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Fireplaces

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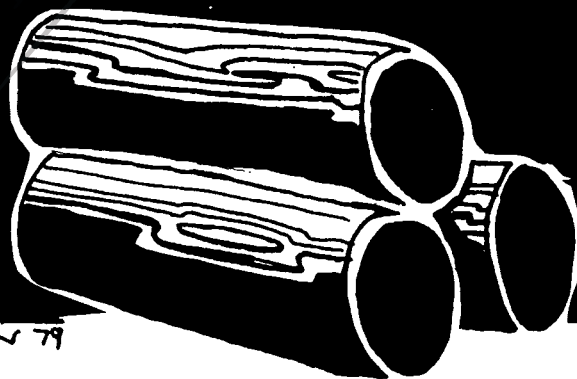
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FS 723

fireplaces



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Cooperative Extension Service
South Dakota State University
U.S. Department of Agriculture

fireplaces

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A cheery fire crackling in an open grate has a strong appeal to most people. As utility bills continue to rise, some families are turning to fireplaces as an alternative method of heating their homes. But before you install a fireplace and expect it to carry a major portion of your heating load, here are some points you should consider.

Efficiency

When considering various types of fireplaces, it is important to understand the difference between efficiency and net efficiency. Efficiency measures that portion of the energy input (fuel) which emerges as usable heat. Net efficiency takes into account possible changes in a home's total heating needs when a fireplace is used.

Fireplaces are not an efficient source of heat for a home. Estimates of the fuel efficiency of a standard masonry (brick or stone) fireplace range from 0 to 10%. Net efficiency can be negative, which means there is a loss of heat through the fireplace. A net efficiency loss is attained when the fireplace is used during very cold weather, especially if the fire is allowed to die out over night.

Much of the efficiency rating of the fireplace is related to its internal design. Fireplaces designed to optimize heating effectiveness must take into consideration the three major ways a fireplace can affect the energy needs in a home: 1. Radiant energy heats the room where the fireplace is located. 2. Hot gases escaping up through the chimney give off some heat to the chimney walls, which pass some of this heat to surrounding walls or rooms. 3. Warm air already in the house is pulled into the

fireplace to provide oxygen for combustion. A fire tends to suck more air from a room than is needed for combustion to occur, so there is a drain of already heated air up the chimney.

Design

Ideal fireplaces maximize the heat gain from radiation and minimize heat lost by reducing ventilation — pulling heated air from the room up the chimney.

There are actually two types of radiation from the fireplace. Primary radiation comes directly from the fuel (wood), while secondary radiation is reflected or given off by the fireplace walls after they have become heated. Direct radiation is maximized by fireplaces which are shallow, tall and wide. (See Figure 1.)

Secondary radiation can be increased by sloping the upper back of the fireplace forward and by angling the side walls outward. (See Figure 2.) Using highly insulating materials in the construction of the fireplace will increase the amount of radiated heat, because less heat will be absorbed by the walls.

Minimizing the loss of room air through the chimney and max-

imizing the heat conducted into the home require reducing the air flow into the fireplace. This is normally accomplished by having a narrowing in the throat of the fireplace before the chimney begins. A damper is normally installed in this throat area. Adjustable damper settings are useful in meeting varying conditions of fireplace use; however, there is a limit to which the air flow into the fireplace can be restricted, because too little air flow causes the fireplace to smoke. Minimizing the air flow can also be accomplished by making a narrower and shorter fireplace opening (Figure 3), but this cuts down on the amount of heat given off by radiation.

Some fireplaces draw air from outside or unheated areas of the home (basement or garage), decreasing the heat loss due to ventilation. By using air from outside the room, drafts on the floor due to fireplace ventilation can be eliminated or greatly reduced.

Some fireplaces are also equipped with smoke shelves. (See Figure 3.) These are believed to help prevent problems of downward drafts, which cause the fireplace to smoke. Many prefabricated fireplace units and some masonry fireplaces operate well without a smoke shelf.

Exterior masonry chimneys and oversized chimneys are especially susceptible to problems with downdrafts. The best chimneys are proportionately sized, are not located on an exterior wall, and are equipped with wind caps. It is best to try and locate a mason or contractor whose customers are satisfied with their chimneys, rather than to try to design a chimney yourself.

With so many design variables, some of which tend to counteract efficiency, it is very difficult to

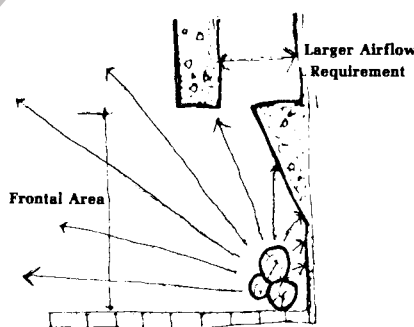


Figure 1. A shallow, tall fireplace increases direct radiation.

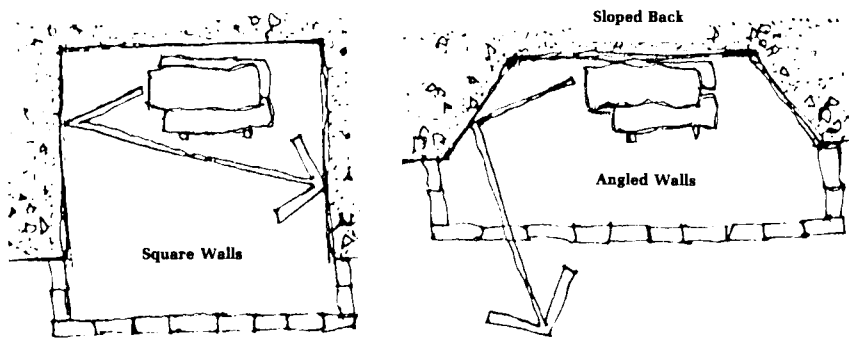


Figure 2. Increasing secondary radiation in a fireplace with a sloped back and angled walls.

design a masonry fireplace with a net heat gain. In addition, the prevailing winds in your location will tend to affect each type of design differently. A steady wind will cause a vacuum, resulting in a greater loss of heated air up the chimney.

Location

In new installations of any type, consider location of a wood supply, maintenance needs, furniture arrangement possibilities, and thermostat location (should not be in the same room as the fireplace). Overall efficiency will be greater if the fireplace and chimney are not located on an exterior wall, because less heat will be lost directly to the outdoors. If you plan to add a masonry fireplace to an existing home, you will be limited in the choice of location because of the footing support necessary. This is not such a major consideration with free-standing or zero-clearance fireplaces.

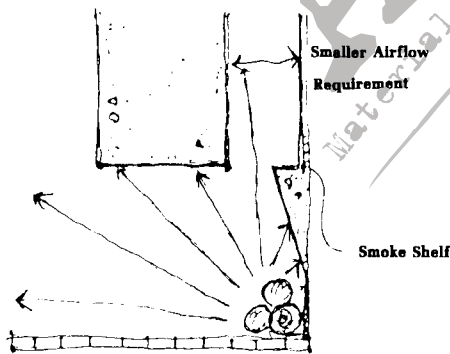


Figure 3. Minimizing the air flow of the fireplace with a narrower, shorter opening.

Accessories

There are a number of products on the market designed to either increase the amount of heat extracted from the fireplace or to restrict the loss of warm room air up the chimney. Because the normal efficiency of a fireplace is low, any heat which can be saved with these various accessories could significantly increase the unit's overall efficiency. There is a wide range of prices available. If you plan to use the fireplace as a heat source in power emergencies, avoid motorized blowers which would not function if electricity is out.

The simplest accessory is a tubular metal grate to hold the wood. (See Figure 4.) The grate uses natural convection (the physical phenomenon which makes hot air rise) to draw in cooler room air at the bottom and return heated air to the room through the top. Some of these grates use blowers to speed up the movement and push the heated air further into the room than when no blower is used. The tube grate can also introduce smoke into the room as well as warm air.

Glass doors are a popular addition to many fireplaces and are frequently sold as "energy saving" devices. Very little test data exist to support this theory. It is true that the doors will cut down on the room air lost up the chimney. However, the glass also cuts down considerably on the amount of radiated heat which enters the room. For the most efficient operation, open the doors

during the hotter stages of the burning process and close them at other times.

The amount of air ventilated up a chimney when the fireplace is not in use depends on the original design of the fireplace, the weatherization "tightness" of the home, and the chimney design. The amount of money saved by installing glass doors depends on how effectively they reduce ventilation.

Use only heat-tempered glass to avoid shattering in the presence of heat from the fire.

If heat loss up the chimney when no fire is burning is a major problem, a special panel could be devised to cover the opening, or to seal it completely.

Fireplace flue heat extractors are another option available. The hot flue gases (the air moving up the chimney from the fire) pass over tubes which redistribute the heat to the room — either by convection or with the use of blowers. (See Figure 5.)

Prefabricated Fireplaces

The most expensive type of accessory to add to an existing masonry fireplace is a new metal or metal and glass prefabricated unit. In most cases, these can be inserted into the old fireplace shell. However, compared to the

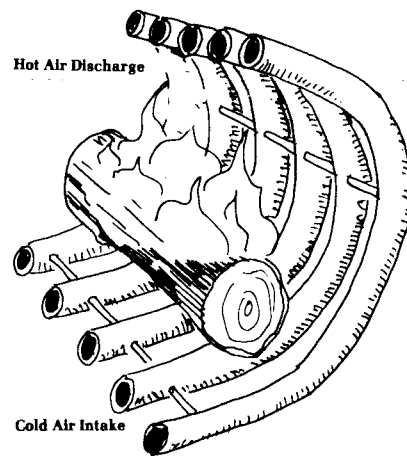


Figure 4. A tube grate for a fireplace allows fresh room air to enter the lower ends of the tubes. The air is heated as it circulates under and around the back of the fire. Streams of hot air then emerge into the room from the upper ends of the tubes.

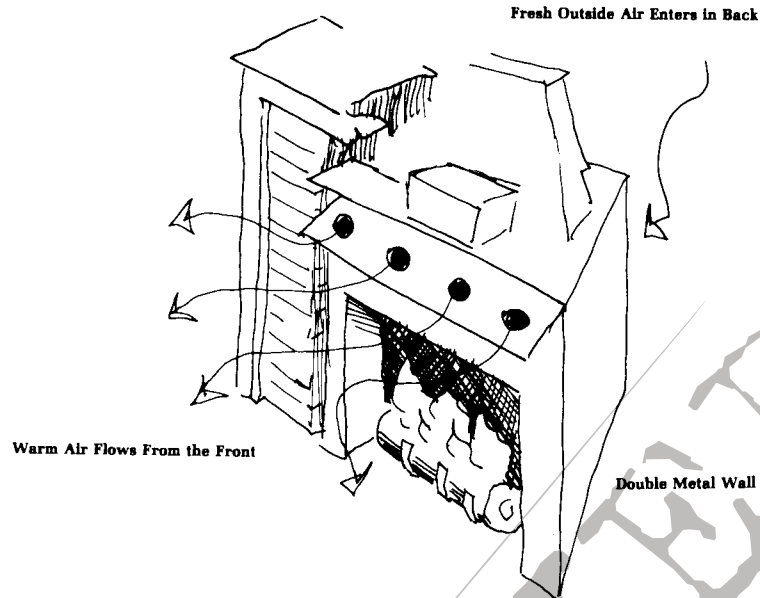


Figure 5. A prefabricated, circulating fireplace.

cost of a new masonry fireplace, the prefabricated fireplaces are very reasonable in cost and are much more efficient than the masonry type. It is possible that carefully designed prefabricated fireplaces can attain an efficiency of up to 35%, which compares to some lower grade stoves.

Most of the prefab units consist of a double metal wall construction with a space between the walls through which air can be circulated. This circulation can be either natural convection or assisted by blowers. (See Figure 6.)

Some units come equipped with glass or metal doors.

Summary

Although fireplaces are very appealing, they are not an efficient source of home heating.

It is possible that newer models will come onto the market in the future which will offer more advantages over present selections. At this time, the comparison of models is difficult and can only be done under standard conditions which tend to be quite different than those existing in most homes. Until recently few tests have been conducted; these results were

both inconclusive and are not generally available.

Some accessories can help to increase efficiency, but even the new prefabricated units can't match the efficiency of a good stove.

The following fact sheets complete this series on fireplaces and stoves, and are available from your County Extension Office.

- FS 721, Fireplaces, Stoves and Fuels—What are the Choices?
- FS 722, Wood Burning Stoves.
- FS 724, Wood Stove and Fireplaces, Safety and Maintenance.

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