ASHRAE 90.1-2004 Appendix G

Performance Rating Method

Presented By

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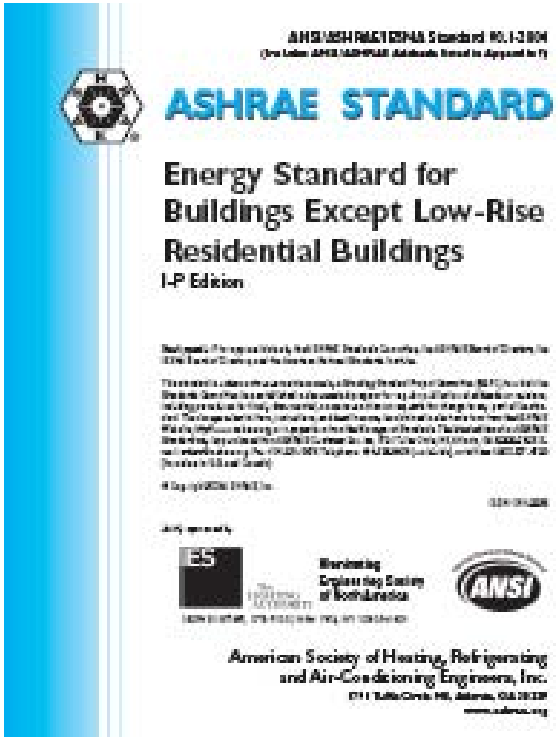
Federal Building Energy Efficiency Standard Overview

- Energy Policy Act of 2005 (Section 109) requires new federal buildings meet a target of at least 30% energy savings (compared to ASHRAE 90.1. 2004), if cost-effective

- Rules Found in:
  - 10 CFR Part 433 – effective January 3, 2007
  - Rules require use of **ASHRAE 90.1-2004 Appendix G**

Performance Rating Method Overview

- ANSI/ASHRAE/ IESNA Standard 90.1-2004
  - Prevailing private sector energy standard for commercial and high-rise multi-family residential buildings



Performance Rating Method Overview

- **Appendix G**
  - Appendix chapter to ASHRAE Standard 90.1
  - A modification of Energy Cost Budget (ECB)
- **ECB**
  - Modeling rules designed to show a building that doesn't meet prescriptive requirements, will have an equivalent energy cost to a building that meets those requirements.
  - **Not Flexible**

Performance Rating Method Overview

- **Appendix G -** Modeling rules for rating buildings that are designed to be substantially "Better Than Code"
  - **Built-in Flexibility**
- Incorporates standard practice as well as code requirements
- Allows more discretion by the "Rating Authority"

Performance Rating Method Overview

- Used For “Beyond Code Programs”
  - LEED
  - Utility Programs
  - EPACT 2005 Federal Tax Incentives
  - **Federal Buildings energy efficiency requirements from EPACT 2005**

Performance Rating Method Overview

LEED EA Credit 1 - OPTION 1 – WHOLE BUILDING ENERGY SIMULATION (1-10 Points)

"*Demonstrate a percentage improvement in the proposed building performance rating compared to the baseline building performance rating per ASHRAE/IESNA Standard 90.1-2004 (without amendments) by a whole building project simulation using the* ***Building Performance Rating Method in Appendix G*** *of the Standard*."

LEED-NC

Green Building Rating System
For New Construction &
Major Renovations

Version 2.2

Performance Rating Method Overview

EPACT 2005 - Federal Tax Incentives for Commercial Buildings

"*The energy performance of the Reference Building shall be determined by following the methods for baseline building performance in the PRM in* ***Appendix G of Standard 90.1-2004***."

Performance Rating Method Overview

10 CFR Part 433—Energy Efficiency Standards For The Design And Construction Of New Federal Commercial And Multi-Family High-Rise Residential Buildings

"*Each Federal agency shall determine energy consumption levels for both the baseline building and proposed building by using the Performance Rating Method found in* ***Appendix G of ANSI/ASHRAE/IESNA Standard 90.1–2004****, Energy Standard for Buildings Except Low-Rise Residential Buildings.*"

Performance Rating Method Overview - Terminology

- Proposed Design

"A computer representation of the actual proposed building design or portion thereof used as the basis for calculating the design energy cost"

  - matches the actual design – with some limitations

- Baseline Design

"A computer representation of a hypothetical design based on the proposed building project. This representation is used as the basis for calculating the baseline building performance for rating above-standard design"

  - just meets code and standard practice

Performance Rating Method Overview

- Credit allowed for ECMs Previously Off Limit
  - Building Mass
  - Building Orientation
  - HVAC System Selection
  - Fan Power Energy Savings
  - Appropriate Equipment Sizing
  - Natural Ventilation
  - Demand Controlled Ventilation
  - Service Water Heating
  - Automated Shading Devices
  - Daylighting and Other Lighting Controls
  - Non-Regulated Loads **(Not for Federal Building Standard)**

G1.2 Performance Rating - Metric

- Could Be Cost Or Energy Consumption

% improve = 100 x (baseline – proposed) / baseline

- From 10 CFR Part 433

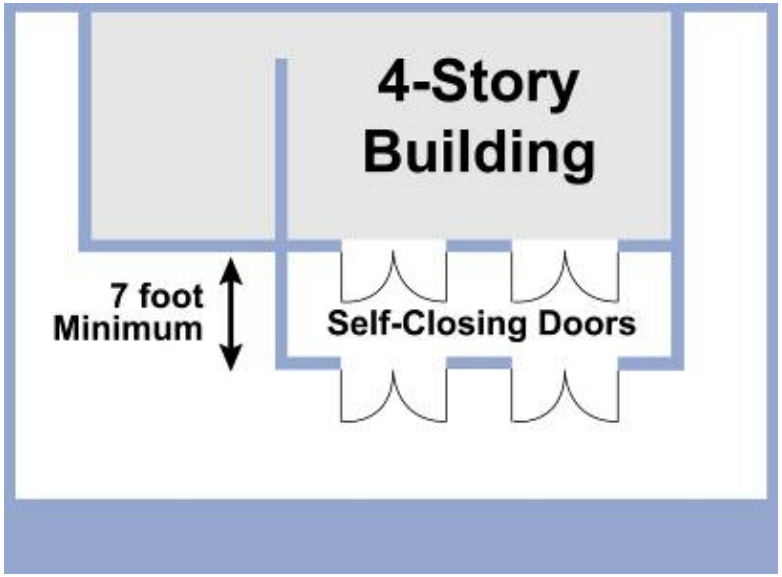
"*Under the revised standards, new Federal buildings must be designed to achieve **energy consumption** levels that are at least 30 percent below the updated minimum standards referenced*"

G1.2 Performance Rating - Disclaimer

- May not accurately predict energy use
  - Reality will differ from model due to variations in:
    - Occupancy
    - Weather
    - Requirement for heating and cooling
    - Building O&M
    - Changes in energy rates between design and occupancy
    - Precision of calculation tool
    - Skill of analyst

G1.2 Performance Rating

- Mandatory provisions (5.4, 6.4, 7.4, 8.4, 9.4, and 10.4) are prerequisites
  - Air Leakage (vestibules)
  - HVAC and SWH Equipment Efficiency
  - Labeling
  - HVAC Controls
  - HVAC Construction
  - Lighting Controls
  - Exterior Lighting Power
  - Motor Efficiency



G1.2 Performance Rating

- All End Uses - Includes “Non-Regulated” Loads
  - Plug loads
  - Process loads
  - Etc.

G1.2 Performance Rating

- **From 10 CFR Part 433**

"*Energy consumption for the purposes of calculating the 30 percent savings shall include space heating, space cooling, ventilation, service water heating, lighting and all other energy consuming systems normally specified as part of the building design* ***except for receptacle and process loads***."

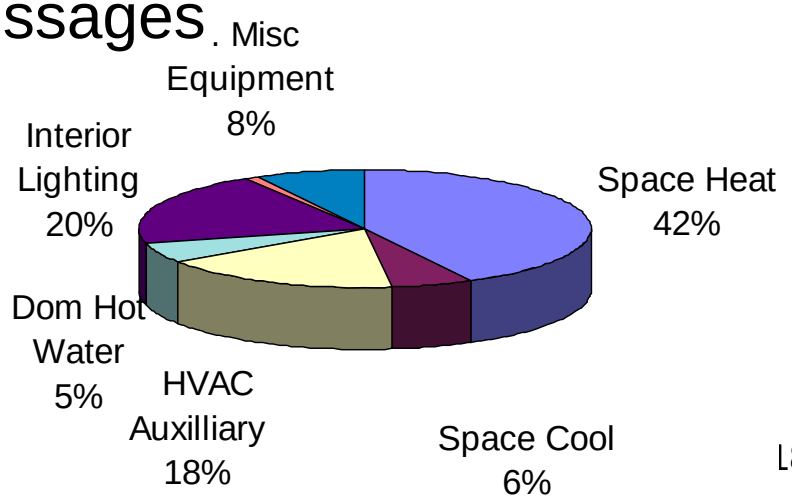
- Included in model – to determine loads
- Not eligible for savings
- Not included in calculation of savings %

G1.3 Retrofits

- May apply to retrofits
- For retrofits, only the components being modified shall be allowed to vary
  - Parameters for unmodified or future components identical for determining both baseline and proposed

G1.4 Documentation Requirements

- Documentation submitted to **“Rating Authority”**
  - Performance of baseline, proposed, and % improvement
  - List of energy-related features and differences
  - Software input and output reports
  - Energy end use breakdown
  - Amount of time any loads aren’t met by HVAC system
  - Explanation of error messages

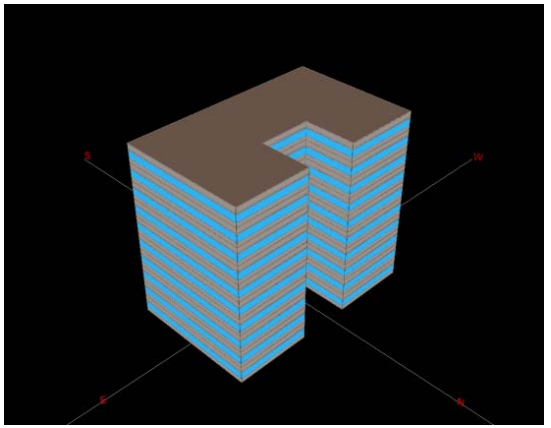


G2.1 Performance Calculation Requirements

- Both proposed and baseline models use same
  - Simulation program
  - Weather data
  - Energy rates

G2.2 Simulation Program Requirements

- Computer-based energy model
  - Examples
    - DOE-2
    - BLAST
    - EnergyPlus



- Program must be capable of simulating components being modeled
- For components that can't be modeled by simulation program, use "Exceptional Calculation Methods"

G2.5 Exceptional Calculation Method

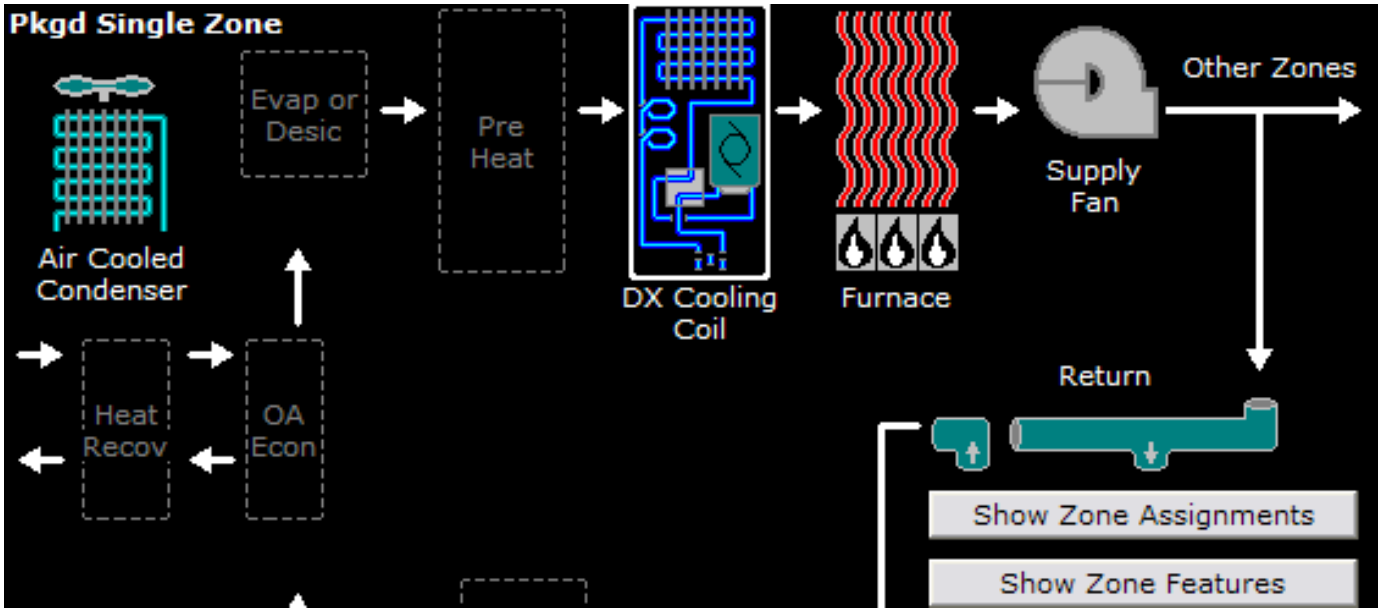
- Exceptional Calculation Method
  - Used when no simulation program is available that adequately models a design, material, or device
  - Approved at the discretion of the “rating authority”
    - Must include documentation of the calculations and equipment performance
    - Include any other supporting information

G2.2 Simulation Program Requirements

- Approved by rating authority
- Have ability to explicitly model
  - 8760 hours/year
  - Hourly variations establish separate schedules for each day of the week and holidays
    - Occupancy
    - Lighting power
    - Miscellaneous equipment power
    - Thermostat setpoints
    - HVAC system operation
  - Thermal mass effects
  - Ten or more thermal zones
  - Part-load performance curves for mechanical equipment
  - Air-side economizers with integrated control

G2.2 Simulation Program Requirements

- Performs design load calculations to size HVAC equipment
- Uses hourly temperature and humidity



G2.4 Energy Rates

- Determine energy costs
  - Use actual rates for purchased energy OR
  - State average prices published by DOE
  - Do not mix rates from different sources in same project
- Exception
  - On-site renewable energy sources or site-recovered energy
    - Considered “free energy”
    - For baseline energy source - use backup source OR
    - If no backup energy source specified - electricity

G3.1 Building Performance Calculations

- Section provides rules for modeling the Baseline and Proposed Building
- General Rule
  - Proposed Building = Design (some limits)
  - Baseline Building inputs must be identical to Proposed Building inputs – except those specifically allowed to differ
    - Each of the Baseline components is assumed to just meet the applicable mandatory and prescriptive requirements of 90.1

Table G3.1 Modeling Requirements for Proposed and Baseline

No.	Proposed Building Performance	Baseline Building Performance
1. Design Model	(a) The simulation model of the *proposed design* shall be consistent with the design documents, including proper accounting of fenestration and opaque envelope types and areas; interior lighting power and controls; HVAC system types, sizes, and controls; and service water heating systems and controls. All end-use load components within and associated with the building shall be modeled, including, but not limited to, exhaust fans, parking garage ventilation fans, snow-melt and freeze-protection equipment, facade lighting, swimming pool heaters and pumps, elevators and escalators, refrigeration, and cooking.	The *baseline building design* shall be modeled with the same number of floors and identical conditioned floor area as the *proposed design*.
	(b) All conditioned spaces in the *proposed design* shall be simulated as being both heated and cooled even if no heating or cooling sys-tem is to be installed, and temperature and humidity control set-points and schedules shall be the same for *proposed* and *baseline building designs*.	
	(c) When the *performance rating method* is applied to buildings in which energy-related features have not yet been designed (e.g., a lighting system), those yet-to-be-designed features shall be described in the *proposed design* exactly as they are defined in the *baseline building design*. Where the space classification for a space is not known, the space shall be categorized as an office space.	

Table G3.1.1 Design Model Proposed and Baseline

- All conditioned spaces modeled as being both heated and cooled
  - Even if no heating or cooling system installed
- Temperature and humidity control setpoints and schedules are the same for baseline and proposed design

Table G3.1.1 Design Model Proposed and Baseline (c)

- Yet-to-be-designed features
  - Same for proposed and baseline designs
- Unknown space classification
  - Categorize as office space

Table G3.1.2 Additions and Alterations – Proposed and Baseline

- Can exclude parts of existing buildings if:
  - Work in excluded parts meets Sections 5-10
  - Excluded parts are served by entirely separate HVAC systems than those serving included parts
  - Design space temperature setpoints and HVAC system operating schedules are essentially the same on either side of boundary between included and excluded parts
  - Rate reflects utility block or rate for building plus addition

Table G3.1.4 Schedules

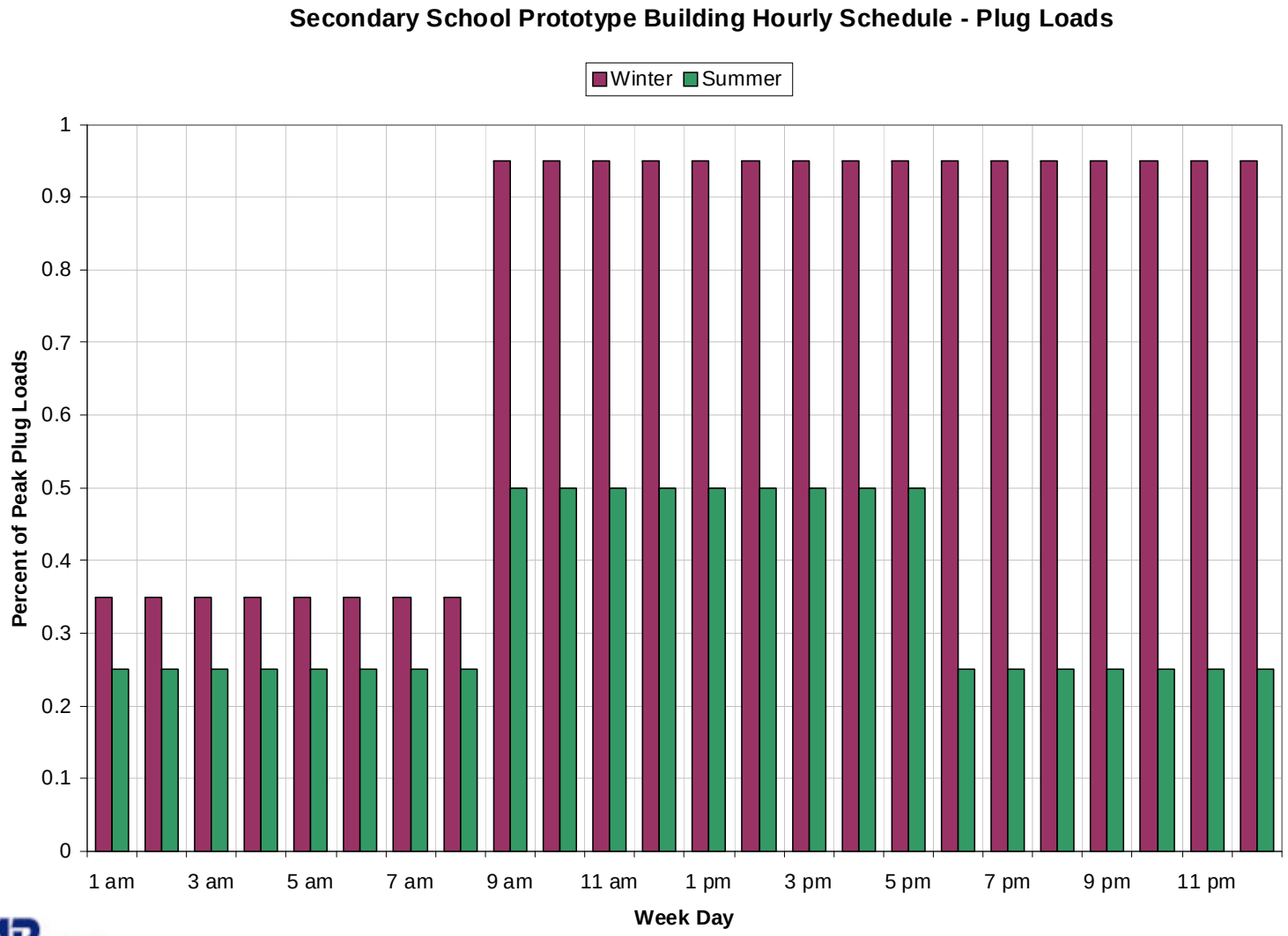


Table G3.1.4 Schedules - Proposed

- Use schedules that model hourly variations in:
  - Occupancy
  - Lighting power
  - Miscellaneous equipment
  - Thermostat setpoints
  - HVAC system operation
- Typical of proposed building type
  - Determined by designer and AND
  - Approved by rating authority

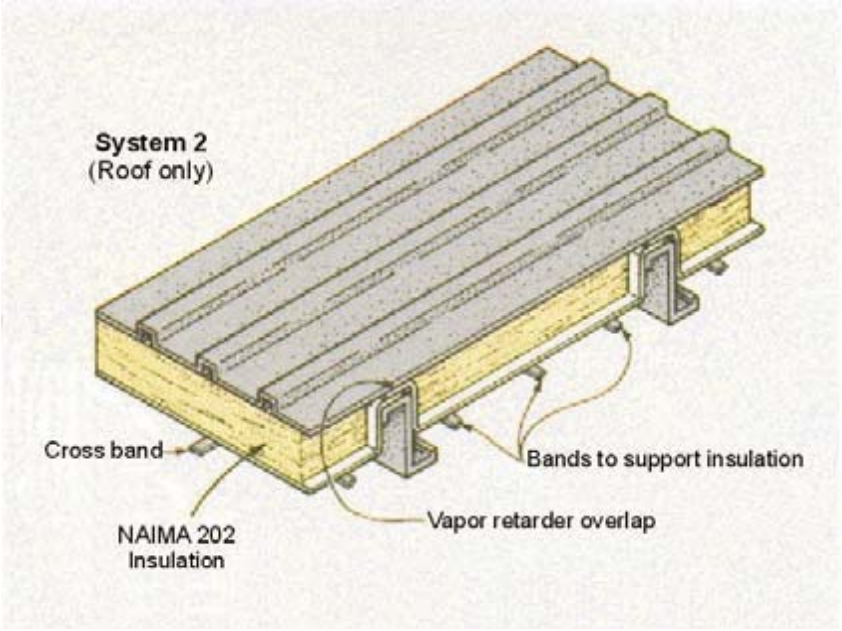
Table G3.1.4 Schedules - Proposed (cont'd)

- HVAC Fan Schedules
  - When spaces are
    - Occupied – fans run continuously
    - Unoccupied – fans cycle on and off to meet heating and cooling loads
  - Exception
    - When heating and/or cooling system simulated only to meet Appendix G requirements fans may be modeled to cycle on and off to meet heating and cooling loads during ALL hours

Table G3.1.4 Schedules - Baseline

- Same as Proposed
- Exception
  - ➢ May differ if approved by rating authority
    - If necessary to model non-standard efficiency measures
      - – Examples:
        - » Lighting controls
        - » Natural ventilation
        - » Demand control ventilation
        - » Measures that reduce service water heating loads

Table G3.1.5 Building Envelope



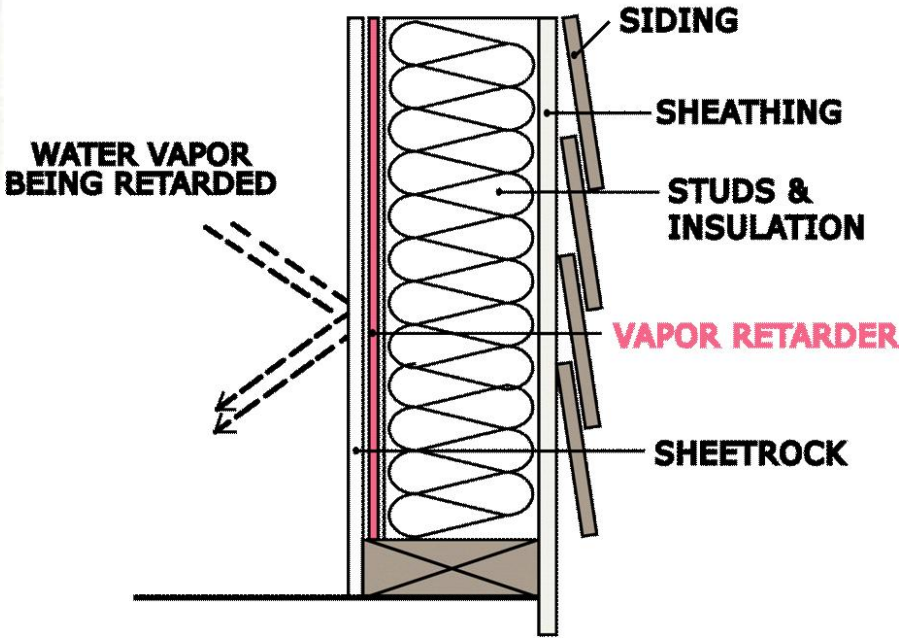


Table G3.1.5 Building Envelope – Proposed

- Model all components as shown on architectural drawings or as built for existing buildings
- Exceptions
  - Assemblies that cover < 5% of total area of that assembly type may be added to the area of a similar assembly with same orientation and thermal properties
  - However, uninsulated assemblies **must** be separately modeled

Table G3.1.5 Building Envelope - Proposed (cont'd)

- Similarly oriented surfaces can be grouped under a single tilt or azimuth if
  - Azimuth orientation and tilt differ by < 45º

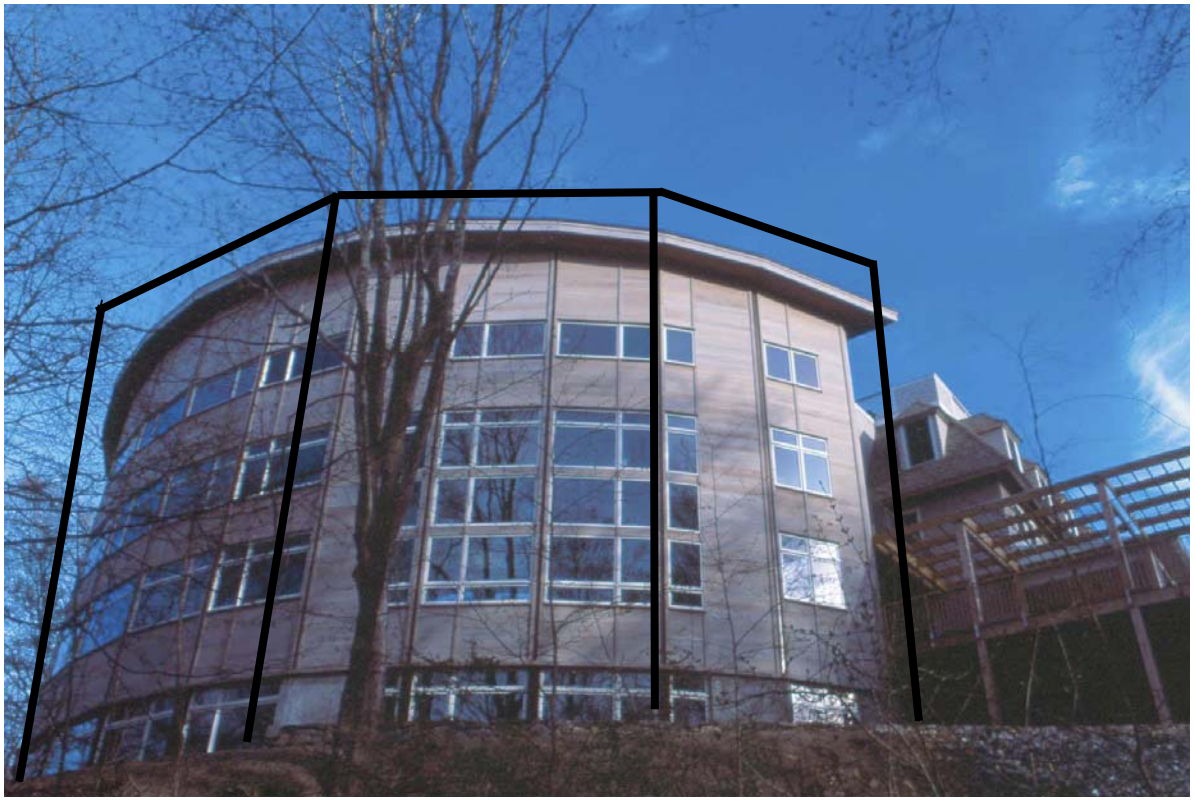


Table G3.1.5 Building Envelope - Baseline

- Same dimension and gross area as proposed for each exterior envelope component type
  - Walls
  - Roof
  - Floor

Table G3.1.5 Building Envelope - Baseline (cont'd)

- Opaque assemblies – use lightweight construction
  - New buildings or additions
    - Use maximum prescriptive U-factors from Tables 5.5-1 through 5.5-8 and the following assembly types
      - Roofs – insulation entirely above deck
      - Above-grade walls – steel-framed
      - Floors – steel-joist
      - Slabs – match prescriptive F-factor for unheated slabs
  - Alterations
    - Conform with prescriptive requirements in 5.1.3
  - **Credits mass construction**

Table G3.1.5 Building Envelope - Proposed Roof Albedo

- Roofs modeled with
  - Reflectance 0.45 if
    - Reflectance > 0.70 and Emittance > 0.75
      - Based on ASTM testing standards
  - Reflectance 0.30
    - For all other roof surfaces

Table G3.1.5 Building Envelope - Baseline Roof Albedo

- Roof albedo – model all roof surfaces with reflectivity of 0.30

Photo from US EPA

Table G3.1.5 Building Envelope - Proposed Vertical Fenestration

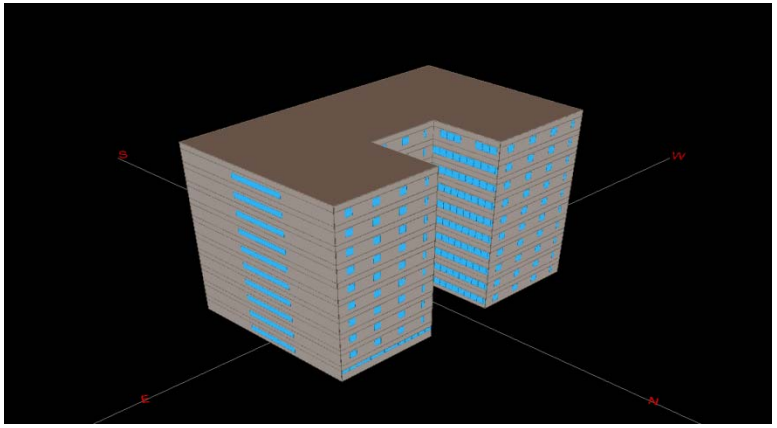
- Fenestration area, U-factor, and SHGC
  - As designed
- Fenestration shading devices
  - Manual – not modeled
  - Automatically controlled – may be modeled
  - Permanent devices – may be modeled

Table G3.1.5 Building Envelope - Baseline Vertical Fenestration

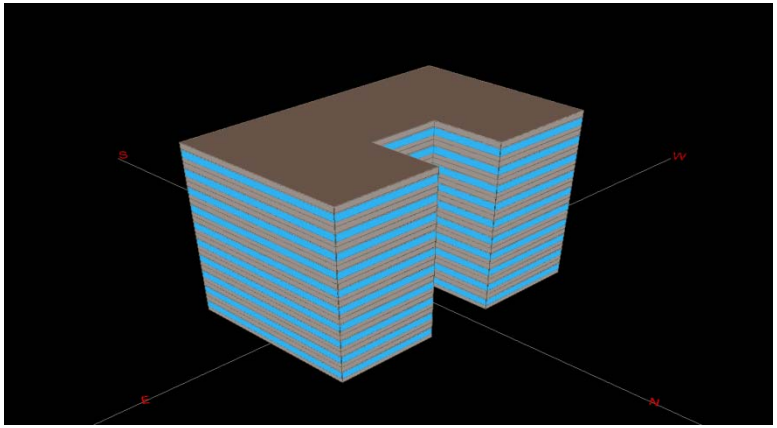
- Thermal and shading properties
  - U-factors and SHGC match requirements in Tables 5.5-1 through 5.5-8 for U_{fixed} and $SHGC_{all}$
  - Modeled as fixed and flush with exterior wall
  - No shading projections or manual shading devices modeled

Table G3.1.5 Building Envelope - Baseline Vertical Fenestration

- Fenestration Area
  - Area equals proposed or **40%** of gross **above-grade** wall area, whichever is smaller
  - Distributed uniformly in horizontal bands across the all orientations



Proposed



Baseline

Table G3.1.5 Building Envelope - Baseline Building Orientation

- Building Orientation
  - Simulate with actual orientation and again after rotating the entire building 90º, 180º, 270º, then average the results. Model the building so it doesn't shade itself
  - **Credits optimized orientation**

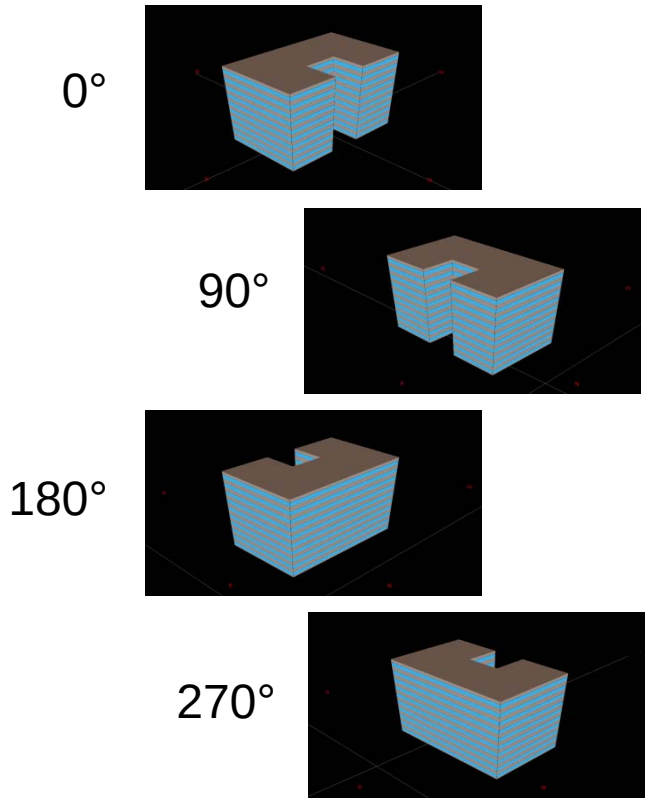


Table G3.1.5 Building Envelope - Proposed Skylights

- Matches design area, tilt, thermal and shading properties

Table G3.1.5 Building Envelope - Baseline Skylights

- Skylight area = proposed or 5% of gross roof area, whichever is smaller
- If skylight area > 5% of gross roof area
  - Decrease size of each skylight until total skylight area is exactly 5%
- Skylight orientation and tilt = proposed
- Skylight U-factor and SHGC match requirements in Tables 5.5-1 through 5.5-8

Table G3.1.5 Building Envelope – Proposed – Existing Buildings

- Existing Buildings
  - Modeled as modified on architectural drawings or as existing if unchanged

Table G3.1.5 Building Envelope - Baseline – Existing Buildings

- Existing Buildings
  - Model existing conditions prior to any revisions

Table G3.1.6 Lighting

Table G3.1.6 Lighting – Proposed Lighting Power

- Complete **existing** system
  - Use actual existing lighting power
- Lighting system **designed**
  - Use designed lighting power
- No existing lighting or specified
  - Determine with Building Area Method for appropriate building type

Table 9.5.1 Lighting Power Densities Using the Building Area Method

Building Area Type[a]	Lighting Power Density (W/ft2)
Automotive Facility	0.9
Convention Center	1.2
Court House	1.2
Dining: Bar Lounge/Leisure	1.3
Dining: Cafeteria/Fast Food	1.4
Dining: Family	1.6
Dormitory	1.0
Exercise Center	1.0
Gymnasium	1.1
Health Care-Clinic	1.0
Hospital	1.2

Table G3.1.6 Lighting – Proposed Lighting Power

- Include all lighting system components shown on plans (including task and furniture mounted)
  - Exception
    - Multifamily living units, hotel/motel guest rooms, and other spaces with lighting systems not shown on plans
      - Assume identical lighting for proposed and baseline in simulations
- Include lighting power for parking garages and building facades

Table G3.1.6 Lighting – Baseline Lighting Power

- Lighting power = max. allowed in Chapter 9 using Building Area or Space-By-Space Method

Table 9.6.1 Lighting Power Densities Using the Space-by-Space Method

Common Space Types[a]	LPD (W/ft2)	Building Specific Space Types	LPD (W/ft2)
Office-Enclosed	1.1	Gymnasium/Exercise Center	
Office-Open Plan	1.1	Playing Area	1.4
Conference/Meeting/Multipurpose	1.3	Exercise Area	0.9
Classroom/Lecture/Training	1.4	Courthouse/Police Station/Penitentiary	
For Penitentiary	1.3	Courtroom	1.9
Lobby	1.3	Confinement Cells	0.9
For Hotel	1.1	Judges Chambers	1.3
For Performing Arts Theater	3.3	Fire Stations	

Table G3.1.6 Lighting – Proposed Lighting Controls

- Credit may be taken for automatically controlled lighting systems beyond prescriptive requirements of Chapter 9
  - By reducing the connected lighting power following Table G3.2 **OR**
  - By modifying the schedules used for the proposed design

TABLE G3.2 Power Adjustment Percentages for Automatic Lighting Controls

Automatic Control Device(s)	Non-24-h and ≤5000 ft^2	All Other
1. Programmable timing control	10%	0%
2. Occupancy sensor	15%	10%
3. Occupancy sensor and programmable timing control	15%	10%

Table G3.1.6 Lighting – Proposed Lighting Controls

- Automatic daylighting controls
  - May take credit if:
    - Modeled directly in building simulation OR
    - Modeled in building simulation through schedule adjustments determined by a separate daylighting analysis approved by rating authority

Table G3.1.6 Lighting – Baseline Lighting Controls

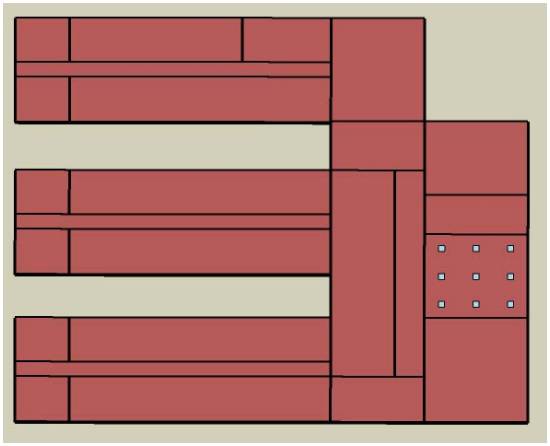
- Lighting schedules are understood to reflect mandatory control requirements in the Chapter 9
- No additional automatic lighting controls modeled

Table G3.1 HVAC Systems

Table G3.1.7 Thermal Blocks HVAC Zones Designed - Proposed

- Model each HVAC zone separately
  - As shown on HVAC design drawings
  - Exception
    - Can combine zones if all these are met:
      - all of the space use classifications are the same
      - when adjacent to glazed exterior walls orientations vary by < 45º
      - all zones served by same HVAC system or by same kind of HVAC system

Table G3.1.7 Thermal Blocks – HVAC Zones Designed - Baseline



Baseline = Proposed

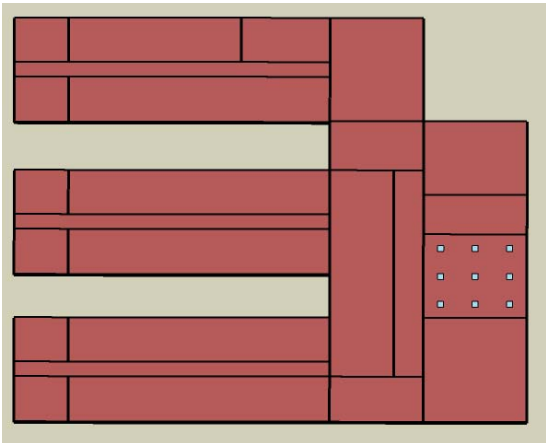


Table G3.1.8 Thermal Blocks – HVAC Zones Not Designed - Proposed

- Define thermal blocks based on:
  - Internal load densities
  - Occupancy patterns
  - Lighting
  - Thermal and space temperature
  - Schedules
  - Orientation
  - Proximity to exterior surfaces

Table G3.1.8 Thermal Blocks – HVAC Zones Not Designed – Proposed (cont'd)

- Rules
  - Separate thermal blocks for interior and perimeter spaces
    - Interior space – located > 15 ft from an exterior wall
    - Perimeter space – located within 15 ft of an exterior wall
  - Separate thermal blocks for spaces
    - adjacent to glazed exterior walls
    - for each major orientation
      - Exception - orientations that differ by < 45º may be combined

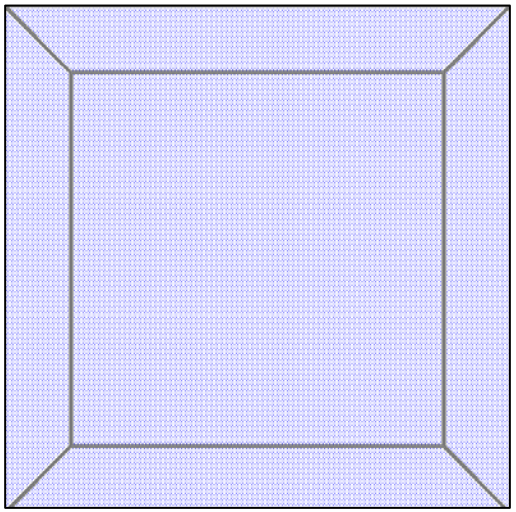
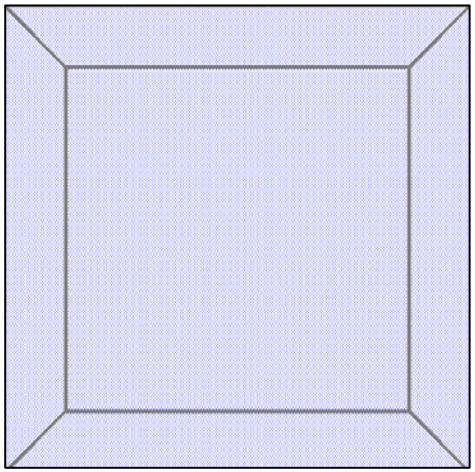


Table G3.1.8 Thermal Blocks – HVAC Zones Not Designed – Proposed (cont'd)

- Each zone to include all floor area ≤ 15 ft from a glazed perimeter wall
  - Exception
    - Floor area within 15 ft of glazed perimeter walls with more than one orientation shall be divided proportionately between zones
- Separate top, bottom, and middle floors



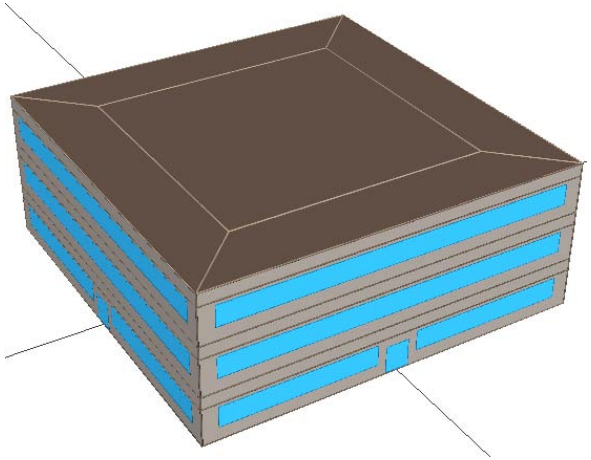
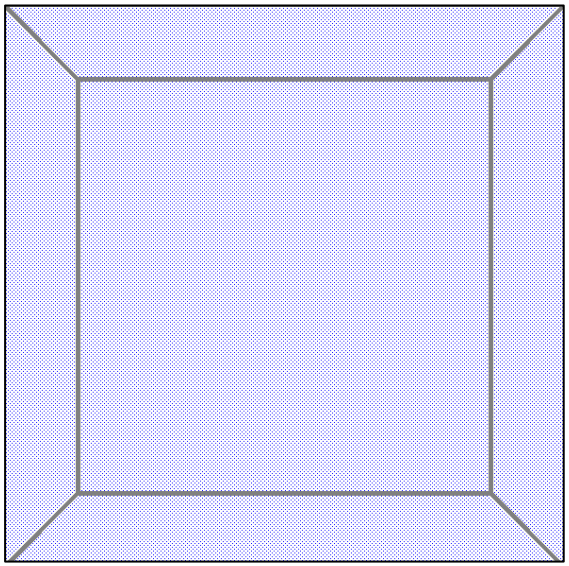


Table G3.1.8 Thermal Blocks – HVAC Zones Not Designed – Baseline

- Same as Proposed



Baseline = Proposed

Table G3.1.9 Thermal Blocks – Multifamily Residential Buildings - Proposed

- Modeled using at least one thermal block per living unit
  - Exception
    - Units facing same orientation may be combined
- Corner units and units with roof or floor loads only combined with similar units

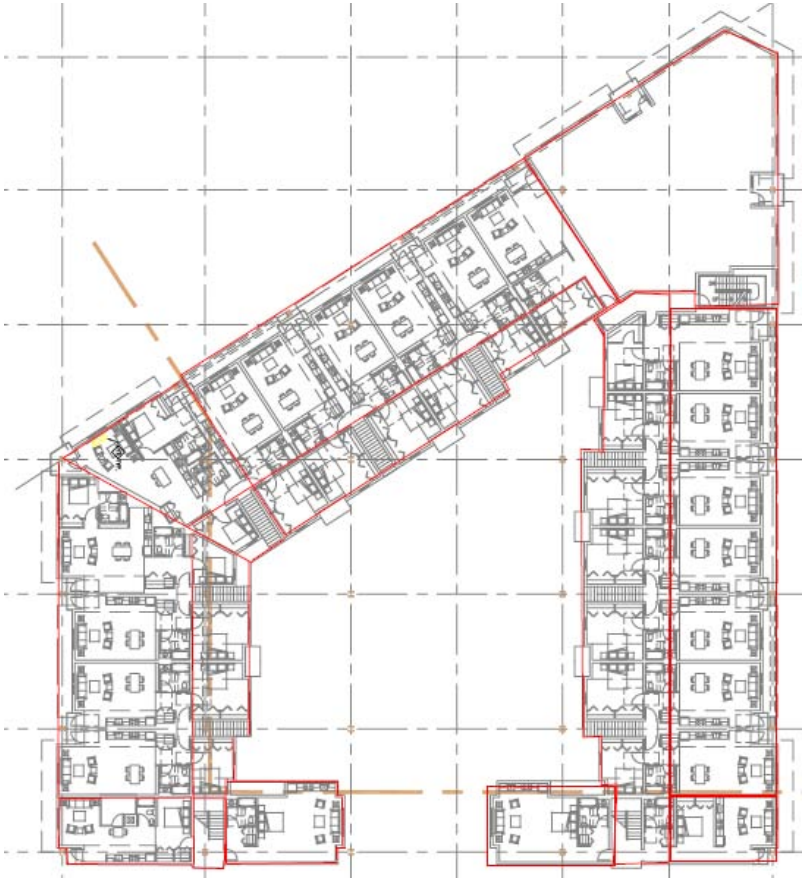
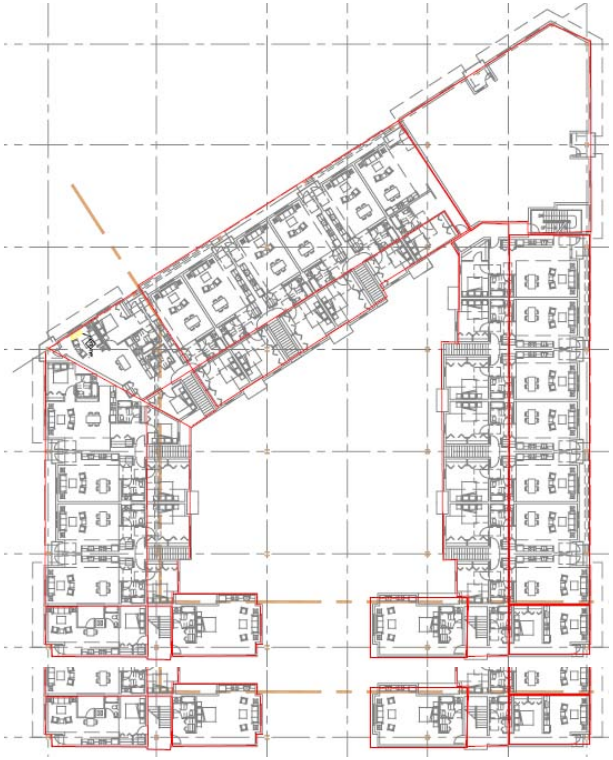


Table G3.1.9 Thermal Blocks – Multifamily Residential Buildings - Baseline

- Same as proposed



Baseline = Proposed

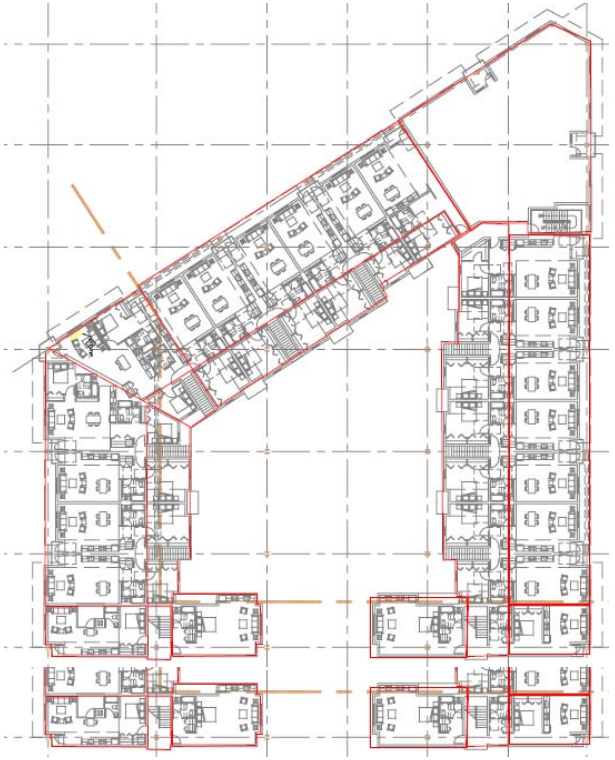


Table G3.1.10 HVAC Systems – Proposed

- Where a complete system already exists
  - model reflects existing system type using actual capacities and efficiencies
- Where a system is designed
  - HVAC model consistent with design documents
  - Mechanical equipment efficiencies adjusted from design conditions to standard rating conditions (if required by simulation model)

Table G3.1.10 HVAC Systems – Proposed (cont'd)

- Where no heating system exists or is specified
  - Assume heating system classification is electric
  - System characteristics to be identical to baseline
- Where no cooling system exists or is specified
  - Assume cooling system is identical to baseline

Table G3.1.10 HVAC Systems Baseline

- Type of HVAC system based on
  - Building use, number of floors, area, heating source
  - **Credits good system selection**

TABLE G3.1.1A *Baseline* HVAC System Types

Building Type	Fossil Fuel, Fossil/Electric Hybrid, & Purchased Heat	Electric and Other
Residential	System 1 – PTAC	System 2 - PTHP
Nonresidential & 3 Floors or Less & <75,000 ft^2	System 3 – PSZ-AC	System 4 – PSZ-HP
Nonresidential & 4 or 5 Floors & <75,000 ft^2 or 5 Floors or Less & 75,000 ft^2 to 150,000 ft^2	System 5 - Packaged VAV w/ Reheat	System 6 - Packaged VAV w/PFP Boxes
Nonresidential & More than 5 Floors or >150,000 ft^2	System 7 - VAV w/Reheat	System 8 - VAV w/PFP Boxes

HVAC Systems Baseline (cont'd)

- Exceptions
  - Use additional system types for mixed use buildings (residential/nonresidential)
    - If conditions apply to > 20,000 ft^2 of conditioned floor area
  - Use separate single-zone systems (System 3 or System 4) for spaces significantly different
    - Occupancy, loads, schedules
    - Examples: computer server rooms, natatoriums, kitchens.
  - Use separate single-zone systems (System 3 or System 4) for spaces with special pressurization or cross contamination requirements.
    - Labs, isolation rooms, clean rooms

Table G3.1.1B HVAC Systems Baseline

- System Description Table

TABLE G3.1.1B *Baseline* System Descriptions

System No.	System Type	Fan Control	Cooling Type	Heating Type
1. PTAC	Packaged terminal air conditioner	Constant Volume	Direct Expansion	Hot Water Fossil Fuel Boiler
2. PTHP	Packaged terminal heat pump	Constant Volume	Direct Expansion	Electric Heat Pump
3. PSZ-AC	Packaged rooftop air conditioner	Constant Volume	Direct Expansion	Fossil Fuel Furnace
4. PSZ-HP	Packaged rooftop heat pump	Constant Volume	Direct Expansion	Electric Heat Pump
5. Packaged VAV w/ Reheat	Packaged rooftop variable air volume with reheat	VAV	Direct Expansion	Hot Water Fossil Fuel Boiler
6. Packaged VAV w/PFP Boxes	Packaged rooftop variable air volume with reheat	VAV	Direct Expansion	Electric Resistance
7. VAV w/Reheat	Packaged rooftop variable air volume with reheat	VAV	Chilled Water	Hot Water Fossil Fuel Boiler
8. VAV w/PFP Boxes	Variable air volume with reheat	VAV	Chilled Water	Electric Resistance

G3.1.2 HVAC Systems – Baseline

- General System Requirements
  - Purchased heat
  - Equipment efficiency
  - Equipment capacity
  - Preheat coils
  - Fan operation
  - Ventilation
  - Economizers
  - Design airflow rate
  - Fan power
  - Energy recovery

G3.1.1.1- Baseline Purchased Heat

- Purchased Heat
  - Hot water or steam costs based on actual utility rates
  - Baseline building – use same purchased hot water or steam source and rate
  - Onsite boilers are not modeled

G3.1.2.1 Baseline Equipment Efficiencies

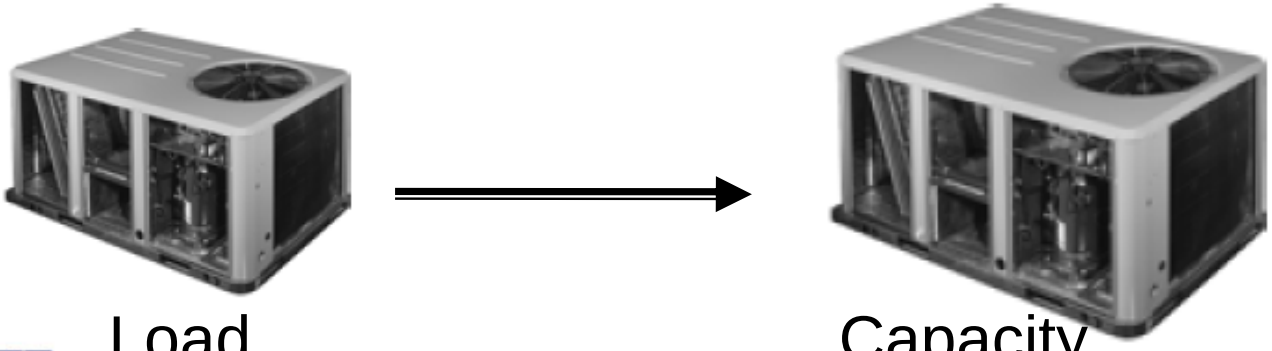
- All HVAC equipment in baseline modeled at minimum efficiency levels, both part load and full load, in accordance with Section 6.4 (prescriptive minimums)
- Remove fan energy from ratings such as EER and COP which include fan energy
  - Fan energy is modeled separately

Electric Input Ratio (EIR) = (1-R) / (EER/3.413 +R)

Where R is the ratio of Supply fan power to total system power at the rating condition.

G3.1.2.2 Baseline Equipment Capacities

- Based on sizing runs for each orientation
  - Using historical weather data OR
  - Design day
    - Heating design 99.6%
    - Cooling design 1% dry-bulb and 1% wet bulb
- Oversized by
  - 15% for cooling
  - 25% for heating
- **Credits proper equipment sizing**



Load

Capacity

G3.1.2.2 Baseline Equipment Capacities (con't)

- Unmet load hours
  - Not to exceed 300 (of 8760) – proposed or baseline
    - If > 300, simulated capacities should be increased incrementally, until < 300 hours OR
    - Excess approved by rating authority
  - Proposed not to exceed baseline by > 50 hours
    - If > 50, size of equipment in baseline should be reduced incrementally until < 50 hours

G3.1.2.3 Baseline Preheat Coils

- Same as proposed

"If the HVAC system in the proposed design has a preheat coil … the baseline system shall be modeled with a preheat coil controlled in the same manner as the proposed design."

G3.1.2.4 Baseline Fan System Operation

- Supply and return fans
  - Operate continuously whenever spaces are occupied
  - Cycled to meet heating and cooling loads during unoccupied hours

G3.1.2.5 Baseline Ventilation

- Minimum OA ventilation rates the same for proposed and baseline
- Exception
  - When modeling demand-control ventilation in proposed design when its use isn't required by 6.4.3.8 (Ventilation Controls for High-Occupancy Areas)

G3.1.2.6 Baseline Economizers

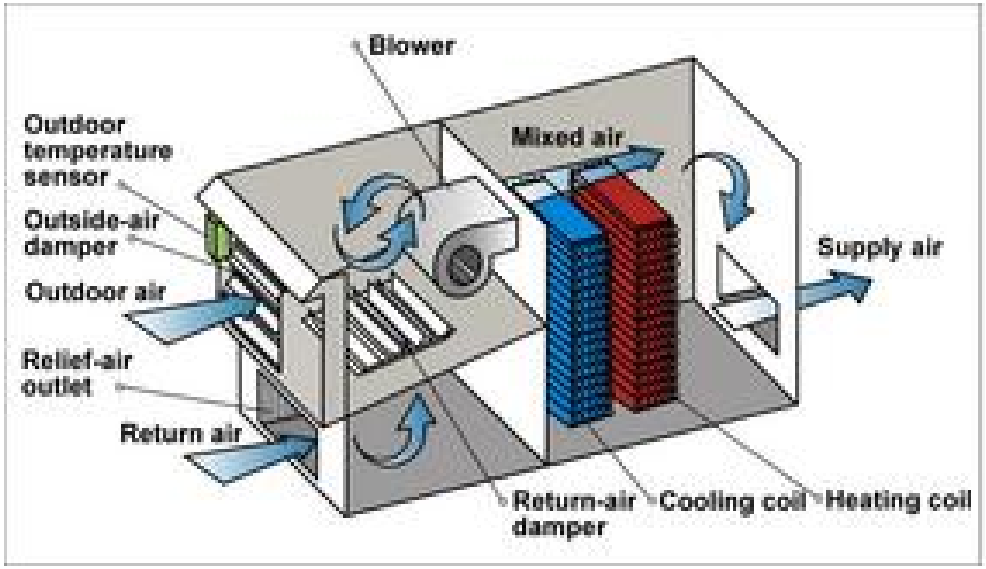
- HVAC Systems 1 and 2 – no economizers
- HVAC Systems 3 and 4, depending on
  - Climate
  - Floor area
  - Type of zone (interior or perimeter)
- HVAC Systems 5-8 - based on climate
- Economizer controls include drybulb high limit

TABLE G3.1.2.6B Climate Conditions under which Economizers are Included for Baseline Systems 5 through 8

Climate Zone	Conditions
1a,1b,2a,3a,4a	N.R.
Others	Economizer Included
N.R. means that there is no conditioned building floor area for which economizers are included for the type of zone and climate.	

G3.1.2.6 Baseline Economizers - Exceptions

- Don’t include economizers for systems meeting one or more of the following:
  - Systems that include gas-phase air cleaning to meet the requirements of 6.1.2 of Standard 62
  - Supermarket with open refrigerated casework
    - Exceptions only used if proposed doesn’t use an economizer



G3.1.2.8 Baseline Design Air Flow Rates

- Baseline
  - System design supply air flow rates based on a supply-air-to-room air temperature difference of 20°F
  - If return or relief fans are specified in proposed, baseline shall also be modeled

G3.1.2.9 Baseline Fan Power

- System fan electrical power for supply, return, exhaust, and relief (excluding power to fan-powered VAV boxes)

$$P_{fan} = 746 / (1 - e^{[-0.2437839 \times \ln(bhp) - 1.685541]}) \times bhp$$

TABLE G3.1.2.9 Baseline Fan Brake Horsepower

Supply Air Volume	*Baseline* Fan Motor Brake Horsepower	
	Constant Volume Systems 1 – 4	Variable Volume Systems 5 – 8
<20,000 cfm	17.25 + (cfm - 20000) x 0.0008625	24 + (cfm - 20000) ×0.0012
≥20,000 cfm	17.25 + (cfm - 20000) x 0.000825	24 + (cfm - 20000) ×0.001125

G3.1.2.9 Baseline Fan Power (cont'd)

- Exception
  - Credit for systems that require high pressure drop filtration

$$\text{Pressure Credit (watts)} = CFM_{filter} * (Sp_{filter} - 1)/4.984$$

Where

CFM_{filter} = supply air volume of the proposed system with air filtration system in excess of 1 in. w.c.

Sp_{filter} = air pressure drop of the filtering system in w.g. when the filters are clean

G3.1.2.10 Baseline Exhaust Air Energy Recovery

- Exhaust air energy recovery required for systems with
  - Supply air ≥ 5000 cfm and
  - Minimum outdoor air supply of ≥ 70%
- Must have minimum 50% energy recovery effectiveness
  - A change in enthalpy of the OA supply = 50% of difference between OA and return air at design conditions
- Must allow for economizer operation

G3.1.2.10 Baseline Exhaust Air Energy Recovery - Exceptions

- Exhaust air energy recovery not included in baseline design for:
  - Systems serving spaces that aren't cooled and are heated to < 60ºF
  - Systems exhausting toxic, flammable, or corrosive fumes or paint or dust*
  - Commercial kitchen grease hoods (Type 1)*
  - Heating systems in climate zones 1-3
  - Cooling only systems in climate zones 3c, 4c, 5b, 5c, 6b, 7, and 8
  - Where largest single exhaust source < 75% of design OA flow*
  - Systems requiring dehumidification that employ energy recovery in series with cooling coil*

*Exception only used if exhaust air energy recovery not used in proposed design

G3.1.3 System-Specific Baseline HVAC System Requirements

- System Specific Requirements
  - Heat pumps
  - Boilers
  - Chillers
  - Heating and chilled water supply temperature and reset
  - Heating and chilled water pumps
  - Piping losses
  - Heat rejection equipment
  - Supply air temperature reset
  - VAV minimum flow
  - Fan powered terminal units
  - VAV part load performance

G3.1.3.1 Heat Pumps (Baseline Systems 2 and 4)

- Electric air-source heat pumps modeled with electric auxiliary heat
- Systems controlled with
  - Multi-stage space thermostats and
  - An outdoor air thermostat
    - Wired to energize auxiliary heat only on the last thermostat stage and when outdoor air temperature is less than 40°F

G3.1.3.2 Boilers (Baseline Systems 1, 5, and 7)

- Boiler shall use the same fuel as proposed and should be natural draft
- Buildings ≤15,000 ft^2 – single boiler
- Buildings >15,000 ft^2 – two equally sized boilers
- Boilers should be staged as required by the load
- If proposed uses purchased heat, baseline uses purchased heat (G3.1.1.1)

G3.1.3.3 Hot Water Supply Temp (Baseline Systems 1, 5, and 7)

- Supply HW modeled at 180°F
- Return HW modeled at 130°F

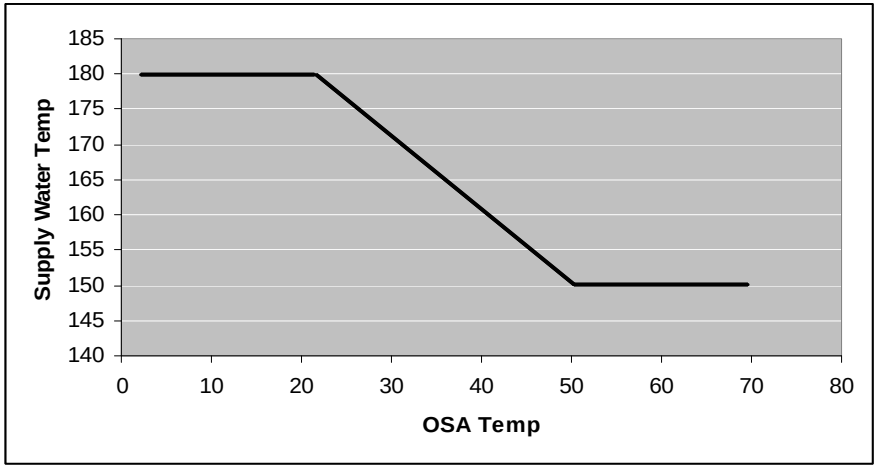
Photo from LBL

G3.1.3.4 Hot Water Supply Temperature Reset (Baseline Systems 1, 5, and 7)

- Reset based on outdoor dry-bulb temperature using the following schedule:
  - 180°F HW at 20°F OSA and below
  - 150°F HW at 50°F OSA and above
  - Between 20°F and 50°F OSA
    - Ramped linearly between 180°F and 150°F HW

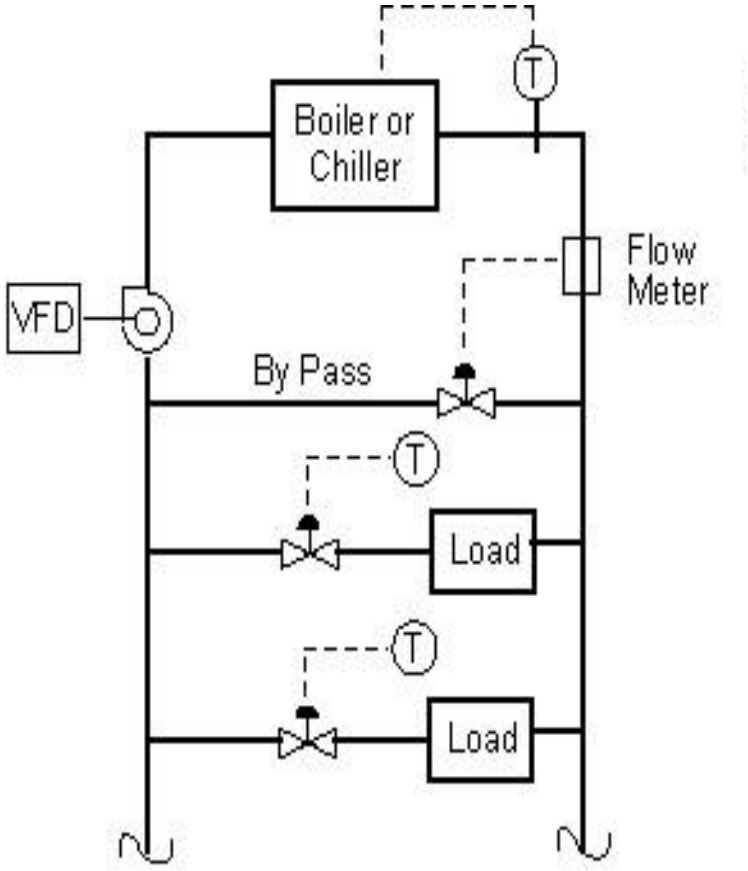
OSA Temp	Hot Water Temp
20^0 F.	180^0 F.
50^0 F.	150^0 F.

Heating Water Reset



G3.1.3.5 Hot Water Pumps (Baseline Systems 1, 5, and 7)

- Baseline hot water pump power = 19 W/gpm
- Pumping system should be modeled as primary-only with continuous variable flow
- Hot water systems serving
  - Buildings ≥ 120,000 ft^2
    - Pump modeled with variable-speed drives
  - Buildings < 120,000 ft^2
    - Pump modeled as riding the pump curve



Primary Only Pumping System

G3.1.3.6 Piping Losses (Baseline Systems 1, 5, 7, and 8)

- Piping losses not modeled in either proposed or baseline for
  - Hot water,
  - Chilled water, or
  - Steam piping

G3.1.3.7 Type and Number of Chillers (Baseline Systems 7 and 8)

- Electric chillers should be used in baseline regardless of cooling energy source. For example:
  - Direct-fired absorption
  - Absorption from purchased steam
  - Purchased chilled water (unlike rule for purchased heat)

G3.1.3.7 Type and Number of Chillers (Baseline Systems 7 and 8)

- Number and type of chillers in the Baseline Building are determined by Table G3.1.3.7 as a function of building conditioned floor area

TABLE G3.1.3.7 Type and Number of Chillers

Building-Conditioned Floor Area	Number and Type of Chiller(s)
≤120,000 ft2	1 screw chiller
> 120,000 ft2, < 240,000 ft2	2 screw chillers sized equally
≥240,000 ft2	2 centrifugal chillers minimum with chillers added so that no chiller is larger than 800 tons, all sized equally

G3.1.3.8 Chilled Water Design Supply Temperature (Systems 7 and 8)

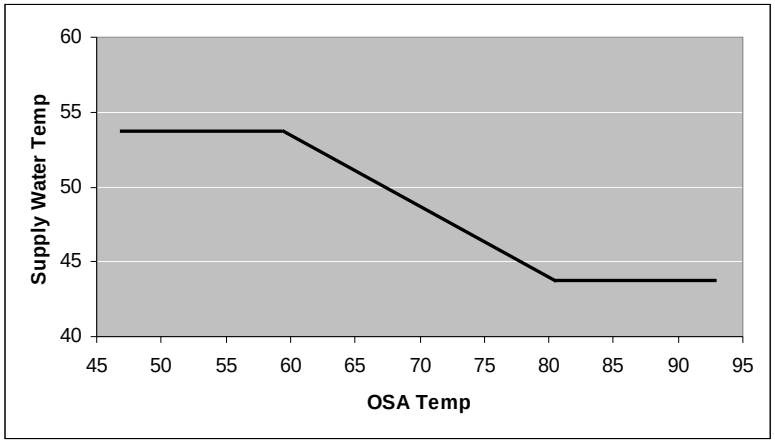
- Supply CHW modeled at 44˚F
- Return CHW modeled at 56˚F

G3.1.3.9 Chilled Water Supply Temperature Reset (Systems 7 and 8)

- Reset based on outdoor dry-bulb temperature using the following schedule:
  - 44°F CHW at 80°F OSA and above
  - 54°F CHW at 60°F OSA and below
  - Between 80°F and 60°F OSA
    - Ramped linearly between 44°F and 54°F CHW

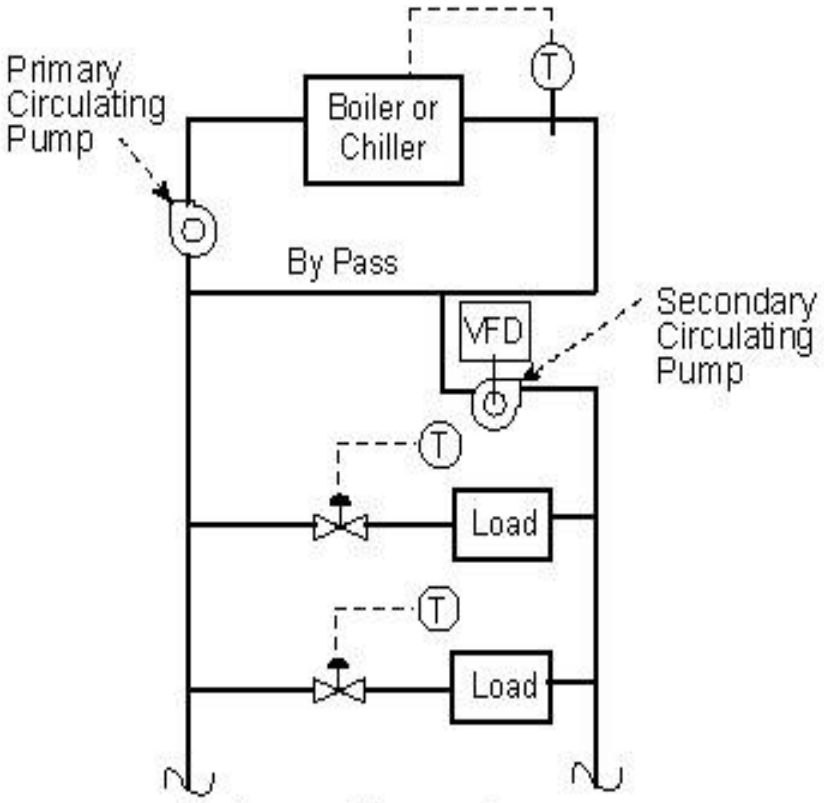
OSA Temp	Chilled Water Temp
80^0 F.	44^0 F.
60^0 F.	54^0 F.

Chilled Water Reset



G3.1.3.10 Chilled Water Pumps (Baseline Systems 7 and 8)

- Baseline chilled water pump power = 22 W/gpm
- Pumping system modeled as primary/secondary with variable flow on the secondary loop
- Systems serving
  - Buildings ≥ 120,000 ft^2
    - Secondary Pump modeled with variable-speed drives
  - Buildings < 120,000 ft^2
    - Secondary pump modeled as riding the pump curve



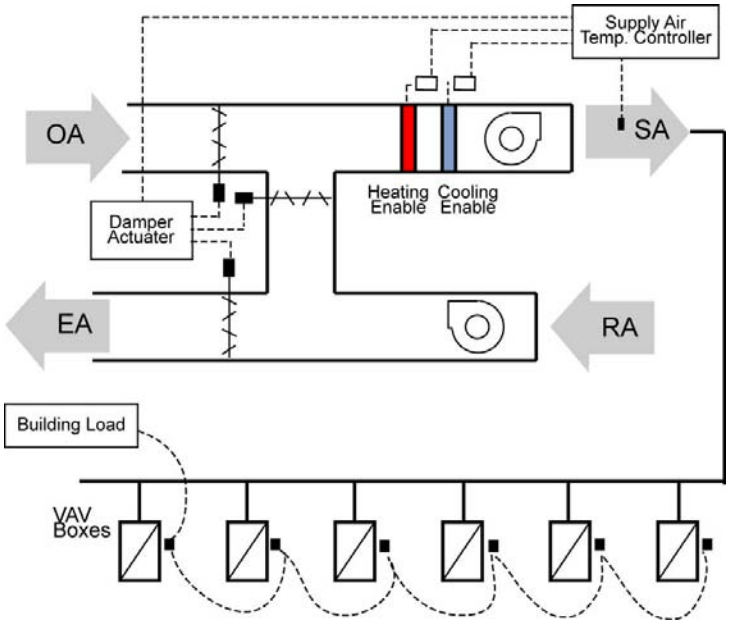
Primary/Secondary Pumping System

G3.1.3.11 Heat Rejection (Baseline Systems 7 and 8)

- Cooling tower with two-speed axial fans
- Condenser water design supply temperature should be 85°F or 10°F approach to design wet-bulb temperature, whichever is lower, with a design temperature rise of 10°F
- Tower controlled to maintain a 70°F leaving water temperature where weather permits, floating up to leaving water temperature at design conditions
- Condenser water pump power = 19 W/gpm
- 1 condenser water pump and 1 chilled water pump per chiller
- Pumps interlocked to operate with the associated chiller

G.3.1.3.12 Supply Air Temperature Reset (Baseline Systems 5 through 8)

- Supply air temperature reset
  - Based on zone demand from design temperature difference to a 10ºF temperature difference under minimum load conditions
  - Design air flow rates
    - Sized for reset supply air temperature (i.e., a 10ºF temperature difference)

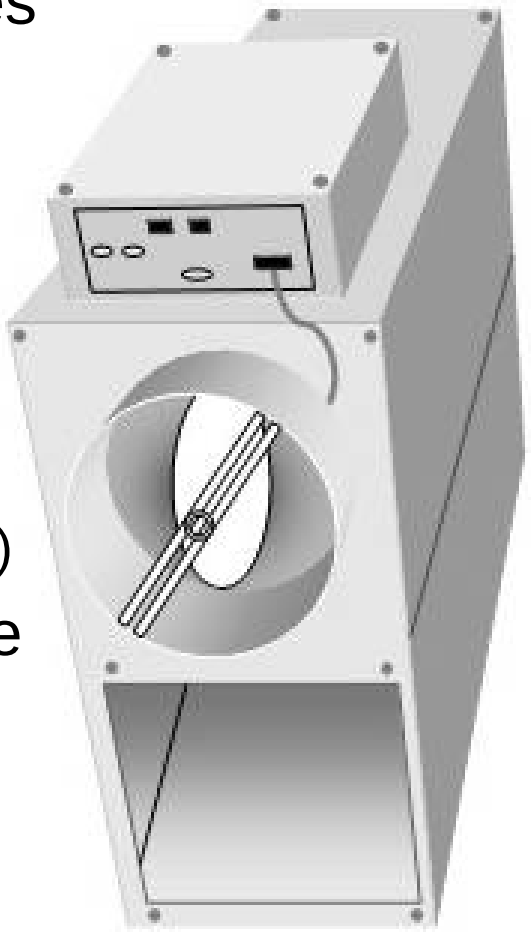


G.3.1.3.13 VAV Minimum Flow Setpoints (Baseline Systems 5 and 7)

- Minimum volume setpoints for VAV reheat boxes
  - 0.4 cfm/ft^2 of floor area served

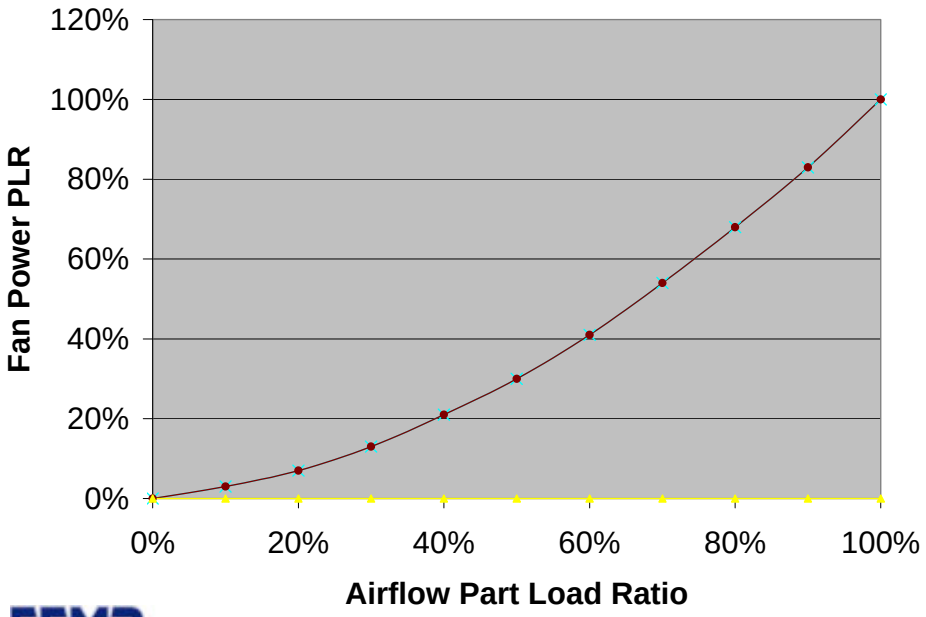
G.3.1.3.14 Fan Powered Terminal Units (Baseline Systems 6 and 8)

- Fans in parallel VAV fan-powered boxes
  - Sized for 50% of peak design flow rate
  - Modeled with 0.35 W/cfm fan power
- Minimum volume setpoints for fan-powered boxes
  - Equal to 30% of peak design flow rate OR
  - Rate required to meet the minimum OA ventilation requirement (whichever is larger)
- Supply air temperature setpoint shall be constant at design condition



G.3.1.3.15 VAV Fan Part-Load (Baseline Systems 5 through 8)

- VAV system supply fans
  - Modeled with variable-speed drives with part-load performance from Table G3.1.3.15



Method 1 – Part-Load Fan Power Data	
Fan Part-Load Ratio	**Fraction of Full-Load Power**
0.00	0.00
0.10	0.03
0.20	0.07
0.30	0.13
0.40	0.21
0.50	0.30
0.60	0.41
0.70	0.54
0.80	0.68
0.90	0.83
1.00	1.00
Method 2 – Part-Load Fan Power Equation	
$P_{fan} = 0.0013 + 0.1470 \times PLR_{fan} + 0.9506 \times (PLR_{fan})^2 - 0.0998 \times (PLR_{fan})^3$	
where	
P_{fan} = fraction of full-load fan power and	
PLR_{fan} = fan part-load ratio (current cfm/design cfm).	

Table G3.1.11 Service Hot Water Systems

Table G3.1.11 Service Hot Water Systems – Proposed

- If a complete SHW system exists:
  - use existing component capacities and efficiencies
- If a system is specified:
  - model consistent with design documents
- If no system exists or specified, but building will have SHW loads:
  - Model system to match baseline, serving same hot water loads
- If there will be no SHW loads:
  - No system should be modeled

Table G3.1.11 Service Hot Water Systems – Baseline

- Use same energy source as Proposed
- If a complete system exists:
  - use existing component capacities and efficiencies
- If system specified:
  - Model equipment to match minimum efficiency requirements in 7.4.2
  - If proposed energy source is electric:
    - Heating method is electric resistance

Table G3.1.11 Service Hot Water Systems – Baseline (cont'd)

- If no system exists or specified, but building will have SHW loads:
  - Assume system with electric resistance heat
  - Match minimum efficiency requirements in 7.4.2
  - Model identically in proposed and baseline designs
- If there will be no SHW loads:
  - No system should be modeled
- If combined HW/SHW system specified:
  - Use separate systems meeting minimum efficiency requirements applicable of each system individually

Table G3.1.11 Service Hot Water Systems – Baseline (cont'd)

- For large, 24-hour/day facilities that meet prescriptive criteria for use of condenser heat recovery systems per 6.5.6.2
  - System is included in baseline design regardless of exceptions to 6.5.6.2
  - Exception
    - If a condenser heat recovery system meeting 6.5.6.2 can't be modeled
      - Requirement for including such a system in the actual building shall be met as a prescriptive requirement per 6.5.6.2
      - No heat recovery system included in proposed or baseline designs

Table G3.1.12 Receptacle and Other Loads - Proposed

- Should be estimated based on building type or space type category
- Include loads in simulations and when calculating proposed and baseline performance
- But for Federal Building Standards do not include in % savings calculations

Table G3.1.12. Receptacle and Other Loads - Baseline

- Modeled same as proposed
  - Unless authorized by rating authority
- Motors covered by Section 10
  - Modeled as having the lowest efficiency allowed

TABLE 10.8 Minimum Nominal Efficiency for General Purpose Design A and Design B Motors[a]

	Minimum Nominal Full-Load Efficiency (%)					
	Open Motors			Enclosed Motors		
Number of Poles ==>	**2**	**4**	**6**	**2**	**4**	**6**
Synchronous Speed (RPM) ==>	**3600**	**1800**	**1200**	**3600**	**1800**	**1200**
Motor Horsepower						
1	–	82.5	80.0	75.5	82.5	80.0
1.5	82.5	84.0	84.0	82.5	84.0	85.5
2	84.0	84.0	85.5	84.0	84.0	86.5
3	84.0	86.5	85.5	85.5	87.5	87.5

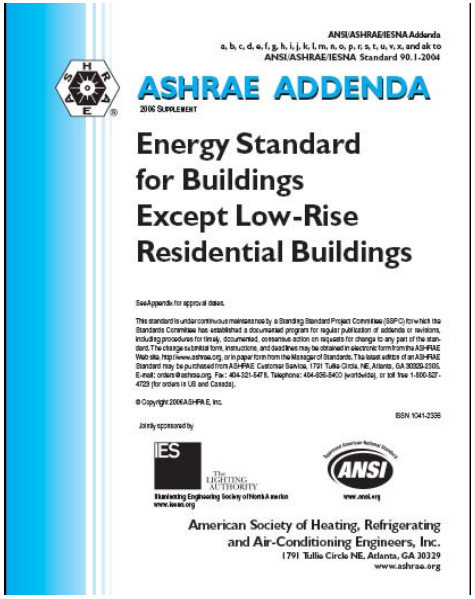
What's New for Appendix G 2007?

- Software Requirements
- Baseline System Selection
- Various Laboratory Fixes
- Fan Power Changes
- Baseline Chiller Selection
- Service Water Heating
- Other Changes

What's New for Appendix G 2007?

- Software Testing Requirements

"G.2.2.4 The simulation program shall be tested according to ANSI/ASHRAE Standard 140 and the results shall be furnished by the software provider"



What's New for Appendix G 2007?

- Baseline Vertical Fenestration

Table G3.1.5.5. Building Envelope

ASHRAE 90.1-2004:
"… shall be distributed uniformly in horizontal bands across the four orientations"

ASHRAE 90.1-2007
"… shall be distributed on each face of the building in the same proportion as in the proposed design"

What's New for Appendix G 2007?

- Lighting Power Diversity

ASHRAE 90.1-2004 Version:

Table G3.1.5.5. Lighting

"Lighting power in the proposed design shall be determined as follows:

(a) Where a complete lighting system exists, the actual lighting power shall be used in the model."

ASHRAE 90.1-2007

"Lighting power in the proposed design shall be determined as follows:

(a) Where a complete lighting system exists, the actual lighting power for each thermal block shall be used in the model."

What's New for Appendix G 2007?

- System Map

2004:

TABLE G3.1.1A *Baseline* HVAC System Types

Building Type	Fossil Fuel, Fossil/Electric Hybrid, & Purchased Heat	Electric and Other
Residential	System 1 – PTAC	System 2 - PTHP
Nonresidential & 3 Floors or Less & <75,000 ft2	System 3 – PSZ-AC	System 4 – PSZ-HP
Nonresidential & 4 or 5 Floors & <75,000 ft2or 5 Floors or Less & 75,000 ft2to 150,000 ft2	System 5 - Packaged VAV w/ Reheat	System 6 - Packaged VAV w/PFP Boxes
Nonresidential & More than 5 Floors or >150,000 ft2	System 7 - VAV w/Reheat	System 8 - VAV w/PFP Boxes

2007:

TABLE G3.1.1A *Baseline* HVAC System Types

Building Type	Fossil Fuel, Fossil/Electric Hybrid, & Purchased Heat	Electric and Other
Residential	System 1 – PTAC	System 2 - PTHP
Nonresidential & 3 Floors or Less & <25,000 ft2	System 3 – PSZ-AC	System 4 – PSZ-HP
Nonresidential & 4 or 5 Floors & <25,000 ft2or 5 Floors or Less & 25,000 ft2to 150,000 ft2	System 5 - Packaged VAV w/ Reheat	System 6 - Packaged VAV w/PFP Boxes
Nonresidential & More than 5 Floors or >150,000 ft2	System 7 - VAV w/Reheat	System 8 - VAV w/PFP Boxes

What's New for Appendix G 2007?

- System Assignments

"G3.1.1 Baseline HVAC Typed and Description.
For systems 1, 2, 3, and 4, each thermal block shall be modeled with its own HVAC system. For systems 5, 6, 7, and 8, each floor shall be modeled with a separate HVAC system. Floors with identical thermal blocks can be grouped for modeling purposes"

What's New for Appendix G 2007?

- Lab Updates

Various modifications to baseline based on "Labs 21"

- Lab system assignments
- Fan runtime requirements
- Peak design airflow determination
- Fan power requirements

What's New for Appendix G 2007?

- System Assignments – Laboratories

ASHRAE 90.1-2004 Version:

G3.1.1- Baseline HVAC System Type and Description

Exceptions to G3.1.1:

(c) If the baseline HVAC system type is 5, 6, 7, or 8, use separate single-zone systems conforming with the requirements of System 3 or System 4 (depending on building heat source) for any zones having special pressurization relationships, cross-contamination requirements, or code-required minimum circulation rates.

ASHRAE 90.1-2007 adds exception:

(d) Laboratory spaces with a minimum of 5000 cfm of exhaust shall use systems type 5 or 7, which reduce the exhaust and makeup air volume to 50% of design values during unoccupied periods. For all electric buildings the heating shall be electric resistance.

What's New for Appendix G 2007?

- Specifies Design Airflow Rates

G.3.1.2.8 Design Air Flow Rates

ASHRAE 90.1-2004 Version:

"System design supply air flow rates for the baseline building design shall be based on a supply-air-to-room-air temperature difference of 20°F. …..".

ASHRAE 90.1-2007 adds:

"System design supply air flow rates for the baseline building design shall be based on a supply-air-to-room-air temperature difference of 20°F or the required ventilation air or make up air whichever is greater……"

What's New for Appendix G 2007?

- G.3.1.2.4 Fan System Operation

ASHRAE 90.1-2004 Version:

"Supply and return fans shall operate continuously whenever spaces are occupied and shall be cycled to meet heating and cooling loads during unoccupied hours."

ASHRAE 90.1-2007 adds:

"Supply, return and/or exhaust fans shall remain on during occupied and unoccupied hours in spaces that have health and safety mandated minimum ventilation requirements during unoccupied hours"

What's New for Appendix G 2007?

- Simplifies Fan Power

Baseline Fan Power. "*System fan electrical power for supply, return, exhaust, and relief (excluding power to fan-powered VAV boxes) shall be calculated using the following formulas*:"

ASHRAE 90.1-2004 Version:

P_{fan} = 746 / (1 - e[-0.2437839 × ln(bhp) - 1.685541]) × bhp

ASHRAE 90.1-2007

For Systems 1 and 2

P_{fan} = CFM_S * 0.3

For Systems 3 through 8

P_{fan} = bhp x 746 / Fan Motor Efficiency

What's New for Appendix G 2007?

- Fan Power – Brake Horsepower

ASHRAE 90.1-2004:

TABLE G3.1.2.9 Baseline Fan Brake Horsepower

Supply Air Volume	*Baseline* Fan Motor Brake Horsepower	
	Constant Volume Systems 1 – 4	Variable Volume Systems 5 – 8
<20,000 cfm	17.25 + (cfm - 20000) x 0.0008625	24 + (cfm - 20000) × 0.0012
≥20,000 cfm	17.25 + (cfm - 20000) x 0.000825	24 + (cfm - 20000) × 0.001125

ASHRAE 90.1-2007:

TABLE G3.1.2.9 Baseline Fan Brake Horsepower

Baseline Fan Motor Brake Horsepower	
Constant Volume Systems 3–4	Variable Volume Systems 5–8
$CFM_s \cdot 0.00094 + A$	$CFM_s \cdot 0.0013 + A$

Where A is calculated according to Section 6.5.3.1.1 using the pressure drop adjustment from the proposed building design and the design flow rate of the baseline building system. Do not include pressure drop adjustments for evaporative coolers or heat recovery devices that are not required in the baseline building system by Section G3.1.2.10.

What's New for Appendix G 2007?

- Fan Power – Additional Credit Allowance

ASHRAE 90.1-2004:

Pressure Credit (watts) = CFM_{filter} * (SP_{filter} – 1)/4.984

where

CFM_{filter}= supply air volume of the proposed system with air filtration system in excess of 1 in. w.c.

SP_{filter} = air pressure drop of the filtering system in w.g. when the filters are clean.

What's New for Appendix G 2007?

- Fan Power – Additional Credit Allowance 2007

TABLE 6.5.3.1.1B Fan Power Limitation Pressure Drop Adjustment

Device	Adjustment
Credits	
Fully ducted return and/or exhaust air systems	0.5 in. w.c.
Return and/or exhaust airflow control devices	0.5 in. w.c.
Exhaust filters, scrubbers, or other exhaust treatment	The pressure drop of device calculated at fan system design condition
Particulate Filtration Credit: MERV 9 through 12	0.5 in. w.c.
Particulate Filtration Credit: MERV 13 through 15	0.9 in. w.c.
Particulate Filtration Credit: MERV 16 and greater and electronically enhanced filters	Pressure drop calculated at 2× clean filter pressure drop at fan system design condition
Carbon and other gas-phase air cleaners	Clean filter pressure drop at fan system design condition
Heat recovery device	Pressure drop of device at fan system design condition
Evaporative humidifier/cooler in series with another cooling coil	Pressure drop of device at fan system design condition
Sound Attenuation Section	0.15 in. w.c.
Deductions	
Fume Hood Exhaust Exception (required if 6.5.3.1.1 Exception [c] is taken)	–1.0 in. w.c.

What's New for Appendix G 2007?

- **G3.1.2.10 Exhaust Air Energy Recovery**

ASHRAE 90.1-2004 Version:

Current version doesn't exempt labs from Exhaust Air Energy Recovery in the baseline system.

ASHRAE 90.1-2007 adds exception h

(h) Systems serving laboratories with exhaust rates of 5,000 cfm or greater.

What's New for Appendix G 2007?

- Baseline Chiller Selection

2004 TABLE G3.1.3.7 Type and Number of Chillers

Building-Conditioned Floor Area	Number and Type of Chiller(s)
≤ 120,000 ft^2	1 screw chiller
> 120,000 ft^2, < 240,000 ft^2	2 screw chillers sized equally
≥ 240,000 ft^2	2 centrifugal chillers minimum with chillers added so that no chiller is larger than 800 tons, all sized equally

2007 TABLE G3.1.3.7 Type and Number of Chillers

Building Peak Cooling Load	Number and Type of Chiller(s)
≤300 tons (≤1055 kW)	1 water-cooled screw chiller
> 300 tons, < 600 tons (> 1055kW, < 2110 kW)	2 water-cooled screw chillers sized equally
≥600 tons (≥ 2110 kW)	2 water-cooled centrifugal chillers minimum with chillers added so that no chiller is larger than 800 tons (2813 kW), all sized equally

What's New for Appendix G 2007?

- Defines chilled water pumps power and hydronic loop type of baseline building

G3.1.3.10 Chilled Water Pumps

ASHRAE 90.1-2004

"The baseline building design pump power shall be 22 W/gpm. Chilled water systems serving 120,000 ft2 or more shall be modeled as primary/secondary systems with variable-speed drives on the secondary pumping loop. Chilled water pumps in systems serving less than 120,000 ft2 shall be modeled as primary/secondary systems with secondary pump riding the pump curve"

ASHRAE 90.1-2007

"The baseline building design pump power shall be 22 W/gpm. Chilled water systems with a cooling capacity of 300 Tons or more shall be modeled as primary/secondary systems with variable-speed drives on the secondary pumping loop. Chilled water pumps in systems serving less than 300 Tons cooling capacity shall be modeled as a primary/secondary systems with secondary pump riding the pump curve."

What's New for Appendix G 2007?

- VAV Minimum Turndown

G3.1.3.13 VAV Minimum Flow Setpoints (Systems 5 &7)

ASHRAE 90.1-2004:

"*Minimum volume setpoints for VAV reheat boxes shall be 0.4 cfm/ft2 of floor area served.*"

ASHRAE 90.1-2007:

"Minimum volume setpoints for VAV reheat boxes shall be 0.4 cfm/ft2 of floor area served or the minimum ventilation rate, whichever is larger."

What's New for Appendix G 2007?

- Credit for Cycling Fans

  Table G3.1– HVAC Fan Schedules Proposed Design

  "Schedules for HVAC fans that provide outdoor air for ventilation shall run continuously whenever spaces are occupied and shall be cycled on and off to meet heating and cooling loads during unoccupied hours."

What's New for Appendix G 2007?

- **Economizer Fix - Table Removed for 2007**

  "Outdoor air economizers shall be included in baseline HVAC Systems 3 and 4 as specified in Table G3.1.2.6A based on building conditioned floor area, whether the zone served is an interior or perimeter zone, and climate."

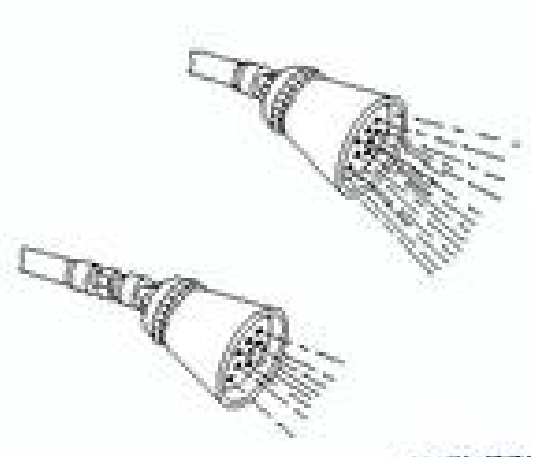
TABLE G3.1.2.6A Minimum Building Conditioned Floor Areas at Which Economizers Are Included for Baseline Systems 3 and 4

Climate Zone	Area Interior	Area Perimeter
1a,1b,2a,3a,4a	N.R.	N.R.
2b,5a,6a,7,8	15,000 ft2	N.R.
3b,3c,4b,4c,5b,5c,6b	10,000 ft2	25,000 ft2

N.R. means that there is no conditioned building floor area for which economizers are included for the type of zone and climate.

What's New for Appendix G 2007?

- Service Hot Water 2007 Updates
  - Allows credit for service HW reductions due to "documented water conservation measures"
  - Allows credit for service HW reductions due to "sanitizing technologies", heat recovery, etc.



What's New for Appendix G 2007?

- Receptacle and Other Unregulated Loads

ASHRAE 90.1-2004 Version

"...assumed to be identical in the proposed and baseline building design"

ASHRAE 90.1-2007 Version

"… variations of the power requirements, schedules or control sequences of the equipment modeled in the baseline building from those in the proposed design may be allowed by the rating authority based upon documentation that the equipment installed in the proposed design represent a significant verifiable departure from documented conventional practice. The burden of this documentation is to demonstrate that accepted conventional practice would result in baseline building equipment different from those installed in the proposed design"

ASHRAE 90.1 2004 Appendix G

Questions?

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