BEYOND SMART CITIES

ADVANCED ENERGY MODELING FOR LEED ONLINE TRAINING COURSE

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ENERGY SPECIALIST CURRICULUM COURSE

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ENERGY MODELING REQUIREMENTS -1 FOR ENERGY PROFESSIONALS

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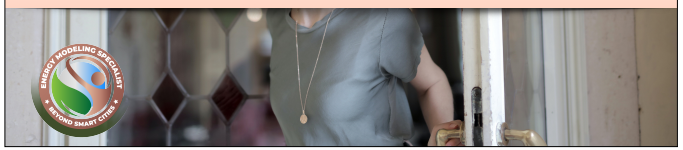
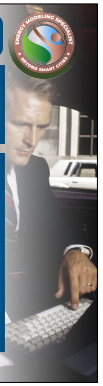


WHAT SHOULD YOU LEARN

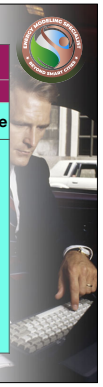
- Energy Modeling Requirements
- Energy Modeling Requirements as per ASHRAE 90.1.2016
- Comparison of Modeling Requirements for ASHRAE 90.1 and California Title 24

ENERGY MODELING REQUIREMENTS

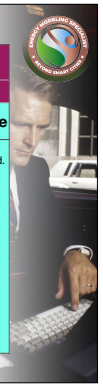
- The methodology described in ASHRAE 90.1–2016, Appendix G, and California Title 24–2019 involves the generation of two energy models: one representing a baseline minimum-standard building and the other representing the proposed building with all its designed energy enhancements.
- Next Section summarizes the three referenced standards' modeling requirements for typical projects. Since project specific information may vary, project teams should refer to the referenced standard for all applicable details and modeling requirements. LEED-CS, LEED for Schools, LEED for Commercial Interiors (CI), LEED for Retail (NC and CI), and LEED for Healthcare are identical to LEED-NC except as noted in this table. For LEED-CI projects, the simulation should use either the energy cost budget method or the Appendix G performance rating method. If served by a common building HVAC system, a LEED-CI project should include both the project space and the building segment that uses the common HVAC system.



ASHRAE 90.1.2016		California Title 24	
Schedule of operation			
Baseline Case	Proposed Case	Baseline Case	Proposed Case
Same as proposed design. exception: Schedule may differ from proposed design if proposed design is implementing some nonstandard efficiency measures.	Use actual operating hours for schedule of operation in proposed design. **Exception:** Schedules can be modified if schedule changes are necessary to model nonstandard efficiency measures, such as lighting controls, natural ventilation, demand control ventilation, or service water heating load reductions (Table G3.1.4). Describe any schedule of operation differences between baseline and proposed cases. Follow modeling guidance in Chapters 3 and 4 of this manual. **LEED-CI** Follow Table 11.3.1. 4 or Table G3.1.4 of ASHRAE 90.1–2016 when field verification cannot be obtained.	Same as proposed design. Automatically modeled in compliance mode.	Use default Title 24 schedules for heating, cooling, fans, lighting, receptacle loads, etc



ASHRAE 90.1.2016		California Title 24	
Orientation			
Baseline Case	Proposed Case	Baseline Case	Proposed Case
Four baseline design simulations are required for generating baseline building performance. Models are identical except that building orientation for each model is modified as described in Table G3.5.1(a), and window solar heat gain coefficients are revised to reflect minimum ASHRAE building envelope requirements for revised building orientation.	Model proposed design (with minor exceptions).	Same as proposed design. Automatically modeled in compliance mode. Simulations of four orientations are not required.	Model building orientation as designed.



ASHRAE 90.1.2016		California Title 24	
Building envelope			
Baseline Case	**Proposed Case**	**Baseline Case**	**Proposed Case**
Model building envelope using Table G3.1.5. new buildings: Model above- grade walls, roof, and floor assemblies using lightweight assembly types (i.e., steel- framed walls, roofs with insulation entirely above deck, and steel-joist floors). Match values with appropriate assembly maximum U-factors in Tables 5.5.1–5.5-8 new buildings: Model above- grade walls, roof, and floor assemblies using lightweight assembly types (i.e., steel-framed walls, roofs with insulation entirely above deck, and steel-joist floors). Match values with appropriate assembly maximum U-factors in Tables 5.5.1–5.5-8.existing buildings: Model building envelope using existing (pre-retrofit) building envelope thermal parameters rather than referenced standard's prescriptive building envelope requirements for specified climate. Existing buildings with less than 50% renovations should not be rotated, since building orientation is considered an existing condition leed-CI For envelope components inside project space, use existing envelope conditions for existing components and use ASHRAE mandatory and prescriptive requirement for any upgraded envelope components. Rest of envelope should be modeled as is, identically to proposed case. Alternative baseline case: Use G3.1.5 (Appendix G method) or Table 11.3.1.5 (energy cost budget method) for entire baseline segment.	Model building components as shown in architectural drawings. Model any exceptions using Table G3.1.5. existing buildings: Include any renovations in existing building envelope (such as replacing windows or increasing roof insulation). leed-CI Use proposed design of project space, and use existing envelope conditions for rest of modeled building segment.	Automatically modeled in compliance mode 2. major difference from ashrae 90.1–2016 Assembly U-values are typically higher than default ASHRAE assembly U-values, especially for wall assemblies. Same framing type typically used in baseline and proposed cases. All west-facing glazing that is greater than 40% of wall area must be modeled as opaque surface, even if overall window-to-wall ratio is less than 40%. note: Model existing buildings as for new construction or use ASHRAE 90.1–2016, since Title 24 has no specific category for major renovations.	Model building components as shown in architectural drawings or as built for existing building envelopes.

ASHRAE 90.1.2016		California Title 24	
Building envelope +			
Baseline Case	**Proposed Case**	**Baseline Case**	**Proposed Case**
Match percentage of vertical fenestration in proposed design, or use 40% of gross wall area, whichever is smaller. Distribute windows on each face of building in same proportion as in proposed design (e.g., if proposed case has overall window-to-wall ratio of 60%, and baseline case has overall window-to-wall ratio of 40%, determine area of each baseline case window by using corresponding proposed case window multiplied by ratio of overall window-to- wall ratio for baseline versus proposed case:(40% / 60% = 2/3). Fenestration U-factor must match appropriate requirements in Tables 5.5-1 through 5.5-8.	Model fenestration location and its properties (U-value, solar heat gain coefficient, and transmittance) as shown on architectural drawings.		
Use fixed vertical glazing in baseline design, flush to exterior wall with no shading projections. Do not model manually controlled interior shading devices, such as blinds or curtains, in baseline design.	Shading projections to reduce solar gain may be modeled to demonstrate energy savings compared with baseline. Do not model manually controlled interior shading devices, such as blinds and curtains. Automatically controlled interior shading devices may be modeled, as per Appendix G.		
Model all roof surfaces with reflectivity of 0.30.	"Cool roofs" (light-colored roof finishes that have low heat absorption) may be modeled to show reduced heat gain. Model proposed roof with solar reflectance greater than 0.70 and emittance greater than 0.75 with reflectivity of 0.45 (accounting for degradation in actual reflectivity) versus default reflectivity value of 0.30.		

ASHRAE 90.1.2016		California Title 24	
lighting systems			
Baseline Case	**Proposed Case**	**Baseline Case**	**Proposed Case**
Model lighting using building area (Section 9.5) or space-by-space (Section 9.6) method depending on proposed design categorization. If using building area method (9.5), each distinct building function should be modeled based on building area allowance for that building function (e.g., office or retail or parking garage). Baseline design model should also include exterior lighting power allowance (9.4.5). Lighting in multifamily living units should be modeled identically in baseline and proposed cases, based on proposed case lighting power allowance.	Model proposed design with installed lighting power density. If using space-by-space method, model interior lighting power density as designed for each thermal block. Account for all installed lighting on site, including interior ambient and task lighting, parking garage lighting, and exterior lighting	Automatically modeled in compliance mode 2. major difference from ashrae 90.1–2016 Exterior lighting and unconditioned lighting must be added to analysis manually unless LEED compliance module from software developer allows user to add exterior lighting and unconditioned lighting. Multiply total power with equivalent full-load hours (EFLHs). Title 24 provides allowance for general site illuminance, per 2005 BEES Table 147-A. This is tradable within its own category. Credit may be taken for improved efficiency. Title 24 also provides allowance for specific applications in 2005 BEES Table 147-B. Credit may not be taken for improved efficiency.	Model lighting system as designed. major difference from ashrae 90.1–2016 0.20 W/sf portable lighting must be modeled in open office spaces whose portable lighting design is not completed. Different lighting power savings allowance: 10% to 20% for occupancy sensors. Exterior lighting and unconditioned lighting must be manually added to analysis; multiply total power times equivalent full-load hours.

ASHRAE 90.1.2016		California Title 24	
lighting systems +			
Baseline Case	**Proposed Case**	**Baseline Case**	**Proposed Case**
LEED - CS Model lighting power in core and shell areas as determined by space type classification in Table 9.6.1. For tenant spaces, model separate electric meters for lighting in core building and tenant spaces. Use lighting power allowances for each space as indicated in Section 9.6.1.	LEED - CS Model proposed design with installed lighting power density and account for all installed lighting on site, including interior ambient and task lighting, parking garage lighting, and exterior lighting. For project areas where no lighting system has been specified, model lighting identically in both baseline and design cases as minimally code compliant according to building area method, using appropriate space type classification in Table 9.6.1. For tenant spaces, model separate electric meters for lighting in core building and tenant spaces. If tenant lighting is designed or installed, use as-designed values; otherwise classify space types for building spaces and use lighting power allowances for each space as indicated in Section 9.6.1.	LEED - CS Same as ASHRAE 90.1–2016.	LEED - CS Same as ASHRAE 90.1–2016.

ASHRAE 90.1.2016		California Title 24	
lighting systems +			
Baseline Case	**Proposed Case**	**Baseline Case**	**Proposed Case**
leed-CI Use either Section 9.5 or 9.6 for project space; use same values in proposed model for rest of modeled building segment. Alternative baseline case: Use either Section 9.5 or 9.6 for entire modeled building segment. Include lighting system in model but omit cost from calculation for energy reduction.	leed-CI Use proposed design for project space, and use field-verified lighting for rest of modeled building segment. Include lighting system in model but omit cost from calculation for energy reduction.	leed-Cs Same as ASHRAE 90.1–2016.	leed-Cs Same as ASHRAE 90.1–2016.
Do not take credit for automatic lighting controls, such as daylight controls, occupancy controls, or programmable controls.	Model any daylight-responsive lighting control systems in proposed design. Also model occupant sensor lighting controls (Table G3.1, No. 6) in spaces where they are not mandatory; note that such controls are mandatory in classrooms, conference rooms and employee lunch and break rooms (Section 9.4.1.2).		
Lighting exempted from interior lighting power allowance is classified as process energy and must be identical to proposed case.	Model lighting exempted from interior lighting power allowance; include this lighting under process energy (Table G.3.1.6).		