TECHNOLOGY

Alternative building technology

The construction materials being used these days are major contributors to global warming. Dr. M. R. Yogananda suggests eco-friendly alternatives which are more sustainable and cost effective in building construction.

THE construction practices of today depend excessively on materials like burnt bricks, cement, steel, aluminum and glass. These are highly energy-intensive materials which consume a lot of thermal energy during production and thus one of the main contributors to global warming the world over. Moreover, they often need to be transported over long distances resulting in escalating the costs of building. The need to conserve our precious energy resources and reduce the impact on the fragile environment is the need of the hour. Hence, it is important to focus on decentralised production of materials consuming less energy which will also generate employment locally. Traditional systems which were simple, utilitarian and aesthetic need to be improved with the latest scientific understanding, revived and adapted to suit present-day building requirements. Hence there is an urgent requirement to find alternative building technologies which are also affordable.

A two storeyed SMB house in Bengaluru

Research and development

The search for alternatives was not restricted to any one country or one institution. ASTRA (presently CST), Indian Institute of Science, Bengaluru, was a front runner in this research. Several innovative technologies were developed in the last three decades. Stabilised Mud Block (SMB) Technology for wall construction was the most important technology which gained popularity among users. Several roofing alternatives to the modern concrete roofs were also developed during this period.

Stabilised Mud Blocks

Earth or mud has been in use as a building material for thousands of years. It has been used for wall construction in most parts of rural India. The mud walls generally being thick have the advantage of good thermal insulation. Various traditional techniques of construction using mud are still in practice. They are the adobe, cob wall, rammed earth and wattle and daub. However, use of plain mud in wall construction has some disadvantages. These walls hardly have any wet strength and are more prone to termite-related problems. The walls thus built using plain mud require regular maintenance. Stabilisation is a technique of altering the properties of mud in such a way that it will possess the adequate wet strength and durability required for wall construction. Compacting a mixture of sandy soil and stabiliser (normally cement/lime) at optimum moisture in a press

SMB making in progress using Mardini Press

results in stabilised mud blocks (SMB). Since the stabiliser used is in small quantities (6 to 8 per cent cement of the mix) the overall energy consumption in SMB is quite small (about one-third) in comparison with the burnt bricks. Compaction of soil-stabiliser mix can be done by using a manually operated or a mechanised press. The press should be capable of generating sufficient force to produce a dense block. It is advantageous to use a manually operated press like MARDINI to eliminate additional energy needs in terms of electricity or diesel. The size of SMBs made in this manually operated press is 230x190x100 mm. The blocks thus made have to be cured for three weeks by keeping the block surfaces moist. Red sandy soils are ideally suitable for cement stabilisation. Additives like sand, rock dust and various other mine or factory wastes can be used effectively along with natural soil. One such example can be seen in TVS Brakes India factory (foundry division) in Tamil Nadu. The foundry waste was utilised along with the locally available soil to produce SMBs and few buildings (school and dormitory) were constructed using the same in their campus. SMBs were used in their office buildings also.

SMBs can be used for load bearing construction up to four storeys without reinforced concrete columns by adjusting the stabiliser percentage depending on the number of storeys and roof spans for a particular building. Higher percentages of stabiliser will lead to higher block strengths. The walls constructed using SMBs need not be plastered. However, the joints in the masonry should be finished with pointing.

Special purpose blocks namely interlocking blocks, pigmented blocks, cornice blocks etc., can also be made with stabilised mud. There are probably more than 20,000 houses in India using SMB technology. Bengaluru in Karnataka, Kutch in Gujarat (after the 2001 earthquake) and Orissa have contributed to a major share in the dissemination of this technology. The SMB technology has been disseminated by the author in other countries also like Indonesia, Sri Lanka etc.

Rammed Earth Wall

It is sometimes convenient to build a wall of stabilised mud directly without the intermediate step of making a block. In other words, a large stabilised block of mud may be made in-situ; so, the construction of the wall and ramming of the mud block happen simultaneously. In rammed earth construction technique, a strong and sturdy mould is used to construct portions of wall wherein the compaction of soil-stabiliser mix is done by rammers. The ramming process is done manually to achieve cost effectiveness in construction. The size of the mould can be varied to suit the project requirement. A mould size of 230x300x600 mm has been used to build some of the houses in Bengaluru. The advantage of using rammed earth technique in wall construction is that the mould can be fabricated, using wood or steel or a combination of both, with the local expertise and with lesser capital cost.

Stabilised Adobe Blocks

This is another technique of block making using a similar process to that of making sun-dried bricks (adobe). In this process a four sided mould of a suitable size (normal brick size or slightly bigger) is used to shape the soil-stabiliser mix. The soil-stabiliser mix with appropriate moisture content should be mixed thoroughly and pugged (kneaded) before making the block. The process of pugging is a very important step in the production of good quality stabilised adobe and this is generally done by stamping (use of legs). The mix is then hand pressed into the mould to make a block. Care should be taken to remove any air gaps in the mix when the block is made. This method is very useful in the absence of a press to make SMBs.

Roofing alternatives

Reinforced concrete slab for roofing are becoming more and more expensive. The expensive concrete used in the tension zone of a RC slab is not very useful as it hardly takes any stress to improve the slab performance. Thus RC slabs are less efficient. Filler slab roofs with SMB's as filler material

A house built with SMB walls and filler slab roof using earthen pots

in the tension zone can be a very effective alternative for conventional RC slabs. One can explore other filler materials such as Mangalore tiles, earthen pots, etc., as may be appropriate. Jack arch roofs with SMB arch panels can be a good alternative too. The arch panels can be pre-cast and assembled with partially pre-cast RC joists thus eliminating the need for conventional centering. Masonry vaults and domes are good options for roofing leading to better thermal comfort. They can be built using SMBs and do not need the regular centering for construction. Such roofs require much less steel as compared to RC slabs. Several buildings have been constructed using SMBs with these special features leading to cost effectiveness.

The above alternatives give us a direction towards exploring and using sustainable technologies in building construction. The research has to continue to make them more sustainable and affordable. Training architects, engineers, masons and semi-skilled personnel in these alternative methods of construction is a very important step towards implementing these ideas in the field. Gramavidya (an NGO) and Mrinmayee (testing lab and consultancy firm) in Bengaluru have been playing this role to some extent.

References

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