

# Design of a solar bakery oven in Tilcara /Argentina 2003

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## General description

The project was financed by the cooperative PIRCA in Tilcara/Argentina. The bakery oven, which is described in this report, is powered by a 8 m<sup>2</sup> Scheffler reflector. The latitude of the site is 22° south. Using this reflector a maximum power of 3500W was measured. At a temperature of 300 degrees the efficiency of the system consisting of the reflector in conjunction with the zic-zac receiver is found to be between 45-50 percent. So the power available at the oven is 1700 W.

The baking chamber measures 60 x 60 x 60 cm<sup>3</sup>. The whole system is built completely out of materials which are available in Argentina. The oven operates without active ventilation. A convective airflow is accomplished by a 1 meter long chimney, which lets the airflow in at the top of the baking chamber. From there the air flows through the baking product and leaves the chamber at the bottom. There the air partially transfers its heat to a pebblebed storage to store some thermal energy for one to two hours of independent baking. This is mainly to insure that the baking product isn't spoiled when the sun is hidden by clouds. In this case the airflow would reverse and enter at the bottom and leave at the top. When the air passes through the pebblebed it re-enters the receiver of the Scheffler reflector. This receiver is constructed from iron sheet which is bent in a zic-zac profile. This improves efficiency since the radiation losses are minimized.

The temperature measured inside the oven rises to 310 degrees. To achieve working temperature, 45 to 60 minutes are needed

(depending on the storage capacity of the stones). The performance can be seen in the diagram in the chapter 3, measurement results.

## Construction

The following pictures show the stages of construction of the oven.



The picture shows the interior of the baking chamber with an aligned zic-zac receiver. All edges have to be welded carefully to insure that there is no contact with the isolation material, which

would contaminate the baking product. The chamber is made of 0.8 mm thick steel sheet.



When the inner chamber is finished, the outer protective cover can be attached. This cover is made of galvanised steel. Each side of the oven is one single piece, which will be connected so that it is rain proofed. Rivets are used to connect the individual pieces.



The hole in the bottom of the baking chamber serves as an air outlet for the chamber. From there it flows into the pebblebed. To prevent the oil or other material polluting the pebblebed, it is protected with a cover.



This picture shows the back of the oven with the receiver window. A few connection points are needed to support the weather protection. Four corner profiles are used as a stand for the complete oven.



The receiver is protected by a glass window. To prevent the glass breaking with heat expansion, it has to be cut in stripes. To make the glass easily replaceable it slides into a U-profile, which is welded to the oven.



The back cover of the oven has to be adapted for the receiver window.



After all parts are finished the oven can be insulated with mineral or rock wool. The spacing between inner and outer wall is 10 cm. All in all 8 m<sup>2</sup> of mineral wool is needed.



The receiver window is left open.



Finally the cover is placed on the box and is riveted.



Through the bottom cover the pebblebed chamber is filled with stones.



Final test of the oven.



View of the front side with the oven door.

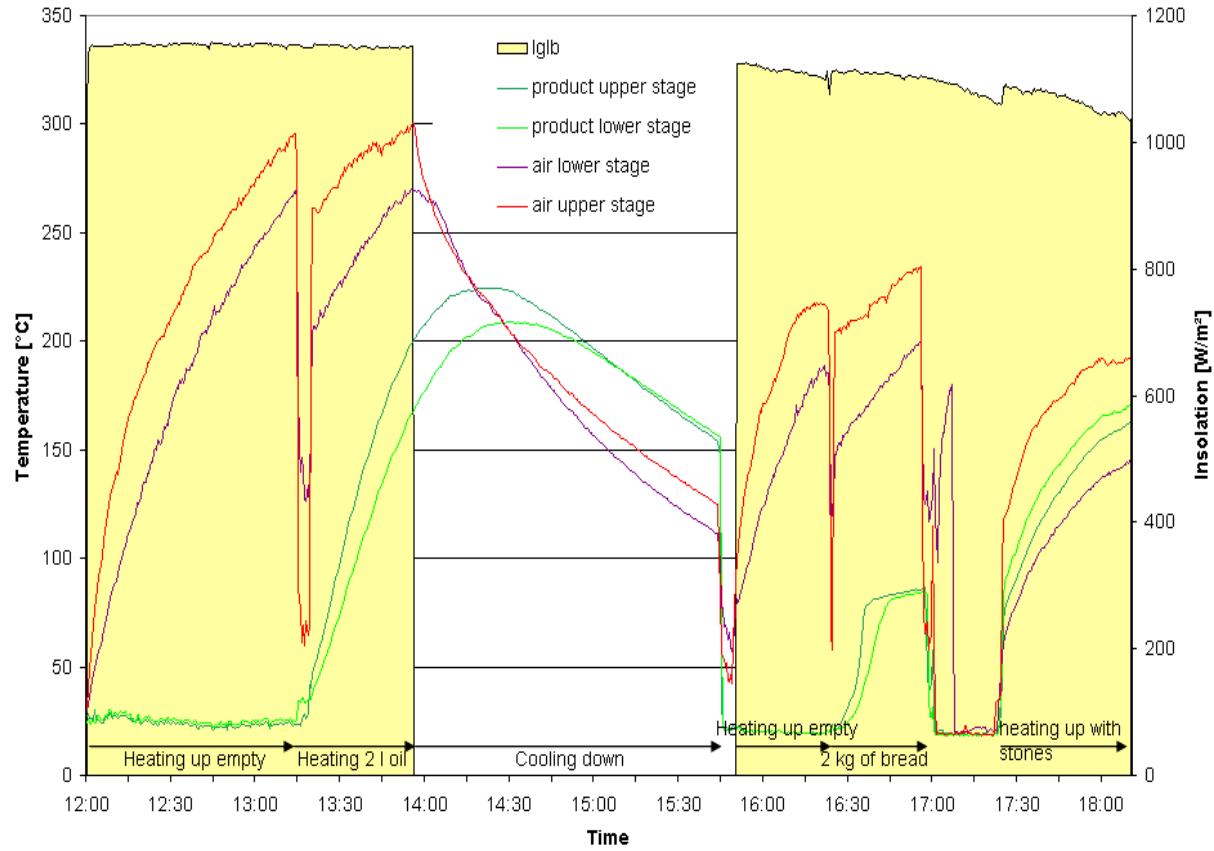


Bread rolls and croissant in a first test. This result was achieved within 25 minutes of baking time.

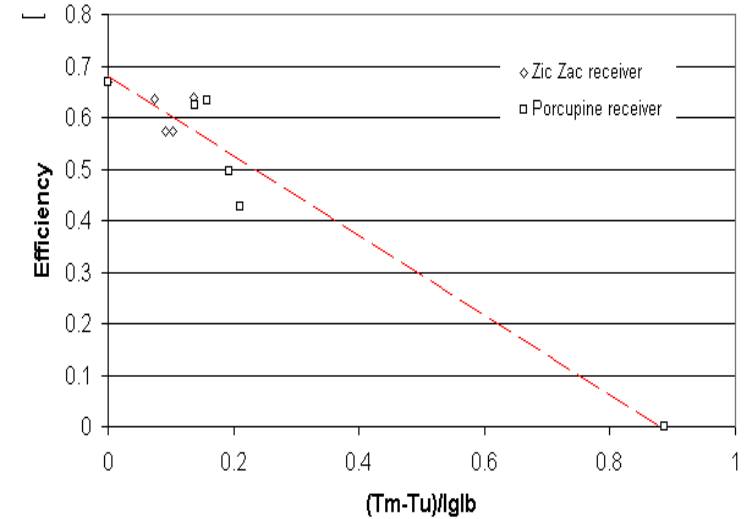




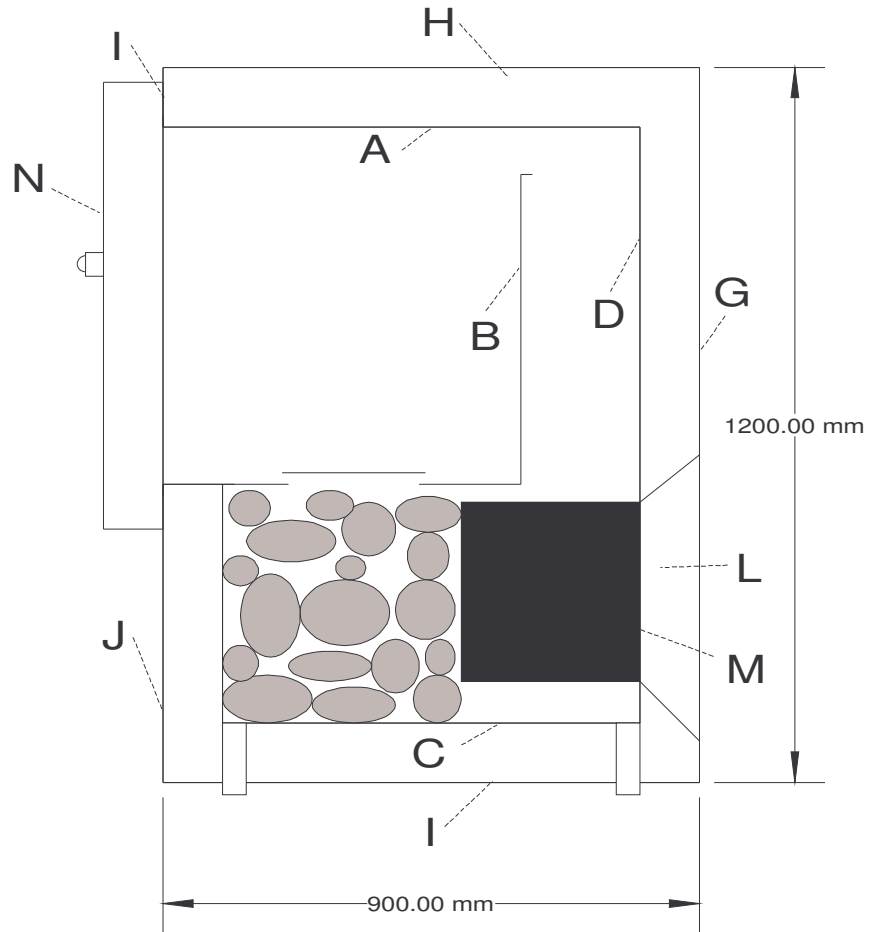
### Measurement results



Measurement of different operating conditions

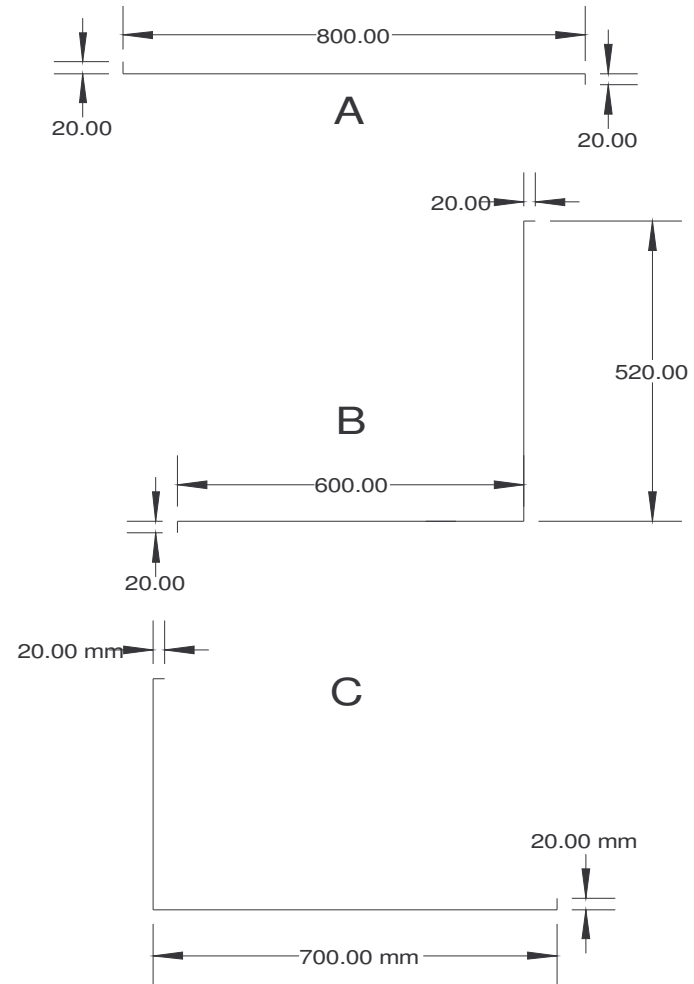


Characteristic efficiency curve of reflector and zic-zac-receiver



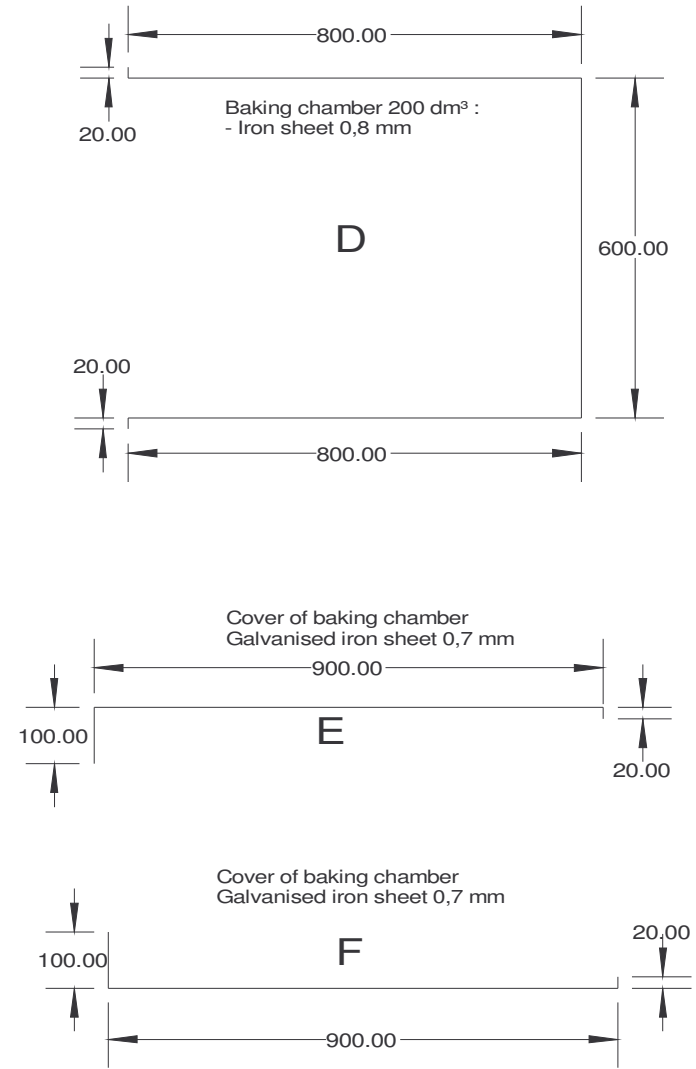
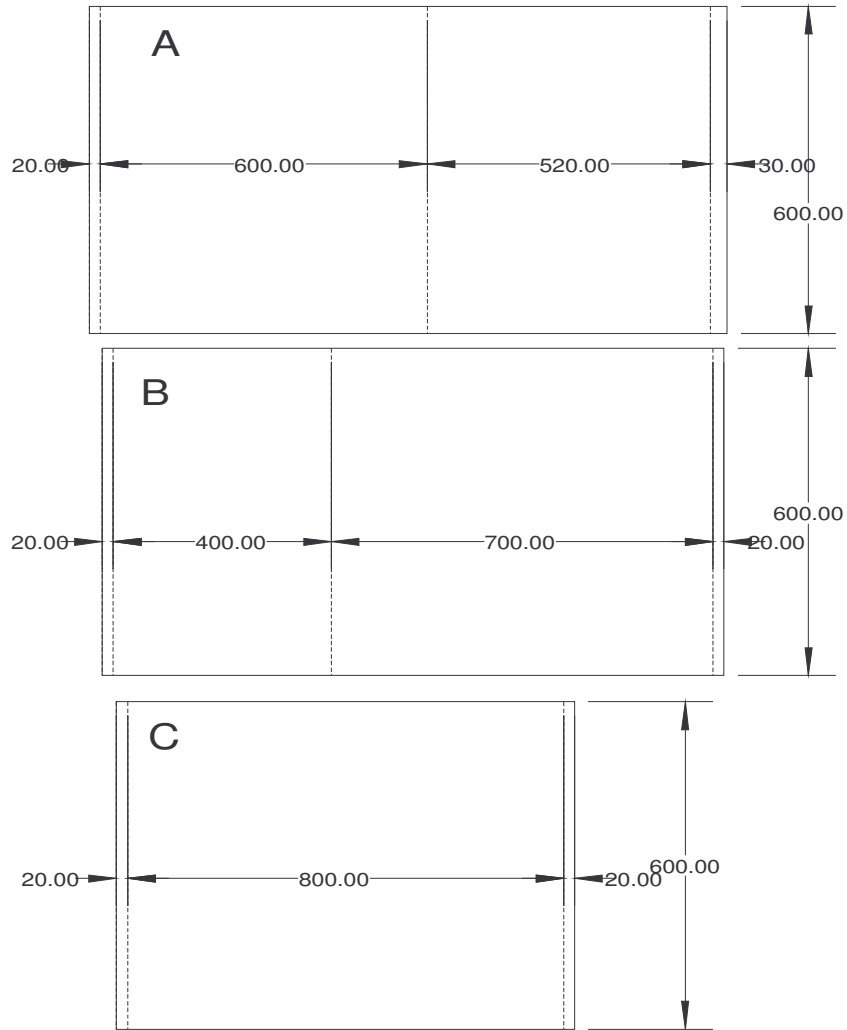
Baking chamber 200 dm<sup>3</sup> :

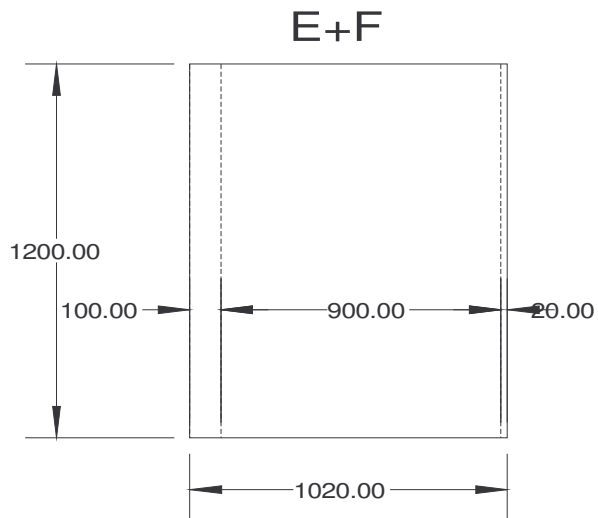
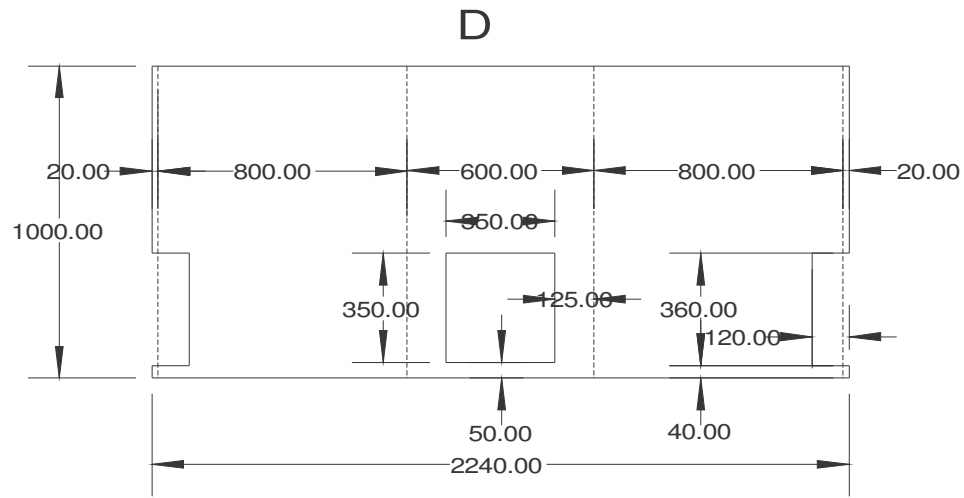
- Iron sheet 0,8 mm
- width 600 mm



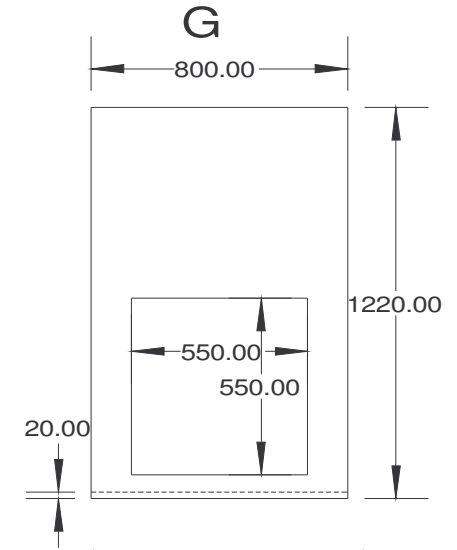
Baking chamber 200 dm<sup>3</sup> :

- Iron sheet 0,8 mm
- width 600 mm

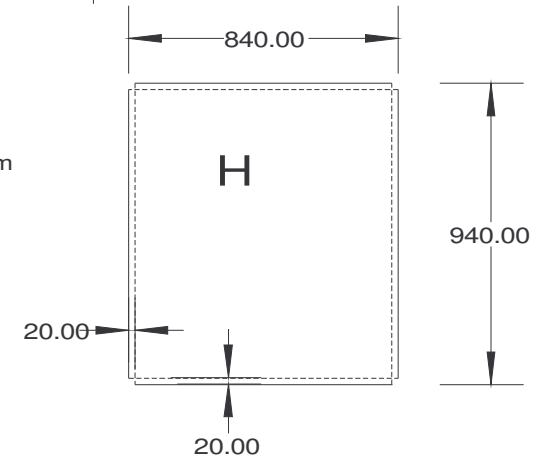


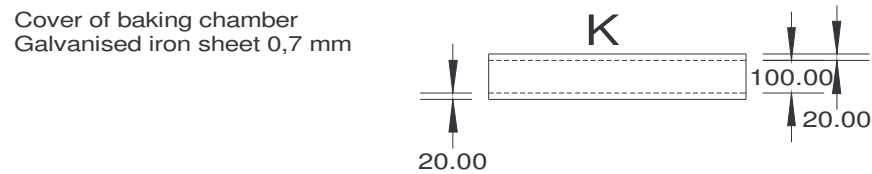
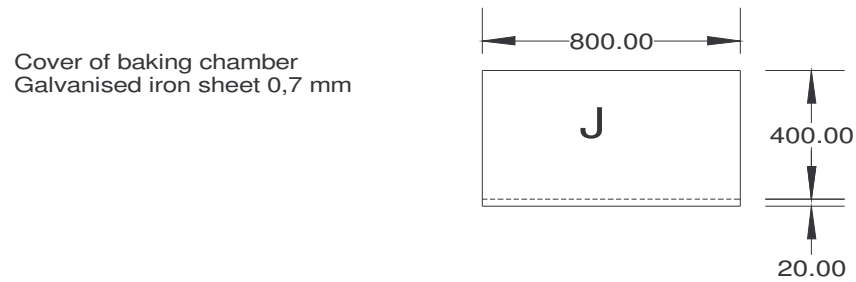
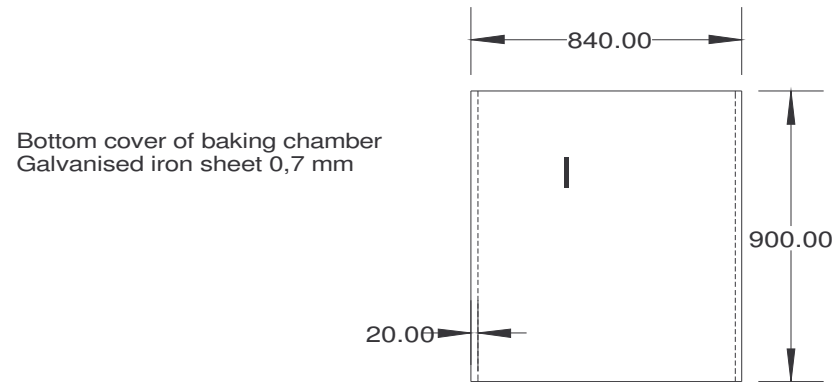


Cover of baking chamber  
 Galvanised iron sheet 0,7 mm

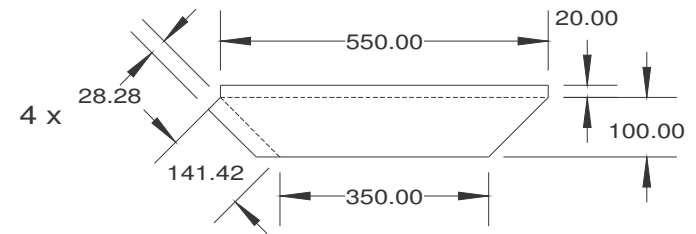


Cover of baking chamber  
 Galvanised iron sheet 0,7 mm

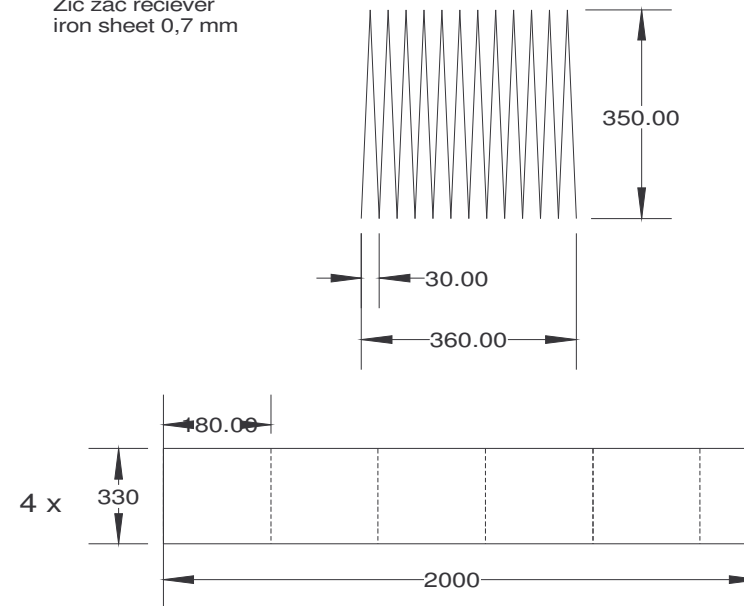




Window frame of reciever  
 Galvanised iron sheet 0,7 mm

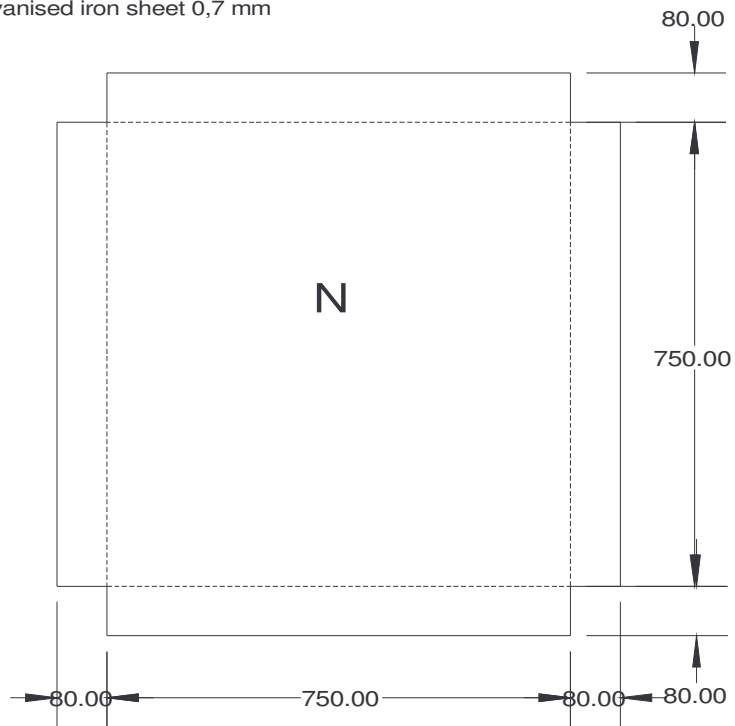


Zic zac reciever  
 iron sheet 0,7 mm



Solar Bakery 12/2003  
Cooperative Pirca (Tilcara/Argentina)  
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Door of bakery chamber  
Galvanised iron sheet 0,7 mm



Iron sheet 750 x 750 mm