CE 6016 - PREFABRICATED STRUCTURES ①

UNIT- I

INTRODUCTION :-

Need for Prefabrication - Principles - Materials - Modular co-ordination - Standardization - Systems - Production - Transportation - Erection.

Introduction :

Prefabricated structures are component members which are precast either in factories or in temporary plants established on the site

These Precast members are transported to the site where they are hoisted, set into their final positions and assembled to form a complete structure

Definition :

Prefabrication is the practice of assembling components of a structure in a factory or other manufacturing sete and transporting complete assemblies to the construction site where the structure is to be located.

Need for Prefabrication:

⇒ Prefabricated structures are used for sites, which are not suitable for normal construction methods.
Such as hilly region, and also when normal construction materials are not easily available.

⇒ Prefabricated structures facilities can also be created at near a site as is done to make concrete blocks used in plane of conventional structure.

⇒ Speed in construction.

⇒ Lack of space.

⇒ Proper utilization of space.

⇒ Mass production.

Principles of Prefabricated Structures:-

→ Design for prefabrication, Pre assembly and modular construction.

→ Simplify and standardize connection details

→ Simplify and separate building systems.

→ Minimize building components and materials ③

→ Select fittings, fasteners, adhesives and sealants that allow for quicker assembly and facilitate the removal of reusable materials.

→ Reduce building complexity

→ Design of reusable materials.

Uses of Prefabrication:

→ Prefabrication techniques are used in the construction of apartment blocks, and housing developments with repeated housing units.

→ Prefabricating steel sections reduces on site cutting and welding costs as well as the associated hazards.

→ This techniques is also used in office blocks, ware houses and factory buildings

→ Prefabricated steel and glass sections are widely used for the exterior of

large buildings offers bridge designers ④ and contractors significant advantages in terms of construction time, safety, environmental impact, constructability and cost.

→ Prefabrication can also help minimize the traffic congestion arising during bridge building.

Prefabricated Materials:

Prefabricated building materials are used for buildings that are manufactured off site and shipped later to be assembled at the final location.

Some of the commonly used prefabricated building materials are aluminum, steel, wood, fiberglass and concrete.

Synthetic materials are used for the walls and roofs. To provide enhanced security, a combination of both

metal and cloth materials are used.

→ plastic flooring materials can be quickly assembled and are very durable

→ Prefabricated building materials used for small prefabricated buildings are steel, wood, fiberglass, plastic or aluminum materials.

These materials are cheaper than regular brick and concrete buildings.

Characteristics of Materials:

→ Easy availability
→ light weight for easy handling
→ thermal insulation property
→ Durability in all weather conditions.
→ Economy in cost.

Modular Co-ordination

→ Dimensional co-ordination employing the basic module or a multi module.

Purpose of modular co-ordination are

→ To reduce the variety of component size produced

→ To allow the building designer greater flexibility in the arrangement of components.

Bases of Modular Co-ordination

Dimensional co-ordination employing the basic module or a multi modale.

Purposes of module co-ordination are

→ To reduce the variety of component size produced.

→ To allow the building designer greater flexibility in the arrangement of components

The modular co-ordination is defined as the basic module to be adopted, the size of which is selected for general application for building and its components

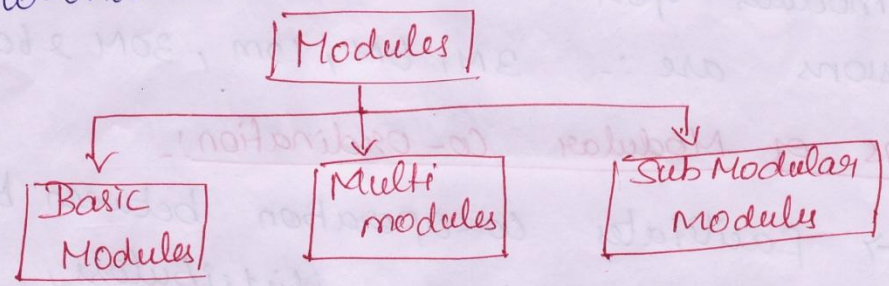
The value of the basic module ① chosen is 100mm for maximum flexibility and convenience.

The symbol used for basic module is M

1M = 100mm → It is international standard value.

Modules:

Modules is a standard unit of size of co-ordinate the dimensions of buildings



Basic Module:

It is the fundamental unit of size of modular co-ordination.

The basic module is represented by letter M while its international standardized value is

1M = 100mm

Multi Modules:

Multi modules are standardized

by selected whole multiples of the basic module.

Different multi-modules will suit particular applications. By using multi modules it is possible to achieve a substantial reduction in the number of modular sizes.

The international standard values of multi modules for horizontal Co-ordinating dimensions are :- 3M, 6M, 12m, 30M & 60M.

Aims of Modular Co-ordination :-

→ facilitates co-operation between building designer manufacturers distributors, contractors, and authorities.

→ Permits a flexible type of standardization which encourages the use of a number of standardized building components for the construction of buildings and building components.

→ Ensures dimensional Co-ordination between installation as well as with the rest of the building.

Advantages of Standardization:

→ Easier design
→ Easier Manufacture
→ Easier erection and completion.

Factors influencing standardization

→ The no of types of elements will be limited and they should be used in large quantities.

→ To the extent possible the largest size to be used which results in less no of joints.

→ The size and the no of the prefabricate in limited by the weight in overall dimension that can be handled by the transportation.

Systems:

The term production of systems describes a series of operation directly concerned in the process of making or more aptly of molding precast units on

the face of it there are very many techniques.

Large prefabrication System:-

In large prefabrication system most of the members like wall panels, roofing/flooring systems, beams and columns are prefabricated.

One of the main factor which affects the factory prefabrication is transport. Suppose the factory is situated far away from the construction site and the vechicle needs to cross congested traffic areas with heavy weighing elements the Cast inside prefabrication is preferred.

Open system of prefabrication

In the total prefabrication systems, the space frames are casted as a single unit and erected at the site. This wall fitting and fixing or done on site.

Closed system :-

In this system, the whole things are casted with fixing and erected on their position.

Small Prefabrication :

Small, medium & large prefabrication systems are mainly classified according to their degree of precast elements using in that construction.

For eg:- brick is a small unit precasted and used in buildings. This is called as small prefabrication.

That the degree of precast element is very low.

Medium Prefabrication

Suppose the roofing systems and horizontal members are provided with precast elements. These constructions are known as medium prefabricated construction.

Here the degree of precast elements are moderate

Off site (Factory) Prefabrication

One of the main factors which affect the factory prefabrication is transport. The width of road walls, mode of Transport vechicles are the factors which factors the prefabrications which is to be done on site (or) factory

Open prefabrication system:-

There are two categories of open prefabricated systems depending on the extent of prefabrication used in the construction as given below.

⟹ Partial Prefabrication Open System
⟹ Full Prefabrication Open System.

Partial Prefabrication Open system:-

The system basically emphaizes the use of precast roofing and flooring components and other minor elements like lintels, sunshades, kitchen sills in conventional building construction.

The structural system could be in the form of insitu frame work or load bearing walls.

Full Prefabrication Open system:

In this system, almost all the structural components are prefabricated. The fillers walls may be of bricks or of any other local materials.

Wall system:

Structural scheme with precast large panel can be classified as

- cross wall system
- Longitudinal wall system.

Cross wall system:-

In this system the cross walls are load bearing walls.

The facade walls are non-load bearing walls. This system is suitable for high rise buildings.

Longitudinal wall System:-

In this system, cross walls are non bearing walls, longitudinal wall are load bearing walls. This system is suitable for low rise buildings.

Factory Prefabrication:

→ Done in a centrally located plant to manufacture of standardized components

→ Capital intensive work done throughout year preferably under a closed shed to and effects of seasional Variation.

→ High level of Mechanization
→ Curing
→ Moulds
→ concreting, Vibration.

Disadvantages:-

→ Extra Cost- transportation from Plant to site

→ Shape and site size and is limited due to lack of transport arrangement.

Site Fabrication:

→ Manufactured at site or near the site

→ Normally in Open space with local labours

(17)

→ Equipments, machines and moulds mobile in nature.

→ Reduction of Transport cost

Disadvantages:

→ Not Suitable for high degree of Mechanization.

→ Continuity of work is not available.

Process involved in Manufacture of Prefabricated Structures

The various processes involved in the manufacture of precast elements may be classified as

Main Process:

→ Providing and assembling the moulds, placing reinforcement cage in position for reinforced concrete work, and stressing the wires in the case of prestressed elements.

→ Fixing the wires and tubes, where necessary.

→ Pouring the concrete
→ Vibrating the concrete into the moulds
⇒ Demoulding the forms and stacking the precast products
→ Curing (Steam curing if necessary)

Auxiliary Process:

Process necessary for the successful Complement of the processes covered by the main process.

→ Mixing and manufacture of fresh concrete (done in a mixing station or by a batching plants).

→ Prefabrication of reinforcement cage. (done in a steel yard or workshop)
→ Manufacture of inserts and other finishing items to be incorporated in the main precast products.
→ Finishing the precast products &
→ Testing of products.

Transportation:

⇒ It must be carried out with extreme care to avoid any jerk and distress in elements and handled / Transported as far as possible in the same orientation as it is to be placed in final position.

⇒ It should be properly planned and conformity with traffic rules and regulation as authorities.

⇒ The size of the element decide mode of/ size of transport vechicle.

⇒ Avoid excessive cantilever projection while transport.

⇒ Special cases in sharp bend curves/ uneven roads which leads undesirable stresses

⇒ Before loading, proper bare packing materials, proper location, packing must be kept strictly one over the other.

Delievery:

⇒ Delivery of Precast elements should

planned according to the general erection sequence to minimize unnecessary site storage and handling.

⇒ Precast elements should be loaded and delivered with proper supports, frames, cushioning and tie-downs to prevent damage during transports.

Handling:

⇒ Lifting and handling position shall be clearly defined particularly where these sections are critical.

⇒ It mainly involves the removal of the precast elements from the mould, transportation to the storage yard, and unloading operation and erection of these element at the job site.

⇒ We have to handle the elements according to their size and shape to avoid excessive stresss during handling.

⇒ Conveying equipment, such as belt conveyor, chain conveyors, screw conveyors bucket elevator, hoists etc.

⇒ Concrete mixers – Mixing machines

⇒ Concrete vibrators – Vibrating machines.

⇒ Erection equipment, such as cranes, derricks, hoists, chain pully blocks etc.

⇒ Transport machinery, such as tractor-cum-trailers, dumpers, lorries locomotive, motor boats and rarely even helicopters.

⇒ Bar straightening, bending and welding machines to make reinforcement cages.

In addition to the above, pumps and soil compacting machinery are required at the building site for the execution of civil engineering projects involving Prefabricated components.

Types of Cranes:

For erection of prefabricated buildings the following cranes are used

Stationary Cranes:

- → Guyed derrick
- → Climbing crane
- → Tower crane with fixed base

Cranes on rails

- → Portal Cranes
- → Tower Cranes

Mobile Crane moving on ground

- → Truck mounted
- → Crawler mounted.

Stationary Cranes.

Guyed derrick:

These are used on framed buildings for erection of floor panels, columns and slab strips.

The dericks being lighter in weight can be shifted from floor to floor operating from an erected floor.

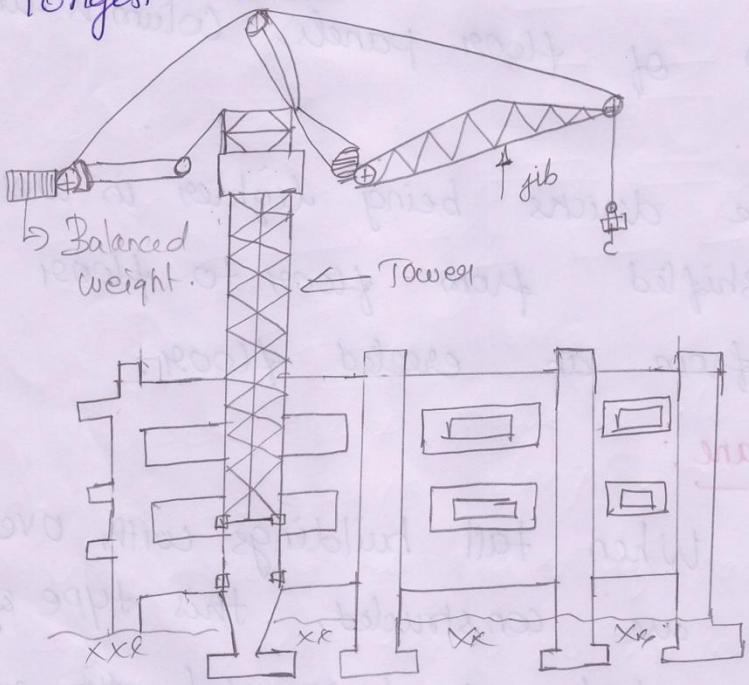
Climbing Crane:

When tall buildings with over 20 storeys are constructed, this type of cranes are used. A horizontal jib and

balancing counter weight is placed on the (24) top of the shaft.

→ This shaft itself is stationary and crane operates 360° around the pivot on the shaft the crane can be lifted up to a new position as the building goes up on completion of the building Creation the crane is dismantled and taken out through the sides.

Such cranes will have to be Used when construction is carried out in longest areas.

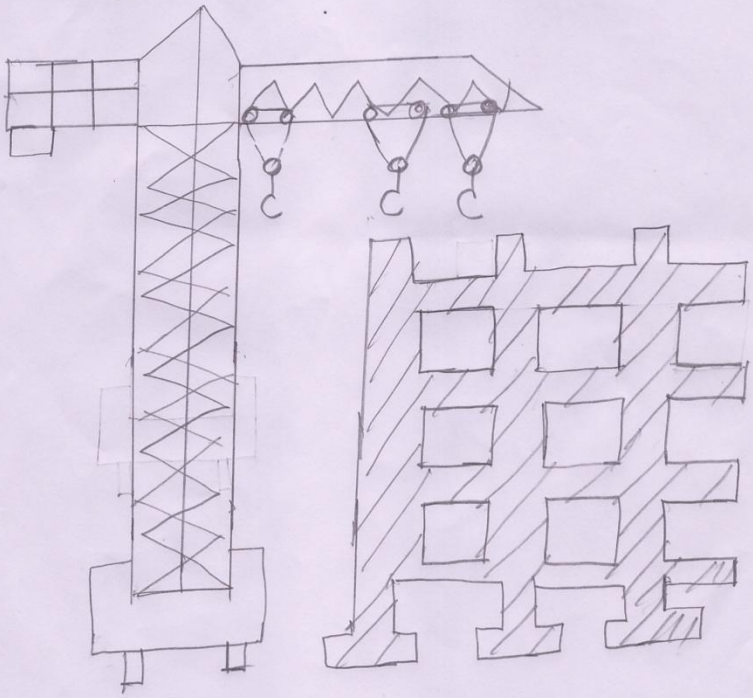


Climbing Crane.

Tower cranes :-

The most versatile equipment used in prepabrication is a tower moving on rails.

The serious draw back with such a crane is that they require heavy crane tracks, lengthly & expensive assembly and dismantling.



Tower Crane.

Tower cranes have a tower carriage on rails although long straight rails tracks are use, curves in tracks of radius of 5m, can also be built for slow movement aroun building

The reach of the crane is by a horizontal fabrication often provided with a crab which moves on the horizontal fabrication.