

Appendix I-0: Suggested Implementation for all Indoor Environmental Quality Guidelines

I.1 Restrict Environmental Tobacco Smoke

Agency Planning

- The Owner certifies that the building will be operated as a smoke-free building and establishes a no-smoking policy for the building. Therefore, special barriers and controls will not be designed inside these buildings.

Construction Documents

- In design documentation state explicitly that the building was designed assuming that smoking would not occur in the building.
- In plan drawings and other documentation indicate outdoor designated smoking areas to ensure that smoke will not be introduced into the building through doorways, windows, outdoor air intakes or other openings.

Ongoing Occupancy

- Maintain the location of designated outdoor smoking areas or relocate areas with building changes or additions to ensure that smoke will not be introduced into the building through doorways, windows, outdoor air intakes or other openings.

Next Use

- The decision that this building was designed to be operated as a smoke-free building should be clarified for any new owner.
- The proper location of designated outdoor smoking areas should be communicated to any new owner, property manager, and occupants.

I.2 Specify Low-emitting Materials

Schematic Design

- For those building materials and furnishings covered by the performance criteria and any additional materials or products included in the design. Specifications should include the requirement that pollutant emission rates of the materials are certified by the manufacturer.

Design Development

- Verify continued selection of materials and products to reflect guideline requirements or more stringent project team goals for material emission limits.
- Develop drawings and specifications which support material properties selected.

Construction Documents

- Specify low-emitting materials in construction documents. Ensure that emission limits are clearly stated in each section where materials covered by this guideline are addressed.

Construction

- Adopt an appropriate management plan during construction to prevent problems that will adversely affect IAQ when the building is occupied. See P.4 Design and Construction Commissioning.

Construction Administration

- Monitor submittals and construction site to ensure that materials, products, and systems are being correctly installed to preserve project goals and objectives. Review substitutions based on performance criteria to ensure consistency and compliance with goals as represented in the drawings and specifications.
- Document changes to requirements for construction that occur that may seriously impact the provision or installation of materials, products, or components that were intended to ensure indoor air quality standards are achieved.

Ongoing Occupancy

- Based on the Operations Commissioning Plan (developed prior to occupancy, see P.5 Operations Commissioning), use low or no-VOC emitting materials for products including cleaning supplies, pest management applications, minor remodeling, and maintenance associated with "churn" or standard product replacement of furnishings and finishes.

I.3 Moisture Control

Predesign-Programming

- In the program document, note any unusual water uses in the building for this occupancy class.

Predesign-Site Selection

- In site selection documents, note any potential water intrusion potential associated with the site.

Schematic Design

- Design building envelope and mechanical systems to meet the performance criteria for I.3. Calculate dew points for interior surfaces of all exterior wall elements at winter design day conditions.

Construction Documents

- In bid documents, describe how materials at construction site are to be stored to protect them from moisture damage during construction and procedures that will be followed to remove moisture-damaged materials from the construction site.

Construction

- Store materials appropriately to prevent water damage. Do not accept moisture sensitive materials with evidence of moisture damage, including stains. Remove them from the site and dispose of properly. Replace any moldy materials with new, undamaged materials.
- Sequence drying of construction materials appropriately during the construction process to prevent future problems. Follow guidance found in Appendix P-3a. Also See Performance Management.

Ongoing Occupancy

- Conduct regular inspections that ensure there are no visible signs of moisture intrusion or accumulation.
- Conduct regular testing of exterior wall construction to detect moisture in the exterior wall system.
- When exterior water intrusion, leakage from interior water sources, or other uncontrolled accumulation of water occurs, correct the intrusion, leakage or accumulation because of the potential for these conditions to cause the growth of mold. (Title 8, Chapter 4, Section 3362(g) of California Occupational Safety and Health Standards, Sept. 2002.) Establish maintenance procedures that will identify unintended water intrusion, leakage or accumulation quickly and provide drying or removal of building structure elements within 48 hours of the unintended event (Horner, 2001.) Review past water damaged materials to ensure mold growth has not occurred. Also See Performance Management.
- In spaces adjacent to new construction remove source of moisture intrusion or accumulation.

Next Use

- Site information and ways the design team prevented potential problems should be passed to new owners. See Performance Management.

I.4 Ventilation Design

Predesign-Programming

| I.4B | I.4C | I.4D | Task |
|-------------|-------------|-------------|---|
| X | X | X | Obtain ASHRAE 62.1– 2004 (or later version) and all applicable referenced standards and addenda. |
| | X | X | Work with the owner to identify high occupancy areas in the building. |
| | X | X | Determine design occupancy levels to calculate design CO2 emissions in occupied zones. Use estimated design occupancy levels or ASHRAE design occupancy levels by space type. |

Schematic Design

| I.4B | I.4C | I.4D | Task |
|------|------|------|---|
| X | X | X | Incorporate the requirements of ASHRAE 62.1 into the design process as appropriate for the phase. |
| | X | X | When the initial ventilation design is completed using ASHRAE 62.1, compute the expected steady-state CO2 concentrations in high occupancy areas of the building. |
| | | X | Determine the ventilation rate per person needed to limit CO2 concentrations to 450 ppm above the outdoor concentrations in all occupied zones. Use CO2 generation rates based on the activity level of occupants. See appendix a of the 62.1 user's manual or other source of metabolic rates of building occupants. |
| | | X | Compare these ventilation rates with those calculated in based on ASHRAE standard 62.1. The guideline design ventilation rate for each space is the larger of the value required from 62.1 or the CO2 concentration requirement above. |
| | | X | Coordinate with the energy analysis process, so that actual design ventilation rates are the same in both ventilation and energy design processes. The design team should consider using strategies that will provide the opportunity to reduce energy use associated with ventilation. The list recommended to consider includes but is not limited to: <ul style="list-style-type: none"> • CO2 or other occupancy control to reduce ventilation in the building when it is unoccupied. • Use of ventilation strategies that increase ventilation efficiency such as displacement ventilation. • Using economizer cycles where possible. • Using heat recovery strategies in the ventilation design chosen. |

Design Development through Construction Documents

| I.4B | I.4C | I.4D | Task |
|------|------|------|---|
| X | X | X | Incorporate the requirements of ASHRAE 62.1 into the design process as appropriate for this phase. |
| | X | X | Specify appropriate instrumentation to monitor CO2 continuously in high occupancy areas of the building. |
| X | X | X | Update the design ventilation rate as any changes are made to the design occupancy levels planned for the building. Communicate these changes to the parties evaluating energy performance, so that significant changes in ventilation rate can be taken into account in energy calculations and strategies that address minimizing energy use in the building. |

Construction

| I.4B | I.4C | I.4D | Task |
|------|------|------|--|
| X | X | X | Follow a Construction IAQ Management Plan during construction to prevent problems that will adversely affect IAQ when the building is occupied. See P.4 Design and Construction Commissioning. At a minimum, utilize the requirements found in section 7 of standard 62.1 for construction and startup phases of the building. |

Ongoing Occupancy

| I.4B | I.4C | I.4D | Task |
|------|------|------|--|
| X | X | X | Use the requirements found in section 8 of Standard 62.1 for operations and maintenance of the building. Observe the minimum maintenance frequencies presented in table 8.1 of Standard 62.1 for ventilation system components. |
| | X | | Compare the expected values of CO ₂ concentrations found in high-occupancy spaces in the building with those expected from the building design using ASHRAE 62.1. This should be done at three-month intervals during the initial year of occupancy and annually thereafter. |
| | | X | Compare the expected values of CO ₂ concentrations found in high-occupancy spaces in the building with those expected from the building design using ASHRAE 62.1 and the supplementary CO ₂ requirement. This <u>should</u> be done at three-month intervals during the initial year of occupancy and annually thereafter. |

Next Use

| I.4B | I.4C | I.4D | Task |
|------|------|------|--|
| X | X | X | Transfer assumptions about ventilation rates and carbon dioxide concentrations in high occupancy spaces to a new owner of the building. See P.5 Operations Commissioning for record keeping and transfer procedures. |

I.5 Thermal Comfort

Pre-design-Programming

- Determine special thermal comfort requirements or problems that may be encountered in the building due to work activities or siting or design considerations.
- Review conditions that affect thermal comfort using ASHRAE Standard 55-2004 or Human Factors Design Handbook. Perform any baseline studies on thermal problems or issues that may exist in current facilities if the project involves a move or remodel.

Schematic Design

- Estimate thermal comfort performance measures using ASHRAE Standard 62 occupancy limits for spaces and comfort zone and other thermal conditions in ASHRAE Standard 55. Ensure that no major design characteristic of the building required by these guidelines will push these variables outside general comfort ranges as defined by the guidelines.

Design Development

- Consider additional calculations of thermal comfort indices as appropriate to specific project conditions. Additional measures may include operative temperature, new effective temperature (which combines air temperature and relative humidity,) or wet-bulb globe temperature (which combines dry bulb, wet bulb and globe temperature measures.) The latter is the effective index under potential heat stress conditions.

Correction Period

- Measure performance variables on site. (See Guideline P.4 Design and Construction Commissioning for commissioning procedures.)

Ongoing Occupancy

- Document thermal comfort-related complaints. (See P.5 Operations Commissioning for documentation procedures.) and resolve as appropriate to satisfy these guidelines and general Human Factors Engineering practices.

I.6 Quality Lighting

Pre-design-Programming

- Incorporate performance criteria into lighting design criteria in program document. Develop additional quality lighting criteria as needed for special facility issues. Example: security or anti-vandalism lighting may need to be incorporated into lighting considerations.

Schematic Design

- Conduct a first order check for design constraints on lighting design. Ensure that general daylighting schemes and lighting plans are not in conflict with achieving lighting quality and any additional lighting criteria.

Design Development

- Complete a lighting analysis and develop the lighting design in conformance with performance criteria. Perform any lighting modeling studies as needed to confirm or substitute for calculations.

Construction Administration

- Observe and verify that the room, window, finish, and lighting variables (upon which estimated compliance was based) are proceeding according to goals as reflected in drawings and specifications.

Correction Period

- Conduct onsite measurements once all lighting is operational. (See P.4 Design and Construction Commissioning for commissioning requirements.)

Ongoing Occupancy

- Log complaints related to lighting conditions. (See P.5 Operations Commissioning for record keeping requirements.)

I.7 Effective Acoustics

Pre-design-Programming

- Include performance criteria in programming document. Develop any additional special acoustical performance requirements to support functional programming of building. (E.g. sources of recurrent noise that needs to be controlled, special user populations which may have distinct auditory performance limitations, multiple uses of building spaces which may have different acoustic criteria. Investigate and choose appropriate acoustics modeling software for the project. (See Tools.)

Schematic Design

- Consider performance in building layout and form. Ensure that there are no inherent acoustic conflicts or limits to meeting performance criteria at schematic design level. Perform initial software simulations to ensure that general acoustics parameters are met.

Design Development

- Demonstrate complete compliance with acoustical performance criteria via calculations or more detailed simulation modeling.

Construction Documents

- Address explicit performance criteria in design and materials selection and specification. Check to ensure materials selection meets necessary criteria for acoustical controls.

Correction Period

- Measure acoustic performance onsite with full systems running. Check against predictions from software models.

Ongoing Occupancy

- Log noise and other sonic environment complaints. Check for needed sonic modifications if programmed activities of spaces change to require different supports. (See Guideline P.5 Operations Commissioning for recordkeeping procedures.)

I.8 Reduce Vibration in Buildings

Predesign-Programming

- Include performance criteria in programming document. Identify any potential sources of unusual vibration conditions within building (e.g. heavy equipment or machinery operations, inclusion of windpower generators, etc.)

Schematic Design

- Consider performance criteria in placement of machinery and in general building form and layout. Confirm isolation of vibration sources in schematic design, or tag for special treatment in design development.

Design Development

- Demonstrate compliance via structural calculations or table citation.

Correction Period

- Verify achievement of performance criteria onsite with full systems running and with stops and starts of systems at varying degrees of load.

Ongoing Occupancy

- Log vibration related complaints. (See Guideline P.5 Operations Commissioning for recordkeeping procedures.)

I.9 Daylight

Pre-design-Programming

- While programming identify and list continuously occupied spaces without security, hazard or other restrictions to windows and daylighting as appropriate for daylighting.
- Using the Daylight Factor Calculator or other tool to establish room proportions, window area and surface properties that satisfy the required performance criteria for each of the main prototype spaces.

Schematic Design

- Using the Daylighting Factor Calculator or similar tool establish room proportions, window area and surface properties that satisfy the required performance criteria, if this has not already been completed. Begin organizing the building volume and fenestration so as to maintain the required performance criteria. Use the output from the Daylighting Factor Calculator to check the performance periodically as the design evolves.
- For each of the main prototype spaces, test and determine the implications for orientation, room proportion, window area, and finishes that achieve the performance criteria. Coordinate this effort with related lighting quality (I.6) and view space guidelines (I.10) and with energy conservation approaches (E.1.)
- The Daylighting Factor Calculator is designed to identify the physical attributes for room dimensions, surfaces and fenestration in order to just meet the performance criteria for standard CIE overcast sky conditions. It does not currently take into account light shelves, partitions, non-orthogonal planes, significant exterior obstructions or exterior reflecting surfaces. For such parameters that go beyond the current capability to the Daylighting Factor Calculator, physical models or computer simulations are recommended to refine the volumetric and surface attributes of the final design in order to assure compliance with the required and recommended performance criteria.

Design Development

- Demonstrate compliance using the Daylighting Factor Calculator, computer simulation or physical modeling whichever tool is appropriate. For each of the main prototype spaces, show a summary of calculations, and quantitative results indicating conformance with performance criteria. Coordinate this effort with related lighting quality (I.6) and view space (I.10) guidelines and with energy conservation approaches (E.1.)

Construction Administration

- Observe and verify that the room, window, finishes (upon which estimated compliance was based) are proceeding according to goals and are reflected in drawings and specifications.

Correction Period

- Acceptance Testing: Measure performance criteria on site. Develop sampling plan to confirm daylighting performance over first three years of occupancy. Compare performance at specific test times to what would be expected under same conditions in model. For example, if the onsite lighting measurements are taken at noon, on September 21, compare to a model condition at noon on September 21.
- Acceptance Testing: Demonstrate that performance criteria are maintained via a sampling plan of daylighting performance over varying conditions during the first three years of occupancy.

I.10 View Space and Window Access

Predesign-Programming

- Include performance criteria in the program document. Develop any special view and window requirements during functional programming of activities for the building. Examples: presence of an amenity view space, special security concerns for windows in certain locations of the building.

Schematic Design

- Determine implications of performance criteria for space planning and incorporate into schematic design. Perform first order estimates of view access given projected uses within building and initial sizing and placement of windows. Identify any problems with window configuration and placement.

Design Development

- Confirm compliance with a check of design development drawings.

Construction Administration

- Observe and verify that the room, window, and furnishing variables (upon which estimated compliance was based) are proceeding according to goals as reflected in drawings and specifications.

Correction Period

- Verify that performance criteria are met by checking performance on site.

Ongoing Occupancy

- Log comments relating to view space and window access. (See P.5 Operations Commissioning for record keeping procedures.)

I.11 Personal Control of IEQ Conditions and Impacts

Predesign-Programming

- Include performance criteria in programming documents. Perform an ecological matrix analysis to demonstrate the planned means of occupant control over environmental quality variables under their routine and foreseeable extreme variations.

Schematic Design

- Consider personal control criteria impact on the schematic design. Check that there are no obvious limits on personal control strategies in the schematic design and that personal control strategies are incorporated in the general design of building.

Design Development

- In the design documentation and documentation of compliance for this phase, call out the personal control strategies enabled by and included in the design.

Construction Documents

- Include testing of occupant control options over indoor environmental qualities in the commissioning plan.

Correction Period

- Verify achievement of performance criteria by exercising the range of occupant control strategies available on site per the commissioning plan. (See P.4 Design and Construction Commissioning for commissioning plan.)

Ongoing Occupancy

- Log complaints or shortcomings noticed in lack of personal control over indoor environment. (See P.5 Operations Commissioning for record keeping procedures.)

I.12 Encourage Healthful Physical Activity

Pre-design-Programming

- Look for opportunities in programming of building to encourage healthful physical activity by occupants. Include suggestions for activities and explicit performance criteria in programming documents.

Schematic Design

- Incorporate physical movement strategies in design of building. Include general layout and programming considerations for increasing occupant circulation as well as amenities that accommodate exercise activities during daily operations (e.g. inclusion of shower and locker to accommodate lunchtime joggers.)

Design Development

- In the design documentation and documentation of compliance for this phase, call out explicit physical movement strategies. Include necessary signage in design to encourage and direct circulation.

Correction Period

- Test stair use for potential variety of users. Check that signage and circulation amenities are present and installed correctly. (See P.4 Design and Construction Commissioning for commissioning plan.)

Ongoing Occupancy

- Include a physical-movement-related question on scheduled staff surveys. Track improvements in staff health and organizational productivity related to better physical circulation and social communication and analyze and document results in the annual Guideline Report. (See P.5 Operations Commissioning for record keeping procedures.)