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Dual-Zone Solar Control Indoor Shade:

Demonstration at the Ronald V. Dellums Federal Building and U.S. Courthouse, 1301 Clay Street, Oakland, California and the Lawrence Berkeley National Laboratory Advanced Windows Testbed, Berkeley, California

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GSA's GPG program and DOE's High Impact Technology (HIT) Catalyst program enable federal and commercial building owners and operators to make sound investment decisions in next generation building technologies based on their real-world performance.

Executive Summary

Standard window shades are used to control sunlight, glare, window heat gains, and daylight. The challenge with conventional shades is that once the shades are lowered to reduce discomfort, daylight is reduced, which, in turn, increases the need for electric lighting. View is also obstructed, reducing the occupants' connection to the outdoors. The strategy of subdividing the window wall and admitting daylight from above and controlling sunlight and view through the lower aperture can yield significant energy and peak demand savings over conventional shading systems, and improve the daylight quality of the indoor environment. This study evaluated a dual zone solar control (DZSC) shade with an upper, automated, horizontal, venetian blind with concave-up, matte white slats and a lower, manually operated, roller shade made of a transparent, reflective film. The automatic controls were designed to adjust the upper slat angle to maximize daylight to the room interior. The lower shade, when lowered, provided an unobstructed view to the outdoors.

For the qualitative analysis, the DZSC shades were installed on windows in the southeast half of one floor in the Ronald V. Dellums Federal Building and U.S. Courthouse or hereafter referred to as the Oakland Federal Building (OFB) in Oakland, California. The position of the DZSC shades were observed and recorded periodically. Surveys were issued to occupants in the private offices and open plan workstations affected by the shades. For the quantitative analysis, the DZSC shades were installed in the south-facing windows of thermally isolated, fully instrumented, test chambers in the Advanced Windows Testbed at the Lawrence Berkeley National Laboratory (LBNL) in Berkeley, California. Measurements of window heat loads, daylight illuminance and environmental conditions related to visual and thermal comfort were collected over a six-month, solstice-to-solstice period. The performance of the DZSC shade was compared to fabric roller shades and venetian blinds since these are the two most common types of shades used in both commercial and Federal buildings.

Several DZSC design permutations were evaluated: 1) manual or automated control of the upper louver system ("man" or "auto") and 2) tinted or silvered reflective film for the lower shade ("Gray-Gray (GG)" or "Gray-Silver (GS)"[1]). The automated, reflective shade (auto-GS) reduced dimmable fluorescent lighting energy use by 51% and window cooling load by 13-15% compared to a conventional fabric roller shade with dual-pane, spectrally selective, low-e windows during the summer period (winter period was not measured). Qualitative analysis revealed that the auto-GS shade was preferred by 80% of the survey respondents compared to the existing vertical fabric blinds with single-pane, tinted windows in the occupied building. Survey results indicated that visual discomfort was reduced and thermal discomfort was also reduced during warm or hot weather. Occupants expressed greater satisfaction with the unobstructed view. Results are summarized in Tables 1a and 1b.

Installation and commissioning of the DZSC shades was fairly straightforward with some minor problems due to inadequate installation instructions and improper wiring. A few occupants expressed dissatisfaction with the automatic controls for the upper louvers due to visual discomfort, erroneous control, and motor noise.

[1] The labels GG and GS were product designations provided in the manufacturer's cut sheet.

Table 1a: Quantitative Performance Objectives – LBNL Advanced Windows Testbed

Objective	Success Criteria[1]	M&V Results (Baseline – Fabric Roller Shade; summer)[2]	M&V Results (Baseline – Horizontal Venetian Blind; summer and winter)[3]
Reduce lighting electricity usage	Reduce annual lighting electricity consumption by 10% in 15-ft deep perimeter zone	**Met** 51% lighting energy savings with auto-GG shade; 25% savings with man-GG or man-GS shade	**Not met** 150-300% increased lighting energy use with auto-GG, man-GG and man-GS shade
Reduce HVAC usage	Reduce HVAC energy use by 14% in 15-ft deep perimeter zone	**Met** 13-15% cooling load savings with man-GS; 4% increase in cooling load with man-GG or auto-GG.	**Not met** 5% increase in cooling load with man-GS; 30-36% increase in cooling load with man-GG or auto-GG
Control glare	Discomfort levels below glare threshold 95% of the time	**Met** Criteria met by all three DZSC configurations; below perceptible glare threshold, except when sun orb in field of view or when upper shade was raised	**Met** Criteria met by all three DZSC configurations; below perceptible glare threshold, except when sun orb in field of view or when upper shade was raised
Minimize thermal discomfort	Percentage of people dissatisfied (PPD)[4] with the thermal environment is less than 20%	**Met** PPD<10% for all three DZSC configurations	**Met** PPD<10% for all three DZSC configurations
Maximize natural daylight	Levels within acceptable range 80% of the time. Levels meet PBS P-100 guidelines.	**Met** 80% criteria met by all three DZSC configurations (roller shade daylight levels were within range for only 64% of the time)	**Met** 80% criteria met by all three DZSC configurations and the venetian blind
Cost-effective	8-10 year payback	**Not Met** 16-year payback for end-of-life replacement or new construction with the man-GS shade.	**Not Met** Energy use was increased with the DZSC shade

Note: The dual zone solar control (DZSC) shade was evaluated with three configurations, where **auto**=automated control of upper zone daylight-redirecting blinds (tilt and raise/lower function), **man**=manual control of upper zone (lowered and tilted to angle for noon hour), **GG**=tinted gray-gray lower roller shade film; **GS**=reflective, gray-silver, lower roller shade film; the lower roller shade was tested at a fully lowered position.

[1]Manufacturer claims were in comparison to a fabric roller shade, which is what is installed in the majority of commercial buildings. The GSA portfolio has more venetian blinds than roller shades.

[2] Fabric roller shade tested at LBNL Windows Testbed; summer only.

[3] Horizontal, white venetian blinds tested at LBNL Advanced Windows Testbed; summer 40° and winter 58° slat angle. The blinds did not provide sufficient glare control so if closed to reduce glare, lighting energy use would have increased and cooling loads would have decreased. Lighting and HVAC energy use results given as the average of both summer and winter periods.

[4] The thermal comfort metric Percentage People Dissatisfied (PPD) is defined in Section IIC-1d.

Table 1b: Qualitative Performance Objectives – Oakland Federal Building

Objective	Success Criteria	M&V Results (Baseline – Vertical Venetian Blinds)[1]
Ease of Installation	Less than one day to install and commission	**Met** – the incremental time needed to install the additional components (upper shade, sensors, power, controls) was completed in one day[2] for the entire installation
Maintenance	No increase in cleaning requirements for fingerprints and dust	**Met** – there was no increase in cleaning requirements; there was no evidence of fingerprints or dust on the lower window film four months after installation
Operability	Operation of the shades was satisfactory to the majority of the occupants	**Met** – there were five survey respondents who expressed dissatisfaction with the automated control of the upper DZSC shade out of a total of 51 occupants in the private and open plan office area (16 of whom sat next to the windows)
Visual comfort	Increased visual comfort compared to the original condition	**Met** – Visual discomfort due to glare from the window was reduced with the DZSC shade compared to the original window. This result was statistically significant for the lower window.
Thermal comfort	Increased thermal comfort	**Met** – There was a reduction in the perception of heat from the window with the DZSC shade by most occupants compared to the original window.
Increased satisfaction	Increased occupant satisfaction	**Met** – 80% of the survey respondents preferred the DZSC shades compared to the windows in the original condition.
Preservation of view	Maximized views to the outdoors	**Met** – The number of survey respondents who liked their view increased from 8 before to 12 after the DZSC shades were installed. Sixteen occupants were seated next to the windows. The remaining were in open plan offices with high partitions and limited access to view.

[1]Qualitative M&V results were based survey and service log data collected in the Oakland Federal Building (see Section IIC-2).
Vertical venetian blinds were the base case at the Oakland Federal Building (OFB). The DZSC shades were installed March 6, 2017, and surveys were issued May 30, 2017, three months later. Both GS and GG shades with automated upper louvers (see Table 3 and Figure 8) were installed on the southeast side of one upper floor of the building.
[2]The entire installation took one three-day weekend. Data from the rooftop sensors could be used for control in other areas and floors of the building if the total job scope was larger than this demonstration.

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I. Introduction

A. WHAT WE STUDIED

Standard window shades are used in buildings to control sunlight, manage window heat gains and reduce discomfort. Once lowered, shades often remain lowered, resulting in an unnecessary reliance on wasteful artificial lighting. Dual-zone indoor shades address this problem by integrating two separate daylight control strategies into a single unit—an upper shade that maximizes daylight harvesting and a separate lower shade that controls glare and reduces window heat gains and losses.

In this study, a dual-zone solar control (DZSC) indoor shade was evaluated for commercial office building applications (Figure 1) where:

- The upper clerestory zone consisted of motorized, inverted horizontal louvers that were automatically adjusted based on sun angle and outdoor daylight conditions to increase daylight to the indoor space; and
- The lower view zone consisted of a manually operated roller shade made of a metalized reflective transparent film designed to reduce solar heat gains and maintain outdoor views.

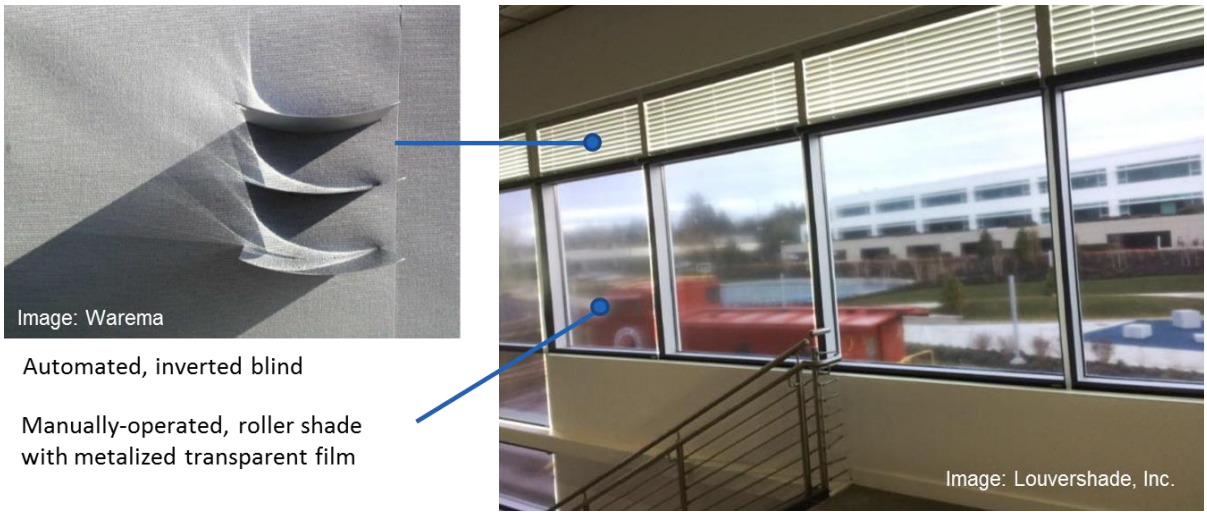


Figure 1. Example installation of the dual-zone solar control indoor shade.

B. WHY WE STUDIED IT

In 2015, total U.S. energy use due to the commercial building sector was 18.2 quadrillion Btu (quads, or $1x10^{15}$ Btu), or 19% of the total primary energy use dedicated to supporting the buildings, industrial and transportation sectors in the United States (buildings are the single largest sector of energy use) [D&R International, 2012].

Of the total primary energy use, 4.13 quads (23%) is due to space heating and cooling and 3.05 quads (17%) is due to lighting. Fenestration shading and daylighting attachments, such as the one in this study, influence heating, ventilation and air conditioning (HVAC) and lighting energy use.

- Of the total heating and cooling loads in commercial buildings, 32% of the cooling load is due to solar heat gains through windows and 21% of the heating load is offset by solar gains through windows.[2] The net impact of solar heat gains on primary energy use is 0.50 quads.
- Of the total heating and cooling loads in commercial buildings, 8% of the cooling load is offset by conductive loads through windows and 22% of the heating load is due to conductive loads through windows. The net impact of conductive heat gains and losses on primary energy use is 0.57 quads.
- Daylight through windows already reduces lighting energy use in buildings. More effective use of daylight would result in an estimated 1 quad of additional electric lighting energy use savings.

In combination, solar control and daylighting technologies can affect a total of 2.07 quads (11%) of total primary energy use in the commercial building sector. A detailed analysis to estimate U.S. technical potential has not been conducted. If a 14% reduction in cooling load and 10% reduction in lighting energy use is attained with the DZSC shade across the commercial building sector, then primary energy use would be reduced by 170 TBtu (1.7×10^{12} Btu), a savings of $1.63 billion.

II. Evaluation Plan

A. EVALUATION DESIGN

The manufacturer (Louvershade, Inc.) claimed that its DZSC technology could deliver 10% lighting energy savings and 14% HVAC energy savings compared to a fabric roller shade, and provide additional non-energy benefits of improved access to exterior views and improved tenant satisfaction with thermal comfort. Stated benefits were as follows:

ENERGY EFFICIENCY

The manufacturer estimated greater than 10% annual lighting energy savings, as well as 14% annual HVAC energy savings, when compared with a fabric roller shade.

COST-EFFECTIVENESS

Payback was estimated at between 8 and 10 years, assuming advanced lighting controls were already in place. Installed costs range between $\$12/ft^2$ and $\$14/ft^2$; motorization and automated systems add between $\$10/ft^2$ and $\$15/ft^2$. Costs are given per unit area of the window.

OPERATIONS & MAINTENANCE

Installation is simple with minimal impact on the building. Maintenance and cleaning is similar to that of other interior shades.

[2] This is a total for the entire U.S. commercial building stock. The percentage of cooling and heating energy use and loads due to solar gains varies by individual building type, climate zone, and actual operating conditions.

OCCUPANT SATISFACTION

By controlling glare, maximizing available natural daylight and minimizing uncontrolled heat gain and heat loss, dual-zone shades promise to increase visual and climate-related occupant satisfaction.

DEPLOYMENT POTENTIAL

The technology is best suited to open-plan offices with partitions that are less than 48 inches in height, and windows with a head height of greater than 9 feet that have unobstructed access to direct sunlight with minimal exterior attachments.

B. TESTBED SITE

1 TEST LOCATION

Evaluation of the DZSC technology occurred at two locations:

1) **Ronald V. Dellums Federal Building and U.S. Courthouse, 1301 Clay Street, Oakland, California**. *Qualitative* performance of the DZSC technology, such as ease of installation, maintenance and occupant comfort and satisfaction, was evaluated on the seventh floor in a 20,000 ft.^{2} installation over a six-month period. The demonstration involved open plan and private offices with full-time occupants working on-site during daytime hours. This site was selected because it was located in a sunny climate, had large-area, south-, east- and west-facing, single-pane windows, and was configured with both open plan and private office layouts. Both the tenants and the local facilities management team were supportive of the study. Site selection criteria are given in Appendix A1.

2) **Advanced Windows Testbed (Building B71T) at the Lawrence Berkeley National Laboratory (LBNL), Berkeley, California**. *Quantitative* performance was evaluated in three, side-by-side, calibrated, thermally isolated test chambers designed to emulate 10x15x9 ft. private offices, each with a large south-facing window, over a six-month, solstice-to-solstice period. This facility enabled a significantly more accurate assessment of lighting energy use, HVAC load and visual and thermal comfort without inconveniencing the occupants in the Ronald V. Dellums Federal Building and U.S. Courthouse or hereafter referred to as the Oakland Federal Building (OFB).

2 WHAT WAS TESTED

a DZSC shade

There are a wide variety of possible DZSC shade material and control options. This demonstration selected the options that best met the performance and aesthetic requirements of the project.

- For the upper zone, inverted horizontal louvers with a white, semi-gloss finish were selected. Two modes of operation were evaluated: automated (“auto”) or manually operated (“man”).
- For the lower zone, a “GS” transparent metallized reflective film (metallized polyethylene terephthalate, or MPET) or a “GG” transparent tinted film was used for the roller shade. The height of the roller shade was manually adjusted.

- When automated, the upper shade was raised when cloudy and lowered when sunny. Sunny conditions were determined by a vertical outdoor photosensor mounted on each façade orientation. The slat angles of the louvers were adjusted on a pre-calculated schedule, if conditions were sunny. The schedule was based on solar position relative to the facade. The louver slat angle was tilted to prevent admission of downward transmitted sunlight into the space.
- At the OFB, the automatic controls could be manually overridden using a wall switch located on the wall outside the offices. When manually operated, occupants could raise and lower the blind and adjust the slat position. The manual override would affect all shades (and, therefore, multiple private offices) connected to the single motor controller and wall switch.

b Reference shades

The performance of the DZSC technologies was compared to three reference conditions that were defined and agreed upon by the project team. The basis for the reference conditions was knowledge of conventional practice in commercial buildings and, for the federal sector, standard practice by the U.S. General Services Administration (GSA).

- In the OFB, the existing shading system consisted of manually operated white vertical fabric blinds. In two offices, a white plastic backing had been installed on one side of the fabric blind to reduce visual and thermal discomfort.
- In B71T, two reference conditions were evaluated:
    1) A horizontal white venetian blind was installed to cover the entire window. The slat angle was set to a cut-off angle to block direct sun. This reference condition is the standard shading system used in GSA buildings.
    2) A light gray basketweave roller shade with a 3% openness factor was installed and lowered to a height of 2.1 ft. above the floor. This reference condition is common in many commercial buildings.

Tables 2-4 summarize the test configurations and comparisons that were made at each testbed site. Figures 2-17 illustrate the test conditions. Additional details of the test conditions at each site are given in Appendices A2 and A3.

Table 2. Summary of reference and test conditions at each site

Site	OFB	B71T
Location	Oakland, CA	Berkeley, CA*
Space type	17 private and 34 open plan offices	3 private offices
Window-to-wall ratio	0.40	0.59
Window orientation	SE, S, E, NW	Due south
Existing glass	Single-pane, green tinted glass	Dual-pane, low-emittance glass
SHGC	0.60	0.40
Tvis	0.75	0.62
U-value (Btu/h-ft^2-°F)	0.96	0.30
Existing frame	Non-thermally broken aluminum	Thermally broken aluminum
Reference indoor shade	Manually operated, 4-inch wide, vertical fabric blinds; opaque white backing on shades in 3 private offices	**VB**: 1-inch wide, horizontal venetian blinds fully lowered, blocking slat angle (58° winter, 40° summer); or, **RS**: Fabric roller shade lowered to 2.1 ft. above the floor
Test indoor shade		
Upper shade	Automated, inverted white horizontal louvers with manual override	**Auto**: Automated, inverted white louvers or **Man**: "Manually" operated, static, inverted white louvers
Lower shade	Manually operated, GS reflective roller shade; GG tinted roller shade used in three locations (SE and E private offices); header installed at 7 ft. above the floor	**GS**: Static, fully lowered GS reflective roller shade; header installed at 6.5 ft. above the floor or **GG**: Static, fully-lowered GG tinted roller shade; header installed at 6.5 ft. above the floor

Notes:
SE=southeast, S=south, E=east, NW=northwest; SHGC: solar heat gain coefficient; Tvis: visible transmittance.
* The climates in Berkeley and Oakland are nearly identical since the two cities are immediately adjacent.

Table 3. Reference and test case comparisons at the OFB site

	Reference case	Test case
Northwest office	Manual, vertical blinds	Manual upper louvers and GS lower shade
SE, S and E offices	Manually operated, vertical blinds	Automated* upper louvers with manual GS lower shade
Two SE, one E office	Manually operated, vertical blinds with opaque backing	Automated* upper louvers with manual GS lower shade
Three offices (SE, E)	Manually operated, vertical blinds	Automated* upper louvers with manual GG lower shade

* with manual override

Table 4. Reference and test case comparisons at the B71T site

	Reference case 1	Test cases	Reference case 2
Winter	**VB-58**: Venetian blind, fully lowered, slat angle 58°	**Auto-GG**: automated upper slats; GG lower shade fully lowered	
	Same as above	**Man-GG**: fixed upper slats* at 53°; GG lower shade fully lowered	
	Same as above	**Man-GS**: fixed upper slats* at 53°; GS lower shade fully lowered	
Summer	**VB-40**: Venetian blind, fully lowered, slat angle 40°	**Auto-GG**: automated upper slats; GG lower shade fully lowered	**RS**: Roller shade lowered to 2.1 ft. above the floor
	Same as above	**Man-GG**: fixed upper slats* at 0°; GG lower shade fully lowered	Same as above
	Same as above	**Man-GS**: fixed upper slats* at 0°; GS lower shade fully lowered	Same as above

* Slat angle of upper "manually operated" louvers was set to 53° (winter) and 0° (summer). The slat angle was selected based on the angle the automated system would have used at noon had it been in control.

Figure 2. Outdoor view of the Oakland Federal Building north tower.

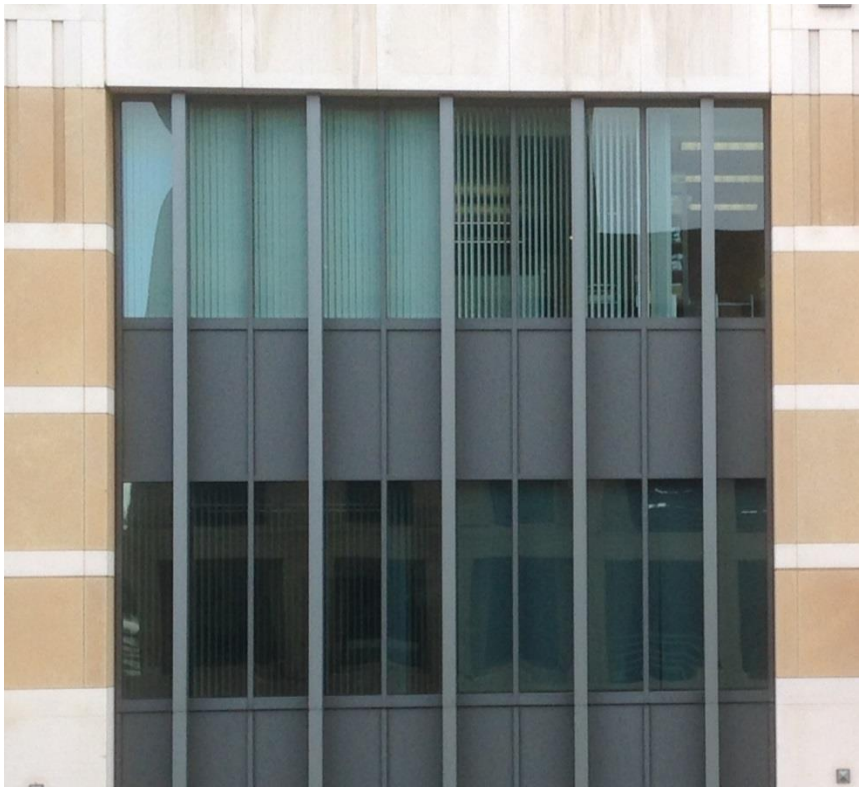


Figure 3. Outdoor view of the Oakland Federal Building with existing vertical blinds in fully closed position (upper left row of windows), partially open and fully drawn positions.

Figure 4. Indoor views of the existing indoor vertical blind system in the Oakland Federal Building. Upper left: blind with white opaque backing; lower left: fabric blind without backing, which was typical throughout the building.

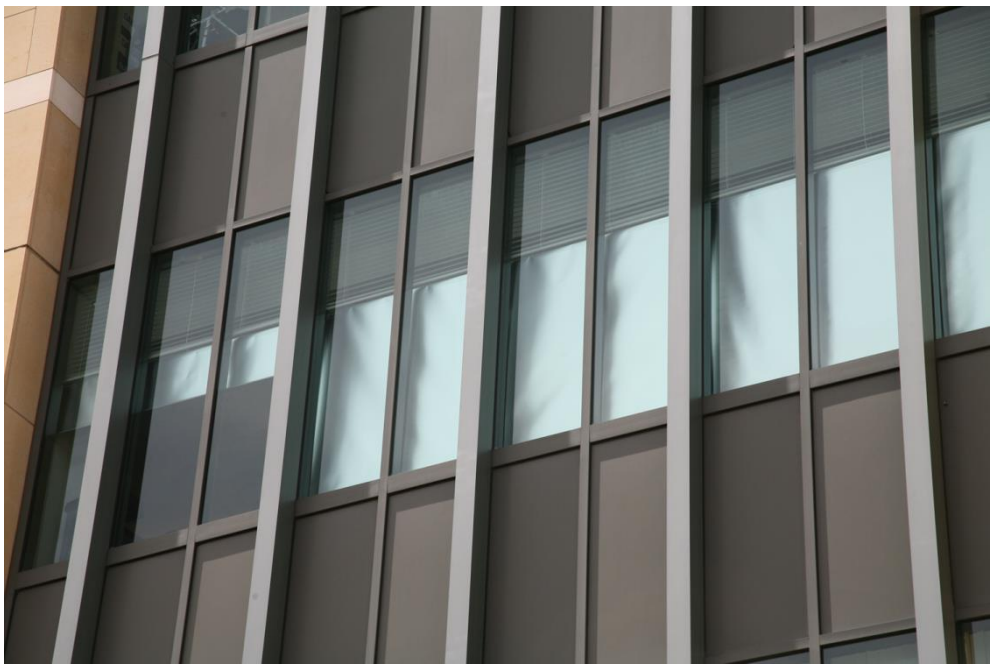


Figure 5. Outdoor view of the Oakland Federal Building with automated upper louvers and lower manually operated GS (bright white) shades on the southeast facade. On the left, the lower GS shades are partially raised. The remaining GS shades are fully lowered.

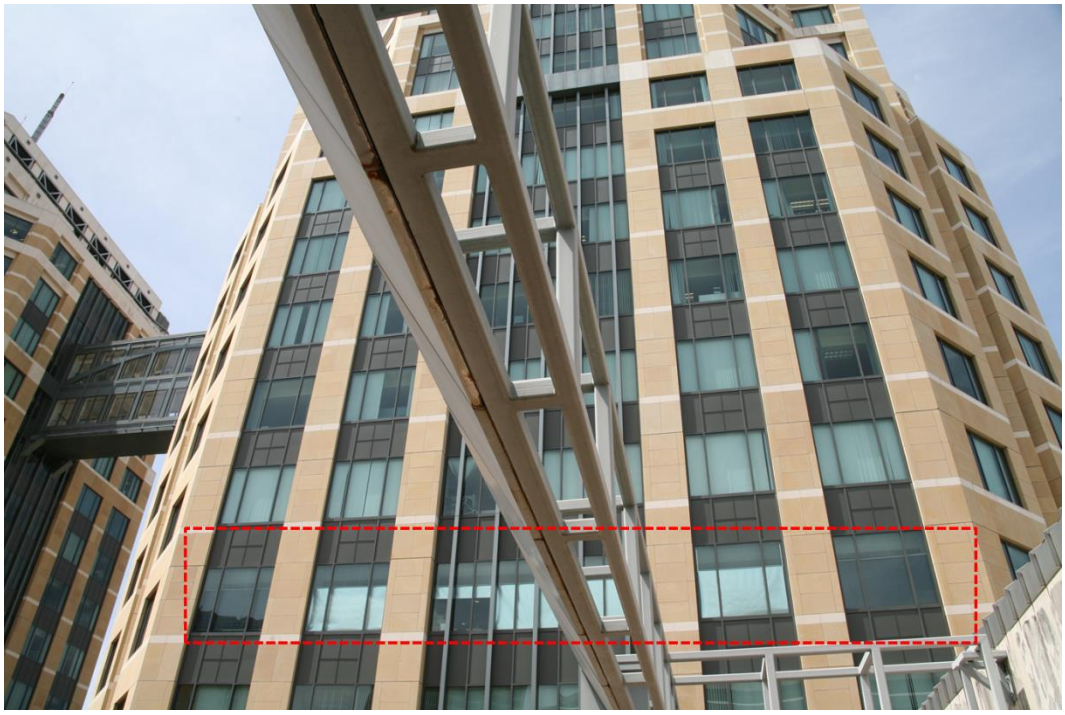


Figure 6. Outdoor view of the Oakland Federal Building with manually operated GS (bright white) and GG (dark gray) shades on the southeast facade.

Figure 7. Outdoor view of the Oakland Federal Building with automated upper louvers and lower manually operated GS (bright white) or GG (dark gray) shades on the southeast facade.

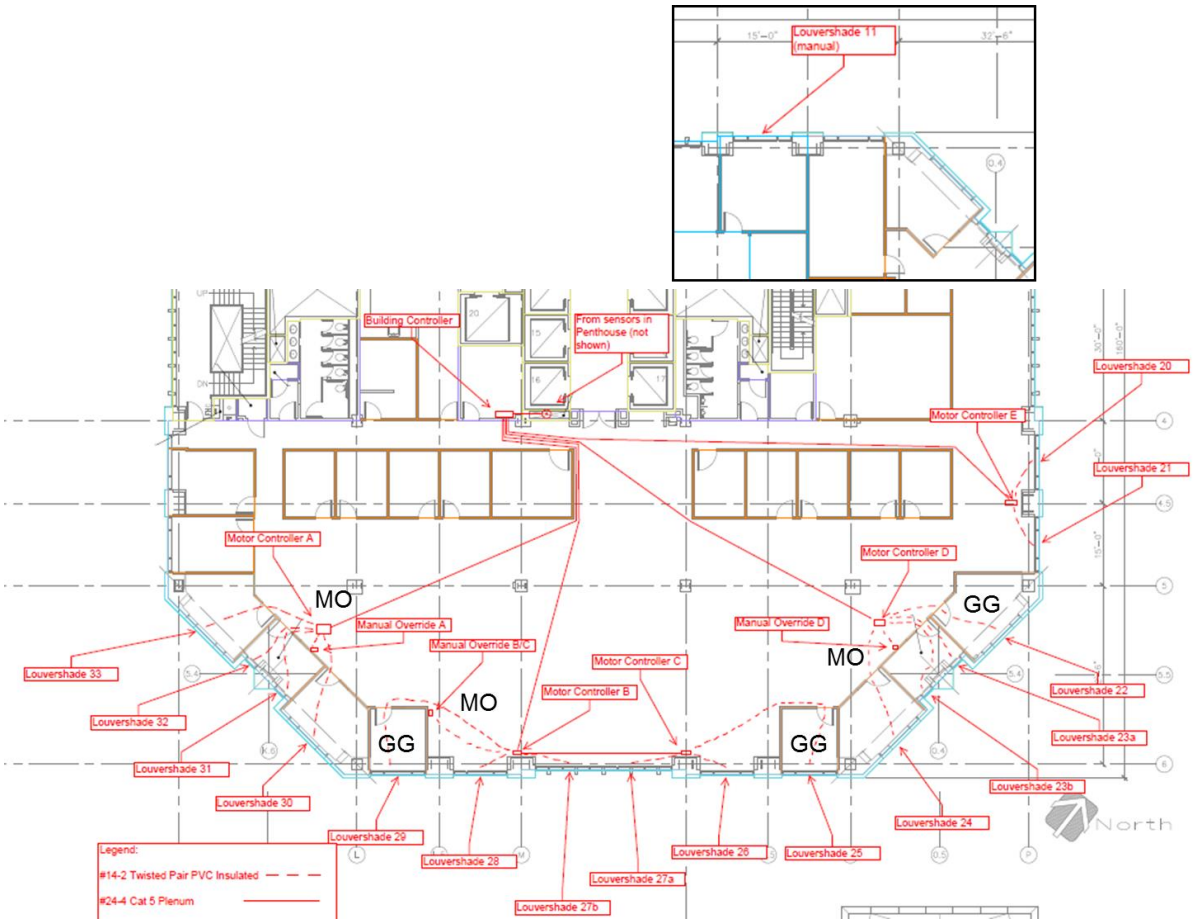


Figure 8. Floor plan of south section of the floor in the Oakland Federal Building with automated upper louvers and lower manually operated GS shades on the facades, except in three offices with GG shades. Manual override ("MO") switches were located on the wall outside the private offices and controlled multiple groups of shades. The inset shows the location of the northwest office with manually operated upper and lower DZSC shades.

Figure 9. Indoor view of a southeast-facing office in the Oakland Federal Building with automated upper louvers and lower manually operated GS shades on the southeast facade. The GS shade is fully lowered in this photograph.

Figure 10. Indoor view of the northwest-facing office in the Oakland Federal Building with manually operated upper louvers and manually operated lower GS shade. The GS shade is partially lowered in this photograph.

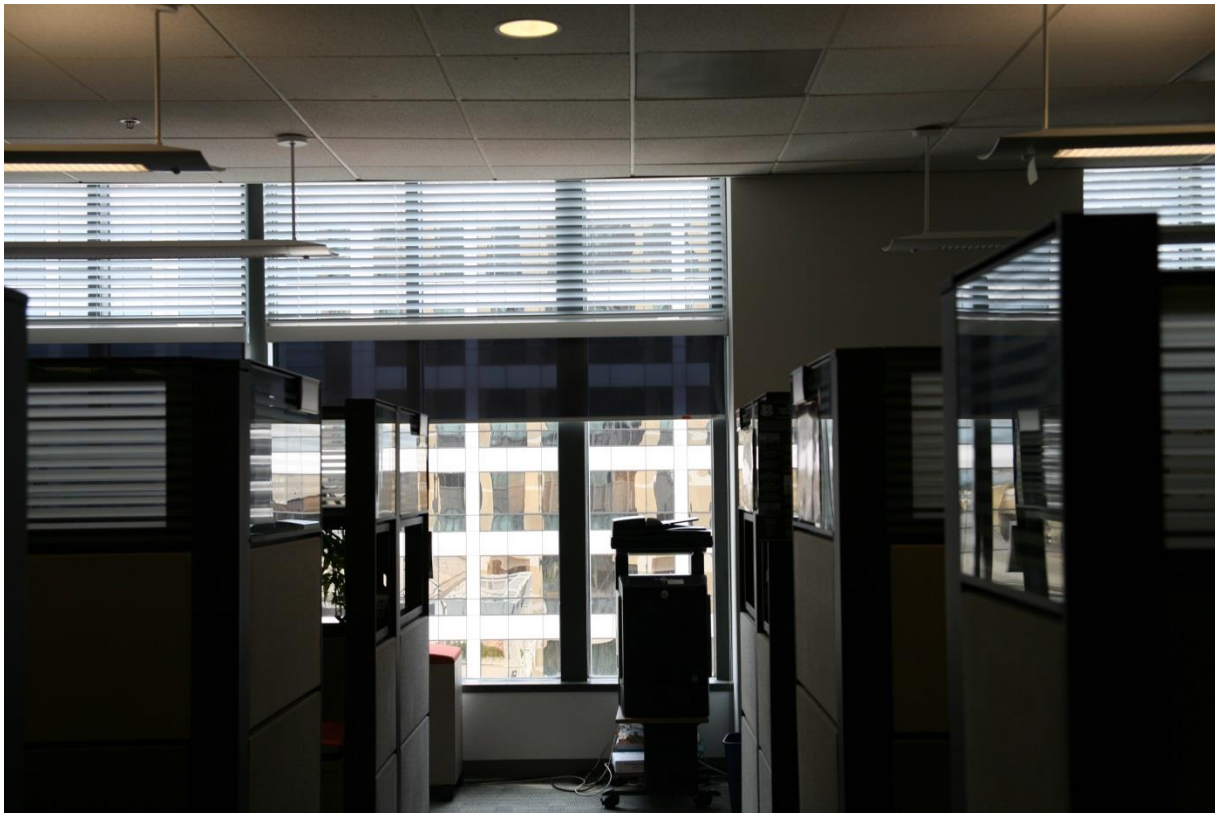


Figure 11. Indoor view of the southeast-facing open plan office area in the Oakland Federal Building with automated upper louvers and manually operated lower GS shade. The GS shade is partially lowered in this photograph. Workstation partitions were 5.5 ft. high.

Figure 12. Close-up view of reflected daylight off the upper white louvers in the Oakland Federal Building.

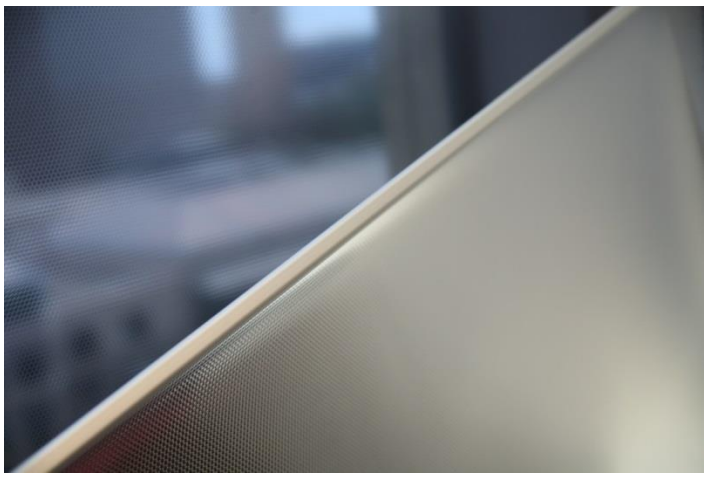


Figure 13. Close-up view of the lower GS roller shade in the Oakland Federal Building: upper area shows the slightly diffused view through the film and the lower area shows the slightly textured reflective back side of the same film.

Figure 14. Exterior view of the LBNL Advanced Windows Testbed (B71T). The auto-GG shade is shown in the middle test chamber. A conventional roller shade (left) and venetian blind (right) are shown in the other two test chambers.

Figure 15. Exterior view of B71T. Left: Man-GS reflective roller shade. Right: Auto-GG tinted roller shade.

Figure 16. Exterior view of B71T. Left: Outdoor view of the reference venetian blind. Right: Indoor view of the reference fabric roller shade.

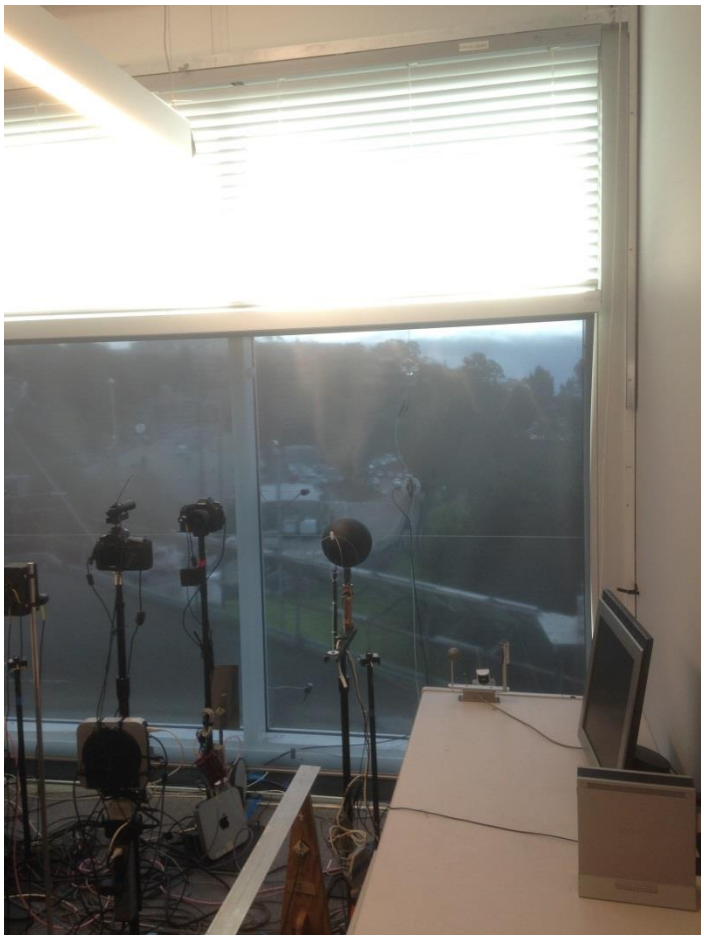


Figure 17. Indoor view of the DZSC shade in B71T.

C. METHODOLOGY

The technical objectives of the study were to determine whether use of the DZSC shades resulted in:

- Significant HVAC and lighting energy use savings;
- Occupant comfort, acceptance and satisfaction with the technology and the resultant indoor environment being the same or improved;
- Economic payback of 8-10 years, assuming that lighting controls are already in place; and
- Simple installation and maintenance requirements that are similar to that of conventional shades.

Strong evidence of positive performance in all of these categories would indicate the suitability of the shades for further deployment in commercial office buildings.

1 QUANTITATIVE STUDY DESIGN – LBNL ADVANCED WINDOWS TESTBED

The quantitative evaluation was conducted in the LBNL Advanced Windows Testbed (B71T) over the winter and summer solstice periods from November 21, 2016, to June 19, 2017. During the winter period, the venetian blind reference condition (static venetian blind, 58° tilt angle (VB-58)) and three DZSC test conditions were evaluated. During the summer period, the roller shade reference condition was added to the tests. Test conditions are summarized in Table 4, above.

Simultaneous measurements between the three test chambers enabled comparisons of performance under identical weather conditions. Measurements were performed as described in the below sections. Sensors used for the test are listed in Table 5 – all points were sampled once per second and the average recorded every minute. A detailed schedule of tests is given in Section II.D.3.

Table 5. Instrumentation at the OFB site

Monitored variable	Sensor	Range, accuracy
Indoor workplane and vertical illuminance	Li-cor LI-210SA photometer	13,000 lux, ± 3 lux
Indoor air temperature, shielded	High stability thermistors, YSI 46016	<0.01°C drift at 70°C for 100 months
Indoor mean radiant temperature	U.S.Sensor, Digi-Key 615-1003-ND thermistor	-40° to 100°C, ± 0.2°C
Indoor relative humidity	HOBO ZW-003	10 to 90% RH, ± 2.5%
Indoor air velocity	F900-O-5-1-9-2 Omnidirectional	0.015 to 6 m/s
Energy use (lighting, heating, fan, equipment)	Ohio Semitronics GW5	0.2% of reading
Chilled water flow	Turbine flowmeter, Hoffer 3/8 in.	Linear flow range 0.75-7.5 gpm
Chilled water inlet and outlet temperatures	High stability thermistors, YSI 46016	<0.01°C drift at 70°C for 100 months
Outdoor global and diffuse horizontal irradiance	Delta T SPN1	0-5000 W/m^2, ± 1.2 W/m^2
Outdoor dry-bulb temperature, shielded	High stability thermistors, YSI 46016	<0.01°C drift at 70°C for 100 months
HDR imaging for room luminance	Canon EOS 60D camera	

a Lighting energy savings

Lighting energy use was computed based on monitored workplane illuminance (Figures 18-19). A dimmable fluorescent electric lighting system with an installed lighting power density of 1 W/ft^2 was assumed. If the average workplane illuminance from daylight monitored at a 1-min interval at 12.5 ft. from the window was less than the setpoint illuminance of 300 lux, then the electric lights were assumed to top up the lighting level so that the average was 300 lux. The light-to-power dimming

relationship was linear from minimum (20% power, 5% light output) to full power (100%), with a standby power of 30 W when the lights could be turned off due to sufficient daylight. Lighting energy use was computed at a 1-min interval and summed over the period of 8 AM to 6 PM local time.

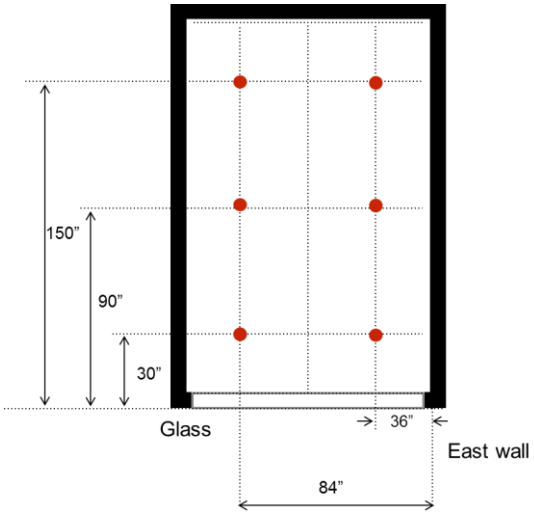


Figure 18. Floor plan of B71T test chamber showing location of workplane illuminance sensors at 2.5, 7.5, and 12.5 ft. from the window.

Figure 19. Photograph of B71T test chamber showing location of workplane illuminance sensors.

b HVAC load

Net heat flow (heating and cooling loads) due to the window and DZSC system was determined from measurements of chilled water supply, difference in inlet and outlet chilled water temperature and reheat energy for each dedicated fan coil unit that supplied heating and cooling to each test chamber. Heat from plug loads, fan and lighting end uses were removed from the calculation, assuming 100% conversion of energy to heat, to isolate the measurement to net heat flow from the window. Thermal conditions in and surrounding each of the test chambers were maintained at a fixed temperature (72±1°F) to minimize heat flow through the ceiling and walls of the chamber. Each test chamber was thermally isolated from adjacent test chambers, the exterior walls and roof. The floor was heavily

insulated to minimize heat flow to the crawl space below. More detailed information can be found in the following report [Lee *et al*., 2009].

Measurements of net heat flow with unshaded windows were made for a minimum of two weeks prior to each measurement period to calibrate the test cells. Hourly measurement error was 20-60 W between test cells, with the smaller error associated with sunny periods when cooling loads were high. During DZSC test periods, daily cooling load was determined by summing net heat flow measurements made at a 1-min interval over the period from 8 AM to 6 PM local time. The peak cooling load was defined as the maximum hourly load that occurred over the 8 AM to 6 PM period (where 12 PM corresponded to 12-12:59 PM average). Peak cooling reductions were computed based on non-coincident loads in the reference and test rooms.

c Visual comfort

Discomfort glare was evaluated by measuring the pattern of brightness or luminance within the field of view using a calibrated high dynamic range (HDR) imaging system at a 5-min interval, then computing the daylight glare probability (DGP) value from these measurements using the *evalglare* software tool [Wienold 2012]. The DGP metric was derived from thousands of HDR measurements taken within a full-scale daylit environment that were correlated to subjective response data [Wienold 2009]. In this study, DGP was computed using *evalglare* assuming that the occupant was performing a computer-based task.

Measurements were taken at four locations within each test room at a seated height (4 ft. above the floor) with views parallel, facing toward and facing away from the window (Figures 20-21). Indoor lighting levels were maintained at all times at a minimum level of 300 lux at the workplane to ensure that room luminance levels were kept at typical levels during periods of low daylight. DGP data over the period from 8 AM to 6 PM local time were then summarized by "class" based on the 95% percentile value and upper 5% percentile value (Table 6). Class A denotes a day when discomfort levels were minimal for a large percentage of the day. Class D denotes a day when discomfort levels were uncomfortable for a large percentage of the day.

Table 6. Daylight glare probability classes

Max DGP of 95% of period		Avg DGP of 5% of period	Class	Meaning
≤ 0.35 imperceptible	and	≤ 0.38 perceptible	A	Best
		> 0.38	B	Good
≤ 0.40 perceptible		≤ 0.42 disturbing	B	Good
		> 0.42	C	Reasonable
≤ 0.45 disturbing		≤ 0.53 intolerable	C	Reasonable
		> 0.53	Discomfort	Discomfort
> 0.45 disturbing		> 0.53	Discomfort	Discomfort

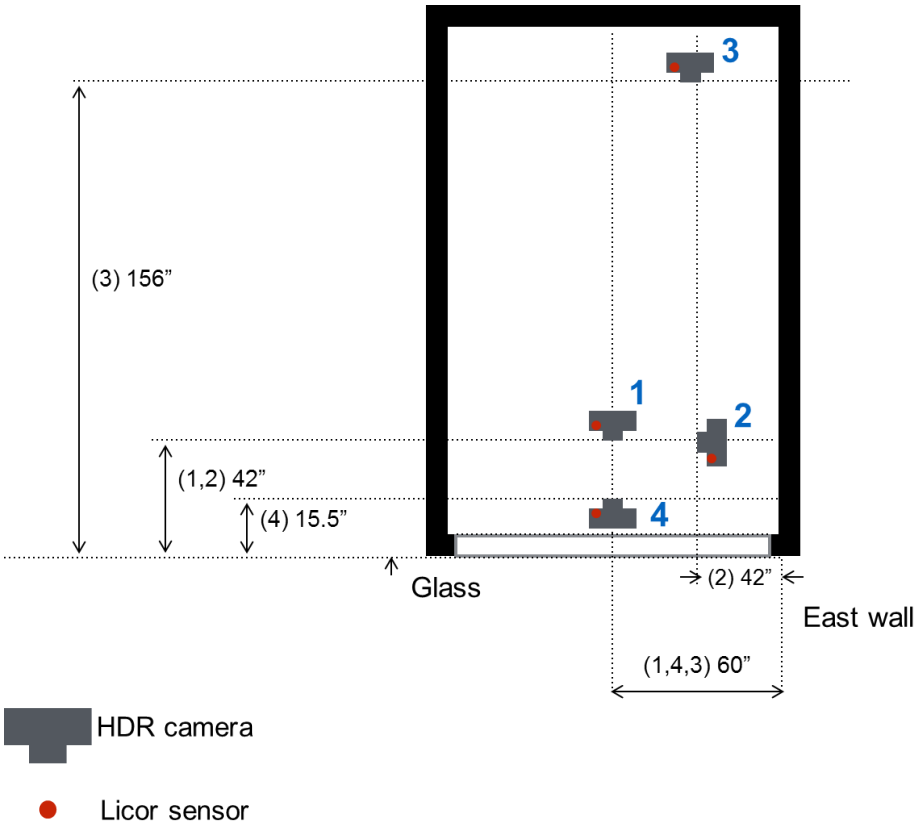


Figure 20. Location of HDR sensors in the B71T test chambers.

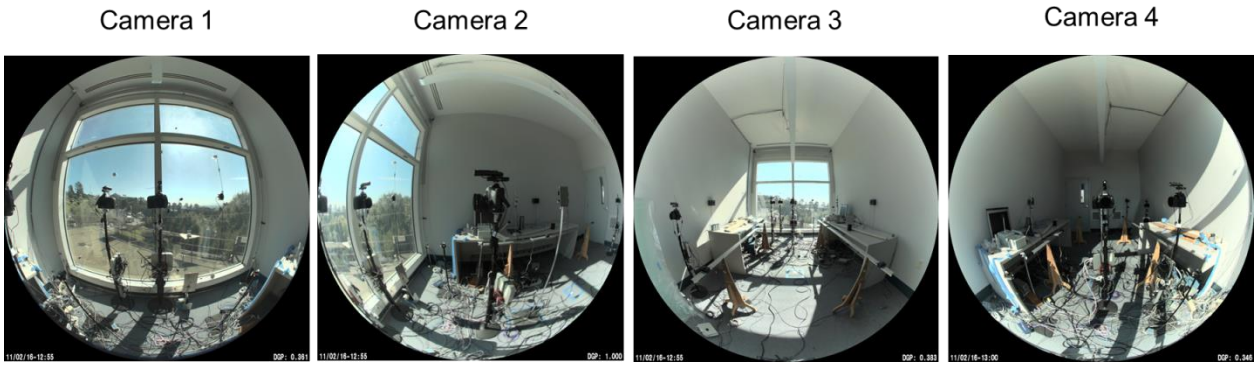


Figure 21. Fisheye views from the HDR sensors in the B71T test chambers.

d Thermal comfort

Various environmental variables related to thermal comfort – air temperature, globe temperature, air velocity, relative humidity – were measured 3 ft. from the window, 3 ft. from the west side wall and 4 ft. high at a 1-min interval using instrumentation listed in Table 5. These data were used to compute Fanger's predicted mean vote (PMV) and predicted percentage of dissatisfied (PPD) over the 8 AM to 6 PM local time period [Fanger 1970]. A moderate level of office clothing (long pants, long-sleeve shirt, lightweight jacket, clo = 1.1) and a sedentary activity level (typing) was assumed (met = 1.1).

PMV and PPD values were defined as:

- PMV value, which provides information on how occupants will perceive the space's thermal conditions (values range from -3 to 3; values of -3, -2, -1, 0, 1, 2, 3 imply the space being perceived as "cold," "cool," "slightly cool," "neutral," "slightly warm," "warm," and "hot", respectively) and
- PPD value, which represents the percentage of people who would be dissatisfied with the thermal conditions in the space.
- Target values between -0.5 and 0.5 for PMV and below 20% for PPD meet the ASHRAE 55 Standard for thermal comfort [ASHRAE 2013].

e Daylight quality

Useful daylight illuminance (UDI) provides a method of evaluating the adequacy of daylight in a space, based on the percentage of time when illuminance levels are excessive, within an acceptable range or are too low. A space where the majority of the time the daylight illuminance levels are in the "too low" or "too high" ranges of illuminance defined by the UDI would be considered inadequately daylit and gloomy or too bright and glary, respectively [Nabil and Mardaljevic 2005].

Average workplane illuminance at 7.5 ft. from the window was monitored at a 1-min interval from 8 AM to 6 PM local time in each of the three test chambers, then these data were binned based on three ranges of illuminance: 0-100 lux, 100-2000 lux and greater than 2000 lux. A daylighting system that is able to deliver daylight to the workplane within the range of 100-2000 lux for the majority of the day is considered successful in delivering qualitatively acceptable daylight.

2 QUALITATIVE STUDY DESIGN – OAKLAND FEDERAL BUILDING

a Occupant surveys

Occupant comfort and satisfaction with the DZSC technology were evaluated using a survey that was issued to occupants located in 17 private offices with windows and 34 open plan offices (10 located within 5 ft. from the window) at the southeast side of the seventh floor. Occupants were asked to respond to questions concerning the conditions before and after the installation of the DZSC technology (see Appendix A6 for survey questions). The surveys were developed in collaboration with GSA and approved by the LBNL Human Subjects Review Committee.

Surveys were issued by GSA to occupants who had been working in the demonstration area for at least six months prior to the study and for the entire duration of the period after the DZSC had been installed.

Participation in the study was voluntary. The goal was to obtain survey data from 30 occupants[3] seated within 5-10 ft. of the window (surveys issued to 30 or more occupants). The paper-based survey was issued May 30, then collected two weeks later. A total of 21 surveys were received.

b Blind surveys

The positions of the existing shades and the DZSC technology were recorded by GSA every two weeks starting after the DZSC was installed and fully commissioned to the end of the summer solstice monitoring period (April 4 to July 3). An assessment of the physical condition of the DZSC was made every month to determine whether the shades had been damaged by occupant handling of the shade, particularly the lower roller shade made of the transparent film. Observations were to include any noted fingerprints, smudges, crumpling of film, or any other damage to the lower roller shade and dust accumulation, misalignment between blind slat angle, quality of motion when activated, and motor noise of the upper motorized blind.

c Service log

GSA maintained a service log that recorded service requests made by the occupants in the DZSC demonstration area. The requests were resolved in consultation with the manufacturer.

3 DATA ANALYSIS

a Measured data at the B71T site

To derive annual energy savings from limited monitored data collected at B71T, timestep data were summarized to daily values, then correlated to the reference case data over the measurement period. There were several challenges that prevented this from occurring with the intended level of conclusiveness. First, the initial study was designed to measure one test condition and to compare the results to one reference condition over three two-week measurement periods corresponding to the equinox and winter and summer solstices. A two-week period of measurement is typically sufficient to capture the range of typical sun and sky conditions. The six-month, solstice-to- solstice period captures the range in sun angles that occur over the course of a year. However, GSA was concerned with the outdoor appearance of the GS reflective shade when it first observed the installation at the start of the B71T field test and requested that the GG tinted shade also be evaluated. They also wanted to quantify the difference in performance for the manually operated versus automated upper DZSC louver system. These additional test conditions were added, so the period per test configuration had to be shortened as a result.

During the winter solstice period, measurements made from November 21, 2016 to February 2, 2017, in one test room were determined to be invalid due to a faulty DZSC motor. The motor was replaced and a new set of measurements were made between January 27 to February 28, 2017. Since this 15-week period well exceeded the intended two-week period, the March 21 equinox measurement period (which was fairly close to the February 28th end date) was eliminated.

During the summer period, the roller shade reference condition was also added. Originally, GSA indicated that venetian blinds were the standard shading system for the Federal commercial building

[3] A sample size equal to or greater than 30 subjects enables researchers to determine whether the observed effect reflects the characteristics of the general population rather than a random sampling error).

stock. Roller shades, which constitute 70-80% of the market in typical commercial buildings, were later added to the test conditions. Measurements were taken from May 16 to June 19, 2017.

Results from each of the comparisons are, therefore, indicative of potential annual performance due to a) the limited range of solar conditions and b) limited number of days per solar condition and DZSC comparison. A summary schedule of the B71T test is given in Table 7.

Table 7. Test schedule for the monitored evaluation in the Advanced Windows Testbed (B71T)

Test period	Dates	Notes
Winter solstice	Nov 21 to Feb 2 (15 weeks)	Faulty DZSC motor
Winter to equinox	Jan 27 to Feb 28 (4 weeks)	Successful test
Summer solstice	May 16 to Jun 19 (5 weeks)	Successful test

b Occupant survey data at the OFB site

Occupant survey data were analyzed on a per question basis, where survey responses were given typically on a nine-point Likert scale. Comments were reviewed and summarized based on the nature of the posed question. Analysis centered on subjective impressions of the DZSC system in comparison to the prior existing shade condition (which remained installed on the north side of the same floor). Statistical significance was assessed, at the 95% level (i.e., p-value < 0.05), by an equal variance two-tailed t-test. A summary schedule of the OFB test is given in Table 8.

Table 8. Test schedule for the qualitative evaluation in the Oakland Federal Building (OFB)

Test period	Dates	Notes
Test 1	March 6 to May 18 (11 weeks)	Faulty sensor placement
Test 2	May 19 to September 30 (19 weeks)	Correct sensor placement
Blind surveys	April 14 to July 3	Conducted by GSA
Occupant surveys	May 30 to June 9	Issued for 2 weeks

III. Demonstration Results

A. QUANTITATIVE RESULTS FOR THE ADVANCED WINDOWS TESTBED (B71T) SITE

1 LIGHTING ENERGY USE

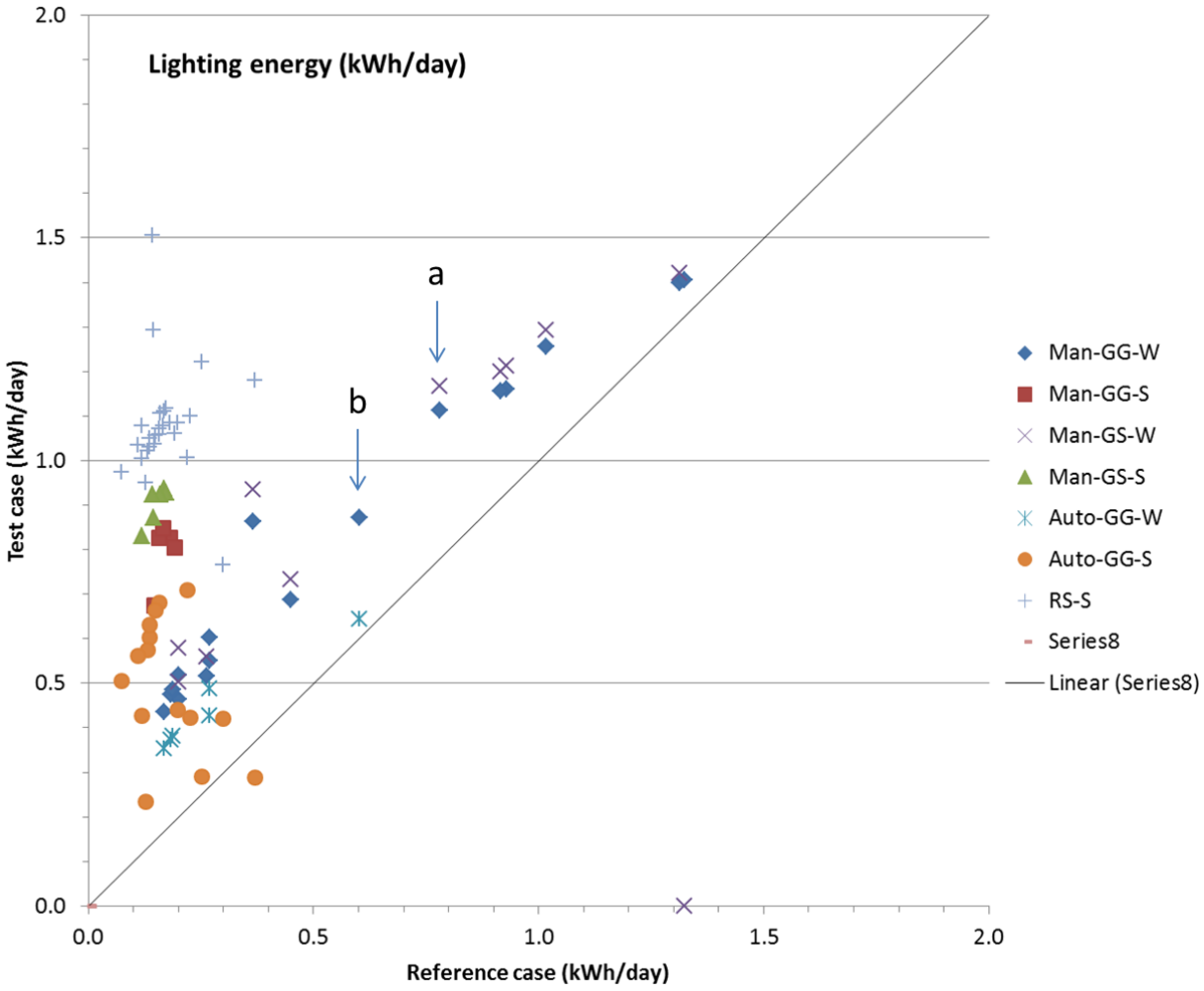


Figure 22. Daily lighting energy use (kWh/day) for the reference and test shade conditions. W=winter, S=summer data. Day = 8 AM to 6 PM local time.

Daily lighting energy use is plotted for the reference (x-axis) and test (y-axis) cases in Figure 22, where in both cases, the lighting system is a dimmable fluorescent electric lighting system (see description in Section III-A1). Winter and summer data for each test condition are denoted using a different symbol on the plots. Points above the diagonal line indicate that daily lighting energy use of the test case is greater than the reference case (static Venetian blind). Lighting energy savings for each period for each test condition are summarized in Tables 9-11. Note that some of the scatter is due not only to seasonal differences in solar position but also differences in sky condition (sunny or cloudy). Supporting data are given in Appendix A4.

Note in the plots how for the same day (same reference case x-axis value, different y-axis values), the man-GG-W (W=winter) produced slightly lower lighting energy use than the man-GS-W case due to the lower transmittance of the GS material compared to the GG material (see arrow "a" in Figure 22). Note also how for the same day, the automated shade (auto-GG-W) produced significantly lower lighting energy use compared to the manually operated shade (man-GG-W case, arrow "b").

Table 9. Daily lighting energy use savings (kWh/day) and percentage savings compared to a Venetian blind, fully lowered, slat angle 58° (VB-58) -- Winter period

	Man-GG	Man-GS	Auto-GG	Man-GG	Man-GS	Auto-GG
avg	-0.27	-0.32	-0.16	-85%	-81%	-77%
sdev	0.09	0.12	0.06	59%	64%	39%
n	17	10	6	17	10	6

n=number of days measured; avg=average; sdev=standard deviation; test condition defined in Table 4; negative values mean that energy use was increased compared to the reference case; day = 8 AM to 6 PM local time.

Table 10. Daily lighting energy use savings (kWh/day) and percentage savings compared to a Venetian blind, fully lowered, slat angle 40° (VB-40) -- Summer period

	Man-GG	Man-GS	Auto-GG	RS	Man-GG	Man-GS	Auto-GG	RS
avg	-0.63	-0.75	-0.32	-0.91	-374%	-504%	-235%	-597%
sdev	0.06	0.03	0.20	0.14	43%	64%	173%	222%
n	5	6	15	26	5	6	15	26

n=number of days measured; avg=average; sdev=standard deviation; test condition defined in Table 4; negative values mean that energy use was increased compared to the reference case; day = 8 AM to 6 PM local time.

Table 11. Daily lighting energy use savings (kWh/day) and percentage savings compared to a fabric roller shade, partially lowered (RS) -- Summer period

	Man-GG	Man-GS	Auto-GG	VB-40	Man-GG	Man-GS	Auto-GG	VB-40
avg	0.27	0.30	0.54	0.91	25%	24%	51%	84%
sdev	0.05	0.17	0.19	0.14	5%	10%	15%	7%
n	5	6	15	26	5	6	15	26

n=number of days measured; avg=average; sdev=standard deviation; test condition defined in Table 4; negative values mean that energy use was increased compared to the reference case; day = 8 AM to 6 PM local time.

2 HVAC LOAD AND PEAK DEMAND

Daily cooling load is plotted in Figure 23 using the same method used for Figure 22. Cooling load savings are summarized in Tables 12-14. Supporting data are given in Appendix A4.

Note how both the man-GG-W and the auto-GG-W cooling loads (during the W=winter period) are significantly greater than that of the reference venetian blind. The reference venetian blind is able to

reflect direct solar radiation more effectively compared to the tinted GG film. The auto-GG has a slightly greater cooling load compared to the man-GG because the automated adjustment of the upper blind slats causes more sunlight to be reflected into the room.

With the reflective man-GS system, the cooling loads are almost comparable to that of the white venetian blind during the winter and are the same or slightly lower than the venetian blind during the summer.

Compared to the roller shade, the man-GS and VB-40 were able to reduce cooling loads 10-13%, whereas the man-GG and auto-GG increased the cooling load by 4%.

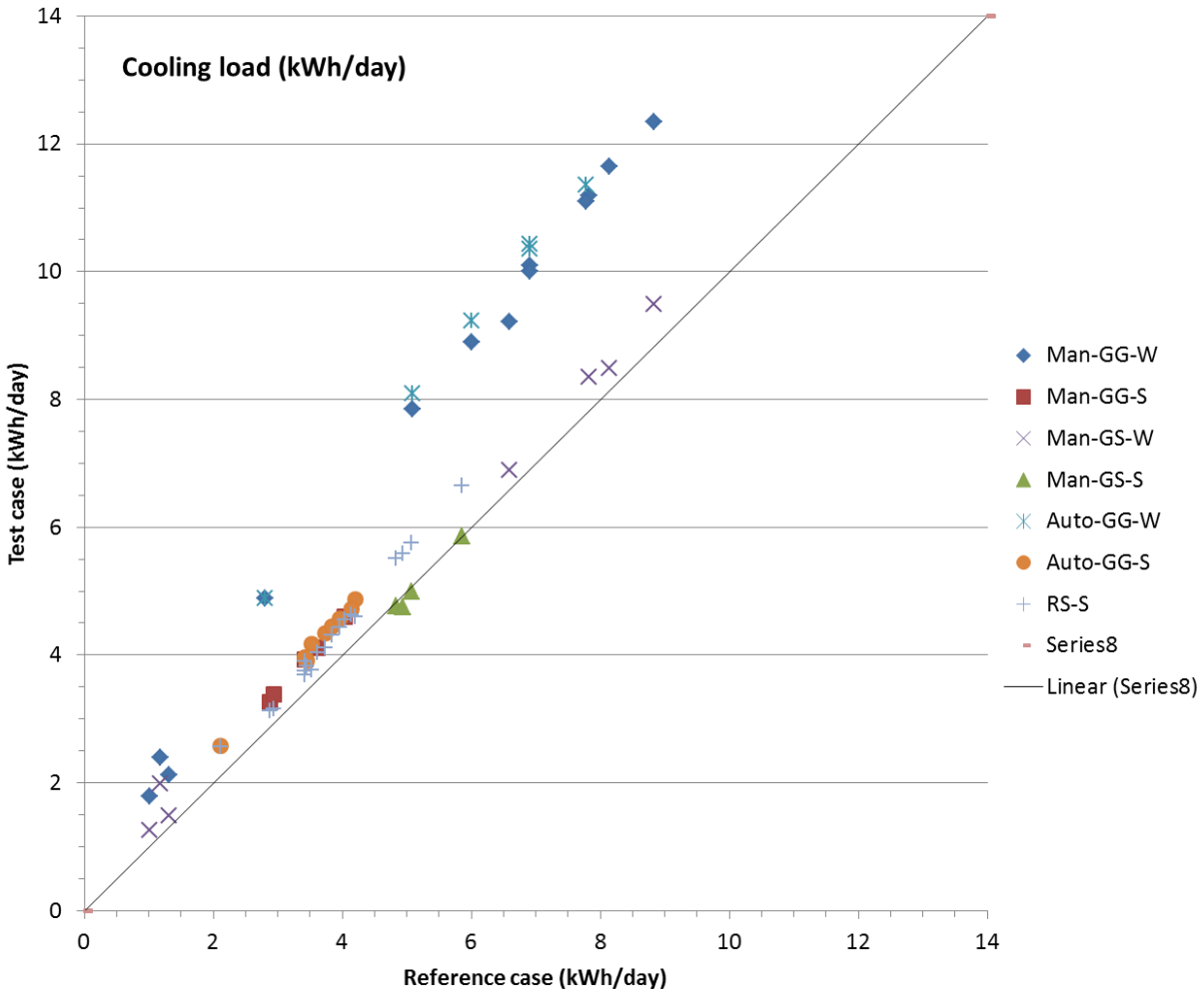


Figure 23. Daily cooling load due to the window and shading system (kWh/day) for the reference and test shade conditions. W=winter, S=summer data. Day = 8 AM to 6 PM local time.

Table 12. Daily cooling load savings (kWh/day) and percentage savings compared to a Venetian blind, fully lowered, slat angle 58° (VB-58) -- Winter period VB-58 -- Winter period

	Man-GG	Man-GS	Auto-GG	Man-GG	Man-GS	Auto-GG
avg	-2.23	-0.37	-3.14	-45%	-12%	-56%
sdev	1.27	0.25	0.56	34%	24%	10%
n	15	9	6	15	9	6

n=number of days measured; avg=average; sdev=standard deviation; test condition defined in Table 4; negative values mean that energy use was increased compared to the reference case; day = 8 AM to 6 PM local time.

Table 13. Daily cooling load savings (kWh/day) and percentage savings compared to a Venetian blind, fully lowered, slat angle 40° (VB-40) -- Summer period

	Man-GG	Man-GS	Auto-GG	RS	Man-GG	Man-GS	Auto-GG	RS
avg	-0.48	0.08	-0.57	-0.45	-14%	2%	-16%	-12%
sdev	0.07	0.08	0.07	0.16	1%	2%	2%	3%
n	5	4	10	19	5	4	10	19

n=number of days measured; avg=average; sdev=standard deviation; test condition defined in Table 4; negative values mean that energy use was increased compared to the reference case; day = 8 AM to 6 PM local time.

Table 14. Daily cooling load savings (kWh/day) and percentage savings compared to a fabric roller shade, partially lowered (RS) -- Summer period

	Man-GG	Man-GS	Auto-GG	VB-40	Man-GG	Man-GS	Auto-GG	VB-40
avg	-0.15	0.78	-0.17	0.45	-4%	13%	-4%	10%
sdev	0.09	0.04	0.12	0.16	3%	1%	3%	3%
n	5	4	10	19	5	4	10	19

n=number of days measured; avg=average; sdev=standard deviation; test condition defined in Table 4; negative values mean that energy use was increased compared to the reference case; day = 8 AM to 6 PM local time.

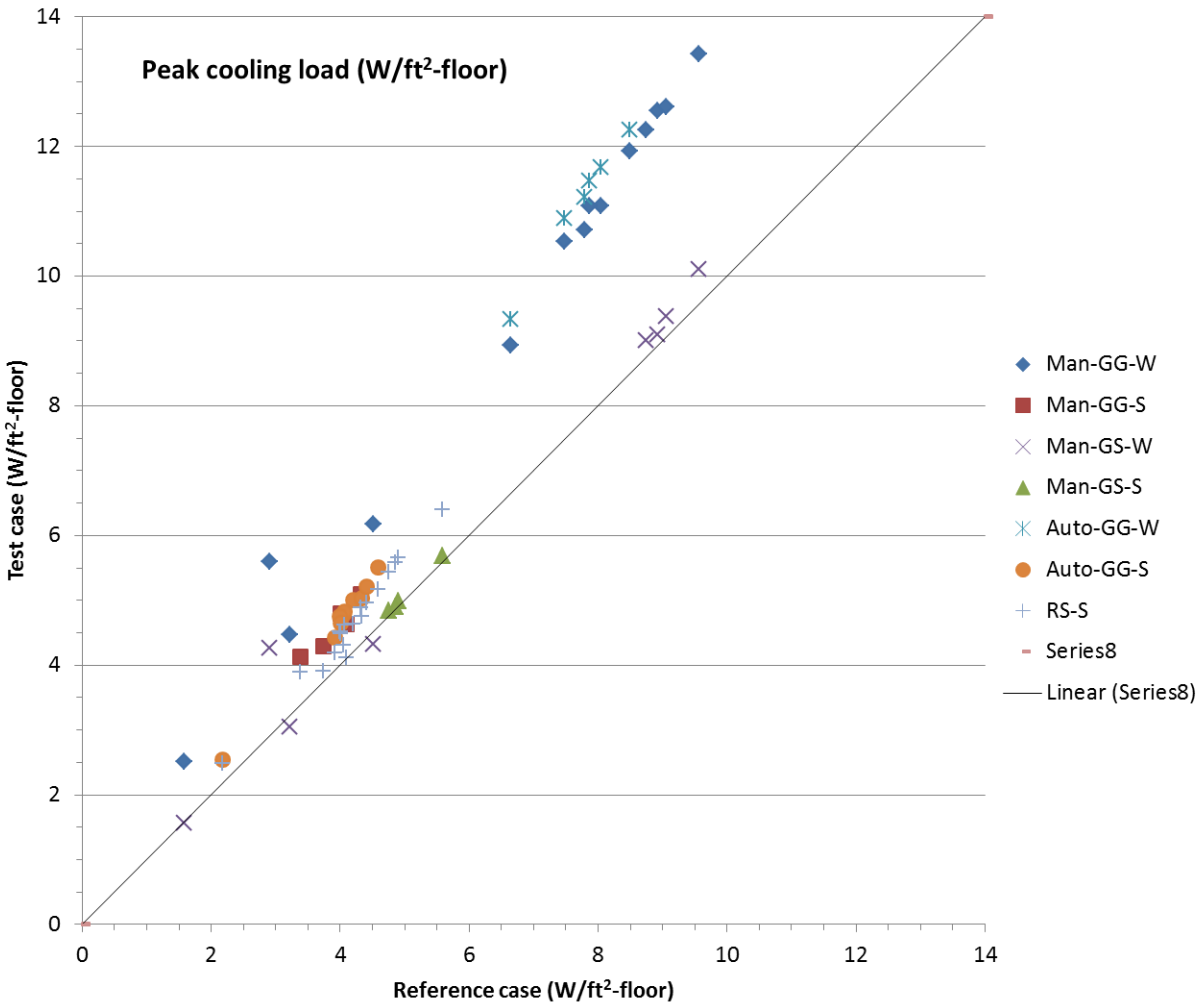


Figure 24. Peak cooling load (W/ft²-floor) due to the window and shading system for the reference and test shade conditions. W=winter, S=summer data. Day = 8 AM to 6 PM local time.

Peak cooling load followed the same trends as the daily cooling loads (Figure 24, Tables 15-17). The tinted lower indoor film (GG) absorbed solar radiation, contributing to significantly greater peak cooling loads during the sunny winter period when sun angles were low and cooling loads were at their highest. The reflective film (GS) reflected direct solar radiation, achieving near comparable peak loads to the white venetian blind. Supporting data are given in Appendix A4.

Table 15. Peak cooling load savings (W/ft^2-floor) and percentage savings compared to a Venetian blind, fully lowered, slat angle 58° (VB-58) -- Winter period

	Man-GG	Man-GS	Auto-GG	Man-GG	Man-GS	Auto-GG
avg	-2.79	-0.28	-3.42	-44%	-6%	-44%
sdev	0.92	0.50	0.38	15%	17%	2%
n	14	8	6	14	8	6

n=number of days measured; avg=average; sdev=standard deviation; test condition defined in Table 4; negative values mean that energy use was increased compared to the reference case.

Table 16. Peak cooling load savings (W/ft^2-floor) and percentage savings compared to a Venetian blind, fully lowered, slat angle 40° (VB-40) -- Summer period compared to VB-40 -- Summer period

	Man-GG	Man-GS	Auto-GG	RS	Man-GG	Man-GS	Auto-GG	RS
avg	-0.68	-0.08	-0.70	-0.48	-17%	-2%	-17%	-11%
sdev	0.12	0.02	0.16	0.21	4%	0%	2%	4%
n	5	4	10	19	5	4	10	19

n=number of days measured; avg=average; sdev=standard deviation; test condition defined in Table 4; negative values mean that energy use was increased compared to the reference case.

Table 17. Peak cooling load savings (W/ft^2-floor) and percentage savings compared to a fabric roller shade, partially lowered (RS) -- Summer period

	Man-GG	Man-GS	Auto-GG	VB-40	Man-GG	Man-GS	Auto-GG	VB-40
avg	-0.32	0.66	-0.26	0.48	-8%	11%	-6%	10%
sdev	0.13	0.05	0.11	0.21	3%	1%	2%	3%
n	5	4	10	19	5	4	10	19

n=number of days measured; avg=average; sdev=standard deviation; test condition defined in Table 4; negative values mean that energy use was increased compared to the reference case.

A summary of energy savings for a 15 ft. deep, south-facing office in Berkeley, California is given in Table 18. A coefficient of performance of 3.0 was used to convert cooling loads to HVAC energy use. Savings are given for the summer period.

Table 18. Quantitative Savings: Lighting and cooling energy savings compared to a roller shade – summer period

Site test case	Baseline Performance – roller shade (kWh/ft²-yr)	Technology Performance – test case (kWh/ft²-yr)	% Savings Compared to Baseline (kWh/ft²-yr, % savings)
Auto-GG	4.19	3.34	0.86 (20%)
Man-GS	4.19	3.60	0.59 (14%)
Man-GG	4.19	3.85	0.35 (8%)

3 VISUAL COMFORT

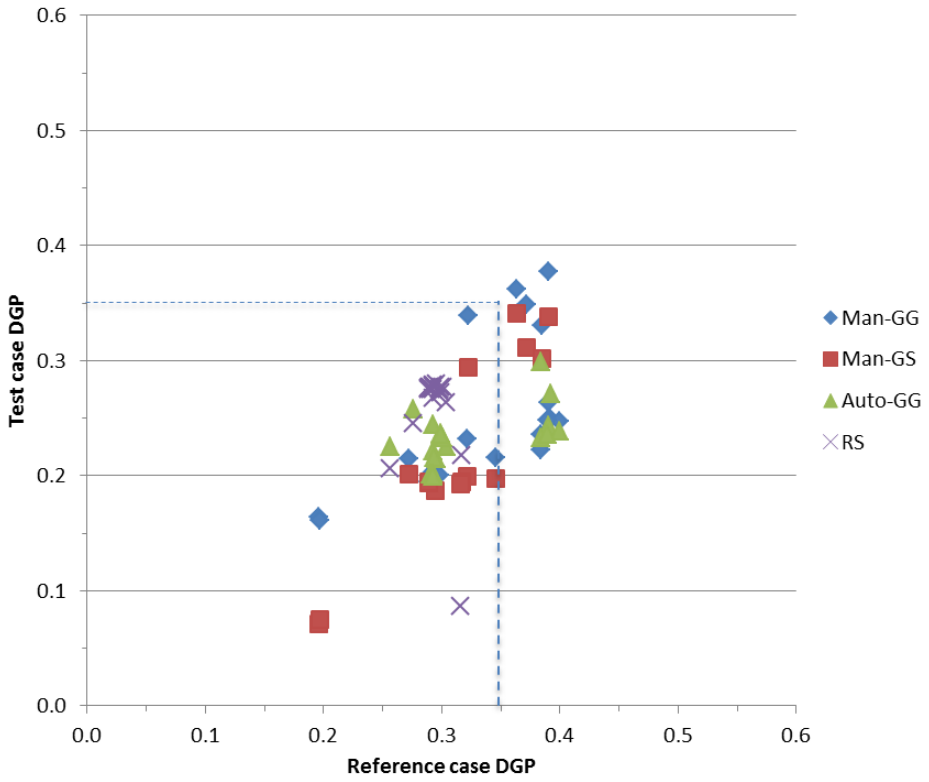


Figure 25. Camera 2 – Reference case (VB) versus test case average DGP of upper 5% values for the day. Day = 8 AM to 6 PM local time.

For a view position close to and parallel to the window (Camera 2), visual discomfort for the test cases was lower than the reference venetian blind case (Figure 25). The test cases achieved Class A, (best) for

all but a few days, while the reference case achieved only an occasional Class A with the remaining days between Class B-D. Supporting data are given in Appendix A4. Similar results were obtained for Cameras 3 and 4.

Because of the position of the HDR camera relative to the window, the evaluation of visual comfort from camera position 1 (close to and facing the window) did not capture critical periods (Figures 26-27). Low angle direct sun on sunny winter days through the lower window film aperture would likely have caused glare discomfort. The window mullion, however, blocked the sun throughout the day. Most of the upper 5% DGP values for the test cases were, therefore, below the "imperceptible" glare level (dashed lines in Figure 27) for all measured days.

The venetian blind reference case caused significant glare even though it blocked views of the sun. In this case, the total vertical illuminance at the eye was the primary source of glare and discomfort glare levels were between imperceptible to intolerable levels for this view position.

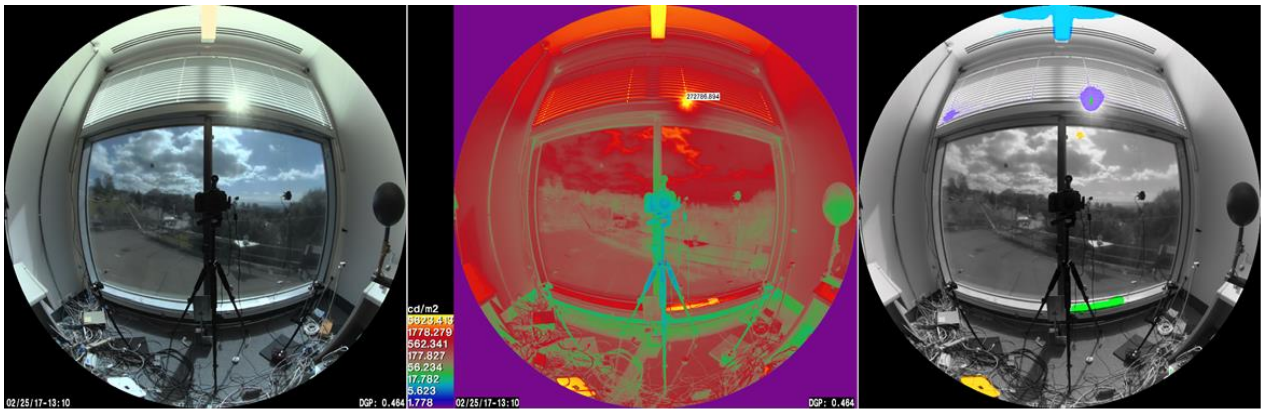


Figure 26. Camera 1 – Photograph (left), falsecolor luminance image (middle), and glare sources (right image) for the man-GG system on February 25, 2017, at 1:10 PM. The DGP is 0.464 for this image, where DGP=0.45 is disturbing glare and DGP=0.53 is intolerable glare.

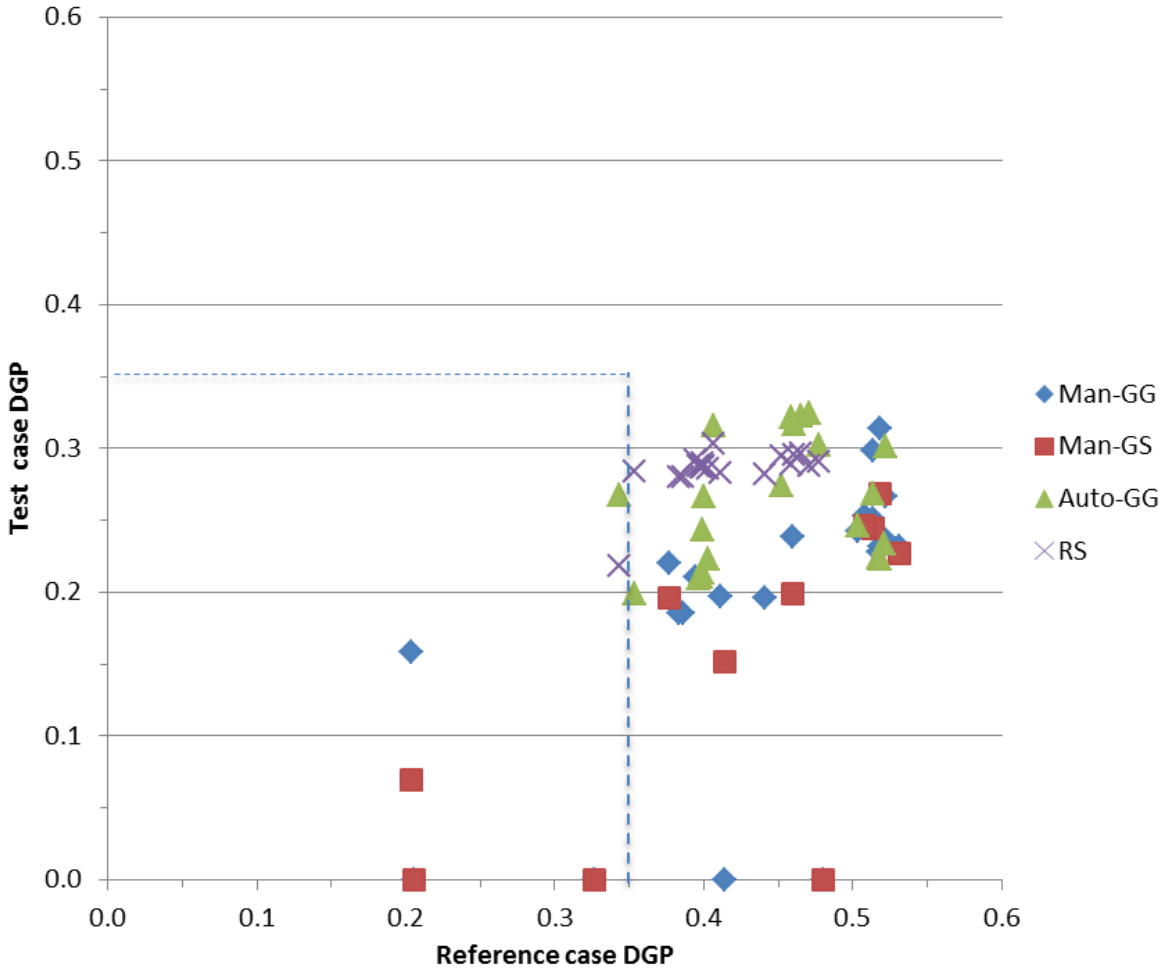


Figure 27. Camera 1 – Reference case (VB) versus test case average DGP of upper 5% DGP values for the day. Day = 8 AM to 6 PM local time.

4 THERMAL COMFORT

For almost all days during the winter and summer, PPD levels were within 5-10%. ASHRAE 55 requires that PPD levels be lower than 20%, so for both the reference and test conditions during the winter and summer, this requirement was met. Note, however, that the measurements during the winter did not include sunny days when discomfort from low angle direct sunlight was most likely to occur. Supporting data are given in Appendix A4.

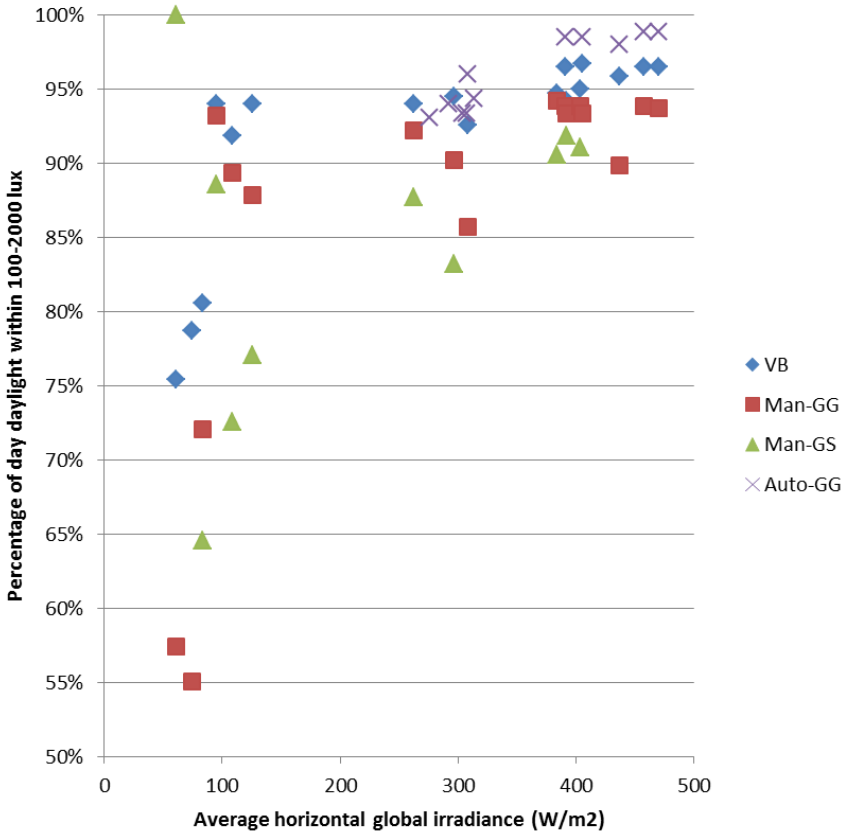


Figure 28. Winter period – Average horizontal irradiance (W/m^2) versus percentage of day that the workplane illuminance at 7.5 ft. from the window was within 100-2000 lux range. Day = 8 AM to 6 PM local time.

During the winter period, a brightly daylit indoor environment can lead to greater workplace satisfaction, but discomfort glare from low angle sun can be a problem. The DZSC shade is designed to maintain high daylight levels through the upper light-redirecting aperture even when the shades are lowered in the lower aperture to control glare. This claim is supported by daylight levels being within a range of illuminance that is not too bright nor not too dark (100-2000 lux) for the majority of the day during sunny winter conditions (average global irradiance levels greater than 250 W/m^2 in Figure 28). Daylight levels were within the 100-2000 lux range for an average of 38 min more with the auto-GG system versus the man-GG system and an average of 12 min more compared to the static venetian blind system on sunny winter days. For overcast winter days, the man-GG and man-GS shades were less successful at maintaining adequate useful daylight levels compared to the reference venetian blind.

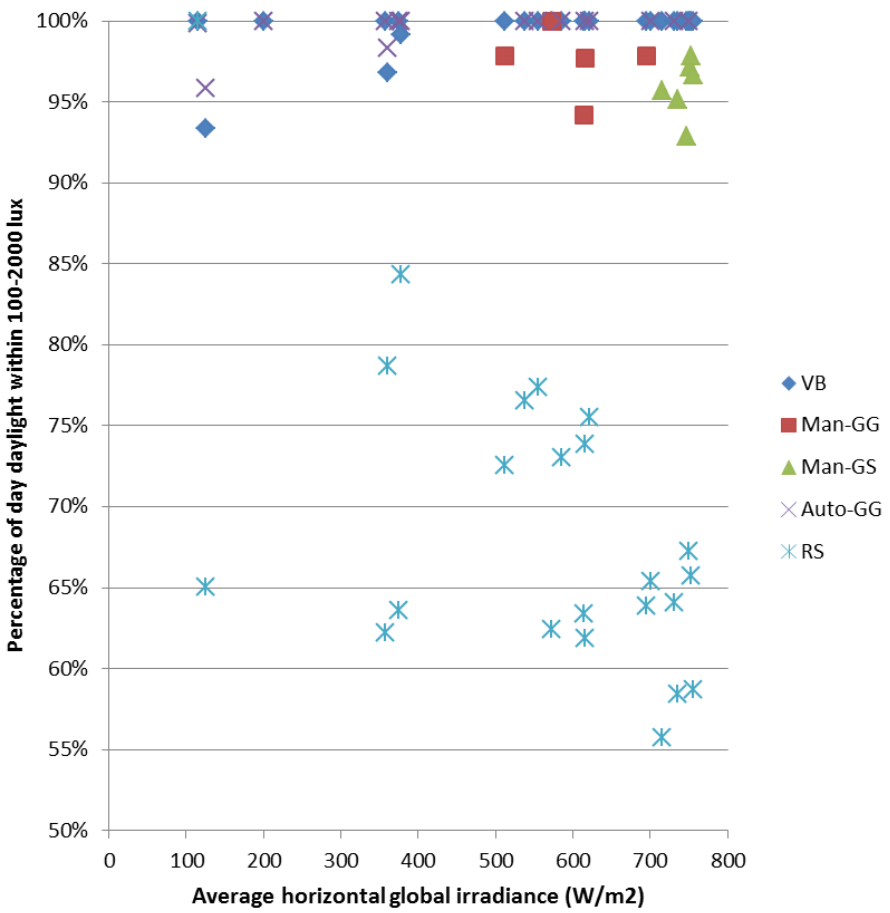


Figure 29. Summer period – Average horizontal irradiance (W/m^2) versus percentage of day that the workplane illuminance at 7.5 ft. from the window was within 100-2000 lux range. Day = 8 AM to 6 PM local time.

During the summer period (Figure 29), all systems except for the roller shade were able to maintain adequate daylight illuminance levels (i.e., 95% or greater percentage of the day for most days). The roller shade maintained adequate daylight illuminance levels for 64% of the day (2.8 hours less than the DZSC shade). The man-GG and man-GS systems produced useful daylight for a slightly lower percentage of the day under sunny conditions compared to the automated system (auto-GG).

B. QUALITATIVE RESULTS FOR THE OAKLAND FEDERAL BUILDING SITE

1 EASE OF INSTALLATION, MAINTENANCE AND OPERABILITY

a Installation

Installation of the DZSC shades involved designing and fabricating a simple bracket system to attach to the window framing system. This bracket was designed to facilitate removal of the shading system after the study was completed and was, therefore, atypical of what would occur in a standard installation.

Power to the upper shade motors was routed from junction boxes located in the ceiling plenum. CAT5 plenum rated wiring (#24-4) for communication of control signals to the upper shade motors was run from the building shade controller located in the electrical closet near the elevator shafts to the master motor controller located in the ceiling plenum near the windows. Twisted pair wiring (#14-2) was run from the master motor controller to the slave motor controller on each of the motorized upper shades for RS485 control communications. The motor controller was wired to two to four slave motor controllers and a single manual keypad mounted on the wall near the shades. The general contractor was able to install the shades without incident and had no specific concerns regarding the hardware installation. More than one motor had the wiring reversed (before shipment to the site), so after the shade had been installed, the shade had to be removed to correct the wiring.

Sensors were installed on each façade orientation at the roof level of the building. Wiring for the sensors was run vertically down the elevator shaft through existing conduit to the floor with the motorized shades and connected to the building shade controller in the electrical closet.

The controls were intended to be set up by the local vendor's technician, but the technician was unavailable on the scheduled weekend, so GSA and LBNL staff reviewed the set up prior to occupancy, checked the assignment of control zones in the software to the control hardware and made minor adjustments. The building shade controller had been shipped preconfigured, so no on-site adjustments were needed within the control software. A laptop was connected to the building shade controller so that GSA could view and adjust the control settings, if desired – this user interface is normally not provided. No adjustments were made to the control settings over the course of the study.

After an initial run period in the occupied zones, GSA held discussions with the vendor, to determine the source of complaints from some of the occupants (but not logged in the complaint log). The vendor requested that the sensors be checked for proper installation. GSA provided photographic documentation to the vendor, who then determined that the sensors had been installed incorrectly. The sensors were subsequently repositioned on May 18, 2017. In this case, there was considerable

[4] GSA has a strict policy against endorsing any product, service or enterprise. Report should not make reference to a specific commercial product, process or service by its trade name, trademark, manufacturer, or otherwise, that implies its endorsement, recommendation or favoring by the United States Government. However, GSA recognizes that results are often specific to a specific vendor's product. The product should therefore be described in sufficient enough detail to be specific to that vendor's product (without revealing IP claims), but not cast judgement on other vendors' products in the same category. For example, a particular vendor may have a badly designed control system that affects the outcome of the performance of its particular implementation of a technology, while another may have a superior system that would yield different performance.

[5] Life-cycle costing methodology, including guidance on applicable discount rate and escalation rate, can be found in 10 CFR 436 (http://www.wbdg.org/pdfs/10cfr436.pdf).

confusion as to the proper orientation of the sensors, in part because the vendor provided ambiguous information (the vendor had toured the site prior to providing the equipment and installation instructions) and due to changes in GSA project staff. For example, the electrical plans showed sensors that were labeled with an orientation ("South") and value (180°) but the convention for the value was undefined *(i.e.*, 180° from true north, magnetic north or project north; where project north deviated significantly between both true and magnetic north). The drawings also indicated that the sensors be located 24 inches above the roof deck, but this height caused some sensors to be shaded by the nearby parapet.

b Maintenance

GSA reported that maintenance requirements were minimal over the six-month period of the installation. Surveys of the blinds indicated no physical damage (*e.g.*, crumpling of the lower shade film), no indication of handling by the occupant or maintenance staff (*e.g.*, fingerprints, smudges on the film) and minimum to no evident dust accumulation.

c Operability

There were a total of four service requests entered into the service log over the study period and they were all entered between March 6-23, 2017, just after the shades were installed. For two of the requests, LBNL had found that the manual switch was not working correctly for two of the motor controllers. The wiring for the motors had been installed incorrectly. Another request was to address the sensor position, which was found by LBNL to be too low. Sensors were repositioned. The fourth request was made to address the problem that one of the motor controllers was in manual mode instead of automatic mode. The vendor reprogrammed the controller settings and GSA uploaded the new settings into the building shade controller.

No occupant complaints were logged. However, there were complaints made by the occupants to GSA (while GSA was conducting the blind position surveys) regarding illogical movement of the automated upper shade that caused visual discomfort or dissatisfaction with the indoor environment (e.g., cloudy day and the louvers were not raised).

For this particular system, there was no logged history indicating the actual position of the upper shades or manual overrides of the automated controls. This made it difficult to troubleshoot occupant complaints.

2 SURVEYS

a Survey of DZSC shade position

The positions of the DZSC shades were observed and recorded every two weeks by GSA between April 4 and July 3. The surveys were conducted around mid-day when it was less likely to disturb the occupants. Results indicate that the upper slat angle was positioned for the most part at 40-57° (mid-range of tilt angles) or 72° (fully closed in upward tilt angle) when the observations were made (Figure 30, Table 19). Of the 160 observations (16 offices, ten surveys), only 12 were at 0° (horizontal tilt angle) and 29 were with the shade fully raised. There was no discernible difference in surveyed shade position between the initial test period (before May 19) when the outdoor sensors were not correctly positioned and the remaining observations after May 19 when the sensors were adjusted. The slat angle should have been the same for a single motor controller (even with manual override), but this was not the case

for any of the motor controllers. This may have been due to the challenge of distinguishing between the mid-range and fully closed slat angle positions during survey visits. While this inconsistency in tilt angle within a motor controller group is unexplained, overall the upper shade positions were in keeping with the expected automatic control.

With manual operation of the lower shades, it would be ideal if occupants lowered the GS shades to reduce solar heat gains and, thus, cooling energy use. This was confirmed by the observations – shade height was correlated to window orientation (Table 20). DZSC shades in the single northeast office (upper and lower shade was manually operated) tended to be in a more raised position. On the east, southeast and south facades, shades were almost always lowered between 50-100% (on the south, shades on windows 31 and 32 were almost always fully raised in the conference room).

Figure 30. Left: Slat angle convention for upper shade (upper) and lower shade (lower). Right: Floor plan showing numbered GZSC shade locations at the OFB site. Windows 22, 25, and 29 were installed with the GG shade. The remaining windows were installed with the GS shade. Windows 25, 30and 33 had the opaque backing on the vertical blinds prior to replacement with DZSC shades.

Table 19. Slat angle of the upper DZSC shade at the OFB site

window no	11	20	21	22	23	24	25	26	27a	27b	28	29	30	31	32	33
Date	man	auto	auto	auto	auto	auto	auto	auto	auto	auto	auto	auto	auto	auto	auto	auto
April 4, 02:05pm	40	0	50	–	40	72	up	up	up	up	up	up	40	0	0	72
April 14, 01:50pm	0	0	0	40	–	40	up	up	up	up	up	up	up	up	up	up
April 21, 12:20pm	40	40	40	40	–	72	72	40	40	40	40	40	40	40	40	40
April 24, 1pm	72	0	40	40	–	72	40	40	40	40	40	40	40	0	40	72
May 2, 12:40	40	40	40	40	40	72	72	40	40	40	40	40	40	40	40	40
May 17, 1pm	40	40	72	72	0	72	72	40	40	40	40	0	72	40	40	72
June 2, 1pm	40	72	40	0	up	72	72	40	40	40	40	40	40	40	40	0
June 19, 11:45	40	72	72	40	72	72	40	40	72	72	40	40	40	40	40	72
July 3, 1pm	40	40	40	40	72	40	40	40	40	72	72	72	40	40	40	40
July 26, 12:40	–	up	up	72	–	72	up	up	up	up	up	up	up	up	up	up
	NW	NE		East			SE						South			

Table 20. Shade height of the lower, manually-operated, DZSC shade at the OFB site

window no	11	20	21	22	23	24	25	26	27a	27b	28	29	30	31	32	33
Date	GS	GS	GS	GG	GS	GS	GG	GS	GS	GS	GS	GG	GS	GS	GS	GS
April 4, 02:05pm	50	0	0	0	50	100	100	25	100	100	75	75	75	0	100	100
April 14, 01:50pm	50	0	0	0	–	100	50	0	100	50	100	25	75	0	0	100
April 21, 12:20pm	75	0	0	100	–	100	100	100	100	100	100	0	75	0	0	100
April 24, 1pm	50	25	25	0	–	100	100	100	100	25	100	100	100	25	25	100
May 2, 12:40	75	0	0	100	100	100	100	100	100	100	100	0	75	0	0	100
May 17, 1pm	75	25	50	100	75	100	50	75	100	100	75	0	75	0	0	100
June 2, 1pm	50	50	0	100	75	100	100	50	100	100	100	0	75	0	0	50
June 19, 11:45	50	100	100	100	50	75	100	100	50	50	100	0	75	0	0	50
July 3, 1pm	75	0	0	50	100	100	100	100	100	100	50	50	100	0	0	50
July 26, 12:40	–	25	0	100	–	100	100	100	100	75	75	100	100	25	25	100
	NW	NE			East						SE					South

b Occupant surveys

Surveys were issued to all occupants on the southeast half of the floor on May 30, three months after the initial shade installation. There were 21 responses to the surveys from occupants working in the private offices and the open plan area[6]. For open plan workstations located further from the windows, the thermal influence of the windows was negligible.

Thermal comfort

After the DZSC shades were installed, there was an improvement in the rating of temperature conditions during warm or hot weather. The average response on a Likert scale of 1-9 (with 5 being "just right") was 5.7 with the DZSC shades and 6.9 (towards the scale of "too hot") with the original windows (Figure 31). This result was statistically significant. During cool or cold weather, the perception was "just right" with the DZSC shades and a little below "just right" with the original windows (not statistically significant). Of the comments received from the survey, four did not like the management of heat through the DZSC shades (note that the survey was issued prior to the warm to hot period that usually occurs in the summer through autumn period).

Some occupants commented that the vertical blind with opaque backing provided better thermal comfort than the DZSC shade (one of the three offices with opaque backing had the GG shade installed so the solar heat gains would have been increased). Other occupants in the open plan office area reported that thermal comfort was better with the DZSC shade than the vertical blind (without the opaque backing), but that it was still too hot when the weather was warm. Occupants reported that they could feel heat coming out of the bottom and sides of the DZSC shades.

Visual comfort

Occupants indicated that glare was reduced from just below "uncomfortable" (6.1-6.7) to "acceptable" (4-4.1) with the DZSC shade compared to the original window, both from the upper 2 ft. area of the window and the rest of the window (Figure 31). This perception of reduction in glare (from the rest of the window) was statistically significant.

Of the comments received from the survey, four occupants did not like the glare from the upper DZSC shade and two did not like the glare from the lower DZSC shade. Glare discomfort was due to sunlight through the upper louvers when viewing the window directly or glare on the computer screen even with

[6] Subjective data from a diverse population of about 30 or more subjects can be used to generate results that are statistically representative of the general population. If the sample size is less than 30, then one can still draw statistically significant conclusions if there is a strong enough difference in subjective response between the refererence and test conditions.

the lower shade completely lowered. Glare was also due to views of the unshaded portion of the lower window in the early morning. One person indicated that sunlight reflected onto the sill by the GS shade caused intolerable glare when the shade was not fully lowered. Two others found the glare to be tolerable and commented positively about being able to see the view outside.

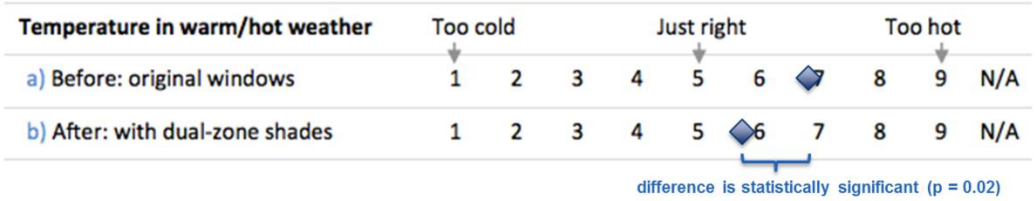
Daylight quality

Occupants' responses to light level were nearly the same before and after the DZSC shades were installed (slightly above "just right" toward more glare).

Overall satisfaction

In response to the question (B2) "Overall, how satisfied are you with the performance of the dual-zone shades versus the original windows?", the range of response was between 6 and 7.2 ("more satisfied"), with 80% preferring the DZSC shades compared to the windows in the original condition. Occupants responded that the DZSC shades somewhat enhanced their ability to get their job done.

B1) Please assign a rating from 1 to 9 (or N/A = not applicable) to the following conditions in your office.



Glare from windows
[Insert diagrams showing the two sections of window, both pre- and post-installation]

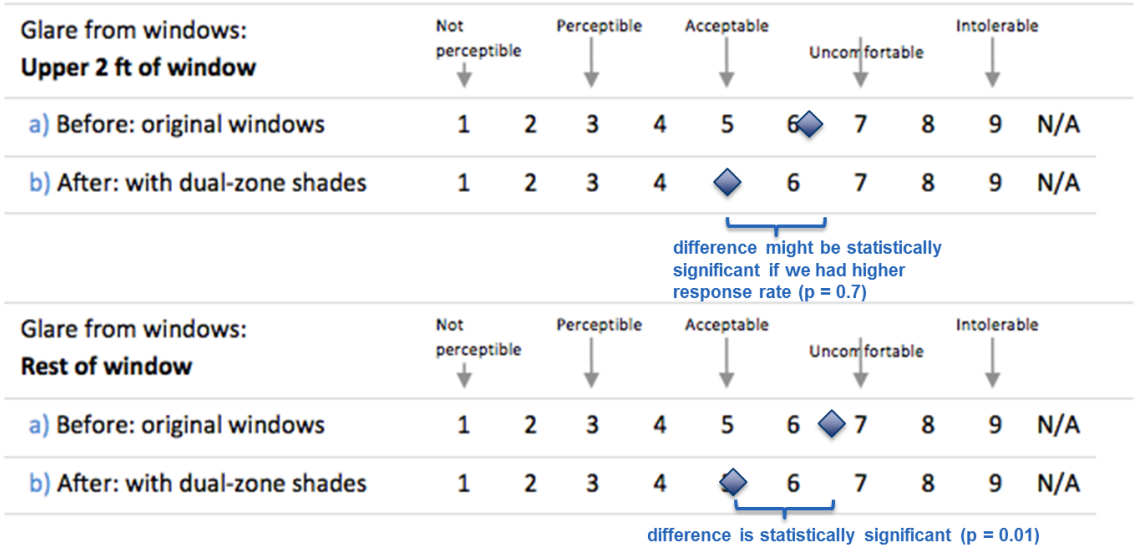


Figure 31. Average response on select survey questions from the OFB site.

The number of occupants who indicated that they somewhat or very much liked their view of the outside through the windows increased from 8 responses before the DZSC shades were installed to 12 responses after the DZSC shades were installed (out of the 21 total responses). There were 16 occupants seated next to the windows. Four occupants commented that they liked the increased view provided by the DZSC shades.

There were comments from five survey respondents who expressed dissatisfaction with the automated control of the upper DZSC shade. Similar comments were made to GSA staff at the end of the study in September. One did not like how one switch controlled shades in multiple private offices, which caused disagreements between occupants. Three comments indicated that they did not like the controls or thought that the automatic controls were not working properly. Two disliked the automatic controls. Several commented about the noise from the motors.

Four comments indicated that they liked the option to override the automatic controls with a manual switch.

C. COST-EFFECTIVENESS

Cost effectiveness was determined for the configuration tested in the LBNL Advanced Windows Testbed. Annual lighting energy use was computed based on the field monitored daily lighting energy use for a dimmable fluorescent electric lighting system (see description in Section III-A1) averaged over the full monitored period for each reference and test case, then multiplied by a five-day work week (8:00 AM to 6:00 PM work day) and 50 weeks per year. The roller shade data collected for the summer condition was assumed to be representative of annual performance. Comparisons with a previously collected, more comprehensive data set collected in the same facility for the same roller shade condition indicated that the annual energy use intensity values were within 5% [Lee et al. 2009]. Average annual cooling

energy use savings was computed using the same method. A coefficient of performance of 3.0 was used to convert cooling loads to HVAC energy use.

The cost for the technology was provided by the manufacturer and reflected current volume pricing and typical installation costs. The technology was recommended for end-of-life replacement where a like for like industry-standard replacement technology, such as a roller shade, would have been used.

With an average local time-of-use utility rate of $0.12/kWh [PG&E 2017], annual energy cost savings were derived. A simple payback based on the incremental cost of the technology was computed. The payback for the auto-GG, man-GG and man-GS shades versus the roller shade was 66, 27and 16 years, respectively. Data for the man-GS shade are given in Table 21. For all comparisons to the venetian blind, energy use was increased and, therefore, the DZSC was determined to be not cost-effective.

Table 21. Economic Assessment (End-of-Life), Roller shade vs DZSC shade (man-GS)

	Industry-Standard Replacement	Tested Technology (After)[1]	Difference
Equipment Cost[2]	$8	$9	$1
Installation[3]	$2	$3	$1
Total Cost per Unit ($/ft²-window)	$10	$12	$2
Annual Maintenance ($/ft²-window-yr)	$1	$1	$0
Annual Energy Consumption (kWh/ft²-floor-yr)[4]	4.19	3.59	0.60
Annual Energy Costs @ $0.12/kWh ($/ft²-floor-yr)	$0.50	$0.43	$0. 07
Simple Payback		16 yrs	
Savings-to-Investment Ratio		1.06	

[1]Current technology and installation costs provided by vendor.
[2]Equipment Lifespan is 15 years.
[3]Labor is x 1 hour @ $50/hr.

[4] Annual energy use in a 10x15 ft. perimeter zone office with a south-facing 60 ft.[2] window, dimmable fluorescent electric lighting system (see description in Section III-A1), and an HVAC system with a coefficient of performance of 3.0.

IV. Summary Findings and Conclusions

A. OVERALL TECHNOLOGY ASSESSMENT AT DEMONSTRATION FACILITY

Compared to conventional, manually operated roller shades, the automated DZSC shade reduced energy use, improved indoor daylight quality and maintained visually comfortable conditions. Lighting energy savings with dimmable fluorescent electric lighting (see description in Section III-A1) were 51% with automation and 25% without automation, where the upper louvers were set to the same slat angle throughout the day in the latter case. The lower, manually operated, reflective film reduced window cooling load by 13-15% and peak cooling demand by 11%. It also provided an unobstructed, transparent view to the outdoors. These findings reflect summer measurements in a private office with a south-facing, dual-pane, low-e window.

Compared to a conventional, horizontal venetian blind, lighting and HVAC energy use were not reduced, but the DZSC shade was able to provide an unobstructed view and less discomfort glare. These findings reflect summer and winter measurements in a private office with a south-facing, dual-pane, low-e window.

Compared to a conventional vertical blind with fabric slats (and in some offices, opaque fabric slats), the automated DZSC shade was preferred by 80% of the survey respondents. Visual discomfort from glare was reduced. Thermal discomfort during warm or hot weather was also reduced with the DZSC shade compared to the fabric slats, but discomfort still remained for some individuals due to heat coming through the sides and lower edge of the lower shade. Occupants expressed greater satisfaction with the unobstructed view. These findings resulted from an installation in an occupied commercial building with private and open plan offices and southeast-facing, single-pane, tinted windows.

Installation and commissioning of the DZSC shades was fairly straightforward with some minor problems due to inadequate installation instructions and improper wiring. A few occupants expressed dissatisfaction with the automatic controls for the upper louvers due to visual discomfort, erroneous control and motor noise.

Overall, the concept behind the DZSC shade is good. By subdividing the window wall into a lower view and upper daylight zone, the function for each of these zones can be satisfied more optimally. The DZSC best addresses human factors related to indoor environmental quality; *i.e.*, an unobstructed view and daylight quality. The occupant response data showed an overwhelming preference for the DZSC shade compared to the conventional shade. For the Oakland Federal Building, however, thermal discomfort has been a significant problem with its large-area, single-pane, tinted glass windows. The reflective shade reduced thermal discomfort, but did not meet the aesthetic requirements for the exterior façade. Separately, periodic observations of the lower shade suggested that occupants used the reflective shade to minimize visual and thermal discomfort during sunny weather. During the cloudy, winter period (which was not monitored in this study), the operable lower shade may prove to have additional passive solar heating and daylighting benefits over a conventional static reflective window film (if the occupants actively manage the lower shade). This aspect was not evaluated in this study.

B. LESSONS LEARNED AND BEST PRACTICES

Procurement

The DZSC shade involves automated control of the upper shade system to improve daylight performance in buildings. Whether or not to invest in automated control is dependent on the requirements of the project. For hospitals, schools, offices, libraries, and public spaces, for example, a brightly daylit, glare-free environment can be an important qualitative aspect of the overall indoor environment that complements energy efficiency and peak demand reduction goals. The added cost of shade automation may be well justified for such projects.

Similarly, the primary benefit of the lower DZSC shade is the unobstructed view. If the aesthetics of the reflective film are unacceptable, then the facility manager must consider whether provision of an unobstructed view is warranted over a potential increase in cooling energy use and thermal discomfort. The magnitude of these impacts will be dependent on the original window condition.

When it comes to making procurement decisions, there is no design guidance available that quantifies these trade-offs for the wide variety of window conditions (*i.e*., window type, area, orientation, climate, building type). The Attachments Energy Rating Council (AERC) is working to develop a standardized rating system for the commercial building sector so that the energy and non-energy impacts of shading systems can be compared.

Installation, commissioning, and operations

Implementing the automated controls was fairly straightforward, but there are innovations that could reduce occupant dissatisfaction with the controls and make the systems easier to commission and maintain. The manufacturer of the Master motor controllers offers IP-enabled communications (*e.g*., KNX, BacNetIP). This enables control of individual shades using the same basic installed components as the current RS485 network used in the OFB installation, and it also can facilitate troubleshooting in the event of occupant complaints. For controls that are entirely dependent on outdoor sensors, it will be essential that the outdoor sensors be regularly maintained. Wireless, battery powered, WIFI sensors are now available that could be installed on the interior of the window and take the place of the rooftop sensors.

C. DEPLOYMENT RECOMMENDATIONS

For the DZSC shade with a reflective (GS) lower shade, deployment should target end-of-life, one-for-one replacement opportunities in existing buildings where the original window has poor solar rejection properties and the indoor shade is a fabric roller shade. Manual (non-automated) operation of the upper zone blind is recommended since it provides the best balance between financial performance, facility requirements, and occupant response.

While the DZSC shade would be beneficial for daylighting and view in new construction applications, they are not likely to meet the criteria of cost effectiveness based on energy savings alone because new construction tends to have more energy-efficient windows that provide better solar and thermal control.

The ideal application would have the following characteristics:

Commercial buildings

- Sunny and mixed climates; minimal impact in climates with predominantly overcast sky conditions
- Retrofit construction
- High daytime occupancy
- Internal-load dominated, where strategies that minimize cooling energy use and peak demand are important (*e.g*., offices)
- High daytime lighting loads at the perimeter zone due to low daylight availability or high installed lighting power density (e.g., legacy dimmable fluorescent lighting)

Façade orientation

- South, east and west

Exterior obstructions

- Windows with minimal unobstructed access to direct sunlight for the majority of the year
- Minimal setback of window glass from face of façade (< 1 ft.)
- Minimal to no exterior attachments, such as overhangs, fins, balconies, or adjacent building wings

Window

- Windows with head height greater than or equal to 9 ft. above finished floor
- Window-to-wall ratio greater than or equal to 0.30
- Windows with poor solar heat gain rejection qualities (*e.g*., single- or double-pane low-e glass installed before about year 1995; windows with a solar heat gain coefficient of 0.50 or more); windows with dark tinted, single pane glass are unlikely to benefit from this technology
- Windows with relatively high daylight transmittance (either high visible transmittance (>0.50) or of large area, or both)
- Windows where indoor shades are lowered for the majority of the year due to glare or thermal discomfort from solar heat gains

Perimeter zone configuration

- Open plan office zone with minimal vertical obstructions to daylight to a depth of 10-15 ft. from the window (*e.g*., partitions no higher than 4 ft. above the floor)
- Ceiling and walls with matte finish and high visible reflectance (*e.g.,* 80% for ceilings, 50% for walls)

Lighting

- Ability to dim or switch the lights on and off in response to available daylight in areas close to the window (*e.g.,* 0-15 ft. from the window or more, if unobstructed by walls or partitions)
- Spaces with pendant fixtures that block redirected daylight would be less ideal

V. Appendices

A. RESEARCH DETAILS

APPENDIX A1. SITE CRITERIA CHECKLIST

Appended below.

GPG FY16 Technology and Site Criteria

Dual Zone Indoor Shades (LouverShade)

Technology Overview

This technology integrates two separate daylight control strategies in a single unit. The proposed application will integrate an automated, motorized upper section that maximizes daylight harvesting while controlling for glare and a user-controlled lower section that reduces HVAC energy use associated with window heat gains and losses.

GSA Value Proposition

Increased daylight and solar control can improve both tenant satisfaction and energy efficiency, with an estimated 20-60% projected lighting savings and 14-17% HVAC savings in perimeter zones, compared to standard roller shades. Installation is simple and non-permanent.

M&V Strategy & Objectives

GPG will test two versions of the dual-zone shade: 1) manually controlled upper and lower shades, and 2) motorized and automated upper shades with manually controlled lower shades. Testing will be in a single building, either on two floors with similar layouts, or on two separate sides of a single floor with appropriately zoned lighting circuitry. A third space with existing conventional shades will serve as a control. Testing may be conducted in more than one region. While a variety of materials can be used, an ideal solution would involve a concave-up, venetian blind in the upper zone for daylight redirection and a transparent roller shade made with a metallized reflective film (metallized polyethylene terephthalate, or MPET) in the lower zone. A mockup of the technology will be installed in the space prior to installation.

Facility Manager Workload

Medium. Retrofit installation will require one day outside of standard business hours. The automated system will involve installation of low-voltage motors, control networking and communications between each motor and the control system, installation of a weather station on the roof of the building, and a communications link between the roof sensors and the control system. Will not require coordination with OCIO.

Tenant Impact

High. Tenants will be given a brochure explaining how to use the shading system. If motorized and automated, tenants may notice and hear the upper shades change position over the course of the day. Tenants may notice a difference in their workspace as more daylight is introduced into the space. If the MPET film is used, tenants will have greater access to view and sunlight in the lower window and privacy from the outdoors will be reduced. Views through the clerestory portion of their windows will be blocked by the upper shade. Tenants will be asked to participate in two user satisfaction surveys.

How Will Success Be Measured?

QUANTITATIVE OBJECTIVES	METRICS & DATA	SUCCESS CRITERIA
Energy Savings	Lighting energy use HVAC energy use	> 10% lighting savings > 14% HVAC savings (baseline = cloth roller shade)
Light Quality	Illuminance range Illuminance levels Glare Threshold	Levels within acceptable range 80% of the time Levels meet P-100 guidelines Levels below glare threshold 95% of the time
Cost-Effectiveness	Simple payback SIR	< 8-10 year payback (motorized, baseline = cloth roller shades) > 1 SIR
Deployability	Modeling across climate zones	Payback and energy savings achieved in all climate zones
QUALITATIVE OBJECTIVES		
Ease of Installation	Interview with installer Time required to install & configure Labor associated with install	Less than one day to install and commission
Maintenance	Cleaning frequency and duration Performance measured after x days to account for dust	No increase in cleaning requirements for fingerprints and dust No degradation in performance over time
Operability	Interview with O&M Usability opinion of facility operators	No impact to O&M effort
Occupant Satisfaction	Visual comfort (glare) Thermal comfort Operation Appearance Preservation of views	Statistically significant results indicating that the test case results in the same or greater comfort, satisfaction, and acceptance of the workplace environment compared to the baseline case

Site Requirements

SYSTEM	CHARACTERISTIC
Facility	**>50,000 sq. feet and 3 similar floors to test shading technologies and provide a control ***
Facade Orientation	**South, east, west ***
Exterior Obstructions	**Windows with unobstructed access to direct sunlight for the majority of the year. Minimal to no exterior attachments such as overhangs, fins, balconies, or adjacent building wings. ***
Windows	**Head height >= 9' above finished floor (AFF).** **Window to wall ratio > 40%.** **Width: <= 8'** **Existing glass: Double pane Low-E *** **Glass visible transmittance: >= 0.40 preferred**
Office Configuration	**Open plan office adjacent to windows with depth >=20-30 feet, partitions no higher than 48", no major light obstructions (e.g., columns). ***
Occupancy	**>= 30 occupants per space for each type of dual-zone shade, with consistent occupancy. ***
Ceiling/wall	**White, matte surfaces with equal or better than standard GSA-required reflectance (80% for ceilings, 50% for walls). ***
Lighting Control	**Automatic continuous daylighting controls ideal. Manual on-off or bi-level lighting controls in private offices are acceptable. LED 0-10v ***
Glazing Perimeter Zone	50% of commercial space

***Required** ****Strongly Preferred**

APPENDIX A2. OAKLAND FEDERAL BUILDING (OFB) TEST SITE – DETAILED DESCRIPTION

The Oakland Federal Building consists of two 18-story towers connected by a five-story glass rotunda, totaling 99.87 km^2 (1.075 Mft^2) gross floor area. The office building has been occupied since 1992 and is located in downtown Oakland, California.

Some details about the building:

- The site orientation is 62.6° E of true south.
- Floor-to-ceiling height is 9 ft.
- Partition height in the open plan area is 5.5 ft. ft.
- Occupant seated near the window in the open plan area are 4 ft. ft. from the window.

Reference window condition

- A typical window rough opening has a width of 4.57 to 7.62 m (15 to 25 ft. ft.) and a height of 2.74 m (9 ft. ft.), with divided lights ranging in width from 0.91 to 1.52 m (3 to 5 ft. ft.). Silll height is 11.5 inches.
- The window glazing is recessed 0.15 to 0.41 m (0.5 to 1.33 ft. ft.) from the face of the building and has mullions that are 0.13 m (5 in.) deep on the interior and 2.5 cm (1 in.) deep on the exterior.
- The window system consists of 6-mm (0.25-in) single-pane conventional tinted green glass (Tvis=0.75, SHGC=0.60, U-factor=5.44 W/m^2-˚K (0.96 $Btu/hr\text{-}ft^2$-˚F)).
- Aluminum framing is not thermally broken. Matte finish, olive color (interreflections within the 5-inch deep cavity will be minimal).
- Manually-operated, off-white, 4-inch wide vertical blinds; perforated louvers (< 5% perforation), (moderate ability to reflect solar radiation out when closed)
    - Mounted so that when closed (flat), distance between face of shade and framing is 1-2 inches and distance between face of shade and glass is 6-7 inches.
    - Overlap between vertical slats is 0.5-1 inches when closed
    - White opaque backing (facing towards the outdoors) was installed on all vertical louvers in two south-facing private offices

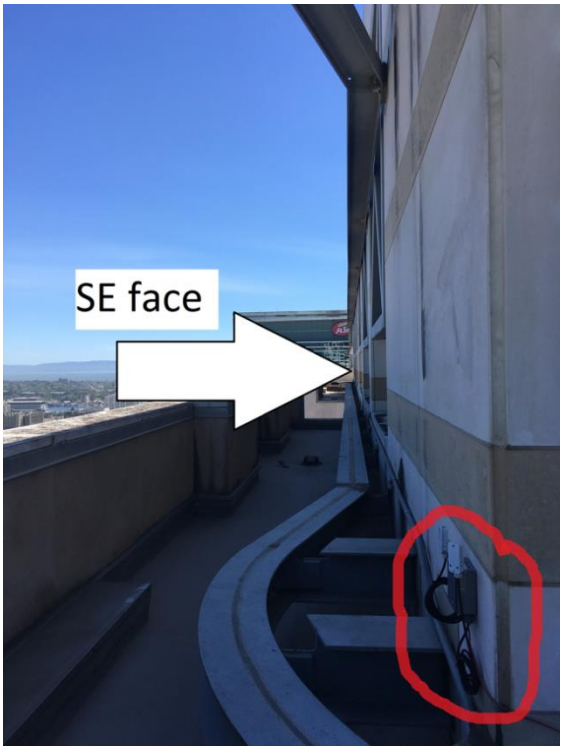
Test window condition

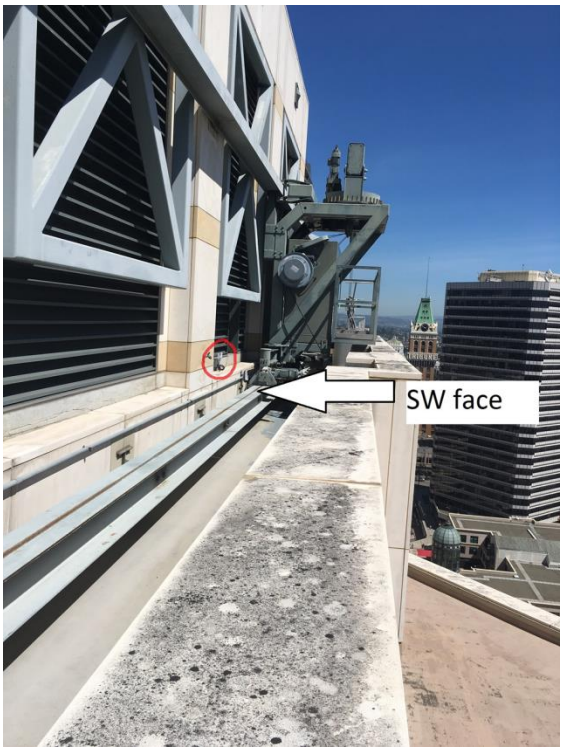
- Window divided into a lower solar control aperture and upper daylighting aperture
    - Dual-zone indoor shade was mounted 1 ft. ft. above the 9 ft. ft. dropped ceiling; separate headers/ supporting beams for each shade
    - Shades were mounted inboard of the window framing system (not between the vertical mullions)
        - Mounting distance between surface of lower roller shade film was 1-2 inches from the inboard face of the framing
    - Lower edge of the daylight-redirecting aperture was 7 ft. ft. above finished floor
    - Existing vertical blinds were removed and stored off site and replaced at the conclusion of the study

- GS film: Lower solar control aperture: transparent film with a textured surface, silver on outboard surface and gray inboard surface (Halcyon GS/EM, color: gray silver embossed)
    - When combined with single-pane ¼" clear glass, the lower shade provides:
        - Visible light transmittance (Tvis) is 0.02
        - "Percent solar energy rejected" is 83%
        - "Daytime Security": Yes, GSA Schedule Number GS-03F-0126Y
        - Winter U-value: 0.46 Btu/h-ft^2-°F
- Upper daylighting aperture: 2" wide concave up louver with 205 white satin finish on both upper and lower surfaces of the louver; motorized shade; automated with vendor's control system; lift and tilt operation
    - Zone A: upper blind automated (all SE, S, and E facing offices)
    - Zone B: upper blind manually operated (NW office)
    - Motor and control system for automated upper blind
        - Somfy Animeo software
        - Scheduled values for slat angle defined per façade orientation by vendor
        - Scheduled values do not account for outdoor exterior obstructions
        - Outdoor sensor determines whether it is "sunny" outdoors
            - One sensor per façade orientation on the vertical face of the façade
            - No wireless communications
            - Signal from sensor is delivered to the central control server via twisted pair wiring
        - Blind is adjusted to the appropriate tilt angle when sunny
        - Blind is raised if overcast, after user-specified time delay
        - Shade height positions: fully raised or lowered only

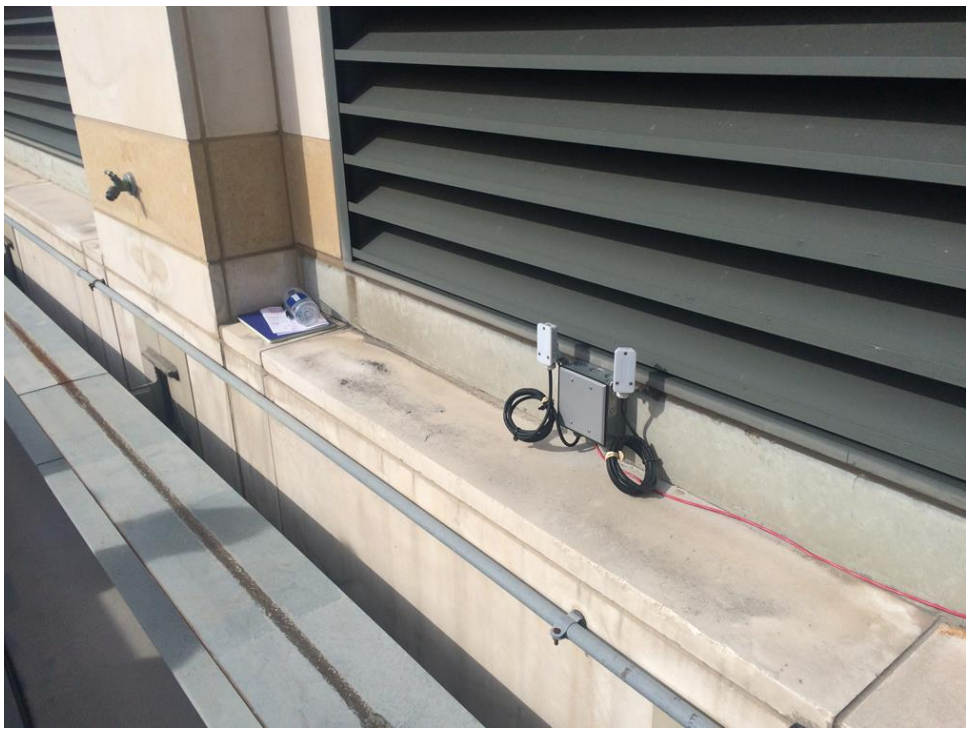
Related systems

- Lighting: Recessed, parabolic troffers with T8 lamps; dimmable lighting based on photoelectric and occupancy-based controls
- HVAC: Conventional VAV system with overhead air delivery, no additional perimeter heating or cooling at the window wall





Location of rooftop sensors.



Location of rooftop sensors.

APPENDIX A3. LBNL ADVANCED WINDOWS TESTBED (B71T) – DETAILED DESCRIPTION

The LBNL Advanced Windows Testbed, also referred to as Building 71T, consists of:

- Three side-by-side, thermally-isolated test chambers designed to emulate private offices that enable investigation of system-level interactions between façade, lighting systems, and HVAC systems
- Chamber net heat flow measurements to within ±20-60 W accuracy
- Sensor network metering of HVAC, lighting, and equipment loads (electrical loads to within 1% accuracy), visual comfort using latest HDR imaging systems, thermal comfort, occupant response, and outdoor weather conditions (comprehensive solar and sky radiation measurements)
- Interchangeable curtainwall, shading, and lighting systems

Reference condition

- Berkeley, California (latitude 37°4'N, longitude 122°1'W)
- 10x15x11 ft. ft. private office, thermally-isolated (except floor)
- 10x8.5 ft. ft. window wall, facing due south, WWR=0.59 (vision), WWR=0.73 whole window (excluding spandrel)
    - The horizontal division between the upper and lower zones occurred at a height of 6.5 ft. ft. above the floor.
    - Dual-pane, low-e glass: Viracon VRE-67 on ultrawhite, center of glass properties:
        - SHGCc=0.40
        - Tvis-c = 0.62
        - U-value-c = 0.30 Btu/h-ft^2-F
    - Thermally-broken aluminum framing.
- 1-inch interior venetian blind; white, semi-gloss finish; fully lowered, slat angle to block direct sun and minimize glare (seasonal cut-off angle + additional closure to reduce glare: tilt angle from horizontal set for winter, equinox, and summer periods)
    - Mounted inboard of framing

Test condition

- Same window configuration but:
    - Dual-pane, electrochromic glass in static clear state (Sage Electrochromics, Inc.)
        - SHGCc= 0.41
        - Tvis = 0.60
        - U-value-c = 0.28 Btu/h-ft^2-F
- Window divided into a lower solar control aperture and upper daylighting aperture
    - Dual-zone indoor shade mounted at 9 ft. ft. head height
    - Shades mounted inboard of the window framing system
        - Mounting distance between surface of lower roller shade film was within 1 inch from the inboard face of the framing
    - Lower edge of the daylight-redirecting aperture mounted no lower than 6.5 ft. ft. above finished floor
- Lower solar control aperture: transparent film with a textured surface, gray appearance on both sides of the film (Halcyon RS-10 G/S EM, color: gray/silver EM)

- Upper daylighting aperture: 2” wide concave up louver with 205 white satin finish on both upper and lower surfaces of the louver; motorized shade; automated with vendor’s control system; lift and tilt operation (same configuration as OFB)

Related systems

- Lighting: Pendant LED dimmable fixtures
    - Fixed output to 300 lux
    - Compute daylighting energy savings based on photosensor signal to enable comparable conditions between rooms
- HVAC: Dedicated fan coil unit with electric resistance heat and chilled water supply

APPENDIX A4. SUMMARY OF MONITORED DATA

Table A4-1. Daily lighting energy use (kWh/day) -- Winter period

Date	Max solar altitude (°)	Sky conditions	LE (kWh/day)				
			VB-58	Man-GG	Man-GS	Auto-GG	RS
20170127	33.93	Clear				0.374	
20170128	34.20	Clear				0.396	
20170129	34.47	Dynamic				0.472	
20170130	34.75	Dynamic				0.487	
20170131	35.03	Dynamic				0.658	
20170201	35.32	Overcast				0.969	
20170202	35.61	Overcast				0.782	
20170211	38.44	Clear	0.201	0.464	0.502		
20170212	38.78	Clear	0.202	0.518	0.578		
20170213	39.11	Dynamic	0.366	0.864	0.935		
20170214	39.46	Dyn+Clear	0.264	0.516	0.560		
20170215	39.80	Cloudy	0.929	1.160	1.213		
20170216	40.15	Dynamic	0.450	0.688	0.734		
20170217	40.50	Overcast	1.314	1.400	1.420		
20170218	40.86	Cloudy	0.781	1.112	1.167		
20170219	41.22	Cloudy	1.017	1.256	1.292		
20170220	41.58	Overcast	1.324	1.405			
20170221	41.94	Dynamic	0.916	1.155	1.199		
20170223	42.68	Clear	0.169	0.435		0.354	
20170224	43.05	Dynamic	0.269	0.602		0.488	
20170225	43.42	Dynamic	0.602	0.872		0.643	
20170226	43.80	Clear+Dyn	0.269	0.552		0.428	
20170227	44.18	Clear	0.184	0.474		0.372	
20170228	44.56	Clear	0.187	0.486		0.381	

Table A4-2. Daily lighting energy use (kWh/day) -- Summer period

Date	Max solar altitude (°)	Sky conditions	LE (kWh/day)				
			VB-40	Man-GG	Man-GS	Auto-GG	RS
20170526	73.42	Overcast	0.252			0.290	1.222
20170527	73.58	Dyn+clear	0.075			0.506	0.974
20170528	73.74	Ovc+clear	0.198			0.439	1.084
20170529	73.89	Overcast	0.226			0.423	1.099
20170530	74.04	Dynamic	0.127			0.234	0.949
20170531	74.31	Clear+Dyn	0.136			0.603	1.031
20170601	74.31	Dyn+Clear	0.119			0.428	1.005
20170602	74.44	Clear	0.157			0.680	1.059
20170603	74.56	Dyn+Clear	0.131			0.574	1.022
20170604	74.67	Clear	0.149			0.663	1.056
20170605	74.78	Clear	0.137			0.631	1.051
20170606	74.88	Clear	0.109			0.561	1.035
20170607	74.98	Dynamic	0.219			0.708	1.006
20170608	75.07	Dynamic	0.370			0.287	1.179
20170610	75.22	Dynamic	0.182	0.827			1.085
20170611	75.29	Dynamic	0.192	0.805			1.060
20170612	75.35	Dynamic	0.147	0.675			1.037
20170613	75.40	Clear	0.157	0.827			1.072
20170614	75.45	Clear	0.167	0.847			1.078
20170616	75.52	Clear	0.169		0.937		1.110
20170617	75.55	Clear	0.174		0.927		1.117
20170618	75.57	Clear	0.161		0.923		1.106
20170619	75.58	Clear	0.118		0.830		1.077
20170620	75.59	Clear	0.145		0.871		1.292
20170621	75.58	Clear	0.142		0.924		1.505

Table A4-3. Daily cooling load due to the window and shading system (kWh/day)

Date	Max solar altitude (°)	Sky conditions	Cooling load (kWh/day)				
			VB	Man-GG	Man-GS	Auto-GG	RS
20170211	38.44	Clear	8.14	11.65	8.48		
20170212	38.78	Clear	7.82	11.20	8.36		
20170213	39.11	Dynamic					
20170214	39.46	Dyn+Clear	8.83	12.34	9.48		
20170215	39.80	Cloudy	1.17	2.39	1.99		
20170216	40.15	Dynamic	6.59	9.22	6.90		
20170217	40.50	Overcast	-1.36	-1.43	-1.22		
20170218	40.86	Cloudy	1.31	2.12	1.48		
20170219	41.22	Cloudy	-0.68	-0.34	-0.58		
20170220	41.58	Overcast					
20170221	41.94	Dynamic	1.01	1.78	1.26		
20170223	42.68	Clear	7.78	11.11		11.36	
20170224	43.05	Dynamic	5.08	7.85		8.09	
20170225	43.42	Dynamic	2.81	4.89		4.89	
20170226	43.80	Clear+Dyn	6.00	8.90		9.23	
20170227	44.18	Clear	6.91	10.10		10.43	
20170228	44.56	Clear	6.91	10.00		10.36	
20170530	74.04	Dynamic	3.52			4.18	3.76
20170531	74.31	Clear+Dyn	3.73			4.34	4.11
20170601	74.31	Dyn+Clear	4.19			4.87	4.59
20170602	74.44	Clear	4.14			4.72	4.63
20170603	74.56	Dyn+Clear	3.84			4.45	4.31
20170604	74.67	Clear	3.44			3.91	3.83
20170605	74.78	Clear	3.96			4.56	4.42
20170606	74.88	Clear	3.42			3.96	3.90
20170607	74.98	Dynamic	3.42			3.97	3.75
20170608	75.07	Dynamic	2.11			2.57	2.56
20170610	75.22	Dynamic	2.87	3.27			3.13
20170611	75.29	Dynamic	2.93	3.38			3.15
20170612	75.35	Dynamic	3.42	3.93			3.69
20170613	75.40	Clear	3.61	4.11			4.04
20170614	75.45	Clear	4.04	4.61			4.56
20170616	75.52	Clear	4.83		4.77		5.51
20170617	75.55	Clear	4.94		4.75		5.59
20170618	75.57	Clear	5.86		5.86		6.65
20170619	75.58	Clear	5.07		4.99		5.76
20170620	75.59	Clear			4.40		
20170621	75.58	Clear			4.25		

Table A4-4. Peak cooling load due to the window and shading system (W/ft^2-floor)

Date	Max solar altitude (°)	Sky conditions	Peak cooling load (W/ft^2-floor)				
			VB	Man-GG	Man-GS	Auto-GG	RS
20170211	38.44	Clear	8.92	12.55	9.09		
20170212	38.78	Clear	8.75	12.25	9.01		
20170214	39.46	Dyn+Clear	9.57	13.43	10.11		
20170215	39.80	Cloudy	2.91	5.60	4.27		
20170216	40.15	Dynamic	9.06	12.61	9.38		
20170218	40.86	Cloudy	3.21	4.47	3.05		
20170219	41.22	Cloudy	1.58	2.51	1.56		
20170221	41.94	Dynamic	4.52	6.17	4.32		
20170223	42.68	Clear	8.49	11.92		12.25	
20170224	43.05	Dynamic	7.47	10.54		10.89	
20170225	43.42	Dynamic	6.65	8.94		9.33	
20170226	43.80	Clear+Dyn	8.05	11.08		11.67	
20170227	44.18	Clear	7.87	11.08		11.47	
20170228	44.56	Clear	7.79	10.71		11.22	
20170530	74.04	Dynamic	4.06			4.78	4.31
20170531	74.31	Clear+Dyn	4.21			5.00	4.63
20170601	74.31	Dyn+Clear	4.33			5.03	4.75
20170602	74.44	Clear	4.59			5.50	5.16
20170603	74.56	Dyn+Clear	4.07			4.83	4.62
20170604	74.67	Clear	3.99			4.75	4.51
20170605	74.78	Clear	4.40			5.22	4.95
20170606	74.88	Clear	4.00			4.65	4.48
20170607	74.98	Dynamic	3.92			4.42	4.19
20170608	75.07	Dynamic	2.18			2.55	2.48
20170610	75.22	Dynamic	3.38	4.12			3.89
20170611	75.29	Dynamic	3.74	4.29			3.90
20170612	75.35	Dynamic	4.10	4.64			4.12
20170613	75.40	Clear	4.01	4.80			4.52
20170614	75.45	Clear	4.32	5.09			4.88
20170616	75.52	Clear	4.76		4.84		5.44
20170617	75.55	Clear	4.90		4.98		5.66
20170618	75.57	Clear	5.59		5.69		6.40
20170619	75.58	Clear	4.86		4.91		5.58
20170620	75.59	Clear			4.63		
20170621	75.58	Clear			4.61		

Table A4-5a. Visual discomfort from window and shading system – Cameras 1 and 2 – winter

Date	Sky conditions	Camera 1					Camera 2				
		VB	Man-GG	Man-GS	Auto-GG	RS	VB	Man-GG	Man-GS	Auto-GG	RS
20170127	Clear				B					C	
20170128	Clear				A					C	
20170129	Dynamic				A					B	
20170130	Dynamic				A					C	
20170131	Dynamic				A					A	
20170201	Overcast				A					A	
20170202	Overcast				A					A	
20170211	Clear	D	A	A			C	A	A		
20170212	Clear	D	A	A			B	A	A		
20170213	Dynamic	C	A	A			A	A	A		
20170214	Dyn+Clear	D	A	A			B	A	A		
20170215	Cloudy	A	A	A			A	A	A		
20170216	Dynamic	D	A	A			C	A	A		
20170217	Overcast	A	A	A			A	A	A		
20170218	Cloudy	C	A	A			A	A	A		
20170219	Cloudy	A	A	A			A	A	A		
20170220	Overcast	A	A	A			A	A	A		
20170221	Dynamic	D	A	A			A	A	A		
20170223	Clear	D	A		A		C	A		A	
20170224	Dynamic	D	A		A		C	A		A	
20170225	Dynamic	D	A		A		C	A		A	
20170226	Clear+Dyn	D	A		A		C	A		A	
20170227	Clear	D	A		A		C	A		A	
20170228	Clear	D	A		A		C	A		A	

Table A4-5b. Visual discomfort from window and shading system – Cameras 1 and 2 -- summer

Date	Sky conditions	Camera 1					Camera 2				
		VB	Man-GG	Man-GS	Auto-GG	RS	VB	Man-GG	Man-GS	Auto-GG	RS
20170525	Dynamic	B			A	A	A			A	A
20170526	Overcast	A			A	A	A			A	A
20170527	Dyn+clear	C			A	A	A			A	A
20170528	Ovc+clear	C			A	A	A			A	A
20170529	Overcast	C			A	A	A			A	A
20170530	Dynamic	D			A	A	A			A	A
20170531	Clear+Dyn	B			A	A	A			A	A
20170601	Dyn+Clear	C			A	A	A			A	A
20170602	Clear	B			A	A	A			A	A
20170603	Dyn+Clear	B			A	A	A			A	A
20170604	Clear	B			A	A	A			A	A
20170605	Clear	B			A	A	A			A	A
20170606	Clear	C			A	A	A			A	A
20170607	Dynamic	C			A	A	A			A	A
20170608	Dynamic	A			A	A	A			A	A
20170610	Dynamic	B	A			A	A	A			A
20170611	Dynamic	C	A			A	A	A			A
20170612	Dynamic	C	A			A	A	A			A
20170613	Clear	B	A			A	A	A			A
20170614	Clear	B	A			A	A	A			A
20170616	Clear			A		A	A		A		A
20170617	Clear			A		A	A		A		A
20170618	Clear			A		A	A		A		A
20170619	Clear			A		A	A		A		A
20170620	Clear			A		A			A		A
20170621	Clear			A		A			A		A

Table A4-6. Percentage of people dissatisfied (PPD) with the thermal environment over the day with the reference or test condition

		VB-40					Man-GG					Man-GS					Auto-GG					RS				
Date	Sky conditions	PPD>=20%	15%<=PPD<20%	10%<=PPD<15%	5%<=PPD<10%	PPD<=5%	PPD>=20%	15%<=PPD<20%	10%<=PPD<15%	5%<=PPD<10%	PPD<=5%	PPD>=20%	15%<=PPD<20%	10%<=PPD<15%	5%<=PPD<10%	PPD<=5%	PPD>=20%	15%<=PPD<20%	10%<=PPD<15%	5%<=PPD<10%	PPD<=5%	PPD>=20%	15%<=PPD<20%	10%<=PPD<15%	5%<=PPD<10%	PPD<=5%
20170214	Dyn+Clear	0%	0%	25%	75%	0%	0%	7%	49%	44%	0%	0%	0%	17%	83%	0%										
20170215	Cloudy	0%	0%	0%	100%	0%	0%	0%	0%	100%	0%	0%	0%	0%	100%	0%										
20170216	Dynamic	0%	0%	19%	81%	0%	0%	2%	33%	65%	0%	0%	0%	4%	96%	0%										
20170217	Overcast	0%	0%	0%	100%	0%	0%	0%	0%	100%	0%	0%	0%	0%	100%	0%										
20170218	Cloudy	0%	0%	0%	100%	0%	0%	0%	0%	100%	0%	0%	0%	0%	100%	0%										
20170219	Cloudy	0%	0%	0%	100%	0%	0%	0%	0%	100%	0%	0%	0%	0%	100%	0%										
20170220	Overcast	0%	0%	0%	100%	0%	0%	0%	0%	100%	0%	0%	0%	0%	100%	0%										
20170221	Dynamic	0%	0%	0%	100%	0%	0%	0%	1%	99%	0%	0%	0%	0%	100%	0%										
20170530	Dynamic	0%	0%	0%	100%	0%											0%	0%	0%	100%	0%	0%	0%	0%	100%	0%
20170531	Clear+Dyn	0%	0%	0%	100%	0%											0%	0%	0%	100%	0%	0%	0%	0%	100%	0%
20170601	Dyn+Clear	0%	0%	0%	100%	0%											0%	0%	0%	100%	0%	0%	0%	0%	100%	0%
20170602	Clear	0%	0%	0%	100%	0%											0%	0%	0%	100%	0%	0%	0%	0%	100%	0%
20170603	Dyn+Clear	0%	0%	0%	100%	0%											0%	0%	0%	100%	0%	0%	0%	0%	100%	0%
20170604	Clear	0%	0%	0%	100%	0%											0%	0%	0%	100%	0%	0%	0%	0%	100%	0%
20170605	Clear	0%	0%	0%	100%	0%											0%	0%	0%	100%	0%	0%	0%	0%	100%	0%
20170606	Clear	0%	0%	0%	100%	0%											0%	0%	0%	100%	0%	0%	0%	0%	100%	0%
20170607	Dynamic	0%	0%	0%	100%	0%											0%	0%	0%	100%	0%	0%	0%	0%	100%	0%
20170608	Dynamic	0%	0%	0%	100%	0%											0%	0%	0%	100%	0%	0%	0%	0%	100%	0%
20170610	Dynamic	0%	0%	0%	100%	0%	0%	0%	0%	100%	0%											0%	0%	0%	100%	0%
20170611	Dynamic	0%	0%	0%	100%	0%	0%	0%	0%	100%	0%											0%	0%	0%	100%	0%
20170612	Dynamic	0%	0%	0%	100%	0%	0%	0%	0%	100%	0%											0%	0%	0%	100%	0%
20170613	Clear	0%	0%	0%	100%	0%	0%	0%	0%	100%	0%											0%	0%	0%	100%	0%
20170614	Clear	0%	0%	0%	100%	0%	0%	0%	0%	100%	0%											0%	0%	0%	100%	0%
20170616	Clear	0%	0%	0%	100%	0%						0%	0%	0%	100%	0%						0%	0%	0%	100%	0%
20170617	Clear	0%	0%	0%	100%	0%						0%	0%	0%	100%	0%						0%	0%	0%	100%	0%
20170618	Clear	0%	0%	0%	100%	0%						0%	0%	0%	100%	0%						0%	0%	0%	100%	0%
20170619	Clear	0%	0%	0%	100%	0%						0%	0%	0%	100%	0%						0%	0%	0%	100%	0%
20170620	Clear	0%	0%	0%	100%	0%						0%	0%	0%	100%	0%						0%	0%	0%	100%	0%
20170621	Clear	0%	0%	0%	100%	0%						0%	0%	0%	100%	0%						0%	0%	0%	100%	0%

Table A4-7a. Percentage of day that the average workplane illuminance at 7.5 ft. from the window is within the useful daylight illuminance range (100-2000 lux) – winter

Date	Sky condition	VB	Man-GG	Man-GS	Auto-GG	RS
20170127	Clear				94%	
20170128	Clear				93%	
20170129	Dynamic				93%	
20170130	Dynamic				94%	
20170131	Dynamic				93%	
20170201	Overcast				89%	
20170202	Overcast				93%	
20170211	Clear	95%	94%	91%		
20170212	Clear	95%	94%	91%		
20170213	Dynamic	94%	92%	88%		
20170214	Dyn+Clear	94%	93%	92%		
20170215	Cloudy	94%	88%	77%		
20170216	Dynamic	95%	90%	83%		
20170217	Overcast	79%	55%	22%		
20170218	Cloudy	94%	93%	89%		
20170219	Cloudy	81%	72%	65%		
20170220	Overcast	75%	57%	100%		
20170221	Dynamic	92%	89%	73%		
20170223	Clear	97%	93%		99%	
20170224	Dynamic	97%	94%		99%	
20170225	Dynamic	93%	86%		96%	
20170226	Clear+Dyn	96%	90%		98%	
20170227	Clear	97%	94%		99%	
20170228	Clear	97%	94%		99%	

Table A4-7b. Percentage of day that the average workplane illuminance at 7.5 ft. from the window is within the useful daylight illuminance range (100-2000 lux) -- summer

Date	Sky condition	VB	Man-GG	Man-GS	Auto-GG	RS
20170525	Dynamic	100%			100%	100%
20170526	Overcast	100%			100%	49%
20170527	Dyn+clear	100%			100%	77%
20170528	Ovc+clear	100%			100%	64%
20170529	Overcast	100%			100%	62%
20170530	Dynamic	99%			100%	84%
20170531	Clear+Dyn	100%			100%	76%
20170601	Dyn+Clear	100%			100%	77%
20170602	Clear	100%			100%	64%
20170603	Dyn+Clear	100%			100%	73%
20170604	Clear	100%			100%	65%
20170605	Clear	100%			100%	67%
20170606	Clear	100%			100%	74%
20170607	Dynamic	97%			98%	79%
20170608	Dynamic	93%			96%	65%
20170610	Dynamic	100%	100%			62%
20170611	Dynamic	100%	94%			63%
20170612	Dynamic	100%	98%			73%
20170613	Clear	100%	98%			64%
20170614	Clear	100%	98%			62%
20170616	Clear	100%		95%		58%
20170617	Clear	100%		96%		56%
20170618	Clear	100%		97%		59%
20170619	Clear	100%		98%		66%
20170620	Clear	100%		97%		16%
20170621	Clear	100%		93%		11%

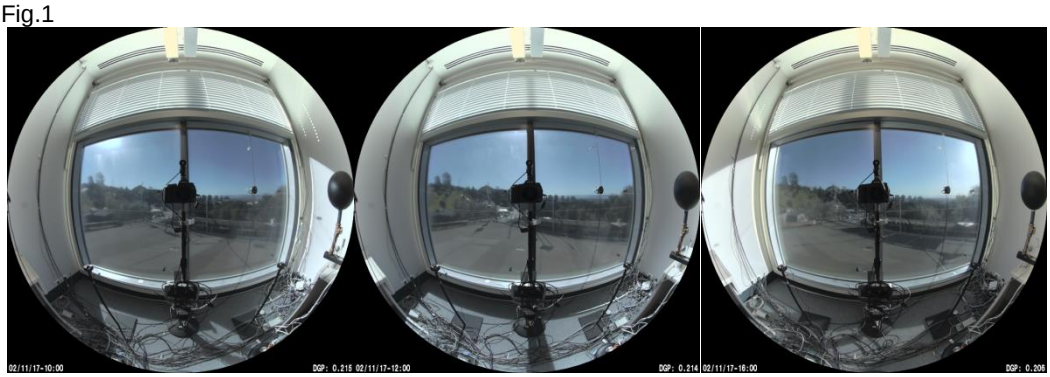
APPENDIX A5. DETAILED HDR ANALYSIS

Manually operated DZSC shade

Camera1

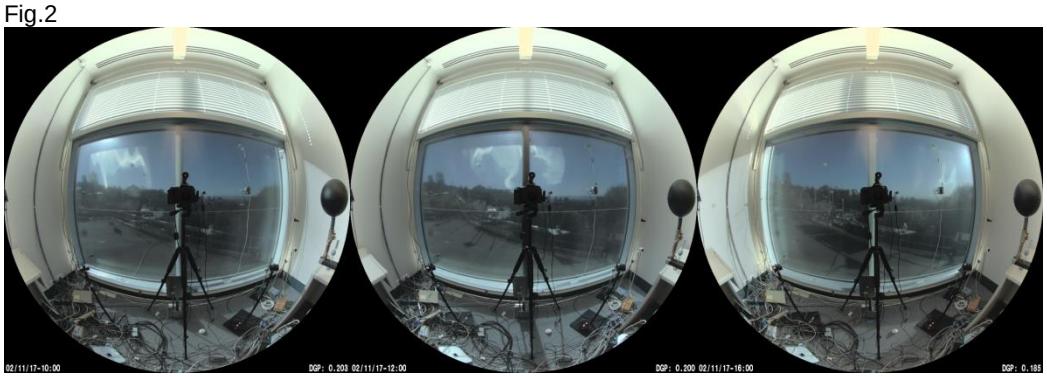
During the clear and dynamic sky days from February 11th - 16th, 2017, the window mullion blocked the direct sun at this view point for the whole day in both rooms. DGP was mostly lower than 0.350 and no visible glare appeared (fig.1 and fig.2). Man-GS is likely to reduce more glare than Man-GG, but increase the reflected light that created non-uniformity pattern on the lower window pane as appears in the example on February 11th, 2017 in Fig.2.

Fig.1



Date	2017-02-11	2017-02-11	2017-02-11
Time	10:00	12:00	16:00
Blinds	Man-GG	Man-GG	Man-GG
DGP	0.215	0.214	0.206

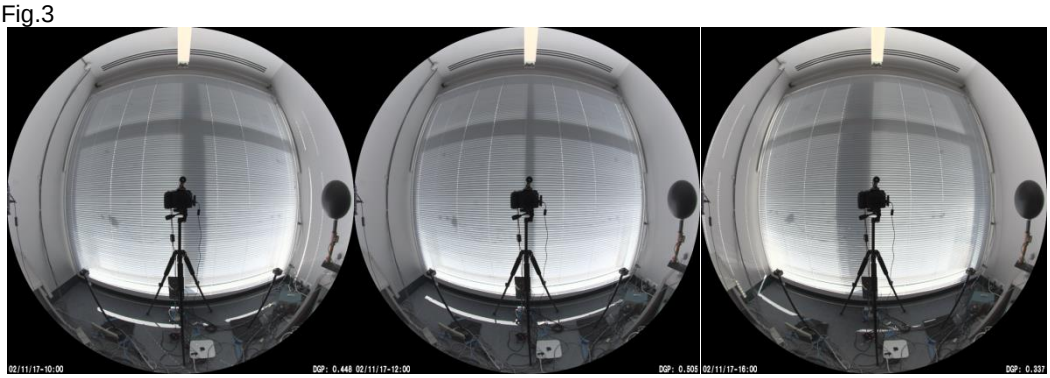
Fig.2



Date	2017-02-11	2017-02-11	2017-02-11
Time	10:00	12:00	16:00
Blinds	Man-GS	Man-GS	Man-GS
DGP	0.203	0.200	0.185

These two test rooms when compared to the reference room with VB-58 (fig.3), on the same day and time (February 11th, 2017), we could see that both Man-GG and Man-GS reduced glare significantly at this view point (fig.4a and 4b). The lower blinds of Man-GG and Man-GS blocked completely the reflected light that fall on the lower window frame and lower part of the window in the test rooms, this reflected light appeared in the reference room with VB-58 and caused DGP as high as 0.505 at noon time. The glare sources in the test rooms with Man-GG and Man-GS moved upper to the upper window and ceiling, which on this day, February 11th, the luminance was not high enough to cause glare.

Fig.3



Date	2017-02-11	2017-02-11	2017-02-11
Time	10:00	12:00	16:00
Blinds	VB-58	VB-58	VB-58
DGP	0.448	0.505	0.337

Fig.4a

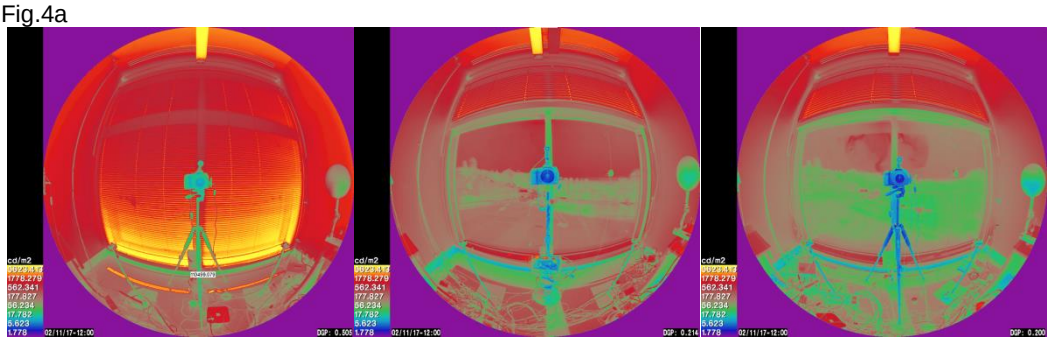
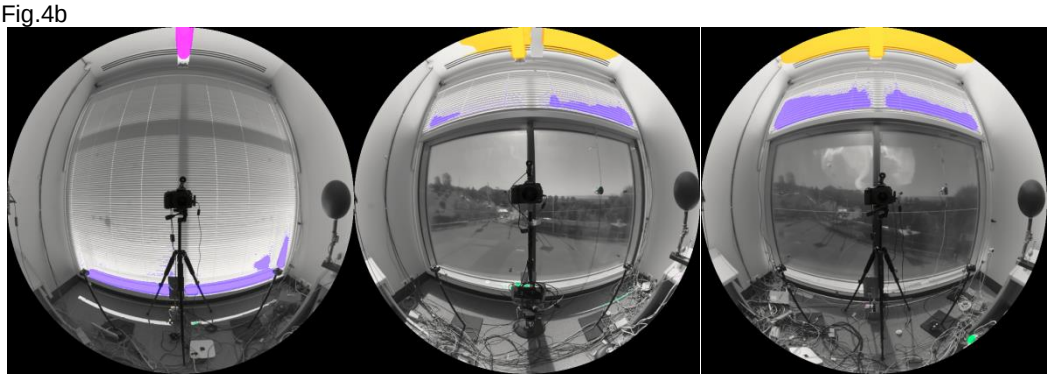


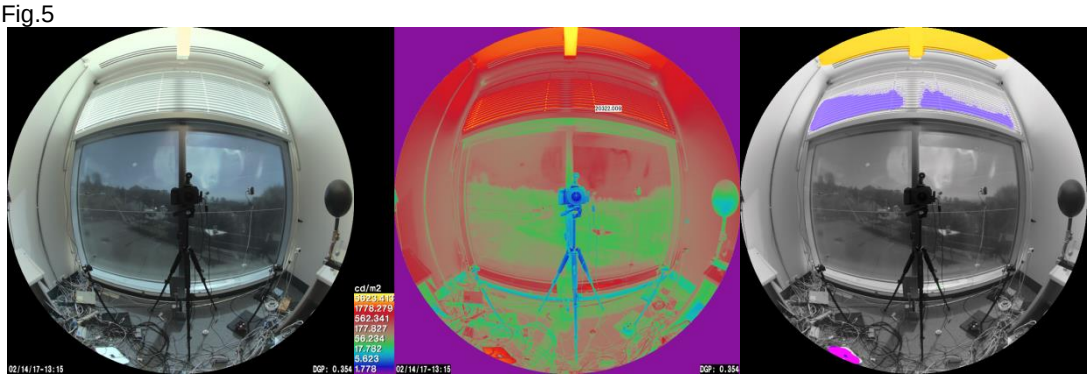
Fig.4b



Date	2017-02-11	2017-02-11	2017-02-11
Time	12:00	12:00	12:00
Blinds	VB-58	Man-GG	Man-GS
DGP	0.505	0.214	0.200
Max Luminance	110,499		

However even when the Sun was blocked behind the mullions, the reflected light moved up the ceiling and upper window, glare could occasionally be occurred in the test rooms with Man-GG and Man-GS, for example, on February 14th, 2017 at13:15 in the test room with Man-GS (fig.5), DGP reached 0.354. As shown in the evalglare image (fig. 5 right), the glare sources were the reflected light on the blinds and ceiling that had the max luminance value up to 20,322 cd/m^2.

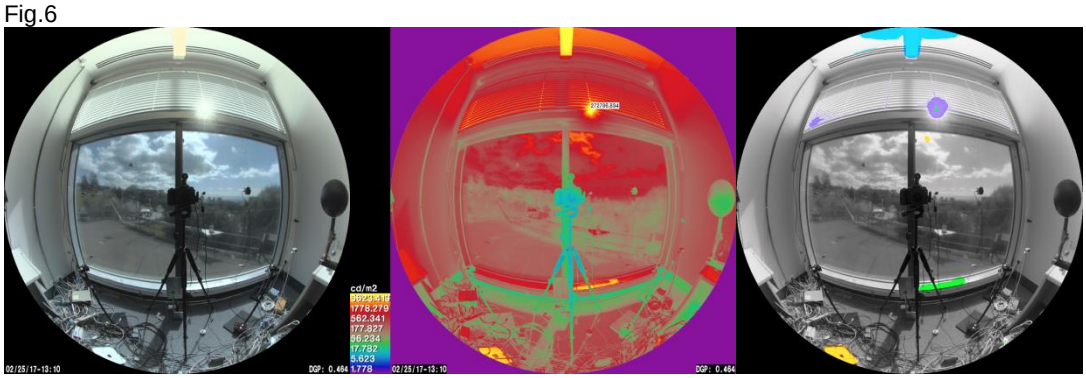
Fig.5



Date	2017-02-14
Time	13:15
Blinds	Man-GS
DGP	0.354
Max Luminance	20,322

Moreover, even higher DGP could be found in the test rooms when the solar angle was higher and the Sun was not fully blocked by the mullion in late February; for example on February 25th in the room with Man-GG (fig.6), solar angle was slightly appeared higher than the mullion and penetrated sunlight appeared behinds the blinds and caused glare, resulted in DGP as high as 0.464, at 13:10 in the afternoon.

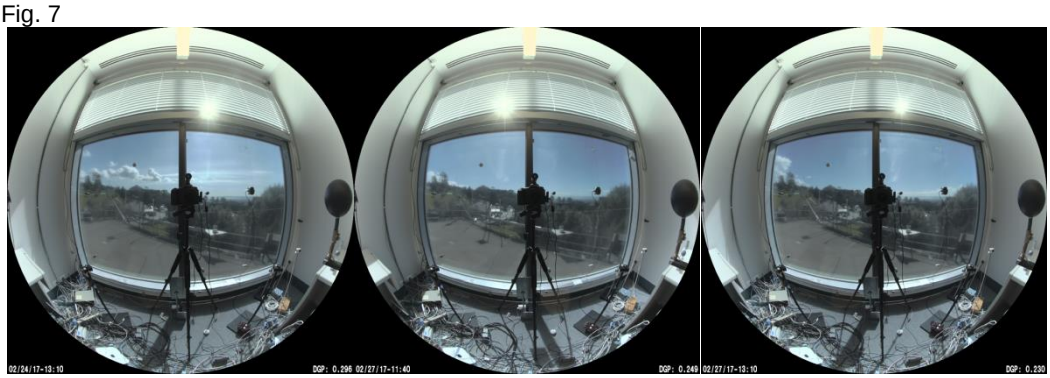
Fig.6



Date	2017-02-25
Time	13:10
Blinds	Man-GG
DGP	0.464
Max Luminance	272,787

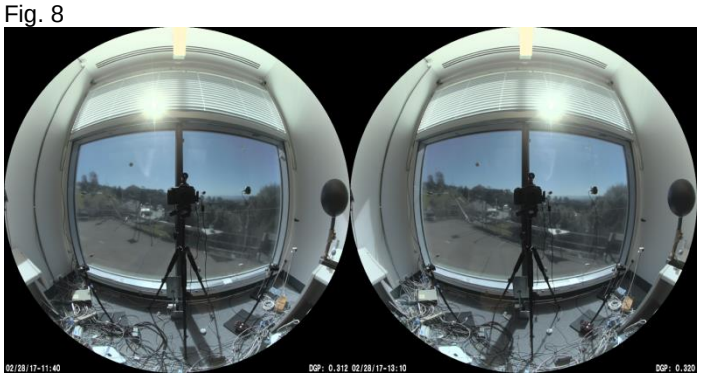
This occurrence had happened almost everyday from February 23rd to February 28th on the clear and dynamic days in test room with Man-GG (Fig. 7 and 8). However the DGP were varied, 0.296 at 13:10 on February 24th, 0.249 at 11:40 on February 27th, 0.230 at 13:10 on February 27th ,0.312 at 11:40 on February 28th and 0.320 at 13:10 on February 28th .

Fig. 7



Date	2017-02-24	2017-02-27	2017-02-27
Time	13:10	11:40	13:10
Blinds	Man-GS	Man-GS	Man-GS
DGP	0.296	0.249	0.230

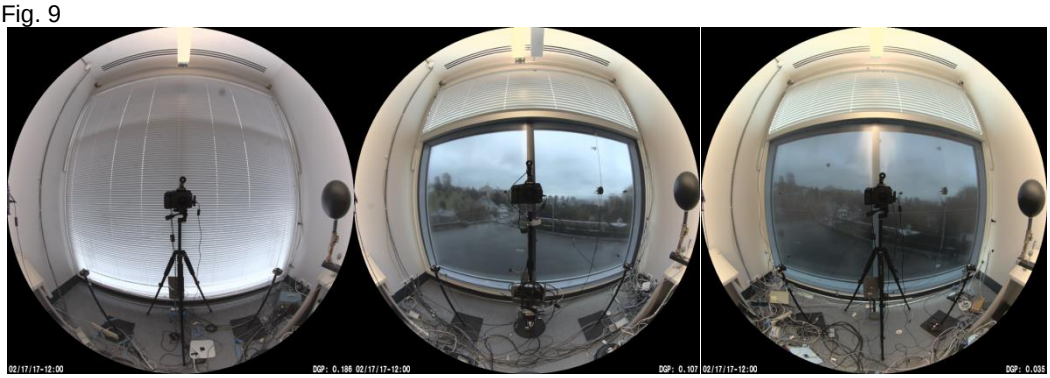
Fig. 8



Date	2017-02-28	2017-02-28
Time	11:40	13:10
Blinds	Man-GS	Man-GS
DGP	0.312	0.320

On an overcast sky day, February 17th, 2017, because blinds are always fully down in both test rooms and there was no sun appeared on the window, DGP of both rooms and the reference room with VB-58 were always lower than 0.350, no glare was found, DGP in the reference room with VB-58 was always higher than what monitored in the test room with Man-GG and DGP in the test room with Man-GG was always higher than what's happened in the test room with Man-GS (fig.9).

Fig. 9

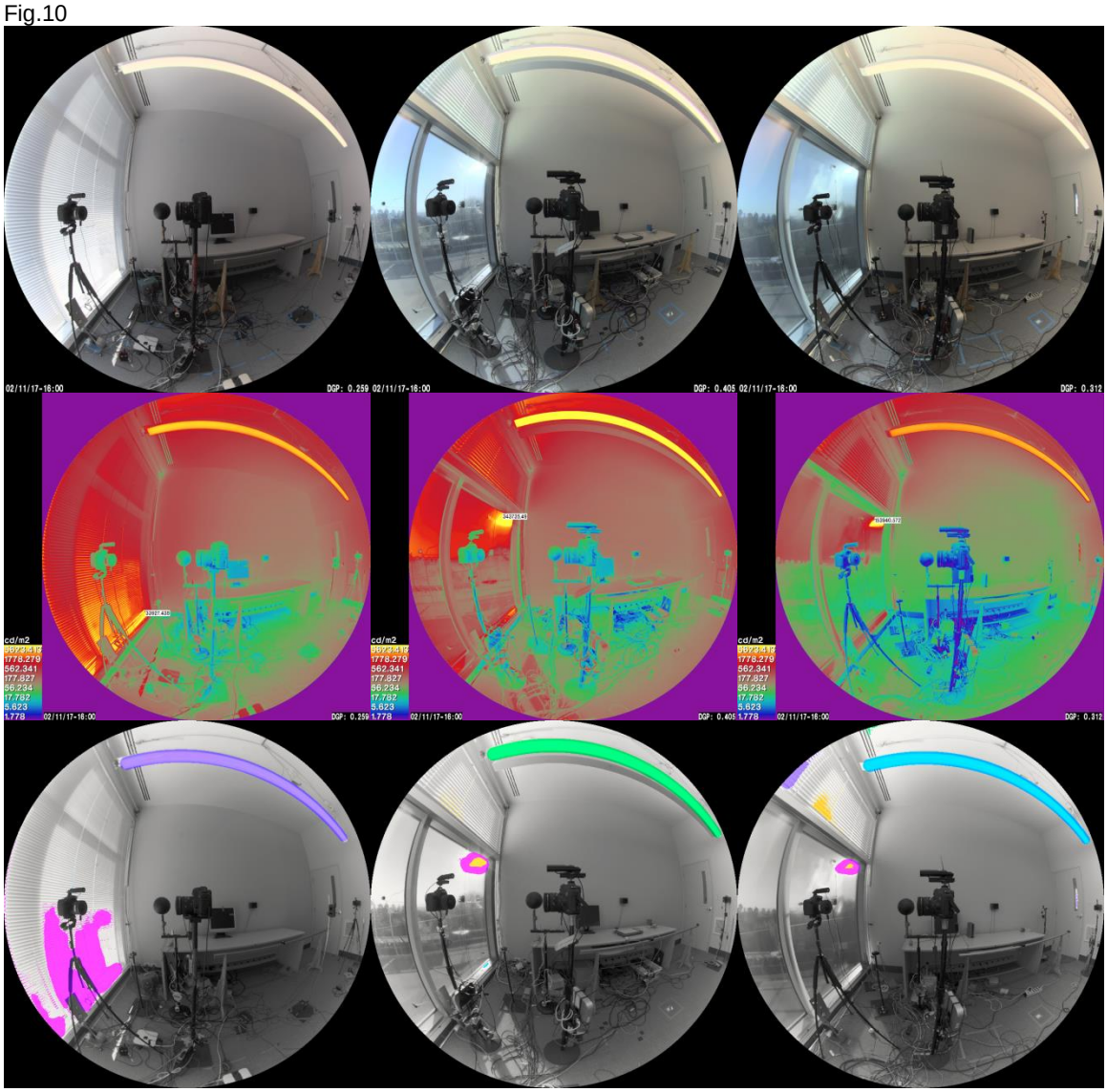


Date	2017-02-17	2017-02-17	2017-02-17
Time	12:00	12:00	12:00
Blinds	VB-58	Man-GG	Man-GS
DGP	0.186	0.107	0.035

Camera 2

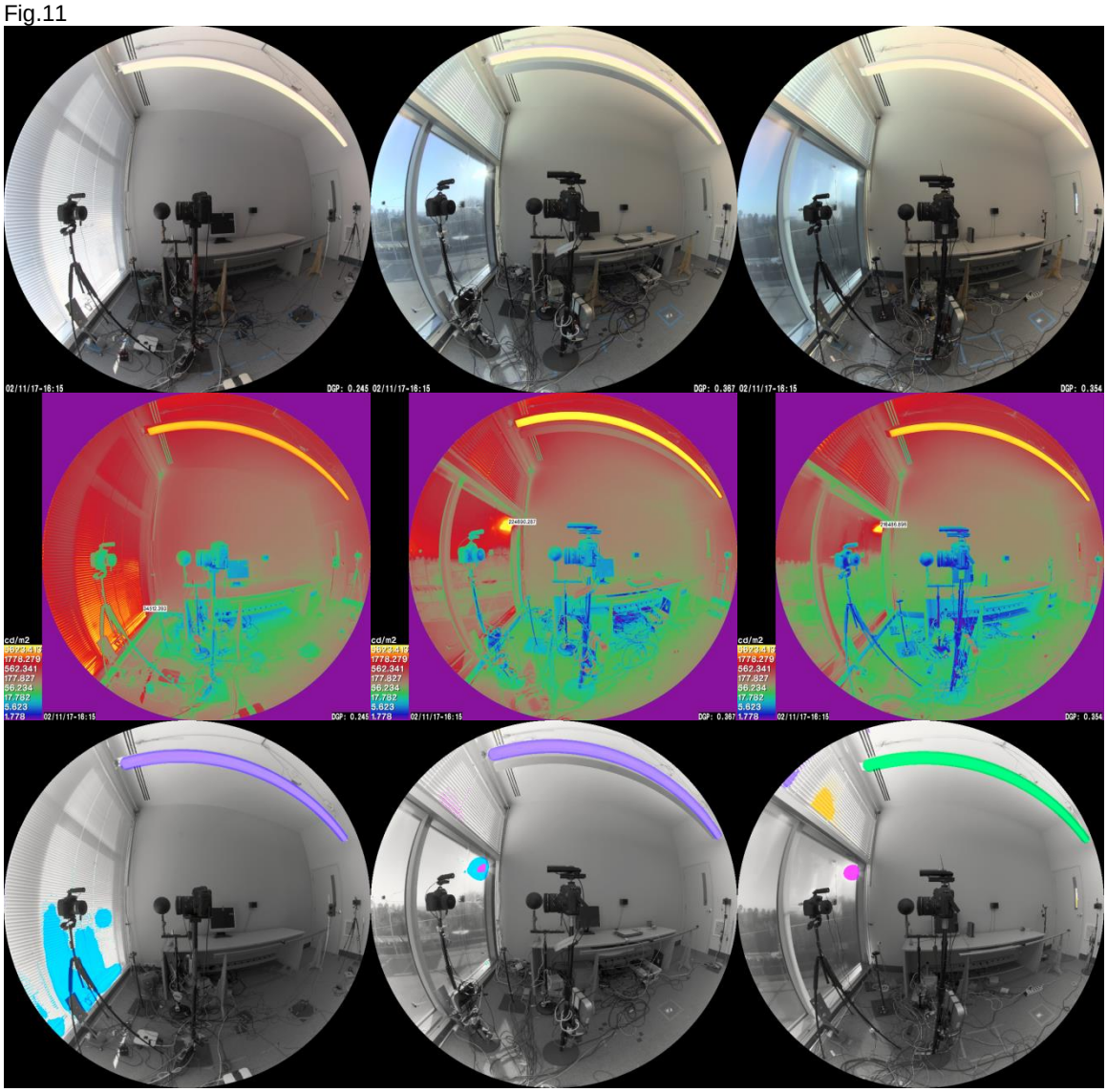
From this viewpoint towards the west wall, the afternoon is more vital than the morning for glare risk. At around this time of the year, February 11, 2017, when the solar angle was still low. The Sun could appear on the window. In the test room with Man-GG, the sun orb had shown up on the lower window from 15:25 to 16:25 (60mins), which Max DGP up to 0.405 at 16:00 (fig.10center) and in the test room with Man-GS, the sun orb had shown up on the lower window from 15:30 to 16:20 (50mins), which Max DGP reached up to 0.354 at 16:15 (fig.11 right). Even though the time period that disturbing glare occurred is less than 5% of the whole working hours, this could cause the displeasured and annoyed visual comfort for the occupants.

Fig.10



Date	2017-02-11	2017-02-11	2017-02-11
Time	16:00	16:00	16:00
Blinds	VB-58	Man-GG	Man-GS
DGP	0.259	0.405 (max of the day)	0.312
Max Luminance	33,927	343,735	153,941

Fig.11



Date	2017-02-11	2017-02-11	2017-02-11
Time	16:15	16:15	16:15
Blinds	VB-58	Man-GG	Man-GS
DGP	0.245	0.367	0.354 (max of the day)
Max Luminance	34,512	224,690	216,487

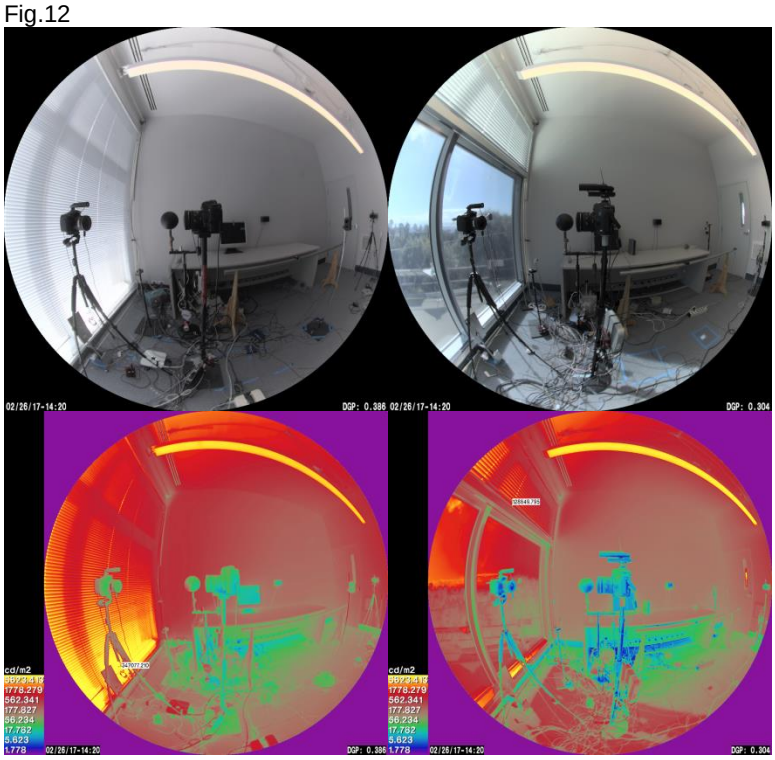
This occurrence had happened everyday from February 11th to February 16th on the clear and dynamic days in both rooms

Date	2017-02-11	2017-02-12	2017-02-13	2017-02-14	2017-02-16
Time	15:25 – 16:25	15:35 – 16:20	16:00 – 16:20	15:55 – 16:15	15:50 – 16:15
Duration	60mins	45mins	20mins	20mins	25mins
Blinds	Man-GG	Man-GG	Man-GG	Man-GG	Man-GG
Max DGP	0.405	0.382	0.366	0.360	0.352

Date	2017-02-11	2017-02-12	2017-02-13	2017-02-14	2017-02-16
Time	15:30 – 16:20	15:35 – 16:20	16:00 – 16:15	15:55 – 16:15	15:50 – 16:10
Duration	50mins	45mins	15mins	20mins	20mins
Blinds	Man-GS	Man-GS	Man-GS	Man-GS	Man-GS
Max DGP	0.354	0.354	0.351	0.330	0.337

However, difference from the camera 1 position, when the solar angle was higher in late February, in the test room with Man-GG, the sun orb was fully blocked by the upper blinds and DGP was always lower than 0.304 (Fig. 12). When compared to the reference room with VB-58, the test room with Man-GG reduced significant amount of glare and lower the DGP.

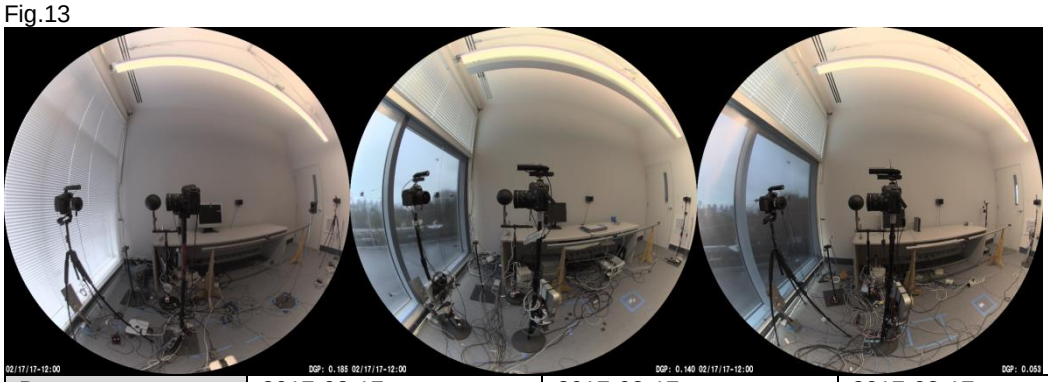
Fig.12



Date	2017-02-26	2017-02-26
Time	14:20	14:20
Blinds	VB-58	Man-GG
DGP	0.386	0.304
Max Luminance	347,077	128,850

On an overcast sky day, February 17th, 2017, because blinds are always fully down in both test rooms and there was no sun appeared on the window, DGP of both rooms and the reference room with VB-58 were always very low, no glare was found, DGP in the reference room with VB-58 was always higher than what monitored in the test room with Man-GG and DGP in the test room with Man-GG was always higher than what's happened in the test room with Man-GS (fig.13).

Fig.13



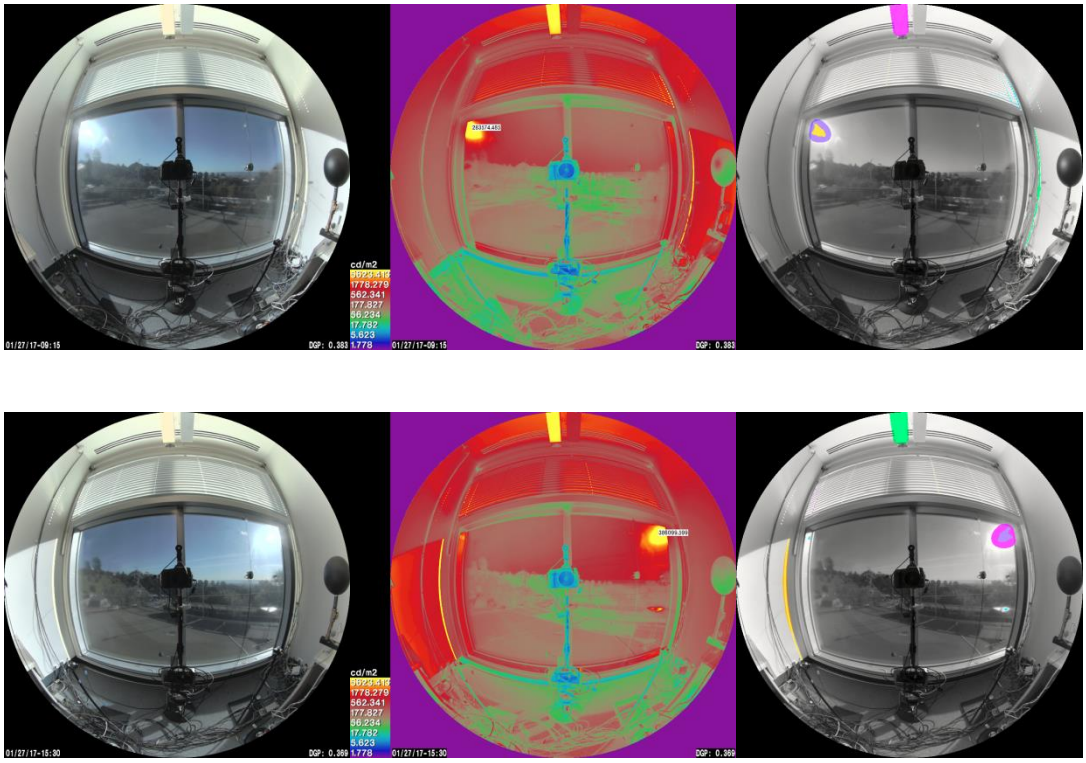
Date	2017-02-17	2017-02-17	2017-02-17
Time	12:00	12:00	12:00
Blinds	VB-58	Man-GG	Man-GS
DGP	0.185	0.140	0.053

Auto-GG shade operation during the OFB test

Fig.14. Position of upper shade during the winter period for the OFB test.

Date	Max sol alt	Sky condition	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00
20170127	33.93	Clear																
20170128	34.2	Clear																
20170129	34.47	Intermediate																
20170130	34.75	Dynamic																
20170131	35.03	Dynamic																
20170201	35.32	Overcast																
20170202	35.61	Overcast																
20170223	42.68	Clear																
20170224	43.05	Dynamic																
20170225	43.42	Dynamic																
20170226	43.8	Clear																
20170227	44.18	Clear																
20170228	44.56	Clear																

Green = upper shade is fully lowered; pink = upper shade is fully raised.



View of the window (left), falsecolor luminance map of the window (center), and glare sources (color) identified by *evalglare*.

APPENDIX A6. OCCUPANT SURVEY

Appended below.

Dual-zone indoor shades: occupant survey

Welcome!

Thank you for your participation in this pilot evaluation of a dual-zone indoor shade system. This study is sponsored by the GSA Proving Ground Program (GPG) and is being conducted by the Lawrence Berkeley National Laboratory (LBNL).

Your feedback will help understand how well the dual-zone indoor shades installed in the windows in your space meet the needs of GSA tenants such as yourself. Results will help GSA decide whether to deploy this technology more widely.

Survey Details

- **Time:** The survey usually takes 15 minutes to complete.
- **Confidentiality:** Your answers are confidential. Survey responses will not be linked to an individual's identity, including when survey responses contain information that might allow such identification. To avoid bias, please do not discuss your impressions with anyone else.
- **Voluntary Participation:** Your participation in this study is voluntary. You are free to skip any questions you don't want to answer and to end your participation at any time. Your decision to fill out the survey or not will have no effect on your job or any benefits you receive now or in the future.
- **Questions.** If you have any other questions about the study, please contact LBNL researcher Luis Fernandes (llfernandes@lbl.gov, 510-495-8892) or the LBNL Human Subjects Committee (harc@lbl.gov, 510-486-5399).

Instructions

Please fill out this questionnaire as completely as possible, skipping any question you are unable to answer or do not want to answer. Please respond to all of the items as openly and honestly as possible. There are no right or wrong answers; it is only your opinions that are important.

When you are done with the questionnaire, please place it in the provided envelope and seal the envelope before returning it.

Dual-Zone Indoor Shade System

A dual-zone indoor shade system has two independently controlled shading systems: one for the upper part of the window and another one for the lower part of the window. The dual-zone indoor shade system being evaluated in this study comprises reflective louvers which redirect daylight that enters through the upper portion of windows to the ceiling, and roller shades in the lower portion of the windows.

In March 2017, dual-zone indoor shades were installed on the 7th floor of the North Tower of the Dellums Federal Building, as pictured above.

For this survey, please refer to the period from mid-March 2017 until now (after new shades were installed).

Part A: Background Questions

A1) In which area of the floorplan shown below is your usual workstation located?

a) Interior cubicles (orange shaded area)

b) Window office/cubicle (green shaded area)

c) Window office/cubicle (blue shaded area)

A2) Sometimes men and women have different physiological responses to their environments. Are you:

a) Female

b) Male

c) Decline to state

A3) Are you…

a) Under 40 years old?

b) 40 or over?

c) Decline to state

A4) Do you wear glasses at work?

a) Yes

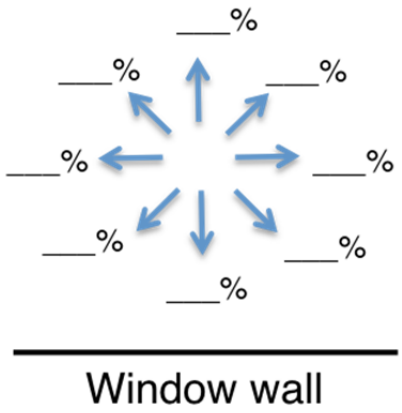
b) No

c) Decline to state

A5) At your usual workstation, what percentage of your time is spent on each of the following tasks?

Task	Percentage (%)
Computer-based tasks	_____
Paper-based tasks	_____
Telephone-based tasks	_____
Other (please specify)_____	_____

A6) At your usual workstation, what percentage of the time do you face the directions shown in the diagram below, relative to the nearest window wall:



A7) When seated at your usual workstation, can you see any portion of the windows?

a) Yes

b) No

A8) How many hours per day to you spend at your usual workstation?

a) An hour or less

b) 2-4 hours

c) 5-7 hours

d) 8 hours or more

A9) When at your usual workstation, what is your typical work schedule?

a) Approximately 8-9 AM to 5-6 PM

b) Arrive before 8 AM and leave before 5 PM

c) Arrive after 9 AM and leave after 6 PM

d) Other (please specify) _____

A10) Please assign a rating from 1 (unimportant) to 9 (very important) indicating the importance of each item in making your work environment pleasant and productive:

	Unimportant				Moderately Important				Important
a) Comfortable ambient temperature	1	2	3	4	5	6	7	8	9
b) Ability to control temperature	1	2	3	4	5	6	7	8	9
c) Good lighting	1	2	3	4	5	6	7	8	9
d) Windows	1	2	3	4	5	6	7	8	9
e) A view outside	1	2	3	4	5	6	7	8	9
f) Privacy	1	2	3	4	5	6	7	8	9
g) A quiet workplace	1	2	3	4	5	6	7	8	9
h) Controllable lights or windows	1	2	3	4	5	6	7	8	9
i) An aesthetically appealing environment	1	2	3	4	5	6	7	8	9
j) Other (please specify) _____	1	2	3	4	5	6	7	8	9

A11) Please assign a rating from 1 (least sensitive) to 9 (very sensitive) indicating your sensitivity to the following items.

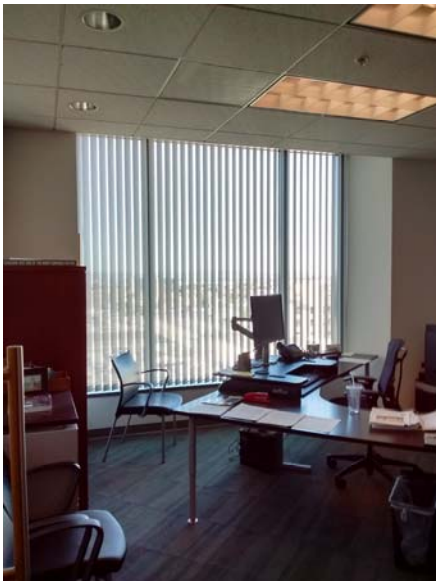
	Not sensitive				Moderately sensitive				Very sensitive
a) Glare	1	2	3	4	5	6	7	8	9
b) Cold	1	2	3	4	5	6	7	8	9
c) Heat	1	2	3	4	5	6	7	8	9
d) Darkness	1	2	3	4	5	6	7	8	9
e) Noise	1	2	3	4	5	6	7	8	9
f) Visual Distractions	1	2	3	4	5	6	7	8	9

A12) When you perform your usual work tasks, what is your preferred light level in your workspace?

	Very low		Low		Moderate		Bright		Very Bright
Light level	1	2	3	4	5	6	7	8	9

Part B: Subjective Evaluation

In this section, you will be asked about the performance of the dual-zone interior shades versus that of the original window configuration. The images below show each of the two window configurations.



BEFORE: Original window configuration

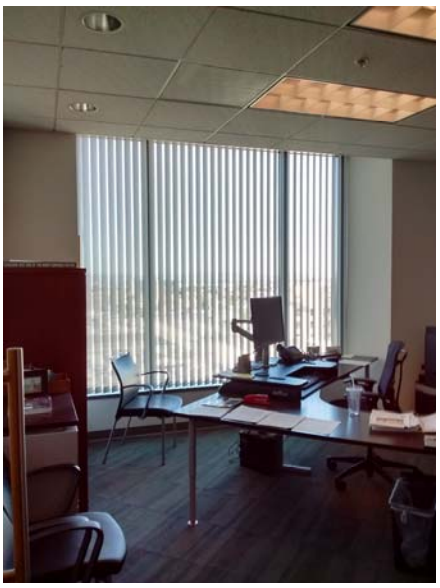
AFTER: Window with dual-zone shades

B1) Please assign a rating from 1 to 9 (or N/A = not applicable) to the following conditions in your office.

Temperature in warm/hot weather	Too cold				Just right				Too hot	
	↓				↓				↓	
a) Before: original windows	1	2	3	4	5	6	7	8	9	N/A
b) After: with dual-zone shades	1	2	3	4	5	6	7	8	9	N/A

Temperature in cool/cold weather	Too cold				Just right				Too hot	
	↓				↓				↓	
a) Before: original windows	1	2	3	4	5	6	7	8	9	N/A
b) After: with dual-zone shades	1	2	3	4	5	6	7	8	9	N/A

Light level	Too dark				Just right				Too bright
	↓				↓				↓
a) Before: original windows	1	2	3	4	5	6	7	8	9
b) After: with dual-zone shades	1	2	3	4	5	6	7	8	9



BEFORE: Original window configuration

AFTER: Window with dual-zone shades

Glare from windows

[Insert diagrams showing the two sections of window, both pre- and post-installation]

Glare from windows: **Upper 2 ft of window**	Not perceptible		Perceptible		Acceptable		Uncomfortable		Intolerable	
a) Before: original windows	1	2	3	4	5	6	7	8	9	N/A
b) After: with dual-zone shades	1	2	3	4	5	6	7	8	9	N/A

Glare from windows: **Rest of window**	Not perceptible		Perceptible		Acceptable		Uncomfortable		Intolerable	
a) Before: original windows	1	2	3	4	5	6	7	8	9	N/A
b) After: with dual-zone shades	1	2	3	4	5	6	7	8	9	N/A

Glare from light fixtures	Not perceptible		Perceptible		Acceptable		Uncomfortable		Intolerable	
a) Before: original windows	1	2	3	4	5	6	7	8	9	N/A
b) After: with dual-zone shades	1	2	3	4	5	6	7	8	9	N/A

Glare from other sources (Specify:_____)	Not perceptible		Perceptible		Acceptable		Uncomfortable		Intolerable	
a) Before: original windows	1	2	3	4	5	6	7	8	9	N/A
b) After: with dual-zone shades	1	2	3	4	5	6	7	8	9	N/A

B2) Overall, how satisfied are you with the performance of the dual-zone shades versus the original windows? (E.g., 9 means that you were much more satisfied with the dual-zone shades than with the original configuration.)

	Much less satisfied		Less satisfied		No difference		More satisfied		Much more satisfied
Satisfaction: dual-zone shades vs. original	1	2	3	4	5	6	7	8	9

B3) Overall, would you prefer the windows in your area to have dual-zone interior shades or left in their original condition?

a) Dual-zone interior shades

b) Windows in the original condition

B4) Overall, do the dual-zone interior shades enhance or interfere with your ability to get your job done?

Significantly interfere	Interfere	Somewhat interfere	Neither enhance nor interfere	Somewhat enhance	Interfere	Significantly enhance
-3	-2	-1	0	1	2	3

B5) In general, how well does your work environment support your personal productivity?

Does not suport at all	Does not support moderately	Does not support a little	Neutral	Supports a little	Supports moderately	Supports completely
-3	-2	-1	0	1	2	3

Part C: Subjective Evaluation — Detailed Questions

C1) How often did you experience glare?

	Before (Original) *Check one*	After (Dual-zone) *Check one*
a) Never	○	○
b) Occasionally (less than once a week)	○	○
c) Sometimes (once or twice a week)	○	○
d) Almost every day	○	○
e) Every day	○	○

C2) When you experienced glare, how much of the day was affected?

	Before (Original) *Check one*	After (Dual-zone) *Check one*
a) I did not experience glare	○	○
b) A few seconds	○	○
c) A few minutes (less than 10 minutes)	○	○
d) Up to one hour (10 minutes to 1 hour)	○	○
e) A few hours (2 to 4 hours)	○	○
f) Pretty much the whole day (5 to 8 hours)	○	○

C3) When you experienced glare, what were the sources? (Check all that apply)

	Before (Original)	After (Dual-zone)
Sunlight coming through the shades (vertical blinds or roller shades)	❑	❑
Sunlight from the reflective louvers (upper 2 ft of window)	N/A	❑
Bright light from the sky or nearby buildings	❑	❑
Bright light from the overhead electric lights	❑	❑
Bright light from indoor objects	❑	❑
Sunlight on my computer screen	❑	❑
Reflected daylight on my computer screen	❑	❑
Others (please specify _____)	❑	❑

C4) How often did you adjust the height (by raising or lowering) of the blinds or roller shades in your office area?

	Before (Original) *Check one*	After (Dual-zone) *Check one*
a) Never	○	○
b) Less than once a week	○	○
c) Not every day but at least once a week	○	○
d) Once a day	○	○
e) At least twice a day	○	○

C5) If you lowered the blinds or roller shades, what were usually the primary reasons? (Check all that apply)

	Before (Original)	After (Dual-zone)
To reduce glare from daylight/sunlight	❑	❑
To reduce glare when the sun is directly visible	❑	❑
To reduce the overall brightness of the space	❑	❑
To increase privacy	❑	❑
To reduce the heat from the sun	❑	❑
To reduce the cold draft from the window	❑	❑
To decrease the level of visual stimulus from outside	❑	❑
To decrease the brightness of reflections on my computer monitor	❑	❑
Others (please specify _____)	❑	❑
Not applicable: No access to the blinds or roller shades	❑	❑

C6) If you raised the blinds or roller shades, what were usually the primary reasons? (Check all that apply)

	Before (Original)	After (Dual-zone)
To increase the overall brightness of the space	❑	❑
To be able to see the view	❑	❑
To allow the heat from the sun into the space	❑	❑
To increase the level of visual stimulus from the outside	❑	❑
Others (please specify _____)	❑	❑
Not applicable: No access to the blinds	❑	❑

C7) How did you like your view of the outside through the windows?

	Before (Original) *Check one*	After (Dual-zone) *Check one*
a) Not at all	○	○
b) Not so much	○	○
c) Neither like nor dislike	○	○
d) Somewhat like	○	○
e) Very much like	○	○

C8) How did you rate the amount of view outside through the windows that you had access to from your usual workstation?

	Before (Original) *Check one*	After (Dual-zone) *Check one*
a) I don't have a view outside at all	○	○
b) I can see outside only through a small portion of the window	○	○
c) I have a moderate amount of view to the outside	○	○
d) I have a large amount of view of the outside	○	○
e) I have a very large amount view to the outside	○	○

C9) How often did you experience thermal discomfort (too cold/too hot)?

	Before (Original) *Check one*	After (Dual-zone) *Check one*
a) Never	○	○
b) One or two days at a time	○	○
c) A week or more at a time	○	○
d) More than 80% of the time for the whole period	○	○
e) Every day for the whole period	○	○

C10) When you experienced thermal discomfort, what were the reasons? (Check all that apply)

	Before (Original)	After (Dual-zone)
Too warm/hot because of warm/hot weather	❑	❑
Too warm/hot because of the heat from the sun	❑	❑
Too warm/hot, unrelated to weather or sunny conditions	❑	❑
Too cool/cold because of cool/cold weather	❑	❑
Too cool/cold, unrelated to weather	❑	❑
Too drafty	❑	❑
Too stuffy	❑	❑

C11) How often did you experience feeling too warm/hot due to the heat from the sun?

	Before (Original) *Check one*	After (Dual-zone) *Check one*
a) Never	○	○
b) Occasionally (less than once a week)	○	○
c) Sometimes (once or twice a week)	○	○
d) Almost every day	○	○
e) Every day	○	○

C12) When you experienced feeling too warm/hot due to the heat from the sun, how much of the day was affected?

	Before (Original) *Check one*	After (Dual-zone) *Check one*
a) I did not experience feeling too warm/hot due to the heat from the sun	○	○
b) A few seconds	○	○
c) A few minutes (less than 10 minutes)	○	○
d) Up to one hour (10 minutes to 1 hour)	○	○
e) A few hours (2 to 4 hours)	○	○
f) Pretty much the whole day (5 to 8 hours)	○	○

Part D: Comments

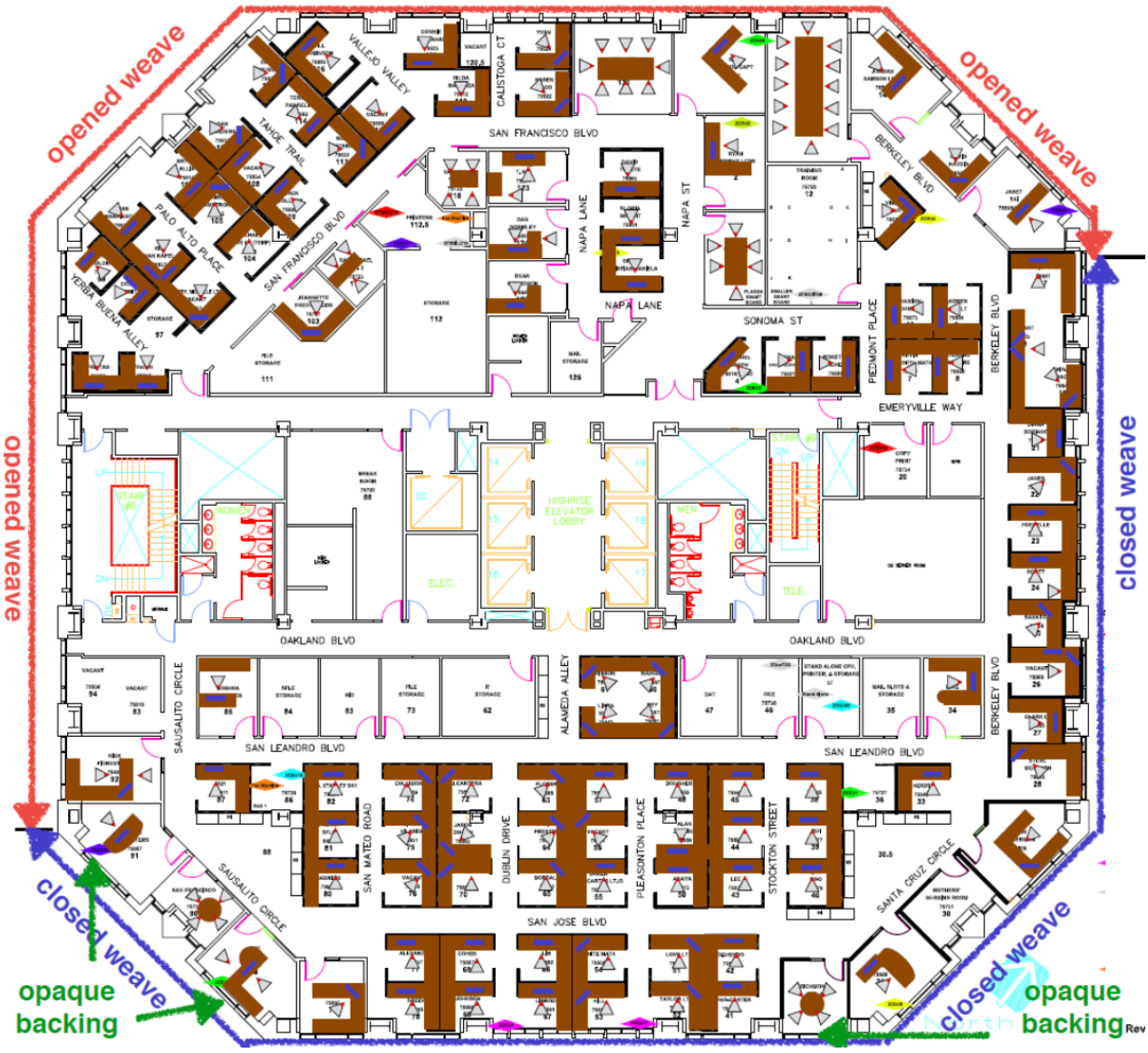
D1) Please provide any comments on the windows in your space.

Comments

D2) Please provide any comments regarding the dual-zone interior shades installed on the windows in your space.

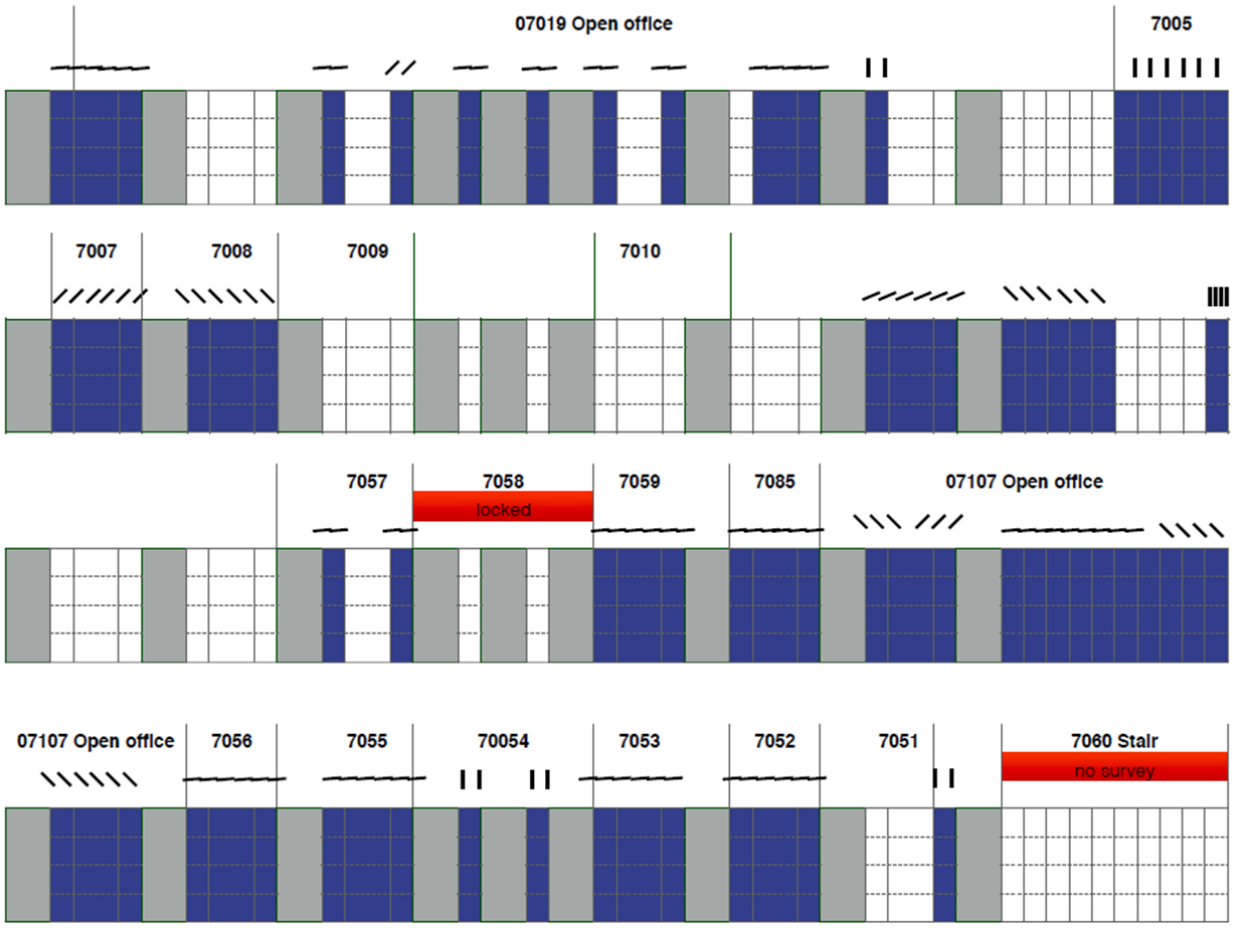
Additional comments

APPENDIX A7. OFB: SURVEY OF EXISTING CONDITIONS – BLIND POSITION, DECEMBER 1, 2016



Floor plan view showing existing vertical blind condition: more closed weave on the south (blue line), more open weave on the north (red line), opaque backing on the blinds in three south and south-east facing offices (green). Location of the computer screen is indicated in each workstation in blue. Occupant's primary direction of view is shown as a triangle with red tip in the direction of view.

blinds survey

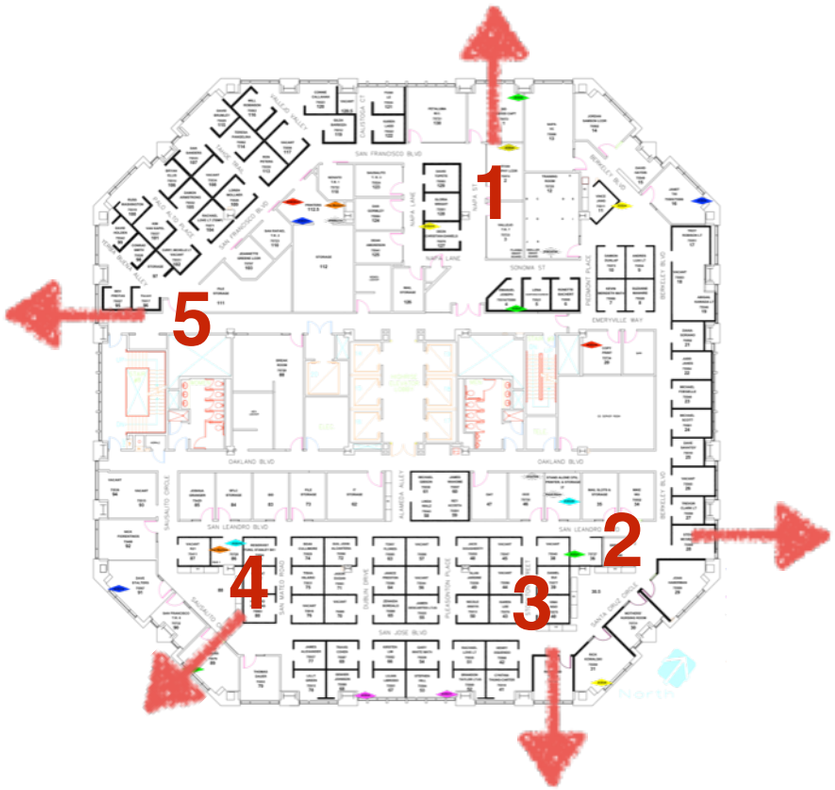


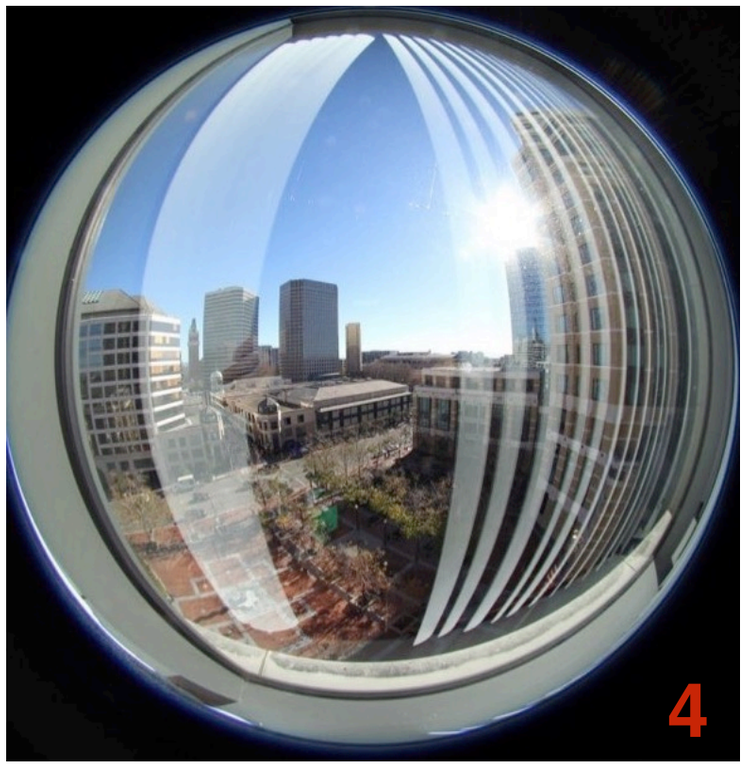
Elevation view of the window wall showing the position of the vertical blinds on the 7th floor before the DZSC shades were installed on the windows. The survey starts with the northwest corner of the floor then wraps around the entire perimeter clockwise to the southwest corner of the floor. December 1, 2016, clear, sunny conditions.

APPENDIX A8. OFB: SURVEY OF EXISTING CONDITIONS – DECEMBER 1, 2016, PHOTO DOCUMENTATION

Appended below.

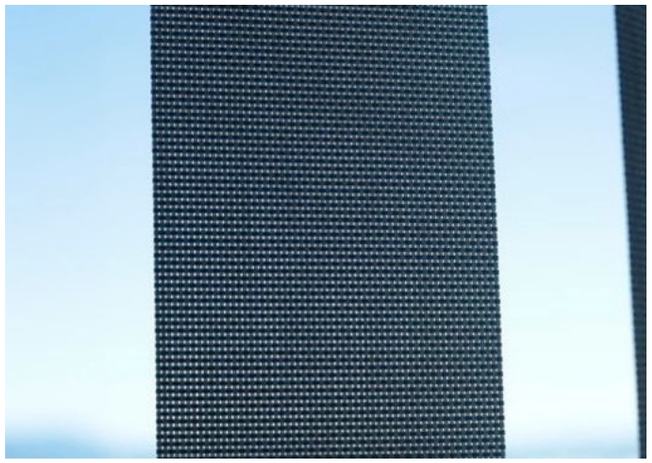
Surroundings

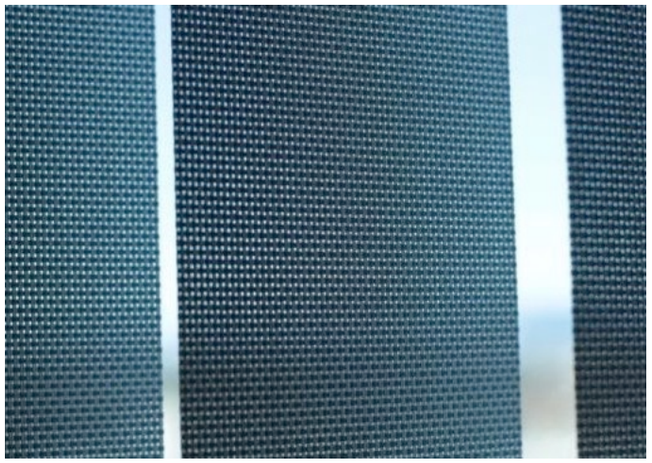


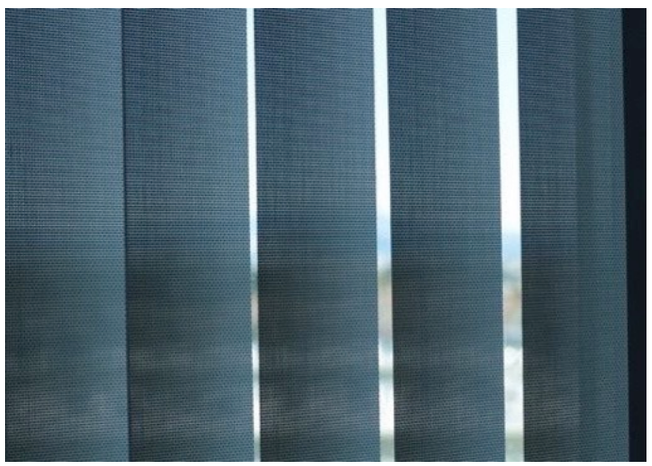


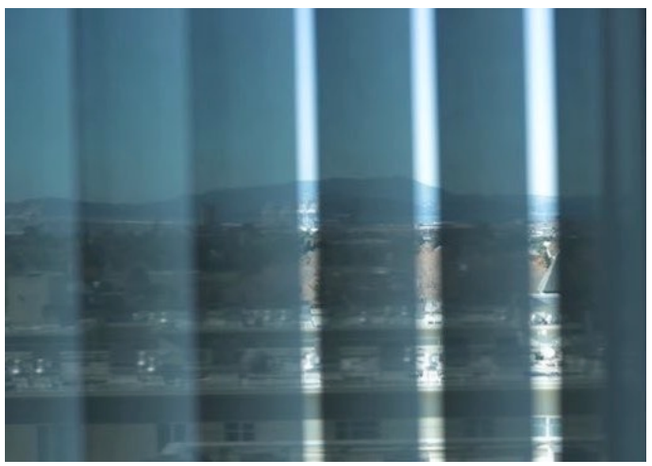
room 75572 - blinds

(LS manual will be here).





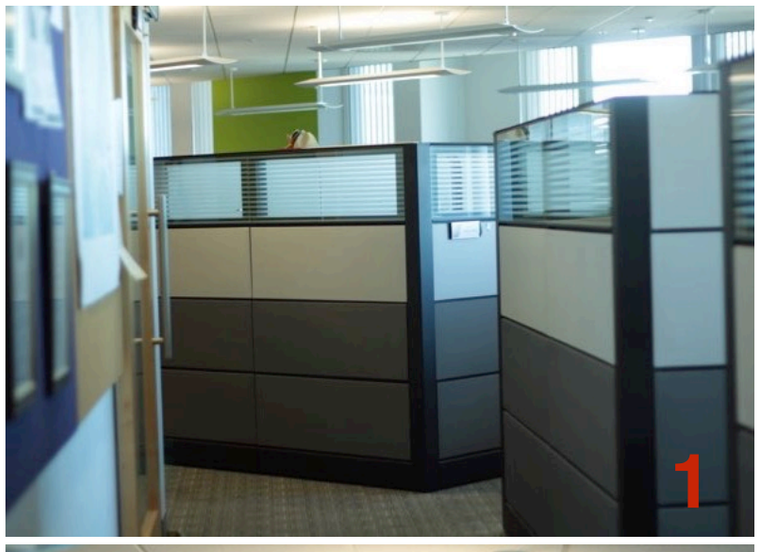


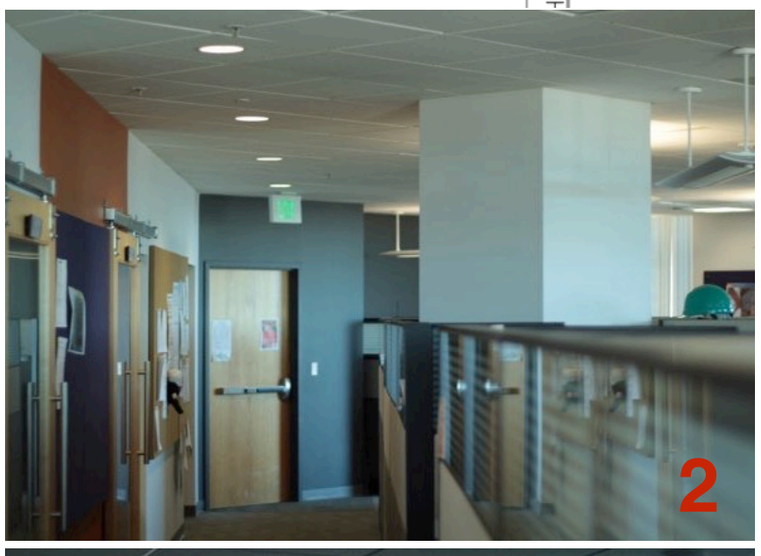


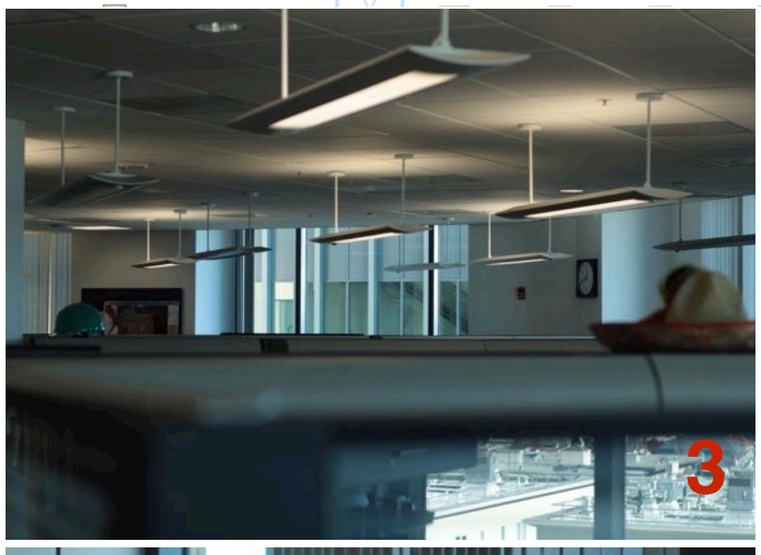
room 75572 - light fixtures

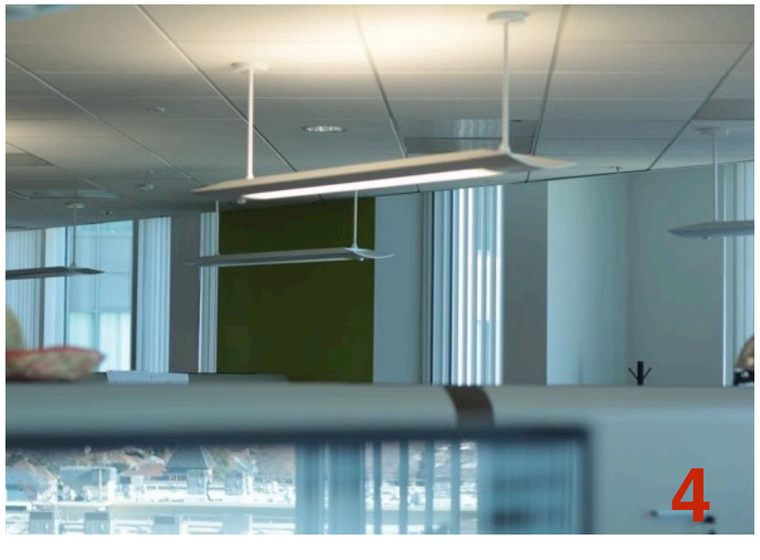
(LS manual will be here).

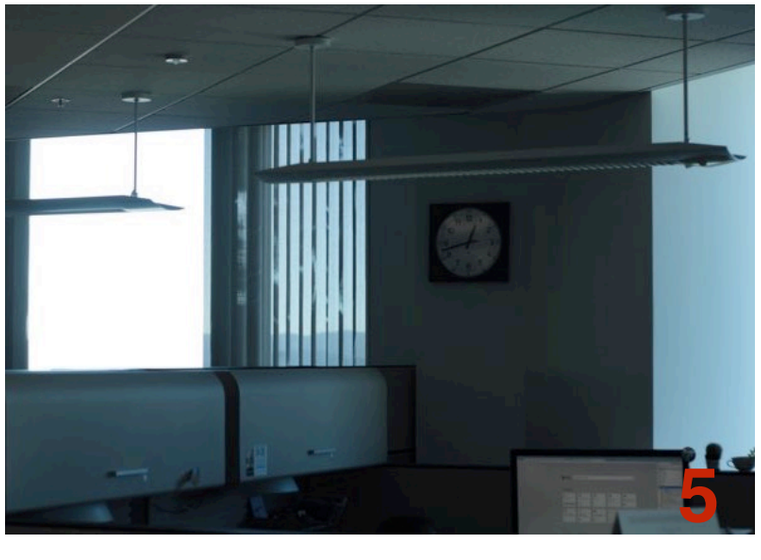
Open office - W



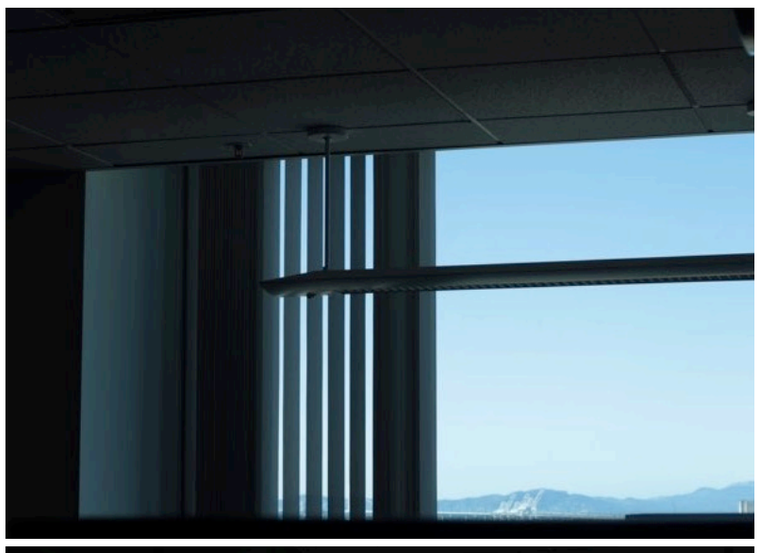


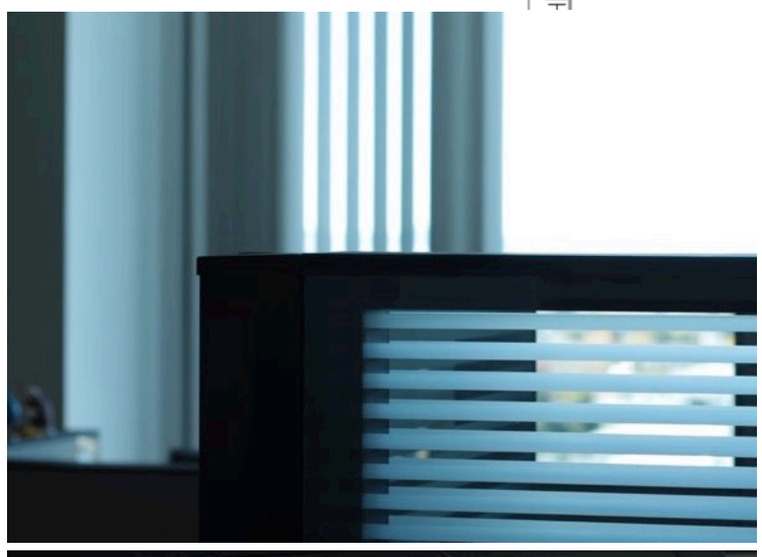


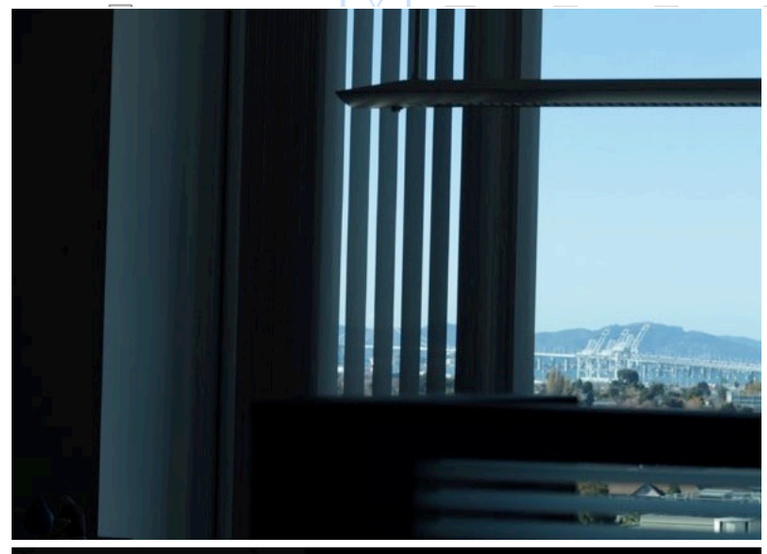


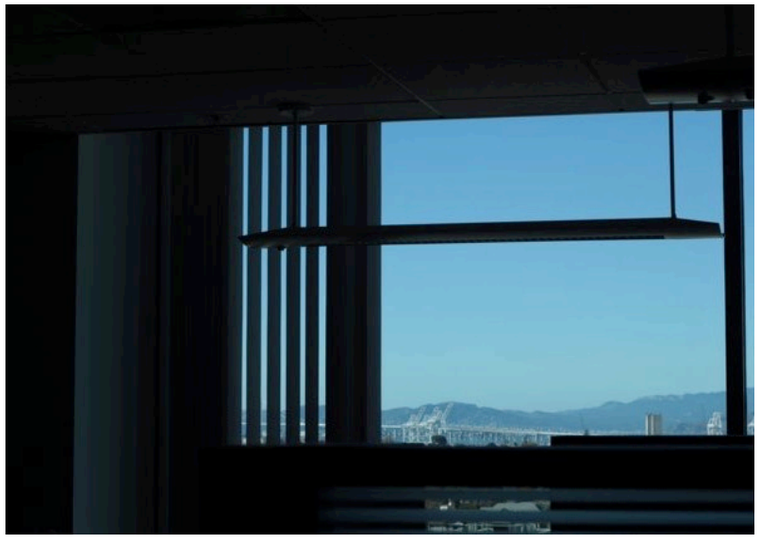


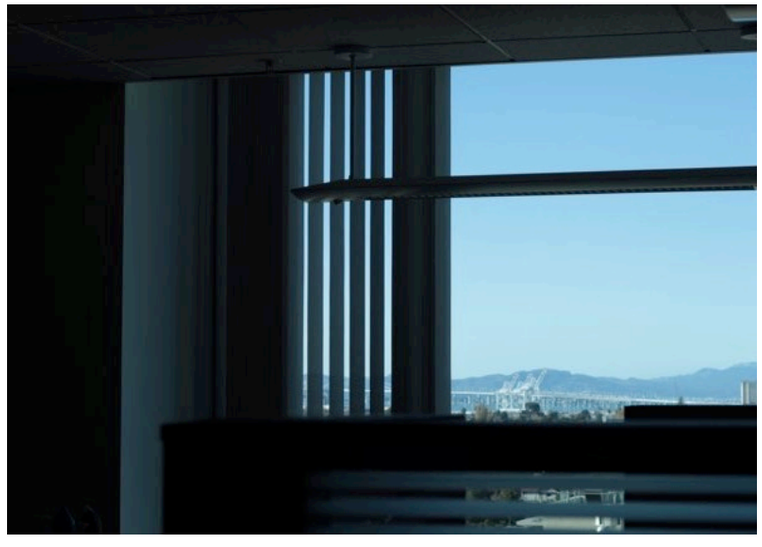
Open office - W

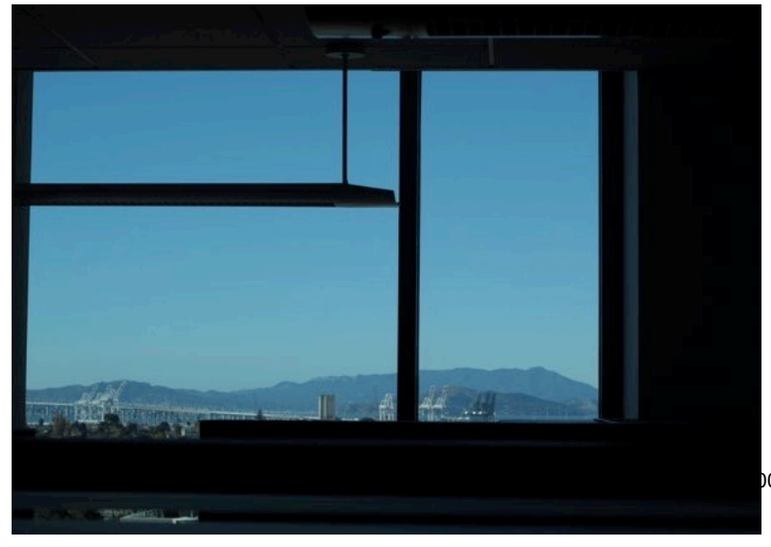












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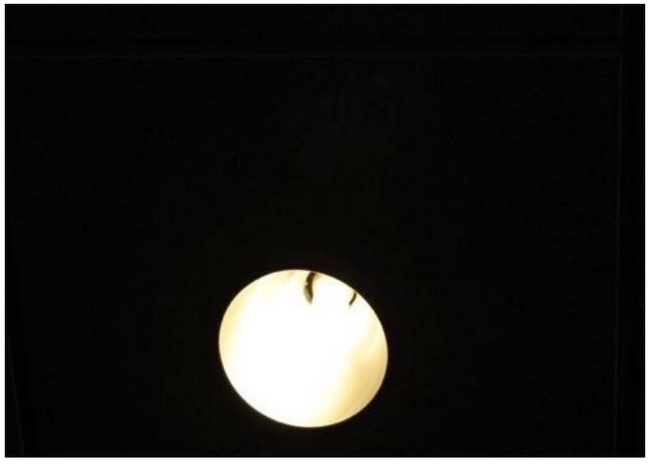

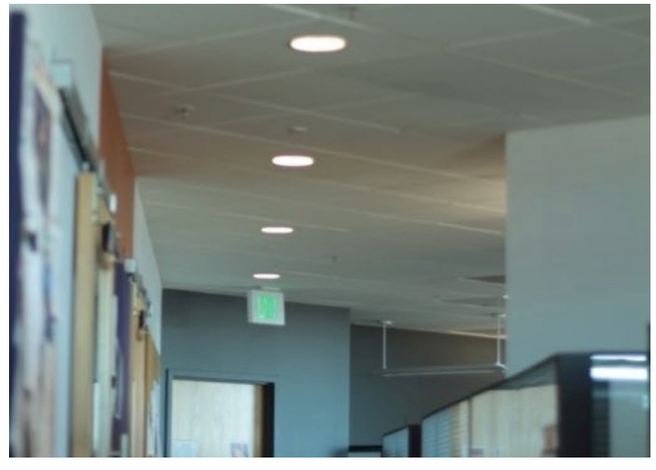

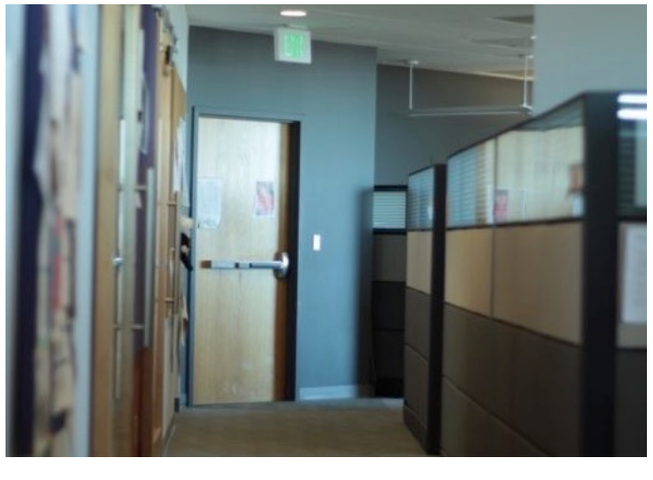

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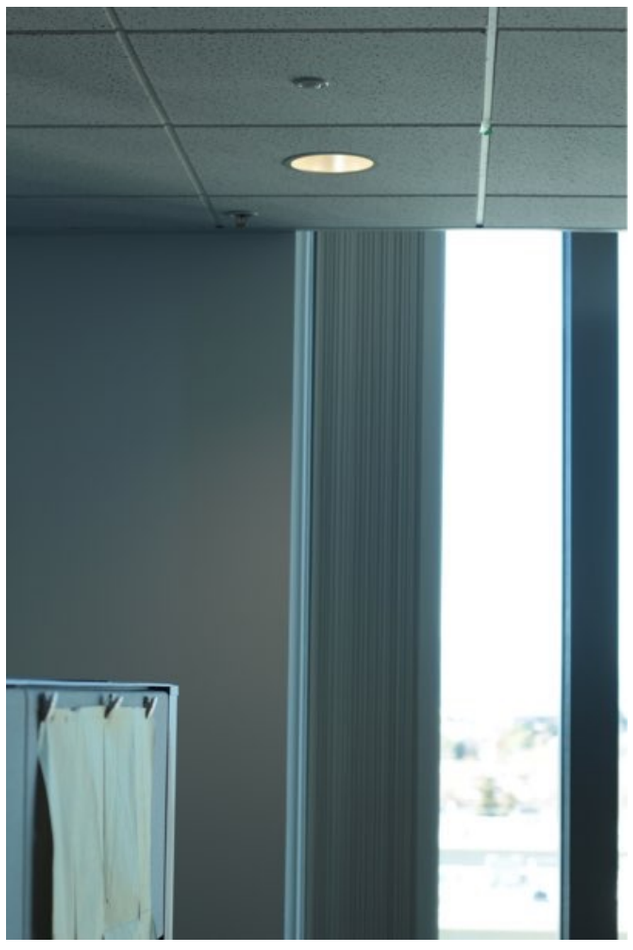
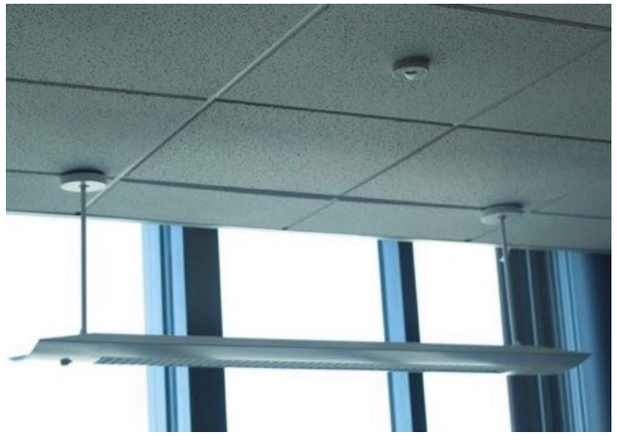
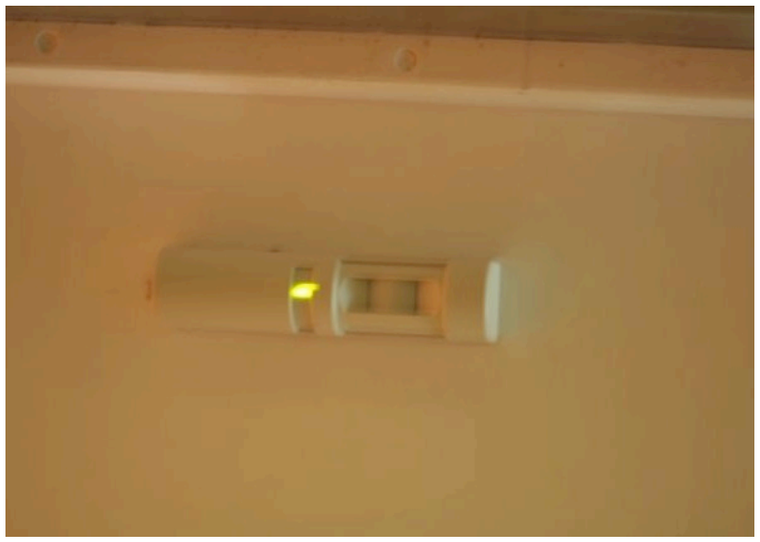
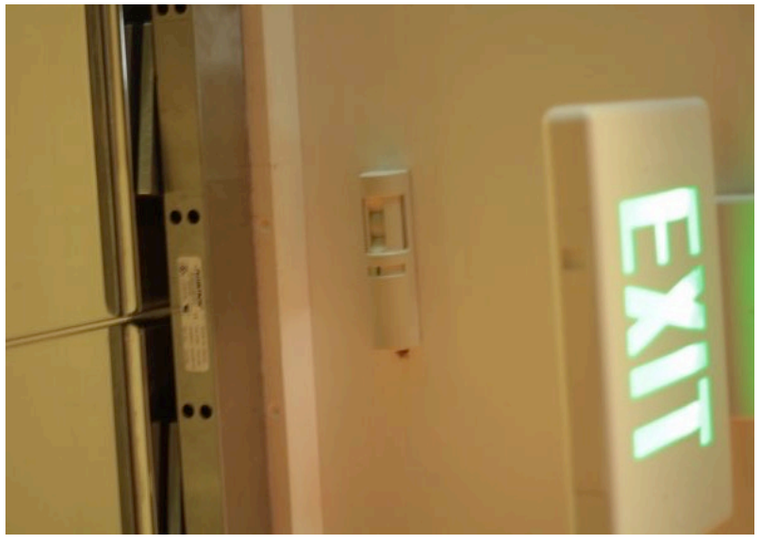
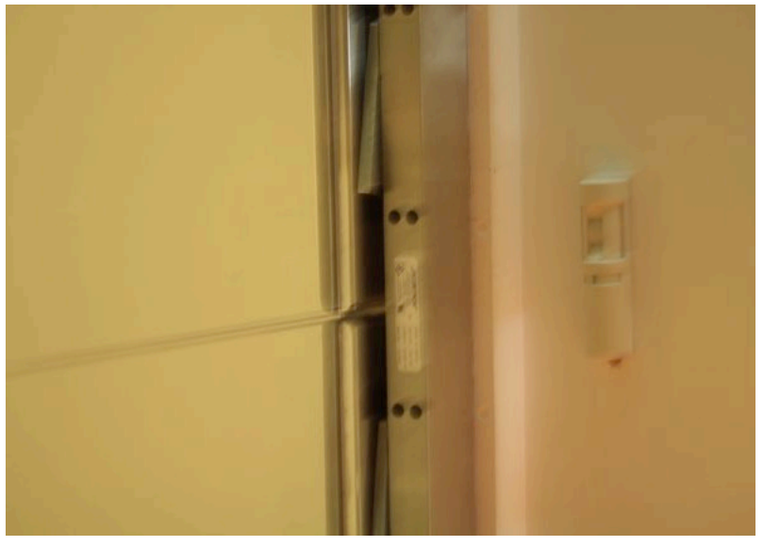




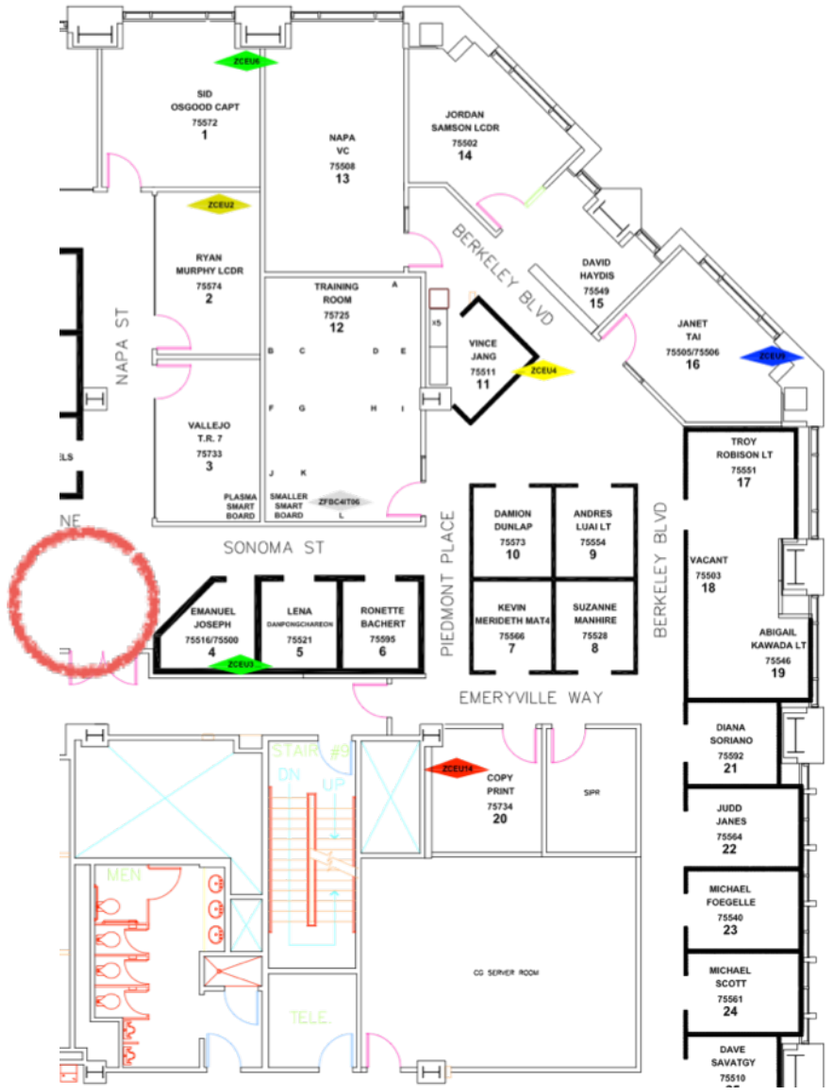
Open office - N

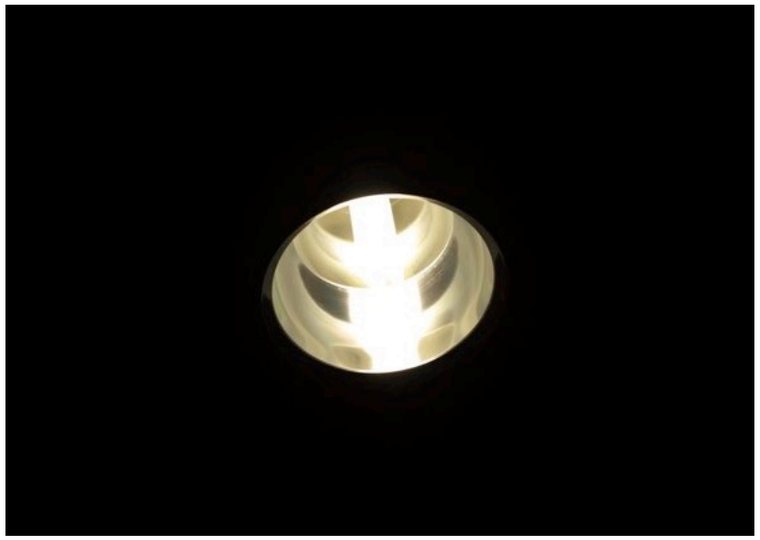




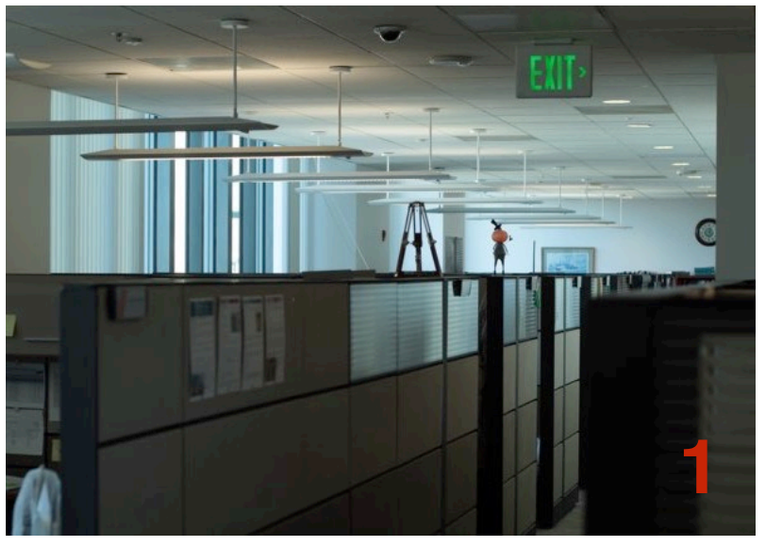


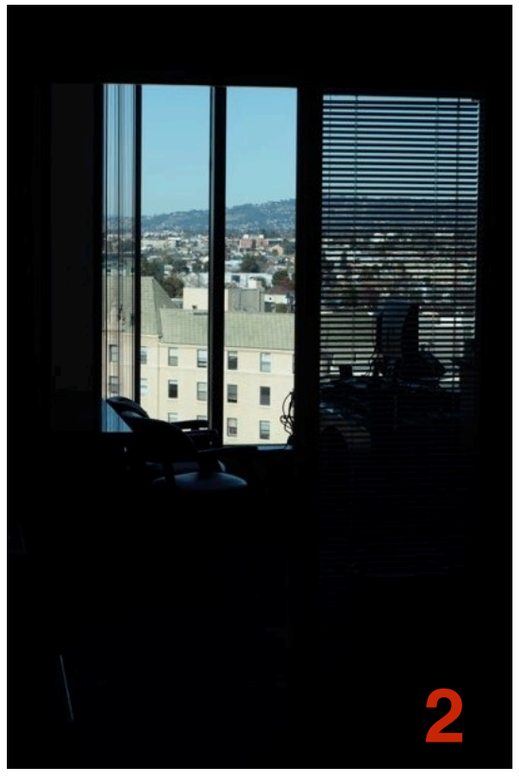
Open office - N

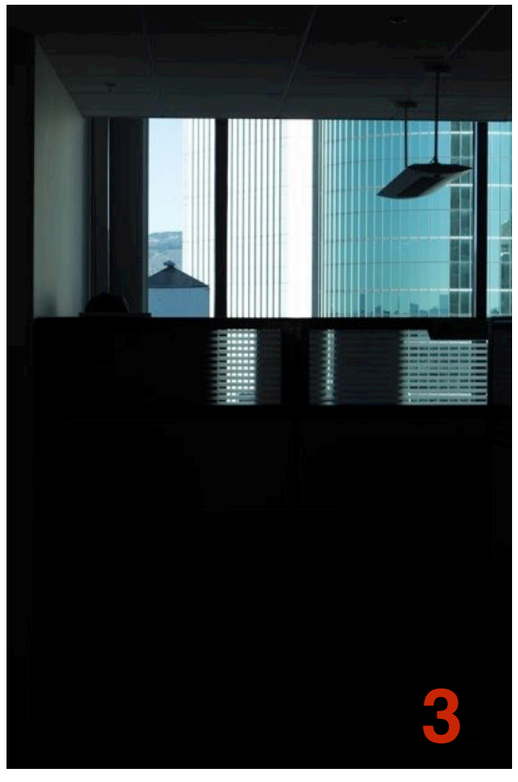


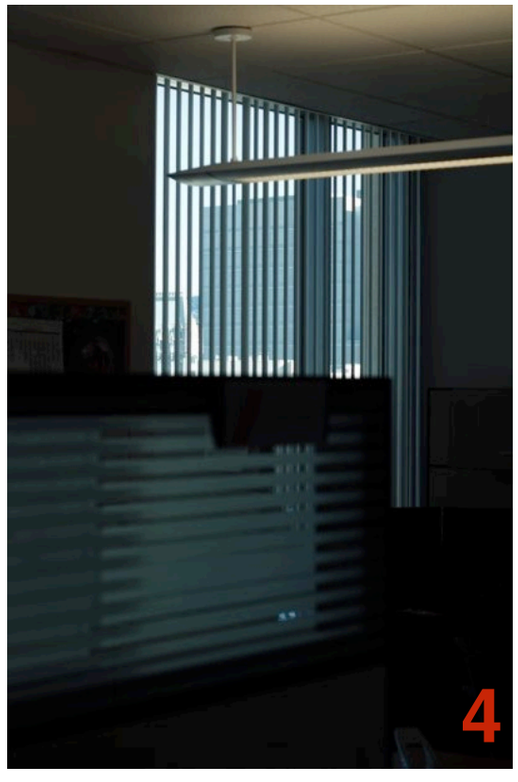


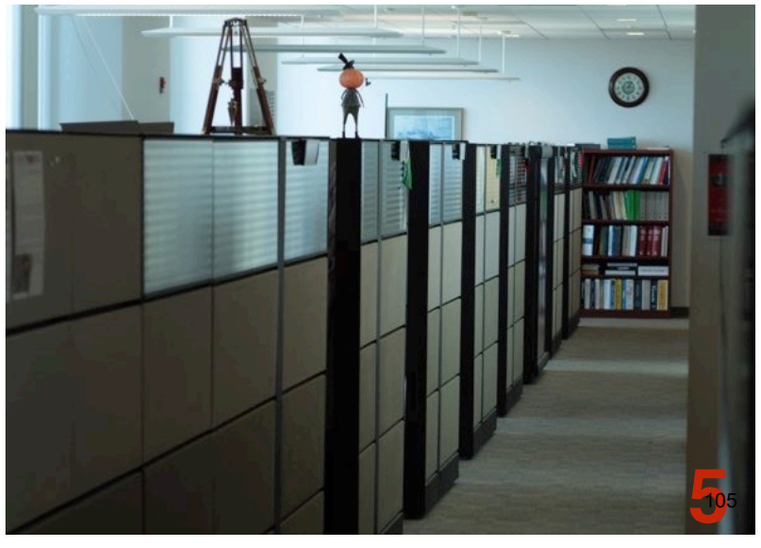
Open office - N









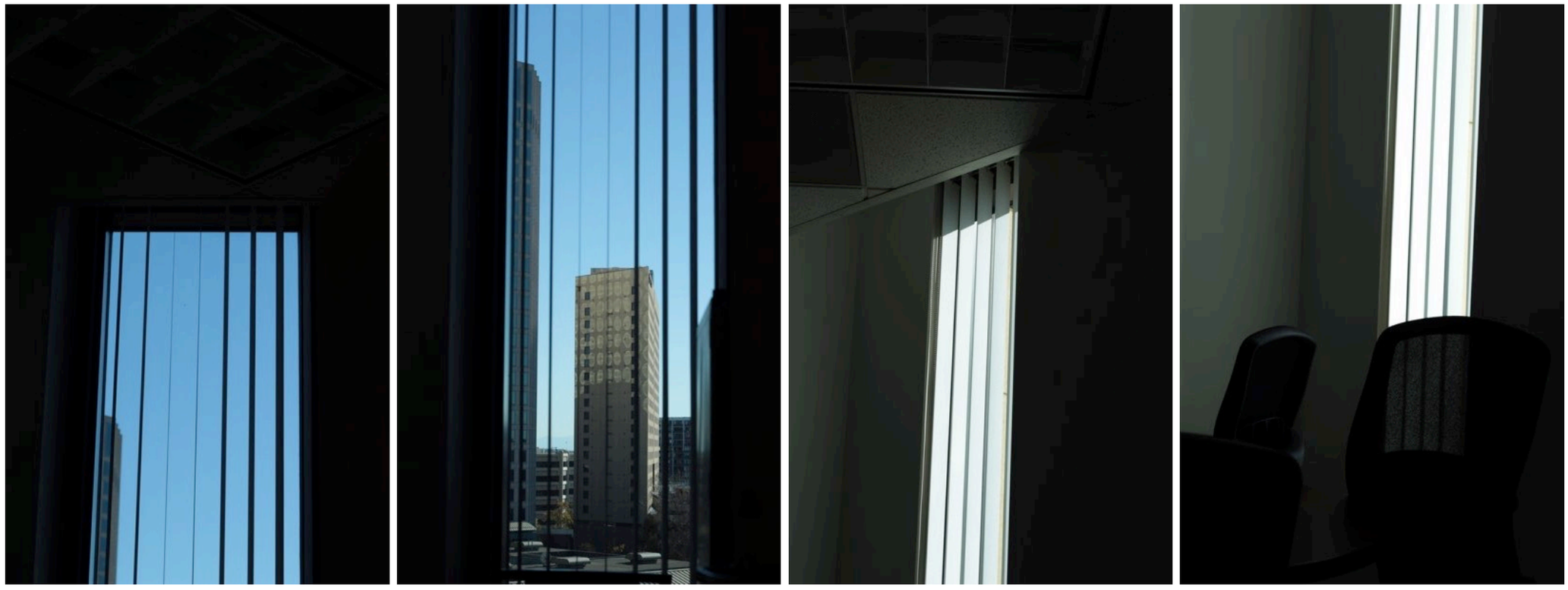


room 75579

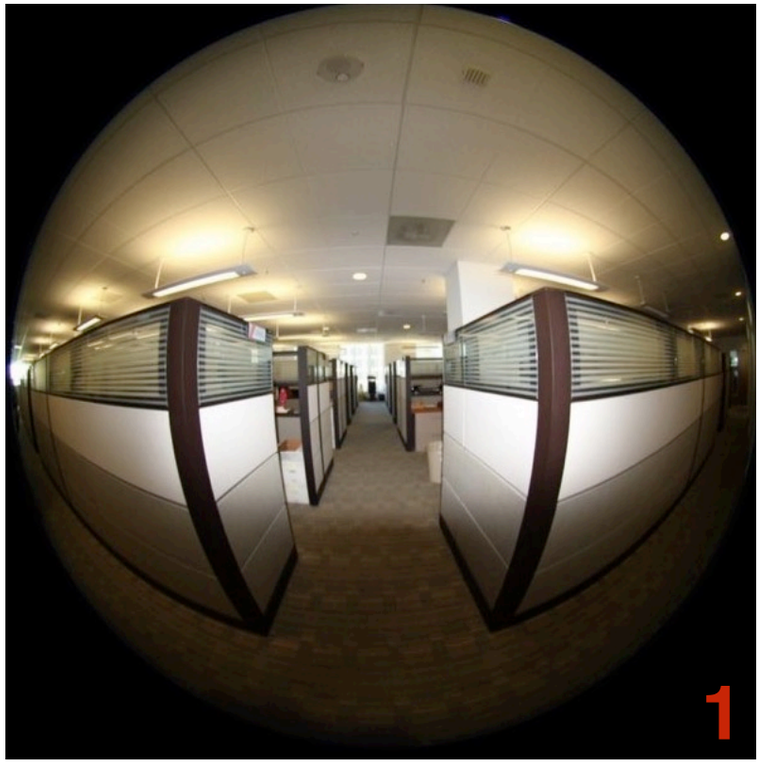
(LS 30).

room 75732

(LS 31 and LS 32).



Open office - SE



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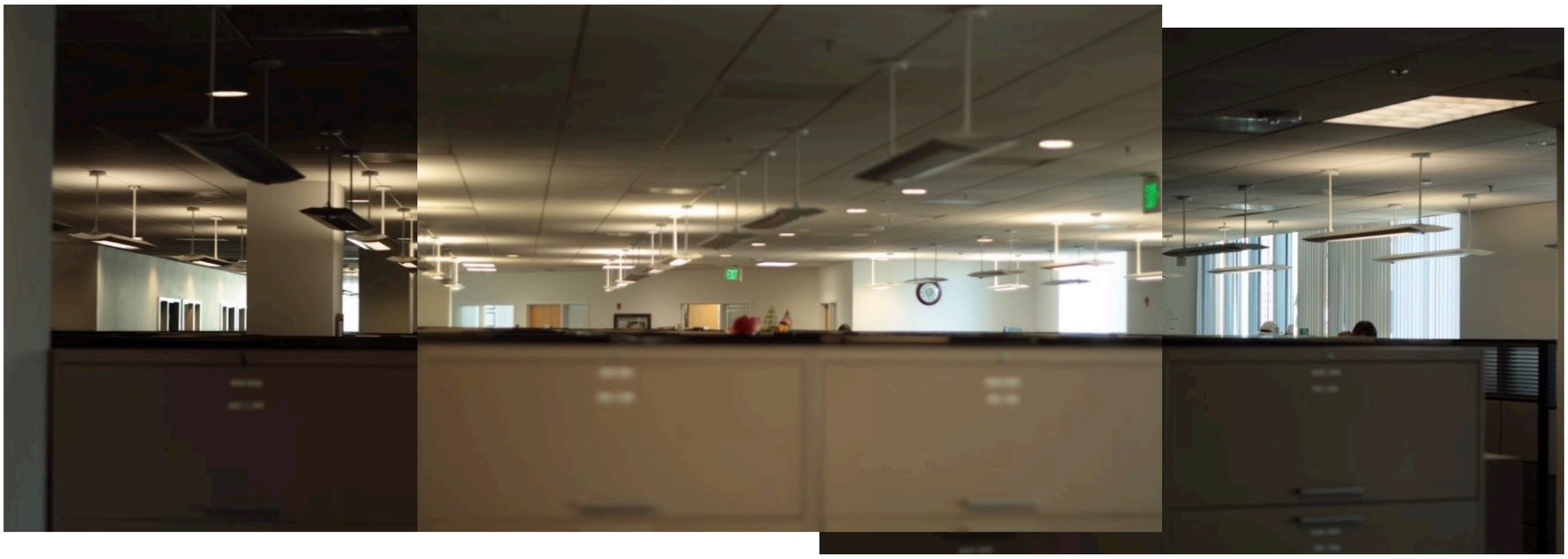
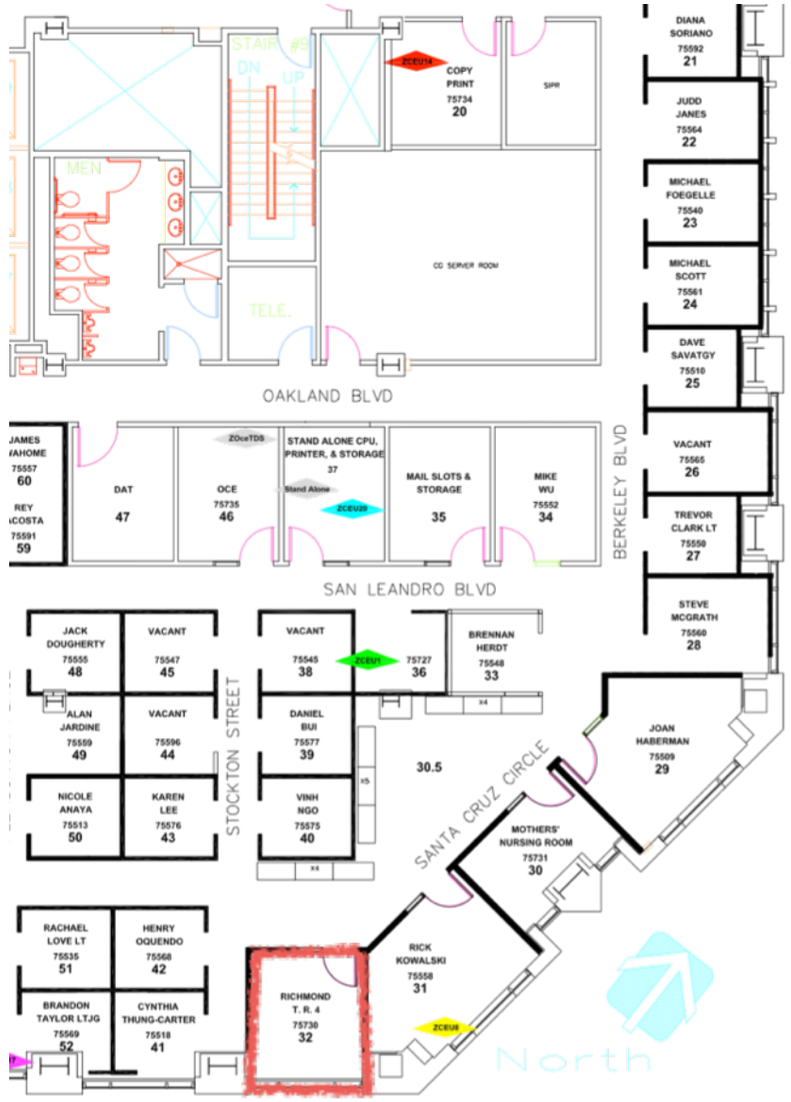
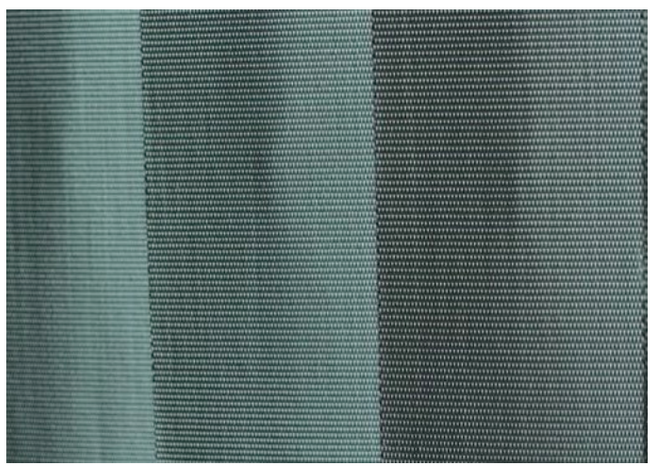
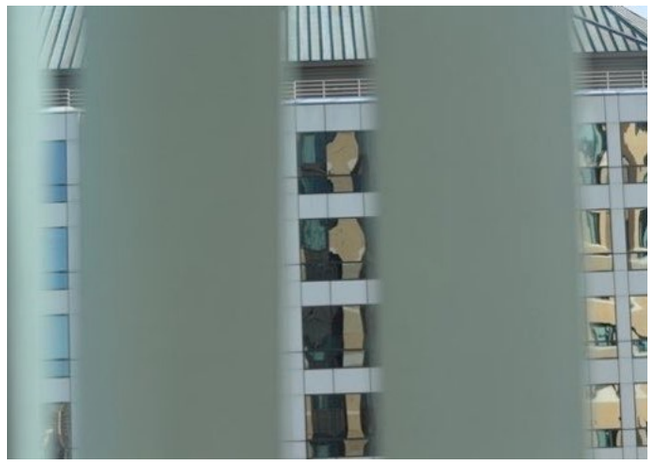


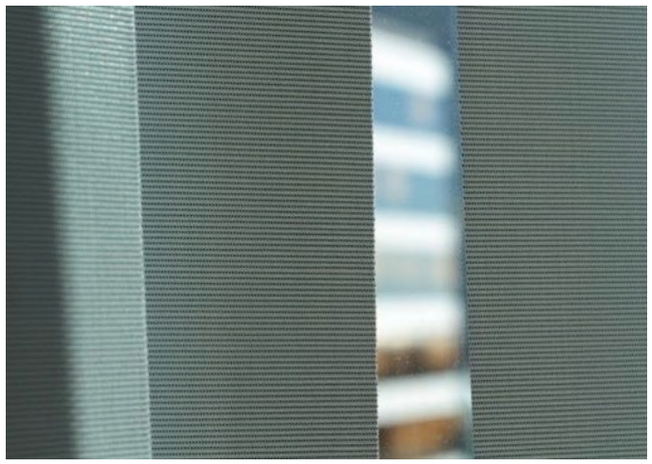
room 75730 - blinds

(LS 25)









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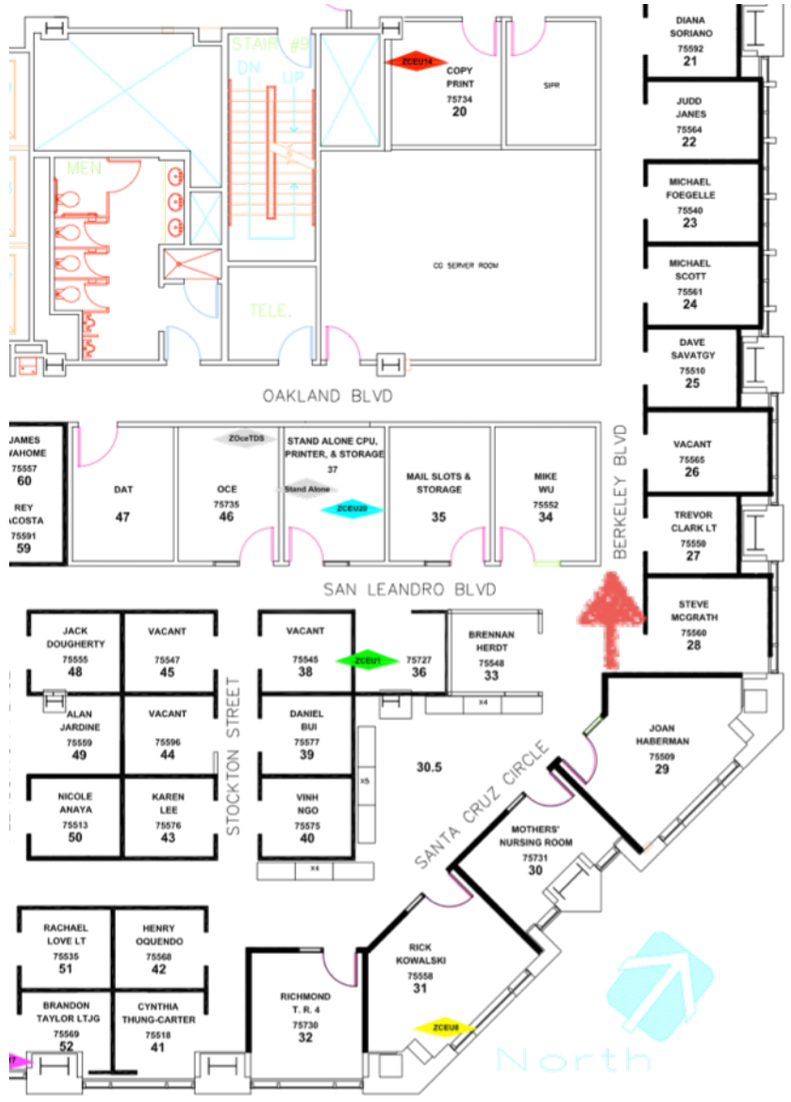

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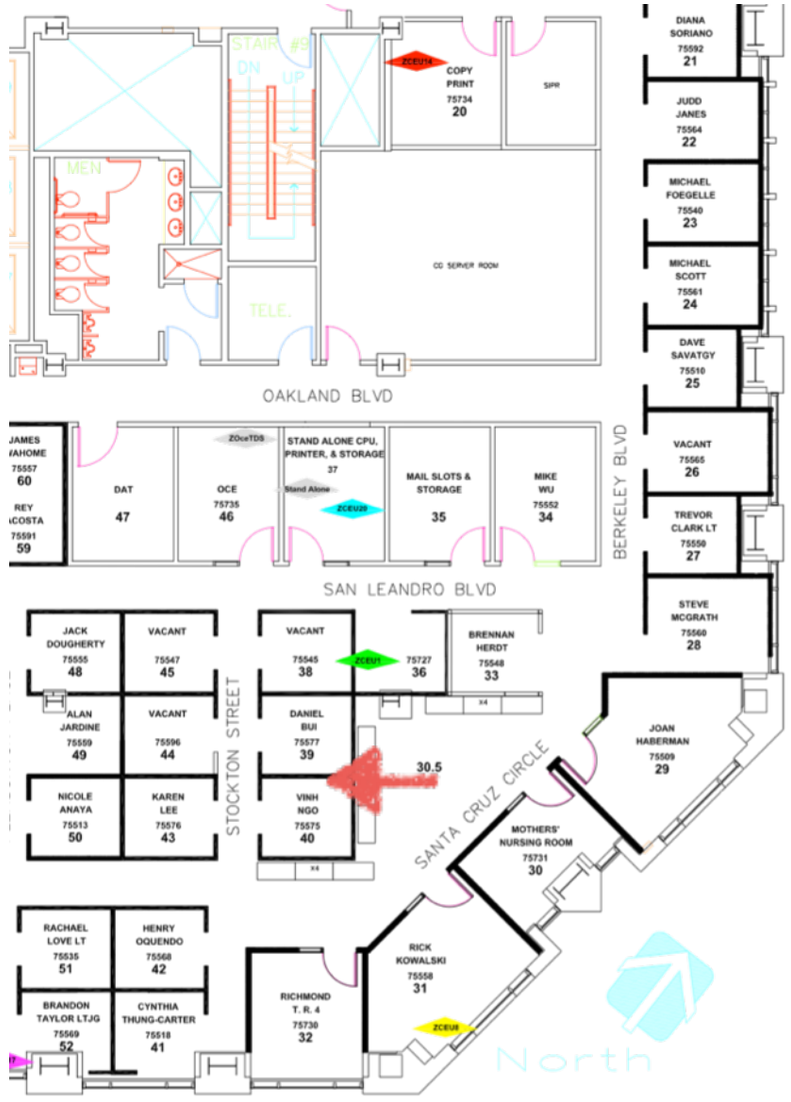

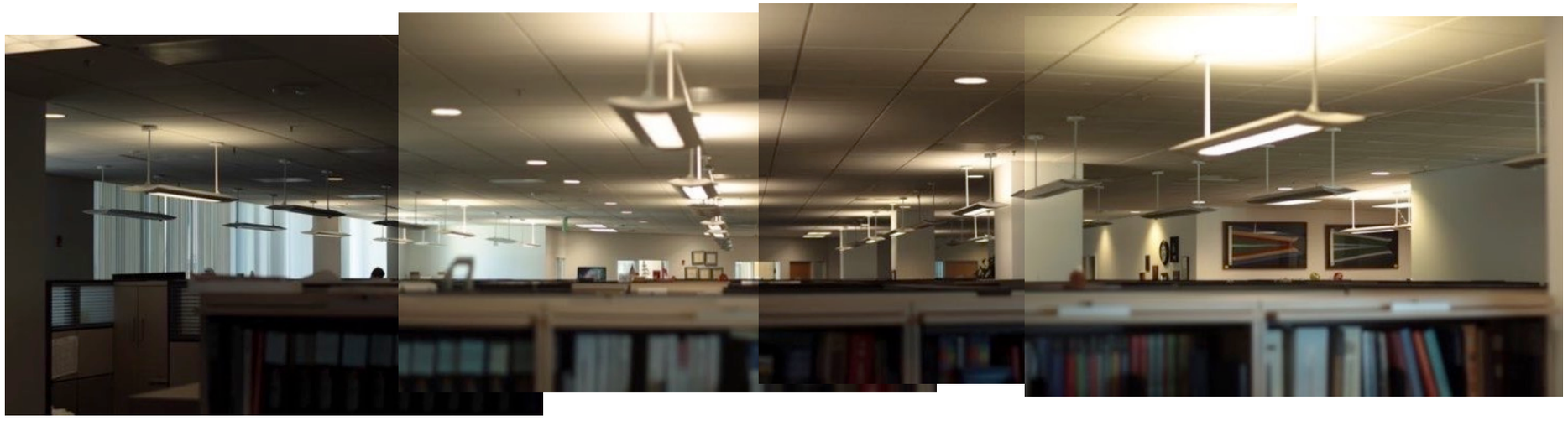

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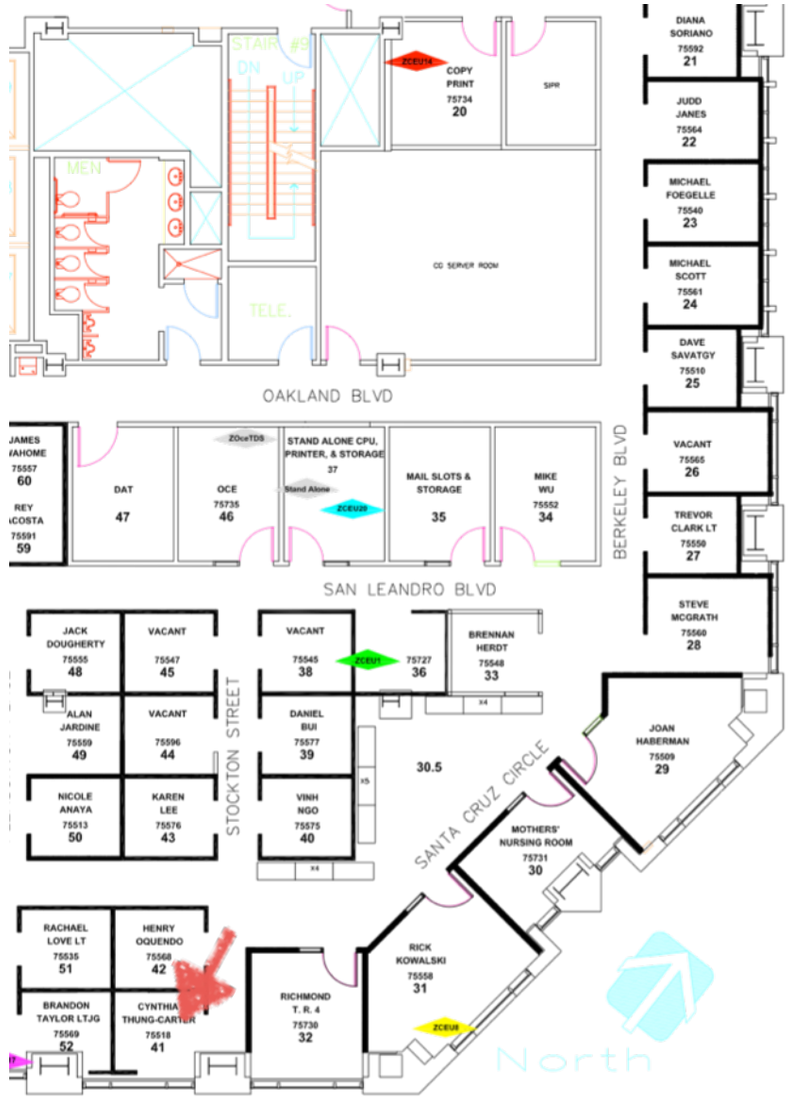

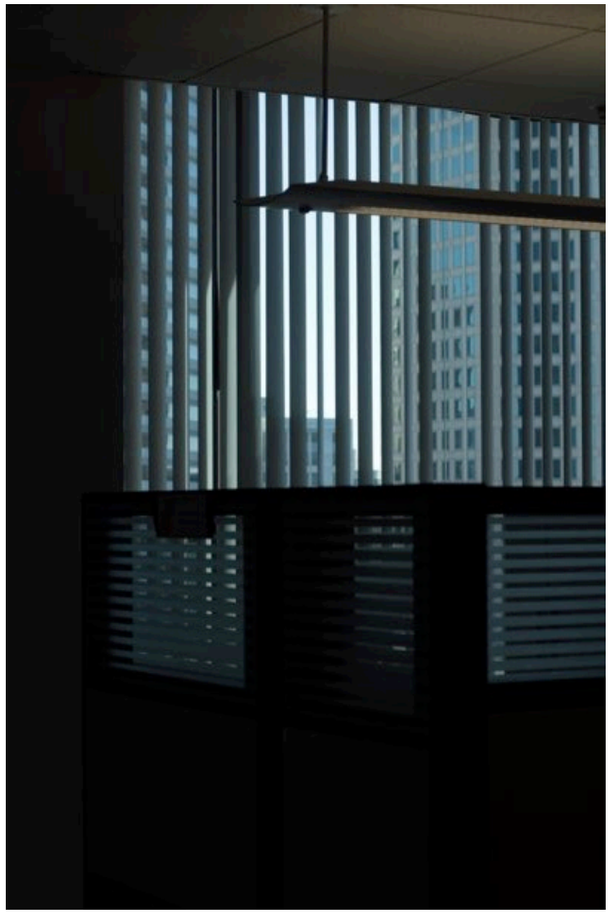

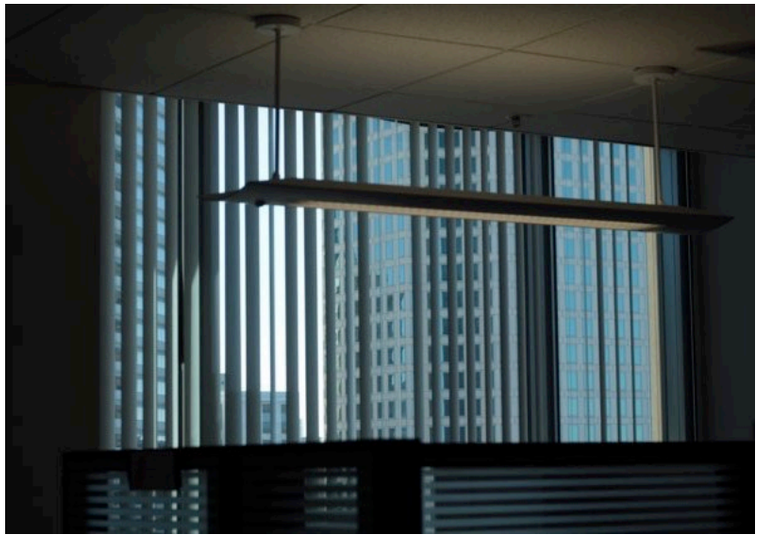

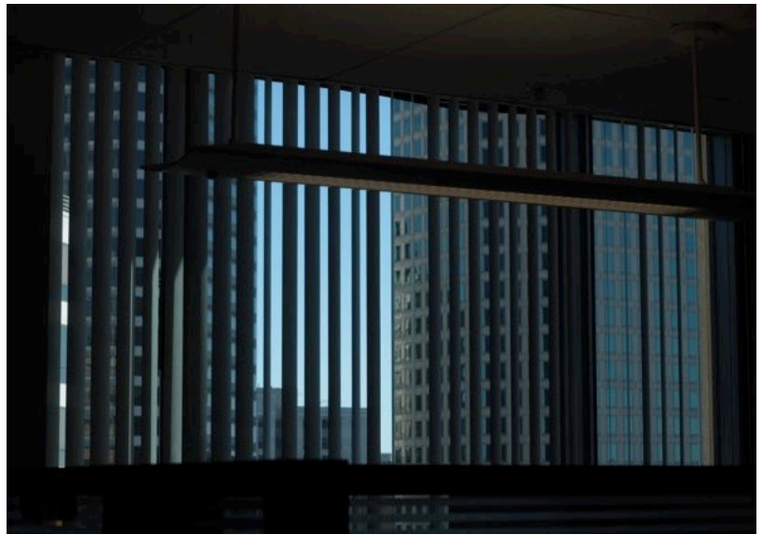

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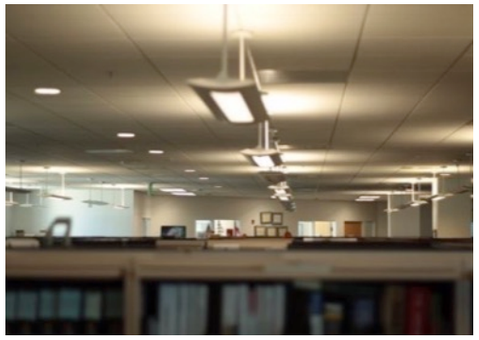

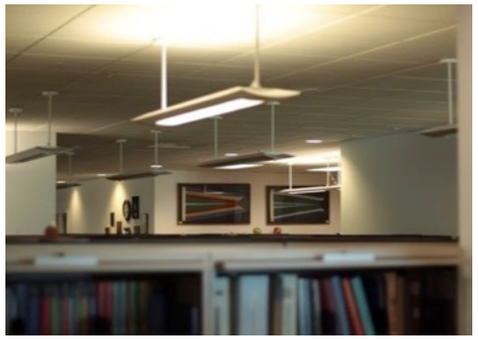

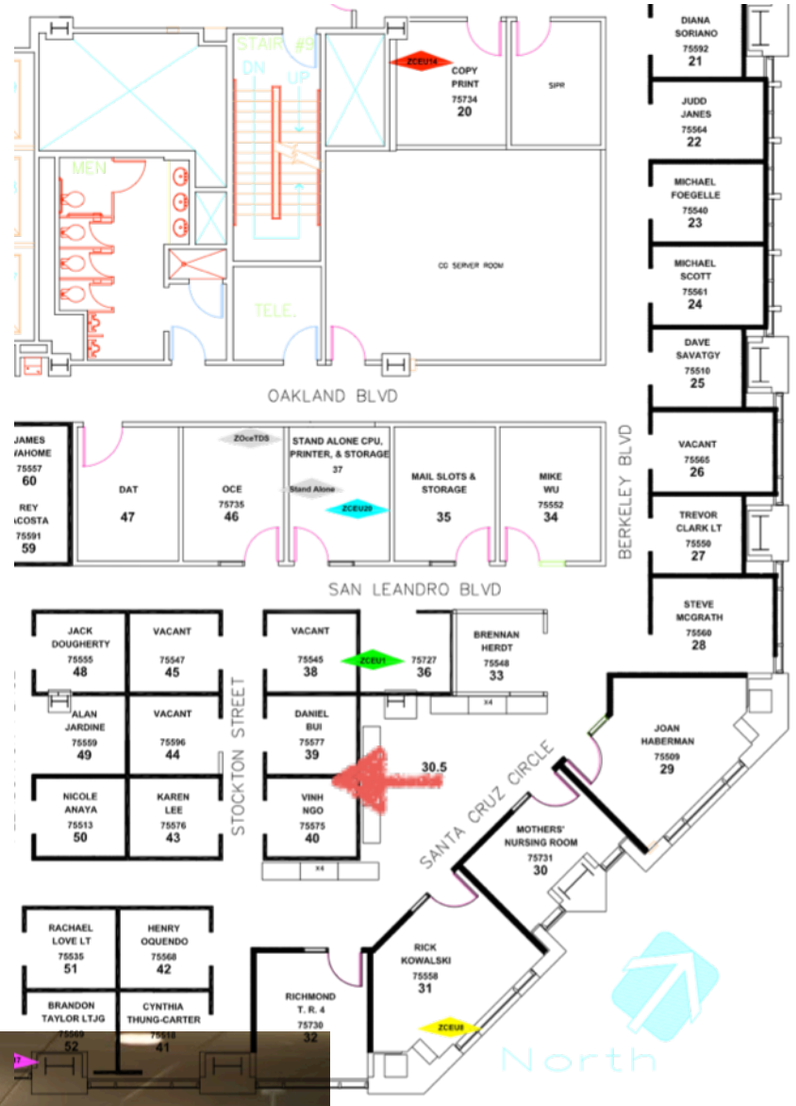

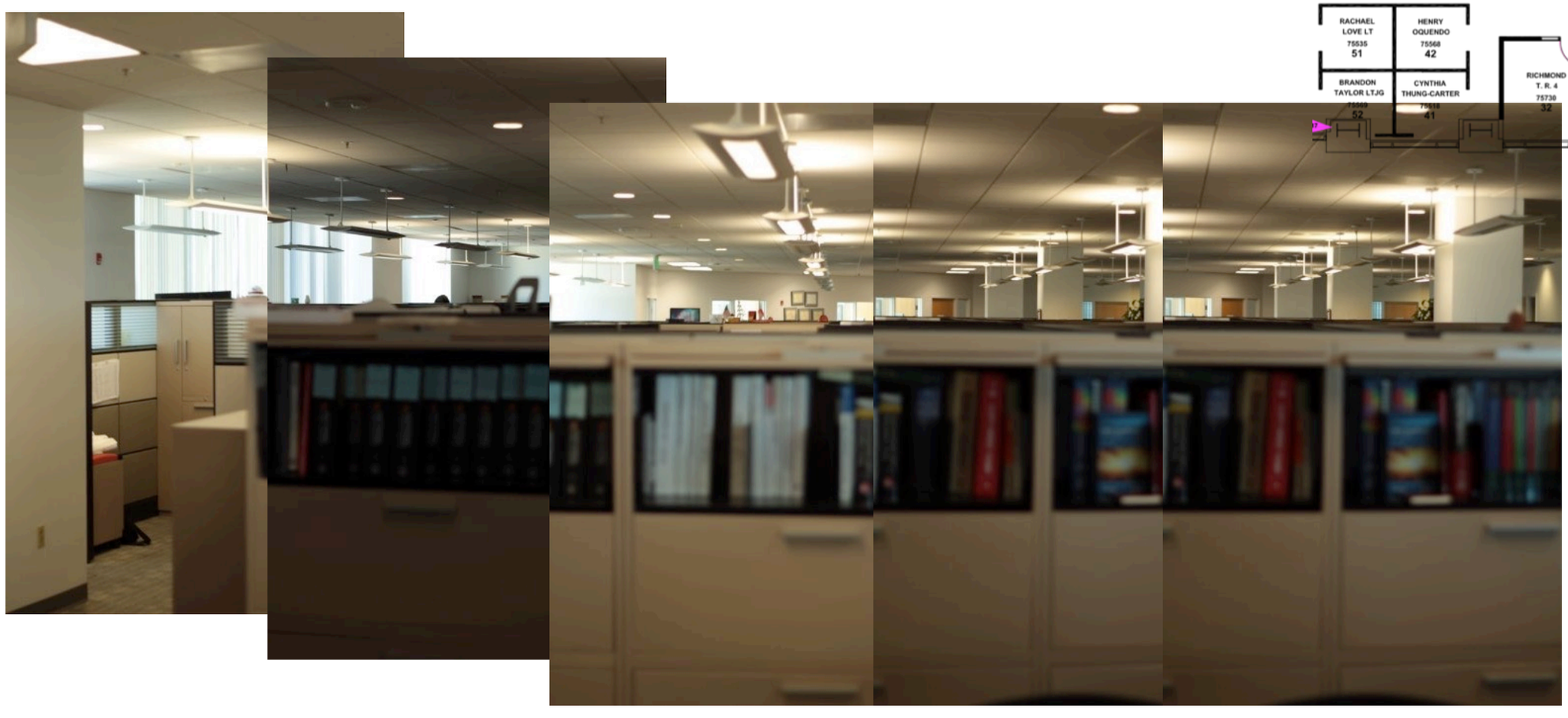

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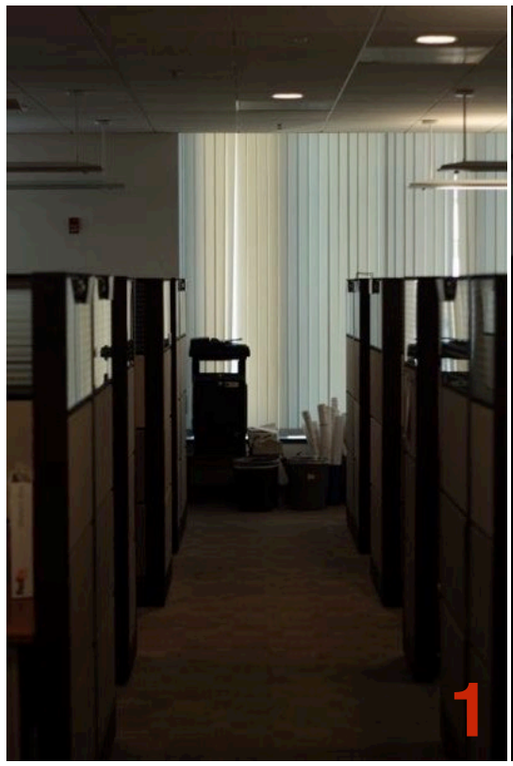
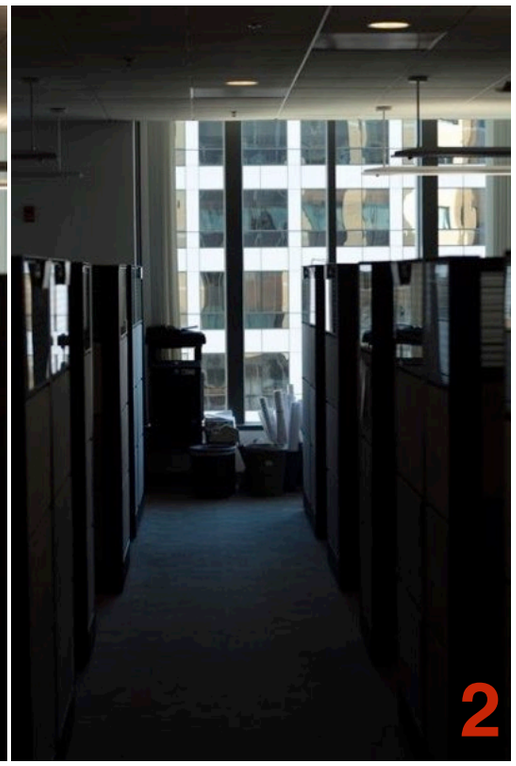
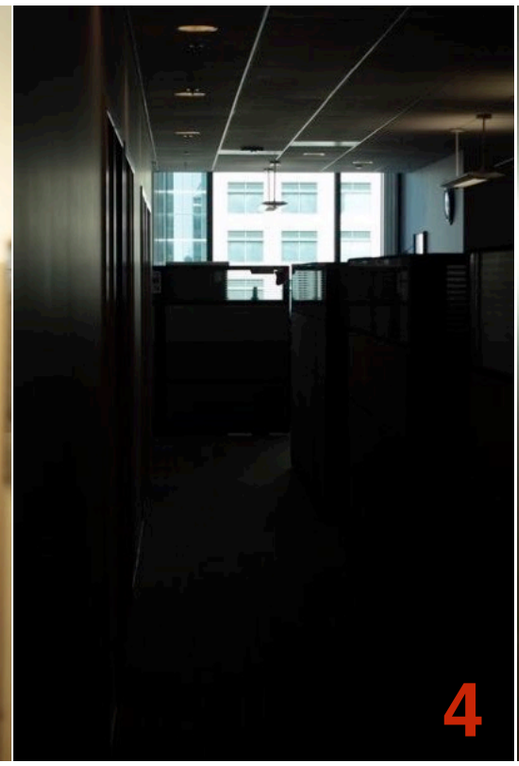
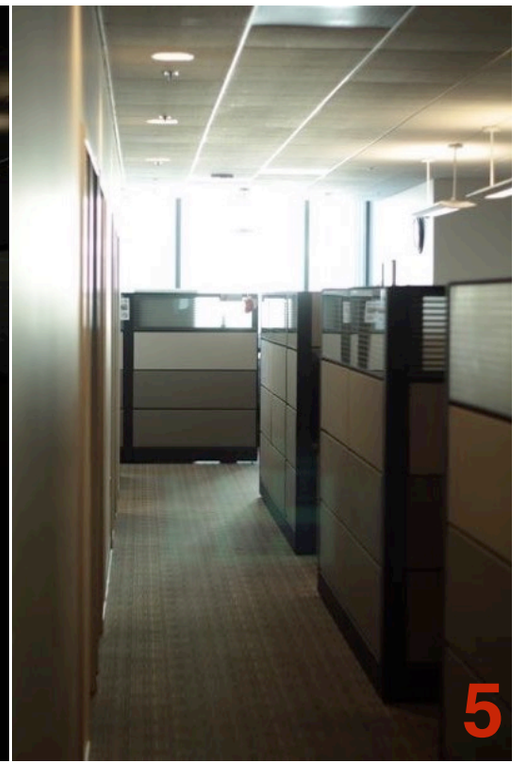


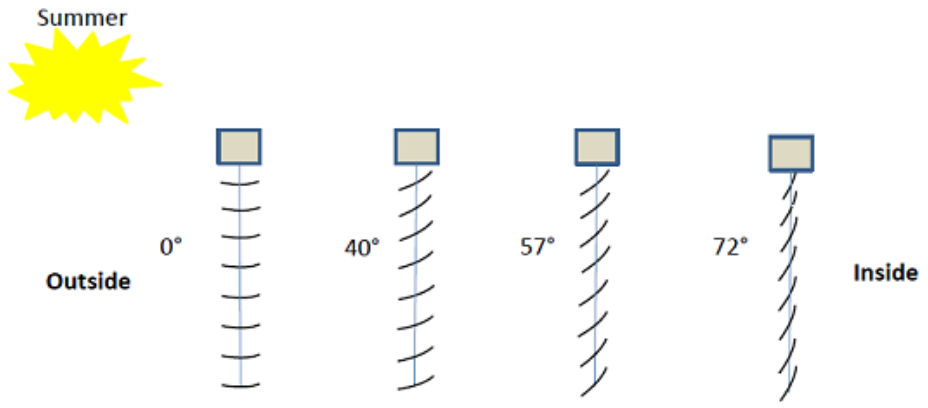






APPENDIX A9. OFB: SURVEYS OF DZSC AND VERTICAL BLIND POSITION – APRIL-JULY 2017

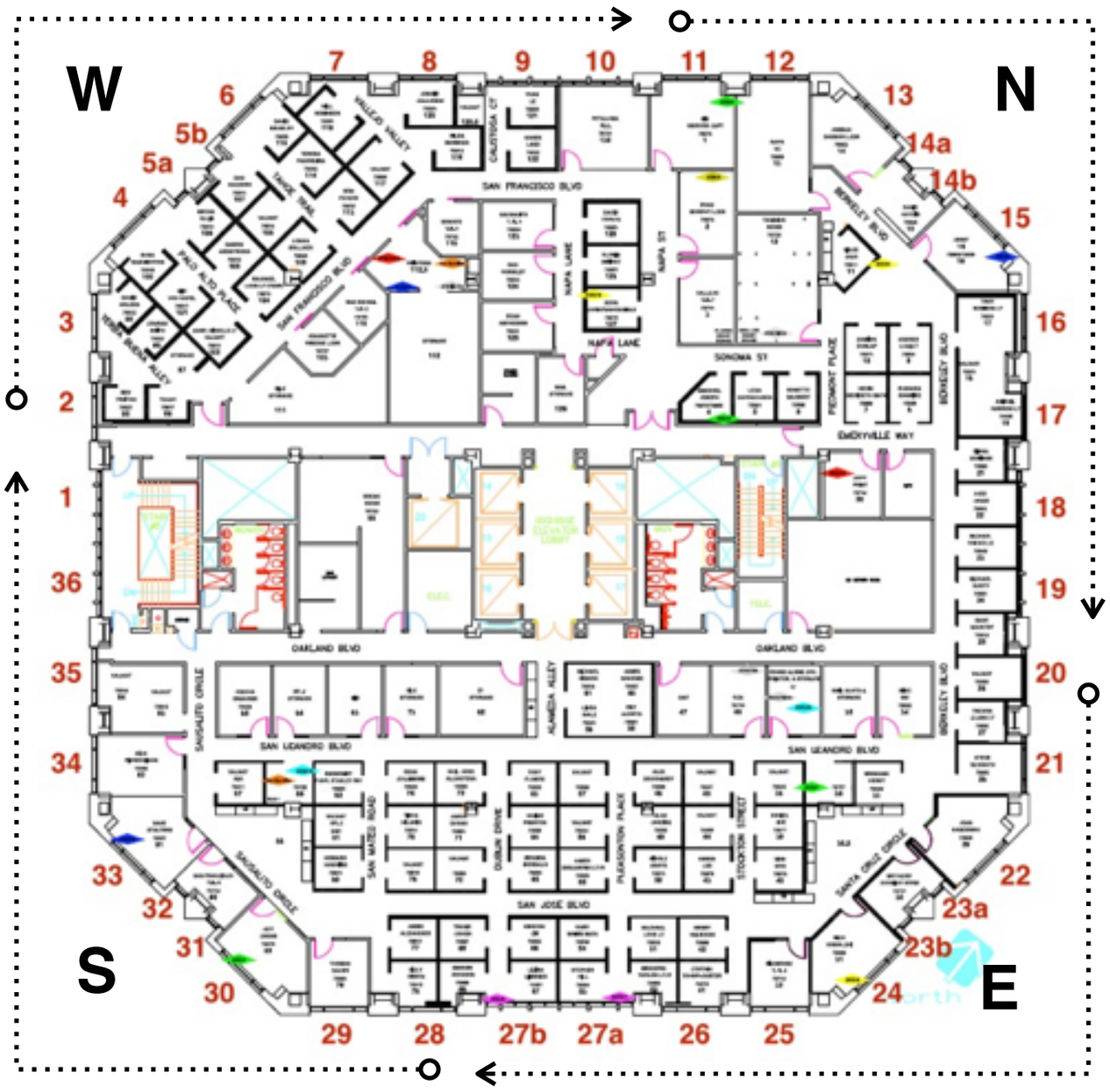
Appended below.



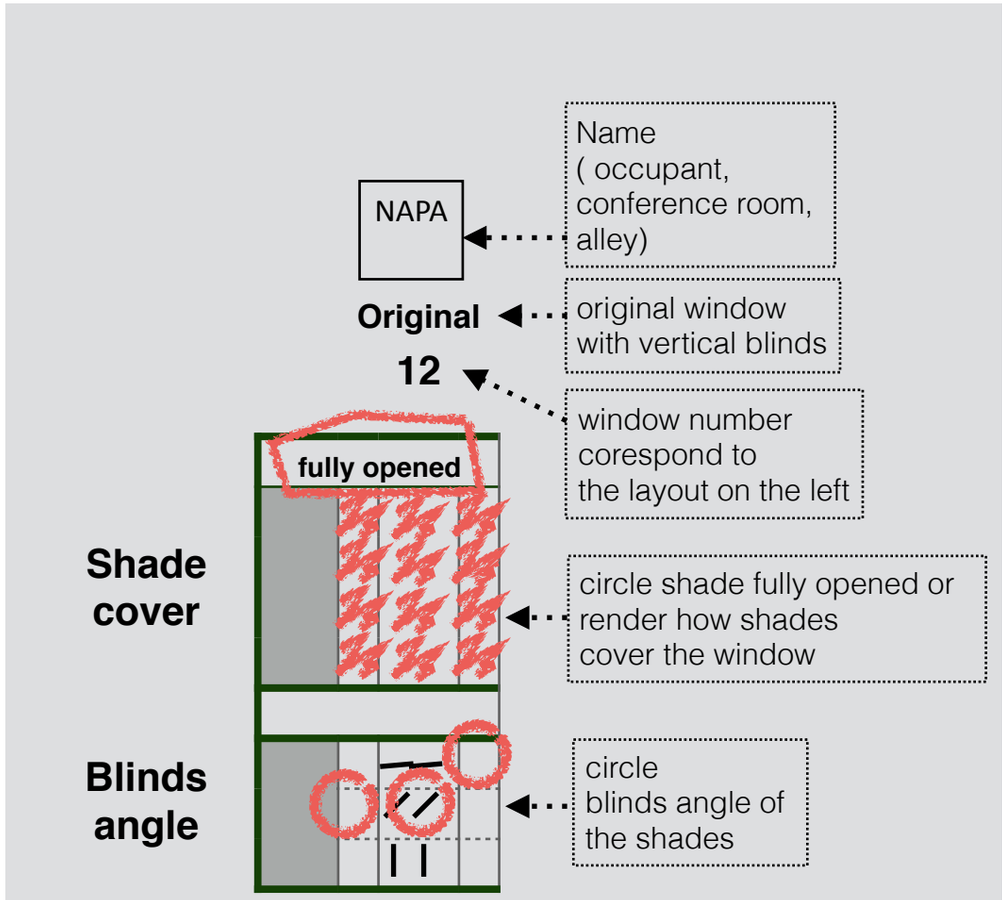
Convention for tilt angle used by DZSC control system for the upper blind angle.

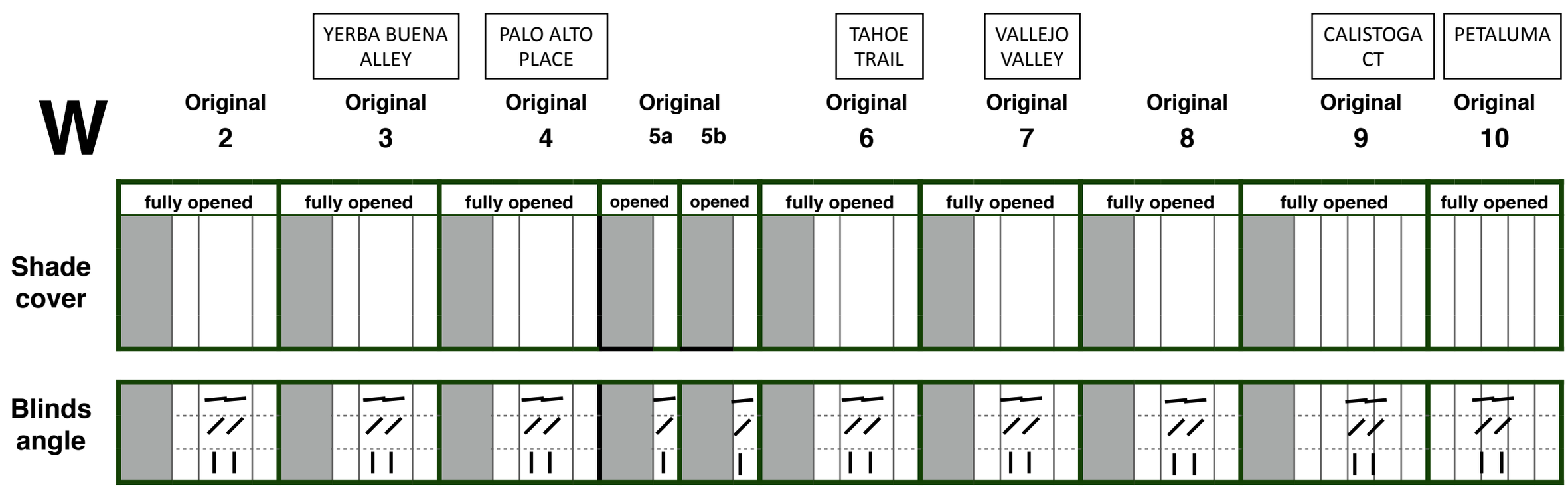
Page 1

Date_____ Time_____



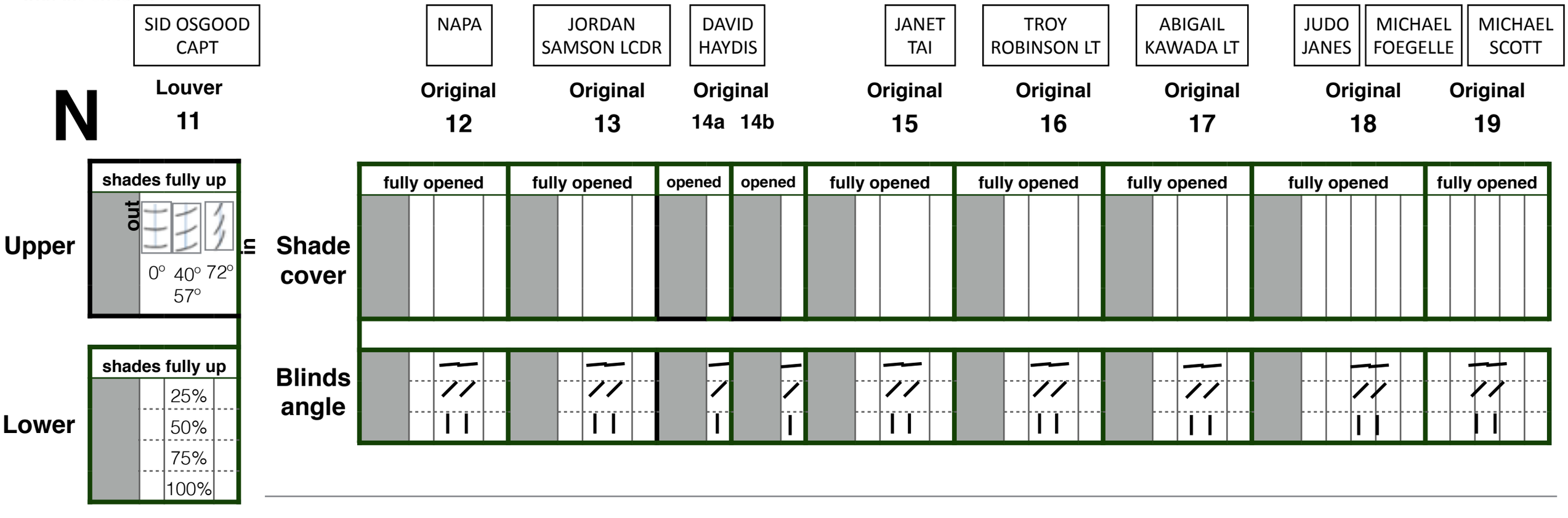
Instructions for vertical shades





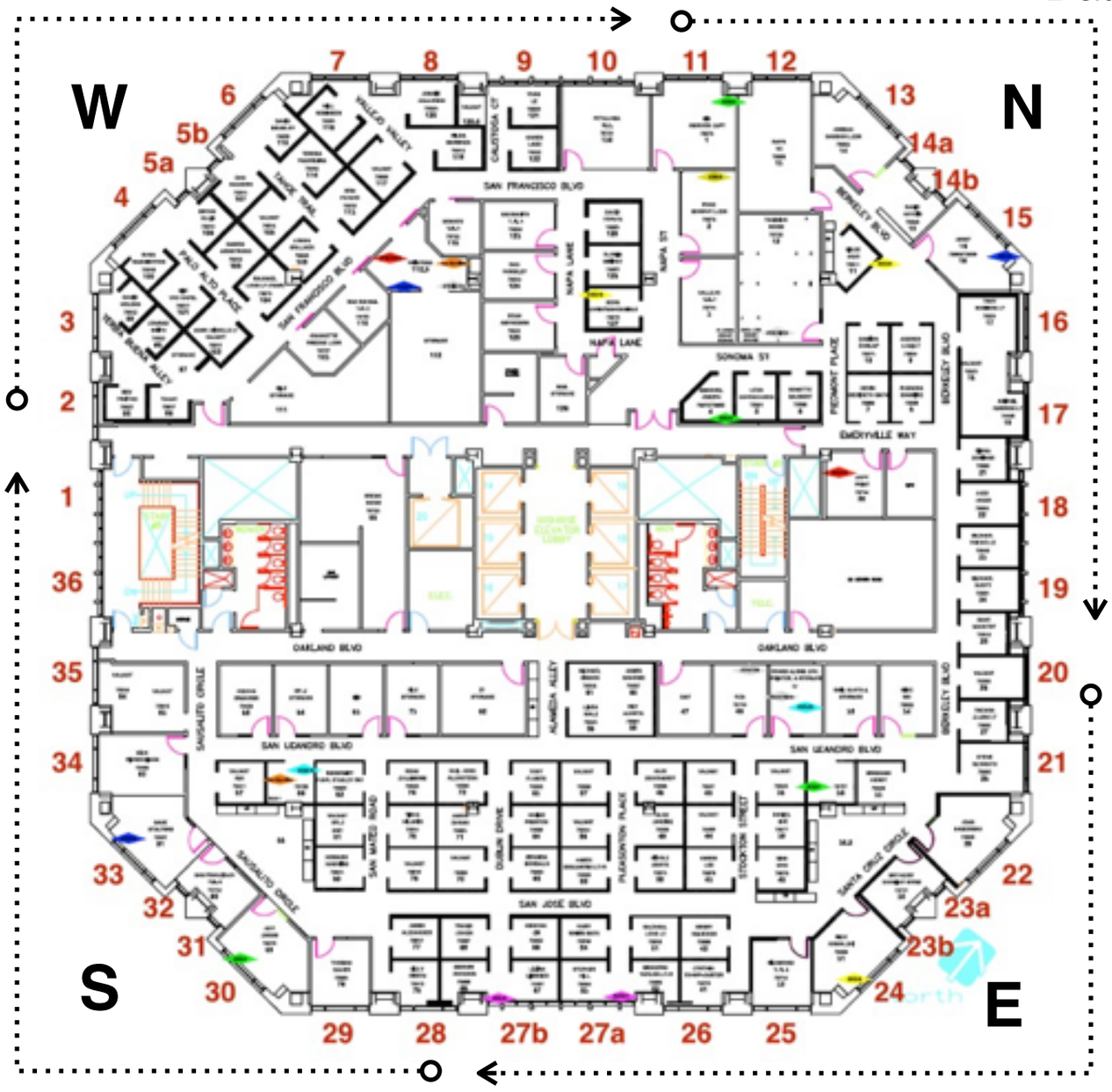
Note:

scratches, smears, tears, paper put up on the windows to block glare, anything wrong with the shades.

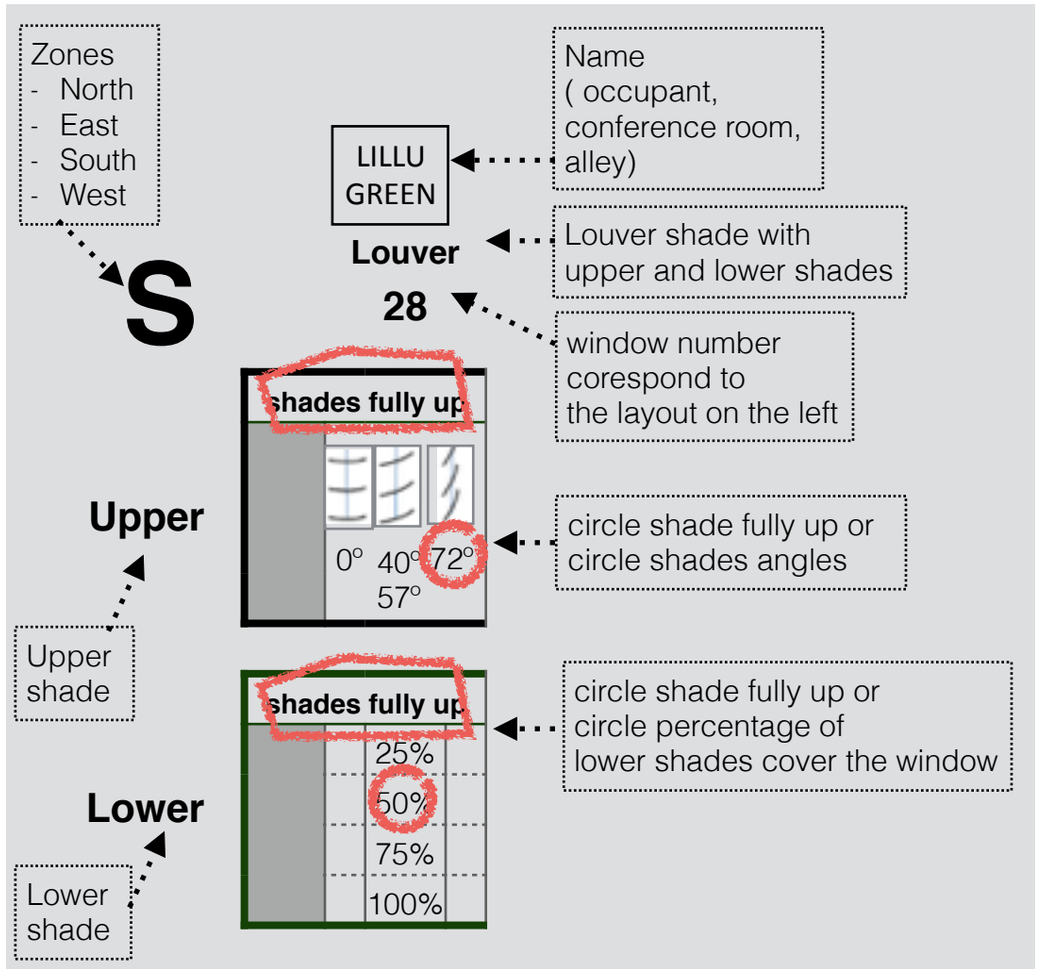


Page 2

Date_____ Time_____



Instructions for Louver shades



E

	STEVE MCGRATH	JOAN HABERMAN	NURSING ROOM		RICK KOWALSKI	RICHMOND	CYNTHIA THUNG-CARTER	PLEASONTON PLACE	LILIAN LIBRODO
	Louver	Louver	Louver		Louver	Louver	Louver	Louver	Louver
	20	21	22	23a 23b	24	25	26	27a	27b
Upper	shades fully up (out / in) 0° 40° 72° 57°	shades fully up (out / in) 0° 40° 72° 57°	shades fully up (out / in) 0° 40° 72° 57°	fully up (in) 0° 40° 57° 72°	fully up (out) 0° 40° 57° 72°	shades fully up (out / in) 0° 40° 72° 57°	shades fully up (out / in) 0° 40° 72° 57°	shades fully up (out / in) 0° 40° 72° 57°	shades fully up (out / in) 0° 40° 72° 57°	shades fully up (out / in) 0° 40° 72° 57°
Lower	shades fully up 25% 50% 75% 100%	shades fully up 25% 50% 75% 100%	shades fully up 25% 50% 75% 100%	fully up 25 50 75 100	fully up 25 50 75 100	shades fully up 25% 50% 75% 100%	shades fully up 25% 50% 75% 100%	shades fully up 25% 50% 75% 100%	shades fully up 25 50 75 100	shades fully up 25% 50% 75% 100%

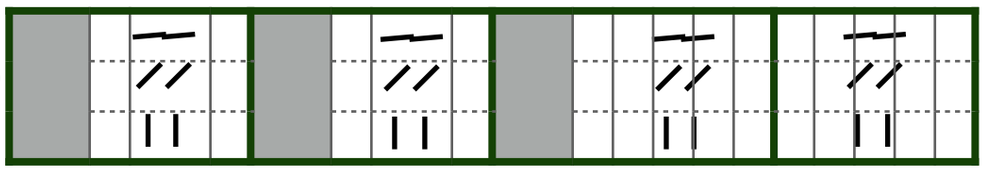
Note:

scratches, smears, tears, paper put up on the windows to block glare, anything wrong with the shades.

S

	LILLU GREEN	THOMAS DAUER	JEFF CROSS	SAN FRANCISCO	DAVE STALTERS	NICK FIORENTINOS	VA-CANT	OAKLAND BLVD	STAIRS	STAIRS
	Louver	Louver	Louver	Louver	Louver	Original	Original		Original	Original
	28	29	30	31 32	33	34	35		36	1
Upper	shades fully up (out / in) 0° 40° 72° 57°	shades fully up (out / in) 0° 40° 72° 57°	shades fully up (out / in) 0° 40° 72° 57°	fully up (in) 0° 40° 57° 72°	fully up (out) 0° 40° 57° 72°	shades fully up (out / in) 0° 40° 72° 57°				
Lower	shades fully up 25% 50% 75% 100%	shades fully up 25% 50% 75% 100%	shades fully up 25% 50% 75% 100%	fully up 25 50 75 100	fully up 25 50 75 100	shades fully up 25% 50% 75% 100%				

Shade cover: fully opened | fully opened | fully opened | fully opened

Blinds angle: 

B. REFERENCES

ASHRAE, 2013. ANSI/ASHRAE Standard 55-2013, Thermal Environmental Conditions for Human Occupancy, American Society of Heating, Refrigerating and Air-Conditioning Engineering, Atlanta, GA.

D&R International, Ltd., 2011. Building Energy Data Book, Building Technologies Program, Energy Efficiency and Renewable Energy, U.S.Department of Energy, Tables 1.5.5, 3.1.5, and 3.1.12, March 2012.

Fanger, PO, 1970. Thermal Comfort: Analysis and applications in environmental engineering. McGraw-Hill Inc., US.

Lee, E.S., D.L. DiBartolomeo, J.H. Klems, Ph.D., R.D. Clear, Ph.D., K. Konis, M. Yazdanian, B.C. Park, 2009. Field Measurements of Innovative Interior Shading Systems for Commercial Buildings. *ASHRAE Transactions* 115(2): 706-728.

Lee, E.S., B. Coffey, L. Fernandes, S. Hoffmann, A. McNeil, A. Thanachareonkit, G. Ward, 2014. High Performance Building Façade Solutions–Phase II, Final project report, California Energy Commission, CEC 500-2014, 2014.

Nabil, A. and J. Mardaljevic, 2005. Useful daylight illuminance: a new paradigm for assessing daylight in buildings. Lighting Research and Technology 37(1):41–59.

PG&E, 2017. PG&E Average Annual Large Commercial Rates, Fact Sheet, E-19: https://www.pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/economicdevelopment/factsheet/ed-elec_rate_comp_v3.pdf, accessed October 5, 2017.

Wienold, J., 2009. Dynamic daylight glare evaluation. Proceedings of Building Simulation 2009, 11th International IBPSA Conference, Glasgow, Scotland, July 27–30, 2009.

Wienold J., 2012. *evalglare* version 1.0. Fraunhofer Institute for Solar Energy Systems, Freiburg, Germany.

C. GLOSSARY

Daylight Glare Probability (DGP)	A metric for visual comfort. Its values range from 0 to 1, representing the probability that a person would experience disturbing glare in a particular situation.
Daylight Harvesting	A control strategy that reduces electric light levels in the presence of available daylight, “harvesting” the daylight to save electrical lighting energy.
Illuminance	The amount of luminous flux falling on a surface. Its customary units of measurement are lux (lx) or foot-candles (fc). It can be understood as the amount of visible light falling on a surface.
Low-e (low-emittance) coating	A thin (<100 nm) metal, metal oxide or multilayer coating deposited on glass to reduce its thermal infrared emittance and radiative heat transfer.
Luminance	The amount of luminous flux leaving a surface in a particular direction. Its customary unit of measurement is the candela per square meter (cd/m^2). It can be understood as a measure of brightness of a particular point in the field of view.
Solar heat gain coefficient (SHGC)	The fraction of solar radiation admitted through a window including both directly transmitted and absorbed radiation that is released inward to the building. The SHGC has replaced the shading coefficient (SC) as the standard indicator of solar control. It is expressed as a number between 0 and 1. The lower the value, the less solar heat the window transmits.
U-value	The heat transmission per unit time through a unit area of material or construction (including the boundary air films on the surface of the material) induced by a unit temperature difference between the environments on each side of the material. The lower the U-value, the greater the insulating value or the window’s resistance to heat flow. Also known as the U-factor.
Visible transmittance (Tvis)	The fraction of solar radiation transmitted by the glazing system between the limits of 380 to 770 nanometers at normal incidence. It is weighted according to the photopic response of the human eye and is expressed as a number between 0 and 1.
Window-to-wall ratio (WWR)	The ratio of the total area of the windows (glass area plus frame) divided by the total area of the floor-to-floor exterior wall.

D. MANUFACTURER CUT REFERENCES

Appended below.

LouverShade

Order

Harvesting Daylight
Creating Comfort

www.louvershade.com
Phone 425-260-1688 E-mail rrisdon@shadesinmotion.com

Customer Information

Dellums Federal Building
Halcyon

Ship To

Date: 11/16/16

Order #: 7431

Daylight Glazing Louvers	View Glazing Shades	Qty.	Item Price	Total Price
118.75 X 33 IB	GS/EM 118.75" X 67" IB WEIGHT BAR: ANODIZED FASCIA: ANODIZED, SQUARE CHAIN: STAINLESS CLUTCH: BLACK, RIGHT HAND CONTROL full length Side mark: Window 20	1		$0.00
118.25 X 33 IB	GS/EM 118.25" X 67" IB WEIGHT BAR: ANODIZED FASCIA: ANODIZED, SQUARE CHAIN: STAINLESS CLUTCH: BLACK, RIGHT HAND CONTROL full length Side mark: Window 21	1		$0.00
113.75 X 33 IB	GS/EM 113.75" X 67" IB WEIGHT BAR: ANODIZED FASCIA: ANODIZED, SQUARE CHAIN: STAINLESS CLUTCH: BLACK, RIGHT HAND CONTROL full length Side mark: Window 22	1		$0.00
28.25 X 33 IB	GS/EM 28.25" X 67" IB WEIGHT BAR: ANODIZED FASCIA: ANODIZED, SQUARE CHAIN: STAINLESS CLUTCH: BLACK, RIGHT HAND CONTROL full length Side mark: Window 23a	1		$0.00
28.25 X 33 IB	GS/EM 28.25" X 67" IB WEIGHT BAR: ANODIZED FASCIA: ANODIZED, SQUARE CHAIN: STAINLESS CLUTCH: BLACK, RIGHT HAND CONTROL full length Side mark: Window 23b	1		$0.00
114.25 X 33 IB	GS/EM 114.25" X 67" IB WEIGHT BAR: ANODIZED FASCIA: ANODIZED, SQUARE CHAIN: STAINLESS CLUTCH: BLACK, RIGHT HAND CONTROL full length Side mark: Window 24	1		$0.00
118.25 X 33 IB	GS/EM 118.25" X 67" IB WEIGHT BAR: ANODIZED FASCIA: ANODIZED, SQUARE CHAIN: STAINLESS CLUTCH: BLACK, RIGHT HAND CONTROL full length Side mark: Window 25	1		$0.00

118.25 X 33 IB	GS/EM 118.25" X 67" IB WEIGHT BAR: ANODIZED FASCIA: ANODIZED, SQUARE CHAIN: STAINLESS CLUTCH: BLACK, RIGHT HAND CONTROL full length Side mark: Window 26	1		$0.00
86.50 X 33 IB	GS/EM 86.50" X 67" IB WEIGHT BAR: ANODIZED FASCIA: ANODIZED, SQUARE CHAIN: STAINLESS CLUTCH: BLACK, RIGHT HAND CONTROL full length Side mark: Window 27a	1		$0.00
110.125 X 33 IB	GS/EM 110.125" X 67" IB WEIGHT BAR: ANODIZED FASCIA: ANODIZED, SQUARE CHAIN: STAINLESS CLUTCH: BLACK, RIGHT HAND CONTROL full length Side mark: Window 27b	1		$0.00
89.125 X 33 IB	GS/EM 89.125" X 67" IB WEIGHT BAR: ANODIZED FASCIA: ANODIZED, SQUARE CHAIN: STAINLESS CLUTCH: BLACK, RIGHT HAND CONTROL full length Side mark: Window 27c	1		$0.00
118.75 X 33 IB	GS/EM 118.75" X 67" IB WEIGHT BAR: ANODIZED FASCIA: ANODIZED, SQUARE CHAIN: STAINLESS CLUTCH: BLACK, RIGHT HAND CONTROL full length Side mark: Window 28	1		$0.00
118.75 X 33 IB	GS/EM 118.75" X 67" IB WEIGHT BAR: ANODIZED FASCIA: ANODIZED, SQUARE CHAIN: STAINLESS CLUTCH: BLACK, RIGHT HAND CONTROL full length Side mark: Window 29	1		$0.00
114.25 X 33 IB	GS/EM 114.25" X 67" IB WEIGHT BAR: ANODIZED FASCIA: ANODIZED, SQUARE CHAIN: STAINLESS CLUTCH: BLACK, RIGHT HAND CONTROL full length Side mark: Window 30	1		$0.00
28.25 X 33 IB	GS/EM 28.25" X 67" IB WEIGHT BAR: ANODIZED FASCIA: ANODIZED, SQUARE CHAIN: STAINLESS CLUTCH: BLACK, RIGHT HAND CONTROL full length Side mark: Window 31	1		$0.00
28.25 X 33 IB	GS/EM 28.25" X 67" IB WEIGHT BAR: ANODIZED FASCIA: ANODIZED, SQUARE CHAIN: STAINLESS CLUTCH: BLACK, RIGHT HAND CONTROL full length Side mark: Window 32	1		$0.00
113.75 X 33 IB	GS/EM 113.75" X 67" IB WEIGHT BAR: ANODIZED FASCIA: ANODIZED, SQUARE CHAIN: STAINLESS CLUTCH: BLACK, RIGHT HAND CONTROL full length Side mark: Window 33	1		$0.00

118.25 X 33 IB	GS/EM 118.25" X 67" IB WEIGHT BAR: ANODIZED FASCIA: ANODIZED, SQUARE CHAIN: STAINLESS CLUTCH: BLACK, RIGHT HAND CONTROL full length Side mark: Window 11	1		$0.00
				$0.00

Special Instructions:

Sub Total	$0.00
Tax	
Dealer Discount	$0.00
Estimated Freight	$0.00
Total	$0.00

LouverShade

Order

Harvesting Daylight
Creating Comfort

www.louvershade.com
Phone 425-260-1688 E-mail rrisdon@louvershade.com

Customer Information

Dellums Federal Building
Research Project

Ship To

LouverShade
505 S 4th Street
Renton WA 98057

Date: 11/09/16

Order #: 7501 Rev 2

Item #	Item	Qty.	Item Price	Total Price
1822065	BuCo	1		$0.00
9011975	din rail mount	1		$0.00
ASE12X12X4	enclosure	1		$0.00
9001606	outside sensor box	1		$0.00
9011993	sensor box power supply	1		$0.00
9154043	sun sensor w/bracket	4		$0.00
ASE12X12X4	enclosure for sensor box	1		$0.00
1860085	DC MoCo	5		$0.00
9011975	MoCo din rail	5		$0.00
ASE12X12X4	MoCo enclosure	5		$0.00
1800074	Dual Switch	3		$0.00
1800432	Single switch	2		$0.00
9011994	24V DC 5A Din Rail Mount Power	5		$0.00
9012519	USB Converter and Software	1		$0.00
9011975	Power Supply Din Rail Mount	4		$0.00
				$0.00
				$0.00
				$0.00

Sub Total	$0.00
Tax	
Dealer Discount	$0.00
Estimated Freight	$0.00
Total	$0.00

Special Instructions:

Green Proving Ground
Louvershade Install Plan

Notes:
1. All wiring to be mounted above drop ceiling.
2. Building Controller to be wall-mounted in electrical room.
3. Motor Controllers to be mounted above drop ceiling.
4. Existing vertical blinds to be removed and stored on-site for future reinstallation.
5. Louvershades to be ceiling-mounted in drywall where possible. Refer to mounting bracket plan for Louvershades 27a and 27b.
6. Louvershades, Louvershade headrails, motor controllers, building controller, and sensors to be furnished by Government. Additional hardware required for mounting to be furnished by contractor.

Louvershade 11 (manual)

Building Controller

From sensors in Penthouse (not shown)

Motor Controller A

Motor Controller B

Motor Controller C

Motor Controller D

Motor Controller E

Louvershade 20

Louvershade 21

Louvershade 22

Louvershade 23a

Louvershade 23b

Louvershade 24

Louvershade 25

Louvershade 26

Louvershade 27a

Louvershade 27b

Louvershade 28

Louvershade 29

Louvershade 30

Louvershade 31

Louvershade 32

Louvershade 33

Legend:
#14-2 Twisted Pair PVC Insulated
#24-4 Cat 5 Plenum

North

From outer space to your space

TECHNOLOGY | COMFORT | SECURITY | ENERGY

Halcyon SHADES

halcyonshades.com

Created for NASA, delivered by Halcyon

Technology developed for NASA protected our astronauts in outer space. Today, it can keep the sun's damaging rays out of your space.

Halcyon Shades are custom fit, professionally installed window shades that create comfort and promote health in your space, while reducing heat and cooling costs. Energy efficiency is easy with Halcyon.

Up to **99.9%** of harmful UV rays are blocked

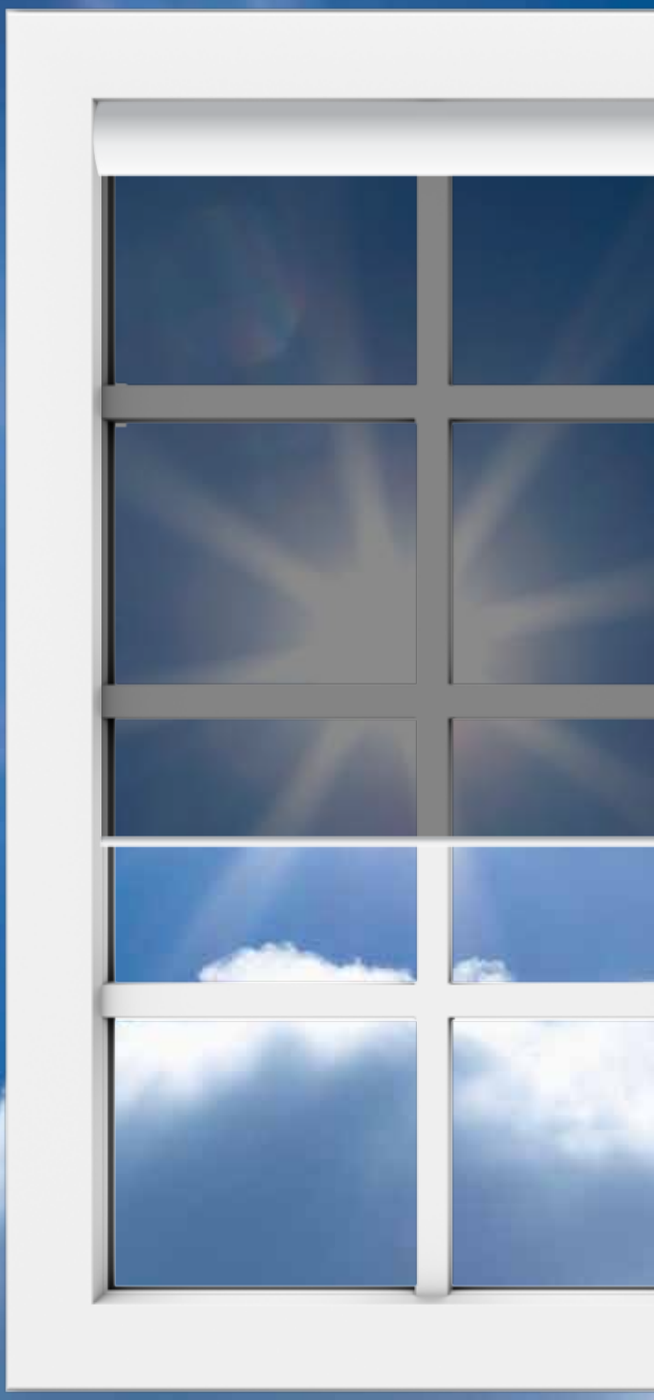
Up to **80%** of solar heat gain is reflected

Glare is reduced by up to **97%**

Transparency maintains the **view**

Over **6,000** design options

Earn points for **LEED** certification



Using space age sun-blocking material, the future is looking a lot brighter for your home or business with Halcyon Shades.

Halcyon Shades Benefits:

- reduce energy costs by reducing energy loss through windows
- pay for themselves in as few as 2 years through energy savings
- maintain health and furnishings by blocking UV rays
- protect customers and employees from eye strain by eliminating the glare
- properties provide an outside view while maintaining privacy
- earn up to 8 LEED points on certified projects

Acting much like a Thermos®, Halcyon Shades work to retain the temperature inside a building despite the temperature outside. Energy costs drop as heat is blocked in the summer and internal heat is reflected during the winter.

The American dream is alive and well at Halcyon.

Staying ahead of the competition while investing in US manufacturing, employees and veterans.

Halcyon Shades:

- **Only green manufacturer** in St. Louis
- Utilized a product developed incorporating **space age technology**
- Originally a division of **Solutia**
- **Relocated manufacturing** from Mexico to St. Louis
- Cares about St. Louis urban renewal and the **green economy**
- Received repeated recognition for their employment practices:
  Show Me Heroes Award - awarded by Governor Jay Nixon in 2012 for hiring returning veterans.
  Business of the Year - selected by Mayor Slay in 2009 for bringing the manufacturing plant across the border and creating jobs in St. Louis.

EDUCATION

Security

Unfortunately, in today's world, our children need to be protected at school. School access is now restricted to one entrance monitored by school security. The unique properties of Halcyon Shades prohibit outsiders from seeing into the school entrance or classrooms while allowing school personnel to visually survey all visitors before allowing entrance.

During new safety procedures, window coverings are lowered in the classrooms to prevent potential attackers from seeing if the room is occupied. Halcyon Shades can be down at all times, allowing an outside view for students, teachers and personnel while preventing outsiders from seeing inside the classroom. Halcyon Shades can help make schools a safer place while preventing a view of the inside, blocking glare, and conserving energy costs.

HEALTH CARE

Sanitary and safe

Healthcare-acquired infections are a threat to patients' health and the financial stability of all healthcare establishments. Up to 70% of surfaces in the rooms of infected patients are contaminated with potentially harmful microorganisms, according to studies reviewed by the Association for Professionals in Infection Control and Epidemiology (APIC). Staphylococcus aureus, one of the most common germs, can live up to three weeks on a dry surface, according to APIC. Other types of germs can live on dry surfaces for periods of up to four months, some surviving as a spore. Halcyon Shades can reduce this danger with the recommended cleaning method: wipe the shades with a lint-free cloth doused in isopropyl alcohol to disinfect the shade's surface for better health and a perfect view.

Save money and resources with energy efficiency, automation, and LEED points

The technology of Halcyon Shades provides an incomparable barrier between the outdoors and indoors. The metal film in the shades reflects the heat outside during the summer, lowering the load on HVAC systems. In the winter, the building's heat is reflected inside, keeping rooms warm and conserving energy.

Automation of shades eliminates human error, allowing the utmost efficiency and energy savings. Groups of up to 400 shades can be controlled from one computer. Programmed timing and light sensors ensure that shades are down at peak glare and heat times, every day.

Energy efficiency is such a focus during our product development that Halcyon Shades can earn public buildings up to eight LEED points on certified projects. LEED certification is one of the most prestigious honors a green building can receive.

DONALD DANFORTH PLANT SCIENCE CENTER
St. Louis, Missouri

CORPORATE OFFICES

SCOTT AIR FORCE BASE
Illinois

GOVERNMENT

Heightened security for the military

Halcyon shades meet military specifications for instances of heightened alerts. The unique properties of our shades maintain visibility of the outdoors for indoor personnel, while preventing anyone outside from seeing in.

Currently in use in offices and conference rooms on major military bases, Halcyon shades are also utilized in military air traffic control towers, government buildings, and other high-security applications. Halcyon shades can provide comfort to employees by reducing glare and making government buildings more energy efficient. Our GSA Schedule Number is GS-03F-0126Y.

Air Traffic Control Tower
Scott Air Force Base

RETAIL & RESTAURANTS

Block the heat and glare – create happier employees and customers while protecting merchandise

Transparency provides trust and comfort when entering a store or restaurant, making windows important for these establishments. Large amounts of sunlight, however, can create issues. Glare can contribute to eye strain for employees as they attempt to read their register screen. Customers may find seating to be uncomfortable due to both the heat and glare. Finally, UV rays can damage products for sale and furnishings, costing owners thousands. Halcyon custom-designed shades create a comfortable environment for both customers and employees by blocking the heat and glare. Halcyon Shades increase profits with energy savings and reduce product shrink by eliminating UV rays.

RESIDENTIAL

Protect your home and budget

Natural sunlight in the home is beautiful, but UV rays can be extremely harmful to skin and furnishings. The sun's UV rays damage antiques, artwork, hardwood flooring, furniture, and carpeting. Halcyon Shades will eliminate as much as 99.9% of UV rays, while allowing natural light indoors. They protect the people and everything in the home – including the view. The Department of Energy has found that Halcyon Shades can pay for themselves in as little as two years by reducing the effects of outside temperatures and lowering energy costs.

How to improve your space with Halcyon Shades

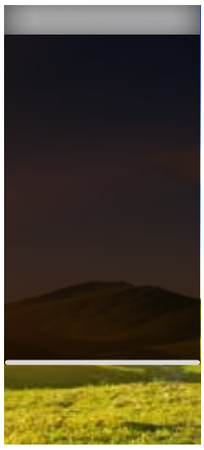
Determine the right level of performance and transparency for your space

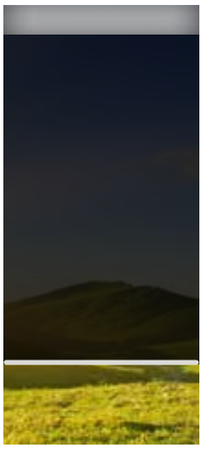
LEGEND

The values shown reflect:

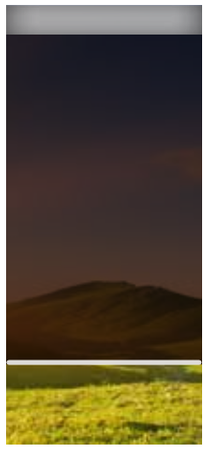
Single-Pane, 1/4 inch (6mm), clear glass
Dual-Pane, 1/8 inch (3mm), clear glass

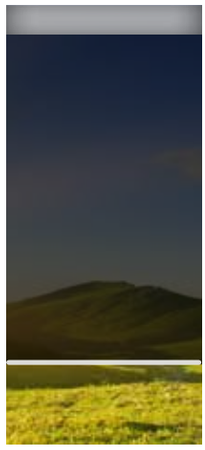
2" airspace between shade and glass





Maximum Performance / Lower Transparency

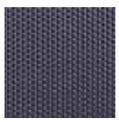




High Performance / More Transparency

Product #	B/S EM	B/S TR	G/S EM	G/S TR	B/B EM	B/B TR	G/G EM	G/G TR
Color / Texture*	Bronze Textured	Bronze Smooth	Gray Textured	Gray Smooth	Bronze Textured	Bronze Smooth	Gray Textured	Gray Smooth
Color exposed to outside	Silver	Silver	Silver	Silver	Bronze	Bronze	Gray	Gray
% UV Light Rejected	99.9%	99.9%	99.9%	99.9%	99.9%	99.9%	99.9%	99.9%
	99.9%	99.9%	99.9%	99.9%	99.9%	99.9%	99.9%	99.9%
Winter U Value	0.46	0.46	0.45	0.45	0.46	0.46	0.46	0.46
	0.29	0.29	0.29	0.29	0.30	0.30	0.30	0.30
% Visible Light Transmittance	2%	2%	2%	2%	11%	11%	7%	7%
	2%	2%	2%	2%	10%	10%	7%	7%
% Glare Reduction	98%	98%	98%	98%	88%	88%	92%	92%
	98%	98%	98%	98%	89%	89%	92%	92%
% Solar Energy Rejected	83%	83%	83%	83%	50%	50%	50%	50%
	80%	80%	80%	80%	48%	48%	48%	48%
Daytime Security	yes	yes	yes	yes	yes	yes	yes	yes

Choose the material for your shades



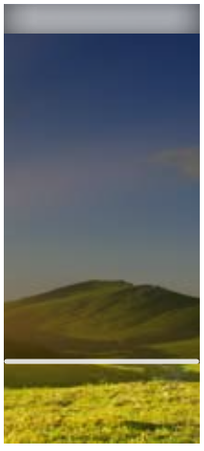
Textured shades diffuse the light and add durability

Smooth shades offer the highest level of transparency

Room darkening shades provide complete privacy

** Custom colors are available. Ask a representative for details.*

Optimize your energy savings, health, privacy and comfort

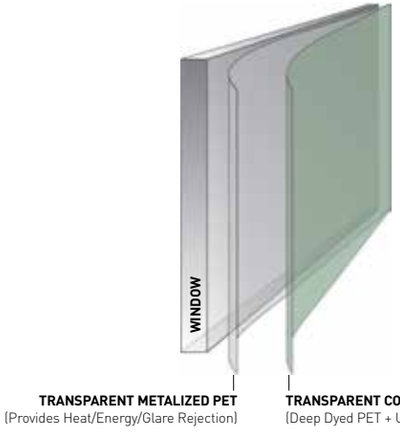


Medium Performance / High Transparency

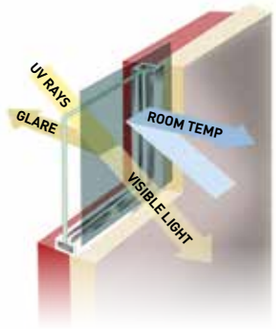
Room Darkening/ No Transparency

	LTG EM	LTG TR	WH/WH EM
	Light Gray Textured	Light Gray Smooth	White Textured
	Light Gray	Light Gray	White
	99.9%	99.9%	100%
	99.9%	99.9%	100%
	0.47	0.47	0.50
	0.30	0.30	0.50
	46%	46%	0.1%
	43%	43%	0.1%
	49%	49%	100%
	52%	52%	100%
	39%	39%	91%
	39%	39%	91%
	no	no	yes

Halcyon Technology



Halcyon shades have the light- and heat-reflecting properties of metal. A precise, vacuum coating process bonds a micro thin layer of metal with a strong laminating adhesive to provide exceptional reflective properties for the best solar solution.



UV Rays and glare are reflected outdoors while visible light shines through. Room temperature is reflected back into the room.

Customization:

- Motorization with remote, timers and/or light sensors for automation
- Remote control and/or automation for individual shades or groups of shades
- Cassette covers available in squared, rounded and wood options (conceals the shade roll)
- Side rails to eliminate light gaps
- Weight bar
- Beaded chain

Definitions

UV Light Rejected: Percentage of ultraviolet solar energy rejected by a window and associated window treatments.

Winter U-Value: Factor indicating the film's ability to reflect heat back into a space (thermal resistance). The lower the U-value, the higher the resistance to heat transfer.

Visible Light Transmittance: Percentage of the visible solar energy that is allowed to pass through/transmitted into the interior of the space.

Glare Reduction: Percentage of the visible solar energy that is not allowed (rejected) to pass through a window and associated window treatments. A near opposite of Visible Light Transmission.

Solar Energy Rejected: Percentage of the total solar energy spectrum that is reflected or absorbed by the window and associated window treatments.

The photos shown above are simulations, created to convey the variations in transparency available.

Halcyon Fabric Shades

Add a soft touch to your decor while minimizing the glare with Halcyon Fabric Shades – the sunscreen fabric backed by a lifetime warranty.

Outward Visibility - Openness Factor

Halcyon Fabric Shades offer different levels of glare reduction and transparency through the openness factor — the tightness of the weave in the fabric. A 10% openness factor allows the most sunlight between the threads, offering more transparency but lower glare and UV reduction. The 0% openness of the Halcyon Blackout Shades completely blocks sunlight.

Environmentally Friendly and Safe

The world's first non-toxic PVC compound coats polyester to form a yarn that is stronger, lighter and less expensive to produce than traditional vinyl coated fiberglass fabrics. Declared safe by Oeko-Tex® Standards 100 Low Odor Specially formulated non-toxic PVC does not contain odor-causing compounds generally associated with solar screen material.

Anti-Bacterial

Reduces the spread of germs in hospitals and other public institutions; certified SGS-ASTM G21, 22

Indoor Air Quality

Awarded GREENGUARD and GREENGUARD Children & School certification — an indoor air quality certification program for low emitting products and materials. It is a requirement reference in the LEED™ rating system.

Fire and Smoke Classification

Made from stable, endurable, and fire resistant materials; certified M1, B1, B2, CA Title 19, NFPA 701

Incredibly Durable

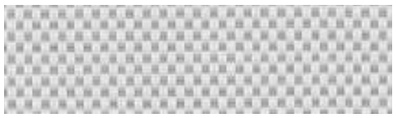
A unique manufacturing process delivers technically superior fabrics; backed by a Lifetime Warranty.

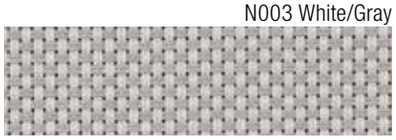
Select colors available with extended lead times. Ask a representative for details.

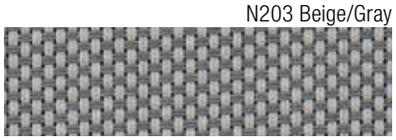
Aesthetic versatility and a lifetime warranty

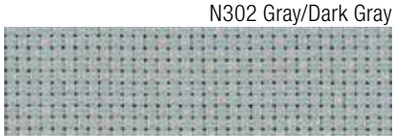
Available in 1%, 3%, 5%, and 10% openness | 3000 NET

N001 White/White


N003 White/Gray

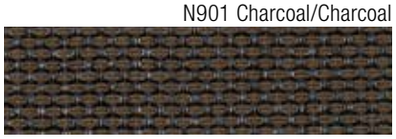

N203 Beige/Gray

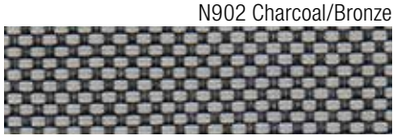

N302 Gray/Dark Gray


N303 Gray/Blue Gray


N304 Gray/Blue


N901 Charcoal/Charcoal


N902 Charcoal/Bronze

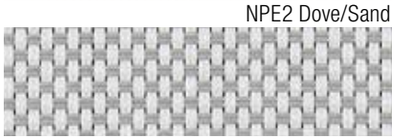

N903 Charcoal/Gray

Available in 3%, 5%, and 10% openness | 4000 NET

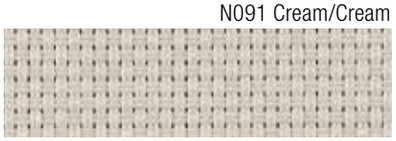

NPE1 Dove/Dove

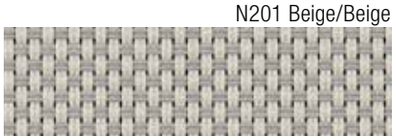

N002 White/Beige

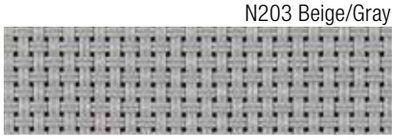

NPE2 Dove/Sand

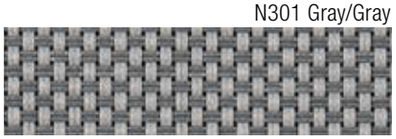

N003 White/Gray

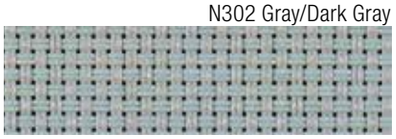

N091 Cream/Cream


N201 Beige/Beige


N203 Beige/Gray


N301 Gray/Gray


N302 Gray/Dark Gray

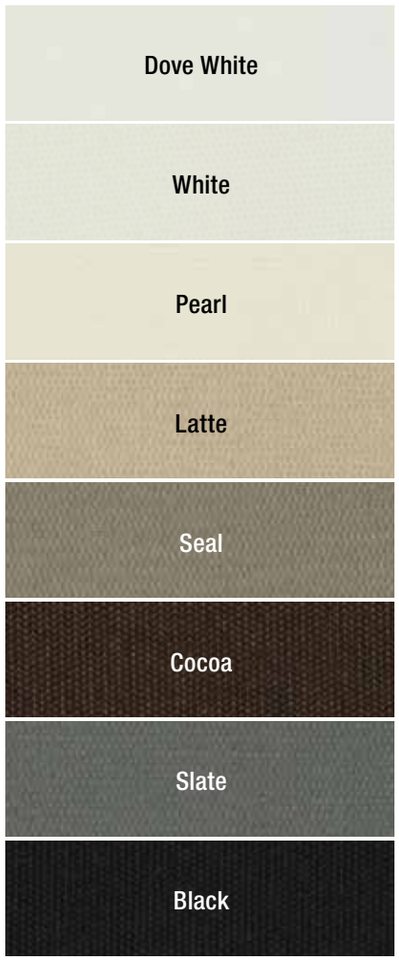

N303 Gray/Blue Gray


N801 Bronze/Bronze


N901 Charcoal/Charcoal


N902 Charcoal/Bronze

0% openness | Halcyon SierraSol Mesa



0% openness | Halcyon SierraSol Vista

Motors and Sensors

Automated shading systems are functional and easy to use with Radio Frequency Somfy Wire Free options. Easily installed and without wires or plugs, the motors are concealed within the window covering, maintaining the aesthetic appeal. Motorization is activated via remote, wall switch or sensors.

Roll Up WireFree™ RTS LT30

Ideal for areas with limited access to power outlets or wiring, this battery-powered low-voltage tubular motor has a range of 65 feet. Compatible with the full range of RTS controls and accessories. Convert to a plug-in system with the use of a transformer. #1001683

Battery Tube

The 12V DC Reloadable Battery tube uses 8 AA lithium batteries for Somfy powered WireFree™ motorized window coverings. Just unscrew the cap and replace the batteries as needed. Clips for easy mounting and an extension cord are available. Only works with LT3) motor. #9014020

Sonesse® 30

Premium, quiet performance is provided with a low voltage 24V DC motor. Compact and low-profile, Sonesse 30 motors are easily concealed within the cassette. Speed regulation allows precise alignment of adjacent shades. Available in Radio Technology Somfy® (RTS), dry contact and digital RS485. DCT: #1000668; RTS: #1001524; ILT: 1000658

Sonesse® 40

The Sonesse® 40 continues the Sonesse® range tradition of silence. When operating at normal conditions, the Sonesse® 40 is nearly silent from 3 feet away. To enhance the value of Sonesse® 40 installations, Somfy has created a line of specialized accessories with industry partners Acmeda and Rollease to provide maximum acoustic comfort. Available in both RTS and Wired control technologies and is powered by standard line voltage (120VAC). #1001636

Indoor Sunis WireFree™ RTS Sun Sensor

Automatically control window coverings based on the intensity of the sun. Sensors can be installed and programmed in a few seconds, and can easily be added to any new or existing RTS installation. Compatible with all interior RTS motorized window coverings. # 9013707

Remote Operation

Solar control with flexibility and programming

INDIVIDUAL CONTROL

Single Channel Control
A single channel remote allows control of 1 window covering

Multi-Channel Control
A 5-channel remote can control up to 5 individual window coverings

GROUP CONTROL

Single Channel Control
A single channel remote allows control of a single group of window coverings

Multi-Channel Control
A 5-channel remote can control up to 5 specific groups of window coverings

Telis RTS

Telis hand-held remotes offer convenient and simple operation of every type of motorized application featuring Radio Technology Somfy® (RTS). Available in 1, 5 and 16 channel versions. Each channel can control an individual motorized window covering or a group of motorized coverings. Telis 1 Pure: #1810632; Telis 4 Pure: #1810633; Telis 16 RTS Pure: #1811081

DecoFlex WireFree™ RTS Wall Switch

Includes the same features as the Telis hand-held remote but located on the wall, providing control of window coverings when entering or exiting a room. Completely wireless and battery-powered and easily installed, they are available in 1-5 channel versions and a variety of finishes such as white, black, almond, and ivory. Personalize the names of each channel with engraved buttons. Table mount option also available. DecoFlex

WireFree 5 Channel: White #1810813, Ivory #1810814, Black #1810830, Almond #1811181; DecoFlex WireFree 4 Channel (kit): White #1811074, Ivory #1811075, Black #1811073; DecoFlex WireFree 3 Channel (kit): White #1811071, Ivory #1811072, Black #1811070; DecoFlex WireFree 2 Channel (kit): White #1811068, Ivory #1811069, Black #1811067; DecoFlex WireFree 1 Channel: White #1810897, Ivory #1810898, Black #1810899, Almond #1811180; DecoFlex face plate 4 channel: White #61114043, Ivory #61114044, Black #61114045; DecoFlex face plate 3 channel: White #61114033, Ivory #61114034, Black #61114035; DecoFlex face plate 2 channel: #61114024, Ivory #61114025, Black #61114026; DecoFlex WireFree Table Top: Silver #1810972, Black #1811051, White #1811185

Telis 1 Chronis RTS

The functionality of a programmable timer in a single channel RTS hand-held control. Compatible with all motorized RTS applications. An on-screen display and simple programming make operation simple. The Quick Set feature allows programming with a brief button press; Automatic Mode allows one open and one close function per day, with different operation available for weekdays and weekends; Manual Mode allows the user to override the programmed operation at any time. Wall mount clip available. #1805237

myLink

Somfy's powerful sunlight management app

Remote Access: Activate Somfy-powered applications even when you're away from home with a single tap.

Timed Events: Schedule scenes to automate motorized applications on a seven day schedule so you can effortlessly enjoy their many benefits.

On-screen Setup Wizard: Intuitive installation and setup allows you to enjoy your myLink experience in a short few minutes.

Flexible: Choose the best way to control your motorized applications with options such as individual control, group control, and more.

Compatible: Controls all Radio Technology Somfy® RTS products as well as RTS enabled lighting devices. #1811403

animeo

Mange your building's solar shades from one computer. Cutting edge sun-tracking technology with an intuitive interface automates motorized solar shades in large groups for optimal performance.

animeo IP

A total solar management system with digital keypads and weather sensors. The system's controllers, sensors and keypads can be added to both new and existing Somfy Digital Network installations for comprehensive solar management as either a stand-alone solution or integrated into third party control systems. An intuitive user interface allows for simplified commissioning, building management and technical support, featuring drag-and-drop zone creation, motor auto discovery and at-a-glance system status updates. #1860201SubCo

animeo IP System Design

Every animeo IP installation includes an animeo IP Building Controller that supports up to 200 motors. The animeo IP is a scalable system – network capacity is expanded by adding one Sub Controller for each additional group of 200 motors. For systems exceeding 1,000 motors, the Building Controller is configured to only manage network traffic and not have any direct motor connections. The animeo IP Controller resides on a standard Somfy Digital Network (SDN) bus. Proper SDN system design must be respected for optimal animeo IP performance. #1822314BuCo

Put the finishing touches on your shades for perfect performance.

Cover styles

Wood Cassette Beautifully stained, high quality wood to complement your home decor. Available in Light Oak, Cherry, and Sugar Maple.

Modern = Squared Squared design available in a rust-proof aluminum box in White, Alabaster, Bronze, Black, Blue, and Silver Anodized finishes. Shade retracts fully into the cassette.

Contemporary = Rounded Rounded design available in White, Alabaster, Bronze, Black, Blue, and Silver Anodized finishes. Shade retracts fully into the cassette.

Fascia Rounded and squared style fascia with matching end caps to conceal larger roller tube – 3" in White or Bronze (4" available for larger shades). Additional colors available upon request.

Retro Style Shade Exposed roller/clutch. Clutch available in White or Black.

Additional details

Exposed Weight Bar Exclusive extruded aluminum design provides a finished appearance; available in durable Silver Anodized and painted finishes in White, Bronze, Black, and Blue.

Weight Bar for Fabric Shades Exclusive extruded aluminum design provides a finished appearance; available in durable Silver Anodized and painted finishes in White, Bronze, Black, and Blue.

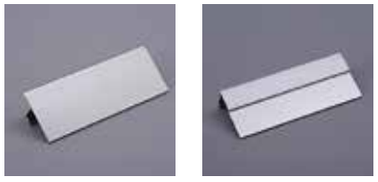
Hold-Down Clips Attached at bottom of shade – weight bar slides onto stop to anchor shade in place to prevent swinging or banging when door is opened or closed.

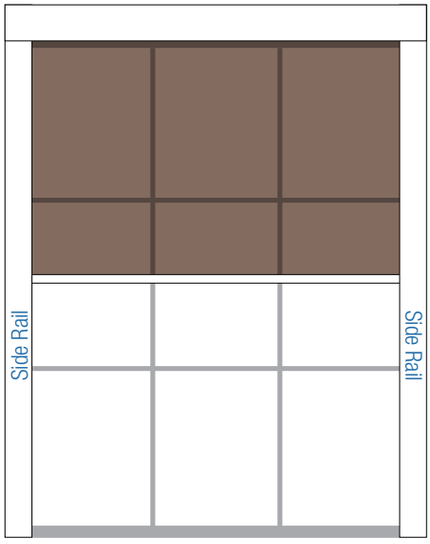
Beaded Chain Loop In heavy-duty coated plastic available in Light Grey, White, Bronze, Black, and Stainless steel with matching Chain Stop to hold at desired position. (Child Safety-Tension device included with each shade at no charge.)

RollEase Clutch systems are installed on all shades and guarantee smooth, precise raising and lowering of the shade, and hold the shade at the desired height. Their ten-year clutch warranty ensures trouble-free performance. Universal mounting brackets can be used for all types of mounting. Shades can be mounted for either right or left-hand operation. Spring roller available upon request.

Side Rails

Eliminate light gaps with Silver Anodized aluminum or vinyl side rails, customized for fit and installed on each side of the window. The weight bar is designed to "float" inside of the rail to ensure secure and smooth shade operation. Can be used with cassette, fascia or retro shades. Available in White, Black, Bronze and Alabaster.

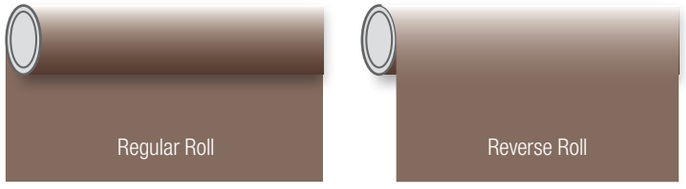




Configurations

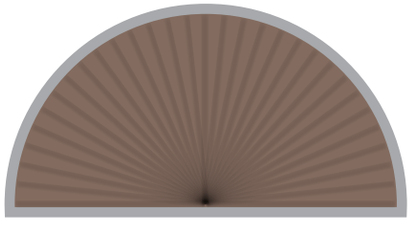
Halcyon Shades are customized to meet individual customer needs in performance, form and function. Customized features include the various configurations shown here. Halcyon is committed to working with customers to offer solutions outside of what is shown below.

Two-On-One Cassette For side-by-side windows or wide windows where individual operations are preferred: two shades that open and close independently, sharing the same cassette.



Regular Roll or Reverse Roll Regular Roll allows the shade material to roll down from the rear of the shade. With a Reverse Roll, the material will roll over the front of the shade, which is useful if there is an obstacle in the window such as a crank handle. Regular Roll is standard.

Tapered Shade Allows for windows with a different top-to-bottom angle. The bottom portion of the shade must always be smaller than the top of the shade.



Arched Shade Pleated shade, stationary. Maximum width 5'. Exact radius height must be 50% width (e.g., a shade 5' wide must be 2.5' tall). Available in Bronze/Silver, Gray/Silver and Bronze/Bronze.

EASY CLEANING AND SANITATION
Wipe the shades with isopropyl alcohol to clean

FLAME RETARDANCY STANDARDS
All films meet the requirements of NFPA 701 Test Method (1-2004 Edition)

WARRANTY
Textured - 5 years; Smooth - 3 years

MAINTENANCE
There are no service-oriented parts supplied with the shade. Adjustment or repair should only be performed by the professional installer. Complete maintenance instructions are included with each shade.

CHILD SAFETY
Young children can strangle in cord and bead chain loops. They can also wrap cords around their necks and strangle.

Always keep cords and bead chains out of children's reach. Move cribs, playpens and other furniture away from cords and bead chains. Children can climb furniture to get to cords. Attach tension device to wall or floor. This can prevent children from pulling cords and bead chains around their necks.

SIZE LIMITATIONS AND SEAMS
Shades may require a seam if both the width and the height of the window exceed 70" each. Shades can not exceed a three to one ratio of length and width. Contact our customer service department for more information.

Halcyon SHADES

halcyonshades.com

Contact your Halcyon Rep Group, or authorized Halcyon Shades Dealer for more information and to receive an estimate.

Halcyon SHADES

1600 S 39th St | St. Louis, MO 63110
(314) 282-8088
halcyonshades.com

At Halcyon Shades pigs fly every day.

Green Proving Ground
Louvershade Install Plan

Notes:
1. All wiring to be mounted above drop ceiling.
2. Building Controller to be wall-mounted in electrical room.
3. Motor Controllers to be mounted above drop ceiling.
4. Existing vertical blinds to be removed and stored on-site for future reinstallation.
5. Louvershades to be ceiling-mounted in drywall where possible. Refer to mounting bracket plan for Louvershades 27a and 27b.
6. Louvershades, Louvershade headrails, motor controllers, building controller, and sensors to be furnished by Government. Additional hardware required for mounting to be furnished by contractor.
7. All equipment and wiring mounting locations are approximate.

Louvershade 11 (manual)

Building Controller

From sensors in Penthouse (not shown)

Motor Controller A

Motor Controller B

Motor Controller C

Motor Controller D

Motor Controller E

Manual Override A

Manual Override B/C

Manual Override D

Louvershade 20

Louvershade 21

Louvershade 22

Louvershade 23a

Louvershade 23b

Louvershade 24

Louvershade 25

Louvershade 26

Louvershade 27a

Louvershade 27b

Louvershade 28

Louvershade 29

Louvershade 30

Louvershade 31

Louvershade 32

Louvershade 33

Legend:

#14-2 Twisted Pair PVC Insulated

#24-4 Cat 5 Plenum

North

Not To Scale

Metal Enclosure
Centralized BuCo
*Loc. Mec. Room
(Supplied)

12/2 w/Ground
120V~ AC 60Hz
(By Others)

animeo IB+ 8-zone Building Controller 1
16222065

SDR-120-24

12/2 w/Ground
120V~ AC 60Hz
(By Others)

18/4
2 Twisted Pairs
or CAT5
Bus + 24V DC
(By Others)

18/2
1 Twisted Pair Ea.
Communication Bus
(If greater than 6' from box)
(By Others)

(4)Photocell with L Bracket
and 6' Factory Lead

NorthEast
Sun Sensor
45°
1

East
Sun Sensor
90°
2

SouthEast
Sun Sensor
135°
3

South
Sun Sensor
180°
4

animeo IB+ Outside Sensor Box
9001606

Outside Sensor Box
*Loc. Penthouse
(Supplied)

18/4
2 Twisted Pairs
or CAT5
Communication Bus
(Motor Controllers)

18/3 or CAT5
Dry Contact
(By Others)

Local Switch
Single Zone
(Decora Low Voltage)

Note:
C to G (Common)
▲ to U (Up)
▼ to D (Down)

1 — E — 21, 20 — 12/2 w/Ground 120V~ AC 60Hz (By Others)

2 — D — 24, 23b, 23a, 22 — 12/2 w/Ground 120V~ AC 60Hz (By Others)

3 — C — 27a, 26, 25 — 12/2 w/Ground 120V~ AC 60Hz (By Others)

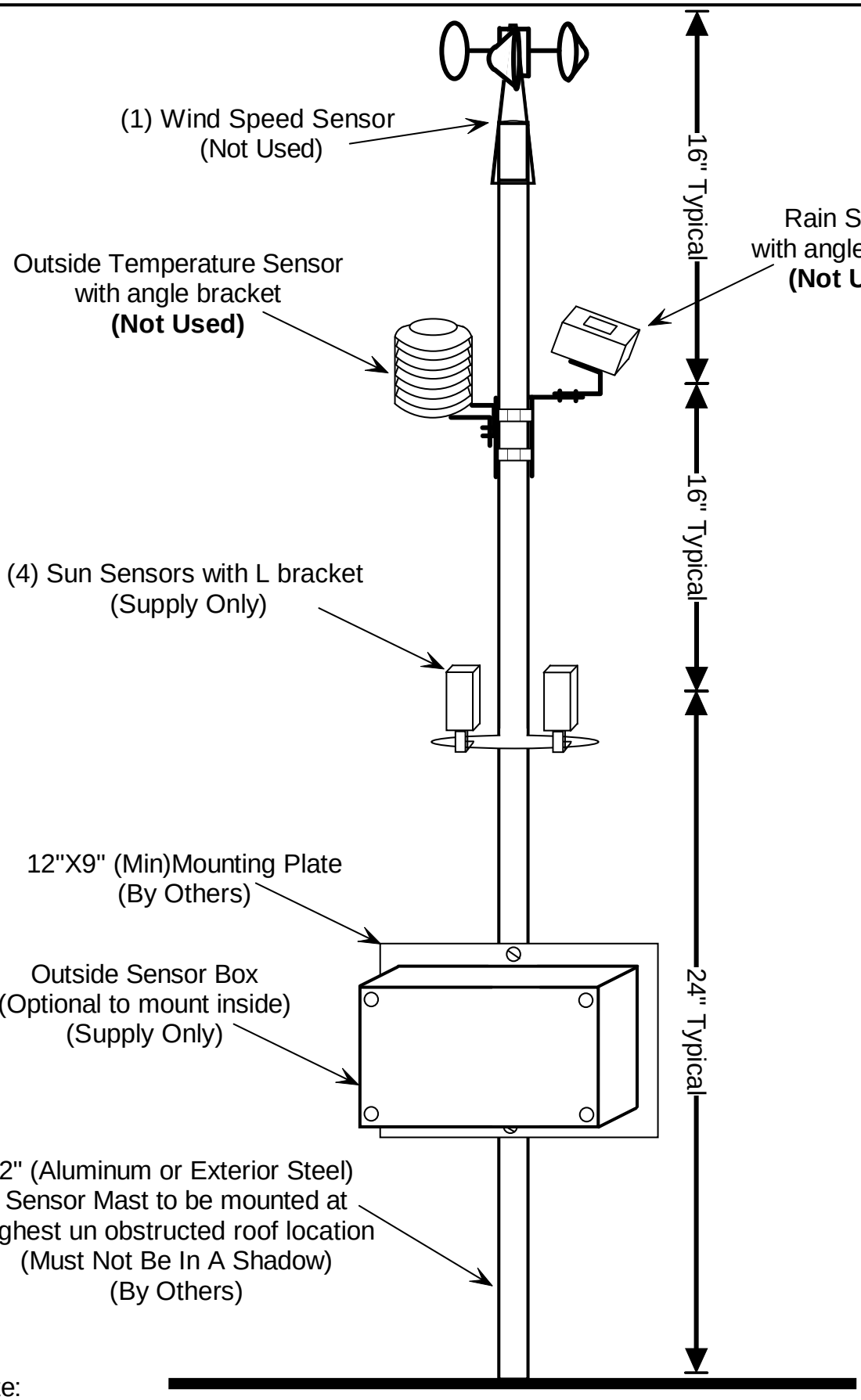
4 — B — 29, 28, 27b — 12/2 w/Ground 120V~ AC 60Hz (By Others)

5 — A — 33, 32, 31, 30 — 12/2 w/Ground 120V~ AC 60Hz (By Others)

Metal Enclosure
Local MoCo
(Supplied)

LouverShade
harvesting daylight. creating comfort
505 S 4th Street
Renton, WA 98057
LouverShade.Com

All Electrical components are supply only to be installed by others.
All cable and required jboxes to be supplied by others.
MoCo(s) and BuCo, with power supplies relays, will be supplied within Hoffman enclosure.
GC to coordinate install location of control box, sensors, sensor box, and switches.

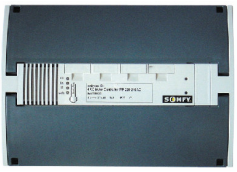


N.S.S. Example

Note:
Mast and all mounting plates by others. Outside Sensor Box can optionally be mounted inside.
All sensors include 6' (foot) factory lead. Any required junction boxes by others.
Sun Sensors must be mounted above snow line. Mast should also be located away from any exhaust source. Sensor and Box electrical connections by others. See one line.

animeo ® IB+

Technologies



animeo IB+ uses different communication technologies between its different system components.

Each one of these technologies has been optimized to enhance the competitiveness of the system, and to provide a maximum of simplicity and flexibility for installation.

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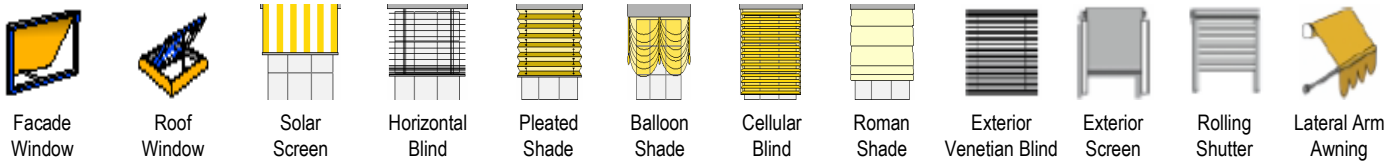

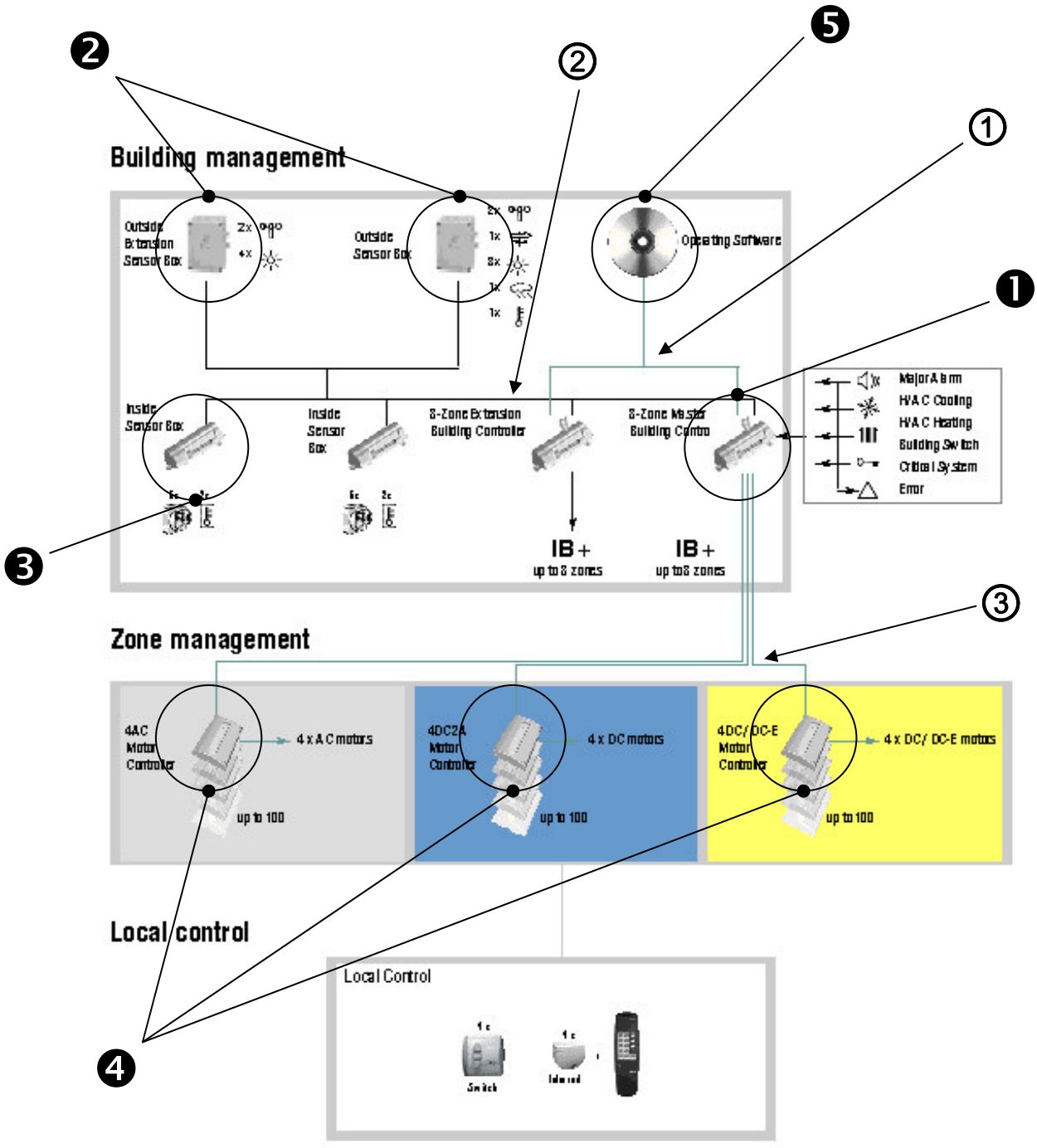

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① RS485, 4 wires

Low voltage two-way full-duplex communication. Data rate : 9600 bd

Max. cable length : 3300 ft / 1000 m

Cable type : 18AWG, 2 twisted pairs mandatory

Max. network members :
- 1 x PC
- 2 x Building Controllers

The PC communicates with the Building Controller(s) via its serial port through a RS232/485 converter (provided by Somfy) which has to be installed at less than 33 ft / 10 m from the PC

② RS485, 2 wires

Low voltage two-way half-duplex communication. Data rate : 9600 bd

Free topology, but no ring

Max. cable length : 1650 ft / 500 m

Cable type : 18AWG, twisted pair mandatory

Max. network members :
- 2 x Building Controllers
- 2 x Inside Sensor Boxes (1 x Inside Sensor Box per Building Controller max.)
- 1 x Outside Sensor Box
- 1 x Outside Extension Sensor Box

The network must be terminated by a 120R Resistance at both ends

③ IB+ communication line, 4 wires

4 wires :
- Common
- ▲ signal
- ▼ signal
- One-way digital communication from Building Controller to Motor Controllers. Data rate : 300 bd

Low voltage

Free topology, but no ring

Max. cable length per output : 3300 ft / 1000 m

Cable type : 16-18AWG, 2 twisted pairs recommended

Per zone :
- max. of 100 Motor Controllers
- no mix of Motor Controllers
- no mix of lift / tilt-and-lift shades

The Building Controller has 8 identical outputs, one for each zone it commands. Up to 2 Building Controllers can be part of an installation

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❶ Building Controller

INPUTS / OUTPUTS	MAX DISTANCE	CABLE TYPE
120AC	Cable must comply with local electrical codes	3 wires, 14-16AWG
Critical System Error Output	330 ft / 100 m	2 wires, 14-18AWG
Building Switch Input	330 ft / 100 m	3 wires, 14-18AWG
HVAC Cooling Input	330 ft / 100 m	2 wires, 14-18AWG
HVAC Heating Input	330 ft / 100 m	2 wires, 14-18AWG
Major Alarm Input	330 ft / 100 m	2 wires, 14-18AWG

❷ Inside Sensor Box

INPUTS / OUTPUTS	MAX DISTANCE	CABLE TYPE
120AC	Cable must comply with local electrical codes	3 wires, 14-16AWG
Inside Temperature Sensors (x2)	1650 ft / 500 m	2 wires, 14-18AWG
Switches (x8)	330 ft / 100 m	3 wires, 14-18AWG

❸ Outside Sensor Box

INPUTS / OUTPUTS	MAX DISTANCE	CABLE TYPE
24AC or DC / 1A	Depend on Power Supply Unit	
Wind Speed Sensor (x2)	330 ft / 100 m	2 or 3 wires, 14-18AWG
Wind Direction Sensor	330 ft / 100 m	3 wires, 14-18AWG
Sun Sensor (x8)	330 ft / 100 m	2 wires, 14-18AWG
Rain Sensor	330 ft / 100 m	2 wires, 14-18AWG
Outside Temperature Sensor	330 ft / 100 m	2 wires, 14-18AWG

❸ Outside Extension Sensor Box

INPUTS / OUTPUTS	MAX DISTANCE	CABLE TYPE
24AC or DC / 1A	Depend on Power Supply Unit	
Wind Speed Sensor (x2)	330 ft / 100 m	2 or 3 wires, 14-18AWG
Sun Sensor (x8)	330 ft / 100 m	2 wires, 14-18AWG

❹ 4AC Motor Controller

INPUTS / OUTPUTS	MAX DISTANCE	CABLE TYPE
120AC	Cable must comply with local electrical codes	3 wires, 14-16AWG
Motors (x4)	500 ft / 300 m	4 wires, 14-16AWG
Switches (x4)	330 ft / 100 m	3 wires, 14-18AWG
IR Sensors	65 ft / 20 m	2-pair telephone cable

❹ 4DC-2A / 4DC-DCE Motor Controllers

INPUTS / OUTPUTS	MAX DISTANCE	CABLE TYPE
24DC	33 ft / 10 m	2 wires, 14-16AWG
Motors (x4)	65 ft / 20 m	4 wires, 14-18AWG
Switches (x4)	330 ft / 100 m	3 wires, 14-18AWG
IR Sensors	65 ft / 20 m	2-pair telephone cable

❺ PC

PC requirements : Pentium® II 500 MHz or equivalent min., 128 Mb internal memory, 40 Mb free hard disc space, 12 Mb extra hard disc space per year (log function), true color graphic card, 1024*768 resolution monitor, CD-ROM drive, keyboard and pointing device, free serial RS232 communication port, Windows® 2000 Pro min., Acrobat® Reader™

Optional email functions require : Outlook® or Outlook Express® , access to an email server

Optional email and remote access functions require : pcAnywhere® 10.5, access to the Internet at 500 kb/s min., unique IP address

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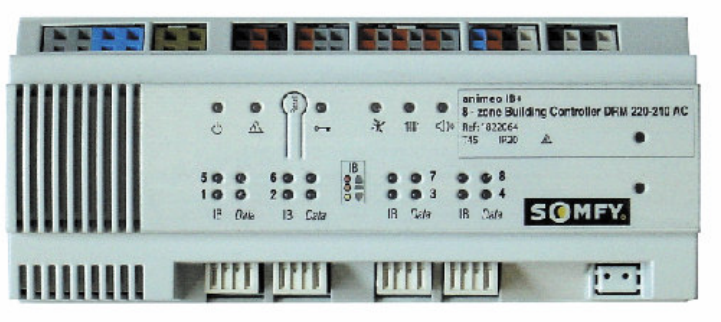
animeo ® IB+

8-zone Building Controller

ref : 1822065



The Building Controller is the brain of the animeo IB+ system.

Through the communication with the PC animeo IB+ Operating software, with the different Sensor Boxes and with the Motor Controllers, the Building Controller manages the shades and the windows in a building according to its architecture, to the climatic conditions and the occupants' needs.

It enables a mix control between the occupants' comfort and the facility manager's expectations such as energy savings.

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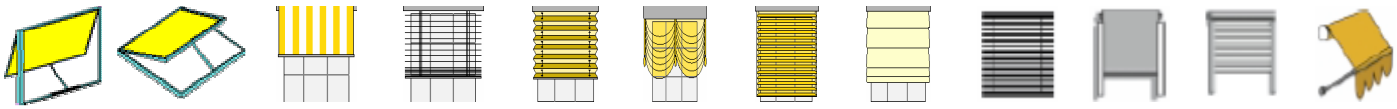

Facade Window | Roof Window | Solar Screen | Horizontal Blind | Pleated Shade | Balloon Shade | Cellular Blind | Roman Shade | Exterior Venetian Blind | Exterior Screen | Rolling Shutter | Lateral Arm Awning

Application	Management of 8 zones of shades and windows according to data coming from sensors, and settings made through the PC animeo IB+ Operating software Up to 16 zones with a 2nd Building Controller (Extension Building Controller, same product reference) Dry contact inputs for functional links with the HVAC (Heating/Ventilation/Air-Conditioning) system and the Security/Safety system
Installation	DIN Rail Housing Color code of connectors, screw less terminals 8 plug-in connectors for the zones
Configuration	All settings are done through the Graphical User Interface of the animeo IB+ Operating software, and are password protected Settings per zone : - shade or window running time (and tilting time when appropriate) - 2 Intermediate Positions - sensors assignment - sensors parameters : time delays, thresholds, actions on the shades or the windows - suntracking functions for shades : 3 positions per day per month, calculated to cut direct glare according to the real position of the sun - actions of the dry contact inputs - weekly timer : 2 periods per day with a programmed position per period - operational mode : choice between user comfort, energy savings and performance (user comfort during occupancy hours, energy savings during non-occupancy hours) Settings for the building - weekly timer : 2 periods per day with a programmed position per period - 3 reset times for manual to automatic mode manual : a manual override disables the next sun commands automatic : the next sun command is enabled
Operation	Automatic control of the zones based on the settings and on the sensor inputs Through the Graphical User Interface of the animeo IB+ Operating software : - momentary or locked control of every zone - visualization of the position of the shades or windows per zone due to Building Controller's commands (excluding manual overrides) - ability to change any setting (password protection)
Maintenance	On the Building Controller : - LEDs to visualize the status of the zone outputs and of the dry contact inputs/output Through the Graphical User Interface of the animeo IB+ Operating software : - visualization of the status of every active function per zone - visualization of the status of every sensor - record on the PC hard disk of every command given by the Building Controller to every zone any change in settings all sensor measurements (one record every 5 minutes) - ability to generate automatically emails on number of operations of the shades and windows, and on error detection

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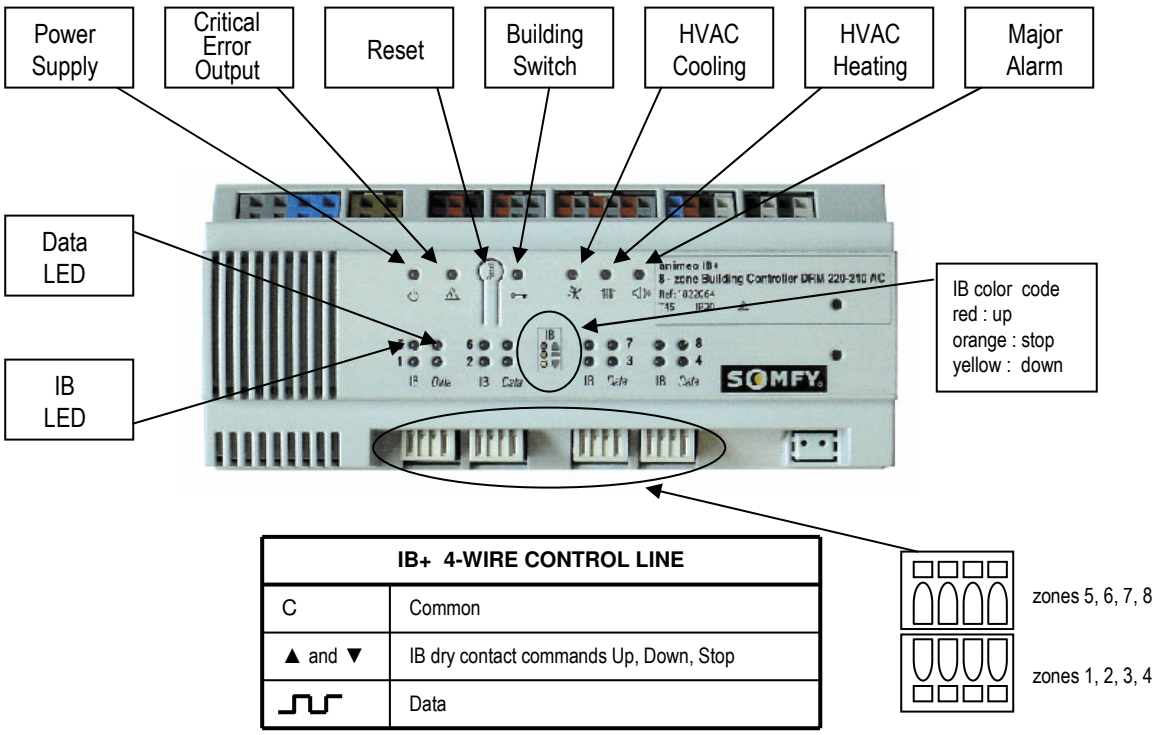

IB+ 4-WIRE CONTROL LINE	
C	Common
▲ and ▼	IB dry contact commands Up, Down, Stop
⎍	Data

TECHNICAL SPECIFICATIONS		
Power Supply	Voltage	100-120AC Nominal
	Frequency	50-60 Hz
	Primary Max. Operating Current	86 mA
Housing	Housing Type	DIN Rail
	Weight	23 ¼ oz. / 660 g
	Length x Height x Width	12 TE = 8 ¼" x 2 ½" x 3 ½" / 210 x 63 x 90 mm
	Plastic Type	CC-ABS Polycarbonat
	Plastic Weight	7 ½ oz. / 210 g
Protection Class		IP20
Fuse	Thermal fuse	Self resetable or Polyswitch
Critical Error Output		Dry contact, Normally Closed (NC), 24V/1A max.
Building Switch, HVAC Heating and Cooling Inputs		Dry contact, Normally Open
Major Alarm Input		Dry contact, Normally Closed
Temperature ranges	Operating	32°F to 113°F / 0°C to 45°C
	Storage	-4°F to 158°F / -20°C to 70°C
Humidity Rate		85% max.
Electromagnetic Compatibility		IEC 60 730-1
Standard Compliance		IEC 730 (electric safety), IEC 60 721-3-1, IEC 60 721 3-2
Approvals		cUL listed (file nr : E160923)

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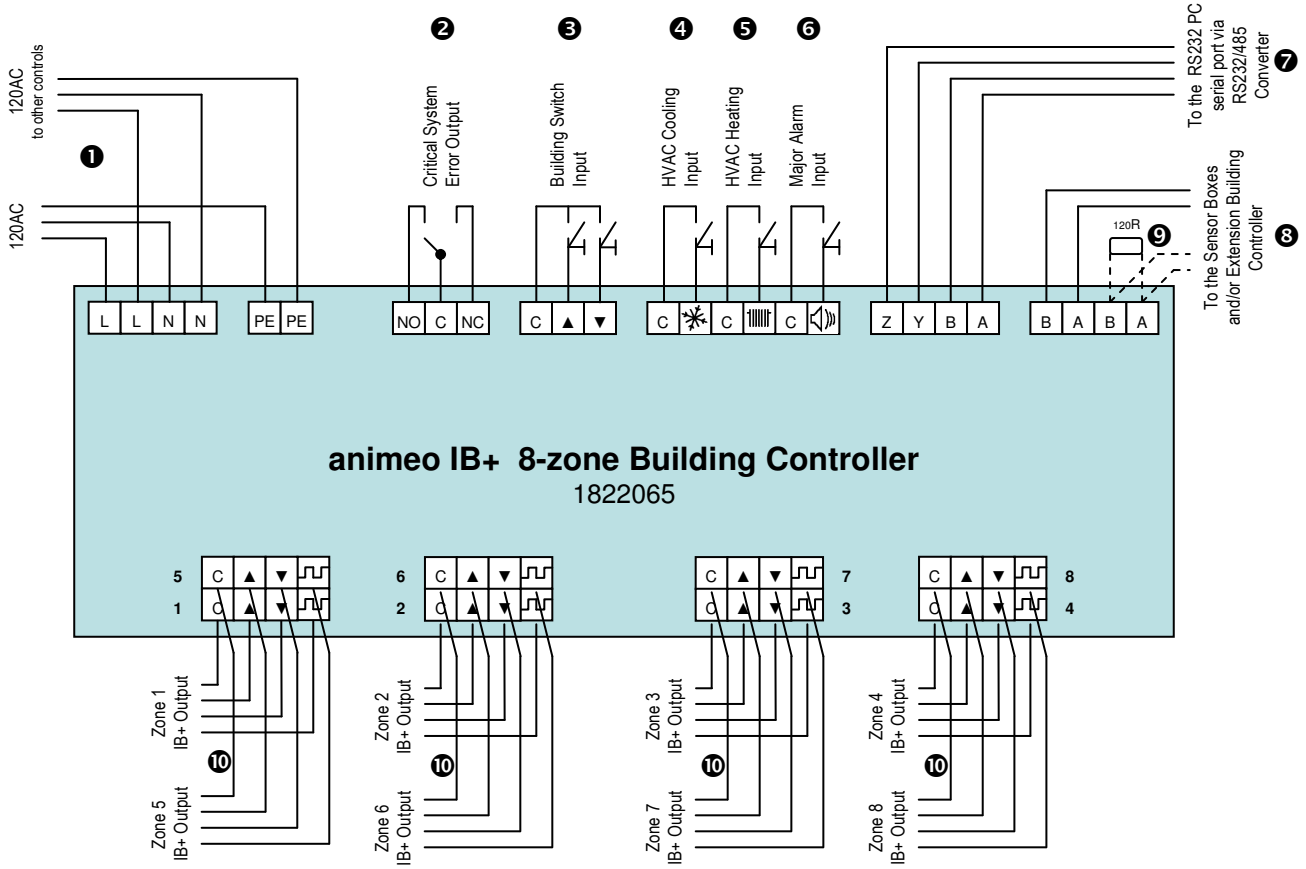

	INPUTS / OUTPUTS		MAX CABLE LENGTH	CABLE TYPE
❶	120AC	2 sets of terminals to daisy chain the 120AC between controllers Cable must comply with local electrical codes		14-16AWG
❷	Critical System Error Output	Dry contact output Select Normally Open (NO) or Normally Closed (NC) contact	330 ft 100 m	14-18AWG
❸	Building Switch Input	2 Normally Open (NO) dry contact inputs ▲ : up (shades), close (windows), ▼ : down (shades), open (windows) ▲ and ▼ simultaneously : stop (shades / windows)	330 ft 100 m	14-18AWG
❹	HVAC Cooling Input	Normally Open (NO) dry contact input Action on zones configured via Operating software	330 ft 100 m	14-18AWG
❺	HVAC Heating Input	Normally Open (NO) dry contact input Action on zones configured via Operating software	330 ft 100 m	14-18AWG
❻	Major Alarm Input	Normally Closed (NC) dry contact input If not used, wire a strap between the 2 connectors Action on zones configured via Operating software	330 ft 100 m	14-18AWG
❼	To PC RS232 Serial Port	Connection to PC via a RS232/485 converter	3300 ft 1000 m	18AWG 2 twisted pairs mandatory
❽	To Sensor Box(es) and/or Extension Building Controller	RS485 network 2 sets of terminals to daisy chain the network between controllers	1650 ft 500 m	18AWG twisted pair mandatory
❾	120R Resistor	Necessary on both ends of the RS485 network Do not remove the resistor if the connectors are not used to daisy chain the Building Controller with the Sensor Box(es) and/or the Extension Building Controller		
❿	Zones 1 to 8 Outputs	Send commands to the zones of the installation	3300 ft 1000 m	16-18AWG 2 twisted pairs recommended

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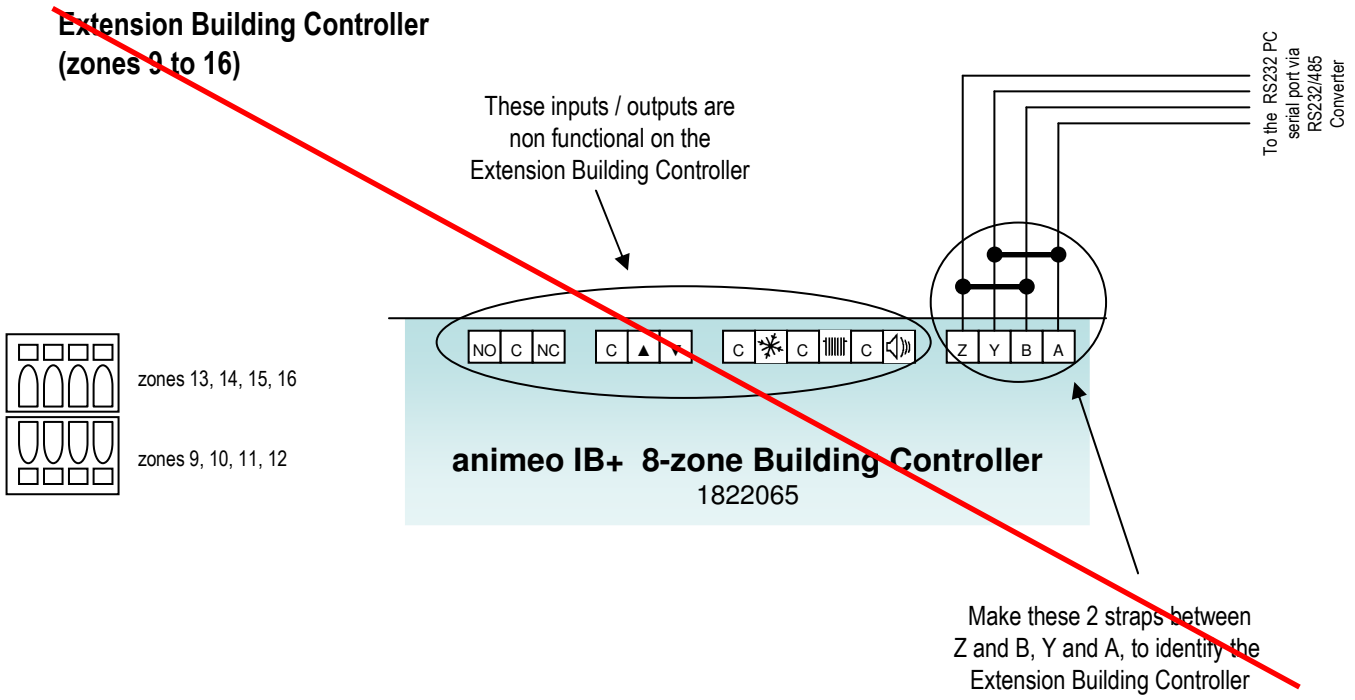

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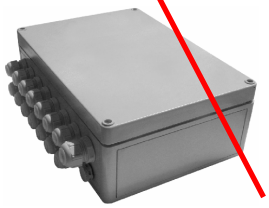
animeo ® IB+

Sensor Interfaces and Sensors

Outside Sensor Box
ref : 9001606

Outside Extension Sensor Box
ref : 9001607



Inside Sensor Box
ref : 9001615

Sun Intensity, Outside Temperature, Wind Speed, Wind Direction, Rain and Inside Temperature are monitored to control shades and windows depending on outdoor and indoor conditions to provide visual and thermal comfort, improve productivity and save energy.

The Sensor Interfaces centralize data coming from the sensors and transmit them in a digital way to the Building Controller(s) of the animeo IB+ system.

The Inside Sensor Box provides also dry contact inputs for manual control of the zones of the installation or to enable the control of them by the Building Management System.

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SENSORS FOR animeo IB+ SENSOR INTERFACES

SENSOR Reference		SUN INTENSITY 915043	OUTSIDE TEMPERATURE 915043	LARGE WIND SPEED 915043	SMALL WIND SPEED 915043	WIND DIRECTION 915043	RAIN 915043	INSIDE TEMPERATURE 915043
SENSOR CAPACITY	Outside Sensor Box	8	1	2*		1	1	-
	Outside Extension Sensor Box	4	-	2*		-	-	-
	Inside Sensor Box	-	-		-	-	-	2**
RANGE OF MEASUREMENT		5 to 55 klux	-40°F to 158°F -40°C to 70°C	4 to 67 mph 7 to 108 km/h	4 to 67 mph 7 to 108 km/h	N, NE, E, SE, S, SW, W, NW		-58°F to 221°F -50°C to 105°C
HOUSING	Material	Lexan	Nylon	Anodized Aluminum	Luran S	Anodized Aluminum	ABS	-
	Color	White	White	Light Blue	White and Black	Light Blue	White	-
	Protection Index	IP55	IP65	IP65	IP43	IP65	IP65	IP65
	Overall Dimensions	H 1⅜" x W 3" x D 1⅛" H 34 x W 75 x D 47 mm	H 3½" x Ø 3⅜" H 89 x Ø 85 mm	H 7⅔" x Ø 7⅔" H 195 x Ø 195 mm	H 3⅔" x W 6" x D 4¾" H 93 x W 150 x D 120 mm	H 6" x W 19⅞ x D 2½" H 152 x W 504 x D 64 mm	H 1⅜" x W 3⅜" x D 2" H 35 x W 85 x D 50 mm	-
CABLE	Number of Wires	2	2	2	2	2	3	2
	Cross Section of Wires	AWG 20 0.6 mm²	0.25 mm²	AWG 20 0.6 mm²	0.75 mm²	AWG 20 0.6 mm²	AWG 20 0.6 mm²	AWG 20 0.6 mm²
	Color of Cable	Black	Grey	Grey	White	White	not provided	Black
	Length	6¾ ft / 2 m	5 ft / 1.5 m	3 ft 2½" / 2.5 m	6¾ ft / 2 m	3 ft 2½" / 2.5 m		2 ft / 0.6 m
TEMPERATURE RANGES	Operating	-4°F to 140°F -20°C to 60°C	-40°F to 158°F -40°C to 70°C	-13°F to 167°F -25°C to 75°C	-4°F to 140°F -20°C to 60°C	-13°F to 167°F -25°C to 75°C	-22°F to 140°F -30°C to 60°C	-58°F to 221°F -50°C to 105°C
	Storage	-4°F to 140°F -20°C to 60°C	-40°F to 158°F -40°C to 70°C	-13°F to 167°F -25°C to 75°C	-4°F to 140°F -20°C to 60°C	-13°F to 167°F -25°C to 75°C	-22°F to 140°F -30°C to 60°C	-58°F to 221°F -50°C to 105°C
WEIGHT		5⅛ oz 145 g	15⅞ oz 450 g	26⅞ oz 750 g	5⅔ oz 160 g	2⅝ lb 1200 g	5⅔ oz 160 g	5⅔ oz 160 g

* : ALL WIND SPEED SENSORS IN AN INSTALLATION MUST BE OF THE SAME TYPE. IT IS RECOMMENDED TO CHANGE THE SMALL WIND SPEED SENSORS EVERY 3 YEARS

** : THE INSIDE SENSOR BOX HAS 8 ADDITIONAL INPUTS FOR MANUAL CONTROL OF THE ZONES OF THE INSTALLATION OR TO CONTROL THE ZONES BY A BUILDING MANAGEMENT SYSTEM

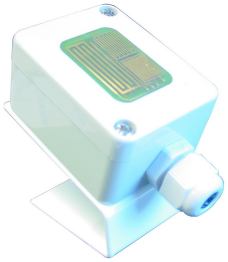
SUN SENSOR

LARGE WIND SPEED SENSOR

SMALL WIND SPEED SENSOR

WIND DIRECTION SENSOR

RAIN SENSOR



OUTSIDE TEMPERATURE SENSOR

INSIDE TEMPERATURE SENSOR

Pictures not at the same scale

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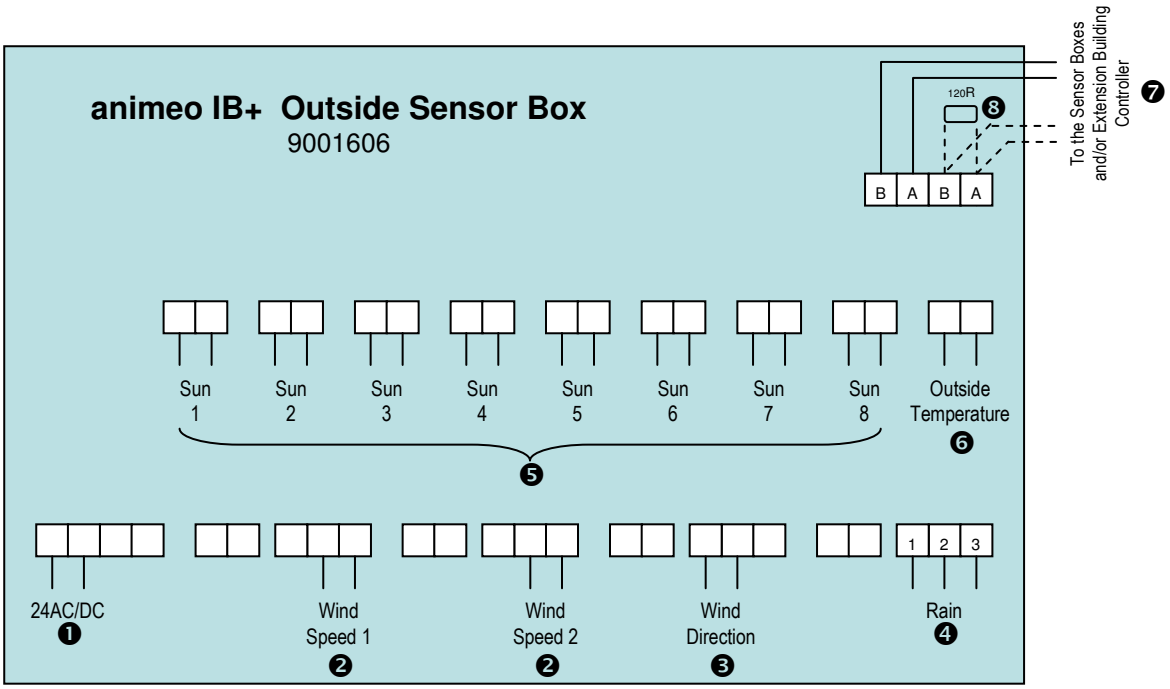
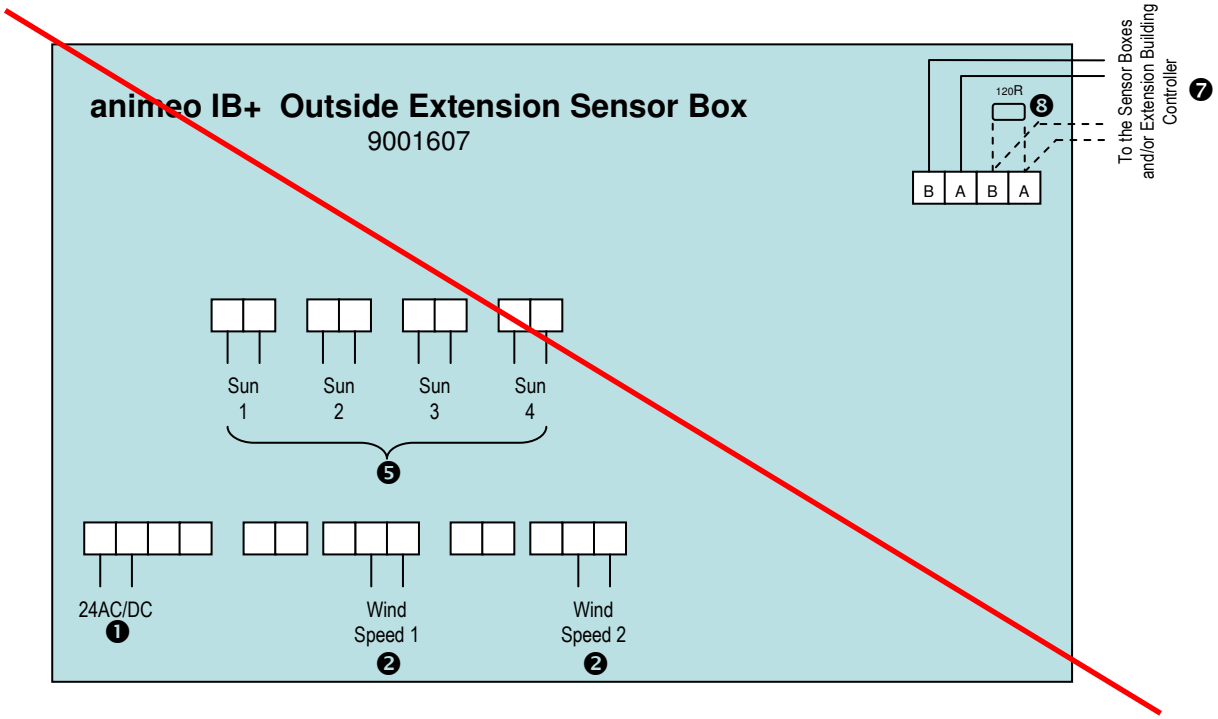
OUTSIDE SENSOR BOX
OUTSIDE EXTENSION SENSOR BOX





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OUTSIDE SENSOR BOX
OUTSIDE EXTENSION SENSOR BOX

	INPUTS / OUTPUTS		MAX CABLE LENGTH	CABLE TYPE
❶	24AC/DC	Power supply can be either AC or DC	330 ft 100 m	14-16AWG
❷	Wind Speed Sensor (x2)	When 2 Wind Speed Sensors are used, they must be of the same type	330 ft 100 m	14-18AWG twisted pair recommended
❸	Wind Direction Sensor		330 ft 100 m	14-18AWG twisted pair recommended
❹	Rain Sensor	1 : Blue 2 : Black 3 : Brown	330 ft 100 m	14-18AWG
❺	Sun Sensor (x8)		330 ft 100 m	14-18AWG twisted pair recommended
❻	Outside Temperature Sensor		330 ft 100 m	14-18AWG twisted pair recommended
❼	Building Controller(s) and Sensor Box(es) Network	RS485 network 2 sets of terminals to daisy chain the network between controllers	1650 ft 500 m	18AWG twisted pair mandatory
❽	120R Resistor	Necessary on both ends of the RS485 network Do not remove the resistor if the connectors are not used to daisy chain the Outside (Extension) Sensor Box to the other controllers of the RS485 network		

TECHNICAL SPECIFICATIONS		
Power Supply	Voltage	24 AC/DC
	Current Consumption with all Sensors (each Sensor Box)	1 A
Housing	Housing Type	Waterproof, UV proof
	Weight	38 oz. / 1080 g
	Length x Height x Width	10" x 8¼" x 4" / 255 x 210 x 100 mm
	Plastic Type	Polycarbonate, recyclable
	Plastic Weight	29¼" oz. / 830 g
Temperature ranges	Operating	-22°F to 158°F / -30°C to 70°C
	Storage	-22°F to 158°F / -30°C to 70°C
Electromagnetic Compatibility		IEC 60 730-1
Standard Compliance		IEC 60 721-3-1, IEC 60 721 3-2

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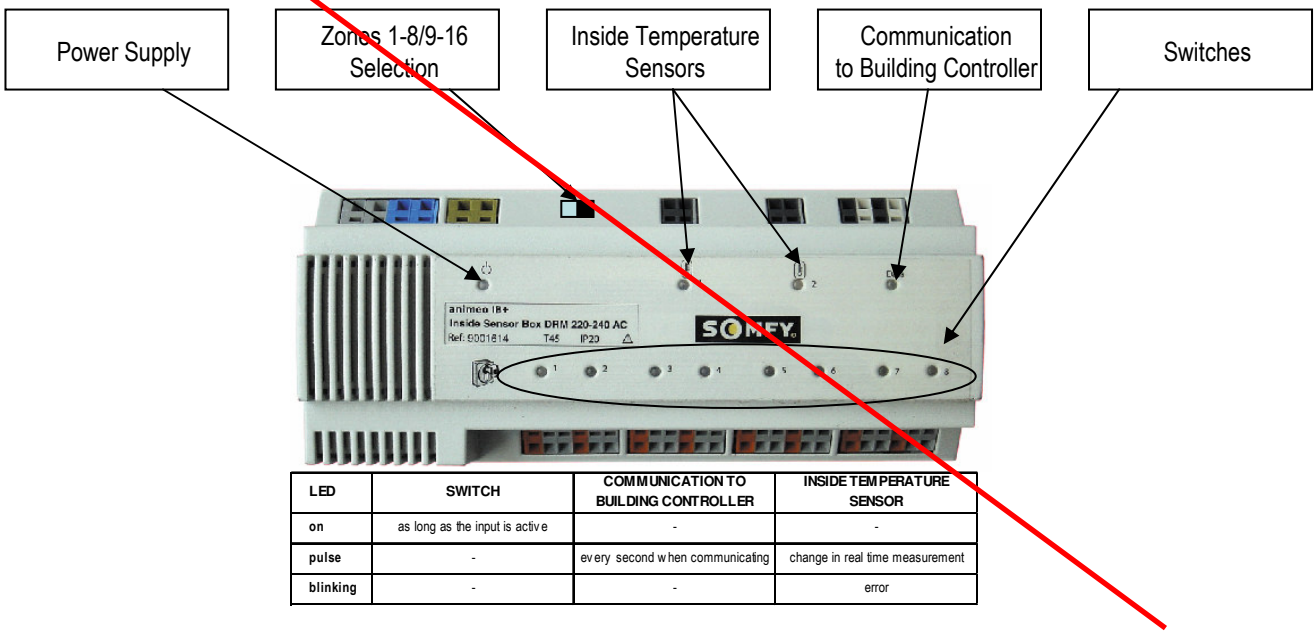
INSIDE SENSOR BOX



LED	SWITCH	COMMUNICATION TO BUILDING CONTROLLER	INSIDE TEMPERATURE SENSOR
on	as long as the input is active	-	-
pulse	-	every second when communicating	change in real time measurement
blinking	-	-	error

TECHNICAL SPECIFICATIONS		
Power Supply	Voltage	100-120AC Nominal
	Frequency	50-60 Hz
	Primary Max. Operating Current	74 mA
Housing	Housing Type	DIN Rail
	Weight	19 oz. / 540 g
	Length x Height x Width	12 TE = 8 ¼" x 2 ½" x 3 ½" / 210 x 63 x 90 mm
	Plastic Type	CC-ABS Polycarbonat, recyclable
	Plastic Weight	7 ½ oz. / 210 g
Protection Class		IP20
Fuse	Thermal fuse	Self resetable or Polyswitch
Switch Inputs (x8)		2 dry contacts, Normally Open
Temperature ranges	Operating	32°F to 113°F / 0°C to 45°C
	Storage	-4°F to 158°F / -20°C to 70°C
Humidity Rate		85% max.
Electromagnetic Compatibility		IEC 60 730-1
Standard Compliance		IEC 730 (electric safety), IEC 60 721-3-1, IEC 60 721 3-2
Approvals		cUL listed pending

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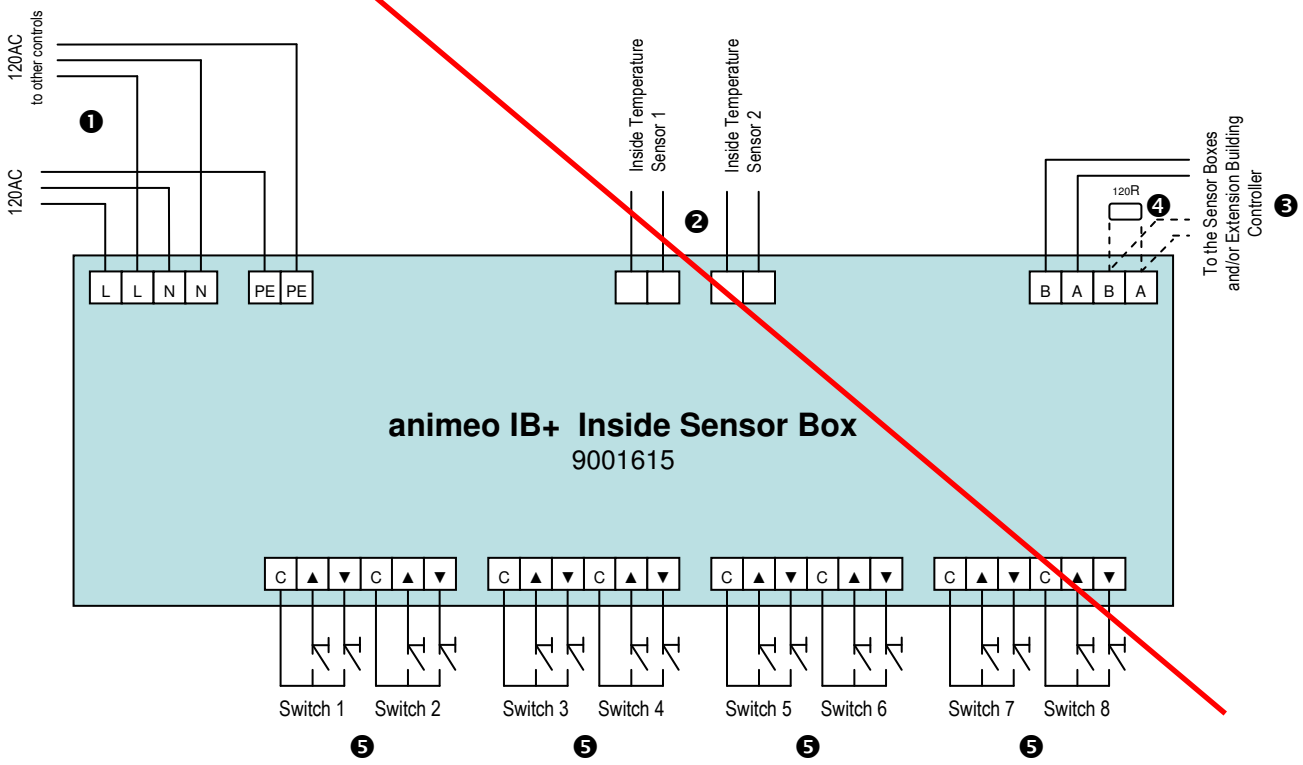
INSIDE SENSOR BOX



	INPUTS / OUTPUTS		MAX CABLE LENGTH	CABLE TYPE
❶	120AC	2 sets of terminals to daisy chain the 120AC between controls Cable must comply with local electrical codes		14-16AWG
❷	Inside Temperature Sensor Inputs (x2)	NTC Input	1650 ft 500 m	14-18AWG
❸	To Building Controller(s) and Other Sensor Box(es)	RS485 network 2 sets of terminals to daisy chain the network between controllers	1650 ft 500 m	18AWG twisted pair mandatory
❹	120R Resistor	Necessary on both ends of the RS485 network Do not remove the resistor if the connectors are not used to daisy chain the Inside Sensor Box to the Building Controller(s) and to the other Sensor Box(es)		
❺	Switch Inputs (x8)	2 Normally Open (NO) dry contact inputs ▲ : up (shades), close (windows), ▼ : down (shades), open (windows) ▲ and ▼ simultaneously : stop (shades / windows)	330 ft 100 m	14-18AWG

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animeo ® IB+

4DC-2A Motor Controller

ref : 1860085

The animeo IB+ 4DC-2A Motor Controller controls 4 shades or 4 windows operated by DC motors.

Through configuration, made locally or via the PC animeo IB+ Operating software and the Building Controller (ref 1802065), it is able to control either lift shades or tilt-and-lift shades, or façade windows or roof windows.

It manages the priorities between the commands from the Building Controller (ref 1802065) and the local commands, by wired switches and / or remote controls.

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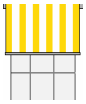
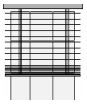
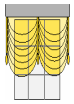
Facade Window


Roof Window

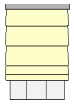

Solar Screen


Horizontal Blind


Pleated Shade


Balloon Shade


Cellular Blind


Roman Shade

Application

Management of 4 shades or windows according to commands received from the Building Controller on the IB+ control line, and to local manual commands by wired switches and / or remote control.

Motor outputs are compatible with DC motors up to 2.1A each.

Dry contact inputs for 4 wired switches. Slot for plug-in remote control module.

Installation

Wall-mounted housing. Possibility to fix it on DIN Rail

Color code of connectors, screw less terminals. Fixation of cables via wire ties for strain relief

2 plug-in connectors to daisy chain the IB+ control line between Motor Controllers in the zone

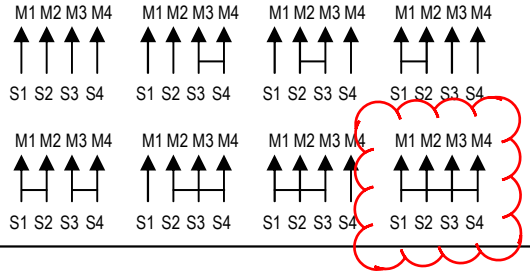
Each Motor Controller has a unique ID for identification on floor plans and for configuration

Configuration

Settings can be done through the Graphical User Interface of the animeo IB+ Operating software or on the controller itself

Setting	Controller	Operating Software
Shade / Window Selection *	X	X
Running Time	X	X
Tilting Time **	X	X
Intermediate Positions	1	2
Swith Assignment ***		X
Remote control Module (Addressing)	X	

* Products connected to a Motor Controller must be of the same type
** For tilt-and-lift shades only
*** The Switch Assignment can be one of the following :



Operation

The Motor Controller receives commands from the Building Controller and from the local switches or remote controls.

Commands	User Comfort Mode	Energy Saving Mode	Performance Mode	
			User Comfort	Energy Saving
Local Command	enabled / disabled by PC	disabled	enabled / disabled by PC	disabled
IB+ Priority Command	always executed	always executed	always executed	always executed
IB+ Non-Priority Command (without presence of Priority Command)	always executed	always executed	executed unless a local command occurred since the last non-priority command	always executed

Commands from the PC can be : full up, full down, stop, Intermediate Position 1, Intermediate Position 2, or any % between the up and down limits.
Local commands can be : full up, full down, stop, Intermediate Position 1.

Maintenance

LEDs to visualize the command from the IB+ control line

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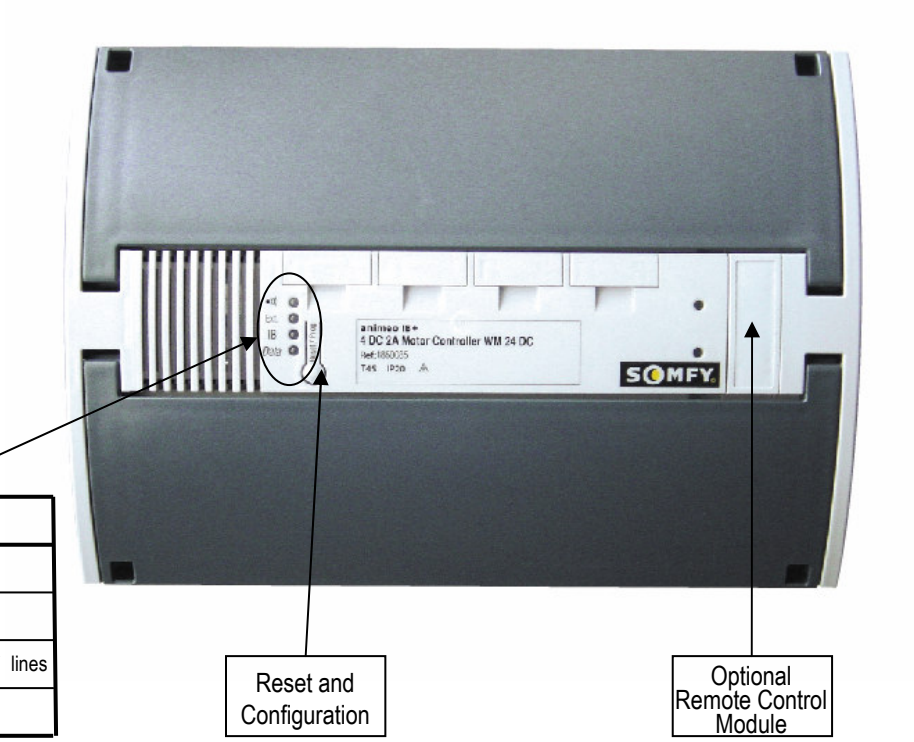

LEDs	
Green	Reception of remote control telegram
Yellow	Not used
Orange	Reception of a command on the IB+ ▲ and ▼ lines
Red	Reception of a telegram on the IB+ data line

Refer to the Installation guide for the LEDs' meaning in the configuration mode

TECHNICAL SPECIFICATIONS		
Power Supply	Voltage	21.5 – 25 VDC Nominal
	Max. Operating current (Without Motors)	100 mA
	Max Current per Motor Ouput	2.1 A
Housing	Housing Type	Wall mounted / Can be installed on DIN Rail
	Weight	24 ¾ oz. / 700 g
	Length x Height x Width	10" x 2 ½" x 3 ½" / 255 x 63 x 90 mm
	Plastic Type	CC-ABS Polycarbonat, recyclable
	Plastic Weight	20 oz. / 570 g
Protection Class		IP20
Fuse	Thermal fuse	Self resetable or Polyswitch
Temperature ranges	Operating	32°F to 113°F / 0°C to 45°C
	Storage	-4°F to 158°F / -20°C to 70°C
Humidity Rate		85% max.
Electromagnetic Compatibility		IEC 60 730-1
Standard Compliance		IEC 730 (electric safety), IEC 60 721-3-1, IEC 60 721 3-2

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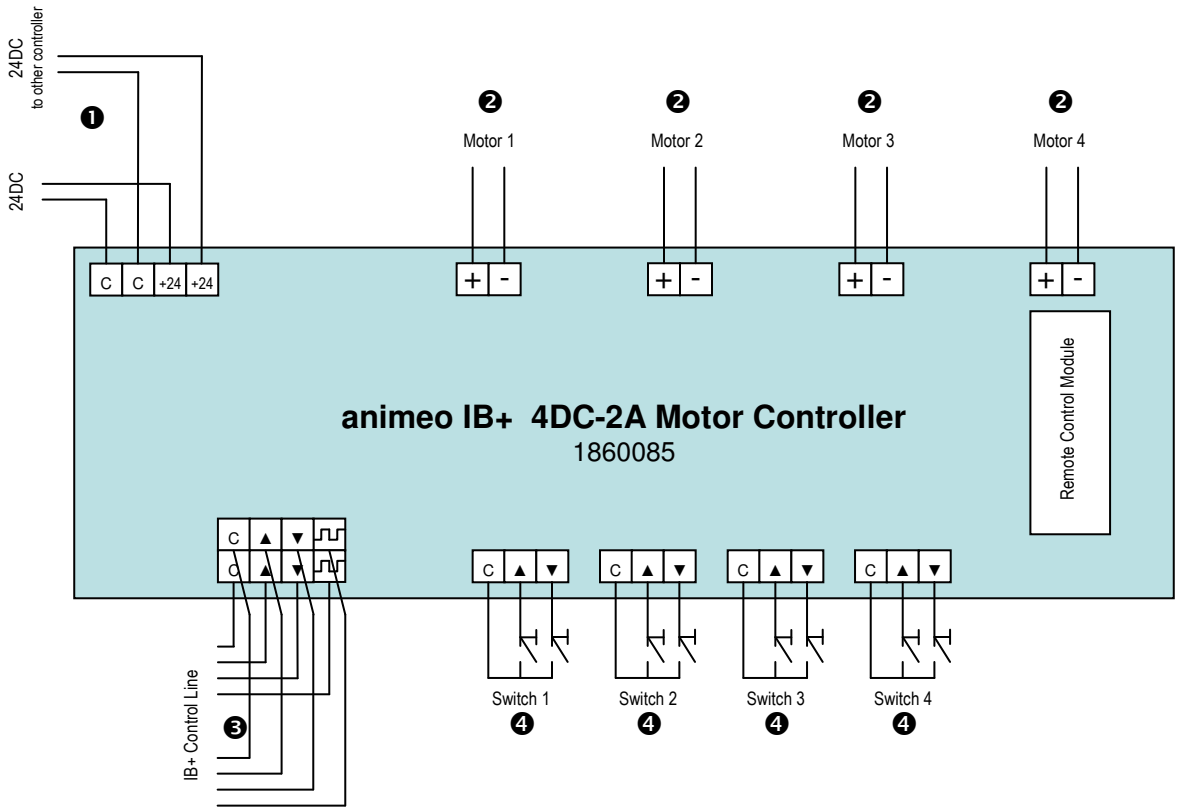

	INPUTS / OUTPUTS		MAX CABLE LENGTH	CABLE TYPE
❶	120AC	2 sets of terminals to daisy chain the 24DC power supply between controllers Make sure cables to controllers have the same length to get the same speed	33 ft 10 m	14-16AWG
❷	Motor Outputs	Make sure cables to the motors have the same length to get the same speed	65 ft 20 m	14-18AWG
❸	IB+ Control Line for the Zone	2 sets of terminals to daisy chain the IB+ control line between controllers in the zone	3300 ft 1000 m	16-18AWG 2 twisted pairs recommended
❹	Switches for Local Control	2 Normally Open (NO) dry contact inputs ▲ : up (shades), close (windows), ▼ : down (shades), open (windows) ▲ and ▼ simultaneously : stop (shades / windows)	330 ft 100 m	14-18AWG

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animeo ®

Manual Switches

Single Switch

white **6301908**

~~ivory **6301910**~~

Dual Switch

white **6301909**

ivory **6301911**

Those switches provide :
- up, down, stop commands for shades
- open, close, stop commands for windows.

They can be used as :
- master switch with the Building Controller
- zone switch with the Inside Sensor Box
- shade / window switch with the Motor Controllers.

They are low voltage, installed on a single gang box, with screw type connectors.

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Features :

- High efficiency 91% and low power dissipation
- 150% peak load capability
- Built-in active PFC function, PF>0.93
- Protections: Short circuit / Overload / Over voltage / Over temperature
- Cooling by free air convection
- Can be installed on DIN rail TS-35/7.5 or 15
- UL 508 (industrial control equipment) approved
- EN61000-6-2(EN50082-2) industrial immunity level
- Built-in DC OK relay contact
- 100% full load burn-in test
- 3 years warranty

SPECIFICATION

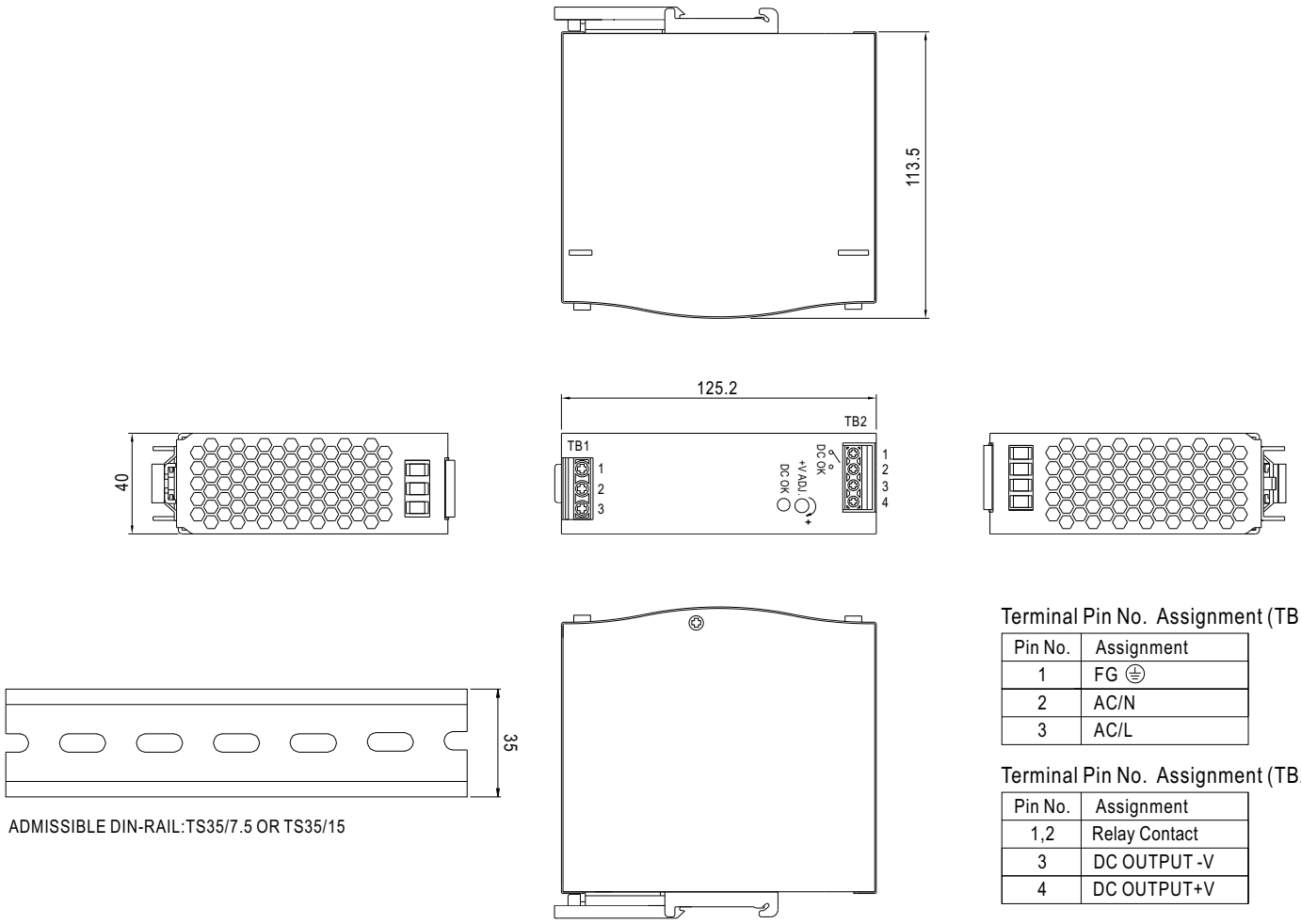
MODEL		~~SDR-120-12~~	SDR-120-24	~~SDR-120-48~~
OUTPUT	DC VOLTAGE	12V	24V	48V
	RATED CURRENT	10A	5A	2.5A
	CURRENT RANGE	0 ~ 10A	0 ~ 5A	0 ~ 2.5A
	RATED POWER	120W	120W	120W
	PEAK CURRENT	15A	7.5A	3.75A
	PEAK POWER Note.6	180W (3 sec.)		
	RIPPLE & NOISE (max.) Note.2	100mVp-p	100mVp-p	120mVp-p
	VOLTAGE ADJ. RANGE	12 ~ 14V	24 ~ 28V	48 ~ 55V
	VOLTAGE TOLERANCE Note.3	±1.0%	±1.0%	±1.0%
	LINE REGULATION	±0.5%	±0.5%	±0.5%
	LOAD REGULATION	±1.0%	±1.0%	±1.0%
	SETUP, RISE TIME	1500ms, 60ms/230VAC 3000ms, 60ms/115VAC at full load		
	HOLD UP TIME (Typ.)	20ms/230VAC 20ms/115VAC at full load		
INPUT	VOLTAGE RANGE Note.7	88 ~ 264VAC 124 ~ 370VDC		
	FREQUENCY RANGE	47 ~ 63Hz		
	POWER FACTOR (Typ.)	0.93/230VAC 0.96/115VAC at full load		
	EFFICIENCY (Typ.)	89%	91%	90.5%
	AC CURRENT (Typ.)	1.4A/115VAC 0.7A/230VAC		
	INRUSH CURRENT (Typ.)	35A/115VAC 70A/230VAC		
	LEAKAGE CURRENT	<1mA / 240VAC		
PROTECTION	OVERLOAD	Normally works within 110 ~ 150% rated output power for more than 3 seconds and then shut down o/p voltage		
		>150% rated power, constant current limiting with auto-recovery within 3 seconds and shut down o/p voltage after 3 seconds		
	OVER VOLTAGE	14 ~ 17V	29 ~ 33V	56 ~ 65V
		Protection type : Shut down o/p voltage, re-power on to recover		
	OVER TEMPERATURE	95℃±5℃ (TSW : detect on heatsink of power switch)		
		Protection type : Shut down o/p voltage, recovers automatically after temperature goes down		
FUNCTION	DC OK REALY CONTACT RATINGS (max.)	60Vdc/0.3A, 30Vdc/1A, 30Vac/0.5A resistive load		
ENVIRONMENT	WORKING TEMP.	-25 ~ +70℃ (Refer to "Derating Curve")		
	WORKING HUMIDITY	20 ~ 95% RH non-condensing		
	STORAGE TEMP., HUMIDITY	-40 ~ +85℃, 10 ~ 95% RH		
	TEMP. COEFFICIENT	±0.03%/℃ (0 ~ 50℃)		
	VIBRATION	Component:10 ~ 500Hz, 2G 10min./1cycle, 60min. each along X, Y, Z axes; Mounting: Compliance to IEC60068-2-6		
SAFETY & EMC (Note 4)	SAFETY STANDARDS	UL508, TUV EN60950-1 approved		
	WITHSTAND VOLTAGE	I/P-O/P:3KVAC I/P-FG:1.5KVAC O/P-FG:0.5KVAC O/P-DC OK:0.5KVAC		
	ISOLATION RESISTANCE	I/P-O/P, I/P-FG, O/P-FG:>100M Ohms / 500VDC / 25℃/ 70% RH		
	EMC EMISSION	Compliance to EN55022 (CISPR22) Class B, EN61000-3-2,-3		
	EMC IMMUNITY	Compliance to EN61000-4-2,3,4,5,6,8,11, EN55024, EN61000-6-2 (EN50082-2), EN61204-3, heavy industry level, criteria A, SEMI F47, GL approved		
OTHERS	MTBF	289.9Khrs min. MIL-HDBK-217F (25℃)		
	DIMENSION	40*125.2*113.5mm (W*H*D)		
	PACKING	0.67Kg; 20pcs/14.4Kg/1.16CUFT		

NOTE

1. All parameters NOT specially mentioned are measured at 230VAC input, rated load and 25℃ of ambient temperature.
2. Ripple & noise are measured at 20MHz of bandwidth by using a 12" twisted pair-wire terminated with a 0.1uf & 47uf parallel capacitor.
3. Tolerance : includes set up tolerance, line regulation and load regulation.
4. The power supply is considered a component which will be installed into a final equipment. The final equipment must be re-confirmed that it still meets EMC directives.
5. Installation clearances : 40mm on top, 20mm on the bottom, 5mm on the left and right side are recommended when loaded permanently with full power. In case the adjacent device is a heat source, 15mm clearance is recommended.
6. 3 seconds max., please refer to peak loading curves.
7. Derating may be needed under low input voltage. Please check the derating curve for more details.

■ Mechanical Specification

Case No.992A Unit:mm



ADMISSIBLE DIN-RAIL:TS35/7.5 OR TS35/15

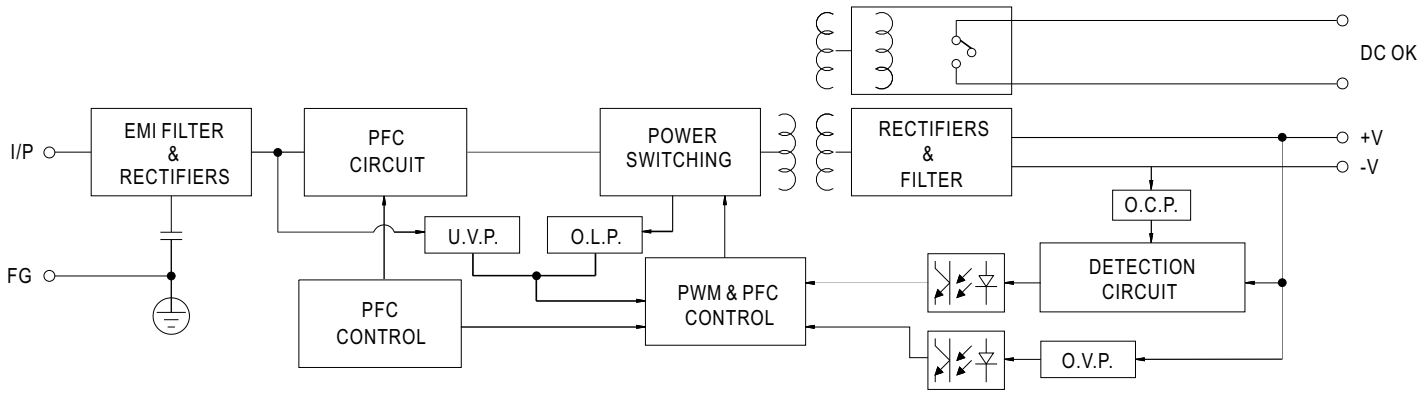
Terminal Pin No. Assignment (TB1)

Pin No.	Assignment
1	FG ⏚
2	AC/N
3	AC/L

Terminal Pin No. Assignment (TB2)

Pin No.	Assignment
1,2	Relay Contact
3	DC OUTPUT -V
4	DC OUTPUT+V

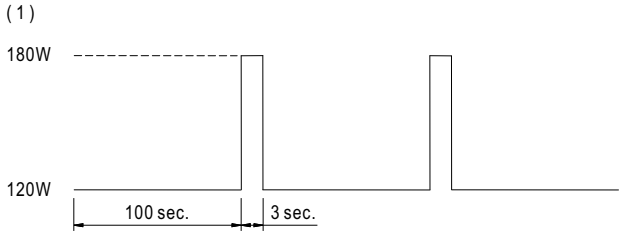
■ Block Diagram

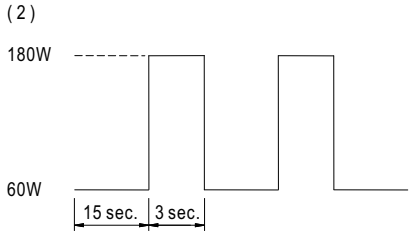


■ DC OK Relay Contact

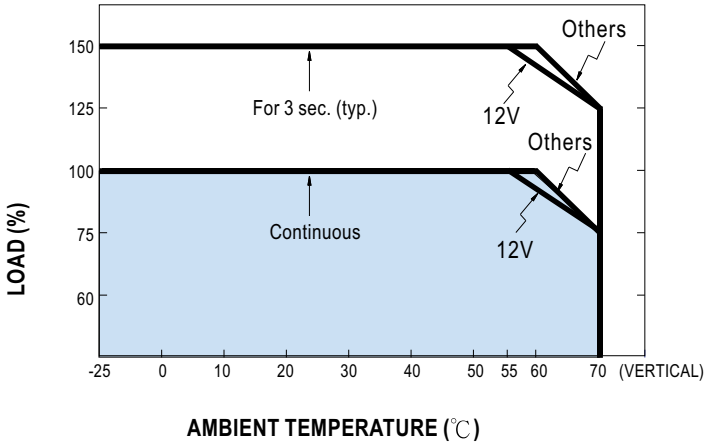
Contact Close	PSU turns on / DC OK.
Contact Open	PSU turns off / DC Fail.
Contact Ratings (max.)	30V/1A resistive load.

■ Peak Loading

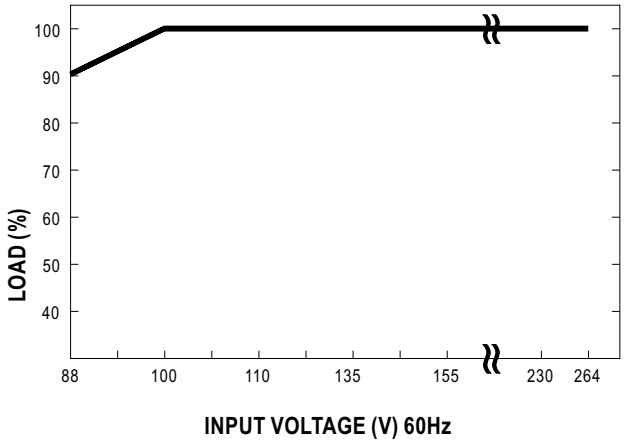




■ Derating Curve



■ Output derating VS input voltage



Screw Cover Type 1 Pull Boxes

Application

Designed for use as a junction box and pull box in commercial and general industrial applications. Flush covers and door frames must be ordered separately for flush installations.

Features

- Unique keyhole screw slots in the cover permit removal of the cover without extracting the screws
- Available with or without knockouts. Various sizes of easily removable concentric knockouts on all four sides of standard boxes with knockouts.
- Optional flush-mounted door frame available
- Optional flush covers are designed to mount on enclosures for flush installations

Construction

- 16, 14, or 12 gauge steel or galvanized steel
- Flat, removable covers fastened with plated steel screws
- Provision for grounding
- Mounting holes on back of box

Finish

ANSI 61 gray polyester powder paint finish inside and out. Unless otherwise specified, all custom pull boxes are finished with ANSI 61 gray polyester powder paint.

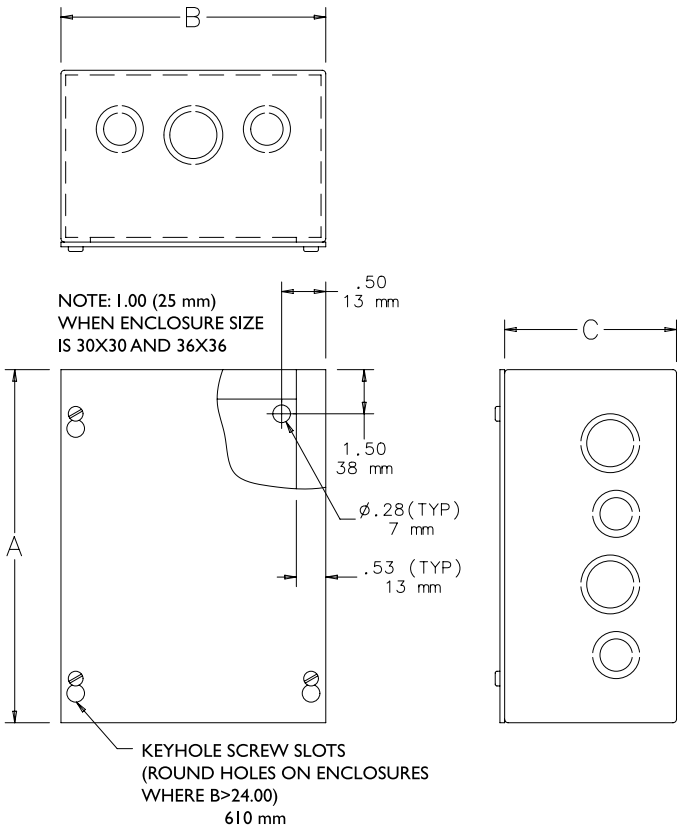
Industry Standards

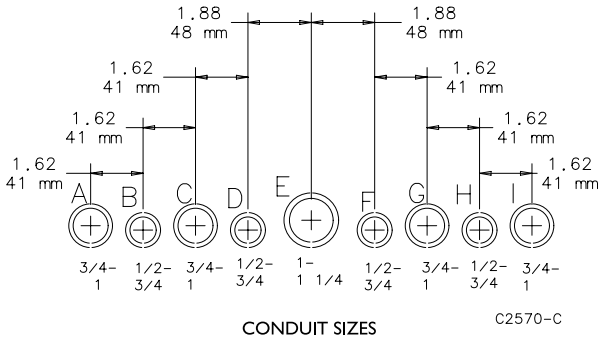
UL 50, File No. E27525, Type 1
NEMA/EEMAC Type 1
cUL CSA C22.2 No. 40, File No. E27525, Type 1
IEC 60529, IP30

Accessories

See also Accessories chapter.

Flush Covers
Flush-Mounted Door Frame
Grounding Device
Locking Window
Touch-Up Paint (ATPPY61)





CONDUIT SIZES

Knockout Pattern
(from outside of box)

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Screw Cover Type 1 Pull Boxes

Standard Sizes Screw Cover Pull Boxes

Catalog Number	A x B x C in. (mm)	Style	Number of Cover Screws	Knockout Pattern along "A" Sides	Knockout Pattern along "B" Sides
ASE4X4X3	4.00 x 4.00 x 3.00 (102 x 102 x 76)	Painted with Knockouts	2	B-C	B-C
ASG4X4X3	4.00 x 4.00 x 3.00 (102 x 102 x 76)	Galvanized with Knockouts	2	B-C	B-C
ASE4X4X3NK	4.00 x 4.00 x 3.00 (102 x 102 x 76)	Painted without Knockouts	2	—	—
ASG4X4X3NK	4.00 x 4.00 x 3.00 (102 x 102 x 76)	Galvanized without Knockouts	2	—	—
ASE6X6X3	6.00 x 6.00 x 3.00 (152 x 152 x 76)	Painted with Knockouts	2	B-C-D	B-C-D
ASG6X6X3	6.00 x 6.00 x 3.00 (152 x 152 x 76)	Galvanized with Knockouts	2	B-C-D	B-C-D
ASE6X6X3NK	6.00 x 6.00 x 3.00 (152 x 152 x 76)	Painted without Knockouts	2	—	—
ASG6X6X3NK	6.00 x 6.00 x 3.00 (152 x 152 x 76)	Galvanized without Knockouts	2	—	—
ASE8X6X3	8.00 x 6.00 x 3.00 (203 x 152 x 76)	Painted with Knockouts	2	F-G-H-I	B-C-D
ASG8X6X3	8.00 x 6.00 x 3.00 (203 x 152 x 76)	Galvanized with Knockouts	2	F-G-H-I	B-C-D
ASE8X6X3NK	8.00 x 6.00 x 3.00 (203 x 152 x 76)	Painted without Knockouts	2	—	—
ASG8X6X3NK	8.00 x 6.00 x 3.00 (203 x 152 x 76)	Galvanized without Knockouts	2	—	—
ASE16X14X3	16.00 x 14.00 x 3.00 (406 x 356 x 76)	Painted with Knockouts	4	B-C-D-E-F-G-H	B-C-D-E-F-G-H
ASE16X14X3NK	16.00 x 14.00 x 3.00 (406 x 356 x 76)	Painted without Knockouts	4	—	—
ASE18X14X3	18.00 x 14.00 x 3.00 (457 x 356 x 76)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	B-C-D-E-F-G-H
ASE20X14X3NK	20.00 x 14.00 x 3.00 (508 x 356 x 76)	Painted without Knockouts	4	—	—
ASE4X4X4	4.00 x 4.00 x 4.00 (102 x 102 x 102)	Painted with Knockouts	2	B-C	B-C
ASG4X4X4	4.00 x 4.00 x 4.00 (102 x 102 x 102)	Galvanized with Knockouts	2	B-C	B-C
ASE4X4X4NK	4.00 x 4.00 x 4.00 (102 x 102 x 102)	Painted without Knockouts	2	—	—
ASG4X4X4NK	4.00 x 4.00 x 4.00 (102 x 102 x 102)	Galvanized without Knockouts	2	—	—
ASE6X4X4	6.00 x 4.00 x 4.00 (152 x 102 x 102)	Painted with Knockouts	2	B-C-D	B-C
ASG6X4X4	6.00 x 4.00 x 4.00 (152 x 102 x 102)	Galvanized with Knockouts	2	B-C-D	B-C
ASE6X4X4NK	6.00 x 4.00 x 4.00 (152 x 102 x 102)	Painted without Knockouts	2	—	—
ASG6X4X4NK	6.00 x 4.00 x 4.00 (152 x 102 x 102)	Galvanized without Knockouts	2	—	—
ASE6X6X4	6.00 x 6.00 x 4.00 (152 x 152 x 102)	Painted with Knockouts	2	B-C-D	B-C-D
ASG6X6X4	6.00 x 6.00 x 4.00 (152 x 152 x 102)	Galvanized with Knockouts	2	B-C-D	B-C-D
ASE6X6X4NK	6.00 x 6.00 x 4.00 (152 x 152 x 102)	Painted without Knockouts	2	—	—
ASG6X6X4NK	6.00 x 6.00 x 4.00 (152 x 152 x 102)	Galvanized without Knockouts	2	—	—
ASE8X6X4	8.00 x 6.00 x 4.00 (203 x 152 x 102)	Painted with Knockouts	2	F-G-H-I	B-C-D
ASG8X6X4	8.00 x 6.00 x 4.00 (203 x 152 x 102)	Galvanized with Knockouts	2	F-G-H-I	B-C-D
ASE8X6X4NK	8.00 x 6.00 x 4.00 (203 x 152 x 102)	Painted without Knockouts	2	—	—
ASG8X6X4NK	8.00 x 6.00 x 4.00 (203 x 152 x 102)	Galvanized without Knockouts	2	—	—
ASE8X8X4	8.00 x 8.00 x 4.00 (203 x 203 x 102)	Painted with Knockouts	4	F-G-H-I	F-G-H-I
ASG8X8X4	8.00 x 8.00 x 4.00 (203 x 203 x 102)	Galvanized with Knockouts	4	F-G-H-I	F-G-H-I
ASE8X8X4NK	8.00 x 8.00 x 4.00 (203 x 203 x 102)	Painted without Knockouts	4	—	—
ASG8X8X4NK	8.00 x 8.00 x 4.00 (203 x 203 x 102)	Galvanized without Knockouts	4	—	—
ASE10X6X4NK	10.00 x 6.00 x 4.00 (254 x 152 x 102)	Painted without Knockouts	4	—	—
ASG10X6X4NK	10.00 x 6.00 x 4.00 (254 x 152 x 102)	Galvanized without Knockouts	4	—	—
ASE10X8X4	10.00 x 8.00 x 4.00 (254 x 203 x 102)	Painted with Knockouts	4	F-G-H-I	F-G-H-I
ASG10X8X4	10.00 x 8.00 x 4.00 (254 x 203 x 102)	Galvanized with Knockouts	4	F-G-H-I	F-G-H-I
ASE10X8X4NK	10.00 x 8.00 x 4.00 (254 x 203 x 102)	Painted without Knockouts	4	—	—
ASG10X8X4NK	10.00 x 8.00 x 4.00 (254 x 203 x 102)	Galvanized without Knockouts	4	—	—
ASE10X10X4	10.00 x 10.00 x 4.00 (254 x 254 x 102)	Painted with Knockouts	4	F-G-H-I	C-D-E-F-G
ASG10X10X4	10.00 x 10.00 x 4.00 (254 x 254 x 102)	Galvanized with Knockouts	4	F-G-H-I	C-D-E-F-G
ASE10X10X4NK	10.00 x 10.00 x 4.00 (254 x 254 x 102)	Painted without Knockouts	4	—	—
ASG10X10X4NK	10.00 x 10.00 x 4.00 (254 x 254 x 102)	Galvanized without Knockouts	4	—	—
ASE12X6X4NK	12.00 x 6.00 x 4.00 (305 x 152 x 102)	Painted without Knockouts	4	—	—
ASG12X6X4NK	12.00 x 6.00 x 4.00 (305 x 152 x 102)	Galvanized without Knockouts	4	—	—
ASE12X8X4	12.00 x 8.00 x 4.00 (305 x 203 x 102)	Painted with Knockouts	4	C-D-E-F-G	F-G-H-I
ASG12X8X4	12.00 x 8.00 x 4.00 (305 x 203 x 102)	Galvanized with Knockouts	4	C-D-E-F-G	F-G-H-I
ASE12X8X4NK	12.00 x 8.00 x 4.00 (305 x 203 x 102)	Painted without Knockouts	4	—	—
ASG12X8X4NK	12.00 x 8.00 x 4.00 (305 x 203 x 102)	Galvanized without Knockouts	4	—	—
ASE12X10X4	12.00 x 10.00 x 4.00 (305 x 254 x 102)	Painted with Knockouts	4	C-D-E-F-G	C-D-E-F-G
ASG12X10X4	12.00 x 10.00 x 4.00 (305 x 254 x 102)	Galvanized with Knockouts	4	C-D-E-F-G	C-D-E-F-G
ASE12X10X4NK	12.00 x 10.00 x 4.00 (305 x 254 x 102)	Painted without Knockouts	4	—	—
ASG12X10X4NK	12.00 x 10.00 x 4.00 (305 x 254 x 102)	Galvanized without Knockouts	4	—	—
ASE12X12X4	12.00 x 12.00 x 4.00 (305 x 305 x 102)	Painted with Knockouts	4	C-D-E-F-G	C-D-E-F-G
ASG12X12X4	12.00 x 12.00 x 4.00 (305 x 305 x 102)	Galvanized with Knockouts	4	C-D-E-F-G	C-D-E-F-G
ASE12X12X4NK	12.00 x 12.00 x 4.00 (305 x 305 x 102)	Painted without Knockouts	4	—	—
ASG12X12X4NK	12.00 x 12.00 x 4.00 (305 x 305 x 102)	Galvanized without Knockouts	4	—	—
ASE15X15X4NK	15.00 x 15.00 x 4.00 (381 x 381 x 102)	Painted without Knockouts	4	—	—
ASG15X15X4NK	15.00 x 15.00 x 4.00 (381 x 381 x 102)	Galvanized without Knockouts	4	—	—

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Standard Sizes Screw Cover Pull Boxes (Cont.)

Catalog Number	A x B x C in. (mm)	Style	Number of Cover Screws	Knockout Pattern along "A" Sides	Knockout Pattern along "B" Sides
ASE16X12X4	16.00 x 12.00 x 4.00 (406 x 305 x 102)	Painted with Knockouts	4	B-C-D-E-F-G-H	C-D-E-F-G
ASG16X12X4	16.00 x 12.00 x 4.00 (406 x 305 x 102)	Galvanized with Knockouts	4	B-C-D-E-F-G-H	C-D-E-F-G
ASE16X12X4NK	16.00 x 12.00 x 4.00 (406 x 305 x 102)	Painted without Knockouts	4	—	—
ASG16X12X4NK	16.00 x 12.00 x 4.00 (406 x 305 x 102)	Galvanized without Knockouts	4	—	—
ASE18X12X4	18.00 x 12.00 x 4.00 (457 x 305 x 102)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	C-D-E-F-G
ASG18X12X4	18.00 x 12.00 x 4.00 (457 x 305 x 102)	Galvanized with Knockouts	4	A-B-C-D-E-F-G-H-I	C-D-E-F-G
ASE18X12X4NK	18.00 x 12.00 x 4.00 (457 x 305 x 102)	Painted without Knockouts	4	—	—
ASG18X12X4NK	18.00 x 12.00 x 4.00 (457 x 305 x 102)	Galvanized without Knockouts	4	—	—
ASE18X15X4NK	18.00 x 15.00 x 4.00 (457 x 381 x 102)	Painted without Knockouts	4	—	—
ASE18X18X4	18.00 x 18.00 x 4.00 (457 x 457 x 102)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASG18X18X4	18.00 x 18.00 x 4.00 (457 x 457 x 102)	Galvanized with Knockouts	4	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASE18X18X4NK	18.00 x 18.00 x 4.00 (457 x 457 x 102)	Painted without Knockouts	4	—	—
ASG18X18X4NK	18.00 x 18.00 x 4.00 (457 x 457 x 102)	Galvanized without Knockouts	4	—	—
ASE24X12X4	24.00 x 12.00 x 4.00 (610 x 305 x 102)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	C-D-E-F-G
ASE24X12X4NK	24.00 x 12.00 x 4.00 (610 x 305 x 102)	Painted without Knockouts	4	—	—
ASE24X18X4NK	24.00 x 18.00 x 4.00 (610 x 457 x 102)	Painted without Knockouts	4	—	—
ASG24X18X4NK	24.00 x 18.00 x 4.00 (610 x 457 x 102)	Galvanized without Knockouts	4	—	—
ASE24X24X4	24.00 x 24.00 x 4.00 (610 x 610 x 102)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASG24X24X4	24.00 x 24.00 x 4.00 (610 x 610 x 102)	Galvanized with Knockouts	4	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASE24X24X4NK	24.00 x 24.00 x 4.00 (610 x 610 x 102)	Painted without Knockouts	4	—	—
ASG24X24X4NK	24.00 x 24.00 x 4.00 (610 x 610 x 102)	Galvanized without Knockouts	4	—	—
ASE30X24X4	30.00 x 24.00 x 4.00 (762 x 610 x 102)	Painted with Knockouts	6	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASE30X24X4NK	30.00 x 24.00 x 4.00 (762 x 610 x 102)	Painted without Knockouts	6	—	—
ASE30X30X4NK	30.00 x 30.00 x 4.00 (762 x 762 x 102)	Painted without Knockouts	8	—	—
ASE6X6X6	6.00 x 6.00 x 6.00 (152 x 152 x 152)	Painted with Knockouts	2	B-C-D	B-C-D
ASG6X6X6	6.00 x 6.00 x 6.00 (152 x 152 x 152)	Galvanized with Knockouts	2	B-C-D	B-C-D
ASE6X6X6NK	6.00 x 6.00 x 6.00 (152 x 152 x 152)	Painted without Knockouts	2	—	—
ASG6X6X6NK	6.00 x 6.00 x 6.00 (152 x 152 x 152)	Galvanized without Knockouts	2	—	—
ASE8X6X6	8.00 x 6.00 x 6.00 (203 x 152 x 152)	Painted with Knockouts	2	F-G-H-I	B-C-D
ASE8X6X6NK	8.00 x 6.00 x 6.00 (203 x 152 x 152)	Painted without Knockouts	2	—	—
ASG8X6X6NK	8.00 x 6.00 x 6.00 (203 x 152 x 152)	Galvanized without Knockouts	2	—	—
ASE8X8X6	8.00 x 8.00 x 6.00 (203 x 203 x 152)	Painted with Knockouts	4	F-G-H-I	F-G-H-I
ASG8X8X6	8.00 x 8.00 x 6.00 (203 x 203 x 152)	Galvanized with Knockouts	4	F-G-H-I	F-G-H-I
ASE8X8X6NK	8.00 x 8.00 x 6.00 (203 x 203 x 152)	Painted without Knockouts	4	—	—
ASG8X8X6NK	8.00 x 8.00 x 6.00 (203 x 203 x 152)	Galvanized without Knockouts	4	—	—
ASE10X8X6	10.00 x 8.00 x 6.00 (254 x 203 x 152)	Painted with Knockouts	4	F-G-H-I	F-G-H-I
ASG10X8X6	10.00 x 8.00 x 6.00 (254 x 203 x 152)	Galvanized with Knockouts	4	F-G-H-I	F-G-H-I
ASE10X8X6NK	10.00 x 8.00 x 6.00 (254 x 203 x 152)	Painted without Knockouts	4	—	—
ASG10X8X6NK	10.00 x 8.00 x 6.00 (254 x 203 x 152)	Galvanized without Knockouts	4	—	—
ASE10X10X6	10.00 x 10.00 x 6.00 (254 x 254 x 152)	Painted with Knockouts	4	F-G-H-I	C-D-E-F-G
ASG10X10X6	10.00 x 10.00 x 6.00 (254 x 254 x 152)	Galvanized with Knockouts	4	F-G-H-I	C-D-E-F-G
ASE10X10X6NK	10.00 x 10.00 x 6.00 (254 x 254 x 152)	Painted without Knockouts	4	—	—
ASG10X10X6NK	10.00 x 10.00 x 6.00 (254 x 254 x 152)	Galvanized without Knockouts	4	—	—
ASE12X6X6NK	12.00 x 6.00 x 6.00 (305 x 152 x 152)	Painted without Knockouts	4	—	—
ASE12X8X6NK	12.00 x 8.00 x 6.00 (305 x 203 x 152)	Painted without Knockouts	4	—	—
ASG12X8X6NK	12.00 x 8.00 x 6.00 (305 x 203 x 152)	Galvanized without Knockouts	4	—	—
ASE12X10X6	12.00 x 10.00 x 6.00 (305 x 254 x 152)	Painted with Knockouts	4	C-D-E-F-G	C-D-E-F-G
ASG12X10X6	12.00 x 10.00 x 6.00 (305 x 254 x 152)	Galvanized with Knockouts	4	C-D-E-F-G	C-D-E-F-G
ASE12X10X6NK	12.00 x 10.00 x 6.00 (305 x 254 x 152)	Painted without Knockouts	4	—	—
ASG12X10X6NK	12.00 x 10.00 x 6.00 (305 x 254 x 152)	Galvanized without Knockouts	4	—	—
ASE12X12X6	12.00 x 12.00 x 6.00 (305 x 305 x 152)	Painted with Knockouts	4	C-D-E-F-G	C-D-E-F-G
ASG12X12X6	12.00 x 12.00 x 6.00 (305 x 305 x 152)	Galvanized with Knockouts	4	C-D-E-F-G	C-D-E-F-G
ASE12X12X6NK	12.00 x 12.00 x 6.00 (305 x 305 x 152)	Painted without Knockouts	4	—	—
ASG12X12X6NK	12.00 x 12.00 x 6.00 (305 x 305 x 152)	Galvanized without Knockouts	4	—	—
ASE16X12X6	16.00 x 12.00 x 6.00 (406 x 305 x 152)	Painted with Knockouts	4	B-C-D-E-F-G-H	C-D-E-F-G
ASG16X12X6	16.00 x 12.00 x 6.00 (406 x 305 x 152)	Galvanized with Knockouts	4	B-C-D-E-F-G-H	C-D-E-F-G
ASE16X12X6NK	16.00 x 12.00 x 6.00 (406 x 305 x 152)	Painted without Knockouts	4	—	—
ASG16X12X6NK	16.00 x 12.00 x 6.00 (406 x 305 x 152)	Galvanized without Knockouts	4	—	—
ASE16X16X6	16.00 x 16.00 x 6.00 (406 x 406 x 152)	Painted with Knockouts	4	B-C-D-E-F-G-H	B-C-D-E-F-G-H
ASG16X16X6	16.00 x 16.00 x 6.00 (406 x 406 x 152)	Galvanized with Knockouts	4	B-C-D-E-F-G-H	B-C-D-E-F-G-H
ASE16X16X6NK	16.00 x 16.00 x 6.00 (406 x 406 x 152)	Painted without Knockouts	4	—	—
ASG16X16X6NK	16.00 x 16.00 x 6.00 (406 x 406 x 152)	Galvanized without Knockouts	4	—	—

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Screw Cover Type 1 Pull Boxes

Standard Sizes Screw Cover Pull Boxes (Cont.)

Catalog Number	A x B x C in. (mm)	Style	Number of Cover Screws	Knockout Pattern along "A" Sides	Knockout Pattern along "B" Sides
ASE18X12X6	18.00 x 12.00 x 6.00 (457 x 305 x 152)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	C-D-E-F-G
ASG18X12X6	18.00 x 12.00 x 6.00 (457 x 305 x 152)	Galvanized with Knockouts	4	A-B-C-D-E-F-G-H-I	C-D-E-F-G
ASE18X12X6NK	18.00 x 12.00 x 6.00 (457 x 305 x 152)	Painted without Knockouts	4	—	—
ASG18X12X6NK	18.00 x 12.00 x 6.00 (457 x 305 x 152)	Galvanized without Knockouts	4	—	—
ASE18X18X6	18.00 x 18.00 x 6.00 (457 x 457 x 152)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASG18X18X6	18.00 x 18.00 x 6.00 (457 x 457 x 152)	Galvanized with Knockouts	4	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASE18X18X6NK	18.00 x 18.00 x 6.00 (457 x 457 x 152)	Painted without Knockouts	4	—	—
ASG18X18X6NK	18.00 x 18.00 x 6.00 (457 x 457 x 152)	Galvanized without Knockouts	4	—	—
ASE24X12X6NK	24.00 x 12.00 x 6.00 (610 x 305 x 152)	Painted without Knockouts	4	—	—
ASG24X12X6NK	24.00 x 12.00 x 6.00 (610 x 305 x 152)	Galvanized without Knockouts	4	—	—
ASE24X18X6	24.00 x 18.00 x 6.00 (610 x 457 x 152)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASG24X18X6	24.00 x 18.00 x 6.00 (610 x 457 x 152)	Galvanized with Knockouts	4	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASE24X18X6NK	24.00 x 18.00 x 6.00 (610 x 457 x 152)	Painted without Knockouts	4	—	—
ASG24X18X6NK	24.00 x 18.00 x 6.00 (610 x 457 x 152)	Galvanized without Knockouts	4	—	—
ASE24X20X6NK	24.00 x 20.00 x 6.00 (610 x 508 x 152)	Painted without Knockouts	4	—	—
ASG24X20X6NK	24.00 x 20.00 x 6.00 (610 x 508 x 152)	Galvanized without Knockouts	4	—	—
ASE24X24X6	24.00 x 24.00 x 6.00 (610 x 610 x 152)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASG24X24X6	24.00 x 24.00 x 6.00 (610 x 610 x 152)	Galvanized with Knockouts	4	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASE24X24X6NK	24.00 x 24.00 x 6.00 (610 x 610 x 152)	Painted without Knockouts	4	—	—
ASG24X24X6NK	24.00 x 24.00 x 6.00 (610 x 610 x 152)	Galvanized without Knockouts	4	—	—
ASE30X24X6	30.00 x 24.00 x 6.00 (762 x 610 x 152)	Painted with Knockouts	6	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASG30X24X6	30.00 x 24.00 x 6.00 (762 x 610 x 152)	Galvanized with Knockouts	6	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASE30X24X6NK	30.00 x 24.00 x 6.00 (762 x 610 x 152)	Painted without Knockouts	6	—	—
ASG30X24X6NK	30.00 x 24.00 x 6.00 (762 x 610 x 152)	Galvanized without Knockouts	6	—	—
ASE30X30X6NK	30.00 x 30.00 x 6.00 (762 x 762 x 152)	Painted without Knockouts	8	—	—
ASG30X30X6NK	30.00 x 30.00 x 6.00 (762 x 762 x 152)	Galvanized without Knockouts	8	—	—
ASE36X24X6	36.00 x 24.00 x 6.00 (914 x 610 x 152)	Painted with Knockouts	6	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASG36X24X6	36.00 x 24.00 x 6.00 (914 x 610 x 152)	Galvanized with Knockouts	6	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASE36X24X6NK	36.00 x 24.00 x 6.00 (914 x 610 x 152)	Painted without Knockouts	6	—	—
ASG36X24X6NK	36.00 x 24.00 x 6.00 (914 x 610 x 152)	Galvanized without Knockouts	6	—	—
ASE36X30X6NK	36.00 x 30.00 x 6(914 x 762 x 152)	Painted without Knockouts	8	—	—
ASE36X36X6NK	36.00 x 36.00 x 6.00 (914 x 914 x 152)	Painted without Knockouts	8	—	—
ASG36X36X6NK	36.00 x 36.00 x 6.00 (914 x 914 x 152)	Galvanized without Knockouts	8	—	—
ASE8X8X8	8.00 x 8.00 x 8.00 (203 x 203 x 203)	Painted with Knockouts	4	F-G-H-I	F-G-H-I
ASE8X8X8NK	8.00 x 8.00 x 8.00 (203 x 203 x 203)	Painted without Knockouts	4	—	—
ASG8X8X8NK	8.00 x 8.00 x 8.00 (203 x 203 x 203)	Galvanized without Knockouts	4	—	—
ASE10X10X8NK	10.00 x 10.00 x 8.00 (254 x 254 x 203)	Painted without Knockouts	4	—	—
ASG10X10X8NK	10.00 x 10.00 x 8.00 (254 x 254 x 203)	Galvanized without Knockouts	4	—	—
ASE12X10X8NK	12.00 x 10.00 x 8.00 (305 x 254 x 203)	Painted without Knockouts	4	—	—
ASE12X12X8	12.00 x 12.00 x 8.00 (305 x 305 x 203)	Painted with Knockouts	4	C-D-E-F-G	C-D-E-F-G
ASG12X12X8	12.00 x 12.00 x 8.00 (305 x 305 x 203)	Galvanized with Knockouts	4	C-D-E-F-G	C-D-E-F-G
ASE12X12X8NK	12.00 x 12.00 x 8.00 (305 x 305 x 203)	Painted without Knockouts	4	—	—
ASG12X12X8NK	12.00 x 12.00 x 8.00 (305 x 305 x 203)	Galvanized without Knockouts	4	—	—
ASE16X12X8	16.00 x 12.00 x 8.00 (406 x 305 x 203)	Painted with Knockouts	4	B-C-D-E-F-G-H	C-D-E-F-G
ASE16X12X8NK	16.00 x 12.00 x 8.00 (406 x 305 x 203)	Painted without Knockouts	4	—	—
ASE18X12X8	18.00 x 12.00 x 8.00 (457 x 305 x 203)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	C-D-E-F-G
ASE18X12X8NK	18.00 x 12.00 x 8.00 (457 x 305 x 203)	Painted without Knockouts	4	—	—
ASG18X12X8NK	18.00 x 12.00 x 8.00 (457 x 305 x 203)	Galvanized without Knockouts	4	—	—
ASE18X18X8NK	18.00 x 18.00 x 8.00 (457 x 457 x 203)	Painted without Knockouts	4	—	—
ASG18X18X8NK	18.00 x 18.00 x 8.00 (457 x 457 x 203)	Galvanized without Knockouts	4	—	—
ASE24X12X8	24.00 x 12.00 x 8.00 (610 x 305 x 203)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	C-D-E-F-G
ASE24X12X8NK	24.00 x 12.00 x 8.00 (610 x 305 x 203)	Painted without Knockouts	4	—	—
ASG24X12X8NK	24.00 x 12.00 x 8.00 (610 x 305 x 203)	Galvanized without Knockouts	4	—	—
ASE24X18X8	24.00 x 18.00 x 8.00 (610 x 457 x 203)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASE24X18X8NK	24.00 x 18.00 x 8.00 (610 x 457 x 203)	Painted without Knockouts	4	—	—
ASG24X18X8NK	24.00 x 18.00 x 8.00 (610 x 457 x 203)	Galvanized without Knockouts	4	—	—
ASE24X20X8NK	24.00 x 20.00 x 8.00 (610 x 508 x 203)	Painted without Knockouts	4	—	—
ASG24X20X8NK	24.00 x 20.00 x 8.00 (610 x 508 x 203)	Galvanized without Knockouts	4	—	—
ASE24X24X8	24.00 x 24.00 x 8.00 (610 x 610 x 203)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASE24X24X8NK	24.00 x 24.00 x 8.00 (610 x 610 x 203)	Painted without Knockouts	4	—	—
ASG24X24X8NK	24.00 x 24.00 x 8.00 (610 x 610 x 203)	Galvanized without Knockouts	4	—	—
ASE30X24X8NK	30.00 x 24.00 x 8.00 (762 x 610 x 203)	Painted without Knockouts	6	—	—

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Standard Sizes Screw Cover Pull Boxes (Cont.)

Catalog Number	A x B x C in. (mm)	Style	Number of Cover Screws	Knockout Pattern along "A" Sides	Knockout Pattern along "B" Sides
ASG30X24X8NK	30.00 x 24.00 x 8.00 (762 x 610 x 203)	Galvanized without Knockouts	6	—	—
ASE30X30X8NK	30.00 x 30.00 x 8.00 (762 x 762 x 203)	Painted without Knockouts	8	—	—
ASG30X30X8NK	30.00 x 30.00 x 8.00 (762 x 762 x 203)	Galvanized without Knockouts	6	—	—
ASE36X24X8	36.00 x 24.00 x 8.00 (914 x 610 x 203)	Painted with Knockouts	6	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASE36X24X8NK	36.00 x 24.00 x 8.00 (914 x 610 x 203)	Painted without Knockouts	6	—	—
ASG36X24X8NK	36.00 x 24.00 x 8.00 (914 x 610 x 203)	Galvanized without Knockouts	6	—	—
ASE36X36X8NK	36.00 x 36.00 x 8.00 (914 x 914 x 203)	Painted without Knockouts	8	—	—
ASG36X36X8NK	36.00 x 36.00 x 8.00 (914 x 914 x 203)	Galvanized without Knockouts	8	—	—
ASE12X12X10NK	12.00 x 12.00 x 10.00 (305 x 305 x 254)	Painted without Knockouts	4	—	—
ASG12X12X10NK	12.00 x 12.00 x 10.00 (305 x 305 x 254)	Galvanized without Knockouts	4	—	—
ASE18X12X10	18.00 x 12.00 x 10.00 (457 x 305 x 254)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	C-D-E-F-G
ASE18X12X10NK	18.00 x 12.00 x 10.00 (457 x 305 x 254)	Painted without Knockouts	4	—	—
ASE18X18X10	18.00 x 18.00 x 10.00 (457 x 457 x 254)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASE18X18X10NK	18.00 x 18.00 x 10.00 (457 x 457 x 254)	Painted without Knockouts	4	—	—
ASG18X18X10NK	18.00 x 18.00 x 10.00 (457 x 457 x 254)	Galvanized without Knockouts	4	—	—
ASE24X12X10	24.00 x 12.00 x 10.00 (610 x 305 x 254)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	C-D-E-F-G
ASE24X12X10NK	24.00 x 12.00 x 10.00 (610 x 305 x 254)	Painted without Knockouts	4	—	—
ASE24X18X10	24.00 x 18.00 x 10.00 (610 x 457 x 254)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASE24X18X10NK	24.00 x 18.00 x 10.00 (610 x 457 x 254)	Painted without Knockouts	4	—	—
ASE24X24X10	24.00 x 24.00 x 10.00 (610 x 610 x 254)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASE24X24X10NK	24.00 x 24.00 x 10.00 (610 x 610 x 254)	Painted without Knockouts	4	—	—
ASG24X24X10NK	24.00 x 24.00 x 10.00 (610 x 610 x 254)	Galvanized without Knockouts	4	—	—
ASE30X24X10NK	30.00 x 24.00 x 10.00 (762 x 610 x 254)	Painted without Knockouts	6	—	—
ASE30X30X10NK	30.00 x 30.00 x 10.00 (762 x 762 x 254)	Painted without Knockouts	8	—	—
ASG30X30X10NK	30.00 x 30.00 x 10.00 (762 x 762 x 254)	Galvanized without Knockouts	8	—	—
ASE36X24X10	36.00 x 24.00 x 10.00 (914 x 610 x 254)	Painted with Knockouts	6	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASE36X24X10NK	36.00 x 24.00 x 10.00 (914 x 610 x 254)	Painted without Knockouts	6	—	—
ASG36X24X10NK	36.00 x 24.00 x 10.00 (914 x 610 x 254)	Galvanized without Knockouts	6	—	—
ASE36X36X10NK	36.00 x 36.00 x 10.00 (914 x 914 x 254)	Painted without Knockouts	8	—	—
ASG36X36X10NK	36.00 x 36.00 x 10.00 (914 x 914 x 254)	Galvanized without Knockouts	8	—	—
ASE12X12X12NK	12.00 x 12.00 x 12.00 (305 x 305 x 305)	Painted without Knockouts	4	—	—
ASG12X12X12NK	12.00 x 12.00 x 12.00 (305 x 305 x 305)	Galvanized without Knockouts	4	—	—
ASE24X12X12	24.00 x 12.00 x 12.00 (610 x 305 x 305)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	C-D-E-F-G
ASE24X12X12NK	24.00 x 12.00 x 12.00 (610 x 305 x 305)	Painted without Knockouts	4	—	—
ASG24X12X12NK	24.00 x 12.00 x 12.00 (610 x 305 x 305)	Galvanized without Knockouts	4	—	—
ASE18X18X12	18.00 x 18.00 x 12.00 (457 x 457 x 305)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASE18X18X12NK	18.00 x 18.00 x 12.00 (457 x 457 x 305)	Painted without Knockouts	4	—	—
ASG18X18X12NK	18.00 x 18.00 x 12.00 (457 x 457 x 305)	Galvanized without Knockouts	4	—	—
ASE24X18X12	24.00 x 18.00 x 12.00 (610 x 457 x 305)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASE24X18X12NK	24.00 x 18.00 x 12.00 (610 x 457 x 305)	Painted without Knockouts	4	—	—
ASE24X24X12	24.00 x 24.00 x 12.00 (610 x 610 x 305)	Painted with Knockouts	4	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASE24X24X12NK	24.00 x 24.00 x 12.00 (610 x 610 x 305)	Painted without Knockouts	4	—	—
ASG24X24X12NK	24.00 x 24.00 x 12.00 (610 x 610 x 305)	Galvanized without Knockouts	4	—	—
ASE30X24X12	30.00 x 24.00 x 12.00 (762 x 610 x 305)	Painted with Knockouts	6	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASE30X24X12NK	30.00 x 24.00 x 12.00 (762 x 610 x 305)	Painted without Knockouts	6	—	—
ASE30X30X12NK	30.00 x 30.00 x 12.00 (762 x 762 x 305)	Painted without Knockouts	8	—	—
ASG30X30X12NK	30.00 x 30.00 x 12.00 (762 x 762 x 305)	Galvanized without Knockouts	8	—	—
ASE36X24X12	36.00 x 24.00 x 12.00 (914 x 610 x 305)	Painted with Knockouts	6	A-B-C-D-E-F-G-H-I	A-B-C-D-E-F-G-H-I
ASE36X24X12NK	36.00 x 24.00 x 12.00 (914 x 610 x 305)	Painted without Knockouts	6	—	—
ASG36X24X12NK	36.00 x 24.00 x 12.00 (914 x 610 x 305)	Galvanized without Knockouts	6	—	—
ASE36X36X12NK	36.00 x 36.00 x 12.00 (914 x 914 x 305)	Painted without Knockouts	8	—	—
ASG36X36X12NK	36.00 x 36.00 x 12.00 (914 x 914 x 305)	Galvanized without Knockouts	8	—	—
ASE48X48X12NK	48.00 x 48.00 x 12.00 (1219 x 1219 x 305)	Painted without Knockouts	12	—	—
ASG48X48X12NK	48.00 x 48.00 x 12.00 (1219 x 1219 x 305)	Galvanized without Knockouts	12	—	—
ASE30X30X16NK	30.00 x 30.00 x 16.00 (762 x 762 x 406)	Painted without Knockouts	8	—	—
ASE36X36X16NK	36.00 x 36.00 x 16.00 (914 x 914 x 406)	Painted without Knockouts	8	—	—
ASG36X36X16NK	36.00 x 36.00 x 16.00 (914 x 914 x 406)	Galvanized without Knockouts	8	—	—
ASE48X48X16NK	48.00 x 48.00 x 16.00 (1219 x 1219 x 406)	Painted without Knockouts	12	—	—
ASG48X48X16NK	48.00 x 48.00 x 16.00 (1219 x 1219 x 406)	Galvanized without Knockouts	12	—	—

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Screw Cover Type 1 Pull Boxes

Flush Covers

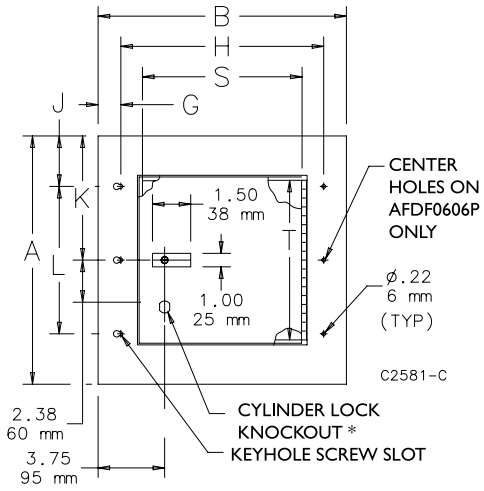
Designed to mount on enclosure for flush installations. Cover is 16 or 14 gauge steel finished with ANSI 61 gray polyester powder paint.

Catalog Number	A x B in. (mm)	Fits Box Size A x B (in.)	Fits Box Size A x B (mm)	Cover Gauge
AFE6X6	7.50 x 7.50 (191 x 191)	6.00 x 6.00	152 x 152	16
AFE8X6	9.50 x 7.50 (241 x 191)	8.00 x 6.00	203 x 152	16
AFE8X8	9.50 x 9.50 (241 x 241)	8.00 x 8.00	203 x 203	16
AFE10X8	11.50 x 9.50 (292 x 241)	10.00 x 8.00	254 x 203	16
AFE12X8	13.50 x 9.50 (343 x 241)	12.00 x 8.00	305 x 203	16
AFE10X10	11.50 x 11.50 (292 x 292)	10.00 x 10.00	254 x 254	16
AFE12X12	13.50 x 13.50 (343 x 343)	12.00 x 12.00	305 x 305	16
AFE18X12	19.50 x 13.50 (495 x 343)	18.00 x 12.00	457 x 305	16
AFE18X18	19.50 x 19.50 (495 x 495)	18.00 x 18.00	457 x 457	16
AFE24X18	25.50 x 19.50 (648 x 495)	24.00 x 18.00	610 x 457	14
AFE24X24	25.50 x 25.50 (648 x 648)	24.00 x 24.00	610 x 610	14

Flush-Mounted Door Frames

For use in Screw Cover Pull Box telephone cabinet installations or in communication wiring and signal systems. Also as a junction or pull box and switch enclosure.

- Continuous hinge
- 14 gauge steel door frame with ANSI 61 gray polyester powder paint finish
- Rugged black compositie slide latch
- Optional tamper-resistant lock kit includes cylinder lock, tamper-resistant screws, and special driver bitLock Kit (ACLFDF)



* Not available on AFDF0606P

Catalog Number	Frame Size A x B (in.)	Frame Size A x B (mm)	Door Size T (in.)	Door Size T (mm)	Door Size S (in.)	Door Size S (mm)	Fits Box Size A x B (in.)	Fits Box Size A x B (mm)	G (in.)	G (mm)	H (in.)	H (mm)	J (in.)	J (mm)	K (in.)	K (mm)	L (in.)	L (mm)
AFDF0606P	8.00 x 8.00	203 x 203	3.00	76	3.00	76	6.00 x 6.00	152 x 152	1.28	32	5.44	138	N/A	N/A	4.00	102	N/A	N/A
AFDF1212P	14.00 x 14.00	356 x 356	9.00	229	9.00	229	12.00 x 12.00	305 x 305	1.28	32	11.44	291	2.84	72	7.00	178	8.31	211
AFDF1812P	20.00 x 14.00	508 x 356	15.00	381	9.00	229	18.00 x 12.00	457 x 305	1.28	32	11.44	291	2.84	72	10.00	254	14.31	364
AFDF1818P	20.00 x 20.00	508 x 508	15.00	381	15.00	381	18.00 x 18.00	457 x 457	1.28	32	17.44	443	2.84	72	10.00	254	14.31	364
AFDF2418P	26.00 x 20.00	660 x 508	21.00	533	15.00	381	24.00 x 18.00	610 x 457	1.28	32	17.44	443	2.84	72	13.00	330	20.31	516
AFDF2424P	26.00 x 26.00	660 x 660	21.00	533	21.00	533	24.00 x 24.00	610 x 610	1.30	33	23.41	595	2.84	72	13.00	330	20.31	516
AFDF3024P	32.00 x 26.00	813 x 660	27.00	686	21.00	533	30.00 x 24.00	762 x 610	1.30	33	23.41	595	2.84	72	16.00	406	26.31	668

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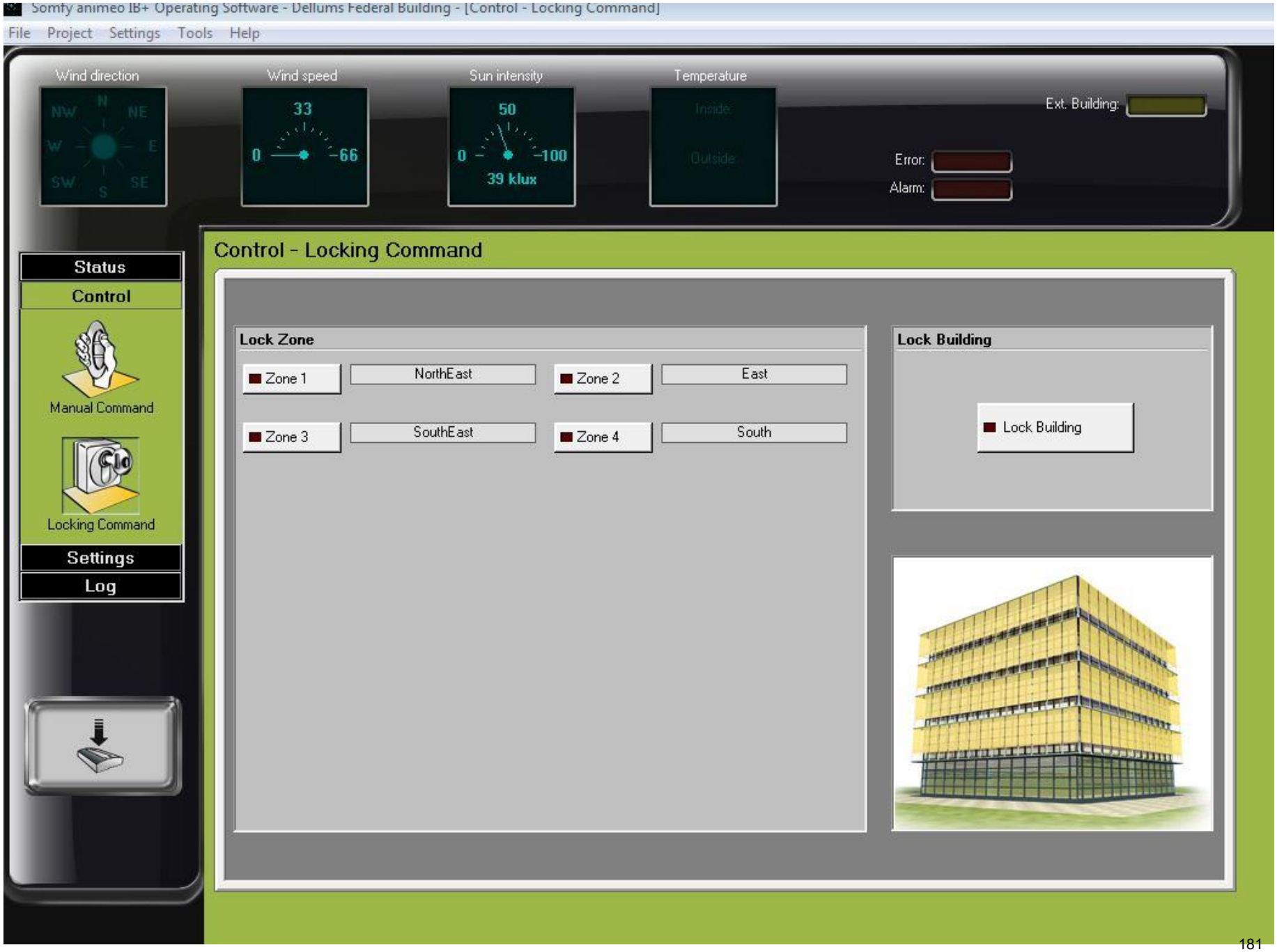
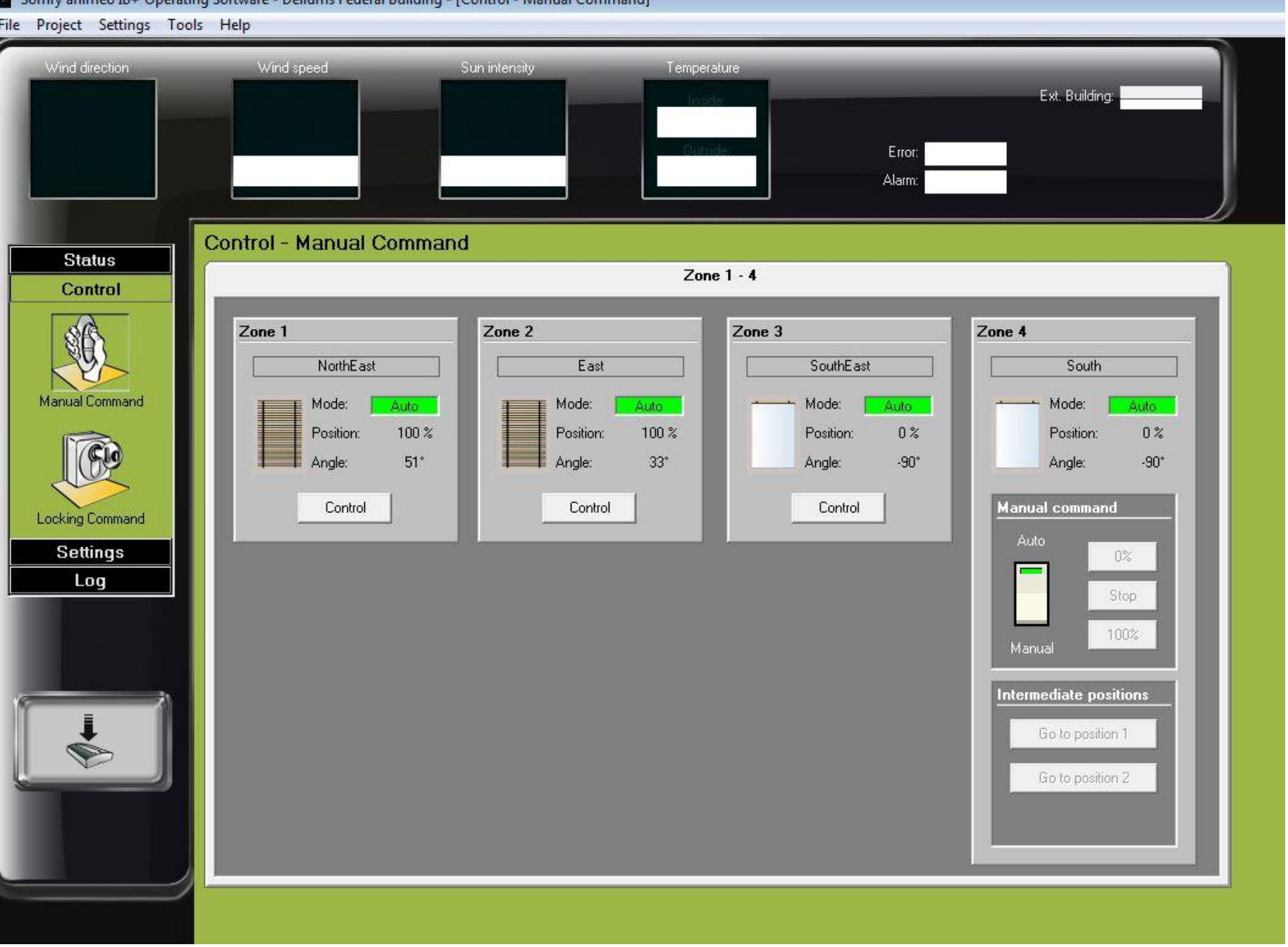
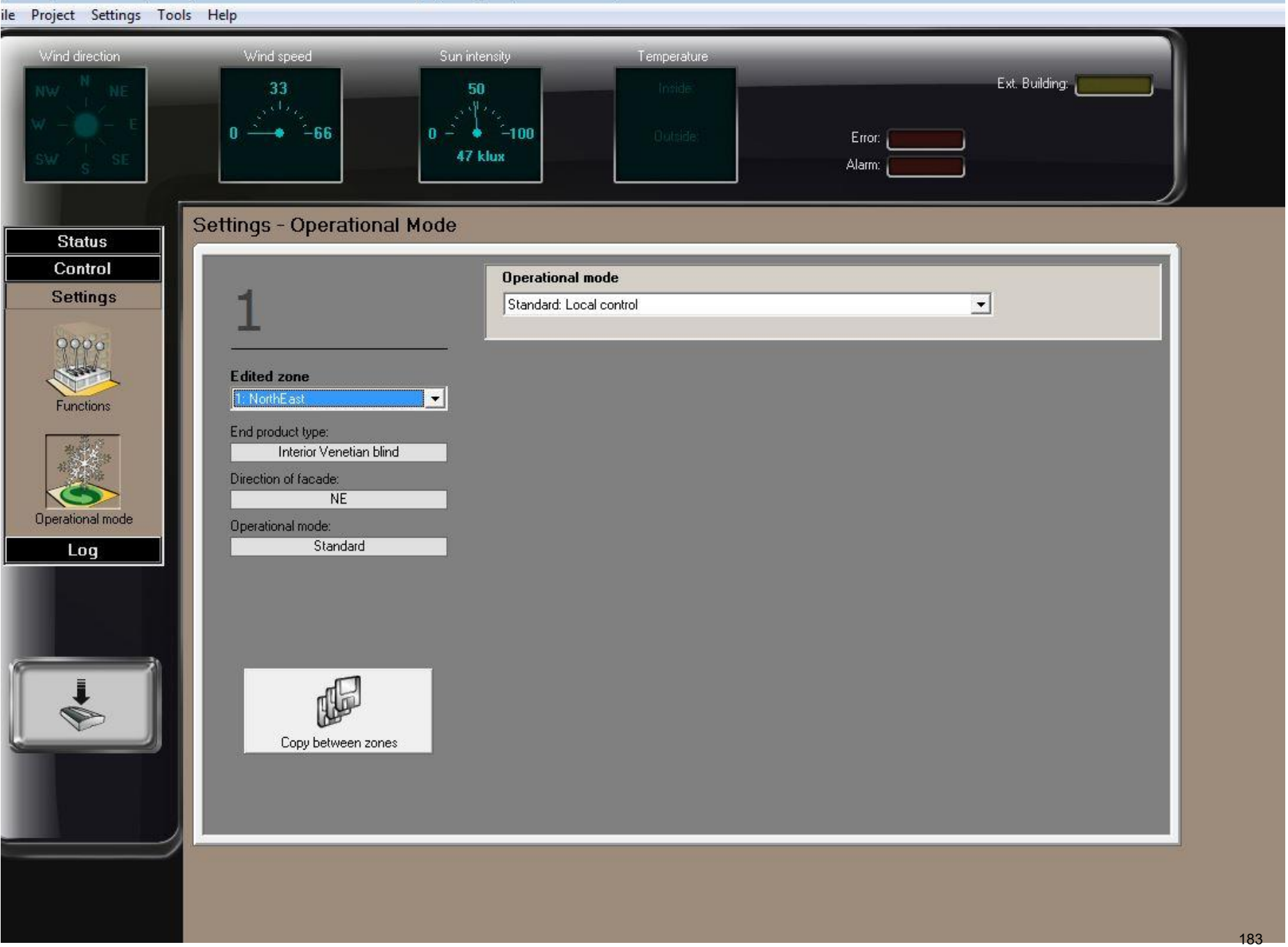


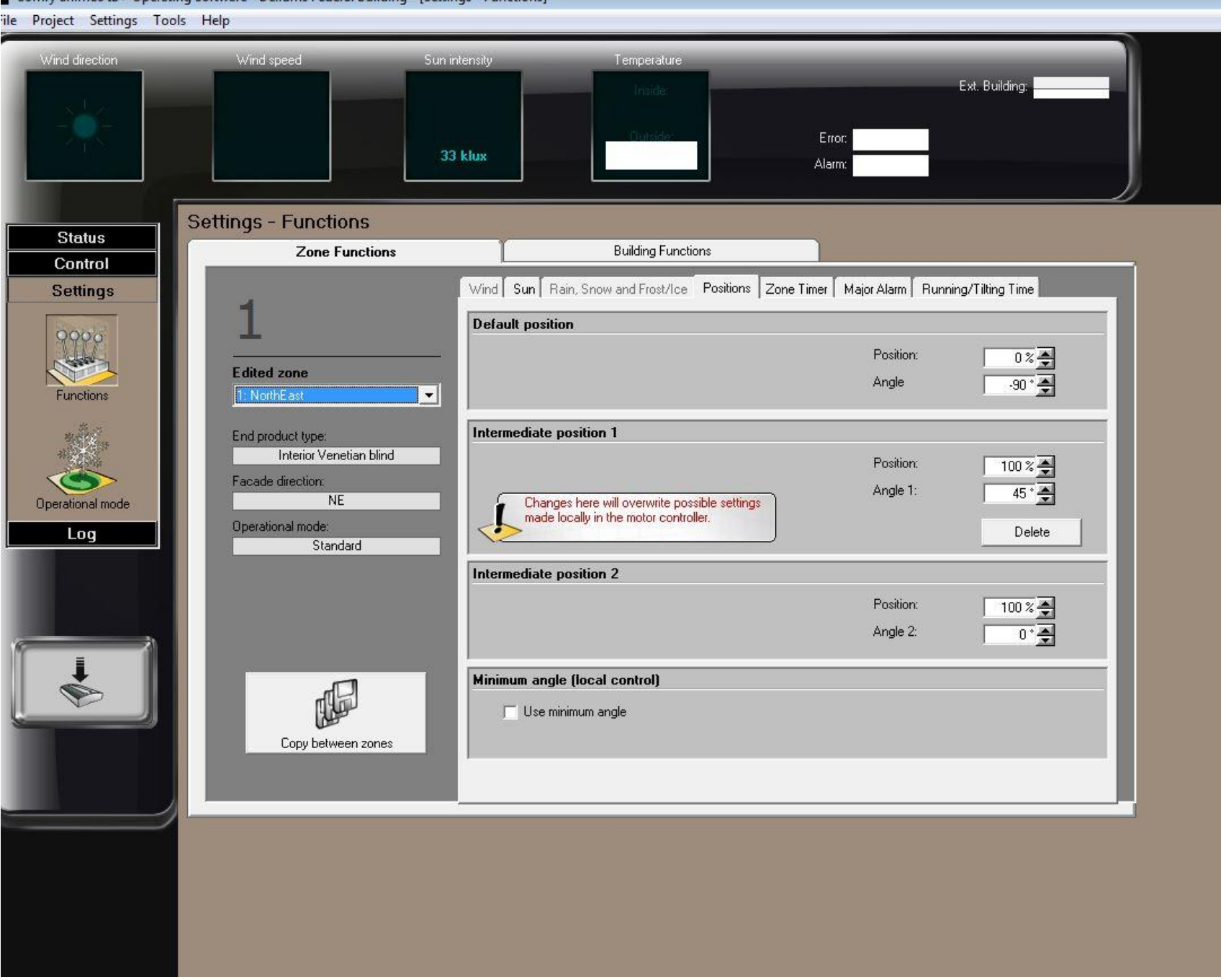
Control locking



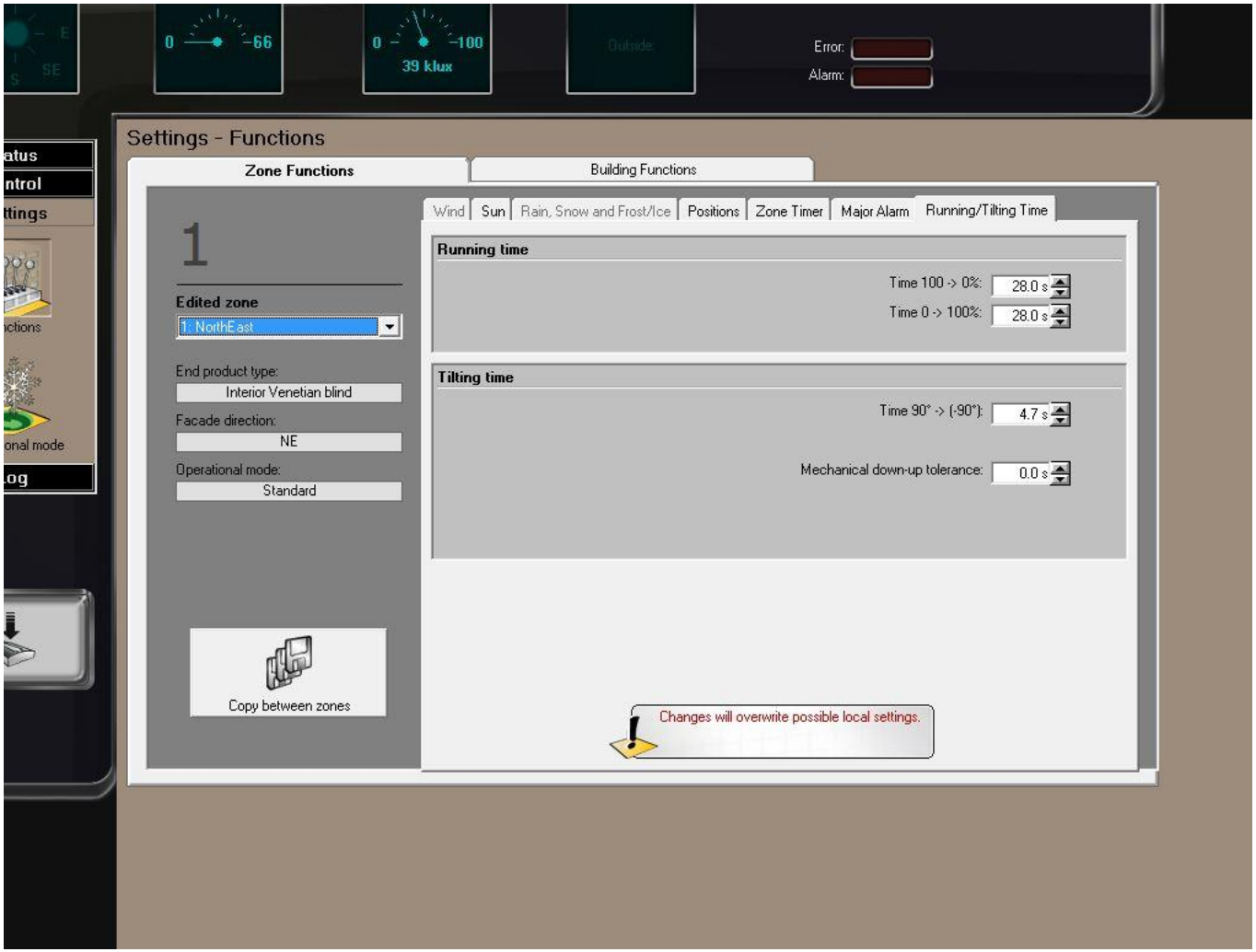
Control manual



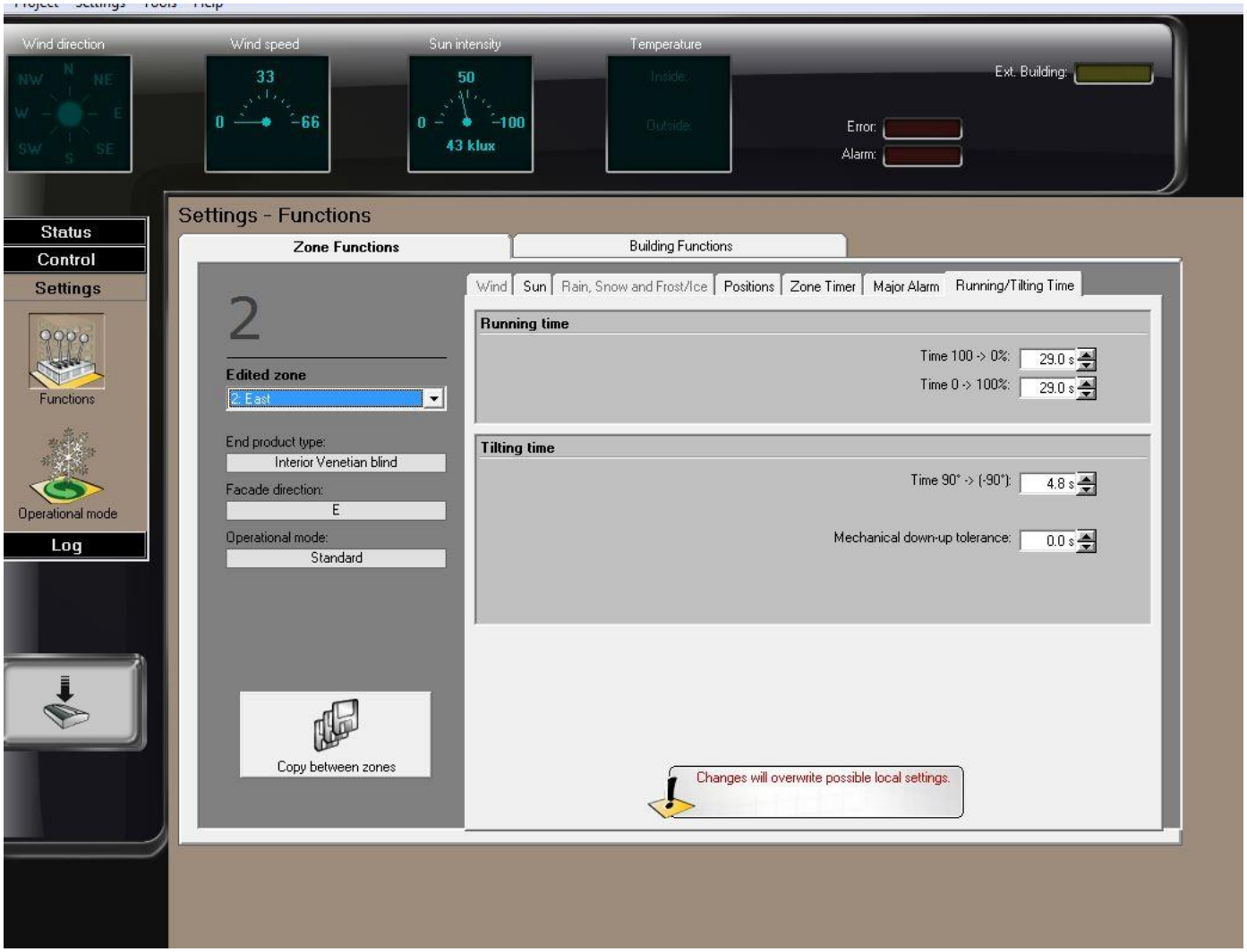
Operations all same



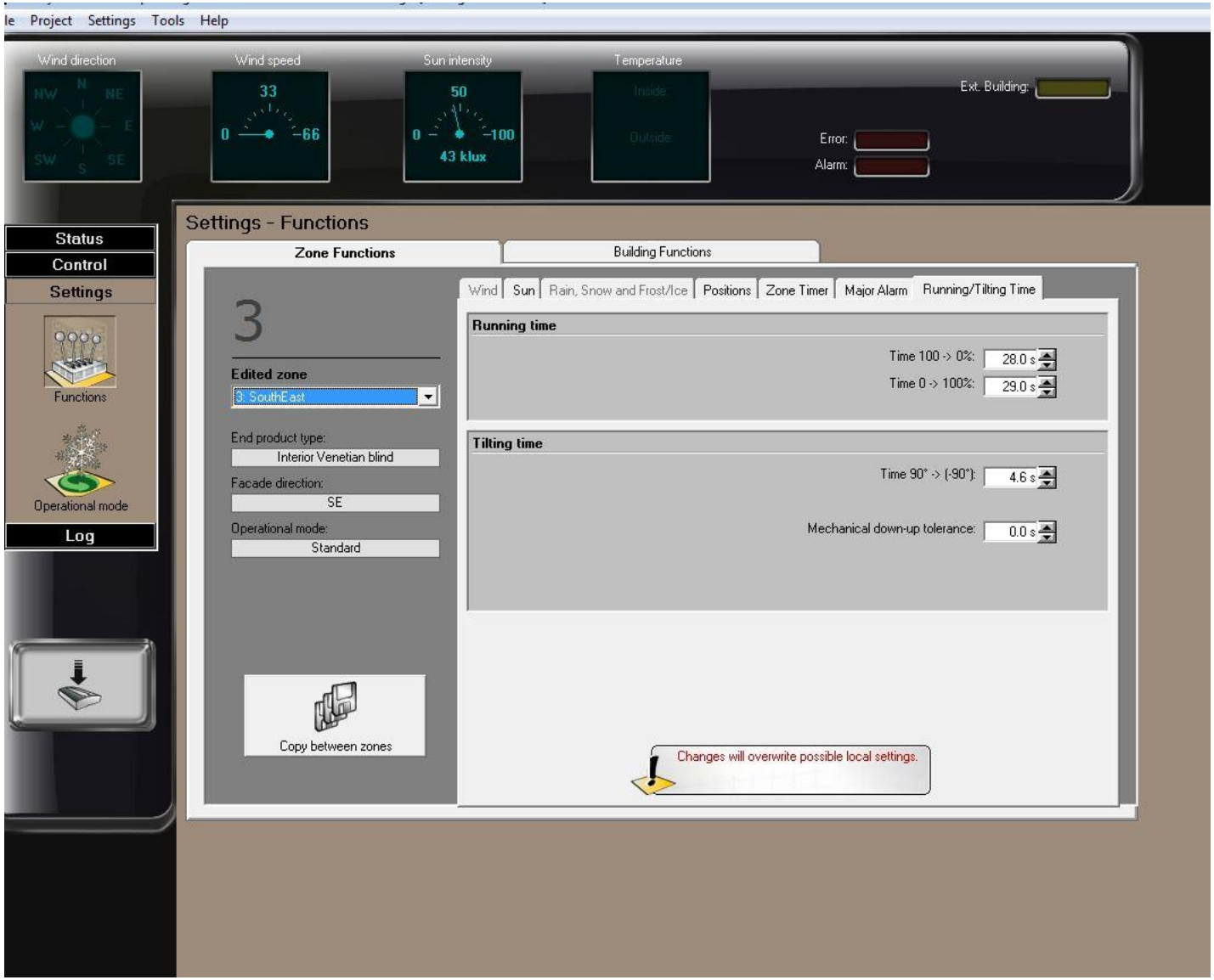
Position all same


0
66
0
100
39 klux
Outside
Error:
Alarm:
Settings - Functions
Zone Functions
Building Functions
1
Edited zone
1: NorthEast
End product type:
Interior Venetian blind
Facade direction:
NE
Operational mode:
Standard
Copy between zones
Wind
Sun
Rain, Snow and Frost/Ice
Positions
Zone Timer
Major Alarm
Running/Tilting Time
Running time
Time 100 -> 0%:
28.0 s
Time 0 -> 100%:
28.0 s
Tilting time
Time 90° -> (-90°):
4.7 s
Mechanical down-up tolerance:
0.0 s
Changes will overwrite possible local settings.

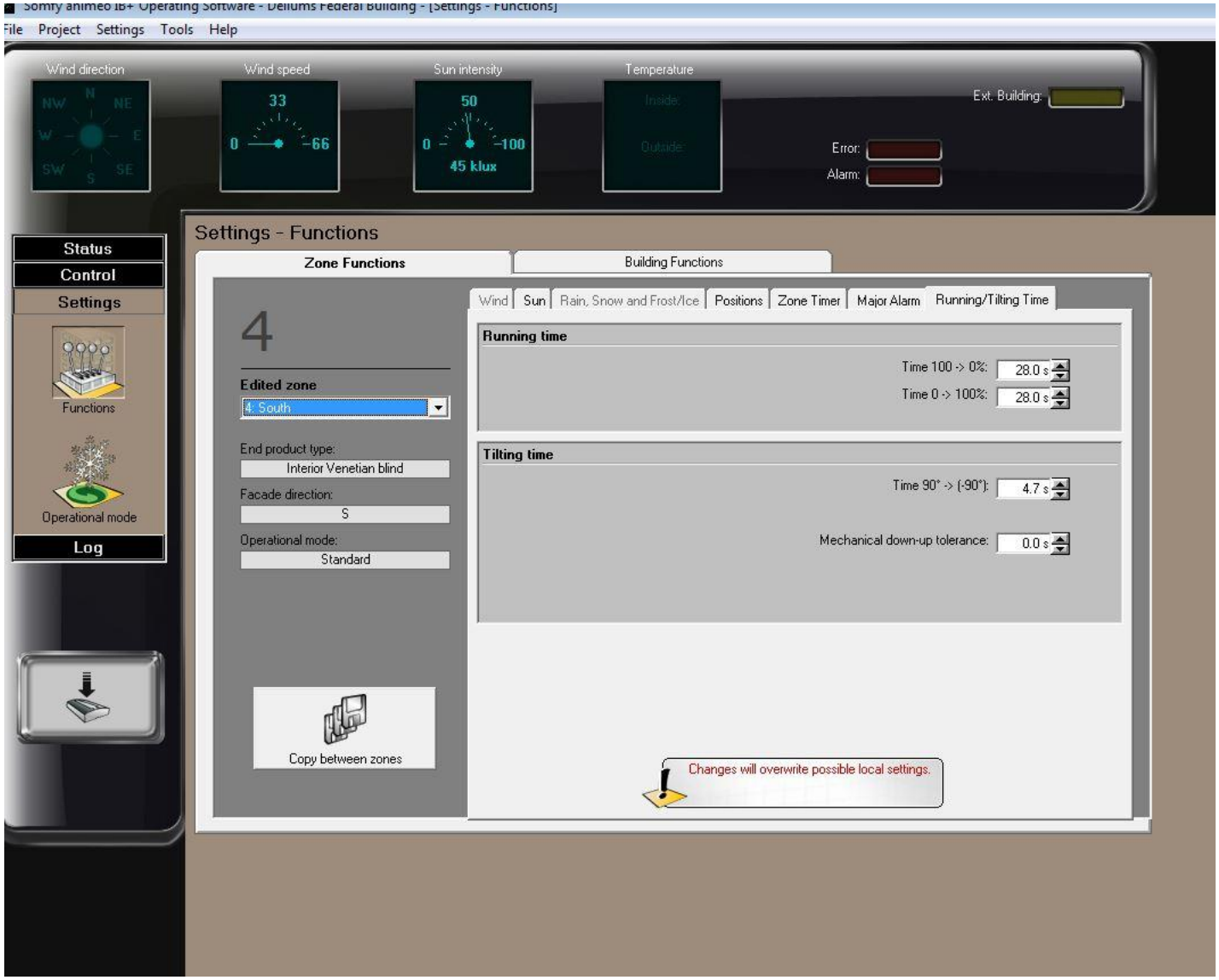
Runtime 1


Wind direction
Wind speed
33
0
66
Sun intensity
50
0
100
43 klux
Temperature
Inside:
Outside:
Ext. Building:
Error:
Alarm:
Settings - Functions
Status
Control
Settings
Functions
Operational mode
Log
Zone Functions
Building Functions
2
Edited zone
2: East
End product type:
Interior Venetian blind
Facade direction:
E
Operational mode:
Standard
Copy between zones
Wind
Sun
Rain, Snow and Frost/Ice
Positions
Zone Timer
Major Alarm
Running/Tilting Time
Running time
Time 100 -> 0%:
29.0 s
Time 0 -> 100%:
29.0 s
Tilting time
Time 90° -> (-90°):
4.8 s
Mechanical down-up tolerance:
0.0 s
Changes will overwrite possible local settings.

Runtime 2


le Project Settings Tools Help
Wind direction
Wind speed
33
0
66
Sun intensity
50
0
100
43 klux
Temperature
Inside
Outside
Ext. Building:
Error:
Alarm:
Status
Control
Settings
Functions
Operational mode
Log
Settings - Functions
Zone Functions
Building Functions
3
Edited zone
3: SouthEast
End product type:
Interior Venetian blind
Facade direction:
SE
Operational mode:
Standard
Copy between zones
Wind
Sun
Rain, Snow and Frost/Ice
Positions
Zone Timer
Major Alarm
Running/Tilting Time
Running time
Time 100 -> 0%:
28.0 s
Time 0 -> 100%:
29.0 s
Tilting time
Time 90° -> (-90°):
4.6 s
Mechanical down-up tolerance:
0.0 s
Changes will overwrite possible local settings.

Runtime 3


File Project Settings Tools Help
Wind direction
Wind speed
33
0 66
Sun intensity
50
0 100
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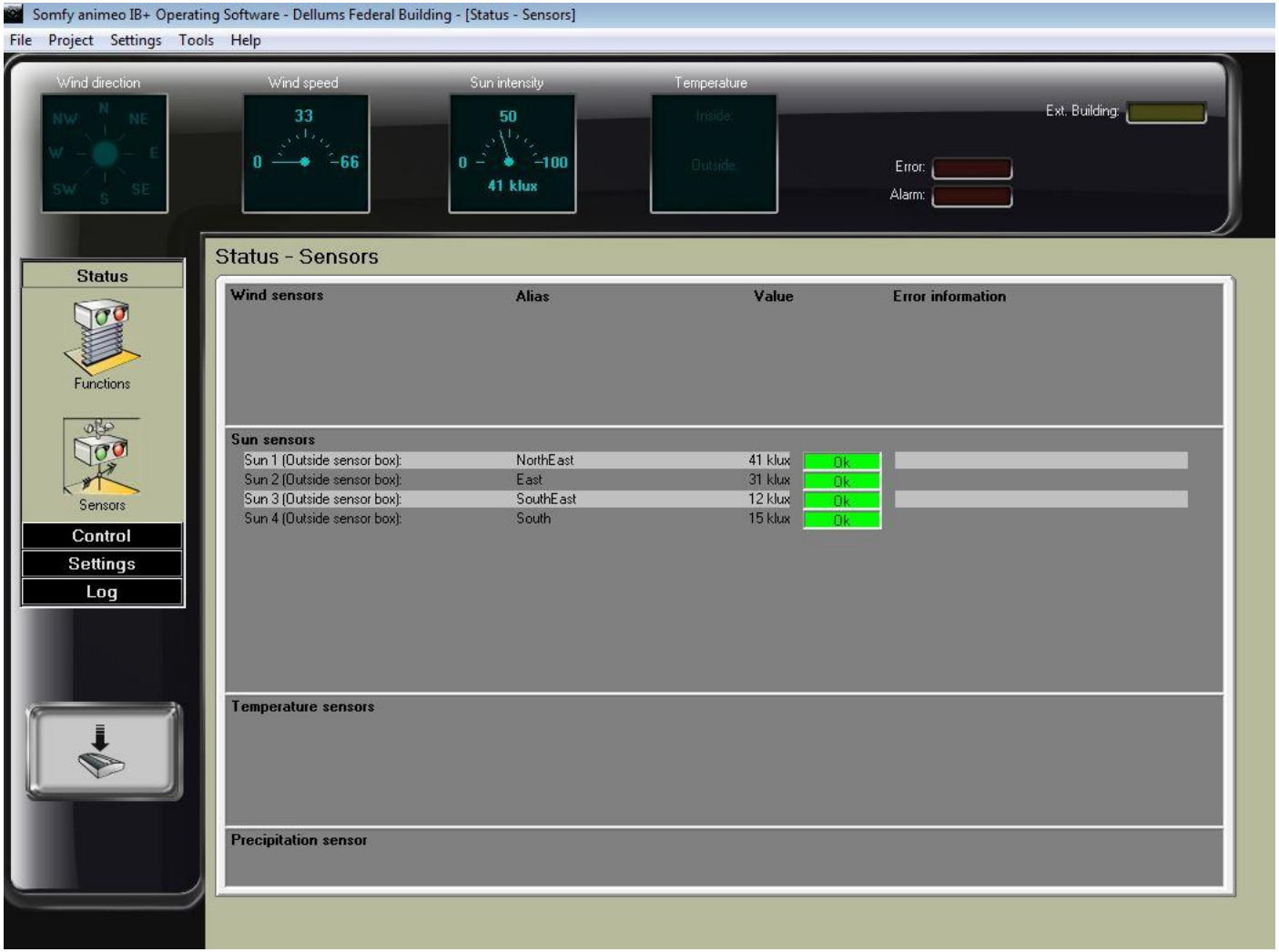
Temperature
Inside:
Outside:
Ext. Building:
Error:
Alarm:
Status
Control
Settings
Functions
Operational mode
Log
Settings - Functions
Zone Functions
Building Functions
Wind
Sun
Rain, Snow and Frost/Ice
Positions
Zone Timer
Major Alarm
Running/Tilting Time
4
Edited zone
4: South
End product type:
Interior Venetian blind
Facade direction:
S
Operational mode:
Standard
Copy between zones
Running time
Time 100 -> 0%: 28.0 s
Time 0 -> 100%: 28.0 s
Tilting time
Time 90° -> (-90°): 4.7 s
Mechanical down-up tolerance: 0.0 s
Changes will overwrite possible local settings.

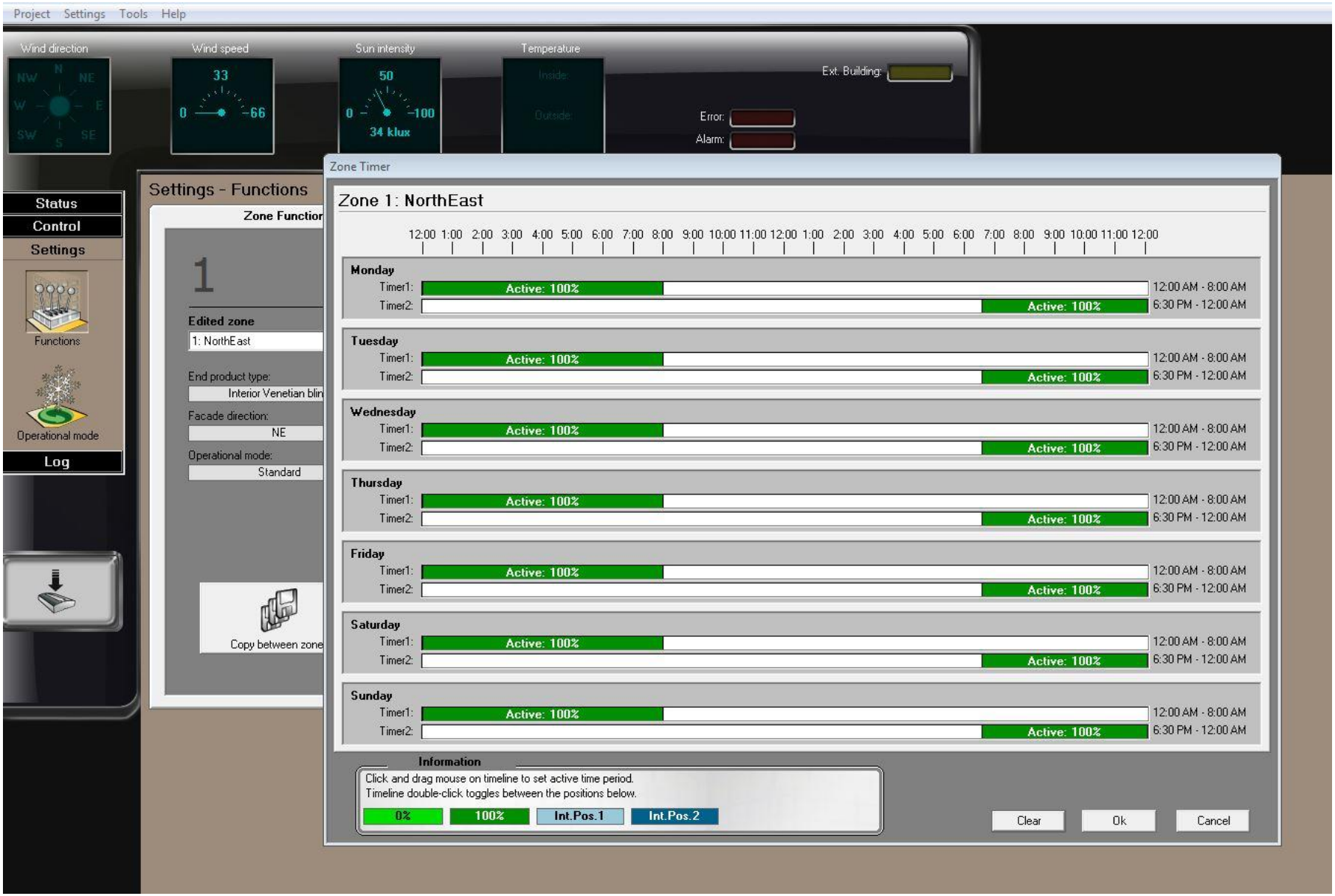
Runtime 4


Somfy animeo IB+ Operating Software - Dellums Federal Building - [Status - Functions]
File Project Settings Tools Help
Wind direction
Wind speed
33
0 66
Sun intensity
50
0 100
41 klux
Temperature
Inside:
Outside:
Ext. Building:
Error:
Alarm:
Status
Functions
Sensors
Control
Settings
Log
Status - Functions
Zone 1 - 4
NorthEast
East
SouthEast
South
Auto
100% / 51°
100% / 33°
0% / -90°
Interior Venetian blind
Standard mode
Major Alarm
PC Building Lock 0%
PC Zone Lock 0%
Key Building Lock 0%
Key Zone Lock 0%
Major Error
Wind Speed
Wind Direction
Snow
Frost/Ice
Rain
Building Timer
Key Building 100%
PC Zone Command
Switch Building Command
Switch Zone Command
Zone Timer
Reset Building 0%
Solar Heating
Solar Heating HVAC
Maintain Heat
Ventilation Cooling
Ventilation Cooling HVAC
Zone Synergy
Sun
Information
Security functions
Active
Inactive
Disabled
Non security functions
Active
Inactive
Energy active
Energy inactive
Disabled
Not used in manual mode

status



Status sensors


Project Settings Tools Help
Wind direction
Wind speed
33
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Sun intensity
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34 klux
Temperature
Inside:
Outside:
Ext. Building:
Error:
Alarm:
Status
Control
Settings
Functions
Operational mode
Log
Settings - Functions
Zone Functior
1
Edited zone
1: NorthEast
End product type:
Interior Venetian blin
Facade direction:
NE
Operational mode:
Standard
Copy between zone
Zone Timer
Zone 1: NorthEast
12:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00
Monday
Timer1: Active: 100% 12:00 AM - 8:00 AM
Timer2: Active: 100% 6:30 PM - 12:00 AM
Tuesday
Timer1: Active: 100% 12:00 AM - 8:00 AM
Timer2: Active: 100% 6:30 PM - 12:00 AM
Wednesday
Timer1: Active: 100% 12:00 AM - 8:00 AM
Timer2: Active: 100% 6:30 PM - 12:00 AM
Thursday
Timer1: Active: 100% 12:00 AM - 8:00 AM
Timer2: Active: 100% 6:30 PM - 12:00 AM
Friday
Timer1: Active: 100% 12:00 AM - 8:00 AM
Timer2: Active: 100% 6:30 PM - 12:00 AM
Saturday
Timer1: Active: 100% 12:00 AM - 8:00 AM
Timer2: Active: 100% 6:30 PM - 12:00 AM
Sunday
Timer1: Active: 100% 12:00 AM - 8:00 AM
Timer2: Active: 100% 6:30 PM - 12:00 AM
Information
Click and drag mouse on timeline to set active time period.
Timeline double-click toggles between the positions below.
0% 100% Int.Pos.1 Int.Pos.2
Clear Ok Cancel

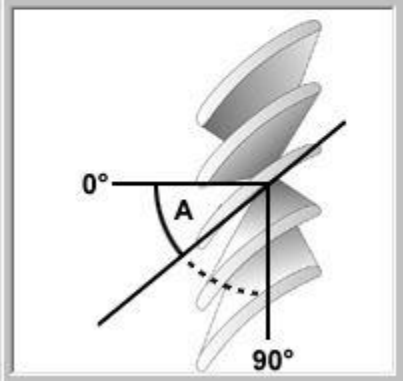
timer

Suntracking

Zone 1: NorthEast Direction: NE

Suntracking angles and change times

	Angle1	Angle2	Time	Angle3	Time
January	80 °	39 °	7:45 AM	39 °	8:00 AM
February	80 °	70 °	7:15 AM	50 °	7:45 AM
March	80 °	69 °	7:00 AM	47 °	7:45 AM
April	80 °	68 °	6:45 AM	51 °	7:30 AM
May	80 °	72 °	6:15 AM	54 °	7:15 AM
June	80 °	70 °	6:15 AM	53 °	7:15 AM
July	80 °	71 °	6:15 AM	53 °	7:15 AM
August	80 °	70 °	6:30 AM	50 °	7:30 AM
September	80 °	72 °	6:45 AM	53 °	7:30 AM
October	80 °	67 °	7:15 AM	49 °	7:45 AM
November	80 °	66 °	7:30 AM	39 °	8:00 AM
December	80 °	39 °	7:45 AM	39 °	8:00 AM

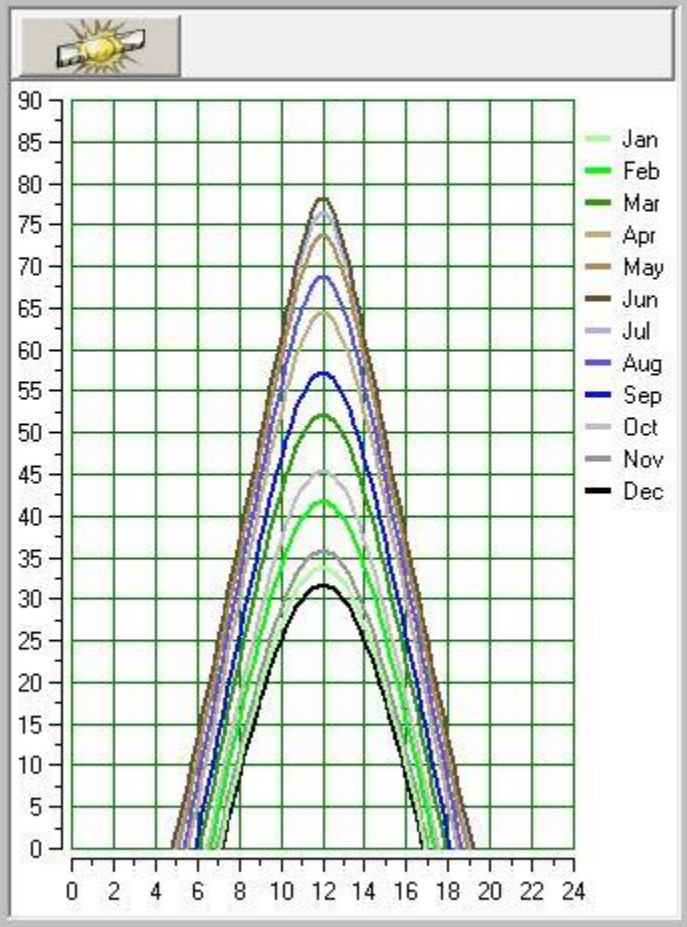


Max. allowed angle (A): 90

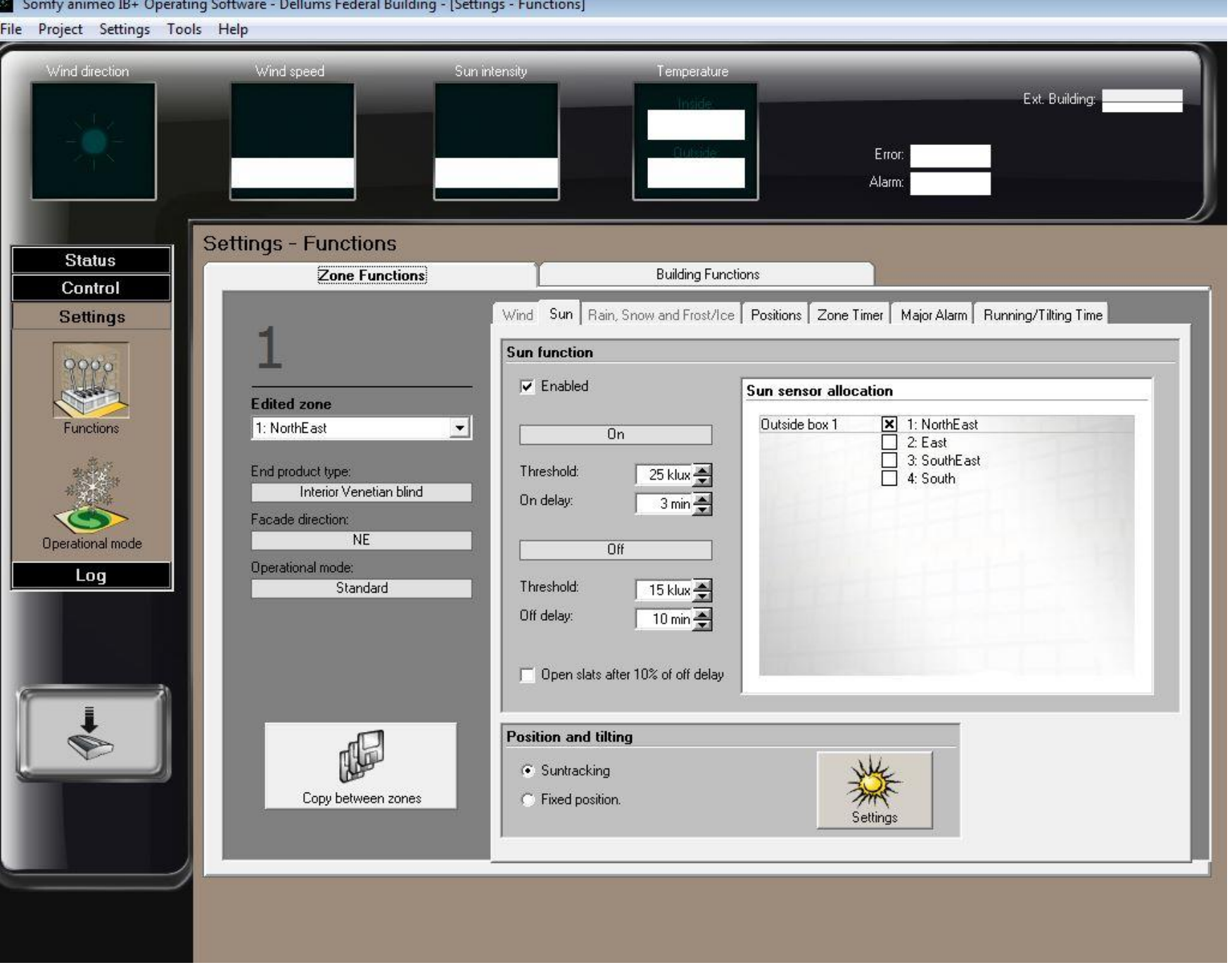
Default

Calculate

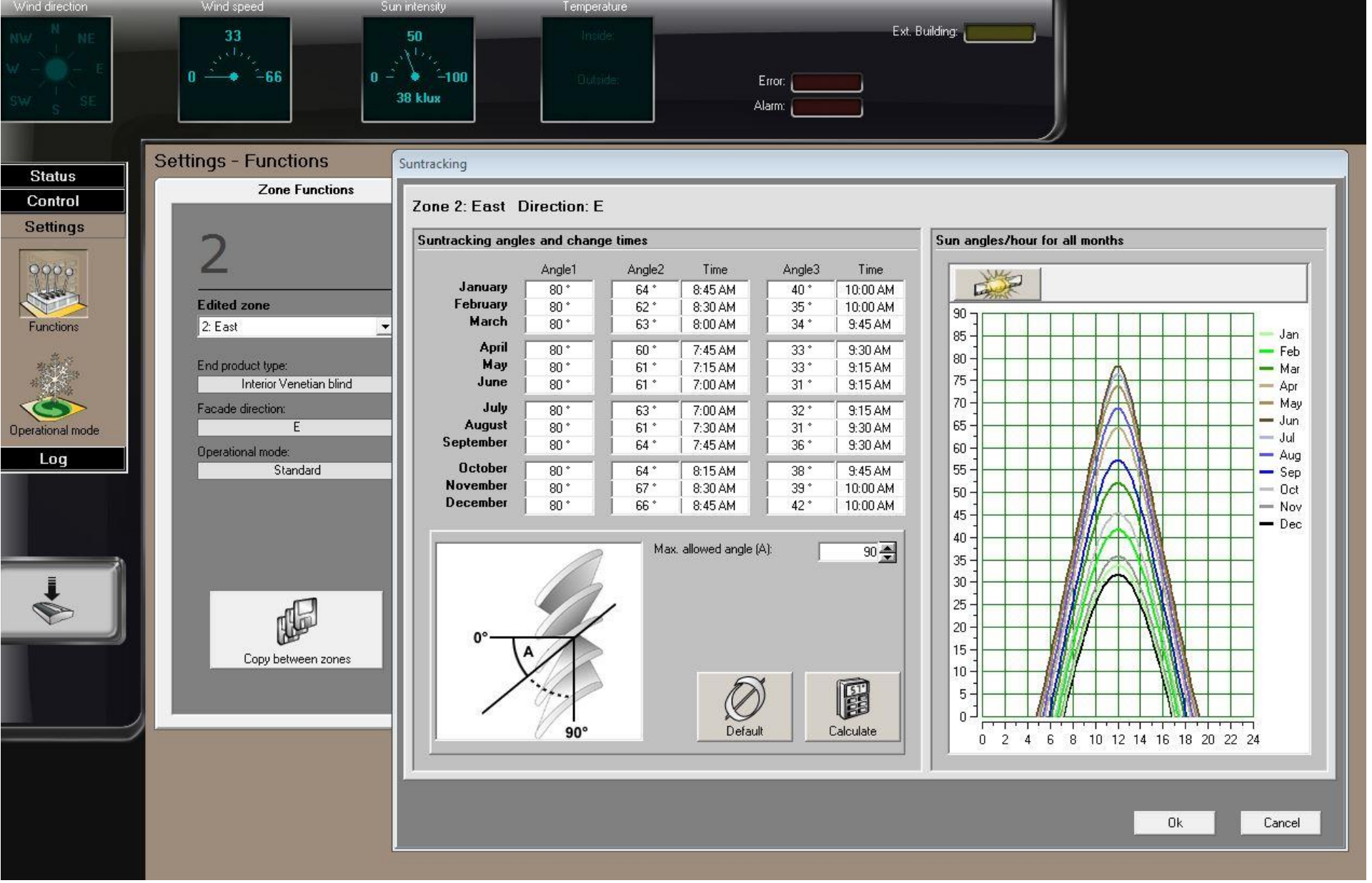
Sun angles/hour for all months



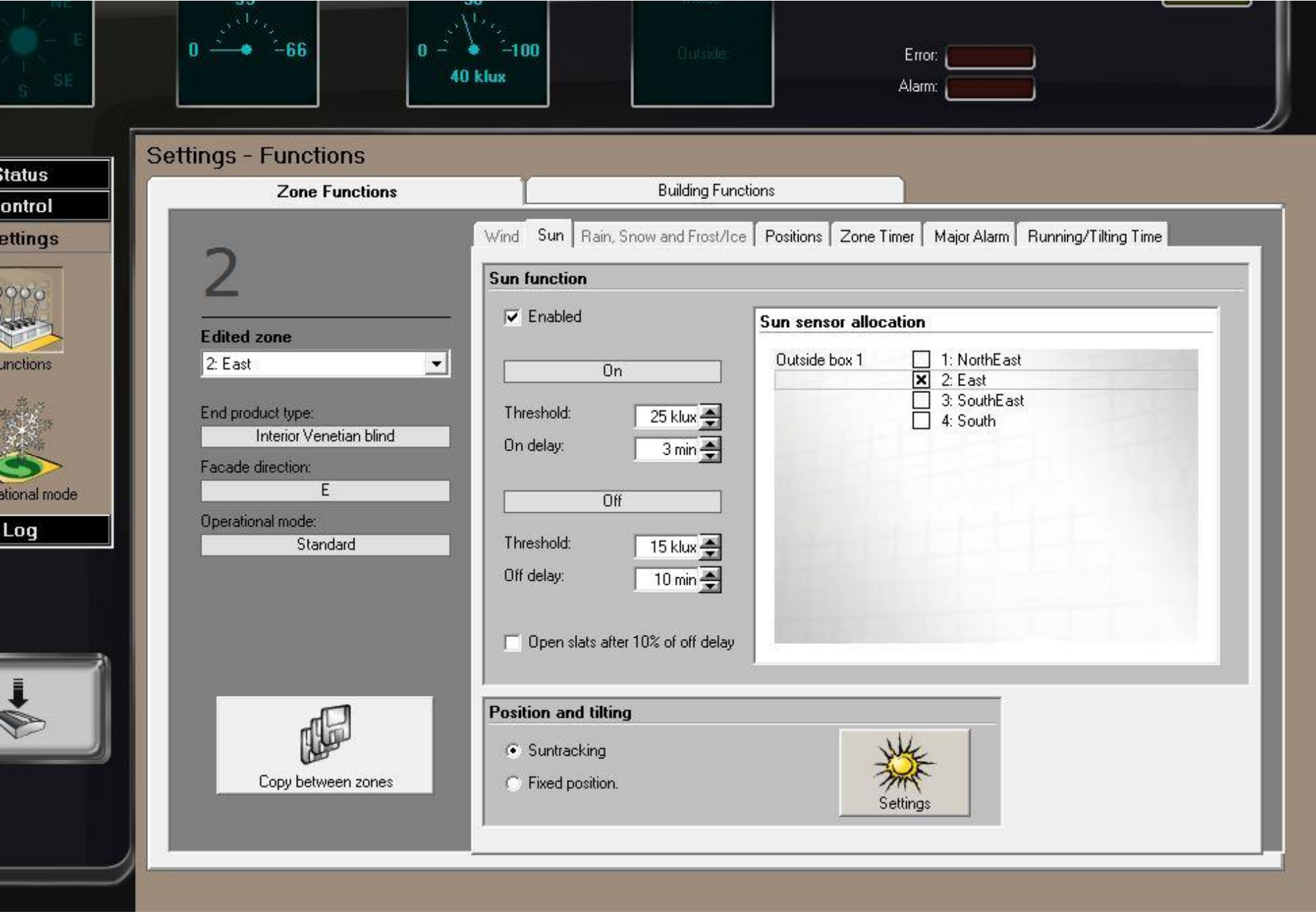
Zone 1


Somfy animeo IB+ Operating Software - Dellums Federal Building - [Settings - Functions]
File Project Settings Tools Help
Wind direction
Wind speed
Sun intensity
Temperature
Inside
Outside
Ext. Building:
Error:
Alarm:
Settings - Functions
Status
Control
Settings
Functions
Operational mode
Log
Zone Functions
Building Functions
Wind
Sun
Rain, Snow and Frost/Ice
Positions
Zone Timer
Major Alarm
Running/Tilting Time
1
Edited zone
1: NorthEast
End product type:
Interior Venetian blind
Facade direction:
NE
Operational mode:
Standard
Sun function
Enabled
On
Threshold: 25 klux
On delay: 3 min
Off
Threshold: 15 klux
Off delay: 10 min
Open slats after 10% of off delay
Sun sensor allocation
Outside box 1
1: NorthEast
2: East
3: SouthEast
4: South
Copy between zones
Position and tilting
Suntracking
Fixed position.
Settings

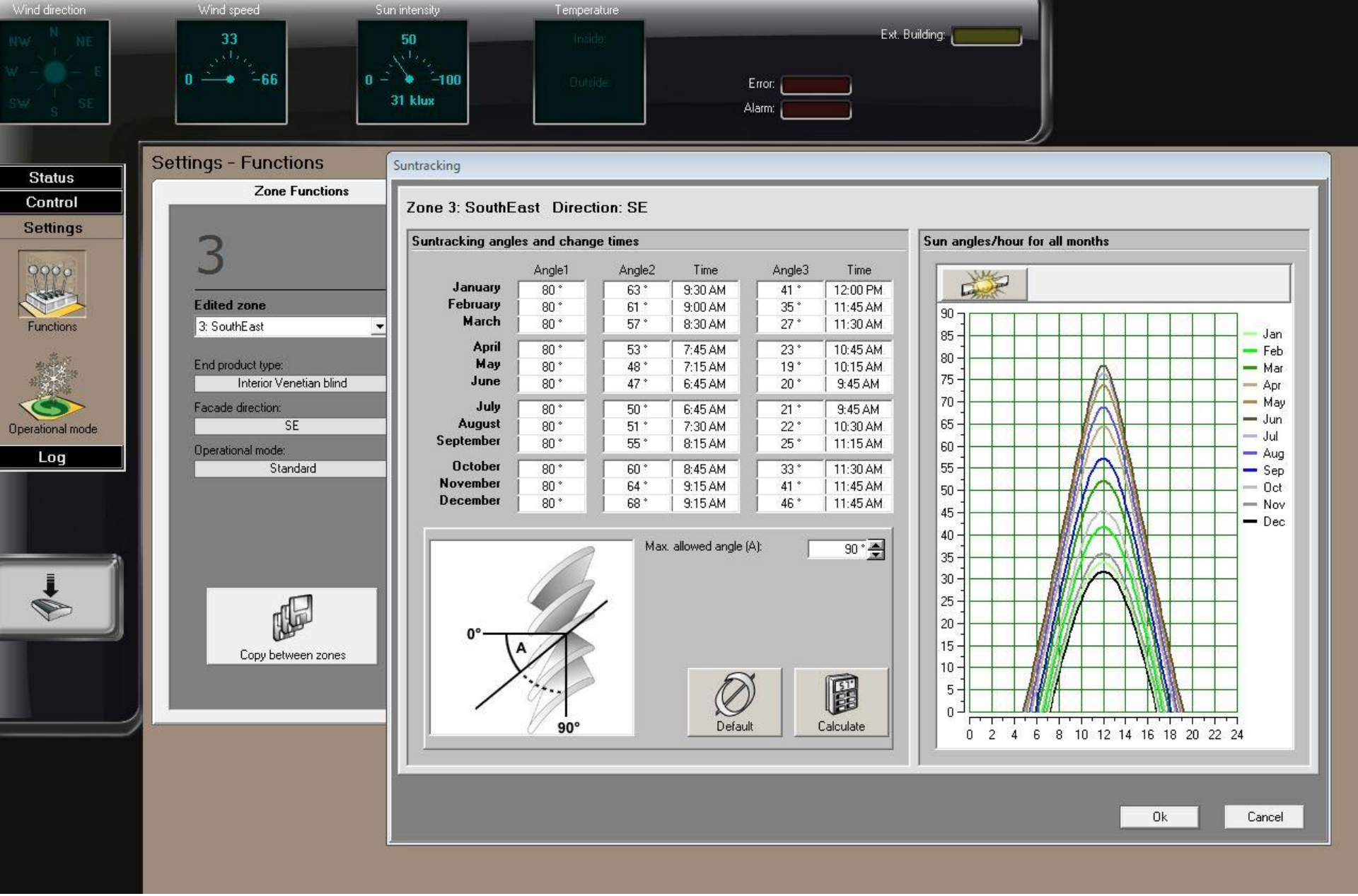
Zone 1.1


Wind direction
Wind speed
33
0
66
Sun intensity
50
0
100
38 klux
Temperature
Inside:
Outside:
Ext. Building:
Error:
Alarm:
Status
Control
Settings
Functions
Operational mode
Log
Settings - Functions
Zone Functions
2
Edited zone
2: East
End product type:
Interior Venetian blind
Facade direction:
E
Operational mode:
Standard
Copy between zones
Suntracking
Zone 2: East Direction: E
Suntracking angles and change times
Angle1
Angle2
Time
Angle3
Time
January 80 ° 64 ° 8:45 AM 40 ° 10:00 AM
February 80 ° 62 ° 8:30 AM 35 ° 10:00 AM
March 80 ° 63 ° 8:00 AM 34 ° 9:45 AM
April 80 ° 60 ° 7:45 AM 33 ° 9:30 AM
May 80 ° 61 ° 7:15 AM 33 ° 9:15 AM
June 80 ° 61 ° 7:00 AM 31 ° 9:15 AM
July 80 ° 63 ° 7:00 AM 32 ° 9:15 AM
August 80 ° 61 ° 7:30 AM 31 ° 9:30 AM
September 80 ° 64 ° 7:45 AM 36 ° 9:30 AM
October 80 ° 64 ° 8:15 AM 38 ° 9:45 AM
November 80 ° 67 ° 8:30 AM 39 ° 10:00 AM
December 80 ° 66 ° 8:45 AM 42 ° 10:00 AM
0°
A
90°
Max. allowed angle (A):
90
Default
Calculate
Sun angles/hour for all months
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Ok
Cancel

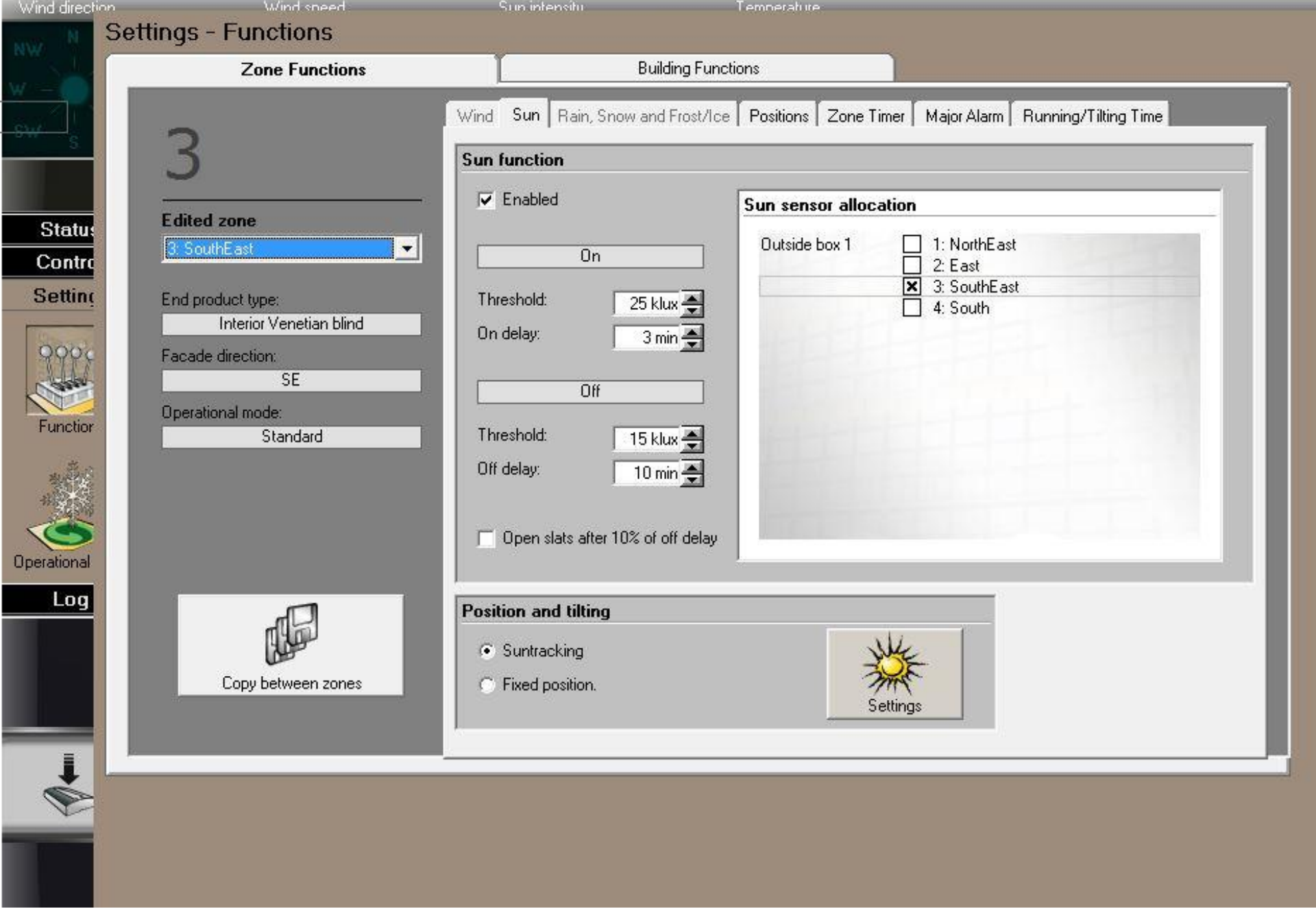
Zone 2


0 -66
0 -100
40 klux
Outside
Error:
Alarm:
Status
ontrol
ettings
unctions
ational mode
Log
Settings - Functions
Zone Functions
Building Functions
2
Edited zone
2: East
End product type:
Interior Venetian blind
Facade direction:
E
Operational mode:
Standard
Copy between zones
Wind
Sun
Rain, Snow and Frost/Ice
Positions
Zone Timer
Major Alarm
Running/Tilting Time
Sun function
Enabled
On
Threshold:
25 klux
On delay:
3 min
Off
Threshold:
15 klux
Off delay:
10 min
Open slats after 10% of off delay
Sun sensor allocation
Outside box 1
1: NorthEast
2: East
3: SouthEast
4: South
Position and tilting
Suntracking
Fixed position.
Settings

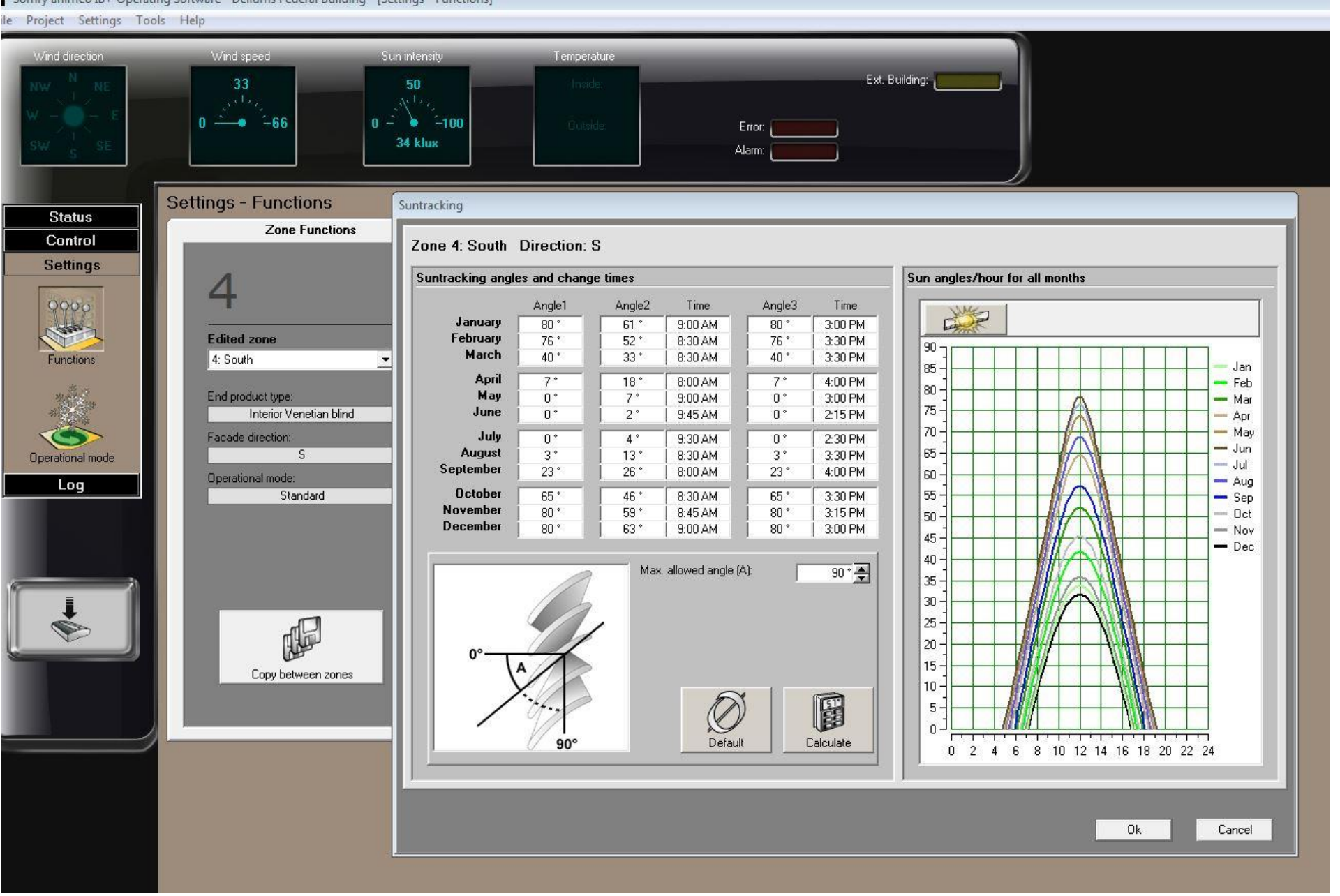
Zone 2.1


Wind direction
Wind speed
33
0
66
Sun intensity
50
0
100
31 klux
Temperature
Inside:
Outside:
Ext. Building:
Error:
Alarm:
Status
Control
Settings
Functions
Operational mode
Log
Settings - Functions
Zone Functions
3
Edited zone
3: SouthEast
End product type:
Interior Venetian blind
Facade direction:
SE
Operational mode:
Standard
Copy between zones
Suntracking
Zone 3: SouthEast Direction: SE
Suntracking angles and change times
Angle1 Angle2 Time Angle3 Time
January 80 ° 63 ° 9:30 AM 41 ° 12:00 PM
February 80 ° 61 ° 9:00 AM 35 ° 11:45 AM
March 80 ° 57 ° 8:30 AM 27 ° 11:30 AM
April 80 ° 53 ° 7:45 AM 23 ° 10:45 AM
May 80 ° 48 ° 7:15 AM 19 ° 10:15 AM
June 80 ° 47 ° 6:45 AM 20 ° 9:45 AM
July 80 ° 50 ° 6:45 AM 21 ° 9:45 AM
August 80 ° 51 ° 7:30 AM 22 ° 10:30 AM
September 80 ° 55 ° 8:15 AM 25 ° 11:15 AM
October 80 ° 60 ° 8:45 AM 33 ° 11:30 AM
November 80 ° 64 ° 9:15 AM 41 ° 11:45 AM
December 80 ° 68 ° 9:15 AM 46 ° 11:45 AM
0°
A
90°
Max. allowed angle (A):
90 °
Default
Calculate
Sun angles/hour for all months
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Ok
Cancel

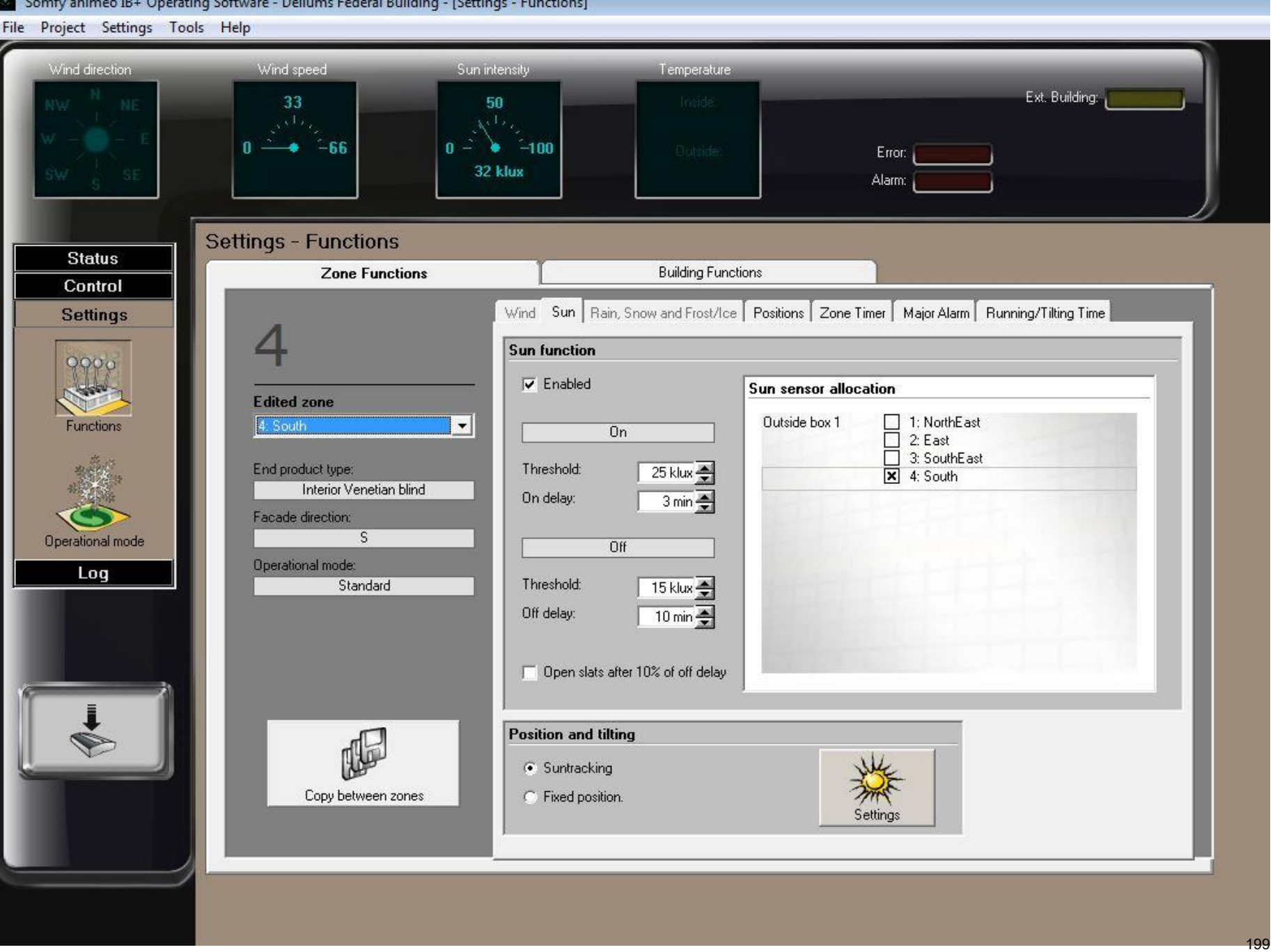
Zone 3


Wind direction
Wind speed
Sun intensity
Temperature
Settings - Functions
Zone Functions
Building Functions
Status
Control
Setting
Function
Operational
Log
3
Edited zone
3: SouthEast
End product type:
Interior Venetian blind
Facade direction:
SE
Operational mode:
Standard
Copy between zones
Wind
Sun
Rain, Snow and Frost/Ice
Positions
Zone Timer
Major Alarm
Running/Tilting Time
Sun function
Enabled
On
Threshold:
25 klux
On delay:
3 min
Off
Threshold:
15 klux
Off delay:
10 min
Open slats after 10% of off delay
Sun sensor allocation
Outside box 1
1: NorthEast
2: East
3: SouthEast
4: South
Position and tilting
Suntracking
Fixed position.
Settings

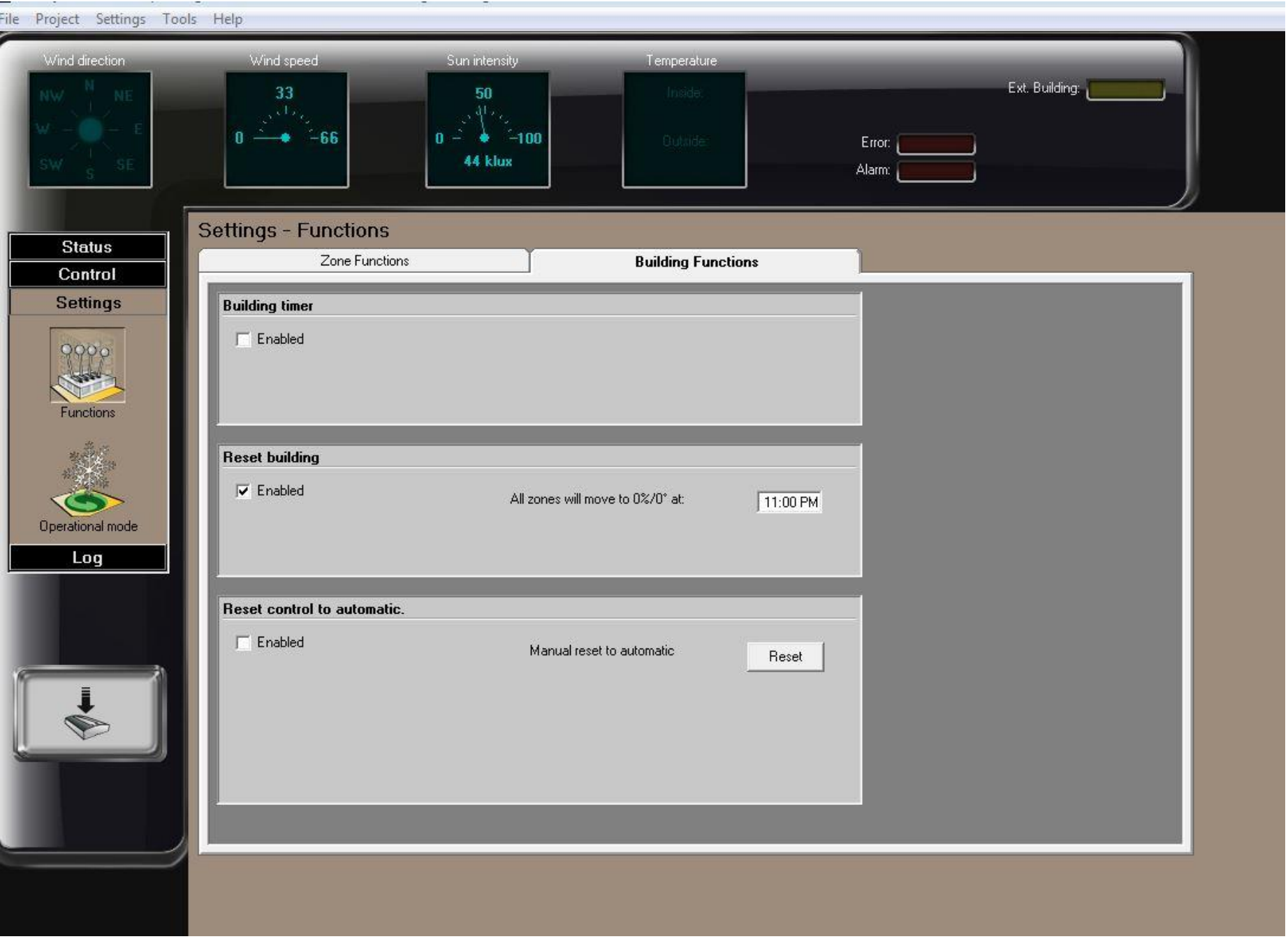
Zone 3.1


Project Settings Tools Help
Wind direction
Wind speed
33
0 -66
Sun intensity
50
0 -100
34 klux
Temperature
Inside:
Outside:
Ext. Building:
Error:
Alarm:
Status
Control
Settings
Functions
Operational mode
Log
Settings - Functions
Zone Functions
4
Edited zone
4: South
End product type:
Interior Venetian blind
Facade direction:
S
Operational mode:
Standard
Copy between zones
Suntracking
Zone 4: South Direction: S
Suntracking angles and change times
Angle1 Angle2 Time Angle3 Time
January 80 ° 61 ° 9:00 AM 80 ° 3:00 PM
February 76 ° 52 ° 8:30 AM 76 ° 3:30 PM
March 40 ° 33 ° 8:30 AM 40 ° 3:30 PM
April 7 ° 18 ° 8:00 AM 7 ° 4:00 PM
May 0 ° 7 ° 9:00 AM 0 ° 3:00 PM
June 0 ° 2 ° 9:45 AM 0 ° 2:15 PM
July 0 ° 4 ° 9:30 AM 0 ° 2:30 PM
August 3 ° 13 ° 8:30 AM 3 ° 3:30 PM
September 23 ° 26 ° 8:00 AM 23 ° 4:00 PM
October 65 ° 46 ° 8:30 AM 65 ° 3:30 PM
November 80 ° 59 ° 8:45 AM 80 ° 3:15 PM
December 80 ° 63 ° 9:00 AM 80 ° 3:00 PM
0°
A
90°
Max. allowed angle (A):
90 °
Default
Calculate
Sun angles/hour for all months
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Ok
Cancel

Zone 4


Somfy animeo IB+ Operating Software - Dellums Federal Building - [Settings - Functions]
File Project Settings Tools Help
Wind direction
Wind speed
33
0 66
Sun intensity
50
0 100
32 klux
Temperature
Inside:
Outside:
Ext. Building:
Error:
Alarm:
Status
Control
Settings
Functions
Operational mode
Log
Settings - Functions
Zone Functions
Building Functions
Wind Sun Rain, Snow and Frost/Ice Positions Zone Timer Major Alarm Running/Tilting Time
4
Edited zone
4: South
End product type:
Interior Venetian blind
Facade direction:
S
Operational mode:
Standard
Copy between zones
Sun function
Enabled
On
Threshold: 25 klux
On delay: 3 min
Off
Threshold: 15 klux
Off delay: 10 min
Open slats after 10% of off delay
Sun sensor allocation
Outside box 1
1: NorthEast
2: East
3: SouthEast
4: South
Position and tilting
Suntracking
Fixed position.
Settings

Zone 4.1


File Project Settings Tools Help
Wind direction
NW N NE W E SW S SE
Wind speed
33
0 -66
Sun intensity
50
0 -100
44 klux
Temperature
Inside:
Outside:
Ext. Building:
Error:
Alarm:
Status
Control
Settings
Functions
Operational mode
Log
Settings - Functions
Zone Functions
Building Functions
Building timer
Enabled
Reset building
Enabled
All zones will move to 0%/0° at:
11:00 PM
Reset control to automatic.
Enabled
Manual reset to automatic
Reset

Building