A Simple Mechanical Device for Building Cylindrical RWH Tanks faster and better

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Abstract

Structurally cylindrical/circular tanks are more cost effective than box/rectangular tanks, requiring less reinforcing. It is however more difficult to build a cylindrical/circular wall than a straight wall. To this end the operation and merits of a simple mechanical device is explained which substantially simplifies the building of circular tanks. The device amounts to an arm that swivels on a fixed upright pole that is planted in the center of the excavation.

The pole-arm assembly is useful in a number of ways: firstly to guide the excavation team as they dig, resulting in an excavation with a vertical face of the correct diameter, and perfectly level excavation floor; secondly, as a tool for leveling the concrete in the floor during the pour; thirdly, to lay the bricks at the correct elevation and radius; fourthly, as a means of striking off the plaster on the walls to a uniform thickness.

Considerable savings are possible. For example, an excavation with a level floor means concrete is not wasted filling up undulations; the process of leveling the freshly poured concrete in the floor is fast and simple; the walls do not have to be continually checked for plumb with a spirit level, and neither do the individual courses of block work need continuous checking for level. The savings in time and material thus achieved are not inconsiderable.

The arm is telescopic and can thus be adjusted to suit different radii for different diameter tanks. Furthermore the change in radius from the excavation setting to the wall building setting to the plaster setting is equally simple, a matter of moving the locking-pin from one predrilled hole to the next. Finally, the pole is also predrilled, to establish the elevation of the excavation's base, that of the concrete floor-slab, as well as that of the vertical spacing of the block/brick courses.

Sketches are supplied with sufficient dimensioning for the pole-arm assembly to be constructed in a workshop.

About the Author

In 2006, as part of the experimental phase of the RWH program in South Africa, the author was appointed by the Department of Water Affairs and Forestry to build a number of underground storage tanks. All the tanks were built using the pole/arm assembly. Further tanks were built in 2007, again using the pole/arm method, and at one of the sites a complete wall for a 30000 litres tank was built in one day.

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Cylindrical Rain Water Harvesting reservoirs, hereafter referred to as RWH dams as they are commonly referred to in the villages in South Africa, are more cost effective than rectangular or box shaped reservoirs, mainly because substantially less steel reinforcing is required to safeguard the walls from cracking, and also less walling is required for a given volume. However it is easier to build a straight wall than a circular wall - all that is required is two upright planks and a fish line!

To overcome this problem use may be made of an arm assembly that is guided by a central pole. The arm assembly is made up of three components, a 'sliding pipe' (which slides over the 'central pole'), a 'horizontal member' which is attached to the lower end of the sliding pipe, with a 'telescopic member' that slides inside the fixed arm, and finally a 'diagonal member' is attached to the top of the sliding pipe at the one end, and to the fixed arm at its outer end. The diagonal member is fitted with a turnbuckle at its center.

A view of the pole/arm arrangement may be seen in figure 1.

As its name implies, the central pole is planted in the centre of the excavation, while the arm assembly is free to slide up and down on the pole, and it can also swing freely around the pole. The pole is drilled through at regular intervals corresponding to the gauge of the block/brick work (see figure 8).

The sliding pipe is supported by a 'locking pin' (see figure 9) after it has been inserted into the hole corresponding to the course to be constructed. It follows that providing the horizontal member is truly horizontal, that the hole's level can be transferred to the other end of the telescopic member, and providing further that the central pole is vertical, then by swinging the arm assembly around the pole, the desired level will be transferred to the wall in a full 360 arc.

Use is made of a spirit level to plumb the pole. To begin with the pole is placed in a pre-made hole and made to rest on a timber plank or a brick at the base of the hole – to prevent it from gradually creeping downwards into the relatively soft ground. The hole is then backfilled with ground that is thoroughly compacted. Alternatively use can be made of a pipe 'sheath' (see figure 9) into which the pole can be inserted. This makes it easier to remove the pipe afterwards. Note that a 110mm PVC pipe should be placed around the central pole prior to casting the concrete floor to ensure that the pole can be removed and re-used. The angle of the vertical pole is adjusted by three sets of 'guide wires' (see figure 1). Each wire is anchored to the top of the pole with a hook, while it is anchored to the ground by means of a stake, and each guide wire also has a turnbuckle for adjusting the pole into the vertical position.

The bring the horizontal member into level, the spirit level is place on top of member, while turning the turnbuckle of the diagonal member either clock or anticlockwise.

Applications

The pole/arm assembly can be used to perform a number of tasks as follows:

- Excavate a cylindrical hole that has a wall that is vertical and a base that is horizontal – both to relatively fine tolerances.
- Cast a concrete floor that is level
- Build walls that are vertical
- Apply plaster that has a uniform thickness

The degree of accuracy achieved will depend on how vertical the pole was set up and similarly how horizontal the arm assembly was set up. But assuming these have been accurately set up, excellent tolerances will be achieved.

The elevation of the excavation's base, that of the concrete floor, as well as that of each course of brickwork/blockwork are all established by moving the locking pin into the various predrilled holes in the central pipe, shown in figure 9.

Likewise the radial positions of the excavation's wall, the cylindrical tank's wall, and finally that of the plaster are achieved by corresponding predrilled holes in the telescopic arm as shown in figure 5. Whichever position is required is selected by means of a second locking pin.

Finally, the various components of the central-pole/arm-assembly are listed in table 1.

Conclusion

A central-pole/arm-assembly arrangement has been described which facilitates (a) the excavation of a precise cylindrical hole, (b) the building of a vertical wall which lies in a precise circle, and (c) the uniform application plaster. This both speeds up the rate of construction and improves the quality of the RWH dams, and thereby also reduces their cost.

The drawings that are supplied herewith are sufficiently detailed for the various components to be manufactured in a simple engineering workshop.

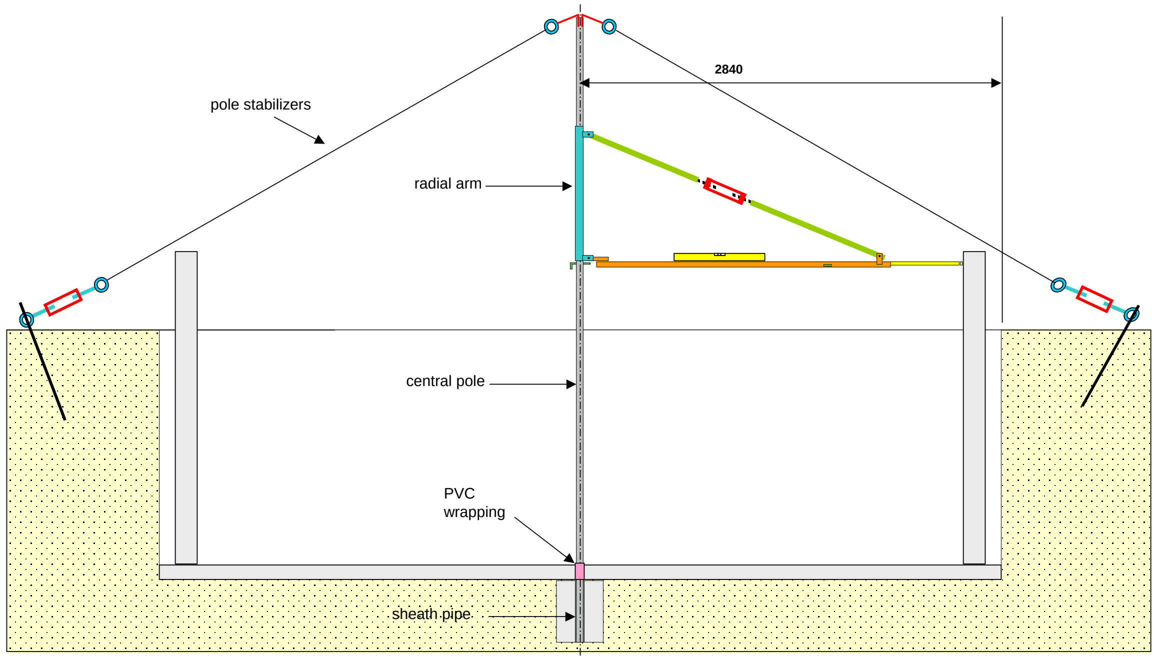


Figure 1 – General Arrangement of Pole/Arm

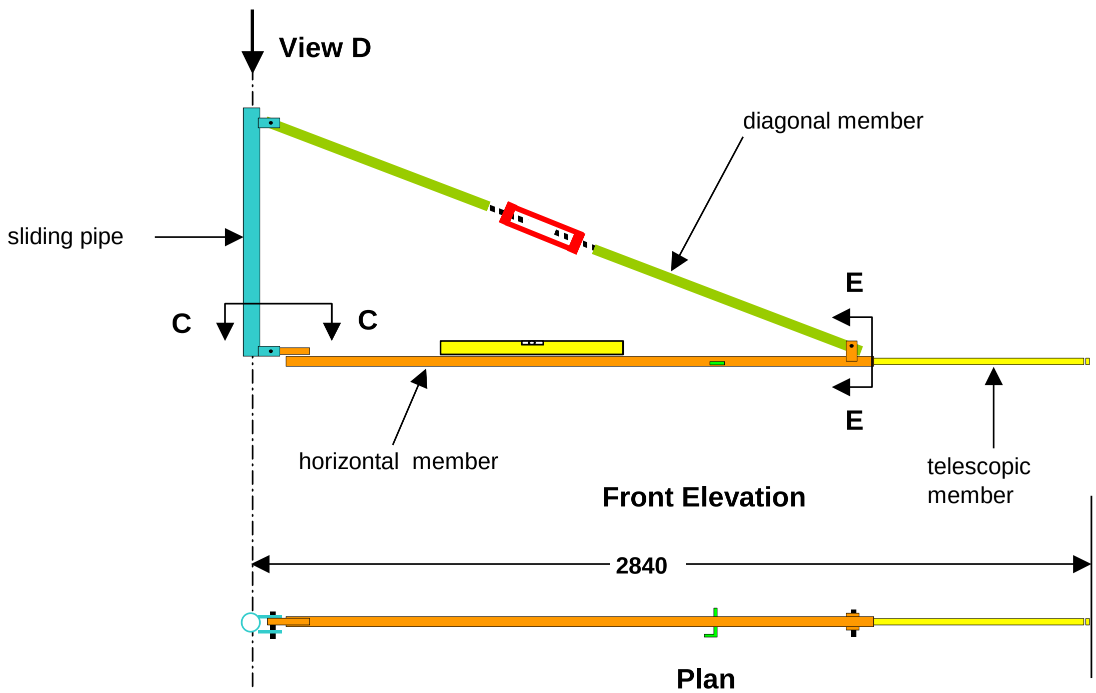


Figure 2 – Components of Arm

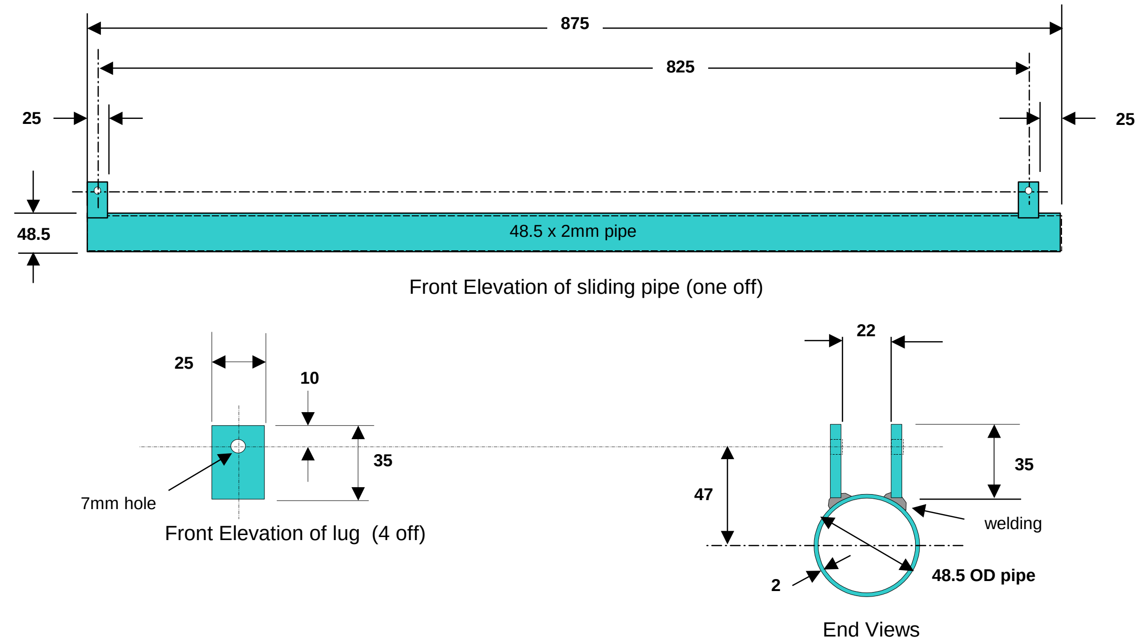


Figure 3 – Front elevation of sliding pipe

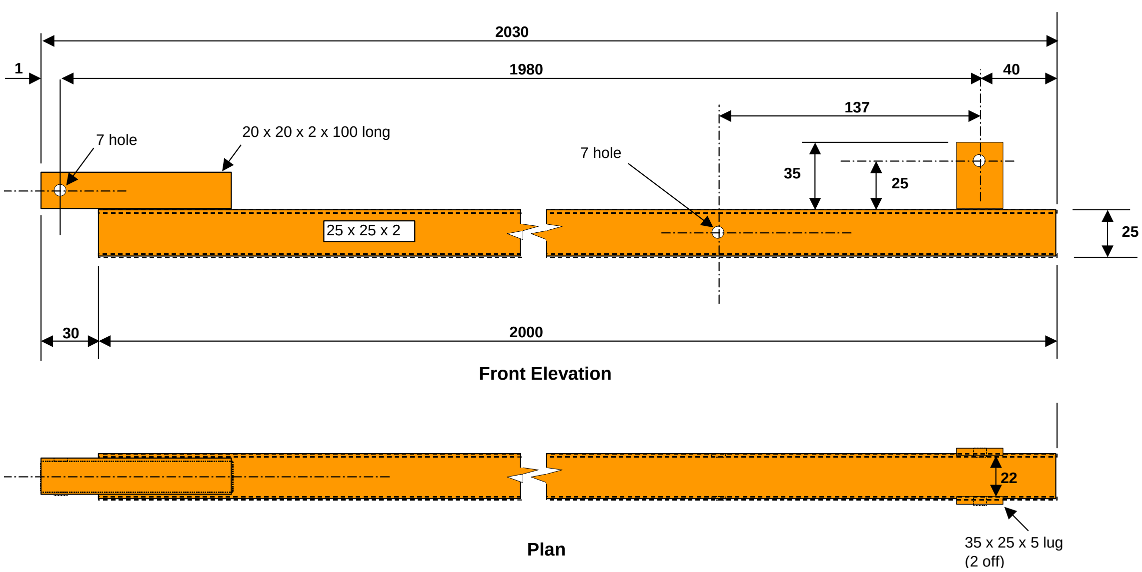


Figure 4 – Front elevation of fixed tube

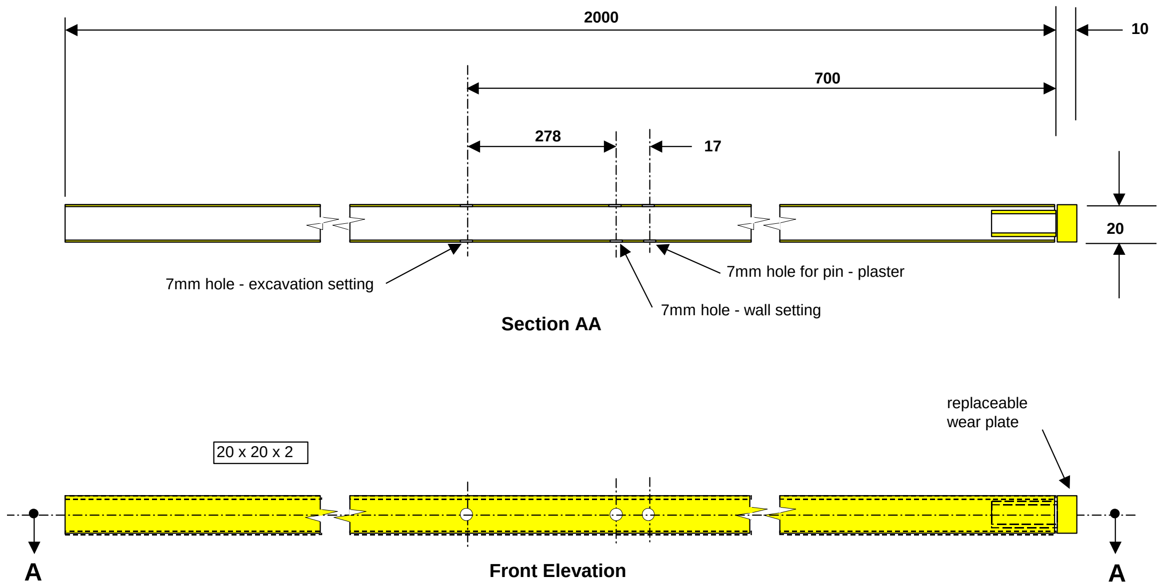


Figure 5 – View of telescopic arm

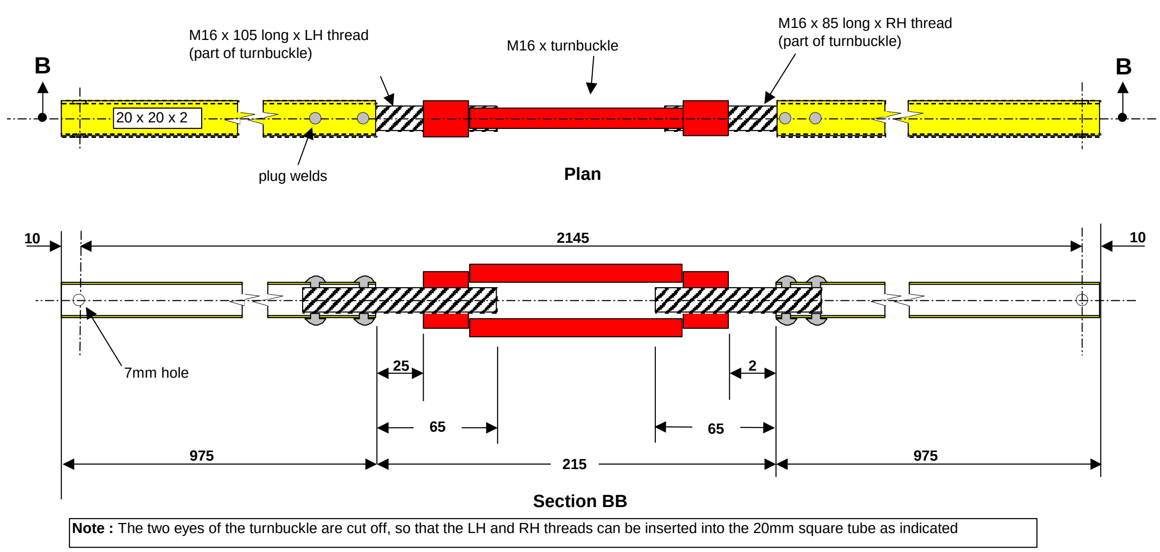


Figure 6 – View of diagonal member

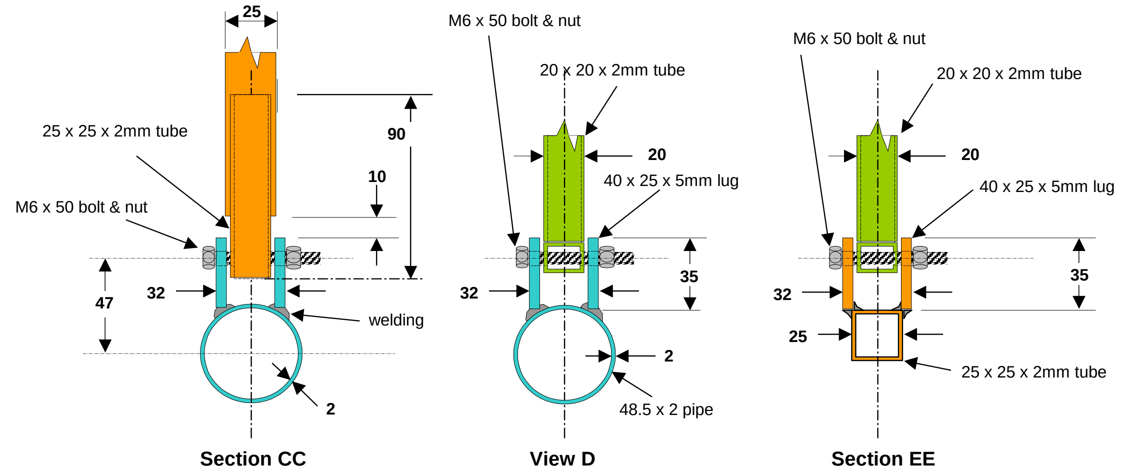


Figure 7 – Connection details for connecting the various members of the arm assembly together

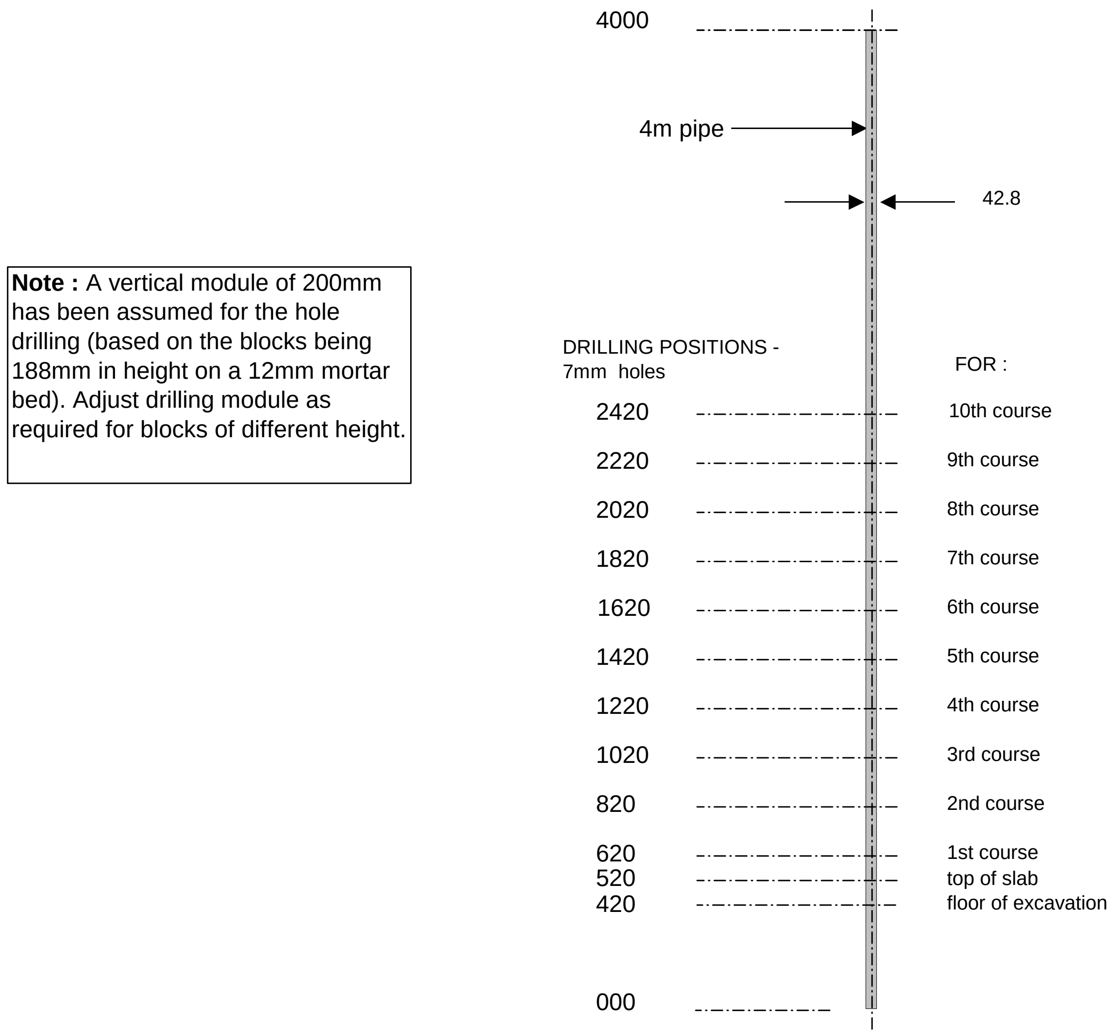
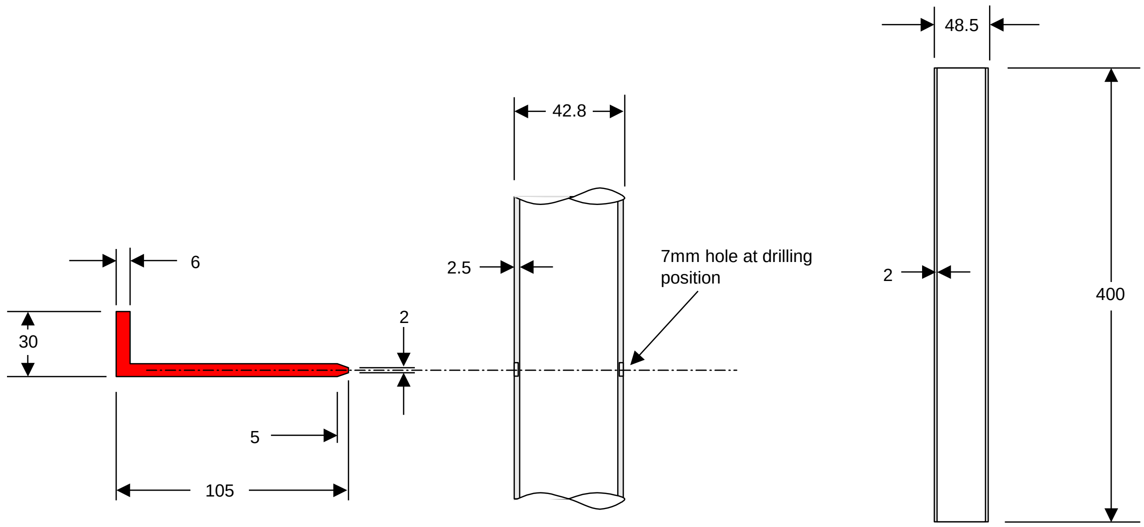


Figure 8 – View of Central Pole



Front Elevation of locking pin (2 off)

Longitudinal Section of portion of central Pole

Longitudinal Section through Sheath Pipe (1 off per dam)

Figure 9 – View of locking pin and sheath pipe

Table 1 : Materials List for Pole - Arm System

Item no.	Materials	for use in …	main component	Quantity
1	48.5mm x 2mm x 875 mm steel pipe	sliding pipe	radial arm	1
2	5mm x 25mm x 35mm long steel flatbar	sliding pipe	radial arm	4
3	5mm x 25mm x 35mm long steel flatbar	horizontal member	radial arm	2
4	25mm x 25mm x 2mm x 2000mm long steel square tube	horizontal member	radial arm	1
5	20mm x 20mm x 2mm x 100mm long steel square tube	horizontal member	radial arm	1
6	8mm steel pin x 140mm long	horizontal member	radial arm	1
7	600mm long spirit level	horizontal member	radial arm	2
8	20mm x 20mm x 2mm x 2000mm long steel square tube	telescopic member	radial arm	1
9	100mm x 100mm x 10mm steel plate	telescopic member	radial arm	1
10	20mm x 20mm x 2mm x 975mm long steel square tube	diagonal member	radial arm	2
11	M16 turnbuckel	diagonal member	radial arm	1
12	M6 x 50mm bolts and nut		radial arm	3
13	42.8mm x 2.5mm x 4000mm long steel pipe		central pole	1
14	8mm steel pin x 140mm long		central pole	1
15	48.5mm x 2mm x 400 mm steel pipe		sheath pipe	1
16	M12 turnbuckle		pole stabilizer	3
17	450mm portion of 1.8m steel fence dropper		pole stabilizer	3
18	1.6mm binding wire x 5m long		pole stabilizer	3
19	6mm steel bar x 200mm long (hook at top)		pole stabilizer	3