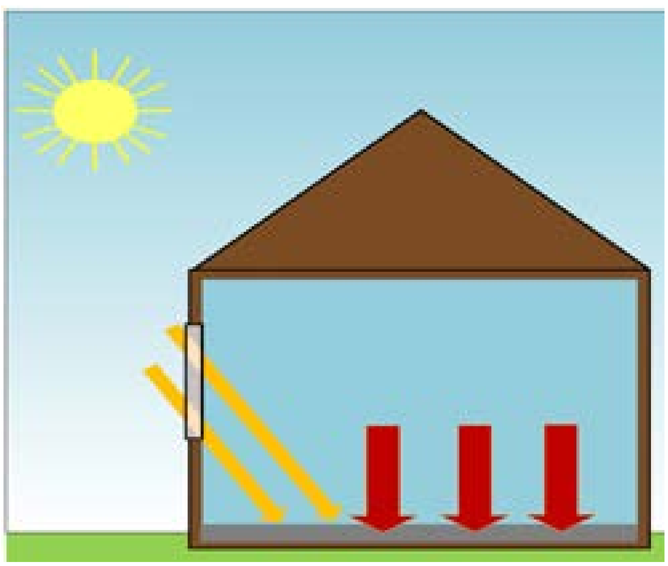
Thermal Mass in Construction:
Presentation Handout*

In construction, thermal mass refers to heavy, dense building components with a high capacity to absorb, store and release heat. It is typically used as a structural component in a building, such as in a wall or in the floor. Some examples of construction materials with high thermal mass are logs, concrete, masonry, and adobe.

Logs are a construction material with high thermal mass.

The terms thermal mass and thermal storage are distinct in construction. Thermal storage heating systems, such as a solar thermal system with a storage tank of hot water, have dedicated control systems to handle the collection, storage, and delivery of heat. On the other hand, the term thermal mass on its own refers to mass in the envelope that passively acts to heat or cool a home.



Thermal mass in a passive solar application.

Thermal mass can be used in passive solar systems in homes to improve occupant comfort and offset space heating demand on days when solar radiation is entering the home. For instance, on a sunny day, the sun's rays might enter a house through a south-facing window, and fall onto a concrete floor. The heavy floor is able to absorb the solar radiation, preventing the ambient temperature in the room from becoming too high during the afternoon hours when the sun is shining. The heat in the floor will then move into the room later in the day, as the outside temperature drops and the room cools off. This softens the indoor swing in temperature while offsetting some of the space heating demand.

Notes:

*This handout complements the presentation on thermal mass located here: http://www.cchrc.org/thermal-mass-study

Thermal Mass and Annual Heat Demand: Energy Modeling

Thermal mass located on the interior side of the building envelope of a home provides structure and improves occupant comfort by lessening indoor temperature swings. It can also have an effect on the building's annual heating demand. However, the magnitude of that effect depends on the climate.

The graph shows the effect of thermal mass on the annual heating demand of a typical house in three locations – Clayton, New Mexico; Juneau, Alaska; and Fairbanks, Alaska. Fairbanks and Juneau are cold in the winter and shoulder seasons, and feature little solar radiation during the cold months of the year. The mixed climate of Clayton features several months where the daytime outdoor temperature is higher than the inside set temperature and outside night temperatures are lower.

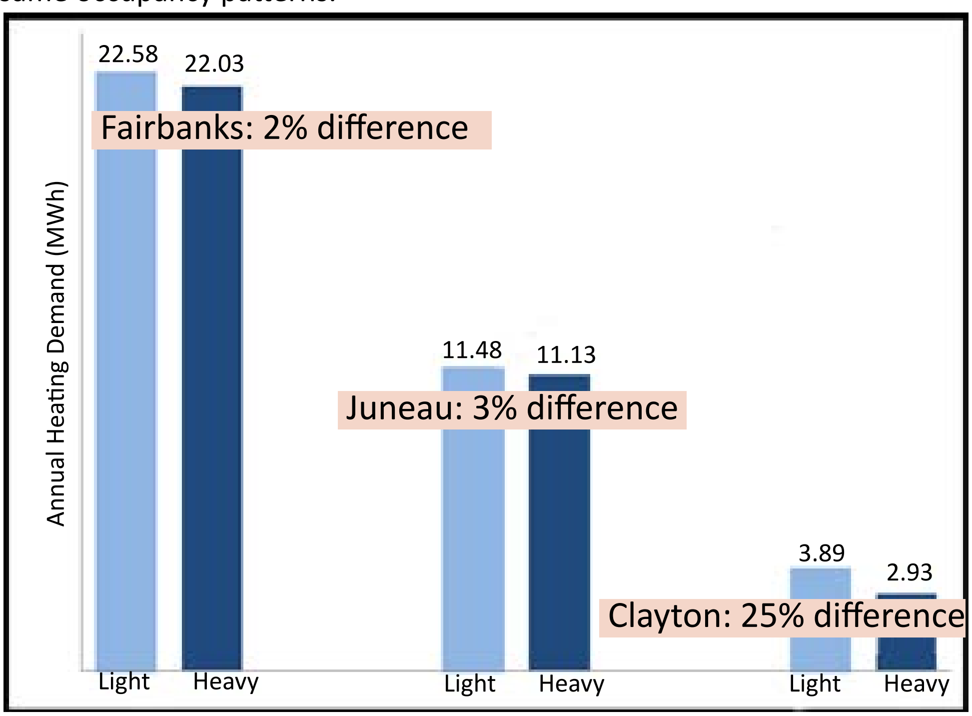
The annual heating demand is shown for houses with little thermal mass (light) and with added thermal mass in the walls and floor (heavy) in each location. Except for the difference in thermal mass, the light and heavy houses in the modeling study were equal - they had the same R-value in the building envelope and the same occupancy patterns.

This energy modeling study shows that to reduce the fuel use of a typical residence in a cold climate, strategies such as **adding insulation in the building envelope, making the envelope air-tight, and using an efficient heating appliance** will have a bigger effect than incorporating thermal mass.

More information about this modeling study, and other research, is available at www.cchrc.org/thermal-mass-study.

In all locations, the low thermal mass houses correspond to the highest heating demand. However, in Clayton, the mixed climate means the thermal mass can lower the home's annual heating demand by a larger percentage than in the other locations. The home with more thermal mass in Clayton has a lower heating demand by approximately 25 percent over the home with little thermal mass, even though walls in the homes have the same R-value. The hot days allow the thermal mass in the home to absorb heat, and the cooler nights provide an opportunity for that stored heat to offset heating demand.

On the other hand, the effect of thermal mass on heat demand is small in Alaska, which has a long heating season. During the winter, the outdoor temperature remains below the indoor temperature for months at a time and there is little solar radiation. Heat consistently flows from the interior of the home to outside during the winter. In these locations, the insulation in the envelope, rather than the amount of thermal mass, has a much greater effect on annual heating demand. In this study, the light and heavy houses had the same R-value, and thus differences in annual heating demand were small.



The effect of thermal mass in the building envelope in three different locations.

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