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R O O F S T R U C T U R E S F O R L O W - C O S T H O U S I N G
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R O O F S T R U C T U R E S F O R L O W - C O S T H O U S I N G
COST COMPARISON FOR VARIOUS ROOFING MATERIALS

Range of roof covering materials for low-cost structures

The cost of roof covering represents a rather large proportion of the total cost of a low-cost house¹⁾ and an even larger part of the cost of a simple shelter comprising main walls, roof support structure and roof covering only²⁾.

The above leads to large scale application of roof covering materials at the bottom of the cost scale. The main products in this category are³⁾:

- corrugated galvanised iron sheeting;
- corrugated asbestos-cement sheeting;
- concrete roofing tiles;
- burnt clay roofing tiles.

Until recently the cheapest available material was corrugated galvanised iron sheeting. This material, manufactured locally out of imported raw materials, was cheaper than products made entirely out of local materials (burnt clay and concrete tiles) and than material with low import content manufactured in a neighbouring country (asbestos-cement from Uganda).

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- 1) 10 - 15% of total cost of house
 - 2) 20 - 25% of total cost of shelter
 - 3) a. materials listed are limited to 'modern' durable materials, and traditional 'rural' materials (grass thatching, palm leaf thatching, etc.) have not been considered here as
 - (i) their application in dense urban development is not favourably considered by the authorities, and
 - (ii) cost of this type of roof covering varies greatly geographically.
 - b. aluminium roof sheeting has not been considered here as it is not manufactured in Kenya but imported from Tanzania. For cost comparison with other metal roof sheeting see HRDU publication: Cost of metal roof sheeting for low-cost structures, J.Eygelaar. Nov. 1974.
 - c. bitumen based products (roofing felt, asphalt shingles, etc.) require specialised labour input and are thus not directly applicable for self-help building. These products will be considered in a separate paper.

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In recent months the relative cost of the various low-cost materials has changed considerably due to international movement of raw material prices, increased cost of energy, and the introduction of locally manufactured asbestos-cement.

As a result of the above, corrugated galvanised iron sheeting⁴⁾ is at present not cheaper than the other available materials. On the other hand a direct price comparison of the cost per unit of area of the covering material only should not be the governing criterium for selection of the roof type, as the support structure for the various materials cannot be kept uniform. Weights and permissible spans are different, and even minimum roof slopes are not the same for all materials⁵⁾.

System adopted for cost comparison

In order to arrive at practical guidelines (based on cost only) for the selection of roof covering materials, it is necessary to compare the overall cost of roof covering and support structure for a range of covering materials. For this purpose a simple type of roof structure for a low-cost house (shelter) has been worked out in full detail, and costs are compared for a typical bay, width 2.00 m., covering two rooms of a depth of 3.00 m.

Vertical sections of 6 typical roofs are shown in the attached drawings R-1 to R-6. Covering materials chosen for comparison are the following:

- R-1 corrugated galvanised iron, standard profile (8 x 3")
- R-2 corrugated galvanised iron, trough profile (IT 4)
- R-3 corrugated asbestos-cement, standard profile (4mm. thick)
- R-4 low pitch concrete roofing tiles (Manson Hart Kenya Ltd.)
- R-5 light weight concrete roofing tiles (Mareba Enterprises Ltd.)
- R-6 burnt clay roofing tiles, Mangalore type (Clayworks Ltd.)

4) of a thickness which guarantees a minimum degree of durability and structural strength, i.e. not lighter than s.w.g.26 (thickness 0.5 mm)

5) see also HRDU publication: Roof slopes for low-cost structures, J. Eygelaar, January 1975.

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Dimensioning of the timber support members is based on the following structural design assumptions:

Dead load: self weight of covering materials and support members.

Live load: 100 N/m^2 perpendicular to roof surface to cover wind loads and occasional loads.

No allowance is made for the weight of erectors working on the roof as these loads would exceed "permanent" working loads thus resulting in unwarranted oversizing of support members. Although this necessitates special precautions during the erection process (and during eventual repair works at a later date) the considerable saving obtained justifies this procedure.

The roof pitch has been fixed at 1:3 ($18^{\circ}30'$) for the corrugated sheeting (R-1 to R-3) and for the low pitch roofing tiles (R-4), and at 1:2 ($26^{\circ}30'$) for the other tiled roofs (R-5 and R-6) to ensure waterproofness without the need for sarking. The cost of the additional masonry required for heightening the central load-bearing wall has been taken into account in the cost comparisons.

Roof overhangs are minimal to simplify the structure. In many cases larger overhangs are desirable and allow for cheaper external wall construction. Cost comparison for larger roof overhangs will be prepared later.

Cost comparison sheets

The cost comparison sheets (C-1 to C-6) have been drawn up for material costs only. This simplified method has been chosen because:

- a. the construction method suggested is suitable for execution as (aided) self-help construction;
- b. labour input for the 6 types of roofs is proportionate to the material cost; comparison for contractor-built structures will be similar to the calculated 'self-help' costs.