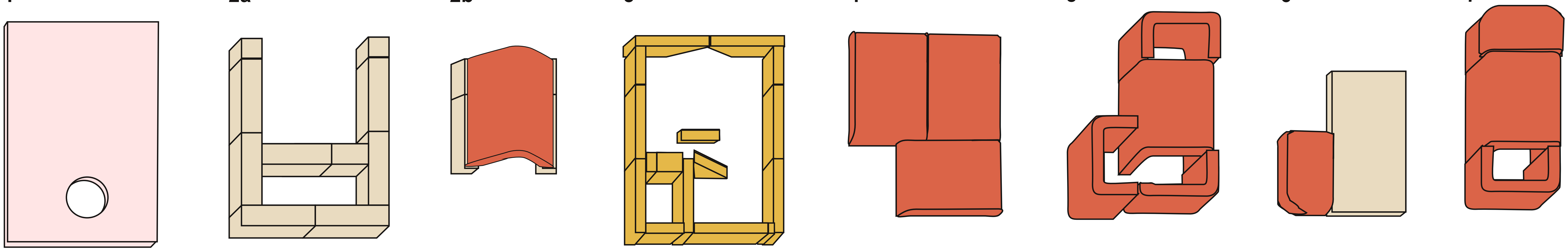
1 2a 2b 3 4 5 6 7



Kiko's Heater Hat:

Drawings by Erica Wisner, based on Kiko Denzer's report at www.handprintpress.com:
http://www.handprintpress.com/authors/masonry-heater-hat-videos-construction-details/
http://www.handprintpress.com/ovens/bring-in-the-mud/

Kiko Denzer built this "heater hat" prototype, a mini masonry-heater atop a small woodstove. Above are the complete set of parts. Below, you see how they fit together.

1 - A large slab of high-temp refractory cement, with a hole cast into it to fit the stove's collar. Mortar and kaowool gasketing are used between stove and slab (expansion joint and seal).

2a- Firebrick, cut and pieced as needed, define the outer perimeter and the back of a "white oven" (smokeless baking oven).

2b- The oven, made from pieces of firebrick and ceramic chimney liner.

3- Half-firebricks continue the walls and trap the smoke. The center-bottom brick traps some heat around the oven. Firebrick are cut to fit over the oven's curved shape.

3b) Scraps of firebrick block the back of the oven, and support the next course over the oven roof. (The scraps shown vary slightly from Kiko's video, but show the general placement.)

4- A floor course of large ceramic slabs, mostly made by cutting down wide chimney-liner tiles

5- A set of channels in cut chimney tile. The side channel with no floor is the 'chimney' for the course below. (Note: The side slot connecting these channels does not show in the video; it was cut later.)

6 - Capping slabs of tile or refractory. The grey slab stops short of the end to allow smoke upward.

7 - Final channel: capped at far end, open at back to exhaust into stovepipe chimney over the original stove opening.

Assembly:

After dry prototyping, the assembly was built in place. Bricks were set w/homemade mortar: fines and clay; thin joints. (Note: commercial refractory cement is just fines, sodium silicate, and water. Kiko's formula is a traditional masonry heater mortar, with clay as the binder instead of sodium silicate).

An outer layer of earthen plaster provides secondary seal, with decorative tiles and slabs set in the plaster. The wooden oven door is carved to fit the opening, and clay plaster at the edges makes a perfect fit. (The traditional wooden door is soaked before baking, and has not needed replacement yet.)

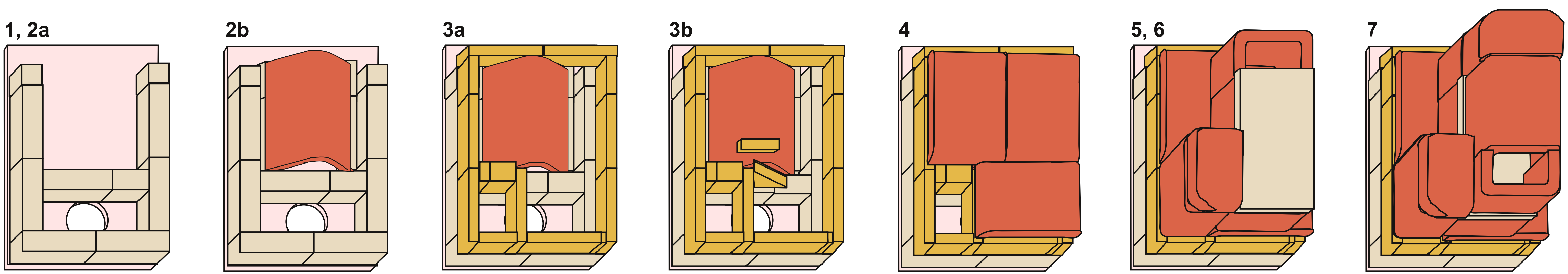
Performance Report:

The hat is holding up well, stores heat for hours or even overnight, and has baked numerous loaves of bread.

The uneven shapes and heating have caused a few cracks, some big enough to leak smoke (with the damper closed) and presumably air (with the damper open). With earthen plaster, cracks can be repaired almost as soon as they are detected. Kiko also wishes he had included more cleanout access to the channels somehow.

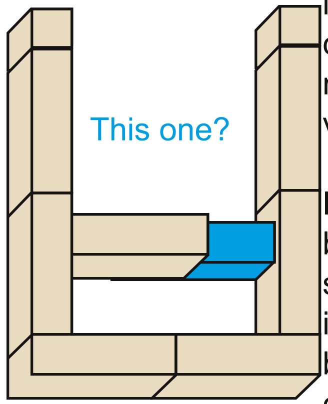
Next Steps: Kiko is considering a similar design with more symmetry (like a round bell to trap heat), to reduce the stress that comes from different-temperature parts and the concentration of those forces at particular points in the design.

1, 2a 2b 3a 3b 4 5, 6 7



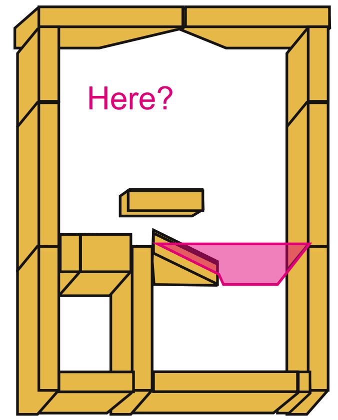
2a

NEW, ADDITIONAL NOTES TO THE PDF SCHEMATIC:



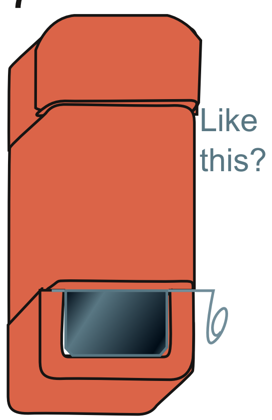
in 2a, the left hand brick in the upper horizontal course is short, allowing gases in the oven bell to move around and up (this is barely visible in the video).

3



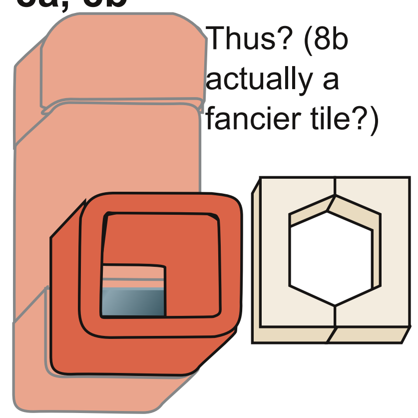
In 3, the bricks above that slot (middle horizontal bricks on the left) must also be sized so the cross-sectional surface area is the same as the entrance into the heater (i.e., the same as the hole at the bottom of fig. 1 — it may be that I removed them completely?). While this is not evident in the video, the heater would not work w/out it. I must have caught that error when I was actually laying up the brick. While the detail photos don't actually catch that step, they provide a bit more info and context than the diagram.

7



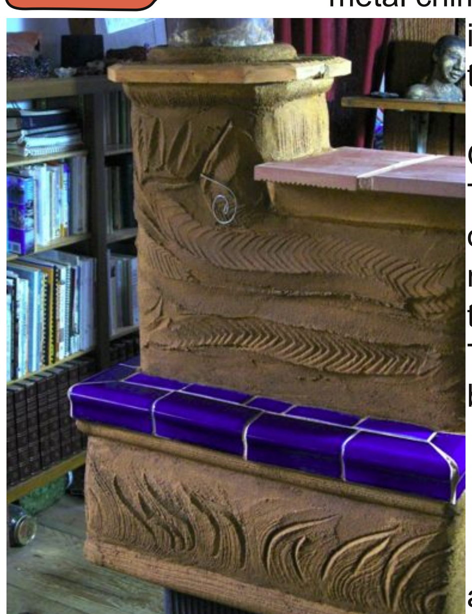
At fig. 7, there is a damper made out of stainless sheet metal. See the detail photos for a good view: the hinge is a bit of wire running L to R along the upper side. The sheet metal wraps around the wire. The L end of the wire makes a pin which sits on the brick. The R side goes through the brick to make the handle, which is bent into a spiral.

8a, 8b



Thus? (8b actually a fancier tile?)

What would be fig 8 (see detail pix) is just a final bit of square tile to make the final connection to the metal chimney. The end of the metal pipe is wrapped in a kaowool gasket mudded in place (visible in the photo as a 1/4 round collar).



A photo of the cracks seems like the easiest way to show this - we can increase the contrast or highlight the cracks on a high-res photo.

On cracking: most of the cracks are vertical. Three of them extend from level 2 to level 4, one each at the corners, and one in the middle. The middle crack continues up through the next level — that's the widest one. The horizontal crack is at level 4, from the bottom L up to the bottom of the flat red tile.

questions:

Q: When the smoke first exits the iron stove can it either circulate around the top of the oven, as well as taking a more direct path into heat-absorbing labyrinth? In other words, can the smoke take one of two paths, or must all of it circulate over the top of the oven? It appears to me that the smoke can take two paths.

A: as drawn in the plans, the oven chamber will function as a "bell" — a chamber where gasses stratify, allowing for heat transfer up high, and flow below (cooler gases would flow below the central yellow brick at the bottom, over the round hole from the firebox). However, I may have actually left a passage on the right side of 3a and 3b, to allow hot gasses to flow through the oven chamber. Since I haven't opened it since building it (several years ago now), and since I didn't manage to document every detail, I can't say for certain. That said, both strategies can work. Look up "bell theory" for more info and designs, and see the "russian rocket" post in the home heat section here on handprintpress.

Any clarification needed in the diagrams? Could you doodle a smoke-path on top of one of the photos, e.g. on a printout, then send the picture?

Q: What is the purpose of the second slab of refractory cement (layer 6)? Why don't you instead use flat sections of the flue tile, such as you use in layers 4, 6, and 7 to cap off vertical runs?

A: layer 6 is a thin casting of leftover refractory that I used to add mass and to cover a gap that needed covering. The whole thing was made of scrap bits and pieces.

Q: Is the first slab of refractory cement (layer 1) reinforced in any way? How thick is it? Since it overhangs the iron stove is there any concern that it might crack and break under the load of the masonry it is supporting?

A: layer 1 is not reinforced. It's 1.5″ thick. The overhang is approximately 3″. I thought of adding legs for extra support, but after I'd built it, it seemed to me that the weight of the masonry was not enough to cause an unsupported 3″ of layer 1 to shear off. So far, I haven't seen any evidence to the contrary. See Max's comment (after this one) and sketch of another solution to this problem.

Q: From the added photos it appears that the Layer 1 slab has a hole in it under the oven section, presumably to allow more heat from the iron stove to radiate into the oven. That hole is not shown in the PDF diagram. Do you bridge that hole with anything when it comes time to actually bake something in the oven?

A: No: layer 1 only has the one hole. The hole you're seeing and referring to is actually a hole in the top of the iron stove itself; it was originally covered by an iron plate over the firebox. I removed the plate to allow more direct heat transfer to the bottom of layer 1, which does also serve as the oven floor.

Q: Have you ever heard of anyone building a masonry heater using flexible or rigid stainless steel smoke pipe instead of fire brick or flue tile to conduct the flue gasses, and then just using ordinary brick to absorb heat, and for the main structure?

A: Yes, absolutely. What you're describing is the ducting approach used in building a rocket mass heater (tho you can use mild steel pipe if you can't find or don't want to pay for stainless). But if you're going to go to the trouble of wrapping the pipe in brick, you don't really need the expensive pipe, too. By the same token, if you use pipe, you can just wrap it in cob (much easier than laying brick!)

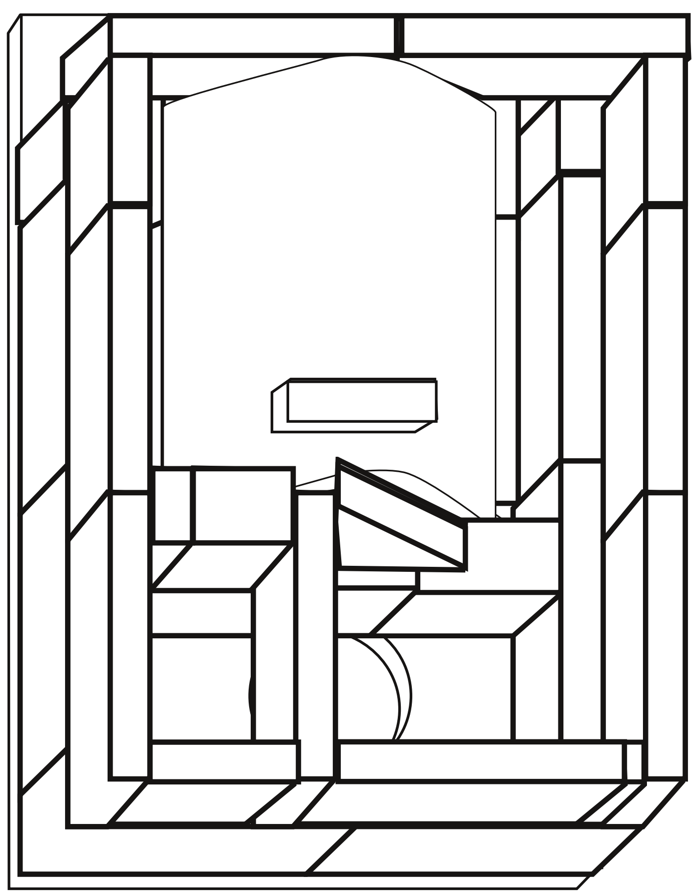
Q: It seems to me that an inexperienced DIY mason would be better off relying on the SS pipe to not leak smoke, rather then hoping that he had designed the firebrick channels in such a way that they did not crack. Plus, the round, smooth SS pipe would create less turbulence of the smoke, and so might draw better then the square-ish masonry smoke channels.

A: yes. The basic masonry heater design came from an era when steel pipe was not available. However, despite all theoretical concerns about flow and turbulence, the square brick channels work! That said, many modern heater masons will use extruded clay tiles for channels exactly because they're smoother and easier than laying lotsa little brix. Finally, depending on how hot the pipe gets, metal and masonry together can generate problems due to the fact that metal expands more with heat than masonry.

Thanks again for sharing your interesting ideas,
John Hess

Please doodle the flow path on these if you'd like a flow path diagram in the plans. We could also show those critical cross-sectional areas as transparancies intersecting the flow path.

3b



7