Chapter 12

Concrete Construction

Part 1

Chapter 12: Concrete Construction

- **12-1 CONSTRUCTION APPLICATIONS OF CONCRETE**
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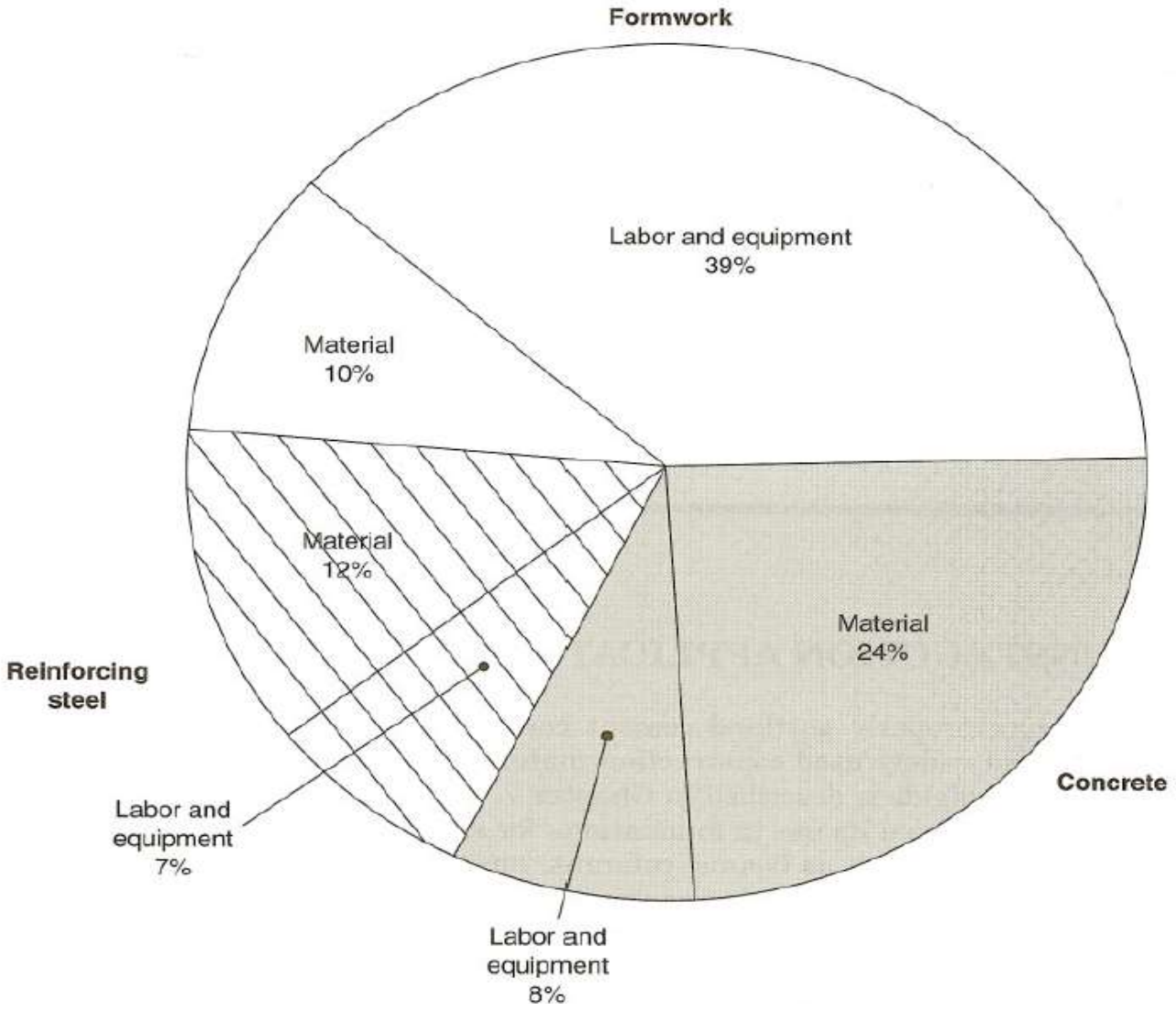
12-1 CONSTRUCTION APPLICATIONS OF CONCRETE

- Concrete, or more properly portland cement concrete, is one of the world's most versatile and widely used construction materials.
- construction applications:
  - paving of highways and airfields.
  - its use in foundations for small structures, through structural components such as beams, columns, and wall panels, to massive concrete dams.
- all concrete used for structural purposes contains reinforcing steel embedded in the concrete to increase the concrete member's tensile strength. (*Reinforced Concrete*)

12-1 CONSTRUCTION APPLICATIONS OF CONCRETE

- The objective of the construction manager should be to develop a construction plan which minimizes construction costs while meeting all safety and quality requirements.
- Major elements of a concrete construction cost analysis include:
  - Formwork costs including labor, equipment, and materials.
  - Cost of reinforcing steel and its placement.
  - Concrete materials, equipment, and labor for placing, curing, and finishing the concrete.

FIGURE 12-1: Typical distribution of concrete construction costs.



12-1 CONSTRUCTION APPLICATIONS OF CONCRETE

- **Cast-in-Place Concrete**
- **Precast Concrete**
- **Prestressed Concrete**
- **Architectural Concrete**

1. Cast-in-Place Concrete

- Concrete structural members have traditionally been built in-place by placing the plastic concrete into forms and allowing it to harden.
- The forms are removed after the concrete has developed sufficient strength to support its own weight and the weight of any construction loads.

FIGURE 12-2: Typical cast-in-place column and wall shapes.

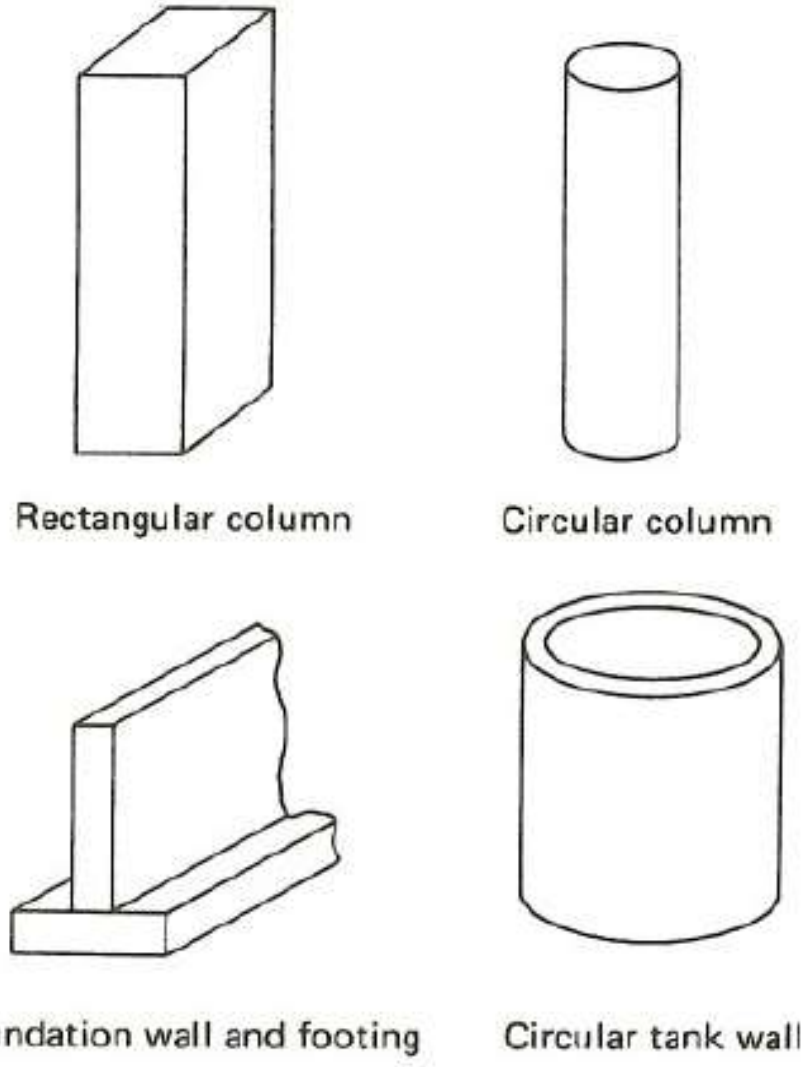
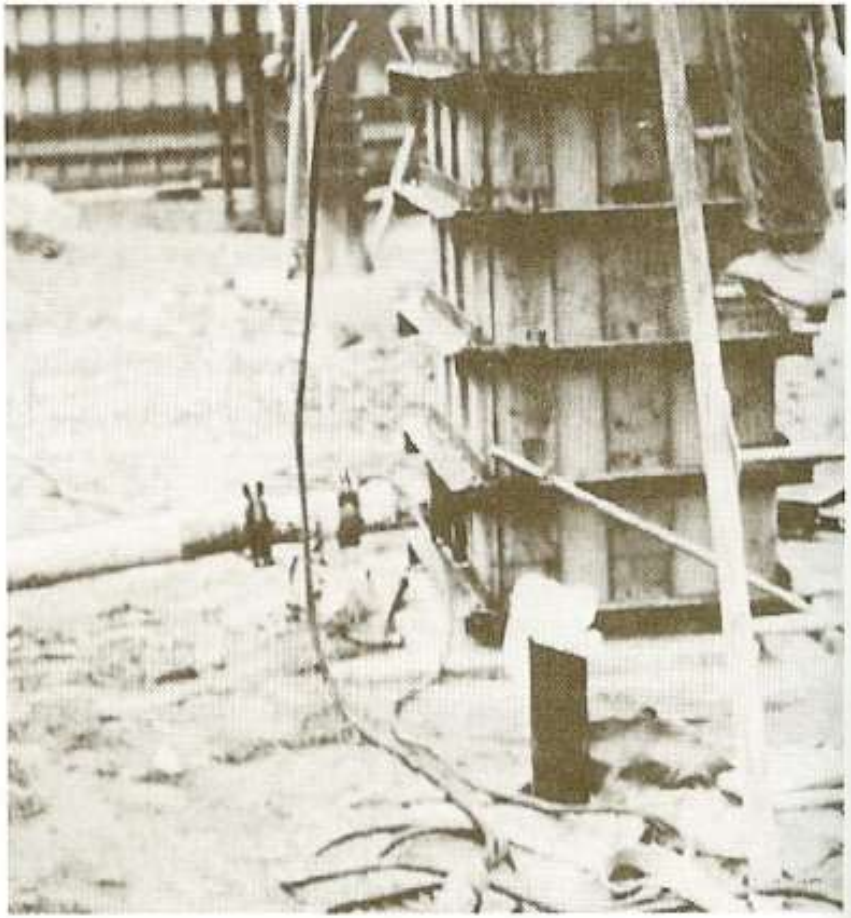


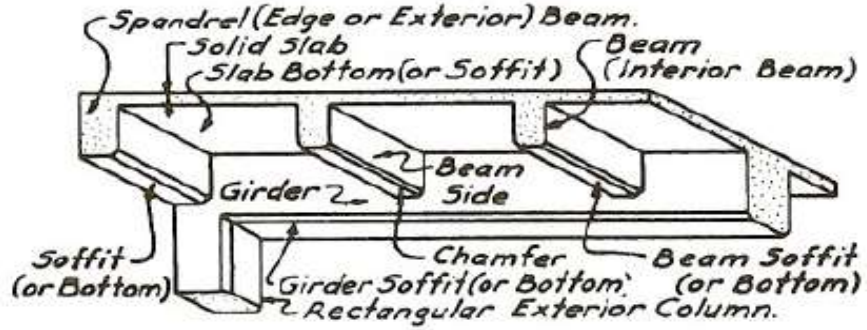
FIGURE 12-3: Pumping concrete into bottom of column form.
(Courtesy of Gates & Sons, Inc.)

a. Preparation of form

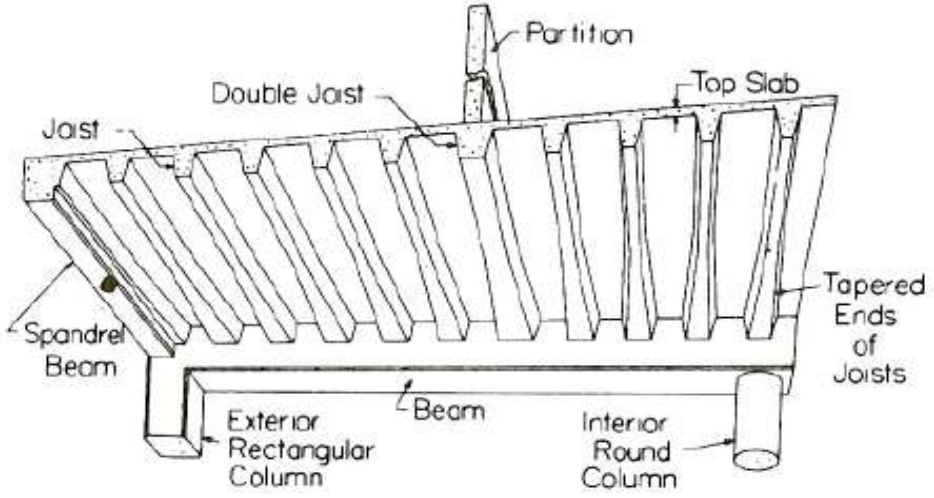


b. Pumping hose in place on fixture at bottom of form

FIGURE 12-4: Floor slab construction.
(Courtesy of Concrete Reinforcing Steel Institute)



a. Slab-beam-and-girder floor



b. Concrete joist floor

FIGURE 12-5: Waffle slab.

(Courtesy of Concrete Reinforcing Steel Institute)

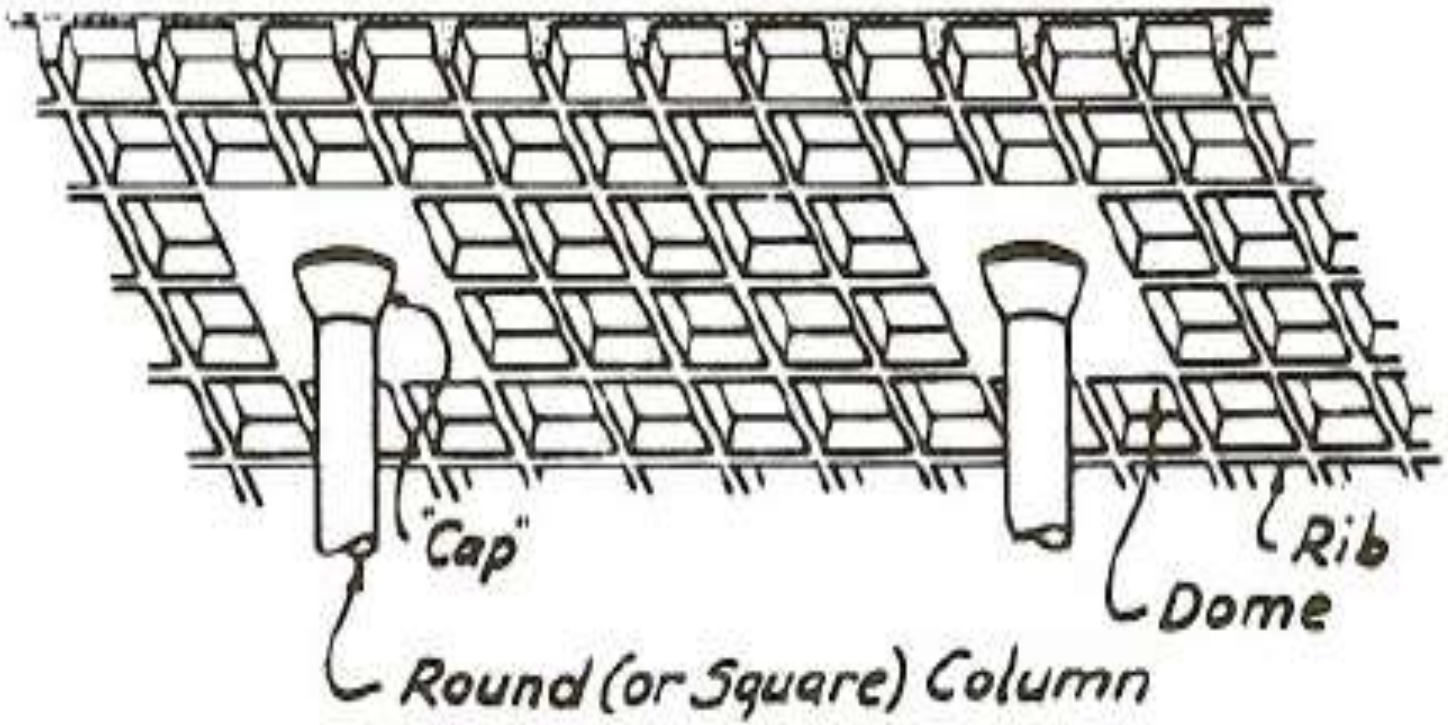
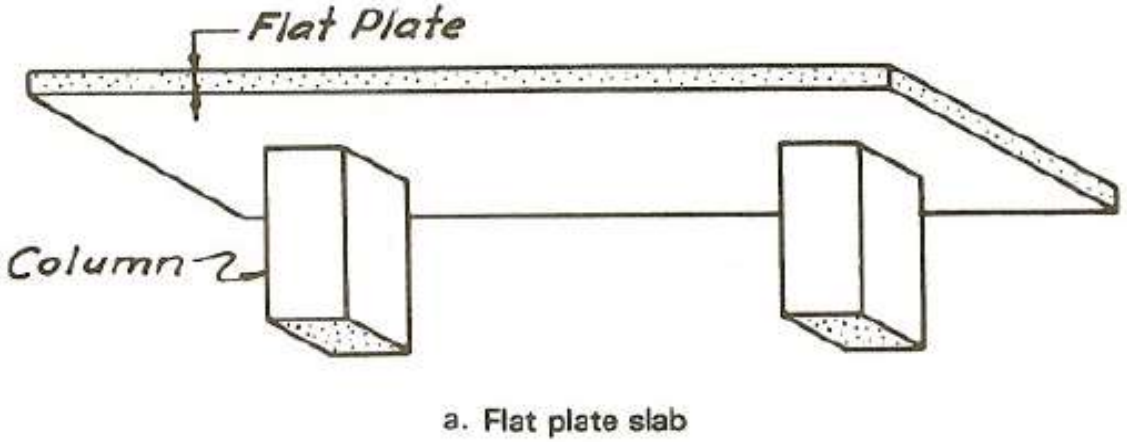
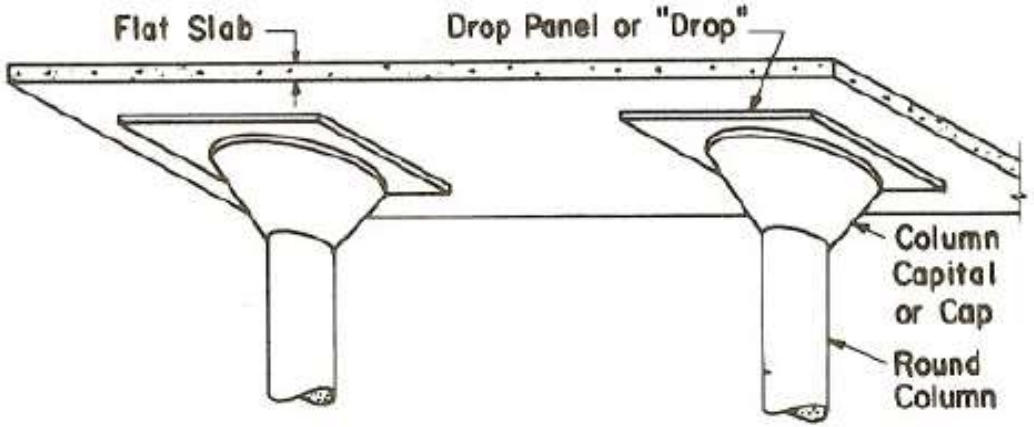


FIGURE 12-6: Flat slab and flat plate slab.

(Courtesy of Concrete Reinforcing Steel Institute)



a. Flat plate slab



b. Flat slab

2. Precast Concrete

- *Precast concrete* is concrete that has been cast into the desired shape prior to placement in a structure.
- There are a number of advantages obtained by removing the concrete forming, placing, finishing, and curing operations from the construction environment.
- Pre-casting operations usually take place in a central plant where industrial production techniques may be used.
- Since standard shapes are commonly used, the repetitive use of formwork permits forms to be of high quality at a low cost per unit.

Precast Concrete

- There are a number of standard shapes commonly used for precast concrete structural members.
- Figure 12-7 illustrates some common beam and girder sections.
- Figure 12-8 illustrates Precast roof and floor panels.

FIGURE 12-7: Precast beam and girder shapes.

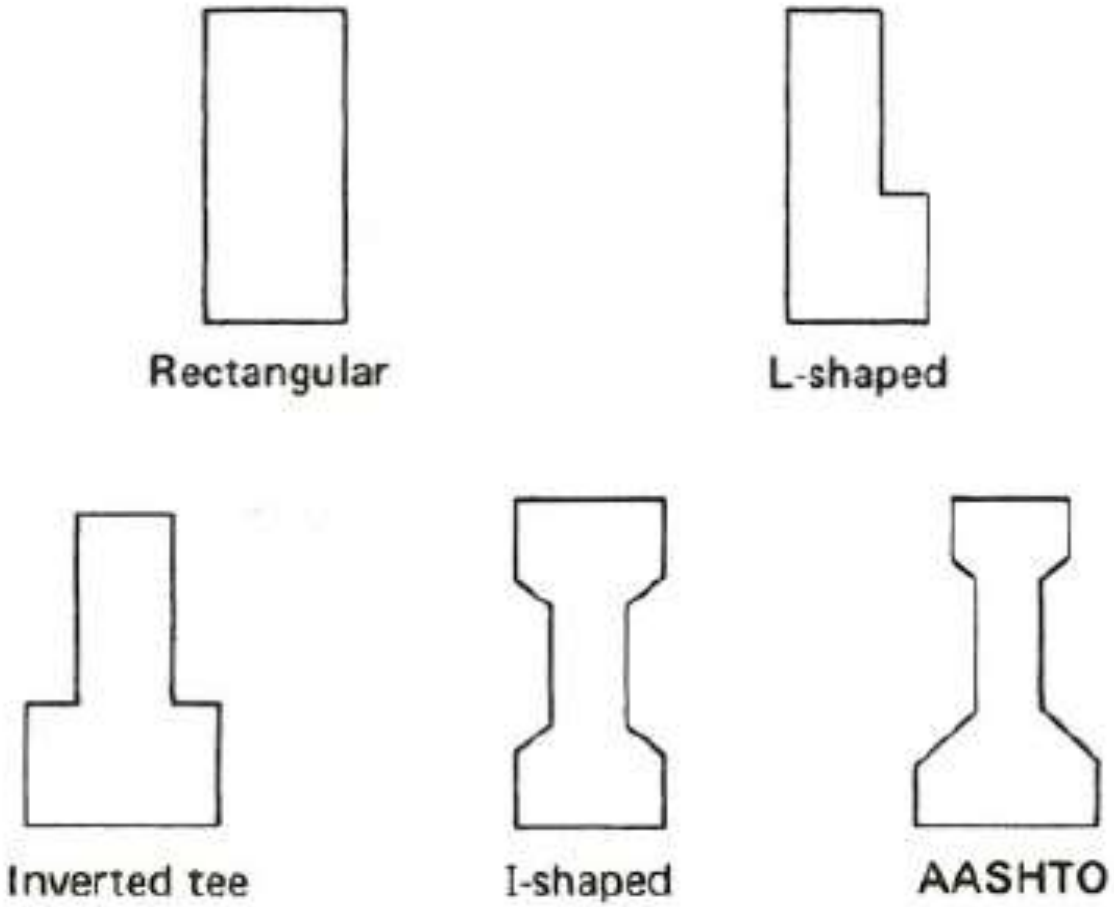


FIGURE 12-8: Precast slab shapes.

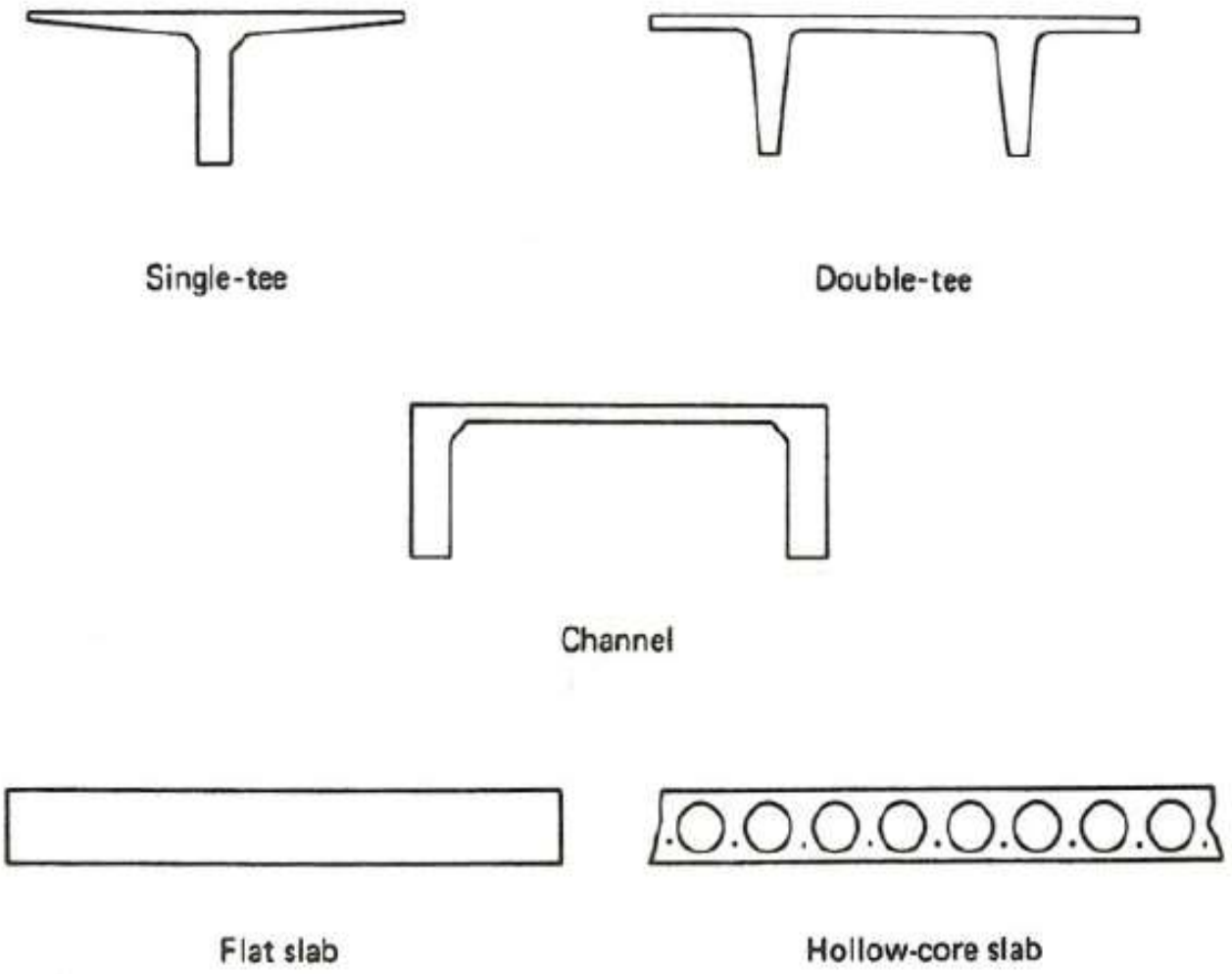


FIGURE 12-9: Steps in tilt-up construction.

(Courtesy of The Burke Company)

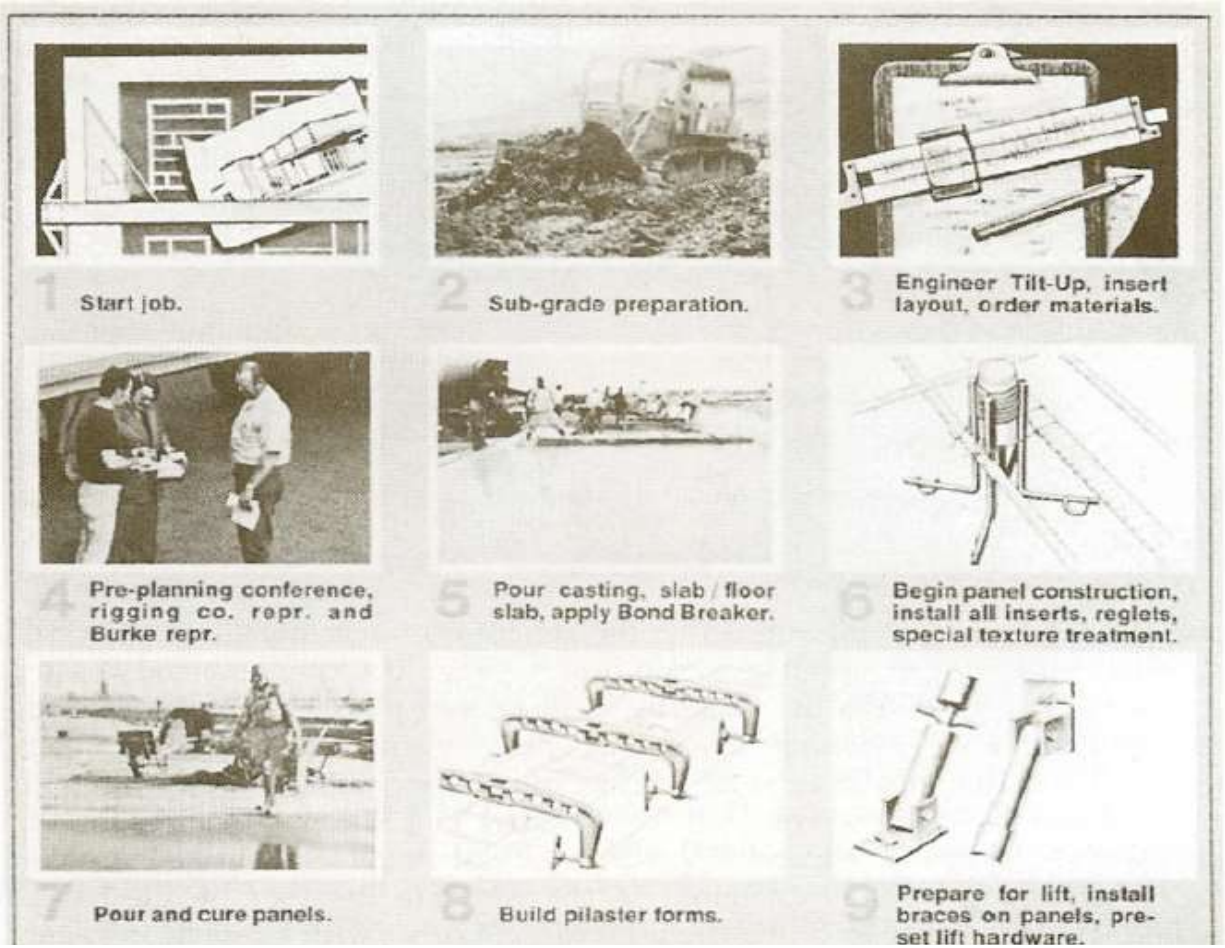
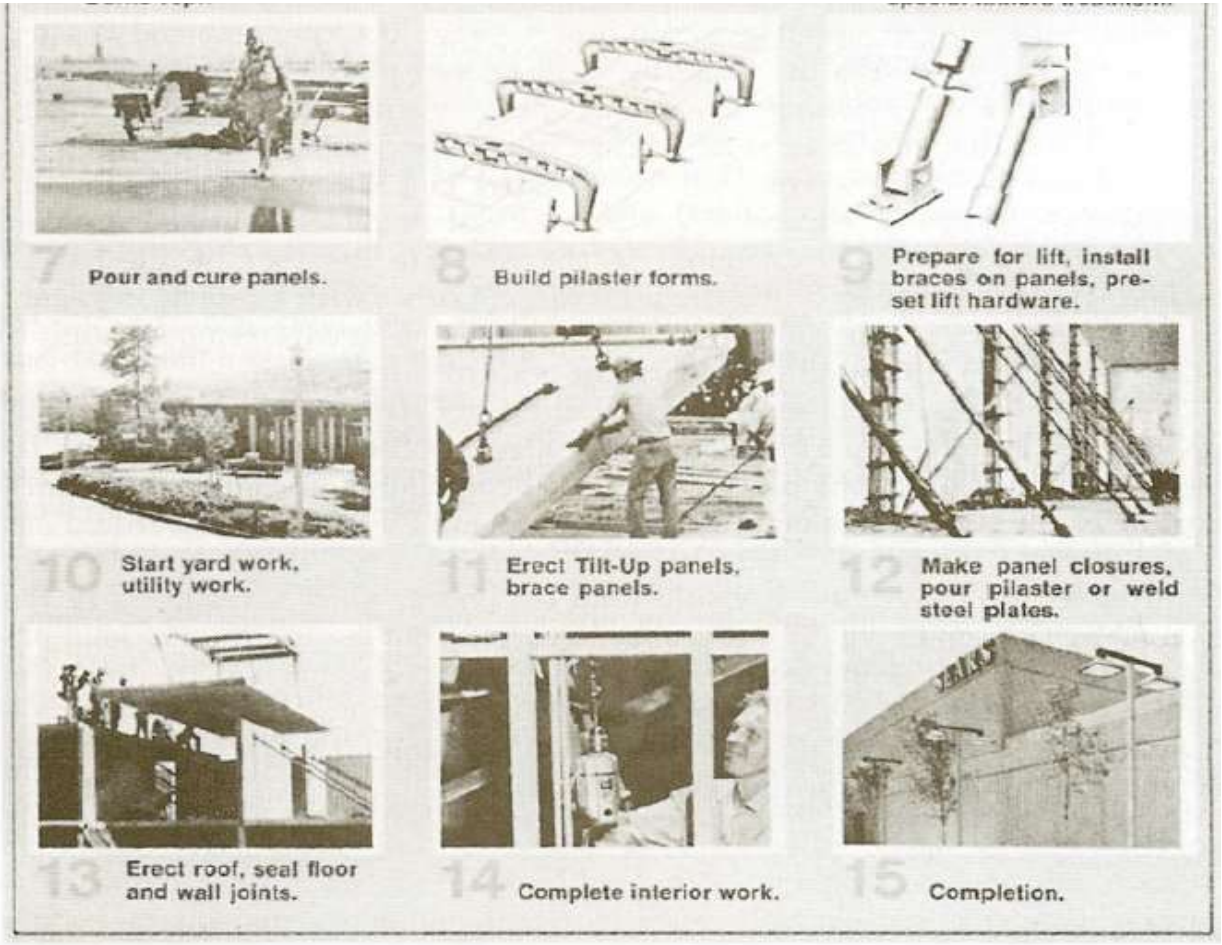


FIGURE 12-9: Steps in tilt-up construction.

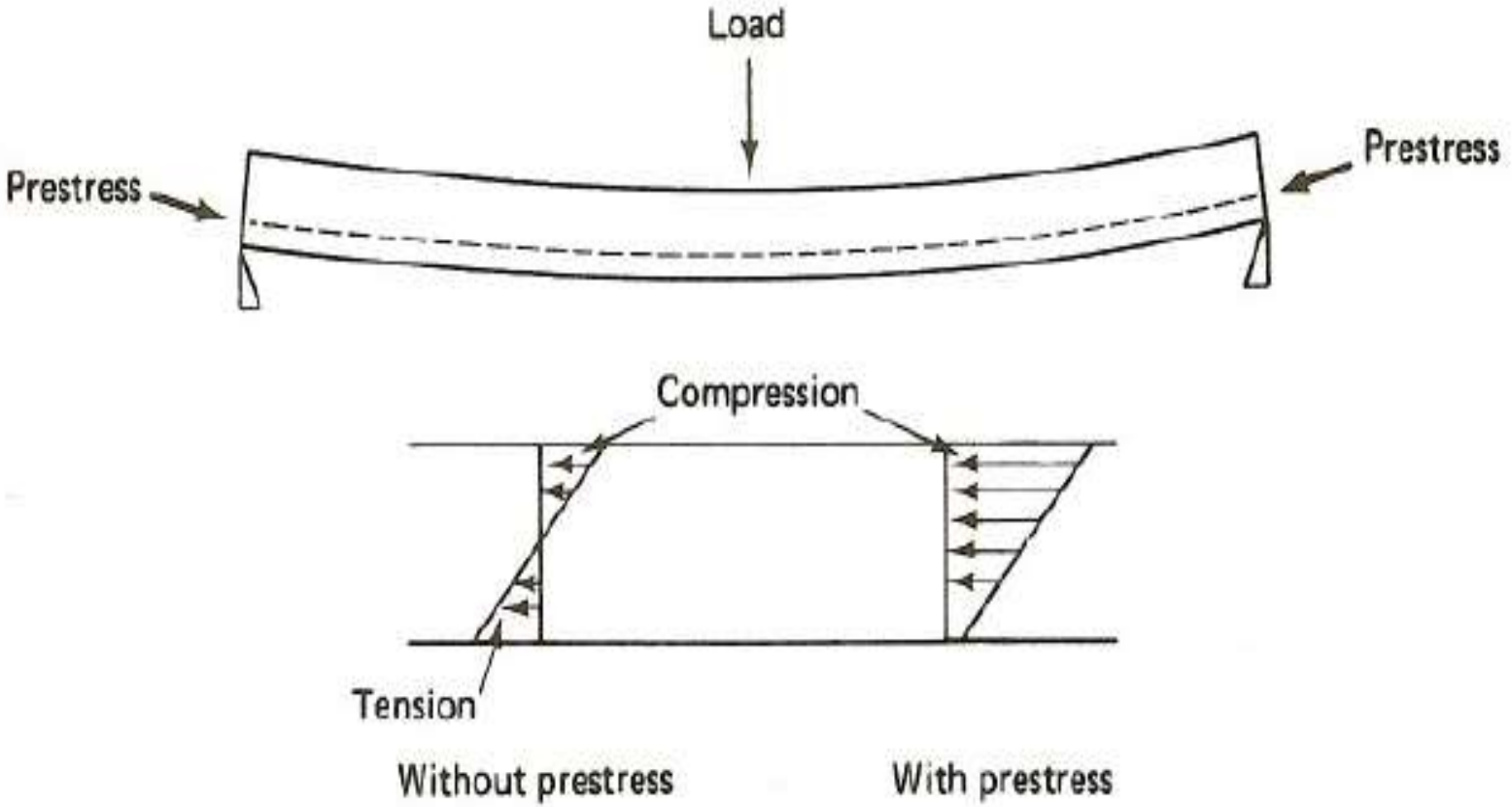
(Courtesy of The Burke Company)



3. Prestressed Concrete

- *Prestressed concrete* is concrete to which an initial compression load has been applied.
- Prestressing serves to increase the load that a beam or other flexural member can carry before allowable tensile stresses are reached.
  - because the concrete is quite strong in compression but weak in tension,

FIGURE 12-10: Stresses in a prestressed simple beam.



Prestressed Concrete

- Advantages:
  - permits a smaller, lighter member to be used in supporting a given load.
  - reduces the amount of deflection in a beam.
  - Since the member is always kept under compression, any cracking that does occur will remain closed up and not be apparent.
- Disadvantages:
  - higher material, equipment, and labor cost involved in the production of prestressed components.

Prestressed Concrete

- There are two methods for producing prestress in concrete members;
  - pretensioning and
  - posttensioning.

Prestressed Concrete

- Caution must be observed in handling and transporting pretensioned prestressed members, particularly if they are asymmetrically stressed.

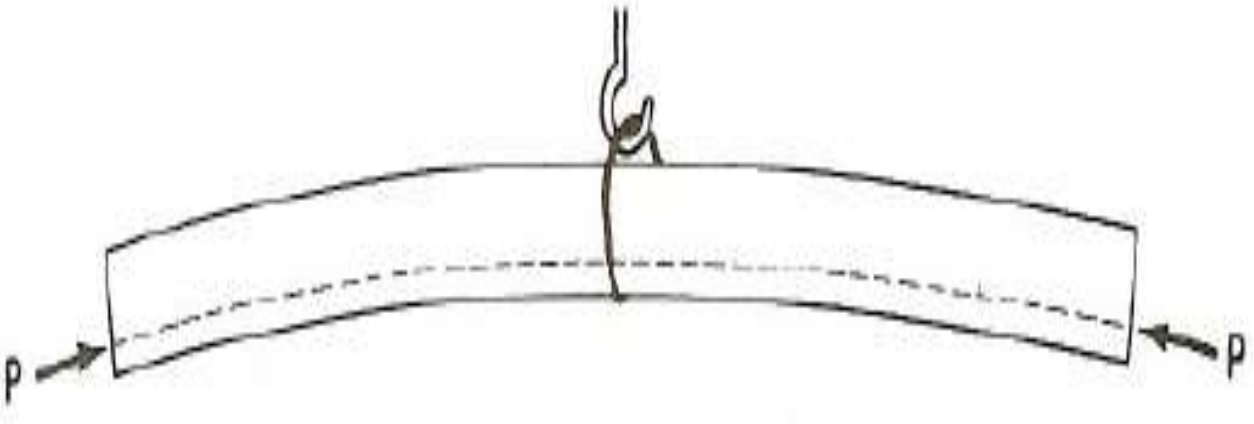


FIGURE 12-11: Lifting prestressed beam at the center.

- It should be lifted by the ends or by using multiple lift points along the beam.

Architectural Concrete

- The architectural use of concrete to provide appearance effects has greatly increased in recent years.
- Architectural effects are achieved by the shape, size, texture, and color used.

FIGURE 12-12: Application of architectural concrete.

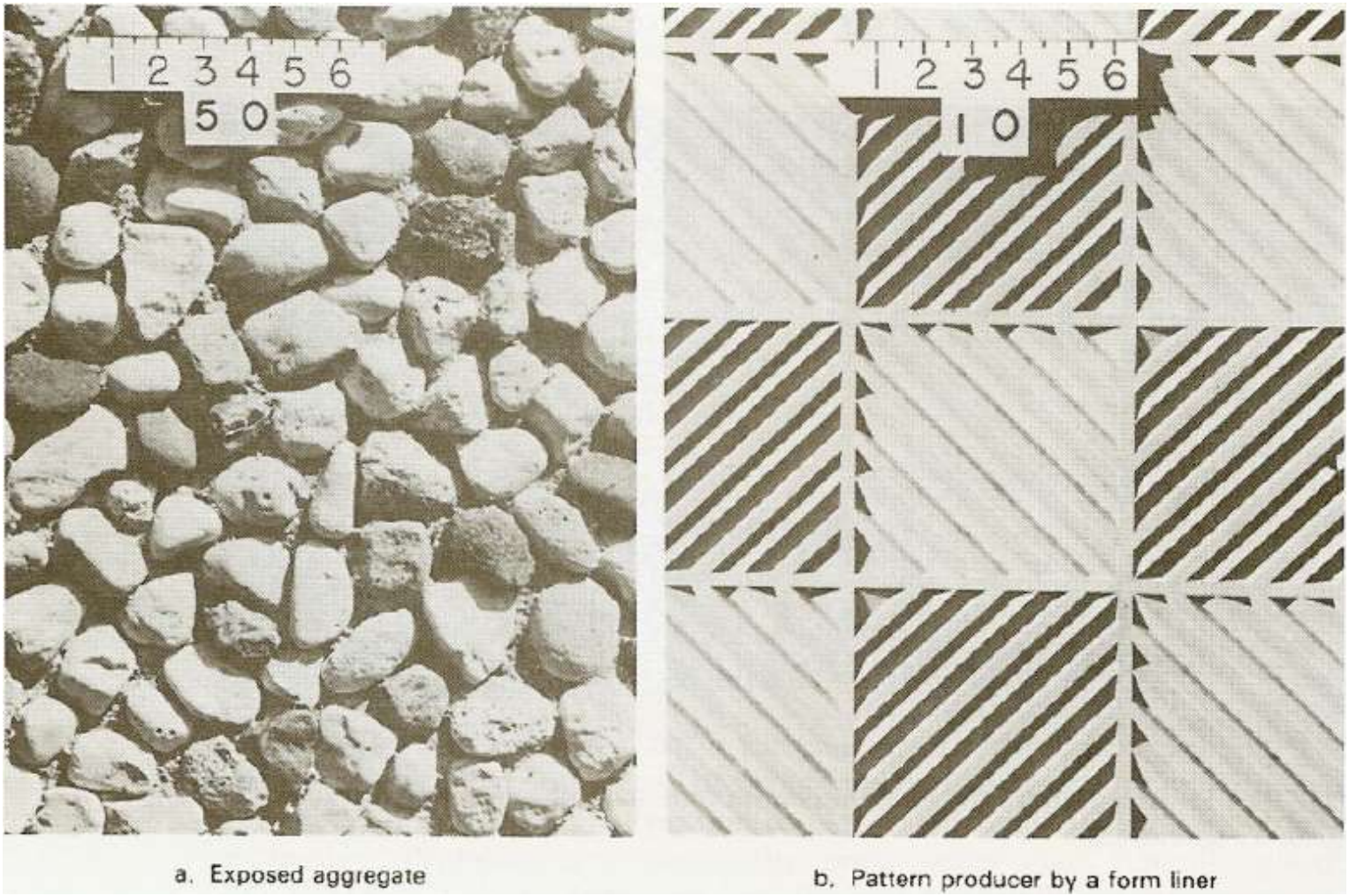
(Courtesy of Portland Cement Association)

Architectural Concrete

- Some of the major methods used for obtaining architectural concrete effects include:
  - exposed aggregate surfaces (Figure 12-13a),
  - special surface designs and textures achieved by the use of form liners (Figure 12-13b), and
  - mechanically produced surfaces (Figure 12-14).
- Exposed aggregate surfaces are produced by removing the cement paste from the exterior surface, exposing the underlying aggregate.

FIGURE 12-13: Architectural concrete surfaces.

(Courtesy of Portland Cement Association)



a. Exposed aggregate

b. Pattern producer by a form liner

FIGURE 12-14: Mechanically produced concrete surface texture.
(Courtesy of Portland Cement Association)