Advanced Framing

Energy Efficiency

Energy codes across the country are promoting the use of increased insulation in the walls of homes and businesses as a way to reduce energy use, greenhouse gas emissions, and reliance on foreign oil. Compliance gets tougher with each new edition of the energy codes, and building material producers must adjust to provide code-compliant products.

The Stucco Manufacturers Association is at the forefront of these energy code changes. To build energy efficient walls, we must take a systems approach. We may focus on insulation between and outside the framing members, but the framing itself also has a large impact on the overall performance of a wall. There are two major innovations that provide for improved energy efficiency in wall assemblies:

1) Advanced framing techniques
2) Continuous insulation

Advanced Framing

Wall studs are traditionally placed 16 inches apart, which is commonly called "16 inch on center." In residential construction in the Southwestern U.S., 2x4 wood studs have historically been used, because they give sufficient support and strength for the typical home. And the industry has adapted standard conventions for framing in openings for windows and doors and constructing corners. These normal methods of construction mean that, on average, 25% of the wall is wood. Wood is not a good insulator, so this makes a big difference in the energy efficiency of the wall.

In Advanced Framing, these normal methods are questioned and re-engineered. 2x6 wood studs are substituted to allow for more insulation in the deeper walls, and studs are spaced 24" apart to reduce heat transmission through the studs. These changes alone reduce the wood in the wall to 22% on average. By using 2x6 framing, designers can comply with energy code and:

- Build more sustainably by reducing the amount of lumber used
- Eliminate foam insulation board
- Utilize conventional construction practices
- Reduce fasteners length, as compared to CI, reducing concern about stucco weight causing movement
- Preserve 3-coat stucco fire ratings, wind loadings, and durability
- Receive credits with energy codes and energy rating systems such as LEED

Adopt a few more innovations, and the wood content in the wall can come down to 17% on average, which makes a significant difference in the performance of the wall. Some of these advanced framing techniques are:

- Double-stud corners instead of triple-stud corners
- Spacing windows and doors to coincide with the stud spacing to reduce extra framing
- Single headers where possible
- Reducing over-engineering of non-load-bearing walls
- Removing cripple and jack studs

Continuous Insulation

CI uses a complete layer of insulation to reduce thermal bridging, typically on the exterior of the studs. Used in place of or in addition to between-stud insulation, CI increases the insulation value of the wall by providing additional insulation and stopping the transmission of heat through the studs.

Energy Codes

Both methods of improving wall insulation can achieve code compliance. >>>

CALIFORNIA

Continuous insulation (CI) is a code-compliant system for residential construction in California as of July 1, 2014. Advanced framing provides an alternative to CI by using thicker walls with more insulation and reduced thermal bridging through studs. Table 1 shows California compliant wall systems with and without CI. Note that California now uses an overall U-factor to determine compliance, where the insulation value of all wall components are factored in. Lower U-factors provide better insulation and energy-efficiency.

TABLE 1: RESIDENTIAL WOOD FRAMING WALL STANDARD (CALIFORNIA)

Climate Zones	*Compliant System*	*Effective U-factor*	*Equivalent System w/o CI*
All Climate Zones (1-16)	2x4 & R-15 & R-4 CI 2x4 & R-13 & R-5 CI	0.065	2x6 spaced 24" o.c. & R-21

Note that adding Advanced Framing techniques in the above R-21 system with 2x6 wood studs spaced 24" on center further reduces the effective U-factor to 0.060. This can make possible trade-offs in the building, such as additional glazing and more square footage. Mass walls (greater than 7.0 Btu/h-ft2) qualify for different standards, as do below-grade walls.

The predominant wall system used in California prior to 2014 utilized 2x4 wood studs spaced 16" on center, R-13 batts between studs, and no CI. This system had an effective U-factor of 0.102, so the new standard reflects a significant step forward in insulation of homes.

Metal-framed walls must meet the same standards for new residential construction. In order to do so, building designers will have to make use of CI wall assemblies, or make significant tradeoffs elsewhere in the building design. Tables 2 and 3 show code-compliant wall systems for high-rise residential and commercial buildings.

TABLE 2: HIGH-RISE RESIDENTIAL WALL STANDARDS (CALIFORNIA)

Climate Zones	*Compliant System*	*Effective U-factor*	*Equivalent System w/o CI*
1-10, 12, 13, wood-framed	2x6 & R-19 & R-4 CI	0.059	2x8 & R-25
11, 14, 15, 16, wood-framed	2x8 & R-25 & R-5 CI	0.042	none
1-8, metal-framed	2x8, 24" o.c. & R-30 & R-7 CI	0.061	none
9-16, metal-framed	2x4 & R-13 & R-5 CI	0.105	none

TABLE 3: NON-RESIDENTIAL WALL STANDARDS (CALIFORNIA)

Climate Zones	*Compliant System*	*Effective U-factor*	*Equivalent System w/o CI*
15, wood-framed	2x8 & R-24 & R-5 CI	0.042	none
2, 4, 9-14, 16, wood-framed	2x6 & R-19 & R-4 CI	0.059	2x8 & R-25
1, 5, 8, wood-framed	Not needed	0.102	2x4 & R-13
3, 6, 7, wood-framed	Not needed	0.110	2x4 & R-11
2, 4, 5, 8, 9-16, metal-framed	2x8 & R-19 & R-10 CI	0.062	none
3, metal-framed	2x6, 24" o.c. & R-21 & R-6 CI	0.082	none
1, 6, 7, metal-framed	2x4 & R-11 & R-6 CI	0.098	none

Renovations also trigger the 2014 California Energy standards, depending on the size of the addition. >>>

TABLE 4: RESIDENTIAL ADDITIONS WALL STANDARDS (CALIFORNIA)

Square Footage Added	*Compliant Wall System*	*Effective U-factor*
Less than 700 sqft	2x4 & R-13 batts; 2x6 & R-19 batts	2x4 U<0.102 2x6 U<0.074
More than 700 sqft	2x4 & R-15 & R-4 CI; 2x6, 24" o.c. & R-21	0.065

OTHER ENERGY CODES

TABLE 5: WASHINGTON STATE

	Climate Zone 5 & Marine 4	*Climate Zone 6*
Wood Frame Wall U-Factor	Equivalent U factor - 0.056	Equivalent U factor - 0.044
Wood Frame R-Value	R-21 in cavity	R-21 in cavity & R-5 continuous insulation

- There is no CI required for zones 5 and 4. They use R-21 batts in 2x6 framing.
- There is no prescribed option without CI in zone 6. They use R-21 batts in 2x6 framing plus one inch of XPS R-5 on exterior.

TABLE 6: BRITISH COLUMBIA

	Lower Mainland	*Cariboo, Kootenays*	*Northern Region*
Wood Frame RSI Insulation/Code	3.5	3.5	3.85
Conversion to R-Value	19.88	19.88	21.86

- In the Lower Mainland and other moderate region, R-20 batts in 2x6 framing are being utilized.
- In Northern Region, R-22 batts in 2x6 framing are being utilized.
- There is no requirement for CI in any area for wood framing.

Conclusion

Building designers should consider framing along with insulation in achieving compliance with local energy codes. Consult a stucco manufacturer for assistance with designing wall systems for energy efficiency and compliance with energy codes.