
Heat-Kit System

Modular Contraflow Masonry Heater Core

Assembly Manual

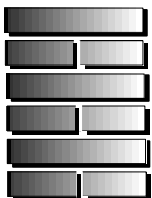
HK-22fo

22" Firebox with Front or Rear Bake Oven

modified for top chimney exit

Table of Contents:

Material List (in addition to core components).....	2
Assembling the Bottom End.....	2
Setting Firebricks.....	5
Assembling the Firebox.....	6
Choosing Between Method A and Method B	6
METHOD A.....	6
METHOD B.....	11
Building the Upper Firebox.....	12
Completing The Core	21
Fiberglass Slip Joint.....	25



**Masonry Stove
Builders**

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Material List (in addition to core components)

200	Standard Firebricks 4.5"x9"x2.5" (2.5" dimension may vary. Important: The 4.5" and 9" dimensions are important)
22	Firebrick "Splits" 4.5"x9"x1.25"
30	Common clay bricks (8"x4" nominal). These are used for the fill pieces underneath the firebox floor.
3 bags	"Mortar Mix" (ie., premixed with sand, as opposed to "Masonry Cement", which requires mason's sand)

Assembling the Bottom End

The bottom end of a contraflow heater is the most complicated part of the whole job. The two downdraft channels connect here, underneath the firebox. As well, the chimney connection and the cleanout openings for the particular installation need to be determined and located here.

We've removed as much of this complication as possible with the Heat-Kit system. The insulated base slab allows you to do a dry layout first and make sure that everything is located properly in relation to the chimney and the slab. As well, our thinwall refractory castings simplify the job of making the necessary cutouts with a portable masonry saw or a skilsaw. If you take a little extra time at this stage, particularly with the layout, you'll avoid problems later on.

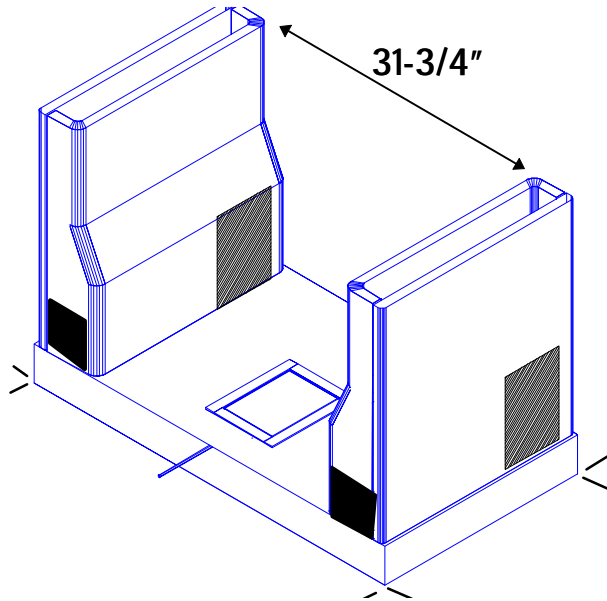


Figure 1.
2 Base channels sit dry on insulating base

Position insulating base slab dry to determine layout for heater and chimney.

Mark final position at corners with a pencil.

Install insulating base slab level onto a mortar bed.

Before setting base channels, determine the best place in your layout to locate the cleanouts. One is needed for each base channel.

Mark clean out cuts on the base channels. Mark chimney connection on base channel.

Cut appropriate holes for chimney connection and for clean outs. In this example, a right side chimney and front channel cleanouts are shown.

Set base channels dry as shown. Bottom seam will be sealed later by mortar slush between channels and facing.

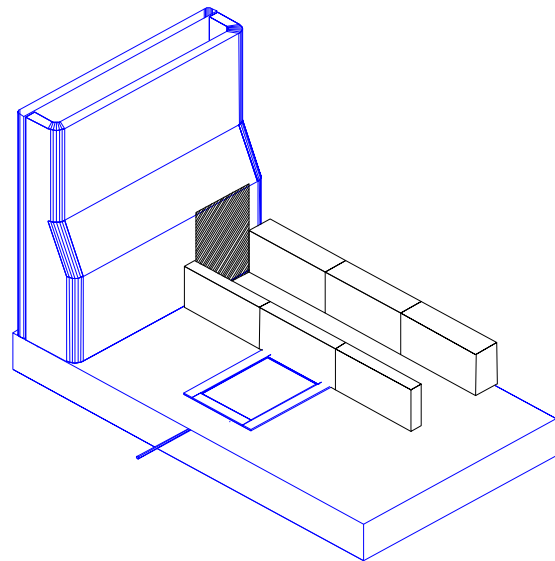


Figure 2.
Connecting channel is started
Right base channel not shown (for clarity)

Build connecting channel, using refractory mortar.

(If there is a rear chimney, leave opening and span with flat bar supplied (notch bricks to accept flat bars, thus allowing you to maintain thin joints)).

Firebrick shiner is flush with outside of slab. Firebrick split shiner is set to form a 6-1/2" channel.

(Note: "shiner" = brick set on edge)



Figure 3

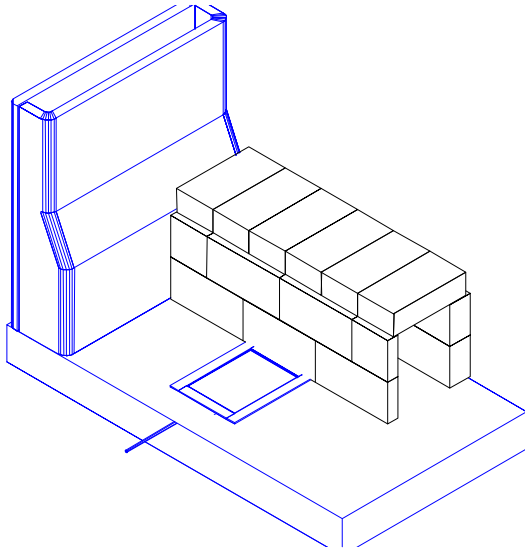


Figure 4

Form connecting channel ceiling as shown.
 Sponge inside of channel to remove hanging drips.
 Fill any large gaps between bricks and lower channel with regular mortar.

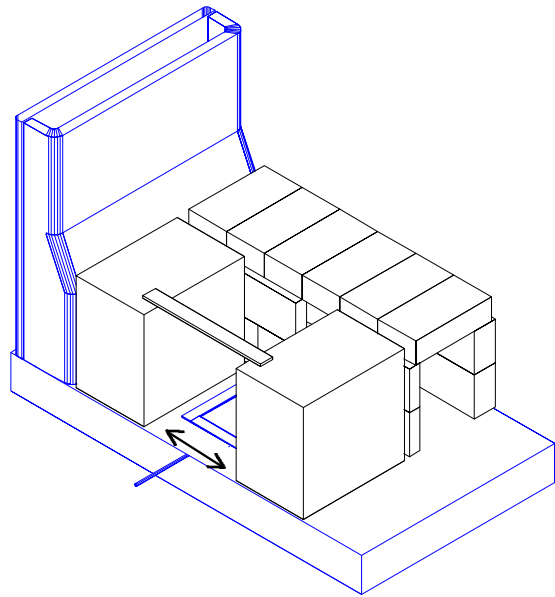


Figure 5

To form support for firebox floor, build up fill as shown to same height as firebrick. Use the 30 common bricks (see materials list) for the fill pieces. Arrow indicates approx. 8" channel for ashes.
 Install 14" flatbar as shown to provide extra support for firebox floor. Use mortar joint to gain height.

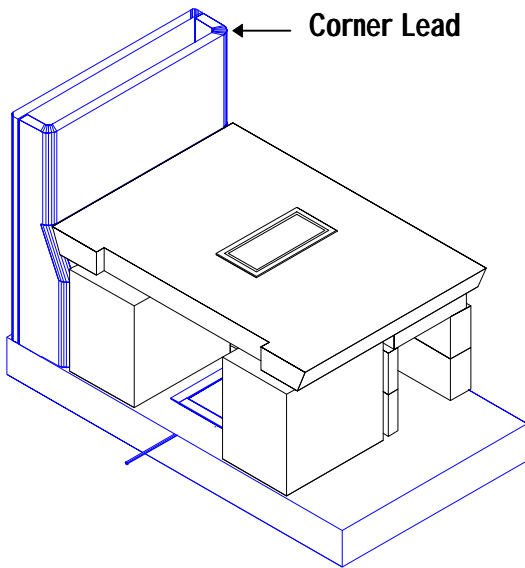


Figure 6

Install firebox floor onto generous mortar bed and level accurately.
 Back corners of floor line up with leads that are precast into lower channels.
 Ensure full mortar bed between flat bar and floor.
 You are now ready to build the firebox.

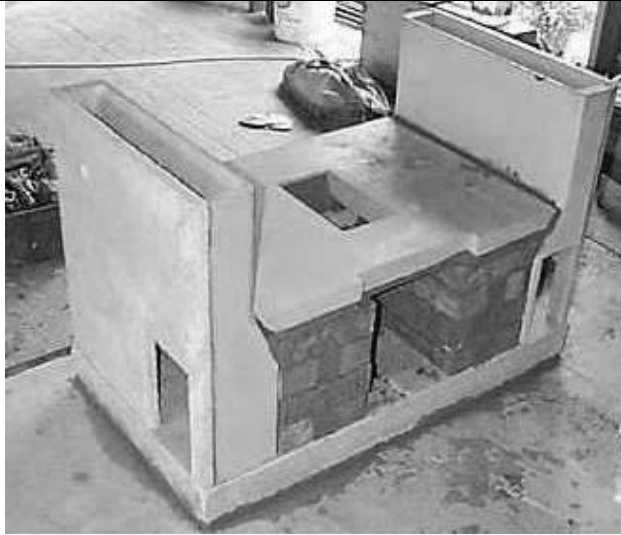


Figure 7

View of assembly up to firebox floor level.

Note that the fill bricks underneath the floor have been dry stacked in order to come out to the right height. Mortar is used to seal the head joints and the spaces between the bricks and the rear and side channels.

The 2 steel flat bars are mortared, and there is a full mortar bed between the flat bars and the firebox floor.

The two lower channel cutouts in this installation are connections for a heated bench.

Setting Firebricks

Firebricks are laid up with clay air setting refractory mortar (“Sairset”, or fire cement) with thin joints. Only enough clay needs to be used to completely fill the joint. No joint thickness needs to be built up - you are only filling in gaps and irregularities between the bricks. Although masons are used to trowelling firebricks, the best joints are obtained by dipping the bricks into mortar that has been thinned to the right consistency. It looks messy, but the cleanup is easy later with a sponge.

The Sairset that comes with the heater core kit is at trowelling consistency. For dipping, you will need to thin it with water. A drill powered drywall mud mixer works well for this. You can tell if the Sairset has the right consistency by floating a firebrick in it. It will sink about half way. We like to dip the bricks and also keep a margin trowel (small rectangular trowel) handy for the odd bit of trowelling.

Assembling the Firebox

The firebox is laid up from standard firebricks. Standard firebricks are 4 ½ wide by 9” long by 2 ¼” thick. The thickness will vary between 2 ¼” and 2 ½” depending on the supplier. Since the Heat-Kit is designed around the standard firebrick module, it is important to check the width and length of your bricks beforehand, to avoid having to make modifications to the assembly procedure.

There are two methods of building the firebox, **Method A** and **Method B**. Method A gives you a replaceable firebox, and method B is easier to build.

Choosing Between Method A and Method B

The advantage of a replaceable firebox is that, should the firebox ever burn out, you can replace it without dismantling the heater. Although we have never had to replace a firebox, there have been a handful of heaters over the years that required repair work to the firebox, usually replacing a few bricks at the rear bottom, where they get the hottest. All of these heaters were regularly over-fired by the operators. In addition they all had an older combustion air system that used a grate in the firebox floor. With this older air system, the burn rate was extremely fast, resulting in a lot of stress on all the firebox components.

The current combustion air system was developed after extensive testing. It is known as overfire air. Compared to the older underfire air, the heater burns cooler, cleaner, and with higher efficiency. The burn itself takes longer (about 2 hours as opposed to 1 hour).

We have not seen ANY damaged fireboxes since we have been using the new air system (about 5 years). This includes heaters that we have purposely abused. Therefore, building a non-replaceable firebox is a pretty safe bet. On the other hand, having the firebox be replaceable is a unique feature not found on other masonry heaters.

The replaceable firebox requires more cutting of bricks, and requires about 2 - 3 hours of extra time for a mason.

METHOD A

The firebox consists of two shells of firebricks set on edge. This allows the inner shell to be a field replaceable firebox liner. The firebrick installation sequence has been numbered. By following this order, you maximize the ability to “bury” odd lengths where they don’t show and reduce the

amount of precise cutting that you have to do. Note that full contact between inner and outer shell is not required at the inside corners. Where convenient, a little play right at the corner provides some expansion room for the liner.

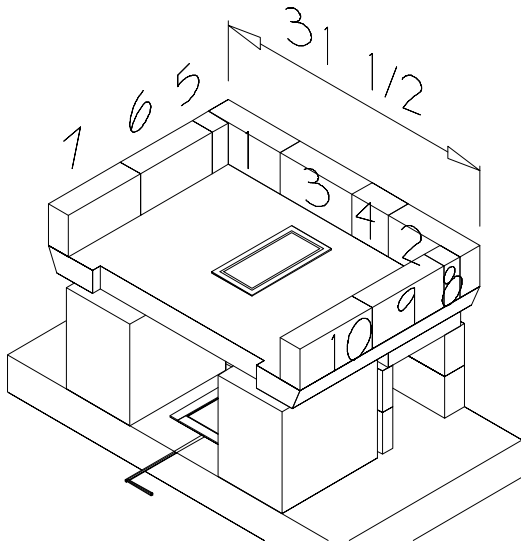


Figure 8

Lay out the firebox as indicated, using air setting refractory mortar. Line up back corners with the leads that are precast into the lower channels (right channel deleted from drawings for clarity).

Outer width of firebox is 31 1/2. Firebricks sit dry against base channels.

Figure 8 shows the firebricks numbered in the order in which they are installed.

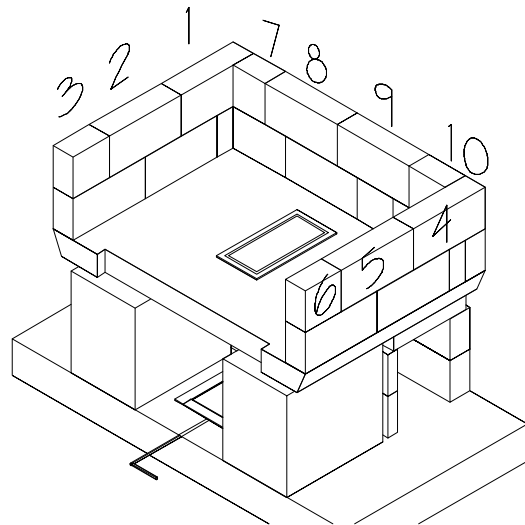


Figure 9

Exact bond is dependent on firebrick thickness, generally between 2-1/4" and 2-1/2".

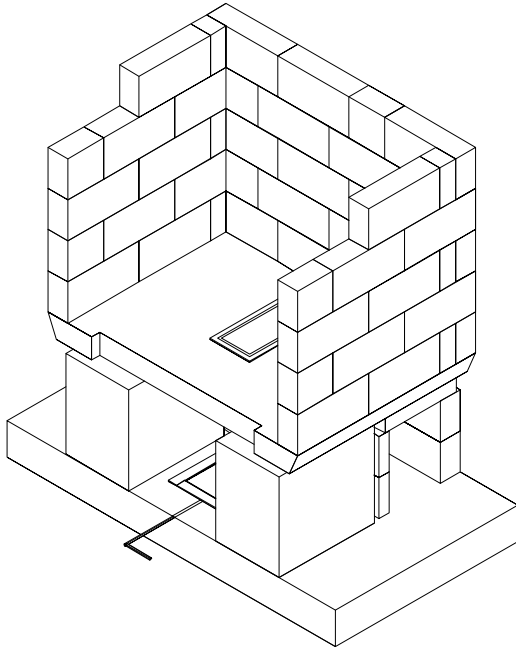


Figure 10

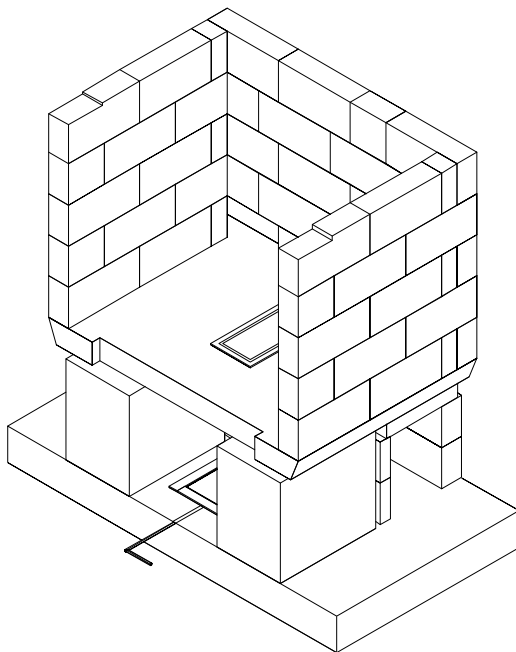


Figure 12

Top front firebricks are notched 1/4" x 4" for firebox lintel.

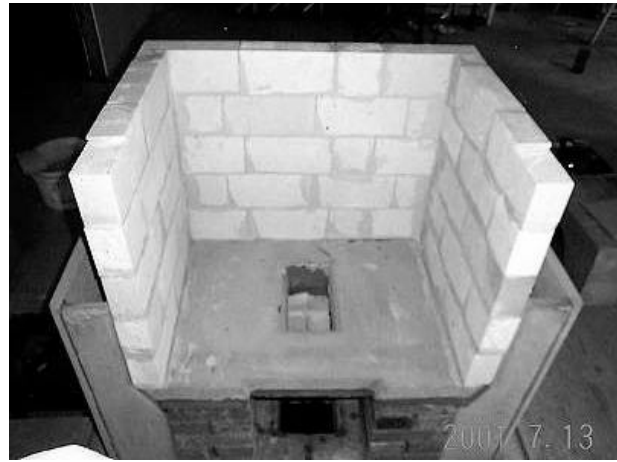


Figure 11

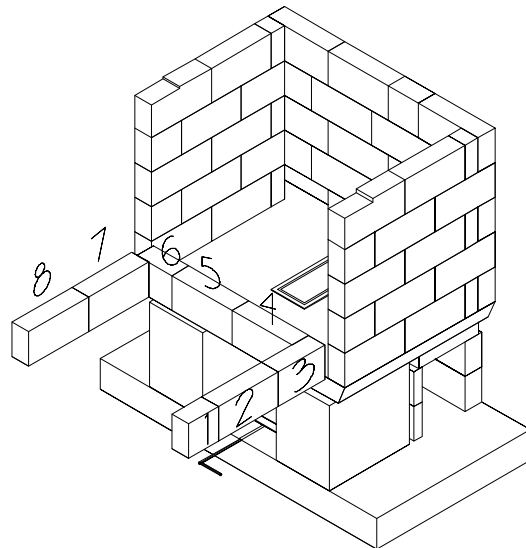


Figure 13

Begin inner firebox. Note that the bricks are left about 1/4" short at the blind inside corners. The cut edges on these bricks are hidden.

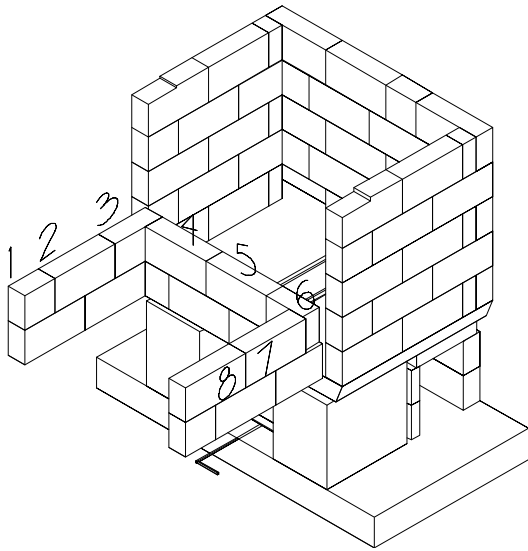


Figure 14

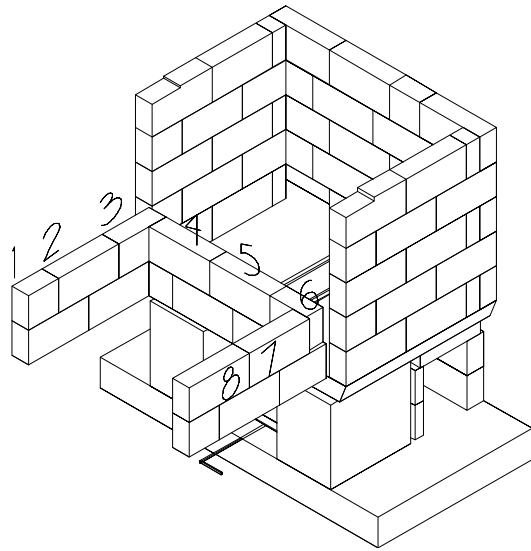


Figure 15

The inner firebox is set dry against the outer firebox. There is no mortar joint between the two fireboxes.

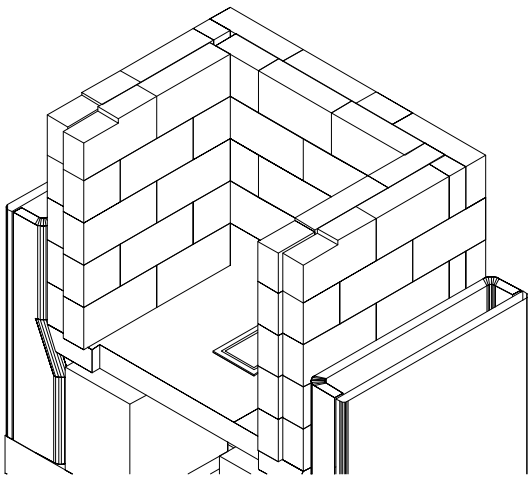


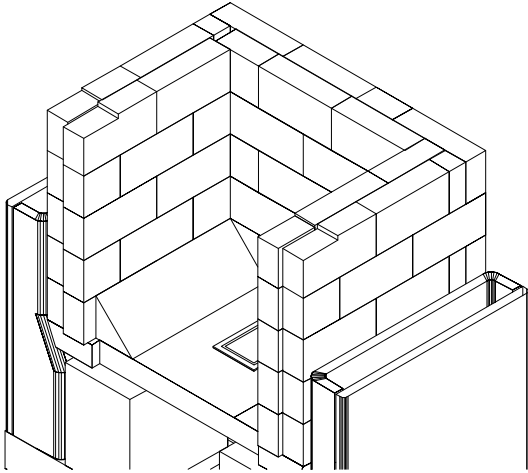
Figure 16

Notch top course of liner as shown. Notches are 1/4" x 4"



Figure 17

Immediately wash down the firebox with a sponge and a liberal amount of water. Rinse with clean water. If this is done right away, it is easy to get a clean looking firebox.



Firebrick floor slopes are glued in place with Sairset - this can be done later.

Continue at Figure 22

Figure 18

METHOD B

Use the same instructions for setting firebricks as Method A. Instead of building a double shell firebox with bricks set on edge, you will be building a single shell firebox using bricks set flat. Use the layout shown in Figure 19 to Figure 21.

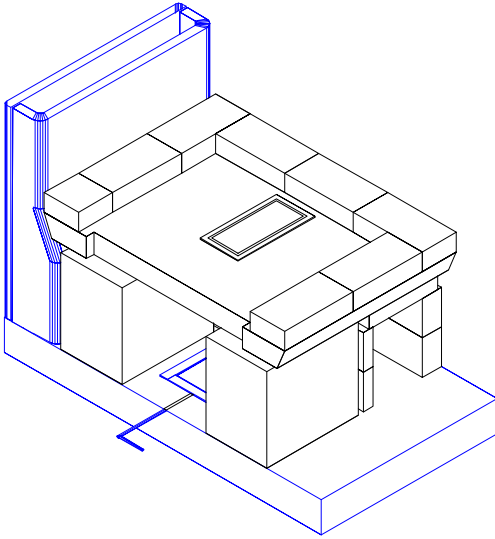


Figure 19

The cut edge of the half brick should point towards you as you stand in front of the heater.

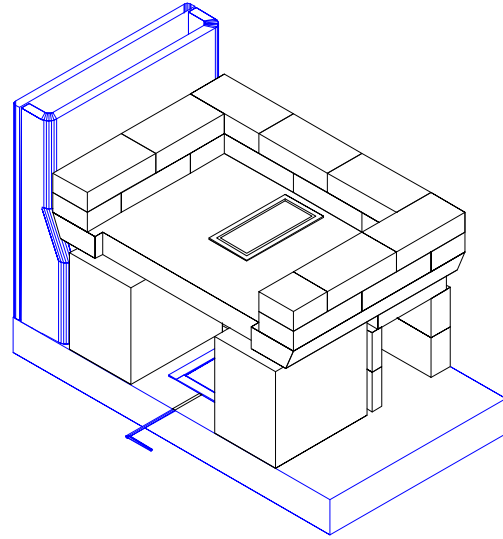


Figure 20

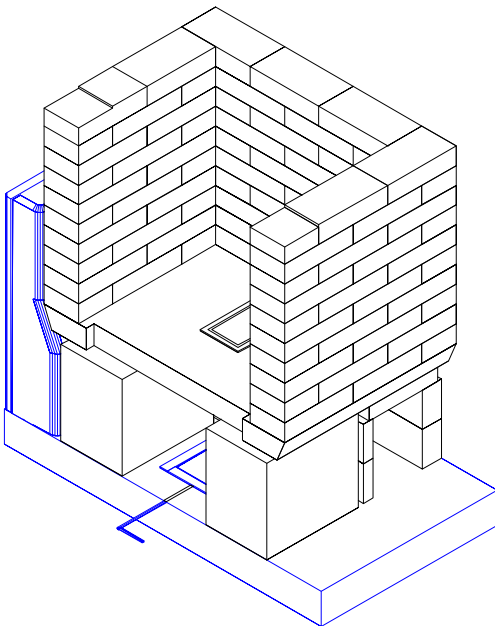


Figure 21

Notch the two front bricks on the top course 1/4" X 4" as shown. This provides space for the firebox lintel shown in Figure 22

Building the Upper Firebox

Rear Bake Oven: The drawings below show a front bake oven. For a rear bake oven, reverse the plan at this point. In other words, flip the remaining layout by 180 degrees.

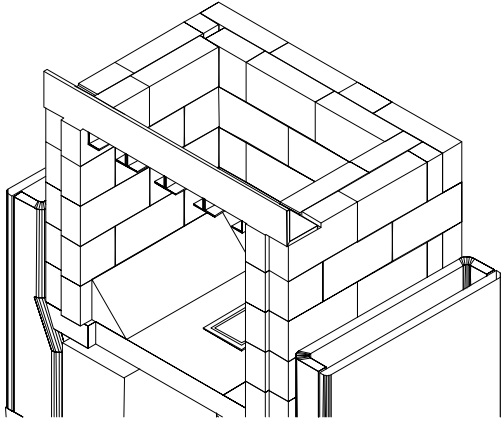


Figure 22

Install firebox lintel. Brackets on lintel are for heat shields (firebrick splits, installed later, see Figure 61).

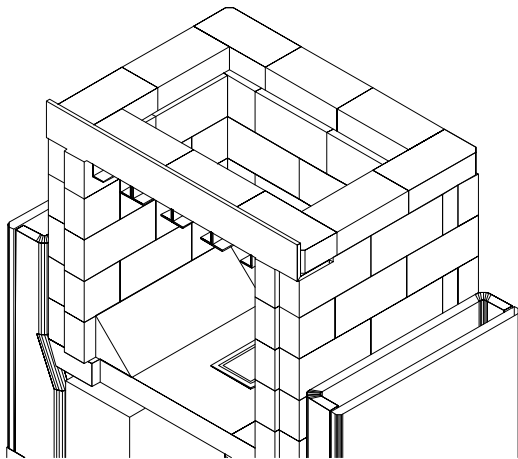


Figure 23

Lay up next course as shown. Use a dry joint with lintel.

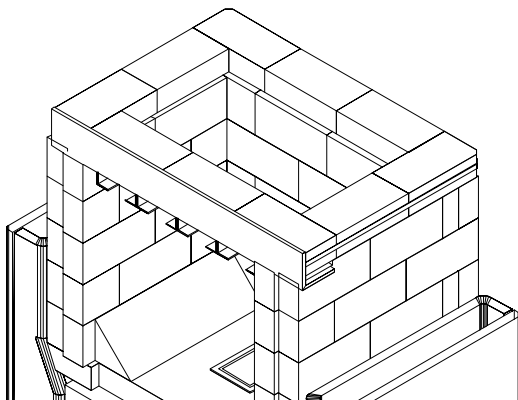


Figure 24

If you have access to strapping tools, this course can be strapped as shown. This is optional. If a strap is used, then round outside corners of bricks slightly.

The purpose of the strap is to transfer weight onto the outer firebox.

This allows the complete inner firebox to be removed, if necessary, rather than in sections.

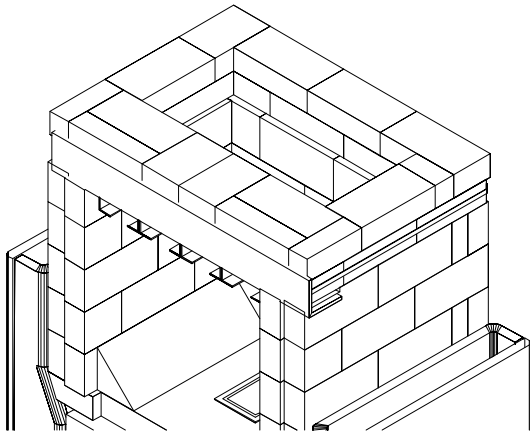


Figure 25

A total of 10 soaps (5 bricks ripped lengthwise) is used. All bricks are either full length (9"), $\frac{3}{4}$ length (6 $\frac{3}{4}$) or half length (4 $\frac{1}{2}$)

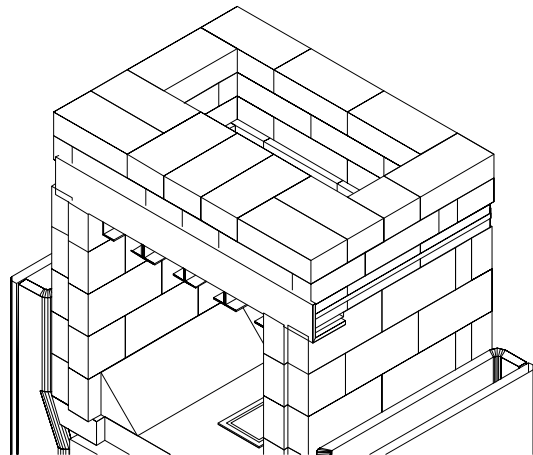


Figure 26

Next course.

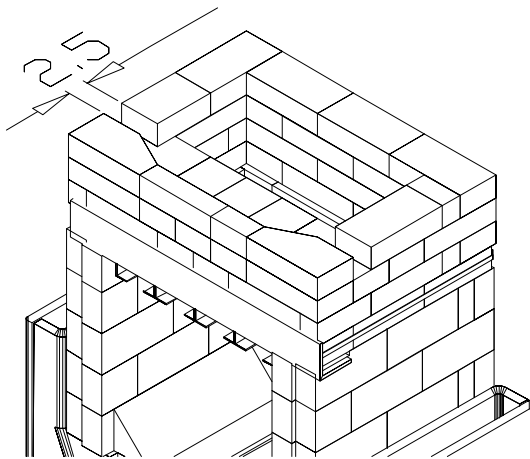


Figure 27

Check bricks for level before starting this course to see if there are high or low spots. When setting this course, carefully level the section where the oven will sit.

Cut front corner bricks as shown. Leave oven floor heat bypass gaps as shown. Standard gap is 2 $\frac{1}{2}$ inches.

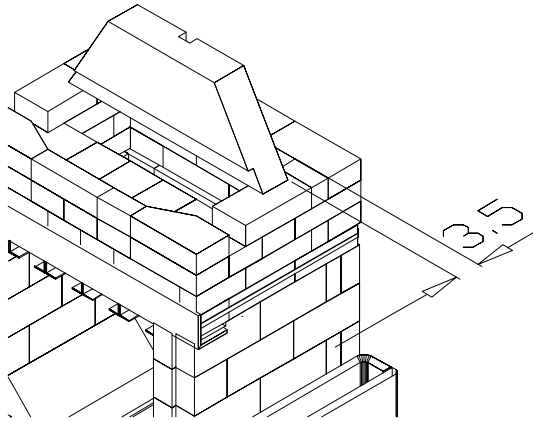


Figure 28

Dry set oven back as shown. Leave a 3 $\frac{1}{2}$ inch channel behind.

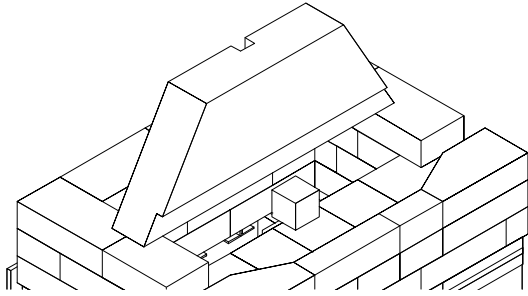


Figure 29

Install small floor support piece as shown.

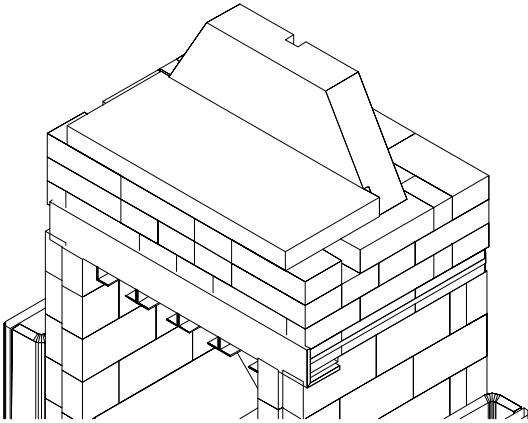


Figure 30

Install oven floor as shown. Set floor into Sairset. Inset into relief in oven back, without Sairset.

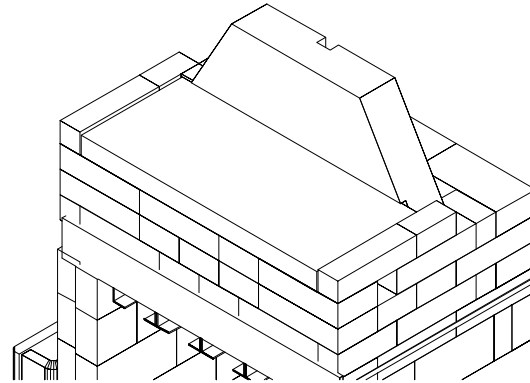


Figure 31

Install soaps as shown and level.



Figure 32

Photo of oven back and oven floor in place.

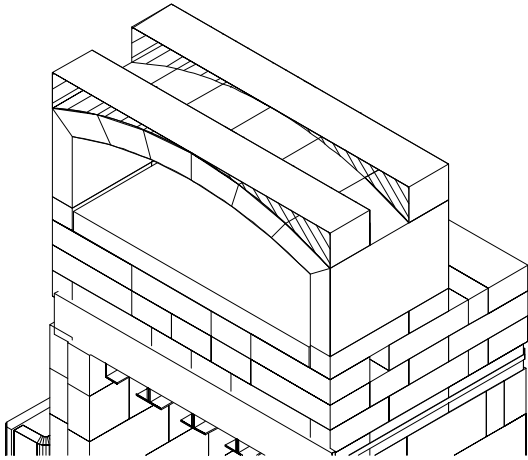


Figure 33

Apply Sairset to the soaps that will be under oven sidewalls. Make sure that you have adequate foot scaffold, and install large oven casting as shown.

Use a helper, being sure to set oven straight down vertically onto back.

The oven and floor are flush with the outside of the core.

Note: ignore the extra lines on the drawing of the oven itself. These are an artifact of the CAD drawing system.

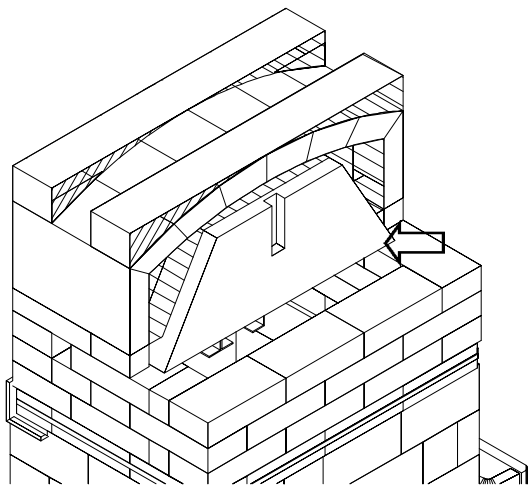


Figure 34

View from rear.

If necessary, oven back insert can be shimmed with cut-up brick ties to ensure snug gasket space at top (other side)

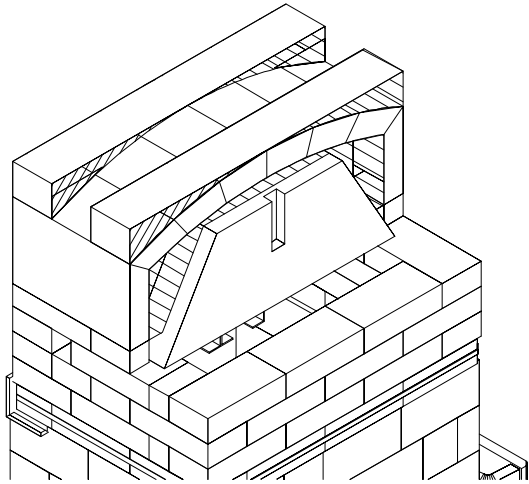


Figure 35
View from the back

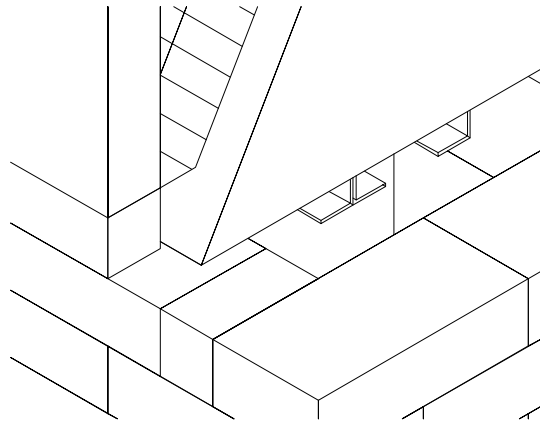
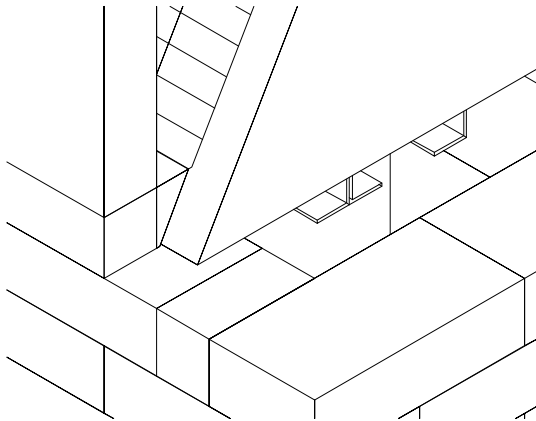


Figure 36
Closeup of rear corner of oven.



Install small wedge cuts (supplied) where shown. Mortar them in with Sairset.

Figure 37

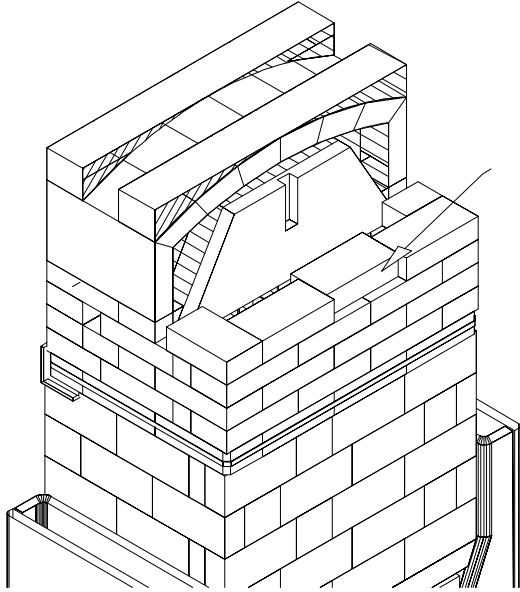


Figure 38

Project back brick $\frac{3}{4}$ as shown to form ledge for millboard.

The recess formed by the setback brick can be filled later with ordinary mortar to maintain a smooth surface on the outside of the core.



Figure 40

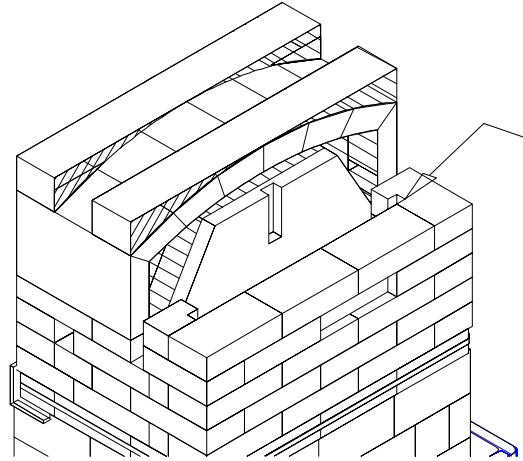


Figure 39

Form notches as shown for 1 inch millboard. Make notches slightly over 1 inch to allow for irregularities when sliding in millboard. The easiest way to cut these notches is to make 2 or 3 saw kerfs and pop the piece out with brick hammer.

There are 5 courses of notches.

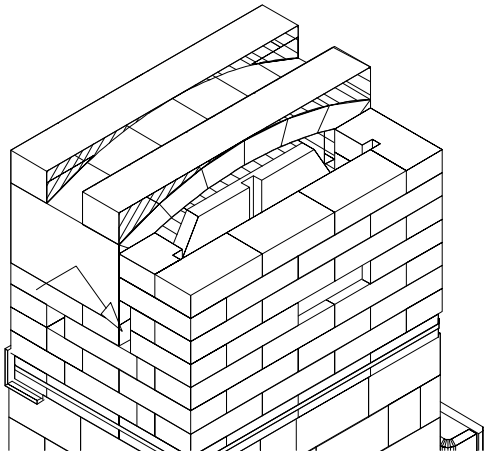


Figure 41

Note that first two courses of notched bricks are shorter, to clear oven back insert. Continue as shown

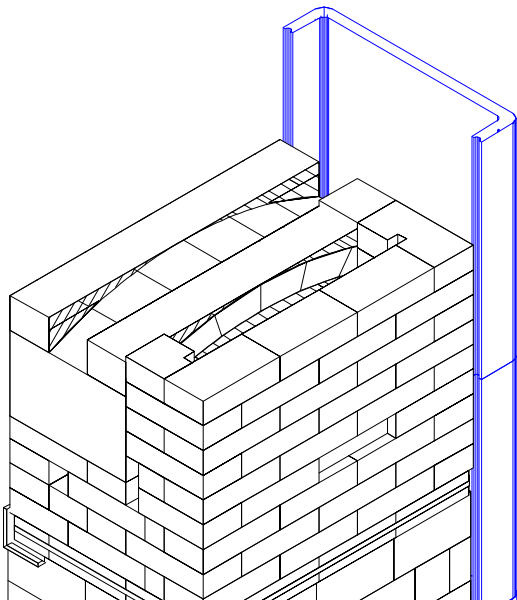


Figure 42

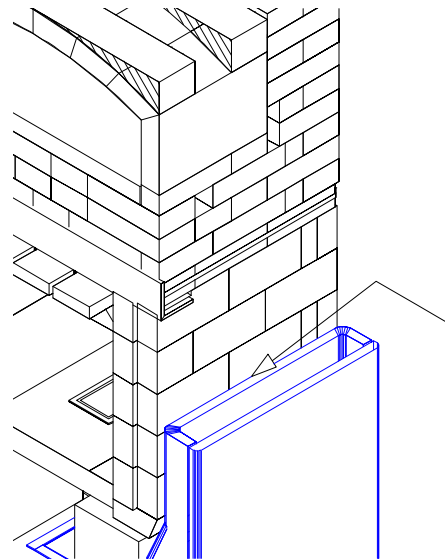
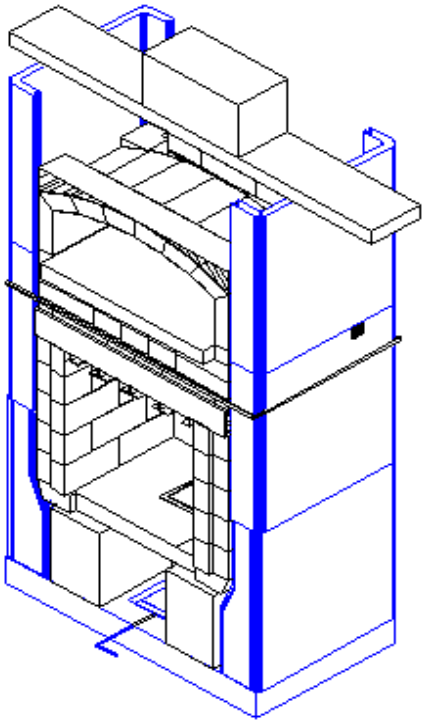


Figure 43

Seal horizontal gap between lower channels and heater with a bead of silicone

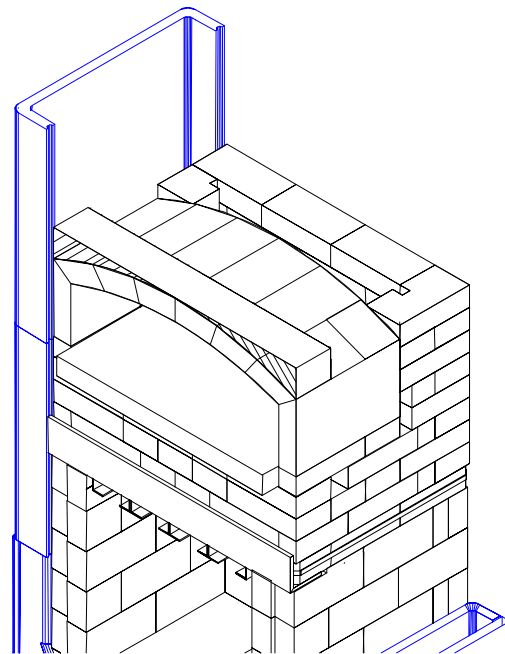
**Figure 44**

Install middle channels onto a bed of Sairset.

Strap middle channels or use tie wire. When strapping, compress expansion joint gaskets no more than 50%.

Clean off joints from inside. Make sure there is no mortar bridging at the expansion joints from inside.

Install top channels and brace temporarily as shown.

**Figure 45**

Right channels not shown for clarity.

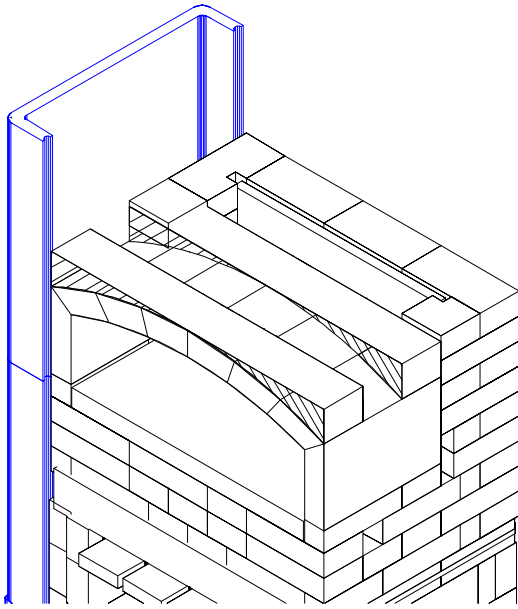


Figure 46

Slide in 24 1/2 x 12" millboard. Handle millboard carefully.

The purpose of the millboard is to maximize the heat transfer to the oven back.

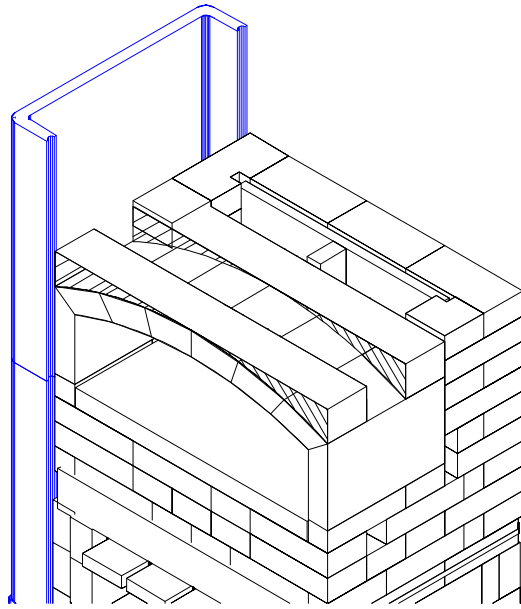


Figure 47

Rip firebrick split and insert into oven back notch to form retainer for millboard as shown.

Install fiberglass rope gaskets (supplied) inside oven. Use a screwdriver or similar tool to stuff the gasket into the space provided around the oven back insert, and around all 3 sides of the oven floor.



Figure 48

Completing The Core

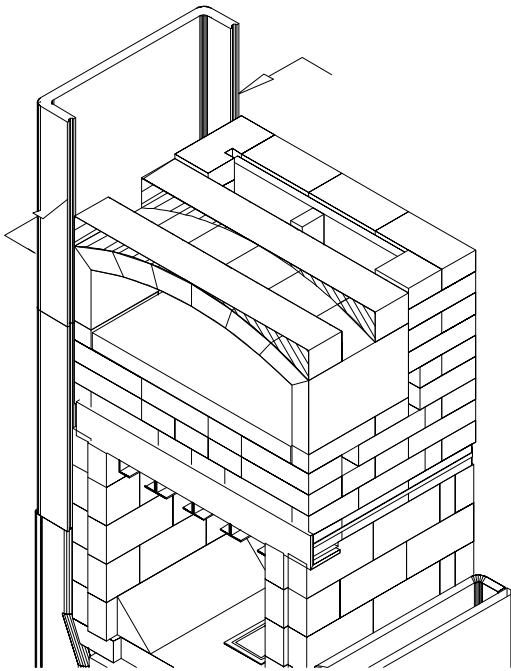


Figure 49 Height adjustment

At this point, a height adjustment is necessary.

Measure the height of two courses of firebricks (for example, 4-1/2"). Add 5" to this distance (for example, 9-1/2")

Place a pencil mark this distance (9-1/2" in this example, for this particular brick) from the top on all 4 channel ears.

The pencil mark indicates the top of the next course. If an adjustment greater than 1-1/4" needs to be made, insert a course of splits. If the adjustment is less than 3/4", use ordinary brick mortar. For 3/4" to 1-1/4", use castable refractory. Alternatively, you can cut the bricks to height on a brick saw.



Figure 50

In this example, a row of splits and a 1/4" mortar joint is required.

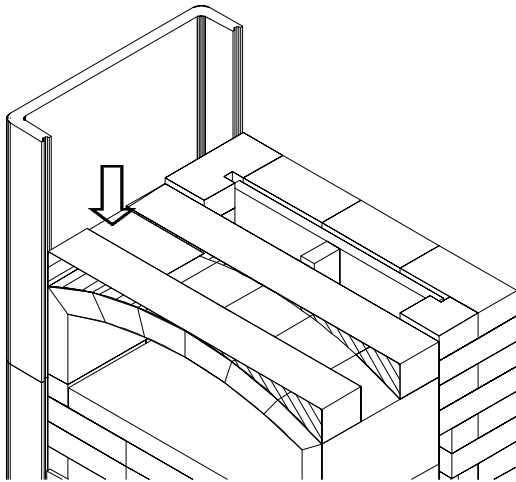


Figure 51

Fill in the oven notch as shown. Use castable refractory or a cut piece of firebrick

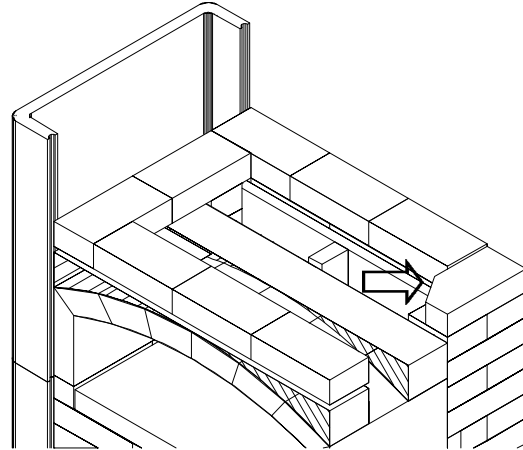


Figure 52

Make the height adjustment and proceed as shown.

Note chamfered brick.

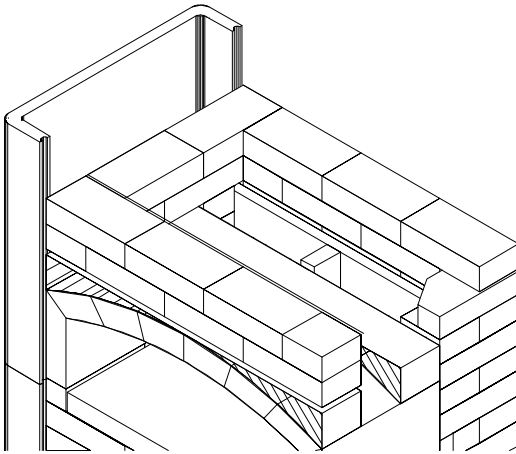


Figure 53

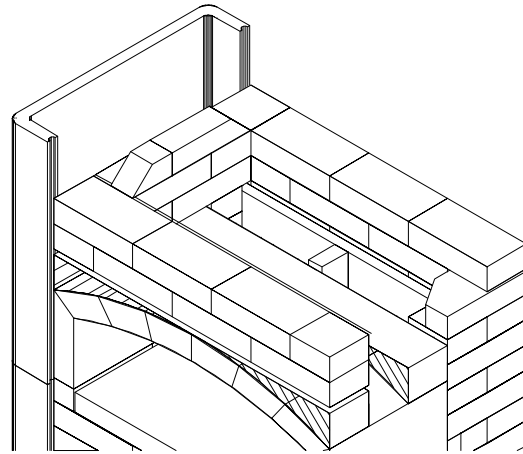
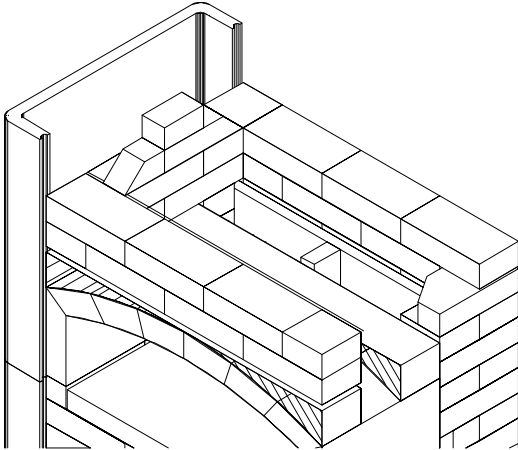


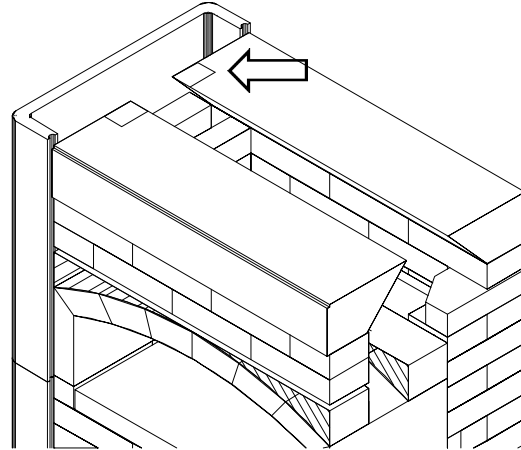
Figure 54

Install 1-1/2 soaps with 45 degree angles cut into the ends.

Smooth off the ledge that is created with mortar.

**Figure 55**

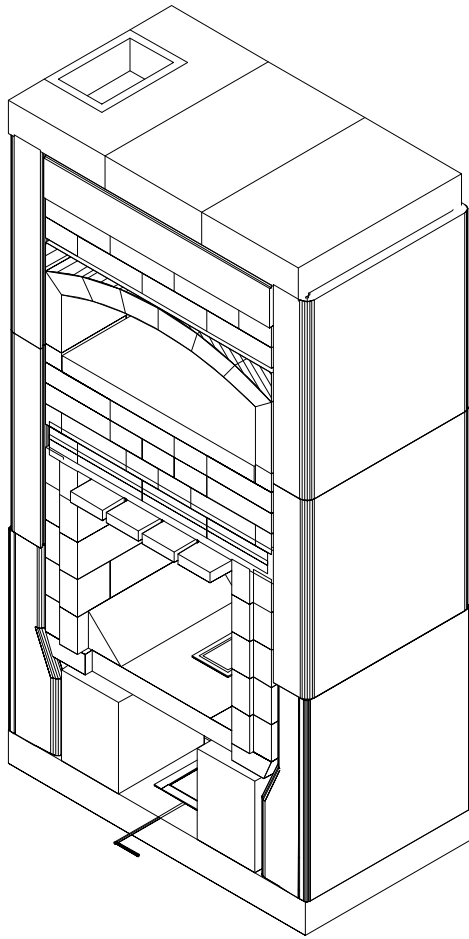
Top off with a half soap. The gaps on the end serve as a “gas slot” or small permanent bypass to aid with cold starts.

**Figure 56**

Notch ceiling transitions where shown. Notches are 2” wide (left to right) and 3” deep.

Install ceiling transitions. They should be 1/16” to 1/8” higher than side channels.

Use a full bed of Sairset.



Install ceiling slabs. Use a helper, and set up adequate staging (foot planks).

Using GE clear silicone, carefully seal all ceiling slab joints, particularly the shiplap joints and the bottom joint. If gap between slab and top of side channels is greater than $3/16$ " , stuff with ceramic fiber first.

Next, check firebricks for full joints.

Next, check side channel gaskets and use silicone to tighten where needed.

Figure 57

Fiberglass Slip Joint

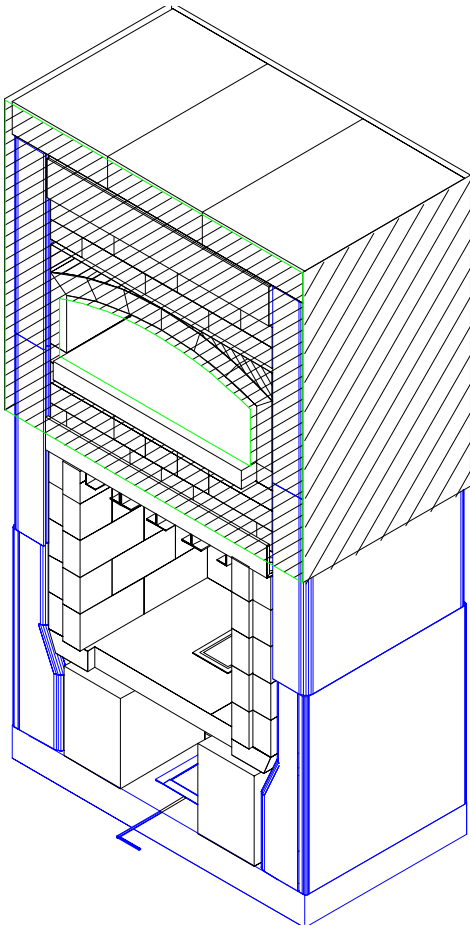


Figure 58

Next comes a double wrap of fiberglass matt to act as an expansion and slip joint. The mat is somewhat fragile, and releases glass fibres if handled too much - wear old clothes.

Two pieces of fiberglass are supplied -- a 38" wide piece and a 52" wide piece. Start with the 38" wide piece.

Quickly dab silicone approximately 4" - 6" o.c. over entire area indicated. Start at top of ceiling slab and go 38" down. Carefully unfold fiberglass mat and, with a helper, wrap around heater. Make sure mat goes all the way to top of ceiling slab. Have helper hold in ends in place, and go around heater, patting the mat onto the silicone.

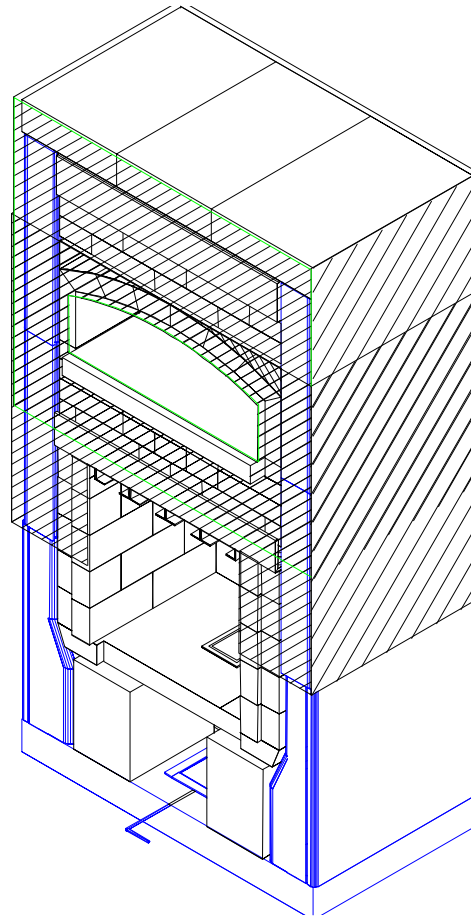


Figure 59

Trim to give approx. 4" overlap, and secure end with metal tape supplied

Second wrap of fiberglass mat is 52" wide, and also starts at top. Use same procedure as before. Trim around firebox and use offcuts to cover exposed firebricks at front. (Figure 60)

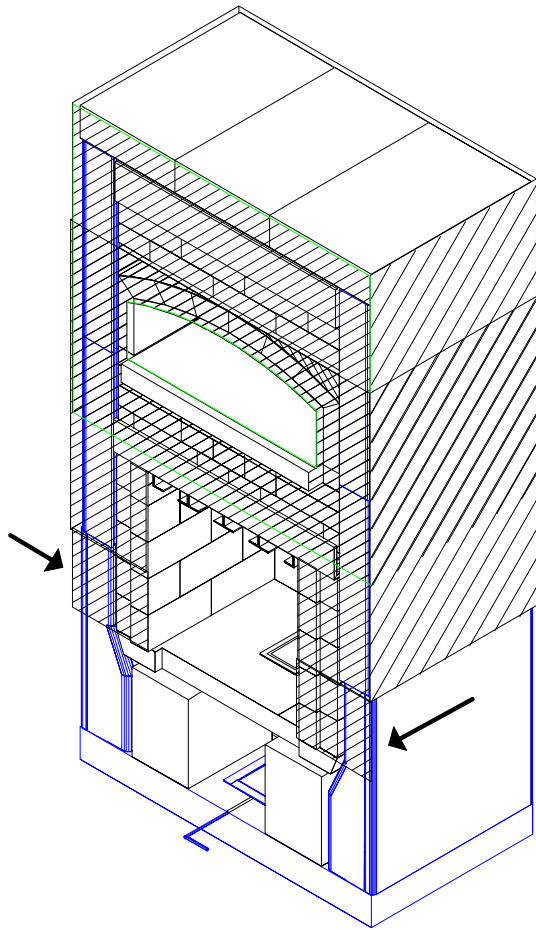


Figure 60

Add two additional pieces as shown.

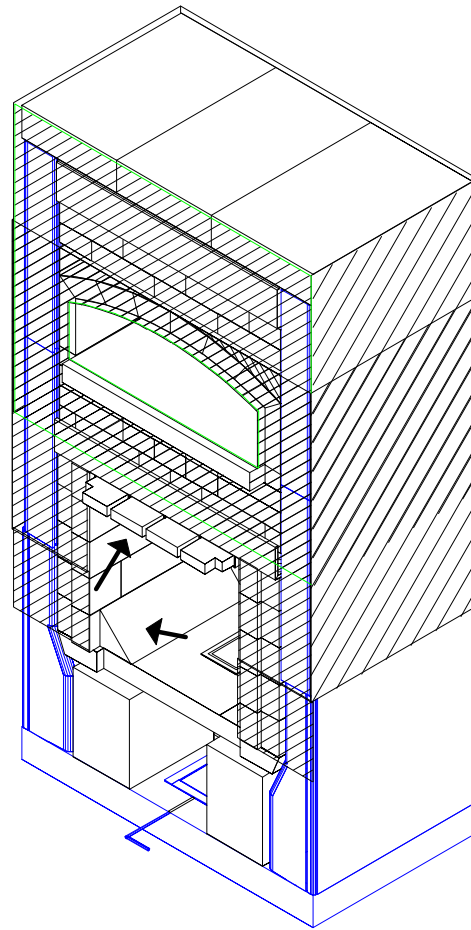


Figure 61

Note location of firebrick split heat shields. Outer bricks are notched to clear facing.

If not installed already, set sloped floor pieces onto a bed of refractory mortar, similar to setting a firebrick.

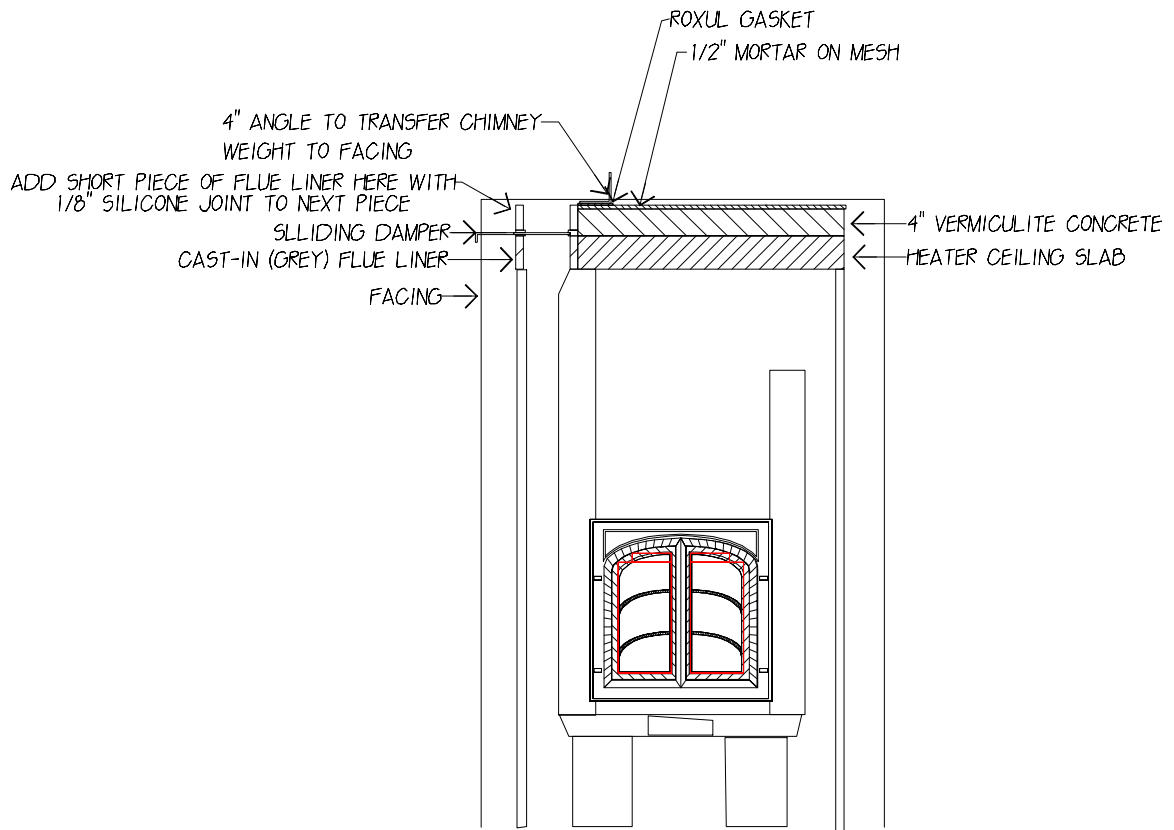


Figure 62

Section showing flue damper and connection of chimney flue at top of heater.

The heater core expands up and down, and cannot carry any weight. Therefore, the weight of the chimney has to be transferred out onto the facing, using angle iron.