APPROPRIATE BUILDING MATERIAL TECHNOLOGIES

V.T.L. BOGAHAWATTE
National Building Research Organisation
99/1, Jawatte Road
Colombo 5.

Housing is a high-priority area for all countries in the world. Population growth, urbanisation and the growth of insanitary dwellings all emphasise the urgency of the problem.

The building materials industry plays a key role in solving economic and social objectives of housing since nearly 50 per cent of the investment in the construction sector is on building materials and components. In order that the housing problems are solved in a practical way, it is necessary to adopt local materials and construction technologies that will minimise the use of scarce national resources such as capital and energy. The local construction industry must recognise that the problems cannot be solved by a quick recipe but instead requires inter-disciplinary interaction among engineers, researchers, architects, planners and builders. A multifaceted approach involving (1) indigenous building materials, technical knowledge and skills (2) promotion of labour intensive technologies and (3) the development of national policies and finance mechanisms is required. Finally, the spectrum of human settlement problems must be addressed ranging from research and development on building materials, development of a viable building industry base, entrepreneurship and social and functional aspects of low-cost housing.

Choice of Building Materials

Cement with its inherent advantages such as better binding properties, early strength development and availability in ready to use condition became the obvious choice during the last few decades. This has led to the decline of the use of traditional meterials such as earth, limestone and rubble. The establishment of the steel industry based on imported raw materials too had been contributory to this development.

However, in recent times production of such materials has not kept pace with the increased demand of the construction industry. This has led to the importation of raw materials, products and components resulting in a considerable drain of valuable foreign exahange. Also, the indiscriminate use of new and imported materials with scant attention to their quality, performance and application probably made their optimisation less important. In Sri Lanka, Portland cement is predominantly used in low-strength applications, for foundations, plasters and mortars. This wrong application of Portland cement escalates the cost of construction. The degree to which Portland cement is wrongly applied in construction has reached alarming proportions, and it is estimated that only 20 per cent of the worldwide use of cement requires the strength of Portland cement (Journal of the Network, 1989). Furthermore, some of the imported building materials such as asbestos and corrugated iron roofing sheets are unaffordable to the vast majority of the rural population.

The use of timber adds another dimension to the problem. Our forest resources are dwindling at an alarming rate. But first class timber species are still the prime commodities in construction. The selection and use of secondary and less durable timber species for building are issues of utmost importance. The question that now arises is how appropriate is the choice of building materials.

The Search for a Solution

In order to overcome the problems created by the overdependence on cement and other imported building materials, the production and application strategy of our building materials need to be redesigned. A number of alternatives exist, some of which have been adopted in

other developing countries where socio-economic conditions are not too dissimilar to Sri Lanka. In summary, these may be grouped as follows:

(1) Rationalisation on the production and use of cement,

(2) Production of blended cements with OPC and other cementitious materials produced from clays and agricultural and industrial waste.

(3) Adoption of other appropriate building materials and construction technologies such as

- use of bricks and blocks

- fibre reinforced concrete

(4) Development of lime-based binders and products

Traditional Materials

The National Building Research Organisation (NBRO) conducted an islandwide survey on rural housing in 1984. This survey revealed that earth (61.8%), burnt clay bricks (16.2%), rubble (8.1%), cement products (4.8%), cabook (4.1%), timber and other materials (4.6%) are the materials used in superstruture walls of rural houses. Earth construction was mainly in the form of wattle and daub (50.4%) with rammed earth (8.4%) and adobe (4.6%) confined to certain areas of the country.

As regards roofing material, cadjan is the most popular with 42.6% of the housing units using it as the prime material. Straw and palmyrah thatching have been used in 4.1% and 1.6% houses respectively. Clay tiles constitute 33.8% of the houses while 10.8% houses are roofed with corrugated sheets (Rural Housing Survey, 1984).

The majority of urban houses have brick walls (82%) tiled roof cover (47.7%) and cement floors (78%) (Housing in Sri Lanka, 1976).

Appropriate Materials-Improvements through R and D

Considerable research and development work has been done in a number of institutions in Sri Lanka (NBRO, NERDC, IDB, NHDA and some national universities) and abroad to improve the quality of building materials traditionally used in housing construction. Some of the materials developed which are of immediate relevance to Sri Lanka in view of their local availability as well as the relative simplicity and convenience of their processing and application are outlined below.

(1) **Lime-Based Cementing Materials**

Portland cement could be partially replaced by lime-pozzolana mixtures. Technology for producing these materials is relatively simple, and can be used on a very small scale. The pozzolanas for lime-based cements may be either natural or artificial. The first group includes among others siliceous and opaline shales. It is probable that such materials exist in Sri Lanka. Among artificial pozzolanas the most common is calcined clay. Finally, the ash from burnt rice husks, dried banana leaves and sugar cane stalks have also shown good pozzolanic activity.

The technology used to produce artificial pozzolanas in its simplest form involves activating clay by firing to the appropriate temperature followed by mixing and grinding with lime. The method of manufacture augurs well with the rural development programmes of Sri Lanka.

(2) **Soil Stabilisation**

Hand operated blockmaking machines which can be fabricated at a cost of about Rs. 7500/= have been developed for the production of cement or lime-stabilised soil blocks (NBRO, NHDA). Cured blocks give a compressive strength of about 2.8 Nmm ^ 2, which is adequate for the construction of most single storey houses. However, greater attention is required in the evaluation of soils for blockmaking.

(3) **Blended Cement**

Blended cement is a mixture of Portland cement clinker together with active or inactive material ground finely to produe the required cement. This type of cement is being produced in many countries all over the world. Different materials being added are sand, rice husk ash, slag and a variety of industrial wastes. Research is underway at the NBRO.

(4) **Secondary Species of Timber**

esearch on extending the life of non-durable timber species through proper seasoning and chemical treatement have been undertaken at the NBRO. A solar seasoning kiln has been developed in which timber has been successfully seasoned eliminating the use of fuel for steam seasoning.

(5) **Coir Fibre Roofing Sheets**

The technology of production of coir fibre cement bonded roofing sheets has been perfected in many local institutions (NBRO, IDB, Moratuwa University). The cost effectiveness f the material depends on the conditions of manufacture. The sheets can be used for semi-permanent roofs in the same way as asbestos-cement sheets. The production of sheets on a self-help basis on the site probably makes it a viable product.

References

1. Housing in Sri Lanka, Marga Research Studies-6, Marga Publication, 1976.

2. Journal of the Network, Vol. 1, No. 1, April 1989. UNCHS/CSC Publication.

3. Rural Housing Survey, NBRO Publication, 1984.