2016 Building Energy Efficiency Standards

2016 STAFF WORKSHOP ON DRAFT LANGUAGE

LOW RISE RESIDENTIAL

MANDATORY AND PRESCRIPTIVE REQUIREMENTS

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Agenda

150.0 – MANDATORY FEATURES AND DEVICES

- Air Conditioner Filter Dryer

150.1 – PERFORMANCE AND PRESCRIPTIVE COMPLIANCE

- Attics
- Ducts
- Walls

150.2 – ADDITIONS AND ALTERATIONS

- Exceptions

Acknowledgement

This Energy Commission Staff proposal is based heavily on the work of the California Statewide Codes and Standards Enhancement (CASE) Program that is funded, in part, by California utility customers under the auspices of the California Public Utilities Commission.

CASE Reports are posted on CEC's rulemaking website:

http://www.energy.ca.gov/title24/2016standards/prerulemaking/documents/2014-07-21_workshop/final_case_reports/

In some instances, Staff's proposal varies from the Statewide CASE Team proposed code changes

Air Conditioner Filter Dryer

Air conditioner Liquid Line Filter Driers

- **Shall be installed if required by manufacturers specifications**

Proposed Code Change for Attics and Ducts

2 Prescriptive Package Options in CZ 1, 2, 4, 8-16, based on Ducts and Duct Location

1. **Ducts in a High Performance Vented Attic (HPA)**
   - Roof Deck Insulation Options
   - R-38 Ceiling Insulation
   - Ducts: R-8 Insulation, Tested 5% Leakage

OR

2. **No Ducts or Air Handlers in any Attic (attic same as 2013)**
   - ❖ Ducts in Conditioned Space (DCS)
     - Locate ducts and air handler in conditioned space
     - HERS verification of no duct leakage to outside

     OR
   - ❖ Ducts in Other Unconditioned Spaces
     - Locate ducts and/or air handler in basement or crawl space

     OR
   - ❖ Ductless HVAC systems

Except Additions of 700 ft2 or less

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High Performance Vented Attic Insulation

Roof Deck Insulation Options

Continuous Insulation Above the Roof Rafters

- R6 for Roofing with Air Space (e. g. tile)
- R8 for Roofing with no Air Space (e. g. asphalt shingles)

OR

Below Deck Insulation at the Roof Rafters

- For Roofing with Air Space (e. g. tile) R13
- For Roofing with no Air Space R18
- No radiant barrier

And

Ceiling Insulation R38

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Ducts

1. **Ducts in a High Performance Vented Attic (HPA)**
   - R8 duct insulation
   - Tested 5% Leakage

2. **Other Ducts**
   - No change from 2013 requirements

Current Code Requirements

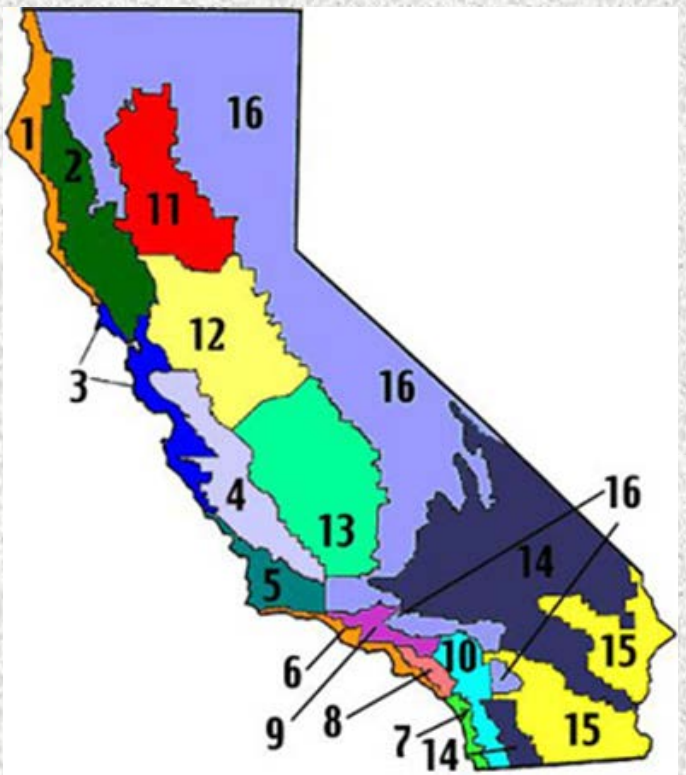
2013 Title 24 Requirements

Mandatory

- Duct leakage rate: 6% verified
- R-30 ceiling insulation

Prescriptive Requirements

- Ceiling insulation:
  - R-30 (CZ 2-10) or
  - R-38 (CZ 1,11-16)
- Duct insulation:
  - R-6 (CZ 1-10,12,13) or
  - R-8 (CZ 11, 14-16)



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Current Code Requirements

2013 Performance Approach

Standard Design Assumptions

- Ducts and equipment located in unconditioned space
  - 100% in attic for single-story
  - 65% in attic/35% in conditioned space for 2 or more stories
- Supply duct surface area is 27% of Conditioned Floor Area
- 1 to 300 attic ventilation
  - Higher with whole house fan

Current Code Requirements

2013 Performance Compliance Options

- Ducts located outside of the attic
- Roof deck insulation: above- and below-deck
- Low solar absorptivity cool roof
- Verified Low Leakage Air Handler and reduced duct leakage
- Increased duct insulation, buried ducts
- Verified duct design for reduced duct surface area
- Increased attic insulation, raised heel truss

Current Code Requirements

– 2012 IECC for comparison

Ceiling insulation: R-38 for most of CA

Allows R-30 if insulation uncompressed at edges (i.e., raised heel truss)

Supply ducts insulation R-8 in attic

Duct sealing (Mandatory): Total leakage shall be ≤ 4 cfm25 per 100 s.f. CFA

For a 2100 s.f. home with 3.5 ton system, matches 6% duct leakage requirement in Title 24

Air handlers shall have an air leakage of ≤ 2% of design air flow rate

Typical Practice

Current CA standard practice

- Ducts and air handler in vented attic
- Insulation at the ceiling
- Measured duct leakage rate consistently less than 6%
- Duct insulation is a mix of R-4.2, R-6 and R-8
- No duct design, default area

High Performance Vented Attic Advantages

- Reduces attic temperature
- Incremental changes to standard practice
- No change to duct and air handler location
- Package of measures will provide similar savings to having ducts in conditioned space

Present Value of Energy Savings

HPA package: R-13 Below Roof Deck, R-38 at Ceiling, R8 Ducts with 5% Leakage

Climate Zone	Benefit: TDV Energy Cost Savings + Other Cost Savings (2017 PV$)	Cost: Total Incremental Cost (2017 PV$)	Lifecycle Savings (2017 PV$)	Benefit to Cost Ratio
1	$1,441	$1,042	$399	1.4
2	$1,444	$995	$449	1.5
3	$710	$995	-$285	0.7
4	$1,640	$995	$645	1.6
5	$594	$995	-$401	0.6
6	$782	$995	-$213	0.8
7	$343	$995	-$652	0.3
8	$1,825	$995	$830	1.8
9	$3,032	$995	$2,037	3.0
10	$2,708	$995	$1,713	2.7
11	$3,605	$589	$3,016	6.1
12	$3,059	$753	$2,306	4.1
13	$4,531	$753	$3,778	6.0
14	$3,125	$670	$2,455	4.7
15	$5,389	$589	$4,800	9.1
16	$2,711	$958	$1,753	2.8

Note: A positive Life Cycle Savings means the measure is cost effective

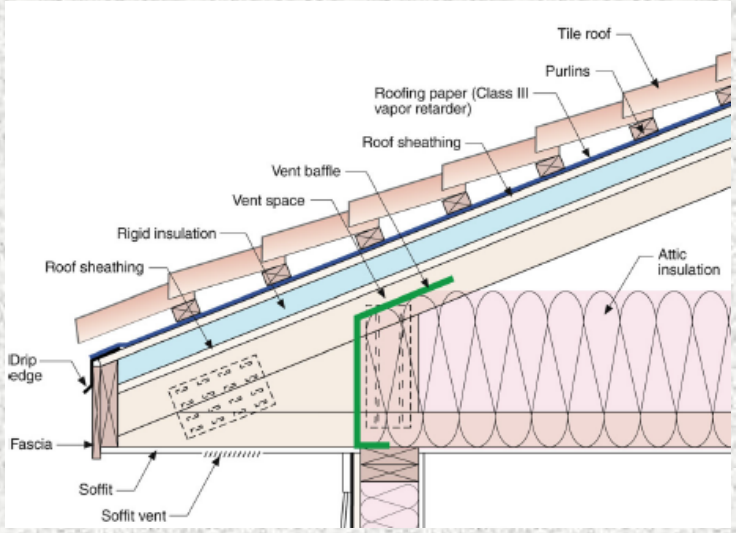
Above Deck Insulation

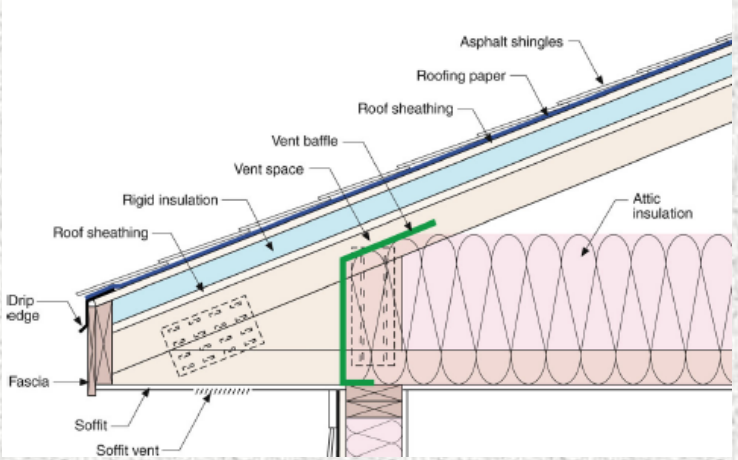
Product types

- Polystyrene: EPS (expanded) and XPS (extruded)
- Polyisocyanurate
- Polyurethane

Industry discussions

- Roof product fire rating
- Roof product attachment and ventilation
- Moisture management





Source: BSC 2011

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Above deck foam board

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Above Deck Insulated Tile

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Below deck fiber insulation

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Below deck spray foam insulation

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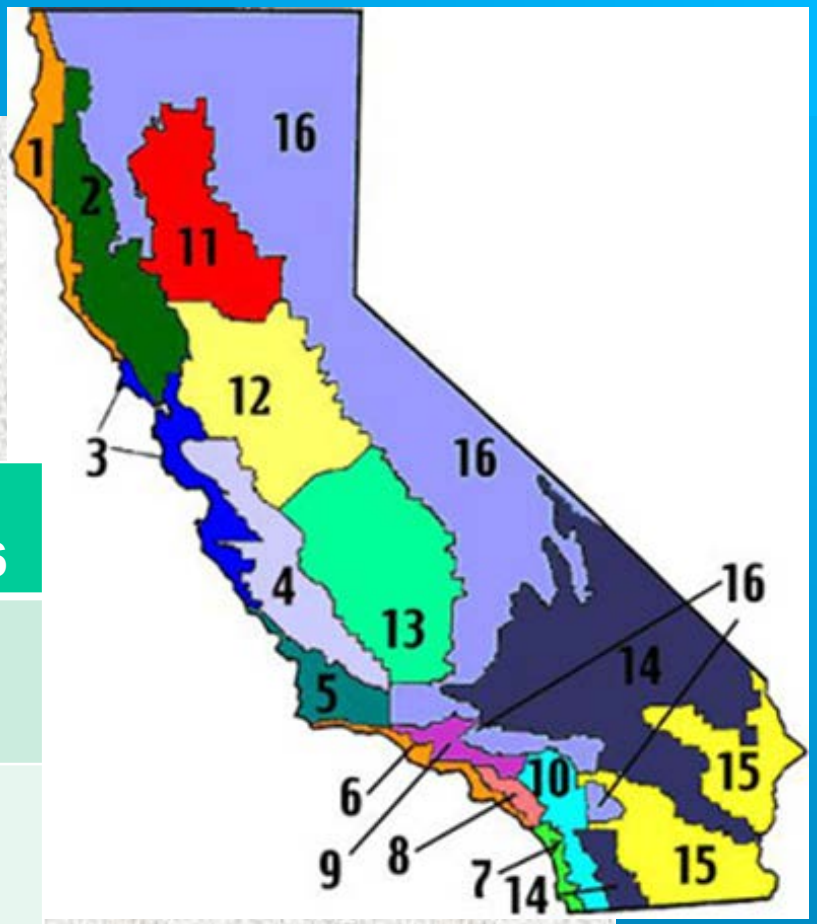
Proposed Code Change for Walls

- Prescriptive U-factor 0.050 for exterior walls
  - Example: 2x6 with R19 cavity insulation and R6 sheathing
  - CZs 1-6 and 8-16
  - Applies to all low-rise residential buildings except:
    - For additions, extensions of existing wood framed walls may retain the dimensions of the existing walls and shall install cavity insulation of R-15 in a 2x4 and R-19 for a 2x6 framing.

Current Code Requirements



Effective Code	CA CZ 2-10	CA CZ 11-13	CA CZ 1, 14-16
2008 Prescriptive	R-13	R-19	R-21
2013 Prescriptive	**Maximum U-factor: 0.065 (R-15+4 or R-13+5)**		
2013 Compliance Option (Performance)	SIPs, ICFs, AWF, or other wall assemblies (i.e., 2x6 @ 24" o.c. etc.)		

Note: These climate zones are California specific.

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Methodology for Savings Analysis

Energy and Life Cycle Costs

- CBECC-Res energy simulation
- Analysis using 2016 TDV
- Prototype buildings
  - Res: 2,700 SF (2-story) and 2,100 SF (1-story)

    55/45 weighting for applicability of prototypes statewide
- Baseline:
  - Minimally compliant with 2013 Prescriptive Requirements

    (U: 0.065 aka 2x4" studs w/ R15 cavity + R4 continuous insulation, no QII)

Incremental Cost Scenarios

2013 Prescriptive Baseline

Stud	Cavity	Exterior	U-factor	Incremental Cost	IMC /s.f. wall area	Cavity Insulation Type
2x4	R15	R4 (1")	0.065	-	-	High density batt
2x6	R21	R4 (1")	0.051	$463	$0.26	Loose-fill cellulose or high density batt
2x6	R23	R4 (1")	0.049	$507	$0.29	High density batt or mineral wool
2x6	R19	R6 (1.25")	0.048	$477	$0.27	Low density fiberglass batt
2x6	R23	R5 (1")	0.047	$887	$0.50	High density batt or mineral wool
2x6	R21	R6 (1.25")	0.046	$783	$0.44	Loose-fill cellulose or high density batt
2x4	R15	R10 (2")	0.045	$989	$0.56	High density batt
2x6	R23	R6 (1.25")	0.044	$827	$0.47	High density batt or mineral wool

These scenarios all assume 16" O.C. framing

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Present Value of Energy Savings

Prescriptive Wall Cost Effective in All Climate Zones except 7

Framing: 2x6 @ 16" o. c.

Cavity Insulation: R19 batt

Continuous Sheathing: R6

U-factor: 0.0480

Incremental Cost: $0.27/ft2-wall

Climate Zone	Net Present Value
1	$884
2	$580
3	$285
4	$482
5	$247
6	$50
7	-$192
8	$137
9	$519
10	$594
11	$1,420
12	$1,107
13	$1,433
14	$1,326
15	$1,506
16	$1,333

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Proposed Prescriptive Standard Wall

U-factor of 0.050

- Climate Zones **1-6 and 8-16**, all but San Diego coast (CZ 7)
- Cost effective using
  - 2x6 @ 16”OC, R19 + R6 (.048)
- Many other wood frame options:
  - 2x4 @ 16”OC, R15 + R8 (.050)
  - 2x6 @ 16” OC, R21 + R5 (.048)
  - 2x6 AWF R19 + R4 (.050)

Advanced Framing

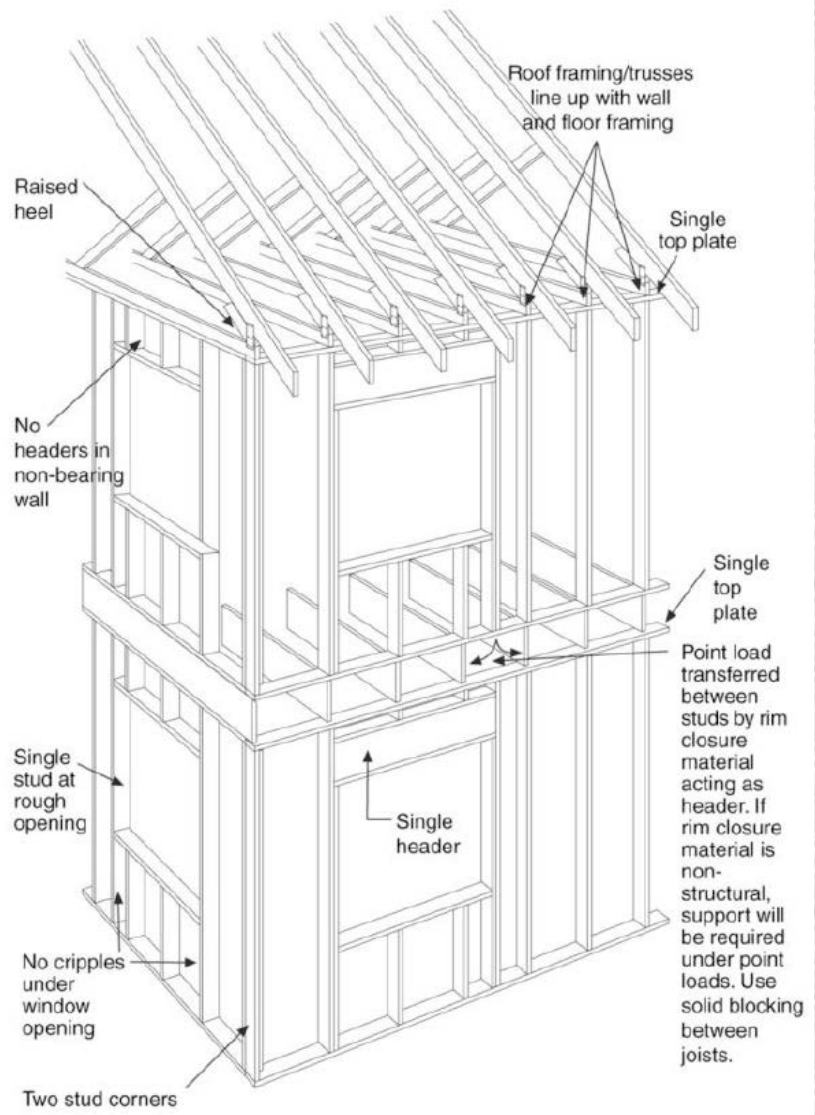

Figure 2: Advanced framing

Source: Building Science Corporation (2010)

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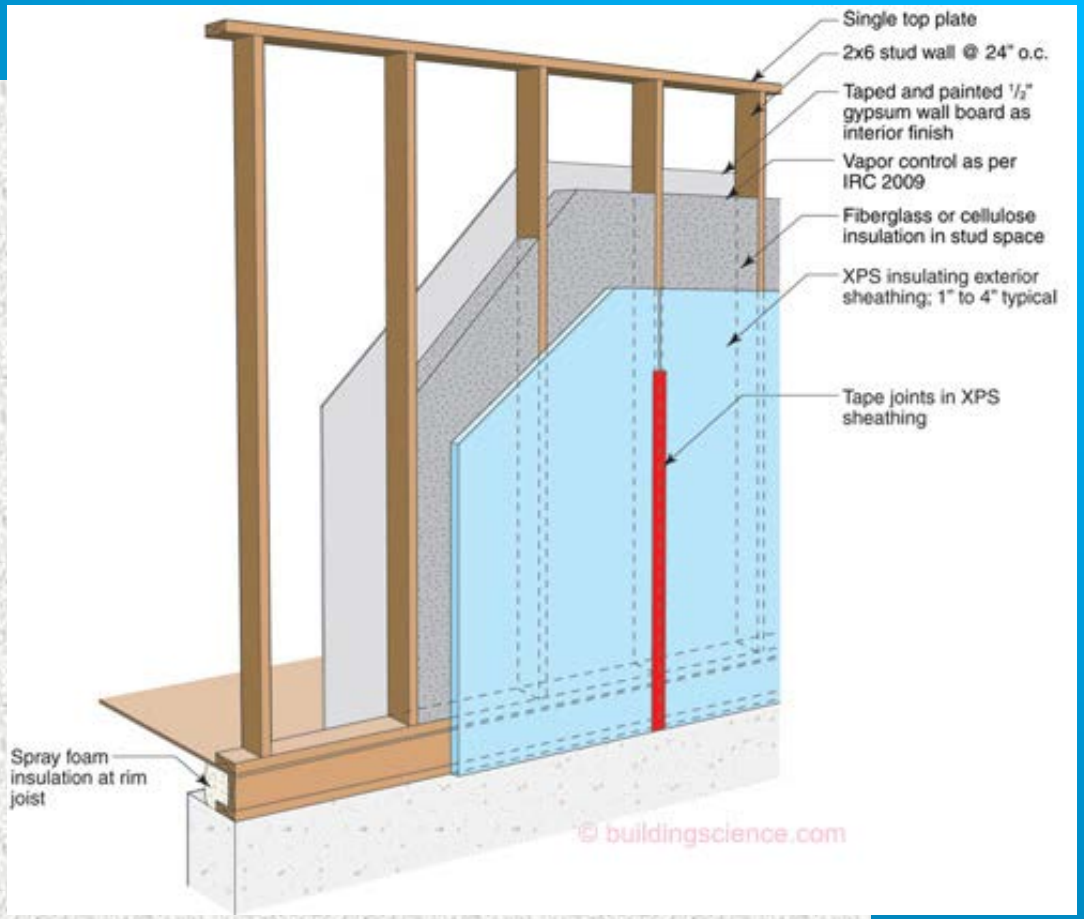
Advanced Framing



Source: Building Science Corporation (2003)

Benefits:

- Reduces material costs
- Reduces labor (after learning curve)
- Reduces thermal bridging (lower framing factor)
- Dry wall clips can reduce drywall cracking

Challenges:

- Learning curve
- Additional upfront planning more important to reap full benefits

Additional Builder Resources:

- APA Construction Guide: Advanced Framing M400

Questions?