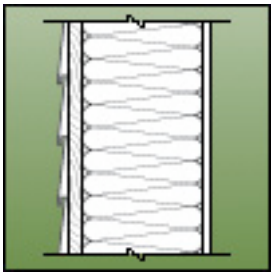

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FACT SHEET

ASSEMBLIES: WALL

Description

The exterior walls affect the structural, thermal, visual, maintenance, and aesthetic aspects of the building. In order to meet the major goals of minimizing material resource impacts, the interaction of all components of the wall assembly must be considered. Using one material, product, or system will directly affect the energy performance of the wall, while seeking to optimize energy performance will seriously impact the visual access the wall provides. Durable products, which require minimal upkeep and less replacement, may have more significant environmental impacts in their extraction and production phases than products with a shorter lifespan. To make tradeoffs, it is necessary to evaluate the total assembly rather than just the individual products. The following comparative analysis identifies the relative economic, energy, and environmental implications of four different wall assemblies: 2x4 and 2x6 standard framing (16” or 24” o.c.), 2x6 advanced framing, structural insulated panels (SIP), and structural engineered panels (SEP).

Recommendations

Within the conventional wood frame options, 2x6 24"o.c. advanced framing reduces whole house first cost and decreases operational costs by as much as 40% annually over conventional framing ($300 to $500 annually). Advanced framing reduces material by reducing the overall amount of lumber required. Although it requires some retraining, typical carpentry skills are adequate.

SIP construction has the least environmental impact due to reduced material resource use and increased energy efficiency. SIPs have a higher first cost, but when combined with high performance windows, first cost may be offset by reducing the size of heating and cooling equipment.

The new SEP construction system may prove to be a low cost high performance alternative to both framing and SIP construction.

Each framing system has distinct economic, environmental, and construction advantages and disadvantages. Priorities and trade-offs will need to be determined in order to select the most appropriate system for a given project.

In general when planning exterior systems the following should be considered to reduce and eliminate environmental impacts.

- Use locally or regionally manufactured wood products to reduce transportation and increase community economic benefits. Wood framing used in this region comes from the Western or Southeastern US, as well as Canada. Panel products are manufactured within 500 miles and insulations are manufactured within 1000 miles.
- Use materials which maximize rapidly renewable resources: Exterior oriented strand board (OSB) uses fast-growing aspen and waste products; however, use materials from FSC-certified producers to ensure sustainable growing and harvesting practices and prevent use of 'plantation' grown products.
- Use less toxic materials: When selecting composites (OSB), use formaldehyde-free sheathing products to protect workers and installers from the production effects. Use expanded polystyrene or polyisocyanurate insulations which do not use HCFC blowing agents in panel construction (SEP and SIP).

Citations

Forest Stewardship Council (FSC): www.fscus.org A third-party certification organization established to promote sustainable growth and harvesting practices throughout the world's forests.

alternatives	cost/sf-habitable	energy cost/sf-habitable	material/sf-habitable		IAQ	LCT	practice
2x4 16oc (R-11)			lumber (b.f.) sheathing (s.f.) sheetrock (s.f.) insulation B (s.f.)	0.04 0.93 0.93 0.73	typical	typical	standard
2x6 16oc (R-19)	$12.93	$1.52	lumber (b.f.) sheathing (s.f.) sheetrock (s.f.) insulation B (s.f.)	0.06 0.93 0.93 0.73	typical	typical	standard
2x6 24 oc (R-19)	$12.65	$1.14	lumber (b.f.) sheathing (s.f.) sheetrock (s.f.) insulation B (s.f.)	0.05 0.93 0.93 0.76	typical	good	standard
2x6 24 oc adv (OVE) (R-19)	$11.84	$0.91	lumber (b.f.) sheathing (s.f.) sheetrock (s.f.) insulation B (s.f.)	0.03 0.93 0.93 0.79	typical	better	standard
SEP (R-20)	TBD	TBD	lumber (b.f.) 1.25" OSB (s.f.) insulation A (s.f.)	0.01 0.93 2.79	better	TBD	emerging technolgy
SIP (R-20)	$15.52	$0.91	lumber (b.f.) .75" OSB (s.f.) insulation A (s.f.)	0.02 1.86 5.12	better	good	training required

Criteria Summaries

Cost: Examination of the cost of alternative framing and exterior enclosure options suggest that 2x6 24"o.c. advanced framing is a clear winner reducing whole house first cost by 1% of the total budget and decreasing operational costs by as much as 40% annually compared to conventional framing ($300 to $500 annually).

alternatives	whole house cost	percent of budget	cost/sf-habitable	energy cost/sf-habitable
2x6 16oc	$11,175.00	13	$12.93	$1.52
2x6 24 oc	$10,929.82	13	$12.65	$1.14
2x6 24 oc adv (OVE)	$10,233.35	12	$11.84	$0.91
SEP	TBD	TBD	TBD	TBD
SIP	$13,410.00	16	$15.52	$0.91

SIP construction increases whole house first cost by 3% and reduces operational costs from 30-50%. Early indication suggests that SEP technology will offer a reduction in first cost and operating costs. Both panel systems offer a fast enclosure time accelerating the construction schedule. A crane is required for setting panels.

Energy: SIP and SEP wall assemblies outperform conventional construction systems because they eliminate a large portion of the thermal bridging and their rigid insulation eliminates convective loops within cavities of convectional wall assemblies. Decreased infiltration rates are also a potential advantage of the panelized systems. Advanced framing has an estimated 10% higher actual R-value performance over traditional framing due to reduced thermal bridging.

IAQ: Mold development related to condensation within wall cavities is a primary health concern; systems which eliminate wall cavities are at a lower risk. Stud system when properly air sealed can reduce the risk of mold development. Off-gassing in exterior wall material does not significantly impact IAQ since exterior wall materials are encased by finishes.

Expected Product Life: Systems and products which do not support mold-growth ensure longer-lasting construction. Protection against water-penetration, infiltration, and exposure improves system and product life and performance.

Life Cycle Thinking: Evaluate materials on the following:

- Energy consumption (especially non-renewable, fossil fuel energy): Wood products require significant amounts of energy for processing and drying; gypsum products require more energy throughout every phase of their production.
- Pollutants generated in production: Plywood produces the least amount of pollutants during harvesting and production, while OSB produces the most. Toxic materials are used in the production of most wood panel products, creating health issues for production workers. Select products that minimize toxic chemical use in their production, come from factories meeting the highest EPA standards, and avoid formaldehydes which can off-gas to the atmosphere.
- Potential for out-gassing in the building: Because these are exterior products and will be enclosed by other materials, their effects on the indoor environment are minimal.

- Durability of the product: If protected against moisture, either during construction or through the operational life of the building, gypsum sheathing and OSB have the longest life cycle. Plywood, because it can delaminate, is most susceptible to moisture exposure at all stages of its use.
- Potential for future recycling: Plywood has the most direct reuse potential, primarily because it can be downcycled one more step before being landfilled or used for fuel. However, in locations where gypsum board can be recycled into a soil amendment, it has the least long-term detrimental effects. Use of adhered moisture barriers, finishes and sealers can increase negative impacts when sheathings (interior and exterior) are composted.

Practice: Alternative wall systems require training for trades, and may include the use of more energy-intensive equipment (cranes for lifting SIP and SEP panels into place most efficiently, or additional crew members to handle the panels if cranes are not employed.) It is important to train all crew members when using advanced framing, SIP, and SEP to ensure quality of construction. Large developments using alternative wall system construction methods will benefit from added efficiencies as crews carry experience from one unit to the next.