DURABILITY OF BUSH MATERIALS

Bal Saini
Emeritus Professor of Architecture
University of Queensland

In hot humid areas, owing to high rainfall, the traditional materials are organic, such as timber. grasses, reeds, leaves, canes and bamboo. Of these only timber has proved durable and sturdy enough to be acceptable as a building material under modern conditions., The other, though impermanernt, still continue to be used in rural areas where the pressures of population have not depleted their supplies.

Bush materials

Throughout most islands of the Pacific, large or small, a rich tradition of indigenous building exists. Regional materials such as bush-pole frames; roof thatch from pandanus, sago leaves, and kunai; and wall mats from sago palm mid-rib, pit-pit, and bamboo are extensively used. To the islanders, the advantages of these items have always been obvious. Apart from abundant supplies in most regions, the structures themselves are light and can therefore withstand earthquakes and other shocks. They are cool and their walls are ideal for cross ventilation in coastal areas where this is of utmost importance. Fabrication and later repairs are easy and their reclamation value is fairly high.

Few of these materials, however, are able to survive the numerous agents of decay such as weather and insects. In some coastal areas the average life of thatch roofs and wall mats rarely exceed four to five years. The fire hazard is usually great, and as a consequence there have been incidents when whole villages have been reduced to ashes. The supply of these materials tends to deplete as one reaches the more urbanized centres with their greater concentrations of people.

Building components in traditional construction were generally put together by tying sennit. Thios is now being replaced by nails which aere manufactured locally in Papua New Guinea.

Impermanence and inadaptability of these materials to mass production, and the need for more durable structures, have limited their use to rural and outback areas in some territories. The absence of a local manufacturing industry forces constructors in urban areas to rely heavily on imported materials which can be very expensive indeed, and whose use, moreover, denies full employment of available local skills, which are generally geared to traditional materials.

It is, no doubt, desirable to encourage increased industrial production of such basic materials as cement and milled timber, but all such schemes require extensive capital outlay and large-sized plants much beyond the immediate means of most island administrations.

There is, therefore, a fairly strong case for improvement and better utilization of those local materials and techniques already in use.

Apart from long-range plans for afforestation, it is possible to increase the durability of most organic materials by the suitable use of chemical preservatives. In high-rainfall areas where these preservatives could leach out it may be possible to press low-cost grasses, reeds, leaves, and timber wastes into simple building boards. Efforts along these lines could initiate a chain of small-scale industries and workshops in areas where board production is justified by a survey of present and future building needs.

Preservation

Preservation of most organic materials depends upon the end-use and the conditions of service. Generally, the risk of damage can be minimized considerably by careful attention to details of design and by the proper selection of materials.

Structural frames of most traditional building systems allow the use of lighter walls of pit-pit, sago, or bamboo mats. It is possible to replace these without disturbing the structure. Durability of the frame itself can be improved by chemical treatment of bush poles or timber, but in some cases use of light metal tubing may be desirable.

It is also possible to increase the life of mats or reeds by similar treatment. Since small children usually find one of the first areas of decay at ground level where, apart from rain, it may also have to withstand mutilation, it may be desirable to construct the lower portion of the walls in masonry materials. This could be raised as much as 9 inches or more above ground floor level, and the rest of the wall could then be constructed in semi-durable materials. Building boards are far more durable than loose mats or reeds.

Roof thatches, perhaps, bear the maximum brunt of weathering. If chemically treated they can be made to last anything from 12 to 15 years. It would be unsafe to use such roofs for collection of drinking water, however, because of the poisonous nature of the chemicals.

Fungi and Insects

Deterioration owing to fungi can be checked by keeping the building dry and thus avoiding condensation under the floor and in the walls. Damp-proof courses, good ventilation, eaves overhand, and sound plumbing are of considerable help. In very moist areas some form of chemical preservation treatment is essential.

Most common forms of insects are powder-post borers and termites. The former insect (including lectus) is very common; it loves everything, which contains starch and provides room for the laying of eggs. Because of starch in their sap wood most tropical timbers, unless the surfaces are sealed with paint, polish, or preservative before infestation, are unable to resist their attack.

The soil-dwelling termites can be checked by appropriate precautions during construction, such as ant caps and soil barriers. Dry-wood termites are more difficult to control because they can fly. It is possible, however, to obtain some protection by use of fly-wire screening at all openings, and by the surface coating of exposed wood with a termiticide such as sodium arsenite or Dieldrin.

Fire Resistance

Perhaps the best protection against fire is to isolate all possible sources of heat. In a house this means segregation of such items as kerosene heaters or cookers from wall mats, and of chimneys from thatch roofs.

It is easier to light a splinter than a large piece of wood. Consequently, the heavier the construction the less likelihood there is of it catching fire. Lightweight materials such as pitpit or bamboo woven mats and thatches present a great fire risk. Once alight the flames spread very quickly.

Fire-retardant coatings are of considerable value. They are generally made from boric acid or ammonium phosphate. Some recently developed mixtures contain a water-repellent component, which could provide further advantages.

Liberal coats of fire retardants, whilst substantially reducing the hazard, are not very resistant to leaching by rain. The problem can be answered partly by compacting loose materials into buildings and to building boards, which can be protected further by a coating of stabilised mud, lime, plaster, or cement render.

The old “wattle and daub” system of construction offers an excellent possibility. The only requirement is a form of lathe made from split timber, bamboo, or some other reed. The plaster can take the form of mud or crushed coral stabilised with bitumen, lime or cement. The potentialities of mud plaster can be well realised by an examination of such world-renowned buildings as the Katsura palaces in Japan, the walls of which are plastered with mud prepared according to intricate formulae developed over many centuries. Attractive textures and colours have been obtained by mixing oil and straw with local clays. In the Pacific region, apart from delaying the initial ignition, such coatings could well provide better insulation in the high altitude regions on some islands.

Vermin

Vermin such as insects, lice, cockroaches, and rats can considerably reduce the useful life of a building. The most obvious remedy is to minimise, in design and construction, areas where they can hide and breed.

Chemical Preservatives.

These are generally oil or any of the fixed or unfixed water-borne salts. Preservatives such as pentachlorophenol in oil are used outside where they are exposed to weather, but their disadvantage lies in a persistent odour, and an oily surface, which is unpaintable.

Fixed water-borne salts such as Tenalith-C, Celcure-A, and Boliden Salts are all copper-chrome-arsenic complexes, which, if used in the right concentration, provide excellent protection against decay, borers, and termite attack. For internal constructional work where only borers and termites are a hazard, 0.35 lb. of preservative per cubic foot of material is sufficient. For external use such as weatherboards, exposed pit-pit or bamboo mats, thatches, and fences, where leaching is greater, but which are not in contact with the soil, as much as 0.75 - 1.00 lb. per cubic foot of treated material may be necessary.

Durability of Bush Materials

Unfixed salts are much cheaper and easily penetrate into loose, fibrous materials. On the other hand, they leach out just as easily, especially when used outside or in contact with the soil. Simple organic salts such as boron type (boric acid, borax, etc.) are used for control of borer attack. With a slight additional loading of arsenic, which is compatible, it can give protection against the white ants as well as the borers.

Preservation Processes

Preservation processes range from simple brush coatings and dipping treatments through sap replacement, open tank (hot or cold bath) or convection processrs, to pressure treatments. The selection depends largely upon the circumstances of use, amount of material to be treated, and the capital and time available. Pressure treatment is comparatively expensive and its use can be justified only in cases where the volume of material to be treated is sufficient to offset the capital cost of the equipment.

Among simpler treatments, dip, dip diffusion, and sap replacement are described as follows:

(a) Dip Treatments.

The leaves or bundles of grass for thatches, loose or loosely tied together can be dipped into the preservative solution. These should be turned about a little in order to ensure proper absorption on all sides. Thatch is usually tied with split reeds or bamboos and these can either be dipped along with the thatch or separately. In order to avoid wastage, all material should be cut and shaped before being put into the tank for dipping. Mats can be made up and rolled into a cylindrical form before immersion.

All materials to be treated should be dried until their moisture level falls to about 1-15 per cent. Materials with more than

20 per cent moisture content have little capacity to absorb preservatives and may, in fact, even dilute the solution with excess water. For a simple solution, the duration of dipping need not exceed 6 hours for grass and 24 hours for leaves.

If fire retardants have been used, then the duration should be extended up to 32 hours for grass and 48 hours for leaves. Mats will also require at least 48 hours. Prolonged soaking in fixed water-borne preservative is not recommended because of the probability of differential absorption of the components resulting in lack of balance in the treated material, with consequent lack of fixation.

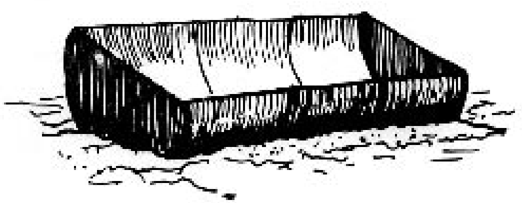
(b) Dip Diffusion.

This treatment appears to be ideal in cases where only a small amount of material (especially timber) is to be treated, and the capital available for treatment is limited.

Dip diffusion is a suitable method of treatment for small amounts of timber.

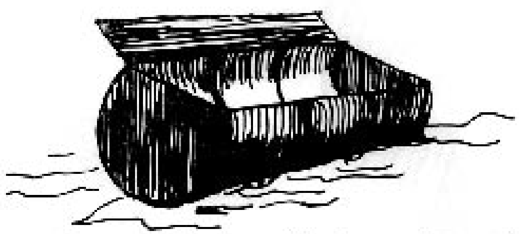
Green, freshly sawn building timber is momentarily dipped in or sprayed with a concentrated solution of the preservative, and is then built up into a solid stack which is covered and allowed to remain so far a period of about three weeks. After this diffusion period the preservative will be well distributed in the outer half-inch of the timber. This depth is sufficient to compensate for the ordinary machining and cutting that may take place during construction. If diffusion-treated timber is exposed to the weather without some form of protection such as painting, some of the preservative may leach out. Diffu-

1



HALF DRUM: Cheap and convenient when quantity of material to be treated is not too great.

2

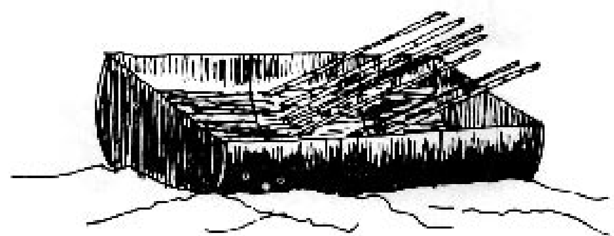


Cut surface turned back can be used as platform for draining of solution from material after treatment and before final removal for drying, thus avoiding any waste of solution.

3

Cut half drums joined together to make bigger containers using wooden blocks for stability

4



Bamboos or reeds to be used can be dipped along with thatch or seperately as convenient. If bamboo lengths are more than container dip as shown and reverse to complete treatment

Containers required for the treatment

sion-treated timber should not be used in direct contact with the ground.

(c) Sap Replacement.

Sap replacement and cold-soaking processes are very simple. A measured quantity of preservative solution is placed in a trough. Freshly cut barked poles are then stood in the solution, and absorbed evaporates as sap from the top end.

In outlying areas the only requirements are transportation of salts and a vessel or container to hold the material. In fact, in most cases, even this may not be necessary, as the treatment can be carried out in a trench in the ground which has been lined with "polythene" or some other waterproof material This method is effective so long as care is taken not to perforate the lining. Bush poles are used extensively in most rural areas, and this simple preservation procedure should ensure adequate protection against decay.

Although arsenic preservatives are poisonous they are quite safe if the normal precautions taken with all arsenic compounds are strictly observed. These are as follows: -

1. Keep the salts completely out of reach of children and animals.

2. Cover the treatment containers securely to prevent animals from drinking the solution.

3. Avoid inhaling dust from the salts when weighing out or mixing.

4. Wash hands before smoking or eating.

As all the solutions are sufficiently acid to damage clothing, splashes should be washed out immediately. Waterproof gloves may be used to prevent the solution from staining the hands. Drums of dry preservatives should be kept tightly closed.

So far, the chief objection to large-scale use of chemical preservatives is their high cost. Proportionately, the cost of Preservative treatment for roof thatch was found to be 24.3 per cent higher than the cost of untreated material. This figure does not take into consideration the methods and costs of installing equipment. In the case of mats which are extensively used for wall and ceiling lining, a protective coat or two of oily preservatives has proved quite effective. In high-rainfall areas there is need for more frequent applications. However, yearly application has proved successful in most areas where this has been tried.

Building Boards

The small-scale manufacture of building boards from organic materials offers significant possibilities of development in many areas. Apart from securing greater durability and increased exploitation of local products in the building industry, these building boards offer other advantages, some of which are: -

(a) There is a considerable saving in time and labour cost as they are large structural units.

(b) Excellent adaptability for prefabrication.

(c) Because of their lightweight and compact nature, transportation is easier.

(d) Modest capital outlay for manufacturing plant.

(e) Versatility for use in building construction.

A large range of raw materials can be used for their manufacture. Some of these are grasses, reeds, bamboo, barks of trees, coconut husks, and agricultural wastes and wood wastes from various wood-working or utilising industries, such as sawmill waste, veneer waste, and un-utilised timbers.

Some of the organic products, which have been subjected to experimentation, are mentioned below. As some of them are already being manufactured in various countries, their fabrication and use are well understood by the building industry. These products may not entirely be suited to the conditions and requirements of all areas, but they do help point the direction along which small-scale manufacture of building components could be organised wherever their production is justified by a survey of potential and likely needs.

Straw and Grass Boards.

These are, perhaps, the simplest of all boards. Basically, their fabrication involves compression of straw or grasses into compact lengths and holding the compressed materials together with stitches. The board is further reinforced with longitudinal wires on both the face and under face of the material. This produces a rigid sheet with the advantages of compactness and easy transport.

It is possible to manufacture such a board in regions with extensive growth of grass. Boards already manufactured to meet insulation requirements of the refrigeration industry in some countries indicate that their production may be governed by the following requirements: -

1. Lengths of material suitable for machines are from 2 ft 6 ins to 3 ft 6 ins.

2. The quantity of raw material required for a minimum production of 1 sq. yd would be 1 cwt.

3. Personnel required for operation of plant and maintenance of machinery would comprise one man with some mechanical knowledge capable of learning how to operate the machine, and five unskilled labourers. The knowledge needed could be imparted in a few days tuition.

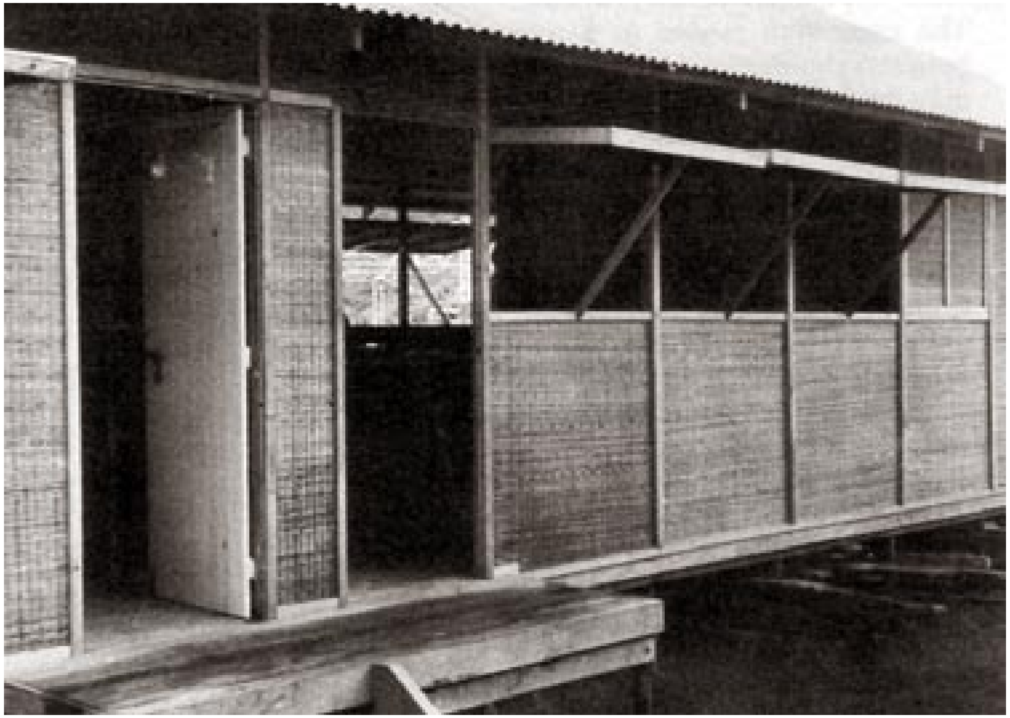
4. The plant can be transported from place to place to meet

the supply of raw materials. This would have to be done by heavy transport, as the machines weigh approximately 2 tons. Setting up of the machines requires only a concrete base with a head-high pit 8 ft long and 4 ft wide.

Boards of Wood Waste.

Building boards from wood shavings and other waste and by-products of the timber industry offer ideal possibilities for manufacture of products far more durable than grass boards. Chemically treated wood fibre is bound with Portland cement and precision moulded into slabs which are non-inflammable, white-ant proof, possess high thermal and sound insulation, and provide a good key for painting and plaster work. Because of their high cement content they are likely to be far more expensive than grass or straw boards. Another disadvantage is their heavy weight. A one-inch slab weighs 25 lb per sq. yd. A two-inch slab with half-inch plaster on both sides weighs approximately 17-1⁄2 lb. per sq. ft.

The material owes its beginning to the Second World War when a similar material, called “Wood-wool”, which came in slabs, was found to be better able to withstand the force of bomb blasts than masonry. In warm and humid regions, apart from its fire resistance and sound and thermal insulation properties, its major advantage lies in its resistance to dry rot, other fungi, termites, and vermin. Its immunity to termites has been established by results in Portuguese West Africa. Slabs with softwood inserts were laid in the vicinity



Left: The walls of this timber framed experimental structureare lined with Sago woven mats manufactured by a locally developed handloom.

of a termite colony for a period of six months. At the conclusion of the test, examination revealed that the slabs were unaffected, while the softwood inserts were almost completely consumed.

Reed Board

This is another multipurpose board, which uses reeds as a basic material. It has been used to great advantage for walls, roofs, partitions, and shuttering, and can be plastered with cement, lime, or mud. Reeds are cut to a predetermined size and then passed through a machine, which binds them with galvanised wire, thus transforming them into compact and extremely strong building boards. Its dimensions can be adjusted suitably and the boards' thicknesses range from one to two inches.

The technique is not new: in fact, European manufacturers who have profitably exported their products to developing countries in Asia and Africa have used it for many years.

Its main appeal lies in the abundant supplies of raw materials and cheap methods of fabrication.

Other characteristics of reed boards are their high insulation value, lightness, and easy transportability, all factors requiring a minimum of construction time. The product is water proofed with bitumen mastic, which can be further enhanced by plastering on the outside.

Plastering also helps to increase resistance to fire.

Bamboo mat boards made experimentally at the Building Research Station, Roorkee, India, were found to possess excellent tensile bending strength and good water resistance. A variety of fillers-sawdust, cork dust, sand, etc. – could be used. In addition to mats suitable for lining, corrugated multi-layer boards and stringer boards should find widespread use in walls, decking, sunshades, and flush doors.

Most Pacific islands produce several billion nuts a year, but the husks obtained from nuts are either burnt off or destroyed in some other way. Possibilities exist where some of these could be processed into building boards. In a recent experiment at Dehra Dun, India, coconut particleboards proved to be quite attractive in appearance, had good strength, and gave a satisfactory resistance to decay and fire.

It was also found that the proportion of synthetic resin binder (Phenol formaldehyde) required is only 0.5 per cent by weight of the chips as compared to 6-10 per cent in conventional manufacturing processes. This could be a great saving since adhesives constitute the chief cost in their manufacture. In the experiments conducted at the Forest Research Institute, Dehra Dun, dry husks were cut into two-inch pieces on a circular saw, beaten with a wooden mallet, and shredded by hand into thin fibre bundles. An aqueous dispersion of adhesive was applied uniformly by spraying into a revolving drum containing the chips. These were then spread as an even layer in a mould (4 ft x 3 ft 6 ins) and consolidated into a mat by cold pressing. The mat was loaded into a hot press and compressed at 150 C. After storage for a week at room temperature, the boards (approx. 3⁄4” thick) were then ready for use in building.

Conclusion

Increases of populations in most Pacific territories have created a substantial demand for housing. To alleviate this problem the contribution of lightweight, traditional bush materials should not be underestimated. Although cheap, they are admittedly not very durable when used in their traditional form. If given proper treatment, however, their performance can be improved considerably.

What is important is to understand their limitations and capabilities and then to treat and use them under conditions most conducive to their maximum performance. It should be possible to use them under varying circumstances wither wholly or in combination with other low-cost building materials, thus relating construction to the needs and capacity of the local economy.

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