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Speaker Barry Taheri – Principal of California Consultants

Barry Taheri is the founder and principal of California Consultants and holds certifications and licenses in the fields of Builder and Fenestration/Cladding Specialist, Water Management and Control, as well is licensed in California and Hawaii as well as a published technical writer. In addition, he has been a Specification Developer in the fenestration industry and acted as expert witness on building issues for the Office of the Attorney General of California.

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Certifications and Qualifications:

- Government designated industry expert
- Extensive experience in Forensics, Weatherization, Field Testing
- Building Envelope member of the Los Angeles Chapter of the BEC
- Certified Water Testing with equipment calibrated bi-annually
- Certified Thermography Imaging
- Experience in Forensic Investigation Litigation Case Review: Contracts, Codes, Standard of Care
- Accredited Speaker (AIA)
- State of California License B 904491
- Architectural School Consultant (USC)
- DuPont Envelope Certification in Commercial, Liquid and Residential sheet applied Wraps
- Mold Training Certificate
- Moisture Training Certificate
- State of CA Weatherization Training Certificate
- State of CA Certification Shell and Sealing (Envelope/Enclosure/HVAC)
- State of CA Certification Blower Door Testing
- EPA Lead Safe certified
- CIM Certified
- Henkel Corporation Certified
- RCI Certified

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What are building energy efficiency Standards?

Building energy efficiency standards are designed to ensure new and existing buildings achieve energy efficiency and preserve outdoor and indoor environmental quality. These measures (Title 24, Part 6) are listed in the California Code of Regulations.

When did building Standards start?

California's first building energy efficiency Standards went into effect in 1978.

How much will these new Standards add to the cost of a new house?

On average, these Standards add an additional $2,290 to the cost of constructing a new residential building, but will return $6,200 in energy savings over 30 years. In other words, when factored into a 30-year mortgage, the Standards will add approximately $11 per month for the average home, but will save $27 on monthly heating, cooling, and lighting bills.

How much energy will the 2013 Standards save?

The 2013 Standards will use 25% less energy for lighting, heating, cooling, ventilation, and water heating than the 2008 Standards. Additionally, the Standards will save 200 million gallons of water per year (equal to more than 6.5 million wash loads) and avoid 170,500 tons of greenhouse gas emissions per year.

How much have Standards saved?

Since 1978, the California Energy Commission has saved Californians $66 billion in electricity and natural gas savings through energy efficient building and appliance standards.

What are the long term savings?

After 30 years of implementing the standards, California will save nearly 14,000 GWh or enough electricity to power 1.67 million homes.

What policy goals are addressed by the Standards?

Several state energy policy goals drive the design of the current standards: the "Loading Order," which directs California's growing demand must first be met with cost-effective energy efficiency; "Zero Net Energy" (ZNE) goals for new homes by 2020 and commercial buildings by 2030; Governor Brown's Executive Order on Green Buildings; the Green Building Standards Code, and AB 32, which mandates that California reduce its greenhouse gas emissions to 1990 levels by 2020.

Who is responsible for enforcing the Standards?

Typically, the local city or county building department has the authority to verify compliance with applicable codes and standards, including building energy efficiency.

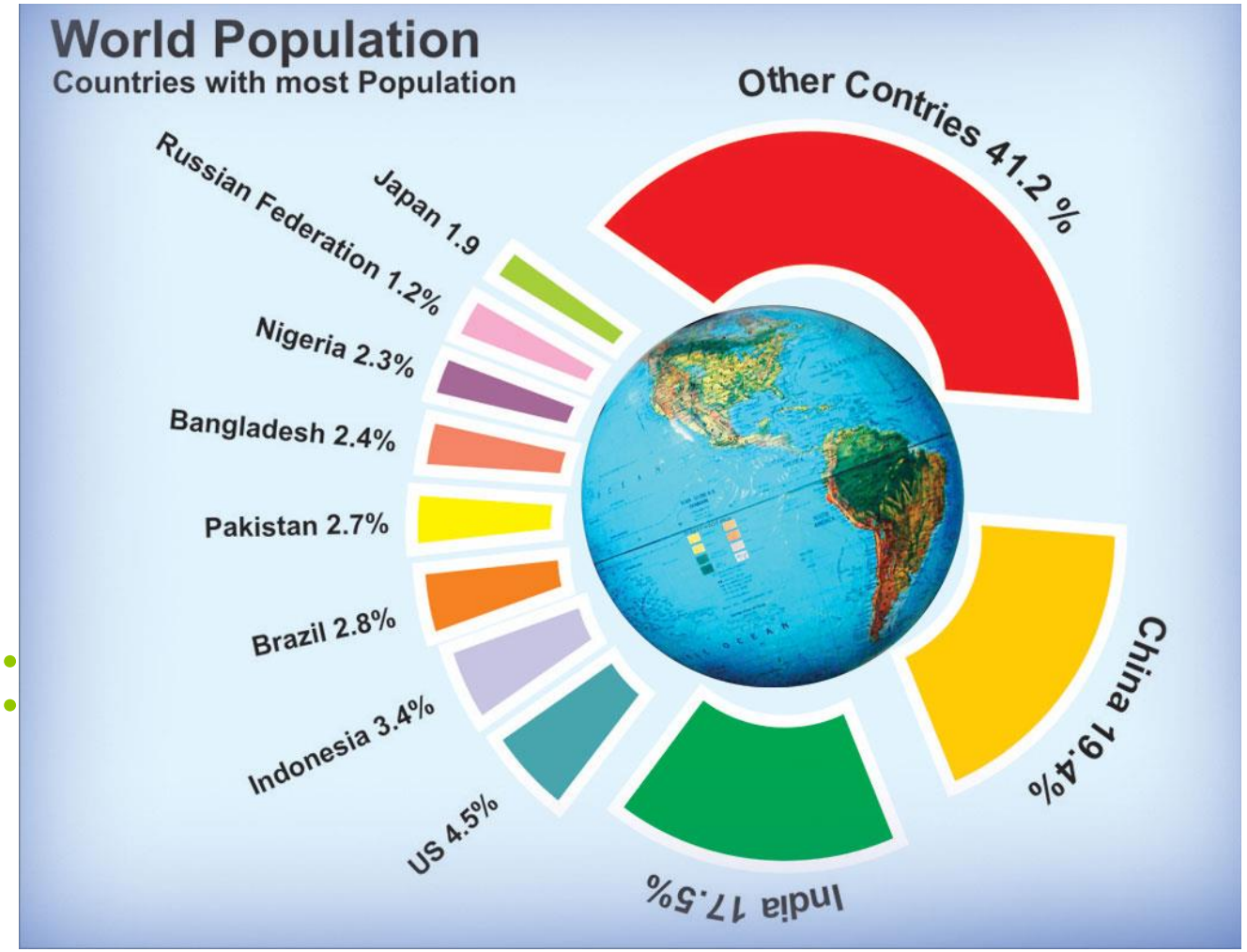
What are the critical highlights of the Standards?

Improved window performance to reduce heat loss in the winter and heat gain in the summer

Fact or Fiction?

- Can you build too air tight? Or not tight enough?
- An "air barrier" could make a house "Too Tight"
- Building's must leak in order for them to have fresh air?
- 78% of failures in construction defect involve water/moister infiltration?
- More products have been introduced to the construction industry in the past 10 years than in the entire history of construction.
- 75% of construction defects meet code standards?

Why new codes:



Why new codes:

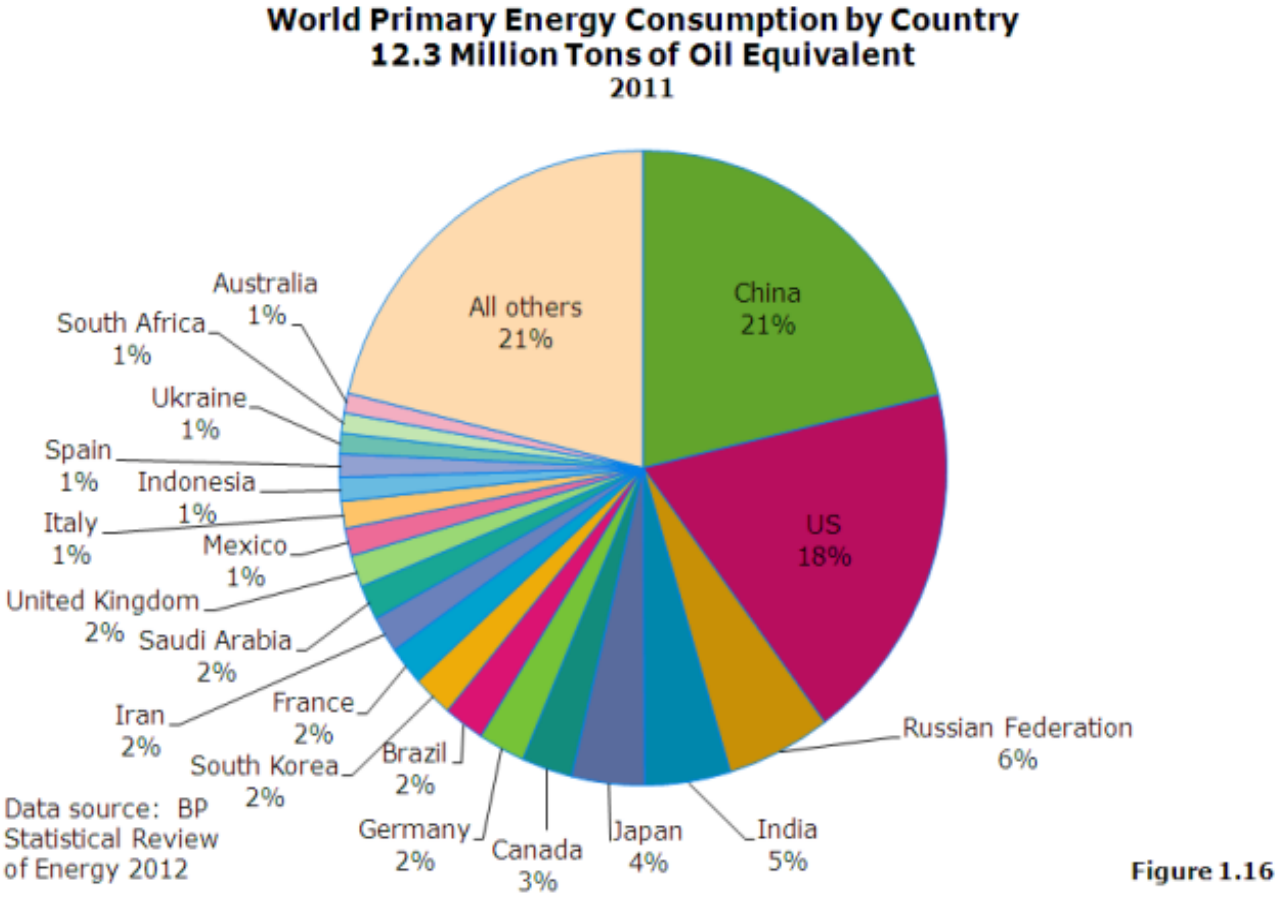
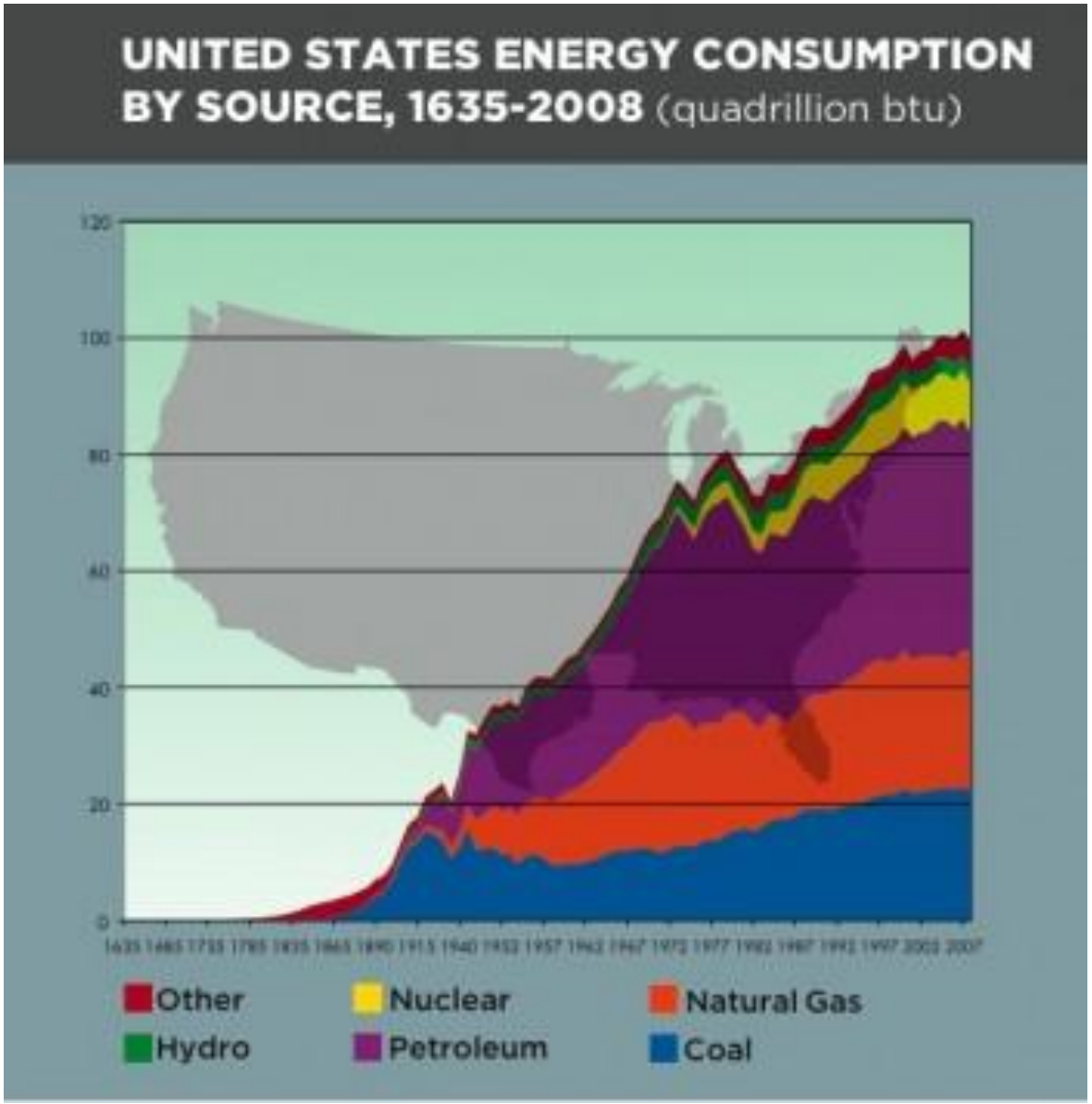
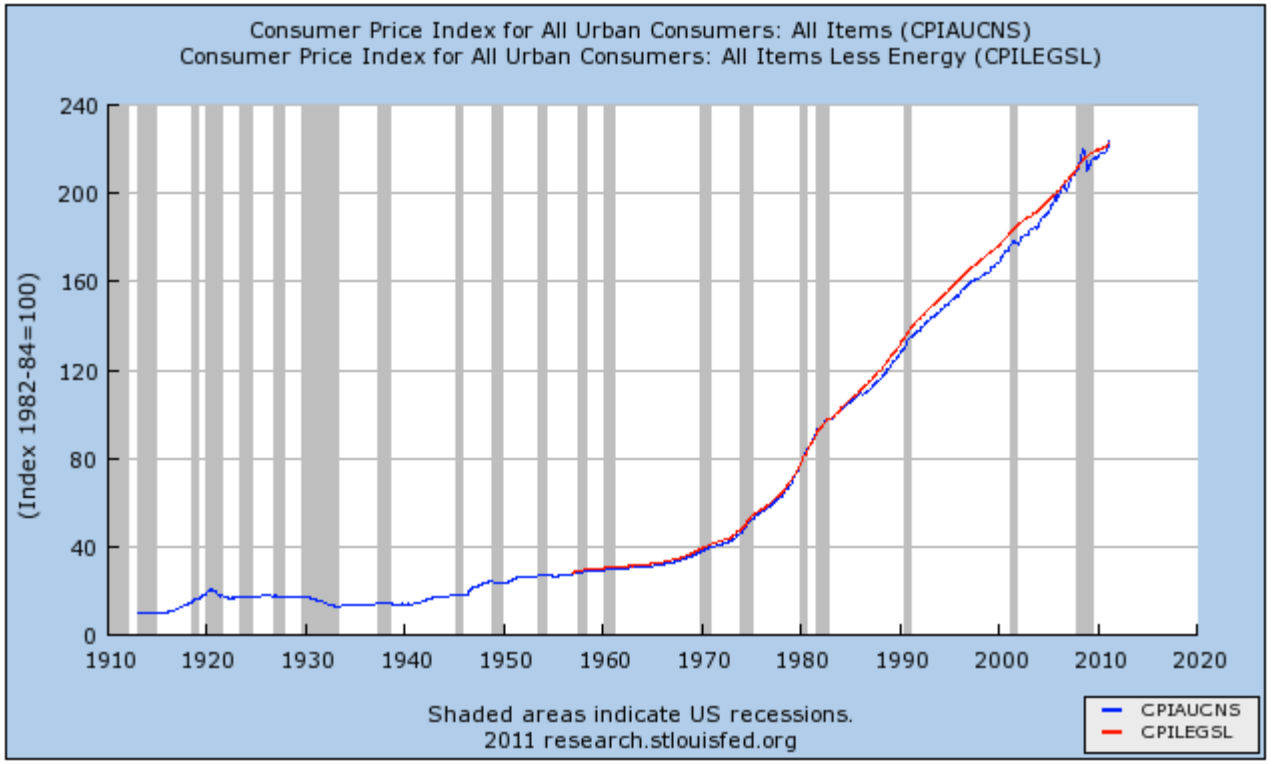


Figure 1.16

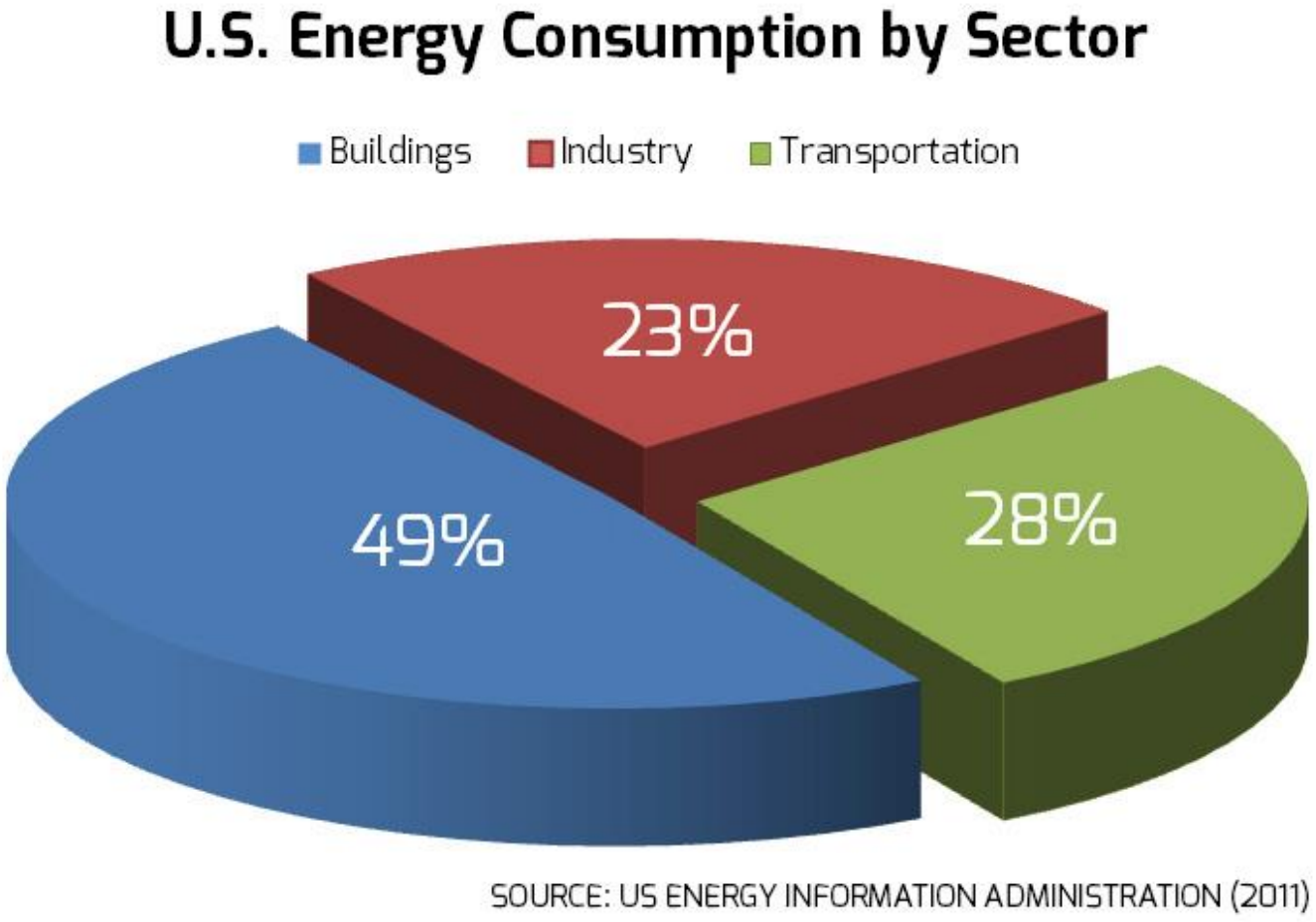
Why new codes:



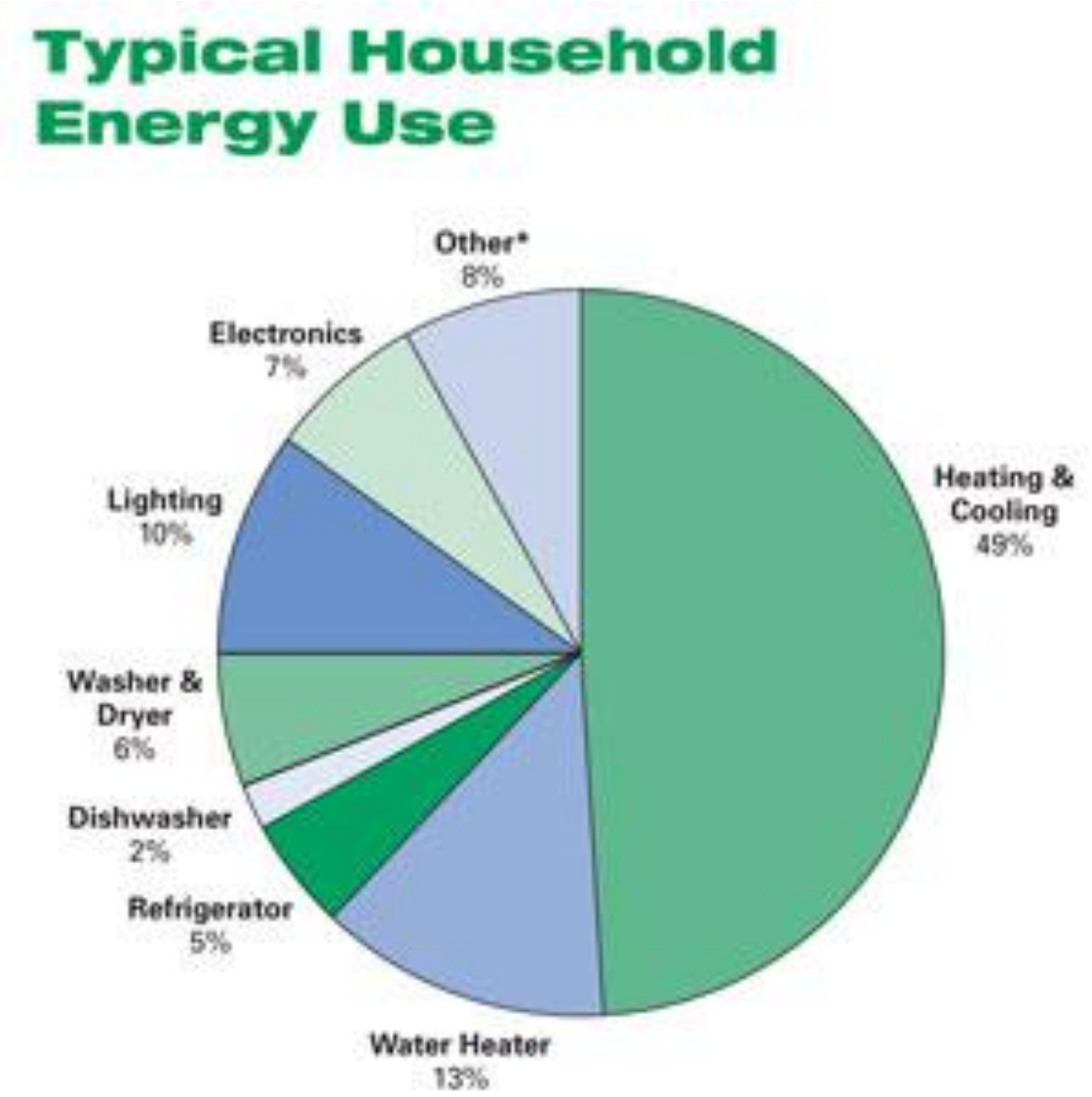
Why new codes:



Why new codes:



Break-down


Typical Household Energy Use
Other*
8%
Electronics
7%
Lighting
10%
Heating & Cooling
49%
Washer & Dryer
6%
Dishwasher
2%
Refrigerator
5%
Water Heater
13%

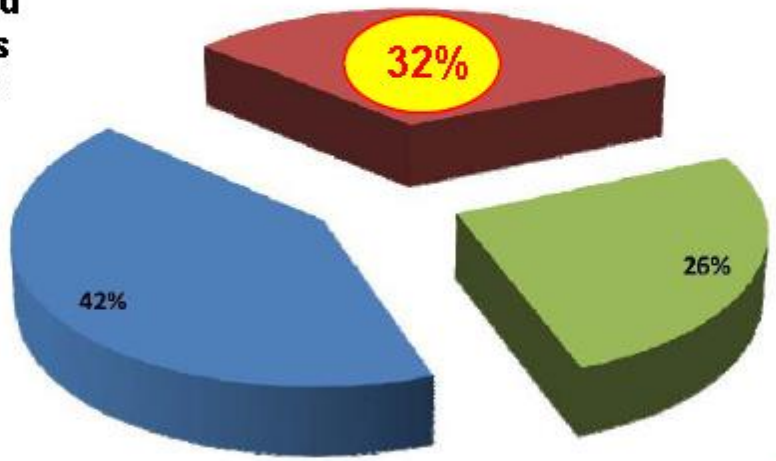
Break-down

Aggregate Building Loads

Heating and cooling breakdown--COOLING:

The energy consumed by air conditioning is further broken down:

- **32% is used to offset solar heat gain from fenestration**



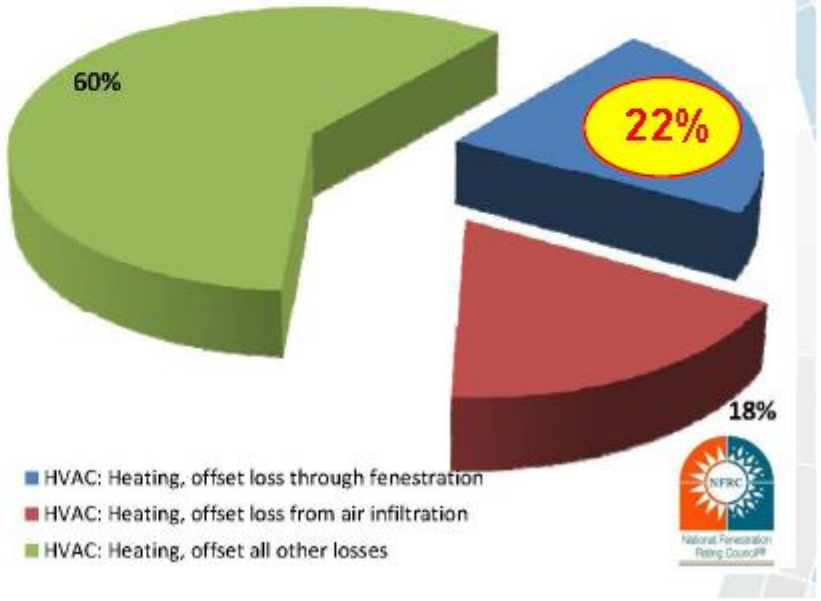
Break-down

Aggregate Building Loads

Heating and cooling breakdown--HEATING:

The energy consumed by heating is further broken down:

- **22% is used to offset heat loss thru fenestration**



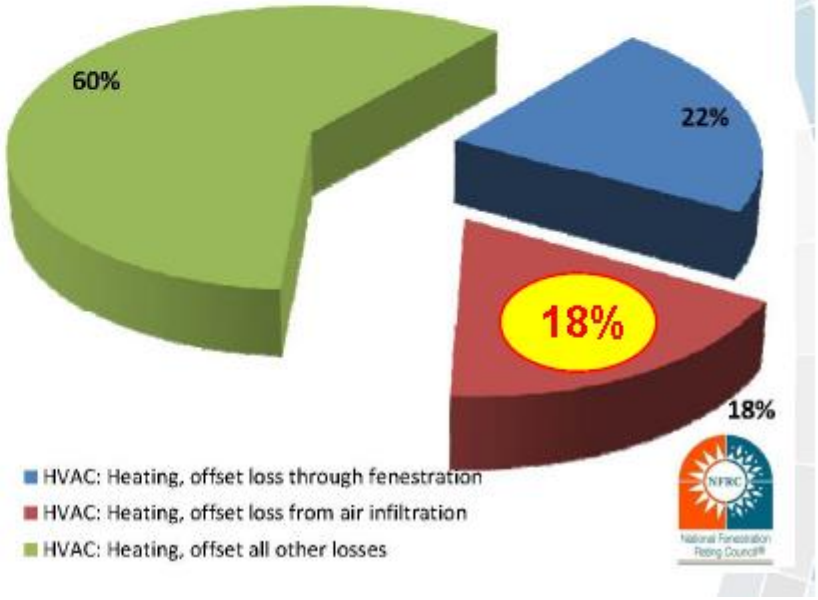
Break-down

Aggregate Building Loads

Heating and cooling breakdown--HEATING:

The energy consumed by heating is further broken down:

- **18% is used to offset heat loss due to all sources of air infiltration, including fenestration**



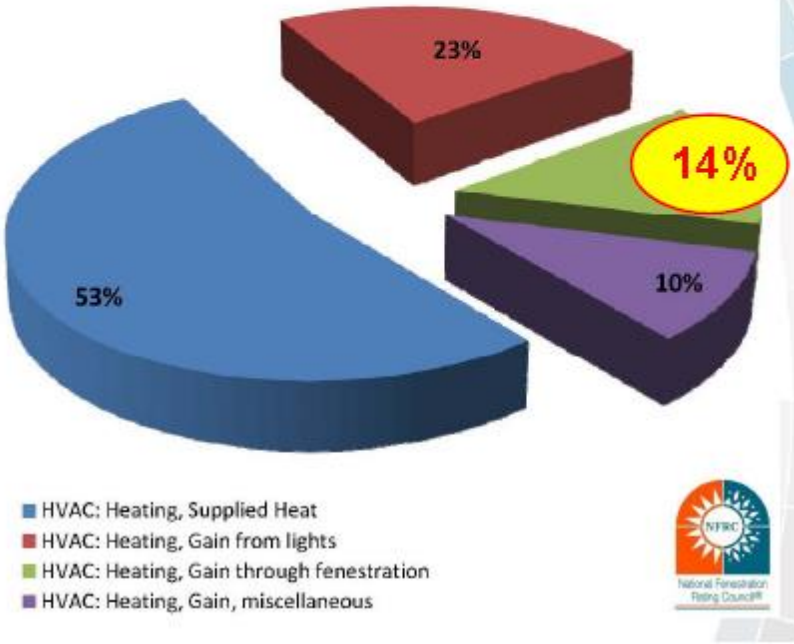
Break-down

Aggregate Building Loads

Heating and cooling breakdown--HEATING:

Do not ignore the "free energy" (solar gain) that offsets heating:

- **Solar gain contributes 14% of the heating requirements!**



E. Prescriptive Compliance Using South-Facing Overhangs

2013 Residential Compliance Manual

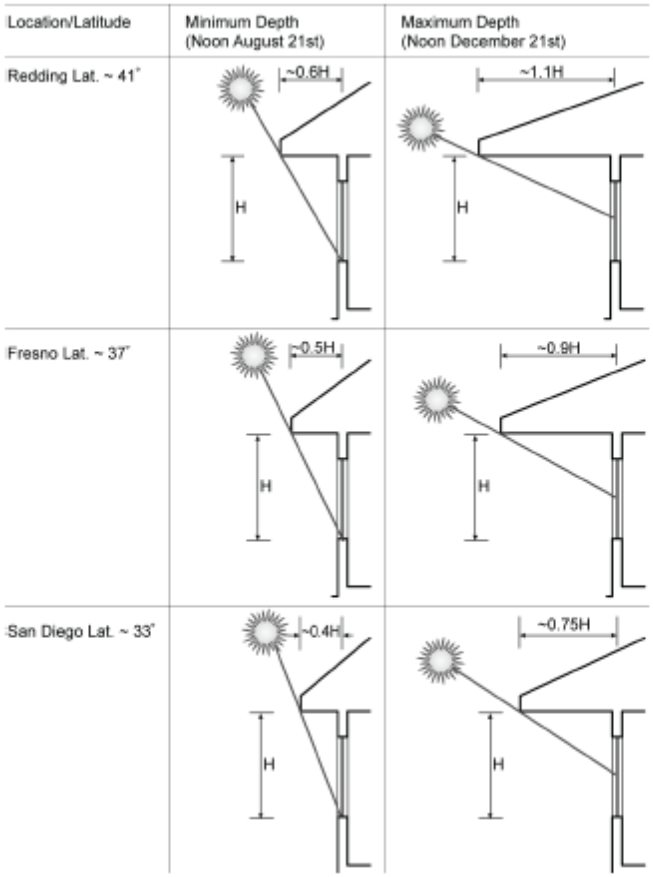
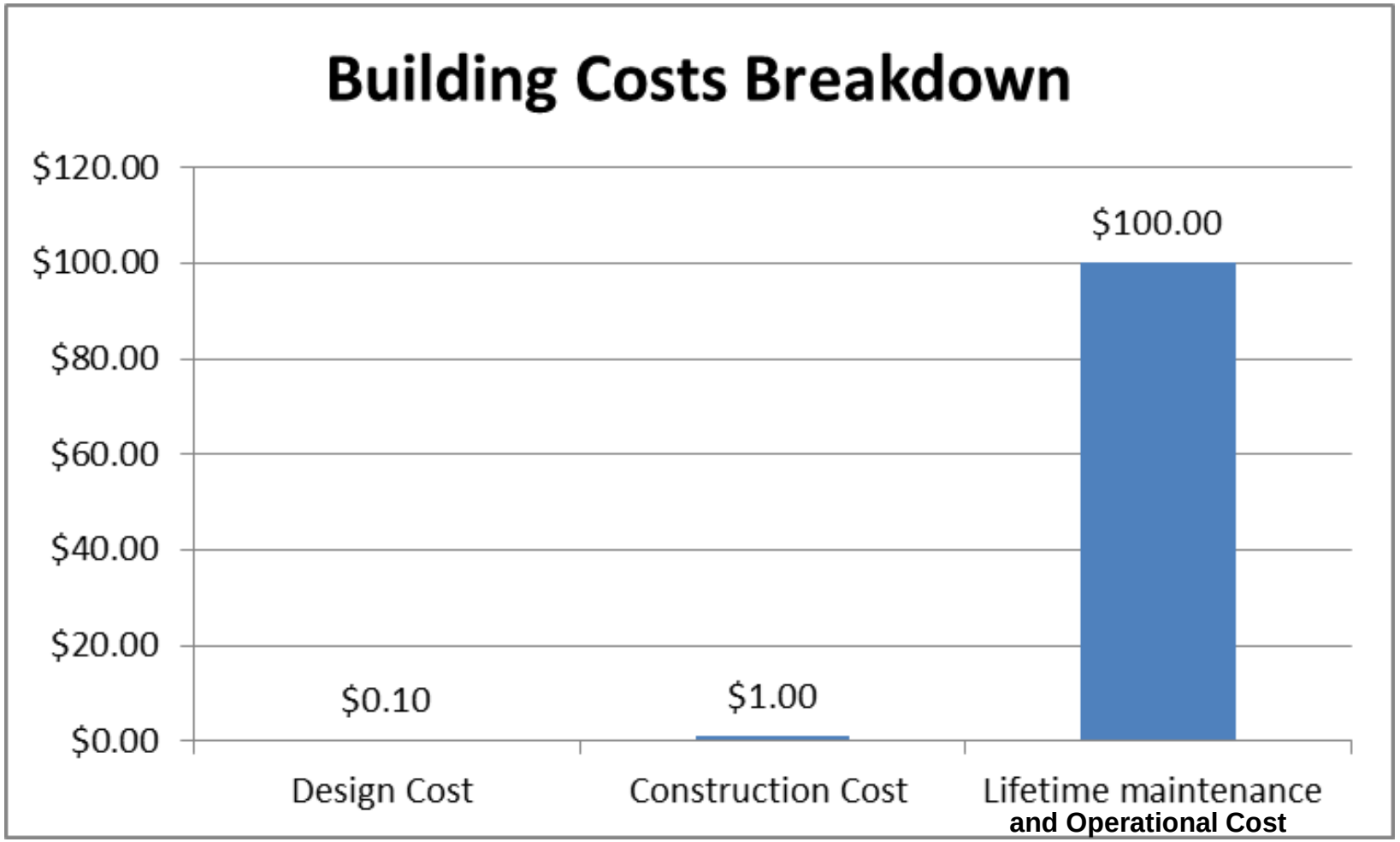
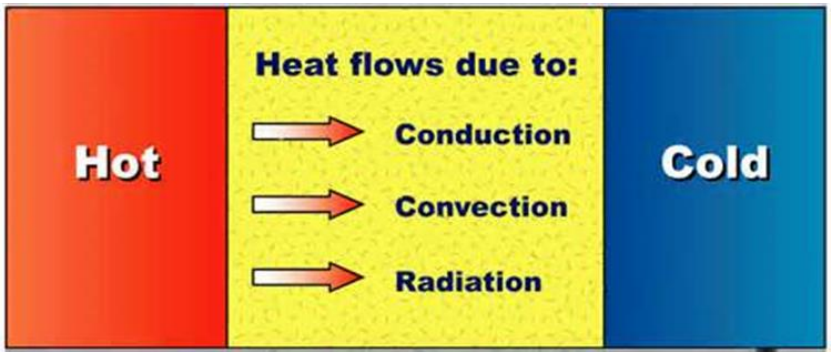


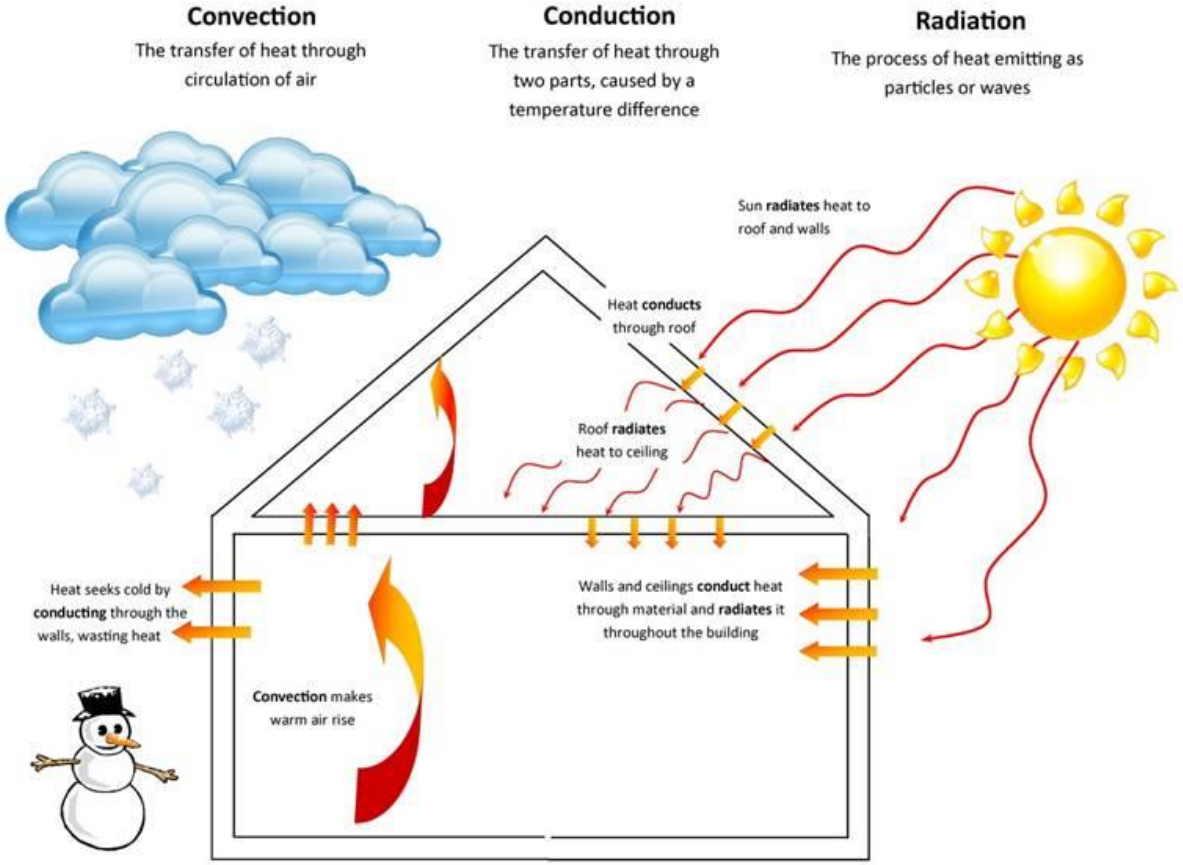
Figure 3-12 – South-Facing Overhang Dimensions for Prescriptive Compliance



School of Architecture (USC)



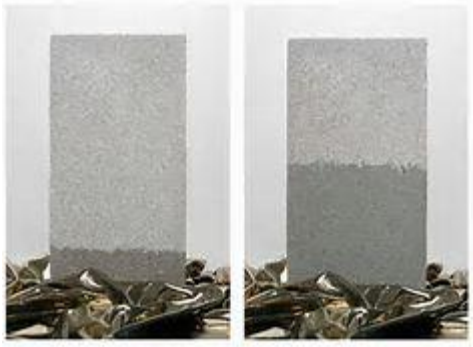
Building Science



Building Science

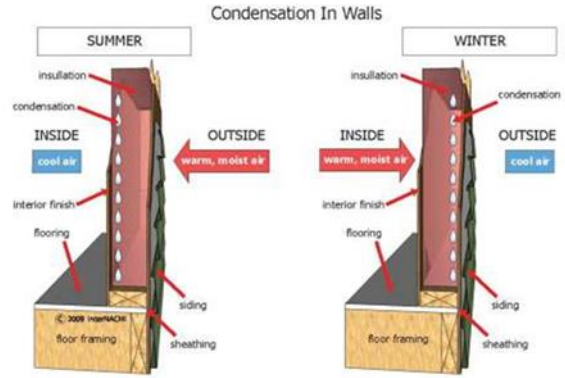
Surface tension

Capillary action



Absorption and wicking

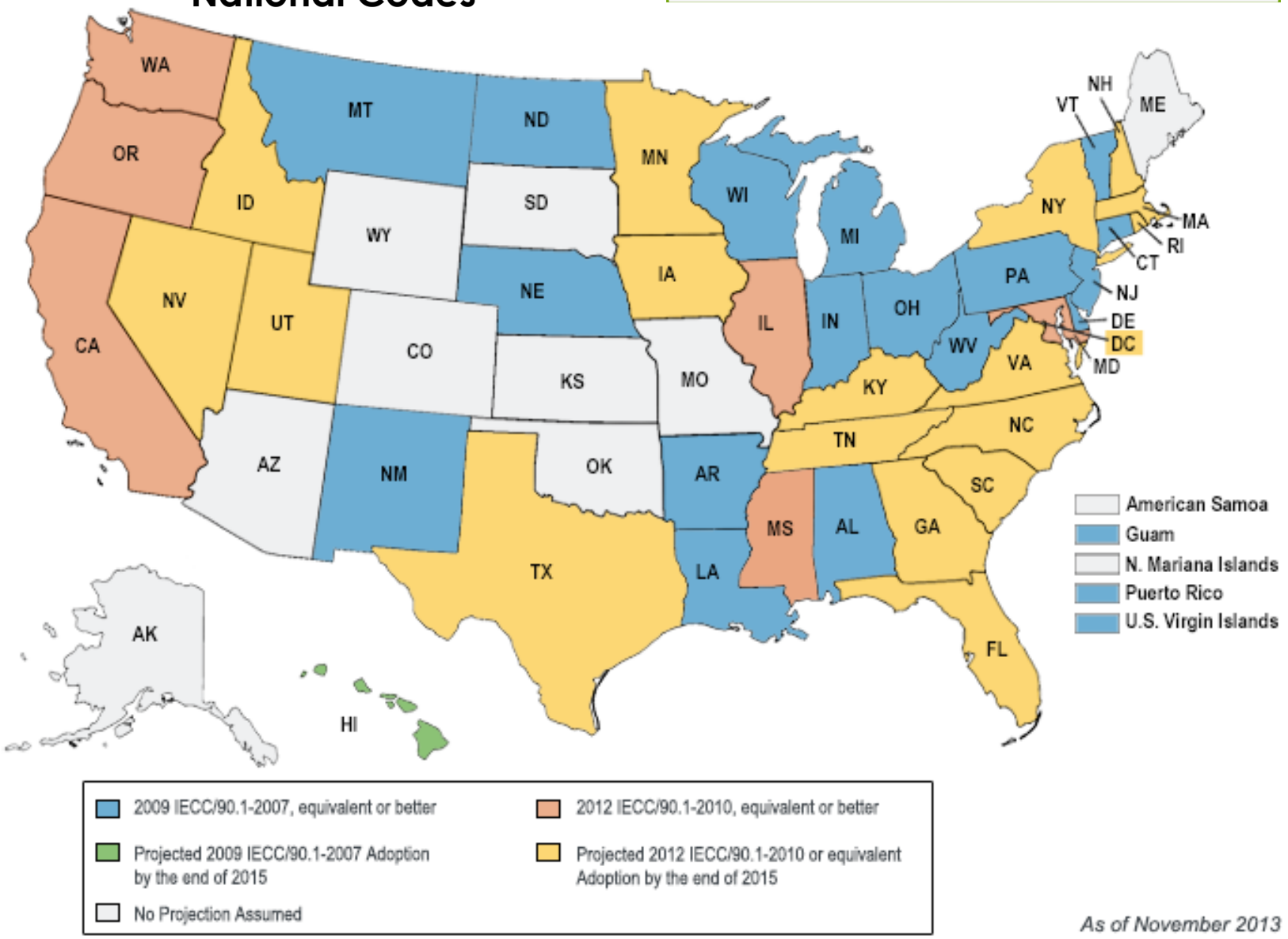
Condensation



Construction Code definition:

A building code, or building control, is a set of rules that specify the minimum acceptable level of safety for constructed objects such as buildings and nonbuilding structures. The main purpose of building codes are to protect public health, safety and general welfare as they relate to the construction and occupancy of buildings and structures. The building code becomes law of a particular jurisdiction when formally enacted by the appropriate governmental or private authority.

National Codes



Title 24 definition:

The California Building Standards Code is the building code for California, and title 24 of the California Code of Regulations (CCR). It is maintained by the California Building Standards Commission.

As they are, in effect, amended versions of copyright works such as the International Building Code (IBC) maintained by the International Code Council (ICC), the regulations have substantial portions under copyright, and hence may be withheld from the public or individuals, but still have the force of law. In 2008, Carl Malamud published the California Building Standards Code on ***Public.Resource.Org***

CEC Reference links:

1. 2013 Building Energy Efficiency Standards
2. 2013 Residential Compliance Manual
3. 2013 Nonresidential Appendices

List of parts: (Title 24)

Part 1: California Building Standards Administrative Code
Part 2: California Building Code (based on the IBC)
Part 2.5: California Residential Building Code (based on the IRC)
Part 3: California Electrical Code (based on the NEC)
Part 4: California Mechanical Code (based on the UMC)
Part 5: California Plumbing Code (based on the UPC)
Part 6: California Energy Code
Part 8: California Historical Building Code
Part 9: California Fire Code (based on the International Fire Code)
Part 10: California Existing Building Code
Part 11: California Green Building Standards Code (CALGreen Code)
Part 12: California Reference Standards Code

What's New for 2013 (Title 24)

The most significant changes in the 2013 Building Energy Efficiency Standards affecting residential buildings include the new requirements for high performance fenestration products.

There are two methods to comply with Title 24 requirements. Prescriptive and Performance.

Due to the limiting factors and higher demands of the Prescriptive approach requirements, it is projected that over 90% of the projects under Title 24 jurisdiction will default to the Performance and calculated approach.

What's New for 2013 (Title 24)

What are some highlights of the Standards?
In addition to simplifying and streamlining compliance documents, other major improvements include:

RESIDENTIAL:

- ✓ Insulated hot water pipes save water and energy and cut the time it takes to get hot water where it is needed
- ✓ Improved window performance to reduce heat loss in the winter and heat gain in the summer
- ✓ Whole house fans to cool homes and attics with cool evening air instead of air conditioning
- ✓ "Solar ready roof" design makes it easier to install solar photovoltaic or solar thermal panels at a future date
- ✓ Continuous Insulation /Better insulation (R)values

What's New for 2013 (Title 24)

What are some highlights of the Standards?

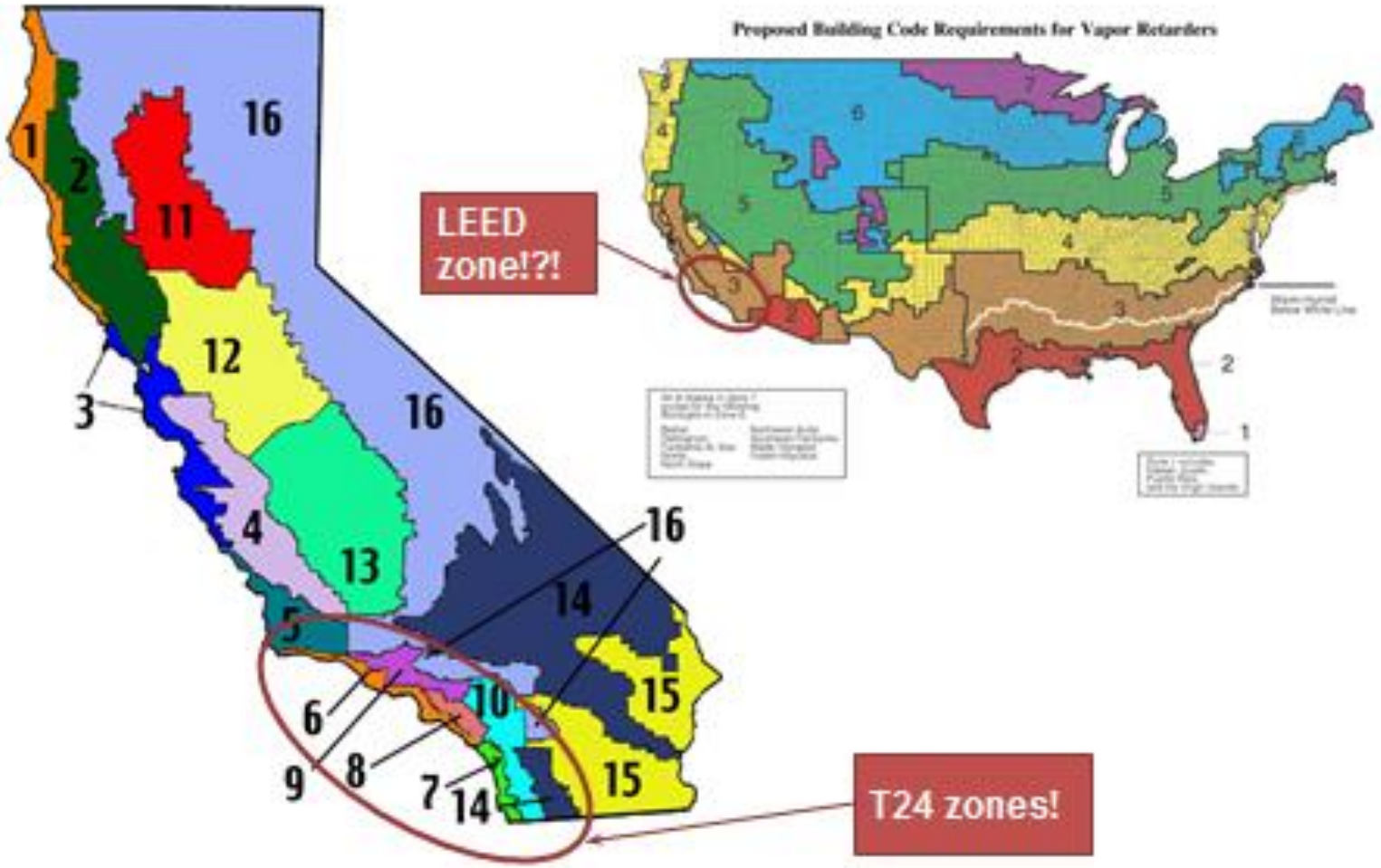
In addition to simplifying and streamlining compliance documents, other major improvements include:

NONRESIDENTIAL:

- ✓ High performance windows, sensors and controls that allow buildings to use "daylighting" to avoid unnecessary use of installed lighting
- ✓ Efficient process equipment in grocery stores,
- ✓ commercial kitchens, data centers, laboratories, and parking garages
- ✓ Advanced lighting controls to synchronize light levels with daylight and building occupancy, and provide demand response opportunities
- ✓ "Solar ready roof" design makes it easier to install solar photovoltaic or solar thermal panels at a future date
- ✓ Occupant Controlled Smart Thermostats allow an occupant to set and maintain a desired temperature and voluntarily participate in a utility's demand response programs
- ✓ Cool roof technologies

Be Aware

Zones Title 24 vs IECC



(California only)

Title 24 Energy Code Regulates:

Residential

Non-Residential

All buildings, except I Occupancy
(Occupancies A, B, E, F, H, M, R, S or U)

Even unconditioned buildings now
Historic structures per local jurisdiction…

Code Update

- The California Energy Commission (CEC) has recently revised its building energy standard, Title 24. As part of the revision of the energy code the CEC incorporated the air tightness testing protocols established in RESNET's Chapter 8, "RESNET Standard for Performance Testing and Work Scope".

(Residential Compliance Manual)

3 Building Envelope Requirements

- This chapter describes the requirements that affect the design of the building envelope for residential buildings. The building's design and choices made for individual components can significantly impact the energy demand needed to meet heating and cooling loads to maintain the building's desired inside comfort temperature. Heating and Cooling load calculations are used to determine the mechanical system design needed for space heating and cooling. The principal components of heating loads are infiltration and conduction losses through building envelope components, including walls, roofs, floors, slabs, windows and doors. Cooling loads, on the other hand, are dominated by solar gains through windows and skylights.

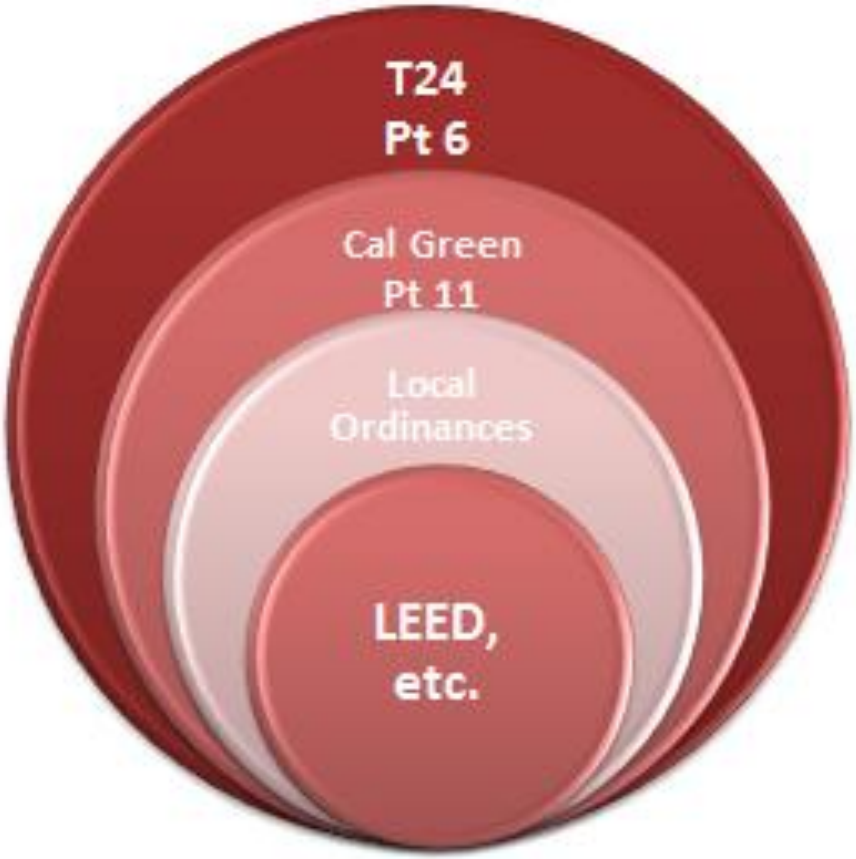
Code Update

- In a move to reduce energy costs, save consumers money, and increase comfort, the CEC unanimously approved the revision of the state's energy efficiency standards for new homes and commercial buildings.

- *The Energy Commission's 2013 Building Energy Efficiency Standards are 25 percent more efficient than the previous state standard for residential.*

- The revised standard took effect on July 1 , 2014. This is the step to meeting **the state's commitment to net zero energy homes by 2020**.

Multiple Codes



- Part 6 Code & Standards support the baseline energy requirements of CalGreen
- Local Ordinances may be stretch codes
- LEED over & above

The modeling procedures and requirements for compliance

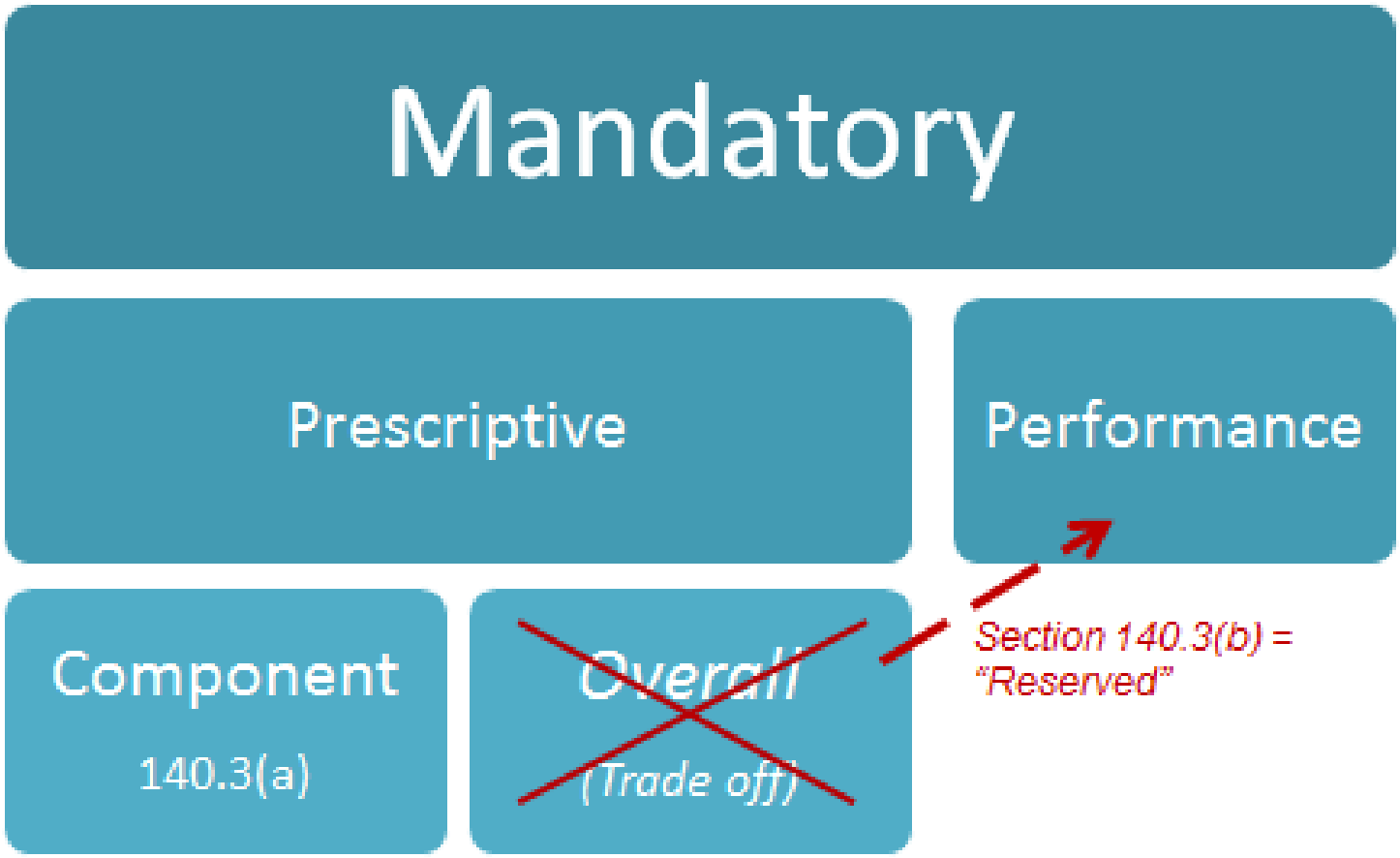
§150.1

A. The **prescribed mandatory measures** and **prescriptive requirements** affect the design and operation of the building. Mandatory measures, prescriptive requirements and operational schedules establish a minimum performance level which can be exceeded by other design measures and construction practices resulting in greater energy savings.

B. **The performance approach** is a more sophisticated compliance method and it offers greater design flexibility than the prescriptive approach. The performance approach may be used for any unique design element(s) that the user of compliance modeling software believes can contribute to the building's overall energy use.

C. **The performance approach** allows for more energy tradeoffs between building features, such as increasing HVAC equipment efficiency in order to allow more fenestration area.

Title 24 Compliance Methods



Title 24 Compliance

Mandatory Measures

- Frame wall insulation minimum = R-13
- Ceiling Roof insulation minimum = R-30
  - Exception: Addition\Alteration = R-19
- Raised floor insulation minimum = R-19
- Vapor barrier on walls in Zones 14 & 16
- All zones, unvented crawlspace vapor barrier
- Maximum fenestration U-factor = 0.58
  - Can average across entire home
  - Exception: up to 10 sqft (or 0.5% times of floor area) of fenestration whichever is greater, is exempt from the maximum fenestration U-factor requirement.

Title 24 Compliance

Mandatory Measures

- **Insulation**

- Prescriptive ceiling insulation increases to R-38 (zones 1, 11-16)
- R-30 in zones 2-10

Insulation

- Prescriptive Wall Insulation
- U-factor = 0.065
    - R-15 in 2x4 wall cavity
    - Additional R-4 rigid over framing members

OR;

    - R-13 in 2x4 wall cavity
    - Additional R-5 rigid over framing members

Title 24 Compliance

Mandatory Measures

Radiant Barriers

- Prescriptive requirement in climate zones 2-15

Additions and Alterations

- Clarifies that all IAQ requirements apply to additions less than 1,000 sqft except the whole house ventilation

- Glazing replacements need to meet the prescriptive criterial from prior slide

  Exception applies if all items are met
  - Area <= 75 sqft
  - U-factor <=0.40
  - SHGC <= 0.35 (zones 2, 4, 6-16)

Title 24 Compliance

Mandatory Measures

Additions and Alterations

- Two performance paths for analysis
  - Standard approach gives very little credit
  - Third party HERS verification allows full credit

Standard Design for Alterations		
Component	Without HERS	With HERS
Roof Insulation	R-30	Existing Condition
Wall Insulation	R-13	Existing Condition
Floor Insulation	R-19	Existing Condition
Windows	U=0.40, SHGC=0.35	U=0.40, SHGC=0.35 unless existing is
Window Film	U=0.40, SHGC=0.35	

Fenestration

Prescriptive Method and Limitations

As previously mentioned there are stringent requirements and limitations to following this method that will offer little flexibility as well as additional potential expenses.

Table 3-3 – Maximum U-factors, SHGC and Fenestration Area by Climate Zone in Packages A

Climate Zone	1, 3, 5	2,4,6-16
Maximum U-factor	0.32	0.32
Maximum SHGC	NR	0.25
Maximum Fenestration Area	20%	20%
Maximum West-Facing Fenestration	NR	5%

TABLE 150.1-A COMPONENT PACKAGE-A Standard Building Design

		Climate Zone															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Fenestration	Maximum U-factor[d]	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
	Maximum SHGC[e]	NR	0.25	NR	0.25	NR	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
	Maximum Total Area	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Maximum West Facing Area	NR	5%	NR	5%	NR	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%

SECTION 110.6 –
MANDATORY REQUIREMENTS FOR FENESTRATION PRODUCTS AND EXTERIOR DOORS

The residential fenestration parameters are as follows:

1. ***Air Leakage*** *– A minimum of .3 or better is required on all products.*

Manufactured fenestration products and exterior doors shall have air infiltration rates not exceeding 0.3 cfm/ft² of window area, 0.3 cfm/ft² of door area for residential doors, 0.3 cfm/ft² of door area for nonresidential single doors (swinging and sliding), and 1.0 cfm/ft² for nonresidential double doors (swinging), when tested according to NFRC-400 or ASTM E283 at a pressure differential of 75 Pascal's (or 1.57 pounds/ft²), incorporated herein by reference.

EXCEPTION to Section 110.6(a) 1: Field-fabricated fenestration and field-fabricated exterior doors

SECTION 110.6 –
MANDATORY REQUIREMENTS FOR FENESTRATION PRODUCTS AND EXTERIOR DOORS

U-factor - Is defined as the rate of heat transfer through the window- from inside to outside when it is cold and from outside to inside when it is hot. The lower the U-factor, the better the insulating properties, resulting in greater energy efficiency.

U-Factor is the reciprocal of R-Value
U = 1/R
(R-1.2 is the same as U = 0.58)
(R-3 is the same as U = 0.33)

The residential fenestration parameters are as follows:

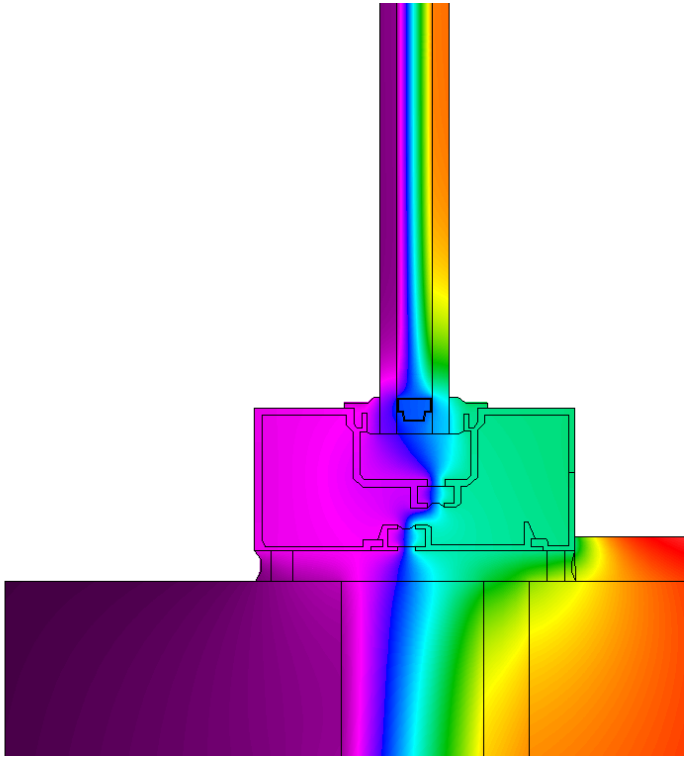
2. ***U-Factor*** *– A minimum of .58 or better (lower numeric number) is required for the Performance approach*. Prescriptive approach requires .32 or better for all zones.

The fenestration product's U-factor shall be rated in accordance with NFRC 100, or use the applicable default U-factor set forth in TABLE 110.6-A.

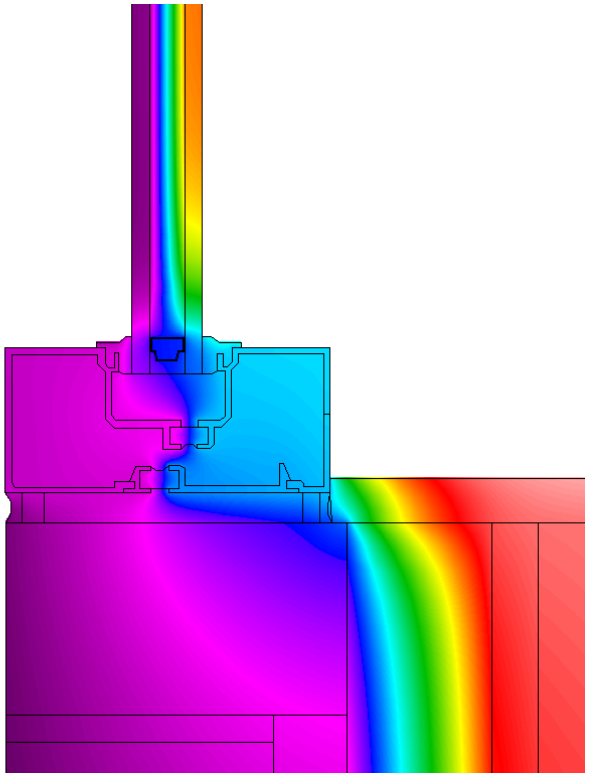
Effective R-value of a Window

Window positioning matters!

- Use thermal models to optimize window placement

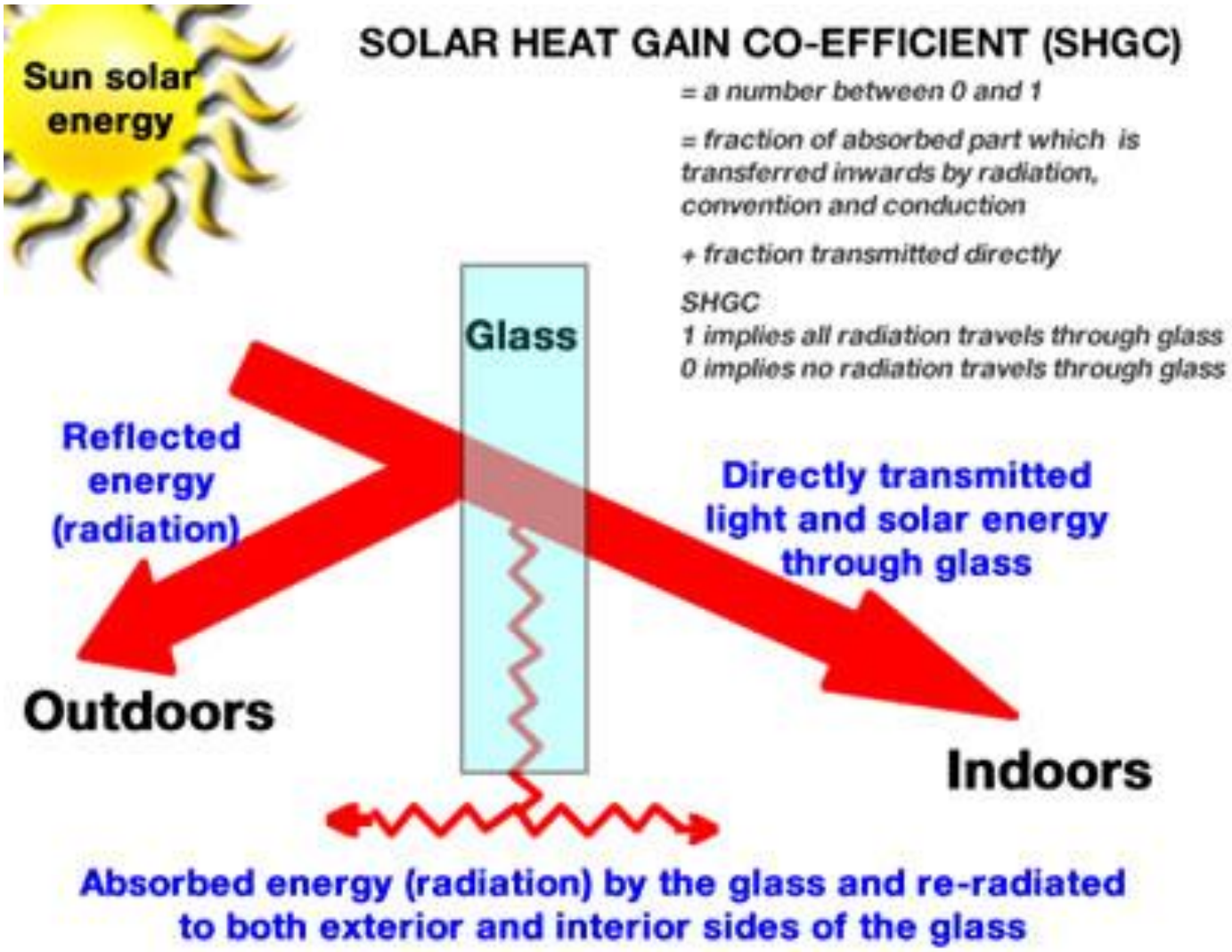


- Ideal Placement – IGU in Line w/Insulation
  - Coordinate with waterproofing detailing



- Bad for Heat Loss and for Risk of Condensation
  - Then input U-factors into energy model

SECTION 110.6 –
MANDATORY REQUIREMENTS FOR FENESTRATION PRODUCTS AND EXTERIOR DOORS



SECTION 110.6 –
MANDATORY REQUIREMENTS FOR FENESTRATION PRODUCTS AND EXTERIOR DOORS

Solar heat gain coefficient (SHGC) - Is defined when sunlight hits a window and the solar heat is absorbed and subsequently released inward. The SHGC represents the fractional amount of the solar energy that ends up warming the house. The lower the SHGC, the less solar heat it transmits.

The residential fenestration parameters are as follows:

3. ***RSHGC (Residential Solar Heat Gain Coefficient)*** – Even though this number does weigh in towards the performance and compliance of the over-all building, there is no performance minimum requirement residentially. Prescriptively zones 1, 3 & 5 are exempt and all other zones are required to have a .25 or better.

Solar Heat Gain Coefficient (SHGC)

The fenestration product's SHGC shall be rated in accordance with NFRC 200, or use the applicable default SHGC set forth in TABLE 110.6-B.

SECTION 110.6 –
MANDATORY REQUIREMENTS FOR FENESTRATION PRODUCTS AND EXTERIOR DOORS

The residential fenestration parameters are as follows:

Visible transmittance (VT) - Is defined as the measure of how much visible light passes through a window. This is influenced by glass selection, glazing as well as the amount of the opening taken up by non-transparent components such as the frame. The higher the VT, the better potential to maximize daylight.

4. ***VT (Visible Transmission)*** – Not required for projects, but for identification purposes the VT number must be identified on the default label.

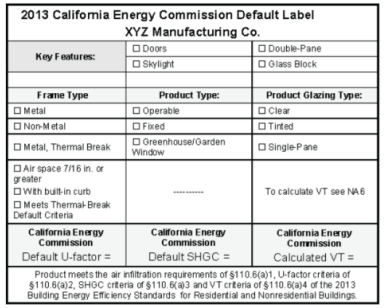
SECTION 110.6 –
MANDATORY REQUIREMENTS FOR FENESTRATION PRODUCTS AND EXTERIOR DOORS

- The fenestration product's VT shall be rated in accordance with NFRC 200 or ASTM E972, or for default labeling purposes use the formulation below (applicable to residential and non-residential).
- **NA6.4 Default Visible Transmittance, VT**
- (a) Equation NA6-3 - VT of Center of Glass (COG) calculation
- **VTT = VTF x VTC**
- Where:
- VTT = Is the Total Performance of the fenestration including glass and frame
- *VTF = 0.53 for projecting windows, such as casement and awning windows*
- *VTF = 0.67 for operable or sliding windows*
- *VTF = 0.77 for fixed or non-operable windows*
- VTC = Center of glass VT is calculated in accordance with NFRC 200 Section 4.5.1.1 or NFRC 202 (provided by glass manufacturer).

SECTION 110.6 –
MANDATORY REQUIREMENTS FOR FENESTRATION PRODUCTS AND EXTERIOR DOORS

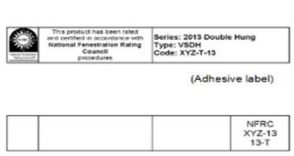
Labeling Requirements (Default vs NFRC)

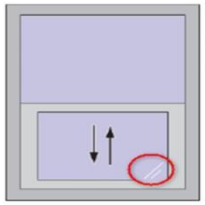
In lieu of the NFRC label a "Default Label" along with a "Compliance Certificate" can be used and must remain attached until the building inspector has verified its efficiencies. As long as the Air Leakage and U-Factor minimums have been met and the Solar Heat Gain Coefficient has been identified, a Default Label based on the Default Table, may be used in lieu of an NFRC Label. Please note that while the VT is not required residentially from a performance stand point, the value must be identified on the default label.



2013 California Energy Commission Default Label XYZ Manufacturing Co.		
Key Features:	☐ Doors	☐ Double-Pane
	☐ Skylight	☐ Glass Block
Frame Type	**Product Type:**	**Product Glazing Type:**
☐ Metal	☐ Operable	☐ Clear
☐ Non-Metal	☐ Fixed	☐ Tinted
☐ Metal, Thermal Break	☐ Greenhouse/Garden Window	☐ Single-Pane
☐ Air space 7/16 in. or greater ☐ With built-in curb ☐ Meets Thermal-Break Default Criteria	----------	To calculate VT see NA6
California Energy Commission Default U-factor =	**California Energy Commission** Default SHGC =	**California Energy Commission** Calculated VT =
Product meets the air infiltration requirements of §110.6(a)1, U-factor criteria of §110.6(a)2, SHGC criteria of §110.6(a)3 and VT criteria of §110.6(a)4 of the 2013 Building Energy Efficiency Standards for Residential and Nonresidential Buildings.		

Figure 3-2 – Sample of Default Temporary Label




(Marking or etching on glass)

REFERENCES (BUILDING ENERGY EFFICIENCY STANDARDS 2013) – Section 110.6 – 5:

Code (highlights of) areas of impact

Envelope

Now an Enclosure

Air Barrier
Testing:
Blower Door ASTM 779

IECC or
ASHRAE 90.1 OR
Title 24 (Cal only)

Breaches & Transitions
are Key

Often, the air barrier assembly is a non-maintainable component of the building enclosure. You only have one chance to ensure correct installation prior to the application of other components in the building enclosure.

Envelope

- Air Barrier materials must meet:
  ASTM E 2357, E1677 or E 83
- Air Barrier must be continuous, joints and sealants shall be sealed including transitions in places and changes in materials
- Air Barrier penetrations and path of air leakage shall be caulked, gasketed otherwise sealed
- A Whole Building Blower Door Test may be required by local agencies.

Envelope

3.3.1 Mandatory Features and Devices

§150.0

When compliance is being demonstrated with either the prescriptive or performance compliance paths, there are mandatory measures that must be installed. Minimum mandatory measures must be met regardless of the method of compliance being used. For example, a building may comply using performance computer modeling software with only a U-factor of U-0.41(R-2.4) insulation in a wood-framed attic roof, but a Ufactor of at least U-0.031(R-30) must be installed because that is the mandatory minimum.

Envelope

TABLE 150.1-A COMPONENT PACKAGE-A Standard Building Design

				Climate Zone														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Building Envelope	Insulation[1]	Roofs/Ceilings		U 0.025 R 38	U 0.031 R 30	U 0.031 R 30	U 0.031 R 30	U 0.031 R 30	U 0.031 R 30	U 0.031 R 30	U 0.031 R 30	U 0.031 R 30	U 0.031 R 30	U 0.025 R 38	U 0.025 R 38	U 0.025 R 38	U 0.025 R 38	U 0.025 R 38	U 0.025 R 38
		Walls	Above Grade	2x4 Framed[9]	U 0.065 R 15+4 or R 13+5	U 0.065 R 15+4 or R 13+5	U 0.065 R 15+4 or R 13+5	U 0.065 R 15+4 or R 13+5	U 0.065 R 15+4 or R 13+5	U 0.065 R 15+4 or R 13+5	U 0.065 R 15+4 or R 13+5	U 0.065 R 15+4 or R 13+5	U 0.065 R 15+4 or R 13+5	U 0.065 R 15+4 or R 13+5	U 0.065 R 15+4 or R 13+5	U 0.065 R 15+4 or R 13+5	U 0.065 R 15+4 or R 13+5	U 0.065 R 15+4 or R 13+5	U 0.065 R 15+4 or R 13+5
				Mass Wall Interior[1]	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.059 R 17
				Mass Wall Exterior[1]	U 0.125 R 80	U 0.125 R 8	U 0.125 R 80	U 0.125 R 80	U 0.125 R 80	U 0.125 R 80	U 0.125 R 80	U 0.125 R 80	U 0.125 R 80	U 0.125 R 80	U 0.125 R 80	U 0.125 R 80	U 0.1025 R 80	U 0.125 R 80	U 0.070 R 13
			Below Grade	Below Grade Interior[1]	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.066 R 15
				Below Grade Exterior[1]	U 0.200 R 50	U 0.200 R 50	U 0.200 R 50	U 0.200 R 50	U 0.200 R 50	U 0.200 R 50	U 0.200 R 50	U 0.200 R 50	U 0.200 R 50	U 0.200 R 50	U 0.200 R 50	U 0.200 R 50	U 0.100 R 10	U 0.100 R 10	U 0.053 R 19
		Floors	Slab Perimeter	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	U 0.58 R 7.0
			Raised	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19
			Concrete Raised	U 0.092 R 80	U 0.092 R 80	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.092 R 80	U 0.138 R 40	U 0.092 R 80	U 0.092 R 80	U 0.138 R 40	U 0.092 R 80
	Radiant Barrier			NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
	Roofing Products	Low-sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.63	NR	0.63	NR
			Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	NR	0.75	NR
		Steep-Sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.20	0.20	0.20	0.20	0.20	0.20	NR
			Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	0.75	0.75	0.75	0.75	0.75	NR
	Fenestration	Maximum U-factor[4]		0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
		Maximum SHGC[3]		NR	0.25	NR	0.25	NR	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
		Maximum Total Area		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
		Maximum West-Facing Area		NR	5%	NR	5%	NR	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%

SECTION 110.7 – MANDATORY REQUIREMENTS TO LIMIT AIR LEAKAGE

All joints, penetrations and other openings in the building envelope that are potential sources of air leakage shall be caulked, gasketed, weather stripped, or otherwise sealed to limit infiltration and exfiltration.

Envelope

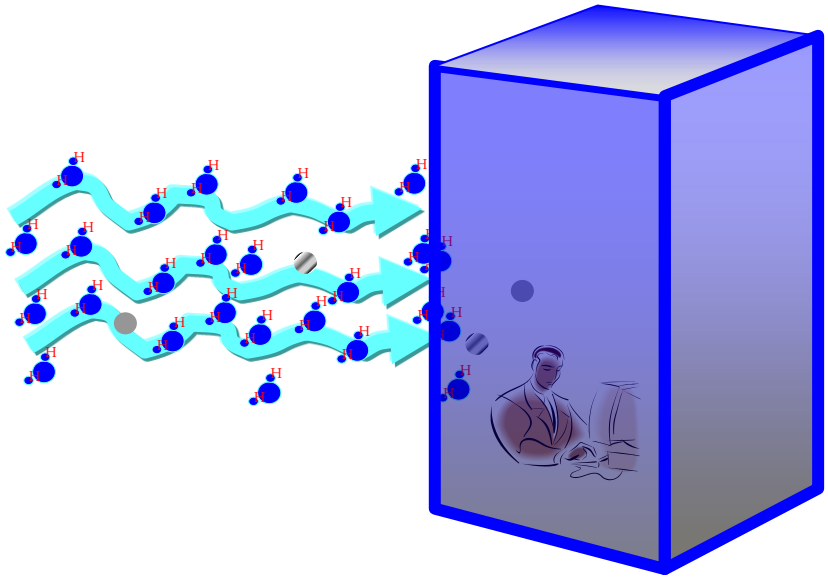
TABLE 140.3-B – PRESCRIPTIVE ENVELOPE CRITERIA FOR NONRESIDENTIAL BUILDINGS (INCLUDING RELOCATABLE PUBLIC SCHOOL BUILDINGS WHERE MANUFACTURER CERTIFIES USE ONLY IN SPECIFIC CLIMATE ZONE; NOT INCLUDING HIGH-RISE RESIDENTIAL BUILDINGS AND GUEST ROOMS OF HOTEL/MOTEL BUILDINGS)

				Climate Zone															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Envelope	Maximum U-factor	Roofs/ Ceilings	Metal Building	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065
			Wood Framed and Other	0.049	0.039	0.039	0.039	0.049	0.075	0.067	0.067	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
		Walls	Metal Building	0.113	0.061	0.113	0.061	0.061	0.113	0.113	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.057	0.061
			Metal-framed	0.098	0.062	0.082	0.062	0.062	0.098	0.098	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
			Mass Light[1]	0.196	0.170	0.278	0.227	0.440	0.440	0.440	0.440	0.440	0.170	0.170	0.170	0.170	0.170	0.170	0.170
			Mass Heavy[1]	0.253	0.650	0.650	0.650	0.650	0.690	0.690	0.690	0.690	0.650	0.184	0.253	0.211	0.184	0.184	0.160
			Wood-framed and Other	0.102	0.059	0.110	0.059	0.102	0.110	0.110	0.102	0.059	0.059	0.059	0.059	0.059	0.059	0.042	0.059
		Floors/ Soffits	Mass	0.092	0.092	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.092	0.092	0.092	0.092	0.092	0.058
			Other	0.048	0.039	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.039	0.071	0.071	0.039	0.039	0.039
	Roofing Products	Low-sloped	Aged Solar Reflectance	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
			Thermal Emittance	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
		Steep-Sloped	Aged Solar Reflectance	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
			Thermal Emittance	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0. 75	0.75	0.75	0.75	0.75	0.75	0.75
	Air Barrier			NR	NR	NR	NR	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ
	Exterior Doors, Maximum U-factor		Non-Swinging	0.50	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	0.50
			Swinging	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70

SECTION 110.7 – MANDATORY REQUIREMENTS TO LIMIT AIR LEAKAGE

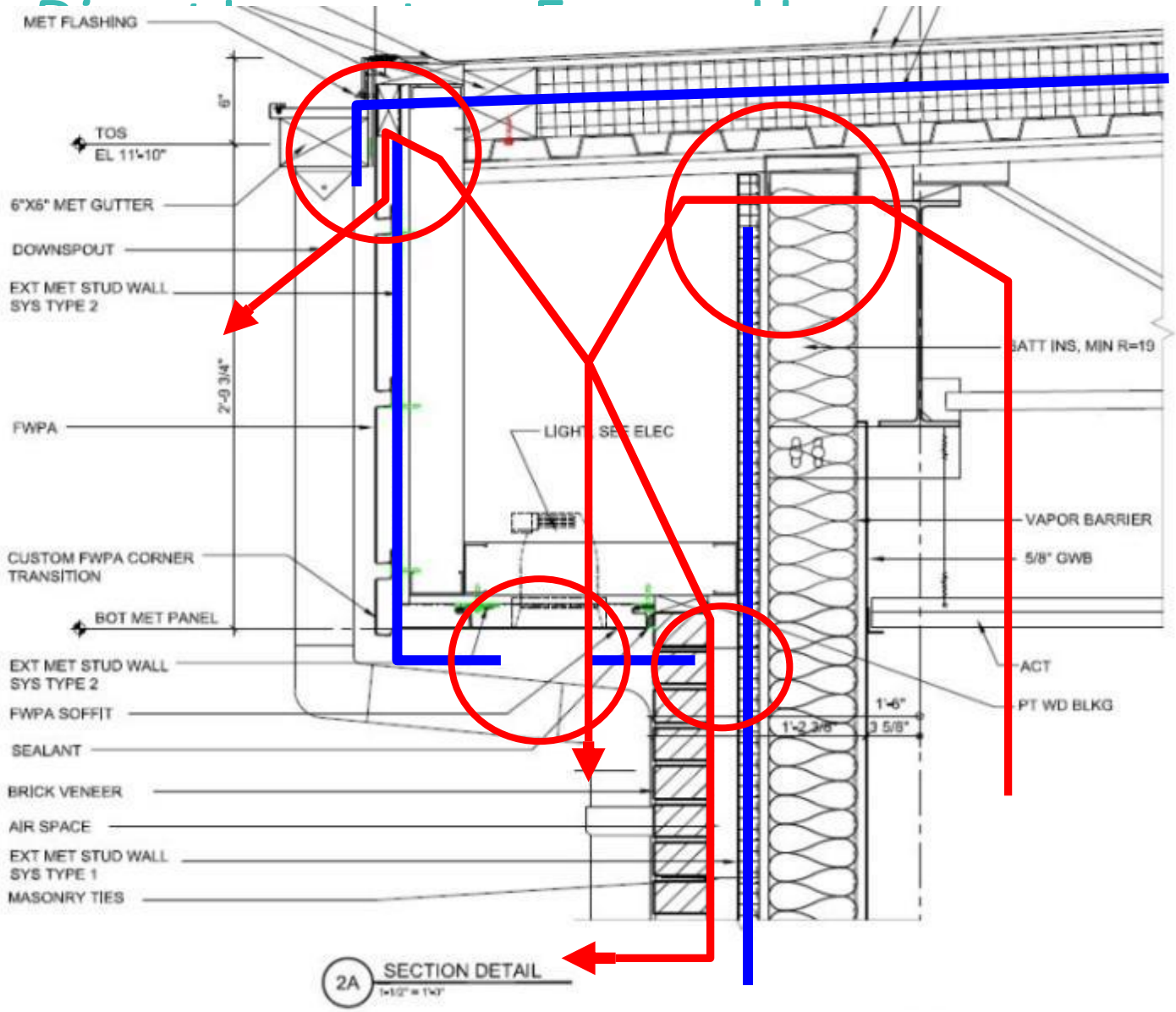
All joints, penetrations and other openings in the building envelope that are potential sources of air leakage shall be caulked, gasketed, weather stripped, or otherwise sealed to limit infiltration and exfiltration.

Air Leakage Impact



up to 40%*

Transport of:	Impact on Buildings
Heat →	Energy Efficiency
Moisture →	Durability
Contaminants →	Occupants' Safety & Comfort


MET FLASHING
6"
TOS
EL 11'-10"
6"X6" MET GUTTER
DOWNSPOUT
EXT MET STUD WALL
SYS TYPE 2
2'-9 3/4"
FWPA
CUSTOM FWPA CORNER
TRANSITION
BOT MET PANEL
EXT MET STUD WALL
SYS TYPE 2
FWPA SOFFIT
SEALANT
BRICK VENEER
AIR SPACE
EXT MET STUD WALL
SYS TYPE 1
MASONRY TIES
BATT INS, MIN R=19
VAPOR BARRIER
5/8" GWB
ACT
PT WD BLKG
1'-6"
2A
SECTION DETAIL

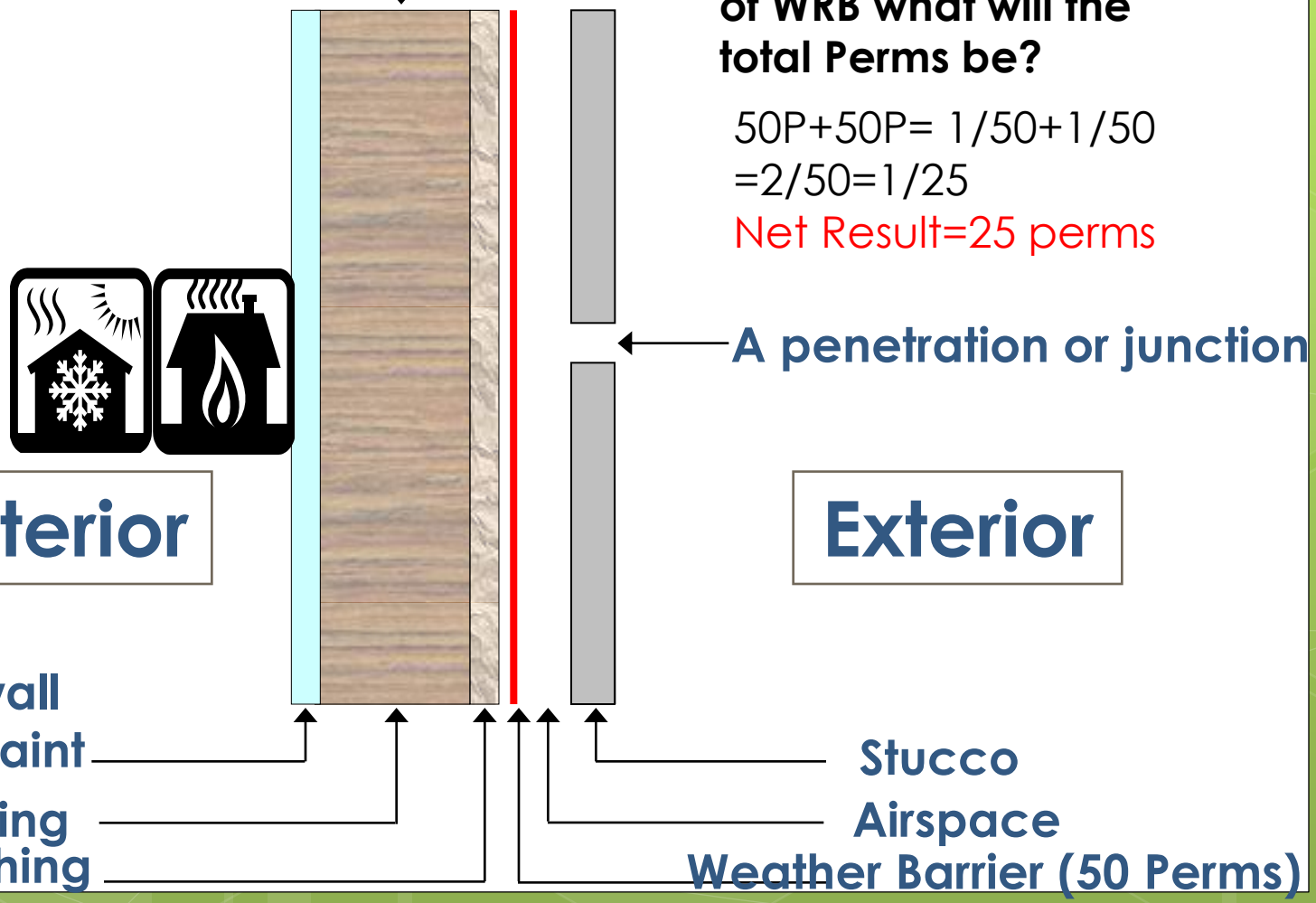
To shear or not to shear?

Figure 1: Sheathing only at shear locations

Figure 2: Continuous sheathing

Cladding and Envelope/Flashing Performance?

Rainscreen Installation?



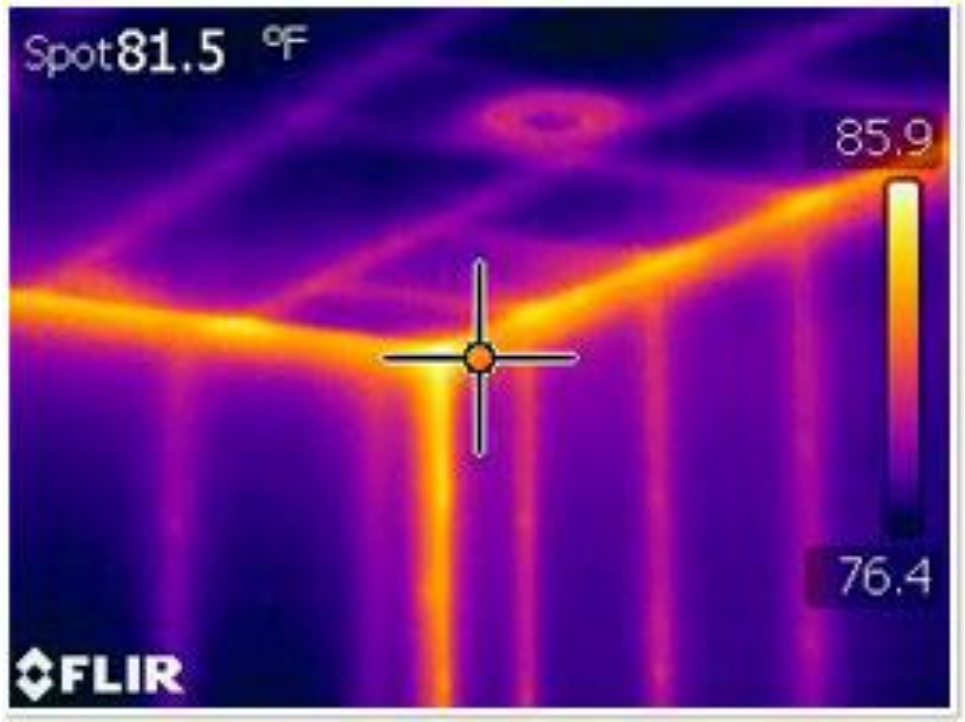
Code (highlights of) areas of impact

2-Insulation-Reality of cavity insulation

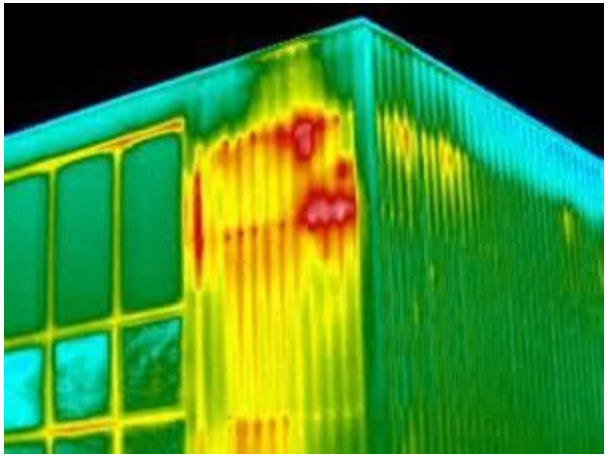
- ✓ Continuous Insulation
- ✓ Total insulation Values for perspective zones

2x6= R19= Effectively with 16" on center
= R7.1

2-Insulation-Reality of cavity insulation



Thermography



Insulation-Reality of cavity insulation

Title 24

LOW-RISE RESIDENTIAL**: WOOD FRAME *Mandatory = January 1st 2014*			
CA ZONE	ALL ZONES		
U FACTOR	*.065*		
Cavity Insulation + CI***	R19 + NO CI (Wood frming must include 2"X8" Studs) or		
	R15 + R4 CI (Framing is 2"X4" wood stud)		
2008 California Energy Code (Under Component Package D)			
CA ZONE	1,14-16	2-10	11-13
UFACTOR***	R21	R-13	R19

COMMERCIAL (ALL NON-RESIDENTIAL CONSTRUCTION)* *Unchanged from 2008 CA Energy Code*							
	Steel Frame			Wood Frame			
CA Zone	1,6,7	2,4,5,8-16	3	1,5,8	2,4,9-14&16	3,6,7	15
U Factor	.098	.062	.082	.102	.059	.110	.042
Cavity Insulation+ CI***	R19+R5	R21+R11	R19+R7	R13+0	R19+R4	R11+0	R21+R8

Envelope, Air Barrier and Continuous Insulation in one!

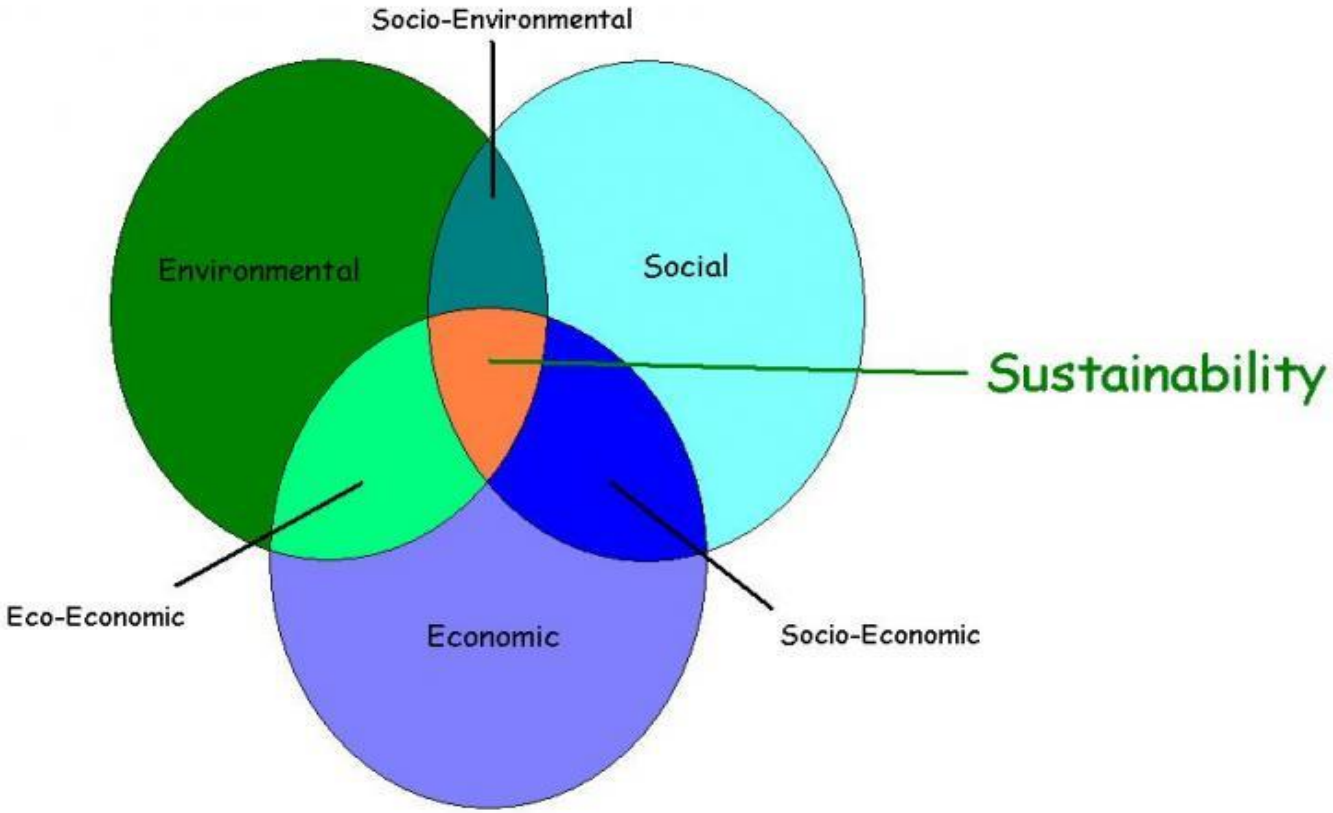
Beyond Title 24

What is sustainable construction

Sustainable construction aims at reducing the environmental impact of a building over its entire lifetime, while optimizing its economic viability and the comfort and safety of its occupants.

While standard building practices are guided by short term economic considerations, sustainable construction is based on best practices which emphasize long term affordability, quality and efficiency. At each stage of the life cycle of the building, it increases comfort and quality of life, while decreasing negative environmental impacts and increasing the economic sustainability of the project. A building designed and constructed in a sustainable way minimizes the use of water, raw materials, energy, land … over the whole life cycle of the building.

Forensics, Testing & Defect



CA Law
BILL NUMBER: SB 800
CHAPTERED

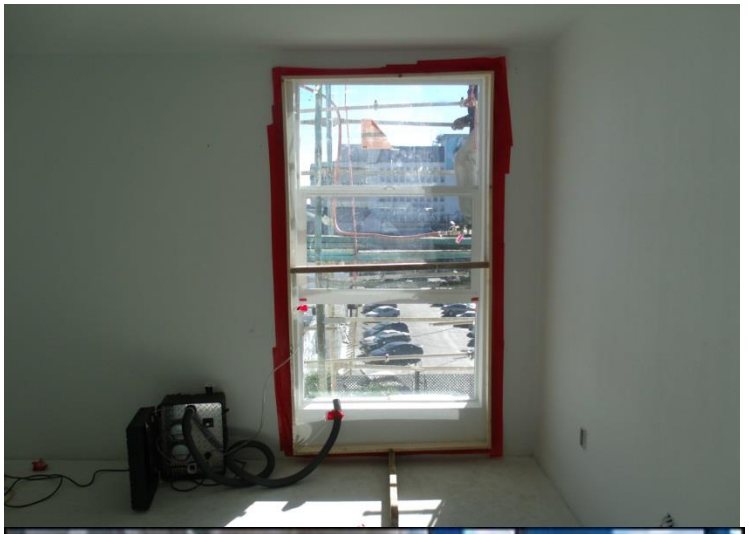
- CHAPTER 2. ACTIONABLE DEFECTS 896

- **(10) Stucco, exterior siding, exterior walls, including, without limitation, exterior framing, and other exterior wall finishes and fixtures and the systems of those components and fixtures, including, but not limited to, pot shelves, horizontal surfaces, columns, and plant-ons, shall be installed in such a way so as not to allow unintended water to pass into the structure or to pass beyond, around, or through the designed or actual moisture barriers of the system, including any internal barriers located within the system itself. For purposes of this paragraph, "systems" include, without limitation, framing, substrate, flashings, trim, wall assemblies, and internal wall cavities, if any.**

- **(11) Stucco, exterior siding, and exterior walls shall not allow excessive condensation to enter the structure and cause damage to another component. For purposes of this paragraph, "systems “include, without limitation, framing, substrate, flashings, trim, wall assemblies, and internal wall cavities, if any.**

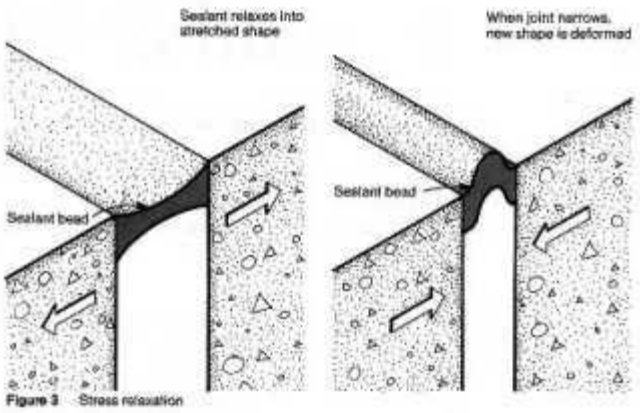
Water Tests

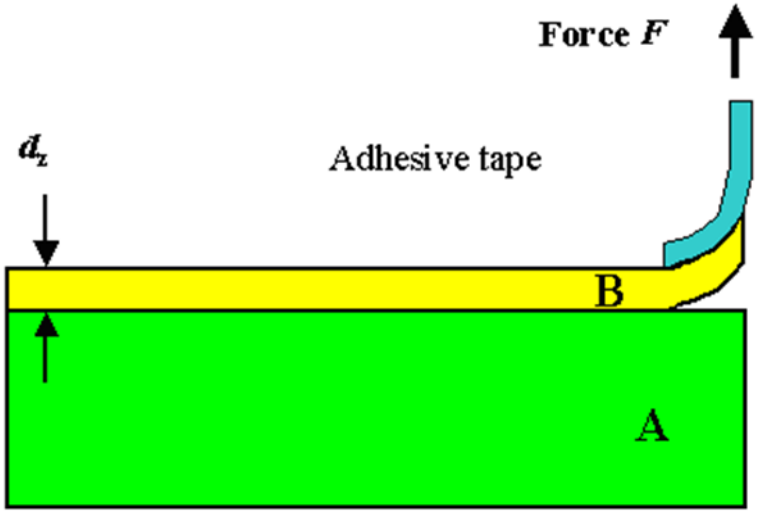
ASTM & AAMA



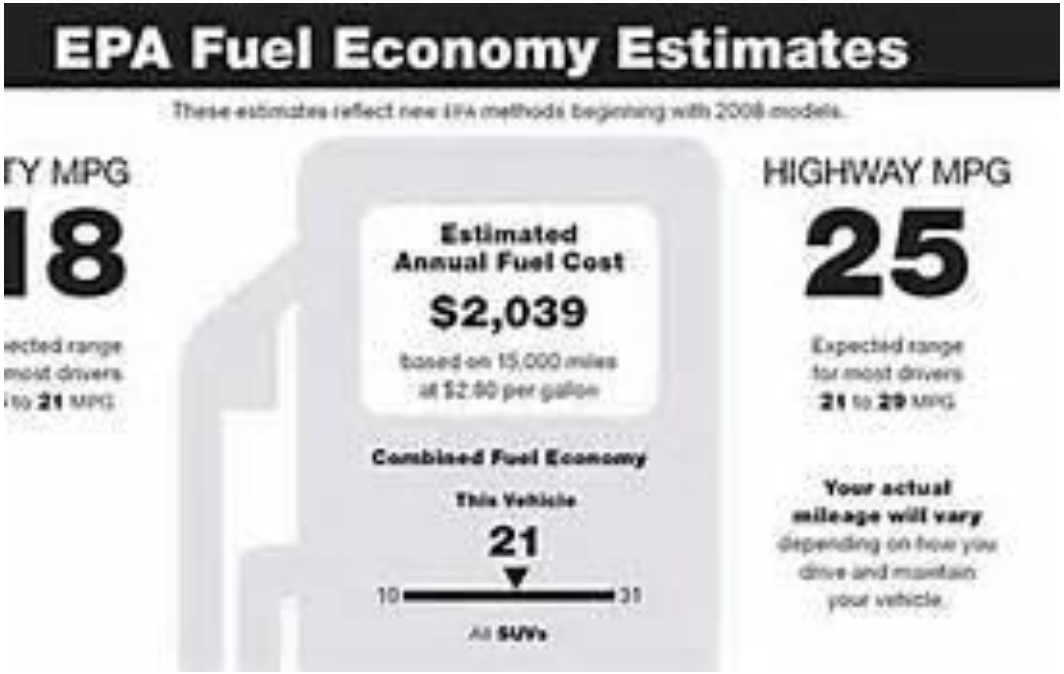
Compatibility tests

Adhesion Test



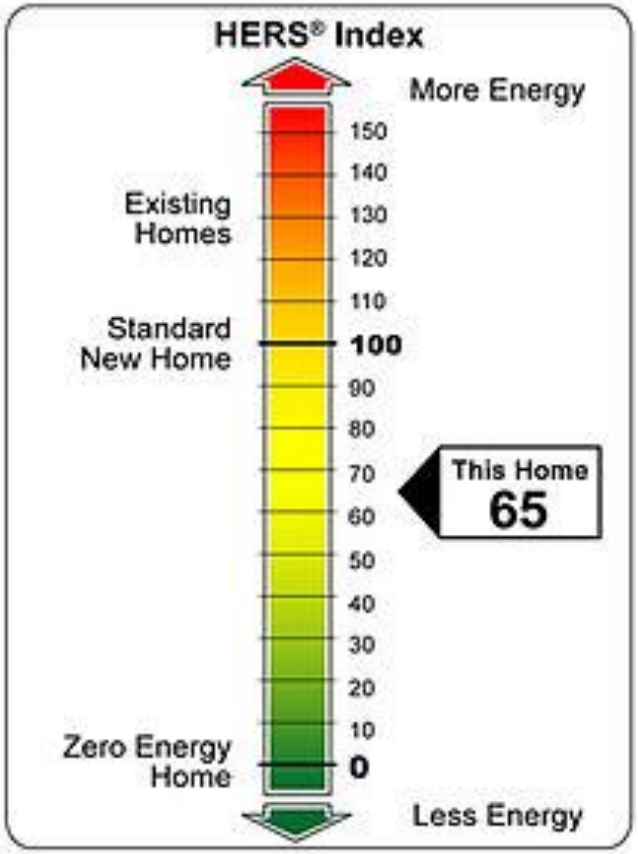


How are homes rated (Energy)

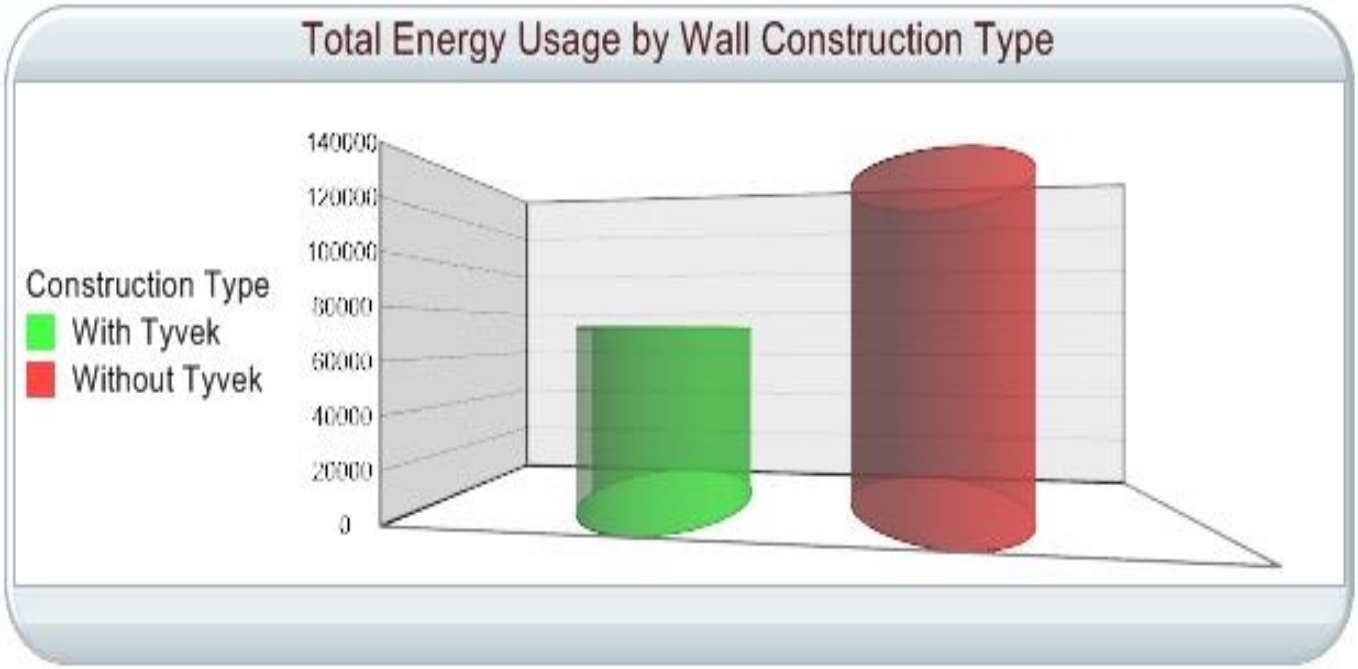


How are homes rated (Energy)

Ratings provide a relative energy use index called the HERS Index – a HERS Index of 100 represents the energy use of the "American Standard Building" and an Index of 0 (zero) indicates that the building uses no net purchased energy (a Zero Energy Building). The lower the value, the better.



- **Energy Analysis & Tittle 24**



Design/Environmental

performance – water penetration resistance

RELATIONSHIP BETWEEN

WIND VELOCITY AND STATIC PRESSURE

Wind Velocity Miles per Hour (MPH)	Pressure Pounds per Ft² (PSF)	Pressure Inches of Water	Pressure Pascals (Pa)	Pressure Inches of Mercury (Hg)
5	0.06	0.01	3.06	0.00
10	0.26	0.05	12.24	0.00
15	0.58	0.11	27.54	0.01
20	1.02	0.20	48.96	0.01
25	1.60	0.31	76.49	0.02
30	2.30	0.44	110.15	0.03
35	3.14	0.60	149.93	0.04
40	4.10	0.79	195.82	0.06
45	5.19	1.00	247.87	0.07
50	6.40	1.23	305.97	0.09
55	7.74	1.49	370.23	0.11
60	9.22	1.77	440.60	0.13
65	10.82	2.08	517.09	0.15
70	12.54	2.41	599.70	0.18
75	14.40	2.76	688.44	0.20
80	16.38	3.15	783.29	0.23
85	18.50	3.55	884.26	0.26
90	20.74	3.98	991.35	0.29
95	23.10	4.44	1104.56	0.33
100	25.60	4.92	1223.88	0.36
105	28.22	5.42	1349.33	0.40
110	30.98	5.95	1480.90	0.44
115	33.86	6.50	1618.59	0.48
120	36.86	7.08	1762.39	0.52
125	40.00	7.68	1912.32	0.57
130	43.26	8.31	2068.37	0.61
140	50.18	9.63	2398.81	0.71
150	57.60	11.06	2753.74	0.81
160	65.54	12.58	3133.15	0.93
170	73.98	14.20	3537.03	1.05
180	82.94	15.93	3965.39	1.17
190	92.42	17.74	4418.22	1.31
200	102.40	19.66	4895.54	1.45

Conversions:

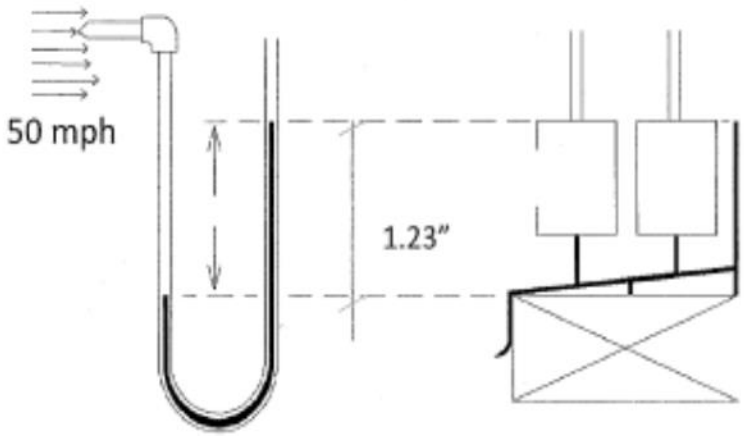
PSF = 0.00256(MPH)² Inches of H_2O = 0.192227(PSF) Pascals = 249(Inches of H_2O)

Inches of Hg = In. H_2O (0.0735539) Inches of Hg = 0.014139 (PSF) PSF = 70.7262 (In. Hg)

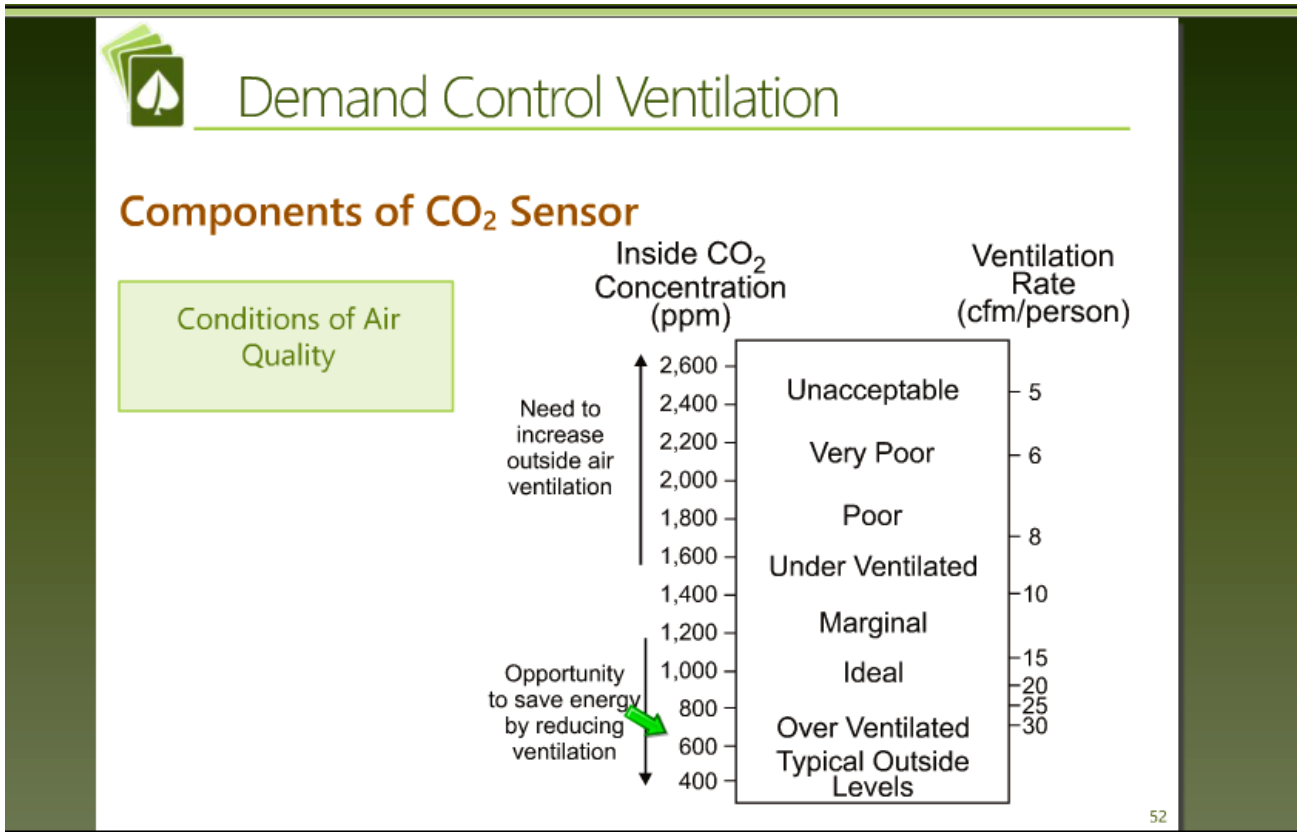
Reference ASCE 7-88

Relationship between wind velocity and pressure?

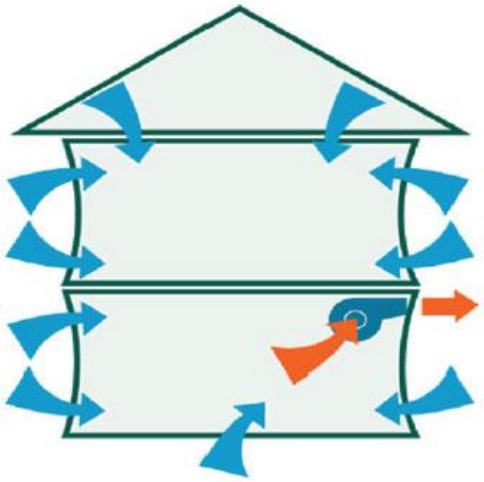
6.4 PSF = 1.23" Water Head



Code (highlights of) areas of impact

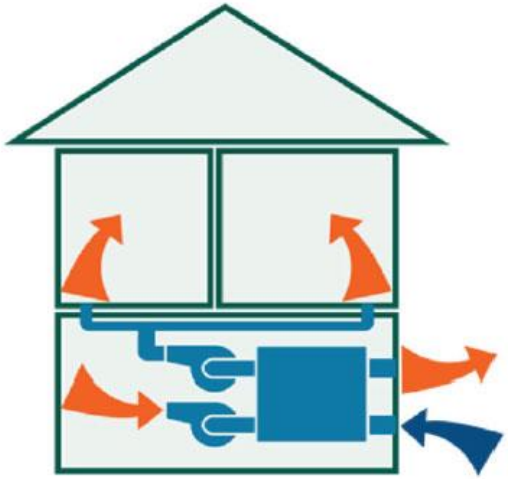


Air Exchangers



Negative Air Pressure

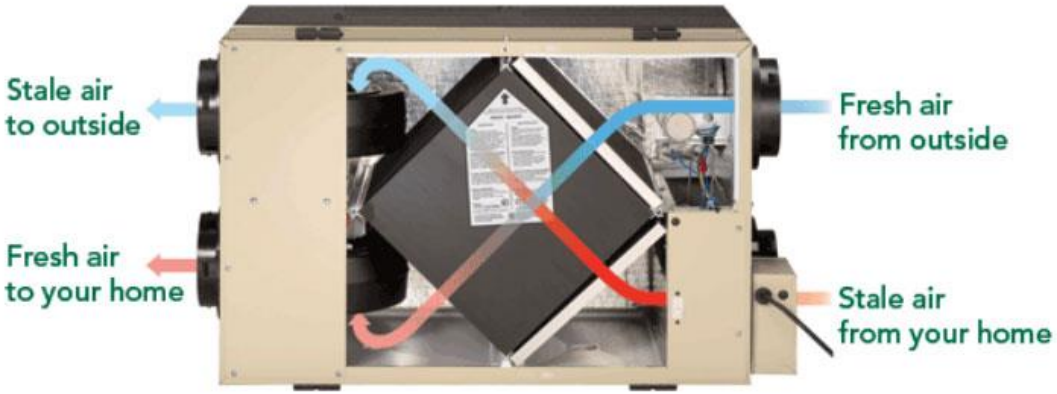
(Exhaust only fan like bath fans)
The unfiltered air increases risks of mold and causes energy costs to be higher. Potential for backdraft from combustion appliances (stove, fireplace, water heater)



Equal Air Pressure

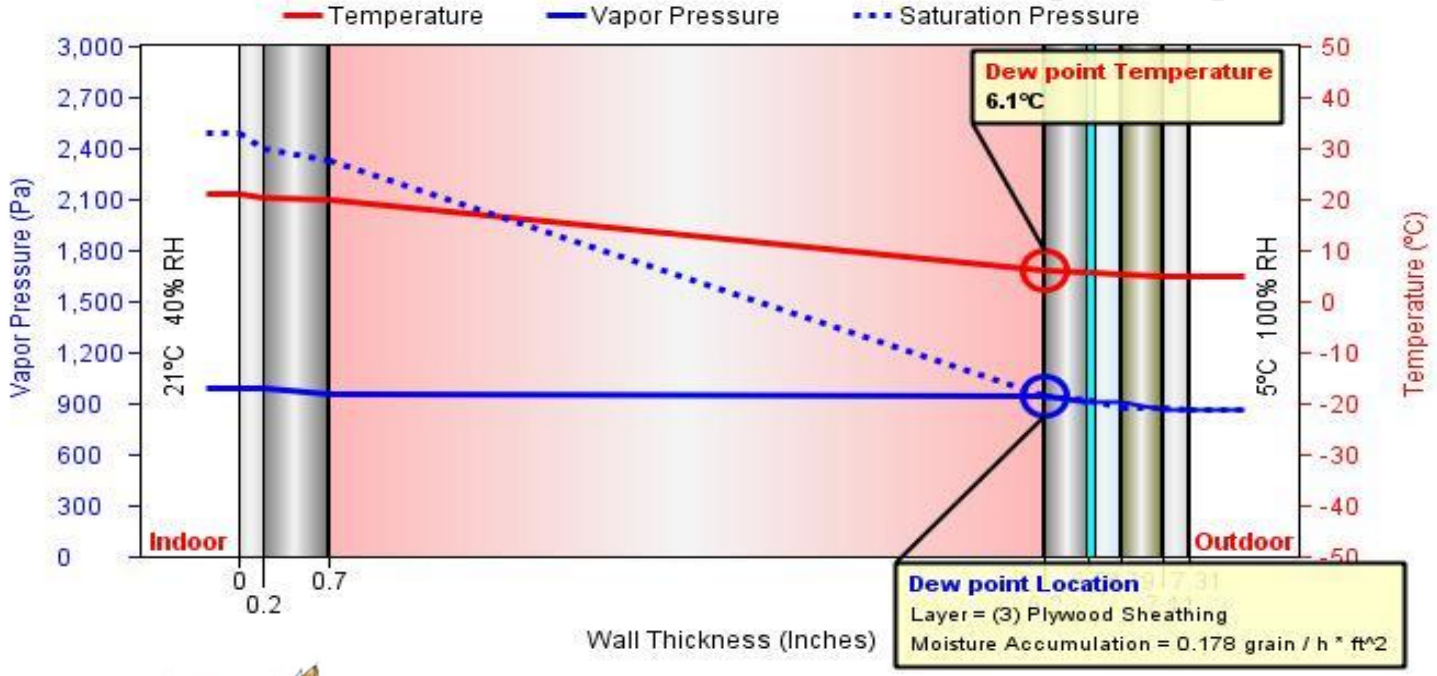
(Air Exchanger)
Airflow supplied is equal to stale air exhaust. Unless otherwise noted, balancing is required on all units

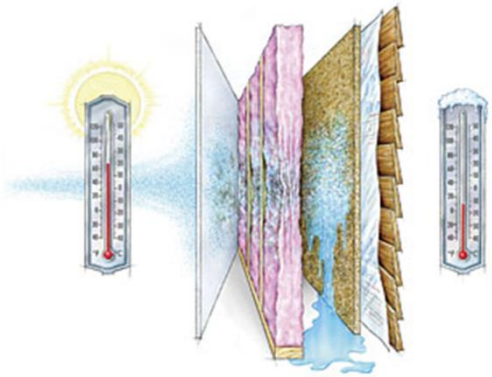
Air Exchangers
How do they work?



What happened here?

•Wall Condensation Analysis (WUFI)





Concerns:

<u>*Vapor Permeance*</u> of the <u>*whole assembly*</u>

1. Potential condensation due to vapor diffusion
2. Potential condensation due to air leakage
3. Potential impact of water accumulation and Storage into the stucco layer

Become irrelevant or change

Examples of change ?

- ✓ **Verizon Communications /AT&T**
- ✓ **Toyota/Lexus**
- ✓ **Best Buy**
- ✓ **Amazon**
- ✓ **Google**
- ✓ **Apple**

Irrelevant?

- **Block Buster**
- **My Space**
- **AOL**
- **Tower Records**
- **Blackberry**
- **Laser discs**
- **JCPenny**

California Consultants

Forensics, Field Testing & Consulting

Thank you all!

SMA STUCCO MANUFACTURERS ASSOCIATION

Questions?

Consistent rule of thumb holds true: "build tight, ventilate right."

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