# INCINERATION

The solution for (soft) waste in stabilised situations lies more in incinerators with double combustion chambers. As such, the residence time of the (flammable) gasses will be increased and a better turbulence will be obtained within the hearth, thus creating a better mixture with the available oxygen, which finally leads to a better combustion. Incinerators made with refractory bricks reach higher temperatures in comparison with metal waste reducers / incinerators and their lifespan will also increase enormously.

The double combustion, leading to higher temperatures and longer residence time, results in more decontaminated and unrecognisable solid residues (ash), and less toxic smoke that contains also less thermo-resistant pathogens.

In order to limit the running costs for low-income countries, it's often preferable to choose for auto-combustion incinerators. Auto-combustion means that the (soft) waste itself is the fuel to run the incinerator and that no other additional fuel is needed, except during the pre-heating phase or when the (soft) waste is extremely wet.

Although the temperatures that can be reached in a small (auto-combustion) incinerator are higher than in a volume reducer, it still won't melt metallic sharps. Again, the liquids in the organic waste will reduce considerably the temperatures of the (auto-)combustion, requiring lots of additional fuel which are often too expensive for health structures in low-income countries. The temperatures and retention times obtained in small (auto-combustion) incinerators are definitely not enough to destroy hazardous wastes like laboratory chemicals and expired drugs.

A recommended small auto-combustion incinerator is the De Montfort 8a model with external wall, which is relatively cheap and easy to build, and has a good performance when well managed.

Be aware however that the De Montfort incinerator is only a tool to deal with (soft) waste amongst other technical solutions, and that Medical Waste Management also includes Human Related Aspects ("Software component").

De Montfort 8a incinerator with external wall

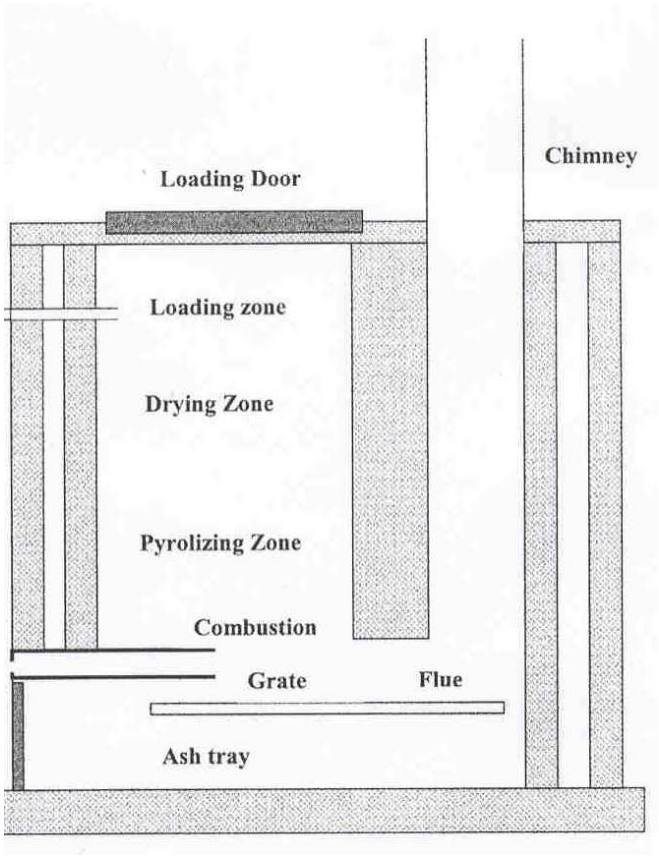
For further information: Medical Waste Management in Low-Income Countries, MSF

# DE MONTFORT INCINERATOR

The De Montfort incinerator is composed of two combustion chambers; the primary and the secondary.

The primary combustion chamber has different zones:

- Ash tray zone: collection of the incinerated residues.
- Combustion zone: place where the primary combustion takes place because the three factors of the fire triangle are present: fuel / combustible waste, heat generated by the flames and oxygen.
- Pyrolyzing zone: only two factors of the fire triangle are present: fuel / combustible waste and heat. The heat will still decompose the waste into combustible gasses, but due to the lack of oxygen, they can't ignite (so no fire in this zone). When the loading door is opened however, oxygen can get in contact with the hot combustible gasses which can ignite suddenly, potentially creating a high flame.
- Drying zone: the heat at this point isn't high enough anymore to decompose the waste into combustible gasses, but it still dries the (soft) waste that is wet.
- Loading zone: place where new batches of (soft) waste are introduced in the incinerator.




Source: De Montfort University

The secondary combustion chamber consist mainly of the flue where the flammable gasses of the primary combustion chamber that haven't burnt yet are drawn into. As these gasses pick up oxygen and heat when passing through the flames of the primary combustion chamber again, they ignite in the flue, creating a lot of heat. This helps to burn different components in the fumes, which reduces the toxic output of the exhaust a bit more, and thermo-resistant pathogens that might have survived the primary combustion will be eliminated as well.

Although that the chimney isn't part of the secondary combustion chamber as such, flames are often noticed there as well. This can lead to an accelerated corrosion of the chimney, needing a more frequent replacement.

# INCINERATION IN EXISTING INDUSTRIAL FACILITIES

It is recommended to do the incineration as much as possible on-site to avoid accidents and potential fraud. However in certain situations, it will be impossible to do the incineration on-site (e.g. urban and peri-urban zones). Incineration in existing industrial facilities can be an alternative. Also for certain **hazardous wastes** (e.g. some laboratory chemicals and pharmaceutical waste), existing industrial facilities that reach very high temperatures with long retention times can be a very good solution.

Several industrial processes can provide temperatures and residence times similar to those of special (hazardous) medical waste incinerators in high-income countries, and thus have the potential to recover the heating value of the waste, to remove halogens (e.g. chlorides), and to provide an equivalent destruction and removal efficiency (DRE). Potential industrial alternatives in low-income countries are cement, lime and aggregate kilns, and blaze furnaces, although they often lack the washers and scrubbers as found on (hazardous) medical waste incinerators of high-income countries.

The most common industrial solution in low-income countries is most probably the kilns of cement factories. They obtain temperatures of at least 1400 °C up to 2000 °C for the combustion gasses, and have retention times of several seconds. Thus cement factories are suitable for the destruction of certain (hazardous) wastes. Some of these (hazardous) wastes even have a heating value that will support the combustion. But it might also be that they will have to be removed from their packaging and even grinded in order not to block the feeding mechanisms of the hearth. Hazardous waste and/or their packaging that can explode shouldn't be incinerated at all (e.g. aerosols). It will be up to the kiln's responsible to decide if ampoules and vials can be incinerated, as they often give small explosions when the glass pops due to the heat, and therefore can cause damages to the kiln.

As usual, it should be checked if the national legislation permits the destruction of (hazardous) medical waste in these existing industrial facilities. It's recommended to have an official authorisation letter of the concerned authorities for the destruction of (hazardous) waste, before starting the whole negotiation procedure with the industry. Make sure to have the list with (hazardous) waste ready before the first meeting with the industrials takes place. Once an agreement is reached and a price determined, a contract will have to be made to ensure that the (hazardous) waste that is brought to the factory is effectively destroyed by incineration. This contract needs to be signed by both parties, and potentially as well by the concerned authorities. If possible, it is recommended to be present during the destruction of the (hazardous) waste, to make sure that it doesn't get another destination. After the incineration, a certificate of destruction should be asked for (part of the contract) as proof of the correct elimination of the (hazardous) waste.

For further information: Hazardous Waste Manual, MSF

# CONSTRUCTION OF THE DE MONTFORT MARK 8A INCINERATOR

Concept of: D.J. Picken

In collaboration with: Médecins Sans Frontières

# WARNING!

**Maintain the following rules because they will:**

- increase the lifespan of the De Montfort incinerator.
- reduce the risks during the construction of the De Montfort incinerator.

- Read this chapter completely before constructing the De Montfort incinerator.
- Purchase good quality material.
- Hire skilled people and train them for the specificity of constructing a De Montfort incinerator.
- Choose the right site within the waste zone to construct the incinerator, so that it doesn't cause nuisances nor fire hazards inside the health structure, nor to the surroundings. Make also sure that the incinerator will be away from trees, buildings or other objects that could hinder the correct functioning of its chimney.
- Follow the construction instructions precisely.
- Do not change the form and size of the incinerator as this can lead to serious consequences on its performance.

# REQUIRED MATERIAL LIST

- **Foundation**
  - Concrete (300 kg/m³) and reinforcement bars
- **Incinerator body**
  - Refractory bricks with high Al2O3 content: 160 + 5 % reserve
  - Refractory cement (pre-mix): 50 kg
- **Insulation and outer wall**
  - Vermiculite granularity 1: 300 l
  - Vermiculite granularity 3: 300 l
  - Lafarge Fondu cement: 100 kg
  - Normal bricks or cement blocks
  - Portland cement
- **Metal works** (see appropriate pages below; all dimensions in mm)
  - Top frame with loading door and chimney spigot: (stainless) steel
  - Ash door / tray with grate: (stainless) steel
- **Chimney**
  - Steel pipes Ø 120 – 150 mm, min. 2 mm thick, total length at least 4 m
  - Chimney cap
  - Cables, tensioning devices and accessories
- **Tools**
  - Mason’s and Metal worker’s tools
  - Heavy and Soft (rubber or plastic) hammers
  - Flat chisel
  - Welding machine and accessories, tools and protective equipment

# FOUNDATION

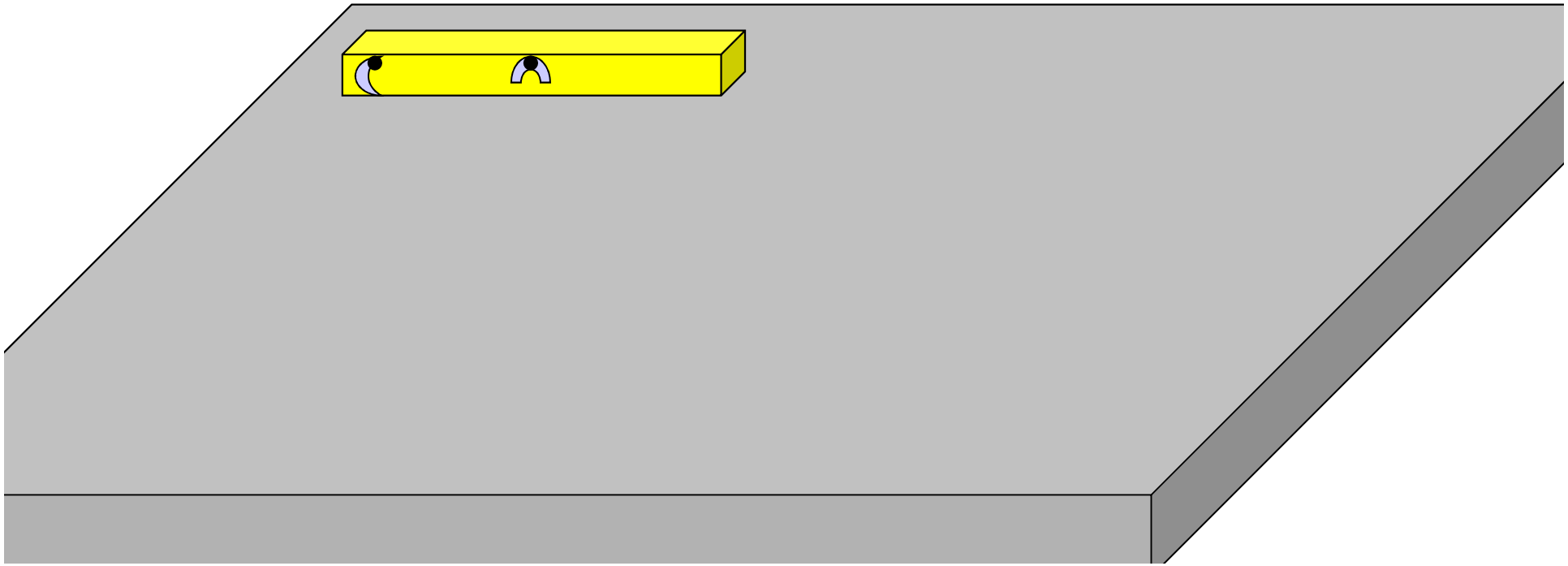
•Cast a solid reinforced concrete foundation (300 kg/m³) that can resist the final weight of the incinerator (about 1000 kg).

-Its dimensions should be at least: 2 m x 2 m x 0.15 m, which includes immediately a small temporary storage area for the soft waste bins. For big health structures, a bigger platform should be foreseen.

-The foundation should be level in its length and width.

•Mark out where the incinerator has to be positioned exactly.

The foundation shouldn’t be too rough at the place where the incinerator will be constructed, to keep the refractory mortar layer in between the concrete and the first layer of refractory bricks as thin as possible (2 to 3 mm thick).



# PREPARATORY WORKS

During the curing of the foundation, which should last for at least a week, the preparatory works for the construction of the De Montfort incinerator can be done.

•Bring in all the material and equipment, and store them safely under a shelter.

-This is to avoid theft, but also to protect them against damages and adverse weather conditions (e.g. sun, rain).

-The refractory cement should be stored on pallets in a dry location where temperatures can be kept between 5 and 30 °C. Warm storage is recommended in extreme cold conditions. If the pallets are covered with plastic sheeting or tarps, ventilation is required in order to prevent condensation.

-The refractory bricks should also be stored on pallets.

•Keep the refractory bricks at all times in the shade in order to avoid that they get warm!

This should be done for all the refractory bricks used for the incinerator, even during the construction itself.

•Provide some kind of temporary shelter over the manufacturing area to protect the incinerator against the rain or sun during its construction.

Exposure to rainwater as well as the heat of the sun during the construction phase could have a negative impact on the lifespan of the incinerator.

# PREPARATORY WORKS

Before the actual construction starts, it's recommended to try out already the refractory cement according to the manufacturer's instructions. For Surebond 50 DAE mixture, proceed as follows:

•Verify the refractory cement.

In case lumps have been formed due to the pressure and settlement during its storage, it should still be possible to break them down by hand. Don't use the refractory cement when the lumps can't readily be broken down by hand.

•Make sure all mixing equipment is clean and dry.

Contaminants, such as Portland cement, can adversely affect the physical and bonding characteristics of Surebond 50 DAE mortar.

•Use only clean, non-salty water with a pH between 6 and 8.

Warm mixing water, with a temperature between 25 and 30 °C is preferred. Mixing water should accurately be weighed or measured. Refer to the chart provided below for water requirements (but don't mix a full bag at once).

| Consistency | Bag size<br>kg | Water addition<br>Wt % | Water/bag<br>Volume<br>in litres | Water/bag<br>Weight<br>in kg |
|---|---|---|---|---|
| Brick setting | 25 | 23 | 5.8 | 5.8 |

•Mix until the mortar is uniform.

The total mixing time should not exceed three to five minutes.

# LAYER 1

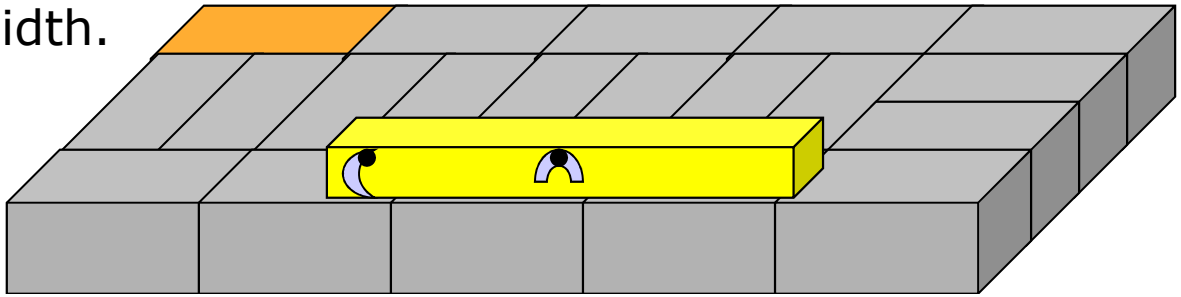
•Prepare the refractory mortar according the manufacturer's instructions.
-To be used as quickly as possible (max. 30'), therefore make several batches!
-Refractory cement / mortar might be aggressive, so do wear protective clothing.

•Apply a thin layer (max. 2 – 3 mm thick) of the refractory mortar directly on the bottom of the 1st brick, like smearing chocolate paste on a sandwich, and trim the layer under 45° at all its edges.
The picture indicates how the layer is applied.

•Position the prepared brick (indicated in orange) in the corner of the foundation's markings.

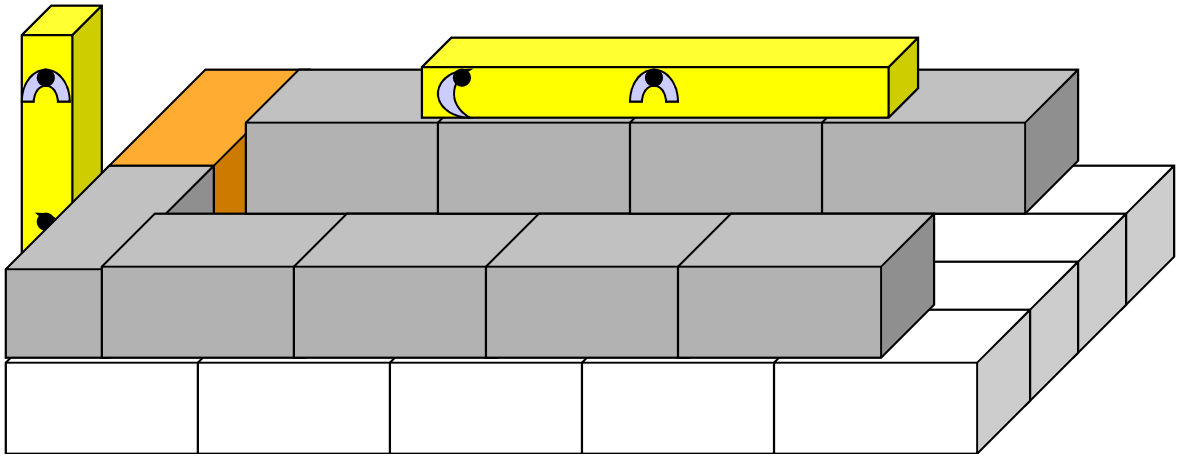
•Apply a thin layer of refractory mortar in a similar way on the bottom of a 2nd brick (max. 2 – 3 mm thick) and its side (1 – 2 mm thick) that will be in contact with the 1st brick, and position the brick as required.
A rubber hammer can be used to ease the exact positioning.

•Keep on doing this until all 20 bricks of the 1st layer are in place according to the drawing, and verify if the whole is level in its length and width.



# LAYER 2

- Apply a thin layer (max. 2 – 3 mm) of the refractory mortar on the bottom of the 1st brick and trim the layer under 45° at all its edges.
- Position the prepared brick at the back corner of the incinerator.
- Prepare in a similar way a 2nd brick with a thin layer of refractory mortar on its bottom and its side that will be in contact with the 1st brick.
- Position the prepared brick next the 1st one.
  A rubber hammer can be used to ease the exact positioning.
- Keep on doing this until all the bricks of the 2nd layer are in place according to the drawing.
- Verify at different places on all sides if the 2nd layer is level in its length, width and height.
  This should be repeated for all the layers!



# LAYER 3

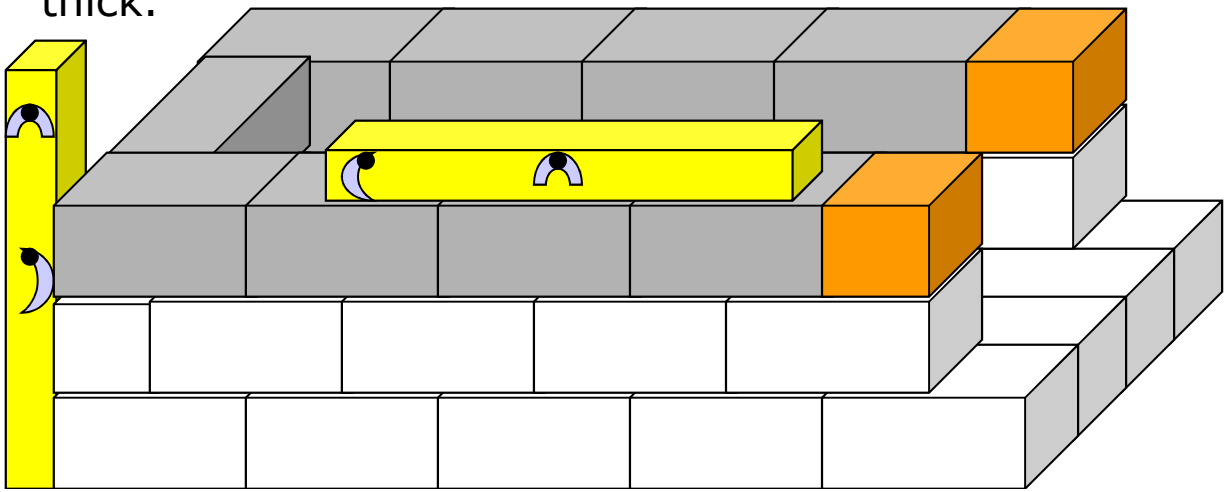
•Cut 1 refractory brick in half.

A small V-shaped cut must be made all around the middle of the brick by means of a flat chisel and a heavy hammer. Once the V-cut is made, a heavy blow with the hammer on the flat chisel inside the V-cut should be sufficient to break the brick in two.

**<u>Attention:</u>**
**Protective goggles are important because small pieces of the brick can be projected!**

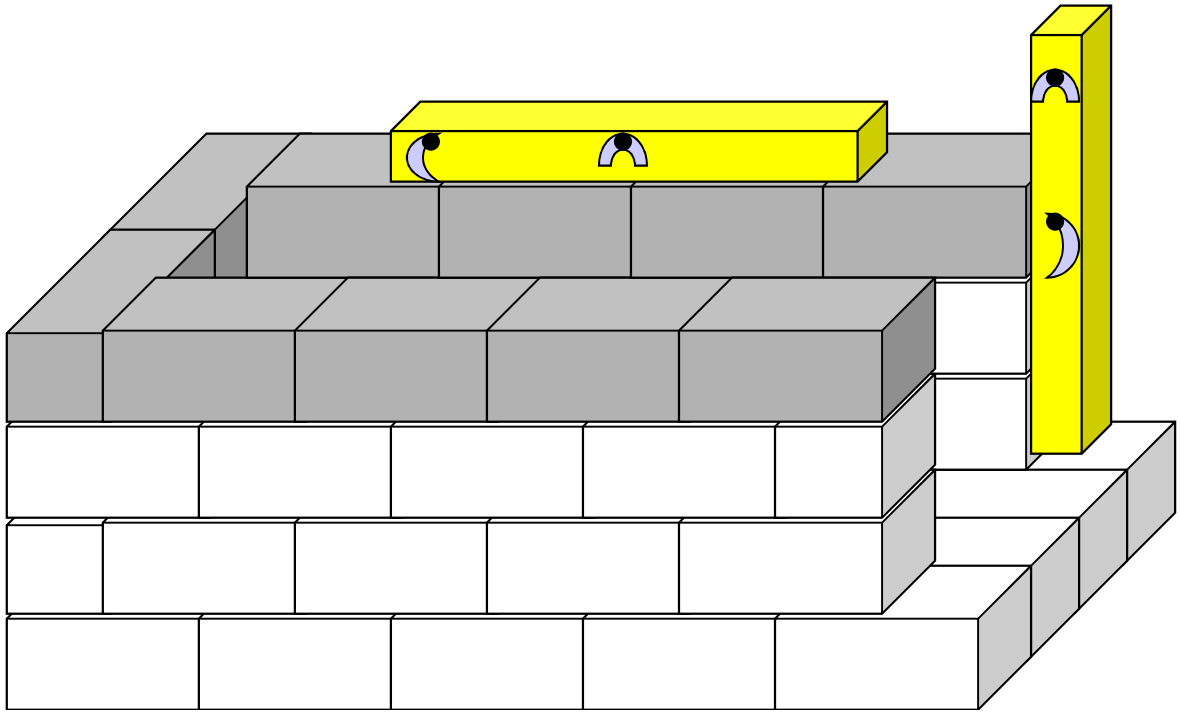
•Build the 3rd layer as described before and according to the drawing, making sure both rough faces of the cut brick are facing outwards.

The latter is to avoid that the mortar layers in between the bricks become too thick.



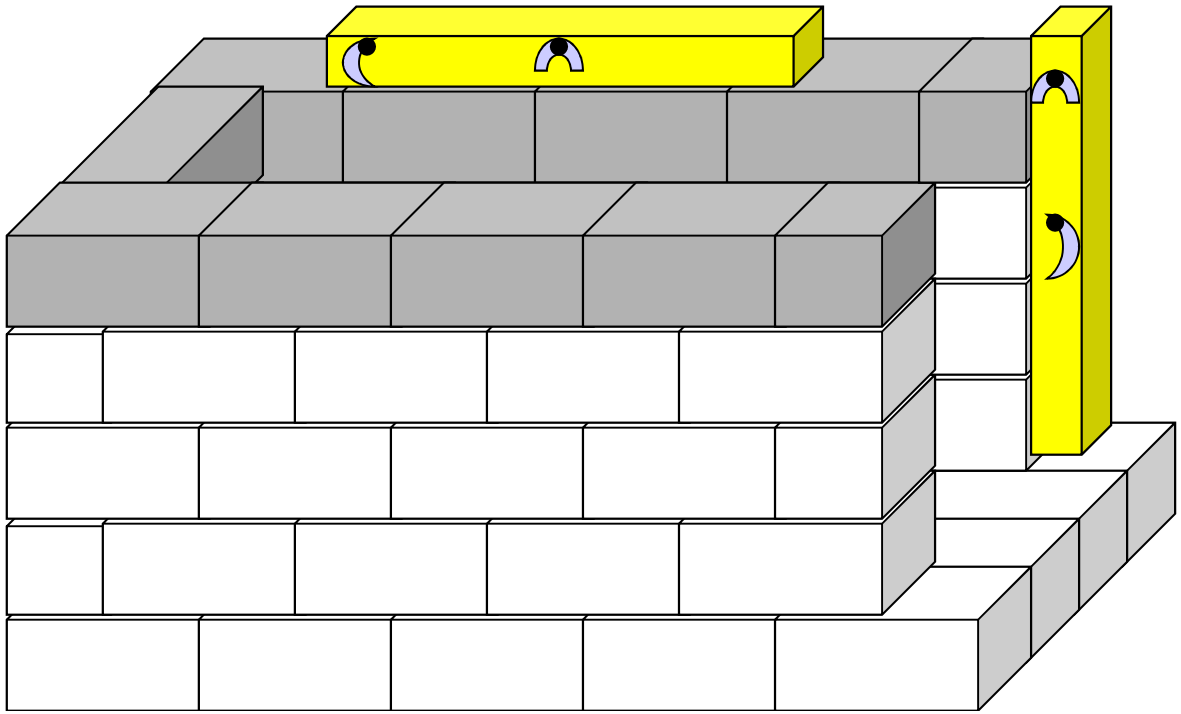
# LAYER 4

- Build the 4th layer as described before and according to the drawing.



# LAYER 5

- Cut 1 refractory brick in half as described before.
- Build the 5th layer as described before and according to the drawing, making sure both rough faces of the cut brick are facing outwards.



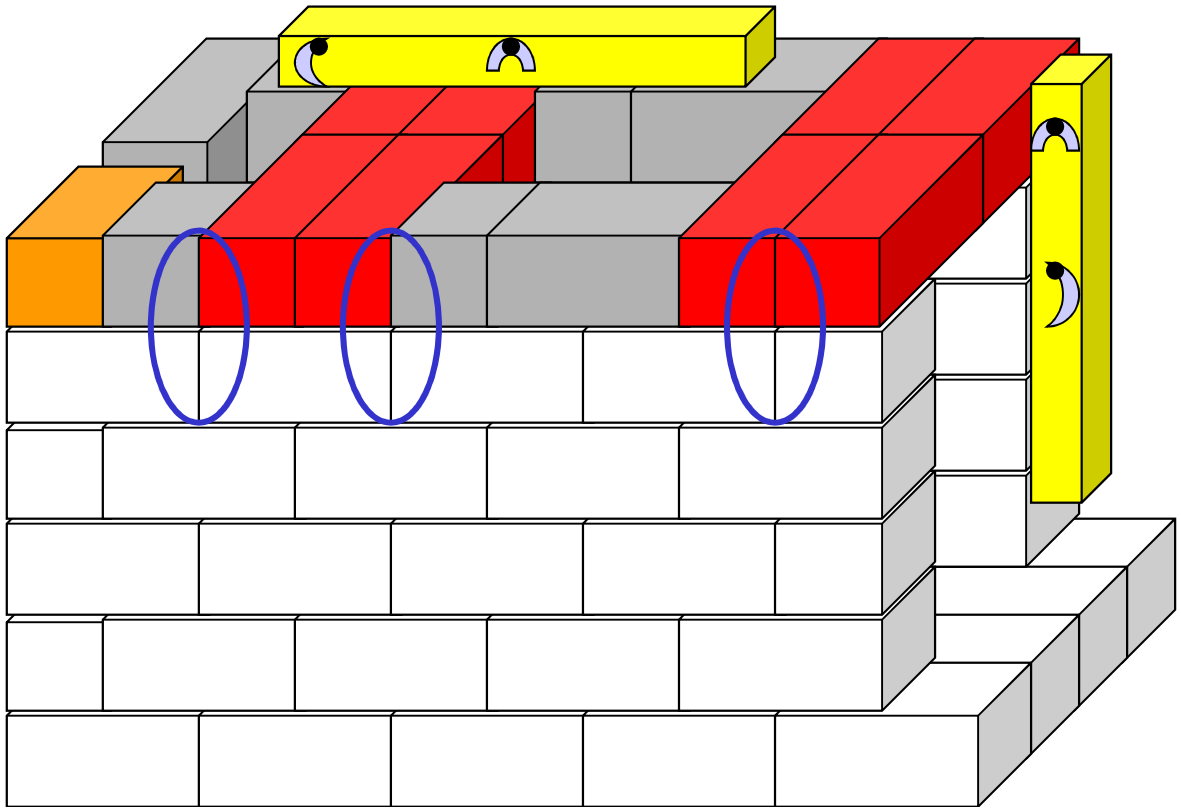
# LAYER 6

•Cut 2 refractory bricks in half, and 1 to ¾ of its length.

•Build the 6th layer as described before and according to the drawing, inserting the ¾ brick at the back of the incinerator and making sure all rough faces of the ½ cut bricks are facing outwards.

-The opening created at the back of the incinerator is a peephole to monitor the secondary combustion (see the operation chapter further in this manual).

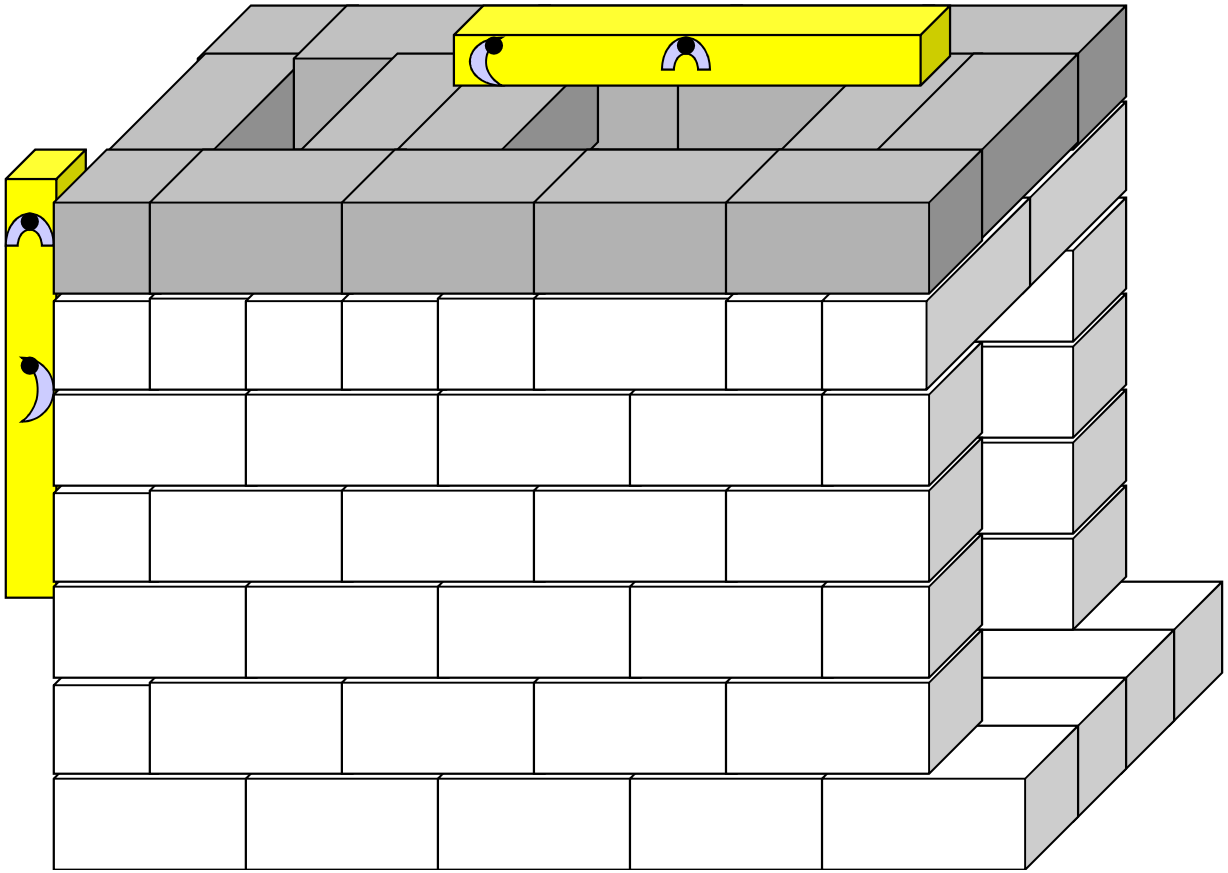
-For the brick bridges (indicated in red) to stay in place as the cement dries, provide a support in bricks or wood underneath.



From layer 6 onwards, superposing joints are to be noticed. From a constructor's point of view, this isn't ideal. But as these aren't structural walls, and the failures seen on existing De Montfort incinerators were more related to bad curing (see below), it has been opted to ease the construction, instead of following strict building rules.

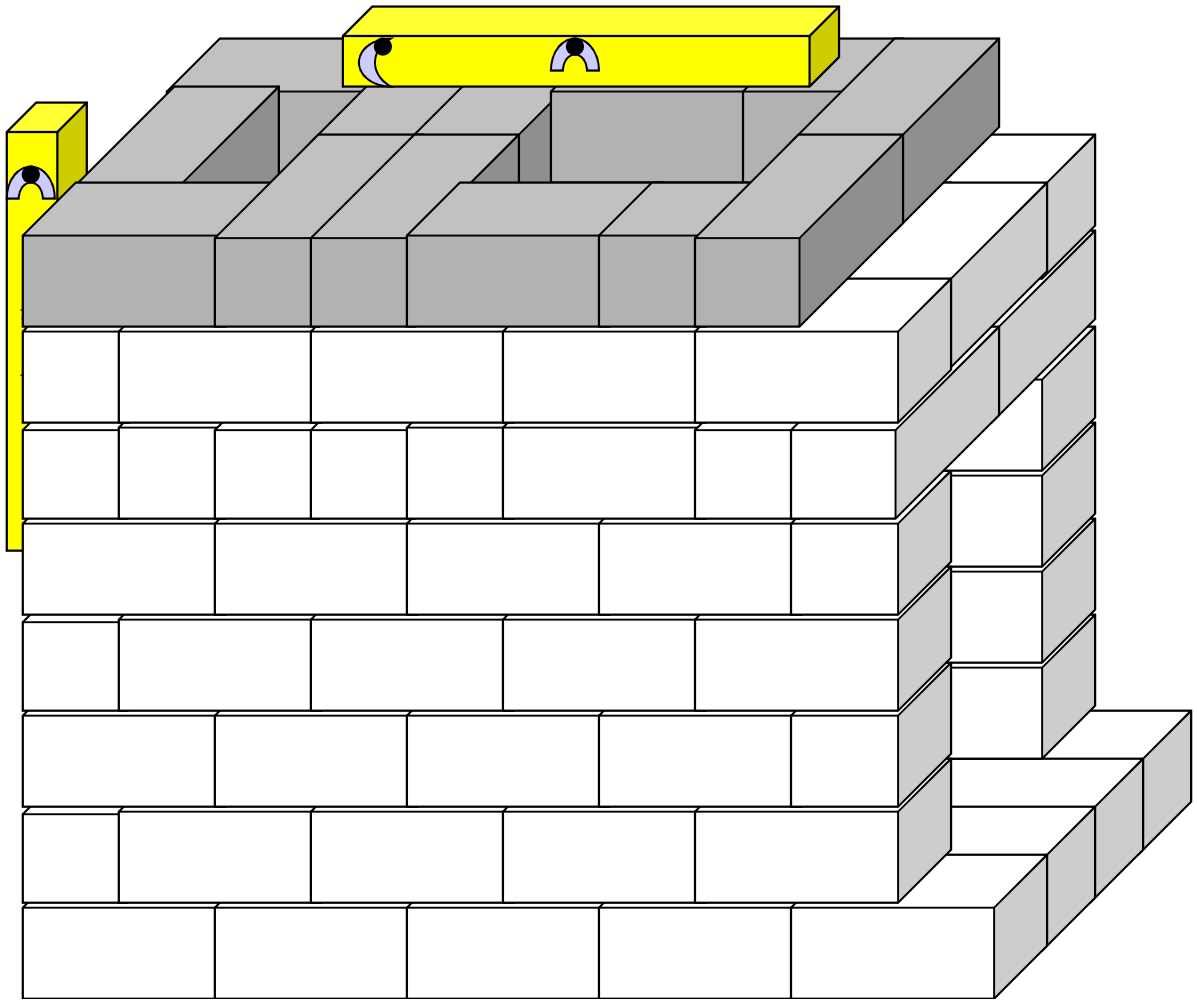
# LAYER 7

- Cut 1 refractory brick in half as described before.
- Build the 7th layer as described before and according to the drawing, making sure both rough faces of the cut brick are facing outwards.



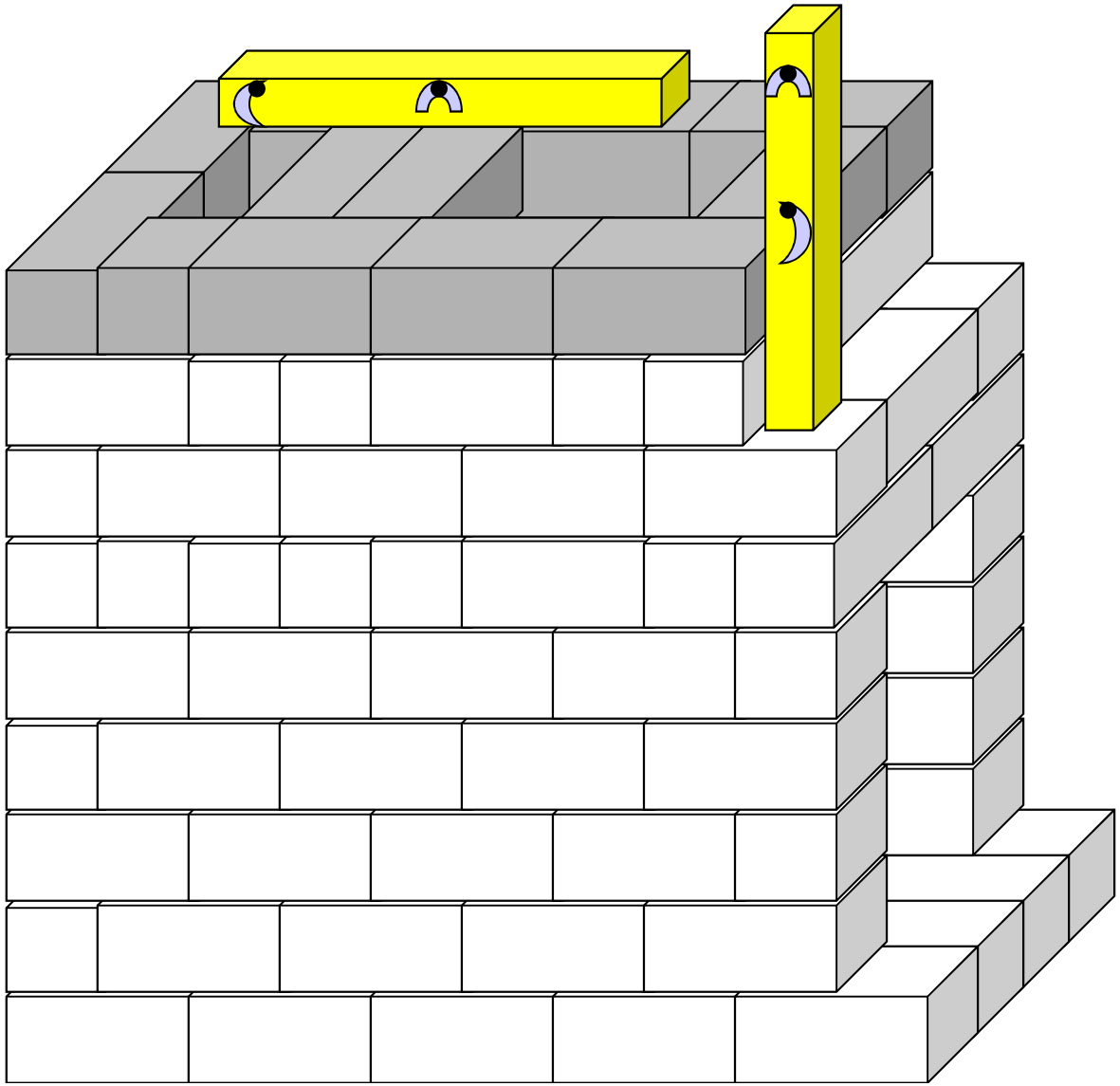
# LAYER 8

- Cut 1 refractory brick in half as described before.
- Build the 8th layer as described before and according to the drawing, making sure both rough faces of the cut brick are facing outwards.



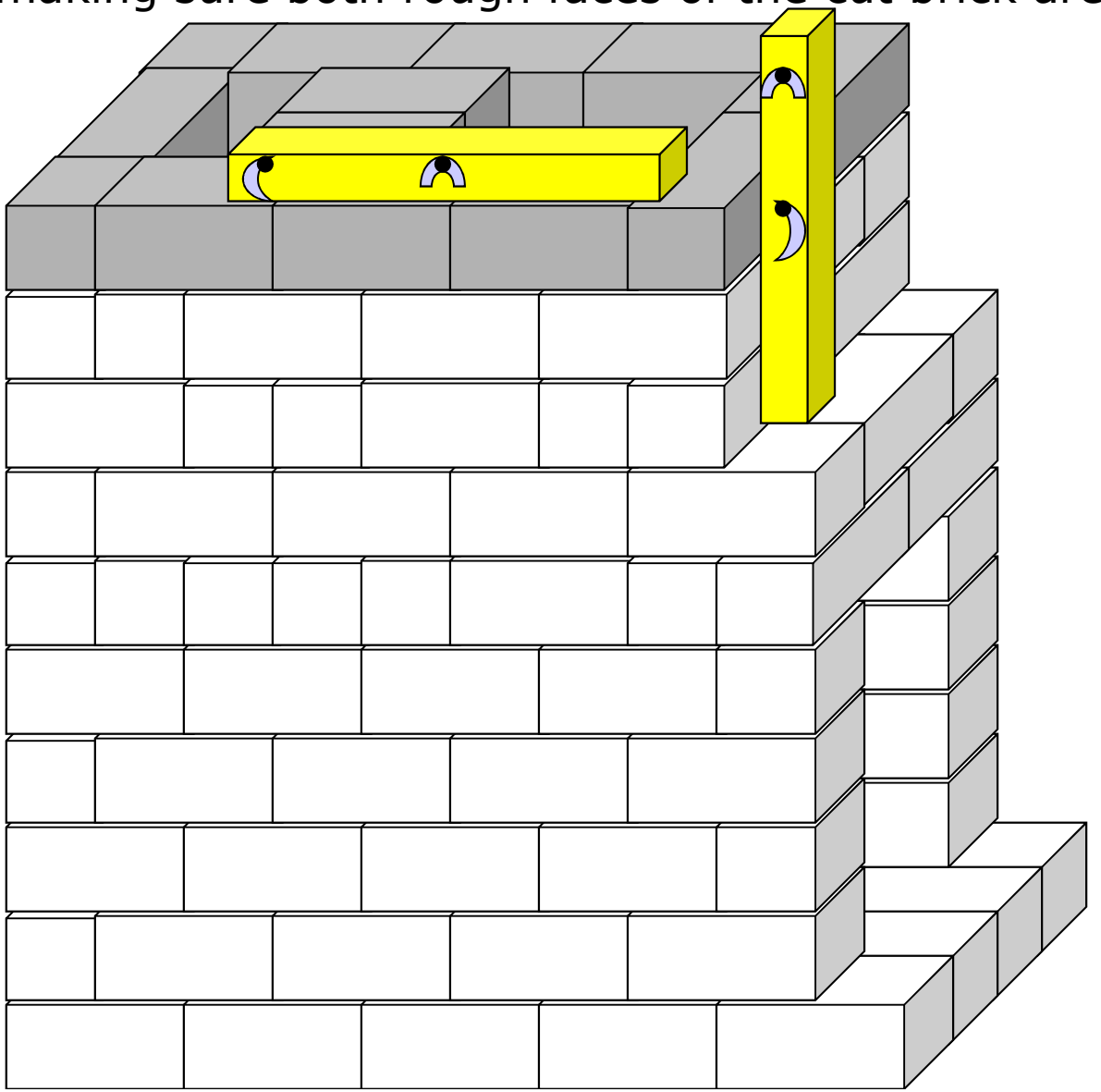
# LAYER 9

- Cut 1 refractory brick in half as described before.
- Build the 9th layer as described before and according to the drawing, making sure both rough faces of the cut brick are facing outwards.



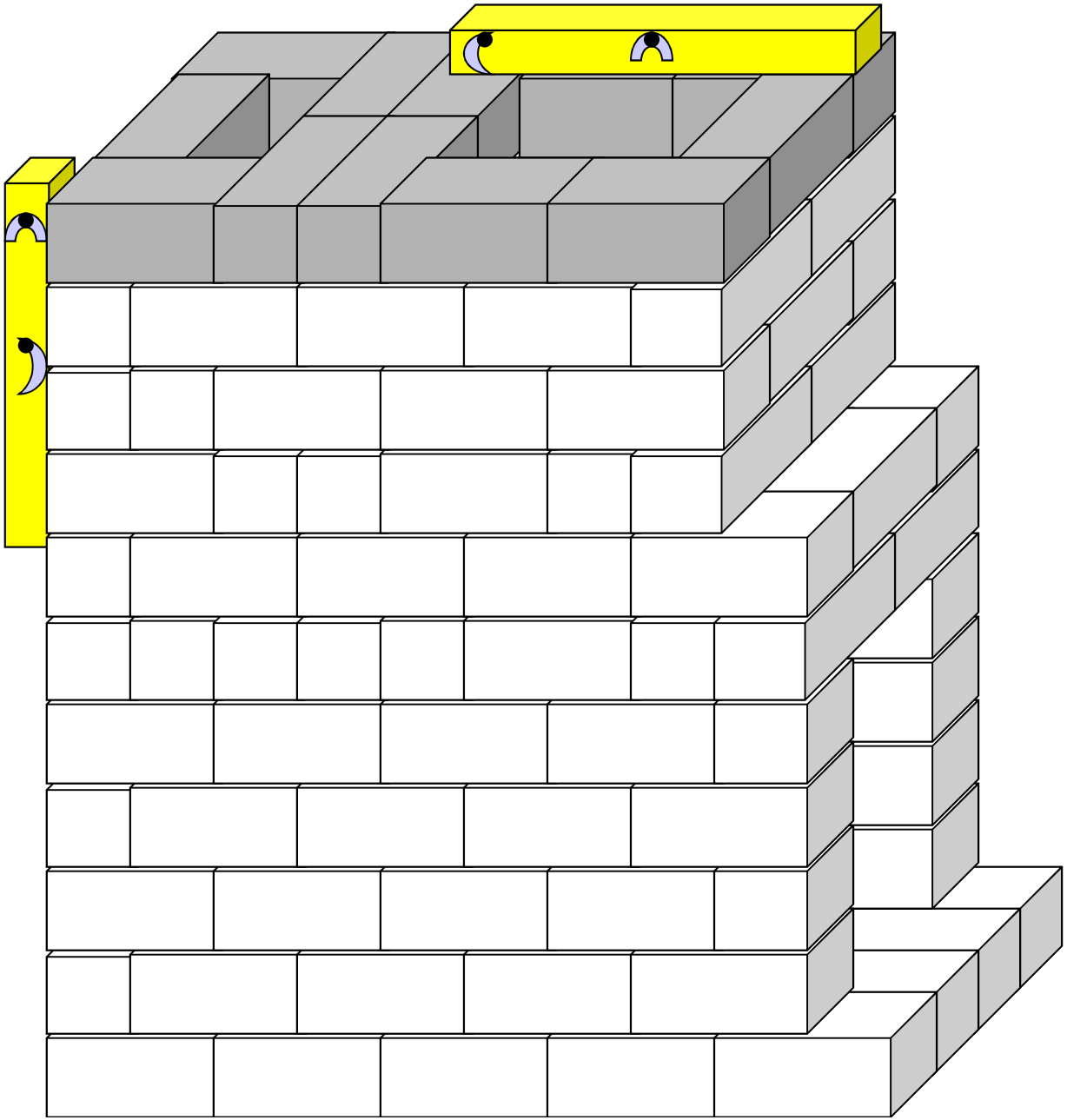
# LAYER 10

- Cut 1 refractory brick in half as described before.
- Build the 10th layer as described before and according to the drawing, making sure both rough faces of the cut brick are facing outwards.

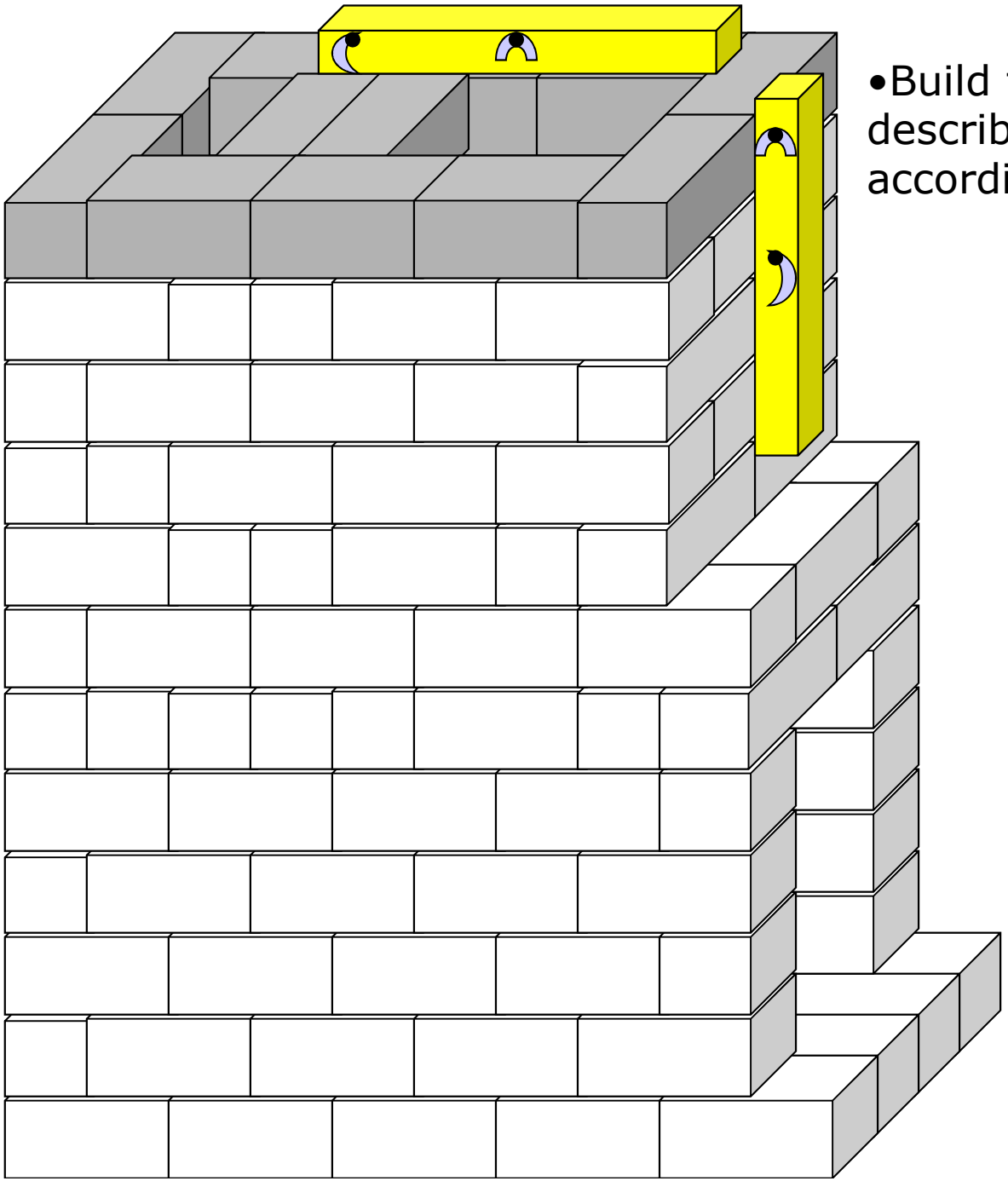


# LAYER 11

- Build the 11th layer as described before and according to the drawing.

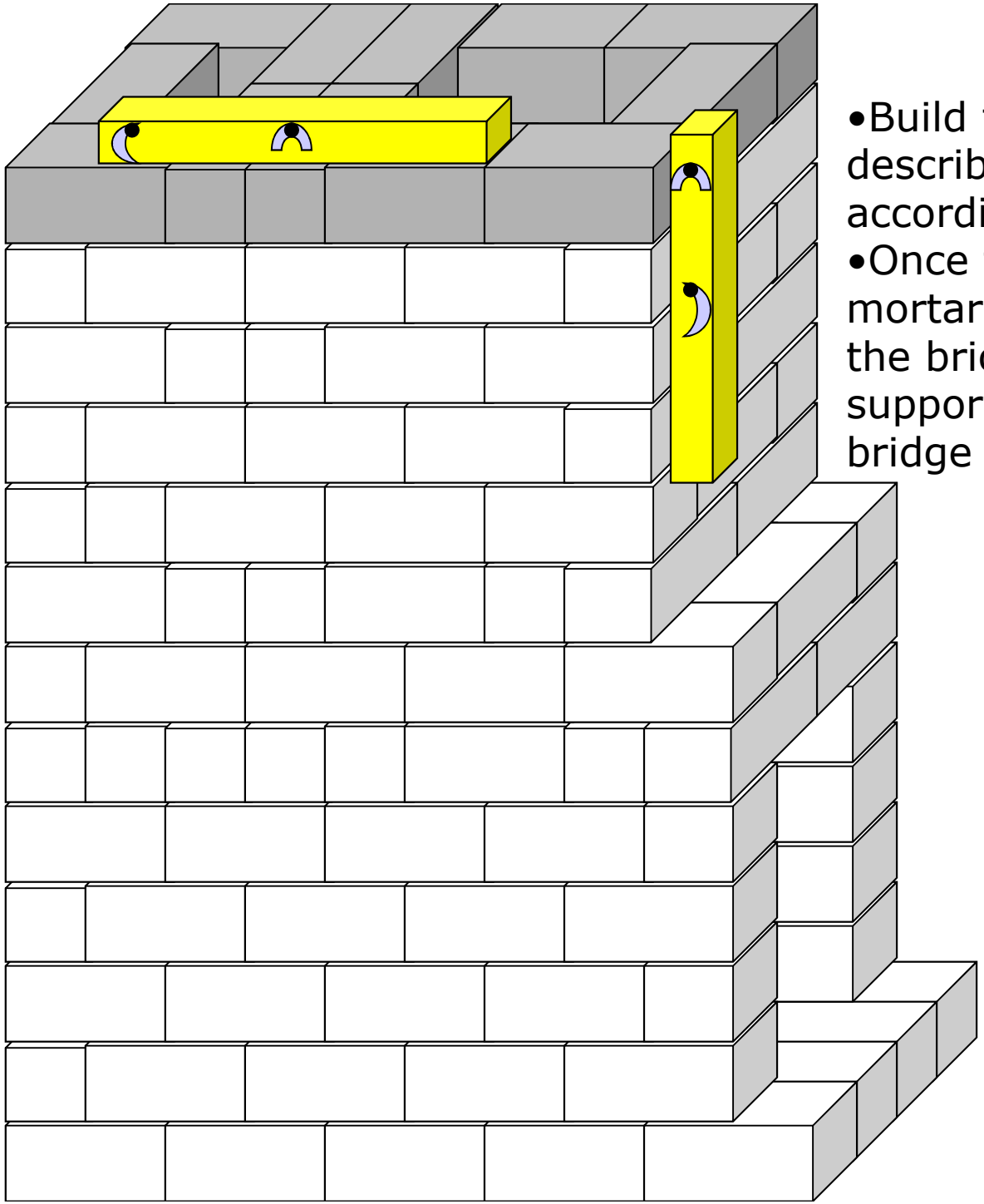


# LAYER 12

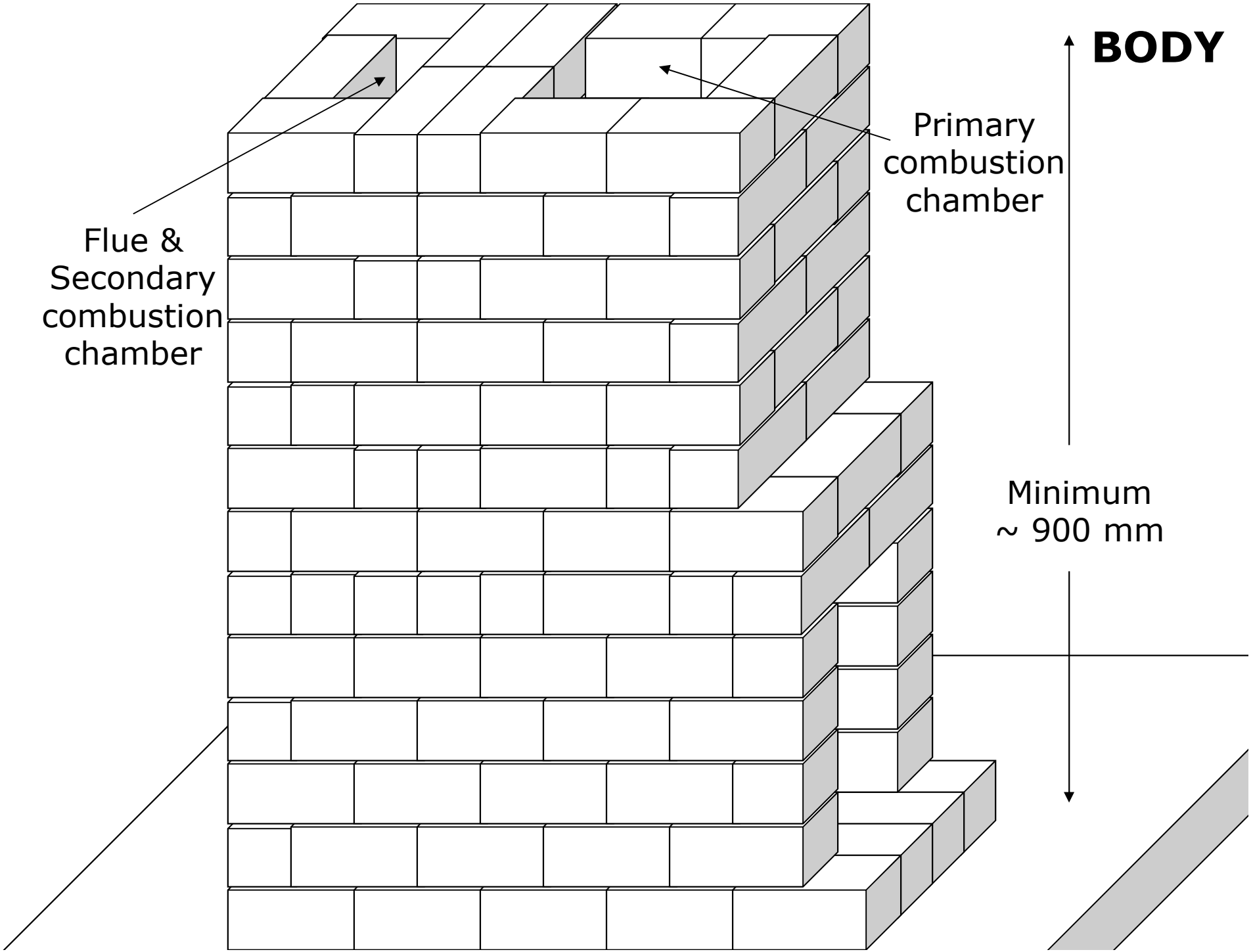


- Build the 12th layer as described before and according to the drawing.

# LAYER 13

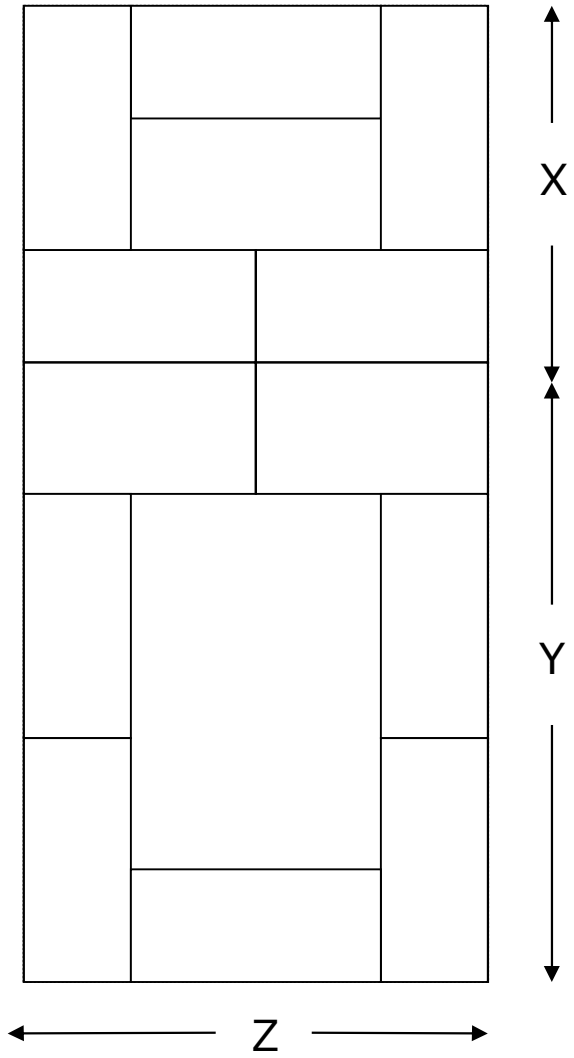


- Build the 13th layer as described before and according to the drawing.
- Once the refractory mortar has dried enough, the brick or wooden support underneath the bridge can be removed.


BODY
Primary combustion chamber
Flue & Secondary combustion chamber
Minimum ~ 900 mm

# TOP FRAME

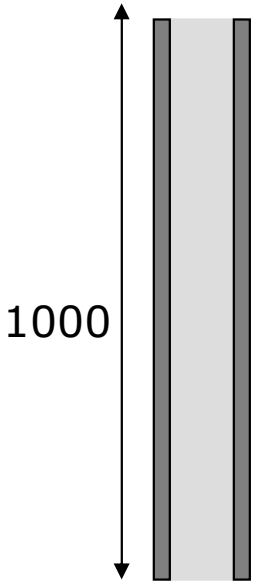
•Measure the exact external top dimensions of the refractory construction (body of the incinerator).



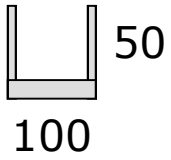

The list concerning the material needed for the metal works of the top frame with loading door and chimney spigot are to be found on the next page.

The dimensions (in mm) given on the material list for the top frame are for an incinerator made with the standard refractory bricks of 230 mm length x 114 mm width, and might have to be adapted if non-standardized bricks are used!

# TOP FRAME




x 4

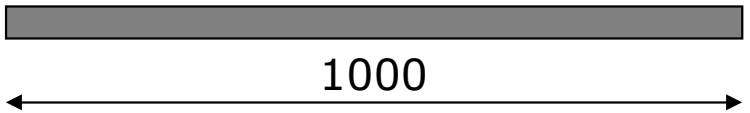


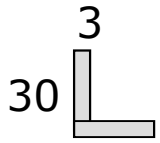

Cross section of metal U-profile

Flat metal strip

40 x min. 3 mm thick


x 1



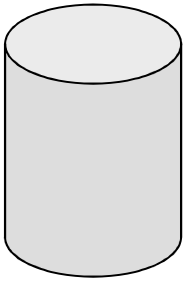

Metal Angle

x 8

(Partly for ashtray)

Metal pipe

Ø >114

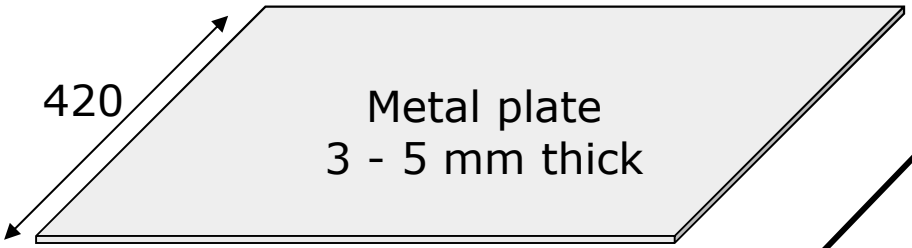



x 1

min. 3 mm thick

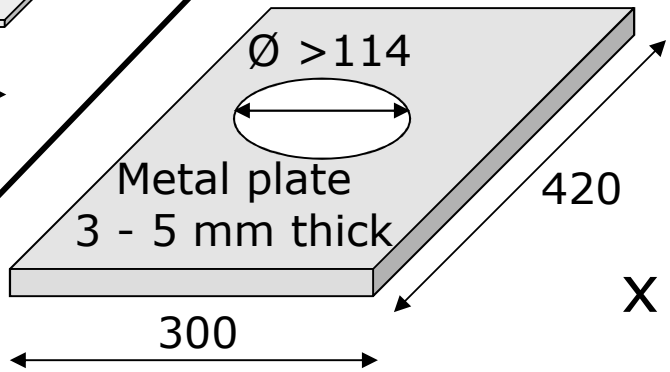
Metal pipe Ø15 x 1000

x 1




Metal plate 3 - 5 mm thick

x 1




Metal plate 3 - 5 mm thick

x 1

Metal pipe Ø10 x 500

x 1

# TOP FRAME

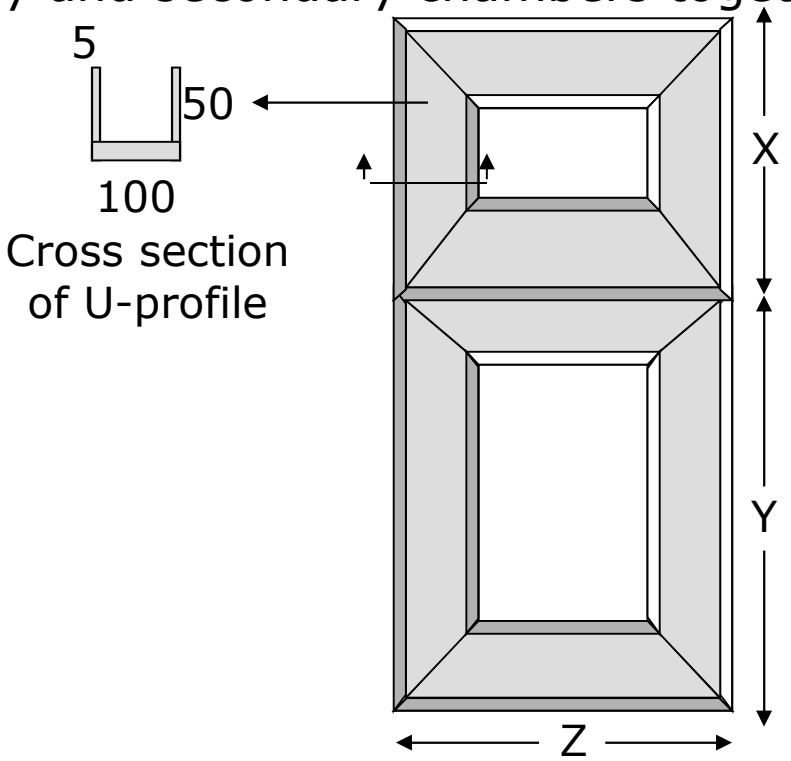
•Cut the metal U-profile at the needed external lengths (X, Y, Z) under 45°.
-If U-profile isn't available, metal angles can be welded together to form a U-shape, but this complicates things enormously.

-An alternative is to order module 3: Metal Works (see annexes) at your HQ.

•Remove all sharp edges that could cause injury.

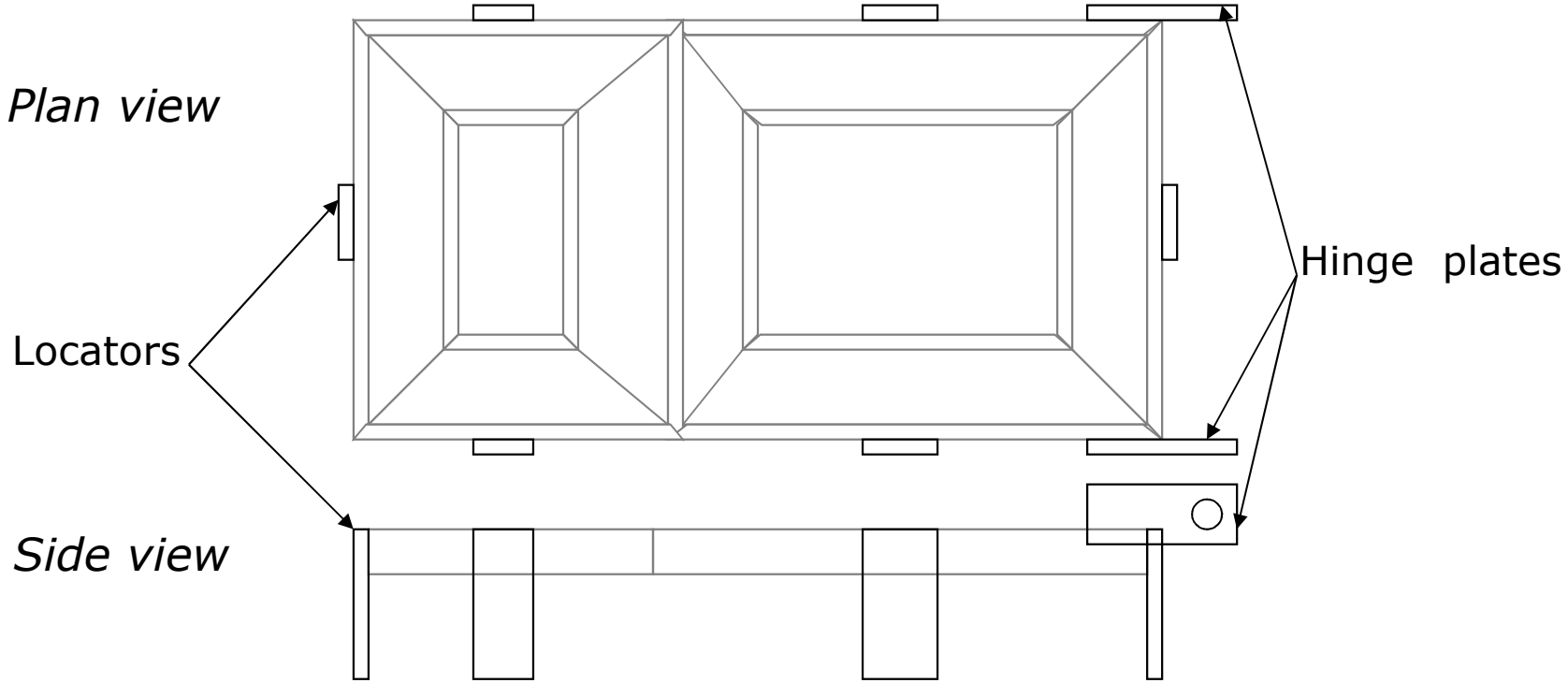
•Weld the profiles together, so that they become two frames. Be aware that some deformation will occur during the welding. Therefore, hire a skilled welder who knows how to deal with this phenomenon (by tacking).

•Weld the frames of the primary and secondary chambers together.



# TOP FRAME

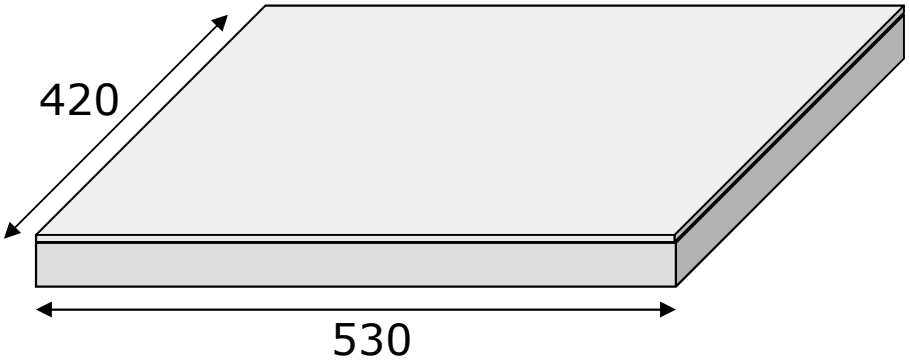
- Cut 8 pieces of flat metal strip (min. 3 mm thick) to a length of 150 mm.
- Remove all sharp edges that could cause injury.
- Weld 6 of them to the centres of the combined top frames (as indicated on the drawing), where they'll function as locators.
- Provide holes to the 2 remaining strips (hinge plates) with a (slightly bigger diameter) as the hinge bar / bolts (Ø 10 mm; see further).
- Weld the 2 hinge plates to the top frame as indicated on the drawing.
- Verify if the top plate fits on the body of the incinerator.

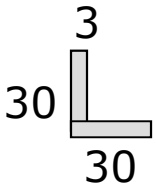


# LOADING DOOR

- Cut the metal angles under 45° to the lengths indicated on the drawing.
- Cut a 3 – 5 mm thick metal plate to the size indicated on the drawing.
- Remove all sharp edges that could cause injury.
- Weld the metal angle lengths together with the metal plate to form the loading door.

Underside



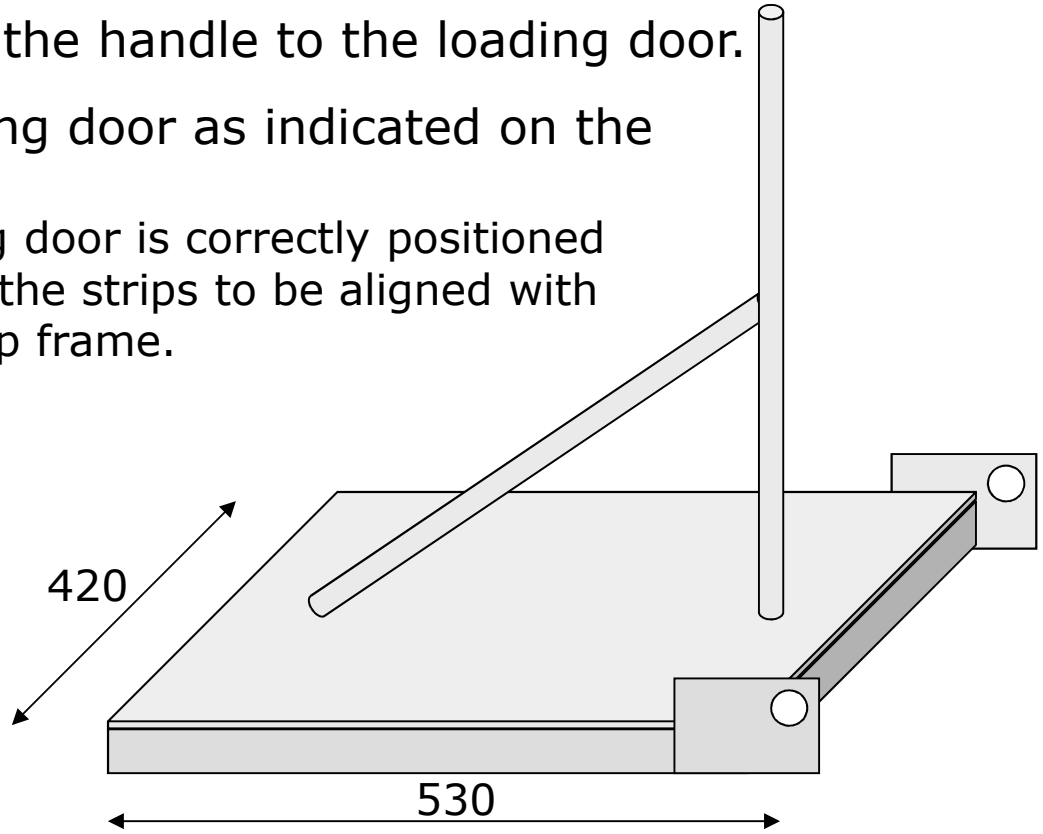




Metal Angle

# LOADING DOOR

- Cut 2 pieces of flat metal strip (min. 3 mm thick) to a length of 150 mm.
- Drill holes in the 2 strips with the same diameter as the hinge bar / bolts (Ø 10 mm).
- Cut 2 pieces of metal pipe (at least Ø 15 mm) to the desired length.
- Remove all sharp edges that could cause injury.
- Weld the pipes that will form the handle to the loading door.
- Weld the 2 strips to the loading door as indicated on the drawing.

This is best done when the loading door is correctly positioned on the top frame, for the holes of the strips to be aligned with those of the hinge plates of the top frame.



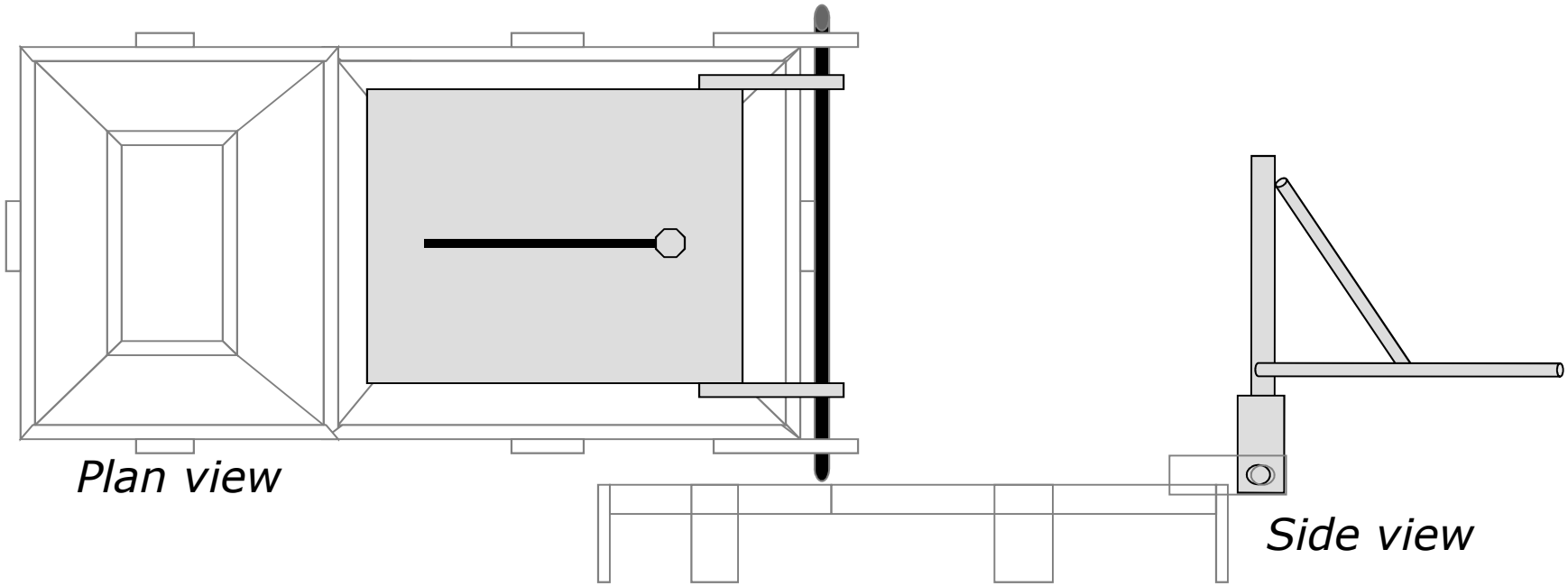
# LOADING DOOR

- Cut the metal hinge bar to length and remove all sharp edges.
- Place the loading door on the top frame.
- Slide the metal hinge bar trough the holes of all the hinge plates.
- Weld the hinge bar to the strips of the loading door, and preferably fix this assembly to the top frame.

-To fix the assembly, drill a perpendicular hole in the hinge bar on both its extremities and install on each side a pin.
-In case a hinge bar isn't available, replace it with big bolts and nuts.

- Verify if the loading door opens easily.

Use grease if necessary and/or un-tighten the nuts if bolts are used.

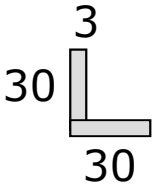


*Plan view*

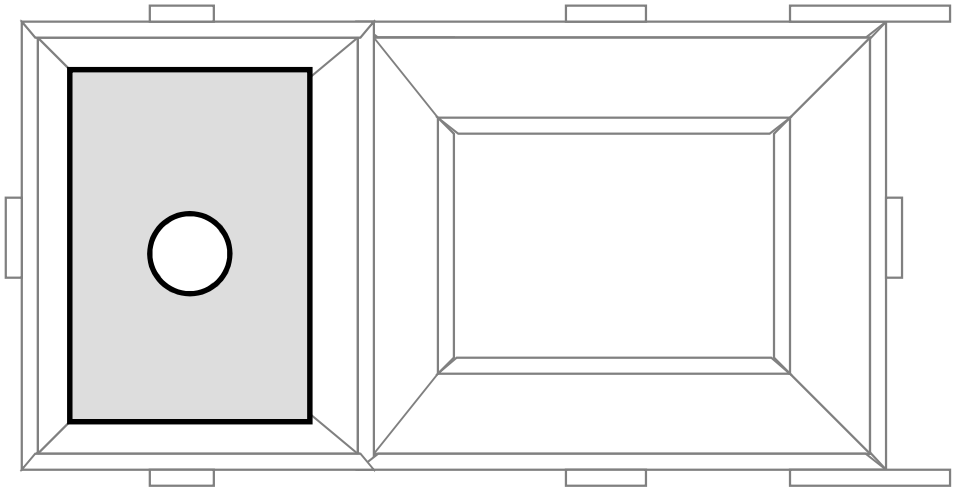
*Side view*

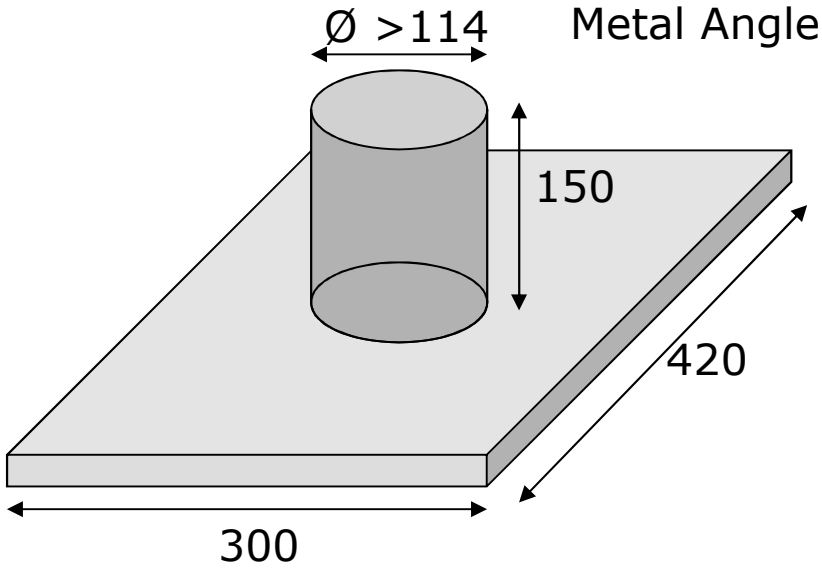
# CHIMNEY SPIGOT

- Cut the metal angles under 45° to the lengths indicated on the drawing.
- Cut a 3 - 5 mm thick metal plate to the size indicated on the drawing.
- Cut the steel pipe (with min. 3 mm thickness) to a length of 150 mm.
- Cut a hole with the inner diameter of the pipe in the centre of the plate.
- Remove all sharp edges that could cause injury.
- Weld the metal angle lengths together, and the metal plate to form the chimney spigot.
- Weld the tube to the chimney spigot in a straight angle.
- Position the chimney spigot on the top frame to verify if it fits.

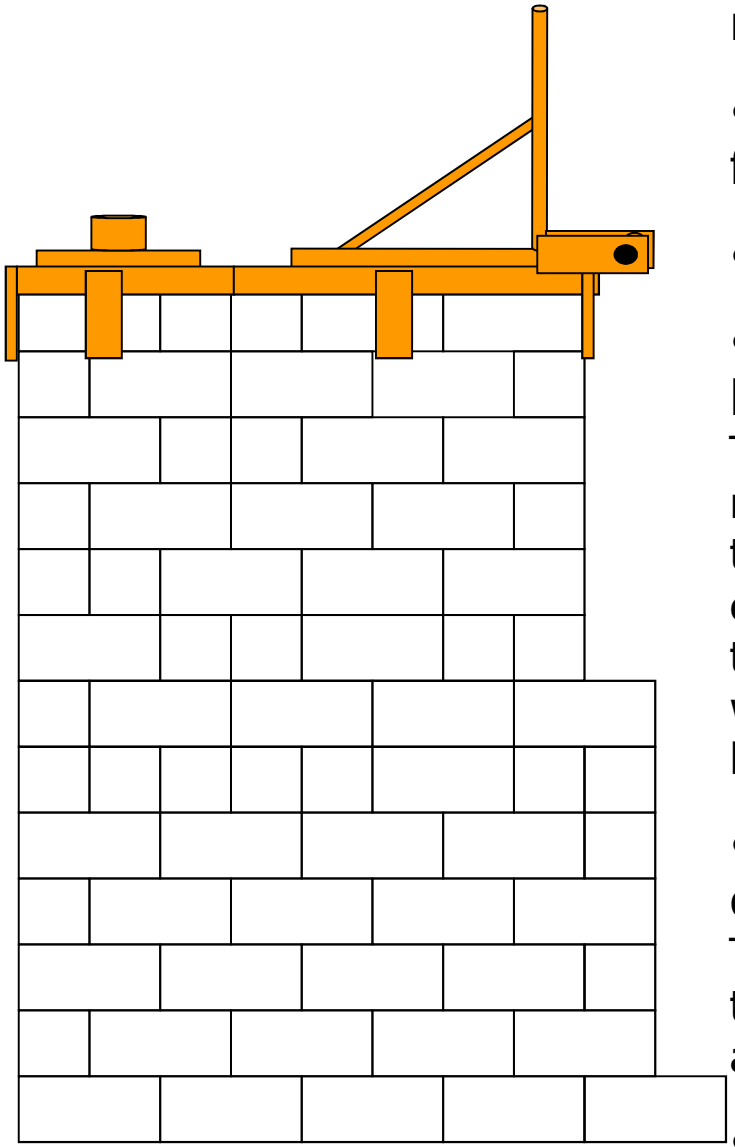


Metal Angle





# FITTING THE TOP FRAME



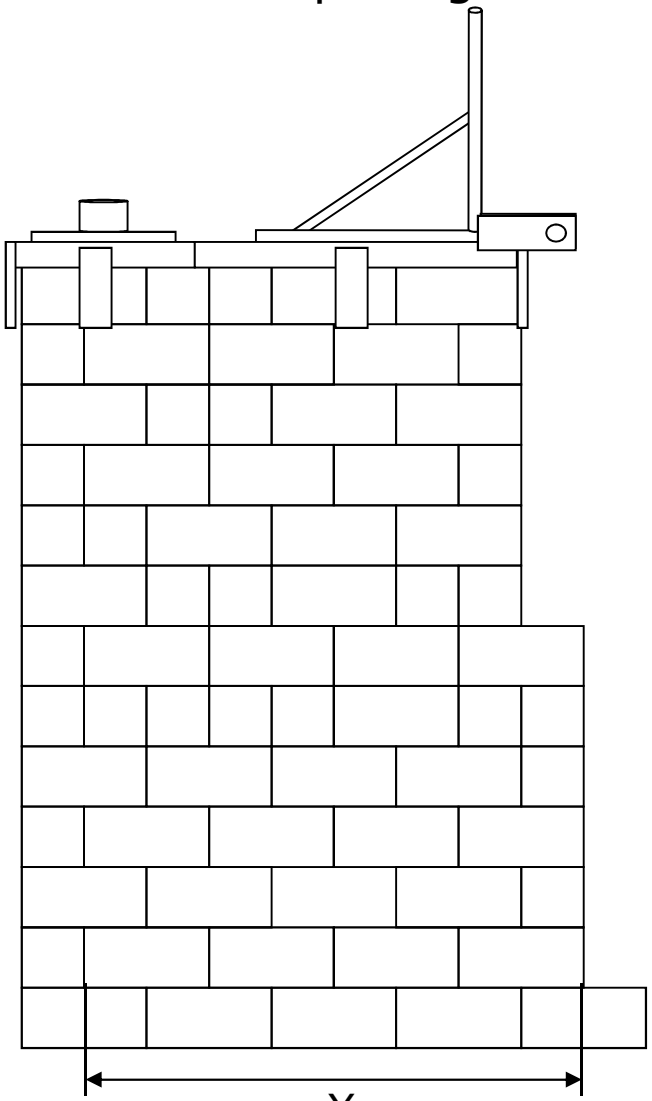
- Paint the top frame assembly with heat-resistant paint to inhibit corrosion.
- Verify once again if the top frame assembly fits on the body of the incinerator.
- Remove the top frame from the body.
- Smear a layer of (old) engine oil on the bottom of the top frame.

  This oil avoids that the top frame will stick to the refractory mortar once installed, which could lead to serious cracks of the refractory mortar and even the refractory bricks due to deformation of the top frame once the incinerator is lit. The oil will disappear gradually when the incinerator will be in use.
- Apply a thin coating of refractory mortar on the top layer of the refractory bricks.

  The coating should be just thick enough to close the gaps in between the body of the incinerator and the top frame once installed.
- Install the top frame assembly on the body of the incinerator.

# ASH TRAY / DOOR

•Measure the total depth of the incinerator (X), the width and the height of the ash opening.

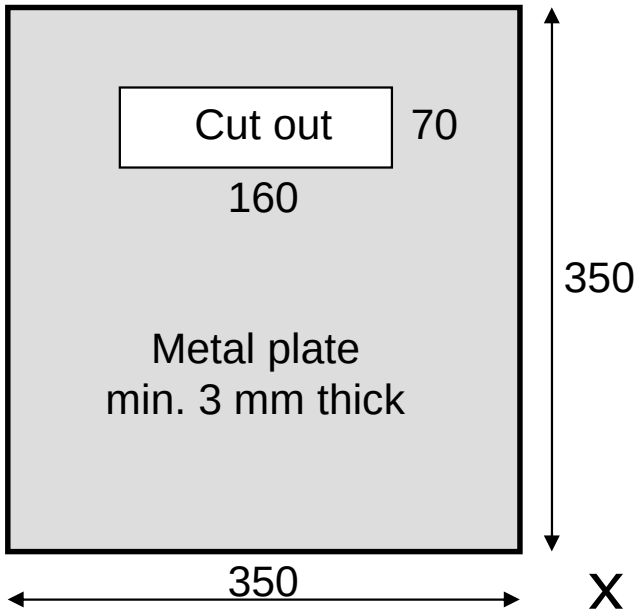



The list concerning the material needed for the metal works of the ashtray / door are to be found on the next page.

The dimensions (in mm) given on the material list for the ash tray / door are for an incinerator made with the standard refractory bricks of 230 mm length x 114 mm width x 74 mm height, and might have to be adapted if non-standardized bricks are used!

# ASH TRAY / DOOR

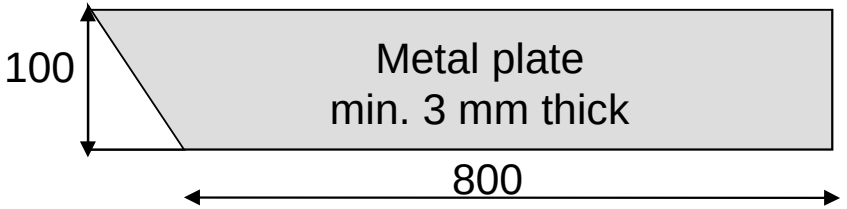
Front plate - door




x 1

Side plates

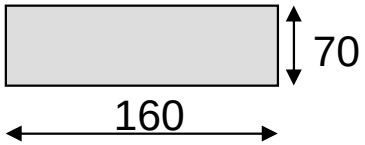
x 1




Ground plate


x 1

Deflector plate - cut out

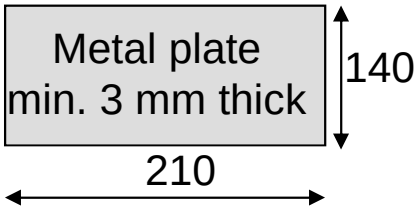



x 1

Deflector triangles

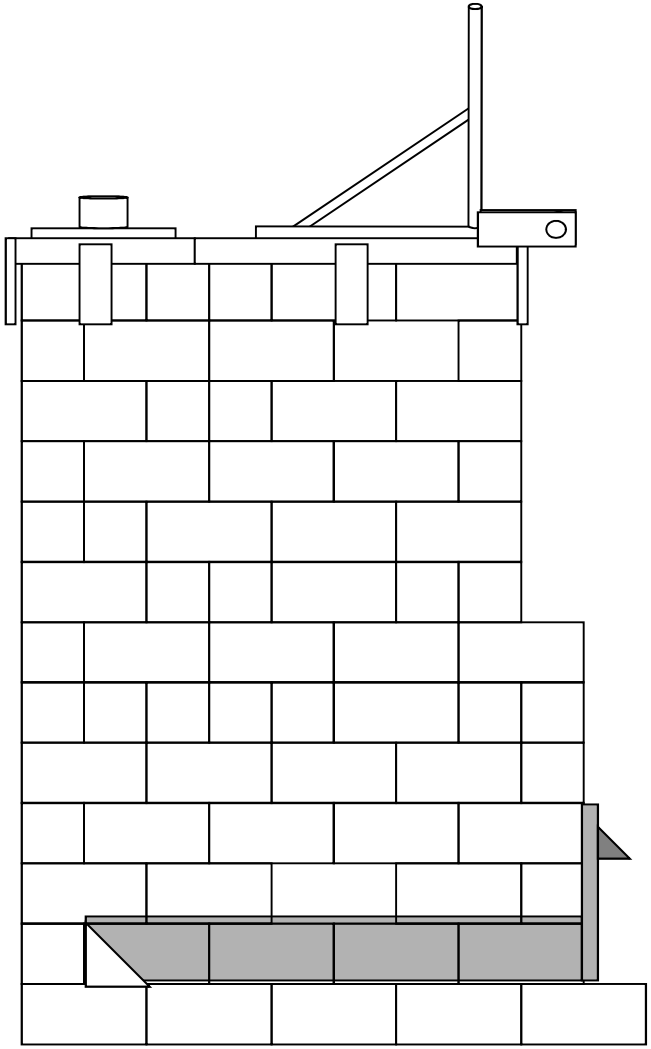

x 2

Back plate




x 1

# ASH TRAY / DOOR



•Cut the metal plates (min. 3 mm thick) as depicted on the previous page:
- 2 side plates
- 1 ground plate
- 1 back plate
- 1 front plate for the door
- 2 triangular plates for the deflector

The dimensions of the different plates as depicted might have to be adapted if non-standardized refractory bricks are used. The front plate should be at least bigger than the ash removal opening.

•Cut an opening of 160 x 70 mm in the front plate.

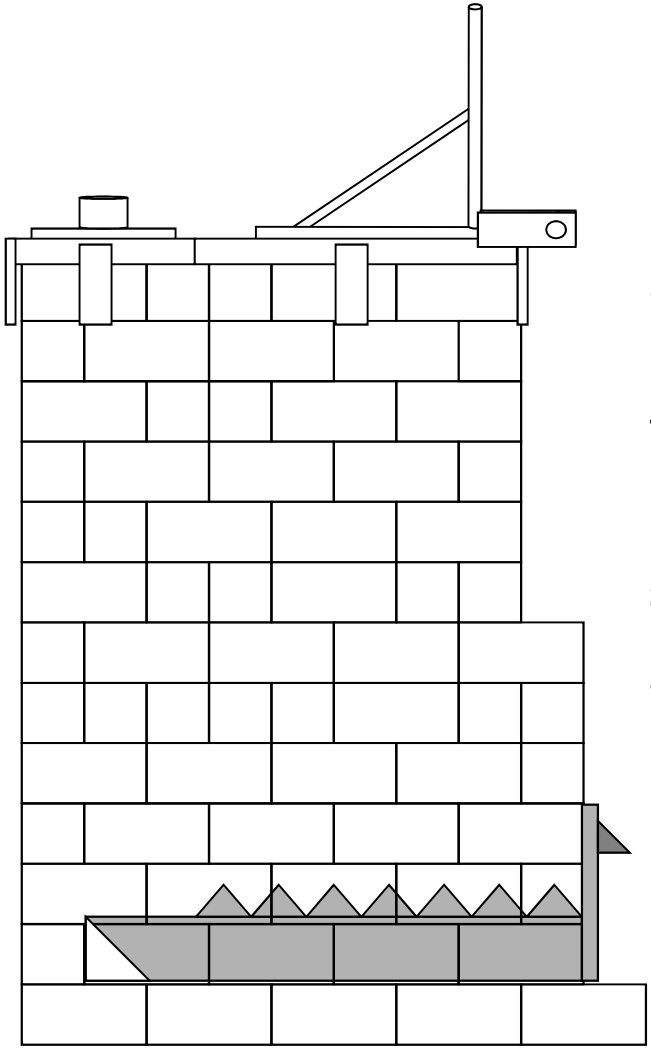
This little cut out together with the two little triangular plates will serve as a deflector against potential projections caused by unexpected explosions.

•Remove all sharp edges that could cause injury.

•Weld all the plates together to form the ashtray.

All big plates should be welded perpendicular to each other. The ashtray can be reinforced with metal angles at its corners.

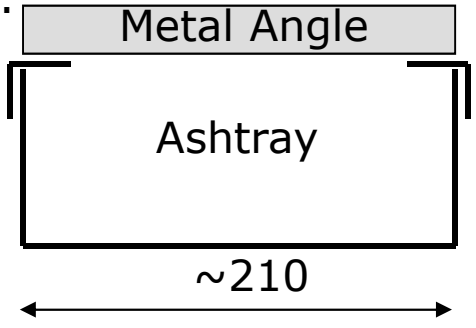
# ASHTRAY GRATE



- Cut 8 to 10 metal angles (30 x 30 x 3 mm) with a length equal to the width of the ashtray.
- Cut 2 metal angles (30 x 30 x 3 mm) with a length equal to the upper length of the ashtray.
- Remove all sharp edges that could cause injury.
- Lay the long metal angles inverted along the ashtray as indicated on the drawing.
- Weld the short metal angles perpendicular to the long metal angles, spaced out by 20 mm in between two angles as seen on the picture.

-There is no real need for a grate underneath the secondary combustion chamber. -

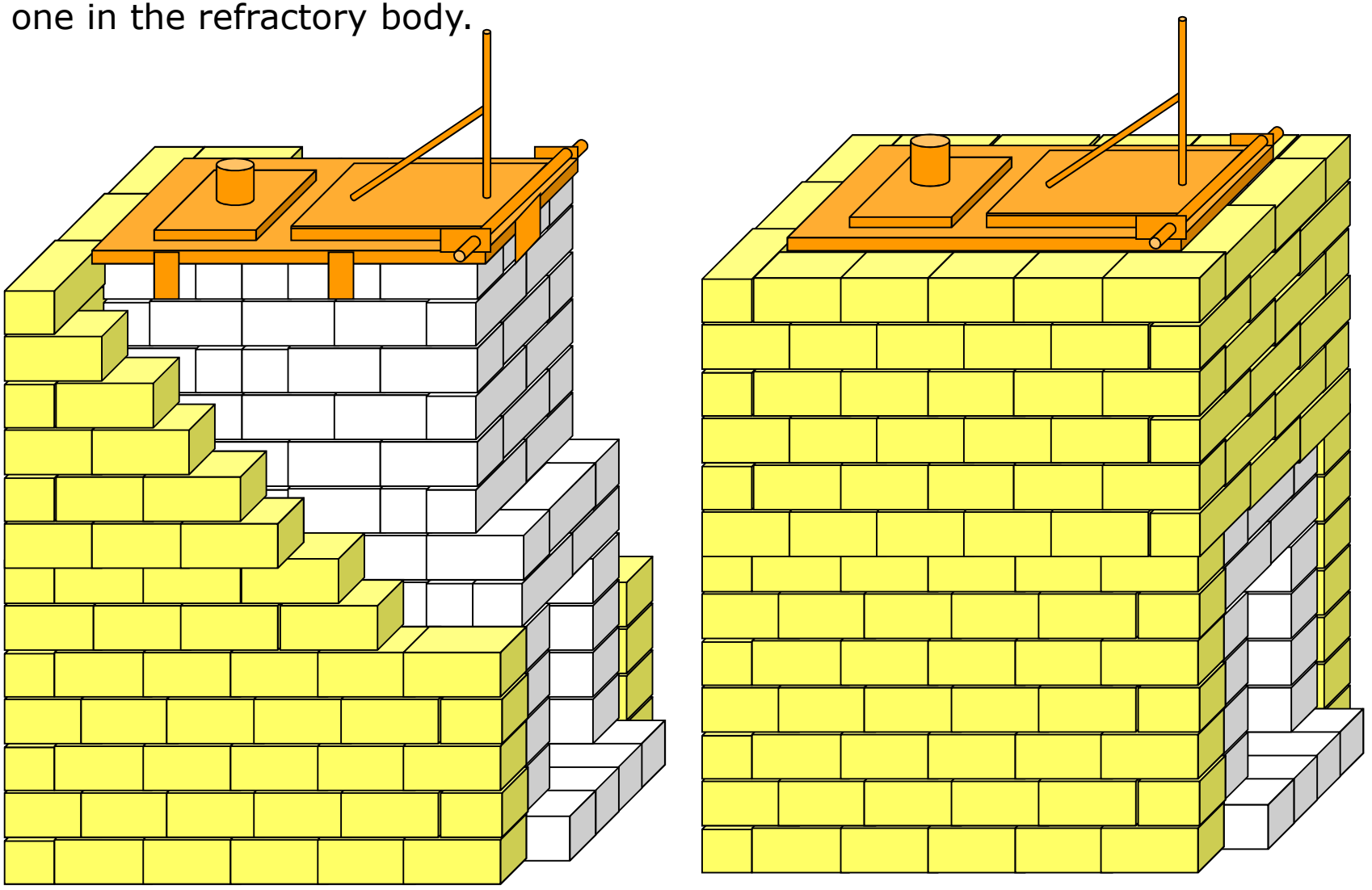
-To avoid that the grate would fall into the ash pit when being emptied, block the grate on the ashtray by means of little bolts and nuts on both sides, or with a hook.



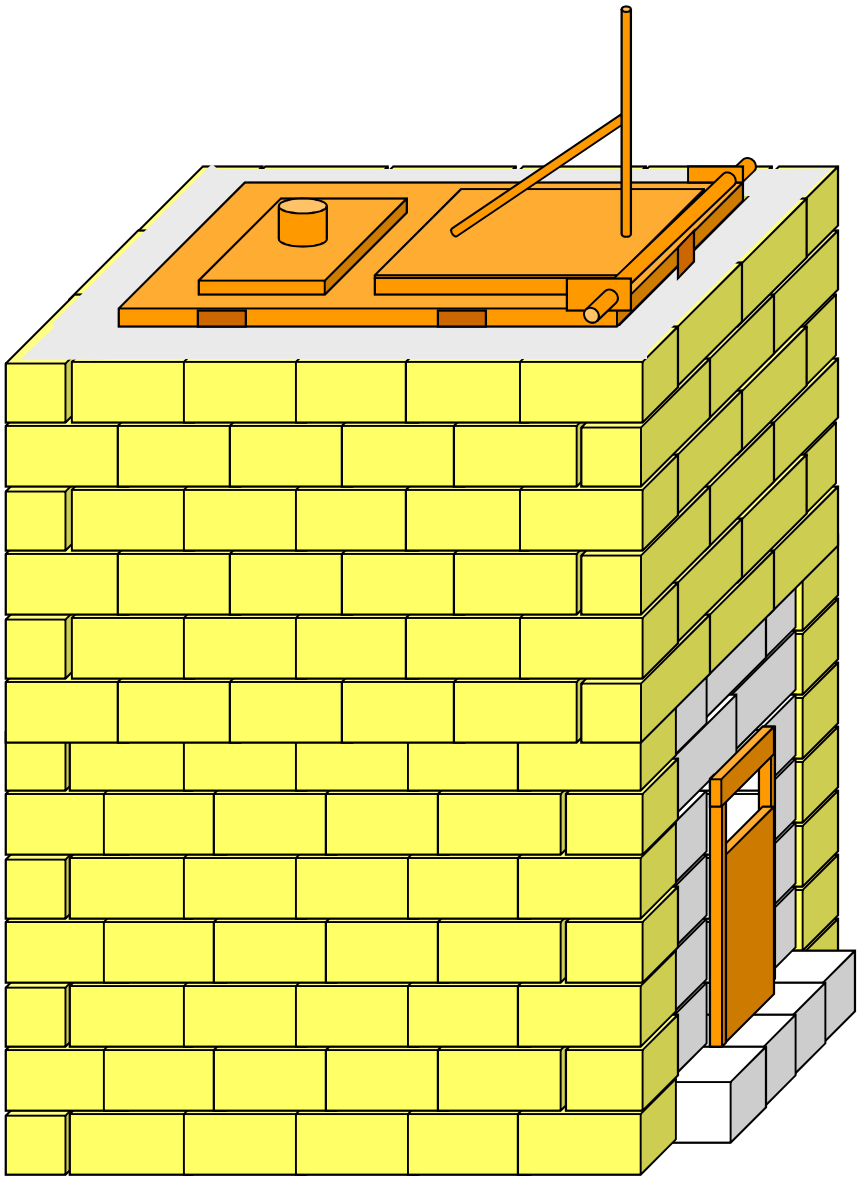

# OUTER WALL

•Build an outer wall around the incinerator's body with normal bricks and (Portland) cement as indicated on the drawings.

The distance in between the body and the outer wall should be about 115 mm (except at the front). Don't forget to foresee a peephole that is aligned with the one in the refractory body.



# STABILIZE THE INCINERATOR



•Paint the ash tray / door with heat-resistant paint to inhibit corrosion.

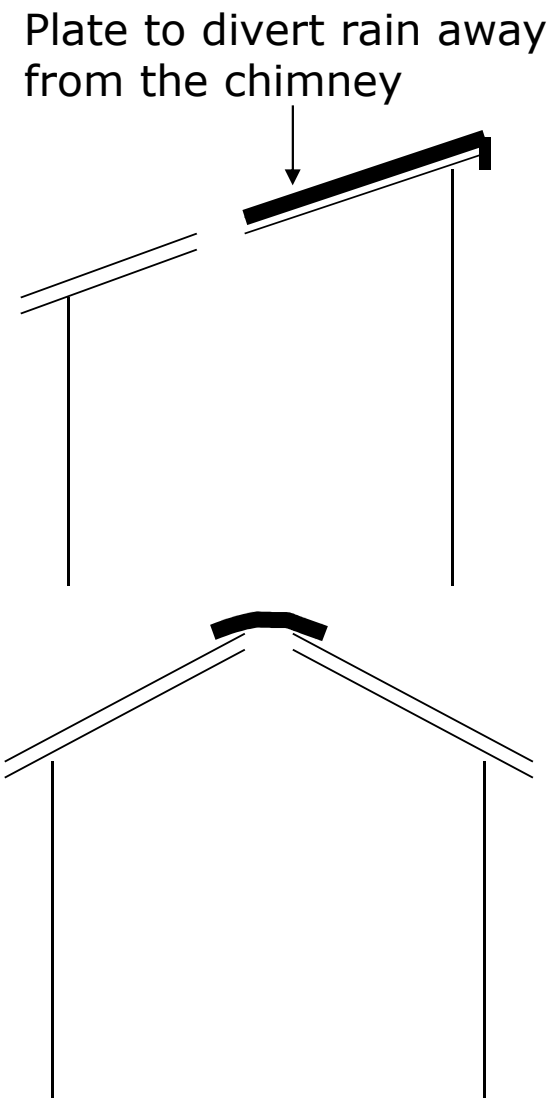
•Mix thoroughly:
1 volume of Lafarge Fondu cement,
3 ½ volumes of Vermiculite N°1,
3 ½ volumes of Vermiculite N°3
and add some water to humidify.
The mixture shouldn’t be liquid, just humid enough to link the Vermiculite together. It’s recommended to make the mixture in different batches.

•Pour each mixture batch in between the body of the incinerator and the outer wall, until the upper edge.
Putting Vermiculite concrete in between the incinerators body and the outer wall solidifies the refractory bricks more, which increases the lifespan of the incinerator. It also improves the isolation. Don’t block the peephole at the back with the Vermiculite concrete however.

•Finish the top layer of Vermiculite concrete with some refractory mortar.

# SHELTER

•Construct a real roof over the incinerator and the temporary storage area for the soft waste bins.




-The roof can be single or double sloped, although the former is easier to build and drains rainwater away from the waste zone. Whatever the form, the shelter should be well ventilated.

- Use non-combustible materials, such as iron sheeting and poles. Part of the fence around the waste zone can be used as support for the roof (e.g. honeycombed wall).
- Anchor the vertical poles into concrete for solidity.
- The shelter should be high enough for the operator to be able to walk all around the incinerator without having to duck, and wide enough to avoid rain coming in contact with the incinerator and the soft waste bins, even with heavy side winds.

•Provide a protective plate to divert the rainwater away from the chimney.

Rainwater that flows down the future chimney will enhance its corrosion, certainly at its hottest part.

•Foresee a rainwater collection system on the roof (optional).

The collected rainwater can be used to clean and disinfect the waste bins before being put back into circulation.

# SAND SEALS

- Open the loading door and remove the spigot.
- Pour white construction sand in the U-profiles of the top frame as indicated by the drawing.
  The sand will function as a seal to avoid gasses escaping via the top frame.
- Close the loading door and replace the spigot.

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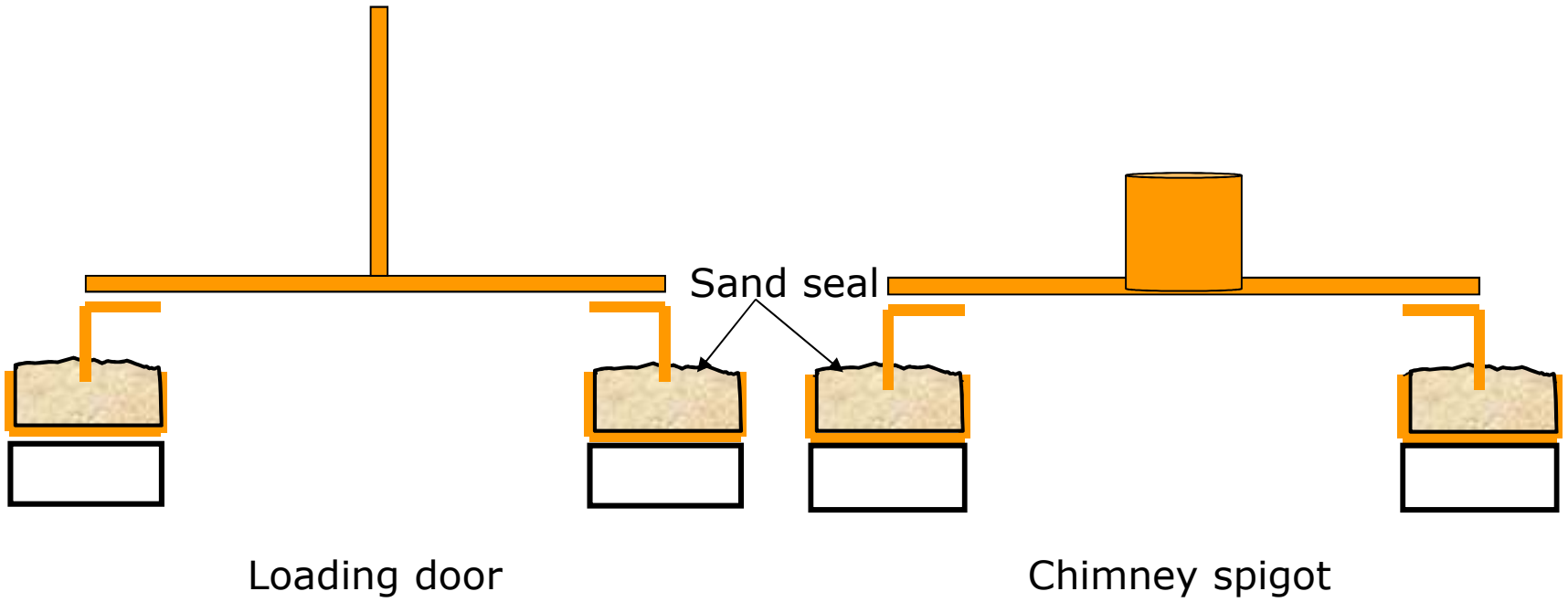
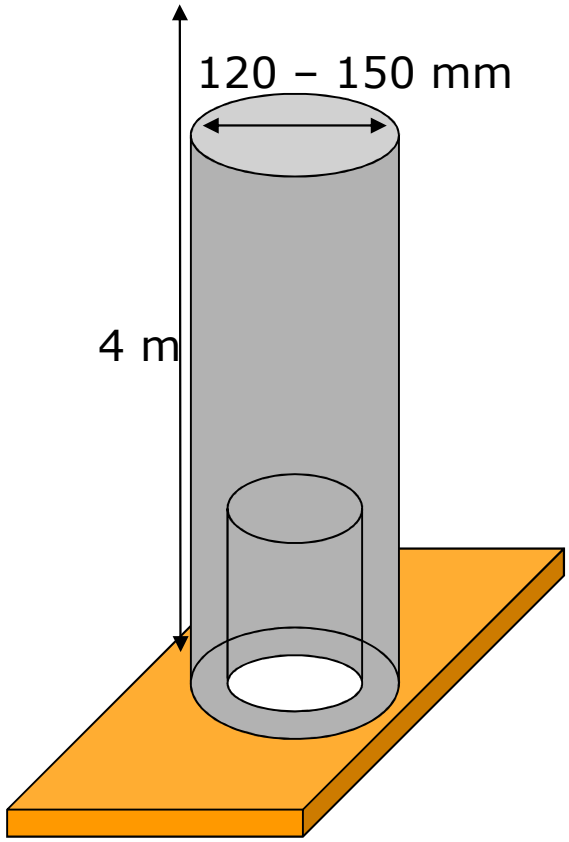


# CHIMNEY




Chimney guard for safety

- Install a rain cap on the chimney.
- Slide the chimney through the roof and over the spigot without seals.

The chimney should be made of (stainless) steel pipe, at least 2 mm thick and 4 m long (it can be in several parts, preferably welded together).

- Anchor the chimney by means of the roof and/or steel cables.

  - *Flexible stainless steel pipe is an alternative, but it needs poles to hold it up.*
  - *A seal in between the chimney and the spigot / roof will most often melt or crack when the metal chimney expands due to the heat, thus it isn't recommended.*
  - *The chimney is the most vulnerable metal part due to the corrosive gasses that pass through and the high temperatures that will be reached inside. Thus having spare chimney pipes in stock is highly recommended.*
  - *The bottom part of the chimney can be protected by a screen to avoid burn injuries.*

# CURING THE INCINERATOR

•Heat up charcoal until it is hot, outside of the incinerator.
In absence of charcoal, normal wood can be burnt as well until hot residues are obtained.

•Transfer the hot charcoal in the incinerator's ashtray.

•Slide the ashtray inside the incinerator to heat it up slowly.

•Remove the ashtray from the incinerator, once the charcoal has cooled down completely.

•Repeat this action several times, depending on the humidity of the incinerator.
Try having the charcoal a little hotter each time, until it is eventually red hot.

▪*The curing of the incinerator is essential. When the incinerator is put in function without this procedure, the humidity (water) inside its refractory bricks and mortar will expand rapidly, leading (rather) quickly to irreparable cracks. The curing procedure will permit the humidity to evaporate slowly, thus reducing the risk of these cracks.*

▪*Curing is always done for high-temperature ovens / incinerators made with refractory bricks. In high-income countries, the slow evaporation is reached by keeping the oven / incinerator during several days at a constant temperature of 150 °C with gas burners. As this might be difficult to implement in low-income countries, the above mentioned procedure is proposed.*

# OPERATION OF THE DE MONTFORT INCINERATOR

# WARNING!

## Maintain the following rules because they will:

- increase the lifespan of the De Montfort incinerator.
- reduce the risks during use of the De Montfort incinerator.

- Read this chapter completely before operating the De Montfort incinerator.
- Train motivated persons for their specific job, who will most probably be managing all the Medical Waste.
- Provide the operators with Personal Protective Equipment:
  - Overall (or long sleeve shirt and working trousers)
  - Leather apron (if available)
  - (Multipurpose) heavy-duty gloves (preferably heat, cut & chemical resistant, waterproof)
  - Safety boots
  - Respirator (preferably FFP2 / N95; or at least dust mask)
  - Face shield (or goggles)

  If this equipment can't be found locally, be aware that a Personal Protective Equipment module can be ordered from MSF.
- Follow the operation instructions precisely.

| | |
|---|---|
| **Step 1** |  |
| Open the residues (ash) pit. | |
| **Step 2** |  |
| Remove the ashtray from the incinerator.<br><br>Make sure the residues have cooled down enough to avoid injuries and not to damage the cleaning equipment. | |

| | |
|---|---|
| **Step 3**<br><br>Empty the ashtray in the residues pit. |  |
| **Step 4**<br><br>Wipe the remaining ashes off the ashtray into the residues pit by means of a small brush. |  |

| | |
|---|---|
| **Step 5**<br><br>Clean the lower inner part of the incinerator by means of a brush and a dustpan. |  |
| **Step 6**<br><br>Empty the dustpan in the residues pit. |  |

## Step 7

Close the residues pit.

## Step 8

Put the ashtray back in the incinerator.

Don’t slide the ashtray completely to the back yet, as the fire will be lit via the ashtray opening.

## Step 9

Open the loading door of the incinerator.

## Step 10

Choose a waste bin with plenty of paper and cardboard (e.g. from the administration), and pour some via the loading door into the incinerator.

Load maximum up to half the height of the combustion chamber, without compacting.

## Step 11

Add some dry firewood on top of the paper and cardboard.

The wood sticks should have a diameter of maximum 2 – 3 cm, and not be longer than the loading opening of the incinerator. Make sure the wood is really dry. Dried coconut shells or wood shavings can be used as well.

## Step 12

Close the loading door.

It is recommended to make it a habit to always stand aside the air inlet, which is integrated within the ashtray door (see further).

| | |
|---|---|
| **Step 13**<br><br>Light the paper and/or cardboard via the ashtray opening, and let the fire take. |  |
| **Step 14**<br><br>Close the ashtray door completely once the fire has taken off well. |  |

## Step 15

Verify after a while via the little peephole at the back of the incinerator if flames start to develop in the secondary combustion chamber.

This may take some minutes.

## Step 16

Prepare for loading (soft) waste when high flames are visible in the secondary combustion chamber.

In case the fire in the primary combustion chamber starts to die out without having flames in the secondary combustion chamber, more dry firewood (or dried coconut shells / wood shavings) will have to be added.

## Step 17

Open the loading door.

Always stand to the side of the incinerator and behind its loading door when the latter is opened. With the ongoing fire, a big flame might shoot out of the primary combustion chamber just after the loading door has been opened.

## Step 18

Fill the incinerator via the loading door with (soft) waste or more dry firewood / coconut shells / wood shavings.

The additional combustibles are only necessary if no flames are visible in the secondary combustion chamber.

## Step 19

Close the loading door immediately once the filling is completed in order to avoid that too much heat is lost.

Always stand to the side of the incinerator when closing the loading door as a flame might shoot out of the air intake at the bottom of the incinerator (integrated within the ashtray door). This is a risk when the loading door is closed too quickly.

## Step 20

Verify shortly after via the little peephole at the back of the incinerator if flames are still visible in the secondary combustion chamber. If not, add plenty of dry wood.

High quantities of wet (soft) waste reduce the combustion temperature a lot (potential sizzling noise), thus the fire in the 2ndary chamber can't be sustained.

## Step 21

Keep on repeating the filling procedure on a very regular basis until all the (soft) waste has been incinerated.
**(steps 17 till 20).**
Experience will learn when new batches of (soft) waste will have to be added. But be aware that once the incinerator is working properly, the combustion process goes very fast.

## Step 22

Push the waste that has fallen beside the loading opening into the incinerator by means of a metal stick or a solid brush, after having added the last batch of (soft) waste.

## Step 23

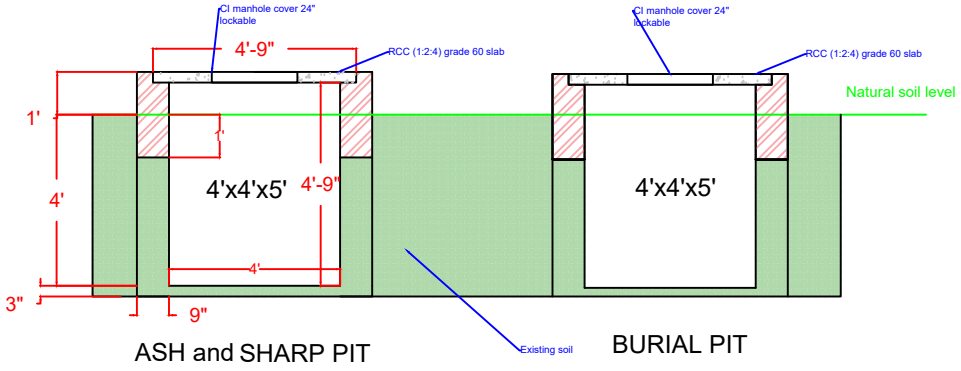
Close the loading door and let the last batch burn until the fire dies out naturally.

No extra attention should be given to the last batch, except when the fire would die out immediately due to a too high humidity content of the waste. If this is the case, additional combustibles should be added.

The ashes should only be removed after they have cooled down completely, so at the next incineration cycle (e.g. the next day).

## Remarks:

- Be careful not to injure yourself by burns, cuts caused by exploding vials or ampoules, or needle stick injuries (all sharps which could accidentally have slipped into the soft waste). So always wear your protective equipment during incineration: overall with long legs and sleeves, heavy duty gloves, safety boots, respirator and face shield / goggles, leather apron if available.
- The removal of the (ash) residues before starting a new incineration cycle is important because they may hinder a good combustion (e.g. due to blockages of the air flow).
- The recommended additional combustibles (for preheating) are dry fire wood or dried coconut shells, because their glowing residues in the ashtray help to maintain a temperature buffer when the incinerator is opened to add a new batch of waste. Kerosene and (natural) gas have a higher heating value, but as they don't leave glowing residues behind, they don't have the temperature buffer effect. On top of that, special safety and operator's measures will be required. Contact your technical referent for more information.
- A good combustion, which makes a roaring noice, will consume the soft waste very fast. Therefore, it is important to stay beside the incinerator to keep on charging new batches of (soft) waste. Once the last batch of soft waste has been added into the incinerator and a good fire is noticed as well in the primary as in the secondary combustion chambers, no particular actions have to be done anymore. This is because the fire will die out eventually once all combustible material has been incinerated.
- Once a waste bin is emptied, it can be moved towards the washing area of the waste zone for cleaning and disinfection!
- Hands should be washed with water and soap after the intervention.




SOLID WASTE PITS

NOTES:

PREPARED BY: DOABA FOUNDATION

RHC 53M, BHU Gilywal, BHU 12 MPR LODHRAN

SOLID WASTE PITS

**Pictures for Health care waste management supplies:**

**Medical waste segregation Bins with SS frame**

**Digital weighing scale**

**Ash removal tool**


**Safety gloves**

Respirator mask

**Safety googgles**

Safety boots

Safety Jacket


Sanitizer sprayer

Shoe cover


Sharp container