LEED BD&C Version 3.0 (2009) Certification & Accreditation

Session 6: Indoor Environmental Quality

June 8, 2009

California Department of General Services

Today's Agenda

- Minimum IAQ, tobacco smoke control, outdoor air delivery monitoring
- Increased ventilation, construction IAQ management plans
- Low emitting materials, indoor chemical & pollutant source control
- Controllability of systems, thermal comfort, daylight & views

Indoor Environ. Quality		NC	Schools	CS
		15 Pts.	20 Pts.	12 Pts.
Prereq 1	Minimum IAQ Performance	Req'd	Req'd	Req'd
Prereq 2	Environmental Tobacco Smoke (ETS) Control	Req'd	Req'd	Req'd
Prereq 3	Minimum Acoustical Performance	NA	Req'd	NA
Credit 1	Outdoor Air Delivery Monitoring	1	1	1
Credit 2	Increased Ventilation	1	1	1
Credit 3.1	Construction IAQ Management Plan, During Construction	1	1	1
Credit 3 2	Construction IAQ Management Plan, Before Occupancy	1	1	NA
Credit 4	Low-Emitting Materials	1 to 4	4 max*	1 to 4
	Credit 4.1: Low-Emit. Mat'ls, Adhesives & Sealants	1	1*	1
	Credit 4.2: Low-Emit. Mat'ls, Paints & Coatings	1	1*	1
	Credit 4.3: Low-Emit. Mat'ls, Flooring Systems	1	1*	1
	Credit 4.4: Low-Emit. Mat'ls, Comp. Wd & Ag. Products	1	1*	1
	Credit 4.5: Low-Emit. Mat'ls, Furniture and Furnishings	NA	1*	NA
	Credit 4.6: Low-Emit. Mat'ls., Ceiling and Wall Systems	NA	1*	NA
Credit 5	Indoor Chemical & Pollutant Source Control	1	1	1
Credit 6.1	Controllability of Systems, Lighting	1	1	NA
Credit 6.2	Controllability of Systems, Thermal Comfort	1	1	1-C6
Credit 7.1	Thermal Comfort, Design	1	1	1-C7
Credit 7.2	Thermal Comfort, Verification	1	1	NA
Credit 8.1	Daylight & Views, Daylight 75% of Spaces	1	1 to 3	1
Credit 8.2	Daylight & Views, Views for 90% of Spaces	1	1	1
Credit 9	Enhanced Acoustical Performance	NA	1	NA
Credit 10	Mold Prevention	NA	1	NA

EA Prereq. 1: Minimum IAQ Performance

1. Required for NC, Schools & CS
2. Design Phase Requirement
3. Intent
   - Establish minimum indoor air quality (IAQ) performance to enhance indoor air quality in buildings, thus contributing to the comfort and well-being of the occupants.

EQ Prereq. 1: Minimum IAQ Performance

4. Requirements

Case 1 – Mechanically Ventilated Spaces

- Meet min. reqmts of **ASHRAE 62.1-2007** Ventilation for Acceptable Indoor Air Quality, Sections 4-7
  - Use ventilation rate procedure or more stringent applicable local code
- In addition, CS project mechanical systems must be capable of meeting projected ventilation levels
  - Based on anticipated future tenant reqmts

Case 2 – Naturally Ventilated Spaces

- Comply w/ ASHRAE 62.1-2007 paragraph 5.1

EQ Prereq. 1: Minimum IAQ Performance

5. Strategies & Implementation

Case 1 – Mechanically ventilated buildings

- Generally speaking, if local code has higher outdoor air rate requirement, it is more stringent
- Ventilation rate procedure described in Section 6 of ASHRAE 62.1-2007& is easier to apply than IAQ procedure
- If occupancy category is not included in Standard, designer chooses category best corresponding with space usage.

Case 2 – Naturally ventilated buildings

- Use the ASHRAE 62.1-2007, Section 5.1 to determine size and location of ventilation openings
- All naturally ventilated spaces must be within 25 feet of operable wall or roof openings
- Operable area must be 4% of net occupiable floor area

Mixed-Mode Ventilated Spaces

- Meet min. vent. rates of ASHRAE 62.1-2007 Chapter 6

CS – Use ASHRAE table 6-1 for default occupancy counts

EQ Prereq. 1: Minimum IAQ Performance

6. Documentation
   - Select whether mechanically or naturally ventilated (or combination)
   - If mechanically ventilated:
     1. Mechanical designer to initial verifying compliance with ASHRAE 62.1-2007 or more stringent local code
     2. Upload completed ASHRAE calculator or more stringent local code calculator. Include schedules showing CFM by zone and MERV level by air handler type
   - If naturally ventilated in part or in whole:
     1. Indicate the naturally ventilated area complies with ASHRAE 62.1-2007, Paragraph 5.1
        - Complete table showing floor/window ration of rooms
     2. If engineered natural ventilation system, mechanical designer can initial to verify
        - Upload output summaries from CFD analysis
   - Additional details of any special circumstances

EQ Prereq. 2: Environmental Tobacco Smoke (ETS) Control

1. Required for NC, Schools & CS
2. Design Phase Credit
3. Intent
   - Prevent or minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems to environmental tobacco smoke (ETS).

EQ Prereq. 2: Environmental Tobacco Smoke (ETS) Control

4. NC & CS Requirements

CASE 1 – ALL PROJECT TYPES

OPTION 1 – Prohibit smoking in the building

- Prohibit on-property smoking within 25 feet of entries, outdoor air intakes and operable windows.
- Provide signage to allow smoking in designated areas, prohibit smoking in designated areas or prohibit smoking on the entire property

EQ Prereq. 2: Environmental Tobacco Smoke (ETS) Control

4. NC & CS Rqmts – CASE 1 – ALL PROJECT TYPES

OPTION 2 – Prohibit smoking in building except in designated smoking areas

- Prohibit on-property smoking within 25 feet of entries, outdoor air intakes and operable windows.
- Provide signage to:
  - Allow smoking in designated areas – OR –
  - Prohibit smoking in designated areas – OR –
  - Prohibit smoking on entire property
- Provide designated smoking rooms designed to contain, capture & remove ETS from building.
  a) Directly exhaust to the outdoors, away from intakes & paths
  b) No re-circulation of ETS air to the non-smoking areas
  c) Enclosed with impermeable deck-to-deck partitions
  d) Operate exhaust to create neg. pressure (5 Pascals min.) and when doors to smoking room are closed (1 Pascal min.) **– OR –**

EQ Prereq. 2: Environmental Tobacco Smoke (ETS) Control

4. NC & CS Requirements

CASE 2 – Residential & Hospitality Project Types

- Prohibit smoking in all common areas of building
- Locate any exterior smoking areas including balconies where smoking is permitted ≥25 ft. from entries, outdoor air intakes & operable windows opening to common areas
- Prohibit on-property smoking within 25 ft of entries, outdoor air intakes & operable windows
  - Provide signage to allow smoking in designated areas, prohibit smoking in designated areas, or prohibit smoking on entire property
- Weather-strip all exterior doors and operable windows in residential unit to minimalize leakage from outdoors.

EQ Prereq. 2: Environmental Tobacco Smoke (ETS) Control

4. NC & CS Requirements (cont.)

CASE 2 – Residential & Hospitality Project Types (cont.)

- Demonstrate acceptable sealing of units by blower door test per ANSI/ASTM-E779-03 method
- Use progressive sampling methodology defined in Chapter 4 Residential Manual for Compliance w/ 2001 CA T-24
  - Demonstrate <1.25 sq. in. leakage per 100 sq. ft. of enclosure area

Schools:

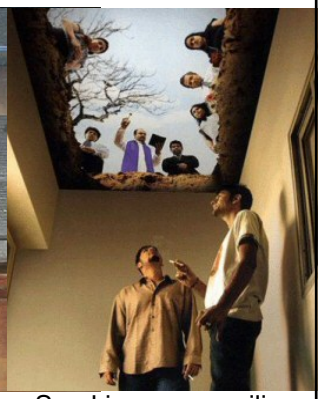
- Prohibit smoking in the building
- Prohibit on-property smoking within 25 ft of entries, outdoor air intakes & operable windows
  - Provide signage

EQ Prereq. 2: Environmental Tobacco Smoke (ETS) Control

5. Strategies & Implementation
   - Smoking already prohibited in commercial buildings in California
   - If non-California building allows smoking, make sure ventilation designated smoking rooms are separately ventilated and sealed from other spaces.
   - For residential & hospitality buildings, prohibit smoking in common areas, design building envelope and systems to minimize ETS transfer among units.
   - Recommend prohibiting smoking from school sites altogether

If that doesn't work, other measures are:

Special signage



Smoking room ceiling

EQ Prereq. 2: Environmental Tobacco Smoke (ETS) Control

6. Documentation
   - Select type of site smoking policy
     - Smoking prohibited on entire site – OR -
     - Smoking prohibited within 25 feet of entries, OA intakes, operable windows
   - Interior smoking policy
     - Project building includes residential units – OR –
     - Project includes designated smoking rooms – OR –
     - None of the above – If smoking is prohibited in building, Owner must initial LEED-Online form
   - Additional Details
     - Special circumstances precluding documentation
     - If using alternative compliance path

EA Prereq. 3: Min. Acoustical Performance

1. Required for Schools only
2. Design Phase Requirement
3. Intent
   - Provide classrooms that are quiet so that teachers can speak to the class without straining their voices and students can effectively communicate with each other and the teacher.

EA Prereq. 3: Min. Acoustical Performance

4. Requirements
   - Design classrooms and other core learning spaces to include sufficient sound-absorptive finishes
     - For compliance with reverberation time requirements of ASI S12.60-2002
   - Achieve a max. background noise level of 45 dBA from HVAC systems in classrooms & core learning spaces

– AND –

EA Prereq. 3: Min. Acoustical Performance

4. Requirements (cont.)

Case 1 – Classrooms & core learning spaces <20,000 sq. ft.

- Option 1 – Confirm that 100% of ceiling areas in all classrooms & core learning spaces are finished with materials w/ Noise Reduction Coefficient (NRC) ≥0.70
  - Excluding lights, diffusers & grilles

– OR –

- Option 2 - Confirm that total area of acoust. wall panels, clg. finishes and other sound absorbent finishes ≥ clg. area
  - Finish with materials rated NRC ≥0.70

Case 2 – Classrooms & core learning spaces ≥20,000 sq. ft.

- Confirm through ANSI S12.60-2002 calculations that all classrooms and core learning spaces >20,000 cu. ft. are designed with a reverberation time of 1.5 seconds or less

EA Prereq. 3: Min. Acoustical Performance

5. Strategies & Implementation

- Reduce background noise
  - Don't install fans, compressors or other noisy HVAC equipment in or near classrooms, libraries & or other core learning spaces
  - Select quieter HVAC equipment
  - Isolate HVAC & other noise
  - Use acoustical liners in ductwork
  - Insulated windows, solid doors, gaskets
- Reduce reverberation
  - Reverberation time (RT) is the time to decay by 60 dB after a sound has stopped
  - Calculate using room volume, interior surface area (sq. ft.), sound absorption coefficient for each interior surface & Surface area of interior fixed elements (see table page 429)
  - Place absorptive materials opposite hard reflective surfaces (ceiling & high on walls)

EA Prereq. 3: Min. Acoustical Performance

6. Documentation

CASE 1 – NOISE REDUCTION COEF. & CLG. AREA

- If volume of core learning spaces <20,000 cu. ft.:
  - Document 100% of ceiling area meeting NRC of 0.70 or higher
  - Calculate total ceiling area (less lights, diffusers, etc.) and document that equiv. or greater ceiling & wall areas meet 0.70

CASE 2 – REVERBERATION TIME

- If volume of core learning spaces ≥20,000 cu. ft.:
  - Calculate reverberation time (RT) to be less than 1.5 seconds
  - Calculate separately for 500, 1000 & 2,000 Hz frequencies
  - Determine sound absorption coefficient for each material in space @ the three frequencies (attach manuf. Data)
  - Table page 429 shows coefficients for common materials

EA Prereq. 3: Min. Acoustical Performance

6. Documentation

CASE 2 – REVERBERATION TIME (cont.)

Equation 1: Sound absorption for room

$$A = (a_1 s_1 = a_2 s_2 + a_3 s_3 + \ldots a_n s_n)$$

a_1 = sound absorption coefficient for material @ 500, 1000 or 2000 Hz

s_1 = total surface area for material (sq. ft.)

- Include all finish surfaces in room
- Equation 1 must be calculated separately at each frequency

Equation 2: Reverberation time for room

$$RT = 0.049 \times V/A$$

V = room volume (cu. ft.)

A = total sound absorption in room @3 frequencies (Equation 1)

- All three reverbation times must meet specified RT (1.5 seconds)
- See example calcs pages 431-432

EQ Credit 1: Outdoor Air Delivery Monitoring

1. One point available for NC, Schools & CS
2. Design Phase Credit
   - Aligns with LEED-EB credit
3. Intent
   - Provide capacity for ventilation system monitoring to help promote occupant comfort and well-being

EQ Credit 1: Outdoor Air Delivery Monitoring

4. Requirements

- Provide permanent CO_2 monitoring to ensure ventilation systems maintain design minimum requirements
- Configure all monitoring equip. to generate alarm when airflow values or CO_2 levels vary ≥10% from design values
  - Building automation alarm to building operator – OR –
  - Visual or audible alert to building occupants

Case 1 – Mechanically ventilated spaces

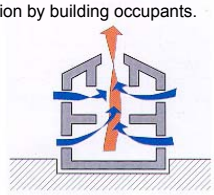
- Monitor CO_2 for densely occupied spaces (≥ 25 people/1000 sq.ft.)
- CO_2 monitors located 3-6 feet above the floor.
- Provide direct outdoor airflow measurement device to measure min. outdoor air intake flow per ASHRAE 62.1-2007
  - For vent. spaces where ≥20% of design supply airflow serves nondensely occupied spaces

EQ Credit 1: Outdoor Air Delivery Monitoring

4. Requirements

Case 2 – Naturally ventilated spaces

- Monitor CO_2 concentrations within all naturally ventilated spaces
- CO_2 monitors located 3-6 feet above the floor.
- One CO_2 sensor may represent multiple spaces if the natural ventilation design uses passive stack(s) or other means to induce airflow through those spaces equally and simultaneously without intervention by building occupants.



EQ Credit 1: Outdoor Air Delivery Monitoring

5. Strategies & Implementation
   - Install CO_2 and airflow measurement equipment for high occupancy zones
     - Conference rooms, auditoriums, etc.
   - Monitor vent. air flow for non-densely occupied spaces
     - Compare against min. required ventilation rate
     - Typically measured @ outdoor air intakes
     - Must be capable of measuring within ±15% accuracy
   - Can feed info to the HVAC system and/or Building Automation System (BAS) to trigger corrective action
   - Monitors to inform occupants of low outside air levels if automatic controls not compatible w/ building systems

EQ Credit 1: Outdoor Air Delivery Monitoring

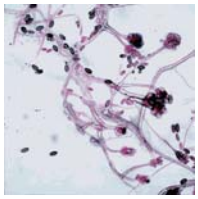
6. Documentation
   - Licensed Professional Exemption (LPE) - streamlined path
     - Available for professional engineers (PE) in lieu of providing plans, drawings & AHU info, and monitor programming confirmation
   - Check off if project building is mechanically or naturally ventilated, or both
   - If full compliance path (not PE), must upload:
     - Upload floorplan highlighting location of CO2 sensors
     - Upload controls drawing sample showing outdoor air flow measurement devices for less occupied spaces
     - If naturally ventilated, upload floorplan highlighting location & size of naturally ventilated zones, windows & CO2 sensors.
   - Describe special circumstances or alternative compliance approach used instead of standard submittal paths

EQ Credit 2: Increased Ventilation

1. One point available for NC, Schools & CS
2. Design Phase Credit
   - Aligns with LEED-EB credit
3. Intent
   - Provide additional outdoor air ventilation to improve indoor air quality (IAQ) and promote occupant comfort, well-being and productivity.

EQ Credit 2: Increased Ventilation

4. Requirements
   - **Case 1 – Mechanically Ventilated Spaces**
     - Increase breathing zone outdoor air ventilation rates to all occupied spaces ≥ 30% above min. rates per **ASHRAE Standard 62.1-2007**
     - As determined by IEQ Prereq. 1



EQ Credit 2: Increased Ventilation

4. Requirements
   - **Case 2 - Naturally Ventilated Spaces**
     - Design natural ventilation systems for occupied spaces to meet the **Carbon Trust "Good Practice Guide 237"** [1998]
     - Determine effectiveness of natural ventilation strategy following flow diagram process shown in Figure 1.18 of the Chartered Institution of Building Services Engineers (CIBSE) Applications Manual 10: 2005, Natural ventilation in non-domestic buildings.

- AND -

     - Use diagrams and calculations to show design of natural ventilation systems meets recommendations set forth in the **CIBSE** Applications Manual 10: 2005, Natural ventilation in non-domestic buildings.

- OR -

     - Use a macroscopic, multi-zone, analytic model to predict that room-by-room airflows will effectively naturally ventilate, defined as providing the minimum ventilation rates required by **ASHRAE 62.1-2007 Chapter 6**, for at least 90% of occupied spaces.

EQ Credit 2: Increased Ventilation

5. Strategies & Implementation
   - **Case 1 - Mechanically ventilated Spaces:**
     - Higher ventilation rates promotes improved comfort and productivity (may result in higher retention)
     - Use heat recovery, where appropriate, to minimize additional energy consumption associated with higher ventilation rates.
     - Size mechanical equipment to accommodate increased ventilation rates
     - Use ventilation rate procedure or IAQ procedure
     - When following ventilation rate procedure, refer to Section 6.2 of ASHRAE 62.1-2007
       - See ASHRAE Table 6-1 for breathing zone info for different occupancies

EQ Credit 2: Increased Ventilation

5. Strategies & Implementation
   - **Case 2 - Naturally ventilated Spaces:**
     - Follow Carbon Trust Good Practice Guide 237 eight design steps
       1) Develop design requirements
       2) Plan airflow paths
       3) Identify building uses and features requiring special attention
       4) Determine ventilation requirements
       5) Estimate external driving pressures
       6) Select types of ventilation devices
       7) Size ventilation devices
       8) Analyze the design. Use free software like NIST's CONTAM, Multizone Modeling Software, along with LoopDA, Natural Ventilation Sizing Tool, to analytically predict room-by-room airflows.

EQ Credit 2: Increased Ventilation

6. Documentation
   - Check off type of ventilation used
   - **Case 1 – Mechanically Ventilated Spaces**
     - Ventilation systems designer to initial that breathing zone ventilation rates are designed to exceed ASHRAE 62.1-2007 by a minimum of 30%.
     - Upload completed ASHRAE 62.1-2007 Calculator or more stringent local version calculator
     - Detailed narrative describing ventilation system design, and fresh air intake volume for each occupied zone showing design exceeds standard by at least 30%.
     - See Table 1, page 447 for sample demonstrating ventilation rate procedure

EQ Credit 2: Increased Ventilation

6. Documentation
   - **Case 2 – Naturally Ventilated Spaces**
     a) CIBSE: Upload diagrams and calculations that show natural ventilation system meets CIBSE 10:2005 recommendations
     - See Figure 1, page 448 for diagram illustrating CIBSE process

     - OR –

     a) ASHRAE: Upload summary report from macroscopic, multi-zone analytic model to predict effective natural ventilation from room-by-room airflows providing min. vent. Rates required by ASHRAE 62.1-2007 for ≥90% of occupied spaces.
   - Describe any special circumstances or alternative compliance paths used for either case pursued

EQ Credit 3.1: Construction IAQ Management Plan: During Construction

1. One point available for NC, Schools & CS
   - CS project can earn exemplary performance credit when enforcing IAQ plan for 100% of tenants
2. Construction Phase Credit
3. Intent
   - Reduce indoor air quality (IAQ) problems resulting from construction/renovation process help promote comfort and well-being of construction workers and building occupants.

EQ Credit 3.1: Construction IAQ Management Plan: During Construction

EQ Credit 3.1: Construction IAQ Management Plan: During Construction

4. Requirements
   - Develop and implement an IAQ Management Plan for the construction and pre-occupancy phases of the building:
     a) During construction, meet Control Measures of Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 2007, ANSI/SMACNA 008-2008 (Chapter 3).
     b) Protect stored on-site and installed absorptive materials from moisture damage.
     c) Use MERV 8 (Minimum Efficiency Reporting Value) filters on permanently installed air handlers if used during construction, at each return air grille, per ASHRAE 52.2-1999.
     d) Replace all filtration media immediately prior to occupancy

EQ Credit 3.1: Construction IAQ Management Plan: During Construction

5. Strategies & Implementation
   - Adopt an IAQ mgmt. plan prior to start of construction & include as regular agenda item at const. meetings:
     a) HVAC:
        - When possible, avoid use during demolition and construction to avoid contamination (try temp. ventilation)
        - Protect ductwork & HVAC openings from dust & moisture
        - Use MERV 8 filters, if air handlers used during construction & replace before occupancy.
     b) Source Control:
        - Specify finish materials w/ low or no toxicity levels when possible
        - Specify control measures for materials containing VOC's
        - Isolate and ventilate containers w/ toxic materials
        - Avoid or exhaust fumes from vehicles and gas-fueled tools to exterior of building

EQ Credit 3.1: Construction IAQ Management Plan: During Construction

5. Strategies & Implem. – IAQ Mgmt. Plan (cont.)
   c) Pathway Interruption:
      - During const. isolate areas of work to prevent contamination, provide temporary barriers as applicable
      - Weather permitting, ventilate 100% outside air during VOC emitting material installation
      - Consider depressurizing work area to better contain dust
   d) Housekeeping
      - Institute cleaning activities to control contaminants in building space during construction
      - Protect all porous materials from moisture and contamination
      - Use vacuum cleaners with high-efficiency particulate filters, and wetting agents for dust

EQ Credit 3.1: Construction IAQ Management Plan: During Construction

5. Strategies & Implem. – IAQ Mgmt. Plan (cont.)
   e) Scheduling:
      - Coordinate const. activities to minimize or eliminate disruption from occupied portions of building
      - Sequence activities to minimize impact on IAQ
      - Plan adequate time to flush out
      - Replace filtration media prior to occupancy
   f) Core & Shell
      - Coordinate IAQ management plans w/ tenant TI's & management plans when applicable
      - Consider minimalizing cross contamination of existing tenant spaces by TI construction

EQ Credit 3.1: Construction IAQ Management Plan: During Construction

6. Documentation
   - Contractor to upload IAQ Management Plan & initial that it was developed & implemented
     - Plan to address IAQ during construction & meet SMACNA IAQ guidelines
     - Plan includes control measures in at least these areas:
       a) HVAC
       b) Source control
       c) Pathway interruption
       d) Housekeeping
       e) Scheduling

EQ Credit 3.2: Construction IAQ Management Plan: Before Occupancy

1. One point available for NC & Schools (not for CS)
2. Construction Phase Credit
3. Intent
   - Reduce indoor air quality (IAQ) problems resulting from construction or renovation to promote the comfort and well-being of construction workers and building occupants.

EQ Credit 3.2: Construction IAQ Management Plan: Before Occupancy

4. Requirements:
   - Develop an (IAQ) Mgmt. Plan and implement it after all finishes are installed & building is completely cleaned
   - **OPTION 1 — Flush-Out**
     - PATH 1 - After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total air volume of **14,000 cu.ft. of outdoor air per sq.ft.** of floor area with min. 60 degrees F internal temperature and ≤ 60% relative humidity.

- OR -

EQ Credit 3.2: Construction IAQ Management Plan: Before Occupancy

4. Requirements:
   - **OPTION 1 — Flush-Out (continued)**
     - PATH 2 - If occupied prior to completion of the flush-out, space may be occupied after at least 3,500 cu.ft. of outdoor air per sq.ft. of floor area to the space.
       - Once occupied, space shall be ventilated ≥ 0.30 cfm/sq.ft. of outside air or the design minimum outside air rate determined in EQ Prerequisite 1, whichever is greater.
       - During each day of the flush-out period, ventilation shall begin at least three hours prior to occupancy and continue during occupancy.
       - These conditions shall be maintained until a total of 14,000 cu.ft./sq.ft. of outside air has been delivered to the space.

EQ Credit 3.2: Construction IAQ Management Plan: Before Occupancy

4. Requirements:
   - **OPTION 2 – Air Testing:**
     - Conduct baseline IAQ testing after construction, prior to occupancy using testing protocols per *EPA Compendium of Methods for the Determination of Air Pollutants in Indoor Air*.
     - Demonstrate the contaminant maximum construction concentrations listed below are not exceeded:

CONTAMINANT	MAXIMUM CONCENTRATION
Formaldehyde	27 parts per billion
Particulates (PM10)	50 micrograms per cubic meter
Total VOC's (TVOC)	500 micrograms per cubic meter
* 4-Phenylcyclohexene (4-PCH)	6.5 micrograms per cubic meter, req'd when using carpets & fabrics w/ styrene butadiene rubber (SBR) latex backing
Carbon Monoxide (CO)	9 part per million and no greater than 2 parts per million above outdoor levels

EQ Credit 3.2: Construction IAQ Management Plan: Before Occupancy

4. Requirements:
   - **OPTION 2 - Air Quality Testing (cont.):**
     - For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest non-compliant concentrations.
     - Repeat until all requirements have been met. When retesting non-complying building areas, take samples from the same locations as in the first test.
     - All interior finishes, millwork, doors, etc. must be installed. Movable furnishings are recommended as well.
     - Follow air sample procedures in ref. guide
       - 1 per 25,000 sq. ft. or floor
       - 3-6 feet above floor 4-hour min. test

EQ Credit 3.2: Construction IAQ Management Plan: Before Occupancy

5. Strategies & Implementation
   - Prior to occupancy, perform a building flush-out or test the air contaminant levels in the building.
   - Flush-out is often used where occupancy is not required immediately upon substantial completion of construction.
     - All construction must be completed, including punchlist items
     - Finalize cleaning, complete HVAC T&B and controls work
     - Commissioning can occur during flushout
     - Remove any temporary filters or duct covers & replace any filters used during construction
   - IAQ testing can minimize schedule impacts but may be more costly.
   - Coordinate with Indoor Environmental Quality Credits 3.1 and 5 to determine the appropriate specifications and schedules for filtration media.

EQ Credit 3.2: Construction IAQ Management Plan: Before Occupancy

6. Documentation
   - Upload IAQ Mgmt. Plan highlighting post-const. practices implemented on bldg.
   - Upload IAQ testing report, if that approach is used, highlighting test dates & concentrations for:
     - Formaldehyde
     - Particulates (PM10)
     - Total VOC's (TVOC)
     - * 4-Phenylcyclohexene (4-PCH)
     - Carbon Monoxide (CO)

EQ Credit 3.2: Construction IAQ Management Plan: Before Occupancy

6. Documentation (cont.)
   - Enter occupancy date
   - Select which type of post-construction IAQ mgmt. practices were implemented
     a) Pre-occupancy flush-out
     b) Early occupancy flush-out
     c) IAQ testing
   - Describe any special circumstances or alternative compliance path used
   - Provide photos and/or any other documentation highlighting IAQ practices used

EQ Credit 4: Low-Emitting Materials

Building Types	NC	Schools	CS
Points Available	1 to 4	4 max*	1 to 4
Cr. 4.1: Low-Emit. Mat'ls, Adhesives & Sealants	1	1*	1
Cr. 4.2: Low-Emit. Mat'ls, Paints & Coatings	1	1*	1
Cr. 4.3: Low-Emit. Mat'ls, Flooring Systems	1	1*	1
Cr. 4.4: Low-Emit. Mat'ls, Comp. Wd & Ag. Products	1	1*	1
Cr. 4.5: Low-Emit. Mat'ls, Furniture and Furnishings	NA	1*	NA
Cr. 4.6: Low-Emit. Mat'ls., Ceiling and Wall Systems	NA	1*	NA

Schools have two additional material categories from which to earn 4 points total

EQ Credit 4.1: Low-Emitting Materials: Adhesives & Sealants

1. 1 point for NC, Schools & CS
2. Design Phase Credit
3. Intent
   - Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.

EQ Credit 4.1: Low-Emitting Materials: Adhesives & Sealants

4. Requirements
   - All adhesives and sealants used on the interior of the building shall comply with the requirements of the following reference standards
     - School building interiors also required to meet CA DHS Standard Practice for Testing Volatile Organic Emissions (01350)
   - **South Coast Air Quality Management District (SCAQMD) Rule #1168 (2005)**.
   - Aerosol Adhesives: Green Seal Standard for Commercial Adhesives **GS-36** reqmts. in effect on October 19, 2000.
   - Building interior defined as inside of the weatherproofing system and applied on-site

EQ Credit 4.1: Low-Emitting Materials: Adhesives & Sealants

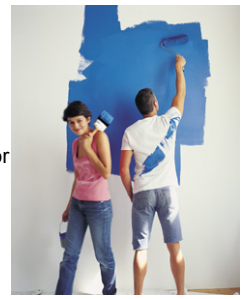
5. Strategies & Implementation
   - Specify low-VOC materials in construction documents
   - Ensure that VOC limits are clearly stated in each section of the specifications where adhesives and sealants are addressed
   - Common products to evaluate include:
     - General construction adhesives
     - Flooring adhesives & cove base adhesives (Consider CRI Green Label Plus http://www.carpet-rug.com/about-cri/cri-signature-programs/green-label-plus-adhesive.cfm)
     - Fire-stopping sealants
     - Caulking
     - Duct sealants
     - Plumbing adhesives

EQ Credit 4.1: Low-Emitting Materials: Adhesives & Sealants

6. Documentation
   - Select approach used:
     a) None of adhesive or sealant products exceed allowable VOC limits
     b) One or more adhesives or sealants exceeded allowable VOC limits
        - Only acceptable if no market alternative
   - Provide list of adhesives, sealants & sealant primers, aerosol adhesives, manuf. & VOC data
   - Upload cutsheets & supporting data for 20% of material items in each table
   - Describe any special circumstances or alternative compliance path used

EQ Credit 4.2: Low-Emitting Materials: Paints & Coatings

1. 1 point for NC, Schools & CS
2. Design Phase Credit
3. Intent
   - Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.



EQ Credit 4.2: Low-Emitting Materials: Paints & Coatings

4. Requirements
   - Interior paints and coatings applied on-site shall comply with the following criteria:
   - Architectural paints, coatings and primers applied to interior walls and ceilings: **Green Seal Standard GS-11**
     - Flats: 50 g/L
     - Non-Flats: 150 g/L
   - Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates:
     - **Green Seal Standard GC-03** - 250 g/L

EQ Credit 4.2: Low-Emitting Materials: Paints & Coatings

4. Requirements (cont.)
   - Clear wood finishes, floor coatings, stains, and shellacs applied to interior elements to meet **South Coast Air Quality Management District (SCAQMD) Rule 1113**, Architectural Coatings
     - See Table 1, Page 483
   - School building paints & coatings also required to meet CA DHS Standard Practice for Testing Volatile Organic Emissions (01350)

EQ Credit 4.2: Low-Emitting Materials: Paints & Coatings

5. Technologies & Strategies
   - Specify low-VOC paints and coatings in construction documents.
   - Ensure that VOC limits are clearly stated in each section of the specifications where paints and coatings are addressed.
   - Track the VOC content of all interior paints and coatings during construction.

EQ Credit 4.2: Low-Emitting Materials: Paints & Coatings

6. Documentation
   - Select approach used:
     a) None of paint/coating products exceed allowable VOC limits
     b) One or more paint/coating exceeded allowable VOC limits
        - Only acceptable if no market alternative
   - Provide list of paint/coating products, manuf. & VOC data, & volume used
   - Upload cutsheets & supporting data for 20% of material items in each table
   - Describe any special circumstances or alternative compliance path used

EQ Credit 4.3: Low-Emitting Materials: Flooring Systems

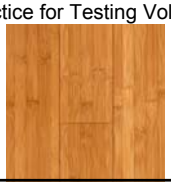
1. 1 point for NC, Schools & CS
2. Design Phase Credit
3. Intent
   - Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.

EQ Credit 4.3: Low-Emitting Materials: Flooring Systems

4. Requirements
   - All carpet installed in the building interior shall meet the testing and product requirements of the Carpet and Rug Institute's **(CRI) Green Label Plus** program.
   - All carpet cushion installed in the building interior shall meet the requirements of the Carpet and Rug Institute Green Label program.
   - All carpet adhesive shall meet the requirements of EQ Credit 4.1: VOC limit of 50 g/L
   - All hard surface flooring must be certified compliant with FloorScore (or more stringent) by ind. 3rd party
     - Vinyl, linoleum, laminate, wood, ceramic, rubber (& wall base)
     - Alt. compliance path: 100% non-carpet finished flooring FloorScore certified & constituting 25% min. of total fin. floor area

EQ Credit 4.3: Low-Emitting Materials: Flooring Systems

4. Requirements
   - Concrete, wood, bamboo and cork floor finishes such as sealer, stain and finish must beet requirements of SCAQMD Rule 113 (see EQ cr. 4.2)
   - Tile setting adhesives and grout must meet SCAQMD Rule 1168 (see EQ cr. 4.1)
   - School building flooring elements also required to meet CA DHS Standard Practice for Testing Volatile Organic Emissions (01350)



EQ Credit 4.3: Low-Emitting Materials: Flooring Systems

5. Strategies & Implementation
   - Clearly specify requirements for product testing and/or certification in the construction documents.
   - Select carpet products **Green Label Plus** certified, which also meet CA Section 01350 requirements
   - All carpet purchased for State of California buildings must meet California Gold Sustainable Carpet Standard
     - Meets Green Label Plus, and other environmentally preferable criteria (incl. min. 10% post-consumer recycled content)
     - Can contribute toward innovation credit for EPP materials
     - See www.green.ca.gov/EPP/Standards
   - ANSI/NSF 140-2007 Platinum certif. also meets criteria

EQ Credit 4.3: Low-Emitting Materials: Flooring Systems

5. Strategies & Implementation
   - Specify hard surface or resilient flooring that is FloorScore (or more stringent) certified by indep. 3rd party
   - Specify any wood floor finishes to also comply with EQ cr. 4.2
   - Specify any grout, adhesives or sealers to comply with EQ cr. 4.1
   - Specify all school flooring finishes to comply with California 01350
     - Green Label Plus & FloorScore already meet 01350

EQ Credit 4.3: Low-Emitting Materials: Flooring Systems

6. Documentation
   - Provide list of indoor flooring & carpet systems & document compliance
   - Verify indoor carpet cushion compliance, if applicable
   - Provide list of flooring adhesives & finishes & document compliance
   - Upload cutsheets & supporting data for 20% of material items in each table
   - Describe any special circumstances or alternative compliance path used

EQ Credit 4.4: Low-Emitting Materials: Composite Wood & Agrifiber Products

1. 1 point for NC, Schools & CS
2. Design Phase Credit
3. Intent
   - Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.

EQ Credit 4.4: Low-Emitting Materials: Composite Wood & Agrifiber Products

4. Requirements
   - Composite wood and agrifiber products used on building interior shall contain **no added urea-formaldehyde** resins.
   - Laminating adhesives used to fabricate on-site and shop-applied assemblies shall contain no added urea-formaldehyde resins.
   - Composite wood and agrifiber products include:

Particleboard	Medium density fiberboard (MDF)
Plywood	Wheatboard, strawboard
Door cores	Panel substrates

   - Materials considered fit-out, furniture, and equipment (FF&E) not included.
   - School composite wood & agrifiber elements also required to meet California Section 01350

EQ Credit 4.4: Low-Emitting Materials: Composite Wood & Agrifiber Products

5. Strategies & Implementation
   - Specify wood and agrifiber products that contain no added urea-formaldehyde resins.
   - Specify laminating adhesives for field and shop applied assemblies that contain no added urea-formaldehyde resins.
   - Specify all school composite wood & agriber products to comply with California 01350

EQ Credit 4.4: Low-Emitting Materials: Composite Wood & Agrifiber Products

6. Documentation
   - List each composite wood or agrifiber product installed
     - Verify no added urea formaldehyde
   - Optional narrative for any special circumstances or alternate compliance approach

EQ Credit 4.5: Low-Emitting Materials: Furniture & Furnishings

1. 1 point for Schools only
2. Design Phase Credit
3. Intent
   - Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.

EQ Credit 4.5: Low-Emitting Materials: Furniture & Furnishings

4. Requirements
   - Classroom furniture manufactured, refurbished or refinished within 1 year prior to occupancy must meet one option below:
     - Includes all student and teacher desks, tables and seats
   - OPTION 1 – Furniture or seating must be GREENGUARD Children and Schools certified

     - OR –
   - OPTION 2 – Calculated indoor concentrations ≤ Table 1 EPA Environmental Technology Verification (ETV) 1999

Chemical Contaminant	Classroom Furniture	Seating
Total VOC's	0.5 mg/cu. meter	0.25 mg/cu. meter
Formaldehyde	50 parts per billion	25 parts per billion
Total aldehydes	100 parts per billion	50 parts per billion
4-Phenylcyclohexene (4-PCH)	0.0065 mg/cu. meter	0.00325 mg/cu. meter

EQ Credit 4.5: Low-Emitting Materials: Furniture & Furnishings

4. Requirements (cont.)

   - OR –
   - OPTION 3 – Calculated indoor air concentrations ≤ those established in table 1 for furniture systems & seating determined by ANSI/BIFMA M7.1-2007 testing protocol conducted by independent 3rd party AQ testing lab.

EQ Credit 4.5: Low-Emitting Materials: Furniture & Furnishings

5. Strategies & Implementation
   - Specify furniture & furnishings meeting one of three options or air concentration methods
   - Salvaged furniture more than 1 year old is exempt
6. Documentation
   - List each classroom furniture or furnishings item
     - Verify which option or method met
     - Verify certifier
   - Upload documentation & cutsheets showing compliance
   - Optional narrative for any special circumstances or alternate compliance approach

EQ Credit 4.6: Low-Emitting Materials: Ceiling and Wall Systems

1. 1 point for Schools only
2. Design Phase Credit
3. Intent
   - Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.

EQ Credit 4.6: Low-Emitting Materials: Ceiling and Wall Systems

4. Requirements
   - All gypsum board, insulation, acoustical ceiling systems and wall coverings installed in building interior must meet CA DHS Standard Practice for Testing Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda
     - AKA California Section 01350

EQ Credit 4.6: Low-Emitting Materials: Ceiling and Wall Systems

5. Strategies & Implementation
   - Specify gypsum board, insulation, acoustical ceiling systems and wall coverings installed in school building interior that meet CA 01350 standard.
6. Documentation
   - List each applicable material in school interior
   - Upload documentation & cut-sheets showing compliance
   - Optional narrative for any special circumstances or alternate compliance approach

EQ Credit 5: Indoor Chemical & Pollutant Source Control

1. 1 point for NC, Schools & CS
2. Design Phase Credit
3. Intent
   - Minimize building occupant exposure to potentially hazardous particulates and chemical pollutants.

EQ Credit 5: Indoor Chemical & Pollutant Source Control

4. Requirements
   a) Design to minimize and control entry of pollutants into buildings & later cross-contamination of regularly occupied areas through these strategies:
      - Install permanent entryway systems ≥ ten feet long in primary direction of travel to capture dirt at all regularly used entryways directly connected to the outdoors.
      - Includes permanently installed grates, grilles, or slotted systems that allow for cleaning underneath.
      - Roll-out mats acceptable only when maintained weekly by contracted service organization (or school maintenance staff)
      - CS projects without entryway systems cannot earn this credit

- AND -

EQ Credit 5: Indoor Chemical & Pollutant Source Control

4. Requirements (cont.)
   b) Sufficiently exhaust each space where hazardous gases or chemicals may be present or used
      - Garages, housekeeping/laundry areas and copying/printing rooms, science labs, shops, prep rooms, art rooms
      - Create negative pressure with the doors closed, at least 0.50 cfm/sq.ft., with no air recirculation & 5 Pascals pressure
      - Self-closing doors & deck to deck partitions or a hard lid ceiling.

EQ Credit 5: Indoor Chemical & Pollutant Source Control

4. Requirements (cont.)

c) In mechanically ventilated buildings, provide **(MERV)13** or better filters for regularly occupied areas of building.
   - Applies to both return and outside air delivered as supply air.

d) Provide containment for appropriate disposal of hazardous liquid wastes in places where water and chemical concentrate mixing occurs
   - Housekeeping, janitorial and science lab
   - Closed container for storage for off-site disposal in reg. compliant storage building preferably outside the building

EQ Credit 5: Indoor Chemical & Pollutant Source Control

5. Technologies & Strategies
   - Install permanent architectural entryway systems such as grills or grates to prevent occupant-borne contaminants from entering the building.
   - Design facility areas with chemical mixing or exhausts with isolated exhaust systems for contaminants.
     - Locate away from occupant work areas when possible
     - Maintain physical isolation from the rest of the regularly occupied areas of the building (deck-to-deck partitions).
     - School science labs should use fans to exhaust chemicals from space, but separate air handling units are not required
   - Install high-level filtration systems in air handling units processing both return air and outside supply air.
     - Ensure that air handling units can accommodate required filter sizes and pressure drops

EQ Credit 5: Indoor Chemical & Pollutant Source Control

6. Documentation
   - Verify & document permanent entry walkway system compliance, or rollup mat maintenance agreement
     - Upload floor plan(s) to document compliance
     - Or describe roll-out mat entryway system, locations and maint. procedure, frequency, responsible party & contract length.
   - List rooms used for chemical storage (garages, laundry, printing) & document exhaust & separation compliance.
     - Upload floor plans documenting location and other drawings to demonstrate compliance
   - Document filtration provided for mech. ventilated spaces
     - Verify replacement just prior to occupancy
   - Verify compliance w/ mixing of water or chemical concentrate mixing occurs in project
     - Or contractor to initial that no such mixing occurs

EQ Credit 6.1: Controllability of Systems: Lighting

1. 1 Point for NC & Schools
2. Construction Phase Credit
3. Intent
   - Provide a high level of lighting system control by individual occupants or by specific groups in multi-occupant spaces (i.e. classrooms or conference areas) and promote their productivity, comfort and well-being.

EQ Credit 6.1: Controllability of Systems: Lighting

4. Requirements - NC
   - Provide individual lighting controls for 90% (minimum) of the building occupants to enable adjustments to suit individual task needs and preferences.

- AND -

   - Provide lighting system controls for all shared multi-occupant spaces to enable lighting adjustment that meet group needs and preferences.

EQ Credit 6.1: Controllability of Systems: Lighting

4. Requirements – Schools

CASE 1 – Administrative Offices and Other Regularly Occupied Spaces

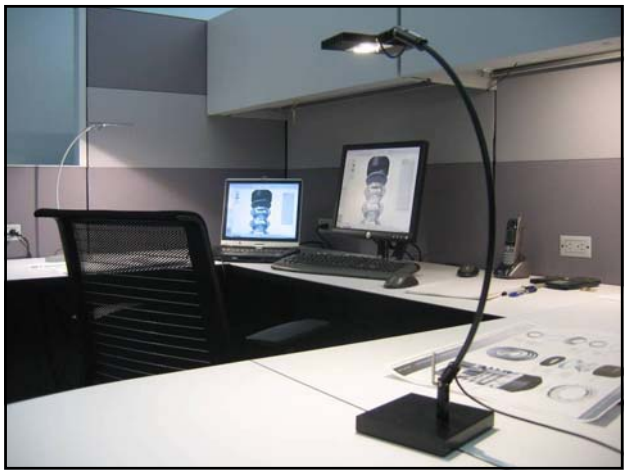
- Provide individual lighting controls for 90% (minimum) of the building occupants to enable adjustments to suit individual task needs and preferences. **- AND -**
- Provide lighting system controls for all learning spaces including classrooms, chemistry labs, art rooms, shops, music rooms, gymnasiums and dance and exercise studios to enable adjustments that meet group needs and preferences

CASE 2 - Classrooms

- Provide a lighting system that operates at least 2 modes: general illumination and A/V.

EQ Credit 6.1: Controllability of Systems: Lighting

5. Strategies & Implementation
   - Design the building with occupant controls for lighting.
   - Strategies to consider include lighting controls and task lighting.
   - Integrate lighting systems controllability into the overall lighting design, providing ambient and task lighting while managing the overall energy use of the building.
   - In classrooms, lighting controls should be easily accessible to teachers



EQ Credit 6.1: Controllability of Systems: Lighting

6. Documentation
   - Complete table showing lighting controls for all regularly occupied spaces
     - Space ID
     - Occupancy type
     - Quantity
     - Lighting control type
     - Lighting control description
   - Quantify occupants, spaces, individual workstations with individual lighting controls & lighting control coverage (%)
   - Upload representative floor plans and any other applicable drawings for building to document
   - Optional narrative for any special circumstances or alternate compliance approach

EQ Credit 6.2: Controllability of Systems: Thermal Comfort

1. 1 Point for NC, Schools & CS (EQ c6)
2. Design Phase Credit
3. Intent
   - Provide a high level of thermal comfort system control by individual occupants or groups in multi-occupant spaces (i.e. classrooms or conference areas) and promote their productivity, comfort and well-being

EQ Credit 6.2: Controllability of Systems: Thermal Comfort

4. Requirements
   - Provide individual comfort controls for ≥50% of occupants to enable adjustments to meet individual needs and preferences.
     - For workspaces only in schools projects
   - Operable windows can be used in lieu of comfort controls for occupants 20 feet inside of and 10 feet to either side of the operable part of the window.
     - Operable window must meet the requirements of ASHRAE 62.1-2007 paragraph 5.1 Natural Ventilation.

- AND -

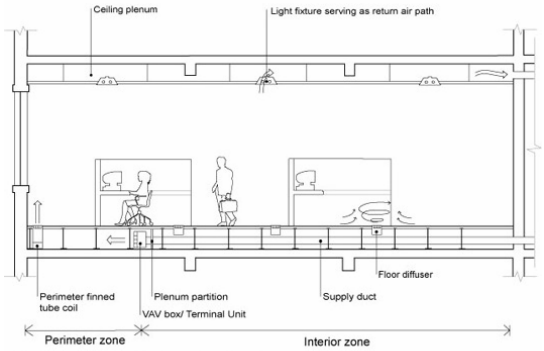
EQ Credit 6.2: Controllability of Systems: Thermal Comfort

4. Requirements (cont.)
   - Provide comfort system controls for all shared multi-occupant spaces to enable adjustments to suit group needs and preferences.
   - Conditions for thermal comfort are described in **ASHRAE Standard 55-2004** to include the primary factors of air temperature, radiant temperature, air speed and humidity.
     - Control over at least one of these primary factors in the occupant's local environment.
   - CS projects not purchasing and/or installing mech. System or operable windows have not met intent of this credit.

EQ Credit 6.2: Controllability of Systems: Thermal Comfort

5. Strategies & Implementation
   - Design systems w/ personal comfort adjustment controls
   - **ASHRAE Standard 55-2004** identifies thermal comfort
   - May include operable windows, mechanical systems or hybrid systems integrating both.
   - Consider individual thermostat controls, local diffusers at floor, desk or overhead levels, control of individual radiant panels.
   - Evaluate interactions between thermal comfort (as required by ASHRAE Standard 55-2004) and acceptable indoor air quality (as required by ASHRAE Standard 62.1-2004, whether natural or mechanical ventilation).

Underfloor Air Distribution (UFAD)



Multi-zoned, limited perimeter ductwork

EQ Credit 6.2: Controllability of Systems: Thermal Comfort

6. Documentation
   - Streamlined Path LPE (PE) available as well as full documentation path
     - Complete table documenting thermal comfort control for all regularly occupied spaces
     - Spaces w/ identical occupancy types and controls may be grouped together for efficiency.
     - Name each space or group of spaces with ID
     - Indicate occupancy type, quantity of spaces in group, thermal comfort control method and brief description
   - Upload representative floor plans/drwgs for bldg.
   - Optional narrative for any special circumstances or alternate compliance approach
     - Include data on individual and group controls

EQ Credit 7.1: Thermal Comfort: Design

1. 1 Point for NC, Schools & CS (EQ c7)
2. Design Phase Credit
3. Intent
   - Provide a comfortable thermal environment that occupant productivity and well-being.

EQ Credit 7.1: Thermal Comfort: Design

4. Requirements
   - Design HVAC systems and the building envelope to meet the requirements of **ASHRAE Standard 55-2004**, Thermal Comfort Conditions for Human Occupancy.
   - Demonstrate design compliance in accordance with the Section 6.1.1 Documentation.
   - Schools also required to demonstrate compliance of natatoriums with chapter 4 of **ASHRAE HVAC Applications Handbook (2003)**
   - CS projects must allow for tenant build-out to meet requirements. Projects designing but not installing mech. ventilation are not eligible.

EQ Credit 7.1: Thermal Comfort: Design

5. Strategies & Implementation
   - Establish comfort criteria per **ASHRAE Standard 55-2004** that support the desired quality and occupant satisfaction with building performance.
   - Design building envelope and systems with the capability to deliver performance to the comfort criteria under expected environmental and use conditions.
   - Evaluate and integrate thermal comfort aspects:
     - Air temperature
     - Radiant temperature
     - Air speed
     - Relative humidity
     - Coordinate with EQ Prerequisite 1, EQ Credits 1 & 2

EQ Credit 7.1: Thermal Comfort: Design

6. Documentation
   - Complete table providing seasonal temp and humidity design criteria & metabolic rates for each space type
   - Clarify compliance if natatorium space is included
   - Contractor to initial declaring submission of systems manual or O&M manual providing info on
     - General & specific O&M instructions for controls
     - Seasonal settings and/or changeovers
     - Limits in adjustment of manual controls
     - Maintenance & inspection schedule for all thermal & other environmental-condition related bldg. systems.

EQ Credit 7.1: Thermal Comfort: Design

6. Documentation (cont.)
   - List sources of weather data
   - Weather design conditions (cooling & heating)
   - Hours per typical year that outdoor temps exceed design conditions (cooling & heating)
   - Complete tables for cooling and heating modes
   - Upload supporting documentation with PMV/PPD calculations, ASHRAE comfort tool results , and/or psychrometric comfort zone chart from Standard 55
   - Complete table on likely local discomfort effects
   - Optional narrative for any special circumstances or alternate compliance approach

EQ Credit 7.2: Thermal Comfort: Verification

1. 1 point for NC & Schools
2. Design Phase Credit
3. Intent
   - Provide for the assessment of building occupants' thermal comfort over time.

EQ Credit 7.2: Thermal Comfort: Verification

4. Requirements
   - Agree to conduct a thermal comfort survey of building occupants within a period of six to 18 months after occupancy.
     - Adults & students grade 6 & above
   - This survey should collect anonymous responses about thermal comfort in the building including an assessment of overall satisfaction with thermal performance and identification of thermal comfort-related problems.
   - Agree to develop a plan for corrective action if the survey results indicate that more than 20% of occupants are dissatisfied with thermal comfort in the building.
   - This plan should include measurement of relevant environmental variables in problem areas in accordance with ASHRAE Standard 55-2004.

EQ Credit 7.2: Thermal Comfort: Verification

4. Requirements (cont.)
   - NC projects also required to provide a permanent monitoring system to ensure that building performance meets desired comfort criteria
     - As determined by IEQ cr. 7.1: Thermal Comfort Design
   - Residential projects not eligible for this credit

EQ Credit 7.2: Thermal Comfort: Verification

5. Strategies & Implementation
   - Refer to ASHRAE Standard 55-2004 for guidance in establishing thermal comfort criteria, documenting and validating building performance.
   - Provide systematic process for occupant feedback.
   - Center for the Built Environment (UC Berkeley) developed post-occupancy research for LEED buildings:
     - http://www.cbe.berkeley.edu/research/briefs-LEED.htm

EQ Credit 7.2: Thermal Comfort: Verification

6. Documentation
   - Owner to initial that they will conduct a thermal comfort survey between 6-18 months occupancy
     - Enter date of occupancy
     - Collect anonymous responses about thermal comfort
     - Will include plan for corrective action if 20% or more of occupants are dissatisfied
     - Upload sample of questionnaire for survey
     - Enter anticipated date of survey administration
     - Describe party/parties responsible for administrating survey
   - Optional narrative for any special circumstances or alternate compliance approach

EQ Credit 7.2: Thermal Comfort: Verification

PROJECT NAME - Occupant Comfort Survey

Occupant's exact location (optional): _____

	Very Dissatisfied	Dissatisfied	Somewhat Dissatisfied	Neutral	Somewhat Satisfied	Satisfied	Very Satisfied	If dissatisfied, please explain
How satisfied are you with the average temperature in your workspace?								
Are you satisfied with your ability to do you job based on the temperature?								
How satisfied are you with the heating in your workspace?								
How satisfied are you with the cooling in your workspace?								
How satisfied are you with the air quality in your work space?								

EQ Credit 8.1: Daylight & Views: Daylight

1. Credit(s) for NC, Schools & CS
2. Design Phase Credit
3. Intent
   - Provide for the building occupants a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.

EQ Credit 8.1: Daylight & Views: Daylight

Schools

Classroom Spaces	Points
75%	1
90%	2
Also 95% of non-occupied spaces	Exemplary Performance

NC & CS

Regularly Occupied Spaces	Points
75%	1
95%	Exemplary Performance

EQ Credit 8.1: Daylight & Views: Daylight

4. Requirements – NC, Schools & CS
   - **OPTION 1 — SIMULATION**
     - Demonstrate through computer simulations that 75% (NC, Schools & CS) or 90% (Schools Only) or more of all regularly occupied spaces achieve a daylight illuminance level of 25-500 fc in design conditions
   - **OPTION 2 — PRESCRIPTIVE**
     - Achieve a value, calculated as the produc t of the visible light transmittance (VLT) and window-to-floor area ration (WFR) of daylight zone 0.150 and 0.180. The window area included in calc. must be at least 30" above floor

       $0.150 < VLT \times WFR < 0.180$
     - See diagrams and instructions page 550-551 for instructions

EQ Credit 8.1: Daylight & Views: Daylight

4. Requirements
   - **OPTION 3 — MEASUREMENT**
     - Demonstrate, through indoor light measurements, min. daylight illumination level of 25 fc in 75% of regularly occupied areas.
     - Measurements taken on 10-foot grid for all occupied spaces and recorded on building floor plans.
     - Only the square footage associated with the portions of spaces meeting the minimum requirements can be applied towards the 75% of total area calculation required to qualify for this credit.
     - Provide daylight redirection and/or glare control devices in all cases to avoid high-contrast situations.
     - Exceptions for areas where tasks would be hindered by the use of daylight will be considered on their merits.

EQ Credit 8.1: Daylight & Views: Daylight

4. Requirements – NC, Schools & CS
   - **OPTION 4 — COMBINATION**
     - Any combination of options may be combined to document min. daylight illumination to levels needed for all regularly occupied spaces.
     - In all cases, only sq. ft. associates with portions of rooms or spaces meeting requirements can be applied toward total area calc for this credit
     - In all cases, provide glare control devices to avoid high-contrast situations that impede visual tasks. Exceptions for areas where tasks would be hindered by use of daylight will be considered on their merits.

EQ Credit 8.1: Daylight & Views: Daylight

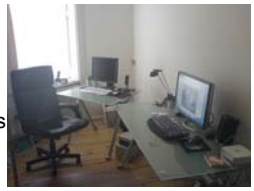
5. Strategies & Implementation
   - Design the building to maximize interior daylighting.
   - Strategies to consider include:
     - Building orientation
     - Shallow floor plates
     - Increased building perimeter
     - Exterior and interior permanent shading devices
     - High performance glazing
     - Automatic photocell-based controls.
   - Predict daylight factors by manual calculations or daylighting modeling strategies with physical or computer models to assess footcandle levels and daylight factors achieved.

EQ Credit 8.1: Daylight & Views: Daylight

6. Documentation
   - Indicate if glare control devices are in place for all windows where direct sunlight would interfere w/ normal activities
   - Upload floorplan and/or other drawings to highlight regularly occupied space & daylit areas/zones
   - Indicate method of demonstrating daylighting met
     a) Computer simulation
     b) Prescriptive measures to achieve daylight threshold
     c) Actual measurement of daylight in spaces
   - Optional narrative for any special circumstances or alternate compliance approach
   - See diagrams and tables pages 557-560 for samples of measurement methods

EQ Credit 8.2: Daylight & Views: Views for 90% of Spaces

1. 1 Point for NC, Schools & CS
2. Design Phase Credit
3. Intent
   - Provide building occupants a connection to the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.



EQ Credit 8.2: Daylight & Views: Views for 90% of Spaces

4. Requirements
   - Achieve a direct line of sight to outdoor via vision glazing between **2'6" - 7'6"** above finish floor for **90%** of all regularly occupied areas.
   - Determine the area w/ direct line of sight by totaling the regularly occupied area that meets the following criteria:
     - In plan & section views, within sight lines from perimeter vision glazing
     - Line of sight may be drawn through interior glazing.
     - For private offices, entire square footage can be counted ≥ 75% of area has direct line of sight to perimeter vision glazing.
     - For classrooms and multi-occupant spaces, count actual square footage with direct line of sight to perimeter vision glazing.
     - CS design must incorporate feasible tenant layout(s) used in analysis of this credit

EQ Credit 8.2: Daylight & Views: Views for 90% of Spaces

5. Strategies & Implementation
   - Design the space to maximize daylighting and view opportunities.
   - Seated views used
   - Only regularly occupied spaces
   - Consider:
     - Lower partition heights
     - Interior shading devices
     - Interior glazing

EQ Credit 8.2: Daylight & Views: Views for 90% of Spaces

6. Documentation
   - Complete Views table & calculate totals of occupied spaces with access to views using supporting calculator (>90% req'd)
   - Upload drawings (floorplans, elevations, sections, photos, etc.) showing line of sight from interior spaces through exterior windows
     - Plan & section drawings
   - Narrative describing any special occupancy areas excluded from compliance
     - Include description of space function
     - Explain why inclusion of views would hinder functions of areas

EQ Credit 8.2: Daylight & Views: Views for 90% of Spaces

6. Documentation (cont.)
   - See tables, diagrams & sample calcs pages 569-571
   - Optional narrative for any special circumstances or alternate compliance approach

EXEMPLARY PERFORMANCE

- Meet 2 of the following 4 measures:

1. 90% of occupied spaces have multiple lines of site to vision glazing in dif. directions at least 90 degrees apart
2. 90% have views including views of at least 2 of 3 options:
   a) Vegetation
   b) Human activity
   c) Objects at least 70 ft. from exterior glazing
3. 90% have unobstructed views within 3 times head height
4. 90% have access to views w/ a view factor ≥3

EQ Credit 9: Enhanced Acoustical Performance

1. 1 Point for Schools only
2. Design Phase Credit
3. Intent
   - Provide classrooms that facilitate better teacher-to-student and student-to-student communications through effective acoustical design.

EQ Credit 9: Enhanced Acoustical Performance

4. Requirements

Sound Transmission

- Design building shell, classroom partitions and other core learning space partitions to meet the Sound Transmission Class (STC) requirements of ANSI Standard S12.60-2002, Acoustical Performance Criteria, Design Requirements and Guidelines for Schools, except windows, which must meet an STC rating of at least 35

- AND -

Background Noise

- Reduce background doise level to 40 dBA or less from HVAC systems in classrooms and other core learning spaces.

EQ Credit 9: Enhanced Acoustical Performance

5. Strategies & Implementation
   - Consider exterior berms to reduce noise transmission from busy roads
   - Select quieter HVAC systems, simple ducting and acoustical liners
   - Use materials with higher STC ratings to reduce sound transmission
   - Seal penetrations & weatherstrip windows & doors

EQ Credit 9: Enhanced Acoustical Performance

6. Documentation
   - Maintain copies of project building plan denoting STC ratings for wall, ceiling and floor assemblies.
   - Describe treatments used for sound control where ductwork or other passages connect classroom spaces
   - Document means by which background noise level in classrooms and other primary spaces was kept below 45 dBA
     - Following ANSI S12-60 methodology or using software based on 2007 HVAQC Applications ASHRAE Handbook, Chapter 47: Sound and Vibration Control
   - Optional narrative for any special circumstances or alternate compliance approach

EQ Credit 9: Enhanced Acoustical Performance

6. Documentation (cont.)

EXEMPLARY PERFORMANCE

- If project achieves:
  a) Oudoor background noise level of 55dBA for playgrounds –AND-
  b) 60dBA for athletic fields or all other school grounds
  c) Or an indoor noise level of 35 dBA

EQ Credit 10: Mold Prevention

1. 1 Point for Schools only
2. Design Phase Credit
3. Intent
   - Reduce the potential presence of mold in schools through preventive design and construction measures.

EQ Credit 10: Mold Prevention

4. Requirements
   - Project teams must achieve the following credits:
   - IEQ Credit 3.1: Construction Indoor Air Quality Management Plan – During Construction
   - IEQ Credit 7.1: Thermal Comfort-Compliance
   - IEQ Credit 7.2: Thermal Comfort-Verification

- AND –

   - Provide HVAC systems and controls designed to limit space relative humidity to 60% or less during all load conditions, both occupied and unoccupied.
   - Develop and implement IAQ management program for buildings based on EPA document, Building Air Quality: A Guide for Building Owners and Facility Managers (EPA ref. number 402-F-91-102 – Dec. 1991)

EQ Credit 10: Mold Prevention

5. Strategies & Implementation
   - Eliminate potential for condensation
   - Pay special attention to know generators of condensation
   - Prevent mold during unoccupied periods
   - Address floods and leaky or failed equipment
   - Design for mold prevention

EQ Credit 10: Mold Prevention

6. Documentation
   - Document method used to limit space relative humidity to 60% or less
   - Maintain a written IAQ management plan addressing operation & maintenance issues
   - Optional narrative for any special circumstances or alternate compliance approach
   - Possible Exemplary Performance, but no prescribed threshold. Evaluated on case-by-case basis

Next Class – Monday, June 15th

- Last Class before Mock LEED-AP Exam
- Review of several other LEED rating systems
  - LEED-O&M, LEED-ID&C, LEED for Schools, LEED-ND
- Course Review
- Exam Preparation Review & Guidance
- LEED Accreditation review
- Suggestions for Study

- LEED-AP Mock Exam Monday, July 13th 9:00 AM - 3 PM

- LEED-NC v2.2 to LEED-BD&C Update Seminar July 9th 9:00 AM – 12:00 PM @Zig