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ADDITIONAL TITLE 24 ISSUES & RECOMMENDATIONS[1] FOR THE 2008 BUILDING ENERGY STANDARDS

GENERAL ISSUES THAT APPLY TO BOTH RESIDENTIAL & NONRESIDENTIAL BUILDING TYPES:

- AGED BOARD INSULATION VALUES: Require that modeled insulation values be based on aged values.

- DEFAULT ASSEMBLIES:
  - ADD NEW ASSEMBLIES: R-21 wood-frame roof, R-21 wood-frame ceiling, insulated fiberglass doors.
  - NOTE ALLOWED DOOR SUBSTITUTES: Opaque door construction is often not known at the time the energy compliance is prepared. Note that insulated FG doors and insulated metal doors are allowed substitutes for wood doors.
  - METAL PIN MODELING: Develop insulation factors for insulation that is secured with metal pin attachments (stick-pins). Metal pins are used not only to hold batt and board insulation to walls and the underside of decks, but also to hold rigid roof insulation laid over roof decks.
  - METAL AND WOOD COMBINATION FRAMING: I have encountered several buildings with metal main roof framing members and wood submembers (perlins). The insulation is interrupted by both metal and wood framing. Typically, I believe, the wood framing interrupts the insulation much more frequently than does the metal framing. Consider a framing factor that assumes the assembly has both metal and wood framing.
  - REMOVE ASSEMBLIES: R-22 roof, R-19 high-density batt

- NUMBER OF BUILDINGS: The Standards should clarify the modeling of projects that contain multiple unique buildings. Perhaps the Standards should require each building to comply separately, except when multiple buildings are served by a single DHW system, or when multiple buildings are served by a single central HVAC system, or both. Clarify whether separate conditioned structures that are structurally tied by residing upon a common parking structure are considered one building or multiple buildings.

  Leaving the decision about modeling multiple structures to building officials is not very practical because it is often difficult, or impossible, to receive an official ruling in a timely manner.

- DWH STANDBY LOSS: Remove Standby Loss as a modeling variable, as SL is no longer a federal test requirement, and is not typically measured by water heater and

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[1] See also Title 24 issues paper by Farber dated Oct. 21, 2005. Note that this paper does not represent CABEC.

storage tank manufacturers. The CEC needs to establish a fixed SL for fired tanks and a fixed SL for unfired tanks.

- ALLOW CEC DISCRETIONARY DISAPPROVAL OF PERFORMANCE MODELING OF CERTAIN EQUIPMENT. Add language to the Standards that allows the CEC to bar the receiving of performance compliance credit for equipment and/or devices, or combinations of equipment and/or devices, that have not explicitly been authorized to receive performance credit, and where the CEC finds that receiving credit for the equipment, device(s), or combination thereof, is not in keeping with the intent of the Standards.

  Example: CEC staff decided after adoption of the 2005 Standards, but before they took effect, that they did not have the authority to ban modeling tankless gas water heaters combined with recirculation systems, although this is a combination of equipment that has not been evaluated for energy efficiency.

- VENTILATION & HEAT RECOVERY:
  - MAXIMUM VENTILATION LIMIT: Consider instituting a prescriptive maximum mechanical ventilation limit for certain primary function types, and not allowing tailored ventilation under performance compliance for same. Or allow ventilation to exceed a set limit when zone incorporates heat recovery (see below). I have plan-checked housing projects where the corridors were exhausting 100% of the conditioned air (100% fresh make-up air). Mechanical designers justify this by the savings from not supplying additional return air ducting.
  - HEAT RECOVERY: Require ventilation air heat recovery (e.g. air-to-air heat exchanger) in buildings or spaces with high OSA design (e.g. above 25% of HVAC system cfm), and certain amount of operating hours (e.g. min. of 20/week). Some residential buildings do have high OSA requirements; for instance, convalescent homes. Many industrial occupancies also have high OSA requirements.

- COLD CLIMATE ZONE VESTIBULES: Consider making vestibules a residential and nonresidential prescriptive requirement in Climate Zones 1 and 16. Under performance compliance, lack of vestibules could be offset by a greater building insulation requirement and/or a lower U-factor requirement. Tighter envelope requirements also be a prescriptive compliance alternative to vestibules.

- COOLING LOAD CALCULATIONS: To reduce the incidence of AC system oversizing, clarify that residential and nonresidential cooling load calculations may not assume glazing SHGCs that exceed those used for envelope compliance, and that structural shading of the fenestration must be modeled (there can be exceptions to shade modeling, such as for north-facing glass, and where the distance between the shade and the edge of the fenestration is greater than the depth of the shading device from the wall in which the fenestration resides).

- FENESTRATION DEFINITIONS:
  - MANUFACTURED: Change "Manufactured" to "Factory Assembled". Curtainwall and storefront systems are manufactured. "Factory Assembled" better

captures the intent of the distinction between this type of fenestration and so-called "site-built" fenestration.

- SITE BUILT: Change "Site-Built" to "CW+SF", or some other nomenclature that better fits Curtainwall and Storefront type fenestration systems. Both of these systems are often assembled off-site – usually at a glazing shop. However, sometimes these systems are assembled at the factory, which makes the distinction between "Site-Built" and "Manufactured fuzzy at best. If the intent is for Curtainwall and Storefront type fenestration to have differing requirements from typical factory assembled fenestration, then the simple solution is to clearly label these two fenestration types as unique, and note that their requirements apply regardless of where they area assembled.

- RADIANT FLOOR HEATING:
  - RAISED CONCRETE RADIANT FLOORS: If the mandatory concrete floor insulation for low-rise and high-rise residential buildings suggested in my Oct. 21 '05 paper is not implemented, then raised concrete floor insulation should be required for heated raised concrete floors. This requirement should apply to nonresidential buildings as well. Consider a requirement of at least R-5. Under performance compliance, perhaps the modeling rule would be to model the floor insulation with R-5 less than the specified insulation, to account for the extra heat loss expected from a warm floor.
  - RADIANT WOOD FLOOR INSULATION: Currently, low-rise residential wood floors with radiant heat must meet minimum insulation values, although there are no minimum floor insulation requirements for high-rise residential and nonresidential floors.

    Consider requiring all raised heated wood floors to receive R-19 insulation (for all building types). In addition, consider requiring that under performance compliance, this floor would be modeled with R-13 insulation to account for the greater heat loss that will occur in a heated raised floor.
  - RAISED RADIANT FLOOR EDGE: It is not unusual for a raised radiant floor to butt up against a retaining wall. Consider addressing the heat loss that would occur if the concrete floor or topping slab abuts the retaining wall and this joint is not insulated.
  - SLAB EDGE INSULATION REQUIREMENT: Consider whether the minimum depth of slab edge insulation should be increased when the slab is tied to a retaining wall, and the slab is many feet below grade. Perhaps the slab edge/retaining wall insulation should be required to cover the entire area of the retaining wall below grade. Of course, where there is a thermal break between heated slab and retaining wall, there would be no wall insulation requirement.
  - RETROFIT HEATED (radiant) SLAB: Standards are not currently clear as to whether retrofit slab insulation is required when adding radiant to a previously unheated slab. This should be clarified, and clearly noted in the Residential Manual.

- INDIRECTLY CONDITIONED OR UNCONDITIONED SPACE? Currently, whether a space not directly conditioned is considered indirectly conditioned or unconditioned is based solely on a UA calculation. This does not account for ventilation at the subject space. Some buildings have very large spaces that are not directly conditioned, such as schools with double-loaded unconditioned enclosed hallways.

  To determine whether spaces not directly conditioned are indirectly conditioned, continue to use the UA calculation for spaces without mechanical ventilation. Spaces with mechanical ventilation should be considered to be unconditioned (possibly with exceptions for mechanically ventilated spaces with very low air change rates, if there are such spaces).

- STAIR AND ELEVATOR FLOOR AREAS: Revise, and make consistent for residential and nonresidential buildings:
  - STAIRS: Count area of treads and mid-floor landings at every floor, except do not count treads and mid-floor landing at top-most conditioned floor of building. In other words, footprint of stairway is counted once per floor, except at the upper-most building level.
  - ELEVATORS: The floor area may optionally be counted once (regardless of the number of floors) or not at all. For nonresidential buildings, elevator lights are often (perhaps usually) overlooked in the lighting compliance calculations. Clarify whether the elevator lights must be modeled. If elevator light fixture modeling is optional, note that the floor area should not be counted unless the lights are modeled.

- SKYLIGHT CURBS: Revisit the curb modeling issue. Curbs often (perhaps usually) are overlooked in building modeling. The easiest way to deal with skylight curbs is to institute a mandatory minimum curb insulation requirement, and not require curbs to be modeled. Barring this, the Title 24 Manuals could better emphasize that all curbs must be modeled, and compliance forms could include a reminder that curbs are to be modeled.

NONRESIDENTIAL ISSUES (both high-rise and low-rise residential issues listed at Residential Issues, next section):

- ELIMINATE CREDIT FOR LOW LIGHTING POWER IN RETAIL SALES AREAS: Under the *performance* compliance approach, retail sales areas should not be able to receive credit for proposed lighting power that is less than the *prescriptive* lighting power allowance. The reason for this proposed restriction is that retail spaces change often, and all lighting changes are allowed to meet the *prescriptive* allowance; therefore, allowing credit for lighting levels lower that area lower than the Complete Building or Area Category compliance methods is a very temporary energy savings trade-off in many retail situations. (Tailored lighting has been "use it or loose it" for many Standards cycles, although this may have not been implemented in ACM compliance until the 2005 Standards).

- COMPLETE BUILDING OFFICE LIGHTING: Provide two compliance LPDs for Complete Office Building lighting: One to be used where actual portable lighting watts will be calculated; the second LPD would be used where portable lighting is not calculated. This new LPD would be reduced to account for the portable lighting power expected in a typical office building.

  Currently, open office areas must be calculated in order to determine the default portable lighting energy, which is contrary to the idea of the Complete Building method simplifying the lighting calculation.

- DISPLAY LIGHTING: Should glass walls count as retail display walls? Should interior walls with large areas of glass, or openings, receive full credit as display walls? Consider changing the basis of the display allowance back to the potential display wall area, in square feet, rather than the display perimeter. Another option would be to only count the linear feet of display wall where the opaque wall is at least 50% of the floor to ceiling height, or at least 4 feet vertical, or similar targets.

- DAYLIGHT ZONE AND CONTROL CREDITS:
  - AUTOMATIC DAYLIGHT CONTROL CREDITS: These credits need updating. At the minimum, there ought to be twice as many VLT categories and twice as many WWR categories.
  - DAYLIGHTING ZONE: Change depth of window daylighting to 15' from window wall or floor to ceiling height, whichever is greater. Currently, some buildings with high ceilings and high windows do not receive credit for many light fixtures in areas receiving adequate daylight to make automatic controls useful. And where automatic controls are not used, the daylit zone separate switching requirement ought to apply to more light fixtures in tall spaces with deeper daylight penetration.
  - VISIBLE LIGHT: The Standards currently use VLT (glass only). NFRC uses VT, which is a fenestration measurement. Consider changing the measure to VT, and include a frame adjustment factor to use for non-NFRC rated glazing.

- AREA CATEGORY LIGHTING CLARIFICATIONS:
  - LIBRARY LIGHTING AREAS: Currently, function choices are Reading and Stacks. Does "Reading" mean the main circulation, check-out, reference and reading areas? If so, rename the function Reading, Circulation, Reference & Check-out.
  - FINANCIAL INSTITUTIONS Currently, there is a Financial Transactions primary function. As this function receives the same LPD as office space, and given that it is always vague how to apply this to public areas of a bank that are primarily circulation, but also contain some areas for completing bank paperwork, consider the following changes:
    - Eliminate Financial Transactions primary function.
    - Clarify that teller areas may be assigned the Office primary function, as well as other areas of the bank where activities area primarily office type tasks.

- Create a Financial Institution Public Area primary function. The LPD for this area would recognize that the area is primarily circulation, but also contains some work stations for customers to complete bank paperwork.

- PROCESS EQUIPMENT LIGHTING: Clarity that when lighting in process equipment is exempt (such as kitchen hoods and walk-in freezers), the floor area representing the footprint of the equipment shall also be excluded from the lighting compliance calculations.

- MANDATORY LIGHTING AUTOMATIC CONTROLS IN SKYLIGHT DAYLIT AREAS [Sect. 131(c)2.]: Clarify whether the 2,500 sq. ft. daylit area trigger only applies when it is a contiguous area, or whether this also applies when the sum of all skylit daylit areas in the permitted space exceed 2,500 sq. ft.

- FENESTRATION INCREASES NOT EXCEEDING 50 SQ. FT.: Currently, for new fenestration at existing conditioned space that does not exceed 50 sq. ft., there is no SHGC requirement. In all climate zones (or perhaps only in warmer climate zones), require that even small additions of glass be either tinted or structurally shaded.

- COOL ROOFS: Consider exempting walkable decks from the prescriptive cool roof requirement (or if decks were intended to be exempt, clarify this in the Standards).

- CONDITIONED FLOOR AREA. Nonresidential floor area for overall building area should be measured to the inside surface of the exterior walls, as it was under the 2nd Generation Standards, and as it currently is for lighting. Not only would there be benefits in having the lighting and overall building area rules match, it also is a more rationale floor area measuring point for energy calculations. There is no good reason for buildings with thicker walls to have a greater energy allowance than buildings with thinner walls (energy is regulated on a per floor area square foot basis). Also, confusion as to whether various exterior elements (pilasters, etc.) should be included in the floor area would be eliminated.

- SKYLIGHT PRESCRIPTIVE EFFICIENCY: Establish skylight efficiency requirements that do not vary based on the type of skylight glazing or type of curb. Varying the requirement, which started with the 2001 Standards, creates a more confusing standard, which can also result in more abuse of the code. Practically, it means that when a contractor decides during construction to use a high-performance glass skylight instead of a lower performance plastic skylight, the Title 24 compliance must be revised.

- OPERABLE WINDOWS: Natural ventilation can save energy if HVAC systems respond appropriately. Give credit for operable windows when they are equipped with an interlock to prevent HVAC operation in the zone in which the opened window resides.

- DEMISING ROOFS, FLOORS: Should there be demising roofs and floors, like there are demising walls? It seems awkward to model demising walls, but model a ceiling

facing unconditioned space as if it was an exterior roof. Consider mandating the following values:

- Frame demising ceiling: R-19
- Concrete demising ceiling: R-16 (4" curtainwall semi-rigid fiberglass insulation)
- Frame demising floor: R-13
- Concrete demising floor: no requirement.

- FOUR ORIENTATION PERFORMANCE COMPLIANCE: Allow four orientation compliance for nonresidential buildings, as is presently allowed for low-rise residential buildings. Hotel/motel developments sometimes use the same building design in multiple orientations on the same site.

NONRESIDENTIAL ACM ISSUES:

- ACM PROGRAM INPUT AND OUTPUT REQUIREMENTS: Compliance programs should be clear to both the energy analyst and to the enforcement agency how complex HVAC systems are modeled, especially with regard to actual system inputs versus "default" system modeling. The following ACM rules will help much in this regard:
  - Program input fields must identify each field that can be defaulted by not inserting any value.
  - Program output must identify all inputs that are default inputs.
  - Performance forms must describe what equipment is allowed when output says "default" equipment modeled. For example, if the secondary pumps are defaulted (assuming they can be defaulted), note whether there is a limit on the number of pumps and horsepower of the pumps.
  - Program output must identify all input fields that have no value input, and are not default capable, by printing the word "none". For example, if no primary CHW loop pump system is modeled, and this is not a default-capable input, the output would say "none" under primary CHW loop.

- BUDGET FAN POWER IN ACM: Since the '98 nonresidential ACM, systems with low fan power (watts/cfm) on the design side have been matched in fan power on the budget side. This was done to eliminate the credit received for low static systems such as ductless warehouse unit heaters, which previously were compared to systems with higher fan power on the budget side, earning them a large energy credit. Unfortunately, this "fix" eliminated the reward for ducted systems that have efficient fans and low static. Consider re-instating the credit for low fan power in ducted systems, while continuing to not reward ductless systems for their low fan power.

- DESIGN VAV FAN POWER FOR "WARM SHELL" PROJECTS: Because the conditioned air distribution system is installed under a future permit for this type of project, the mechanical engineer can only guess what the brake horsepower will be. While the nominal fan horsepower can be used, this seems to be an unfair penalty to impose on a building simply because the air distribution system is unknown. Consider establishing a default static pressure that must be used to calculate the brake horsepower for warm shell buildings.

- FANS & PUMPS:
  - ALLOW FOR MULTIPLE SIZES. ACM compliance software is currently limited to one pump size and one fan size per system. When a system employs multiple size fans and/or multiple size pumps, the input must use an average size, which does not accurately account for the differing efficiencies between small and large fans and pumps. If the modeling engine supports this, require that each system can be modeled with two different size pumps and fans.
  - DHW & CONDENSER WATER PUMP MODELING: Tall buildings tend to suffer a large energy penalty when pump HP and GPM are modeled. Look into whether the ACM provides a realistic pump energy budget for efficient pumps in tall buildings.
  - HYDRONIC HEAT PUMPS: At present, buildings designed with hydronic heat pumps are almost impossible to achieve performance compliance, as the ACM assumes a pump energy use that much exceeds the calculated energy savings of the heat pump unit itself. Explore whether the ACM fixed assumptions and algorithms for this system type are appropriate.

RESIDENTIAL ISSUES:

- VARY RESIDENTIAL SHGC REQUIREMENTS?: Consider adopting a higher SHGC requirement for multi-unit residential buildings that use a central heating system and have no cooling system. Because it is difficult to add mechanical cooling to multi-family buildings with central heating, it is very likely that higher SHGC glass will lower heating energy to a much greater extent than is would increase cooling energy.

  Consider that presently, while high-rise residential buildings are subject to the lower SHGC of any building type in coastal zones, low-rise residential buildings have no SHGC requirement.

- REGULATE MINIMUM SHGC AS WELL AS MAXIMUM SHGC: Currently, there is no limit to how much lower the installed fenestration SHGC may be as compared to either the modeled value (ACM) or prescriptive requirement. Projects modeled under performance compliance in heating-dominant climate zones typically show much higher energy use when low SHGC glazing is modeled than when modeled with clear glass. Unless the ACM compliance program results are not close to reflecting real expected energy results, there should be a limit on how much lower the installed SHGC may be as compared to the ACM program modeled SHGCs and the prescriptive SHGC requirement.

  Consider a maximum value of around 0.10 that can be subtracted from the compliance value for installed fenestration.

- SOUTH GLASS SHADING: Require fixed external shading of south-facing windows to be modeled. If the shading reduces winter solar heat gain, not modeling the shading gives undue compliance advantage to the project.

- ADDITION WEST GLAZING AREA: Barring an increase in the allowable addition glazing area, as suggested in my Oct. 21, '05 paper, allow existing west glazing that will be removed due to placement of an addition to be accounted for in the calculation of the prescriptive maximum addition west glazing area.

- VINTAGE TABLE INSULATION VALUES VERSUS ACTUAL CONDITIONS: Currently either the actual insulation or Vintage Table insulation values may be used. There will be cases where the actual condition is better than the Vintage Table value, thereby allowing more credit for an upgrade than deserved. For 2008, the Standards should state that when modeling existing insulation, the actual conditions must be determined and modeled for all accessible conditions (e.g. attic space, crawl space. The Vintage Table may be used for non-accessible conditions (e.g. sealed walls, vaulted ceilings).

- VINTAGE TABLE ASSEMBLIES: Add existing masonry walls. Currently, modeling existing masonry to remain always yields a performance CF-1R that notes this as an exceptional feature.

- KITCHEN LIGHTING: Clarify whether each kitchen needs to individually comply in multi-family buildings (including duplexes). At least one ACM program was approved for '05 with only the capability to print a single kitchen lighting worksheet.

- PRESCRIPTIVE COMPLIANCE SIMPLIFICATION: In order to make Prescriptive compliance more compatible with common features that are difficult to accomplish with the current Prescriptive packages, but would make very little difference in overall energy efficiency, allow the following exceptions:

  - BAY WINDOW INSULATION: To help simplify the Standards, allow the mandatory minimum insulation requirements to suffice for prescriptive compliance for bay window roofs and floors, and also eliminate the RB requirement for the bay window roof. Bay window roof and floor areas are small enough to do away with the insulation averaging calculation requirement that is now allowed for under-insulated areas.

  - PRESCRIPTIVE FENESTRATION EFFICIENCY:
    - Allow Garden Windows at additions and alterations to meet the prescriptive SHGC requirement by using the center of glass SHGC times a frame factor to achieve a fenestration SHGC value, as is currently allowed for skylights.
    - For new construction as well as additions and alterations, allow up to 6 sq. ft. of glazing to not meet prescriptive requirements. This would allow a small vision panel in a front door, and/or one or two tubular skylights.

- ALTERNATIVE PACKAGE D: To make this alternative to Package D clearer, create a new package for compliance without requiring HERS duct and AC inspection. Currently, this package can only be understood by processing all of the notes to Package D that explain alternative features. A separate package would be much easier to understand exactly what the requirements are.

- DOMESTIC WATER HEATING ISSUES:
  - TANKLESS WATER HEATERS AND RECIRCULATION: Until or unless recirculation energy factors are developed specifically for tankless (or direct) water heaters combined with recirculation systems, do not allow this combination of equipment to be modeled for performance compliance.
  - STORAGE TANKS: I don't believe that storage tanks are addressed, or adequately dealt with, in the ACM. See also Standby Loss above in General Issues section.
  - TANKLESS WATER HEATERS AND STORAGE TANKS: Until or unless ACM modeling algorithms are developed to model this combination of equipment, do not allow this combination of equipment to be modeled for performance compliance.
  - BUILT-IN WATER HEATERS: Some Jacuzzis and dishwashers and other devices have built-in water heaters. Should the Standards remain silent on these, say some or all are exempt, or clearly require all to be included in the energy evaluation?
  - RECIRCULATION MANDATORY CONTROLS: Beginning with the '05 Standards, it is mandatory for multi-family DHW systems to be equipped with automatic time control. I have heard that these are often not used on large multi-family projects, where residents might use hot water at any time, and where the distance between dwelling unit and DWH could result in very long wait times. Unless studies show that time controls are routinely used in larger residential facilities, consider changing the requirement to utilize either time or temperature control, whichever the plumbing designer feels will be most effective for the particular application.

- THERMAL MASS AND RADIANT FLOORS: Mechanically heated slabs do not absorb as much excess heat from solar radiation, due to their higher temperature. Any credit awarded to thermal mass for reducing space heating due to the thermal "flywheel" affect should account for slab temperature just as it does for floor coverings.

- RAISED CONCRETE FLOORS AND FLOOR INSULATION: Account for the heat loss from the concrete floor beyond the perimeter of the heated space when insulation is placed under a concrete raised floor. In some cases, the edge of the concrete floor structure will coincide with the heated space perimeter, resulting in ambient heat loss at the exposed concrete edge. In other cases, the concrete deck continues beyond the heated space perimeter, resulting in heat loss to both ambient conditions and to the adjoining unheated concrete floor structure.

  Placing insulation between the finish flooring and the raised concrete structural floor is more efficient than under-floor-structure insulation, and the Standards should account for this efficiency difference.

RESIDENTIAL ACM ISSUES:

- DHW UNFIRED STORAGE TANK MODELING: Review the modeling of storage tanks in water heating systems utilizing boilers. The ACM may not adequately deal with energy losses associated with the storage tank.