Riding a “Russian Rocket”.

By Alex Chernov

It has been a few years since I first learned about rocket stoves. One of the first detailed conversations about the idea I recall was a lengthy on and off discussion with a good friend of mine, an MHA member and a well-known Swedish oven and heater builder, John Fisher, during our 4-day pilgrimage to Fetze Tigchelaar’s place in Holland. John was fascinated by the idea and convinced that there was something worth exploring. It was John who drew my close attention to the subject sharing his thoughts and ideas, and recommending a book written by Ianto Evans. Several years later, having read Evans’s book, talked to many heater builders, seen a few rocket stoves in operation, participated in some rocket workshops, and thought a lot about the concept, I have arrived at some thoughts that I wanted to share with everyone for a while now.

Although I find the rocket stove concept interesting and respect all the work done through the years around the idea in the natural building scene, I cannot help comparing rocket stoves with masonry heaters. While heavy rocket stoves belong to high-mass heating fireplaces, there are some considerable differences between a rocket stove and a typical masonry heater. Trying to analyze the differences, one can find some rocket stove advantages:

- Simple construction that can utilize widely available, reclaimed and salvaged materials – i.e. inexpensive to build.
- Supposedly, potentially cleaner combustion than in other types of fireboxes.
- Top surface of the embedded steel drum automatically becomes a cook top.

However, we can also find considerable disadvantages in the classic rocket stoves versus standard masonry heaters:

- Necessity to feed fire with multiple small batches versus single large batch loading in masonry heaters;
- Difficult start up;
- High sensitivity to firing conditions and air supply settings that result in unstable burn and high spillage probability;
- Much larger footprint of a classic rocket stove with a very long bench for the same amount of mass and heat output that can be delivered in a compact masonry heater – i.e. very large footprint and necessity for much larger foundation unless it is built over slab on grade or over dirt floors ;
- Design restrictions for built-in bake ovens.
- Difficulty with using glass doors for fire viewing.

Although a promise of potentially very clean combustion in an upside-down firebox is very appealing for many heater builders and other “pyromaniacs”, who form a good-sized group of followers of the idea, trying to develop an ultimate firebox, how does it affect an average home owner? Comparing advantages versus disadvantages, we can see that for an average home owner, masonry heaters should be more appealing. However, there are still many people who give their preference to rocket stoves. I wondered what was the reason for this popularity? This question was answered by a young fellow from Asheville, NC, with whom I chatted about masonry heaters during one of the MHA annual meetings a couple of years ago. He said that he liked masonry heater idea very much, but since they are so expensive to build, he went with the rocket stove for his small home. He wasn’t very satisfied with performance of his rocket stove, but he stated that it was the only way for him to build a masonry heater he could afford. It was at that time that it dawned on me that rocket stove is perceived by many

as the only way to build an inexpensive and simple masonry heater. This perception, however, is incorrect. In fact, there is another way people used over the centuries in the Eastern Europe and Russia, and this is what I would like to describe in this article.

Masonry heaters get expensive because of the building code and ASTM 1602 requirements for a complete refractory core, and because of the way they are typically built in North America to resemble traditional open fireplaces. Rocket stoves are cheap because they are built in single-skin with basic materials of clay brick and clay mortar, having only few firebricks in the firebox and in the fire tube. As such, rocket stoves do not comply with the building codes. However, if one does not want or doesn't have to follow requirements of the building codes, why not build single-skin masonry heaters the way they were always built in the Eastern Europe and Russia instead? One can obviously use reclaimed, collected old clay bricks for such heaters. Bricks are laid in clay mortar that can be dug up. The bricks can even be formed from clay on the spot and the stove can be build with unfired clay bricks. The only need for firebrick is in the firebox liner. This is not absolutely necessary, but without liner, firebox will deteriorate pretty quickly and will have to be rebuilt often. Number of firebricks needed for a firebox liner in such simple heater is comparable to what is required for a classic rocket stove. Doors can be cast-iron cheap clean-out chimney doors or simple home-made tin doors the way they were made for Swedish kakelugns. This way, cost of materials for a single-skin masonry heater would not be any higher than that for a rocket stove. As for ease of construction, single-skin masonry heaters are much less complicated and easier to build than double-wall designs; they are typically designed to be built with the simplest hand tools, and as such are well suited for a do-it-yourself builder.

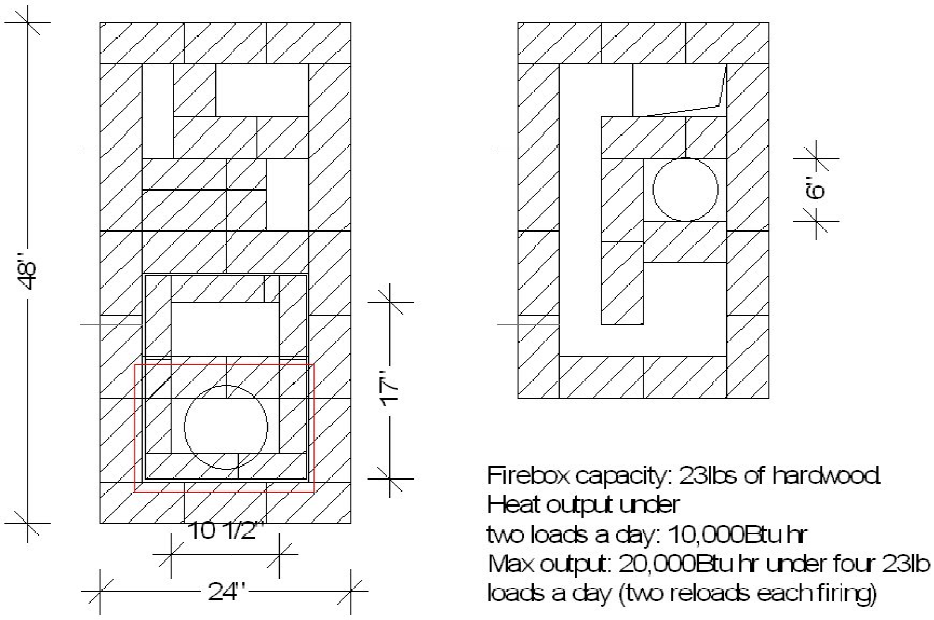
One can argue that those old heaters had firebox designs burning pretty dirty while a rocket stoves can offer very clean combustion. Let's talk about this argument for a minute. Although there are lot of claims out there that rocket stoves are inherently very clean, there was almost no testing of the rocket stoves done, and hard data is almost inexistent. However, the few reports we can access show that emissions in rocket stoves are not particularly low. Testing of the small rocket stoves developed for cooking for third-world countries shows pretty high emission both in CO and particulates http://www.usaid.gov/our_work/economic_growth_and_trade/energy/publications/uganda_emissions_report.pdf , http://www.scscertified.com/lcs/docs/Global_warming_full_9-6-07.pdf As for large heating rocket stoves, as far as I am aware, there is no proper contemporary emission testing done to date. One of the most comprehensive scientific studies ever done on emissions of heating rocket stove principle was work done by Dr. Richard C. Hill in 1977-79 that resulted in development of what is called a Hill Furnace: http://www.hotandcold.tv/woodfiredfurnace.pdf Emissions were measured by smoke spot meter and by measuring CO in the stack. The spot meter recorded emissions similar to standard woodstove on the start up and overall CO levels were around average 2100ppm. Norbert Senf of Masonry Heat Builders has recently conducted some rocket stove experiments that included some CO testing : http://heatkit.com/research/2009/lopez-rocket.htm . Comparing all available emission data, one can see that the best available current masonry heater technology offers emission levels as low and in some cases lower than that of tested rocket stoves. Well-designed grundofen heaters operate at CO levels lower than 1000ppm (Austria has CO emission limit of 1100ppm), well-designed contraflow and double-bell heaters operate at average particulate emission levels between 1-1.5 g/kg and fairly low CO levels: http://heatkit.com/research/2010/2010%20testing%20summary3.pdf .I would like to draw your attention to the fact that the low emission levels in masonry heaters of the best design are achieved with large loads with no to minimum user control of the burn.

It is perfectly possible to utilize the best masonry heater firebox design principles in single-skin simple and cheap masonry heaters. Having a large firebox designed for clean burning, we can keep emissions

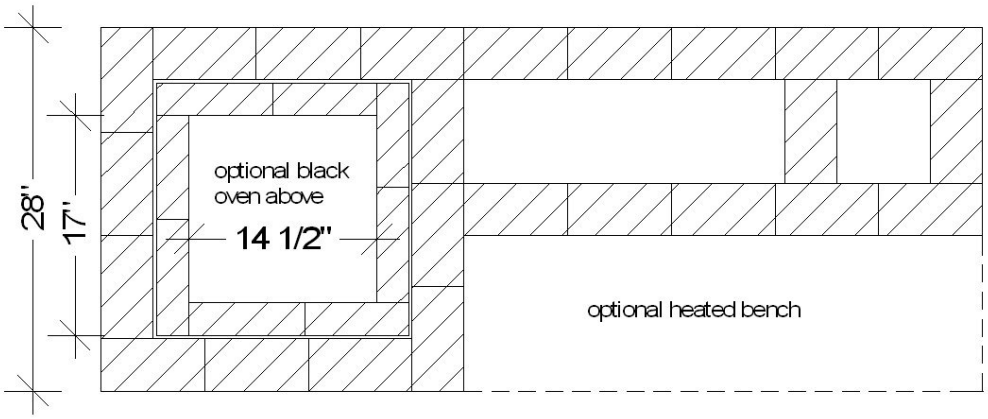
low while avoiding the major drawbacks of the rocket stove: necessity to feed firewood in very small batches and necessity to tend to the finicky fire.

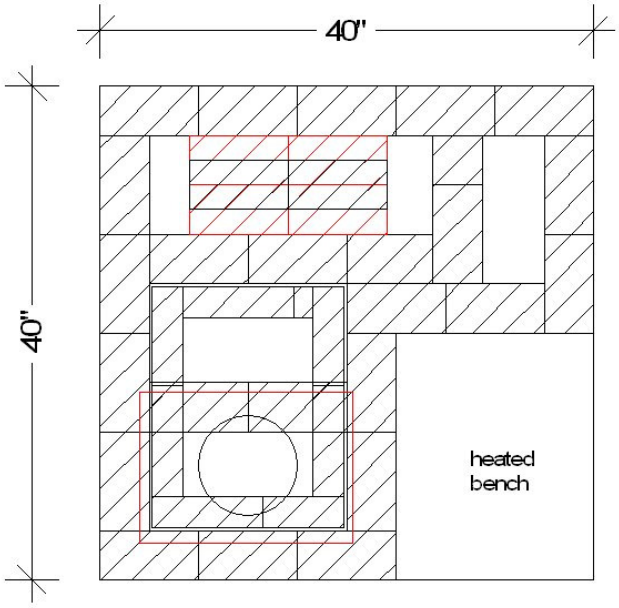
Here we have the basic recipe for creating simple, dirt-cheap, compact, efficient and clean-burning heaters. We only need a flexible design system that can offer easy modifications allowing unlimited number of models within the same simple characteristics. A Russian double-bell heater design system developed by I. Podgorodnikov and expanded by Igor Kuznetsov (www.stove.ru) fits this purpose the best. As majority of masonry heaters are still built in Russia in single-skin construction, there are hundreds of different designs built and being built every day that can be easily converted, and there is always room for new models.

I believe it is time to embrace Russian heritage heater building technology, combining it with the latest achievements in firebox design, creating a new way for building versatile inexpensive single-skin heaters. We will start from a simple and compact heater that is large enough to heat a good-size well-insulated home, and has all necessary functions in one unit: heating, a black bake oven and a small cook-top. The heater can be vented by 6" diameter chimney. This heater will be built at one of the hands-on workshops of the 2011 MHA Annual Meeting:



We are starting with this multi-functional heater to show an alternative to the classic rocket stove, however, options for designs are endless starting from very small room heaters to very large with heated benches and other functions. Here are quick design sketches for a couple of other possible layouts:





Cook top, black oven, heated bench

The heaters described above and all single-skin heaters that can be developed under this “Russian Rocket” initiative are single-skin and as such do not comply with the current North American building codes. However, I see them as a better alternative to the classic rocket stove. The codes may change at some point, but regardless of this fact knowledge of how to build a cheap and efficient multifunctional heater is a great investment in personal independence that, who knows, may as well become an essential survival skill one day...