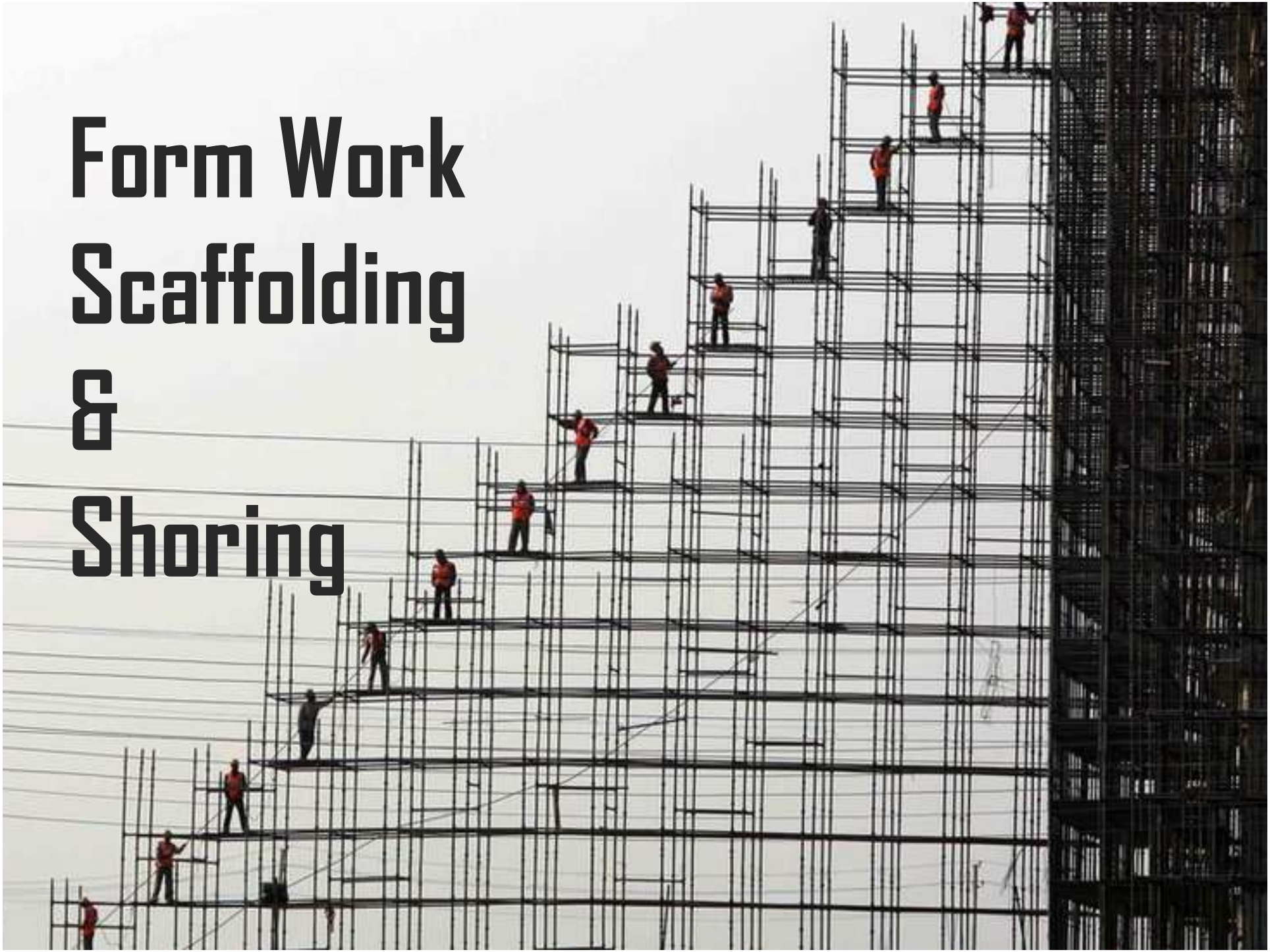
Form Work Scaffolding & Shoring



General

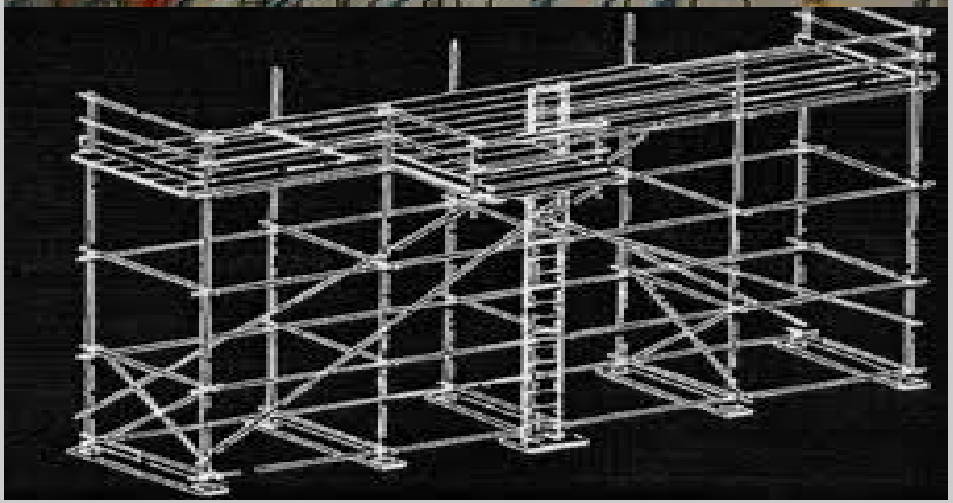
- For the different **construction activities** like
  - Brick work above 5 ft
  - Surface finishing works like plastering, painting, walling etc.
  - Renovation, repair and alteration works.
  - Roof and slab pouring

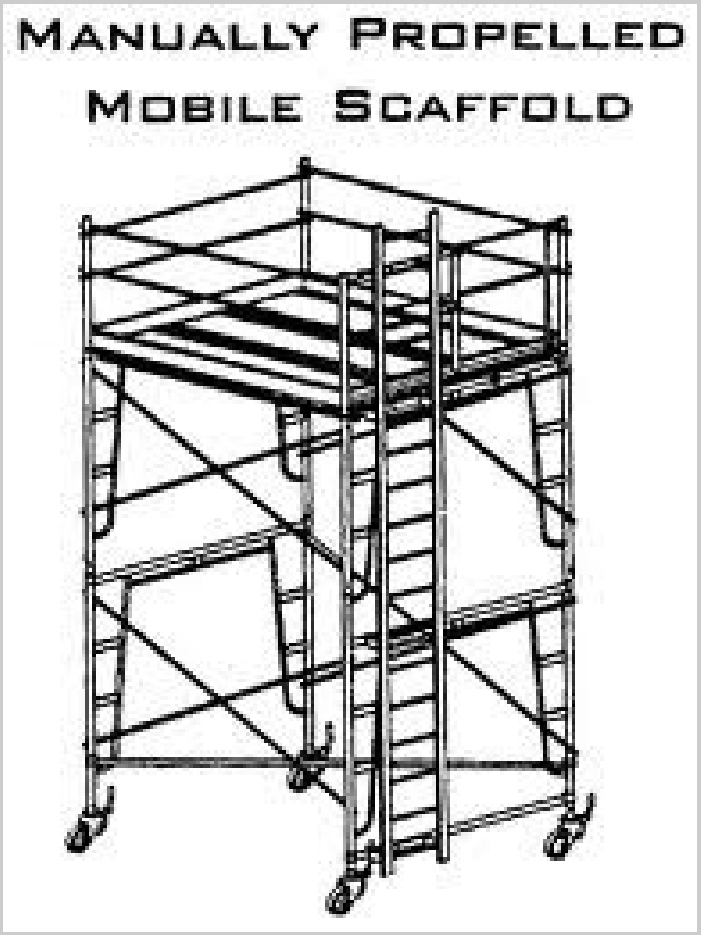
  Some temporary supports are required like

  - **Formwork** (forms in which concrete is poured)
  - **Scaffoldings** (arrangement for working plate forms)
  - **Shoring** (supporting method for unsafe structure)

Formwork

Scaffolding





Shoring

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

Formwork - *Definition*

- Its is a temporary support provided below and around the concrete work.
- Formwork is commonly made up of
  - **Steel**
  - **wood**
- Formwork construction is of prime importance in concrete industry. It shares a significant amount of concrete cost.
- Formwork is designed according to The **ACI** document **SP-4.**

Qualities of formwork

- Formwork should be according to **ACI document SP-4**
- It should be water tight
- It should be strong
- It should be reusable
- Its contact surface should be uniform
- It should be according to the size and shape of member.

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

Steel Formwork

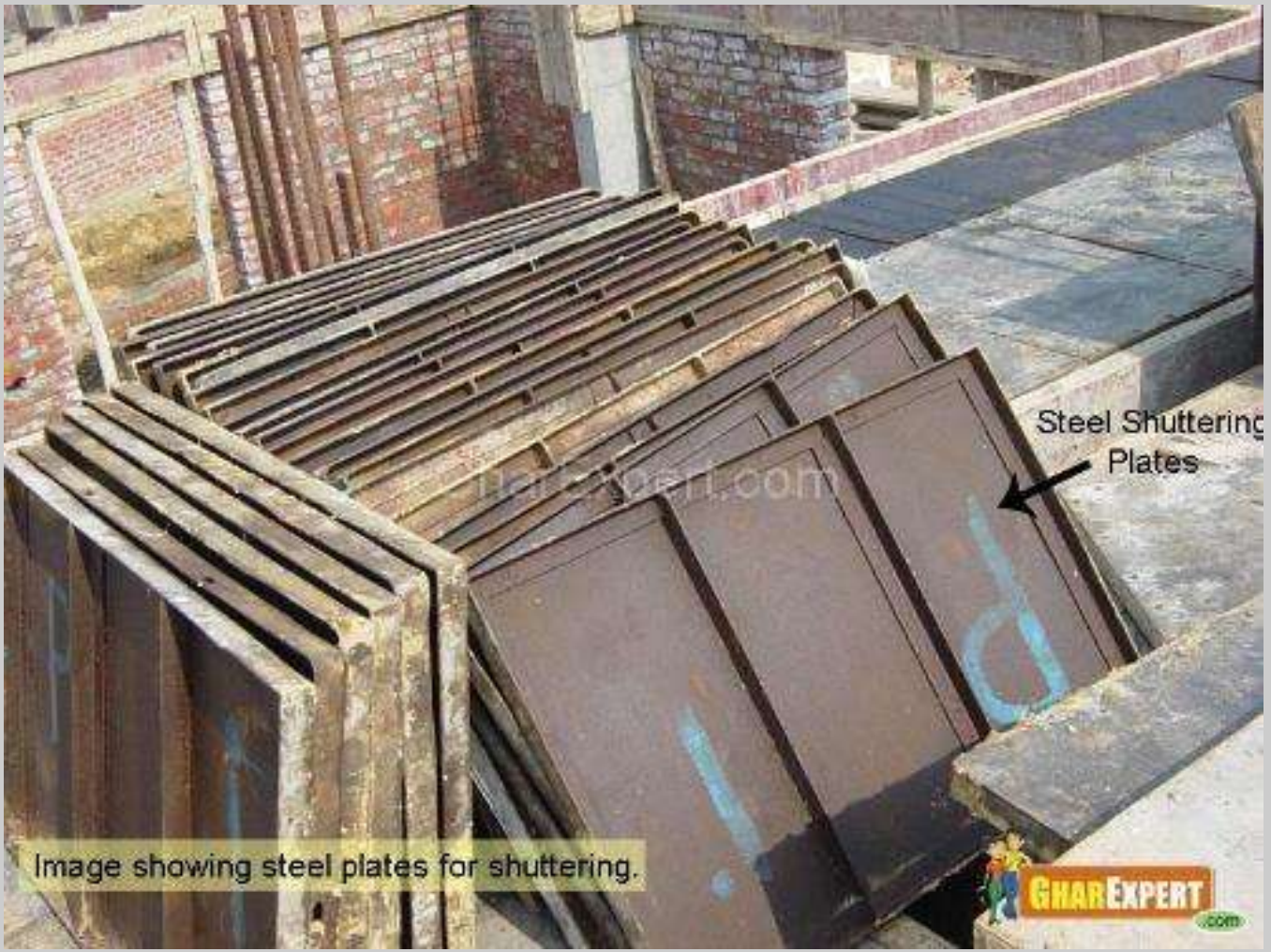


Image showing steel plates for shuttering.

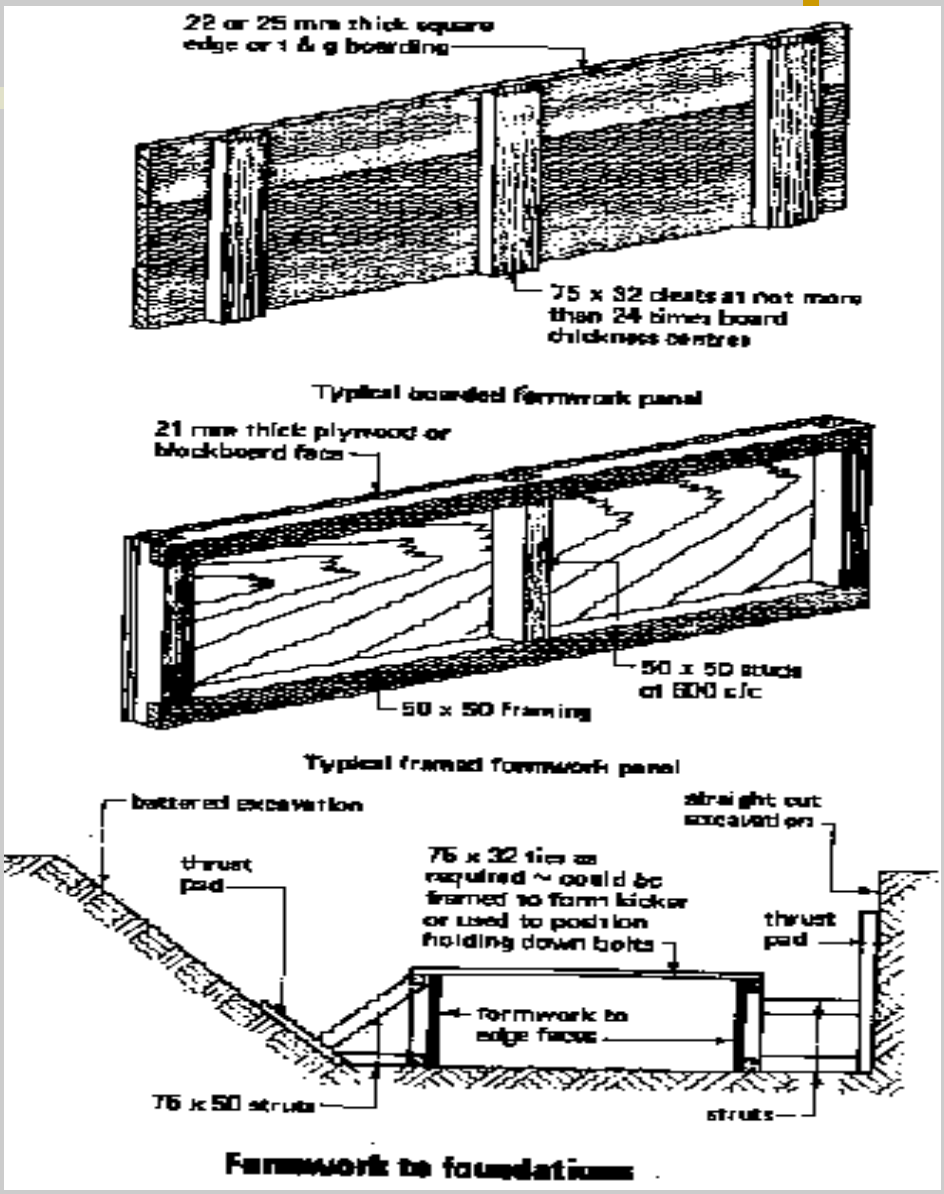
Wooden Formwork

Formwork detail for different structural members

- In concrete construction formwork is commonly provided for the following structural members.
- **Foundations**
- **Walls**
- **Columns**
- **Slabs & beams**
- **Stairs**

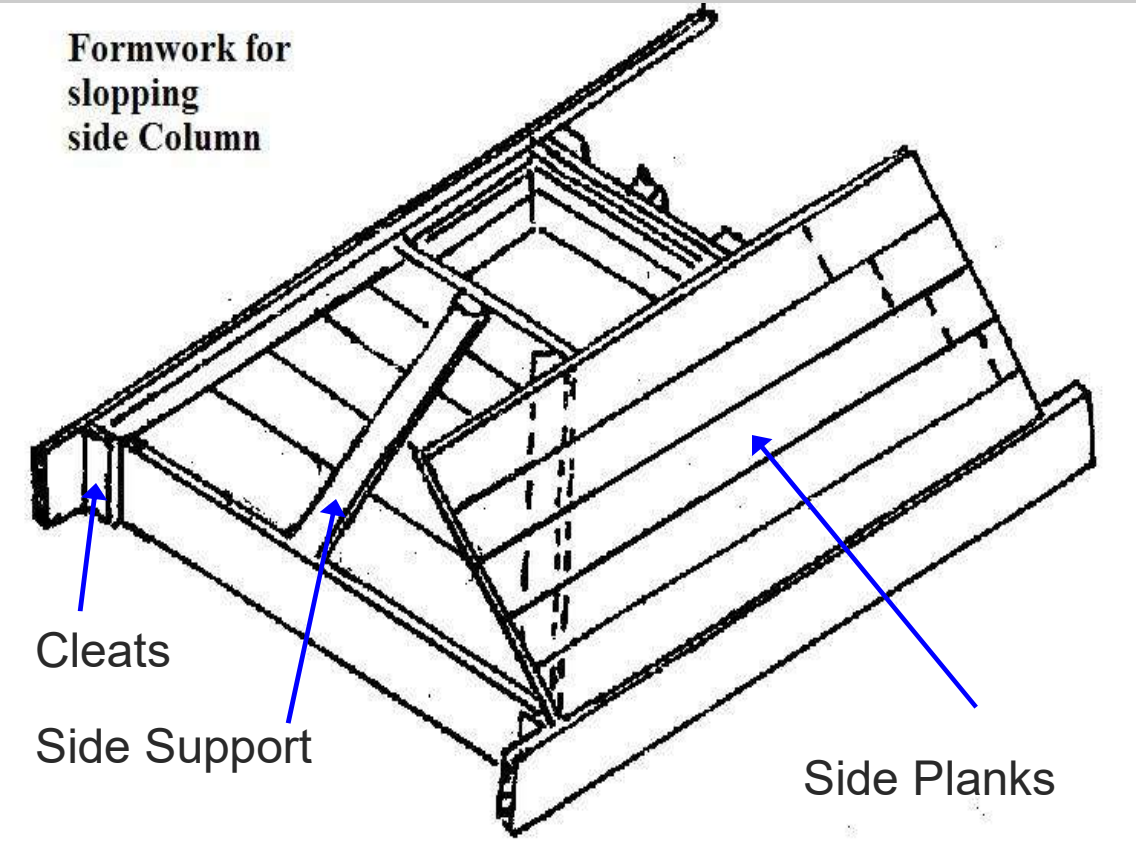
Formwork for Foundations

- Wall foundations
- It consists of
  - Plywood Sheeting
  - Struts



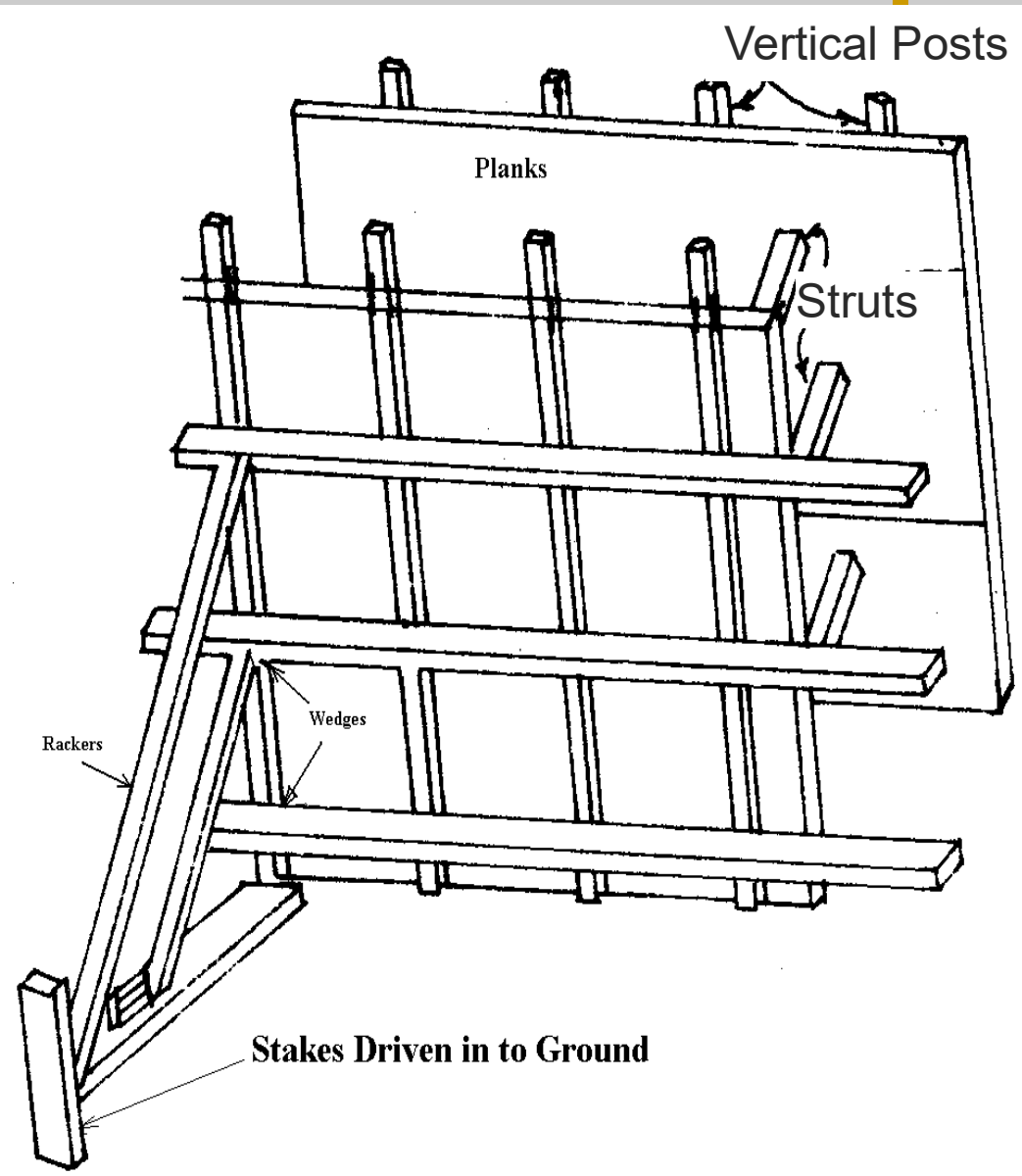
Formwork for Foundations

- Column Foundations
- It consists of
  - Side Supports
  - Side Planks
  - Cleats



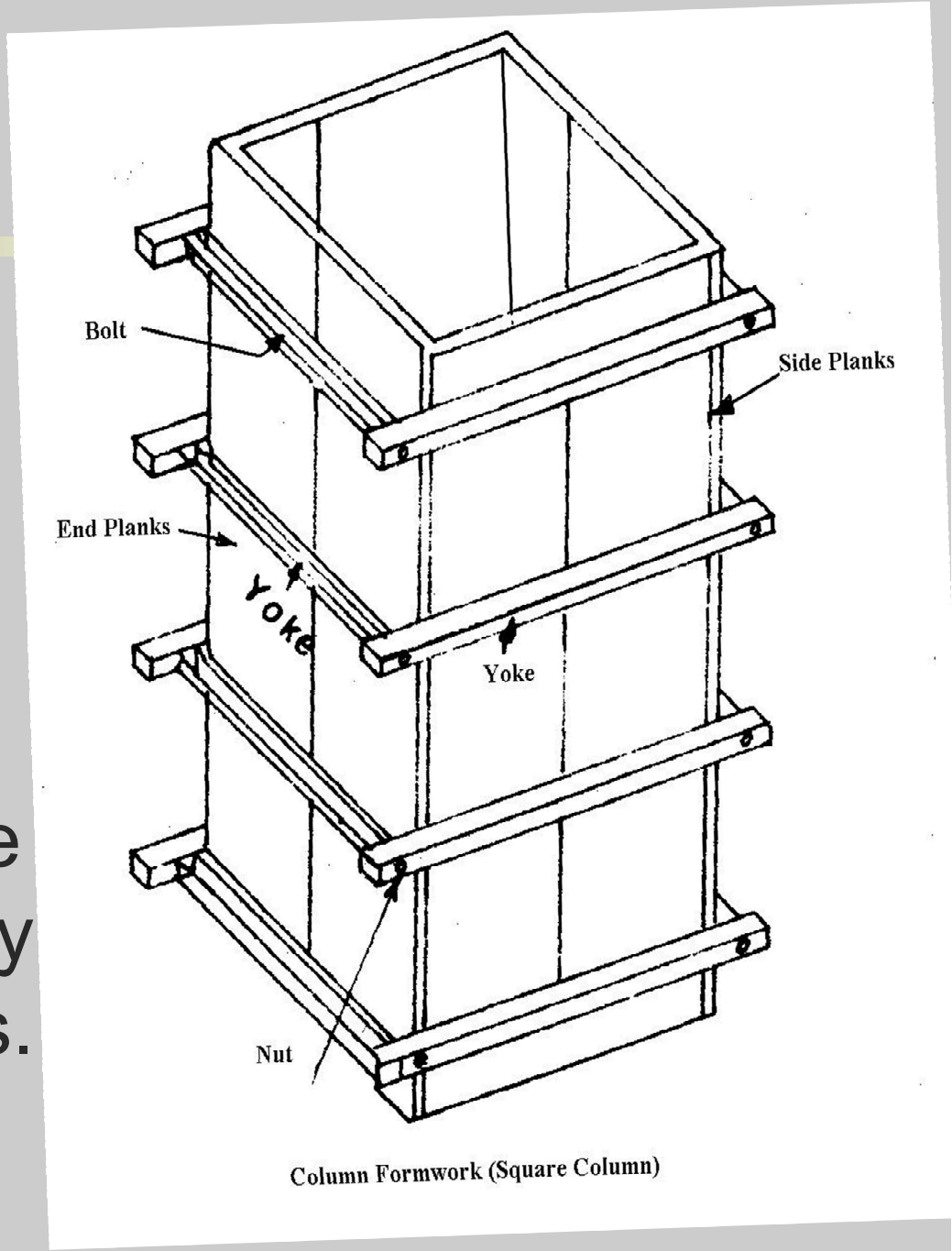
Formwork for Wall

- **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.**



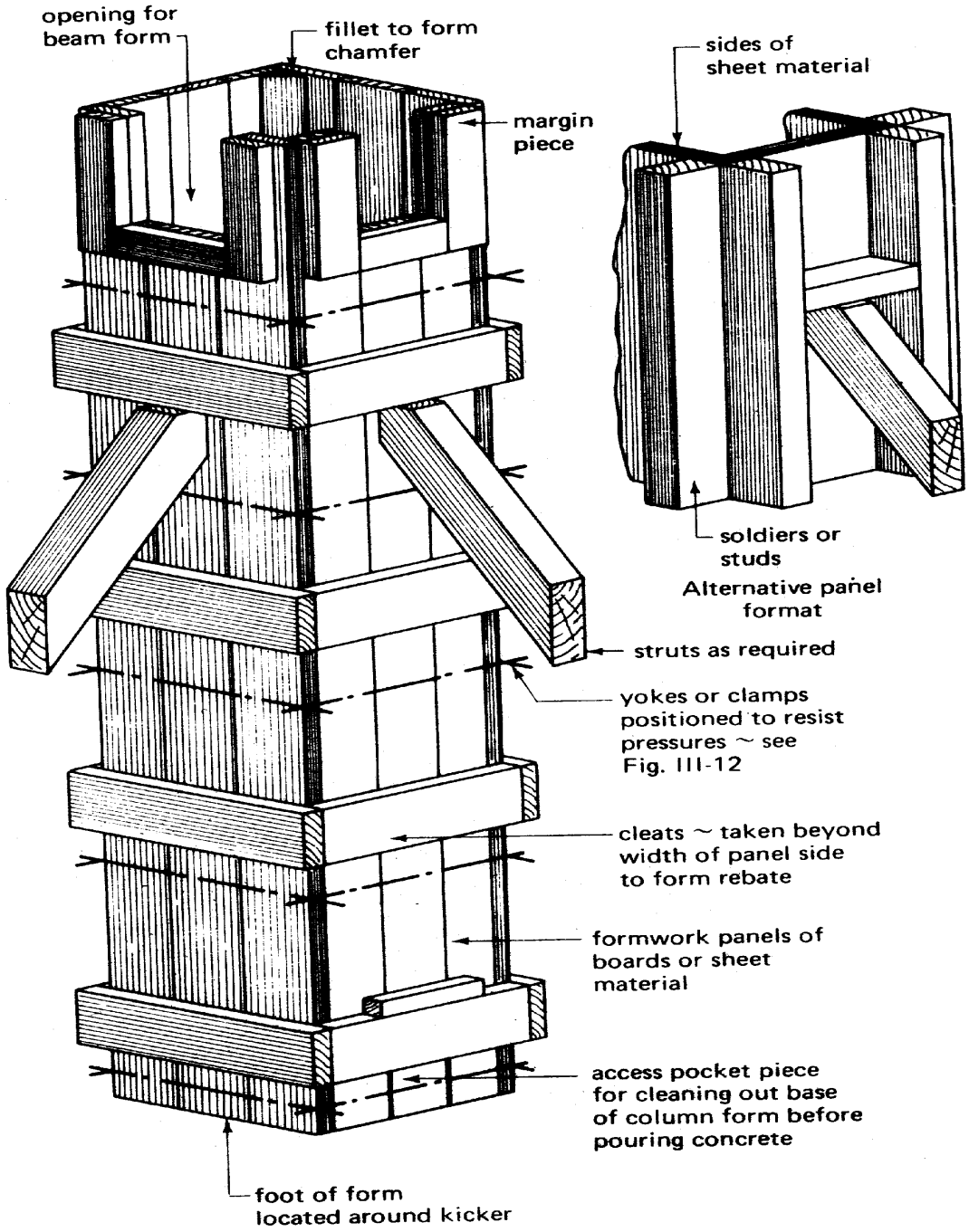
Formwork for Column

- **It consists of the following**
  - Side & End Planks
  - Yoke
  - Nut & Bolts
- Two end & two side planks are joined by the yokes and bolts.

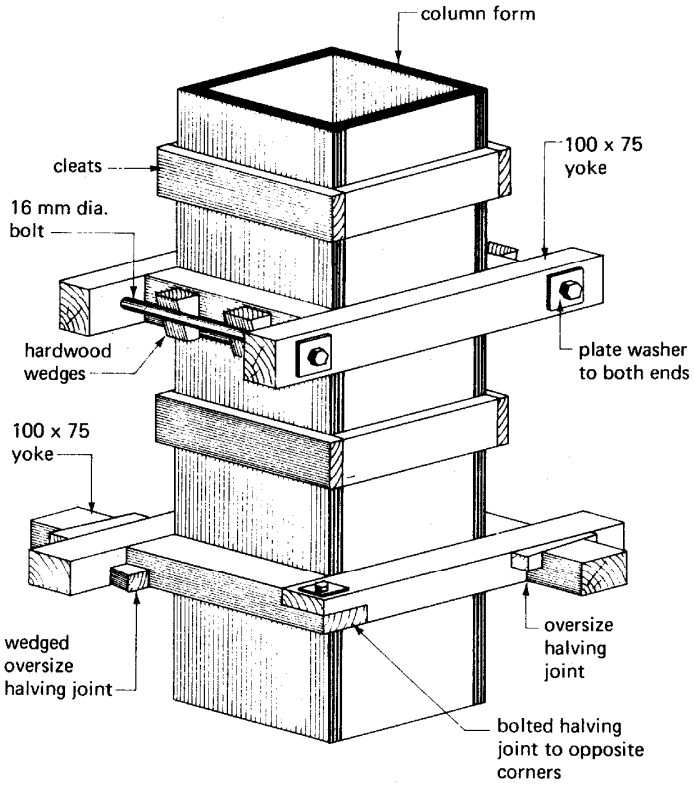


Column Formwork (Square Column)

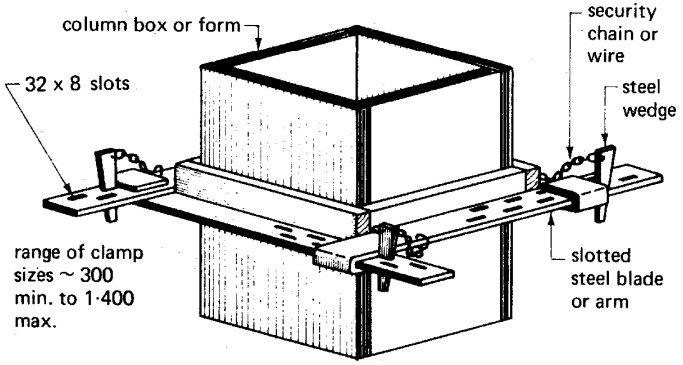
Column form work



Column formwork principles

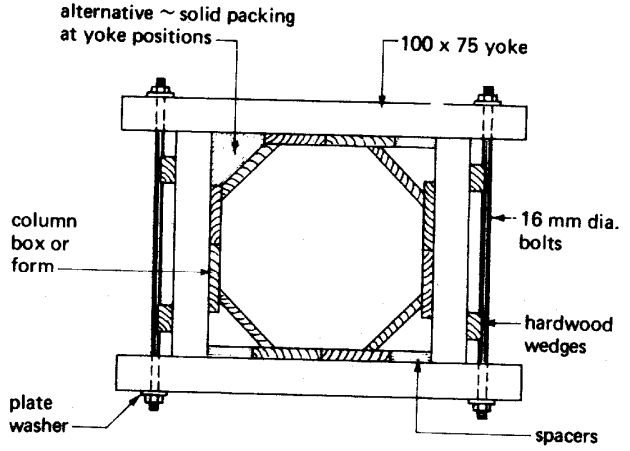


Typical timber yokes

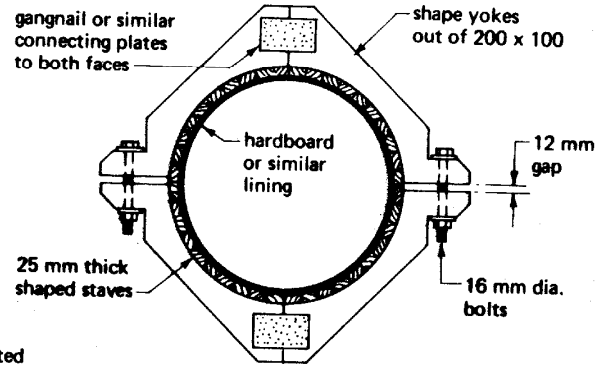


Typical column clamp

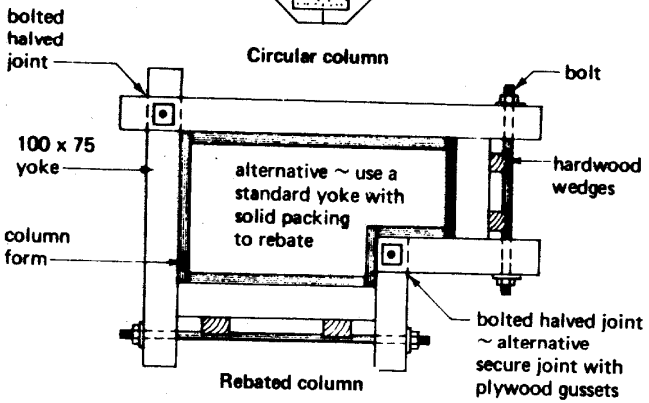
Typical column yokes and clamps



Octagonal column



Circular column

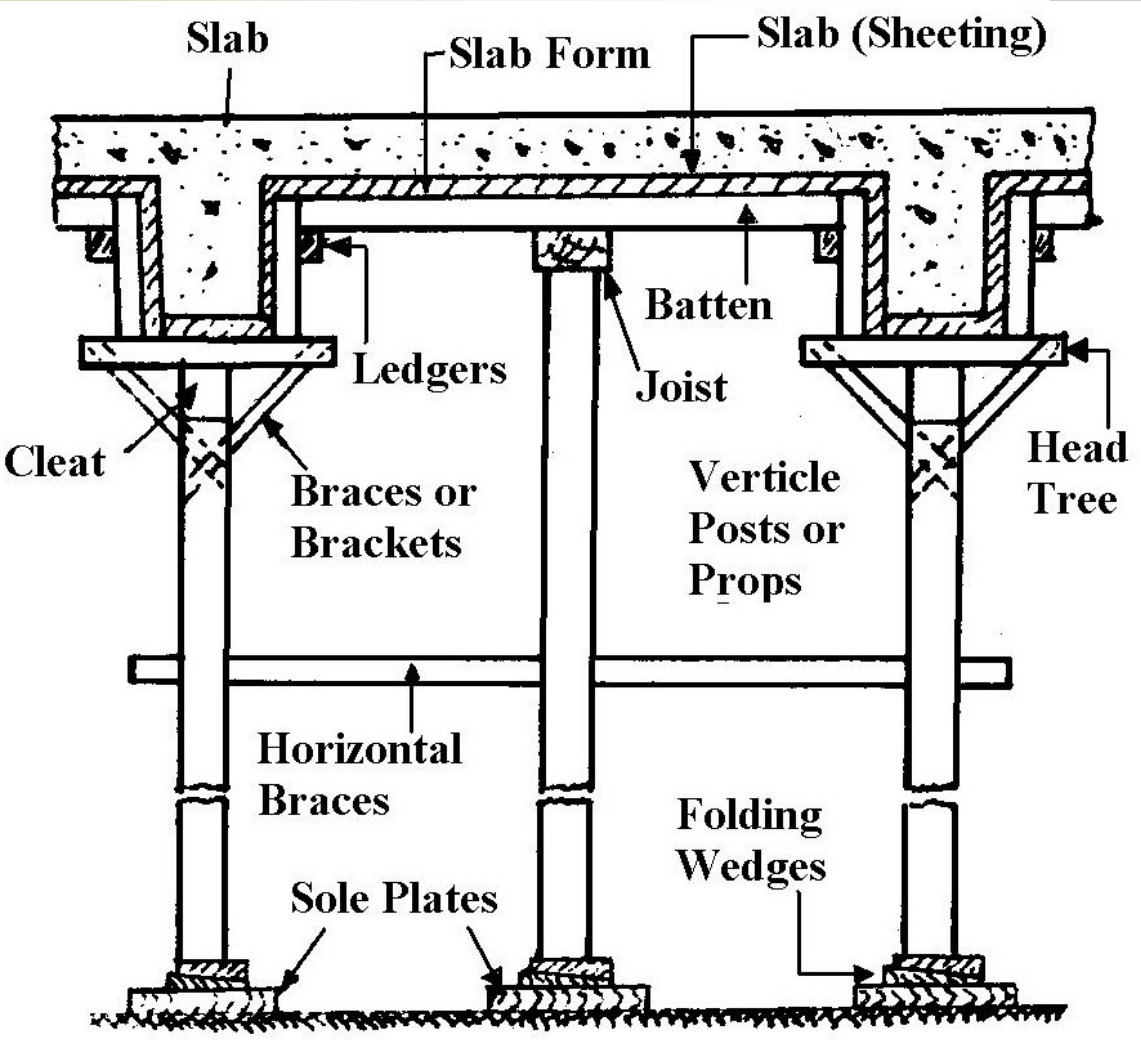


Rebated column

Shaped column forms and yokes

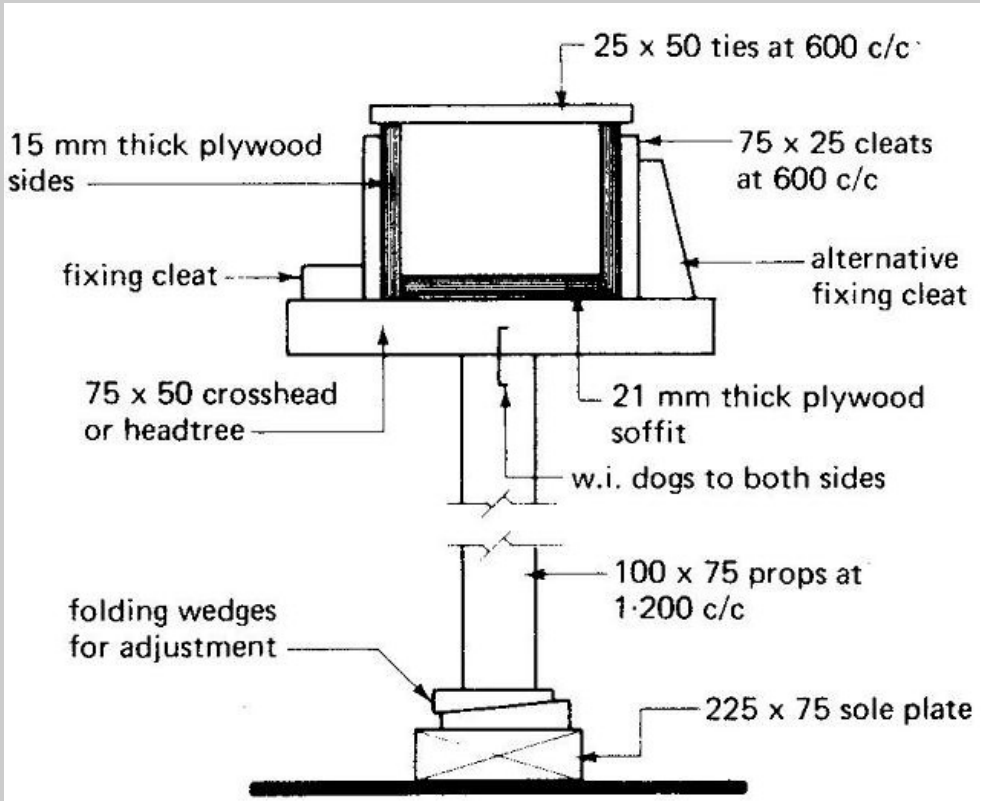
Formwork for Slabs & beams

- 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.

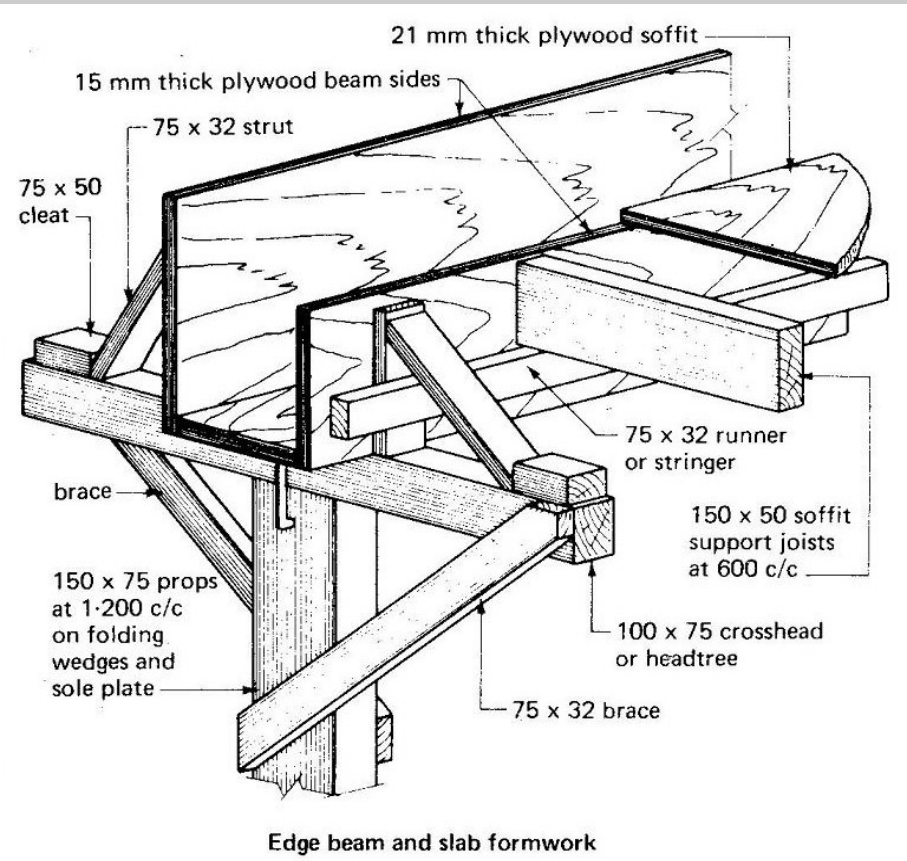


Form Work for concrete Beams & Slabs

Lintel or Beam Formwork



Simple beam or lintel formwork

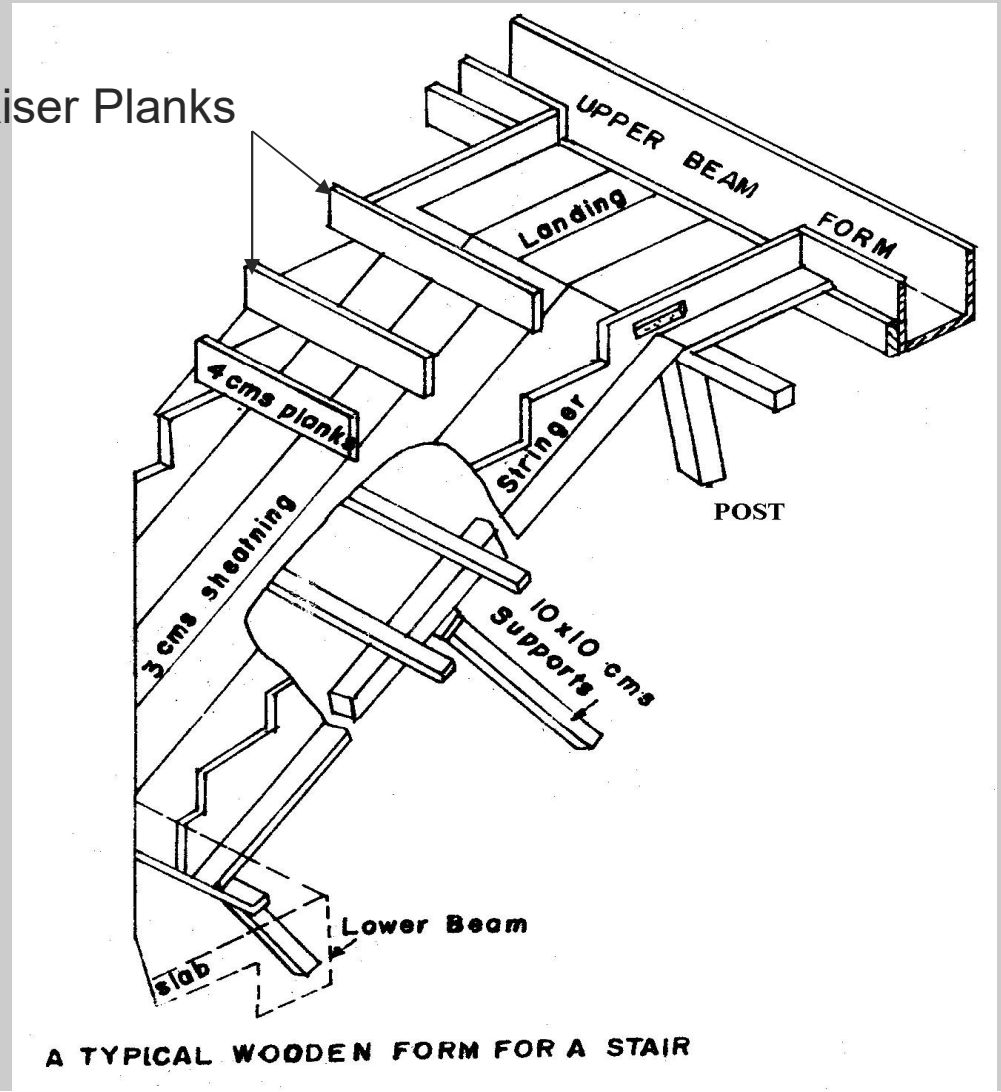


Edge beam and slab formwork

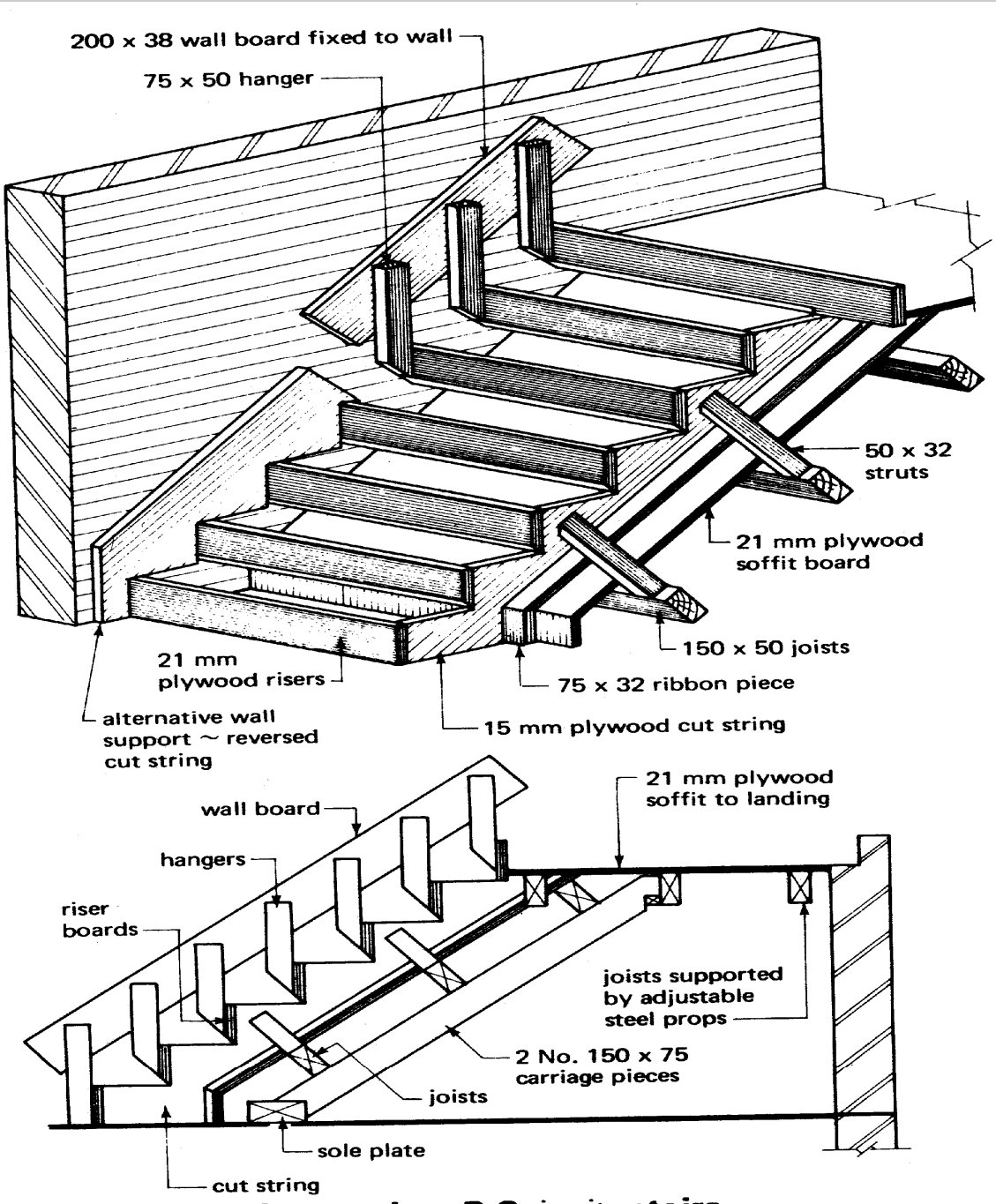
Typical beam formwork

Formwork for Stairs

- It consists of
  - Vertical & inclined posts
  - Inclined members
  - Wooden Planks or sheeting
  - Stringer
  - Riser Planks



A TYPICAL WOODEN FORM FOR A STAIR



Typical formwork to R.C. in situ **stairs**

Removal of formwork

Time of formwork removal 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.

Time of Removal of formwork

Sr. No	Structural Member	OPC (Ordinary Portland Cement)	Rapid Hardening Cement
1	Beam sides, walls & Columns	24 to 48 hours	Within 24 hours
2	Slab (Vertical Supports remains intact)	3 Days	48 hours
3	Slab (Complete Formwork removal)	10 Days	5 Days
4	Beams (Removal of Sheeting, Props remains intact)	8 Days	5 Days
5	Beams & Arches (Complete formwork removal) (up to 6 m span)	14 Days	5-8 Days
6	Beams & Arches (Complete formwork removal) (more than 6 m span)	21 Days	8-10 Days

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 **40%-50%** 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 has more life so can be used for a number of times.
- It is non absorbent.
- It is water tight
- Smooth finish surface obtained.
- No shrinkage of formwork occurs.
- Easy to use.
- Its volume is less
- Its strength is more.

Scaffolding

- Definitions
  - It’s a temporary structure to provide a platform at different levels of a building for workers and Materials.

Types of Scaffolding

- Following are the types of scaffolds
  1. Single Scaffolds
  2. Double Scaffolds
  3. Ladder Scaffolds
  4. Cantilever Scaffolds
  5. Suspended Scaffolds
  6. Steel or Tubular Scaffolds

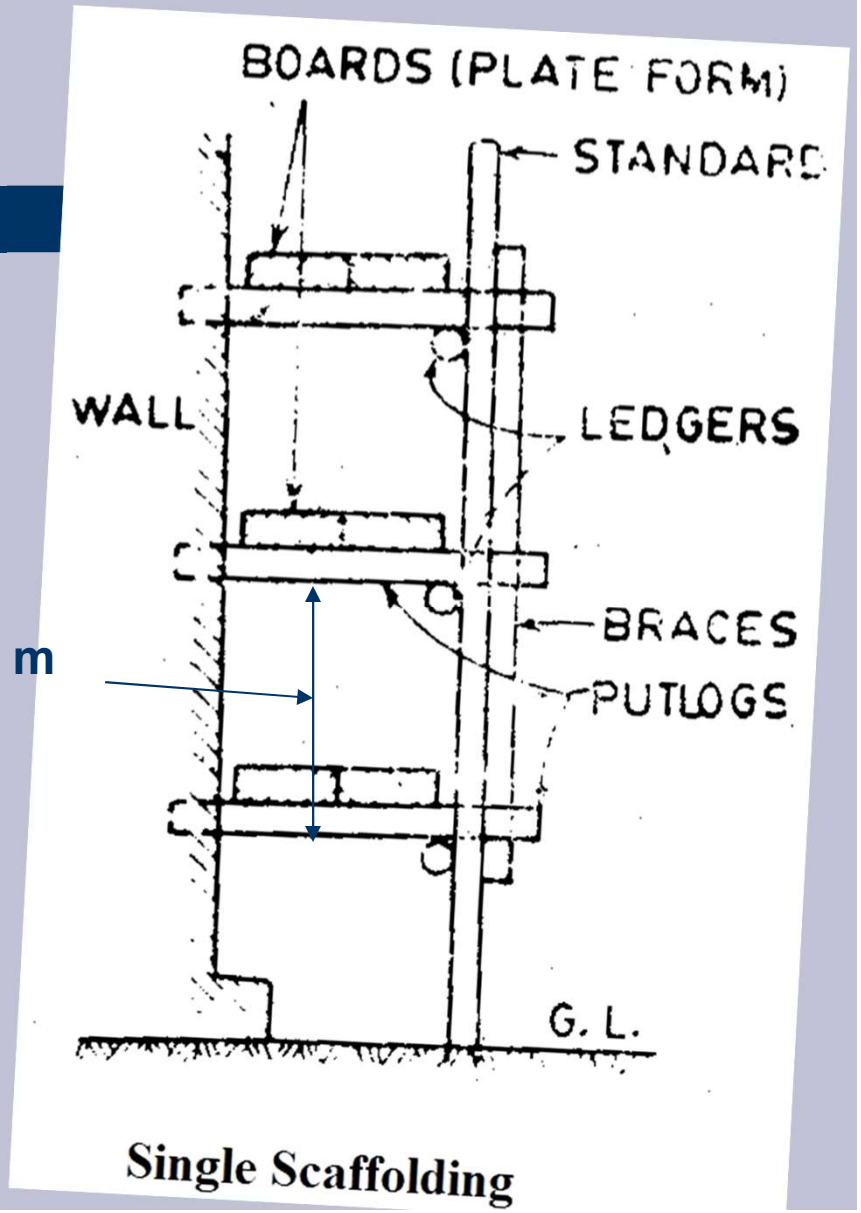
Definition

- Scaffold
  - It is the temporary support system provided for the construction & maintenance purposes.
  - It consists of supports and a working platform for workers and Materials.
- Scaffolding
  - Method of construction of scaffolds is called scaffolding.

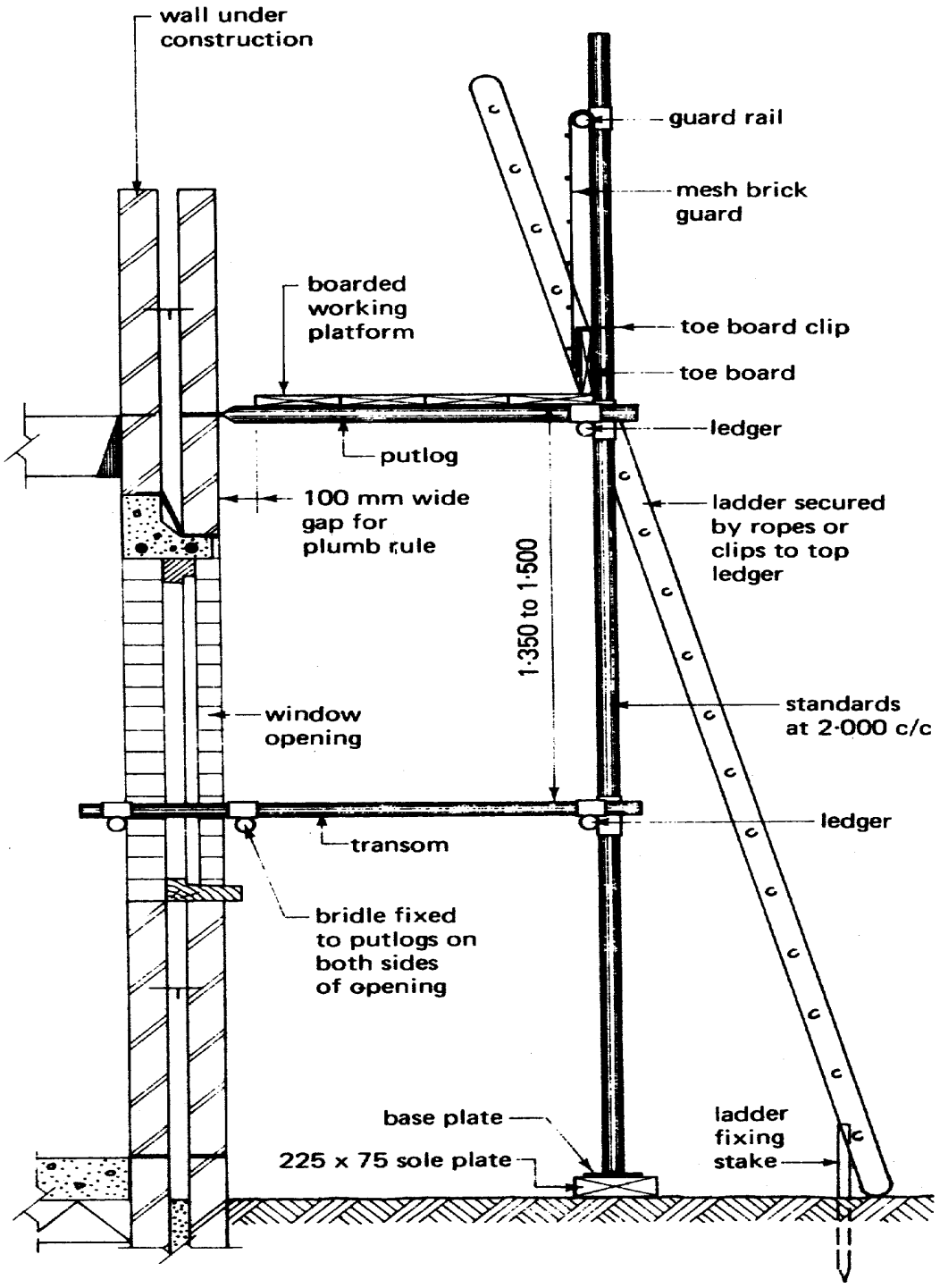
Single Scaffolds

- It consists of
  - Standards posts (10 cm x 10 cm)
  - Putlogs (7.5 x 7.5)cm
  - Ledgers
  - Wooden boards
  - Braces

  Used for ordinary buildings

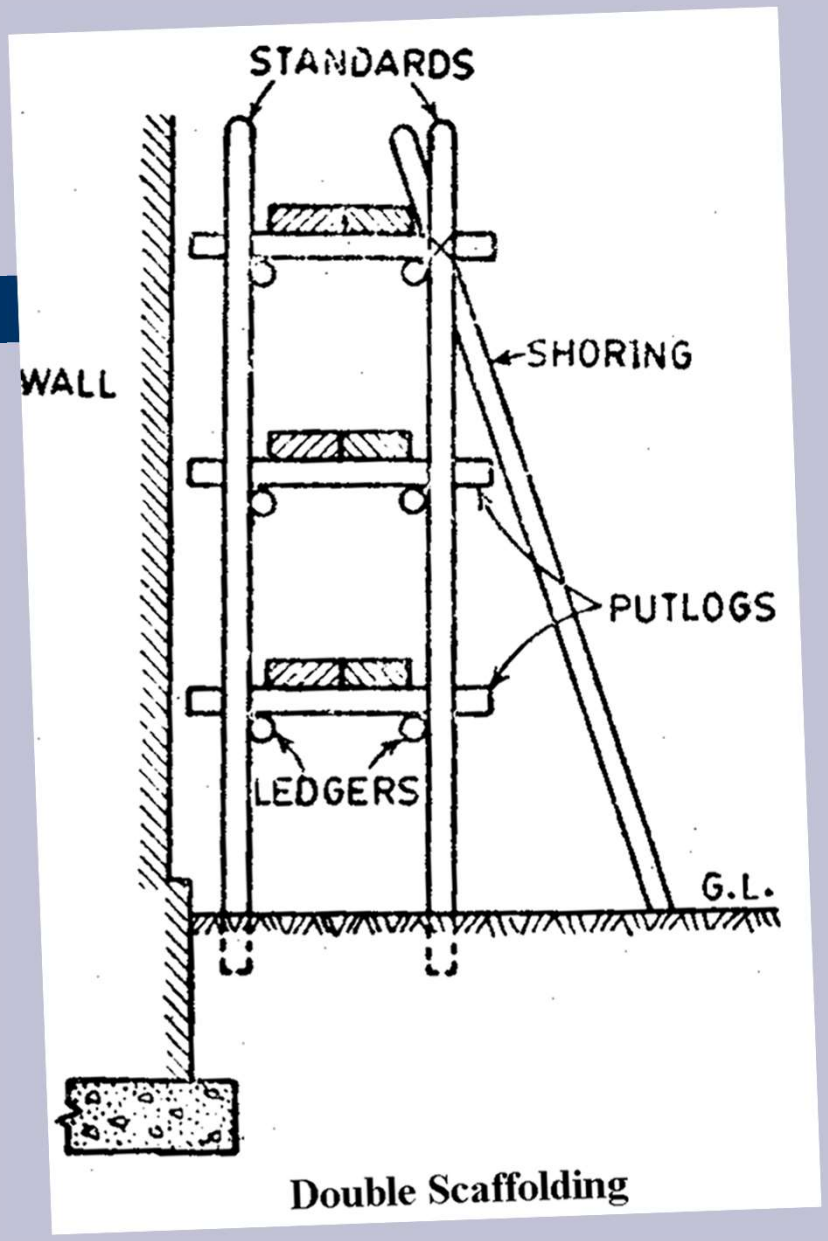


Single Scaffolding

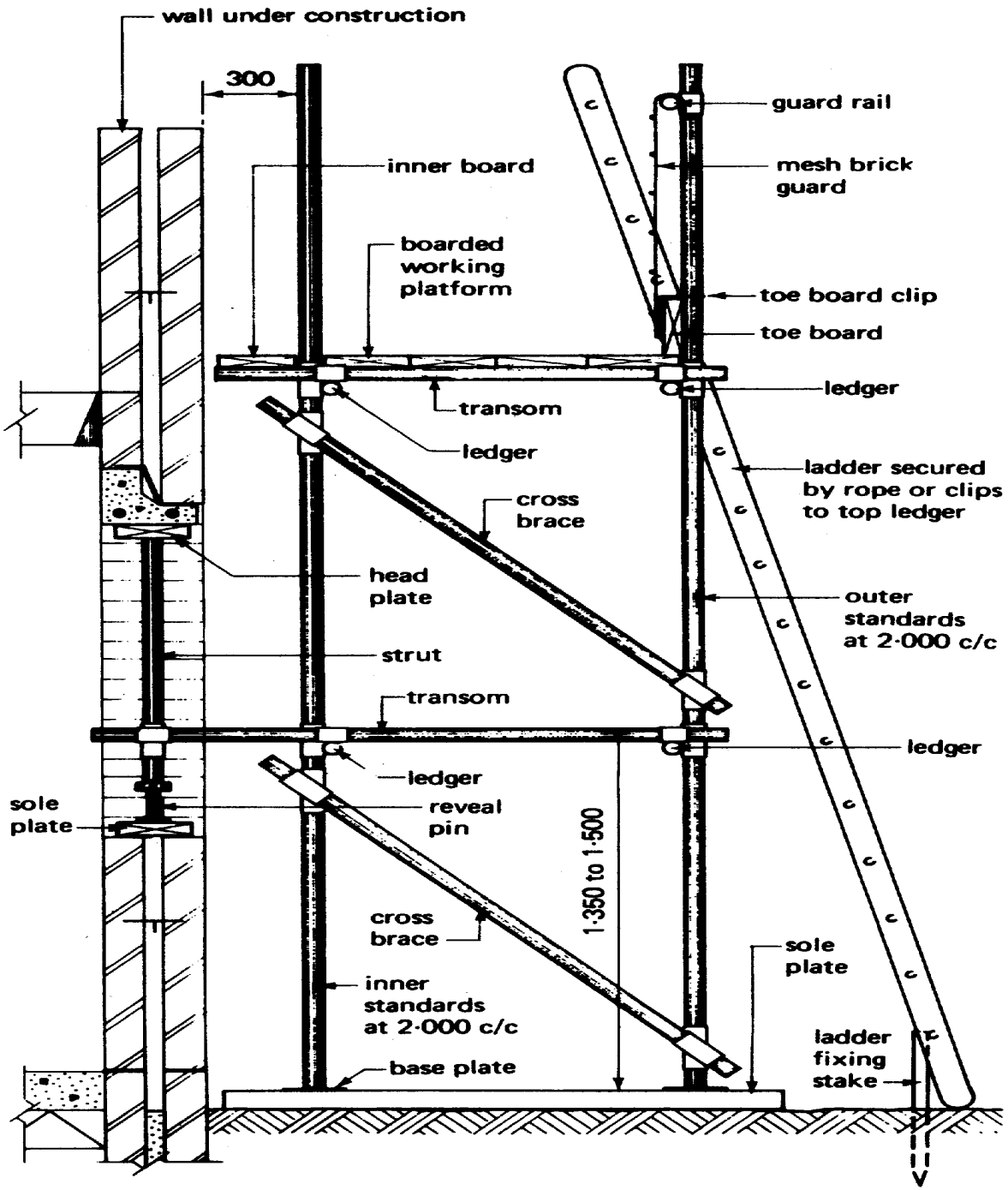

wall under construction
guard rail
mesh brick guard
boarded working platform
toe board clip
toe board
ledger
putlog
100 mm wide gap for plumb rule
1·350 to 1·500
ladder secured by ropes or clips to top ledger
standards at 2·000 c/c
window opening
ledger
transom
bridle fixed to putlogs on both sides of opening
base plate
225 x 75 sole plate
ladder fixing stake

Double Scaffolds

- It consists of
  - Two rows of standards.
    15 cm, 1.5 m
  - Shores are provided.
- Used for superior works



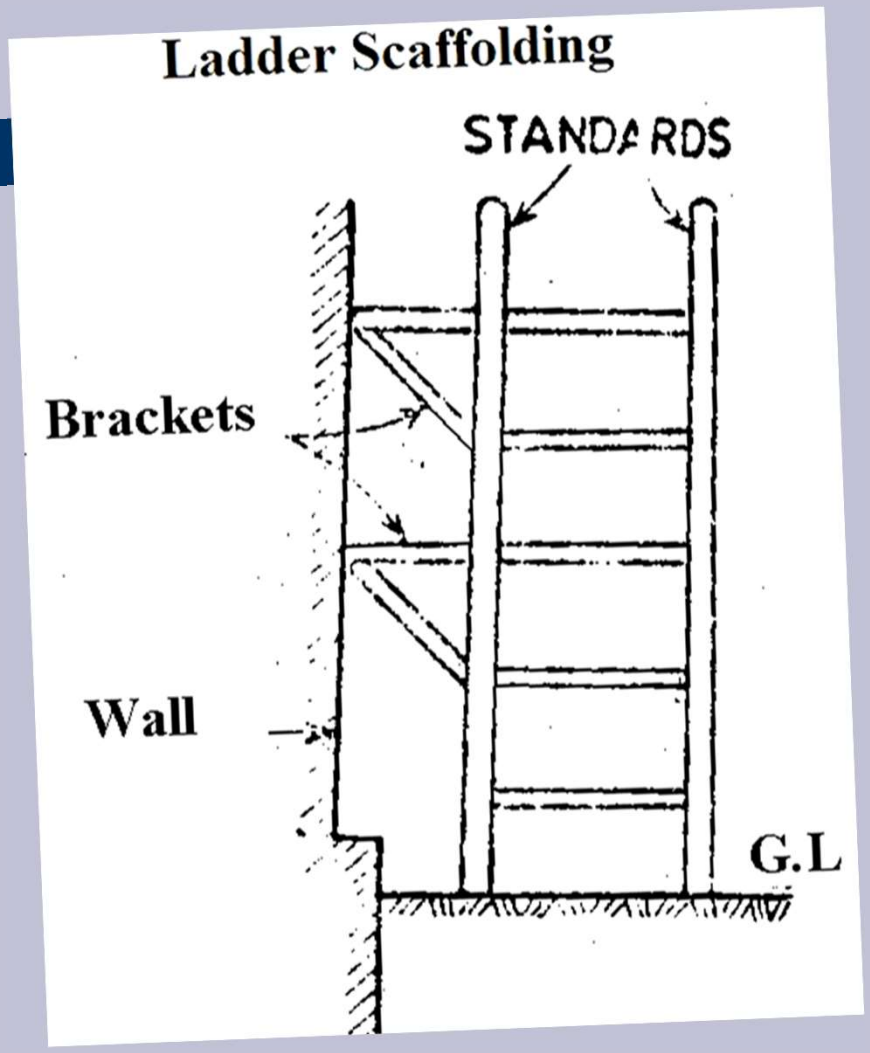
Double Scaffolding



N.B. Not more than 50% of ties should be reveal ties

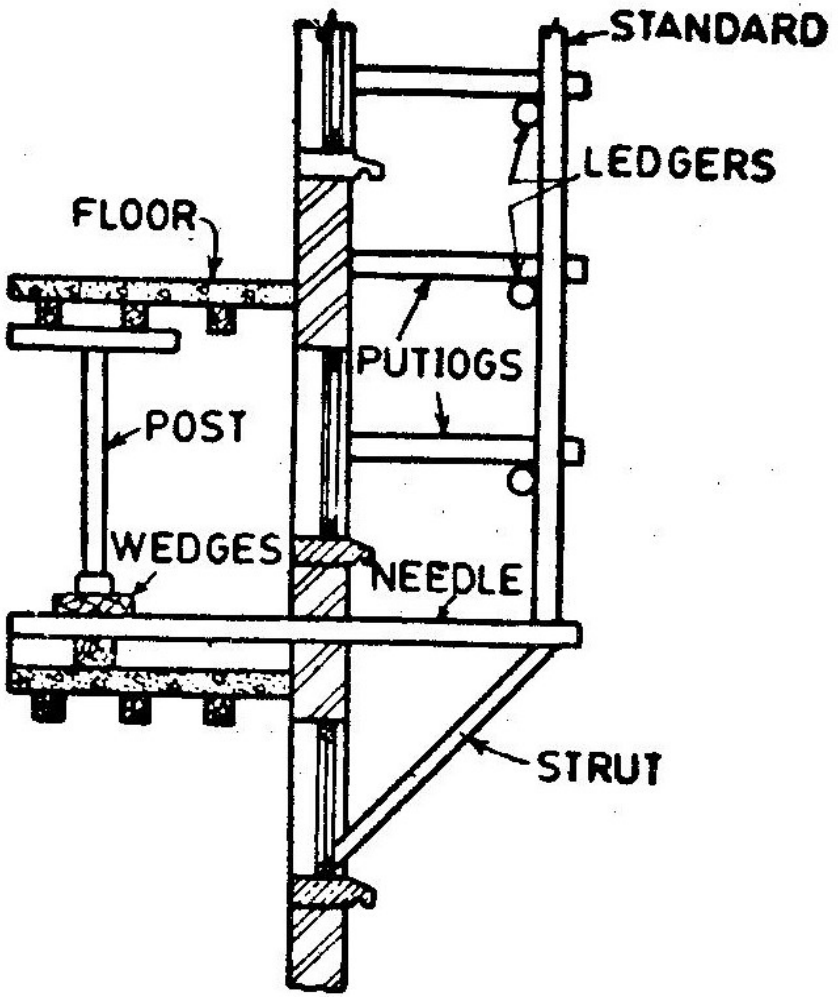
Ladder Scaffolds

- It consists of
  - Brackets for Plate form.



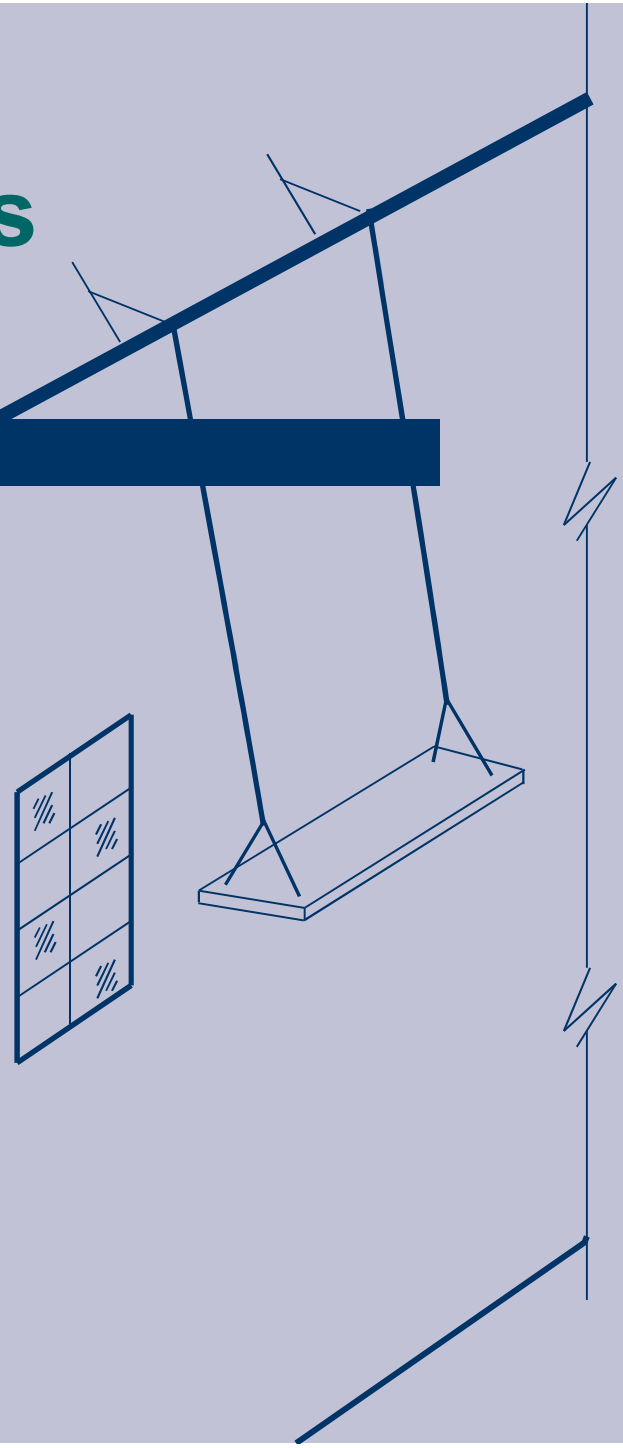
Cantilever Scaffolds

- It consists of
  - Cantilever
  - Struts
  - Standards
  - Putlogs
  - Plate forms
- It is used above ground level



Cantilever Scaffolding.

Suspended Scaffolds



- It consists of
  - Ropes
  - Working platforms

  Ropes can be raised Manually or mechanically

  Used for light construction and finishing works of multistory buildings.

Steel or Tubular Scaffolds

- It consists of
  - Steel tubes (1-1/2” – 2-1/2” diameter)
  - Coupler or Clamps (to hold pipes in different positions)
  - Prop nuts (to hold single pipes)
  - Bolts, Nuts & washers
  - Wedge & Clip

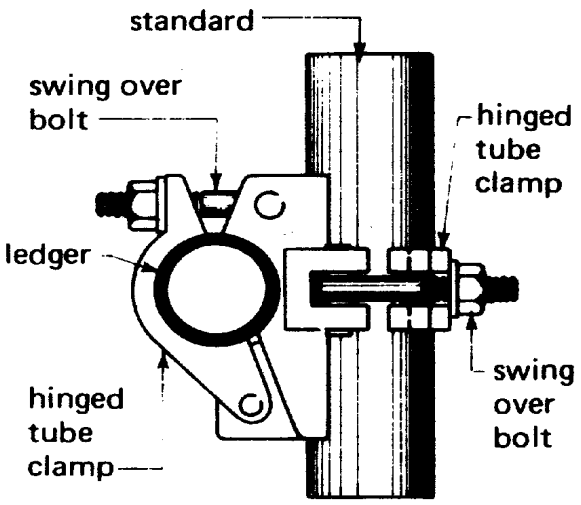
Scaffold pipes

Coupler or Clamps

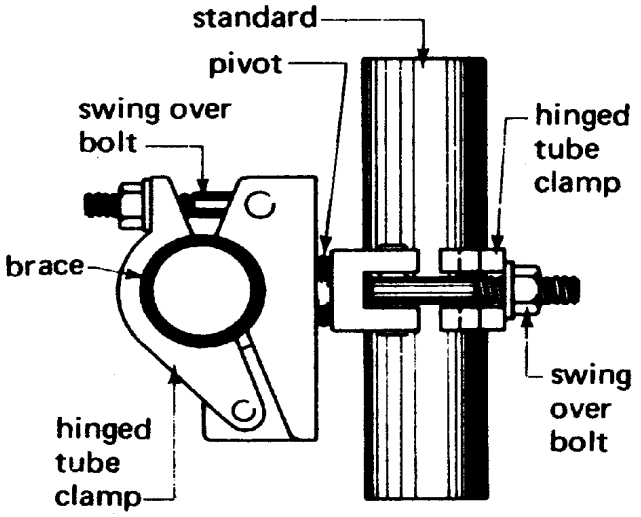
Scaffold fittings

- Double Coupler
  - It joins ledgers and standards.
- Swivel Coupler
  - Composed of two single couplers and used to join two scaffolds at any angle.
- Putlog Coupler
  - Used to join putlogs with transom.
- Base Plate
  - Used at the base of the standards.
- Split joint Pin
  - It’s a connection fitting used to join scaffold tubes.
- Reveal Pin
  - It fit in to the end of a tube to form an adjustable strut.
- Putlog end
  - A flat plate used at the end of a scaffold to convert it in to a putlog.

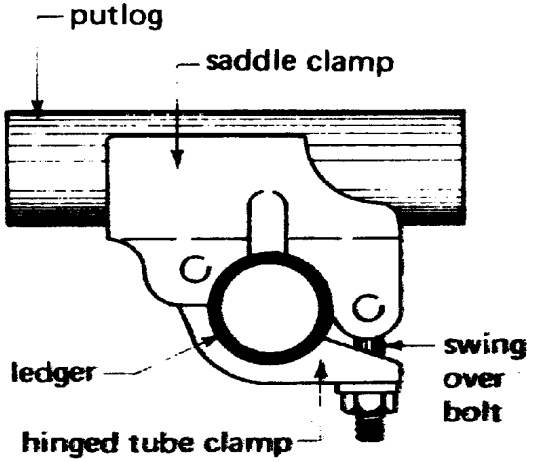
Scaffold fittings



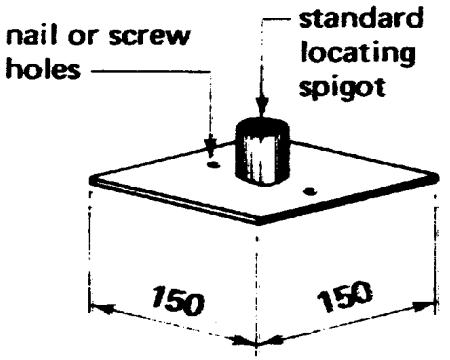
Double coupler



Swivel coupler



Putlog clip



also available with spigot similar to reveal pin

Base plate

Standards

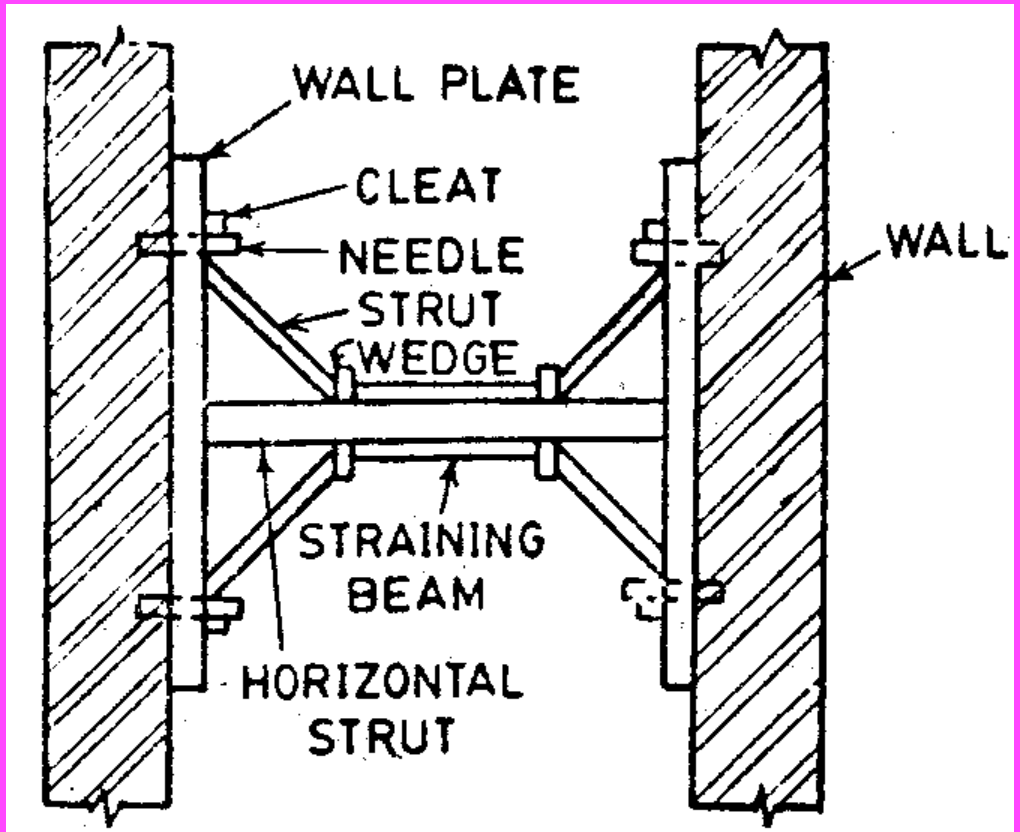
- **BS** 1139:Part 2:Section 2.1 (working scaffolds and false work made of steel tubes)
- **NZ** 3620 Scaffold Planks
- **AS** 1576 Scaffolding

Shoring

- Definition
  - It is the method of providing temporary support (shores) to an unsafe structure.
- Types of Shoring
  - Horizontal shoring or flying shoring
  - Vertical shoring or dead shoring
  - Inclined Shoring or flying shoring

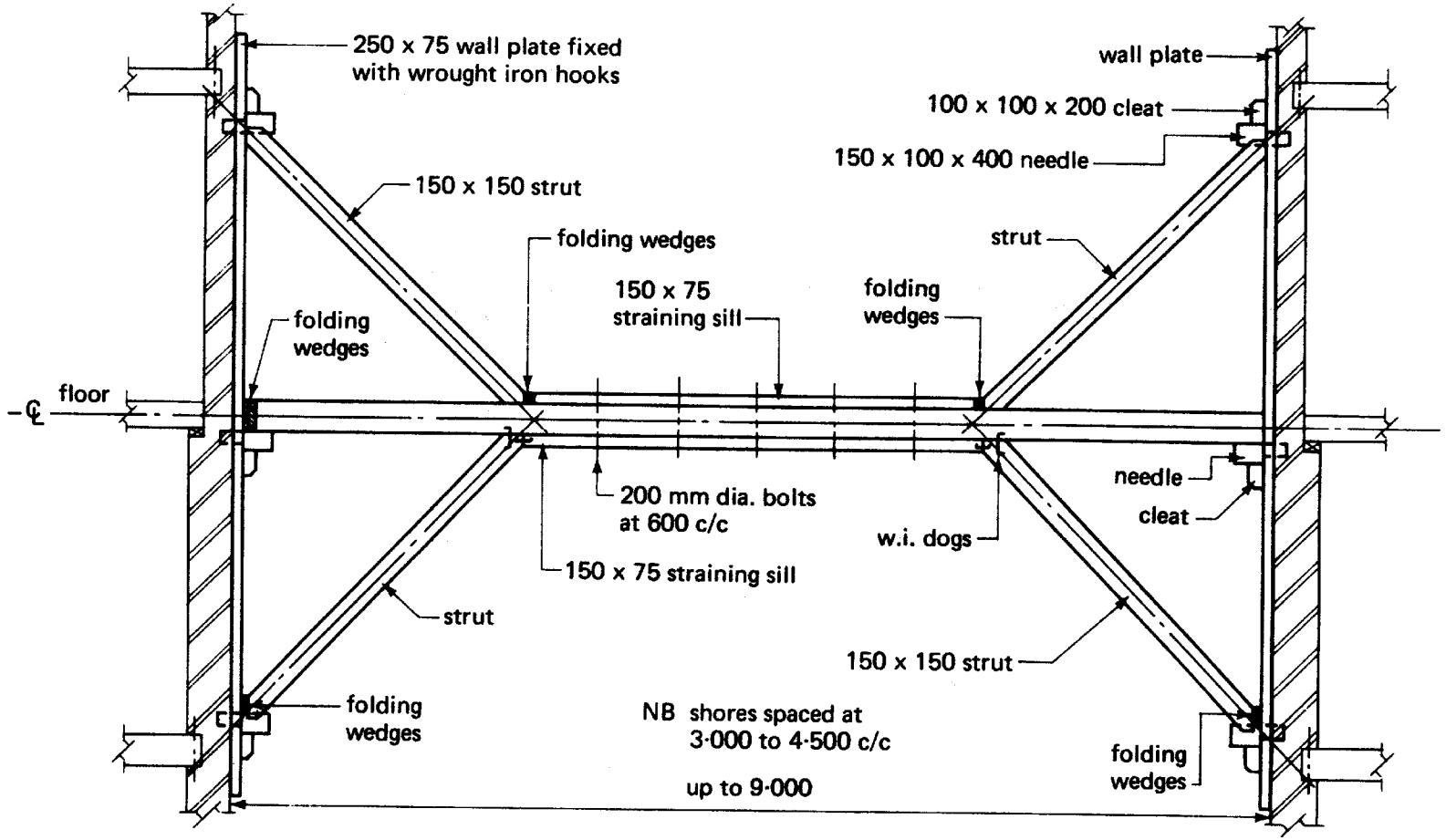
Horizontal shoring

- It consists of
  - Horizontal beam or strut
  - Wall plates
  - Cleats
  - Straining beams
- Used to support two adjacent buildings.



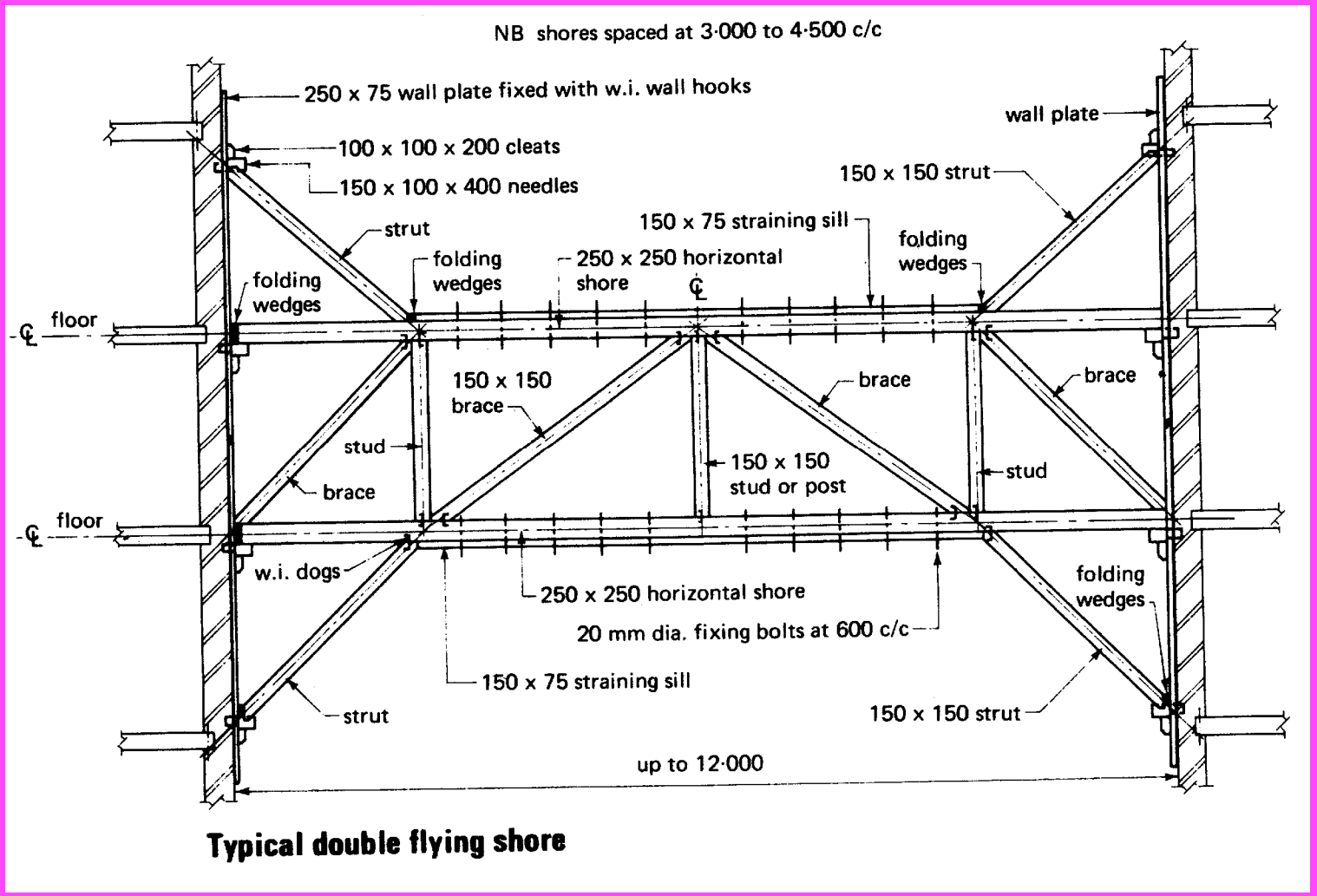
Horizontal Shoring

Single Flying Shoring



Typical single flying shore

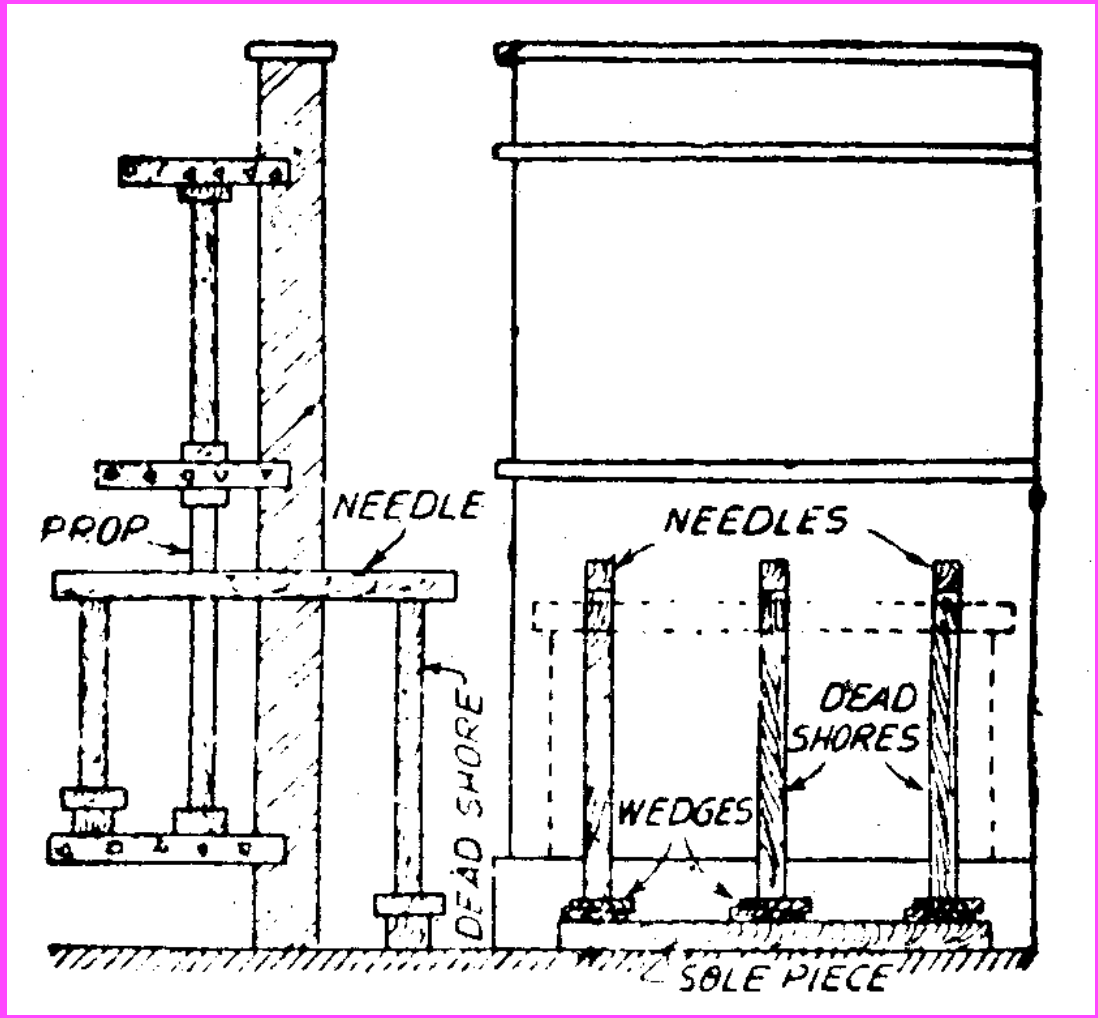
Double Flying Shoring



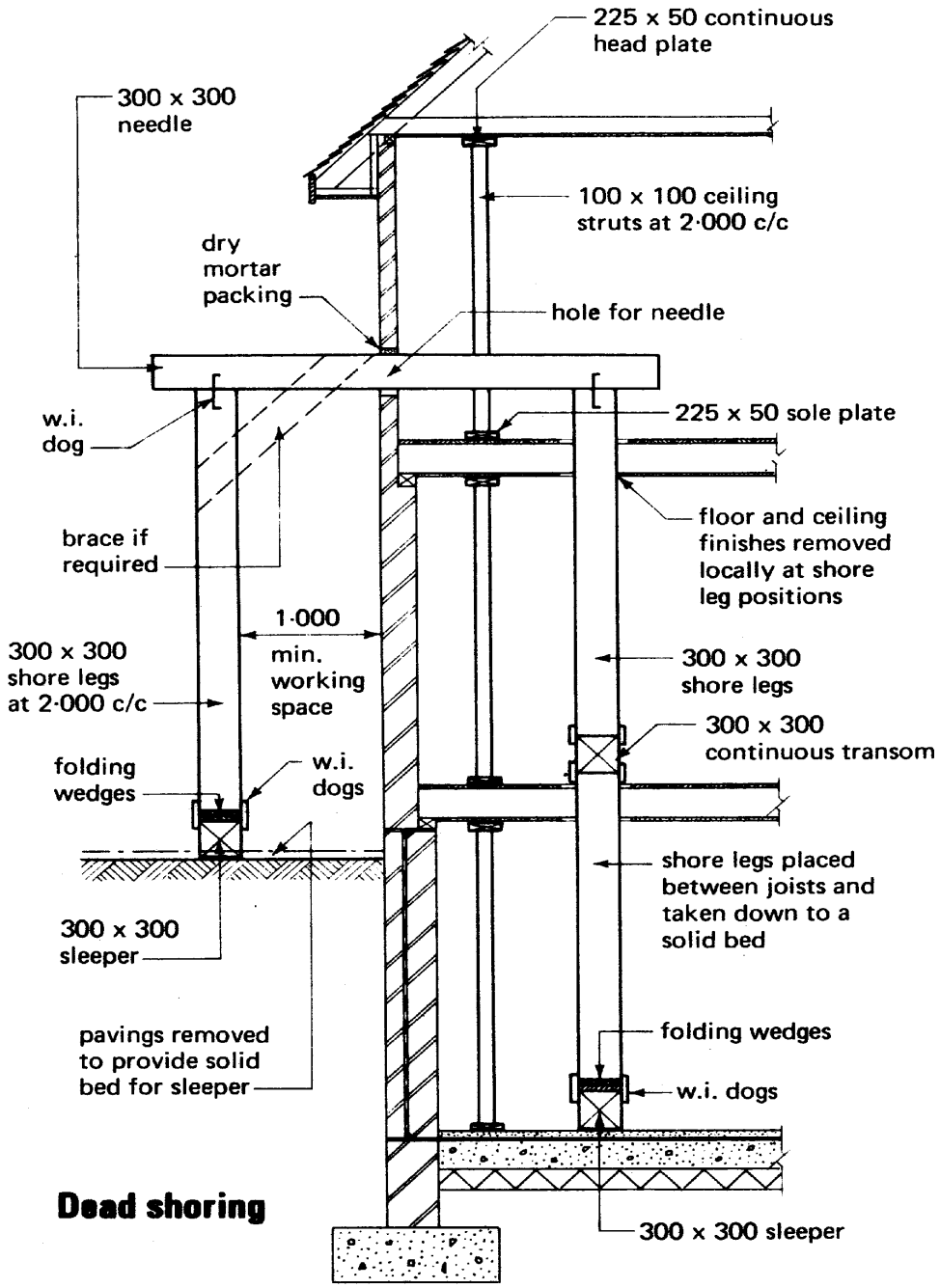
Typical double flying shore

Vertical shoring

- It consists of
  - Dead shores
  - Sole plates
  - Needles
  - Props
- Used for rebuilding of walls.



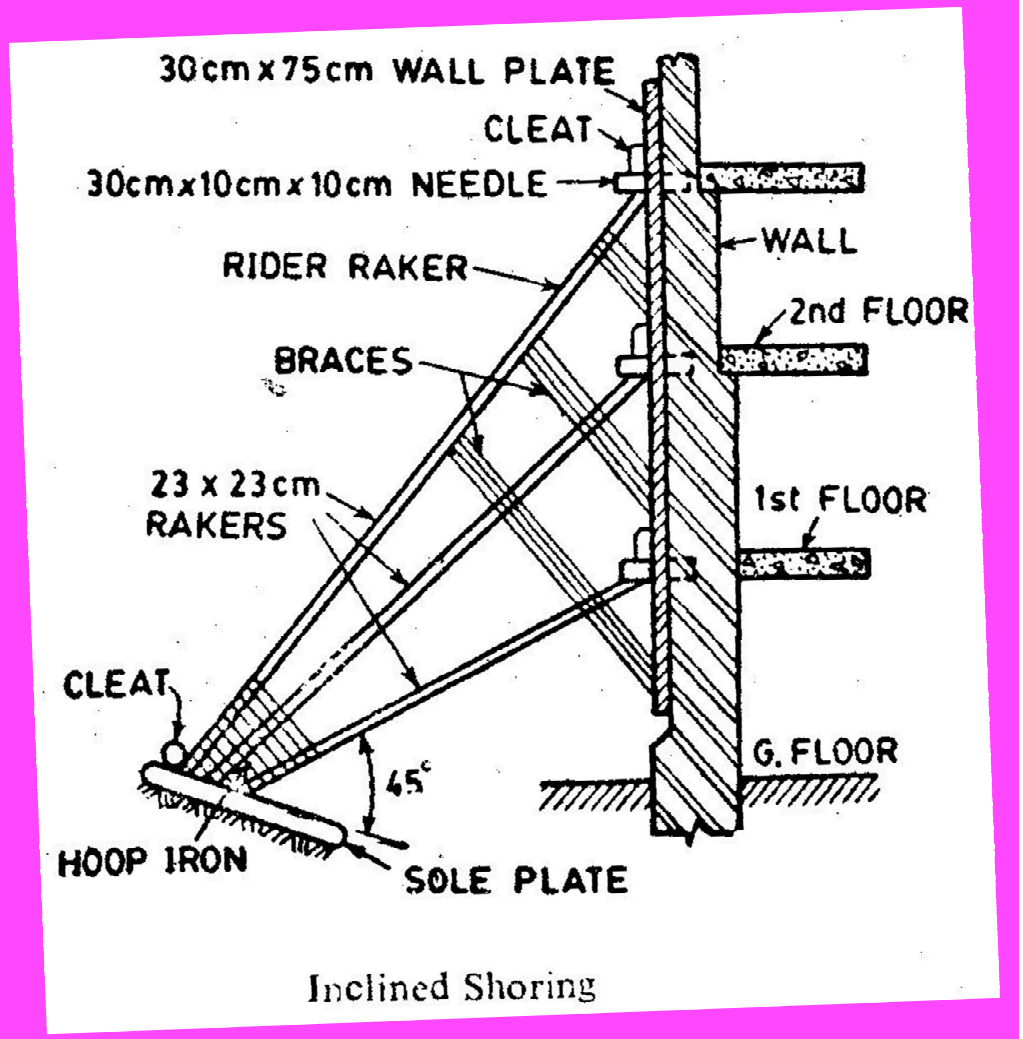
Dead or Vertical Shoring



cross bracing, longitudinal bracing and hoardings to be fixed as necessary

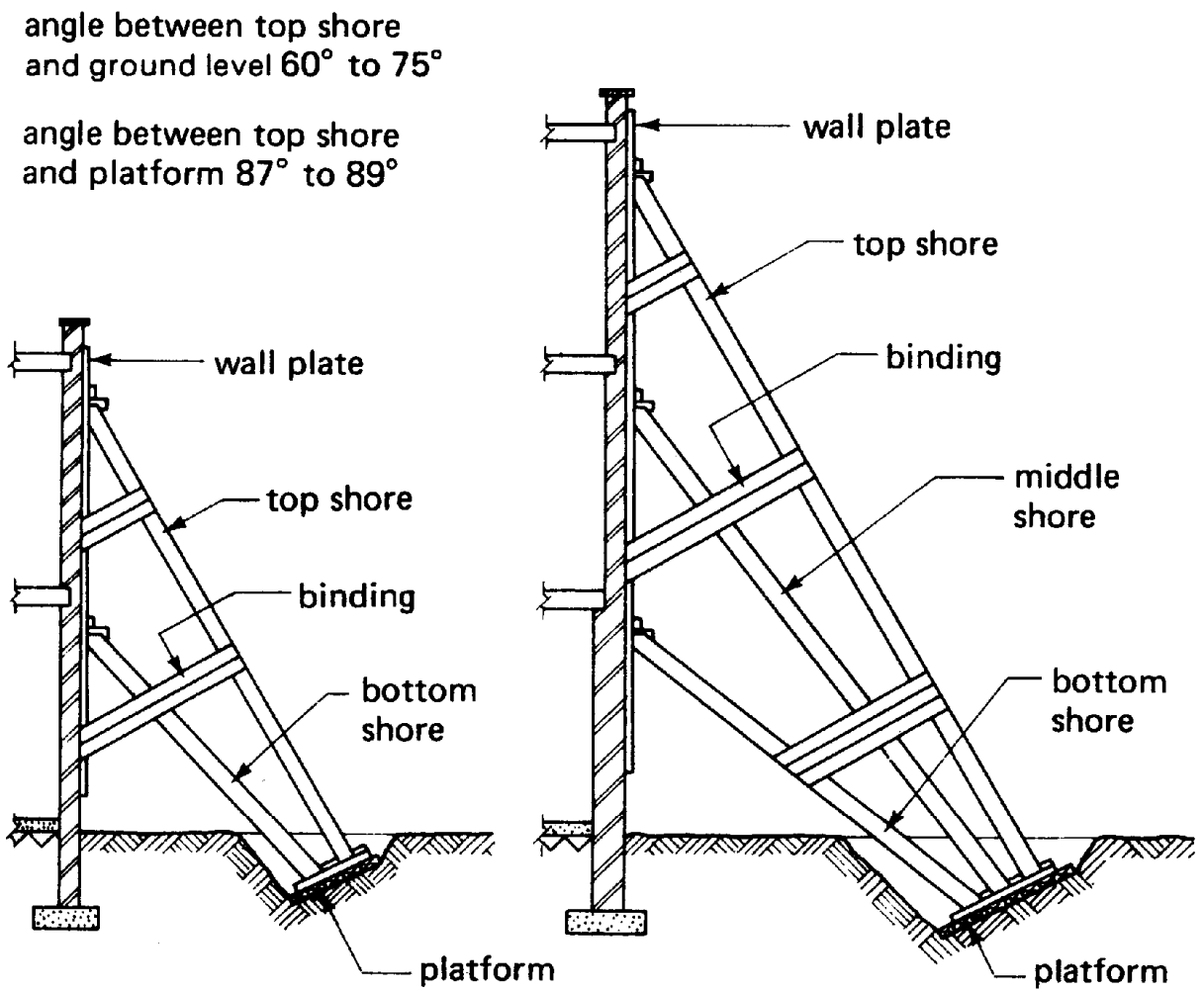
Inclined Shoring

- It consists of
  - Rackers
  - Needles
  - Cleats
  - Braces
  - Sole plate
- Used to strengthen a wall.



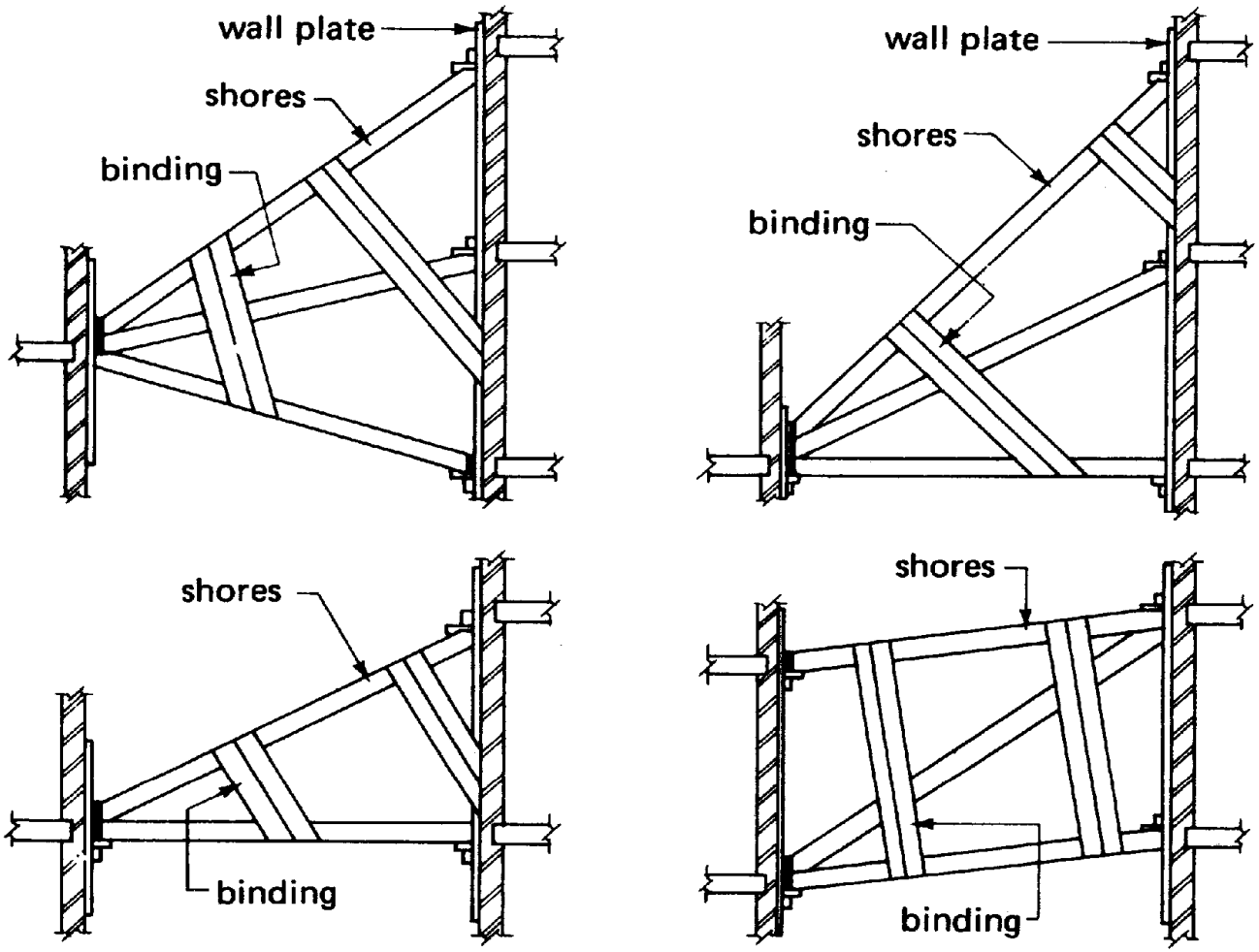
Inclined Shoring

Inclined or Raking Shoring



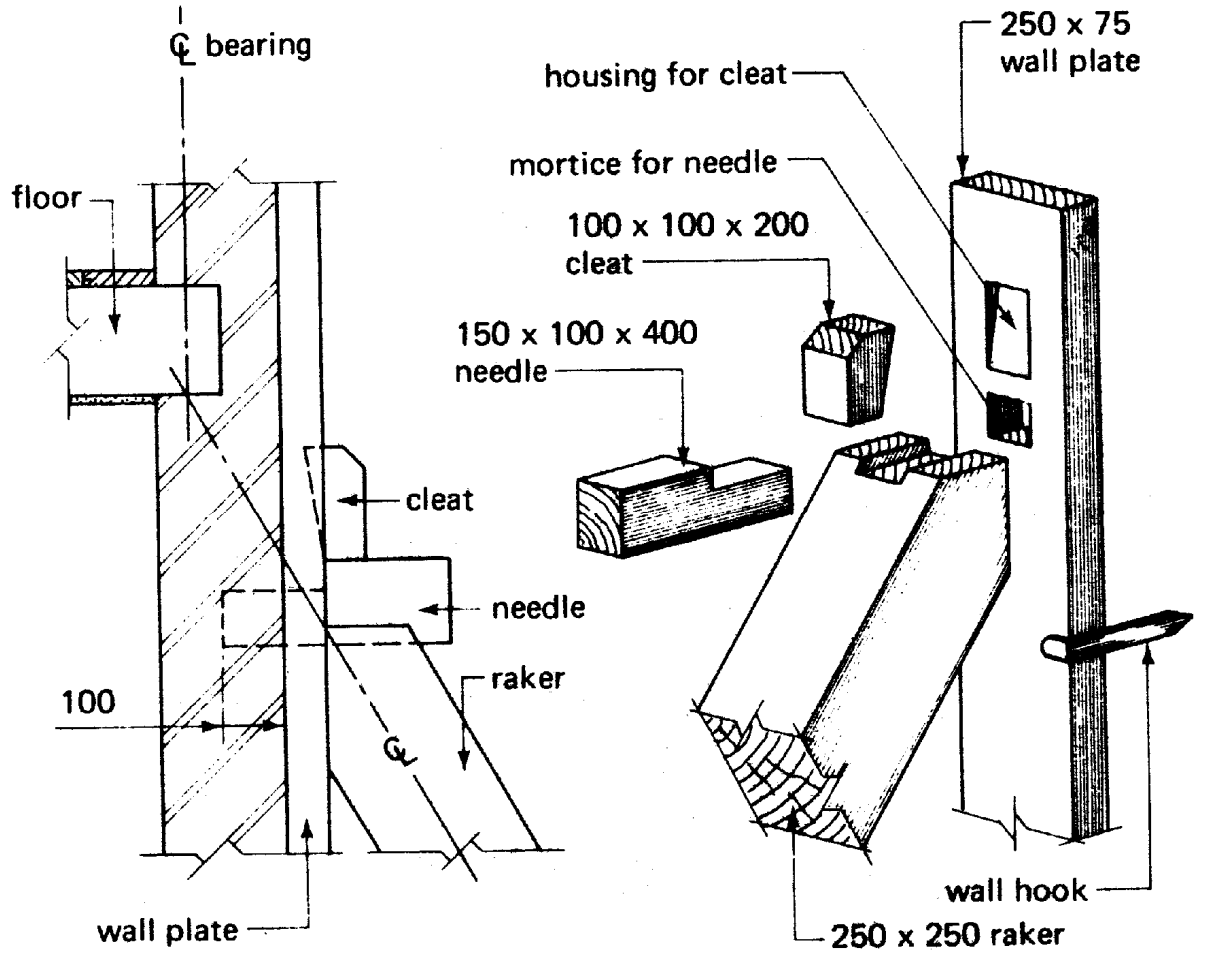
Typical raking shore arrangements

Inclined or Raking Shoring (unsymmetrical)



Unsymmetrical flying shore arrangements

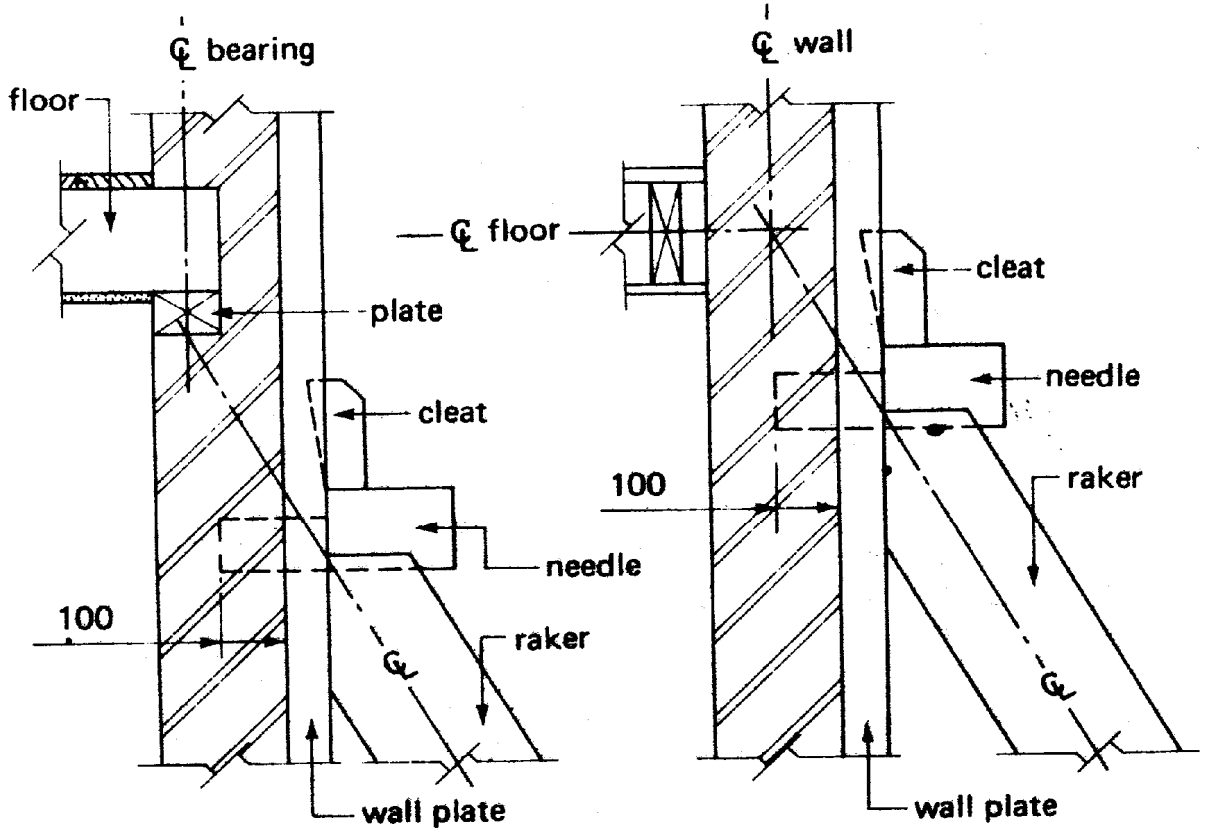
Raking Shoring Details



Floor with wall bearing

Detail at head of raker

Raking Shoring Details

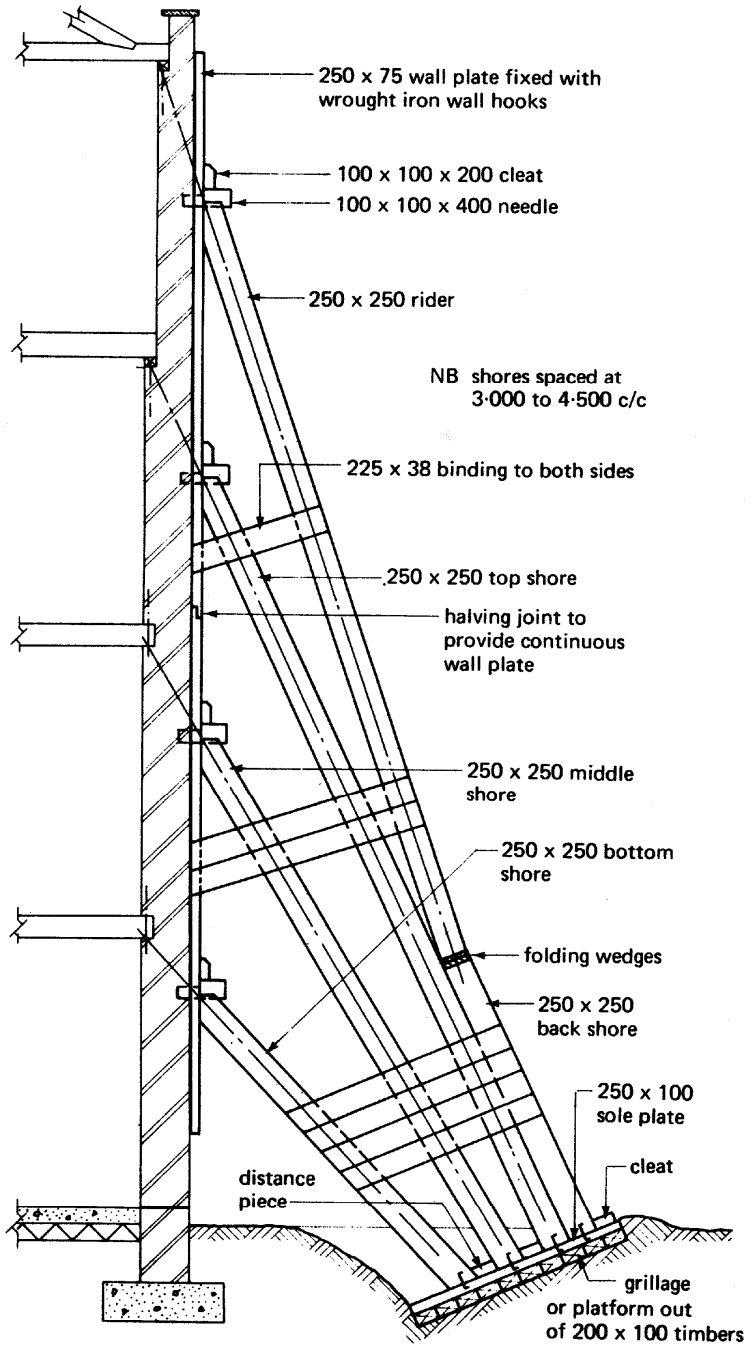


Floor with plate bearing

Floor parallel to wall

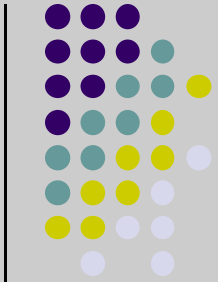
Raking shore intersections

Inclined Shoring or Raking Shoring



Typical multiple raking shore

Under-Pinning

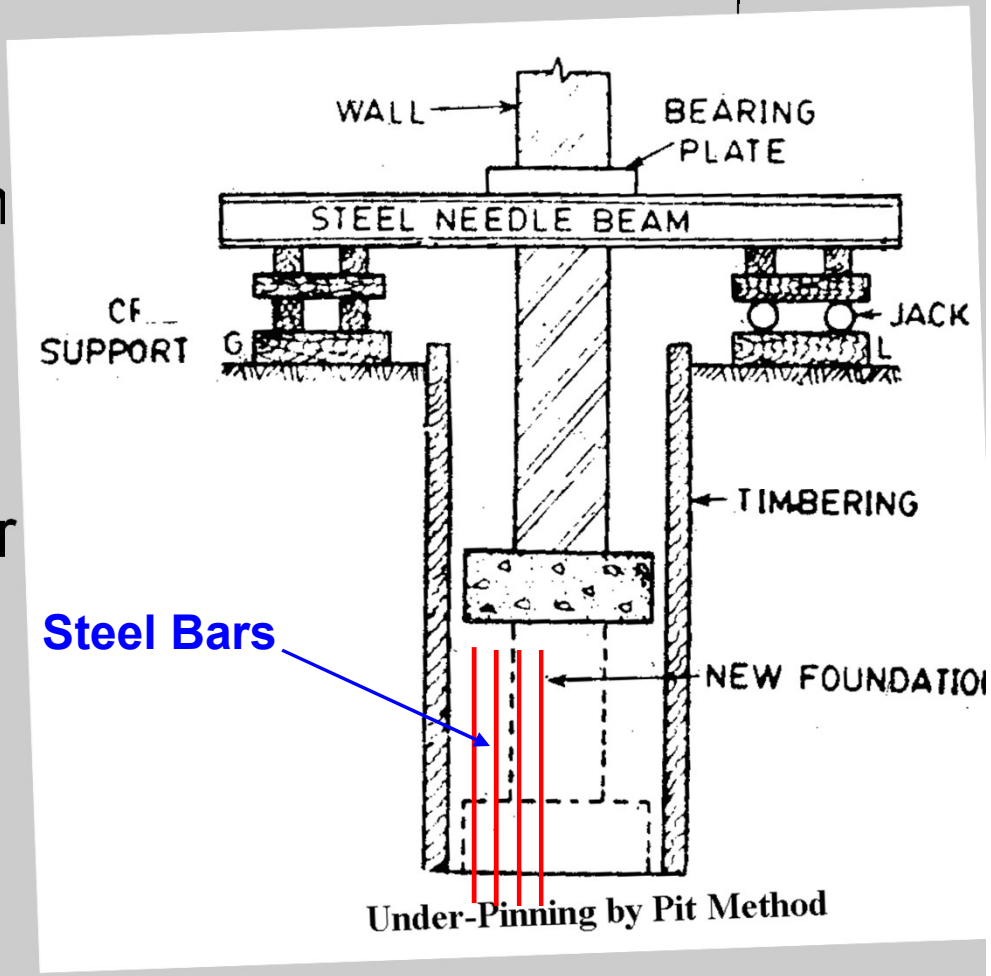


- Definition

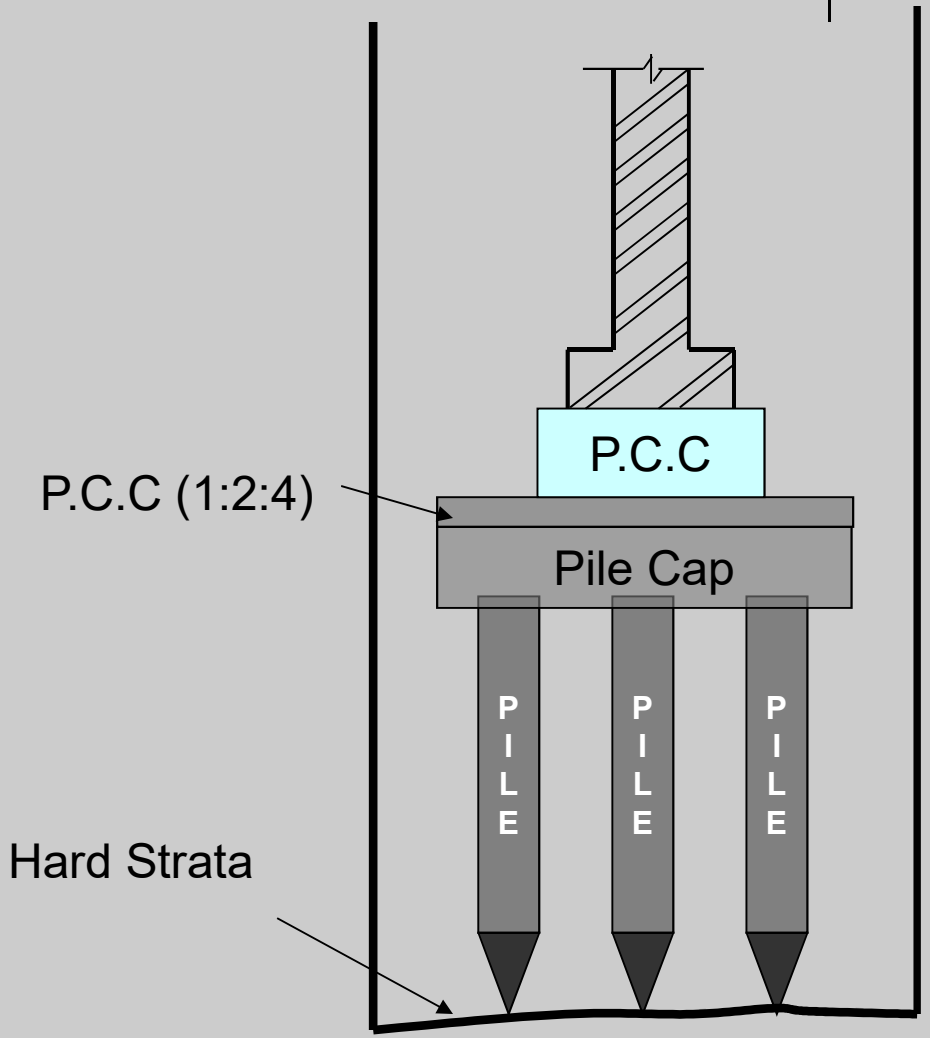
- Methods of Under-Pinning
  - Pit method
  - Pile method

Pit method

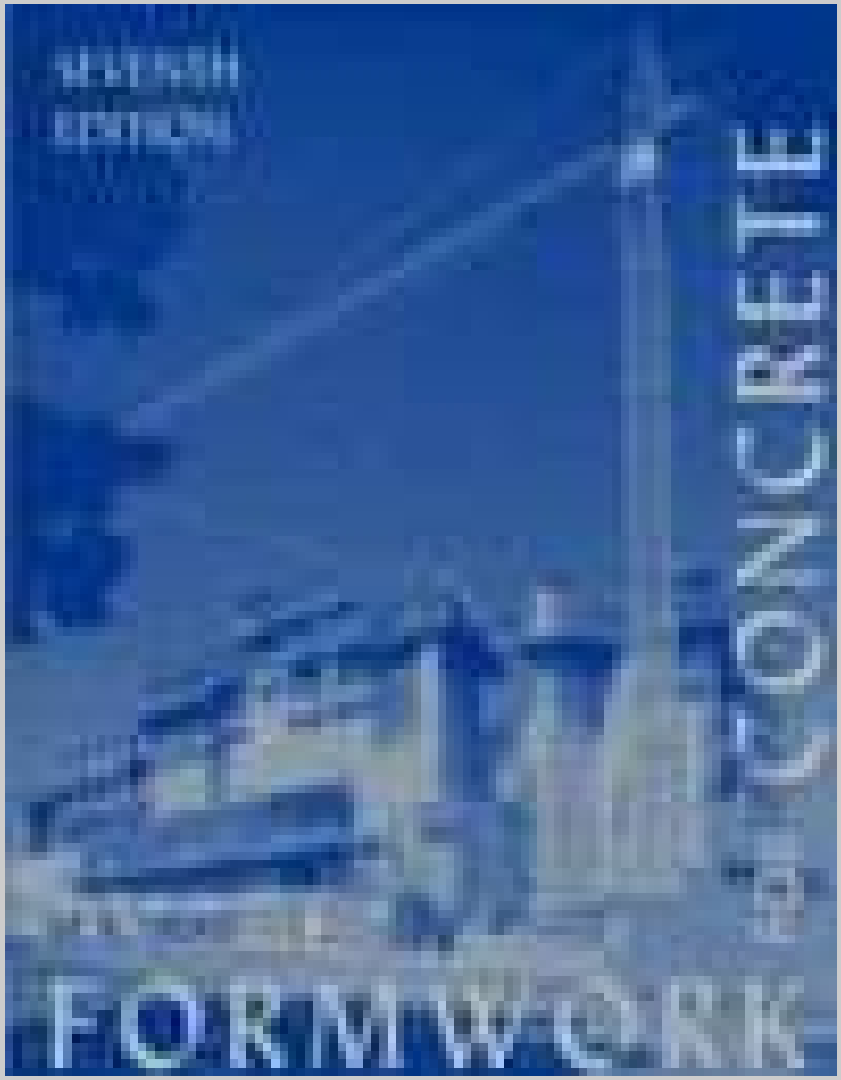
- Old wall is supported by a bearing plate, steel beam and jacks.
- Excavation up to new depth is carried out.
- Foundation is provided for small 5’ (1.5 m) lengths.
- P.C.C (1:2:4) is provided for new foundation.
- For proper joint b/w old and new work, strengthening and to avoid settlement vertical steel bars may be added.



Pile method

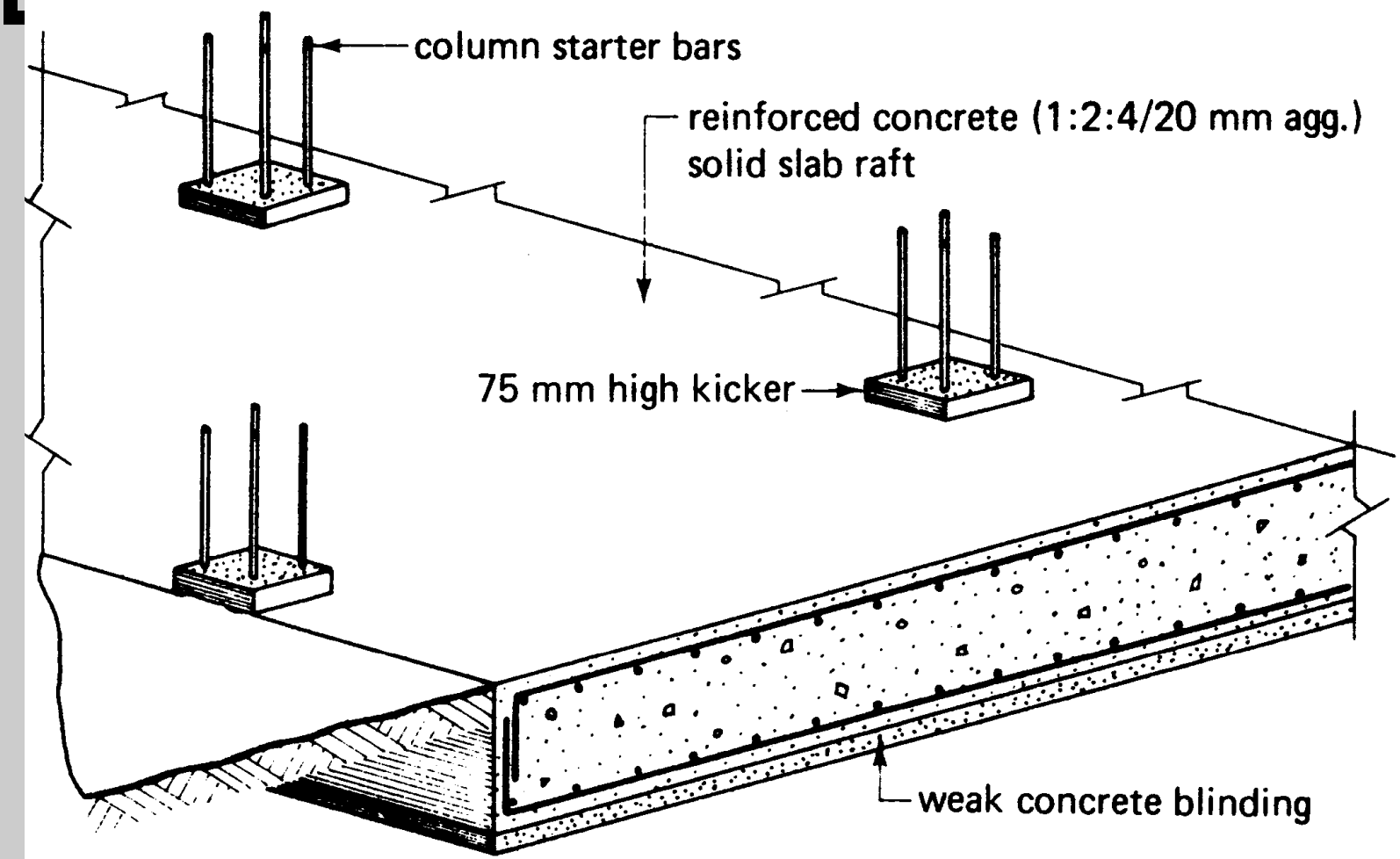


ACI Document SP-4



Back

Kicker or Starter



R.C. solid slab raft foundation

Inverted Beams