

# **SAI SCHOOL OF ENGINEERING**

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## **STUDY MATERIAL**

*ON*

**ADVANCE CONSTRUCTION TECHNIQUE**

**6<sup>th</sup> SEMESTER**

**LECTURE NOTES  
OF  
ADVANCE CONSTRUCTION TECHNIQUE**

## **(A) FIBER AS CONSTRUCTION MATERIAL-**

Fibers are considered as a construction material to enhance the flexural and tensile strength and as a binder that could combine Portland cement in bonding with cement matrices. Fiber is such a reinforcing material. Fibers are small pieces of reinforcing material possessing certain characteristics and properties. Fibers are usually used in concrete to control cracking due to plastic shrinkage and drying shrinkage.

### **-TYPES –**

#### **Glass Fibres-**

Different types of glass exist, with various colours, chemical compositions, and characteristics. Glass fibres have great mechanical properties and excel in terms of strength, thermal properties, durability, and have good interfacial bonding to the matrix. Glass fibres are most frequently used as reinforcement in resins and composites as they have amazing properties in strengthening composites.

Glass fibres are generally used to reinforce polypropylene systems. A composite is formed between the elements to form an excellent material. The resulting composite is cost effective, easy to procure, and possesses the strength and toughness characteristics of glass fiber.

### **Steel Fibres-**

Similar to traditional steel reinforcement, the key characteristic of steel fibres is their high tensile capacity . Steel fibres have been broadly studied in concrete applications , hence, they are commonly used to improve the mechanical properties of concrete .

Research has shown that when steel fibres are used to reinforce concrete structures, there are many improvements in the overall properties . Steel fibres help improve the concrete behaviour in terms of cracking, shrinkage , ductility, toughness, resistance to fatigue, and impact and blast loading . Furthermore, strength properties, such as tensile strength, compressive strength, and flexural strength, are increased for the parent material . This strength increase is due to the steel fibres' characteristics of absorbing energy and controlling cracks. Steel fibres can be an ideal additive to specific applications as they possess good electric, magnetic, and heat conductivity .

### **Carbon Fibres-**

Carbon fibres have been added in materials to form composites with improved properties . The addition of carbon fibres creates a composite that has outstanding mechanical properties , performs well in high temperature environments , and possesses the benefit of durability . Although carbon fibres are quite brittle , with careful consideration in the design stage, carbon fibre-reinforced composites have excellent properties . The disadvantages of carbon fibres are that due to their excellent properties the expense of manufacturing carbon fibres is high , and the bonding between the fibres and material matrix may be difficult to achieve .

Similar to glass fibres, although there are many positives and benefits to carbon fibres, the production of carbon fibres leads to concerns for the environment and questionable sustainability. The problem of the disposal of carbon fibre composites at the end of life phase is also well known . For most carbon fibre composites, recycling could be a possibility, however most products are simply burnt or buried , which is not good for the environment.

## PROPERTIES –

- High tensile strength and modulus of elasticity.
- High resistance to weather and acidic environments, and some alkali resistance.
- Good thermal properties and stability, and can tolerate and perform well in high temperature environments .
- Good electric, electromagnetic, and sound insulation properties.
- Good resistance and stability against corrosion, chemical attack, impact load, and fire .
- Good adhesion and abrasion properties with the ability to mix well with matrix materials.
- Nonreactive and noncombustible.
- Low absorption of moisture/water and thermal conductivity.
- Absorb sound and vibration isolation.
- Resistant to radiation and UV light.
- Strong, hard, and rigid.
- Improved strain failure Basalt fibres are also:
- Easy to produce and process.
- Cost-efficient/inexpensive.
- Used to form lightweight composites with excellent properties.
- Can be recycled for reuse.
- Require no chemicals or additive.
- Natural.
- Biodegradable.
- Ecologically clean, easy to handle, and non-toxic.
- Can be used in a diverse range of applications .
- Titled as green.

## USE OR APPLICATION –

- Improved characteristics and properties, such as strength, toughness, durability, rigidity, and ductility.
- Improved resistance and performance in different environments, and against physical and chemical corrosion and other attacks.
- Improved stability.
- Improved thermal properties and operating temperature.
- Reduction of heat conductivity.
- Reduction of the specific weight and density resulting in a lightweight product that is both energy and cost-efficient.
- Reduction and lower cost of design and installation , as fibres can replace traditional reinforcement methods.
- Reduction of the volume of landfill and saving of energy if a waste product is utilised.
- Prevents the occurrence of shrinkage, cracks, spalling, and swelling.
- Improved environmental-friendliness, economic efficiency, and sustainability [3], particularly if natural, energy efficient, or waste fibre is used.

## **(A) PLASTIC AS CONSTRUCTION MATERIAL**

Plastic is a general name given to a wide range of synthetic materials that are based on polymers. The construction industry uses plastic for a wide range of applications because of its versatility, strength-to-weight ratio, durability, corrosion resistance, and so on.

Plastic can be manufactured into forms such as; pipes, cables, coverings, panels, films, sheets and so on; and can be formed or expanded to create low-density materials; and be dissolved in solvents.

Some of these plastics main uses in the construction industry are:

Cladding panels.

Cables

Pipes and gutters.

Windows and doors.

Shuttering

Wall linings

Floor covering

Ceiling panels.

Roof coverings.

Sinks, basins, baths, and showers.

: The advantages of using plastic in construction are that it is lightweight yet strong which makes it easier to transport and shift around sites. It is also resistant to rot and corrosion and has strong weather ability due to it being capable of achieving tight seals.

: The disadvantages of plastic are that it has a high embodied energy content and a low modulus of elasticity, meaning that it is generally unsuitable for load-bearing applications.

### **PROPERTIES:-**

: Typically, construction professionals select plastic materials based on the following criteria:

1. Durability
2. Cost effectiveness
3. Recycling
4. Energy saving
5. Safety
6. Easy to install

## **Use of Plastics in Different Aspects of the Construction Industry**

### **1. Flooring**

Plastic materials like polyvinyl chloride (PVC) and polyethylene are used to make flooring less prone to wear and tear. It also decreases the sound pollution level and can be cleaned easily.

### **2. Roofing**

To protect the outer surface of the roof from damage, two layers of different plastic materials are required. The upper part is made of colored thermoplastic olefin or vinyl while the lower part consists of polyurethane foam which consumes less energy and keeps the interior of a house cooler.

### **3. Insulation**

Polyurethane spray is frequently used for insulation when constructing green or low energy buildings. Rigid polyurethane foam is known for its high thermal resistance which promotes temperature consistency. Polyurethane foam is also popular because it is lightweight, chemical resistant, and flame retardant. Due to its closed cell nature, polyurethane insulation performs as an air barrier, resulting in significant energy savings.

### **4. Wall**

A structural insulated panel (SIP) is a sandwich of expanded polystyrene amidst two slim layers of oriented strand board. This type of pre-fab, composite wall board can be transferred to the work place easily for a particular task and provide good support to columns and other associated essentials during renovation.

### **5. Pipes**

Commonly made up of polyvinyl chloride (PVC), CPVC, acrylonitrile butadiene styrene (ABS) or polyethylene, plastic pipes are flexible and very light in weight, making them easy to install. All of these plastic materials are also highly chemical and water resistant, making them suitable for many extreme environments.

### **6. Windows**

Polycarbonate is used to manufacture building windows. This plastic material is strong, clear and very light in weight. Polycarbonate windows are considered more burglar-proof than regular glass windows. Two plastics materials, vinyl and fiberglass, are used commonly in the production of window frames. Fiberglass is extremely strong while vinyl is quite durable and also inexpensive.

### **7. Doors**

Some construction projects use doors made from a stiff polyurethane foam core with a fiber reinforced plastic (FRP) coating. The sandwich structure of these doors makes them incredibly strong.



## **TYPES:-**

### **PVC:-**

Polyvinyl chloride (PVC), a synthetic resin made from the polymerization of vinyl chloride. Second only to polyethylene among the plastics in production and consumption, PVC is used in an enormous range of domestic and industrial products, from raincoats and shower curtains to window frames and indoor plumbing. A lightweight, rigid plastic in its pure form, it is also manufactured in a flexible “plasticized” form.

### **RPVC:-**

RPVC means Rigid PolyVinyl Chloride which comes from PVC. Polyvinyl chloride (PVC), also known as vinyl, is a common plastic polymer (a polymer being a large molecule). It comes in two basic forms: flexible and rigid (RPVC). RPVC is used in construction (especially pipes), packaging etc. RPVC Pipes with high impact strength & load bearing capacity!

### **HDPE:-**

High density polyethylene (HDPE) piping systems have been used for municipal and industrial water applications for over 50 years. Within Building & Construction Division, HDPE pipes are used for ground source geothermal applications, also known as earth energy or geoexchange systems.

**FRP:-**

Fibre-reinforced plastic (FRP) (also called fiber-reinforced polymer).FRP bars are used as internal reinforcement for concrete structures. FRP bars, sheets, and strips are used for strengthening of various structures constructed from concrete, masonry, timber, and even steel. Fibre reinforced polymers are used in the construction of special structures requiring electrical neutrality.

**GRP:-**

GRP stands for 'Glass Reinforced Plastic' a material made from a polyester resin, which is reinforced by chopped strand mat glass fibres to form a GRP laminate. It is a very popular composite material to use because not only is it very strong but also surprisingly light.

**Coloured Plastic Sheets:-**

Plastic film is a thin continuous polymeric material. Thicker plastic material is often called a "sheet". Plastic sheets are generally low cost, easy to manufacture, durable, strong for their weight, electrically and thermally insulative, and resistant to shock, corrosion, chemicals, and water.

## (B) ARTIFICIAL TIMBER

Reduction of moisture content along with improving some qualities before the use of woods is called seasoning of timber. By seasoning, generally, the moisture is reduced to about 15% where new cut woods bear about 50%.

### Reasons for Seasoning

Seasoning of timber is done to fulfill some specific requirement. Followings are the reasons to perform timber seasoning.

- 1.To change and improve the properties of wood.
- 2.To make a correct percentage of shrinking of woods.
- 3.To make a confident use of woods.
- 4.To reduce the adverse behaviour of woods.

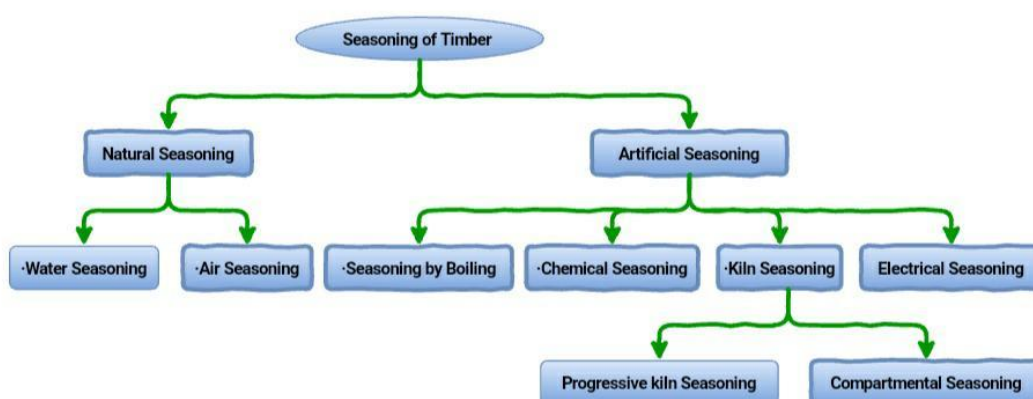
### Methods of Seasoning of Timber

There are mainly two methods of seasoning of timber. These are:

A) Natural Seasoning

B) Artificial Seasoning

Following tree diagram can be used to illustrate all the methods of timber seasoning.



## **Natural Seasoning**

Seasoning of woods or timbers using natural elements is called natural seasoning. eg. water and air seasoning.

### **a. Water seasoning**

Removal of wood sap immersing logs into water flow is called water seasoning. It is carried out on the banks of the river while thicker ends are kept towards upstream. After that, the logs are allowed to dry. Disadvantage: It is time consuming such as 2 to 4 weeks generally.

### **b. Air seasoning**

Exposing the woods to air for seasoning. At first, a platform is required that is built on the ground at 300mm height above the ground.

Secondly, the arrangement of woods in layers. Air circulation is maintained between logs because it helps to reduce the moisture which is important for seasoning. The environment for this need to maintain some conditions. A clean, shady, dry, cool place is preferred. Sometimes logs are coated by the impermeable substance to reduce extreme moisture. To improve the quality oil coating, thick paint coating is maintained. To prevent fungal infection logs are treated with petrol or gasoline.

#### **Advantage:**

Good quality of seasoned wood.

A large amount is convenient in this process.

Well-seasoned timber is formed.

#### **Disadvantage:**

It's a slow process.

## **Artificial Seasoning**

### **a. Seasoning by Boiling**

Seasoning by boiling wood logs in hot water is called seasoning by boiling. Drying is done after proper boiling. For a large amount of wood, it is done in an enclosed place where hot steam is passed.

#### **Advantages**

It takes a short amount of time. Generally, 3-4 hours is good enough.

Develops the strength and elasticity.

#### **Disadvantages**

It is serviceable basically for a small quantity of wood, not convenient for a large amount.

The cost is high.

### **b. Chemical seasoning**

Reduction of moisture using salt solution is called chemical seasoning. After the absorption of water by the solution logs are let to dry.

#### **Advantage**

It increases the strength of the timber.

It is less time-consuming.

#### **Disadvantage**

Chemical reagents can sometimes reduce strength.

It can cause a problem in gluing or finishing or corrosion while using.

### **c. Kiln seasoning**

Seasoning of wood by using a large chamber or oven where there is a good process for the circulation of hot air.

#### **Advantage**

Most effective and economic seasoning.

Kiln seasoning can be done by 2 processes such as:-

1. Progressive kiln Seasoning: Wood log is entered through the kiln and the temperature and humidity differentials are maintained through the length of the kiln to maintain proper drying.

2. Compartmental Seasoning: Its maintained by enclosed container or buildings.

Advantage: It accelerates the process because external energy is used.

#### **d. Electrical seasoning**

Dry wood is non-conductor of electricity while green timber is a conductor, so, can pass alternating current. Thus in this method alternating current is used for The resistance of timber against electricity is measured at every interval of time. When the required resistance is reached seasoning, process is stopped because resistance of timber increases by reducing moisture content in it. It is also called as rapid seasoning and it is uneconomical.

### **(C) Miscellaneous Materials.**

A category of asbestos-containing building material comprised mostly of nonfriable asbestos products and materials, such as ceiling tiles, floor tiles, roofing felt, transit pipes and panels, exterior siding, fabrics, and sheetrock systems.

### **Acoustics Material**

When the sound intensity is more, then it gives the great trouble or nuisance to the particular area like auditorium, cinema hall, studio, recreation centre, entertainment hall, college reading hall. Hence it is very important to make that area or room to be sound proof by using a suitable material called as 'Acoustic material'. It is measured in decibels (db).

### **Properties of Acoustic Material**

- 1.Sound energy is captured and adsorbed.
- 2.It has a low reflection and high absorption of sound.
- 3.Higher density improves the sound absorption efficiency at lower frequencies.
- 4.Higher density material help to maintain a low flammability performance. Hence acoustic material should have higher density.
- 5.It controls the sound and noise levels from machinery and other sources for environmental amelioration and regulatory compliance.
- 6.Acoustic material reduces the energy of sound waves as they pass through.
- 7.It suppresses echoes, reverberation, resonance and reflection.

### **Uses of Acoustic Material**

1. Acoustic materials can be used for noise reduction and noise absorption.

It makes the sound more audible which is clear to listen without any disturbances.

2. It suppresses echoes, reverberation, reflection and resonance.

3. Important specifications for noise reduction and noise absorption products include noise attenuation and noise reduction coefficient.

4. A vinyl acoustic barrier blocks controls airborne noise (street traffic, voices, music) from passing through a wall ceiling or floor.

5. Acoustic foam and acoustic ceiling tiles absorb sound so as to minimize echo and reverberation within a room.

6. Sound proof doors and windows are designed to reduce the transmission of sound.

7. A sound proof wall (treated by a accurate material) can incorporate sound proofing and acoustic materials to meet desired sound transmission class (STC) values.

### **Wall cladding**





Wall cladding is a type of decorative covering intended to make a wall look like it is made of a different sort of material than it actually is. Some of the most common examples are on the outside of buildings, but cladding can also be an artistic element in interior decorating.

The most common types of cladding are Stone Cladding, Brick Cladding, Timber Cladding, Metal Cladding, Concrete Cladding, Glass Cladding.

## **Plasterboard**



Plasterboard is a panel made of calcium sulfate dihydrate (gypsum) usually pressed between a facer and a backer. It is used to make interior walls and ceilings. This 'Drywall' construction became popular as a quicker alternative to traditional lath application.

## **Microsilica**



Microsilica or silica fume is an excellent admixture for concrete as it leads to better engineering properties. It reduces thermal cracking, improves durability, and increases strength. Silica fume concrete has a number of construction applications.

### Artificial Sand



Artificial sand, also called crushed sand or mechanical sand, refers to rocks, mine tailings or industrial waste granules with a particle size of less than 4.75 mm, which are processed by mechanical crushing and sieving, but does not include soft and weathered granules.

### Bonding Agents



Bonding agents are natural, compounded or synthetic materials used to enhance the joining of individual members of a structure without employing mechanical fasteners. The most commonly used types of bonding agents are generally made from natural rubber, synthetic rubber or from any other organic polymers. The polymers include polyvinyl chloride, polyvinyl acetate etc. With the addition of bonding agent in repair mortar or concrete, the reduced water-cement ratio can be adopted for the same workability, thereby reducing drying shrinkage.

## Adhesive



Construction adhesive is a general-purpose adhesive used for attaching drywall, tile, molding, and fixtures to walls, ceilings, and floors. It is most commonly available in tubes intended for use.

## **MODULE-2**

### **PREFABRICATION**

Prefabrication is the practice of assembling components of a structure in a factory or other manufacturing site, and transporting complete assemblies or sub-assemblies to the construction site where the structure is to be located. The term is used to distinguish this process from the more conventional construction practice of transporting the basic materials to the construction site where all assembly is carried out.

The term prefabrication also applies to the manufacturing of things other than structures at a fixed site. It is frequently used when fabrication of a section of a machine or any movable structure is shifted from the main manufacturing site to another location, and the section is supplied assembled and ready to fit. It is not generally used to refer to electrical or electronic components of a machine, or mechanical parts such as pumps, gearboxes and compressors which are usually supplied as separate items, but to sections of the body of the machine which in the past were fabricated with the whole machine. Prefabricated parts of the body of the machine may be called 'sub-assemblies' to distinguish them from the other components.

### **History**

Prefabrication has been used since ancient times. For example, it is claimed that the world's oldest known engineered roadway, the Sweet Track constructed in England around 3800 BC, employed prefabricated timber sections brought to the site rather than assembled on-site.[citation needed]

Sinhalese kings of ancient Sri Lanka have used prefabricated buildings technology to erect giant structures, which dates back as far as 2000 years, where some sections were prepared separately and then fitted together, specially in the Kingdom of Anuradhapura and Kingdom of Polonnaruwa.

After the great Lisbon earthquake of 1755, the Portuguese capital, especially the Baixa district, was rebuilt by using prefabrication on an unprecedented scale. Under the guidance of Sebastião José de Carvalho e Melo, popularly known as the Marquis de Pombal, the most powerful royal minister of D. Jose I, a new Pombaline style of architecture and urban planning arose, which introduced early anti-seismic design features and innovative prefabricated construction methods, according to which large multistory buildings were entirely manufactured outside the city, transported in pieces and then assembled on site. The process, which lasted into the nineteenth century, lodged the city's residents in safe new structures unheard-of before the quake.

Also in Portugal, the town of Vila Real de Santo António in the Algarve, founded on 30 December 1773, was quickly erected through the use of prefabricated materials en masse. The first of the prefabricated stones was laid in March 1774. By 13 May 1776, the centre of the town had been finished and was officially opened.

In 19th century Australia a large number of prefabricated houses were imported from the United Kingdom.

The method was widely used in the construction of prefabricated housing in the 20th century, such as in the United Kingdom as temporary housing for thousands of urban families "bombed out" during World War II. Assembling sections in factories saved time on-site and the lightness of the panels reduced the cost of foundations and assembly on site. Coloured concrete grey and with flat roofs, prefab houses were uninsulated and cold and life in a prefab acquired a certain stigma, but some London prefabs were occupied for much longer than the projected 10 years.[1]

The Crystal Palace, erected in London in 1851, was a highly visible example of iron and glass prefabricated construction; it was followed on a smaller scale by Oxford Rewley Road railway station.

## Current uses



A house being built with prefabricated concrete panels.

The most widely used form of prefabrication in building and civil engineering is the use of prefabricated concrete and prefabricated steel sections in structures where a particular part or form is repeated many times. It can be difficult to construct the formwork required to mould concrete components on site, and delivering wet concrete to the site before it starts to set requires precise time management. Pouring concrete sections in a factory brings the advantages of being able to re-use moulds and the concrete can be mixed on the spot without having to be transported to and pumped wet on a congested construction site. Prefabricating steel sections reduces on-site cutting and welding costs as well as the associated hazards.

Prefabrication techniques are used in the construction of apartment blocks, and housing developments with repeated housing units. The quality of prefabricated housing units had increased to the point that they may not be distinguishable from traditionally built units to those that live in them. The technique is also used in office blocks, warehouses and factory buildings. Prefabricated steel and glass sections are widely used for the exterior of large buildings.

Detached houses, cottages, log cabin, saunas, etc. are also sold with prefabricated elements. Prefabrication of modular wall elements allows building of complex thermal insulation, window frame components, etc. on an assembly line, which tends to improve quality over on-site construction of each individual wall or frame. Wood construction in particular benefits from the improved quality. However, tradition often favors building by hand in many countries, and the image of prefab as a "cheap" method only slows its adoption. However, current practice already allows the modifying the floor plan

according to the customer's requirements and selecting the surfacing material, e.g. a personalized brick facade can be masoned even if the load-supporting elements are timber.

#### Transportation of prefabricated Airbus wing assembly

Prefabrication saves engineering time on the construction site in civil engineering projects. This can be vital to the success of projects such as bridges and avalanche galleries, where weather conditions may only allow brief periods of construction. Prefabricated bridge elements and systems offer bridge designers and contractors significant advantages in terms of construction time, safety, environmental impact, constructibility, and cost. Prefabrication can also help minimize the impact on traffic from bridge building. Additionally, small, commonly used structures such as concrete pylons are in most cases prefabricated.

Radio towers for mobile phone and other services often consist of multiple prefabricated sections. Modern lattice towers and guyed masts are also commonly assembled of prefabricated elements.

Prefabrication has become widely used in the assembly of aircraft and spacecraft, with components such as wings and fuselage sections often being manufactured in different countries or states from the final assembly site. However, this is sometimes for political rather than commercial reasons, such as for Airbus.

## Process and theory

An example from house-building illustrates the process of prefabrication. The conventional method of building a house is to transport bricks, timber, cement, sand, steel and construction aggregate, etc. to the site, and to construct the house on site from these materials. In prefabricated construction, only the foundations are constructed in this way, while sections of walls, floors and roof are prefabricated (assembled) in a factory (possibly with window and door frames included), transported to the site, lifted into place by a crane and bolted together.

Prefabrication is used in the manufacture of ships, aircraft and all kinds of vehicles and machines where sections previously assembled at the final point of manufacture are assembled elsewhere instead, before being delivered for final assembly.

The theory behind the method is that time and cost is saved if similar construction tasks can be grouped, and assembly line techniques can be employed in prefabrication at a location where skilled labour is available, while congestion at the assembly site, which wastes time, can be reduced. The method finds application particularly where the structure is composed of repeating units or forms, or where multiple copies of the same basic structure are being constructed. Prefabrication avoids the need to transport so many skilled workers to the construction site, and other restricting conditions such as a lack of power, lack of water, exposure to harsh weather or a hazardous environment are avoided. Against these advantages must be weighed the cost of transporting prefabricated sections and lifting them into position as they will usually be larger, more fragile and more difficult to handle than the materials and components of which they are made.



## **Types of prefabricated systems**

There are two main types of prefabrication, namely volumetric (often referred to as 'modular') and panellised. Both of these types of construction can be achieved in timber, steel and concrete, and can also be mixed within the same scheme.

Steel systems for housing are usually light gauge galvanised steel. Timber systems can be relatively traditional in that the construction mirrors what might be produced on site using components such as timber studs and sheathing. It can make use of timber lbeams which give longer spans with a relatively lightweight beam. A third option is Structural Insulated Panel systems, which use fewer studs and rely in part on the bond between rigid insulation core and outer sheathing materials for strength.

One factor that differentiates all prefabricated timber systems from what might be termed traditional timber frame is the amount of work undertaken in the factory.

While there does not appear to be a formal definition separating the two, the prefabricated panel might include any insulation material, the sheathing boards and possibly some services.

## Classification of prefabrication

# Classification of prefabr

- ✓ Small prefabrication
- ✓ Medium prefabrication
- ✓ Large prefabrication
- ✓ Partial prefabrication
- ✓ Open system prefabrication
- ✓ Closed system prefabrication
- ✓ Total prefabrication
- ✓ Cast –in-site prefabrication
- ✓ Off- site prefabrication

## Classification of prefabricated construction system

Smaller degree Prefabrication: Here the prefabrication is done in the smaller scale.

precast brick

Medium degree Prefabrication: Here the prefabrication is done in the moderate scale.

Large degree Prefabrication : Here the prefabrication is done in the large scale.

## **Advantages**

1. Moving partial assemblies from a factory often costs less than moving pre-production resources to each site
2. Deploying resources on-site can add costs; prefabricating assemblies can save costs by reducing on-site work
3. Factory tools - jigs, cranes, conveyors, etc. - can make production faster and more precise
4. Factory tools - shake tables, hydraulic testers, etc. - can offer added quality assurance
5. Consistent indoor environments of factories eliminate most impacts of weather on production
6. Cranes and reusable factory supports can allow shapes and sequences without expensive on-site falsework
7. Higher-precision factory tools can aid more controlled movement of building heat and air, for lower energy consumption and healthier buildings
8. Factory production can facilitate more optimal materials usage, recycling, noise capture, dust capture, etc.
9. Machine-mediated parts movement, and freedom from wind and rain can improve construction safety

## **Disadvantages**

1. Transportation costs may be higher for voluminous prefabricated sections than for their constituent materials, which can often be packed more densely.
2. Large prefabricated sections may require heavy-duty cranes and precision measurement and handling to place in position.

## **Design Principal of Prefabrication:**

The Main reasons to choose Precast Construction method over conventional in method.

1. Economy in large scale project with high degree of repetition in work construction.
2. Special requirement in finishing.
3. Consistency in structural quality control.
4. Fast speed of construction.
5. Constraints in availability of site resources(e.g. materials & Laborites )
6. Other space & environmental constraints.
7. Overall assessment of some or all of the above factors which points to the superiority of adopting precast construction over convention method.

The following details gives. The cost implications of precast construction & conventional in situ method.

8. Large groups of buildings from the same type of prefabricated elements tend to v look drab and monotonous.

1. Local Jobs are last.

v The main reasons to choose. Precast Construction method over conventional in situ method.

1. Economy in large scale project with high degree of repetition in work execution.
2. Special architectural requirement in finishing.
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7. Overall assessment of some or all of the above factors which points to the superiority of adopting precast construction over conventional method

The following details gives the cost implications of precast construction & conventional in situ method.

### **Prefabrication Elements :**

1. Flooring / Roofing system.
2. Precast Beams
3. Precast Columns
4. Precast wall panels.
5. Precast Slabs.

### **Classification :**

The Prefabrication is classified as follows from the view of degree of Precast construction.

1. Small prefabrication
2. Medium Prefabrication
3. Large Prefabrication
4. Cast in Site Prefabrication
5. Off-Site (or) factory Prefabrication
6. Open system of prefabrication
7. Closed system of prefabrication
8. Partial prefabrication
9. Total prefabrication

### **Small Prefabrication :**

The first 3 types are mainly classified according to their degree of precast

Elements used in that construction for eg.: brick is a small unit precast and used in building.

This is called as small prefabrication. That the degree of precast element is very positive

### **Medium Prefabrication :**

Suppose the roofing systems and horizontal members are provided with precast elements those constructions are known as medium prefabricated construction here the degree of precast elements are moderate.

### **Large Prefabrication :**

In large prefabrication most of the members like wall panels, roofing / flooring Systems, beams and columns are prefabricated. Here degree of precast elements are high.

### **Cast - in - site prefabrication : OFF - site (factory) prefabrication :**

One of the main factor which affect the factory prefabrication is transport. The width of road, mode of transport, vehicles are the factors which prefabrication is to be done on site or factory.

Suppose the factory situated at a long distance from the construction site and the vehicle have to cross a congested traffic with heavy weighed elements the cost in site prefabrication is preferred even though the same condition are the cast in site prefabrication is preferred only when number of houses and more for small elements the conveyance is easier with normal type of lorry and trailers. Therefore we can adopt factory (or) OFF site prefabrication for this type of construction.

**Open system of prefabrication :**

In the total prefabrication systems, the space framers are casted as a single unit and erected at the site. The wall fitting and other fixing are done on site. This type of construction is known as open system of prefabrication.

**Closed system of prefabrication :**

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

**Partial prefabrication :**

In this method of construction the building element (mostly horizontal) required are precast and then erected. Since the costing of horizontal elements (roof / floor) often take there time due to erection of form work the completion of the building is delayed and hence this method is restored. In most of the building sites this method is popular more. Son in industrial buildings where the elements have longer spans. Use of double tees, channel units, cored stabs, slabs, hyperboloid shall etc., are some of the horizontal elements.

This method is efficient when the elements are readily available when the building reached the roof level. The delay caused due to erection of formwork, delay due to removal eliminated completely in this method of construction Suitable for any type of building provided lifting and erection equipments are available.

## **Total Prefabrication :**

Very high speed can be achieved by using this method of construction. The method can be employed for frame type of construction or for panel type of or the total prefabrication can be on site or off-site. The choice of these two methods depend on the situations when the factory produced elements are transported and erected site we call it off-site prefabrication. If this method is to be adopted then we have a very good transportation of the products to site. If the elements are cast near the building site and erected, the transportation of elements can be eliminated, but we have consider the space availability for establish such facilities though it is temporary. The choice of the method of construction also depends on the following;

1. Type of equipment available for erection and transport.
2. Type of structural scheme ( linear elements or panel)
3. Type of connections between elements.
4. Special equipment devised for special method construction



## **Modular coordination**

Modular coordination is a concept for coordinating dimensions and space for which building components are positioned. Basic unit of MC is module 1M which is equal to 100mm. MC is internationally accepted by the International Standard of Organization (ISO). The introduction of MC in building facilitate proper planning, design construction and assembly of building components. The principle objective of implementation of MC is to improve productivity, more flexibility in design and construction activities.

### **Modular co-ordination Grid:**

#### **Structural Grid:**

It is used to locate the structural components such as beam and columns.

#### **Planning Grid:**

It is used for locating the space for building components like rooms.

#### **Controlling Grid:**

It is used for locating internal walls. Modular coordinated grid is used for locating the building components and the grids can be available in both horizontal and vertical planes. The grids are generated by measurement in modules.

#### **Dimensional Grid:**

Modular coordinated grid network defines the space available for placing the components. An important factor is that the component must always undersized to grid size for providing space for joint space. Manufactured length of unit nominal length  $11 \frac{1}{2}$  inch grid size would be 12 inch because of units were designed to be placed with  $\frac{1}{2}$  inch joints.

In modular coordination system, in place of geometric series, a different system of preferred dimensions is used. For larger dimensions it is represented in modules like  $1M=0.1m$ , for smaller dimensions sub modular increments 50mm or 25mm are used.

**Modular coordination system provides,**

1. Defining coordinating spaces for building elements and components.
2. Rules for maintaining the component size while manufacturing
3. Rules for selecting the component size and providing the required grid size in building.
4. The MC system allows standardization in design of building components, it encourages manufacturers and assemblers to enter in open market.
5. It is difficult to manufacture the component in SI unit mm tolerance. But it is easier for manufacturer to make in module tolerance system.

### **Advantages of Modular Coordination:**

1. Facilitate cooperation between building designer, manufacturer, traders, contractors.
2. Improves freedom in design and permits flexibility.
3. Encourages the possibility of interchanging the components.
4. Simplifies positioning and placing of components
5. Ensures dimensional coordination between component with the rest of the building.
6. It is possible to get maximum economy in the production of components.
7. Reduces the need for making special sizes.
8. Increases the number of choices of components because of interchangeability.
9. Improves quality and productivity of construction.
10. Wastage in production and time taken for installation of components is reduced.
11. It helps to achieve the responsibility in constructing the building.