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Document

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URL originale: http://www.biosandfilter.org/biosandfilter/files/webfiles/BioSandFilter_Mould_Construction_Guidelines.pdf?language=bn
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Droits d'auteur

Bio-Sand Filtration

Mould Construction Guidelines

BioSandFilter.org
December 19, 2007

Introduction

On the following pages, you will find an illustrated construction guide that takes you step-by-step through the process of building a mould that will allow you to cast your own concrete biosand filters. The mould you can make using these guidelines is round, and was an improvement on the square mould previously used since the amount of materials used for one filter reduced significantly, translating into less cost and weight per filter thereby making it more affordable and transportable.

Note that a separate illustrated *filter* construction guide is available from www.biosandfilter.org.

Acknowledgements

The biosand filter was first adapted for household use through using intermittent flow by David Manz in the early 1990s, and since then many thousands of these filters are in use all over the world.

We collected much of the information in this document during a project that was financed and implemented by Medair in Kenya, in 2000. Check www.medair.org for more information on the humanitarian programmes implemented by this organization.

Jawahar Patani did the design for the mould drawings.

Adriaan Mol & Eric Fewster

List of Materials

Construction of a mould is not difficult. It can be made in most small metal workshops in low-income countries. However, a good level of accuracy is required, and a lathe and rolling machine (three-roll bender) are needed, besides a welding machine, drill and grinder.

Please refer to the blueprints in the Annexes in order to obtain the correct specifications.

The following materials are needed for the construction of 1 mould:

Quantity	Description	Where used	Manufacturing process
For the Outer Shell:			
1	Plate 1113mm x 950mm x 2mm	Outer shell body	Roll tube to 354mm OD
1	Flat iron 50mm x 1415mm x 6mm	Outer shell bottom ring	Roll to 354mm ID or cut from plate
1	Flat iron 50mm x 1415mm x 6mm	Outer shell top ring	Roll to 354mm ID or cut from plate, drill as per drawing
4	Flat iron 50mm x 938mm x 6mm	Outer shell locking flats	Drill as per drawing
1	M12 x 50mm bolt & nut	PVC pipe lock	Drill shell, weld nut to shell
1	Plate 265 mm x 260mm x 2mm	Nose	Cut and bend as per drawing
1	Plate 110mm x 180mm x 6mm	Nose plate	Cut & shape as per drawing
1	Flat iron 25mm x 40mm x 6mm	Nose plate lock	Drill and weld M12 nut
2	Flat iron 25mm x 25mm x 6mm	Nose plate aligners	Weld to nose plate
1	M12 x 75mm bolt & nut	Nose plate lock	Weld nut to nose plate lock
2	Bright mild steel shaft 40mm x 50mm long	Puller locking bush	Drill 18mm and weld to shell
2	Flat iron 50mm x 50mm x 6mm	Puller locking bush supports	Drill 11mm hole and weld to puller locking bush
For the Inner Core:			
1	Plate 942.5mm (outer edge), 911 (inner edge) x 252.5mm x 2mm	Cone B: top part of inner core	Roll to 300mm OD (top) and 290mm OD (bottom)
1	Plate 848.2mm (outer edge), 785.4mm (inner edge) x 652.2mm x 2 mm	Cone D: bottom part of inner core	Roll to 270mm OD (top) and 250mm OD (bottom)
1	Plate 450mm x 450mm x 6mm	Plate A that welds to top of Cone B	Cut to 450mm diameter
1	Plate 286mm x 286mm x 2mm	Plate C that welds to bottom of Cone B	Cut to 286mm diameter
1	Plate 250mm x 250 mm x 2mm	Cone E that welds to bottom of Cone D	Cut to 246 mm diameter
1	M25 nut	Core puller nut	Weld to core puller nut support
1	Plate 80mm diameter x 15mm thick	Core puller nut support	Weld to Plate A over central hole
2	Square tube 50mm x 50mm x 3mm x 330mm long	Top reinforcement to inner core	Weld onto plate A as per drawing

Quantity	Description	Where used	Manufacturing process
For the Puller:			
1	Square tube 50mm x 50mm x 3mm x 600 long	Puller top	Drill as per drawing
2	Angle iron 50mmx 50mm x 6mm 600mm long	Puller reinforcements	Drill and weld to above
2	Bright mild steel shaft 16mm x 360mm long	Puller legs	Weld to above
1	Bright mild steel shaft 25mm x 300mm long	Puller bolt	Thread 250mm as M25
1	Bright mild steel shaft 40mm x 50mm long	Puller bolt head	Drill 20mm hole through centre and weld to bolt
1	Washer 60mm diameter with 26mm hole	Puller bolt head	Insert on puller bolt before connecting to puller top
2	Bright mild steel shaft 40mm x 10mm long	Puller legs stopper	Drill 16mm holes & weld to puller legs
1	Pipe 1" class 'B' 900mm long	Puller handle	Weld to shaft
1	Bright mild steel shaft 18mm x 150mm long	Puller handle end that fits puller bolt	Weld to above 50mm in pipe
Miscellaneous:			
28	Bolts & nuts M10 x 25	Connecting outer shells & inner core to outer shells	
1	Spanner # 19	For nuts & bolts on nose plate and PVC pipe locks	
2	Spanners # 17	For all other nuts & bolts	
1 kg	Welding rods	Welding	

Construction Process Step-by-Step

Step 1 – Bending the outer shell plate

Measure 2mm plate: 1113mm x 950mm

Cut the plate for the outer shell body to the right size.

In a three-roll bender roll the plate for the outer shell

Produce a cylinder of 354mm outer diameter.

Tack-weld the edges of the cylinder and roll again for roundness

Step 2 – Bending the inner core plates

Measure 2 x 2mm plates for the inner core with the following dimensions:
Cone B: 942.5mm (outer edge) and 911 (inner edge) x 252.5mm
Cone D: 848.2mm (outer edge) and 785.4mm (inner edge) x 652.2mm

Important:
The plates for the cones have curved edges and must be cut to the exact shape as shown in the drawings in order to get a proper conical shape. Refer to the Annexes for the correct measurements.

The simplest way to cut these templates is as follows (using dimensions of Cone B as an example):

1. Take a rope and tie 2 nails at each end. The distance between the nails should be 7500mm. Keeping one nail as a centre, draw an arc with the other nail. Make a mark of where the centre nail was.
2. Shorten the distance between the nails to 7250mm and draw another arc.
3. Draw a line from the centre to the outer arc.
4. Now mark the sides of the template. This can be done in two ways.
    a. Take a standard protractor. Place it on the centre mark and measure 7.2 degrees on one side – then draw a line to the outer arc. Do the same for the other side of the centre mark. The area between the two arcs is your template.
    b. Using a tape measure, measure 942.5mm on the outer arc. At each end of this measurement, draw a line that connects them to the centre mark. The area between the two arcs is your template.

Note that rolling pressures have to be different when rolling tapered cones on a standard three-roll bender. Therefore, make sure to tighten the rollers unevenly.

Roll Cone B to major outer diameter of 300mm and minor outer diameter of 290mm, and roll Cone D to major outer diameter of 270mm and minor outer diameter of 250mm.

Tack-weld the edges of Cones B and D and roll them again for roundness. If the bender does not allow for this process (most benders have a loose top roll where a welded job can be re-rolled) then hammer it all round using a rubber mallet.

Step 3 – Welding the inner core

The two cones will now be welded to round plates. First cut plates to the following diameters:
Plate A: 450mm diameter x 6mm
Plate C: 290mm diameter x 2mm
Plate E: 246mm diameter x 2mm

On plate A, mark the points for drilling holes. Do this by drawing a circle of 400mm and dividing the circle into 10 equal parts. Subsequently drill 11mm holes at the divisions. In the middle of any one of the divisions, drill one 13mm hole – this is the locating hole for the locating pin which is welded to the top ring on the outer shell. Weld two 330mm lengths of 50mm x 50mm x 3mm square tube to the top of plate A to add reinforcement. Next, drill a 28mm hole in the centre of plate A. Take a piece of 15mm thick plate with diameter of 80mm, drill a 28mm hole in the centre and proceed to weld over the hole that was made in the centre of plate A – this is the puller nut support. Then weld an M25 nut onto this support.

On the opposite side of plate A, draw a circle of 300mm – this is the locating mark for welding Cone B to plate A. Tack-weld Cone B to plate A. Check for distortions and rectify them, then weld the joint completely on both the inside and outside.

Important:
Make sure that the cone assembly is aligned properly to Plate A. This is necessary to allow proper removal of the core from the concrete cast.

Next place plate C on the bottom of Cone B and tack-weld on edges.

Now draw a circle of diameter 270mm in the centre of plate C – this is the locating mark for welding Cone D to plate C. Proceed to tack-weld Cone D to plate C. Check for distortions and rectify them, then weld the joint completely on both the inside and outside.

Place plate E on the bottom of Cone D and tack-weld to edges. Check for distortions and rectify them, then weld the joints at plate C and E completely.

Next, grind the outer weld to a smooth finish. Check the surface of the cones for dents and roundness.

Important:
If any dents are found make sure you remove them, as it will be next to impossible to remove the concrete filter from the mould if dents are present.

Step 4 – Bending the top and bottom rings for the outer shell

Cut two pieces from 6mm flat iron to the following dimensions: 50mm x 1415mm. In a roll bender, fix the ring bending rollers and bend two rings to 450mm outside diameter x 354mm inside diameter. Alternatively, if this facility is not available in the bender then from cut a ring of the above size from 6mm plate.

Weld to form two rings.

Step 5 – Drilling the outer shell locking flats

Cut four pieces from 6mm flat iron to the following dimensions: 50mm x 938mm. Tack-weld 2 pieces together at the edges to ensure drilled holes line up perfectly. Mark and drill 10mm holes as per the drawings in the Annexes.

After drilling, grind away the tack-welds to separate the two pieces. Repeat this for the other pair.

Step 6 – Splitting the outer shell

Take the top and bottom rings for the outer shell that were made in step 4 and weld them to the top and bottom of the outer shell cylinder made in step 1.

Next, take two of the outer shell locking flats made in the step 5 and tack-weld one on either side (the side of the original joint and opposite).

Proceed to split the cylinder to produce the two outer shell halves using a grinder. Once split, tack-weld the other two outer shell locking flats on the second half of the outer shell and join the 2 shells with 10mm nuts & bolts.

Step 7 – Fitting the inner core

Take the inner core and place in the shells and centralize. Tack-weld the inner core to the outer shells and proceed to drill 11mm holes in the top ring of the outer shell, using the existing drilled holes in plate A as a template. Mark on the top ring of the outer shell where the 13mm locating hole is in plate A.

Remove the tack-welds and weld one 12mm locating pin on the top ring of the outer shell to correspond with this hole. Next, bolt the centre core to the shells.

Step 8 – Nose assembly and PVC pipe locking bolt

For the nose plate, take the 110mm x 180mm x 6mm plate and cut as per the drawing in the Annexes.

Drill a 22 mm hole as per the drawing – this is to centralize the PVC pipe during casting.

Next cut and weld the two nose plate aligners (25mm x 25mm x 6mm) to the nose plate. These ensure that the nose plate fits well to the nose itself.

For the nose itself, take the 265mm x 260mm x 2mm plate and draw and cut as per drawings in the Annexes. Fold in centre and grind to shape.

Next, take one of the outer shells. Tack-weld the nose 56mm from top of one of the outer shells and mark its position with a scriber.

Important:
Make sure that the position of the bottom of the nose is 306mm from the top of the outer shell as per the drawings. This is to ensure the correct height positioning of the PVC pipe and therefore the correct height of sand in the finished filter.

Proceed to remove the tacks using a grinder or jig saw. Then in the outer shell, cut away the marked position of the nose. Having opened the mould, place the nose in position from the inside and weld both inside and outside. Take care to grind the inner side to a smooth finish.

Take the flat for the nose plate lock (25mm x 40mm x 6mm) and drill a 13mm hole in the centre. Weld an M12 nut to the base spanning the hole. Then weld this piece to the outer shell 40mm below the nose plate position. The nose plate will be held in position using a 75mm long M12 threaded bolt.

Shown above is the completed nose with the nose plate installed and secured with the lock.

Directly below and in line with the nose plate lock, drill a 13mm hole 100mm from the bottom side of the mould (see arrow for approximate position). Weld an M12 nut over the hole.

Insert a 50mm long M12 threaded bolt. When making a filter this bolt will be used to press the PVC pipe flush with the inner core.

Step 9 - Puller

Take 50mm x 50mm x 3mm square tube and cut one length of 600mm. Weld two 600mm long pieces of 50mm x 50mm x 6mm angle iron to the square tube on either side to add reinforcement. Next, drill a 28mm hole in the centre, as well as two 16mm holes on each side as per the drawing.

Then take a 300mm length of 25mm diameter Bright Mild Steel (BMS) rod and thread a length of 250mm. Take the 40mm diameter x 50mm long BMS rod and drill a 20mm hole through the centre lengthways. Proceed to weld this to the threaded shaft. Take a 60mm diameter washer with 26mm hole and insert it on the 300mm long rod. This is now the puller bolt.

Take the 16mm diameter x 360mm BMS rod and taper the front ends slightly – these are the puller legs. Take two pieces of 40mm diameter x 10mm long BMS rod, drill 16mm holes through the centre and weld to the puller legs 50mm from the bottom at the tapered end, as per drawing. These are the puller leg stoppers. Insert the puller legs through the 16mm holes in the puller top so that they span the square tube and then weld into place.

Insert the puller bolt and washer into the central hole on the square tube – note, this should not be welded.

Take two pieces of 40mm diameter x 50mm long BMS rod and drill 18mm holes lengthways through each – these are the puller locking bushes.

Take the two 50mm x 50mm x 6mm flat iron pieces – these are the puller locking bush supports. Weld these to the puller locking bushes as per the drawings. The weld these pieces to the top of the outer shell on either side.

Take a 900mm long piece of 1" steel pipe class B. Insert a 150mm long piece of 18mm BMS rod 50mm into one end of the pipe and weld in place. This is now the puller handle that inserts into the top of the puller bolt.

Step 10 - Testing the mould

The completed core and outer shells.

The outer shells detached.

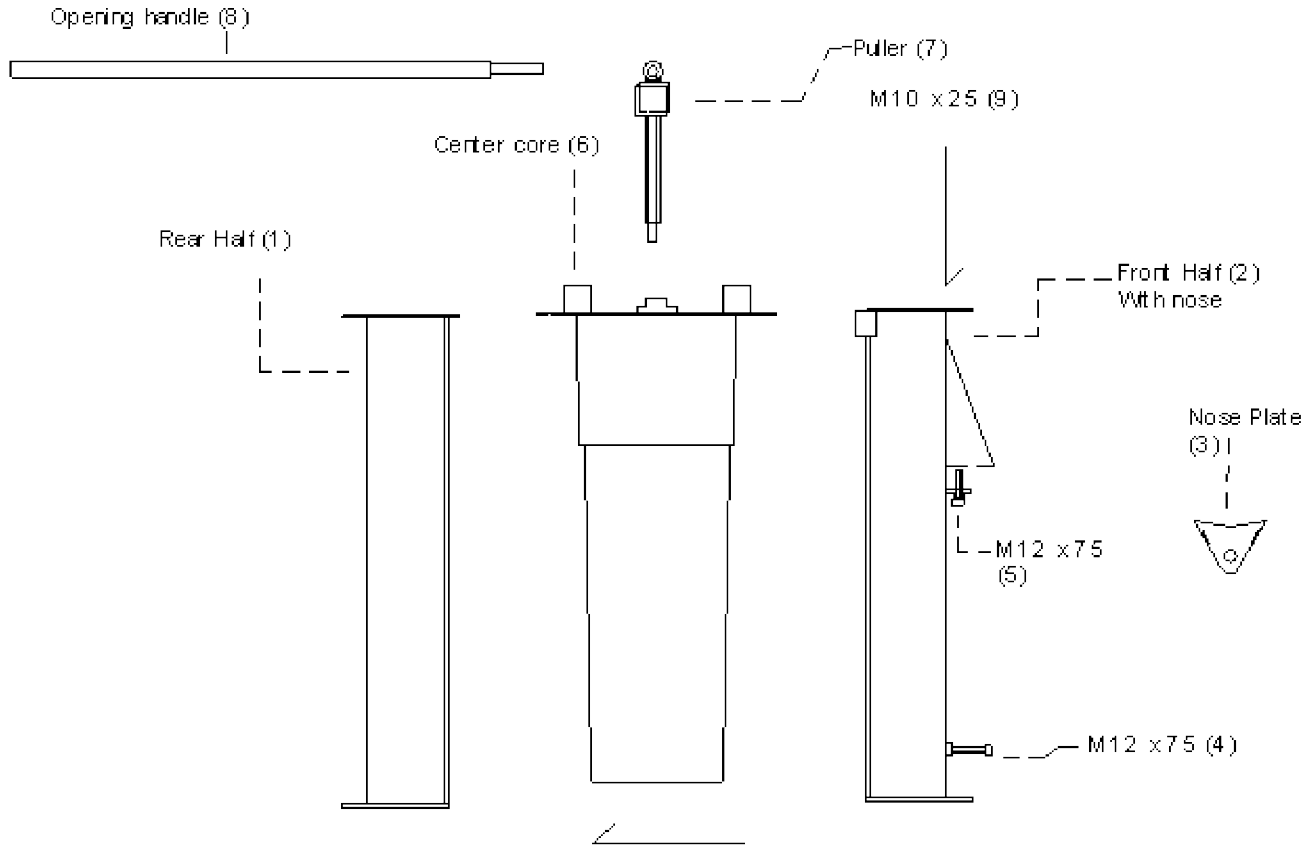
It is advisable to test the mould by making one or more filters while still in the workshop. This way, problems can be easily rectified. For instructions on how to build a filter, please refer to the *Filter Construction Guidelines*, also available on www.biosandfilter.org.

A finished mould consists of the following parts:

- ✓Rear outer shell
- ✓Front outer shell with nose & bolts attached (M12 x 75mm, M12 x 50mm)
- ✓Nose plate
- ✓Inner core
- ✓Puller
- ✓Puller bolt & washer
- ✓Puller handle
- ✓Bolts & nuts M10 x 25

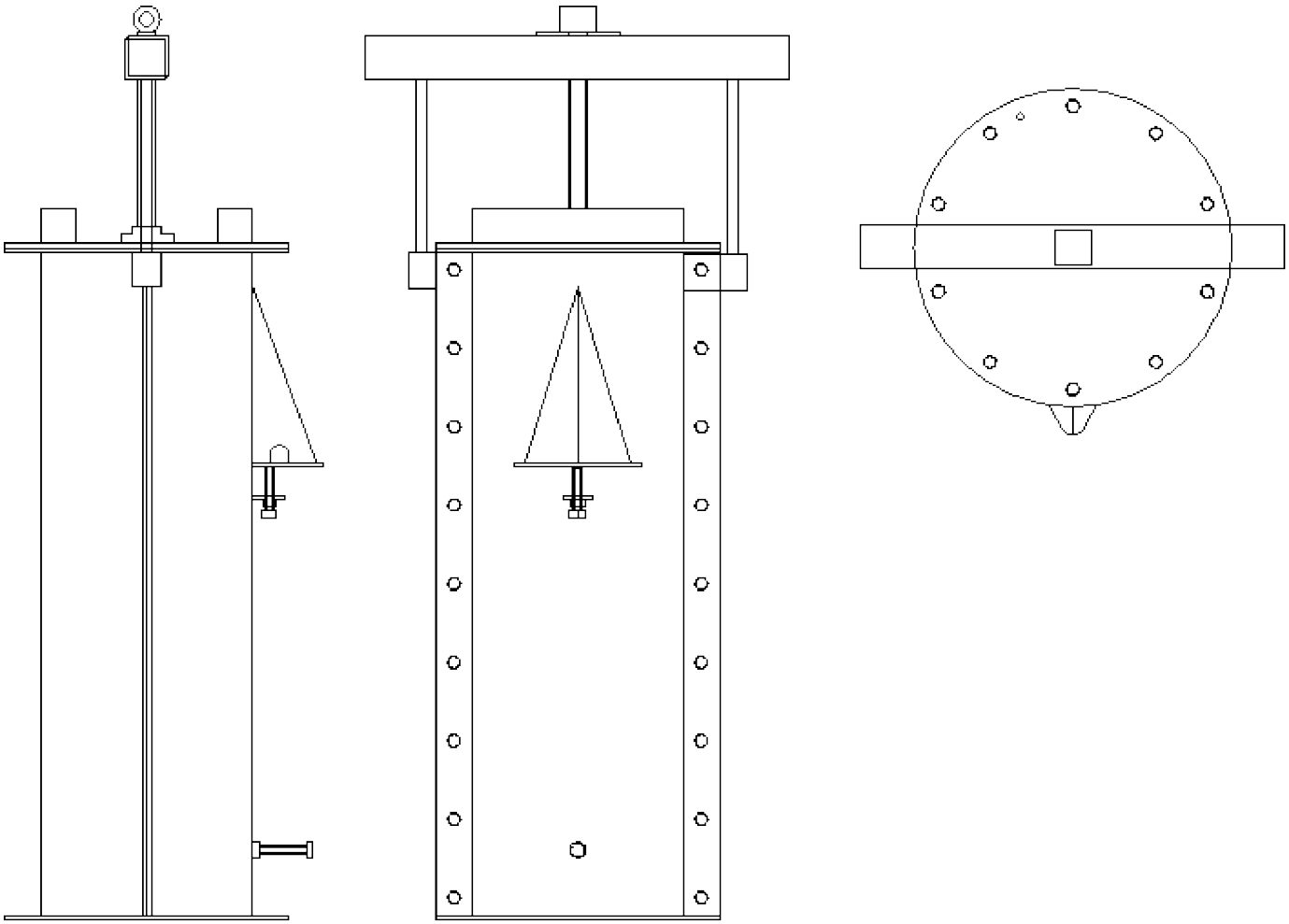
This mould is also available ready-made. For more information and prices, please email info@biosandfilter.org.

Annex 1: All components – separate

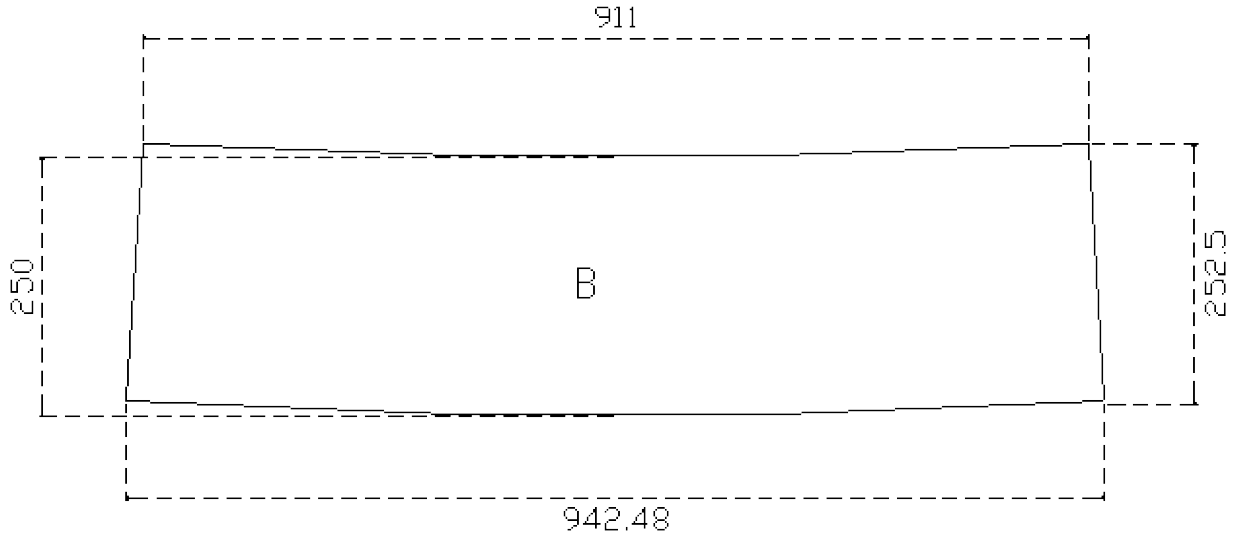


Mould Parts
Page one (1)
Drawn by J Patani
email:
jawaharpatani@hotmail.com

Annex 2: All components - assembled

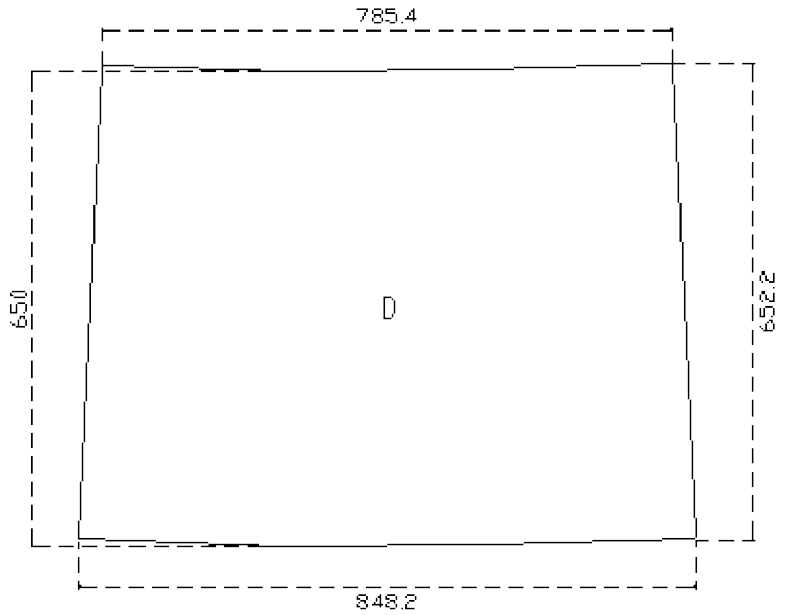


Annex 3: Inner core template 1



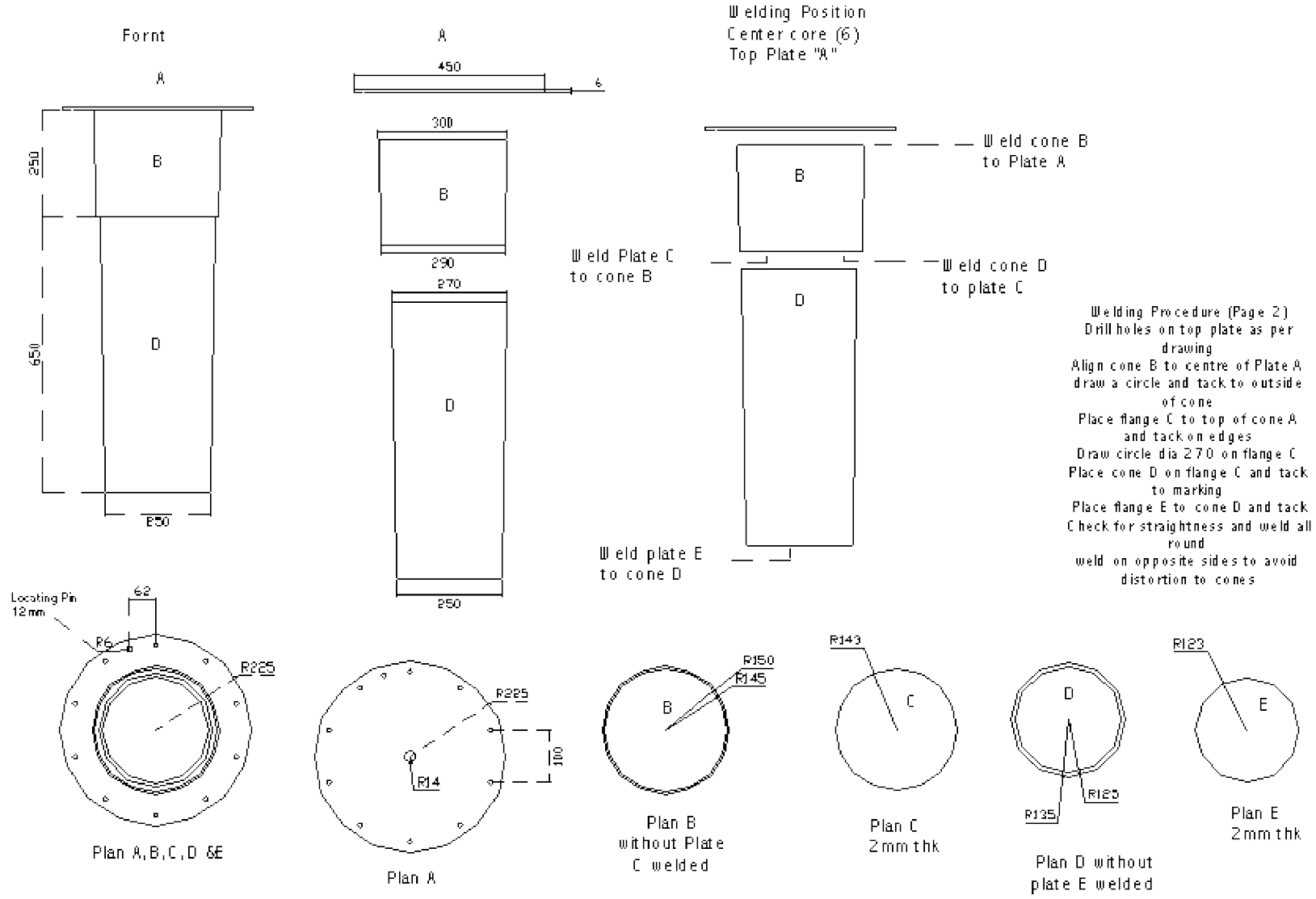
Cone B (Top)
Radius on Major Curve = 7500
Radius on Minor Curve = 7250
Apex angle = 7.2 degrees

Annex 4: Inner core template 2

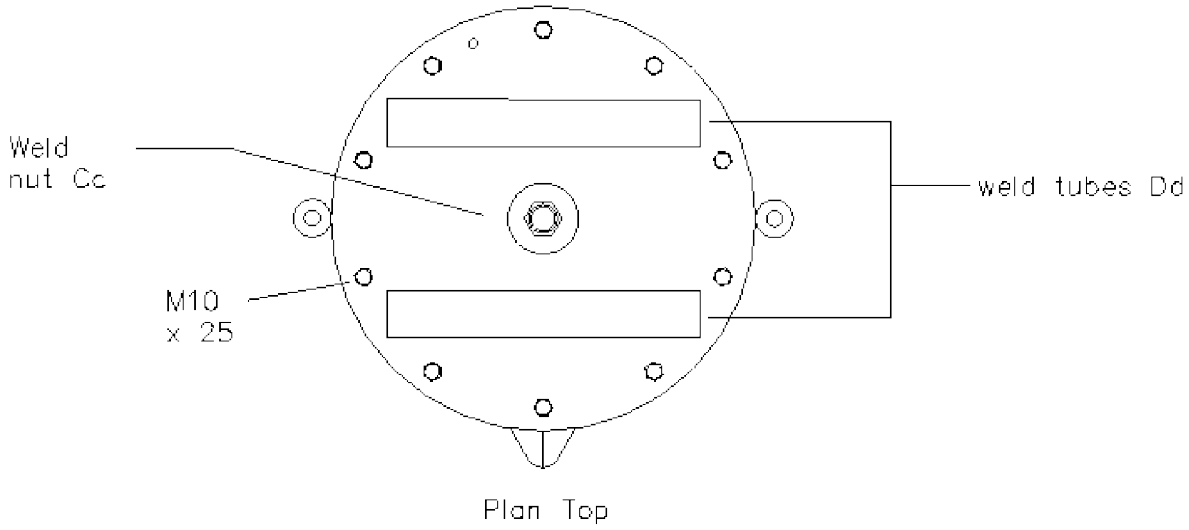


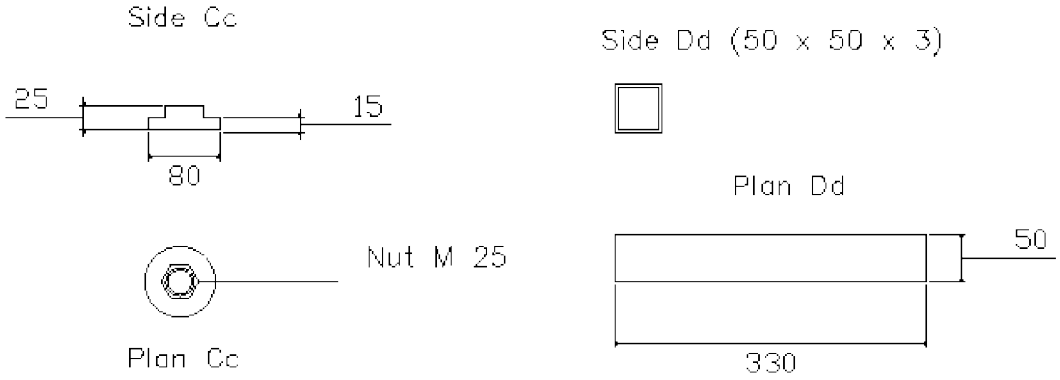
Cone D (Bottom)
Radius on Major Curve = 8775
Radius on Minor Curve = 8125
Apex angle = 5.53 degrees

Annex 5: Inner core construction



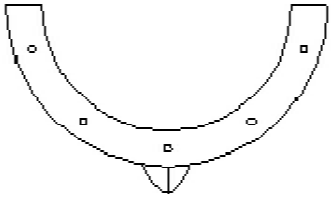
Annex 6: Inner core top plate



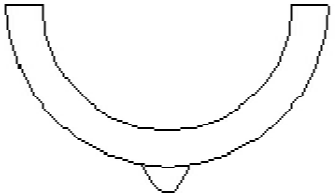


Annex 7: Bottom and top views of outer shells

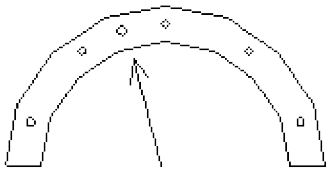
Plan Top



Plan Bottom

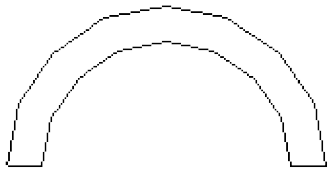


Plan Top

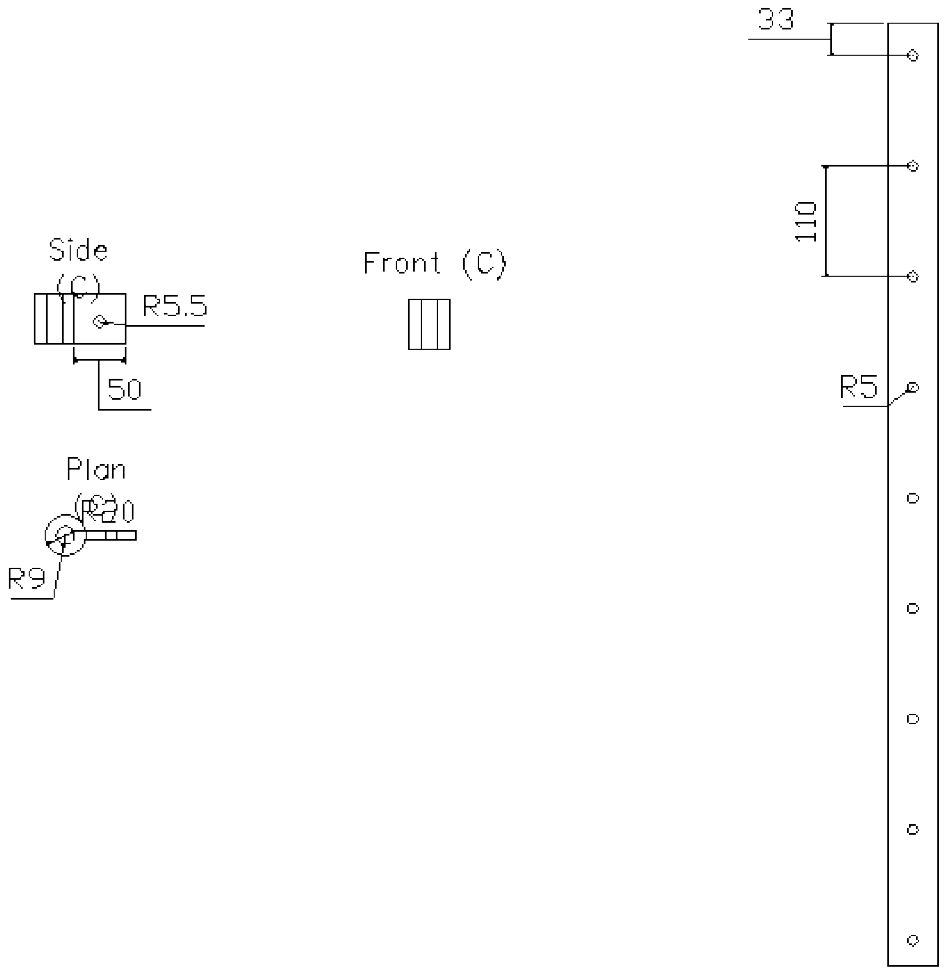


Hole for locating pin

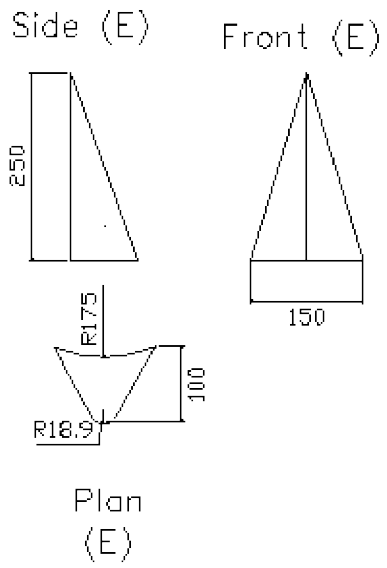
Plan Bottom

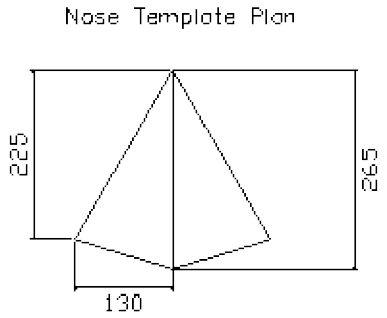


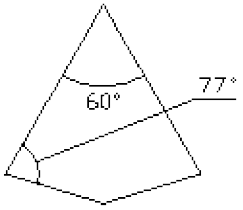
Annex 8: Puller locking bushes & outer shell locking flats

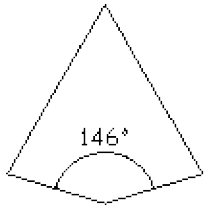


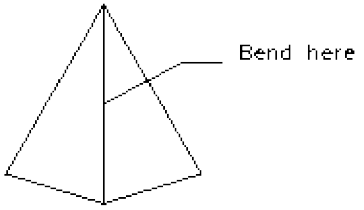
Annex 9: Nose


Side (E)
Front (E)
250
150
R175
100
R18.9
Plan
(E)

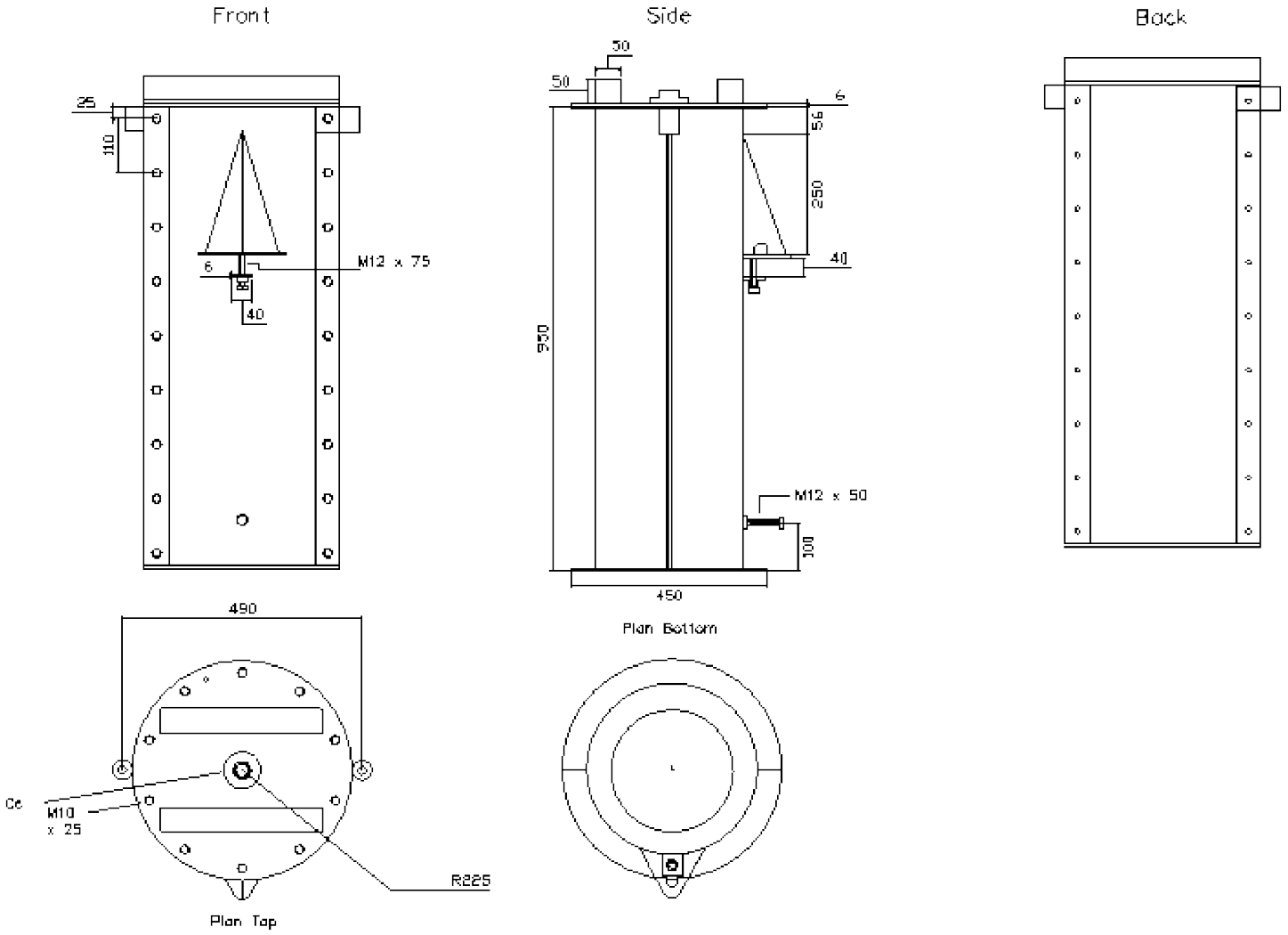

Nose Template Plan
225
265
130


60°
77°

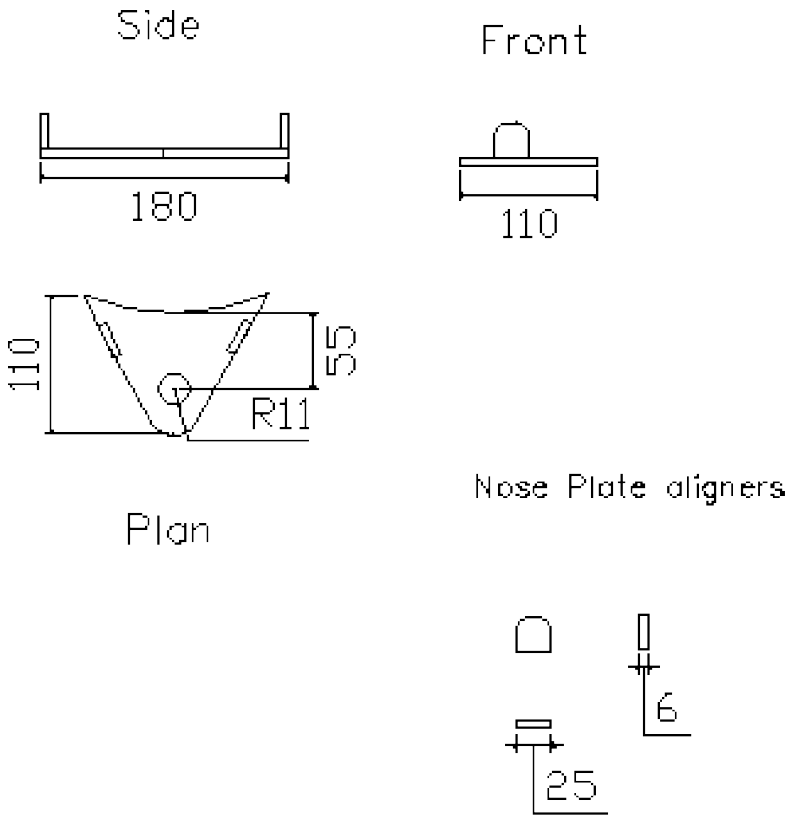

146°


Bend here

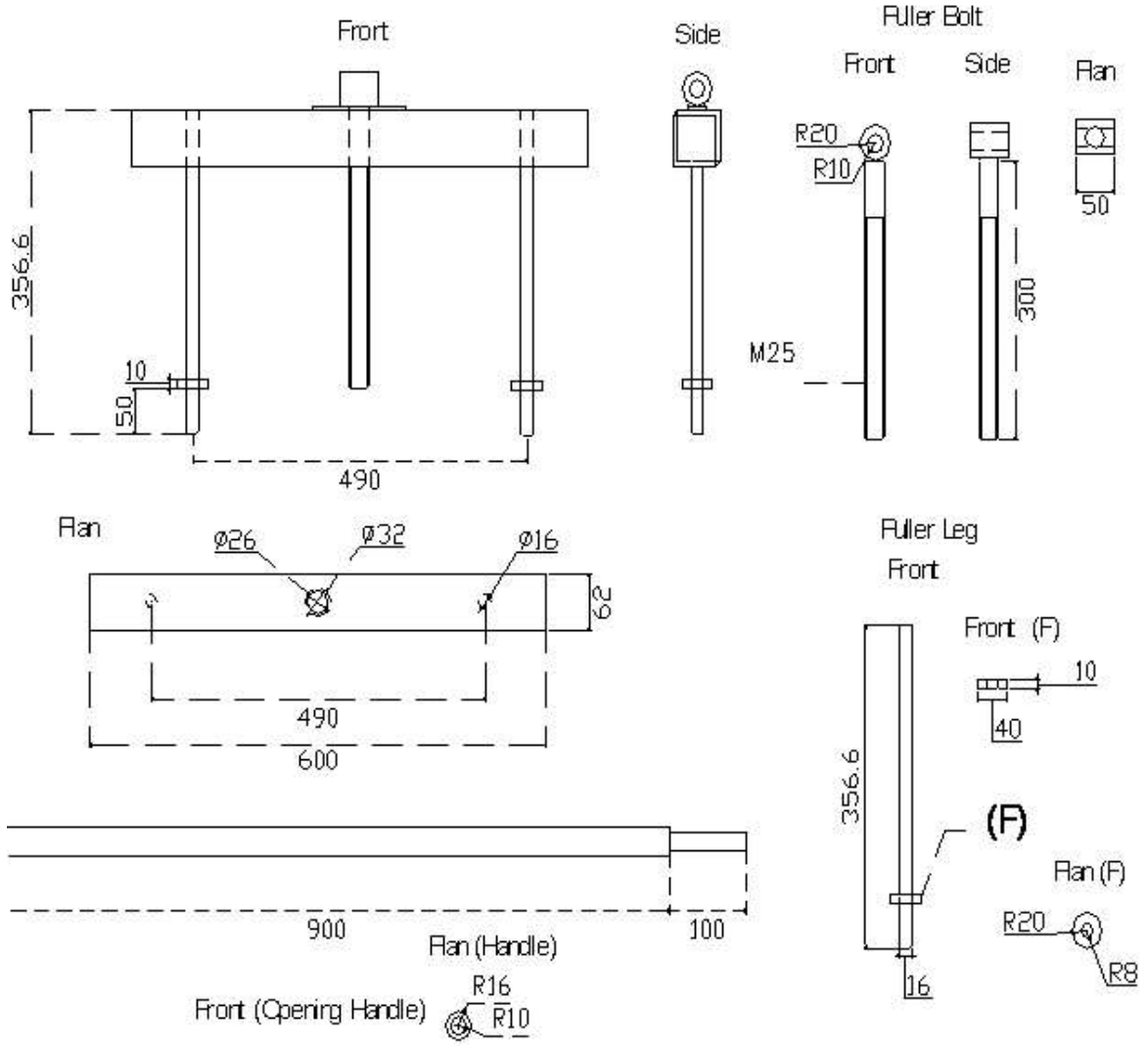
Annex 10: Nose plate lock & PVC pipe lock



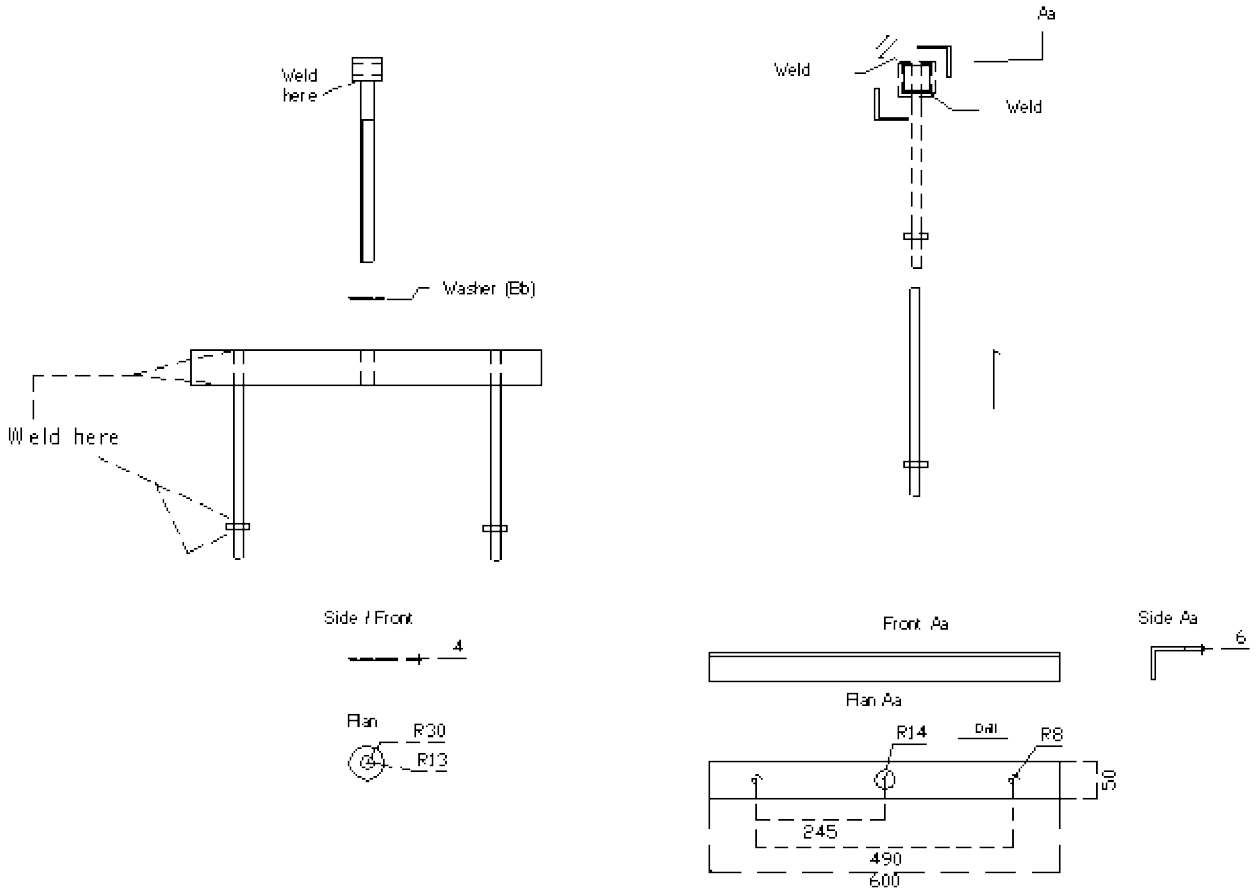
Annex 11: Nose plate



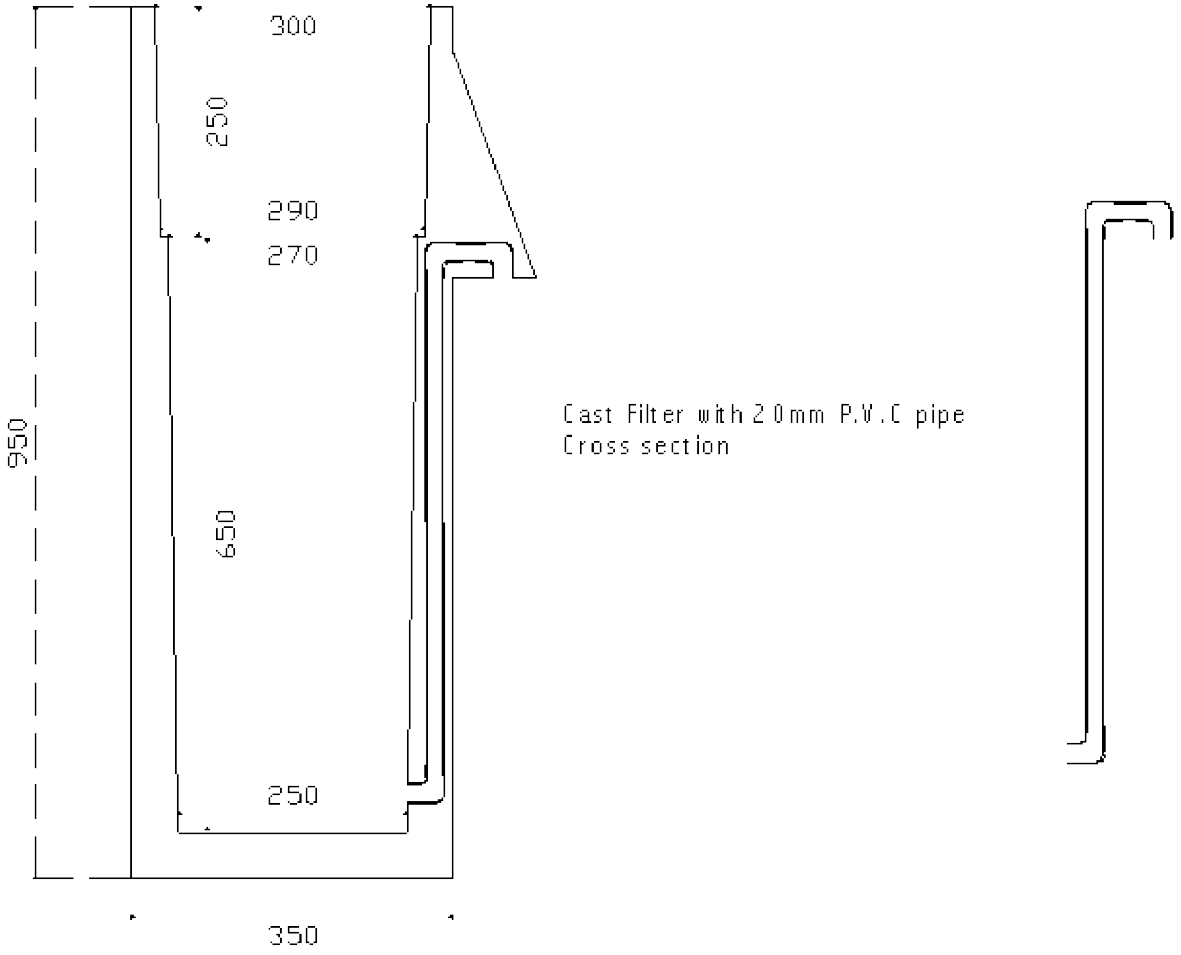
Annex 12: Puller drawing 1



Annex 13: Puller drawing 2



Annex 14: Position of PVC pipe in concrete filter



Annex 15: Where to pour concrete