Pit Latrine

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In the development of a nation, the health of the people is definitely affected by the attitudes towards and procedures used in sanitation. The traditional pit latrine used in Tonga was improved by the use of a more durable material – fibrous ferrocement. The principle and casting procedure of ventilated pit latrine and pour flush latrine are presented.

INTRODUCTION

The ventilated pit latrine or the VIP is a highly improved version of the old pit latrine (Fig. 1). It was developed in Africa principally by the World Bank. Thousands of these units have been built with every conceivable type of material, yet all must employ the same principles. In 1985 there were a total of approximately 40 being used in Tonga, some for as long as 4 years. The improvement over the old style pit latrine is amazing. Flies in the house are practically non-existent (even though there is some fly breeding in the pit). The usual pit latrine smell does not exist and the general atmosphere in the unit makes it more comfortable and acceptable to use.

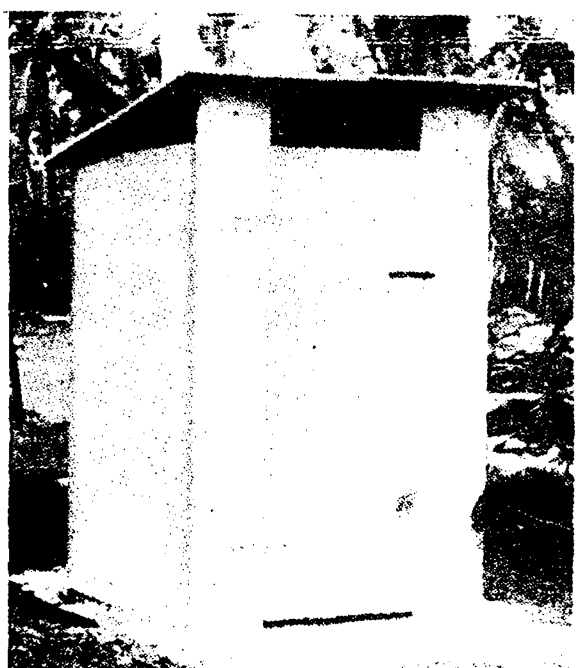

Fig. 1. Ventilated pit latrine.

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Fig. 2. Pour flush latrine.

The pour flush latrine is also known as "Philippine" and "cup and saucer" (Fig. 2). It provides all of the advantages of any water seal toilet without the complications required in the maintenance of a flush tank. As with the VIP, there are no flies, no odors and no fear of children falling through the seat. The unit can be constructed next to or inside the house which will encourage its use. Children especially should be encouraged to use the latrine. Water should always be piped to the pour flush latrine house.

PRINCIPLES OF OPERATION

The ventilation pipe and the airtight pit are the most important components. The ventilation pipe must be thought of more in terms of a chimney than a plumbing vent pipe. It must be large enough to work on temperature differences, like a chimney. As the air goes up the vent pipe it is pulled down through the seat and riser pipe. This keeps the smell from the pit latrine. It is easier for the air to go through any hole in the pit than down the riser pipe so if the pit is not absolutely airtight the VIP ventilation would not be effective and it becomes no better than the old fashioned latrine.

Flies have two weaknesses that are taken advantages of with the VIP. They are attracted by light and they will not fly down and away from light even if they are trying to escape. The light through the vent pipe is the brightest light, since the light from the seat and riser pipe is protected by the house, therefore the flies will fly up the pipe and once there, encounter the screen. Since they will not fly down they stay next to the screen and eventually die. The tight screening of the vent pipe is an absolute must and the maintenance of this screen is critical.

PRECASTING OF FERROCEMENT ELEMENTS

The precasting of ferrocement products is in reality a series of material handling problems. The equipment selected to efficiently handle the heavy products through their production paths must be related to the volume to be handled and are limited only by the ingenuity the designer can employ. For our combination of budget, labor costs, and capital available the monorail system seems to be the best. One of the controlling factors is how often a fork lift is available. In our plant the fork lift is normally used only for loading out pallets of components onto trucks for transport to the erection site. Other than this it is used only about once every two months to rearrange or transport to storage the full pallets (Fig. 3).

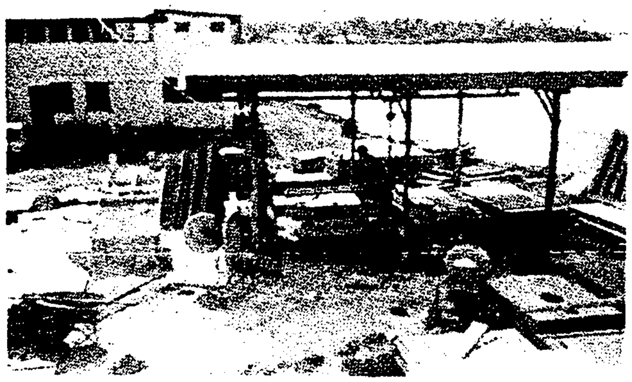

Fig. 3. Casting yard.

Pit Latine Wall Elements

In the typical casting procedure, the cleaned and prepared mold is placed on the vibrating table. The proper volume of materials are measured into the mixer and the high tensile wires as required are cut. In all flat castings one-half of the total volume is mixed at one time. The mortar is placed on the mold, vibrated (Figs. 3-4), and smoothed to the level of the first high tensile wire mesh. The wire mesh is placed (Fig. 5) and the procedure is repeated until completion. Vibration must be thorough and based from our experience there is no need to worry about overvibration. The exposed surface is finished with a steel trowel, however, for exterior surface it is rolled with a 150 mm pipe to provide a dippled surface. Then, holes for the stainless steel tie wire are made through the wet concrete with a piece of wire (Fig. 6).

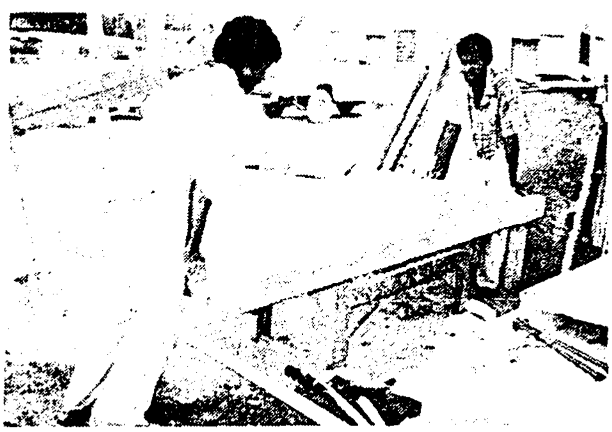

Fig. 4. Holding the mold while vibrating.

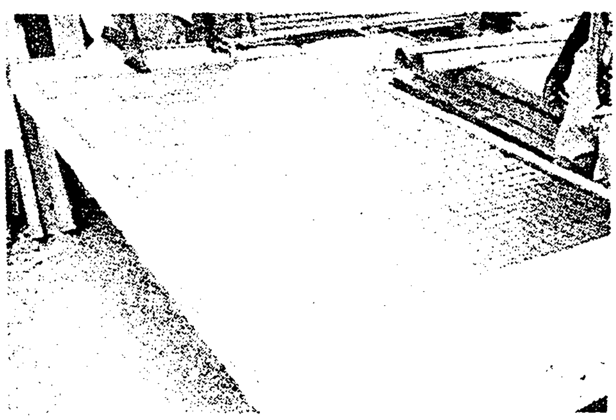

Fig. 5. Placing wire on first layer of mortar.

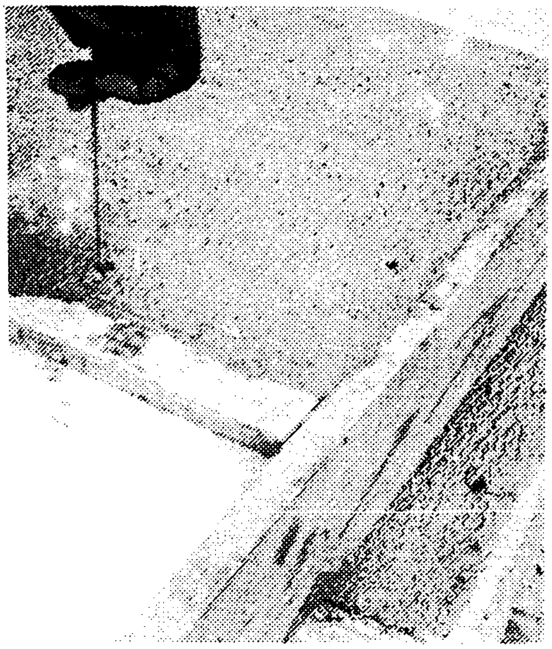

Fig. 6. Making holes for tie wires.

The mold is then left to cure until the next day. The following day the lifting screws are used to break the element away from the mold and the element is lifted (Fig. 7) and stored on a pallet with others of the same size. When the pallets are full they are transported by fork lift to a less active part of the yard for storage and further curing. The curing time at this point is usually about 16 to 18 hours.

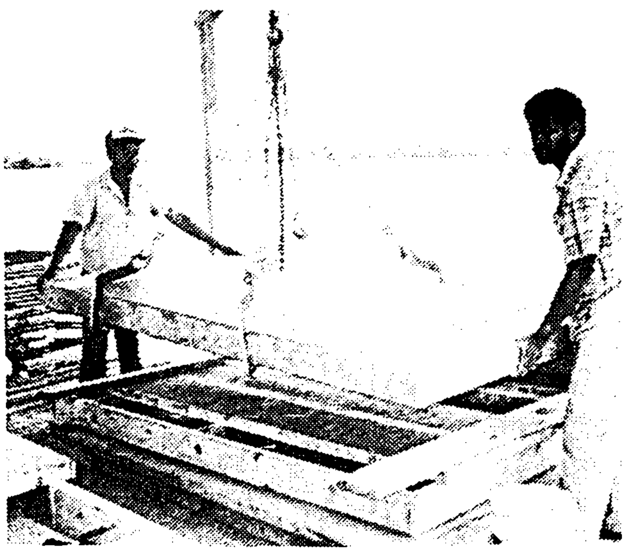

Fig. 7. Moving mold to curing stack.

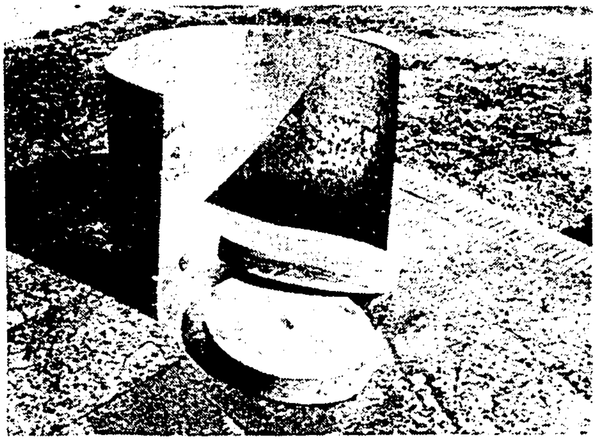

Fig. 8. A complete set of the mold.

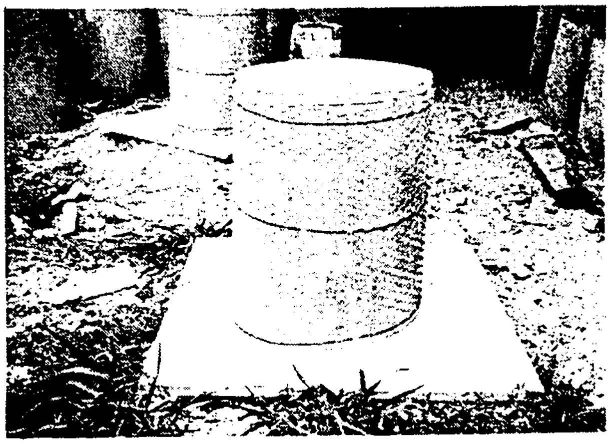

Fig. 9. The assembled mold.

Sanitary Units

The mold of the sanitary unit (Figs. 8-9) is assembled. The mortar is plastered on the outside (Fig. 10) and is cured for the required number of days. All materials to be used are brought from storage and stacked adjacent to the site.

Fig. 10. Plastering.

Fig. 11. Digging after the riser boards are installed.

CONSTRUCTION

Construction is started by digging the form for the foundation ring. This ring reinforces the edge of the hole to help prevent caving in and makes the pit absolutely airtight to the ground. When the foundation is poured, the riser boards are set in the fresh concrete to receive the main slab after the concrete has hardened (Fig. 11). The riser boards must be set perfectly level and square. The level must be checked by the use of a carpenter's level and the dimension should be checked by measuring and adjusting so that distances between the two diagonal corners are exactly the same. If there is any question of the builder's ability to do this it is better to gently set the main slab on and adjust while the concrete is fresh. The main slab (Fig. 12) must be carefully sealed to the riser boards using a rich mortar. This is best done by a man standing inside the pit. The seal may be made airtight by plastering all places where light from the outside can be seen while standing in the pit (Fig. 13). Then install the convertible riser pipes (Fig. 14).

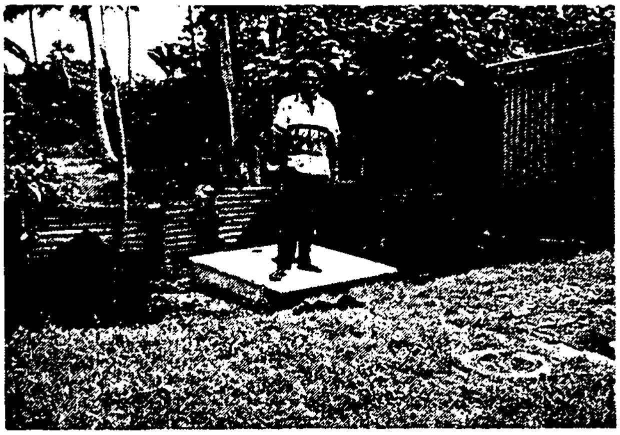

Fig. 12. The main slab in place.

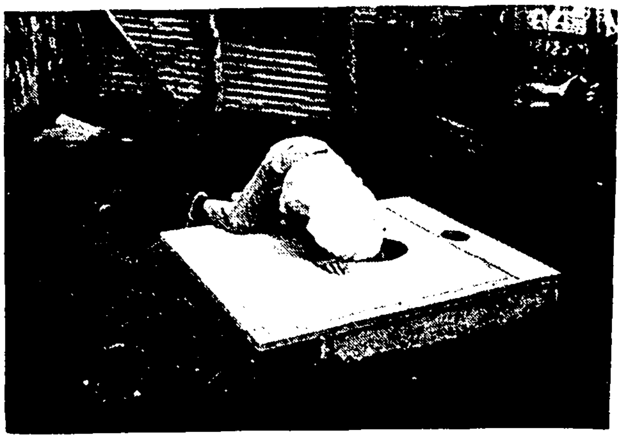

Fig. 13. Final inspection for air leaks.

The house is then assembled using the stainless steel tie wire (Fig. 15). The riser pipe is mortared on the outside only, sufficient to hold it in place. The door, which was custom prefitted with the hinges on the side element, is installed. The earth is slightly mounded near the walls so that any rain will flow away from the unit. Aggregates, small rocks or some form of protection are placed where the rain will fall from the roof so it will prevent any washing or erosion.

Fig. 14. The convertible riser installed.

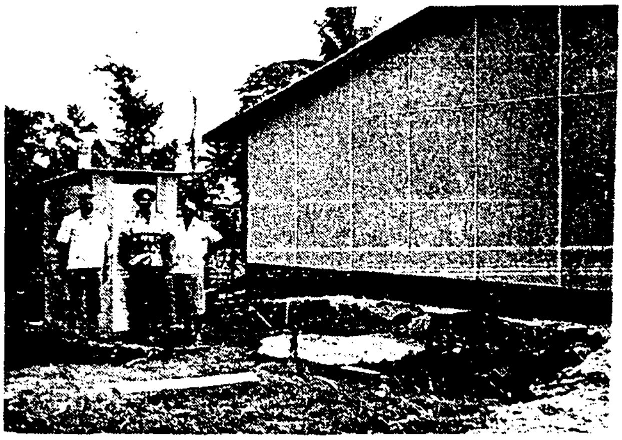

Fig. 15. A new VIP for a new school.

The inside wall of the house was perfectly smoothed so that it can be painted if desired.

Provisions should be made for hand washing after using the VIP even though this is difficult where there is no piped system. It is important that the woman in charge of the home see that this be done.

The pit should be dug as deep as possible considering surrounding soil behavior. The depth of the pit directly affects the expected life of the pit. The expected life of the pit using the standard size unit may be computed by the following equation :

$$\text{Years pit life} = \frac{1.370 \times \text{depth in meters}}{0.050 \times \text{number of people using}}$$

If ground water is encountered while digging the pit, the VIP should not be used, instead use a pour flush type, which is appropriate for this condition. A well can be dug and the water can be used to flush the latrine.

THE CONVERTIBLE RISER PIPE

The convertible riser pipe allows the conversion of a VIP latrine to a pour flush or vice versa by the installation or removal of a plastic liner (Figs. 16-18). This feature was found necessary because of the inconsistency of the water supplies in the villages. Water may be on or off depending on many things including breakdowns, nonpayment of bills so diesel can be purchased, or sometimes how busy the operator gets with other interesting things. On one visit to an outer island in the Ha'apai group in mid 1985, the village of Falemea, was found to have no water for 6 months. This is certain to create a problem in pour flush latrines which are not equipped with the convertible feature.

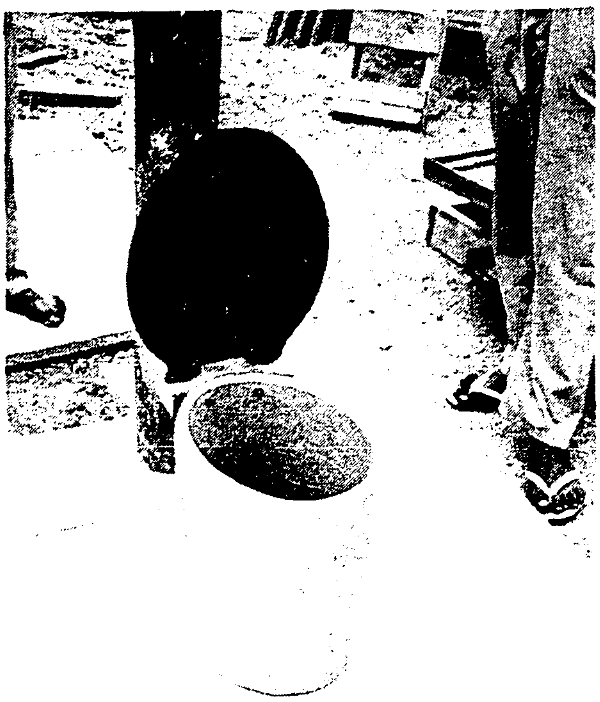

Fig. 16. As a VIP latrine.

Fig. 17. As a VIP with wooden seat.

The convertible riser pipe employs the ultimate in simplicity in the forms required. Two sawn pieces of wood and a flat sheet of metal is all that is required. The thickness of the riser pipe being produced is controlled by the worker making the piece. While it takes several attempts to achieve a good product the skill level is achievable by the average construction worker.

Fig. 18. The plastic liner to convert VIP latrine to a pour flush latrine.

CONCLUSION

Sanitary units constructed, using the described procedure, have been used in Tonga since 1981. They have been carefully monitored and have proven satisfactory.

REFERENCE

Belz, L.H. 1986. *Preacasting Fibrous Ferrocement Sanitary Units.* Tonga : Lloyd H. Belz P.E.*

*Available from L.H. Belz, P.O. Box 908, Nuku'alofa, Tonga for US$6.00 (surface mail); US$7.50 (air mail)