AHRI Air-Conditioning, Heating, and Refrigeration Institute

California Energy Commission
DOCKETED
12-BSTD-06
TN # 68889
DEC 14 2012

December 14, 2012

California Energy Commission (CEC)

Re: Residential Alternative Calculation Method Reference Manual - 2013 Building Energy Efficiency Standards (AHRI Comments on Residential Zoned Air Conditioning; Docket # 12-BSTD-06)

Dear CEC Staff:

The Air-Conditioning, Heating and Refrigeration Institute (AHRI) is the trade association representing manufacturers of heating, cooling, water heating, and commercial refrigeration equipment. Over 300 members strong, AHRI is an internationally recognized advocate for the industry, and develops standards for and certifies the performance of many of the products manufactured by our members. In North America, the annual output of the HVACR industry is worth more than $20 billion. In the United States alone, our members employ approximately 130,000 people, and support some 800,000 dealers, contractors, and technicians.

We have some comments on the presentations that were made by Mr. Wilcox on July 17, 2012 and November 20, 2012 (during the CEC staff workshop) to discuss the development of the residential Alternative Calculation Method (ACM) reference manual with respect to zoning systems. In particular, we have concerns with the requirements specified in the presentations for zoning systems. Also, we would like to understand how these requirements will be integrated into the residential ACM algorithms. The November 15, 2012 draft residential ACM algorithms did not account for zoning systems, thereby eliminating an opportunity for our industry to provide comments on a tangible proposed code language. We would like to work jointly with CEC and its consultants to develop the algorithms on zoning systems.

Slide 27 of the July 17, 2012 presentation (see Attachment 1) states that the cooling system zonal thermostats will be deleted and all spaces will operate in cooling at the conditioned zone set points. The slide also states that an algorithm will be developed to model the impact of bypass ducts on cooling system performance. These two statements seem to conflict with each other since zone thermostat set-points are relevant variables in determining the airflow with respect to bypass air.

Slide 45 of the November 20, 2012 presentation (see Attachment 2) states that supply air dampers must be manufactured and installed so that when they are closed, there is no measurable airflow at the registers. Although we strictly advocate against air leakage into unconditioned spaces, we do believe that allowing for a small percentage of

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leakage across inactive dampers that serve unoccupied zones is an effective way of reducing bypass flow. In our opinion, a complete prohibition against damper leakage past the inactive damper will adversely impact CEC's efforts to reduce bypass flow. As indicated below, the Air Conditioning Contractors of America's (ACCA) Manual Zr makes multiple references to a maximum 20% leakage past the control damper, as a means of reducing bypass flow and reducing air stratification, in air zone control applications:

- **Section 8-5 Distributed Relief** (Page 80) states that the Manual Zr default for flow through a zone damper that is on its stop is 20% of the design CFM value for zone air flow.
- **Step 10, Qualification and Limitation of Appendix A9-5** (Page 215) states that the maximum amount of relief for one zone damper is 20% design value for zone CFM.
- **The Damper Stop Worksheet in Appendix 17** (Page 257) specifies a maximum value of 0.20 for the air relief factor. Additionally, page 258 also states that "the maximum damper stop CFM for a zone is 20% of zone's design CFM."

Not only does a controlled air damper leakage reduce bypass flow, it also reduces air stratification in all areas of the home and increases the true return flow from the home. The correct amount of air leakage can produce an anticipation effect and delay the next heating/cooling operation by off-setting the heat loss or heat gain in a satisfied zone.

Slide 34 of the November 20, 2012 presentation pertains to cooling air flow from conditioned spaces through the return and excludes the bypass duct air flow. The proposed design incorporates a default 260 CFM/ton for zonal control with ducted single speed compressor systems. However, this design is not specified anywhere within the final 2013 Building Energy Efficiency Standards. §150.0(m)15 of the standards specifies that "zonally controlled central forced air cooling systems shall be capable of simultaneously delivering, in every zonal control mode, an airflow from the dwelling, through the air handler fan and delivered to the dwelling, of greater than 350 CFM per ton of nominal cooling capacity…" We request that CEC clarify the rationale behind the proposed adoption of 260 CFM/ton design.

We appreciate this opportunity to provide comments on residential zoned air conditioning. As mentioned earlier, we would appreciate an opportunity to continue working with CEC and its consultants to develop algorithms for the residential ACM reference manuals that are practical, meet CEC's energy efficiency goals, and are not overly burdensome for the industry. If you have any questions or wish to discuss this further, please do not hesitate to call me at (703) 600-0383.

Sincerely,

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Attachments:

1. Slide 27 of Mr. Wilcox's July 17, 2012 Presentation
2. November 20, 2012 Residential ACM Reference Manual Presentation

Zonal Systems

- The cooling system zonal thermostats are deleted and all spaces operate in cooling at the conditioned zone set points
- The heating system zonal thermostats and schedule are maintained for systems that meet the current requirements for that credit
- An algorithm will be developed to model the impact of bypass ducts on cooling system performance

Attachment 2:

2013 RESIDENTIAL COMPLIANCE SOFTWARE PROJECT

Staff Workshop on the 2013 Residential Alternative Calculation Method Reference Manual

November 20, 2012

Bruce Wilcox, P. E.
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2013 RESIDENTIAL SOFTWARE COMPLIANCE PROJECT GOALS

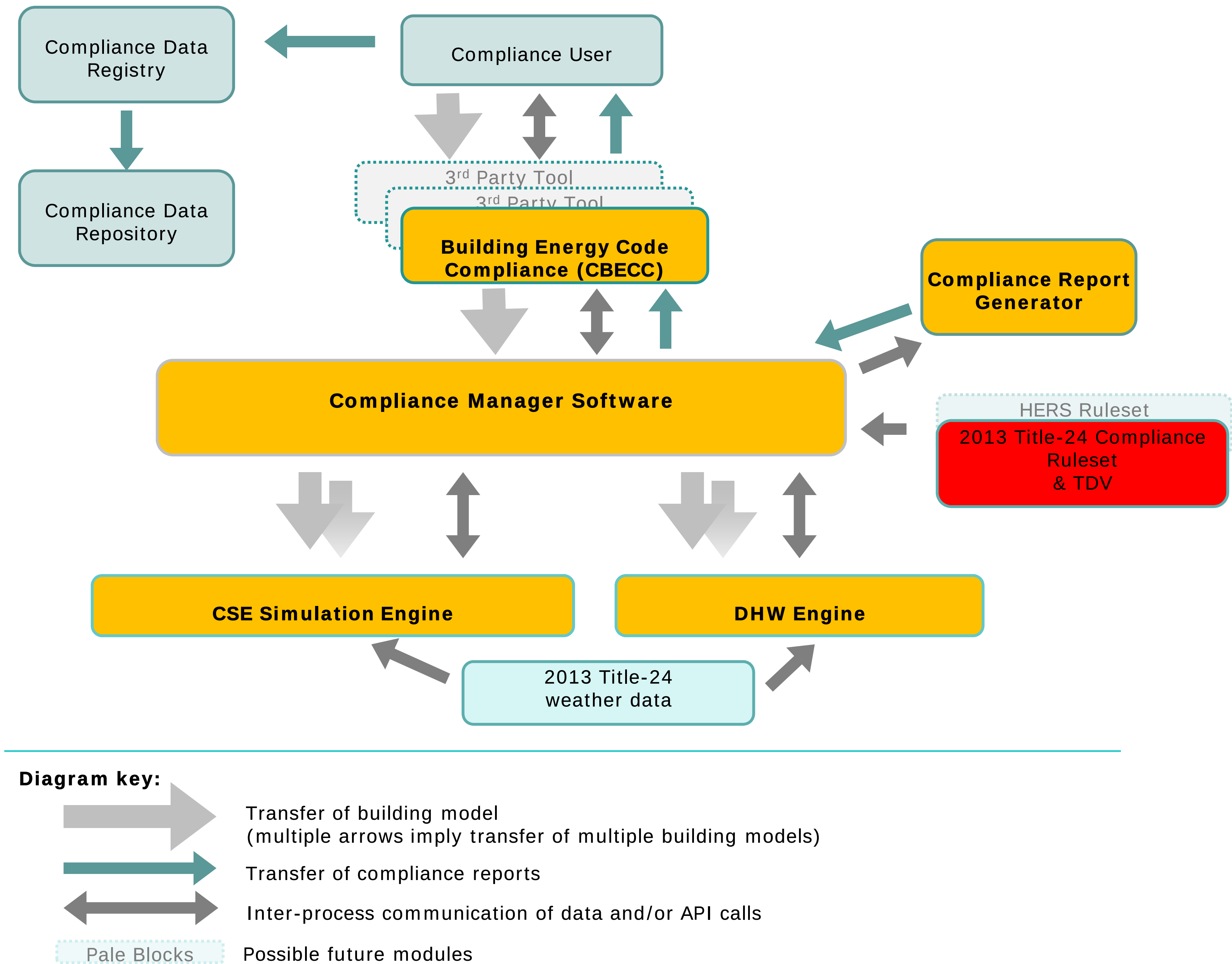
- Provide public software for 2013 Standards compliance

- Improve accuracy, particularly in cooling, to support zero net energy goals

- Foster collaborative software environment for the future

Project Technical Team

Bruce Wilcox	Prime Contractor, Project Manager, Technical Lead
Chip Barnaby	CSE Lead Programmer
Scott Criswell	Compliance Manager Lead Programmer
Dave Krinkel	Development Plan
Phil Niles	CSE chief scientist
Robert Scott	Compliance Form Generator
Ken Nittler	Testing
Marc Hoeschele	DHW Simulation
Doug Herr	DHW Programmer
John Proctor	HVAC modeling


Compliance Data Registry
Compliance User
Compliance Data Repository
3rd Party Tool
3rd Party Tool
Building Energy Code Compliance (CBECC)
Compliance Report Generator
Compliance Manager Software
HERS Ruleset
2013 Title-24 Compliance Ruleset & TDV
CSE Simulation Engine
DHW Engine
2013 Title-24 weather data
Diagram key:
Transfer of building model
(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

UPCOMING MILESTONES

- Typical house beta test mid December
- 2nd RACM Workshop end of January
  - Additions and Alterations etc.
- Software certification June
- Standards Implementation January 2014

2013 Residential ACM Reference Manual

- Prescribes the user inputs for compliance calculations
- Explain how those inputs are used to set up the CSE and DHW calculations for the Proposed and Standard Design
- Specifies the Reporting and Verification required
- Will be approved by the CEC
- Partial draft for public comment. Not included yet:
  - Additions and Alterations
  - Unusual constructions and HVAC systems

2013 Residential ACM Algorithms

- Companion document to the Reference Manual
- Documents the calculations used in the performance method:
  - CSE calculations simulation
  - Compliance manager calculation

The Proposed Design

- The compliance user's description of the building design
- Terminology and scope of the Proposed Design are defined by the Reference Manual
- Allowed components and properties are specified
- Range and validity checking is applied by the software
- Documented in reports for verification by contractors, building officials and HERS Raters
- Simulation in CSE and DHW engines to establish Proposed Design TDV energy use.

The Standard Design

- Automatically generated by the Compliance Manager
- A version of the Proposed Design that exactly meets the 2013 Standards requirements for R-value, SEER etc.
- Has Standard Design rules applied, for example:
  - Equal glazing in the 4 cardinal orientations, same area as proposed up to 20% of conditioned floor area (CFA).
  - Specific HVAC systems, e. g. a heat pump if electric heat is proposed
- Simulation in CSE and DHW engines to establish Standard Design TDV energy use.
- The Proposed Design complies if its TDV energy use is less that the Standard Design TDV energy.

THE BUILDING/PROJECT

- Standards Version
- Climate and Weather
- Air Leakage and Infiltration
- High Quality Insulation Installation
- Dwelling Unit Types
- Orientation
- Natural Gas Availability
- Solar
- Materials and Construction Assemblies
- Heating Subsystems
- Cooling Subsystems
- Fan Subsystems
- Distribution Subsystems
- HVAC Systems
- Cooling Ventilation Systems
- Indoor Air Quality Ventilation

STANDARDS VERSION

- New Input: Standards Version
  - Compliance 2014: through December 2014 (with current Federal Air Conditioning efficiency requirements
  - Compliance 2015: any time (with 2015 Federal Air Conditioning Requirements)
- Standard Design: AC efficiency at specified Federal level
- Reporting:
  - Standards Version
  - SEER & EER if Compliance 2015

Climate and Weather

- New definition of the 16 climate zones
  - 2013 Standards criteria is Zip Code only
- Input is Zip Code of Proposed Building
  - Compliance Manager resolves Zip Code into Climate Zone
- Reporting:
  - Zip Code and Climate Zone

Air Leakage and Infiltration

- Envelope air leakage is a building level characteristic
- Input is Air Changes at 50 Pascals (ACH50) measured according to the CEC approved method (copied from Resnet).
- Default and Standard Design ACH50 is:

	Single Family	All others
Ducts outside of conditioned space	5	7
No ducts outside of conditioned space	4.4	6.2

- A lower value may be used for single family and townhouses if verified, not for multi-family
- Reporting: HERS Required Verification of ACH50 if other than default

Air Leakage Distribution

- Envelope air leakage is located at the building surfaces

% of Total House Leakage by Surface				
Configuration	Ceilings	Floors	Exterior Walls	House to Garage Surfaces
Slab on grade	50	0		
Raised Floor	40	10		
No Garage			50	0
Attached Garage			40	10

High Quality Insulation Installation (QII)

- QII is a building level characteristic
- Input is user choice of Unverified or Verified
- Default and Standard Design are Unverified
- Compliance Manager adjusts constructions to represent the impact of insulation defects only on Unverified (NEW):

Component	**Modification**
Walls	Multiply the cavity insulation R-value/inch by 0.7
Ceilings/Roofs	Multiply the blown and batt insulation R-value/inch by 0.96-0.00347*R
Ceiling below attic	Add a heat flow from the conditioned zone to the attic of 0.015 times the area of the ceiling below attic times (the conditioned zone temperature - attic temperature) whenever the attic is colder than the conditioned space

- Reporting: HERS Required Verification listings

DWELLING UNIT TYPES

- Inputs
  - For each dwelling unit type in the building input
    - Conditioned Floor Area (CFA)
    - Number of bedrooms
    - Dishwasher, Washer and Dryer in conditioned space?
  - For Multi-Family input the number of each dwelling unit type
- Calculate the Indoor Air Quality (IAQ) Ventilation CFM and internal gains for each unit type
- Standard Design: Same Unit Types as Proposed Design
- Reporting: Unit Types and minimum IAQ ventilation CFM’s for verification.

ORIENTATION

- Unchanged from 2008
- Proposed Design:
  - Input is azimuth of building front
    - If rectangular, left, back and right
    - Or azimuth of each surface
  - Compliance for any or a specific orientation
- Standard Design 25% of each wall and window on each cardinal orientation (north, east, south, west).
- Reporting "all orientions" or the orientation of each surface

NATURAL GAS AVAILABILITY

- Unchanged from 2008
- Proposed Design:
  - User specifies whether natural gas is available at the site
- Standard Design
  - Natural gas water heating if gas is available
  - Liquid petroleum gas if not

SOLAR

- New for 2013
- For single family and town houses if
  - standards version is "Compliance 2015"
  - and Zone is 9-15
  - Then input the kWdc of the proposed Photovoltaic system (minimum 2 kWdc)
- Calculate the PV compliance credit as the smaller of:
  - PV Generation Rate (kTDV/kWdc) * kWdc
  - Max PV Cooling Credit * Standard Design Cooling Energy (kTDV)

SOLAR

- PV Credit:

Climate Zone	PV Generation Rate (kTDV/kWdc)	Max PV Cooling Credit (% of Standard Design Cooling kTDV/ft2)	Maximum Impact on Prototype % of total TDV
09	30269	13%	7%
10	30342	15%	8%
11	29791	18%	10%
12	29556	17%	6%
13	29676	17%	10%
14	31969	16%	9%
15	29536	19%	17%

Materials and Construction Assemblies

- New, replaces 2008 Joint Appendix 4 U-factor Tables
  - U-factor calculated in Compliance Manager for Prescriptive compliance and user feedback
  - U-factor is not an input to the CSE Simulation
- Creates Layered constructions for CSE input
  - Material layers selected from CEC approved library
  - Flexible R values for insulation layers
  - Separate frame and cavity surfaces for frame constructions

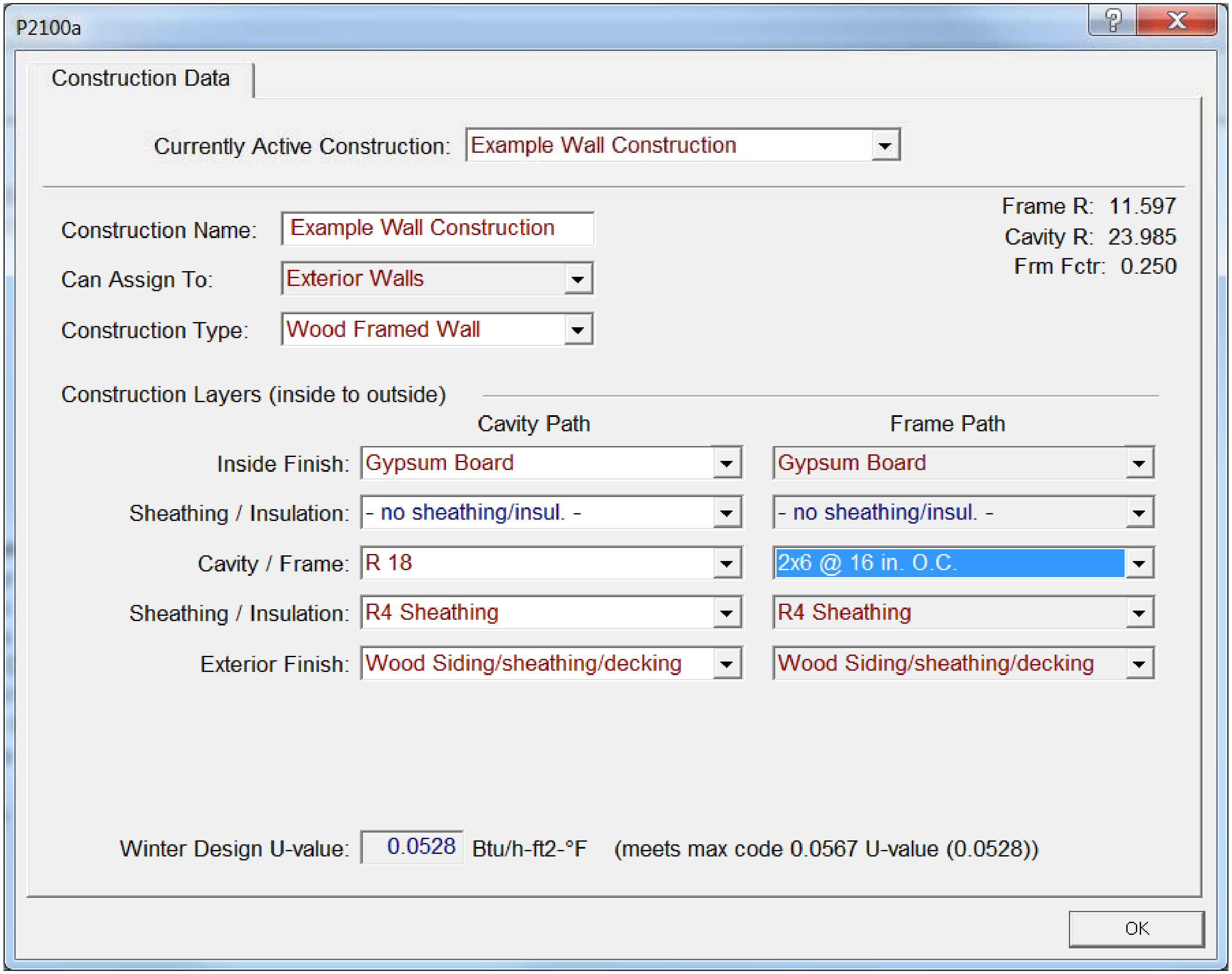
MATERIALS (LIST TO BE EXPANDED)

Material Name	Thickness (in.)	Conductivity (Btu/h-°F-ft)	Coefficient for Temperature Adjustment of Conductivity (°F(-1))	Specific Heat (Btu/lb-°F)	Density (lb/ft3)	R-Value per Inch (°F-ft2-h/Btu-in)
Gypsum Board	0.5	0.09167		0.27	40	0.9091
Wood layer	0.5	0.06127		0.45	41	1.36
R4 Synth Stucco	1	0.02083	0.00418	0.35	1.5	4
3 Coat Stucco	0.875	0.4167		0.2	116	0.2
Carpet	0.5	0.02		0.34	12.3	4.1667
Light Roof	0.2	1		0.2	120	0.0833
SlabOnGrade	3.5	1		0.2	144	0.0833
Earth		1		0.2	115	0.0833
Crawl	12	0.16667		0.24	0.075	0.5
SoftWood		0.08167		0.39	35	1.0204
Concrete		1		0.2	144	0.0833
R1 Sheathing	1	0.08333	0.00418	0.35	1.5	1

CONSTRUCTIONS

- Proposed Design: The user defines a construction for each surface type
  - Any variation in insulation, framing size or spacing, sheathing or finish is a different construction
  - Insulation input is rated R-value rounded to nearest R
  - Layers such as sheetrock, wood sheathing, stucco and carpet whose properties are not compliance variables are included as generic layers
- Standard Design: The Compliance manager creates a construction meeting the prescriptive standards for each user defined construction
- All proposed constructions are documented in the compliance reports (Form 3 type report to be developed)

CONSTRUCTIONS



HEATING SUBSYSTEMS (EQUIPMENT)

- Proposed Design: The user selects a type from the list and supplies
  - rated heating efficiency factor, for example AFUE
  - New, for heat pumps the rated capacity at 17 and 47 F
- Standard Design
  - If electric heat is proposed, a heat pump with minimum HSPF
  - If proposed not electric, a gas furnace with minimum AFUE
- Reports
  - Fuel type and rated efficiency
  - If a heat pump the rated heating capacity at 17 and 47 F

COOLING SUBSYSTEMS (EQUIPMENT)

- Proposed Design: The user selects a type from the list and supplies
  - rated cooling efficiency factor, for example SEER
  - zoning type and ducted or not ducted
  - Optional credits including EER, air flow, fan efficacy, evaporative condensers and ice storage
- Standard Design
  - Not zonal control, split system air conditioner @ minimum SEER
  - Mandatory air flow, fan efficacy
  - verified refrigerant charge in Zones 2 and 8-15.
- All reported and subject to verification

COOLING AIR FLOW

- Air flow from the conditioned spaces through the return (does not include bypass duct air flow)
- Proposed Design:
  - Default 260 CFM/ton for zonal control with ducted single speed compressor systems, 350 CFM/ton is mandatory minimum for all other ducted systems
  - Higher flow input for credit if air flow is verified
- Standard Design
  - 350 CFM/ton for all systems
- Cooling air flow is reported in the HERS Required Verifications
  - Air flow verification or return duct sizing is mandatory except for zonal control with ducted single speed compressor systems

COOLING MODEL

- Improved Cooling Algorithm (see Algorithms)
  - Adds calculation of indoor humidity and latent load
  - Evaporator air flow and conditions affect sensible heat ratio
  - New relationship based on R410 refrigerant
  - Cooling size calculated by CSE and used in simulation
    - Calculated for the Climate Zone weather file conditions
    - Not a compliance variable and no compliance credit

Fan Subsystems

- Component of Cooling and Heating systems, Ventilation Cooling systems, IAQ Ventilation systems.

- Proposed Design
  - W/CFM, Central ducted furnace fan defaults to mandatory minimum 0.58 W/cfm
    - Whole house fan defaults to 0.1 and Standalone IAQ fan to 0.25 W/CFM
  - For furnace fans the motor type (PSC, BPM)

- Standard Design
  - For furnace fans 0.58 W/cfm
  - For whole house fans 0.1 W/cfm
  - For Standalone IAQ fans same as proposed up to 1.2 W/CFM

- Non default fan efficacy is reported in the HERS Required Verifications. Minimum verified fan efficacy is a mandatory requirement for all ducted cooling systems.

Distribution Subsystems

- Ducts in unconditioned spaces are an important component of some:
  - Cooling and Heating systems
  - Cooling, Heating and Ventilation systems
- Same rules and basic model as 2008 with added features:
  - Multiple duct systems located in any zone (attic and crawl for example)
  - Improved treatment of insulation thickness and conductivity
  - Duct segments for accuracy and to support input of reduced area, buried ducts etc
  - Operates in ventilation mode to accurately model CFI IAQ ventilation systems

HVAC Systems

- An HVAC system is a collection of one or more of the following components:
    - cooling subsystem
    - heating subsystem
    - fan subsystem
    - Distribution subsystem
  - Examples
    - Split system cooling, gas furnace, PSC furnace fan, ducts in attic
    - Whole house fan
    - Bathroom exhaust for IAQ ventilation
- All components of a system use the distribution subsystem, if one is defined

Cooling Ventilation Systems

- Mechanical Cooling Ventilation
  - Whole House Fan
  - Integrated Central Fan (Nightbreeze, Smartvent etc)
- Proposed Design
  - The user selects a cooling ventilation system type and cfm
  - Default is no mechanical cooling ventilation
- Standard Design
  - Whole House Fan @ 2 CFM/ft2 in Climate Zones 8-14, none in other zones
- A cooling ventilation system is reported as a special feature.

Whole House Fan Ventilation Cooling

- New measure for 2008
  - Input is total CFM of fans and W/CFM, default 2 CFM/CFA @ 0
  - Effectiveness reduced by 75% to reflect average behavior
  - Available from dawn to 11 PM (requires windows to be opened)
  - Modeled as exhaust fan from conditioned zone to attic in the air network
  - CFM and W/CFM from CEC listing
- Standard Design:
  - 2 CFM/CFA at 0.1 W/CFM in single family in Zones 8-14
- Reporting: Proposed CFM and W/CFM

Integrated Central Fan Ventilation Cooling

- New measure for 2013. Detailed rules to come.
  - Available any time
  - Modeled as supply fan from outdoors to zones with relief to attic in airnet
  - Controlled on current vent setpoints and indoor-to-outdoor delta T
  - Fixed speed systems (Smartvent etc) input fixed CFM and fan W
  - Variable speed systems (Nightbreeze, etc) use manufacturer certified max CFM, W/CFM and off max functions
- Reporting: Type, CFM, W/CFM
- Verification:
  - Type, CFM & W/CFM at max flow
  - Duct leakage in air conditioning mode with damper normally closed (but not specially sealed)

Indoor Air Quality Ventilation Systems

- Same functional requirements as 2008
- New 2013 requirement to verify whole house outdoor ventilation CFM for each dwelling unit.
- Reporting:
  - Type, CFM for each dwelling unit, W/CFM
- Verification:
  - Type, CFM of outdoor air, and W/CFM if not default.

CONDITIONED ZONES

- User inputs Proposed Design zone characteristics
  - Conditioned floor area (CFA), volume, bottom, ceiling height, floor to floor height and number of stories in the zone
  - Ventilation height difference (default 2 ft. for 1 story, 8 ft. for more than 1 story.
  - Ventilation area as fraction of window area (reduced to ½ of 2008 values)
- User specifies previously defined mechanical systems
  - Heating
  - Cooling
  - IAQ ventilation
  - Optional Cooling Ventilation
- Standard Design
  - Same Characteristics as proposed except for non-default window ventilation
  - Prescriptive standard versions of the mechanical systems

Zoning the Building (not Zonal Control)

- Dividing the conditioned space into zones for simulation is optional (recommended for added accuracy even for single zone systems)
  - A 40 ft2 opening will be assumed between adjacent zones
  - Building components such as ceilings, floors, walls, windows and point source internal gains (such as the kitchen) must be assigned to the correct zone
  - Heating and cooling, up to the capacity of the system assigned to the zone, are assumed to be delivered to each zone as required to meet the scheduled set points.
  - The Standard Design building has the same zoning as the proposed design.

Zonal Control Heating Credit

For zoned or multiple heating (new: no credit in cooling) systems, which can potentially save energy by providing conditioning for only the occupied living or sleeping areas of a house. There are unique eligibility and installation requirements (unchanged from 2008):

- Each thermal zone, including a living zone and a sleeping zone, must have individual air temperature sensors
- Each habitable room in each zone must have a source of space heating
- The total non-closeable opening area (W) between adjacent living and sleeping thermal zones (i.e., halls, stairwells, and other openings) must be less than or equal to 40 ft^2
- Each zone must be controlled by a central automatic dual setback thermostat
- Each thermal zone, including a living zone and a sleeping zone, must have individual air temperature sensors

- In addition for ducted systems:
  - Each zone must be served by a return air register located entirely within the zone.
  - Supply air dampers must be manufactured and installed so that when they are closed, there is no measurable airflow at the registers.
  - The system must be designed to operate within the equipment manufacturer's specifications.
  - Air is to positively flow into, through, and out of a zone only when the zone is being conditioned. No measurable amount of supply air is to be discharged into unconditioned or unoccupied space in order to maintain proper airflow in the system.

Window Ventilation Cooling

- Same inputs and reporting as 2008
- Effectiveness reduced by 50% to reflect behavior and experience
- Available from dawn to 11 PM
- Modeled as controlled envelope holes in the air flow network

Thermal Mass

- Inside the zone light mass and surfaces are fixed - next slide.
- No change to slab floors (default 80% carpet, 20% bare)
- Proposed Design: User enters any unusual thermal mass elements, for example:
  - Concrete or other mass interior walls
  - Raised concrete floors
- Standard Design: has only the fixed thermal mass
- Non-default thermal mass elements are documented on the building plans and noted in the *Special Features* on the CF-1R.

Fixed Conditioned Zone Thermal Mass

Item	Description	Simulation Object
Interior walls	The area of one side of the walls completely inside the conditioned zone is calculated as the conditioned floor area of the zone minus ½ of the area of interior walls adjacent to other conditioned zones. The interior wall is modeled as a construction with 25% 2x4 wood framing and sheetrock on both sides.	Wall exposed to the zone on both sides
Interior floors	The area of floors completely inside the conditioned zone is calculated as the difference between the CFA of the zone and the sum of the areas of zone exterior floors and interior floors over other zones. Interior floors are modeled as a surface inside the zone with a construction of carpet, wood decking, 2x12 framing at 16 in. o.c. with miscellaneous bridging, electrical and plumbing and a sheetrock ceiling below.	Floor/ceiling surface exposed to the zone on both sides
Furniture and heavy contents	Contents of the conditioned zone with significant heat storage capacity and delayed thermal response, for example heavy furniture, bottled drinks and canned goods, contents of dressers and enclosed cabinets. These are represented by a 2 in. thick slab of wood twice as large as the conditioned floor area, exposed to the room on both sides.	Horizontal wood slab exposed to the zone on both sides
Light and thin contents	Contents of the conditioned zone that have a large surface area compared to their weight, for example, clothing on hangers, curtains, pots and pans. These are assumed to be 2 BTU per square foot of conditioned floor area	Air heat capacity (Cair) = CFA * 2

Schedule and Thermostats

			Heating	Zonal Control Heating	
Hour	Cooling	Venting	Single Zone	Living	Sleeping
1	78	Off	65	65	65
2	78	Off	65	65	65
3	78	Off	65	65	65
4	78	Off	65	65	65
5	78	Off	65	65	65
6	78	68*	65	65	65
7	78	68	65	65	65
8	83	68	68	68	68
9	83	68	68	68	68
10	83	68	68	68	65
11	83	68	68	68	65
12	83	68	68	68	65
13	83	68	68	68	65
14	82	68	68	68	65
15	81	68	68	68	65
16	80	68	68	68	65
17	79	68	68	68	68
18	78	68	68	68	68
19	78	68	68	68	68
20	78	68	68	68	68
21	78	68	68	68	68
22	78	68	68	68	68
23	78	68	68	68	68
24	78	Off	65	65	65

HERS II Internal Gain

- Internal gains according to HERS II formulas and schedule
  - Appliance efficiency and fuel types default in both Proposed and Standard Design – no compliance credit
    - Dishwasher, washer and dryer included in both if in conditioned space of Proposed Design
  - If multi-zone, specify the zone where point sources (such as kitchen) are located
  - Added latent fraction to HERS II gains:

	Sensible	Latent
Lights	1	0
People	0.573	0.427
Misc	0.97	0.03
Refr	1	0
Dishwash	0.75	0.25
cook	0.33	0.67
Washer	1	0
Dryer	0.5	0.5

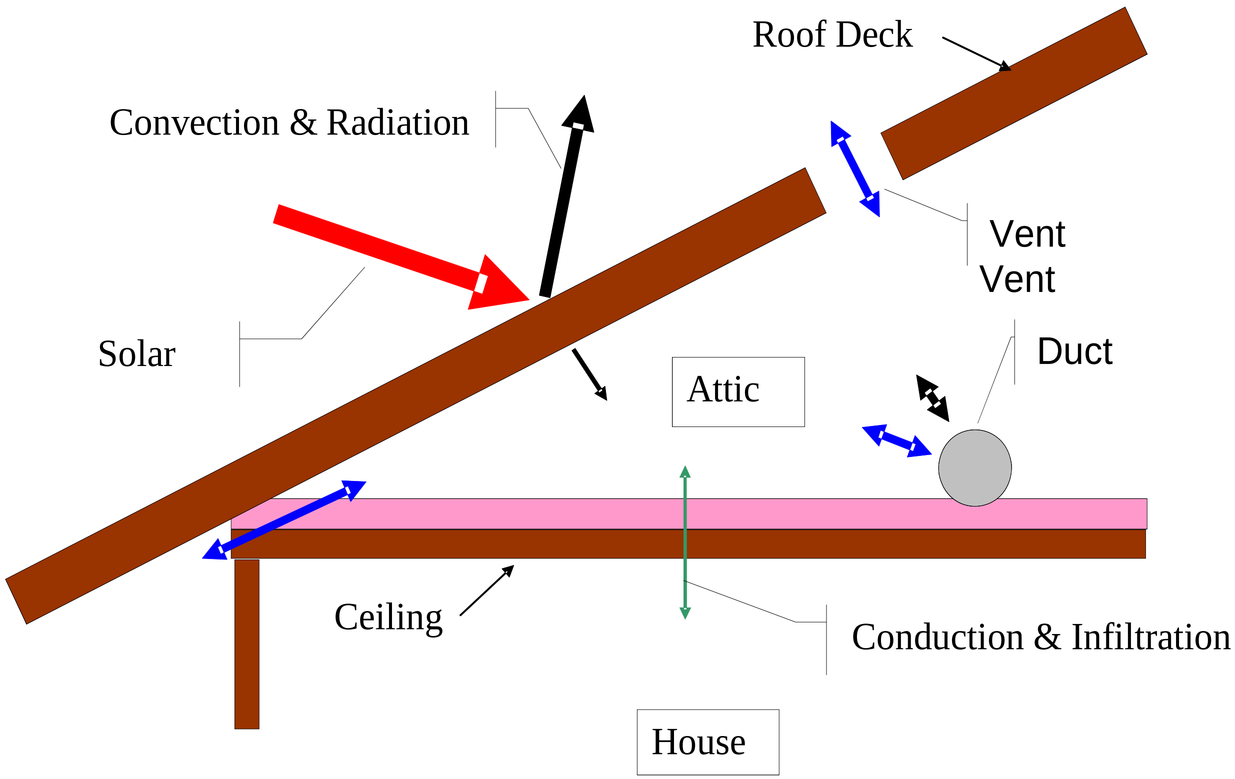
Surfaces

- Surface inputs unchanged except for
  - Construction instead of U-factor
  - Standard Design walls adjacent to unconditioned space have no insulated sheathing
- Airnet holes automatically created in each wall, floor and ceiling, proportional to area as fraction of total area of surface type in building
- Ceilings below Attics
  - Defined in the conditioned space zone below
  - Air net hole to attic automatically created in each surface
- Floors, roofs and ceilings between zones
  - Dimensions and constructions must be entered in one zone
  - Openings defaulted to 40 square feet between conditioned zones in the same dwelling unit
  - Air net holes to unconditioned zone automatically created in each surface

Windows

- Window and skylight inputs and reporting unchanged
- Shade operation for windows
  - Interior shades half open during day, 80% closed at night
  - Automatically operated exterior shades closed when air conditioning. Rules to be developed.

Attic

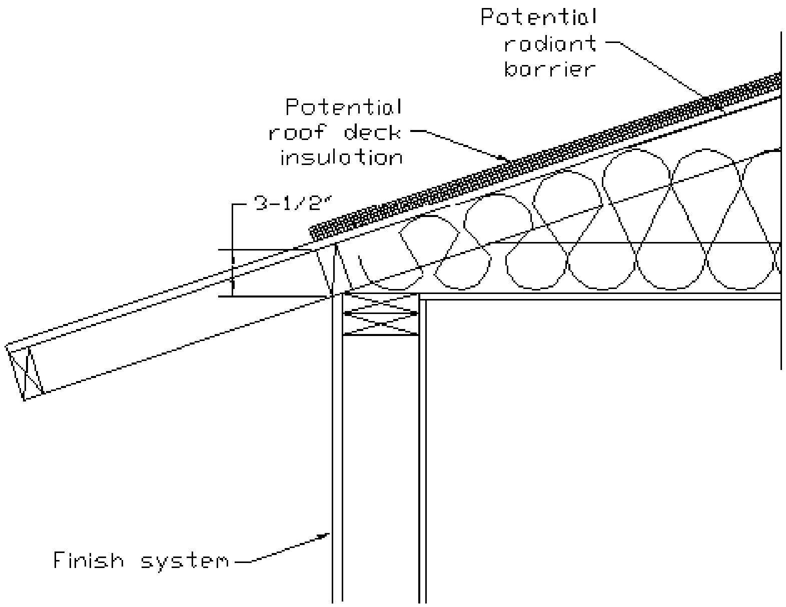


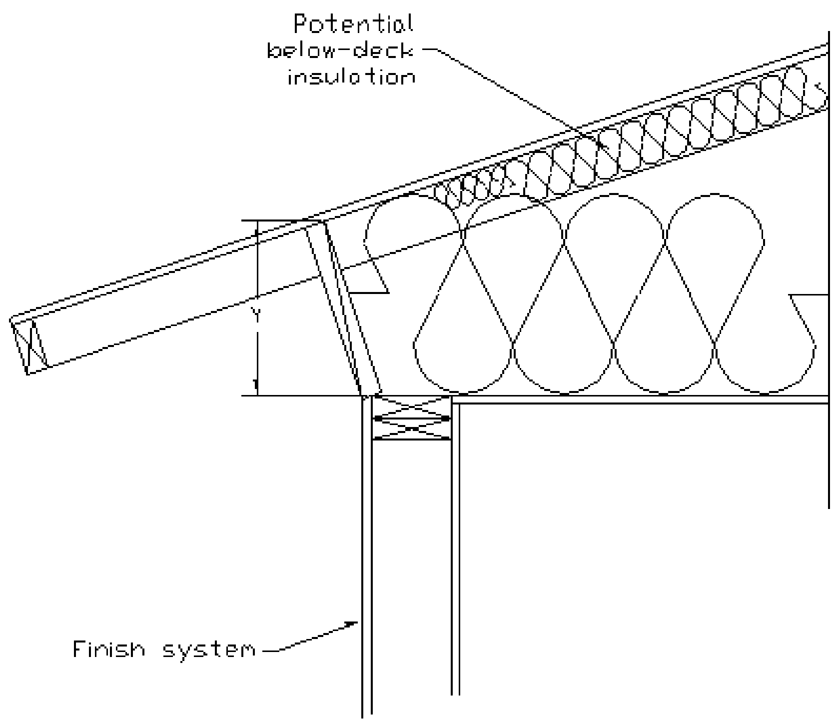
Roof Deck
Convection & Radiation
Vent
Vent
Solar
Duct
Attic
Ceiling
Conduction & Infiltration
House

Attic Zone

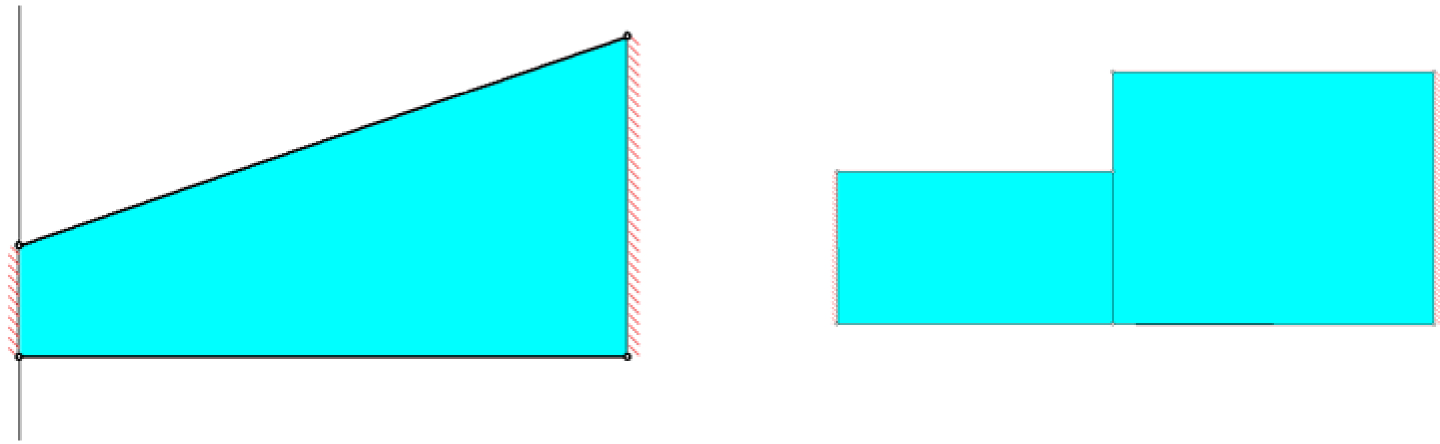
- Attic floor area defined by ceiling areas of zones below
- Attic ventilation is no longer a compliance variable
  - 1/300 soffit ventilation assumed
  - Vent area increased if needed for to provide a minimum of CFM/375 ft2 free area for cooling ventilation fan relief
- Insulation in the attic
  - Input is R value
  - Insulation type (cellulose, fiberglass, foam, etc) is not a variable
  - Assume R = 2.6/inch (typical light blown fiberglass)

Attic Edge – Standard and Raised Truss





Attic Edge

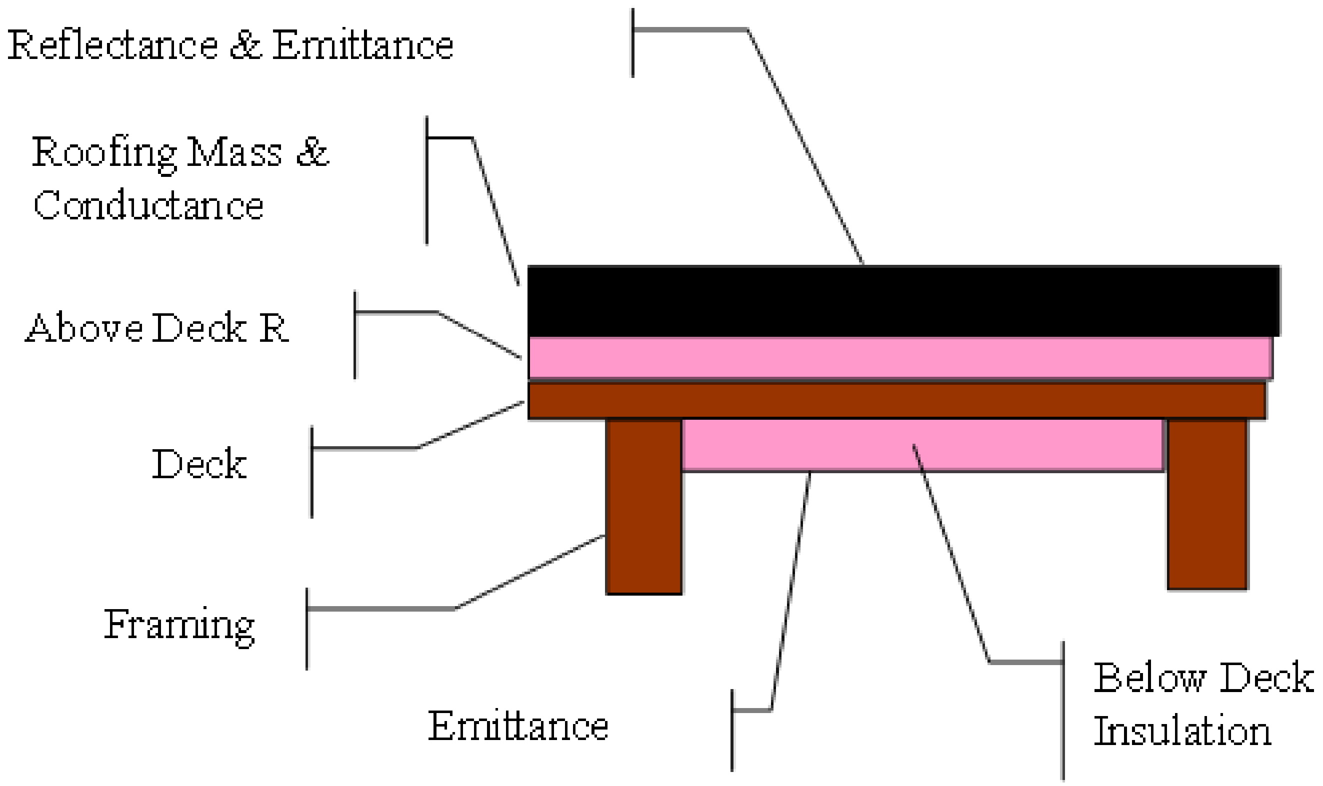


- Solution is to treat the attic edge area (left) as 2 cathedral ceiling surfaces (right)
  - No heat flow to the attic from this area
  - Attic floor area and volume reduced
  - Tapered insulation cross section (and truss path) on left above represented by 2 cathedral ceilings on the right that provide approximately the same heat flow

Attic Edge

- Inputs
  - Roof Pitch
  - Distance from top plate to roof deck, default 3.5”
  - Ceiling Insulation and Below deck insulation R
  - Length of attic edge
    - For simplicity not an input
    - Assume 3 times square root of Attic Floor Area
- Compliance Manager generates the cathedral surfaces
- Standard Design: defaults with Prescriptive R
- Reporting: Heel height for verification if not defaulted

Roof Deck



Reflectance & Emittance
Roofing Mass &
Conductance
Above Deck R
Deck
Framing
Emittance
Below Deck
Insulation

Roof Deck

- Basically unchanged from 2008

- Proposed Design: the user:
  - selects a roofing type and mass
  - defaults or inputs solar reflectance and emmittance
  - selects a predefined roof deck construction including above or below deck insulation and/or radiant barrier

- Standard Design
  - Roof type and mass same as proposed
  - Prescriptive solar reflectance and emmittance
  - Prescriptive radiant barrier
  - 2x4 standard trusses at 24” o.c.

- Roofing type and mass is reported. Reflectance, roof deck insulation and radiant barriers is a special feature

Other Unconditioned Spaces

- Modeling (optional) for improved accuracy and flexibility
  - Crawl Spaces
  - Basements
  - Garages
- Rules to be developed
- Default: Current rules
- Standard Design: Same modeling as proposed
- Reporting: to be developed

Other Topics

- Domestic Hot Water
- Reports