**Construction of Pyramid FGE enclosure:**

**Materials:**

The base and framework were constructed of structural SA Pine which was treated to withstand beetle infestation as per regulation in South Africa.

The fasteners were brass woodscrews used in conjunction with “Balcotan” waterproof wood glue.

The external covering material (skin) over the framework was 9mm commercial waterproof plywood and the internal covering 6mm pine plywood.

The insulation between the internal and external coverings was a South African ceiling insulation product named Isotherm of 40mm thickness, this was layered to fill the entire cavity between the inner and outer plywood layers. This material is fitted after the inner plywood skin is fixed to the framework and can be held in place by adhesive tape or quick setting glue.

The whole of the exterior of the pyramid was covered with a skin of Glass Reinforced Plastic or GRP. This is the most important part of the process as it provides superior strength to the construction as well as protection against ingress of water, wind, dust and sun (UV radiation). The final layer consisted of self-leveling resin including a white pigment only. The white color was selected to reflect solar radiation as much as possible.

**Construction Process:**

The first part of the construction was the square base made of 38 x 152mm SA Pine which was mitred at 45° on the corners. These 45° joints were fixed together with brass screws and Balcotan waterproof glue. The angled frame construction of 38 x76mm SA Pine was completed and fixed to the base with brass screws and Balcotan glue. To this frame the plywood inner and outer skins were fixed again with the brass screws and waterproof glue. The vertical corners of the plywood skin were fixed by means of 90° wooden mouldings for the inner skin and square beadings of approx. 25mm for the corners of the outer plywood skin.

The preparation of the wooden structure before applying the fiberglass and resin coatings was to round-off all sharp corners (internal and external). Internal corners are rounded off by filling with a GRP compatible filler (polyester based). This is done because the glass fibers do not bend readily around corners and would therefore not adhere well in these areas causing air bubbles and subsequent weakening and leaking of the structure. The smallest radius should be not less than 20mm.

**Application of GRP skin:**

As mentioned, the whole construction was waterproofed and strengthened further by coating with four layers of polyester resin and glass fiber material named chopped-strand mat or CSM. This is usually specified in grams per square meter – the thinner material is easier to impregnate with polyester resin and it is advisable to use more layers of thinner material than one or two thicker layers. The first layer was a heavy coating of polyester resin applied directly to the bare exterior plywood skin into which the chopped strand mat (CSM) was pressed (rubber gloves are a must for this operation) a further coat of resin is applied usually by roller or brush until the glass fibers are fully impregnated – this is usually obvious when the whitish color of the glass fibers are no longer visible and the layer looks almost transparent. It is important to mix the correct amount of catalyst (MEKP) hardener into the polyester resin and to mix smallish batches so that the resin does not start to set before it is applied – usually batches of one or two liters are mixed at a time. The next layer should be applied in identical fashion before the first layer has hardened completely as this creates better bonding. As mentioned above, the final layer was self-leveling gelcoat with white pigment (usually pre-mixed) and applied without glass reinforcing material. This gave the product a relatively smooth finish – any loose or protruding fibers in the layer before the final coat must be sanded smooth or they will extend through the gelcoat layer making for a poor finish. It is important to note that the GRP skin extended around and underneath the lower face of the wooden base.

**Access Door Opening**:

The door in the side of the pyramid was made of similar materials to the pyramid itself and sufficient clearance between the mating parts must be allowed (approx 12 millimeters) or the door will not fit into the opening after the application of the GRP layers. This door was attached to the pyramid with a series of 6mm brass studs (spaces at approx 200mm C-C) fixed into the pyramid wall and wing nuts on brass flat washers were used to screw down the door which was sealed against the pyramid face with self adhesive rubber foam sealing strip.

**Inner Plywood Skin:**

The inside skin of the pyramid was painted with a high quality wood primer and white topcoat to give maximum interior light reflection and improved interior visibility.

**Foundation Fixing:**

M10 brass hook bolts, nuts and flat washers (12 ea) were supplied for fixing the base of the pyramid to the concrete foundation. The installation team made a template of the bolt hole positions from the base of the pyramid for positioning the hook bolts in the wet concrete. This worked very well and simplified this process a great deal. A self-adhesive sponge seal supplied to be attached to the underside of the base so as to form a water and dustproof seal when installed on a level concrete foundation. Due to the mass of the completed pyramid and the height of the pillar construction it was designed to cover, the pyramid, as a whole was lifted by mechanical means (in this case a JCB digger/loader) this allowed controlled lowering and positioning onto the concrete base and protruding brass studs. It is important to note that the mounting stud holes should be filled with silicone sealer before fitting the flat washers and tightening the securing nuts as this will prevent de-lamination of the GRP layer from the wood due to water entrance and ensure longevity of the installation.

**Shipping:**

The pyramid was shipped on a custom made wooden pallet to which the base was bolted to protect against damage when loading and unloading.

**Installation on Site:**

The design was intended to simplify installation on site and should only require excavation of a suitable strip foundation of approximately 500x500mm cross-section which would incorporate the fixing bolts as mentioned. It would be advisable to have the strip foundation protrude approx. 100mm (or more) above ground in very wet areas so as to prevent flooding. To accomplish the above some wooden boards to be used as shuttering should be provided to contain the concrete in the desired form. Some wooden or metal stakes to anchor this shuttering would be necessary.