HOW TO MAKE CONTINUOUS INSULATION WORK

The Energy Code and Plaster Assemblies

WCC
WALL & CEILING CONFERENCE
Preface

Energy code regulations, particularly California's Title 24, require a more prevalent use of continuous insulation (CI) over all exterior framed walls. The CI design approach is intended to prevent or minimize the thermal transfer often referred to as "thermal short circuiting" or "thermal bridging." This is related to the natural thermal conductivity of steel. Steel is a recyclable resource and sustainable material preferred by designers. The "prescriptive method" for code compliance is the easiest way to achieve energy savings by adding a rigid foam product over the framing members to prevent the thermal transfer or act as a thermal break.

The plaster industry has always been proactive with energy issues by developing systems or assemblies with variations that can meet the designer's desires for aesthetics and comply with energy requirements. Some of these plaster assemblies are decades old and have proven themselves very successful. Each assembly has unique characteristics and designers are encouraged to explore each one, discuss options with a quality wall and ceiling contractor, your local plaster bureau and then decide which is most appropriate for their specific project.

ALTERNATE METHODS

While the plaster industry will continue to research and develop plaster assemblies to meet owners' desires, provide energy savings and meet code regulations, there are alternatives to exterior CI that can meet energy code requirements. For example, assembly or component improvements in other areas of the building may allow designers to use more traditional plaster cladding assemblies. Another alternative idea is to move the continuous insulation to the inside of the wall cavity or framing member. Some CI plaster assemblies have extremely low assembled U factor ratings and may allow designers flexibility in other areas of design.

The Wall & Ceiling Conference (WCC) is a collective of wall and ceiling technical bureaus designed to research, observe and then promote industry practices in a non proprietary and unified voice. This brochure has been created as a collaborative effort with valuable input from all WCC members.

The Northwest Wall and Ceiling Bureau have offices in Seattle and Portland. www.nwcb.org

The Technical Services Information Bureau have offices in Orange, CA, Phoenix and Las Vegas www.tslb.org

The Wall and Ceiling Bureau is located in Pleasanton, CA. www.wcb.org

Exterior Plaster Systems and Assemblies:

EIFS

Exterior Insulation and Finish Systems (EIFS) were developed for the express purpose to conserve energy and have the aesthetic appearance of stucco. Europe experienced the energy crisis before the United States and the solution to the problem was EIFS. It was discovered that 24 inch by 48 inch foam panels adhesively applied to the exterior of structures provided the continuous insulation (CI) and provided energy savings. A fiberglass mesh embedded into a proprietary polymer enriched cement provides a strong, yet flexible lamina to protect the foam. The lamina provides water resistance and a suitable base for the final decorative acrylic finish.

Designers and contractors are encouraged to first consider these adhesively applied systems to comply with energy code regulations. They provide the ultimate in protection against thermal transference (thermal bridging) at an economical cost. These systems are fully tested and code approved by each proprietary manufacturer. WCC encourages designers to visit www.elma.com for more information about EIFS and contact EIFS manufacturers.

Figure 1. Proprietary EIFS System

- Framing members
- Sheathing board
- Adhesive
- Rigid insulation
- Mesh (troweled into basecoat)
- Base coat
- Finish coat
- Back-wrap termination
ONE-COAT STUCCO

One-coat stucco is another good option for designers and contractors to consider. This system was developed in the southwestern United States during the 1970's energy crisis. The requirement for more R-Value on exterior walls meant builders needed to go from traditional two inch x four inch studs to two inch x six inch studs to make room for more insulation. The plaster industry created the one-coat stucco system over a one inch rigid foam base to allow builders to continue using the two inch x four inch studs and still meet the higher R-Values set by the energy code.

One-coat stucco is a proprietary system incorporating a special blended cement over a tongue and groove Expanded Polystyrene (EPS) foam sheathing board. The systems are typically considered more appropriate for residential and low rise commercial projects. They have had good success when applied per manufacturer's recommendations and with a textured cement finish. One-coat stucco is generally not recommended for smooth or fine sand finish textures. For more information about one-coat stucco visit www.nocsa.org.

GENERIC CEMENT PLASTER (STUCCO)

Generic or conventional three-coat cement plaster is part of the building code and can also be done over rigid foam substrates. ASTM C926 confirms this fact in section 7.1.3: "Portland cement plaster shall be applied on furred metal plaster base when the surface of solid backing consists of gypsum board, gypsum plaster, wood or rigid-foam board type products." WCC has recognized multiple generic cement plaster assemblies incorporating a rigid foam to comply with ASTM C926 and the Energy Codes. Many of these generic plaster assemblies have been installed in the western United States and monitored by regional plaster bureaus for performance and evaluated for serviceability. Plaster bureaus on the West Coast have compiled this data and their experiences to formulate three systems of generic code approved three-coat stucco with rigid foam.

Design Considerations:

Framing spaced at 16 inches on center has traditionally offered better stability for the cement plaster assembly and is typically recommended for best performance. It is recognized that framing spaced at 24 inches on center allows a savings in construction materials, lower U-factors and may promote additional energy savings. Framing spaced at 24 inches on center is possible when the plaster assembly receives skim coat and mesh (lamina) over the brown coat (PWA 104 and 106). This lamina is vapor permeable, increases crack resistance and overall assembly performance. The following are good design recommendations for Portland cement plaster and continuous insulation (CI).

- The deflection design criteria is required to be a minimum of L/360.
- All assemblies require a vapor permeable water-resistant barrier(s) installed in a “shingle-fashion” with water proof flashings. Liquid applied membranes shall be installed per manufacturers' recommendations.
- 24 inch spacing of framing is only recommended when:
  - a sheathing is applied over the framing.
  - a polymer-modified skim coat and mesh (lamina) is applied over the brown coat.
- Tongue and groove rigid foam is not required for these stucco assemblies.
- Plaster mixes shall conform to ASTM C926.
Plaster Wall Assembly – PWA 104  
(continuous insulation under cement plaster)

**General:** This assembly is recommended to have a fiberglass mesh trawled into a skim coat of polymer enriched cement over the set brown coat. The lamina provides superior crack resistance. Eliminating the lamina increases the likelihood of cracking. Comply with chapter 25 of local and national building codes. Refer to Design Considerations of generic cement plaster for additional notes.

**Steel Framing:** Minimum 18 gauge (43 mil). Stud spacing may be 24 inches on center when a lamina is used.

**Sheathing:** Wood or gypsum based. Gypsum based may be required for fire rating. Attach per code and/or fire-rated assembly test. A water-resistive barrier(s) is applied over the sheathing in "single-fashion" with appropriate flashings. Sheathing may be omitted when rigid insulation is engineered to act as the substrate. (Then water-resistive barrier shall be applied per insulation manufacturer’s instructions)

**Rigid Foam:** Expanded Polystyrene (EPS), Extruded Polystyrene (XPS), or Polyiso board with a nominal density of 1.5 pounds per cubic foot. Maximum thickness can be four inches per table 2603.12.1 of the 2015 International Building code and 2016 California Building Code. Flame Spread Index 25 or less, Smoke Develop Index not more than 450. Flat (no grooves) foam may be used if a drainage mat or a water-resistive barrier allowing drainage is installed behind foam.

**Lath:** All lath must be self-furred, expanded metal lath (minimum 3.4 lb/sq.yd), welded or woven wire (minimum 17 gauge). Attachment spacing shall be no more than seven (7) inches apart along framing supports with corrosion resistant self-drilling wafer head screw with length sufficient to have three threads through framing member.

**Accessories:** Control joints are recommended to create panels no larger than 144 square feet. If a lamina is used, spacing of control joints may be increased. Single-piece control joints and corner trims should be wire tied over continuous lath.

Cement (scratch and brown): Mix and application shall be per ASTM C926. If a lamina is applied, hard floating the brown coat is not required.

**Lamina:** Allow brown coat to set minimum 5 days after application prior to applying lamina.

**Caveats:**
- Option 1: No lamina: More cracking may occur when a conventional plaster assembly is installed over rigid foam.
- Option 2: Skim coat only: will give plaster membrane added crack resistance.
- Option 3: Skim coat and mesh: The fiberglass mesh (4-6 ounce) embedded in the skim coat provides superior crack resistance.

**Finish:** Cement or an acrylic finish coat may be applied to this assembly. Verify with the manufacturer that the finish coat is compatible with polymer skim coat (lamina).

**Fire Rating:**
- Generic versions of PWA 104 are generally limited to Type V construction unless a proprietary version conforming to NFPA 285 is used.
- One-Hour (based on UL No U-425 or GA WP 8005-8007): Framing not to exceed 24 inches on center. Exterior side incorporates a 5/8 inch gypsum sheathing and rigid foam with flame spread index of 25 or less. Interior – one or two layers 5/8 inch type X gypsum board
- Two-Hour (based on OSU T-4851 or GA WP 8416-17): Framing not to exceed 16 inches on center, single layer type X gypsum sheathing. Interior – two (2) layers 5/8 inch type X gypsum board.

**Water-Protection:** Meets Weather Protection requirements of Chapter 14 1403.2 of the ICC & CBC by Compliance of ASTM E331 per Intertek Report G1700.01-501-47

**U Factor:** Overall U factor rating varies with size of steel stud, spacing, cavity insulation, and continuous insulation (CI). Refer to Tables A & B foldout for CI requirements.
Figure 3. Termination at Stem Wall/Foundation – PWA 104-fdn

- Self furring lath
- Cement plaster – Refer to assemblies for finish coat options
- Framing member
- Rigid foam
- Sheathing
- Water resistive barrier(s) – Lap over flashing flange
- 2-7/8" (73mm) casing with optional weep holes
- Continuous metal flashing
- CMU or concrete foundation

Figure 4. Insulated Cement Plaster Wall Assemblies – PWA 104

Refer to footnotes for maximum wall framing spacing

- Metal framing members
- Sheathing
- Water resistive barrier(s)
- Rigid foam with shallow drainage channels at back
- Self furring lath
- Cement plaster – Scratch and brown coats 3/4" (19mm) maximum
- (Lamina) Fiberglass reinforcing mesh and polymer cement skim coat – Refer to footnotes for skim coat and mesh criteria
- Finish coat(s) – Refer to footnotes for finish coat criteria

FOOTNOTES:
1. Standard framing is 16 inches on center, Framing spacing may be increased to 24 inches on center when a polymer enriched skim coat and mesh are applied over the brown coat of plaster.

2. Verify with the manufacturer that the finish coat is compatible with the polymer skim coat.
Plaster Wall Assembly – PWA 105
(continuous insulation over cement plaster)

General: This assembly is installed the same as a conventional cement plaster per building code and ASTM C926. Assembly PWA 105 is highly crack resistant due to the expanded polystyrene board (EPS) and lamina, but may have less surface abuse resistance compared to PWA 104 or PWA 106. Comply with Chapter 25 of local and national building codes. Refer to design considerations of generic cement plaster for additional notes.

EPS foam panels are adhesively applied to the cement brown coat and a 4 to 6-ounce fiberglass mesh is troweled into a skim coat of polymer enriched cement over the entire surface. This is not an EIFS system. PWA 105 is a cement plaster assembly with continuous insulation covering the cement plaster.

Framing: Minimum 20 gauge (33 mil) maximum spacing 16 inches on center with no sheathing.

Sheathing: May be wood or gypsum based. Gypsum based required for fire rating of two-hours. Attach per code and/or fire test. The water-resistive barrier(s) is applied over the sheathing in “shingle-fashion” with appropriate flashings.

Lath: All lath must be self-furred, expanded metal lath (minimum 2.5 lb/pq.yd), welded or woven wire (minimum 17 gauge). Attachment spacing shall be more than seven (7) inches apart along framing supports with corrosion resistant self-drilling wafer head screw with length sufficient to have three threads through framing member.

Accessories: Control joints in the cement plaster are not required for this assembly. Expansion joints must be honored through the assembly.

Cement Basecoat (scratch and brown): Mix and apply per ASTM C926. Floating (densification) of the brown coat is not required. Allow brown coat to cure 7 days prior to applying the EPS foam.

Expanded Polystyrene Foam (EPS): Minimum nominal density of 1.0 pound per square foot and a maximum of four inches thick. Flame Spread Index 25 or less, Smoke Develop Index not more than 450. Foam should be rasped to provide a level flat surface. It is recommended to use materials by an EIFS manufacturer, but this is not an EIFS system because the plaster substrate acts as the primary weather barrier.

Lamina: May be applied the day after the foam has been adhered to the brown coat (basecoat). Apply skim coat of polymer enriched/modified cement onto EPS and embed fiberglass mesh into skim coat. Allow lamina to set for a minimum of 24 hours prior to applying finish coat.

Finish: Use only an acrylic finish: ensure compatibility with skim coat.

Fire Ratings:
- One-Hour (based on UL U-434 or GA WP 8122): No sheathing required – Framing spaced no further than 16 inches on center. Spacing may be increased to 24 inches on center when sheathing is used. Encapsulate EPS foam with lamina. Exterior – portland cement plaster 7/8-inch thick. Interior – single layer 5/8-Inch type X gypsum board.

Water-Protection: Finish Assembly should meet criteria of Chapter 14 1403.2 of ICC. Lamina adds additional water-resistance.

U Factor: Overall U Factor rating varies with size of steel stud, spacing, cavity insulation, and continuous insulation (CI). Refer to Table A or B foldout.
Figure 5. Termination at Stem Wall/Foundation – PWA 105-fdn

- Self furring lath
- 3/4" (19mm) Cement plaster (7/8-inch for fire ratings)
- Framing member
- Exterior gypsum sheathing
- Water resistive barrier(s) – Lap over flashing flange
- EPS with mesh/polymer base and acrylic finish – Adhere to cement plaster
- Back-wrap mesh and polymer base around EPS foam
- Casing bead with optional weep holes

CMU or concrete foundation

4" min above raw earth
2" above paved surface

Figure 6. Cement Plaster Wall Assembly – PWA 105

- 24" (610mm)
  On-center maximum
- Metal wall framing members
- Sheathing
- Water resistive barrier(s)
- Self furring lath
- Cement plaster – Scratch and brown coats 3/4" (19mm) maximum (7/8-inch for fire ratings)
- EPS rigid foam
  4" (102mm) thick maximum (average) adhere to plaster brown coat
- (Lamina) Fiberglass reinforcing mesh and polymer cement skim coat (EIFS grade)
- Acrylic finish coat: compatible with polymer cement skim coat
- Adhesive beads applied to back of EPS (vertical or horizontal)
Plaster Wall Assembly – PWA 106
(exterior insulation with Z channels)

General: This assembly incorporates the use of Z furring to create a designed cavity for continuous insulation (CI), providing a sturdy, high abuse resistance and energy efficient assembly. The conventional cement plaster is installed over the outer layer of sheathing and Z furring, install per code, ASTM C1063 and ASTM C926. Refer to design considerations of generic cement plaster for additional notes.

Framing: Minimum 18 gauge (43 mil). Spacing is to be 16 inches on center and may be up to 24 inches on center with lamina.

Sheathing: Gypsum based sheathing required for two-hour fire rating and non-combustible construction. The water-resistive barriers are applied over the outer layer of sheathing in “shingle-fashion” with appropriate flashings. Comply with chapter 25 of local and national building codes. It is recommended to use vapor permeable water resistive barriers.

Z Furring: Minimum 18 gauge (43 mil) and should align with vertical framing members. The thickness (depth) of the Z furring shall not exceed 3 inches, unless approved by an engineer. Attachment to framing shall not exceed 24 inches on center.

(CI) Continuous Insulation: Rigid foam may be EPS, XPS or a Polyisocyanurate product. Flame Spread Index 25 or less, Smoke Develop index not more than 450. Thermal Break Tape: Gypsum panels on each side of the Z furring provide a moderate thermal break. To complete the thermal break, a foam tape (minimum 3/16 inch thick) shall be applied on the face of the Z furring.

Lath: All lath must be self-furred, expanded metal lath (minimum 3.4 lb/sq.yd) or equal. Attachment spacing shall be more than seven (7) inches apart along framing to support with corrosion resistant self-drilling wafer head screw with length sufficient to have three threads through framing member.

Accessories: Apply trim accessories as per ASTM C1063. Single-piece control joints may be installed over continuous lath.

Cement basecoat (scratch and brown): Mix and apply per ASTM C926.

Lamina (recommended): Allow brown coat to set minimum 5 days after application prior to applying lamina.

Caveats:
- Option 1: No lamina: More cracking may occur when a conventional plaster assembly is installed over rigid foam.
- Option 2: Skim coat only: will give plaster membrane added crack resistance.
- Option 3: Skim coat and mesh: The fiberglass mesh (4–6 ounce) in the skim coat provides superior crack resistance.

Finish: Cement or an acrylic finish coat. If lamina is used the finish should be from same manufacturer of the lamina materials.

Fire Rating:

- Four-Hour (based on UL U-450 – non-load bearing): Framing spaced no further than 16 inches on center. Exterior – 5/8 inch type X gypsum sheathing and 7/8 inch cement plaster. Interior – three (3) layers of 5/8 inch type X Gypsum board. Stud cavity filled with spray applied fire resistive material (Type D- C/F and II insulation with an average and minimum density of 13 and 11 pcf.)

Water-Protection: Meets Weather Protection requirements of Chapter 14.1403.2 of the ICC & CBC by Compliance of ASTM E331 per Intertek Report G1700.01-501-47.

U Factor: Overall U factor rating varies with size of steel stud, spacing, type of thermal tape, cavity insulation, and continuous insulation (C). Refer to Table A or B foldout.
Figure 7. Termination at Stem Wall/Foundation – FDN 106

- Self furring lath
- Cement plaster
- Framing member
- High density foam between Z furring aligned with wall framing
- Thermal break foam tape on face of Z channel furring
- Sheathing
- Water resistive barrier(s) - Lap over flashing flange
- Weep screed
- Bottom of flange set below top of foundation and plate line
- CMU or concrete foundation
- Min 3-1/2" flange
- 2" (51mm)
- Alternate perforated weep casing bead
- 4' min above raw earth or 2' above finished surface

Figure 8. Insulated Cement Plaster Wall Assembly – PWA 106

Refer to footnotes for maximum wall framing spacing

- Metal wall framing members
- Sheathing
- 2' (51mm) rigid insulation between Z furring members
- 2' (61mm) Z furring members aligned with wall framing
- Thermal break foam tape on face of Z channel furring
- Sheathing
- Water resistive barrier(s)
- Self furring lath
- Cement plaster - Stretch and brown coats 3/4" (19mm) maximum
- (Lamina) Fiberglass reinforcing mesh and polymer cement skim coat - Refer to footnotes for skim coat and mesh criteria
- Finish coat(s) - Refer to footnotes for optional finish coat criteria

FOOTNOTES:

1. Standard framing is 16 inches on center. Framing spacing may be increased to 24 inches on center when a polymer enriched skim coat and mesh (Lamina) are applied over the brown coat of plaster.

2. Verify with the manufacturer that the finish coat is compatible with the polymer skim coat.
Definitions

ASHRAE: American Society of Heating and Air-Conditioning Engineers

Assembly: Generic wall construction composed of generic and/or proprietary materials.

Cement Finish Coat: A blend of portland cement, lime and sand and pigments, also known as stucco.

Continuous Insulation (CI): Insulation that is continuous across structural members without thermal bridges other than fasteners and service openings. May be installed on the interior or exterior of the structural members.

Exterior Insulation Finish System (EIFS): A proprietary cladding system that incorporates a layer of (CI) foam and resembles cement plaster. Continuous insulation over or under cement plaster is not an EIFS, EIFS is a finish cladding and the weather-resistive barrier.

Expanded Polystyrene foam (EPS): A rigid, closed cell foam usually white and made from pre-expanded polystyrene beads. Also known as "bead board".

Fiberglass Mesh: An alkali resistant mesh made specifically for being troweled into a polymer enriched cement skim coat. Typically 4 to 6 ounces per square yard, heavy duty mesh (high impact areas) is 20 ounces per square yard.

Polymer Enriched Cement: A blended cement with polymers to provide a flexibility and crack resistance.

Polyisocyanurate: A high density and rigid closed cell foam sheathing containing a low conductivity gas. Typically has a plastic or aluminum-type facing.

R-Value: Thermal resistance rating of the insulation alone as stated by the manufacturer.

System: A proprietary wall system composed of specific materials approved by the system manufacturer.

Thermal Break: A material or product that interrupts or restricts the temperature conductivity through a given wall component.

Thermal Bridging: Also known as thermal short circuiting. Refers to an unrestricted path of temperature transmission through an insulated barrier.

Title 24 (Part Six): The California Energy Code, based on National Codes and enhanced to meet the requirements set by California.

U Factor: The measurement of heat transferred through an assembly.

Water-Resistive Barrier (WRB): A moisture barrier complying with section 1404.2 of the International Building Code. Alternative WRB's may be used with local building official approval and installed per manufacturers recommendations.

Extruded Polystyrene foam (XPS): Closed cell foam structure makes a highly water resistant rigid foam board.

Wall & Ceiling Conference

Northwest Wall & Ceiling Bureau
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### Table A

#### National Climate Zones & Prescriptive U Factor Assemblies
(Plastic Construction Walls)

<table>
<thead>
<tr>
<th>2015 IECC</th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>NON-RESIDENTIAL &amp; GROUP R COMMERCIAL (R = Residential Construction falling under the ICC)</strong></td>
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</tr>
<tr>
<td><strong>Steel Frame</strong></td>
<td><strong>Wood Frame</strong></td>
</tr>
<tr>
<td>US ZONE</td>
<td>1&amp;2</td>
</tr>
<tr>
<td>U FACTOR</td>
<td>0.077</td>
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<tr>
<td>EXAMPLE *</td>
<td>R19**+3.5</td>
</tr>
</tbody>
</table>

#### RESIDENTIAL Construction falling under the IRC

R-2 R3 & R4 Buildings three stories or less plus one or two-family dwellings and multi-family (townhomes).

| STEEL & WOOD FRAMED WALLS |  |
| US ZONE | 1-2 | 3-5 | 6-8 |
| U FACTOR | 0.084 | 0.060 | 0.045 |
| EXAMPLE STEEL* | R19**+2.1 | R19**+7.8 | R19**+11.6 |
| EXAMPLE WOOD* | R13 | R13+5 | R13+10 |

Steps to using these tables:
1. Determine local jurisdiction’s energy code standard (and year adopted) and climate zone
2. Determine if project regulated by the ICC or IRC
3. Determine steel frame or wood frame and locate U Factor.
* 1st R value = cavity insulation + second number = R value of CI
** Examples of Cavity insulation are converted to R19 insulation to properly represent commercial and high-rise residential practices and using 6 inch steel studs

#### 2012 IECC

| **NON-RESIDENTIAL & GROUP R COMMERCIAL (R = Residential Construction falling under the ICC)** |  |
| **STEEL FRAME: Comprised & Assumed to be Nominal 2"X6" 18ga Studs 16" On Center** |  |
| US ZONE | 1&2 | 2R,3-7 | 6R | 7R | 8 |
| U FACTOR | 0.077 | 0.064 | 0.057 | 0.052 | 0.045 |
| EXAMPLE | R13+4 | R19+6.5 | R19+7.5 | R19+10 | R19+13 |

| WOOD FRAME |  |
| US ZONE | 1-7 | 6R | 7R | 8 |
| U FACTOR | 0.064 | 0.057 | 0.052 | 0.045 |
| EXAMPLE | R13+3.8 | R13+5 | R20+3.8 | R20+10 |

#### RESIDENTIAL Construction falling under the IRC

R-2 R3 & R4 Buildings three stories or less plus one or two-family dwellings and multi-family (townhomes).

| 2012 IECC | 2009 IECC |
| US ZONE | 1-2 | 3-5 | 6-8 | 1-4 (EXCEPT MARINE 4) | MARINE 4,5-8 |
| U FACTOR | 0.082 | 0.057 | 0.048 | 0.082 | 0.057 |
| STEEL FRAME | R15+3.8 | R15+8.5 | R19+11.6 | R15+R4 | R19+R7.5 |
| WOOD FRAME | R13+0 | R13+5 | R13+10 | R13+R0 | R13+R5 |
**TABLE B**

California Climate Zones & Prescriptive U Factor Assemblies
(Framed Construction Walls)


### COMMERCIAL (ALL NON-RESIDENTIAL CONSTRUCTION)*

<table>
<thead>
<tr>
<th>CA Zone</th>
<th>Steel Frame</th>
<th>Wood Frame</th>
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<tbody>
<tr>
<td></td>
<td>1, 6, 7</td>
<td>2, 4, 9, 10, 12</td>
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<tr>
<td>U Factor</td>
<td>.069</td>
<td>.062</td>
</tr>
<tr>
<td>Example***</td>
<td>R19+R10</td>
<td>R21+R11</td>
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### HIGH-RISE RESIDENTIAL AND HOTELS OVER THREE STORIES*

<table>
<thead>
<tr>
<th>Steel Frame</th>
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<tbody>
<tr>
<td>CA Zone</td>
<td>1-6, 8-14, 16</td>
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<tr>
<td>U Factor</td>
<td>.069</td>
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<tr>
<td>Example***</td>
<td>R19+R10</td>
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</tbody>
</table>

### LOW-RISE RESIDENTIAL**

<table>
<thead>
<tr>
<th>CA Zone</th>
<th>U FACTOR</th>
<th>All Other Zones</th>
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<tbody>
<tr>
<td>2, 6, 7</td>
<td>.065</td>
<td>.051</td>
</tr>
<tr>
<td>Example Wood Frame***</td>
<td>R19 (FRAMING MUST INCLUDE 2&quot;X8&quot; STUDS)</td>
<td>R21+4</td>
</tr>
<tr>
<td>or R15+ R4 (FRAMING IS 2&quot;X4&quot;)</td>
<td>(2&quot;X6&quot; STUDS)</td>
<td></td>
</tr>
<tr>
<td>Example Steel Frame***</td>
<td>R25 + R7</td>
<td></td>
</tr>
</tbody>
</table>

Steps To Using These Tables

1. Determine project’s climate zone (CA. Climate Zones 1-16), Project Type & Framing Type
2. * Steel Frame = Nominal 18Ga. Studs 16” on Center
3. ** Occupancy Group R, DIVISION 1 AND & is Multifamily with 3 stories or less or
   A single family residence of occupancy Group R Division 3.
4. Locate U factor for the climate zone (i.e. climate zone 1 & commercial steel frame = .098)
5. *** An Example of achieving required U Factor with Cavity Insulation and CI (i.e. R19+ R5)
6. Air Barrier will be required in zones 10-16 for all non-residential construction per 2013 Ca. Energy Code.
7. R13 is a mandatory minimum requirement for 2"x4" wood studs. R19 is minimum for 2"x6" wood studs.
### Calculating the Need and Amount of CI
(Continuous insulation)

Determine the type of building (Commercial vs. Residential) and where (the Climate Zone) the structure is being built. The national code has eight climate zones, California has sixteen and they are not in correlation to the national zones.

Use Table A to determine the maximum allowed assembled National U Factor (i.e., .098 or .105). This is the number your wall assembly must meet.

Use Table B to determine the assembly U Factor requirements of the California Building Code. Local jurisdictions are allowed to enforce “stricter” requirements.

Variables for both tables include:
- Spacing of framing members (16 vs 24 inches on center)
- Cavity insulation
- Continuous insulation (CI) may be required to achieve a wall’s overall U Factor
- Note: Framing spacing for 16” O.C. U Factors improve with 24” O.C. spacing

### CONTINUOUS INSULATION MATERIALS:
EPS foam boards are typically 24” x 48” and are a minimum of 3/4” to 4” thick but can vary in density and performance (R-Value, Compressive and Flexural strength, etc.)

<table>
<thead>
<tr>
<th>Classification of foam</th>
<th>Density</th>
<th>R-Value</th>
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<tbody>
<tr>
<td>Type I</td>
<td>0.90 lb/ft³</td>
<td>3.6 per inch</td>
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<tr>
<td>Type VIII</td>
<td>1.15 lb/ft³</td>
<td>3.8 per inch</td>
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<tr>
<td>Type II</td>
<td>1.35 lb/ft³</td>
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<td>Type IX</td>
<td>1.60 lb/ft³</td>
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<tr>
<td>Type XIV</td>
<td>2.40 lb/ft³</td>
<td>4.2 per inch</td>
</tr>
<tr>
<td>Type XV</td>
<td>2.85 lb/ft³</td>
<td>4.3 per inch</td>
</tr>
</tbody>
</table>

XPS foam boards are commonly 24” x 96” and are a minimum of 1” to 2” thick but can vary in density and performance (R-Value, Compressive and Flexural strength, etc.)

<table>
<thead>
<tr>
<th>Classification of foam</th>
<th>Density</th>
<th>R-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type XII</td>
<td>1.20 lb/ft³</td>
<td>4.6 per inch</td>
</tr>
<tr>
<td>Type X</td>
<td>1.35 lb/ft³</td>
<td>5.0 per inch</td>
</tr>
<tr>
<td>Type XIII</td>
<td>1.60 lb/ft³</td>
<td>3.9 per inch</td>
</tr>
<tr>
<td>Type IV</td>
<td>1.55 lb/ft³</td>
<td>5.0 per inch</td>
</tr>
<tr>
<td>Type VI</td>
<td>1.80 lb/ft³</td>
<td>5.0 per inch</td>
</tr>
<tr>
<td>Type VII</td>
<td>2.20 lb/ft³</td>
<td>5.0 per inch</td>
</tr>
<tr>
<td>Type V</td>
<td>3.00 lb/ft³</td>
<td>5.0 per inch</td>
</tr>
</tbody>
</table>

Polyisocyanurate rigid boards are typically 48” x 96.” Polyisocyanurate for walls is not the same rigid foam as used in roof construction. Verify the product is suitable for wall assemblies. The R-Value can vary greatly between manufacturers. Check with each manufacturer before assuming the R-Value per inch. The following are general R-Values only for aged polyisocyanurate.

<table>
<thead>
<tr>
<th>Thickness</th>
<th>R-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 inch</td>
<td>6.5</td>
</tr>
<tr>
<td>1 1/2 inches</td>
<td>9.75</td>
</tr>
<tr>
<td>2 inches</td>
<td>13</td>
</tr>
<tr>
<td>2 1/2 inches</td>
<td>16.875</td>
</tr>
</tbody>
</table>