Mozambique Rocket Roll Baking Oven

Oct 13, 2004

Three different ovens have been built in Mozambique since Nov 2003. The second and third version have been well received but the first version, which featured a baking compartment made of 2mm mild steel sheet metal, was not successful (see photo left). This was due to the different requirements of baking Portuguese rolls as opposed to 'loaf' type breads.

The rolls, which are cooked directly on clay tiles, require 300 degrees Celsius, as compared to 'loaf ' type breads that require only 180 degrees Celsius. The 2mm sheet metal box (which has proved effective in Lesotho and Uganda) was not sturdy enough to withstand these higher temperatures. There were also other complaints such as uneven baking temperatures. The oven was too hot on the bottom and too cold on top.

In March 2004, a new bread oven was designed that utilized a 5 mm T-Bar frame to directly support the clay baking tiles instead of the 2mm mild steel sheet metal baking compartment.
The use of any metal in the baking compartment is an interim measure to assess if the general concept is acceptable to the bakers. The fourth prototype will not have an angle iron frame on the bottom of the baking compartment and will instead be supported entirely by clay bricks.

The heat flow was also modified in the second prototype. In the original oven the heat flowed only around the **outside** of the baking compartment. The new

oven has a heat flow path that travels under the massive clay tiles…

… and then around the bottom corner of the baking compartment of the oven. A 3 cm gap is left between the bottom corner of the metal frame and the loose vermiculite insulation underneath. A 2.5 cm gap is left between the oven body and the bottom side edge of the T-bar baking compartment.

The hot flue gases then travel through the 2.5 cm gap between the T-bar baking compartment and the thin cement vermiculite bricks. The gap between the cement vermiculite bricks and the outer structural bricks will be filled with loose vermiculite. Loose vermiculite is a much better insulator than vermiculite mixed with cement. This is why we use only a thin cement vermiculite tile, thus leaving more room for the loose vermiculite.

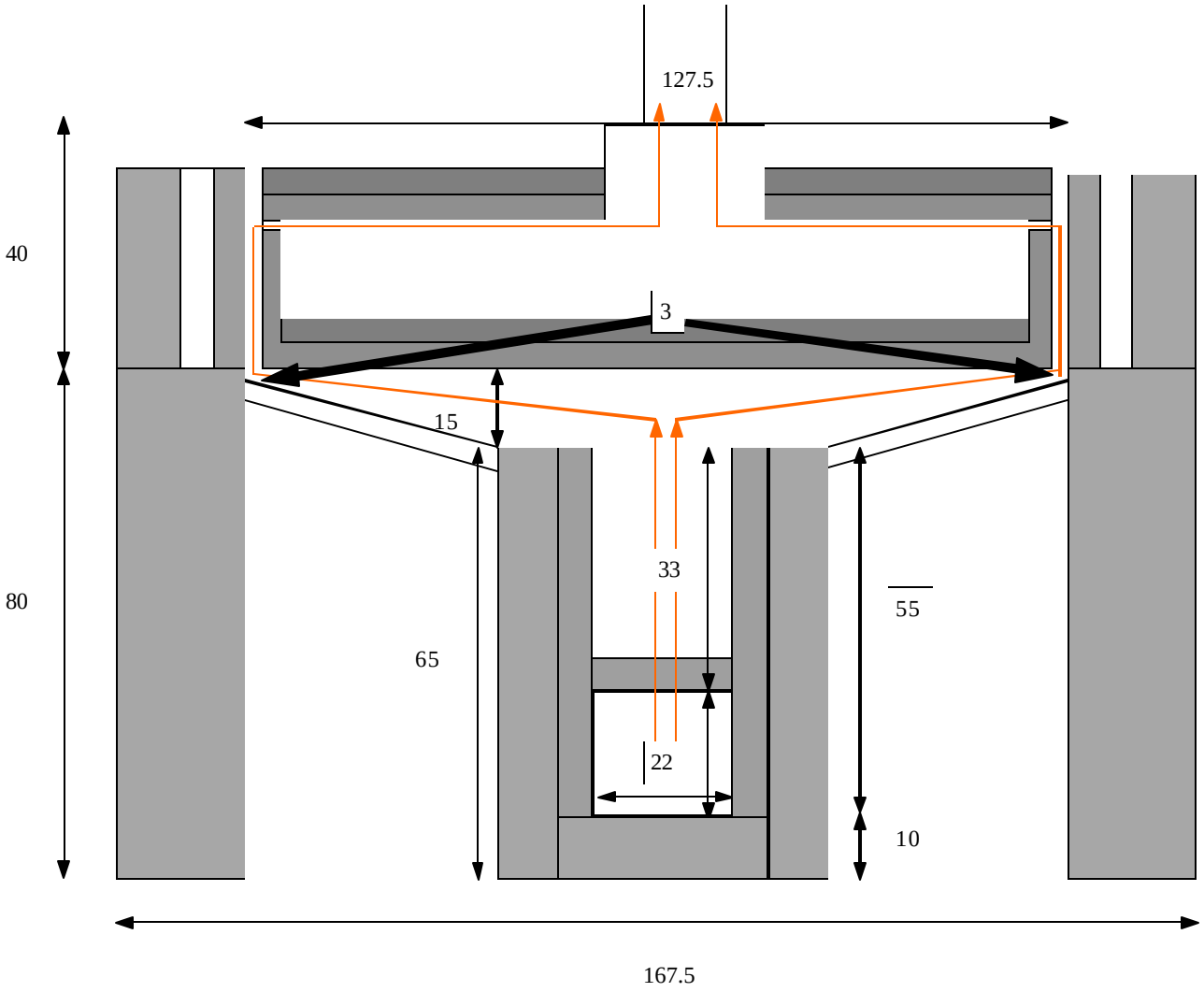
The hot flue gases then enter **inside the baking compartment and under the top** of the baking compartment box .As you can see from this interior view of the bread oven there is a small 1.5-2cm gap that is between the **sides and the top** of the oven. The gap, which is on both sides of the baking compartment allows the hot flue gases to enter into the bread oven and then….

… **exit out through the chimney** that is located in the top course of the brick work.

We then used a metal plate that was salvaged from the first prototype, to produce the interface between the stove and the chimney. Future models would not require the use of an entire metal plate.

Only enough sheet metal is required to make the chimney sleeve and cover the opening in the top course of bricks.

The following schematic shows the complete fire flow path. Measurements in cm



The baker and the owner of the bakery, Senor Joao, favorably received the second prototype. At first Senor Joao was reluctant to try the new design, but after a little prompting by Werner Klaus, the baker used the oven for two months and was very pleased with the design. The Rocket roll oven used less wood than the traditional oven and cooked the rolls in 15 min instead of 20.

Werner Klaus reported daily fuel consumption of 30,000 Meticais with the new oven (each small log costs 10,000 Meticais)

compared to 100,000 Meticais for the traditional oven . When I inquired about fuel consumption a month later the bakers reported that the fuel consumption of the traditional oven was only 80,000 Meticais (40,000 Meticais for each large log . It is unclear what caused this discrepancy between our figures but even considering the lower figure for the traditional oven, the new oven still offers a 62% savings. It is estimated that the new Rocket Bread oven will reduce their annual fuel costs from US$ 1327 to US$498 thus saving the bakery approx US$830 per year. **With more training, we expect even greater fuel savings.**

When I arrived in August 2004 the bread oven had been unused for two weeks due to a construction failure of the oven. When the stove was modified to include more clay tiles it increased the weight of the oven and caused the baking compartment to sink, over time, into the supporting walls of the oven. This needed to be fixed. We also wanted to turn the baking compartment around so that the combustion chamber would be on one side and the entrance to the baking compartment would be on the other. This was one of the suggestions for improvements that the bakers offered (the bakers were concerned about being exposed to too much heat).

The third prototype was modified to incorporate 4 courses of bricks so as to offer more support to the baking compartment. The 4 corners of the outer structure were also reinforced with solid brick instead of thinner walled Ceramica Villa Pery building blocks.

The top of the baking compartment (and in between the supporting outer bricks and the thin cement vermiculite bricks) is insulated with one bag of vermiculite.

A layer of aluminum foil is placed on top of the vermiculite. More vermiculite is used to hold the aluminum foil in place

Here are the finished views of the front of the oven

Combustion Chamber

The bread oven was made with cement and vermiculite bricks and lined with HTZ cement and mortar. No clay sawdust bricks were available during the construction process. In the future all bread ovens should be made with the clay sawdust bricks and lined with HTZ cement.

Portuguese Rocket Roll Oven

Way Forward

- More testing and training of this 3rd Prototype and the construction of a 4th prototype is necessary before more ovens are made.

- The bakers need to be reminded to clean ashes out of the combustion chamber the oven each day



- The baker's complaints about it being to hot to bake next to the baking compartment makes me think that they aren't feeding the oven properly. The fire should only be inside of the Rocket elbow. This is different from the traditional method where the fire is allowed to burn **outside** of the combustion chamber. The bakers need to be instructed to push the wood, every 5 minutes, gently into the combustion chamber.
- An easily adjustable door needs to be fitted on to the stove to reduce airflow through the oven once it has reached baking temperature. This will help to reduce wood consumption during the baking cycle. I left instructions for SAVEPLA to make one but they will need some prompting from Zana.
- A cast iron shelf should be made in Beira. Contact Albertino for possible foundry locations
- A stronger foundation needs to be constructed for the oven.

We need to prototype another oven that is cheaper and uses less metal and more brick. I think the estimated selling price of US$350 is too high. We could make a cheaper oven that uses less metal and will last longer than the present oven. We just haven't built it yet. I imagine that we could lower the price to below US$200.

Even still we would probably have to offer some micro financing for the oven as bakers just don’t seem that interested in paying for an improved oven, even after they see the economic benefits.