# Notes on the Construction of Experimental Huts

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Huts for the experimental evaluation of insecticides applied to their internal surfaces for mosquito control have been used by the Colonial Pesticides Research Unit for over twelve years, during which period they have undergone several changes necessitated by the more exacting demands of the information required. A major problem in all the huts which have been used for this purpose has been the invasion of ants, which consume trapped and dead mosquitos before counts can be made and give rise to inaccurate results. This fact has been largely instrumental in the evolution of the design which is now used.

The first huts, which were used during the early days of the Unit in Uganda from 1945 to 1950, consisted of either completely prefabricated timber and hardboard huts or copies of typical African dwellings specially constructed and modified for the particular purpose.

The prefabricated huts fulfilled several entomological requirements in that they were portable and could be easily rendered ant-proof by simply raising the whole hut off the ground on wooden legs and placing receptables of water under each leg. This type of hut made the trapping of mosquitos comparatively easy, but had the disadvantage that the internal surfaces bore no resemblance to the mud walls and grass roof which is usually met in African houses. Huts with mud walls and grass roofs constructed specially for the purpose could have provision for traps, but the first of these to be built had no provision for the elimination of ants.

At a later stage, at Taveta in Kenya, huts were built of mud and wattle, a concrete floor was laid internally and a completely separate water channel was built round the outside of the hut, but there was nothing to prevent ants from entering the huts by burrowing under the concrete channel and up through the walls. The internal surfaces of these huts were rendered with various plasters of mud, mud and sand, and mud and dung similar to those commonly used in the area.

It is reported by Burnett[a] that there was considerable invasion of ants at the later stages in the investigations at Taveta.

With the commencement of spraying operations in the Taveta area a new site for experimental hut work had to be selected, and a site at the village of Magugu, 95 miles (150 km) from Arusha on the Great North Road, was selected.

It was decided to attempt to overcome the invasion of ants by laying a concrete floor which would be contiguous with a water channel and building the hut on the resulting concrete island. Several huts of this design were built but it was found that, owing to an unstable subsoil, cracks developed in the concrete floor and channel. Although the channels were kept more or less watertight by coating them with bitumen it was found that ants were finding their way into the huts through cracks in the floor.

Construction of this type of hut was also difficult owing to the accuracy with which the floor had to be laid, constant supervision of the semi-skilled African labour by skilled artisans being necessary if the water channel was to have a continuous layer of water round its length.

At this stage sun-dried mud bricks were made on the site for the walls of the huts and they were internally plastered with the plaster to be tested. The manufacture of mud bricks also presented a difficulty, as the work could be carried only out in dry weather and a sudden shower would wash away the results of several days' work.

After several unsuccessful attempts to rectify the trouble of ant invasion in the huts which had already been built, it was decided to abandon them in favour of a completely new design, which it was thought would overcome most of the difficulties of ant-proofing as well as making construction easier with the more or less unskilled labour available.

### *Description of the huts*

Basically the idea was to raise the whole structure off the ground on four short concrete pillars, each of which would have its own water channel round it. A corner block is shown in Fig. 1, and the finished hut in Fig. 2.

The pillars were made one foot cube, and any slight variation in ground level would therefore not seriously affect the water level and a continuous layer of water would be achieved. It was also thought

[a] Burnett, G. F. (1957) *Bull. Ent. Res.*, **48**, 631.

to be unlikely that ants would find their way through a one-foot thickness of concrete.

The design has proved very effective and twenty identical huts have now been built at Magugu and another five at Mto-wa-Mbu, about 50 miles (80 km) away from Magugu. More recently a laboratory has been built on the same principle, so that tins of water do not have to be placed under the legs of the tables and benches to keep ants out of mosquito cages.

*Construction details*

*Shuttering.* Permanent shuttering was made for the casting of the legs and consisted of a bottomless wooden box of 1-inch (2.5-cm) timber bolted together, with internal measurements of 1 × 1 × 1 foot (30 × 30 × 30 cm). On the outside of the lower edge of the box additional pieces of 2-inch (5-cm) wood were fixed to render the bottom three inches of the box three inches thick, so that when the shuttering was removed a channel 3 × 3 inches (7.5 × 7.5 cm) was left in the concrete. Fig. 3 shows a complete box on the left (A) and a dismantled box on the rigth (B).

The surfaces of the box which would come into contact with the wet concrete were lined with light guage galvanized iron sheet so that the shuttering would be easy to remove and would also be protected against warping through contact with the water.

*Foundations.* The standard size decided on for the huts was 8 × 8 feet (2.4 × 2.4 m) inside, with walls 6 feet (1.8 m) to the eaves. This gives a hut of sufficient size to be sprayed and worked in, and is at the same time cheap and easy to construct.

After levelling the site, foundation holes are dug to a solid footing. The holes are 2 × 2 feet (60 × 60 cm) and are situated with their centres at the corners of a square with sides 8 feet 2 inches (2.48 cm) long. This measurement places the centre of the wall over the centre of the blocks, but as the blocks are invariably inaccurately placed by the unskilled labour, the size of the block allows considerable latitude for the subsequent placing of the main beams which carry the load.

A minimum depth of one foot is required for the foundation holes. They are then filled to within 6 inches (15 cm) of the ground level with rock or stones, starting with large stones and levelling off with small stones. After placing the stones in the foundation a layer of concrete is poured over them and the shuttering box is placed centrally on this layer after the concrete has taken its initial set, i. e., after about half an hour. The box itself is then filled with concrete and the outside filled up to ground level. The concrete must be well tamped to eliminate voids, which are the main cause of leaks in the finished channel. A sectional drawing of the shuttering box and a corner block is shown in Fig. 4. As only a small amount of concrete is used on the building, it is advisable to make a strong mixture; a mixture of 1 part of cement to 2 parts sand and 4 parts ¾-inch (20-mm) crushed stone was used at Magugu.

In practice it is advisable to have four sets of shuttering so that the legs of one hut can be cast all at the same time; in this way, also, the four boxes can be placed in the holes simultaneously and positioned and levelled before filling with concrete.

The shuttering may be removed after 24 hours if it is required to cast other blocks, but if this is done great care must be taken to avoid damage to the concrete. It is preferable to leave the shuttering in position for two or three days. The concrete blocks are allowed to mature for at least a week before other work is carried out on them, and during this time they should be covered with grass or sacks and kept damp, particularly if they are being cast in a very dry or hot climate. After about five days the covering can be removed and the concrete allowed to dry out.

In the first huts to be built to this design metal straps were left protruding from the concrete and were later used to tie down the main beams (see Fig. 1). It was found later that these were unnecessary as the weight of the building prevented any movement.

*Floor.* All timber for the floor was pre-cut to size in the workshop and treated with creosote before it was taken to the site. The creosoting is done as far in advance as possible so that it is dry before the timber is used on the huts. Crude creosote was chosen as a preservative rather than one of the proprietary wood preservatives which in many cases contain insecticides. As there is a considerable interval between the application of creosote to the wood and the huts' being used for experiments, there have been no adverse effects on the mosquitos caught in the huts before treatment.

The main beams over which the walls are built, and which take the whole of the load, are made from 9 × 4-inch (23 × 10-cm) softwood cut to a length of 8 feet 4 inches (2.54 m) and laid on edge with one

FIG. 1
CORNER BLOCK OF EXPERIMENTAL HUT

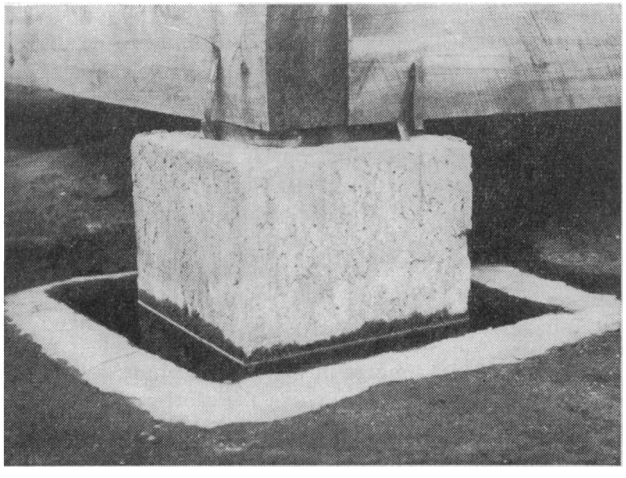


FIG. 2
EXTERIOR OF EXPERIMENTAL HUT

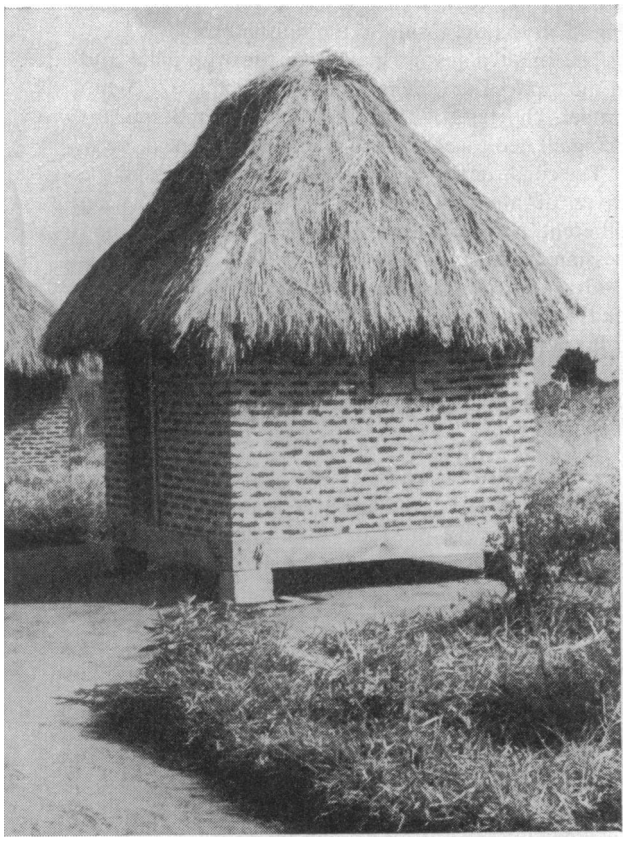


FIG. 3
SHUTTERING FOR CASTING OF CORNER BLOOCKS, ASSEMBLED (A) AND DISMANTLED (B)

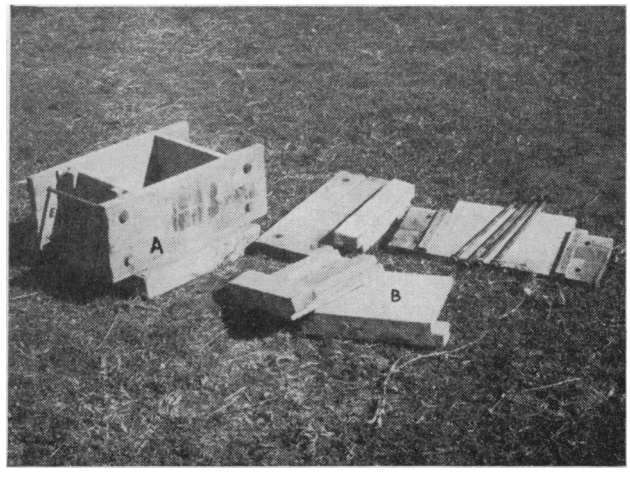
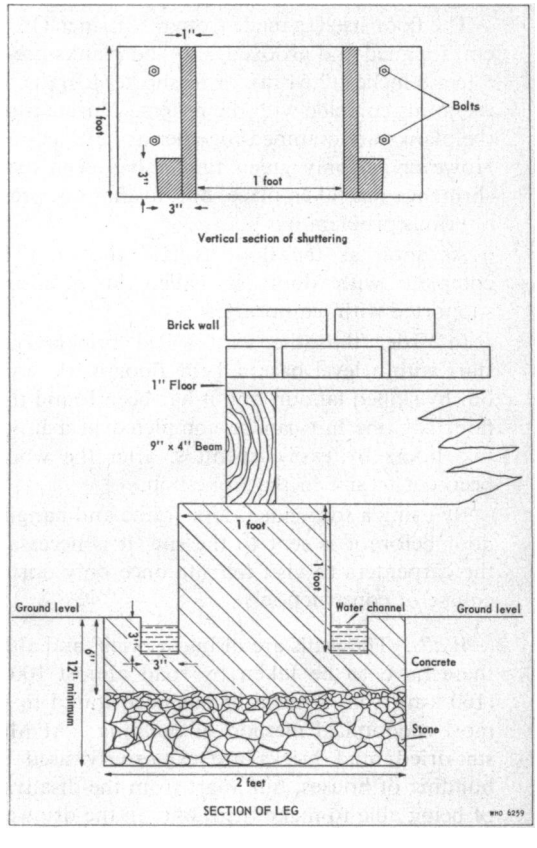



FIG. 4
SECTIONAL VIEWS OF SHUTTERING BOX AND CORNER BLOCK



beam overlapping its partner at each corner so that a square is formed 8 feet 8 inches (2.64 m.) outside and 8 feet (2.44 m) inside. The beams were nailed together at each corner with 6-inch (15-cm) nails.

In the first huts which were built 6 × 4-inch (15 × 10-cm) beams were used, and although there were no signs of failure, a certain amount of bending did occur on some huts. Latterly the larger timber has been used and there has been virtually no bending from load, but a little movement due to warping has taken place in one or two huts, although this has not affected them to any practical extent.

After the beams are nailed together, corrections for level are made and small packing pieces of timber are used to bring the top of the beams dead level. The squareness of the beams is also checked at this stage and they are placed as centrally as possible over the blocks.

Three additional 4 × 2-inch (10 × 5-cm) rafters are fixed on edge equally spaced across the span of the hut at right angles to the direction in which it is intended to lay the floor planks, with their egdes level with the beams.

The floor itself is made from 6 × 1-inch (15 × 2.5-cm) tongued and grooved sofwood planks pre-cut to 8 feet 8 inches (2.64 m), or to shorter lengths, so that the joints coincide with the rafters. During assembly the planks are cramped together as hard as possible. However as, only green timber has been available shrinkage has taken place, but this has not presented a serious problem.

As soon as the floor is laid the door frame, complete with door, is nailed in position and supported with temporary stays.

In order that the semi-skilled bricklayers may start with a level base, all the floor work is carried out by skilled labour, and it has been found that the floor for one hut can be completed in a little over two hours by two carpenters, after the wood has been cut to size in the workshop.

By using a four-sided door frame and hanging the door before it is sent to the site, it is necessary for the carpenters to visit the site once only during the course of construction.

*Walls.* The walls are of burnt brick, and although these have to be taken by road almost 100 miles (160 km) from Arusha, it has been found to be the most economical method of building. At Magugu sun-dried mud bricks are extensively used in the building of houses, but apart from the disadvantage of being able to make them only in the dry weather, an impervious rendering has to be applied to the outside to prevent erosion from rain.

As a guide to the bricklayers the door frame is made the same height as the finished wall would be and the walls, apart from the one in which the window trap is to be situated, are built up solid to that height. The bricklayers are capable of putting in the pre-fabricated window frame themselves. In all the huts at Magugu mud mortar has been used, but in those built at Mto-wa-Mbu cement and sand mortar is used as the soil has been found to be unsatisfactory for mortar.

Metal straps are placed through the walls two courses from the top and bent round to secure a 4 × 2-inch (10 × 5-cm) timber wall-plate.

*Roof.* The roof timbers in the Magugu huts are all constructed with sisal poles, as these are readily available. Whole poles are used for the main trusses and split poles for the purlins. The roof is a hip-roof, coming almost to a point at its apex. The height of the roof from eaves to apex is about 6 feet (1.8 m) and there is an eave of about 1 foot 6 inches (45 cm), which gives a very steep pitch. Fig. 5 shows the inside of the finished roof.

The main poles are nailed to the wall-plate and at the top to a short length of 4 × 2-inch (10 × 5-cm) timber, the rest of the poles and the split purlins being all tied together with sisal binder twine.

The construction of the roof leaves a gap round the eaves of about 4 inches (10 cm), which has on different occasions been filled with bricks or had hessian curtains hung over it.

Grass is used as thatching material and is also tied to the poles with binder twine. The roof follows more or less the pattern of those used in the district, but any locally available material can, of course, be adapted for the purpose.

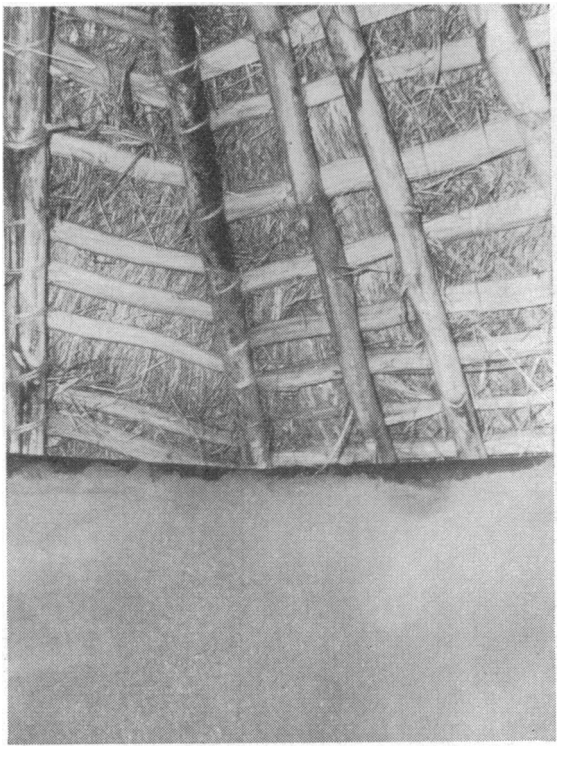
*Finishing.* The huts are finally plastered internally with whatever wall material is to be used for the experiment. It is practicable to put on only about half an inch (12 mm) of mud plaster at a time and, where a thick layer is demanded in order to prevent saturation with insecticide, it is applied in several layers, each being allowed to dry for a day. The undercoats are left rough for keying, and the last layer is given a smooth finish.

On the outside the joints in the brickwork are pointed with sand and cement mortar to prevent the mud being washed out by the rain.

There have been a few cases of leaking channels, owing to bad tamping of the concrete, but these

FIG. 5

INTERIOR OF EXPERIMENTAL HUT, SHOWING ROOF CONSTRUCTION



have been effectively dealt with in every case by plastering with a fairly strong cement plaster to which a small amount of water-proofing compound is added.

Finally, hardboard sheets are cut to cover the floor completely so that there is a smooth surface which facilitates the collection of mosquitos from the floor.

*Quantities and time*

An approximate indication of the quantities of materials locally used for one hut and of their cost is as follows (the cost of transport is not given as it varies so greatly according to the distance of the building site from the source of supply):

| | *Shillings* |
|---|---|
| 1½ cwt. cement | 20 |
| 5 cubic feet of ¾-inch crushed stone | 4 |
| 4 pieces of softwood 9 × 4 inches and 8 feet 4 inches long | 65 |
| 85 feet of 4 × 2-inch sofwood | 18 |
| 100 feet of 1-inch tongue and groove board | 75 |
| 1000 bricks | 120 |
| 14 pounds of sisal twine | 18 |
| Hinges and bolts for door | |
| Nails (6-inch, 4-inch, and 2½-inch) | |
| Creosote | |

At Magugu sand and stone for the foundations were available near to the site and cost only transport and labour in fetching them.

Sisal poles were available from an estate a few miles from the site and were bought at 10 for one shilling; about 50 were required for each hut.

It proved more economical to purchase grass by the bundle than to employ labour to cut it, but in any case, as it had to be transported several miles to the huts it proved to be an expensive item, enough for one hut costing in the region of 40 shillings.

A building labour force of two bricklayers with two or three labourers is all that can work on one hut at a time. The number of labourers is dictated to a certain extent by the distance that water has to be carried to the site.

The bricklayers could lay about 200 bricks each a day, but even at this low rate the quality of the work was very poor; in some cases they were one course out of level in the length of a wall at a height of 6 feet from the ground. The bricklayers and labourers were capable of making the roof and thatching it.

Several varieties of mud from different localities have been used for the internal plastering and no difficulties have been encounterd over getting them to stick to the brick surface, even with those muds which have a tendency to crack on drying. The bricks used were wire-cut and therefore had a rough surface which probably helped to ensure adhesion.

The design of these huts makes it possible at a comparatively low cost to remove the old mud plaster from the inside of a hut at the completion of an experiment and to re-line it. In some cases the whole of the roof has also been replaced at Magugu in order to prevent carry-over from one experiment to another.