EARTHEN BUILDINGS IN SEISMIC AREAS

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THE LOW INVESTMENT/HIGH MAINTENANCE (LI/HM) SYSTEM

1 The problems of earthen buildings are as much social and economical as they are technical.

2 The use of earth as a building material was invented by peasants and perfected for the needs of peasant societies.

3 It forms an integral part of rural economies and is designed to fit the life style of peasant communities.

4 Its main characteristics are minimal initial investments of cash and maximal subsequent investment of labour and time in maintenance.

5 In traditional peasant societies, every farmer is also a house builder. He learns the necessary skills in childhood while helping friends and relatives to build their houses. His tasks as an adult farmer leaves him time to apply these skills to the maintenance of his own house. Agricultural work is heavy, but not evenly distributed throughout the year. Many peasant societies have definite periods each year when everybody is busy house-building or house-repairing.

6 Rural communities are usually small. Homesteads, hamlets and villages are scattered and sufficiently separated from each other to permit the gathering of suitable material for earth building and home repairs without causing ecological damage and often even without the need to fill in borrow pits.

7 In traditional peasant societies and peasant economies, earth building in its various forms is still the best solution of the shelter problem. It forms part of a functioning social, economic and technical system that could not be improved by changing one of its elements alone.

8 As it is, it is also part of a social language through which rural communities express their aspirations and identities. As Paul Oliver's studies of vernacular architecture in Asian, African and Latin American settlements have shown, this language can be of great sculptoral beauty.

THE HIGH INVESTMENT/LOW MAINTENANCE (HI/LM) SYSTEM

9 None of the advantages of earthen buildings exist in towns and cities. Bulk materials for construction are not free as earth is in the neighbourhood of villages. You cannot make a borrow pit in your own - usually small and always valuable - building plot and leave it to nature to fill it in gradually over the years. Earth has to be brought in from far outside the city. Loading, unloading and transport have to be paid for. Far from being free, earth can become an expensive commodity.

10 City jobs go on throughout the year. The urban worker, the trader or service employee cannot count on slack periods which he could use to be an amateur house builder or repairer. Building in the city is a job for specialists who want to be paid for their services. Despite various forms of self-help, urban house building forms part of the urban monetary economy. Most investors prefer to minimise maintenance costs through the use of more expensive but durable wall materials.

11 The tendency for urban house builders and buyers to prefer the High Investment/ Low Maintenance System is reinforced by the attitude of housing finance institutions. Mortgage banks, building societies or savings and loan associations do not accept an earthen wall house a collateral for a loan. Public health inspectors dislike it and the building regulations and by-laws of many cities prohibit it.

12 To sum up, the earth building system that fits rural living so perfectly, does not suit urban conditions and is therefore rare, even in small towns. There are however a few exceptions. They are worth mentioning because they illustrate rather than refute the foregoing observations:

The first is the city of CUTTACK, the former capital of the State of Orissa, in India. "Cuttack" means army camp. The city grew out of a temporary military settlement and, presumably, was not intended for permanent occupations. All walls were made of earth that was dug out of large pits, one by the side of each house. These pits filled with stagnant water and became breeding places for the vectors of malaria and elephantiasis, a cheap solution, but so unhealthy that, in the end, the Government of Orissa decided that Cuttack was unfit to remain the State capital and built a new city at nearby Bhubaneshwar.

The second example is a happier story. It is that of KANO in Northern Nigeria. Kano too is entirely built in earth and a classical example of the beauty that can be achieved with this material. The city appears to have been built almost in one go. A powerful central authority saw to it that all borrow pits were dug on the perimeter of the tightly built-up area and combined to form a deep moat outside the fortifications. In the vicinity of the city gates, this moat was widened to form large stepped cisterns which collect the scarce rainwater of the city's surroundings. The Kano houses are built of earth. They are rendered with a mixture of clay, horse manure, the powdered pods of the locust bean tree and the residue from indigo dyeing which produces an attractive purple-grey colour* They have been well maintained for more than a hundred years, presumably in the context of the Emir of Kano's strict feudal rule.

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*For details see Daldy, A.F., Temporary Buildings in Northern Nigeria, Public Works Department Nigeria, Technical Paper No.10, Lagos 1945.

THE PENUMBRIAL ZONE

13 Every fast growing Third World city is surrounded by a penumbrial zone that is neither town nor village. It consists partly of villages that have been engulfed by the fast growing cities (e.g. the Kampongs of Jakarta) and partly by the huts and shanties of newcomers who have found no room within the city. Their household economies and styles of living are often mixed. One member of the family may cycle daily into the city where he holds an urban job, while others continue with their accustomed rural occupations such as dairy or chicken farming and market

gardening. Until the density of such settlements has reached urban levels, earth building is often feasible and forms an important stage of the "instalment building" system, which is the most frequent method for a newcomer to build up his family home**

14 As the inhabitants become more and more urbanised they have less and less time for the maintenance of their earthen houses. It should be possible therefore to interest them in methods of making earthen walls more durable through stabilization or semi-waterproof rendering. The penumbrial zone around a big city could therefore become a suitable ground for the transfer and development of new technologies.

**The term "instalment building" was coined by the late Charles Abrams for the ubiquitous method of poor men's house building which starts with one or two rooms and adds to them as the owners fortunes improve. The first instalment has frequently earthen walls which are later replaced by more durable materials.

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15 It follows from the foregoing that the earthquake resistance of earthen buildings is a rural or suburban problem. Examples of urban multi-storeyed buildings of dry stone in earth mortar exist in the cities of the Magreb, of Yemen and a few other arid regions, but they are structurally so different that they cannot be called "earthen buildings" and require a separate study.

16 It seems unlikely that many grown-up persons are killed during earthquakes by the debris of collapsing earth walls, particularly if such walls are no more than seven or eight feet high, as is customary in village housing. But it is certain that many are injured or killed by the collapse of the roofs and ceilings that are supported by such walls.

17 It is the construction of roofs and ceilings that needs urgent attention in seismic areas, not the material of the walls. Two lines of approach seem promising: - The one is the construction of independently supported roofs that will stay in position when the walls collapse. The British Karakoram Expedition has studied examples of such solutions in the Pattan Valley of North-Western Pakistan. These could well form the starting point for a programme of research into constructions of this kind for different climates and different locally available materials. The other is the production of rigid light weight roofs that stay in position even if the supporting walls are partly distroyed or cause little harm if they slide to the ground. This second approach might have to go beyond the investigation of conventional methods and include new light weight compounds and ways and means of making them universally and cheaply available.

18 Rural communities have no difficulty in re-building or repairing earth walls that have been damaged by earthquakes. Attempts to strengthen such walls through stabilization would tend to slow down or delay the rebuilding. Moreover, such attempts might well increase rather than decrease the danger to life and limb of the inhabitants. Ordinary earth walls tend to crumble on impact. Stabilized walls may break up in larger pieces that could do greater damage.

19 What seems needed at this stage is therefore a major effort to find and develop a cheap lightweight roof for seismic areas that is accessible, or can be made accessible even to the poorest of the poor or else design additional roof supports that can be built into existing houses.

London, May 1981 Otto H. Koenigsberger