B. ARCHITECTURE

CONSTRUCTION TECHNOLOGY (AR6013)

CONTRUCTION PRACTICE

Lecture – 4

Precast Concrete Elements for Manufacture:

The Manufacture of the component done in a factory for the commercial production established at the focal point based on the market potential or in a site pre-casting yard set up at or near the site of work. So what are precast concrete elements first of all, the precast concrete elements are something we have learned about concrete earlier. So precast there are two types of preparation of concrete elements, one is on site preparation and the second is it can be manufacture parts of elements. The elements of concrete can be manufactured in a factory in a yard and it can be brought to the site and it can be fixed like building blocks on the site, so we will talk about it now the due codes of the lecture and also we will learn how these precast concrete elements, what are the properties of precast concrete elements, how are they created on site, how are they created offside, how are they lifted, how are they transported to the site and how to create the moulds and how to put together to form beautiful structures. So first of all we talk about

- Factory Prefabrication is resorted to in a factory for the commercial production for the manufacture of standardized components on a long term basis. We most often we use standardize components for example bridge constructions, for example girders, for example even parts of columns, for other structural materials, for sheer walls etc. we use precast concrete elements in the construction industry, we use prefabrication of concrete in the construction industry for many components and in it has variety and important uses. It is a capital intensive production where work is done throughout the year preferably under a closed shed to avoid effects of seasonal variations. High level of mechanization can always be introduced in this system

where the work can be organized in a factory like manner with the help of a constant team of workmen.

- Site Prefabrication: In this scheme, prefabricated components are produced at site or near the site of work as possible. Under this category there are two types that is semi-mechanized and fully-mechanized

- Semi Mechanized mode works normally carried out in open space with locally available labour force. The equipment machinery used nay be minor in nature and moulds are of mobile of stationary in nature

- Fully Mechanized: The work carried out under shed with skilled labour. The equipment's used are similar to one of factory production. This type of precast yards will be set up for the production of precast components of high and precise quality and this would also have high rate of production.

The various processes involved in the manufacture of precast elements are classified or listed as below, the main process

- Providing and assembling the moulds, placing reinforcement cage in position for reinforced concrete work and stressing the wires in the case of pre-stressed elements
- Putting concealed service conduits or pipes
- Fixing of inserts and tubes wherever necessary for handling
- Pouring the concrete into the moulds
- Vibrating the concrete and finishing
- Curing can be done steam curing can be done if necessary and
- Demoulding he forms and stacking the precast products

Auxiliary Process

Process such as the following as listed below, necessary for the successful completion of the processes covered by the main process:

- Mixing and manufacture of fresh concrete done in a mixing station or by a batching plant
- Prefabrication of reinforcement café that is done in a steel yard or workshop

- Manufacture of insets and other finishing items to be incorporated in the main precast products
- Finishing the precast products and
- Testing of products

There is the process called subsidiary process. All other works are listed below or involved keeping the main production work to a cyclic working. For example

- Storage of materials
- Transport of cement and aggregates, the transportation or raw materials is important
- Transport of green concrete and reinforcement cages
- Transport and stacking the precast elements
- Repairs and maintenance of tools, tackles and machines is very important
- Repair and maintenance of moulds
- Maintenance of curing yards and
- Generation of steam, etc.

For the manufacture of precast elements all this processes shall be planned in a systematic way to achieve the following

- A cyclic technological method of working to bring in speed and economy in manufacture
- Mechanization of the process to increase productivity and to improve quality
- The optimum production satisfying the quality control requirements and to keep up the expected speed of construction aimed
- Better working conditions for the people on the job
- Minimizing the effect of weather on the manufacturing schedule.

Another precast concrete elements are very important in the construction industry for one important thing that I want to add it right now is the precast concrete elements with the use of precast concrete elements the construction is super-fast because we don’t have to rely on the side conditions, we don’t have to rely on man power at the site, you know the mistakes are made by men at site because the manufacturing process is mechanized and so there is no room for any error and it is the very quality product, it is a very finish product and it there are no deviation two

components are exactly a like there are now deviation from each other, So if you can see the table here the various stage of manufacture of the precast concrete elements are elaborated here in this table. If you see here this are the serial number, this are the precasting stages, the various stages one by one, one after the other this are the names of process and this are the operations involved. I will briefly go take you through the table.

- Procurement and storage of construction materials, the operations involved in coarse -Unloading and transportation of concrete, coarse and aggregates and steel and storing them in bins, silos or storage sheds.
- Testing of materials – Testing of all materials including steel
- Design of concrete mix – Testing of raw materials, plotting of grading curves and trial of mixes in laboratory.
- Making of reinforcement cages – Unloading of reinforcement bars from wagons or Lorries and stacking them in the steel yard, cutting, bending, lying or welding the reinforcements and making in the form of a cage which can be directly introduced into the mould.
- Applying form release agent and laying of moulds in position – Moulds are cleaned, applied with form release agent and assembled and placed at the right place
- Placing or reinforcement cages, inserts and fixtures – The reinforcement cages are placed in the moulds with spacers, etc. as per data sheet prepared for the particular prefabricate
- Preparation of green concrete – Taking out aggregates and cement from bins, silos etc. batching and mixing.
- Transportation of Green Concrete – Now the green concrete that now we prepared has to be transported from the mixer to the moulds. In the case of precast method involving direct transfer of concrete from mixer to the mould or a concrete hopper attached to the mould this prefabrication stage is not necessary.
- Pouring and consolidation of concrete – Concrete is poured and vibrated to a good finish
- Curing of concrete and demoulding – Either a natural curing with water or an accelerated curing and other techniques can be done. In the case of steam curing trenches or autoclaves this stage involves transport of moulds with the green concrete into the trench or autoclave and taking them out after the curing and demoulding elements. Cutting of protruding wires also falls in this stage. In certain cases the moulds

have to be partly removed and inserts have to be removed after initial set. The total demoulding is done after a certain period and the components are then allowed to be cured. So all these fall in this operation.

- Stacking of precast elements together – Lifting of precast elements from the mould and transporting to the stacking yard for further transport by trailer or rail is part of this stage.
- Testing of finished components, now test are a important part because without testing we cannot use it for a structural uses – So tests are carried out on the components individually and in combination to ensure the adequacy of their strength.
- Miscellaneous – For example generation of steam involving storing of coal or oil necessary for steam generation, now second is repair of machines used in the production

So these are the various stages and including miscellaneous activities which are done to produce precast concrete elements. I would like to take you to this figure that is the plant process used for the manufacturing precast concrete elements. Now if you see here there is water, there is fine aggregate, there is coarse aggregate and there is cement all this are measured mixed and they are put together in a Mixture and then there is Mild Steel and there is High tension wires, so this are cut, these are bended and these are binded together and then high tension wires are Threaded, Stressed they are binded together and then the moulds are put together. So in this case what happens there are moulds we have the concrete and then we have the cage that are made up of steel wires, mild steel bars put together in the shape of form we want to put concrete in to, so now what we do is we put the mould, we take the mould we put all this together and then we fill concrete inside, so now happens compacting and then the next step happens curing and detentioning then the happens demoulding, now one important critical step is how this moulds are formed, first of all the formation of moulds also can be done in prefabricated way there are the moulds are basically made up of steel and moulds can also be made up of wood so in these moulds can be reused you know till different processes you know, this moulds can be used and reused and this can be again used for the formation of the precast elements. So here you see once it is demoulded it is cleaned it is fitted if there is any dimension to the mould and then it is again oiled and put to the use of another precast element and then the concrete is coming out of demoulding is cured in the yard and then it is

tested and dispatched by road or by rail. So these are in a flow chat way all the activities that are required for manufacturing the precast elements.

Precast Concrete Elements:

So second point we get the precast elements from the yard. So now how would be prepared and where would be stored.

Preparation & Storage of Materials

Storage of materials is of considerable importance in the precasting industry. From experience in construction, it is clear that there will be very high percentages of loss of materials as well as poor quality due to improper storage and transport. So, in a precast factory where everything is produced with special emphasis on quality, proper storage and preservation of building materials especially cement, coarse and fine aggregates is of prime importance. Storage of materials shall be done in accordance with IS standard 4082.

Moulds

As I described earlier briefly now I will go through properly. The moulds for the manufacture of precast elements may be of steel, timber, concrete and plastic or a combination all of these, For the design of moulds for the various elements, special importance should be given to easy demoulding and assembly to the various parts. At the same time rigidity, strength and water tightness of the mould is an important part taking into consideration the forces which are exerted on the mould due to pouring of green concrete and vibration

Tolerances

The moulds have to be designed in such a way to take into consideration of suitable tolerances

Slopes of the Mould walls

For easy demoulding of the elements from the mould with fixed sides, the required slopes have to be maintained. Otherwise there is a possibility of the elements getting stuck up with the mould at the time of demoulding and it will spoil the concrete.

Accelerated Hardening

In most of the precasting factories, it is economical to use faster curing methods or artificial curing methods, which in turn will allow the elements to be demoulded much earlier permitting early re-use of the forms

Any of the following methods may be adopted:

- By heating the aggregates and water before mixing the concrete
- By steam curing
- By steam injection during mixing of concrete
- Heated air method
- Hot water method
- Electrical Method

After the accelerated hardening of the above products by any of the above accepted methods, the elements shall be cured further by normal curing methods to attain full final strength. Curing for any concrete component curing is an important part, the curing of the prefabricated elements can be effected by the normal methods of curing and sprinkling water and keeping the element moist, this can also be done in case of smaller elements by immersing them in a specially made water tank. In all this cases, the difference between the temperature of the concrete product and the outside temperature should not be more than 60° C for concretes up to M30 and 75° C for concretes greater temperature should not be more than 60°C for concretes less than M25. For concretes greater than M50, the temperature differences can go up to 75° C

Stacking During Transport And Storage

The following points shall be kept in view during stacking

- Care should be taken to ensure that the flat elements are stacked with right side up. For identification, top surfaces should be clearly marked
- Stacking should be done on a hard and suitable found to avoid any sinking of support when elements are stacked
- In case of horizontal stacking, packing materials shall be at specified locations and shall be exactly one over the other to avoid cantilever stress in panels.
- Components should be packed in a uniform way to avoid any undue projection of elements in the stack which normally is a source of accident. Curing of the prefabricated elements can be effected by the

normal methods of curing by sprinkling water and keeping the elements moist.

Handling Arrangements

- Lifting and handling positions shall be clearly defined particularly where these sections are critical. Where necessary special facilities such as bolt holes or projecting loops shall be provided in the units and full instructions supplied for handling. For the purpose of testing the bolts/hooks, bond strength shall be the criteria for embedded bolts and bearing strength for through bolts, for bond strength, pull out test of concrete shall be carried out.
- For precast pre-stressed concrete members, the residual prestress at the age of particular operation of handling and erection shall be considered in conjunction with any stresses caused by the handling or erection of member. The compressive stress thus computed shall not exceed 50 percent of the cube strength of the concrete at the time of handling and erection. Tensile stresses up to limit of 50 percent above those specified in IS 456 shall be permissible

Identification and Marking

1) All precast units shall bear an indelible identification, location and orientation marks as and where necessary. The date of manufacture shall also be marked on the units.
2) The identification markings on the drawings shall be the same as that indicated in the manufacturer's literature and shall be shown in a table on the setting schedule together with the length, type, size of the unit etc. that the time of construction all these units fall into place as per the drawing.

Transport

Transport of precast elements inside the factory and to the site of erection is of considerable importance not only from the point of view of economy but also from the point of view of design and efficient management. Transport of precast elements must be carried out with extreme care to avoid any jerk and distress in elements and handled as far as possible in the same orientation as it is to be placed in final position.

The transportation can happen in two types, one is transport inside the factory now all this precast elements moulded inside the factory can be transported from one place to another and this depends the method of production is selected for the manufacture. Transport from stacking yard inside the factory to the site of erection. The transport of precast concrete elements from the factory to the site of erection should be planned in such a way so as to be in conformity with the traffic rules and regulations as stipulated by the authorities. The size of the elements is often restricted by the availability of suitable transport equipment, such as tractor- cumtrailers, to suit the load and dimensions of the member in addition to the opening dimensions under the bridge and load carrying capacity while transporting the elements over the bridges, so it's the important point if we have massive precast concrete element we cannot transported it's of no use, so we have to check the heights available under the bridges of its way to site we have to check the dimensions available for the transport vehicle, trailers, tracks etc. So it is very important point that the precast elements have to be transported from the factory to the site where it has to be erected.

- While transporting elements in various systems care should be taken to avoid excessive cantilever actions and desired supports are maintained.
- Before loading the elements in the transporting media, care shall be taken to ensure that the base packing for supporting the elements are located at specified positions only. Subsequent packing's shall be kept strictly one over the other.

Erection of the Precast Elements

In the erection of precast elements all the items of work shall be included

- Slinging of the precast element
- Trying up of erection ropes connecting to the erection hooks
- Cleaning of the elements and the site of erection
- Cleaning of the steel inserts before incorporation in the joints lifting up of the elements setting them down into the correct envisaged position
- Adjusting to get the stipulated level, line and plumb
- Welding of cleats
- Changing of the erection tackles
- Putting up and removing of the necessary scaffolding or supports

- Welding of the inserts laying of reinforcements in joints and grouting the joints
- Finishing the joints to bring the whole work to a workmanlike finished product

Equipment

The equipment's used in the precast industry or construction may be classified in to the following categories.

- Machinery requires for quarrying of coarse and fine aggregates
- Conveying equipment's such as Belt conveyors, chain conveyors, screw conveyors, bucket elevators, hoists etc.
- Concrete mixing machines
- Concrete vibrating machines
- Erection equipment such as cranes, derricks, hoists, chain pulley blocks, etc.;
- Transport machinery such as tractor-cum trailers, dumpers, lorries, locomotives, motor boats and rarely even helicopters
- Workshop machinery for making and repairing steel and timber moulds
- Bar straightening, bending and welding machines to make reinforcement cages
- Minor tools and tackles such as wheel barrows, concrete buckets, etc.
- Steam generation plant for accelerated curing

In addition to all this pumps and soil compacting machinery are required at the building site for the execution of civil engineering projects involving prefabricated components. Each of the above groups may further be classified into various categories of machines and further to various other types depending on the source of power and capacity.

Mechanization of the Construction and Erection Processes

These various processes can be mechanized as in any other industry for attaining the advantages of mass production of identical elements which in turn will increase productivity and reduce the cost of production in the long run, at the same time guaranty quality wise perfect without the end product.

On the basis of the degree of mechanization used the various precasting factories can be divided into three categories

- Simple Mechanization
- Partial Mechanization
- Complex Mechanization leading to automation
- In simple Mechanization, simple mechanically operated implements are used to reduce the manual labour and increase the speed.
- In partial mechanization, the manual work is more or less eliminated in the part of a process. For example the batching plant for mixing concrete, hoist to lift materials to a great height and bagger and bulldozer to do earthwork come under this category.
- In this case of complex mechanization leading to automation, a number processes leading to the end product are all mechanized to a large extent without or with a little manual or human element involved. This type of mechanization reduces manual work to the absolute minimum and guarantees the mass production at a very fast rate and minimum cost
- For equipment's relevant Indian standards.

Safety in Dismantling:

Safety principles involved that should take care while dismantling a structure. Now demolition is dismantling, racing, destroying or racking of any building or structure or any part thereof, the demolition works involves the hazards associated with construction. However demolition involves additional hazards due to unknown factors which make demolition work very dangerous. These may include

- Changes from the structure's design introduced during construction
- Approved or unapproved modifications that altered the original design;
- Materials hidden within structural members, such as lead, asbestos, silica, and other chemicals or heavy metals requiring special material handling. It may also happen that radioactive materials may be inside a structure and we do not know when we demolished that we have to take specialize percussions
- Unknown strengths or weaknesses of construction materials such as post tensioned concrete
- Hazards created by the demolition methods used

So in a Broadway while dismantling a structure it is very important to have to follow the safety procedures it is because when we are making the new structure we know what we are doing, we know what we are creating when a structure already exist is very difficult to determine how that particular structure is made up of so it is very it requires lot of planning, a proper methodology and proper inspection to achieve proper dismantling without any accidents.

To combat these, everyone at a demolition worksite must be fully award of the hazards they may encounter and the safety precautions they must take to protect themselves and their employees

Plan ahead to get the job done safely

An engineering survey completed by a competent person before any demolition work takes place. This should include the condition of the structure and the possibility of an unplanned collapse, the structural engineer, the competent authority should cross check that the structure is safe and sound due to demolished and the structure will not collapse unplanned. Locating, securing and/or relocating any nearby utilities. We should check and ensure that there are no mass construction areas like bus stops, like hospitals, like schools etc., so that they it does not the dismantling do not cause any damage to this institutions.

Fire preventions and Evacuation Plan

First aid and emergency medical services and assessments of health hazards completed before any demolition work take place so we need to know what we are dismantling in that regards we have to know that what that particular made up of when because every material for example aspetras, when aspetras when demolished it can cause grave injury to our lungs and also important to

Provide the right protection and equipment

The employer who is overseeing and dismantling process he should provide the right equipment in demolition operation the protections may include eye, face, head, and hand for protection.

Respiratory protection, hearing protection, personal fall arrest systems. Other protective clothing for example cutting or welding operations.