

3.4 Centering and Shuttering – Shoring – Scaffolding

Centering and shuttering are both formworks. Centering term is used when the formwork is horizontal like slab, floor beam, etc. Shuttering term is used when the formwork is vertical as in column, footing, retaining wall, etc. Steel and timber planks are commonly used materials for centering and shuttering.



Requirements of Shuttering and Centering

- The surface of the form should be smooth
- It should be able to withstand all the loads coming on it
- It should be able to retain its shape (horizontal and vertical bracing is done for this)
- It should have minimum deflection under load
- It should be re-usable
- It should not be costly
- It should be water-proof so that it does not absorb water from the fresh concrete
- It should facilitate easy stripping during the time of removal

Types of Formwork (Shuttering)

1. Timber Formwork

Timber for formwork should satisfy the following requirement It should be:

- Well-seasoned
- Light in weight
- Easily workable with nails without splitting
- Free from loose knots

2. Plywood Formwork

Resin-bonded plywood sheets are attached to timber frames to make up panels of the required sizes.

The cost of plywood formwork compares favorably with that of timber shuttering, and it may even prove cheaper in some instances given the following considerations:

1. It is possible to have a smooth finish in which case on cost in surface finishing is there.
2. By the use of large-size panels, it is possible to affect saving in the labor cost of fixing and dismantling.
3. The number of reuses are more as compared with timber shuttering. For estimation purposes, the number of reuses can be taken as 20 to 25.

3. Steel Formwork

This consists of panels fabricated out of thin steel plates stiffened along the edges by small steel angles. The panel units can be held together through the use of suitable clamps or bolts and nuts. The panels can be fabricated in large numbers in any desired modular shape or size. Steel forms are largely used in large projects or in a situation where large number reuses of the shuttering is possible. This type of shutter is considered most suitable for circular or curved structures. Period of Removal of Formwork given below

Description of structural member	Time Period
Walls, columns and vertical sides of beams	1 to 2 days
Slabs (props left under)	3 days
Beam soffits (props left under)	7 days
For slabs spanning over 4.5 m	14 days

Shoring

Shoring is the construction of a temporary structure to support temporarily an unsafe structure. These support walls laterally. Shoring can be used when walls bulge out, when walls crack due to unequal settlement of foundation and repairs are to be carried out to the cracked wall, when an adjacent structure needs pulling down, when openings are to be newly made or enlarged in a wall.

Types of shoring

1. Raking shoring
2. Flying shoring
3. Dead shoring

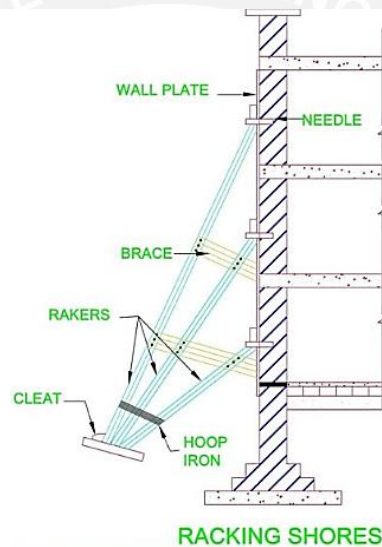
1. Raking Shoring

In this method, inclined members known as rakers are used to give lateral supports to walls (figure 1 to 3). A raking shore consists of the following components:

1. Rakers or inclined member
2. Wall plate
3. Needles
4. Cleats
5. Bracing
6. Sole plate

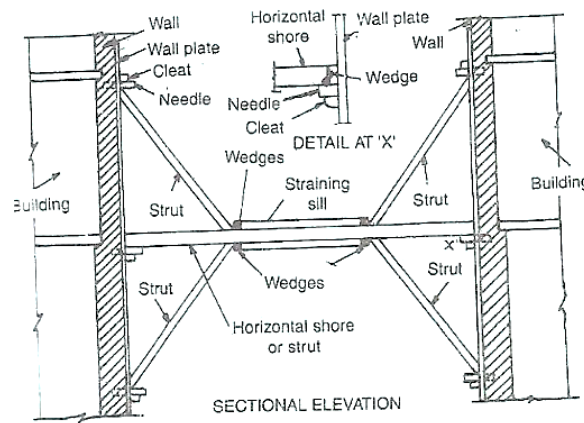
The following points are to be kept in view for the use of the raking shores:

1. Rakers are to be inclined in the ground at 45° . However the angle may be between 45° and 75° .
2. For tall buildings, the length of the raker can be reduced by introducing rider raker.
3. Rakers should be properly braced at intervals.
4. The size of the rakers is to be decided on the basis of anticipated thrust from the wall.
5. The centre line of a raker and the wall should meet at floor level.
6. Shoring may be spaced at 3 to 4.5m spacing to cover longer length of the bar.
7. The sole plate should be properly embedded into the ground on an inclination and should be of proper section and size.
8. Wedges should not be used on sole plates since they are likely to give way under vibrations that are likely to occur.



2. Flying Shoring

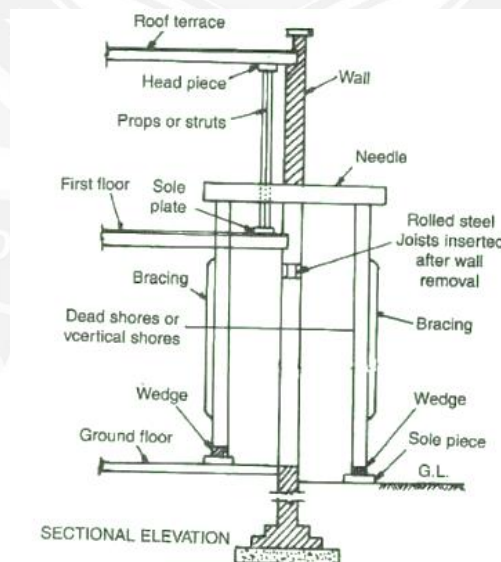
Flying shores is a system of providing temporary supports to the party walls of the two buildings where the intermediate building is to be pulled down and rebuilt (figure 4 and 5). All types of arrangements of supporting the unsafe structure in which the shores do not reach the ground come under this category. The flying shore consists of wall plates, needles, cleats, horizontal struts (commonly known as horizontal shores) and inclined struts arranged in different forms which varies with the situation. In this system also the wall plates are placed against the wall and secured to it. A horizontal strut is placed between the wall plates and is supported by a system of needle and cleats. The inclined struts are supported by the needle at their top and by straining pieces at their feet. The straining piece is also known as straining sill and is spiked to the horizontal shore. The width of straining piece is the same as that of the strut. When the distance between the walls (to be strutted apart) is considerable, a horizontal shore can not be safe and a trussed framework of members is necessary to perform the function of flying shore.



Details of a single flying shore.

3. Dead Shoring

This type of shoring is used to support dead loads that act vertically downwards. In its simplest form, it consists of a vertical prop or shore leg with a head plate, sole-plate, and some means of adjustment for tightening and easing the shore. The usual arrangement is to use two shore legs connected over their heads by a horizontal beam or needle. The loads are transferred by the needle to the shore legs and hence down to a solid bearing surface. It may be necessary to remove pavings and cut holes in suspended timber floors to reach a suitable bearing surface; if a basement is encountered, a third horizontal member called a transom would be necessary because it is impracticable to manipulate a shore leg through two stories.



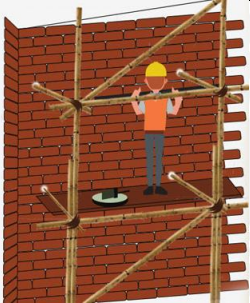




Use of dead-shores in rebuilding or deepening of foundations, or for removing lower part of defective wall.

Scaffolding

Scaffolding is widely used during construction and renovation activities. In its simplest form, a scaffold is any temporary elevated or suspended work surface used to support workers and/or materials. There are many types of scaffolds, both supported and suspended.

Following are types of Scaffolding in construction:

1. Single scaffolding
2. Double scaffolding
3. Cantilever scaffolding
4. Suspended scaffolding
5. Trestle scaffolding
6. Steel scaffolding

 <p>Single scaffolding</p>	 <p>Double scaffolding</p>	 <p>Cantilever scaffolding</p>
 <p>Suspended scaffolding</p>	 <p>Trestle scaffolding</p>	 <p>Steel scaffolding</p>

- **Single scaffolding** is generally used for brick masonry and is also called as brick layer's scaffolding. Single scaffolding consists of standards, ledgers, putlogs etc., which is parallel to the wall at a distance of about 1.2 m. Distance between the standards is about 2 to 2.5 m.
- **Double scaffolding**, a double row of scaffolding makes the entire support structure stronger. The first row sits parallel to the wall, while the other row sits away from the first row. Added putlog holes support the frames

- **Cantilever scaffolding**, also known as needle scaffolding, is a type of scaffolding that is a separate scaffold that is built to angle out from a structure. Usually, this scaffolding is situated near balconies for easy access.
- **Suspended Scaffolds** (also called hanging scaffolds) are work platforms that hang from overhead support structures on roofs or building setbacks.
- **A trestle scaffold** is a scaffold assembled from prefabricated trestles, braces and accessories.
- **Metal scaffolding** or Steel scaffolding allows workers to safely, conveniently access high and difficult locations during various construction projects. It does so through the use of three basic structural elements: Standards: Vertical steel or aluminum tubes that are placed throughout the structure to support it and hold it up.

Advantages

- Enables easy access.
- Provides perfect balance.
- Ensures safety.
- Boosts productivity.
- Offers easy assembly & dismantling.
- Acts a bridge.
- Lasts for a long time

Underpinning

Underpinning is strengthening and reinforcing an existing foundation of a structure, typically by extending the depth and breadth of the foundation. Underpinning gets its name because the underpinning procedure is performed in stages so as not to compromise the entirety of the structure's integrity at once

Purpose of Underpinning

Underpinning is done for the following purposes:

- For the purpose of leading an old shallow foundation to the deeper depth when the adjoining building is constructed with a deep foundation.
- Underpinning is done for **building a basement** in the existing building.
- Underpinning is done to deepen the existing foundation (resting on poor strata) and make it rest on deeper soil strata of higher bearing capacity.
- To strengthen a settled foundation that may be caused by cracks in the wall.

Preparation before underpinning:

- It is necessary to notify the adjoining or not about the proposed works with details typical action about the use underpinning sorry for tying.
- bus site and its building or restricted areas should your mind and carry out a survey. at that time and the effects of cracks are recorded and notified to the adjoining owner(s).
- before starting any under the reason for settlement and its solutions are determined, it is done in the case where the reason for underpinning is the settlement.
- we have Meri on to reduce the load of the structure by removing imposed loads from the floors, reducing the unwanted dead loads, and is saved by requiring props and/or shoring only after that the underpinning works should start.
- If there is any for a portion of the area which is vulnerable by proposed underpinning works should be supported and protected by identifying, tracking, and marking or exposing.

Necessary of underpinning

1. Uneven settlement is caused by the unsymmetrical loading of the building, unequal bearing capacity of all the soil beneath the foundation, By the action of tree roots, or primary or secondary settlements consolidation cohesive soil.
2. Increase in loading: the loading process of building man changed due to the addition of more story or change in the imposed loading due to change in service loading.
3. Lowering of adjacent ground: Nearby Foundation you stop to work available then it is necessary to lower the foundation of the building.

Methods of Underpinning

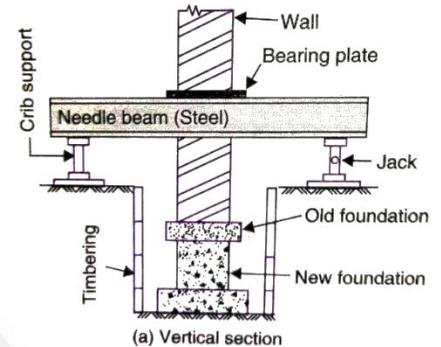
Underpinning can be carried but by the following methods:

1. Pit method
2. Pile methods
3. Underpinning to walls
4. Jack pile underpinning
5. Needle and pile underpinning
6. 'Pynford' Stool method of underpinning
7. Root pile or angle Piling Underpinning columns

Pit method

In this method, the entire length of the foundation to be underpinned is divided into sections of 1.2 to 1.5 m lengths. One section is taken up at a time. Bearing plates are placed above the needle to support the masonry above it. The supporting arrangement of the needle is made by crib supports (wooden blocks) on both sides of the wall and screw jacks.

After that, a foundation pit is excavated up to the required level of new foundation. Then the new foundation is laid in the pit. When the work of one section is over, work on next to next section is taken up, i.e., alternate sections are underpinned in the first round, and then the remaining sections are taken up.

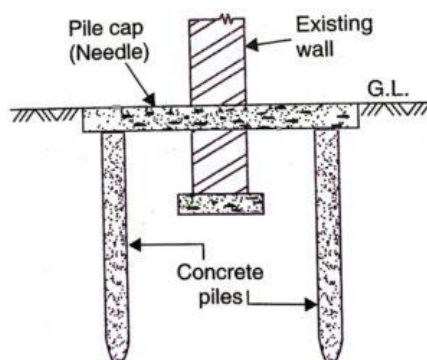


The following points are to be considered in the pit method:

1. **Alternate sections** are taken up in the first round. The remaining intermediate sections are then taken up. Only one section should be taken at a time.
- It is better to start the work from the middle in the case of long wall extended in both directions.
- If the new foundation is deeper, proper timbering of the foundation trench may be done.
- When the foundation has gained full strength then only all the arrangements like needle beams etc. should be removed slowly.
- The needle holes etc. should be closed in masonry using cement mortar.

Pile method

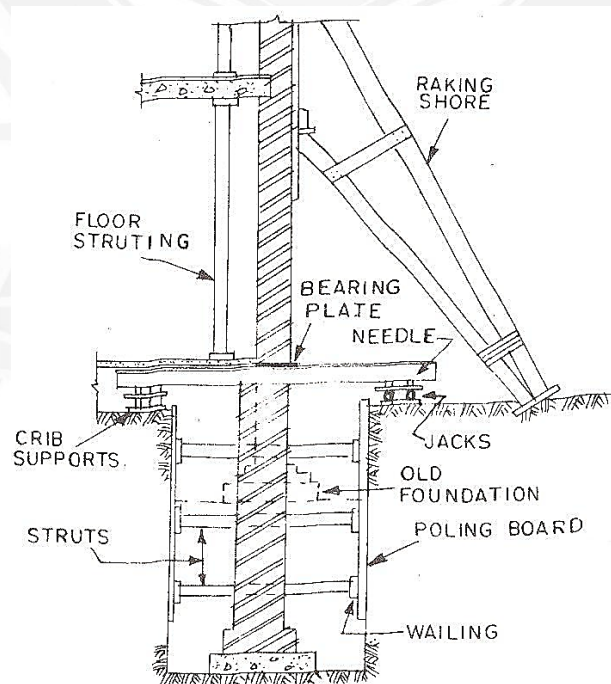
In the Pile method of underpinning, as the name suggests Piles are installed by proper driving technique along both sides of the wall to be strengthened. The piling technique normally used are borehole pile or under-reamed piles are used.



After that, concrete or steel needles are penetrated through the wall and are connected to the Pile. These needles function as beams and act as pile caps also. Pile method is suitable for clayey soils, waterlogged areas, and also in weak bearing strata.

Underpinning to walls

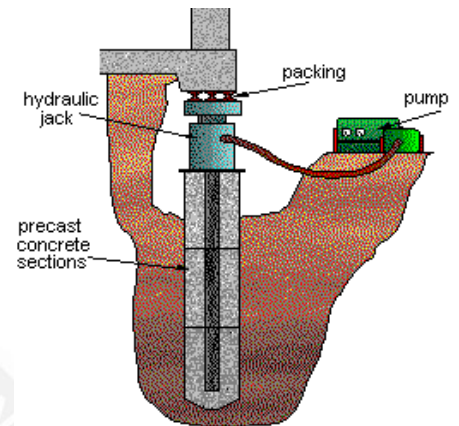
Underpinning is done in short lengths of 12 inches to 18 inches. Holes are cut into the walls at regular intervals and the entire load of the wall is supported by the needles which rest on sole pieces at ground level. The section of the needle depends upon the load to be supported. The needle may be a timber beam or a rolled steel joist. Thus the structure is held well supported in a secured manner and the footings are relieved of the loads from the wall above. When the rolled steel joist beams are used as needles, wooden bearing plates are inserted between the beams and the supported wall to avoid crushing of masonry. A pit of sufficient width to provide easy workability and of the required depth is excavated along the length of the wall. When the foundation of a wall is to be replaced, the section of wall is cut to a length of 90 to 120 cm and new work built. Again, the next 90 to 120 cm length of wall is cut and rebuilt. Thus the entire wall foundation is replaced. When long walls are to be underpinned, the work is started from the centre of the wall and progress is made both ways. The needles are removed only when the new work is completely set and the masonry has gained full strength.



Jack pile underpinning

Jack Piles are a restricted access technique used mainly for underpinning purposes whereby piles are pushed into the ground to a competent bearing stratum. This is a quiet, vibration free operation using the dead weight of an existing structure as a reaction to install the pile.

When the cost of traditional underpinning would be prohibitive due to the depth of good bearing capacity subsoil, Jack Pile Underpinning is an option. As the pile depth may be adjusted to suit the underlying soil, jack pile underpinning is silent, vibration-free, and adaptable. Since the pile caps are cast directly onto the jack pile heads once the hydraulic jacks have been removed, the condition of the existing foundations is critical.



Needle and pile underpinning

Where the traditional or Jack pile underpinning techniques are unsuitable for the existing Foundation condition, then the needle and pile underpinning method can be used for the best result. And the piles used are generally in small diameter bored piles. This method of underpinning can be used where the condition of the existing foundation is unsuitable for traditional or jack pile underpinning techniques. The brickwork above the existing foundation must be in a sound condition since this method relies on the 'arching effect' of the brick bonding to transmit the wall loads onto the needles and ultimately to the piles. The piles used with this method are usually small diameter bored piles.