Lecture – 23

Prefabricated Construction

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Introduction

- The precast structures also known as prefabricated/ modular structures.
- The structural components are standardized and produced in plants in a location away from the building site.
- Then transported to the site for assembly.
- The components are manufactured by industrial methods based on mass production in order to build a large number of buildings in a short time at low cost.

Features

- The division and specialization of the human workforce.
- The use of tools, machinery, and other equipment, usually automated, in the production of standard, interchangeable parts and products.
- Compared to site-cast concrete, precast concrete erection is faster and less affected by adverse weather conditions.
- Plant casting allows increased efficiency, high quality control and greater control on finishes.

AIMS OF PREFABRICATION CONSTRUCTION

- Prefabrication is used to reduce the cost of construction.
- Components manufactured under controlled conditions.
- The speed of construction is increased since no curing period is necessary.
- Prefabrication helps in the use of locally available materials with required characteristics like light-weight; easy workability, thermal insulation, non-combustibility etc.

Comparison

Site-cast

- no transportation
- the size limitation is depending on the elevation capacity only
- lower quality because directly affected by weather
- proper, large free space required

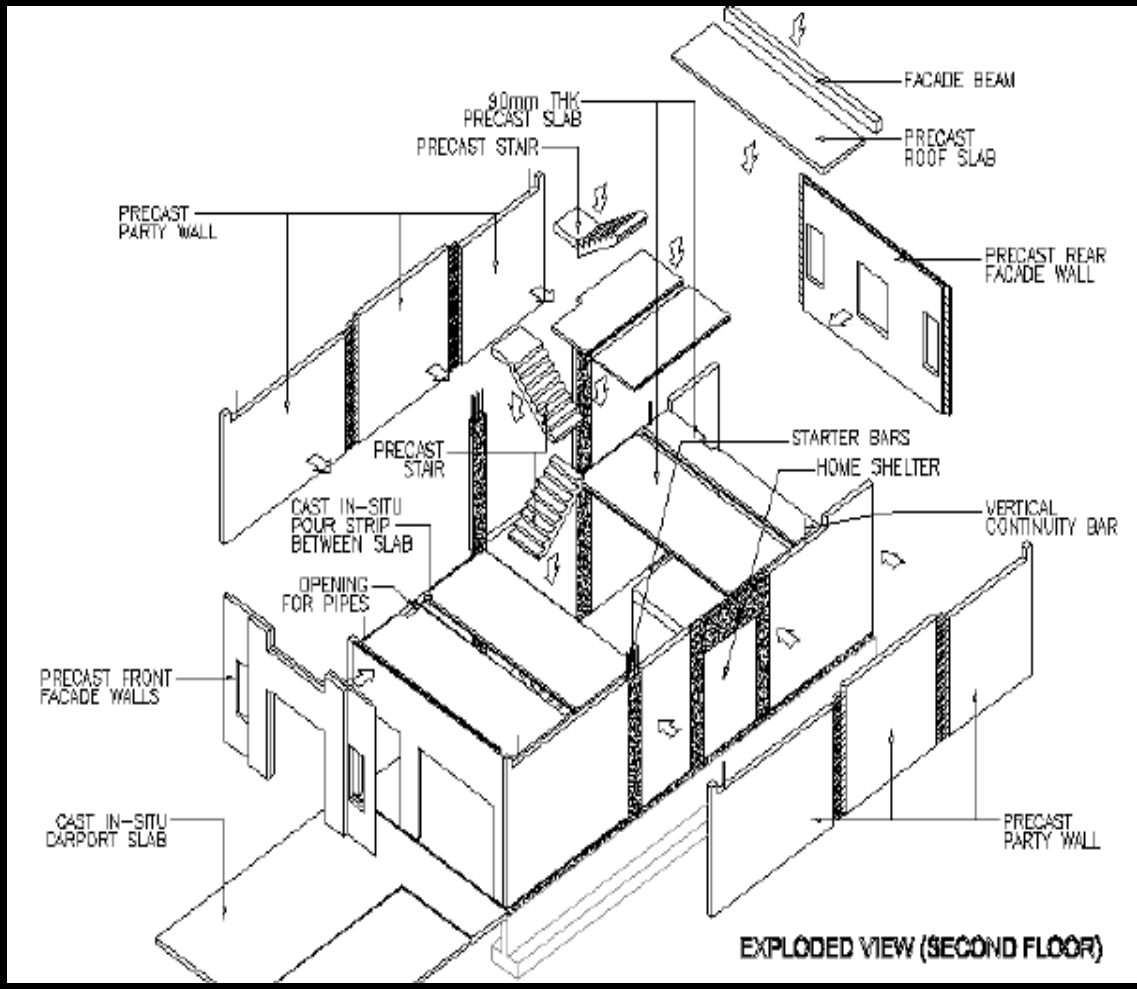
Precast at plant

- transportation and elevation capacity limits the size-
- higher, industrialized quality – less affected by weather
- no space requirement on the site for fabrication
- unlimited opportunities of architectural appearance
- option of standardized components

Design concept for precast concrete buildings

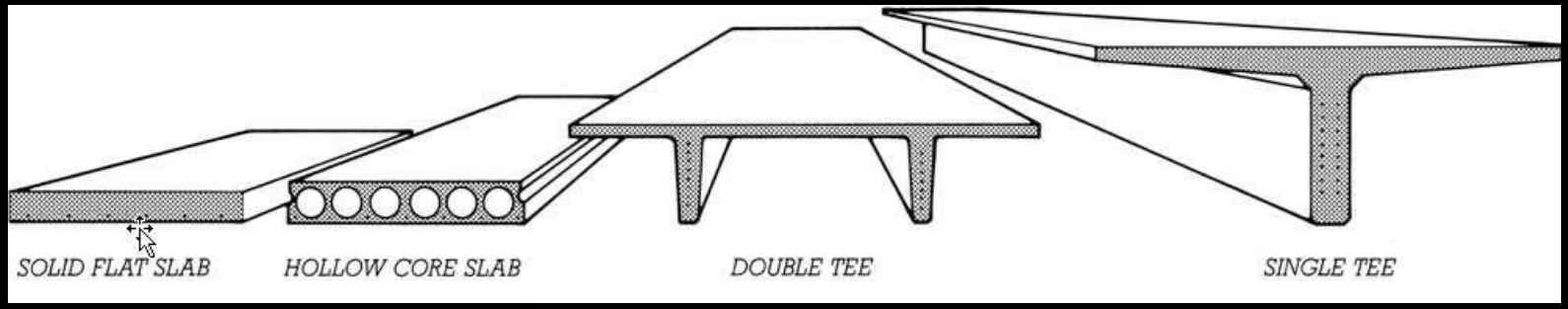
The design concept of the precast buildings is based on

- Build Ability.
- Economy
- Standardization of precast components.

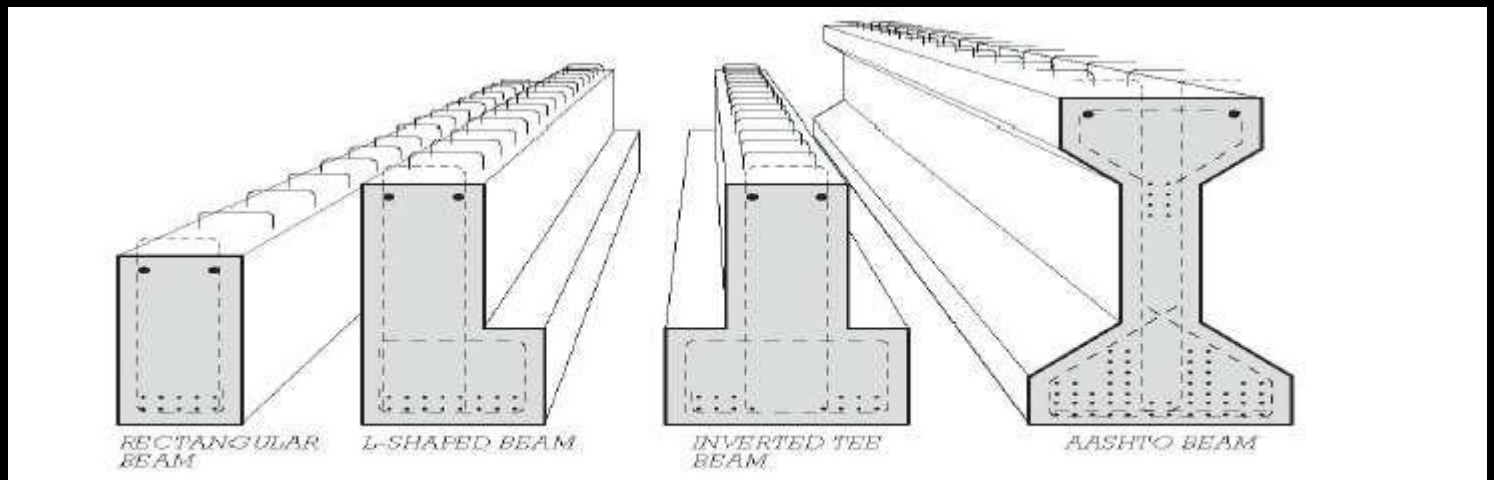


Precast concrete structural elements

Precast slabs



Precast Beam & Girders



Precast Columns

Precast Walls

Precast stairs

Precast concrete Stairs

Steel plates supported on 2 steel beams

Design considerations

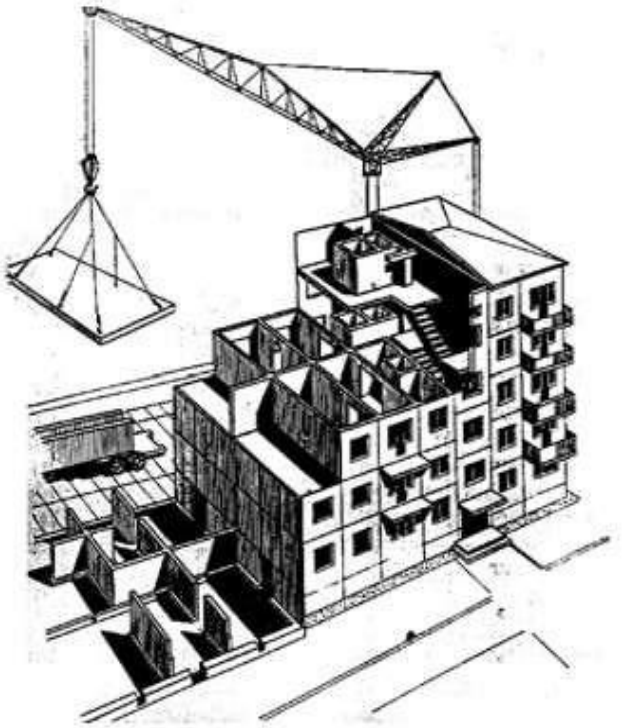
- final position and loads
- transportation requirements – self load and position during transportation
- storing requirements – self load and position during storing – (avoid or store in the same position as it transported / built in)
- lifting loads – distribution of lifting points – optimal way of lifting (selection of lifting and rigging tools)
- vulnerable points (e.g. edges) – reduction of risk (e.g. rounded edges)

Types of pre cast system

1. Large-panel systems
2. Frame systems
3. Slab-column systems with walls (Lift-slab systems)
4. Mixed systems

1. Large-panel systems

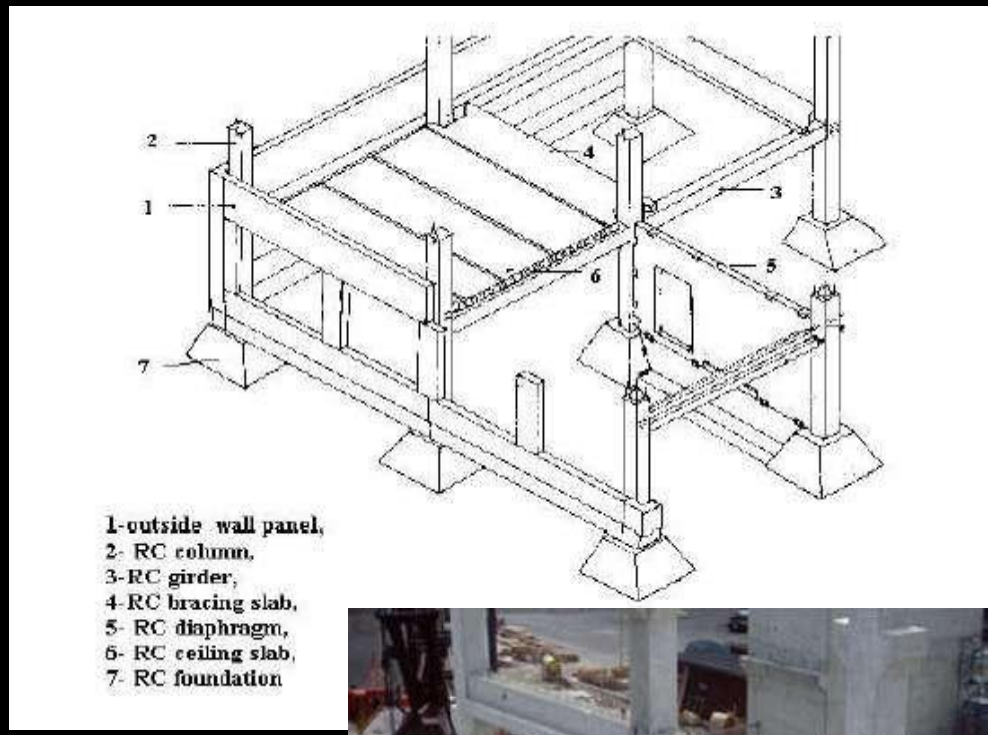
- box-like structure.
- both vertical and horizontal elements are load-bearing.
- one-story high wall panels (cross-wall system/ longitudinal wall system/ two way system).
- one-way or two way slabs.



A large-panel concrete building under construction

2. Frame systems

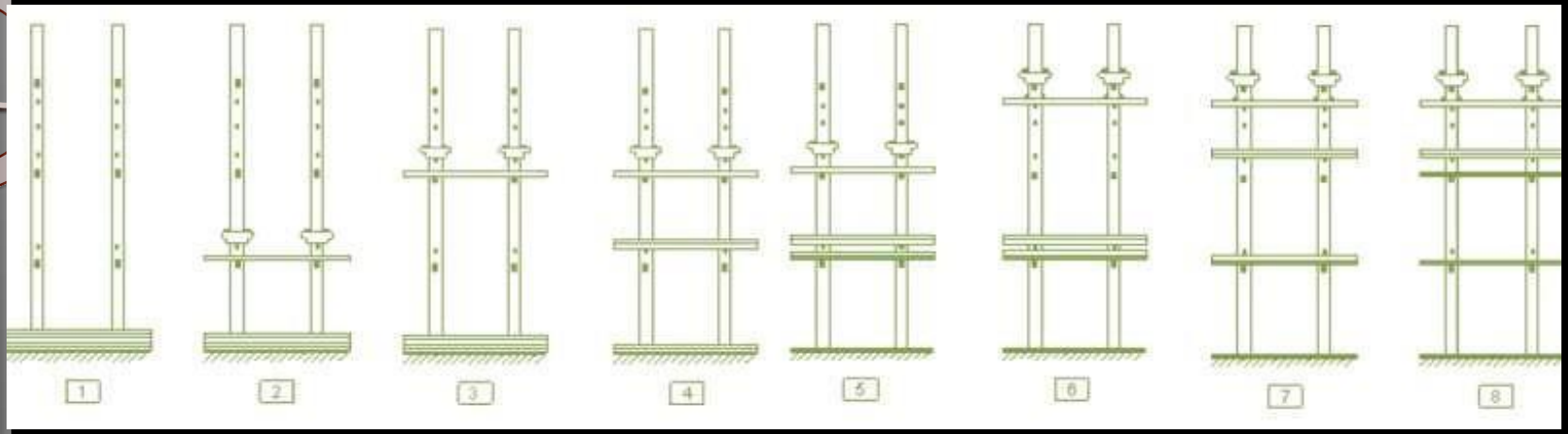
- Components are usually linear elements.
- The beams are seated on corbels of the pillars usually with hinged-joints (rigid connection is also an option).
- Joints are filled with concrete at the site.



3.Lift-slab systems

- Partially precast in plant (pillars) / partially precast on-site (slabs).
- One or more storey high pillars (max 5) and up to 30 storey high constructions.
- special designed joints and temporary joints.
- slabs are casted on the ground (one on top of the other) – then lifted with crane or special elevators.

Lift-slab procedure



1. Pillars and the first package (e.g. 5 pieces) of slabs prepared at ground level
2. Lifting boxes are mounted on the pillars + a single slab lifted to the first floor level

3-8. boxes are sequentially raised to higher positions to enable the slabs to be lifted to their required final position - slabs are held in a relative (temporary) positions by a pinning system

Planning traffic route

- How long transporter vehicle is required?
- What is the required load capacity of the transporter vehicle?
- What is the maximum vertical extension of the shipment?
- Is route permission required?

Equipments

Cranes:

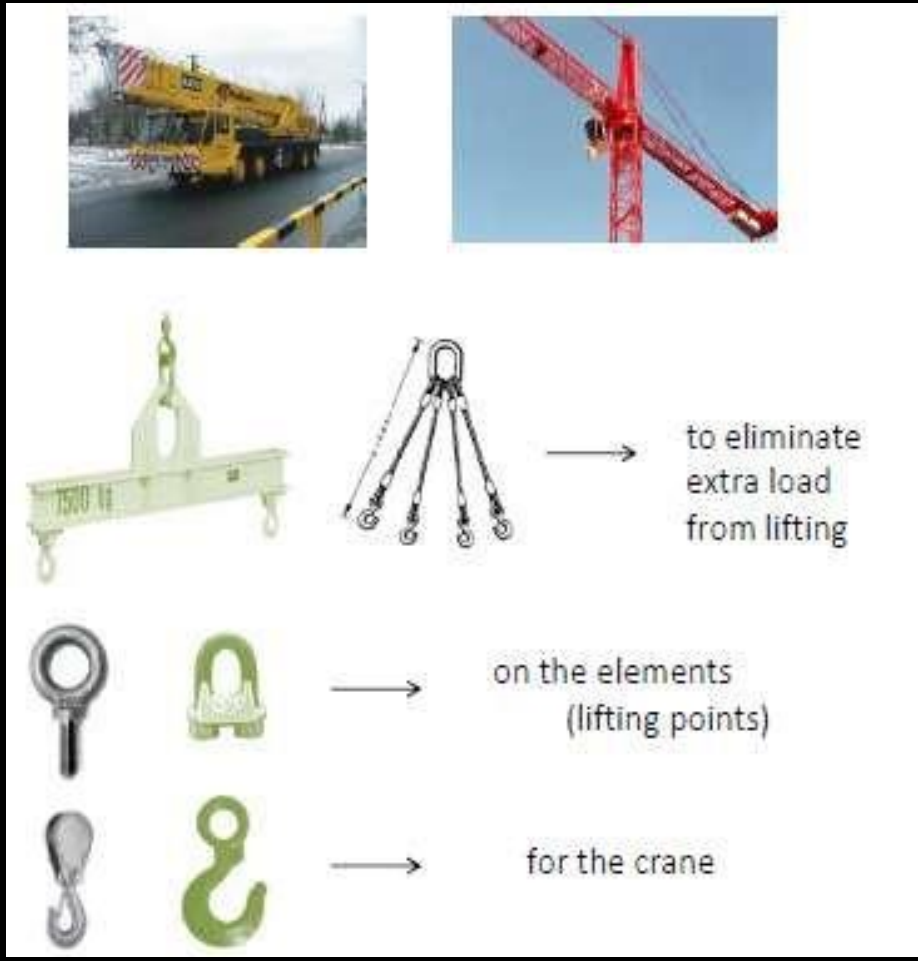
- mobile crane
- tower crane (above 3stories)

Lifting tools

- spreader beams
- wire rope slings

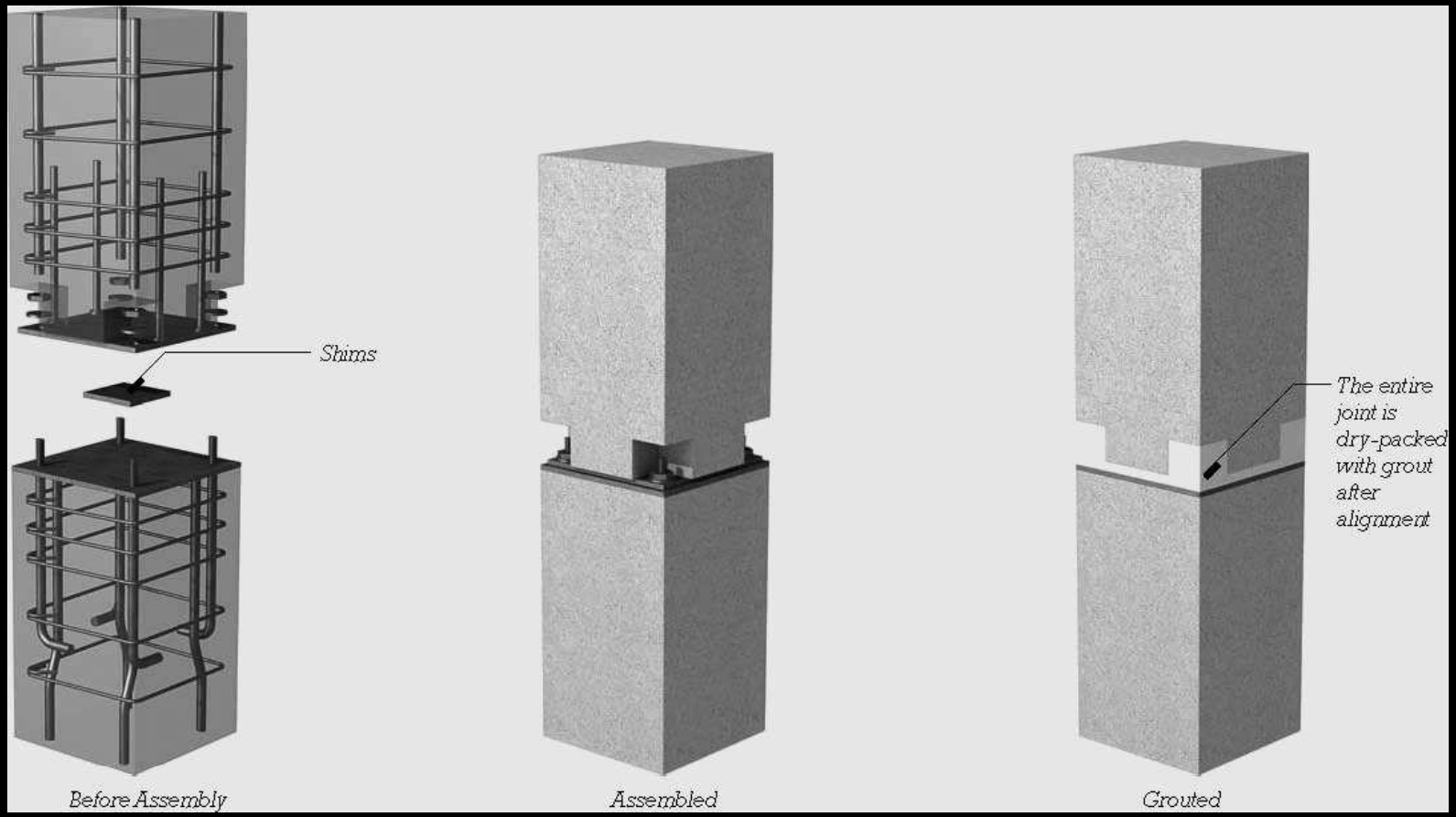
Rigging tools

- eye bolt
- shakles
- hooks

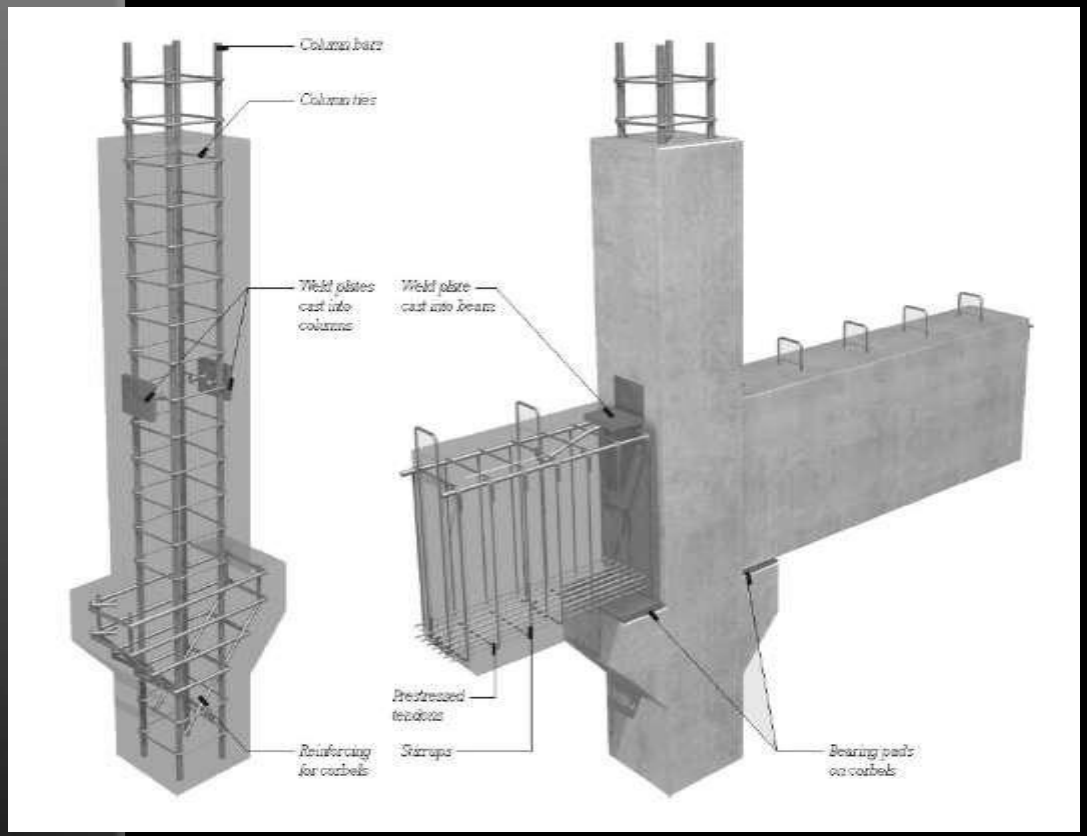


Assembling….

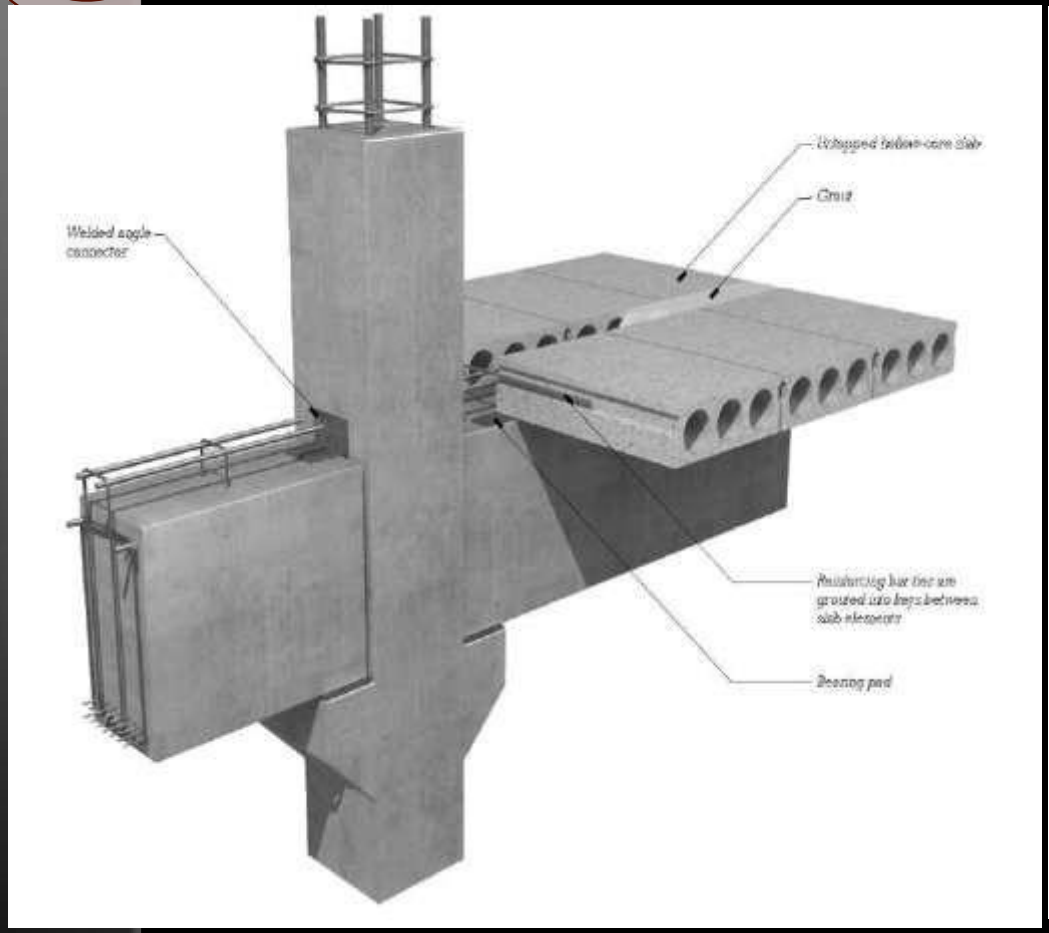
Column to column connection

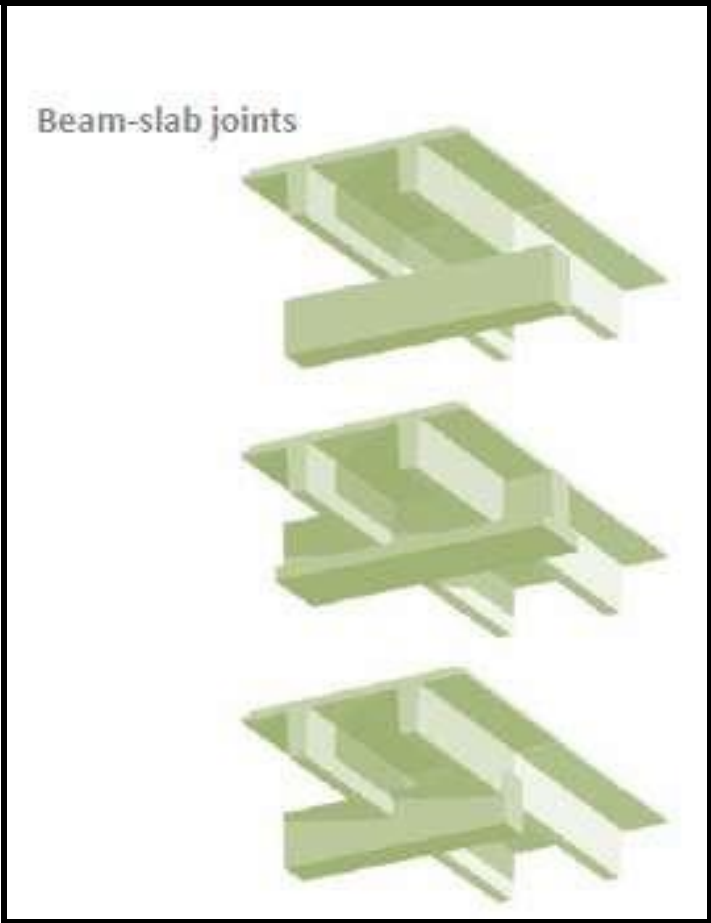


Beam to column connection



Beam-slab joints





Wall to slab connection

Precast concrete structure consisting of solid wall panels and hollow core slabs.

Advantages

- Quick erection times
- Possibility of conversion, disassembling and moving to another site
- Possibility of erection in areas where a traditional construction practice is not possible or difficult
- Low labor intensivity
- Reduce wastage of materials
- Easier management of construction sites
- Better overall construction quality
- Ideal fit for simple and complex structures

Limitations

- size of the units.
- location of window openings has a limited variety.
- joint details are predefined.
- site access and storage capacity.
- require high quality control.
- enable interaction between design phase and production planning.
- difficult to handling & transporting.

Scheduling

some approximate data for installation

- emplacement of hollow core floor slabs - 300 m^2 /day
- erection of pillars/columns - 8 pieces/day
- emplacement of beams - 15 pieces/day
- emplacement of double tee slabs - 25 pieces/day
- emplacement of walls - 15 pieces/day
- construction of stair and elevator shafts - 2 floors/day

Examples….

A hospital in U.S.

Miami Valley Hospital Dayton

Conclusion

O The use of prefabrication and preassembly is estimated to have almost doubled in the last 15 years, increasing by 86%.

O The use of precast concrete construction can significantly reduce the amount of construction waste generated on construction sites.

- Reduce adverse environmental impact on sites.
- Enhance quality control of concreting work.
- Reduce the amount of site labour.
- Increase worker safety.
- Other impediments to prefabrication and preassembly are increased transportation difficulties, greater inflexibility, and more advanced procurement requirements.

References

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Building Construction by **B.C. Punmia**; Ashok Kumar Jain and Arun Kumar Jain
Building Construction & Materials by Gurcharan Singh

Thank you