Form work
For the different **construction activities** like

- Brick work above 5 ft
- Surface finishing works like plastering, painting, walling etc.
- Renovation, repair and alteration works.
- Roof and slab pouring

Some temporary nature supports and structures are required like

- **Formwork** (Supporting Structure)
- **Scaffoldings** (arrangement for working plate forms)
- **Shoring** (supporting method for unsafe structure)
- **Underpinning** (Method of strengthening an existing structure’s footing)
Form work

- Definition
- Qualities of formwork
- Types of formwork
- Formwork detail for different structural members
- Removal of formwork
- Maintenance of formwork
- Cost of formwork
- Advantages of steel form work
Definition

- It's an artificial support provided below and around the precast or cast in situ concrete work.

- Formwork is commonly made of
  - Steel
  - Wood

- Formwork construction & casting is of prime importance in concrete industry. It shares a significant amount of concrete cost. (20% to 25%).

- When concrete has reached a certain required strength, the form is no longer needed & removed. The operation of removing the form work is known as stripping.
Qualities of formwork

- It should be according to IS 456-2000.
- It should be practically water proof so that it should not absorb water from concrete.
- It should be strong.
- It can be cheaper & reusable
- It should be according to the size of member.
Qualities of formwork

- It should be with minimum shrinkage & swelling.
- It should be stiff enough against it’s deflection, buckling under load.
- Its contact surface should be uniform.
- It should be light in weight.
Types of formwork

- Formwork are mainly of two types
  - Steel formwork
  - Wooden formwork

- Steel formwork is made of
  - steel sheets
  - Angle Iron
  - Tee Iron

- Wooden formwork consists of
  - Props
  - Planks battens
  - Ledgers
  - sheeting
Causes of failure

- Overloading of any props when sufficient number or size of props not provided.
- Failure of shuttering due to excessive vibrations of needle surface vibrators.
- Failure due to improper supervision, inadequate design/planning of shuttering, centering & concreting activity.
Causes of failure

- Failure due to dislocation of props or bracing due to careless movement of labourers having access below the formwork of slab or beam.
- Failure due to insufficient cross bracing. Cross bracing improves the stiffness of props against buckling.
Formwork detail for different structural members

- In concrete construction formwork is commonly provided for the following structural members.
  - Foundations
  - Wall
  - Column
  - Slabs & beams
  - Stairs
Formwork for Foundations

- Wall foundations

It consists of
- Plywood
- Sheeting
- Struts
Formwork for Foundations

- Column Foundations
- It consists of
  - Side Supports
  - Side Planks
  - Cleats
Formwork for Wall

- It consists of:
  - Timber sheeting
  - Vertical posts
  - Horizontal members
  - Rackers
  - Stakes
  - Wedges

- After completing one side of formwork reinforcement is provided at the place then the second side formwork is provided.
Formwork for Column

- It consists of the following
  - Side & End Planks
  - Yoke
  - Nut & Bolts

- Two end & two side planks are joined by the yokes and bolts.
Column form work

- opening for beam form
- fillet to form chamfer
- margin piece
- sides of sheet material
- soldiers or studs
- Alternative panel format
- struts as required
- yokes or clamps positioned to resist pressures ~ see Fig. III-12
- cleats ~ taken beyond width of panel side to form rebate
- formwork panels of boards or sheet material
- access pocket piece for cleaning out base of column form before pouring concrete
- foot of form located around kicker

Column formwork principles
Typical column yokes and clamps

- column form
- cleats
- 16 mm dia. bolt
- hardwood wedges
- 100 x 75 yoke
- plate washer to both ends
- wedged oversize halving joint
- oversize halving joint
- bolted halving joint to opposite corners
- column box or form
- 32 x 8 slots
- slotted steel blade or arm
- range of clamp sizes ~ 300 min. to 1-400 max.

Octagonal column
- gangnail or similar connecting plates to both faces
- shape yokes out of 200 x 100
- 25 mm thick shaped staves
- 16 mm dia. bolts
- 16 mm dia. bolts

Circular column
- bolted halved joint

Rebated column
- bolted halved joint
- alternative secure joint with plywood gussets
- alternative use a standard yoke with solid packing to rebate

Shaped column forms and yokes
Formwork for Slabs & beams

- It consists of
  - Sole plates
  - Wedges
  - Props
  - Head tree
  - Planks
  - Batten
  - Ledgers

- Beam formwork rests on head tree
- Slab form work rests on battens and joists
- If prop height are more than 8’ provide horizontal braces.
Lintel or Beam Formwork

Simple beam or lintel formwork

Typical beam formwork

- 15 mm thick plywood sides
- 75 x 25 cleats at 600 c/c
- 25 x 50 ties at 600 c/c
- alternative fixing cleat
- 21 mm thick plywood soffit
- w.i. dogs to both sides
- 75 x 50 crosshead or headtree
- 100 x 75 props at 1:200 c/c
- 225 x 75 sole plate

- 15 mm thick plywood beam sides
- 75 x 32 strut
- 75 x 50 cleat
- 75 x 32 runner or stringer
- 150 x 50 soffit support joists at 600 c/c
- 100 x 75 crosshead or headtree
- 75 x 32 brace

Edge beam and slab formwork
Formwork for Stairs

It consists of:

- Vertical & inclined posts
- Inclined members
- Wooden Planks or sheeting
- Stringer
- Riser Planks
200 x 38 wall board fixed to wall
75 x 50 hanger

21 mm plywood risers
alternative wall support ~ reversed cut string

50 x 32 struts
21 mm plywood soffit board

150 x 50 joists
75 x 32 ribbon piece
15 mm plywood cut string

wall board
hangers
riser boards

21 mm plywood soffit to landing

joists supported by adjustable steel props

2 No. 150 x 75 carriage pieces

sole plate
cut string

Typical formwork to R.C. in situ stairs
Removal of formwork

Time of formwork removal mainly depends on the following factors:

1. **Type of Cement**
   1. Rapid hardening cements require lesser time as compared to OPC (Ordinary Portland Cement)

2. **Ratio of concrete mix**
   1. Rich ratio concrete gain strength earlier as compared to weak ratio concrete.

3. **Weather condition**
   1. Hydration process accelerates in hot weather conditions as compared to cold and humid weather conditions.
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Structural Member</th>
<th>Stripping Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Beam sides, walls &amp; Columns</td>
<td>1-2 Days as decided by Engineer-in-charge</td>
</tr>
<tr>
<td>2</td>
<td>Slab Soffits (props left under)</td>
<td>3 Days</td>
</tr>
<tr>
<td>3</td>
<td>Beams Soffits (props left under)</td>
<td>7 Days</td>
</tr>
<tr>
<td>4</td>
<td>Removal of props to slabs:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>i)  Spanning up to 4.5 m</td>
<td>7 Days</td>
</tr>
<tr>
<td></td>
<td>ii) Spanning over 4.5 m</td>
<td>14 Days</td>
</tr>
<tr>
<td>5</td>
<td>Removal of props to Beams &amp; Arches:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>i)  Spanning up to 6 m</td>
<td>14 Days</td>
</tr>
<tr>
<td></td>
<td>ii) Spanning over 6 m</td>
<td>21 Days</td>
</tr>
</tbody>
</table>
Maintenance of formwork

- Due to continuous use wooden planks & steel plates surfaces become uneven and require maintenance.
- For wooden formwork use cardboard or plastic fiber board. Bolt hole places must also be repaired.
- For steel formwork plates must be leveled by mallet and loose corners must be welded.
Cost of formwork

- For normal works cost of formwork is about **30%-40%** of the concrete cost.
- For special works cost of formwork is about **50%-60%** of the concrete cost.
- Formwork cost is controlled by the following factors
  - Formwork Material cost
  - Formwork erecting cost
  - Formwork removal cost
  - Formwork jointing cost (Nails and Cables)
  - Labor charges.
Advantages of steel form work

- It can be used for a numbers of times.
- It is non absorbent.
- Smooth finish surface obtained.
- No shrinkage of formwork occurs.
- Easy to use.
- Its volume is less.
- Its strength is more.
Thank You !!!