Wood Fired Oven

Introduction

This document is meant to provide instructions and advice on the construction of a particular style of wood-fired oven. It is meant to be very detailed as to be useful for someone with little construction experience.

Overall design

Planning

Foundation

When planning your foundation, you need to think about the type of soil and the climate you live in.

You can also think about ground pressure. To calculate ground pressure, take the total weight of your oven including the foundation and divide that by the area of your foundation. This is the ground pressure.

Stand

The purpose of the stand is to lift the oven up off the ground to a comfortable height for cooking. The easiest and cheapest way to build your stand is using cinder blocks.

Hearth

Recessed Hearth

In a recessed hearth, a void is created in the concrete. This is where the floor insulation and brick will sit. The purpose of a recessed hearth is to make the perimenter concrete flush with the floor of the oven.

A gap of about 1/4 inch should be left between the floor and concrete for the floor to expand as it heats up. It would also be wise to have insulation between the floor bricks and the perimeter concrete.

Getting the floor to be level and level with the perimenter concrete was fairly difficult. And after hours carefully spreading sand, my floor did not come out as perfect as I would hope. Therefore, if I build an oven like this again, I will look into concrete leveler. Concrete leveler comes as a powder that is mixed with water. I forms a thin mix that can be poured and naturally levels using gravity. I want to see is this could be used on both the top of the concrete

perimeter to get it perfectly level and also on the center of the hearth. Then you would have two surfaces that are perfectly level. And possibly, you could use adjust the thickness of level used on each of the surfaces to get the height difference perfect for your floor insulation and brick. If it works as I'm imagining, you could get a perfectly level cooking floor that matches perfectly to the perimeter concrete with alot less hassle. For me, this would have been well worth the high price of concrete leveler. And if you dont want to have the concrete leveler be the finished surface on the perimeter, you can cover it with tile, grantite, or whatever you want; you just have to account for this in the height difference between the surfaces.

Dome

Brick Dome

The tradition method of constructing the dome is using brick.

Cast Dome

There are two ways to build a cast dome: cast-in-place or prefabricated.

Cast-In-Place

With cast-in-place, you build forms and then pour the dome directly on your oven floor. You building a form which fills the inner volume of your oven. You also need some forms around the outside.

Prefabricated

You can buy prefabricated domes. These can come are a single piece or in several pieces.

You can also make your own prefabircated dome.

Segments

You can divide the dome into equal slices like a pie. For example if you divide the dome into ten pieces, each piece will cover 36 degrees of the circle of the dome.

Do pour these segments, you will need a mold. Each segment has 6 faces: Two sides, an inner surface, outer surface, bottom, and nose. The nose surface is created when you truncate the tip of the segment where it meets the axis of the oven.

I had some trouble with concrete adhering to the form. I have made the curved inner surface of the form out of styrofoam. I then covered the styrofoam in drywall compound so that I could get a smooth sandable surface. I then painted the inside of the form with laquer paint, thinking that this would make the concrete come out easier. It was then that I learned that certain paints disolve styrofoam. I also sprayed cooking spray liberally all over the inside of the form before each pour.

My two test pieces came out very easily. But when I went to take out the first piece with refractory concrete, it would not separate from the form with just tapping with a hammer. I had to drive chisels in between the piece and form at the top and bottom to pry it out. Once out, I found that large sections of the drywall compound had been pulled out with the piece. I then had the idea to line the inner surface of the form with kitchen plastic wrap.

If you make your segments too large to effectively manuever by hand, you will need another method for lifting them. Consider not just getting them out of the form, but also lifting them onto the oven floor and mortaring them. Applying the mortar and setting the segment precisely can be very challenging with a large segment.

Since I made my segments very large (around 120 lb), I needed a way to lift them. I thought of different methods using lifting straps. The problem with using straps is that when you go to mortar the segment in place, there will be straps where you want to apply mortar and you will have to somehow remove the straps *after* you set the piece in place. This might be possible if you left small sections un-mortared where the traps are. But this sounded like alot of work and overly complicated.

Through-Hole

Then I thought of the idea to add a lifting point anchored to the segment itself.

One method would be to drill or cast a hole through the piece. An eye bolt would then be inserted. I have not tested this idea and one concern I have is that there will be high stress concentrations where the bolt makes contact with the concrete. However, the concrete could be cast with an extra feature that acts as a shoulder for a washer to make contact with, which would spread the stress more evenly on the concrete.

The best way to do this would be to cast the eyebolt in place in the concrete. That way, the eyebolt can be used to lift the concrete out of the mold. I will remove some material from the inner surface of the mold to make room for the eye bolt and a nut. This will also make a cylindrical feature of concrete extending from that inner surface. A washer will sit on the face of that cylinder. The feature can be cut or ground off later and the hole can be plugged with mortar.

We need to make sure that the bolt will come out of the concrete later. I will tape any threads that would be in contact with the concrete. I will also spray the bolt with cooling oil spray. I will pour a test piece with regular concrete to test this. If the bolt does not come free with just cooking spray, I will try other coatings.

Rebar

But I went with a simpler solution. I bent a piece of rebar such that it was a U shape that sticks out of the external surface of the piece and then extends up and down the segment. This method is simple; it requires bending a piece of rebar and embedding it in the segment as its poured.

However, I didnt think about thermal expansion. There are two ways the rebar can cause excessive cracking due to thermal expansion. First, steel has a higher coefficient of thermal expansion than concrete. So as the two materials heat up together, the steel expands more. With nowhere to go, the steel exert incredible force on the concrete, causing it to crack. This is made worse by the fact that steel has much higher thermal conductivity. As heat is applied to one region of the concrete, the steel will conduct that heat. The steel in regions farter from the heat source will heat up faster than the surrounding concrete. This makes the different in expansion even greater in these areas, causing more stress.

I have thought of one solution to this, that I have plans to test. What if you were to tightly wrap the rebar in plastic wrap? As you cure the oven, the plastic wrap will burn out. This leaves a small gap between the rebar and concrete, just enough space to allow the steel to expand without being restricted by the concrete. There are a couple questions about this idea.

First, will the rebar still work for lifting the concrete, since the adhesion between concrete and rebar is compromised? I think yes. The shape of the rebar is such that is cant slip out of the concrete. In other words, the load of concrete on the rebar is mostly perpendicular to the rebar, not parallel to it. Also, if the plastic wrap is applied tightly, the ridges of the rebar should still be exposed and therefor the concrete can grab on.

Second, will the plastic wrap actually burn out and leave a gap as I've described. Again, I think so. Plastic wrap is made from a hydrocarbon polymer (PVC or LDPE) which should melt at the temperatures experienced during the curing process.

There are alot of unknowns with this solution and it makes me a bit nervous. So I plan to also test the first idea of passing a bolt through the concrete which can later be removed.

Dome Finish - Tile

It seems that the overall idea is:

- Dome. bricks or castable

- Fiber blanket insulation
- Chicken wire. To give the next layer something to grab on to
- a rigid layer
- Could be stucco or some type of concrete.
- Required because the blanket is compressible and you want a rigid surface on which to lay tile.
- Waterproofing
- There are many options. Many are thin liquid coatings that are painted on.
- Mortar
- I have seen suggestions for using Flexbond by Custom. This is a high quality, polymer mortar.
- Tiles
- Grout. Just normal grout?
- Waterproofer for grout?

Example 1

link

Layers:

- blanket
- flexcrete (polymer concrete)
- Mapei AqueDefense
- mortar
- tile

Example 2

link

Example 3

https://community.fornobravo.com/forum/good-background-information/introductions/399799-new-member-and-first-portable-32-build/page2

Layers:

- stucco
- "waterproofing concrete made into a paint and painted on. The same stuff used to waterproof concrete fish ponds"
- "a flexible waterproofing membrane was painted on - thats the bright green stuff"

Chimney

Center Chimney

In this section I will describe the solution I have chosen for my first oven.

The chimney will be place at the top center of the oven. The vent will be located in the door as usual. A passage will be built to take the exhaust from the vent to the chimney.

I passage will consist of three parts. First is a transition from the vent to the second part of the passage. Since it needs to be a complicated shape, I'm thinking of creating a sand mold in place and casting it.

Sand Molds

There are various applications where refractory or reguar concrete is cast on a mold that is partially made from wet sand.

The sand is wetted so that it holds its shape. It is then covered in wet newspaper. Concrete is then applied directly to the newspaper.

The second part is a straight passage along the dome towards the top. My plan is to get a section of steel stove pipe, cut it lengthwise and bend it into a semi-circular shape. I will need to create relief cuts in order to follow the curvature of the dome. The metal will be mortared in place.

The last part will be a precast cylindrical base made from refractory cement. I am planning on pruchasing a clay chimney. The base will designed to mate with the bottom of the chimney. The base will sit directly on the top of the dome. A hole will be cut out of the base to allow exhaust from the second part enter. Steam vents can be drilled

into this part where it is adjacent to the fiber blanket insulation.

Appendix

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