Program Advisory Committee:

California Energy Commission Compliance Software

PAC Meeting #2 – July 18, 2012

Agenda:

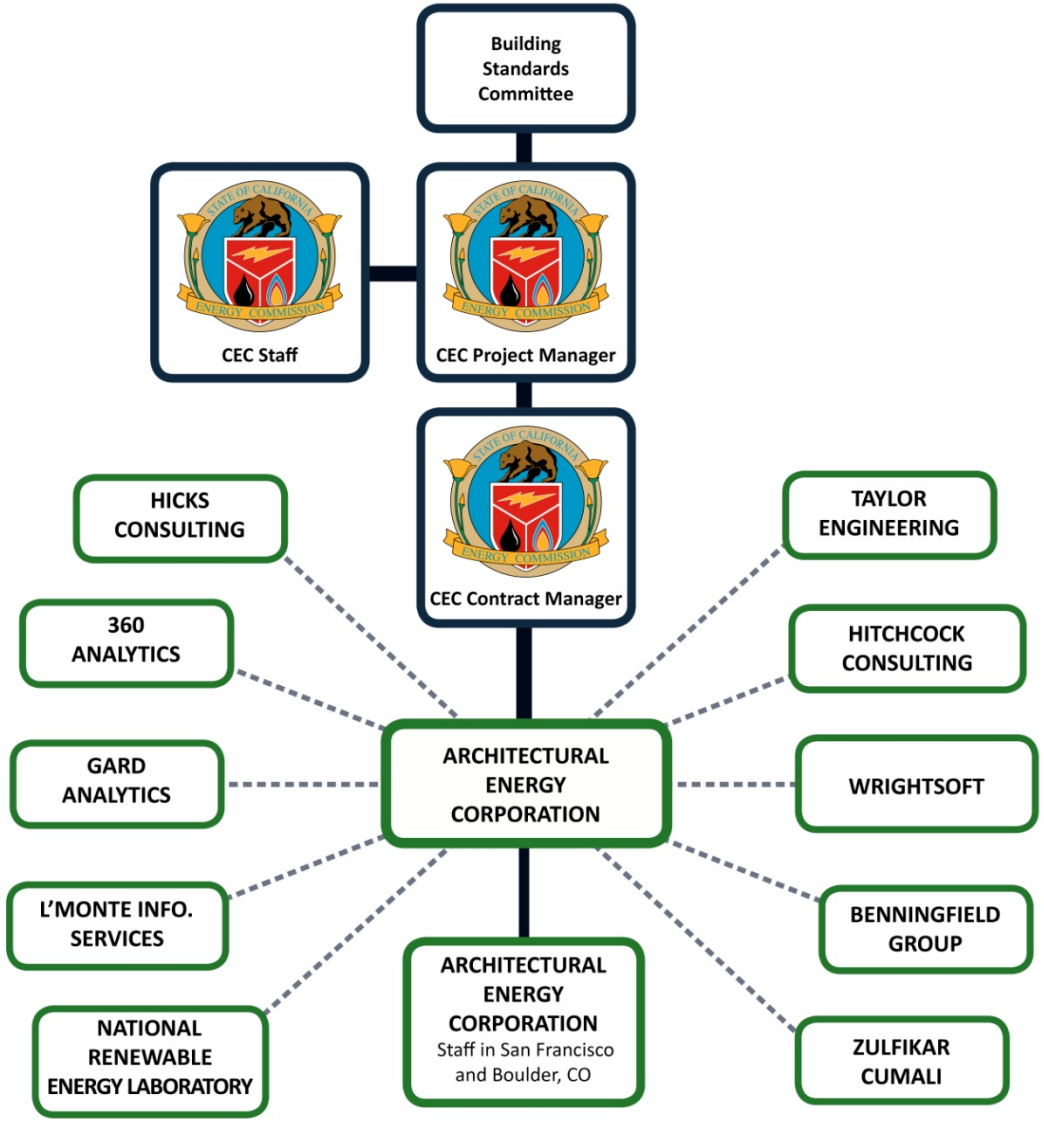
- Introduction (9:00am – 9:15am)
- ACM Manual Summary (9:15am – 11:15am)
- ACM Reference Method Summary (11:15am – 12:00pm)

- Lunch Break (12:00pm – 1:00pm)

- Software Project Update (1:00pm – 1:30pm)
- ACM Ruleset Summary (1:30pm – 2:00pm)
- Proof of Concept Demonstration (2:00pm – 3:00pm)
- PAC Discussion & Wrap Up (3:00pm – 3:30pm)

Introductions

- Project Team
  - CEC
  - AEC
  - Subject Matter Experts



ACM Manual Summary

- Overview of Changes
  - Guiding Principles for ACM Revisions
  - Structural Changes to the ACM
  - Review of Key Changes
  - Review of New Modeling Requirements
- ACM Compliance Ruleset Summary
- Reference Method

ACM Manual Summary

- Guiding Principles for ACM Revisions
  - Retain consistency with Prescriptive Standards
  - Modify rules to be simulation agnostic
    - Remove DOE-2 specific algorithms
    - Remove external calculations where possible
  - Incorporate new measures
  - Provide a more stable baseline (similar to Appendix G) to move towards a performance-based standard
    - ACM used as basis for both compliance and beyond-code programs
    - Provide compliance credit for high-performance designs

ACM Manual Summary

- Structural Changes to ACM
  - Separated regulatory portion from technical portion
  - Technical portion is approved but not adopted
    - Leaves possibility of bug fixes, updates within code cycle
  - Reorganized manual
    - Based on COMNET Modeling Guidelines
    - Baseline rule and proposed input for every building descriptor is explicitly called out
    - New sections added for new modeling features (evaporative cooling, single zone VAV)

ACM Manual Structural Changes

- Each input from the user made separate building descriptor
  - User input may be input directly to simulation, or may require processing
  - Baseline rules and proposed input restrictions clearly specified

Cooling Supply Air Temperature	
Applicability	Applicable to all systems
Definition	The supply air temperature setpoint at design cooling conditions
Units	Degrees Fahrenheit (°F)
Input Restrictions	As designed
Baseline Rules	20°F below the space temperature setpoint (return temperature)

Building Descriptors

- Building descriptor set is translated by software to native simulation input (BDL or IDF)
  - Some building descriptors are directly translated to simulation input, or with minimal processing
    - Cooling Efficiency
  - Some building descriptors affect the baseline building rules for a number of inputs
    - Control System Type (DDC to the zone level)
    - Space Type
  - Some building descriptors modify other inputs
    - Refrigerant Charge Factor
  - The ACM inputs should correspond to data that is readily obtainable by the MEP engineer

2013 Nonres ACM Manual Structure

Chapter 1. Overview

Chapter 2. General Modeling Procedures

Chapter 3. Software Requirements

Chapter 4. Compliance Reports

Chapter 5. Building Descriptor Reference

Focus on Chapters 2 and 5

Reference Method (Chap. 3) covered later

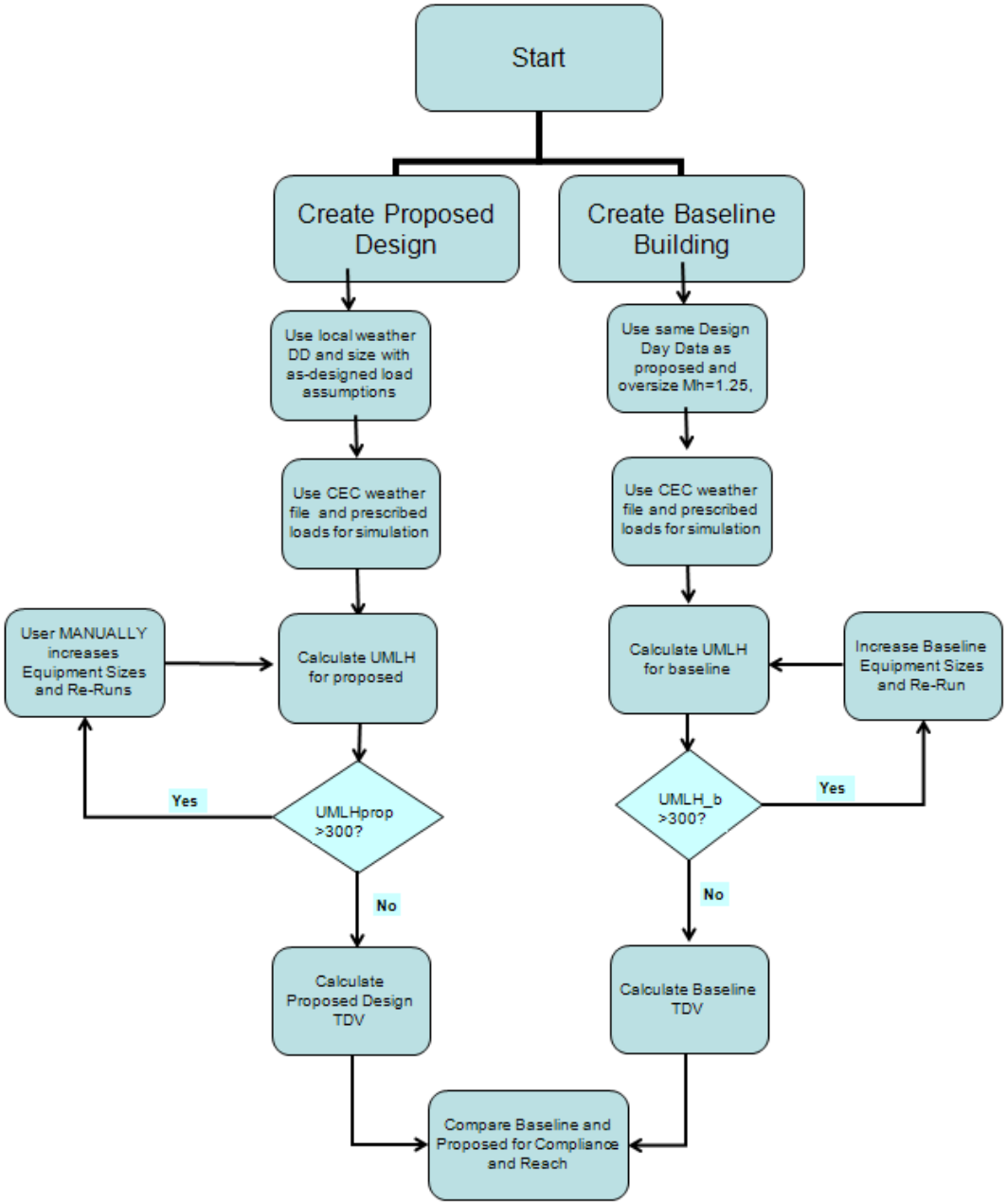
ACM Manual Summary

- Chapter 2: Thermal Blocks and Zone Layout
  - Clarified conditions in which zones can be combined
    - Same space temperature setpoint
    - Operating schedules vary by no more than 40 full load equivalent operating hours (FLEOH)
  - Define daylit zones within the space for baseline
    - Daylight design will impact the space and zone assignments

Chapter 2: System Sizing

- Review of Key Changes: HVAC Sizing
  - Revised sizing method based on Unmet Load Hours
    - Cannot exceed 300 in proposed or baseline
  - Follows ASHRAE 90.1-2010 Appendix G
  - Baseline auto-resized if UMLH exceed 300
  - Allow use of local design day conditions for proposed sizing
  - May require iterative runs if baseline is undersized

Sizing Procedure (based on 90.1)



Chapter 3: Software Requirements

- Reference Method tests based on EnergyPlus
  - Test a greater range of building systems and features
- ASHRAE 140-2007 tests required to verify basic modeling features (not part of Reference Method)
- *Qualitative Tests* ensure that the baseline is properly specified
- *Quantitative Tests* ensure that the simulation predicts absolute energy use and compliance margin to within a specified tolerance
- Prototype buildings based on DOE Prototypes, developed by PNNL

Chapter 4: Standard Reports

- Compliance Forms revised, details to be determined

Chapter 5: Building Descriptors Reference

- Contains bulk of rule information

5.1 Overview

5.2 Project Data

5.3 Thermal Blocks

5.4 Space Uses

5.5 Building Envelope

5.6 HVAC Zone Level Systems

5.7 HVAC Secondary Systems

5.8 HVAC Primary Systems

5.9 Miscellaneous Energy Uses

Section 5.2: Project Data

- Building Classification: sets the whole building activity type for:
  - Space Use classifications
  - Prescriptive Lighting Levels
  - Schedules – building classification mapped to 1 of 11
- Climate Data: revised so that weather extremes coincide with TDV peaks

Chapter 5.3: Thermal Blocks

- New Infiltration Model
- (1) $$Infiltration = I_{design} \cdot F_{schedule} \cdot \left(A + B \cdot \left|t_{zone} - t_{odb}\right| + C \cdot ws + D \cdot ws^2\right)$$
- where:

Infiltration = zone infiltration airflow ($m^3/s\text{-}m^2$)
I_{design} = design zone infiltration airflow ($m^3/s\text{-}m^2$)
$F_{schedule}$ = fractional adjustment from a user input schedule (unitless)
t_{zone} = zone air temperature (° C)
t_{odb} = outdoor dry bulb temperature (° C)
ws = the windspeed (m/s)
A = overall coefficient (unitless)
B = temperature coefficient (1/° C)
C = windspeed coefficient (s/m)
D = windspeed squared coefficient (s^2/m^2)

Infiltration Schedule: Set to 1 when fans are off and 0.25 when fans are on

Chapter 5.3: Thermal Blocks

- Furniture and Contents
  - remove detailed spec of interior mass
  - Set baseline to same as proposed
- Removed:

  FURNITURE-TYPE = HEAVY

  FURN-WEIGHT = 80

  FURN-FRACTION = 0.85

Chapter 5.4.3: Interior Lighting

- Review of Key Changes: Lighting
  - New Space categories for space-by-space method
  - Added Light Heat Gain to space from ASHRAE HOF
  - Revised PAF table
  - Removed custom schedules as an adjustment credit
  - Area Category:
    - Separated *General Lighting Power* from *Custom Lighting Power* into two explicit building descriptors
    - Allowance type determines custom LPD baseline
  - Tailored Lighting Approach
    - Added *Tailored Lighting Mounting Height* input for calculating room cavity ratio and tailored allowance

Interior Lighting Heat Gain

- Specifies fraction of heat gain to space and radiative fraction
  - Source: 2009 ASHRAE HOF, Chapter 18, Table 3
  - Example:
  - Recessed fluorescent luminaire with lens:

    Space Fraction: 0.40. to 0.50 (default 0.45)

    Radiative Fraction: 0.61 to 0.73 (default 0.67)

Chapter 5.4.3: Daylighting

- Modified Daylighting Method – adjustment factors for split-flux method
  - Based on comparison of split flux results with Radiance
  - Adjusts fc setpoint in primary and secondary daylit zone
- Reference Position – based on one window head height for primary daylit zone and two head heights for secondary daylit zone
- Illuminance Setpoint – possible change from equation that is based on LPD to a fixed fc by space type (table lookup)

5.4.5 – 5.4.7: Plug Loads and Refrigeration

- Internal Load Modeling
  - Appendix 5.4 has internal load data by space type
  - Refrigeration Modeling Options:
    (1) Refrigeration Power Density
    (2) DOE model for packaged equipment (kWh/day)
    (3) Model refrigeration COP and condenser location (interior/remote)
    (4) Detailed Refrigeration Model not used – no prescriptive requirements for refrigeration
    - Not used for compliance credit; but used for percent savings calculations
  - Model elevator load with schedule as neutral load

Chapter 5.4.8: Gas Equipment Use

- Gas Equipment Power: (Btu/h-ft2) from Appendix 5.4A
- Gas Equipment Schedule: continuous operation
- Gas Equipment Location: in the space, external
  - Baseline Same as Proposed
- Radiation Factor
  - Default is 0.15
  - Values from ASHRAE HOF for different kitchen appliances
  - See 2009 HOF Chapter 18, Table 5C for details

Appendix 5.4: Whole Building Space Uses

A	B	C	D	E	I	J	K	M	N
2013 NACM	People # per 1000 ft²	Sensible heat per person	Latent heat per person	Receptacle Load W/ft²	Hot water Btu/h per person	Lighting W/ft²	Ventilation CFM/ft²	Refrig Load W/ft2	Schedule
Auditorium Building	143	245	105	1	60	1.5	1.07	0.03	Assembly
Classroom Building	40	246	171	1	108	1.1	0.32	0.03	School
Commercial and Industrial Storage Buildings	5	268	403	0.43	108	0.6	0.15	0.28	Warehouse
Convention Center Building	136	245	112	0.96	57	1.2	1.02	0.03	Assembly
Data Center Buildings (note 9)	5	268	403	note 9	108	0.8	0.15	0	Data Center
Financial Institution Buildings	10	250	250	1.5	120	1.1	0.15	0.06	Office
General Commercial Building/Industrial Work B	7	375	625	1	120	1.0	0.15	0.28	Light Manuf
Grocery Store Buildings	29	252	225	0.91	113	1.5	0.22	0.14	Retail
Library Building	10	250	250	1.5	120	1.3	0.15	0.03	Office
Medical Building/Clinic Building	10	250	213	1.18	110	1.1	0.15	1.12	Health
Office Building	10	250	206	1.34	106	0.80	0.15	0.06	Office
Parking Garage Building	10	250	200	0	0	0.2	0.15	0	Parking
Religious Facility Buildings	136	245	112	0.96	57	1.6	1.03	0.03	Assembly
Restaurant Buildings	45	274	334	0.79	366	1.2	0.38	0.06	Restaurant
School Building	40	246	171	1	108	1.0	0.32	0.03	School
Theater Building	130	268	403	0.54	60	1.3	0.98	0.03	Assembly
All other buildings	10	250	200	1	120	0.6	0.15	0.03	Office
	Note 9 - Receptacle Load shall be specified by the user.								

Appendix 5.4: Area Category Space Uses

(Partial Table)

A	B	C	D	E	J	K	L	M	N
2013 NACM Space Type	People # per 1000 ft²	Sensible heat per person	Latent heat per person	Receptacle Load W/ft²	Lighting W/ft²	Ventilation CFM/ft²	Process Load Btu/h-ft2	Refrig Load W/ft2	Schedule
Auditorium Area (Note 10)	143	245	105	1.0	1.5	1.07	0.04	0.03	Assembly
Auto Repair Area	10	275	475	1.0	0.9	1.50	0.22	0.15	Light Manuf
Bar, Cocktail Lounge and Casino Areas (Note 10)	67	275	275	1.0	1.1	0.50	5.14	0.06	Restaurant
Beauty Salon Area	10	250	200	2.0	1.7	0.40	0.00	0.00	Retail
Classrooms, Lecture, Training, Vocational Areas	50	245	155	1.0	1.2	0.38	0.04	0.03	School
Civic Meeting Place Area (Note 10)	25	250	200	1.5	1.3	0.19	0.09	2.60	Assembly
Commercial and Industrial Storage Areas (conditioned or u	3	275	475	0.2	0.6	0.15	0.00	0.28	Warehouse
Commercial and Industrial Storage Areas (refrigerated)	1	275	475	0.2	0.7	0.15	0.00	0.28	Warehouse
Computer Room (Note 11)	3	275	475	0.0	0.8	0.15	0.00	0.00	Data Center
Convention, Conference, Multipurpose and Meeting Center	67	245	155	1.0	1.4	0.50	0.04	0.03	Assembly
Corridors, Restrooms, Stairs, and Support Areas	10	250	250	0.2	0.6	0.15	0.00	0.00	Office
Dining Area (Note 10)	67	275	275	0.5	1.1	0.50	5.14	0.06	Restaurant
Dry Cleaning (Coin Operated)	10	250	250	3.0	0.9	0.30	0.22	0.15	Light Manuf
Dry Cleaning (Full Service Commercial)	10	250	250	3.0	0.9	0.45	0.22	0.15	Light Manuf

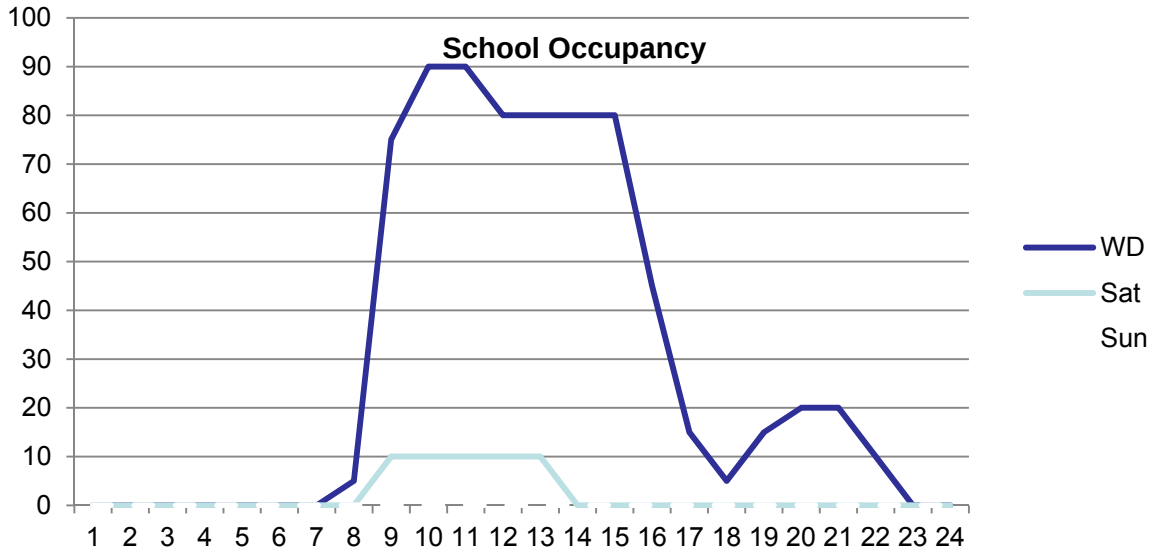
Prescribed: Occupant Density, Occupant Heat Gain, Ventilation Rate

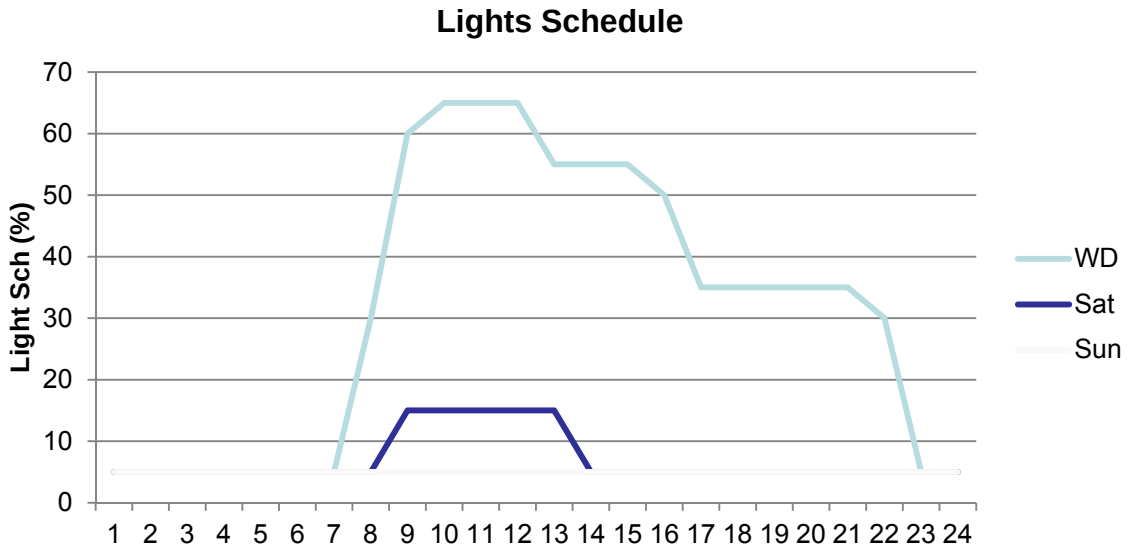
Default: Occupant Schedule, Fan Schedule, Heating/Cooling Schedule

ACM Schedules

- Review of Key Changes: System Schedules
  - Adopting 10 of ASHRAE 90.1-2010 Occupancies (Schedules), and adding a Schedule for Data Centers
  - Follows ASHRAE 90.1-2010 User Manual
  - Assembly, Data Center, Health, Light Manufacturing, Office, Parking, Restaurant, Retail, School, Warehouse, Laboratory
  - Each Schedule Set includes:
    - Occupant Schedule
    - Lighting Schedule
    - Equipment Schedule
    - HVAC Operation Schedule
    - Cooling, Heating Setpoint Schedule
    - Elevator Schedule

ACM Schedule Example: School





Chapter 5.5: Envelope

- Review of Key Changes: Envelope
  - Specify layers for opaque assemblies
    - Provide Appendix of Layers that includes composite layers (framing + insulation)
  - Specify one baseline for opaque envelope
    - Steel-framed walls, steel-joist floors, metal building roofs
  - One Fenestration Requirement for all Climate Zones
    - New VT Requirement
  - Cool Roof Requirement increased in stringency
    - Overall Envelope TDV Approach for alterations

Chapter 5.5: Envelope (cont.)

- Specify simple method for slab-on-grade constructions
  - F-factor corresponding to table in JA4
- Specify C-factor values for below-grade wall assemblies
- Interior blind control under review
- Added new inputs for dynamic glazing:
  - SHGC Dim Fraction – the fraction of full light SHGC when the window is dimmed to the low setting
  - VT Dim Fraction – the fraction of the full VT when the window is dimmed to the low setting
  - Switchable Threshold
  - Switchable Dimming Schedule

Slab-on-grade Heat Transfer

2008 ACM:

1) Insulation level determines coefficients for bi-weekly, monthly and annual components of each transfer
2) Core and heat transfer calculated separately
3) Weighted average of bi-weekly, monthly and annual outside air temperatures used for ground temp

Equation N2-7

$$Q_{slab} = Q_{per} + Q_{core}$$

Equation N2-8

$$Q_{per} = \sum A_{per}\left[\alpha_1\left(T_{in} - T_{bi-weekly}\right) + \alpha_2\left(T_{in} - T_{monthly}\right) + \alpha_3\left(T_{in} - T_{annual}\right)\right]$$

Equation N2-9

$$Q_{core} = \sum A_{core}\left[\alpha_4\left(T_{in} - T_{monthly}\right) + \alpha_5\left(T_{in} - T_{annual}\right)\right]$$

Slab-on-grade Heat Transfer

2013 ACM:

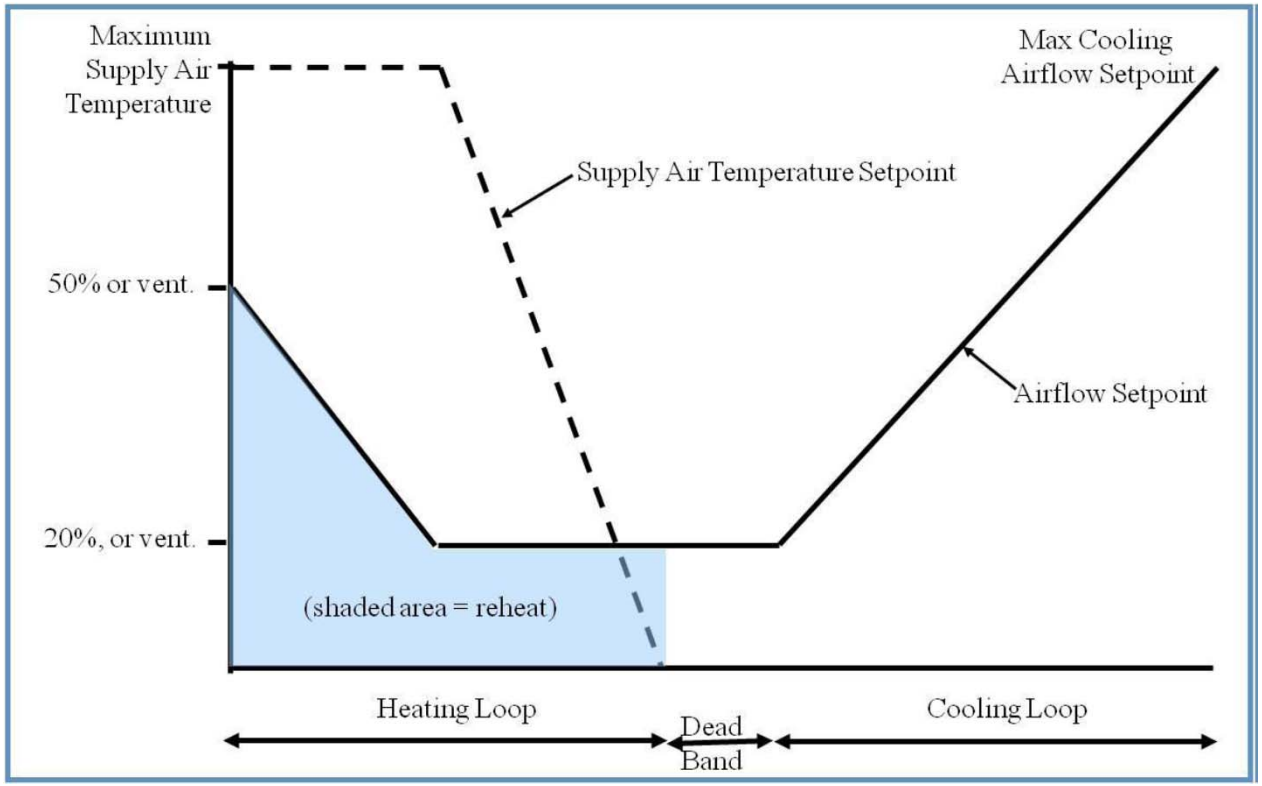
1) F-factor selected from Appendix JA4
2) Simulation model uses built-in algorithm or external calculation
3) Reference Method test verifies software procedure yields acceptable results

Chapter 5.6: Zone Level Systems

- Control System Type
  - DDC or other – affects baseline for some control input
- Space Thermostat Throttling Range – default is 2° F
  - EnergyPlus has tolerance but not the throttling range concept
- Added Baseboard Systems
  - Baseboard Capacity, Baseboard Heat Control inputs
- Terminal Heating Control Type
  - Dual Maximum with “temperature first” reset for DDC control systems
  - Single Maximum for other systems

Section 5.6: Zone Level Systems

- Dual Maximum Control for Systems with DDC to the zone level
- Specific Reset Sequence:
  - Reset SAT up to 95F with airflow at minimum (20%)
  - Reset airflow up to heating max as heating load increases



Chapter 5, 5.7: 2013 System Map

Based on ASHRAE 90.1-2010 App. G, with some modifications for California

Building Type	Fossil Fuel, Fossil/Hybrid, Purchased Heat	Electric and Other
Residential	System 1 - PTAC	System 2 - PTHP
Nonresidential and 3 Floors or Less than <25,000 ft2	System 3 – PSZ AC	System 3 – PSZ AC* **or** System 4 – PSZ HP
Nonresidential and 4 or 5 Floors and <25,000 ft2 or **5 Floors or Less and 25,000 ft2 to 150,000 ft2**	System 5 – PVAV with Reheat	System 5
Nonresidential and More than 5 Floors or >150,000 ft2	System 6 – VAV with reheat	System 6
Nonresidential and 3 Floors or Less and less than 25,000 ft2 and zone cooling load >= 110,000 Btu/h*	System 7 – Single Zone VAV	System 7 – Single Zone VAV* **or** System 8 – Single Zone VAV HP
Heated Only Storage	System 9 – Heating and Ventilation	N/A
Total computer room design cooling load is over 3,000,000 Btu/h or the non-computer loads are served by System Types 5 or 6	System 10 – CRAH Units	N/A
Computer rooms that do not meet the conditions for System 10, CRAH	System 11 – CRAC Units	N/A

** Gas baseline (System 3 or 7) if natural gas is available at site*

2013 System Map (cont.)

System No.	System Type	Fan Control	Cooling Type	Heating Type
1 – PTAC	Package terminal air conditioner	Constant volume	DX	Hot water fossil fuel boiler
2 – PTHP	Package terminal heat pump	Constant volume	DX	Electric Heat Pump
3 – PSZ AC	Package single zone	Constant volume	DX	Fossil fuel furnace
4 – PSZ HP	Package single zone heat pump	Constant volume	DX	Electric Heat Pump
5 – PVAV reheat	Package VAV reheat	Variable volume	DX	Hot water fossil fuel boiler
6 – VAV reheat	VAV reheat	Variable volume	Chilled water	Hot water fossil fuel boiler
7 – SZVAV	Single Zone VAV	Two-Speed*	DX	Fossil fuel furnace
8 – SZVAV HP	Single Zone VAV HP	Two-Speed*	DX	Electric Heat Pump
9 – Heating ventilation	Heating only	Constant volume	None	Gas furnace
10 – CRAH Units	CR Air Handler	Variable volume	Chilled water	N/A
11 – CRAC Units	CR Air Conditioner	Variable volume	DX	N/A

2008 ACM System Map

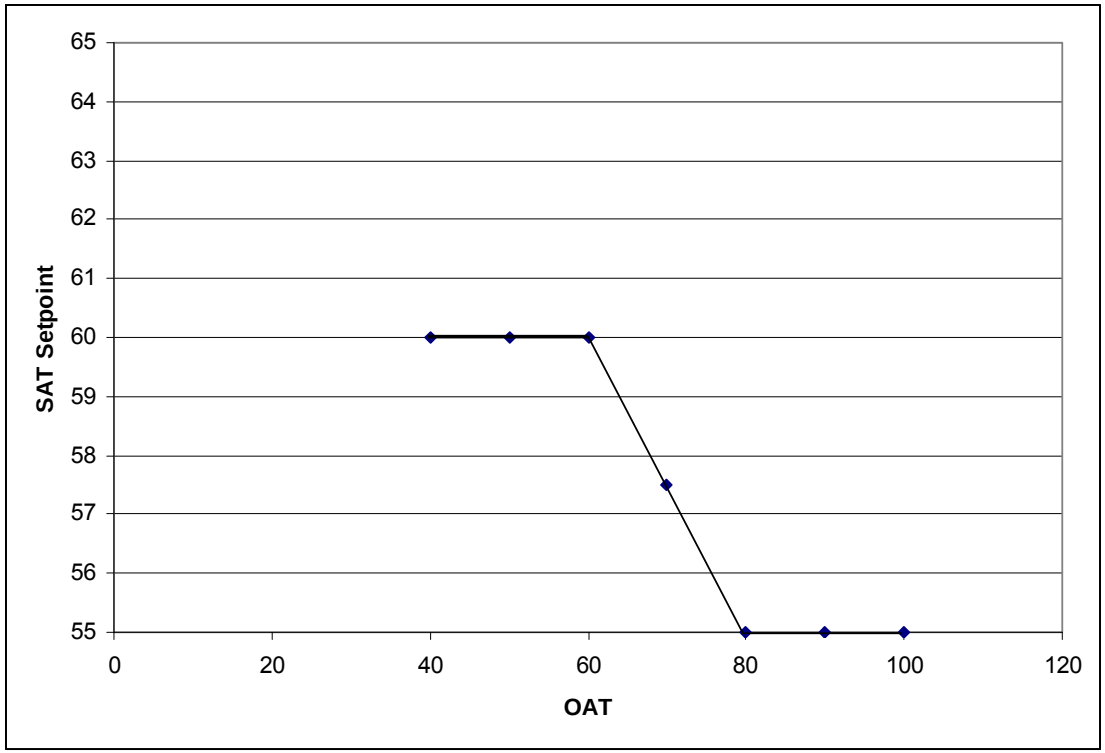
- Review of Key Changes: HVAC System Map

Table N2-13 – Standard Design HVAC System Selection

Building Type	System Type	Proposed Design Heating Source	System
Low-Rise Nonresidential (three or fewer stories above grade)	Single Zone	Fossil	System 1 – Packaged Single Zone, Gas/Electric
		Electric	System 2 – Packaged Single Zone, Heat Pump
	Multiple Zone	Any	System 3 – Packaged VAV, Gas Boiler with Reheat
High Rise Nonresidential (four or more stories)	Single Zone	Any	System 5 – Built-up Single Zone System with Central Plant
	Multiple Zone	Any	System 4 – Central VAV, Gas Boiler with Reheat
All Residential including Hotel/Motel Guest Room	Hydronic	Any	System 5 – Four Pipe Fan Coil System with Central Plant
	Other	Fossil	System 1 (No economizer) – Packaged Single Zone, Gas/Electric
		Electric	System 2 (No economizer) – Packaged Single Zone, Heat Pump

5.7.2 System Control

- Cooling Supply Air Temperature Control
  - Added Staged Setpoint for multi-stage systems (single zone VAV)
- Cooling Reset by OSA – added specific curve as default only



Section 5.7.3: Fan Systems

- Fan System Modeling Method
  - Power-per-unit-flow, brake horsepower, static pressure
- Specify Supply Fan Ratio, Return Fan Ratio, Exhaust Fan Ratio
  - Maintain same proportion of fan power for each fan type in baseline as proposed
- Software that require input of static pressure and eff:
  - Calculate supply fan ratio, return fan ratio, exhaust fan ratio for proposed
    - Ex: SupplyFanRatio = BHP_s / BHP_{total}
  - Specify motor efficiency for each fan from Standard
  - Determine capacity (CFM) for each fan system
  - Calculate equivalent static pressure for baseline fans

Section 5.7.3: Fan Systems

- Adopt ASHRAE 90.1 Fan Power Adjustments for Special filtration, and other design requirements
- 2008 ACM allowed extra static pressure only for systems with design pressure drop in excess of 1” w.g.
- See 90.1-2010 Table 6.5.3.1.1B for details

- Example: MERV 13 filter receives 0.9” w.c.

Brake Horspower Adjustment:

$A = \Sigma\ (PD \times CFM_D/4131)$
where
PD = each applicable pressure drop adjustment from Table 6.5.3.1.1B in in. w.c.
CFM_D = the design airflow through each applicable device from Table 6.5.3.1.1B in cubic feet per minute

Section 5.7.3: Fan Systems (cont.)

- Fan System Modeling Methods – includes all fans that operate at design conditions
  - (1) Power-per-unit-flow – W/cfm for the fan system
  - (2) Brake horsepower – requires brake horsepower and motor efficiency
  - (3) Static pressure – requires, Static pressure, Fan (Static) Efficiency, Motor Efficiency. This option requires plan check.
- Specify Supply Fan Ratio, Return Fan Ratio, Exhaust Fan Ratio
  - Baseline System has same proportion of supply fan bhp, return fan bhp, and exhaust fan bhp as proposed
- Fan Part-Load Curves: added curve for VSD with Static Pressure Reset

Section 5.7.3: Garage Exhaust

- Garage Fan exhaust included as regulated load
- Small Fan Systems (<10,000 cfm) – baseline of 0.35 W/cfm
- Large Fan Systems (10,000 cfm and greater):
  (1) Baseline set at 0.044 W/cfm
  (2) Modeled as Constant Volume – lower fan power approximates effect of CO Control
  (3) No Compliance Credit – modeled as fixed value since this is a mandatory measure

Section 5.7.4: Economizers

- Economizer Control Type
  - Required now for 54,000 Btu/h and above
- Economizer Integration Type
  - Separate building descriptor from control type
- Economizer High Temperature Lockout:
  - Climate Zone 7: dry-bulb high limit of 69° F
  - Climate Zones 6, 8, 9: dry-bulb high limit of 71° F
  - Climate Zones 2, 4, 10: dry-bulb high limit of 73° F
  - Climate Zones 1, 3,5,11-16: dry-bulb high limit of 75° F

Section 5.7.5: Cooling Systems

- Coil Bypass Factor
  - Coil Bypass Factor and Bypass Factor Adjustment Curve – used in DOE-2 only. EnergyPlus uses a different coil model and latent heat transfer.
  - EnergyPlus – uses Sensible Heat Ratio (Total and Sensible Cooling Capacity at rated conditions)
- New rules for multi-stage packaged DX equipment
- New equipment types covered:
  - Evaporative Cooling – new credit for systems that meet the Western Cooling Challenge
  - Evaporative Condenser
  - Desiccant Systems

Western Cooling Challenge

Test Conditions/ Criteria	ARI 340/360	WCC Peak	WCC Annual
Outside Air Condition (Tdb°F/Twb°F)	95/75	105/73	90/64
Return Air Condition (Tdb°F/Twb°F)	78/67	78/64	78/64
Min. Outdoor Ventilation (cfm/nominal-ton)	0	120	120
External Static (in WC)	0.2-0.75	0.7	0.7
Min Filtration	NA	MERV 7	MERV 7
Operating Mode	Full Capacity	Full Capacity	Full or Part Capacity

Figure 4: WCC Test Conditions

	WCC Peak Conditions	WCC Annual Conditions
Min Sensible Credited Capacity *(% sensible credited cooling at peak conditions)*	NA	80%
Min Sensible Credited EER *(kbtu/kWh)*	14	17
Max Supply Air Humidity	0.0092	0.0092
Max Water Use *(gal/ton-h)*	NA	4

Figure 5: WCC Performance Criteria

WCC Test Result is a single EER performance metric.

Systems that meet WCC criteria modeled as DX with high EER

Systems that do not qualify for WCC can still be modeled by the native evaporative cooling software capabilities.

Section 5.7.5: Single Zone VAV

- Multi-stage DX – meet single zone VAV requirement
- Typical System has two or more compressors and a two-speed or variable speed fan
- Building descriptors:
  - Number of Cooling Stages – 1 to 4
  - Total Cooling Capacity by stage – array of fractional capacities
  - Sensible Cooling Capacity by stage – array of fractional capacities
  - Supply Air Temperature Reset by stage – specifies supply air temperature reset amount from design SAT
  - Number of Heating Stages
  - Heating Capacity by Stage
  - Supply Fan Low Speed Ratio
  - Supply Fan Low Power Ratio

Section 5.7.5: Duct Leakage

- Removing external algorithms from ACM
- Previous ACM has algorithm for duct leakage and heat loss to unconditioned space and outdoors
- Propose specifying inputs, not algorithm
  - Duct leakage rate – value determined if sealing and testing done
  - Duct Surface Area
  - Duct Fraction Outdoors
  - Duct Fraction Unconditioned space
  - Duct Insulation Level
- Provide Reference Method test to verify candidate software produces an acceptable result

Laboratory Systems

- VAV Air Handling Unit with 100% OA
- Preheat coil and cooling coil
- Constant volume exhaust modeled as plug load in unconditioned space
- VAV zone controls to set minimum to match level mandated by AHJ

Data Centers and Computer Rooms

- New space type in Appendix 5.4
  - 80° F Cooling Setpoint, receptacle load as designed
  - New Schedules for data center / computer room
- New HVAC Systems:
  - Computer Room Air Handler (CRAH) for larger cooling loads
  - Computer Room Air Conditioner (CRAC) for smaller loads

Data Centers and Computer Rooms

- CRAH Unit Specification

Table N2-17 – System #10 Description

System Description:	Computer room air handler (CRAH)
Supply Fan Power:	See fan power details; 0.49 W/cfm baseline
Supply Fan Control	variable speed drive. Fan power ratio at part load = speed ratio ^3 (e.g. 12.5% of design power at 50% speed).
Minimum Supply Temp:	60
Cooling System:	Chilled water
Cooling Efficiency:	Same as System #6 (Built-up VAV)
Maximum Supply Temp:	80
Heating System:	None
Economizer:	TBD
Supply Temp Control:	Supply air temperature setpoint shall be linearly reset from minimum at 50% cooling load and above to maximum at 0% cooling load. Fan volume shall be linearly reset from 100% air flow at 100% cooling load to minimum air flow at 50% cooling load and below. Minimum fan volume setpoint shall be 50%. (this is effectively an "airflow first" sequence")

Data Centers and Computer Rooms

- CRAC Unit Specification

Table N2-17 – System #11 Description

System Description:	Computer room air conditioner (CRAC)
Supply Fan Power:	0.49 W/cfm at design flow (see equipment sizing) where economizer is required, 0.39 W/cfm where economizer is not required.
Supply Fan Control	Constant speed if total cooling capacity for the room <= 5 tons, otherwise: variable speed drive. Fan power ratio at part load = speed ratio ^3 (e.g. 12.5% of design power at 50% speed).
Return Fan Control:	No return fans
Minimum Supply Temp:	60
Cooling System:	Air-cooled DX
Cooling Capacity:	Equipment sizing CFM and cooling capacity sized at 120% of the calculated room load. One fan system per room.
Cooling Efficiency:	Minimum packaged air conditioner efficiency based on calculated total cooling capacity for each room • If cooling capacity > 20 tons then use 10 ton min efficiency • If cooling capacity <20 tons then use capacity/2 min efficiency
Maximum Supply Temp:	80
Heating System:	None
Economizer:	No economizer if total cooling capacity for the room < 5 tons and building does not have any economizers, otherwise: Integrated differential dry bulb economizer
Supply Temp Control:	**VAV:** Supply air temperature setpoint shall be linearly reset from minimum at 50% cooling load and above to maximum at 0% cooling load. Fan volume shall be linearly reset from 100% air flow at 100% cooling load to minimum air flow at 50% cooling load and below. Minimum fan volume setpoint shall be 50%. (this is effectively an "airflow first" sequence") **CV:** supply air temperature setpoint modulates to meet the load.

Section 5.7.5.3: Evaporative Cooling

Evaporative Cooling

- Direct Stage Effectiveness
- Indirect Stage Effectiveness
- Evaporative Cooling Performance Curve – function of flow
- Auxiliary Evaporative Cooling Power – energy of pumps for cooling stages an indirect evaporative fan
- Evaporative Cooling Scavenger Air Source – air source for indirect stage; can be return air or outside air

Section 5.7.5.4: Evaporative Cooling

Evaporative Pre-Cooling

- Evaporative Condenser Power
- Evaporative Condenser Effectiveness
- Evaporative Condenser Operation Range – dry-bulb temperature range

Section 5.7 – Performance Curves

- Provide more complete set of curves
- Provide software neutral curves where possible
- Specify in Appendix *(in progress)*:
  - Curve Coefficients
  - Performance map
- ASHRAE SPC205 working on standardizing performance curves

Section 5.7 – Performance Curves

- Coil Bypass Factor
  - Specify fixed value – can impact performance
  - Specify fixed performance curve
  - Not applicable for EnergyPlus
- Cooling Tower Capacity Specification
  - Work in progress to true up DOE-2 and E+ defaults

5.7.5.5 Radiant Cooling (chilled slab)

- New modeling feature
- Key Inputs:
  - Tubing length, diameter
  - Control temperature
  - Flow rate
  - Pump Power and efficiency
  - Interlock for condensation control
- Constant and variable flow systems represented

5.7.6.5 Heat Pump heating

- Coil defrost
  - Hot-gas defrost, on-demand
  - Hot-gas defrost, timed 3.5 minute cycle
  - Electric resistance defrost, on-demand
  - Baseline: Electric resistance defrost, timed 3.5 minute cycle
- Coil defrost kW – for systems with electric resistance heat
- Crankcase heater power
  - Defaults to 0

5.7.6.6 Heat Recovery

- New modeling feature
- Sensible heat recovery effectiveness

$$HREFF = \frac{(EEAdb - ELAdb)}{(EEAdb - OSAdb)}$$

- Latent heat recovery effectiveness

$$HREFF = \frac{(EEAw - ELAw)}{(EEAw - OSAw)}$$

- Condenser heat recovery effectiveness
- Heat Recovery Use
  - Reheat coils or water heating

5.8.3 Cooling Towers

- Cooling Tower Total Fan Horsepower
  - Specified as gpm/hp (*2008 ACM uses EIR*)
  - Baseline References Standard 110.2
  - *Cooling Tower Low-Speed Airflow Ratio* – baseline changed from 0.33 to 0.50
- Approach Temperature
  - Work in progress on specifying part-load capacity in a generic format
- Condenser water reset
  - Fixed, or wet-bulb reset
  - Default approach of 10° F

5.8.4 Waterside Economizers

- Waterside Economizer Type
  - HX In Parallel with Chiller (non-integrated)
  - HX In Series
  - Direct (strainer cycle)
  - Thermo-cycle (refrigerant migration)
- Other Inputs
  - HX Effectiveness
  - Maximum DB Temp
  - Maximum CW Supply Temp
  - CWS Setpoint – defaults to 45° F
  - Schedule, Auxiliary kW (pumps/other)

5.8.5 Central Plant Pump Specification

- 2008: Specify design head, impeller efficiency, motor efficiency
  - No credit for reduced design head
- New ACM: incorporate 90.1-2010 specification
  - 22 W/gpm Chilled Water
  - 19 W/gpm Condenser Water
  - 19 W/gpm Hot Water
  - Motor efficiency set from Standard and NEMA regulations as before

5.8 Central Plant Management

- 2008 ACM: rule requires that a chiller or boiler be brought up to 90% capacity before staging on another
- 2013 ACM:
  - Proposed Building: as designed
    - Allows more flexibility for variable speed chillers
  - Baseline Building: same as proposed

5.8.6 Thermal Storage

- Covers chilled water, ice storage but not stratified tanks
- Building Descriptors:
  - Configuration: Series (Upstream,Downstream), Parallel
  - Ice Storage Type: Internal or External
  - Storage Capacity
  - Tank Volume
  - CHW Setpoint Schedule
  - Deadband Temperature difference
  - Minimum Temperature Limit – charging tank disabled

5.8.6 Thermal Storage

- Building Descriptors (cont):
  - Minimum Temperature Limit – charging tank disabled below this temperature
  - Storage Tank Location – Zone, or Exterior
  - Storage Tank Heat Gain Coefficient – between tank and ambient
  - Use Side Heat Transfer Effectiveness
  - Use Side Design Flow Rate
  - Source Side Heat Transfer Effectiveness
  - Source Side Flow Rate

5.9 NAECA Covered Water Heaters

- 2008 ACM: Losses specified through part-load performance curve
  - Custom Curve generated through inputs of standby loss, thermal efficiency and part load fraction
- 2013 ACM: Specify tank loss coefficient as alternate method
  - DOE Test Procedure used to express UA loss coefficient as a function of Energy Factor and Thermal Efficiency

$$UA = \frac{1/EF - 1/RE}{67.5 \times \left(\frac{24}{41094} - \frac{1}{RE \cdot Pon}\right)}$$

5.9.2 Exterior Lighting

- Historically not modeled since no tradeoffs allowed
- Simple inputs provided to record as regulated energy for beyond code programs
- Key Inputs:
  - Exterior Lighting Power
  - Exterior Lighting Control – photocell and time clock
  - Exterior Lighting Schedule

5.9.3 – 5.9.4 Other Energy Uses

- Swimming Pools – must meet mandatory measures and are not required to be modeled
- Miscellaneous Electric Power – outside of the building envelope
- Miscellaneous Gas Power – outside of the building envelope (i.e., snowmelt system)

Other ACM Items in Progress

- Daylighting Model
  - Finish development of daylight adjustment factors
  - Specify rules for Reference Position for Primary and Secondary Daylit Zone
- Alterations – Complete Baseline Specification
- Overall Envelope Tradeoff Specification
  - Primary Use is Roof Reflectance Tradeoff
- Complete Performance Curve Specification
- Compliance Forms

ACM Reference Method Summary

- Overview - EnergyPlus as Reference software
- Review of quantitative test cases
- Review of qualitative (baseline building) test cases
- Overview of documentation for applicant software test results

Reference Method Test

- Compliance Margin- Quantitative Tests
- Rule set Implementation- Qualitative Tests
- Uses DOE Prototype Models
- EnergyPlus v.7.0

Compliance Margin Test

- Quantitative Tests
- Goal – To check if Applicant Software can be used for compliance modeling
  - Simulation Results - within acceptable range.
  - Impact of one or more building or system inputs on compliance margin.
- Approximately 120 Test Cases for assessing -
  - Opaque Envelope
  - Glazing
  - Lighting
  - Daylighting
  - Plug Loads
  - HVAC Systems

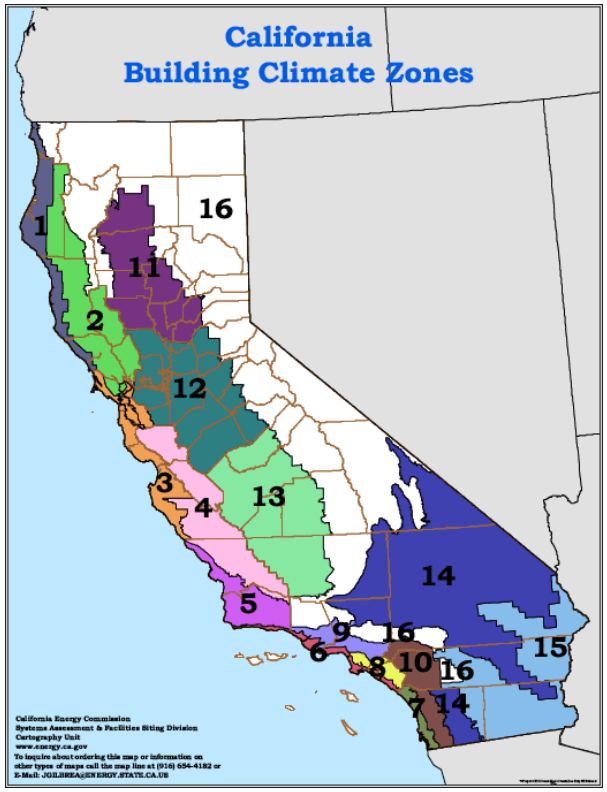
- Opaque Envelope Components:
  - Roof Insulation (CZ-15,16, 6)
  - Wall Insulation (CZ-15,16, 6)
  - Floor Slab Insulation (CZ-15,16, 6)
  - Infiltration (CZ-15,16, 6)
  - Roof Solar Reflectance (CZ-15,16, 6)
  - Envelope Mass (CZ-15,16, 6)
- Glazing Components:
  - Window U value, SHGC (CZ-15,16, 6)
  - Window-Wall ratio (CZ-7,1)
  - Window Overhang (CZ-7,1)
  - Skylight VT (CZ-7,1)
  - Skylight-Roof ratio (CZ-7,1)
- Internal Loads
  - LPD (CZ-15,16, 6)
  - EPD (CZ-15,16, 6)
  - Process Load (CZ-6)

- Daylighting Components:
  - Daylighting w/Cont. Dimming (CZ-7,1)
  - Daylighting w/Cont. Dimming and high VT (CZ-7,1)
  - Daylighting w/Cont. Dimming, high VT and varying WWR (CZ-7,1)
  - Daylighting w/Stepped Dimming (CZ-7,1)
  - Daylighting w/Stepped Dimming and high VT (CZ-7,1)
  - Daylighting w/Stepped Dimming, high VT and varying WWR (CZ-7,1)
  - Daylighting with varying SRR (CZ-7,1)
  - Daylighting with varying SRR and VT (CZ-7,1)

- HVAC Systems:
  - Packaged Terminal Air Conditioner
  - Packaged Terminal Heat Pump
  - Packaged Single Zone System
  - Packaged VAV System
  - Single duct built-up VAV system
  - Fan coil units
  - Water loop heat pump
  - Evaporative cooling system
  - Natural ventilation
  - Hydronic radiant system
  - Under-floor air distribution system
  - Variable refrigerant flow (VRF) system

- HVAC System Efficiency:
  - Economizer Control
  - Fan Efficiency
  - Cooling Coil COP
  - Gas Furnace Efficiency
  - Ventilation rate
  - Fan Static Pressure
  - Fan Status
  - Cooling Set point
  - Heating Set point
  - Chiller Efficiency
  - Boiler Efficiency
  - Heating hot water temperature reset
  - Chilled Water temperature reset
  - Supply Air temperature Reset

- Climate Zones
  - CZ01- Arcata
  - CZ06- Long Beach
  - CZ07- San Diego Lindbergh
  - CZ15- Palm Springs Intl
  - CZ16- Blue Canyon



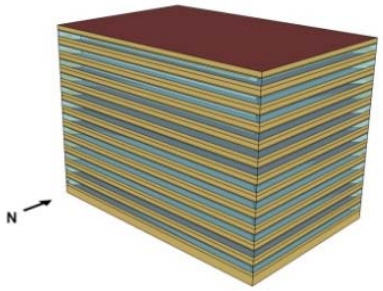
- Run Labeling format:

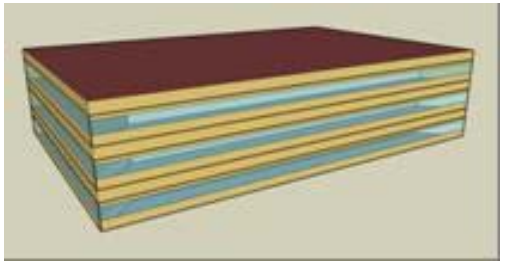
Envelope Test/Medium Office-CZ-15, Roof Insulation

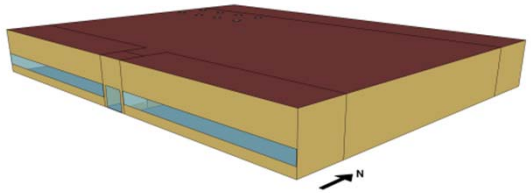
Component/Model Type- Climate Zone, Input character

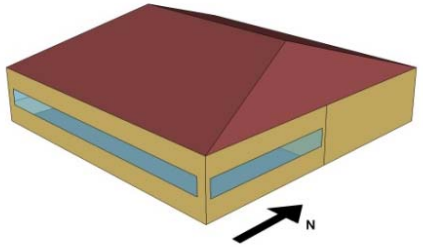
Prototype Models

- T-24 Version of DOE Prototype model for all CZ's
  - Small Office
  - Medium Office
  - Large Office
  - Stand-Alone Retail
  - Fast food restaurant
  - Warehouse
  - Strip-Mall







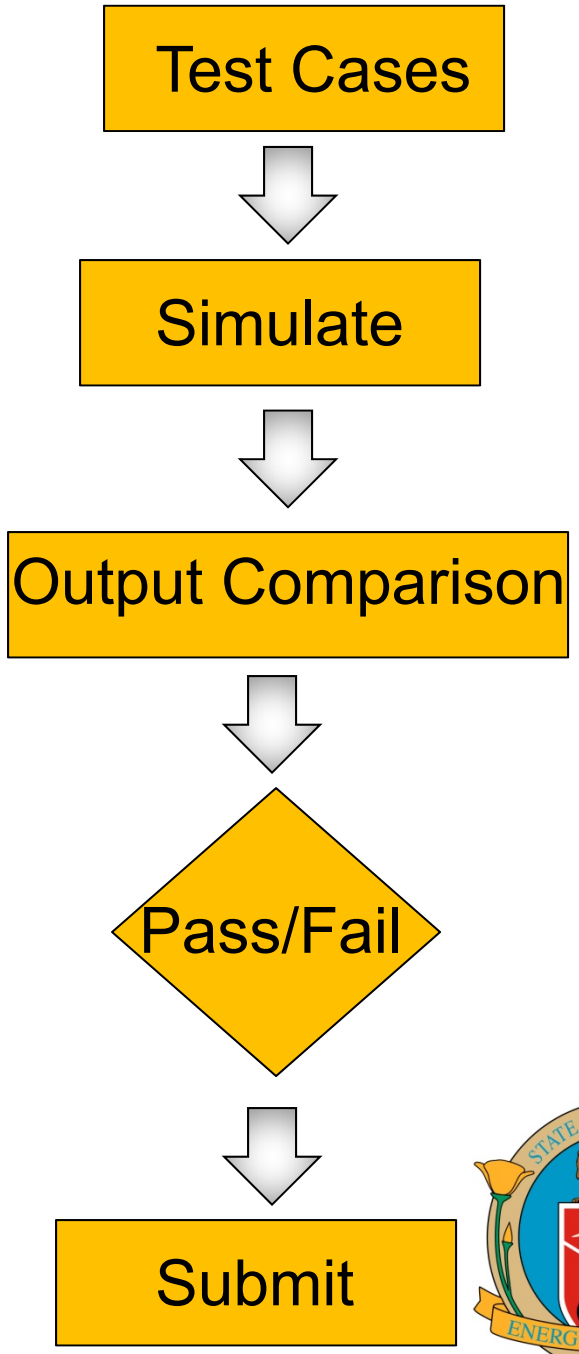


- Summary of Inputs- Appendix A
- Model files posted on CEC's Building Energy Efficiency Software Consortium webpage

  http://www.energydataweb.com/consortium/PACdocsNR.aspx.

Workflow:

- Applicant replicates Baseline Model and Applicant Model for each Test Run.
- Run simulations.
- Outputs reported in results spreadsheet
- Pass/Fail
- Results submitted to CEC



- **Test Case Model** - modification to one or more input

  Example- Envelope Tests

  1. *Envelope Test/Medium Office-CZ-15, Roof Insulation*
  2. *Envelope Test/Medium Office-CZ-15, Wall Insulation*
  3. *Envelope Test/Medium Office-CZ-15, Floor Slab Insulation*
  4. *Envelope Test/Medium Office-CZ-15, Infiltration*
  5. *Envelope Test/Medium Office-CZ-16, Roof Insulation*
  6. *Envelope Test/Medium Office-CZ-16, Wall Insulation*
  7. *Envelope Test/Medium Office-CZ-16, Floor Slab Insulation*
  8. *Envelope Test/Medium Office-CZ-16, Infiltration*

Example- HVAC Tests

…

97. *HVAC Test/PVAV, Medium Office-CZ-6, Low Efficiency*
98. *HVAC Test/PVAV, Medium Office-CZ-6, High Efficiency*
99. *HVAC Test/PVAV, Medium Office-CZ-15, Low Efficiency*
100. *HVAC Test/PVAV, Medium Office-CZ-15, High Efficiency*
101. *HVAC Test/PVAV, Medium Office-CZ-16, Low Efficiency*
102. *HVAC Test/PVAV, Medium Office-CZ-16, High Efficiency*
103. *HVAC Test /VAV, Large Office-CZ-6, Low Efficiency*
104. *HVAC Test /VAV, Large Office-CZ-6, High Efficiency*
105. *HVAC Test /VAV, Large Office-CZ-15, Low Efficiency*
106. *HVAC Test /VAV, Large Office-CZ-15, High Efficiency*

BASELINE MODEL

- Each Test Case compared against a baseline for determining % variation in TDV
- Baseline models- T24 version of DOE Model

Example-

Equipment test Medium OfficeCZ-6 low EPD	**Medium Office CZ-6 Baseline**
Equipment test Medium OfficeCZ-6 high EPD	

Envelope Glazing Test Large OfficeCZ-7 WWR 20%	**Large Office CZ-7 Baseline**
Envelope Glazing Test Large OfficeCZ-7 WWR 60%	
Envelope Glazing Test Large OfficeCZ-7 WWR 60% with South overhang	
Envelope Glazing Test Large OfficeCZ-1 WWR 20%	
Envelope Glazing Test Large OfficeCZ-1 WWR 60%	

- HVAC Baseline Examples

PVAV Test Medium Office CZ-6 Low Eff	PVAV Medium Office CZ-6 Baseline
PVAV Test Medium Office CZ-6 High Eff	

VAV Test Large Office CZ-6 Low Eff	VAV Large Office CZ-6 Baseline
VAV Test Large Office CZ-6 Low Eff	

VRF Test Strip Mall CZ-6 Low Eff	PSZ Strip Mall CZ-6 Baseline
VRF Test Strip Mall CZ-6 High Eff	

SIMULATION RESULTS

- Applicant Model results compared with Reference Model results
- Metrics for comparison
  - Total TDV EUI
  - TDV EUI – Electricity
  - TDV EUI - Natural Gas
  - Site energy EUI for end uses
  - Unmet load hours
- Results for all runs reported in Results spreadsheet CCN3
  - Results Spreadsheet

Slide 82

CCN3 Hyperlink to spreadsheet

Nambiar, Chitra, 7/10/2012

Passing Criteria

- Annual TDV % variation $TDV_{\%} = (TDV_b - TDV_n)/TDV_b$
  - where, $TDV_{\%}$ is the TDV % variation,
  - TDV_n is the annual TDV for test case number n and
  - TDV_b is the annual TDV for the base case run.

For each test case,

- if Reference Model $TDV_{\%r} \leq 1\%$, Applicant Model $TDV_{\%a} \leq 1\%$
- if Reference Model $TDV_{\%r} > 1\%$, Applicant Model $TDV_{\%a}$ shall be within $\pm$ 10% of Reference Model $TDV_{\%r}$

Rule Set Implementation Tests

- Qualitative Tests
- Goal – Accurate Implementation of ACM Rules
- 22 tests to check:
  - Baseline Model
  - ACM rules applied on Proposed Model
- Rule set implementation checked for
  - Envelope Components
  - Internal Load Components
  - HVAC Components
  - Service Hot Water Components
  - Exterior Load Components

ENVELOPE COMPONENTS:

- Roof Construction Assembly Type
- Roof Construction Assembly overall U value
- Roof Construction Assembly layers
- Roof Aged Solar Reflectance
- Roof Thermal Emittance
- Exterior Wall Construction Assembly Type
- Exterior Wall Construction Assembly overall U value
- Exterior Wall Construction Assembly layers
- Above-grade Floor Construction Assembly Type
- Above-grade Floor Construction Assembly overall U value
- Floor F-factor, Area and Perimeter exposed
- Above-grade Floor Construction Assembly layers
- Window assembly U value
- Window SHGC
- Window VT
- Window-Wall Ratio
- Window overhang
- Skylight overall U value
- Skylight SHGC
- Skylight VT
- Skylight to Roof Ratio

INTERNAL LOAD COMPONENTS

- Occupancy Type
- People Density
- Sensible Heat/person
- Latent Heat/person
- Equipment Power Density
- Lighting Power Density
- Ventilation Rate
- Hot-water Load
- Infiltration rate
- Elevator Power
- Occupancy Schedule
- Equipment Schedule
- Lighting Schedule
- Hot Water Schedule
- Elevator Schedule

HVAC COMPONENTS

- HVAC System Type
- Heating , Cooling Type
- Heating, Cooling Efficiency
- System Capacity

- Supply Air Temperature
- SAT Reset Control
- Economizer
- Economizer Limits
- Fan Power
- Fan Control Method
- DX Cooling Efficiency Adjustment Curve
- Cooling Capacity Adjustment Curve
- Heating (Furnace) Part-load Efficiency Curve
- Electric Heat Pump Heating Capacity Adjustment Curve
- Electric Heat Pump Heating Efficiency Adjustment Curve
- Fan Part-load Performance Curve
- HVAC(Availability/Fan) Schedule
- Heating, Cooling Schedule
- Terminal Heat Type
- Terminal Heat Capacity
- Reheat Delta T
- Number of boilers
- Boiler Capacity
- Boiler Efficiency
- Boiler Type

- Boiler Heat Loss
- Boiler Performance Curve
- Hot Water Supply Temperature
- Hot Water Return Temperature
- Boiler, Pump Control Type
- Boiler, Pump Motor Power, Efficiency
- Boiler, Pump Part Load Curve
- Chiller Type
- Number of Chillers
- Chiller Fuel
- Chiller Capacity
- Chiller Efficiency
- Chiller Min. Unloading Ratio
- Chiller Cooling Capacity Adjustment Curve
- Chiller Cooling Efficiency Adjustment Curve
- Chilled Water Supply and Return Temperature
- Condenser Type
- Cooling Tower Fan Control Type
- Cooling Tower Fan Horse Power
- Cooling Tower Set Point Control
- Chiller, Condenser Pump Control Type
- Chiller, Condenser Pump Motor Power
- Chiller, Condenser Pump Motor Efficiency
- Chiller, Condenser Pump Design Flow

SHW COMPONENTS

- Thermal Efficiency
- Energy Factor
- Hot Water Load/person
- SHW Schedule

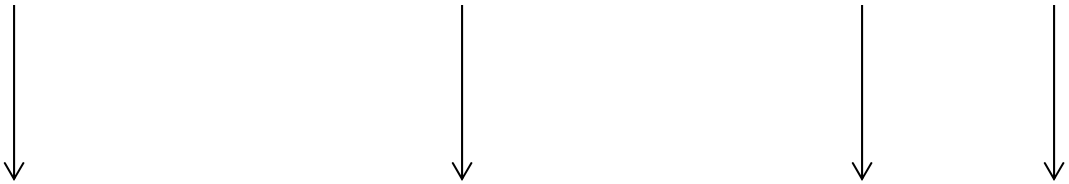
EXTERIOR LOAD COMPONENTS

- Exterior LPD
- Exterior lighting control
- Exterior lighting schedule

- Climate Zones
  - CZ06- Long Beach
  - CZ15- Palm Springs Intl

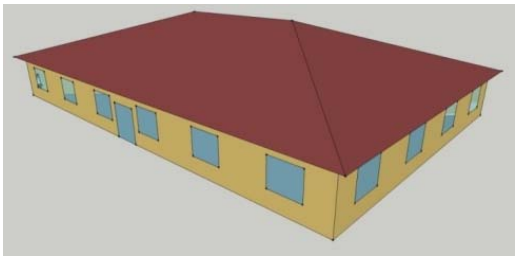
- Run Labeling format:

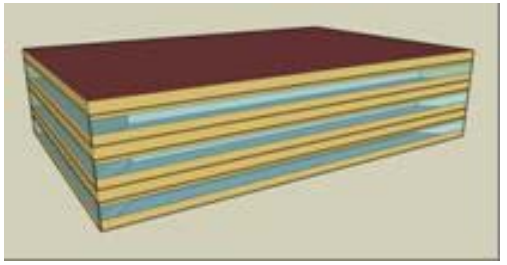
Baseline Exterior Envelope Test/Small Office-CZ-6, Run01

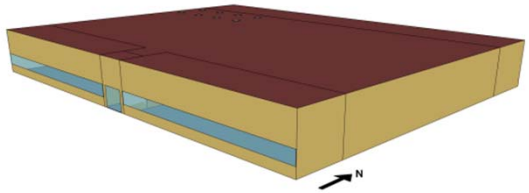


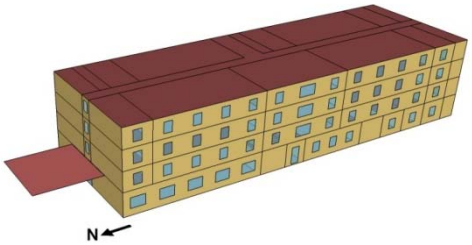
Prototype Models

- T-24 Version of DOE Prototype model for all CZ's
  - Small Office
  - Small Hotel
  - Medium Office
  - Large Office
  - Stand-Alone Retail
  - Warehouse







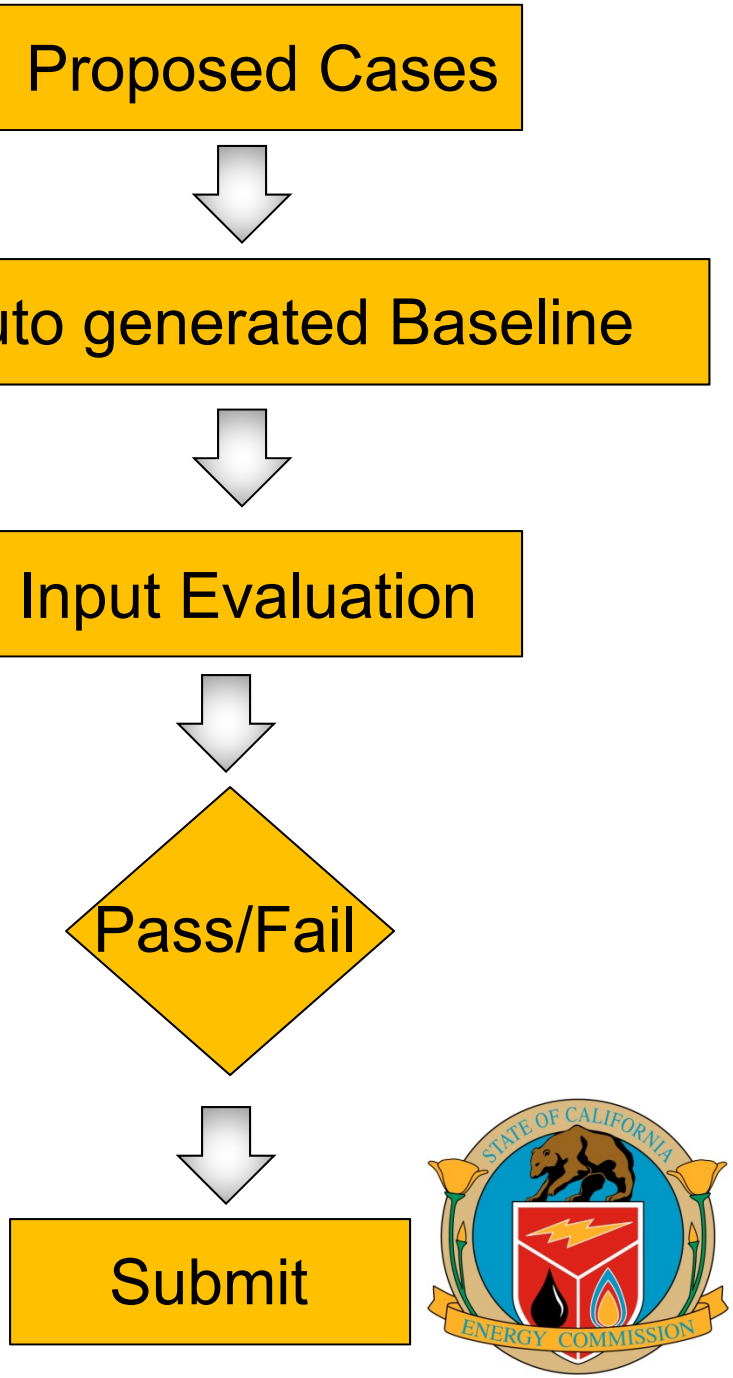


- Summary of Inputs- Appendix A
- Model files posted on CEC's Building Energy Efficiency Software Consortium webpage

  http://www.energydataweb.com/consortium/PACdocsNR.aspx.

Workflow:

- Applicant produces Proposed case for each Test Run.
- Compliance Engine generates Baseline Model
- Proposed and Baseline Inputs reported in spreadsheet
- Inputs evaluated
- Annotated files submitted to Commission



PROPOSED CASE

- Proposed case – modification to Prototype Model

Example:

Baseline Exterior Envelope Test/Small Office-CZ-6, Run01-

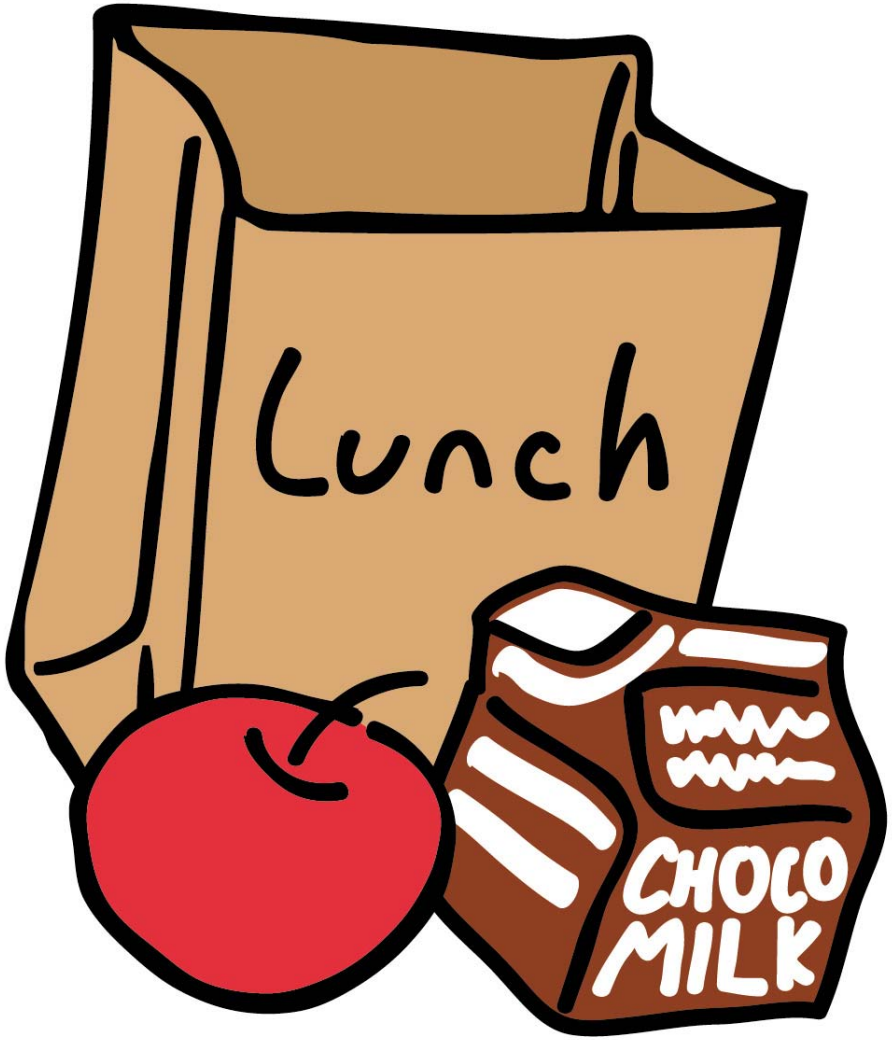
Proposed Case –Small Office in CZ-6 with

- Low sloped concrete roof with assembly U value of 0.065, Aged Solar Reflectance of 0.75 and Thermal emittance of 0.78.
- Wood-framed wall with assembly U value of 0.090
- Mass floor with assembly U value of 0.15.
- Fixed window with U factor of 0.25, RSHGC of 0.20 and V.T of 0.45.

Proposed and Baseline Input Comparison Spreadsheet

- Baseline Input Comparison Spreadsheet

- Compliance Test
  - Software Compliance Specification- Document
  - Summary of Prototype Models
  - Reference case- Idf files
  - Results Tabulation spreadsheet
- Rule set Implementation Test
  - Baseline Tests-Document
  - Summary of Prototype Models
  - Proposed case- Idf files
  - Inputs Comparison spreadsheet
- Model files posted on CEC's Building Energy Efficiency Software Consortium webpage
  http://www.energydataweb.com/consortium/PACdocsNR.aspx.


Lunch
CHOCO
MILK

Project Update

- Quick review of compliance software project
- Project timeline

2013 ACM Standards Compliance Engine Software

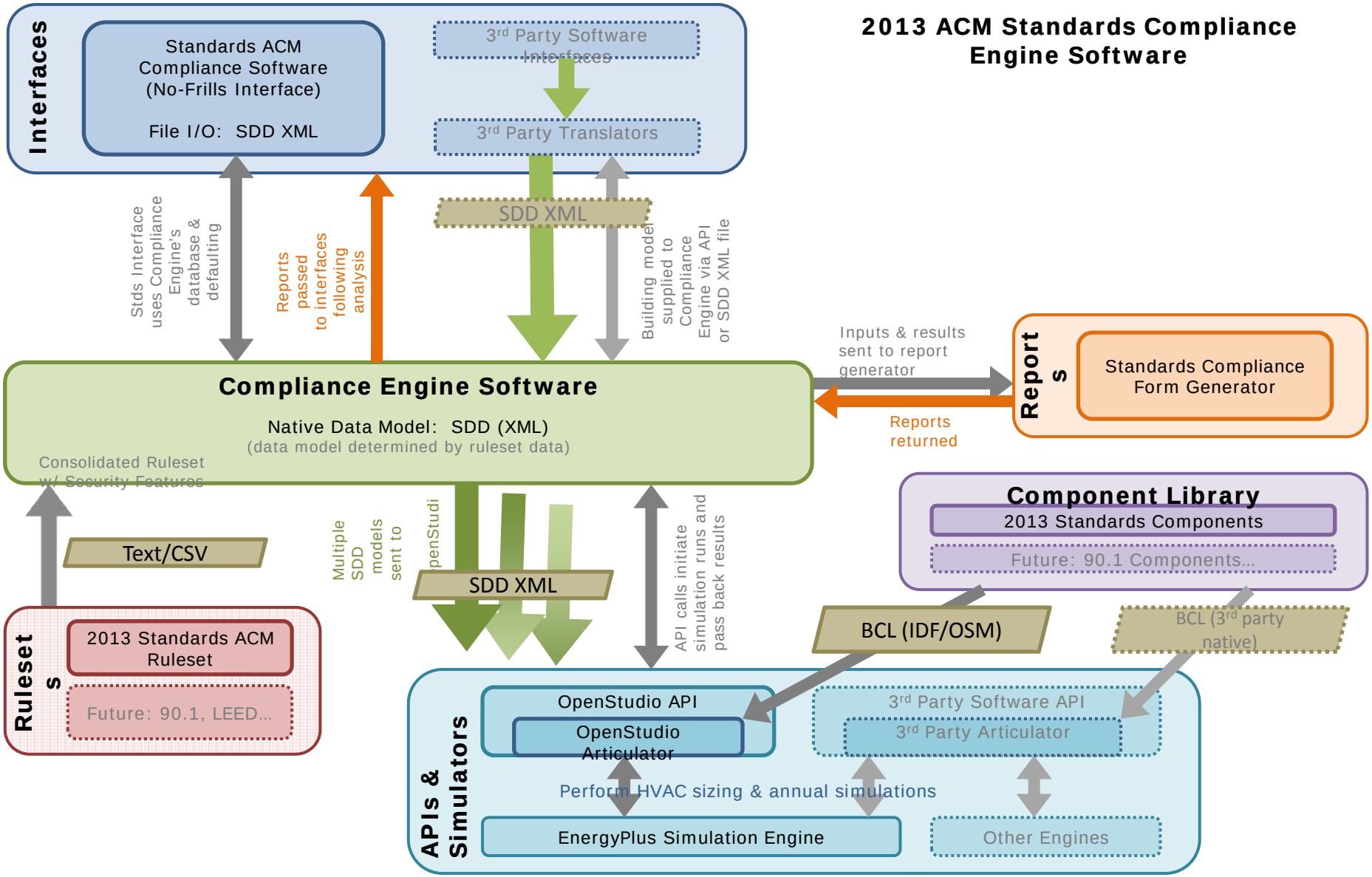
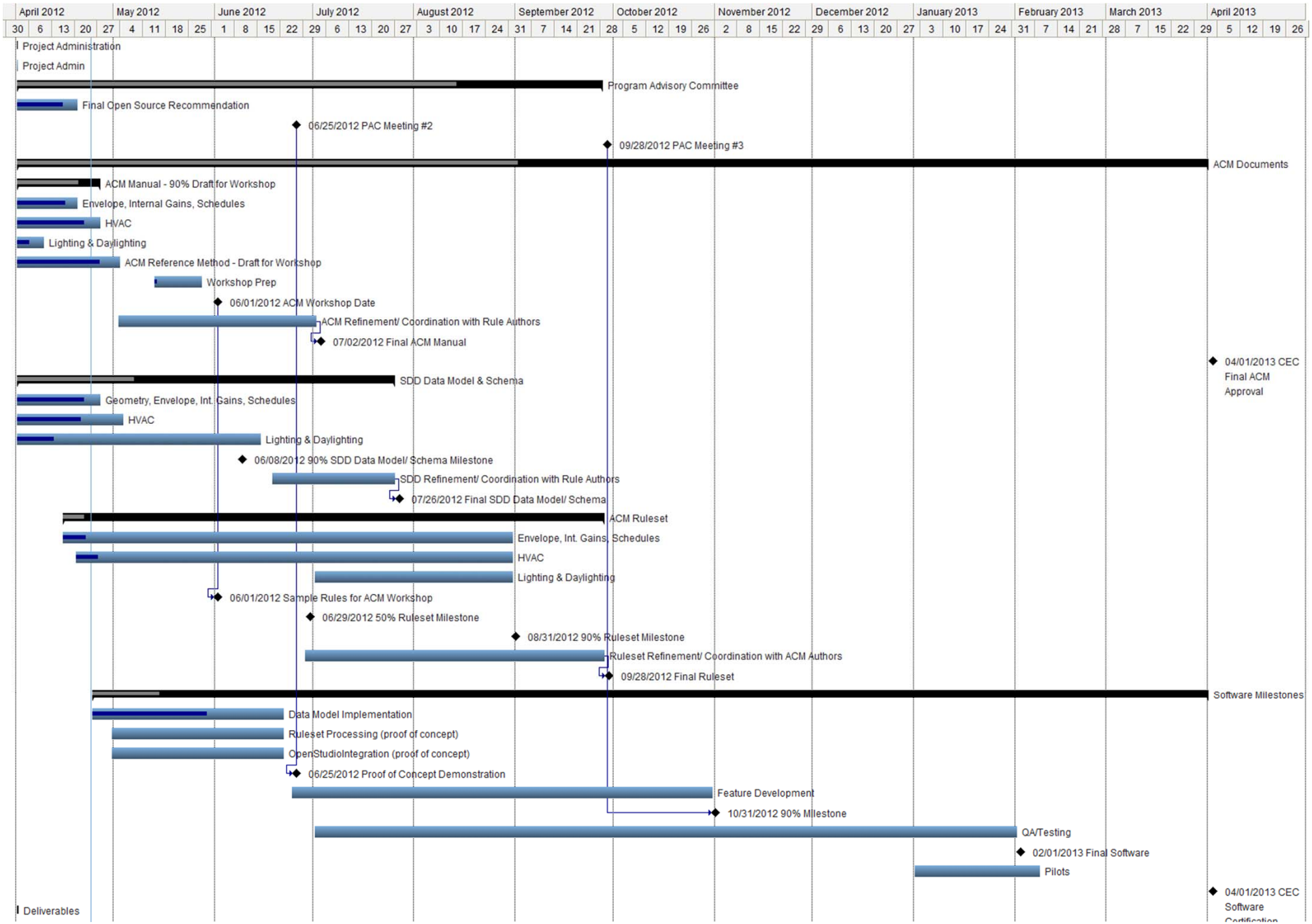


Diagram key:

- Transfer of building model via SDD (XML) (multiple arrows imply transfer of multiple building models)
- Transfer of compliance reports
- Inter-process communication of data and/or API calls
- Pale Blocks — Possible future modules


April 2012
May 2012
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Project Administration
Project Admin
Program Advisory Committee
Final Open Source Recommendation
06/25/2012 PAC Meeting #2
09/28/2012 PAC Meeting #3
ACM Documents
ACM Manual - 90% Draft for Workshop
Envelope, Internal Gains, Schedules
HVAC
Lighting & Daylighting
ACM Reference Method - Draft for Workshop
Workshop Prep
06/01/2012 ACM Workshop Date
ACM Refinement/ Coordination with Rule Authors
07/02/2012 Final ACM Manual
04/01/2013 CEC Final ACM Approval
SDD Data Model & Schema
Geometry, Envelope, Int. Gains, Schedules
HVAC
Lighting & Daylighting
06/08/2012 90% SDD Data Model/ Schema Milestone
SDD Refinement/ Coordination with Rule Authors
07/26/2012 Final SDD Data Model/ Schema
ACM Ruleset
Envelope, Int. Gains, Schedules
HVAC
Lighting & Daylighting
06/01/2012 Sample Rules for ACM Workshop
06/29/2012 50% Ruleset Milestone
08/31/2012 90% Ruleset Milestone
Ruleset Refinement/ Coordination with ACM Authors
09/28/2012 Final Ruleset
Software Milestones
Data Model Implementation
Ruleset Processing (proof of concept)
OpenStudioIntegration (proof of concept)
06/25/2012 Proof of Concept Demonstration
Feature Development
10/31/2012 90% Milestone
QA/Testing
02/01/2013 Final Software
Pilots
04/01/2013 CEC Software
Deliverables

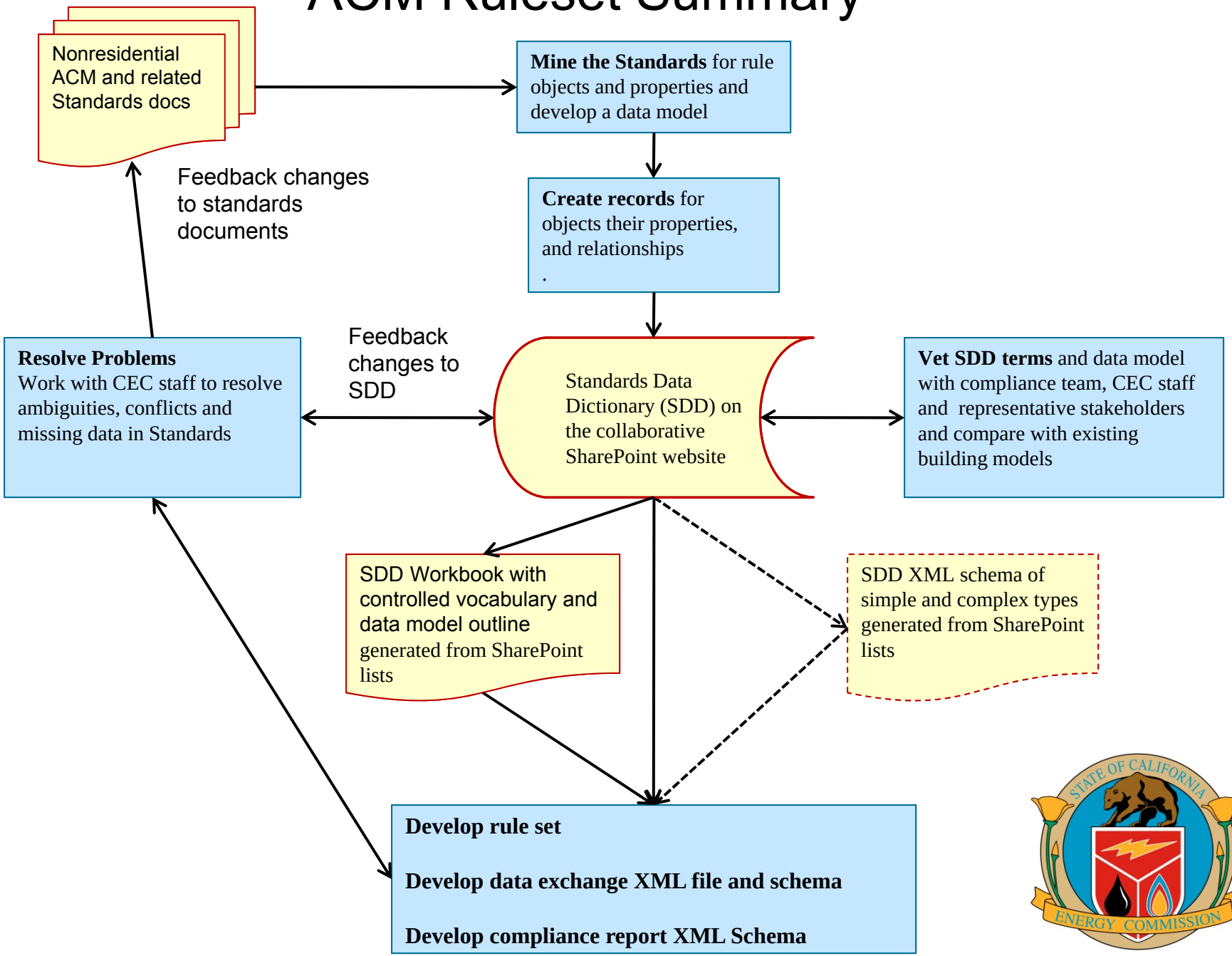
ACM Ruleset Summary

- Overview of SDD and SDD XML and its role in ruleset development
- Overview of ruleset
- Review of ruleset syntax
- Example rule implementation
- Issue Tracking

ACM Ruleset Summary

- Standards Data Dictionary (SDD) Role in Rule Set & XML Data File Development
  - Controlled Vocabulary for expressing any object or property in the rule set or data file.
    - Built-in quality control with predictable spellings, consistent capitalization and abbreviations used in the rule set and the XML data files.
  - Definitions, long and short form, properties, data type, units, relationships to other terms and reference to original standard text.
    - Convenience single repository for all terms and essential data used by the rule set and XML data files.
    - Extensive documentation improves usability/readability of rule set and XML data files
    - Provides data required to generate XML schema simple and complex types for use in developing an XML schema to back the SDD XML file
  - Collaborative Development Process using a SharePoint website
    - Development of SDD for multiple purposes: ruleset, compliance reporting, XML data files
    - Integration with Excel macro technology for
      - generating SDD workbook with data model outline for rule set development
      - generating XML schema simple types from the SharePoint lists
    - Support for developing different rule sets from the SDD

ACM Ruleset Summary



ACM Ruleset Summary

- SDD SharePoint Lists and Excel Workbook are available at:
- https://lmonte.sharepointsite.net/T24ComplianceSW/CEC2011Vocab/default.aspx
  - 2013NR_SDD_LatestVersion is the filename of the SDD workbook. It is posted on this page in the 2013 NR ACM Compliance Software Working Documents section
    - Feel free to ask me for your SharePoint logon info or to reset your password

Overview of Ruleset

- Transform user model into proposed and baseline
- Ruleset is a group of text files
  - OpaqueEnvelope-Walls.txt
  - HVACSecondary-SystemControls.txt
- Each file consists of blocks
  - RULE
  - RULE NEW
  - TABLE

RULE Blocks

- One RULE block for each SDD data element
- Collects all rules and data about the data element in one place
  - Ranges, expressions, descriptions, help, references, defaults
- Order of RULE blocks not important
- Rule processor determines dependencies
- RULE NEW blocks define temporary data elements

Ruleset Syntax

- Common blocks
  - RULE
  - RULE NEW
  - TABLE
- Meta data in a single file
  - RULESET
  - TRANSFORMATIONS
  - RULEFILES
  - TABLEFILES
  - LIBRARYFILES

RULE and RULE NEW

```
RULE <data model element>
  <content of a rule>
ENDRULE

RULE NEW <temp model element>
  <content of a rule>
ENDRULE
```

RULE Sections

- DESCRIPTION
- HELP
- REFERENCE
- MINIMUM
- COMMONMINIMUM
- COMMONMAXIMUM
- MAXIMUM
- UNITS
- OPTION
- DEFAULT
- PROPOSEDSIZING
- PROPOSED
- BASELINESIZING
- BASELINE

RULE Example

```
RULE project:building:buildingStory:space:Roof:ConsAssmRef
  DESCRIPTION
    "Reference to the Construction Assembly Name"
  HELP
    ""
  REFERENCE
    ACM-5.5.3
    App5.5C-Table143A
    App5.5C-Table143B
    App5.5C-Table5.5.1
  INPUTCLASS
    Required
  DEFAULT
    Roof-MetalBldg-R19
```

RULE Example - Continued

```
  PROPOSEDSIZING
    u:ConsAssmRef
  PROPOSED
    u:ConsAssmRef
  BASELINESIZING
    CreateComp(ConstructAssembly, "Roof-MetalBldg-R19")
  BASELINE
    bz:ConsAssmRef
ENDRULE
```

TABLE Block

```
TABLE <table-name>
      <col-1>       <col-2>       <col-3>…
      <ind/dep-1>   <ind/dep-2>   <ind/dep-3>
      <val-1-1>     <val-1-2>     <val-1-3>
      <val-2-1>     <val-2-2>     <val-2-3>
      <val-3-1>     <val-3-2>     <val-3-3>
ENDTABLE
```

Table Example

```
TABLE SpaceUseData
   Type            OccDensity    SensHeatGain   LatHeatGain
   INDEPENDENT     DEPENDENT     DEPENDENT      DEPENDENT
//                 ft2/person    Btu/occupant   Btu/occupant
   Office          100           250            200
   Retail          30            250            200
ENDTABLE

Used in a rule:
  SpaceUseData:SensHeatGain(Type=u:SpaceOccupancy)
```

ACM Manual → Rules

- Review section of ACM
- Identify ACM items
- Identify corresponding SDD elements
- Check if property defined already
- Create RULE blocks for each SDD property in each element (if not used already)
- Create TABLE blocks as needed
- ACM text reviewed and turned into logical expressions

ACM Example

5.5.3 Roofs

Roof Name	
Applicability	All roof surfaces
Definition	A unique name or code that identifies the roof and ties it to the construction documents submitted for energy code review. It is not mandatory to name roofs.
Units	Text, unique
Input Restrictions	None
Baseline Rules	None
Roof Type	
Applicability	All roof surfaces
Definition	A roof classification defined in the baseline standard. The prescriptive U-factor requirements for roofs depend on the type. For California, the roof classification is determined from the proposed design construction choice from Joint Appendix 4. This descriptor can be derived from other building descriptors and it may not be necessary for the software user to specify it directly.
Units	List: metal building or wood framed or other
Input Restrictions	As designed
Baseline Rules	The roof classification shall be metal building.
Roof Geometry	
Applicability	All roofs, required input
Definition	Roof geometry defines the position, orientation, azimuth, tilt, and dimensions of the roof surface. The details of how the coordinate system is implemented may vary between software programs. The data structure for surfaces is described in the reference section of this chapter.

Identify ACM Items

- Roof Name
- Roof Type
- Roof Geometry
- Roof Construction

Corresponding SDD Elements

- Project:Building:BuildingStory:Space:Roof
- Project:Building:BuildingStory:Space:Roof:PolyLoop
- ConstructAssembly
- Material

RULE Blocks Created

In OpaqueEnvelope-Roof.txt

project:building:buildingStory:space:roof:name
project:building:buildingStory:space:roof:roofConstructionType
project:building:buildingStory:space:roof:polyloop:cartesianPoint:coordinate[1]
project:building:buildingStory:space:roof:polyloop:cartesianPoint:coordinate[2]
project:building:buildingStory:space:roof:polyloop:cartesianPoint:coordinate[3]
project:building:buildingStory:space:Roof:ConsAssmRef

Also many rules in OpaqueEnvelope-Constructions.txt

Issue Tracking

- Concurrent development
  - ACM document
  - SDD model
  - Ruleset files
  - Software
- Diverse team
- Support for outside developers/users
- Need shared list of issues
- Tracking and assigning responsibility
- Google Code

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1 - 17 of 17 List Grid

ID	Type	SubType	Status	Priority	Milestone	Owner	Summary + Labels
10	Review	NACM	New	Low	----	JohnJArent	T24 Part 6 100.1 - Residential Function Areas
18	Review	SDD	Started	High	----	lu...@360-analytics.com	Design day properties (object?)
19	Review	NACM	Started	Medium	----	JohnJArent	JA4 Table 4.6.2 - Conductivity
20	Review	NACM	Started	Medium	----	JohnJArent	2.2.11 - Plenum modeling guidelines
21	Review	NACM	Started	Medium	----	JohnJArent	5.7.5 Equipment Efficiency Part Load Curves for DOE-2 vs. EnergyPlus
22	Review	NACM	Started	Medium	----	JohnJArent	5.7.3.2 - Default fan efficiency
25	Review	SDD	New	Low	----	di...@lmonte.com	CoilCooling:DXEIR - Revise to DXCOP?
26	Review	NACM	Started	High	----	JohnJArent	5.7.5.1 - Describing Coil Latent Performance
27	Review	NACM	Accepted	High	----	JohnJArent	5.7.5.1 - Cooling Capacity Adjustment Curves
30	Review	NACM	Accepted	Medium	----	JohnJArent	App 5.5c Table 5.5.1 - References do not correspond to the correct u-valu
36	Review	NACM	Accepted	Medium	----	JohnJArent	5.8.3 cooling tower capacity adjustment - curve not generic
40	Review	NACM	Started	Low	----	rhedr...@archenergy.com	Heat Gain per Person - EnergyPlus has additional modeling inputs
41	Review	NACM	New	Medium	----	JohnJArent	Variable Speed Chillers Performance Curves
42	Review	NACM	New	Medium	----	jglazer@gard.com	Condenser Water Reset Control Options
43	Review	NACM	New	Medium	----	JohnJArent	Baseline Illuminance Setpoint for daylight calculations
44	Review	NACM	Started	High	----	JohnJArent	Scope of ACM
45	Review	NACM	New	Medium	----	JohnJArent	5.9 Hot Water Load Specification in EnergyPlus

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Issue 42: Condenser Water Reset Control Options

1 person starred this issue and may be notified of changes.

‹ Prev 14 of 17 Next ›
Back to list

Status: New
Owner: iglazer@gard.com
Cc: rhedr...@archenergy.com, da...@360-analytics.com

Type-Review
Priority-Medium
Subtype-NACM

Add a comment below

Reported by project member JohnJArent, Jun 29, 2012

What NACM Section(s) are relevant to this issue?

5.8.3 Cooling Towers

Explanation of issue:

For condenser water reset, the two options are fixed or a wet-bulb reset. However, from COMNET there is a Reset Ratio term which provides a dial for a reset that is somewhere between a fixed approach to wet-bulb and a fixed CWS temperature. The default for the Reset Ratio is 0.29. I don't know where this control strategy comes from and I don't know if the simulation tools can readily model it.

Proposed resolution:

Remove Reset Ratio and have either a wet-bulb based reset with fixed approach or a fixed condenser water supply temp (the baseline is fixed at 70F).

Please provide any additional information below.

Comment 1 by project member JohnJArent, Jun 29, 2012

Is the approach used in the wet-bulb reset option the same as the design approach? Is this something that we should allow the user to enter?

Proof of Concept Demonstration

- Demonstration of software functionality
  - Import/Export of SDD XML
  - Ruleset syntax
  - Software Interface
  - Rules processing
  - Results Retrieval

OpenStudio-SDD Translators

- SDD Import into OpenStudio
  - Supports simulation of SDD models with EnergyPlus
  - The OpenStudio SDK is used to run the translator, perform the simulation, and extract results
  - Full featured translator: Site, Geometry, Constructions, Schedules, Internal Loads, HVAC

OpenStudio-SDD Translators

- SDD Export from OpenStudio
  - Enables creation of SDD geometry using the OpenStudio SketchUp Plug-in
  - Partial translator: Geometry, Constructions

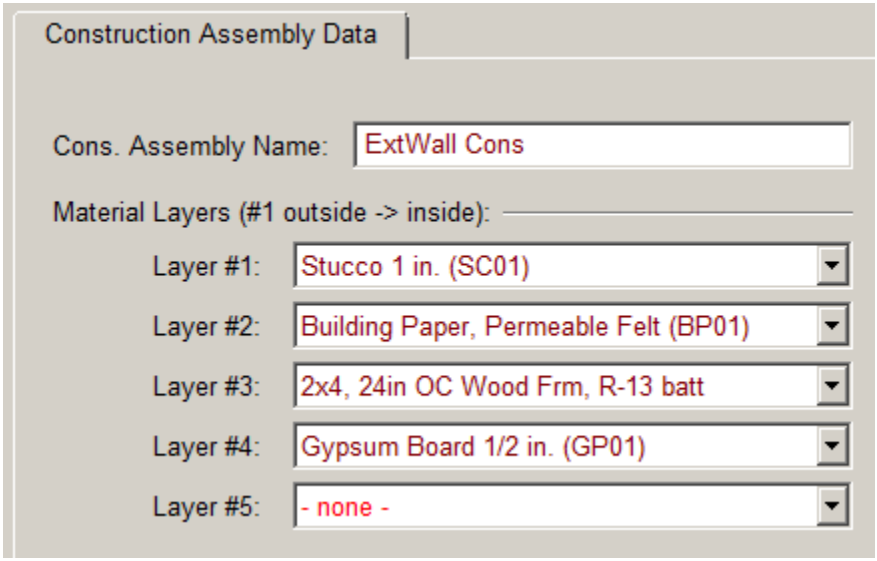
Compliance Engine SDD Schema, Input vs. Simulation

Construction Assemblies – Input restricted to Title-24 material layers and Simulation specifies detailed material characteristics

Simulation

```
- <ConsAssm>
    <Name>ExtWall Cons</Name>
    <MatRef index="0">Stucco 1 in. (SC01)</MatRef>
    <MatRef index="1">Building Paper, Permeable Felt (BP01)</MatRef>
    <MatRef index="2">2x4, 24in OC Wood Frm, R-13 batt</MatRef>
    <MatRef index="3">Gypsum Board 1/2 in. (GP01)</MatRef>
  </ConsAssm>
+ <ConsAssm>
+ <ConsAssm>
+ <ConsAssm>
+ <ConsAssm>
- <Mat>
    <Name>Stucco 1 in. (SC01)</Name>
    <RValue>0.2</RValue>
    <ThrmlCndct>0.4167</ThrmlCndct>
    <SpecHt>0.2</SpecHt>
    <SolAbs>0.7</SolAbs>
    <ThrmlAbs>0.9</ThrmlAbs>
    <VisAbs>0.7</VisAbs>
    <Dens>116</Dens>
    <Roughness>VeryRough</Roughness>
    <Thkns>1</Thkns>
  </Mat>
- <Mat>
    <Name>Building Paper, Permeable Felt (BP01)</Name>
    <RValue>0.06</RValue>
    <SolAbs>0.7</SolAbs>
```

Tool/User input



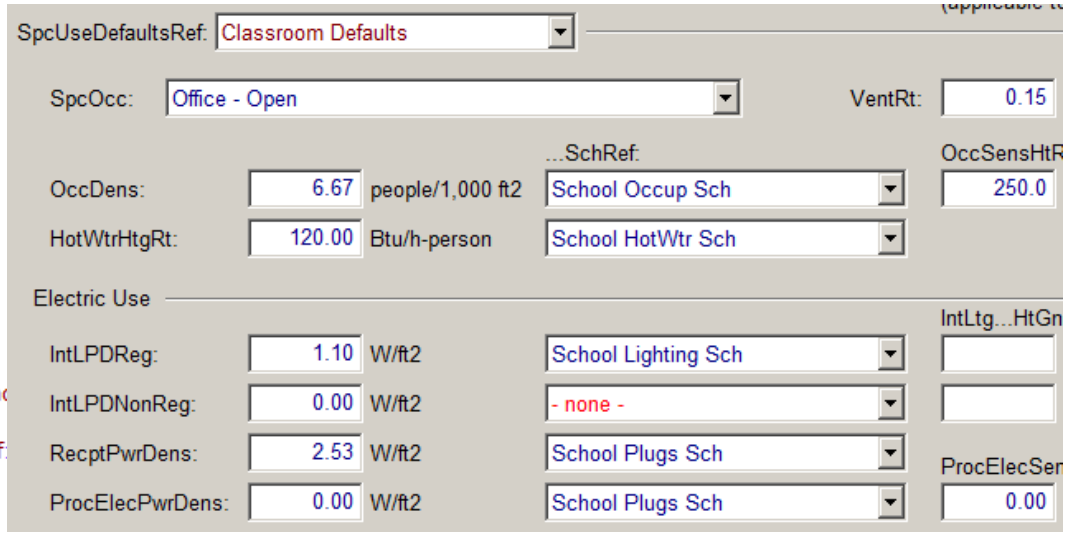
Compliance Engine SDD Schema, Input vs. Simulation

Space Loads – Input encouraged to utilize SpaceUseDefaults and Simulation supplied with detailed inputs for every zone

Simulation

```
- <Space>
    <Name>Wing2_Side1_Class1_Spc</Name>
    <CondgType>DirectlyConditioned</CondgType>
    <ThrmlZnRef>Wing2_Side1_Zn</ThrmlZnRef>
    <Vol>11124.1</Vol>
    <FlrArea>753.474</FlrArea>
    <SpcOcc>Office - Open</SpcOcc>
    <SchOcc>Table G-I Office Occupancy</SchOcc>
    <OccDens>6.67</OccDens>
    <OccSensHtRt>250</OccSensHtRt>
    <OccLatHtRt>200</OccLatHtRt>
    <OccSchRef>School Occup Sch</OccSchRef>
    <VentRt>0.15</VentRt>
    <IntLtgSysChildren>0</IntLtgSysChildren>
    <IntLtgSpecMthd>AreaCategoryMethod</IntLtgSpecMth
    <IntLPDReg>1.1</IntLPDReg>
    <IntLtgRegSchRef>School Lighting Sch</IntLtgRegSchRef
    <IntLPDNonReg>0</IntLPDNonReg>
    <RecptPwrDens>2.53</RecptPwrDens>
    <RecptSchRef>School Plugs Sch</RecptSchRef>
    <ProcElecPwrDens>0</ProcElecPwrDens>
    <ProcElecSensHtRt>0</ProcElecSensHtRt>
    <ProcElecLatHtRt>0</ProcElecLatHtRt>
    <ProcElecSchRef>School Plugs Sch</ProcElecSchRef>
    <CommRfrgEPD>0.06</CommRfrgEPD>
    <CommRfrgEqpSchRef>School Plugs Sch</CommRfrgEqpSchRef>
    <ElevEscalPwrDens>0</ElevEscalPwrDens>
    <ElevEscalSchRef>School Elevator Sch</ElevEscalSchRef>
    <ProcGasPwrDens>0.04</ProcGasPwrDens>
    <ProcGasSchRef>School Plugs Sch</ProcGasSchRef>
```

Tool/User input



(blue fields denote data defaulted via SpaceUseDefaults)

User Interface Demo

Demo

- Envelope Rules
  - project:building:buildingStory:space:roof:roofConstructionType
  - Project:Building:BuildingStory:Space:UndergroundFloor:Ffactor
- HVAC Rules
  - Project:Building:AirSys:AirSystemCoolingControl
  - Library_HVAC.txt

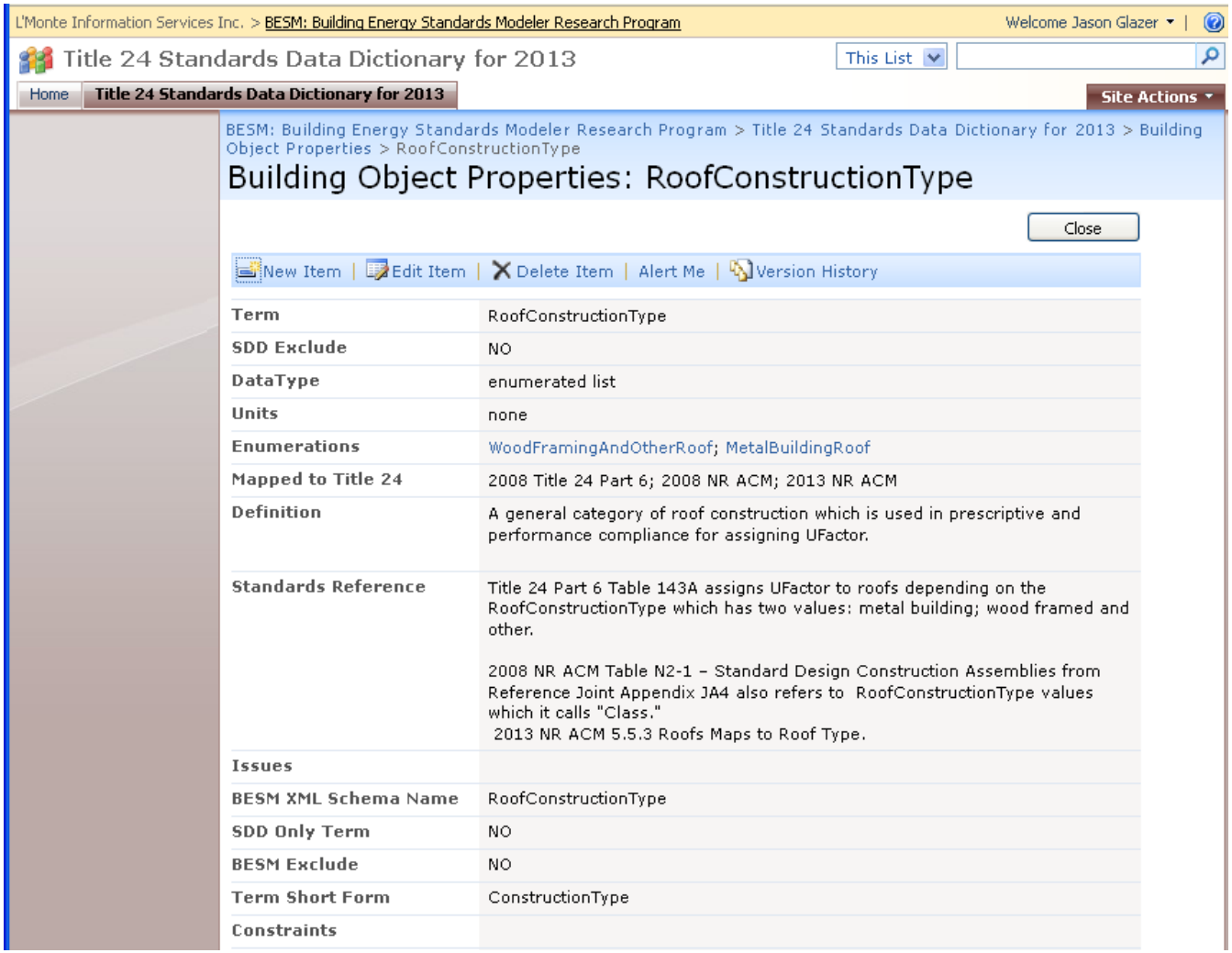
RoofConstructionType

- ACM 5.5.3
- SDD
- OpaqueEnvelope-Roofs.txt
- XML

ACM

Roof Type	
Applicability	All roof surfaces
Definition	A roof classification defined in the baseline standard. The prescriptive U-factor requirements for roofs depend on the type. For California, the roof classification is determined from the proposed design construction choice from Joint Appendix 4. This descriptor can be derived from other building descriptors and it may not be necessary for the software user to specify it directly.
Units	List: metal building or wood framed or other
Input Restrictions	As designed
Baseline Rules	The roof classification shall be metal building.

SDD


L'Monte Information Services Inc. > BESM: Building Energy Standards Modeler Research Program
Welcome Jason Glazer
Title 24 Standards Data Dictionary for 2013
This List
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Title 24 Standards Data Dictionary for 2013
Site Actions
BESM: Building Energy Standards Modeler Research Program > Title 24 Standards Data Dictionary for 2013 > Building Object Properties > RoofConstructionType
Building Object Properties: RoofConstructionType
Close
New Item | Edit Item | Delete Item | Alert Me | Version History
Term
RoofConstructionType
SDD Exclude
NO
DataType
enumerated list
Units
none
Enumerations
WoodFramingAndOtherRoof; MetalBuildingRoof
Mapped to Title 24
2008 Title 24 Part 6; 2008 NR ACM; 2013 NR ACM
Definition
A general category of roof construction which is used in prescriptive and performance compliance for assigning UFactor.
Standards Reference
Title 24 Part 6 Table 143A assigns UFactor to roofs depending on the RoofConstructionType which has two values: metal building; wood framed and other.
2008 NR ACM Table N2-1 – Standard Design Construction Assemblies from Reference Joint Appendix JA4 also refers to RoofConstructionType values which it calls "Class."
2013 NR ACM 5.5.3 Roofs Maps to Roof Type.
Issues
BESM XML Schema Name
RoofConstructionType
SDD Only Term
NO
BESM Exclude
NO
Term Short Form
ConstructionType
Constraints

OpaqueEnvelope-Roofs.txt

```
// -------------- Roof Type --------------------
// Input restriction summary:
//      Input is optional
// Baseline rule summary:
//      baseline is metal building (insulation entirely above deck)

RULE project:building:buildingStory:space:roof:roofConstructionType
  DESCRIPTION
    "A roof classification defined in the baseline standard. "
  HELP
    "A general category of roof construction which is used in prescriptive
    and performance compliance for assigning UFactor."
  REFERENCE
    ACM-5.5.3
  INPUTCLASS
    Required
  OPTION
    WoodFramingAndOtherRoof
    MetalBuildingRoof
  DEFAULT
    MetalBuildingRoof
  PROPOSEDSIZING
    u:roofConstructionType
  PROPOSED
    u:roofConstructionType
  BASELINESIZING
    MetalBuildingRoof
  BASELINE
    MetalBuildingRoof
ENDRULE
```

Rule Demonstration

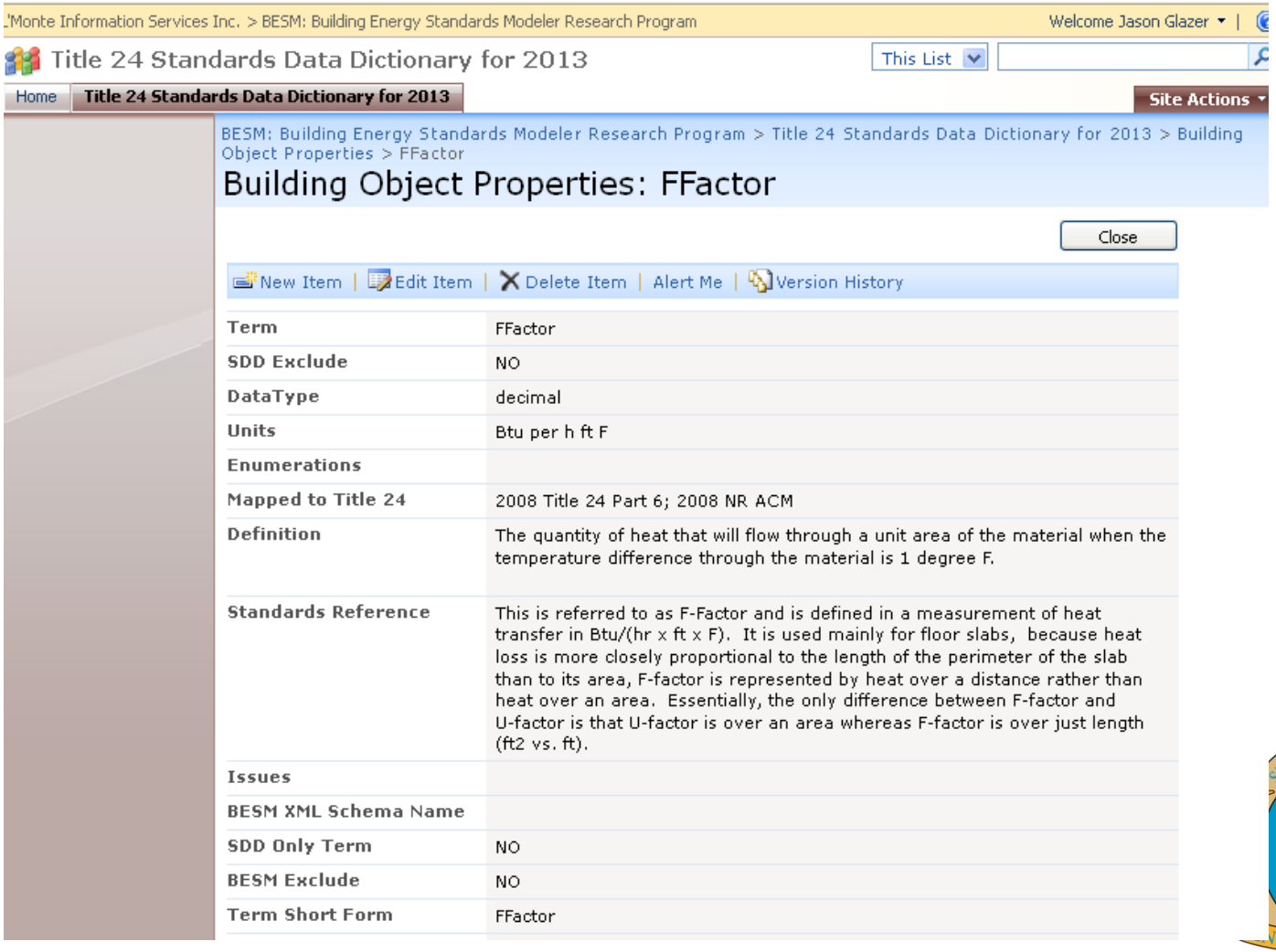
Ffactor

- ACM 5.5.9
- SDD
- OpaqueEnvelope-SlabFloor.txt
- XML

ACM

Slab Floor Construction	
Applicability	All slab floors, required input
Definition	A description of how the slab is insulated (or not). How the construction is described will depend on the energy simulation model. The construction can be represented by an F-factor that represents the entire construction (floor and insulation). Simple models may include just an F-factor, representing an instantaneous heat loss/gain to outside air. The F-factor could be related to the configuration of insulation in the proposed design. Other slab loss models may require that the surface area of the slab floor be divided between the perimeter and the interior. The insulation conditions then define heat transfer between both outside air and ground temperature. The insulation condition for slabs includes the R-value of the insulation and the distance it extends into the earth at the slab edge and how far it extends underneath the slab.
Units	Data structure: depends on the model that is used Simple method: F-factor from Reference Joint Appendix 4 Detailed method: Layer by layer description of insulation with location
Input Restrictions	F-factors shall be taken from Table 4.4.8 of Reference Appendix JA4 for heated slab floors and Table 4.4.7 for unheated slab floors. For all methods, inputs shall be consistent with the construction documents. For heated slab floors, the F-factor shall be no higher than 0.91 for climate zones 1-15 and 0.78 for climate zone 16.
Baseline Rules	Slab loss shall be modeled with the simple method (F-factor). The configuration of insulation and the F-factors for the baseline building heated slab floors are shown in Table 4.4.8 in Joint Appendix 4. The F-factor for the baseline shall be the following: Climate Zones 1-15: 0.91 Climate Zone 16: 0.78 For unheated slab floors the baseline F-factor shall be 0.73.

SDD



Term	FFactor
SDD Exclude	NO
DataType	decimal
Units	Btu per h ft F
Enumerations	
Mapped to Title 24	2008 Title 24 Part 6; 2008 NR ACM
Definition	The quantity of heat that will flow through a unit area of the material when the temperature difference through the material is 1 degree F.
Standards Reference	This is referred to as F-Factor and is defined in a measurement of heat transfer in Btu/(hr x ft x F). It is used mainly for floor slabs, because heat loss is more closely proportional to the length of the perimeter of the slab than to its area, F-factor is represented by heat over a distance rather than heat over an area. Essentially, the only difference between F-factor and U-factor is that U-factor is over an area whereas F-factor is over just length (ft2 vs. ft).
Issues	
BESM XML Schema Name	
SDD Only Term	NO
BESM Exclude	NO
Term Short Form	FFactor

Ffactor Property Location

- In process
  - Project:Building:BuildingStory:Space:UndergroundFloor:Ffactor
  - ConstructionAssembly:Ffactor

OpaqueEnvelope-SlabFloor.txt Part 1

```
RULE Project:Building:BuildingStory:Space:UndergroundFloor:Ffactor
  DESCRIPTION
    "A simplified measure of the overall heat transfer for a slab on grade
    floor."
  HELP
    ""
  REFERENCE
    ACM-5.5.9
  INPUTCLASS
    Optional
  MINIMUM
    0.01
  COMMONMINIMUM
    0.3
  COMMONMAXIMUM
    2.0
  MAXIMUM
    10.0
  UNITS
    Btu/h-ft-F
  DEFAULT
    none  // since it may be used
```

OpaqueEnvelope-SlabFloor.txt Part 2

```
  PROPOSEDSIZING¶
    IF (IsOnGrade=1) THEN   // IsOnGrade=True¶
      // For heated slab floors, the F-factor shall be no higher than 0.91
      // for climate zones 1-15 and 0.78 for climate zone 16.¶
      IF (u:FloorSlabHeating=1) THEN   // FloorSlabHeating=Heated¶
        IF (u:project:ClimateZone = 16) THEN¶
          MIN( Local(Ffactor), 0.78 )¶
        ELSE¶
          MIN( Local(Ffactor), 0.91 )¶
        ENDIF¶
      ELSE¶
        u:Ffactor¶
      ENDIF¶
    ELSE¶
      u:Ffactor¶
    ENDIF¶
  PROPOSED   ¶
    u:Ffactor¶
  BASELINESIZING¶
    IF (IsOnGrade=1) THEN   // IsOnGrade=True¶
      IF (u:FloorSlabHeating=1) THEN   // FloorSlabHeating=Heated¶
        IF (u:project:ClimateZone = 16) THEN¶
          0.78¶
        ELSE¶
          0.91¶
        ENDIF¶
      ELSE¶
        0.73¶
      ENDIF¶
    ELSE¶
      u:Ffactor¶
    ENDIF¶
  BASELINE   ¶
    bz:Ffactor¶
ENDRULE¶
```

Rule Demonstration

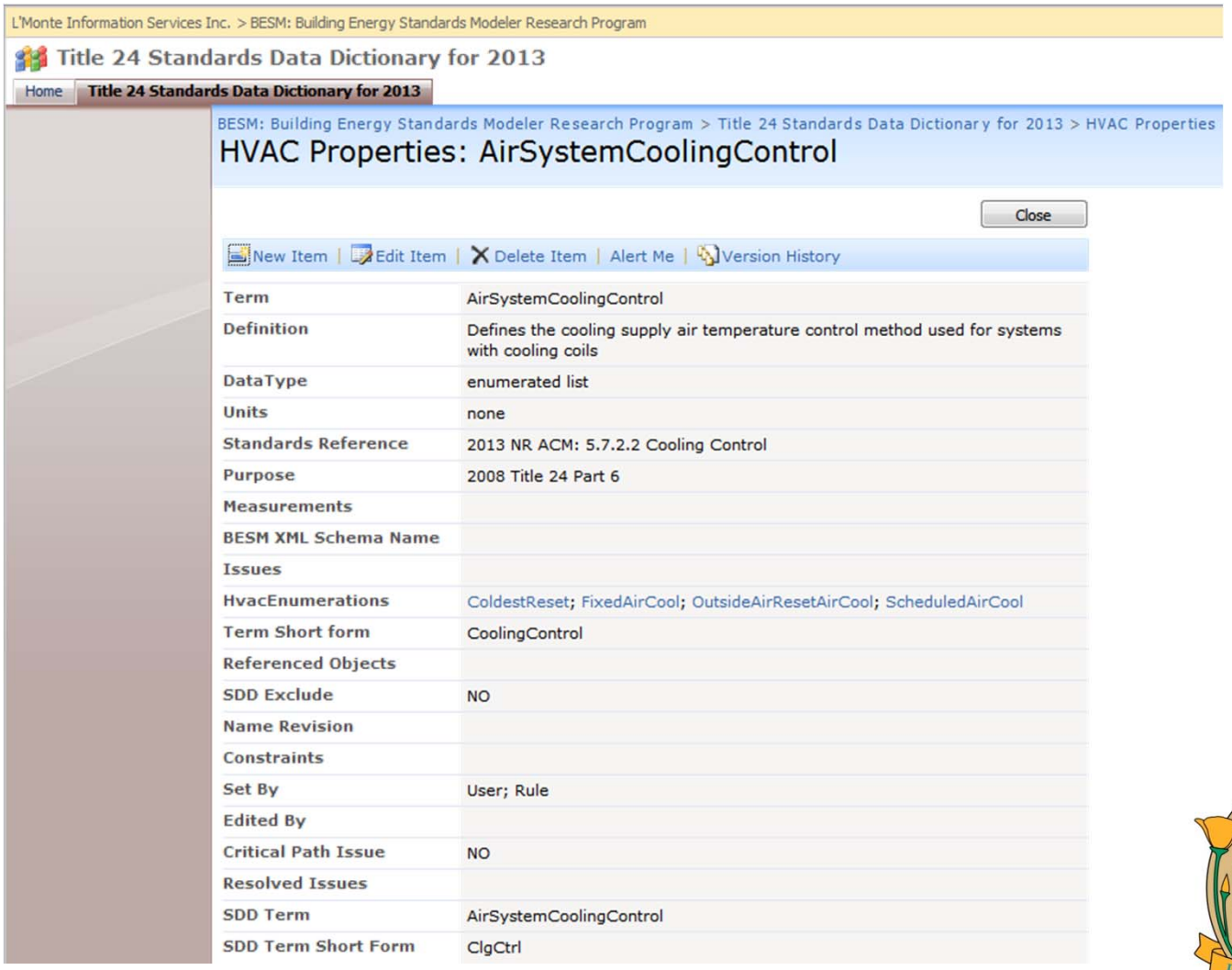
AirSystemCoolingControl

- ACM 5.7.2.2
- SDD
- HVACSecondary-SystemControls.txt
- Demo

ACM

Cooling Supply Air Temperature Control	
Applicability	Any system with multiple cooling stages or unloading
Definition	The method of controlling the supply air temperature. Choices are: • Fixed (constant) • Reset by warmest zone • Reset by outside air dry-bulb temperature • Scheduled setpoint • Staged setpoint (for Single Zone VAV and DX with multiple stages)
Units	List (see above)
Input Restrictions	None
Baseline Rules	For baseline building systems 1 through 4 and 11, the SAT control is fixed. For systems 5 through 8 and 10, the SAT control shall be reset by outside dry-bulb temperature. For system 9 (heating and ventilation) this input is not applicable.

SDD


L'Monte Information Services Inc. > BESM: Building Energy Standards Modeler Research Program
Title 24 Standards Data Dictionary for 2013
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Title 24 Standards Data Dictionary for 2013
BESM: Building Energy Standards Modeler Research Program > Title 24 Standards Data Dictionary for 2013 > HVAC Properties
HVAC Properties: AirSystemCoolingControl
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Term
AirSystemCoolingControl
Definition
Defines the cooling supply air temperature control method used for systems with cooling coils
DataType
enumerated list
Units
none
Standards Reference
2013 NR ACM: 5.7.2.2 Cooling Control
Purpose
2008 Title 24 Part 6
Measurements
BESM XML Schema Name
Issues
HvacEnumerations
ColdestReset; FixedAirCool; OutsideAirResetAirCool; ScheduledAirCool
Term Short form
CoolingControl
Referenced Objects
SDD Exclude
NO
Name Revision
Constraints
Set By
User; Rule
Edited By
Critical Path Issue
NO
Resolved Issues
SDD Term
AirSystemCoolingControl
SDD Term Short Form
ClgCtrl

HVACSecondary-SystemControls.txt Part 1

```
// -------------- Cooling Control - Cooling Air Temperature Control --------------------
// Input restriction summary:
//     None

// Baseline rule summary:
//      Specified, based on system type.
RULE Project:Building:AirSys:AirSystemCoolingControl
  DESCRIPTION
    "The method of controlling the cooling supply air temperature"
  HELP
    "Any system with multiple cooling stages or unloading"
  REFERENCE
    NACM 5.7.2.2
  INPUTCLASS
    Optional
  OPTION
    Fixed
    ColdestReset
    OutsideAirReset
    Scheduled
    StagedSetpoint
```

HVACSecondary-SystemControls.txt Part 1

```
DEFAULT
  Fixed
PROPOSEDSIZING
  UNCHANGED
PROPOSED
  UNCHANGED
BASELINESIZING
  SWITCH Parent( BasePredominantSysNumber )
    CASE  1 : Fixed
    CASE  2 : Fixed
    CASE  3 : Fixed
    CASE  4 : Fixed
    CASE  5 : OutsideAirReset
    CASE  6 : OutsideAirReset
    CASE  7 : OutsideAirReset
    CASE  8 : OutsideAirReset
    CASE  9 : NONE
    CASE 10 : OutsideAirReset
    CASE 11 : Fixed
    default : UNCHANGED
  ENDSWITCH
BASELINE
  Local( bz:AirSystemCoolingControl )
ENDRULE
```

Baseline HVAC System Creation

- ACM 5.1.2
- SDD
- HVACSecondary-BaselineHVACSystems.txt + Library_HVAC_txt

ACM

Table 1 – HVAC System Map

Building Type	Primary Space Heating Source		
	Fossil Fuel, Fossil/Hybrid, Purchased Heat	**Electric and Other (Natural Gas Available)**	**Electric and Other (Natural Gas Unavailable)**
Residential	System 1 - PTAC	System 2 - PTHP	System 2 - PTHP
Nonresidential and 3 Floors or Less than <25,000 ft2	System 3 – PSZ AC	System 3 – PSZ AC	System 4 – PSZ HP
Nonresidential and 4 or 5 Floors and <25,000 ft2 or 5 Floors or Less and 25,000 ft2 to 150,000 ft2	System 5 – PVAV with Reheat**	System 5	System 5
Nonresidential and More than 5 Floors or >150,000 ft2	System 6 – VAV with reheat**	System 6	System 6
Nonresidential and 3 Floors or Less and less than 25,000 ft2 and zone cooling load >= 110,000 Btu/h*	System 7 – Single Zone VAV	System 7 – Single Zone VAV	System 8 – Single Zone VAV HP
Heated Only Storage	System 9 – Heating and Ventilation	N/A	N/A
Total computer room design cooling load is over 3,000,000 Btu/h or the non-computer loads are served by System Types 5 or 6 (Packaged VAV or Built-up VAV)	System 10 – CRAH Units	N/A	N/A
Computer rooms that do not meet the conditions for System 10, CRAH	System 11 – CRAC Units	N/A	N/A

* The single zone VAV system 7 and 8 applies to thermal blocks with design cooling loads greater than 110,000 Btu/h (and in 1/1/2014, 75,000 Btu/h, and 1/1/2016, 65,000 Btu/h). Thermal blocks with smaller design cooling loads shall use the package single zone system 3 or 4.

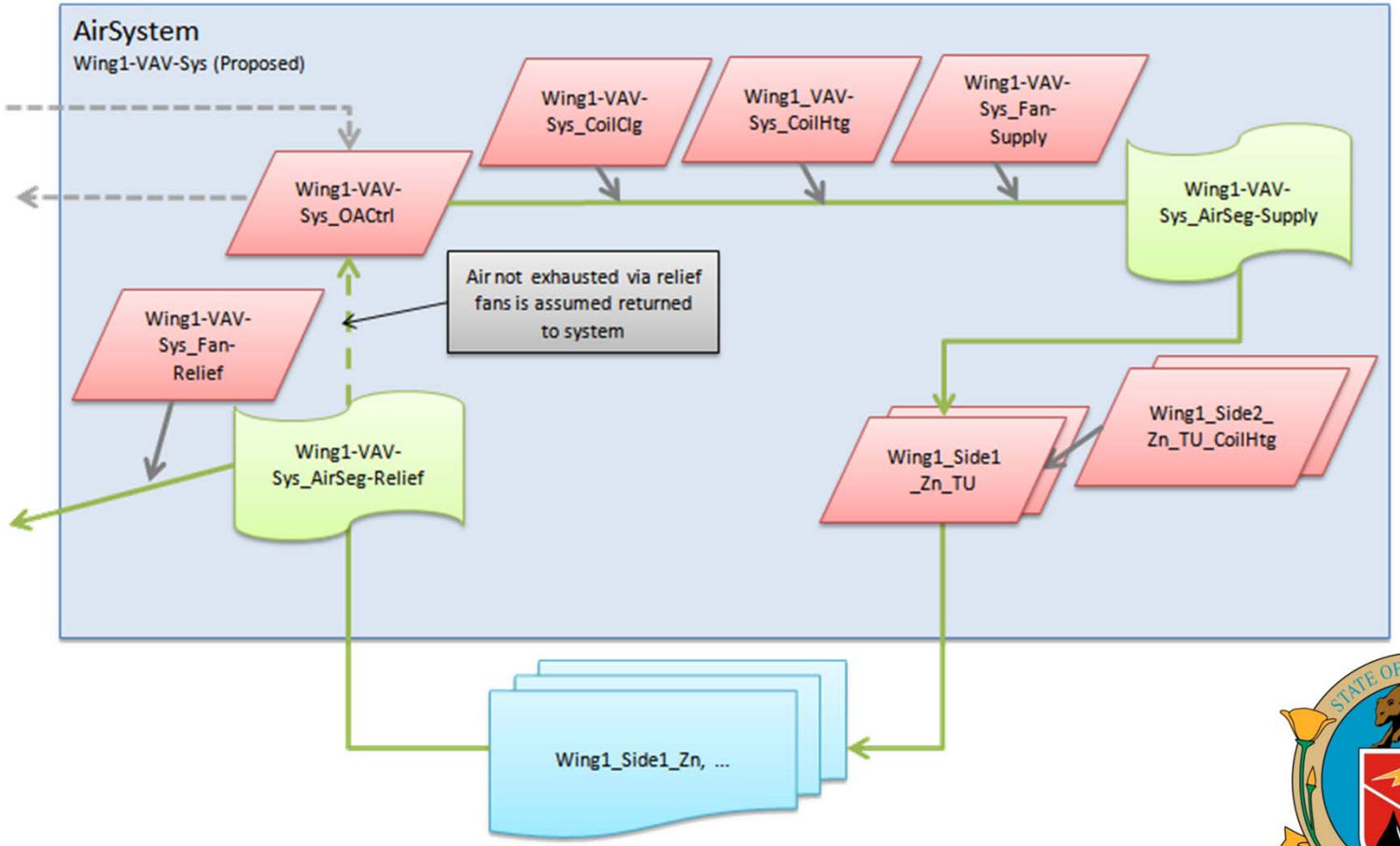
** For laboratory spaces in a building having a total laboratory exhaust rate greater than 5000 cfm, use a single system of type 5 or 6 with a design supply air to room air temperature difference of 17F.

Note a floor is considered a "Habitable Story", defined in the Standards as a story that is at least 50 percent above grade.

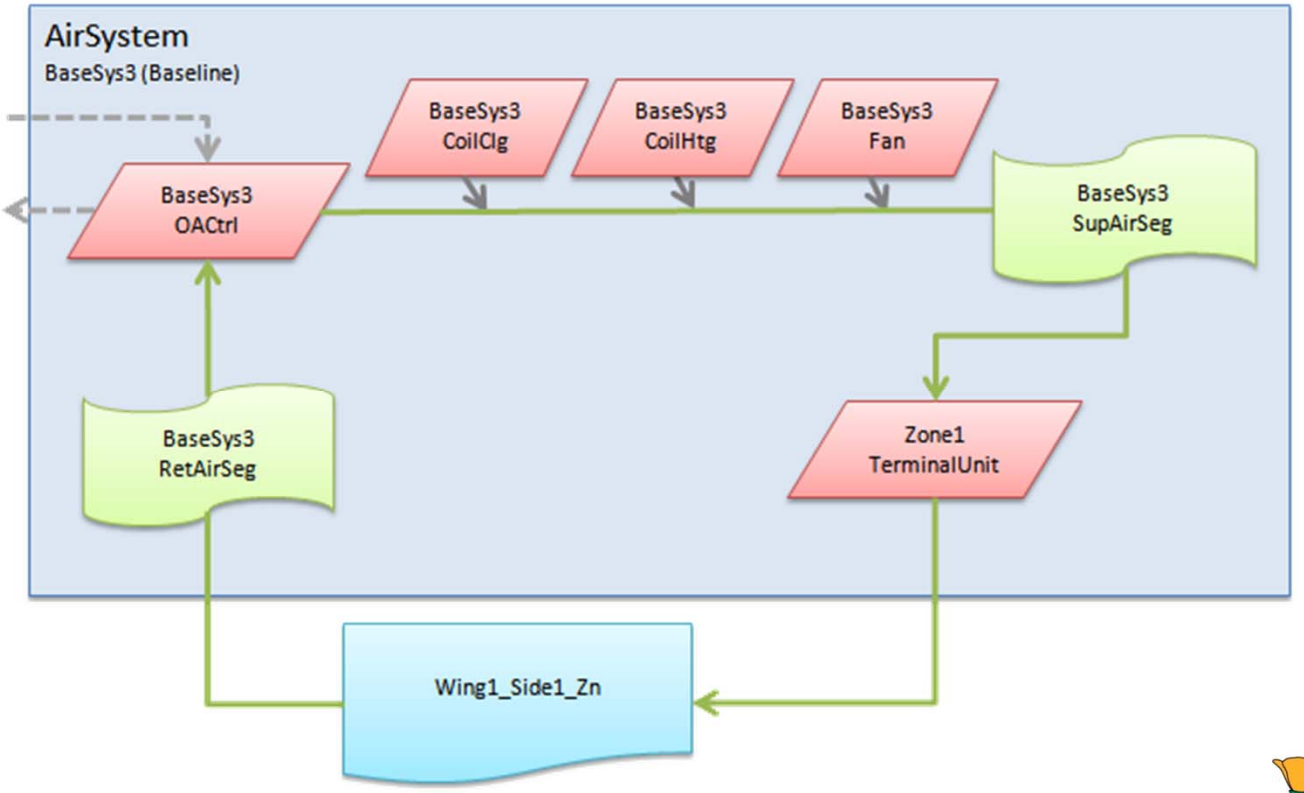
SDD

- HVAC objects
  - AirSystem, AirSegment, CoilCooling, etc.
- Parent/child or reference relationships define system architecture.

SDD
PVAV w/ Elec Reheat



SDD
Baseline PSZ-AC



HVACSecondary-BaselineHVACSystems.txt

```
;// ---------- Create thermal zone baseline systems ------------
;RULE NEW Project:Building:ThrmlZn:BaseZnSys
;  DESCRIPTION
;    ""
;  HELP
;    ""
;  REFERENCE
;
;  BASELINESIZING
;// Will behave additional rules that determine conditions for system exceptions
;    SWITCH Parent( BasePredominantSysNumber )
;      CASE 1 :
;        RuleLibrary( AirSys, "BaseAirSys1" )
;      CASE 2 :
;        RuleLibrary( AirSys, "BaseAirSys2" )
;      CASE 3 :
;        RuleLibrary( AirSys, "BaseAirSys3" )
;      CASE 4 :
;        RuleLibrary( AirSys, "BaseAirSys4" )
;      CASE 7 :
;        RuleLibrary( AirSys, "BaseAirSys7" )
;      CASE 8 :
;        RuleLibrary( AirSys, "BaseAirSys8" )
;      CASE 9 :
;        RuleLibrary( AirSys, "BaseAirSys9" )
;      CASE 10 :
;        RuleLibrary( AirSys, "BaseAirSys10" )
;      CASE 11 :
;        RuleLibrary( AirSys, "BaseAirSys11" )
;      default :
;        UNCHANGED
;    ENDSWITCH
;  BASELINE
;    IF LocalCompAssigned( BaseZnSys )
;      THEN bz:BaseZnSys
;    ELSE
;         UNCHANGED
;    ENDIF
ENDRULE
```

Library_HVAC.txt

```
; RuleLibrary(AirSys, "BaseAirSys3")  // Command used to create the AirSys and its related components

AirSystem   "BaseAirSys3"
     Type = "PSZ-AC"
     SupAirSegRef = "BaseSys3 SupAirSeg"
     RetAirSegRef = "BaseSys3 RetAirSeg"
     OACtrlRef = "BaseSys3 OACtrl"
     ..

AirSegment   "BaseSys3 SupAirSeg"
     Type = "Supply"
     CoilClgRef = "BaseSys3 CoilClg"
     CoilHtgRef = "BaseSys3 CoilHtg"
     FanRef = "BaseSys3 Fan"
     ..

AirSegment   "BaseSys3 RetAirSeg"
     Type = "Return"
     ..

CoilCooling   "BaseSys3 CoilClg"
     Type = "DirectExpansion"
     ..

CoilHeating   "BaseSys3 CoilHtg"
     Type = "Furnace"
     ..

Fan   "BaseSys3 Fan"
     CtrlMthd = "ConstantVolume"
     ..

OAControl   "BaseSys3 OACtrl"
     AirSegSupRef = "BaseSys3 SupAirSeg"
     AirSegRetRef = "BaseSys3 RetAirSeg"
     ..
```

Results Retrieval Demo

PAC Discussion

- Questions and Comments?

Program Advisory Committee:

Thanks for your Participation!

Project Materials available at:
http://www.energydataweb.com/consortium/PACdocsNR.aspx