DAYLIGHTING GUIDE

FOR THE

COMMERCIAL OFFICE

WHO ARE THE PLAYERS?

SPONSOR

Advanced Energy Office

COLLABORATORS

New Buildings Institute
- Dave Hewitt
- Amy Cortese
- Barb Hamilton

IA | Interior Architects
- Nancy Heywood
- Kim Parsley
- Elsa Allen
- Brian van Stipdonk

University of Washington – Integrated Design Lab
- Christopher Meek

PROJECT GOALS

TARGETS

Provide resources to communicate how the design of an office interior provides substantial opportunity to use daylight.

Educate designers and occupants on benefits of buildings illuminated with daylight:

- Healthier and higher quality interior environments
- Increased individual productivity
- Increased human comfort
- Mental and visual stimulation

LAYOUT OF THE GUIDE

Steps to accomplishing specific topic within the guide

DAYLIGHTING GUIDE

For the Commercial Office

INTRODUCTION
PROGRAMMING
SPACE PLANNING
WINDOW COVERING DESIGN
WORKSTATION PANEL DESIGN
INTERIOR SURFACE FINISHES
ELECTRICAL LIGHTING CONTROLS
CONCLUSION

Facts

A mid-day overcast sky in the summer generally provides a range of 2200 to 6400 footcandles.

A mid-day overcast sky in the winter generally provides a range of 650 to 1300 footcandles.

Programming Criteria

For Each Program Element

Is daylight important for this space?

In this space, are views to the exterior important?

How frequently is this space used?

During what time of day and time of year will the space be occupied?

Resources

SOLAR CLIMATE ANALYSIS SOFTWARE DATABASE
http://www.eere.energy.gov/
Search for:
"Solar Climate Analysis"

Glossary

FOOTCANDLE (fc)
A unit of measurement for calculating adequate lighting levels.

It is the amount of light that actually falls on a given surface.

The footcandle is equal to one lumen (a measure of the power of light perceived by the human eye) per square foot.

PROGRAMMING
For Daylight Criteria

In an office TI, we assume that window size, orientation, exterior solar control devices and overall floor plate depth are predetermined. Yet, the interior designer still has a critical role to play in creating a design that meets daylighting criteria appropriate to visual comfort. Placement of the program elements takes into consideration patterns of occupancy, times of use, and orientation of the building to determine the availability and best use of daylight in relation to the program daylight requirements.

Programming for daylight may include LEED™ criteria, however, successful daylighting is far more specific to the visual experience than any single metric.

In order to determine the availability and best use of daylight in relation to the program, the designer must ask themselves a series of qualitative and quantitative questions. The column at left titled Programming Criteria For Each Program Element lists four key queries. While the first two speak of quality of light and view, the second two open up opportunities to hard wire a link between specific programmatic elements and thoughtful daylighting strategies.

An example of a program for daylight criteria might include the following:

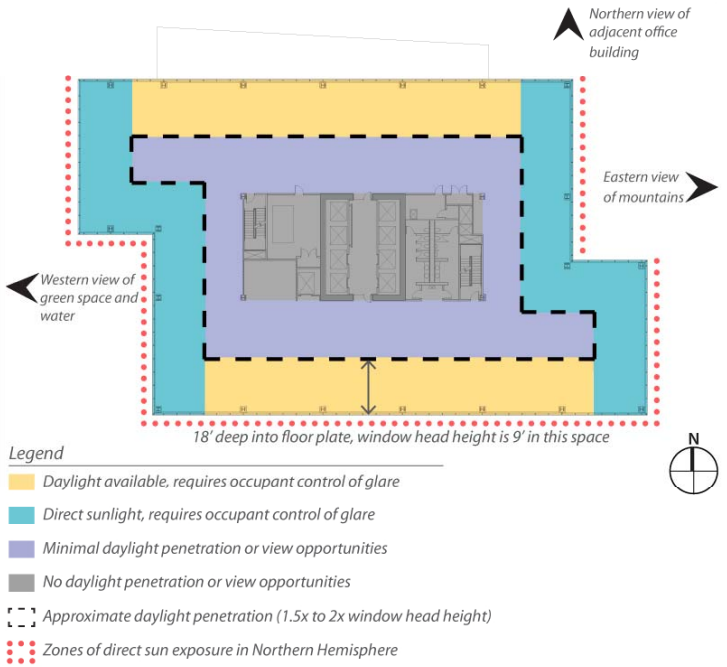
Open Office - Daylight and view desired, occupants have glare control

Private Offices - Daylight and view desired, individual occupant glare control

Support Spaces - Minimal daylight or view opportunities required

Building Core - No daylight or view opportunities are necessary

Example of a daylighting opportunity analysis



LAYOUT OF THE GUIDE

Facts, Tips, and Glossary

- Did you know a mid-day overcast summer sky provides a range of 2200 to 6400 footcandles?
- Footcandles are a unit of measurement for calculating adequate lighting levels.

DAYLIGHTING GUIDE
For the Commercial Office

INTRODUCTION
PROGRAMMING
SPACE PLANNING
WINDOW COVERING DESIGN
WORKSTATION PANEL DESIGN
INTERIOR SURFACE FINISHES
ELECTRICAL LIGHTING CONTROLS
CONCLUSION

Facts

A mid-day overcast sky in the summer generally provides a range of 2200 to 6400 footcandles.

A mid-day overcast sky in the winter generally provides a range of 650 to 1300 footcandles.

Programming Criteria

For Each Program Element

Is daylight important for this space?

In this space, are views to the exterior important?

How frequently is this space used?

During what time of day and time of year will the space be occupied?

Resources

SOLAR CLIMATE ANALYSIS SOFTWARE DATABASE
http://www.eere.energy.gov/
Search for:
"Solar Climate Analysis"

Glossary

FOOTCANDLE (fc)
A unit of measurement for calculating adequate lighting levels.

It is the amount of light that actually falls on a given surface.

The footcandle is equal to one lumen (a measure of the power of light perceived by the human eye) per square foot.

PROGRAMMING
For Daylight Criteria

In an office TI, we assume that window size, orientation, exterior solar control devices and overall floor plate depth are predetermined. Yet, the interior designer still has a critical role to play in creating a design that meets daylighting criteria appropriate to visual comfort. Placement of the program elements takes into consideration patterns of occupancy, times of use, and orientation of the building to determine the availability and best use of daylight in relation to the program daylight requirements.

Programming for daylight may include LEED™ criteria, however, successful daylighting is far more specific to the visual experience than any single metric.

In order to determine the availability and best use of daylight in relation to the program, the designer must ask themselves a series of qualitative and quantitative questions. The column at left titled Programming Criteria For Each Program Element lists four key queries. While the first two speak of quality of light and view, the second two open up opportunities to hard wire a link between specific programmatic elements and thoughtful daylighting strategies.

An example of a program for daylight criteria might include the following:

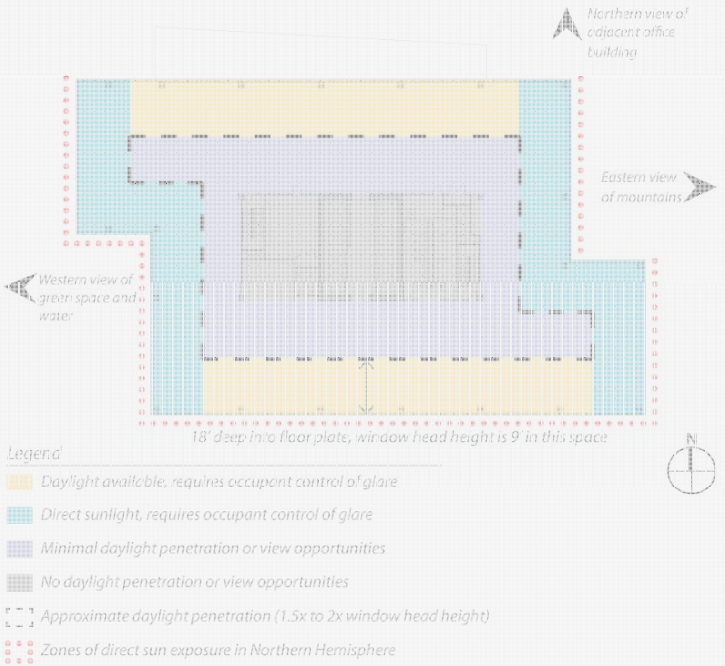
Open Office - Daylight and view desired, occupants have glare control

Private Offices - Daylight and view desired, individual occupant glare control

Support Spaces - Minimal daylight or view opportunities required

Building Core - No daylight or view opportunities are necessary

Example of a daylighting opportunity analysis

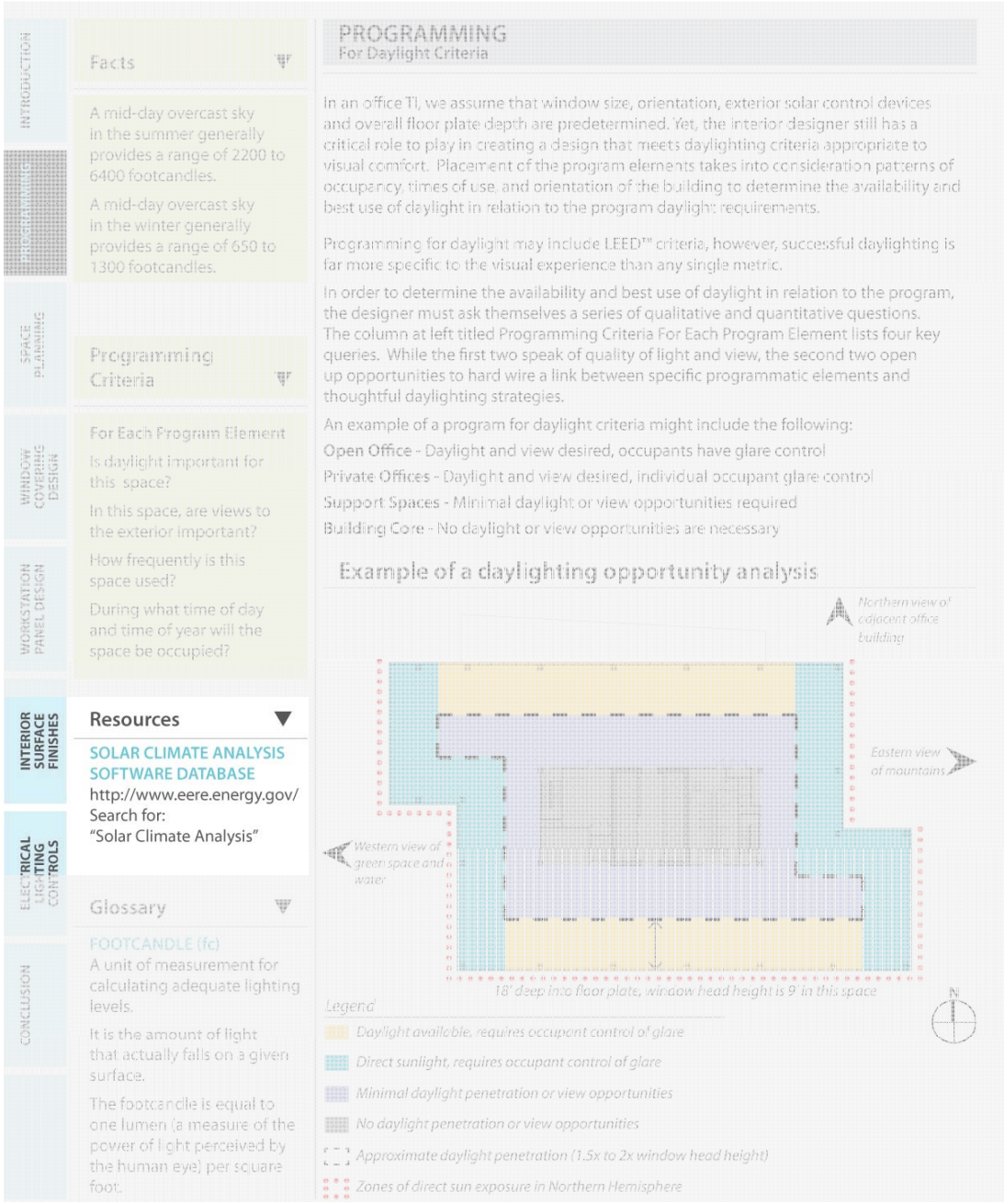


DAYLIGHTING GUIDE FOR THE COMMERCIAL OFFICE

LAYOUT OF THE GUIDE

Resources

- Helpful websites linked in the electronic document and tips for searching the web from the hard copy



LAYOUT OF THE GUIDE

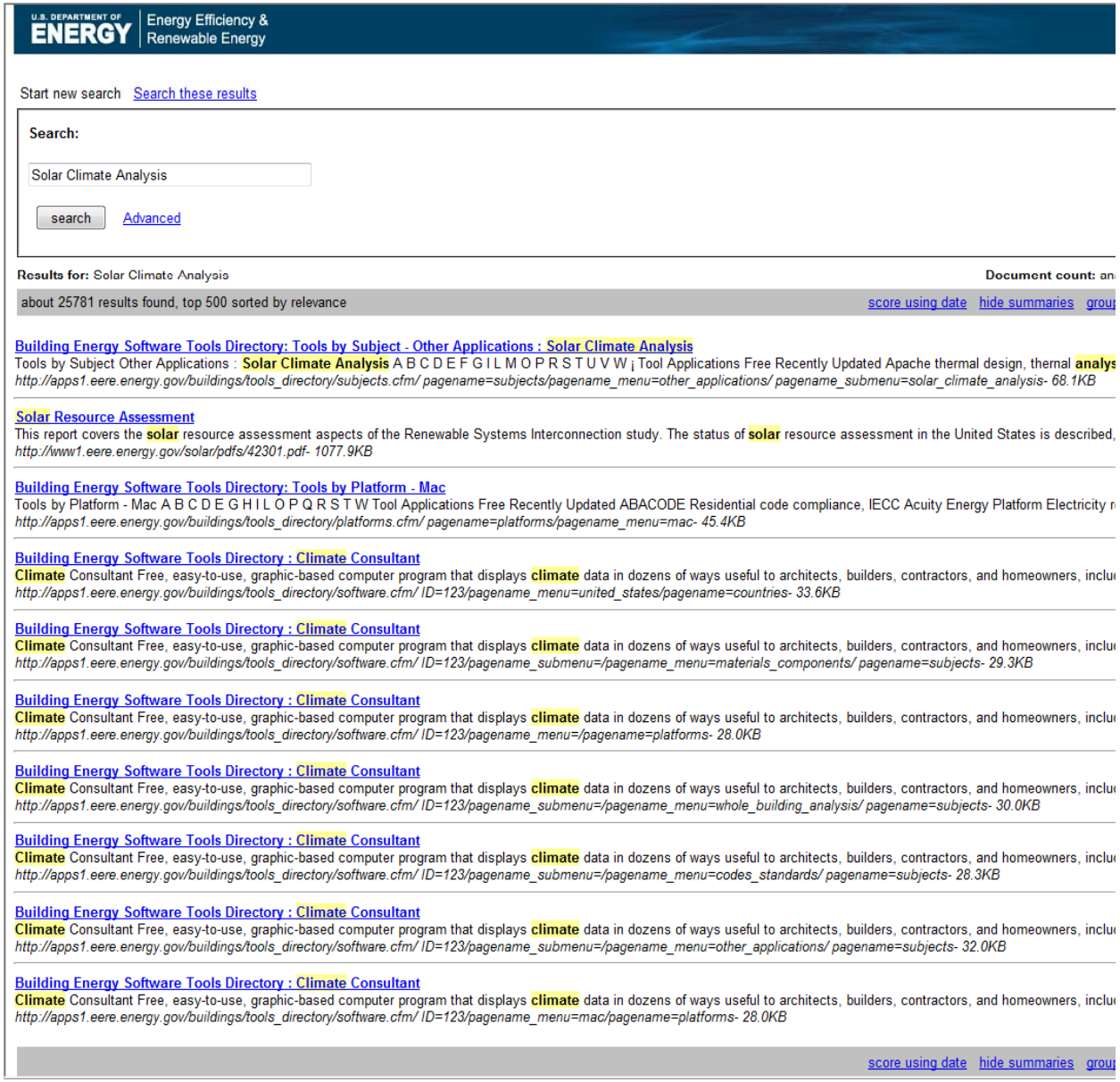
Resources

- Tips for searching the website

LAYOUT OF THE GUIDE

Resources

- Tips for searching the website



DAYLIGHTING GUIDE FOR THE COMMERCIAL OFFICE

PROGRAMMING

- Visit the building site to evaluate:
  - View opportunities
  - Potential glare from adjacent buildings
  - Shading from adjacent buildings
  - Visual privacy
- Determine daylighting and view criteria for each program element
  - Is daylight even desired?
  - How critical is glare control and direct sun?
  - What are the maximum light levels required?

INTRODUCTION
PROGRAMMING
SPACE PLANNING
WINDOW COVERING DESIGN
WORKSTATION PANEL DESIGN
INTERIOR SURFACE FINISHES
ELECTRICAL LIGHTING CONTROLS
CONCLUSION

Facts

A mid-day overcast sky in the summer generally provides a range of 2200 to 6400 footcandles.

A mid-day overcast sky in the winter generally provides a range of 650 to 1300 footcandles.

Programming Criteria

For Each Program Element

Is daylight important for this space?

In this space, are views to the exterior important?

How frequently is this space used?

During what time of day and time of year will the space be occupied?

Resources

SOLAR CLIMATE ANALYSIS SOFTWARE DATABASE
http://www.eere.energy.gov/
Search for:
"Solar Climate Analysis"

Glossary

FOOTCANDLE (fc)
A unit of measurement for calculating adequate lighting levels.

It is the amount of light that actually falls on a given surface.

The footcandle is equal to one lumen (a measure of the power of light perceived by the human eye) per square foot.

PROGRAMMING
For Daylight Criteria

In an office TI, we assume that window size, orientation, exterior solar control devices and overall floor plate depth are predetermined. Yet, the interior designer still has a critical role to play in creating a design that meets daylighting criteria appropriate to visual comfort. Placement of the program elements takes into consideration patterns of occupancy, times of use, and orientation of the building to determine the availability and best use of daylight in relation to the program daylight requirements.

Programming for daylight may include LEED™ criteria, however, successful daylighting is far more specific to the visual experience than any single metric.

In order to determine the availability and best use of daylight in relation to the program, the designer must ask themselves a series of qualitative and quantitative questions. The column at left titled Programming Criteria For Each Program Element lists four key queries. While the first two speak of quality of light and view, the second two open up opportunities to hard wire a link between specific programmatic elements and thoughtful daylighting strategies.

An example of a program for daylight criteria might include the following:

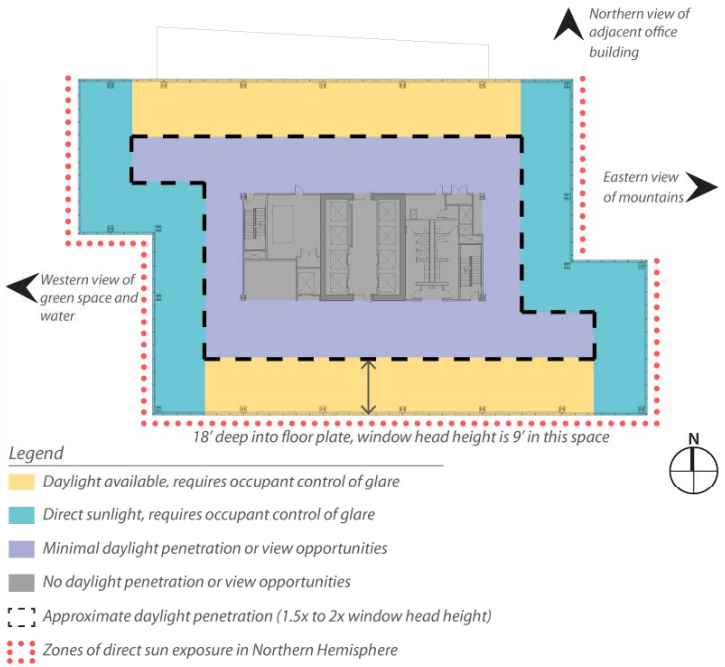
Open Office - Daylight and view desired, occupants have glare control

Private Offices - Daylight and view desired, individual occupant glare control

Support Spaces - Minimal daylight or view opportunities required

Building Core - No daylight or view opportunities are necessary

Example of a daylighting opportunity analysis



PROGRAMMING

- Diagram the daylighting and view opportunities on the floor plan

DAYLIGHTING GUIDE

For the Commercial Office

INTRODUCTION
PROGRAMMING
SPACE PLANNING
WINDOW COVERING DESIGN
WORKSTATION PANEL DESIGN
INTERIOR SURFACE FINISHES
ELECTRICAL LIGHTING CONTROLS
CONCLUSION

Programming Criteria

For Each Daylit Space

What are the minimum daylighting requirements?

How crucial is direct sun and glare control?

What is the minimum footcandle level?

Are there maximum light levels required?

What might be the ideal solar orientation?

What might be the best strategy for providing daylight ?
- Side lighting?
- Toplighting?

Best Practice Footcandle Levels

5 fc: Reception area/ simple orientation for short visits.

10 fc: Working spaces for simple visual tasks.

30 fc: Performance of visual tasks of high contrast and large size.

50 fc: Performance of visual tasks of high contrast and small size, or visual tasks of low contrast and large size.

Herman Miller B-West
Design by IA Interior Architects

The next critical step during programming is to understand the patterns of light specific to the TI space over the course of a day. Daylighting simulation software can be used to understand the distribution of diffuse daylight, while direct sunlight patterns can be understood quickly with any design software that allows for simple shadow casting. Remember that sun control performance is only critical during occupied times.

Understanding patterns of light specific to the TI space is a critical step in the programming process.

- Identify distribution of diffuse illumination and direct sunlight.
- Recognize locations of direct sunlight patterns and the time of day they occur.

Once the characteristics of each daylit TI space are better understood and documented, specific programming criteria can then be applied. The column at left titled Programming Criteria For Each Daylit Space lists six key queries to help define the lighting control strategy of each space.

Work Station: 30-50FC
Occupant can control task light at workstation, accommodating various tasks and personal preferences.

Open Office Pathway: 10-15FC
Light distribution on floor, walls, and ceiling create the perception of a well-lit space.

Common Corridor: 10-25FC
Central pathway requires minimal light, but wall washers at markerboards and accent lighting create interest.

Daylight programming informed the placement of these office spaces and coordination of daylighting and electric lighting strategies.
Online retailer - design by IA Interior Architects
Image courtesy of Keith Sutter for Zuma Photography

Tip

Daylight and views are typically preferred in areas that are most heavily occupied for extended periods of time, such as open office areas. Corridors, circulation paths, break areas, copy/print zones or other short-term gathering spaces may be tolerant of direct sunlight whereas fixed workstations or reception desks will almost never remain comfortable with the presence of direct sun.

Toplighting Strategies

Toplighting via diffuse skylights, or clerestories should be included wherever architecturally possible. Studies show that toplighting tends to provide the most effective daylight performance, since it typically avoids the direct sunlight and glare challenges associated with perimeter windows.

Once a clear description of the daylight performance is in hand, the designer must synthesize the spatial needs of the program elements with the specific patterns of sunlight and diffuse daylight relative to the daylighting design criteria set forth.

DAYLIGHTING GUIDE FOR THE COMMERCIAL OFFICE

SPACE PLANNING

- Align programming criteria with most desirable location on the plan.
  - Locate open office areas within 18’ – 20’ of the perimeter glazing
  - Position private offices where low angle direct sun may otherwise be problematic

INTRODUCTION
PROGRAMMING
SPACE PLANNING
WINDOW COVERING DESIGN
WORKSTATION PANEL DESIGN
INTERIOR SURFACE FINISHES
ELECTRICAL LIGHTING CONTROLS
CONCLUSION

Tip

PRACTICAL DEPTH
For conceptual planning, the practical depth of the daylight zone is limited to 1.5 to 2 times the window height.

Resources

DAYLIGHTING COLLABORATIVE
www.daylighting.org

Glossary

TOPLIGHTING
Daylight that enters the space through skylights or clerestories.

DIFFUSE
Refers to the natural light entering the space through indirect sources, be it obscured by trees, reflected off adjacent buildings or transmitted through translucent materials.

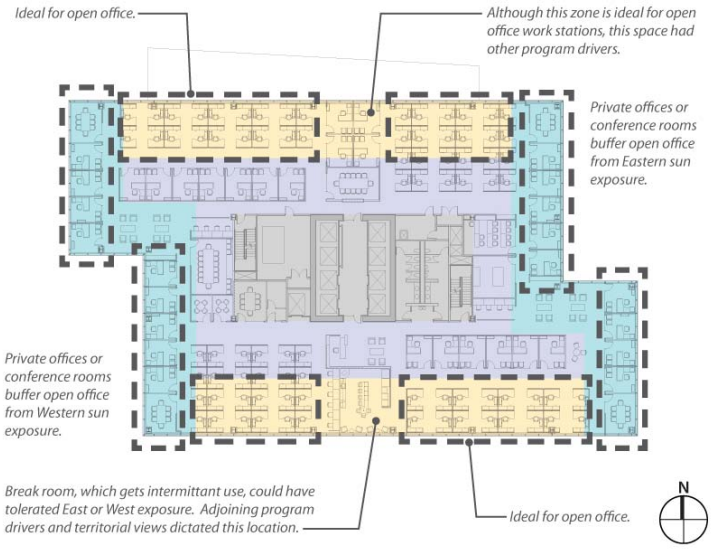
CLERESTORY
Windows set above eye-level on a wall allowing daylight to enter higher within the space.

SPACE PLANNING
Relative to Patterns of Daylight and Times of Occupancy

When space planning for daylight, the designer can synthesize what they know about the patterns of diffuse and direct sun in the space with each program element’s needs, priorities and occupancy patterns.

For example, it is well known that open office environments tend to be occupied by someone nearly continuously during the work day, yet private offices are often unoccupied as much as two-thirds of the time. Occupants in private offices are likely to adjust their blinds frequently, since the “ownership” of their space is clear. In order to ensure an equitable distribution of light and views, the following is recommended:

- Locate open office areas within 18’-20’ of the perimeter zone and at areas where direct sun penetration is limited (North) or less variable (South).
- Position individual offices where low angle direct sun may otherwise be problematic (East and West).



The exact alignment of all program element daylighting criteria and the type of space available to the occupants is not always achievable. However, the visual comfort of building occupants must remain paramount in any performance equation, thus reiterating the importance of an integrated design approach where all strategies in this guide work together to create the most appropriate solution.

DAYLIGHTING GUIDE FOR THE COMMERCIAL OFFICE

WINDOW COVERING DESIGN

- Select appropriate window coverings to diffuse light
- Remember potential for sunlight glare off of adjacent buildings
- Consider the need for visual privacy from neighboring buildings

INTRODUCTION
PROGRAMMING
SPACE PLANNING
WINDOW COVERING DESIGN
WORKSTATION PANEL DESIGN
INTERIOR SURFACE FINISHES
ELECTRICAL LIGHTING CONTROLS
CONCLUSION

Shades / Blinds

Fabric Window Shades:

- Generally reduces diffuse daylight levels by 90% or greater when deployed.
- Does not completely block disc of the sun unless blackout shades.
- Requires user to continuously adjust blind position for optimum daylight performance.
- Easy to use.

Horizontal Blinds:

- Blocks direct sunlight.
- Requires users to continuously adjust blind slat angles for optimum daylight performance.
- Redirect to create diffuse light.

Window Covering Operation

Manual Operation:

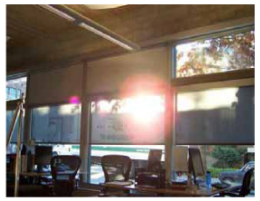
- Proper use can achieve maximum daylight performance.
- Requires frequent user attention to maintain daylight performance.

Automated Operation:

- Deployed and retracted only when needed.
- No user interface required therefore maximizing daylight effectiveness.
- Up to four times as expensive as manual.

WINDOW COVERING DESIGN
For Glare & Thermal Control

The selection of blinds , window coverings, or the lack thereof is likely the most crucial choice a designer will make when seeking to ensure visual comfort while maintaining daylight performance over time.



We have all seen buildings where blinds are down continuously. Typically, this is associated with visual discomfort (glare). The most common source of glare issues in daylighting is a line of sight to the disk of the sun. Selecting a window covering that is opaque enough to block the sun, such as fabric window shades with 3% or less openness or horizontal blinds, can control this phenomena.

Manually operated blind systems can be very effective if properly used. More specifically, a 2" horizontal blind with a white finish can function as a series of mini light shelves casting indirect light into the space when desired. However, they rely on and require constant user attention to maintain complete glare control while achieving maximum daylight performance. For this reason, blinds or shades are often permanently deployed at the "worst case scenario" position to maintain visual comfort throughout the day and year. This typically results in poor daylight performance and the elimination of views to the exterior.

Automated glare control has the distinct advantage of being deployed only when needed and retracting without user intervention when direct sunlight is no longer present to allow for unimpeded diffuse daylight. In most cases, this will deliver longer periods of effective daylight contribution, increased electric lighting power savings, and longer durations of unobstructed views to the exterior. Automation of glare control may provide the most persistent daylight performance where low angle direct sun is present during extended periods of occupancy.

Shading and Exposure Tips

North:
Shading may only be needed in early morning or late afternoon.

South:
Good access to strong illumination but varies through the year. Shading is easier than East/West.

East/ West:
Shading is difficult but critical for comfort.

Direct sunlight can cause visual discomfort. Shutting the blinds here would eliminate the benefit of the daylight.

Example of split window covering strategy to preserve views or block sun where needed, allowing for indirect light into space.

Images courtesy of WAREMA Renkhoff GmbH

DAYLIGHTING GUIDE FOR THE COMMERCIAL OFFICE

WORKSTATION PANEL DESIGN

- Plan for open office workstation panels no higher than 42” where parallel to perimeter windows
- Higher panels can be located perpendicular to path of daylight
- Minimize glare on computer screens but suggesting users orient perpendicular to windows

INTRODUCTION
PROGRAMMING
SPACE PLANNING
WINDOW COVERING DESIGN
WORKSTATION PANEL DESIGN
INTERIOR SURFACE FINISHES
ELECTRICAL LIGHTING CONTROLS
CONCLUSION

Facts

Eye fatigue can result from facing bright windows that create harsh contrasts to tasks at a desk.

Typically, light that reaches a task indirectly, such as bouncing from a white wall or ceiling, is a better quality of light than that which arrives directly from a daylight or electric source.

Images courtesy of New Buildings Institute

Low panels allow for daylight penetration.

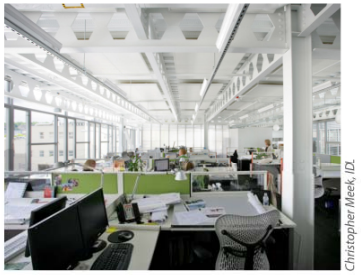
High panels impede daylight penetration.

Glossary

VISUAL DISCOMFORT
Can be caused by glare on a computer screen, direct line of sight to the disk of the sun, or excessive contrast of two items within a person’s visual field. Often occupants will resort to shutting the blinds or shades if the daylight is causing the visual discomfort. If a space then becomes too dark, users will turn on the electric lighting, thus negating the anticipated energy savings of using daylight.

WORKSTATION PANEL DESIGN
And Orientation for Daylight Performance

Influence of Furniture



Christopher Meek, IID.

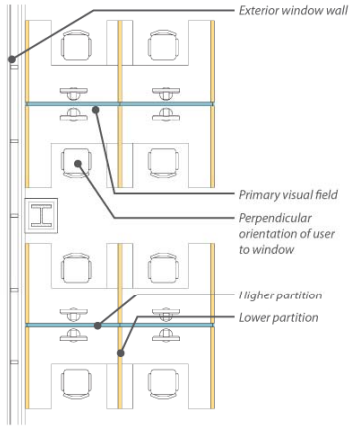
Low panels perpendicular to daylight distribution via exterior window allow light distribution

High panels parallel to daylight aperture impede light distribution

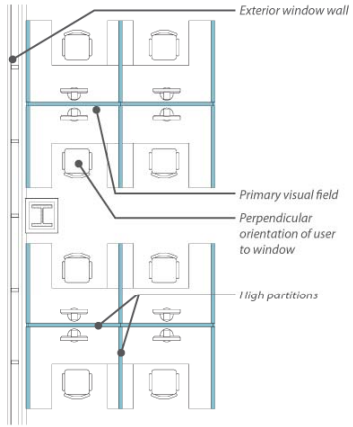
The selection and design of open office furniture, especially workstation panels, requires a continued commitment to the preservation of daylight and views. Workstation panels must be kept low (42” or less) and parallel to the direction of the daylight distribution to ensure the maintenance of views. Where higher panels (48” or greater) are required for privacy or to create a sense of enclosure, they should be oriented perpendicular to the perimeter glazing. Sixty-five inch high panels that are perpendicular to the direction of daylight distribution can enable privacy and allow for ample storage without compromising views or creating dark shadows.

Workstations should be designed whenever possible so that the direction most occupants face while performing visual tasks (i.e. looking at a computer) is perpendicular to daylight openings. This helps avoid the visual discomfort occupants experience when looking into their shadow, or worse, from the excessive contrast occurring when a visual task area is immediately surrounded by the brightness of a view to the exterior.

Workstation Panels



Daylight performance maximized with this panel layout



Daylight essentially blocked with this panel layout

INTERIOR SURFACE FINISHES

- Choose interior finishes that will support the maximum efficiency of lighting
- Early decisions on Light Reflectance Values of finishes are important in appropriate planning of electric light levels
- If windows are an obvious bright spot in an interior environment, the rest of the space will be perceived as dark

Evaluation of Light Reflectance Values

The light reflectance is based on a scale of 0 (total light absorption) to 100 (total light reflection), where 0 is black and 100 is white.

Light reflectance values (LRV) traditionally have been calculated by lighting designers as follows:

80 for ceiling
50 for walls
20 for floors

When estimated LRVs do not match the actual design, the lighting solution may not be appropriate to the space.

It is difficult to achieve maximum energy efficiency, as estimated above, when interior finish selections are dark in tone.

Glossary

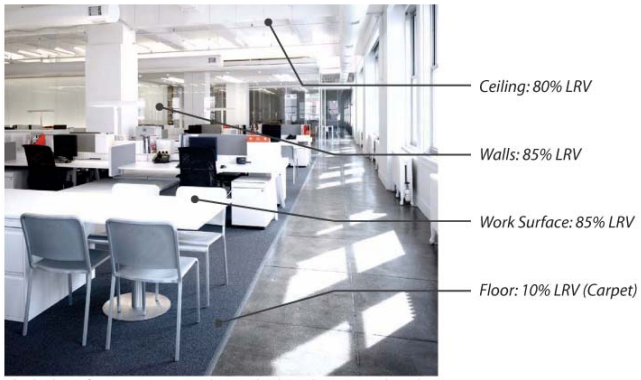
LUMINOSITY
The state of being luminous, emitting light, or glowing brightly.

LUMINOUS INTER-REFLECTION
The reflection of daylight off adjacent surfaces within the tenant space. This can either help balance the brightness of the space or create areas of contrast depending on the reflectance level of the material from which the light is bouncing.

DAYLIGHT APERTURES
An opening such as a window, skylight, or clerestory that allows daylight to enter a space.

INTERIOR SURFACE FINISHES

When done in conjunction with the daylighting goals, effective selection of finishes can substantially improve daylighting performance. The position and visual character of the "back" wall, the wall opposite a perimeter window, can serve a crucial role in receiving and reflecting daylighting that travels horizontally into the space. If this wall receives sufficient daylight, and is of a relatively high reflectance value, it will serve to balance the brightness of the view through the perimeter windows.



This high performance interior is designed to limit direct sun only to the transition/circulation space. Note the LRVs of the ceiling, walls and work surfaces - which help achieve maximum energy efficiency.
IA New York, Design by IA Interior Architects
Image courtesy of Adrian Wilson

Interior surface finishes can be a powerful tool in shaping the perception of brightness within interior spaces. Physiologically, our eyes tend to adjust to the brightest location within an interior space. This means that if the perimeter zone is substantially brighter than the interior zone, the space will tend to be perceived as dark. This is often referred to as the "cave effect."

With typical office ceiling heights and core depths in excess of 25' - 0", it is very difficult to achieve balanced illumination from one side to the other. The balance of daylight distribution within a given volume is crucial to visual comfort and the perception of brightness. Furthermore, structure, beams, ductwork, and other equipment should be positioned so that they do not cast shadows on surfaces that are crucial for daylight inter-reflection. This is especially true with the ceiling plane.

The placement of bright surfaces opposite or around daylight apertures can help to reduce contrast and balance the luminosity in the space. The strategic placement of darker surfaces adjacent to planes that are designed to be perceived as bright can, by contrast, enhance the perception of brightness and uniformity where desired.

LIGHTING AND CONTROLS

- Integrate a lighting control system into the space:
  - What are the desired, maintained light levels in each space?
  - What will the transitions between light levels feel like?
  - Will other light sources interfere with the photocell to control a particular zone?

Guidelines

Open office areas:
Where daylight is present, utilize daylighting controls.

Workstations:
Use occupancy sensor controlled plug strips to control plug loads (computer monitors, task lights and personal items).

Restroom/copy/storage:
Install occupancy sensor controlled lighting.

Private offices/conference rooms/break rooms:
Install vacancy sensor (manual on, auto off) controlled lighting.

Glossary

PHOTOCELL CONTROLS
Photosensors send a signal to automatically adjust the light output of a lighting system based on detected illuminance. While some systems simply turn lights off and on, others can also dim lights.

OCCUPANCY SENSORS
Turn lights on and off by detecting motion within a space. Some sensors can be used in conjunction with dimming controls to keep the lights from turning off completely when a space is unoccupied.

VACANCY SENSORS
Require user to manually turn lights on but will automatically turn lights off after preset duration without detected motion.

ELECTRIC LIGHTING AND CONTROLS INTEGRATION

Implicit in the discussion of daylighting design is the desire to reduce energy waste. This requires that automated controls be superimposed on the electric lighting equipment.

Within the the context of office tenant improvements, any discussion of daylighting design implies that the electric lighting in areas with daylight will be under photocell control. When applied effectively photocell lighting controls can save substantial lighting power by reducing/extinguishing electric light output when available daylight meets workplane illuminance needs.

A crucial step in integrating electric lighting design and controls with a daylighting strategy is the identification of user expectations with respect to their role in operating the lighting system and their tolerance for automated transitions in electric light output when daylight conditions change.

We know that the human eye adapts to a wide range of light levels. However, jarring and unexpected transitions in light distribution and intensity have caused numerous photocell lighting controls systems to be disabled via occupant intervention. This type of occupant annoyance is what gives lighting control systems a bad name. Feedback about this behavior has provided guidance for designers: choose the correct style of control for each space (dual-switching, step-dimming or continuous dimming) and ensure post-occupancy commissioning of the system for user satisfaction.

Organizing Lighting Control Zones

A daylighting "control zone" is a group of fixtures in locations of similar daylight availability. These luminaires are controlled together via a photocell to reduce electric light output when daylight is present. Automated lighting controls should be prioritized to areas where daylight performance is expected to be high over time, and where individual occupant control of lighting is not realistic.

Responsibility for photo-control design and integration occurs at the nexus of the interior designer, the lighting designer, and the electrical engineer. Critical considerations are as follows:

- What type of work area is this; what tasks are performed?
- What are the maintained illumination levels?
- Is the photocell placed in a location where what it "sees" is representative of the luminous experience of the space or zone during typical daylight conditions?
- Will other light sources interfere with the ability of the photocell to control a particular zone or layer of light?
- What will the transition between electric light levels feel like?
- What is the reference location for calibration and commissioning of each zone?
- Who is responsible for doing this work?

Tip

Generally, due to lack of obstructions and therefore better interreflectivity, shared open office areas rather than private offices provide the best opportunity for automated photocell control of electric lighting in an office TI.

LIGHTING AND CONTROLS

- Offices and Retail spaces utilize the most substantial amounts of lighting energy over all building types
- By incorporating optimal daylight strategies, an office's total energy costs can be reduced by one third
- Utilities offer financial rebates for efficient lighting plans and maximized use of occupancy & vacancy sensors
- User education and acceptance is critical in maintaining the proposed lighting controls long term

DAYLIGHTING GUIDE

For the Commercial Office

INTRODUCTION
PROGRAMMING
SPACE PLANNING
WINDOW COVERING DESIGN
WORKSTATION PANEL DESIGN
INTERIOR SURFACE FINISHES
ELECTRICAL LIGHTING CONTROLS
CONCLUSION

Facts

According to the U.S. Department of Energy, when comparing lighting energy in building types, offices and retail consume the most substantial amount of all commercial buildings.

Not only is electric lighting used to light an office's perimeter zone where daylighting already exists, it requires additional cooling due to the heat it creates.

By incorporating optimal daylighting strategies, a commercial office's total energy cost can be reduced by as much as one third.

Incentives

Occupancy sensors provide energy savings simply by turning off lights when the rooms are not being used.

Check with your local utility for rebates associated with occupancy sensors.

Resources

WATTSTOPPER
www.wattstopper.com

Search for Lighting Control Best Practice Guide & Daylighting Control Design and Application Guide

LIGHTING DESIGN LAB
http://www.lightingdesignlab.com/ldlnews/Refining_the_Window.pdf

Legend

- *Lighting Control Zone - Continuous dimming on photocell*
- *Lighting Control Zone and enclosed program - Manual switch "On" with vacancy sensor "Off"*
- *Lighting Control Zone - Continuous dimming on photocell or vacancy sensor and manual switching*
- *Lighting Control Zones per program requirements*

Continuous dimming is achieved by using a single ballast/single circuit that continuously lowers the light output of its lamps from a maximum 100% output to a low end of 50%, 20%, 10%, 5% or 1% depending on the ballast type. Ballast cost typically goes up as the low end dimming range goes down. Controlling for a slow fade-rate maintains occupant satisfaction.

Step-dimming is a confusing term. It is achieved by using a single circuit that "dims" all its lamps by reducing light output (and power consumption) by one or more steps between full ON and OFF (i.e. 100/50/off). Since all lamps in the luminaire are affected equally this control choice maintains the photometric distribution and the aesthetic of the luminaire and is therefore referenced as a form of "dimming." It is designed to be a low-cost, easy-to-install system which simply uses an additional input lead for the switching circuit.

Dual- or Multi-level switching was conceptualized using 3-lamp luminaires. By using 2 ballasts, the center lamp is controlled separately from the outside 2 lamps (commonly referred to as "inboard-outboard"). This method of lowering output and saving energy is achieved by then switching 1 or 2 lamps OFF, providing up to 3 levels of illumination. This requires multiple circuits to each luminaire and produces a shift in photometric distribution and the aesthetic of the luminaire. As energy code restrictions have increased, the use of 3-lamp luminaires has plummeted because they do not meet code and illuminance uniformity requirements.

For most traditional shared open office environments continuous dimming is the appropriate choice. This is because the transition in light level is gradual enough that it is not noticeable, and therefore not disruptive, to most occupants. The unexpected and sudden change in light levels associated with step-dimming or dual-switching should be relegated to the general service areas such as the break room, copy room, corridors, stairwells, etc. It also helps if these spaces are not visible from seated work areas. Another common source of dissatisfaction is that occupants see fixtures that are obviously de-energized (OFF) and perceive that something is "wrong." This speaks to the need for educating occupants so that they understand the systems and why they are used. To overcome this perception, it is imperative that the lighting designer provide light using sources such as balanced vertical illumination, sconces, or task lights for work surfaces.

CHECKLIST

- Critical relationships to remember:
  - The sky as a light source
  - Massing and orientation of a building (or space within a building)
  - Depth of the floor plate
  - Windowcoverings
  - Interior surface finishes
  - Interior furnishings
  - Orientation of the occupant in their workspace

DAYLIGHTING GUIDE

For the Commercial Office

INTRODUCTION
PROGRAMMING
SPACE PLANNING
WINDOW COVERING DESIGN
WORKSTATION PANEL DESIGN
INTERIOR SURFACE FINISHES
ELECTRICAL LIGHTING CONTROLS
CONCLUSION

ADVANCED ENERGY OFFICE
EFFICIENCY·PRODUCTIVITY·CONTROL

AEO design strategies were developed by a national team of leaders in building energy and the indoor work environment.

The strategies reduce the energy used by lighting, plug loads and HVAC systems by 25% and more over current codes, while improving lighting quality and air conditioning/ heating performance.

The measures include:

- Best Practice
- Efficient Plug Loads
- HVAC Performance
- Advanced Metering
- Demand Response Thermostat

Resources

NEW BUILDING INSTITUTE
http://www.newbuildings.org
Search for "daylighting"

INTEGRATED DESIGN LAB
www.integrateddesignlab.com/Seattle/Resources/Daylighting.html

WHOLE BUILDING DESIGN GUIDE
www.wbdg.org/resources
Search for "daylighting"

BETTER BRICKS
www.betterbricks.com

US DEPARTMENT OF ENERGY, ENERGY EFFICIENCY & RENEWABLE ENERGY
www.eere.energy.gov/buildings
Search for "Lighting and Daylighting" in Commercial Buildings

CONCLUSION

Daylighting design goals and aspirations vary widely among program elements and the visual tasks they support. However, there is a common linkage between design relationships that connect the sky and its patterns of illumination at the macro scale with an individual workstation and the specific needs of a person who will use that space to accomplish necessary tasks. This set of relationships includes:

- The site and sky as a light source
- The massing and orientation of the building (or space within the building)
- The depth of the floor plate
- Building aperture sizes and locations
- Architectural elements and window coverings for glare and thermal control
- The interior surfaces and their luminous properties
- Interior furnishings including workstation panel layout
- And ultimately the orientation of the occupant within his/her workstation or office; the direction one faces when performing visual tasks

The interior designer, in partnership with others on an integrated design team, has significant influence in realizing the daylighting potential in any tenant improvement project.

Checklist Items

- ☐ Determine daylighting and view criteria for each program element.
- ☐ Do a site visit to understand the existing conditions during the hours of occupancy: where and when the daylighting enters the space, potential reflection off of or shading created by adjacent buildings.
- ☐ Diagram out the daylighting and view opportunities on the floor plan.
- ☐ Align the program criteria for each space with the most desirable location on the floor plan.
- ☐ Select the appropriate window covering for the space to diffuse light or glare when and where required. Privacy needs are also a consideration with window covering selection.
- ☐ Choose interior finishes that will support the maximum efficiency of electric lighting and daylighting but also support balanced luminosity in the space.
- ☐ Plan for open office workstation panels to be 42" or lower where they are parallel to the perimeter window.
- ☐ Integrate a lighting control system into the space. To help reduce electrical light output, zone areas with similar daylight performance together.

nbi new buildings INSTITUTE
INTEGRATED idl DESIGN LAB Puget Sound
IA INTERIOR ARCHITECTS

CASE STUDY – IA NEW YORK

- 8th floor downtown New York City
- Northern & Western exposures
- No adjacent buildings to the North
- Neighboring building across the street to the West

Designed by IA Interior Architects

CASE STUDY – IA NEW YORK

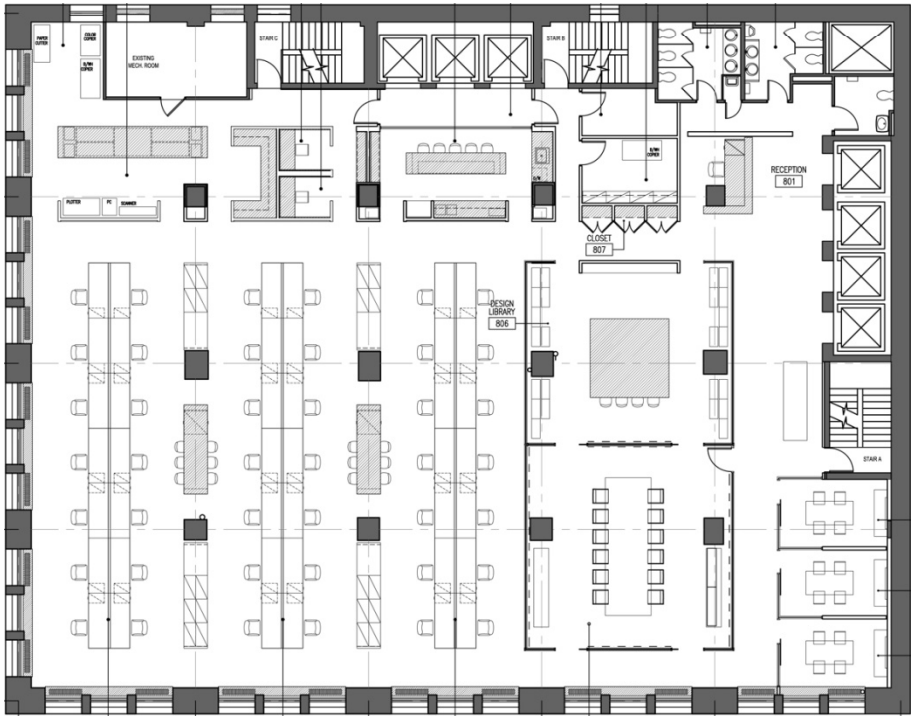
- Daylight important to areas where staff spend most of their day – Open Office
- Direct sun on computer screens or worksurfaces was not desirable
- Desk “benching” layout without workstation panels supports daylighting programming
- Primary visual field (computer screens) oriented perpendicular to Western sun entering space

Designed by IA Interior Architects

View to park below

No adjacent buildings

EAST



NORTH

No adjacent bldgs this height

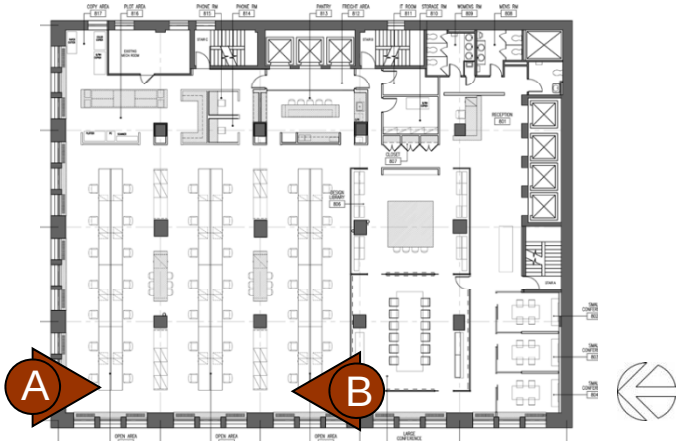
WEST

Building across street is a few stories higher

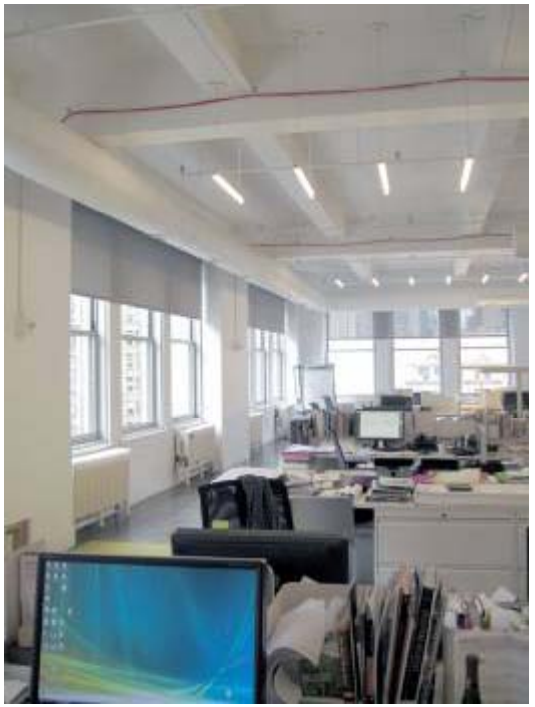
CASE STUDY – IA NEW YORK

- Window shades selected to maintain view outside when shades are down
- Shades have 5% openness factor
- Shades installed on all North side windows
  - Create privacy in evening/late afternoon in Winter
  - Minimize glare off of adjacent buildings during day
- Shades installed on all West side windows

Designed by IA Interior Architects



A Western exposure windows. No direct sun on work surfaces. Shades up.



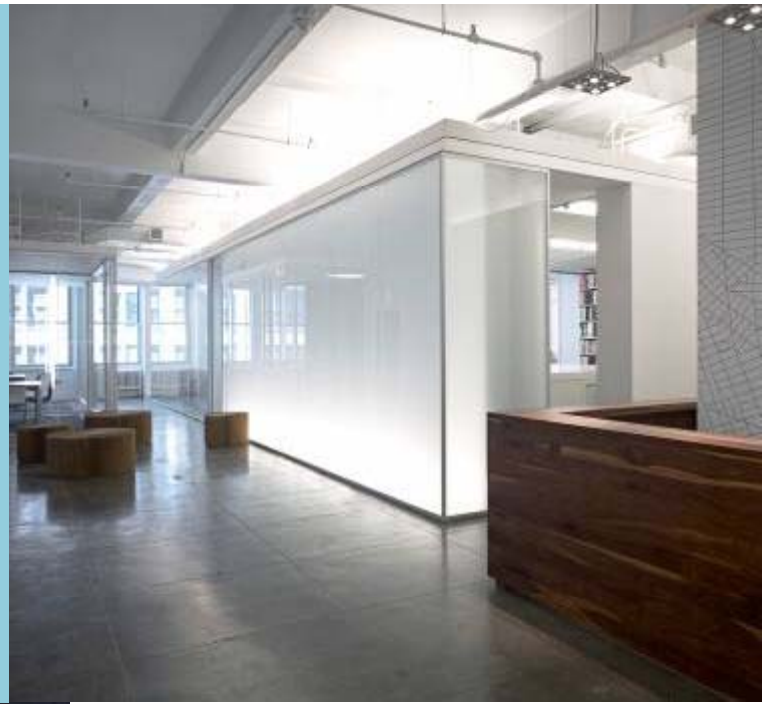
B Computer screens perpendicular to daylight distribution. Shades partially down

CASE STUDY – IA NEW YORK

- Light interior finishes, those with high Light Reflectance Values, maximize the efficiency of lighting (daylight and electric) throughout the space
- Power of the sun is maximized to light the space
- 98” high windows & high light reflectance values on finishes bounce daylight far into the space
- Windows don’t appear as bright spots when the brightness of the adjacent space is balanced

Designed by IA Interior Architects

Balanced brightness at exterior windows

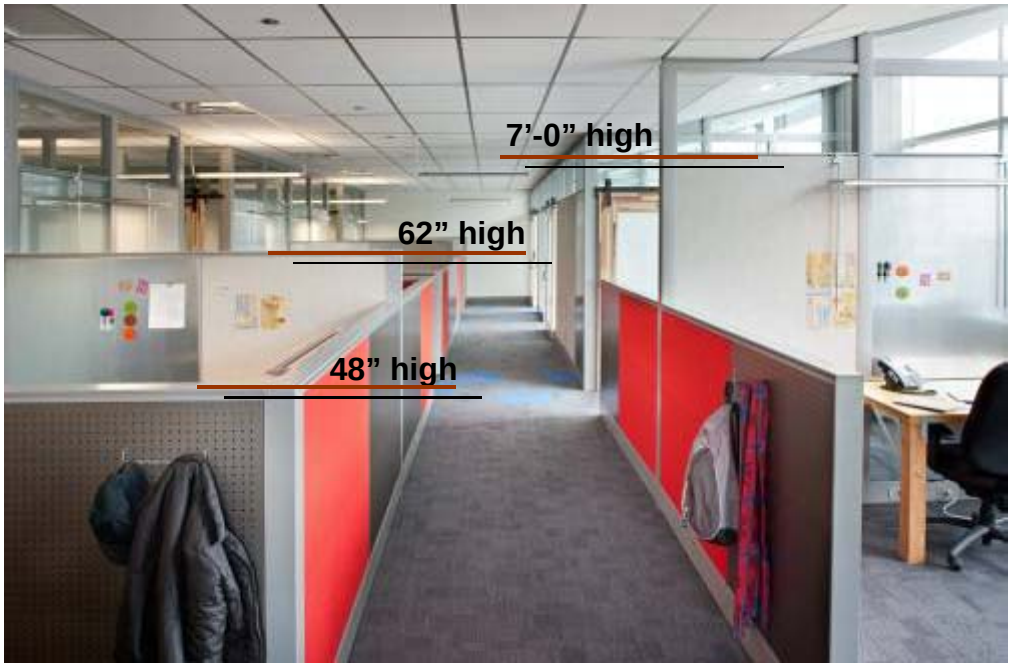


Electric lighting is used to compliment daylight and balance brightness throughout the space

CASE STUDY – SEATTLE HQ

- The lowest, 48” high, workstation panels are oriented perpendicular to daylight distribution
- 62” high panels create a spine for greater visual privacy & more surface area for markerboard and tack
- Ceiling height panels always maintain a clear glass “clerestory” above 7’-0”
  - Still allows some daylight into the space

Designed by IA Interior Architects



Staff with less need for privacy maximize shared daylight and views

CASE STUDY – SEATTLE HQ

- Ceiling mounted fixtures minimized
  - Continuous dimming in daylighting zone
- User-controlled task lights maximized
- Maximized energy efficiency
  - Occupancy sensors integral to task light = rebate from local utility
  - Light only where needed = rebate from local utility
  - Vacancy sensors in conference rooms & offices

Designed by IA Interior Architects

Lighting Control Zone – Continuous Dimming Daylight Controls

Lighting Control Zone –Daylight Zone with Photocell, Continuous Dimming, Manual Switch On, Vacancy Sensor Off

Task Lighting with Occupancy Sensor

Lighting Control Zones Per Program Requirements

Work Station: 30-50FC

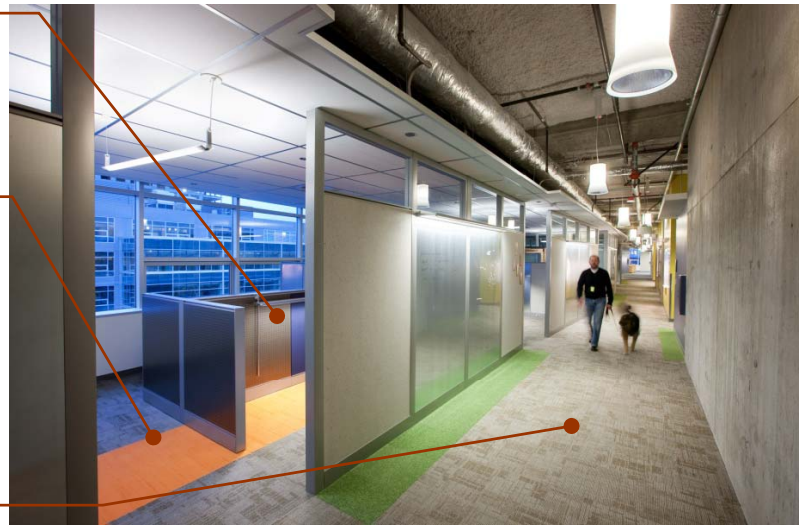
Occupant can control task light at work station, accommodating various tasks and personal preferences.

Open Office Pathway: 10-15FC

Light distribution on floor, walls, and ceiling create the perception of a well-lit space.

Common Corridors: 10-25FC

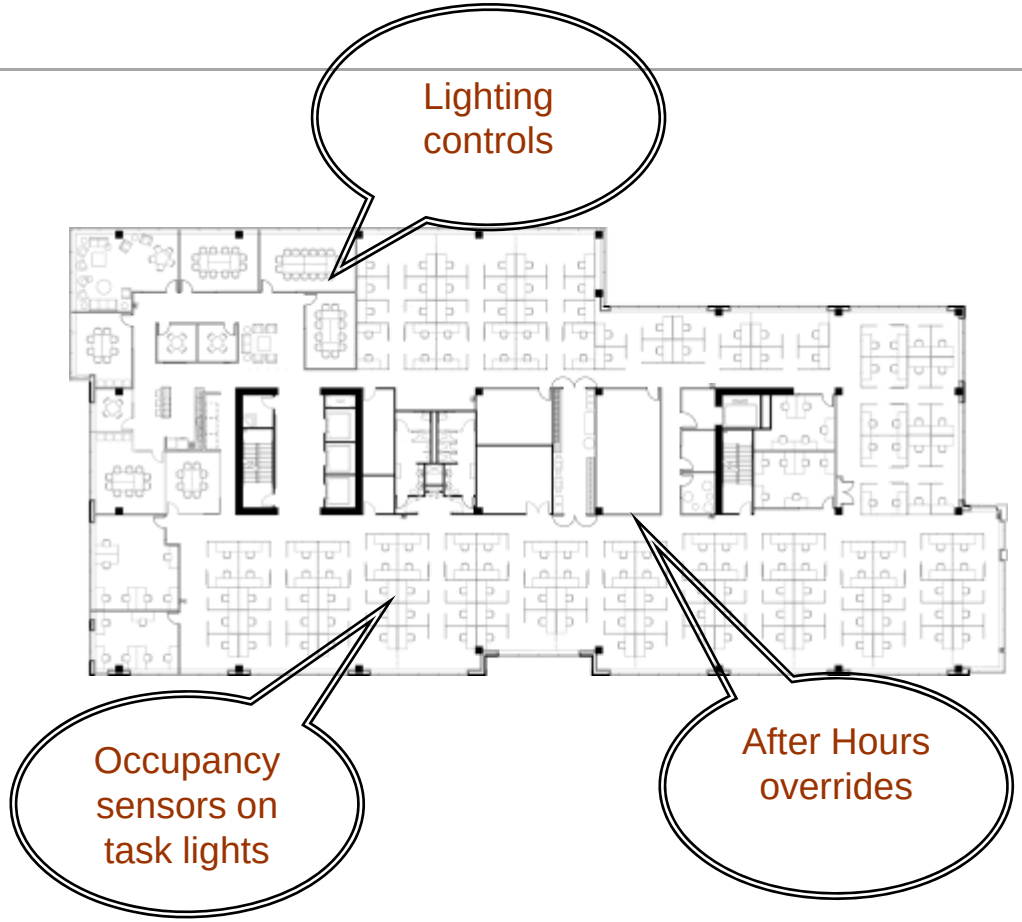
Central pathway requires minimal light, but wall washers at markerboards and accent lighting create interest.



CASE STUDY – SEATTLE HQ

- Occupant education
  - Lighting scene controls
  - Fixtures dimming in daylight zone
  - After hours overrides
- Give purpose to design
  - Cost savings (lower utilities)
  - Minimize CO2 emissions
  - User control
  - Energy conservation

Designed by IA Interior Architects



CASE STUDY – HERMAN MILLER

- Use of skylights key to creating pleasant work environment
- Toplighting tends to provide the most effective daylight performance, since it typically avoids the direct sunlight associated with perimeter windows
- Electric lighting design compliments the toplighting layout to maximize daylight opportunities

Designed by IA Interior Architects

CASE STUDY – HERMAN MILLER

- Depth of floor plate challenging; Use of skylights was critical in providing cues to the outdoors
- Main Street planning concept
- Hubs of activity along Main Street

Designed by IA Interior Architects

CASE STUDY – HERMAN MILLER

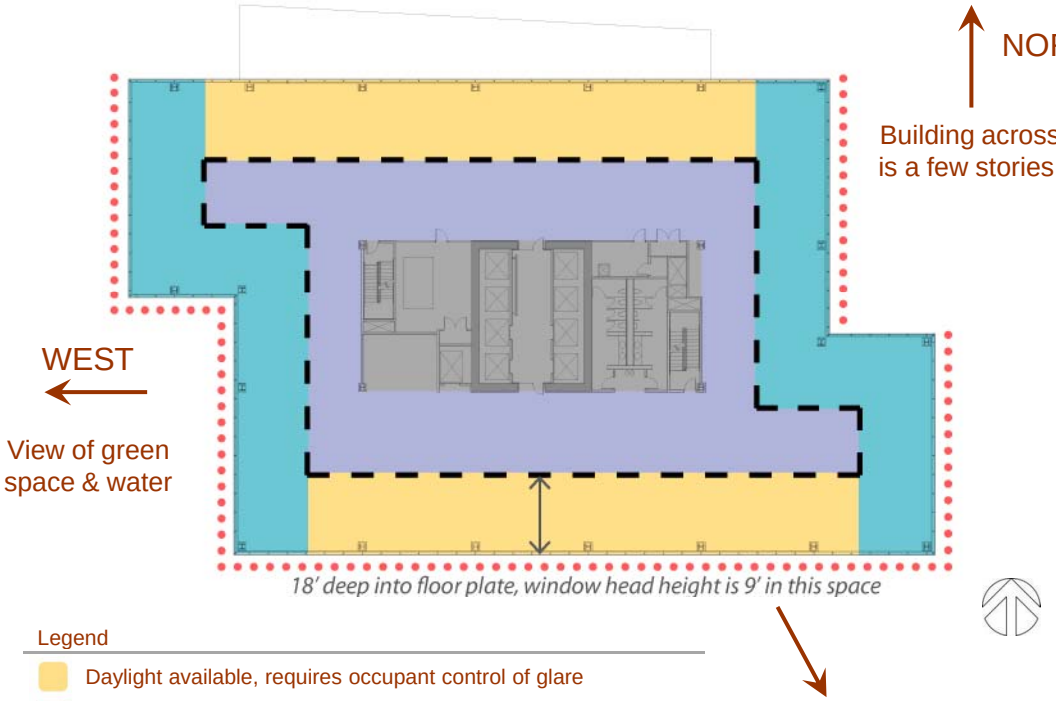
- Herman Miller conducted employee surveys post occupancy.
  Overall 88% say that the changes made were positive
  - 90% say that the changes to their physical environment allow them to get their work done more effectively, a 17% increase.
  - There was a 32% improvement in employee retention.
  - 92% say that the office's physical environment positively affects their job satisfaction, a rise of 30%.
  - There was a 67% improvement in the overall satisfaction of individual workstations.
  - 84% of employees felt that the new office was a quality work environment, as opposed to 31% in the prior space.

Designed by IA Interior Architects

CASE STUDY – EXPEDIA HQ

- Daylight and views important to staff in open office
- Office occupants are not in offices all day long
- Create a reason for people to have lunch in Kitchenettes so they don't stay at desks all day – daylight & view can be a draw
- Target LEED Daylighting & Views credit for Commercial Interiors certification
  - Although dark tinting of exterior glass helped minimize heat loads, it was too dark to achieve Daylighting credit

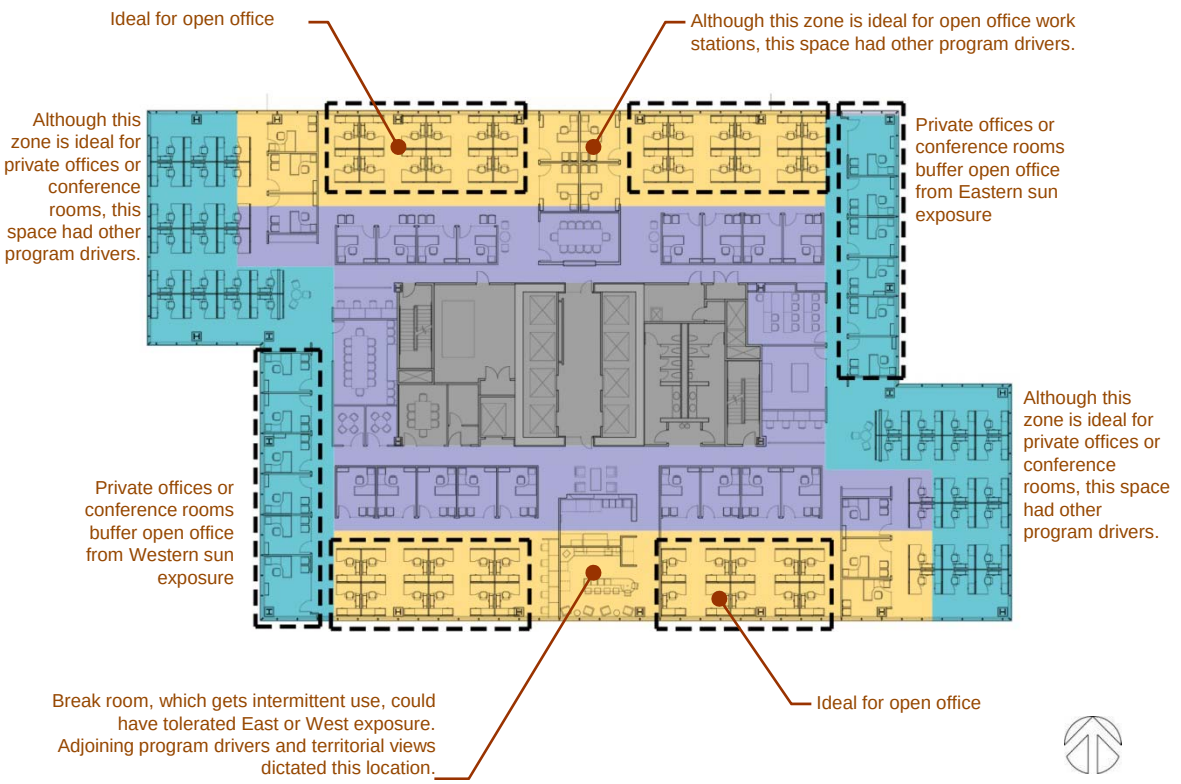
Designed by IA Interior Architects



CASE STUDY – EXPEDIA HQ

- Perimeter offices located so as not to block all access to daylight for Open Office staff
- Private offices can be located on Eastern & Western exposures as occupants are likely to adjust window blinds during the day
- Kitchenette located on windows with view of Mt. Rainier

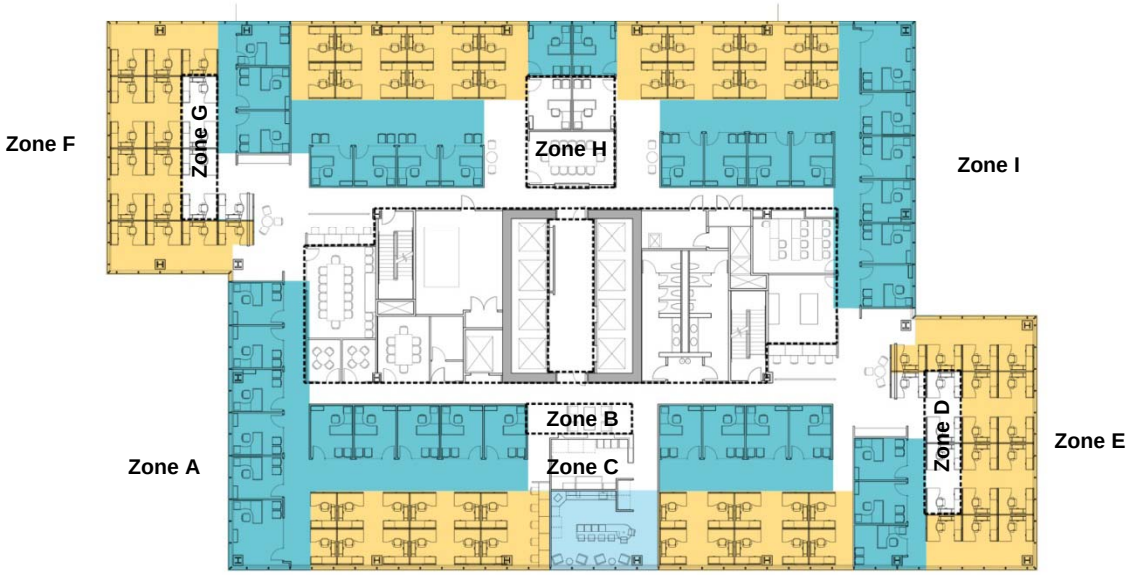
Designed by IA Interior Architects



CASE STUDY – EXPEDIA HQ

- Average LPD for tenant spaces: 0.76 W/sf
- Occupancy sensors located in enclosed spaces – estimated reduction of full load by 10% during operating hours

Designed by IA Interior Architects



Legend

- Lighting Control Zone – Daylighting, Continuous Dimming on Photocell
- Lighting Control Zone and Enclosed Program – Manual Switch “On” with Vacancy Sensor “Off”
- Lighting Control Zone – Continuous Dimming
- Lighting Control Zones Per Program Requirements

CONCLUSION

- www.newbuildings.org
- www.integrateddesignlab.com
- www.interiorarchitects.com

CHECKLIST ITEMS

- ☐ Determine daylighting and view criteria for each program element.
- ☐ Do a site visit to understand the existing conditions during the hours of occupancy.
- ☐ Diagram out the daylighting and view opportunities on the floor plan.
- ☐ Align the program criteria for each space with the most desirable location on the floor plan.
- ☐ Select the appropriate window covering for the space. Privacy needs should be a consideration.
- ☐ Choose interior finishes that will support the maximum efficiency of electrical lighting and daylighting but also support balanced luminosity.
- ☐ Plan for open office workstation panels to be 42” or lower where they are parallel to the perimeter window.
- ☐ Integrate a lighting control system into the space. zone areas with similar daylight performance together to help reduce electrical light output.

nbi new buildings INSTITUTE
INTEGRATED idl DESIGN LAB Puget Sound University of Washington
IA INTERIOR ARCHITECTS