Masonry Heater Project Planning Guide

This guide is for the use of homeowners, architects, and designers working towards the integration of a masonry heater into a home or other environment. Outlined below are the following considerations for masonry heater project planning.

Including:

- The heater and the house envelope
- Placement of the heater
- Sizing of the heater
- Calculating BTU output
- Foundation requirements
- Chimney (venting) requirements
- Clearance requirements
- Make-up Air Requirements

The Heater and the House Envelope

As a rule, masonry heaters are "high mass, slow release" appliances, which means that they do not have a high per hour output of BTU into the living environment (when compared to some other wood burning devices). This does not mean that a heater will not heat a house, but that it does not emit "quick" heat in the way that a metal stove might when loaded with wood and left to burn hot. What a heater does do is burn a relatively small amount of fuel very efficiently and release that energy over a longer period of time. The use of masonry as a radiant panel and storage device slows down

heat transfer somewhat, releasing the energy over a longer period of time. This results in a gentler form of heating, and avoids the "fry or freeze" tendency of metal wood stoves. In the best performing heating systems, the quality of the house envelope in terms of R-Value and "tightness" are integral. If the envelope of the house is very leaky or the R-Value of the insulation is low, then a masonry heater may not be able to keep up with the heat losses as well as, for example, a higher BTU/hour appliance such as a metal stove. There are other factors to consider in this regard, such as the sizing of the heater vs. size of the house (or required heat load), and placement of the heater in the house plan. These general concepts are important to grasp in terms of understanding what to expect from a heater in a given environment.

Placement of the Heater

In the simplest terms, the best placement for a heater will be a central location inside an open floor plan. This placement will result in the most even distribution of the heater's energy inside the home. Modern house plans are increasingly more open and this benefits the working relationship between design and function. First floor location is optimal. A common placement is first floor and as a rough divider between living and kitchen areas. It is possible to build heaters that extend into the second floor and provide some radiant surface in those areas more directly.

Sizing of the Heater

Many factors can be built into the sizing of masonry heaters, including heat load calculations, existing space requirements, choice of materials and layouts, use of heater, room and/or house size, budget, etc. When sizing a heater, it is important to consider all the above, and reference those factors against the client's expectation of the heaters performance. If in one project the heater is required to be the primary heat source for the entire house the options are different for a room heater in another project.

Smaller heaters, with between 60-80 square feet of surface area, are appropriate as room heaters plus primary system supplement. In some cases, they may be all that is required to heat a smaller house, cabin, or bungalow.

The larger sized heaters, with between 100-150 square feet of surface area, are able to be used as the primary heat source for homes in the range of up to 2000-2500 square feet. These larger heaters are the "workhorse" heaters for many North American heater masons. They are in constant operation through the heating system and relied heavily upon for warming comfort by their owners. Depending on sizing, quality of house envelope (windows, insulation, leaks, etc), environmental conditions, and the comfort requirements for residents, larger heaters may or may not be able to provide 100% of heating energy on all heating days. In practical terms, many larger masonry heaters in northern climates (Vermont, for example) are able to provide for all heating requirements about 90% of the heating days. This means that during cold spells and

very cold spells a supplemental system may be required to offset what the heater can not produce.
When possible, it is wise to size a heater a bit larger than may be thought necessary. This way, there is extra heating potential should it be required. If it is not required, then the heater need not be fired as such.

Calculating BTU Output

While calculating the BTU output of a masonry heater can be a complex affair, there is a method that follows "rule of thumb" and checks out well under scrutiny. It assumes an average heater output of 150 BTU per square foot of surface area per hour, based on a firing cycle of two firings per day. (Actual output generally varies between 130 and 180 BTU/hr).

Here's a sample scenario for a heater with 100 square feet of surface area:

150 BTU x 100 square feet= 15,000 BTU per hour or 4.3 kW/h

15,000 BTU x 24 hours= 360,000 BTU/day or 105 kW/day

Heater output is maximized by allowing all sides of the heater exposed to the room. When the surface area of the heater is covered by a wall or other obstruction then heat output from that surface will be reduced by a coefficient of up to 50%, meaning the output of the surface facing the wall will be reduced by half. As such, it is very important to consider the location of the heater respective to exterior and partition walls inside the house.

Source: A.E. Shkolnik "Heating Buildings with Masonry Heaters", Moscow, 1986

Foundation Requirements

Any masonry heater installation will require a suitable foundation. If the heater is to be built on a slab on grade, then the area of the slab underneath the heater should be reinforced according to the local building codes. More commonly, the heater is placed on the first floor of a house with a full basement. In this case, the basement slab in the area of the foundation will need reinforcement and a standard site built masonry foundation, similar to a traditional fireplace foundation, will be installed. This foundation needs to be designed to support the full weight of a heater, which may have a finished installed weight between 6,000 and 13,000 pounds. When in doubt please consult an engineer and make sure the foundation complies with local building codes and with ASTM 1602-03.

Chimney Requirements

Every heater will need to vent exhaust gases with a chimney. Once the gases from the heater enter the chimney (at around 300 F) the goal is to keep the temperature from falling, which will prevent condensation and maintain strong draft characteristics. The chimney is not seen as an extension of the radiant panel of the heater. There are two main types of chimneys commonly used, masonry and class a stainless steel.

Masonry chimneys (brick, stone, stucco/plaster, tile, etc) are sometimes used. Typically these stacks will use either an 8" round or an 8" x 12" clay flue tile, and have a finished dimension between 16" x 16" and 20" x 20" (for a single flue run), depending on materials used. They may be designed to match the aesthetics of the heater, and become part of a heater complex that may also include heated bench and wood storage area. Masonry chimneys will almost always be more expensive than class a stainless steel and tend to not perform as well, although the performance is sufficient. All clearance requirements for combustibles need to be followed for a masonry chimney installation.

Class A Stainless Steel chimneys are often used. The most common size is 8" round ID. These chimneys have better performance qualities than masonry chimneys, as they warm up faster (being insulated) and therefore result in less condensation and more consistent draft. They are less expensive than masonry to install and have somewhat more flexible installation options as they allow the use of offsets to direct the stack just where it needs to go. It is common for many installations to have a masonry chimney for the first 8', and then convert to a class a chimney between the floor joists.

Clearance Requirements

For a complete overview of the clearance requirements for masonry heaters, foundations, and chimneys, please consult ASTM 1602-03 and local building codes.

Make-Up Air Requirements

Masonry heaters require less air for use than other wood burning appliances, due to the design of the combustion system and the shorter firing time. For this reason it is not required to install make-up air ducts as part of a heater installation, even in the tightest homes, as the firing of the heater will not cause excessive depressurization. Please refer to the paper prepared by Norbert Senf on behalf of the Canadian Mortgage and Housing Corporation titled "Air Requirements and Related Parameters for Masonry Heating Systems" (http://heatkit.com/html/papers-n/airreq/cmhc-rep.htm) for further information.