



Construction of Brick Charcoal Dome

Ethiopia | Madagascar | Tanzania





INTRODUCTION: In many developing and under developed countries across Asia and Africa; fuel wood and charcoal are the main household energy sources, resulting in large scale deforestation and destruction of natural forests. This calls for an urgent need to find alternative renewable sources for biomass, to replace timber / wood as biomass.

Bamboo can serve as a viable and sustainable alternative biomass energy source. Bamboo grows rapidly and matures in 4-6 years. Once the bamboo clumps reaches maturity, it provides opportunity for annual harvesting of bamboo poles without deforestation or destruction. Bamboo poles can be used directly as a fuel wood, and/or converted into charcoal.

Traditionally, charcoal is being produced through pit method and mounds or earth kilns. The yield and quality of charcoal produced through the above methods is low. Alternately, production of charcoal using dome kiln is relatively simple, more efficient and safer. Carbonisation carried out with controlled air supply yields good quality charcoal with high calorific value and little ash.

SITE SELECTION

- Charcoal kilns should be established in close proximity to bamboo resources (bamboo forests, plantation, and/or homesteads) to minimize the transportation costs.
- Charcoal kilns should also have good access (road), for transporting charcoal and briquettes to markets.

STEP BY STEP PROCESS

Land Preparation

Flatten the land where the dome kiln is planned to be constructed (minimum of 5 X 5 M).



Create an elevated platform: Dimensions: 5 M X 5 M. Use locally available materials such as stones or bricks on the outer edges to hold the soil inside.



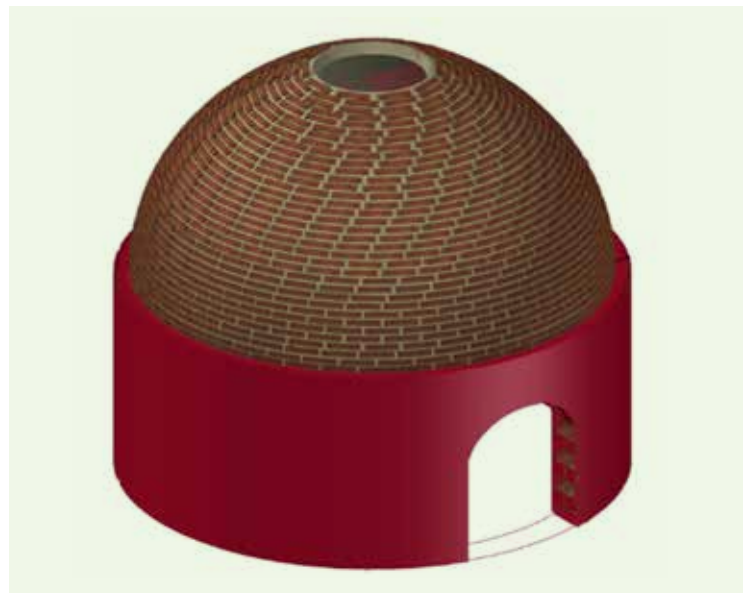
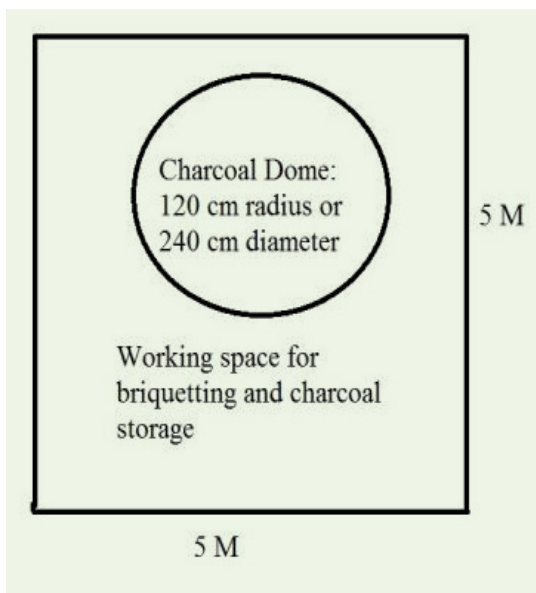
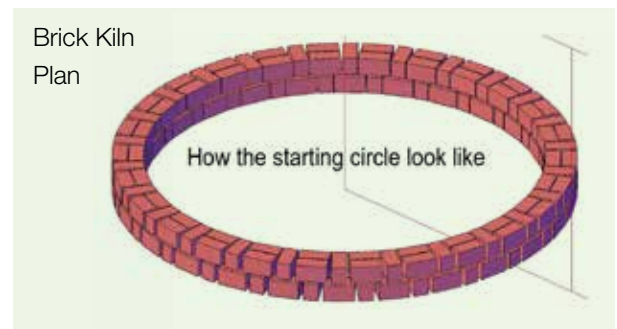
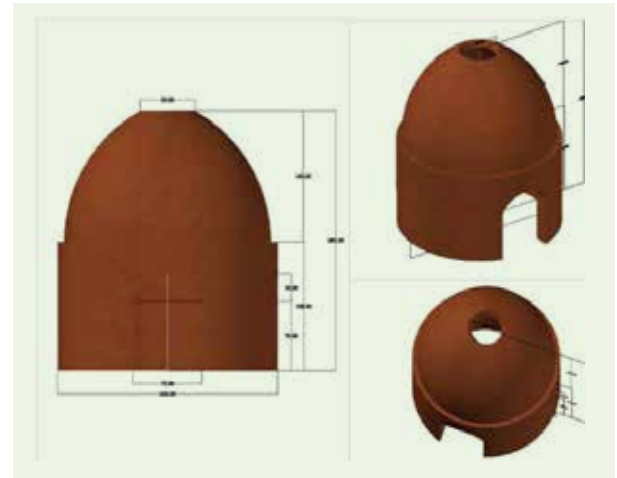
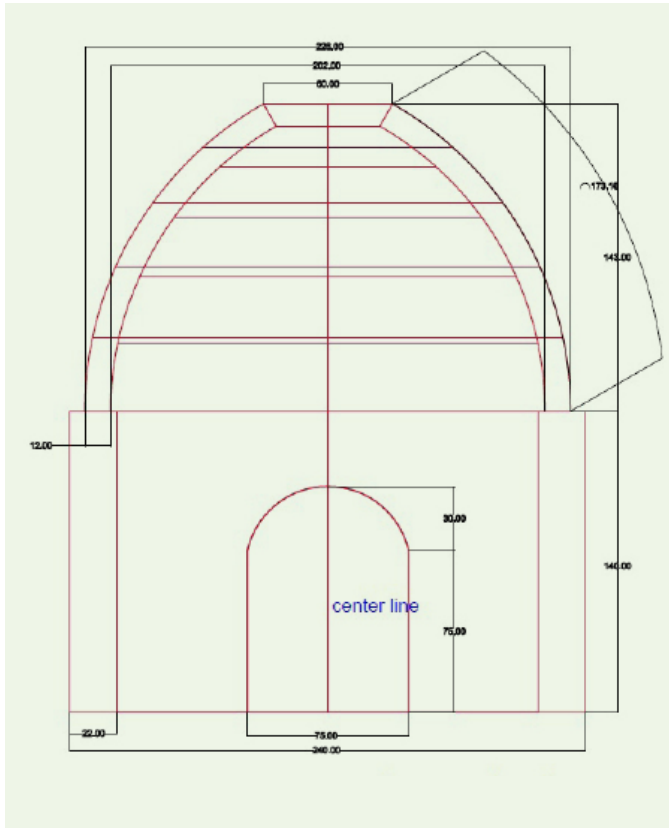
Apply concrete of 2 to 3 inches thick. (Benefit of cemented platform is that it will be easier to store charcoal and briquettes). The platform can be made of soil too.



Construct a simple structure or work shed (5 X 5 M) using local materials to cover the dome kiln (eg wooden poles). Roof can be of thatch or CGI sheet (depending on the budget).



DIAGRAMS:



Material Required

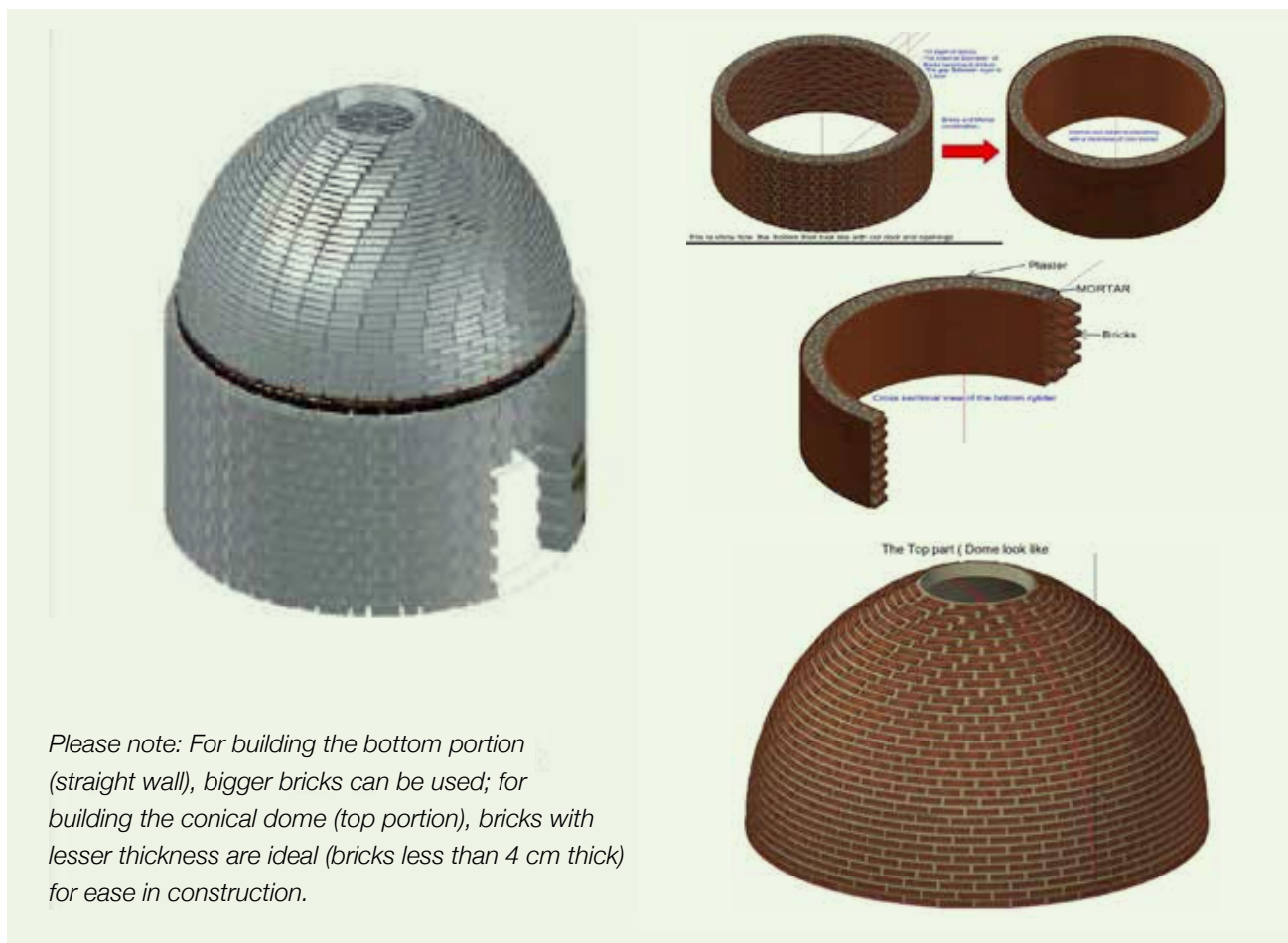
Bricks: Brick size varies across countries as well as regions.

Example 1: If the brick size is 22 X 9 X 5 cm; the total number of bricks required would be ~ 1700 Nos.

Example 2: Bigger bricks (19 X 9 X 9 cm) for bottom straight wall ~ 1150 bricks; smaller bricks (19 X 9 X 4 cm) for conical top portion: 1000 bricks

Estimation: Considering the bottom portion wall thickness of 19 cm, 1.80 cubic meters of bricks would be required. Considering the top conical portion wall thickness of 9 cm, 0.7 cubic meters of bricks would be required. Please calculate the number of bricks required as per local brick sizes.

Brick placement of entire charcoal dome



Please note: For building the bottom portion (straight wall), bigger bricks can be used; for building the conical dome (top portion), bricks with lesser thickness are ideal (bricks less than 4 cm thick) for ease in construction.

CLAY

Identify and use potter's clay or stick clay.



COW DUNG

Use fresh cow dung.



STRAW

Use rice straw / wheat straw / grasses as a binder material. Long straw is chopped into short length (2 to 5cm) for easier mixing.



STEP BY STEP PROCESS

Steel Plate of 60 cm diameter with a handle to cover the top opening after ignition.



Material Required

Please Note: For building the dome structure and first coat of plastering, the proportion of clay: cow dung: straw is 10:1:1; for second and third coat of plastering the proportion of clay and cow dung is 1:1.

The purpose of addition of Cow and straw is to form a reinforcing meshwork in plasters, which helps to hold the plaster together. When clay dries it shrinks and tends to crack, but this cracking can be minimized by the fiber.

Soak the clay, cow dung and straw in specified proportion in water over night for loosening lumps, easy mixing and increase the stickiness.

The mortar prepared should be tight, to have good adhesion.



CONSTRUCTION

Mark the center point of the charcoal dome. Place a straight bamboo pole or wood of 10 ft or 3 m height or tie a vertical rope to ensure whether the dome is straight or not.



From the center point mark the circle (120 cm radius).



At the bottom place or mark 6 single brick holes or air vents at equal distance.



Mark the front door opening (75 cm)



CONSTRUCTION

Start construction inside the reference mark by placing mortar (clay, cow dung and rice husk mix in bottom) and place bricks on it. Wall thickness must be approximately 20 cm.



Brick Placement:
Two brick walls (~ 20 cms). Place bricks alternatively (not exactly one above the other); and mortar should be placed between the bricks (rows and columns) as to increase strength and plug the air flow.

Continue construction upto a height of 70 cm and mark the air holes / vents (6 nos) by keeping the bricks diagonal to the first hole (at 45 degrees approx).



For creating an arch use steel sheet, bent bamboo or wooden planks with props (similar to scaffolding). Height of the arch is around 30 cm.

Continue construction upto a height of 135 cm and mark the air holes (6 nos) by keeping the bricks diagonally to the previous hole (at 45 degrees approximately).



CONSTRUCTION

Complete the construction till 140 cm. Now the double brick wall vertical construction is complete. From this point, construct single brick wall and start making the dome structure.

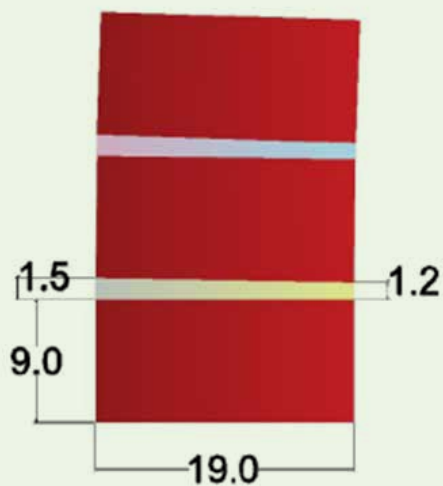


How to make the Dome?

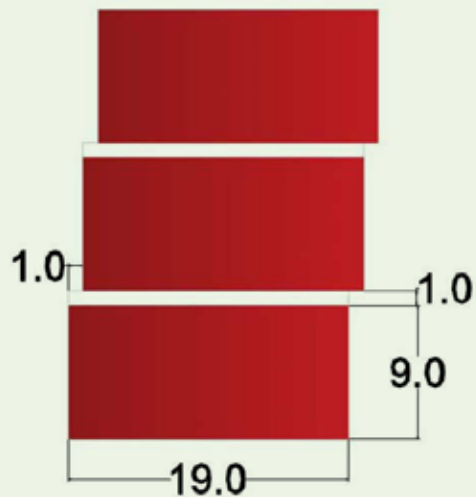
Using wooden planks, make a reference for top opening (60 cm) and tie ropes around that reference top opening till the vertical wall. Hang them by tying bricks at the end.



Option 1: Add slightly more mortar on the outside surface and less mortar on the inside surface (as shown below).



Option 2: Brick laying from one layer to another should be pulled inside slightly ~ 1 cm .



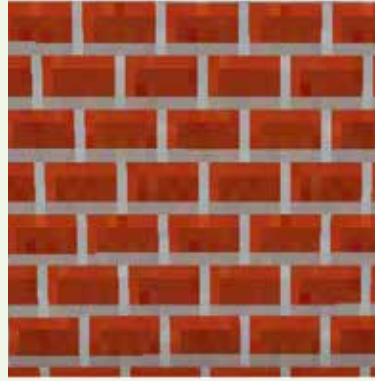
Please Note: During construction, use a measuring tape to ensure that the distance from center to sides is the same.

STEP BY STEP PROCESS

From the inner side of the vertical bottom wall, start constructing the dome.



Brick placement should be such that the joints should not be one above the other but alternate.



Continue construction until the dome reaches 200 cm height from the bottom and then mark the air holes (6 nos) by keeping the bricks (diagonal to the previous hole – 45 degrees approx).



To improve the sturdiness, apply slight mortar both on inside surface as well as outside surface.

Please ensure that the mortar mixture should be tight. The top hole Outer to outer should be 60 cm; same as the size of steel cover.



Continue construction until you reach a height of 240 cm.

Note: While constructing dome structure, after reaching half way – allow it to dry overnight for drying and fixing.

Plastering

The bonding of earth plasters to walls is very important. When undertaking plastering, composition of the mortar (clay, cow dung and straw), proper mixing as well as its application are important factors to create a good bond. Plastering must be applied in multiple coats (at least 4 coats) of recommended thickness.



STEP BY STEP PROCESS

First coat and second coat: Clay, cow dung and straw in proportion of 10:1:1. Mortar should be tight or thick.

Third and fourth coat: Clay, cow dung and straw in proportion of 1:1:1. Mortar should slightly thin or watery, so that mortar can fill in the cracks.

First Coat: Use mortar to plaster entire surface area of the charcoal kiln (both inside and outside surfaces). Thickness of first coat of plaster can be 1-2 cm.



Second Coat: After the first coat of plaster, allow it for drying for 2 days until large cracks appear. In the second coat, apply slightly thinner mortar (clay, cow dung, rice husk / straw combination) by hand in circular motion to fill the cracks. Leave the second coat to dry for 2 days until smaller cracks appear.



STEP BY STEP PROCESS

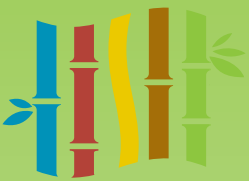
Third coat and fourth coat: Use thin or light mortar to fill the cracks and create an even surface without cracks.



Full view of the different completed charcoal Dome



Note: For bamboo charcoal production using this dome, Please refer to TB: Charcoal production in Dome Charcoal Kiln



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