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COST EFFECTIVE CONSTRUCTION TECHNOLOGY AT COSTFORD

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This document gives an introduction to the Cost Effective Technology adopted or developed by COSTFORD(Center of Science and Technology for Rural Development), Trivandrum, India. The documentation is based on the literature survey and practical experience during my internship with the NGO.

Foundation and Basement.

In ordinary soil, a foundation of 45 cm (1 ½ feet) width and 45 cm (1 ½ feet) depth is normally enough even for a three-storied building. The basement is also of the same size.

If it is a site prone to water logging or clayey soil, necessary changes will be made.

The COSTFORD Engineer will make the final decision only after visiting the site and verifying the site and soil conditions.

Rubble is used for the foundation and basement.

Mud mortar is used for rubble masonry, in which case it is pointed with cement mortar. Cement mortar of ratio 1:8 is also used in some specific conditions.

Superstructure.

The cheapest and most easily recyclable building material locally available is mud. If mud is adequately protected with overhanging roofs, it is an ideal eco-friendly and thermally comfortable material.

Depending on the local availability, materials can vary from brick to laterite or granite to construct the wall.

Where brick is used, country burnt bricks of good quality are selected for our buildings, which are not plastered, on both the inside and the outside. The walls are pointed with cement mortar.

Rat trap bond

Rattrap bond is used for 23 cm (9”) walls. The outer walls of bigger buildings are of 23 cm thickness. The inner walls of such buildings and outer walls of very small buildings are made of 11 cm (4 ½”) walls. Cement mortar 1:8 is used for the brickwork

Strength of Rattrap bond.

The load bearing tests done at the Anna University has proven that a wall in rat-trap bond performs as good as the usual English bond.

Rattrap bond saves consumption of bricks by 18% and cement by 24% as compared to conventional English bond in addition to being lighter by 52% in weight.

Protection of exposed brick walls.

By providing sufficient overhang to the wall, any kind of dampness or growth of moss can be easily avoided.

Plastering is provided in areas like kitchens, bathrooms and toilets. If the client wants and can afford tiles, these may be laid on the walls and floor of bathrooms and toilets. Marble finish can be given on the walls to bring down costs. The cheapest form of tiles is using waste glass tiles embedded in wet cement mortar. This may be applied to the kitchen slab also. Those with a higher budget can even go in for marble on the kitchen slabs.

Stability of exposed brick wall.

The bricks are laid with maximum care to avoid continuous vertical joints for maximum stability. Bricks are soaked sufficiently before using by which any defective bricks can be detected and removed. Plastering alone cannot increase the stability of any structure. It is dependent on the quality of bricks, mortar and workmanship.

On using Country-burnt bricks.

As an organization working on low energy consuming construction methods, COSTFORD aims at propagating use of locally produced or available materials like country-burnt bricks, lime, mud etc. These materials have very satisfactorily proven their strength in the modern laboratory testing. Moreover, their worth has been proved by their continuous usage through the ages.

ROOFING

filler slabs

Light weight, inexpensive materials such as low grade Mangalore tiles, bricks, coconut shells, glass bottles etc. is used as filler materials in filler slabs to replace the redundant concrete in tension zone.

These materials are laid in the grids of steel reinforcement rods (6mm or 8mm dia.), and concreting is done over them. The concrete mix used is 1:2:4. The grid size depends upon the design, span, and the material used. For Mangalore tiles (size 23cm by 40cm), the grid size is 33cm by 50cm. The slab thickness is 10 centimeters.

This technique saves a lot of energy extensive concrete. Roofs and intermediate floors account for 20-25% of the total cost of the house. This roofing costs 30-35% less than conventionally used concrete roofing. Thus a considerable amount is saved in terms of materials, energy and cost.

This technique also reduces the unwanted dead load of roofing. Compared to other roofing systems, it is thermally comfortable and has no health hazards. Galvanized iron and asbestos cement sheet roofs dissipate too much heat and are difficult to live under

Asbestos cement sheets are long associated with disease like lung cancer, hence must be avoided.

R.C.C.Filler slabs are used for both sloping and flat roofing. Rejected Mangalore roof tiles (Vth quality) are used as fillers as they are cheaply available.

The over roof will be plastered and the under roof ceiling will be pointed around the tiles.

Sunshades are not provided at lintel level. The roof slab is projected out as sloping sunshade.

Brick lintels are used above openings in place of concrete lintels.

Strength of filler slabs.

Conventional tests by different institutions and laboratories has proved the load bearing capacity of filler slab and found it no less in performance from the conventional R.C.C. slab.

Since filler roof tiles are firmly bonded to and covered by concrete, it does not collapse under the impact of say, a coconut falling on the roof.

Leak proofing filler slabs.

With proper supervision and workmanship, leaks can be avoided. These steps taken, the chance of a leak in a filler slab is much the same as the conventional R.C.C.slab.

MAINTENANCE

By avoiding plastering on the walls, frequent expenditure on finishes and its maintenance is avoided. Properly protected brick wall will never loose its colour or finish.

Toilets and kitchen, which demand greater maintenance, can be given better finishes enabling easy cleaning.

COSTFORD follows the principle of avoiding unnecessary ornamentation and at the same time doing the necessary things beautifully to achieve maximum cost effectiveness. Therefore, the Organization is allowed to build only those houses that follow the above-mentioned techniques of cost-effective construction.

The Government has allowed tax reduction for the cost-effective construction followed by COSTFORD.

Today, the model of construction followed by COSTFORD has found its way in construction of houses in most parts of Kerala.

ARCHES

One of the most effective ways of spanning an opening is by constructing arches. Arches can be a cost effective alternative to the lintels. In addition they look lot more appealing than flat and dull lintels. Arches can be of different shapes and sizes depending upon span and availability of skilled masons. Most common arch shapes come in semi-circular, pointed, corbelled & bell shapes.

Skilled labor and framework are two essentials in construction of arches. Arches are provided not only in brick houses but also widely used in mud arches.

The easiest of the arches is the 'corbel arch'. It can be constructed without any framework and needs less skilled labor. Each row of bricks projects 4&1/2 inches beyond the course below it, until the bricks meet together in the middle. 'Corbel arch can span opening up to 5 meters.

Flat brick arches can span opening up to 1.2 meters.

FRAMELESS DOORS AND WINDOWS

Door and window frames are not actually required. They are responsible for almost half the cost of timber used. Avoiding frames considerably reduces the cost of timber.

Door planks are screwed together with strap iron hinges to form doors, and this can be carried by 'holdfast' carried into the wall. The simplest and cost effective door can be made of vertical planks held together with horizontal or diagonal battens.

A simplest frameless window consists of a vertical plank (9" wide) set into two holes, one at the top and one at the bottom. This forms a simple pivotal window. Wide span windows can be partially framed and fixed to walls or can have rows of pivotal planks.

RANDOM RUBBLE

Random rubble masonry is extensively used as foundation at places where stones are readily available. An 18" (45 cm) foundation base is adequate for most soils and single or double storey buildings. Depth and size may vary with the addition of number of floors. In case of weak soil, the trench can be widened (50-60cm) and the bottom can be laid with concrete (1:2:4) followed by a 30-35cm wall. For the foundation, trench 50 cm wide is dug and laid with rubble. It can be dry masonry or mud mortar is used. For higher masonry walls, cement mortar (1:10) can be used. (It is always wise to pile the excavated soil between the plinth walls to prevent cost of future filling).

Proper joints (dovetail) must be provided for stronger bonds as in case of any other masonry works. Stones on the upper side and stones must be large in size and the gaps between stones must be filled with smaller stones for proper bonding and stability. Care must be taken to ensure bonding of stones along the length of the wall. Bamboo in lime concrete can be used for foundations, especially in the sandy areas along the sea coast. It is resistant to sea water. It remains intact whereas other foundations will crack with shifting sands. For places where stones and bricks are not available, foundation for mud walls can be of moist soil with layers of split bamboo reinforcement inserted.

LINTELS

In general, lintels are not required over doors and window openings, up to four feet in width. This is because the actual load on the lintel is of the small triangle of masonry just above it. If required, two rows of bricks on edge are placed along the length of the opening, on either side. The space between the bricks is filled with R.C.C. of mix 1:2:4. 6mm or 8mm dia. bars can be used.
This kind of lintel saves cement and steel and costs almost half the conventionally used R.C.C. lintels.

BAMBOO CONSTRUCTIONS

For most parts of the India, bamboo is a locally available material and has been used as building material for centuries. It can be easily grown and is one of the cheapest construction materials. A good bamboo cut into strips has the tensile strength almost equal to that of steel.

It is used for reinforcement, shuttering, scaffolding, roofing, piles, filler material and much more.

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However it needs experience to know about the quality of the bamboo. And it is difficult to calculate the exact strength of slabs with bamboo reinforcements.

FLOORING

Flooring is generally of terracotta tiles or colour oxides. bed is made out of broken brick bats (this saves wastage of brick), over which 3"mortar layer is laid and tiles are placed over it. Various patterns and designs are worked out, depending upon shape, size of tiles, span of flooring, and clients personal taste.

These tiles require little maintenance and are cheap. Also the patterns of tiles are visually attractive. most commonly tile shapes includes square, rectangular, hexagonal, triangular or can be customized.

Electric cables can be run through these floors.

BUILT-IN FURNITURE:

Most of the furniture used by COSTFORD is built - in. These are either of brick or rubble masonry raised above floor level. Raised rubble masonry with finished surface can act as sitting or tables or even beds. Brick furniture's are generally finished with red/black oxide layer. To make it interesting tiles are fixed to these oxides to form an integrated design pattern. bay windows, out door sittings, loft beds, study tables etc are common examples.

Recesses and buttresses in walls are used are shelves, almirahs and cupboards. Common thoughts behind these built in furniture's are that, after constructing houses and buildings, client is left with very little money to buy costly furnitures. so these 'built- in' save money and also provides strength to the walls and altogether to house.

Half-brick walls

Four-and-a-half inch or half brick wall is adequate for small, single storey houses and is apt for partition walls. These walls are adequately strong up to span of 2 meters. However, an isolated, long, half brick wall may fall, knocked off or get crushed by roof load. The stability of the wall can be ensured by providing buttresses or recesses. Also the junctions of these walls increase the stability. Thus the stability of these walls greatly depends upon designing and planning.

Half brick walls apart from being efficient, is also economic as it uses almost half the number of bricks and even less amount of mortar, used for full brick wall. It also saves the labour charges, as it is less time consuming and easier to build.