2016 Title 24 Code Change Advocacy

Request for Input:

High Performance Attics and Ducts /Ducts in Conditioned Space or Ductless Systems (HPAD/DCS) Requirements for Residential Buildings

2016 Title 24 Code Change Advocacy April 2014

Introduction

The California Investor Owned Utilities (IOUs) are actively supporting the California Energy Commission in updating the California Building Energy Efficiency Standards (Title 24). Their joint intent is to achieve significant energy savings through the development of reasonable, responsible, and cost-effective code change proposals for the 2016 code update and beyond. Through Codes and Standards Enhancement (CASE) Reports, the IOUs will provide the Energy Commission with the technical and cost-effectiveness information required to make informed judgments on proposed standards for effective energy efficiency design practices and technologies. This Request for Input provides an opportunity for stakeholders to help inform the development of these codes change proposals. The IOUs encourage participation in this step of the process through the submission of data— both primary sources and references to existing data, e.g., reports, spreadsheets, etc. Further opportunities to provide feedback regarding these code change proposals will follow this Request for Input.

How to submit responses:

Please submit responses to the questions presented below by Friday, May 2, 2014 to: info@title24stakeholders.com.

Summary of Potential Code Change Proposal

This proposed measure is a modification to the prescriptive residential building requirements. One part of the proposal introduces a prescriptive requirement for the location of duct work and equipment in residential and low-rise multifamily buildings. The other part includes an alternative prescriptive requirement that focuses on the performance of duct and attic characteristics. Both prescriptive requirements will reduce space heating and cooling distribution losses.

The measure consists of two alternatives for accomplishing improved envelope characteristics and reduced HVAC distribution losses. These two approaches will have similar energy impacts on the building.

- **Ducts in Conditioned Space** (DCS), locates ducts in the building's thermal and air barrier envelope. Installing ductless systems meets the DCS requirement.
- **High Performance Attics and Ducts** (HPAD) implements a package of measures that minimizes the temperature difference between the attic space and the conditioned air being transported through ductwork in the attic. It also reduces the leakage of

conditioned air into the attic. The option will include additional components needed to achieve the required reduction in distribution losses.

The details of the required package are provided below at the end of the document.

The code change proposal will evaluate the feasibility and cost-effectiveness of the above two approaches to maximize energy savings in the Title 24 Part 6 building energy efficiency standard.

Questions for Interested Parties

The CASE Team is requesting input on the specific questions listed below regarding **DCS (Ducts in Conditioned Space)** and **HPAD (High Performance Attics and Ducts)**. Answers to these questions will inform the cost-effectiveness analysis, energy savings estimates, environmental impacts, and market impacts that will be presented in CASE Reports.

1. Which California climate conditions/ regions would be best suited for:
    a. Ducts in Conditioned Space?
    b. High Performance Attic and Ducts?

Questions about Ducts in Conditioned Spaces:

2. Which of the strategies below are the most and least preferred and why?
    a. Ducts in dropped ceiling
    b. Ducts in plenum space above ceiling plane
    c. Ducts in floor truss space between floors
    d. Unvented conditioned attic
    e. Cathedral ceilings
    f. Ductless systems (mini-splits radiant etc.)
3. What are the primary benefits of the DCS strategies besides energy savings?
4. What are the challenges or barriers of the DCS strategies?
5. How prevalent are the DCS strategies in very high performance homes (Passive House, Zero Net Energy (ZNE) or near ZNE homes etc.)? If yes which strategies are commonly applied?
6. Will any of the DCS strategies become more prevalent in the near future? If so, why?
7. What is the prevalence of sealed combustion equipment in residential new construction?
8. What are some implementation challenges for mechanical closets in conditioned spaces?
9. Are you aware of any recent (2010 onwards) studies or projects of the DCS strategies? Do any of these studies contain cost information for the DCS strategies?
10. Are you aware of any projects that are using structural insulating panels (SIPS) for residential roofs? Please provide supporting documentation or contact information.
11. Can you provide a cost estimate or recommend someone who you think can provide a cost estimate of the net cost impact of applying any of the DCS measures?

Questions about High Performance Attics and Ducts:

12. What are the major barriers to implementing the proposed HPAD components?
    1. Roof Deck Insulation (in addition to the primary insulation at ceiling plane)
    2. Increased Duct Insulation to R-8
    3. Lower required duct leakage rate
    4. Raised heel trusses or extension trusses (increased ceiling insulation effectiveness)
    5. Reduce duct surface area in unconditioned space and maximize buried duct area
    6. Increase attic ventilation ratio to 1/150.
13. Are extension trusses more easily implemented than raised heel trusses?
    a. Are there alternative ways to achieve the same outcome of less compressed ceiling insulation or reduced heat loss to the attic (i.e. rigid insulation used at perimeter of attic)?

14. Is increasing attic ventilation ratio (from the current 1/300) to 1/150 practical for construction and is it compatible with other construction requirements and practices?
15. Are all the HPAD component requirements compatible with the fire code and building code requirements for homes built in a Wildland-Urban Interface Fire Area?
16. What are the major barriers to implementing any individual or combination of the proposed HPAD components?
17. Can you provide a cost estimate or recommend someone who you think can provide a cost estimate of the net cost impact of applying all of the HPAD measures?

Roofing Questions:

18. Have there been changes or improvements in constructability of tile roofing with above-deck insulation products in the past 3 years?
19. Are there any known incompatibility or product warranty issues for shingle roofing on unvented attics? Do these issues apply to all shingles or a subset of the market? Are you aware of how these issues have been resolved?
20. Are there documented examples of moisture issues with unvented attics in California?
21. Are there any safety, durability, warrantee or constructability issues associated with installing insulation either directly above the roof deck or directly beneath the roof deck in any of the California climate zones? How have these issues been addressed?

Duct Questions:

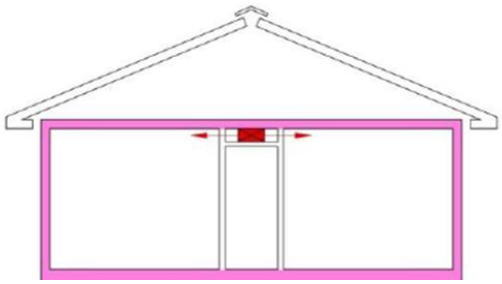
22. What are potential challenges for increased duct insulation?
23. How often are duct designs provided with the mechanical drawings? If rarely, please explain why.
24. How often do builders utilize the "<12 ft of ducts in unconditioned space" performance credit?
    a. Would builders be more inclined if the user could show compliance by entering specs into the software instead of requiring drawings and calculations?

Detailed Measure Descriptions

The following paragraphs provide detailed descriptions on the approaches and strategies that the CASE team is exploring for cost-effectiveness, feasibility and potential energy impacts:

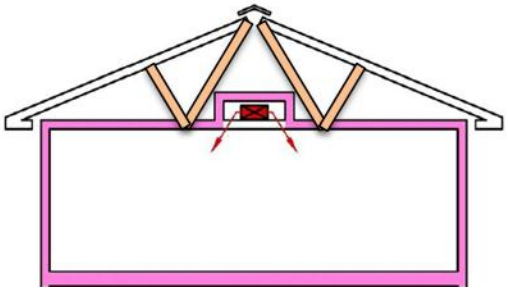
DCS – Dropped Ceiling, with a mechanical closet

This strategy would create a space below the ceiling within the conditioned envelope to house the ducts. In addition, an interior mechanical closet would be needed to house the HVAC equipment. Advantages of this strategy are that it does not require additional ceiling insulation or changes to the attic or ceiling design and construction practices. Disadvantages are that the dropped ceiling reduces the ceiling height, the depth of the space to fit ducts may be limited, and it requires careful sealing of the area above the dropped ceiling plenum space.



DCS – Space above ceiling plane, with a mechanical closet

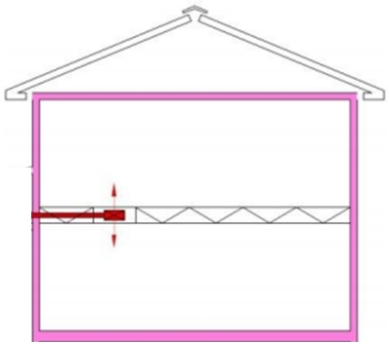
A space may be created through either a scissor truss or a boxed out truss in the attic. The use of a boxed out truss to create a conditioned space in the attic is also termed "plenum truss bulkhead"[1] or "reverse bulkhead"[1]. These spaces may be large enough to house both the ducts and the equipment; if not, a separate mechanical closet may be needed. The location of the mechanical closet could be interior, exterior or insulated in the attic space. The advantage of this strategy is that the original ceiling height is maintained. The disadvantage of this strategy is that it requires modified trusses and extra care associated with air barrier to seal the attic space. See the Mechanical Closet paragraph below for additional details on the mechanical closet strategy.



DCS – Floor Truss space between floors

For multi-story residential buildings, web style floor trusses can be used to support the second story floor. If the floor truss is large enough, ductwork can fit between floors. The advantage of this approach is that no special ceiling design is required for housing the ducts. Disadvantages include the cost of using large web trusses, labor to weave the ducts through the webs, and care required for sealing the band joist between floors.

[1] Burdick, A. 2013. "Measure Guidelines: Implementing a Plenum Truss for a Compact Air Distribution System."

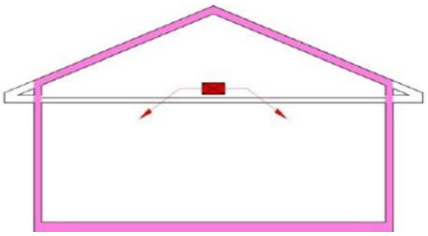


DCS – Mechanical Closet

The mechanical closets in conditioned space provide easy access to equipment, but they may limit equipment selection and use conditioned square footage. Horizontal hydronic fan coils with a hot water coil and a direct expansion cooling coil can in some case fix into a dropped ceiling. For the mechanical closet to be considered to be in the conditioned space, it cannot have combustion air vents but it may be possible to allow them if the closet is sealed off from the conditioned space being served. The best alternative is to use a sealed combustion furnace, a hot water coil (i.e. combined water heating and space heating), or a heat pump.

DCS – Unvented Attic

An unvented attic has the thermal and air barriers at the roof deck instead of the ceiling. This effectively creates an indirectly conditioned attic to house the ducts and equipment. The advantages of this strategy are that the ceiling height is maintained and it provides an additional buffer to the outside temperatures. The disadvantages are that the attic must be sealed to achieve maximum benefits and avoid moisture issues, which can be difficult to achieve. Other disadvantages are that it increases the thermal envelope surface area, creating a larger area that is susceptible to heat exchange with the external environment and increasing the conditioned volume of the house. Depending upon construction and insulation details, there are also potential warranty issues with roofing materials (OSB) if care and planning is not taken during insulation installation and air sealing. Lastly, if a furnace is used, it requires sealed combustion equipment if placed in the unvented attic.



DCS – Cathedral Ceilings

Cathedral ceilings or vaulted ceilings are typically part of the roof deck assembly, with no attic space. The cavity between the roof deck and the cathedral ceiling can be insulated in two ways: 1) the cavity is sealed and is completely filled with insulation or 2) the cavity is ventilated and insulation is installed above the ceiling. If a ducted system is used, all ducts and the air handler are in the conditioned space. Ducts can be exposed or concealed with chases and cavities inside the conditioned space.

DCS – Ductless systems

Ductless systems offer several advantages with the most obvious being that there are no ducts in unconditioned spaces by default, and therefore, no duct losses and no changes are required to the architecture or the design of the envelope. Ductless systems include mini-split heat pumps, hydronic radiant heating and cooling, packaged terminal air-conditioners for heat pumps, through-the-wall furnaces, or through the wall air-conditioners or heat pumps. Mini-split heat pump systems have small capacity fan coils in each room or zone, usually imstalled where a wall meets the ceiling. Radiant systems use water for heating and cooling which is circulated through plastic tubing loops routed in the floor or ceiling in 6 to 12 inch center pattern as needed to meet heating and cooling loads. Floor radiant systems embed the tubing the concrete. Ceiling radiant systems mount the tubing and heat exchange enhancing fins in contact with gypsum dry board with insulation above. Small pumps use about 1/10 to 1/5 of a forced central air blower motor power. Finally, with loads in ZNE-Ready dwellings being much lower, packaged heat pumps (PTHP), packaged air conditioners (PTAC), packaged gas heat with AC (PGAC) and wall furnaces can provide comfort without ducts and ½ to 1 horse power fan motors. Through-the-wall furnaces only provide heating and are generally more obtrusive than either mini-splits or a forced air diffuser.

HPAD

A group of measures that together create a High Performance Attics and Ducts for Vented Attics (HPAD) package. This includes:

1. Roof Deck Insulation (in addition to the primary insulation at ceiling plane)
2. Increased duct insulation to R-8
3. Lower allowed duct leakage rate
4. Raised heel trusses or extension trusses (increased ceiling insulation effectiveness)
5. Reduce duct surface area in unconditioned space and maximize buried duct area
6. Increase attic ventilation ratio from 1/300 to 1/150

High Performance Attics and Ducts is a strategy that increases the efficiency of a typical home with a vented attic. Many of the components listed, other than insulating the roof deck, may be less of a transition for typical residential construction practice than moving ducts into the conditioned space. This allows for duct work and air handlers to remain out of sight in a relatively large and easy to access attic, and since the HPAD approach includes a ventilated attic, this approach is compatible with atmospheric combustion furnaces.

Challenges for this scenario may include a lack of industry familiarity with insulating residential roof decks (though this is common for nonresidential construction), and relatively stringent workmanship requirements to maintain low levels of air leakage from ducts and air handlers. The increased ventilation openings required by HPAD must be coordinated with fire codes and solar ready requirements.