



VERMONT ENERGY
INVESTMENT CORPORATION

“Conditioned Space”: Can We Decide on a Definition Once and for All?

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Overview

- Expectations for this session
- Framing the issue
- Examples of different definitions
- Panel:
 - Bruce Harley, CSG: program implementation
 - Dave Roberts, AEC: software/modeling
 - Iain Walker, LBNL: ventilation and ducts
 - Todd Taylor, PNNL: building codes
- Q&A / Discussion



Expectations

- We won't resolve this today
- Too many interested parties not present:
 - Code bodies
 - Federal Government (DOE, EPA, HUD...)
 - ASHRAE
 - Utilities
 - Realtors
 - NAHB...
- We need to begin the discussion
- Continue with interested parties
- Maybe some day we can all come to agreement(?)



Why Bother Having This Session?

- “Conditioned Space” is defined differently throughout our industry
- Homes have “gray areas”:
 - Basements, kneewall spaces, cathedralized attics, heated garages, crawlspaces...
- Applicability:
 - Rating square foot software inputs
 - Utility program incentives based on “conditioned area”
 - Mechanical ventilation requirements
 - Code insulation requirements
 - Duct sealing and insulation when located in these spaces...



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Some “Conditioned Space/Floor Area” Definitions



ASHRAE 90.2:

- Cooled Space: enclosed space within a building that is cooled by a cooling system whose sensible capacity exceeds **5 Btu/hr-sf** or is capable of maintaining a space dry-bulb temperature of **90F** or less at design cooling conditions.
- Heated Space: enclosed space within a building that is heated by a heating system whose output capacity exceeds **10 Btu/hr-sf** or is capable of maintaining a space dry-bulb temperature of **50F** or more at design heating conditions.
- Indirectly Conditioned Space: enclosed space within a building that is not heated or cooled space, whose area-weighted heat transfer coefficient to heated or cooled space exceeds that to the outdoors or to unconditioned space, or through which air from heated or cooled spaces is transferred at a rate exceeding the air changes per hour.
- Unconditioned Space: space within a building that is not conditioned space.



International Residential Code (2003 & 6) & International Residential Code (2006)

- **Conditioned Space.** For energy purposes, space within a building that is provided with heating and/or cooling equipment or systems capable of maintaining, through design or heat loss/gain, **50F** (10C) during the heating season and **85F** (29C) during the cooling season, or communicates directly with a conditioned space. For mechanical purposes, an area, room or space being heated or cooled by any equipment or appliance.
- **Conditioned Floor Area.** The horizontal projection of the floors associated with conditioned space.



California State Building Energy Code (Title 24) (2005):

- **Conditioned Floor Area.** Is the floor area (in square feet) of enclosed conditioned space on all floors of a building, as measured at the floor level of the exterior surfaces of exterior walls enclosing the conditioned space.
- **DIRECTLY CONDITIONED SPACE** is an enclosed space that is provided with **wood** heating, is provided with mechanical heating that has a capacity exceeding **10 Btu/(hr.xft.²)**, or is provided with mechanical cooling that has a capacity exceeding **5 Btu/(hr.xft.²)**, unless the space-conditioning system is designed for a process space. (See “Process space”).
- **PROCESS SPACE** is a space that is thermostatically controlled to maintain a process environment temperature less than **55° F** or to maintain a process environment temperature greater than **90° F** for the whole space that the system serves, or that is a space with a space-conditioning system designed and controlled to be incapable of operating at temperatures above 55° F or incapable of operating at temperatures below 90° F at design conditions.



Additional Examples

- ACCA Manual J:
 - Based on adjacent space being outside or unheated/uncooled.
- Uniform Mechanical Code (1994):
 - Conditioned space is an area, room or space normally occupied and being heated or cooled by any equipment for human habitation.
- International Energy Conservation Code (2003):
 - Conditioned Floor Area. The horizontal projections of that portion of interior space which is contained within exterior walls and which is conditioned directly or indirectly by an energy using system.
 - Conditioned Space. A heated or cooled space, or both, within a building and, where required, provided with **humidification or dehumidification** means so as to be capable of maintaining a space condition falling within the comfort envelope set forth in **ASHRAE 55**.



Some More Examples

- RESNET:
 - Floor area that is conditioned by heating or cooling systems as per ANSI standard Z765-2003
- ANSI Z765-2003:
 - “Finished Area”: An enclosed areas in a house that is suitable for year-round use, embodying walls, floors, and ceilings that are similar to the rest of the house.
- REM/Rate:
 - The floor area of the total conditioned space heated or cooled either directly or indirectly, by mechanical equipment devices within the building. These areas will remain at **temperatures close to the building's thermostat setpoint temperature**



And Even More Examples

- Vermont Energy Code:
 - Heating or cooling is deliberately or indirectly supplied
- ASHRAE 62.2:
 - The part of a building that is capable of being thermally conditioned for the comfort of occupants.



Panelists

- How different definitions impact their work
- Why multiple definitions are an issue
- Pros and cons of definitions they have to work with
- Strawman definition
- Panelists:
 - Bruce Harley, CSG
 - Dave Roberts, AEC
 - Iain Walker, LBNL
 - Todd Taylor, PNNL



Conditioned Space

RESNET 2007

Bruce Harley, Technical Director
Conservation Services Group



Conservation Services Group



Program Implications

Incentives are sometimes linked to floor area
Compliance thresholds may be affected by choice
Ratings:

- Differentiation of “conditioned” from “buffer zone” may be very counterproductive
- Example: zone is inside both pressure and thermal boundary, testing duct leakage to “outside” must open door/window?





Multiple Definitions – Problematic?

Between programs

Where they lead to misunderstandings or opportunities to “work the system”

But multiple definitions could actually help reduce problems as well, by targeting definitions to application





My suggestion:

Conditioned volume

- For diagnostic testing, modeling
- Include volume contained within insulation and pressure boundaries
- Cathedralized attics, basements with insulated and air sealed walls

Conditioned floor area

- Ventilation, internal gains, program incentives
- Only include finished basement or attic spaces
- Drywall and electrical



Defining Conditioned Space – The Debate

A Software Developer's Perspective

Need consistent direction

It is not feasible to conform to differing standards

Training and guidance

Input error checking

Need clear direction

Terms like “indirectly” and “partially” conditioned are not very useful

Physics

Without knowing details of every room, including air flow and temperature, must assume setpoint is maintained in “conditioned” space

Temperatures of spaces that are not directly conditioned are function of connection to “conditioned” space, connection to other spaces and/or ambient, internal gains (ducts, mechanical equipment)

Determining connection between “conditioned” space and other spaces is complicated by air exchange

Defining Conditioned Space – The Debate

A Software Developer's Perspective

Difficult to develop definition that is both robust and straightforward

Straightforward: maintains setpoint

Overly simplistic, but easy to model

Somewhat straightforward: inside thermal envelope

Problematic in basements, conditioned crawls, cathedralized attics – temperature hard to determine

Robust: model all partitions and air flow in the building

Extremely complex inputs and modeling (CFD)

Ventilation

ASHRAE 62.2 uses floor area to determine required air flow rate.

Cathedralized attic over single story home effective doubles floor area if considered conditioned and significantly changes air flow required.

65 cfm

100 cfm

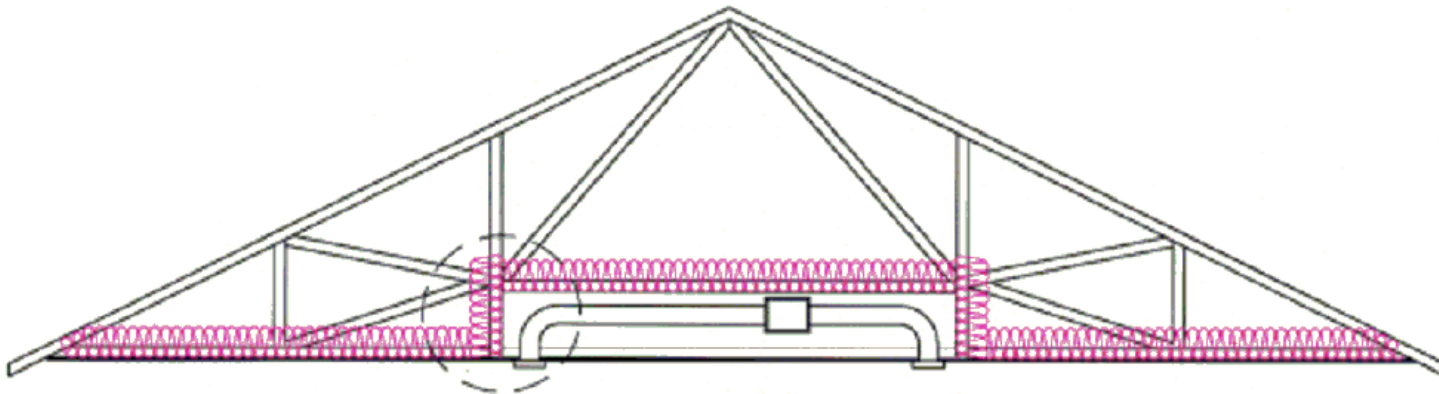
Ducts and Conditioned Space

Dropped Ceiling Coffer Duct System



Drop ceiling

Field tests show
not always inside
air boundary
Needs careful sealing



Sealed and Insulated “Cathedralized” attic



Current Title 24

Proposed Title 24

Strawman – use one of three definitions that best suits your purpose

Ventilation

Ducts and energy in general
Depends on what floor area is used for:

Defining Conditioned Space—The Codes Perspective

- Multiple Definitions of “Conditioned Space”
 - IECC: Heated, cooled, containing ducts, or adjacent to any of those
 - IRC: Can maintain 50F (winter) and 85 (summer)
 - “Conditioned Floor Area”: 68F/80F
 - But...code officials rarely care

Defining Conditioned Space—The Codes Perspective

- IECC uses three terms:
 1. Conditioned Space
 2. Conditioned Floor Area
 3. Conditioned Basement
- IRC adds two more:
 4. Conditioned Attic
 5. Semiconditioned Space

Defining Conditioned Space—The Codes Perspective

- Those terms are used in four contexts:
 1. Defining things in terms of which side of the ***thermal boundary*** they are on
 2. Defining things in terms of which side of the ***pressure boundary*** they are on
 3. Defining things in terms of ***freeze protection***
 4. Establishing requirements that vary with a ***quantity of building space***

Defining Conditioned Space—The Codes Perspective

	Thermal Boundary	Pressure Boundary	Freeze Protection	Quantity-based reqmts
Conditioned Space	IECC / IRC 11 / 14	IECC / IRC 2 / 5	IECC / IRC 0 / 1	IECC / IRC 0 / 0
Conditioned Floor Area	0 / 1	1 / 0	0 / 0	7 / 0
Conditioned Basement	2 / 1	0 / 0	0 / 0	0 / 0
Conditioned Attic	0 / 1	0 / 0	0 / 0	0 / 0
Semiconditioned Space	0 / 0	0 / 0	0 / 1	0 / 0

Defining Conditioned Space—The Codes Perspective

	Thermal Boundary	Pressure Boundary	Freeze Protection	Quantity-based reqmts
Conditioned Space	IECC / IRC 11 / 14	IECC / IRC 2 / 5	IECC / IRC 0 / 1	IECC / IRC 0 / 0
Conditioned Floor Area	0 / 1	1 / 0	0 / 0	7 / 0
Conditioned Basement	2 / 1	0 / 0	0 / 0	0 / 0
Conditioned Attic	0 / 1	0 / 0	0 / 0	0 / 0
Semiconditioned Space	0 / 0	0 / 0	0 / 1	0 / 0

Defining Conditioned Space—The Codes Perspective

- “Conditioned Space”/Thermal Boundary examples:
 - Defining above-grade walls, basement walls, thermal isolation, etc.
 - Exempting low-energy buildings
 - Defining default distribution efficiencies in performance path

Defining Conditioned Space—The Codes Perspective

- “Conditioned Space”/Pressure Boundary examples:
 - Defining which walls must be air-sealed
 - Defining which recessed lighting fixtures must be air-sealed
 - Defining elements of a radon-control system

Defining Conditioned Space—The Codes Perspective

- “Conditioned Floor Area”/Quantity-based requirements examples:
 - Defining standard reference design glazing area, air exchange rate, mechanical ventilation, internal gains, SLA

Defining Conditioned Space—The Codes Perspective

- Are the multiple definitions a problem for codes? (Not really)
- What is the ideal situation?
 - One term to define thermal boundary
 - One term to define pressure boundary
 - One term to define house size
 - Ad-hoc terms to deal with freeze protection and miscellaneous