



PBS-P100

Facilities Standards  
for the  
Public Buildings Service

General Services Administration



# About the P100

The *Facilities Standards for the Public Buildings Service* establishes design standards and criteria for new buildings, repairs and alterations, modernizations, lease construction buildings with government option to purchase, and work in historic structures for the Public Buildings Service (PBS) of the U.S. General Services Administration (GSA). This document contains both performance based standards and prescriptive requirements to be used in the programming, design, and documentation of GSA buildings.

## Introduction

Through its Public Buildings Service (PBS), the U.S. General Services Administration (GSA) designs, constructs, and operates federal civilian buildings. PBS provides workspace to 1.1 million federal employees, primarily with courthouses, land ports of entry, and federal office buildings. It ranks among the largest holders of real estate in the United States.

The PBS-P100, "Facilities Standards for the Public Buildings Service," is GSA's mandatory facilities standard. It applies to design and construction of new federal facilities, major repairs and alterations of existing buildings, and lease construction facilities that GSA intends to own or has the option to own. P100 users span the entire spectrum of building professional disciplines, and the P100 informs and regulates decisions made throughout a project's life.

This edition of the P100 represents the document's substantial transformation from a prescriptive standard to one that contains both performance-based and prescriptive requirements. A large portion of the new standard specifies levels of performance, which allows a design team and GSA's other professional partners to identify and implement the best strategies to meet those goals.

Four levels of performance are defined throughout the P100 in matrices, in which "baseline" performance (plus all prescriptive requirements) is the lowest permissible level, and it is generally commensurate with the standards of the P100 published in 2010. The three higher-performance levels are more rigorous and voluntary. Each project may implement any combination of performance levels, in order to prioritize performance opportunities that stem from climate, site, program, mandates, and other conditions. Metrics will validate performance goals at various phases of design and construction through total building commissioning.



# CHAPTER 1 • GENERAL REQUIREMENTS

The design team must review compliance with the building program at each stage of the project, as required in Appendix A, to ensure that the requirements of the program, the P100, and relevant codes and standards have been met and to guard against unplanned expansion of the program because of design and engineering choices.

## 1.1 Purpose of the Facilities Standards

The Facilities Standards for the Public Buildings Service PBS-P100 (known as the P100) establishes design standards and criteria for new buildings, repairs and alterations, and modernizations for the Public Buildings Service (PBS) of the General Services Administration (GSA). This document also applies to lease construction with government option-to-purchase buildings. This document contains policy and technical criteria to be used in the programming, design, construction, measurement & verification, and documentation of GSA facilities.

The P100 is a mandatory standard. It is not a guideline, textbook, handbook, training manual, nor substitute for technical competence. The P100 represents the current state of practice in designing facilities to meet GSA's commitments, maximize the efficiency of business processes, and comply with the requirements of law.

The P100 must be used in conjunction with the governing standards referenced in this document, as well as the building program for each project. If conflicts exist between the facilities standards and a

specific program and project requirements, contact the Office of Design and Construction for resolution.

The design team must review compliance with the building program at each stage of the project, as required in Appendix A, to ensure that the requirements of the program, the P100, and relevant codes and standards have been met and to guard against unplanned expansion of the program because of design and engineering choices.

## 1.2 Application of the P100

The P100 applies to all new construction projects. New construction includes additions and annexes to existing facilities. In addition, this section describes how to apply the P100 to projects for repair and alterations, modernizations, and lease construction with Government option to purchase.

### 1.2.1 Repairs & Alterations

Repairs & Alterations (R&A) are improvements made to existing facilities. Generally, building systems need only be upgraded to correct deficiencies identified by GSA, unless the entire building is being renovated. All new work is required to meet the applicable national codes and standards adopted by GSA. If a major portion of the building is being renovated, the specific codes must be evaluated to determine if the entire building must be brought into compliance with the code. Any questions or concerns must be discussed with the GSA project manager.

The requirements of the P100 apply to renovations and alterations to the extent those renovations and

alterations are identified in the approved and funded project prospectus. All items within the designer's scope of work need to be designed in accordance with the P100. The designer should have any ambiguities clarified in writing before beginning the design.

### **1.2.2 Lease Construction with Government Option to Purchase**

Lease construction is new construction of a facility for Government use required by GSA's formal Request for Lease Proposals (RLP).

In lease construction where GSA's formal RLP has an option for GSA to purchase the building at a future date, the requirements of the P100 may be considered for inclusion in the RLP on a case by case basis. In addition to the GSA-adopted nationally recognized codes and requirements, State and local government codes apply. If a conflict exists between applicable State and local government codes and the GSA requirements, the developer must identify these conflicts in writing and request a resolution from the GSA contracting officer.

### **1.2.3 Tenant Improvements**

Tenant improvements are defined in the GSA Pricing Desk Guide at [www.gsa.gov/gsa/cm\\_attachments/GSA\\_DOCUMENT/pricing\\_guide\\_R2F-cl-v\\_0Z5RDZ-i34K-pR.pdf](http://www.gsa.gov/gsa/cm_attachments/GSA_DOCUMENT/pricing_guide_R2F-cl-v_0Z5RDZ-i34K-pR.pdf)

## **1.3 Federal Laws, Regulations, and Standards**

The following are Federal laws, regulations, and standards applicable to all projects.

The Public Buildings Amendments of 1988, 40 U.S.C. 3312, require that each building constructed or altered by GSA or any other Federal agency must, to the maximum extent feasible, comply with one of the

nationally recognized model building codes and with other applicable nationally recognized codes.

### **1.3.1 Public Buildings Amendments of 1988**

The Public Buildings Amendments of 1988, 40 U.S.C. 3312, require that each building constructed or altered by GSA or any other Federal agency must, to the maximum extent feasible, comply with one of the nationally recognized model building codes and with other applicable nationally recognized codes.

### **1.3.2 Environmental Protection**

In addition to building-specific codes, all projects must comply with all Federal, State, and local environmental laws, regulations, and Executive Orders. Federal regulations are found typically, but not exclusively, in the Code of Federal Regulations (CFR) Title 40, Protection of Environment, Executive Order 13423 — Strengthening Federal Environmental, Energy, and Transportation Management, and Executive Order 13514 — Federal Leadership in Environmental, Energy, and Economic Performance. In matters of environmental compliance, GSA's policy is voluntary conformity to certain State and local code requirements even when permitting or approvals from local regulators are not required. Confer with the regional environmental coordinator for specific applicability.

### **1.3.3 Energy and Sustainable Design**

Legislation directed toward energy efficiency and sustainability continues to increase.

Laws, regulations, and Executive Orders affecting the design and operation of Federal buildings include:

- Executive Order 13514: Federal Leadership in Environmental, Energy, and Economic Performance
- Energy Independence and Security Act of 2007 (EISA 2007)

- Executive Order 13423: Strengthening Federal Environmental, Energy, and Transportation Management
- Energy Policy Act of 2005 (EPA 2005)
- Guiding Principles for Sustainable New Construction and Major Renovations

For information on the implementation of sustainable design and energy, see Section 1.8, Sustainability.

### **1.3.4 Historic Preservation**

The National Historic Preservation Act (NHPA) of 1966 mandates that Federal agencies use historic properties to the greatest extent possible and strive to rehabilitate them in a manner that preserves their architectural character, in accordance with the Secretary of the Interior’s Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings (36 CFR 67).

### **1.3.5 Accessibility**

GSA policy is to make all Federal buildings accessible without the use of special facilities for persons with disabilities. The intent of this policy is to use standard building products set at prescribed heights and with prescribed maneuvering clearances to allow easy access by disabled employees and visitors. Building elements designated specifically for use by persons with disabilities should be kept to a minimum.

### **1.3.6 The Architectural Barriers Act Accessibility Standard (ABAAS)**

ABAAS is mandatory for all GSA projects. If local accessibility standards exist, the A/E must follow the most stringent requirements between the local standards and ABAAS.

The criteria of these standards should be considered a minimum in providing access for persons with disabilities. Dimensions that are not stated as “maximum” or “minimum” are absolute. All dimensions are subject to conventional industry

tolerances except where the requirement is stated as a range with specific minimum and maximum end points.

### **1.3.7 Accessible Public Entrances**

All public entrances provided in accordance with Paragraph F206.4.1 (Public Entrances) of the ABAAS must have at least one entrance door complying with Section 404.3 (Automatic and Power-Assisted Doors and Gates) of the ABAAS. Where an accessible public entrance has a vestibule with exterior and interior entrance doors, at least one exterior door and one interior door must comply with Section 404.3.

### **1.3.8 Accessibility in Federal Courthouses**

Please refer to Chapter 8, Design Standards for U.S. Court Facilities, Section 8.2, Planning for Accessibility, and Table 8.1, Accessibility Requirements.

### **1.3.9 Occupational Safety and Health Regulations**

The Occupational Safety and Health Administration (OSHA) does not directly regulate facility design; however, the construction, operation, and occupation of facilities must comply with OSHA regulations. The A/E must ensure that facilities can be constructed in a manner compliant with 29 CFR 1926; the design must anticipate facility operations and maintenance and ensure they can be performed in compliance with 29 CFR 1910; and must not subject building occupants to conditions in violation of 29 CFR 1910.

### **1.3.10 Randolph-Sheppard Act**

The Randolph-Sheppard Act provides qualified blind persons the opportunity to operate businesses on Federal, State, or other property. The A/E must coordinate design with the vending facility operators to meet the needs of vendors covered by the act.

### **1.3.11 Buy American Act**

Only domestic construction materials shall be specified in construction contracts performed in the United States except when a waiver to the Buy American Act is granted.

## **1.4 Nationally Recognized Codes and Standards**

For all design and construction work performed on Federal buildings by GSA or those functions under GSA's construction authority, GSA has adopted the technical requirements of the nationally recognized codes and standards referred to in this subsection. The technical requirements of these codes and standards are supplemented by mandates of Federal laws and executive orders, as well as GSA and other Federal agency criteria. The latest edition of these codes and standards, in effect at the time of design contract award, must be used throughout design and construction of the project.

### **1.4.1 Conflicts between Codes or Standards and GSA Requirements**

To ensure flexibility, GSA's policy is to make maximum use of equivalency clauses in all codes and standards. If a conflict exists between GSA requirements and the GSA-adopted codes or standards, the GSA requirements take precedence. All such conflicts must be brought to the attention of the GSA project manager as appropriate for resolution.

### **1.4.2 ICC Family of Codes**

GSA has adopted the technical requirements of the family of codes issued by the International Code Council (ICC), except as noted below. The ICC family of codes is available through [www.iccsafe.org](http://www.iccsafe.org).

### **1.4.3 NFPA Life Safety Code**

GSA has adopted the technical egress requirements of the National Fire Protection Association (NFPA), Life Safety Code (NFPA 101), in lieu of the technical egress requirements of the International Building Code (IBC). The Life Safety Code is available through [www.nfpa.org](http://www.nfpa.org).

### **1.4.4 NFPA National Electrical Code**

GSA has adopted the technical electrical requirements of the NFPA, National Electrical Code (NFPA 70). The National Electrical Code is available through [www.nfpa.org](http://www.nfpa.org).

### **1.4.5 National Standards**

Organizations writing voluntary national standards, including NFPA, the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE), the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), the Institute of Electrical and Electronics Engineers (IEEE), and the American Society of Mechanical Engineers (ASME), publish standards on health, safety, welfare, and security that are recognized by GSA in various chapters of the P100. Consistent with GSA's long-standing policy to comply with nationally recognized standards to the extent practicable, these standards must be used as indicated in the P100. The latest edition of the nationally recognized standards herein, in effect at the time of design contract award, must be used during design and construction.

## **1.5 State and Local Codes**

Facilities built on Federal property are exempt from State and local building codes. GSA recognizes that the national building codes are typically the foundation of State and local building codes, and that State and local codes represent important regional interests and conditions. It is GSA's policy to comply



with State and local building codes to the maximum extent practicable; however, GSA has the final authority to accept or reject any recommendation from State and/or local government officials.

### **1.5.1 State and Local Government Consultation and Review**

The GSA project manager must provide the appropriate State and/or local government officials the opportunity to review the project for compatibility with local planning and zoning compliance. Local reviews must occur early in project development so that the design can easily respond to appropriate recommendations. These reviews include, but are not limited to, the review of drawings and specifications, making recommendations for compliance with local regulations, compatibility with local planning goals, and alignment with first responder requirements. The GSA project manager must inform State and local government officials that GSA and its contractors are not allowed to pay any fee for any actions taken by the State and/or local government officials in connection with local reviews or inspections. GSA will review all recommendations made by State and local government officials. Each recommendation will be carefully considered based on adequacy, cost, and nationally accepted practice. GSA has the final authority to accept or reject any recommendation from State and/or local government officials. The GSA project manager will maintain a record of all recommendations and comments from State and local government officials for the duration of the project.

### **1.5.2 Zoning and Related Issues**

The A/E team must offer local officials an opportunity to review and comment on the design concepts for compatibility with local plans, zoning, and design guide-lines. Local review must be done in coordination with the project design schedule. If local officials choose not to review the design concept, the project manager must document this in the project file.

By law, the A/E must incorporate the National Environmental Policy Act (NEPA) record of decision (ROD) requirements in the design documents.

Local regulations must be followed without exception in the design of systems that have a direct impact on off-site terrain or infrastructure. These systems include, but are not limited to, fire protection services, storm water runoff, erosion control, sanitary sewers and storm drains, water, gas, electrical power, communications, emergency vehicle access, roads, and bridges.

### **1.5.3 Design Review for Code Compliance**

The GSA project manager must provide the appropriate State and/or local government officials the opportunity to review the design for building code compliance. The GSA project manager will officially forward design submissions to the appropriate local officials.

### **1.5.4 Construction Inspections**

If State and local government officials elect to perform code compliance construction inspections, the GSA project manager must include provisions in both the A/E and construction contract for coordination of the work with local officials. State and local government officials do not have the authority to reject, accept, or make changes to the work, and their inspections are done only to assist GSA in achieving code compliance.

## **1.6 Program-Specific Guides and Standards**

In addition to the P100, GSA and its customer agencies use a number of specific guides and standards that address program requirements. Use of these guides is mandatory. In case of conflicts

between the P100 and a specific building guide, the guide takes precedence. If conflicts exist between the facilities standards and specific program and project requirements, contact the Office of Design and Construction for clarification. The websites for these guides are listed in Appendix Section B1, References.

### 1.6.1 Federal Courthouses

The Office of Design and Construction provides guidance on all levels of development of courthouse projects between Congress, OMB, the Administrative Office of the United States Courts (AOUSC), and GSA and serves as a liaison for all courthouse projects. See Chapter 8, Design Standards for U.S. Court Facilities, for detailed descriptions of the publications listed below and their application.

- *GSA Courthouse Visitor's Guide*, February 2003
- *GSA Courthouse Project Handbook*, August 2004
- *U.S. Courts Design Guide*
- *U.S. Marshals Service Judicial Security Systems Requirements and Specifications*, Volume 3, Publication 64, 2005
- *U.S. Marshals Service Requirements and Specifications for Special Purpose and Support Space*, Volume One: Architectural & Engineering, 2007; Volume Two: Electronic Security & Hardware, 2007

### 1.6.2 Land Ports of Entry

The Office of Design and Construction provides guidance on the management of the border station program, including strategic planning, budgeting, benchmarking, and design guidance. For more information see:

- *United States Land Port of Entry Design Guide*, 2010

### 1.6.3 Child Care Centers

Requirements for child care centers must be incorporated early in the design and planning process. The references below provide guidance on such topics as site design, emergency evacuation, food services, safety, security, mechanical, electrical, and plumbing:

- *Child Care Center Design Guide* (PBS-P140)
- Accreditation Criteria and Procedures of the National Association for the Education of Young Children (NAEYC)

### 1.6.4 Security

Please see the following documents for more information on the security design requirements for Federal buildings:

- Interagency Security Criteria (ISC) — Physical Security Criteria for Federal Facilities
- *GSA PBS Site Security Design Guide*
- *GSA PBS Design Notebook for Federal Lobby Security*

### 1.6.5 Other Guides

- GSA National Business Space Assignment Policy
- GSA P120 Project Estimating Requirements
- GSA Order 8000.1C GSA Metric Program
- GSA 3490.1A on Document Security for Sensitive But Unclassified Building Information
- Executive Order 13502, Use of Project Labor Agreements for Federal Construction Projects

## 1.7 Sustainability

Sustainability is the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations. Sustainable design seeks to ensure that future generations are not disadvantaged by the depletion of natural or nonrenewable resources by the current

generation. Sustainable designs follow an integrated, synergistic approach, in which all phases of the facility lifecycle are considered. Following sustainable design principles improves building performance, promotes the health and comfort of building occupants, minimizes environmental impacts, and supports natural resource availability. The result must be an optimal synergy of cost, environmental, societal, and human benefits while meeting the mission and function of the intended facility or infrastructure. Subsequent chapters of the P100 include requirements and recommendations to meet these objectives.

The essential principles of sustainable design and development are:

- Optimize site potential
- Minimize nonrenewable energy consumption
- Protect and conserve water
- Use environmentally preferable products and materials
- Enhance indoor environmental quality, and
- Optimize operations and maintenance practices

These principles must serve as the basis for planning, programming, design, budgeting, construction, commissioning, operation, maintenance, and disposal of all new facilities, major renovations, and existing building alterations. These principles must be applied as appropriate to every project scope. Applicable strategies and opportunities to improve sustainable performance must be included in all projects.

New construction and major renovations of GSA buildings, as well as applicable work in existing GSA buildings, must comply with the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings. Strategies to meet the Guiding Principles are included in each appropriate chapter of the P100. For the latest guidance on implementing the Guiding Principles see [www.wbdg.org/sustainableEO](http://www.wbdg.org/sustainableEO).

### 1.7.1 LEED Certification

Through integrative design and application of sustainable design principles, all new construction projects and substantial renovations must achieve, at a minimum, a LEED Gold rating through the Leadership in Energy and Environmental Design (LEED) Green Building Rating System of the U.S. Green Building Council. GSA's use of LEED is to measure and quantify building performance achievements in relation to our mandates and goals. Pursue LEED credits appropriate to the goals of GSA and to the type of project being designed.

For projects seeking LEED certification, the following prerequisites and credits must be achieved to comply with the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings, unless specifically exempted from the project scope. Credits are listed under each Guiding Principle. Additional credits listed are interrelated and synergize with the Guiding Principles but are discretionary to achieve.

#### I. Employ Integrated Design Principles

- Integrated Design
  - Innovation & Design: LEED Accredited Professional
- Commissioning
  - Energy & Atmosphere Prerequisite: Fundamental Commissioning of the Building Energy Systems
  - Energy & Atmosphere: Enhanced Commissioning

#### II. Optimize Energy Performance

- Energy Efficiency
  - Energy & Atmosphere Prerequisite: Minimum Energy Performance
  - Energy & Atmosphere: Optimize Energy Performance — Improve by 30 percent for New Buildings or 20 percent below pre-renovations 2003 energy use baseline for major renovations

- On-Site Renewable Energy — interrelated discretionary credit
  - Energy & Atmosphere: On-Site Renewable Energy (solar hot water)
- Measurement and Verification/Benchmarking
  - Energy & Atmosphere: Measurement and Verification

### III. Protect and Conserve Water

- Indoor Water
  - Water Efficiency Prerequisite: Water Use Reduction (20 percent reduction)
- Outdoor Water
  - Water Efficiency: Water Efficient Landscaping — Reduce by 50 percent
  - Sustainable Sites: Stormwater Design — Quantity Control (Imperviousness)
  - Sustainable Sites: Stormwater Design — Quality Control (Best Management Practices)

### IV. Enhance Indoor Environmental Quality

- Ventilation and Thermal Comfort
  - Indoor Environmental Quality Prerequisite: Minimum Indoor Air Quality Performance
  - Indoor Environmental Quality: Thermal Comfort — Design
  - Daylighting
  - Indoor Environmental Quality: Daylight and Views — Daylight 75 percent of Spaces
  - Low-Emitting Materials
  - Indoor Environmental Quality: Low Emitting Materials — Adhesives and Sealants
  - Indoor Environmental Quality: Low Emitting Materials — Paints and Coatings
  - Indoor Environmental Quality: Low Emitting Materials — Flooring Systems
  - Indoor Environmental Quality: Low Emitting Materials — Composite Wood and Agrifiber Products
  - Protect Indoor Air Quality during Construction
  - Indoor Environmental Quality: Construction IAQ Management Plan — During Construction

- Indoor Environmental Quality: Construction IAQ Management Plan — Before Occupancy
- Environmental Tobacco Smoke Control
  - Indoor Environmental Quality Prerequisite: Environmental Tobacco Smoke (ETS) Control

### V. Reduce Environmental Impact of Materials

- Recycled Content
  - Materials & Resources: Recycled Content — 10 percent (post consumer + 1/2 preconsumer)
- Biobased Content — interrelated discretionary credit
  - Materials & Resources: Rapidly Renewable Materials
  - Materials & Resources: Certified Wood
  - Environmentally Preferable Products — interrelated discretionary credit
  - Consult the Federal Green Construction Guide for Specifiers at [www.wbdg.org/design/greenspec.php](http://www.wbdg.org/design/greenspec.php)
  - Materials & Resources: Materials Reuse — 5 percent of total value of materials
  - Materials & Resources: Regional Materials — 10 percent Extracted, Processed & Manufactured Regionally
  - Waste and Materials Management
  - Materials & Resources Prerequisite: Storage and Collection of Recyclables
  - Materials & Resources: Construction Waste Management — 50 percent Recycled or Salvaged
  - Ozone Depleting Compounds
  - Energy & Atmosphere Prerequisite: Fundamental Refrigerant Management
  - Energy & Atmosphere: Enhanced Refrigerant Management

## 1.8 Energy Use Targets

Buildings must be designed to comply with the energy performance requirements of EAct 2005 and EISA 2007.

**EPAct 2005 Building Design Energy Compliance**

EPAct 2005 requires buildings to be designed to be at least 30 percent more efficient than the design required by ASHRAE 90.1 if life cycle cost effective. For guidance to achieve a level of energy efficiency 30 percent greater than ASHRAE Standard 90.1-2007, see the final rule 10 CFR, Energy, Parts 433-435 issued by DOE at [www1.eere.energy.gov/femp/pdfs/fr\\_notice\\_cfr433\\_434\\_435.pdf](http://www1.eere.energy.gov/femp/pdfs/fr_notice_cfr433_434_435.pdf).

**EISA 2007 Fossil Fuel Reduction Compliance**

EISA 2007 requires buildings to be designed so that the fossil fuel generated energy use is reduced by the following percentages over CBECS 2003 in designs for prospectus-level new construction and major renovations:

FY2010	55% reduction
FY2015	65% reduction
FY2020	80% reduction
FY2025	90% reduction
FY2030	100% reduction

**1.8.1 Major Renovations**

Pending the final rule on fossil fuel reduction for major renovations, the A/E must design all systems to be replaced with systems that offer the highest level of energy performance available. All designs that improve HVAC systems must include recommissioning of the entire HVAC system. For modernizations where all systems are replaced, the A/E must target at least a 20 percent reduction from the 2003 energy usage of the building. The building’s 2003 energy usage can be obtained from the Office of Design and Construction.

**1.8.2 Energy Use Intensities Design Maximums**

Both EPAct 2005 and EISA 2007 require reductions in the energy use of the overall portfolio of buildings owned by GSA. To meet the goal of reducing total site energy usage by 30 percent by 2015 as compared to a 2003 baseline, energy targets are established for all new construction. The A/E must design all new buildings to have an energy performance below the EISA 2007 energy target or 30 percent below ASHRAE 90.1, whichever is lower.

From concept design through each design phase, the project must demonstrate that it meets the energy target. Use energy modeling that includes the building enclosure systems in concert with mechanical systems and provides documentation showing that systems were chosen based on a life-cycle cost analysis.

For courthouses use the public safety buildings target. For land ports of entry perform the energy analysis for the main building, commercial building, and headhouse, and use public safety target.

**1.9 Health and Safety**

Health and safety regulations are primarily operation-oriented and usually do not directly stipulate building design requirements. The A/E must take a systems approach to risk management, utilizing codes, regulations, guidelines, and best practices to identify and mitigate facility-created health and safety risks early in the design phases of the project life cycle.

**1.9.1 Order of Precedence**

At each phase of the design, the A/E must identify and mitigate safety and health risks in accordance with the following order of precedence (refer to ANSI/AIHA Z10-2005):

## 1.9.2 Eliminate or reduce the hazard

If the hazard cannot be eliminated, the associated risk must be reduced to an acceptable level through design.

## 1.9.3 Isolate the hazard

If the hazard cannot be eliminated through design, the risk must be reduced to an acceptable level using engineering controls, protective safety features, or devices.

## 1.9.4 Provide warning devices

If safety devices do not adequately lower the risk of the hazard, cautions and warnings must be provided using detection and warning systems, as appropriate.

## 1.9.5 Develop procedures and training

Where it is impractical to eliminate hazards through design selection or to reduce the associated risk to an acceptable level with detection and warning devices, incorporate special procedures and training. Procedures may include the use of personal protective equipment. For high-consequence hazards, warnings, cautions, or other written advisories must not be the only risk reduction method.

## 1.9.6 Specific Health and Safety Requirements

### 1.9.6.1 Asbestos

Total renovations of occupied spaces must include the removal of all asbestos-containing material (ACM). Encapsulation, enclosure, or management in place of ACM in occupied spaces is prohibited.

### 1.9.6.2 Lead-Based Paint

Paint must be tested for lead content when alterations or demolitions require the sanding, burning, welding, or scraping of painted surfaces. Lead-based paint controls must be implemented in accordance with 29 CFR 1926.62. Lead-based paint that is intact and in good condition must not be abated, unless required for alteration or demolition. Lead-based paint must be abated in child care centers. Refer to PBS-P140 for specific details. Construction waste containing lead-based paint must be considered hazardous waste unless testing proves otherwise.

### 1.9.6.3 Confined Spaces

The designer must avoid the creation of confined spaces except where required as part of a system (e.g., tanks, pits). Confined space is defined in 29 CFR 1910.

### 1.9.6.4 Fall Protection

The design must consider the inspection, operations, and maintenance of the site, facility, and equipment. Access and fall protection, especially to difficult maintenance needs in high locations, including lighting fixtures, mechanical equipment, and skylights, must be considered in the design. Specific detail is provided in the appropriate technical chapters.

### 1.9.6.5 Soil Contamination

If soil or water contamination is a concern during construction of new buildings, major and minor alterations, and work in historic structures, EPA regulations under 40 CFR must be followed.



## 1.10 Methodologies

### 1.10.1 Space Measurement and Building Efficiency

The A/E must design to the area authorized in the approved prospectus and delineated in the program of requirements. The area must be confirmed at each phase of design and is to be measured in accordance with the GSA National Business Space Assignment Policy dated May 2009 or current edition, including any addendums or other clarifications. Projects that exceed the congressionally authorized area will need to be redesigned.

GSA's National Business Space Assignment Policy establishes current PBS practices for the assignment of space within the federally owned and leased inventory. It provides the methodology and information necessary for the correct assignment of space.

Additionally, this policy document provides details and illustrations of how PBS uses the commercial American National Standards Institute (ANSI) and Building Owners and Managers Association International (BOMA) Standard Method for Measuring Floor Area in Office Buildings (ANSI/BOMA Z65.1) as the foundation for space measurement and assignment.

PBS's measurement and assignment principles are not 100 percent compliant with ANSI/BOMA measurement standards. For example, PBS uses a PBS-specific category in conjunction with ANSI/BOMA's categories. This document provides the details and illustrations showing how PBS's assignment and measurement processes relate to and differ from ANSI/BOMA processes.

Space efficiency is defined as the minimum necessary space for the desired functions to be properly accommodated, with minimum 'waste' between usable area and gross area. The target for the usable-to-gross ratio in new building construction is 80 percent. The National Business Space Assignment

Policy established the definition of usable and gross area. In all building types, space efficiency must be balanced against effectively achieving space requirements and desired aesthetics.

The plan configuration, floor-plate depth, planning module, and circulation patterns together determine the space efficiencies of a building. The historic character of a building can create major inefficiencies where the primary circulation is typically wider and thereby affects the amount of usable space available. However, a building's historic value or design aesthetics should not be compromised to achieve greater space efficiencies.

Plan configuration describes the geometry of a typical floor within a building. A square or rectangular plan with a single central core will be inherently more efficient than a plan that is highly irregular, with distributed service cores. Building types other than office buildings, like courthouses and Land Ports of Entry (LPOE), will likely have lower usable to gross ratios based on numerous special requirements that are addressed in their design guides. When efficiency ratios fall, the floor plan is likely to have more irregularities that, in turn, will increase space utilizations per full-time equivalent (FTE) and restrict furniture and tenant space planning. Configuration of space is an important consideration when selecting a new building design or comparing one with another.

### 1.10.2 Workplace Tools and Processes

Use workplace program analysis and development tools and processes that provide cost- and time-effective ways to analyze existing space performance, space constraints, and organizational mission and goals, and provide design criteria that directly address these issues. The analysis should include the following.

#### 1.10.2.1 A Balanced Scorecard Approach

Developed by Harvard's Kaplan and Norton, this provides a framework to analyze and measure the performance of an organization in four domains — finance, business process, customer, and human capital. GSA uniquely uses this framework to directly link workplace solutions to the organization's goals.

### **1.10.2.2 Quantitative and Qualitative Discovery Processes and Tools**

These are used to derive design concepts and solutions from an understanding of the organization — its goals, culture, and current and desired work practices — using both quantitative and qualitative data. This includes gathering quantitative and qualitative data, gaining in-depth knowledge of the customer organization, conducting on-site observations, interviews, and focus groups, and developing written guidelines to inform the design and design review processes.

### **1.10.2.3 Change Management**

This involves a broad segment of the organization to help define workplace needs and build project consensus. By engaging occupants early on, change management can be approached as an organizational opportunity, and occupant expectations can be managed proactively.

### **1.10.2.4 Feedback Loop**

This involves identifying connections between business and workplace goals and design solutions, measuring for desired outcomes, and using the findings to improve existing and future organizational operations and work-place projects. This includes preoccupancy and post occupancy surveys, design commissioning, testing, and measurement.

For more information on workplace analysis processes and tools, visit [www.gsa.gov/workplace](http://www.gsa.gov/workplace).

### **1.10.2.5 Building Information Modeling (BIM)**

The primary goal of the GSA 3D-4D-BIM program is to incorporate digital visualization, simulation, and optimization technologies in project planning and design and to increase quality and efficiency of business processes throughout GSA project life-cycle.

All major projects are required to have a spatial BIM program submitted to GSA before final concept presentation. GSA uses BIM to validate spatial program requirements (e.g., area and efficiency ratios). See the GSA BIM Guide Series 02 Spatial Program Validation for specific requirements at [www.gsa.gov/bim](http://www.gsa.gov/bim).

### **1.10.2.6 Total Building Commissioning**

Total Building Commissioning (TBC) is a systematic process of ensuring by verification and documentation, from the design phase to a minimum of one year after construction, that facility systems perform interactively in accordance with the design documentation and intent, and in accordance with the owner's operational needs to include preparation of operation personnel.

TBC recognizes the integrated nature of all building systems' performance, which affects sustainability, workplace productivity, occupant safety, and security. All GSA capital construction projects must employ TBC practices.

For more information describing how the designer must include commissioning requirements, see the Building Commissioning Guide, available at <http://www.wbdg.org/ccb/GSAMAN/buildingcommissioningguide.pdf>.

See Chapter 7, Fire Protection and Life Safety for additional information on commissioning the fire protection and life safety systems.

### **1.10.2.7 Building Operations and Maintenance**

Long-term operations and maintenance costs are significantly higher over time than first costs. Systems



must be designed for ease of operation and cost-effective maintenance and repair. System accessibility is a critical consideration in building design. The A/E must ensure building systems and elements are physically accessible for cleaning, maintenance, repair, and replacement.

As an example, design of atrium spaces must provide methods to clean skylights, replace lamps, and maintain fire alarm devices.

The A/E must collaborate with GSA operations and maintenance personnel during design to provide for optimal life-cycle performance.

In addition to hard copies, the A/E must specify that operation and maintenance manuals be provided in electronic format with training videos for the start up and maintenance of all major equipment. At the conclusion of design, the A/E must provide an electronic document describing the design intent for all building systems. These instructions must be developed during the design phase and incorporated into the comprehensive training for operations and maintenance personnel.

### **1.10.2.8 Life-Cycle Costing**

Federal facilities must be designed to achieve the lowest life-cycle cost. A project's design must comprehensively define reasonable scope and performance requirements within the appropriated budget and authorized prospectus for design and construction. Consistent with these constraints, building systems and features must be analyzed and selected to achieve lowest life-cycle cost.

Life-cycle costing (LCC) must be used when selecting a system from several alternative systems or components for a project. LCC is the economic analysis method required by CFR Title 10, Part 436, Subpart A, "Program Rules of the Federal Energy Management Program." OMB requires this methodology, through the Federal Energy Management Program, to evaluate the cost effectiveness of systems that use energy and water. LCC compares initial investment options and

operating and salvage costs over the life of the equipment and identifies the least costly alternatives. Examples of building systems that affect energy use are the building thermal envelope, passive solar features, fenestration, HVAC, domestic hot water, building automation, and lighting.

Many established guidelines and computer-based tools that effectively support present value LCC analyses are available. The National Institute of Standards and Technology (NIST) has prepared the Life Cycle Costing Manual for the Federal Energy Management Program (NIST Handbook 135) and annually issues real growth energy price indices and discount factors for life cycle cost analysis. As a companion product, NIST has also established the Building Life Cycle Cost (BLCC) computer program to perform LCC analyses. The latest versions of the BLCC program not only structure the analysis but also include current energy price indices and discount factor references. These NIST materials define all required LCC methodologies used in GSA design applications. The A/E may obtain the BLCC software and updates from NIST. The latest BLCC software is available at [www.eere.energy.gov/femp](http://www.eere.energy.gov/femp).

The project team must integrate the LCC analysis into the concept design process, and the analysis must be completed by the design development phase.

## **CHAPTER 2 • URBAN DEVELOPMENT AND LANDSCAPE DESIGN**

# 2.1 Urban Planning and Public Use Performance Requirements

2.1 Urban Planning and Public Use Performance Requirements									
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurement & Verification	Plans & Specs	Calculations & Analysis		
<b>Sustainable Locations</b>									
<b>Reference</b>									
<b>Site Uses Existing Infrastructure Resources and Preserves Natural Resources</b>	<ul style="list-style-type: none"> <li>o Site selection process addressed EOs 12072, 13006, 13514, and Implementing Instructions for Sustainable Federal Locations (CEQ 09/2011), AND</li> <li>o Site includes no wetlands, no water bodies, no land w/in 50 ft. of wetlands, and no land w/in 100 ft. of water bodies; complies with all local, state, and federal regulations on wetland and water body conservation.</li> <li>o Site not within a state or locally designated agricultural preservation district; does not disturb prime soils, unique soils, or soils of state significance.</li> <li>o Site not a greenfield.</li> </ul>	<ul style="list-style-type: none"> <li>o The site meets the Baseline requirements, AND:</li> <li>o Site is an infill site within existing urban or suburban development, served by existing water and wastewater infrastructure.</li> </ul>	<ul style="list-style-type: none"> <li>o The site meets the Baseline requirements, AND:</li> <li>o The site is a grayfield or brownfield infill site within existing urban or suburban development, served by existing water and wastewater infrastructure.</li> </ul>	<ul style="list-style-type: none"> <li>o The site meets the Tier 2 High Performance requirements, AND:</li> <li>o The site is identified in consultation with local officials as being targeted for redevelopment in existing local development plans.</li> </ul>	ODC Review of Site Acquisition Package and presentation at relevant reviews	Site Acquisition and Design Concept materials	N/A	EOs 12072, 13006, 13514, and Implementing Instructions for Sustainable Federal Locations (CEQ 09/2011); LEED ND, v2009	Verify relevant design elements from approved Concept presentation.
<b>Site Supports Transit-Use and Reduced Automobile Commuting</b>	<ul style="list-style-type: none"> <li>o Site selection process addressed EOs 12072, 13006, 13514, and Implementing Instructions for Sustainable Federal Locations (CEQ 09/2011), AND</li> <li>o The site is located w/in an MPO-served region and w/in a TAZ where annual VMT does not exceed 90% of average of equivalent metropolitan region value. AND/OR:</li> <li>o Principal functional building entrance of facility is (a) w/in a 1/4 mile walk distance of bus and/or streetcar stops, or (b) w/in a 1/2 mile walk distance of bus rapid transit stops, light or heavy rail stations, and/or ferry terminals, connected by pedestrian and bicycle pathways.</li> </ul>	<ul style="list-style-type: none"> <li>o The site meets the Baseline requirements, AND:</li> <li>o A) The annual per capita VMT of TAZ is between 60 and 89% of average of equivalent metropolitan region value, AND/OR</li> <li>B) The minimum daily service at the transit stops (must include Saturday and Sunday) is:                             <ul style="list-style-type: none"> <li>• For multiple transit types: weekday, up to 100/day; weekends, up to 60/day.</li> <li>• Commuter rail or ferry service only: weekday, up to 24/day; weekends, up to 6/day.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>o The site meets the Baseline requirements, AND:</li> <li>o A) The annual per capita VMT of TAZ is between 30 and 59% of average of equivalent metropolitan region value, AND/OR</li> <li>B) The minimum daily service at the transit stops (must include Saturday and Sunday) is:                             <ul style="list-style-type: none"> <li>• For multiple transit types: weekday, 101-245/day; weekends, 85-150/day.</li> <li>• Commuter rail or ferry service only: weekday, 25-40/day; weekends, 7-10/day.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>o The site meets the Baseline requirements, AND:</li> <li>o A) The annual per capita VMT of TAZ is 30% or less of average of equivalent metropolitan region value, AND/OR</li> <li>B) The minimum daily service at the transit stops (must include Saturday and Sunday) is:                             <ul style="list-style-type: none"> <li>• For multiple transit types: weekday, more than 245/day; weekends, more than 150/day.</li> <li>• Commuter rail or ferry service only: weekday, more than 40/day; weekends, more than 10/day.</li> </ul> </li> </ul>	Maps detailing transit buffers around site; confirmation of transit service from DOT, local transit officials, and/or GSA; confirmation of TAZ based on data from MPO or GSA	Site Acquisition and Design Concept materials	VMT and TAZ calculations based on MPO data and GSA's SU data	EOs 12072, 13006, 13514, and Implementing Instructions for Sustainable Federal Locations (CEQ 09/2011); LEED ND, v2009	Resubmission of maps detailing transit buffers around site; confirmation of transit service from DOT, local transit officials, and/or GSA; confirmation of TAZ based on data from MPO or GSA

2.1 Urban Planning and Public Use Performance Requirements									
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurement & Verification	Plans & Specs	Calculations & Analysis		
<b>Site Supports Neighborhood Connectivity, Walkability, and Bikeability</b>	<ul style="list-style-type: none"> <li>o Site selection process addressed EOs 12072, 13006, 13514, and Implementing Instructions for Sustainable Federal Locations (CEQ 09/2011), AND</li> <li>o Principal functional entry on front façade faces public space, AND</li> <li>o Connectivity of site and adjacent land is at least 90 intersections/sq. mi. as measured w/in a 1/2-mile distance from center of the facility, AND</li> <li>o Primary functional entrance is (a) w/in 1/4-mile walk distance of at least 5 diverse uses or (b) w/in 1/2-mile walk distance of at least 7 diverse uses.</li> </ul>	<ul style="list-style-type: none"> <li>o The site meets the Baseline requirements, AND:</li> <li>o Connectivity of site and adjacent land is between 90-250 intersections/sq. mi. as measured w/in a 1/2-mile distance from center of the facility, AND</li> <li>o Primary functional entrance is (a) w/in 1/4-mile walk distance of at least 7 diverse uses or (b) w/in 1/2-mile walk distance of at least 10 diverse uses.</li> </ul>	<ul style="list-style-type: none"> <li>o The site meets the Baseline requirements, AND:</li> <li>o Connectivity of site and adjacent land is between 251-290 intersections/sq. mi. as measured w/in a 1/2-mile distance from center of the facility, AND</li> <li>o Primary functional entrance is (a) w/in 1/4-mile walk distance of at least 10 diverse uses or (b) w/in 1/2-mile walk distance of at least 12 diverse uses.</li> </ul>	<ul style="list-style-type: none"> <li>o The site meets the Baseline requirements, AND:</li> <li>o Connectivity of site and adjacent land is greater than 291 intersections/sq. mi. as measured w/in a 1/2-mile distance from center of the facility, AND</li> <li>o Primary functional entrance is (a) w/in 1/4-mile walk distance of at least 12 diverse uses or (b) w/in 1/2-mile walk distance of at least 15 diverse uses.</li> </ul>	ODC review of maps detailing connectivity around site and retail and other diverse uses within specified radius or buffer.	Site Acquisition and Design Concept materials	Calculations based on source material from vetted information service or GSA's SLI data.	EOs 12072, 13006, 13514, and Implementing Instructions for Sustainable Federal Locations (CEQ 09/2011); LEED ND, v2009	Resubmission of previously specified maps using updated data as of time of substantial construction completion.
<b>Collaborative Design Process</b>									
<b>Reference</b>									
<b>Design Process Considers Input of Local Officials</b>	<ul style="list-style-type: none"> <li>o For new construction or other projects with significant impact on the public realm (e.g., landscape, facades, perimeter security), GSA's regional project team meets with local officials about the project and considers their input during the preparation of feasibility and similar analysis, prior to requesting design funding.</li> <li>o <u>Prior to Design Kick-off</u>, GSA project manager and A/E meet with local officials, share project info, get officials' input, and review local plans.</li> <li>o <u>At first Peer Review</u>, project team presents input from consultation with local officials, explains project's responding design strategy in that context.</li> <li>o <u>At Final Design Concept presentation</u> for Commissioner's approval, design team presents local input, outlines responding design strategy, and presents detail regarding relevant building and landscape design elements to enable meaningful consideration of the concept.</li> </ul>	<ul style="list-style-type: none"> <li>o Meets Baseline performance requirements, AND:</li> <li>o <u>Prior to approval of the Final Design Concept</u>, project team must share the relevant elements of the proposed design strategy with local officials and address their feedback in the Final Design Concept presentation.</li> </ul>	<ul style="list-style-type: none"> <li>o Meets Tier 1 High Performance Requirements AND:</li> <li>o Project development must be based upon a Feasibility Study that includes input from local officials on relevant design elements.</li> </ul>	<ul style="list-style-type: none"> <li>o Meets Tier 2 High Performance Requirements AND:</li> <li>o Project design and development must be informed by a neighborhood planning or charrette process that was conducted in partnership with local officials.</li> </ul>	ODC Review of Design Narrative and presentation at relevant reviews	Design Concept materials	N/A	Applicable policies: Federal Urban Land Use Act of 1949 (40 USC Sec. 901-905); Public Buildings Amendments of 1988 (40 U.S.C. 3312); and Executive Orders 12072, 13006, and 13514	Verify relevant design elements from approved Concept presentation.

2.1 Urban Planning and Public Use Performance Requirements									
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurement & Verification	Plans & Specs	Calculations & Analysis		
<b>Sustainable Locations</b>									
<b>Reference</b>									
<b>Site Uses Existing Infrastructure Resources and Preserves Natural Resources</b>	<ul style="list-style-type: none"> <li>o Site selection process addressed EOs 12072, 13006, 13514, and Implementing Instructions for Sustainable Federal Locations (CEQ 09/2011), AND</li> <li>o Site includes no wetlands, no water bodies, no land w/in 50 ft. of wetlands, and no land w/in 100 ft. of water bodies; complies with all local, state, and federal regulations on wetland and water body conservation.</li> <li>o Site not within a state or locally designated agricultural preservation district; does not disturb prime soils, unique soils, or soils of state significance.</li> <li>o Site not a greenfield.</li> </ul>	<ul style="list-style-type: none"> <li>o The site meets the Baseline requirements, AND:</li> <li>o Site is an infill site within existing urban or suburban development, served by existing water and wastewater infrastructure.</li> </ul>	<ul style="list-style-type: none"> <li>o The site meets the Baseline requirements, AND:</li> <li>o The site is a grayfield or brownfield infill site within existing urban or suburban development, served by existing water and wastewater infrastructure.</li> </ul>	<ul style="list-style-type: none"> <li>o The site meets the Tier 2 High Performance requirements, AND:</li> <li>o The site is identified in consultation with local officials as being targeted for redevelopment in existing local development plans.</li> </ul>	ODC Review of Site Acquisition Package and presentation at relevant reviews	Site Acquisition and Design Concept materials	N/A	EOs 12072, 13006, 13514, and Implementing Instructions for Sustainable Federal Locations (CEQ 09/2011); LEED ND, v2009	Verify relevant design elements from approved Concept presentation.
<b>Site Supports Neighborhood Connectivity, Walkability, and Bikeability</b>	<ul style="list-style-type: none"> <li>o Site selection process addressed EOs 12072, 13006, 13514, and Implementing Instructions for Sustainable Federal Locations (CEQ 09/2011), AND</li> <li>o Principal functional entry on front façade faces public space, AND</li> <li>o Connectivity of site and adjacent land is at least 90 intersections/sq. mi. as measured w/in a 1/2-mile distance from center of the facility, AND</li> <li>o Primary functional entrance is (a) w/in 1/4-mile walk distance of at least 5 diverse uses or (b) w/in 1/2-mile walk distance of at least 7 diverse uses.</li> </ul>	<ul style="list-style-type: none"> <li>o The site meets the Baseline requirements, AND:</li> <li>o Connectivity of site and adjacent land is between 90-250 intersections/sq. mi. as measured w/in a 1/2-mile distance from center of the facility, AND</li> <li>o Primary functional entrance is (a) w/in 1/4-mile walk distance of at least 7 diverse uses or (b) w/in 1/2-mile walk distance of at least 10 diverse uses.</li> </ul>	<ul style="list-style-type: none"> <li>o The site meets the Baseline requirements, AND:</li> <li>o Connectivity of site and adjacent land is between 251-290 intersections/sq. mi. as measured w/in a 1/2-mile distance from center of the facility, AND</li> <li>o Primary functional entrance is (a) w/in 1/4-mile walk distance of at least 10 diverse uses or (b) w/in 1/2-mile walk distance of at least 12 diverse uses.</li> </ul>	<ul style="list-style-type: none"> <li>o The site meets the Baseline requirements, AND:</li> <li>o Connectivity of site and adjacent land is greater than 291 intersections/sq. mi. as measured w/in a 1/2-mile distance from center of the facility, AND</li> <li>o Primary functional entrance is (a) w/in 1/4-mile walk distance of at least 12 diverse uses or (b) w/in 1/2-mile walk distance of at least 15 diverse uses.</li> </ul>	ODC review of maps detailing connectivity around site and retail and other diverse uses within specified radius or buffer.	Site Acquisition and Design Concept materials	Calculations based on source material from vetted information service or GSA's SLI data.	EOs 12072, 13006, 13514, and Implementing Instructions for Sustainable Federal Locations (CEQ 09/2011); LEED ND, v2009	Resubmission of previously specified maps using updated data as of time of substantial construction completion.

## 2.1 Urban Planning and Public Use Performance Requirements

Attribute	Baseline	★	★★	★★★	Verification			Design	Construction
		Tier 1 High Performance	Tier 2 High Performance	Tier 3 High Performance	Measurement & Verification	Plans & Specs	Calculations & Analysis	Basis of Design	Verification
<b>Design for Public Use</b>									
<b>Reference</b>									
<b>Design for Public Use INTERIORS</b>	<ul style="list-style-type: none"> <li>o Assembly areas in the base building program (e.g., auditoriums, atria, jury assembly rooms) are designed to allow for manageable public access for after-hours use.</li> <li>o Upon project opening, at least one interior building assembly area that holds likely potential for occasional public use is cataloged in the property manager's office and made available for public use.</li> </ul>	<ul style="list-style-type: none"> <li>o Meets Baseline Requirements AND:</li> <li>o Assembly areas within the base building program are positioned in relation to public entries and other building amenities so as to enhance their visibility and utility and to encourage public interest in their use.</li> </ul>	<ul style="list-style-type: none"> <li>o Meets Tier 1 High Performance Requirements AND:</li> <li>o Assembly areas for appropriate public use includes at least one contiguous space that provides a minimum of 2,000 SF.</li> <li>o Upon project opening, GSA has approved a permit (GSA Form 3453) for public use of an interior space.</li> </ul>	<ul style="list-style-type: none"> <li>o Meets Tier 2 High Performance Requirements AND:</li> <li>o Design provides interior spaces or other permanent structures that will be leased for long-term private commercial or other mixed use.</li> </ul>	ODC Review of Design Narrative and presentation at relevant reviews	Design Concept materials	N/A	Public Building Cooperative Use Act of 1976 (40 U.S.C. 601a)	Verify relevant design elements from approved Concept presentation, and submission of completed form 3453, when appropriate
<b>Reference</b>									
<b>Design for Public Use EXTERIORS</b>	<ul style="list-style-type: none"> <li>o Design provides a specific vision for how all exterior public areas are meant to be used, whether for circulation, passive use, or programmed public use. The public spaces are designed and furnished to support that intended use.</li> <li>o Pedestrian circulation networks through and around the project site are designed with a cohesive vision, to create a positive pedestrian experience.</li> <li>o Landscape design elements provide access, comfort, shade, seating options, and visual interest encouraging passive public use by visitors and o Design provides a specific vision for how all exterior public areas are meant to be used, whether for circulation, passive use, or programmed public use. The public spaces are designed and furnished to support that intended use.</li> <li>o Pedestrian circulation networks through and around the project site are designed with a cohesive vision, to create a positive pedestrian experience.</li> <li>o Landscape design elements are assembled in order to provide access, comfort, shade, seating options, and visual interest that encourages passive</li> </ul>	<ul style="list-style-type: none"> <li>o Meets Baseline Requirements AND:</li> <li>o Landscape design includes gathering areas for occasional assembly or passive use. Plaza areas seating choices (shade, sun, sitting walls, tables, furniture, etc.) that provide minimum of one (1) linear foot of seating for every fifty (50) SF of plaza space. Seating for variety of needs (e.g., including 'companion' seating for elderly or disabled visitors).</li> <li>o If not provided under the project construction contract, plaza furnishings (furniture, shade structures, waste cans) are selected and located by the project designer, priced and sourced for later acquisition, and installed upon project opening.</li> </ul>	<ul style="list-style-type: none"> <li>o Meets Tier 1 High Performance Requirements AND:</li> <li>o Landscape design provides a publicly accessible plaza space that provides a minimum of 6,000 square feet of space that is adjacent to and readily accessible to public sidewalks. Plaza areas provide a minimum of one tree for every 1,000 SF of plaza space.</li> <li>o Gathering areas are equipped with publicly accessible WiFi to support use by building occupants and visitors.</li> </ul>	<ul style="list-style-type: none"> <li>o Meets Tier 2 High Performance Requirements AND:</li> <li>o Plaza areas are designed for programmed public use and at least one area includes electrical service to support such use.</li> <li>o Upon project opening, GSA has approved a permit (GSA Form 3453) for public use of the space.</li> </ul>	ODC Review of Design Narrative and presentation at relevant reviews	Design Concept materials	N/A	Public Building Cooperative Use Act of 1976 (40 U.S.C. 601a)	Verify relevant design elements from approved Concept presentation, and submission of completed form 3453, when appropriate

## 2.2 Urban Planning and Design Performance Attributes

GSA has the responsibility to leverage its federal real estate actions in ways that support community development goals, while also meeting client agency needs, wherever possible. This derives from several laws and executive orders: the Federal Urban Land Use Act of 1949 (40 USC Sec. 901-905); the Public Buildings Cooperative Use Act of 1976 (40 U.S.C. 601a); the Public Buildings Amendments of 1988 (40 U.S.C. 3312); and Executive Orders 12072, 13006, and 13514. The goal of designing a Federal building that responds to its site, to the surrounding neighborhood design and plans, and its potential for interactions with the general public is leveraging Federal investment in support of local plans in ways that improve neighborhood design and experience. Achieving this level of design quality requires that attention be paid to sustainably locating the facility near to transit and in pedestrian-friendly neighborhoods, to involving local officials collaboratively in the design process, and to designing the building for maximum potential public use of the exterior and interiors.

### 2.2.1 Sustainable Locations

Sustainably locating a building considers many factors, addressed in various policy directives (listed below). These factors include access to transit along pedestrian- and bike friendly paths and corridors, proximity to neighborhood amenities that meet daily needs of employees and visitors, maximization of existing infrastructure and infill opportunities, and centralization within existing population centers so that jobs and services are accessible to a diverse range of people within the geographic area.

#### 2.2.1.1 Site Uses Existing Infrastructure Resources and Preserves Natural Resources

- Baseline:
  - The site selection process addressed relevant policy directives, as of publication of this standard: Executive Orders 12072, 13006, and 13514; and the Implementing Instructions for Sustainable Federal Locations (Council on Environmental Quality, September 2011).
  - The project site includes no wetlands, no water bodies, no land within 50 feet of wetlands, and no land within 100 feet of water bodies and complies with all local, state, and federal regulations pertaining to wetland and water body conservation.
  - The project site is not within a state or locally designated agricultural preservation district, and does not disturb prime soils, unique soils, or soils of state significance as identified in a state Natural Resources Conservation Service soil survey.
  - The site is not a greenfield.
- Tier 1 High Performance (★):
  - The site meets the Baseline requirements.
  - The site is an infill site within existing urban or suburban development, served by existing water and wastewater infrastructure.
- Tier 2 High Performance (★★):
  - The site meets the Baseline requirements.
  - The site is a grayfield or brownfield infill site within existing urban or suburban development, served by existing water and wastewater infrastructure. A brownfield site is documented as contaminated (by

means of an ASTM E1903-97 Phase II Environmental Site Assessment or a local Voluntary Cleanup Program), or on a site defined as a brownfield by a local, state, or federal government agency; and remediation of the site requires that the controlling public authority approves the protective measures and/or cleanup as effective, safe, and appropriate for the future use of the site.

- Tier 3 High Performance (★★★):
  - The site meets the Tier 2 High Performance requirements.
  - The site is identified in consultation with local officials as being targeted for redevelopment in existing local development plans.

### 2.2.1.2 Site Supports Transit-Use and Reduced Automobile Commuting

- Baseline:
  - The site selection process addressed relevant policy directives as of publication of this standard: Executive Orders 12072, 13006, and 13514; and the Implementing Instructions for Sustainable Federal Locations (Council on Environmental Quality, September 2011), AND
    - A) The site is located within a region served by a metropolitan planning organization (MPO) and within a transportation analysis zone (TAZ) where either:
      - a) the current annual home-based vehicle miles traveled (VMT) per capita (if TAZ is 100% residential), or
      - b) the annual non-home based VMT per employee (if TAZ is 100% non-residential) does not exceed 90% of the average of the equivalent metropolitan region value.

The research must be derived from household or employment transportation surveys conducted by the MPO within ten years of the date of project completion or as provided by GSA, upon request, AND/OR:

- B) The site is located near to existing and/or planned transit service, such that the principal functional building entrance of the facility is:
  - a) within a 1/4 mile walk distance of bus and/or streetcar stops, or
  - b) within a 1/2 mile walk distance of bus rapid transit stops, light or heavy rail stations, and/or ferry terminals, all of which are connected continuously by pedestrian pathways and routes accessible to bicycles.
- Tier 1 High Performance (★):
  - The site meets the Baseline requirements, AND:
    - A) The annual per capita VMT of the TAZ is between 60 and 89% of the average of the equivalent metropolitan region value, AND/OR
    - B) The minimum daily service at the transit stops identified in the Baseline requirement meet the following thresholds (weekend service must include Saturday and Sunday):
      - For facilities near to multiple transit types, weekday trips up to 100 per day and up to 60 trips per day on weekends.
      - For projects with commuter rail or ferry service only, weekday trips up to 24 per day and up to 6 trips per day on weekends.
- Tier 2 High Performance (★★):
  - The site meets the Baseline requirements, AND:
    - A) The annual per capita VMT of the TAZ is between 30 and 59% of the average of the equivalent metropolitan region value, AND/OR



- B) The minimum daily service at the transit stops identified in the Baseline requirement meet the following thresholds (weekend service must include Saturday and Sunday):
    - For facilities near to multiple transit types, weekday trips between 101 and 245 per day and between 85 and 150 trips per day on weekends.
    - For projects with commuter rail or ferry service only, weekday trips between 25 and 40 per day and between 7 and 10 trips per day on weekends.
  - Tier 3 High Performance (★★★):
    - The site meets the Baseline requirements, AND:
      - A) The annual per capita VMT of the TAZ is 30% or less of the average of the equivalent metropolitan region value, AND/OR: B) The minimum daily service at the transit stops identified in the Baseline requirement meet the following thresholds (weekend service must include Saturday and Sunday):
        - For facilities near to multiple transit types, weekday trips of more than 245 per day and more than 150 trips per day on weekends.
        - For projects with commuter rail or ferry service only, weekday trips more than 40 per day and more than 10 trips per day on weekends.
- of this standard: Executive Orders 12072, 13006, and 13514; and the Implementing Instructions for Sustainable Federal Locations (Council on Environmental Quality, September 2011), AND
- The principal functional entry on the front façade faces a public space, such as a street, square, park, or plaza, but not a parking lot, and is connected to sidewalks or equivalent provisions for walking, AND
  - The facility is located such that the connectivity of the site and adjacent land is at least 90 intersections per square mile as measured within a 1/2-mile distance from the geographic center of the facility, AND
  - The facility's primary functional entrance is:
    - a) within 1/4-mile walk distance of at least five diverse uses, OR
    - b) within 1/2-mile walk distance of at least seven diverse uses. These uses must include at least one food retail establishment and at least one other community-serving retail business or service, with the following limitations:
      - A single establishment may not be counted in two categories (e.g., a place of worship may be counted only once even if it also contains a daycare facility, and a retail store may be counted only once even if it sells products in several categories).
      - Establishments in a mixed-use building may each count if they are distinctly operated enterprises with separate exterior entrances, but no more than half of diverse uses can be situated in a single building or under a common roof.
      - Only two establishments in a single category may be counted (e.g., if five restaurants are within the required distance, only two may be counted).

### 2.2.1.3 Site Supports Neighborhood Connectivity, Walkability, and Bikeability

- Baseline:
  - The site selection process addressed relevant policy directives as of publication

- Tier 1 High Performance (★):
  - The site meets the Baseline requirements, AND:
  - The facility is located such that the connectivity of the site and adjacent land is between 91 and 250 intersections per square mile as measured within a 1/2-mile distance from the geographic center of the facility, AND
  - The facility’s primary functional entrance is:
    - a) within 1/4-mile walk distance of at least 7 diverse uses, OR
    - b) within 1/2-mile walk distance of at least 10 diverse uses. These uses must include at least one food retail establishment and at least one other community-serving retail business or service, with the same limitations outlined in the Baseline.
  
- Tier 2 High Performance (★★):
  - The site meets the Baseline requirements, AND:
  - The facility is located such that the connectivity of the site and adjacent land is between 251 and 290 intersections per square mile as measured within a 1/2-mile distance from the geographic center of the facility, AND
  - The facility’s primary functional entrance is:
    - a) within 1/4-mile walk distance of at least 10 diverse uses, OR
    - b) within 1/2-mile walk distance of at least 12 diverse uses. These uses must include at least one food retail establishment and at least one other community-serving retail business or service, with the same limitations outlined in the Baseline.
  
- Tier 3 High Performance (★★★):
  - The site meets the Baseline requirements, AND:
  - The facility is located such that the connectivity of the site and adjacent land is greater than 291 intersections per square

mile as measured within a 1/2-mile distance from the geographic center of the facility, AND

- The facility’s primary functional entrance is:
  - a) within 1/4-mile walk distance of at least 12 diverse uses, OR
  - b) within 1/2-mile walk distance of at least 15 diverse uses.

These uses must include at least one food retail establishment and at least one other community-serving retail business or service, with the same limitations outlined in the Baseline.

### 2.2.2 Collaborative Design Process

The construction and renovation of a Federal facility may be one of the more significant real estate investments in many communities. GSA has a responsibility to meet client needs, but where possible, federal investment should support local development plans, or at a minimum, not negatively impact them. This responsibility derives from the Federal Urban Land Use Act of 1949 (40 USC Sec. 901-905); the Public Buildings Amendments of 1988 (40 U.S.C. 3312); and Executive Orders 12072, 13006, and 13514.

In order to meet this responsibility, the project team must understand local plans and conditions, neighborhood context, and local perspectives early in the project’s development and design. This is the only way to give meaningful consideration to the input of local officials. In many cases, collaboration with local planning and land-use officials will be necessary throughout the project’s design and implementation.

- Baseline:
  - For new construction or other projects with significant impact on the public realm (e.g., landscape, facades, perimeter security), GSA’s regional project team meets with local officials about the project and considers their input during the preparation

of feasibility and similar analysis, prior to requesting design funding.

- Prior to the Design Kick-off meeting, GSA's project manager and A/E must meet with local planning/land use officials to share project info, get officials' input, and review local plans.
  - At the first Peer Review, project team must present the input from consultation with local officials and explain the project's responding design strategy in that context.
  - The Final Design Concept for PBS Commissioner's approval discuss local input, outline the responding design strategy, and present sufficient detail regarding relevant building and landscape design choices to enable meaningful consideration concept proposal.
- Tier 1 High Performance (★):
    - Meets Baseline performance requirements, AND:
    - Prior to approval of the Final Design Concept, project team must share the relevant elements of the proposed design strategy with local officials and address their feedback in the Final Design Concept presentation.
  - Tier 2 High Performance (★★):
    - Meets Tier 1 High Performance Requirements AND:
    - Design process enables local officials, or other relevant stakeholders, to participate in an informal design review meeting during concept design. Prior to such meeting, GSA will make clear that the purpose of the meeting is to get more nuanced feedback from key stakeholders, but that GSA retains authority for all design decisions.
  - Tier 3 High Performance (★★★):
    - Meets Tier 2 High Performance Requirements AND:
    - Project design and development must be informed by a neighborhood planning or

charrette process that was conducted in partnership with local officials.

### 2.2.3 Design for Public Use

The Public Buildings Cooperative Use Act of 1976 (40 U.S.C. 601a) requires GSA to encourage the location of commercial, cultural, educational, and recreational facilities and activities within GSA public buildings and sites, and to encourage the public use of these properties for cultural, educational, and recreational activities. Although much of this responsibility falls to how GSA manages and makes such space available, the design of the spaces – both interior and exterior – is fundamental.

Federal buildings are inherently public buildings, but their design determines how successfully the public is able to access and use the building interior and exteriors. This is especially true given current security requirements and project budgets.

Buildings that are highly successful maximize public investment by both meeting the Federal space need and by enabling public use. Key factors in a successful project include the design's ability to support flexible passive or programmed use in gathering spaces, the shaping and orientation of building program to encourage such use, and, where appropriate, the expansion of the building's program to take advantage of site-specific public use opportunities.

All public areas of the project site, regardless of scale, should take a deliberate and proactive approach to providing a positive usable space for facility users and, where possible, the local community.

#### 2.2.3.1 Interiors

- Baseline:
  - Assembly areas in the base building program (e.g., auditoriums, atria, jury assembly rooms) are designed to allow for manageable public access for after-hours use.

- Upon project opening, at least one interior building assembly area that holds likely potential for occasional public use is cataloged in the property manager's office and made available for public use.
  - Tier 1 High Performance (★):
    - Meets Baseline Requirements AND:
    - Assembly areas within the base building program are positioned in relation to public entries and other building amenities so as to enhance their visibility and utility and to encourage public interest in their use.
  - Tier 2 High Performance (★★):
    - Meets Tier 1 High Performance Requirements AND:
    - Assembly areas for appropriate public use include at least one contiguous space that provides a minimum of 2,000 SF.
    - Upon project opening, GSA has approved a permit (GSA Form 3453) for public use of an interior space.
  - Tier 3 High Performance (★★★):
    - Meets Tier 2 High Performance Requirements AND:
    - Design provides interior spaces or other permanent structures that will be leased for long-term private commercial or other mixed use.
- with a cohesive vision, to create a positive pedestrian experience.
- Landscape design elements are assembled in order to provide access, comfort, shade, seating options, and visual interest that encourages passive public use by building visitors and, where appropriate, the general public.
  - Tier 1 High Performance (★):
    - Meets Baseline Requirements AND:
    - Landscape design includes gathering areas intentionally designed for occasional assembly or passive use. Plaza areas include a variety of seating choices (shade, sun, sitting walls, tables, furniture, etc.) that together provide a minimum of one (1) linear foot of seating for every fifty (50) SF of plaza space. Seating should be placed to provide a variety of choices and to meet a variety of needs (e.g., including 'companion' seating for elderly or disabled visitors).
    - If not provided under the project construction contract, plaza furnishings (furniture, shade structures, waste cans) are selected and located by the project designer, priced and sourced for later acquisition, and installed upon project opening.
  - Tier 2 High Performance (★★):
    - Meets Tier 1 High Performance Requirements AND:
    - Landscape design provides a publicly accessible plaza space that provides a minimum of 6,000 square feet of space that is adjacent to and readily accessible to public sidewalks. Plaza areas provide a minimum of one tree for every 1,000 SF of plaza space.
    - Gathering areas are equipped with publicly accessible Wi-Fi to support use by building occupants and visitors.

### 2.2.3.2 Exterior

- Baseline:
  - Design provides a specific vision for how all exterior public areas are meant to be used, whether for circulation, passive use, or programmed public use. The public spaces are designed and furnished to support that intended use.
  - Pedestrian circulation networks through and around the project site are designed

- Tier 3 High Performance (★★★):
  - Meets Tier 2 High Performance Requirements AND:
    - Plaza areas are designed for programmed public use and at least one area includes electrical service to support such use.
    - Upon project opening, GSA has approved a permit (GSA Form 3453) for public use of the space.

## 2.3 Urban Planning and Design, and Site Prescriptive Requirements

### 2.3.1 Process Criteria

The design team must identify relevant local planning and/or land-use officials and record interactions with them, including meeting schedules and minutes. Note that the appropriate level of government (local, county, state) will differ with each jurisdiction.

The design team must work with client agency and local officials to understand mode share split of employee and visitor commutes, i.e. identify how people arrive at the site and what percentage of people by each mode of transportation. This understanding will assist the design team in effectively orienting building approaches toward the highest-use pedestrian entry points to the site.

### 2.3.2 Design Criteria

#### 2.3.2.1 Exterior connections and gathering spaces

All outdoor pedestrian pathways must connect building entrances safely and contiguously to the means of transportation identified in consultation with client agency and local officials, described above, including transit stops off-site.

Building approaches, pathways, and plazas must be oriented toward primary pedestrian access points to the site. This orientation must give consideration to street connections to transit stops, when appropriate, and to primary neighborhood corridors.

The design team must demonstrate in design drawings how plazas and other gathering spaces allow for several different active and passive uses

(such as farmers markets, seated assemblies, and employee breaks and lunches). Design teams must consider current best practices in public space design. For example, isolated bench seating, seating without shade, and gathering spaces not visible from building entrances or along primary pedestrian pathways are not likely to be used regularly.

Design drawings must demonstrate consideration of human scale in the exterior design by showing building perspectives at eye-level from designed pedestrian pathways (such as sidewalks adjacent to the buildings).

#### 2.3.2.2 Interior spaces and assembly areas

Assembly areas designed for flexible public use both during and after business hours must have direct and clear wayfinding from building entrances.

The design team must demonstrate in design drawings how, when designed for public use, atriums, jury assembly rooms, and other gathering spaces allow for several different public uses, such as a standing reception, a seated dinner, an awards ceremony, or similar.

#### 2.3.3.4 Zoning and Related Issues.

The A/E team must offer local officials an opportunity to review and comment on the design concepts for compatibility with local plans, zoning, and design guidelines. Local review must be done in coordination with the project design schedule. If local officials choose not to review the design concept, the project manager must document this in the project file. By law, the A/E must incorporate the national environmental Policy act (NEPA) record of decision (ROD) requirements in the design documents. Local regulations must be followed without exception in

the design of systems that have a direct impact on off-site terrain or infrastructure. These systems include, but are not limited to, fire protection services, storm water runoff, erosion control, sanitary sewers and storm drains, water, gas, electrical power, communications, emergency vehicle access, roads, and bridges.

### **2.3.3.5 First Responder and Emergency Access.**

Provide fire department vehicle access in accordance with the requirements of the ICC International Fire Code.

### **2.3.3.6 Fire Apparatus Access Roads.**

The A/E must design the emergency vehicle access in accordance with the specific requirements of the local fire department. At a minimum, the fire department must be consulted regarding the surface material of the access roadways, minimum width of fire lanes, minimum turning radius for the largest fire department apparatus, weight of the largest fire department apparatus, and minimum vertical clearance of the largest fire department apparatus.

### **2.3.3.7 Aerial Apparatus Access.**

For buildings or portions of buildings exceeding 9 meters (30 ft.) in height, from the lowest point of fire department vehicle access, provide access roads capable of accommodating fire department aerial apparatus. Overhead utility and power lines must not cross the access roadway.

### **2.3.3.8 Site Signage**

A well-designed site uses as few signs as possible. Signs should make the site wayfinding clear to the first-time user by identifying multiple site entrances, parking, and the main building entrance.

Generally, graphics and style of site signage should be consistent with signage used inside the building. Signs

integrated with architectural elements can also be very effective. Signage must be consistent in font, style, and color as well as with any directional symbology used in site and building signage. Signage placement can be an important detail element of the building design whether prominently displayed and tooled into the exterior building wall materials or as a freestanding component near the entrance to the facility. Exterior signs identifying permanent rooms and spaces must comply with ABAAS (see ABAAS Section F216). Additional information about GSA graphic standards can be found at [www.gsa.gov/logo](http://www.gsa.gov/logo).

### **2.3.3.9 Construction Signs**

Construction signs are to be 3,600 mm by 1,800 mm (12 ft. by 6 ft.) and constructed of a durable, weather-resistant material, properly and securely framed and mounted. The sign will be blue with white lettering and mounted at least 1,200 mm (4 ft.) above the ground. The sign must include the official GSA logo no less than 400 mm (16 in.) square. The lettering, graphic style, and format should be compatible with the architectural character of the building.

### **2.3.3.10 New Construction Signs**

Signs at new construction sites must include the name of the architect and general contractor and may contain an artist's rendering or photograph of the model of the building under construction.

### **2.3.3.11 Repair and Alteration Projects**

Signs at prospectus level repair and alteration project sites must include the name of the architect and/or engineers for the major systems work (e.g., structural, mechanical, electrical), in addition to the name of the general contractor.

### **2.3.3.12 Site Wayfinding**

Minimize the number of wayfinding signs on the site. For complex sites with multiple buildings or other

destinations, consider developing a wayfinding plan for review by the project manager and users.

Obtain approval of local authorities for entrance signs in the public rights-of-way.

Use variable message signs for high-volume areas where entrance patterns need to be altered.

**2.2.3.13 Construction Signs**

Construction signs must provide the following information:

- Building for the People of the United States of America
- (Name of) Federal Building
- Constructed by (building contractor)
- U.S. General Services Administration–Public Buildings Service
- (President’s name), President of the United States
- (Administrator’s name), Administrator, GSA
- (Name), Commissioner, PBS
- (Regional Administrator’s name), Region X Administrator

**2.3.3.14 Flagpoles**

A ground-mounted flagpole, located preferably at the left of the entrance (facing the building), must be provided for new Federal buildings. If ground-mounted poles are not feasible, a roof-mounted pole is permissible; or, if roof mounting is not suitable, an outrigger pole may be used. Only one flagpole is needed for a complex of buildings on a common site. The flag must be illuminated.

**Table. The following are approved flagpole heights and the corresponding flag sizes.**

Flagpole Height	Flag Dimensions
20 ft.	3 1/2 by 6 2/3 ft.
30 ft.	5 by 9 1/2 ft.
40 ft.	5 by 9 1/2 ft.
50 ft.	8 2/3 by 17 ft.
60 ft.	8 2/3 by 17 ft.



# 2.4 Landscape Performance Attributes

2.4 Site Landscape Performance Requirements									
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurement & Verification	Plans & Specs	Calculations & Analysis		
<b>Site Soils</b>									
<b>Reference</b>	SSI 4.3/4.4-2009	SSI 4.3/4.4-2009	SSI 4.3/4.4-2009	SSI 4.3/4.4-2009	SSI 4.3,4.4	SSI 4.3,4.4	SSI 4.8		
<b>Performance</b>	Option 1- Locate 70 percent of soil displacement and disturbance on soils disturbed by previous development with moderate or severe soil disturbance as identified in a site assessment. (or) Option 2- On all areas with healthy or minimally disturbed soil limit disturbance to: a. 50 feet beyond the building perimeter, b. 15 feet beyond surface walkways, terraces, surface parking, and utilities less than 12 inches in diameter, c. 20 feet beyond primary roadway curbs/roadway edges and main utility branch trenches, d. 30 feet beyond constructed areas with permeable surfaces that require additional staging areas in order to limit compaction in the constructed area. (SSI prerequisites 2.1 and 4.3)	Option 1- Locate 80 percent of soil displacement and disturbance on soils disturbed by previous development with moderate or severe soil disturbance as identified in a site assessment. (or) Option 2-On all areas with healthy or minimally disturbed soil limit disturbance to: a. 50 feet beyond the building perimeter, b. 15 feet beyond surface walkways, terraces, surface parking, and utilities less than 12 inches in diameter, c. 20 feet beyond primary roadway curbs/roadway edges and main utility branch trenches, d.30 feet beyond constructed areas with permeable surfaces that require additional staging areas in order to limit compaction in the constructed area. (SSI prerequisites 2.1 and 4.3)	Option 1- Locate 90 percent of soil displacement and disturbance on soils disturbed by previous development with moderate or severe soil disturbance as identified in a site assessment. (or) Option 2-On all areas with healthy or minimally disturbed soil limit disturbance to: a. 40 feet beyond the building perimeter, b. 10 feet beyond surface walkways, terraces, surface parking, and utilities less than 12 inches in diameter, c. 15 feet beyond primary roadway curbs/roadway edges and main utility branch trenches, d. 25 feet beyond constructed areas with permeable surfaces that require additional staging areas in order to limit compaction in the constructed area. (SSI prerequisites 2.1 and 4.3)	•Option1- Locate 100 percent of soil displacement and disturbance on soils disturbed by previous development with moderate or severe soil disturbance as identified in a site assessment. (or) Option 2- On all areas with healthy or minimally disturbed soil limit disturbance to: a. 40 feet beyond the building perimeter, b. 10 feet beyond surface walkways, terraces, surface parking, and utilities less than 12 inches in diameter, c. 15 feet beyond primary roadway curbs/roadway edges and main utility branch trenches, d. 25 feet beyond constructed areas with permeable surfaces that require additional staging areas in order to limit compaction in the constructed area. (SSI prerequisites 2.1 and 4.3)	Yes. Employ the SSI Definitions.	Yes, and Provide Soil Management Plan	Provide comparative analysis covering geotechnical, agricultural and drainage soil properties to establish the reference site soil condition and the proposed soil import/condition.	Describe proposed site zoning and corresponding phasing, lay-down, and sequencing for all areas affected by the construction process that respond to project particulars. Describe engineering controls for restoring site disturbance.	Verify all imported soils and engineered soils meet project performance requirements.
<b>Vegetation</b>									
<b>Reference</b>	SSI 4.1/4.2/4.5/4.6/4.7/4.8/4.9/4.10/4.11/4.12/4.13-2009	SSI 4.1/4.2/4.5/4.6/4.7/4.8/4.9/4.10/4.11/4.12/4.13-2009	SSI 4.1/4.2/4.5/4.6/4.7/4.8/4.9/4.10/4.11/4.12/4.13-2009	SSI 4.1/4.2/4.5/4.6/4.7/4.8/4.9/4.10/4.11/4.12/4.13-2009	SSI 4.1/4.2/4.5/4.6/4.7/4.8/4.9/4.10/4.11/4.12/4.13-2009	SSI 4.1/4.2/4.5/4.6/4.7/4.8/4.9/4.10/4.11/4.12/4.13-2009	SSI 4.1/4.2/4.5/4.6/4.7/4.8/4.9/4.10/4.11/4.12/4.13-2009	SSI 4.6	
<b>Performance</b>	Provide an invasive species management plan. Propose non-invasive native or adapted species. Identify, and if possible preserve all special status vegetation. Propose appropriate plant biomass for the site. Use vegetation to minimize building climate control requirements.	Provide an invasive species management plan. Propose non-invasive native or adapted species. Identify, and if possible preserve, all special status vegetation. Propose appropriate plant biomass for the site. Use vegetation to minimize building climate control requirements.	Provide an invasive species management plan. Exclusively propose plants native to the eco-region. Identify and preserve all special status vegetation. Propose appropriate plant biomass for the site. Use vegetation to minimize building climate control requirements.	Provide an invasive species management plan. Exclusively propose plants native to the eco-region. Identify, preserve and reuse plant communities and special status vegetation native to the eco-region of the site to contribute to regional diversity of flora and provide habitat for native wildlife. Use vegetation to minimize building climate control requirements.	Yes. Employ the SSI Definitions.	Yes	Tier 1, 2 and 3 High Performance: provide an Invasive Species Management Plan. Tier 2 and 3 High Performance: Biomass Density Index.	Describe proposed distribution of plant communities throughout the site that respond to soil, topography and drainage responding to project particulars.	Verify all plant materials meet project performance requirements.

2.4 Site Landscape Performance Requirements									
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design	Construction
					Measurement & Verification	Plans & Specs	Calculations & Analysis	Basis of Design	Verification
<b>Water Use and Management</b>									
<b>Reference</b>	SSI 3.1/3.7/EISA 438	SSI 3.2/3.3/3.7/3.8/EISA 438	SSI 3.2/3.3/3.7/3.8/EISA 438	SSI 3.2/3.3/3.6/3.7/3.8/EISA 438			EPA		
<b>Performance</b>	Reduce water use for irrigation by 50 percent from established baselines. Manage stormwater on site. If possible, design rainwater/stormwater features into the site to provide a landscape amenity. Design water features with minimal or no make-up water from potable sources.	Reduce water use for irrigation by 50 percent from established baselines. If applicable, protect and restore riparian, wetland, and shoreline buffers. Manage stormwater on site. Design rainwater/stormwater features into the site to provide a landscape amenity. Design water features with minimal or no make-up water from potable sources. Install a soil moisture monitoring system.	Reduce water use for irrigation by 75 percent from established baselines. If applicable, protect and restore riparian, wetland, and shoreline buffers. Manage stormwater on site. Design rainwater/stormwater features into the site to provide a landscape amenity. Design water features with minimal or no make-up water from potable sources. Install a soil moisture monitoring system.	Reduce water use for irrigation by 75 percent from established baselines. If applicable, protect and restore riparian, wetland, and shoreline buffers. Manage stormwater on site. Design rainwater/stormwater features into the site to provide a landscape amenity. Design water features with minimal or no make-up water from potable sources. Enhance on-site water resources and receiving water quality. Install a soil moisture monitoring system.	Yes. Employ the SSI Definitions. Submission narrative for planting and irrigation, landscape coefficients, calculations for peak watering month. Indicate all water sources.	Yes, and SWPPP	Provide a Baseline Landscape Water Requirement (BLWR) and a Designed Landscape Water Requirement (DLWR). Calculations that demonstrate that on-site water features can meet water requirements with sustainable water source/supply. Provide calculations of the target water storage capacity of	Describe proposed site hydrology that responds to existing and proposed topographic conditions responding to project particulars.	After occupancy, provide two year of two week trend history for irrigation system. Provide a one year two week trend history for soil moisture via a Soil Moisture Monitoring system so that any required irrigation can be adjusted.
<b>Site Materials</b>									
<b>Reference</b>	SSI 5.1/5.5/5.7-2009	SSI 5.1/5.2/5.5/5.7/-2009	SSI 5.1/5.2/5.3/5.5/5.7/5.8-2009	SSI 5.1/5.2/5.3/5.4/5.5/5.7/5.8-2009			SSI 4.1		
<b>Performance</b>	Only use wood products extracted from non-threatened species to minimize negative effects on other ecosystems. Use recycled content materials. Use regional materials.	Only use wood products extracted from non-threatened species to minimize negative effects on other ecosystems. Maintain or repurpose on-site structures and construction materials to extend life cycle of existing building materials and reduce waste. Use recycled content materials. Use regional materials.	Only use wood products extracted from non-threatened species to minimize negative effects on other ecosystems. Maintain or repurpose on-site structures and construction materials to extend life cycle of existing building materials and reduce waste. Design for deconstruction and disassembly. Use recycled content materials. Use regional materials. Use adhesives, sealants, paints, and coatings with reduced VOC emissions.	Only use wood products extracted from non-threatened species to minimize negative effects on other ecosystems. Maintain or repurpose on-site structures and construction materials to extend life cycle of existing building materials and reduce waste. Design for deconstruction and disassembly. Reuse salvaged plant material. Use recycled content materials. Use regional materials. Use adhesives, sealants, paints, and coatings with reduced VOC emissions.	Yes. Employ the SSI Definitions.	yes	Provide a species list of all proposed wood products and threatened/endangered status. High performance: Provide a narrative with existing site materials and quantifications, including plants, and how it will be reused on site versus how much will enter the waste stream.	Describe proposed approach to site materials that achieves both visual and performance goals responding to project particulars.	Verify all site materials meet project performance requirements.

## 2.5 Landscape Prescriptive Requirements

All proposed site design must meet baseline compliance with all applicable federal, tribal, state and local regulation and/or guidance. This includes all elements of work performed under the scopes of the landscape architect, architect, civil engineer, and geotechnical engineer. The applicable regulations must be determined on an individual project basis.

### 2.5.1 Examples of Federal Design Criteria

#### 2.5.1.1 Section 438 of the Energy Independence and Security Act (EISA) & EISA Technical Guidance

The sponsor of any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow.

#### 2.5.1.2 National Pollution Discharge Elimination System (NPDES) of the Clean Water Act (as delegated to the States)

NPDES is a permitting program that applies to all activities resulting in water pollution discharges, including construction projects of certain sizes. Obtaining such a permit typically requires the development of an Erosion and Sediment Control Plan, and a Stormwater Pollution Prevention Plan (SWPPP). Minimum requirements are developed by the EPA, and delegated to the individual states. The states often add additional performance requirements; therefore, state-by-state compliance is required.

#### 2.5.1.3 Reference Standard

SSI = Sustainable Sites Initiative (2009)

EISA 2007

### 2.5.2 Managing Existing Site Vegetation

#### 2.5.2.1 Documenting Existing Vegetation

To supplement the topographic and boundary survey a Certified Arborist Report (CAR) must be prepared and submitted that clearly demonstrates the size, species, and condition of all existing trees and shrubbery on site.

#### 2.5.2.2 Incorporating Existing Vegetation into a Proposed Project

Detailed plans must be provided for those plants that will be impacted and/or removed for the impacted site. For all new construction projects this includes identifying proposed new tree locations and quantities, as well as the protection plan for existing trees during the construction activity. Further all proposed grade changes affecting the protected site trees should be identified.

#### 2.5.2.3 Defining Tree Protection Zone

Protection Zone is defined as the area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

#### 2.5.2.4 Determine Tree Protection Zone

For trees, the locations of all Critical Root Zones (CRZs) are defined as the area for each tree which contains the estimated minimal amount of both

structural and feeder roots that must be protected to minimize tree damage and retain structural stability. The CRZ for each tree is calculated based on the Tree Species Tolerance to construction impacts and age class, as outlined in the International Society of Arboriculture's Best Management Practices: Managing Trees During Construction (K. Fite, T. Smiley, 2008).

Although CRZs will differ by species and tree age, zones range from ½ foot per one inch DBH (diameter at breast height) to 1½ foot per one inch DBH. If the species tolerance is unknown, then the 1½ foot per one inch DBH standard is assumed. Mixed groupings of trees will base the required area of protection on that area which is required for maintaining the health of the most sensitive individual species composing the cluster. The 1½ foot standard applies unless sufficient information detailing the contrary is provided and a lesser area is approved. For large shrubs and groups of shrubs a protection area shall be provided equivalent to 1.5 times the diameter of the massing itself, unless otherwise indicated.

## 2.5.3 Site Soils

### 2.5.3.1 Purpose

Limit disturbance of healthy soil to protect soil horizons and maintain soil structure, existing hydrology, organic matter, and nutrients stored in soil. Develop and communicate to construction contractors a soil management plan prior to construction to limit disturbance, assist soil restoration efforts, and define the location and boundaries of all vegetation and soil protection zones.

### 2.5.3.2 Applicability

All projects to preserve and conserve existing site soils to promote site health and cost savings.

### 2.5.3.3 Primary areas of work

Include:

- a) Create a Soil Management Plan and
- b) Minimize soil disturbance in design and construction.

Note: Soil impacts described within are intended to manage impacts associated with significant construction activities, not surface landscape improvements. In cases where top soils need to be improved to provide an enhanced growing environment, such dimensional restrictions would not apply. The soils section should be cross-referenced with "Vegetation," and "Water."

## 2.5.4 Parking Fields

1. All open parking areas with 18 spaces or more, or 6,000 square feet that front upon a street, shall be screened by a perimeter landscaped area at least seven feet in width measured perpendicular to the street line.
2. Perimeter landscaped areas may be interrupted only by vehicular entrances and exits, and select walkways that are providing a direct connection between a public sidewalk and walkway within or adjacent to the parking field.
3. Where parking stalls are paved with permeable materials, rooting area computations can incorporate area located below the certified permeable system. Where such an approach is undertaken, sufficient trunk protection must be provided for any proposed trees that include provisions for full prospective tree growth, including buttresses, expanded trunk growth. Further wheel-stops and average car overhang dimensions should allow for the tree to safely reach maturity.
4. The perimeter landscape area surface must typically include living plant material. On water challenged sites, non-paved mineral surfaces may be

substituted for living plant materials on a qualitative basis.

sufficient root development. Design details are required.

5. The open parking area shall be graded to allow stormwater runoff to drain into all required perimeter landscaped areas and/or planting infiltration islands.

6. Proper stormwater drainage rates shall be attained, if required, through under drains that are connected to detention storage that meet/exceed local/regional drainage and flow requirements. Computations are required. If underdrains are not provided, soil boring tests shall be conducted by a licensed engineer to ensure that ponded surface water is capable of draining in at least 24 hours.

7. To allow for adequate drainage, and promote water infiltration, proposed catch basins placed in the planting infiltration areas should be elevated above adjacent grade, to promote ponding and infiltration without posing a public nuisance or maintenance hardship for facility managers.

8. One three-inch caliper tree shall be provided for every 1250 SF of parking area. In regions where water is scarce and therefore establishment of a tree would be burdensome or consumptive of a dwindling resource, a shade structure can be proposed in lieu of trees to shade the interior parking field. The structure is expected to provide shade that is equivalent to the shade that would be provided by an open grown mature shade tree grown under similar conditions in the region. This equivalency is to be submitted and provided for review. The use of a shade structure in lieu of trees would not eliminate the need for islands to reduce horizontal scale of the parking field, provide pedestrian refuge, and manage storm water. Each tree shall have a minimum planting zone of 150SF of pervious area. Any space less than 2' in width shall not contribute to the square footage requirement of the trees requisite planting zone. Computations are required

9. Planting island soil depths should be measured to be at minimum 30" from finished elevation of adjacent parking field, or as required to support

# CHAPTER 3 • ARCHITECTURE AND INTERIOR DESIGN

3.1 Enclosure Performance Requirements									
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurement & Verification	Plans & Specs	Calculations & Analysis		
<b>Envelope - Natural Hazard</b>									
Seismic Resistance	Life Safety	Reduced Damage	Immediate Occupancy	Operational	Performance Mockup Testing		IBC-2012 ASCE 7-10 FEMA356 ASTM E 2026  Design Team Calculations & Inspection	Describe seismic resistance design assumptions.	
Windborne Debris Resistance	Comply with IBC	Large Missile < 30-ft from Grade & Small Missile > 30-ft of Grade	Large Missile < 30-ft from Grade & Small Missile > 30-ft of Grade. No breach in envelope for wind zone.	Site Specific Risk Assessment (Tornado Hazard)	ASTM E 1996/1886  Wind Tunnel Testing & Projectile Impact Testing		ICC/NSSA 500-2008 FEMA 361 ASTM E 1996  Design Team Calculations & Inspection	Describe windborne debris resistance design requirements.	Witness mockup test when provided.
Flood Resistance	100-Year Flood Hazard; Critical Action Facilities Must be Located above the 500-Year Base Flood.	500-Year Flood Hazard and/or Storm Surge Inundation	Site Specific Risk Assessment (Dam, Levee, and Floodwall Failure Hazards)	N/A		Site Planning	FEMA Flood Maps ASCE 24-05, "Flood Resistant Design and Construction"  Design Team Calculations & Inspection	Describe flood resistance design requirements.	Witness mockup test when provided.
<b>Envelope - Serviceability</b>									
Wind Resistance	Deflection within code limits.	Deflection less than code limits. Deflection limit to be selected by design team to result in 4/1000 probability of breakage at design load.	N/A	N/A	ASTM E 330 ASTM E 1300  Wind Tunnel Testing & Performance Mockup Testing		IBC-2012 ASCE 7-10 Design Team Calculations & Inspection	Describe envelope wind resistance design requirements.	

3.1 Enclosure Performance Requirements									
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurement & Verification	Plans & Specs	Calculations & Analysis		
<b>Envelope - Serviceability</b>									
Wind Resistance	Deflection within code limits.	Deflection less than code limits. Deflection limit to be selected by design team to result in 4/1000 probability of breakage at design load.	N/A	N/A	ASTM E 330 ASTM E 1300  Wind Tunnel Testing & Performance Mockup Testing		IBC-2012 ASCE 7-10 Design Team Calculations & Inspection	Describe envelope wind resistance design requirements.	
<b>Water Penetration Resistance</b>									
Fenestration	CW30 @ 15% DP	CW30 @ 20% DP	AW40 @ 25% DP	AW40 @ 30% DP	ASTM E331 ASTM E1105 AAMA 501.1 AAMA E2268 AAMA 501.2	Yes  Water Leakage = Uncontrolled Water Penetration  Delete Test Pressure Upper Limits from AAMA 101-08	ASCE 7-10 AAMA 101-08	Describe fenestration water penetration resistance level utilized in the design.	CxA to witness Performance Mock-Up Test outlined in ASTM E331-09, E1105-08 as applicable
Roofing and Horizontal Waterproofing-Membrane System	Do not use roof surface for Storm Water Retention or allow Water to otherwise pond or remain  Highly resistant to physical damage  Designs that prohibit entrapment of Water	Baseline and Fully Reinforced Membrane System  Membrane System Fully Bonded to the Structural Deck	Tier 1 HP and Membrane System Fully Bonded to the Structural Deck  Monolithic/Seamless	Tier 2 HP and System Protected from Temperature and Ultra Violet Radiation	NRCA Roofing and Waterproofing Manual  SMACNA Architectural Sheet Metal Manual	Yes	Yes	Describe roofing and horizontal waterproofing membrane water penetration resistance construction.	CxA to verify installation and witness testing per ASTM C-1601-05 or NRCA Manual Guideline: "Quality Assurance and Water Test"
Roofing and Horizontal Waterproofing-Minimum Slope	2012 International Building Code, Section 1507	1.5 times greater than Baseline	2.0 times greater than Baseline	2.5 times greater than Baseline	N/A	2012 IBC, Section 1507	Yes	Describe roofing and horizontal waterproofing minimum slope used in design.	CxA to verify installation and witness testing per ASTM C-1601-05 or NRCA Manual Guideline: "Quality Assurance and Water Test"
Roofing and Horizontal Waterproofing-Drainage	2012 International Plumbing Code, Section 1106 for 100 yr. max. 1-hr rainfall design	1.1 times greater than Baseline	1.2 times greater than Baseline	1.4 times greater than Baseline	N/A	2012 IPC, Section 1106 for 100 yr. max. 1-hr rainfall design	2012 IPC, Section 1106 for 100 yr. max. 1-hr rainfall design	Describe basis for designing the roofing and horizontal waterproofing drainage.	CxA to verify installation and witness testing per ASTM C-1601-05 or NRCA Manual Guideline: "Quality Assurance and Water Test"

3.1 Enclosure Performance Requirements									
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurement & Verification	Plans & Specs	Calculations & Analysis		
<b>Roofing and Horizontal Waterproofing-Vegetative Systems</b>	Tier 3 requirements of Roofing and Horizontal Waterproofing Membrane System  Tier 1 for Roofing and Horizontal Waterproofing Minimum Slope  Tier 1 For Roofing and Horizontal Waterproofing Drainage  Tier 1 for Roofing and Horizontal Waterproofing Testing and Monitoring	Baseline and  Tier 2 for Roofing and Horizontal Waterproofing Minimum Slope  Tier 2 For Roofing and Horizontal Waterproofing Drainage	Tier 1 HP and  Tier 3 for Roofing and Horizontal Waterproofing Minimum Slope  Tier 3 For Roofing and Horizontal Waterproofing Drainage  Shall meet Tier 2 for Roofing and Horizontal Waterproofing Testing and Monitoring	Tier 2 HP and  Tier 3 for Roofing and Horizontal Waterproofing Testing and Monitoring	Yes	Yes	Yes	Describe vegetative roofing systems water penetration construction, minimum slope and basis for sizing drainage.	CxA to verify installation and witness testing per ASTM C-1601-05 or NRCA Manual Guideline: "Quality Assurance and Water Test"
<b>Roofing and Horizontal Waterproofing-Testing &amp; Monitoring</b>	100% Flood Test of all Roofing and Horizontal Waterproofing Surfaces for 48 hours.	Baseline and  Utilize Electronic Leak Detection (ELD) or an alternate methods that to pin point breach locations in the membrane without reliance on water passage through the breach during construction.  Limited Area flood testing per ASTM D5957 at drain bodies and other transitions or penetrations that do not allow ELD.  Water nozzle test similar to AAMA 501.2 shall be performed on all roof detailing not included in ELD and flood testing.	Tier 1 HP and  Allow for future ELD testing during the life of the structure as leaks are identified without removal or disassembly of the coverings.	Tier 2 HP and  Provide a maintenance plan including monitoring at regular intervals as determined.  If possible, tie leak detection system into the Building Management System (BMS) and alerts	ASTM D5957  AAMA 501.2  (No Existing Standard for ELD)	Yes	N/A	Describe roofing and horizontal waterproofing testing requirements and leak monitoring system, when used.	CxA to review Testing & Monitoring procedures proposed by contractor  CxA to verify BMS system interface to leak detection in conjunction with balance of systems, if applicable  CxA to verify installation and witness testing per ASTM C-1601-05 or NRCA Manual Guideline: "Quality Assurance and Water Test"
<b>Ground Water Control</b>	Active Ground Water Control	Passive Ground Water Control with emergency back-up pump, as required.	N/A	Select a location, site, or building design that allows for ground water table to remain a minimum of 600mm (2 feet) below the lowest level of the structure.	N/A	2012 IBC, Section 1805.1.3	2012 IBC, Section 1805.1.3	Describe method of ground water control when required.	CxA to test emergency back-up pump, where applicable.
<b>Below Grade Waterproofing</b>	Relieve hydrostatic pressure on substructure walls and allow water drainage to the level of the drain.  Membrane waterproofing must be fully bonded to the substrate and seamless.  Below-grade waterproofing must be applied to the positive pressure side and must be covered by a protection drainage and protection course.	Baseline and  Tier 1 HP designation in Ground Water Control  Provide a system that does not rely on unpredictable or difficult to control site conditions to develop and maintain a water-tight installation.  Complete "Bathtub" waterproofing in the presence of water table to mitigate demand on dewatering system.  May require foundation modification.	Tier 1 HP and  Includes redundant below grade waterproofing systems, such as a water repellent additive to the concrete masonry foundation walls.	Tier 2 HP and  Include secondary drainage layer within below-grade horizontal concrete slab assemblies.	N/A	2012 IBC, Section 1805	2012 IBC, Section 1805	Describe waterproofing system for below grade waterproofing and test method proposed.	CxA shall witness below grade waterproofing test.
<b>Moisture and Condensation Control</b>									
<b>Moisture Control Opaque Assemblies</b>	Design of the above-grade building enclosure must be demonstrated early in the design development. ASHRAE 160-2009, Criteria for Moisture Control Design Analysis in Buildings is an acceptable basis of design	Baseline and  Provide continuous exterior insulation for wall roof, below grade walls and all slab-on-grade containing conditioned space.  Provide analysis of project specific assemblies and exposures.  Provide for the placement of a portion of the thermal control layer to the exterior of the air and moisture control layers to reduce thermal bridging and move the moisture potential toward the exterior.	Tier 1 HP and  Provide thermal controls to the exterior to maintain conditions within the assembly below a 30-day running average of 70% RH when the temperature is between 5°C (41°F) and 40°F C (104°F).  Provide monitoring of "vulnerable" exposures of the assemblies that alerts the building staff to approaching conditions that may be harmful to the assembly or the occupants.	Tier 2 HP and  All thermal controls are outboard of the air and vapor control layers of the assembly.  Monitoring of moisture content of assemblies tied to BMS for each exposure and cladding type.	Yes	Yes	ASHRAE 160-2009	Document requirement in basis of design	CxA to witness tests outlined in ASTM C1601-05, if applicable



3.1 Enclosure Performance Requirements									
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurement & Verification	Plans & Specs	Calculations & Analysis		
<b>Moisture and Condensation Control</b>									
<b>Moisture Control Opaque Assemblies</b>	Design of the above-grade building enclosure must be demonstrated early in the design development. ASHRAE 160-2009, Criteria for Moisture Control Design Analysis in Buildings is an acceptable basis of design	Baseline and Provide continuous exterior insulation for wall roof, below grade walls and all slab-on-grade containing conditioned space. Provide analysis of project specific assemblies and exposures. Provide for the placement of a portion of the thermal control layer to the exterior of the air and moisture control layers to reduce thermal bridging and move the moisture potential toward the exterior.	Tier 1 HP and Provide thermal controls to the exterior to maintain conditions within the assembly below a 30-day running average of 70% RH when the temperature is between 5°C (41°F) and 40°F C (104°F). Provide monitoring of "vulnerable" exposures of the assemblies that alerts the building staff to approaching conditions that may be harmful to the assembly or the occupants.	Tier 2 HP and All thermal controls are outboard of the air and vapor control layers of the assembly. Monitoring of moisture content of assemblies tied to BMS for each exposure and cladding type.	Yes	Yes	ASHRAE 160-2009	Document requirement in basis of design	CxA to witness tests outlined in ASTM C1601-05, if applicable
<b>Condensation Resistance Fenestration</b>	NFRC 500 Thermal Analysis and Modeling	Baseline and Provide laboratory testing per ASTM 1503 of manufacture's typical assemblies, to be included in the project to confirm the NFRC 500 modeling.	Tier 1 HP and Provide project specific laboratory testing per ASTM 1503 on project specific extrusion profiles and assemblies, including typical anchors.	Tier 2 HP and Provide a modified AAMA 501.5 Thermal Cycling of Exterior Walls to include thermal couples of a full-scale project-specific laboratory mock-up to verify the NFRC 500 analysis.	AAMA 1503 NFRC 500	NFRC 500 Testing and Modeling to show that no condensation occurs on uncontrolled surfaces based on the interior and exterior design criteria	NFRC 500	Document requirement in basis of design	NFRC 500-2010 and 102-2010 (Test Procedure) are intended for the laboratory for establishing ratings, not field testing, so there is no CxA witness activity
<b>Air Tightness</b>									
<b>Fenestration</b>	CW30 Minimum Performance Class	Baseline and < 1.5 L/s*m (0.3 cfm/ft) @ 75 Pa (0.3" wc) Performance data correlated to performance testing	Tier 1 HP and AW40 Minimum Performance Class < 1.5 L/s*m (0.3 cfm/ft) @ 300 Pa (1.2" wc) Durability testing as required for Performance Class	Tier 2 HP and AW40 Minimum Performance Class < 0.5 L/s*m (0.1 cfm/ft) @ 300 Pa (1.2" wc) Additional Durability Testing as appropriate for the systems anticipated use.	ASTM E2318 ASTM E283 ASTM E783	AAMA 101-2008	AAMA 101-2008	Document requirement in basis of design	CxA to witness Performance Mock-Up Test outlined in ASTM E783-10, E283-04, as applicable
<b>Enclosure Airtightness (All Six Sides of the Building)</b>	2 L/s/M <sup>2</sup> (0.40 cfm/ft <sup>2</sup> ) @ 75 Pa (0.3" wc)	1.25 L/s/M <sup>2</sup> (0.25 cfm/ft <sup>2</sup> ) @ 75 Pa (0.3" wc)	0.75 L/s/M <sup>2</sup> (0.15 cfm/ft <sup>2</sup> ) @ 75 Pa (0.3" wc)	0.5 L/s/M <sup>2</sup> (0.10 cfm/ft <sup>2</sup> ) @ 75 Pa (0.3" wc)	ASTM E779/E1827	Yes	no	Provide enclosure airtightness performance requirement and measures designed to provide air barrier.	CxA to witness Blower Door Test outlined in ASTM E1827-11
<b>Thermal Performance</b>									
<b>Thermal Performance</b>	ASHRAE 90.1-2010, Section 5.5 and where section 5.5 is referenced	1.15 times greater than Baseline	1.3 times greater than Baseline	1.5 times greater than Baseline	ASHRAE 90.1-2010	Yes	ASHRAE 90.1-2010	Provide thermal performance characteristics of the enclosure assemblies.	CxA to perform HVAC system testing per ASHRAE Guideline 1.1-2007 (Guideline 30 was integrated into Guideline 1 in 2007)

3.1 Enclosure Performance Requirements									
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurement & Verification	Plans & Specs	Calculations & Analysis		
<b>Building Enclosure Commissioning</b>									
Building Enclosure Commissioning	Total Building Commissioning with Building Enclosure Commissioning Per ASHRAE Guideline 0 and NIBS Guideline 3	Baseline plus Fundamental Building Enclosure Commissioning (BECx) per ASTM E2813	Baseline plus Enhanced BECx per ASTM E2813	Baseline Enhanced BECx per ASTM E2813 with Increased performance testing as determined by OPR	ASTM E2813 ASHRAE Guideline 0 NIBS Guideline 3	ASTM E2813 ASHRAE Guideline 0 NIBS Guideline 3	ASTM E2813 ASHRAE Guideline 0 NIBS Guideline 3	Provide any special testing requirements anticipated during commissioning.	CxA inspection and verification to be performed as outlined in NIBS Guideline 3  ASTM WK26027 in review by ASTM, E2813 no longer available  ASHRAE Guideline 3 withdrawn 2004
<b>Enclosure Acoustic Control</b>									
Acoustic Control Assuming NC-35 interior	STC-40/OITC-35 based on standard performance values reported for assemblies	STC-45/OITC-40 & site assessment and lab tests of enclosure components	STC-45/OITC-40 & site assessment and site mockup testing	STC-50/OITC-45 & site assessment, mockup field tests and one field test per 20000 sf of enclosure	ASTM E90, E366 & E966.	Classification by E1332	no	Provide enclosure sound control performance requirements.	Testing witnessed by the CxA per ASTM Standard E1124-10
<b>Enclosure Service Life</b>									
Walls (In years to replacement/major rehabilitation)	50/25	75/30	100/40	150/50	no	Yes, Design Review, Tier 1 and higher: Enclosure Cx CSA S478 plan, Maintenance plan	no	Describe expected service life for each enclosure wall type proposed.	CxA shall confirm through submittal review.
Roofs (Replacement)	20	30	40	50	no	Yes, Design Review, Tier 1 and higher: Enclosure Cx CSA S478 plan, Maintenance plan		Describe expected service life for roof type proposed.	CxA shall confirm through submittal review.
Fenestration (years to frame replacement / IGU + gaskets and seals replacement)	30/15	40/20	50/25	75/25		Yes, Design Review, Tier 1 and higher: Enclosure Cx CSA S478 plan, Maintenance plan		Describe expected service life for each fenestration assembly proposed.	CxA shall confirm through submittal review.

## 3.2 Building Enclosure Performance Attributes

### 3.2.1 Natural Hazards

#### 3.2.1.1 Seismic Resistance

This attribute relates to building enclosure performance levels in terms of extent of damage and continuity of operations following a design basis earthquake with a 10% probability exceedance in 50 years (500-year return period). Seismic demands on the enclosure follow from deformation of the structure as characterized by peak transient inter-story drift and acceleration forces.

- **Baseline:** This performance level is characterized as Life Safety. Baseline performance anticipates serviceability degradation (e.g., glass breakage, weather seal damage, frame distortion, increased air and moisture infiltration) of the enclosure system. Controlled deformation of the enclosure system anchorage is accepted, but catastrophic failure is not allowable. The building structural system remains stable and has significant reserve capacity; hazardous nonstructural damage is controlled. Occupancy not expected after the event until repairs are performed.
- **Tier 1 High Performance (★):** This designation is characterized as Reduced Damage. This performance level anticipates moderate damage to the enclosure system. Ability to provide weather protection is locally compromised. Glass damage may occur, but breakage is mitigated. The building remains safe to occupy; structural and nonstructural repairs are minor.
- **Tier 2 High Performance (★★):** This designation is characterized as Immediate Occupancy. This performance level anticipates negligible structural and nonstructural damage with minimal damage to cladding components. Seals remain intact. Gaskets maybe loosened but

remain functional. No glass breakage is expected.

- **Tier 3 High Performance (★★★):** This designation is characterized as Operational. This performance level anticipates that no serviceability degradation of the enclosure system occurs as a result of a 500-year design basis earthquake.

#### 3.2.1.2 Windborne Debris Resistance

The attribute considers windborne missile impact and cyclic pressure loading resistance requirements in high wind zones and defined windborne debris regions.

- **Baseline:** This performance level for windborne debris resistance serviceability references the IBC. Windborne debris resistance shall be implemented in zones specified by IBC. In non-windborne debris zones, protection is not required at the baseline level.
- **Tier 1 High Performance (★):** This performance level incorporates windborne debris impact provisions designed to mitigate breaches of the enclosure system. The enclosure fenestration system is designed to resist large and small missile impacts and cyclic pressure loading per ASTM E 1996/1886 as referenced in ASCE 7.
- **Tier 2 High Performance (★★):** This designation addresses a perceived increased level of windborne debris risk and decreased allowable impact compared to Baseline. This performance level requires that the building envelope remain unbreached for wind zone.
- **Tier 3 High Performance (★★★):** This performance level is governed by criteria specified for building enclosure resistance to the impacts of tornado windborne debris and wind-

induced loads. Risks associated with tornado hazards should be considered as a separate item where applicable under a site specific assessment and where high performance is desired. Recommended tornado design wind speed is 250 mph (3-second peak gust). Protection of plant function and occupants is desired for critical facilities.

### 3.2.1.3 Flood Resistance

Floodplain management must be accounted for when formulating or evaluating any land use plans and should be correlated with the degree of hazard. Proposed buildings and structures within a flood hazard area shall be programmed and designed in accordance ASCE 24, "Flood Resistant Design and Construction" provisions. Enclosure damage and continuity of operations are the metrics of performance for this attribute.

- **Baseline:** Buildings should be located outside of 100-year floodplain. If this is unavoidable, the enclosure system shall be designed to accommodate a 100-year design flood demand as a Baseline requirement. Critical action facilities cannot be located in either a 100-year or 500-year floodplain unless there is no practicable alternative. If critical action structures must be located within a floodplain they shall be elevated above the 500-year base flood as Baseline. Enclosures below the design flood elevation shall be designed in accordance with ASCE 24 provisions.
- **Tier 1 High Performance (★):** This designation addresses a perceived increased level of flood risk and decreased allowable impact compared to Baseline. The building enclosure system shall be designed for higher performance and increased resiliency in resisting flood conditions associated with a 500-year flood event. Materials with demonstrated increased resistance to flood damage should be incorporated below the design flood elevation. This performance level anticipates cleanup,

drying and minor building enclosure repairs following a 500-year flood event.

- **Tier 2 High Performance (★★):** This performance level is governed by criteria specified for building enclosure resistance to flood demands. Risks associated with man-made flood hazards (dam, levee, and floodwall failure hazards) should be considered as a separate item where applicable under a site specific assessment and where high performance is desired.

## 3.2.2 Serviceability

### 3.2.2.1 Wind Resistance (Serviceability)

This attribute relates to the serviceability of the building enclosure system in response to wind loading. Wind speed and design wind load requirements shall be determined in accordance with applicable ASCE-7 prescriptive methods or wind-tunnel testing procedures. Wind-tunnel testing should be considered for large buildings or structures, in particular those with unusual shape or construction methodology, and those located in hurricane prone regions or surrounded by unusual terrain. The applicability of wind tunnel testing to optimize design should be evaluated by the design team as early as practical in the design process.

- **Baseline:** This performance level for wind resistance serviceability references deflection limits specified in IBC. Baseline criteria includes a glazing hazard consistent with 8/1000 probability of breakage at design load.
- **Tier 1 High Performance (★):** This designation addresses a perceived increased level of serviceability and decreased allowable deflection compared to Baseline. Deflection limits are less than code allowable to be selected by the design team. Characteristic criteria of this high performance level include a decreased glazing hazard consistent with 4/1000

probability of breakage at design load. No permanent framing deformation at overload (150% design load) is allowed. Center of glass deflection relative to glass edges shall not exceed 1". No impacts to serviceability or occupant comfort expected.

### 3.2.3 Water Penetration Resistance

#### 3.2.3.1 Fenestration

Fenestration water penetration resistance requires calculation or wind tunnel testing to determine the project specific design pressure (DP) and water penetration test pressure; requirements must be communicated to the contracting parties in the construction documents. Water penetration resistance can be confirmed with product testing, laboratory mock-up testing, field mock-up testing, and in-situ field testing. Consideration shall be given to prescriptive minimum sampling requirements based on the type of test and number of assemblies to be included.

- Baseline: AAMA 101-2008 designation of CW30; gateway DP per ASCE 7-2010 is a minimum of 720 Pa (30 psf). Water resistance test pressure is calculated at 15% of the DP. The maximum limits provided in AAMA 101-2008 have been removed to allow higher test pressures as warranted by the project conditions. "No Uncontrolled Water Penetration" is also a departure from the AAMA 101-2008 definition and does not allow water penetration on any interior surface that is not drained to the exterior or otherwise controlled.
- Tier 1 High Performance (★): Increases the water resistance test pressure to 20% of the DP.
- Tier 2 High Performance (★★): Increases the gateway requirement to AW40 with a water resistance test pressure to 25% of the DP.

- Tier 3 High Performance (★★★): Maintains the gateway requirement of AW40 with a water resistance test pressure to 30% of the DP.

#### 3.2.3.2 Roofing and Horizontal Waterproofing Membrane System

Roofing and horizontal waterproofing membrane system requires a system that is highly resistive to physical damage, including impact resistance, and prohibits the entrapment of water within the assembly including insulation, protection, and drainage layers.

- Baseline: Prevents the retention of storm water or other accumulation or ponding of water on the membrane surface.
- Tier 1 High Performance (★): Adds requirements for full adhesion to the structural deck and a membrane system that is fully reinforced.
- Tier 2 High Performance (★★): Requires a fully monolithic system without seams or laps joints.
- Tier 3 High Performance (★★★): Requires the added protection of layers above the roofing and horizontal waterproofing systems to fully protect the system from thermal and UV exposures from the environment, such as an inverted roofing membrane assembly (IRMA).

#### 3.2.3.3 Minimum Slope

Minimum slope is intended to eliminate the potential confluence of construction tolerance, creep, and other factors that may create ponding or a reduced evacuation of water from the membrane surfaces and to increase the longevity and performance of the membrane. As the slopes are increased the required "drying" time of the roof is decreased.

- Baseline: The minimum code requirement as per the 2012 Edition of the International Building Code (2012 IBC), specifically section

1507, in which various minimum slopes are identified based on the type of roof covering system intended for use.

- Tier 1 High Performance (★): Increases the minimum slope to 150% of the baseline requirement.
- Tier 2 High Performance (★★): Requires an increase in slope to 200% of the minimum code requirement.
- Tier 3 High Performance (★★★): Requires an increase in slope to 250% of the minimum code requirement.

### 3.3.3.4 Drainage (Size of conductors, leaders, and drains)

The intent of this requirement is to build redundancy into the drainage system. Redundancy in the roof drainage system is intended to mitigate ponding in the event of reduced evacuation of water from the membrane surfaces due to blockages, and to increase the longevity and performance of the membrane and the drainage systems.

- Baseline: The size of conductors, leaders, and drains is based upon the maximum 100-year hourly rainfall amount data per the 2012 Edition of the International Plumbing Code, specifically section 1106. All storm water piping shall be tested per 2012 IPC, Section 312.8.
- Tier 1 High Performance (★): Increase the maximum rainfall to 110% of the requirement.
- Tier 2 High Performance (★★): Increase the maximum rainfall to 120% of the requirement.
- Tier 3 High Performance (★★★): Increase the maximum rainfall to 140% of the requirement.

### 3.2.3.5 Vegetative Systems

Vegetative systems must be designed to meet minimum performance requirements of other attributes to ensure that the waterproofing design is sufficiently robust to ensure continued performance in a concealed location that will be difficult to access.

- Baseline: Must meet the Tier 3 High Performance (★★★) rating for Membrane System, Tier 1 High Performance (★) for Minimum Slope, Tier 1 High Performance (★) for Drainage, and Tier 1 High Performance (★) for Testing and Monitoring.
- Tier 1 High Performance (★): In addition to meeting the Baseline, must meet the Tier 2 High Performance (★★) for Slope and Tier 2 High Performance (★★) for Drainage.
- Tier 2 High Performance (★★): Requires Tier 3 High Performance (★★★) for Slope, Tier 3 High Performance (★★★) for Drainage, and Tier 2 High Performance (★★) for Testing and Monitoring.
- Tier 3 High Performance (★★★): Requires Tier 3 High Performance (★★★) in all roofing and horizontal waterproofing attributes.

### 3.2.3.6 Testing and Monitoring

Testing and monitoring are required for all horizontal waterproofing and roofing surfaces.

- Baseline: 100% flood testing of all horizontal waterproofing and roofing surfaces for 48 hours.
- Tier 1 High Performance (★): Requires electronic leak detection (ELD) or alternate test methods of the primary membrane to pin point breach locations in the system without reliance on water passage through the breach. Testing agency confirmation of the suitability of using non-destructive test equipment (unit type and field protocol) must be established prior to

proceeding with field test activities. Additional testing must be provided for portions of the system that are outside the scope of ELD or an equivalent method.

- Tier 2 High Performance (★★): Requires a “built-in” system wherein testing wiring etc. is left in-place for future use such as an ELD or an equivalent method of leak detection without removal or disassembly of the system or its protections as required during the life of the structure.
- Tier 3 High Performance (★★★): Requires integration of the leak detection into a maintenance plan for regular testing and the integration of the leak detection into the Building Management System (BMS).

### 3.2.3.7 Ground water control

- Baseline: Allows active removal of ground water by means of pumping from the lowest level of the structure. Active systems consume energy and must not run on more than rare occasions.
  - Tier 1 High Performance (★): Requires passive control of ground water without the use of energy for this function, except as an occasional back-up.
  - Tier 2 High Performance (★★): No current designation.
  - Tier 3 High Performance (★★★): Requires the selection of a site where the ground water table is not within 600 mm (2 feet) of the top of the lowest structural floor.
- Baseline: The waterproof membrane must be fully adhered to the structure and applied to the positive hydrostatic pressure side of the structure. Relieve hydrostatic pressure on substructure walls and allow water drainage to the level of the drain. Membrane waterproofing must be fully bonded to the substrate and seamless. Below-grade waterproofing must be applied to the positive pressure side and must be covered by a protection drainage and protection course.
  - Tier 1 High Performance (★): In addition to meeting the Baseline, must meet the Tier 1 High Performance (★) in Ground Water Control and must not rely on compression to maintain the performance criteria, allowing construction activities and future earthwork without compromising the system. When the water table is within 600 mm (2 feet) of the lowest finished floor, a “bathtub” waterproofing system shall be installed to eliminate the need for continual dewatering.
  - Tier 2 High Performance (★★): Requires redundancy in the system, such as the inclusion of additives or penetrating coatings to increase the water resistance of the foundation walls.
  - Tier 3 High Performance (★★★): Requires the Tier 2 High Performance (★★) performance and a redundant secondary drainage system.

## 3.2.4 Moisture and Condensate Control

### 3.2.4.1 Moisture Control Opaque Assemblies

- Baseline: Design of the above-grade building enclosure must be demonstrated early in the design development. ASHRAE 160-2009, Criteria for Moisture Control Design Analysis in Buildings is an acceptable basis of design.

### 3.2.3.8 Below Grade Waterproofing

Below grade waterproofing requires the relief of hydrostatic pressure on the structure’s walls and provision for water to drain to daylight or a storm water management system.



- Tier 1 High Performance (★): Complies with Baseline. Requires analysis of project specific assemblies and exposures. Requires the placement of a portion of the thermal control layer to the exterior of the air and moisture control layers to reduce thermal bridging and move the moisture potential toward the exterior.
- Tier 2 High Performance (★★): Complies with Tier 1 High Performance (★). Requires thermal controls to the exterior to maintain conditions within the assembly below a 30-day running average of 70% RH when the temperature is between 5°C (41°F) and 40°C (104°F). Requires monitoring of "vulnerable" exposures of the assemblies that alerts the building staff to approaching conditions that may be harmful to the assembly or the occupants.
- Tier 3 High Performance (★★★): Complies with Tier 2 High Performance (★★). Requires that all thermal controls are exterior of the air and vapor control layers and additional monitoring is provided so that all exposures and assembly combination is included.

### 3.2.4.2 Condensation Resistance - Fenestration

- Baseline: Perform thermal analysis based on NFRC 500 to determine the performance of a manufacture's typical assembly.
- Tier 1 High Performance (★): Requires laboratory testing per ASTM 1503 of manufacture's typical assemblies to be included in the project to confirm the NFRC 500 modeling.
- Tier 2 High Performance (★★): Requires project specific laboratory testing per ASTM 1503 on project specific extrusion profiles and assemblies, including typical anchors.

- Tier 3 High Performance (★★★): Requires the use of a modified AAMA 501.5 Thermal Cycling of Exterior Walls to include thermal couples of a full-scale project-specific laboratory mock-up to verify the NFRC 500 analysis.

## 3.2.5 Air Tightness

### 3.2.5.1 Fenestration

- Baseline: The minimum performance class is CW 30 Minimum Performance Class, defined in AAMA 101-2008, NAFS – North American Fenestration Standard/Specification for Windows, Doors, and Skylights, and AAMA CW Design Guide for curtainwall and window wall, as that which is "optimal" for its intended use.
- Tier 1 High Performance (★): Requires performance class of CW30 and a maximum air leakage of < 1.5 L/s\*m (0.3 cfm/ft) requirement per AAMA 101-2008.
- Tier 2 High Performance (★★): Increases performance class to AW40 with a maximum leakage of 0.75 L/s/M2 (0.15 cfm/ft2) to incorporate the required durability testing for this class and the increased requirements for air leakage.
- Tier 3 High Performance (★★★): Adds durability testing relevant to the project requirements and further increases the air leakage requirements to align with the AW level designation maximum leakage of 0.5 L/s/M2 (0.10 cfm/ft2) from AAMA 101-2008, section 5.3.2.2.

### 3.2.5.2 Enclosure Air Tightness (all six sides of the building)



Enclosure air tightness on all six sides of the building can be easily measured, and there is growing expertise in the industry of achieving the airtightness targets specified.

- **Baseline:** The minimum performance criteria is based upon the requirement of a maximum air leakage of  $2 \text{ L/s/m}^2$  ( $0.4 \text{ cfm/ft}^2$ ) of enclosure, including all “six sides”, at a pressure differential of  $75 \text{ Pa}$  ( $0.3'' \text{ wc}$ ) when tested in accordance with ASTM E779 or ASTM E1827. This is consistent with the requirements of ASHRAE 189.1-2009 and
- **Tier 1 High Performance (★):** Requires a maximum air leakage of  $1.25 \text{ L/s/m}^2$  ( $0.25 \text{ cfm/ft}^2$ ) of enclosure, including all “six sides”, at a pressure differential of  $75 \text{ Pa}$  ( $0.3'' \text{ wc}$ ) when tested in accordance with ASTM E779, ASTM E1827, and the USACE Air Leakage Test Protocol for Building Envelopes v2.
- **Tier 2 High Performance (★★):** Builds upon Tier 1 High Performance (★) by reducing the allowable air leakage to of  $0.75 \text{ L/s/m}^2$  ( $0.15 \text{ cfm/ft}^2$ ) of enclosure, including all “six sides”, at a pressure differential of  $75 \text{ Pa}$  ( $0.3'' \text{ wc}$ ).
- **Tier 3 High Performance (★★★):** Builds upon Tier 2 High Performance (★★) by reducing the allowable air leakage to of  $0.5 \text{ L/s/m}^2$  ( $0.10 \text{ cfm/ft}^2$ ) of enclosure, including all “six sides”, at a pressure differential of  $75 \text{ Pa}$  ( $0.3'' \text{ wc}$ ).

### 3.2.6 Thermal Performance

- **Baseline:** Requires the prescriptive requirements for the building envelope of ASHRAE 90.1-2010, section 5.5.
- **Tier 1 High Performance (★):** Increases the requirements of ASHRAE 90.1-2010, section 5.5 to 1.15 times its stated value.

- **Tier 2 High Performance (★★):** Increases the requirements of ASHRAE 90.1-2010, section 5.5 to 1.30 times its stated value.
- **Tier 3 High Performance (★★★):** Increases the requirements of ASHRAE 90.1-2010, section 5.5 to 1.50 times its stated value.

### 2.3.7 Building Enclosure Commissioning

- **Baseline:** Requires Total Building Commissioning, including Building Enclosure Commissioning, as described in ASHRAE Guideline 0 and NIBS Guideline 3.
- **Tier 1 High Performance (★):** Adds the requirements of ASTM E2813 and the Fundamental Enclosure requirements within the standard.
- **Tier 2 High Performance (★★):** Includes requirements for Enhanced Commissioning as described in ASTM 2813.
- **Tier 3 High Performance (★★★):** Combines all the above with additional performance testing as required by the project.

### 3.2.8 Acoustic Control

Acoustic control is straightforward in theory, but there is little experience in the industry for achieving specific targets. The target inside acoustic signature must be adjusted for occupancies different than normal office occupancy. ASTM standards exist for measuring performance on-site during construction to verify that the desired performance has been achieved.

- **Baseline:** STC-40/OITC-35 based on standard performance values reported for assemblies

- Tier 1 High Performance (★): STC-45/OITC-40 & site assessment and lab tests of enclosure components
- Tier 2 High Performance (★★): STC-45/OITC-40 & site assessment and site mockup testing
- Tier 3 High Performance (★★★): STC-50/OITC-45 & site assessment, mockup field tests and one field test per 2000 m<sup>2</sup> (20,000 ft<sup>2</sup>) of enclosure

### 3.2.9 Enclosure Service Life

Service life, while very important to many, is very difficult to quantitatively predict, and there are few reliable methods of test and verification. Two targets for each performance level have been identified: the full service life and the time between major rehabilitation. The most important tools are material selection, using experience, and design reviews by third parties, with experience and knowledge related to durability.

#### 3.2.9.1 Walls

- Baseline: Minimum 50 year full service life / 25 year for major rehabilitation
- Tier 1 High Performance (★): Minimum 70 year full service life / 30 year for major rehabilitation 75/30
- Tier 2 High Performance (★★): Minimum 100 year full service life / 40 year for major rehabilitation 100/40

- Tier 3 High Performance (★★★): Minimum 150 year full service life / 50 year for major rehabilitation 150/50

#### 3.2.9.2 Roofs

- Baseline: Minimum 20 year full service life
- Tier 1 High Performance (★): Minimum 30 year full service life
- Tier 2 High Performance (★★): Minimum 40 year full service life
- Tier 3 High Performance (★★★): Minimum 50 year full service life

#### 3.2.9.3 Fenestration

- Baseline: Minimum 30 year full service life / 15 year for major rehabilitation of gasket and seal replacements
- Tier 1 High Performance (★): Minimum 40 year full service life / 20 year for major rehabilitation of gasket and seal replacements
- Tier 2 High Performance (★★): Minimum 50 year full service life / 25 year for major rehabilitation of gasket and seal replacements
- Tier 3 High Performance (★★★): Minimum 75 year full service life / 25 year for major rehabilitation of gasket and seal replacements

## 3.3 Prescriptive Enclosure Requirements

### 3.3.1 Moisture Control

Design of the above-grade building enclosure must be demonstrated early in the design development. ASHRAE 160, Criteria for Moisture Control Design Analysis in Buildings is an acceptable basis of design. Demonstration of the transient hygrothermal behavior of the various multi-layer building components for all critical building enclosure systems must be confirmed through modeling.

Construction documents must clearly depict all drainage and air passages. Detail in three dimensions where practical, indicating critical corner terminations, interface of all differing systems, proper sealant methodologies, etc.

### 3.3.2 Below Grade Systems

#### 3.3.2.1 Ground Water Control

The drainage mat and soil filter should relieve hydrostatic pressure on substructure walls and allow water drainage to the level of the drain. Pipes should not slope less than 1:200. Subsurface drainage should discharge into the storm drain, by gravity if possible. Cleanouts must be provided at grade to facilitate washing out the system.

#### 3.3.2.2 Waterproofing

Membrane waterproofing should follow the recommendations of the National Roofing Contractors Association (NRCA) in The NRCA Waterproofing Manual.

#### 3.3.2.3 Membrane Protection

Below-grade waterproofing must be applied to the positive pressure side and must be covered by a protection mat to shield the waterproofing

membrane from deleterious effects of construction activities, ultraviolet radiation, or aggressive vegetation.

#### 3.3.2.4 Waterstops

Waterstops must be used at construction joints in below-grade walls, footings and other elements where a waterproof system is required. Wherever possible use level changes to create a redundancy with the substrate in the event the water barrier fails.

#### 3.3.2.5 Underslab Insulation

Provide insulation under concrete slabs on grade where a permafrost condition exists, where slabs are heated, and where they support refrigerated structures.

### 3.3.3 Substructure

When soil radon or contaminant levels are present, a substructure depressurization system must be provided. If a passive system is designed, it must have the capability to accommodate future active depressurization.

### 3.3.4 Wall Systems

#### 3.3.4.1 Connections and Fasteners Exposed to Weather

Products constructed of carbon steel are not permitted in exterior construction, which includes exterior walls, soffits, or roofs, except where protected by a galvanic zinc coating of at least 460 grams per m<sup>2</sup> (1.5 ounces per sq. ft.) of surface or other equivalent protection.

### 3.3.4.2 Materials with Organic Content

In hot-humid and mixed-humid climates, do not use vinyl wall coverings as the interior finish of exterior walls. On mass storage walls where water may penetrate the wall, avoid interior finishes made from paper-faced gypsum sheathing or other highly processed organic materials that may promote mold growth.

### 3.3.4.3 Air/Moisture Barrier System

An air/moisture barrier is required of all new construction and should be employed wherever possible during remediation of existing exterior envelopes. The air barrier system is:

- A continuous element or combination of elements designed to control the movement of air across an exterior enclosure system.
- Continuous in three-dimensions from roof-to-wall-to-foundation.
- Consisting of materials and components that are, either individually or collectively, sufficient in stiffness and rigidity to resist air pressure differentials across the exterior wall assembly without permanent deformation or failure.
- Durable and structurally rigid to withstand the construction process.

The interior and exterior air pressures across an air barrier system that need to be examined include, but are not limited to, pressures caused by wind, stack effect, and mechanical systems. Air barriers may be located at different locations within a wall system, and the placement of the air barrier needs to be indicated by the designer on the drawings. The designer must carefully consider placement of the air barrier when the air barrier material(s) will act both as an air barrier and as a vapor retarder to determine if drying of the system will be inhibited by the location of this material within the assembly. Portions of the air barrier may require regular maintenance and an allowance should be made within the design to accommodate this maintenance.

A continuous plane of air tightness, herein called the air barrier system, must be installed as part of the building enclosure (both above- and below-grade) to effectively separate all conditioned air from outdoor and polluted spaces.

The air barrier system must be shown on the drawings as continuous through all section drawings of the enclosure. The air barrier materials and components of each assembly must be clearly identified and labeled as "Air barrier" on construction documents, and detailed at all penetrations, joints, and transitions. The pressure boundary of the air barrier system(s) and the zone(s) to be tested must also be shown on the drawings.

The air barrier material of each assembly must be joined and sealed to the air barrier material of adjacent assemblies with sufficient flexibility to allow for the relative differential movement and with sufficient strength to resist expected peak air pressure differences.

Penetrations of the air barrier system must be sealed to the air barrier system in an airtight manner. These penetrations include, but are not limited to: lighting fixtures, wiring, conduit, gas lines, cable services, windows, doors, ducts, fire protection standpipe connections, and plumbing pipes.

The air barrier system (and all materials and components comprising it) must last the anticipated service life of the enclosure or allow for easy maintenance, repair, and/or replacement.

Where required in the IBC, elevator hoistways shall be provided with a means for venting smoke to the outside air in case of fire. Vents shall be permitted to open automatically upon detection of smoke in the elevator lobbies or hoistway, upon power failure, or upon activation of a manual override control.

Parking garages (attached to or under buildings), other structures connected to the building, including those connected via tunnels, walkways, service conduits, etc., and any storage with contents that can negatively affect indoor air quality must be separated from all other conditioned spaces by an air barrier

system. Access to such spaces must be provided by doors in air-tight vestibules or airtight hatches at building access points.

Boiler rooms not using sealed combustion equipment must be separated from the rest of the building space by an air barrier system and provided with make-up air for combustion.

Additional equipment and other items required for testing the building's airtightness are to be installed by the contractor as specified by the testing agency. This may include: indoor-to-outdoor pressure taps at various locations across the air barrier system, air flow and pressure measuring stations in air conveyance and handling systems, and tight-sealing dampers on all ducts carrying air across the air barrier.

### 3.3.5 Masonry and Concrete Materials

Brick masonry design must follow the recommendations of the Brick Institute of America contained in the publication, Technical Notes on Brick Construction.

Concrete masonry design must follow the recommendations of the National Concrete Masonry Association contained in the publication, TEK Manual for Concrete Masonry Design and Construction.

Architectural precast concrete design must follow the recommendations of the Precast Concrete Institute (PCI) contained in PCI publication, Architectural Precast Concrete, Current Edition.

Exterior limestone design must follow the guidelines of the handbook published by the Indiana Limestone Institute of America.

Marble and marble veneer design must follow the recommendations in Exterior Marble Used in Curtain or Panel Walls, published by the Marble Institute of America. Extreme care should be used in the design and selection of thin marble veneers to prevent thermal hysteresis.

Design alterations and additions to minimize damage to or concealment of historic walls. Clean historic masonry prior to repointing or color matching new materials intended to blend with historic stone, brick, terra cotta or concrete.

## 3.3.6 Fenestration Systems

### 3.3.6.1 Aluminum Windows

Aluminum windows must meet the requirements of ANSI/AAMA Standard 101-85. Only optimal performance classes may be used. Metal windows other than aluminum must meet the requirements of the National Association of Architectural Metal Manufacturers Standard SW-1 for the performance class required. Wood windows should meet the requirements of ANSI/NWMA Standard I.S. 2-87, Grade 60.

### 3.3.6.2 Window Frames

Aluminum frames must have thermal breaks where there are more than 1,670 heating degree days <sup>°C</sup> (3,000 heating degree days <sup>°F</sup>). Window mullions, as much as possible, should be located on the floor-planning grid to permit the abutment of interior partitions.

Metal windows other than aluminum must meet the requirements of Steel Window Institute's (SWI) Specifier's Guide to Steel Windows for the performance class required.

Wood windows must meet the requirements of ANSI/NWMA Standard I.S. 2-87, Grade 60. Wood windows must meet the requirements of AAMA/WDMA 101/I.S.2/NAFS. AW Architectural Class.

Replacement windows in historic structures should exactly match original frame and muntin profiles. First consideration should be given to rehabilitating the existing windows. Insulated glass installed in historic sash must include weep holes and, if required, glass fragmentation protection. See Upgrading Historic

## Windows

([www.gsa.gov/historicpreservationguidelines](http://www.gsa.gov/historicpreservationguidelines)) for additional guidance.

### 3.3.6.3 Entrance Doors

Entrance doors may be aluminum and/or glass of heavy duty construction. Glazed exterior doors and frames must be steel and meet the requirements of SDI Grade III with a G-90 galvanic zinc coating. Vestibules are desired to control air infiltration. Sliding automatic doors are preferred over swinging type. Motion detectors and push plates are preferred over mats as actuating devices. Historic entrance doors must be retained and upgraded with care to preserve the original appearance of the building. Where missing, replicas of the original doors should be installed. All door assemblies installed in the means of egress must meet the requirements of the National Fire Protection Association (NFPA), 101 Life Safety Code.

## 3.3.7 Roof Systems

### 3.3.7.1 Roofing Design

Roofing design must follow the recommendations of the National Roofing Contractors Association as contained in NRCA publication, NRCA Roofing and Waterproofing Manual. The design of metal flashing, trim, and roofing must follow the recommendations of the Sheet Metal and Air Conditioning Contractors' National Association publication, Architectural Sheet Metal Manual. In addition, all roof assemblies and rooftop structures must meet the requirements in the International Building Code (IBC).

### 3.3.7.2 Re-Roofing

Where existing roofing is to be replaced, it should be completely removed and the substrate prepared for new roofing. The new roofing system should not be of greater weight than the old roofing system, unless a structural analysis shows that the framing system can carry the additional weight. Do not overlay new

roofing membrane systems over existing roof membranes. See Historic Building Roofing ([www.gsa.gov/technicalpreservationguidelines](http://www.gsa.gov/technicalpreservationguidelines)) for guidance on repair, replacement and modification of roofing on historic buildings.

### 3.3.7.3 Access to the Roof

An interior permanent stair must be provided to permit access to roof-mounted equipment. Permanent access to all roof levels must be provided to facilitate reoccurring inspection and maintenance.

### 3.3.7.5 Insulation

Roof insulation should use multiple layers to maximize thermal breaks in the roof system.

### 3.3.7.6 Roof Mounted Equipment

Roof mounted equipment must be kept to a minimum and must be housed in penthouses or screened by walls. Penthouses and screen walls should be integrated into the building design and constructed of materials used elsewhere in the building exterior. Some roof-mounted equipment, such as antennae, lightning rods, flagpoles, etc., does not have to be screened, but these elements must be integrated into the building design. Roof-mounted equipment should be elevated as recommended in the NRCA Roofing and Waterproofing Manual and set back from the roof edge to minimize visibility. Critical roof-mounted equipment should be installed in such a way to permit roof system replacement or maintenance without disruption of equipment performance.

Penetrations through the roof to support equipment are extremely vulnerable to leaks. Flashing details must be studied for appropriate continuation of the waterproof barrier. Do not use pitch pockets as part of the roof design.

No building element may be supported by the roofing system except walkways. Provide walkways on the roof along routes to and around equipment for maintenance.

When installing roof top photovoltaic systems, consult with the local building and fire code official for additional access and safety requirements.

### **3.3.7.7 Exterior Soffits**

Design exterior soffits to resist displacement and rupture by wind uplift. Design soffits for access to void space where operating equipment is located or maintenance must be performed. Soffits can be considered totally exposed to weather and should therefore be designed to be moisture resistant. Provide expansion and contraction control joints at the edges and within the soffit. Spacing and configuration of control joints should be in accordance with the recommendations of the manufacturer of the soffit material.

Operating equipment or distribution systems that may be affected by weather should not be located inside soffits. Where it is necessary to insulate the floors over soffits, the insulation should be attached to the underside of the floor construction so that the soffit void may be ventilated to prevent condensation.

### **3.3.7.8 Skylights and Sloped Glazing**

Skylights are defined as prefabricated assemblies shipped ready for installation, while sloped glazing is defined as field-assembled. Skylight design must follow the guidelines of AAMA Standard 1600. For the design of sloped glazing, two AAMA publications are available: Glass Design for Sloped Glazing and Structural Design Guidelines for Aluminum Framed Skylights.

Skylights and sloped glazing should use low emissivity glass. Placement should be calculated to prevent glare or overheating in the building interior.

Condensation gutters and a path for the condensation away from the framing should be designed.

Consideration must be given to cleaning of all sloped glazing and skylights, including access and equipment required for both exterior and interior faces.

Skylights must be guarded for fall protection or meet OSHA structural requirements.

### **3.3.7.9 Edge Protection**

Flat roofs designed for access must include a parapet or perimeter railing at least 42 inches in height.

Where parapets and railings are not feasible, personal fall protection anchorage points must be provided. Equipment should be located away from roof edges and oriented with access panels inboard of the roof edge.

### **3.3.7.10 Rooftop Gardens and Landscaped Roofs**

Vegetated roof, rooftop gardens, and landscaped roofs must also be installed and maintained in accordance with the requirements in the ICC, International Fire Code (IFC).

## **3.3.8 Quality Assurance**

### **3.3.8.1 Mock-ups**

Many unique contemporary building solutions require full scale, laboratory, and on-site mock-ups of critical portions of the building facade. The testing of the laboratory mockup almost always assists in determining the final design solution. Mock-ups should be constructed by same team that will construct the facade.

### **3.3.8.2 Air Barrier Testing**

For new construction, demonstrate performance of the air barrier system for the building enclosure. Tests



can be conducted using either pressurization or depressurization: conducting both provides diagnostic information. The building must not be tested until verifying that the continuous air barrier system has been installed as per the design in accordance with installation instructions.

### 3.3.9 Sun Control Devices

Where sun control devices are used, operable and fixed sun control devices must be used, which allow for ease of maintenance, repair, and replacement. Window washing systems used for the facility must also be compatible with any sunscreens or sun control devices.

### 3.3.10 Window Cleaning

The facility must have provisions for cleaning the interior and exterior surfaces of all windows, skylights, and other glazed openings. The A/E must demonstrate that cleaning and maintenance of interior glazing surfaces can be achieved without extraordinary means and methods. Submit this information with the construction documents.

### 3.3.11 Providing Access to Maintain Equipment in Atriums

The A/E must demonstrate that maintenance of equipment (e.g., lighting, smoke detectors, and other systems that are mounted within atrium spaces) can be achieved without extraordinary means and methods. Submit this information with the construction documents.

### 3.3.12 Providing Access to Elevated Locations

The provision of stanchions with moveable davits is the preferred design. Stanchions must be spaced to accommodate expected scaffold lengths.

If temporary structural attachments are anticipated, the structure must be designed to support the work platform load, including OSHA safety factors.

In some cases, GSA may decide to install engineered systems for window washing and access to elevated locations that must be incorporated into the building design. When the design is for buildings three stories or 12,200 mm (40 ft.) and higher, it must conform to OSHA Standard 29 CFR 1910.66, Subpart F: Powered Platforms, Manlifts, and Vehicle-Mounted Work Platforms, ANSI Standard A120.1, Safety Requirements for Powered Platforms for Building Maintenance, and ANSI/IWCA I-14.1-2001, Window Cleaning Safety.

Regardless of the system selected, secondary tieback anchors must be provided in the vicinity of anticipated suspended scaffold operations. Anchors must be designed to support a 5,000-pound load in any direction. Where feasible, anchors must be located to facilitate routine inspection and load testing.

Facade tiebacks must be provided on buildings over 75 feet high.

Window-washing systems that are widely used in the region of the project must be considered and the preferred system and equipment be identified during design. In large and/or highrise buildings, such glass surfaces as atrium walls and skylights, sloped glazing, pavilion structures, and windows at intermediate design surfaces must be addressed.



### 3.4 INTERIOR PERFORMANCE REQUIREMENTS

<b>Acoustics</b>	No Rating	No Rating	STC 45	STC 50	N/A	ASTM E1425	N/A	Document door STC rating, when applicable.	Verify STC ratings through product submittals during construction for compliance.
<b>Hardware</b>	Grade 1, Bored Locks	Grade 1; Standard duty mortise locks	Grade 1; Heavy duty mortise locks; solid stainless steel or bronze	Grade 1; Heavy duty mortise locks; solid stainless steel or bronze; gasketed for sound transmission	N/A	BHMA A156 Series (door hardware)	N/A	Describe door hardware requirements.	Verify hardware submittal during construction to verify compliance.
<b>Frame</b>	Knock-down hollow metal, Level 3; 0.053" (1.3 mm); untreated	Knock-down hollow metal, Level 3; 0.053" (1.3 mm); untreated	Welded hollow metal, Level 3; 0.053" (1.3 mm); galvanized	Welded hollow metal; Level 4; 0.067" (1.7mm)/galvanized; filled solid with grout	N/A	ASTM/SDI 250.4	N/A	Describe door frame construction.	Verify through shop drawing submittal and product submittal information.
<b>Security</b>	No Rating	No Rating	Time Rated	Forced Entry, Ballistic Resistant	N/A	UL 752	Required for FE and BR ratings	Describe UL 752 door rating level (1-8) when applicable.	Verify through shop drawing submittal and product submittal information.

3.4 Interior Performance Requirements									
Products	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurements & Verification	Plans & Specifications	Calculations & Analysis		
<b>Hollow Metal Doors</b>									
<b>Construction</b>	Level 2; 0.042" (1.0mm)/untreated; Field applied paint	Level 3; 0.053" (1.3mm)/untreated; Field applied paint	Level 3; 0.053" (1.3mm)/untreated; Shop applied paint	Level 4; 0.067" (1.7mm)/galvanized; Electrostatically applied paint	N/A	ASTM/SDI 250.4	N/A	Describe door construction.	Verify door construction through shop drawing submittal and product submittal information.
<b>Durability</b>	Heavy Duty	Extra Heavy Duty	Extra Heavy Duty	Maximum Duty	N/A	ASTM/SDI 250.4	N/A	Document warranty period.	Verify warranty through product submittal information.
<b>Acoustics</b>	No Rating	No Rating	STC 35	STC 35	N/A	ASTM E1425	N/A	Document door STC rating, when applicable.	Verify STC ratings through product submittals during construction for compliance.
<b>Hardware</b>	Grade 1; bored locks	Grade 1; Standard duty mortise locks	Grade 1; Heavy duty mortise locks; solid stainless steel or bronze	Grade 1; Heavy duty mortise locks; solid stainless steel or bronze; gasketed for sound transmission	N/A	BHMA A156 Series (door hardware)	N/A	Describe door hardware requirements.	Verify hardware submittal during construction to verify compliance.
<b>Frame</b>	Knock-down hollow metal, Level 3; 0.053" (1.3 mm); untreated	Knock-down hollow metal, Level 3; 0.053" (1.3 mm); untreated	Welded hollow metal, Level 3; 0.053" (1.3 mm); galvanized	Welded hollow metal; Level 4; 0.067" (1.7mm)/galvanized; filled solid with grout	N/A	ASTM/SDI 250.4	N/A	Describe door frame construction.	Verify through shop drawing submittal and product submittal information.
<b>Security</b>	No Rating	No Rating	Time Rated	Forced Entry, Ballistic Resistant, UL Level 3	N/A	UL 752	Required for FE and BR ratings	Describe UL 752 door rating level (1-8) when applicable.	Verify through shop drawing submittal and product submittal information.
<b>Glazed Aluminum Doors</b>									
<b>Construction</b>	1/8" (3mm) extruded aluminum; mill finish	1/8" (3mm) extruded aluminum; Class II anodic finish	1/8" (3mm) extruded aluminum; Class I anodic or fluoropolymer paint finish	3/16" (5mm) extruded aluminum; Class I anodic or fluoropolymer paint finish	N/A	AAMA 101/I.S.2/A440	N/A	Describe door construction.	Verify door construction through shop drawing submittal and product submittal information.
<b>Durability</b>	Standard Warranty	Standard Warranty	Standard Warranty	5 Year Warranty	Manufacturer's Warranty	N/A	N/A	Document warranty period.	Verify warranty through product submittal information.
<b>Hardware</b>	Offset pivots, BHMA Grade 2	Offset pivots, BMHA Grade 1	Center pivots, BMHA Grade 1	Center pivots, BMHA Grade 1	N/A	BHMA A156 Series (door hardware)	N/A	Describe door hardware requirements.	Verify hardware submittal during construction to verify compliance.
<b>Glazing</b>	1/4" (6mm) clear safety glass	1/4" (6mm) clear safety glass	1" (25mm) clear insulating laminated glass	1/2" (13mm) laminated clear or decorative glass	N/A	ASTM C 1048	N/A	Describe glazing system proposed in glazed aluminum doors.	Verify glazing in glazed aluminum door submittal during construction to verify compliance.
<b>Security</b>	Lock Set Only	Lock Set Only	Lock Set Only	Electronically Controlled Access	N/A	N/A	N/A	Describe security requirement for glazed aluminum doors.	Verify through shop drawing submittal and product submittal information.

3.4 Interior Performance Requirements									
Products	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurements & Verification	Plans & Specifications	Calculations & Analysis		
<b>All Glass Entrances</b>									
<b>Construction</b>	All glass with top and bottom rails or patches	All glass with top and bottom rails or patches	All glass with top and bottom rails or patches	N/A	N/A	N/A	N/A	Describe door construction.	Verify door construction through shop drawing submittal and product submittal information.
<b>Hardware</b>	Offset pivots, BMHA Grade 1	Center pivots, BMHA Grade 1	Center pivots, BMHA Grade 1	N/A	N/A	BMHA A156 Series (door hardware)	N/A	Describe door hardware requirements.	Verify hardware submittal during construction to verify compliance.
<b>Glazing</b>	1/2" (13mm) clear safety glass	1/2" (13mm) clear safety glass	1/2" (13mm) clear or decorative safety glass	N/A	N/A	ASTM C 1048	N/A	Describe glazing system proposed.	Verify glazing in door submittal during construction to verify compliance.
<b>Security</b>	Lock Set Only	Lock Set Only	Electronically Controlled Access	N/A	N/A	N/A	N/A	Describe security requirement for glazed aluminum doors.	Verify through shop drawing submittal and product submittal information.
<b>Wood Framed Interior Lights</b>									
<b>Construction</b>	AWI Custom grade; field fabricated and painted	AWI Custom grade; shop fabricated and field applied stained	AWI Premium grade; shop fabricated and stained	AWI Premium grade; shop fabricated and stained	N/A	AWI Architectural Woodwork Quality Standards	N/A	Describe construction of wood framed interior lights.	Verify through mockup, shop drawing submittal and product submittal information.
<b>Frame</b>	Birch, Poplar or clear softwood	Oak, Maple, Cherry, Walnut or similar	Oak, Maple, Cherry, Walnut or similar	Teak, Rosewood or similar	N/A	N/A	N/A	Describe frame construction of wood framed interior lights.	Verify through mockup, shop drawing submittal and product submittal information.
<b>Glazing</b>	1/4" (6mm) clear safety glass	1/4" (6mm) clear safety glass	1" (25mm) clear insulating laminated glass	1/2" (13mm) laminated clear or decorative glass	N/A	ASTM C 1048	N/A	Describe proposed glazing for wood framed interior lights.	Verify through mockup, shop drawing submittal and product submittal information.
<b>Hollow Metal Framed Interior Lights</b>									
<b>Construction</b>	Knock-down hollow metal, field painted	Welded hollow metal, shop applied paint	Welded hollow metal, custom profile, electrostatically applied paint	Welded hollow metal, custom profile, electrostatically applied paint	N/A	ASTM/SDI A250.4	N/A	Describe construction of hollow metal framed interior lights.	Verify through mockup, shop drawing submittal and product submittal information.
<b>Frame</b>	0.042" (1.0mm)/untreated	0.053" (1.3mm)/galvanized in wet areas	0.053" (1.3mm)/galvanized in wet areas	0.053" (1.3mm)/galvanized in wet areas	N/A	ASTM/SDI A250.4	N/A	Describe frame construction of hollow metal framed interior lights.	Verify through mockup, shop drawing submittal and product submittal information.
<b>Glazing</b>	1/4" (6mm) clear safety glass	1/4" (6mm) clear safety glass	1" (25mm) clear insulating laminated glass	1/2" (13mm) laminated clear or decorative glass	N/A	ASTM C 1048	N/A	Describe proposed glazing for hollow metal framed interior lights.	Verify through mockup, shop drawing submittal and product submittal information.

### 3.4 Interior Performance Requirements

Products	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurements & Verification	Plans & Specifications	Calculations & Analysis		
<b>Aluminum Framed Interior Lights</b>									
<b>Construction</b>	Manufacturer's standard profile; mill finish	Manufacturer's standard profile; Class II anodic finish	Manufacturer's standard profile; Class I anodic or fluoropolymer paint finish	Custom profile; Class I anodic or fluoropolymer paint finish	N/A	AAMA 101/I.S.2/A440	N/A	Describe construction of aluminum framed interior lights.	Verify through mockup, shop drawing submittal and product submittal information.
<b>Frame</b>	1/8" (3mm) extruded aluminum	1/8" (3mm) extruded aluminum	1/8" (3mm) extruded aluminum	1/8" (3mm) extruded aluminum	N/A	AAMA 101/I.S.2/A440	N/A	Describe frame construction of aluminum framed interior lights.	Verify through mockup, shop drawing submittal and product submittal information.
<b>Glazing</b>	1/4" (6mm) clear safety glass	1/4" (6mm) clear safety glass	1" (25mm) clear insulating laminated glass	1/2" (13mm) laminated clear or decorative glass	N/A	ASTM C 1048	N/A	Describe proposed glazing for aluminum framed interior lights.	Verify through mockup, shop drawing submittal and product submittal information.
<b>Metal Stud Partitions</b>									
<b>Construction</b>	3-5/8" x min. 25 ga. metal studs @ 24" o.c., 5/8" gypsum board each side (max. deflection L/240)	3-5/8" x min. 25 ga. metal studs @ 16" o.c., 5/8" gypsum board each side (max. deflection L/360)	3-5/8" x min. 16 ga. light gage metal framing studs @ 16" o.c., 2 layers 5/8" gypsum board, 9 ga. wire mesh between studs and gypsum each side (max. deflection L/360)	N/A	N/A	ASTM C 645, ASTM C 1396	N/A	Describe partition construction.	Verify compliance through product submittal information.
<b>Durability (Impact Resistance)</b>	Standard	Standard	High	N/A	N/A	N/A	N/A	Describe impact resistance requirement, when applicable.	Verify compliance through product submittal information.
<b>Height</b>	Deck to Ceiling	Deck to Slab or Deck Above	Deck to Slab or Deck Above	N/A	N/A	N/A	N/A	Describe partition height requirements.	Verify compliance through design submittals.
<b>Acoustics</b>	STC 40	STC 45	STC 50	N/A	N/A	ASTM E 90	N/A	Document partition assembly STC rating.	Verify STC ratings through product submittals during construction for compliance.
<b>Security</b>	No Rating	No Rating	SCIF	N/A	N/A	N/A	Required for FE and BR ratings	Document security requirement.	Verify compliance through design submittals and shop drawings

3.4 Interior Performance Requirements									
Products	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurements & Verification	Plans & Specifications	Calculations & Analysis		
<b>Masonry Partitions</b>									
<b>Construction</b>	6" CMU, 1-5/8" metal studs @ 16" o.c. and 5/8" gypsum board each side	8" filled and reinforced CMU, 9 ga. wire mesh one side, 1-5/8" metal studs @ 16" o.c. and 2 layers 5/8" high impact resistant gypsum board each side	N/A	N/A	N/A	ASTM C 129, ASTM C 645, ASTM C 1396	N/A	Describe partition construction.	Verify compliance through product submittal information.
<b>Durability (Impact Resistance)</b>	Standard	High	N/A	N/A	N/A	N/A	N/A	Describe impact resistance requirement, when applicable.	Verify compliance through product submittal information.
<b>Acoustics</b>	STC 50	STC 70	N/A	N/A	N/A	ASTM E 90	N/A	Document partition assembly STC rating.	Verify STC ratings through product submittals during construction for compliance.
<b>Security</b>	Moderate	High	N/A	N/A	N/A	N/A	Required for FE and BR ratings	Document security requirement.	Verify compliance through design submittals and shop drawings
<b>Demountable Partitions</b>									
<b>Construction</b>	Standard Panel Width Prefinished Metal Panels	Custom Panel Width Gypsum Board Panels	Custom panel width; transoms and borrowed lights Gypsum Board Panels	Custom panel width; transoms and borrowed lights Gypsum Board Panels	N/A	N/A	N/A	Describe partition construction.	Verify compliance through product submittal information.
<b>Acoustics</b>	STC 40	STC 45	STC 45	STC 50	N/A	ASTM E 90	N/A	Document partition assembly STC rating.	Verify STC ratings through product submittals during construction for compliance.
<b>Operable Walls</b>									
<b>Construction</b>	Steel or MDF/Vinyl/3" (75mm)	Steel or MDF/vinyl, fabric, or veneer/3" (75mm)	Steel or MDF/vinyl, fabric, veneer, or marker board/3" (75mm)	Steel, MDF, or gypsum/vinyl, fabric, veneer, or marker board/4" (100mm)	N/A	N/A	N/A	Describe partition construction.	Verify compliance through product submittal information.
<b>Acoustics</b>	STC 40	STC 45	STC 50	STC 55	N/A	ASTM E 90	N/A	Document partition assembly STC rating.	Verify STC ratings through product submittals during construction for compliance.
<b>Operation</b>	Single panels or hinged pairs, manual	Single panels or hinged pairs, manual	Continuously hinged panels, motorized	Hinged pairs, manual	N/A	N/A	N/A	Describe operable wall operation type.	Verify compliance through product submittal information.

3.4 Interior Performance Requirements									
Products	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurements & Verification	Plans & Specifications	Calculations & Analysis		
<b>Millwork and Cabinets</b>									
<b>Construction</b>	Particle Board Plastic Laminate	Particle Board Wood Veneer	Particle Board Wood Veneer	Solid Wood Detailed Molding/Trim	N/A	N/A	N/A	Describe construction and document any environmental (temperature/humidity) limits, if any.	Verify compliance through product submittal information.
<b>Durability</b>	Moderate	Moderate	Extended Life	Extended Life	N/A	N/A	N/A	Describe anticipated service life.	Verify compliance through product submittal information.
<b>Quality</b>	AWI Custom grade, factory standard products. Grade 2 hardware.	AWI Custom grade, shop fabricated by millworker. Grade 1 hardware.	AWI Premium grade, shop fabricated by millworker. Grade 1 hardware.	AWI Premium grade, shop fabricated by millworker. Grade 1 hardware.	N/A	AWI Architectural Woodwork Quality Standards	N/A	Describe quality of millwork and cabinets.	Verify through shop drawing submittal and product submittal information.
<b>Countertops</b>									
<b>Construction</b>	Particle Board, Plastic Laminate Top and Edge	Particle Board, Exterior Glue, Solid Surface Material Top	Exterior Grade Plywood, Stone Top	Exterior Grade Plywood, Chemical Resistant or stainless steel top	N/A	N/A	N/A	Describe countertop construction.	Verify compliance through product submittal information.
<b>Durability</b>	Limited	Moderate	Extended Life	Extended Life	N/A	N/A	N/A	Describe anticipated service life.	Verify compliance through product submittal information.
<b>Quality</b>	AWI Custom grade	AWI Premium grade	AWI Premium grade	AWI Premium grade	N/A	AWI Architectural Woodwork Quality Standards	N/A	Describe quality of countertops.	Verify through shop drawing submittal and product submittal information.

### 3.4 Interior Performance Requirements

Products	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design	Construction
					Measurements & Verification	Plans & Specifications	Calculations & Analysis	Basis of Design	Verification
Broadloom/ Carpet Tile									
Durability	Heavy Traffic	Severe Traffic	Severe Traffic	Severe Traffic		ASTM D 5252/ ASTM D 7330		Document the Texture Appearance Retention Rating (TARR).	Verify compliance through mockup and product submittal information.
	Type 6 or Type 6,6 BCF Nylon	Type 6 or Type 6,6 BCF Nylon	Type 6 or Type 6,6 BCF Nylon	Type 6 or Type 6,6 BCF Nylon or Bio Based fiber	N/A	N/A	N/A	Describe the nylon type used.	Verify compliance through mockup and product submittal information.
Maintenance	Green Label Certified cleaners	Green Label Certified cleaners	Green Label Certified cleaners	Green Label Certified cleaners	N/A	N/A	N/A	Describe type of cleaning required.	Verify through maintenance agreements after installation
Service Life	10 Year Warranty	10 Year Warranty	15 Year Warranty	15 Year Warranty	Provide copy of Manufacturers Published Warranty	N/A	N/A	Document warranty period.	Verify compliance through product submittal information.
Environmental	10% Pre or Post Consumer Recycled Content or 7% Bio Based Fiber	15% Pre or Post Consumer Recycled Content or 7% Bio Based Fiber	25% Post Consumer Recycled Content or 15% Bio Based Fiber	35% Post Consumer Recycled Content or 15% Bio Based Fiber	Recycled content/ Bio Based must be calculated in terms of total product weight	NSF/ANSI 140 current version at time of ordering	N/A	Document the percent recycled content.	Verify compliance through product submittal information.
	NSF 140 Gold Level	NSF 140 Gold Level + Must have take back program	NSF 140 Platinum Level	NSF 140 Platinum Level + Published Environmental Product Declaration	Provide Link to Published EPD & NSF 140 certificate	N/A	N/A	Describe NSF level.	Verify compliance through product submittal information.
	Meets Green Label Plus certification and equivalent CHPS protocol	Meets Green Label Plus certification and equivalent CHPS protocol	Meets Green Label Plus certification and equivalent CHPS protocol	Meets Green Label Plus certification and equivalent CHPS protocol	Provide GLP Certificate and letter from Mfg that product is CHPS compliant	Green Label Plus	N/A	Document environmental testing requirements for <del>carpet, padding and adhesives.</del>	Verify compliance through product submittal information.

3.4 Interior Performance Requirements									
Products	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design	Construction
					Measurements & Verification	Plans & Specifications	Calculations & Analysis	Basis of Design	Verification
Vinyl Tile (VT)									
Durability	Standard VCT - (Class I Solid Color; Class II Through Pattern; Class III Surface Decorated)	Standard VCT - (Class I Solid Color; Class II Through Pattern)	N/A	Premium Vinyl Tile(SVT) (Class III 20 mil wear Layer) & (Class I Monolithic)	N/A	ASTM F 1066 for Standard VCT; ASTM F 1700 for Premium	N/A	Describe tile construction.	Verify compliance through product submittal information.
	Minimum Overall Thickness = nom 0.125 inch	Minimum Overall Thickness = nom 0.125 inch	N/A	Minimum Overall Thickness = nom 0.100 inches(Class III) & nom 0.125 inches(Class I)	N/A	N/A	N/A	Describe tile thickness.	Verify compliance through product submittal information.
	Static Limit Load >125psi	Static Limit Load >125psi	N/A	Static Limit Load >175psi	N/A	ASTM F 970	N/A	Document static limit load rating for VCT.	Verify compliance through product submittal information.
Maintenance	Ex Factory Surface	Specialty Top Coat	N/A	Specialty Top Coat	N/A	ASTM F 410	N/A	Describe maintenance requirements.	Verify compliance through product submittal information.
Service Life	5 Year Warranty	5 Year Warranty	N/A	5 Year Warranty	N/A	N/A	N/A	Document warranty period.	
Environmental	0 % Recycled Content	5% Recycled Content	N/A	25% Recycled Content	N/A	N/A	N/A	Document the percent recycled content.	Verify compliance through product submittal information.
	CA 1350 Compliant	CA 1350 Compliant + Floor Score Certification	N/A	CA 1350 Compliant + Floor Score Certification	N/A	NSF/ANSI 332	N/A	Document compliance with CA 01350.	Verify compliance through product submittal information.
	Sustainability None	Sustainability NSF 332	N/A	Sustainability NSF 332	N/A	Floor Score Certified	N/A	Describe environmental testing requirement.	Verify compliance through product submittal information.



3.4 Interior Performance Requirements									
Products	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design	Construction
					Measurements & Verification	Plans & Specifications	Calculations & Analysis	Basis of Design	Verification
Sheet Vinyl									
Durability	Heterogeneous Vinyl	Heterogeneous Vinyl	N/A	Homogeneous Vinyl	N/A	ASTM F 1303/ ASTM F 1913	N/A	Describe tile construction.	Verify compliance through product submittal information.
	Type I (Clear Wear Layer 0.014 inches) Type II (Filled Wear Layer 0.030 inches)	Type I (Clear Wear Layer 0.020 inches) Type II (Filled Wear Layer 0.050 inches)	N/A	nom 0.075 inches	N/A	ASTM F 1303/ ASTM F 1913	N/A	Describe type of backing when used.	Verify compliance through product submittal information.
	Static Limit Load >125psi	Static Limit Load >175psi	N/A	Static Limit Load >250psi	N/A	ASTM F 1303/ ASTM F 1913	N/A	Document static limit load rating.	Verify compliance through product submittal information.
Maintenance	Ex-Factory Surface	Specialty Top Coat	N/A	Specialty Top Coat	N/A	ASTM F 1303	N/A	Describe maintenance requirements.	Verify compliance through product submittal information.
Service Life	5 Year Warranty	5 Year Warranty	N/A	5 Year Warranty	N/A	N/A	N/A	Document warranty period.	Verify compliance through product submittal information.
Environmental	CA 1350 Compliant	CA 1350 Compliant + Floor Score Certification	N/A	CA 1350 Compliant + Floor Score Certification	N/A	N/A	N/A	Document compliance with CA 01350.	Verify compliance through product submittal information and manufacturer certification.
	0 % Recycled Content	5% Recycled	N/A	25% Recycled	N/A	N/A	N/A	Document the percent recycled content.	Verify compliance through product submittal information and manufacturer certification.
	Sustainability None	Sustainability NSF 332	N/A	Sustainability NSF 332	N/A	NSF/ANSI 332	N/A	Describe environmental testing requirement.	Verify compliance through product submittal information and manufacturer certification.

3.4 Interior Performance Requirements									
Products	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurements & Verification	Plans & Specifications	Calculations & Analysis		
Rubber Tile									
Durability	Class II Laminated A&B (A=Solid Color Wear Layer; B=Mottled Wear Layer)	N/A	N/A	Class I Homogenous A&B (A=Solid Color Wear Layer; B=Mottled Wear Layer)	N/A	ASTM F 1344	N/A	Describe rubber tile construction.	Verify compliance through product submittal information.
	Min Overall Thickness = nom 0.080 inches Hardness >85	N/A	N/A	Min Overall Thickness = nom 0.125 inches Hardness >85	N/A	ASTM D 2240	N/A	Describe tile thickness.	Verify compliance through product submittal information.
Maintenance	Class II A&B	N/A	N/A	Class I A&B	N/A	ASTM F 1344	N/A	Describe maintenance requirements.	Verify compliance through product submittal information.
Service Life	5 Year Warranty	N/A	N/A	5 Year Warranty	N/A	N/A	N/A	Document warranty period.	Verify compliance through product submittal information.
Environmental	0 % Recycled Content	N/A	N/A	50% Recycled Content	N/A	N/A	N/A	Document the percent recycled content.	Verify compliance through product submittal information.
	Voc Emissions = CA 1350 Compliant	N/A	N/A	Voc Emissions = CA 1350 Compliant + Floor Score Certification	N/A	N/A	N/A	Document compliance with CA 01350.	Verify compliance through product submittal information.
	Sustainability None	N/A	N/A	Sustainability NSF 332	N/A	NSF/ANSI 332	N/A	Describe environmental testing requirement.	Verify compliance through product submittal information.

3.4 Interior Performance Requirements									
Products	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurements & Verification	Plans & Specifications	Calculations & Analysis		
Linoleum									
Durability	Thickness >2.5mm	N/A	N/A	Thickness >3.2mm	N/A	ASTM F 2034	N/A	Describe linoleum thickness.	Verify compliance through product submittal information.
	Static Limit Load >150psi	N/A	N/A	Static Limit Load >400psi	N/A	ASTM F 970	N/A	Document static limit load rating.	Verify compliance through product submittal information.
Maintenance	Ex-Factory Surface	N/A	N/A	Low Maintenance Coating	N/A	ASTM F 2034	N/A	Describe maintenance requirements.	Verify compliance through product submittal information.
Service Life	2 Year Warranty	N/A	N/A	3 Year Warranty	N/A	N/A	N/A	Document warranty period.	Verify compliance through product submittal information.
Environmental	10% Recycled Content and/or 30% Bio Based Content	N/A	N/A	20 % Recycled Content and/or 50% Bio Based Content	N/A	N/A	N/A	Document the percent recycled content.	Verify compliance through product submittal information and manufacturer certification.
	NSF 332 - None	N/A	N/A	Sustainability NSF 332	N/A	N/A	N/A	Describe environmental testing requirement.	Verify compliance through product submittal information and manufacturer certification.
	Binder Content min 30 %	N/A	N/A	Binder Content min 30 %	N/A	N/A	N/A	Describe binder content.	Verify compliance through product submittal information and manufacturer certification.
	Voc Emissions = CA 1350 Compliant	N/A	N/A	Voc Emissions = CA 1350 Compliant + Floor Score Certification	N/A	California Section 01350	N/A	Document compliance with CA 01350.	Verify compliance through product submittal information and manufacturer certification.

3.4 Interior Performance Requirements									
Products	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurements & Verification	Plans & Specifications	Calculations & Analysis		
Pressed Floor Tile									
Durability	Conforms to ANSI A137.1	Conforms to ANSI A137.1	N/A	Conforms to ANSI A137.1	N/A	ANSI A137.1	N/A	Document conformance with ANSI A137.1.	Verify compliance through mockup and product submittal information.
	Abrasion Class III	Abrasion Class IV	N/A	Abrasion Class IV	N/A	ASTM C1027	N/A	Document ASTM abrasion resistance.	Verify compliance through product submittal information.
	N/A	Max. Absorp. Class P3	N/A	Max. Absorp. Class P2	N/A	ASTM C373	N/A	Document water absorption requirement.	Verify compliance through mockup and product submittal information.
	N/A	Breaking Strength >350lbs	N/A	Breaking Strength >400lbs	N/A	ASTM C648	N/A	Document floor tile breaking strength.	Verify compliance through product submittal information.
Maintenance	Stain Class Reported	Stain Class B or Better	N/A	Stain Class A	N/A	ASTM C1378	N/A	Describe Stain Class.	Verify compliance through product submittal information.
	Chem Class Reported	Chem Class B or Better	N/A	Chem Class A	N/A	ASTM C650	N/A	Describe Chemical Class.	Verify compliance through product submittal information.
Service Life	1 Year Warranty	18 Month Warranty	N/A	2 Year Warranty	N/A	Manufacturer	N/A	Document warranty period.	Verify compliance through product submittal information and manufacturer certification.
Environmental	Green Squared Certification	Green Squared Certification	N/A	Green Squared Certification with Level 2 recycled /reclaimed content elective satisfied	Provide 3rd party Certificate	ANSI A138.1 & Green Squared Certification Program	N/A	Describe environmental testing requirement.	Verify compliance through product submittal information and manufacturer certification.
	N/A	N/A	N/A	Publically Available Environmental Product Data	Provide link to EPD Operators Website	ISO 14025	N/A	Describe environmental testing requirement.	Verify compliance through product submittal information and manufacturer certification.

3.4 Interior Performance Requirements									
Products	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurements & Verification	Plans & Specifications	Calculations & Analysis		
Quarry Tile									
Durability	Conforms to ANSI A137.1	Conforms to ANSI A137.1	Conforms to ANSI A137.1	Conforms to ANSI A137.1	N/A	ANSI A137.1	N/A	Document conformance with ANSI A137.1.	Verify compliance through mockup and product submittal information.
	Abrasion Class III	Abrasion Class IV	Abrasion Class IV	Abrasion Class V	N/A	ASTM C1027	N/A	Document ASTM abrasion resistance.	Verify compliance through product submittal information.
	N/A	Max. Absorp. Class E3	Max. Absorp. Class E2	Max Absorp. Class E1	N/A	ASTM C373	N/A	Document water absorption requirement.	Verify compliance through mockup and product submittal information.
	N/A	Breaking Strength >350lbs	Breaking Strength >400lbs	Breaking Strength >450lbs	N/A	ASTM C648	N/A	Document floor tile breaking strength.	Verify compliance through product submittal information.
Maintenance	Stain Class Reported	Stain Class B or Better	Stain Class A	Stain Class A	N/A	ASTM C1378	N/A	Describe Stain Class.	Verify compliance through product submittal information.
	Chem Class Reported	Chem Class B or Better	Chem Class A	Chem Class A	N/A	ASTM C650	N/A	Describe Chemical Class.	Verify compliance through product submittal information.
Service Life	1 Year Warranty	18 Month Warranty	2 Year Warranty	3 Year Warranty	N/A	Manufacturer	N/A	Document warranty period.	Verify compliance through product submittal information and manufacturer certification.
Environmental	Green Squared Certification	Green Squared Certification	Green Squared Certification with Level 2 recycled /reclaimed content elective satisfied	Green Squared Certification with Level 3 recycled / reclaimed content elective satisfied + 3 Innovation Credits	Provide 3rd party Certificate	ANSI A138.1 & Green Squared Certification Program	N/A	Describe environmental testing requirement.	Verify compliance through product submittal information and manufacturer certification.
	N/A	N/A	Publically Available Environmental Product Data	Publically Available Environmental Product Data	Provide link to EPD Operators Website	ISO 14025	N/A	Describe environmental testing requirement.	Verify compliance through product submittal information and manufacturer certification.

### 3.4 Interior Performance Requirements

Products	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurements & Verification	Plans & Specifications	Calculations & Analysis		
<b>Mosaic Tile</b>									
Durability	Conforms to ANSI A137.1	Conforms to ANSI A137.1	Conforms to ANSI A137.1	Conforms to ANSI A137.1	N/A	ANSI A137.1	N/A	Document conformance with ANSI A137.1.	Verify compliance through mockup and product submittal information.
	Abrasion Class III	Abrasion Class IV	Abrasion Class IV	Abrasion Class V	N/A	ASTM C1027	N/A	Document ASTM abrasion resistance.	Verify compliance through product submittal information.
	N/A	Max. Absorp. Class P3/E3/O3	Max. Absorp. Class P2/E2/O2	P1/E1/O1	N/A	ASTM C373	N/A	Document water absorption requirement.	Verify compliance through mockup and product submittal information.
	N/A	Breaking Strength >350lbs	Breaking Strength >400lbs	Breaking Strength >450lbs	N/A	ASTM C648	N/A	Document floor tile breaking strength.	Verify compliance through product submittal information.
Maintenance	Stain Class Reported	Stain Class B or Better	Stain Class A	Stain Class A	N/A	ASTM C1378	N/A	Describe Stain Class.	Verify compliance through product submittal information.
	Chem Class Reported	Chem Class B or Better	Chem Class A	Chem Class A	N/A	ASTM C650	N/A	Describe Chemical Class.	Verify compliance through product submittal information.
Service Life	1 Year Warranty	18 Month Warranty	2 Year Warranty	3 Year Warranty	N/A	Manufacturer	N/A	Document warranty period.	Verify compliance through product submittal information and manufacturer certification.
Environmental	Green Squared Certification	Green Squared Certification	Green Squared Certification with Level 2 recycled /reclaimed content elective satisfied	Green Squared Certification with Level 3 recycled / reclaimed content elective satisfied + 3 Innovation Credits	Provide 3rd party Certificate	ANSI A138.1 & Green Squared Certification Program	N/A	Describe environmental testing requirement.	Verify compliance through product submittal information and manufacturer certification.
	N/A	N/A	Publically Available Environmental Product Data	Publically Available Environmental Product Data	Provide link to EPD Operators Website	ISO 14025	N/A	Describe environmental testing requirement.	Verify compliance through product submittal information and manufacturer certification.
<b>Limestone Tile</b>									
Durability	Abrasion Resistance >10	NA	NA	Abrasion Resistance >15	N/A	ASTM C568	N/A	Document ASTM abrasion resistance.	Verify compliance through product submittal information.
Maintenance	Absorption max. 7.5	NA	NA	Absorption max. 3	N/A	ASTM C97	N/A	Document water absorption requirement.	Verify compliance through mockup and product submittal information.
<b>Slate Tile</b>									
Durability	Abrasion Resistance >8	NA	NA	Abrasion Resistance >15	N/A	ASTM C629	N/A	Document ASTM abrasion resistance.	Verify compliance through product submittal information.
Maintenance	Absorption	NA	NA	Absorption	N/A	ASTM C121	N/A	Document water absorption requirement.	Verify compliance through mockup and product submittal information.

3.4 Interior Performance Requirements									
Products	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurements & Verification	Plans & Specifications	Calculations & Analysis		
<b>Marble</b>									
Durability	Abrasion Resistance >10	NA	NA	Abrasion Resistance >15	N/A	ASTM C503	N/A	Document ASTM abrasion resistance.	Verify compliance through product submittal information.
Maintenance	Absorption max. 0.20 / Density 144 min	NA	NA	Absorption max. 0.20 / Density 168 min	N/A	ASTM C97	N/A	Document water absorption requirement.	Verify compliance through mockup and product submittal information.
<b>Granite</b>									
Durability	Abrasion Resistance >25	N/A	N/A	Abrasion Resistance >25	N/A	ASTM C615	N/A	Document ASTM abrasion resistance.	Verify compliance through product submittal information.
Maintenance	Absorption max. 0.50	N/A	N/A	Absorption max. 0.40	N/A	ASTM C97	N/A	Document water absorption requirement.	Verify compliance through mockup and product submittal information.
<b>Terrazzo</b>									
<b>Cementitious</b>					<b>Epoxy</b>				
Durability	Polyacrylate 3/8"	N/A	N/A	1/4" or 3/8"	N/A	N/A	N/A	N/A	N/A
	Abrasion<40% Loss	N/A	N/A	Ha-10 minimum	N/A	MIL-D-3134 Par. 4.7.10/ ASTM C 241	N/A	Document ASTM abrasion resistance.	Verify compliance through product submittal information.
Maintenance	Anti-fracture Membrane	N/A	N/A	Flexible Membrane and vapor barrier	N/A	ASTM E 1745	N/A	Document maintenance requirements.	Verify compliance through product submittal information.
Environmental	No VOC Local Resources Recycled Marble Chips	N/A	N/A	Low VOC Local Resources Recycled Glass/Stone Chips	N/A	N/A	N/A	Describe environmental testing requirement.	Verify compliance through product submittal information and manufacturer certification.

3.4 Interior Performance Requirements									
Products	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurements & Verification	Plans & Specifications	Calculations & Analysis		
Laminate Flooring									
Commercial									
Heavy Commercial									
Durability	Wear Resistance IP>4000 cycles	N/A	N/A	Wear Resistance IP>6000 cycles	N/A	NAFLA LF-01	N/A	Document wear resistance rating.	Verify compliance through product submittal information.
	Static Load Limit >8 MPa (1160 psi)	N/A	N/A	Static Load Limit >8 MPa (1160 psi)	N/A	NAFLA LF-01	N/A	Document static load limit.	Verify compliance through product submittal information.
Maintenance	High Wear Resistant Thermoset Surface	N/A	N/A	High Wear Resistant Thermoset Surface	N/A	NAFLA Stds	N/A	Document maintenance requirements.	Verify compliance through product submittal information.
Service Life	10 Year Warranty	N/A	N/A	10 Year Warranty	N/A	N/A	N/A	Document warranty period.	Verify compliance through product submittal information and manufacturer certification.
	CARB Verified Phase 2 Compliant	N/A	N/A	CARB Verified Phase 2 Compliant	3rd Party Certified	ASTM E1333/ASTM D6007	N/A	Document CARB compliance.	Verify compliance through product submittal information and manufacturer certification.
Environmental	VOC Emissions - CA 1350	N/A	N/A	CA 1350 - (Floor Score Certified)	N/A	N/A	N/A	Document compliance with CA 01350.	Verify compliance through product submittal information and manufacturer certification.
	50% Recycled Content	N/A	N/A	90% Recycled Content	N/A	NAFLA Stds	N/A	Document the percent recycled content.	Verify compliance through product submittal information and manufacturer certification.
Wood Flooring									
Durability	Hardness - 380-950	Hardness - 950-1500	Hardness - 1500-2600	Hardness - 2600-3800	N/A	Janka Test	N/A	Document Janka Test hardness level.	Verify compliance through product submittal information.
Maintenance	Varnish top coat	Varnish top coat	Polyurethane top coat	Polyurethane top coat	N/A	ASTM D 4060	N/A	Describe maintenance requirements.	Verify compliance through product submittal information.
Environmental	Local Resources, 91% Bio Based	Local Resources, 91% Bio Based	Local Resources, 91% Bio Based	Local Resources, 91% Bio Based	N/A	Green Label Certified	N/A	Describe regional material content, recycled material content and environmental testing requirement.	Verify compliance through product submittal information and manufacturer certification.
Bamboo Flooring									
Durability	Hardness 1300 min	Hardness 1400 min	Hardness 1500 min	Hardness 1600 min	N/A	Janka Test	N/A	Document Janka Test hardness level.	Verify compliance through product submittal information.
Maintenance	Varnish top coat	Varnish top coat	Polyurethane top coat	Polyurethane top coat	N/A	ASTM D 4060	N/A	Describe maintenance requirements.	Verify compliance through product submittal information.
Environmental	91% Bio Based, Recycled, Low VOC	91% Bio Based, Recycled, Low VOC	91% Bio Based, Recycled, Low VOC	91% Bio Based, Recycled, Low VOC	N/A	Green Label Certified	N/A	Describe regional material content, recycled material content and environmental testing requirement.	Verify compliance through product submittal information and manufacturer certification.



### 3.4 Interior Performance Requirements

Products	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurements & Verification	Plans & Specifications	Calculations & Analysis		
<b>Glazed Wall Tile</b>									
Durability	Conforms to ANSI A137.1	Conforms to ANSI A137.1	Conforms to ANSI A137.1	Conforms to ANSI A137.1	N/A	ANSI A137.1	N/A	Document conformance with ANSI A137.1.	Verify compliance through mockup and product submittal information.
	Absorp. Class P4	Absorp. Class P4	Absorp. Class P4	Absorp. Class P4	N/A	ASTM C373	N/A	Document water absorption requirement.	Verify compliance through product submittal information.
		Breaking Strength >175lbs	Breaking Strength >200lbs	Breaking Strength >225lbs	N/A	ASTM C648	N/A	Document breaking strength.	Verify compliance through product submittal information.
Maintenance	Stain Class Reported	Stain Class B or Better	Stain Class A	Stain Class A	N/A	ASTM C1378	N/A	Describe Stain Class.	Verify compliance through product submittal information.
	Chem Class Reported	Chem Class B or Better	Chem Class A	Chem Class A	N/A	ASTM C650	N/A	Describe Chemical Class.	Verify compliance through product submittal information.
Service Life	1 Year Warranty	18 Month Warranty	2 Year Warranty	3 Year Warranty	N/A	Manufacturer	N/A	Document warranty period.	Verify compliance through product submittal information and manufacturer certification.
Environmental	Green Squared Certification	Green Squared Certification	Green Squared Certification with Level 2 recycled /reclaimed content elective satisfied	Green Squared Certification with Level 3 recycled / reclaimed content elective satisfied + 3 Innovation Credits	Provide 3rd party Certificate	ANSI A138.1 & Green Squared Certification Program	N/A	Document the percent recycled content.	Verify compliance through product submittal information and manufacturer certification.
	N/A	N/A	Publically Available EPD	Publically Available EPD	Provide link to EPD Operators Website	ISO 14025	N/A	Describe environmental testing requirement.	Verify compliance through product submittal information and manufacturer certification.
<b>Paint</b>									
Durability			x						
	Burnish Resistant	Burnish Resistant	N/A	Burnish Resistant	N/A	ASTM D6736/MPI	N/A	Document requirements in basis of design.	Verify compliance through product submittal information.
	N/A	Stain Resistant	N/A	Stain Resistant	N/A	ASTM 3450/MPI	N/A	Describe finish types and maintenance requirements.	Verify compliance through product submittal information.
	N/A	N/A	N/A	Highly Scrubbable	N/A	ASTM 2486/MPI	N/A	Describe finish types and maintenance requirements.	Verify compliance through product submittal information.
Environmental	Low VOC, 20% Recycled Postconsumer Light Colored, 50% Postconsumer Dark Colored or 20% Bio Based	Low VOC, 20% Recycled Postconsumer Light Colored, 50% Postconsumer Dark Colored or 20% Bio Based	Low VOC/20% Recycled Postconsumer Light Colored, 50% Postconsumer Dark Colored or 20% Bio Based	Low VOC, 20% Recycled Postconsumer Light Colored, 50% Postconsumer Dark Colored or 20% Bio Based	N/A	CARB 2007 SCM	N/A	Document that all paints are listed in the CARB Approved Products List.	Verify compliance through product submittal information and manufacturer certification.

### 3.4 Interior Performance Requirements

Products	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurements & Verification	Plans & Specifications	Calculations & Analysis		
Wall Covering - Type II									
Durability	Compliance to W-101 (2011)	Compliance to W-101 (2011)	Compliance to W-101 (2011)	Compliance to W-101 (2011)	Manufacturer Provided Specifications	N/A	W 101 Physical Test Requirements	Describe durability requirements.	Verify compliance through product submittal information.
Maintenance	Scrubability - 300 cycles/ min Washability - 100 cycles/ min	Scrubability - 300 cycles/ min Washability - 100 cycles/ min	Scrubability - 300 cycles/ min Washability - 100 cycles/ min	Scrubability - 300 cycles/ min Washability - 100 cycles/ min	Manufacturer Provided Specifications	ASTM F 793	W 101 Physical Test Requirements	Describe maintenance requirements.	Verify compliance through product submittal information.
Environmental	NSF 342 Conformant Level + 5% Minimum Recycled Post Consumer or 10% Pre-Consumer Content	NSF 342 Silver Level + 5% Minimum Recycled Post Consumer or 10% Pre-Consumer Content	NSF 342 Gold Level + 5% Minimum Recycled Post Consumer or 10% Pre-Consumer Content	NSF 342 Platinum Level + 5% Minimum Recycled Post Consumer or 10% Pre-Consumer Content	Provide 3rd Party NSF 342 Certificate; Recycled content must be calculated in terms of total product weight	N/A	W 101 Physical Test Requirements	Document the percent recycled content.	Verify compliance through product submittal information and manufacturer certification.
	VOC - Meets CA 1350	VOC - Meets CA 1350	VOC - Meets CA 1350	VOC - Meets CA 1350	Provide 3rd Party Lab Results	N/A	N/A	Document compliance with CA 01350.	Verify compliance through product submittal information and manufacturer certification.
	Adhesives SCAQMD Rule 1168	Adhesives SCAQMD Rule 1168	Adhesives SCAQMD Rule 1168	Adhesives SCAQMD Rule 1168	Provide 3rd Party Lab Results	N/A	N/A	Document compliance with SQAQMD Rule 1168.	Verify compliance through product submittal information and manufacturer certification.
Wall Paneling Plastic/Laminate									
Durability	Standard Laminate	High Pressure Laminate	Fiber Reinforced Laminate	Fiberglass Reinforced Plastic		ASTM D 695/ NEMA Testing		Describe proposed laminate system.	Verify compliance through product submittal information.
	Abrasion Resistance >400	Abrasion Resistance >420	Abrasion Resistance >440	Abrasion Resistance >460	N/A	NEMA Testing	N/A	Document NEMA abrasion resistance.	Verify compliance through product submittal information.
Maintenance	Cleanability 20 cycles	Cleanability 18 cycles	Cleanability 14 cycles	Cleanability 10 cycles	N/A	NEMA Testing	N/A	Describe cleanability and maintenance requirements.	Verify compliance through product submittal information.
Service Life	1 Year Warranty	2 Year Warranty	5 Year Warranty	10 Year Warranty	N/A	N/A	N/A	Document warranty period.	Verify compliance through product submittal information and manufacturer certification.
Environmental	Low VOC/Low VOC Installation	Low VOC/Low VOC Installation	Low VOC/Low VOC Installation	Low VOC/Low VOC Installation	N/A	N/A	N/A	Describe environmental testing requirement.	Verify compliance through product submittal information and manufacturer certification.
	40% Recycled Material	50% Recycled Material	60% Recycled Material	60% Recycled Material	N/A	N/A	N/A	Document the percent recycled content.	Verify compliance through product submittal information and manufacturer certification.

3.4 Interior Performance Requirements									
Products	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurements & Verification	Plans & Specifications	Calculations & Analysis		
Wall Paneling/ Wood									
Durability	Hardness - 380-950	Hardness - 950-1500	Hardness - 1500-2600	Hardness - 2600-3800	N/A	Janka Test	N/A	Document Janka Test hardness level.	Verify compliance through product submittal information. Conduct Janka test to verify compliance after installation.
Maintenance	Varnish top coat	Varnish top coat	Polyurethane top coat	Polyurethane top coat	N/A	ASTM D 4060	N/A	Describe cleanability and maintenance requirements.	Verify compliance through product submittal information.
Environmental	Local Resources, 91% Bio Based	Local Resources, 91% Bio Based	Local Resources, 91% Bio Based	Local Resources, 91% Bio Based or Recycled Materials	N/A	N/A	N/A	Describe regional material content, recycled material content and environmental testing requirement.	Verify compliance through product submittal information and manufacturer certification.
Wall Paneling/ Composite Board									
Durability	Min 6mm thickness	Min 10mm thickness	Min 20mm thickness	Min 30mm thickness					
Maintenance	Sealant	Top Coat	Top Coat	Polyurethane top coat	N/A	ASTM D 4060	N/A	Describe cleanability and maintenance requirements.	Verify compliance through product submittal information.
Environmental	Low VOC/Low VOC Installation	Low VOC/Low VOC Installation	Low VOC/Low VOC Installation	Low VOC/Low VOC Installation	N/A	N/A	N/A	Describe environmental testing requirement.	Verify compliance through product submittal information and manufacturer certification.
	20% Recycled Material or 89% Bio Based	30% Recycled Material or 89% Bio Based	40% Recycled Material or 89% Bio Based	50% Recycled Material or 89% Bio Based	N/A	N/A	N/A	Document the percent recycled content.	Verify compliance through product submittal information and manufacturer certification.

3.4 Interior Performance Requirements									
Products	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurements & Verification	Plans & Specifications	Calculations & Analysis		
Wall Paneling/ Sculptural Panel									
Durability	Min 6mm thickness	Min 10mm thickness	Min 20mm thickness	Min 30mm thickness				Describe proposed thickness.	Verify compliance through product submittal information.
Maintenance	900 psi.	920 psi.	940 psi.	960 psi	N/A	ASTM D 638	N/A	Describe cleanability and maintenance requirements.	Verify compliance through product submittal information.
Environmental	Low VOC/Low VOC Installation	Low VOC/Low VOC Installation	Low VOC/Low VOC Installation	Low VOC/Low VOC Installation	N/A	N/A	N/A	Describe environmental testing requirement.	Verify compliance through product submittal information and manufacturer certification.
	20% Recycled Material or 89% Bio Based	30% Recycled Material or 89% Bio Based	40% Recycled Material or 89% Bio Based	50% Recycled Material or 89% Bio Based	N/A	N/A	N/A	Document the percent recycled content.	Verify compliance through product submittal information and manufacturer certification.
Wall Base									
Durability	Type TV	Type TPR	N/A	Type TS	N/A	ASTM F 1861	N/A	Describe ASTM F 1861 wall base type.	Verify compliance through product submittal information.
Maintenance	Group II	Group I or II	N/A	Group I	N/A	ASTM F 1861	N/A	Describe cleanability and maintenance requirements.	Verify compliance through product submittal information.
Service Life	1 Year Warranty	1 Year Warranty	N/A	5 Year Warranty	N/A	N/A	N/A	Document warranty period.	Verify compliance through product submittal information and manufacturer certification.
Environmental	Low VOC	Low VOC	N/A	Low VOC PVC Free	N/A	NSF/ANSI 332	N/A	Describe recycled material content and environmental testing requirement.	Verify compliance through product submittal information and manufacturer certification.

3.4 Interior Performance Requirements									
Products	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurements & Verification	Plans & Specifications	Calculations & Analysis		
<b>Ceilings</b>									
<b>Surface Texture</b>	Directional or non directional fissured	Fine Texture with perforations	Fine Texture	Fine Texture				Describe surface texture for each ceiling type.	Verify compliance through product submittal information and manufacturer certification.
<b>Acoustics</b>									
Open Plan NRC	≥ 0.70	≥ 0.80	≥ 0.90	≥ 0.95	UL Classified Acoustical Performance	ASTM C423	N/A	Describe acoustical properties for each ceiling type.	Verify compliance through product submittal information and manufacturer certification.
Open Plan CAC	N/A	N/A	N/A	N/A	UL Classified Acoustical Performance	ASTM D 1414	N/A		
Closed Plan NRC	≥ 0.50	≥ 0.55	≥ 0.60	≥ 0.70	UL Classified Acoustical Performance	ASTM C423	N/A		
Closed Plan - CAC	≥ 30	≥ 35	≥ 35	≥ 35	UL Classified Acoustical Performance	ASTM D 1414	N/A		
<b>Durability</b>									
Durability	N/A	N/A	Impact Resistance	Impact Resistance		Modified ASTM D1037	N/A	Describe impact, scratch and sag resistance for each ceiling type.	Verify compliance through product submittal information and manufacturer certification.
	N/A	N/A	Scratch Resistance	Scratch Resistance	Hess Rake Test		N/A		
	N/A	Sag Resistance	Sag Resistance	Sag Resistance			N/A		
<b>Maintenance</b>									
Maintenance	N/A	N/A	N/A	Washable		ASTM D4828	N/A	Describe if ceiling is washable and scrubbable.	Verify compliance through product submittal information and manufacturer certification.
	N/A	N/A	N/A	Scrubbable		Modified ASTM D2486	N/A		
<b>Service Life</b>									
Service Life	1 Year Warranty	5 Year Systems Warranty	10 Year Systems Warranty	20 Year Systems Warranty	Manufacturer's Warranty	N/A	N/A	Describe service life for each ceiling type.	Verify compliance through product submittal information
<b>Environmental</b>									
Environmental	Total Recycled Content ≥ 20%	Total Recycled Content ≥ 30%	Total Recycled Content ≥ 40%	Total Recycled Content ≥ 50%	N/A	ISO 14021	N/A	Describe total recycled content, light reflectance and emission requirements.	Verify compliance through product submittal information and manufacturer certification.
	Recyclable in a closed Loop Process or 37% Bio Based	Recyclable in a closed Loop Process or 37% Bio Based	Recyclable in a closed Loop Process or 37% Bio Based	Recyclable in a closed Loop Process	Manufacturer's Certification Letter	N/A	N/A		
	Light Reflectance ≥ 80%	Light Reflectance ≥ 85%	Light Reflectance ≥ 85%	Light Reflectance ≥ 85%	N/A	ASTM E-1477	N/A		
	CHPS Compliant	CHPS Compliant	CHPS Compliant	CHPS Compliant	N/A	CA Dept of Health Services Std Practices 2010	N/A		
	Product EPD Available	Product EPD Available	Product EPD Available	Product EPD Available	Environmental Product Data	ISO 14025	N/A		

## 3.5 Interior Construction and Interior Finishes

### Performance Attributes

Interior construction is described in two categories: construction products and materials, those elements that are built to create functional spaces, and finish materials, those products that are applied to the construction products to conceal, protect, or enhance the appearance of construction products or to provide wearing surfaces.

*Construction Products and Materials* include doors, windows (borrowed lights), permanent partitions, demountable partitions, operable partitions, and millwork. Each product has been evaluated based on its applicable characteristics. Products have been evaluated for construction, durability, acoustic properties, security, operability/flexibility, and other characteristics that reflect the functional requirements of the product under consideration.

Interior Finishes and Materials addresses performance levels of typical floor, wall, and ceiling finishes, focusing on each product's durability, maintenance, service life, and environmental qualities. Metrics and attributes vary by finish based on performance need. Durability describes composition/content, thickness, hardness, strength, wear resistance, load limit, and water absorption. Maintenance addresses wear layer/sealer, barrier/backing, cleanability, stain resistance, microbial resistance, and mold/mildew resistance. Service life is described in terms of the length of warranty available. Environmental addresses recycled content, renewable resources, local materials, and VOC emissions.

#### 3.5.1 Construction Products and Materials

Fire ratings must meet regulatory requirements without regard to performance level selected. They do not necessarily enhance performance, durability, appearance, or other attributes. Therefore, products and materials are described without regard to fire rating.

The baseline performance characteristics described are commercial quality products and would be suitable for use in most applications.

Acoustical performance is described in terms of Sound Transmission Coefficient (STC) as determined by ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements. Rules of thumb for interpreting ratings are:

STC 35: Loud speech audible but not intelligible.

STC 40: Onset of "privacy".

STC 45: Loud speech barely audible.

STC 50: Loud speech not audible; shouting barely audible.

STC 55: Very loud sounds such as musical instruments or a stereo can be faintly heard.

STC 60: Superior soundproofing; most sounds inaudible.

For specific guidance on office acoustics refer to: [www.gsasoundmatters.gov](http://www.gsasoundmatters.gov)

### 3.5.1.1 Solid Core Wood Doors

Wood doors may have vision panels and other features that do not change their level of performance. Performance characteristics described are a minimum combination for each group. Any one of the characteristics might be enhanced without changing the performance level (e.g.: A rosewood veneer could be applied to a Tier 1 High Performance (★) door without changing its performance level). Doors may have power assist or may be power operated and may have various types of electronically controlled locking mechanisms such as magnetic locks or electric strikes. Doors shall be fabricated in accordance with WDMA I.S.-1.A, Architectural Wood Flush Doors, and DHI A115-W, Wood Door Hardware Standards, Hardware Preparation. Hardware shall comply with BHMA A156 series requirements. Hollow metal frames shall be fabricated to meet requirements of ASTM/SDI 250.4, Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings. All doors and frames should be factory prepared for hardware installation. Hollow metal frames should be factory primed.

- Baseline: Bonded stave core construction, AWI Custom Grade. Hardwood (birch or poplar) or medium density overlay (MDO) veneer for field painting. Grade 1 bored (cylinder) locks with plated finish. Knock-down hollow metal frame, 0.053-inch (1.3mm) thick, galvanized for installation in wet areas. Twenty-five year warranty. No acoustical rating. Security features are provided by door swing, hinge pin selection, and lock function.
- Tier 1 High Performance (★): Bonded particle board core, AWI Custom Grade. Field finished oak, maple, or similar hardwood veneer, random match. Grade 1 standard duty mortise locks with plated finish. Knock-down hollow metal frame, Level 3, 0.053-inch (1.3mm) thick, galvanized for installation in wet areas. Lifetime warranty. No acoustical rating. Security features are provided by door swing, hinge pin selection, and lock function.
- Tier 2 High Performance (★★): Bonded structural composite core, AWI Premium Grade. Shop finished cherry, walnut or similar hardwood veneer, running match. Grade 1 heavy duty mortise locks, solid stainless steel or bronze. Welded hollow metal frame, Level 3, 0.053-inch (1.3mm) thick, galvanized. Lifetime warranty. STC 45. Time rated (15 minute) forced entry rating.
- Tier 3 High Performance (★★★): Bonded structural composite core, AWI Premium Grade. Shop finished teak, rosewood or similar hardwood veneer, book match. Grade 1 heavy duty mortise locks, solid stainless steel or bronze. Welded hollow metal frame, Level 4, 0.067-inch (1.7mm) thick, galvanized. Lifetime warranty. STC 50; gasketed frame. Forced entry and ballistic resistant.

### 3.5.1.2 Hollow Metal Doors

Hollow metal doors may have vision panels and other features that do not change their level of performance. Performance characteristics described are a minimum combination for each group. Any one of the characteristics might be enhanced without changing the performance level. Doors may have power assist or may be power operated and may have various types of electronically controlled locking mechanisms such as magnetic locks or electric strikes. Doors and frames shall be fabricated to meet requirements of ASTM/SDI 250.4, Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings. Hardware shall comply with BHMA A156 series requirements. All doors and frames should be factory primed and prepared for hardware installation.

- Baseline: Heavy duty, Level 2, 0.042-inch (1.0mm) sheet metal, galvanized in wet areas. Field painted. Grade 1 bored (cylinder) locks with plated finish. Knock-down hollow metal frame, Level 3, 0.053-inch (1.3mm) thick, galvanized for installation in wet areas. Manufacturer's standard warranty. No

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acoustical rating. Security features are provided by door swing, hinge pin selection, and lock function.

- Tier 1 High Performance (★): Extra heavy duty, Level 3, 0.053-inch (1.3mm) sheet metal, galvanized in wet areas. Field painted. Grade 1 Standard duty mortise locks with plated finish. Knock-down hollow metal frame, Level 3, 0.053-inch (1.3mm) thick, galvanized for installation in wet areas. Manufacturer's standard warranty. No acoustical rating. Security features are provided by door swing, hinge pin selection, and lock function.
- Tier 2 High Performance (★★): Extra heavy duty, Level 3, 0.053-inch (1.3mm) sheet metal, galvanized. Shop painted. Grade 1 Heavy duty mortise locks, solid stainless steel or bronze. Welded hollow metal frame, Level 3, 0.053-inch (1.3mm) thick, galvanized. Manufacturer's standard warranty. STC 35. Time rated (15 minute) forced entry rating.
- Tier 3 High Performance (★★★): Maximum duty, Level 4, 0.067-inch (1.7mm) sheet metal, galvanized. Electrostatic paint. Grade 1 Heavy duty mortise locks, solid stainless steel or bronze. Welded hollow metal frame, Level 4, 0.067-inch (1.7mm) thick, galvanized. Manufacturer's standard warranty. STC 35. Forced entry and ballistic resistant.

### 3.5.1.3 Glazed Aluminum Doors

Aluminum doors are typically fully glazed. They are constructed as aluminum entrances or part of a storefront system even though they are for interior use. Aluminum doors are usually installed in aluminum frames. Doors and frames shall be fabricated in accordance with AAMA101/I.S.2/A440, North American Fenestration Standard/Specification for Windows, Doors, and Skylights. They cannot have a fire rating and are not bullet resistant or forced entry protected. Safety glass in compliance with

ASTM C1048, Standard Specification for Heat Treated Flat Glass, must be used. Sound transmission can be reduced through the use of insulating glass. Doors may have power assist or may be power operated and may have various types of electronically controlled locking mechanisms such as magnetic locks or electric strikes. Finishes shall comply with AAMA 611, Specification for Anodized Architectural Aluminum or AAMA 260, Specification for Pigmented Organic Coatings.

- Baseline: Manufacturer's standard profile 1/8-inch (3mm) extruded aluminum door and frame with mill finish. Fully glazed with ¼-inch (6mm) clear glass. Grade 2 top and bottom (center pivot if required for size and weight of door) offset pivots. Manufacturer's standard warranty. Security features are provided by door swing and lock function.
- Tier 1 High Performance (★): Manufacturer's standard profile 1/8-inch (3mm) extruded aluminum door and frame with Class II anodized finish. Fully glazed with ¼-inch (6mm) clear glass. Grade 1 top and bottom (center pivot if required for size and weight of door) offset pivots. Manufacturer's standard warranty. Security features are provided by door swing and lock function.
- Tier 2 High Performance (★★): Manufacturer's standard profile 1/8-inch (3mm) extruded aluminum door and frame with Class I anodized finish. Fully glazed with 1-inch (25.4mm) clear insulating glass. Grade 1 top and bottom center pivots. Manufacturer's standard warranty. Security features are provided by door swing and lock function.
- Tier 3 High Performance (★★★): Custom profile 3/16-inch (5mm) extruded aluminum door and frame with Class I anodized or fluoropolymer paint finish. Fully glazed with ½-inch (13mm) clear or decorative laminated glass. Grade 1 top and bottom center pivots. Five year manufacturer's warranty. Electronically



controlled access. Power assisted or automatic operator.

### 3.5.1.4 All Glass Entrances

All glass entrances are installed without traditional frames. They are not available as fire rated assemblies or forced entry resistant. They may be considered in and of themselves to be higher performance than any of the above door types because of their cost and appearance. Glass must be either laminated or tempered in compliance with ASTM C1048, Standard Specification for Heat Treated Flat Glass. Doors may have power assist or may be power operated and may have various types of electronically controlled locking mechanisms such as magnetic locks or electric strikes.

- **Baseline:** All glass with stainless steel or chrome plated top and bottom rails or patches. Clear safety glass, ½-inch (13mm) thick. Grade 1 top and bottom pivots. Concealed floor or overhead closer. Security features are provided by lock function.
- **Tier 1 High Performance (★):** All glass with polished stainless steel, brass or chrome plated top and bottom rails or patches. Clear safety glass, ½-inch (13mm) thick. Grade 1 top and bottom pivots. Concealed floor or overhead closer. Security features are provided by lock function.
- **Tier 2 High Performance (★★):** All glass with polished stainless steel, brass or chrome plated top and bottom rails or patches. Clear safety or decorative glass, ½-inch (13mm) thick. Grade 1 top and bottom pivots. Concealed floor or overhead closer. Three year manufacturer's warranty. Electronically controlled access.
- **Tier 3 High Performance (★★★):** Not used.

### 3.5.1.5 Borrowed Lights

Borrowed lights are used to allow natural light to penetrate into interior spaces or to allow visual connection between adjacent spaces. They can make small spaces feel more open. Borrowed lights include sidelights, transoms, and openings in other wall construction. Borrowed lights in corridors and sidelights are required to be glazed with tempered, laminated or some other form of safety glass complying with ASTM C1048, Standard Specification for Heat Treated Flat Glass.

### 3.5.1.6 Wood Framed Interior Lights

Wood framed borrowed lights cannot be fire rated.

- **Baseline:** Field fabricated and finished. Painted Birch, Poplar or clear softwood. AWI Custom Grade. Clear ¼-inch (6mm) safety glass.
- **Tier 1 High Performance (★):** Shop fabricated with field applied clear or tinted stain. Oak, Maple, Cherry, Walnut or similar hardwood. AWI Custom Grade. Clear ¼-inch (6mm) safety glass.
- **Tier 2 High Performance (★★):** Shop fabricated and finished with clear or tinted stain. Oak, Maple, Cherry, Walnut or similar hardwood. AWI Premium Grade. Insulating glass or two ¼-inch (6mm) lights of laminated glass with ½-inch (13mm) gap for reduced sound transmission.
- **Tier 3 High Performance (★★★):** Shop fabricated and finished with clear or tinted stain. Teak, Rosewood or similar hardwood. AWI Premium Grade. Decorative laminated glass, ½-inch (13mm) thick.

### 3.5.1.7 Hollow Metal Framed Interior Lights

Hollow metal framed borrowed lights may be fire rated if dimensions comply with the requirements for required rating and glazed with appropriate material.

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- Baseline: Knock-down hollow metal frame, 0.042-inch (1.0mm) thick, untreated, field painted. Clear ¼-inch (6mm) safety glass.
- Tier 1 High Performance (★): Welded hollow metal frame, 0.053-inch (1.3mm) thick, galvanized for installation in wet areas, shop applied painted finish. Clear ¼-inch (6mm) safety glass.
- Tier 2 High Performance (★★): Welded hollow metal frame, 0.053-inch (1.3mm) thick with custom profile, galvanized for installation in wet areas, and electrostatically applied painted finish. Insulating glass with two ¼-inch (6mm) lights of laminated glass with ½-inch (13mm) gap for reduced sound transmission.
- Tier 3 High Performance (★★★): Welded hollow metal frame, 0.053-inch (1.3mm) thick with custom profile, galvanized for installation in wet areas, and electrostatically applied painted finish. Decorative laminated glass, ½-inch (13mm) thick.
- Tier 2 High Performance (★★): Manufacturer's standard profile extruded aluminum frame, 1/8-inch (3mm) thick, with Class I anodized or fluoropolymer paint finish. Glazed with 1-inch (25.4mm) insulating glass made up of two ¼-inch (6mm) clear, laminated lights for reduced sound transmission.
- Tier 3 High Performance (★★★): Custom profile extruded aluminum frame, 1/8-inch (3mm) thick, with Class 1 anodized or fluoropolymer paint finish. Glazed with ½-inch (13mm) decorative or clear laminated glass.

### 3.5.1.8 Aluminum Framed Interior Lights

Aluminum framed borrowed lights are typically fabricated from storefront or curtainwall framing systems. Aluminum framed borrowed lights cannot be fire rated. Finishes shall comply with AAMA 611, Specification for Anodized Architectural Aluminum or AAMA 260, Specification for Pigmented Organic Coatings.

- Baseline: Manufacturer's standard profile extruded aluminum frame, 1/8-inch (3mm) thick, with mill finish. Glazed with ¼-inch (6mm) clear safety glass.
- Tier 1 High Performance (★): Manufacturer's standard profile extruded aluminum frame, 1/8-inch (3mm) thick, with Class II anodized finish. Glazed with ¼-inch (6mm) clear safety glass.

### 3.5.1.9 Metal Stud Partitions

Performance level does not take into account fire rating requirements. Metal stud framing shall comply with ASTM C645, Standard Specification for Nonstructural Steel Framing Members. Stud sizes and thickness are minimums; increased dimensions and/or reduced spacing may be necessary to meet deflection requirements. Gypsum board shall comply with C1396, Standard Specification for Gypsum Board. Gypsum board selection will vary depending on application: Type X gypsum board for fire rated assemblies, Type MR for locations subject to moisture or high humidity, Type IR where impact resistance is needed, or cementitious backer board in showers.

- Baseline: 3-5/8-inch (92mm) x min. 25 ga. metal studs @ 24-inch (610mm) o.c., 5/8-inch (13mm) gypsum board each side (max. deflection L/240). Partition extends from slab to ceiling. Minimum STC rating of 40.
- Tier 1 High Performance (★): 3-5/8-inch (92mm) x min. 25 ga. metal studs @ 16-inch (406mm) o.c., 5/8-inch (16mm) gypsum board each side (max. deflection L/360). Partition extends from slab to slab or deck above. Sound attenuation blankets to provide minimum STC rating of 45.

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- Tier 2 High Performance (★★): 3-5/8-inch (92mm) x min. 16 light gage metal framing @ 16-inch (406mm) o.c., 2 layers of 5/8-inch (16mm) gypsum board each side (max. deflection L/360), and 9 ga. wire mesh between studs and gypsum board on one side. Partition extends from slab to slab or deck above. Sound attenuation blankets to provide minimum STC rating of 50. SCIF level security.
- Tier 3 High Performance (★★★): Not used.

### 3.5.1.10 Masonry Partitions

Performance level does not take into account fire rating requirements. Concrete masonry units shall comply with ASTM C129, Standard Specification for Non-load bearing Concrete Masonry Units. Metal furring shall comply with ASTM C645, Standard Specification for Nonstructural Steel Framing Members. Gypsum board shall comply with C1396, Standard Specification for Gypsum Board. Gypsum board selection will vary depending on application: Type X gypsum board for fire rated assemblies, Type MR for locations subject to moisture or high humidity, Type IR where impact resistance is needed, or cementitious backer board in showers.

- Baseline: 6-inch (150mm) CMU, 1-5/8-inch (41mm) metal studs @ 16-inches (406mm) o.c. and 5/8-inch (16mm) gypsum board each side. Minimum STC rating of 50.
- Tier 1 High Performance (★): 8-inch (200mm) CMU with reinforcing and grout-filled cells. 1-5/8-inch (41mm) metal studs @ 16-inches (406mm) o.c. and 2 layers of high impact resistant 5/8-inch (16mm) gypsum board each side. 9 ga. wire mesh between studs and gypsum board on one side. Minimum STC rating of 70. SCIF level security.
- Tier 2 High Performance (★★): Not used.
- Tier 3 High Performance (★★★): Not used.

### 3.5.1.11 Demountable Partitions

Demountable partitions are prefabricated assemblies designed to be installed, removed, and relocated in various configurations. Partitions extend from finish floor to ceiling. Systems include doors, hardware, and borrowed lights. Demountable partitions do not have fire ratings.

- Baseline: Manufacturer's standard panel widths with prefinished metal panels. Minimum STC rating of 40.
- Tier 1 High Performance (★): Custom panel widths with gypsum board on exposed surfaces. Minimum STC rating of 45.
- Tier 2 High Performance (★★): Custom panel widths with gypsum board on exposed surfaces. Transoms and borrowed lights. Minimum STC rating of 45.
- Tier 3 High Performance (★★★): Custom panel widths with gypsum board on exposed surfaces. Transoms and borrowed lights. Minimum STC rating of 50.

### 3.5.1.12 Operable Walls

Operable walls described below are welded steel construction, hung from a supporting structure above, and move on a fixed track system. Accordion type room dividers are not considered here.

Operable walls do not provide fire ratings.

- Baseline: Single or hinged pairs of panels, steel or MDF/Vinyl finish, 3-inches (75mm) thick, manually operated. Minimum STC rating of 40.
- Tier 1 High Performance (★): Single or hinged pairs of panels, steel or MDF/vinyl, fabric or veneer finish, 3-inches (75mm) thick, manually operated. Minimum STC rating of 45.
- Tier 2 High Performance (★★): Continuously hinged panels, steel or MDF/vinyl, fabric,

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veneer, or marker board finish, 3-inches (75mm) thick, electrically operated. Gasketed at top, bottom, and panel joints. Minimum STC rating of 55.

- Tier 3 High Performance (★★★): Hinged pairs of panels, steel, MDF, or gypsum/vinyl, fabric, veneer or marker board finish, 4-inches (100mm) thick, manually operated. Gasketed at top, bottom, and panel joints. Minimum STC rating of 55.

### 3.5.1.13 Millwork and Cabinets

Millwork includes custom wood fabrications such as paneling, built-in furniture, shelving, and other items of architectural woodwork. Cabinets include base and wall cabinets. The descriptions below do not apply to metal cabinets or casework such as the type that might be found in laboratories. Quality descriptions for millwork and cabinets are based on the AWI's Architectural Woodwork Quality Standards. Quality standards for hardware such as drawer slides, hinges, pulls, latches and locks, and shelf supports are based on ANSI/BMHA 156.9, Cabinet Hardware.

- Baseline: AWI Custom Grade. Particle board core with plastic laminate veneer. Factory fabricated to standard sizes. Grade 2 hardware, plated finish.
- Tier 1 High Performance (★): AWI Custom Grade. Particle board core with wood veneer on exposed to view surfaces. Shop fabricated by millworker to custom sizes and configurations. Grade 1 hardware, plated finish.
- Tier 2 High Performance (★★): AWI Premium Grade. Particle board core with wood veneer on exposed to view surfaces. Shop fabricated by millworker to custom sizes and configurations. Grade 1 hardware, solid stainless, brass, or bronze.
- Tier 3 High Performance (★★★): AWI Premium Grade. Solid wood, custom detailed molding and

trim. Shop fabricated by millworker to custom sizes and configurations. Grade 1 hardware, solid stainless, brass, or bronze.

### 3.5.1.14 Countertops

Countertops, often associated with millwork and cabinets, include any fabricated work surface including those in offices, kitchens, laboratories or toilet rooms. Countertops include backsplashes and endsplashes. Quality descriptions are based on the AWI's Architectural Woodwork Quality Standards.

- Baseline: Particle board with plastic laminate top and edge. AWI Custom Grade.
- Tier 1 High Performance (★): Particle board with exterior glue and solid surface material top and edge. AWI Premium Grade.
- Tier 2 High Performance (★★): Exterior grade plywood with stone top and edge. AWI Premium Grade.
- Tier 3 High Performance (★★★): Exterior grade plywood with chemical resistant or stainless steel top and edge. AWI Premium Grade.

## 3.5.2 Interior Finishes and Materials

Finishes must meet requirements of the International Building Code. Other codes (Example: NFPA Fire Safety Codes) and application specific performance attributes (Examples: Severe traffic area; Raised access flooring) need to be taken into account. Finishes should incorporate recycled-content materials to the maximum extent where possible.

### 3.5.2.1 Broadloom Carpet

- Baseline: Texture appearance retention rating of 3 or higher (Heavy traffic). Type 6 or Type 6, 6, BCF Nylon. Green label certified cleaners applied. 10 year warranty. 10% Pre or Post

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Consumer Recycled Content. NSF 140 Gold Level Certified. Meets Green Label Plus certification and equivalent CHPS protocol.

- Tier 1 High Performance (★): Texture appearance retention rating of 3.5 or higher (Severe traffic). Type 6 or Type 6, 6, BCF Nylon. Green label certified cleaners applied. 10 year warranty. 10% Pre or Post Consumer Recycled Content. NSF 140 Gold Level Certified with take back program. Meets Green Label Plus certification and equivalent CHPS protocol.
- Tier 2 High Performance (★★): Texture appearance retention rating of 3.5 or higher (Severe traffic). Type 6 or Type 6, 6, BCF Nylon. Green label certified cleaners applied. 15 year warranty. 15% Pre or Post Consumer Recycled Content. NSF 140 Platinum Level Certified. Meets Green Label Plus certification and equivalent CHPS protocol.
- Tier 3 High Performance (★★★): Texture appearance retention rating of 3.5 or higher (Severe traffic). Type 6 or Type 6, 6, BCF Nylon or Bio Based Tile. Green label certified cleaners applied. 15 year warranty. 15% Pre or Post Consumer Recycled Content or 15% Bio Based Fiber. NSF 140 Platinum Level Certified with published Environmental Declaration. Meets Green Label Plus certification and equivalent CHPS protocol.

### 3.5.2.2 Vinyl Composition Tile

- Baseline: Standard VCT. Class I Solid Color, Class II Through Pattern, or Class III Surface Decorated. Thickness of 0.125" or greater. Static load limit greater than or equal to 125 psi. Factory finish applied. 5 year warranty. 0% recycled content. Is CA 1350 compliant.
- Tier 1 High Performance (★): Standard VCT. Class I Solid Color; Class II Through Pattern. Thickness of 0.125" or greater. Static load limit

greater than or equal to 125 psi. Specialty finish applied. 5 year warranty. 5% recycled content. Meets NSF, is CA 1350 compliant and Floor Score Certified.

- Tier 2 High Performance (★★): N/A
- Tier 3 High Performance (★★★): Premium Vinyl Tile. Class III 20 mil wear Layer or Class I Monolithic. Thickness of 0.100" or greater (Class III) or 0.125" or greater (Class I). Static load limit greater than or equal to 175 psi. Specialty finish applied. 5 year warranty. 5% recycled content. Meets Sustainability NSF 332, is CA 1350 compliant and Floor Score Certified.

### 3.5.2.3 Sheet Vinyl

- Baseline: Heterogeneous Type I (Clear Wear Layer 0.014 inches) Type II (Filled Wear Layer 0.030 inches). Static load limit greater than or equal to 125 psi. Factory surface applied. 5 year warranty. 0% recycled content and CA 1350 compliant.
- Tier 1 High Performance (★): Heterogeneous Type I (Clear Wear Layer 0.020 inches) Type II (Filled Wear Layer 0.050 inches). Static load limit greater than or equal to 175 psi. Specialty top coat applied. 5 year warranty. 5% recycled/renewable content, meets Sustainability NSF332 and is CA 1350 compliant.
- Tier 2 High Performance (★★): N/A
- Tier 3 High Performance (★★★): Homogeneous. Thickness of 0.075 or greater. Static load limit greater than or equal to 250 psi. Specialty top coat applied. 5 year warranty. 5% recycled/renewable content, meets Sustainability NSF332 and is CA 1350 and Floor Score compliant.

### 3.5.2.4 Rubber Tile

- Baseline: Class II Laminated A&B (A=Solid Color Wear Layer; B=Mottled Wear Layer). Thickness of 0.080" or greater. 5 year warranty. 0% recycled content and VOC emissions – CA 1350 compliant.
- Tier 1 High Performance (★): N/A
- Tier 2 High Performance (★★): N/A
- Tier 3 High Performance (★★★): Class I Homogenous A&B (A=Solid Color Wear Layer; B=Mottled Wear Layer). Thickness of 0.125" or greater. 5 year warranty. 10% recycled content, Floor Score Certified, meets Sustainability NSF332 and is VOC emission – CA 1350 compliant.

### 3.5.2.5 Linoleum

- Baseline: Thickness no less than 2.5mm. Static load limit greater than or equal to 150 psi. Factory surface applied. 2 year warranty. 10% recycled/renewable content. 30% minimum binder content. Is VOC emission – CA 1350 compliant.
- Tier 1 High Performance (★): N/A
- Tier 2 High Performance (★★): N/A
- Tier 3 High Performance (★★★): Thickness no less than 3.2mm. Static load limit greater than or equal to 400 psi. Low maintenance coating applied. 3 year warranty. 20% recycled/renewable content. 30% minimum binder content. Is VOC emission – CA 1350 compliant.

### 3.5.2.6 Pressed Floor Tile

- Baseline: Conforms to ANSI A137.1. Light commercial (Abrasion Class III). Stain and

chemical class reported. 1 year warranty. Green Squared Certified.

- Tier 1 High Performance (★): Conforms to ANSI A137.1. Commercial (Abrasion Class IV). Semi-virtuous (Class P3 maximum absorption). Breaking strength greater than or equal to 350 lbs. Stain and chemical Class B or better. 18 month warranty. Green Squared Certified.
- Tier 2 High Performance (★★): N/A
- Tier 3 High Performance (★★★): Conforms to ANSI A137.1. Commercial (Abrasion Class IV). Virtuous (Class P2 maximum absorption). Breaking strength greater than or equal to 400 lbs. Stain and chemical Class A. 2 year warranty. Green Squared Certified, Level 2 recycled/reclaimed content with publically available Environmental Product Data.

### 3.5.2.7 Porcelain Tile

- Baseline: Conforms to ANSI A137.1. Light commercial (Abrasion Class III). Stain and chemical class reported. 1 year warranty. Green Squared Certified.
- Tier 1 High Performance (★): Conforms to ANSI A137.1. Commercial (Abrasion Class IV). Virtuous (P3/E3/O3). Breaking strength greater than or equal to 350 lbs. Stain and chemical Class B or better. 18 month warranty. Green Squared Certified.
- Tier 2 High Performance (★★): Conforms to ANSI A137.1. Commercial (Abrasion Class IV). Virtuous (P2/E2/O2). Breaking strength greater than or equal to 400 lbs. Stain and chemical Class A. year warranty. Green Squared Certified, Level 2 recycled/reclaimed content and publically available Environmental Product Data.



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- Tier 3 High Performance (★★★): Conforms to ANSI A137.1. Heavy commercial (Abrasion Class V). Virtuous (P1/E1/O1). Breaking strength greater than or equal to 450 lbs. Stain and chemical Class A. 3 year warranty. Green Squared Certified, Level 3 recycled/reclaimed content, 3 Innovation Credits and publically available Environmental Product Data.

### 3.5.2.8 Quarry Tile

- Baseline: Conforms to ANSI A137.1. Light commercial (Abrasion Class III). Stain and chemical class reported. 1 year warranty. Green Squared Certified.
- Tier 1 High Performance (★): Conforms to ANSI A137.1. Commercial (Abrasion Class IV). Virtuous (Class E3). Breaking strength greater than or equal to 350 lbs. Stain and chemical Class B or better. 18 month warranty. Green Squared Certified.
- Tier 2 High Performance (★★): Conforms to ANSI A137.1. Commercial (Abrasion Class IV). Virtuous (Class E2). Breaking strength greater than or equal to 400 lbs. Stain and chemical Class A. 2 year warranty. Green Squared Certified, Level 2 recycled/reclaimed content and publically available Environmental Product Data.
- Tier 3 High Performance (★★★): Conforms to ANSI A137.1. Heavy commercial (Abrasion Class V). Virtuous (Class E1). Breaking strength greater than or equal to 450 lbs. Stain and chemical Class A. 3 year warranty. Green Squared Certified, Level 3 recycled/reclaimed content, 3 Innovation Credits and publically available Environmental Product Data.

### 3.5.2.9 Mosaic Tile

- Baseline: Conforms to ANSI A137.1. Light commercial (Abrasion Class III). Stain and

chemical class reported. 1 year warranty. Green Squared Certified.

- Tier 1 High Performance (★): Conforms to ANSI A137.1. Commercial (Abrasion Class IV). Virtuous (P3/E3/O3). Breaking strength greater than or equal to 350 lbs. Stain and chemical Class B or better. 18 month warranty. Green Squared Certified.
- Tier 2 High Performance (★★): Conforms to ANSI A137.1. Commercial (Abrasion Class IV). Virtuous (P2/E2/O2). Breaking strength greater than or equal to 400 lbs. Stain and chemical Class A. 2 year warranty. Green Squared Certified, Level 2 recycled/reclaimed content and publically available Environmental Product Data.
- Tier 3 High Performance (★★★): Conforms to ANSI A137.1. Heavy commercial (Abrasion Class V). Virtuous (P1/E1/O1). Breaking strength greater than or equal to 450 lbs. Stain and chemical Class A. 3 year warranty. Green Squared Certified, Level 3 recycled/reclaimed content, 3 Innovation Credits and publically available Environmental Product Data.

### 3.6.2.10 Limestone Tile

- Baseline: Abrasion resistance greater than or equal to 10. Maximum absorption of 7.5.
- Tier 1 High Performance (★): N/A
- Tier 2 High Performance (★★): N/A
- Tier 3 High Performance (★★★): Abrasion resistance greater than or equal to 15. Maximum absorption of 3.

### 3.5.2.11 Slate Tile

- Baseline: Abrasion resistance greater than or equal to 8. Maximum absorption of 0.45.

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- Tier 1 High Performance (★): N/A
- Tier 2 High Performance (★★): N/A
- Tier 3 High Performance (★★★): Abrasion resistance greater than or equal to 15. Maximum absorption of 0.25.
- Tier 2 High Performance (★★): N/A
- Tier 3 High Performance (★★★): Epoxy 1/4" or 3/8" thick with flexible membrane and vapor barrier. Hardness greater than or equal to 10. Local resources and recycled marble chips. No VOCs.

### 3.5.2.12 Marble

- Baseline: Abrasion resistance greater than or equal to 15. Maximum absorption of 0.20. Density greater than or equal to 144.
- Tier 1 High Performance (★): N/A
- Tier 2 High Performance (★★): N/A
- Tier 3 High Performance (★★★): Abrasion resistance greater than or equal to 10. Maximum absorption of 0.20. Density greater than or equal to 168.

### 3.5.2.13 Granite

- Baseline: Abrasion resistance greater than or equal to 25. Maximum absorption of 0.50.
- Tier 1 High Performance (★): N/A
- Tier 2 High Performance (★★): N/A
- Tier 3 High Performance (★★★): Abrasion resistance greater than or equal to 25. Maximum absorption of 0.40.

### 3.5.2.14 Terrazzo

- Baseline: Cementitious Polyacrylate 3/8" thick with anti-fracture membrane. Abrasion resistance no greater than 40% loss. Local resources and recycled marble chips. No VOCs.
- Tier 1 High Performance (★): N/A

### 3.2.5.15 Laminate Flooring

- Baseline: Classified as Commercial flooring. Wear resistance no less than 4,000 cycles using NEMA test 3.7- Taber model 5130 test or equivalent. Static load limit greater than or equal to 8 MPa. High wear resistant thermoset surface. 10 year warranty. California Air Resources Board (CARB) verified Phase 2 and VOC emissions – CA 1350 compliant with 50% recycled content.
- Tier 1 High Performance (★): N/A
- Tier 2 High Performance (★★): N/A
- Tier 3 High Performance (★★★): Classified as Heavy Commercial flooring. Wear resistance no less than 6,000 cycles using NEMA test 3.7- Taber model 5130 test or equivalent. Static load limit greater than or equal to 8 MPa. High wear resistant thermoset surface. 10 year warranty. California Air Resources Board (CARB) verified Phase 2 and VOC emissions – CA 1350 compliant with 60% recycled content.

### 3.2.5.16 Wood Flooring

- Baseline: Hardness rating between 380 and 950. Varnish top coat applied. Local resources.
- Tier 1 High Performance (★): Hardness rating between 950-1500. Varnish top coat applied. Local resources.
- Tier 2 High Performance (★★): Hardness rating between 1500-2600. Polyurethane top coat applied. Local resources.



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- Tier 3 High Performance (★★★): Hardness rating between 2600-3800. Polyurethane top coat applied. Local resources and recycled materials.

### 3.2.5.17 Bamboo Flooring

- Baseline: Hardness greater than or equal to 1300. Varnish top coat applied. Renewable and recycled materials. Low VOCs.
- Tier 1 High Performance (★): Hardness greater than or equal to 1400. Varnish top coat applied. Renewable and recycled materials. Low VOCs.
- Tier 2 High Performance (★★): Hardness greater than or equal to 1500. Polyurethane top coat applied. Renewable and recycled materials. Low VOCs.
- Tier 3 High Performance (★★★): Hardness greater than or equal to 1500. Polyurethane top coat applied. Renewable, recycled and local materials. Low VOCs.

### 3.2.5.18 Glazed Wall Tile

- Baseline: Conforms to ANSI A137.1. Absorption Class P4. Stain and chemical class reported. 1 year warranty. Green Squared Certified.
- Tier 1 High Performance (★): Conforms to ANSI A137.1. Absorption Class P4. Breaking strength greater than or equal to 175 lbs. Stain and chemical Class B or better. 18 month warranty. Green Squared Certified.
- Tier 2 High Performance (★★): Conforms to ANSI A137.1. Absorption Class P4. Breaking strength greater than or equal to 200 lbs. Stain and chemical Class A. 2 year warranty. Green Squared Certified, Level 2 recycled/reclaimed

content and publically available Environmental Product Data.

- Tier 3 High Performance (★★★): Conforms to ANSI A137.1. Heavy commercial (Abrasion Class V). Virtuous (P1/E1/O1). Breaking strength greater than or equal to 450 lbs. Stain and chemical Class A. 3 year warranty. Green Squared Certified, Level 3 recycled/reclaimed content, 3 Innovation Credits and publically available Environmental Product Data.

### 3.2.5.19 Paint

Low VOC information: Limits are expressed as VOC Regulatory (except as noted), thinned to the manufacturer's maximum thinning recommendation, excluding any colorant added to tint bases. Table 1 architectural coating regulatory category and VOC content compliance determination shall conform to the CARB 2007 AIM SCM - [http://www.arb.ca.gov/coatings/arch/Approved\\_2007\\_SCM.pdf](http://www.arb.ca.gov/coatings/arch/Approved_2007_SCM.pdf). \* Effective January 1, 2014: All interior flat, non-flat, and high gloss coatings containing colorants must meet the VOC limits indicated within the CARB 2007 AIM SCM, after colorant has been added.

- Baseline: Burnish resistant qualities. Conforms to the CARB 2007 AIM SCM.
- Tier 1 High Performance (★): Burnish and stain resistant qualities. Conforms to the CARB 2007 AIM SCM.
- Tier 2 High Performance (★★): N/A
- Tier 3 High Performance (★★★): Burnish and stain resistant qualities. Highly scrubbable. Gloss finish. Low VOCs.

### 3.2.5.20 Wall Covering

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- Baseline: Type II wall covering compliant with W-101 (2011). Scrubbability no less than 300 cycles per minute. Washability no less than 100 cycles per minute. NSF 342 Conformant Level. VOC emissions – CA 1350 compliant with 5% recycled post consumer content or 10% pre-consumer content.
- Tier 1 High Performance (★): Type II wall covering compliant with W-101 (2011). Scrubbability no less than 300 cycles per minute. Washability no less than 100 cycles per minute. NSF 342 Silver Level. VOC emissions – CA 1350 compliant with 5% recycled post consumer content or 10% pre-consumer content.
- Tier 2 High Performance (★★): Type II wall covering compliant with W-101 (2011). Scrubbability no less than 300 cycles per minute. Washability no less than 100 cycles per minute. NSF 342 Gold Level. VOC emissions – CA 1350 compliant with 5% recycled post consumer content or 10% pre-consumer content.
- Tier 3 High Performance (★★★): Type II wall covering compliant with W-101 (2011). Scrubbability no less than 300 cycles per minute. Washability no less than 100 cycles per minute. NSF 342 Platinum Level. VOC emissions – CA 1350 compliant with 5% recycled post consumer content or 10% pre-consumer content.

### 3.2.5.21 Wall Paneling - Plastic/Laminate

- Baseline: Type - Standard laminate. Abrasion resistance greater than or equal to 400. Cleanability no greater than 20 cycles. 1 year warranty. 40% recycled material.
- Tier 1 High Performance (★): Type – High pressure laminate. Abrasion resistance greater than or equal to 420. Cleanability no greater than 18 cycles. 2 year warranty. 50% recycled material.

- Tier 2 High Performance (★★): Type – Fiber reinforced laminate. Abrasion resistance greater than or equal to 440. Cleanability no greater than 14 cycles. 5 year warranty. 60% recycled material.
- Tier 3 High Performance (★★★): Type – Fiberglass reinforced laminate. Abrasion resistance greater than or equal to 460. Cleanability no greater than 10 cycles. 10 year warranty. 60% recycled material.

### 3.2.5.22 Wall Paneling - Wood

- Baseline: Hardness rating between 380 and 950. Varnish top coat applied. Local resources.
- Tier 1 High Performance (★): Hardness rating between 950-1500. Varnish top coat applied. Local resources.
- Tier 2 High Performance (★★): Hardness rating between 1500-2600. Polyurethane top coat applied. Local resources.
- Tier 3 High Performance (★★★): Hardness rating between 2600-3800. Polyurethane top coat applied. Local resources and recycled materials.

### 3.2.5.23 Wall Paneling – Composite Board

- Baseline: Minimum thickness of 6mm. Factory sealant applied. Low VOC/Low VOC installation. 40% recycled material.
- Tier 1 High Performance (★): Minimum thickness of 10mm. Factory sealant applied. Low VOC/Low VOC installation. 50% recycled material.
- Tier 2 High Performance (★★): Minimum thickness of 20mm. Factory sealant applied. Low VOC/Low VOC installation. 60% recycled material.

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- Tier 3 High Performance (★★★): Minimum thickness of 30mm. Factory sealant applied. Low VOC/Low VOC installation. 90% recycled material.

### 3.2.5.24 Wall Paneling – Sculptural Panel

- Baseline: Minimum thickness of 2mm. 900 psi. Low VOC/Low VOC installation. 20% recycled material.
- Tier 1 High Performance (★): Minimum thickness of 6mm. Factory sealant applied. Low VOC/Low VOC installation. 30% recycled material.
- Tier 2 High Performance (★★): Minimum thickness of 10mm. Factory sealant applied. Low VOC/Low VOC installation. 40% recycled material.
- Tier 3 High Performance (★★★): Minimum thickness of 14mm. Factory sealant applied. Low VOC/Low VOC installation. 50% recycled material.

### 3.2.5.25 Wall Base

- Baseline: Thermoplastic vinyl (Type TV) w/ layered construction (Group II). 1 year warranty. Low VOC/Conforms to NSF 332.
- Tier 1 High Performance (★): Thermoplastic rubber (Type TPR) w/ layered construction or solid (homogeneous) construction (Group I or II). 1 year warranty. Low VOC/Conforms to NSF 332.
- Tier 2 High Performance (★★): N/A
- Tier 3 High Performance (★★★): Vulcanized thermoplastic rubber (Type TS) w/ solid (homogeneous) construction (Group I). 1 year warranty. Low VOC/Conforms to NSF 332.

### 3.2.5.26 Ceilings

- Baseline: Directional or non-directional fissured texture. Acoustical qualities as follows: Open Plan NRC  $\geq 0.80$ ; Open Plan CAC = N/A; Closed Plan NRC  $\geq 0.70$ ; Closed Plan =  $\geq 30$

1 year warranty. Recycled content greater than or equal to 20%. Recyclable in a closed loop process. Light reflectance no less than 80%. CHPS compliant with Environmental Product Data available.

- Tier 1 High Performance (★): Fine texture with perforations. Acoustical qualities as follows: Open Plan NRC  $\geq 0.80$ ; Open Plan CAC = N/A; Closed Plan NRC  $\geq 0.55$ ; Closed Plan =  $\geq 35$

Sag resistant with 5 year systems warranty. Recycled content greater than or equal to 30%. Recyclable in a closed loop process. Light reflectance no less than 85%. CHPS compliant with Environmental Product Data available.

- Tier 2 High Performance (★★): Fine texture. Acoustical qualities as follows: Open Plan NRC  $\geq 0.90$ ; Open Plan CAC = N/A; Closed Plan NRC  $\geq 0.60$ ; Closed Plan =  $\geq 35$

Sag, impact and scratch resistant with 10 year systems warranty. Recycled content greater than or equal to 40%. Recyclable in a closed loop process. Light reflectance no less than 85%. CHPS compliant with Environmental Product Data available.

- Tier 3 High Performance (★★★): Fine texture. Acoustical qualities as follows: Open Plan NRC  $\geq 0.95$ ; Open Plan CAC = N/A; Closed Plan NRC  $\geq 0.70$ ; Closed Plan =  $\geq 35$

Sag, impact and scratch resistant with washable and scrubbable surface. 20 year systems warranty. Recycled content greater than or equal to 50%. Recyclable in a closed loop process. Light reflectance no less than 85%. CHPS compliant with Environmental Product Data available.

## 3.6 Interior Construction and Interior Finishes

### Prescriptive Requirements

#### 3.6.1 Workspace Requirements Development

GSA's pricing policy mandates developing a "comprehensive, professional requirements package for all projects including new expansion or replacement' office space." Part of GSA's pre-design project planning includes developing customer requirements, an in-depth analysis of the customer's workspace requirements referred to as the RD process. The process uses analytical tools, methods, and technology to structure input from a broad range of client staff, and integrates experienced insights and recommendations concerning the following:

- Formal and informal amenities for collaborative spaces.
- Space adjacencies, types, and sizes necessary to support the tenant's mission.
- Analysis and documentation of clients work patterns and styles.
- Flexibility to adapt to future change
- Mobility of workforce and accommodating technology

For quality assurance purposes, the workplace consultant must meet the designers-of-record and inform them on the findings to ensure the client's requirements are translated into the design. A/E must be invited to participate in client meetings during the RD process. Similarly, the workplace consultant must have the opportunity to review and comment throughout the development of Design Intent Drawings (DIDs). This feedback must be reflected in the final construction documents.

#### 3.6.2 Tenant Spaces

When designing and planning the tenant space, the following factors should be established as the primary criteria for calculating the total space needed:

- Ratio of open to enclosed space, based on percentages of employee population.
- Average size of open workstations (36-64 SF is recommended)
- Average size of enclosed offices (100-150 is recommended)
- Percentage of collaborative space, both informal and formal
- Percentage of workforce with job mobility for desk-sharing potential

Additionally, design goals should include:

- Maximize natural light in open spaces and avoid placing enclosed rooms along the windows.
- Provide adequate speech privacy and consider sound masking if necessary to ensure appropriate acoustics.
- Circulation patterns should be clearly recognizable and wayfinding must be user friendly. Proceeding through the office should be pleasant and intuitive for the users, encouraging informal communication. See Circulation Guide.
- Provide and minimize centrally located resource centers for files, supplies, and equipment.
- Provide adequate space for the recycling program within café area.
- Choose workplace components and furnishings that occupants can easily move themselves and reconfigure to accommodate change, without skilled labor or technical contract support.

### 3.6.2.3 Acoustics

The standards in this section establish adequate acoustic qualities in Federal buildings. Post-construction commissioning will confirm that the acoustical standards have been met.

## 3.6.3 General Criteria for Building Spaces

Four key concepts govern the quality of office acoustics. See Table 3-2 for design criteria.

- 1 **Speech Privacy:** The degree to which a conversation cannot be overheard in an adjacent space.
- 2 **Background Sound:** Continuous background sound may have to be supplemented with additional electronically generated sound to provide for masking of speech while private conversation is being conducted. The A/E will differentiate between enclosed and open office environments to meet these objectives.
- 3 **Equipment Vibration and Reverberation:** Office equipment noise levels must meet the standards at the workstations. Reverberation and echoes must be controlled in courtrooms, auditoriums, and conference, team, and training room spaces that may require professional acoustical engineers to meet the standards. Sound transmission through building frames must be inhibited.
- 4 **Exterior Noise:** Facilities located near airports, highways, rail corridors, or other sources of significant environmental noise levels must have building envelope assemblies controlling noise intrusions to the required standards.

### 3.6.3.1 Closed Offices versus Open Plan

For work that does not require acoustic and/or visual privacy, an open plan environment with low or no partitions between workstations is permitted. For work that requires a balance between ongoing, active collaboration, easy workgroup reconfiguration,

flexible settings, and minimized unwanted acoustic distraction, an open plan setting with a well-engineered acoustical design is recommended.

Key components of such engineered open plan designs are highly absorptive ceilings, suitable height partition panels that both absorb and block sound, suitable levels of background sound (typically provided by electronic sound masking systems), and ready access to acoustically private (closed-office) meeting spaces.

Closed offices must be provided for workers who routinely require extended periods of concentration, in-office meetings, and/or confidential conversation. Meeting spaces and closed offices that require speech security must be designed in conjunction with a qualified acoustical consultant.

In enclosed offices, HVAC background sound may be an important component in achieving the required level of privacy because it helps to cover up or "mask" speech transmitted between adjacent spaces. In open plan areas, the background sound provided by contemporary HVAC equipment is often not uniform and/or does not have the tonal balance and loudness needed to mask speech transmitted between adjacent cubicles. For this reason, additional electronic background noise or sound masking is often deployed in these areas.

### 3.6.3.2 Mechanical and Plumbing Noise

All mechanical equipment must be vibration isolated from the building frame as required by Chapter 5. Ambient noise from mechanical equipment must not exceed noise criteria (NC) values described in the acoustical section of this chapter. Diffusers with an NC rating 5 points less than the noise criterion for the space being served must be used where occupied space occurs adjacent to, above, or below mechanical or electrical equipment or machine rooms, or adjacent to HVAC or elevator shafts. The intervening structure (partitions, shaft walls, doors, floor and ceiling assemblies, etc.) must be sufficient to control noise intrusion to no greater than the maximum NC

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or room criteria (RC) values. Where an elevator shaft or equipment room occurs adjacent to noise-sensitive spaces (NC/RC 35 or lower), the maximum intrusion level of elevator noise must be limited to 5 dB below the maximum NC/RC for the space in all octave bands. In the walls, ceilings, and floors enclosing noise-sensitive spaces (Table 3-2, column 1, RC/NC 35 or less), all water, wastewater, and drain piping must be vibration-isolated from the structure, finishes, and other piping. Install R-11 batt insulation in all wall spaces where such piping is located and install the piping at least 200 mm (1 in.) away from the gypsum wall board.

### 3.6.3.3 Noise Isolation, Room Acoustics, and Speech Privacy

Absorptive materials are required in speech-sensitive spaces to control reverberation and echoes. Table 3-2, columns 2 and 3, lists spaces that require absorptive finishes. The first number in each column refers to the minimum level of the material's performance; the second refers to the minimum percentage of the ceiling or wall that must have finishes achieving this performance.

Floor and ceiling assemblies separating office spaces must achieve an NIC of not less than 50 (when furnished) and Field Impact Isolation Class (FIIC) of not less than 50. Table 3-2, column 4, lists the minimum noise isolation (NIC) for spaces requiring acoustically rated walls.

For constructions on suitable slab floors, when properly detailed and constructed, and with all connections caulked airtight with acoustical sealant, the following wall assemblies typically will satisfy the minimum specified NIC requirements, with the spaces furnished typically. These wall examples are not the only constructions that will satisfy the performance criteria; they are intended solely to provide guidance on projects that do not require a qualified acoustical consultant during the design phase.

- NIC 53 (teleconference room): Double stud wall, two layers of gypsum board each side, batt insulation in the stud cavities. Full height (slab to slab).
- NIC 48 (meeting rooms, training facilities): Staggered stud wall, two layers of gypsum board each side, batt insulation in the stud cavity. Full height (slab to slab).
- NIC 45 (private offices, confidential speech privacy): Single stud wall, two layers of gypsum board each side, batt insulation in the stud cavity. Full height (slab to slab) or 6 inches above a hung gypsum board ceiling.
- NIC 40 (private offices, normal speech privacy): Single stud wall, two layers of gypsum board one side, one layer of gypsum board the other side, batt insulation in stud cavity. Slab to slab (preferred); minimum 6 inches above acoustical tile ceiling (minimum CAC 44).
- NIC 35 (private offices, normal speech privacy, sound masking): Single stud wall, single layer gypsum board each side, batt insulation in stud cavity. Minimum 6 inches above acoustical tile ceiling (minimum CAC 44).
- NIC 31 (private offices, normal speech privacy, low voice level, miscellaneous other spaces): Single stud wall, single layer of gypsum board each side, batt insulation in the stud cavity. Terminates at underside of acoustical tile ceiling (minimum CAC 35).

Acoustical performance will be verified during the commissioning of the building. The commission requirements are further defined in the GSA Building Commissioning Guide.

### 3.6.3.4 Parameters Used in Acoustical Design

The following parameters are used to specify acoustical standards for GSA buildings:

- Background noise The loudness of noise is quantified by NC, balanced NC-B, and RC contours.

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- Environmental noise The continuous noise outside a building. The day-night average noise level (DNL) is a descriptor established by the U.S. Environmental Protection Agency to describe the average day-night sound level. Lower values are quieter.
- Noise isolation The amount of noise transmitted through the perimeter boundary elements of a space. Sound transmission class (STC) quantifies the sound insulating performance of building elements such as walls, windows, and doors when tested in a laboratory in accordance with ASTM E90. NIC quantifies the field-tested sound isolation between two enclosed spaces separated by a partition when tested in accordance with ASTM E336. FIIC quantifies the field-tested impact sound insulating properties of a floor/ceiling assembly when tested in accordance with ASTM E1007.
- Reverberation time The time required for sound to decay 60 decibels in the 500 Hz band in an enclosed space. Reverberation time becomes longer as the sound absorption is reduced and/or the room volume increases.
- Sound absorption The amount of sound absorbed by a surface finish. Sound absorption average (SAA) quantifies the efficiency of a material in absorbing sound energy when tested in accordance with ASTM C423.

**Table: Acoustics**

Space	1 Maximum Mechanical Noise (RC/NC)	2 Minimum Absorption: Ceiling (SAA/NRC)	3 Minimum Absorption: Wall (SAA/NRC) <sup>1</sup>	4 Minimum Noise Isolation (NIC)	5 Optimum Reverberation (RT60)
Teleconference Facility	20	0.8/ 50%	0.8/ 25%	53	0.5
Meeting rooms, Training facilities	25	0.8/ 50%	0.8/ 25%	48 <sup>2</sup>	0.6
Private offices, confidential speech privacy	30	n/a	0.8/ 25%	45	n/a
Private offices, normal speech privacy	35	n/a	0.8/ 25%	40	n/a
Plan offices, normal speech privacy, sound masking	35 <sup>3</sup>	n/a	0.8/ 25%	35	n/a
Private offices, normal speech, low voice level	35	n/a	0.8/ 25%	31	n/a
Open Plan offices, normal speech privacy, sound masking	40 <sup>4</sup>	0.9/ 100%	0.8/ 25%	n/a	n/a
Open Plan offices, No speech privacy	40	0.8/ 100%	n/a	n/a	n/a
Child care center	35	0.8/ 80%	0.8/ 25%	31	0.5

<sup>1</sup> Absorption should be placed on two adjacent walls.

<sup>2</sup> Operable walls and partitions must achieve the required NIC rating for the spaces that they are separating.

<sup>3</sup> Steady state background noise provided by electronic sound masking system: 40-42dBA.

<sup>4</sup> Steady state background noise provided by electronic sound masking system: 45-48dBA.



### 3.6.3.5 Fire Performance and Smoke Development

Interior wall and ceiling finish materials shall comply with the applicable requirements in the International Building Code (IBC) for fire performance and smoke development (i.e., flame spread index and smoke developed index). The allowable fire performance and smoke development of interior wall and ceiling finish materials are based on occupancy classification. Typically, interior wall or ceiling finishes are classified as either Class A (i.e., flame spread index 0-25; smoke developed index 0-450), Class B (i.e., flame spread index 26-75; smoke developed index 0-450), or Class C (i.e., flame spread index 76-200; smoke developed index 0-450) based on test results from ASTM E84 or ANSI/UL 723. Wherever the use of Class C interior wall and ceiling finish is required, Class A or Class B shall be permitted. Wherever the use of Class B interior wall and ceiling finish is required, Class A shall be permitted.

Interior floor finish and floor covering materials must meet the applicable fire performance floor finish and floor covering material requirements in the IBC. Typically, interior floor finishes are classified as either Class I having a critical radiant flux of not less than  $0.45 \text{ W/cm}^2$  or Class II having a critical radiant flux of no less than  $0.22 \text{ W/cm}^2$  but less than  $0.45 \text{ W/cm}^2$  based on test results from NFPA 253 or ASTM E 648. Wherever the use of Class II interior floor finish is required, Class I interior floor finish shall be permitted.

Carpet and carpet like interior floor finishes shall comply with ASTM D 2859 or DOC FF-1 "pill test" (CPSC 16 CFR Part 1630).

Decorative materials and trim shall comply with the applicable requirements in the IBC. Decorative materials are considered materials applied over the

building interior finish for decorative, acoustical or other effect (such as curtains, draperies, fabrics, streamers and surface coverings), and all other materials utilized for decorative effect (such as batting, cloth, cotton, hay, stalks, straw, vines, leaves, trees, moss and similar items), including foam plastics and materials containing foam plastics. Decorative materials do not include floor coverings, ordinary window shades, interior finish and materials 0.025 inch (0.64 mm) or less in thickness applied directly to and adhering tightly to a substrate. Typically, decorative materials suspended from walls or ceilings shall meet the flame propagation performance criteria of NFPA 701 or be noncombustible.

Combustible materials installed on or embedded in floors of buildings of Type I or Type II construction shall comply with the applicable interior finish requirements in the IBC.

### 3.6.3.6 Cornerstone

A cornerstone is required for all new buildings as a part of the exterior wall. The cornerstone must be a cut stone block having a smooth face of size adequate to present the following incised letters: UNITED STATES OF AMERICA, (PRESIDENT'S NAME), PRESIDENT, GENERAL SERVICES ADMINISTRATION, (YEAR OF PROJECT COMPLETION). Only the name of the President is allowed on the cornerstone. The words UNITED STATES OF AMERICA should be in letters 50 mm (2 in.) high and other letters should be proportionally sized by rank.

The name should be the President in office at the time construction funds were appropriated, if construction is completed during a subsequent President's term of office.

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4.1 Structural Performance Requirements										
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Reference Standard	Design	Construction
					Measurement & Verification	Plans & Specs	Calculations & Analysis		Basis of Design	Verification
<b>Live Load</b>										
Vibrations	Limited Vibration Control	Enhanced Vibration Control for Still Environments	Enhanced Vibration Control for Laboratories and Sensitive Equipment	N/A	Y	Y	Design Team should provide calculations showing requirements are met. Calculations required at all performance levels.	AISC Design Guide Series 11, Floor Vibrations Due to Human Activity	Describe design narrative for how the floor structure design addresses the effects of vibration.	N/A
<b>Wind</b>										
Structure	15% in 50 Yr Exceedance	7% in 50 Yr Exceedance	3% in 50 Yr Exceedance	N/A	Y	Y	Design Team should provide calculations showing requirements are met. Calculations required at all performance levels.	ASCE 7-10	Describe wind resistance design assumptions.	N/A
<b>Seismic</b>										
Structure	Life Safety	Immediate Occupancy	Operational Performance	N/A	N/A	Y	Design Team should provide calculations showing requirements are met. Calculations required at all performance levels.	ASCE 41-06	Describe seismic resistance design assumptions.	The design review should include: Review of any site-specific seismic criteria employed in the analysis including the development of site-specific spectra and ground motion time histories. Review of acceptance criteria used to demonstrate the adequacy of structural elements and systems to withstand the calculated force and deformation demands, together with that laboratory and other data used to substantiate these criteria. Review of the preliminary design including the selection of structural system and the configuration of structural elements. Review of the final design of the entire structural system and all supporting analyses.
Nonstructural	Life Safety	Immediate Occupancy	Operational Performance	N/A	N/A	Y	Design Team should provide calculations showing requirements are met. Calculations required at all performance levels.	ASCE 41-06	N/A	N/A
<b>Flood</b>										
Flood Mitigation	100-Year Flood Hazard	500-Year Flood Hazard	Determined on a Site Specific Basis	N/A	N/A	Y	Design Team must provide calculations showing requirements are met. Calculations required at all performance levels.	FEMA Flood Maps ASCE 24-05, "Flood Resistant Design and Construction"	Describe how structural design is responsive to the flood level performance metric.	N/A

## 4.2 Structural Performance Attributes

### 4.2.1 Live Load

#### 4.2.1.1 Vibrations

This attribute relates to the design of floor systems for occupant comfort relating to walking induced vibrations. AISC Design Guide 11 “Floor Vibrations Due to Human Activity” is the primary reference for this attribute. Design should consider proposed use of building and possible future uses.

- **Baseline:** The floors will be designed for “Office” acceleration limits per AISC Design Guide 11.
- **Tier 1 High Performance (★):** This performance level is intended for areas that require still environments such as the bench in a courtroom. The floors will be designed for acceleration limits that are between the “Office” level and the ISO baseline level per AISC Design Guide 11.
- **Tier 2 High Performance (★★):** This performance level is intended for areas that contain sensitive equipment such as laboratories. Design for the specific equipment type expected per AISC Design Guide 11 Chapter 6.

### 4.2.2 Natural Hazard

#### 4.2.2.1 Wind Resistance of Structure Lateral Force Resisting System

This attribute relates to building structure to resist wind loading. See the enclosure attributes for performance attributes related to the wind performance of the cladding and roof components. The primary reference for this attribute is ASCE 7-10. The higher performance levels correspond to designing the structure for higher velocity basic wind speeds associated with a less frequent wind event

(expressed as probability of exceedance in a 50 year period). It is not permitted to design the building for wind speeds below the applicable building code specified minimum. Wind speeds are dependent on region and other factors specified in ASCE 7-10. Wind tunnel testing may be used during the design phase to determine loads on building structure more precisely than ASCE 7-10. A rigid model test can be used to determine pressures applied to the building. An aero-elastic model test can be used to evaluate the dynamic response of the building due to wind loading.

- **Baseline:** Design structure for a wind speed with a 15% probability of exceedance in 50 years or the minimum wind speed required by code.
- **Tier 1 High Performance (★):** Design structure for a wind speed with a 7% probability of exceedance in 50 years or the minimum wind speed required by code.
- **Tier 2 High Performance (★★):** Design structure for a wind speed with a 3% probability of exceedance in 50 years or the minimum wind speed required by code.

#### 4.2.2.2 Seismic Resistance of Structure Lateral Force Resisting System

This attribute relates to the performance of the structural system in response to a design basis earthquake with a 10% probability exceedance in 50 years (500-year return period). Higher performance levels are expressed as lower inter-story drifts and damage during the seismic event. The primary reference is ASCE 41 “Seismic Rehabilitation of Existing Buildings”. The guidelines from ASCE 41 are intended to be applied to new buildings as well to

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existing buildings to achieve higher performance levels. It is not permitted to design the building for seismic performance below the minimum level specified by IBC and ICSSC RP 8 (NISTIR 6762).

- Baseline: Life Safety - Design structure for a “Life Safety” level of performance per ASCE 41. Structure will suffer moderate damage that requires repair before it is operational.
- Tier 1 High Performance (★): Immediate Occupancy - Design structure for an “Immediate Occupancy” level of performance per ASCE 41. Structure will suffer light damage and can be made operational with minimal downtime. Designers should consider the use of advanced seismic response modification technologies such as base isolation or dampers at this performance level.
- Tier 2 High Performance (★★): Continued Operations - Design structure for an “Operational” level of performance per ASCE 41. Structure will suffer very light damage and will remain operational during and after the seismic event. Designers should consider the use of advanced seismic response modification technologies such as base isolation or dampers at this performance level.

### 4.2.2.3 Seismic Resistance of Non-Structural Components

This attribute relates to the performance of the non-structural components in response to a design basis earthquake with a 10% probability exceedance in 50 years (500-year return period). Higher performance levels are expressed as lower damage states and recovery costs after the seismic event. The primary reference is ASCE 41 “Seismic Rehabilitation of Existing Buildings”. The guidelines from ASCE 41 are intended to be applied to new buildings as well as existing buildings to achieve higher performance levels. It is not permitted to design the building for seismic performance below the minimum level specified by the applicable building code.

- Baseline: Heavy Damage - Moderate Damage - Design structure for a “Life Safety” level of performance per ASCE 41. Non-structural components will suffer moderate damage during the seismic event.
- Tier 1 High Performance (★): Limited Damage - Design structure for an “Immediate Occupancy” level of performance per ASCE 41. Non-structural components will suffer limited damage during the seismic event.
- Tier 2 High Performance (★★): Minimal Damage - Design structure for an “Operational” level of performance per ASCE 41. Non-structural components will remain operational during the seismic event with minor damage that does not impact the function of the building.

### 4.2.2.4 Flood Mitigation

Floodplain management must be accounted for when formulating or evaluating any land use plans and should be correlated with the degree of hazard. Proposed buildings and structures within a flood hazard area shall be programmed and designed in accordance ASCE 24, "Flood Resistant Design and Construction" provisions. Structural system damage and continuity of operations are the metrics of performance for this attribute.

- Baseline: Buildings should be located outside of 100-year floodplain. If this is unavoidable, the structure system shall be designed to accommodate a 100-year design flood demand as a Baseline requirement. Critical action facilities cannot be located in either a 100-year or 500-year floodplain unless there is no practicable alternative. If critical action structures must be located within a floodplain they shall be elevated above the 500-year base flood as Baseline. Structure below the design flood elevation shall be designed in accordance with ASCE 24 provisions.

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- Tier 1 High Performance (★): This designation addresses a perceived increased level of flood risk and decreased allowable impact compared to Baseline. The building structural system shall be designed for higher performance and increased resiliency in resisting flood conditions associated with a 500-year flood event. The structure shall be designed for loads from the 500- year floor event. This performance level anticipates cleanup, drying and minor building repairs following a 500-year flood event.
- Tier 2 High Performance (★★): This performance level is governed by criteria specified for building structure resistance to flood demands. Risks associated with man-made flood hazards (dam, levee, and floodwall failure hazards) should be considered as a separate item where applicable under a site specific assessment and where high performance is desired.

## 4.3 Prescriptive Structural Requirements

### 4.3.1 Innovative Materials and Methods

The use of special construction, innovative methods and the installation of any material is permitted when necessary, advantageous, and economical. However, specifying new or untried materials or methods of construction should be avoided until the merits of the methods or materials have been established. When the merits are established, new, unusual, or innovative materials, systems, or methods may be incorporated into designs when evidence shows that such use is in the best interest of the Government from the standpoint of economy, lower life-cycle costs, and quality of construction. When new and innovative methods and materials are proposed for a specific building a peer review panel, determined by GSA, must evaluate the adequacy of the methods, systems, and materials proposed by the engineer. The evaluation will be based on the best interest of the Government from the standpoint of economy, lower life-cycle costs, and quality of construction.

### 4.3.2 IBC for Structural Design of New Buildings

The structural design (including wind, snow, and earthquake) of new buildings, structures, and portions thereof must be in full compliance with the latest edition of the IBC. Unless otherwise specified, all new buildings must be assigned a Risk Category II according to Chapter 16 of the IBC.

### 4.3.3 ISC Security Standards

The Interagency Security Committee (ISC) Physical Security Criteria for Federal Facilities applies to new construction of Federal office buildings and courthouses. Where prudent and appropriate the

criteria apply to major modernization projects. Also see Physical Security Performance Requirements.

### 4.3.4 Design Methods

If Load and Resistance Factor Design (LRFD) method is used, the design narrative must specifically address floor vibration.

### 4.3.5 Structural Loads

Design loads shall be in accordance with International Building Code (IBC) except as noted:

Since locations of corridors are not always known until after the completion of construction documents and are subject to change over time, use a uniform live load of 100 pounds per square foot (psf) over the entire floor for all elevated slabs unless the tabulated uniform live load required by the International Building Code is higher than 100 psf. This load includes 15 pounds per square foot of partitions, but excludes heavy loads like the planned use of space saver file systems.

Do not use live load reductions for (1) horizontal framing members, (2) transfer girders supporting columns, and (3) columns or walls supporting the roofs where mechanical equipment can be located. Live load reductions shall be considered in the design of foundation members regardless of the restrictions placed on individual members.

Plazas: For building having plaza area where there is possibility of large trucks or vans entering and parking, the design loads for the trucks and vans shall be provided for design of the plaza.

### 4.3.6 Structural Systems and Elements

Precast floor framing systems should be used only for Federal office buildings when the design can be demonstrated to adapt well to future changes in locations of heavy partitions or equipment. Precast systems may be considered for low-rise structures such as parking garages, industrial building, and storage and maintenance facilities. Precast shall not be used as part of the structural framing to prevent progressive collapse

Pre-tensioning and post-tensioning systems are not allowed.

Exception: Pre-tensioned or post-tensioned systems, bonded or unbonded, for parking structures that are separate from the occupied building is allowed.

Footings and permanent support structures, such as tiebacks, must not project beyond property lines.

### 4.3.7 Alterations in Existing Buildings and Historic Structures

Alteration requires ingenuity and imagination. It is inherently unsuited to rigid sets of rules, since each case is unique. It is recognized that total compliance with standards may not be possible in every case. Where serious difficulties arise, creative solutions that achieve the intent of the standard are encouraged.

### 4.3.8 Seismic Upgrading

Historic buildings should meet the same life safety objectives as other buildings while preserving historic spaces and features to the greatest extent possible. Any decision made to preserve essential historic features must not result in a lesser seismic performance than that required by “Standards of Seismic Safety for Existing Federally Owned and Leased Buildings” ICSSC Recommended Practice 8 (RP8).

Where deficiencies in the attachment of elements of structures, nonstructural components, and equipment pose a life safety risk, they must be prioritized and those elements with the greatest life safety risk strengthened first to meet current standards.

### 4.3.9 Seismic Instrumentation

New and existing Seismic Design Category D,E, and F buildings over six stories in height with an aggregate floor area of 5,574 m<sup>2</sup> (60,000 ft<sup>2</sup>) or more, and every Seismic Design Category D,E, and F building over 10 stories in height regardless of floor area, must be provided with U.S. Geological Survey (USGS) approved recording accelerographs. The Seismic instrumentation of Buildings (with Emphasis on Federal Buildings), Special GSA/USGC project, USGS Project No 0-7460-68170 ([http://nsmp.wr.usgs.gov/celebi/gsa\\_report\\_instrumentation.pdf](http://nsmp.wr.usgs.gov/celebi/gsa_report_instrumentation.pdf)) should be used.

## 4.4 Physical Security Performance Attributes

4.4 Physical Security Performance Requirements										
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Reference Standard	Design Basis of Design	Construction Verification
					Measurement & Verification	Plans & Specs	Calculations & Analysis			
Physical Security Performance	ISC Level I or II - minimum or low level of protection	ISC Level III - medium level of protection	ISC Level IV - high level of protection	ISC Level V - very high level of protection	N/A	N/A	Design Team must provide calculations showing requirements are met. Calculations required at Tier 1 High Performance and above.	Interagency Security Criteria	ISC Physical Security Criteria and the Building Specific Risk assessment. Describe ISC Level used in design and how the criteria and risk assessment were met. See the Prescriptive Physical Security requirements section for further information	N/A



## 4.5 Physical Security Performance Attributes

The following physical security performance levels reference the Interagency Security Committee (ISC) “Physical Security Criteria for Federal Facilities”. Other reference documents include the ISC “Facility Security Level Determinations for Federal Facilities”, the ISC “The Design-Basis Threat” report, and the General Services Administration Facility Security Requirements for Explosive Devices Applicable to Facility Security Levels III and IV, GSA’s Interpretation of the Interagency Security Committee (ISC) Physical Security Criteria, August 2, 2011. Each of these documents is For Official Use Only (FOUO) and contains sensitive details that are not repeated here. Refer to the ISC references for more information.

This attribute relates to the design of the buildings physical security, and its ability to resist the Design Basis Threats. These threats include but are not limited to blast, progressive collapse, vehicle ramming, and ballistics. GSA buildings are to meet the ISC Security Criteria for the given Facility Security Level (FSL).

- **Baseline:** ISC FSL I and II facilities have minimum and low levels of protection. These buildings are to be classified as Baseline for Physical Security Performance.
- **Tier 1 High Performance (★):** ISC FSL Level III facilities have medium levels of protection and are to be classified as GSA Tier 1 for Physical Security Performance.
- **Tier 2 High Performance (★★)** ISC FSL Level IV facilities have medium levels of protection and are to be classified as GSA Tier 2 for Physical Security Performance.
- **Tier 3 High Performance (★★★)** ISC FSL Level V facilities have medium levels of protection and are to be classified as GSA Tier 3 for Physical Security Performance.

## 4.6 Prescriptive Physical Security Requirements

GSA buildings shall meet the Interagency Security Committee's (ISC) standards and best practices for protecting Federal facilities in the United States. These Standards include:

The *Physical Security Criteria for Federal Facilities* (PSC) establishes a baseline set of physical security measures to be applied to all Federal facilities and provides a framework for the customization of security measures to address unique risks at a facility.

The ISC's *Design-Basis Threat* (DBT) report is a stand-alone threat analysis to be used with the Physical Security Criteria. The DBT document establishes a profile of the type, composition, and capabilities of adversaries.

The Building Specific Risk Assessment is developed for each building or project. The assessment evaluates the credible threats, identifies vulnerabilities, and assesses consequences.

General Services Administration Facility Security Requirements for Explosive Devices Applicable to Facility Security Levels III and IV, GSA's Interpretation of the Interagency Security Committee (ISC) Physical Security Criteria, August 2, 2011.

All of the above documents are For Official Use Only (FOUO)

The GSA P100 Physical Security Requirements are intended to align with the ISC Facility Security Level. These physical security performance requirements are not intended to supersede the ISC standards, but to coincide with them:

ISC FSL I and II facilities have minimum and low levels of protection. These buildings are classified to be GSA Baseline for Physical Security Performance.

ISC FSL Level III facilities have medium levels of protection and are to be classified as GSA Tier 1 for Physical Security Performance.

ISC FSL Level IV facilities have high levels of protection and are to be classified as GSA Tier 2 for Physical Security Performance.

ISC FSL Level V facilities have very high levels of protection and are to be classified as GSA Tier 3 for Physical Security Performance

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5.1 Mechanical Performance Requirements									
Attribute	Baseline	★	★★	★★★	Verification			Design	Construction
		Tier 1 High Performance	Tier 2 High Performance	Tier 3 High Performance	Measurement & Verification	Plans & Specs	Calculations & Analysis	Basis of Design	Verification
<b>Temperature</b>									
Reference	ASHRAE 55-2010	ASHRAE 55-2010	ASHRAE 55-2010	ASHRAE 55-2010	ASHRAE 0 ASHRAE 1.1 SMACNA	ASHRAE 0 ASHRAE 1.1			
Performance	24±2°C (75±3°F) cooling, 22±2°C (72±3°F) heating, Allowance for unoccupied hour setup and setback optimized with re-occupancy pick-up and pull-down energy demands within a range of 13°C to 28°C (55°F to 83°F), Thermal zones limited to 42 m <sup>2</sup> (450 ft <sup>2</sup> ) at the perimeter 5m (15ft) (or no more than 3 private offices on the same solar orientation) and 140 m <sup>2</sup> (1500 ft <sup>2</sup> ) interior	Baseline features and add control or provide that surface radiant temperatures are ±4°C (±7°F) of the air temperature, Thermal zones limited to 42 m <sup>2</sup> (450 ft <sup>2</sup> ) at the perimeter 5 m (15ft) (or no more than 3 private offices on the same solar orientation) and 75 m <sup>2</sup> (800 ft <sup>2</sup> ) interior	Tier 1 High Performance features and add control or provide that surface radiant temperatures are ±1°C (±2°F) of the air temperature, or inversely offset expanded air temperature ranges and do not form condensation.	Tier 2 High Performance and individual occupant controlled surface radiant temperatures and optimized air at 24-27 °C (75-80°F) cooling 18-22 °C (65-72°F) heating	Baseline: No Tier 1 High Performance: No Tier 2 High Performance: Yes Tier 3 High Performance: Yes	Baseline: Yes Tier 1 High Performance: Yes Tier 2 High Performance: Yes Tier 3 High Performance: Yes	Provide calculations of the transient coupled one-dimensional heat and moisture transport in multi-layer building components exposed to natural weather using WUFI-ORNL/IBP for each construction condition.	Show proposed zoning and corresponding square footage for all conditioned spaces. Show temperature range for each zone and interior surface temperatures, when applicable.	After occupancy, provide 2 weeks of 15 minute trend history of space and surface temperature (when controlled).
<b>Humidity Control</b>									
Reference	ASHRAE 55-2010, graphic comfort zone method		ASHRAE 55-2010, Michalski (1998), 2011 ASHRAE Handbook – HVAC Applications, Chapter 23, <i>Museums, Galleries, Archives, and Libraries</i>	ASHRAE 55-2010, Michalski (1998), 2011 ASHRAE Handbook – HVAC Applications, Chapter 23, <i>Museums, Galleries, Archives, and Libraries</i>	ASHRAE 0 ASHRAE 1.1 SMACNA	ASHRAE 0 ASHRAE 1.1			
Performance	Maximum 13°C (55°F) dew point	RH setpoint (Historic annual average at indoor dry bulb temperature = 21°C (70°F), default 50%RH), Class C (ASHRAE Applications) control (no short term RH range), 25% to 75% seasonal setpoint adjustment, and 13°C (55°F) dew point maximum.	RH setpoint (Historic annual average at indoor dry bulb temperature = 21°C (70°F), default 45%RH), Class B (ASHRAE Applications) controlled range of +/- 10% RH short term, +/- 10% seasonal setpoint adjustment, and 13°C (55°F) dew point maximum.	RH setpoint (Historic annual average at indoor dry bulb temperature = 21°C (70°F), default 45%RH, Class A (ASHRAE Applications) controlled range of +/- 5% RH short term, +/- 10% seasonal setpoint adjustment (OR +/- 10% RH and NO seasonal setpoint adjustment), and 13°C (55°F) dew point maximum.	Baseline: No Tier 1 High Performance: No Tier 2 High Performance: Yes Tier 3 High Performance: Yes	Baseline: Yes Tier 1 High Performance: Yes Tier 2 High Performance: Yes Tier 3 High Performance: Yes		Show relative humidity control range for each zone and describe method of control when applicable.	After occupancy, provide 2 weeks of 15 minute trend history of space relative humidity (when controlled).

5.1 Mechanical Performance Requirements									
Attribute	Baseline	★	★★	★★★	Verification			Design	Construction
		Tier 1 High Performance	Tier 2 High Performance	Tier 3 High Performance	Measurement & Verification	Plans & Specs	Calculations & Analysis	Basis of Design	Verification
<b>Air Movement</b>									
Reference	ASHRAE 55-2010	ASHRAE 55-2010	ASHRAE 55-2010	ASHRAE 55-2010	ASHRAE 0 ASHRAE 1.1 SMACNA	ASHRAE 0 ASHRAE 1.1			
Performance	Less than 0.2 m/s (40 fpm) at occupied level	Occupant controlled between 0.1 and 0.76 m/s (20 and 150 fpm)	Occupant controlled between 0.1 and 0.76 m/s (20 and 150 fpm)	N/A	Baseline: No Tier 1 High Performance: Yes Tier 2 High Performance: Yes Tier 3 High Performance: Yes	Baseline: Yes Tier 1 High Performance: Yes Tier 2 High Performance: Yes Tier 3 High Performance: Yes		Describe air speed performance and how it will be achieved by the proposed design.	Verify space air speed at occupant level during TAB/Cx.
<b>Pressure</b>									
Reference	2009 ASHRAE Handbook – HVAC Fundamentals	2009 ASHRAE Handbook – HVAC Fundamentals	2009 ASHRAE Handbook – HVAC Fundamentals, Lstiburek (1999), Quirouette (2004)		ASHRAE 0 ASHRAE 1.1 SMACNA	ASHRAE 0 ASHRAE 1.1		Coordinate with Building Enclosure Air Tightness metric.	
Performance	Positive building pressure when occupied, and when outside dew point is higher than 8°C (47°F) when unoccupied.	Active pressure control by floor to achieve 12Pa (0.05" wc) positive building pressure when occupied, and when outside dew point is higher than 8°C (47°F) when unoccupied.	Maintain building perimeter zones at 12 Pa (0.05" wc) positive pressure with respect to outdoor; control per exposure per floor when outside dew point is higher than 8°C (47°F). No design negative pressure spaces at building perimeter.	Tier 2 High Performance and provide envelope cavities at 5 Pa (0.02" wc) positive pressure with respect to interior occupied space when outside temperature drops below dew point of inside air.	Baseline: Yes Tier 1 High Performance: Yes Tier 2 High Performance: Yes Tier 3 High Performance: Yes	Baseline: Yes Tier 1 High Performance: Yes Tier 2 High Performance: Yes Tier 3 High Performance: Yes		Describe building air pressure performance and how it will be achieved by the proposed design.	Prior to occupancy, provide 24 hours of 5-min trend history of building air pressure.
Performance	Comply with 2011 ASHRAE Applications Chapter 48, Table 1	Comply with 2011 ASHRAE Applications Chapter 48, Table 1	Comply with 2011 ASHRAE Applications Chapter 48, Table 1 Provide sound masking	Comply with 2011 ASHRAE Applications Chapter 48, Table 1 Provide sound masking	Baseline: Yes Tier 1 High Performance: Yes Tier 2 High Performance: Yes Tier 3 High Performance: Yes	Baseline: Yes Tier 1 High Performance: Yes Tier 2 High Performance: Yes Tier 3 High Performance: Yes		List design RC level goals for all space types and describe how design will meet these goals.	Verify space acoustic sound levels during TAB/Cx.

5.1 Mechanical Performance Requirements									
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurement & Verification	Plans & Specs	Calculations & Analysis		
<b>Ventilation</b>									
Reference	ASHRAE 62.1-2010	ASHRAE 62.1-2010 LEED 2009	ASHRAE 62.1-2010 LEED 2009	ASHRAE 62.1-2010 LEED 2009	ASHRAE 0 ASHRAE 1.1 SMACNA	ASHRAE 0 ASHRAE 1.1			
Performance	<ul style="list-style-type: none"> <li>Standard 62.1 Ventilation Rate Procedure only</li> <li>Air Flow Measurement Stations (AFMS) on VAV systems</li> </ul>	<ul style="list-style-type: none"> <li>Standard 62.1 Ventilation Rate Procedure only</li> <li>LEED IAQ materials credits</li> <li>Air Flow Measurement Stations on VAV systems</li> </ul>	<ul style="list-style-type: none"> <li>9.4 L/s (20 cfm) per person minimum for all occupancies in the breathing zone</li> <li>LEED IAQ materials credits</li> <li>Air Flow Measurement Stations on all systems</li> </ul>	<ul style="list-style-type: none"> <li>Tier 2 High Performance, and:</li> <li>Provide an occupant indoor air quality survey in the Post Occupancy Evaluation (POE)</li> </ul>	Baseline: Yes Tier 1 High Performance: Yes Tier 2 High Performance: Yes Tier 3 High Performance: Yes	Baseline: Yes Tier 1 High Performance: Yes Tier 2 High Performance: Yes Tier 3 High Performance: Yes	Provide Standard 62.1 VRP calculations for each air handling system	Describe how minimum ventilation rates will be maintained for all systems.	Verify HVAC system minimum ventilation rates during TAB/Cx. Provide 24 hours of 15 minute trend history of each AFMS to verify minimum ventilation control.
<b>Filtration</b>									
Reference	ASHRAE 62.1-2010, ASHRAE 52.2-2007	ASHRAE 62.1-2010, ASHRAE 52.2-2007	ASHRAE 62.1-2010, ASHRAE 52.2-2007	ASHRAE 62.1-2010, ASHRAE 52.2-2017	ASHRAE 0 ASHRAE 1.1 AABC, NEBB, or TABB	ASHRAE 0 ASHRAE 1.1			
Performance	<ul style="list-style-type: none"> <li>MERV 8 upstream of all cooling coils and other devices with wetted surfaces</li> <li>MERV 8 on OA where PM10 limit exceeded</li> <li>MERV 11 on OA where PM2.5 limit exceeded</li> </ul>	<ul style="list-style-type: none"> <li>MERV 8 for all coils</li> <li>MERV 11 on OA</li> </ul>	<ul style="list-style-type: none"> <li>MERV 8 for all coils</li> <li>MERV 13 for outdoor air</li> </ul>	<ul style="list-style-type: none"> <li>MERV 13 for all supply air units with OA</li> <li>MERV 8 for recirculating units with coils</li> <li>UVGI at cooling coils</li> </ul>	Baseline: Yes Tier 1 High Performance: Yes Tier 2 High Performance: Yes Tier 3 High Performance: Yes	Baseline: Yes Tier 1 High Performance: Yes Tier 2 High Performance: Yes Tier 3 High Performance: Yes	Describe proposed filtration design for all air handling systems.	Verify installed filtration during TAB/Cx.	

5.1 Mechanical Performance Requirements									
Attribute	Baseline	★	★★	★★★	Verification			Design	Construction
		Tier 1 High Performance	Tier 2 High Performance	Tier 3 High Performance	Measurement & Verification	Plans & Specs	Calculations & Analysis	Basis of Design	Verification
<b>HVAC Noise Control</b>									
Reference	ASHRAE Handbook - Applications 2007	ASHRAE Handbook - Applications 2008	ASHRAE Handbook - Applications 2009	ASHRAE Handbook - Applications 2010	ASTM E336			Coordinate with Building Enclosures STC Metric	
Performance	Comply with 2011 ASHRAE Applications Chapter 48, Table 1	Comply with 2011 ASHRAE Applications Chapter 48, Table 1	Comply with 2011 ASHRAE Applications Chapter 48, Table 1 Provide sound masking	Comply with 2011 ASHRAE Applications Chapter 48, Table 1 Provide sound masking	Baseline: Yes Tier 1 High Performance: Yes Tier 2 High Performance: Yes Tier 3 High Performance: Yes	Baseline: Yes Tier 1 High Performance: Yes Tier 2 High Performance: Yes Tier 3 High Performance: Yes		List design RC level goals for all space types and describe how design will meet these goals.	Verify space acoustic sound levels during TAB/Cx.
<b>HVAC Operational Efficiency</b>									
Equipment Performance	90.1-2010	90.1-2010	189.1-2011	Greater of Tier 2 Energy Star or 189.1-2011	Yes	Yes		Describe what efficiency level is proposed for the HVAC equipment.	Cx agent to confirm equipment efficiencies during equip. submittal review.
Fan Energy Performance	90.1-2010	5% below 90.1-2010	189.1-2011	10% below 189.1-2011		Yes	Provide fan power limitation calculation per 90.1-2010 Table 6.5.3.1.1.A.	Describe how fan energy performance will be less than metric.	Cx agent to confirm fan equip. efficiencies during equipment submittal review.
HVAC Energy Performance	90.1-2010	10% below 90.1-2010	15% below 189.1-2011	30% Below 189.1-2011			Provide 90.1-2007 Appendix G energy model showing HVAC annual energy does not exceed project target.	Describe HVAC strategies employed in energy model that result in energy target being met.	Cx agent to confirm energy model HVAC equip. performance assumptions on design reviews and submittal reviews.
HVAC Energy Metering	Not Required	50% of HVAC Energy	80% of HVAC Energy	100% of HVAC Energy	Yes	Yes	Provide energy model results showing % HVAC energy metering is met.	Describe proposed HVAC metering scheme.	Calibrate all meters and provide 2 weeks of 15 minute trend history for all HVAC meters.

## 5.2 Mechanical Performance Attributes

The premise of achieving higher levels of building performance is to provide indoor environments that are most conducive to comfort, health, and productivity, to increase the longevity of the property, and to deliver these in an optimally energy efficient and cost effective manner. Protection of property includes assets such as wood furnishings, art, archives where applicable, as well as minimizing detrimental effects of mold growth and material corrosion and decay.

### 5.2.1 Temperature

Temperature is one of several determining factors of a comfortable and productive environment; however, maintenance and control of temperature alone does not assure an acceptable environment. Other component attributes include air movement, humidity, acoustics, air quality, as well as the physical and psychological dispositions of the occupants, and the ability of the occupants to have autonomy over the control of their environment. Increasing levels of indoor environmental performance as impacted by the discrete attribute of temperature are defined as follows.

- **Baseline:** Control of dry bulb temperature range, allowing for seasonal and unoccupied setpoint adjustment.
- **Tier 1 High Performance (★):** Adds the provision of control of surface temperatures surrounding the occupants to limit the detrimental effects of radiant temperature asymmetry, as well as decreasing the size of control zones, so that fewer personal preferences are subject to a common environment. Control of surface temperatures is to be done passively, such as better R-values in materials, and synergistically, through intentional delivery of heating and cooling media (air, water, electricity, refrigerant) to

offset undesirable surface temperatures. Better adaptation to individual preferences is necessary to achieve the goal of lower PPD (predicted percentage of dissatisfied).

- **Tier 2 High Performance (★★):** Adds Building Automation System (BAS) control of surface temperatures to reduce the detrimental aspects of radiant temperature asymmetry on occupants and allow for space air dry bulb temperature reset from the baseline parameters.
- **Tier 3 High Performance (★★★):** Additionally allows for occupant control of the surface temperatures within optimized limits determined by a BAS.

### 5.2.2 Humidity Control

Humidity is one of several determining factors of an acceptable environment, but the limits for occupant comfort and productivity are much more widespread than the humidity limits required for asset protection and longevity. ASHRAE Standard 55-2010 “Thermal Environmental Conditions for Human Occupancy” does not require a lower limit of humidity with respect to maintaining an acceptable environment.

Occupant satisfaction does not increase when humidity is controlled more precisely than the requirements of ASHRAE Standard 55. Therefore, for general occupancy, higher levels of humidity control performance are not required or encouraged. The high performance tiers of humidity performance are intended to protect humidity-sensitive finishes and contents of the space, if present, such as art collections, rare documents, vulnerable woodwork, etc. The selected levels of performance reference the 2011 ASHRAE Handbook – HVAC Applications, Chapter 23, Museums, Galleries, Archives, and Libraries.

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Increasing levels of indoor environmental performance as impacted by the discrete attribute of humidity are defined as follows.

- Baseline: Provide a maximum indoor dew point limitation, applicable to all times and seasons.
- Tier 1 High Performance (★): Adds the provision of Class C control and seasonal setpoint adjustment for the preservation of "medium vulnerability" woodwork; this does not necessarily require humidification equipment.
- Tier 2 High Performance (★★): Upgrades to the provision of Class B control and seasonal setpoint adjustment for the preservation of "high vulnerability" woodwork. No archival storage of fabrics, books, film, or photos is considered.
- Tier 3 High Performance (★★★): Upgrades to the provision of Class A control and seasonal setpoint adjustment for the preservation of "high vulnerability" woodwork, through which also allows a small risk to archival storage items such as fabrics, books, film, or photos.

### 5.2.3 Air Movement

Air movement is discussed under the temperature attribute, because the amount and control of air movement directly affects the level of temperature control required to maintain a comfortable and productive environment. Levels of indoor environmental performance as impacted by the discrete attribute of air movement are defined as follows.

- Baseline: Less than 0.2 m/s (40 fpm) air speed at the occupied level.
- Tier 1 High Performance (★): Group occupant controlled air speed at the occupied level adjustable between 0.1 and 0.76 m/s (20 and 150 fpm), but subject to not more than six occupants per control zone so that 1) fewer

occupants are dissatisfied with their environment, and 2) space temperatures can be reset upward for overall energy savings in the cooling mode, and internal heat recovery in transitional seasons.

- Tier 2 High Performance (★★): Individual occupant controlled air speed at the occupied level adjustable between 0.1 and 0.76 m/s (20 and 150 fpm), adapting to individual preferences to achieve the goal of lower PPD.
- Tier 3 High Performance (★★★): Continues Tier 2 High Performance; no further enhancement.

### 5.2.4 Pressure

Pressure is a factor contributing to longevity of the property, and the resultant indoor air quality. Under ordinary conditions, the relatively small orders of magnitude of air pressure experienced in and immediately around a facility do not usually create uncomfortable indoor environments. Control of space pressurization is important, in overall facility operations, to manage moisture, water vapor, airborne contaminants, and the consequent effects of mold growth. Levels of building performance as impacted by the discrete attribute of pressure are as follows.

- Baseline: Maintain positive building pressure when occupied, and when outside dew point is higher than 8°C (47°F) when unoccupied.
- Tier 1 High Performance (★): Manage the differential flow rates of building outdoor air and exhaust air by the HVAC equipment, reset as determined by the pressure differential of each floor's exterior space with the outdoor, to achieve 12Pa (0.05" wc) positive building pressure when occupied.
- Tier 2 High Performance (★★): Maintain building perimeter zones at 5 Pa (0.02" wc)



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positive with respect to outdoor, with control zones no larger than per exposure and per three floors in height. Return air plenums require isolation near the perimeter. Note: The architectural design cannot locate negative pressure spaces at building perimeter.

- Tier 3 High Performance (★★★): Provide envelope cavities at 5 Pa (0.02" wc) positive with respect to interior occupied space when outside temperature drops below the dew point of inside air.

### 5.2.5 Ventilation

Ventilation is one of the key elements (along with source control and air cleaning) to achieving acceptable indoor air quality. Source control alone is not sufficient because it is impossible to eliminate all off-gassing materials in the built environment and people are also a source of pollutants (bioeffluents). Hence, ventilation is required in all occupied spaces. ASHRAE Standard 62.1 is the consensus standard prescribing ventilation requirements in the U.S. It has been integrated into the International Mechanical. Ventilation rates higher than Standard 62.1 rates have been shown in several studies to increase alertness, reduce indoor air quality concerns, and reduce absenteeism.

- Baseline: Ventilation rates shall comply with Standard 62.1-2010 using the Ventilation Rate Procedure. (The IAQ procedure is not practical since it is not possible to identify all pollutants, their source strengths, and their maximum acceptable concentrations.)

All variable air volume systems shall include devices to measure and control minimum outdoor air flow.

- Tier 1 High Performance (★): Comply with the baseline requirements

Comply with all the technical requirements of LEED 2009 Indoor Environmental Quality credits

for building materials including IEQ Credit 4.1 (Low-Emitting Materials – Adhesives and Sealants), IEQ Credit 4.2 (Low-Emitting Materials–Paints and Coatings), IEQ Credit 4.3 (Low-Emitting Materials–Flooring Systems), IEQ Credit 4.4 (Low-Emitting Materials–Composite Wood and Agrifiber Products)

- Tier 2 High Performance (★★): Breathing zone outdoor air ventilation rates for private and open office spaces shall be equal to or greater than a total of 9.4 L/s/person (20 cfm/person).

Comply with all the technical requirements of LEED 2009 Indoor Environmental Quality credits for building materials including IEQ Credit 4.1 (Low-Emitting Materials – Adhesives and Sealants), IEQ Credit 4.2 (Low-Emitting Materials–Paints and Coatings), EQ Credit 4.3 (Low-Emitting Materials–Flooring Systems), EQ Credit 4.4 (Low-Emitting Materials–Composite Wood and Agrifiber Products)

All systems shall include devices to measure and control minimum outdoor air flow.

- Tier 3 High Performance (★★★): Comply with Tier 2 High Performance requirements

Provide an occupant indoor air quality survey in the POE.

### 5.2.6 Filtration

Filtration and air cleaning can improve indoor air quality by removing contaminants from ventilation air. It is particularly effective in areas where outdoor air quality is poor. Particulate filtration can also improve air quality by reducing dirt on surfaces that can support microbial growth such as cooling coils.

- Baseline: Provide minimum MERV 8 filters upstream of all cooling coils and other devices with wetted surfaces per Standard 62.1-2010 Section 5.8

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Provide minimum MERV 8 filters on all ventilation outdoor air intakes where the national standard for PM10 is exceeded per Standard 62.1-2010 Section 6.2.1.1

Provide minimum MERV 11 filters on all ventilation outdoor air intakes where the national standard for PM2.5 is exceeded per Standard 62.1-2010 Section 6.2.1.2

- Tier 1 High Performance (★): Comply with baseline

Provide minimum MERV 11 filters on all outdoor air

- Tier 2 High Performance (★★): Comply with Tier 1 High Performance

Provide minimum MERV 13 filters on all outside air, and MERV 8 filters upstream of all cooling coils and other devices with wetted surfaces.

- Tier 3 High Performance (★★★): Comply with Tier 2 High Performance

Provide ultra-violet germicidal irradiation (UVGI) for cooling coils and other devices with wetted surfaces.

### 5.2.7 HVAC Noise Control

Acoustics in the workplace can affect productivity and excessive noise can also cause physical symptoms. Cross-talk in open offices can also be a detriment to worker productivity. However, there is no evidence to suggest that these factors are improved with lower sound pressure levels. Hence requirements are to simply meet the industry standard Room Criteria (RC) levels for all levels.

- Baseline: Design all systems so that space RC is equal to or less than those listed in 2011 ASHRAE Applications, Chapter 48, Noise and Vibration Control, Table 1, Design Guidelines for HVAC-Related Background Sound in Rooms

- Tier 1 High Performance (★): Comply with baseline requirements

- Tier 2 High Performance (★★): Comply with baseline requirements

Provide sound masking in open office spaces per PBS-P100 2010.

Confirm design sound levels are achieved through field measurements in accordance with ASTM E336 "Field Measurement of Sound Insulation in Buildings and General Services Administration (GSA) Workplace 20•20 testing protocol for speech privacy calculation in private offices

- Tier 3 High Performance (★★★): Comply with Tier 2 High Performance requirements

Provide an occupant indoor acoustical survey in the POE.

### 5.2.8 HVAC Operational Efficiency

The goal of HVAC operational efficiency is to maximize system energy efficiency in order to reduce HVAC energy consumption and costs. Although annual HVAC energy consumption is impacted by many other factors in the building including building envelope, lighting, and equipment loads, this metric focuses strictly on the HVAC equipment and system efficiencies by utilizing industry standards for the various levels of efficiency.

- Baseline: HVAC equipment efficiencies shall comply with the minimum efficiencies shown in ASHRAE Standard 90.1-2010

HVAC fan energy consumption shall not exceed that allowed by ASHRAE Standard 90.1-2010 Fan System Power Limitation Requirements

Building HVAC energy performance shall not exceed that allowed using ASHRAE Standard 90.1-2010 Appendix G

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- Tier 1 High Performance (★): HVAC equipment efficiencies shall comply with the minimum efficiencies shown in ASHRAE Standard 90.1-2010

HVAC fan energy consumption shall be 5% less than that allowed by ASHRAE Standard 90.1-2010 Fan System Power Limitation Requirements

Building HVAC energy performance shall be 10% below that allowed using ASHRAE Standard 90.1-2010 Appendix G

Provide energy sub-metering for at least 50% of the building HVAC energy

- Tier 2 High Performance (★★): HVAC equipment efficiencies shall comply with the minimum efficiencies shown in ASHRAE Standard 189.1-2011

HVAC fan energy consumption shall not exceed that allowed by ASHRAE 189.1-2011 Fan System Power Limitation Requirements

Building HVAC energy performance shall be 15% below that allowed using ASHRAE Standard 189.1-2011 Section 7.5.2

Provide energy sub-metering for at least 80% of the building HVAC energy

- Tier 3 High Performance (★★★):

HVAC equipment efficiencies shall meet the maximum efficiency required by Tier 2 Energy

Star or ASHRAE Standard 189.1-2011 minimum efficiencies

HVAC fan energy consumption shall be 5% less than that allowed by ASHRAE 189.1-2011 Fan System Power Limitation Requirements

Building HVAC energy performance shall be 30% below that allowed using ASHRAE Standard 189.1-2011 Section 7.5.2

Provide energy sub-metering for 100% of the building HVAC energy

### 5.2.9 Energy Performance

The attribute of energy performance considers the whole building synergistically and measured with respect to both energy utilization (consumption) and carbon emissions (total or source) on an annual basis.

Federal law requires minimum levels of performance for Federal facilities and total portfolio performance for Federal agencies. The related attribute of energy cost is required to be reported for LEED certification, and this may be a driving requirement in terms of systems selection, particularly thermal storage and demand peak shaving/load offset.

Energy cost and its effect on life cycle cost is an essential consideration in the design of GSA buildings. However, because there is no federal mandate on energy cost, it is not a direct report for P100 Performance.

Energy software used to demonstrate compliance must be compliant with ASHRAE Standard 140-2011.

## 5.3 Mechanical Engineering Prescriptive Requirements

All mechanical and electrical equipment within the building or on the property must be located in areas not subject to flooding and 1.6 meters (5 ft.) above the 100-year flood plain.

### 5.3.1 Design Criteria

Outdoor air design criteria must be based on weather data tabulated in the latest edition of the ASHRAE Handbook of Fundamentals.

- Winter design conditions must be based on the 99.6 percent column dry bulb temperature.
- Summer design conditions for sensible heat load calculations must be based on the 0.4 percent column dry bulb temperature, with its mean coincident wet bulb temperature.
- Design conditions for the summer ventilation load, cooling tower selection, and all dehumidification load calculations must be based on the 0.4 percent dew point, with its mean coincident dry bulb temperature.

Designer to provide ranges, fill out table, and state what criteria is used. Designer must submit list of rooms with negative pressure. Designer shall submit occupancy loads as the basis of design.

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Type of Area	Summer DB	Winter DB
Locker rooms	26°C (78°F)	21°C (70°F)
Electrical closets	26°C (78°F)	13°C (55°F)
Mechanical spaces	35°C (95°F)	13°C (55°F)
Electrical switchgear	35°C (95°F)	13°C (55°F)
Elevator machine room	26°C (78°F)	13°C (55°F)
Emergency generator room	40°C (104°F)	18°C (65°F)
Transformer vaults	40°C (104°F)	
Stairwells	(none)	18°C (65°F)
Storage room	30°C (85°F)	18°C (65°F)
Other		

**Table 1. Indoor Design Conditions – Supplemental Spaces**

Occupancy loads must be determined as follows:

- Determine occupant density (persons/m<sup>2</sup> or persons/ft<sup>2</sup>) from the occupancy schedule of the Project Program of Requirements.
- In the event this information is not available, use the occupancy density values in ASHRAE 62.1-2010.
- For dining areas, auditoriums, and other high-occupancy spaces, occupancy densities must represent the number of seats available.
- Sensible and latent loads per person must be based on the latest edition of the ASHRAE Handbook of Fundamentals.

The HVAC load calculations must be performed with a computer-based program using the latest ASHRAE Handbook of Fundamentals Heat Balance (HB)

Method, Radiant Time Series (RTS) Method, or Transfer Function Method (TFM), developed for the hourly analysis of heating and cooling loads in commercial buildings.

The program must be capable of calculating each zone’s peak heating and cooling loads as well as the whole-building simultaneous peak load. The program must, at a minimum, calculate solar gains through fenestration, internal gains from occupants, including latent heat for cooling purposes, internal gains from lighting and equipment, outside air loads (sensible and latent) from ventilation and infiltration, and heat and moisture gains or losses through fenestration, walls, floors, and roofs. The heating load calculations must be done without credit for occupants and internal gains. The HVAC load calculations must not include additional safety factors unless specifically asked for in the applicable tenant design guides (i.e. the Courts Design Guide has 20 percent sensible added to courtrooms).

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Provide HVAC load calculations at each design phase. The HVAC load calculations report must include all input and output used in the heating and cooling calculation program. The report must also include zone peak heating and cooling loads results and whole-building simultaneous peak load, air-handling unit coil selections, and psychrometric charts that show the complete cycle of all of the processes in the HVAC system.

### 5.3.1.2 Energy Analysis

A building energy analysis must be performed at each phase of the design to demonstrate that the building design meets or exceeds the energy performance goals established for the project. Energy software used for proof of compliance must conform with ASHRAE Standard 140-2011.

The compliance methodology must be in accordance with Sections 5 (except Section 5.6), 6, 7, 8, 9, and 10 of ASHRAE Standard 90.1.

## 5.3.2 HVAC Systems

### 5.3.2.1 Chiller Plant

If the whole building or property simultaneous peak cooling load is 3520 kW (1000 Tons) or more, a minimum of three chillers must be provided. If the whole-building simultaneous peak cooling load is less than 3520 kW (1000 tons), a minimum of two equally sized chillers at 67 percent of the peak capacity must be provided. All units must have adequate valving to isolate of the offline unit without interruption of service.

A waterside-economizer cycle must be analyzed during the design of the chiller plant and incorporated in the design if it improves the performance.

### 5.3.2.2 Boiler Plant

The central boiler plant within the building or on the property must be provided with modular boilers. For

boiler plants greater than 300kW (1,000 MBH), a minimum of three boilers must be provided. For buildings less than 300kW (1,000 MBH) peak demand, two equally sized modular boilers sized at 67 percent of peak demand must be provided.

### 5.3.2.3 Cooling Towers

Each chiller must have its own matching cooling tower or cell, and condenser and chilled water pump. Multiple cooling towers must have equalizing lines and the necessary automatic control valves for individual chiller/cooling tower operation.

### 5.3.2.4 Distribution Systems

Supply air distribution systems must be fully ducted to the spaces that are served.

### 5.3.2.5 Roof-Mounted Equipment

Mechanical equipment, except for cooling towers, air-cooled chillers, evaporative condensers, and exhaust fans, is not permitted on the roof of the building. Access to roof-mounted equipment must be by stairs or freight elevator; ship's ladders are not permitted.

### 5.3.2.6 Special Area HVAC Systems

Develop table to show dedicated systems, energy requirements, and redundancy requirements,

Special areas such as atriums, auditoriums, entrance lobbies and vestibules, cafeterias, mail rooms, loading docks, computer and server rooms, fire pump rooms, BAS control rooms, and fire command centers must have dedicated HVAC systems, separate from all other HVAC in the building, with individual controls to condition these spaces as required.

Each courtroom must have its own dedicated air-handling unit, and each courtroom must be provided with a minimum of three thermostatic zones.

A separate dedicated air-handling system must be provided for each mail room. Airflow must maintain

negative pressure in the room relative to adjacent spaces.

### 5.3.3 HVAC Components

#### 5.3.3.1 Air Handling Units

All AHU must have DDC (BACnet or LonTalk) self-contained controls that are capable of being connected to the central BAS. Controller must have a current-sensing device that transmits information to the BAS for calculating the energy consumption of the AHU motor.

All AHUs except OAVS must be provided with factory-fabricated mixing boxes on the return side of the AHU.

AHU housing must consist of formed and reinforced, insulated panels, fabricated to allow removal for access to internal parts and components. All AHUs must be double wall construction.

There shall be a maximum 1% leakage on the casing.

#### 5.3.3.2 Outdoor Air Intake Locations

The placement and location of outdoor air intakes must be in compliance with the ISC criteria.

On buildings more than 12 m (40 ft.) tall, intakes must be located a minimum of 12 m (40 feet) above grade. On buildings less than 12 m (40 ft.), the intakes must be located as high as practical on the roof or on a wall. Table 6-2 provides requirements for minimum separation distances between ventilation air intakes and other building features.

Outdoor air intakes must be ducted directly to the AHU cabinet; the equipment room must not be used as an outdoor air intake plenum.

Object	Minimum Distance	
	m	ft
Garage entry, loading dock	7	25
Driveway, street, or public way	3	10
Limited-access highway	7	25
Cooling tower or evaporative condensers	7	25
Exhaust fans and plumbing vents	5	15
Kitchen exhaust air	7	25

**Table 2. Air Intake Minimum Separation Distances**

### 5.3.3.3 Temperature and Airflow Control

Psychrometric process charts must be prepared for each air-handling unit application, characterizing full-load and part-load operating conditions for all processes in the system. Air-handling unit/coil designs must ensure that conditioned space temperatures and humidity levels are within an acceptable range, per programmed requirements.

### 5.3.3.4 Cooling and Heating Coils

Equipment and other obstructions in the air stream must be located sufficiently downstream of the coil so that it will not come in contact with the water droplet carryover. Cooling coils must be selected at or below 2.5 m/s (500 fpm) face velocity. Heating coils must be selected at or below 3.8 m/s (750 fpm) face velocity.

HVAC coils subject to outside air in hot, humid and marine climates shall be provided with copper tubes and copper fins or electro coated copper tubes with electro coated aluminum fins with a coating thickness to be maintained between 0.6 –mil and 1.2- mil and with minimum salt spray resistance of 6,000 hours.

Individual finned-tube cooling coils five or fewer rows may have a maximum of 12 fins per inch. Individual finned-tube cooling coils of six rows or more should not exceed 10 fins per inch.

### 5.3.3.5 Boilers

Boilers for hydronic heating applications must be modular units. Boilers must be installed in a mechanical room with all provisions made for breaching, flue stack, and combustion air.

### 5.3.3.6 Hot Water Piping and Pumps

Materials acceptable for piping systems are stainless steel, black steel, cast iron and copper.

For copper piping, brazed, soldered and press-seal (test to 2100 kPa (300 psig) fittings are acceptable;

grooved or mechanically formed T-type fittings are not acceptable.

Partial-load and full-load performance must be shown on the pump curve.

### 5.3.3.7 Isolation of Piping at Equipment

Isolation valves, shutoff valves, bypass circuits, drain valves, flanges, and unions must be provided for piping at equipment to facilitate equipment repair and replacement. Equipment requiring isolation includes boilers, chillers, pumps, coils, terminal units, and heat exchangers. Valves must also be provided for zones off vertical risers, including drain valves.

### 5.3.3.8 Flexible Pipe Connectors

Flexible pipe connectors must be fabricated from annular close pitched corrugated and braided stainless steel. All pumps, chillers, cooling towers, and other rotating equipment must have flexible connectors. All flexible piping must be sized one size larger than the piping connected size.

### 5.3.3.9 Cooling Towers

Galvanized steel is prohibited on water contact surfaces for cooling towers.

### 5.3.3.10 Meters, Gauges, and Flow Measuring Devices

Each piece of mechanical equipment must be provided with instrumentation in addition to test ports to verify critical parameters, such as capacity, pressures, temperatures, and flow rates. Each meter, gauge, and flow measuring device must be calibrated before startup and must have provisions for periodic calibration at its location. All the metering devices must be capable of transmitting information to the central BAS for monitoring and control.



### 5.3.4 Air Distribution

#### 5.3.4.1 Air Delivery Devices

Ceiling diffusers or booted-plenum slots must be specifically designed for VAV air distribution. Booted plenum slots must not exceed 1.2 m (4 ft.) in length unless more than one source of supply air is provided. The locations of the air delivery devices and the ranges of their outlet airflow rates must be selected

to ensure that the air diffusion performance index (ADPI) values remain above 80 percent during all full-load and part-load conditions, and below the specified noise level to achieve the background noise criteria, in accordance with the test procedures specified in Appendix A of ASHRAE Standard 113. Adequate space ventilation requires that the selected diffusers effectively mix the total air in the room with the supplied conditioned air that contains adequate ventilation air.

Shall be submitted in Basis of Design:

Application	Controlling Factor – Noise Generation			
	Main Ducts		Branch Ducts	
	m/s	fpm	m/s	fpm
Private offices	6	1,200	4	800
Conference rooms				
Libraries				
Theaters	4	800	2	400
Auditoriums				
General offices	7.5	1,500	5	1,000
Cafeterias	9	1,800	6	1,200

**Table 3. Recommended Air Velocities for Supply, Ducted Return, and Exhaust**

## 5.3.5 Water Treatment

### 5.3.5.1 Submittal Requirements

A licensed water treatment specialist must design the water treatment for closed and open hydronic systems with consideration of the operational and maintenance needs of all system equipment including such components as boilers, chillers, cooling towers, other heat exchangers, pumps, and piping. The design must address four aspects of water treatment: biological growth, dissolved solids and scaling, corrosion protection, and environmental discharge regulations. Subject to the specific requirements of the components, the performance of water treatment for closed and open systems must include:

### 5.3.5.2 Closed Systems

- The pH must be in the ranges of 8.5–9.5 for chilled water systems, and 9–10.5 for heating water systems.
- The alkalinity of the water must be maintained between 100 and 500 ppm.
- Total dissolved solids must have a maximum value not to exceed 5 ppm.

### 5.3.5.3 Open Systems

- The pH of the water must be maintained between 7.5 and 9.5.
- The alkalinity of the water must be maintained between 100 and 500 ppm.
- The iron content of the water must have a maximum value not to exceed 3 ppm.
- Soluble copper must have a maximum value not to exceed 0.2 ppm.
- Total dissolved solid must have a maximum value of 5 ppm.
- Total aerobic plate counts shall have maximum values not to exceed 1,000 organisms/ml, and an additional limit of 10 CFU/ml Legionella.

The methods used to treat the systems' makeup water must have demonstrated prior success in existing facilities on the same municipal water supply and must follow the guidelines outlined in ASHRAE Applications Handbook.

The chemical feed system must have BACnet or LonTalk self-contained controls.

### 5.3.5.4 Primary Heating Systems

GSA requires low-temperature hot water heating systems, with the lowest working pressure suitable for the system and a maximum temperature limitation of 93.3°C (200°F).

### 5.3.5.5 District Steam Heating

When steam is furnished to the building, it must be converted to hot water with a heat exchanger in the mechanical room near the entrance into the building. Steam heating is discouraged inside the building, other than the conversion of steam to hot water in the mechanical room.

The designer must investigate the use of district steam condensate for preheating domestic hot water.

### 5.3.5.6 Hot Water Heating Systems

If glycol is used for freeze protection, it should be propylene glycol; use of ethylene glycol is prohibited

### 5.3.5.7 Piping Systems

Hot water and chilled water air systems must use a four-pipe main distribution system. Dual temperature piping systems are not permitted.

### 5.3.5.8 Piping Insulation

Pipes subject to condensation must be insulated with non-permeable insulation (of perm rating 0.000), such as cellular glass or preformed composite insulation

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system. Composite insulation system shall provide 0.000 permeability rating.

### 5.3.5.9 Noise Control in Duct Systems

Acoustic duct lining used in supply air systems shall be non-fiberglass material impregnated with an antimicrobial agent and covered by an internal perforated sheet metal liner.

### 5.3.5.10 Controls/Building Automation Systems (BAS)

For new construction, use DDC with an open BACnet or LonTalk communication protocol in accordance with ASHRAE Standard 135-2004.

For repair and alteration projects and new additions to existing projects, the following options are permitted: 1) installation of DDC with the BACnet or LonTalk protocol, 2) integrating the existing system with customized gateways to the BACnet or LonTalk protocol.

See Sections 5.6 and 5.18 for additional requirements.

### 5.3.5.11 Coordination of Digital Control Systems

Digital building control systems are beginning to share common protocols, compatible equipment, and uniform standards with other building IT services. GSA seeks BAS designs that integrate with other IT systems to minimize costs and improve operations. Since this technology is in a constant state of improvement and contract methodologies are not well established in the design and construction industry, the A/E and Project Manager must coordinate the design of controls and monitoring systems with the PBS CIO (Chief Information Officer) at the beginning of design. These systems include, but are not limited to; utility metering, HVAC building automation systems, lighting controllers, and renewable energy systems.

The CIO may provide Government Furnished Equipment and will specify system components to insure compatibility with the GSA network. Related IP network design must be reviewed and approved by the CIO. All network connections will be made through the GSA network. All server applications must be able to be hosted in a virtual server environment. Other GSA IT policies and procedures may also apply.

### 5.3.6 Plumbing Fixtures

Plumbing fixtures must comply with the International Plumbing Code and local building codes.

In compliance with EISA 2007 Section 433(a), water conservation technologies must be applied to the extent that the technologies are life-cycle cost-effective.

GSA requires the use of plumbing products labeled under the EPA WaterSense program. WaterSense is a partnership program sponsored by the U.S. Environmental Protection Agency. Its mission is to protect the future of our nation's water supply by promoting and enhancing the market for water-efficient products and services.

More information is available at <http://www.epa.gov/watersense/index.html>.

Plumbing fixture accessibility clearances, installation, and accessories must be compliant with The Architectural Barriers Act Accessibility Standard (ABAAS).

All plumbing fixtures must be water-conserving/saving-type fixtures, faucets, and valves. Low-flow water fixtures must be provided.

#### 5.3.6.1 Water closets (toilets) — flushometer valve type

Water closets must be either dual-flush or low-flow type, manually controlled. For single flush, maximum flush volume when determined in accordance with ASME A112.19.2–4.8 L (1.28 gal). For dual-flush,

effective flush volume determined in accordance with ASME A112.19.14 and USEPA WaterSense Tank-Type High Efficiency Toilet Specification – 4.8 L (1.28 gal).

### **5.3.6.2 High Efficiency Toilets (HET) Water Closets — Tank-Type**

Tank-type water closets must comply with the performance criteria of the U.S. EPA WaterSense Tank-Type High-Efficiency Toilet Specification.

### **5.3.6.3 High Efficiency Urinals (HEU)**

Urinals must be low-flow, flush-type fixtures. Maximum flush volume when determined in accordance with ASME A112.19.2 – 0.5 L (0.125 gal).

### **5.3.6.4 Public Lavatory Faucets**

Use metered-type faucets for lavatories. Maximum water use — 1.0 L (0.25 gal) per metering cycle when tested in accordance with ASME A112.18.1/CSA B125.1.

### **5.3.6.5 Emergency Fixtures**

Eyewash (0.025 L/s [0.4 gpm] per fountain), face wash (0.2 L/s [3 gpm] each), or shower (1.3 L/s [20 gpm] each) must be tempered immediately at the fixture or group of fixtures within 7.6 m (25 ft) to deliver tepid water between 29°C (85°F) and 37.8°C (100°F), at 0.207 megapascal (30 psi), within 10 seconds, for a minimum period of 15 minutes, and must account for temperature drop across the valve (generally 7°C or 20°F) at flow.

### **5.3.6.6 Solar Water Heating**

In compliance with EISA 2007, if lifecycle cost-effective, as compared to other reasonably available technologies, not less than 30 percent of the hot water demand for each new Federal building or Federal building undergoing a major renovation must be met through the installation and use of solar hot water heaters.

## **5.3.7 Operability and Maintainability**

### **5.3.7.1 Accessible for Maintenance**

Install equipment so that it can be safely and easily maintained and inspected. Comply with requirements for mechanical room sizes and manufacturer’s recommended clearances around installed equipment.

Do not install equipment that requires maintenance below a raised access floor.

### **5.3.7.2 Simple/Understandable to Operate**

The sequence of operation for the control systems must be clearly described and comprehensively documented. The HVAC system design should minimize the need for overly complex control systems.

### **5.3.7.3 Operations**

Design the HVAC system so that equipment failures and normal maintenance have minimal impact on the tenants. Failure of one piece of equipment should not shut down large portions of the building. Install piping and valves so that equipment can be easily isolated for repair and so that different combinations of equipment can be used during replacement and overhaul. Equipment components, spare parts, and materials should be readily available and the equipment should be repairable by crafts people available in the local area. This is especially important in the remote locations of some Land Ports.

### **5.3.7.4 Robust and Reliable: Extended Life Expectancy**

Public buildings have a longer life expectancy than most commercial office buildings. Forty percent of GSA’s occupied inventory is over 50 years old. Many buildings are over 100 years old and are expected to continue in service for decades to come. HVAC systems are expected to have extended service lives.

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They will be modified many times over the life of the building and operated by many different maintenance firms and occupied by many different tenants. Selection of robust, reliable, energy efficient equipment is important. Systems that can be reliably operated at near design conditions over the long term are needed.

### 5.3.7.5 Alterations in Existing Buildings and Historic Structures

The following steps must be followed for HVAC work in historic buildings:

- Design HVAC systems to avoid affecting other systems and historic finishes, elements, and spaces.
- Place exterior equipment where it is not visible. Recess equipment from the edge of the roof to minimize visibility of the equipment from grade. Alternatively, explore creating a vault for easier access to large mechanical equipment. If equipment cannot be concealed, specify equipment housings in a color that will blend with the historic face. As a last resort, enclose equipment in screening designed to blend visually with the facade.
- Locate equipment with particular care for weight and vibration on older building materials. These materials cannot accept the same stress as when the equipment is used in newer construction.
- If new ceilings are to be installed, ensure that they do not block any light from the top of existing windows or alter the appearance of the building from the outdoors. Original plaster ceilings in significant spaces, such as lobbies and corridors, must be retained to the extent possible and modified only as necessary to accommodate horizontal distribution. Use soffits and false beams where necessary to minimize the alteration of overall ceiling heights.
- In buildings containing ornamental or inaccessible ceilings, piping and ductwork must be routed in furred wall space or exposed in the occupiable building area. Exposed ducts must also be considered in historic industrial buildings with open plan, tall ceiling, and high window spaces suited to flexible grid/flexible density treatments.
- If new vertical air distribution risers are required, they should be located adjacent to existing shafts.
- Select system types, components, and placement to minimize the alteration of significant spaces. In previously altered spaces, design systems to allow historic surfaces, ceiling heights, and configurations to be restored. Reuse of HVAC system elements is permitted only with written documentation obtained from GSA Property Management by the A/E.
- Retain decorative elements of historic systems where possible. Ornamental grilles and radiators and other decorative elements must be retained in place.
- Retain and enhance the performance of the original type of system where a new one cannot be totally concealed or would adversely affect historic spaces or features. For example, adapt existing radiators with modern heating and cooling units, rather than adding another type of system that would require the addition of new ceilings or other non-original elements.
- To the greatest extent possible, ensure that space is available to maintain and replace equipment without damaging significant features and select components that can be installed without dismantling window or door openings.
- Select temperature and humidity conditions that do not cause deterioration of building materials.

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Refer to HVAC Upgrades in Historic Buildings ([www.gsa.gov/technicalpreservationguidelines](http://www.gsa.gov/technicalpreservationguidelines)) for additional guidance.

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5.4 Whole Building Energy Performance Requirements									
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design	Construction
					Measurement & Verification	Plans & Specs	Calculations & Analysis	Basis of Design	Verification
<b>Whole Building Energy Performance</b>									
<b>Reference</b>	EISA 2007 Section 433, Executive Order 13423, Executive Order 13514, Guiding Principles for Sustainable New Construction and Major Renovations	EISA 2007 Section 433, Executive Order 13423, Executive Order 13514, Guiding Principles for Sustainable New Construction and Major Renovations	EISA 2007 Section 433, Executive Order 13423, Executive Order 13514, Guiding Principles for Sustainable New Construction and Major Renovations	EISA 2007 Section 433, Executive Order 13423, Executive Order 13514, Guiding Principles for Sustainable New Construction and Major Renovations					
	ASHRAE 90.1-2007	ASHRAE 90.1-2007	ASHRAE 90.1-2007	ASHRAE 90.1-2007 U.S. Department of Energy, Zero Energy Buildings: A Critical Look at the Definition (Washington, DC: GPO, 2006), 6-7. Definition of Net Zero Site Energy.					
<b>Whole Building Energy Utilization</b>	30% reduction in energy usage compared to an ASHRAE Standard 90.1-2007 baseline building as analyzed using the informative Appendix G	40% reduction in energy usage compared to an ASHRAE Standard 90.1-2007 baseline building as analyzed using the informative Appendix G	50% reduction in energy usage compared to an ASHRAE Standard 90.1-2007 baseline building as analyzed using the informative Appendix G	The expected annual EUI when the building is designed in compliance with a goal to achieve zero-net-energy (ZNE)	Baseline thru Tier 3 High Performance: No	Baseline thru Tier 3 High Performance: No	Provide 90.1-2007 Appendix G energy model demonstrating whole building energy performance.	Provide written narrative showing how energy model meets energy reduction target.	Cx agent to confirm energy model material and equipment performance assumptions on design reviews and submittal reviews.  Calibrate building energy model to first year building historical data and compare energy performance to actual measured energy performance.
<b>Whole-Building Carbon Emissions</b>	Reduce fossil fuel-generated energy consumption by 55% when compared to a similar building in most recent CBECS Database	Reduce fossil fuel-generated energy consumption by 65% when compared to a similar building in most recent CBECS Database	Reduce fossil fuel-generated energy consumption by 80% when compared to a similar building in most recent CBECS Database	Reduce fossil fuel-generated energy consumption by 100%	Baseline thru Tier 3 High Performance: No	Baseline thru Tier 3 High Performance: No	Provide calculation showing fossil fuel based energy reduction compared to a similar building in FY 2003.	Provide written narrative showing how building meets carbon reduction target.	Calculate fossil fuel based energy used in the first year of operation from utility bills as kBtu/ft2-yr.
<b>Whole-Building Metering</b>	All major utilities	Baseline, plus All major building systems	Tier 1 High Performance, plus Building subsystems	Tier 2 High Performance, plus Tenant Metering	Baseline thru Tier 3 High Performance: No	Baseline thru Tier 3 High Performance: No		Describe proposed building metering and subsystem	Calibrate all meters and provide 2 weeks of 15 minute trend

# 5.5 Whole Building Performance Attributes

## 5.5.1 Energy Performance

The attribute of energy performance considers the whole building synergistically and measured with respect to both energy utilization (consumption) and carbon emissions (total or source) on an annual basis.

Federal law requires minimum levels of performance for Federal facilities and total portfolio performance for Federal agencies. The related attribute of energy cost is a driving requirement in terms of systems selection, particularly thermal storage and demand peak shaving/load offset.

Energy cost, however, is not a direct report for P100 Performance, as it is possible to decrease energy consumption without a corresponding decrease in the annual cost of energy. It is possible to decrease the annual energy cost while experiencing an increase in annual energy consumption through technologies such as thermal storage. Because this would be counter to the goals of the Federal mandates, it is for this reason that only energy consumption and carbon emissions are to be measured here.



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6.1 Lighting Performance Requirements										
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification	
					Measurement & Verification	Plans & Specs	Calculations & Analysis			
<b>Lighting Quality - Interior Electric</b>										
Luminance Balance	None	3 to 1 (task to immediate surround); 40 to 1 (non work areas)	3 to 1 (task to immediate surround); 20 to 1 (non work areas)	3 to 1 (task to immediate surround); 20 to 1 (non work areas)	Yes	Yes	Provide photometric calculations.	Describe luminance balance requirements.	Using photometer measure footcandle levels at task and at immediate surroundings at 3' above floor level. Record illumination levels in footcandles and verify conformance to attribute.	
<b>Spectral Distribution</b>										
CCT	<3500K	<3500K	<3500K	Tunable	Yes	Yes		Document color temperature requirements.	Use luminance meters with built in color sensors to confirm CCT and CRI and verify conformance with attribute.	
CRI	>80	>85	>90	>95		Yes		Document color rendering index requirements.	Use luminance meters with built in color sensors to confirm CCT and CRI and verify conformance with attribute.	
<b>Lighting Layers</b>										
Ambient	Yes	Yes	Yes	Yes	Yes	Yes		Describe how ambient lighting requirement is met.	Verify provision of ambient lighting layer after construction	
Personalized	Minimal	Task	Personal	Personal	Yes	Yes		Describe task lighting system.	Verify provision of personal lighting layer after construction.	
Visual Comfort (Glare)	Minimal	Direct/Indirect	Direct/Indirect	Direct/Indirect	Yes	Yes		Describe how the design will minimize glare.	Verify provision of indirect/direct lighting fixture as part of submittal review during construction.	
User Acceptance	>60%	>70%	>80%	>90%				Describe how this POE Survey will be implemented.	Survey users after installation to determine the percentage of users that are satisfied with lighting quality and quantify the percentage of satisfied users.	
<b>Lighting Quality - Interior Daylight</b>										
Luminance Balance	View Preserving Blinds	View Preserving Blinds	View Preserving Blinds	View Preserving Blinds	Yes	Yes		Describe blind system to preserve luminance balance.	Verify provision of the blinds during design submittal.	
Lighting Layers	None	Maximize daylight access with toplighting, sidelighting, interior glazing, and low partitions on the perimeter spaces.				Yes	Yes	Yes	Describe lighting layers utilized in design.	Confirm provision of daylighting during submittal review
Visual Comfort (Glare)	View Preserving Blinds	View Preserving Blinds	View Preserving Blinds	View Preserving Blinds	Yes	Yes		Describe blind system to preserve luminance balance.	Verify provision of the blinds during design submittal.	
User Acceptance	>60%	>70%	>80%	>90%			Yes	Describe how this POE Survey will be implemented.	Survey users after installation/occupancy to determine the percentage of users that are satisfied with lighting quality and quantify the percentage of satisfied users.	
Views (11 degree minimum)	Minimal	50%	80%	100%	Yes	Yes		Document provision of views in basis of design	Measure angle of views from each user to confirm direct views to daylight/outside.	

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6.1 Lighting Performance Requirements									
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurement & Verification	Plans & Specs	Calculations & Analysis		
<b>Lighting Quality - Exterior</b>									
<b>Spectral Distribution</b>									
CCT	<4200K	<4200K	<4200K	Tunable	Yes	Yes		Describe color temperature requirement.	Use luminance meters with built in color sensors to confirm CCT and verify conformance with attribute.
CRI	>80	>80	>90	>90		Yes		Describe color rendering index requirement.	Use luminance meters with built in color sensors to confirm CRI and verify conformance with attribute.
Environmental	<3500K	<3500K	<3500K	Tunable	Yes	Yes		Describe color temperature requirements.	Use luminance meters with built in color sensors to confirm CCT and verify conformance with attribute.
Visual Comfort (Glare)	Meet G ratings per lighting zone of site	Meet G ratings per lighting zone of site (not to exceed G2)	Meet G ratings per lighting zone of site (not to exceed G1)	Meet G ratings per lighting zone of site (not to exceed G1)		Yes	Yes	Describe G rating requirements.	Verify luminaire G ratings during submittal review.
User Acceptance	>60%	>70%	>80%	>90%			Yes	Describe how this POE Survey will be implemented.	Survey users after installation/occupancy to determine the percentage of users that are satisfied with lighting quality and quantify the percentage of satisfied users.
Light Pollution / Light Trespass	Meet BUG ratings per lighting zone of site	Meet BUG ratings per LZ2	Meet BUG ratings per LZ1	Meet BUG ratings per LZ1		Yes		Describe BUG ratings for fixtures.	Verify luminaire BUG ratings during submittal review.
<b>Lighting Quantity - Interior Electric</b>									
<b>Illuminance</b>									
Horizontal	Meets IES 10th Handbook	Meets IES 10th Handbook	Meets IES 10th Handbook	Meets IES 10th Handbook			Provide photometric calculations.	Describe horizontal illuminance requirements.	Measure illuminance levels at 3' A.F.F. using a footcandle meter after installation/commissioning to verify compliance with IES.
Vertical	Meets IES 10th Handbook	Meets IES 10th Handbook	Meets IES 10th Handbook adjustable	Meets IES 10th Handbook adjustable			Provide photometric calculations.	Describe vertical illuminance requirements.	Measure illuminance levels on vertical surfaces/walls using a footcandle meter after installation/commissioning to verify compliance with IES.
<b>Availability</b>									
Surface Reflectance (Ceiling/Wall/Floor)	>80/50/20	>90/60/20	>90/70/30	>90/70/30	Yes	Yes		Define accepted surface reflectance of ceiling/wall and floor.	Measure surface reflectance levels using a reflectance meter after installation/commissioning to verify compliance.
<b>Operational Efficiency</b>									
Ambient	None	80%	70%	60%	Yes	Yes	Provide calculations.	Define percentage of ambient lighting.	Measure provision of ambient lighting levels as a percentage of overall lighting using a footcandle meter after installation/commissioning to verify compliance.
Personalized	None	20%	30%	40%	Yes	Yes	Provide calculations.	Define percentage of personalized lighting.	Verify conformance by calculating the installed percentage of personalized lighting to overall lighting.

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Lighting Performance									
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Design Basis of Design	Construction Verification
					Measurement & Verification	Plans & Specs	Calculations & Analysis		
<b>Lighting Quantity - Interior Daylight</b>									
Surface Reflectance (Ceiling/Wall/Floor)	>80/50/20	>90/60/20	>90/70/30	>90/70/30	Yes	Yes		Define accepted surface reflectance of ceiling/wall and floor.	Measure surface reflectance levels using a reflectance meter after installation/commissioning to verify compliance.
Daylight Autonomy (10-500 fc)	Minimal	>50%	>80%	>100%	Yes	Yes		Describe provision of daylighting autonomy as a percentage.	Provide daylight model as part of submittals to verify compliance.
<b>Lighting Quantity - Exterior Illuminance</b>									
Meets IES 10th HB	Meets IES 10th Handbook	Meets IES 10th Handbook	Meets IES 10th Handbook	Meets IES 10th Handbook	Yes	Yes	Provide photometric calculations.	Define acceptable exterior illuminance levels in conformance with IES 10th HB.	Measure horizontal illuminance levels at floor level using a footcandle meter after installation/commissioning to verify compliance with IES.
Vertical	Meets IES 10th Handbook	Meets IES 10th Handbook	Meets IES 10th Handbook (adjustable)	Meets IES 10th Handbook (adjustable)	Yes	Yes	Provide photometric calculations.	Define acceptable illuminance levels in conformance with IES 10th HB.	Measure illuminance levels using a footcandle meter after installation/commissioning on vertical walls/facades to verify compliance with IES.
<b>Lighting Energy Use - Interior Electric</b>									
System Efficiency	Exceeds ASHRAE 90.1-2007 by 30%	Exceeds ASHRAE 90.1-2007 by 40%	Exceeds ASHRAE 90.1-2007 by 50% (performance)	Exceeds ASHRAE 90.1-2007 by 70% (performance)	Yes	Yes	Yes	Provide ASHRAE 90.1-2007 Appendix G energy model demonstrating lighting annual energy does not exceed project target.	Measure interior lighting energy after installation/commissioning and confirm percentage exceeding ASHRAE requirements by documenting the ratio of actual interior lighting power density to ASHRAE allowed lighting power density and calculate/document actual percentage.

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## 6.1 Lighting Performance Requirements

Lighting Energy Use - Interior Electric									
Controls	Exceeds ASHRAE 90.1-2007 by 30%	Automatic OC + personal	DALI Equivalent + personal	DALI Equivalent + personal	Yes	Yes		Describe lighting control system.	Verify control system operation/commission system after installation to verify compliance.
Real Time Energy Use	Minimal	Modeling	Modeling + Monitoring	Modeling, Monitoring, Feedback		Yes	Yes	Describe real time energy use scheme proposed in the design.	Document interior lighting energy after installation/commissioning and confirm/document actual interior lighting energy consumed to modeled energy.
Lighting Energy Use - Exterior									
Lighting Power Density <sub>(w/sf)</sub>	Exceeds 90.1-2007 by 30%	Exceeds 90.1-2007 by 40%	Exceeds 90.1-2007 by 50% (performance)	Exceeds 90.1-2007 by 70% (performance)		Yes	Provide calculations.	Provide requirement for describing exterior lighting energy separately and showing exceeding ASHRAE requirements.	Measure exterior lighting energy after installation/commissioning and confirm percentage exceeding ASHRAE requirements by documenting the ratio of actual exterior lighting power density to ASHRAE allowed lighting power density and calculate/document actual percentage.
Controls	Nighttime setback controls added (Not less than 50% maximum output)	Nighttime setback controls added (Not less than 50% maximum output)	Network Controls (Not less than 50% maximum output)	Network Controls (Not less than 50% maximum output)	Yes	Yes		Describe lighting control system.	Verify control system operation/commission system after installation to confirm nighttime set back controls at less than 50%.
Real Time Energy Use	Minimal	Modeling	Modeling + Monitoring	Modeling, Monitoring, Feedback		Yes	Yes	Describe real time energy use scheme proposed in the design.	Document exterior lighting energy after installation/commissioning and confirm/document actual exterior lighting energy consumed to modeled energy.
Power Quality									
Power Factor	>0.85	>0.90	>0.90	>0.95		Yes		Describe power factor accepted values in basis of design.	Use power meter to confirm ratio of total active to reactive power to confirm the power factor of the system. Measure input power on light fixtures circuits to confirm the parameter and verify compliance.
Total Harmonic Distortion	<20%	<15%	<10%	<5%	Yes	Yes		Describe acceptable percentages of total harmonic distortion in ballasts.	Use power meter to confirm total harmonic distortion. Measure input power quality on lighting circuits to confirm the parameter after installation to verify compliance.
Wiring	Run separate neutral for each circuit	Run separate neutral for each circuit	Run separate neutral for each circuit	Run separate neutral for each circuit		Yes		Indicate provision of a separate neutral for each lighting circuit in basis of design.	Provide in Lighting specifications and confirm by inspecting during installation to verify compliance.

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Lighting Performance									
Attribute	Baseline	★	★★	★★★	Verification			Design Basis of Design	Construction Verification
		Tier 1 High Performance	Tier 2 High Performance	Tier 3 High Performance	Measurement & Verification	Plans & Specs	Calculations & Analysis		
<b>Maintenance</b>									
Equipment Life	1 Yr Warranty	5 Yr Warranty	Performance Based	Service Provider		Yes		Describe warranty for each equipment.	Verify through light fixture submittals and warranty certificates.
Accessibility	Coordinate design with facilities maintenance to ensure all luminaires can be reached with lifts, ladders, etc.				Yes	Yes	Yes	Provide requirement for easy access to luminaires and their components.	Verify installation of fixtures heights and locations in shop drawing submittal and actual heights and clearances after installation.
Diagnostics	Minimal	Minimal	Full Ability	Full Ability + Predictive	Yes	Yes		Describe the ability to diagnose lighting systems.	Verify through shop drawing submittal and product submittal information.
<b>Service Life</b>									
Replacement	10 Years	15 Years	20 Years	20 Years		Yes		Describe serviceable life of lighting system.	Verify through light fixture submittals and warranty certificates.
Retrofit	2 Years	5 Years	10 Years	10 Years		Yes		Describe service life requirement for retrofit of system.	Verify through light fixture submittals and warranty certificates.

## 6.2 Lighting Performance Attributes

The following attributes make up a lighting system for any space. The descriptions below do not isolate electric lighting from daylighting. Instead, the attributes apply to both sources of light and continually interact throughout the day to provide adequate and appropriate visibility.

### 6.2.1 Lighting Quality

The quality of a visual environment considers a wide range of variables including luminance balance, color appearance, visibility of multiple visual tasks (often accomplished by a layered lighting system), visual comfort, daylight and views, control and finally, user acceptance.

Luminance balance refers to the brightness of surfaces (vertical and horizontal) within the view of an occupant. When excessive brightness and darkness are combined in the same view, the contrast leads to visual discomfort and even headaches as the eyes continually adjust between the extremes. Balancing these luminance values means maintaining good uniformity between all the surfaces that make up a field of view. Lighting the vertical wall surfaces is one of the best ways to improve luminance balance. Since luminance, especially for interior areas, is difficult to calculate, the IES 10<sup>th</sup> Edition Handbook recommends illuminance and uniformity values for vertical surfaces such as walls. If surfaces have very low reflectance values such as dark wooden walls, these illuminance values may need to be increased.

Color appearance is made up of the correlated color temperature (CCT - the color of the light source) the color rendering index (CRI - how well the light portrays the color of objects) as well as the individual wavelengths that make up the light (the Spectral Power Distribution [SPD]). The R9 value refers to a specific rating of the red component of the light color.

Office and industrial building occupants generally prefer warm to neutral color temperatures in the  
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3000-4100K range. Cooler colors than this can produce slightly higher visual acuity in some applications but may also create a sense of starkness and institutionalism.

Layering the lighting system with ambient, task, and accent light creates variety in spaces and makes it easier to maintain the luminance balance. An ambient layer provides a low level of diffuse lighting that can help illuminate objects and people's faces, which is helpful for general wayfinding and for face-to-face communication, a sense of brightness and illuminates the architectural surfaces, such as the walls and ceiling. Task lighting provides the actual quantity of light necessary to perform a job (such as reading paperwork or filing) and draws the eye to the work surface. Accent lighting adds emphasis and visual variety in a space. Luminance balance means keeping enough brightness variety in the space to make it interesting and to highlight work areas, without making the lighting appear spotty or full of shadows.

Visual comfort relates mostly to glare from any light source – a luminaire, window, skylight, etc. Unfortunately, glare tolerance is often subjective and varies between individuals. Glare is controlled by selecting luminaires that direct their light toward the ceiling, walls, or work areas, but not into the employee's eyes. Louvers, shields, fins, overhangs, and blinds all reduce glare from windows and skylights; louvers, lenses, baffles, and the optics of the luminaire control glare from electric sources.

Closely related to visual comfort, views to the outdoors are an essential part of visual comfort – providing a link to activity, changes in time and weather, more organic forms, and other variety for the eyes. However, care must be taken to eliminate unwanted glare and excessive brightness that can occur at some times of day at some times during the year. Glare from windows must be minimized and balanced with the other views of the space.

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Lighting control is essential for the users. View-preserving blinds or shades minimize direct sun and glare from windows or skylights. Personal controls give the individual user the ability to adjust task lighting and balance brightness in their own workstation. Automatic controls for daylight dimming and occupancy save energy.

The true test of a quality lighting system is customer feedback. Post occupancy evaluation of the daylighting, views, electric lighting, and controls will be best evaluator of the lighting quality success.

All of these components result in some level of user acceptance of the lighting system.

- **Baseline:** Does not have any requirements for vertical surface illuminance or color appearance, allows for CCT up to 5000K and minimum CRI of 70. The baseline also has no minimal requirements for task lighting, glare control, and access to views.
- **Tier 1 High Performance (★):** This level requires maximum illuminance uniformity ratios of 40:1, CCT of no more than 4100K, and CRI of at least 80. It also requires task lighting, direct/indirect ambient lighting, view-preserving blinds, and views for at least 50% of regularly occupied areas.
- **Tier 2 High Performance (★★):** Raises uniformity ratios to 20:1 and CRI to 80 and R9 of at least 50. For outdoor lighting, that could have a negative effect on flora and fauna, CCT cannot exceed 4100K. Occupants should have personal control over their entire work area or task lighting and access to views is increased to 80% of regularly occupied area.
- **Tier 3 High Performance (★★★):** This performance level continues Tier 2 High Performance (★★) but allows for tunable CCT. Additionally, at this level, color rendering may be measured with a new color quality scale. Also

at this level, views are provided for 90% of regularly occupied spaces.

### 6.2.2 Lighting Quantity

The quantity of light is easier to measure and verify than the many components of lighting quality.

Illuminance measures the quantity of light falling on a surface (either vertical or horizontal). Recommended values of illuminance are recommended by the Illuminating Engineering Society (IES) calculated, and measured.

Availability refers to the how well the daylight is provided to the space. With good building orientation and glare control, quality daylight can be provided throughout the space. High reflectance surfaces and high ceilings also help to distribute daylight throughout the space. Low partitions and interior glazing allow for this daylight delivery deeper into the building, as well as providing views to the outdoors for more occupants. Operational efficiency relates to the availability and the quality aspect of layered lighting. Because the light level recommended for a particular task does not need to be provided throughout an entire space, a specific portion of the work area can be illuminated with task lighting. As more and more of the lighting requirements are met with task lighting (close to the task) the ambient layer can be lowered as long as luminance balance is maintained. This shifting between lighting layers results in a net improvement in system efficiency.

- **Baseline:** Meets the IES 10<sup>th</sup> Edition Handbook recommendations for horizontal illuminance and meets minimum average base surface reflectance recommendations of 80% for ceilings, 50% for walls, and 20% for floors.
- **Tier 1 High Performance (★):** Meets the IES 10<sup>th</sup> Edition Handbook recommendations for both horizontal and vertical illuminance. Surface reflectances are increased to 90%/60%/20%. Daylight provides adequate lighting for 50% of the daytime occupancy and the electric lighting

system is made up of 80% ambient and 20% task (+/- 10%).

- Tier 2 High Performance (★★): This level maintains Tier 1 High Performance (★) but also allows for adjustable illuminance levels and recommends 90%/70%/25% minimum base surface reflectance. Additionally, daylight now provides for 80% of the daytime requirements and layers are divided 70% ambient and 30% task (+/- 10%).
- Tier 3 High Performance (★★★): This level maintains Tier 2 High Performance (★★), but increases daylight autonomy to 100%, and splits electric light between 60% ambient and 40% task (+/- 10%). Daylight autonomy refers to the percentage of annual daytime hours that daylight alone provides the required illuminance levels in regularly occupied spaces.

### 6.2.3 Energy Use

The lighting power density (LPD) of a space reflects the actual lighting power use in a space if the entire lighting system is energized at one time. However, with the use of controls, the actual energy use is significantly lower than what the LPD might suggest. Controls can provide a level of user satisfaction because the user has more adjustability of his or her own working environment, and controls also save energy. They also eliminate energy use when daylight provides adequate or a partial level of visibility, when a space is unoccupied, and when less light is desired.

An additional element of lighting control shows the building manager the real time energy use of the different building systems including lighting. While not a control that reduces energy use, it can identify potential maintenance and operation issues or potential areas for additional energy savings.

Daylighting glare control is also necessary for each occupant near windows or skylights. Either manual or automatic shade controls helps the occupant adjust

the personal luminance balance when glazing luminance is too high.

- Baseline: Exceeds ASHRAE 90.1 2007 by 30% for overall system efficacy and control requirements. It also meets LPD values of 0.60 watts/SF for ambient and 0.1 watts/SF for task lighting.
- Tier 1 High Performance (★): This level exceeds ASHRAE by 40% and lowers the LPD allowances to 0.48 ambient and 0.12 task. Additionally, daylight, occupancy, and personal controls are required in all occupied spaces and energy modeling is required as a step toward real-time energy monitoring.
- Tier 2 High Performance (★★): Exceeds ASHRAE by 50% with LPD allowances of 0.35 and 0.15 ambient and task. Addressable lighting control systems are required at this level in addition to personal control. These systems also allow for energy monitoring.
- Tier 3 High Performance (★★★): Exceeds ASHRAE by 60% with LPD allowances of 0.18 and 0.12 ambient and task. At this level, tunable CCT and real time energy monitoring and feedback features are added to the addressable control system.

### 6.2.4 Power Quality

Lighting, and especially dimmable lighting, can have a negative effect on the overall power quality of a building. Dimming of fluorescent and LED sources can lower the power factor and introduce harmonic distortion to the electrical system. In many cases, electrical components must be added at the building service entrance.

Additionally, separate neutrals must be run for circuits that contain LED dimming. Otherwise, flickering can occur over the entire circuit, even when part of the circuit is not being dimmed.



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- **Baseline:** All circuits must run separate neutrals. The overall electrical system must have a power factor (PF) of at least 0.90 and have a Total Harmonic Distortion (THD) less than 20%.
- **Tier 1 High Performance (★):** Continues all of the Baseline criteria but lowers the THD limit to 15%.
- **Tier 2 High Performance (★★):** Continues all of the Baseline criteria but lowers THD to 10%.
- **Tier 3 High Performance (★★★):** This level maintains Tier 2 High Performance (★★) but lowers THD to 5%.

### 6.2.5 Maintenance

Maintenance of a lighting system includes starting out with long life light sources and high quality luminaires or ballast and drivers that will not fail before the light sources. Fluorescent sources can last between 20,000 and 60,000 hours. LED sources now are rated for at least 50,000 hours. Induction lighting is rated for 100,000 hours. Some solid state lighting such as LEDs may not burn out, but slowly dim over the course of their life. In these instances, life is based on an L70 or when the light source is producing only 70% of its initial light output.

In addition to the life of the lighting equipment, diagnostic controls and models can pinpoint failed components such as ballasts or drivers and predict the end-of-life periods, provide real time energy use, and recommend replacement times.

- **Baseline:** 1 year warranty on all lighting equipment.
- **Tier 1 High Performance (★):** 5 year warranty on all lighting equipment.
- **Tier 2 High Performance (★★):** At this level, a performance based life is required rather than a warranty. This difference requires the lighting

equipment to meet a certain level of performance for a given amount of time – not just replace a component failure. Additionally, diagnostics must be part of the lighting control system to assist in trouble shooting and maintenance activities.

- **Tier 3 High Performance (★★★):** At this point, “visibility” becomes the responsibility of a service provider. This entity agrees to meet the high performance criteria of the HP level for a set rate. Then capital, energy, maintenance and any other associated costs are paid by the provider. The incentive of lower operating costs keeps the system at its most cost effective and efficient. Also as part of this system the controls are upgraded to include some level of predictive ability as well as diagnostic.

### 6.2.6 Service Life

The serviceable life of the lighting system may not be as long as the actual life of all of its individual components. Space uses change. Retrofits may make sense for improved energy savings. Renovations may require changes in lighting locations. The replacement of luminaires and sources might make sense in some cases. Ideally, individual components could be easily replaced rather than entire luminaires. Sources could be relocated or simply replaced with more efficient versions with the same form factor. As solid state lighting such as LEDs and OLEDs take on a wider and wider range of applications and shapes while still rapidly increasing in efficiency, service life must be carefully considered.

- **Baseline:** Lighting equipment should be expected to be replaced within 5 years. Light source or driver technology may be upgraded after 2 years.
- **Tier 1 High Performance (★):** At this level, improved lighting equipment should not need replacement within 10 years. If technological advances such as LED efficacy make a retrofit

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desirable, the equipment should accommodate such upgrades for the first 5 years.

- Tier 2 High Performance (★★): Replacement and retrofit levels increase to 20 years and 10 years respectively.
- Tier 3 High Performance (★★★): At this level, the service provider replaces and retrofits the lighting equipment on a time frame based on cost effectiveness with appropriate technologies.

## 6.3 Lighting Prescriptive Requirements

### 6.3.1 Indoor Lighting and Daylighting Criteria

#### 6.3.1.1 Qualifications of the Lighting Practitioner

Lighting design for new construction, lighting renovations and energy retrofits must be performed or supervised by a lighting practitioner with a minimum of 10 years full time experience in lighting design with at least two of the three following qualifications of LC, IES member, or IALD member, and that devotes the majority of his/her professional time to the design of architectural lighting.

#### 6.3.1.2 Artwork

Museum standards for lighting works of art must follow the IES 10<sup>th</sup> Edition Handbook; see Chapter 4.1, Installation Standards, in Fine Arts Collection Policies and Procedures 2007 for additional information.

#### 6.3.1.3 Exterior Lighting Design Criteria

Exterior lighting must meet the IES 10<sup>th</sup> Edition Handbook recommendations and comply with the IDA/IES Model Lighting Ordinance (MLO) for lumen density limits and backlight, up-light, and glare (BUG) ratings or light pollution and light trespass performance method.

Exterior luminaires and control systems must comply with all local zoning laws, and lighting levels for exterior spaces shall not exceed the IES 10th Edition Lighting Handbook recommendations.

Luminaires with instant strike light sources at all entrances and exits must be connected to the emergency lighting system.

#### 6.3.1.4 Site Lighting

Illumination of exterior exit discharges must be in accordance with the requirements in NFPA 101.

The flagpole must be illuminated and controlled.

#### 6.3.1.5 Open Parking Lots and Roadway Lighting

Parking lots and roadway lighting must be designed per RP-8 current version in addition to the IES and IDA/IES MLO requirements.

#### 6.3.1.6 Parking Structures

Parking structure lighting must be designed per the IES and dimmed to at least 50% during periods of low activity and turned off when daylight is plentiful.

Luminaires must meet the following standards:

- Efficacy of a minimum of 63 lumen per watt (LPW)
- Wet-location rated
- Withstand mechanical vibration
- Life of minimum 25,000 operating hours for LED fixtures before reaching the L<sub>70</sub> lumen output degradation with no catastrophic failures per IES standard LM-21-11
- Lumen depreciation per IES standard LM-79-08
- Luminaire classification per IES TM-15-11

#### 6.3.1.7 Illumination of Means of Egress

Illumination of means of egress shall be provided in accordance with the requirements in NFPA 101. In addition, the use of automatic, motion sensor-type lighting switches shall be permitted within the means of egress, provided that the lighting control devices comply with the requirements in NFPA 101.

### **6.3.1.8 Exit Stair Illumination and Photoluminescent Materials**

Exit enclosures where photoluminescent materials are installed must comply with the requirements in NFPA 101

### **6.3.1.9 Emergency Lighting Criteria**

Power loss resulting from utility system interruptions, building electrical distribution system failure, or the accidental opening of switches or circuit breakers dictates the requirement for emergency lighting.

### **6.3.1.10 Luminaires**

Emergency electric lighting systems may consist of separate luminaires and wiring with an independent power source, e.g., a diesel generator, or separate luminaires or unit devices supplied by the normal power supply and a secondary source that comes on automatically when the normal power supply fails.

### **6.3.1.11 Emergency Lighting**

Emergency lighting for means of egress must be provided in accordance with the requirements in NFPA 101. Emergency lighting outside the building must also provide illumination to either a public way or a safe distance away from the building, whichever is closest to the building being evacuated.

### **6.3.1.12 Performance of Emergency Lighting System**

The performance of the emergency lighting system must be in accordance with the requirements in NFPA 101

## **6.3.2 Load Criteria**

### **6.3.2.1 Lighting Loads**

The lighting and daylighting systems must be sensitive to the architectural design, provide adequate quality and quantity of illumination for interior and exterior lighting, comply with the design criteria, minimize maintenance requirements, and use 30 percent less electrical energy (kwh) than required for compliance with Section 9.6 (Alternative Compliance Path: Space-by-Space Method) of ASHRAE Standard 90.1-2007.

General lighting must comply with the following luminaire, lamp, light source ballast and driver requirements.

### **6.3.2.2 Luminaires**

All luminaires must be appropriately selected based upon the expected application. Luminaires must have a minimum luminaire efficiency of 65 percent.

Where parabolic luminaires are used, louvers must be semi-specular or diffuse finishes; specular finishes must not be used.

LED lamps must not be retrofitted into existing luminaires.

Minimize lamps, light sources ballasts and driver types.

### **6.3.2.3 Lamps**

Effort must be made to minimize the number of lamp types within a facility to simplify lamp maintenance.

In retrofit scenarios, all fluorescent lamps must be recycled by firms that recover the mercury that is contained within the lamps. All PCB-containing ballasts must be disposed of through specialized disposal firms that destroy the PCBs.

### 6.3.2.4 Ballasts and Drivers

Ballasts for fluorescent lamps must be “NEMA Premium” when applicable. Ballasts must be compatible with control system.

Electronic ballasts and drivers must be used wherever possible and have a sound rating of “A.” When EM ballasts must be used in special applications, EM ballasts must have a sound rating of “A” for 430MA (Standard Output) lamps, or “B” for 800 MA lamps, and “C” for 1,500 MA lamps. Special consideration must be given to the ballast types where an electronic clock system is also specified to confirm compatibility of application.

### 6.3.2.5 Lighting Controls

Control systems must be compatible with lamps, light sources, ballasts and lamps.

Lighting controls must use individual luminaire control, such as DALI equivalent. Ambient lighting must be adjusted per daylight availability, occupant/vacancy, and other BAS signals, such as demand response. Task and personalized ambient lighting must be adjusted per occupancy/vacancy and personal dimming.

Lighting controls must be commissioned to operate as intended without false triggering. All lighting controls must be compatible with luminaires. Lighting control devices provided for illumination within exit enclosures must comply with the requirements in NFPA 101.

## 6.3.3 Security Lighting, Exit Signs, and Emergency Lighting

### 6.3.3.1 Security Lighting

Security lighting is lighting that remains on during unoccupied hours per applicable GSA and tenant criteria. Security lighting in daylit spaces must be controlled by photosensors. When security lighting GSA P-100 Version 1.0, issued March 2014

also functions as emergency lighting, separate circuits and emergency ballasts are required.

### 6.3.3.2 Exit Signs

Exit signs must meet the requirements in NFPA 101 and be energy efficient and environmentally friendly products (e.g., light emitting diodes (LED type), photoluminescent type. Tritium exit signs must not be installed.

### 6.3.3.3 Emergency Lighting

Emergency lighting must be provided in accordance with the requirements of NFPA 101. At a minimum, unswitched emergency lighting must be provided in the following areas:

- Zones covered by closed-circuit TV cameras
- Security zones
- Fire command center
- Security control center
- Where required in NFPA 101
- UPS and battery rooms

Emergency lighting may be manually switched from within in the following areas:

- Communication equipment rooms
- Electrical rooms
- Technology/server rooms
- Engineers’ offices

Supplemental battery-powered emergency lighting must be provided in the following spaces to bridge the generator startup time:

- Generator rooms
- Main mechanical and electrical rooms
- Any locations where lighting cannot be interrupted for any length of time

### 6.3.4 Specific Lighting Requirements

([www.gsa.gov/technicalpreservationguidelines](http://www.gsa.gov/technicalpreservationguidelines)) for additional guidance.

#### 6.3.4.1 Special Areas

Certain areas, where the lighting design must be an integral part of the architecture, require special lighting design concepts. The certified lighting designer must integrate the design with the interior finishes and furniture arrangement to enhance the functionality of the spaces. Further consideration must be taken to adhere to the energy criteria and maintenance criteria, as well as minimizing the number of special lamp types and fixtures required. Areas generally requiring special lighting treatment are as follows:

- Main entrance lobbies
- Atriums
- Elevator lobbies
- Public corridors
- Public areas
- Auditoriums
- Conference rooms
- Training rooms
- Dining areas and serveries
- Libraries

#### 6.3.4.2 Lighting – Historic Buildings

Historic chandeliers, pendant lights, sconces, and other period lighting may be upgraded with energy efficient light sources and optical enhancements that preserve the historic appearance of the luminaire and space. Replica lighting for restoration zones should be fabricated or modified to accept energy efficient lamps. Supplemental lighting, when required, must be designed and located to minimize penetration of ornamental wall and ceiling surfaces and to avoid competing visually with historic lighting.

Recommended alternatives for increasing light levels in ceremonial spaces, when relamping is not sufficient, include compatibly designed floor lamps, task lights, and discretely placed indirect lighting. Refer to Upgrading Historic Building Lighting

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6.4 Electrical Performance Requirements										
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Reference Standard	Design Basis of Design	Construction Verification
					Measurement & Verification	Plans & Specs	Calculation & Analysis			
<b>Transformers</b>										
Efficiencies for Network Transformers and Substation Transformers (<= 600V Secondary & <=34.5 KV Primary)	NEMA TP-1-2002	10 Percent less losses than NEMA TP-1 -2002	20 Percent less losses than NEMA TP-1 -2002	25 Percent less losses than NEMA TP-1 -2002	Yes	Submit certified performance data for each unit		NEMA TP-1 -2002	Describe transformer efficiency requirements.	Verify submittals and certified performance data from manufacturer for supplied transformer units to verify compliance.
Insulating fluid for oil-filled Network Transformers and Substation Transformers (<= 600V Secondary & <=34.5 KV Primary)	65 °C non-petroleum-based insulating-oil	65 °C non-petroleum-based insulating-oil	65 °C FR3 non-petroleum-based insulating-oil	65 °C FR3 non-petroleum-based insulating-oil		Yes		NEMA TP-1 -2002	Describe transformer insulating fluid requirements.	Verify submittals and certified performance data from manufacturer for supplied transformer units to verify compliance.
Efficiencies for Low-voltage Distribution Transformers (120/208 3Ph, 4W Secondary; 480V, 3Ph, 3W Primary)	NEMA TP-1-2002	10 Percent less losses than NEMA TP-1 -2002	20 Percent less losses than NEMA TP-1 -2002	25 Percent less losses than NEMA TP-1 -2002		Certified Representative Factory Test Report		NEMA TP-1 -2002	Describe low voltage distribution transformer efficiencies.	Verify submittals and certified performance data from manufacturer for supplied transformer units to verify compliance.
Impedance for Low-voltage Distribution Transformers (120/208 3Ph, 4W Secondary; 480V, 3Ph, 3W Primary)	>4 %Z	>4 %Z	>4 %Z	>5 %Z		Certified Representative Factory Test Report		NEMA TP-1 -2002	Describe transformer impedance requirements.	Verify submittals and certified performance data from manufacturer for supplied transformer units to verify compliance.
Harmonic Rated Transformers & Harmonic Mitigating Transformers	K-13 or higher w/200% neutral >4% Z	K-20 or higher w/200% neutral >4% Z	Zigzag 3rd Harmonic Mitigating Transformers (0 degree, and 30 degree), Copper windings, >4% Z, K13 or higher (Match 0 and 30 degree transformers in distribution for harmonic mitigation of 5th and 7th order harmonics)	Zigzag 3rd Harmonic Mitigating Transformers (0 degree, 15 degree and 30 degree), Copper windings, >4% Z, K13 or higher (Match 0, 15 and 30 degree transformers in distribution for harmonic mitigation of 5th and 7th order harmonics)		Certified Representative Factory Test Report		NEMA TP-1 -2002	Describe transformer harmonic requirements.	Verify submittals and certified performance data from manufacturer for supplied transformer units to verify compliance.
<b>Variable Frequency Drives</b>										
Use on motors 5HP (3.7kW) to 25 Hp (18.7kW)	6-pulse width modulation (PWM) IGBT Drives	6-pulse width modulation (PWM) IGBT Drives Passive Harmonic Filtration <5% THD Current at Drive Terminals	6-pulse width modulation (PWM) IGBT Drives Active Harmonic Filtration <5% THD Current at Drive Terminals	6-pulse width modulation (PWM) IGBT Drives IGBT Front End <5% THD Current at Drive Terminals >95% Input Power Factor				IEEE 519 5% Current THD at Drive Input Terminals, IEEE 519 3% Voltage THD in at Sensitive Equipment Panels, and 5% Voltage THD at 480/277 Transformer Secondary Terminals	Describe VFD requirements to show compliance with metrics.	Verify submittals and certified performance data from manufacturer for supplied VFD's s to verify compliance.
Use on motors 30HP (22.4kW) to 100HP (74.6 kW)	6-pulse width modulation (PWM) IGBT Drives. Provide 12 or 18 pulse where the harmonic analysis indicates noncompliance	12-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM) <= 5% THD Current at Drive Terminals	18-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM) <= 5% THD Current at Drive Terminals	18-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM) <= 5% THD Current at Drive Terminals				IEEE 519 5% Current THD at Drive Input Terminals, IEEE 519 3% Voltage THD in at Sensitive Equipment Panels, and 5% Voltage THD at 480/277 Transformer Secondary Terminals	Describe VFD requirements to show compliance with metrics.	Verify submittals and certified performance data from manufacturer for supplied VFD's s to verify compliance.
Use on motors 125HP (93.3kW) and larger	18-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM) <= 5% THD Current at Drive Terminals	18-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM) <= 5% THD Current at Drive Terminals	18-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM) <= 5% THD Current at Drive Terminals	18-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM) <= 5% THD Current at Drive Terminals				IEEE 519 5% Current THD at Drive Input Terminals, IEEE 519 3% Voltage THD in at Sensitive Equipment Panels, and 5% Voltage THD at 480/277 Transformer Secondary Terminals	Describe VFD requirements to show compliance with metrics.	Verify submittals and certified performance data from manufacturer for supplied VFD's s to verify compliance.

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6.4 Electrical Performance Requirements										
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Reference Standard	Design Basis of Design	Construction Verification
					Measurement & Verification	Plans & Specs	Calculation & Analysis			
<b>Metering</b>										
Metering at Building Mains	Voltmeter reading all phase to phase and phase to neutral voltages. Switchable ammeter and three-phase totalizing watt-hour meter. The power meter should be pulse-type and digital networked and/or tied into the Advanced Metering System.	Baseline, plus Utility Class 0.2% (Phase Volts, Phase Currents, Neutral Currents, Ground Currents, power consumption KWH, adjustable power demand KW, KVA & KVAR, Power Factor)	Tier 1 High Performance, plus Harmonic Waveform Analysis	Tier 2 High Performance, plus Transient Disturbance Monitoring for capture, remote alarm monitoring and disturbance download to laptop	yes		yes	ANSI C12.1 & C12.20	Describe building electrical meter requirements and show on single line diagram.	Verify submittals and supplied meter specifications to verify compliance.
Metering for Building Feeders	As required for Advanced Building Metering and Control	As required for Advanced Building Metering and Control and to coordinate with ECMs for M&V (KW, KVA Demand, KWH)	As required for Advanced Building Metering and Control and to coordinate with ECMs for M&V (KW, KVA Demand, KWH)	As required for Advanced Building Metering and Control and to coordinate with ECMs for M&V (KW, KVA Demand, KWH)	yes				Describe building electrical sub-metering requirements and show on single line diagram.	Verify submittals and supplied meter specifications to verify compliance.
Metering Trending	As required for Advanced Building Metering and Control	As required for Advanced Building Metering and Control and with trending configured to coordinate with ECMs for M&V (KW, KVA Demand, KWH)	As required for Advanced Building Metering and Control and with trending configured to coordinate with ECMs for M&V (KW, KVA Demand, KWH)	As required for Advanced Building Metering and Control and with trending configured to coordinate with ECMs for M&V (KW, KVA Demand, KWH)	yes				Describe electrical metering scheme and trend requirements.	Verify submittals and supplied meter specifications to verify compliance.
<b>Building Automation System - Interface from Electrical Systems</b>										
Electrical Meters input to BAS and graphic displays	MODBUS/TCP/IP Protocol Meters/BACnet/LonWorks protocol Meters to match BAS with twisted pair to BAS for monitoring. The power meter should be networked and/or tied into the Advanced Metering System.	MODBUS/TCP/IP/BACnet/LonWorks Protocol Meters to match BAS with twisted pair to BAS for monitoring and graphics. Interfaced to BAS and configured for Advanced Metering System. Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end.	MODBUS/TCP/IP/BACnet/LonWorks Protocol Meters to match BAS with twisted pair to BAS for monitoring and graphics (also ethernet for TCP/IP for metering customized graphical GUI at BAS front end)	MODBUS/TCP/IP/BACnet/LonWorks Protocol Meters to match BAS with twisted pair to BAS for monitoring and graphics (also ethernet for TCP/IP for metering customized graphical GUI at BAS front end) and Wireless Submeters	yes		yes	ANSI C12.1 & C12.20; EPACKT 2005, EISA 2007 - Section 434(b)	Describe meter/BAS interface requirements.	Verify interface with BAS system and confirm metering data to verify compliance.
PV Systems Input to BAS and graphic displays	As required for Advanced Building Metering and Control	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for alarms. Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end.	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH], status and alarms. Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH], status and alarms. Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end	yes		eMerge Alliance 24VDC Occupied Space Standard	Describe PV system metering/BAS interface requirements.	Verify interface with BAS system and confirm indicated metered data to verify compliance.	
Automatic Transfer Switches input to BAS and graphic displays	N/A	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for ATS status (also ethernet for TCP/IP for ATS customized graphical GUI at BAS front end)	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH] status, and alarms Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end.	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH] status, and alarms Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end.					Describe ATS/BAS interface requirements.	Verify interface with BAS system and confirm indicated metered data to verify compliance.
Standby Generator input to BAS and graphic displays	N/A	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for generator status and alarms	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH] and generator status and alarms (NFPA 110 status and alarms)	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH] and generator status and alarms (NFPA 110 status and alarms) Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end.					Describe Standby Generator/BAS interface requirements.	Verify interface with BAS system and confirm indicated metered data to verify compliance.



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6.4 Electrical Performance Requirements										
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Reference Standard	Design Basis of Design	Construction Verification
					Measurement & Verification	Plans & Specs	Calculation & Analysis			
<b>Building Automation System - Interface from Electrical Systems</b>										
Standby Generator input to BAS and graphic displays	N/A	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for generator status and alarms	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH] and generator status and alarms (NFPA 110 status and alarms)	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH] and generator status and alarms (NFPA 110 status and alarms) Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end.					Describe Standby Generator/BAS interface requirements.	Verify interface with BAS system and confirm indicated metered data to verify compliance.
Uninterruptible Power Systems input to BAS and graphic displays	N/A	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for alarms (also ethernet for TCP/IP for metering customized graphical GUI at BAS front end)	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH] and alarms. Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end.	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH] and alarms. Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end.	Yes				Describe UPS/BAS interface requirements.	Verify interface with BAS system and confirm indicated metered data to verify compliance.
Variable Frequency Drives Input to BAS and graphic displays	N/A	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH, Amps, % speed], status (HOA, run, bypass), troubles, and alarms. Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end.	Yes				Describe VFD/BAS interface requirements.	Verify interface with BAS system and confirm indicated metered data to verify compliance.
Motor Starters Input to BAS and graphic displays	N/A	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers	MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for status [HOA, run], power measurements [KW, KVA, Power Factor, KWH], and alarms. Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end.	Yes				Describe motor starters/BAS interface requirements.	Verify interface with BAS system and confirm indicated metered data to verify compliance.
Additional computer-based BAS interface requirements	DDC using BACnet or LonTalk open communication protocols	IP sensors, thermostats, & devices	wireless self powered switches & devices	wireless self powered switches & devices	Yes		yes	EnOcean Alliance	Describe BAS interface requirements with switches and devices.	Verify interface with BAS system and confirm indicated devices to verify compliance.
Additional computer-based BAS interface requirements	Energy management & monitoring software	interface with smart phones & tablets	interface with smart phones & tablets	interface with smart phones & tablets	yes		yes		Provide BAS interface requirements with smart phones and tablets.	Verify interface with BAS system and confirm indicated devices to verify compliance.
Separate grounding system for Lightning Protection System and single point bond to building counterpoise system.	N/A	5 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method.	5 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method.	5 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method.				NFPA 70, 780, UL 96	Describe grounding requirements.	Measure grounding resistance using fall of potential method per IEEE 81 standard to verify compliance with stated values.
Equipment Grounding Conductors	All low voltage power distribution systems must be supplemented with a separate, insulated ground conductor routed with the phase and neutral conductors.								Describe grounding conductor requirements.	Verify provision of grounding conductors for each of the low voltage distribution systems.



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6.4 Electrical Performance Requirements										
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Reference Standard	Design Basis of Design	Construction Verification
					Measurement & Verification	Plans & Specs	Calculation & Analysis			
<b>Interior Electrical Distribution</b>										
Energy saving controls for automatic interruption of non-critical power after operating hours	N/A	Time of day scheduling for auto shutdown of task lighting receptacle circuits or integrate occupancy sensors with task lights.	Time of Day controllable branch panel breakers for automatic shutdown of computers, displays and task lighting after scheduled hours	IT network smart controls for automatic hot standby after initial period of inactivity & automatic power down after extended period of inactivity. Automatic controls for automatic shutdown of task lighting or time of day scheduling for auto shutdown of task lighting receptacle circuits or integrate occupancy sensors with task lights.	yes			ASHRAE 90.1, LEED M&V Standards	Describe scheme for automatic shut down of lighting and computer/display and task lighting circuits.	Verify shut down of stated loads after installation of systems to verify control sequences and shut down of stated loads after scheduled hours.
Distribution for Energy Monitoring	As required for Advanced Building Metering and Control	As required for Advanced Building Metering and Control and to measure individual Energy Cost-saving Measures (ECM) for M&V (KW, KVA Demand, KWH).	As required for Advanced Building Metering and Control with meters for separate load types (1. Lighting loads, 2. Receptacle loads, 3. Motor loads(VFD's) 4. (Motor loads (Non-VFD's), 5. Central Plant Equipment, and 6. Special purpose rooms, e.g. computer/server rooms. Also to measure individual Energy Cost-saving Measures (ECM) for M&V (KW, KVA Demand, KWH). Panels assigned to tenants shall also be individually metered.	As required for Advanced Building Metering and Control with meters for separate load types (1. Lighting loads, 2. Receptacle loads, 3. Motor loads(VFD's) 4. (Motor loads (Non-VFD's), 5. Central Plant Equipment, and 6. Special purpose rooms, e.g. computer/server rooms. Also to measure individual Energy Cost-saving Measures (ECM) for M&V (KW, KVA Demand, KWH). Panels assigned to tenants shall also be individually metered.	yes			ASHRAE 90.1, LEED M&V Standards	Describe advance building metering requirements.	Verify submittals and supplied meter specifications to verify compliance.
<b>Arc-Flash Reduction Maintenance Switches (ARMS) and Arc Flash barriers</b>										
Arc Reduction Maintenance Switches (ARMS)	N/A	N/A	All Switchgear and Main Breaker at Motor Control Centers,	All Switchgear and Main Breaker at Motor Control Centers,				NFPA 70, 70E, NEMA, UL	Describe requirements of arc flash maintenance switches.	Verify submittals and shop drawings from manufacturer for supplied units to verify compliance.
Arc-Flash barriers upon insertion of equipment	N/A	N/A	All Switchgear Main Breakers and tie breakers. Motor Control Centers,	All Switchgear Main Breakers tie breakers, and feeder breakers. Motor Control Centers,				NFPA 70, 70E, NEMA, UL	Describe requirements of arc flash barriers.	Verify submittals and shop drawings from manufacturer for supplied units to verify compliance.
<b>Power Factor Correction</b>										
	95% PFC with harmonic-tuned filters	95% PFC with automatic controls and harmonic-tuned filters	95% PFC with automatic controls and active harmonic filters	98% PFC with automatic controls and active harmonic filters				NFPA 70, NEMA	Describe power factor correction requirements.	Measure power factor using a power meter to confirm compliance with stated requirements.
<b>Surge Protection Devices</b>										
277/480 Volt distribution at Main Switchgear	Surge Protection Device - Type 2 (SPD-2) (250KA)	Surge Protection Device - Type 2 (SPD-2) (250KA)	Surge Protection Device - Type 2 (SPD-2) (250KA)	Surge Protection Device - Type 2 (SPD-2) (250KA)				UL 1449 Current Edition	Describe surge protection requirements at main switchgear.	Verify submittals and shop drawings from manufacturer for supplied units to verify compliance.
277/480V Volt distribution at Distribution Panels	Surge Protection Device - Type 2 (SPD-2) (160KA)	Surge Protection Device - Type 2 (SPD-2) (160KA)	Surge Protection Device - Type 2 (SPD-2) (160KA)	Surge Protection Device - Type 2 (SPD-2) (160KA)				UL 1449 Current Edition	Describe surge protection requirements at distribution panels.	Verify submittals and shop drawings from manufacturer for supplied units to verify compliance.
277/480V Volt Branch Panels	N/A	N/A	N/A	Surge Protection Device - Type 2 (SPD-2) (50KA)				UL 1449 Current Edition	Describe surge protection requirements at branch panels.	Verify submittals and shop drawings from manufacturer for supplied units to verify compliance.
120/208V Volt Branch Panels	N/A	N/A	N/A	Surge Protection Device - Type 2 (SPD-2) (50KA)				UL 1449 Current Edition	Describe surge protection requirements at branch panels.	Verify submittals and shop drawings from manufacturer for supplied units to verify compliance.

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6.4 Electrical Performance Requirements										
Attribute	Baseline	★ Tier 1 High Performance	★★ Tier 2 High Performance	★★★ Tier 3 High Performance	Verification			Reference Standard	Design Basis of Design	Construction Verification
					Measurement & Verification	Plans & Specs	Calculation & Analysis			
<b>Lightning Protection Systems (LPS)</b>										
Lightning Protection Systems	Yes where required per NFPA evaluation	Yes where required per NFPA evaluation	Yes where required per NFPA evaluation	Yes where required per NFPA evaluation		Yes			Describe lightning protection system.	Verify submittals and shop drawings from manufacturer for supplied units to verify compliance.
Lightning Protection Systems UL Compliance	UL 96	UL 96	UL 96	UL 96		Yes		UL 96, NFPA 780	Describe lightning protection system.	Verify submittals and shop drawings from manufacturer for supplied units to verify compliance.
Lightning Protection Systems UL Master Label Compliance	N/A	N/A	Master Label	Master Label		Yes		UL 96 (Master Label)	Describe lightning protection system.	Verify submittals and shop drawings from manufacturer for supplied units to verify compliance.
Surge Protection for building service, incoming copper cables and equipment per Master Label Requirements	N/A	N/A	Yes	Yes		Yes		UL 96 (Master Label)	Describe lightning surge protection requirements.	Verify submittals and shop drawings from manufacturer for supplied units to verify compliance.
<b>Grounding</b>										
Earth counterpoise	N/A	5 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method.	2 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method.	1 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method.	Yes			NFPA 70, IEEE, BICSI/TIA	Describe grounding requirements.	Measure grounding resistance using fall of potential method per IEEE 81 standard to verify compliance with stated values.
Separate grounding system for Lightning Protection System and single point bond to building counterpoise system.	N/A	5 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method.	5 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method.	5 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method.				NFPA 70, 780, UL 96	Describe grounding requirements.	Measure grounding resistance using fall of potential method per IEEE 81 standard to verify compliance with stated values.
Equipment Grounding Conductors	All low voltage power distribution systems must be supplemented with a separate, insulated ground conductor routed with the phase and neutral conductors.								Describe grounding conductor requirements.	Verify provision of grounding conductors for each of the low voltage distribution systems.
<b>Uninterruptible Power Systems (UPS)</b>										
Efficiency	Double conversion efficiency of 90%	Double conversion efficiency of 95%	IGBT rectifier and IGBT inverter Double conversion efficiency of 96%	IGBT rectifier and IGBT inverter Double conversion efficiency of 97%	Yes				Describe UPS efficiency requirements.	Verify submittals from manufacturer for supplied units to verify compliance.
Power Factor - Output	80%	80%	90%	90%	Yes				Describe UPS output power factor requirements.	Measure output power factor using a power meter to confirm compliance with stated requirements.
Power Factor - Input	80%	80%	90%	100%	Yes				Describe UPS input power factor requirements.	Measure input power factor using a power meter to confirm compliance with stated requirements.
Input Harmonics	<30% current THD	Rectifier with filters for <7% current THD	IGBT rectifier for <5% current THD	IGBT rectifier for <5% current THD	Certified Representative Factory Test Report				Describe UPS THD requirements.	Measure harmonics using a power meter per IEEE 519 standard to confirm compliance with stated requirements.

# 6.5 Prescriptive Electrical Engineering Requirements

## 6.5.1 Goals and Objectives

This chapter identifies criteria that must be used to program and design electrical power, lighting, and communications systems in GSA buildings. These systems support the many types of equipment in a reliable fashion. During the life span of a Federal building, many minor and major alterations are necessary as the missions of Government agencies change. The flexibility to adjust to alterations must be designed into the building systems from the outset. Electrical power, lighting, and communications systems must provide ample capacity for increased load concentrations and allow modifications to be made in one area without causing major disruptions in other areas of the facility.

The electrical system design must be signed by a registered professional electrical engineer.

### 6.5.1.1 Design Intent

The design of electrical power, lighting, communications systems, and other building components must function together resulting in a building that meets the project's program requirements, as well as incorporating GSA's commitment to sustainability and energy efficiency.

GSA recognizes that communication needs and technology are growing at an increasingly rapid pace. Work stations are becoming more powerful, requiring faster and easier access to more information. It is GSA's intent to provide the wiring and interfaces to support these requirements. The design of all communications cabling systems is the responsibility of GSA's Federal Acquisition Service (FAS).

A computer-based Building Automation System (BAS) that interfaces, monitors, and automatically controls

lighting, heating, ventilating, and air conditioning is critical to the efficient operation of modern Federal buildings, including courthouses, office buildings, and other facilities. GSA requires the integration of building automation systems, with the exception of fire alarm and security systems, which must function as stand-alone systems with a monitoring-only interface to the BAS (see Electrical Performance Criteria).

Security is important in the design, construction, and operation of electrical power, lighting, and communications systems design. Refer to ISC Security Guidelines.

Electrical power, lighting, and communications systems must be adapted to support all performance objectives defined for the project, typically including sustainability, workplace performance (productivity and efficiency), fire safety, security, historic preservation, and improved operations and maintenance. Compliance with Appendix A, Submission Requirements, is required to demonstrate that these systems have been adapted into the project at each phase of the design.

Maintainability and reliability are paramount to the operation of Federal buildings. Therefore, the design and installation of all electrical systems and equipment must allow for the safe repair, removal, and replacement—including major components such as switchgear, motor control centers, and emergency/standby generators—without removal of exterior walls and impact to adjacent equipment and building occupants.

Electrical power, lighting, and communications systems must be specifically designed to meet all of the defined performance objectives of the project at full-load and part-load conditions that are associated

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with the projected occupancies and modes of operation.

Commissioning of major changes to electrical power, lighting, and communications systems must be initiated at the conceptual design phase of the project and continue through all design and construction phases.

For special design considerations and design criteria for U.S. Court facilities, see Chapter 8, Design Standards for U.S. Court Facilities.

### 6.5.2 Codes, Standards, and Guidelines

Refer to Chapter 1 for guidance on code compliance.

#### 6.5.2.1 Electrical Design Publications and Standards

The latest editions of publications and standards listed here are intended as guidelines for design. They are mandatory only where referenced as such in the text of this chapter or in applicable codes. The list is not meant to restrict or preclude the use of additional guides or standards.

When publications and standards are referenced as mandatory, any recommended practices or features must be considered as “required.” When discrepancies between requirements are encountered, GSA will determine the governing requirement.

The following Codes and Standards requirements must be incorporated into any GSA project design.

##### Codes and Standards

- ASME: American Society of Mechanical Engineers
- ASME A17.1, Safety Code for Elevators and Escalators
- ASTM: American Society for Testing and Materials

- ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings
- BICSI, (Building Industry Consulting Service International) Telecommunications Distribution Methods Manual
- BICSI, Wireless Design Reference Manual
- California Energy Commission, 2008 Building Energy Efficiency Standards (Title 24)
- CBM: Certified Ballast Manufacturers
- ETL: Electrical Testing Laboratories
- FAA: Federal Aviation Agency
- Federal Information Processing Standard 175, Federal Building Standard for Telecommunication Pathways and Spaces
- IESNA: Illuminating Engineering Society of North America
- IESNA Lighting Handbook, Ninth Edition
- IESNA RP-1-04, American National Standard Practice of Office Lighting
- IESNA RP-5-99, Recommended Practice for Daylighting
- IESNA LM-79-08, Electrical and Photometric Measurements of Solid-State Lighting Products
- IESNA LM-80-08, Measuring Lumen Maintenance of LED Light Sources
- IESNA TM-15-07, Luminaire Classification System for Outdoor Luminaires
- IEEE: Institute of Electrical and Electronics Engineers
- ICEA: Insulated Cable Engineers Association
- NEMA: National Electrical Manufacturers Association
- NFPA: National Fire Protection Association
- NFPA 70, National Electrical Code
- NFPA 70E, Standard for Electrical Safety in the Workplace
- NFPA 101, Life Safety Code
- NFPA 110, Standard for Emergency and Standby Power Systems
- NFPA 111, Standard on Stored Electrical Energy Emergency and Standby Power Systems
- NFPA 780, Standard for the Installation of Lightning Protection Systems
- UL: Underwriters’ Laboratories

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- UL50, Enclosures for Electrical Equipment for Types 12, 3, 3R, 4, 4X, 5, 6, 6P, 12, 12K, and 13
- UL67, Panelboards

### Communication System Pathways and Spaces Design Standards

The communications system pathways and spaces must be designed in accordance with the latest edition of the BICSI Telecommunications Distribution Methods Manual, and coordinated with GSA's FAS to fulfill specific system requirements. The following standards define the minimum allowable requirements.

Wireless systems must be designed in accordance with the latest edition of the BICSI Wireless Design Reference Manual, and coordinated with GSA's FAS to fulfill specific requirements.

Electronic Industries Alliance/Telecommunications Industry Association (EIA/TIA) Standards are listed below.

- EIA/TIA Standard 568, Commercial Building Wiring Standard (and related bulletins)
- EIA/TIA Standard 569, Commercial Building Standard for Telecommunications Pathways and Spaces (and related bulletins)
- EIA/TIA Standard 606, Administration Standard for the Commercial Telecommunications Infrastructure (and related bulletins)
- EIA/TIA Standard 607, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications (and related bulletins)
- EIA/TIA Standard 758, Customer-Owned Outside Plant Telecommunications Cabling Standard

### 6.5.2.2 Load Criteria

In determining electrical loads for Federal buildings, it is important to look beyond the immediate requirements stated in the project program. Future moves and changes have the effect of redistributing electrical loads. Unless otherwise specifically defined in the program requirements, the connected receptacle loads and lighting loads must be combined with other electrical loads in the building, multiplied by the appropriate demand factors and with spare capacity added, to determine the overall electrical load of the building. The specific electrical power loads must be determined independently for the following load groups:

- Lighting
- Receptacle loads
- Motor and equipment loads
- Elevator and other vertical transportation loads
- Miscellaneous loads

#### Receptacle Loads

A list of typical receptacle load requirements is shown in Table 6-10. Refer to Section 6.10 for further information on the receptacle design conditions and constraints.

Area/Activity	Service Equipment		Distribution Equipment	
	W/m <sup>2</sup>	W/ft <sup>2</sup>	W/m <sup>2</sup>	W/ft <sup>2</sup>
Office/enclosed	14.00	1.30	27	2.50
Office open	14.00	1.30	35	3.25
Non-workstation areas	5.00	0.50	10	1.00
Core and public areas	2.50	0.25	5	0.50
Technology/server rooms	540.00	50.00	700	65.00

**Table. Minimum Receptacle Load**

**Motor and Equipment Loads**

Loads associated with motors and equipment must use the rated brake horsepower of specified equipment and nominal full-load efficiencies that exceed those in Table 10-A of ASHRAE Standard 90.1-2004. Refer to Section 5.3 for additional criteria.

**Elevator and Other Vertical Transportation Loads**

Electrical power loads for elevators and other vertical transportation equipment must be based on the rated brake horsepower of the specified equipment and nominal full-load efficiencies that exceed those in Table 10-A of ASHRAE Standard 90.1-2004. Demand factors identified in NFPA 70, Chapter 6 must be applied. Refer to Section 5.3 for additional criteria.

**Miscellaneous Loads**

These loads include:

- Security, communication, BAS, and alarm systems
- Heat tracing
- Kitchen equipment
- Central computer servers and data centers
- Uninterruptible power supply (UPS) and battery rooms

Electrical loads for miscellaneous equipment must be based on the rated electrical power requirements or brake horsepower of the specified equipment and on the nominal full-load efficiencies that exceed those in Table 10-A of ASHRAE Standard 90.1. Demand factors identified in NFPA 70 must be applied.

**6.5.2.3 Demand Load and Spare Capacity**

To ensure maximum flexibility for future systems changes, the electrical system must be sized for the demand load with additional spare capacity as follows:

Demand factors identified in NFPA 70, Chapter 6, must be applied.

- Panelboards for branch circuits : 50 percent spare ampacity and 35 percent spare circuit capacity
- Panelboards serving lighting only: 50 percent spare ampacity and 25 percent spare circuit capacity
- Switchboards and distribution panels: 35 percent spare ampacity and 25 percent spare circuit capacity
- Main switchgear: 25 percent spare ampacity and 25 percent spare circuit capacity



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All distribution equipment ampacities must be calculated in accordance with NFPA Article 220 and as modified in this chapter. If the addition of 25 or 35 percent spare circuit capacity results in the need for a two-section panel, the design engineer must limit the spares to the capacity of the panel in question and assign sufficient space in the electrical closet layout to accommodate a future panel and associated transformer.

All panelboards must be fully populated with breakers of a size and rating of breakers actively being used in the panelboard.

Spare overcurrent devices must be provided for the installation of future protective devices.

Before adding the spare equipment ampacity to account for future load growth, it is important that the load study reflect actual demand loads rather than connected loads. The designer must apply realistic demand factors by taking into account various energy-conserving devices such as variable frequency drives applied to brake horsepower, energy-efficient motors, occupancy sensors, and so on. The designer must also avoid adding the load of standby motors and must be careful to distinguish between summer and winter loads by identifying such “noncoincidental” loads. A “diversity factor” must be applied to account for the fact that the maximum load on the elevator system, as a typical example, does not occur at the same time as the peak air conditioning load. Once the estimated “peak demand” load is established, the factor for load growth must be added.

### 6.5.2.4 Visual Impact

Options regarding the location and selection of electrical work that will have a visual impact on the interior and exterior of the building must be closely coordinated with the architectural design. This includes the placement and specification of the lightning protection system, colors, and finishes of light fixtures, outlets, switches, and device plates.

### 6.5.2.5 Equipment Grounding Conductor

Except for isolated ground systems, all low-voltage power distribution systems must be supplemented with a separate, insulated equipment grounding conductor.

### 6.5.2.6 Lightning Protection

Lightning protection must be provided in accordance with NFPA 780. The system must be carefully designed to ensure that static discharges are provided with an adequate path to ground. Surge arrestors on the main electrical service must be provided. Systems served at utilization voltages 208Y/120V or 480Y/277V must be provided with two levels of protection for sensitive electronic loads.

## 6.5.3 Utility Coordination

### 6.5.3.1 Power Company Coordination

A detailed load study, including connected loads and anticipated maximum demand loads, as well as the estimated size of the largest motor, must be included in the initial contact with the local utility company to prepare its personnel for discussions relative to the required capacity of the new electrical service.

The service entrance location for commercial electrical power must be determined concurrently with the development of conceptual design space planning documents. Standards for equipment furnished by utility companies must be incorporated into the concept design. Locations of transformers, vaults, meters, and other utility items must be coordinated with the architectural design to avoid conflicts with critical architectural features such as main entrances and must accommodate both equipment ventilation and equipment removal. All major electrical equipment must be located 5 feet above the 100-year flood plain.

### 6.5.3.2 Communications Service Coordination

The telecommunications design professional must contact the local telecommunications providers and coordinate with the client agency GSA's FAS to determine the number, size, and location of the incoming services and to determine the enclosure and pathway requirements for telecommunications systems. The scope of services varies with each project; it includes, at a minimum, the design of the infrastructure (pathway and enclosure) and may include the full design and specification of the telecommunications system. The design professional must contact the local telecommunications providers through GSA's FAS early in the project.

Provision must also be made to provide either cable television (CATV) or satellite service to the facility. CATV or satellite service may be independent from other communications services. The need for multiple space service conduits to accommodate multiple voice/data vendors must be evaluated.

The need for separate redundant internal and external pathways may be required depending on the level of security and mission that may be required by the building occupant.

### 6.5.3.3 Site Requirements

The routing of site utilities and location of manholes must be determined early in the design process in coordination with the site civil engineer. The designer must coordinate with the utility company to determine the capabilities, rate structure options, and associated initial costs to the project and must evaluate the available utility service options.

#### Electrical Power Services

For buildings less than 100,000 gross square-foot (gsf), utility power must be requested at the main utilization voltage, i.e., 480Y/277V or 208Y/120V.

For buildings greater than 100,000 gsf and less than 250,000 gsf, at least one electrical secondary service at 480Y/277V must be provided. For buildings 250,000 gsf and larger, or for campus sites, electrical service must be provided to the site, at medium-voltage distribution, up to 34.5kV, for primary power distribution to substations.

#### Primary Cable Selection

*Medium-voltage cable selection must be based on all aspects of cable operation and on the installation environment, including corrosion, ambient heat, rodent attack, pulling tensions, potential mechanical abuse, and seismic activity. Conductors for newly construction buildings rated above 150 amperes may be cooper or aluminum, insulated with cross-linked polyethylene (XLP) or ethylene propylene rubber (EPR). Conductors rated 150 amperes and below shall be copper. New cabling to be connected to equipment built or installed before 1980 shall be investigated to determine compatibility of aluminum-to-copper terminations prior to specifying aluminum cabling. Insulation must be rated at 133 percent. Individual conductor size must not exceed 240 mm<sup>2</sup> (500 mcm).*

#### Direct Buried Conduit

Direct buried Schedule 80 PVC, coated intermediate metallic conduit (IMC), or rigid galvanized steel must be used only for the distribution of exterior branch circuits 38 mm (1.5 in.) or larger. Backfill around the conduits must be selected based on the thermal conductivity and be free of materials detrimental to the conduit surface.

#### Concrete-Encased Ductbanks

Concrete-encased PVC Schedule 40 ductbanks must be used where runs are under permanent pavements and where service reliability is paramount.

Concrete-encased ducts must be provided with a cover that is at least 750 mm (30 in.) thick. Ductbanks under railroads must be reinforced. Ducts must slope toward manholes and all entries into buildings must have watertight seals. Changes in direction must be by sweeps with a radius of 1.2 m (4 ft.) or more. Stub-ups into electrical equipment may be installed with

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manufactured elbows. Duct line routes must be selected to avoid the foundations of other buildings and structures. Electrical power and communication ducts must be kept clear of all other underground utilities, especially high-temperature water, steam, or gas. Direct buried duct banks should be continuously indicated by installation of tracer tape 300 mm (12") above the exterior of the duct bank.

Where it is necessary to run communication cables parallel to power cables, two separate ductbanks must be provided with separate manhole compartments. The same holds true for normal and emergency power cables. Ductbanks must be spaced at least 300 mm (1 ft.) apart. Site entrance facilities, including ductbanks and manholes, must comply with the requirements stated in Federal Information Processing Standard 175, Federal Building Standard for Telecommunication Pathways and Spaces. [See also EIA/TIA (Electronic Industrial Association/Telecommunication Industry Association) Standard 568-A and related bulletins.]

Where redundant service is required (power, communications, and/or life safety), alternate and diverse paths with 1-hour fire separations must be provided.

### **Duct Sizes and Quantity**

Ducts must be sized as required for the number and size of cables. All ducts for medium-voltage services must be a minimum of 100 mm (4 in.). Inner ducts must be provided inside communication ducts wherever fiber optic cables will be used. Spare ducts must be included for planned future expansion; in addition, a minimum of 25 percent spare ducts must be provided for unknown future expansion and/or cabling replacement.

### **Manholes**

Manholes must be spaced no farther than 150 m (500 ft.) apart for straight runs. The distance between the service entrance and the first manhole must not exceed 30 m (100 ft.). Double manholes must be used where electric power and communications lines follow the same route. Separate manholes must be provided for low- and medium-voltage systems.  
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Manholes must have clear interior dimensions of no less than 1,800 mm (6 ft.) in depth, 1,800 mm (6 ft.) in length, and 1,800 mm (6 ft.) in width, with an access opening at the top of not less than 750 mm (30 in.) in diameter. Medium-voltage manholes must be sized in accordance with utility company requirements. Manholes must have a minimum wall space of 1,800 mm (6 ft.) on all sides where splices may be racked. Manholes must be provided with pulling eyes, sumps, and grounding provisions as necessary.

### **Stubs**

A minimum of two spare stubs must be provided (to maintain a square or rectangular ductbank), so that the manhole wall will not need to be disturbed when a future extension is made. Stubs for communications manholes must be coordinated with GSA's Federal Technology Service.

### **Handholes**

Handholes may be used for low-voltage feeders (600V and below), branch circuits, or communications circuits. If used, they must be not less than 1,200 mm (4 ft.) in depth, 1,200 mm (4 ft.) in length, and 1,200 mm (4 ft.) in width, and must be provided with standard manhole covers and sumps of the same type provided for manholes. Generally, at least four racks must be installed. Where more than two splices occur (600V feeders only), a 1,800 mm (6 ft.) by 1,800 mm (6 ft.) by 1,800 mm (6 ft.) manhole must be required.

### **Penetrations**

Lighting and communication circuits that penetrate fire walls, fire barriers, fire partitions, smoke barriers, smoke partitions, and between floors must be properly sealed in accordance with the requirements of the IBC with approved firestopping materials.

### **Exterior Concrete**

Concrete pads constructed to support exterior mechanical and electrical equipment must be provided with sufficient conduit penetrations to provide the necessary power and control connections plus an additional 50 percent for future equipment additions and modifications. Spare conduits need not extend more than 1,200 mm (4 ft.) past the end of the

concrete slab. All spare conduits must be capped at both ends.

### 6.5.3.4 Advanced Building Metering and Control

All projects must install advanced meters for electricity in accordance with EAct 2005, and install advanced meters for gas and steam in accordance with EISA 2007, Section 434 (b), and EAct 2005, "Guidance for Electric Metering in Federal Buildings." Government facilities must be prepared to reduce demand quickly and effectively and include intelligent electric meters capable of bidirectional monitoring of phase voltages, phase currents, power consumption (demand), power factor, kVAR, and availability. These meters must be capable of communicating via MODBUS/TCP/IP. Meters must meet at a minimum the definition stated. Government projects must also include demand reduction logic in the building automation system that is capable of activation upon input from the building operator or the intelligent meters. Ideally, the logic would be capable of three tiers of demand reduction—low/no occupant impact, minor occupant impact, and some impact. The equipment curtailed or set-points changed during each level must be identified by the A/E and agreed to by the project manager.

Further information for advanced metering and guidance is offered by the PBS Chief Information Officer's Advanced Metering System Implementation Guide.

## 6.5.4 Distribution System Alternatives

### 6.5.4.1 Primary Distribution

Where the design alternatives have been thoroughly evaluated and a medium-voltage service is selected as the optimal utility service for the application, the design professional must request that the utility company provide multiple 15 kV (nominal) feeders to

serve the facility. Feeders must not be connected to the same utility switchgear bus section. Where feasible, it should be requested that facility feeders be extended from different substations.

The following types of primary distribution systems are listed in terms of increasing flexibility, reliability, and cost:

- 1 Looped primary (not recommended)
- 2 Radial primary
- 3 Primary selective
- 4 Primary selective-secondary selective
- 5 Network

The selection of a primary distribution system must be based on a study comparing the relative advantages and disadvantages of the feasible alternatives, including a life-cycle cost comparison. Where primary service is provided, GSA will provide, own, and maintain the building transformers.

### Medium-Voltage Switchgear

Design of the medium-voltage switchgear must meet all of the requirements of the local utility. Switchgear must be provided with enclosed, drawout-type vacuum interrupter breakers, one per each size fully equipped spare cubicle/breakers up to 1,600 amps, a breaker lifting device, and a ground and test device. The ground and test device must be stored in a spare switchgear cubicle.

Voltmeters, ammeters, and watt-hour digital meters with demand registers on each feeder must be provided for medium-voltage switchgear in addition to utility-approved digital relaying. Meters must be digital pulse-type for connection to and monitoring by the Advanced Metering Equipment. IR camera inspection ports shall be considered on the enclosure of all medium voltage switchgear for ease of inspecting switchgear for thermal problems while under load.

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All switchgear sections must be installed on four-inch concrete housekeeping pads.

### Medium-Voltage Conductors

Conductors must be copper, insulated with XLP or EPR. Insulation must be rated at 133 percent of the voltage rating. Individual conductor size must not exceed 240 mm<sup>2</sup> (500 mcm).

### Network Transformers

Where continuity of service is determined to be critical by the program, network transformers must be considered as the first priority.

Network transformers must be liquid-filled and have a kVA rating as required, with copper primary and secondary windings. Transformers must be equipped with provisions for fans and/or dual temperature ratings to increase the rated capacity and must be provided with sufficient contacts to permit the remote monitoring of the status of the network protector, temperature and pressure in the enclosure, and other components recommended by the manufacturer. Fans must not be used in determining the initial rating of the transformer. In addition, transformers must be provided with voltage taps  $\pm 2.5$  percent with a no-load tap changer. Network transformers and tap changers located in areas subject to flooding or water backup must be specified as waterproof. Network transformers must be provided with disconnects for safe isolation servicing. The energized status of the transformers must be monitored by the Advanced Metering System.

### Double-Ended Substations

Where either a primary selective or primary selective-secondary selective (double-ended) substation is selected, the following paragraph applies:

If reliability is critical and spot networks are not feasible, double-ended substations must be used. Transformers must be equipped with provisions for fans to increase the rated capacity. The sum of the estimated demand load of both ends of the substation must not exceed the rating of either transformer and must not exceed the fan cooling rating. All double-ended substations must be

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equipped with two secondary main breakers and one tie breaker configured for open transition automatic transfer, initiated through the use of an under-voltage relaying scheme. Breakers must be of the electrically operated drawout type.

### Network Substations

Network substations are usually close-coupled to the secondary switchboards serving the respective loads. All circuit breakers up to and including the secondary switchgear main circuit breaker must be drawout type.

### Transformers

Transformers in double-ended and network substations must be dry type with epoxy resin cast coils or liquid filled, 300 C° insulation, non-petroleum-based insulating-oil type. Liquid-filled transformers must be used outdoors and for below-grade vault construction. Provide lightning arrestors on the primary side of all transformers. Provide surge suppression on the secondary and/or downstream busses.

Where silicon or oil-filled transformers are used, the design must comply with all spillage containment and electrical code requirements.

## 6.5.4.2 Secondary Distribution

### Main Switchgear (480 V Service)

In the case of double-ended substations, all main and secondary feeder breakers must be draw-out power type. Breakers with solid state trip units should have modbus communications allowing the trip units to be remotely monitored via the AMS system.

Each metering section must contain a voltmeter, ammeter, and watt-hour meter with demand register. Meters must be pulse type for connection to and monitoring by the BAS. Switchgear must be front and rear accessible.

All breakers in the 480 volt-rated service main switchgear must be fully rated. Series rating is not to be permitted. Main and feeder breakers must be

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provided with integral solid-state ground-fault protection tripping elements.

### **Main Switchgears and Switchboards (208 V Service)**

Switchboards with 208 V service, including substation secondary switchboards, must be freestanding and provided with a single main service disconnect device. This main device must be insulated case, power air circuit breaker, or bolted-pressure fusible switch, have ground fault protection, and must be individually mounted, drawout type (as applicable). Insulated case and power air circuit breakers must be electrically operated. Branch feeders must be protected by fusible load-break switches or by fully rated molded case circuit breakers. Front access is required.

### **Surge Suppression**

Surge suppression on the main incoming service secondary switchboard must be provided.

### **Switchgear Metering**

All main switchgear metering sections should contain a voltmeter capable of reading all phase-to-phase and phase-to-neutral voltages. The meter section should have a switchable ammeter and a three-phase totalizing watt-hour meter. The power meter should be networked and/or tied into the Advanced Metering System.

## **6.5.5 Space Conditions**

It is the joint responsibility of the architect and the electrical engineer, functioning as part of an integrated design team, to provide adequate space and suitable locations for the electrical systems serving the facility and a planned method to install and replace this equipment. However, it is the sole responsibility of the electrical engineer, during the concept phase, to provide detailed space requirements and suggested preferred locations of all critical space requirements for the power and communication systems for the facility. The cooperation of the architect is then required to

provide the required space conditions, clear of any structural columns or beams as well as shear walls, stairways, duct shafts, and other obstructions. Equipment space selection must take into consideration adjacencies, such as stairs, mechanical rooms, toilets, elevators, air/piping shafts, and fire-rated assemblies, to permit secondary distribution of electrical and telecommunications circuitry to exit the assigned spaces. In addition, electrical equipment must be located at five feet above the 100-year flood plain. The electrical engineer must determine from local jurisdictions any additional freeboard requirements above this base level.

Do not run electrical power or communication systems within stair enclosures unless power or communication serves the stair or is part of the emergency communication system.

Note: The designers must refer to Chapter 3, Section 3.8, Chapter 5, Section 5.7, and Chapter 7, Section 7.6 for design criteria related to the following elements of the electrical and communication systems:

- Main equipment rooms
- Electrical rooms
- Communications rooms
- Building engineer's office
- Security control center
- Fire command center
- UPS systems and batteries
- Emergency generator.

### **6.5.5.1 Main Equipment Rooms – Electrical and Telecommunications**

The size of the electrical service room will depend on the type of service provided by the local utility company. If a secondary (480 V or 208 V) service is provided, the size of the room must be determined by the number of service stubs into the room and the respective number and size of switchgear. In this case, the rooms must be located securely in a vault or inside the building along a perimeter wall at an elevation that minimizes the transformer secondary feeder lengths. Main switchgear room doors must be



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large enough (in width and height) to allow for the removal and replacement of the largest piece of equipment. All equipment doors and personnel doors must swing out and be provided with panic hardware.

The sizes and locations of the telecommunications service rooms must be established in concert with the local communications service provider. Depending on the equipment selected, telecommunication service rooms may require 24-hour HVAC service, and may need protection from contaminants by proper filtration equipment.

Where the application of water from fire sprinklers installed in a main electrical room constitutes a serious life or fire hazard, the main electrical room must be separated from the remainder of the building by walls and floor/ceiling or roof/ceiling assemblies having a fire-resistance rating of not less than 2 hours.

### 6.5.5.2 Electrical Rooms

Electrical rooms are generally located within the core areas of the facility and must be stacked vertically. Adequate numbers of electrical rooms must be provided, such that no electrical room serves more than 930 m<sup>2</sup> (10,000 sq. ft.). Electrical rooms must be provided with minimum clear dimensions of 1,800 mm by 3,000 mm (6 ft. by 10 ft.). If transformers are located in the rooms, ventilation must be provided. Doors must swing out.

### 6.5.5.3 Communications Rooms

Communications rooms are also generally located within the core areas of the facility and must be stacked vertically. Rooms must be sized to contain adequate floor space for frames, racks, and working clearances in accordance with EIA/TIA standards. Depending on the equipment selected, provisions may be required for 24-hour air conditioning in these rooms. The installation of dedicated electrical panelboards within the communications rooms should be considered to minimize electrical noise and to prevent unauthorized access.

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### 6.5.5.4 Building Engineer's Office

Even if not included in the building program, office space for the building engineer must be evaluated. Most GSA buildings require such a space, which houses the consoles for the BAS and remote annunciators for other critical systems such as fire alarm, generator status, miscellaneous alarm systems, and lighting control systems. This space is normally located near the loading dock or main mechanical spaces.

### 6.5.5.5 Security Control Center

Each GSA building with a local security force must have a control center. In the event that the building will not be served by a local security force, this room may be combined with the building engineer's office or the fire command center.

The security control center must be located within the most secure area of the building and must be sized to house the command station for the security guards and their equipment, for current as well as anticipated future building needs.

### 6.5.5.6 Spaces for Uninterruptible Power Systems (UPS) and Batteries

Since all UPS systems are considered above standard for GSA space, the requirement for a UPS system will be a tenant agency requirement. To establish the proper size, locations, and environmental requirements for the UPS and battery systems, the electrical engineer must arrange to meet with the architect and representatives of the tenant agencies to determine the required/estimated load and physical size requirements and the nature of the critical loads. Refer to the UPS and battery manufacturers' installation instructions for heat

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dissipation requirements, weights, dimensions, efficiency, and required clearances in the design.

For small systems up to 50kVA, the UPS modules and sealed cabinet batteries must be installed in the room with the equipment being served.

For medium and large systems greater than 50kVA, the UPS system must be provided with standby generator backup to limit the battery capacity. The UPS system equipment and batteries must be in separate rooms and located on the lowest level above the 100-year flood plain because of the weight of the batteries and the noise of the UPS equipment.

Space for storage of safety equipment, such as goggles and gloves, must be provided. Special attention must be given to floor loading for the battery room, entrance door dimensions for installation of the UPS, and ceiling height for clearance of the appropriate HVAC systems and exhaust systems.

### 6.5.5.7 Fire Command Center

See Fire Protection and Life Safety, for specific requirements for the Fire Command Center.

### 6.5.5.8 Flood Plain Clearance

Electrical equipment must be located at five feet above the 100-year flood plain.

## 6.5.6 Secondary Branch Power Distribution

### 6.5.6.1 Feeder Assignments (Bus Ducts vs. Cable-In-Conduit)

The secondary main branch power distribution system conveys power to the various load groups distributed throughout the building. The decision as to whether this power is conveyed to the various

loads in copper cables-in-conduit or in copper bus duct must be based on the following factors:

- Size and shape of the facility
- Design of the main switchgear
- Coordination with piping and ductwork in the lower levels
- Design of the electric rooms – proximity to the transformer vault
- Ceiling space available
- Access to bus splice connections for testing
- Flexibility
- Reliability
- Cost

At the early stages of a project, alternate designs comparing the factors listed above must be evaluated to determine the feeder assignments. Results must be submitted in accordance with Appendix A.

### Bus Duct

Bus ducts must be copper, fully rated, 3-phase, 3-wire or 3-phase, 4-wire with 100 percent neutral and an integral ground bus, sized at 50 percent of the phase bus. NEMA Class 3R or higher jacketing should be considered if the bus duct is to be installed in areas to be sprinkled or located adjacent to steam lines. Calculations supporting the specified short-circuit rating must be submitted in accordance with Appendix A.

### 6.5.6.2 Motor Control Centers

Grouped motor controls must be used where eight or more starters are required in an equipment room. Motor control center (MCC) construction must be NEMA Class I, Type B copper, with magnetic (or solid-state if appropriate) starters and either molded case circuit breakers or fused switches. The minimum starter size in motor control centers must be Size 1. MCC's must be provided with Advanced Metering for remote monitoring. Control circuit voltage must be 120V connected ahead of each starter via a fused control transformer. Reduced-voltage starters may be used for larger motors to reduce starting kVA.



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Time-delay relays must be incorporated in the starters or programmed in the BAS system to reduce inrush currents on the electrical system.

Where variable frequency drives (VFDs) are used on a project, an LCC evaluation must be conducted to determine when VFDs must be incorporated into the MCCs. If determined not appropriate, then VFDs must be powered from distribution panels installed for that purpose. See below for additional VFD requirements.

### 6.5.6.3 Elevator and Other Vertical Transportation Power

If two or more switchgears are available, the load of the elevator and other vertical transportation feeders must be divided among the secondary switchgears, provided that alternate elevator machines must be fed from different switchgears.

Note: One elevator in each bank must be connected to the emergency generator. Where multiple elevators are in a common bank, provide a common emergency feeder from the elevator automatic transfer switch (ATS), to allow each elevator to be operated individually during an emergency. See Section 6.12 for additional requirements. Interlocking the ATS with the elevator group controller, programming must be made by the elevator supplier to set up a controlled return to the terminal floor and then to limit the number of elevators in that bank that can be run concurrently.

See Chapter 7 for additional information on standby power requirements for fire service access elevators and occupant evacuation elevators. Sufficient standby power must be provided to operate all designated fire service access elevators and occupant evacuation elevators along with their associated controllers and the cooling and ventilation equipment serving their machinery rooms and machinery spaces, simultaneously.

Elevator machines must be powered from circuit breakers with a shunt trip and with padlocking capability, located in the elevator machine rooms.

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Electrical design standards in ASME A17.1, Safety Code for Elevators and Escalators, must be followed.

### 6.5.6.4 Variable Frequency Drive

Variable frequency drives must be used on all speed control motors larger than 3.7 kW (5 horsepower) to reduce the energy consumption of the project. However, VFDs generate harmonics, which are injected into the secondary power distribution system. These harmonics must be minimized through the use of filters tuned to the peak harmonic generated by the drive. All VFDs must be provided with a contactor bypass option.

VFDs must use a minimum 6-pulse width modulation (PWM) design because of their excellent power factors and high efficiencies. VFDs must be specified with passive harmonic filters and also with isolation transformers where required. Individual or simultaneous operation of the variable frequency drives must not add more than 5 percent total harmonic voltage distortion to the normal bus, nor more than 10 percent while operating from the standby generator (if applicable), per IEEE 519, latest edition. The load side of the main breaker must be the point of common coupling.

A harmonic (voltage and current) analysis must be conducted by the electrical engineer, including all calculations, and submitted in accordance with Appendix A, Sections A.3 and A.4.

Where the harmonic analysis indicates noncompliance, the application of 12-pulse, pulse width modulation, or zig-zag transformers or other approved alternate method must be used to reduce the total harmonic voltage distortion.

Thermal sensors must be specified that interlock with the VFD control circuit for additional protection for motors running at low speeds and subject to overheating. This is in addition to the standard over-current protection required.

VFD's should typically be located less than 50' from their load.

## 6.5.7 Branch Wiring Distribution Systems

### 6.5.7.1 Lighting – Circuit Loading

120 volt circuits must be limited to a maximum of 1,400 volt-amperes.

277 volt circuits must be limited to a maximum of 3,200 volt-amperes.

### 6.5.7.2 Receptacles – Circuit Loading

120 volt circuits for convenience receptacles must be limited to a maximum of 1,440 volt-amperes (8 receptacles at 180 watts).

Each special purpose receptacle must be circuited on a dedicated circuit to a protective device to match the rating of the receptacle.

In GSA buildings, general wiring devices must be specification grade. Emergency receptacles must be red. Isolated grounding receptacles must be orange. Special purpose and dedicated receptacles must be gray. The color of standard receptacles and switches must be coordinated with the architectural color scheme; for example, white, not ivory, devices must be used if walls are white or light gray.

Building standard receptacles must be duplex, specification-grade NEMA 5-20R. Each Ground Fault Circuit Interrupter (GFCI) receptacle should have a light indicating when it has been tripped.

Communication room equipment receptacles should be locking type to prevent accidental disconnection. Special purpose receptacles must be provided as required. Device plates must be plastic, colored to match the receptacles. Device plates and lighting switch plates must be labeled on the exterior with

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typewritten machine-made labels indicating the panel and circuit number from which they electrically feed.

Occupancy-based, time-schedule based, or building-management system based plug load controls should be considered by the designer for all office cubicles and private office workstations.

### 6.5.7.3 Placement of Receptacles

#### Corridors

Receptacles in corridors must be located 15 m (50 ft.) on center and 7.5 m (25 ft.) from corridor ends.

#### Office Space

Receptacles for housekeeping must be placed in exterior walls and walls around permanent cores or corridors. Where receptacles are placed on exterior walls, installation of conduits and wallboxes must minimize air infiltration and moisture incursion. See Section 5.3 and Chapter 3 for additional requirements.

Placement of receptacles in walls must be avoided where raised access floors are used. See Section 6.10, Underfloor Raceway Systems, for additional requirements. For areas where raised access floors or underfloor raceway systems are not used, placement of receptacles must comply with the project requirements.

Each office and workstation must have an isolated ground receptacle located adjacent to each convenience that could be used for powering computer based equipment. There should be a minimum of two for each office and a minimum of one for workstations. If modular furniture is to be installed, it may be necessary to connect the IG receptacle box to the convenience box with a conduit to allow wire extension to modular furniture whips.

#### Conference and Training Rooms

Conference rooms and training rooms must be served in the same fashion as office space, except where specifically outfitted for audio-visual equipment.

### **Courtrooms and Related Areas**

Refer to Chapter 8 for special electrical requirements.

### **Maintenance Shops**

Maintenance shops require plug-mold strips above work benches with duplex outlets 900 mm (36 in.) on center. Receptacles must be wired on alternating circuits. Receptacles or circuit breakers must be of the ground fault interrupt (GFI) type. Provide emergency power off stations and associated contactors for shops containing freestanding equipment.

### **Electrical and Communications Rooms**

Electrical rooms require one emergency power receptacle that is identified as emergency power at the receptacle. Communication rooms must contain power and grounding for the passive and active devices used for the telecommunications system, including at least two dedicated 20A, 120 volt duplex electrical outlets on emergency power, and additional lock type convenience outlets at 1,800 mm (6 ft.) intervals around the walls and direct connection to the main building grounding system. If uninterruptible power is required in communications rooms, it must be furnished as part of the communications system. Larger communication rooms must be provided with ceiling-mounted locking receptacles on ceiling-hung strain relief whips.

### **Main Mechanical and Electrical Rooms**

Main mechanical and electrical equipment rooms must each have, at a minimum, one emergency power receptacle that is identified as such at the receptacle.

### **Exterior Mechanical Equipment**

Provide one receptacle adjacent to mechanical equipment exterior to the building, including each roof section. Receptacles must be of the weatherproof GFI type. Receptacles must be located within 7.62 m (25 ft.) of each piece of equipment in accordance with NFPA 70 210-63.

### **Toilet Rooms**

Each toilet room must have at least one GFI receptacle at the vanity or sink. All receptacles located in toilet rooms must be GFI protected. Carefully coordinate the location of the receptacles with all toilet accessories.

## **6.5.7.4 Underfloor Raceway Systems**

Underfloor raceways fall into three categories:

### **Raised Access Floors**

All wiring beneath a raised access floor must meet the requirements in NFPA 70 and must be routed in rigid metal or flexible conduit to underfloor distribution boxes. One distribution box per bay is recommended. Flush-mounted access floor service boxes must be attached to the underfloor distribution boxes by means of a modular, prewired system to facilitate easy relocation.

### **Cellular Metal Deck**

In cellular metal decks that frame the concrete floor slabs in a steel building, the cells are generally fully “electrified” by the placement of steel sheets enclosing the underside of the cells. Access to the individual cells is obtained by a series of compartmented header ducts. The width of the header duct is sized according to the area served and the depth is 63 mm (2 1/2 in).

### **Underfloor Duct System**

A 3-cell underfloor duct system is placed in a 100 mm (4 in.) concrete fill over the concrete slab. The cells are generally located on 1,500 mm (5 ft.) to 1,800mm (6 ft.) centers. Note: This type of raceway system is frequently found in existing buildings selected for modernization.

The cell assignments in cellular metal deck systems and the 3-cell duct systems are generally designated as 1) power, 2) voice/data, and 3) signal. However, the recent increase in bandwidth required by the latest IT equipment has been accompanied by the use of CAT 6 cables and fiber optic cables. The CAT 6 cables cannot tolerate the proximity to the power

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cables and neither of these cables is compatible with the sharp bends from the header ducts to the cells and to the outlets, which significantly diminishes the practical use of these systems.

### 6.5 7.5 Panelboards

Panelboards must be constructed to comply with the requirements of UL 67 and UL 50.

All panelboard interiors must be constructed using hard-drawn copper of 98 percent conductivity, with AIC bracing greater than the calculated available fault current. The minimum short circuit rating for 208Y/120V panelboards must be 10,000 amperes symmetrical. The minimum short circuit rating for 480Y/277V panelboards must be 14,000 amperes symmetrical. A 200 percent neutral must be provided for panelboards serving office loads feed from the secondaries of K-rated transformers or harmonic canceling transformers. A full-size copper ground bus for connecting ground conductors must be bonded to the steel cabinet. Provide isolated ground bus where required.

Branch circuit breakers must be bolt-on designed for replacement without disturbing the adjacent units. Breakers must comply with the requirements of UL 489, thermal magnetic type with a short-circuit rating greater than the calculated available fault current. Panels must be specified with “door-in-door” trim.

#### Power Distribution Panels

Circuit breaker-type panels must be the standard of construction for Federal buildings. With the exception of lighting and receptacle panelboards, fusible switches may be considered if specific design considerations warrant their application, such as in electrical coordination of electrical over-current devices.

#### Lighting and Receptacle Panelboards

Lighting and receptacle panelboards must be circuit breaker type: a maximum of 30 poles for 100 amp

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panelboards, and a maximum of 42 poles for 225 amp panelboards.

#### Conduit Systems

The specification must list the various types of conduit systems that are approved for use on the project and the specific raceway applications for which they are to be used, as follows:

- RSC – Rigid galvanized steel conduit – ANSI C80.1 Exposed outdoors, wet, or damp locations
- RAC – Aluminum conduit (with steel elbows) Indoor feeders – exposed and/or concealed
- IMC – Intermediate steel conduit – ANSI C80.6 Indoor feeders – exposed and/or concealed
- EMT – Electrical metallic tubing (full compression steel fittings) – ANSI C80.3 Branch circuit wiring, exposed and/or concealed
- FMC – Flexible steel conduit – connections to recessed lighting fixtures and concealed in movable and/or dry wall partitions
- LFMC – Liquid flexible steel conduit with PVC jacket. Connections to vibrating equipment (motors, transformers, etc.)
- PVC – Underground feeders encased in concrete envelope. Indoors and outdoors. Transition to steel or aluminum when not encased.

#### Conductors

Aluminum or copper conductors are acceptable for motor windings, distribution transformer windings, switchgear bussing, and switchboard bussing, where the conductor is purchased as part of the equipment. Copper conductors must be used for cables and conductors.

### 6.5.8 Voice and Data Distribution System

The configuration and type of the voice and data cabling distribution systems must be developed at the

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earliest stages of design, since the space requirements are so significant and widespread. System requirements are user generated and are generally translated into distribution system requirements by the design engineer in conjunction with GSA's FAS, who together develop systems in accordance with the latest edition of the BICSI Telecommunications Distribution Methods Manual and the Telecommunications Distribution Design Guide.

### 6.5.8.1 Communications Raceways

Communication raceways must meet the installation requirements in NFPA 70.

#### Raised Access Floor

If GSA has determined that raised access floors are to be used for cable management in the project (see Section 6.10), the communications services must be installed by laying the cable in a tray for main runs and then branching directly on the floor slab below the raised access flooring system.

#### Cable Trays in Hung Ceilings

Since underfloor raceway systems cannot accommodate the large turning radii required by the CAT 6 and fiber optic cables, the primary alternative to a raised floor system is a series of cable trays installed above accessible hung ceilings. Cable trays must be continuously grounded.

## 6.5.9 Emergency and Standby Power Systems

Emergency and standby power systems must be designed to comply with the requirements of the IBC, NFPA 110, and NFPA 111. Compliance with the electrical safety of the installation, operation, and maintenance of emergency systems is required, as addressed in Article 700 of NFPA 70. Unless otherwise specifically authorized by the contracting officer, all facilities must be provided with a standby generator to supply power to the facility in the event of a sudden loss of power.

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### 6.5.9.1 Classification of Emergency Power Supply Systems (EPSSs)

The class and type of Emergency Power Supply Systems (EPSSs) for Federal buildings must be a minimum of Class 72, where 72 is the minimum time in hours for which the EPSS is designed to operate at its rated load without being refueled (see Chapter 4, NFPA 110). The EPSS must have a designation of Type 10, where 10 is the maximum time in seconds that the EPSS will permit the load terminals of the transfer switch to be less than 90 percent of the rated voltage.

Where the standby generator supplies a switchboard, power may be distributed from the switchboard to the emergency, legally required standby, and optional standby systems, in accordance with Figure B.1 (a) and B.1 (b), NFPA 110.

#### Emergency System

The EPSS must supply emergency loads through an automatic transfer switch upon failure of the normal supply. The transfer time limit must not exceed 10 seconds. At all critical facilities, automatic transfer switches shall be provided with maintenance bypass switches to allow the automatic transfer switch to be maintained while still providing power to the building. Emergency illumination must include all required egress lighting, illuminated exit signs, and all other lights specified as necessary to provide required illumination. See Sections 6.3 and 6.8 for additional criteria and requirements.

An emergency supply source must supply equipment classified as emergency through an automatic transfer switch upon failure of the normal supply.

- Emergency loads (life safety loads) must include:
- Emergency lighting
- Fire alarm system
- Exit signs
- Automatic fire detection equipment for smokeproof enclosures
- Emergency voice/alarm communication systems

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- Smoke control systems• Exit stairway pressurization systems
- Fire pump
- Pressure maintenance (jockey) pump
- Air compressors serving dry pipe or pre-action systems
- Power and lighting for fire command center and security control center
- Fire service access elevators and associated controllers and the cooling and ventilation equipment serving their machinery rooms and machinery spaces (simultaneously all designated elevators).
- Occupant evacuation elevators and associated controllers and the cooling and ventilation equipment serving their machinery rooms and machinery spaces (simultaneously all designated elevators).

### Required Standby System

This system must automatically supply power to selected loads (other than those classified as the emergency system) upon failure of the normal source. The transfer time limit must not exceed 60 seconds.

Required standby loads must include:

- Visitor screening equipment
- Telephone switches and fiber cable battery systems
- Security systems
- Mechanical control systems
- BASs
- Sump pumps
- Sewage ejection pumps
- Uninterruptible power systems serving technology/server rooms
- HVAC systems for technology/server rooms, UPS rooms, and communications rooms
- Exhaust fan in UPS battery rooms
- FAA aircraft obstruction lights
- Drinking water booster pumps (high rise buildings)

### Optional Standby System

This system must supply power to the facilities or property where life safety does not depend on the performance of the system. The optional standby system must supply on-site generated power to selected loads, either automatically or by manual transfer.

Optional standby system loads may include:

- General areas of the buildings
- HVAC and refrigeration systems
- Data processing and communications systems
- Boiler, hot water pumps, perimeter HVAC units, and any other ancillary heating equipment necessary to freeze-protect the building
- Receptacles and emergency lighting in large conference rooms to facilitate command and control operations during an emergency situation

### 6.5.9.2 Generator System

The emergency and standby generator system must consist of one or more central engine generators and a separate distribution system with automatic transfer switches, distribution panels, lighting panels, and, where required, dry-type transformers feeding 208Y/120V panels. The electrical engineer must coordinate with the mechanical engineer and architect on the design of the generator system.

#### Service Conditions

If possible locate the generators outside and on grade. If installed outdoors, they must be provided with a suitable walk-in acoustic enclosure and jacket water heaters to ensure reliable starting in cold weather. If critical action structures must be located within a floodplain, generators shall be elevated above the 500-year base flood elevation.

When installed at high altitudes or in areas with very high ambient temperatures, the generators must be derated in accordance with manufacturers'



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recommendations. Operation of starting batteries and battery chargers must also be considered in sizing calculations. In humid locations heaters can reduce moisture collection in the generator windings. Critical silencers are required for all generators. Acoustical treatment of the generator room must be provided as necessary. Temperature and ventilation must be maintained within the manufacturers' recommendations to ensure proper operation of the unit. Calculations to support the size of the intake air supply for combustion, cooling, and radiation, as well as exhaust piping and exhaust paths, must be provided by the mechanical engineer in accordance with Appendix A, Sections A.3 and A.4.

Radiators must be unit mounted if possible. If ventilation is restricted in indoor applications, remote installation is acceptable. Heat recovery and load shedding must not be considered. The remote location of radiators must be designed to avoid excess pressure on the piping seals.

A permanently installed load bank, sized at a minimum of 50 percent of generator rating, must be provided. The load bank may be factory mounted to the radiator. Care should be taken in selecting materials that will tolerate the high temperatures associated with radiator-mounted load banks to include belts, flex connections, motors, sprinkler heads, and so on.

### Capacity

The engine generators must be sized to serve approximately 150 percent of the design load and to run at a maximum of 60 percent to 80 percent of their rated capacities after the effect of the inrush current declines. When sizing the generators, the initial voltage drop on generator output due to starting currents of loads must not exceed 15 percent. Day tanks must be sized for a minimum capacity of four hours of generator operation. Provide direct fuel oil supply and fuel oil return piping to the on-site storage tank (see Section 5.20 for additional requirements). Piping must not be connected into the boiler transfer fuel oil delivery "loop."

Care must be exercised in sizing fuel oil storage tanks by taking into account that the bottom 10 percent of the tank is unusable and that the tank is normally not full (normally at a 70 percent level) before the operation of the generator.

### Generator Alarms

Generator alarms must be provided on the exterior wall of the generator room. All malfunctions must be transmitted to the BAS. In all buildings, with or without BAS, a generator alarm annunciator must be located within the fire command center. The generator output breaker must have a contact connected to the BAS indicating output breaker position, to allow annunciation of the open position on the BAS.

### Automatic Transfer Switches

Automatic transfer switches serving motor loads must have in-phase monitors (to ensure transfer only when normal and emergency voltages are in phase) to prevent possible motor damage caused by an out-of-phase transfer. They must also have pretransfer contacts to signal time delay returns in the emergency motor control centers.

Automatic transfer switches must include a bypass isolation switch that allows manual bypass of the normal or emergency source to ensure continued power to emergency circuits in the event of a switch failure or required maintenance.

### Fuel Distribution System

See Chapter 5 for additional requirements for venting, fuel oil piping, and underground fuel oil tanks.

### Location

The generators and the generator control panel must be located in separate rooms or enclosures.

### Load Shedding

Life safety generators may be designed to operate in parallel with the local utility, thus allowing for load shedding and smart grid and intelligent building initiatives. Before designing emergency generators for peak shaving purposes, local, State, and Federal authorities must be contacted due to the need for

possible noise, air quality permitting, and additional hardware requirements.

## 6.5.10 Clean Power Systems

### 6.5.10.1 Uninterruptible Power Systems

In some facilities, technology/server room backup systems are designed by the tenant agency. If this is the case, shell space and utility rough-ins must be provided. In facilities where UPS systems are to be provided as part of the building construction, they must be designed as described in this section. All UPS systems are considered to be above standard for GSA space. Tenant agencies with UPS requirements should be advised that a maintenance contract is recommended.

Requirements for UPS systems must be evaluated on a case-by-case basis. If UPS is required, it may or may not require generator backup. When generator backup is unnecessary, sufficient battery capacity must be provided to allow for an orderly shutdown.

#### Critical Technical Loads

The nature, size, and locations of critical loads to be supplied by the UPS will be provided in the program. Noncritical loads must be served by separate distribution systems supplied from either the normal or electronic distribution system. A UPS system must be sized with at least a 25 percent spare capacity. The specification of a redundant module must depend upon the criticality of the loads.

#### Emergency Electrical Power Source Requirements

When the UPS is running on the site emergency generator, the amount of current to recharge the UPS batteries must be limited so as to not overload the generator. This limited battery charging load must be added to the required standby load (see Section 6.12) when sizing the standby generator.

If the UPS system is backed up by a generator to provide for continuous operation, the generator must provide power to all necessary auxiliary equipment,

i.e., the lighting, ventilation, and air conditioning supplying the UPS and the critical technical area (see Section 6.12).

#### System Status and Control Panel

The UPS must include all instruments and controls for proper system operation. The system status panel must have an appropriate audio/visual alarm to alert operators of potential problems. It must include the following monitoring and alarm functions: system on, system bypassed, system fault, out of phase utility fault, and closed generator circuit breaker. It must have an audible alarm and alarm silencer button. Since UPS equipment rooms are usually unattended, an additional remote system status panel must be provided in the space served by the UPS. The alarms must also be transmitted to the BAS.

#### UPS and Battery Room Requirements

Emergency lighting must be provided in both spaces and a telephone must be provided in or adjacent to the UPS room. The battery room design must provide proper ventilation, hydrogen detection, spill containment, and working clearances. See Chapters 3, 5, and 7 for additional requirements for the UPS and battery rooms. Also, see NFPA 70.

### 6.5.10.2 Computer Center Power Distribution Unit

In some GSA buildings the power distribution system for computer centers is designed by the tenant agency. If this is the case, utility rough-in must be provided under the construction contract. If power distribution is to be provided under the building contract, it must be designed according to the criteria in this section.

#### Power Distribution Units (PDUs)

PDUs with internal or remote isolation transformers and output panelboards must be provided in all computer centers to reduce/eliminate harmonic currents generated by nonlinear loads and reflected back to the neutral service conductors. Neutral busses/conductors must be sized at 200 percent of phase busses/conductors. PDUs with internal or



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remote isolation transformers must be K-rated or harmonic mitigating to serve nonlinear loads. The transformer rating must take the increased neutral size into account.

### Computer Center Grounding

To prevent electrical noise from affecting computer system operation, a low-frequency power system grounding and a high-frequency signal reference grounding system must be provided. The design of the technology/server room grounding system must be coordinated with the computer center staff.

### Low-Frequency Power System Grounding

A safe, low-frequency, single-point grounding system must be provided that complies with Article 250 of NFPA 70. The single-point ground must be established to ground the isolation transformer or its associated main service distribution panel.

A grounding conductor must be run from the PDU isolation transformer to the nearest effective earth grounding electrode as defined in NFPA 70. All circuits serving automated data processing (ADP) equipment from a PDU must have grounding conductors equal in size to the phase conductors.

### High-Frequency Power System Grounding

A high-frequency signal reference grounding system shall consist of a grid made up of 600 mm (2-ft.) squares must be provided as a signal reference grounding system. If a raised floor has been provided, its grid with mechanically bolted stringers may be used. Alternatively, a grid can be constructed by laying a 600 mm mesh (2 ft. squares) of braided copper strap or 1.3 mm (16 gauge, 0.051 in.) by 50 mm (2 in.) copper strap directly on the structural floor. Data processing equipment must be connected to the reference grid by the most direct route with a braided copper strap.

### Common-Mode Noise Reduction

The reduction of common-mode noise is particularly important for the proper operation of computer-based, distributed microprocessor-based systems, i.e., BASs, electronic security systems, card-access control systems, and local area networks.

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The following steps must be taken to reduce common-mode noise:

- Avoid running unshielded metallic signal or data lines parallel to power feeders.
- Where metallic signal or data lines are routed in noise-prone environments, use shielded (grounded at one end) cables or install wiring in ferrous metal conduit or enclosed cable trays.
- Locate metallic signal or data lines and equipment at a safe distance from arc-producing equipment such as line voltage regulators, transformers, battery chargers, motors, generators, and switching devices.
- Provide isolation transformers, electronic power distribution panelboards, or power conditioners to serve critical electronics equipment loads.
- Provide isolated grounding service on dedicated circuits to critical data terminating or communicating equipment.
- Replace metallic data and signal conductors with fiber optic cables where practical.

### 6.5.10.3 Harmonic Generation, K-Rated and HMT Transformers, Sizing of Neutrals

Harmonic frequencies are introduced into the branch circuit distribution system by the power supplies of the following equipment:

- Electronic ballasts
- Variable frequency drives
- PCs
- Laser printers
- File servers
- Fax machines
- Copiers
- Telecommunication equipment

K-rated transformers (K13 or higher) with a 200% neutral must be used to help to dissipate the additional heat that is a direct result of harmonic distortion. A much better solution is to eliminate or

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cancel this harmonic distortion by the use of harmonic mitigating transformers (HMT). Since energy efficiency is of primary concern, HMTs are the preferred solution.

Harmonic distortion will create overheating and power quality problems such as overheating in transformer and conductor neutrals, motor failure, false tripping of protective devices, computer operational problems, and hardware component failures. To correct these problems, the electrical design engineer must investigate the use of K-Rated transformers (K-13 or higher) with a 200 percent neutral, must feed branch circuit panelboards with 200 percent neutrals, and/or the use of harmonic mitigating transformers (HMT). HMT are preferred since they actually cancel the harmonic frequency distortion.

All isolated ground, computer room, and communication room transformers should have these features specified.

### 6.5.11 Grounding Systems

Grounding systems must be designed to coordinate with the specific type and size of the electrical distribution system, including the following applicable generic types of grounding systems or grounding components.

#### 6.5.11.1 Separate Equipment Ground Conductors

The types, sizes, and quantities of equipment grounding conductors must comply with NFPA 70, Article 250, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

- Insulated equipment grounding conductors must be installed with circuit conductors for the following items, in addition to those required by NFPA 70:
- Feeders and branch circuits
- Lighting circuits

- Receptacle circuits
- Single-phase motor and appliance branch circuits
- Three-phase motor and appliance branch circuits
- Flexible raceway runs
- Metal clad cable runs
- Cabletrays (bond each individual section)

#### 6.5.11.2 Busway Supply Circuits

Insulated equipment grounding conductors must be installed from the grounding bus in the switchgear, switchboard, or distribution panel to the equipment grounding bar terminal on the busway.

#### 6.5.11.3 Separately Derived Grounds

To minimize extraneous “noise” on certain systems, particularly those in which harmonics are generated, the specific system grounds must be separated before grounding at the service grounding electrode or counterpoise.

#### 6.5.11.4 Isolated Grounds

Isolated grounds must be applied where the equipment served may be particularly sensitive to external interference from sources generating third harmonics and higher. In these instances the grounds, beginning from the panelboard ground and the grounding conductor from the raceway to the grounding terminal at the receptacle or outlet box, must be electrically isolated from the main grounding system. The isolated grounds must terminate at a common ground or counterpoise.

In buildings where a 208Y/120V service is supplied by the power company and there is no intermediate transformer isolating the utilization voltages from the various harmonic generators previously mentioned, the use of isolated ground panels serving the office power requirements must be installed.

### 6.5.11.5 Raised Floors

All access floors must be grounded. A grounding conductor must be bonded to every other floor pedestal and must be extended to the technology/server room common ground bus.

### 6.5.11.6 Counterpoise

Where feasible, a grounding conductor (counterpoise) must be provided in an isosceles triangle configuration with sides greater than or equal to 3 meters (10 ft.). The conductor must be tinned copper not less than No. 4/0 AWG and must be electrically connected to the incoming domestic water services (provided the piping for the water service is a conducting material) on either side of the building as well as the various clusters of three ground rods spaced at intervals. Ground rods must be 15 mm (5/8 in.) diameter by 2,400 mm (96 in.) long and must be tin coated copper. The counterpoise loop will involve direct burial in earth 600 mm (24 in.) below grade. The following items must be connected to the counterpoise loop. All ground rod and grounding connections must be exothermically welded:

- Lightning protection system “down conductors”
- Transformers in substations
- Emergency generator ground
- Telecom and data room grounds
- Separately derived grounds
- Isolated ground panels
- Main switchgears
- Normal and emergency distribution systems
- Flagpoles

### 6.5.11.7 Common Ground System

Consideration should be given to providing a common ground bus throughout the building. Conceptually a common ground bus would originate from the main service entrance and run up through stacked electrical rooms, where an insulated wall-mounted copper ground plate would be installed for

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connecting any equipment needing a common ground. Where conditions might prohibit an isosceles triangle counterpoise ground, consideration should be given to installing chemical ground rods in trenches or borings supplemented with conductivity-enhancing soil conditioners such as Bentonite clay or conductive concrete.

## 6.5.12 Safety Systems, Equipment, and Personal Protection

### 6.5.12.1 Lightning Protection Systems

Lightning protection systems are important safety features in the design of electrical distribution systems. Their application on any specific project is a function of its geographic location, height, proximity of taller adjacent structures, regional ground resistance, and the architectural configuration of the building. The decision to provide a lightning protection system must be made at the earliest stages of design and must be supported by a study, as prescribed by NFPA 780.

If a decision is made to provide a lightning protection system, specify that it be installed in compliance with NFPA 780 and the components meet the requirements of UL 96.

#### Alternate Systems

The requirement of a UL certification imposes certain restrictions or limitations on the design of the system, which may be in conflict with the architectural design, particularly if the facade includes large curved surfaces that preclude the installation of air terminals and where the spacing of down conductors is limited. In those instances, the electrical engineer may appeal to the contracting officer to waive the UL certification requirement on the basis that the design generally

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follows the Faraday Cage principle of lightning protection.

### **Grounding**

The down conductors must follow direct paths from the air terminals to the ground connections or to the counterpoise loop. Lightning ground conductors should have long sweeping bends and not hard 90 degree bends forcing them to conform to architectural building features.

### **6.5.12.2 Security Systems**

Every government building, virtually without exception, whether new or existing, large or small, recent vintage or historic, must have provisions for a security system. The type and level of security system must be determined by GSA, FPS, and the client agency. The security requirements must be integrated into the design for the project. The systems must be integrated with the emergency and standby power systems.

### **6.5.12.3 Short Circuit and Coordination Study**

The electrical engineer must submit a preliminary short circuit analysis on all projects in accordance with Appendix A, Sections A.3 and A.4. The final coordination and analysis must be completed by the electrical contractor's testing agency or by an independent agency employed by GSA, and a report must be submitted as part of the commissioning process (see Chapter 1 for commissioning requirements). This language must be written into the design specifications.

### **Arc Flash**

The design engineer must submit a computer-generated arc flash analysis for the entire building

electrical distribution system. The data from the arc flash calculations for individual pieces of electrical equipment must be transposed to NFPA 70E-approved labels and all panelboards, motor control centers, switchgear, and major electrical equipment must be appropriately labeled and protection boundaries delineated per OSHA 1910 Subpart and NFPA 70E requirements.

## **6.5.13 Alterations in Existing Buildings and Historic Structures**

The goal of alteration projects is to meet the same standards described in this document for new projects. The prospectus for a capital project, or statement of work for a smaller project, will describe the extent of the replacement and upgrade of existing systems and equipment. Equipment that is unsafe or beyond the useful service life must be demolished and new systems designed to meet the current and future usage of the facility. Renovation and rehabilitation designs must satisfy the immediate occupancy needs and anticipate additional future changes. Remodeling must make building systems more flexible. Parameters of reuse and disruption of service must be clearly specified in construction documents. All replacement and upgrades must comply with the requirements of this chapter. The result of these projects should be enhanced performance, not just equipment replacement.

### **6.5.12.1 Lighting – Historic Buildings**

Historic fixtures may be upgraded with energy efficient lamps, ballasts, reflectors, or other means to achieve required light levels, if changes can be made without affecting the appearance of the fixture. Energy-efficient light sources should match incandescent light or daylight as closely as possible in regards to temperature (color rendering) and the surrounding lighting. In restoration zones, opportunities should be sought to replace unsympathetic contemporary lighting with replicas of original historic fixtures. Replica fixtures in which light

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sources are not exposed should incorporate high-output, energy efficient lamps as necessary to achieve required light levels and meet energy conservation standards. Supplemental lighting, if required, should be designed and placed to minimize penetration of ornamental wall and ceiling surfaces and to avoid competing visually with historic lighting. Freestanding torchieres, task lighting, and discrete accent lighting are recommended for increasing light levels in ceremonial spaces containing historic chandeliers, pendant lights, or sconces.

### 6.5.14 Photovoltaic Systems

The installation of photovoltaic systems (PV) presents concerns for safety (energized equipment, trip hazards, etc.) and fire fighting operations (restricting venting locations, limiting walking surfaces on roof structures, etc.). The intent of the requirements below is to address these issues while embracing the environmental advantages of this technology.

Be cognizant that because of the growing demand for photovoltaic system products, manufacturers are developing new products and methods daily and therefore GSA may encounter photovoltaic systems that will require an alternative means of compliance. Please note that it is not intended to prohibit the use of alternative systems, methods, or devices not specifically prescribed, provided GSA approves all proposed alternatives.

Before the PV system installation, the GSA project manager must meet with the contractor, GSA property manager, GSA fire protection engineer, GSA safety specialist, local power utility company, and local fire official to ensure the proposed PV system design and layout is acceptable to all parties.

Before the acceptance of the PV system, the GSA project manager must confirm that the PV system has been tested. All testing must be witnessed and documented by a qualified independent third party test entity. The third party test entity must have an advanced understanding of the installation, operation, and maintenance of the PV system

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installed. Third party test entities must be licensed (certified) where required by applicable codes and standards. At completion of witnessing the PV system testing, the third party test entity must provide to the GSA project manager documentation verifying that the PV system is in compliance with the design and specifications and all applicable codes and standards.

#### 6.5.14.1 Requirements

The installation of PV systems at GSA Federal buildings must comply with the requirements in the International Building Code, International Fire Code, and National Fire Protection Association (NFPA) 70, National Electrical Code.

#### 6.5.14.2 Special Requirements

The following requirements take precedence over the requirements in the International Building Code and International Fire Code:

- The materials used for marking must be reflective and weather resistant in accordance with UL 969 that is suitable for the environment.
- Signage is required on all stairway doors providing access to the roof where PV systems are installed. Each stairway door providing access to the roof must have a sign affixed to the interior side of the stairway door. The signage must contain the text "CAUTION PHOTOVOLTAIC SYSTEM INSTALLED ON ROOF." The sign must consist of letters having a principal stroke of not less than 3/4 inch wide and be at least 6 inches high on a contrasting background.

#### Marking Direct Current (DC) Circuits

All interior and exterior DC conduits, raceways, enclosures, cable assemblies, and junction boxes associated with the PV system must be marked to alert individuals that DC power is present. The

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marking must be placed every 10 feet or fraction thereof, at turns and above and below penetrations, and on all DC combiner and junction boxes.

The marking must contain the text "CAUTION: PV CIRCUIT ENERGIZED" in capital letters a minimum of 3/8 inches in height with white letters on a red background. The materials used for marking must be reflective and weather resistant in accordance with UL 969 that is suitable for the environment.

### 6.5.14.3 Roof Clearance Requirements

The PV system, including supports and power conductors, must not interfere with roof drains, expansion joints, air intakes, existing electrical and mechanical equipment, existing antennas, and planned areas for future installation of equipment.

Rooftop installation must coordinate with the building rigging plan associated with powered platforms, boatswain chairs, etc., and address the relocation or incorporation of the davits.

In addition to the pathway requirements noted above, a 3-foot clear path of travel must be maintained to and around all rooftop equipment.

### 6.5.14.4 Roof Mounting Requirements

Mounting systems must be either fully ballasted or must limit penetrations of the roofing system. All roof penetrations must be designed and constructed in collaboration with the roofing professional or manufacturer responsible for the roof and roofing material warranty for the specific site. The number and size of the penetrations necessary to extend the power and control cable into the building must be kept to a minimum and grouped in a single location when practicable. All weather-proofing of penetrations must be compatible with the roof warranty.

### 6.5.14.5 Equipment and Components

All PV hardware and structural components must be either stainless steel or aluminum.

All interconnecting wires must be copper. Power provided must be compatible with on-site electric distribution systems.

### 6.5.14.6 Safety

Provide detailed Lock Out/Tag Out instructions for all equipment.

Provide lightning protection meeting UL96 and NFPA780.

The design must meet the local, State and Federal criteria for wind, snow, and seismic loads.

PV Modules must be UL Listed and must be properly installed according to manufacturer's instructions, NFPA 70, and as specified herein.

### 6.5.14.7 PV System Approval

Before PV system installation, the GSA project manager must ensure the proposed PV system design and layout is acceptable to all parties:

- GSA Property Manager
- GSA Fire Protection Engineer
- GSA Safety Specialist
- GSA or contract structural engineer
- GSA electrical engineer
- Local fire officials
- The A/E must verify PV placement with the local authorities.



# Chapter 7 · Fire Protection and Life Safety

## 7.1 Goals and Objectives

The goal of GSA's fire protection program is to incorporate into all projects fire protection and life safety systems that are effective in detecting, extinguishing, or controlling a fire event, thereby improving overall building safety to an acceptable level. The primary goal is to protect human life from fire and products of combustion. The secondary goals are to reduce Federal Government and taxpayers' potential losses from fire (i.e., protect Federal real and personal property, maintain client agency mission continuity, and control environmental impact).

### 7.1.1 Scope

This chapter provides the fire protection and life safety requirements for GSA facilities to meet the goals identified above. Areas where GSA's requirements differ from the referenced national codes and standards are delineated in Chapter 1. The provisions located in the introduction and in Chapter 1 within this document also apply to this chapter. All other text is mandatory.

### 7.1.2 Applicability

Where work areas consist of portions of a building, the requirements within this chapter must be limited to the work area in which work is being performed, unless specified otherwise by the GSA regional fire protection engineer.

### 7.1.3 Responsibilities

#### 7.1.3.1 Design Team Fire Protection Engineer

A fire protection engineer must be a full participant of the design team for each phase of the project from

concept through design, construction, and occupancy. The design team fire protection engineer must be licensed and have at least six years' experience, of which at least three consecutive years are directly involved in fire protection engineering and life safety applicable to the specific project as determined by the GSA regional fire protection engineer, and which can be verified by documentation. (Please note that GSA does not require the design professional to be licensed in the State where the project is being constructed, so the design team fire protection engineer may be licensed in any State that formally recognizes a professional fire protection engineer.) The design team fire protection engineer must perform the following:

Analysis of:

- Building construction
- Occupancy classification
- Means of egress
- Fire alarm system
- Water-based fire extinguishing system(s)
- Non-water-based fire extinguishing system(s)
- Smoke control system(s)

Calculations for:

- Egress
- Water supply
- Smoke control (fire dynamics) and timed egress
- Audibility for fire alarm system

Design of all fire protection and life safety systems, including, but not limited to:

- Fire alarm system
- Water-based fire extinguishing system(s)
- Smoke control systems and stair pressurization systems

The design team fire protection engineer must also establish and maintain a dialog with the GSA regional fire protection engineer to ensure that all fire protection and life safety issues are addressed throughout each phase of the project.

See the Appendices for New Construction and Modernizations and for Alteration Projects for specific submission requirements.

### **7.3.1.2 GSA Regional Fire Protection Engineer**

The GSA regional fire protection engineer will participate in each phase of the project from concept through design, construction, final acceptance, and occupancy to ensure fire protection and life safety requirements are incorporated into the project. The GSA regional fire protection engineer will review design plans, specifications, and related information; review contractors' submittals for compliance with contract documents; witness acceptance testing and commissioning of fire protection and life safety systems; and upon successful completion of commissioning and acceptance of tested systems, will issue certificates of occupancy (or temporary certificates of occupancy) before occupancy.

The GSA regional fire protection engineer is the authority having jurisdiction (AHJ) for technical requirements in this chapter, including all fire protection and life safety code interpretations and code enforcement requirements. As the AHJ, the GSA regional fire protection engineer has the right to revise the specific requirements within this chapter based on a technical evaluation and analysis and the project's specific needs.

### **7.3.1.3 Alternative Designs**

The design team fire protection engineer may propose alternative designs to that prescribed herein, but the GSA regional fire protection engineer must approve the alternative design. Such review must determine if the proposed alternative is deemed

equivalent or superior to the intent of the prescribed requirements in this chapter. See Chapter 1 for additional information.

### **7.3.1.4 Certificate of Occupancy**

No portion of a project may be occupied until the GSA regional fire protection engineer has issued a certificate of occupancy to the GSA project manager. Issuance of a certificate of occupancy must not be construed as an approval of any violation of a national code or GSA design standard or criterion.

The GSA regional fire protection engineer is required to issue a certificate of occupancy to the GSA project manager once the GSA regional fire protection engineer has determined that to the best of his or her knowledge all fire protection and life safety systems have been completed, inspected, successfully tested, and approved, and all outstanding fire and life safety deficiencies have been corrected to afford a reasonable degree of safety to the building occupants from fire and similar emergencies.

The GSA regional fire protection engineer is authorized to issue a temporary certificate of occupancy that allows partial occupancy of the building in a specific area(s) before completion of the project. The temporary certificate of occupancy identifies the specific area(s) of the project where occupancy is permitted and will be issued only if all life safety and fire protection systems serving the areas proposed for occupancy and all the floors below it have been completed, inspected, successfully tested, and approved by the GSA regional fire protection engineer. Following the issuance of a temporary certificate of occupancy, the GSA regional fire protection engineer is required to set a time frame for the completion of all remaining life safety and fire protection systems and the correction of any outstanding life safety and fire protection deficiencies. The GSA regional fire protection engineer will issue a (final) certificate of occupancy to the GSA project manager once the GSA regional fire protection engineer has determined that to the best of his or her knowledge all fire protection and life



safety systems have been completed, inspected, successfully tested, and approved, and all outstanding fire and life safety deficiencies have been corrected.

## 7.2 References

The national codes and standards adopted by GSA are discussed in Chapter 1. Additional codes and standards for the design of fire protection and life safety systems are included in the text of this chapter and listed in Appendix B, References.

## 7.3 General Design Requirements

### 7.3.1 Fire Safety During Construction and Renovation Projects

Fire safety during construction must comply with the requirements in the IBC, IFC, and NFPA 241.

#### 7.2.3.1 Fire Protection Systems

Disruptions to fire alarm and sprinkler systems must be kept to a minimum or avoided. The design team fire protection engineer must delineate phasing of construction to ensure that installations of new systems are expedited and existing systems are kept in service until the replacement system is operational. If fire protection systems are to be disrupted, procedures must be incorporated into the design to maintain equivalent levels of fire protection and provide formal notification to the facility while systems are down.

The GSA regional fire protection engineer must make the final determination of the adequacy of proposed equivalent levels of fire protection before the disruption of any fire protection system. For example, the provision of a 24-hour fire watch by qualified

individuals may provide an equivalent level of fire protection during system disruption in some circumstances.

### 7.3.2 Building Construction

For each construction type, fire-resistive ratings of structural members, building height, area, separation, and requirements for rated exterior walls and openings for protection from exposure by adjacent buildings or hazards must comply with the requirements in the IBC.

### 7.3.3 Occupancy Classifications

Occupancy classifications must meet the requirements in the IBC.

## 7.4 Means of Egress

The means of egress requirements for the building must meet the requirements in NFPA 101. The technical egress requirements in NFPA 101 must be used in place of the technical egress requirements in the IBC.

### 7.4.1 Special Requirements

The following requirements take precedence over the requirements in NFPA 101:

- In buildings that are protected throughout by an automatic sprinkler system, one-hour fire-rated corridors are not required.
- Interlocking (scissor) stairs must count as only one exit stair. A minimum of two exit stairs are required for any multistory building.
- For common paths of travel and dead-end corridors, GSA permits the NFPA 101 exceptions for sprinkler protection to apply to individual floors protected through-out by

sprinklers, even if the other floors of the building do not have sprinkler protection.

- Fire escapes, as defined in the NFPA 101, are not considered approved exits.
- In addition to meeting the arrangement of egress requirements, where the building has an occupied floor surface located more than 22.8 m (75 ft.) above the lowest level of fire department vehicle access, the exit stair enclosures must be separated by a distance not less than 9.1 m (30 ft.) or not less than one fourth of the length of the overall diagonal dimension of the building or area served, whichever is less. The distance must be measured in a straight line between the nearest point of the exit stair enclosure.
- Where the building has an occupied floor surface located more than 22.8 m (75 ft.) above the lowest level of fire department vehicle access, or more than 9.1 m (30 ft.) below the level of exit discharge serving such floor levels, exit stairways must be pressurized in accordance with the requirements in the IBC.

### 7.4.2 Exit Stair Path Markings and Stairway Identification Signage

Where the building has an occupied floor surface located more than 22.8 m (75 ft.) above the lowest level of fire department vehicle access, exit enclosures must be equipped with exit stairway identification signage meeting the requirements in NFPA 101 and made of a material having a luminescent background.

## 7.5 Interior Finishes

The interior finish requirements for walls, ceilings, floors, draperies, curtains, and movable partitions must meet the requirements in the IBC.

### Special Requirements

The following requirements take precedence over the requirements in the IBC:

- Adhesives and other materials used for the installation of carpets must be limited to those having a flash point of 60° C (140° F) or higher.
- Wood used in construction that is required to be fire retardant must be treated with fire retardant chemicals by a pressure impregnation process or other method that treats the materials throughout (as opposed to surface treatment).

## 7.6 Fire Alarm and Emergency Communication Systems

Fire alarm and emergency communication systems must be installed in accordance with the requirements in NFPA 72, the IBC, and the appropriate GSA fire alarm system specification.

### Special Requirements

The following requirements take precedence over the requirements in NFPA 72 and the IBC:

- All fire alarm systems installed in buildings must be an emergency communication system when any one of the following conditions exists:
  - The building is two or more stories in height above the level of exit discharge.
  - The total calculated occupant load of the building is 300 or more occupants.
  - The building is subject to 100 or more occupants above or below the level of exit discharge.
- The emergency communication system must provide an automatic voice message in response to the receipt of a signal indicative of a fire emergency. Manual control with the capability of making live voice announcements must also be furnished to

provide occupants notification on either a selective or all-call basis.

- With the exception of mass notification, a fire alarm and emergency communication system are not permitted to be integrated with other building systems such as building automation, energy management, security, and so on. Fire alarm and emergency communication systems must be self-contained, standalone systems able to function independently of other building systems.
- Fire alarm and emergency communication system control equipment that is installed in non-high-rise buildings must be located within a room separated from the remainder of the building by not less than a one-hour fire resistance-rated fire barrier. The room must be provided in a location approved by the GSA fire protection engineer after consultation with the local fire department. The room must be a minimum of 9.3 m<sup>2</sup> (100 sq. ft.) with a minimum dimension of 2.4 m (8 ft.).
- Fire alarm and emergency communication system control equipment that is installed in U.S. Courthouses must include redundant functionality installed within the U.S. Marshals Service (USMS) Command and Control Center. The redundant controls must have the same capabilities and operation as the main fire alarm and emergency communication system control unit, including annunciation, except there must be no capability to initiate “Signal Silence” (turning notification appliances off), “Acknowledge” (of any signal), and “Reset” (resetting the system to normal) operations. In addition, the control unit’s alarm, supervisory, and trouble audible signals must be capable of being silenced. Subsequent alarm, supervisory, and trouble conditions must cause the local audible signal to resound. The master microphone located at the main fire alarm and emergency

communication system control unit must be arranged to take priority over the redundant microphone located in the USMS Command and Control Center.

- All fire alarm signals (i.e., alarm, supervisory, and trouble signals) must be automatically transmitted to a supervising station evaluated by Underwriters Laboratories (UL) to UL Standard 827, Central Station Alarm Services (UUFX Category Code). The communication methods used to transmit signals to the supervising station shall meet the requirements in NFPA 72. Two different communication paths are required to be provided.
- Operation of a duct smoke detector must initiate a supervisory signal.
- All fire alarm wiring shall be solid copper and installed in conduit. Stranded wiring must not be used.
- Conduit must be rigid metal or electrical metallic tubing, with a minimum inside diameter of 19 mm (3/4 inch) that utilizes compression type fittings and couplings.

### 7.6.1 Manual Fire Alarm Boxes

Manual fire alarm boxes must be installed in accordance with the requirements in NFPA 72 and the IBC.

#### Special Requirements

The following requirement takes precedence over the requirements in NFPA 72 and the IBC:

- Manual fire alarm boxes must be installed in all new fire alarm system projects in accordance with the spacing and location requirements in NFPA 72.

### 7.6.2 Waterflow Switches

Waterflow switch(es) must be installed in accordance with the requirements in NFPA 13, NFPA 72, and the IBC.

### Special Requirements

The following requirements take precedence over the requirements in NFPA 13, NFPA 72, and the IBC:

- Waterflow switch(es) must be installed on each floor or fire area protected by sprinkler systems.
- Each waterflow switch must be separately annunciated at the main fire alarm control unit and all required annunciators.

## 7.6.3 Smoke Detectors

Smoke detectors must be installed in accordance with the requirements in NFPA 72 and the IBC

### Special Requirements

The following requirements take precedence over the requirements in NFPA 72 and the IBC:

- Area smoke detectors must not be installed in any of the following rooms: mechanical equipment rooms, electrical closets, telephone closets, and emergency generator rooms.
- Smoke detectors specifically for the protection of the fire control unit(s), notification appliance circuit power extenders, and supervising station transmitting equipment must not be installed in a building protected throughout by an automatic sprinkler system.
- Smoke detection appropriate for the application must be installed in each of the following: uninterruptible power service rooms, electrical switch gear rooms, transformer vaults, telephone exchanges, and information technology equipment as specified in this chapter. When smoke detection is installed in rooms having high voltage equipment, the smoke detection must not be installed directly above the high voltage equipment.

- Duct smoke detectors must meet the requirements in NFPA 90A.

## 7.6.4 Audible Notification Appliances

Performance, location, and mounting of audible notification appliances must be in accordance with the requirements in NFPA 72.

### Special Requirements

The following requirements take precedence over the requirements in NFPA 72:

- The design for achieving the required minimum dBA levels must take into consideration all building construction materials such as carpeting, hard surfaces, walls, doors, etc., and any other materials that can cause sound level attenuation and/or clarity problems in the placement and location of all audible notification appliances.
- Where emergency communication systems are provided, fire alarm speakers must be installed in elevator cars and exit stairways; however, they must only be activated to broadcast live voice messages (e.g., manual announcements). The automatic voice messages must be broadcast through the fire alarm speakers on the appropriate floors, but not in stairs or elevator cars.
- To prevent external tapping of the audio/speaker circuit(s) serving a sensitive compartmented information facility, any of the following methods are permitted to be used:
  - Self-amplified speakers
  - Remote dedicated amplification
  - Remote signal modules

## 7.6.5 Visible Notification Appliances

Placement and spacing of visible notification appliances must be in accordance with the requirements in NFPA 72.

### Special Requirements

The following requirements take precedence over the requirements in NFPA 72:

- Unless the project includes a new fire alarm system or a complete replacement of an existing fire alarm system, visible notification appliances are not required to be installed in areas where visible notification appliances do not currently exist or where noncompliant existing visible notification appliances currently exist. This requirement does not preclude the addition of new visible notification appliances to existing fire alarm systems that contain existing compliant visible notification appliances.
- Visible notification appliances must be installed only in public and common areas. For the purposes of this requirement, visible notification appliances are not required to be installed in individual offices. Public and common areas include public rest rooms, reception areas, building core areas, conference rooms, open office areas, and so on.
- Visible notification appliances are not permitted to be installed in exit enclosures (e.g., exit stairs).

## 7.6.6 Occupant Notification

Transmission of an alarm signal from any fire alarm system initiation device to notify the occupants throughout the building must be in accordance with the requirements in NFPA 72 and the IBC.

### Special Requirements

The following requirement takes precedence over the requirements in NFPA 72 and the IBC:

- All alarm signals transmitted from any fire alarm system initiation device must activate the respective building audible and visible notification appliances to notify the occupants.

- Duct smoke detectors must not activate the fire alarm system notification appliances.

## 7.6.7 Fire Alarm Notification Strategies for High-Rise Buildings

In high-rise buildings, the fire alarm and emergency communication system must be designed for selective evacuation, unless specifically approved otherwise by the GSA regional fire protection engineer. The GSA regional fire protection engineer must establish a dialogue with the design team fire protection engineer to determine specific evacuation strategies for the building and subsequent operational features of the fire alarm system. This includes, but is not limited to, determining how and where the “fire zone” and “safe area zone” messages are used. The visible alarm notification appliance circuits must not be activated on floors designated as safe area zones.

## 7.6.8 Survivability

The fire alarm and emergency communication system must meet the survivability requirements in NFPA 72.

### Special Requirements

The following requirements take precedence over the requirements in NFPA 72:

- Two vertical risers (e.g., supply and return inter-connected network circuits Style 7–Class X) must be installed as far from each other as practicable so that a single fire does not impact both risers.
- The two vertical risers must be protected by a minimum two-hour rated enclosure or an approved two-hour rated cable or system that is not common to both vertical risers. (Pathway Survivability Level 2 or 3).
- The horizontal interconnection between the two vertical risers at the top and bottom must be protected by a minimum two-hour rated enclosure, or an approved two-hour rated

- cable or system, or an approved construction material having a two-hour fire resistance rating. (Pathway Survivability Level 2 or 3).
- All circuits (speaker/audio, SLC, network, and/or power) necessary for the operation of the notification appliances must be protected until they enter the evacuation signaling zone (usually a floor) by a minimum two-hour rated enclosure, or an approved two-hour cable or system, or an approved construction material having a two-hour fire resistance rating. (Pathway Survivability Level 2 or 3)
  - A minimum of two distinct fire alarm audible notification appliance circuits and a minimum of two distinct visible notification appliance circuits must be provided on each floor.
  - Circuit integrity cable, if used, must be installed in EMT, IMT, or rigid metal conduit for mechanical protection.
  - Provide a minimum of three Class B Signaling Line Circuits (SLC) per floor if the gross floor area is greater than 2,415 m<sup>2</sup> (26,000 sq. ft.) but less than 4,830 m<sup>2</sup> (52,000 sq. ft.) gross area. Provide a minimum of four Class B Signaling Line Circuits (SLC) for all floors where the aforementioned areas are exceeded. The floor SLC's must be isolated from the SLC risers and network. The system must be designed and installed so that a single wire to wire short or any other single Style 4 (Class B) impairment on an SLC does not affect more than one half of the area of the floor or 1,207 m<sup>2</sup> (13,000 sq. ft.), whichever is less.

### 7.6.9 Fire Command Center

The fire command center must meet the requirements in the IBC.

#### Special Requirements

The following requirements take precedence over the requirements in the IBC:

- Each fire command center must be provided in a location approved by the GSA regional fire protection engineer after consultation with the local fire department.
- Each fire command center must be provided with appropriate lighting, ventilation, and emergency lighting.
- Each fire command center must have a way to provide the responding fire department with the ability to operate the building's lighting system from the fire command center.

### 7.6.10 Annunciator

All fire alarm systems must have at least one annunciator located in plain view within 7.6 m (25 ft.) of the primary fire department entrance to the building.

## 7.7 Water Supply for Fire Protection

The design team fire protection engineer must assess the adequacy of the existing water supply. The design team fire protection engineer must perform water supply flow testing of fire hydrants and/or fire pumps. If the hydraulic data is less than one year old and is available from the local jurisdiction, the design team fire protection engineer must verify the locations involved as well as the quality and accuracy of the data. The required fire water flows and pressures for buildings must comply with the requirements in NFPA 13, 14, and 20. In addition, a secondary on-site water supply equal to the hydraulically calculated sprinkler demand must be provided for high-rise buildings assigned to Seismic Design Category C, D, E, or F as determined by the IBC.

### 7.7.1 Fire Pumps

When a fire pump is necessary to supplement fire water flow and pressure, the size and the installation

of the fire pump must be in accordance with the requirements of NFPA 13, 14, and 20.

#### **Special Requirements**

The following requirements take precedence over the requirements in NFPA 13, 14, and 20:

- The building's fire pump must be sized for the sprinkler system requirements only if the local responding fire department can provide the necessary flow and pressure for manual fire fighting operations (i.e., hose stations), through fire department Siamese connections. Where fire pumps are provided to supply other fire suppression activities, they must be sized in accordance with the appropriate NFPA standard.
- A fire pump must start automatically at 69 kPa (10 psi) below pressure maintenance pump (jockey pump) start pressure. The fire pump must be manually shut down.
- The fire pump installation must include a test header and a flow meter.
- Emergency power must be provided in accordance with the requirements in Chapter 6.
- The power transfer switch and the fire pump controller must be factory assembled and packaged as a single unit. Separate transfer switches are not permitted. The fire pump controller must be monitored by the fire alarm system.

### **7.7.2 Pressure Maintenance Pump (Jockey Pump)**

A pressure maintenance pump must be used to maintain a uniform or relatively high pressure on the fire protection system. A jockey pump must be sized to make up the allowable leakage rate within 10 minutes or 3.8 lpm (1 gpm), whichever is larger. The pressure maintenance pump must be equipped with emergency power.

### **7.7.3 Fire Hydrants**

New fire hydrants must be installed in accordance with the requirements in NFPA 24 and the IFC unless the locations of the existing fire hydrants provide adequate coverage for the subject project. The local fire department must be consulted with regard to the location of the fire hydrants and thread types for hydrant outlets.

### **7.7.4 Post Indicator Valve**

In a campus setting a post indicator valve is required on the fire protection service for each building.

## **7.8 Automatic Sprinkler and Standpipe Systems**

Automatic sprinkler systems must be installed in accordance with the requirements in NFPA 13, the IBC, and the appropriate GSA sprinkler system specification.

#### **Special Requirements**

The following requirements take precedence over the requirements in NFPA 13 and the IBC:

- Automatic sprinklers must be installed throughout all new construction and renovation projects where the building has a sufficient municipal water supply system for the design and installation of a sprinkler system at the site.
- Automatic sprinklers must be installed throughout the designated work area for all alteration projects where the building has a sufficient municipal water supply system for the design and installation of a sprinkler system at the site.
- Where project sites are located in remote or isolated areas having insufficient or nonexistent water supplies in close proximity, design the fire sprinkler system in accordance



with NFPA 13. See Automatic Sprinkler Systems for Remote or Isolated Facilities for additional information regarding automatic sprinkler system requirements.

- Where automatic sprinklers are required to be installed, they must be installed throughout all locations unless the subject locations are specifically exempted by NFPA 13 or the IBC. Where sprinklers are exempted from rooms or areas, such rooms or areas must be separated from adjacent sprinklered rooms or areas by fire barriers having a two-hour fire-resistance rating.
- All sprinkler systems must be wet-pipe sprinkler systems, unless installed in areas subject to freezing.
- In areas subject to freezing, dry-pipe sprinkler systems, dry pendent sprinklers, heating the space, or rerouting sprinkler piping to heated areas is required. Heat tape is not permitted on sprinkler piping.
- Seismic protection must be installed where required in the IBC.
- Sprinkler systems must be designed using a minimum system design area of 139 m<sup>2</sup> (1,500 sq. ft.). No decreases are permitted.
- Where floor openings are not classified as atriums, the sprinklers at the ceiling must be zoned with the lower level if it is enclosed on the upper level (the enclosure is effectively creating a high ceiling). Otherwise, sprinklers must be zoned with the upper level.
- Sprinkler system control valves must be located in accessible spaces. Sprinkler system control valves are not permitted in above-ceiling spaces.
- Antifreeze sprinkler systems are not permitted to be installed.
- Pre-action-type sprinkler systems are not permitted to be installed.
- Sprinkler guards must be provided in the following locations:
  - Sprinklers installed less than 2.1 m (7 ft.) above the floor

- Sprinklers installed within elevator machine rooms and elevator pits
- Sprinklers installed within electrical closets
- Sprinklers installed within electrical equipment rooms
- Sprinklers installed in electrical switchgear rooms and transformer vaults must be provided with separate manual isolation valves and a separate water flow switch located outside the room in an accessible location. Tamper switches must be provided on all such valves.

### 7.8.1 Types of Sprinklers

Sprinklers must be selected based on the associated hazards within the occupancy to be protected in accordance with the requirements in NFPA 13 and the IBC.

#### Special Requirements

The following requirements take precedence over the requirements in NFPA 13 and the IBC:

- Sprinklers equipped with “O-ring” water seals are not permitted to be installed.

### 7.8.2 Sprinkler Piping

Sprinkler piping, fittings, control valves, check valves, and drain assemblies must meet the requirements in NFPA 13.

#### Special Requirements

The following requirements take precedence over the requirements in NFPA 13:

- Black steel piping and copper tubing must be used for all wet-pipe sprinkler piping. Chlorinated polyvinyl chloride sprinkler piping is not to be installed unless specifically approved for installation by the GSA regional fire protection engineer.
- Galvanized (internal and external) sprinkler piping is not permitted to be used for dry-pipe sprinkler systems.



- Steel pipe sizes 51 mm (2 in.) and smaller must be Schedule 40 and must be threaded.
- Steel pipe sizes larger than 51 mm (2 in.) must be minimum Schedule 10. Piping less than Schedule 40 must be roll grooved.
- Threadable lightwall pipe is not permitted to be installed.
- Steel piping having a corrosion-resistant ratio less than 1 is not permitted to be installed.
- Plain-end fittings are not permitted to be installed.

### 7.8.3 Automatic Sprinkler Systems for Remote or Isolated Facilities

The requirements below apply to facilities located in remote or isolated areas having insufficient or nonexistent water supply sources for the design and installation of a fire sprinkler system in accordance with the requirements in NFPA 13. These facilities must also meet the criteria set forth below to determine when it is not economically feasible to install automatic fire sprinkler protection in accordance with NFPA 13.

If the following conditions exist, the sprinkler system must be designed in accordance with the requirements in NFPA 13D:

- The costs associated with the installation of the interior NFPA 13 fire sprinkler system (which include all costs such as labor, materials, the adequate water supply source, pumps, etc.) exceed \$10.00 per square foot; and
- The costs associated with connecting the interior NFPA 13 fire sprinkler system to the adequate water supply source (which include all costs such as labor, materials, the adequate water supply source, pumps, etc.) are greater than 50 percent of the cost for the installation of the interior NFPA 13 fire sprinkler system.

#### Special Requirements

The following requirements take precedence over the requirements in NFPA 13D:

- The water supply source for the sprinkler system must be a minimum of 3,785.4 liters (1,000 gallons) and must be capable of meeting system demands for at least 30 minutes.
- Antifreeze sprinkler systems are not permitted to be installed.

### 7.8.4 Fire Department Connections

Fire department connections must meet the requirements in the IBC.

#### Special Requirements

The following requirement takes precedence over the requirements in the IBC:

- UL-listed locking fire department connection caps must be installed on all fire department connections where the local fire department has a program and the hardware to accommodate locking fire department caps.

### 7.8.5 Standpipes

Standpipes must be installed in buildings where required in the IBC.

#### Special Requirements

The following requirements take precedence over the requirements in the IBC:

- All standpipes must be connected to the fire protection water supply, permanently pressurized, and installed in accordance with the requirements in NFPA 14. The standpipe water supply must be in accordance with the requirements specified within this chapter.
- Dry standpipes must be permitted to be installed only in spaces subject to freezing.

- Where standpipe and sprinkler systems are required, a combination sprinkler/standpipe system design must be provided.

### 7.8.6 Fire Department Hose Outlets

Fire department hose outlets must be installed in buildings where required in the IBC.

#### Special Requirements

The following requirements take precedence over the requirements in the IBC:

- Each fire main riser must be provided with 63 mm (2 1/2 in.) fire department hose outlets.
- Each outlet must be located in the stair shaft and have a removable 38 mm (1 1/2 in.) adapter and cap. Threads and valves must be compatible with the local fire department requirements.

## 7.9 Non-Water-Based Fire Extinguishing Systems

### 7.9.1 Wet Chemical Extinguishing Systems

Wet chemical extinguishing systems must be installed to protect commercial food heat-processing appliances required to have a Type 1 hood in accordance with the requirements in NFPA 17A.

### 7.9.2 Dry Chemical Extinguishing Systems

Dry chemical extinguishing systems are not permitted to be installed to protect any commercial cooking equipment installations.

### 7.9.3 Clean Agent Extinguishing Systems

Clean agent extinguishing systems are not permitted to be installed, unless specifically approved for installation by the GSA regional fire protection engineer. The approved clean agent extinguishing system is considered a supplemental fire extinguishing system and is not to be installed in place of a wet-pipe sprinkler system.

### 7.9.4 Carbon Dioxide Fire Extinguishing Systems

Carbon dioxide fire extinguishing systems are not permitted to be installed.

### 7.9.5 Portable Fire Extinguishers and Cabinets

Portable fire extinguishers and cabinets must be installed in accordance with the requirements of the IBC.

#### Special Requirements

The following requirements take precedence over the requirements in the IBC:

- In office buildings protected throughout with quick-response sprinklers, portable fire extinguishers must only be installed in areas such as mechanical and elevator equipment areas, computer rooms, UPS rooms, generator rooms, kitchen areas, and special hazard areas.

## 7.10 Elevator Systems

Elevator systems must be designed and installed in accordance with the requirements in ASME Standard A17.1/CSA B44 and the IBC.

### Special Requirements

The following requirements take precedence over the requirements in the IBC:

- In sprinklered buildings, each elevator machine room must be protected by a wet-pipe sprinkler system using standard response sprinklers having an intermediate-temperature rating, unless the GSA regional fire protection engineer permits the elimination of the sprinklers in the elevator machine room.
- The sprinkler system for the elevator machine room must be provided with separate manual isolation valves and a separate water flow switch located outside the room in an accessible location. Tamper switches must be provided on all such valves.
- Sprinkler protected elevator machine rooms containing elevator control equipment must be provided with a means to disconnect automatically the main line power supply to the affected elevator immediately upon or prior to the discharge of water from sprinklers in accordance with the requirements in NFPA 72.
- Except for enclosed lobbies required for fire service access elevators and occupant evacuation elevators, enclosed elevator lobbies are not required to be provided in buildings protected throughout by an automatic sprinkler system unless the total height of any hoistway(s) sharing a common atmosphere exceeds 420 feet (128 m).
- The height of elevator hoistways sharing a common atmosphere by elevator door openings at a common floor or by openings between hoistways shall be measured from the top of the lowest finished floor to the top of the highest finished floor of the floors served by the non separated hoistways.
- Fire service access elevators and occupant evacuation elevators can share a common lobby. Access to not more than one of the

two required exits can be provided through enclosed elevator lobbies.

## 7.10.1 Fire Service Access Elevators

Fire service access elevators must be designed and installed in accordance with the requirements in the IBC and ASME Standard A17.1/CSA B44.

### Special Requirements

The following requirements take precedence over the requirements in the IBC and ASME Standard A17.1/CSA B44:

#### *General*

Where fire service access elevators are required, a minimum of two elevators each having a minimum 1,588 kilograms (3,500 pounds) capacity serving every floor must be provided. At least one fire service access elevator must be sized to accommodate a stretcher in accordance with the requirements in the IBC. These fire service access elevators are not intended to be for exclusive use of the fire department and may be available for public use under nonemergency conditions.

### Water Protection

An approved method to prevent water from infiltrating into the hoistway enclosure from the operation of the automatic sprinkler system outside the enclosed fire service access elevator lobby shall be provided. The performance-based language permits alternate design options to prevent water from an operating sprinkler system outside the enclosed fire service access elevator lobby from infiltrating the hoistway enclosure.

### Standby Power

Sufficient standby power (Type 60/Class X/Level 1) must be provided to operate all designated fire service access elevators along with their associated controllers and the cooling and ventilation equipment serving their machinery rooms and machinery spaces, simultaneously. The design team fire protection engineer must evaluate and conduct an analysis to determine the appropriate minimum time, in hours,

that standby power must be provided following loss or failure of the normal power supply for the fire service access elevators to operate for the specific building and application.

#### **7.10.1.4 Occupant Evacuation Elevators**

Occupant evacuation elevators must be designed and installed in accordance with the requirements in the IBC and ASME Standard A17.1.

##### **Special Requirements**

The following requirements take precedence over the requirements in the IBC and ASME Standard A17.1:

##### **General**

In any new construction project, when the building has an occupied floor more than 36.5 m (120 ft.) above the lowest level of fire department vehicle access, occupant evacuation elevators must be installed. All passenger elevators for general public use, except for those designated as fire service access elevators, must be designated as occupant evacuation elevators in accordance with this section.

##### **Water Protection**

An approved method to prevent water from infiltrating into the hoistway enclosure from the operation of the automatic sprinkler system outside the enclosed occupant evacuation elevator lobby shall be provided. The performance-based language permits alternate design options to prevent water from an operating sprinkler system outside the enclosed occupant evacuation elevator lobby from infiltrating the hoistway enclosure.

##### **Standby Power**

Sufficient standby power (Type 60/Class X/Level 1) must be provided to operate all designated occupant evacuation elevators along with their associated controllers and the cooling and ventilation equipment serving their machinery rooms and machinery spaces, simultaneously. The design team fire protection engineer must evaluate and conduct an analysis to determine the appropriate minimum time, in hours, GSA P-100 Version 1.0, issued March 2014

that standby power must be provided following loss or failure of the normal power supply for the occupant evacuation elevators to operate for the specific building and application.

### **7.11 Special Fire Protection Requirements**

#### **7.11.1 Air Distribution Systems**

Fire dampers and smoke dampers installed in air distribution systems must be installed in accordance with the requirements in NFPA 90A.

##### **Special Requirements**

The following requirements take precedence over the requirements in NFPA 90A:

- In buildings protected throughout by an automatic sprinkler system, smoke dampers are not required to be installed at penetrations of shafts unless smoke dampers are used as part of a smoke control system.

#### **7.11.2 Information Technology Equipment Rooms**

Information technology equipment rooms containing high-value or mission-essential electrical equipment (such as mainframe computers) with the potential for high dollar loss or business interruption must be designed in accordance with the requirements in NFPA 75 and the appropriate GSA computer room fire alarm system specification.

### Special Requirements

The following requirements take precedence over the requirements in NFPA 75:

- A wet-pipe sprinkler system must be provided throughout the area, including data storage areas.
- Quick-response sprinklers must be installed throughout the area, including data storage areas.
- The sprinkler system must have a separate isolation valve and a separate water flow switch located outside of each protected area in an accessible location. Each valve must be provided with a tamper switch that is connected to the building's fire alarm system.
- Activation of the sprinkler water flow switch must disconnect power to the information technology equipment and to the HVAC systems with no time delay.
- The activation of one intelligent analog/addressable photoelectric smoke detector utilizing early warning smoke detection technology (e.g., smoke detectors having enhanced algorithms, fire alarm control panel having capability to program individual smoke detector response parameters, or smoke detectors using air sampling technology for use in information technology equipment rooms) within a single protected area must disconnect power to the information technology equipment and to the HVAC system after a preset time delay.
- Clean agent fire extinguishing systems are not permitted to be installed in information technology equipment rooms, unless warranted by risk and specifically approved by the GSA regional fire protection engineer.
- Underfloor spaces within information technology equipment rooms must be protected with a fire suppression system only where the risk warrants this protection and when approved by the GSA regional fire

protection engineer. If underfloor fire suppression is to be installed in an underfloor space that is 457 mm (18 in.) or greater in height, an automatic sprinkler system must be installed. If underfloor fire suppression is to be installed in an underfloor space that is less than 457 mm (18 in.) in height, use of a clean agent extinguishing system is permitted provided the design is specifically approved by the GSA regional fire protection engineer.

### 7.11.3 Places of Confinement (Holding Areas)

Places of confinement must be designed in accordance with the IBC.

#### Special Requirements

The following requirements pertaining to places of confinement take precedence over the requirements in the IBC when the aggregate number of detainees within each holding area is not more than 50 detainees, and where no individual is detained for more than 24 hours.

- Places of confinement must be designed in accordance with the requirements in NFPA 101 for lock-ups.
- Sprinklers must be installed within all places of confinement, including, but not limited to, prisoner holding cells, the main prisoner detention cell block, and prisoner attorney interview rooms.
- The sprinklers installed must be institutional quick-response flush pendent sprinklers designed for standard and extended coverage applications.
- The institutional sprinklers must have a solder-link-type fusible element, a tamper-resistant escutcheon, and a retaining flange that prevents sprinkler movement away from walls and ceilings.

### 7.11.4 Atriums

Atriums must be designed in accordance with the requirements in the IBC.

#### Special Requirements

The following requirements take precedence over the requirements in the IBC:

- The atrium sprinkler system must be designed as a separate sprinkler zone. In addition, a separate manual isolation valve and a separate water flow switch must be located in an accessible location. A tamper switch must be provided on all such valves.
- Atrium smoke control systems must be installed using the exhaust method in accordance with the requirements in the IBC.

### 7.11.5 Cooling Towers

Cooling towers must meet the requirements in NFPA 214.

#### Special Requirements

The following requirements take precedence over the requirements in NFPA 214:

- Cooling towers that are more than 57 m<sup>3</sup> (2,000 cu. ft.) in size and have combustible fill must be protected with an automatic deluge sprinkler system.
- Automatic sprinkler protection is not required to be installed in cooling towers that are over 57 m<sup>3</sup> (2,000 cu. ft.) in size, constructed of noncombustible materials, and have noncombustible components (including piping) and noncombustible decks.
- Automatic sprinkler protection must be installed in cooling towers that are constructed of combustible materials, have combustible components (such as PVC fill, louvers, drift eliminators, etc.), or have a combustible deck.

### 7.11.6 Residential Housing Units

Residential housing units must meet the requirements in the International Residential Code (IRC).

#### Special Requirements

The following requirements take precedence over the requirements in the IRC:

- Stairways in residential housing units must have a maximum riser height of 178 mm (7 in.) and a minimum tread depth of 279 mm (11 in.).
- Residential housing units are required to be protected by an automatic sprinkler system. The design of the automatic sprinkler system for the residential housing unit must be based on the design and installation requirements in NFPA 13D. Each residential housing unit must be provided with a local waterflow switch that will initiate a local alarm. The sprinkler waterflow alarm must be arranged so that the operation of the waterflow switch must produce an alarm signal that is audible throughout all inhabited areas of the individual housing unit. The sprinkler system waterflow switch and control valve must be monitored for alarm, supervisory, and trouble conditions.
- Residential housing units must be provided with approved multiple-station smoke alarms in all of the following locations:
  - In all sleeping rooms
  - Outside of each separate sleeping area in the immediate vicinity of the sleeping rooms
  - On each level of the dwelling unit, including basements
- All smoke alarms must be designed and installed in accordance with the requirements in the NFPA 72. All smoke alarms within the residential housing unit must be interconnected in such a manner that the activation of any single smoke alarm will activate all the smoke

alarms within the individual residential housing unit and produce an alarm signal that is audible throughout all inhabited areas of the individual residential housing unit.

- Manual fire alarm stations must not be installed in the residential housing unit.

### 7.11.7 Chemical Laboratories

Laboratories must meet the design requirements in NFPA 45 and the IBC.

#### Special Requirements

The following requirements take precedence over the requirements in NFPA 45:

- Laboratories handling or storing hazardous chemicals, flammable gases, flammable liquids, explosives, and biological laboratories must not be expanded in existing office buildings.
- All chemical laboratories must be equipped with sprinklers, regardless of size. Sprinkler protection must be calculated to provide a density of  $6.1 \text{ (L/min)/m}^2$  ( $0.15 \text{ gpm/ft.}^2$ ) over  $279 \text{ m}^2$  ( $3,000 \text{ ft.}^2$ ).

### 7.11.8 Record Storage Facilities

Record storage facilities that have a storage volume of records exceeding  $1,416 \text{ m}^3$  ( $50,000 \text{ cu. ft.}$ ) must meet the requirements in NFPA 232.

#### Special Requirements

The following requirements take precedence over the requirements in NFPA 232:

- Record storage facilities that store Federal records must meet the requirements in the National Archives and Records Administration (NARA) guidelines published in the NARA Code of Federal Regulations—36 CFR Part 1234, Appendix B—Alternative Certified Fire-safety Detection and Suppression System(s) and, when specified GSA P-100 Version 1.0, issued March 2014

by NARA, the archival storage standards published in NARA Directive 1571.

### 7.11.9 Flammable and Combustible Liquid Storage Arrangements

The storage arrangements and protection of a flammable and combustible liquid storage area must meet the requirements in NFPA 30 and the applicable factory mutual data sheets.

### 7.11.10 Compact Storage Modules

A type of shelving unit consisting of compact storage whereby the units move to allow for storage to be pushed together creating a storage unit with no flues or minimal spaces between units. Aisles are created by moving the shelving unit. Compact storage modules can be manual or electric in operation.

Compact storage modules must meet the following requirements:

- Compact storage modules must meet the requirements in NFPA 13.
- For floor loading requirements, refer to Chapter 4.

## 7.12 Required Design Guides and Manuals

### 7.12.1 U.S. Court Facilities

For special fire protection and life safety requirements for U.S. Court facilities refer to Chapter 9 and the U.S. Courts Design Guide.

### 7.12.2 U.S. Marshal Service Space



For special fire protection and life safety requirements for U.S. Marshals Service space, refer to the USMS Requirements and Specifications for Special Purpose and Support Space, Volumes I, II, and III.

### 7.12.3 Land Port of Entry Facilities

For special fire protection and life safety requirements for land port of entry facilities, refer to the Land Port of Entry Design Guide.

### 7.12.4 GSA Child Care Centers

For special fire protection and life safety requirements for GSA child care centers, refer to the GSA Child Care Center Design Guide (PBS-140).

## 7.13 Historic Structures

For an overall fire protection plan and to emphasize the design team's responsibility to address fire protection and to preserve the historic integrity of historic structures, the design team must explore alternative approaches outlined in State rehabilitation codes, International Existing Building Code, and national performance-based codes to resolve conflicts between prescriptive code requirements and preservation goals. In addition, the requirements and recommendations in NFPA 914 must be considered for rehabilitation projects in historic structures. The design team must also evaluate the U.S. Department of Housing and Urban Development Guideline on Fire Ratings of Archaic Materials and Assemblies, which provides test data on the fire resistance of a variety of historic materials, and the GSA publication titled Fire Safety Retrofitting in Historic Buildings.

### 7.13.1 Responsibility

The GSA regional fire protection engineer is the AHJ for all fire protection and life safety requirements who must exercise professional judgment to assess

the acceptability of alternative compliance solutions. Early and frequent coordination between the architects, State historic preservation officer, regional historic preservation officer, preservation specialists, external review groups, and the design team's fire protection engineer is needed for timely resolution of conflicts between fire safety and preservation goals.

### 7.13.2 Impact on Historic Fabric

Before the design development submission for a project in a historic building, the design team fire protection engineer must consult with the GSA regional historic preservation officer and the GSA regional fire protection engineer regarding the impact of the fire protection design features as required within this chapter on the historic fabric.

### 7.13.3 Fire Protection Alternatives for Consideration

Listed below are fire protection alternatives for the design team's fire protection engineer to consider when designing a project in a historic building:

- New stair enclosures in historic buildings should be designed to minimize visual impact on significant spaces, including historic lobbies and corridors. Cross-corridor doors should be designed to provide maximum height and width clearance and avoid visually truncating the corridor. Oversized hold-open doors will achieve this end in most circumstances. For more ornamental spaces, accordion-rated doors may be used. Transparent treatments, such as rated glass assemblies or historic doors modified to incorporate rated glass, should be considered when barriers should be kept closed to maintain a rated enclosure. Nonprescriptive compliance solutions, such as modification of historic door assemblies, should be approved by GSA's regional fire protection engineer.



- New fire-rated doors in preservation zones should be designed to resemble historic doors in panel detailing and finish. True-paneled fire doors are preferred for replacement of original paneled stair or corridor doors.
- In historically significant spaces, sprinklers should be carefully placed to minimize damage to ornamental materials. Develop detailed drawings for architecturally sensitive areas, showing precise sprinkler locations and finishing notes as necessary to ensure proper installation. Sprinklers should be centered and placed symmetrically in relation to ornamental patterns and architectural features defining the space, such as arched openings.
- Sprinklers and escutcheons should match original architectural surfaces or hardware. Oxidized brass or bronze heads are recommended for use in deeply colored (unpainted) woodwork. In elaborately decorated ceilings, heads should be camouflaged by custom coating and omitting escutcheon plates. In such cases, low-profile, quick-response sprinklers are preferred.
- In historically significant spaces, smoke detectors should be placed to minimize destruction of ornamental surfaces. Where ceilings are elaborately embellished, explore alternative detection products and approaches such as air sampling detection, projected beams, low-profile spot detectors, recessed installation, or custom-coating detector housings to blend with ornamental finishes. Application of special finish treatments outside of the standard factory process should be coordinated with, and approved in writing by, the manufacturer to ensure that UL labels and detector performance are not compromised. Smoke detector housings should be removed before application of special finishes.

## 7.14 Mass Notification Systems

Mass notification systems are emergency voice communications systems that can be used to broadcast nonfire emergencies such as severe weather, biological/chemical spills, terrorist acts, etc. to occupants within a single building, to multiple buildings, or throughout a campus. Mass notification systems use audible and visible notification appliances, similar to fire alarm and emergency communication systems, however, the appliances may be used to direct occupants to remain in the building for their safety, rather than evacuate or relocate as they would normally do in a fire emergency.

Mass notification systems may merely be simple extensions to fire alarm and emergency communication systems, involving additional audible and visible devices. This would typically be for systems installed within a single building. Mass notification systems become more costly and complex when installed to serve multiple buildings or a campus, as these installations involve additional wiring, multiple command centers and the possibility of exterior audio and visual devices. Because of these variances, every mass notification system project needs to be evaluated individually, and involve the GSA regional fire protection engineer. It should also be noted that a good time to install a mass notification system is when a new fire alarm system is being installed, since mass notification systems generally use the same equipment contained in a fire alarm and emergency communication system.

Regardless of the scope, a mass notification system must be designed in accordance with NFPA 72. However, the following special requirements take precedence over the requirements in NFPA 72:

- Mass notification system control equipment must be integrated with the fire alarm and emergency communication system control equipment.

- Occupant emergency notification must use fire alarm audio-visual appliances (e.g., speakers and strobes).
- Nonfire alarm notification appliances are permitted to be used for exterior building broadcasting announcements.
- Mass notification systems must have the capability of generating both automatic prerecorded and manual (live voice) emergency messages via the audible notification appliances, including speakers that are installed in elevator cars and exit stairways.
- Live voice emergency messages must override any automatic prerecorded message.
- Mass notification messages are permitted to over-ride the fire alarm and emergency communication system if approved by the GSA regional fire protection engineer.
- Visible notification appliances must be the same type as used for the fire alarm system visible notification appliances; however, they must not be identified by the word “fire.”
- Additional means for notifying occupants of a nonfire emergency (e.g., such as emergency message displays, scrolling text message displays, video displays, or text messaging, etc.) are permitted provided they are approved by the GSA regional fire protection engineer.
- The building fire alarm and emergency communication system must have manual over-ride capabilities at the main fire alarm and emergency communication control equipment and USMS Command and Control Center where appropriate. Additional locations are permitted if approved by the GSA fire protection engineer.
- An abnormal condition of a mass notification system component must not adversely affect the performance of the fire alarm and emergency communication system and vice versa.

## 7.15 Performance-Based Design

GSA encourages the use of performance-based design for new construction and major renovation and alteration projects. Performance-based design is an engineering approach to fire protection design based on established fire safety objectives and functional statements, analysis of fire scenarios, and assessment of designs based on those objectives and functional statements. Performance-based design differs from traditional prescriptive design in that specific methods for achieving compliance with the design intent are established by the design team, subject to the GSA regional fire protection engineer’s concurrence, and a life safety solution is developed that is tailored to the specific building, fire, and occupant characteristics contained within the building being assessed. Information on performance-based designs can be found in the International Code Council Performance Code, Society of Fire Protection Engineers (SFPE) Engineering Guide to Performance-Based Fire Protection Analysis and Design of Buildings, and the SFPE Handbook of Fire Protection Engineering.

## 7.16 Commissioning Fire Protection and Life Safety Systems

When total building commissioning is required as part of the project, the commissioning process must ensure that the fire protection and life safety systems and equipment installed in a building are in compliance with the owner’s project requirements and design intent documents.

The commissioning team must include a fire commissioning agent (FCxA) to perform all fire protection and life safety commissioning activities. The FCxA must be separate, both by contract and employment, from the A/E design team.

The FCxA must prepare a written commissioning plan that identifies the processes, procedures, methods, and documentation for each phase of the commissioning process for all types of active and passive fire protection and life safety systems from concept through post-occupancy. The completed commissioning plan, including all appendixes, must form the commissioning record turned over at the end of the construction phase. The commissioning plan must be continuously updated by the FCxA throughout the predesign, design, construction, and occupancy phases of the building life cycle. At a minimum, the commissioning plan must include:

- Commissioning scope and overview specific to the project
- General project information
- Commissioning team members, roles, and responsibilities
- General communication plan and protocol
- Commissioning process tasks and activities through all phases
- Commissioning schedule
- Required commissioning process documentation and deliverables
- Required testing procedures
- Recommended training
- The following materials must be added, as applicable, to the appendix of the completed commissioning plan:
  - Owner's project requirements
  - Basis of design
  - Commissioning specifications
  - Design review
  - Submittal review
  - Issues log
  - Construction checklists
  - Site visit and commissioning meeting minutes
  - Systems manual review
  - Training
  - Functional performance and seasonal testing procedures
  - Warranty review
  - Test data reports

- Sequence of operation (matrix)

The FCxA must assist the design team fire protection engineer in the development of the construction contract specifications to align the actions of the construction contractor with the commissioning plan, addressing all involved tests, special inspections, and certifications.

All active and passive fire protection and life safety systems must be commissioned including, but not limited to:

- Infrastructure supporting the fire protection and life safety systems within the boundaries of the project
- Fixed fire suppression and control systems
- Fire alarm systems
- Emergency communications systems
- Smoke control and management systems
- Normal and emergency power and lighting systems
- Explosion prevention and control systems
- Fire doors, windows, walls, and other fire- and smoke-resistant assemblies
- Commercial cooking operations
- Elevator systems
- Fire extinguishers
- Means of egress systems and components
- Other passive and active fire and life safety systems and equipment
- Other systems or installations integrated or connected to a fire or life safety system, such as, but not limited to access control, critical processes, and hazardous operations.
- Fire and smoke dampers
- Fire and smoke doors
- Through penetration fire stops
- Fire walls, barriers, and partitions
- Smoke barriers and partitions

For more information on commissioning requirements, see the Building Commissioning Guide, available at <http://www.wbdg.org/ccb/GSAMAN/buildingcommissioningguide.pdf>.



# Chapter 8 · Design Standards for U.S. Court Facilities

## 8.1 Goals and Objectives

This chapter refers to program and design issues in an effort to relate the design intent directly to the technical requirements for the building systems and finishes.

This chapter does not cover issues related to selection of audiovisual, data, or telecommunications systems. (These criteria are developed in the U.S. Courts Courtroom Technology Manual.) Reference is made to these systems in Chapter 8 only with regard to the electrical service requirements in the areas where they are being installed.

The following complementary documents provide comprehensive programming and design criteria for U.S. Court facilities.

## 8.2 Design Guidance

### 8.2.1 U.S. Courts Design Guide (USCDG)

This publication focuses on the functional program requirements, Court and court-related adjacency relationships, finish materials, and specific performance criteria for acoustics, environmental systems, including special heating, cooling, and lighting requirements. The USCDG also addresses security, telecommunications, and audio-visual design requirements.

The USCDG includes a tabular comparison of funding responsibilities for all components of the courthouse and court functional space. (This information is organized into budget requirements for GSA,

judiciary, and the judiciary-related executive branch agencies.)

The USCDG refers to technical information related to performance criteria to help illustrate the rationale for the requirements and to establish the standard for level of quality.

### 8.2.2 U.S. Marshals Service Criteria

Criteria for space controlled by the U.S. Marshals Service (USMS) are found in Requirements and Specifications for Special Purpose and Support Space Manual (USMS Publication 64). Use the latest version including all volumes and addenda. This publication provides the finish criteria for USMS functional program requirements, spatial relationships, electronic and physical security, and hardware standards and special HVAC requirements within the U.S. Courts and court-related spaces.

The USCDG and USMS Publication 64 speak directly to the functional requirements of the user and tenant. Chapter 8 presents the most cost-effective and efficient building systems and materials to achieve the appropriate environment from the perspective of the building owner (GSA) by reference to applicable technical standards, security standards, and life safety and accessibility requirements.

The USMS Publication 64 standards are complementary documents to both the USCDG and this chapter. These documents establish, in detail, the environmental, security, functional, and technical requirements for the USMS spatial accommodations within U.S. courthouses. They include information regarding secure environments for prisoners being held in preparation for a court appearance, USMS staff facilities, and general building security requirements. GSA is responsible for power to the

electronic security devices, but the design consultants should understand that the USMS security contractor provides detailing and environmental requirements related to security within the functional area dedicated to the courts. Chapter 8 indicates general requirements, but the USMS Publication 64 is the standard the A/E must follow.

## 8.3 General Requirements

### 8.3.1 Planning for Future Requirements

The master plan for each courthouse facility is intended to accommodate 30 years of growth, and the design of the initial phase of construction must provide the spatial requirements for 10 years.

The conversion of general office or other support spaces to courtroom use will potentially put greater demands on the HVAC, electrical, and communications systems. These systems will require expansion capacity and space for additional equipment related to the future courts in the initial building design. Historic courthouses require special considerations. For guidance on renovation of historic courthouses, consult with the regional historic preservation officer. Accessibility ramps should be installed in historic buildings, unless such ramps will result in substantial loss of historic material. Under exceptional conditions, an application for a waiver may be made for a temporary ramp.

### 8.3.2 Planning for Accessibility

All U.S. Court facilities must be accessible to persons with physical challenges.

The detailed functional aspects of each courtroom component include an integrated reference to accessibility accommodation within the description of Courtroom Requirements in chapter 4 of the USCDG.

The following information is intended only as a summary of the basic circulation, change in elevation, and spatial requirements that must be addressed at each respective component with regard to accessibility for individuals with physical challenges.

Design for accessibility must comply with the requirements of the Architectural Barriers Act Accessibility Standard (ABAAS).

GSA and judiciary policy requires all Federal courtrooms have the lectern, counsel tables, witness stands, and jury boxes accessible in the original design, and the judge's bench, clerk's station, and other court personnel workstations adaptable for accessibility, regardless of local or State code.

ABAAS requires a totally accessible interior route from the point of entry to all areas of a building used by the public. The design elements affected by this requirement include:

- Vestibule configuration
- Door sizes and pressure of operation
- Corridor widths
- Elevator access and control
- Toilet room and stall dimensions
- Telephone and TTY (text telephone) provisions
- Drinking fountain location and dimensions
- Visual and audible alarm accommodations
- Signage design and location
- Quantity of accessible seating
- Ramps or platform lift access to all raised seating

Access to all raised areas in courtrooms must be by platform lifts or permanent ramps. If platform lifts are provided, they must be an integral part of the architecture of the courtroom. Bench areas must be designed to accommodate this equipment, including structural slabs with a shallow pit for the lift platform.

U.S. Court facilities have several conditions that are unique to Federal building planning and design. There are provisions within the courtroom for fixed millwork

to include elevated platforms for judges, witnesses, clerk staff, reporters, and jurors. In addition, design of spectator seating areas must consider visitors with physical challenges, including individuals with sight and hearing difficulties. (All areas of the courtrooms must accommodate listening systems for the hearing impaired, and translators, note takers, and interpreters for the visually disabled.)

Table 8-1 outlines the accessible standards that apply specifically to courts and highlights instances where policy or preferences developed by GSA, in conjunction with the Judicial Conference of the United States, differ from ABAAS. Adaptability requires that dimensional consideration be included in the original design to incorporate accessible elements at a later time. Wherever ramps or platform lifts are provided for access to a raised area, railings must be provided as required.

### 8.3.3 Infrastructure

Electrical outlets, wiring, conduit, or raceways to support sound and visual communication equipment for persons with physical challenges will be provided

by GSA. Electrical service may be required for transcription services, telephone handset amplifiers, telephones compatible with hearing aids, closed caption decoders, text telephones (TTYs), or other devices to assist those with hearing or visual impairments.

### 8.3.4 Acoustic Planning Requirements

Acoustical performance is of the utmost importance in courthouse design. The A/E must include an acoustic consultant who must develop the appropriate information at each stage of the design process to assure the courts and GSA that sound and vibration issues have been properly addressed. Chapter 14 of the USCDG has specific guidance and requirements for the acoustic performance of each courthouse facility space. The design must provide these acoustic requirements. The finished space performance will be tested against these specific requirements. Where detailed criteria are not provided in the USCDG the requirements of P100 will be followed.

**Table 8-1 Accessibility Requirements**

SPACE	ACCOMMODATION
COURTROOM	
Circulation routes	Clearance and turning radius for wheelchairs throughout the courtroom.
Public seating	Number of wheelchair spaces and location are set by ABAAS
Litigant and counsel tables	Height clearance at table(s) and circulation space requirements of ABAAS.
Jury box	One wheelchair space along the general circulation path at the box. (If located on a tier, provide a ramp or lift.)
Witness stand	Comply with clear floor space and maneuvering requirements of ABAAS. Permanent ramp or platform lift to provide access. (Adjacent space is required for an interpreter.)
Judge's bench	Comply with clear floor space and maneuvering requirements of ABAAS. Adaptable for future inclusion of ramp or platform lift. (Electrical service, space, and floor depression must be included in the initial design for future platform lift.)
Courtroom clerk, bailiff, and court reporter stations	Comply with clear floor space and maneuvering requirements of ABAAS. Adaptable for future inclusion of ramp or platform lift. (Electrical service, space, and floor depression must be included in the initial design for a future platform lift.)
Lectern	Include an adjustable platform with a height variation between 710 mm and 760 mm (28 in. and 30 in.) above the floor. Knee space at least 685 mm (27 in.) high. The lectern must be at least 760 mm (30 in.) wide and 480 mm (19 in.) deep.
JURY & ANCILLARY FACILITIES	
Jury assembly room	Must be located on accessible route. Refer to ABAAS for number of wheelchair spaces. ABAAS also determines requirements for listening devices, kitchenette-type service units, and associated vending and seating areas.
Jury deliberation rooms	One space at tables. Clearance provided at coat storage and dedicated toilet rooms. Portable assistive listening system (provided by judiciary) may be used if there is more than one deliberation room.
Attorney/witness rooms, attorney work rooms and	Provide proper clearance for circulation and height at tables for wheelchairs.



conference rooms	
Grand jury suite	Refer to ABAAS for the number of wheelchair spaces and listening devices. Clearance provided at coat storage, service unit, and toilet rooms. Witness stand with wheelchair turning radius clearance.
USMS FACILITIES	
Court holding areas	Each classification of holding must have one holding cell accommodating wheelchair clearances and an appropriate toilet plus lavatory in accordance with ABAAS.
Visitor booths and attorney/prisoner areas	At least 5 percent, but no less than 1 percent, of booth/areas must provide clear floor space, maneuvering clearances and counter height dimensions for a wheelchair on both sides in accordance with ABAAS.

### 8.3.5 Architectural and Interior Design

This section addresses technical requirements for architectural materials and systems in buildings designed to serve the U.S. Courts. Specific requirements are presented for all special or unique court spaces and court-related agencies, including those to accommodate the U.S. Marshals Service.

### 8.3.6 Building Enclosure Systems

The baseline standard of exterior materials for U.S. Court facilities is precast concrete with limited stone, brick, or other durable materials. Fundamental construction standards for the majority of the exterior building systems are discussed in Chapter 3.

Specific additional provisions for U.S. Court facilities include:

- Vehicular sallyport doors that meet USMS requirements
- Appropriate (ballistic-resistant) glazing at various levels of a facility

General building design concepts for GSA-owned structures are based on an overall “systems” approach, utilizing all design elements of the building, including ceiling cavities, floor cavities created by use of access flooring, stacked vertical distribution cores, and centrally located

support areas to increase functionality, improve flexibility for future modifications, and provide buildings that are efficient regarding construction, operation, and maintenance costs.

- Physical and electronic security design features at vulnerable areas that will decrease risk of attack to occupants or escape of prisoners
- Level of facility as determined by the ISC Facility Security Level Determination of Federal Facilities dated February 21, 2008

### 8.3.7 Floor Systems

An important issue in the design of GSA-owned structures has been the evaluation and selection of an appropriate floor system, especially with

the potential of using the cavity below for the horizontal distribution of power, data,

telecommunications, and low-voltage system cabling, and the flexibility to position connections above the floor. Accessible flooring systems can be defined as a suspended floor plane above the structural slab with relocatable modular components. Raised access floor systems for Federal facilities must use a minimum of 150 mm (6 in.) above the concrete deck to allow adequate space for wire management systems and the crossing of large conduits. The requirement for raised access flooring in courthouses is described in Chapter 15 of USCDG.

The height of the accessible floor system must be included in the determination of floor-to-floor dimensions.

Select standard floor finishes within each function of the court facility primarily based on acoustic enhancement, general durability, and ease of access to underfloor electrical, telecommunication, and data distribution systems.

The USCDG contains detailed information on specific requirements for the use of carpet and other floor finish materials under each category of functional space. See Chapter 12 of the USCDG. The USMS Publication 64 contains very stringent requirements for the USMS in all detention-related areas of its facilities.

### **8.3.8 Interior Wall Systems**

Most interior wall partitions will be composed of gypsum board on metal studs, with the exception of USMS detention spaces. There may be instances in the general building construction where concrete masonry is

used if building elements, including elevator or plumbing shafts, are stacked systematically floor upon floor.

### **8.3.9 Ceiling Systems**

The USCDG outlines all of the appropriate interior finishes for U.S. Court-related spaces.

Chapter 3 of this document outlines the general parameters for selection of a ceiling system in typical office spaces. There are several types of spaces with custom ceiling system requirements, which may include courtrooms, public spaces, office and conference spaces of the courts or other agencies, and detainee areas. In historic buildings, acoustical requirements should be satisfied using removable finishes and features so that original ornamental surfaces may be maintained.

### **8.3.10 Office and Conference Spaces**

In office and conference spaces, flexibility and durability are also the main considerations in the selection of a ceiling system that must accommodate change and accessibility above the ceiling plane. The ceiling material must absorb sound to provide speech privacy and control transfer of noise from machines, computers, light ballasts, and other sources within adjacent office areas.

The use of a standard 600 mm by 600 mm (2 ft. by 2 ft.) suspension system with a commercial-quality acoustic ceiling tile is recommended. The use of this system allows future flexibility in partition arrangement and corresponding relocation of mechanical diffusers, lights, sprinklers, and components of other systems such as speakers and fire alarm notification appliances.

### **8.3.11 Courtrooms**

In courtrooms, acoustic characteristics and aesthetics are the main considerations in the selection of a ceiling system. The ceiling design and materials must enhance the acoustic performance of the well area. (Ideal reverberation time in a courtroom is 0.6 to 0.7 seconds. See Chapter 14 of the USCDG.) This will involve the use of reflective and absorptive materials in the space. At no point in the ceiling design must the

highest point exceed the maximum ceiling height requirements in the USCDG.

### 8.3.12 Public Spaces

In public spaces, the ceiling system must accommodate future changes to the layout of the space and allow access for maintenance of the building systems above and within the ceiling plane, including mechanical systems, diffuser locations, communication devices, lights, and fire protection systems. Acoustic tile in a suspended ceiling grid is typically provided in these areas, along with supplemental use of gypsum wallboard in soffits, perimeter coves, recesses, and reveals.

### 8.3.13 Detainee Areas

In detainee areas, security and durability are the main considerations in the selection of a ceiling system. Refer to USMS Publication 64 for suggested ceiling materials in these spaces.

### 8.3.14 Fixed and Movable Furniture

Components to be provided by GSA in U.S. Court facilities include fixed and limited movable furniture and millwork required for the operations of the courts in courtrooms, grand jury rooms, hearing rooms, jury assembly rooms, and public transaction counters. See Chapter 12 of the USCDG.

In general, built-in furniture must be designed with integral cable raceways plus conduits sized for future expansion and change. Built-in furnishings must also include access panels to permit easy cable and wiring changes. Provisions for power, data, and telecommunications outlets and inputs, and sound and other systems must be confirmed during the design development phase of the project on a position-by-position basis. Courthouse furniture must meet a variety of needs, and selection must consider function, cost, availability, and aesthetic criteria. The selection and design of fixed and limited movable furniture must be carefully coordinated to achieve a consistent image, proper function, and required clearances.

The movable furniture provided by GSA in the U.S. Court facilities are lecterns and counsel tables for courtrooms. Typical provisions for movable furnishings in U.S. Courts are indicated in tables provided for each category of space use in the USCDG. All items to be provided by GSA within the baseline rent charges are assumed to be included within the anticipated construction budget.

Refer to USMS Publication 64 for a detailed description of USMS fixed and movable furniture requirements in U.S. Court facilities.

Table 8-2 outlines the basic fixed furniture elements that are provided for all court-related functions.

**Table 8-2 Typical Interior Fixed Furniture Elements**

SPACE	TYPE OF FURNITURE ELEMENT
Courtroom	Judge’s bench (See AO publication U.S. Courts Design Reference Manual 2007)  Deputy clerk desk (Adaptable for computer and printer)  Court reporter / Recorder desk  Witness box  Fixed base chairs for jury and one not fixed  Spectator rail and seating  Jury box  Spectator benches
Grand Jury Room	Bench  Witness stand  Jury rails
Judge’s Chambers Suite	Kitchenette-type serving unit with sink (cabinets above and below) Built in book shelves
Judge’s Robing Room	Lockers for robes
Judge’s Private Toilet and Judge’s Robing Room Toilet	Vanity, mirror, and medicine cabinet
Jury Assembly	Check-in counter  Coat closet with rods  Kitchenette-type serving unit (cabinets above and below)
Jury Areas	Toilets with vanity and mirror  Kitchenette-type serving unit  Coat closet with rods
Library Spaces	Standup counter and stacks
Probation and Pretrial Services Entrance and	Standup counter (break resistant windows)

Urinalysis Testing Toilets and Lab	Toilet with mirror
Bankruptcy Appellate Panel Clerk	Intake counters
District and Bankruptcy Public Areas	Public counters and workstation
USMS Detention Cells	Benches  Modesty screen
USMS Prisoner/Attorney Interview Room	Counter  Stool (Prisoner side)
USMS Reception/Cashier Area	Service counter
USMS Staff Locker Rooms (Men's and Women's)	Lockers and benches  Grooming shelf and mirrors  Metal lockers  Hooks or open closet rod and shelf for coats
USMS and CSO Work/Mail Room	Base cabinets  Work surface  Shelving
Central Mail Facilities	Personal Protection equipment storage, counter sink with eye wash

### 8. 3.15 Signage and Graphics

Many Federal courthouses are large, complex structures requiring clear and coordinated systems of signage and wayfinding that allow first-time users to locate their destination as quickly and directly as possible.

A standardized system of signage, with interchangeable components, must be provided throughout the courthouse. ABAAS guidelines are specific about parameters of design, including location, size, color, and tactile qualities of signage and use of graphic symbols to assist nonreaders.

In addition to providing all general building identification and way-finding signage, GSA supplies

all court-related signs in public corridors of the building. Signage requirements within the courts' dedicated space, related to their function, are provided by the courts. See Chapter 13 of the USCDG. GSA supplies signs for life safety and public convenience (restrooms) within the functional areas of the courts. The A/E is responsible for designing all GSA-supplied signage and graphics.

For installation of signage in historic buildings, the A/E must consult with the regional historic preservation officer regarding the integration of signage in the historic facility or district.

The following signage must be furnished by GSA under the A/E design contract, and any remaining requirements will be determined and provided by the courts.

### 8.3.16 Identification and Information Signage

- Building identification/seal/cornerstone
- Division/department, tenant agency identification
- Courtroom/room/area identification
- Special function identification—library, media center, cafeteria, etc.

### 8.3.17 Directional Signage

- Main directory at building entrance—graphic plan
- Floor directory on each floor—graphic plan
- Directory of building occupants with suite locations
- Directional signage for building access by persons with physical challenges
- Directional signage for parking/restricted entrances
- Directional signage for service vehicles

### 8.3.18 Regulatory/Security Signage

- Signage for core functions—restrooms, stairs, telephones, and other elements on ABAAS-accessible path to building services
- Signage for controlled access areas—judicial and staff areas; if admission to controlled areas is based on acceptable identification, instructions for operating the call button/camera must be provided at the controlled door
- Signage for dedicated systems/facilities—elevators, stairs, staff restrooms (identification as dedicated and regulations for use must be stated)
- Signage for special locking arrangements

## 8.4 Structural Systems

### 8.4.1 General Requirements

The selection of the primary structural system for a new U.S. Court facility must be based on a variety of functional, technical, and load criteria. Whatever system is selected, the building must be planned with the longest logical clear spans (spacing between columns) consistent with design to prevent progressive collapse, and simplified structural framing to provide flexibility for modification/adaptation to accommodate areas of special use, including future courtrooms. (If space is dedicated to future courts, the column layout must not disrupt internal sightlines of the courtrooms.)

Design of the courtrooms and court-area structural configuration must respond to the needs for electrical and data/telecommunications systems and their related horizontal/vertical distribution network.

An important consideration for a structural design is the number and size of floor slab penetrations required in court areas for initial and future renovation.

## 8.4.2 Other Structural Design Requirements

Floor-to-floor heights must provide adequate space under raised access floors to allow for all systems within the floor cavity to be placed without interference with each other and to have adequate access for maintenance.

Floor-to-floor heights must be designed to provide sufficient space above the ceiling assembly to allow for all systems within the ceiling cavity to be placed without interference with each other and to have adequate access for maintenance.

Floor-loading capacities must be planned to accommodate initial and planned future loads, particularly in areas near building cores that can serve as special high-service zones.

Adequate floor structural capacity must be provided to accommodate the secure, solid-filled, reinforced security walls wherever they may occur in the dedicated USMS space.

Adequate roof structure must be provided to carry general personnel and equipment loads, and to accommodate additional loads for antennas, satellite dishes, and window washing equipment.

Special structural capacity must also be provided in the following areas of U.S. Court facilities:

- Court library stack areas (headquarters, satellite, and unstaffed): 7.2 kPa (150 lb/sf) live load capacity.
- Moveable shelving live loads must be determined by reference to International Building Code requirements in the location where construction is taking place. The minimum loading for these areas is 14.4 kPa (300 lbs/sf).
- Design floor loads of the USMS space as required by USMS Publication 64.

- Clerk of the Court file storage area must be designed to accommodate high-density file storage as identified by the court.

## 8.5 Mechanical Systems

This section focuses on technical requirements for the mechanical engineering systems that should be provided in buildings designed to serve the U.S. Courts. Specific requirements are presented for all special or unique spaces used by the U.S. Courts and court-related agencies, including spaces designed to accommodate the U.S. Marshals Service.

Federal court facilities must be designed to take advantage of integrated systems and controls to provide better building performance through energy conservation, economy of operations, maintenance, and flexibility for changes. Opportunities for system integration must be evaluated throughout the design process.

U.S. Court facilities require a variety of space types, each with its own set of specific requirements. In addition, court functions require flexibility in the time of operation and control of dedicated HVAC systems. See Chapter 15 of the USCDG.

### 8.5.1 System Selection and Design

All criteria in this section are mandatory.

#### 8.5.1.1 HVAC Specific Design Criteria

Outdoor winter temperature equal to ASHRAE 1-percent design dry bulb and coincident wet bulb.

Outdoor summer temperatures equal to ASHRAE 99-percent design dry bulb/97.5 percent wet bulb.

- Indoor air in courtrooms: 24° +/- 1°C (75° +/- 2°F) in summer and 22° +/- 1°C (72° +/- 2°F) in winter.

- Maintain 45 to 50 percent relative humidity for summer conditions and 25 to 35 percent relative humidity for winter conditions.
- All materials and methods of construction used to protect through penetrations and membrane penetrations of horizontal assemblies and fire-resistance-rated wall assemblies must meet the requirements of the International Building Code.
- Do not use duct lining. Ductwork must be acoustically designed as described in Chapter 5 of the P100 and Chapter 15 of the Courts Design Guide.
- HVAC systems must be designed to provide optimum flexibility in scheduling the use of courtrooms and chamber areas.

### 8.5.1.2 General Criteria

The selection of the HVAC systems, equipment, and source of energy must be in accordance with the guidelines and procedures established in Chapter 5. A life cycle cost (LCC) analysis must be conducted to ensure selection of the most cost-effective alternative environmental considerations.

The HVAC system must be designed to provide 23.4°C (74°F) in judges' chambers, courtrooms, and trial jury suites on average. The courtroom HVAC system must be designed so that courtroom thermostats can be reset from the building automation system to precool the courtrooms to 21.1°C (70°F) before scheduled occupancy.

Trial jury suites (when located adjacent to a courtroom), judges' chamber suites (when located adjacent to a courtroom), attorney/witness rooms, attorney work room, and courtrooms must be placed on the same system with separate zones having related thermostats and the design must account for variation in occupancy load.

Humidification must be provided as specified in Chapter 5. See Chapter 15 of the USCDG.

Mechanical systems will provide 5.7 cubic meters (20 cubic feet) per minute as a minimum per person in all occupiable areas of U.S. Court facilities.

The HVAC systems must be zoned in such a manner that the requirements of the special areas can be satisfied by efficient use of the systems and equipment.

To allow flexible and efficient use of the HVAC systems for hours of activity occurring at times other than standard building operations and to satisfy specific requirements in a U.S. Court facility, the central plant equipment (chillers, boilers, cooling towers, pumps, air handling units (AHUs), etc.) must be designed using redundant equipment of various sizes to satisfy the requirements of differing number and sizes of zones. (The goal is to service no more than two courtrooms per air handling unit.)

Piping systems must allow arrangements to permit changing courtroom HVAC systems from primary to secondary chilled water for off hours.

The HVAC design must allow submetering of utilities and equipment to permit the facility manager to allocate cost of operation beyond standard hours of operation.

The HVAC system design for the courtroom, judge's chamber suite, and the jury deliberation room, which compose a single "court set," must be designed to allow the HVAC system to operate after standard building operations hours in an efficient manner.

The design must include winter humidification for areas in the building with custom millwork.

### 8.5.1.3 Courtrooms/Chambers

#### Temperature and Systems Control

The HVAC system serving judges' chambers, courtrooms, and trial jury suites must provide an average temperature of 23.4° (74°F). The courtroom system zone must be designed to allow thermostats



to be reset from the building automation system to precool to 21.1°C (70°F) before scheduled occupancy.

**Air Distribution (See Chapter 15 of the USCDG)**

Three HVAC zones must be provided: one for the judge and attorney areas; a second for the jury areas; and a third for the spectator area.

The diffusers serving the spectator areas must be sized to serve the allowable seating capacity, plus 25 percent, to accommodate extra seating. The diffusers must be selected to meet minimum ventilation requirements at no loads, with no appreciable increase in system noise during load changes.

A minimum air exchange per hour: Appellate Judges' EnBanc and Panel, Special Proceeding Courtrooms 6-8; District, Magistrate and Bankruptcy Judge's courtrooms 8-10 (See Chapter 14 of the USCDG). Six air changes per hour must be provided for rooms with a ceiling height up to 4.6 meters (15 ft.) and eight air changes per hour for rooms with a ceiling height greater than 4.6 meters (15 ft.). Systems must be designed to meet these requirements when spaces are fully occupied, unless otherwise noted.

The maximum percentage of recirculated air must not exceed 85 percent.

If the courtroom is served by a fan system dedicated to more than one courtroom, the return air from each courtroom and its associated areas must be ducted directly to the unit.

Return air from the chamber suites must be ducted directly toward the return air shaft for a minimum distance of 4.5 meters (15 ft.). Ductwork will be treated to meet the acoustical courtrooms/chambers design criteria.

**8.5.1.4 Jury Facilities**

**System Description and Control**

Trial jury suites should be served from the same system as the associated courtrooms. A separate thermostat for each trial jury room is desirable.

**Air Distribution**

Air distribution systems in the jury facilities must provide separate temperature control and a high degree of acoustical isolation, particularly in the grand jury and trial jury rooms. Ductwork will be treated to meet the acoustical deliberation room design criteria.

**Air Changes**

In the jury assembly suites, trial jury suites, grand jury suites, and libraries, the system must provide 10 air changes per hour (ACH) with 80-85 percent return.

Refer to USMS Publication 64 for all detention requirements.

**Expansion Capability**

Since U.S. Court facilities should be expected to have a long, useful life, new construction and renovation projects must be planned to provide adequate mechanical and electrical capability to the site and building(s) to support future additions. It is particularly important to design the systems for specialized areas of the building (lobby, food service, mechanical rooms, electrical rooms) to support the anticipated 30-year needs of the occupants.

This can be accomplished by building additional space for future growth of the HVAC systems during initial construction and temporarily allocating it to building or tenant storage.

The A/E must locate equipment adjacent to the building perimeter wall that will abut future expansion for orderly tie-in to new system components.

**8.5.1.5 Acoustic Performance**

Acoustic performance must be a major consideration in the selection of HVAC equipment. Systems serving the courtrooms and auxiliary spaces must be designed with sound attenuation to provide consistent and acceptable sound levels. This is particularly critical in the design of court facilities that

require extensive use of sound and audiovisual equipment for recording and presentations.

To control noise during all modes of operation and for all load conditions, the HVAC system should be provided with one or more of the following:

- Sound traps
- Low-velocity, low static-pressure fan systems
- Special low-noise diffusers

If air is returned by the ceiling plenum, special attention should be given to the location of any partitions extending to the floor structure above and to the acoustical treatment of the required penetration of these partitions for return air.

HVAC equipment, including AHUs and variable air volume (VAV) boxes, must not be located in close proximity to courtrooms, jury rooms, and chambers. The minimum distance should be 7.6 meters (25 ft.) between AHU and courtrooms. (Refer to Chapter 5, Theaters and Auditoriums, for criteria regarding maximum duct velocity.) General system design must provide appropriate treatment of mechanical supply/return ducts to minimize sound and voice transfer from courtrooms, chambers, jury deliberation spaces, and witness rooms to surrounding areas.

Noise criteria (NC) (the limits that the octave band spectrum of noise source must not exceed) must range from 25 to 30 in courtrooms. (See Chapter 14 of the USCDG). For sound level maintenance, the courtroom must be served by constant volume air supply. The system must also support variable outside air requirements and variable cooling loads. Air ducts serving the trial jury and grand jury suites must be double-walled sound-attenuating ducts for a length of at least 3.7 meters (12 ft.) from the diffuser or return air intake.

### **8.5.1.6 Mechanical System Diffusers and Vents**

Mechanical system diffusers and grills in public and staff areas must be secure from tampering, particularly in areas that provide some degree of seclusion and privacy (restrooms, attorney-client visitation rooms, etc.). Maximum-security detention-type grilles, secured with tamper-proof fasteners, must be provided at all areas accessible to prisoners. (Refer to USMS Publication 64 for more information.)

### **8.5.1.7 Changes in Building Envelope to Meet Energy Guidelines**

Due to the energy load requirements of court facilities, designers must use the alternative design processes of ASHRAE 90.1R to meet Federal energy guidelines for overall building energy usage. Increases in building envelope energy resistance must be used to compensate for higher-than-average load requirements resulting from court functions. Total building energy usage must be established according to calculations using mandatory design standards contained in Chapter 5. To demonstrate the same total energy usage, a new calculation must be done, incorporating factors for energy reduction strategies to offset increased lighting, cooling, and heating energy loads.

### **8.5.1.8 Information Technology System Loads**

Information technology systems are not the largest source of heat within the office spaces, but may be the largest sources in other areas. Information technology systems may be the most uncertain source of heat flows during design phases; therefore, the HVAC system must be planned with capacity and control to accommodate the need for constant temperature and humidity environments 24 hours a day, where systems hardware could be placed.

The design of the HVAC systems must take into consideration provisions for separate units for critical areas such as computer rooms, USMS control room, elevator machine rooms, etc., which generate

additional heat loads. The HVAC design for these areas must have redundancy and be connected to the emergency power system.

## 8.6 Fire Protection and Security Systems

Refer to Chapter 7, Fire Protection and Life Safety, for all fire protection and life safety system requirements.

All security systems must be connected to emergency power. In addition, any security hardware (e.g., electronic locks, card readers, magnetic locks, etc.) that is installed on exit doors and exit access doors must meet the requirements of the National Fire Protection Association 101, with regard to function, design, operation, and maintenance. This includes, but is not limited to, any security hardware being installed on exit stair doors, building perimeter exit doors, and elevator lobby enclosure doors, as well as any door in the means of egress.

## 8.7 Electrical Systems

GSA will provide emergency and secondary power distribution as a basic requirement.

Normal building distribution systems must be designed to comply with Chapter 6. They must include a special electrical distribution system consisting of an isolation transformer with associated branch circuit distribution equipment, and must be designed to serve the data network system and associated equipment supporting nonlinear loads.

Uninterruptible power systems (UPS) must be provided to serve security, emergency smoke evacuation, and any other critical systems and be connected to the emergency power distribution system. Additional systems must be provided by the tenants for any specific tenant related requirements.

### 8.7.1 Spare Capacity

General design requirements for office and courtroom areas must be based on anticipated loads and requirements as outlined in Chapter 6. The capacity of the feeders serving all areas of the building must accommodate growth to the extent shown in the 30-year long-range plan for the facility.

### 8.7.2 Number of Outlets

The number of outlets provided in U.S. Court facilities must be in accordance with Table 8-3, electrical codes, and good practice.

**Table 8-3 Electrical Power Requirements/Outlets\***

LOCATION	EQUIPMENT/OUTLET(S)	NOTES
COURTROOMS		
Judge’s Bench	Isolated ground quadruplex receptacle for general purpose use; Duplex receptacle for computer, monitor; additional duplex receptacle for video arraignment.	
Courtroom Lobby	Duplex outlet with dedicated circuit for portable magnetometer. Branch circuits will be provided for additional loads dictated by the courts.	
Court Deputy Clerk Workstation	One isolated ground quadruplex receptacle (general use) and one duplex receptacle for PC and monitor per clerk position.	Printers as a group.
Court Reporter/Recorder’s Workstation	One quadruplex receptacle (general use), one duplex receptacle for reporter’s computer/CRT	Provide additional duplex receptacle(s) at alternate CR position(s) in the courtroom.
Witness Box	One duplex receptacle and one dedicated outlet.	
Jury Box	One quadruplex receptacle for general purpose use.	Mounted on inside of jury box enclosure.
Attorney Tables	One quadruplex receptacle (general use) Recessed floor box.	Per attorney table position.
Appellate Judge’s Courtroom Clerk	One isolated ground quadruplex receptacle (general use) and one duplex receptacle for PC and monitor.	Printer
Spectator Seating	One Isolated ground duplex outlet at front rail (“bar”) for computer/monitor for CRT or other use.	Mounted on spectator side Of rail enclosure.
Equipment Room/Area	Multiple outlets (as required) for sound, assisted listening system (ALS), data, telecommunications, and video recording and presentation equipment.	
Other	Duplex outlets at 20 ft. intervals along the walls of courtroom. Duplex outlets at two locations (minimum.) in front of bench millwork. Additional outlets at appropriate locations for ceiling-mounted screen, fixed or movable positions for slide projector, video monitor, video recorder, interactive white-	The courtroom well will have a suspended access floor system for flexible location of outlets

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	board and image copier, and x-ray viewer equipment. Locate underfloor boxes for multiple possible locations of a lectern and alternative locations for attorney tables. Provide additional outlets for initial/future location of video cameras. Provide outlet for wall-mounted clock. Provide outlet(s) for ALS unit(s). Provide outlets as required for video conferencing/arraignment equipment, video monitors/VCR equipment, security, and so on.	
<b>COURT SUPPORT</b>		
Witness Waiting Rooms	Distributed convenience outlets, including provisions for cleaning and housekeeping.	
Attorney/Witness Conference	Distributed convenience outlets, including provisions for cleaning and housekeeping, and for audiovisual equipment (monitor/VCR).	
Public Waiting Areas	Distributed convenience outlets, including provisions for cleaning/housekeeping. Provide outlets for clock. Duplex outlet with dedicated circuit for magnetometer outside sound lock.	
Media Room(s)	Distributed convenience outlets, including provisions for cleaning equipment and motor loads. Provide separately metered power outlets for news agencies telecast equipment.	
Court Reporter Office	One isolated ground quadruplex receptacle (general use). Duplex outlet(s), two minimum, for PC, monitor, printer, FAX.	Computer and office equipment (PC, monitor, printer) not in FF&E budget.
Judges Shared Conference/Reference Room(s)	Distributed convenience outlets. Provide Isolated ground outlets as required for video conferencing/arraignment equipment, video monitors/DVR equipment, security, sound-system, ALS and other equipment, based on anticipated locations of equipment.	Computer and office equipment (PC, monitor, printer) not in FF&E budget.
<b>JUDICIAL CHAMBERS</b>		
Judge's Chambers	Quadruplex receptacle for general purpose use. Two duplex receptacles for miscellaneous uses (TV monitor, slide projector use, etc.). Two isolated ground duplex receptacles for PC, monitor, printer	Duplex outlets for PC and monitor positions to be located in multiple positions (based on

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	and other computer equipment. Additional duplex receptacle for video arraignment and FAX equipment where required (initial/future use).	likely furniture placement). Computer and office equipment (PC, monitor, printer) not in FF&E budget.
Secretary/Judicial Assistant	One quadruplex receptacle (general use). Duplex isolated ground outlets, two minimum, for PC, monitor, printer, FAX.	
Law Clerk Office	One quadruplex receptacle general use). Duplex isolated ground outlet(s), two minimum, for PC, monitor, printer, FAX.	Computer and office equipment (PC, monitor, printer) not in FF&E budget.
Work Area	Quadruplex receptacle for general purpose use. Duplex outlets for coffee machine, microwave unit, refrigerator, based on equipment/furniture layouts. Additional outlet(s) for copier.	Equipment not included in base building budget. Refrigerator included in FF&E budget. Other equipment (PC, monitor, printer, FAX, copier, etc.) not in FF&E budget.
Conference /Reference General	Provide isolated ground outlets for video conferencing, TV monitor, projectors. Distributed convenience outlets in reception/waiting and general office areas. Provide outlets for floor-cleaning equipment and motor loads. Provide outlets as required for video conferencing/arraignment equipment, security, sound-system, ALS or other equipment, based on anticipated locations of equipment.	Computer and office equipment (PC, monitor, printer) not in FF&E budget.
Service Unit	Distributed convenience outlets	Coffee maker, microwave, refrigerator
TRIAL JURY SUITE(S)		
Jury Deliberation Room	Distributed convenience outlets, including provisions for cleaning/housekeeping. Outlets (GFI) on separate circuit for kitchen type service unit equipment (microwave, coffee maker). Isolated ground outlets for film/slide projection equipment, TV monitor and DVR, audio tape recorder/player. Outlet for wall-mounted clock	Computer and office equipment (PC, monitor, printer) not in FF&E budget.

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Other areas	Distributed convenience outlets, including provisions for cleaning/housekeeping.	GFI in toilet areas, per codes.
GRAND JURY		
Witness Box	Duplex receptacle.	
Jury Seating	Convenience outlets, including provisions for cleaning equipment and motor loads.	
Court Reporter's Workstation	One quadruplex receptacle (general use), one isolated ground duplex receptacle for reporter's computer/CRT.	Provide additional duplex receptacle(s) at alternate court reporter position(s), if applicable.
Attorney Tables	One quadruplex receptacle (general use). Recessed floor box, if appropriate. Foreperson: one quadruplex receptacle (general use).	Recessed floor box, if appropriate.
Other areas	Distributed convenience outlets, including provisions for cleaning/housekeeping.	GFI in toilet areas, per codes.
General	Distributed convenience outlets, including provisions for cleaning/housekeeping. Outlets (GFI) on separate circuit for kitchen type service unit equipment (microwave, coffee maker). Outlets for film/slide projection equipment, TV monitor and VCR, audio tape recorder/player. Outlet for wall-mounted clock. Power for sound, video system, if any.	Computer and office equipment (PC, monitor, printer) not in FF&E budget.
JURY ASSEMBLY		
Jury Assembly Room	Distributed convenience outlets. Provide isolated ground outlets as required for video conferencing equipment, video monitors/DVR equipment, security, sound-system, ALS and other equipment, based on anticipated locations. Provide outlets for use at carrels and tables for jurors for personal use.	Computer and office equipment (PC, monitor, printer) not in FF&E budget.
Jury Clerk Workstation(s)	Once quadruplex receptacle (general use). Duplex isolated ground outlet(s), two minimum, for PC, monitor, printer, FAX.	Computer and office equipment (PC, monitor, printer) not in FF&E budget.
Other Area(s)	Distributed convenience outlets, including provisions for cleaning equipment/motor loads.	

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LAW LIBRARY		
Circulation Desk	Isolated ground outlets for PC, other equipment. Distributed convenience outlets.	
Public Waiting Areas	Distributed convenience outlets, including provisions for cleaning/housekeeping.	
Entry Control	Isolated ground outlets for security equipment. Distributed convenience outlets, including provisions for cleaning/housekeeping.	Recessed floor box, if/as required.
Staff Offices	One quadruplex receptacle (general use). Duplex isolated ground outlet(s), two minimum (for PC, monitor, printer, FAX) per workstation.	Computer and office equipment (PC, monitor, printer) not in FF&E budget.
Staff Work Areas	Distributed convenience outlets; quadruplex receptacle(s) for general purpose use. Additional outlet(s) for copier.	Computer and office equipment (PC, monitor, printer) not in FF&E budget.
CALR Areas	Duplex isolated ground outlet(s), two minimum (for PC, monitor, printer, FAX) per workstation.	Recessed floor box, if/as required.
Carrel/Casual Seating Areas	Distributed convenience outlets. Provide outlets for use at carrels and tables.	
Conference/Group Study/Work Rooms	Multiple outlets (as required) for sound, ALS, data, telecommunication and video recording and presentation equipment. Duplex outlet for microfiche machine.	
CLERK OF COURT AREAS		
Public Counter and Workstations	One quadruplex receptacle (general use); duplex isolated ground outlet(s), two minimum, for PC, monitor, printer, FAX, per workstation. Provide additional outlet(s) for cash registers, additional printers, shared-access PCs, printers	Computer and office equipment (PC, monitor, printer) not in FF&E budget.
Records Exam Areas	Provide duplex outlet(s) for public access PCs, monitor, printer, and FAX equipment. Provide outlet(s) on separate circuits for public access copier(s).	Computer and office equipment (PC, monitor, printer) not in FF&E budget.
Other Staff Workstations	One quadruplex receptacle (general use). Duplex Isolated ground outlet(s), two minimum, for PC,	Computer and office equipment (PC, monitor,



	monitor, printer, FAX.	printer) not in FF&E budget.
Shared Staff Work Areas	Distributed convenience outlets; quadruplex receptacle(s) for general purpose use. Additional outlet(s) for copier(s), FAX equipment, etc.	Computer and office equipment (PC, monitor, printer) not in FF&E budget.
Staff Break Rooms	Distributed convenience outlets, including provisions for cleaning/housekeeping. Outlets (GFI) on separate circuit for kitchen type service unit equipment (microwave, coffee maker).	Equipment not included in base building or FF&E budget.
COURT-RELATED AGENCIES/SPACES		
	Similar to Court Clerk/Court Administrative areas above.	
NOTE:		
	(1) For all electrical power and outlet requirements in USMS dedicated spaces, refer to USMS Publication 64.  (2) The power outlet requirements for each project should be verified.	

\* This table is comprehensive, but may not be complete as needs and systems change over time and from court to court. These requirements are in addition to those in Chapter 6.

### 8.7.3 Grounding

Provide grounding as indicated in Chapter 6.

### 8.7.4 Isolated Ground Circuits

Most courthouse computers and data/telecommunication equipment will not be connected to the building backup emergency generators or UPS system. To minimize this type of equipment operational and performance problem, it is necessary to mitigate the amount of electrical disturbance that this type of equipment will be subjected to. All courthouse desks and work areas

should be provided with regular power receptacles as well as an isolated ground (IG) power receptacle. IG power systems are especially designed to minimize electrical disturbances, thus only computers and data/telecommunication should be connected. All other types of equipment including task lighting, heaters, radios, photocopiers, and vacuum cleaners should be connected to the regular power receptacles.

### 8.7.5 Below-Floor Electrical Distribution

Most areas of the courthouse incorporate below-floor horizontal distribution systems. Final horizontal

distribution plans must be designed considering potential EMI/RFI sources. (Access floor areas must comply with Chapter 6.)

### **8.7.6 Emergency and UPS Power Systems**

In addition to the emergency power systems required in Chapter 6, provide backup power to systems described in Chapter 15 of the Courts Design Guide.

### **8.7.7 Service and Distribution**

Emergency and normal electrical panels, conduits, and switchgear must be installed separately at different locations. Electrical distribution must also run at separate locations.

### **8.7.8 Exterior Connection**

Conduit and feeders must be installed on the exterior of the building to allow use of a trailer-mounted generator to connect to the building's electrical system. This must be regarded as a tertiary source of power for systems in the building where operational continuity is critical. (An operational plan must be in place to provide this service quickly when needed.)

Emergency power must be derived from generators sized to carry the required loads. Generators must be synchronized to serve a common distribution board which, in turn, serves appropriate automatic transfer switches (ATSs) and the fire pump. Separate ATSs must be provided for the life safety/security system, UPS system, and essential systems. Essential systems will serve the ventilation and equipment loads required for personnel and building protection in the event of a commercial power failure or other catastrophic event.

### **8.7.9 Coordination with Telecommunications System Design**

Electrical IG power distribution for the various areas of U.S. Court facilities must be coordinated with the design of the telecommunications power/grounding systems to improve the overall integrity of the telecommunications utility. See Chapter 15 of the USCDG.

As technology continues to increase in speed/performance, better distribution coordination becomes necessary. If this is not done, the grounding systems will not operate efficiently at the higher frequency ground currents, reducing the integrity of the telecommunications utility, creating errors in transmission, etc.

A secure, air-conditioned data/telecommunications closet must be located near the judges' chambers, courtrooms, and court offices to contain network equipment. The use of cable trays rather than conduits must be considered.

### **8.7.10 Lighting Systems**

Illumination levels, lighting types, and lighting controls in specific court functional areas are provided in the USCDG. See Chapter 15 of the USCDG. In all other spaces, illumination levels and lighting controls must be provided as specified in Chapter 6. Task lighting must be variable to 100 FTC (1100 lx).

The lighting system should have good color rendition and avoid bright spots on the ceiling plane. Modulation of lighting should be used to distinguish the courtroom well and spectator areas. The A/E must provide fixtures with accurate color rendition and avoid the use of metal halide fixtures. The use of indirect pendant-mounted fluorescent fixtures provides good, soft diffuse general lighting in a courtroom, complemented with recessed

concentrated light sources at the judge's bench, the witness box, and attorneys' tables. Lighting levels must consider the impact on courtroom finishes.

An override switch will be located at the judge's bench and at the courtroom deputy clerk station to allow an instantaneous override of all dimming controls in an emergency.

The following lighting controls can be specified depending on the size of the courtroom, lighting arrangements, and lamp types:

- A more complex lighting installation consisting of local, wall, box-type, electronic, silicon-controlled rectifier dimmers; or
- Remote electronic dimmers with preset lighting arrangements, for large courtrooms with high ceilings.
- Control of lighting is the responsibility of the courtroom deputy clerk or another designated court officer and must be operated with a key. Light switches must not be accessible from the spectator seating area or witness box. Provision of integrated electronic controls must be considered with preset lighting schemes having integrated controls for shading devices at windows and skylights, plus controls for presentation screens (if provided by the courts). The controls must allow varying levels of light to suit the needs and desires of the courtroom participants.

Electronic ballasts for fluorescent lamps must not be used in areas that contain sensitive security devices or special equipment that is sensitive to electronic interference, such as ALD infrared emitters.

Guidelines for site illumination are specified in Chapter 6. Lighting in parking areas must allow for identification of vehicle color, and the design should avoid the use of low-pressure sodium fixtures.

Emergency lighting for courtrooms and security areas, to include USMS detention facilities, must have built-in batteries plus emergency generator service.  
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### **8.7.11 Audiovisual Requirements in U.S. Court Facilities**

All audiovisual design and technical infrastructure requirements are indicated in the Administrative Office of the United States Courts publication, Courtroom Technology Manual. These requirements are provided and funded by the tenant.

## **8.8 Security Design: Agency Responsibilities**

Courthouse security is the joint responsibility of the judiciary, Department of Homeland Security, Federal Protective Service, and USMS. The USMS has the primary role in security decisions. Decisions regarding security planning and design are made by individual agencies and the local Court Security Committee (CSC), or for multitenant buildings, the Facility Security Committee (FSC). See Chapter 16 of the USCDG.

The CSC is responsible for identifying a court's specific security requirements and developing a security plan for judicial facilities and operations throughout the district.

All security systems and equipment must be consistent with requirements in ISC Physical Security Criteria for Federal Facilities and the ISC Security Level Determination of Federal Facilities dated February 21, 2008; USCDG; and Requirements and Specifications for Special Purpose and Support Space Manual Volumes 1-3, USMS Publication 64. The CSC must be informed about and have the opportunity to review all security-related design decisions.

The USMS Central Courthouse Management Group's (CCMG) facilities management team is responsible for design considerations involving secure prisoner movement, holding cell and interview facility

requirements, and USMS-occupied office and support space. The Judicial Security Systems Team within the CCMG is responsible for the planning, design, and installation of security systems in spaces occupied by the judiciary. The USMS coordinates the work of the security system and security construction contractors.

In addition, the CCMG often acts as security engineer for court buildings, designing and integrating security systems for building perimeters in conjunction with GSA and FPS.

Refer to the USCDG and USMS Publication 64 for a more detailed explanation of security design responsibilities.

Once the functional planning criteria including security-related issues, as outlined in the USCDG and USMS Publication 64, are implemented into the conceptual design for the new or renovated court facility, they are intended to help in the development of the technical drawings, specifications, and other information to incorporate the security components into the project.

### **8.8.1 Areas that require battery backup to maintain camera and direct visual surveillance in the event of power failure include:**

- Vehicular sallyports
- Prisoner sallyports and secured circulation
- Detention cell block areas
- Communications centers
- Prisoner processing areas
- Squad rooms
- Public reception rooms
- Prisoner-attorney interview rooms
- Court holding cell areas
- Judges' chambers
- Interconnecting doors from public corridors to controlled corridors
- Command and control centers
- Courtrooms
- Witness/Attorney rooms
- Restricted circulation

# Appendix Submission Requirements and Resources

## Submission Requirements

- A.1 General Requirements
- A.2 Performance Expectations Matrices
- A.3 New Construction and Modernization
- A.4 Alteration Projects
- A.5 Surveys and Geotechnical Reports
- A.6 Energy Analysis Input and Output

## Resources

- B.1 References
- B.2 Acronyms and Abbreviations

# A.1 General Requirements

These design submission requirements have been developed to ensure a rational, well-documented design process and to facilitate reviews by GSA staff, tenant agencies, and local regulatory agencies or review boards as the design develops. The submission requirements listed here apply to all projects where design services are performed by architects and engineers under contract to GSA.

These requirements are the minimum standards and the specific A/E scope of work will take precedence on each project.

In each phase of work, project documents must be submitted to GSA in electronic and hard copy format as determined by the GSA project manager.

## Drawings

### Drawing Size

All drawings of a single project must be a uniform standard size, as designated by the American National Standards Institute (ANSI) below. International Organization for Standardization (ISO) or architectural-sized sheets may also be approved for use.

	Size (in)	Size (mm)
ANSI A	8.5 x 11	216 x 279
ANSI B	11 x 17	279 x 432
ANSI C	17 x 22	432 x 559
ANSI D	22 x 34	559 x 864
ANSI E	34 x 44	864 x 1118

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### Drawing Lettering

Lettering on drawings must be legible when drawings are reduced to half size. This applies to concept and design development drawings as well as construction documents.

### Drawing Scale

All drawings are to be created at full scale and plotted at a selected scale. The drawings or views (such as details) should include numeric and graphic scales. The scale selected should be appropriate for high resolution and legibility to include reduced copies (such as half-sized).

There are nine preferred metric scales: 1:1 (full size), 1:5, 1:10, 1:20, 1:50, 1:100, 1:200, 1:500, and 1:1000. Other scales may be used as needed (such as 1:2 half full size). Floor plan drawings should be plotted at 1:100 (close to 1/8 inch scale).

Architectural floor plans must be dual dimensioned with English units and contain English scales so that the Spatial Data Management (SDM) Coordinator can reconcile the drawings with the program requirements.

### CAD Standards

The PBS CAD Standards must be obtained from GSA's [www.gsa.gov/cad](http://www.gsa.gov/cad) or [www.gsa.gov/cifm](http://www.gsa.gov/cifm) website. These guidelines must be followed for all CAD deliverables. GSA regions and other programs, such as Spatial Data Management (SDM), may have further requirements. These further requirements are considered supplements to the PBS CAD Standards, for example, see base scale example above under Drawing Scale. Check for and obtain any supplements from the PBS CAD Manager or SDM Coordinator in the region where the project is located.

A north arrow must be included on all site drawings and plan view drawings.

## Dimensioning

The millimeter is the only unit of measurement to appear on construction documents for building plans and details for all disciplines except civil engineering, which must be stated in meters. However, building elevation references are stated in meters. Use of millimeters is consistent with how dimensions are specified in major codes. No dimension requires the "mm" label. On the drawings the unit symbol is eliminated and only an explanatory note such as: "All dimensions are shown in millimeters" or "All dimensions are shown in meters," is provided. Whole numbers always indicate millimeters; decimal numbers taken to three places always indicate meters. Centimeters will not be used for dimensioning.

If dual dimensioning is utilized on drawings, SI units must be primary, with English units secondary and in parentheses.

## Seals

Each sheet of the construction documents must bear the seal and signature of the responsible design professional. (Specification and calculations cover page only.) Electronic plans may have digital signatures and seals.

## Cover Sheet

Provide code certification statement for compliance with specified codes and standards by each discipline with the professional seal and signature. The intent is to formally recognize the responsibility for compliance.

## Document Security Requirements

All sensitive but unclassified (SBU) building information must be handled as described in GSA Order PBS 3490.1A, Document Security for Sensitive But Unclassified Building Information, 06/01/2009.

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Within any electronic or printed document, pages containing SBU building information must have the following mark imprinted or affixed:

**SENSITIVE BUT UNCLASSIFIED (SBU)**

**PROPERTY OF THE UNITED STATES GOVERNMENT**

**FOR OFFICIAL USE ONLY**

**Do not remove this notice**

**Properly destroy or return documents**

**when no longer needed**

The following mark must be affixed to the cover or first page of any document (such as the cover page on a set of construction drawings) containing pages marked as required by the paragraph above:

**SENSITIVE BUT UNCLASSIFIED (SBU)**

**PROPERTY OF THE UNITED STATES GOVERNMENT,**

**COPYING, DISSEMINATION, OR DISTRIBUTION OF**

**THIS DOCUMENT TO UNAUTHORIZED RECIPIENTS**

**IS PROHIBITED**

**Do not remove this notice**

**Properly destroy or return documents**

**when no longer needed**

The previous two statements must be prominently labeled in bold type in a size appropriate for the document or portable electronic data storage device or both, if applicable. On a set of construction drawings, for example, the statements must be in a minimum of 14 point bold type or equivalent. The SBU markings must be used regardless of the medium through which the information appears or is conveyed.

The construction drawings, plans, and specifications are to be disseminated only to those requiring the information necessary for design, construction bidding, construction coordination, or other GSA procurement competition processes.

## Building Information Model

GSA requires the use of interoperable Building Information Models (BIM) on all projects over prospectus throughout the project lifecycle. During all phases of the project, BIM models must be included with all existing submission requirements. BIM models must be delivered in both native and IFC file formats. For questions or feedback, please contact your GSA Regional BIM Champion or visit [www.gsa.gov/bim](http://www.gsa.gov/bim).

## BIM Standards

GSA BIM Standards shall be obtained from GSA's BIM Website ([www.gsa.gov/bim](http://www.gsa.gov/bim)). These guidelines shall be followed for all BIM submissions. The BIM shall be set up such that 2D CAD drawings should be derived from the model and meet PBS CAD Standards.

## BIM Execution Plan and Scorecard

A BIM Execution Plan and a BIM Scorecard are required for each project to ensure that BIM objectives, processes, workflows, technologies, performances are established and tracked in alignment with the project requirements. The BIM Execution Plan and the BIM Scorecard shall be established in coordination with GSA Project Managers, GSA Regional BIM Champions and Subject Matter Experts, and GSA Central Office Subject Matter Experts. Refer to GSA BIM Guide Series 01 ([www.gsa.gov/bim](http://www.gsa.gov/bim)) and contact GSA Regional BIM Champions and GSA Central Office BIM Subject Matter Experts to develop a project specific plan and scorecard. The BIM Execution Plan shall be agreed upon by all parties prior to the start of design.

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## Spatial Data Management

Project teams shall provide at each submission stage 2D CAD plans, one for each level of the facility, with assignment data and space boundaries in compliance with the National Business Space Assignment Policy.

- Provide space boundaries as MPOLYGON AutoCAD drawing elements on layer LNK-NON separately for every room and space such that all areas within the total level area are contained in one and only one boundary and the sum of the areas of the space boundaries is exactly equal to the total level area.
- Provide a comma delimited ascii text file with double quote mark text identifiers and column headers containing the assignment data for every boundary in the facility
- Provide assignment data tags for each boundary as MTEXT Autocad drawing elements on layer Q\_TXT\_SPACE placed within the associated boundary with the following data as shown below:
  - Space ID
  - Agency Short Name: Agency Bureau Code
  - Room Name
  - Occupancy Agreement number
  - ANSI BOMA classification code: PBS space category code: PBS space type code
  - Area in sq. ft. (2 decimal places)

SDM deliverable requirements can be met by generating deliverables from a BIM that meets the GSA BIM Guide Series 02 – Spatial Program Validation standards. Project teams shall contact the Regional BIM Champion and SDM Coordinator for additional guidance to streamline BIM and SDM deliverables.



## Specifications

### Format

Specifications should be produced according to the 2004 edition Construction Specification Institute (CSI) division format. Each page should be numbered.

Specifications should be bound and include a table of contents. The specifications must include instructions to bidders and Division 1, edited to GSA requirements.

### Editing of Specifications

The A/E is responsible for the editing of all specification sections, including any Government-furnished guide sections, to reflect the project design intent, GSA policy requirements, and Federal law. Technical specifications must be carefully coordinated with drawings to ensure that everything shown on the drawings is specified. Specification language that is not applicable to the project must be deleted.

### Dimensioning in Specifications

Domestically produced hard metric products must be specified when they meet GSA guidelines regarding cost and availability; see Chapter 1, General Requirements, Metric Standards, in this document. In the event a product is not available domestically in hard metric sizes, a non-metric sized product may be specified, and its data will be soft converted to a metric equivalent.

### Turnover Documents

Electronic and hard copy documentation on all building systems should be provided for the guidance of the building engineering staff and long-term asset management. Documents should show the actual elements that have been installed, how they performed during testing, and how they operate as a

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system in the completed facility. Examples are as follows:

- Contractor "redline" as-built drawings and specifications (including building/site actual measurements, changes to details, actual panel schedules, etc.) as required by the construction contract.
  - Architect/engineer's final "record" drawings to include final changes to design and contractor noted as-built conditions.
  - Operating manuals with a schematic diagram, sequence of operation, and system operating criteria for each system installed. Custom-written operating manuals; minimum standard should be submission of Word documents.
  - Training materials and videos.
  - Equipment maintenance manuals with complete information for all major components.
- In addition, asset data and documentation, including special data and documentation as to engineering, calculations, record drawing information, and visual media, should be provided to document the configuration, engineering assumptions, actual material/sizes installed for future maintenance, repairs, and improvements. Prior to acceptance for design completion or substantial completion, all required submittals and deliverables must be verified by a Government representative as received and complete, such as:
  - Drawings: design, redline, and record drawings
  - Submittals, fabrication, and shop drawings, including:
    - Equipment schedules;
    - Equipment (or other) data sheets, product literature, minimum standard should be submission of PDFs, allows for regional supplementation;

- Equipment inventories, testing, adjusting, and balancing (TAB) reports, and Commissioning functional performance test (FPT) results to be submitted as electronic data tables (Excel or Access files are acceptable), including fields specified in the specifications;
- BAS point and device data must be submitted as electronic data tables, to include necessary unique identification information such as point numbers, device ID numbers, network numbers, etc., as well as English-language descriptions and location information.
- All test records
- Fire Sprinkler and Alarm Systems: Calculations (including energy, structural, lighting, fire alarm system voltage drops and battery requirements, fire sprinkler hydraulics, etc.)

All electronic media must be readable by GSA's current software versions and optimum file sizes of desktop media, such as Acrobat, Microsoft, AutoCAD DWG format, BIM native and IFC format, video media, electronic photo (e.g., ".jpg"), and Webcam archive data. Electronic data should be provided to the Government via the GSA electronic project management system (ePM) and on CD-ROM, unless otherwise specified. As-built BIM files shall be delivered in accordance with As-Built Documentation specifications in P100. At a minimum, all Operating Manuals, Training Videos and Documents, and Equipment Manuals should be linked to the BIM according to the BIM execution plan defined by the project team at the beginning of Construction.

For all software installed in support of installed equipment, provide backup CDs with all files necessary to reinstall, all user and programming support manuals, and all files produced for the specific installation (e.g., graphics files, DDC program files, etc.).

Note that specification section 01781, Project Record Documents, should be edited to reflect Electronic Final Submittals and Data as noted above.

## Design Narratives and Calculations

### Format

Typed, bound narratives should be produced for each design discipline.

### Content

Narratives serve to explain the design intent and to document decisions made during the design process. Like drawings and specifications, narratives are an important permanent record of the building design. Drawings and specifications are a record of what systems, materials, and components the building contains; narratives should record why they were chosen. The narrative of each submittal may be based on the previous submittal, but it must be revised and expanded at each stage to reflect the current state of the design.

### Calculations

Manual and/or computer based calculations should accompany narratives where required to support technical analysis. Each set of calculations should start with a summary sheet, which shows all assumptions, references applicable codes and standards, and lists the conclusions. Calculations should include engineering sketches as an aid to understanding by reviewers. The calculations for each submittal should be cumulative, so that the final submittal contains all calculations for the project. Calculations submitted at early stages of the project must be revised later to reflect the final design. Calculations must refer to code, paragraph of code used, standards, and text books used for specific

portion of calculation. Refer to drawing number where the results of the calculations have been used. Example: number and sizes of re-bars used in reinforced concrete members.

## Performance Criteria

As part of the development of concepts through construction documents there must be a check of building performance criteria as noted in Section A.2.

## Design Quality Reviews

Design Quality Reviews will be performed by an independent third-party review team at three stages of project design: Final Concepts (FC), Design Development (DD), and Construction Documents (CD). These reviews are sponsored by the Office of Design and Construction and are diagnostic in nature. Using a predefined review process and random sampling techniques, the review teams will evaluate each project for applications of best practices, conformance with criteria, building and systems performance, efficient and effective design, cost drivers, risk factors for successful execution, and customer satisfaction, as well as several other indicators of overall project suitability and readiness to move to the next phase in execution. At each design stage, the design A/E will be required to complete the Design Quality Review Questionnaire and submit it to GSA Central Office along with one complete set of design submittal documents including drawings, specifications, and design narratives. These submittals may be made in electronic form as agreed with GSA on a case-by-case basis.

## Energy Analysis

In addition to GSA's goal of USGBC LEED Gold Certification for all new construction and major modernizations, the release of Executive Order 13524 on October 5, 2009, increased the importance of

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Federal energy goals. An energy analysis must be submitted at the preconcept phase of design and updated throughout the development of the project to continually look for creative ways to reduce energy use. Many opportunities exist for the reduction, recycling, or production of new energy in site, architectural, and building systems design. An energy analysis as described in Section A.6 and in Section 5.3 (Energy Analysis Criteria) is required for each project.

## Cost Management Requirements

Cost estimates and market studies must be provided at various stages of the design process in compliance with GSA document P120, Project Estimating Requirements, and the estimating requirements outlined below, with the technical clarification from the GSA estimating staff.

## General Requirements

The Government requires that the design team prepare cost estimates at a minimum for the following stages of design:

- Preliminary concept design stage with multiple schemes of design
- Final concept design preceding value engineering
- Final concept design
- Design development documents preceding value engineering
- Final design development documents
- 75% Construction documents
- 90% Construction documents
- 100% Construction documents
- Post-award bid analysis
- The cost management services required by GSA are summarized in Table A-1.

## Independent Cost Estimates

In order to aid in effective project controls and assist in tracking the budget, GSA will develop two separate

independent government estimates (IGE)— one in the Region and another in the Central Office, at a minimum for the following phases of design:

- Final concept design
- Final design development
- 90% Construction development
- 100% Construction development

The design team must provide all necessary documentation for these estimates and be available to support this activity.

Development of the multiple estimates may include the requirement for estimate reviews and reconciliation efforts, as identified in Table A-1.

## Cost Estimate Reporting

Cost estimates must be reported in an electronic spreadsheet format. Each of the cost estimate submissions must contain the following, at a minimum:

- 1 Executive summary
- 2 Basis of estimate, rationale, assumptions and market analysis, as required in P120,
- 3 GSA Report 3474
- 4 GSA Report 3473
- 5 Summary Reports (ASTM UNIFORMAT II and CSI MasterFormat formats as applicable)
- 6 Detailed line item cost reports

## Warm Lit Shell and Tenant Improvements Cost Estimates

The organization of the cost elements must be in accordance with the GSA pricing policy, which calls for

a separate tenant improvement (TI) breakdown of all tenant space fit-out identified by the agency.

The estimate must be broken down into 1) Warm Lit Shell, and 2) Tenant Agency Fit-Out, as defined by the agency in the housing plan and the supporting floor plans. The amortized capital security costs, (i.e., vehicular barriers, secure doors and locks, progressive collapse, blast mitigation and window glazing costs) must be broken down per tenant, as applicable.

## Estimates for Campus Development Projects

Projects that reflect campus developments or multiple buildings require that cost estimates be developed for each of the individual building or campus components, as reflected in the design documents. The reporting requirements must reflect the individual estimates, as well as a campus summary estimate report.

## Post-award Bid Analysis

After award of the construction contract, GSA will provide the A/E 1) the abstract of bids received with an indication of the award amount, 2) a breakdown or verification of contractor prices in the course of contract award, and 3) the contract's approved progress payment schedule.

The A/E must perform an analysis of the contractor planned payment schedule and the independent cost estimate, which reflects the design upon which the construction award is based. The A/E must complete the GSA Form 3472 and submit the form to the GSA Regional Office and Central Office. The GSA Form 3472 must report the construction costs, as awarded, based on the UNIFORMAT Level III subsystem parameters for use in contributing to the GSA, PBS Construction Cost Database, as spelled out in the PBS P120.

**Table A-1: Cost Management Matrix**

Project Sub-Phase	Estimate Tree Structure			Estimate Methodology	Notes
	WBS	Detail Level	Summary Level		
Preliminary Concept Submission	UNIFORMAT II	III	II	Parameter	1, 2, 3, 4
Draft Final Concept Submission - Before VE	UNIFORMAT II	IV	II	Parameter and Quantification	1, 2, 3, 4
Final Concept Submission – After VE Implementation	UNIFORMAT II	IV	II	Parameter and Quantification	1, 2, 3, 4
Draft Design Development Submission - Before VE	UNIFORMAT II	V	III	Parameter and Quantification	1, 2, 3, 4, 5, 6, 7
	CSI MasterFormat	V	III		
Final Design Development Submission – After VE Implementation	UNIFORMAT II	V	III	Quantification and Parameter	1, 2, 3, 4, 5, 6, 7, 9
	CSI MasterFormat	V	III		
75% CD	UNIFORMAT II	N/A	III	Quantification and Parameter	1, 2, 3, 4, 5, 6, 8, 9
	CSI MasterFormat	VI	III		
90% CD & 100% CD	UNIFORMAT II	N/A	III	Quantification	1, 2, 3, 4, 5, 6, 8, 9
	CSI MasterFormat	VI	III		
Post-Award Bid Analysis	UNIFORMAT II	III	II	Parameter	10
<p>Note 1. All UNIFORMAT II classification requirements must be in accordance with the ASTM Standard E-1557-05.</p> <p>Note 2. Services to be any or all of the following: A) cost estimating, B) market studies, C) estimate reviews, D) cost estimate reconciliation meetings, and E) cost estimate revision. Cost estimates are required for all submissions, as dictated by the P120. Estimate reconciliation meetings and estimate revision submissions required when a third-party estimate is prepared, or an estimate review is conducted.</p> <p>Note 3. If the project is for a campus development, cost estimates, including summary reports, detail reports, GSA Forms 3473 and 3474, must be prepared for each campus component, building, canopies, and sitework. If a project is phased, a separate estimate must be prepared for each project phase.</p> <p>Note 4. The organization of the cost elements must be in accordance with the GSA pricing policy, requiring a separation between the building core/shell costs, tenant improvement costs for each tenant, and the amortized capital security costs (i.e., vehicular barriers, secure doors and locks, progressive collapse, blast mitigation and window glazing costs) per each tenant, as applicable.</p> <p>Note 5. If the detailed drawings and outline specifications are available, provide the CSI Masterformat cost estimate at the greatest detail that the drawings and specifications would support.</p> <p>Note 6. The summary of the cost estimate in CSI Masterformat must correspond with UNIFORMAT Level III as defined in PBS P120.</p> <p>Note 7. The level of detail of the cost estimate in CSI Masterformat must correspond with UNIFORMAT Level V as defined in PBS P120.</p> <p>Note 8. The level of detail of the cost estimate in CSI Masterformat must correspond with UNIFORMAT Level VI as defined in PBS P120.</p> <p>Note 9. Unit prices must be broken down into labor, materials, and equipment, as defined in the P120.</p> <p>Note 10. After the construction contract is awarded, the A/E will analyze bid cost data, including the planned payment schedule, and review the IGE. Upon reviews, the A/E must complete the GSA Form 3472, as identified in the PBS P120, and submit to the Regional and Central Office for use in GSA cost database.</p>					

## A.2 Performance Expectations Matrices

At the beginning of each project, the GSA project manager, tenants and design A/E need to define the functional objectives of a project. A functional objectives matrix, similar to the one shown in Figure A-1, while not required, may be an effective tool to define these objectives. (Such a matrix may also exist within the project's design programming documents.) By providing a numeric impact weight (e.g., 1-3, where 3 is high) at each intercept, a graphic check list becomes apparent as to which systems/features are most important in delivering a project's performance expectations. The high impact matrix intercepts call for design solutions that will optimize functional interests, consistent with the need to integrate solutions that will support all functional objectives.

High impact intercepts require formal design team technical discussions to help optimize design solutions. These technical discussions must take the form of either a preconcept design charrette and/or a series of design team technical meetings during the concept phase. The technical discussion agenda can be organized by discipline (systems) and/or by functional objective heading, but should address:

- Functional performance goals
- Integrated solution options

- Heading off what can go wrong
- Inspections/certification requirements
- Coordinating construction and turnover-phase issues/deliverables

For both the design concept and design development submissions, the design A/E must identify the attainment of building functional objectives as represented by the matrix. This must take the form of a narrative report that, by system, indicates how the proposed design supports expected building performance.

The Functional Objectives Matrix can be further refined by establishing a matrix for each expectation, e.g., that provided for sustainability, in Figure A-2. While not required, these matrices may help ensure a comprehensive response to functional objectives by breaking down each major function into its component principles/objectives. Sample matrices for productivity, security, and other functional objectives are available upon request through the Office of Design and Construction.

Figure A-1: Program Goals Matrix

		FUNCTIONAL OBJECTIVES							
		Productivity	Sustainability	Security	Seismic	Fire-Protection and Life Safety	Accessibility	Historic Preservation	Maintainable
SYSTEMS									
Foundations		1	1	1	3	1	1	1	1
On/ Below Grade		1	1	2	3	1	2	1	1
Superstructures		1	1	3	3	2	2	2	1
Enclosure	Walls	2	3	3	3	2	1	3	2
	Window/ Doors	3	3	3	2	1	3	3	3
Roofing	Coverings	1	3	2	1	3	1	3	3
	Openings	2	3	2	1	1	1	3	3
Interior Construction	Partitions/ Doors	2	2	3	2	3	3	3	2
	Access Floors	3	1	1	2	2	1	1	1
Interior Finishes	Walls	3	2	1	1	2	1	1	2
	Floors	3	3	1	1	2	1	1	3
	Ceiling	3	3	1	2	2	1	1	3
Conveying		2	1	1	2	2	3	1	3
Plumbing		1	3	1	2	2	3	1	3
HVAC	Central Plant	3	3	1	1	1	1	1	3
	Distribution	3	3	1	2	3	1	1	3
Fire Protection		1	1	1	3	3	1	1	1
Electrical	Service/Distribution	2	1	1	3	2	1	1	1
	Lighting	3	3	3	2	2	1	1	3
Equipment		1	1	3	1	2	1	1	2
Furnishings		3	3	1	1	2	3	1	2
Special Construction		1	2	1	2	2	1	1	2
Demolition	Building Elements	3	3	1	1	1	1	3	1
	Hazardous Materials	3	3	1	1	1	1	1	1
Building Sitework	Site Preparation	1	3	1	1	1	2	1	1
	Landscaping	2	3	2	1	1	1	1	3
	Utilities	1	1	1	3	2	1	1	2
Sitework		2	3	1	2	1	3	1	2

Figure A-2: Sustainability Matrix

		PRINCIPLES/ OBJECTIVES					
		Energy	Water	Materials	Indoor Env. Quality	Sitework.	O & M
SYSTEMS							
Foundations		1	1	2	1	1	1
On/ Below Grade		1	1	2	1	1	2
Superstructures		1	1	2	1	1	2
Enclosure	Walls	3	1	2	2	1	3
	Window/ Doors	3	1	1	2	1	3
Roofing	Coverings	3	1	2	3	1	3
	Openings	3	1	1	2	1	3
Interior Construction	Partitions/ Doors	1	1	3	3	1	3
	Access Floors	1	1	2	1	1	3
Interior Finishes	Walls	2	1	3	2	1	3
	Floors	2	1	3	2	1	3
	Ceiling	2	1	3	2	1	3
Conveying		2	1	1	1	1	3
Plumbing		3	3	2	1	1	2
HVAC	Central Plant	3	3	2	1	1	3
	Distribution	3	2	1	1	1	3
Fire Protection		1	1	1	1	1	1
Electrical	Service/Distribution	1	1	1	1	1	1
	Lighting	3	1	1	2	2	2
Equipment		2	2	1	1	1	1
Furnishings		1	1	2	2	1	2
Special Construction		1	1	1	1	2	1
Demolition	Building Elements	1	1	2	2	2	1
	Hazardous Materials	1	1	3	3	2	1
Building Sitework	Site Preparation	2	1	1	1	3	2
	Landscaping	3	3	2	1	2	2
	Utilities	1	1	1	1	1	1
Sitework		2	1	1	1	1	1



## A.3 New Construction and Modernization

The design process and related submission requirements for new construction and modernizations are somewhat different than those for alteration projects. A modernization is defined as the comprehensive replacement or restoration of virtually all major systems, tenant-related interior work (such as ceilings, partitions, doors, floor finishes, etc.), and building elements and features. The following flow diagram, Figure A-3, and related definitions describe this process for New Construction and Modernization.

### Peer Review

The peer review, arranged through the Office of Design and Construction Programs, is required for all new construction projects and any modernization project with significant alterations to the building aesthetic or systems. Designs must be presented to the PBS Commissioner, chief architect, chief engineer, key GSA project team members, and Nationally Selected Peers for approval. The peer reviews occur at all phases of the project to review design concepts, schedule, cost, energy goals, etc.

**Figure A-3: Design Process and Related Submission Requirements for New Construction and Modernization**

STAGES	ACTIVITIES	SUBMISSIONS
<b>CONCEPTS</b>		
<ul style="list-style-type: none"> <li>Review Space Directive</li> <li>Integrate Expectations into Major Systems and Features</li> </ul>	<p>PROGRAM REVIEW            DESIGN CHARRETTE            PRELIMINARY CONCEPTS            (3 or more)            VALUE ENGINEERING            (Systems Level)            COMMISSIONER'S APPROVAL            FINAL CONCEPTS</p>	<ul style="list-style-type: none"> <li>Massing Models (New Construction only)</li> <li>Narrative to Include Proposed Building Systems</li> <li>Rendering/ Photos</li> <li>Concept Drawings and BIM Level: Narratives/Studies Calculations Cost Estimates Design Quality Review Questionnaire</li> <li>Space Program Statement/Reconciliation</li> </ul>
<b>DESIGN DEVELOPMENT</b>		
<ul style="list-style-type: none"> <li>System/Feature Analyses for Selection</li> <li>Final Selection of All Building Systems</li> <li>Inter System Coordination</li> </ul>	<p>PROGRAM REVIEW            VALUE ENGINEERING            (Analysis Stage)            PRODUCTION STAGE            PROJECT DIRECTIVE MEETING</p>	<ul style="list-style-type: none"> <li>Architectural Background Drawings Complete</li> <li>Design Development Level: Drawings and BIM Narratives/Studies Calculations Cost Estimates Design Quality Review Questionnaire</li> <li>Concurrence on Narrative for All Building Design Characteristics &amp; Systems</li> <li>Space Program Reconciliation</li> </ul>
<b>CONSTRUCTION DOCUMENTS</b>		
<ul style="list-style-type: none"> <li>Presentation of Design in a Format Suitable to Parties Unfamiliar with the Site</li> </ul>	<p>PROGRAM REVIEW            75% COMPLETE            90% COMPLETE            100% COMPLETE            POST DESIGN SERVICES</p>	<ul style="list-style-type: none"> <li>Progress Drawings</li> <li>Draft Specifications</li> <li>Narrative Update</li> <li>Current Calculations</li> <li>Final: Drawings and BIM Specifications Narratives Calculations Cost Estimate Design Quality Review Questionnaire</li> <li>Incorporation of Review Comments</li> <li>Space Program Reconciliation</li> </ul>

## Design Process Definitions

### General

These definitions are for new construction.

Some requirements will be eliminated for a modernization project, such as zoning area, form, massing, etc.

### Program Review

Prior to initiating each phase of design, the design team (including the GSA, A/E, and customer agency) must meet to review design program expectations and to exchange ideas, lessons-learned, and concerns.

Such technical "partnering" sessions allow a clearer understanding of expectations, a well defined project scope, and help keep the project on budget and schedule.

### Preliminary Concepts

A submission that demonstrates compliance with the Building Program (space tabulation of building program) including all adjacency and functional requirements.

This submission also shows that the proposed project is within the zoning area, and that the building and massing are compatible with the surroundings. The aesthetics should support the design philosophy of GSA shown in the general approach to architecture in the preceding chapters of this document. Building systems and building envelope appropriate for the conceptual designs must be defined in order that they can be evaluated early for effectiveness and efficiency related to operation, maintenance, and energy consumption.

Since there are many options to accomplish these ends with any particular program and site, GSA will participate in the normal design process of comparing options by working with the A/E through Preliminary GSA P-100 Version 1.0, issued March 2014

Concepts. In this phase, the design team should develop their strategy for achieving LEED Gold Certification as defined by the U.S. Green Building Council.

During Preliminary Concepts, three or more concepts must be presented; these Preliminary Concepts are intended to be working level and not presentation documents. They are to be developed only to the level that allows selection of a concept that will still be within program operation and budget goals. This selected concept is to be further refined and presented as the Final Concept by the A/E.

### Value Engineering (Systems Level)

Value engineering (VE) is a process that is somewhat continuous throughout the project but its greatest emphasis should be in the early stages of the project (concepts and design development).

GSA policy is to have an independent VE consultant facilitate a value engineering study with an independent team, including participation by the design A/E and the design A/E estimator throughout the study and implementation process. The A/E team must be part of this effort and incorporate the VE consultant's recommendations that were approved by the GSA into the design as part of the scope of work.

### Final Concepts

The concept phase study is conducted to focus on the macro level elements of the design. These elements include, but are not limited to, siting, building massing, and environmental and community impacts and concerns. The conceptual phase study workshop is generally of two to four days duration.

For major projects, a presentation is made to the Commissioner of the Public Buildings Service for final approval.

## Design Development

This set of submissions reflects a more comprehensive project design developed from the selected final concept design. DD finalizes the selection of all systems with respect to type, size, and other material characteristics.

Systems are not only structural, mechanical, fire protection, and electrical, but include all other building components such as the building envelope (wall, window, and roof), interior construction (flooring, ceiling, and partitions), service spaces, elevators, and so on.

In this phase, the design team should submit a LEED worksheet or comprehensive plan for how the architectural and buildings systems will achieve a LEED Gold Certified building as determined by USGBC.

The design submissions consist of a combination of drawings, narratives, calculations, specifications, and cost estimates. Although final design development plans, sections, and elevations must be to scale, drawings made in the analysis stage to illustrate various options may be freehand.

These submissions are not preliminary construction documents. The approval at the project directive meeting may require that building layout or size changes be incorporated into the construction documents. No design discipline should start work on construction documents until the project directive has been approved.

## Life-Cycle Cost Analysis

As specified herein and within programming requirements, life-cycle cost assessments must be made, leading to system/feature selections. Though customer agencies might only look at the first costs of a project, the design team must evaluate life-cycle costs, especially as they relate to sustainable technologies and the GSA energy goals for reducing cost of energy consumption over time. The benefit of

life-cycle costs may far outweigh the first costs of a project.

## Production Stage

The production stage is the development of each system with supporting calculations and narrative. Plans, sections, elevations, and details showing systems must be included.

## Value Engineering (Analysis Stage)

GSA policy is to have an independent VE consultant facilitate a value engineering study with an independent team, including participation by the design A/E and the design A/E estimator throughout the study and implementation process. The A/E team must be part of this effort and incorporate the VE consultant's recommendations that were approved by the GSA into the design as part of the scope of work.

The DD phase VE study is conducted to focus on the subsystem and detail level elements of the design. These elements include but are not limited to the following:

- Material selections
- Specific building systems selection and design
- Proposed design details
- Overall layout options within overall building shell
- Phasing and scheduling plans
- Structural loads and elements
- Major constructability issues
- Site paving, grading, and utilities
- The DD phase study generally takes three to five days. The DD phase study is held after receipt of the draft DD phase submission of the documents. The final design development submission is prepared upon agreement of all implemented VE proposals.

- As the project is developed the focus will shift to detailed aspects of the earlier decisions during design development.
- Diagrams, narratives, and sketches with calculations to demonstrate the life-cycle cost effectiveness of the system must be prepared and received during this phase.
- This approach requires a diligent effort and commitment by all project team members early in the project to systems and materials that make sense economically and allow quality and durability.

## Project Directive

The report summarizes analysis and design to date at completion of the DD phase. A meeting among GSA, the client, and A/E staff, particularly those who will be working on the construction documents, is held to review the project directive for concurrence.

## Construction Documents

This phase requires a detailed set of documents coordinated by all disciplines into one coherent document to become the basis for a construction contract. The construction documents should include all levels of detail drawings from site planning to construction details, as well as specifications, cost estimates, and calculations.

## As-Built Documents

The as-built BIM must be populated with, at a minimum, all equipment attributes required for regional or national computerized maintenance management system (CMMS) use. The content, format, and classification system of the attributes shall be provided by GSA and incorporated into the BIM execution plan at the beginning of the project. Mechanical, electrical, plumbing and vertical transportation equipment, roofs, window systems and all other building equipment with moving parts must be incorporated in the BIM with links to

electronic copies of product documentation and shop drawings.

## Site Analysis and Preliminary Concepts

### Requirements

The preliminary concepts submittal consists of three or more distinctly different architectural design schemes presented in sketch format (single line, drawn freehand to scale), along with massing models, site slides and photographs, and sufficient narrative to allow comparison and selection of a design direction for preparation of a final design concept.

### Site Survey

If a survey is part of the scope of work for the project, see Appendix Section A.5 for requirements.

The information requested in subparagraphs 1 and 2 may be in progress and not yet complete. Present site sketches as appropriate.

### Drawings

1. Site location plan [at least 2 kilometers (1.25 miles) around site], showing:

- a. Site relative to location of city center, major landmarks, major parking facilities, major roads, and airport
- b. Location of subway stations and other mass transit links
- c. Location of distinct land use types and districts in the vicinity of the site (e.g., historic districts, retail nodes, civic districts, etc.)

2. Existing site plan (at least one block around site), describing:

- a. Site boundaries, approximate topography, existing buildings, setbacks, and easements
- b. Climatic conditions including path of sun

## APPENDIX

- c. Description of flood plain issues related to building location and mechanical and electric equipment
- d. Location of on-site and off-site utilities
- e. Natural landscape
- f. Pedestrian and vehicular circulation (include direction of traffic on adjoining streets)
- g. Neighboring land uses, existing and planned

### 3. Site plans for each design scheme, showing:

- a. Building location and massing
- b. Building expansion potential
- c. Parking and service area
- d. Description of local plans for surrounding area, relation of each concept to those plans, and summary of relevant recommendations from local officials

### 4. Floor plans, showing at a minimum:

- a. Entrances, lobbies, corridors, stairways, elevators, work areas, special spaces, mechanical rooms for major equipment and air handlers, and service spaces (with the principal spaces labeled). Dimensions for critical clearances, such as vehicle access, should be indicated.

### 5. Building sections (as necessary), showing:

- a. Floor-to-floor heights and other critical dimensions
- b. Labeling of most important spaces
- c. Labeling of floor and roof elevations

### 6. Photographs

- a. Minimum of six 8 x 10 photographs showing the site and elevations of existing buildings (or landscape, as applicable) surrounding the site

### 7. Models

- a. Massing models of each architectural design scheme on a common base. (No fenestration should be provided at this stage of design development.)

### 8. Narrative

- a. Site statement, describing:
  - i. Existing site features

- ii. Climatic conditions
- iii. Topography and drainage patterns
- iv. Any existing erosion conditions
- v. Wetlands and locations of flood plains
- vi. Surrounding buildings (style, scale)
- vii. Circulation patterns around site

### b. Site access

- i. Noise/visual considerations
- ii. Local zoning restrictions
- iii. Federal Aviation Administration requirements

- iv. Hazardous waste
- v. Pollution

### c. Historic preservation considerations, if applicable

- i. Site photographs, showing contiguous areas and affected preservation zones

- ii. Existing major site utilities
- iii. Potential archeological artifacts

### d. Description of each architectural design scheme, explaining:

- i. Organizational concept
- ii. Expansion potential
- iii. Building efficiency
- iv. Energy considerations
- v. Advantages and disadvantages

### e. Sustainable design considerations

- i. Potential for incorporation of renewable energy systems in the design
- ii. Potential use of geothermal systems

### f. Mechanical system and strategy to comply with P100, Chapter 5 and with the assigned energy goal in Section 1.9.

### g. Description of structural design scheme considerations for each design scheme explaining:

- i. design loads
- ii foundation system
- iii. building framing system
- iv. lateral load resisting system
- v. advantages and disadvantages
- h. Fire protection design considerations

### i. Security features

- j. Code statement. Provide a brief statement from each design team discipline member regarding the code requirements that relate to the site and occupancy use. For example, items such as, but not limited to: classification of construction and occupancy group(s), fire resistance requirements and general egress requirements, etc., would be prepared by the design team fire protection engineer.

### k. Preliminary concept phase cost estimates

- i. Provide a UNIFORMAT cost estimate for each proposed design scheme submitted
- ii. Cost estimating must be in accordance with the P120 and Table A-1 in this document
- iii. Provide separate estimate for phased work, or bid alternates/options
- iv. Verify that each design scheme presented can be constructed within the project budget
- l. Space program statement/reconciliation—provide in metric and imperial units
- m. Preliminary energy analysis for compliance with the assigned energy goals for each architectural concept in accordance with Section A.6
- n. Art in architecture statement. Provide statement of the lead designer’s architectural design philosophy as exemplified by past building projects, including those that featured collaborations with artists, and will discuss way he or she can envision working with artists on the GSA project. Provide a summary of meetings with the Art in Architecture Panel.
- o. A description of any deviation from the PBS P100.

### Building Information Model

A BIM for each preliminary concept is required to a minimum Level 100 detail (in accordance with AIA E202 Standards). The contents of the BIM shall be such that the BIM shall be the source for 2D drawings and SDM requirements to the greatest extent possible. When 2D deliverables require a finer level of detail, the BIM shall be the central source for 2D details and/or be modeled in greater detail to accommodate the specific requirements. The BIM Execution Plan shall also be reviewed and a VDC Scorecard analysis shall be conducted to ensure all parties are in compliance.

### Final Concept

#### Site Planning and Landscape Design

The following information must be complete for the final concept submittal of all buildings. (If materials produced for the preliminary concepts submittal do not require modification, such materials are acceptable for this submission.)

### Site Plan

(At least one block around site), describing:

- 1 Site boundaries, approximate topography, existing buildings, setbacks, and easements
- 2 Building orientation with respect to path of sun
- 3 Building massing and relationship to massing of surrounding buildings
- 4 Future building expansion potential
- 5 Location of on-site and off-site utilities
- 6 Grading and drainage
- 7 General landscape design, showing location of major features
- 8 Pedestrian and vehicular circulation (include direction of traffic on adjoining streets)
- 9 Parking and service areas
- 10 Fire protection, water supplies, fire hydrants, and fire apparatus access roads

### Narrative

- 1 Description of site and landscape design final concept
- 2 Demolition, if required
- 3 Circulation
- 4 Parking
- 5 Paving
- 6 Landscape design
- 7 Irrigation, if any
- 8 Utility distribution and collection systems
- 9 Method for storm water detention or retention
- 10 Landscape maintenance concept
- 11 Fire protection, water supplies, fire hydrants, and fire apparatus access roads
- 12 Accessibility path for the physically disabled

13 Summary of consultation with local officials regarding site and architectural design and the design's response to relevant recommendations

## Architectural

### 1. Drawings

- a. Demolition plans, if required
- b. Floor plans, showing at a minimum:
  - i. Work areas, lobbies, corridors, entrances, stairways, elevators, special spaces, and service spaces (with the principal spaces labeled). Dimensions for critical clearances, such as vehicle access, should be indicated.
  - ii. Office areas must show proposed layouts down to the office level of detail verifying the integration between the approved program and the building concept is achievable.
- c. Proposed interior layouts showing:
  - i. Open office plan
  - ii. Enclosed office plan
  - iii. Indicate how major mechanical and electrical equipment can be removed/replaced
- d. Elevations of major building facades, showing:
  - i. Fenestration
  - ii. Exterior materials
  - iii. Cast shadows
- e. Elevations of major interior spaces, showing:
  - i. Lobby/atrium
  - ii. Typical public elevator lobby
  - iii. Typical courtroom elevations
- f. Building sections (as necessary), showing:
  - i. Adequate space for structural, mechanical and electrical, telecommunications, and fire protection systems
  - ii. Mechanical penthouses
  - iii. Floor-to-floor and other critical dimensions
  - iv. Labeling of most important spaces
  - v. Labeling of floor and roof elevations

**2. Color rendering** [Minimum size must be 600 mm by 900 mm (24 in. by 36 in.).]

### 3. Photographs

- a. Four 200 mm by 250 mm (8 in. by 10 in.) color photographs, mounted, identified, and framed of the rendering or model image (showing at least two vantage points). In addition, provide for all building

elevations (at least one vantage point per each elevation).

- b. Two of the photographs are to be sent to the GSA project manager.

- c. Provide two additional 600 mm by 900 mm (24 in. by 36 in.) photographs of the rendering for the GSA project manager. (For courthouse projects only.)

### 4. Model

- a. Provide a model of the final concept with sufficient detail to convey the architectural intent of the design.

### 5. Calculations

- a. Acoustical calculations, including noise transmission through:
  - i. Envelope
  - ii. Interior walls, floors (including raised floors), and ceilings
  - iii. Mechanical and electrical equipment
- b. Heat transfer through and dew point locations in building envelope
- c. Toilet fixture count analysis
- d. Illumination, daylighting, and glare analysis
- e. Passenger and freight elevator analysis
- f. Loading dock analysis
- g. Energy analysis in accordance with Section A.6.

### 6. Narrative

- a. Architectural program requirements
  - i. Show in tabular form how the final concept meets the program requirements for each critical function.
  - ii. A revised description of any deviation from P100.
  - iii. Description of final concept, explaining:
    - (1) Expansion potential
    - (2) Building floor efficiency

- b. Location and sizes of mechanical equipment rooms for accessibility, maintenance and replacement of equipment (including cooling towers and emergency generators)

- c. Conveying systems design (passenger and freight elevators, escalators)

- d. Loading docks



- e. Thermal, air leakage, and operational performance and maintainability of the building envelope
- f. Design strategy to attain the assigned energy goal
- g. Treatment of historic zones, if applicable
- h. Operations and maintenance goals (exterior and interior window washing, relamping, etc.)
- i. Sustainable design concepts (LEED strategy)
- j. Vertical transportation analysis (passenger and freight elevators and escalators)
- k. Code analysis
  - i. The Code criteria must be reviewed by each design team discipline member to the degree of detail necessary to assure that tasks accomplished in this phase meet all the Code requirements.

- ii. A Code/Criteria analysis must be prepared by each design team discipline member that documents an investigation of the applicable codes and agency criteria that will govern the design of a specific project. This analysis should alert the Government to any conflicts in the project's design criteria so that they can be resolved early. The analysis should also provide a common perspective for the design and review of the project. This analysis is probably most critical in building modernization and repair/alteration projects.

## Historic Preservation

8.5 in. x 11 in. report, signed by qualified preservation architect, including:

### 1. Narrative

- a. General: Project purpose, scope, groups, and individuals involved
- b. Existing conditions, describing:
  - i. Overall building size, configuration, character
  - ii. Project location
  - iii. Existing original materials and design, relevant alterations
- c. Preservation design issues and prospective solutions, including:
  - i. Location of new work/installation: visibility, impact on historic finishes
  - ii. Compare options for preserving/restoring historic materials and design
  - iii. Identify further study required to avoid adverse effects as applicable

## 2. Photographs

- a. General and detail views showing existing conditions at affected preservation zones, keyed to plan showing location and orientation of each view
- b. Captions identifying location, subject, condition shown

## 3. Drawings

- a. Reduced to 8.5 in. x 11 in., 11 in. x 17 in. foldout or placed in cover pocket
- b. Site and floor plans, as applicable
- c. Sketches or schematic CAD drawings (elevations, plans) showing preservation design concepts

## Structural

### 1. Drawings

- a. Framing and foundation plans of the proposed structural system showing column locations, bay sizes, and location of expansion and seismic joints

### 2. Narrative

- a. Identification of unusual local code requirements
- b. Code compliance statement
- c. Name of model building code followed
- d. Building classification
- e. Identification of region of seismicity, wind speed, etc.
- f. Identification of special requirements, such as high-rise
- g. For new buildings:
  - i. Statement certifying that the structural engineer has reviewed the building configuration for blast, seismic, progressive collapse, and hurricane adequacy, and the criteria in PBS P100 have been met. The structural engineer and the architect must sign this statement.

## Mechanical

For the system approved and selected from the three concepts, provide the following:

### 1. Drawings

- a. Demolition plans, if required
- b. HVAC Systems
  - i. Floor plan(s):
    - (1) Identification of equipment spaces for mechanical equipment

(2) Location of mechanical equipment, including size, weight, access to loading docks and freight elevators, and clearance requirements for operation, maintenance, and replacement

ii. Flow diagram(s):

(1) Air flow riser diagrams representing supply, return, outside air, and exhaust systems

(2) Water flow riser diagrams of the main mechanical systems in the mechanical room(s) and throughout the building

c. Plumbing Systems

i. Floor plan(s):

(1) Proposed building zoning and major piping runs

(2) Locations of proposed plumbing fixtures and equipment

ii. Systems schematics and flow diagrams

2. Narrative

a. HVAC

A written narrative describing the selected mechanical systems and equipment, including:

i. Indoor and outdoor design conditions for all spaces under occupied, 24-hour, and unoccupied conditions

ii. Ventilation rates, dehumidification, and pressurization criteria for all spaces under occupied, 24-hour, and unoccupied conditions

iii. Equipment capacities, weights, sizes, and power requirements

iv. Description of heating, cooling, ventilating, and dehumidification systems for each major functional space

v. Description of heating, cooling, ventilating, and dehumidification control strategies for each air handling system under occupied, 24-hour, and unoccupied conditions

vi. Fuel and utility requirements

vii. A code compliance statement

b. Plumbing

i. Description of proposed plumbing systems, including domestic cold and hot water, sanitary and storm drainage, and irrigation

ii. Evaluation of alternate sources for preheating of domestic water (solar or heat recovery)

c. Calculations and energy and water analyses

i. Building heating and cooling load calculations

ii. Psychrometric calculations for HVAC systems at full load and partial loads. (Partial loads at 50% and 25%, and unoccupied periods)

iii. Energy consumption calculations and analysis in accordance with Section A.6

iv. Water consumption calculations and analysis including make-up water for HVAC systems, domestic water consumption, and water consumption for irrigation

v. Fuel consumption estimates

3. Specifications

a. Table of contents identifying specifications to be used on the project

## Fire Protection

Fire protection and life safety submission requirements must be identified as a separate Fire Protection section as outlined in this document.

1. Drawings

a. Plans showing

i. Equipment spaces for fire protection systems (e.g., fire pump, fire command center, etc.)

ii. Fire protection water supplies, fire hydrant locations, fire apparatus access roads, and fire lanes

2. Narrative

a. Description of the building's proposed fire protection systems including the egress system

b. Code compliance analysis

i. The design team fire protection engineer must prepare an analysis of the applicable codes and agency criteria that will govern the design of the specific project. For example, items such as, but not limited to classification of construction and occupancy group(s), rating of structural components, fire resistance requirements, interior finish, occupant load calculations, exit calculations, identification of areas to receive automatic sprinkler systems and/or automatic detection systems, smoke control systems, etc. would be prepared by the design team fire protection engineer as necessary to provide a complete fire protection and life safety analysis for the final concept.

## Electrical

1. Drawings

a. Plans showing equipment spaces for all electrical equipment to include: panels; switchboards; transformers; uninterruptible power supply (UPS); and generators

2. Narrative

- a. Description of at least two potential electrical systems
- b. Describe the proposed lighting and lighting control system
- c. Proposed special features of electrical system
- d. Code compliance statement

## Certification Requirements

The architect/engineer (lead designer) must certify that the concept design complies with the program requirements, PBS P100, GSA's energy goals, Federal energy goals, and local regulatory agencies and review boards.

In bullet form, identify how proposed design features will support performance expectations of the project. Expectations are identified in the project's design program and within the Functional Objectives Matrix, Figure A-1.

Final concept energy analysis, in accordance with Section A.6.

## Life-Cycle Cost Analysis

A life-cycle cost analysis of three options for the various building systems under design and evaluation that have been modeled should be included with this submittal.

## Final Concept Cost Estimate

A cost estimate must be provided, as required in the P120 and in accordance with the P100.

The final concept estimate submission must include the following:

- Executive summary
- Basis of estimate, rationale, assumptions, and market analysis as required in P120
- GSA Report 3474, GSA Report 3473
- Summary reports (ASTM UNIFORMAT II and CSI MasterFormat formats as applicable)
- Detail line item cost reports
- Core/shell and TI cost estimate, as per GSA pricing policy. TI estimates must be prepared for each tenant.

- Provide separate estimates for phased work, or bid alternates/options.
- To ensure the project is developing on-budget, a list of cost-saving items that would collectively reduce the project cost to approximately 10 percent below budget.
- Verify that the final concept can be constructed within the project budget.
- A life-cycle cost analysis of three options for the various building systems under design and evaluation that have been modeled should be included with this submittal.

## Building Information Model

A BIM for each final concept is required to a minimum Level 200 development (in accordance with AIA E202 Standards). The contents of the BIM shall be such that the BIM shall be the source for 2D drawings and SDM requirements to the greatest extent possible. When 2D deliverables require a finer level of detail, the BIM shall be the central source for 2D details and/or be modeled in greater detail to accommodate the specific requirements. The BIM Execution Plan shall also be reviewed and a VDC Scorecard analysis shall be conducted to ensure all parties are in compliance.

## Design Development

### Site Planning and Landscape Design

1. Calculations
  - a. Site storm drainage combined with building storm drainage and sanitary sewer calculations
  - b. Storm water detention calculations, if applicable
  - c. Parking calculations, if applicable
  - d. Dewatering calculations
    - i. Calculations modeling dewatering rates during dry and wet season excavation. Calculations must take into account effect of dewatering on adjacent structures and improvements.
    - ii. Calculations must assume a specific shoring system as part of a comprehensive excavation system.
2. Narrative
  - a. Site circulation concept, explaining:

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- i. Reasons for site circulation design and number of site entrances
- ii. Reasons and/or calculations for number of parking spaces provided
- iii. Reasoning for design of service area(s), including description of number and sizes of trucks that can be accommodated
- iv. Proposed scheme for waste removal
- v. Proposed scheme for fire apparatus access and fire lanes
- b. Site utilities distribution concept
  - i. Brief description of fire protection water supplies
  - ii. Brief description of fire hydrant locations
  - iii. Drainage design concept
- c. Landscape design concept, explaining:
  - i. Reasoning for landscape design, paving, site furnishings, and any water features
  - ii. Reasoning for choice of plant materials
  - iii. Proposed landscape maintenance plan and water conservation plan
  - iv. Brief operating description of irrigation system
- d. Site construction description
  - i. Brief description of materials proposed for pavements and utilities
- e. Code analysis
  - i. The code criteria must be reviewed by each design team discipline member to the degree of detail necessary to ensure that tasks accomplished in this phase meet all the code requirements.
  - ii. Identify local zoning and all building code requirements and provide a complete analysis as they pertain to the project.
3. Drawings
  - a. Demolition drawings, if required
  - b. Site layout plan, showing:
    - i. All buildings, roads, walks, parking, and other paved areas (including type of pavement)
    - ii. Accessible route from parking areas and from public street to main facility entrance
    - iii. Fire apparatus and fire lanes
  - c. Grading and drainage plan, showing:
    - i. Site grading and storm drainage inlets, including storm water detention features
  - d. Site utilities plan, showing:
    - i. Sizes and locations of domestic and fire protection water supply lines, sanitary sewer lines, steam/condensate lines, and chilled water supply and return lines, if applicable
  - e. Landscape design plan, showing:

- i. General areas of planting, paving, site furniture, water features, etc.
- ii. Irrigation plan, if applicable

### Architectural

1. Calculations
  - a. Acoustical calculations, including noise transmission through:
    - i. Envelope
    - ii. Interior walls, floors (including raised floors), and ceilings
    - iii. Mechanical and electrical equipment
  - b. Heat transfer through dew point locations in building envelope
  - c. Toilet fixture count
  - d. Illumination, daylighting, and glare
  - e. Passenger and freight elevator analysis
  - f. Loading dock analysis
  - g. Energy analysis in accordance with Section A.6
2. Narrative
  - a. Building concept, explaining:
    - i. Reasons for building massing, entrance locations, and service locations
    - ii. Building circulation and arrangement of major spaces
    - iii. Interior design
    - iv. Adherence to the building preservation plan, if applicable
    - v. Energy conservation design elements
    - vi. Water conservation considerations
    - vii. Explain how all these design considerations are combined to provide a well integrated cohesive design concept
    - viii. Analysis of refuse removal, recycled materials storage and removal, and maintenance requirements
  - b. Building construction description, explaining:
    - i. Structural bay size
    - ii. Exterior materials, waterproofing, air barriers/vapor retarders, and insulation elements
    - iii. Roofing system(s)
    - iv. Exterior glazing system
    - v. Interior finishes, with detailed explanation for public spaces
  - c. Potential locations for artwork commissioned under the Art in Architecture program, as a result of collaboration between the artist, architect, and Art in Architecture Panel.
  - d. Use of recycled materials
  - e. Sustainable design concepts and LEED strategy
  - f. Review of project for code compliance

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i. Code criteria should be reviewed by each discipline to the degree of detail necessary to assure that tasks accomplished in this phase meet the code requirements.

ii. For major alterations, provide a determination whether an accessible floor is needed.

g. Building maintenance, explaining:

i. How unique and tall architectural spaces such as atriums or grand staircases will be cleaned, have their light fixtures maintained, have interior and exterior glass surfaces cleaned and typical maintenance performed.

ii. How courtrooms, dining facilities, and other assembly spaces with fixed seating, multilevel spaces, or with sloped floors will have their ceilings, lights, and other ceiling elements maintained and repaired.

iii. Proposed scheme for window washing equipment

iv. Consideration and prevention of bird nesting on exterior surfaces

v. How major mechanical and electrical equipment can be serviced and/or replaced in future years giving the necessary dimension clearances

h. Describe the project-specific security design

i. Report verifying the current design's compliance with the approved space program. Any deviations must be clearly reported. Report in metric and English units.

j. Curtain Wall Report

i. In projects with complex curtain wall systems, describe size and locations of major movement joints to accommodate structural drift due to seismic and/or wind loading. Describe proposed curtain wall attachment methods to accommodate these lateral movements.

ii. Describe water migration

iii. Describe exterior fire safety systems, if applicable

iv. Describe typical interfaces between exterior wall system and interior finishes

v. Describe interfaces between major enclosure assemblies such as glass curtain wall to precast or stone panels

vi. Identification of at least three suppliers that can provide proposed exterior wall system

vii. Address any requirement for blast resistance in the context of "Windgard" simulations and/or blast testing results, as provided by the Office of Design and Construction

k. Design development energy analysis, in accordance with Section A.6

l. Building keying: Report must fully define the keying hierarchy for the entire building incorporating various levels of access, security, and fire egress. A/E should coordinate with GSA fire safety engineer for keying.

m. Signage Report: Signage system and room numbering system must be integrated with keying system.

n. Provide two finish boards for both public and tenant interior areas and two finish boards of exterior finishes composed of actual material samples and color coded plans, sections, and elevations of major space showing their use.

3. Drawings

a. Demolition drawings, if required

b. Building floor plans, showing:

i. Spaces individually delineated and labeled

ii. Enlarged layouts of special spaces

iii. Dimensions

iv. Planning module

c. Building reflected ceiling plans, showing:

i. Enlarged layouts of special spaces

ii. Spaces individually delineated

iii. Materials labeled

iv. Ceiling heights labeled

## APPENDIX

- v. Lighting fixture types indicated and scheduled
- d. Building roof plan, showing:
  - i. Drainage design, including minimum roof slope
  - ii. Dimensions
  - iii. Membrane and insulation configuration of the roofing system
  - iv. Mechanical equipment rooms and their relationship to freight elevators
- e. Elevations, showing:
  - i. Entrances, window arrangements, doors
  - ii. Exterior materials with major vertical and horizontal joints
  - iii. Roof levels
  - iv. Raised flooring and suspended ceiling space
  - v. Dimensions
- f. Interior elevations, showing:
  - i. Lobby, atrium
  - ii. Public corridors
  - iii. Jury assembly room
  - iv. Grand jury
  - v. Restrooms
  - vi. Chambers
  - vii. Typical public elevator lobby
  - viii. Typical courtroom elevations
  - ix. Typical tenant corridors
  - x. Typical conference rooms
- g. One longitudinal and one transverse section, showing:
  - i. Floor-to-floor dimensions
  - ii. Stairs and elevators
  - iii. Typical ceiling heights
  - iv. General roof construction
- h. Exterior wall sections, showing:
  - i. Materials of exterior wall construction, including flashing, connections, method of anchoring, insulation, vapor retarders, and glazing treatments
  - ii. Vertical arrangement of interior space, including accommodation of mechanical and electrical services in the floor and ceiling zones
- i. Proposed room finish schedule, showing:
  - i. Floors, bases, walls, and ceilings
  - ii. Finish schedule may be bound into narrative
  - iii. Perspective sketches, renderings and/or presentation model, if included in the project scope
- j. Proposed site furniture, showing:
  - i. Site furniture cut sheets or photos
  - ii. Proposed locations

- k. Diagrams illustrating the ability to access, service, and replace mechanical/electrical equipment showing the pathway with necessary clearance
- l. Location of accessible pathways and services for the physically disabled
- m. Placement of Art in Architecture elements
- n. Design of typical building signage, including wayfinding and room identification, building directory, exterior building signage, and major interior building identification
- 4. Photographs
  - a. Two sets of 200 mm by 250 mm (8 in. by 10 in.) photographs for:
    - i. rendering or model image (if changed from concept submission),
    - ii. elevation views for all exposures (if changed from concept submission)

### Historic Preservation

8.5 in. x 11 in. report, signed by qualified preservation architect, including:

#### 1. Narrative

- a. Cover page: Building name, address, project title, project control number, author (preservation architect), preservation architect's signature, date of submission
- b. General: Project purpose, scope, groups and individuals involved, substantive changes to approach described in concept submission
- c. Existing conditions, describing:
  - i. Overall building size, configuration, character
  - ii. Project location
  - iii. Existing original materials and design, alterations
  - iv. New findings from testing or analysis in concept phase
- d. Preservation solutions explored, how resolved and why, including:

- i. Location of new work: visual impact, protection of ornamental finishes
  - ii. Design of new work/installation: visual and physical compatibility with existing original materials and design; materials/finishes chosen
  - iii. Methods of supporting new work/installation
  - iv. Preservation and protection of historic materials during construction through tenant move-in
- e. Effects, describing:
- i. How project will affect the building's architecturally significant qualities
  - ii. Measures proposed to mitigate any adverse effects on historic materials or design

## APPENDIX

### f. Photographs

i. General and detail views showing existing conditions at affected preservation zones, keyed to plan showing location and orientation of each photo view

ii. Captions identifying location, subject, condition shown

### 2. Drawings

a. Reduced to 8.5 in. x 11 in., 11 in. x 17 in. foldout or placed in cover pocket:

b. Site and floor plans, as applicable

c. Elevations, plans, and section details showing preservation design solutions for each issue identified, as approved by regional preservation officer

### Structural

Design report containing structural design criteria and the following information:

1. Calculations For any computer-generated results, submit a program user's manual, a model of the input data, and all pertinent program material required to understand the output. A narrative of the input and results for computer-generated calculations for the recommended structural concept should be contained in the calculations as well.

a. Gravity load and lateral load calculations, with tabulated results showing framing schedules

b. Foundation calculations

c. Calculations showing that the system is not vulnerable to progressive collapse

d. Vibration calculations

e. Blast calculations

### 2. Narrative

a. Code criteria should be reviewed by each discipline to the degree of detail necessary to ensure that tasks accomplished in this phase meet the code requirements.

b. Comparative cost analysis of at least three potential framing systems

i. The analysis should compare first costs based on the design of a typical cross-section of the building, one interior column bay in width, including a comparison of lateral load-resisting elements.

Nonstructural building systems that have a bearing on the overall cost of the systems must be included. For example, in a comparison between steel and concrete systems, the cost of fireproofing the steel structure must be considered, if fireproofing is required by code.

ii. The analysis should include a brief narrative listing factors that may have a bearing on the final selection, such as the availability of local labor skilled in the erection systems, speed of construction, and other concerns.

c. Description of recommended structural concept, including:

i. Choice of framing system, including lateral load-resisting elements, and proposed foundation design

ii. Verification of adequacy of all assumed dead and live loads

d. Identify all code requirements and provide a complete analysis as it pertains to this project including but not limited to:

i. Required fire-resistance rating of structural elements

ii. Summary of special requirements resulting from applicable local codes

e. Proposed methods of corrosion protection, if applicable

f. Geotechnical engineering report, including boring logs (if part of scope of work)

i. See Section A.5 for specific requirements

g. Geologic hazard report. See Section A.5 for specific requirements

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h. Blast consultant's report and analysis (if part of scope of work)

i. Progressive collapse, seismic, and wind analysis if applicable

### 3. Drawings

a. Framing plans and key details

### 4. Specifications

a. Provide an index of specification section to be used on the project

## Mechanical

### 1. Calculations and Energy and Water Analyses

a. Updated building heating and cooling load calculations

b. Updated psychrometric calculations for HVAC systems at full and partial loads (partial loads at 50% and 25%, and unoccupied periods)

c. Updated energy consumption calculations and analysis in accordance with Section A.6

d. Updated water consumption calculations and analysis including make-up water for HVAC systems, domestic water consumption, and water consumption for irrigation

e. Updated fuel consumption estimates

### 2. Drawings: HVAC

a. Demolition drawings, if required

b. Floor plan(s):

i. Single line piping and ductwork schematic layout

ii. Show terminal air units

iii. Perimeter terminal units

c. Quarter-inch scale drawings of mechanical equipment room(s) showing all mechanical equipment, ductwork, and piping, including equipment access and service requirements in plan, elevations, and cross-sections

d. Roof plan showing all roof-mounted equipment and access to roof

e. Show adequate access from mechanical equipment room(s) to freight elevators

f. Single line schematic flow and riser diagram(s):

i. Airflow quantities and balancing devices for all heating/cooling equipment

ii. Water flow quantities and balancing devices for all heating/cooling equipment

iii. Flow/energy measuring devices for water and air systems for all cooling, heating, and terminal equipment

g. Automatic control diagram(s):

i. Control flow diagrams showing all sensors, valves, and controllers (analog and digital)

ii. Sequence of operations of all the systems that describes the control sequences during occupied, 24-hour operations, and unoccupied conditions

h. Schedules:

i. Provide schedules of major equipment that includes chillers, boilers, pumps, air handling units, and terminal units, cooling towers, and all equipment required for 24-hour operations

i. Air terminal devices

j. Air balance relationships between spaces

### 3. Drawings: Plumbing



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- a. Demolition drawings, if required
- b. Floor plan(s):
  - i. Proposed building zoning and major piping runs
  - ii. Locations of proposed plumbing fixtures and equipment
- c. Systems schematics and flow diagrams

### 4. Narrative: HVAC

A written narrative describing the final mechanical system and equipment selection including:

- a. Updated indoor and outdoor design conditions for all spaces under occupied, 24-hour, and unoccupied conditions
- b. Provide a dew point analysis
- c. Updated ventilation rates, dehumidification, and pressurization criteria for all spaces under occupied, 24-hour, and unoccupied conditions
- d. Updated equipment capacities, weights, sizes, and power requirements
- e. A complete description of the air side and water side systems and the associated components including operating characteristics, ranges, and capacities, spaces served, and special features
- f. Descriptions of control strategy and sequence of operations for all spaces under occupied, 24-hour, and unoccupied conditions
- g. Updated fuel and utility requirements
- h. A P100 compliance statement
  - i. A description of any deviation from the HVAC system as approved in the Final Concept submittal, in accordance with P100

### 5. Narrative: Plumbing

- a. Updated description of plumbing system, including domestic cold and hot water, sanitary and storm drainage, and irrigation systems

- b. Updated evaluation of alternate sources for reheating of domestic water (solar or heat recovery)

### 6. Specifications

- a. Draft of each specification section to be used on the project

### Fire Protection

Fire protection and life safety submission requirements must be identified as a separate Fire Protection section as outlined in this document.

#### 1. Calculation

- a. Occupant load and egress calculations
- b. Fire protection water supply calculations
  - i. Includes water supply flow testing data
- c. Fire pump calculations where applicable
- d. Smoke control calculations where applicable (e.g., atrium)
- e. Stairway pressurization calculations where applicable
- f. Calculations contained in The SFPE Handbook of Fire Protection Engineering for calculating sound attenuation through doors and walls for placement and location of fire alarm system audible notification appliances

#### 2. Drawings

- a. Floor plans showing:
  - i. Equipment spaces for fire protection systems (e.g., fire pump, fire command center)

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- ii. Fire protection water supply lines, fire hydrant locations, fire apparatus access roads, and fire lanes
- iii. Standpipes and sprinkler risers
- iv. Remoteness of exit stairways
- v. Location of firewalls and smoke partitions
- vi. Identification of occupancy type of every space and room in building
- vii. Calculated occupant loads for every space and room in the building
- viii. Location of special fire protection requirements (e.g., kitchens, computer rooms, storage)

b. Riser diagrams for sprinkler system

c. Riser diagram for fire alarm system

### 3. Narrative

a. Building egress description

- i. Includes egress calculations and stairway exit capacities, remoteness, exit discharge, etc.

b. All building fire alarm and suppression systems

c. Smoke control system(s), where applicable

d. Special fire protection systems (e.g., kitchen extinguishing system), where applicable

e. Fire resistance rating of building structural elements

- i. Coordinate with structural engineer

f. Fire alarm system

- i. Interface of fire alarm system with BAS and security systems

- ii. Review of building for compliance with life safety requirements and building security requirements

g. Interior finish requirements as they pertain to the life safety requirements

h. Mass notification system

## Electrical

### 1. Calculations

a. Lighting calculations for a typical 186 m<sup>2</sup> (2,000 sq. ft.) open office plan with system furniture

b. Lighting calculations for a typical one-person private office

c. Power calculations from building entry to branch circuit panel

d. Load calculations

e. Life-cycle cost analysis of luminaire/lamp system and associated controls

f. Power density analysis for lighting of each area

### 2. Narrative

a. Description of alternative power distribution schemes

- i. Compare the advantages and disadvantages of each approach. Include the source of power, potential for on-site generation, most economical voltage, and primary vs. secondary metering.

b. Proposed power distribution scheme

- i. Provide a detailed description and justification for the selected scheme. Address special power and reliability requirements, including emergency power and UPS systems.

c. Proposed lighting systems

- i. Discuss typical lighting system features, including fixture type, layout, and type of controls

- ii. Discuss special spaces such as lobbies, auditoria, dining rooms, and conference rooms

## APPENDIX

- iii. Discuss exterior lighting scheme
  - iv. Discuss lighting control systems and daylighting
  - v. Describe the energy usage of the lighting system
  - vi. Interface with BAS
  - vii. Methods proposed for energy conservation and integration with BAS
  - viii. Engineering analysis for demand limit controls
- d. Description of each proposed signal system
- i. Description of proposed security systems' features and intended mode of operation
  - ii. Proposed zone schedule
  - iii. Proposed card access controls, CCTV assessment and intrusion protection system, if applicable
- e. Proposed telecommunications Infrastructure
- i. Systems proposed for infrastructure and cabling to accommodate the communications systems. These must be designed and provided in compliance with EIA/TIA building telecommunications wiring standards.
- f. Code criteria should be reviewed by each discipline to the degree of detail necessary to ensure that tasks accomplished in this phase meet the code requirements.

### 3. Drawings

- a. Site plan
  - i. Proposed site distribution for power and communications, proposed service entrance and location of transformers, generators, and vaults, etc.
- b. Floor plans

- i. Proposed major electrical distribution scheme and locations of electrical rooms and closets and communication closets
  - ii. Proposed major routing of major electrical feeder runs, bus duct, communication backbone systems, and security systems
  - iii. Plan layouts of electrical rooms, showing locations of major equipment, including size variations by different manufacturers
- c. Single line diagram of the building power distribution system
- d. Plan of typical office lighting layout
- e. Single line diagram of other signal system including: telephones, security, public address, and others
- f. Security system site plan
- i. Proposed locations for CCTV, duress alarm sensors, and access controls for parking lots. If the system is not extensive, these locations may be shown on the electrical site plan.
  - ii. Security system floor plans
  - iii. Proposed locations for access controls, intrusion detection devices, CCTV, and local panels
- g. Lightning protection and building grounding

### Design Development Cost Estimate

A cost estimate must be provided, as required in the P120 and in accordance with the P100.

The Design Development Estimate submission must include the following:

- Executive summary
- Basis of estimate, rationale, assumptions and market analysis as required in P120
- GSA Report 3474, GSA Report 3473

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- Summary Reports (ASTM UNIFORMAT II and CSI MasterFormat formats as applicable)
- Detail line item cost reports
- Core/shell and TI cost estimate, as per GSA pricing policy. TI estimates must be prepared for each tenant.
- Provide separate estimates for phased work, or bid alternates/options
- To ensure the project is developing on-budget, a list of cost-saving items that would collectively reduce the project cost to approximately 10 percent below budget,
- Verify that the design development submission can be constructed within the project budget

Address what value engineering items were incorporated from the concept VE workshops. (Document all VE workshop sessions during design development and show what is to be incorporated into the final design.)

### Specifications

Assemble all project-related construction guide specifications and mark out all content that does not apply to the project.

### Certification Requirements

The A/E (lead designer) of record must provide certification that the project has been designed and is in compliance with project program requirements, PBS P100, and GSA's energy goal.

Assemble material for LEED rating submission, indicating features and points that ensure desired LEED rating.

The A/E of record must provide certification that all VE decisions made during DD are in compliance with the program requirements and PBS P100, and approved by the design team and all GSA and client stakeholders.

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In bullet form, identify how selected design features will support the project's performance expectations. All building systems involved with the project must be discussed, each addressing all performance expectations as covered in the design program and Section A.2.

### Building Information Model

A BIM for design development is required to a minimum Level 200 development (in accordance with AIA E202 Standards). The contents of the BIM shall be such that the BIM shall be the source for 2D drawings and SDM requirements to the greatest extent possible. When 2D deliverables require a finer level of detail, the BIM shall be the central source for 2D details and/or be modeled in greater detail to accommodate the specific requirements. The BIM Execution Plan shall also be reviewed and a VDC Scorecard analysis shall be conducted to ensure all parties are in compliance.

### Construction Documents

The construction documents must be complete, coordinated between disciplines, biddable, readable, and buildable, with no room for unreasonable additional interpretation. The drawings listed below represent requirements for GSA's review, and do not constitute any limitation on the documentation required to properly contract for the construction of the project, or limit the professional design liability for errors and omissions.

Update of code analysis. Each design team discipline member must review, to the degree of detail necessary, the design to assure all the code requirements are met.

### Site Planning and Landscape Design

1. Calculations

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- a. Final drainage calculations, including stormwater detention
- b. Final parking calculations, if applicable
- c. Pipe sizing calculations for water and sewer pipes
- d. Pavement design calculations

2. Drawings, General: The plans listed below, except the demolition plans, may be combined on small projects.

- a. Demolition plans, if required
- b. Site layout plan
  - i. Location of all buildings, roads, walks, accessible routes from parking and public street to building entrance, parking and other paved areas, and planted areas
  - ii. Limits of construction
  - iii. Locations and sizes of fire protection water supply lines, fire hydrants, fire apparatus access roads, and fire lanes
  - iv. Location of floodplains and wetlands
- c. Grading and drainage plan, showing:
  - i. Existing and new contours [use 600 mm (2 ft.) interval minimum in area around buildings]
  - ii. Spot elevations at all entrances and elsewhere as necessary
  - iii. Elevations for walls, ramps, terraces, plazas, and parking lots
  - iv. All surface drainage structures
  - v. Water retention and conservation
- d. Site utilities plan, showing:
  - i. All utilities, including inlets, manholes, clean-outs, and invert elevations
- e. Planting plan, showing:
  - i. Building outline, circulation, parking, and major utility runs
  - ii. Size and location of existing vegetation to be preserved (include protection measures during construction)
  - iii. Location of all new plant material (identify function, such as windbreak or visual screen where appropriate)
  - iv. Erosion control
- f. Planting schedule, showing:
  - i. Quantity of plants, botanical names, planted size, and final size,
- g. Irrigation plan, if applicable
  - i. Include schematic of irrigation control system
- h. Planting and construction details, profiles, sections, and notes as necessary to fully describe design intent
  - i. Construction phasing, if part of project

- i. Survey of surrounding buildings, structures, and improvements in both wet and dry season to document preconstruction elevations
- j. Potential archeological artifacts

## Architectural

1. Calculations and Compliance Reports
  - a. Final acoustical calculations, including noise transmissions through:
    - i. Envelope
    - ii. Interior walls, floors (including raised floors), and ceilings
    - iii. Mechanical and electrical equipment
  - b. Final heat transfer through and dew point locations in building envelope
  - c. Final toilet fixture count
  - d. Final illumination, daylighting, and glare analysis
2. Drawings
  - a. Project title sheet, drawing index
  - b. Demolition plans if required
  - c. Floor plans
  - d. Show planning grids and raised access floor grid, if applicable,
    - i. Reflected ceiling plans
    - ii. Show ceiling grid and location of all elements to be placed in the ceiling
  - e. Building sections
    - i. Vertical zoning for electrical and mechanical utilities must be indicated on sections
  - f. Roof plans
    - i. Roof plans must show slopes, low points, drains and scuppers, equipment, equipment supports, roof accessories, and specialty items, if applicable
  - g. Exterior elevations
  - h. Wall sections
    - i. Interior elevations
  - j. Details
  - k. Schedules. Diagrams illustrating proper clearance for servicing and replacement of equipment
3. Specifications
  - a. Room finish, ceiling types, floor finish, color, and door schedules can be incorporated into either the specifications or drawings
  - b. Call for thermographic scans of building envelope to identify sources of heat transfer
  - c. Call for assembly of visual and performance mock-ups for spaces such as courtrooms and sample office space fit outs
  - d. Provide lighting fixture type schedule

## Historic Preservation

### Specifications

Competency of bidder and restoration specialist qualification requirements, Sections 00120 and 009[00], cross-referenced in material specifications.

1. Technical specifications for repair and restoration of historic materials, including:
  - a. Specialized materials and procedures for repair and restoration of historic materials,
  - b. Procedures for protecting historic materials in areas being altered,
  - c. Sample review requirements of repair and restoration procedures,
  - d. Sample submittal requirements for replacement materials and new installations in preservation zones,

## Structural

### Calculations

For any computer-generated results, submit a model of the input data and all pertinent program material required to understand the output. A narrative of the input and results should be contained in the calculations as well.

Whenever a figure is obtained from some other page of the calculations, refer to that page number in parentheses next to the figure used in the calculation.

Provide sketches showing framing plans with dimensions and grid lines, free-body/force diagram in support of the calculations. Refer to drawing numbers where the calculated items are shown on the drawing: for example, structural sizes, rebar sizes, connection details, etc.

Narrative/description must be submitted explaining the computer program used to perform the calculation.

1. Final structural calculations, including:

- a. Gravity loads
- b. Lateral loads (seismic and wind)
- c. Foundations
- d. Thermal loads where significant

- e. Vibration propagation

- f. Progressive collapse

- g. Supports for nonstructural elements, including mechanical and electrical equipment on the roof and in equipment rooms, louvers, and other penetrations

- h. Steel connections

- i. Blast analysis

2. Drawings

- a. Demolition plans (when applicable)

- b. Full set of structural construction drawings

- i. Drawings must be fully dimensioned, noted and detailed for accurate bidding and construction

- ii. Load criteria for all floor live loads, roof live load, roof snow load, wind load, earthquake design data, and special loads must be shown on drawings. Live load reduction of the uniformly distributed floor live loads, if used in the design, must be indicated.

- iii. Basic wind speed (3-second gust), miles per hour (km/hr), wind importance factor, I, and building category, wind exposure, the applicable internal pressure coefficient must be indicated.

- iv. Seismic design criteria, such as seismic use group, spectral response coefficients SDS and SD1, site class, basic seismic-force-resisting system, design base shear, and analytical procedure must be indicated. Additional information may be required by the local building official.

- v. Soil bearing pressure and lateral earth pressure must be indicated.

- vi. Properties of basic materials must be indicated

- vii. Blast-resistant requirements if applicable

- viii. Indicate the codes and standards used to develop the project.

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### c. Schedules

i. Schedules for foundations, columns, walls, beams, slabs, and decks, as applicable

d. Structural details. (All typical details must be shown on the drawings.)

i. Include details for steel connections

ii. Include details for all fire-rated assemblies, indicating Underwriters Laboratories Inc. or other nationally recognized testing laboratory fire resistance directory design numbers

iii. Include details indicating if the assembly is restrained or unrestrained in accordance with Appendix X to ASTM E119 (the classification must be determined by a licensed structural engineer)

iv. Include details for anchorage of building system equipment and nonstructural building elements (may be shown on mechanical, electrical, or architectural drawings, as applicable). The anchorage details, if shown on other disciplines, must be referenced on the structural drawings.

## Mechanical

### 1. Drawings HVAC

a. Demolition plans, if required

b. Floor plan(s):

- i. Double line piping and ductwork layout
- ii. Show terminal air units
- iii. Perimeter terminal units
- iv. Show locations of automatic control sensors (e.g., temperature, relative humidity, CO<sub>2</sub>, room pressurization)

c. Roof plan showing all roof-mounted equipment and access to roof,

i. Show adequate access from mechanical equipment room(s) to freight elevators

d. Mechanical details:

i. Quarter-inch scale drawings of mechanical equipment room(s) showing all mechanical equipment, ductwork, and piping including access and service requirements in plan, elevations, and cross-sections

ii. All valves must be shown. Indicate locations where temperature, pressure, flow, contaminant/combustion gases, or vibration gauges are required, and if remote sensing is required.

iii. Mechanical room piping and ductwork layout must be double line.

iv. All dampers—both fire dampers and volume control dampers—must be shown. Ductwork ahead of the distribution terminals must be indicated in true size (double line).

e. Single line schematic flow and riser diagram(s):

i. Airflow quantities and balancing devices for all heating/cooling equipment

ii. Water flow quantities and balancing devices for all heating/cooling equipment

iii. Show location of all flow/energy measuring devices for water and air systems for all cooling, heating, and terminal equipment, and their interface with the BAS

f. Automatic control diagrams:

i. Control flow diagrams showing all sensors, valves, and controllers (analog and digital inputs for controllers, front end equipment, and system architecture)

ii. Diagrams to show control signal interfaces, complete with sequence of operation of all heating, ventilating, and cooling systems during occupied, 24-hour, and unoccupied conditions

g. Schedules:

i. Provide schedules of equipment that includes chillers, boilers, pumps, air handling units, terminal units, cooling towers, and all equipment required for 24-hour operations.

ii. Air terminal devices

h. Air balance relationships between spaces

### 2. Drawings: Plumbing

a. Demolition plans, if required

b. Floor plans

i. Plumbing layout and fixtures, equipment and piping; large-scale plans should be used where required for clarity

c. Riser diagrams for waste and vent lines

d. Riser diagrams for domestic cold and hot water lines

e. Plumbing fixture schedule

### 3. Narrative HVAC

a. A written narrative describing the final mechanical system and equipment selection including:

i. Final indoor and outdoor design conditions for all spaces under occupied, 24-hour, and unoccupied conditions

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- ii. Final ventilation rates, dehumidification, and pressurization criteria for all spaces under occupied, 24-hour, and unoccupied conditions.
  - iii. Final equipment capacities, weights, sizes, and power requirements
  - iv. Final psychometrics of HVAC systems
  - v. A final description of the air side and water side systems and the associated components including operating characteristics, ranges, and capacities, spaces served, and special features
  - vi. Final descriptions of the control strategy and sequence of operations for all spaces under occupied, 24-hour, and unoccupied conditions
- b. Final fuel and utility requirements
- c. A final code compliance statement
- d. A final P100 compliance statement
- e. A final description of any deviation from the HVAC system as approved in the Final Concept submittal, in accordance with P100
4. Narrative: Plumbing
- a. A final description of plumbing system, including domestic cold and hot water, sanitary and storm drainage, and irrigation systems
  - b. A final evaluation of alternate sources for preheating of domestic water (solar or heat recovery)
5. Calculations and Energy and Water Analyses HVAC
- a. Final building heating and cooling load calculations
  - b. Final system pressure static analysis at peak and minimum block loads for occupied and unoccupied conditions
  - c. Building pressurization analysis for peak and minimum block loads for occupied and unoccupied conditions
  - d. Acoustical calculations for peak and minimum block loads for occupied conditions
  - e. Flow and head calculations for pumping systems for peak and minimum block loads for occupied conditions
  - f. Final selection of equipment, cut sheets of selected equipment
  - g. Final psychrometric calculations for the selected HVAC systems at full and partial loads (partial loads at 50% and 25%, and unoccupied periods)
  - h. Final energy consumption calculations and analysis in accordance with Section A.6
  - i. Final fuel consumption estimates
  - j. Sizing of fuel storage and distribution system
  - k. Sizing of vibration isolators for mechanical equipment
6. Calculations: Plumbing
- a. Include entire building, including roof drainage calculations and hot water heating calculations

- b. Water supply calculations, including pressure
  - c. Roof drainage calculations
  - d. Sanitary waste sizing calculations
  - e. Final water consumption calculations and analysis including make-up water for HVAC systems, domestic water consumption, and water consumption for irrigation
7. Specifications
- a. Completely edited version of each specification section to be used on the project,

## Fire Protection

Fire protection and life safety submission requirements must be identified as a separate Fire Protection section as outlined in this document.

1. Drawings
- a. Demolition plans, if required
  - b. Full set of fire protection construction drawings
    - i. Drawings must be carefully dimensioned, noted, and detailed for accurate bidding and construction
  - c. Fire protection details (all typical details must be shown on the drawings)
    - i. Building construction
      - (1) Building's construction type (e.g., 443, 222, etc.)
      - (2) Firewalls and smoke partition
      - (3) Panel and curtain walls
      - (4) Fire-stopping configurations. Include details of all openings between the exterior walls (including panel, curtain, and spandrel walls) and floor slabs, openings in floors, and shaft enclosures
      - (5) Mass notification system equipment
    - ii. Life safety
      - (1) Each stair
      - (2) Horizontal exits
      - (3) Each required fire door
      - (4) Stairway pressurization fans
      - (5) Security door hardware, including operation procedures
    - iii. Water supply
      - (1) Fire pump configuration
      - (2) Anchorage of underground fire protection water supply lines
      - (3) Standpipe riser
    - iv. Water-based fire extinguishing systems
      - (1) Installation of waterflow switches and tamper switches
      - (2) Sprinkler floor control valves, sectional valves, and inspector text assembly



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- v. Non-water-based fire extinguisher systems
  - (1) Special fire extinguishing systems (e.g., wet chemical)
- vi. Fire alarm system
  - (1) Fire alarm riser
  - (2) Typical firefighter telephone station
  - (3) Typical firefighter telephone jack
  - (4) Electrical closets for fire alarm system
- panels
  - (5) Fire alarm telephone panel (includes voice paging microphone and firefighter telephone system)
  - (6) Visual indicating device control and power detail, typical for floors (state location)
  - (7) Amplifier rack (state location)
  - (8) Typical location of duct smoke detectors
  - (9) Outdoor fire alarm speaker
  - (10) Wall-mounted cone fire alarm speaker
  - (11) Typical terminal cabinet
  - (12) Lay-in ceiling-mounted fire alarm speaker
- combination speaker/strobe
  - (13) Lay-in ceiling-mounted fire alarm combination speaker/strobe
  - (14) Wall-mounted strobe device
  - (15) Typical manual fire alarm box
- installation
  - (16) Fire alarm system input/output matrix
  - (17) Graphic annunciator panel
  - (18) Installation of the graphic annunciator
  - (19) Fire command center showing the locations of each panel to be installed
- 2. Specifications
  - a. Final specifications
  - b. Specifications must be based on GSA Fire Protection Supplements to Masterspec
- 3. Calculations For any fire modeling generated results, submit a copy of the input data and all pertinent program material and assumptions required to understand the output and the analysis. A narrative of the input and results must be part of the calculations.
  - a. Final occupant load and egress calculations
  - b. Final fire protection water supply calculations. Includes water supply flow testing data.
  - c. Final fire pump calculations where applicable
  - d. Final smoke control calculations where applicable (e.g., atrium)
  - e. Final stairway pressurization calculations
  - f. Fire modeling
  - g. Final calculations contained in The SFPE Handbook of Fire Protection Engineering for calculating sound attenuation through doors and

walls for placement and location of fire alarm system audible notification appliances

## Electrical

- 1. Drawings: General Systems must be fully drawn and sized to permit accurate bidding and construction.
  - a. Demolition plans, if required
  - b. Floor plans
    - i. Show lighting, power distribution, and communications raceway distribution, and locations of fire alarm and annunciator panels
  - c. Single-line diagram of primary and secondary power distribution
  - d. Include normal power, emergency power, and UPS
  - e. Single-line diagram of fire alarm system
  - f. Single-line diagram of telecommunications system
  - g. Circuit layout of lighting control system
  - h. Details of underfloor distribution system
    - i. Site plan
  - i. Indicate service locations, manholes, ductbanks, and site lighting,
  - j. Layout of electrical equipment spaces
    - i. Show all electrical equipment. Include elevations of substation transformers and disconnect switches
  - k. Schedules for switchgear, switchboards, motor control centers, panelboards, and unit substations
  - l. Grounding diagram
  - m. Complete phasing plan (if required) for additions and alterations
  - n. Security systems site plan
    - i. Final locations of all security devices and conduit runs
  - o. Security system floor plans
    - i. Layout of all security systems
  - p. Storage areas for electrical equipment/spare parts
- 2. Specifications
  - a. Final specification
  - b. Zone schedules may be bound into the specifications or shown on drawings
- 3. Calculations
  - a. Illumination level and lighting power calculations
  - b. Lighting power densities must be calculated by the electrical engineer. The illumination levels for all spaces are to be calculated by the architect, who must also calculate daylighting and glare.
  - c. Short circuit calculations
  - d. Voltage drop calculations
  - e. Overcurrent coordination study
  - f. Generator calculations

- i. Include starter loads

## Certification Requirements

The A/E (lead designer) must provide certification that the project has been designed and is in compliance with ASHRAE 90.1 and will meet GSA energy goal requirements.

Certification will also indicate that the architectural/engineering design elements have been integrated with the overall project design, and that the building can meet the programmed LEED rating.

All VE decisions made during construction documentation are in compliance with code requirements, the PBS P100 criteria and requirements, and have been approved by the GSA and client stakeholders.

The A/E certification must be signed and sealed by a principal of the architectural/engineering firm in charge of the project.

## Construction Documents Cost Estimate

A cost estimate must be provided, as required in the P120 and in accordance with the P100.

The construction documents estimate submissions must include the following:

- Executive summary
- Basis of estimate, rationale, assumptions, and market analysis as required in P120
- GSA Report 3474, GSA Report 3473
- Summary Reports (ASTM UNIFORMAT II and CSI MasterFormat formats as applicable)
- Detail line item cost reports
- Core/shell and TI cost estimate, as per GSA pricing policy. TI estimates must be prepared for each tenant.

- Provide separate estimates for phased work, or bid alternates/options.
- To ensure the project is developing on-budget, a list of cost-saving items that would collectively reduce the project cost to approximately 10 percent below budget.
- Verify that the construction documents submissions can be constructed within the project budget.

## Data and Operations Manual

An operations manual must be prepared and training provided for the building Operations and Maintenance personnel describing the design objectives and how to operate the building. The manual must include: as-built drawings, equipment data, model numbers for the equipment, parts lists, equipment options, operating manuals for each piece of equipment, testing and balancing reports and certifications, maintenance schedules, videos, and warranty schedules. The manual must be reviewed and certified complete by the GSA project manager before submission to the facilities manager.

## Building Information Model

A BIM for construction documents is required to a minimum Level 300 development (in accordance with AIA E202 Standards). The contents of the BIM shall be such that the BIM shall be the source for 2D drawings and SDM requirements to the greatest extent possible. When 2D deliverables require a finer level of detail, the BIM shall be the central source for 2D details and/or be modeled in greater detail to accommodate the specific requirements. The BIM Execution Plan shall also be reviewed and a VDC Scorecard analysis shall be conducted to ensure all parties are in compliance.

## A.4 Alteration Projects

The design process and related submission requirements for alterations are somewhat different than those for new construction and modernizations. An alteration is defined as a limited construction project for an existing building that comprises the modification or replacement of one or a number of existing building systems or components. Alterations

are less than total building modernizations. Figure A-4 and the following definitions define the design process and related submission requirements for alterations, including renovations.

**Figure A-4: Design Process and Related Submission Requirements for Renovation**

STAGES	ACTIVITES	SUBMISSIONS
<b>CONCEPTS</b>		
<ul style="list-style-type: none"> <li>● Review Space Directive</li> <li>● Study Adjacencies Circulation Aesthetics</li> <li>● System/Features that Integrate Delivery of Expectations</li> </ul>	<p>PROGRAM REVIEW DESIGN CHARRETTE CONCEPT (1 or more) VALUE ENGINEERING (Systems Level)</p>	<ul style="list-style-type: none"> <li>● Drawings</li> <li>● Narratives</li> <li>● Rendering/ Photos</li> <li>● Proposed Systems</li> <li>● Cost Estimates</li> </ul>
<b>DESIGN DEVELOPMENT</b>		
<ul style="list-style-type: none"> <li>● System/Feature Analyses for Selection</li> <li>● 30% Complete Documentation</li> <li>● Final Selection of All Building Systems</li> </ul>	<p>PROGRAM REVIEW VALUE ENGINEERING (Analysis Stage)</p>	<ul style="list-style-type: none"> <li>● Drawings</li> <li>● Narratives</li> <li>● Calculations</li> <li>● Cost Estimates</li> </ul>
<b>CONSTRUCTION DOCUMENTS</b>		
<ul style="list-style-type: none"> <li>● Presentation of Design in a Format Suitable to Parties Unfamiliar with the Site</li> </ul>	<p>PROGRAM REVIEW 75% COMPLETE 90% COMPLETE 100% COMPLETE POST DESIGN SERVICES</p>	<ul style="list-style-type: none"> <li>● Progress Drawings</li> <li>● Draft Specifications</li> <li>● Narrative Update</li> <li>● Current Calculations</li> <li>● Final: Drawings Specifications Narratives Calculations Cost Estimate</li> <li>● Incorporation of Review Comments</li> </ul>

## Design Process Definitions

### Program Review

Prior to initiating each phase of design, the design team should meet to review design program expectations and to exchange ideas, lessons-learned, and concerns. Such technical "partnering" sessions allow a clearer definition of expectations while remaining within the project's scope and budget.

### Phases of Construction

Prior to each phase of design, a construction phasing plan must be prepared to ensure that services such as power, lighting, HVAC, plumbing, elevators, fire-safety, building security, telecommunications, and data are available in the area/spaces which will be occupied during the phased construction. This phasing plan must be coordinated with clients, property managers, and other stakeholders.

### Demolition Plan

Prior to each phase of design, a demolition narrative and drawings must be prepared for each element (i.e., architectural, site, structural, mechanical, electrical, fire-safety) to ensure coordination of the demolition and removal of the elements. Abandonment-in-place of unused elements is not permitted.

### Concept

A submission that will demonstrate that the space program has been accomplished, including any adjacency and functional requirements. This submission will also show that the proposed project is compatible with the project authorization and complies with the criteria and requirements in Chapters 1-9 of this document. A preliminary analysis of proposed building systems must be accomplished to determine the most cost-effective alternatives.

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## Design Development

A set of submissions and meetings that will finalize the selection of type, size, and other material characteristics of all systems. Systems are not only structural, mechanical, fire protection, and electrical, but all other building components such as envelope (wall, window, and roof), interior (flooring, ceiling, and partitions), toilet and service rooms, elevators, and so on. The submission will consist of a combination of drawings, narrative, and calculations.

### Construction Documents

A set of detailed and coordinated submissions that become the basis of a construction contract. They must be produced in a general fashion that any construction contractor nationwide can understand. Designs must be illustrated to distinguish between existing construction and new work, and be clear enough to result in a single interpretation of a specific set of data or facts. Language used in the specifications must be consistent and complementary to notes on the drawings. The documents must avoid using terms that the design specialist may know, but which have nothing to do with the purchase and installation of a product.

### Specifications

Specifications to be organized according to CSI format, fully edited, typed, and bound.

### Code Analysis

Code criteria should be reviewed by each discipline to the degree of detail necessary to ensure that tasks accomplished in each phase meet the code requirements.

## Concept

### Site Planning and Landscape Design

A sitework drawing and narrative need to be submitted only if sitework is a substantial part of the scope of work for the alteration.

1. Drawings
  - a. Site plans as described in Section A.3
2. Narrative
  - a. Existing site features
    - i. Topography and drainage patterns
    - ii. Any existing erosion conditions
    - iii. Wetlands and location of flood plains
    - iv. Circulation patterns around site
    - v. Site access
  - b. Noise/visual considerations
  - c. Local zoning restrictions
  - d. Historic preservation considerations, if applicable
    - i. Potential archeological artifacts
  - e. Fire protection considerations, if applicable
  - f. Site analysis of utilities, if utilities are to be changed
  - g. Description of site and landscape design concept
    - i. Proposed changes to circulation design
    - ii. Proposed changes to parking
    - iii. Proposed method for stormwater detention or retention
    - iv. Proposed changes to paving
    - v. Description of local urban design goals for surrounding neighborhood and summary of relevant recommendations from local officials

### Architectural

An architectural concept needs to be submitted only if architectural work is a part of the scope of work for the alteration.

1. Drawings
  - a. Demolition plans
  - b. Floor plans, elevations, and sections as described in Section A.3
  - c. Existing and new spaces, circulation, entrances, stairways, elevators, freight elevators, loading docks, special spaces and service spaces, and service rooms

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and space for mechanical, fire protection, electrical, and communication equipment. Dimensions for critical clearances, such as vehicle access, fire apparatus access, deliveries, and maintenance should be indicated.

2. Narrative
  - a. Architectural program requirements
    - i. Describe how the design meets the project authorization
  - b. Design concept, explaining:
    - i. General layout
    - ii. Treatment of historic zones, if applicable

3. Calculations
  - a. Where building renovation involves window or insulated wall systems, perform a life-cycle cost assessment to optimize selection

### Historic Preservation

8.5 in. x 11 in. report, signed by qualified preservation architect, including:

1. Narrative
  - a. General: Project purpose, scope, groups, and individuals involved
  - b. Existing conditions, describing:
    - i. Overall building size, configuration, character
    - ii. Project location
    - iii. Existing original materials and design, relevant alterations
  - c. Preservation design issues and prospective solutions, including:
    - i. Location of new work/installation: visibility, impact on historic finishes
    - ii. Compare options for preserving/restoring historic materials and design
    - iii. Identify further study required to avoid adverse effects as applicable

2. Photographs
  - a. General and detail views showing existing conditions at affected preservation zones, keyed to plan showing location and orientation of each view
  - b. Captions identifying location, subject, condition shown

3. Drawings
  - a. Reduced to 8.5 in. x 11 in., 11 in. x 17 in. foldout or placed in cover pocket:

- i. Site and floor plans, as applicable.
- ii. Sketches or schematic CAD drawings (elevations, plans) showing preservation design concepts.

## Structural

Structural drawings and narrative only need to be submitted if a structural upgrade is part of the scope of work.

### 1. Drawings

- a. Structural plans as described in Section A.3

### 2. Narrative

a. Description of current structural systems, state of repair, variances from present codes and available spare load capacity. Data may be obtained from review of original construction drawings and codes or from an analysis of the actual structure.

- i. This report may have been completed as part of the prospectus development study
- b. Identification of governing codes
- c. Description of recommended changes to the structural system, addressing:
  - i. Structural materials, required selective demolition or alteration of existing structural elements, roof and floor framing system, means of resisting lateral loads, and connections between existing and new structural systems
- d. If a seismic evaluation study exists for the building, describe any variations taken in design, compared to the study's recommendations.

## Mechanical

Mechanical drawings, narrative, and calculations need to be submitted only if the alteration scope of work involves changes to the mechanical systems.

### 1. Drawings

- a. Demolition plan of all piping, ductwork, equipment, and controls that are to be removed
- b. Drawings for new work must be provided as described in Section A.3

### 2. Narrative

a. Description of current mechanical systems, state of repair, variances from present codes and P100. Data may be obtained from review of original construction drawings, P100 requirements and codes, and from an analysis of the actual facility.

- b. Description of changes to existing systems as authorized and described in the prospectus and the building evaluation report
  - c. Describe existing and proposed HVAC and plumbing systems, including available capacities, compliance with the criteria and requirements in Chapter 5 of this document and their operational characteristics
  - d. Identify how new systems will be integrated with existing systems
  - e. Provide analysis of energy conservation opportunities for the project
- ### 3. Calculations and Energy Analysis
- a. Calculations and energy analysis for alterations must show compliance with Chapters 1, 3, 5, and Sections A.3 and A.6.

## Fire Protection

Fire protection and life safety submission requirements must be identified as a separate fire protection section as outlined in this document.

### 1. Drawings

- a. Demolition plans
  - i. Identify existing fire protection systems (e.g., sprinklers, fire alarm notification appliances)
- b. Floor plans, showing a minimum:
  - i. New fire protection systems (e.g., sprinklers, fire alarm notification appliances)

2. Narrative A fire protection narrative needs to be submitted only if the fire protection work is a substantial part of the scope of work for the alteration or involves changes to a fire protection system.

- a. Fire protection program requirements
- b. Description of the building's proposed fire protection systems including modifications to the existing egress systems
- c. Code statement identifying changes in building occupancy classification, occupancy group(s), fire resistance requirements, egress requirements, and so on.

## Electrical

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An electrical narrative needs to be submitted only if the alteration scope of work involves changes to the type or location of major electrical systems.

### 1. Narrative

a. Description of requested changes to existing systems.

i. Describe lighting, power, and signal systems, including available capacity versus criteria in Chapter 6, and operational characteristics.

ii. Describe code deficiencies. Identify how new systems will be tied into existing systems.

iii. This report may have been completed as part of the prospectus development study.

b. Describe both existing and new distribution systems within the building

i. Special power and reliability requirements should be addressed, including emergency power and UPS systems.

## Concept Cost Estimate

The final concept phase estimate submission must include the following:

1. Executive summary
2. Basis of estimate, rationale, assumptions and market analysis as required in P120
3. GSA Report 3474, GSA Report 3473
4. Summary reports (ASTM UNIFORMAT II, Work Items and CSI MasterFormat formats as applicable)
5. Detail line item cost reports
6. Core/shell and TI cost estimate, as per GSA pricing policy. TI estimates must be prepared for each tenant.
7. Provide separate estimates for phased work, or bid alternates/options.
8. To ensure the project is developing on-budget, a list of cost-saving items that would collectively reduce the project cost to approximately 10 percent below budget.
9. Verify that the final concept submissions can be constructed within the project budget.

A life-cycle cost analysis of three options that have been modeled should be included with this submittal.

## Design Development

### Site Planning and Landscape Design

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### 1. Calculations

a. Storm drainage and sanitary sewer calculations  
b. Storm water detention facility calculations, if applicable  
c. Parking calculations, if applicable

### 2. Narrative

a. Site circulation concept, explaining:

i. Reasons for site circulation design and number of site entrances

ii. Reasons and/or calculation for number of parking spaces provided

iii. Reasoning for design of service area(s), including description of number and sizes of trucks that can be accommodated

iv. Proposed scheme for waste removal

v. Proposed scheme for fire apparatus access (including aerial apparatus), roads, and fire lanes

b. Site utilities distribution concept

c. Drainage design concept

d. Landscape design concept, explaining:

i. Reasoning for landscape design, paving, site furnishings, and any water features

ii. Reasoning for choice of plant materials

iii. Proposed landscape maintenance plan

iv. Brief operating description of irrigation system

v. Summarize water conservation opportunities that have been studied

vi. Brief description of fire protection water supplies

vii. Brief description of fire hydrant locations

viii. Reasoning for urban design choices and their relation to local urban design goals

e. Site construction description

i. Brief description of materials proposed for pavements and utilities

f. Code analysis

i. Analysis of applicable local zoning and building code requirements

### 3. Drawings

a. Demolition plans (when applicable)

b. Preliminary site layout plan, showing:

i. Roads, walks, parking, and other paved areas (including type of pavement). Show access route for the physically disabled from parking and from public street to main entrance.



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- ii. Fire apparatus access (including aerial apparatus) and fire lanes
- c. Preliminary grading and drainage plan, showing:
  - i. Preliminary site grading, storm drainage inlets, including detention facilities
- d. Preliminary site utilities plan, showing:
  - i. Sizes, inverts, and locations of domestic and fire protection water supply lines, sanitary sewer lines, gas lines, steam/condensate lines and chilled water supply and return lines, if applicable
- e. Preliminary landscape design plan, showing:
  - i. Preliminary hardscape design, including site furniture, water features, etc.
  - ii. Preliminary planting scheme
  - iii. Preliminary irrigation design

## Architectural

### 1. Narrative

- a. Building concept, explaining:
  - i. Entrance locations and service locations
  - ii. Building circulation and arrangement of major spaces
  - iii. Interior design
  - iv. Adherence to the historic building preservation plan, if applicable
- b. Building construction description, explaining, if applicable:
  - i. Exterior materials, waterproofing, air barriers/vapor retarders and insulation elements
  - ii. Roofing system(s)
  - iii. Exterior glazing system
  - iv. Interior finishes, with detailed explanation for public spaces
  - v. Potential locations for artwork commissioned under the Art in Architecture program, if applicable, as determined by the collaboration of the artist, architect, and Art in Architecture Panel

### 2. Drawings

- a. Demolition plans
- b. Building floor plans, showing:
  - i. Spaces individually delineated and labeled
  - ii. Enlarged layouts of special spaces
  - iii. Dimensions

- iv. Accessible routes for the physically disabled as well as other compliance requirements regarding signage, toilets, etc.

- c. Building roof plan, if applicable, showing:
  - i. Drain
  - ii. Dimensions
  - iii. Membrane and insulation configuration of the roofing system
- d. Elevations of major building facades (if changes to the exterior are proposed), showing:
  - i. Existing and new fenestration
  - ii. Existing and new exterior materials
  - iii. Cast shadows
- e. Two building sections (of renovated areas only), showing:
  - i. Accommodation of structural systems
  - ii. Mechanical penthouses, if any
  - iii. Floor to floor and other critical dimensions
  - iv. Labeling of most important spaces
- f. Exterior wall sections, showing:
  - i. Materials of exterior wall construction, including flashing, connections, and method of anchoring
  - ii. Vertical arrangement of interior space, including accommodation of mechanical, fire protection, and electrical services in the floor and ceiling zones
- g. Proposed room finish schedule, showing:
  - i. Floors, base, walls, and ceilings
  - ii. Finish schedule may be bound into narrative

### Historic Preservation

8.5 in. x 11 in. report, signed by qualified preservation architect, including:

#### 1. Narrative

##### a. Cover

- i. Building name, address, project title, project control number, author (preservation architect), preservation architect's signature, date of submission

b. General: Project purpose, scope, groups, and individuals involved, substantive changes to approach described in concept submission

c. Existing conditions, describing:

## APPENDIX

- i. Overall building size, configuration, character
  - ii. Project location
  - iii. Existing original materials and design, alterations
  - iv. New findings from testing or analysis in concept phase
  - d. Preservation solutions explored, how resolved, and why, including:
    - i. Location of new work: visual impact, protection of ornamental finishes
    - ii. Design of new work/installation: visual and physical compatibility with existing original materials and design; materials/finishes proposed (as specified)
    - iii. Methods of supporting new work/installation
    - iv. Preservation and protection of historic materials during construction through tenant move-in
  - e. Effects, describing:
    - i. How project will affect the building's architecturally significant qualities
    - ii. Measures proposed to mitigate any adverse effects on historic materials or design
- ### 2. Photographs
- a. General and detail views showing existing conditions at affected preservation zones, keyed to plan showing location and orientation of each photo view
  - b. Captions identifying location, subject, condition shown
- ### 3. Drawings
- a. Reduced to 8.5 in. x 11 in., 11 in. x 17 in. foldout or placed in cover pocket:
  - b. Site and floor plans, as applicable
  - c. Elevations, plans, and section details showing preservation design solutions for each issue identified, as approved by Regional Preservation Officer

## Structural

1. Calculations For any computer-generated results, submit a model of the input data and all pertinent program material required to understand the output.

A narrative of the input and results should be contained in the calculations as well.

- a. Gravity load calculations
- b. Lateral load calculation
- c. Foundation calculations
- d. Calculations showing that system is not vulnerable to progressive collapse
- e. Vibration calculations
- f. Results of any other studies necessary for the project design

### 2. Narrative

- a. Description of structural concept, including:
  - i. Choice of framing system, including lateral load resisting elements
  - ii. Proposed foundation design
  - iii. Verification of adequacy of all assumed dead and live loads
- b. Code analysis
  - i. Building classification, required fire resistance of structural elements, identification of seismic zone, wind speed, etc.
  - ii. Identification of special requirements, such as high-rise
  - iii. Summary of special requirements resulting from applicable local codes
- c. Proposed methods of corrosion protection, if applicable
- d. Geotechnical engineering report, including boring logs (if part of scope of work). See Section A.5 for specific requirements.
- e. Geologic hazard report

### 3. Drawings

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- a. Demolition plans (where applicable)
- b. Preliminary framing plans and key details
  - i. Include column locations, bay sizes, and location of expansion and seismic joints
- c. Preliminary schedules, including:
  - i. Column, beam, slab, metal deck, and wood framing schedules, as applicable
  - ii. Preliminary seismic details

## Mechanical

In addition to the design development submission of the demolition plan, drawings, narrative, and calculations and analysis must be provided as described in Chapters 1, 3, 5 and Sections A.3 and A.6.

## Fire Protection

Fire protection and life safety submission requirements must be identified as a separate Fire Protection section as outlined in this document.

- 1. Calculations
  - a. Occupant load and egress calculations
  - b. Fire protection water supply calculations
  - c. Fire pump calculations where applicable
  - d. Smoke control calculations where applicable (e.g., atrium)
  - e. Stairway pressurization calculations where applicable
  - f. Calculations contained in The SFPE Handbook of Fire Protection Engineering for calculating sound attenuation through doors and walls for placement and location of fire alarm system audible notification appliances
- 2. Narrative
  - a. Building egress system
    - i. Includes egress calculations and stairway exit capacities, remoteness, exit discharge, etc.
  - b. All building fire alarm and suppression systems
  - c. Smoke control system(s), where applicable
  - d. Special fire protection systems (e.g., kitchen extinguishing system), where applicable
  - e. Fire resistance rating of building structural elements
    - i. Coordinate with structural engineer

- f. Fire alarm system
  - g. Interface of fire alarm system with BAS and security systems
  - h. Review of building for compliance with life safety requirements and building security requirements
  - i. Interior finish requirements as they pertain to the life safety requirements
3. Drawings
- a. Floor Plans showing:
    - i. Equipment spaces for fire protection systems (e.g., fire pump, fire alarm)
    - ii. Fire protection water supply lines, fire hydrant locations, fire apparatus access roads, and fire lanes
    - iii. Standpipes and sprinkler risers
    - iv. Riser diagrams for sprinkler system
    - v. Riser diagram for fire alarm system
    - vi. Remoteness of exit stairways
    - vii. Location of firewalls and smoke partitions
    - viii. Identification of occupancy type of every space and room in building
    - ix. Calculated occupant loads for every space and room in the building
    - x. Location of special fire protection requirements (e.g., kitchens, computer rooms, storage)

## Electrical

- 1. Calculations
  - a. Lighting calculations for a typical 186 m<sup>2</sup> (2,000 sq. ft.) open plan office with system furniture
  - b. Lighting calculations for a typical one person private office
  - c. Power calculations from building entry to branch circuit panel
  - d. Load calculations
  - e. Life cycle cost analysis of luminaire/lamp system
  - f. Life cycle cost study on the options to integrate related building systems
- 2. Narrative
  - a. Proposed power distribution scheme
    - i. Provide a detailed description and justification for the selected scheme
  - b. Interface with BAS
    - i. Methods proposed for energy conservation and integration with BAS
  - c. Engineering analysis for demand limit controls
  - d. Description of each proposed signal system
  - e. Description of proposed security systems features and intended mode of operation

## APPENDIX

- i. Proposed zone schedule
- ii. Proposed card access controls, CCTV assessment and intrusion protection system, if applicable
3. Drawings
  - a. Demolition plans
  - b. Site plan
    - i. Proposed site distribution for power and communications, proposed service entrance and location of transformers, generators, and vaults, etc.
  - c. Floor plans
    - i. Proposed major electrical distribution scheme and locations of electrical closets
  - d. Floor plans
    - i. Major routing of communications system, communications equipment rooms, and closets
  - e. Underfloor distribution system
    - i. Show typical detail for power and communications services
  - f. One-line diagram
  - g. Typical lighting layout
    - i. Include lighting for special areas
  - h. Exterior lighting scheme
  - i. Layout of electrical room
    - i. Show locations of major equipment
  - j. One-line diagrams of other signal systems
  - k. Security system site plan
    - i. Location for CCTV, duress alarm sensors and access control locations for parking lots shown. If the system is not extensive, these locations may be shown on the electrical site plan.
  - l. Security system floor plans
    - i. Access controls, intrusion detection devices, and CCTV locations shown. Preliminary local panel locations shown.

### Design Development Cost Estimate

The Design Development Phase Estimate submissions must include the following:

1. Executive Summary
2. Basis of Estimate, Rationale, Assumptions and Market Analysis as required in P120
3. GSA Report 3474, GSA Report 3473
4. Summary Reports (ASTM UNIFORMAT II, Work Item and CSI MasterFormat formats as applicable)
5. Detail Line Item Cost Reports
6. Core/Shell and Tenant Improvement Cost Estimate, as per GSA Pricing Policy. TI estimates must be prepared for each tenant.

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7. Provide separate estimates for phased work, or bid alternates/options
8. To ensure the project is developing on-budget, a list of cost-saving items that would collectively reduce the project cost to approximately 10 percent below budget.
9. Verify that the Design Development Phase Submissions can be constructed within the project budget.

### Construction Documents

The construction documents must be complete, coordinated between disciplines, biddable, readable and buildable, with no room for unreasonable additional interpretation.

The A/E firm must provide a signed and dated professional seal on all final contract documents. The cover sheet should also include a statement by the design A/E, certifying the design meets the listed design criteria. Exceptions and waivers to the design criteria should also be listed on the cover sheet of the contract documents, including the name and date of the individual providing authorization.

### Site Planning and Landscape Design

#### 1. Cover Sheet

- a. Provide code clarification statement for compliance with specified codes and standards by each discipline with professional seals and signatures. In addition, include a drawing index.

2. Drawings, General: The plans listed below, except the demolition plans, may be combined on small projects.

- a. Demolition plans
- b. Site layout plan
  - i. Location of all buildings, roads, walks, accessible routes, parking, and other paved areas and planted areas
  - ii. Limits of construction
  - iii. Locations of fire protection water supply lines, fire hydrants, fire apparatus access roads, and fire lanes
- c. Grading and drainage plan, showing:
  - i. Existing and new contours [use 500 mm (2 ft.) interval minimum in area around buildings]
  - ii. Spot elevations at all entrances and elsewhere as necessary
  - iii. Elevations for walls, ramps, terraces, and plazas

## APPENDIX

- iv. All surface drainage structures
- d. Site utilities plan, showing:
  - i. All underground utilities, including inlets, manholes, clean-outs, and invert elevations
- e. Planting plan, showing:
  - i. Building outline, circulation, parking, and major utility runs
  - ii. Size and location of existing vegetation to be preserved (include protection measures during construction)
  - iii. Location of all new plant material (identify function, such as windbreak or visual screen where appropriate)
- f. Planting schedule, showing:
  - i. Quantity of plants, botanical names, planted size, and final size
- g. Irrigation plan, if applicable
  - i. Include schematic of irrigation control system
- h. Construction details, profiles, and sections and notes as necessary to fully describe design intent
  - i. Construction phasing, if part of project
- 3. Calculations
  - a. Final drainage calculations, including stormwater detention
  - b. Final parking calculations, if applicable
  - c. Pipe sizing calculations for water and sewer pipes
  - d. Pavement design calculations

## Architectural

- 1. Drawings
  - a. Demolition plans
  - b. Floor plans
    - i. Show planning grids and raised access floor grid, if applicable
  - c. Reflected ceiling plans
    - i. Show ceiling grid and location of all elements to be placed in the ceiling
  - d. Building sections
    - i. Vertical zoning for electrical and mechanical utilities must be indicated on sections
  - e. Roof plans
    - i. Roof plans must show slopes, low points, drains, and scuppers, if applicable
  - f. Exterior elevations
  - g. Wall sections
  - h. Interior elevations
  - i. Details
  - j. Schedules
- 2. Specifications

- a. Instructions to bidders
- b. Division 1, edited to suit specific GSA requirements
- c. Room finish, color, and door schedules can be incorporated into either the specifications or drawings

## Historic Preservation

- 1. Specifications Division 1
  - a. Competency of bidder and restoration specialist qualification requirements, cross referenced in material specifications
- 2. Technical specifications for repair and restoration of historic materials, including:
  - a. Specialized materials and procedures for repair and restoration of historic materials
  - b. Procedures for protecting historic materials in areas being altered
  - c. Sample review requirements of repair and restoration procedures
  - d. Sample submittal requirements for replacement materials and new installations in preservation zones

## Structural

- 1. Drawings
  - a. Demolition plans (where applicable)
  - b. Full set of structural construction drawings
    - i. Drawings must be fully dimensioned, noted and detailed for accurate bidding and construction.
    - ii. Load criteria for all floor live load, roof live load, roof snow load, wind load, earthquake design data, and special loads must be shown on drawings. Live load reduction of the uniformly distributed floor live loads, if used in the design, must be indicated.
      - iii. Basic wind speed (3-second gust), miles per hour (km/hr), wind importance factor, I, and building category, wind exposure, and the applicable internal pressure coefficient must be indicated.
      - iv. Seismic design criteria, such as seismic use group, spectral response coefficients SDS and SD1, site class, basic seismic-force-resisting system, design base shear, and analytical procedure must be indicated. Additional information may be required by the local building official.
        - v. Soil bearing pressure and lateral earth pressure must be indicated
  - c. Schedules

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i. Schedules for foundations, columns, walls, beams, slabs, and decks, as applicable  
d. Structural details. (All typical details must be shown on the drawings.)

- i. Include details for steel connections
- ii. Include details for all fire-rated assemblies, indicating Underwriters Laboratories Inc. or other nationally recognized testing laboratory fire resistance directory design numbers
- iii. Include details indicating if the assembly is restrained or unrestrained in accordance with Appendix X to ASTM E119 (the classification must be determined by a licensed structural engineer)
- iv. Include details for anchorage of nonstructural building elements

**2. Calculations** For any computer-generated results, submit a model of the input data and all pertinent program material required to understand the output. A narrative of the input and results should be contained in the calculations as well.

- a. Final structural calculations, including:
  - i. Gravity loads
  - ii. Lateral loads
  - iii. Foundations
  - iv. Thermal loads where significant
  - v. Vibration propagation
  - vi. Progressive collapse
  - vii. Supports for nonstructural elements, including mechanical and electrical equipment
  - viii. Steel connections

## Mechanical

In addition to the construction documentation submittal for the demolition plan, drawings, narrative, and calculations and analysis must be provided as described in Chapters 1, 3, 5 and Sections A.3 and A.6.

## Fire Protection

Fire protection and life safety submission requirements must be identified as a separate fire protection section as outlined in this document.

### 1. Drawings

- a. Demolition plans
- b. Full set of fire protection construction drawings

i. Drawings must be carefully dimensioned noted and detailed for accurate bidding and construction

c. Fire protection details (all typical details must be shown on the drawings)

- i. Building construction
  - (1) Building's construction type (e.g., 443, 222)
  - (2) Firewalls and smoke partitions
  - (3) Panel and curtain walls
  - (4) Fire-stopping configurations. Include details of all openings between the exterior walls (including panel, curtain, and spandrel walls) and floor slabs, openings in floors, and shaft enclosures.
- ii. Life safety
  - (1) Each stair
  - (2) Horizontal exits
  - (3) Each required fire door
  - (4) Stairway pressurization fans
  - (5) Security door hardware, including operation procedures
- iii. Water supply
  - (1) Fire pump configuration
  - (2) Anchorage of underground fire protection water supply line
  - (3) Standpipe riser
- iv. Water-based fire extinguishing systems
  - (1) Installation of waterflow switches and tamper switches
  - (2) Sprinkler floor control valves, sectional valves, and inspector test assembly
- v. Non-water-based fire extinguisher systems
  - (1) Special fire extinguishing systems (e.g., wet chemical)
- vi. Fire Alarm System
  - (1) Fire alarm riser
  - (2) Typical firefighter telephone station
  - (3) Typical firefighter telephone jack
  - (4) Electrical closets for fire alarm system panels
  - (5) Fire alarm telephone panel (includes voice paging microphone and firefighter telephone system)
  - (6) Visual indicating device control and power detail, typical for floors (state location)
  - (7) Amplifier rack (state location)
  - (8) Typical location of duct smoke detectors
  - (9) Outdoor fire alarm speaker
  - (10) Wall-mounted cone fire alarm speaker
  - (11) Typical terminal cabinet
  - (12) Lay-in ceiling-mounted fire alarm speaker

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- (13) Lay-in ceiling-mounted fire alarm combination speaker/strobe
- (14) Wall-mounted strobe device
- (15) Typical manual fire alarm box installation
- (16) Fire alarm system input/output matrix
- (17) Graphic annunciator panel
- (18) Installation of the graphic annunciator
- (19) Fire command center showing the locations of each panel to be installed

**2. Calculations** For any fire modeling generated results, submit a copy of the input data and all pertinent program material and assumptions required to understand the output and the analysis. A narrative of the input and results must be part of the calculations.

- a. Final occupant load and egress calculations
- b. Final fire protection water supply calculations
- c. Includes water supply flow testing data
- d. Final fire pump calculations where applicable
- e. Final smoke control calculations where applicable (e.g., atrium)
- f. Final stairway pressurization calculations
- g. Fire modeling
- h. Final calculations contained in The SFPE Handbook of Fire Protection Engineering for calculating sound attenuation through doors and walls for placement and location of fire alarm system audible notification appliances

## Electrical

- 1. Drawings
  - a. Demolition plans
  - b. Floor plans
    - i. Show lighting, power distribution, and communications raceway distribution
  - c. Single-line diagram of primary and secondary power distribution
    - i. Include normal power, emergency power, and UPS
  - d. Single-line diagram of fire alarm system
  - e. Single-line diagram of telecommunications system
  - f. Circuit layout of lighting control system
  - g. Details of underfloor distribution system
  - h. Site plan
    - i. Indicate service locations, manholes, ductbanks, and site lighting
  - i. Layout of electrical equipment spaces

- i. Show all electrical equipment. Include elevations of substation transformers and disconnect switches
  - j. Schedules for switchgear, switchboards, motor control centers, panelboards, and unit substations
  - k. Grounding diagram
  - l. Complete phasing plan (if required) for additions and alterations
  - m. Security systems site plan
    - i. Final locations of all security devices and conduit runs
  - n. Security system floor plans
    - i. Layout of all security systems
  - o. Storage areas for electrical equipment/spare parts
- 2. Calculations**
- a. Illumination level calculations
  - b. Short circuit calculations
  - c. Voltage drop calculations
  - d. Overcurrent coordination study
  - e. Generator calculations
  - f. Include starter loads
  - g. UPS calculation (if UPS provided)

**3. Code criteria** should be reviewed by each discipline to the degree of detail necessary to ensure that tasks accomplished in this phase meet the code requirements.

## Construction Documents Specifications

- 1. Instructions to bidders
- 2. Division 1, edited to suit specific GSA requirements
- 3. Technical specifications sections, organized according to CSI format
- 4. Specifications must be fully edited, typed, and bound. Room finish, color, and door schedules can be incorporated into either the specifications or drawings.

### Construction Documents Cost Estimate

The construction documents cost estimate submissions must include the following:

- 1. Executive summary
- 2. Basis of estimate, rationale, assumptions, and market analysis as required in P120
- 3. GSA Report 3474, GSA Report 3473
- 4. Summary reports (ASTM UNIFORMAT II, Work Items and CSI MasterFormat formats as applicable)
- 5. Detail line item cost reports

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6. Core/shell and TI cost estimate, as per GSA pricing policy. TI estimates must be prepared for each tenant.
7. Provide separate estimate for phased work, or bid alternates/options
8. To ensure the project is developing on-budget, a list of cost-saving items that would collectively reduce the project cost to approximately 10 percent below budget

9. Verify that the construction documents submissions can be constructed within the project budget



## A.5 Surveys and Geotechnical Reports

### Site Survey

Site surveys are generally prepared for GSA projects involving sitework. The survey may be contracted separately by GSA or may be included in the scope of the A/E for the project. The guidelines given here apply in either case. In cases where GSA contracts for the survey directly, the A/E may be requested to review the scope of work for the survey and recommend modifications to the technical requirements to suit the specific project site. The geotechnical report must be available to all contractors so that there will be a common reference on which to base their bids. Also, the report would subsequently function as the basic reference for evaluating "changed conditions" or "differing site conditions" during construction and, therefore, need be of sufficient detail, number of borings, groundwater, and contamination evaluations to support the design and mitigate large changed conditions issues.

The criteria listed here are not absolute; they should be modified by the civil engineer to suit the particular conditions of the project. All surveys should be prepared and sealed by a surveyor licensed in the state where the project is located.

### General Requirements

Surveys should generally contain the following information:

- Locations of all permanent features within limits of work, such as buildings, structures, fences, walls, concrete slabs and foundations, above-ground tanks, cooling towers, transformers, sidewalks, steps, power and light poles, traffic control devices, manholes, fire hydrants, valves, culverts, headwalls, catch basins or inlets, property corner markers, benchmarks, etc.
- Location of all adjacent and abounding roads or streets and street curbs within limits of work, including driveways and entrances. Type of surfacing and limits should be shown. For public streets, right-of-way widths and centerlines should also be shown.
- Location of all trees, shrubs, and other plants within limits of work. For trees, caliper size should be shown; dead trees should be indicated.
- Location of all overhead telephone and power lines within the limits of work and their related easements.
- Based on existing records, location of underground utilities, such as gas, water, steam, chilled water, electric power, sanitary, storm, combined sewers, telephone, etc., should be shown. Sizes of pipes (I.D.), invert elevations, inlet, or manhole rim elevations should be indicated. Where appropriate, information should be verified in the field.
- Based on existing records, location of underground storage tanks or other subsurface structures.
- Topography field criteria should include such items as 300 millimeter or 600 millimeter (1 to 2 ft.) contour intervals plotted on a grid system appropriate to the scale of the survey; elevations at top and bottom of ditches and at any abrupt changes in grade; periodic top-of-curb and gutter elevations, as well as street centerline elevations; elevations at all permanent features within the limits of work; ground floor elevations for all existing buildings.

Bearings and distances for all property lines within the limits of work.

Official datum upon which elevations are based and the benchmark on or adjacent to the site to be used as a starting point.

Official datum upon which horizontal control points are based.

If there are not already two benchmarks on the site, establish two permanent benchmarks.

Elevations of key data points of all building structures and improvements directly adjacent and across the street from the project site during both wet and dry season.

Delineate location of any wetlands or floodplains, underground streams, or water sources.

## Geotechnical Investigation and Engineering Report

On most GSA projects geotechnical investigations will take place at three separate stages: during site selection, during building design, and during construction. The requirements for geotechnical work during site selection and during construction are described in other GSA documents. The requirements for geotechnical work for the building design are defined here. They apply whether GSA contracts for geotechnical work separately or includes the geotechnical investigation in the scope of the A/E services.

### Purpose

The purpose of the geotechnical investigation during building design is to determine the character and physical properties of soil deposits and evaluate their potential as foundations for the structure or as material for earthwork construction. The investigation must also determine the hydrological capacities of the soil. The type of structure to be built and anticipated geologic and field conditions has a significant bearing on the type of investigation to be conducted.

The investigation must therefore be planned with knowledge of the intended project size and anticipated column loads, land utilization, and a broad knowledge of the geological history of the area.

The guidelines given here are not to be considered as rigid. Planning of the exploration, sampling and testing programs, and close supervision must be vested in a competent geotechnical engineer and/or engineering geologist with experience in this type of work and licensed to practice engineering in the jurisdiction where the project is located.

1. Analysis of Existing Conditions The report should address the following:

- a. Description of terrain
- b. Brief geological history
- c. Brief seismic history
- d. Surface drainage conditions
- e. Groundwater conditions and associated design or construction problems
- f. Description of exploration and sampling methods and outline of testing methods
- g. Narrative of soil identification and classification, by stratum
- h. Narrative of difficulties and/or obstructions encountered during previous explorations of existing construction on or adjacent to the site
- i. Description of laboratory test borings and results
- j. Plot plan, drawn to scale, showing test borings or pits
- k. Radon tests in areas of building location
- l. Soils resistivity test, identifying resistivity of soil for corrosion protection of underground metals and electrical grounding design
- m. Boring logs, which identify:
  - i. Sample number and sampling method
  - ii. Other pertinent data deemed necessary by the geotechnical engineer for design recommendations, such as:
    - (1) Unconfined compressive strength
    - (2) Standard penetration test values
    - (3) Subgrade modulus
    - (4) Location of water table
    - (5) Water tests for condition of groundwater
    - (6) Location and classification of rock
    - (7) Location of obstructions
    - (8) Atterberg tests

- (9) Compaction tests
- (10) Consolidation tests
- (11) Triaxial compression test
- (12) Chemical test (pH) of the soil
- (13) Contamination

**2. Engineering Recommendations** Engineering recommendations based on borings and laboratory testing should be provided for the following:

- a. Recommendations for foundation design, with discussion of alternate solutions, if applicable, include:
  - i. Allowable soil bearing values
  - ii. Feasible deep foundation types and allowable capacities, where applicable, including allowable tension (pull-out) and lateral subgrade modulus
  - iii. Feasibility of slab on grade versus structurally supported floor construction, including recommended bearing capacities and recommended subgrade modulus (k)
- b. Discussion of evidence of expansive soils and recommended solutions
- c. Lateral earth design pressures on retaining walls or basement walls, including dynamic pressures
- d. Design frost depth, if applicable
- e. Removal or treatment of contaminated soil
- f. Discussion of potential for consolidation and/or differential settlements of substrata, with design recommendations for total settlement and maximum angular distortion
- g. Use and treatment of in-situ materials for use as engineered fill
- h. Recommendations for future sampling and testing
- i. Recommendations for pavement designs, including base and sub-base thickness and subdrains
- j. Recommendations for foundation and subdrainage, including appropriate details
- k. Discussion of soil resistivity values
- l. Discussion of soil hydrological capabilities
- m. Discussion of radon values and recommendation for mitigating measures, if required

## Geologic Hazard Report

A geologic hazard report must be prepared for all new building construction in regions of low, moderate, and high seismicity, except for structures located in regions of low seismicity designed to the life safety performance level. Geologic hazard reports are not required for minor or relatively unimportant facilities for which earthquake damage would not pose a significant risk to either life or property.

### Required Investigation

When required by the project scope, a geologic hazard investigation that addresses the hazards indicated below should be performed. Whenever possible, a preliminary investigation should be performed in the planning stage of siting a facility, to provide reasonable assurance that geologic hazards do not preclude construction at a site. During a later stage of geotechnical investigations for a facility at a selected site, supplemental investigations may be conducted as needed to define the geologic hazards in more detail and/or develop mitigating measures. The scope and complexity of a geologic hazard investigation depends on the economics of the project and the level of acceptable risk. In general, major new building complexes, high-rise buildings, and other high value or critical facilities must have thorough geologic hazard investigations. Small, isolated buildings need not have elaborate investigations.

### Surface Fault Rupture

For purposes of new building construction, a fault is considered to be an active fault and a potential location of surface rupture if the fault exhibits any of the following characteristics:

- Has had documented historical macroseismic events or is associated with a well-defined pattern of microseismicity
- Is associated with well-defined geomorphic features suggestive of recent faulting

- Has experienced surface rupture (including fault creep) during approximately the past 10,000 years (Holocene time)

Fault investigations must be directed at locating any existing faults traversing the site and determining the recency of their activity. If an active fault is found to exist at a site and the construction cannot reasonably be located elsewhere, investigations must be conducted to evaluate the appropriate set-back distance from the fault and/or design values for displacements associated with surface fault rupture.

### **Soil Liquefaction**

Recently deposited (geologically) and relatively unconsolidated soils and artificial fills, without significant cohesion and located below the water table, are susceptible to liquefaction. Sands and silty sands are particularly susceptible. Potential consequences of liquefaction include foundation bearing capacity failure, differential settlement, lateral spreading and flow sliding, flotation of lightweight embedded structures, and increased lateral pressures on retaining walls. The investigation must consider these consequences in determining the size of the area and the depth below the surface to be studied. An investigation for liquefaction may take many forms. One acceptable method is to use blow count data from the standard penetration test conducted in soil borings. This method is described in publications by H. B. Seed and I. M. Idriss, (1982), *Ground Motions and Soil Liquefaction During Earthquakes: Earthquake Engineering Research Institute, Oakland, CA, Monograph Series, 134 p.* and H.B. Seed et al, (1985) "The Influence of SPT Procedures in Soil Liquefaction Resistance Evaluations": *Journal of Geotechnical Engineering, ASCE 111(12): pp. 1425-1445.*

### **Landsliding**

New construction must not be sited where it may be within a zone of seismically induced slope failure or located below a slope whose failure may send soil and

debris into the structure. Factors that affect slope stability include slope angle, soil type, bedding, ground water conditions, and evidence of past instability. The geologic hazard investigation must address the potential for seismically induced slope deformations large enough to adversely affect the structure.

### **Differential Settlement**

Loosely compacted soils either above or below the water table can consolidate during earthquake shaking, producing surface settlement. The potential for total and differential settlements beneath a structure must be assessed. If liquefaction is not expected to occur, then in most cases, differential settlement would not pose a significant problem to construction.

### **Flooding**

Earthquake-inducing flooding can be caused by tsunamis, seiches, and dam and levee failures. The possibility of flooding must be addressed for new construction located near bodies of water.

### **Duration of Strong Ground Shaking**

Estimates of the duration of strong ground shaking at a site are defined by earthquake magnitude and must be used to assess geologic hazards such as liquefaction and slope failure. Strong motion duration is strongly dependent on earthquake magnitude.

Estimates of the duration of strong ground shaking must be based on the assumption of the occurrence of a maximum considered earthquake generally accepted by the engineering and geologic community as appropriate to the region and to the subsurface conditions at the site.

### **Mitigative Measures**

A site found to have one or more geologic hazards may be used, provided the hazards are removed,

abated, or otherwise mitigated in the design, or if the risk is judged to be acceptable. Examples of mitigative measures include: removal and recompaction of poorly compacted soils; use of special foundations; stabilizing slopes; and draining, compaction, or chemical treatment of liquefiable soils. The geological hazard report must identify feasible mitigative measures.

### **Required Documentation**

Investigations of geologic hazards must be documented. As noted in the paragraph entitled "Required Investigation" above, a preliminary geologic hazard investigation must be conducted and a report issued during the siting phase for a facility. However, unless the geologic hazard investigations have been documented in a stand-alone report, they must be addressed in a section of the geotechnical engineering report prepared during the design phase of a project. The geologic hazard report, whether it is

a separate report or a section of the geotechnical engineering report, must at a minimum contain the following:

- List of hazards investigated, which must include the five described earlier in this section
- Description of the methods used to evaluate the site for each hazard
- Results of any investigations, borings, etc.
- Summary of findings
- Recommendations for hazard mitigation, if required
- In some cases, estimates of site ground motions may be needed for assessment of geologic hazards such as liquefaction and slope failure.

## A.6 Energy Analysis Input and Output

This Appendix defines the procedures to achieve compliance with the requirements in Section 5.3 (Energy Analysis Criteria).

### Procedures

The Architectural/Engineering Design Team (A/E) must reference and utilize the following format for building input parameters, schedules of building operations, and categories for reporting results for the baseline and alternate building models. These procedures must be consistent throughout the design process. Input parameters and output data must be provided in all document submissions (see Section 5.3).

At each phase of the design process (i.e., conceptual design, design development, and construction documentation), the A/E must provide inputs as indicated in this appendix, if they are not otherwise defined in the program requirements (see P100 Section 5.3). The A/E must refer to ASHRAE Standard 90.1-2007 (including addenda) documents for climate zone and other pertinent information as may be required. If any changes are required to these input values due to special field conditions, the A/E must adjust the inputs giving an explanation in the beginning of the energy analysis report.

The analysis must document the sources of input data and all assumptions.

### Conceptual Design

The A/E must conduct an energy analysis for each of the three preliminary concepts (see Section A.3), using approved simulation software (See P100 Section 5.3). The primary variables in these analyses are orientation and massing. For the conceptual design, GSA P-100 Version 1.0, issued March 2014

the performance parameters for the envelope, which include glazing, must be equal to the prescriptive minimum values listed in the applicable sections of ASHRAE Standard 90.1-2007, as referenced by P100 Input Table A6-1. All other parameters and input values as may be necessary to complete the model must be the minimum compliance values obtained from Input Tables A6-2 through A6-5. For the conceptual design analyses, glass and wall ratios and the shape must be configured to achieve the requirements of Chapters 1, 2, 3, 5 and 6 of P100.

Building site-energy and property site-energy consumption rates must be calculated for each of the three concepts, and presented as indicated by Output Table A6-6. For comparison purposes, all energy system alternatives for each concept must be adjusted to equivalent building site-energy consumption rates.

For the final concept submission, the energy analysis must provide output data to indicate optimization of the envelope, massing, and orientation that minimize the annual building or property site-energy consumption rates. This energy analysis report must include a statement summarizing the optimization findings and comparing the results with the energy target (see Chapter 1).

### Design Development

The A/E must optimize system performance using simulation software (See P100, Section 5.3) to minimize annual building site-energy and property site-energy consumption rates. The primary variables in these analyses are the internal electrical and thermal loads imposed by the interior and exterior lighting, power requirements, other fixed loads (e.g., elevators, computer facilities), and schedules in accordance with P100, Chapters 3, 5, 6, 7 and 8. All other parameters and input values as may be

necessary to complete the model must be obtained from those used in the final concept simulations and Input Tables A6-2 through A6-5 in this appendix. Project-specific envelope construction details must be applied as determined and detailed on the project submission drawings by the A/E. These analyses must be performed for the HVAC system as approved in the Final Concept submittal, in accordance with P100.

If alternative HVAC systems and components are to be considered (See Section 5.5), energy analyses must be conducted and compared to the results from the analysis of the reference system that has the lowest first cost of the alternatives being considered, in accordance with P100, Sections 1.12 and 5.3. These results must also be used as the input data to the life-cycle analysis required in P100, Section 1.12. At completion of the DD phase, the system selection must be completed from which annual building site-energy and property site-energy consumption rates must be calculated. For these analyses, assume pump heads of 90 feet and fan total static pressures of 4 in.

For the 100 percent DD submission, the energy analysis must provide output data to indicate optimization of the baseline reference system and any cost-effective alternatives that minimize the annual building or property site-energy consumption. This energy analysis report must include a statement summarizing the optimization findings and comparing the results with the final concept results. Additionally, this analysis must continue to document the sources of input data and all assumptions, and refinements to the assumptions made in the concept phase. Equipment performance capacities and full- and part-

load efficiencies must be substantiated by including representative equipment selections from manufacturers forming the basis of design. At least two additional simulations must be conducted to determine this impact of the input assumptions, which are to be varied to their maximum, or worst-case minimum, limits.

## Construction Documents

The A/E must refine the optimized results from the 100 percent DD submission by using the actual input values rather than the assumed input values for the envelope, lighting, and power wattage, assumed pump heads and fan static pressures, HVAC and thermal zoning criteria, and schedules of operation (i.e., in lieu of Tables A6-1 through A6-5 in this appendix).

For the 90 percent construction document (CD) submission, the energy analyses must provide updated listings of input values including schedules of operation, and output data to indicate refinements in the optimization of the baseline and any cost-effective alternatives in the 100 percent DD analysis that minimize the annual building or property site-energy consumption rate. The 90 percent CD energy analysis report must include a statement summarizing the refined optimization findings and comparing the results with the 100 percent DD results.



# B.1 References

## List of Reference Publications and Web Sites

All references are to the edition in effect at the time of execution of the A/E contract for the project, unless noted otherwise.

### Introduction

The following references apply to all P100 chapters.

#### Publications

- Guiding Principles of Federal Architecture
- Hallmark of the Productive Workplace
- 42 U.S.C. 4151 et seq., Architectural Barriers Act Accessibility Standard (ABAAS)

#### Web Sites

- [www.gsa.gov/firstimpressions](http://www.gsa.gov/firstimpressions) (First Impressions Program)
- [www.gsa.gov/workplace](http://www.gsa.gov/workplace) (Workplace 20/20 Program)
- [www.gsa.gov/bim](http://www.gsa.gov/bim) (3D-4D Building Information Modeling)
- [www.wbdg.org/ccb/GSAMAN/buildingcommissioningguide.pdf](http://www.wbdg.org/ccb/GSAMAN/buildingcommissioningguide.pdf) (Building Commissioning Guide)

## Chapter One

### General Requirements

The following references apply to all P100 chapters.

#### Publications—General Federal

- 40 U.S.C. 601a, Public Buildings Cooperative Use Act of 1976
- Energy Policy Act of 2005
- National Historic Preservation Act of 1966 as amended (NHPA)
- 40 CFR, Protection of Environment
- Federal Management Regulation (FMR), based on the Public Buildings Amendments of 1988, Title 40, Subtitle II, Part A, Chapter 33, Section 3312
- 36 CFR 67, Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings



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- 29 CFR 1926, Safety and Health Regulations for Construction, Section 1926.62, Lead (including lead-based paint)
- 29 CFR 1910 Occupational Safety and Health Standards, Section 1910.146(b)—Definition of “Confined space”
- EO 13423 Strengthening Federal Environmental, Energy, and Transportation Management (includes guiding principles of Federal leadership in high-performance and sustainable buildings) <http://www.wbdg.org/sustainableEO>
- Executive Order 13502, Use of Project Labor Agreements for Federal Construction Projects, February 6, 2009 <http://edocket.access.gpo.gov/2009/pdf/E9-3113.pdf>
- EO 13514 Federal Leadership in Environment, Energy, and Economic Performance
- EPA Comprehensive Procurement Guidelines (CPG) (recycled products) <http://www.epa.gov/cpg>
- USDA BioPreferred Program <http://www.biopreferred.gov>
- DOE Guidance for Electric Metering in Federal Buildings DOE/EE 0312
- Food, Conservation and Energy Act of 2008
- Farm Security and Rural Investment Act of 2002
- Architectural Barriers Act Accessibility Standard (ABAAS)
- FMR Part 102-76 (Design and Construction), Subpart C (Architectural Barriers Act)
- 36 CFR Part 1191 Appendices C and D (ABA Chapters 1-10)
- Publications Related to Specific GSA PBS Programs
- PBS Design Excellence Policies and Procedures
- PBS Pricing Desk Guide
- GSA BIM Guide Series <http://www.gsa.gov/bim>
- PBS National Business Space Assignment Guide <http://www.gsa.gov/sdm>
- GSA 3490.1A on Document Security for Sensitive But Unclassified Building Information

### Accessible Design

- 42 U.S.C. 4151 et seq., Architectural Barriers Act Accessibility Standard (ABAAS)
- Federal Courthouses
- GSA Courthouse Visitor’s Guide, February 2003
- GSA Courthouse Project Handbook, August 2004
- U.S. Courts Design Guide
- U.S. Marshals Service Judicial Security Systems Requirements and Specifications, Volume 3, Publication 64, 2005
- U.S. Marshals Service Requirements and Specifications for Special Purpose and Support Space, Volume One: Architectural & Engineering, 2007; Volume Two: Electronic Security & Hardware, 2007

### Land Ports of Entry

- United States Border Station Design Guide (PBS-PQ130)

### Childcare Centers

## APPENDIX

- Child Care Center Design Guide (PBS-P140)
- Accreditation Criteria and Procedures of the National Association for the Education of Young Children (NAEYC)

### Design Excellence

- GSA PBS Design Excellence Policies and Procedures
- GSA PBS Design Excellence in Leasing

### Art in Architecture and Fine Arts

- GSA PBS Art in Architecture Program, Policies and Procedures
- GSA PBS Fine Arts Program Policies and Procedures
- Office of Design and Construction
- GSA PBS Project Management Guide
- GSA PBS Project Planning Guide
- GSA PBS Project Estimating Requirements Guide
- GSA PBS Building Commissioning Guide
- GSA PBS Site Selection Guide
- GSA PBS PQ Z60 Metric Design Guide

### Security

- Interagency Security Committee's Physical Security Criteria for Federal Facilities and the ISC Security Level Determination of Federal Facilities, dated February 21, 2008 (Official Use Only—request from project manager)
- GSA PBS Design Notebook for Federal Lobby Security
- GSA PBS Site Security Design Guide
- Office Facilities Management and Services Programs
- GSA PBS Floodplain Management Desk Guide
- GSA PBS NEPA Desk Guide
- GSA PBS UST Guide
- GSA PBS Universal Waste Guide

### Publications from Industry

- American National Standards Institute/American Industrial Hygiene Association (ANSI/AIHA):
- Z10-2005, American National Standard—Occupational Health and Safety Management Systems
- American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
- Standard 62.1-2004—Ventilation for Acceptable Indoor Air Quality
- ASHRAE Fundamentals Handbook
- International Code Council (ICC)
- International Building Code (IBC)

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- International Fire Code (IFC)
- International Mechanical Code (IMC)
- International Plumbing Code (IPC)
- International Property Maintenance Code (IPMC)
- International Fuel Gas Code (IFGC)
- International Private Sewage Disposal Code (IPSDC)
- International Zoning Code (IZC)
- International Wildland-Urban Interface Code (IWUIC)
- International Energy Conservation Code (IECC)
- International Existing Building Code (IEBC)
- International Residential Code (IRC)
- International Code Council Performance Code (ICCPC)  
National Fire Protection Association (NFPA) [www.nfpa.org](http://www.nfpa.org)
- NFPA 241: Standard for Safeguarding Construction, Alteration, and Demolition Operations
- NFPA 101: Life Safety Code
- NFPA 70: National Electrical Code
- American Institute of Architects (AIA)  
[www.aia.org](http://www.aia.org)  
AIA Document E202 – Building Information Modeling Protocol Exhibit

### Additional Web sites

- [www.iccsafe.org](http://www.iccsafe.org) (International Code Council)
- [www.wbdg.org](http://www.wbdg.org) (Whole Building Design Guide)

## Chapter 2 Site Engineering and Landscaping

In addition to references cited for the Introduction and Chapter 1, the following are specifically relevant to Chapter 2.

### Publications

- 33 U.S.C. 1251 Federal Water Pollution Control Act (Clean Water Act)
- GSA PBS The Site Selection Guide [www.gsa.gov/siteselection](http://www.gsa.gov/siteselection)
- GSA PBS Site Security Design Guide
- GSA ADM 1095.6, Consideration of Floodplains in Decision Making
- GSA PBS Wetlands Impact Management Desk Guide
- GSA PBS NEPA Desk Guide
- GSA PBS Sustainability Matters [www.gsa.gov/sustainabledesign](http://www.gsa.gov/sustainabledesign)
- U.S. Army Corps of Engineers (USACE)  
Wetlands Delineation Manual
- American National Standards Institute (ANSI)

- American Standard for Nursery Stock/American National Landscape Association (ANLA) [www.anla.org](http://www.anla.org)
- EPA Document No. EPA-832-R-92-005

## Additional Web Sites

- [www.gsa.gov/environmental](http://www.gsa.gov/environmental)
- [www.access-board.gov](http://www.access-board.gov)
- [www.gsa.gov/nepa](http://www.gsa.gov/nepa)
- [www.epa.gov/owow/nps/lid/lidlit.html](http://www.epa.gov/owow/nps/lid/lidlit.html)  
(EPA Low Impact Development (LID) Literature Review and Fact Sheets)
- [www.invasivespeciesinfo.gov](http://www.invasivespeciesinfo.gov)
- <http://www.thecptedpage.wsu.edu/Resources.html>  
(Crime Prevention Through Environmental Design— CPTED)

## Chapter 3 Site and Architectural Planning and Design

In addition to references cited for the Introduction and Chapter 1, the following are specifically relevant to Chapter 3.

### Publications

- GSA PBS Concession Management Desk Guide (PMFC-93)
- Fine Arts Policies and Procedures, Appendix F
- PBS Order No. 3490.1, Document Security for Sensitive but Unclassified Paper and Electronic Building Information, Section 7.d.(1.)

### Publications from Industry

- American Architectural Manufacturers Association (AAMA)
- 1502.7, Voluntary Test Method for Condensation Resistance of Windows, Doors, and Glazed Wall Sections
- 101/I.S.2/A440-05, Standard/Specification for Windows, Doors, and Unit Skylights (includes AAMA/WDMA 101/I.S.2/NAFS)
- 1600 Voluntary Specification for Skylights
- American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
- Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings
- American Society of Mechanical Engineers (ASME)
- A17.1 Safety Code for Elevators and Escalators
- A18.1 Safety Standard for Platform Lifts and Stairway Chairlifts
- American Society of Testing and Materials (ASTM)
- C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

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- C635, Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
- C636, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
- C645, Standard Specification for Nonstructural Steel Framing Members
- C1371, Standard Test Method For Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers
- C1396, Standard Specification for Gypsum Board
- E90, Standard Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building
- E336, Standard Test Method for Measurement of Airborne Sound Insulation in Buildings
- E903, Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres
- E1007, Standard Test Method for Field Measurement of Tapping Machine Impact Sound Transmission through Floor-Ceiling Assemblies and Associated Support Structures
- E1130, Standard Test Method for Objective Measurement of Speech Privacy in Open Offices Using Articulation Index
- E1414, Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
- E1918, Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field
- E1946, Standard Practice for Measuring Cost Risk of Buildings and Building Systems
- E1980, Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque
- E2396, Standard Test Method for Saturated Water Permeability of Granular Drainage Media [Falling-Head Method] for Green Roof Systems
- E2397, Standard Practice for Determination of Dead Loads and Live Loads Associated with Green Roof Systems
- E2398, Standard Test Method for Water Capture and Media Retention of Geocomposite Drain Layers for Green Roof Systems
- E2399, Standard Test Method for Maximum Media Density for Dead Load Analysis of Green Roof Systems
- E2400, Standard Guide for Selection, Installation, and Maintenance of Plants for Green Roof Systems
- American National Standards Institute (ANSI)
- ANSI/ASSE Provision of Slip Resistance on Walking/Working Surfaces
- Architectural Woodwork Institute (AWI)
- Architectural Woodwork Quality Standards (for grades of interior architectural woodwork, construction, finishes, and other requirements)
- Brick Industry Association (BIA)
- Technical Notes on Brick Construction
- Indiana Limestone Institute (ILI)
- ILI Handbook
- Marble Institute of America
- Dimension Stone Design Manual
- National Concrete Masonry Association (NCMA)
- TEK Manual for Concrete Masonry Design and Construction
- Annotated Design and Construction Details for Concrete Masonry

- National Roofing Contractors Association (NRCA)
- Roofing Manual: Membrane Roof Systems
- Roofing and Waterproofing Manual
- Steep-Slope Roofing Manual
- Architectural Metal and Sheet Metal Roofing Manual
- Precast/Prestressed Concrete Institute
- Architectural Precast Concrete
- Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- Architectural Sheet Metal Manual
- Steel Door Institute (SDI)
- SDI 122-99 Installation and Troubleshooting Guide for Standard Steel Doors and Frames
- Telecommunications Industry Association/Electronic Industries Alliance (TIA/EIA)
- TIA/EIA-569-A, Commercial Building Standards for Telecommunications Pathways and Spaces

## Chapter 4 Structural Engineering

In addition to references cited for the Introduction and Chapter 1, the following are specifically relevant to Chapter 4.

### Publications

- Federal Emergency Management Agency (FEMA):
- Recommended Seismic Design Criteria for New Steel Moment-Frame Buildings (FEMA 350)
- Recommended Seismic Evaluation and Upgrade Criteria for Existing Welded Steel Moment-Frame Buildings (FEMA 351)
- Recommended Post-Earthquake Evaluation and Repair Criteria for Welded Steel Moment-Frame Buildings (FEMA 352)
- Recommended Specifications and Quality Assurance Guidelines for Steel Moment-Frame Construction for Seismic Applications (FEMA 353)
- Techniques for the Seismic Rehabilitation for Existing Buildings (FEMA 547)
- American Society for Testing and Materials (ASTM)
- C 150, Standard Specifications for Portland Cement
- C 311, Standard Methods of Sampling and Testing Fly Ash and Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete
- C 595, Standard Specification for Blended Hydraulic Cements
- C 618, Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
- C 989, Ground Granulated Blast-Furnace Slag for Use in Concrete Mortars
- Interagency Committee on Seismic Safety in Construction (ICSSC)
- ICSSC RP 6 (NISTIR 6762), Standards of Seismic Safety for Existing Federally Owned Leased Buildings. ICSSC RP 6 can be downloaded as a PDF at <http://fire.nist.gov/bfrlpubs/build01/PDF/b01056.pdf>
- American Institute of Steel Construction (AISC) Series
- Steel Design Guides

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- American Society of Civil Engineers
- ASCE/SEI 31, Seismic Evaluation of Existing Buildings
- ASCE/SEI 41, Seismic Rehabilitation of Existing Buildings
- Telecommunications Industry Association/Electronic Industries Alliance (TIA/EIA)
- TIA/EIA-569-A, Commercial Building Standards for Telecommunications Pathways and Spaces

### Web sites

- <http://fire.nist.gov/bfrlpubs/build01/PDF/b01056.pdf>
- [http://nsmg.wr.usgs.gov/celebi/gsa\\_report\\_instrumentation.pdf](http://nsmg.wr.usgs.gov/celebi/gsa_report_instrumentation.pdf)

## Chapter 5 Mechanical Engineering

In addition to references cited for the Introduction and Chapter 1, the following are specifically relevant to Chapter 5.

### Publications

- American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE)
- Handbook of Fundamental
- Handbook of Refrigeration
- Handbook of HVAC Applications
- Handbook of HVAC Systems and Equipment
- Standard 15: Safety Code for Mechanical Refrigeration
- Standard 52.2: Method of Testing: General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
- Standard 55: Thermal Environmental Conditions for Human Occupancy
- Standard 62.1: Ventilation for Acceptable Indoor Air Quality
- Standard 90.1-2004: Energy Standard for Buildings Except Low-Rise Residential Buildings
  
- Standard 100-2006: Energy Conservation in Existing Buildings
- Standard 105-1999: Standard Method of Measuring and Expressing Building Energy Performance
- Standard 111-1988: Practices for Measurement, Testing, Adjusting and Balancing of Building HVAC Systems
- Standard 113-2005: Method of Testing for Room Air Diffusion
- Standard 135-2004: BACnet: A Data Communication Protocol for Building Automation and Control Networks
- Guideline 0-2005: The Commissioning Process
- Guideline #4-1993: Preparation of Operating and Maintenance Documentation for Building Systems
- Guideline #12-2000: Minimizing the Risk of Legionellosis Associated with Building Water Systems
- Guideline #29-2007: Guideline for Risk Management of Public Health and Safety in Buildings
- American National Standards Institute (ANSI)
- ANSI Z 223.1., National Fuel Gas Code

- American Society of Plumbing Engineers (ASPE)
- ASPE Data Books
- American Society for Testing and Materials (ASTM)
- ASTM E-84, Surface Burning Characteristics of Building Materials
- Sheet Metal and Air Conditioning Contractors' National Association, Inc., (SMACNA)
- HVAC Duct Construction Standards: Metal and Flexible HVAC Air Duct Leakage Test Manual
- Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
- Seismic Restraint Manual Guidelines for Mechanical Systems
- National Fire Protection Association (NFPA)
- NFPA 70, National Electrical Code
- NFPA 101, Life Safety Code
- EIA/TIA Standard 569
- Commercial Building Standard For Telecommunications Pathways and Spaces (and related bulletins)
- Underwriters Laboratories (UL)
- UL 710

## Chapter 6 Electrical Engineering

In addition to references cited for the Introduction and Chapter 1, the following are specifically relevant to Chapter 6.

### Publications

- American National Standards Institute (ANSI)
- ANSI/ASHRAE/IESNA: Standard 90.1-2004: Energy Standard for Buildings Except Low-Rise Residential Buildings
- ANSI/UL50, Enclosures for Electrical Equipment for Types 12, 3, 3R, 4, 4X, 5, 6, 6P, 12, 12K, and 13,
- American Society of Mechanical Engineers (ASME)
- A17.1: Safety Code for Elevators and Escalators
- BICSI
- Telecommunications Distribution Methods Manual
- Wireless Design Reference Manual
- Federal Information Processing Standard 175
- Federal Building Standard for Telecommunication Pathways and Spaces
- Illuminating Engineering Society of North America (IESNA)
- Lighting Handbook
- National Fire Protection Association (NFPA)
- NFPA 70, National Electrical Code
- NFPA 70E, Standard for Electrical Safety in the Workplace
- NFPA 101, Life Safety Code
- NFPA 110, Standard for Emergency and Standby Power Systems
- NFPA 111, Standard on Stored Electrical Energy Emergency and Standby Power Systems
- NFPA 780, Standard for the Installation of Lightning Protection Systems



- Underwriters Laboratories (UL)
- UL 67 Panelboards
- UL 96

## Chapter 7 Fire Protection and Life Safety

In addition to references cited for the Introduction and Chapter 1, the following are specifically relevant to Chapter 7.

### Publications

- American Society of Mechanical Engineers (ASME)
- ASME A17.1, Safety Code for Elevators and Escalators
- American Society for Testing Materials (ASTM)
- ASTM E-2073, Standard Test Method for Photopic Luminance of Photoluminescent (Phosphorescent) Markings
- Code of Federal Regulations (CFR)
- CFR 36 Part 1228, Subpart K—Facility Standards or Record Storage Facilities
- International Code Council (ICC)
- International Building Code (IBC)
- International Fire Code (IFC)
- International Residential Code (IRC)
- International Code Council Performance Code (ICCPC)
- National Archives and Records Administration (NARA)
- NARA Directive 1571
- National Fire Protection Association (NFPA)
- NFPA 13, Standard for the Installation of Sprinkler Systems
- NFPA 13D, Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes
- NFPA 14, Standard for the Installation of Standpipe and Hose Systems
- NFPA 17A, Standard for Wet Chemical Extinguishing Systems
- NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection
- NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances
- NFPA 30, Flammable and Combustible Liquids Code
- NFPA 45, Standard on Fire Protection for Laboratories Using Chemicals
- NFPA 72, National Fire Alarm and Signaling Code
- NFPA 75, Standard for the Protection of Information Technology Equipment
- NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems
- NFPA 101, Life Safety Code
- NFPA 170, Standard for Fire Safety Symbols
- NFPA 214, Standard on Water-Cooling Towers
- NFPA 232, Standard for the Protection of Records

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- NFPA 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations
- NFPA 914, Code for Fire Protection of Historic Structures
- Society of Fire Protection Engineers (SFPE)
- SFPE Engineering Guide to Performance-Based Fire Protection Analysis and Design for Buildings
- SFPE Handbook of Fire Protection Engineering
- Underwriters Laboratories (UL)
- UL 1994 Standard for Luminous Egress Path
- Marking Systems

## B.2 Acronyms and Abbreviations

A/E	architect/engineer	ASME	American Society of Mechanical Engineers
AABC	Associated Air Balance Council	ASPE	American Society of Plumbing Engineers
AAMA	American Architectural Manufacturers Association	ASTM	American Society of Testing and Materials
ABA	Architectural Barriers Act of 1968	ATS	automatic transfer switch
ABAAS	Architectural Barriers Act Accessibility Standard	AWI	Architectural Woodwork Institute
ACH	air changes per hour	BAS	building automation system
ACM	asbestos-containing material	BF	ballast factor
ADP	automated data processing	BIA	Brick Institute of America
ADPI	air diffusion performance index	BICSI	Building Industry Consulting Service International
AEDG	Advanced Energy Design Guide	BIM	building information modeling
AHJ	Authority having jurisdiction	BIM	building information models
AHU	air-handling unit	BLCC	building life-cycle cost
AIHA	American Industrial Hygiene Association	BOMA	Building Owners and Managers Association International
AISC	American Institute of Steel Construction	BPP	Building Preservation Plan
ALS	assisted listening system	BSO	basic safety objective
ANLA	American National Landscape Association	CATV	cable television
ANSI	American National Standards Institute	CAV	constant air volume
AOC	Administrative Office of the United States Courts	CCMG	Central Courthouse Management Group
AOUSC	Administrative Office of the United States Courts	CCR	Criteria Change Request
ASD	allowable stress design	CD	construction drawings
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers	CD	construction documentation
		CDC	Centers for Disease Control
		CFC	chlorofluorocarbon

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CFL	compact fluorescent lamps	FAS	Federal Acquisition Service
CFR	Code of Federal Regulations	FC	final concepts
CHP	combined heat and power plant	FCxA	fire commissioning agent
CPG	Comprehensive Procurement Guidelines	FEMA	Federal Emergency Management Agency
CPI	Consumer Price Index	FIIC	field impact isolation class
CPTED	Crime Prevention through Environmental Design	FMR	Federal Management Regulation
CPVC	chlorinated polyvinyl chloride	FPS	Federal Protective Service
CRF	condensation resistance factor	FPT	functional performance test
CRI	color rendering index	FSC	Forest Stewardship Council
CSC	Court Security Committee	FSC	Facility Security Committee
DC	direct current	FTE	full-time equivalent
DD	design development	GFI	ground fault interrupt
DDC	direct digital control	GSA	General Services Administration
DHS	Department of Homeland Security	Gsf	gross square feet
DNL	day-night average noise level	HB	heat balance
EA	environmental assessment	HET	high efficiency toilet
ECS	emergency communications systems	HEU	high efficiency urinal
EIA	Electronic Industries Alliance	HGL	hydraulic grade line
EIS	environmental impact statement	HID	high intensity discharge
EISA 2007 Act of 2007	Energy Independence and Security Act of 2007	HMT	harmonic mitigating transformers
EPAct 2005	Energy Policy Act of 2005	HUD	Department of Housing and Urban Development
EPO	emergency power off	HVAC	heating, ventilating, and air conditioning
EPPS	emergency power supply system	IBC	International Building Code
EPR	ethylene propylene rubber	ICC	International Code Council
ETS	environmental tobacco smoke	ICSSC	Interagency Committee on Seismic Safety in Construction
FAR GSA P-100 Version 1.0, issued March 2014	Federal Acquisition Regulation	IEBC	International Existing Building Code

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IESNA	Illuminating Engineering Society of North America	MRL	machine roomless
IG	isolated ground	NAEYC	National Association for the Education of Young Children
IGE	independent government estimate	NARA	National Archives and Records Administration
ILI	Indiana Limestone Institute	NC	noise criteria
IMC	intermediate metallic conduit	NC-B	balanced noise criteria
IRC	international residential code	NCMA	National Concrete Masonry Association
IRI	International risk insurance	NEBB	National Environmental Balance Bureau
IRMA	inverted membrane roof assembly	NEII	National Elevator Industries, Inc.
ISC	Interagency Security Committee	NEPA	National Environmental Policy Act
ISC	Interagency Security Criteria	NESHAP	National Emission Standards for Hazardous Air Pollutants
ISO	International Organization for Standardization	NFPA	National Fire Protection Association
JSST	Judicial Security Systems Team	NHPA	National Historic Preservation Act
LCC	life-cycle costing	NIC	noise isolation class
LCS	luminaire classification system	NIST	National Institute of Standards and Technology,
LED	light emitting diode	NRCA	National Roofing Contractors Association
LEED	Leadership in Energy and Environmental Design	OAVS	outdoor air ventilation system
LID	Low impact development	ODCP	Office of Design and Construction Programs
LLD	lamp lumen depreciation	OMB	Office of Management and Budget
LPD	lighting power density	OSHA	Occupational Health and Safety Administration
LPOE	Land Ports of Entry	P100	Public Buildings Service PBS 100
LPW	lumen per watt	PBAX	telephone exchange
LRFD	load resistance factor design	PBS	Public Buildings Service
MCC	motor control center	PBS -P140	Child Care Center Design Guide
MERV	minimum efficiency reporting value		
MOA	memorandum of agreement		

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PBS -PQ130	United States Border Station	SCAQMD	South Coast Air Quality Management
Design Guide		District	
PBS -PQ260	Metric Design Guide	SCIF	sensitive compartmented information
PBT	persistent bio-accumulative toxin	facility	
PCC	point of common coupling	SDI	Steel Door Institute
PCI	Precast Concrete Institute	SDM	Spatial Data Management
PDA	personal digital assistant	SFI	Sustainable Forestry Initiative
PDI	Plumbing and Drainage Institute	SFO	solicitation for offers
PDU	power distribution unit	SFPE	Society of Fire Protection Engineers
PER	project estimating requirements	SI	international system
PF	power factor,	SIR	savings to investment ratio
PMFC	Concession Management	SLC	signaling line circuits
93	Desk Guide	SMACNA	Sheet Metal and Air Conditioning
POE	post occupancy evaluation	Contractors' National Association	
PV	photovoltaic system	STC	sound transmission class
PWM	pulse width modulation	SWAT	smart water application technology
R&A	repairs and alterations	TAB	testing, adjusting, and balancing
RAF	raised access floor	TABB	Testing, Adjusting, and Balancing Bureau
RC	room criteria	TBC	Total Building Commissioning
RD	requirements development	TCLP	toxicity characteristic leaching procedure
RGS	rigid galvanized steel	TDS	total dissolved solid
RH	relative humidity	TFM	transfer function method
RHPO	Regional Historic Preservation Officer	THD	total harmonic distortion
ROD	record of decision	TI	tenant improvement
RTS	radiant time series	TIA	Telecommunications Industry Association
SAA	sound absorption average	TM	training manual
SBU	sensitive but unclassified	TTY	text telephone
		USACE	U.S. Army Corps of Engineers

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UFAD	underfloor air distribution	UV	ultraviolet
UL	Underwriters Laboratory	VAV	variable air volume
UPS	uninterruptible power supply	VE	value engineering
USCDG	U.S. Courts Design Guide	VFD	variable frequency drive
USMS	U.S. Marshals Service	VOC	volatile organic compound
UST	underground fuel oil storage tank	XLP	cross-linked polyethylene