



## FACT SHEET

### HOUSE: HEIGHT

#### Description

This section on height explores the impact house configuration has on cost, material utilization, and energy use. Configuration is the size in square footage, the number of floors, and the utilization of attic space. A 2-story home has become the norm in Minnesota, particularly in urban areas where land costs are high and urban lots are small, however there are alternatives to this default standard. The following comparative analysis identifies the relative economic, energy, and environmental implications of a 1-story, 1-1/2-story, 1-1/2-story with a knee wall, and 2-story configurations for houses.

#### Recommendations

The most efficient house height or configuration balancing the cost and environmental impact is the 1-1/2-story house with a 2-foot knee wall. The house encloses the most useful square footage with a minimum of materials and balances energy use. The 2-story house is also efficient, with the best utilization of the foundation system.

#### General Guidelines

- Design simple envelopes avoiding extra corners or eccentric shapes
- Do not enclose space that is not habitable such as basements and attics
- Space under a roof structure should be utilized as habitable space

## Height Alternatives

alternatives	cost/sf-habitable	energy cost/sf-habitable	material/sf-habitable
1story (864 s.f.)	95.97	1.57	lumber (b.f.) 0.18 sheathing (s.f.) 2.26 subfloor (s.f.) 1.00 sheetrock (s.f.) 1.93 glass (s.f.) 0.13 concrete (C.Y.) 0.02 steel (lbs.) 0.76 insulation A (s.f.) 0.56 insulation B (s.f.) 0.73 Insulation C (s.f.) 1.00
1 1/2 story (1368 s.f.)	86.73	1.28	lumber (b.f.) 0.17 sheathing (s.f.) 1.63 subfloor (s.f.) 1.33 sheetrock (s.f.) 1.45 glass (s.f.) 0.13 concrete (C.Y.) 0.01 steel (lbs.) 0.50 insulation A (s.f.) 0.37 insulation B (s.f.) 0.43 Insulation C (s.f.) 0.87
1 1/2 story w/kneewall (1512 s.f.)	83.63	1.31	lumber (b.f.) 0.15 sheathing (s.f.) 1.42 subfloor (s.f.) 1.18 sheetrock (s.f.) 1.26 glass (s.f.) 0.13 concrete (C.Y.) 0.01 steel (lbs.) 0.44 insulation A (s.f.) 0.33 insulation B (s.f.) 0.36 Insulation C (s.f.) 0.77
2 story (1728 s.f.)	82.82	1.26	lumber (b.f.) 0.15 sheathing (s.f.) 1.70 subfloor (s.f.) 1.00 sheetrock (s.f.) 1.46 glass (s.f.) 0.13 concrete (C.Y.) 0.01 steel (lbs.) 0.38 insulation A (s.f.) 0.28 insulation B (s.f.) 0.76 Insulation C (s.f.) 0.50
The energy model is a Minnesota code base zone 2, with wood siding, 15% window-to-floor area, unshaded windows with double low-E argon glazing, distributed equal with regard to orientation, 80 AFUE furnace, and 10 EER air conditioning. Cost information is based on Means Cost Works 2004. Energy modeling was conducted on Visual DOE 3.1.			

## Criteria Summaries

**Cost:** First cost and energy cost both support 1-1/2, 1-1/2 knee wall, and 2-story configurations as being comparable. All cases are built on the same 24 x 36 foundation, so the smaller 1-story option fails to capitalize on the initial the common costs of the foundation, and mechanical systems which are largely fixed costs. All the house configurations have a simple shape with a minimum of corners and complexity, which minimizes cost.

alternatives	whole house cost	cost/sf-habitable	energy cost/sf-habitable
1 story (864 s.f.)	82,920.00	95.97	1.57
1 1/2 story (1368 s.f.)	118,650.00	86.73	1.28
1 1/2 story w/kneewall (1512 s.f.)	126,450.00	83.63	1.31
2 story (1728 s.f.)	143,105.00	82.82	1.26

**Energy:** The 2-story unit performs best with regard to energy. It is lower than both the 1-1/2-story and 1-1/2-story with knee wall options by 2% and 4% respectively on a per square foot basis. All multi-level options outperform the 1-story unit, which uses 17-20% more energy on a per square foot basis.

**Materials:** The 1-1/2 story house with a 2 foot knee wall has the best overall utilization of wood material per square foot of habitable space. It achieves this by enclosing the most useful floor area with a minimum of materials. It utilizes the space under the roof, eliminates an interior ceiling, and expands the useful floor area with a 2 foot knee wall. The 2-story house has the best utilization overall of the materials related to the foundation system, which due to its use of concrete has a high environmental impact. Overall the 1-story house uses the most material on a per square foot basis because it uses more materials on the foundation and the roof, per square foot of habitable space. As with cost, materials are minimized by a simple shape, with a minimum of corners and complexity.