Lightweight Toilet Superstructures

Manufacturing Guide

WATER RESEARCH COMMISSION

TT 483/10

LIGHTWEIGHT TOILET SUPERSTRUCTURES – MANUFACTURING GUIDE

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Report to the
Water Research Commission

by

University of Pretoria

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Lightweight Toilet Superstructures: installation & Assembly guide (WRC Report No TT 484/10)

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Index

Manual explained

This manual has been compiled to make the manufacturing process as simple as possible. It is however vital to understand the three different elements involved in the process.

1) The input materials, i.e. materials that need to be bought in order to manufacture the components that form part of the toilet.

2) The manufacturing process will be subdivided into five procedures.
   a) Mould assembly
   b) Steel preparation
   c) Casting procedure
   d) Curing procedure
   e) De-Moulding /cleaning procedure

3) The output materials i.e. every single item that has been manufactured or bought to form the final product, ready for installation.

Input Materials

The following materials are required to manufacture **one** complete toilet set.

Steel Requirements – Buy from Steel Merchant

- 6 x 5.6 mm Re-bar lengths(6 m)
- 4 x 1.2*2.4 m wire-mesh(50x50x3.15 mm)
- 30 x 30 mm M10 Galvanized Long Nuts
- 25 x 15 mm M10 Galvanized Bolts
- 2 x 100 mm M10 & 2 x 50 mm M10 Galvanized Bolts
- Welding Rods

Material Requirements – 100l Mix – Available from Agent

A total of 3 mixes is required for all components to be cast.

-1 MIX =
* 3 x 45 kg Sand/Stone bags
* Steel Fibres 5kg
* CSF 5 kg (Condensed Silica Fume)
* Chryso Addmix 650 ml
* 18 ℓ Water
* Cement 50 kg Bag – Buy from Hardware Store – Only one of the following 3 bags allowed. NB!!!
  * Lafarge Powercrete Plus
  * PPC OPC Cem1
  * AfriSam High Strength Cement

AfriSam
High Strength Cement

Required Tool

The following tools are required to manufacture the components of the toilet.

BUY ONCE -OFF

- 200 ℓ Concrete Mixer
- Welding Machine & Accessories
- 2 x no17 socket spanner, Rubber Mallet/Hammer
- 1 x 20 ℓ Water Bucket marked to 18 ℓ
- Bolt Cutter
- 1 complete set of VIP Toilet Moulds (10 Moulds Total) – Available from Agent
- Steel bending rig – Available from Agent
- Vibrating Table – Available from Agent

Moulds Checklist

Please take careful note that the unique code of each mould is the same as the concrete element that it produces when manufacturing.

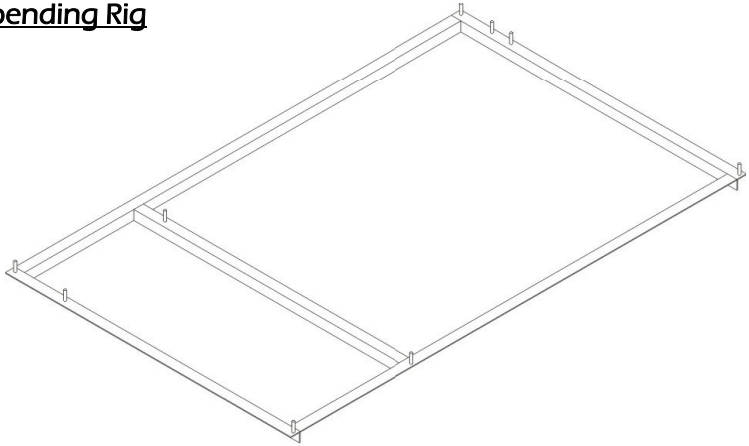
Base moulds

1a – 1 x Base Panels(no holes or pipe inserts)
1b – 1 x Base Panels(no holes or pipe inserts)
1c – 1 x Base Panel with 300 mm hole
1d – 1 x Base Panel with waste pipe hole
1e – 1 x Front Cross Beam
1f – 1 x Back Cross Beam

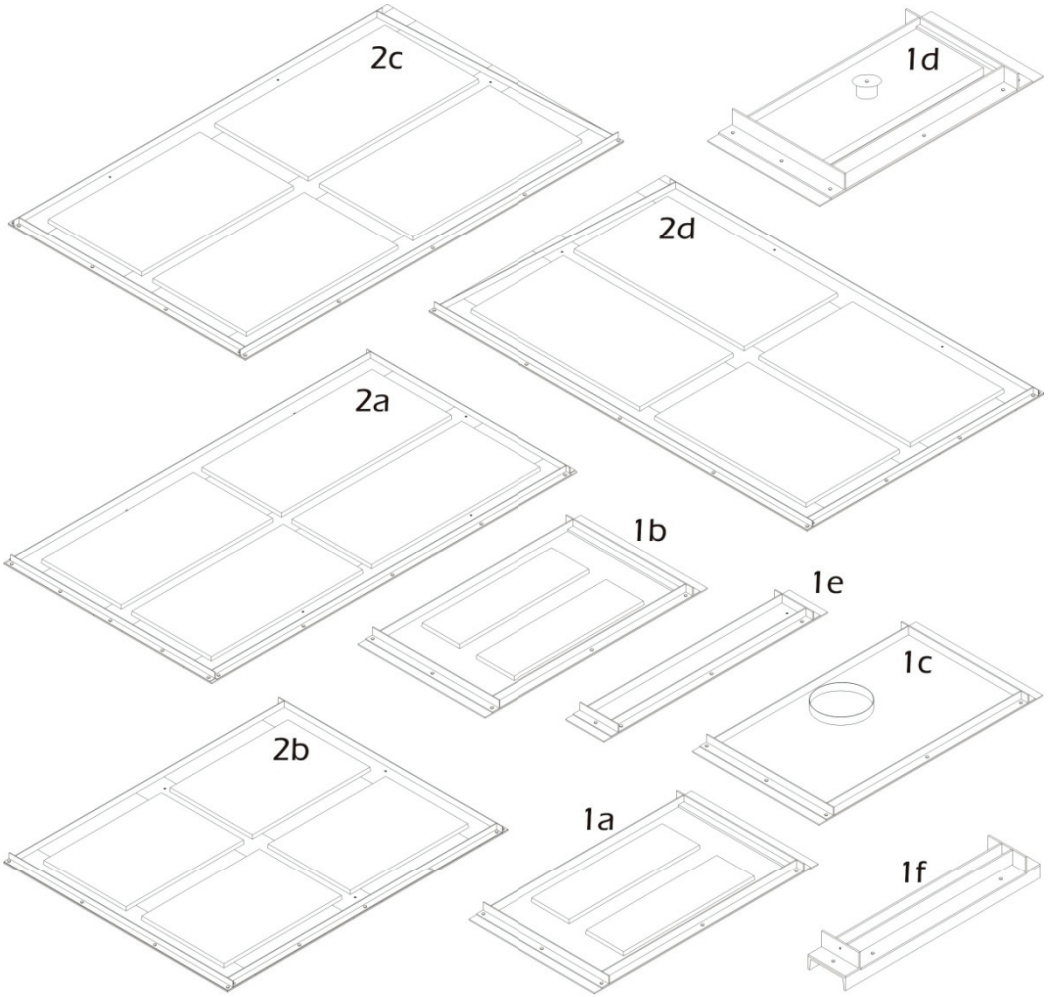
Panel moulds

2a – 1 x Back Panel
2b – 1 x Roof Panel
2c – 1 x Left Side Panel
2d – 1 x Right Side Panel(Inverse of Left Panel)

Steel bending Rig



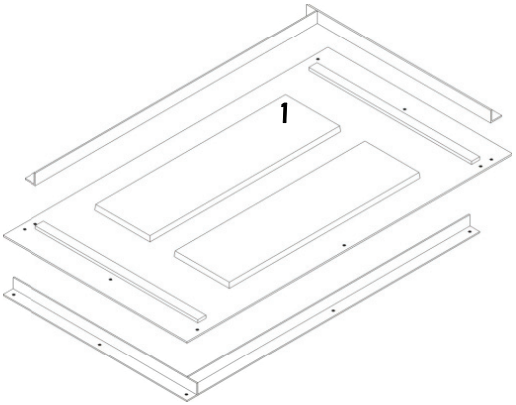
10 VIP Toilet Moulds

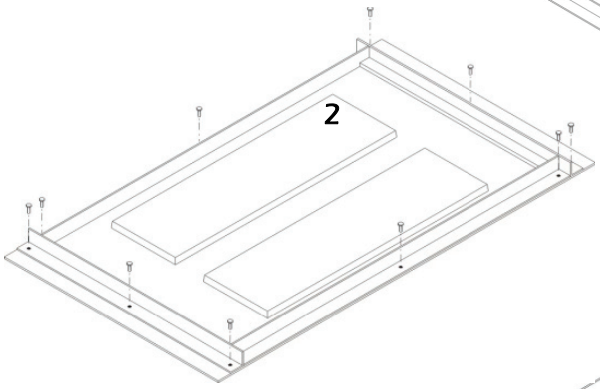


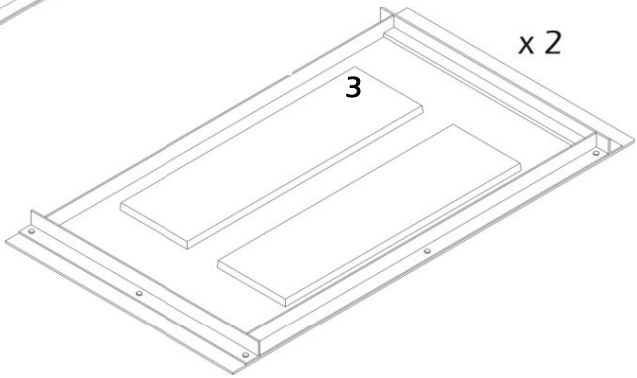
Mould Assembly

1a,b – BASE PANEL MOULD

- Place the 2 L-shaped angle irons into place.
- Fasten the 25 mm bolts as shown below.
- NB! The mould needs to be cleaned & oiled with de-moulding oil before placing the reinforcing steel.

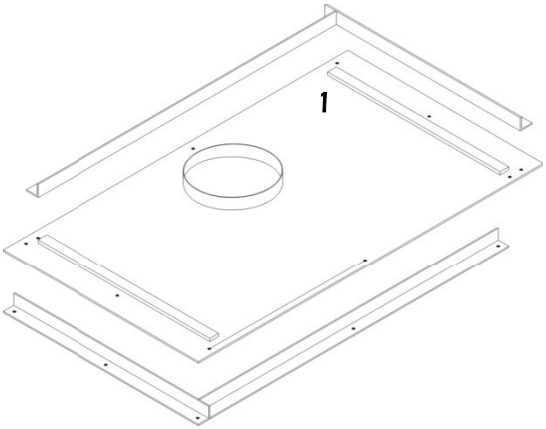


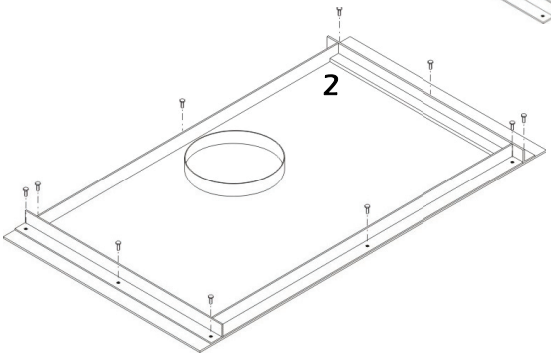


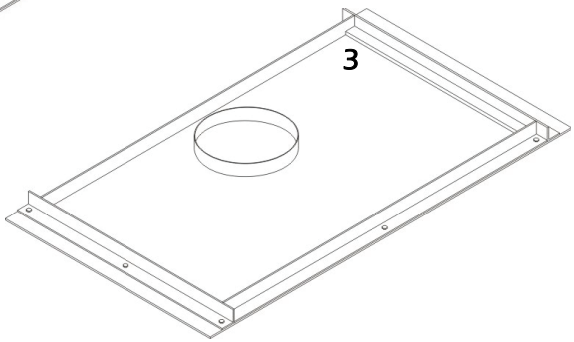


1c – BASE PANEL MOULD with 300mm Hole

- Place the 2 L-shaped angle irons into place.
- Fasten the 25 mm bolts as shown below.
- NB! The mould needs to be cleaned & oiled with de-moulding oil before placing the reinforcing steel.

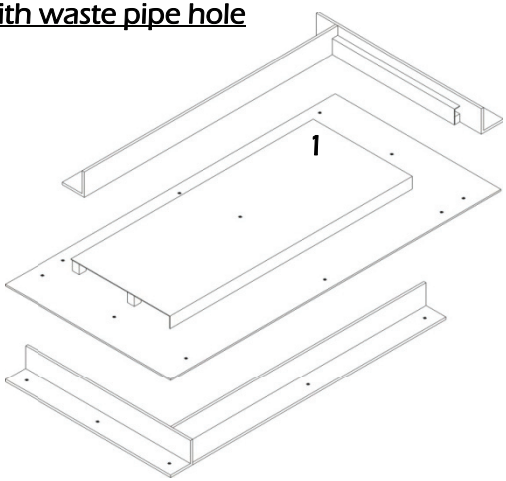


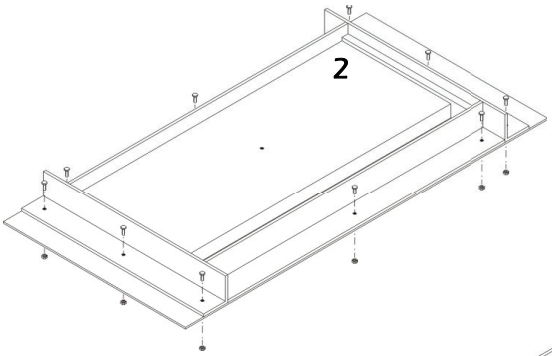


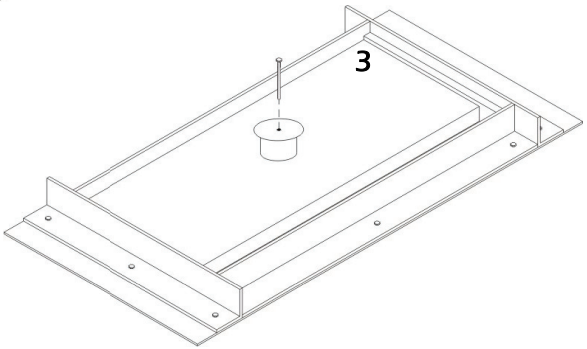


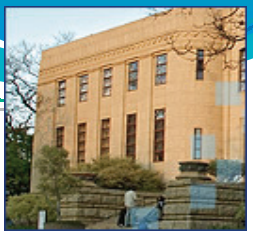
1d – BASE PANEL MOULD with waste pipe hole

- Place the 2 L-shaped angle irons into place.
- Fasten the 25 mm bolts as shown below.
- Fasten the void cup with the supplied long bolt.
- NB! The mould needs to be cleaned & oiled with de-moulding oil before placing the reinforcing steel.



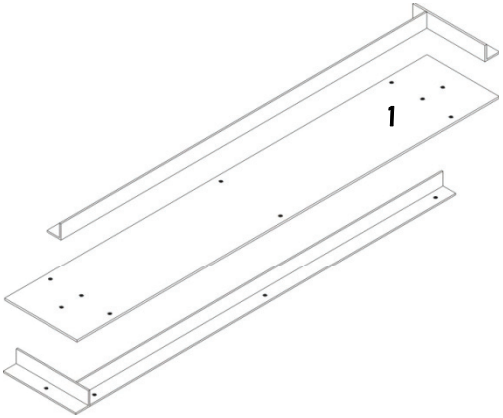


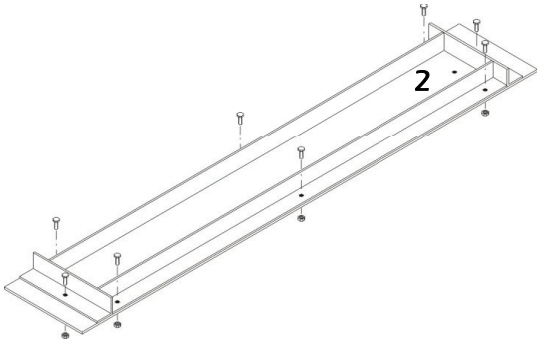


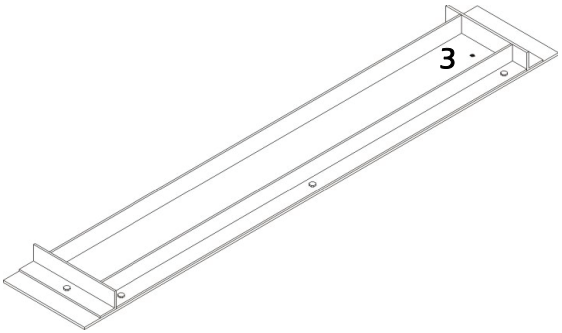


1e – FRONT CROSS BEAM MOULD

- Place the 2 L-shaped angle irons into place.
- Fasten the 25 mm bolts as shown below.
- NB! The mould needs to be cleaned & oiled with de-moulding oil before placing the reinforcing steel.

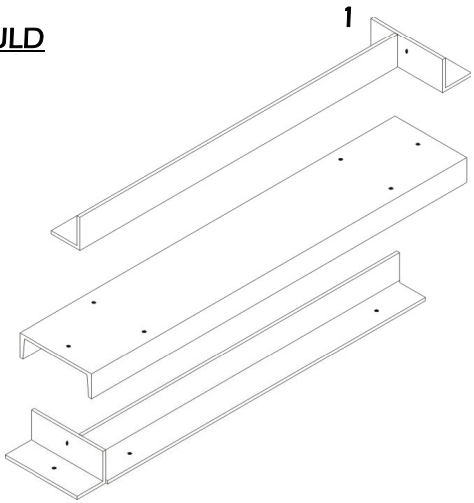


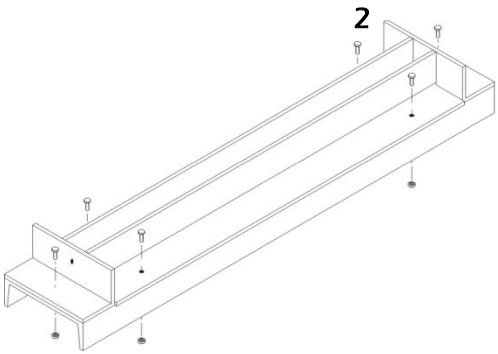


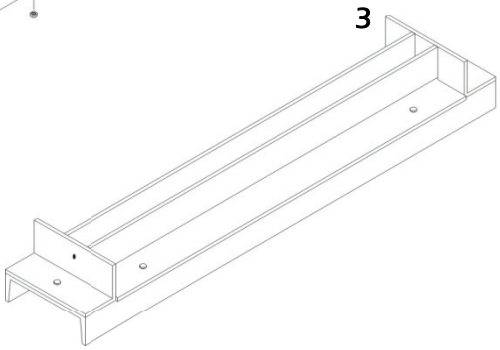


1f – BACK CROSS BEAM MOULD

- Place the 2 L-shaped angle irons into place.
- Fasten the 25 mm bolts as shown below.
- NB! The mould needs to be cleaned & oiled with de-moulding oil before placing the reinforcing steel.





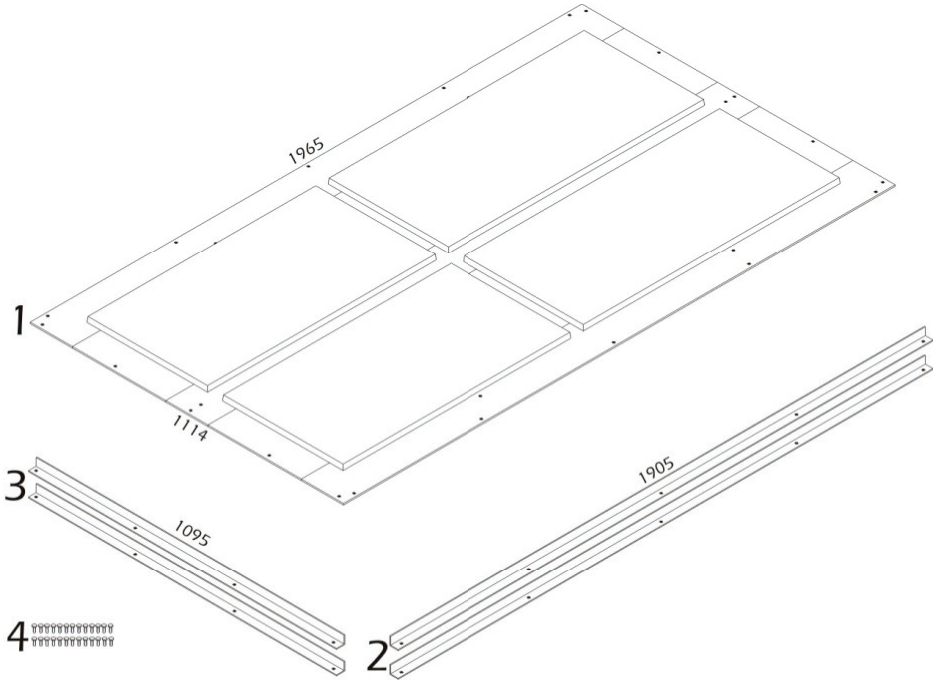


2a – BACK PANEL MOULD

Components

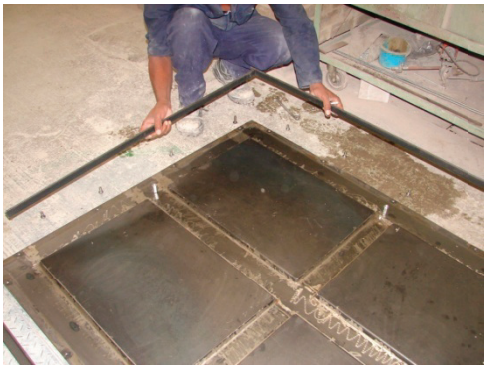
- Please check the quantity of all components, before starting assembly.

1) 1 x 1114x1965 mm Base Plate
2) 2 x 1905x30 mm Angle Iron
3) 2 x 1095x30 mm Angle Iron
4) 26 x M10 25 mm Nuts



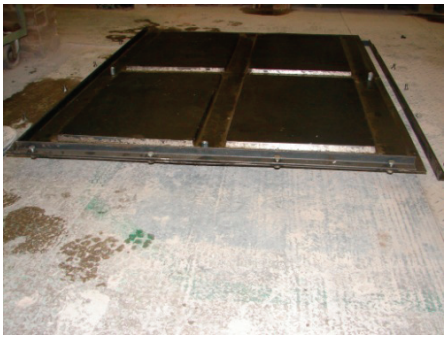
Step 1

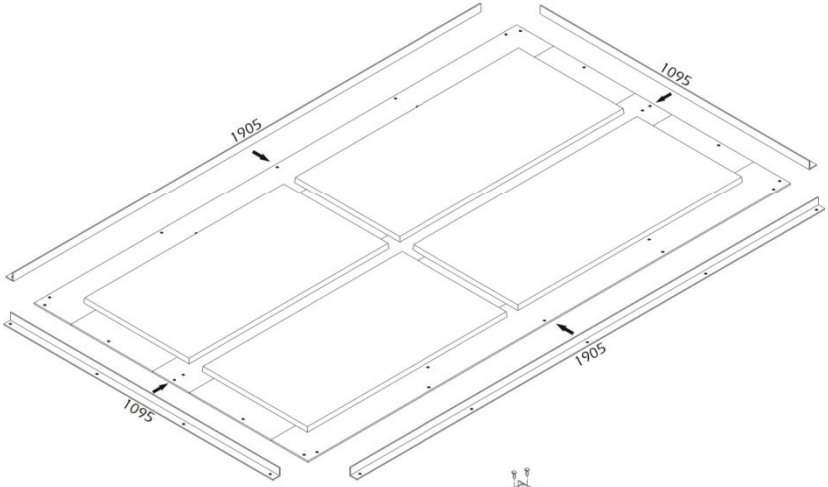
- Place the angle iron onto the mould as displayed on the right.
- Make sure the holes align so that the bolts can be fastened.

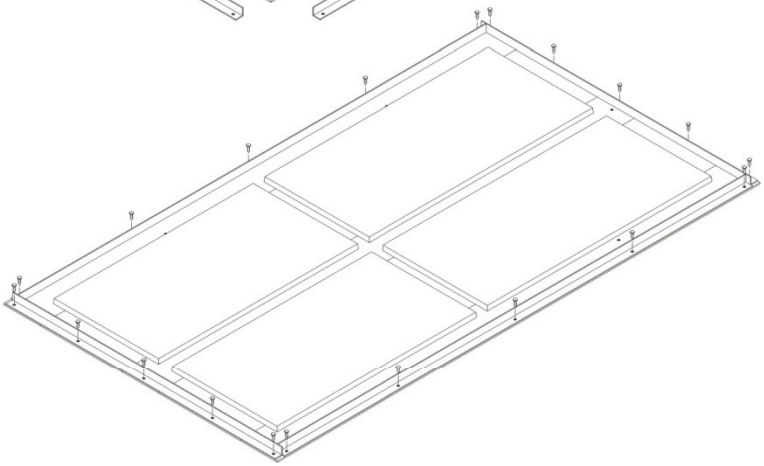


Step 2

- Screw in the M10 Bolts making sure they are nice and tight.
- CAUTION not to over-tighten as this could strip the nuts.



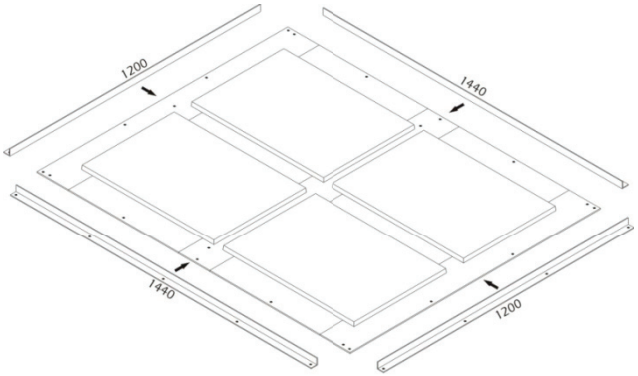

1095
1905
1905
1095



2b – ROOF PANEL MOULD

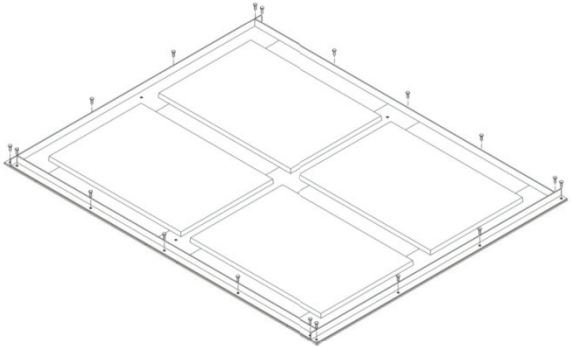
Step 1

- Place the angle iron onto the mould as displayed below.
- Make sure the holes align so that the bolts can be fastened.



Step 2

- Bolt in the M10 Bolts making sure they are nice and tight.
- CAUTION not to over-tighten as this could strip the nuts.

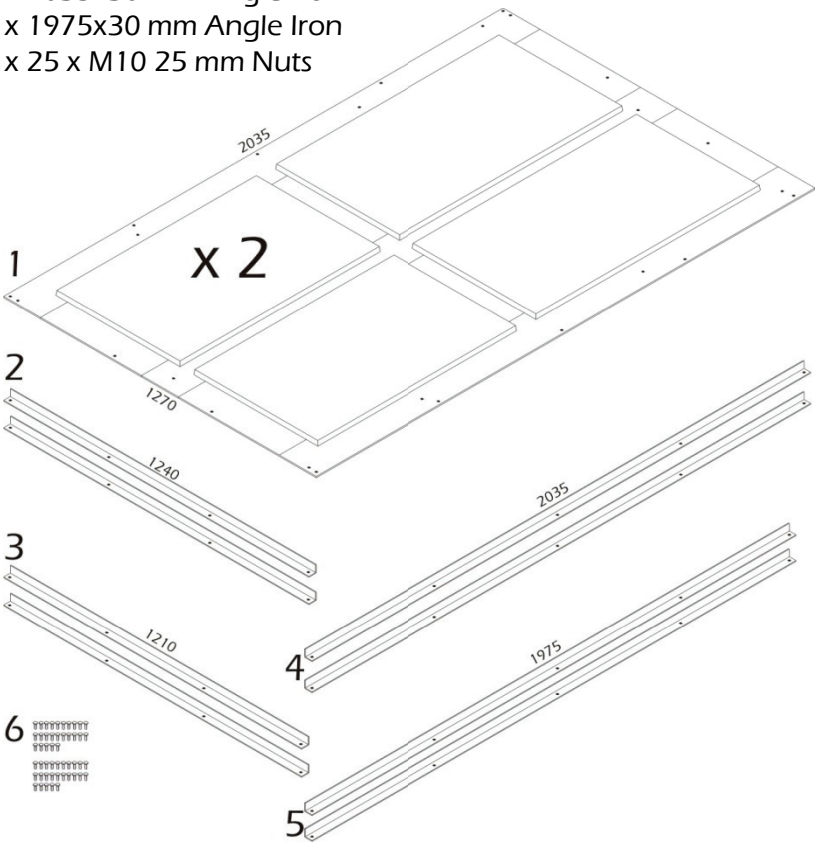


2c,d – LEFT & RIGHT PANEL MOULDS

Components

- Please check the quantity of all components, before starting assembly.

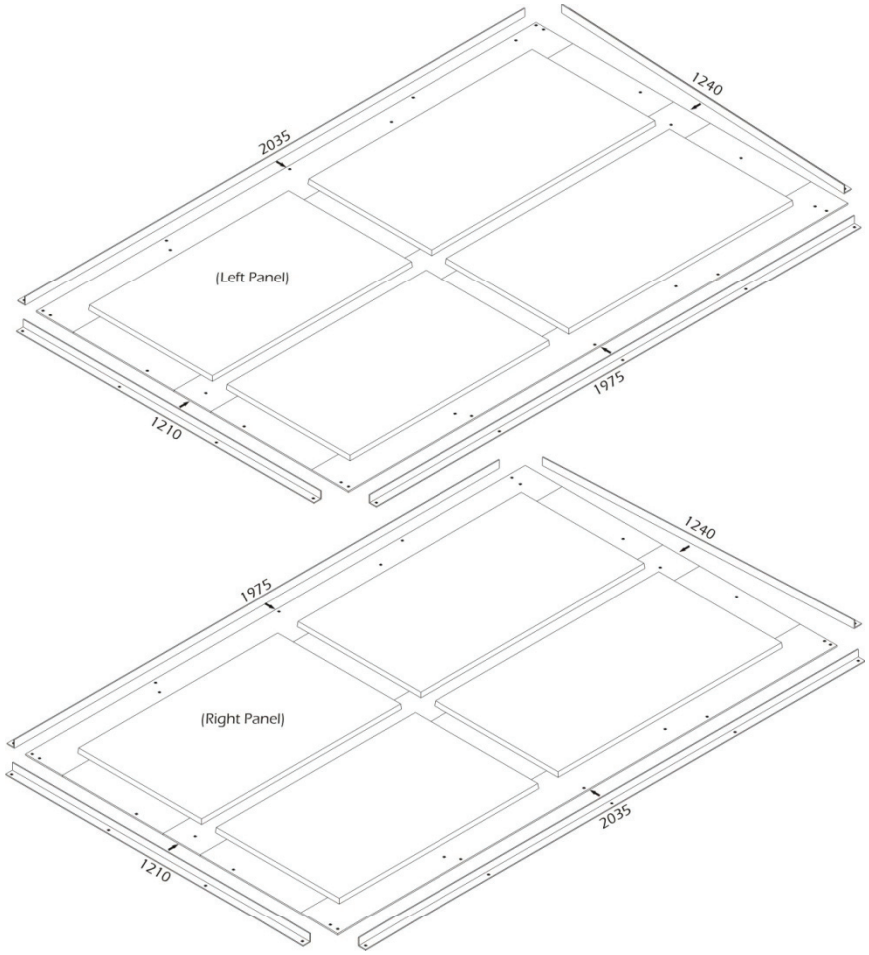
1) 2 x 2035x1270 mm Base Plate
2) 2 x 1240x30 mm Angle Iron
3) 2 x 1210x30 mm Angle Iron
4) 2 x 2035x30 mm Angle Iron
5) 2 x 1975x30 mm Angle Iron
6) 2 x 25 x M10 25 mm Nuts

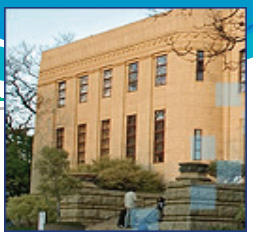


Step 1

-Place the angle iron onto the moulds as displayed on the right.

- Make sure the holes align so that the bolts can be fastened.

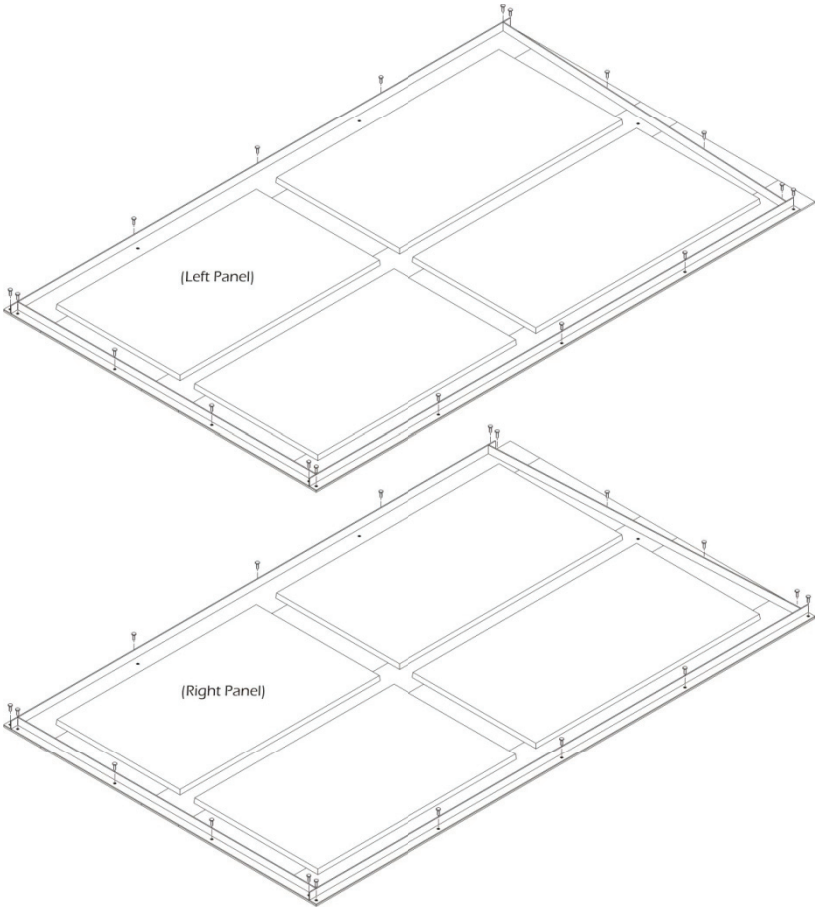




Step 2

-Screw in the M10 Bolts making sure they are nice and tight.

- CAUTION! not to over-tighten, as this could strip the nuts.

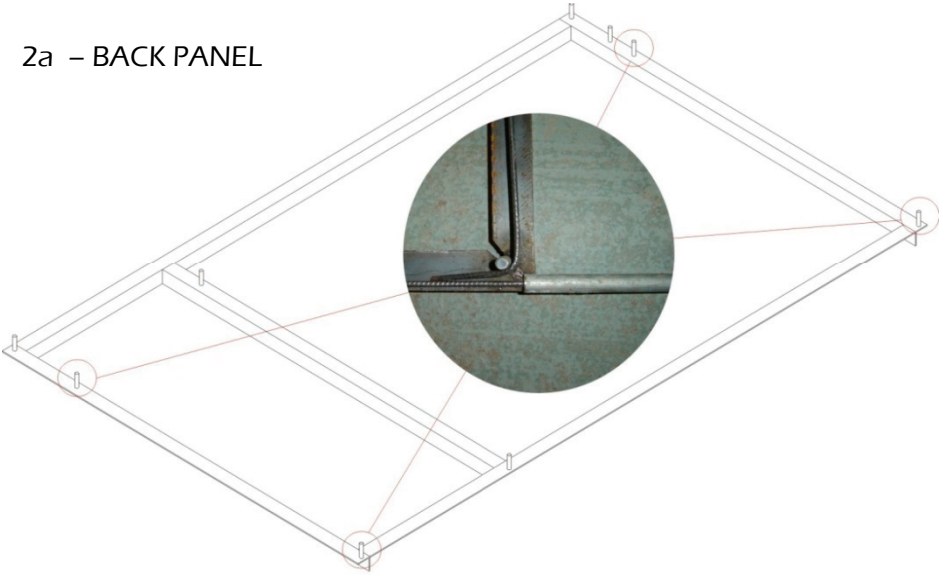


Steel Preparation

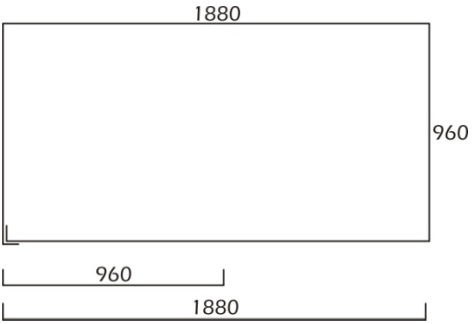
Please use gloves when working with steel. Make sure to use the correct safety equipment when welding.

STEP 1

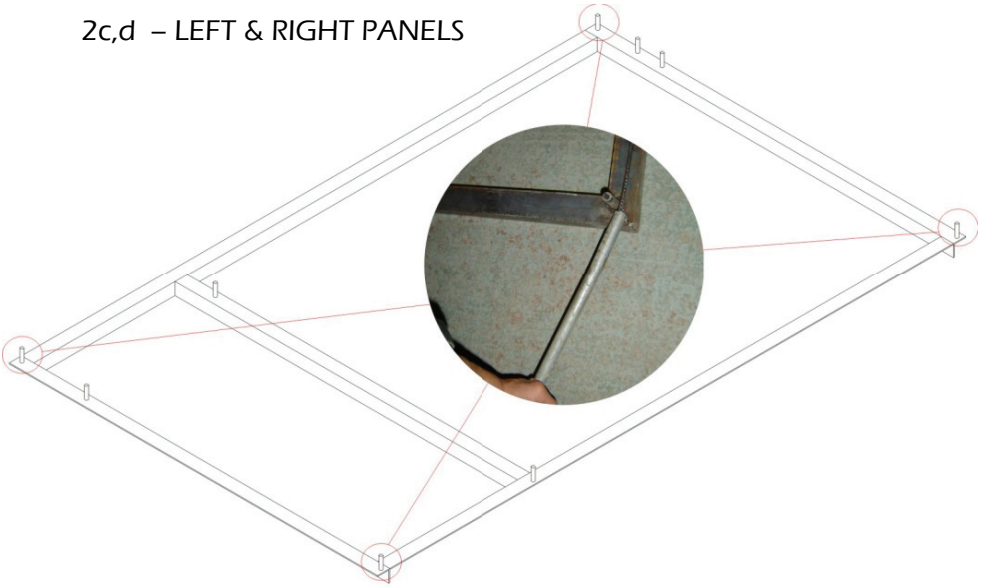
2a – BACK PANEL



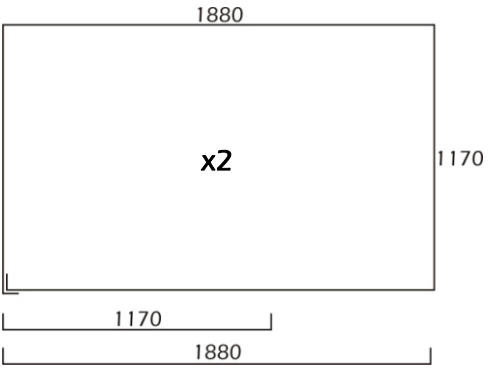
• Bend one length of 5.6 mm Re-Bar using a 10 mm pipe into a rectangle 1880 x 960 mm.
• Cut and bend a second length to form a 960 mm and 1880 mm channel with a 40 mm lip as shown to the right. Use bolt cutter for cutting.



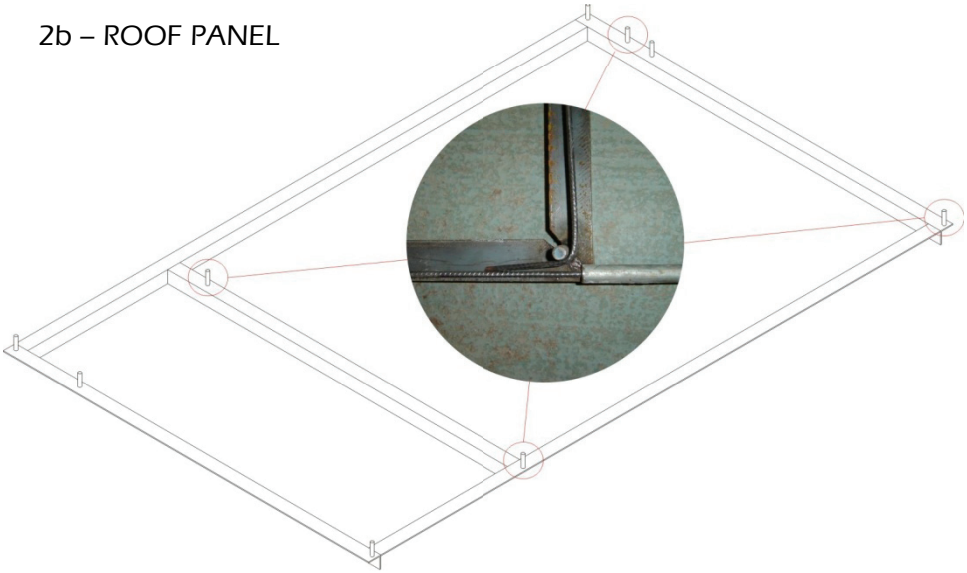
2c,d – LEFT & RIGHT PANELS



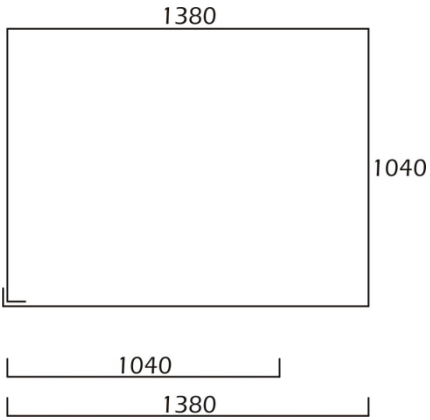
• Bend two lengths of 5.6 mm Re-Bar using a 10 mm pipe into two 1880 x 1170 mm rectangles.
• Cut and bend a third and fourth length to form two 1880 mm and two 1170 mm channels with a 30 mm lip as shown to the right.



2b – ROOF PANEL



- Bend one length of 5.6 mm Re-Bar using a 10 mm pipe into a rectangle 1380 x 1040 mm.
- Cut and bend a second length to form a 960 mm and 1880 mm channel with a 40 mm lip as shown to the right.



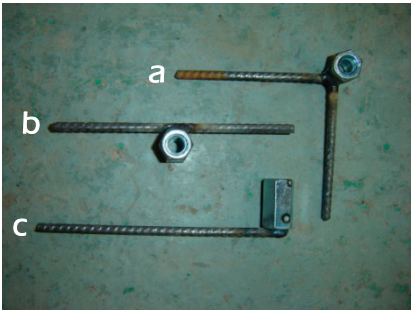
STEP 2

• Place a single 1200 x 2400 mm mesh sheet onto the **2a Back Panel Mould** and then cut the mesh to size with a bolt cutter so that it fits into the mould.

• Repeat this step for all panel moulds, i.e. **2b Roof Panel Mould, 2c Left Panel Mould, 2d Right Panel Mould.** Keep the off-cuts for the base panel moulds, i.e. 1a, 1b, 1c, 1d, & 1e.

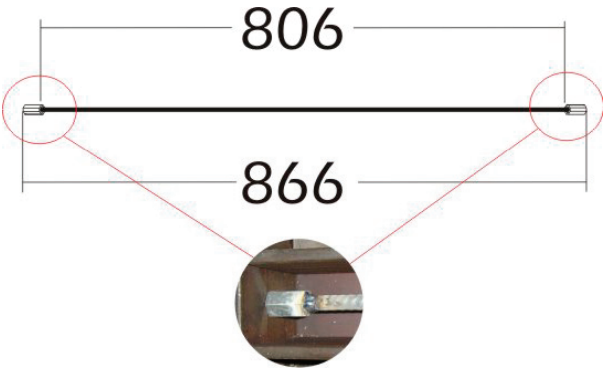
STEP 3

• Cut one length of 5.6 mm Re-Bar into 17 x 150 mm & 16 x 80 mm lengths. Then weld them onto the centres of long nuts as shown to the right. You will need the following quantities.
• a x 8
• b x 15
• c x 2
• This will be used to manufacture **2a, 2b, 2c & 2d**



STEP 4

• Cut one length of 5.6 mm Re-Bar to 806 mm length. Then weld a long nut onto both ends, making sure the total length is 866 mm.
• This will be used to manufacture **1f**.

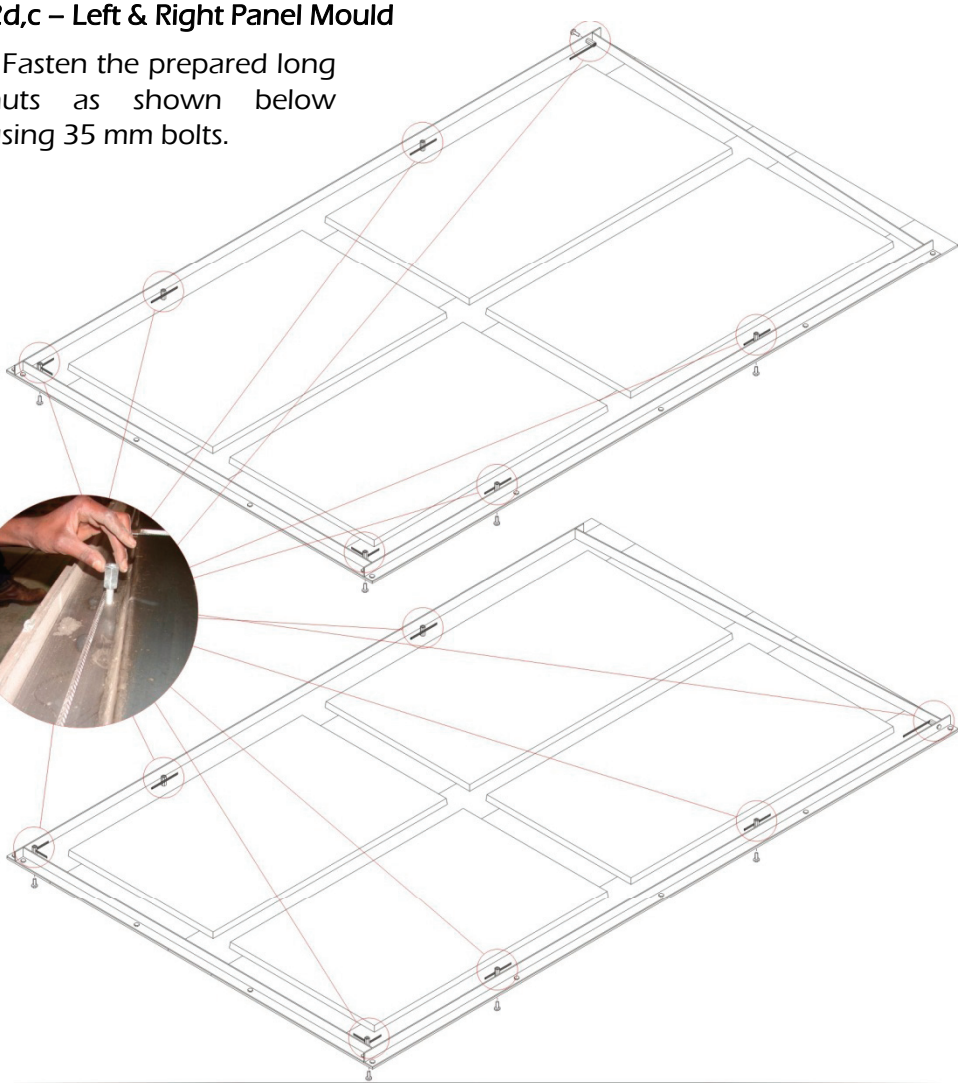


Steel Placing

STEP 1 – Fastening of long nuts

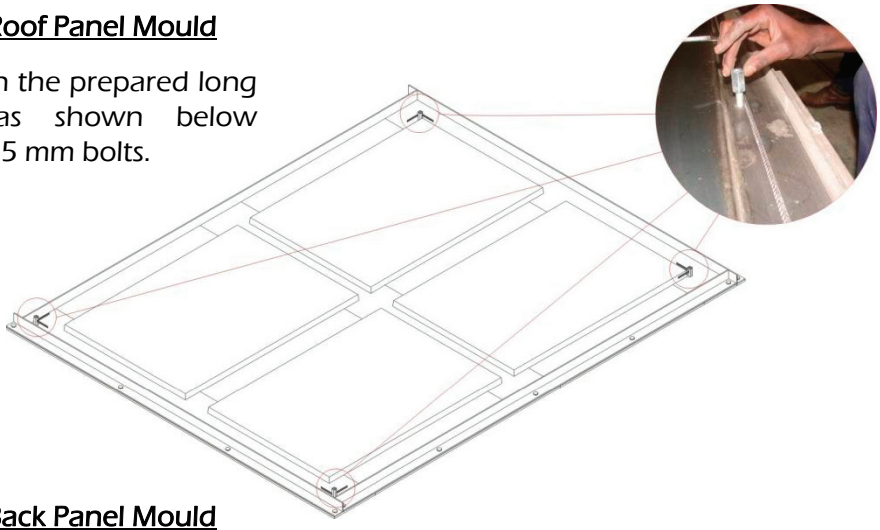
2d,c – Left & Right Panel Mould

• Fasten the prepared long nuts as shown below using 35 mm bolts.

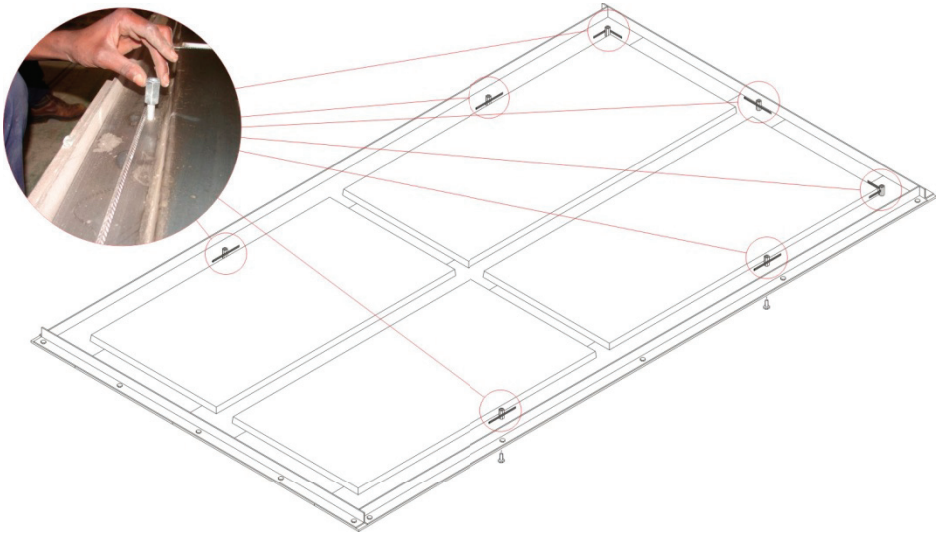


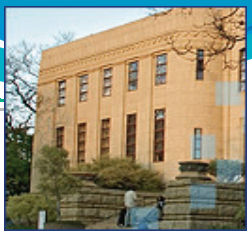
2b – Roof Panel Mould

• Fasten the prepared long nuts as shown below using 35 mm bolts.



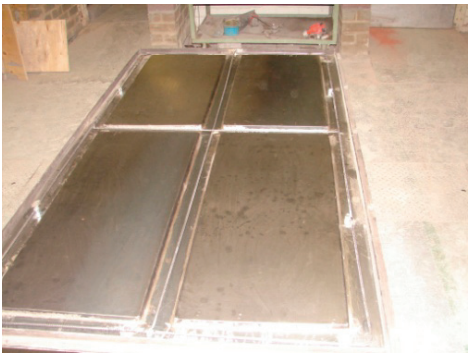
2a – Back Panel Mould

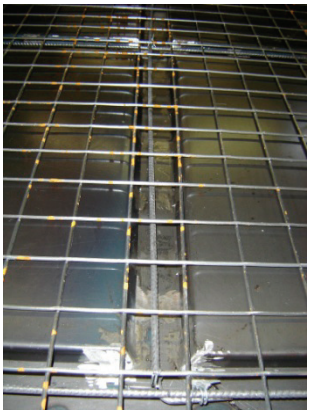




STEP 2 – Placing 5.6mm re-bar & wire mesh

- Place the bent 5.6 mm re-bar rectangles into the appropriate pan mould. Then place the two cross sections into the mould as well. And fasten them on the ends with some wire.
- Place the wire mesh on top & fasten it with some wire.
- Do the same for all the panel moulds 2a,b,c & d





1a,b Base Panels

• Trim the wire mesh off cut to fit in the two base panel moulds.

1c Base Panel wit 300 mm Hole

• Trim the wire mesh off cuts to fit into the mould and cut out the 300 mm hole.

1 e Front Cross Beam

• Cut two copper or PVC pipes with 10 mm internal diameter to 40 mm length. Then fasten them in place with 50 mm bolts. Trim the wire mesh off-cut to size and fit into mould as shown below.

1d – Base Panel mould with vent pipe hole

- Place the void cap into place and fasten it as shown below.
- Then trim the off cut wire-mesh and place it in the mould.

1f – Back Cross Beam

- Fasten the prepared re-bar/long nut re-enforcing with two 15 mm bolts on either side as shown below.

1a,b,c,d,e Base Moulds

2a,b,c,d Panel Moulds

• Before casting concrete check that none of the steel is protruding from the top of the moulds. Also check that the wire mesh is not lying flat on the mould surfaces. Bend the wire on the edges to make it stand up a bit or use small spacers.

Casting Procedure

Please use the correct safety equipment when casting concrete. Rubber gloves are essential.

Mix Design

• All the materials that go into the mix will be pre-bagged and supplied to you by your agent. The only ingredient you will need to buy at your local Hardware is Cement. It is vital to understand that you **MAY NOT USE ANY CEMENT. NB!!!** The only three different types of cement allowed are the following:

1) PPC = OPC Cem I

2) Lafarge = Powercrete PLUS

3) AfriSam = High Strength 42,5N

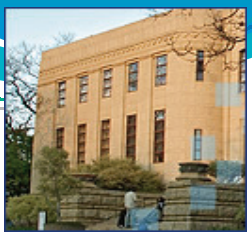
High Strength Cement

• One mix consists of the following 6 components.

1) 3 x 45 kg Aggregate/Sand mix bags
2) 1 x 5 kg Steel Fibres
3) 1 x 4 kg CSF
4) 1 x 50 kg bag Cement
5) 1 x 650 ml Add-mix
6) 1 x 18 ℓ Water – Note bucket is market at 18 ℓ

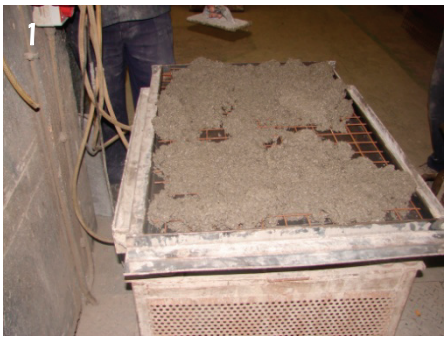
Mix 1 - Cast all BASE MOULDS = 1a - f

- Add the pre-mix bag of 1) Aggregates, 3) CSF and 4) Cement into the mixer.
Then add the indicated 6) 18 ℓ water and 5) 650 ml Add-mix into the mixer and let it mix for 4 minutes (Image 1-2).
- Add the 2) 5 kg steel fibres bag to the mix (Image 3)
- Allow to mix for an additional 5 minutes, after which the entire mix may be emptied into a wheel barrow. Use a spade to remove small, stuck bits and peaces (Image 4).



Placing Concrete and Vibrating

- Place any one of the base moulds onto the vibrating table.
- Fill the mould with some concrete and then start the vibrator.
- Manoeuvre the concrete into place with a plastic trowel.
- scrape any access concrete off with the trowel and float the concrete while vibrating.
- Make sure not to over fill the mould. The level must be 100%.
- Do this with all base moulds 1a-f one after the other.



Mix 2 - Cast Left & Roof Panel = 2b,c

- Add the pre-mix bag of 1) Aggregates, 3) CSF and 4) Cement into the mixer.
Then add the indicated 6) 18 ℓ water and 5) 650 ml Add-mix into the mixer and let it mix for 4 minutes (Image 1-2).
- Add the 2) 5 kg steel fibres bag to the mix (Image 3)
- Allow to mix for an additional 5 minutes, after which the entire mix may be emptied into a wheel barrow. Use a spade to remove small, stuck bits and peaces (Image 4).

Placing Concrete and Vibrating

• Fill the prepared 2b roof panel mould with some concrete, which has been firmly placed onto the vibrating table (Image 1).
• Scrape the concrete flush using the scraper, while the table vibration is switched on (Image 2).
• Float all excess concrete off the mould making sure it's flush with the edges. Then float until it has a smooth finish (Image 3).
• Place the filled mould aside and cover with a black sheet of plastic.
• Do the exact same for the 2c left panel mould.

Mix 3 - Cast Right & Back Panel = 2d,a

- Add the pre-mix bag of 1) Aggregates, 3) CSF and 4) Cement into the mixer.
Then add the indicated 6) 18 ℓ water and 5) 650 ml Add-mix into the mixer and let it mix for 4 minutes (Image 1-2).
- Add the 2) 5 kg steel fibres bag to the mix (Image 3)
- Allow to mix for an additional 5 minutes, after which the entire mix may be emptied into a wheel barrow. Use a spade to remove small, stuck bits and peaces (Image 4).

Placing Concrete and Vibrating

• Fill the prepared 2b roof panel mould with some concrete, which has been firmly placed onto the vibrating table (Image 1).
• Scrape the concrete flush using the scraper, while the table vibration is switched on (Image 2).
• Float all excess concrete off the mould making sure it's flush with the edges. Then float until it has a smooth finish (Image 3).
• Place the filled mould aside and cover with a black sheet of plastic.
• Do the exact same for the 2c left panel mould.

Curing Procedure

- Place all the filled moulds 1a-f & 2a-d next to each other on the floor in a room where they can rest, so the concrete can harden and cure.
- Check to make sure the concrete has been properly floated and that the moulds haven't been over filled.
- Once the above have been checked cover the concrete/moulds with a sheet of black plastic. This is VERY important as it allows the concrete to cure to the required strength. Allow to stand for a minimum of 16 hours.

De-moulding Procedure

- De-moulding refers to the process of taking the cast concrete component out of the mould.
- Once the concrete has been cured for 16 hours you can take it out of it's mould. It is very simple. All you need to do is reverse the mould assembly procedure. In other words loosen all the bolts and remove the angle irons.
- Gently tap the concrete out of it's mould by using a rubber hammer.
- Place the components safely aside and cover up with plastic again.

Cleaning Moulds

- Once the components have been removed from the mould it is vital to scrape any access concrete from the mould with a scraper.
- It is now just as important to oil the mould properly with a paint brush using the correct De-Moulding OIL.
- You are ready for assembly and starting the entire cycle again.

Output Materials

The following list of items, when assembled, will complete the VIP toilet. It is vital to use this checklist when shipping out the toilet for assembly. Some items have been manufactured others have been bought and a few are special orders from your agent.

Manufactured Items

1a – 1 x Base Panels
1b – 1 x Base Panels
1c – 1 x Base Panel with 300 mm hole
1d – 1 x Base Panel with waste pipe hole
1e – 1 x Front Cross Beam
1f – 1 x Back Cross Beam
2a – 1 x Back Panel
2b – 1 x Roof Panel
2c – 1 x Left Side Panel
2d – 1 x Right Side Panel(Inverse of Left Panel)

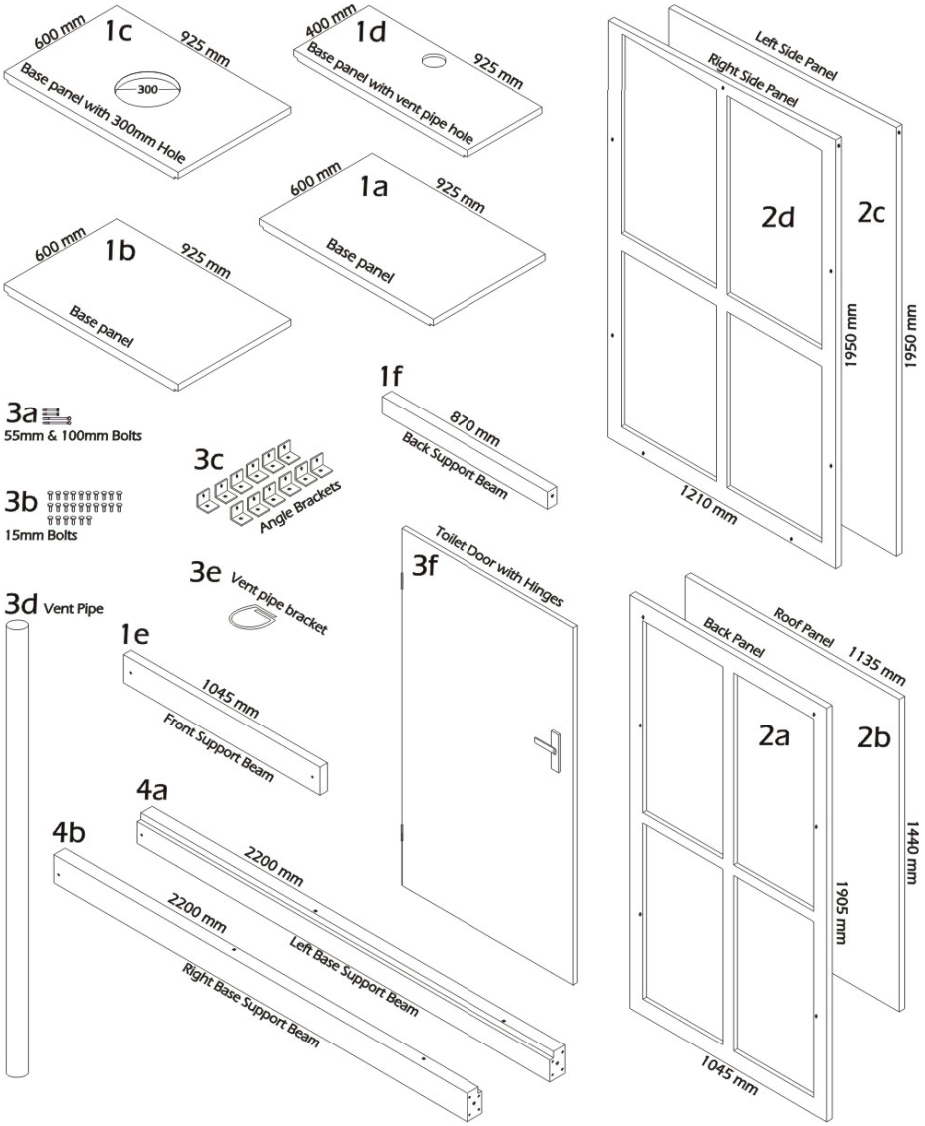
Bought Items

3a – 2 x M10, 100 mm & 2 x M10, 50 mm - Galvanized Bolts
3b – 25 x M10, 15 mm - Galvanized Bolts
3c – 12 x Aluminium Angle Brackets
3d – 1 x 3 m Vent Pipe

Special Items from Agent

4a – 1 x Left Base Support Beam
4b – 1 x Right Base Support Beam
3e – 1 x Vent Pipe Bracket
3f – 1 x Toilet door & hinges

Complete Toilet Components Checklist



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