C.V. RAMAN POLYTECHNIC, BHUBANESWAR

C.V.Raman Polytechnic

Quality Education for the New Millenium

LECTURE NOTE

ADVANCED CONSTRUCTION TECHNIQUES & EQUIPMENT,
(Th.3)

SEM-6th

BRANCH- CIVIL ENGINEERING

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Ch-1 Advance construction Material

Fibers and Plastics:-

(a) Fibers as construction Material :-

→ Fibers are consider as a construction material to enhance the flexuteral and tensile strength and as a binder that could combine Portland cement in bonding with cement matrices.

→ Fibers is such as raintorcing material small pieces of ~~transtorcing~~ raintorcing processing suddern characteristics and properties.

→ Fibers are usually used in concrete to control cracking due to plastic shrinkage and drying shrinkage.

(b) Types of fibers:-

(1) Glass fibers:-

→ Different types of glass exbit with various colour chemical composition and characteristic.

→ Glass fiber have grade mechanical properties and exel in terms of strength. thermal properties and have good interfacial bonding to the matrics.

→ Glass fibers are generally used to raintorce Polypropy system.

→ A composite is formed between the element to form an exellent material.

→ The resulting composite is cost effective easy to Proqueere and Porreeer and toughnerr Characteristic to glaer biber.

(b) Steel biber :-

→ similar to traditional steel reinforcement the Key characteristic of steel biber is they are high tenrile capacity.

→ Steel biberr have been broadly rtudid in concrete application hence they are commonly ureed to improve the Mechanical properties of concrete.

→ Steel biberr help in improving the concrete behaviolen in terme of cracking, shrinkage, ductility, toughnerr, impact and blart loading.

→ The rtrength increare is due to the steel biberr characteristic of absorbing energy and controlling crack.

→ Steel biberr can be an ideal aditive to specitic application as they porreeer good electric, Magnet and heat conductivity.

(c) carbon biber;- (carbon content in carbon biber 93-95%.)

→ carbon biber having added in materiale to form composite with improve properties.

→ The addition of carbon biber create a composite that has outstanding Mechanical Propertiee Perform well in high temperature environment

and possess the benifit of durability.

→ The disadvantage of carbon fiber are that due to their excellent properties the expense of manufacturing carbon fiber is high.

→ Similar to glass fiber although there are many positives and benifits to carbon fiber the production of carbon fiber leads to concern for the environment and portraible sustanability.

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Properties of Fibers :-

→ High tensile strength and modules of elasticity.

→ High resistance to weather, acidic environment and some alkali resistance.

→ Good thermal properties and stability can tollered and perform well in high temprature environment.

→ Good electric, electric management and sound insulation property.

→ Good resistance and stability against corrosion, chemical attack, impact load and time.

Non reactive and Non-combustible :-

→ Low absorbtion and thermal conductivity
→ Absorb sound, vibration and isolation.
→ Resistant to radiation UV light.
→ Strong, hard and rigid.
→ Easy to produce and process.
→ cost efficient.

→ Use to form light wave composite with accelent Properties.
→ Require no chemical aditives.
→ Natural and bio-degreedable.
→ Ecologically clean easy to handle and non toxic.

Use or Application :-

→ Improve characteristic and Properties such as strength toughness, durability, rigidity and ductility.

→ Improve resistance and Performance in different environment and against Physical and chemical corrosion and other attach.

→ Improve stability, thermal Properties and operating temprature.

→ Reduction of heat conductivity.
→ Reduction of the specific weight and density resulting in a light weight product that is both energy and cost efficient.

→ Reduction and lower cost of design and installation, each fiber can replace traditional reinforcement method.

→ Prevent the occurance of shrinkage crack and swelling.

→ Improved environmental ——→ Friendliness.

→ Economic efficiency and sustainability.

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 use plastic for a wide range of application because of its versatility strength to weight ratio, durabilit corrosion resistance and show on.

→ Plastic can be manufactured in to formed such as pipes cables coverings, tunnel sheet etc. 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 covering
→ Sinks, basins, baths and showers

→ The advantages of using plastic in construction are that it is light weight yet strong which makes it easier

to transport and shart around sites. It is also resistante 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 decreased 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 light weight, chemical resistant. Due to its closed cell nature polyurethane insulation performs as an 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. poly carbonate windows are considered more burglar-proof commonly than regular glass windows. two plastic 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 light weight, 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 and 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 and construction division, HDPE pipes are used for ground source geothermal applications, also known as earth energy or geo exchange systems.

FRP :-

→ Fibre-reinforced plastic (FRP) (also called fiber-

reinforced polymer). FRP bars are used as internal reinforcement for concrete structure. 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 insulative, and resistant to shock, corrosion, chemicals and water.

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Artificial timber:-

→ Reduction of moisture content along with improving some some quantities before the use of wood is called seasoning of timber. By seasoning, generally

the moisture is reduced to about 15-1. Where new cut woods bear about 50-1.

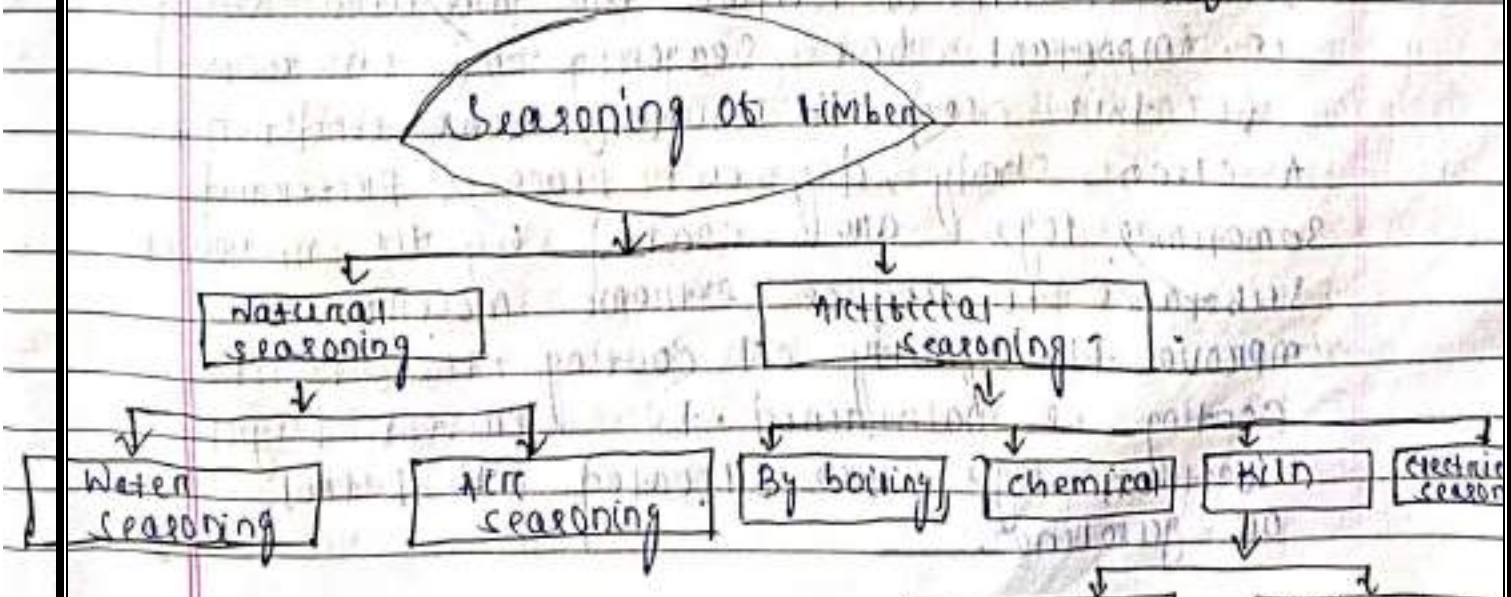
Reasons for seasoning :-

→ Seasoning of timber is done to fulfill some specific requirement. following 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 wood.
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. There 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 in to 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 fugal 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 left 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 a process such as :-

$CaSO_4 \cdot 2H_2O$ (Gypsum)

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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 :- it is 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.

Miscellaneous Material :-

→ A category of asbestos containing building materials comprised mostly of non-fewable asbestos products and materials such as ceiling, tiles, floor tiles, roofing felt, transit pipe and panels, exterior siding, fabrics etc.

Acoustics Materials-

→ When the sound intensity is more than it gives the great troubles to the particular area like auditorium, cinema hall, studio, entertenment hall college, reading hall etc.

→ Hence it is very important to make that area or room to be sound proof by using a suitable material called as acoustics material.

Properties of Acoustics material :-

→ Sound energy is capture and absorbed.
→ It has a low reflection and high absorbtion of sound.
→ Higher density improves the sound absorbtion efficiency at lower frequency.
→ Acoustics material reduces the energy of sound ways as they passed through.
→ It suppresses echos, river beration and reflection.

Uses of Acoustic materials :-
→ Acoustic material can be used for noise reduction and noise absorbtion.
→ It makes the sound more audiable which is clear to listen without any disturbances.
→ A vinyl acoustic barrier block controls

air borne noise like street traffic, voice, music from passing through a wall ceiling or floor.

→ sound proof door and ~~windows~~ Windows are designed to reduce the transmission of sound.

→ Acoustic foam and acoustic ceiling tiles absorb sound as to minimize echo and reflection within a room.

Adhesive :-

→ construction of adhesive is a general-Purpose adhesive use for attaching dry wall, tile, molding and fixtures to walls, ceilings and floors. it is most commonly available in tubes intended for use-

→ 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 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

Plaster board :-

→ Plaster board 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 "dry wall" 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 application

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 4.75mm which are processed by mechanical crushing and sieving but does not include soft and weathered granules.

Bonding Agents :-

→ Bolding agents are natural or compounded or synthetic materials used to enhance the joining of individual members of a structure without employing mechanical fasteners. the most common

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 on concrete, the reduced water cement ratio can be adopted for the same workability, thereby reducing drying shrinkage.

~ Uses of Acoustic material :-

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

→ It makes the sound more audiable which is clear to listed without any disturbances.

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

3. Important specifications for noise reduction and noise absorbtion products include noise attenuation and noise reduction co-efficient.

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.

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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

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 practices 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 part 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 Srilanka 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 ministers of D. José I, a new Pombaline style of architecture and urban planning arose, which introduced early anti-seismic design features and innovative

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Prefabricated construction methods, according to which large multistory buildings were entirely manufactured outside the city, transported in pieces and then reassembled on site. The process, which lasted into the nineteenth century lodged the city's residents in safe new structures unheard-of before the quake.

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 form work required to mould concrete components on site and delivering wet 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 on 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 on frame-wood construction in particular benefits from the improved quality. However tradition often favors building by habit in many countries and the image of Prefab as a "cheap" method only shows its adoption. However, current practice already allows the modifying the floor plan according to the customers 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 system often 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.

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Types of Prefabricated System:-

→ There are two main type of prefabrication mainly volumetric or modular and panelized.

→ Both of these type of construction can be achieved in timber, steel and concrete.

→ Steel system for housing are usually light gauge galvanised steel.

→ Timber system can be relatively traditional which might be produced on site using component such as timber stud.

→ It can make use of timber becoms which gives longe life span with a relatively light weight beam.

→ A third option is structural insulated panel system which use fewer stud and rely in part on the bond between rigid insulation core and outer sheaphing material for strength.

→ One factor that differentiate all Pretabricated timber system from what might be traditional timber frame is the amount of work undertaking in the factory.

Classification of Pre tabrication;-

(A) Small Pre tabrication.
(B) Medium Pre tabrication.
(C) Large Pre tabrication.
(D) Partial Pre tabrication.
(E) Open system Pre tabrication.
(F) Close system Pre tabrication.
(G) Total Pre tabrication.
(H) Cast inside the tabrication.
(I) OFF side Pre tabrication.

Classification of Pre tabricated construction system;-

1. Smaller degree fabrication: (Here the fabrication is done in the smaller scale).

2. Medium degree Pre fabrication:- (Hence the Prefabrication is done in the moderate shape).

3. Large degree Pre fabrication:- (Hence the Prefabrication is done in the large scale).

Advantages:-

→ Moving Partial assemblies from a factory often cost less than moving Pre-production resources to each side.

→ Deploying resources on side can add cost, Prefabricating assemblies can save cost by reducing on side work.

→ Factory tools like crains, conveyors etc. can made production faster and more precise.

→ Factory tools like shape table hydraulic jetters can often added quality assurance.

→ consistent indoor environment of factories eliminate most impact of weather on production.

→ Crains and reusable factories supports can allow shape and sequences without expensive

on site labour work:

→ Factory production can facilitate more optimal usage recycling, noise capture, dust capture etc.

Disadvantage:-

→ Transportation cost may be higher for voluminous Pre fabricated section than for their constituent materials.

→ Large prefabricated section may require heavy duty and precision measurement and handling to place in position.

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 section 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 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 assembly 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.

→ 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 fitting 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.

Design principle 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. consistency in ~~structural quality control~~ availability of site resources (e.g material and labour)

6. ~~Fast speed of construction.~~

- other space and 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.

→ superiority of adopting precast construction over convention method.

→ The following details give the cost implications of precast construction and conventional in situ method.

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

1. Local jobs are lost.

→ 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

3. consistency in structural quality control.

4. Fast speed of construction.

5. constraints in availability of site resources. eg

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materials and labour etc.
6. other space and environmental constraints.
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 and conventional site method.

Prefabrication Elements :—
1. Flooring / Roofing system.
2. precast Beams
3. precast columns.
4. precast Wall panels.
5. precast stabs.

Classification :—
→ The prefabrication is classified as follow from the view of degree of Precast construction.

1. small prefabrication.
2. medium Prefabrication.
3. large Prefabrication.
4. cast on 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 type are mainly classified according to their degree of precast.

→ Elements using 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 positio

Medium prefabrication :—

→ Suppose the roofing systems and horizontal members are provided with precasted elements those construction 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 wall mode of transport, vehicles are the factors which prefabrication is to be done on site or in factory.

→ Suppose the factory situated at a long distance

from the construction site and the vehicle have to cross a congested traffic which heavy weighed elements the cost (inside Prefabrication) is preferred even through the same condition are the cost inside 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 frames 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 casting of horizontal elements (roof/floor) often take more time due to erection of frame 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 so on industrial buildings. Where the elements have longer spans. Use of double tees, channel units, cored 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 form work, delay due to removal eliminated completely in this method of construction suitable for any type of building provided fitting 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 ~~situation~~ Prefabrication can be on site or off site. The choice of these two methods depends on the situations. When the factory produced elements are transported and erected site we call it off-site Prefabrication. If this method is 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 through it is temporary. the choice of the method of construction also depends on the following :-

1. Type of equipment available for erection and transpo

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

Modular co-ordination:-

→ Modular co-ordination is a concept for co-ordinating dimensions and space for which building components are positioned. Basic unit of mc is Module 1m which is equal to 100m. 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 column.

Planning grid:-
→ It is used for locating the space for building components like rooms.

Controlling Grid:-
→ It is used for locating internal walls modular co-ordinated 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 co-ordinated 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 1/2 inch grid size would be 12 inch because of units were designed to be placed with 1/2 inch joints.

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

✓ Advantages of modular co-ordination :—
1. Facilitate co-operation between building designers, manufacturers and trades 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 co-ordination between components 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 a 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.

Earthquake resistant construction

Unit:- Building configuration

→ Buildings having simple regular Geometry and uniformly distributed mass and stiffness in plan as well as in elevation suffer much less damaged is known as building configuration.

→ The configuration of building (Plan and Elevation) should be as simple as possible.

→ The ~~form configuration~~ formation should generally be based on hard and uniform ground.

→ The members resisting horizontal forces should be arrange show that the torsional deformation is not produced structure of building should be dynamically simple and definite the frame of building structures should have adequate ductility in addition to required strength.

⇒ The building shaped like a box such as rectangular in both plan and elevation is inherently

Stronger than one that is U-shaped ex:- A building with wings.

→ The effect gives origin to undesired stresses concentration in some resisting members of the building.

~ Lateral load Resisting structure:-

→ The first step in architectural planning of a building is to select the lateral load resisting system.

→ The load resisting system must be closed loops so that it is able to transfer all forces acting either vertically or horizontally on ground.

→ BIS has approved three measured types of lateral resisting system such as
(1) Moment resisting frame.
(2) Bearing wall system.
(3) Dual system.

Building characteristics in earthquake resistant construction:-

→ ~~Building characteristics~~ The following assumption should be made in a earthquake resistant design of structure:-

→ Earthquake causes impulsive ground motion which are complex and irregular in character changing in period and amplitude each lasting for a small duration. Therefore resonance of the type as visualized under a rigid stay sinusoidal

excitation will not occur as it would need to built of such amplitude.

→ Earthquake is not likely to occur symaltaneously with wind on maximum flood or maximum sea wave.

→ The value of elastic modulus of material whenever required may be taken as for starting analysis unless a more definite value is available for use in such condition.

Structural irregularity in building :-

→ A building that lacks symmetry and has discontinuity in Geometry mass or load resisting element is called irregular.

→ The irregularities may caused interaction of force flow and stress concentration a symmetrical arrangement of mass and stiffness of element may caused a large torsional coarse. the irregularities may be classified as :- (a) Horizontal irregularities or plan configuration Problem.

(b) Vertical irregularities

Horizontal irregularities :-

⇒ Refers to sudden change of strength stiffness

Geometry and Mass which results in irregular distribution of forces and deformation over the height of building. they are also known as plan configuration problem. and they are follows :-

(i) Torsion irregularities :- Torsion irregularity is considered when the floor diphargms are rigid in their own plan in relation to vertical structural element that resist the lateral force.

(ii) Diphargm discontinuity

→ Discontinuity in diphargm stiffness lead to plan irregularity the diphargm is a horizontal resistant element that is responsible for transferring forces betn vertical resistance elements.

(iii) Re entrant corners :-

→ The re entrant or inward cutting corners is a common irregularity in overall building configuration that in plant assume the shape of L TH or combination of these shapes resulting lack of tensile capacity and force concentration.

→ The reentrant corner of the buildings are subjected to two types of problem the first is that they tend to Produced variations of rigidity and hence differential motions betn different