Paper: [illegible]

ASPECTS OF LOW-COST URBAN CONSTRUCTION IN PAKISTAN

By

Z.MIAN, K. MAHMOOD

AND

S.T. WASTI

Civil Engineering Department
University of Engineering and Technology,
LAHORE

Paper:123

ASPECTS OF LOW-COST URBAN CONSTRUCTION IN PAKISTAN

By
Z. Mian, K. Mahmood and S.T. Wasti

ABSTRACT

Prevalent methods of low cost construction in urban areas of Pakistan are discussed and available data on large scale housing in some major cities are given. It is suggested that available techniques of low cost construction as practised in developed countries be applied to construction in Pakistan. These include an industrialized approach to building, greater use of pre-cast elements, rationalization of building procedures, introduction of modular construction and exploration of the possible utilization of pneumatic structures.

*Civil Engineering Department,
University of Engineering and Technology
Lahore

1.0 INTRODUCTION

In Pakistan, as in other developing countries, there is a big need for the improvement of housing and work space in urban as well as rural areas. Suitable techniques should, therefore, be developed for the design and construction of "low cost" dwellings , educational buildings and industrial plants for various regions of the country. In urban areas of Pakistan, building construction is often carried out by entrepreneurs without recourse to the expertise of planners, architects and structural engineers. The enforcement of codes, building regulations and specifications in the private sector is often feeble.

Developing countries can use the know-how of developed countries for the proper design and construction of structures. However, the successful application of this know-how to a developing country will depend on the creation of technical infrastructure in accordance with the needs and requirements of the country (1).

The housing problem in Pakistan is acute in both urban and rural areas. The national per capita income is about Rs.1500 ($ 150) per annum and the high cost of house construction makes it impossible for most people ever to own a house. The magnitude of the urban housing shortage may be gauged from the information (2) that even in Karachi,the wealthiest place in the country, the average number of persons per habitable room is 3.9 and the figure for the lowest income people with a monthly salary of less than Rs. 300 ($ 30) per month is 4.7.

The investment of capital and labour in the construction field and the large scale migration of the rural population to big cities in search of higher pay and less manual work have resulted in the rise of the price of land for housing to an urban average of Rs.400 ($ 40) per square metre. Costs of construction have also risen to Rs.1000 ($ 100) per square metre. A stage in the industrialization of developing countries emerges when neither materials nor labour rates are cheap. Pakistan may be said to have reached that stage because of world-wide inflation, export of skilled

labour to the Middle East and other factors. In spite of the above factors, investment in domestic and industrial construction is considered a worthwhile venture.

The design and construction needs of rural structures in Pakistan have been described elsewhere (3). The present paper deals with aspects of low cost construction in the urban areas of the country and discusses some of the existing low cost housing schemes of big cities in Pakistan.

2.0 PREVALENT URBAN CONSTRUCTION PRACTICE

The definition of a low cost structure depends on a number of factors and therefore varies from region to region. These factors include availability and cost of building materials, construction practices, the degree of skilled labour required and the price of land. Low cost construction can be achieved by using capital intensive or labour intensive procedures. Standardization of building plans and structural components is regarded as one of the most important aspects of low cost construction.

In Pakistan, various schemes of low cost housing have been accomplished, mainly in the big cities of Karachi, Lahore, Islamabad and Faisalabad. These housing schemes have generally been prepared and executed by the Development Authorities of the respective cities and were built for low income groups. The main features of these schemes are repetition of building plans, optimum utilization of space and large scale construction of houses under the supervision of the city development authorities. Labour intensive procedures were employed for these schemes generally using brick masonry walls and cost-in-situ concrete slabs. The variety of building plans ranges from one-room single storey houses to multistorey buildings consisting of 2-room flats. Table-1 shows the comparison of costs of some of these low cost housing schemes.

The increase in cost over the period from 1973 to 1976-77 is obviously due to the sharp increase in the cost of building materials and labour rates over this period. It may be difficult to control the rising trend of the prices

of materials, but the total cost of construction could be markedly brought down by proper standardization of functional units of the house and careful as well as economical selection of the materials, sizes of the units and methods of construction for those parts of the building that contribute towards a major proportion of the total cost.

The cost statement in Table-1 indicates that construction with prefabricated units involves less cost than in-situ construction. National measures should therefore be initiated to promote investment in prefabrication works in order to increase the volume of low cost construction. Large scale application of prefabrication methods may not only prove to be the key to reduction in costs but to increased employment of labour without impairing the quality of the end product.

3.0 TRENDS IN LOW COST CONSTRUCTION

Various types of low cost construction have been used in developing as well as developed countries of the world to provide adequate and safe shelter to the population. Continuous research and surveys are carried out in developed countries to assess the needs and problems of housing. Such studies provide essential data for the formulation of the national housing policy of a particular country.

3.1 Precast Construction

Block making machines and floor beam manufacturing moulds form the basis of industrialized construction in many countries. Three basic types of industrialized construction, namely, the post and beam system, the panel system and the box system, are presently in use in different countries. However, the suitability of a particular system for a region will depend on a number of factors. Availability of raw materials and labour, machinery and transportation facilities are some of the deciding factors in the choice of a system. Long transportation distances are not considered economical and feasible for large panel and box system.

Modular coordination, standardization, simplicity, mass production and reduction in weight are considered some

of the important parameters for keeping the cost of construction low.

Even in the simplest form of industrialized construction, where only block masonry and precast roof elements are used for construction, various concepts have been developed in many countries. Fig.1 shows a typical roof slab which is called 'concrete composite slab' and is used in Austria for low cost construction (4). About 4 cm thick slab units are cast in factories complete with light steel girder reinforcement and then completed on site, after installing them in place, by concreting the upper layer. This type of construction eliminates the need of formwork.

Fig.2 shows ventilated roof construction which may be suitable for countries having hot climates (4). A false ceiling is provided on the underside of inverted-U precast elements, thus creating a duct for transverse ventilation.

Besides dwellings, economical plans have also been suggested for schools, industrial buildings, and sports complexes to suit the local conditions of various regions (5).

3.2 Pneumatic Structures

The potential of pressurised construction i.e. pneumatic structures, for providing inexpensive shelter and space enclosures has only recently been recognized. Although there are several different types of pneumatic structure, the most conveniently employed type is the air supported membrane which is efficient, portable and lightweight. It is estimated that,at present, air supported structures cost about $ 25 (Rs. 250) per square metre of covered area, but the cost decreases with increasing the floor area. Thus Dent (6) quotes the following as prices in 1971 for the superstructure - 5000 (Rs.90,000) for an area of 1000 square metres including membrane, anchorages, openings and inflation equipment but excluding foundations. Erection costs are estimated

as ৳ 300 (Rs.5400), dismantling cost at ৳ 75 (Rs.1350) and the cost of inflation fans at ৳ 5 (Rs.90) per square metre of covered area per week at 1971 prices.

Pneumatic structures are now available with increasingly sophisticated design features such as air curtains at the entrances, automatic air pressure jacks, dual walls for insulation, etc. They are finding special use in the erection of temporary structures for seasonal storage of commodities, for exhibitions which have to be moved from place to place and for providing protection against cold weather. Inflatable bridges have also been developed for military purposes (Fig. 3).

From the viewpoint of the application of the available expertise to pneumatic structures in a developing country like Pakistan the following aspects need to be considered:-

a) Pneumatic Structures especially inflatable houses, tents and bridges could be used for disaster relief after floods, earthquakes and other disasters in urban and rural areas.

b) Urban structures such as schools, mobile dispensaries, halls for cultural, educational and community purposes, swimming pools and sports facilities and temporary structures of all kinds can utilize principles of pneumatic construction, especially in slum areas of cities.

c) To safeguard against collapse due to failure of electricity for inflating fans, hybrid pneumatic structures incorporating tubular metal members or inflated ribs as auxiliary elements should be used.

4.0 CONCLUSIONS

There is certainly no lack of knowledge on all aspects of low cost urban construction. It would be

normal to expect that available knowledge would be employed by the urban builder to produce better and cheaper structures. However, there is great difficulty in transferring such knowledge to building sites because the organization, which would collect such information and pass it on to the builder, preferably in local languages and in a manner they can readily adopt, is lacking. The only alternative to having such a building infrastructure is for a National Housing Authority to actually take up the manufacture of low cost houses on a large industrial scale so that the urban house holder is enabled to purchase a small, more or less prefabricated dwelling on a no-profit no-loss basis and the necessary contemporary building knowledge is thus grafted on to the population.

Whatever the difficulties to enforcing available knowledge in the fields of urban and rural structures in Pakistan, certain measures which do not increase building costs may be applied immediately. In fact, rationalization of building features and application of architectural concepts may result in lower rather than higher construction costs.

The type of low cost construction in Pakistan is also variable depending on the materials used and the prevalent construction practices in each region. In some cases 8 in. thick concrete masonry load bearing walls are envisaged for low cost structures. These walls though made of material of suitable strength may tend to be unstable.

On the basis of the 1974 composite schedule of rates of the Government of the Punjab, an analysis has shown that the cost of the roof is 35% to 50% of the total cost of the structure (7). A considerable reduction in the cost of a house can thus be achieved by a reduction in cost of the roof.

A very large percentage of urban construction in Pakistan is carried out by using in-situ concrete. In most cases, it is found that the concrete used is of poor quality due to lack of quality control and inadequate

nowledge of batching and mixing. It may be economical
o introduce ready-mixed concrete even for small-scale
rban construction. Similarly, reusable formwork for in-
itu concrete will result in better concrete surfaces
t lower cost.

Lack of uniformity in standardization and
odular coordination inhibits the pace of low cost con-
truction. It is essential that the quality and dimen-
ions of commonly used building materials and compo-
ents be standardized at the national level. This could
e highly useful as it would allow for interchangeability
f components and their use by construction agencies
ithout the difficulties generally associated with using
on the same structure) various materials that have been
tandardized on different bases. Cooperation among
rivate and public investors to obtain and use standar-
ised designs should be encouraged.

5.0 REFERENCES

1. Wasti, S.T. and Mahmood, K.," How Developing Countries can best use the Construction know-how of Developed Countries and Apply it to Local Conditions ", IABSE Symposium, Munich, 1977.

2. " The Karachi Development Plan 1974-1985 ", The Master Plan Department, K.D.A., Karachi 1974.

3. Mahmood, K., Mian, Z. and Wasti, S.T., " Design and Construction Needs for Rural Structures ", International Seminar on Low Cost Farm Structures, Peshawar,1978.

4. Stoecher, H., " Austrian Experience in upto date Low Cost Construction " UNIDO Joint Consultation in Prefabrication for Industrial Construction, Warsaw, 1975.

5. Koncz, T., " Manual of Precast Concrete Construction " (3 vols.), Bauverlag GMBH, Wiesbaden and Berlin,1971.

6. Dent, R.N., " Principles of Pneumatic Architecture ", The Architectural Press London, 1971.

7. Javed, M.Y. and Mian, Z., " A Comparison of Costs for various Sized Rooms of a School Building ". National Seminar on Low Cost Buildings for Primary Schools, Karachi, 1975.

TABLE 1

PLACE	AGENCY	YEAR OF COMPLETION	TYPE OF UNITS	NO. OF UNITS	ACCOMMODATION	AREA PER UNIT.	TYPE OF CONSTRUCTION	COST PER UNIT AREA/UNIT.
Karachi S.I.T.E	Karachi Development Authority (K.D.A.)	1973	Multi-storeyed flats.	586	1-2 room Kitchen bath W.C	Not available	Precast R.C.C. slab over 8" concrete masonry walls	Rs. 141/- sq m
Landhi	K.D.A.	1973		512				
Korangi	K.D.A	1973		400				
Karachi S.I.T.E.	K.D.A.	in progress	"	320	-do-	-do-	-do-	Rs. 135.5/sq.
Landhi				270				Rs. 132.5/sq.
Korangi				176				Rs. 285.4/sq.
								Rs. 297.2/sq.
								Rs. 289.5/sq.
Faisalabad	Department of Housing & Physical Planning(D.H.P.P.)	1975	Four storeyed flats	512	2 rooms kitchen bath W.C. Terrace	51.1 sq. meter	Precast R.C.C roof over brick masonry walls.	Rs. 370/sq. met
Lahore	D.H.P.P.	1975	"	380	-do-	51 sq.meter	Cost in situ R.C.C. roof over brick masonry walls.	Rs. 470/sq. met
Karachi	K.D.A	In progress	Nucleus houses	400	Not available	Not available	Precast R.C.C. slab over 8" concrete masonry walls	Rs. 7955/unit.
S.I.T.E				350				
Landhi				250				
Korangi								
Faisalabad	DHPP/ Faisalabad Development Authority	1976-77	Single storeyed houses	750	One room bath W.C. cooking space back-yard	Plot area 75 sq. meter covered area 23.6 sq. meter	R.C.C. roof over brick masonry walls	Rs. 12,000/- un
								(Provision of an 23.2 sq. mt. co area at owner's discretion).

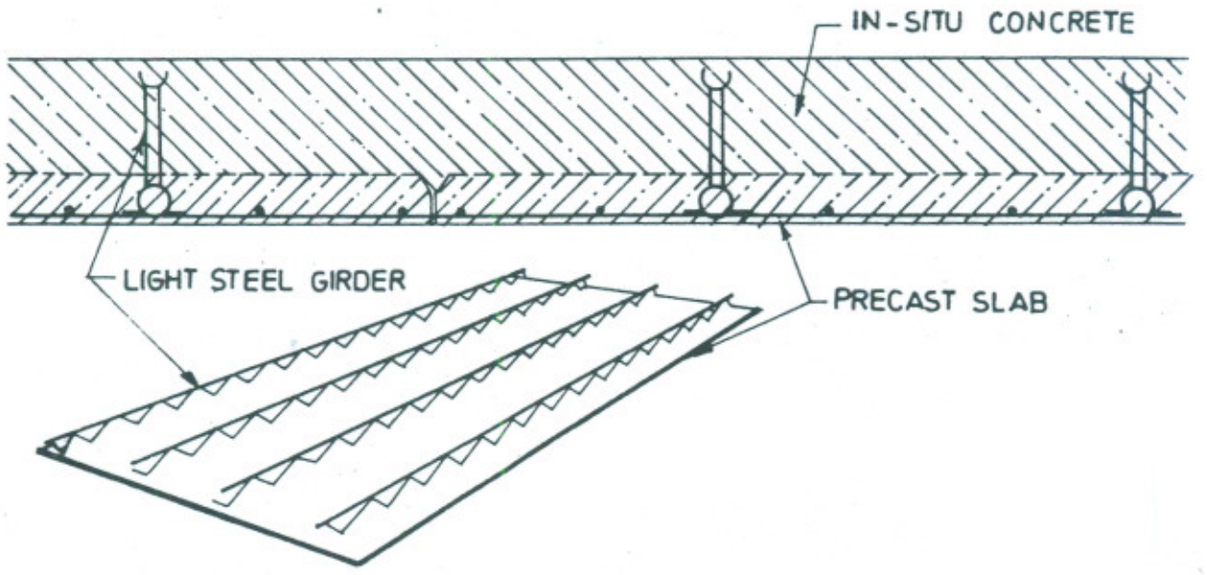


FIG.1: PRECAST COMPOSITE SLAB CONSTRUCTION (Ref 4)

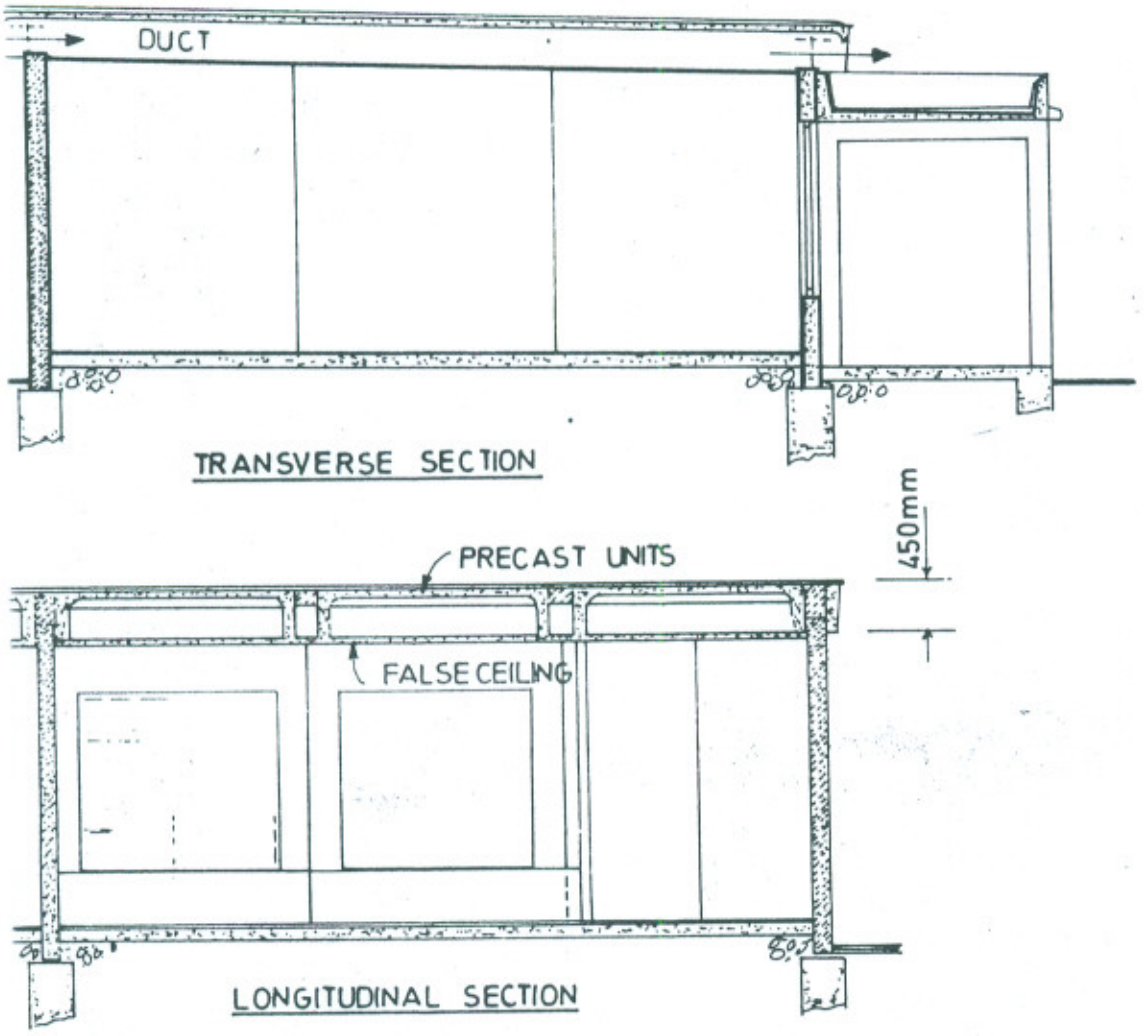


FIG: 2. VENTILATED ROOF CONSTRUCTION (Ref. 4)

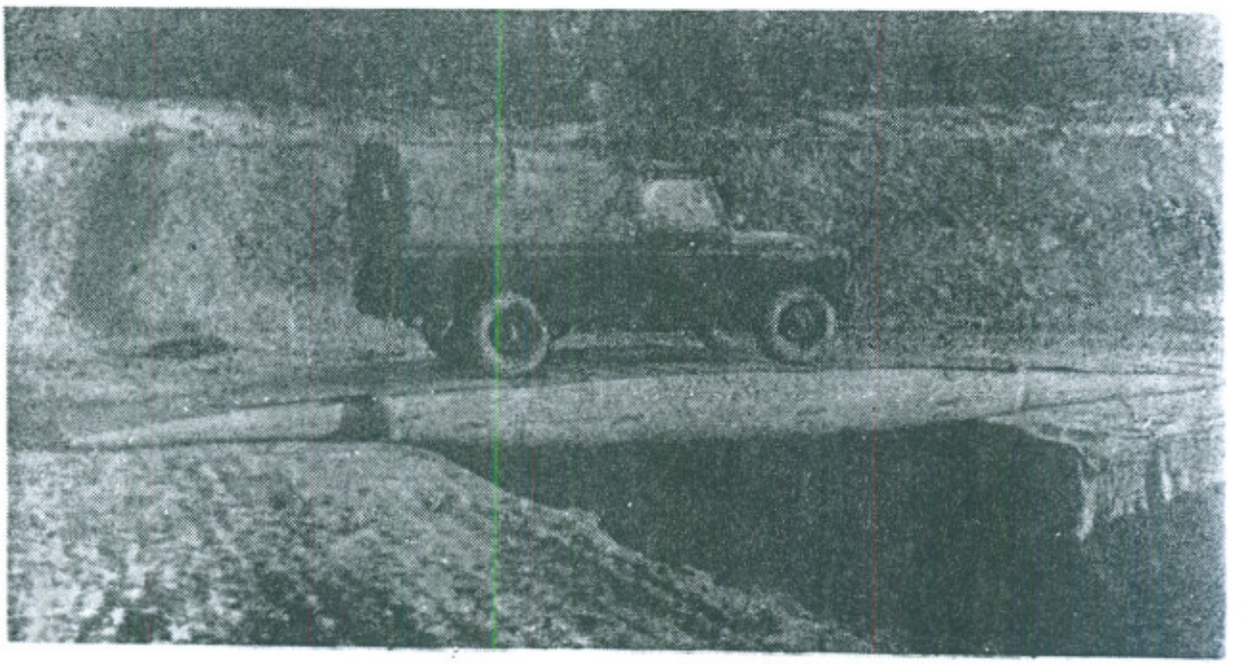


FIG: 3. INFLATABLE BRIDGE (Ref. 6)