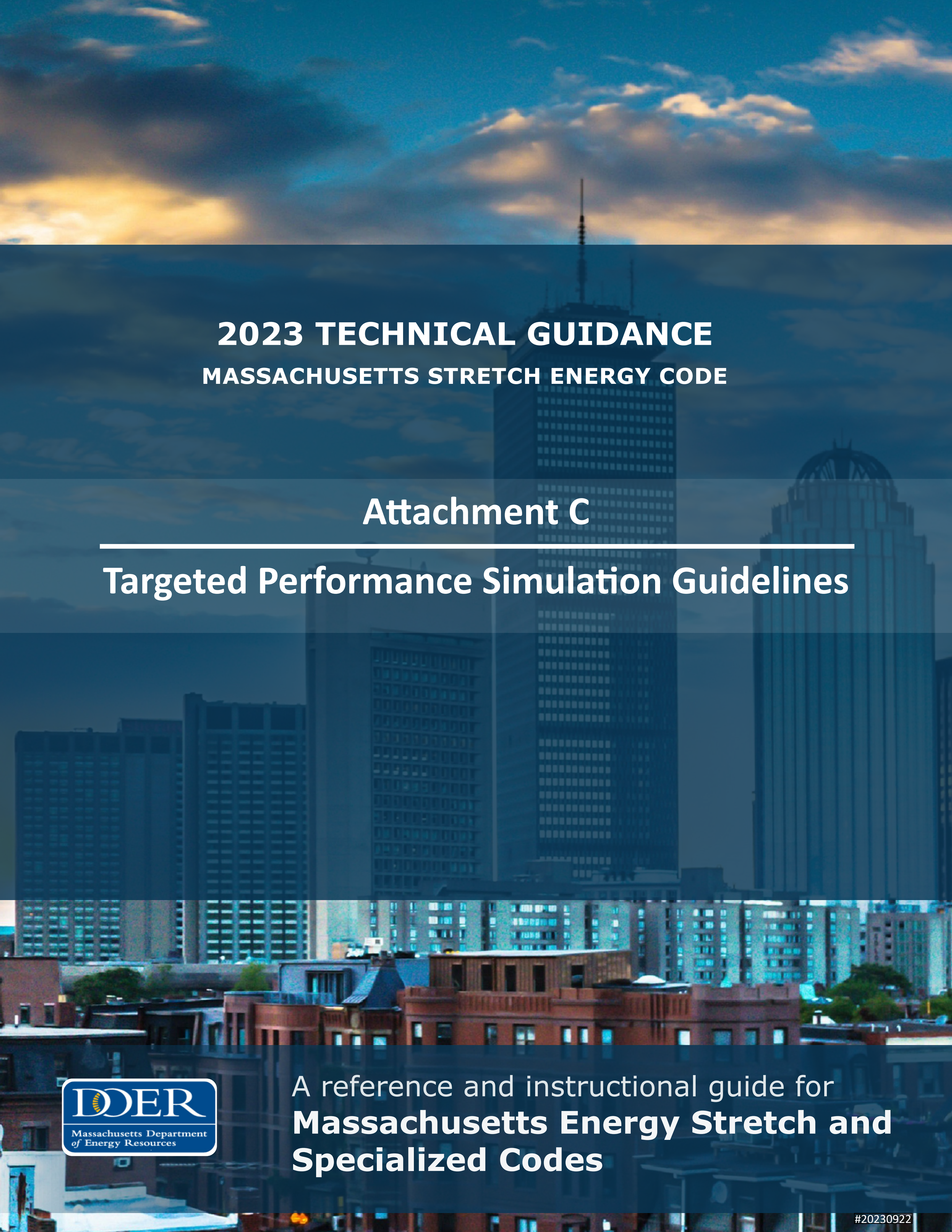

2023 TECHNICAL GUIDANCE

MASSACHUSETTS STRETCH ENERGY CODE

Attachment C

Targeted Performance Simulation Guidelines

DOER
Massachusetts Department of Energy Resources

A reference and instructional guide for
Massachusetts Energy Stretch and Specialized Codes

#20230922

Attachment C
Targeted Performance Simulation Guidelines

Contents

Purpose and Scope

These Simulation Guidelines are a companion to Section C407.1 and include the modeling requirements that must be followed when documenting compliance with the Targeted Performance path (Section C401.2.1, Part 2).

The purpose of these guidelines is to improve consistency in compliance outcomes across projects and preserve focus on minimizing *building* heating and cooling loads.

The Guidelines include the following:

1. Default interior floor plan and thermal zoning; HVAC system type, efficiency and controls; and fan and pump system efficiency and controls that may be used in lieu of specified systems and components to streamline modeling
2. Simulation inputs that are prescribed and must be used irrespective of specified systems and components. These inputs correspond to the design elements and *building* operating conditions that are not meant to impact Section C407.1 compliance. Examples of prescribed inputs include the following:
    a. Weather file
    b. Minimum mechanical ventilation rates, except when the specified ventilation rate exceeds the prescribed value
    c. Interior lighting system power and controls
    d. Miscellaneous plug and process loads and schedules
    e. Operating and occupancy schedules such as *building* operating hours, lighting runtime, thermostat setpoints, etc.
3. Systems and components that must be modeled as shown on construction documents or based on testing results. Examples of such systems include the following:
    a. *Opaque* envelope insulation accounting for thermal bridges and thermal mass effects
    b. *Fenestration* area and orientation
    c. Thermal and solar properties of windows and skylights
    d. Shape of exterior envelope
    e. Envelope air leakage
    f. *Building* orientation
    g. Fixed exterior shading (e.g., fenestration set back in envelope plane, side fins, and overhangs) and site shading (e.g., from surrounding *buildings*).
    h. Mechanical ventilation rate when it exceeds the prescribed value
    i. Exhaust air energy recovery efficiency and control
4. *Building* systems that do not interact with heating and cooling loads of the *building* or that are not permanent that must be excluded from the simulations.

The energy models developed for compliance with Section C407.1 are not predictive of actual energy consumption of the proposed design after construction for the following reasons:

- Use of prescribed weather files, internal gains, and other inputs as described herein which may vary from planned design but are necessary to ensure compliance consistency and facilitate design team focus on reducing heating and cooling thermal energy demands by improving other design parameters.
- Variations in *building* operation and maintenance
- Precision of the energy modeling tool.

Informative Note: DOER maintains a library of models which conform to the requirements herein for various building prototypes that are subject to Section C407.1. These sample models were used to validate TEDI targets and can be downloaded from the DOER website. The models were developed using Energy Plus version 22.1.0.

Using This Guide

Look for these color-coded icons and boxes with helpful context, additional information and calculation support.

Important Information

Additional Resources

Example Calculation

1. Definitions and Acronyms

above grade wall. (from IECC 2021): a *wall* associated with the *building thermal envelope* that is more than 15 percent above grade and is on the exterior of the building or any *wall* this is associated with the *building thermal envelope* that is not on the exterior of the building. This includes, but is not limited to, between-*floor* spandrel, peripheral edge of *floors*, roof knee *walls*, dormer *walls*, gable end *walls*, *walls* enclosing a mansard *roof* and skylight shafts.

economizer, air. (from 90.1 2019): a duct and damper arrangement and automatic control system that together allow a cooling system to supply outdoor air to reduce or eliminate the need for mechanical cooling during mild or cold weather.

below grade wall. (from IECC 2021): a *wall* associated with the basement or first story of the *building* that is part of the *building thermal envelope*, is not less than 85 percent below grade and is on the exterior of the building.

building. (from 90.1 2019): any structure used or intended for supporting or sheltering any use or occupancy.

building thermal envelope. (from IECC 2021): the basement *walls*, *exterior walls*, *floors*, ceilings, *roofs* and any other building element assemblies that enclose *conditioned space* or provide a boundary between *conditioned space* and *unconditioned space*.

conditioned space. (from IECC 2021): an area, room or space that is enclosed within the *building thermal envelope* and is directly or indirectly heated or cooled. *Spaces* are indirectly heated or cooled where they communicate through openings with *conditioned spaces*, where they are separated from *conditioned spaces* by uninsulated *walls*, *floors*, or ceilings, or where they contain uninsulated ducts, piping or other sources of heating or cooling.

COPnfcooling. full load cooling efficiency with fan power extracted from the rated efficiency.

COPnfheating. full load heating efficiency with fan power extracted from the rated efficiency.

daylighting. the control of electric lighting by a device or system that provides automatic control of light levels based on the amount of daylight in a space.

daylight area. (from 90.1 2019): the floor area substantially illuminated by daylight.

door. an operable opening area in the *building thermal envelope* that is not *fenestration.*

demand control ventilation. (from 90.1 2019): a ventilation system capability that provides for the automatic reduction of outdoor air intake below design rates when the actual occupancy of spaces served by the system is less than design occupancy.

enclosed space. (from 90.1 2019)*: a* volume substantially surrounded by solid surfaces, such as walls, floors, roofs, and openable devices, such as doors and operable windows.

exterior wall. walls *including both* above grade walls *and* below grade walls.

fenestration. an assembly, including the frame, that allows light to pass.

floor. includes *opaque* area and *fenestration*, that is horizontal or tilted at an angle of less than 60 degrees from horizontal.

floor area, gross. (from 90.1 2019): the sum of the floor areas of the spaces within the *building*, including basements, mezzanine and intermediate-floored tiers, and penthouses with a headroom height of 7.5 feet or greater. It is measured from the exterior faces of walls or from the center-line of walls separating *buildings*, but excluding covered walkways, open roofed-over areas, porches and similar spaces, pipe trenches, exterior terraces or steps, chimneys, roof overhangs, and similar features.

modeled floor area. the total enclosed floor area of the *building* including *conditioned space* and excluding *unconditioned space.*

nonresidential. *(from 90.1 2019):* all occupancies other than *residential*.

opaque. an assembly that does not allow light to pass and excludes openings such as vents and grilles.

orientation. (from 90.1 2019): the direction an envelope element faces, i.e., the direction of a vector perpendicular to and pointing away from the surface outside of the element.

photosensor. (from 90.1 2019): a device that detects the presence of visible light, infrared (IR) transmission, and or ultraviolet (UV) energy.

residential. occupancies in a building that are used primarily for living and sleeping such as multifamily dwelling units and dormitory rooms

roof. (from 90.1 2019): the upper portion of the *building thermal envelope*, including *opaque* areas and *fenestration*, that is horizontal or tilted at an angle of less than 60 degrees from horizontal.

simulation program. a computer program, including the simulation engine and the corresponding user interface, that is capable of simulating the energy performance of *building* systems.

skylight. (from 90.1 2019): a *fenestration* surface having a slope of less than 60 degrees from the horizontal plane. Other *fenestration*, even if mounted on the roof of a building, is considered *vertical fenestration*.

slab-on-grade floor. *(from 90.1 2019):* that portion of a slab floor of the *building thermal envelope* that is in contact with the ground and that is either above grade or is less than or equal to 24 in. below the final elevation of the nearest exterior grade.

space. (from 90.1 2019): an *enclosed space* within a *building*.

temperature control throttling range: the number of degrees that room temperature must change in order to go from full heating to no heating or from full cooling to no cooling.

thermal block. a collection of one or more *spaces* grouped together for simulation purposes. *Spaces* need not be contiguous to be combined within a single *thermal block*.

unconditioned space. (from 90.1 2019): an *enclosed space* within a *building* that is not a *conditioned space*.

unmet load hour. an hour in which one or more zones is outside of the *thermostat set point* plus or minus one half of the *temperature control throttling range*. Any hour with one or more zones with an unmet cooling load or unmet heating load is defined as an *unmet load hour*.

vertical fenestration **(from 90.1 2019)**. all *fenestration* other than *skylights*.

wall. an *opaque* area or *fenestration* area that is vertical or tilted at an angle of 60 degrees from horizontal or greater.

1.1 Acronyms

AHJ: Authority Having Jurisdiction

ASHP: Air Source Heat Pump

DCV: Demand Control Ventilation

DOAS: Dedicated Outdoor Air System

FCU: Fan Coil Unit

HVAC: Heating, Ventilation, And Air Conditioning

SHGC: Solar Heat Gain Coefficient

TEDI: Thermal Energy Demand Intensity

VT: Visible Transmittance

WSHP: Water Source Heat Pump

2. Energy Modeler Qualifications

Energy models shall be created by persons qualified by education and training to perform such work. The modeling documentation submitted to *AHJ* shall be signed by a professional meeting qualification requirements outlined in Modeler_Quals_FINAL.pdf (energycodes.gov).

3. Simulation Program

The *simulation program* shall be a computer-based program for the analysis of *energy* consumption in *buildings.* Simulations shall be performed at an hourly timestep. The following *simulation programs* are pre-approved:

- eQUEST version 3.65 or higher using DOE2.3 engine
    - **Exception:** DOE2.2 can be used for projects that do not include HVAC systems and designs that require workarounds in DOE2.2 but are explicitly supported in DOE2.3, such as variable refrigerant flow heat pumps and dedicated outdoor air systems.
    - Energy Plus version 9.3.0 or higher
- IES Virtual Environment version 2021.4.0.0 or higher

When the approved *simulation program* does not model a specified design, material or device, an external calculation shall be used as approved by the *AHJ*. The documentation submitted in support of the external calculations shall include a narrative explaining the methods, theoretical or empirical information supporting its accuracy, and documentation required in ASHRAE 90.1 2019 Section G2.5 (a) – (e).

4. Site and Climate Data

a. Projects shall use MAStretch2023 weather file included in the Schedules and Loads Guidelines Supplement Package. Local weather file may be used when permitted by AHJ.

b. Ground temperatures from the weather file and or software defaults shall be used.

c. The solar reflectance of the site ground surface equals 0.2

d. No holidays shall be modeled.

e. Shading from adjacent structures, significant vegetation and topographical features shall be reflected in the simulation. All elements with height greater than their distance from a proposed *building* and whose width facing the proposed *building* is greater than one-third that of the proposed *building* shall be modeled.

5. TEDI Calculations

The heating *TEDI* shall be determined as a ratio of the annual heating energy delivered to the *spaces* and ventilation systems within the *building* to the *modeled floor area.*

Equation 1

$$\text{Heating TEDI}\left[\frac{\text{kBtu}}{ft^2}\right] = \frac{\sum\text{Space and Ventilation Heating Output [kBtu]}}{\text{Modeled Floor Area [ft}^2\text{]}}$$

Where:

Σ*Space* and Ventilation Heating Output = the annual heating output of all systems in the *building* that maintain *space* temperature setpoints and heat ventilation air including the heating coils of the central air systems (e.g., make-up air units and air handling units) and terminal equipment (e.g., fan coils, heat pumps and unit heaters).

Modeled floor area = the total enclosed *floor* area of the *building*, as reported by the *simulation program*, including *conditioned* and excluding *unconditioned spaces*.

The cooling *TEDI* shall be determined as the ratio of the annual energy extracted from the *spaces* within the *building* and ventilation systems to maintain the thermostat setpoints to the *modeled floor area*.

Equation 2

$$\text{Cooling TEDI}\left[\frac{\text{kBtu}}{ft^2}\right] = \frac{\sum\text{Space and Ventilation Cooling Output [kBtu]}}{\text{Modeled Floor Area [ft}^2\text{]}}$$

Where:

Σ*Space* and Ventilation Cooling Output = the annual cooling output of all *HVAC* systems that maintain space temperature setpoints and cool ventilation air, including but not limited to the cooling coils of the central air systems (e.g., make-up air units, air handling units.) and terminal equipment (e.g., fan coils and heat pumps).

Exception: If modeling as-designed HVAC systems per Sections 13.1 and 13.3 and heated only thermal zone floor area accounts for more than 10% of the modeled floor area then the heated only floor area shall be subtracted from the modeled floor area for the purposes of determining the Cooling TEDI.

Annex 1 includes steps for extracting the simulation outputs necessary to calculate cooling and heating *TEDI* from the simulation reports generated by the approved energy modeling tools.

Example Calculation

Scenario: What types of spaces would typically be included in the Modeled Floor Area?

Solution:

All spaces that are considered *conditioned spaces* include those that are directly and indirectly conditioned. Based on the definition of conditioned space the following spaces are typically included because they include direct heating or cooling, uninsulated heating or cooling system ductwork and or piping and are typically not isolated from the rest of adjacent *conditioned spaces* with insulation:

- Storage rooms
- Stairs
- Mechanical rooms (those not isolated from the rest of adjacent condition spaces with insulation)

Scenario: What types of spaces would typically be excluded from the Modeled Floor Area?

Solution:

All *unconditioned spaces* are excluded from the modelled floor area. Based on the definition of conditioned space the following spaces are typically excluded because they are not directly heated or cooled, exclude uninsulated heating or cooling system ductwork and or piping, and are thermally isolated from the rest of the adjacent *conditioned spaces* in insulation:

- Elevator shafts
- Crawl spaces
- Parking garages
- Insulated HVAC shafts with insulated ductwork and or piping

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Scenario: Can unconditioned spaces be included in the energy model but be modeled as unconditioned and excluded from the Modeled Floor Area when determining TEDI?

Solution: Yes.

Scenario: How should atriums and other double height spaces be accounted for in the Modeled Floor Area?

Solution:

Similar to PHIUS, the contribution to the *Modeled Floor Area* includes only the floor area of the atrium and or double heighted space. In other words, the footprint of the space is only counted once in the *Modeled Floor Area*.

6. Unmet Loads

Unmet load hours shall not exceed 300 (of the 8760 hours simulated). U*nmet load hours* exceeding these limits shall be permitted to be accepted by the *AHJ*, provided that sufficient justification is given indicating that the accuracy of the simulation is not compromised by these unmet loads.

7. Systems Excluded from Simulation

The following systems and components shall be excluded from the simulation:

a. Exterior lighting system power and controls

b. Heating loads unrelated to maintaining indoor air related occupant comfort such as swimming pool water heaters, outdoor comfort heating (e.g., patio heaters and exterior fireplaces), gas-fired appliances (stoves and dryers), heat tracing.

c. Renewable energy systems including but not limited to PV and solar thermal hot water collectors

d. Other electricity generation systems such as Combined Heat and Power.

e. Service water heating systems.

8. Thermal Blocks

8.1 General Approach

Thermal blocks shall be modeled as follows:

Thermal blocks shall be modeled as prescribed in 90.1 2019 Appendix G Table G3.1, Proposed Building Performance column Row 9 for multifamily buildings and Row 7 for all other occupancy types.

Exception: Projects that are modeled with the default HVAC system following Section 13.2 are permitted to be modeled with the default thermal blocks as prescribed in Sections 8.2 and 8.3

8.2 Default Thermal Blocks

This section describes simplifications that may be made to the interior floor plan and *HVAC* zoning . on projects following Section 13.2. These simplifications shall be used irrespective of project design state and the floor plan and zoning shown on design or construction documents. Section 8.2.1 describes the types of *thermal blocks* that shall be modeled depending on the *building* use type. Section 8.3 describes criteria for further aggregating the *thermal blocks*.

8.2.1 Types of Thermal Blocks Depending on Building Use Type

The following *thermal blocks* shall be modeled depending on the *building* use type:

a. **Residential Buildings**

1. *Residential thermal blocks* representing *spaces* that are used primarily for living and sleeping such as multifamily dwelling units and dormitory rooms.
2. *Supporting spaces thermal blocks* representing corridors, stairs, trash rooms, lobbies and mechanical rooms.
3. *Nonresidential thermal blocks* representing *spaces* such as lounges, laundry, leasing offices, fitness rooms, common bathrooms, community and conference rooms.

b. **K-12 Schools**

1. *Cafeteria*, including food preparation (i.e., kitchen) and dining areas
2. *Gymnasium*, including locker rooms and showers
3. *Auditorium*
4. *School thermal blocks* representing classrooms, corridors, restrooms and offices.

c. **Offices, fire stations, libraries, police stations, post offices, and town halls**

1. *Office thermal blocks* representing variety of *spaces* found in office *buildings*.

The *modeled floor area* of *residential* and *nonresidential thermal blocks* in residential buildings and cafeteria, gymnasium and auditorium thermal *blocks* in K-12 schools shall be within 5% of the actual design shown on construction documents. The exterior envelope area of each *thermal block* shall reflect construction document.

Exception: Thermal blocks based on the specified HVAC zones may be used for the “supporting spaces” and “nonresidential” thermal blocks in residential buildings, “school” thermal blocks in K-12 schools and “office” thermal blocks in offices, fire stations, libraries, police stations, post offices, and town halls. When more detailed thermal blocks are modeled following this exception, these thermal blocks are subject to all rules in these guidelines that are applicable to the corresponding aggregated thermal blocks, including but not limited to the standardized assumptions for miscellaneous loads, lighting, occupancy and schedules.

Informative note: The simplifications described in this section are similar to those appropriate for the early design modeling cycles, such as the Load Reduction cycle, described in the ASHRAE Standard 209 Computer Simulation Aided Design. They allow evaluating compliance with Section C407.1 early in the design process before the *building* programming and *HVAC* zoning schemes are finalized.

8.3 Criteria for Aggregating Thermal Blocks

a. *Thermal blocks* of the same type shall be aggregated, except separate *thermal blocks* shall be assumed for interior and perimeter areas. Interior areas shall be those located greater than 15 feet from an *exterior wall*. Perimeter areas shall be those located within 15 feet of an *exterior wall.*

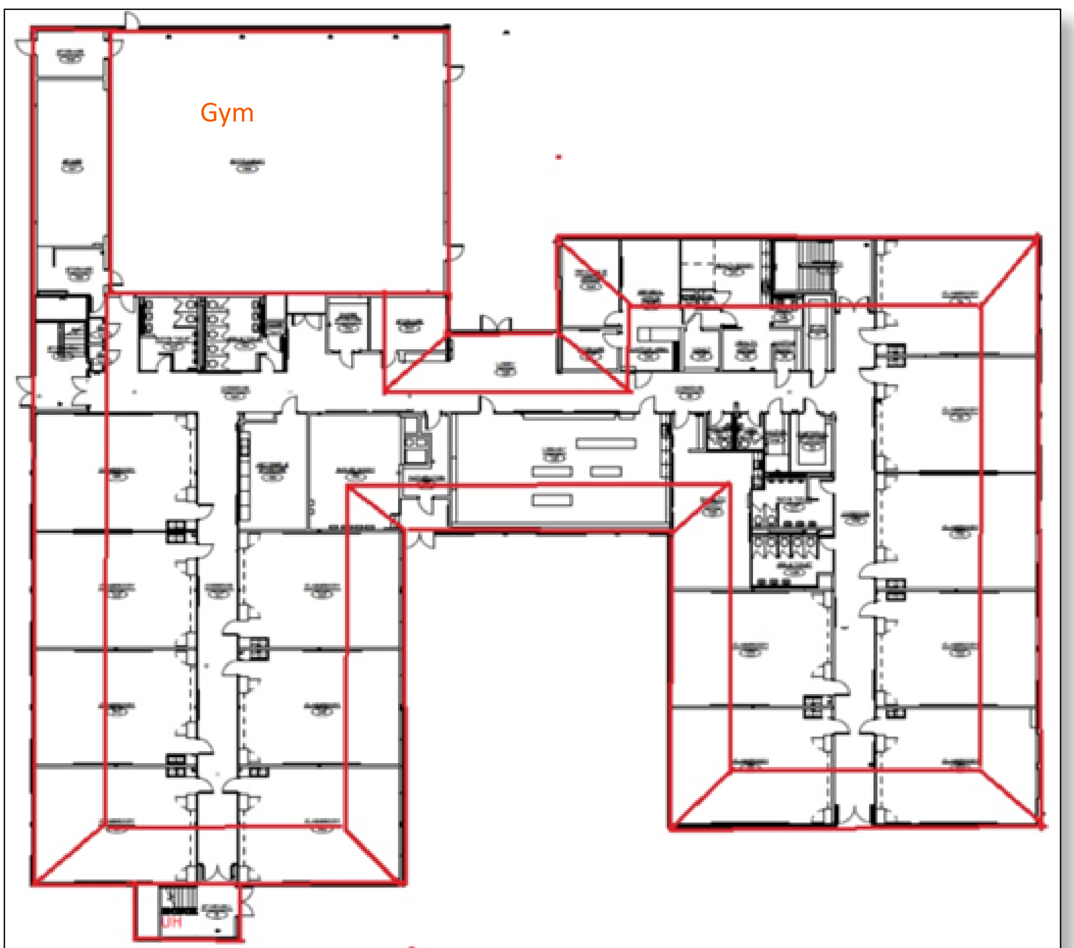


Figure 1: Simplified Thermal Blocks Example for a School Project

Exceptions:

a. *Residential*, *residential* supporting, cafeteria, gymnasium and auditorium *thermal blocks* shall not be split into perimeter and core *thermal blocks*.

b. Separate *thermal blocks* shall be assumed for *spaces* adjacent to glazed *exterior walls*; a separate *thermal block* shall be provided for each *orientation*, except that *orientations* that differ by less than 45 degrees may be considered to be the same *orientation*. Each *thermal block* shall include all floor area that is 15 feet or less from a glazed perimeter *exterior wall*, except that *floor area* within 15 feet of glazed perimeter *exterior walls* having more than one *orientation* shall be divided proportionately between *thermal blocks*.

c. Separate *thermal blocks* shall be assumed for *spaces* having *floors* that are in contact with the ground or exposed to ambient conditions from zones that do not share these features.

d. Separate *thermal blocks* shall be assumed for *spaces* having exterior ceiling or *roof* assemblies from spaces that do not share these features.

e. *Spaces* served by mechanical systems with exhaust air energy recovery shall not be aggregated into the same *thermal block* with *spaces* served by mechanical systems that do not have exhaust air energy recovery.

9. Building Envelope Shape and Areas

a. The modeled exterior envelope geometry shall be consistent with construction documents, including proper accounting of *fenestration* and *opaque* building envelope types and areas. Each modeled *thermal block* shall reflect the total area, type and orientation of *opaque* surfaces (i.e., *above and below-grade exterior walls, roof, above and below grade floors*) and *fenestration* associated with the spaces included in the block.

b. The total *modeled floor area* of *conditioned spaces* shall be within 5% of the *gross floor area* shown on the architectural drawings unless justification is provided to *AHJ*.

Informative Note: Common reason for the deviation between the *modeled floor area* and the floor area reported on the construction documents include differences in accounting for area taken by interior partitions, mechanical chutes and stairwells and thickness of exterior walls.

10. Building Envelope Properties

10.1 General Requirements

a. All components of the *building* envelope shall be modeled as shown on architectural drawings and as described in this section.

b. Simulation shall account for thermal mass of the exterior surfaces.

c. Exterior surfaces whose azimuth *orientation* and tilt differ by less than 45 degrees and are otherwise the same may be described as either a single surface or by using multipliers.

10.2 Exterior walls

Exterior walls shall be modeled with the U-factors derated to account for thermal bridging using the derating methods described in Section C402.7.

10.3 Roof surfaces

Exterior *roof* surfaces shall be modeled using the aged solar reflectance and thermal emittance determined by testing in accordance with CRRC S100. Where aged test data are unavailable, the *roof* surface shall be modeled with a reflectance of 0.30 and a thermal emittance of 0.90.

10.4 Fenestration

a. Modeled *fenestration* properties shall reflect performance of the complete assembly including frame and glazing and reflect U-factor, *SHGC* and *VT* established by a laboratory accredited by a nationally recognized accreditation organization, such as the National Fenestration Rating Council (NFRC) and as described in Section C402.4.6. *Fenestration* products that do not have such rating shall be modeled with the default properties from

90.1 Table A8.1 for unlabeled *skylights* and Table A8.2 for unlabeled vertical *fenestration*.

b. Manual *fenestration* shading devices, such as blinds or shades, are allowed to be modeled in the *residential spaces*. In all other *space* types, manual *fenestration* shading devices shall not be modeled.

c. Automatically controlled *fenestration* shades or blinds shall not be modeled.

d. Permanent shading devices, such as fins, overhangs, and light shelves shall be modeled.

e. Shading due to setting *fenestration* faces back from surround *wall* faces shall be modeled.

f. Automatically controlled dynamic glazing may be modeled. Manually controlled dynamic glazing shall use the average of the minimum and maximum *SHGC* and *VT*.

10.5 Air leakage

a. The modeled air leakage rate of the *building* envelope shall be based on air leakage testing completed following Section C402.5.2.

b. The air leakage rate of the *building envelope* shall be converted to appropriate units for the *simulation program* using one of the methods in 90.1 Section G3.1.1.4.

c. The infiltration flow shall be assigned to the thermal blocks in proportion to the area of surfaces adjacent to exterior.

d. Infiltration modeling algorithm selected within simulation tool shall include adjustment for weather.

Example Calculation

Scenario:

Why do automatic interior shades <u>not</u> contribute to TEDI compliance?

Solution:

TEDI focuses on the aspects of envelope design that are permanent and have long useful life such as insulation of opaque surfaces, mitigation of thermal bridging, efficient envelope aspect ratio and orientation, quality fenestration, aperture area and solar exposure, solar gains, and air leakage. While automatic shades cannot be modeled and used to contribute to TEDI compliance, they should still be considered by design team due to their potential to reduce building energy use and improve occupant comfort.

Scenario:

Project initiated *TEDI* modeling early in design process to ensure compliance of envelope design. However, air leakage testing can only be performed after construction is completed. What air leakage rate should be modeled?

Solution:

EDI models are typically created before air leakage testing is performed, so infiltration rate must be estimated. Since model will ultimately be updated to reflect the test results, it is recommended to avoid overly optimistic air leakage assumptions to ensure that *TEDI* compliance is not jeopardized. For example, 0.35cfm/ft2 at 75Pa, the maximum allowed in Section C402.5.2, may be used as an early air leakage estimate.

Example Calculation

Scenario:

A 5-story office *building* has the following envelope dimensions:

a. *Gross floor area*: 40,000 ft2, including 30,000 ft2 adjacent to exterior walls or roof.

b. Gross *roof* area: 8,000 ft2

c. *Slab-on-grade floor* area: 8,000 ft2

d. Total gross *above grade exterior wall* area 17,117 ft2

The air leakage rate measured following ASTM E3158 test is 0.30 cfm/ft2 at a pressure differential of 0.3 inch water gauge (75 Pa). How should air leakage be modeled?

Solution:

<u>Step 1</u>. Calculate the *building* envelope area S as the sum of the *roof* area and *above grade wall* area.

S= 8,000 + 17,117 =25,117 [ft2] (*slab-on-grade floor* area is not included in S)

<u>Step 2</u> Calculate the air leakage flow rate at wind pressure following 90.1 Section G3.1.1.4

Q=0.112*0.30 [cfm/ft2]* 25,117[ft2] = 844 [cfm]

<u>Step 3</u> Enter the calculated flow rate into simulation tool using the approved infiltration modeling algorithm and distributing air leakage in proportion to area of exterior surfaces within each *thermal block*. For example, in eQuest the 844 cfm would be distributed to each space proportionally based on each space's exterior surface area compared to the total exterior surface area (i.e., S). The cfm would then be converted to ACH based on the volume of the space and input into the simulation tool per Section 10.5.d. below.

- **eQuest** – model the Infiltration Method (keyword: INF-METHOD) as Air-Change and enter the infiltration value to be modeled for each space as A-C Air Change/hr (keyword: AIR-CHANGES/HR). Remember to zero out A-C Infiltration Flow (cfm/ft2) (keyword: INF-FLOW/AREA) to avoid over modeling infiltration. See the screenshot below for reference.

Display Mode: Infiltration

	Space Name	Parent Floor	Activity Desc.	Infiltration Method	Infiltration Schedule	A-C Air Changes/hr	A-C Infiltration Flow (cfm/ft2)	S-(R
99	36_Void 1	E8 Ground Flr	VOI	Air Change	LT_ON_Yrly	0.00	0.0000	
100	36_Elev	E8 Ground Flr	VOI	Air Change	LT_ON_Yrly	0.04	0.0000	
101	36_Void 2	E8 Ground Flr	VOI	Air Change	LT_ON_Yrly	0.00	0.0000	
102	36_Trash Room	E8 Ground Flr	STO	Air Change	LT_ON_Yrly	0.00	0.0000	
103	36_Apt A_0br	E8 Ground Flr	0br	Air Change	LT_ON_Yrly	0.11	0.0000	
104	36_Apt B_0br	E8 Ground Flr	0br	Air Change	LT_ON_Yrly	0.05	0.0000	

- **EnergyPlus** – model using the ZoneInfiltration:DesignFlowRate object. Link to object details can be found here. Model the Design Flow Rate Calculation Method as Flow/ExteriorArea and the Velocity Term Coefficient as 0.224. See the screenshot below for reference.

Field	Units	Obj3
Name		Infiltration 1 cfm 3
Zone or ZoneList Name		SecondarySchool Classroom
Schedule Name		SchSec INFIL_SCH_PNNL
Design Flow Rate Calculation Method		Flow/ExteriorArea
Design Flow Rate	m3/s	
Flow per Zone Floor Area	m3/s-m2	
Flow per Exterior Surface Area	m3/s-m2	0.000227584
Air Changes per Hour	1/hr	
Constant Term Coefficient		0
Temperature Term Coefficient		
Velocity Term Coefficient		0.224
Velocity Squared Term Coefficient		

- **IESVE**- model based on a room/template level (Space Data) whereby a formula profile may be applied, referencing wind speed and or wind direction.

e. Infiltration schedule shall be as specified in the Schedules and Loads Guidelines Supplement for the appropriate thermal block type.

11. **Standardized Assumptions**

The standardized assumptions prescribed in Table 1-6 in the Schedules and Loads Guidelines Supplement shall be modeled for each *thermal block* depending on the *building* use type, *gross floor area* and *thermal block* type.

12. **Lighting**

a. Interior lighting power shall be modeled based on *building* use type, *modeled floor area* and *thermal block* use type as prescribed in Tables 1-6 in the Schedules and Loads Guideline Supplement.

   Informative Notes:

   1. The prescribed lighting power density (LPD) for schools and *residential building* types are based on the assumed relative area of different space types within each thermal block type and the lighting power requirements for these space types in 90.1 2019 Table 9.6.1, Lighting Power Density Allowances Using the Space-by-Space Method.
   2. For office, fire station, library, police station, post office, town hall, and other the prescribed lighting power density is based on the office *Building* Area Type allowance in 90.1 2019 Table 9.5.1. Prescribed schedules were established based on the occupancy controls that were assumed in the models used to establish the *TEDI* limits in Table C407.1.1.5.

b. *Daylighting* shall not be modeled in residential *thermal blocks*. In all other *thermal blocks* *daylighting* shall be modeled as follows:

   1. For thermal blocks with vertical fenestration, the daylight area shall be modeled as directly adjacent to the vertical fenestration with a width equal to the width of the vertical fenestration and a depth equal to the head height of the vertical fenestration. A photosensor shall be modeled as located at the center of the width of the daylight area, at the depth of the daylight area and at a height of 3 feet.
   2. In each nonre*sidential* zone associated with *skylights*, the *daylight area* under skylights shall be modeled as bounded, in each direction, by the edge of the *skylight* area plus 10 feet or the distance to the edge of the zone, whichever is less. A *photosensor* shall be modeled as located at the center of the horizontal plane of the *skylight* and at a height of 5 feet.

13. **Heating, Ventilation and Air-conditioning Systems**

13.1 General Approach

The heating, ventilation and air-conditioning systems, their components and controls shall be modeled as follows:

a. Buildings and areas within the building for which HVAC systems are not designed and are not shown on the construction documents shall be modeled with the default HVAC systems following Sections 13.2 and 13.4.

b. Buildings and areas within the building for which HVAC systems are designed shall be modeled following either of the following options:

   1. With the specified systems following Sections 13.3 and 13.4
   2. With the default HVAC systems following Section 13.1(a).

The selected approach shall be followed for the entire project.

13.2 Default HVAC System Configuration

13.2.1 Heating and Cooling System Type and Description

The modeled heating and cooling system types shall be determined using Table 1 based on the *building* type and the total *modeled floor area*. Table 2 provides additional details for each system type.

Exceptions:

a. K-12 school cafeterias (including dining and food preparation areas), auditoriums, and gymnasiums shall be modeled with variable volume single zone system that has same heating and cooling type as the remainder of the *building*.

Building Type	Heating/Cooling System Type
Office, fire station, library, police station, post office, town hall >= 125,000 ft^2	System 2 *FCU*
Office, fire station, library, police station, post office, town hall between 75,000 & 125,000 ft^2	System 2 *FCU*
Office, fire station, library, police station, post office, town hall <= 75,000 ft^2	System 1 *ASHP*
K-12 School >= 125,000 ft^2	System 2 *FCU*
K-12 School between 75,000 and 125,000 ft^2	System 2 *FCU*
K-12 School <= 75,000 ft^2	System 1 *ASHP*
Residential multifamily and dormitory >= 125,000 ft^2	System 3 *WSHP*
Residential multifamily and dormitory between 75,000 and 125,000 ft^2	System 1 *ASHP*
Residential multifamily and dormitory <= 75,000 ft^2	System 1 *ASHP*
All other >= 125,000 ft^2	System 2 *FCU*
All other between 75,000 and 125,0000 ft^2	System 2 *FCU*
All other <= 75,000 ft^2	System 1 *ASHP*

Table 1: Heating and Cooling System Types by Building Type

System Number	System Type	Fan Control	Cooling Type	Heating Type
System 1 ASHP	Air source heat pump	Constant volume	Direct expansion	Electric heat pump
System 2 FCU	4-Pipe fan coil units with CHW and HW		Chilled water	Hot-water electric boiler
System 3 WSHP	*Water source heat pump*		*Direct expansion*	Electric heat pump, condenser water loop served by electric boiler

Table 2: Heating and Cooling System Details

Informative Note: The prescribed heating and cooling system types are **not** a design recommendation. They were selected to simplify energy modeling and ensure that *TEDI* compliance is not affected by the differences in the *HVAC* system design across projects to preserve the focus on *building* envelope performance. The prescribed systems are well supported by the *simulation programs* which simplifies the modeling, reducing modeling mistakes and effort of documenting *TEDI* compliance. These system types and parameters were used to verify TEDI targets HVAC system types and parameters were selected based on the following considerations:

- Typical systems and parameters expected for the *building* type and size so that models could be useful to design teams even with the default systems (i.e., the models could be used to assess multiple design decisions early in the design process).
- To simplify the modeling process for TEDI by selecting simple systems and by providing modelers with readily available required model inputs.
- To establish model inputs that avoid simultaneous heating and cooling.

13.2.2 Air-Side Economizer

a. *Air economizer* shall only be modeled for the single zone systems modeled following Section 13.2.1 Exception (a).

b. *Air economizers* shall be modeled with a differential dry bulb temperature control to set the outdoor airflow to minimum ventilation requirements when the dry-bulb temperature of outdoor air is higher than the dry-bulb temperature of the return air with a low temperature minimum temperature setpoint cutoff of 45F. Modeled *air economizer* systems shall be capable of and configured to modulate outdoor air and return air dampers to provide up to 100% of the design supply air quantity as outdoor air for cooling.

c. The exhaust air recovery shall be locked out during *air economizer* operation if applicable.

13.2.3 Mechanical Ventilation System Type and Description

The modeled ventilation system(s) shall comply with the following:

a. Mechanical ventilation shall be provided by a dedicated outdoor air system (DOAS), de-coupled from the system that provides heating and cooling.

   Exception: Single zone systems modeled following Section 13.2.1 Exception (a) shall be modeled as also providing mechanical ventilation to the *thermal block*.

b. *Demand control ventilation* shall not be modeled.

c. Exhaust air energy recovery effectiveness shall be modeled as specified. The modeled controls shall allow bypassing energy recovery to permit *air economizer* operation and allow free cooling when outdoor air conditions are favorable. Controls shall be modelled to prevent overheating or overcooling of the mixed/supply air by the system.

d. *DOAS* systems shall be modeled with preheating and precooling coils of the same type as modeled for the space conditioning heating and cooling systems.

   Exception: Projects modeling System 3 to provide heating and cooling shall model the DOAS system(s) providing minimum outdoor air requirements with an electric resistance heating coil and DX cooling coil.

e. The DOAS shall not heat supply air above 60°F when representative building loads or outdoor air temperature indicate that the majority of zones require cooling.

f. The DOAS shall not cool supply air below 70°F when representative building loads or outdoor air temperature indicate that the majority of zones require heating.

g. No dehumidification controls shall be modeled.

Example Calculation

Scenario:

What default heating, cooling, and ventilation systems should be modeled for a 320,000 ft2 K-12 school with a 34,000 ft2 gymnasium, a 10,600 ft2 auditorium, and a 9,040 ft2 cafeteria, which includes a kitchen and dining area?

Other space types include classrooms, lounges, corridors, restrooms, heated only storage rooms, mechanical rooms, and offices.

Solution:

The following systems should be modeled:

Heating and cooling systems

- Based on Table 1, all school thermal blocks (including heated-only spaces) are modeled with heating and cooling provided by constant volume fan coil units with hot water and chilled water coils. (K-12 schools over 125,000 ft2)
- Based on Section 13.2.1 Exception (a), the gymnasium, auditorium, and cafeteria are modeled with single zone variable volume units with hot water and chilled water coils

Ventilation systems

- Based on Section 13.2.2 (a), school thermal blocks must be modeled with the dedicated outdoor air system (DOAS), de-coupled from the heating and cooling systems (i.e., OA provided to thermal zone separately from the heating and cooling system)
- Based on the exception to Section 13.2.2 (a), the gymnasiums, cafeterias, and auditoriums shall be modeled with OA provided via the heating and cooling system serving the associated thermal blocks.

Scenario:

The as-designed *HVAC* systems in the previous example all include exhaust air energy recovery with an enthalpy recovery ratio of 75% except for the system serving heated only storage room. How should energy recovery be modeled?

Solution:

Per Section 13. 2.2.c exhaust air energy recovery must be modeled as specified. Therefore, exhaust air energy recovery with the 75% enthalpy recovery ratio is modeled for the *DOAS* system serving school *thermal blocks*, and for the single zone variable volume systems serving gymnasium, auditorium, and cafeteria.

Exhaust air energy recovery is not modeled for the heated only *thermal blocks* because it is not specified for these areas. Note that these are modeled as both heated and cooled as there are no provisions for heating-only *thermal blocks* for a school project in Section 8.2. Also, following Section 8.3 (e) *thermal blocks* without energy recovery cannot be aggregated with *thermal block* with energy recovery specified.

13.2.4 Unitary Equipment Efficiency

a. Air source heat pumps shall be modeled with a cooling efficiency of 3.74 *COPnfcooling* and a heating efficiency of 3.66 *COPnfheating* at 47F DB.

b. Water source heat pumps shall be modeled with a cooling efficiency of 4.4 *COPnfcooling* at an entering water temperature of 86F and a heating efficiency of 5.0 *COPnfheating* at an entering water temperature of 68F.

13.2.5 Equipment Capacities and Sizing

Heating and cooling coil capacities shall be auto sized based on sizing runs and shall be oversized by 15% for cooling and 25% for heating. The following design day conditions shall be used in the sizing runs:

a. Space temperature design setpoints

- Summer: 75F DB
- Winter: 70F DB

b. Outdoor ambient design conditions

- Summer: 87F DB; 71F WB
- Winter: 7F DB

c. Design day schedules included in the Schedules and Loads Guidelines Supplement shall be used.

13.2.6 Design Airflow Rates

a. Supply airflow rates for system 1 through 3 shall be auto sized and based on a supply-air-to-room temperature set-point difference of 20°F, or the minimum outdoor airflow rate, whichever is greater.

13.2.7 Fan System Operation

a. Heating and cooling system fans that do not provide outside air to meet minimum ventilation requirements shall cycle on and off to meeting heating and cooling loads.

b. *DOAS* fans shall operate continuously during occupied hours and remain off during unoccupied hours.

c. Heating and cooling system fans in single zone systems modeled following Section 16.2 Exception a that provide outside air to meet minimum ventilation requirements (e.g., systems serving cafeterias, auditoriums, and gymnasiums) shall operate continuously during occupied hours and shall cycle to meet heating and cooling loads during unoccupied hours.

13.2.8 System Fan Power

a. Design fan power shall be modeled per **Table 3** and

b. **Table 4** based on the *building* type, areas served, and the system type.

c. Ventilation systems serving *thermal blocks* for which exhaust air energy recovery other than a coil runaround loop is specified in the proposed design shall be modeled with additional fan power determined as follows:

1. For each airstream determine the pressure drop (PD) through the specified energy recovery device based on design documents and or manufacturer specification.
2. Calculate the additional brake horsepower to be modeled

   (bhp) = sum of (PD × cfmD/4131)

   cfmD = the cfm of each applicable air stream
3. Convert bhp to kW = bhp × 0.746/fan motor efficiency

   Fan motor efficiency = the efficiency from ASHRAE 90.1 2019 Section 10 for the next motor size greater than the bhp.

13.2.9 System 2 Chilled and Hot Water Plant Description

a. Chilled water plant description

1. Water cooled centrifugal chillers with a 6.6 COP shall be modeled.
2. Chilled-water design supply temperature shall be modeled at 44°F and return water temperature at 56°F. Chilled-water supply temperature shall be reset based on outdoor dry-bulb temperature using the following schedule: 44°F at 80°F and

Building Type	Areas Served	Heating/Cooling System Type	Fan Power, kW/CFM
Office, fire station, library, police station, post office, town hall, K-12 school, and all other	All except gyms, cafeterias, auditoriums	System 1 and System 2	0.00024
Residential multifamily and dormitory	All	System 1	0.00012
Residential multifamily and dormitory	All	System 3	0.00017
K-12 school	Gyms, cafeterias, and auditoriums only	System 1 and System 2	0.00050

Table 3: Fan Power Modeling Requirements for Heating and Cooling Equipment

Building Type	Fan Power, kW/CFM
Office, fire station, library, police station, post office, town hall, K-12 school, and all other	0.00063
Residential multifamily and dormitory	0.0005
Residential multifamily and dormitory	All
K-12 school	Gyms, cafeterias, and auditoriums only

Table 4: Fan Power Modeling Requirements for DOAS

above, 54°F at 60°F and below, and ramped linearly between 44°F and 54°F at temperatures between 80°F and 60°F.

3. Chilled-water systems shall be modeled as primary/secondary with a constant-flow primary loop and a variable-flow secondary loop. Pump power shall be 9.0 W/gpm for the primary loop and 13 W/gpm for the secondary loop at design conditions. The secondary pump shall be modeled with a variable-speed drive and a minimum flow of 25% of the design flow rate.
4. Heat-rejection system shall be an axial-fan open-circuit cooling tower with variable-speed fan control and an efficiency of 40.2 gpm/hp at an entering water temperature of 95F DB, a leaving water temperature of 85F DB, and an entering air temperature of 75F WB.
5. The condenser-water design supply temperature for all system types shall be modeled using a cooling tower approach temperature of 7F and range of 10F.
6. The cooling tower shall be controlled to maintain a leaving water temperature of 70F, where weather permits, floating up to the design leaving water temperature for the cooling tower.
7. The condenser-water pump power shall be modeled as 19 W/gpm. The condenser water pumps shall be constant volume with each chiller modeled with separate condenser-water and chilled-water pumps interlocked to operate with the associated chiller.

b. Hot Water Plant Description

1. Hot water shall be provided by 100% efficient electric resistance boilers.
2. Hot-water design supply temperature shall be 180°F; design return temperature shall be 130°F.
3. Hot-water supply temperature shall be reset based on outdoor dry-bulb temperature.

using the following schedule: 180°F at 20°F and below, 150°F at 50°F and above, and ramped linearly between 180°F and 150°F at temperatures between 20°F and 50°F.

4. The pump system shall be modeled as primary-only with continuous variable flow and a minimum of 25% of the design flow rate.
5. Modeled hot-water pump power shall be 19 W/gpm.

13.2.9 System 3 WSHP Description

c. Hot Water Plant Description

1. Condenser loop heat shall be provided by 100% efficient electric resistance boiler.
2. Boilers shall maintain a condenser water temperature between 60F and 90F.

d. Heat Rejection System Description

1. Heat-rejection system shall be an axial-fan open-circuit cooling tower with variable-speed fan control and shall have an efficiency of 40.2 gpm/hp at an entering water temperature of 95F DB, a leaving water temperature of 85F DB, and an entering air temperature of 75F WB.
2. The condenser-water design supply temperature shall be modeled using a cooling tower approach temperature of 7F and range of 10F.
3. The cooling tower shall be controlled to maintain leaving water temperatures between 60°F and 90°F.
4. The condenser-water pump power shall be modeled as 19 W/gpm and the variable speed drives. Condenser water loop flow shall be variable with flow shutoff at each heat pump when its compressor cycles OFF.

13.3 Modeling As-designed HVAC Systems

a. Where an *HVAC system* has been designed and submitted with design documents, the HVAC model shall be consistent with design documents including all components and controls except as prescribed in Section 13.4 and in the Schedule and Loads Guidelines Supplement.

Exception: System air flows and heating and cooling capacities shall be auto sized per Section 13.2.4.

b. Where *efficiency* ratings include supply fan *energy*, the *efficiency* rating shall be adjusted to remove the supply fan *energy* from the *efficiency* rating.

c. The systems shall be modeled using *manufacturers*' full- and part load data for the *HVAC system* without fan power.

d. Demand Control Ventilation

The minimum ventilation rate shall be modeled as follows for HVAC systems with demand control ventilation:

1. At the peak occupancy, VRmax shall equal the OA CFM/ft² from Tables 1-6 of the Schedules and Loads Guidelines Supplement for the *building* use type or the specified ventilation rate if the rate exceeds minimum code requirements by more than 135%, whichever is greater.
2. At the minimum occupancy, the minimum ventilation rate shall be no less than VRmin

Where:

VRmax=CFMFPP x Per x OFmax + Aflow

VRmin=CFMFPP x Per x OFmin + Aflow

VRmax= maximum ventilation rate, CFM/ft² accounting for the occupant ventilation requirement per person and per area separately.

VRmin= minimum ventilation rate, CFM/ft² accounting for the occupant ventilation requirement per person and per area separately.

CFMFPP = flow per person, CFM/person from design documents or adjusted value to achieve a VRmax per the requirements of 13.3.d.i CFM/ft² (see example below).

Per = occupant density from Tables 1-6 of the Schedules and Loads Guidelines Supplement for the *building* use type

OFmax = the maximum hourly fraction for the occupancy schedule from the Schedules and Loads Guidelines Supplement for the *building* use type

OFmin = the minimum hourly fraction for the occupancy schedule from the Schedules and Loads Guidelines Supplement for the *building* use type

Aflow (ventilation requirement/area) = minimum ventilation rate per unit area from design documents.

13.4 Other HVAC Modeling Requirements

13.4.1 Minimum Ventilation Flow Rate

The minimum ventilation flow rate shall be modeled using the OA CFM/ft² rate from Tables 1-6 of the Schedules and Loads Guidelines Supplement for the *building* use type.

Exception: The specified rate shall be modeled when both of the following applies:

a. The specified ventilation rate exceeds the minimum requirements of applicable codes and standards by more than 135% and

b. The specified ventilation rate exceeds the OA CFM/ft² value from Tables 1-6 of the Schedules and Loads Guidelines Supplement for the *building* use type, .

Minimum required outdoor air and specified ventilation rates shall be documented as described in Section C103.2 #16.

Informative Note: The ventilation rates prescribed in Tables 1-6 in the Schedules and Loads Guidelines Supplement are based on assumed relative areas of different *space* types within each *thermal block* type and the minimum ventilation requirements for each space type in 62.1 2019 increased by up to 30%.

13.4.2 Piping and Ductwork Losses

Piping and ductwork losses shall not be modeled.

14. Special Cases

14.1 Core and Shell and Initial Tenant Fit-out

For projects in which systems and components that must be modeled as designed following these guidelines have not yet been designed, those yet-to-be-designed features shall be modeled to comply with but not exceed the requirements of the most current version of 225 CMR 23: Massachusetts Commercial Stretch Energy Code. Core and shell *buildings* where the details of the *building* occupancy is not known shall be categorized as an office *building*.

For initial tenant fit-out projects, existing unmodified systems and components shall be modeled as- built. Section C401.2 does not apply to subsequent tenant fit-out projects. Tenant fit-outs after the initial tenant fit-out shall be treated as alterations or change of use as appropriate.

14.2 Additions

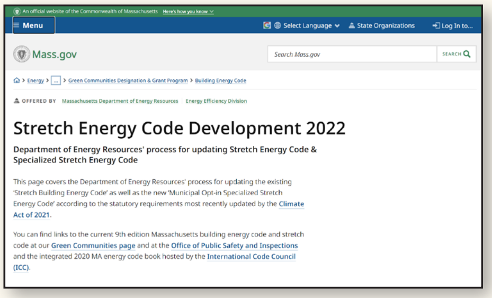
Following C502.1, large additions which are either more than 100% of the size of the existing *building* or equal to or greater than 20,000 ft² require conformance to C401.2. If the addition use type is office, dormitory, fire station, library, office, school, police station, post office, or town hall, the addition must show compliance with the Targeted Performance Compliance (C401.2 Part 2). In this scenario, the existing *building* shall be excluded from the model so that only the addition is modeled. Surfaces separating the addition from existing *building* shall be modeled as adiabatic.

See examples on the following two pages.

Additional Resources

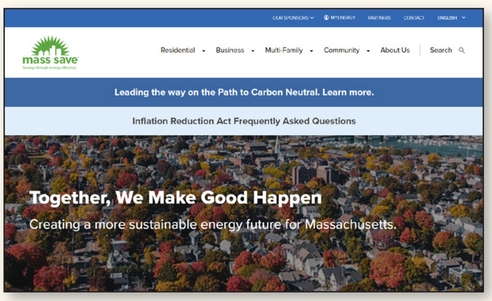
Still have questions?

Many resources are available to answer questions and assist with demonstrate compliance.



Visit the **Department of Energy Resources (DOER)** website for additional information about code development.

https://www.mass.gov/info-details/stretch-energy-code-development-2022



The **Mass Save Collaborative** is a rate-payer funded partnership among local electric and natural gas utilities and energy efficiency service providers to provide energy expertise and incentives to residents and businesses across Massachusetts.

Call: 1-855-757-9717

Email: energycodesma@psdconsulting.com

https://www.masssave.com/

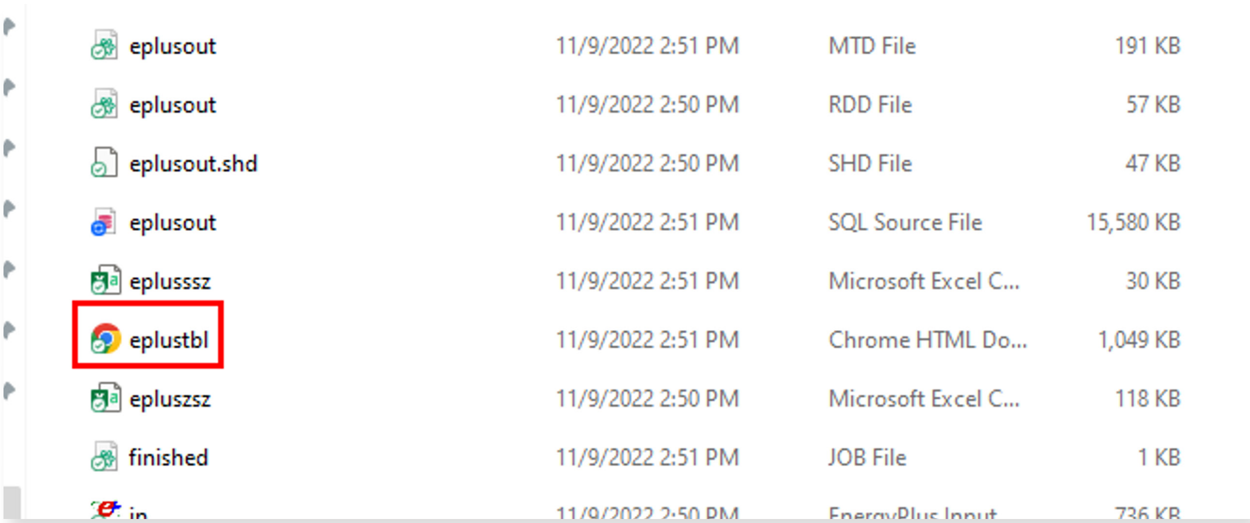
Annex 1: Extracting Simulation Results to Determine TEDI

This Appendix describes how to extract information necessary to calculate TEDI from the simulation reports generated by the approved simulation programs including OpenStudio, EnergyPlus, and IESVE. Due to a commonly observed bug in multiple simulation tools, heating loads modeled during the months of June, July, and August are allowed to be subtracted from the space and ventilation heating output (i.e., the numerator of the heating TEDI equation) prior to calculating the heating TEDI. Documentation (e.g., excerpt of model output report showing heating load during June, July, and/or August) and backup calculations shall be provided to justify the heating load removal.

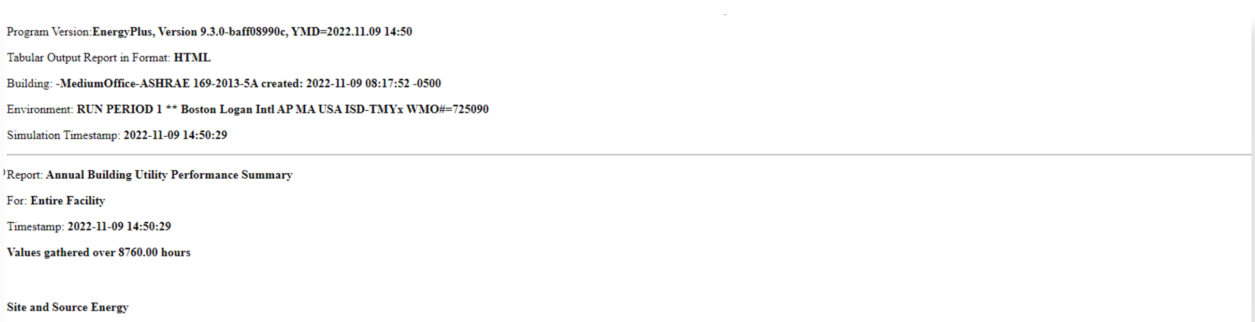
Openstudio/Energyplus

References to get E+/Openstudio to generate all summary output reports in html format: https://bigladdersoftware.com/epx/docs/8-6/input-output-reference/output-table-summaryreports.html and https://bigladdersoftware.com/epx/docs/8-0/input-output-reference/page-095.html

Step 1: Open the eplustbl html output document generated by E+/Openstudio



Step 2: Click the hyperlink to get to the Table of Contents


Program Version:**EnergyPlus, Version 9.3.0-baff08990c, YMD=2022.11.09 14:50**

Tabular Output Report in Format: **HTML**

Building: **-MediumOffice-ASHRAE 169-2013-5A created: 2022-11-09 08:17:52 -0500**

Environment: **RUN PERIOD 1 ** Boston Logan Intl AP MA USA ISD-TMYx WMO#=725090**

Simulation Timestamp: **2022-11-09 14:50:29**

Report: **Annual Building Utility Performance Summary**

For: **Entire Facility**

Timestamp: **2022-11-09 14:50:29**

Values gathered over 8760.00 hours

Site and Source Energy

Step 3: Using the Table of Contents hyperlinks to navigate to the Energy Meters section

Table of Contents

Top
Annual Building Utility Performance Summary
Input Verification and Results Summary
Demand End Use Components Summary
Source Energy End Use Components Summary
Component Sizing Summary
Surface Shadowing Summary
Adaptive Comfort Summary
Initialization Summary
Annual Heat Emissions Summary
Climatic Data Summary
Envelope Summary
Shading Summary
Lighting Summary
Equipment Summary
HVAC Sizing Summary
Coil Sizing Details
System Summary
Outdoor Air Summary
Object Count Summary
Energy Meters
Sensible Heat Gain Summary
Standard 62.1 Summary
LEED Summary

BUILDING ENERGY PERFORMANCE - ELECTRICITY

| Meter |

BUILDING ENERGY PERFORMANCE - NATURAL GAS

Step 4: Scroll down to the "Annual and Peak Values – Other" table.

Annual and Peak Values - Other

	Annual Value [kBtu]	Minimum Value [Btu/h]	Timestamp of Minimum {TIMESTAMP}	Maximum Value [Btu/h]	Timestamp of Maximum {TIMESTAMP}
EnergyTransfer:Facility	2548892.60	0.00	17-JAN-00:10	1489813.35	10-JUL-11:30
EnergyTransfer:Building	830472.04	0.00	04-JAN-22:10	530951.45	10-JUL-15:30
EnergyTransfer:Zone:CORE_BOTTOM ZN	282645.50	0.00	01-JAN-00:10	143790.80	24-JUL-07:20
Heating:EnergyTransfer	38940.71	0.00	04-JAN-22:10	340743.38	02-JAN-05:10
Heating:EnergyTransfer:Zone:CORE_BOTTOM ZN	14.68	0.00	01-JAN-00:10	16794.57	02-JAN-07:10
General:Heating:EnergyTransfer	38940.71	0.00	04-JAN-22:10	340743.38	02-JAN-05:10

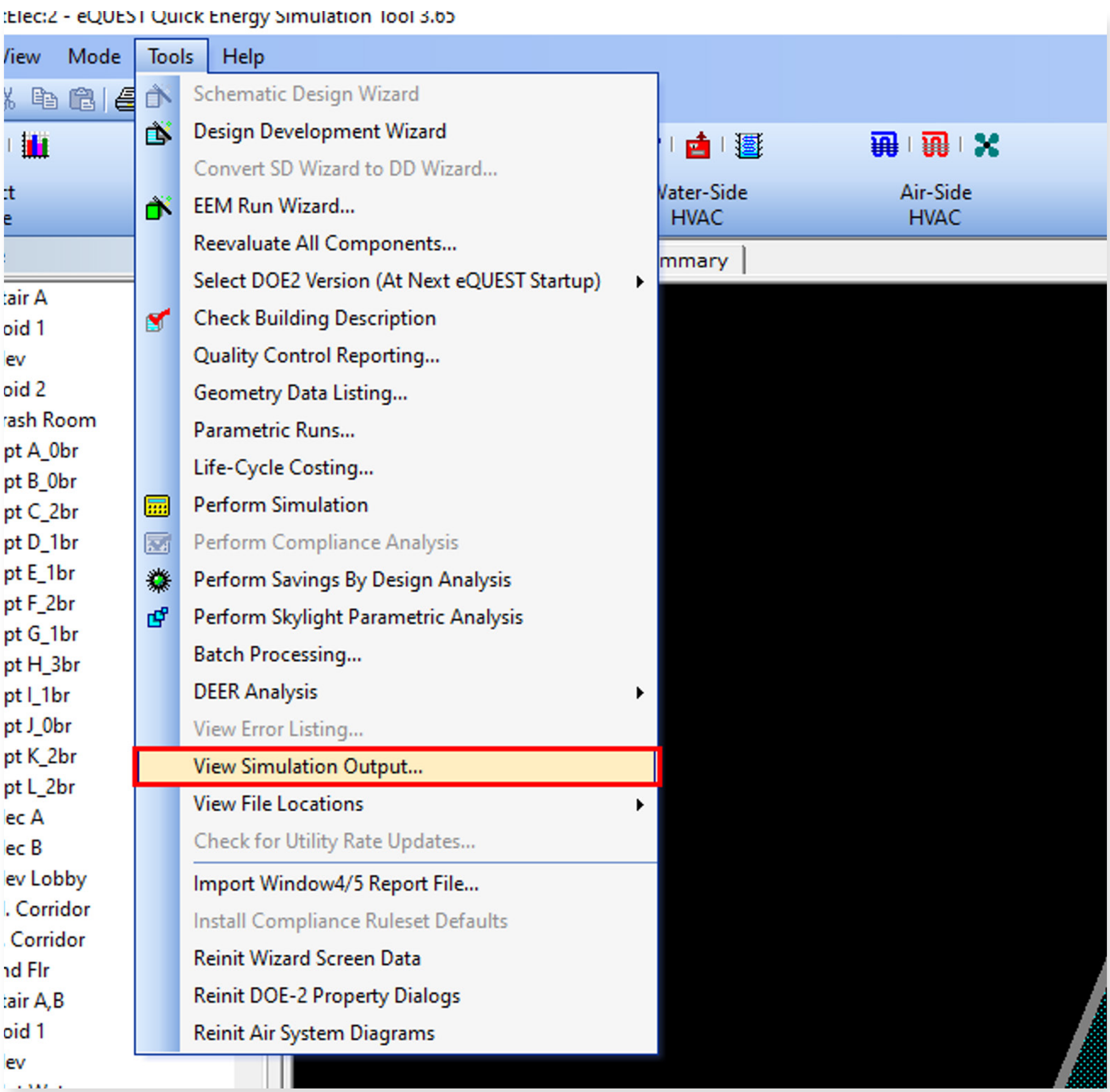
Step 5: The CoolingCoils:EnergyTransfer, HeatingCoils:EnergyTransfer, and, if applicable, the Baseboard:EnergyTransfer rows are the modeled total cooling and heating loads to use to calculate TEDI. If the html report was generated in imperial units, then these numbers will be in units of kBtu. Divide each by modeled floor area to arrive at the modeled cooling and heating TEDI values.

	CoolingCoils:EnergyTransfer	968493.29
	HeatingCoils:EnergyTransfer	85068.42

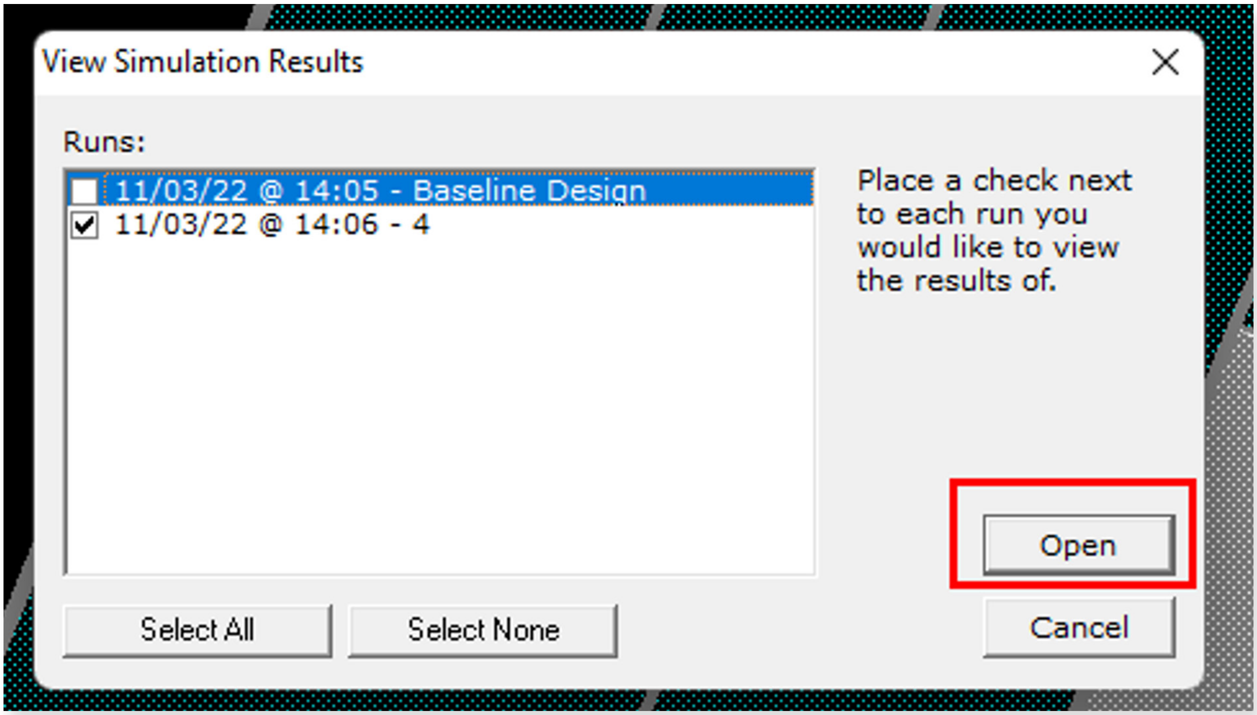
Cooling:EnergyTransfer:Zone:THERMAL ZONE: OFFICES_ZN_1_FLR_4	53023.68	
EnergyTransfer:HVAC	3455815.20	
Baseboard:EnergyTransfer	70452.91	
PlantLoopHeatingDemand:Facility	211871.10	

eQuest

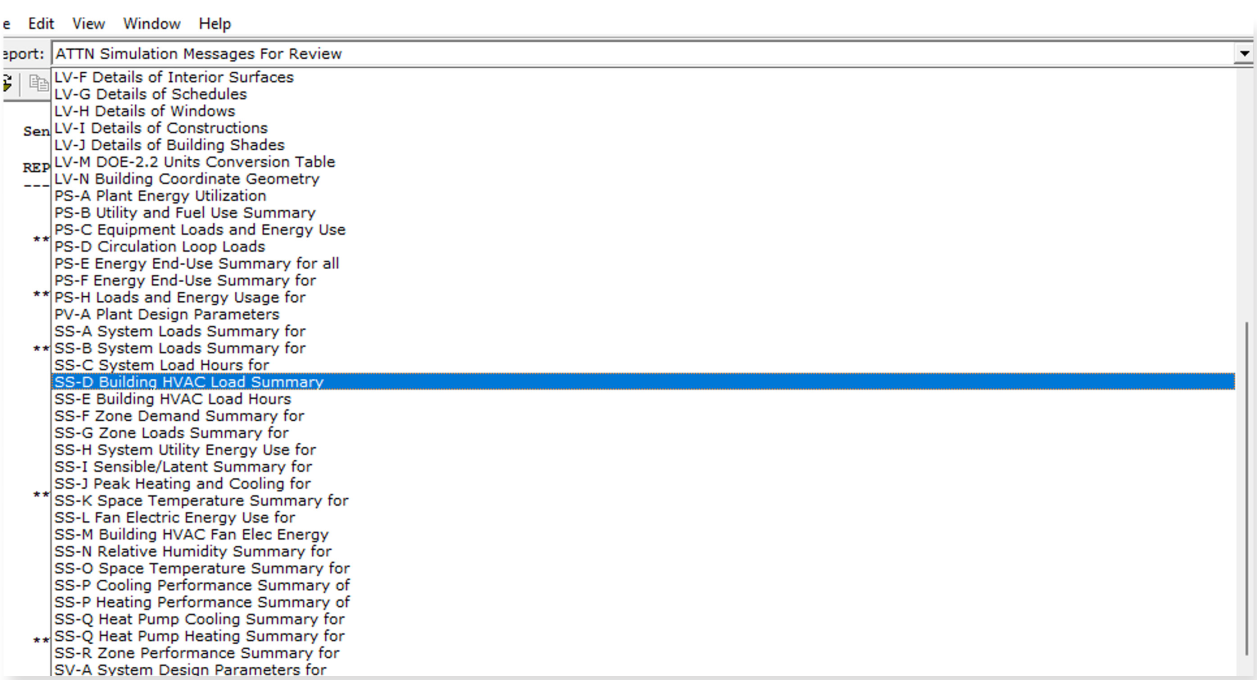
Step 1: After running the simulation to Tool → View Simulation Output…



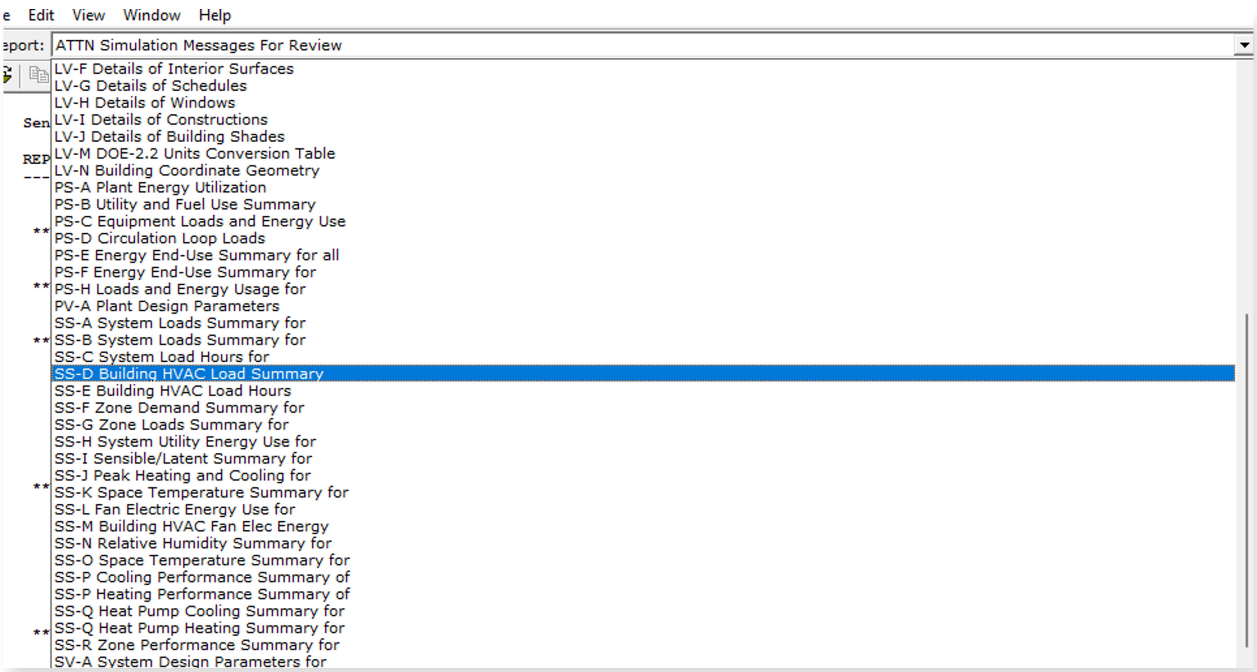
Step 2: Open the output for the simulation



Step 3: Navigate to the SS-D report



Step 4: Find the heating and cooling loads at the locations shown below in the SS-D report. Multiply each number by 1,000 to convert to kBtu and then divide each by the modeled floor area to arrive at the modeled cooling and heating TEDI values.



IESVE

Please visit the IESVE frequently asked questions (FAQ) page for instructions for determining heating and cooling TEDIs from the IESVE energy model. The instructions on the web page are for generating the heating TEDI, to generate the cooling TEDI just replace "heating" with "cooling" for both cases of the variables referenced on the FAQs page. Please use the definition in Section 1 for modeled floor area for determining the floor area that needs to be manually entered per the instructions on the FAQ page.

Link: https://www.iesve.com/support/ve/knowledgebase_faq/faq/tedi/13803

If the TEDIs generated by IESVE following the instructions on the web page are in units of kWh/m2/yr they will need to be converted to units of kBtu/ft2/yr by multiplying by 0.317.

End of Document.