

## Potential of Prefabrication Technology in P.D.R. Yemen

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### Abstract

The paper presents a study of the application of the prefabrication technology in the P.D.R. Yemen. A study is made concerning the application of various structural systems such as the block system, large panel system and box unit system. A discussion is included regarding the role of prefabrication technology in developing countries and the possibility of application of the same in Yemen, through the analysis and study of the Yemeni conditions based on the basic requirements such as the technological, the economical and the social requirements. These studies are made towards finding a solution for the problems of shortage of housing.

### Introduction

Prefabrication technology is a method of construction in which the component parts of a building are wholly precast at site or at factory. It consists of three processes: design, manufacture and assembly. On the other hand the traditional method has two phases, viz. design and construction.

Traditional method of construction is not a solution for the urgent need of housing; where traditional method is employed it has good architecture appearance, but it needs more skilled labour. Prefabrication technology on the other hand permits construction more quickly with less labour at site and less cost if it is applied in a correct way.

The P.D.R. Yemen has been using the traditional method of construction. After independence, there has been a fast development in various sectors, through a systematic programme of the Five-Year Plans. It was recognised that there is acute shortage of housing in urban areas specially in Aden governorate because of the heritage of the past.

The present paper is aimed at identifying the problem related to the application of prefabrication techniques to the Yemen conditions; vis-a-vis the prefabrication technology used in other parts of the world.

### Industrialized Building Technology in Developed Countries

The building technology is a systematic knowledge and activity aiming at the universal solution of the problems of the industrialized building processes. There are two ways of the industrialization of the building system: one concentrating their production at the site and the other systems at the factory.

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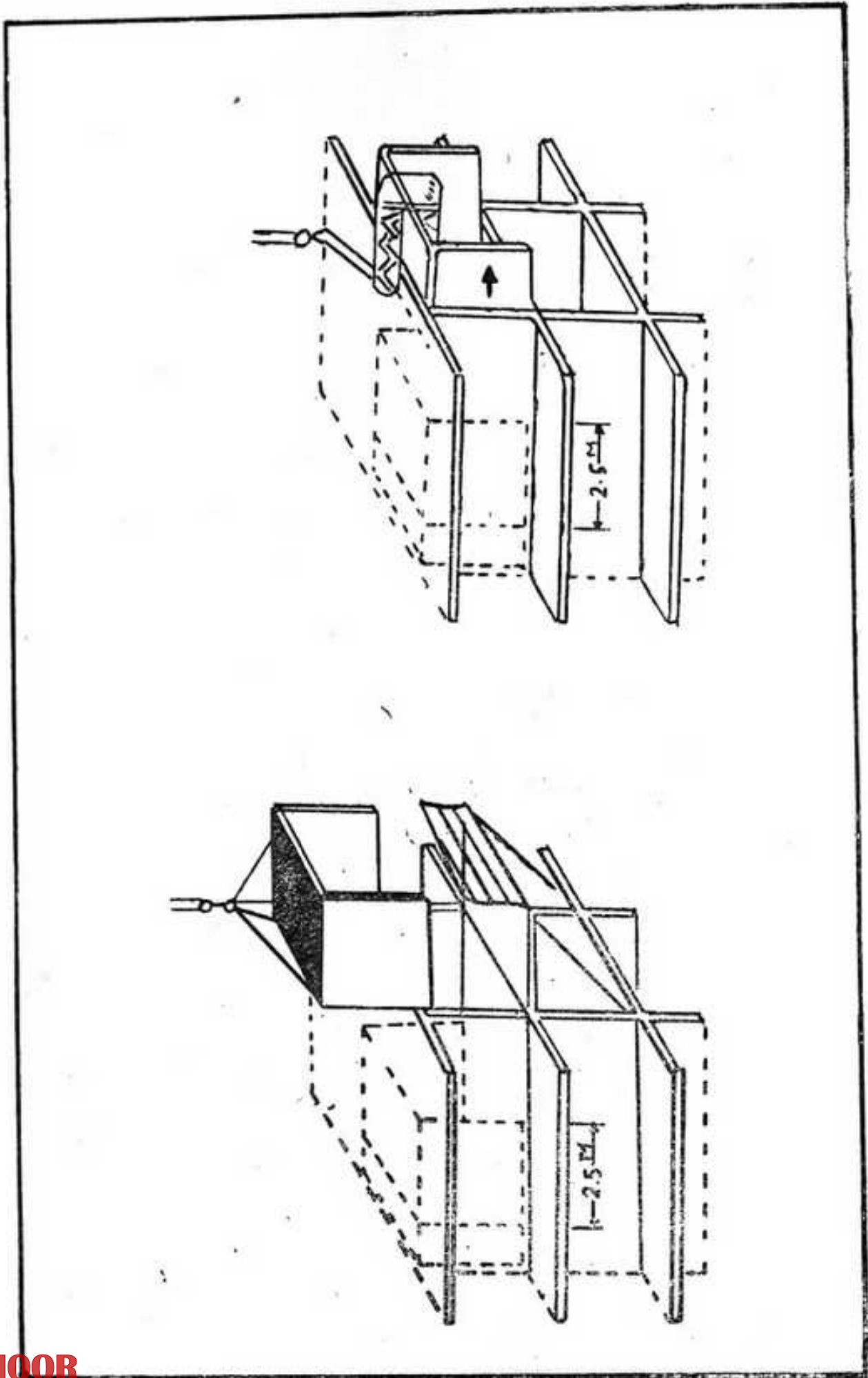


Fig. 15.1. Tunnel casting system.

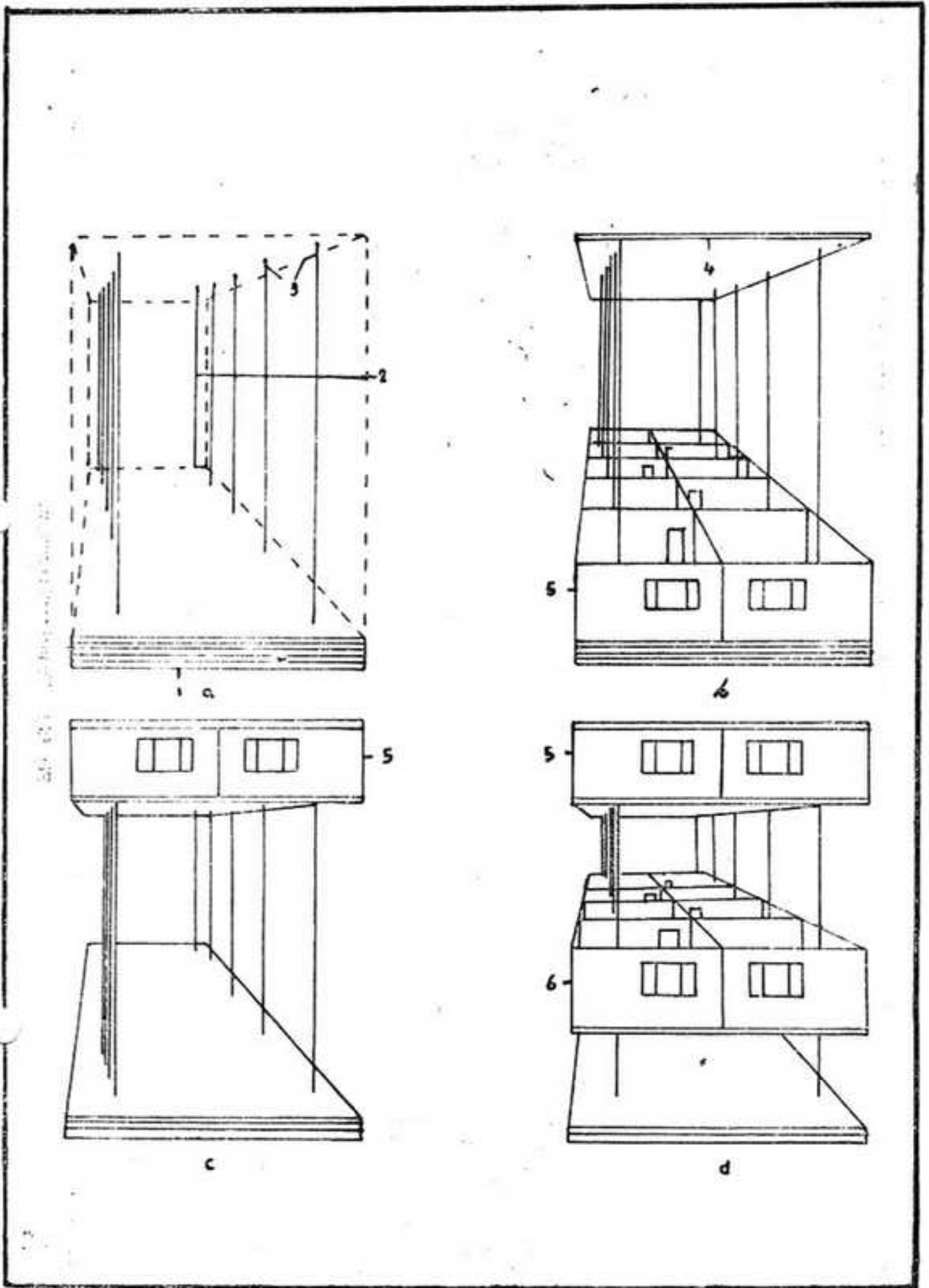


Fig. 15.2. Lift slab system.

## 1. Production at the Site

There are many existing building systems in the developed countries which employ component manufacturing at the site, and differs marginally in one or more aspects. These factories make moulds which are used for creating monolithic reinforced concrete elements at the site. There are several types of systems as follows :

### 1.1 Tunnel Casting System

This system uses regainable moulds mostly made of steel for casting the walls and floors of the building at the same time. Usually these systems are equipped with sophisticated machinery for pouring the concrete and for moving the moulds. These systems are mostly used for housing and are shown in Fig. 15.1.

### 1.2 Lift Slab System

This system uses factory-made columns of two or more levels. After erecting these columns they produce the monolithic reinforced concrete slab structures among them on the

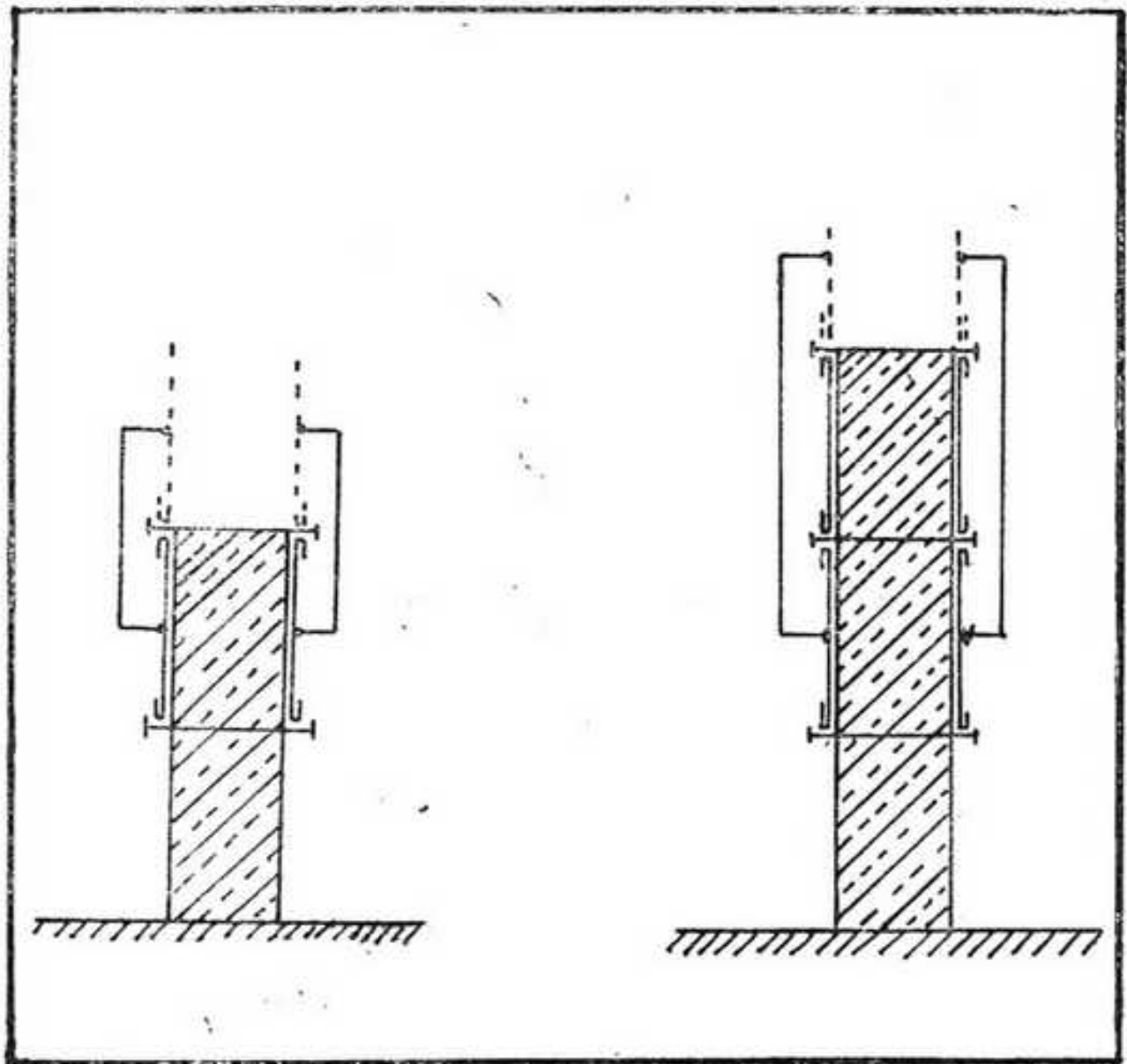


Fig. 15.3. Lift mould system.

ground level (underneath final position) using regainable stel moulds, and then the slabs are lifted by hydraulic equipments to their final position. This system is used for producing low rise houses, offices etc., as illustrated in Fig. 15.2. The numbers in the figure indicate the sequence of operations.

### 1.3. Lifting Mould System

This system also uses regainable moulds mostly made of steel for casting all the walls of a building at the same time, with a certain height. During concreting the mould is lifted continuously by hydraulic equipments. The floors are produced only after completing the walls. This system is used mostly for construction of sky scrapers or towers, as shown in Fig. 15.3.

### 1.4 Built-in Mould System

This system uses factory made surface elements *i.e.* moulds, mostly made of gypsum or any other kind of material of low specific gravity. They produce the monolithic reinforced concrete structures by pouring the concrete between or on the top of the surface elements. This system used for housing, as shown in Fig. 15.4.

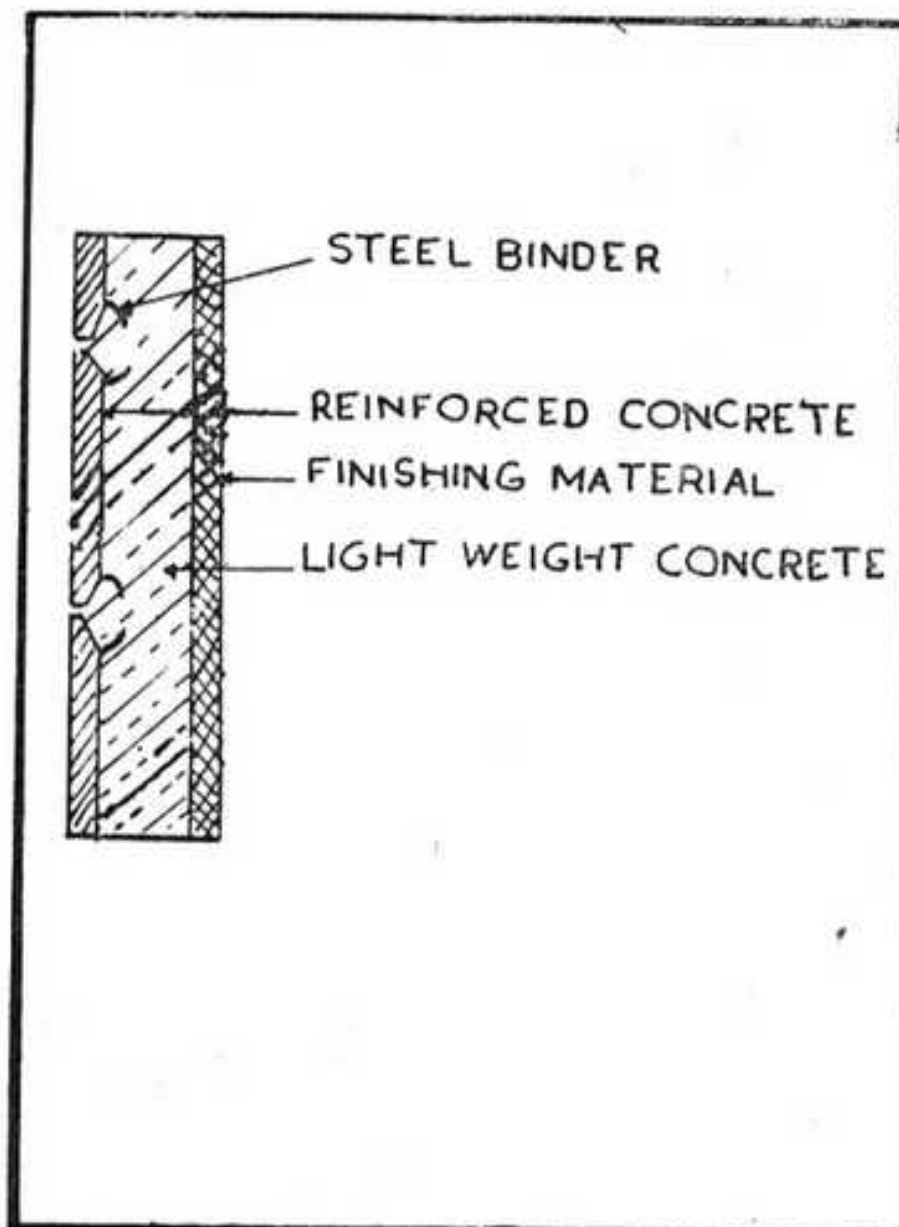


Fig. 15.4. Built in mould system.

The following are the characteristic features of production technology at the site :—

- (i) Transportation is easy.
- (ii) Manufacturing depends on weather conditions.
- (iii) Products may have quality deviation.
- (iv) Bigger, complex and individual heavy structures are obtained.

## 2. Production at Factory

There are many existing systems in developed countries concentrating their activities in an established factory. They are based on different ideas and patterns, but in all these systems the emphasis of manufacture is on the elements of the load bearing structures. The prefabricated structural elements are transported to the site and then assembled.

These systems have mass-produced reinforced concrete structural elements of several dimensions. The main featured of the design is the modular coordination and the architectural variability, which depends on the basic choice of different kinds of element. The economy in the component production is ensured by mass production and the repetitive use of moulds.

The main aspect of the assembly is to reduce the construction work at the site which depends both on the manpower demand and the machinery requirements. Some of these systems are described below :

### 2.1 Block System :

The reinforced concrete elements of the block systems are one dimensional, which means one dimension of the elements is equal to the span or the height of one level, but the other dimensions are less than the parameter size. The thickness of elements is usually constant (Fig. 15.5).

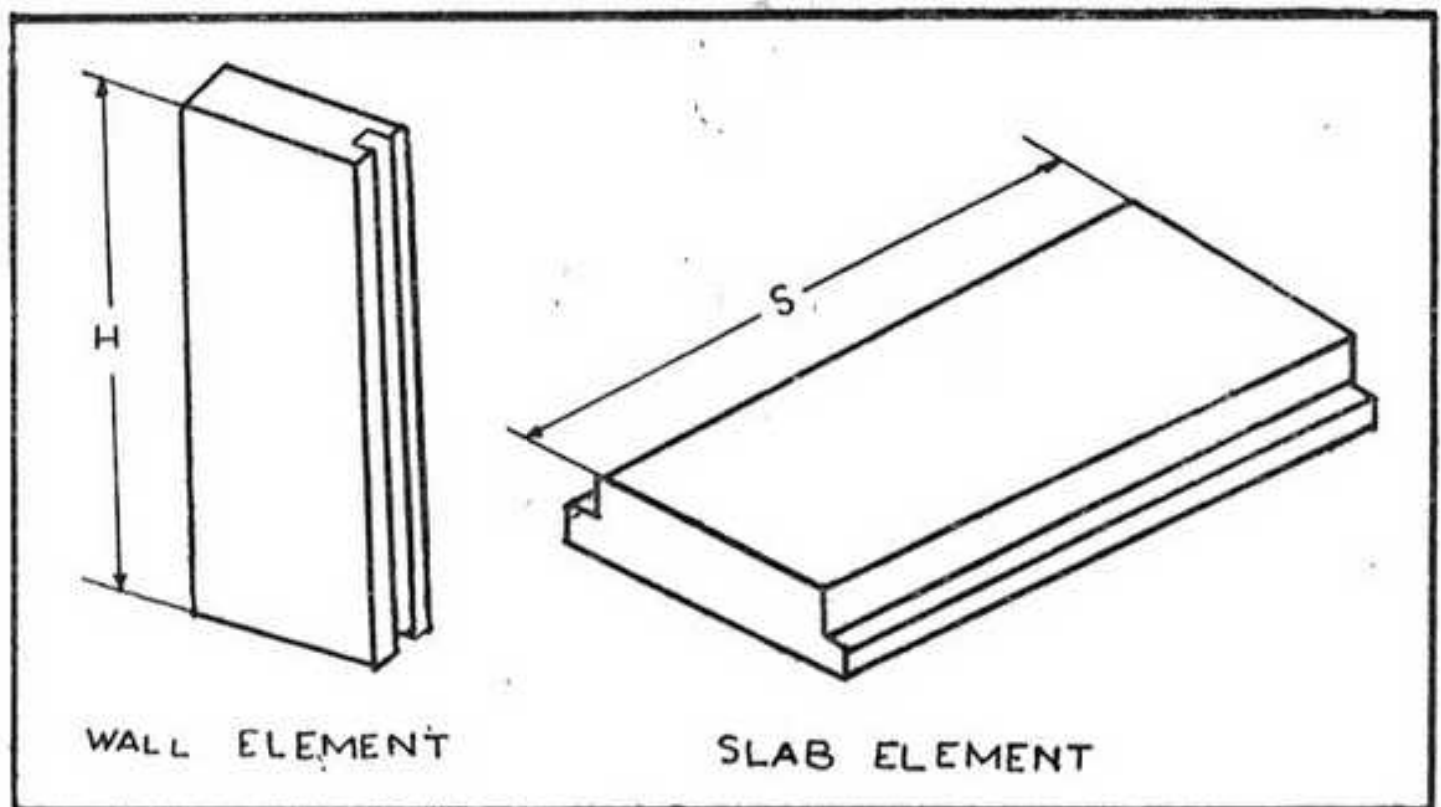


Fig. 15.5 Block System

The block system can be an open system. Its architecture variability is rather high, depending on the real choice of the different type of elements. The number of repetitions in manufacture is relatively high compared to the large panel system. But compared to the traditional building method the man-power demand is quite low, and the system does not need much skilled labour.

## 2.2 Large Panel System

The reinforced concrete component of the large panel system is two dimensional which means, two dimensions for the elements are equal to the span or the height or length of a room. Thickness of the elements is constant.

The large panel system is a closed, its architectural variability is extremely low. The repetition of producing the same element is rather high. It needs only a few special skilled labour at the site with huge lifting and transportation equipments.

## 2.3 Box Unit System

The reinforced concrete structural elements of the box-unit system are three dimensional, which means that all the dimensions are respectively equal to the height, the width and the length of room. So the object of manufacture is a complete unit as illustrated in Fig. 15.6.

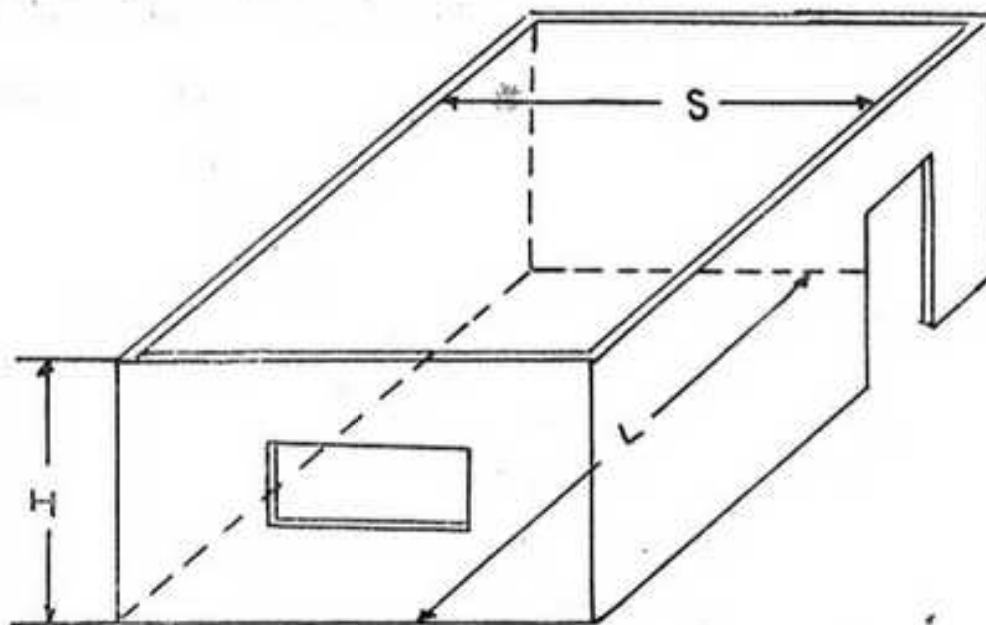


Fig. 15.6 Box Unit System

The box-unit system is totally a closed one. There is no architectural variability at all. The repetition in the manufacture is the highest. It needs very low number of highly skilled labour with heavy lifting and transportation equipments.

The characteristic features of production technology at the factory can be summarised as :—

- (i) Transportation is complicated.
- (ii) Manufacture does not depend on weather conditions.
- (iii) Products have good quality control.
- (iv) Smaller, simpler, mass-produced structural elements are available.

### 3. Light-Weight Structural Systems

These systems use several kinds of factory made building components. They produce generally structural elements for the skelton of the buildings. Usually the walls and the partitions have no load bearing capacity, and the basic materials are steel for the skeleton, aluminium and plastic or other materials for curtain walls and partitions.

These systems can be open from the architectural point of view which depends on the choice of the elements and the flexibility of their joining. The number of repetition in producing elements can be quite high. The assembling work needs a few specialized skilled labour with special tools for several working processes.

#### Applications in P.D.R. Yemen

There are two ways of applying prefabrication technology in P.D.R. Yemen :—

- (i) To import existing technology and pay for a ready-made project, which is very expensive. This is also a solution for the quick provision of houses and shortage of labour, but it requires light weight structures which are expensive and also require foreign labour for erection and for maintenance afterwards.
- (ii) The build a factory which may run continuously. It is appropriate to import a factory only, and then to train local labour to deal with the system. This is a desirable solution.

The following requirements should be satisfied to install the prefabricated building technology, which is applicable to the local conditions of P.D.R. Yemen :—

#### (i) Technology Requirements :

- Technology should be based on the uses of local materials.
- It should adaptable to Yemen architecture and functional requirements.
- It should applicable to the native physical and climate conditions including earthquake effects.

#### (ii) Economical Requirements :

- Technology should not be bound to the conditings of infrastructure which may need heavy transportation facilities and sophisticated equipment requiring a huge initial investment.



