FAQ's

1. Write a note about pre cast concrete elements highlighting steps from manufacture to erection.

- The manufacture of the components can be done in a factory for the commercial production established at the focal point based on the market potential or in a site precasting yard set up at or near the site of work.
- Factory prefabrication is resorted to in a factory for the commercial production for the manufacture of standardized components on a long-term basis. 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

The work is normally carried out in open space with locally available labour force. The equipment machinery used may be minor in nature and moulds are of mobile or stationary in nature.

Fully-mechanized

The work carried out under shed with skilled labour. The equipments 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 quality, high rate of production.

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

Main process

a) 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;

b) Putting concealed service conduits/pipes;

c) Fixing of inserts and tubes, where necessary (for handling);

d) Pouring the concrete into the moulds;

e) Vibrating the concrete and finishing;

f) Curing (steam curing, if necessary); and

g) Demoulding the forms and stacking the precast products.

Auxiliary process

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

a) Mixing and manufacture of fresh concrete (done in a mixing station or by a batching plant);

b) Prefabrication of reinforcement cage (done in a steel yard or workshop);

c) Manufacture of inserts and other finishing items to be incorporated in the main precast products;

d) Finishing the precast products; and

e) Testing of products.

Subsidiary process

All other works, such as the following, involved in keeping the main production work to a cyclic working:

a) Storage of materials;

b) Transport of cement and aggregates;

c) Transport of green concrete and reinforcement cages;

d) Transport and stacking the precast elements;

e) Repairs and maintenance of tools, tackles and machines;

f) Repair and maintenance of moulds;

g) Maintenance of curing yards; and

h) Generation of steam, etc.

i) For the manufacture of precast elements all the above processes shall be planned in a systematic way to achieve the following:

   a) A cyclic technological method of working to bring in speed and economy in manufacture;

   b) Mechanization of the process to increase productivity and to improve quality;

   c) The optimum production satisfying the quality control requirements and to keep up the expected speed of construction aimed;

   d) Better working conditions for the people on the job; and

   e) Minimizing the effect of weather on the manufacturing schedule.

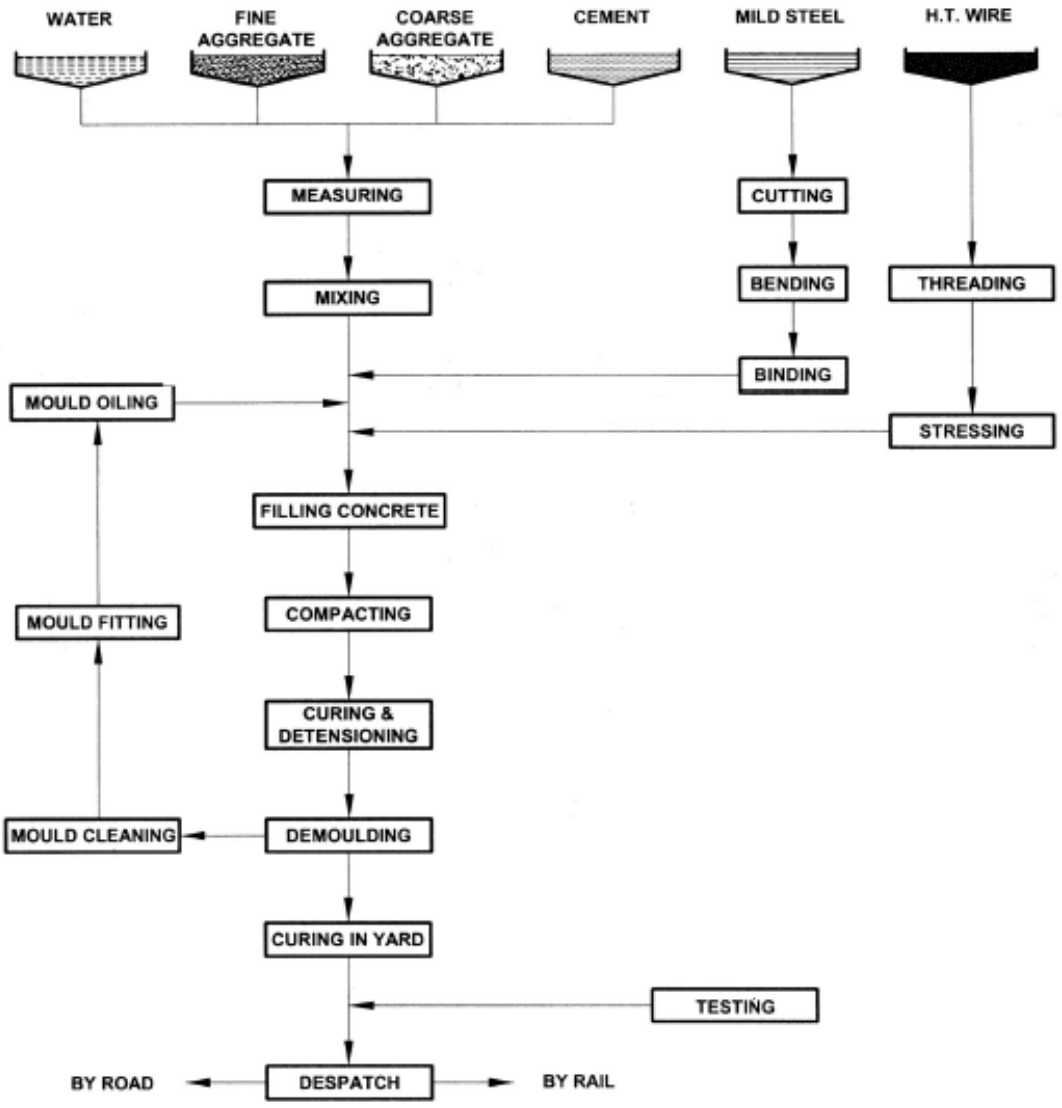
Manufacturing Stages:

Table 2 Stages of Precasting of Concrete Products
(*Clause* 11.1.5)

Sl No. (1)	Precasting Stage No. (2)	Name of Process (3)	Operations Involved (4)
i)	1	Procurement and storage of construction materials	Unloading and transport of cement, coarse and aggregates, and steel, and storing them in bins, silos or storage sheds
ii)	2	Testing of materials	Testing of all materials including steel
iii)	3	Design of concrete mix	Testing of raw materials, plotting of grading curves and trial of mixes in laboratory
iv)	4	Making of reinforcement cages	Unloading of reinforcement bars from wagons or lorries and stacking them in the steel yard, cutting, bending, tying or welding the reinforcements and making in the form of a cage, which can be directly introduced into the mould
v)	5	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
vi)	6	Placing of 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
vii)	7	Preparation of green concrete	Taking out aggregates and cement from bins, silos, etc, batching and mixing
viii)	8	Transport of green concrete	Transport of green concrete 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

ix)	9	Pouring and consolidation of concrete	Concrete is poured and vibrated to a good finish
x)	10	Curing of concrete and demoulding	Either a natural curing with water or an accelerated curing using steam curing and other techniques. In the case of steam curing using 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. All these fall in this operation
xi)	11	Stacking of precast elements	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
xii)	12	Testing of finished components	Tests are carried out on the components individually and in combination to ensure the adequacy of their strength
xiii)	13	Miscellaneous	a) Generation of steam involving storing of coal or oil necessary for generation of steam and providing insulated steam pipe connection up to the various technological lines b) Repair of machines used in the production

Plant Process:



Preparation & Storage of Materials:

Storage of materials is of considerable importance in the precasting industry, as a mistake in planning in this aspect can greatly influence the

economics of production. 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 4082.

Moulds:

Moulds for the manufacture of precast elements may be of steel, timber, concrete and plastic or a combination thereof. For the design of moulds for the various elements, special importance should be given to easy demoulding and assembly of the various parts. At the same time rigidity, strength and water tightness of the mould, taking into consideration forces due to pouring of green concrete and vibrating, are also important.

Tolerances

The moulds have to be designed in such a way to take into consideration the 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.

Accelarated 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
- Steam curing
- 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

The curing of the prefabricated elements can be effected by the normal methods of curing by sprinkling water and keeping the elements moist. This can also be done in the case of smaller elements by immersing them in a specially made water tanks.

In all these 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 than M45. In the case of light weight concrete, the difference in 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 ground 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. This can also be done in the case of smaller elements by immersing them in a specially made water tanks.

Handling Arrangements

1. 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.

2. 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 a 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 and the sizes and arrangement of all reinforcement.

3. 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.

4. 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.

Transport Inside the Factory

Transport of precast elements moulded inside the factory depends on the method of production, selected for the manufacture.

Transport from Stacking Yard inside the Factory to the Site of Erection

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-cum trailers, 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 bridge.

1. While transporting elements in various systems, that is, wagons, trucks, bullock carts, etc, care should be taken to avoid excessive cantilever actions and desired supports are maintained. Transportation of prefabricated element should be done with safety ties and vibrations to the elements in transit should be minimum. Special care should be taken at location of sharp bends and on uneven or slushy roads to avoid undesirable stresses in elements.
2. 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 packings shall be kept strictly one over the other.

Erection:

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

a) Slinging of the precast element;

b) Tying up of erection ropes connecting to the erection hooks;

c) Cleaning of the elements and the site of erection;

d) Cleaning of the steel inserts before incorporation in the joints, lifting up of the elements, setting them down into the correct envisaged position;

e) Adjustment to get the stipulated level, line and plumb;

f) Welding of cleats;

g) Changing of the erection tackles;

h) Putting up and removing of the necessary scaffolding or supports;

j) Welding of the inserts, laying of reinforcements in joints and grouting the joints; and

k) Finishing the joints to bring the whole work to a workmanlike finished product.

Equipment:

The equipment used in the precast concrete industry/ construction may be classified into the following categories:

a) Machinery required for quarrying of coarse and fine aggregates;

b) Conveying equipment, such as belt conveyors, chain conveyors, screw conveyors, bucket elevators, hoists, etc;

c) Concrete mixing machines;

d) Concrete vibrating machines;

e) Erection equipment, such as cranes, derricks, hoists, chain pulley blocks, etc;

f) Transport machinery, such as tractor-cum trailers, dumpers, lorries, locomotives, motor boats and rarely even helicopters;

g) Workshop machinery for making and repairing steel and timber moulds;

h) Bar straightening, bending and welding machines to make reinforcement cages;

j) Minor tools and tackles, such as wheel barrows, concrete buckets, etc; and

k) Steam generation plant for accelerated curing.

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

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

The 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 guaranteeing quality for the end-product.

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

a) With simple mechanization;

b) With partial mechanization; and

c) With 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 the case of complex mechanization leading to automation, a number of 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 equipments relevant Indian Standards.

2. Write a note about Safety principles in dismantling of precast elements.

Demolition is the dismantling, razing, destroying or wrecking of any building or structure or any part thereof. Demolition work involves many of the hazards associated with construction. However, demolition involves additional hazards due to unknown factors which makes demolition work particularly 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;
- Unknown strengths or weaknesses of construction materials, such as post-tensioned concrete;
- Hazards created by the demolition methods used.

- To combat these, everyone at a demolition worksite must be fully aware 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.
- Locating, securing, and/or relocating any nearby utilities
- Fire prevention and evacuation plan.
- First Aid and Emergency Medical Services.
- An assessment of health hazards completed before any demolition work takes place.
- Provide the right protection and equipment
- The employer must determine what Personal Protective Equipment (PPE) will be required.

In demolition operations, PPE may include:

- Eye, face, head, hand, foot protection
- Respiratory protection
- Hearing protection
- Personal Fall Arrest Systems (PFAS)
- Other protective clothing (for example, cutting or welding operations)