



Client Enrichment Series

Welcome to today's presentation:

Workplace Design - Lighting and Acoustics

December 9, 2021

The presentation will start at 2 pm Eastern

Note: Phones are automatically muted during the presentation. A formal Q&A document, session slide deck, and a recording of this class will be made available on www.gsa.gov/ces



Workplace Design - Lighting and Acoustics

The Low Hanging Fruit of Successful Post-COVID Workplaces

December 9, 2021

Presented by:

Kevin Kelly

Senior Architect

Center for Workplace Strategy

GSA-PBS Office of Design and Construction (CO)



Hosted by:

James Fotopoulos

Regional Account Manager

GSA-PBS Heartland Region - R6



Light – The How and Why of Improving Workplace Lighting



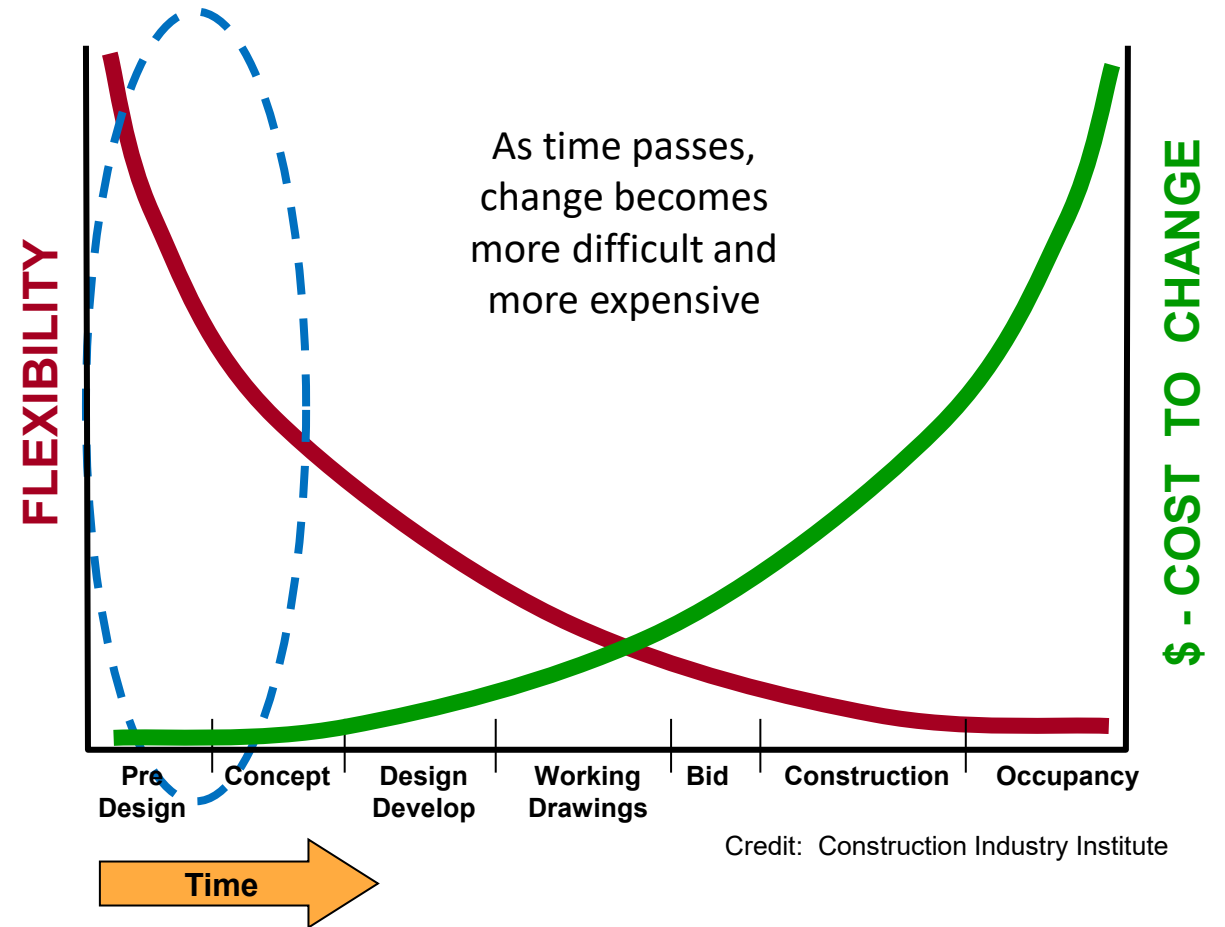
“Light is my almighty physician”

– Thomas Jefferson

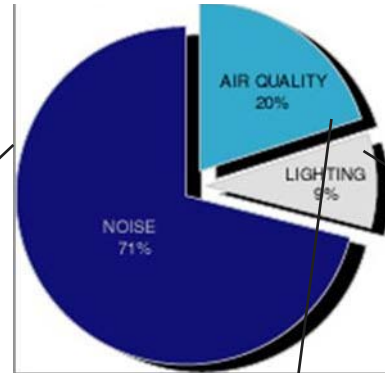
Schedule Adequate Time for Pre-Design and Design

Lighting and Acoustic issues are typically nearly impossible to fix *after* build out

Understanding workplace drivers early in the process allows you to create a future workplace that truly supports *how people work*.



CWS Tools to Address Workplace Dissatisfaction



GSA

SOUND MATTERS

How to achieve acoustic comfort in the contemporary office

Produced by GSA Public Buildings Service
December 2011

PART 1		PART 2	
What is Acoustical Comfort?	4	A Closer Look at the Where and How of Acoustic Mitigation	12
Why is it So Important?	4	WHAT: Behavior Works—The Human Element of Acoustics	13
How To Deliver It?	4	WHERE: Zoning and Designing Workplace Neighborhoods	18
The Current Situation—What Research is Telling Us	6	HOW: Technical Tips for Physical Acoustic Mitigation	28
The Challenge—Why Acoustics is More Important Than Ever	9	Special Conditions & New Acoustical Treatments	27
The Solution—Checklist for Success	10	Talk Like an Acoustician (or at least understand them)—A Short Glossary	38
		Putting it all Together: Costs	40
		References	41
		Acknowledgements	42

[“Sound Matters” publication](#)

Total Workplace Scorecard

GSA's Center for Workplace Strategy views the workplace as an integrated system of space and technology that enables work wherever it occurs. To support this mission, the Total Workplace Scorecard benchmarks and measures quality improvement between existing and new workplace conditions.

ADDITIONAL RESOURCES

- Download Example Scorecard
- GSA Center for Workplace Strategy
- Choosing Health-Enhancing Strategies

[Total Workplace Score Card](#)

GSA

LIGHT MATTERS

How to achieve a cost efficient, effective lighting experience in the contemporary workplace

Produced by GSA Public Buildings Service
October, 2020

DRAFT

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Very Helpful CWS Tools to Direct Design

GSA

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- Putting It All Together: Acoustical Treatments 42

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Table 7: Checklist to Achieve Successful Lighting Strategies in a Workplace

BEHAVIOR		
<p>Education: Health Impacts</p> <p>Educate employees, leaders, and the design community on the health benefits of light in general.</p>	<p>Education: Lighting Usage</p> <p>Provide user training and manuals on how to effectively operate lighting and related building systems to best support employee health, performance, and sustainability.</p>	<p>Type of Work</p> <p>Identify the agency mission, types of work performed, and degree of required security and confidentiality. Also, evaluate the variability of occupant workstyles.</p>
DESIGN PROCESS AND PLANNING		
<p>Project Planning</p> <p>Integrate lighting as part of a comprehensive design process. The earlier it is considered, the greater its potential impact on the organization and opportunities for synergies with other design strategies.</p>	<p>Daylight and View Equity</p> <p>Provide daylight and view equity to all occupants, including those who have limited access to daylight because of security issues related to agency mission or type of work performed.</p>	<p>Performance Measurements</p> <p>Before implementation, identify methods to assess the effectiveness of a lighting strategy. Consider a comprehensive evaluation that combines qualitative and quantitative metrics to understand the impacts on employee health, performance, and sustainability. Once data are gathered, institute continual feedback loops to optimize the lighting solutions.</p>
LIGHTING DESIGN		
<p>Existing Conditions</p> <p>Assess daylight access, conduct an analysis of light barriers, and evaluate the optimal level of daylight penetration for the space.</p>	<p>Integrate Daylight and Electric Light</p> <p>Develop an integrated electric and daylighting design that achieves greater energy efficiency while also accommodating variation in the type of work performed and user preferences.</p>	<p>Electric Lighting Solutions</p> <p>Use multiple light sources, including ambient, task, and accent lighting, and evaluate lighting controls to support a variety of tasks and user preferences.</p>
<p>Minimize Glare</p> <p>Provide proper ergonomics, light levels, and architectural tactics for reducing glare and improving employee satisfaction, performance, and health.</p>		

Total Workplace Score Card

TEN STEPS TO ACHIEVING ACOUSTIC COMFORT IN THE CONTEMPORARY OFFICE

BEHAVIOR

1. Work patterns - Identify the balance of concentration and interaction among the workers in the office to help create zones. Reference PBS's WSL which has a survey to determine this.
2. Speech Privacy - Identify the level of privacy required for the work based on the work patterns in the WSL.
3. Behavioral change - support behavioral adaptations with mobile technologies, multiple work spaces, and policy.
4. Behavioral protocols - develop protocols with the participation of the subject work group, aimed at reducing distractions and appropriate use of space use.

DESIGN

5. Zoning - After determining the work patterns, (see #1 above, under "Behavior"), develop a layout strategy which will locate incompatible functions apart from each other. Locate conference and focus rooms convenient for interactive workers to "duck into" and to act as barriers between various work patterns. Consider elements such as file banks to further separate incompatible functions.
6. Planning - Carefully consider the effect on neighboring workstations when locating supporting activities such as copier rooms, coffee bars and entries to conference rooms where a queue could be anticipated - adjacent to large conference rooms, for instance.
7. Furniture - Select furniture which complies with LEED NC credits EQ 8.1 and 8.2 to obtain 1 or 2

LEED credits. The low partitions required will achieve the desired access to natural light and view while allowing occupants to be aware of other nearby workers. Where a work station partition is in front of the worker when seated at the desk, the noise reduction coefficient (NRC) of the partition should be .07 so that speech is not reflected backward when the worker seated at his or her desk speaks. Where possible, the layout should locate the desks so that workers will not be speaking directly "at" each other.

ACOUSTIC TREATMENT

8. Sound Absorbing Ceilings and Walls - Specify ceilings having a minimum NRC of 0.9 in open plan office areas and NRC 0.8 in meeting rooms and training facilities. In conference, meeting and training facilities, provide absorptive panels on 25% of walls with a minimum NRC of 0.8.
9. Sound Masking Systems - Specify sound masking systems, particularly in open plan office areas. See page 42 for information regarding sound masking systems.
10. Walls - Specify Sound Rated Wall Constructions as follows:
 - STC 53 minimum to isolate video conference and training rooms.
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Highlights From “Light Matters”

Table 7: Checklist to Achieve Successful Lighting Strategies in a Workplace

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<p>✔ Education: Health Impacts Educate employees, leaders, and the design community on the health benefits of light in general.</p>	<p>✔ Education: Lighting Usage Provide user training and manuals on how to effectively operate lighting and related building systems to best support employee health, performance, and sustainability.</p>	<p>✔ Type of Work Identify the agency mission, types of work performed, and degree of required security and confidentiality. Also, evaluate the variability of occupant workstyles.</p>
DESIGN PROCESS AND PLANNING		
<p>✔ Project Planning Integrate lighting as part of a comprehensive design process. The earlier it is considered, the greater its potential impact on the organization and opportunities for synergies with other design strategies.</p>	<p>✔ Daylight and View Equity Provide daylight and view equity to all occupants, including those who have limited access to daylight because of security issues related to agency mission or type of work performed.</p>	<p>✔ Performance Measurements Before implementation, identify methods to assess the effectiveness of a lighting strategy. Consider a comprehensive evaluation that combines qualitative and quantitative metrics to understand the impacts on employee health, performance, and sustainability. Once data are gathered, institute continual feedback loops to optimize the lighting solutions.</p>
LIGHTING DESIGN		
<p>✔ Existing Conditions Assess daylight access, conduct an analysis of light barriers, and evaluate the optimal level of daylight penetration for the space.</p>	<p>✔ Integrate Daylight and Electric Light Develop an integrated electric and daylighting design that achieves greater energy efficiency while also accommodating variation in the type of work performed and user preferences.</p>	<p>✔ Electric Lighting Solutions Use multiple light sources, including ambient, task, and accent lighting, and evaluate lighting controls to support a variety of tasks and user preferences.</p>
<p>✔ Minimize Glare Provide proper ergonomics, light levels, and architectural tactics for reducing glare and improving employee satisfaction, performance, and health.</p>		

Let's
explore
Glare
mitigation



Tips to Minimize Glare

Avoid highly reflective materials and surfaces



Avoid fixtures with bare or exposed bulbs



Use Indirect Lighting

- Indirect pendants
- Cove lighting
- Wall washers
- Floor Lamps

Utilize daylight

Use layers of light vertically and horizontally

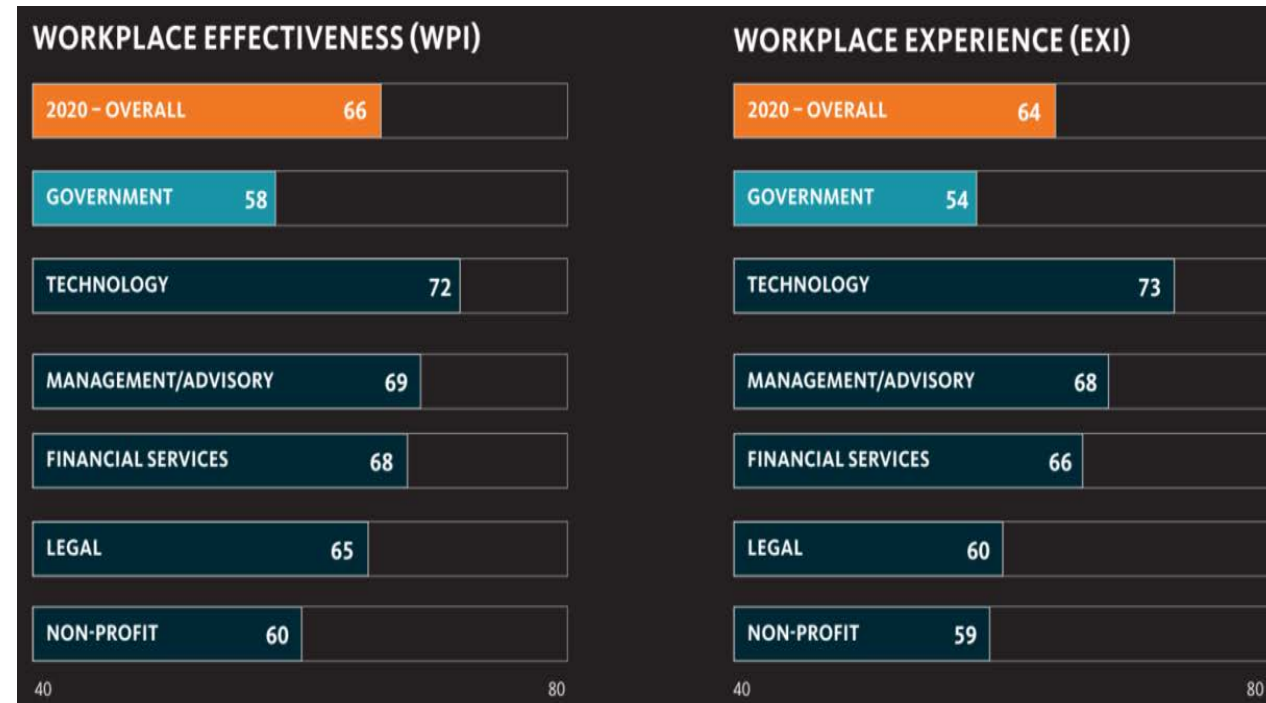
- Ambient Lighting
- Accent Lighting
- Task Lighting

Optimal computer use

- Minimize direct light on screens
- Uniform vertical illumination to minimize contrast

6 Reasons Why Light Matters Now...and in the Future

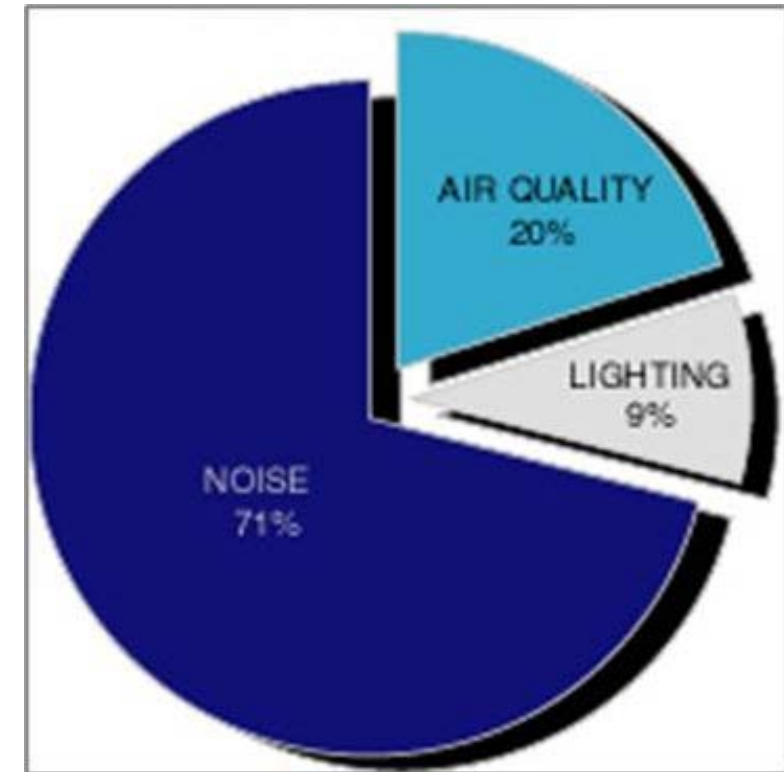
- **Recent LED technology** has GREATLY improved the quality of the lighting, its cost and sustainability
- We have not dealt with quality lighting in office space and it is essential to **raise the governments experience Index** which is the lowest of all sectors
- Competition from the **home office** experience where experience of light and view may be much better



Credit: Gensler Workplace Research

6 Reasons Why Light Matters Now...and in the Future, con't

- **Health and Wellness** will be a priority post-COVID-19
- We know lighting matters to mental and physical health and performance
- **Workers more effective** with better lighting (more alert- better rested – better mood) when lighting is synced to the appropriate color light at the time of day.



Credit: Gensler Workplace Research

Per Center for the Built Environment, UC Berkeley, the top 3 office complaints

Returning to the Office: Moving From the Light?

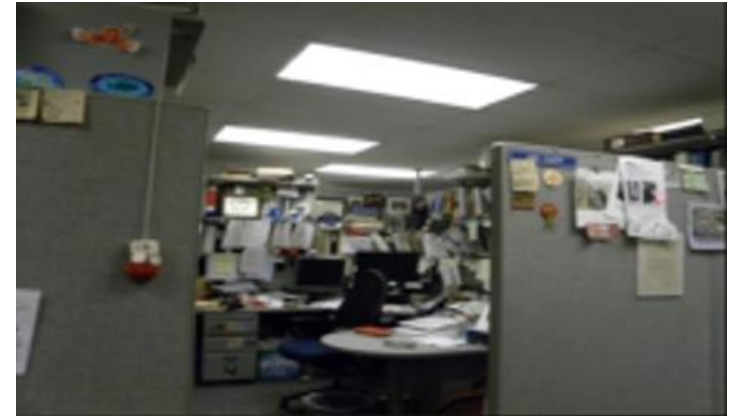
The home office often has access to light and view ...but not for everyone



many have interruptions, dependent care and bandwidth problems - with far fewer spatial alternatives...

Returning to The Office: Moving Into the Dark?

The contrast may prove to be a morale shock. Equity issues are apparent.



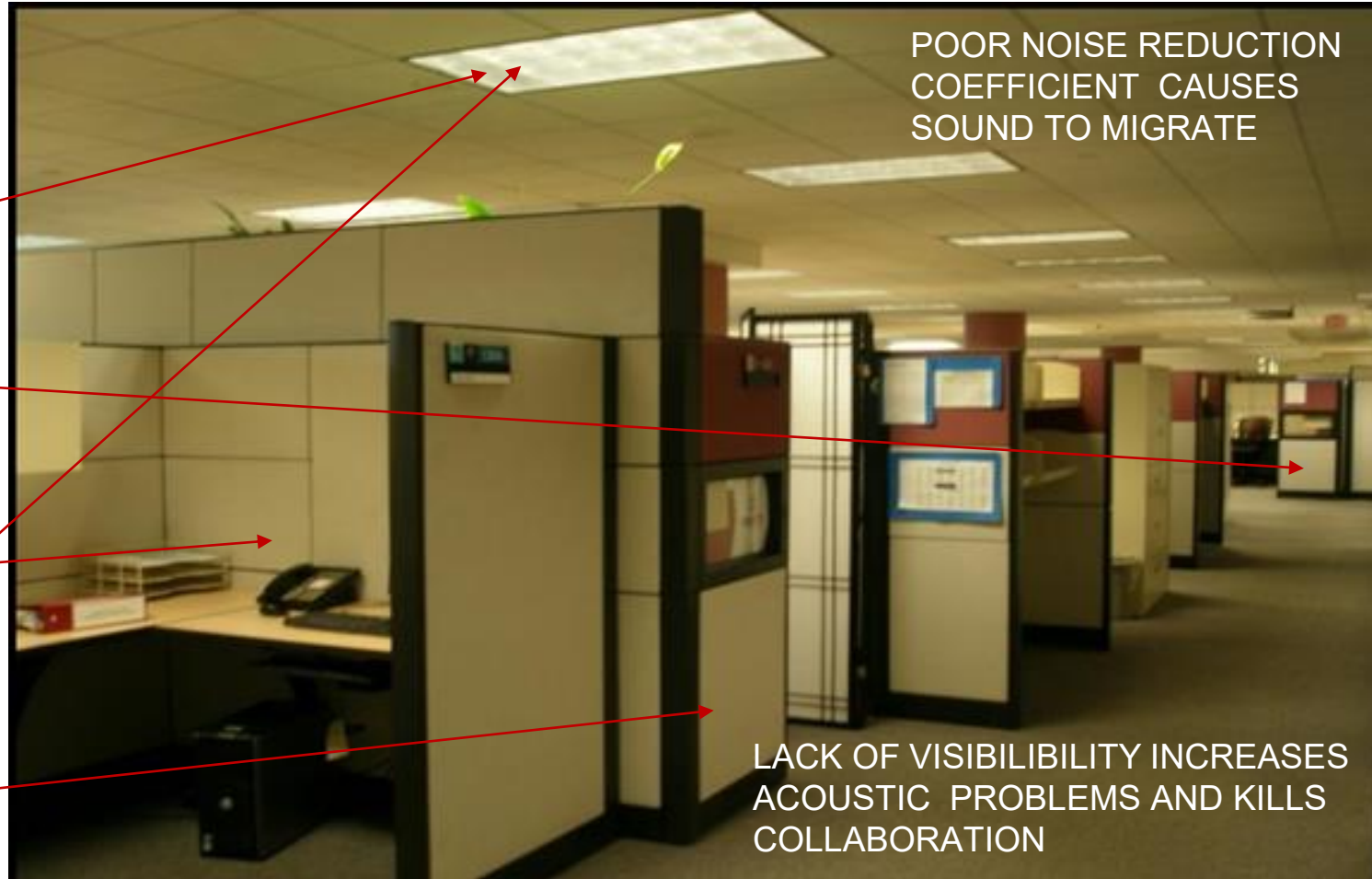
What's Wrong With This Picture?

VIEW FROM SEATED POSITION RENDERS TERRIBLE GLARE WHEN LOOKING AT STANDING INDIVIDUAL

TOTAL LACK OF CIRCADIAN STIMULATION

MISALIGNMENT OF LIGHTING ABOVE WORKSURFACE BELOW CAUSES DIM WORKSURFACE

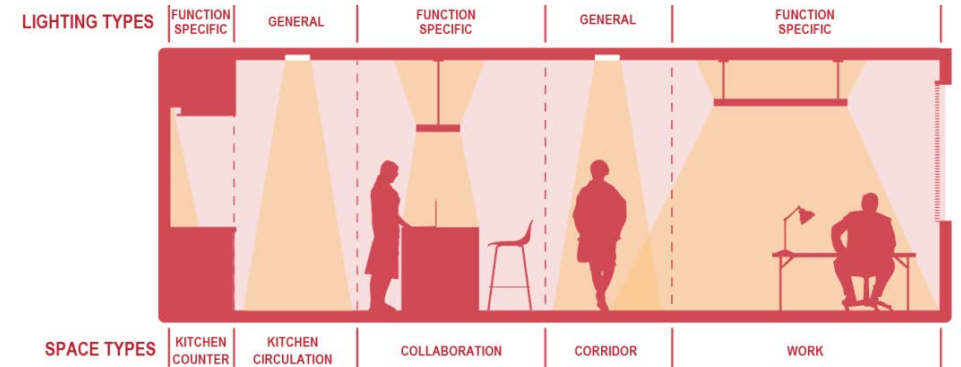
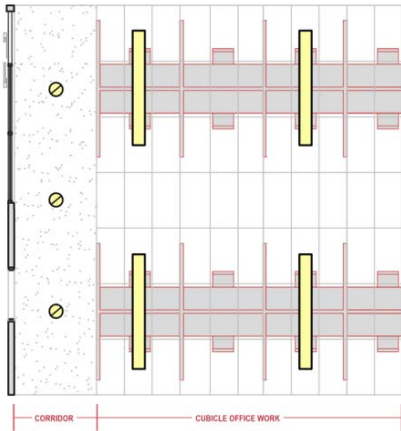
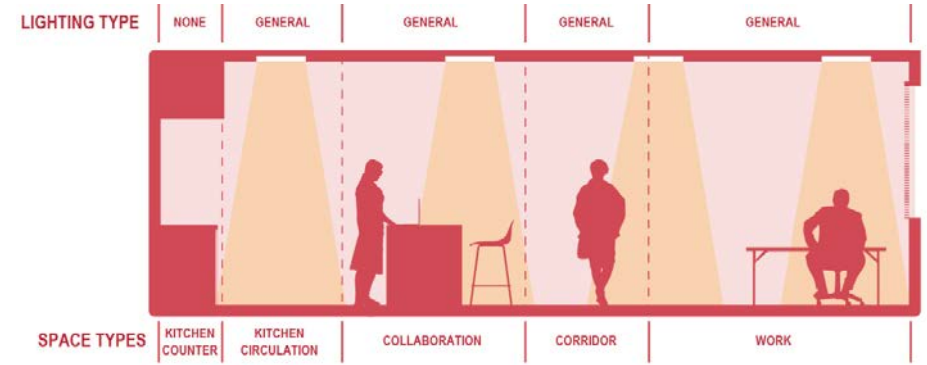
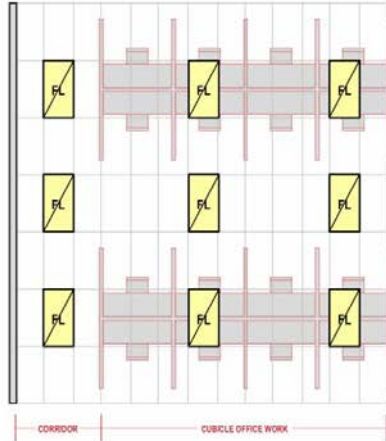
LACK OF COLOR (WHCH HUMAN BEINGS CRAVE) AND POOR CRI



POOR NOISE REDUCTION COEFFICIENT CAUSES SOUND TO MIGRATE

LACK OF VISIBILIBITY INCREASES ACOUSTIC PROBLEMS AND KILLS COLLABORATION

Change Lighting Strategies: Ceiling Plans Matter



Break Rooms – Should Not Break the Spirit!

Really???

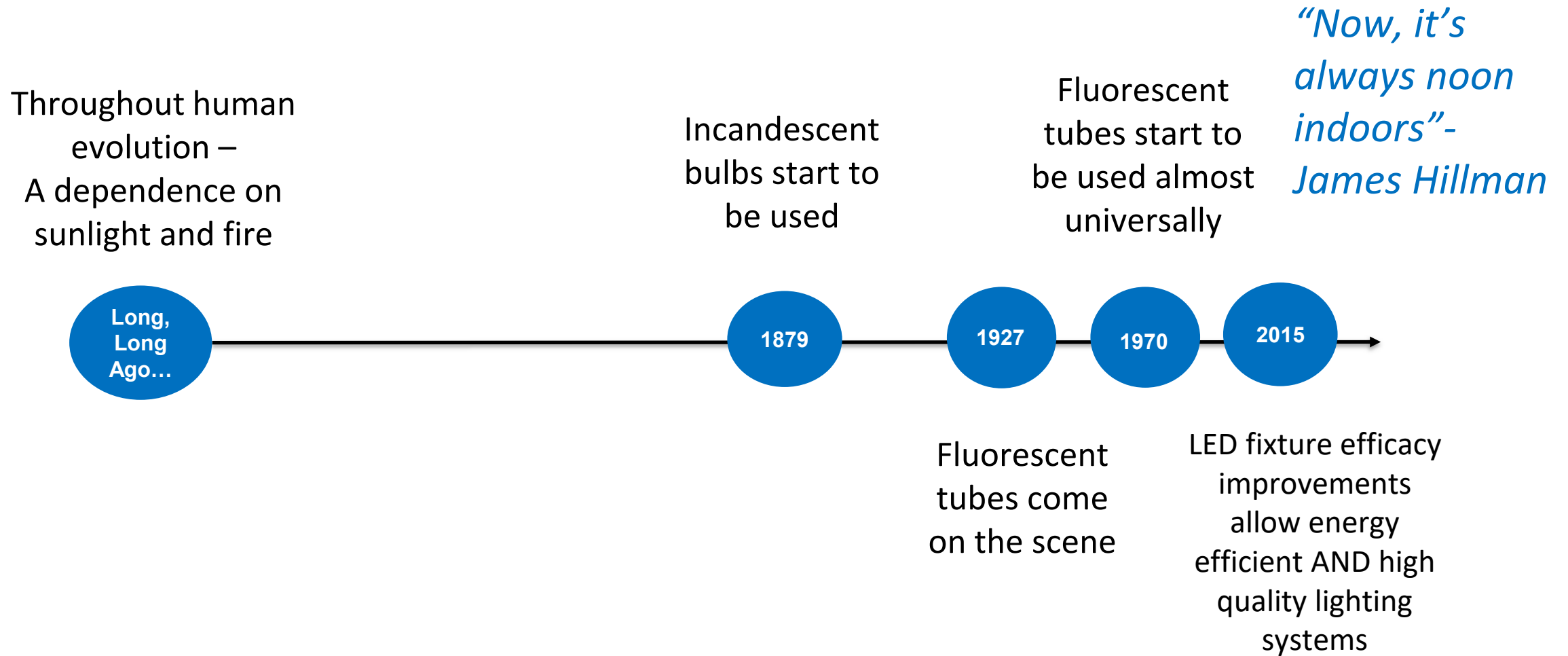


Strive for the
vibe you hope
to achieve



Credit: Gensler Workplace Research

The History of Lighting – At a Glance



Sustainable and Human-Centric Architecture

Back to the Future??

**Government Office Building,
Washington, DC, 1970**



**Government Offices (Uffizi)
Florence, 1560**



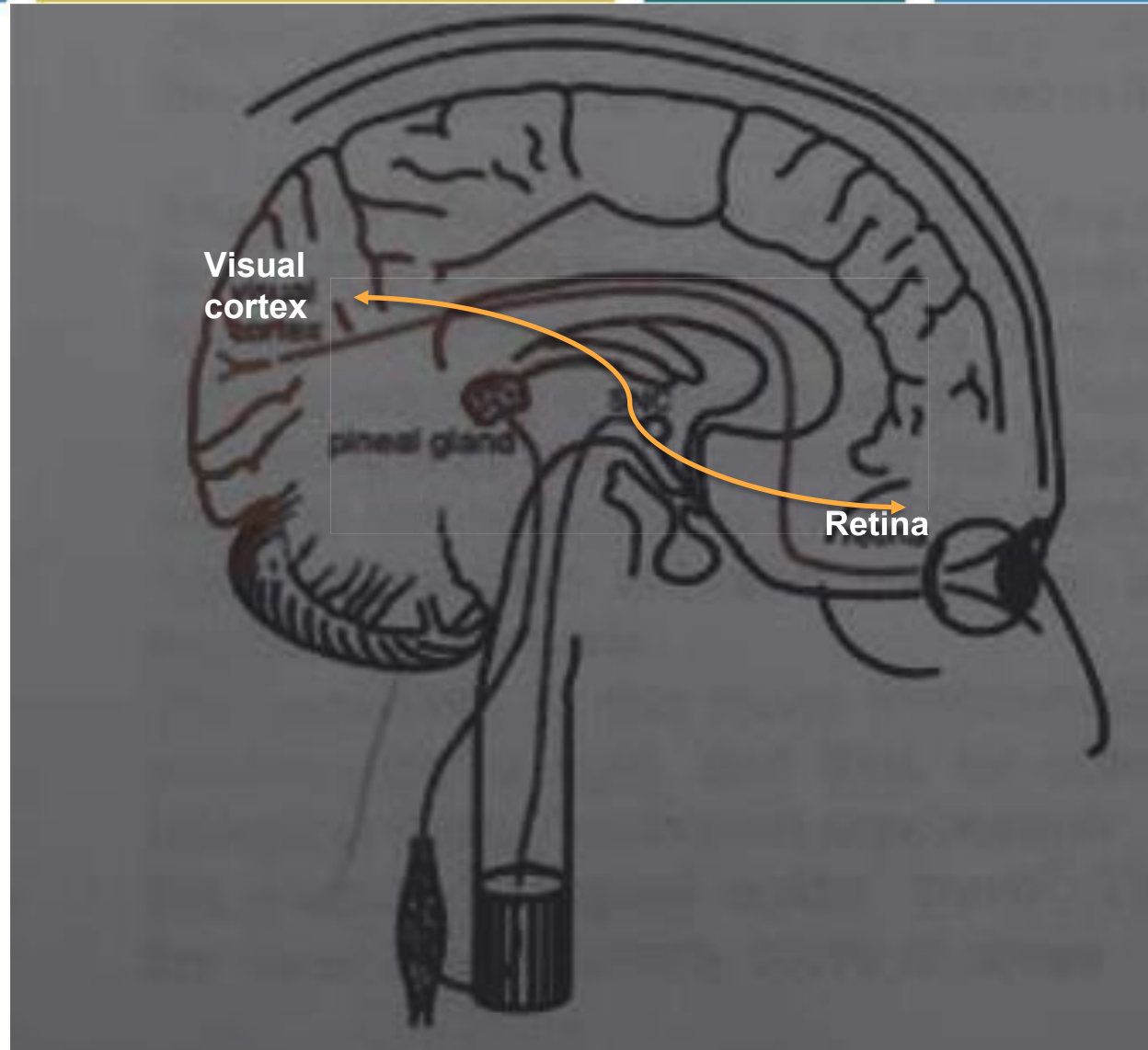
More than 30% of electric power in office buildings typically goes to lighting

Most of it is wasted due to poor design or outdated equipment

Due to the use of fluorescents, light levels are 300-400 times greater today than 100 years ago

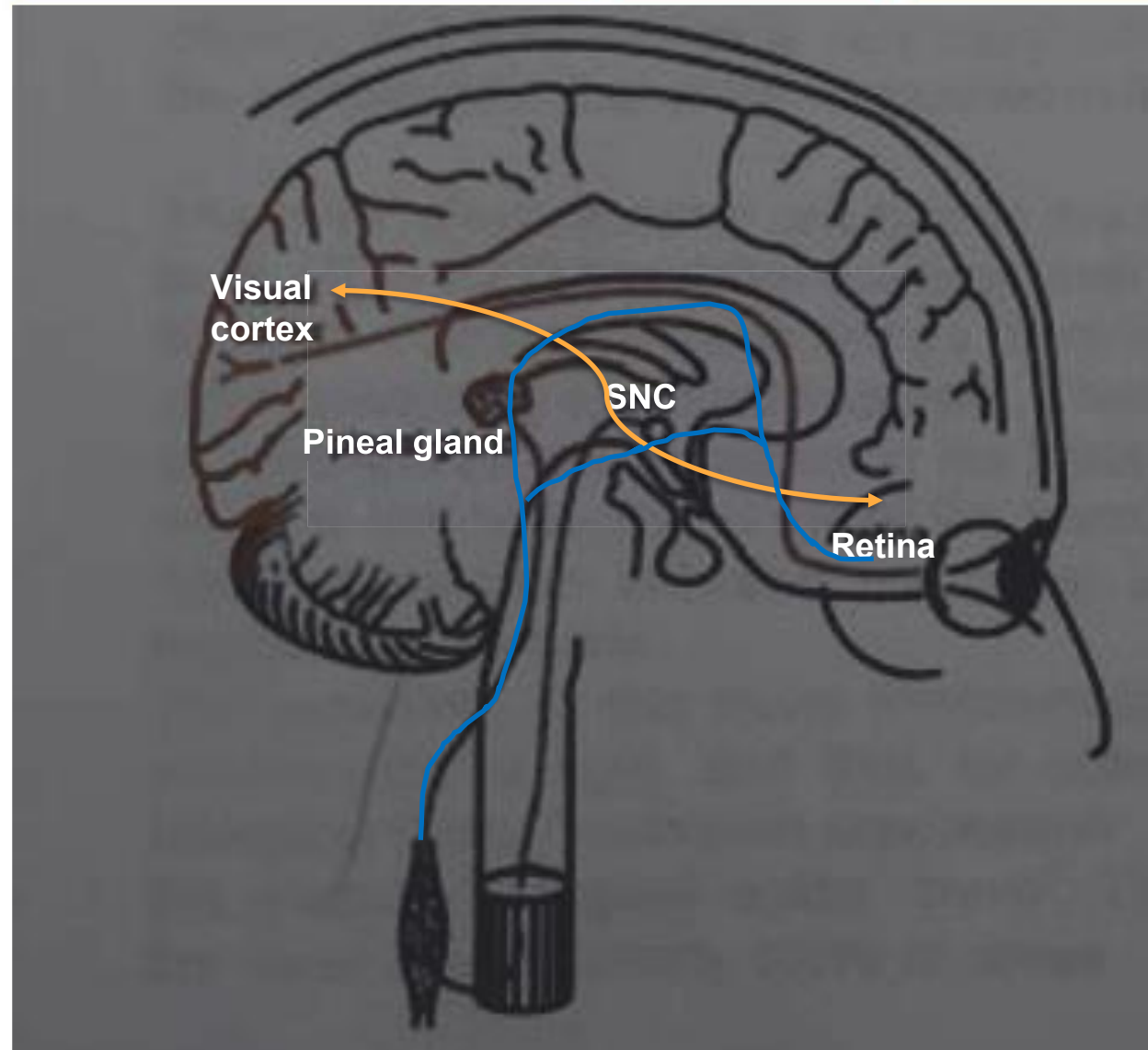
It's All in Your Head!

How a
utilitarian
understanding
of vision
began



1722: Antony van Leeuwenhoek discovered “rods and cones”

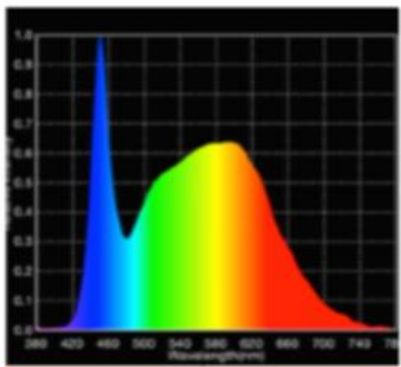
How a Discovery Promises to Revolutionize Lighting



2002 David Berson et al discovered a novel receptor that sends impulses to a completely different area of the brain and to glands that are essential to regulating the “body clock” that we term Circadian rhythms, from the Latin, roughly translated as throughout or “around the day.

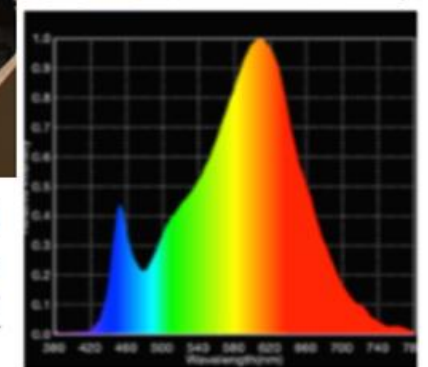
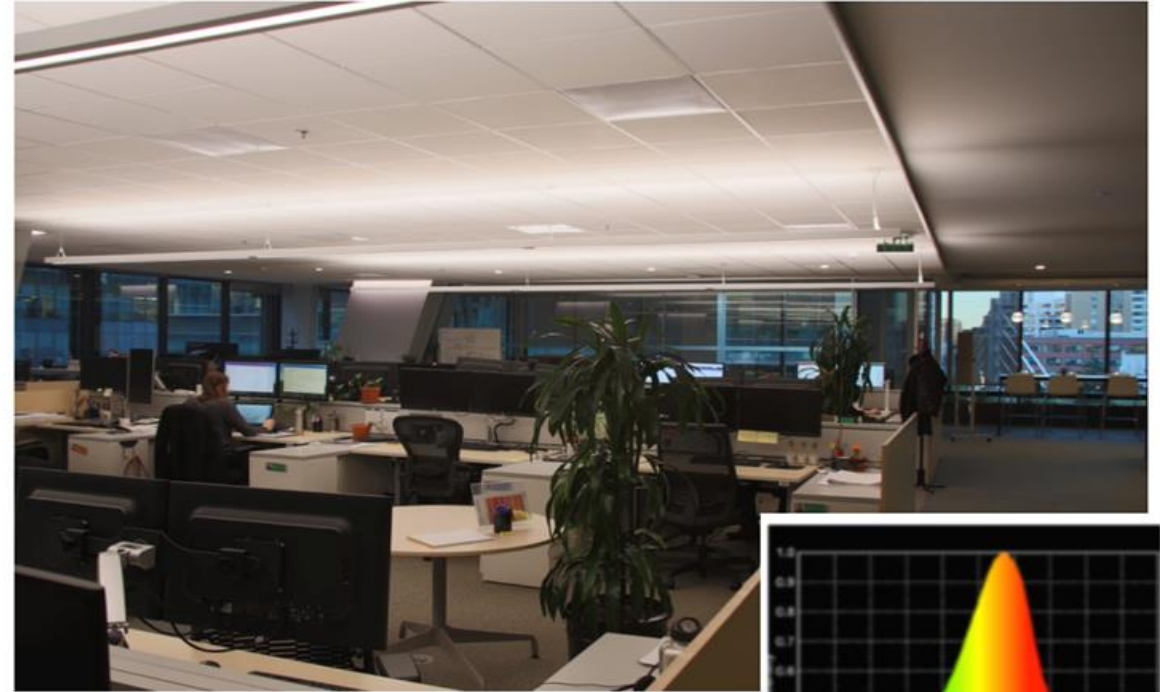
Introduce Circadian Lighting Strategies and Equipment

To Improve Alertness , Performance and Morale!



Mid-day
Color temperature
set at 5000K

See the Blue spike at the beginning of the day?



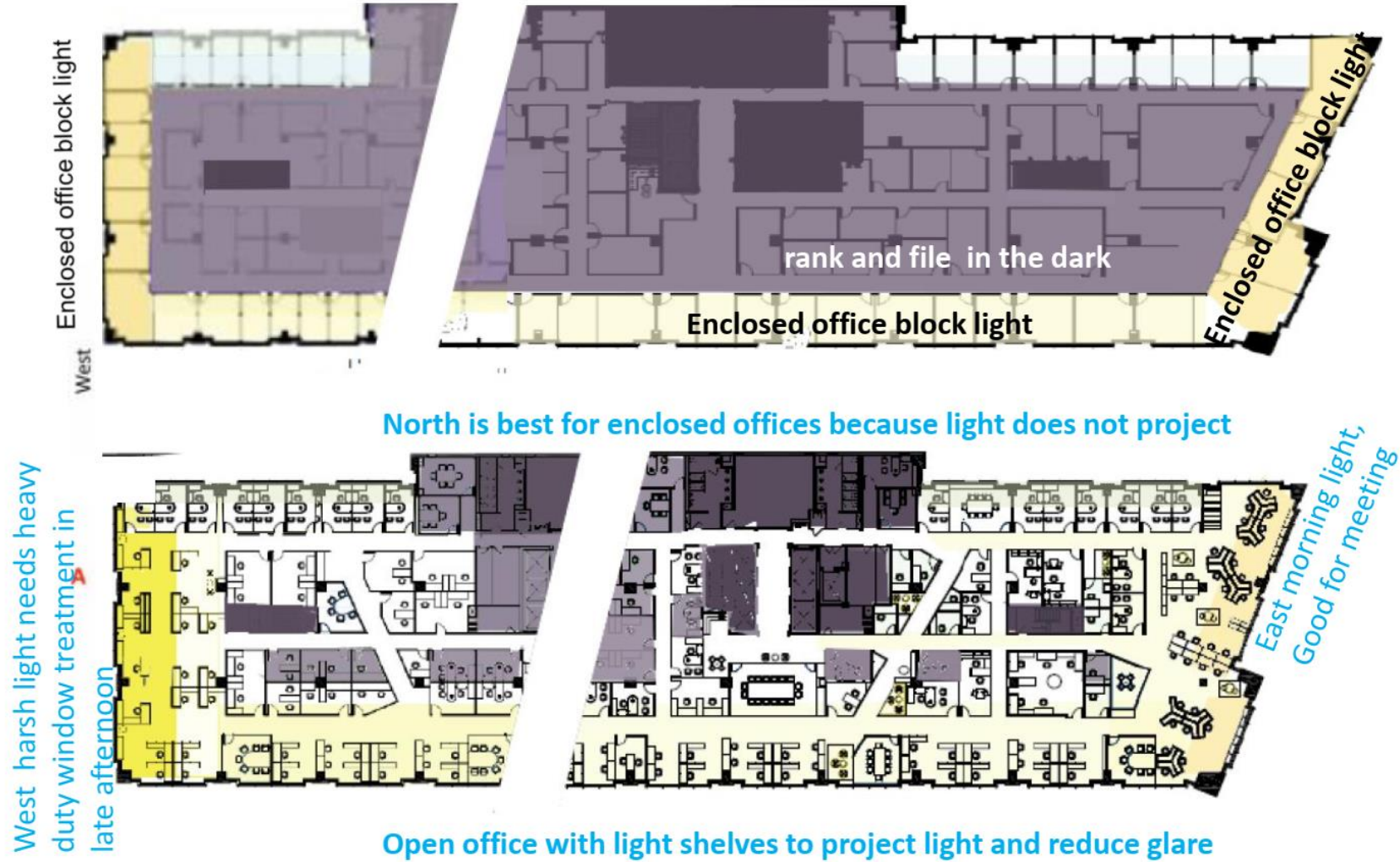
Evening
Color temperature
set at 3000K

See more red in the light?

Credit: Arup San Francisco Office



Zone Work Activities With Reference to Solar Orientation



Sunlight Sells Itself – Humanistic Orientation

46mins

Office workers with windows had more sleep per night than those who didn't.

40%

Workplaces with good daylight had a 3% - 40% gain in productivity and sales.

No. 1

Daylight is the number one wanted natural element in workplace design.

16%

Well-designed classrooms with natural light explained a 16% variation in learning.

15%

Workers in offices with natural elements, such as greenery and sunlight were found to be 15% more creative.

6.5%

View quality and daylight explained a 6.5% variation in sick leave in a workplace study.



Natural light improves moods, reduces stress and positively impacts circadian system functioning.

Vit. D

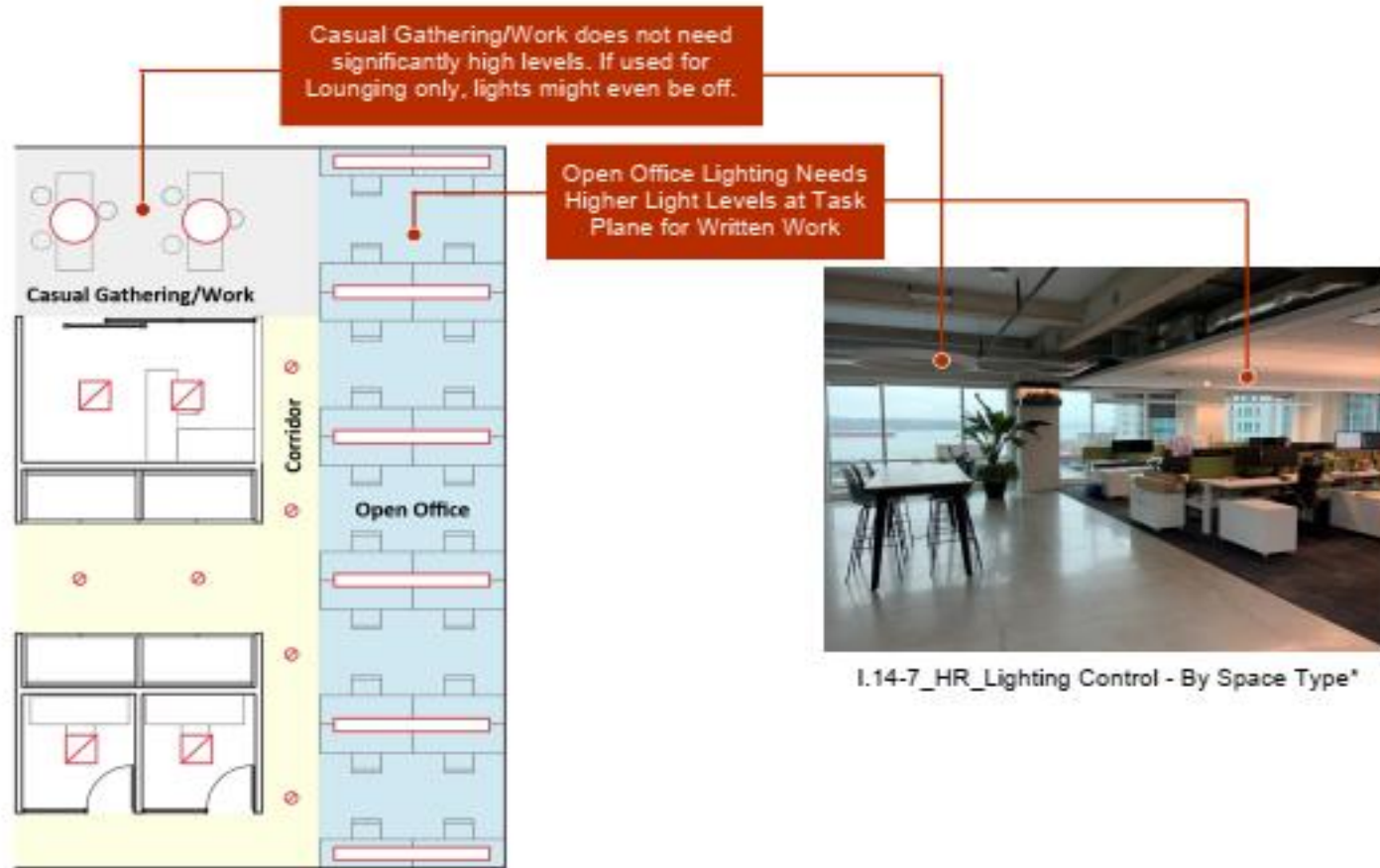
Daylight supports the regulation of Vitamin D, serotonin, melatonin and promotes healthy eye development.

Refer to cohere.com.au for references | @CohereSustain

Rewilding Design | Benefits of Natural Light



Zone Electric Lighting to Support Variation in Work Tasks



LEGEND

- ⊗ or ◻ Recessed Fixture (Shape & size reflect actual fixture)
- ⊕ or ⊖ Surface Mount (Shape & size reflect actual fixture)
- or ▭ Suspended Fixture or Pendant (Shape/size reflect actual fixture)

Insist on Lighting Vertical Surfaces



The Low Cost of Fluorescent Lighting...

...Fundamentally Changed the Dependence Between Inside and Outside

- HUGE FLOOR PLATES
- NO INTEREST IN BUILDING ORIENTATION



The Landed Gentry



The Proletariat

How Can We Respond Quickly and Inexpensively?

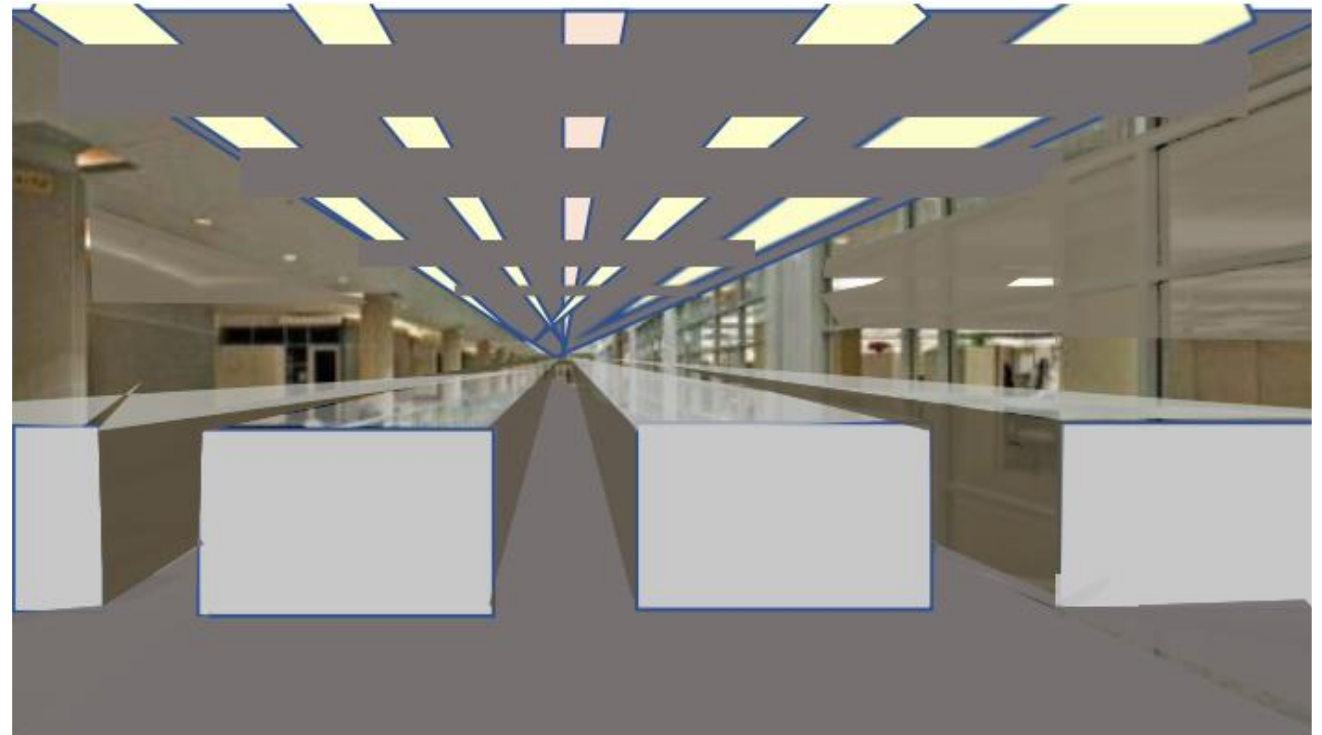


“Circadian Shower” Examples



Case Study: “Abandon Hope, All Ye Who Enter Here”

Dante Alighieri – The Inferno



Post Script

In the future workplace - to keep the organizational culture from dissipating, we may need to “hack” our buildings - to make them livable, attractive and able to compete with the home office.



*SSA Offices now
Credit: Hensel Phelps*

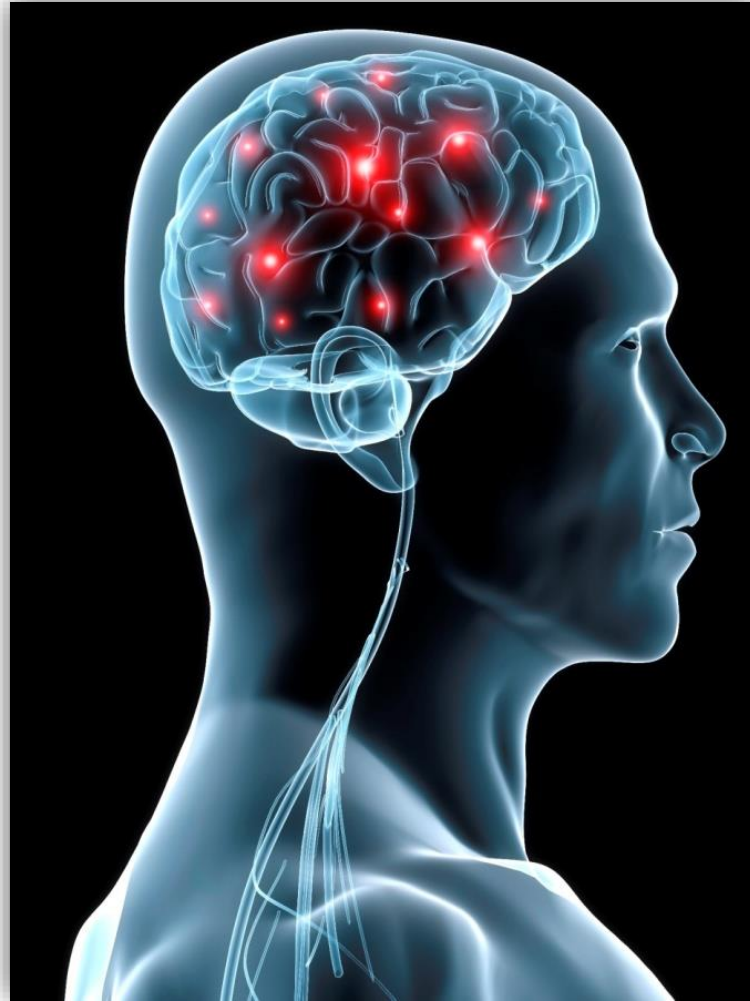
Lighting Design and Acoustic Mitigation Can Overlap



Acoustic Mitigation Becomes Part of the Workplace Toolkit



Why Acoustics Matter to Work



The Mental & Behavioral Effects of Noise

- **Increased aggressiveness**
- Impatience and nervousness
- **Decreased helping behaviors**
- Lowered attention span
- **Decreased problem solving**
- Memorization problems
- Comprehension problems
- Neurotransmitter deficiencies
- **Interpersonal problems**
- **Social behavior problems**

- Credit: Dr. Gary Madaras Rockfon Corp.

Why Acoustics Matter to Health



Clinical Manifestations of Stress Occurring with Noise

- **Increased heart rate**
- **Elevated blood pressure**
- Dilation of pupils
- Increased respiration rate
- Increased muscle tension
- Fatigue and nausea
- **Heart attacks**
- **Increased ulcer formation**
- Intestinal motility changes
- Increases in adrenaline

“Sound Matters” To the Rescue



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ACOUSTIC TREATMENT

8. Sound Absorbing Ceilings and Walls - Specify ceilings having a minimum NRC of 0.9 in open plan office areas and NRC 0.8 in meeting rooms and training facilities. In conference, meeting and training facilities, provide absorptive panels on 25% of walls with a minimum NRC of 0.8.
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DESIGN

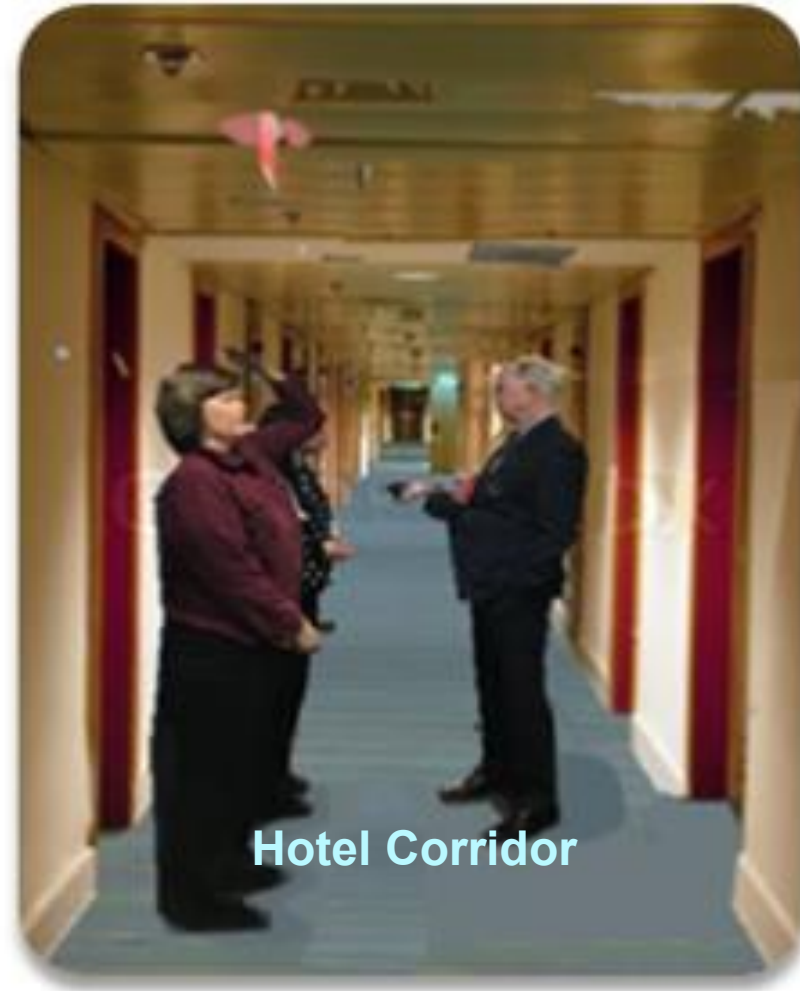
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The Acoustic Case Against High Partitions

If I can't see you, I'm not disturbing you...



Workspace



Hotel Corridor

Work Patterns and Acoustic Expectations

The modern office is a combination of “The Library and the Bazaar”



Work Patterns and Acoustics



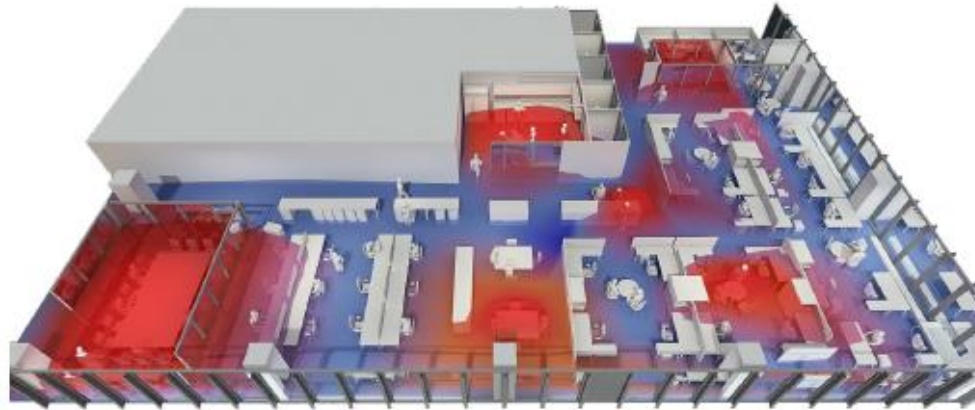
- Noisier Areas
- Quieter Areas

GSA's Workplace 2030 Program will expand these categories to reflect hybrid work



- Internally-mobile Interactive
- Externally-mobile Interactive
- Desk-bound Interactive
- Internally-mobile Concentrative
- Externally-mobile Concentrative
- Desk-bound Concentrative

Follow “Sound Matters” Guidance – Achieve Acoustic Comfort



■ Distractions

■ Quiet

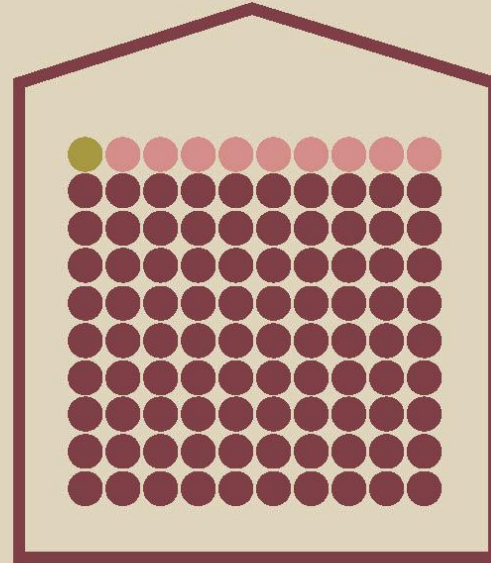


Why Acoustics Matter to Cost

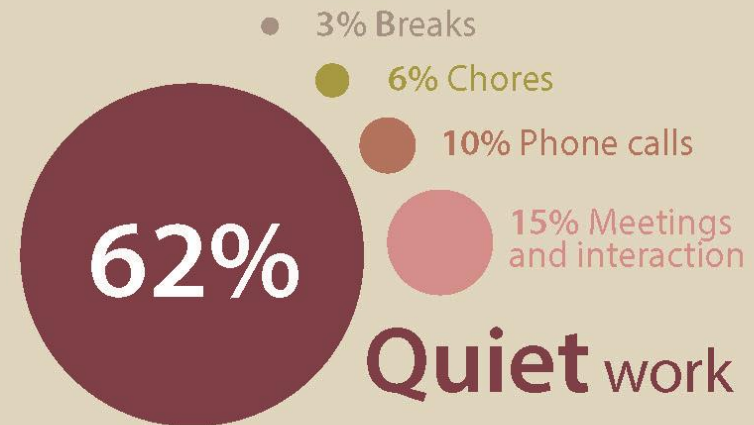
BUSINESS OPERATION COSTS

Over a 10 year period

1% Energy costs
9% Rental costs
90% Staff costs



HOW DO WE SPEND OUR TIME AT WORK?



Graphic Credit: Dr. Gary Madaras, Rockfon Corp.

Sources

- World Green Building Council (2014): *Health, Wellbeing & Productivity in Offices – The next chapter for green building*
- Brille et al. for BOSTI Associates (2001): *Disproving Widespread Myths About Workplace Design*

The ABC's of Acoustics

A

Sound **ABSORPTION** via various materials, particularly at the ceiling (but also at walls and carpeting), absorbs sound and keeps it from reflecting deeper into the space. (Absorption is measured in **Noise Reduction Coefficient - NRC**)

B

Solid barriers are used in **BLOCKING** sound transmission from one space to another. (Blocking ratings are expressed as the **Sound Transmission Coefficient - STC**)

C

Sound masking **COVERS** conversations, helping to reduce its intelligibility and thus, it's ability to distract. (Cover ratings are expressed in the **Noise Coefficient – NC**)

The ABC's of Acoustics – A is for Absorption

A

Absorption

Noise Reduction Coefficient (NRC)



NRC CATEGORIES

BEST NRC 0.90

BETTER NRC 0.80

GOOD NRC 0.70

AVOID NRC < 0.70

A “Good” NRC of .70 is typical in private offices

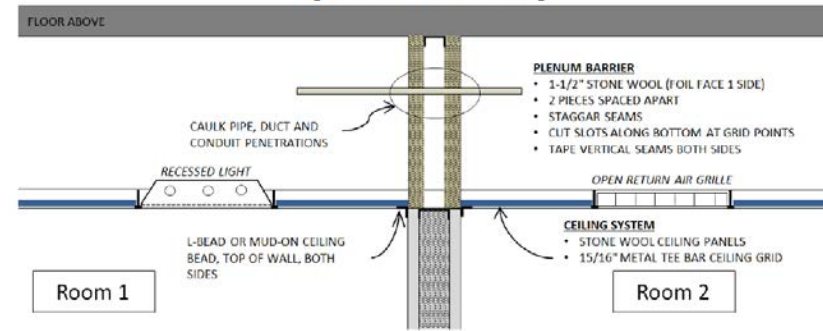
The ABC's of Acoustics – B is for Blocking

B

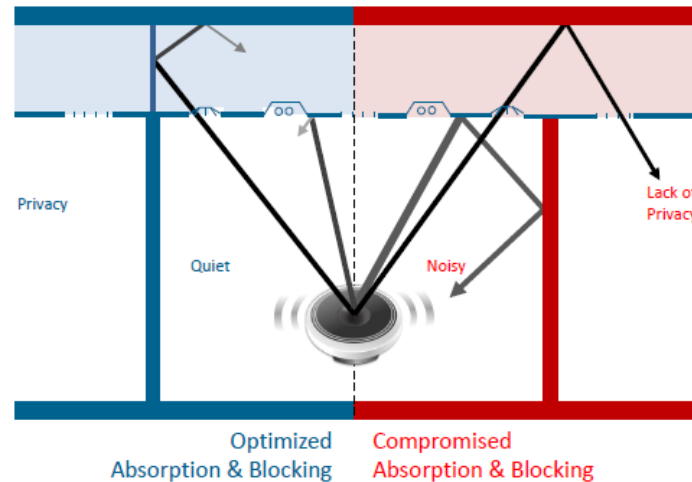
Blocking

Sound Transmission Coefficient (STC)

Plenum Barriers – Better/Best (STC 45-50)



Use a double-layer plenum barrier over walls between rooms that do not have doors or glass.



Plenum Barriers – Stone Wool



Single-Layer Stone Wool (STC 40)



Double-Layer Stone Wool (STC 52)

The ABC's of Acoustics – C is for Cover

C

Cover

Noise Coefficient (NC)



STC + NC = Speech Privacy Potential (SPP)

Cover Sound – Degrees of Speech Privacy

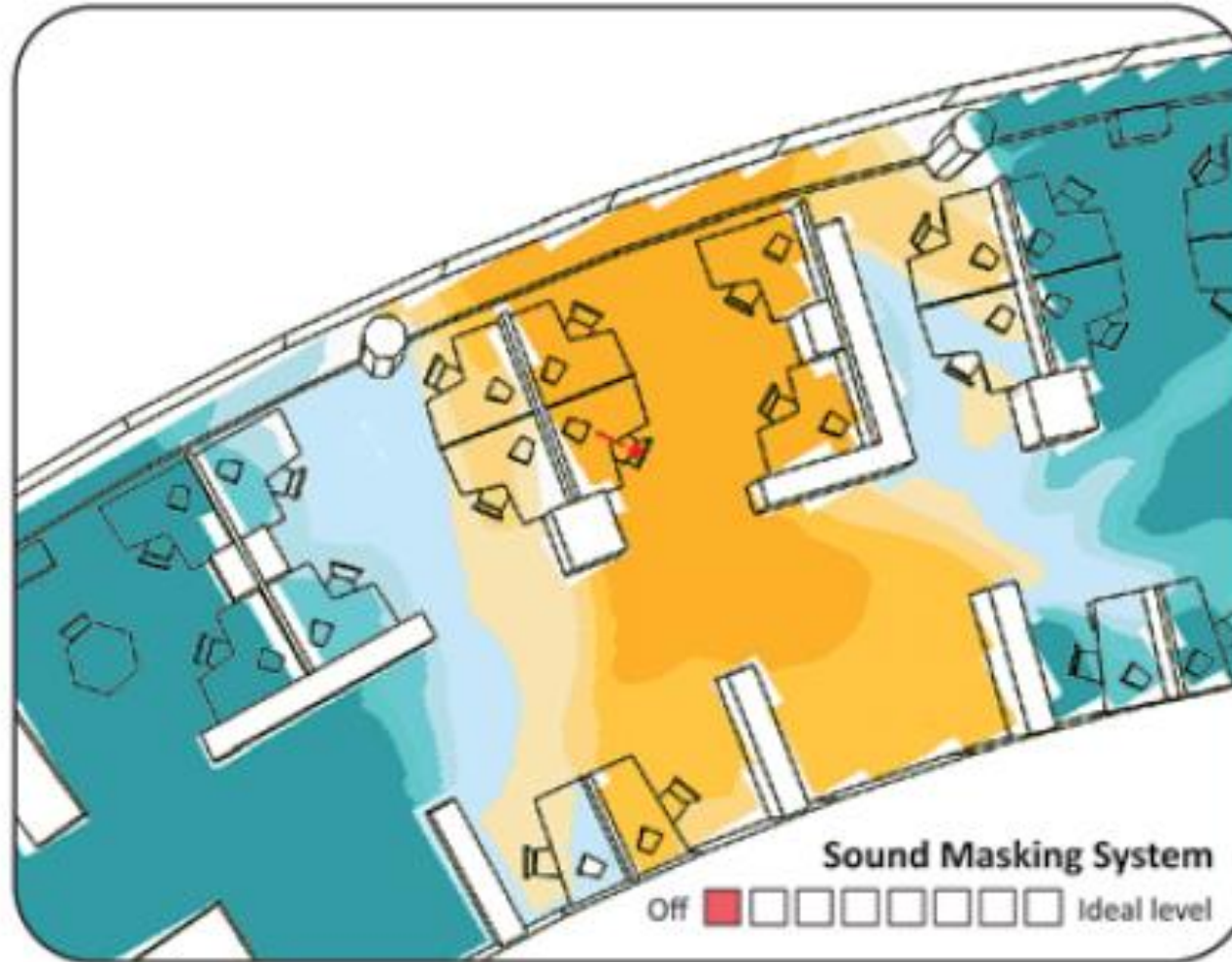
Degrees of Speech Privacy

PRIVACY RATING	SPEECH PRIVACY POTENTIAL (SPP)	DESCRIPTION OF PRIVACY
Total privacy	90	Shouting is only barely audible.
Highly confidential	85	Normal levels are not audible. Raised voices are barely audible but not intelligible.
Excellent	80	Normal voice levels are barely audible. Raised voices are audible, but most unintelligible.
Good	75	Normal voices are audible but unintelligible most of the time. Raised voices are partially intelligible.
Fair	70	Normal voices are audible and intelligible some of the time.
Poor	65	Normal voices are audible and intelligible most of the time.
None	Less than 60	No speech privacy.

STC + NC = Speech Privacy Potential (SPP)

$$55 + X = 80 \text{ (SPP)}$$

Good Sound Masking Makes Good Neighbors



Credit: Cambridge Acoustics

Cover Sound – A Component in Employee Productivity!



YOUR ROI CALCULATOR RESULTS



Taking control of background sound is key to improving privacy and productivity.

The LogiSon Acoustic Network gives you power over this aspect of your environment by distributing an engineered background sound throughout your facility. The sound covers conversations and noise while remaining comfortable and unobtrusive.

You've used our ROI Calculator, so you know just how much this is worth.

Here's what you entered:		Here are your results:	
Size:	150000	Total Investment:	\$225,000.00
Number Of Employees:	1000	Total Employee Cost:	\$62,500,000.00
Overhead Multiplier:	1.25	Annual Productivity Cost:	\$1,875,000.00
Cost Per Unit:	\$1.50	Payback (Months):	1.44
Average Employee Salary:	\$50,000.00	Payback (Years):	0.12
Productivity Increase:	3.00 %		

Here's what you'll get back in one, three, five and ten years:



While others might claim to provide the same benefits, the LogiSon Acoustic Network is uniquely designed to maximize both masking effectiveness and occupant comfort – ensuring your employees get the most out of your investment in sound masking technology.

Each small zone of 1 to 3 loudspeakers offers volume control in fine 0.5 dB steps as well as third-octave frequency adjustment from 63Hz to 10kHz, providing exceptional control over the entire treated area. And then we precision-tune with our TARGET software, maximizing performance.

Focus on performance. Get sound masking that works.

Info@logison.com www.logison.com 1.866.LOGISON

Example:

For 1,000 Employees/ \$50,000 Average Salary / \$1.50.
square foot investment + overhead multiplier =

@3% productivity enhancement =
0.12 Year ROI!

\$ 225,000 first cost /1,000 workers =
\$19,000,000 savings
after 10 years

Cover Sound Corollary

Ceilings should be NRC .90



20% of the walls should be NRC .80

Panels should be NRC .65 to prevent noise ricochet

Cover Sound Corollary, con't

Panel Height Matters



You want to partitions to be high enough that from a seated position, you can't see over them.

If you can only understand 20% of someone's conversation when you are not looking at them, the ability to see their lips moving increases the amount to nearly 55%.

If you start at 50%, it increases to almost 90%.

Thank You For Attending!

Workplace Design - Lighting and Acoustics

The Low Hanging Fruit of Successful Post-COVID Workplaces

December 9, 2021

Q&A

Kevin Kelly
Senior Architect
Center for Workplace Strategy
GSA-PBS Office of Design and Construction (CO)
Kevin.Kelly@gsa.gov



[Center for Workplace Strategy](#)
[National and Regional POCs](#)



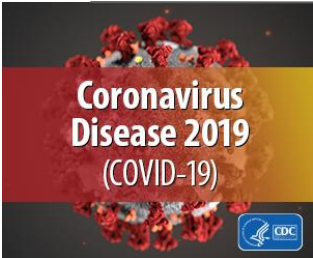
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Join us for the next Client Enrichment Series session!

eRETA Digest

February 8th, 2022 1:00pm-2:30pm

Register Now!



GSA's COVID-19 Resources for Customers

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