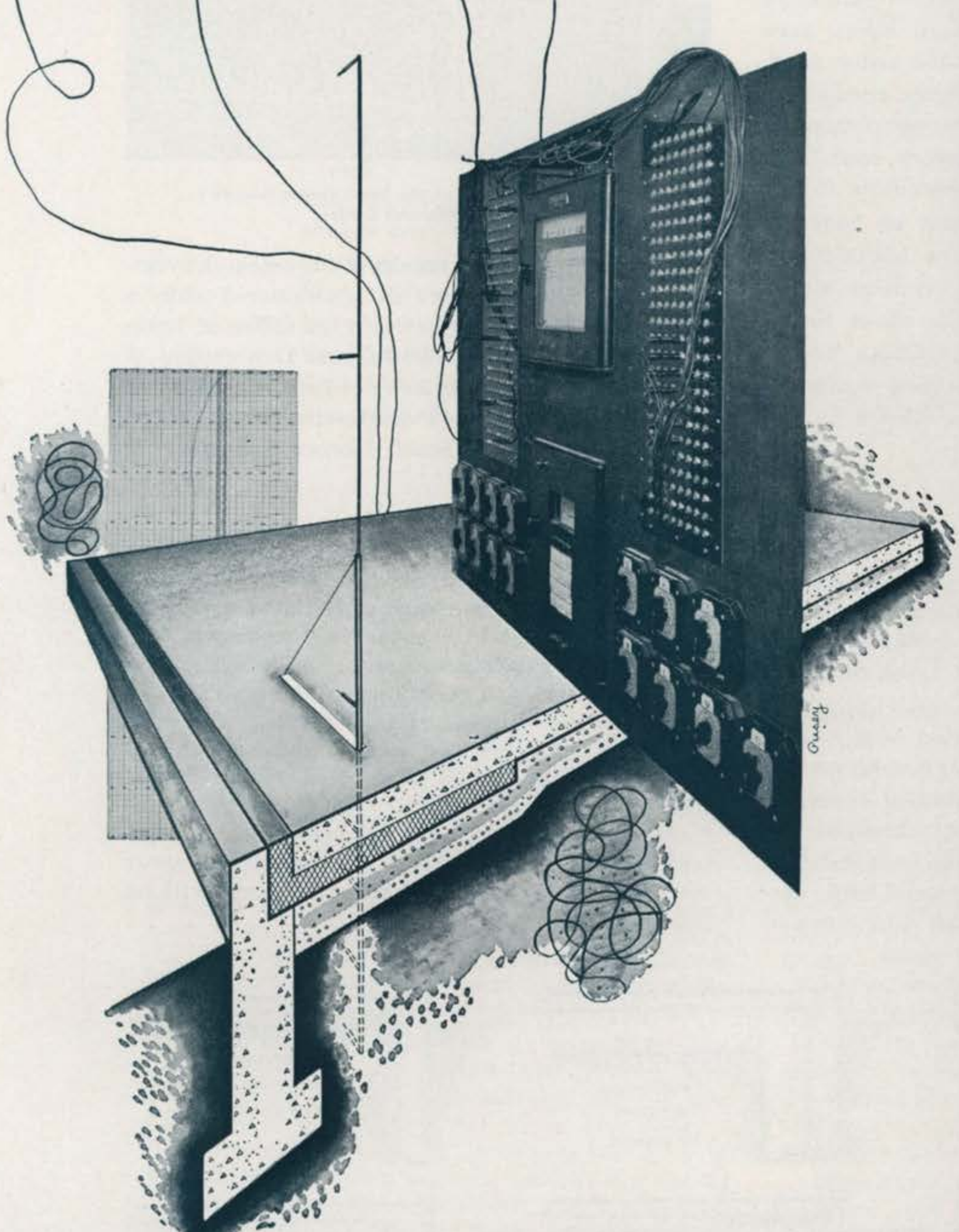
CONCRETE FLOORS

For Basementless Houses



CIRCULAR SERIES

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CONCRETE FLOORS
SMALL HOMES COUNCIL F4.3

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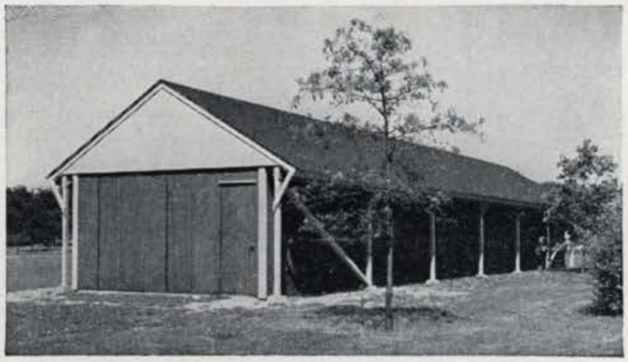
PROBLEM: Making Concrete Floors Warm and Dry

The convenience and economy of the one-floor basementless house have resulted in the increased use of concrete floors laid on the ground. This type of floor has been built without adequate test data or established construction standards relating to conditions involving comfort — dampness and floor temperature. Many such floors have proved to be cold, especially at the outer edge. Some have also been damp — damp enough to damage floor coverings and wall construction.

To determine the most satisfactory floor from the standpoint of comfort, the University of Illinois has studied the construction of concrete floor slabs which are laid on the ground and which are designed for use in climates where central heating is desirable. The slabs tested were limited to floors for basementless houses having a conventional type of heating system — floors without heating pipes or ducts in, or under, them.



Floor slab laboratory at the Small Homes Council's Home Research Center

This circular presents results of the research investigation on concrete floor slabs conducted under a cooperative agreement between the Office of Technical Services of the United States Department of Commerce and the University of Illinois. The work was carried on by the Department of Mechanical Engineering and the Small Homes Council.

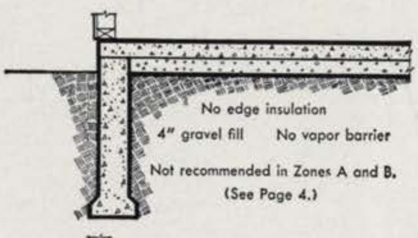
FLOORS TESTED

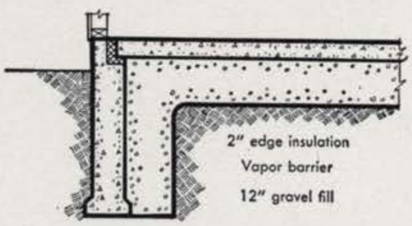
Nine different types of concrete floor slabs were tested in an effort to determine the proper design of floors for basementless homes with respect to:

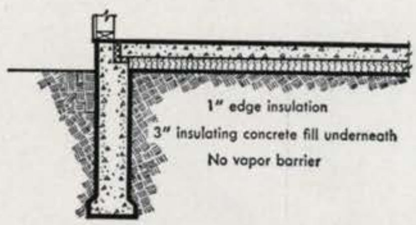
1. Heat losses of the different types of floors.
2. Temperatures at various points throughout the floors. (This information was sought for proper placement of floor insulation.)
3. The amount of moisture passing from the ground to the top of the concrete slab.

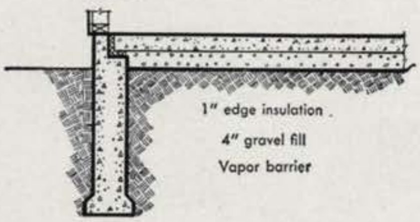
The floors selected for test represented standard construction practices and, at the same time, permitted the use of varying amounts and types of insulation along the edges. (See sketches below.) The floor slabs were tested simultaneously under similar conditions in a specially constructed laboratory. This laboratory was divided into test compartments, each containing a test floor.

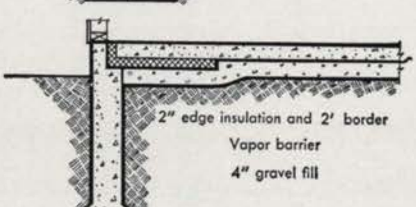
By means of electrical devices (thermocouples), temperatures were measured at 350 points in the floors and in the test compartments. Readings were taken daily. Outdoor air temperatures, wind direction and velocities, and sun intensity were also recorded. (A technical report covering temperature and moisture tests will be published later.)

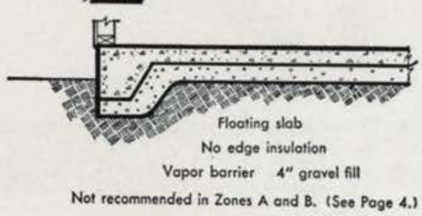


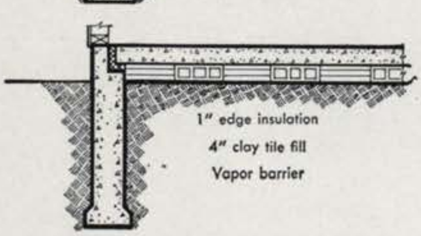


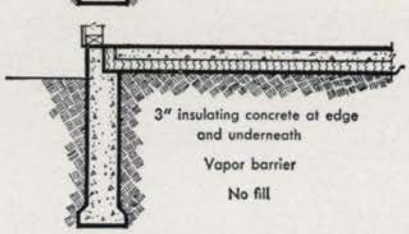


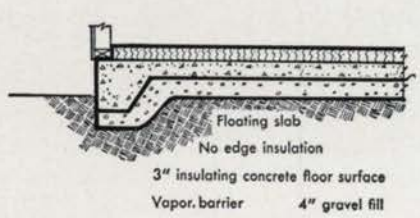










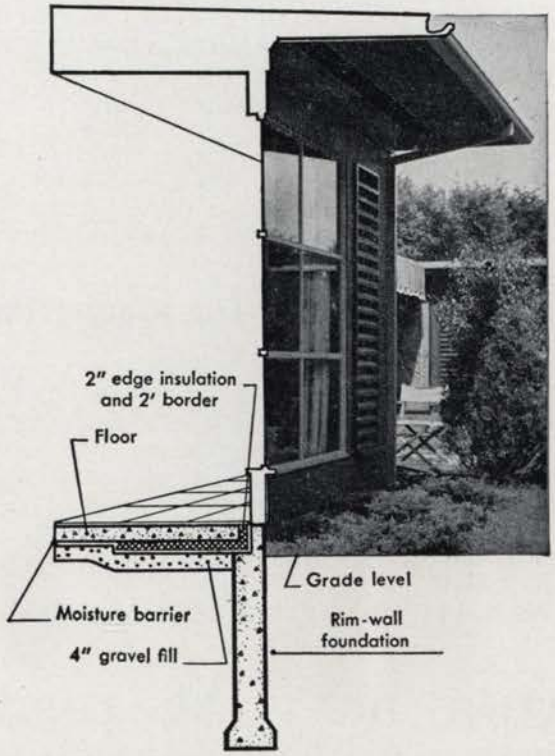


HOW TO BUILD A GOOD CONCRETE FLOOR ON THE GROUND

To be warm and dry, a concrete floor laid on the ground should:

- **Have edge insulation**
- **Have a moisture barrier**
- **Be laid on well-drained land over a fill of gravel or crushed rock.**

The illustration at the right shows one recommended construction for such a concrete floor. This recommendation is based on an investigation of the floor slabs shown on Page 2, and also on proven construction methods.



Essentials of Good Construction

Good drainage is a primary requirement. The floor slab must be above the level of the surrounding land. ***The ground must slope away from the building.*** There should be no pockets into which roof water or drainage can collect. (See Small Homes Council Circular B2.1 — "Selecting The Home Site.")

A 4-inch fill of coarse washed gravel or crushed rock should be spread over the entire area where the floor is to be laid. Structural clay tile can also be used. This fill reduces the capillary rise of moisture — ***it is not insulation.***

A barrier should be provided to prevent the rise of moisture from the ground into the floor slab. This barrier should be placed over the fill, and extended to the outside edge of the floor area.

The membrane used as a moisture barrier must be sufficiently strong to resist puncturing during the pouring of the concrete floor. A rigid asphalt board (approximately 1/8" thick) or a reinforced duplex paper with asphalt center is acceptable. Sheets should overlap four inches.

If a base layer of concrete is laid, then asphalt-saturated building paper or roofing felt can be used as a moisture barrier underneath the floor slab. This construction is satisfactory, but it increases the cost.

Insulation along the outside edge of the floor slab is essential.

In zero weather, a floor slab having edge insulation will be about 20 degrees warmer along the outside wall than an uninsulated floor. A floor having no edge insulation may become so cold that the moisture in the air condenses on the floor near the outside wall just as it sometimes does on windows.

At least 2 inches of rigid waterproof insulation should be placed along the exposed edge of the floor. Extend this 2 feet under the floor as a border. (This amount and placement of the insulation proved to be the best for the floors investigated. Some authorities recommend that the insulation be placed vertically along the inside of the foundation wall.)

To keep the insulation dry, place it above the moisture barrier. Use only those types of insulation which do not absorb moisture or deteriorate in the presence of moisture. (In the floors tested, a cellular glass insulation board* was used.)

If insulating concrete (concrete made with a material such as expanded mica) is used as edge insulation, it should be 4 inches or more thick in order to give the same insulating effect as the 2-inch rigid waterproof insulation board used in this investigation.

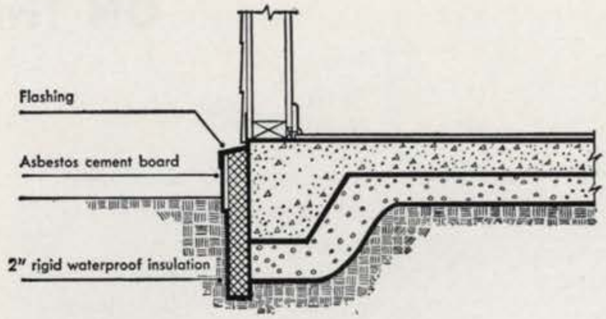
The drawing above shows a rim-wall foundation carried below the frost line. In many areas, the foundation walls are omitted and the slab merely thickened at the edge to form a grade beam. If a grade beam is used, the insulation may be placed on the outside. (See top sketch on Page 4.)

* "K" value: 0.40 Btu per (hour) (square foot) (Fahrenheit degree temperature difference) (inch of thickness).

How to Cure a Cold Floor

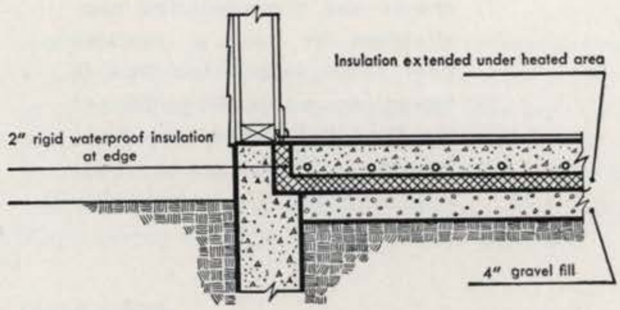
Uninsulated floors in existing basementless houses, such as the two uninsulated floors on Page 2, can be made warmer by placing insulation as shown in the sketch at the right.

Use 2-inch rigid waterproof insulation, extending from the floor level into the ground at least 12 inches. Fasten the insulation to the foundation with wire ties or anchor bolts. Place flashing over the top of the insulation to prevent water from working in behind it. An asbestos cement board should be placed against the insulation to protect against lawn mowers and stones.



Insulation for Floors Having Panel Heat

When panel heating systems are used with concrete floors, the heat loss to the ground and at the edge is increased due to the higher temperatures maintained in the floors. To prevent excessive heat losses in such floors, a minimum of two inches of rigid waterproof insulation should be provided at the edge. In addition, the use of insulation under the entire heated floor area is recommended. Gravel and rock fills are desirable for drainage controls, but they have no insulating value.

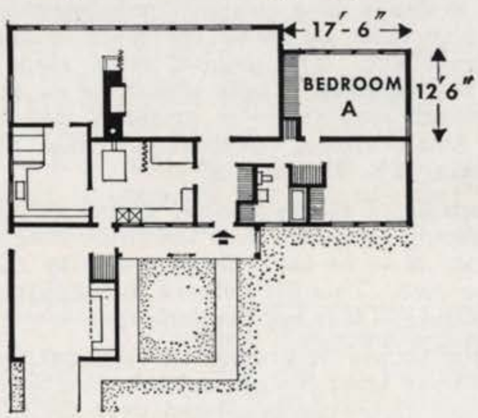


ESTIMATING HEAT LOSS THROUGH CONCRETE FLOORS

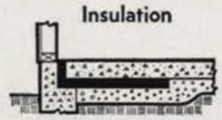
In order to determine the heat required for each room, the heating contractor must know the heat loss through the upper part of the room (through the walls, ceilings, windows, and cracks). This may be estimated by use of standard heat loss equations given in the *Heating, Ventilating, Air Conditioning Guide,* published by the American Society of Heating and Ventilating Engineers.

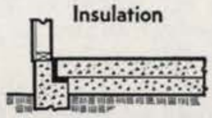
In addition to this loss, the heat loss through the floor must be considered. The heat loss for concrete floor slabs in British thermal units per hour may be estimated by multiplying the length of the exposed edges of a room and the appropriate factor given in the chart below.

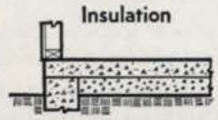
Example: House plan shown is to be built in Zone B (design temperature of −10° F). It will have a concrete floor with recommended 2" edge insulation. The heat loss through the upper part of Bedroom A was estimated at 7,000 Btu per hour. In addition, the heat loss through the floor is 30 feet (exposed edge) x 45 Btu/hr/ft (factor from chart) = 1,350 Btu per hour. Therefore, the total heat requirement for Bedroom A is 8,350 Btu per hour.



Design Factors for Three Types of Floor Construction







Temperature Zone for Design Purposes	Recommended 2" Edge Insulation	1" Edge Insulation	*No Edge Insulation
−20° F	50	60	75
−10° F	45	55	65
0° F	40	50	60

*This floor is not recommended. It is included for comparison only.