

# FARM ENERGY

## Conserve heat energy in the farm shop

Proper insulation and a well-designed heating system are important for an energy efficient and comfortable farm shop. Most farm shops are used throughout the winter—some on a daily basis and others more sporadically. By maintaining a minimal temperature level, typically about 40 degrees Fahrenheit, supplies and equipment are protected from freezing. It also is easier to warm up the space to comfortable working temperature—typically 55–65°F.

### Insulation and energy conservation

Good insulation is critical for energy efficiency, because a farm shop does not need as much ventilation as other facilities, such as livestock buildings, during winter heating. The minimum recommended insulation levels are R-Values of 15 to 20 in side walls, 30 in ceilings, and 10 for doors. A vapor barrier of 6-mil polyethylene should be installed between the inside wall or ceiling panels and the insulation to keep moisture out of the insulation.

Insulate the foundation with at least 2 inches of extruded polystyrene insulation (R10 to R12). This will keep the floor warmer and reduce heat loss through the floor. This perimeter insulation can be installed on the outside of the foundation wall to a depth of 4 feet or it can be installed underneath the floor for 4 feet around the outside edge. Maintain continuity of this foundation insulation up to the wall insulation to avoid having a cold spot with higher energy losses. Examples of these insulation methods are shown in figure 1.

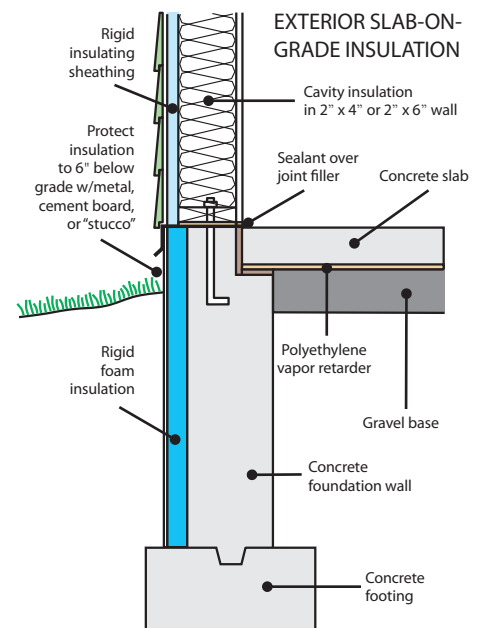
Install windows primarily on the south side to allow sun in during the winter and minimal solar gain in the summer. Windows in walls and overhead doors should contain double glazing.

Place large doors for bringing in equipment on the south or east side of the shop if possible to avoid wintertime prevailing winds from the north and west. Also, any snow and ice on door approaches will melt off more quickly on the south side of the shop.

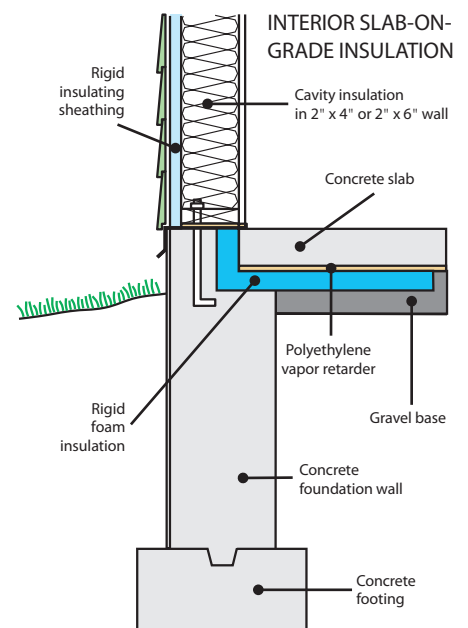
### Heating systems

The size and type of heating system will depend on the size of the shop, how often the shop is used, and how often large doors will be opened and closed. Many types of heating systems are used in shops, including forced-air furnaces, infrared heaters, and in-floor heat. The most frequently used fuels are propane, wood, fuel oil, or waste oil.

Ceiling-mounted, forced-air space heaters work well, because the furnace blast helps keep hot air from stagnating near the ceiling. The furnace should be sized at approximately 50 BTU/hour per square foot of shop floor area. Use a minimum size of 70,000 BTUs per hour if the shop is fan-ventilated at the 1,000-cfm rate.



Foam boards are the most common form of exterior slab-on-grade insulation. The above grade portion must have UV and structural protection.



Interior slab-on-grade insulation can be horizontal. Interior placement avoids the need for protection, but may require cutting small pieces and more difficult details.

Figure 1 from Joseph E. King and Gene Meyer, *A Builder's Guide to Residential Foundation Insulation*, Kansas State University, Fall 1999.



Power-vented or condensing type heaters are much more efficient than natural draft heaters. A power-vented heater and a condensing type heater are approximately 13% more efficient and 25% more efficient, respectively, than a natural draft heater. Unvented liquid propane (LP) heaters, which are common in livestock buildings, are not recommended in farm shops because of the lack of ventilation and the danger of carbon monoxide poisoning.

Managing forced-air heaters for energy efficiency is somewhat difficult. Lowering the temperature when the shop is not in use will save energy; however, lowering the temperature too much will create an uncomfortable work environment due to the cold temperature of the concrete flooring. Maintaining the minimum temperature within 10°F of the desired working temperature is advised.

Infrared radiant heaters are more expensive than space heaters. However, radiant heating systems are very efficient at low shop temperatures, because the radiant heat warms the surfaces it strikes, providing comfortable equipment and surface temperatures.

Radiant heating systems can provide approximately the same comfort level as forced air heaters at a 10°F lower shop temperature. This reduces heat loss when large entry doors are opened. Radiant heat systems should be sized at 40 BTU/hour per square foot of shop floor area.

In-floor heating systems are popular for farm shops even though they are more expensive than most other heating systems. They are best suited to farm shops that are used frequently during winter.

In-floor heat has the following advantages:

- Warm floors dry quickly and are comfortable to work on.
- Snow and ice melt quickly from vehicles.
- Heating is very uniform.
- The floor retains heat for long periods.

It also has some disadvantages:

- It is relatively high cost compared with other heating systems.
- The system can be damaged if the floor cracks badly.
- It is not well-suited for occasional use.
- By itself, it may not maintain 70°F room temperature during the coldest weather.

The best temperature for a heated shop floor is 75–85°F (warmer floors become uncomfortable). For a floor at 85°F and air temperature of 70°F, heat output is approximately 38 BTU/hour • ft<sup>2</sup>. If the air temperature cools to 60°F, the heat input to the shop will increase. It is recommended to design for 45 BTU/hour • ft<sup>2</sup> and size the system slightly larger to account for system losses.

This heat output will keep a reasonably insulated shop at 55–60°F but does not have extra capacity for quick warm-up or reserve heat when large doors are opened in cold weather. Rather than depending entirely on an in-floor system, a smaller ceiling-level forced-air furnace can be used to provide a portion of the heating. This furnace should be hung to one side of the most frequently used large door. This will provide quicker temperature recovery following opening of the door in cold weather. If both an in-floor heat and a forced air system are used, provide a total of 50 BTU/hour per square foot of shop floor area between the two systems.

More information on designing floor heating systems is available in Extension Circular AE-1014, "Hot Water Floor and Space Heating," which is available from Extension Agricultural Engineering at North Dakota State University. A similar design bulletin is available from Canada Plan Service at <http://www.cps.gov.on.ca/english/plans/E9000/9735/M-9735La.pdf>.



Prepared by Greg Brenneman, extension ag engineer; Jay Harmon, professor, ag and biosystems engineering; and Dana Petersen, program coordinator, ISU Farm Energy; Iowa State University Extension. Sponsored by the Iowa Energy Center.

#### ... and justice for all

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 202-720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue SW, Washington, DC 20250-9410, or call 800-795-3272 (voice) or 202-720-6382 (TDD). USDA is an equal opportunity provider and employer. Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914 in cooperation with the U.S. Department of Agriculture. Cathann A. Kress, director, Cooperative Extension Service, Iowa State University of Science and Technology, Ames, Iowa.