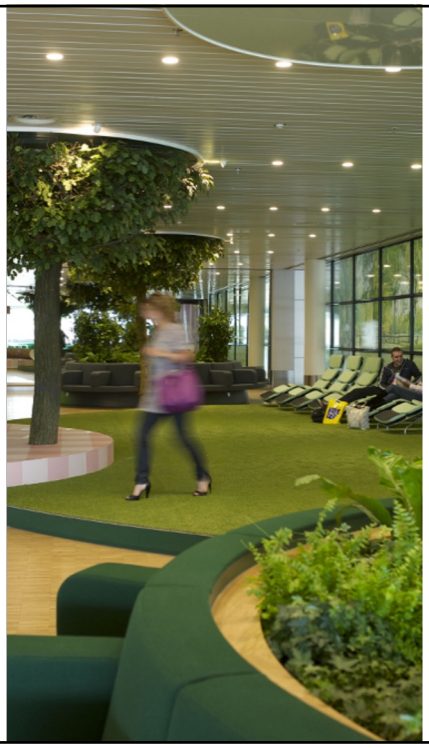
# LEED V4 TRAINING PROGRAM

## INDOOR ENVIRONMENT QUALITY



ECOBUILD

1

## INDOOR ENVIRONMENTAL QUALITY

| TITLE | | | | D/C | SCORE |
|---|---|---|---|---|---|
| IEQ | PREREQUISITE | 1 | MINIMUM INDOOR AIR QUALITY | D | PREREQUISITE |
| IEQ | PREREQUISITE | 2 | ENVIRONMENTAL TOBACCO SMOKE CONTROL | D | PREREQUISITE |
| IEQ | CREDIT | 1 | ADVANCED INDOOR AIR QUALITY STRATEGIES | D | 2 |
| IEQ | CREDIT | 2 | LOW EMITTING MATERIALS | C | 3 |
| IEQ | CREDIT | 3 | INDOOR AIR QUALITY MANAGEMENT PLAN DURING CONSTRUCTION | C | 1 |
| IEQ | CREDIT | 4 | INDOOR AIR QUALITY ASSESSMENT | C | 2 |
| IEQ | CREDIT | 5 | THERMAL COMFORT | D | 1 |
| IEQ | CREDIT | 6 | BUILDING INTERIOR LIGHTING | D | 1 |
| IEQ | CREDIT | 7 | DAYLIGHT | D | 2 |
| IEQ | CREDIT | 8 | QUALITY VIEW | D | 2 |
| IEQ | CREDIT | 9 | ACOUSTIC PERFORMANCE | D | 2 |

ECOBUILD

2

# TYPICAL CONTAMINANTS IN INDOOR ENVIRONMENTS

| Indoor Air | | Typical Content | Solution |
|---|---|---|---|
| Pollution Source | Emission Source | VOCs + Others | Demand-controlled ventilation |
| Human Beings | Breathing | Acetone, Ethanol, Isoprene | |
| | | CO2 | |
| | | Humidity | |
| | Skin Respiration and Perspiration | Nonanal, Decanal, Pinene | |
| | | Humidity | |
| | Wind | Methane, Hydrogen | |
| | Cosmetics | Limonene, Eucalyptol | |
| | Home Material Uses | Alcohols, Esters, Limonene | |
| | Combustion, Machines, Devices, Smoking | Unburned Hydrocarbons | |
| | | CO | |
| | | CO2 | |
| | | Humidity | |
| ‣ Building Materials<br>‣ Furniture<br>‣ Office Equipment<br>‣ Consumer Products | Paints, Adhesives, Solvents, Carpets | Formaldehyde, Alkanes, Alcohols, Aldehydes, Ketones, Siloxanes | Permanent 5-10% ventilation |
| | PVC | Toluene, Xylene, Decane | |
| | Computers, Copiers, Printers | Benzene, Styrene, Phenols | |

ECOBUILD

3

# INDOOR ENVIRONMENTAL AIR QUALITY INFLUENCING $CO_2$ LEVELS

| CO2 | AIR QUALITY |
|---|---|
| 2100 | POOR<br>It is heavily contaminated air.<br>Ventilation is required. |
| 2000 | |
| 1900 | |
| 1800 | |
| 1700 | |
| 1600 | |
| 1500 | MEDIUM LEVEL<br>It is contaminated air.<br>Ventilation is required. |
| 1400 | |
| 1300 | |
| 1200 | |
| 1100 | |
| 1000 | SUITABLE |
| 900 | |
| 800 | GOOD |
| 700 | |
| 600 | EXCELLENT |
| 500 | |
| 400 | |

4

## WHY IS THE INDOOR ENVIRONMENTAL QUALITY IMPORTANT?

- People spend 90% of their time indoors.
- EPA reports indicate that indoor pollutant levels are 2-5 times higher than that of the outdoors.
- There are 17 million asthma patients and 40 million allergy sufferers in the USA alone.
- Ensuring healthy indoor air quality will provide a healthy generation.
- It is possible to eliminate, reduce, and manage indoor pollutant sources.
- Thermal comfort and system selection not only provide significant energy savings but also ensure user satisfaction.
- Enabling users to connect with the outdoors increases productivity and helps patients recover quickly in hospitals.
- Natural lighting enhances efficiency in workplaces and schools.
- Reducing noise increases productivity in workplaces and schools.
- Improving IEQ increases efficiency in offices and schools. In schools, absenteeism decreases, while in hospitals, discharge times shorten.
- Increased lighting leads to higher sales in shopping malls.

ECOBUILD

5

## INDOOR ENVIRONMENTAL QUALITY

| TITLE | | | | D/C | SCORE |
|---|---|---|---|---|---|
| IEQ | PREREQUISITE | 1 | MINIMUM INDOOR AIR QUALITY | D | PREREQUISITE |
| IEQ | PREREQUISITE | 2 | ENVIRONMENTAL CIGARETTE SMOKE CONTROL | D | PREREQUISITE |
| IEQ | CREDIT | 1 | ADVANCED INDOOR AIR QUALITY STRATEGIES | D | 2 |
| IEQ | CREDIT | 2 | LOW-EMITTING MATERIALS | C | 3 |
| IEQ | CREDIT | 3 | INDOOR AIR QUALITY MANAGEMENT PLAN FOR CONSTRUCTION | C | 1 |
| IEQ | CREDIT | 4 | INDOOR AIR QUALITY ASSESSMENT | C | 2 |
| IEQ | CREDIT | 5 | THERMAL COMFORT | D | 1 |
| IEQ | CREDIT | 6 | INDOOR LIGHTING | D | 1 |
| IEQ | CREDIT | 7 | DAYLIGHT | D | 2 |
| IEQ | CREDIT | 8 | QUALITY VIEW | D | 2 |
| IEQ | CREDIT | 9 | ACOUSTIC PERFORMANCE | D | 2 |

ECOBUILD

6

## IEQ PREREQUISITE 1: MINIMUM INDOOR AIR QUALITY

### PURPOSE

The main goal is to establish and implement minimum indoor air quality standards to protect the health of building occupants.

Ventilation and

Monitoring must be adhered to under both headings:

ECOBUILD

7

## IEQ PREREQUISITE 1: MINIMUM INDOOR AIR QUALITY

### REQUIREMENTS

Ventilation

In mechanically ventilated building volumes (including mixed systems where mechanical ventilation is activated alongside natural ventilation);

Option 1. ASHRAE Standard 62.1-2010

The ventilation procedure should be carried out by meeting the requirements of ASHRAE 62.1-2010. If there is a national standard that demands conditions more stringent than ASHRAE 62.1-2010, it may be accepted.

The ventilation conditions for indoor air quality as stated in section 4-7 of ASHRAE 62.1-2010 Standard must be adhered to.

Option 2. CEN EN 15251-2007 and EN 13779-2007 Standards

Projects outside the USA must determine minimum fresh air requirements according to the Comité Européen de Normalisation (CEN) Standard EN 15251-2007 Annex B and CEN Standard EN 13779-2007 (excluding sections 7.3, 7.6, A.16 and A.17).

ECOBUILD

8

# IEQ PREREQUISITE 1: MINIMUM INDOOR AIR QUALITY

Ventilation

In naturally ventilated volumes,

For naturally ventilated areas (and in cases where mechanical ventilation is not active in mixed-mode systems), the requirements for natural ventilation defined in ASHRAE Standard 62.1-2010 Section 6.4 will be followed. If there are stricter national standards, they will be applied.

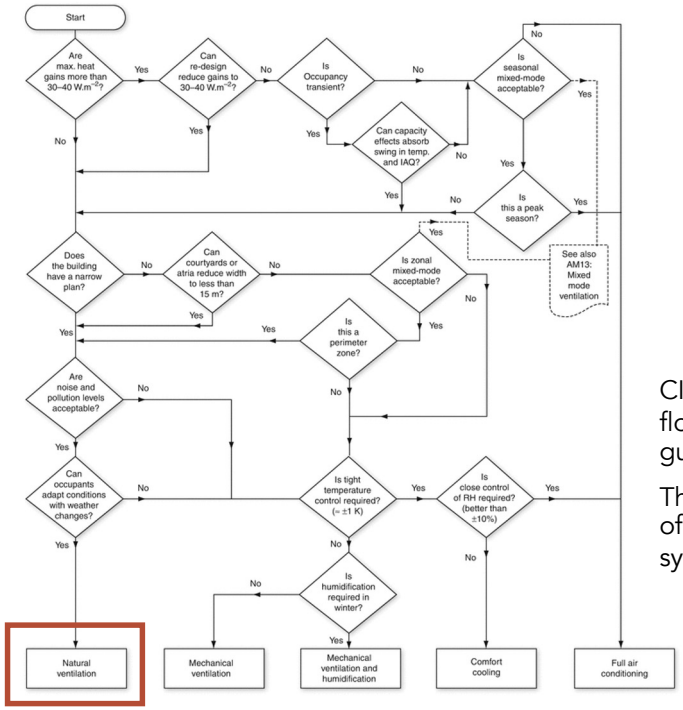
To effectively design natural ventilation, the Chartered Institution of Building Services Engineers (CIBSE) Application Guide AM10, March 2005, Natural Ventilation in Non-Domestic Buildings, should be followed, ensuring that natural ventilation is an effective strategy for the project as indicated in the flow diagram in Figure 2.8, and meeting the requirements of ASHRAE 62.1-2010 Standard Section 4 is necessary. Alternatively, stricter local/national equivalent standards may be used.

In all volumes,

ASHRAE Standard 62.1-2010 Section 6.3 cannot be used to provide the prerequisites for Indoor Air Quality procedures.

ECOBUILD

9




# AIR CONDITIONING SYSTEM SELECTION FLOWCHART

CIBSE Application Manual 10 provides a flowchart for the selection of ventilation systems, guiding towards the correct system selection.

This way, project teams can achieve the selection of the most economical and efficient ventilation system.

ECOBUILD

10

## IEQ PREREQUISITE 1: MINIMUM INDOOR AIR QUALITY

### REQUIREMENTS

Voz = Vbz / Ez

Voz: The amount of fresh air that needs to be supplied to the area

Vbz: The amount of fresh air in the breathing area

Ez : Air distribution efficiency

Vbz = (Rp x Pz) + (Ra x Az)

Vbz: The amount of fresh air in the breathing area

Rp : The amount of fresh air per person

Ra : The amount of fresh air per area

Pz : The number of people in the area

Az : Area of the region

ECOBUILD

11

## IEQ PREREQUISITE 1: MINIMUM INDOOR AIR QUALITY

### REQUIREMENTS

- Monitoring (monitoring and tracking)
- In Mechanically Ventilated Areas
- In mechanically ventilated areas (also when mechanical ventilation is activated in mix mode ventilation systems), the fresh air intake should be monitored as specified below:
- In variable air volume systems, there should be flow meters or flow switches that directly measure the amount of fresh air. These sensors should be able to measure the design minimum outdoor air flow rate with an accuracy of (+/-) 10%; and an alarm should be triggered when the fresh air value taken into the system differs by 15% from the minimum design value.
- In constant volume systems, fresh air dampers should be set to the minimum fresh air flow rate defined in ASHRAE Standard 62.1-2010 or above. It is necessary to install a flow meter, air flow switch, or similar monitoring device on the supply fan.

ECOBUILD

12

## IEQ PREREQUISITE 1: MINIMUM INDOOR AIR QUALITY

### REQUIREMENTS

- Monitoring (monitoring and tracking)
- In Naturally Ventilated Volumes
- For naturally ventilated areas (and in cases where mechanical ventilation is ineffective in hybrid systems), at least one of the following strategies must be followed:
- A measuring device that can measure the direct exhaust air flow should be provided. This device should be able to measure the exhaust air flow rate with an accuracy of +/- 10% according to the design exhaust flow rate values. Alarm should be given when the air flow values change by 15% or more from the design exhaust air flow set point.
- All openable windows included in the project must have automatic opening indicator devices to meet the minimum openable window requirements. If any of these openings are closed during the hours when the building is occupied, the indicator devices should trigger an alarm.
- Carbon dioxide (CO2) concentrations should be monitored in each thermal zone. CO2 sensors should be mounted between 3 and 6 ft (900 and 1,800 millimeters) in the thermal zone where monitoring is taking place. CO2 sensors should have an audible or visual indicator or should alert the building automation system when the detected CO2 concentration exceeds the set point by 10%. It is necessary to calculate appropriate CO2 set points using the methods specified in ASHRAE 62.1-2010, Annex C.

ECOBUILD

13

## IEQ PREREQUISITE 1: MINIMUM INDOOR AIR QUALITY

### REQUIREMENTS

- Monitoring (surveillance and monitoring) for Residential Buildings:
- In addition to the above conditions, if the project has building residential units, each residential unit must meet all of the following conditions:
- Unvented combustion devices (such as decorative fireplaces) are not allowed.
- Carbon monoxide sensors must be installed on every floor of each residential unit.
- All indoor fireplaces and stoves must have solid glass enclosures or doors that do not leak to the outside when shut.
- Fireplaces and stoves that do not have closed combustion or mechanical ventilation must pass the backdraft potential test. It must be shown that the pressure drop in the zone where the combustion equipment is located is below 5 Pa.
- Equipment used for water or space heating must have closed combustion chambers, or active exhausts, or must be located in a separated area of the building or outside the building.
- Residential projects located in areas with high radon risk (EPA Radon Zone 1 or local equivalents for projects outside the US) must be constructed using radon-resistant building techniques for the first four floors above ground level. Techniques defined in EPA Building Radon Out; NFPA 5000, Section 49; International Residential Code, Appendix F; CABO, Appendix F; ASTM E1465 or more stringent local equivalents must be applied.

ECOBUILD

14

## IEQ PREREQUISITE 1: MINIMUM INDOOR ENVIRONMENTAL AIR QUALITY

### VENTILATION FOR HOSPITALS

Condition 1. Mechanically Ventilated Spaces

In mechanically ventilated building volumes (including mixed systems where mechanical ventilation is activated in addition to natural ventilation), the minimum outdoor air flow rate for mechanical ventilation systems should be determined according to the most stringent of ASHRAE Standard 170-2008, Section 7; the requirements of the 2010 FGI Guidelines for Design and Construction of Health Care Facilities (Table 2.1-2); or an equivalent local standard. For spaces not included in ASHRAE 170 or FGI guidelines, ASHRAE 62.1 or a local equivalent (whichever is more stringent) should be used as a basis, and the minimum requirements of ASHRAE Standard 170-2008, Section 6-8 must be met.

or,

Condition 2. Naturally Ventilated Spaces

For naturally ventilated areas (and in cases where mechanical ventilation is not active in mixed-mode systems), ASHRAE Standard 62.1-2010 is followed for natural ventilation calculations. If stricter national standards exist, those should be applied.

The Chartered Institution of Building Services Engineers (CIBSE) Application Guide AM10, March 2005, the flowchart in Figure 2.8 should be followed to confirm that natural ventilation is an effective strategy for the project.

ECOBUILD

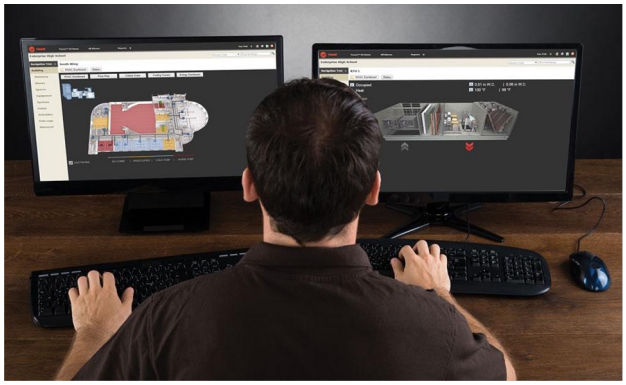
15

## IEQ PREREQUISITE 1: MINIMUM INDOOR AIR QUALITY

### MONITORING FOR HOSPITALS

Status 1. Mechanically Ventilated Spaces

In mechanically ventilated volumes (also when the mechanical ventilation is activated in mix mode ventilation systems), there should be flow meters or flow switches that directly measure the amount of fresh air. These sensors should be able to measure the design minimum outdoor air flow rate with an accuracy of (+/-) 10%; and they should trigger an alarm when the amount of fresh air taken into the system differs by more than 15% from the minimum design value.



ECOBUILD

16

# IEQ PREREQUISITE 1: MINIMUM INDOOR AIR QUALITY

## MONITORING FOR HOSPITALS

- Condition 2. Naturally Ventilated Spaces
- For naturally ventilated areas (and in cases where mechanical ventilation is ineffective in hybrid mode systems), at least one of the following strategies must be observed:
- A measurement device capable of measuring direct exhaust airflow should be provided. This device should measure the exhaust air flow rate with an accuracy of +/- 10% relative to the design exhaust flow rate values. Alarm should be triggered when airflow values deviate by 15% or more from the design exhaust airflow setpoint.
- All operable windows included in the project must have automatic opening indicator devices to meet minimum operable window requirements. Indicator devices should trigger an alarm when any of these openings are closed during the hours the building is in use.
- Carbon dioxide (CO2) concentrations must be monitored within each thermal zone. CO2 sensors should be installed at heights between 3 and 6 ft (900 and 1,800 millimeters) in the thermal zone being monitored. CO2 sensors must have audible or visual indicators or should alert the building automation system when the detected CO2 concentration exceeds the set point by 10%. It is necessary to calculate appropriate CO2 set points using methods specified in ASHRAE 62.1-2010, Appendix C.



17

# IEQ PREREQUISITE 1: MINIMUM INDOOR AIR QUALITY

## REQUIRED DOCUMENTS - ALL BUILDINGS

| Documentation | Option 1 | Option 2 | Natural Ventilation | Mixed Ventilation |
|---|---|---|---|---|
| Confirmation that the project meets the following conditions ASHRAE 62.1–2010, Sections 4–7, or CEN Standard 13779–2007 | ✓ | ✓ | | ✓ |
| If the project has areas with PM 2.5, it must have MERV 11 or better filters. | ✓ | ✓ | | ✓ |
| Tables explaining the calculation variables for CEN ventilation rate calculations | ✓ | ✓ | | ✓ |
| Documents showing that the project meets the exhaust ventilation requirements of ASHRAE Standard 62.1–2010, Section 7, Section 6.5 | | | ✓ | ✓ |
| Documentation for CIBSE flow diagram for the project process | | | ✓ | ✓ |
| Natural ventilation procedure calculations and ventilation opening information | | | ✓ | ✓ |
| Compliance of the mechanical ventilation system for any situation not covered by natural ventilation (ASHRAE 62.1–2010, Section 6.4) | | | ✓ | ✓ |
| Any situation outside the authority's jurisdiction | | | ✓ | ✓ |
| Drawings showing monitoring devices (outside air flow measuring device, flow converter, air flow switch or similar monitor, automatic indicator device, $CO_2$ sensor) Controls | ✓ | ✓ | ✓ | ✓ |

18

# IEQ PREREQUISITE 1: MINIMUM INDOOR AIR QUALITY

## REQUIRED DOCUMENTS - HOSPITALS

| Documentation | Mechanical Ventilation | Natural Ventilation | Mixed Ventilation |
|---|---|---|---|
| Confirmation that the project meets the minimum requirements of ASHRAE Standard 170-2008, Section 6-8 | ✓ | | ✓ |
| If possible, a summary table of air balance to show that the minimum fresh air changes, minimum total air exchange, and provided space pressurization relations are compliant with FGI or ASHRAE Standard 170 | ✓ | | ✓ |
| Documentation of ventilation rate procedure calculations and assumptions for calculation variables, if applicable | ✓ | | ✓ |
| Documentation of the CIBSE flow diagram process for the project | | ✓ | ✓ |
| Natural ventilation procedure calculations and ventilation opening information | | ✓ | ✓ |
| Any natural ventilation exceptions arising from the mechanical ventilation system (ASHRAE 62.1-2010, Section 6.4) | | ✓ | ✓ |
| Any exceptions arising from local regulations should be specified. | | ✓ | ✓ |
| Drawings showing monitoring devices (outdoor air flow measuring device, flow converter, air flow switch or similar monitor, automatic display device, $CO_2$ sensor) | ✓ | ✓ | ✓ |

19

# IEQ PREREQUISITE 1: MINIMUM INDOOR AIR QUALITY

## REFERENCE STANDARDS

- ASHRAE Standard 62.1–2010: Ventilation for Acceptable Indoor Air Quality
- European Committee for Standardization (CEN) Standard EN 15251–2007: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics
- European Committee for Standardization (CEN) Standard EN 13779–2007: Ventilation for nonresidential buildings, Performance requirements for ventilation and room conditioning systems
- Chartered Institution of Building Services Engineers (CIBSE) Applications Manual AM10, March 2005, Natural Ventilation in Nondomestic Buildings
- ASHRAE Standard 170–2008: Ventilation of Health Care Facilities
- 2010 FGI Guidelines for Design and Construction of Health Care Facilities

## CALCULATIONS

- Design of projects in accordance with ASHRAE 62.1-2010 and ASHRAE 170-2008
- Preparation of fresh air calculation tables
- Preparation of project drawings

ECOBUILD

20

## IEQ PREREQUISITE 1: MINIMUM INDOOR AIR QUALITY

### V4.1 AMENDMENTS

ASHRAE Standard 62.1-2016 version is valid.

The ISO 17772-1:2017 and EN 16798-3:2017 standards have replaced the EN 15251-2007 and EN 13779-2007 standards.

In Mechanical Ventilation projects, fresh air monitoring requirement has been made mandatory for systems with a capacity greater than 1000 cfm (472 L/s).

In Natural Ventilation projects, three options have been introduced:

Option 1: ASHRAE 62.1-2016 Sections 4, 6.4, and 6.5 requirements must be met.

Option 2: A designed natural ventilation system can be developed. ASHRAE 62.1-2016 Sections 4 and 6.5 requirements must be met.

Option 3: For projects located in a building registered as a local or national historic building, the ASHRAE 62.1-2016 Sections 4, 6.4.1, 6.4.2, 6.4.3, and 6.5 requirements must be met.

For hospital projects, the ASHRAE Standard 170-2017 version is valid.

ECOBUILD

21

## IEQ PREREQUISITE 2: ENVIRONMENTAL TOBACCO SMOKE CONTROL

### PURPOSE AND REQUIREMENTS

The main aim is to protect building occupants and ventilation systems from the effects of tobacco smoke.

Smoking should be banned outside the building, except in designated smoking areas located at least 25 ft (7.5 meters) away from building entrances, fresh air intakes, and operable windows. Additionally, smoking should also be prohibited in areas used for work purposes that are outside of the property line.

If there is a local regulation that prevents the prohibition of smoking and the use of other tobacco products within 25 ft (7.5 m), documents related to this regulation should be provided.

No smoking signs must be located within a maximum distance of 10 ft (3 meters) from all building entrances.

ECOBUILD

22

## IEQ PREREQUISITE 2: ENVIRONMENTAL TOBACCO SMOKE CONTROL

### REQUIREMENTS

In Housing Projects

Option 1: No Smoking Policy

It is necessary to meet the requirements mentioned above.

Option 2: Segregation of Smoking Areas

The use of tobacco products should be prohibited in all common areas of the building. The prohibition should be communicated to the building users through lease agreements or commitments and restrictions of housing or cooperative associations. There should be provisions for enforcement.

Requirements for smoking areas outside the building should be applied in housing as in other projects.

No Smoking signs should be placed a maximum of 10 ft (3 meters) from all building entrances.


ECOBUILD

23

## IEQ PREREQUISITE 2: ENVIRONMENTAL TOBACCO SMOKE CONTROL

### REQUIREMENTS

- In residential projects
- To prevent excessive leakage between all housing units, it is necessary to make partitioning:
- In housing units, all exterior doors and operable windows must be insulated to minimize leakage.
- All doors opening to common corridors from residential units must be insulated.
- Uncontrolled passages that allow the transfer of smoke and other indoor air pollutants between residential units must be minimized. It is necessary to insulate leaks (penetrations) in walls, ceilings, and floors, as well as any adjacent vertical shafts (including service shafts, trash chutes, mail slots, and elevator shafts) of the residential units.
- At a pressure of 50 Pa, a blower door test must be conducted, showing a maximum leakage of 1.17 liters per square meter per second (0.23 $ft^3$ per $ft^2$ per minute) for the entire floor area of all apartments (including exterior and party walls, floors, and ceilings, encompassing all surfaces surrounding the apartment).

ECOBUILD

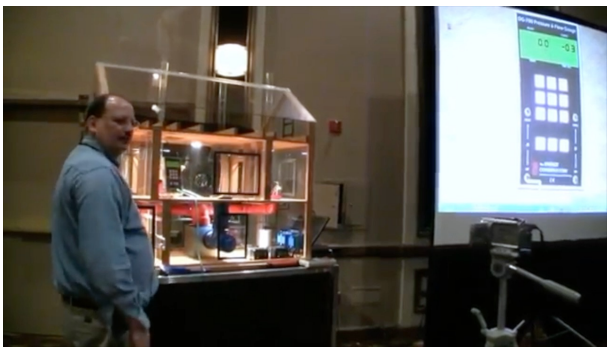
24

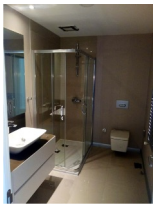
## IEQ PREREQUISITE 2: ENVIRONMENTAL TOBACCO SMOKE CONTROL

### REQUIREMENTS

Our sample project, Tepe-Mesa Park Mosaic Housing in Ankara Blower Door Test:

| Block Name | Test Result (ach) |
|---|---|
| Vertical Block Tests | 0.60 |
| Horizontal Block Tests | 0.70 |
| Passive House Standard | 0.50-0.60 |





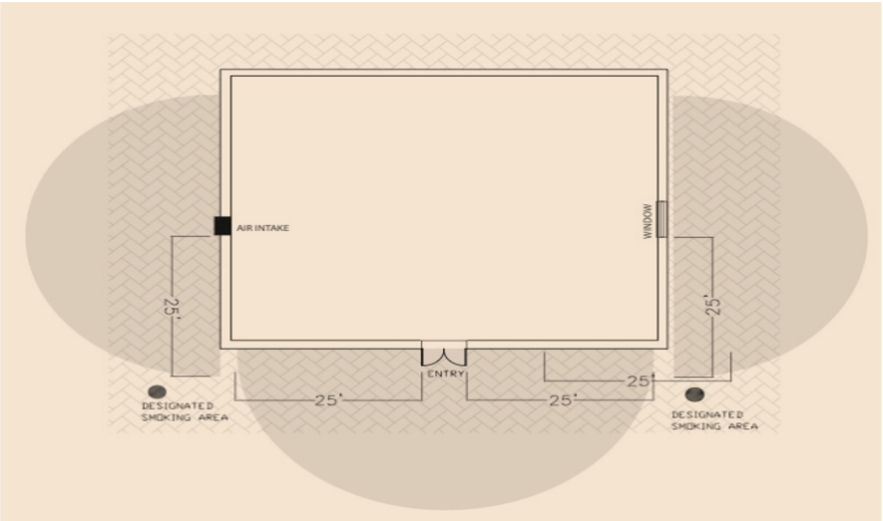
The principles of applying the Blower Door test are presented in the images. All potential leakage areas are detected using special methods.

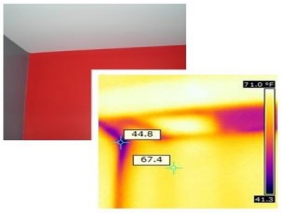
ECOBUILD

25

## IEQ PREREQUISITE 2: ENVIRONMENTAL TOBACCO SMOKE CONTROL

### REQUIREMENTS




ECOBUILD

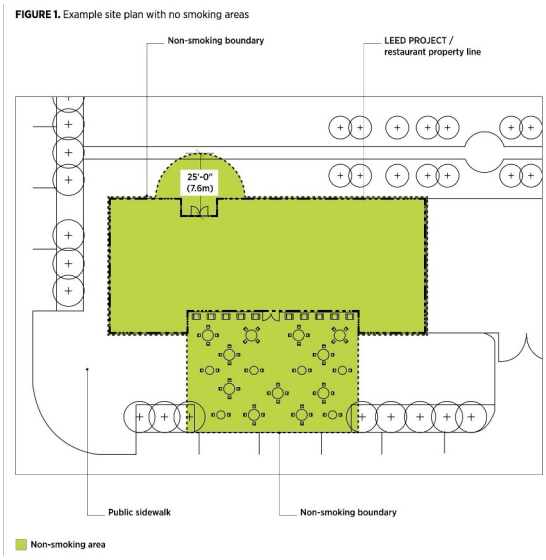
26

## IEQ PREREQUISITE 2: ENVIRONMENTAL CIGARETTE SMOKE CONTROL

### REQUIREMENTS

On the side, there is a sample layout plan.

The boundaries of smoke-free areas and information related to non-smoking zones are included in the plan.




ECOBUILD

27

## IEQ PRE-REQUISITE 2: ENVIRONMENTAL TOBACCO SMOKE CONTROL

### REQUIRED DOCUMENTS

| Documentation | All Projects | Residences |
|---|---|---|
| A document explaining how the no-smoking policy is implemented in the building and communicated to the building users | ✓ | ✓ |
| A photocopy of the no-smoking policy and a copy of any legal regulations that impede the no-smoking law if applicable | ✓ | |
| Documents showing the insulation properties of doors opening to common areas of residential units | | ✓ |
| Blower-door test report for residences | | ✓ |
| A scaled site plan or map showing designated smoking areas and non-smoking areas, the location of the property line, and the boundary of the site marked at distances of 25 ft (7.5 meters) from building openings | ✓ | ✓ |
| Drawings, photographs, or a copy of the no-smoking policy, photographs of no smoking signs, and other supporting documents | ✓ | ✓ |
| Any codes or landlord restrictions that prevent enforcement of no smoking requirements | ✓ | ✓ |

ECOBUILD

28

# IEQ PREREQUISITE 2: ENVIRONMENTAL TOBACCO SMOKE CONTROL

## REFERENCE STANDARDS

- Standard Test Method for Determining Air Leakage Rate by Fan Pressurization, ASTM E779-03
- Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door, ASTM E1827-11
- Nondestructive testing, Leak testing—Criteria for method and technique selection, CEN Standard EN 1779—1999
- Nondestructive testing, Leak testing, Tracer gas method, CEN Standard EN 13185—2001
- Nondestructive testing, Leak testing, Calibration of reference leaks for gases, CEN Standard EN 13192—2001
- RESNET Standards
- ENERGY STAR Multifamily Testing Protocol

ECOBUILD

29

# IEQ PREREQUISITE 2: ENVIRONMENTAL TOBACCO SMOKE CONTROL

## V4.1 CHANGES

- The scope of credit now includes smoke from the burning of cannabis and similar stimulants in addition to tobacco product smoke, as well as electronic cigarette smoke.
- The requirement to place a no smoking sign 3 meters away from entrances has been removed.
- The distance criterion for smoking areas in relation to building entrances, windows, or fresh air intakes has been changed to 7.5 m or the maximum distance permitted by local codes.
- The airtightness criterion in residential buildings has been raised from 1.17 l/s.m2 to 1.53 l/s.m2.
- A new airtightness criterion of 0.50 cfm/ft2 has been added for renovation projects that maintain the existing building envelope.

ECOBUILD

30

# IEQ CREDIT 1: ADVANCED INDOOR AIR QUALITY STRATEGIES

## OBJECTIVE

The primary objective is to promote the comfort, well-being, and productivity of building occupants by improving indoor air quality.

Increasing the indoor air quality of buildings directly correlates with human health.

Not only health but also the productivity of employees working inside the building is related to indoor air quality.

It should be noted that people spend about 90% of their lifetime indoors.

The human body, which spends a significant amount of time indoors, is naturally affected by the pollutants inside the building. The level of these pollutants is relatively 5 times higher than that of outdoor air.

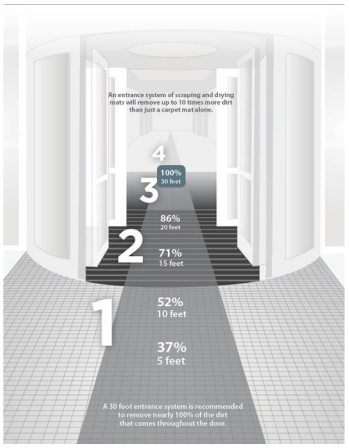
ECOBUILD

31

# IEQ CREDIT 1: ENHANCED INDOOR AIR QUALITY STRATEGIES

## REQUIREMENTS

- Option 1: Enhanced IAQ strategies (1 point)
- To be applicable, comply with the following conditions:
- Mechanically ventilated areas:
- Building entryway systems
- Prevention of cross-contamination within the building
- Filtration
- In naturally ventilated areas:
- Building entryway systems
- Natural ventilation design calculations.
- Mixed mode ventilation systems:
- Building entryway systems
- Prevention of cross-contamination within the building
- Filtration
- Natural ventilation design calculations and
- Mixed-mode design ventilation calculations




ECOBUILD

32

## IEQ CREDIT 1: ENHANCED INDOOR AIR QUALITY STRATEGIES

### REQUIREMENTS

A. Building Entryway Systems

All building entrances that are frequently used to capture dirt and infectious particles coming from outside the building must have permanent entry systems (doormats) that are at least 10 feet (3 meters) long in the direction of pedestrian traffic. Acceptable entry systems include dust trap fixed mounted grates, rollout mats with a cleaning chamber underneath, and systems that provide equivalent or better performance.

All systems should be maintained weekly.

ECOBUILD

33

## IEQ CREDIT 1: ENHANCED INDOOR AIR QUALITY STRATEGIES

### REQUIREMENTS

B. Building Indoor Cross Contamination Prevention

In areas where hazardous gases or chemicals are present (such as garages, cleaning and laundry areas, copying and printing rooms), exhaust ventilation should be provided at the flow rates specified in IEQ Prerequisite 1 or 0.5 cfm/ft2 (whichever is greater).

These areas should be maintained under negative pressure relative to adjacent spaces.

The doors to these areas should have self-closing mechanisms, and the areas should be divided by floor-to-ceiling partition walls or have airtight ceilings.

The ozone gas present in photocopy rooms is hazardous to human health and a significant carcinogen.


34

## IEQ CREDIT 1: ADVANCED INDOOR AIR QUALITY STRATEGIES

### REQUIREMENTS

- C. Filtration
- All ventilation systems that provide fresh air in the areas used by building occupants must have particle filters or air cleaning devices that meet the filter requirements specified below:
- Filters must have a minimum efficiency reporting value (MERV) of 13 or higher according to ASHRAE Standard 52.2-2007, or
- filters must possess class F7 or higher as defined by CEN Standard EN 779–2002, Particulate Air Filters for General Ventilation, Determination of the Filtration Performance.
- All air filters must be replaced after the completion of the construction and before the occupants begin using the building.


ECOBUILD

35

## IEQ CREDIT 1: ADVANCED INDOOR AIR QUALITY STRATEGIES

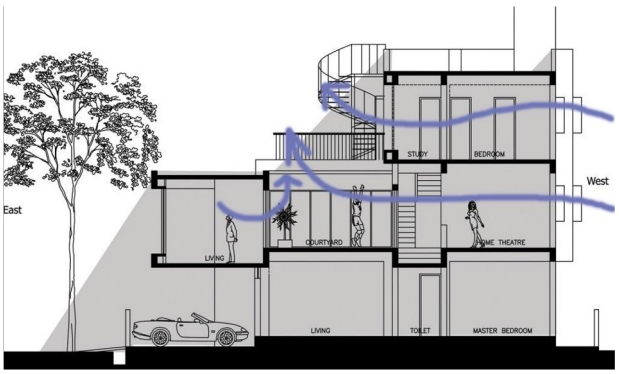
### REQUIREMENTS

D. Natural Ventilation Design Calculations

The system design for the spaces used by building occupants should be demonstrated to comply with the strategies outlined in the Chartered Institution of Building Services Engineers (CIBSE) Application Guide AM10, March 2005, Natural Ventilation in Non-Domestic Buildings, Section 2.4.

E. Mixed Mode System Design Calculations

The system design for the spaces used by building occupants should conform to the Mixed Mode Ventilation CIBSE Applications Guide 13-2000.




ECOBUILD

36

## IEQ CREDIT 1: ADVANCED INDOOR AIR QUALITY STRATEGIES

### REQUIREMENTS

- Option 2: Additional Advanced IAQ Strategies (1 point)
- As applicable, comply with the following conditions:
- In mechanically ventilated areas, select one of the following:
- Preventing Outdoor Pollutant Entry;
- Increased Ventilation;
- Carbon Dioxide Monitoring or
- Additional Pollutant Source Control and Monitoring.
- In naturally ventilated areas, select one of the following:
- Preventing Outdoor Pollutant Entry;
- Additional Pollutant Source Control and Monitoring; Or
- Room-by-Room Calculations for Natural Ventilation
- For hybrid systems, select one of the following:
- Preventing Outdoor Pollutant Entry;
- Increased Ventilation;
- Additional Pollutant Source Control and Monitoring; Or
- Room-by-Room Calculations for Natural Ventilation


ECOBUILD

37

## IEQ CREDIT 1: ADVANCED INDOOR AIR QUALITY STRATEGIES

### REQUIREMENTS

- A. Preventing the Entry of Outdoor Pollutants
- Design the project to minimize and control the entry of pollutants into the building.
- It must be calculated that the pollutant concentration at outdoor air inlets is below the thresholds listed in Table 1 (or local equivalents for projects outside the US);
- Fluid dynamics (CFD) modeling results,
- Gaussian distribution analyses,
- Wind tunnel tests, or one of the tracking gas modeling methods should demonstrate this.

Table 1. Maximum concentration of air from building outdoor air inlets

| Pollutants | Maximum Concentration | Standard |
|---|---|---|
| Pollutants defined by the National Ambient Air Quality Standards (NAAQS) | Permitted annual average | National Ambient Air Quality Standards (NAAQS) |
| | Or, | |
| | If no annual standard, 8-hour or 24-hour average | |
| | Or, | |
| | 3-month rolling average | |

ECOBUILD

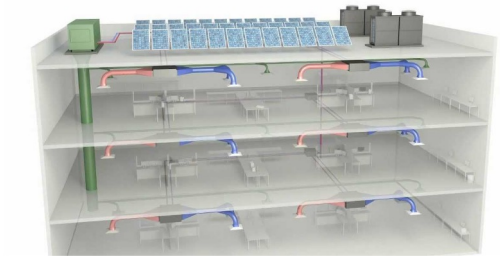
38

## IEQ CREDIT 1: ADVANCED INDOOR AIR QUALITY STRATEGIES

### REQUIREMENTS

B. Enhanced Ventilation, 30% Rate

Increase the percentage of outdoor air (fresh air) in all areas used by building occupants within the breathing zone by at least 30% based on the minimum values set in the IEQ prerequisite Minimum Indoor Air Quality criteria.



ECOBUILD

39

## IEQ CREDIT 1: ADVANCED INDOOR AIR QUALITY STRATEGIES

### REQUIREMENTS

C. Monitoring Carbon Dioxide Levels Inside the Building

It is necessary to monitor CO2 concentrations in all user-dense areas. CO2 measuring devices should be placed within the space, at a height of 3 and 6 ft (900 and 1,800 millimeters) in the breathing zone.

CO2 sensors should have audible or visual indicators.

When the detected CO2 concentration exceeds the designated set value by 10%, the building automation system should be alerted.

Appropriate CO2 alarm set values should be calculated using the methods described in ASHRAE 62.1-2010, Appendix C.


ECOBUILD

40

## IEQ CREDIT 1: ADVANCED INDOOR AIR QUALITY STRATEGIES

### REQUIREMENTS

D. Additional Pollutant Source Control and Monitoring

In places where air pollutants are likely to be present, the potential presence of pollutant sources other than CO2 should be evaluated.

A plan should be developed and implemented to address how pollutant-containing materials will be handled to reduce the likelihood of pollutant emissions. Monitoring systems equipped with sensors should be used to detect specific pollutants. These sensors should provide alarms in unusual or hazardous situations.

E. Natural Ventilation Room-by-Room Calculations

Effective natural ventilation provided by room-by-room airflow should be demonstrated by applying CIBSE AM10, Section 4, Design Calculations.


ECOBUILD

41

## IEQ CREDIT 1: ADVANCED INDOOR ENVIRONMENTAL AIR QUALITY STRATEGIES

### REQUIRED DOCUMENTS

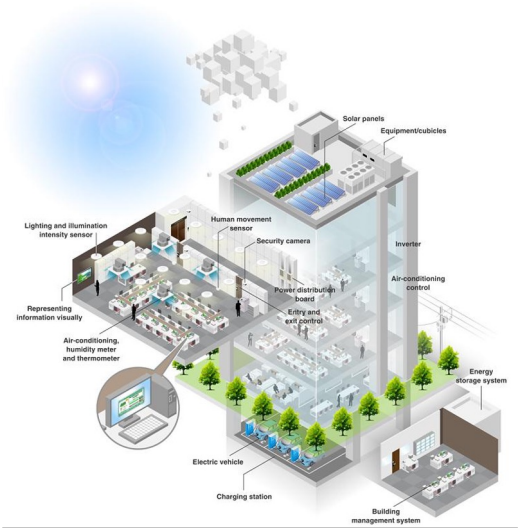
| Documentation | Option 1 | Option 2 |
|---|---|---|
| Entryway systems: Scaled floor plans showing locations and measurements | ✓ | |
| Indoor cross-contamination prevention: Room list, areas, exhaust rates, separation methods | ✓ | |
| Filtration: List of devices showing MERV or equivalent filter class for all ventilation systems | ✓ | |
| Natural ventilation design: Calculations and narrative showing strategies compliant with the referenced standard | ✓ | |
| Mixed-mode design: Calculations and narrative showing strategies compliant with the referenced standard | ✓ | |
| Prevention of outdoor contaminant ingress: Narrative describing the type of modeling; model result reports emphasizing contaminant levels and required thresholds | | ✓ |
| Increased ventilation: Calculations documented under EQ Prerequisite Minimum Indoor Air Quality Performance. | | ✓ |
| Carbon dioxide monitoring: List showing types of frequently used volumes, design CO2 concentrations, floor plan sensor locations, narrative explaining desired values for CO2 levels | | ✓ |
| Additional pollutant source control and monitoring: Plan describing potential air pollutants, material handling strategies, and showing installed monitoring systems | | ✓ |
| Natural ventilation: Narrative and diagrams showing room-to-room calculations according to the referenced standard | | ✓ |

42

# IEQ CREDIT 1: ADVANCED INDOOR AIR QUALITY STRATEGIES

## REFERENCE STANDARDS

- ASHRAE Standard 52.2–2007
- CEN Standard EN 779–2002
- Chartered Institution of Building Services Engineers (CIBSE) Applications Manual AM10, March 2005, Natural Ventilation in Nondomestic Buildings
- Chartered Institution of Building Services Engineers (CIBSE) Applications Manual 13, 2000
- National Ambient Air Quality Standards (NAAQS)




ECOBUILD

43

# IEQ CREDIT 1: ADVANCED INDOOR AIR QUALITY STRATEGIES

## V4.1 CHANGES

Filter standards in mechanically ventilated projects have been updated as follows:

ASHRAE Standard 52.2-2017 (minimum requirement MERV 13)

ISO 16890-2016 (minimum requirement ePM1 50%)

The EN 779-2007 standard has been revoked.

ECOBUILD

44

# IEQ CREDIT 2: LOW-EMITTING MATERIALS

## PURPOSE AND REQUIREMENTS

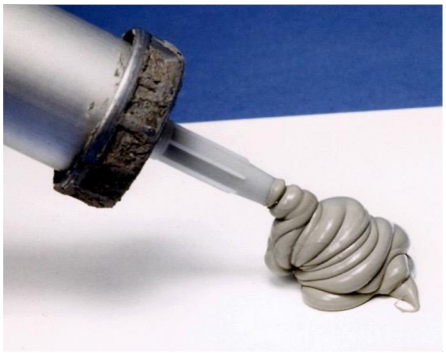
The aim is to prevent the harm caused by pollutants that lead to air pollution to construction workers and building users.

Option 1: Product Category Accounts

This credit includes requirements not only for the manufacturing of these credit products but also for project teams. This credit title covers the emission of volatile organic compounds (VOCs) into the indoor air, as well as the VOC content of materials and the test methods specified for these contents.

In order to meet the credit requirements, different requirements have been defined for different material categories. Performance thresholds for indoor and outdoor are organized into seven categories.

In this credit, 'indoor' encompasses all materials that are inside the waterproofing layer. 'Outdoor' includes everything outside the primary and secondary waterproofing. For example, all types of waterproofing membranes and air/water-resistant barrier materials.



ECOBUILD

45

# IEQ CREDIT 2: LOW EMITTING MATERIALS

## SUITABILITY THRESHOLDS

| | Category | Thresholds | Emission and content requirements |
|---|---|---|---|
| 1. | Interior paints and coatings applied in the building | At least 90%, by volume, for emissions; 100% for VOC content | General Emissions Evaluation for paints and coatings applied to walls, floors, and ceilings |
| | | | VOC content requirements for wet-applied products |
| 2. | Adhesives and sealants applied on-site (including flooring adhesives) | At least 90%, by volume, for emissions; 100% for VOC content | General Emissions Evaluation |
| | | | VOC content requirements for wet-applied products |
| 3. | Floor coverings | 100% | General Emissions Evaluation |
| 4. | Composite wood | 100% does not cover other categories | Composite Wood Evaluation |
| 5. | Ceilings, walls, thermal and sound insulation | 100% | General Emissions Evaluation |
| | | | Additional insulation requirements for Healthcare, Schools |
| 6. | Furniture (if within the scope of work, should be added to calculations) | At least 90%, by price | Furniture Evaluation |
| 7. | For Health Care and School Projects only: Products applied to the building exterior | At least 90%, by volume | Exterior Applied Products |

ECOBUILD

46

# IEQ CREDIT 2: LOW EMISSION MATERIALS

## SCORE DISTRIBUTIONS

| Eligible Categories | Points |
|---|---|
| NC, CS, NC Retail, DC, WDC, NC Hos projects - Without Furniture | |
| 2 | 1 |
| 4 | 2 |
| 5 | 3 |
| NC, CS, NC Retail, DC, WDC, NC Hos projects with furniture, CI, CI Retail, CI Hos | |
| 3 | 1 |
| 5 | 2 |
| 6 | 3 |
| Schools, Healthcare - Without Furniture | |
| 3 | 1 |
| 5 | 2 |
| 6 | 3 |
| Schools, Healthcare - With Furniture | |
| 4 | 1 |
| 6 | 2 |
| 7 | 3 |

47

# IEQ CREDIT 2: LOW EMITTING MATERIALS

## REQUIREMENTS

Option 2: Budget Calculation Method

The budget calculation method can be used if some products do not meet the standards in the categories.

The budget method organizes the interior of the building under 6 headings:

Flooring;

Ceilings;

Walls;

Thermal insulation;

Sound insulation;

Furniture.

Furniture is included in the calculations if it is part of the project's scope. Walls, ceilings, and flooring are defined as interior construction products; every layer of the structural assembly, including paints, coatings, adhesives, and sealants, should be evaluated for compatibility. Insulation is monitored separately.

| Total % | Points |
|---|---|
| ≥ 50% and < 70% | 1 |
| ≥ 70% and < 90% | 2 |
| ≥ 90% | 3 |

48

# IEQ CREDIT 2: LOW EMITTING MATERIALS

## REQUIREMENTS

- Equation 1. Total percentage of materials meeting credit requirements

$$\text{Total \% compliant for projects without furniture} = \frac{(\text{\% compliant walls} + \text{\% compliant ceilings} + \text{\% compliant flooring} + \text{\% compliant insulation})}{4}$$

$$\text{Total \% compliant for projects with furniture} = \frac{(\text{\% compliant walls} + \text{\% compliant ceilings} + \text{\% compliant flooring} + \text{\% compliant insulation}) + (\text{\% compliant furniture})}{5}$$

- Equation 2. Percentage of materials meeting credit requirements based on the system

$$\text{Flooring, walls, ceilings, insulation \% compliant} = \frac{(\text{compliant surface area of layer 1} + \text{compliant surface area of layer 2} + \text{compliant surface area of layer 3} + \ldots)}{(\text{total surface area of layer 1} + \text{total surface area of layer 2} + \text{total surface area of layer 3} + \ldots)} \times 100$$

- Equation 3. Percentage of furniture meeting credit requirements according to ANSI/BIFMA assessment

$$\text{\% compliant for furniture} = \frac{0.5 \times \text{cost compliant with §7.6.1 of ANSI/BIFMA e3-2011} + \text{cost compliant with §7.6.2 of ANSI/BIFMA e3-2011}}{\text{total furniture cost}} \times 100$$

ECOBUILD

49

# IEQ CREDIT 2: LOW EMITTING MATERIALS

## STRATEGIES

Materials that naturally do not emit (stone, ceramics, powder-coated metals, coated or anodized metals, glass, concrete, clay brick, and untreated wood flooring) meet credit requirements without VOC testing.

However, within these materials, there should be no organic-containing surface coatings, adhesives, or pastes.

ECOBUILD

50

## IEQ CREDIT 2: LOW-EMITTING MATERIALS

### REQUIRED DOCUMENTS

| Documentation | Option 1 | Option 2 |
|---|---|---|
| USGBC low-emission materials calculator | ✓ | ✓ |
| Product information (e.g., MSDS, third-party certifications or test results) | ✓ | ✓ |

ECOBUILD

51

## IEQ CREDIT 2: LOW EMITTING MATERIALS

### REFERENCE STANDARDS

- California Department of Public Health (CDPH) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, v. 1.1–2010
- ISO 17025
- ISO Guide 65
- German AgBB Testing and Evaluation Scheme (2010)
- ISO 16000-3:2011- Indoor air -- Part 3: Determination of formaldehyde and other carbonyl compounds in indoor air and test chamber air -- Active sampling method
- ISO 16000-6:2011- Indoor air -- Part 6: Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA sorbent, thermal desorption and gas chromatography using MS or MS-FID
- ISO 16000-7:2007- Indoor air -- Part 7: Sampling strategy for determination of airborne asbestos fibre concentrations
- ISO 16000-11:2006- Indoor air -- Part 11: Determination of the emission of volatile organic compounds from building products and furnishing -- Sampling, storage of samples and preparation of test specimens
- South Coast Air Quality Management District (SCAQMD) Rule 1168
- South Coast Air Quality Management District (SCAQMD) Rule 1113
- European Decopaint Directive

ECOBUILD

52

# IEQ CREDIT 2: LOW EMITTING MATERIALS

## REFERENCE STANDARDS

- Canadian VOC Concentration Limits for Architectural Coatings
- Hong Kong Air Pollution Control Regulation
- California Air Resources Board (CARB) 93120 Airborne Toxic Control Measure (ATCM) for formaldehyde emissions from composite wood products
- ANSI/BIFMA M7.1 Standard Test Method for Determining VOC Emissions from Office Furniture Systems, Components and Seating
- ANSI/BIFMA e3–2011 Furniture Sustainability Standard
- NIOSH, Asphalt Fume Exposures During the Application of Hot Asphalt to Roofs, Publication No. 2003-112
- ISO 4224 Ambient air—Determination of carbon monoxide—Nondispersive infrared spectrometric method
- ISO 7708 Air quality—Particle size fraction definitions for health-related sampling
- ISO 13964 Air quality—Determination of ozone in ambient air—Ultraviolet photometric method
- U.S. EPA Compendium of Methods for the Determination of Air Pollutants in Indoor Air, IP-1: Volatile Organic Compounds, IP-3: Carbon Monoxide and Carbon Dioxide, IP-6: Formaldehyde and other aldehydes/ketones, IP-10 Volatile Organic Compounds
- U.S. EPA Compendium of Methods for the Determination of Inorganic Compounds in Ambient Air, TO-1: Volatile Organic Compounds, TO-11: Formaldehyde, TO-15: Volatile Organic Compounds, TO-17: Volatile Organic Compounds
- ASTM D5197–09e1 Standard Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology)
- ASTM D5149–02(2008) Standard Test Method for Ozone in the Atmosphere: Continuous Measurement by Ethylene Chemiluminescence

ECOBUILD

53

# IEQ CREDIT 2: LOW EMISSION MATERIALS

## V4.1 CHANGES

The scoring table has been updated as follows:

| Eligible Categories | Scores |
|---|---|
| 2 product categories | 1 |
| 3 product categories | 2 |
| 4 product categories | 3 |
| 5 product categories | 3 + sample performance |
| Exceeding 90% threshold in at least 3 product categories | +1 additional point if sample performance or 1 or 2 points are obtained in the above categories |

Paints and Coatings / Adhesives and Putties: The VOC emission threshold has been reduced from 90% to 75%. The VOC emission threshold calculated by volume can alternatively be calculated based on the surface area where the product is applied.

ECOBUILD

54

## IEQ CREDIT 2: LOW EMITTING MATERIALS

### V4.1 CHANGES

- Floor and Ceiling Systems: At least 90% of the cost or surface area must meet the VOC emission criteria, or consist of naturally non-emitting materials, or consist of salvaged and reused materials.
- Wall Systems: At least 75% of the cost or surface area must meet the VOC emission criteria, or consist of naturally non-emitting materials, or consist of salvaged and reused materials.
- Insulation Materials: At least 75% of the cost or surface area must meet the VOC emission criteria. Mechanical system insulation is excluded.
- Furniture: At least 75% of the cost must meet the furniture emission criteria, or consist of naturally non-emitting materials, or consist of salvaged and reused materials.
- Composite Wood: At least 75% of the cost or surface area must meet the formaldehyde emission criteria, or consist of salvaged and reused materials.
- VOC emission testing is conducted according to CDPH Standard Method v1.2-2017.
- The most current versions of VOC content standards as of 2019 are valid.
- New standards have been introduced for Formaldehyde Emission Assessment.

ECOBUILD

55

## IEQ CREDIT 3: INDOOR ENVIRONMENTAL AIR QUALITY MANAGEMENT PLAN

### PURPOSE AND REQUIREMENTS

- The primary aim is to prevent harm caused by dust and other pollutants that arise during work on construction sites to the workers and building users.
- Manufacturing should comply with SMACNA IAQ Guidelines during construction.
- Stored materials should be protected from adverse conditions such as dust and moisture.
- Ventilation systems operated during construction must have air filters of MERV8 class installed in all return air ducts according to ASHRAE 52.2-2007 standard, and these filters should be replaced after construction is completed.
- Before construction begins, an Indoor Environmental Quality Plan (IEQ Plan) compliant with SMACNA criteria should be prepared:
- HVAC Protection
- Source Control
- Closure of Passages
- Cleaning and Planning

ECOBUILD

56

## IEQ CREDIT 3: CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT PLAN

### REQUIREMENTS

For Hospital Projects;
Humidity Control: Develop and implement a humidity control plan to protect the moisture-absorbing materials on-site and installed from moisture damage. Properly remove any material that has grown and developed microbiological media on it from the building and replace it with new, undamaged materials. In addition, the strategies you employ should protect the building against moisture, as well as prevent building users from being exposed to mold and fungal spores.
Harmful Particles: During construction, if ventilation units are to be operated, a filter in MERV 8 class, which stands for Minimum Efficiency Reporting Value, determined by ASHRAE 52.2-2007, should be used. It is also defined as an F5 filter. Immediately before use, replace all filters with MERV 13 filters in accordance with the manufacturer's recommendations.
VOC, Volatile Organic Compounds: Schedule construction procedures to minimize the exposure of absorbent materials to VOC emissions. Complete the application of painting and sealants before storing or assembling "dry" materials; These can accumulate pollutants and release them over time. Store fuels, solvents and other VOCs separately from absorbents.

ECOBUILD

57

## IEQ CREDIT 3: INDOOR ENVIRONMENTAL QUALITY CONSTRUCTION AIR QUALITY MANAGEMENT PLAN

### REQUIREMENTS

For Hospital Projects;
Outdoor Air Emissions: Building waterproofing, asphalt (bituminous) roofing membrane, parking lot sealing chemicals, or other outdoor construction materials that produce high VOC emissions can pollute indoor air. Develop a plan to manage pollutant fumes that may arise from these and similar materials and prevent them from seeping into areas regularly used by building occupants. Comply with the rules established by NIOSH regarding the formation of asphalt fumes during the application of Hot Asphalt to the Roof. (NIOSH Publication 2003-112)
Cigarettes and Tobacco Products: Prohibit the use of tobacco products inside the building and within 25 ft (8 meters) of the building entrance during construction.
Noise and Vibration: Implement a plan to reduce noise and vibration generated by construction equipment and other motors as outlined in British Standard BS-5228. Develop your plan by specifying the lowest decibel level that meets the low noise emission design performance requirements stated in British Standard BS-5228. Construction workers must wear hearing protection in areas where sound levels exceed 85 dB for extended periods.

ECOBUILD

58

## IEQ CREDIT 3: INDOOR ENVIRONMENTAL AIR QUALITY MANAGEMENT PLAN

### REQUIREMENTS

For Hospital Projects;

Infection Control: For renovation and building addition projects adjacent to currently used facilities, establish an integrated infection control team consisting of the building owner, designer, and contractor, following the FGI 2010 Guidelines for Design and Construction of Health Care Facilities and the rules of the Guidelines and Standards Committee for Health Facility Design and Construction. This team can assess infection control risks and document the necessary precautions in the plan specifically created for the project. Use the infection control risk assessment standard published by the American Society of Healthcare Engineering and the U.S. Centers for Disease Control and Prevention (CDC) as a guide to assess risk and select risk reduction procedures for construction activities. (American Society of Healthcare Engineering and the U.S. Centers for Disease Control and Prevention - CDC)

Manufacturing during construction must comply with SMACNA IAQ Guidelines (Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 2nd edition, 2007, ANSI/SMACNA 008–2008, Chapter 3.).

ECOBUILD

59

## IEQ CREDIT 3: CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT PLAN

### STRATEGIES

- Source control,
- Storage of construction materials free from moisture
- HVAC protection, temporary ventilation if necessary
- Preventing the transfer of pollution through walkways
- Protection of stored materials from moisture
- Personnel Training
- A sample IAQ plan will be shared with the construction company for the creation of this plan. This plan will be prepared and used throughout the construction period. The contractor will assign one of their personnel (construction engineer) to IAQ issues. This person's sole duty will not be this; they will also oversee the IAQ plan alongside their other responsibilities in the construction. However, their other duties should not interfere with the tasks of following up, controlling, and reviewing the IAQ plan. The IAQ responsible person will take photographs every week, fill out the inspection report every month, sign it, and these reports will be kept for use in reporting along with their attachments.

ECOBUILD

60

IEQ CREDIT 3: INDOOR ENVIRONMENTAL QUALITY MANAGEMENT PLAN FOR CONSTRUCTION

## STRATEGIES

- Protection of Ventilation Systems: The construction company will protect all ventilation equipment from dust and odors of volatile substances. During the manufacturing of ventilation ducts, the open ends of the ducts will be covered with plastic wrap at the end of the shift. If the ventilation system needs to be operated while construction is ongoing, all return ducts will be closed, and the system will operate in 100% fresh air mode, or air filters with at least F4 efficiency will be installed at the openings of the return ducts. Additionally, mechanical rooms will not be used for material storage.
- Source Control: The construction company will separate storage areas for all materials that can release volatile chemicals (paints, adhesives, etc.) from other materials. The storage of such materials will be prevented in areas where the manufacturing of air ducts is ongoing. During construction, there will be no duct manufacturing or activities involving materials that can hold such chemicals (drywall, insulation, acoustic panels, etc.) in areas where construction activities create dust, dirt, smoke, chemicals, etc. that could affect indoor air quality.
- Closure of Passages: In completed areas of construction, temporary measures will be taken to separate ongoing areas from finished spaces, preventing the passage of dust, dirt, and volatile chemicals into the finished area.
- Cleaning: The construction company is responsible for the overall cleaning of the construction site and ensuring that storage areas are free from dust, moisture, and dirt. They will periodically and frequently clean material storage areas and will demonstrate maximum care for overall construction cleanliness.
- Time Planning: The contractor will create a work schedule considering the requirements of the IAQ plan. Activities that could affect indoor air quality should be separated from other activities as much as possible.

ECOBUILD

61

# IEQ CREDIT 3: INDOOR AIR QUALITY MANAGEMENT PLAN

## REQUIRED DOCUMENTS

| Documentation | All Projects | Hospitals |
|---|---|---|
| IAQ management plan or detailed checklist emphasizing the no smoking policy | ✓ | |
| EQMP (Indoor Environmental Quality Management Plan) or detailed checklist emphasizing the no smoking policy | | ✓ |
| Description defining protective measures for absorbent materials | ✓ | ✓ |
| Explanatory photographs of measures taken for indoor air and environmental quality | ✓ | ✓ |
| Records of filters | ✓ | ✓ |

ECOBUILD

62

## IEQ CREDIT 3: CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT PLAN

### REFERENCES STANDARDS

- ASHRAE Standard 52.2–2007
- CEN Standard EN 779–2002
- Sheet Metal and Air-Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 2nd edition, 2007, ANSI/SMACNA 008–2008 (Chapter 3)
- British Standard 5228—2009
- Infection Control Risk Assessment (ICRA) Standard, published by the American Society of Healthcare Engineering (ASHE) and the U.S. Centers for Disease Control and Prevention (CDC)
- NIOSH, Asphalt Fume Exposures During the Application of Hot Asphalt to Roofs, Publication No. 2003-112
- ISO 4224 Ambient air—Determination of carbon monoxide—Nondispersive infrared spectrometric method
- ISO 7708 Air quality—Particle size fraction definitions for health-related sampling
- ISO 13964 Air quality—Determination of ozone in ambient air—Ultraviolet photometric method
- U.S. EPA Compendium of Methods for the Determination of Air Pollutants in Indoor Air, IP-1: Volatile Organic Compounds, IP-3: Carbon Monoxide and Carbon Dioxide, IP-6: Formaldehyde and other aldehydes/ketones, IP-10 Volatile Organic Compounds
- U.S. EPA Compendium of Methods for the Determination of Inorganic Compounds in Ambient Air, TO-1: Volatile Organic Compounds, TO-11: Formaldehyde, TO-15: Volatile Organic Compounds, TO-17: Volatile Organic Compounds
- ASTM D5197–09e1 Standard Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology)
- ASTM D5149–02(2008) Standard Test Method for Ozone in the Atmosphere: Continuous Measurement by Ethylene Chemiluminescence

ECOBUILD

63

## IEQ CREDIT 3: CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT PLAN

### V4.1 CHANGES

- Filter standards in mechanically ventilated projects have been updated as follows:
- ASHRAE Standard 52.2-2017 (minimum requirement MERV 8)
- ISO 16890-2016 (minimum requirement ISO coarse 90%)
- The EN 779-2007 standard has been revoked.

ECOBUILD

64

## IEQ CREDIT 4: INDOOR ENVIRONMENTAL AIR QUALITY ASSESSMENT

### PURPOSE AND REQUIREMENTS

Ensure that the indoor air quality in the building is better when the construction is finished and users have started to use the building. The main objective is to prevent the harm caused by VOCs, dust, and similar pollutants generated during construction to the workers and users of the building.

After construction is completed and the building is thoroughly cleaned, please choose one of the two options to be implemented.

All interior surfaces such as carpentry, doors, paint, carpets, acoustic ceiling tiles, and movable furniture (for example, workstations sections) should be installed, and major VOC control checklist (punch-list) items must have been used or installed in the building. Options cannot be combined.

ECOBUILD

65

## IEQ CREDIT 4: INDOOR AIR QUALITY ASSESSMENT

### REQUIREMENTS

- Option 1: Flush-out (1 Point)
- Path 1: Pre-Occupancy
- After construction is completed, new filters are installed in the fresh air units, providing 14,000 ft3 of fresh air per ft2 (4,267,140 liters per square meter). The temperature must be at least 60 °F (15 °C) and at most 80 °F (27 °C). Humidity should not exceed 60%.
- Filters should be replaced with new ones after the flush out.
- Path 2: While the Building is in Use
- After construction is completed, before occupancy, 3,500 ft3/ft2 of fresh air is provided. During occupancy, ventilation is done at a rate of 0.3 cfm/ft2 (1.5 liters of fresh air per square meter per second) or at the rates specified in IEQ Prerequisite 1. This way, the provided amount of fresh ventilation is completed to 14,000 ft3 per ft2.
- The ventilation rate must be at least 0.3 cfm/ft2.
- The ventilation system must start operating at least 3 hours before the working hours of the employees.


ECOBUILD

66

# IEQ CREDIT 4: INDOOR AIR QUALITY ASSESSMENT

## REQUIREMENTS

- Option 2: Air Quality Test
- Before the building is put to use, air quality testing should be conducted in all areas used by the occupants, applying consistent protocols through the methods listed in Table 1, under typical ventilation conditions. As specified in the table, current versions of ASTM standard methods, EPA summary methods, or ISO methods should be utilized. Laboratories conducting formaldehyde and volatile organic compounds (VOC) chemical analysis tests must be accredited for their testing methods under ISO/IEC 17025. Retail stores can conduct their tests within 14 days after the building is opened for use.
- Testing is conducted before the building is put to use.
- Testing is conducted after the application of finishing materials is completed.
- A separate test is conducted for each ventilation zone and one test is conducted for every 25,000 ft2 area.
- Air samples must be taken at a height of 3-6 feet from the ground within a 4-hour time frame.


ECOBUILD

67

# IEQ CREDIT 4: INDOOR AIR QUALITY ASSESSMENT

Table. REQUIREMENTS FOR AIR TESTING Maximum Concentration Levels According to Pollutant and Test Method

| Pollutant | Maximum Concentration | Maximum Concentration for Hospitals | ASTM and U.S. EPA Method | ISO Method |
|---|---|---|---|---|
| Formaldehyde | 27 ppb | 16.3 ppb | ASTM D5197; EPA TO- 11 or EPA Compendium Method IP-6 | ISO 16000-3 |
| Particulates (PM10 for all buildings; PM2.5 for buildings in EPA nonattainment areas, or local equivalent) | PM10: 50 micrograms per cubic meter PM2.5: 15 micrograms per cubic meter | 20 micrograms per cubic meter | EPA Compendium Method IP-10 | ISO 7708 |
| Ozone (for buildings in EPA nonattainment areas) | 0.075 ppm | 0.075 ppm | ASTM D5149 - 02 | ISO 13964 |
| Total Volatile Organic Compounds (TVOCs) | 500 micrograms per cubic meter | 200 micrograms per cubic meter | EPA TO-1, TO-15, TO-17, or EPA Compendium Method IP-1 | ISO 16000-6 |
| Target chemicals listed in CDPH Standard Method v1.1, Table 4-1, except formaldehyde | CDPH Standard Method v1.1–2010, Allowable Concentrations, Table 4-1 | CDPH Standard Method v1.1–2010, Allowable Concentrations, Table 4-1 | ASTM D5197; EPA TO-1, TO-15, TO-17 | ISO 16000-3, 16000-6 |
| Carbon Monoxide (CO) | 9 ppm; no more than 2 ppm above outdoor levels | 9 ppm; no more than 2 ppm above outdoor levels | EPA Compendium Method IP-3 | ISO 4224 |

68

## Table 1. Maximum concentration levels and test methods for pollutants

| Contaminant | | | Maximum concentration | ASTM and U.S. EPA methods | ISO method |
|---|---|---|---|---|---|
| **Particulates** | **PM10** (for all buildings) | | 50 µg/m³<br>Healthcare only: 20 µg/m³ | EPA Compendium Method IP-10 | ISO 7708 |
| | **PM2.5** (for buildings in EPA nonattainment areas for PM2.5, or local equivalent) | | 15 µg/m³ | | |
| **Ozone** (for buildings in EPA nonattainment areas for Ozone, or local equivalent) | | | 0.075 ppm | ASTM D5149 - 02 | ISO 13964 |
| **Carbon monoxide (CO)** | | | 9 ppm; no more than 2 ppm above outdoor levels | EPA Compendium Method IP-3 | ISO 4224 |
| **Total volatile organic compounds (TVOCs)** | | | 500 µg/m³<br>Healthcare only: 200 µg/m³ | EPA TO-1, TO-17, or EPA Compendium Method IP-1 | ISO 16000-6 |
| **Formaldehyde** | | | 27 ppb<br>Healthcare only: 16.3 ppb | ASTM D5197, EPA TO-11, or EPA Compendium Method IP-6 | ISO 16000-3 |
| **Target volatile organic compounds*** | 1 | Acetaldehyde | 140 µg/m³ | | |
| | 2 | Benzene | 3 µg/m³ | ASTM D5197; EPA TO-1, TO-17, or EPA Compendium Method IP-1 | ISO 16000-3, ISO 16000-6 |
| | 3 | Carbon disulfide | 800 µg/m³ | | |
| | 4 | Carbon tetrachloride | 40 µg/m³ | | |
| | 5 | Chlorobenzene | 1000 µg/m³ | | |
| | 6 | Chloroform | 300 µg/m³ | | |
| | 7 | Dichlorobenzene (1,4-) | 800µg/m³ | | |
| | 8 | Dichloroethylene (1,1) | 70 µg/m³ | | |
| | 9 | Dimethylformamide (N,N-) | 80 µg/m³ | | |
| | 10 | Dioxane (1,4-) | 3000 µg/m³ | | |
| | 11 | Epichlorohydrin | 3 µg/m³ | | |
| | 12 | Ethylbenzene | 2000 µg/m³ | | |
| | 13 | Ethylene glycol | 400 µg/m³ | | |
| | 14 | Ethylene glycol monoethyl ether | 70 µg/m³ | | |
| | 15 | Ethylene glycol monoethyl ether acetate | 300 µg/m³ | | |
| | 16 | Ethylene glycol monomethyl ether | 60 µg/m³ | | |
| | 17 | Ethylene glycol monomethyl ether acetate | 90 µg/m³ | | |
| | 19 | Hexane (n-) | 7000 µg/m³ | | |
| | 20 | Isophorone | 2000 µg/m³ | | |
| | 21 | Isopropanol | 7000 µg/m³ | | |
| | 22 | Methyl chloroform | 1000 µg/m³ | | |
| | 23 | Methylene chloride | 400 µg/m³ | | |
| | 24 | Methyl *t*-butyl ether | 8000 µg/m³ | | |
| | 25 | Naphthalene | 9 µg/m³ | | |
| | 26 | Phenol | 200 µg/m³ | | |
| | 27 | Propylene glycol monomethyl ether | 7000 µg/m³ | | |
| | 28 | Styrene | 900 µg/m³ | | |
| | 29 | Tetrachloroethylene (Perchloroethylene) | 35 µg/m³ | | |
| | 30 | Toluene | 300 µg/m³ | | |
| | 31 | Trichloroethylene | 600 µg/m³ | | |
| | 32 | Vinyl acetate | 200 µg/m³ | | |
| | 33-35 | Xylenes, technical mixture (m-, o-, p-xylene combined) | 700 µg/m³ | | |

ppb = parts per billion; ppm = parts per million; µg/cm = micrograms per cubic meter

*The target volatile organic compounds are from CDPH Standard Method v1.1, Table 4-1. The Maximum concentration limits for these target compounds are the full CREL adopted by Cal/EPA OEHHA in effect on June 2014 http://oehha.ca.gov/air/allrels.html.

ECOBUILD®

69

## IEQ CREDIT 4: INDOOR AIR QUALITY EVALUATION

### REQUIRED DOCUMENTS

| Documentation | Option 1 | | Option 2 |
|---|---|---|---|
| | Path 1 | Path 2 | |
| Flush-out report | ✓ | ✓ | |
| Air quality test report | | | ✓ |

The Flush-Out process can also be carried out with additional air exhaust devices if necessary after the building construction is completed and the furniture is installed.

ECOBUILD®

70

# IEQ CREDIT 4: INDOOR AIR QUALITY ASSESSMENT

## REFERENCE STANDARDS

- ASTM D5197–09e1 Standard Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology)
- ISO 16000-3:2011- Indoor air -- Part 3: Determination of formaldehyde and other carbonyl compounds in indoor air and test chamber air -- Active sampling method
- ISO 16000-6:2011- Indoor air -- Part 6: Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA sorbent, thermal desorption and gas chromatography using MS or MS-FID
- ASTM D5149–02(2008) Standard Test Method for Ozone in the Atmosphere: Continuous Measurement by Ethylene Chemiluminescence
- ISO 4224 Ambient air—Determination of carbon monoxide—Nondispersive infrared spectrometric method
- ISO 7708 Air quality—Particle size fraction definitions for health-related sampling
- ISO 13964 Air quality—Determination of ozone in ambient air—Ultraviolet photometric method
- U.S. EPA Compendium of Methods for the Determination of Air Pollutants in Indoor Air, IP-1: Volatile Organic Compounds, IP-3: Carbon Monoxide and Carbon Dioxide, IP-6: Formaldehyde and other aldehydes/ketones, IP-10 Volatile Organic Compounds
- U.S. EPA Compendium of Methods for the Determination of Inorganic Compounds in Ambient Air, TO-1: Volatile Organic Compounds, TO-11: Formaldehyde, TO-15: Volatile Organic Compounds, TO-17: Volatile Organic Compounds
- California Department of Public Health (CDPH) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, v. 1.1–2010

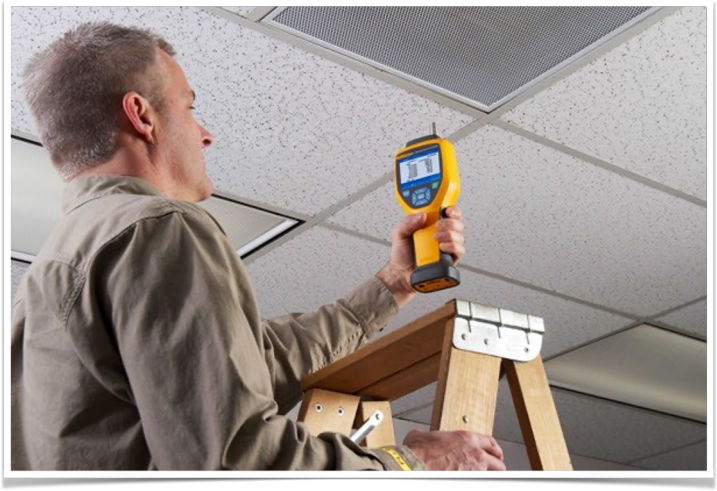
ECOBUILD

71

# IEQ CREDIT 4: INDOOR AIR QUALITY ASSESSMENT

## VERSION 4.1 CHANGES

- The air testing option has been made dual depending on the type of pollutants measured.
- Path 1: Particulate Matter and Inorganic Gases (1 Point)
- Path 2: Volatile Organic Compounds (1 Point)
- The number of measured volatile organic compounds has been reduced.



ECOBUILD

72

## IEQ CREDIT 5: THERMAL COMFORT

### OBJECTIVE

The aim is to increase the satisfaction of building users by providing general thermal comfort.

For credit requirements, both the requirements for thermal comfort design and thermal comfort control must be met.





ECOBUILD

73

## IEQ CREDIT 5: THERMAL COMFORT

### REQUIREMENTS - DESIGN

- HVAC systems must be designed according to the ASHRAE 55-2010 Thermal Environmental Conditions for Human Occupancy standard.
- Option 1: ASHRAE 55-2010 Standards
- HVAC systems should be designed according to the ASHRAE 55-2010 Thermal Environmental Conditions for Human Occupancy standard or within a local national standard. For swimming pools (Natatoriums), the ASHRAE HVAC Applications Handbook, 2011 edition, Section 5, must comply with typical Natatorium Design Conditions for collective areas.
- Or,
- Option 2: ISO and CEN Standards
- HVAC systems and building envelope should be designed by meeting the requirements of the following applicable standards:
- ISO 7730:2005, which uses PMV and PPD indices and local thermal comfort criterion for thermal environment, analytical stability and interpretation of thermal comfort, and Thermal Environment Ergonomics
- CEN Standard EN 15251:2007, indoor air quality, thermal environment, lighting and acoustics Section A2, Energy Performance Design and Assessment Indoor Environment Entry Parameters for Buildings.

ECOBUILD

74

# IEQ CREDIT 5: THERMAL COMFORT

## REQUIREMENTS - CONTROL

- Separate thermal comfort controls must be provided for at least 50% of the areas occupied by individual users.
- For all multi-occupied areas, group thermal comfort controls must be provided without individual controls.
- Building occupants should be able to use thermal comfort controls to adjust at least one of the following in their local environment:
- Air Temperature,
- Radiant Temperature,
- Air Velocity,
- Humidity Level


ECOBUILD

75

# IEQ CREDIT 5: THERMAL COMFORT

## REQUIRED DOCUMENTS

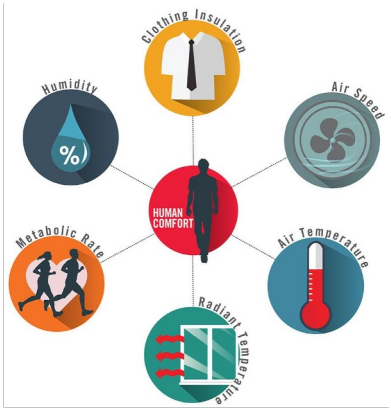
| Documentation | Thermal Comfort Design | | Thermal Comfort Controls | For warehouse & distribution centers systems |
|---|---|---|---|---|
| | Option 1 | Option 2 | | |
| Description of weather data used to determine operative temperatures, relative humidity, and outdoor temperatures | ✓ | | | |
| Drawings or calculations: Showing compliance of design parameters with the following. ASHRAE Standard 55–2010 for 80% acceptability (e.g., psychometric chart; PMV or PPD calculations; ASHRAE Thermal Comfort Tool results; copy of ASHRAE 55–2010, Figure 5.2.4.1, Figure 5.2.4.3, or Figure 5.2.4.4; or predicted worst-case indoor conditions for each month on copy of Figure 5.3) | ✓ | | | |
| Calculations and documents showing compliance of thermal comfort conditions with the following standards: ISO 7730 or EN 15251, as applicable (e.g., for ISO, calculations based on Sections 4.1 and 6 or Annex H, computer program results based on Annex D, tables based on Annex E, or copy of Figures 2, 3, 4, A.1, A.2; for EN, documentation of worst-case indoor conditions for each month on copy of Figure A1) | | ✓ | | |
| List of Spaces: Type, quantity, and thermal comfort controls | | | ✓ | |
| List of regularly used, bulk storage, sorting, and distribution areas | | | | ✓ |
| A narrative describing design and usage intent for each volume | | | | ✓ |

76

# IEQ CREDIT 5: THERMAL COMFORT

## REFERENCE STANDARDS

- 2011 HVAC Applications, ASHRAE Handbook, Chapter 48, Noise and Vibration Control
- European Committee for Standardization (CEN) Standard EN 15251–2007: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics
- ASHRAE Standard 55–2010, Thermal Environmental Conditions for Human Occupancy
- The Lighting Handbook, 10th edition, Illuminating Engineering Society of North America
- IES Lighting Measurements (LM) 83-12, Approved Method: IES Spatial Daylight Autonomy (sDA) and Annual Sunlight Exposure (ASE)
- Windows and Offices: A Study of Office Worker Performance and the Indoor Environment
- ANSI S1.4, Performance Measurement Protocols for Commercial Buildings
- 2010 Noise and Vibration Guidelines for Health Care Facilities




ECOBUILD

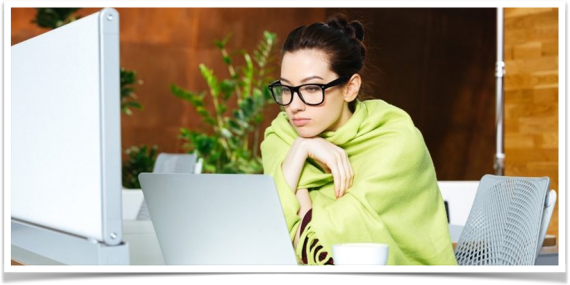
77

# IEQ CREDIT 5: THERMAL COMFORT

## V4.1 CHANGES

The thermal comfort standard is the ASHRAE Standard 55-2017 version.

The EN 15251:2007 standard has been replaced by the current version, ISO 17772-2017 standard.



ECOBUILD

78

## IEQ CREDIT 6: INDOOR LIGHTING

### OBJECTIVE

- The aim is to enable building users to control the lighting according to their preferences, thereby increasing their productivity.
- At least 90% of building users should be able to adjust the lighting according to their personal preferences.
- In shared multi-user environments, there should be lighting systems that can be adjusted according to the preferences of the group.

ECOBUILD

79

## IEQ CREDIT 6: INDOOR LIGHTING

### REQUIREMENTS

- Option 1: Lighting Control (1 point)
- Individual and multiple user areas should be defined.
- Lighting controls should be designed for these specified areas. Task lighting can be used to meet credit requirements in individual usage areas. The wiring for task lighting applications, such as individual desk lamps (there is no requirement for fixed wiring), can also be done by plugging them in.
- All lighting controls must provide at least three lighting levels. These should be on, off, and medium. The medium level is defined as a lighting level that is 30% to 70% of the highest lighting level (not including daylight contributions). Daylight is not considered a separate lighting level.
- For multiple rooms that can be divided by movable walls or partitions, necessary lighting controls should be provided for each subsection of the area.
- Tables of individual and multiple user areas and their respective lighting controls should be created. It should be verified that 90% of the individual user areas and 100% of the multiple user areas meet the credit requirements. The percentage of individual usage areas is calculated based on the number of rooms, not the floor area.

ECOBUILD

80

## IEQ CREDIT 6: INDOOR LIGHTING

### REQUIREMENTS

A. Option 2: Lighting Quality (1 point)
B. At least 4 of the following 8 strategies must be implemented in the project:
C. Use lighting equipment that produces less brightness than 2,500 cd/m2 at vertical angles between 45 and 90 degrees (rarely) for all regularly used areas.
D. Use a light source with a CRI value of 80 or higher for the entire project.
E. Use a light source with a specified lifespan of at least 24,000 hours (or L70 for LED) for 75% of the total connected lighting load.
F. Use directly-mounted lighting fixtures that account for 25% (or less) of the total connected lighting load in all regularly used areas.

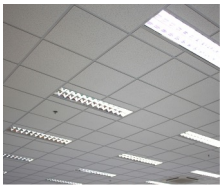
ECOBUILD

81

## IEQ CREDIT 6: INDOOR LIGHTING

### REQUIREMENTS

E. In the regularly used volumes of the building, ensure the following thresholds for the 'area-weighted average surface reflectance' in 90% of the floor area:
F. a. %85 for suspended ceilings
G. b. %60 for walls
H. c. %25 for floors
I. In the building, if the furniture is included, select the surface finishes of the furniture to comply with the following 'area-weighted average surface reflectance' thresholds:
J. a. %45 for work areas
K. b. %50 for movable partition areas
L. For 75% of the floor area of the regularly used volumes in the building, the ratio of the illuminance level of the wall surface (excluding windows) to the average working surface illuminance level will not exceed 1:10. Additionally, strategies 'E' and 'F' must be provided or, the walls must show 60% area-weighted surface reflectance.
M. For 75% of the floor area of the regularly used volumes in the building, the ratio of the average suspended ceiling illuminance level (excluding windows) to the average working surface illuminance level will not exceed 1:10. Additionally, strategies 'E' and 'F' must be provided or, the ceilings must show 85% area-weighted surface reflectance.



ECOBUILD

82

# IEQ CREDIT 6: INDOOR LIGHTING

## REQUIRED DOCUMENTS

| Documentation | Option 1 | Option 2 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | H |
| Lighting controls for each space (individual or multiple) | ✓ | | | | | | | | |
| Table of regularly used areas and lightings | | ✓ | | | ✓ | | | | |
| Calculation of total connected lighting load | | | | ✓ | ✓ | | | | |
| Lighting details: Manufacturer, model, estimated results or laboratory test results | | ✓ | ✓ | ✓ | ✓ | | | | |
| List of suspended ceilings: Wall and floor surface areas and reflection values | | | | | | ✓ | | | |
| Areas and reflection values of work surfaces and movable partitions | | | | | | | ✓ | | |
| Average surface reflection calculations | | | | | | ✓ | ✓ | | |
| List of work surfaces and illuminance values (lux) | | | | | | | | ✓ | |
| List of ceiling surfaces and illuminance values (lux) | | | | | | | | | ✓ |
| Calculations of lighting ratios | | | | | | | | ✓ | ✓ |

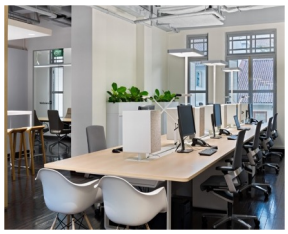
ECOBUILD

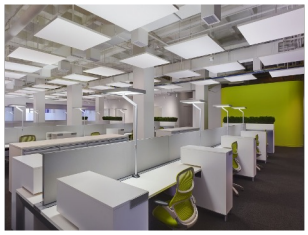
83

# IEQ CREDIT 6: INDOOR LIGHTING

## REFERENCE STANDARDS

- The Lighting Handbook, 10th edition, Illuminating Engineering Society of North America
- IES Lighting Measurements (LM) 83-12, Approved Method: IES Spatial Daylight Autonomy (sDA) and Annual Sunlight Exposure (ASE)
- Windows and Offices: A Study of Office Worker Performance and the Indoor Environment
- ANSI S1.4, Performance Measurement Protocols for Commercial Buildings
- 2010 Noise and Vibration Guidelines for Health Care Facilities





ECOBUILD

84

# IEQ CREDIT 7: DAYLIGHT

## OBJECTIVE

- The main objective is to enable building occupants to benefit from daylight, establish connections with the outside air, enhance the circadian rhythm (biological clock), and reduce electricity consumption for lighting.
- Devices for controlling daylight glare (glare control devices) should be provided for all regularly used areas, either manually or automatically (overriding manual operation).
- In patient rooms, blinds or shade applications can be used.
- There are 3 options under this credit title. One of these must be selected.

ECOBUILD

85

# IEQ CREDIT 7: DAYLIGHT

## REQUIREMENTS

- Option 1. Simulation: Spatial Daylight Autonomy - sDA (2-3 points, 1-2 points Healthcare)
- Spatial daylight autonomy 300/50% (sDA300/50%) Minimum %55, %75, %90 is obtained. It is calculated through computer simulations. The floor area of regularly occupied spaces is used in the simulation. In healthcare (hospital) projects, the area specified under the IEQ Credit Quality Views must be utilized.
- Points are awarded according to the Points Table on the side. 2 points can be obtained in healthcare projects.

| New Construction, Core and Shell, Schools, Retail, Data Centers, Warehouses & Distribution Centers, CI, Hospitality | | Hospitals | |
|---|---|---|---|
| sDA (for regularly occupied spaces) | Points | sDA (for perimeter floor area) | Points |
| %55 | 2 | %75 | 1 |
| %75 | 3 | %90 | 2 |

ECOBUILD

86

## IEQ CREDIT 7: DAYLIGHT

### REQUIREMENTS

- And
- With computer simulations, the annual sunlight exposure value of 1000/250 (ASE1000, 250) should not exceed 10%. Calculations are made for floor areas benefiting from daylight in SDA300/%50 simulations.
- In SDA and ASE simulations, the calculation intervals should consist of squares of at most 2 ft (600 millimeters) and should be placed at a height of 30 inches (76 millimeters) above the finished floor (unless otherwise specified) in areas regularly used by building occupants. Analysis should be conducted at an hourly time-step based on typical meteorological year data or the nearest equivalent weather station. Permanently existing internal obstacles within the building should be included in the model. Movable furniture and partitions may be excluded.

ECOBUILD

87

## IEQ CREDIT 7: DAYLIGHT

### REQUIREMENTS

Option 2. Simulation: Daylight Calculations (1-2 points)

The light levels in the floor areas specified in Table 2 should be demonstrated through computer simulations, showing values between 300 lux and 3000 lux at 09:00 and 15:00 on a day when there is an equal amount of day and night, under clear sky conditions. The floor area of regularly used spaces should be taken into account. In health projects, the area defined under the IEQ Credit Quality View must be utilized.

In Table 2, points are shown for the floor area that meets the Daylight Criteria.

| New Construction, Core and Shell, Schools, Retail, Data Centers, Warehouses & Distribution Centers, Hospitality, CI | | Hospitals | |
|---|---|---|---|
| Percentage values for regularly used areas | Points | Percentage value of floor area | Points |
| %75 | 1 | %75 | 1 |
| %90 | 2 | %90 | 2 |

ECOBUILD

88

## IEQ CREDIT 7: DAYLIGHT

### REQUIREMENTS

- Option 3. Measurement (2-3 points, 1-2 points for Hospitals)
- Scores based on the percentage of building floor area providing lighting levels between 300 lux and 3000 lux are presented in Table 3.
- Measurements should be taken at appropriate working plane height at any time between 9 AM and 3 PM.
- Perform one measurement in any month when the building is in regular use, and the timing of the second measurement should be determined according to Table 4.
- For areas larger than 150 ft2 (14 square meters), measurements should be taken at maximum intervals of 10 ft (3 meters).
- For areas of 150 ft2 (14 square meters) or smaller, measurements should be taken at maximum intervals of 3 ft (900 millimeters).

| New Construction, Core and Shell, Schools, Retail, Data Centers, Warehouses & Distribution Centers, Hospitality, CI | | Hospitals | |
|---|---|---|---|
| Percentage values according to regularly used areas | Points | Frame Floor Area % | Points |
| %75 | 2 | %75 | 1 |
| %90 | 3 | %90 | 2 |

ECOBUILD

89

## IEQ CREDIT 7: DAYLIGHT

ECOBUILD

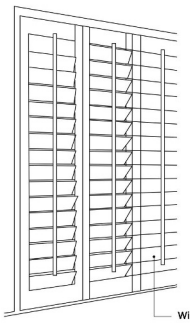
### Table 4. Measurement Timeline

| MONTH OF FIRST MEASUREMENT | PERIOD OF SECOND MEASUREMENT |
|---|---|
| January | May-September |
| February | June-October |
| March | June-July, November-December |
| April | August-December |
| May | September-January |
| June | October-February |
| July | November-March |
| August | December-April |
| September | December-January, May-June |
| October | February-June |
| November | March-July |
| December | April-August |

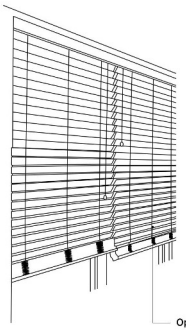
90

# IEQ CREDIT 7: DAYLIGHT

## GLARE CONTROL



Window with fixed louvres



Operable window blinds

**Unacceptable Glare Control Devices**

- Fixed exterior overhangs
- Fixed fins
- Fixed louvres
- Dark color glazing
- Frit glazing treatment
- Additional glazing treatments

**Acceptable Glare Control Devices**

- Interior window blinds
- Interior shades
- Curtains
- Moveable exterior louvres
- Moveable screens
- Moveable awnings

Glare Control Equipment

ECOBUILD

91

# IEQ CREDIT 7: DAYLIGHT

## REQUIRED DOCUMENTS

| Documentation | All Projects | Option 1 | Option 2 | Option 3 |
|---|---|---|---|---|
| Floor plans showing regularly used areas (For health structures, regularly used areas located in the perimeter zone) | ✓ | ✓ | ✓ | ✓ |
| List of glare control devices with control mechanisms for all windows | ✓ | ✓ | ✓ | ✓ |
| List of spaces meeting credit requirements along with SDA and ASE annual summary values | | ✓ | | |
| Geometric drawings obtained from simulations | | ✓ | ✓ | |
| Reports or narratives showing the daylight simulation program, simulation inputs, and meteorological data | | ✓ | ✓ | |
| List of areas meeting credit requirements with their calculated illuminance values | | | ✓ | |
| List of spaces meeting credit requirements with measured illuminance values for each node or floor plans | | | | ✓ |
| Calculations showing the percentage of spaces meeting credit requirements between 300 lux and 3000 lux | | | | ✓ |

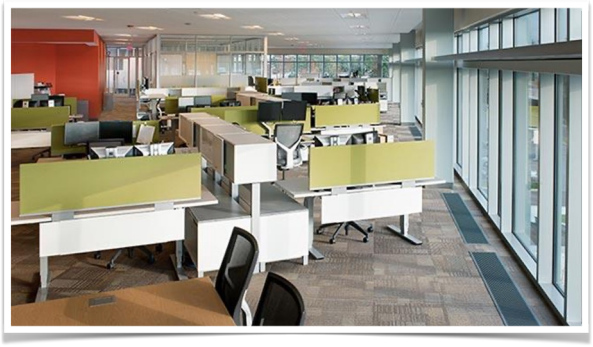
ECOBUILD

92

# IEQ CREDIT 7: DAYLIGHT

## REFERENCE STANDARDS

- IES Lighting Measurements (LM) 83-12, Approved Method: IES Spatial Daylight Autonomy (sDA) and Annual Sunlight Exposure (ASE)
- The Lighting Handbook, 10th edition, Illuminating Engineering Society of North America
- Windows and Offices: A Study of Office Worker Performance and the Indoor Environment
- ANSI S1.4, Performance Measurement Protocols for Commercial Buildings



ECOBUILD

93

# IEQ CREDIT 7: DAYLIGHT

## V4.1 CHANGES

Option 1: Spatial Daylight Autonomy

This option refers to the IES LM-83-12 standard.

The average sDA value is used in calculations.

The scoring table has been updated.

| sDA (for regularly occupied spaces) | Points (excluding hospitals) | Points (hospitals) |
|---|---|---|
| Average sDA value at least 40% | 1 | 1 |
| Average sDA value at least 55% | 2 | 2 |
| Average sDA value at least 75% | 3 | Example Performance |
| sDA value at least 55% in all spaces | If 1 or 2 points were earned from example performance or the criteria above, +1 point | If 1 or 2 points were earned from example performance or the criteria above, +1 point |

ECOBUILD

94

# IEQ CREDIT 7: DAYLIGHT

## V4.1 CHANGES

- Option 2: Simulation - Daylight Calculations
- Threshold values for points have been lowered. The maximum attainable points have been increased from 2 to 3.
- The points table has been updated.

| New Construction, Core and Shell, Schools, Retail, Data Centers, Warehouses & Distribution Centers, Hospitality, CI | | Hospitals | |
|---|---|---|---|
| Percentage values of regularly used areas | Points | Floor area percentage value | Points |
| %55 | 1 | %55 | 1 |
| %75 | 2 | %75 | 2 |
| %90 | 3 | %90 | Example Performance |

ECOBUILD

95

# IEQ CREDIT 7: DAYLIGHT

## V4.1 CHANGES

- Option 3: Measurement to be Made
- The scoring table has been updated.

| New Construction, Core and Shell, Schools, Retail, Data Centers, Warehouses & Distribution Centers, Hospitality, CI | | Hospitals | |
|---|---|---|---|
| Percentage values according to regularly used areas | Scores | Percentage values according to regularly used areas within the Frame Floor Area | Scores |
| %55 (one measurement per year) | 1 | %55 (one measurement per year) | 1 |
| %75 (two measurements per year) | 2 | %75 (two measurements per year) | 2 |
| %90 (two measurements per year) | 3 | %90 (two measurements per year) | Example performance |

ECOBUILD

96

# IEQ CREDIT 8: QUALITY VIEW

## PURPOSE

The aim is to enable building users to benefit from the view, to connect with the outside, and thereby enhance the health, satisfaction, and productivity of building users.

Plan Calculation: Areas with access to views must be calculated for 75% of the continuously used building footprint. The windows of the spaces contributing to the credit should not have glasses, ceramic glasses, fibers, patterned glasses, or layers that disrupt color balance, should not be frosted, and must create a clear view without obstruction.

Section Calculation: Access to views must be shown in the section at the seating height (42 inches). If 75% of a space meets the specified criteria, the entire area of the space is counted towards earning points.

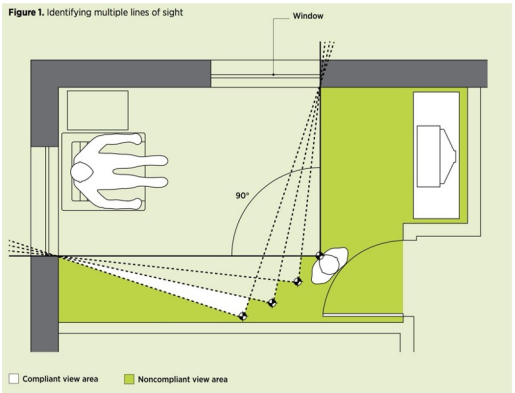
ECOBUILD

97

# IEQ CREDIT 8: QUALITY VIEW

## REQUIREMENTS

- Additionally, at least two of the following four types of landscape criteria must be met by 75% of the regularly used floor area:
- There must be a view window in different directions with at least 90 degrees apart.
- At least two of the following:
- 1. Flora, fauna, or sky
- 2. Moving objects
- 3. Visibility of objects at least 25 ft (8m) from the glass exterior
- Unobstructed view from a distance of three head heights from the window
- The "view factor" as defined in the guide "Windows and Offices; Office Worker Performance and Indoor Environment Studies" must be 3 or more.




ECOBUILD

98

# IEQ CREDIT 8: QUALITY VIEW

## REQUIREMENTS

All permanent internal barriers present in the area must be included in the calculations. Movable furniture and partition panels may be excluded from the calculations.

Windows facing internal atriums (areas like indoor gardens but with open tops) can be used to meet about 30% of the required area.

In Hospital Projects;

The requirements listed above are applicable for inpatient units and grant 1 point.

For other areas of the hospital, the perimeter area values defined as a 4.5 m zone from the window must comply with Table 1, and it must be shown that quality views are accessible in this area. When this requirement is met, an additional point can be earned.

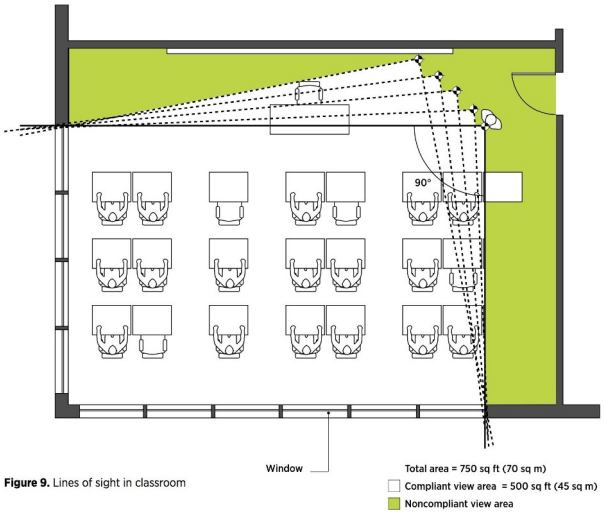



**Figure 9.** Lines of sight in classroom

ECOBUILD

99

# IEQ CREDIT 8: QUALITY VIEW

Table 1: Minimum Environmental Area Providing Credit Title Based on Ground Area

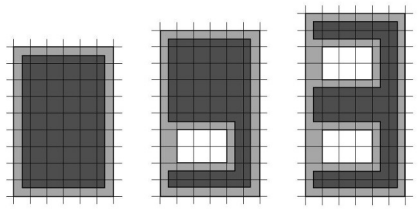
| Ground Area | | Surrounding Area (perimeter area) | |
|---|---|---|---|
| ft2 | m2 | ft2 | m2 |
| Up to 15,000 | Up to 1,400 | 7,348 | 682 |
| 20,000 | 1,800 | 8,785 | 816 |
| 25,000 | 2,300 | 10,087 | 937 |
| 30,000 | 2,800 | 11,292 | 1,049 |
| 35,000 | 3,300 | 12,425 | 1,154 |
| 40,000 | 3,700 | 13,500 | 1,254 |
| 45,000 | 4,200 | 14,528 | 1,349 |
| 50,000 and larger | 4,600 and larger | 15,516 | 1,441 |

ECOBUILD

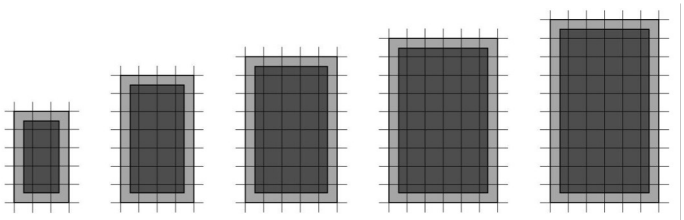
100

# IEQ CREDIT 8: QUALITY LANDSCAPE

## HEALTH FACILITIES ENVIRONMENTAL AREA CALCULATION EXAMPLES



| | | | |
|---|---|---|---|
| **Floor Plate Area:** | 48,600 sq ft (4 515 sq m) | 48,600 sq ft (4 515 sq m) | 48,600 sq ft (4 515 sq m) |
| **Compliant Perimeter Area (% of Area)** | 25.9 | 38.9 | 51.9 |



| | | | | | |
|---|---|---|---|---|---|
| **Floor Plate Area:** | 13,500 sq ft (1 254 sq m) | 25,000 sq ft (2 323 sq m) | 36,000 sq ft (3 345 sq m) | 48,600 sq ft (4 515 sq m) | 54,000 sq ft (5 017 sq m) |
| **Compliant Perimeter Area (% of Area)** | 46.7 | 35.7 | 30.0 | 25.9 | 25.0 |

101

# IEQ CREDIT 8: QUALITY VIEW

## EXAMPLES

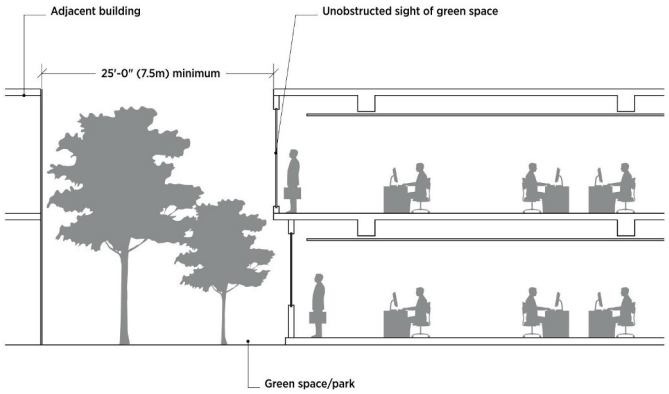



**Figure 10.** Flora within sight of space

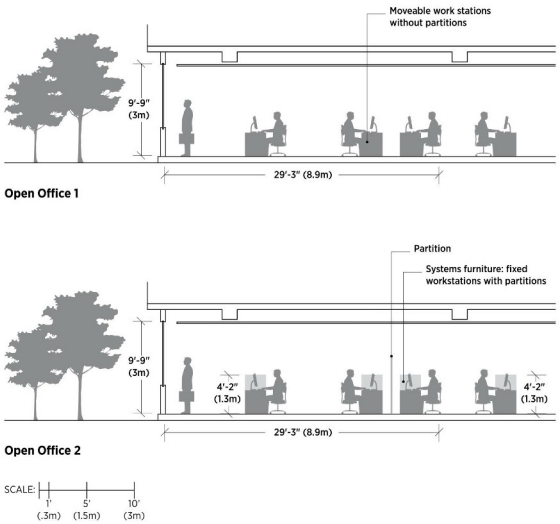



**Figure 12.** Compliant and noncompliant office spaces

102

# IEQ CREDIT 8: QUALITY VIEW

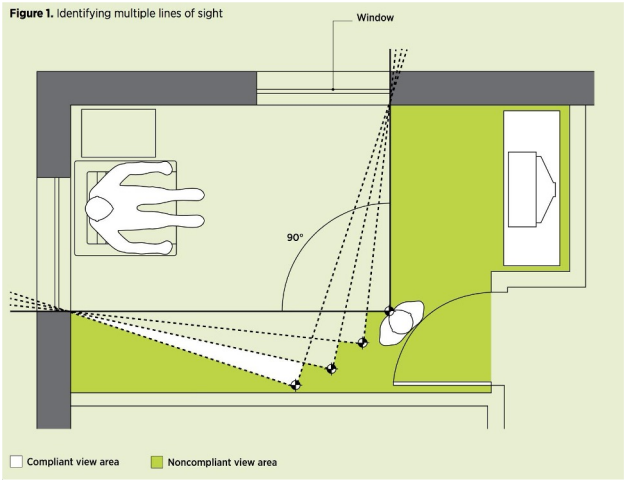
## DEFINITIONS

View Type 1: The presence of view windows at least 90 degrees apart in different directions.

On floor plans or furniture plans, draw two sight lines for the view window from every location within the area. If the area or location has sight lines that are at least 90 degrees apart and are not obstructed by permanent interior barriers, it meets the credit requirements.

If necessary, draw sight lines in sections or views to confirm that uninterrupted interior barriers do not obstruct the sight lines.

Instead of drawing at every point within the space, it may be easiest to draw a boundary distinguishing areas that meet the credit requirements from those that do not.




103

# IEQ CREDIT 8: QUALITY VIEWS

## DEFINITIONS

View Type 2: View access containing at least two of the following:

1) Flora, fauna, or sky;

2) Movement; And

3) Objects at least 25 feet (7.5 meters) away from the exterior of the glass

On plans, label the attributes present in the view window.

Two features must be specified.

Movement (2nd feature) includes activities such as people walking, cars driving on streets, and boats passing through the water.

It is inappropriate to consider the movement of plants and trees due to wind.

As the height of the floors changes, design teams are responsible for changes in the external appearance.

On the plan, draw a sight line for the view window for each point in the area. The area or point qualifies for the credit conditions if the sight line was not obstructed by permanent interior barriers. If necessary, draw sight lines on section or height plans to verify that the permanent interior barriers do not obstruct the sight lines.

104

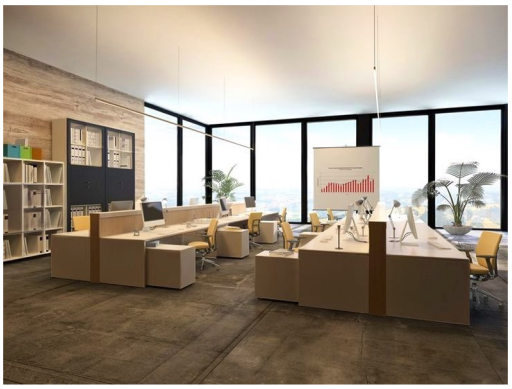
## IEQ CREDIT 8: QUALITY VIEW

### DEFINITIONS

View Type 3: Access to the view from a distance three times the height of the top of the window

Determine the height of the window head in all regularly used areas. Identify the regularly used floor areas (perimeter zone) at a distance three times the height of the window head on the plan.

The space or point meets the credit conditions if the sight line is not obstructed by permanent internal barriers. Permanent internal barriers are prohibited regardless of height. Floor area not located within the identified perimeter zone does not contribute to the credit.



105

## IEQ CREDIT 8: QUALITY VIEW

### DEFINITIONS

View Type 4: As defined in the guide for Windows and Offices linked in the appendices, views with a view factor of 3 or greater:

Identify the typical locations of occupants in each regularly used area on the floor plan or furniture plan. (for example, open office workstations, closed offices, conference room chairs, counter) Indicate whether the location is a primary view location or a break view location.

Assess the view factor based on the primary view or break view for each of these locations.

Show how the view factor was determined through sections or elevations or drawings or images.

Table 4. View Factor

| Primary View Factor | View Angle | |
|---|---|---|
| | Min–max (degrees) | Gray area range (degrees) |
| 1 | 1–4 | |
| 1 or 2 | | 4–5 |
| 2 | 5–9 | |
| 2 or 3 | | 9–11 |
| 3 | 11–15 | |
| 3 or 4 | | 15–20 |
| 4 | 20–40 | |
| 4 or 5 | | 40–30 |
| 5 | 50–90 | |

106

# IEQ CREDIT 8: QUALITY VIEW

## DEFINITIONS

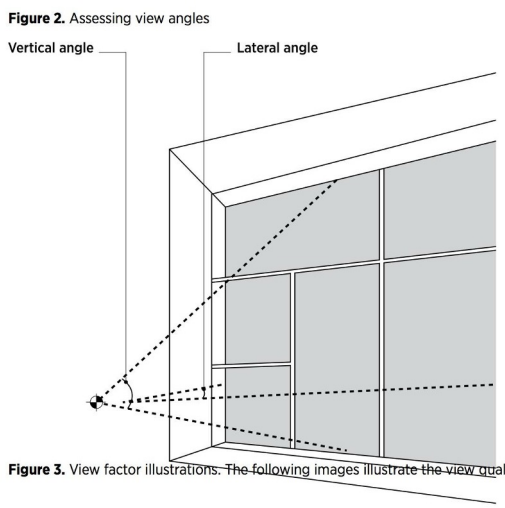



**Figure 2.** Assessing view angles

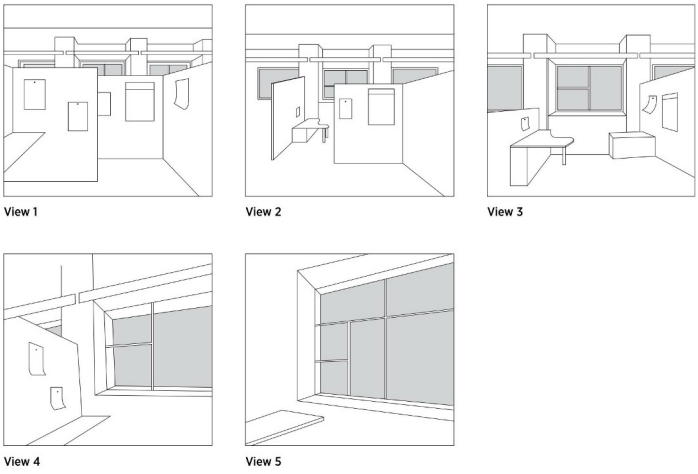



**Figure 3.** View factor illustrations. The following images illustrate the view quality associated with each view factor level.

107

# IEQ CREDIT 8: QUALITY VIEW

## REQUIRED DOCUMENTS

| Documentation | All Projects | Landscape Type | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 |
| | | Multiple sight lines | External features | Unobstructed views within 3H | Viewing factor |
| A list of floor area and view characteristics that meet credit requirements for all regularly used areas in every volume | ✓ | | | | |
| Sections, views, diagrams, renders, and photographs showing sight lines | ✓ | | | | |
| Floor plans or diagrams showing regularly used areas and the following: | ✓ | | | | |
| Multiple sight lines for each regularly used area | | ✓ | | | |
| Sight lines and external objects; if the object views change with floor height, multiple floor plans should be prepared | | | ✓ | | |
| Sight lines and areas showing three head heights | | | | ✓ | |
| Areas with a landscape factor of 3 or greater | | | | | ✓ |
| Sections, interior views, or other documents showing landscape factors | | | | | ✓ |
| The method for determining landscape factor for each typical building user location | | | | | ✓ |

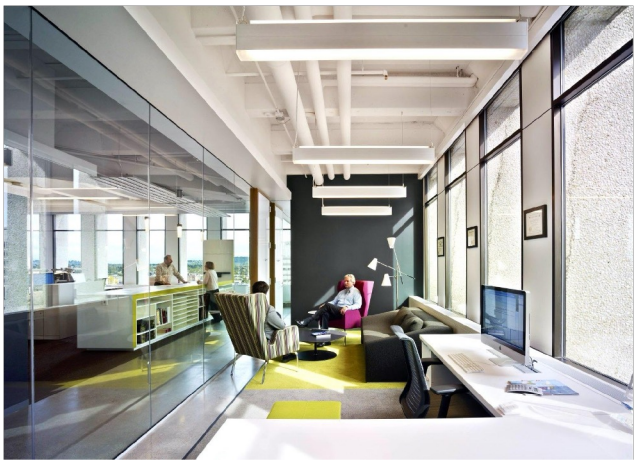
ECOBUILD

108

## IEQ CREDIT 8: QUALITY LANDSCAPE

### REFERENCE STANDARDS

- Windows and Offices: A Study of Office Worker Performance and the Indoor Environment
- ANSI S1.4, Performance Measurement Protocols for Commercial Buildings
- 2010 Noise and Vibration Guidelines for Health Care Facilities



ECOBUILD

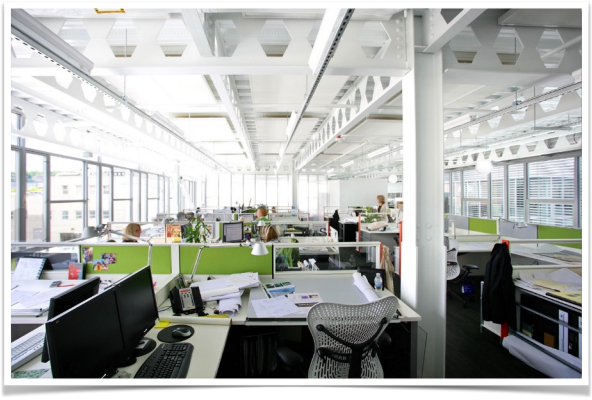
109

## IEQ CREDIT 9: ACOUSTIC PERFORMANCE - ALL BUILDINGS

### REQUIREMENTS

The goal is to ensure the well-being, efficiency, and communication of building users through effective acoustic design.

For all regularly used areas, HVAC background noise, sound insulation, reverberation time with sound reinforcement and masking systems (if available in the project) must meet the following requirements.



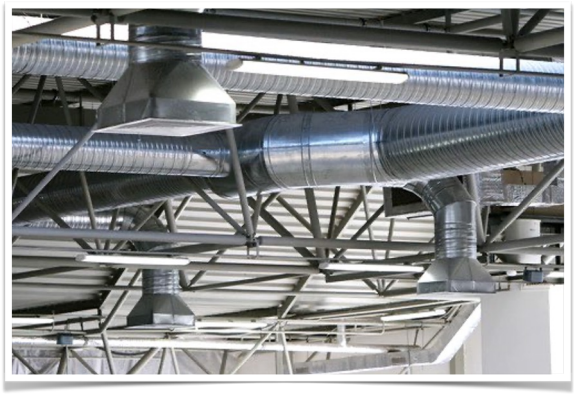
ECOBUILD

110

# IEQ CREDIT 9: ACOUSTIC PERFORMANCE - ALL BUILDINGS

## REQUIREMENTS

- HVAC Background Noise
- All equipment used for heating, ventilation, and air conditioning must meet the conditions for maximum background sound levels as outlined in the 2011 ASHRAE Handbook HVAC Application Section 48, Table 1, AHRI Standard 885-2008, Table 15. A local equivalent may be used if available.
- For measurements, type 1 (precision) or type 2 (general purpose) sound measurement devices in accordance with ANSI S1.4, or a local equivalent may be used.
- HVAC noise level design criteria must conform to the sound transmission path standards listed in the ASHRAE 2011 Applications Handbook, Table 6, or a local national equivalent.



ECOBUILD

111

# IEQ CREDIT 9: ACOUSTIC PERFORMANCE - ALL BUILDINGS

## REQUIREMENTS

- Sound Insulation
- The values for Composite Sound Transmission Class (STCC) specified in Table 1, or the values of local building regulations should be used.

- Table 1. Maximum Composite Sound Transmission Class Ratings for Adjoining Areas

| Boundary Combinations | | STCC |
|---|---|---|
| Residence (within a multifamily residence), hotel or motel room | Residence, hotel or motel room | 55 |
| Residence, hotel or motel room | Common hallway, stairway | 50 |
| Residence, hotel or motel room | Retail | 60 |
| Retail | Retail | 50 |
| Standard office | Standard office | 45 |
| Executive office | Executive office | 50 |
| Conference room | Conference room | 50 |
| Office, conference room | Hallway, stairway | 50 |
| Mechanical equipment room | Occupied area | 60 |

ECOBUILD

112

# IEQ CREDIT 9: ACOUSTIC PERFORMANCE - ALL BUILDINGS

## REQUIREMENTS

- Reverberation Time
- The requirements for reverberation time listed in Table 2 must be met.
- Table 2 is adapted from Performance Measurement Protocols for Commercial Buildings Table 9.1.

- Table 2. Reverberation Time Requirements Adapted from ASHRAE (2007d), ASA (2008), ANSI (2002), and CEN (2007)

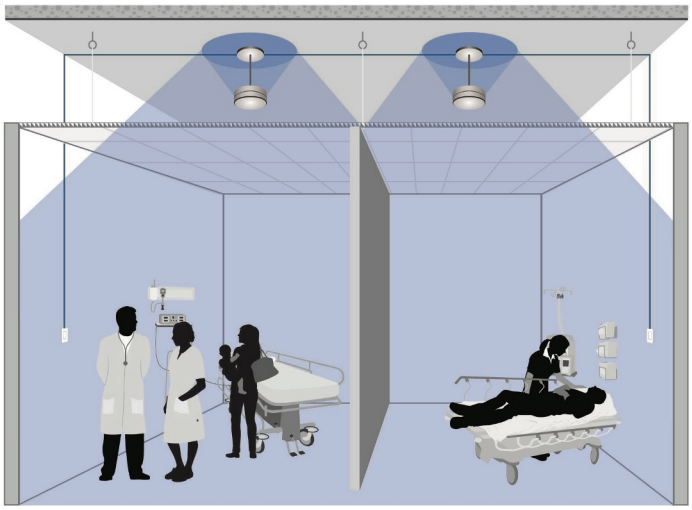
| Room Type | Application | T60 (sec), at 500 Hz, 1000 Hz, and 2000 Hz |
|---|---|---|
| Apartment and condominium | — | < 0.6 |
| Hotel/motel | Individual room or suite | < 0.6 |
| Meeting or banquet room | < 0.8 | |
| Office building | Executive or private office | < 0.6 |
| Conference room | < 0.6 | |
| Teleconference room | < 0.6 | |
| Open-plan office without sound masking | < 0.8 | |
| Open-plan office with sound masking | 0.8 | |
| Courtroom | Unamplified speech | < 0.7 |
| Amplified speech | < 1.0 | |
| Performing arts space | Drama theaters, concert and recital halls | Varies by application |
| Laboratories | Testing or research with minimal speech communication | < 1.0 |
| Extensive phone use and speech communication | < 0.6 | |
| Church, mosque, synagogue | General assembly with critical music program | Varies by application |
| Library | | < 1.0 |
| Indoor stadium, gymnasium | Gymnasium and natatorium | < 2.0 |
| Large-capacity space with speech amplification | < 1.5 | |
| Classroom | — | < 0.6 |

113

# IEQ CREDIT 9: ACOUSTIC PERFORMANCE - ALL BUILDINGS

## REQUIREMENTS

- Sound Reinforcement and Masking Systems
- Sound Masking Systems: In projects utilizing masking systems, the design level should not exceed 48 dBA.
- Sound Reinforcement Systems:
- It should be assessed whether sound reinforcement or AV playback is needed in conference halls and amphitheaters with more than 50 users. If necessary, sound reinforcement systems:
- Speech Transmission Index = 0.6 or above must be achieved.
- Sound level must be a minimum of 70 dBA.
- Sound level coverage in the space should be within a +/- 3 dB range in the 2000 Hz octave band.



ECOBUILD

114

# IEQ CREDIT 9: ACOUSTIC PERFORMANCE - ALL BUILDINGS

## REQUIRED DOCUMENTS - ALL BUILDINGS

| New Construction, Data Centers, Warehouses and Distribution Centers, Hospitality | | All Projects |
|---|---|---|
| HVAC background noise | 'sound level values in the used spaces | ✓ |
| | Calculation, measurement narrative, or manufacturer's data | ✓ |
| | Noise reduction narrative | ✓ |
| sound insulation | STC rating for volume proximity | ✓ |
| | Calculation, measurement narrative, or manufacturer's data | ✓ |
| reverberation time | STCC rating for volume proximities | ✓ |
| | Calculation, measurement narrative, or manufacturer's data | ✓ |
| Sound reinforcement and masking systems | List of all major conference rooms and meeting rooms | ✓ |
| | Description of sound reinforcement methods (if applicable) | ✓ |
| | Description of sound reinforcement system components and specifications (if applicable) | ✓ |
| | Description of masking system components and specifications (if applicable) | ✓ |

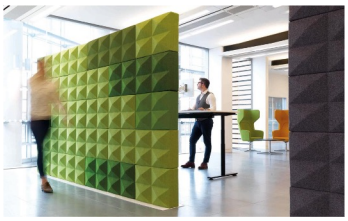
ECOBUILD

115

# IEQ CREDIT 9: ACOUSTIC PERFORMANCE - ALL BUILDINGS

## V4.1 CHANGES

- At least two of the HVAC background noise, sound transmission, and reverberation time criteria must be met. An additional option for achieving a sample performance score has been added by meeting all three.
- The ASHRAE Handbook 2015 edition is valid for HVAC background noise criteria.
- The option to comply with local regulations in sound transmission calculations has been removed.
- As an alternative to the sound transmission class (STC), the noise isolation class (NIC) parameter has been included.
- The number of limit combinations specified in Table 1 has been increased.
- Requirements related to sound reinforcement and masking systems have been removed.
- The FGI Guidelines 2018 edition is valid for the acoustic design of hospitals.



ECOBUILD

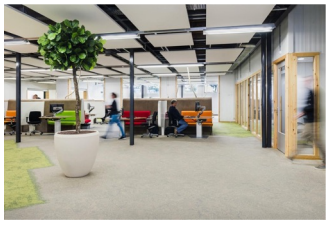
116

## IEQ CREDIT 9: ACOUSTIC PERFORMANCE - HOSPITALS

### OBJECTIVE

The aim is to provide workspaces and educational classrooms that promote the health, productivity, and comfortable communication of building users with an effective acoustic design.

Design should be carried out in accordance with the sound and vibration criteria specified in the 2010 FGI Guidelines for Design and Construction of Health Care Facilities (aka 2010 FGI Guidelines) and the Sound and Vibration Design Guidelines for Health Care Facilities (aka 2010 SV Guidelines) developed for health facilities.




ECOBUILD

117

## IEQ CREDIT 9: ACOUSTIC PERFORMANCE - HOSPITALS

### REQUIREMENTS

Option 1: Speech Privacy, Sound Isolation, and Background Noise (1 point)

Speech Privacy and Sound Isolation

Speech privacy must be ensured through sound insulation to provide a minimum level of discomfort from sources generating noise for acoustic comfort. Consider the sound levels at both the source and receiver points, background sound field points, and the acoustic privacy and acoustic comfort requirements of building users in your design. Speech privacy is defined in ANSI T1.523-2001, Telecom Glossary 2007 as "techniques that render conversations unintelligible to third-party listeners".

Design the health facility in accordance with the criteria in the 2010 FGI Guidelines Table 1.2-3: Design Criteria for Minimum Sound Isolation Performance between Enclosed Rooms and Table 1.2-4 Speech Privacy for Enclosed Room and Open-Plan Spaces (2010 FGI Guidelines and 2010 SV Guidelines).

Calculate or measure sound isolation and speech privacy parameters for adjacent spaces (example spaces are sufficient). Confirm the compliance of the results with the 2010 FGI Guidelines Section 1.2-6.1.5 and 1.2-6.1.6 (including associated sections of the Appendix) and the related reference standard SV Guidelines.

ECOBUILD

118

## IEQ CREDIT 9: ACOUSTIC PERFORMANCE - HOSPITALS

### REQUIREMENTS

Option 1: Speech Privacy, Sound Isolation, and Background Noise

Assess background sound levels from all mechanical-electrical and plumbing systems, air distribution systems, and other noise sources in the building.

Design the healthcare facility according to the 2010 FGI Guidelines Table 1.2-2 Minimum-Maximum Design Criteria for Noise in Representative Interior Rooms and Spaces (refer to Appendix-2).

Measure or calculate sound levels in sample rooms and areas using sound measurement devices compliant with ANSI S1.4 (type 1 - precision, type 2 - general purpose). For areas not listed in Table 1.2-2, refer to ASHRAE 2007 Handbook, Chapter 47, Sound and Vibration Control, Table 42.

ECOBUILD

119

## IEQ CREDIT 9: ACOUSTIC PERFORMANCE - HOSPITALS

### REQUIREMENTS

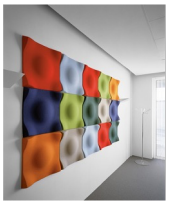
Option 2 (2 points)

Please fulfill Option 1 and

Acoustic Coatings

2010 FGI Guidelines Table 1.2-1 Design Room Sound Absorption Coefficients (including associated sections of the Appendix) (see Appendix-3) and identify materials, products, and application details that meet the requirements of the 2010 SV Guidelines.

Show through measurement or calculation that the average sound absorption coefficients for each room type meet the credit requirements.



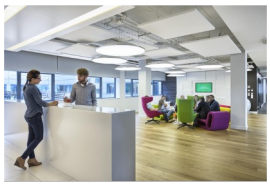
ECOBUILD

120

## IEQ CREDIT 9: ACOUSTIC PERFORMANCE - HOSPITALS

### REQUIREMENTS

- External Noise
- Minimize the impact of external noise on building users. External noise sources: traffic noise, aircraft noise, railways, helipads, emergency generators, mechanical devices in the outdoor environment, and building service equipment. At the same time, minimize the impact of noise generated by the mechanical devices and activities of the health facility on the surrounding communities in accordance with local regulations or in accordance with stricter standards than Table 1.2-1 of the 2010 FGI Guidelines and the supporting Table 1.3-1 of the 2010 SV Guidelines.
- Demonstrate compliance with the relevant sections of the 2010 FGI Guidelines for each of the following categories:
- Helipads – A1.3-3.6.2.2
- Generators – 2.1-8.3.3.1
- Mechanical Devices – 2.1-8.2.1.1
- Building Services – A2.2-5.3



ECOBUILD

121

## IEQ CREDIT 9: ACOUSTIC PERFORMANCE - HOSPITALS

### REQUIREMENTS

Outdoor Noise

Conduct measurements and analyses to determine the Outdoor Noise Class (A, B, C, or D) of the area where the facility is located.

See Table A1.2a: Categorization of Health Care Facility Sites by Exterior Ambient Sound in the 2010 FGI Guidelines and Table 1.3-1 in its reference standard, the 2010 SV Guidelines (Appendix-4).

Design the building envelope's composite STC rating (STCc) according to the 2010 FGI Guidelines for the Categorization of Health Care Facility Sites by Exterior Ambient Sound and analyze the compliance of the bid documents with credit requirements.

Measure the sound insulation performance of representative sections of the exterior building envelope to determine the composite sound transmission class (STCc) for representative facade sections for Exterior Site Exposure Categories B, C, or D. Measurements should comply with the current version of the ASTM E966 Standard Guide for Field Measurements of Airborne Sound Insulation of Building Façades and Façade Elements standard.

ECOBUILD

122

# IEQ CREDIT 9: ACOUSTIC PERFORMANCE - HOSPITALS

## REQUIRED DOCUMENTS - HOSPITALS

| Hospitals | | Option 1 | Option 2 |
|---|---|---|---|
| Speech privacy and sound insulation | List of areas, adjacent spaces, STC ratings | ✓ | |
| | List of areas, privacy index values | ✓ | |
| | Calculation or simulation results or field measurement report | ✓ | |
| Room noise levels | List of spaces, design criteria, values | ✓ | |
| | Laboratory test reports and simulation results or field measurement report | ✓ | |
| Acoustic finishes | Documents for wall, ceiling, and floor finishes with associated NRC values | | ✓ |
| | Calculated average sound absorption coefficients for the represented room types | | ✓ |
| Outdoor ambient noise | Exterior building envelope STC rating | | ✓ |
| | Site noise exposure category description | | ✓ |
| | Description of sound reduction measures included in each 2010 FGI guideline | | ✓ |
| | Project-specific space assessment description | | ✓ |

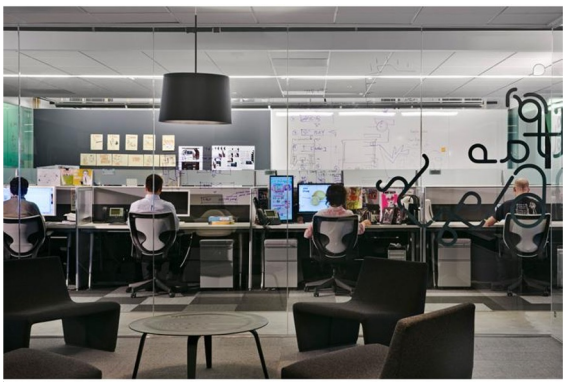
ECOBUILD®

123

# IEQ CREDIT 9: ACOUSTIC PERFORMANCE - HOSPITALS

## REFERENCE STANDARDS

- 2011 HVAC Applications, ASHRAE Handbook, Chapter 48, Noise and Vibration Control
- AHRI Standard 885–2008, Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets
- 2010 Noise and Vibration Guidelines for Health Care Facilities
- American National Standards Institute (ANSI)/ASHRAE Standard S12.60–2010, Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools
- 2010 FGI Guidelines for Design and Construction of Health Care Facilities



ECOBUILD®

124