DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION
177 GOVERNMENT POLYTECHNIC, SIDDAPURA (U.K)

177 GOVERNMENT POLYTECHNIC SIDDAPURA (U.K) CONSTRUCTION TECHNIQUES - 20CE33P

PERFORMACE CRITERIA

NAGESHA M R

2022

DEPARTMENT OF CIVIL ENGINEERING

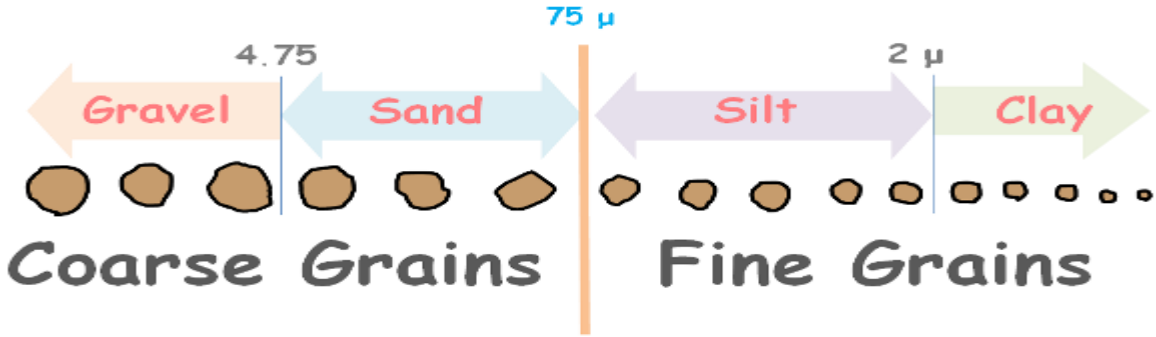
TABLE OF CONTENT

WEEK 01 PRACTICE 01A

AIM: Field identification of type of soil based on visualization

THEORY:

Soils are generally divided on the basis of their particle size into coarse grained and fine-grained soils. Coarse-grained soils are of particle size greater than 0.075 mm or 75 micron and particles smaller than this make up fine-grained soils. Further coarse grains are divided into gravel and sand, and fine grains are divided into silt and clay sized.



Gravel sized particles are larger than 4.75mm and sand particles are between 4.75mm to 75 micron. Silt sized particles are of size 75 micron to 2 micron, and clay sized particles are of size less than 2 micron. To identify the type of soil in the field, first we try to distinguish the soil as coarse grained soil and fine grained soil and we can do so by simply looking at the soil.

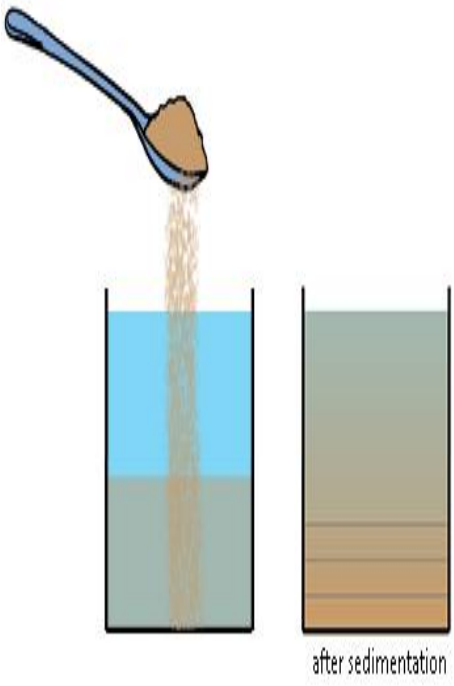
We take the soil sample and spread it on a flat surface. If we can see the grains of the soil through our naked eyes, provided naked eyes must not be the defective, and if we are able to separate them, those are the coarse grain particles. On the other hand if we are not able to do so, then those are fine-grained particles. These particles are microscopic and are not visible through the naked eye.

After identifying soil as coarse and fine-grained we can further separate them as gravel, sand, silt or clay. From our soil sample if we pick up a soil particle clearly visible like a pebble, roughly larger than 5 mm, then it is gravel particle and if it appears smaller it is sand particle.

Particles smaller than sand are microscopic and are either silt or clay. We need to perform a couple of tests to distinguish between them.

Let's begin with,

SEDIMENTATION



For sedimentation we take a spoonful of soil sample and mix it in a jar full of water. We shake the jar to make the soil suspension.

Now the jar is placed on the flat surface and the suspension material is allowed to settle. We will notice that suspended particles settle in layers. The gravel and coarse sand will settle almost immediately to the bottom and fine sand will take around 1 to 2 minutes to settle. The silt will take about an hour and the clay will remain suspended for even longer period of times. We can estimate the relative quantity of each component (sand, silt, and clay) by comparing the relative thickness of each of the layer at the bottom of the jar.

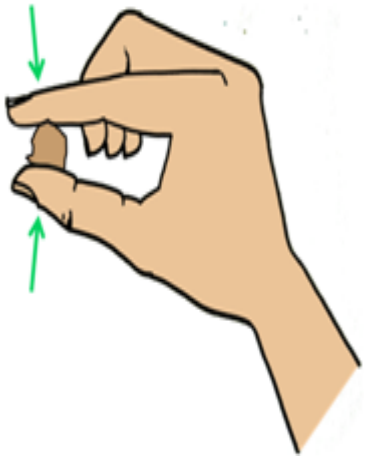
DILATANCY OR SHAKING TEST

Silt soils are more permeable than clay soils. Using this property we can perform another test to distinguish between these two, called Dilatancy or shaking test. We add water to our soil sample so as to nearly saturate it. A small pat of this soil is placed in the palm of the hand and vigorously shaken horizontally, striking against the other hand several times.

If the surface of the soil becomes glossy in appearance it is an indication that moisture present in the sample has risen to the surface. If the soil surface becomes shiny this way quickly, then soil contains silt or very fine sand, and if soil surface does not become glossy at all, the soil is probably clayey. If this glistening of surface occurs slowly, we can infer the soil is predominantly silt with possible small amount of clay.

DRY STRENGTH TEST

We also perform Dry Strength Test to distinguish between clay and silt. For that we completely dry our earlier used soil sample in sun or air due to which lumps are formed in the soil. These lumps are pressed between thumb and forefinger and the resistance of these lumps to breaking is termed as dry strength. We describe the strength as very low, medium, or high.



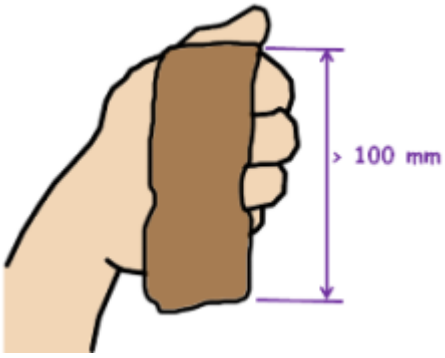
If a dried soil lump can be powdered easily without application of much force, it is said to have a low dry strength and such soil may contain fine sand and silt.

If considerable finger pressure is required to break the lump, it possesses medium dry strength and that soil contains silt with few amount of clay.

If the dried soil lump cannot be powdered with fingers at all, it is has high dry strength and we can be sure that soil contains appreciable amount of clay.

RIBBON TEST

We also perform a Ribbon Test to distinguish between silt and clay



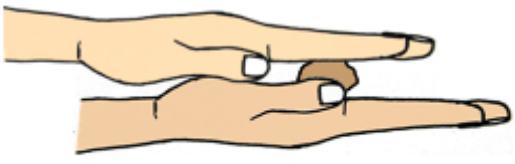
In this test we take some soil in hand and add some water to it to make workable. Then we press it slowly between the thumb and index finger to make a ribbon like shape of about 3 mm thick and as long as it can be formed before it breaks itself under its own weight.

If we could form a ribbon of longer than 100 mm then soil contains high amount of clay.

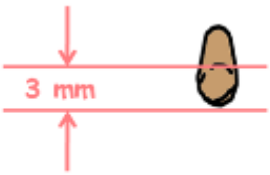
While silt and other non-plastic materials cannot be moulded into ribbon at all.

PLASTICITY TEST

Then there is one more test to distinguish clay and silt which is Plasticity Test. We performed this test to determine the plastic limit of the clayey soil.



rolling soil pat between hands



Clayey Soil

Silty Soil

We mix water in the soil sample and over saturate it. Then we take a soil pat into hand and roll it into a thread. If we manage to roll the soil pat into long threads of diameter as small as 3 mm without cracking the soil contains high clay content. While soils containing Silt can seldom be rolled into threads of such a small diameter without severe cracking.

RESULT

- Field identification of type of soil based on visualization is_____

FOR RESULTS REFER THE FOLLOWING TABLES

Table 1. Grain Size Distribution

Soil Constituent	Size Limits	Familiar Example
Boulder	12 in. (305 mm) or more	Larger than basketball
Cobbles	3 in (76 mm) -12 in (305 mm)	Grapefruit
Coarse Gravel	¾ in. (19 mm) – 3 in. (76 mm)	Orange or Lemon
Fine Gravel	4.75 mm (No.4 Sieve) – ¾ in. (19 mm)	Grape or Pea
Coarse Sand	2 mm (No.10 Sieve) – 4.75 mm (No. 4 Sieve)	Rocksalt
Medium Sand	0.42 mm (No. 40 Sieve) – 2 mm (No. 10 Sieve)	Sugar, table salt
Fine Sand*	0.075 mm (No. 200 Sieve) – 0.42 mm (No. 40 Sieve)	Powdered Sugar
Fines	Less than 0.0075 mm (No. 200 Sieve)	-

*Particles finer than fine sand cannot be discerned with the naked eye at a distance of 8 in (20 cm).

Table (3a). Criteria for Describing Dry Strength

Description	Criteria
None	The dry specimen ball crumbles into powder with the slightest handling pressure.
Low	The dry specimen crumbles into powder with some pressure form fingers.
Medium	The dry specimen breaks into pieces or crumbles with moderate finger pressure.
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface.
Very High	The dry specimen cannot be broken between the thumb and a hard surface.

Figure 1. Shape of Coarse-Grained Soil Particles

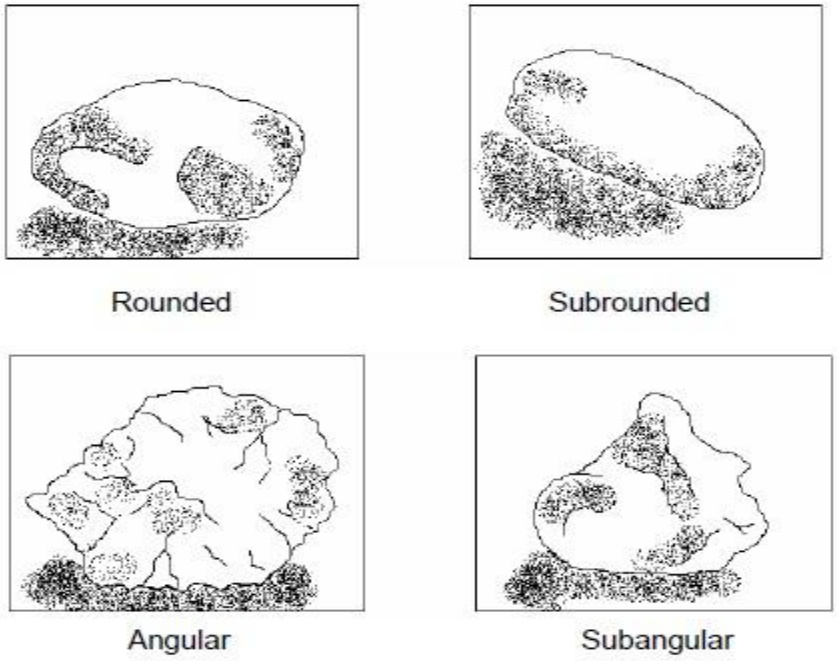


Table 2. Criteria for Describing Shape of Coarse-Grained Soil Particles

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Particles are similar to angular description, but have rounded edges.
Subrounded	Particles have nearly plane sides, but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

Table (3c). Criteria for Describing Soil Plasticity

Description	Criteria
Non-plastic	A 1/8" (3-mm) thread cannot be rolled at any water content.
Low	The thread is difficult to roll and a cohesive mass cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and little time is needed to reach the plastic limit. The thread cannot be re-rolled after the plastic limit is reached. The mass crumbles when it is drier than the plastic limit.
High	Considerable time is needed, rolling and kneading the sample, to reach the plastic limit. The thread can be rerolled and reworked several times before reaching the plastic limit. A mass can be formed when the sample is drier than the plastic limit

Note: The plastic limit is the water content at which the soil begins to break apart and crumbles when rolled into threads 1/8" in diameter.

Table (3b). Criteria for Describing Dilatancy of a Soil Sample

Description	Criteria
None	There is no visible change in the soil samples.
Slow	Water slowly appears and remains on the surface during shaking or water slowly disappears upon squeezing.
Rapid	Water quickly appears on the surface during shaking and quickly disappears upon squeezing.

Table (3d). Criteria for Describing Soil Toughness

Description	Criteria
Low	Only slight pressure is needed to roll the thread to the plastic limit. The thread and mass are weak and soft.
Medium	Moderate pressure is needed to roll the thread to near the plastic limit. The thread and mass have moderate stiffness.
High	Substantial pressure is needed to roll the thread to near the plastic limit. The thread and mass are very stiff.

Table 4. Identification of Inorganic Fine-Grained Soils

Soil Symbol	Dry Strength	Dilatancy	Toughness
ML	None or Low	Slow to Rapid	Low or thread cannot be formed
CL	Medium to High	None to Slow	Medium
MH	Low to Medium	None to Slow	Low to Medium
CH	High to Very High	None	High

Note: ML = Silt; CL = Lean Clay (low plasticity clay); MH = Elastic Soil; CH = Fat Clay (high plasticity clay). The terms 'lean' and 'fat' may not be used in certain geographic regions (midwest).

Table 5. Criteria for Describing Soil Moisture Conditions

Description	Criteria
Dry	Soil is dry to the touch, dusty, a clear absence of moisture
Moist	Soil is damp, slight moisture; soil may begin to retain molded form
Wet	Soil is clearly wet; water is visible when sample is squeezed
Saturated	Water is easily visible and drains freely from the sample

VISUAL SOIL CLASSIFICATION

DATA SHEET

Soil Number: Soil A
Classified by: RES
Date: 09-29-02

1. Color brown
2. Odor none
3. Texture Coarse
4. Major soil constituent : gravel
5. Minor soil constituents: sand, fines

Type	Approx. % by weight
gravel	60
sand	30
fines	10

6. For coarse-grained soils:

   Gradation: well graded
   Particle Shape: subrounded

7. For fine-grained soils:

   Dry Strength _____
   Dilatancy _____
   Plasticity _____
   Toughness _____
   Soil Symbol _____

8. Moisture Condition: dry

Classification:

Brown gravel, some sand, trace fines, well graded, subrounded, dry

Engineering Properties of Soils Based on Laboratory Testing
Prof. Krishna Reddy, UIC

REFERENCES

1. **https://www.elementaryengineeringlibrary.com/civil-engineering/soil mechanics/field-identification-of-soil**
2. **https://www.apsed.in/post/field-identification-of-soil**
3. **https://cemmlab.webhost.uic.edu/Experiment%208-Visual%20Classification.pdf**
4. **Video Link https://www.youtube.com/watch?v=JvU-OXOyiTU**

WEEK 01 PRACTICE 01B

AIM: Validating the type of soil by conducting sieve analysis test - Particle size distribution using semi-log graph IS: 2720 (PART IV):1985

APPARATUS:

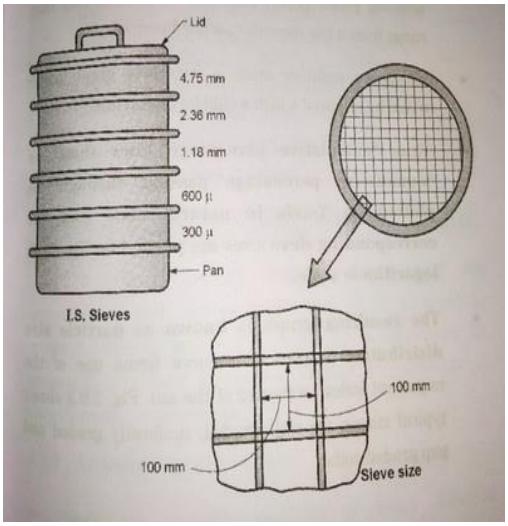
- I.S. Sieve Set (4.75mm,2.36mm,1.18mm.600,300,150, 75 Micron & Pan),
- Sieve Shaker, Weighing Balance. Tray plates.

THEORY:

An analysis of this kind express quantitatively the proportions by mass of the various sizes of particles present in the soil. In a soil the gravel, sand silt and clay fractions are recognized as containing particles of decreasing magnitude. The actual ranges of dimensions of the particles are given in IS: 1498-1970. The results of a grain size analysis may also be represented graphically in the form of a grain size distribution curve in which the cumulative percentages finer than known equivalent grain sizes are plotted against these sizes, the latter being on a logarithmic scale. Widely used in soil classification.

The results of grain size analysis are the data obtained from grain size distribution curves is used in the design of filters for earth dams to determine the suitability of soils for road construction. Particle size distribution is important for classification of soil. It is also used for the design of drainage filters. It is used for selecting filling materials for embankment, earthen dams, road sub-base etc. Particle size distribution is also used to estimate performance of grouting chemical injection.

OBSERVATIONS:



- Weight of sample taken = 1000 Grams.
- Percentage of aggregates passing = $\frac{weight\ retained}{weight\ of\ sample\ taken}\ x\ 100$

NOTE:

- The sample shall be brought to an air-dry condition before weighing and sieving. This may be achieved either by drying at room temperature or by heating at a temperature of 100° to 110°C. The air-dry sample shall be weighed and sieved successively on the appropriate sieves starting with the largest. Care shall be taken to ensure that the sieves are clean before use.
- Each sieve shall be shaken separately over a clean tray until not more than a trace passes, but in any case for a period of not less than two minutes. The shaking shall be done with a varied motion, backwards and forwards, left to right, circular clockwise and anti-clockwise, and with frequent jarring, so that the material is kept moving over the sieve surface in frequently changing directions. Material shall not be forced through the sieve by hand pressure, but on sieves coarser than 20 mm, placing of particles is permitted. Lumps of fine material, if present, may be broken by gentle pressure with fingers against the side of the sieve. Light brushing with a soft brush on the underside of the sieve may be used to clear the sieve openings.
- Light brushing with a fine camel hair brush may be used on the 150micron and 75micron IS Sieves to prevent aggregation of powder and blinding of apertures. Stiff or worn out brushes shall not be used for this purpose and pressure shall not be applied to the surface of the sieve to force particles through the mesh.
- On completion of sieving, the material retained on each sieve, together with any material cleaned from the mesh, shall be weighed.

PROCEDURE:

- The 4.75 mm sieve separates the soil into 2 parts. The fraction larger than 4.75 mm is called as coarse fraction. This fraction is analysed by the following series of sieves: 100 mm, 63 mm, 20 mm, 10 mm and 4.75 mm sieves.
- The sieves are arranged in descending sizes from top to bottom. A weighed, dry soil sample is put onto the top sieve. Generally 1000 gm sample is analysed. The top sieve is covered with lid and the bottom sieve has a pan below it.
- The entire assembly is then shaken either manually with careful up-down and circular motion or in a machine known as sieve shaker. Usually 10 minutes of shaking is sufficient.
- The soil retained on each sieve is then weighed and the weight is recorded. The soil collected in the pan is subjected to further analysis.

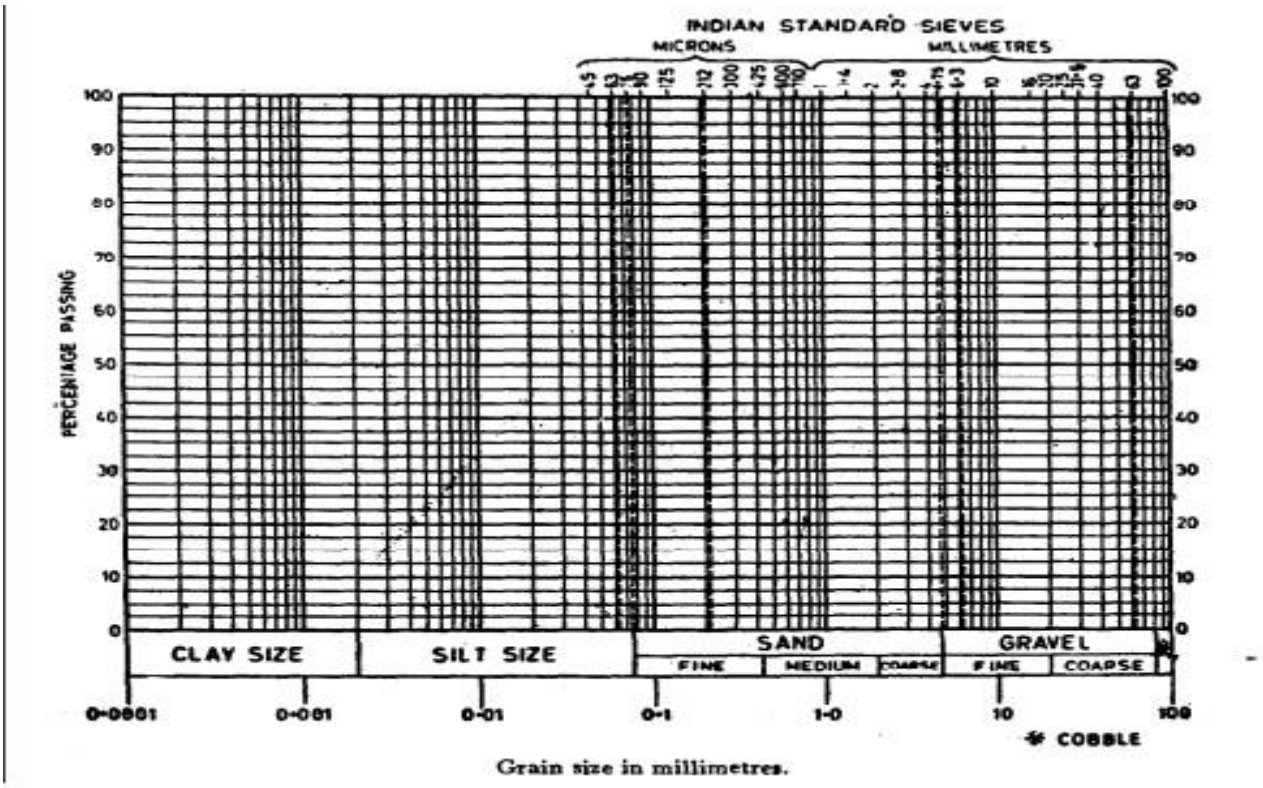
- Arrange the sieves in order of 4.75, 2.36, 1.18, 600, 300, and 150 μ keeping sieve 4.75 mm at top and 150 μ at bottom.
- Shake the sieves with the pan at the bottom and cover at the top.
- Keep the soil in the top 4.75 mm sieve, carry out the sieving in the set of sieves arranged before for not less than 10 minutes.
- Two grams of sodium hexameta phosphate or one gram of sodium hydroxide and one gram of sodium carbonate per litre of water used should then be added to the soil.
- The mix should be thoroughly stirred and left for soaking. The soil soaked specimen should be washed thoroughly on 75-micron IS Sieve until the water passing the sieve is substantially clean.
- The fraction retained on 75micron sieve should be emptied carefully without any loss of material in separate trays. Oven dried at 105 to 110°C and each fraction weighed separately and the masses recorded.
- Find the weight retained in each sieve.
- Determine the percentage retained in order to find out cumulative percentage retained.
- Draw a graph on semi log sheet, Particle size on the X axis, Percentage finer on the Y axis.
- Determine the values of D_{10}, D_{30} & D_{60} from the plotted graph.
- After knowing the values of D_{10}, D_{30} & D_{60}, Determine Coefficient of curvature (C_C) & Coefficient of uniformity (C_U).
- After knowing the values Coefficient of curvature (C_C) & Coefficient of uniformity (C_U) refer to table in IS 1498-1970 for validating the type of soil.

FORMULA USED:

- $\text{Coefficient of Uniformity } (C_U) = \frac{D_{60}}{D_{10}}$
- $\text{Coefficient of Curvature } (C_C) = \frac{D_{30}^2}{D_{10} \times D_{60}}$

RESULT:

- The given soil sample is _____after conducting sieve analysis test.



Grain size in millimetres.

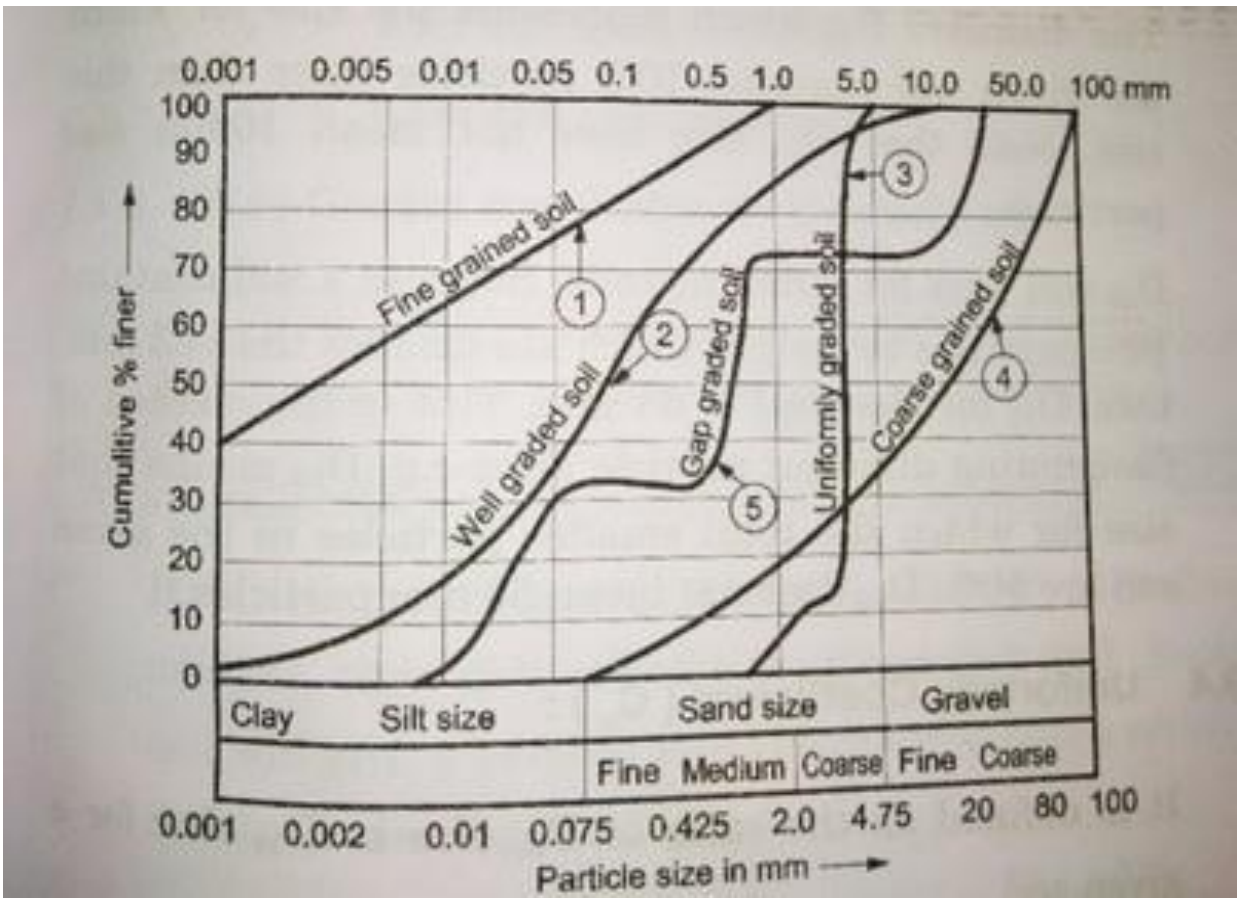


Table 4.2 Unified Soil Classification System

Major division			*Group symbol*	*Typical name*	*Classification criteria*	
Coarse-grained soils (More than 50% retained on No. 200 ASTM sieve)	Gravels 50% or more of coarse fraction retained on No. 4 ASTM sieve	Clean gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines.		$U = D_{60}/D_{10}$ greater than 4 $C_c = D^2_{30}/(D_{60} \times D_{20})$ between 1 and 3.
			GP	Poorly-graded gravels and gravel-sand mixtures, little or no fines.	Classification on the basis of percentage of fines. Less than 5% passing No. 200 ASTM sieve—GW, GP, SW, SP. More than 12% passing No. 200 ASTM sieve— GM, GC, SM, SC. 5% to 12% passing No. 200 ASTM sieve—Border-line classification requiring use of dual symbols.	Not meeting both criteria for GW.
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures.		Atterberg limits plot below *A*-line or plasticity index less than 4.
			GC	Clayey gravels, gravel-sand-clay mixtures.		Atterberg limits plot above *A*-line or plasticity index less than 4.
	Sands More than 50% of coarse fraction passes No. 4 ASTM sieve	Clean sands	SW	Well-graded sands and gravelly sands, little or no fines.		U greater than 6 C_c between 1 and 3.
			SP	Poorly-graded sands and gravelly sands, little or no fines.		Not meeting both criteria for SW.
		Sands with fines	SM	Silty sands, and-silt mixtures.		Atterberg limits plot below *A*-line or plasticity index less than 4.
			SC	Clayey sands, sand-clay mixtures.		Atterberg limits plot above *A*-line or plasticity index greater than 7.
Fine-grained soils (50% or more passes No. 200 ASTM Sieve)	Silts and Clays (Liquid limit 50% or less)		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands.	Check Plasticity Chart	
			CL	Inorganic clays or low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.		
			OL	Organic silts and organic silty clays of low plasticity.		
	Silts and clays (Liquid limit greater than 50%)		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts.		
			CH	Inorganic clays of high plasticity, fat clays.		
			OH	Organic clays of medium to high plasticity.		
Highly organic clays			P_t	Peat, muck and other highly organic soils.	Fibrous organic matter, will char, burn, or glow. Readily identified by colour, odour, spongy feel, and fibrous texture.	

Note: Boundary classification: Soils possessing characteristics of two groups are designated by combinations of group symbols — for example, GW-GC, well-graded, gravel-sand mixture with clay binder

DATA SHEET

EXPARIMENT NO:

EXPARIMENT NAME: SIEVE ANALYSIS TEST - PARTICLE SIZE DISTRIBUTION USING SEMI-LOG GRAPH OF FINE AGGREGATES

NAME OF STUDENT: **DATE: / /**

SOURCE / LOCATION: POLYTECHNIC BUILDING, SIDDAPURA-581355

WEIGHT OF FINE AGGREGATE SAMPLE (W_1) = 1000 Grams.

OBSERVATIONS:

SL NO	SEIVE SIZE	Empty weight of sieve	Weight of sieve with aggregates	Weight of aggregates retained W_2	% of weight retained	Cumulative % of weight retained	Cumulative % of passed aggregates
		A	B	B - A	$\frac{W2}{W1} X\ 100$	X	100 - X
1	4.75MM						
2	2.36MM						
3	1.18MM						
4	600 MIC						
5	300 MIC						
6	150 MIC						
7	75 MIC						
8	PAN						
TOTAL							

SIGNATURE OF STUDENT **SIGNATURE OF COURSE COORDINATOR**

REFERENCES:

1. https://civilengineeringnotes.com/particle-size-distribution-curve-of-soil/
2. VIDEO LINK https://www.youtube.com/watch?v=CAezS3mPzOc

WEEK 01 PRACTICE 02A

AIM: To determine the Liquid limit of given soil sample as per IS: 2720 (Part V) – 1985

APPARATUS:

- Equipment for the determination of moisture content (weighing to 0.01 g).
- Soil mixing equipment (glass plate, spatulas, water).
- Casagrande liquid limit device.
- Grooving tool and height gauge.
- Drying oven set at 105°C.

THEORY:

The liquid limit (LL) is arbitrarily defined as the water content, in percent, at which a pat of soil in a standard cup and cut by a groove of standard dimensions will flow together at the base of the groove for a distance of 13 mm (1/2 in.) when subjected to 25 shocks from the cup being dropped 10 mm in a standard liquid limit apparatus operated at a rate of two shocks per second.

SIGNIFICANCE:

The Swedish soil scientist Albert Atterberg originally defined seven "limits of consistency" to classify fine-grained soils, but in current engineering practice only two of the limits, the liquid and plastic limits, are commonly used. (A third limit, called the shrinkage limit, is used occasionally.)

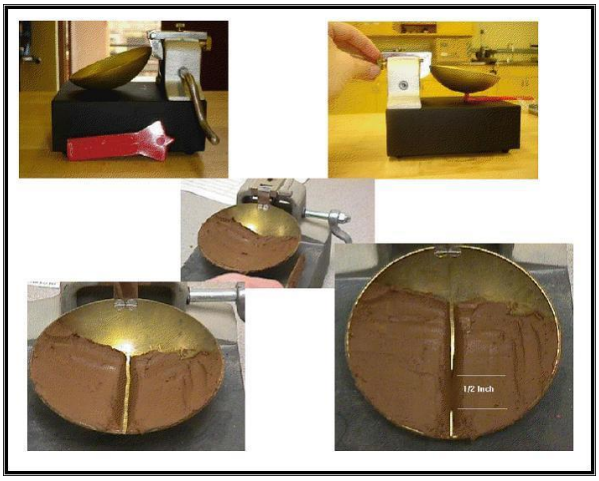
The Atterberg limits are based on the moisture content of the soil. The plastic limit is the moisture content that defines where the soil changes from a semi-solid to a plastic (flexible) state. The liquid limit is the moisture content that defines where the soil changes from a plastic to a viscous fluid state.

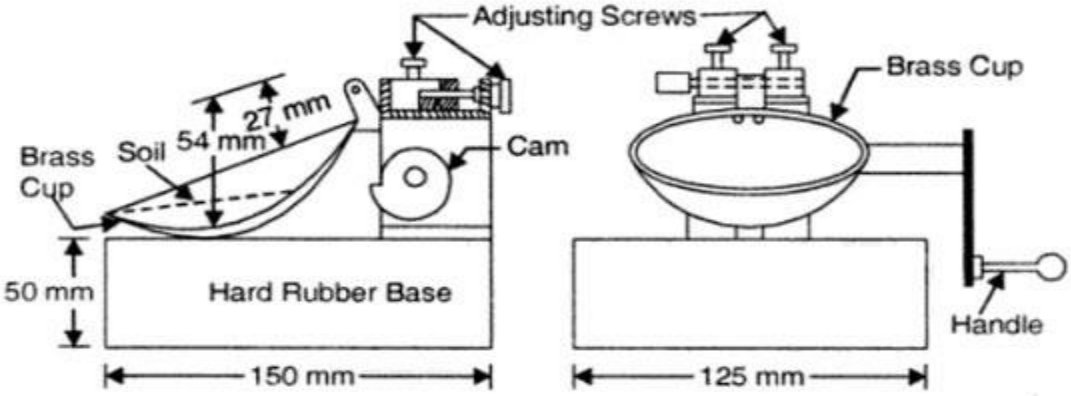
The shrinkage limit is the moisture content that defines where the soil volume will not reduce further if the moisture content is reduced. A wide variety of soil engineering properties have been correlated to the liquid and plastic limits, and these Atterberg limits are also used to classify a fine-grained soil according to the Unified Soil Classification system or AASHTO system.

ADJUSTMENT OF THE MECHANICAL DEVICE

- The liquid limit device shall be inspected to determine that it is clean, dry and in good working order, that the cup falls freely and it does not have too much side play at its hinge. The grooving tool shall also be inspected to determine that it is clean and dry.
- Using the gauge on the handle of the grooving tool or a separate gauge and by means of the adjustment plate of the mechanical liquid limit device, the height through which the cup is lifted and dropped shall be adjusted so that the point on the cup which comes in contact with the base falls through exactly one centimeter for one revolution of the handle. The adjustment plate shall then be secured by tightening the screw.

OBSERVATIONS:





(i) Liquid Limit Apparatus

DIVIDED SOIL CAKE BEFORE TEST

SOIL CAKE AFTER TEST

PROCEDURE:

- Take roughly 300grams of the soil and place it into the porcelain dish. Assume that the soil was previously passed though a 425 Micron sieve, air-dried, and then pulverized. Thoroughly mix the soil with a small amount of water until it appears as a smooth uniform paste. Cover the dish with cellophane to prevent moisture from escaping.
- Weigh four of the empty moisture cans with their lids, and record the respective weights and can numbers on the data sheet.
- Adjust the liquid limit apparatus by checking the height of drop of the cup. The point on the cup that comes in contact with the base should rise to a height of 10 mm. The block on the end of the grooving tool is 10 mm high and should be used as a gauge. Determine the correct rate to rotate the crank so that the cup drops approximately two times per second.
- Place a portion of the previously mixed soil into the cup of the liquid limit apparatus at the point where the cup rests on the base. Squeeze the soil down to eliminate air pockets and spread it into the cup to a depth of about 10 mm at its deepest point. The soil pat should form an approximately horizontal surface.
- Use the grooving tool carefully cut a clean straight groove down the center of the cup. The tool should remain perpendicular to the surface of the cup as groove is being made. Use extreme care to prevent sliding the soil relative to the surface of the cup.
- Make sure that the base of the apparatus below the cup and the underside of the cup is clean of soil. Turn the crank of the apparatus at a rate of approximately two drops per second and count the number of drops, N, it takes to make the two halves of the soil pat come into contact at the bottom of the groove along a distance of 13 mm (1/2 in.)
- Take a sample, using the spatula, from edge to edge of the soil pat. The sample should include the soil on both sides of where the groove came into contact. Place the soil into a moisture can cover it. Immediately weigh the moisture can containing the soil, record it's mass, remove the lid, and place the can into the oven. Leave the moisture can in the oven for at least 16 hours. Place the soil remaining in the cup into the porcelain dish.
- Remix the entire soil specimen in the porcelain dish. Add a small amount of water to increase the water content so that the number of drops required to close the groove decrease.
- Repeat steps six, seven, and eight for at least two additional trials producing successively lower numbers of drops to close the groove. One of the trials shall be for a closure requiring 25 to 35 drops, one for closure between 20 and 30 drops, and one trial for a

closure requiring 15 to 25 drops. Determine the water content from each trial by using the same method used in the first laboratory. Remember to use the same balance for all weighing.

- Plot a graph between number of blows V/S moisture content to determine Liquid Limit of given sample for 25 blows to fill the gap.

RESULT:

- From test results the Liquid limit of given soil sample is = _____%

DATA SHEET

EXPARIMENT NO:

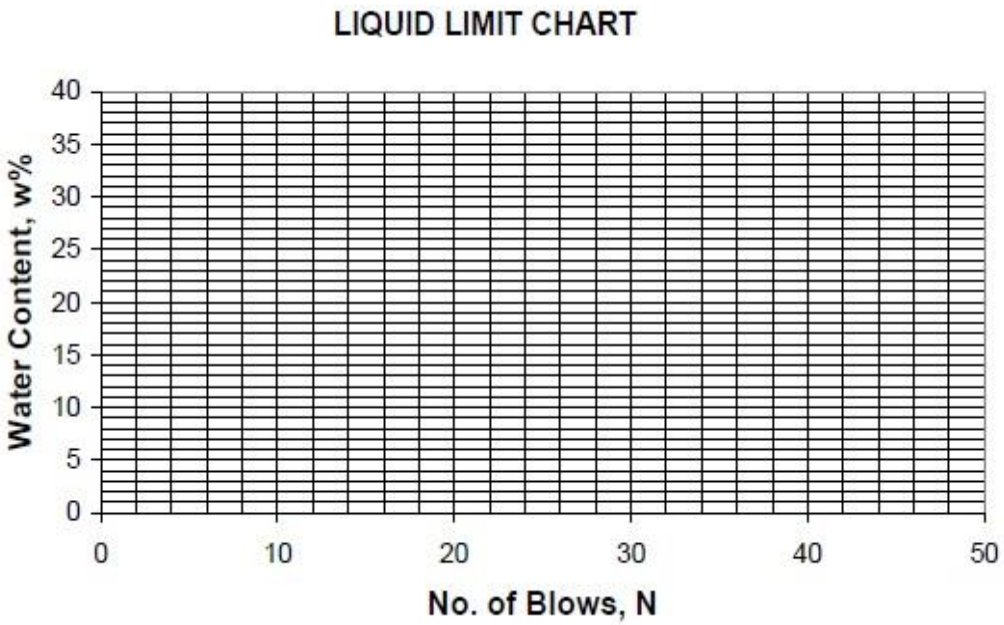
EXPARIMENT NAME: LIQUID LIMIT OF GIVEN SOIL SAMPLE

NAME OF STUDENT: **DATE: / /**

SOURCE / LOCATION: POLYTECHNIC BUILDING, AVARAGUPPA, SIDDAPURA

OBSERVATION & CALCULATION

S.N	DESCRIPTION	TRAIL NUMBER			
01	Sample number	**01**	**02**	**03**	**04**
02	Moisture can & lid number				
03	Weight of empty can W_1 grams				
04	Weight of can + Moist soil W_2 grams				
05	Weight of can + Dry soil W_3 grams				
06	Weight of soil solids W= W_3 - W_1 grams				
07	Weight of Moisture M = W_3 – W_2 grams				
08	Moisture content = m = (M/W)*100				
09	Number of drops (N)				



SIGNATURE OF STUDENT **SIGNATURE OF COURSE COORDINATOR**

REFERENCES:

1. https://www.youtube.com/watch?v=pM-w_cvk1nA

WEEK 01 PRACTICE 02B

AIM: To determine the Plastic limit of given soil sample as per IS: 2720 (Part V) – 1985

APPARATUS:

- Equipment for the determination of moisture content (weighing to 0.01 g).
- Soil mixing equipment (glass plate, spatulas, water).
- Casagrande liquid limit device.
- Grooving tool and height gauge.
- Drying oven set at 105°C.
- Ground glass plate – 20cm x 15cm
- Rod – 3mm dia. and about 10cm long

THEORY:

Plastic limit is the minimum water content at which soil can be rolled into a thread of 3 mm diameter without crumbling. In other words, it is the moisture content at which soil can be deformed plastically.

SIGNIFICANCE:

The Swedish soil scientist Albert Atterberg originally defined seven "limits of consistency" to classify fine-grained soils, but in current engineering practice only two of the limits, the liquid and plastic limits, are commonly used. (A third limit, called the shrinkage limit, is used occasionally.)

The Atterberg limits are based on the moisture content of the soil. The plastic limit is the moisture content that defines where the soil changes from a semi-solid to a plastic (flexible) state. The liquid limit is the moisture content that defines where the soil changes from a plastic to a viscous fluid state.

The shrinkage limit is the moisture content that defines where the soil volume will not reduce further if the moisture content is reduced. A wide variety of soil engineering properties have been correlated to the liquid and plastic limits, and these Atterberg limits are also used to classify a fine-grained soil according to the Unified Soil Classification system or AASHTO system.

OBSERVATIONS:

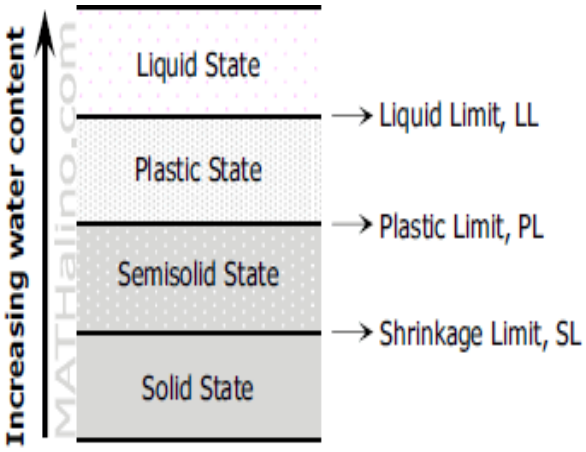
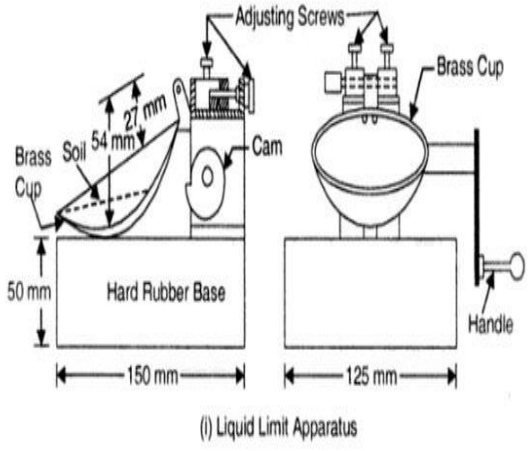


Figure 2 Atterberg Limits



(i) Liquid Limit Apparatus

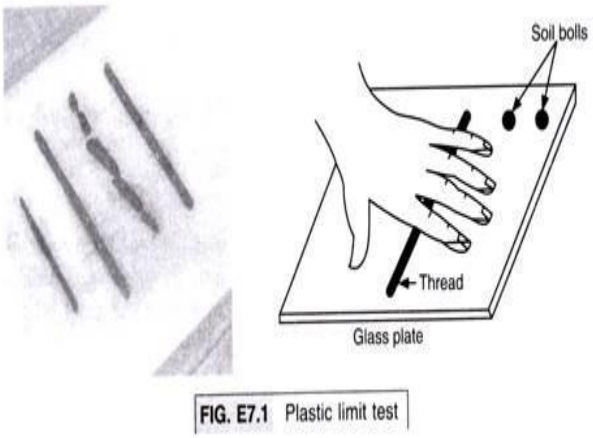


FIG. E7.1 Plastic limit test

PROCEDURE:

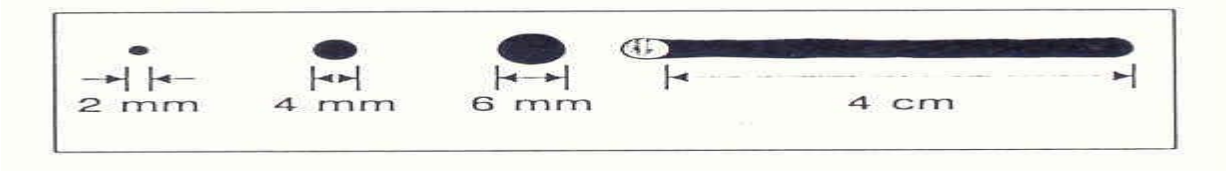
- Take about 40 gm of soil passing 425 micron IS sieve in a glass plate.
- Add small quantity of water in the soil and mix it thoroughly. Leave the soil for some time to mature.
- Make small balls of the soils and roll it on the glass plate with fingers.
- Continue rolling till the thread reaches the diameter of 3 mm.
- Knead the soil thread and roll it again into a thread.
- Continue the process until the thread just crumbles at 3 mm diameter.
- Collect the crumbled soil thread in the aluminium container and determine its water content.
- Repeat the test at least twice again. The average of the three tests will be the plastic limit of the soil.

PRECAUTIONS:

- Roiling should be stopped when the thread is just starts crumbling.
- Diameter of rolled thread should be of 3 mm diameter.
- Weights of container, wet soil and dry soil should be taken accurately

CONCLUSION:

- **Non-Plastic**–will not form a 6 mm dia, 4 cm long wire, or if formed , cannot support itself if held on end
- **Slightly Plastic**–6 mm dia, 4 cm long wire supports itself, 4 mm dia, 4 cm long wire does not support itself if held on end
- **Moderately Plastic**–4 mm dia, 4 cm long wire supports itself, 2 mm dia, 4 cm long wire does not support itself if held on end
- **Very Plastic**–2 mm dia, 4 cm long wire



RESULT:

- From test results the Plastic limit of given soil sample is = _____%

DATA SHEET

EXPARIMENT NO:

EXPARIMENT NAME: PLASTIC LIMIT OF GIVEN SOIL SAMPLE

NAME OF STUDENT: **DATE: / /**

SOURCE / LOCATION: POLYTECHNIC BUILDING, AVARAGUPPA, SIDDAPURA

OBSERVATION & CALCULATION

S.N	DESCRIPTION	TRAIL NUMBER			
01	Sample number	**01**	**02**	**03**	**04**
02	Moisture can & lid number				
03	Weight of empty can W_1 grams				
04	Weight of can + Moist soil W_2 grams				
05	Weight of can + Dry soil W_3 grams				
06	Weight of soil solids W= W_3 - W_1 grams				
07	Weight of Moisture M = W_3 – W_2 grams				
08	Moisture content = m = (M/W)*100				
09	Average Moisture content				

SIGNATURE OF STUDENT **SIGNATURE OF COURSE COORDINATOR**

REFERENCES:

1. https://www.youtube.com/watch?v=pM-w_cvk1nA

WEEK 02 PRACTICE 01A

AIM: To determine the water content in given soil sample by oven drying method as per IS: 2720 (Part II) – 1973

APPARATUS:

- Thermostatically controlled oven maintained at a temperature of 110 ± 5°C.
- Weighing balance, with an accuracy of 0.04% of the weight of the soil taken.
- Air-tight container made of non-corrodible material with lid.
- Tongs

THEORY:

The water content of soil is the ratio of mass of water to mass of soil which is expressed in percentage. Oven Dry Method and Pycnometer Method are commonly used to determine the water content of soil in laboratory.

OBSERVATIONS:

Minimum Quantity of Soil Required for Water Content Determination

Size of particles more than 90% of passing	Minimum Quantity (grams)
425 micron sieve	25
2 mm sieve	50
4.25 mm sieve	200
10 mm sieve	300
20 mm sieve	500
40 mm sieve	1000

PROCEDURE:

- In first step, clean and dry the containers and weigh them and note down the mass of each container (M_1). Also note down the number of each container along with its weight.
- Collect the soil sample from field. Remove the top layer of soil and collect the wet soil from bottom layers.
- Fill the containers with required quantity of soil sample and weigh the each container and note down its mass (M_2).
- Place the containers in hot air oven, arrange temperature to $110^o \pm 5^o$ C and allow them to dry for 24 hours.
- After 24 hours turn off the oven and take out the containers using tongs.
- Cool down the containers in desiccators for one hour.
- After that weigh containers and note down the mass (m_3) of each container.

RESULT:

- From test results the moisture content of given soil sample is = _____%

DATA SHEET

EXPARIMENT NO:

EXPARIMENT NAME: DETERMNATION OF MOISTURE CONTENT OF SOIL BY OVEN DRYING METHOD

NAME OF STUDENT: **DATE: / /**

SOURCE / LOCATION: POLYTECHNIC BUILDING, AVARAGUPPA, SIDDAPURA

OBSERVATION

MOISTURE CONTENT

SL NO	DESCRIPTION	DETERMINATION NUMBER		
		I	II	III
01	Mass of container = W_1 gm			
02	Mass of Wet soil + container = W_2 gm			
03	Mass of Dry soil + container = W_3 gm			
04	Mass of Moisture =W_4 =M_2 – M_3			
05	Mass of Dry Soil = W_5 =M_3 – M_1			
06	Moisture content = w =$\frac{M_4}{M_5}$ X 100			
08	Average Moisture content of soil = M_{AVG}			

CALCULATION

SIGNATURE OF STUDENT **SIGNATURE OF COURSE COORDINATOR**

REFERENCE:

1. https://www.youtube.com/watch?v=N2J-tvEeI4c

WEEK 02 PRACTICE 01B

AIM: To determine the in-situ dry density of soil by core cutter method as per IS: 2720 (Part XXIX) – 1975

APPARATUS:

- **Cylindrical steel core cutter:** 130 mm long and of 100±2 mm internal diameter, with a wall thickness of 3mm bevelled at one end.
- **Steel dolly:** 25 mm high and of 100 mm internal diameter, with a wall thickness of 5mm, fitted with a lip to enable it to be located on top of the core cutter.
- **Steel rammer.**
- **Weighing Balance:** readable to 1 g.
- **Palette knife:**
- **Steel rule:** graduated to 0.5 mm.
- Short-handled hoe, or spade, and pickaxe.
- **Straightedge**
- **Apparatus for moisture content determination.**

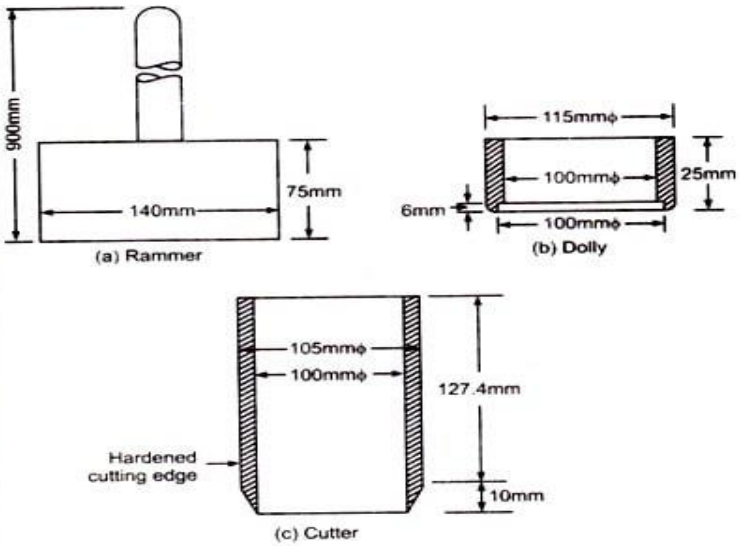
CARE OF APPARATUS.

The condition of the cutting edge should be frequently checked as any damage will lead to inaccuracy in the test. A badly damaged edge may be reformed on a lathe taking care to cut the new edge square to the long axis of the mould. Any repair to the cutting edge will require the mould factor to be predetermined.

THEORY:

This method is only used on fine-grained cohesive soils which do not contain stones. It is, therefore, very useful for control of earthworks and sub grade materials but is not suitable for coarse grained pavement materials. The test involves jacking or hammering a steel cylinder of known mass and volume into the soil, excavating it and finding the mass of soil contained in the cylinder.

OBSERVATIONS:



Internal diameter of core cutter = D = _____MM

Internal height of core cutter = H = _____MM

Volume of core cutter = V =_____cc

PROCEDURE:

- The internal volume (V) of the core cutter in cc should be calculated from its dimensions which should be measured to the nearest 0.25mm.
- The core cutter should be weighed to the nearest gram (W1).
- A small area, approximately 30cm square of the soil layer to be tested should be exposed and levelled.
- The steel dolly should be placed on top of the cutter and the latter should be rammed down vertically into the soil layer until only about 15mm of the dolly protrudes above the surface, care being taken not to rock the cutter.
- The cutter should then be dug out of the surrounding soil, care being taken to allow some soil to project from the lower end of the cutter.
- The ends of the soil core should then be trimmed flat in level with the ends of the cutter by means of the straightedge.
- The cutter containing the soil core should be weighed to the nearest gram (W2).
- The soil core should be removed from the cutter and a representative sample should be placed in an air-tight container and its water content (w) is determined.

PRECAUTIONS:

- No stroke should be applied on the soil inside the core cutter.
- Apply the strokes on the collar.
- No soil should fall down from the core cutter before weighing it.
- Edges of the core cutter should be levelled with a straight edge, and there should not be any cavity in the soil

RESULT:

- From test results in place density of soil (ϒ) = _____ gm/cc
- From test results in place dry density of soil (ϒD) = _____ gm/cc

DATA SHEET

EXPARIMENT NO:

EXPARIMENT NAME: FIELD DENSITY OF SOIL BY CORE CUTTER TEST

NAME OF STUDENT: **DATE: / /**

SOURCE / LOCATION: POLYTECHNIC BUILDING, AVARAGUPPA, SIDDAPURA

FIELD DENSITY

SL NO	DESCRIPTION	DETERMINATION NUMBER		
		I	II	III
01	Internal diameter of core cutter			
02	Internal height of core cutter			
03	Volume of core cutter (V) in CC			
04	Weight of core cutter W_1 in gm			
05	Weight of core cutter + Soil W_2 in gm			
06	Weight of Soil = W = $W_2 - W_1$ in grams			
07	Bulk Density of soil = $\Upsilon = \frac{W_2 - W_1}{V}$ in gm/cc			
08	Average Bulk Density of soil= Υ_{AVG}			

DRY DENSITY

SL NO	DESCRIPTION	DETERMINATION NUMBER		
		I	II	III
01	Mass of container = M_1 gm			
02	Mass of Wet soil + container = M_2 gm			
03	Mass of Dry soil + container = M_3 gm			
04	Mass of Moisture = $M_4 = M_2 - M_3$			
05	Mass of Dry Soil = $M_5 = M_3 - M_1$			
06	Moisture content = w = $\frac{M_4}{M_5} X\ 100$			
07	Dry Density of soil = $\Upsilon_D = \frac{\square}{1+w}$ in gm/cc			
08	Average Dry Density of soil = $\Upsilon_{D\ AVG}$			

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REFERENCE:

1. https://www.youtube.com/watch?v=5rDHjZ_RJq0&t=535s

WEEK 02 PRACTICE 02

AIM: To determine the required amount of water to be used when compacting the soil in the field and the resulting degree of denseness, which can be expected from compaction at optimum moisture content as per IS: 2720 (Part VII) – 1983

APPARATUS:

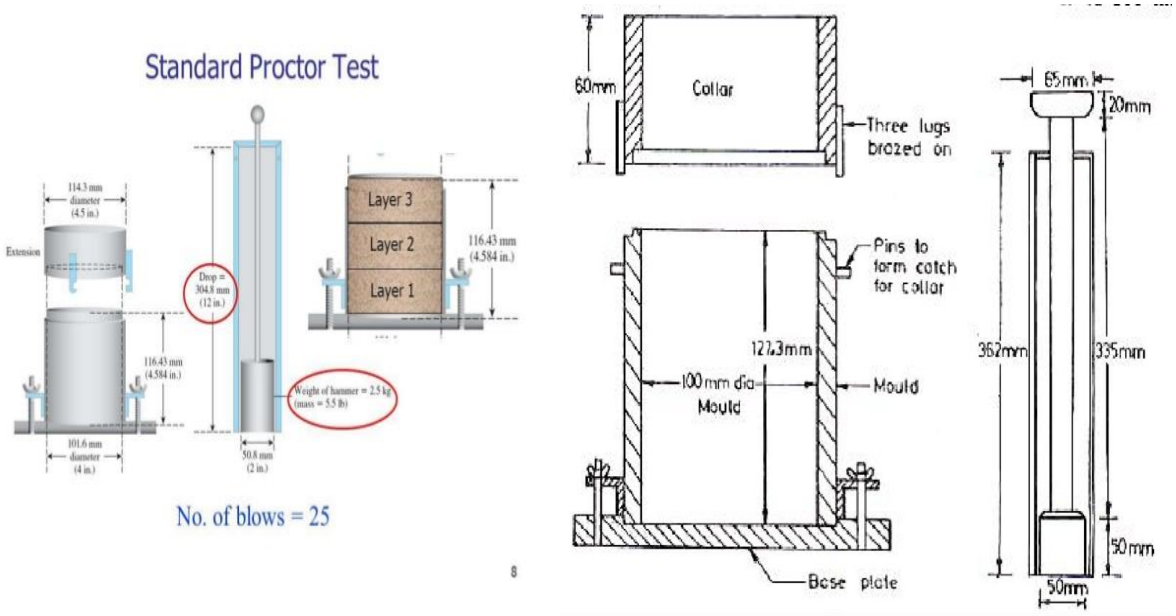
- Cylindrical metal mould shall be either of 100mm diameter and 1000cm^3 volume or 150mm diameter and 2250cm^3 volume and shall confirm to IS: 10074 – 1982.
- Balance of capacity 15Kg and sensitivity one gram.
- Thermostatically controlled oven with capacity up to 250 0C.
- Airtight containers.
- Steel straight edge about 30cm in length and having one bevelled edge.
- 4.75mm, 19mm and 37.5mm IS sieves confirming to IS 460 (Part 1).
- Mixing tools such as tray or pan, spoon, trowel and spatula.
- Heavy compaction rammer confirming to IS: 9189 -1979.

THEORY:

In geotechnical engineering, soil compaction is the process in which a stress applied to a soil causes densification as air is displaced from the pores between the soil grains. It is an instantaneous process and always takes place in partially saturated soil (three phase system). The Proctor compaction test is a laboratory method of experimentally determining the optimal moisture content at which a given soil type will become most dense and achieve its maximum dry density.

Determination of the relationship between the moisture content and density of soils compacted in a mould of a given size with a 2.5 kg rammer dropped from a height of 30 cm. the results obtained from this test will be helpful in increasing the bearing capacity of foundations, Decreasing the undesirable settlement of structures, Control undesirable volume changes, Reduction in hydraulic conductivity, Increasing the stability of slope sand so on.

OBSERVATIONS:



Internal diameter of cylinder = D = _____MM

Internal height of cylinder = H = _____MM

Volume of core cutter = V =_____cc

PROCEDURE:

- Take a representative sample of air dried soil of about 5 kg (soil not susceptible to crushing during compaction) or 3 kg from 15 kg sample (soil susceptible to crushing during compaction) passing through 19mm IS sieve and mix thoroughly with a suitable amount of water depending on the type of soil, generally 4 to 6 percent for sandy and gravelly soils and plastic limit minus 8% to 10% for cohesive soils.

- For soils susceptible to crushing during compaction take different samples for every determination and for soils not susceptible to crushing during compaction use the same sample for all the determinations.
- Weigh the 1000cc capacity mould with base plate attached and without extension to the nearest gram (m1).
- Place the mould on a solid base such as a concrete floor or plinth and compact the moist soil into the mould, with the extension attached in 5 layers of approximately equal mass, each layer being given 25 blows with the 4.90kg hammer dropped from a height of 450mm above the soil.
- Distribute the blows uniformly on each layer.
- The amount of soil used shall be sufficient to fill the mould leaving not more than about 6mm to be struck off when the extension is removed.

PRECAUTIONS:

- With clays of high plasticity or where hand mixing is employed, it may be difficult to distribute the moisture uniformly throughout the air dried soil by mixing alone, so it may be necessary to preserve the mixed sample in a sealed container for a minimum period of about 16 hours before conducting the test.

REPORT:

- Plot the values obtained for each determination on a graph representing moisture content on x-axis and dry density on y-axis.
- Draw a smooth curve through the resulting points and determine the position of the maximum in the curve.
- Report the dry density corresponding to the maximum point to the nearest 0.01
- Report the percentage corresponding to the maximum dry density i.e. optimum moisture content to the nearest 0.2 % for values below 5% and to the nearest 0.5% for values from 5 to 10% and to nearest whole number for values exceeding 10 %.

RESULT:

- From test results the Maximum Dry density of soil (Υ) = _____ gm/cc
- From test results the optimum moisture content of soil (M %) = _____ %

DATA SHEET

EXPARIMENT NO:
EXPARIMENT NAME: STANDARD PROCTOR COMPACTION TEST
NAME OF STUDENT: **DATE: / /**
SOURCE / LOCATION: POLYTECHNIC BUILDING, AVARAGUPPA, SIDDAPURA
NO. OF BLOWS PER LAYER: 25NUMBERS **NO. OF LAYERS: 03LAYERS**
VOLUME OF CYLINDER= V= AREA x HEIGHT =

OBSERVATION & CALCULATION

FIELD DENSITY

SL NO	DESCRIPTION	DETERMINATION NUMBER		
		I	II	III
01	Internal diameter of cylinder			
02	Internal height of cylinder			
03	Volume of cylinder (V) in CC			
04	Weight of cylinder W_1 in gm			
05	Weight of cylinder + Soil W_2 in gm			
06	Weight of Soil = W = $W_2 - W_1$ in grams			
07	Bulk Density of soil = $\Upsilon = \frac{W_2 - W_1}{V}$ in gm/cc			
08	Average Bulk Density of soil= Υ_{AVG}			

DRY DENSITY

SL NO	DESCRIPTION	DETERMINATION NUMBER		
		I	II	III
01	Moisture can number			
02	Mass of container = M_1 gm			
03	Mass of Wet soil + container = M_2 gm			
04	Mass of Dry soil + container = M_3 gm			
05	Mass of Moisture = $M_4 = M_2 - M_3$			
06	Mass of Dry Soil = $M_5 = M_3 - M_1$			
07	Moisture content = w = $\frac{M_4}{M_5} X\ 100$			
08	Dry Density of soil = $\Upsilon_D = \frac{\Upsilon}{1+w}$ in gm/cc			
09	Average Dry Density of soil = $\Upsilon_{D\ AVG}$			

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REFERENCES:

1. https://www.youtube.com/watch?v=c4i_y6u-tsE&t=235s

WEEK 03 PRACTICE 01

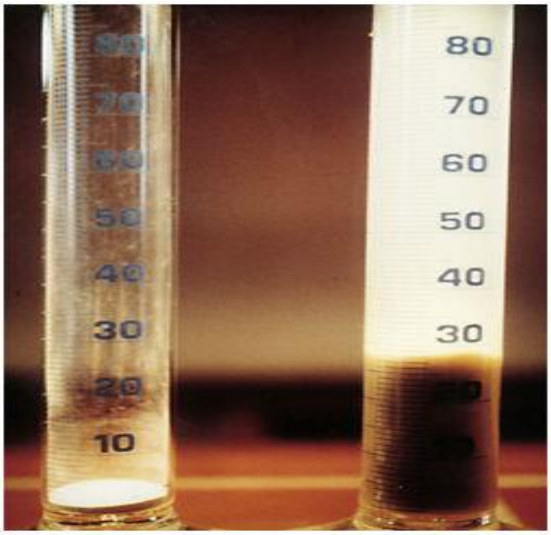
AIM: To determine the free swell index of soil as per IS: 2720 (Part XL) – 1977.

PRINCIPLE:

Free swell or differential free swell, also termed as free swell index is the increase in volume of soil without any external constraint when subjected to submergence in water. The possibility of damage to structures due to swelling of expansive clay need be identified by an investigation of those soils likely to possess undesirable expensive characteristics. This testing is provided to reflect the potential of the soil to swell under different simulated conditions

APPARATUS:

- IS Sieve of size 425µm
- Oven
- Balance with an accuracy of 0.01g
- Graduated glass cylinder- 2 nos., each of 100ml capacity



FORMULA USED

$$Free\ Swell\ Index = \frac{(V_d - V_k)}{V_k} \times 100\%$$

where, Vd = volume of soil specimen read from the graduated cylinder containing distilled water.
Vk = volume of soil specimen read from the graduated cylinder containing kerosene.

PROCEDURE:

1. Take two specimens of 10g each of pulverised soil passing through 425µm IS Sieve and oven-dry.
2. Pour each soil specimen into a graduated glass cylinder of 100ml capacity.
3. Pour distilled water in one and kerosene oil in the other cylinder upto 100ml mark.
4. Remove entrapped air by gently shaking or stirring with a glass rod.
5. Allow the suspension to attain the state of equilibrium (for not less than 24hrs.).
6. Final volume of soil in each of the cylinder should be read out.

PRACTICAL UTILITY OF FREE SWELL INDEX:

As stated in theory, this test gives the idea about potential of the soil to expand when it submerged in the water. Thus possibility of damage to the structure due to swelling can be identified and possible precaution can be taken. For guideline table 8 of IS code has been given below.

Liquid Limit (%)	Plasticity Index (%)	Shrinkage Index (%)	Free Swell (%)	Degree of Expansion	Degree of Severity
20-35	<12	<15	<50	Low	Non-Critical
35-50	12-23	15-30	50-100	Medium	Marginal
50-70	23-32	30-60	100-200	High	Critical
70-90	>32	>60	>200	Very High	Severe

RESULTS:

Free swell index = ------ %

DATA SHEET

EXPARIMENT NO:
EXPARIMENT NAME: FREE SWELLI NDEX OF SOIL
NAME OF STUDENT: **DATE: / /**
SOURCE / LOCATION: POLYTECHNIC BUILDING, AVARAGUPPA, SIDDAPURA

OBSERVATION & CALCULATION

SL NO	DESCRIPTION	TRAIL NUMBER		
		I	II	III
01	Mass of Dry soil passing through 425Micron sieve in Grams			
02	Volume in water after 24 hours swell V_d in cc			
03	Volume in Kerosene after 24 hours swell V_k in cc			
04	$Free\ Swell\ Index = \frac{(V_d - V_k)}{V_k} \times 100\%$			
05	Average free swell index in %			

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REFERENCES

1. https://www.civilengineeringweb.com/2021/09/free-swell-index-test.html
2. https://wecivilengineers.wordpress.com/2018/01/23/free-swell-index/
3. https://www.youtube.com/watch?v=XHpJa0Gl9a8

WEEK 03 PRACTICE 02A

AIM: To determine the water absorption of given sample of Brick. (IS 3495 PART 2: 1992)

APPARATUS:

- Weighing Balance.
- Dry bricks.

OBSERVATIONS:

- Weight of dry sample of brick= W_1 Grams
- Weight of saturated sample of brick = W_2 Grams
- Weight of water absorbed = $W_3 = W_2 - W_1$
- Percentage of water absorption = $\frac{w3}{w1}\ x\ 100$

THEORY

Brick for external use must be capable of preventing rain water from passing through them to the inside of walls of reasonable thickness. A good brick should absorb water maximum $1/7^{th}$ of the weight of the brick. The bricks, when tested in accordance with the procedure laid down in IS 3495 (Part 2) : 1992 after immersion in cold water for 24 hours, water absorption shall not be more than 20 percent by weight up to class 12.5 and 15 percent by weight for higher classes.

PROCEDURE:

- 5 bricks are taken randomly from a stack.
- The bricks are put in an oven at a temperature of 105^0C for drying.
- A brick are weighed in a digital weighing machine and is record as W_1.
- The bricks are immersed in water at room temperature for 24 hours.
- After 24 hours immersion, the bricks are taken out of water and wiped with a damp cloth for 3 minutes.
- The bricks are weight again and recorded as W_2.
- Water absorption of brick = $\frac{W2-W1}{W1}$ X 100

RESULT:

- The water absorption of given sample of BRICK =

NOTE:

- The dimension shall be measured to the nearest 1 mm.
- All apparatus and testing equipment shall be calibrated at frequent intervals.
- The number of specimens for the test shall be selected according to IS 5454: 1978.
- A sensitive balance capable of weighing within 0.1 percent of the mass of the specimen; and a ventilated oven.

CALCULATION:

SL.NO	DRY WEIGHT OF BRICK W_1 Grams	WET WEIGHT OF BRICK W_2 Grams	% OF WATER ABSORPTION	AVERAGE % OF WATER ABSORPTION
1				
2				
3				
4				
5				

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REFERENCES:

1. https://www.youtube.com/watch?v=NVibXq8hGnU

WEEK 03 PRACTICE 02B

AIM: To determine the field tests on given sample of Brick.

APPARATUS:

- Dry bricks.

PROCEDURE:

1. EFFLORESCENCE TEST

This test should be conducted in a well ventilated room. The brick is placed vertically in a dish 30 cm x 20 cm approximately in size with 2.5 cm immersed in distilled water. The whole water is allowed to be absorbed by the brick and evaporated through it. After the bricks appear dry, a similar quantity of water is placed in the dish, and the water is allowed to evaporate as before. The brick is to be examined after the second evaporation and reported as follows:

Nil: When there is no perceptible deposit of salt

Slight: When not more than 10% of the area of brick is covered with salt

Moderate: When there is heavy deposit covering 50% of the area of the brick but Unaccompanied by powdering or flaking of the surface.

Heavy: When there is heavy deposit covering more than 50% of the area of the brick accompanied by powdering or flaking of the surface.

Serious: When there is heavy deposit of salts accompanied by powdering and/or flaking of the surface and this deposition tends to increase in the repeated wetting of the specimen.

Bricks for general construction should not have more than slight to moderate efflorescence

2. HARDNESS TEST

A good brick should resist scratches against sharp things. So, for this test a sharp tool or finger nail is used to make scratch on brick. If there is no scratch impression on brick then it is said to be hard brick

3. COLOUR TEST

A good brick should possess bright and uniform colour throughout its body

4. SOUNDNESS TEST

Soundness test of bricks shows the nature of bricks against sudden impact. In this test, 2 bricks are chosen randomly and struck with one another. Then sound produced should be clear bell ringing sound and brick should not break. Then it is said to be good brick

5. STRUCTURE TEST

To know the structure of brick, pick one brick randomly from the group and break it. Observe the inner portion of brick clearly. It should be free from lumps and homogeneous

6. SIZE AND SHAPE TEST

Shape and size of bricks are very important consideration. All bricks used for construction should be of same size. The shape of bricks should be purely rectangular with sharp edges. Standard brick size consists length x breadth x height as 19cm x 9cm x 9cm.

To perform this test, select 20 bricks randomly from brick group and stack them along its length, breadth and height and compare. So, if all bricks similar size then they are qualified for construction work

RESULT:

- Field test on given sample of bricks have been conducted.

SIGNATURE OF STUDENT **SIGNATURE OF COURSE COORDINATOR**

REFERENCES:

1. **https://theconstructor.org/building/types-of-tests-on-bricks/12701/**
2. **https://civilblog.org/2014/04/18/what-are-the-field-tests-on-bricks/**
3. **VIDEO LINK: https://www.youtube.com/watch?v=jM15T1EURFs**

WEEK 03 PRACTICE 03A

AIM: To determine the compressive strength of given sample of Brick.

APPARATUS:

- Weighing Balance.
- Dry bricks.
- Compression Testing Machine.

OBSERVATIONS:

- Compression Strength = $\frac{LOAD}{CROSS\ SECTIONAL\ AREA}$ N/MM^2

THEORY

Bricks are mostly subjected to compression and tension. The usual crushing strength of common hand moulded well burnt bricks is about 5 to 10 N/mm2 (50 to 100/kg/cm2) varying according to the nature of preparation of the clay. Pressed and machine moulded bricks made of thoroughly pugged clay are stronger than common hand moulded bricks from carelessly prepared clay.

PROCEDURE:

- Five bricks are taken for the compressive strength testing.
- The bricks are then immersed in water at room temperature for 24 hours.
- Then these are taken out of water and surplus water on the surfaces is wiped off with a moist cloth.
- The frog of the bricks is flushed level with cement mortar (1:3)
- The bricks are stored under damp jute bags for 24 hours followed by its immersion in water at room temperature for three days.
- The bricks are placed in the compression testing machine with flat faces horizontal and mortar filled face being upwards.
- Load is applied at a uniform rate till failure.

RESULT:

- The Compression Strength of given sample of BRICK =

CALCULATION:

SL.NO	CROSS SECTIONAL AREA IN MM^2	LOAD @ FAILURE IN "N"	COMPRESSION STRENGTH	AVERAGE COMPRESSION STRENGTH
1				
2				
3				
4				
5				

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WEEK 03 PRACTICE 03B

AIM: To determine the Dimensionality tolerance of given sample of Brick (IS 1072: 1992)

APPARATUS:

- Dry bricks.
- Measuring Tape.

OBSERVATION:

DIMENSION:

The standard modular size of common building bricks shall be (Figure 1A and 1B)

LENGTH (L) MM	WIDTH (B) MM	HEIGHT (H) MM
190	90	90
190	90	40

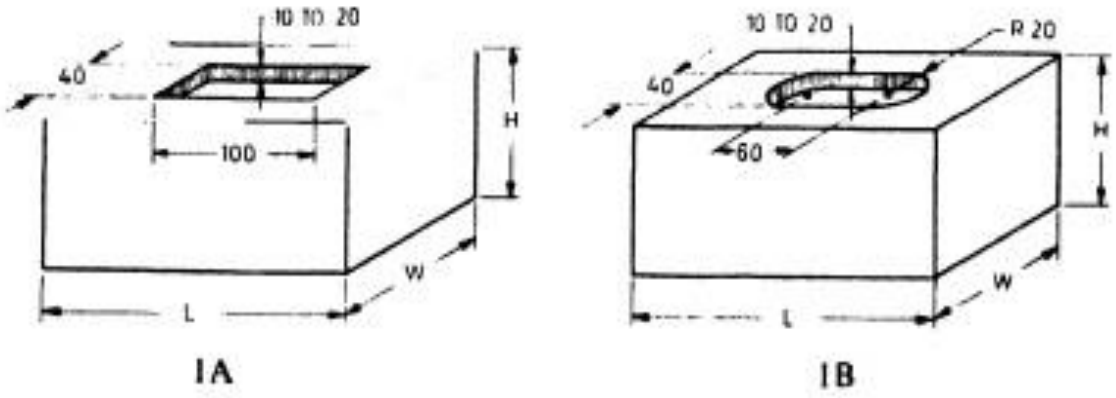
The standard non modular size of common building bricks shall be (Figure 1A and 1B)

LENGTH (L) MM	WIDTH (B) MM	HEIGHT (H) MM
230	110	70
230	110	30

TOLARANCE:

The dimensions of bricks when tested in accordance to dimension shall be within the following limits per 20 bricks:

For Modular Bricks	length 3720 to 3880 mm (3800 ± 80mm) Width 1760 to 1840 mm (1800 ± 40mm) Height 1760 to 1840 mm (1800 ± 40mm) For 90mm High Bricks 760 to 840 mm (800 ± 40mm) For 40mm High Bricks
For Non Modular Bricks	length 4520 to 4680 mm (4600 ± 80mm) Width 2160 to 2240 mm (2200 ± 40mm) Height 1360 to 1440 mm (1400 ± 40mm) For 70mm High Bricks 560 to 640 mm (600 ± 40mm) For 30mm High Bricks



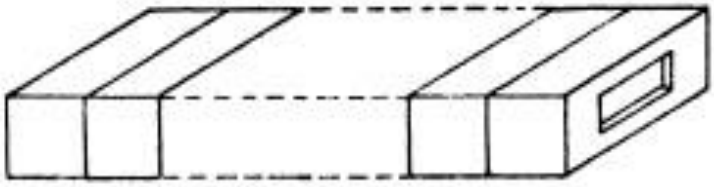
1A 1B

All dimensions in millimetres.

FIG. 1 SHAPE AND SIZE OF FROGS IN BRICKS

2A MEASUREMENT OF LENGTH

2B MEASUREMENT OF WIDTH



2C MEASUREMENT OF HEIGHT

FIG. 2 MEASUREMENT OF TOLERANCES OF COMMON BUILDING BRICKS

PROCEDURE:

- Twenty or more according to the size of stack) whole bricks shall be selected at random from the sample selected (Sampling and criterion for conformity of common bricks shall be done in accordance with the procedure laid down in IS 5454: 1978).
- All blisters, loose particles of clay and small projections shall be removed.
- They shall then be arranged upon a level surface successively as indicated in Fig. 2A, 2B and 2C in contact with each other and in a straight line.
- The overall length of the assembled bricks shall be measured with a steel tape or other suitable inextensible measure sufficiently long to measure the whole row at one stretch.
- Measurement by repeated application of short rule or measure shall not be permitted. If. For any reason it is found impracticable to measure bricks in one row, the sample may be divided into rows of 10 bricks each which shall be measured separately to the nearest millimeter.
- All these dimensions shall be added together..

RESULT:

- The Tolerance of given sample of bricks are =

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WEEK 04 PRACTICE 01A

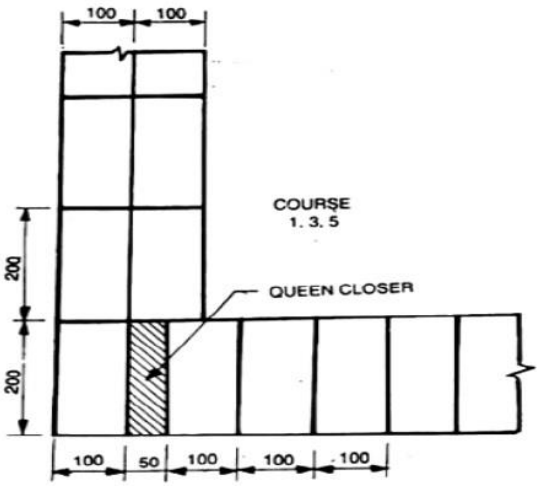
AIM: Construction of one brick thick / one and half brick thick wall in English bond

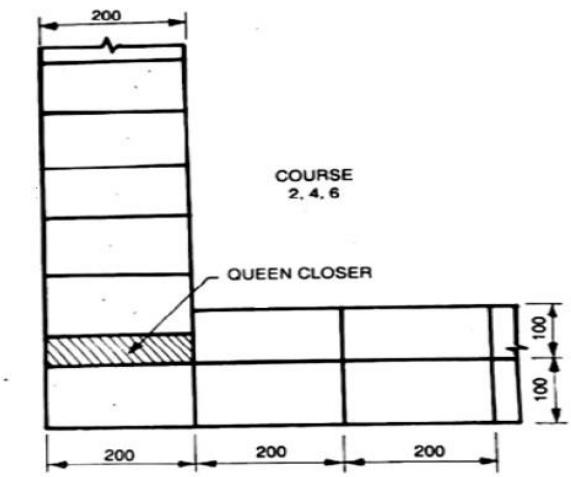
MATERIALS AND EQUIPMENT'S: line string, tri square, plumb bob, level tube, trowel, measuring tape, spirit level, mortar pan, bucket, spade, sieve, bricks, cement, sand and water

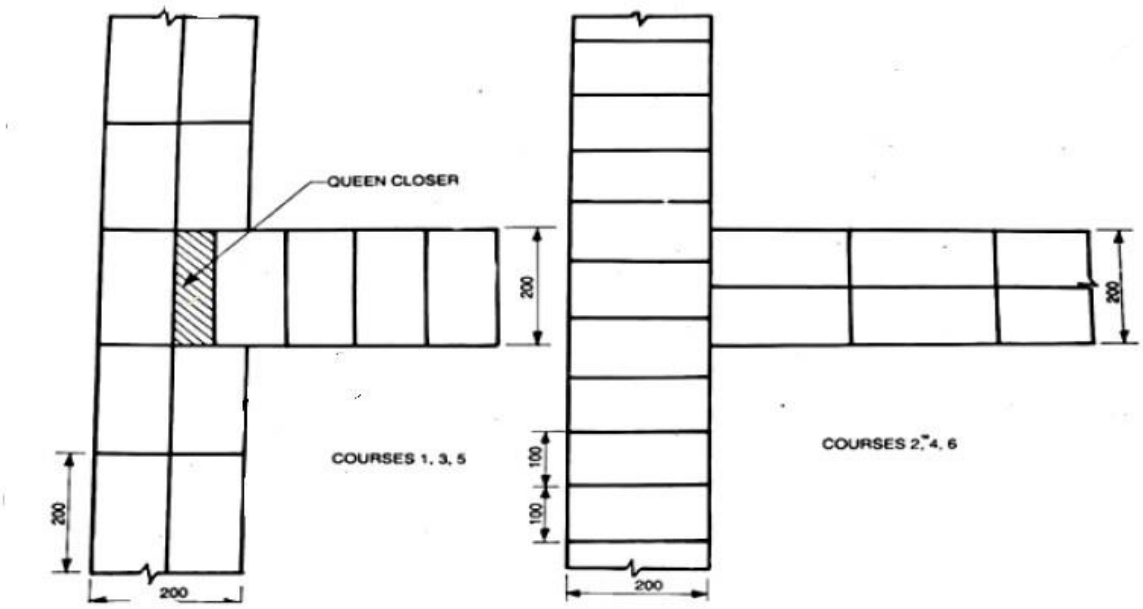
PROCEDURE:

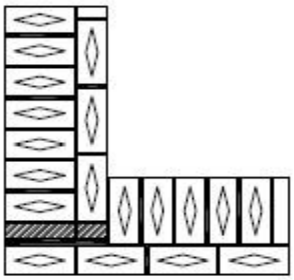
1. Before start of work brick should be immersed in water 24 hours. So that they don't absorb water from mortar.
2. Bricks should be laid with frog upward.
3. Spread the mortar over an area to be covered by the edges of wall, depth of mortar spread should be 15mm thick.
4. Lay one brick at the corner press it with hand, the bed joint remains only about 10mm thick.
5. Clean the excess mortar from the joint check the level and alignment simultaneously. Fill the joints with mortar.
6. Start second coarse by laying the mortar and spreading it over the first coarse and arrange bricks to level and check the alignment of the bricks.
7. The corner constructed should be done with great care by frequently checking to plumb and alignment.
8. Repeat the above procedure till the required height.
9. At the end of days work the joints should be clean and finished by raking

OBSERVATION:

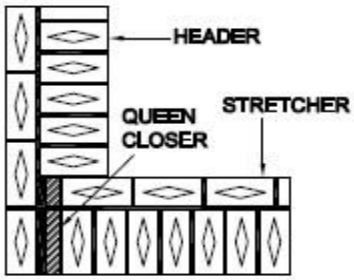




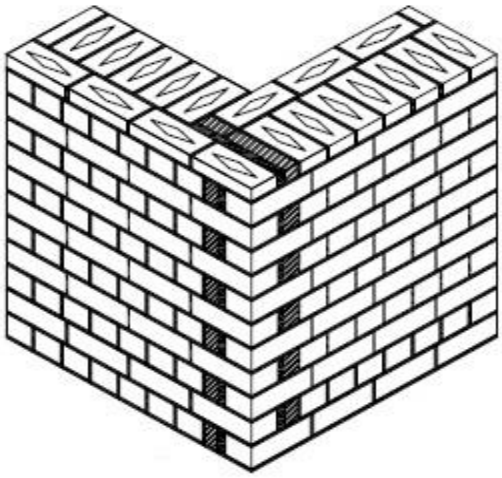




1,3,5 LAYER



2,4,6 LAYER



RESULT:

- Construction of one brick thick / one and half brick thick wall in English bond has been done.

WEEK 04 PRACTICE 01B

AIM: Construction of wall in Flemish bond

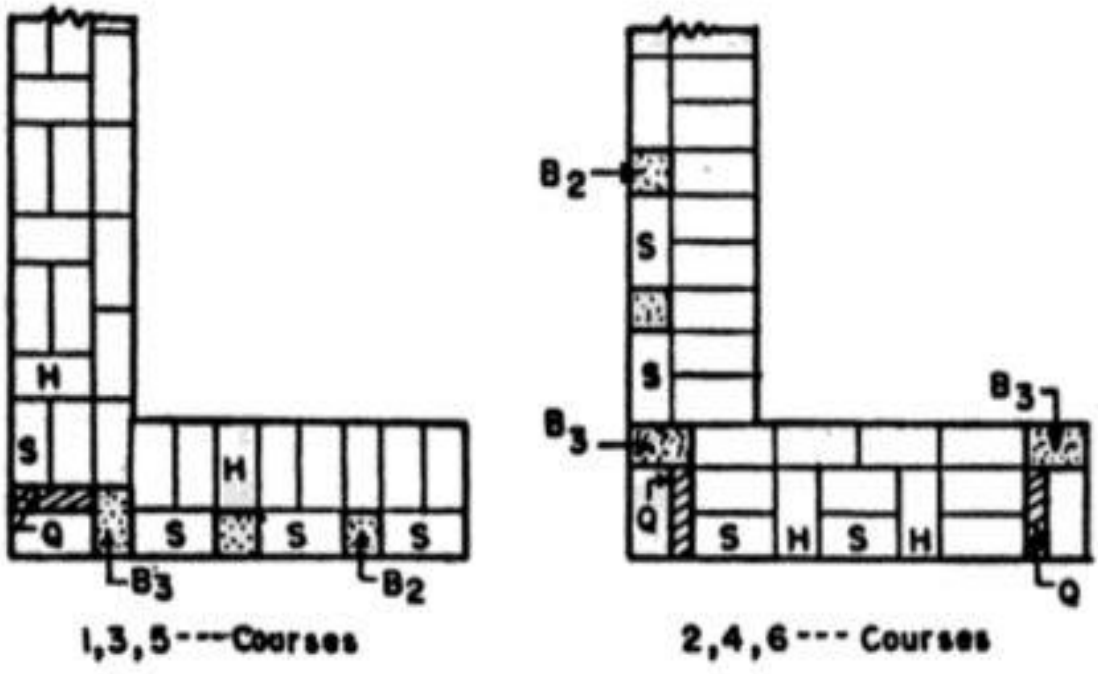
MATERIALS AND EQUIPMENT'S: line string, tri square, plumb bob, level tube, trowel, measuring tape, spirit level, mortar pan, bucket, spade, sieve, bricks, cement, sand and water

THEORY:

A Flemish bond pattern consists of each course of alternate headers and stretchers. Every alternate course starts with a quoin header at the corner. To the next of quoin header, quoin closer is placed in alternate courses to develop face lap. The patterns arrange such that every header is centrally supported over the stretcher below it.

SINGLE FLEMISH BOND:

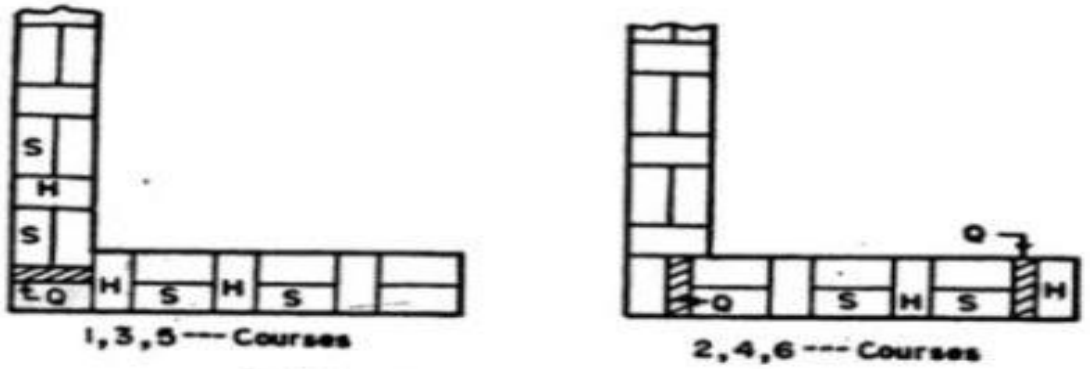
A single Flemish bond comprises the double Flemish bond on its facing and English bond as backing with hearting in each course. Hence, the bond makes use of the strength of both English and Flemish bond. This bond can be used for the construction of walls with a thickness not less than one and a half brick. The facing with double Flemish bonds is employed with good quality expensive bricks. For backing and hearting, cheap bricks can be used.



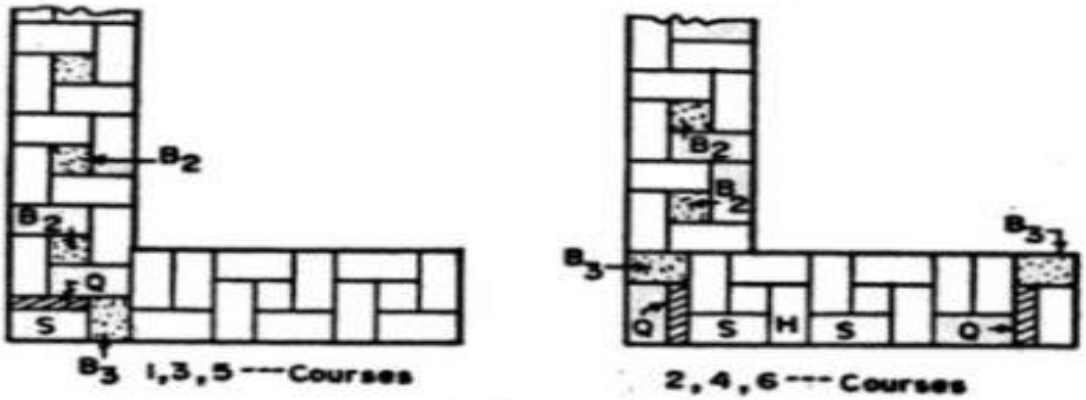
(a) Plan for 1½ Brick Thick Wall

DOUBLE FLEMISH BOND:

Double Flemish bond with alternate headers and stretchers in each course. The feature of the double Flemish bond is that it has the same appearance both in the front face as well as in the back face. This feature hence gives a better appearance compared to the English bond for all the wall thickness.



(a) Plan for one Brick Thick Wall



(b) Plan for $1\frac{1}{2}$ Brick Thick Wall

ENGLISH BOND	FLEMISH BOND
Bond pattern with alternate header and stretcher course	Bond Pattern with each course having alternate header and stretcher
More strength given for bricks with thickness greater than one & half brick	Less strong and compact compared to English bond
Less pleasing appearance	Appearance is more attractive and pleasing
Expensive	Economical
No strict supervision and skill is demanded	Requires good workmanship and careful supervision.

RESULT:

- Construction of wall in Flemish bond has been done.

WEEK 04 PRACTICE 01C

AIM: Prepare a masonry check list for before and after construction

CHECKS PRIOR TO START OF WORK

- Follow the latest "Good for Construction" drawings duly signed by the architect.
- Check for any variations/deviations from the approved architectural and services drawings.
- All concrete surfaces of beams and columns coming in contact with block work is to be hacked (80 indents per sq.ft. and each indent is considered to be 1 cm long)
- Use cement mortar slurry of 1:2 on the hacked surface to create a roughened surface for proper bonding, 3 days prior to start of block work. Cure the roughened surface for these 3 days, by spraying water.
- Aluminium templates provided by SGMPL should be available at site to ensure correct door / window openings.
- For non-load bearing walls use solid / hollow 4 N/mm2 compressive strength blocks or as specified by structural consultant. For load bearing walls use solid / hollow 7 N/mm2 compressive strength blocks or as specified by structural consultant.
- Use silt free (less than 5%) medium gritty clean sand for mortar.
- Approved grade cement not more than 30 days should be used. The date of manufacture is put on the bag.
- Ensure that all required tools, accessories and materials are available at the place of work.
- Finished floor level should be button marked on structural slab. Lintels, chajjas and sills to be cast with respect to finished floor level.
- For bonding of block work to columns, wall ties shall be cast into columns at a vertical spacing not greater than 500mm and should be aligned with the horizontal mortar band.

CHECKS DURING BLOCK WORK

- Place the marker course of block (1st course) after checking the vertical & horizontal alignment. Get it checked by the architect.
- If hollow blocks are used fill the lowest (1st course) with concrete 1:3:6 using 12mm jelly to give a firm base for chipping to fix skirting.
- Mix mortar in proportion of 1:5 on MS sheet, using Farma box for measuring sand and a measuring can to standardize quantum of water to get a consistent mix. Mix well for uniformity. Mix mortar in small manageable quantities and use it within ½ an hour.

- Mortar joints should not be more than 10 mm for both vertical and horizontal joints. The joints should be neatly pointed using an Aluminium Straight edge or German pointing trowel.
- Do not construct more than 1 metre height in a day.
- Give concrete band of 1:2:4 with 8 mm steel (2 Nos.) in a 100 mm thick wall at every 1 metre height.
- Do not place the topmost block under the beam until the immediate upper floor block work is raised up to the beam bottom, less one course.
- In the top floor, build the parapet wall and do the waterproofing and screed concrete before placing and packing the last course.
- Adjuster course in concrete 1:2:4 should be laid two in courses below the beam and not above the topmost course.
- Use hollow blocks at the location of electrical conduit and raise the conduit along with the block work.
- Dowel blocks to be left for further extension of block masonry.
- Continuous horizontal chasing should be avoided. Chase block work using chasing machines.
- Start chasing after at least 21 days of block work construction
- For tiled surfaces it is a better option to chase after rough plaster is done and cured for 21 days.
- All nibs adjacent to columns and less than 200mm should be cast in RCC at site using M20 grade of concrete and curing for 7 days by covering with hessian clothes.
- For mortar joints more than 10mm, packing of chasing for pipes; junction box etc. should be done in P.C.C. 1:2:4 using 12mm jelly and cured for minimum 3 days.
- Write down the date of work in paint on the block work and monitor the curing accordingly.
- Cure the block work by spraying water on the mortar joints only for at least 7 days.
- Cast the cut lintel, sill, and chajja by giving a maximum bearing of 200mm and with bed block.
- In the case of lintel, sill, and chajja over large openings, places them as end-to-end beam type.
- If bearing cannot be given as required, lockset the reinforcement of lintel into the column for a depth of 4days for cast in situ works.

- Check chajjas and sills for toppling effect. If suspect, build counterweight courses for lintel, sill, and chajjas.
- Continuous vertical mortar joints should be staggered and vertical movement joints to be given every 12 metres.

CARE AFTER BLOCK WORK

- Do not entertain excessive chasing as it disturbs the mortar joints causing hairline cracks and weakening the work.
- Do not soak the blocks with water while curing. The moisture absorbed by the blocks will be released subsequently causing volumetric variations and shrinkage cracks.
- The interface between block and concrete is the most critical zone and needs special care. This is due to incompatibility between two heterogeneous materials. Before plastering, these zones should be given special treatment. (Discussed separately under plastering)
- After 7 days curing of mortar joints drive a nail into the joint to test the strength of joints at random. Also look for colour variation in the mortar joints to identify problem areas.

TOOLS TO BE USED BY TRADESMEN

Required tools must be available at site to ensure correct work. Basic tools of the masons are:

1. Trowels
2. Line dori
3. Sand Sieve
4. Tube levels
5. Plumb bobs
6. Measurement Tape
7. Spirit levels 1-2m
8. Aluminium straight edge
9. Right angle
10. Chipping Tools
11. Masons trowels
12. Masons hammer
13. Levelling threads
14. Masons brushes and buckets
15. Mortar boxes
16. Water Barrel

INSPECTION METHODOLOGY FOR QUALITY ASSURANCE

- First measure if the given area is to plan as per correct and updated drawings
- The block work should be neat and clean visually
- The first course in block-work is the most important one. Using the spirit levels, check if the erected wall is perfect – the surface should be free of undulations, and cracks.
- Using the tape measure, ensure the diagonals are equal.
- Check if the mesh used at required joints are properly placed & plastered.
- Using the 3-meter Spirit levels and aluminium flats check if the erected surface is parallel. Check plumb at door and window openings.
- Measure openings at various points for uniformity. If in doubt, crosscheck with diagonals.
- Check if the corners are at right angles using the right angle template.
- Ensure door and window aluminium templates are always readily available.
- The joints should be of uniform thickness. Check joint thickness and strength after 7 days (nail test).
- Always use blocks of the same height and dimensions [Two different sizes have been observed of 190mm and 200-205mm respectively]

TOOLS TO BE USED FOR QUALITY INSPECTION

- Measuring tape
- Spirit levels - 3m
- Right angle template
- Related “Good for Construction” drawings

RESULT:

- Check list for before and after construction of masonry work has been prepared.

REFERENCE:

1. **Technology Manual by Sobha Developer Pvt. Ltd.**

CHECKLIST FOR ON-SITE INSPECTION			ACTIVITY:BLOCKWORK	
PROJECT:		**DATE:**		
LOCATION:				
SN	**ITEM**	**YES**	**NA**	**REMARKS**
1	Name, Date & Number of drawing			
	PRE EXECUTION CHECKS			
2	Are the latest "Good for Construction" drawings available?			
3	Are the required numbers of blocks available? (both load bearing and non-load bearing)			
4	Has the hacking at contact surfaces of column & beam beendone?			
5	Has cement mortar slurry been applied over the hacked surfaceand cured for 3 days?			
6	Have aluminum templates used for door/window openings?			
7	Are the required tools available?			
8	Are there any specific requirements of the client?			
9	Cement - is it of the approved grade and less than 1 month old?			
10	Sand - is it medium gritty, clean and silt-free (less than 5%)?			
11	Is the finished floor level button marked on structural slab?			
12	Are the markings for reference lines on pillars done?			
13	Have the wall ties been cast into columns at a vertical spacing (<500mm)?			
	CHECKS DURING EXECUTION			
14	Is the block work checked in vertical and horizontal directions?			
15	Is the marker/ lowest course of hollow blocks filled with concrete 1:3:6 (12mm jelly)?			
16	Is the mortar in proportion 1:5 on MS sheet using farma box?			
17	Has the check for diagonals & dimensions been done?			
18	Has the thickness for joints been checked?			
19	Has raking and pointing of joints been done?			
20	Is the RCC band for 100mm walls done?			
21	Has the procedure of not constructing more than 5 courses aday been followed?			
22	Has the top course been packed below the concrete beam?			
	POST EXECUTION CHECKS			
23	Has the curing of block work done for at least 7 days?			
24	Has care been taken of not entertaining excessive chasing?			
25	Has a nail been driven to test the strength of joint after 7 daysof curing?			

CHECKED BY **APPROVED BY**

WEEK 04 PRACTICE 02

AIM: Construction of concrete block masonry wall of height 1meter.

MATERIALS AND EQUIPMENT'S: line string, tri square, plumb bob, level tube, trowel, measuring tape, spirit level, mortar pan, bucket, spade, sieve, concrete blocks, cement, sand and water

OBSERVATION:

THEORY:

Concrete block masonry is a widely used style for its excellent properties of durability and high resistance to rain, fire, and inclement environmental conditions. Proper workmanship plays a crucial role in the completion of the masonry structure. Therefore, correct construction procedures must be followed while using concrete blocks masonry.

PROCEDURE:

1. **Wetting of Concrete Blocks:** The concrete blocks need not be wetted before or during laying in the walls. In places with high temperatures, the sides and the top of the blocks shall only be moistened to prevent the absorption of water from the mortar and ensure the formation of the required bond with the mortar.

2. **Laying of Concrete Blocks**
    - The concrete blocks shall be laid in the mortar of the required mix as specified and thoroughly bedded in mortar.
    - Mortar shall be spread over the top surface of the previous course, creating a uniform layer with a minimum thickness of 10mm and not exceeding 12mm.
    - All the concrete block courses shall be laid truly horizontal, and all vertical joints made truly vertical.
    - The concrete blocks shall break joints with those above and below for not less than a quarter of their length.
    - Precast half-length closers (and not cut from full-size blocks) shall be used.
    - For battered faces, bedding shall be at right angles to the face unless otherwise directed.
    - Care must be taken during construction to ensure that the edges of the blocks are not damaged.
3. **Provisions for Door and Window Frames in Concrete Block Masonry**
    - A solid concrete block masonry course shall be provided under door and window openings (or a 10 cm thick precast concrete sill block under windows). The course shall extend for at least 20 cm beyond the opening on either side.
    - In case of jambs of very large doors and windows, either solid concrete blocks or the hollow blocks shall be filled in with concrete of mix 1:3:6 using 12.5 mm nominal size aggregates.

4. **Provisions for Roof in Concrete Block Masonry:** The concrete course below the roof slab and top of the roof course must be built using solid blocks. The top of the roof course built using solid concrete blocks shall have a smooth finish with a layer of cement sand mortar of 1:3 and 10 mm thickness. It should be covered with a thick coat of whitewash or crude oil to ensure free movement of the slab.

5. **Fixtures and Fittings in Concrete Block Masonry:** The fixtures, fittings, etc. in the concrete block masonry shall be built into the masonry in cement and coarse sand mortar 1:3 while laying the blocks. The holdfasts shall be driven into the joints of the block masonry during laying. Holes, sleeves, chases, openings, etc. of the required size and shape or fixing pipes, service lines, a separate passageway for water shall be formed in

the masonry with special concrete blocks while laying. After service lines, pipes, etc. are fixed, the voids left shall be filled up with cement concrete 1:3:6 and neatly finished.

6. **Finishes in Concrete Block Masonry**
    - Rendering for the concrete block wall shall not be done if the walls are wet.
    - Joints for plastering or pointing as specified shall be raked to a depth of 12 mm.
    - Joints on internal faces, unless otherwise indicated, shall be raked for plastering.
    - If the internal faces of masonry are not to be plastered, the joints shall be finished flush as the work proceeds, or pointed flush where indicated.

RESULT:

- Construction of concrete block masonry wall of height 1metre has been done.

REFERENCES

1. https://theconstructor.org/practical-guide/construct-concrete-block-masonry/55066/

WEEK 05 PRACTICE 01

AIM: Study & present important types of doors, windows and Ventilators in general use

THEORY

It is evident that houses in the ancient times had no doors! There used to be a passage that was meant for the exit or entry in the home. Later, doors did come into existence, but people were still carefree and slept at night keeping the doors of their houses open. Even today, if you visit any tribal or remote area, the houses hardly have any door. They have an entrance which is either covered with a piece of cloth or grass hay. The concept of 'door' still does not exist there.

But with passage of time, where everything was under the process of evolution, houses were no exception. Slowly and gradually they made progress in the process and thus, in the modern age, we find the concept of 'home' completely changed. 'Security' has become a major concern nowadays. Especially in the urban areas, it is a major concern. Hence, the technology has stepped in and for security reasons; today we have doors available that can be opened only with their passwords.

In big cities, there is always a fear of theft and burglary; hence it is equally essential for the doors to be strong enough so that they cannot be easily broken or opened. But apart from security, safety and privacy; there is an aspect of art and décor associated with it since the homes started adopting the concept of doors. Today the choice is majorly governed by it, as the other factors are bound to be present and common with all types of doors.

In this article, we are discussing about the various types of doors depending upon their location, the material used for their manufacturing, operation of door shutter, method of construction, the arrangement of door components etc

TYPES OF DOORS BASED ON THEIR VARIOUS CLASSIFICATIONS

There are different types of doors available in the market i.e. Flush Door, Panel Door, Glass Door, PVC Door, etc. Generally, the doors are classified in following ways,

BASED ON LOCATION

While designing your house, it is important to know where the door needs be placed. Based on their location, doors are classified in following ways

- **EXTERIOR DOORS**

Exterior doors or front doors of a dwelling are given the utmost importance. The exterior doors allow entrance to or exit from a house and provide a measure of security. These doors must be weather resistant as they are exposed to various climatic conditions.

The exterior doors are provided with adequate thickness, stability and durability of construction. The exterior doors are given a protective coating of paint and polish. They are generally made of steel or wood. They are well designed to accommodate different types of locks

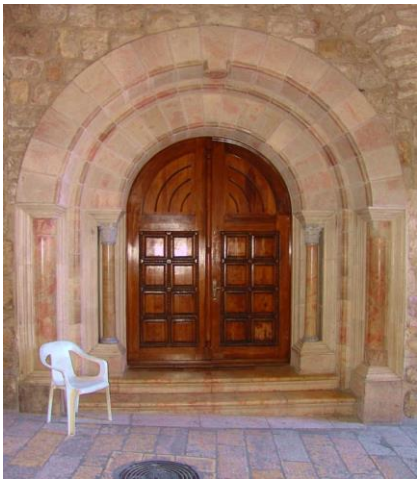
- **INTERIOR DOORS**

Interior doors do more than just separating rooms and providing privacy. Generally, interior doors are thinner than the exterior doors, and it comes in a variety of styles. They are available in different materials. They do not undergo the severities to the weather.

BASED ON MATERIALS

If you know the materials available for various types of doors, it can help you in making a better decision for the doors of your house. The doors are made of different materials like wood, steel, aluminium, glass, PVC, etc. Based on material used for the construction of doors, they are classified in following ways:

- **WOODEN OR TIMBER DOORS**



Wooden doors or timber doors are primarily used for interior door applications. Timber is the oldest material used for the doors and timber never seems out of fashion. There are many good reasons for using wood such as wooden doors provide soundproofing, insulation and security. They are easy to install and clean. They have long life. Being natural material, they have a different appeal. They do look elegant. They are very costly.

- **GLASS DOORS**

Glass doors look elegant and add richness and beauty to your home. They are a direct walkway to light in your home. Cut glass panel fitted into the wooden frames are beautiful option for front doors. The disadvantage of this door is that they are easily broken. Hence, they must be handled with care. However, with the toughen glass this would not happen easily.

- **STEEL DOORS**

Steel doors are used in the interior as well as in exterior application. These doors have a steel face with a foam core for insulation. They are very strong as compared to the other doors. They might not look as attractive as wooden or glass door.

- **PVC DOORS**

PVC doors are light in weight and easy to use. They come in a variety of designs and colours and look beautiful. These doors do not corrode and do not need much maintenance. But they are not scratch proof.

- **FIBER GLASS DOORS**

Fiber glass doors are most commonly used for exterior application. These doors have many design options and can be easily moulded into different shapes and style. These doors are durable and hard. They are generally preferred for affordable houses. They do not excel other types as far as looks are concerned. Of course, cost-wise they are economical.

- **ALUMINIUM GLAZED DOORS**

Aluminium doors with glass panel are most commonly used in commercial applications. They are strong, durable and hence, used as a security door. However, with the full aluminium panel, their look may not be as appearing as others

- **FIBER REINFORCED PLASTIC DOORS /FRP DOORS**

Fiber Reinforced Plastics doors are also known as FRP Doors. It is available in various colours and finishes in the market. Fiber reinforced plastic doors give numerous advantages such as higher strength, very low maintenance, all-weather resistant, easy fabrication, lightweight, and corrosion-free.

BASED ON OPERATION OF DOOR SHUTTER

- **Folding Doors**

Folding doors are used singly or as folding partitions so that two rooms can be used together as a single room or separately as per the requirement. They are more often used in room opening to garden, patios and verandah etc.

- **Sliding Doors**

The sliding doors consist of steel, wooden and glass shutter to which steel rollers are fixed. These steel rollers move along a track provided at the top and bottom. It has one or more sliding shutter based on opening available. In olden times, the sliding doors of steel and wood were commonly used for the large openings of godowns, workshops; garage etc.

Nowadays, sliding doors are mostly used in offices and where the area is congested because sliding doors save space and increase the efficiency of usage.

- **Swinging Doors**

Swinging doors are hinged near one edge to rotate about a vertical axis. It is hung on butts or hinges on the door frame. These doors have its shutter attached to the frame by means of double action springs. Hence shutter can move both inward and outward.

Two types of swinging doors are available – one is single-acting doors which can swing 90° or more in only one direction; and double-acting doors which can

swing 90° or more in each of two directions. Swinging door is mostly used in offices.

- **Revolving Doors**

In the Revolving door, the arrangements are made to rotate the door about central pivot. These doors revolve about one side of the shutter and get closed automatically.

Revolving door is desirable to exclude draughts, minimize the entering of street noises and to avoid heat losses. Revolving doors are mostly used in heavy traffic areas i.e. high-rise buildings, public buildings, hospitals, etc. to regulate entry.

- **Rolling Shutter Doors**

In the rolling shutter doors, the door shutter acts like a steel curtain. The rolling shutter doors are advantageous as it does not require much space. These doors are very strong, durable and offer proper safety. They are mostly used in stores, workshops, factories, garages and shops fronts etc.

- **Collapsible Doors**

Collapsible doors are fabricated from mild steel flats or channels and can be opened or closed by slight pull or push. The arrangement of collapsible doors is made in such a way that, when you open the door, all the strips are folded together and while you close, the strips are stretched. They occupy the least space and so it is preferable. Collapsible doors are used for the main entrance of the residential buildings, shops, godowns, cinema hall etc.

- **Pivot Doors**

Pivot doors function on a special pivot hinge, with pins that attach at the top and bottom of the door. The significant benefit of pivot hinges is, it can support much wider and heavier doors than traditional pin and barrel hinges.

With the technical benefit, it gives aesthetic uniqueness in opening and closing and gives eye-catching swinging function. Pivot doors are generally used for the entry doors

BASED ON METHOD OF CONSTRUCTION

- **Panel Doors**

Panel doors are the most commonly used inside house since long time. The British Standard gives a wide variety of panel doors based on one, two, three or four-panel format.

The panel can be made of plywood, block board, veneer, glass, wood, etc. they are one of the strongest doors. They offer various design but are labour intensive and skilled workforce

- **Flush Doors**

Nowadays, the flush doors are the most common type used in the house as well as public buildings due to its pleasant appearance and simple construction. These doors have a joint less surface on both sides. Because of the plain face, they are easy to clean and decorate.

The flush doors also have high strength, durability and are cheaper than the panel door. With varieties of laminates and veneers, which resembles natural wood, they look beautiful and are attractive appealing and available to a wide range of choices

- **Louvered Doors**

Louvered door is one of very old type of door. Main advantages of this door are that even when it is closed, it will admit light, air and keep up the privacy of the room. The louvered doors are used when privacy, along with natural ventilation and tranquillity for rest, is desired. The Louvers are made of glass, timber or plywood. They are different to make

- **Wire Gauzed Doors**

Wire Gauzed doors are widely used in the house for preventing the entry of insects and mosquitoes into the house. These doors are provided in kitchens, canteens, cupboards used for food storage, refreshment rooms, hotels, sweet shops etc., with a view to get light and restrict the entry of mosquitoes and other insects.

WINDOWS:

Windows are provided to give light and ventilation. They are located at a height of 0.75 m to 0.90 m from the floor level. In hot and humid regions, the window area should be 15 to 20 per cent of the floor area. It is preferable to have at least two openings in two different walls. Another thumb rule used to determine the size of the window opening is for every 30 m3 inside volume there should be at least 1 m^2 window opening.

Various windows used may be classified on the basis of materials used, types of shutters, types of openings of shutters and the position of windows. Timber, steel and aluminium are commonly used to make window frames. Timber may get termite attacks, steel may rust but aluminium does not have any such defects. However they are costly.

Shutters of windows may be panelled, glazed or louvered. Louvered windows are generally used for bathrooms and toilets where vision is not to be allowed but ventilation is required. Lower parts panelled and upper parts glazed windows are commonly used. Instead of panelled one may think of using translucent glasses. Window shutters may be fixed, centrally pivoted, sliding type or double hung.

TYPES OF WINDOWS

Depending upon the position of windows, they may be classified as:

- **CASEMENT WINDOWS**

Windows having shutters which open like doors are called casement windows. This has a frame consisting of stiles, top rail and bottom rail. The window frame is made in the same manner as a door frame except that it has a sill at the bottom. However, it may have an additional central vertical member which is called a mullion. Additional horizontal members known as transoms may also be used. The wooden frame can be made as one unit with the door frame

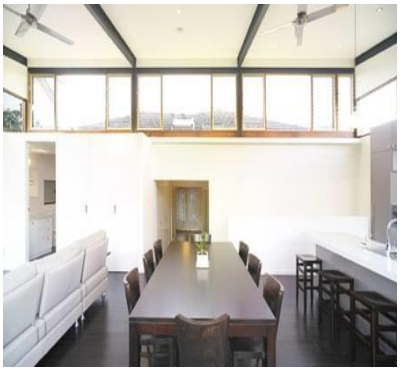
- **BAY WINDOWS**

This is a window which projects outward from the face line of the wall or a building. This gives extra floor area to the room and at the same time provides an additional space for admitting light and air into the room. A number of these windows might increase the architectural beauty of the entire house.

- **CORNER WINDOWS**

As the name suggests this type of window is essentially located in the comer of a room. By the use of this window it is possible to ensure light and ventilation from two directions at right angles to each other. In addition, it serves as an architectural feature for improving the elevation of the building

- **CLEAR STORY WINDOWS**



This type of windows are used to achieve better ventilation and cooling effect in the living or main rooms of a building, which have a ceiling height greater than the surrounding room. Clear-storey windows are provided near the top of the roof of the main rooms, and they open out above a lean-to-roof or the roof slab of the adjoining veranda

- **GABLE WINDOWS**

The window provided in the gable end of a pitched roof is known as a gable Window. Gable windows are provided in the gable portion of the building. They are required in the stair cases or in the halls with gable walls

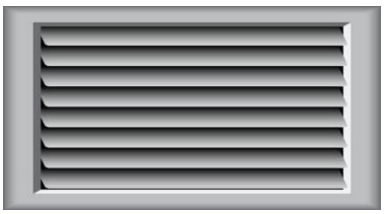
- **SKY LIGHT WINDOWS**

This is a type of fixed window provided on the sloping surface of a pitched roof, the window being parallel to the sloping surface. Sky lights are provided with a view to permit the room below to be fully lighted with natural light. The opening for the sky light is made by cutting the common rafter suitably

- **DORMAR WINDOWS**

It is a vertical window built in the sloping side of a pitched roof. This window is provided to achieve proper ventilation and lighting of the enclosed space below the Roof. Dormer also provides architectural feature for the building

- **VENTILATORS**



Ventilators are provided close to roof level or over the door frames. They help in pushing out exhaust air. They may be provided with two split and separated glasses or with hung shutters.

CONCLUSION

Nowadays, Flush door, panel door and glass doors are the common types used in the house. The doors play a pivotal role in anchoring the safety of the house and also protecting your health. The doors are regarded as the face of any house; hence, they must be given utmost importance like all other elements that beautifies a house. And of course, its pleasing appearance will always keep you in good moods. Information regarding the types of doors will help you to

make the right choice of the door- be it your house, your office, your workshop, shop or any other commercial building.

To conclude the whole thing, we can say that the choice of doors ultimately depends on the following factors:

- It must satisfy the intended function
- Ensure privacy, safety and security
- Easy to make and use
- Aesthetic look and appearance
- Future repairs and maintenance
- Budget
- Future life
- Fire resistance, insulation properties etc.

RESULT:

- Study & present important types of doors, windows and Ventilators in general use has been done

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WEEK 05 PRACTICE 02

AIM: Prepare a process manual for installation of doors, windows and Ventilators.

THEORY:

Installing a door can be a tricky job, and you need to make sure you do it right because if you don't, you may find the door isn't level or that you can't open or close it properly. For this reason, you need to know the correct steps to follow to make a success of the project. Having said that, if you know what you're doing, you have the correct tools to do it and you are careful to do each step properly, most people with a reasonable amount of DIY skill should be able to manage. And if you're looking for a step-by-step guide, here's how to install a door. If you want a preview of some of the things we're going to be talking about – as well as a lot of practical extra hints and tips – you can check out this highly informative video before reading on.

STEP BY STEP ON INSTALLATION OF DOOR

1. **Remove The Old Door And Frame:** The first step is to remove the old door and frame if it is still there. Start by removing the old lock and hinge pins so you can lift the door out the frame. Next, pry off the old trim and remove the jambs and header. What you are left with is a gap in the wall known as the rough opening.

   Pro tips: The sides of the door are known as the "jambs", which comes from the French word for leg, jamb. You may sometimes hear people call the top of the door the "top jamb", but this doesn't make any sense – we don't have legs on our heads! The correct name for the top part is the "header", while the bottom is known as the "sill".

   Pro tip: Place the putty knife between the wall and the pry bar. This will protect the wall from damage, and you won't need to repair or repaint it after.

2. **MEASURE AND LEVEL THE ROUGH OPENING:** Before you buy a new door, you need to check the dimensions of the rough opening. It may surprise you to know the sides are not always completely straight ("plumb"), the gap between the sides at the top and the bottom might not be the same and the floor might not be level.

   For this reason, you need to measure and level everything carefully at this point before you continue. Measure the height of the rough opening and measure the width at the top and the bottom. Next, you should also check the sides of the rough opening to see if they are level. They probably won't be perfect, but you need to know how much difference there is since this will allow you to make sure the door you want to install will fit.

   Pro tip: If possible, it is better to take these measurements before you buy your door. This way, you can be sure that you buy a door with the correct dimensions.

3. **CHECK THE SILL:** The next step is very important. To ensure the door fits properly, you need to check the sill. If the floor isn't level, the door won't open and close smoothly, so you need to check this out before moving on. If the floor isn't level, raise the levelling tool by placing wooden shims underneath it at the lower end until it is level.

   Measure the height of the shims you needed to use (or the height between the level and the floor). This is the amount you will need to remove from the bottom of one of the door jambs for the door to function properly.

4. **ADJUST THE JAMB ACCORDING TO THE MEASURMENT YOU TOOK:** The measurement you just took tells you how much higher the floor is at one side of the door compared to the other. You now need to adjust the door jamb by removing this amount from the bottom. Be careful that you cut the correct jamb. The one that will be on the side where the sill is higher is the one that needs to be shortened. If you cut the wrong one, you will then have to take twice as much off the other side to correct it, and if you do this, it will probably mean the jambs no longer fit correctly in your rough opening.

   Pro tip: You can use a manual saw or a circular saw to cut the jamb. If you use a circular saw, use a blade with a larger number of teeth to minimize splintering the wood as you work.

5. **SECURE THE FRAME WITH SHIMS:** You now need to secure the door frame in place using shims. Place one wooden shim on the hinge side of the door and place another behind the hinge attachment in the door frame. After this, work around the frame adding more shims at various points to ensure the door is held firmly and securely in place. As you work, keep measuring with the level and continue adjusting until the frame is plumb.
   Pro tip: This part of the work can take a bit of time, but it is important to work carefully and make sure you get it right because the door fitting correctly depends on it.

6. **SCREW THE FRAME INTO PLACE:**

Once you have got the frame into place, you can now use screws to fix it in place. Use screws at each location where you placed the shims to fix the whole thing securely. You can also put shims where the hinges go. This way, you can then screw them in with longer screws, giving them an extra level of strength and rigidity.

7. **SET THE DOOR IN PLACE AND TEST IT:**

You can now set the door in place. Set the door on the hinges, using shims underneath to support it as necessary. Insert the hinge pins and knock them in with a hammer if you need to. You can now test the door to see if it opens and closes correctly. Ideally, you want around a 1/8" gap at the top and along the strike side while you are looking for a 1/16" gap on the hinge side. If the gaps are much different from this, you will need to take the door down and make the necessary adjustments. Keep adjusting it as required until you get it just right.

Pro tip: Sometimes you might have trouble getting the hinges on the door to line up. If this happens, you can loosen the screws slightly to give yourself a bit more play. This will allow you to get the hinges lined up, after which you can tighten the screws again.

8. **FIT THE TRIM AND FINISH UP:**

If the door is in place and opens and closes correctly, you can now fit the trim and finish up. Sand the trim lightly and paint as required. You may also need to fit the doorknob, in which case you can do this now.

Extra Pro Tips for Installing A Door

Here are some extra pro tips that will help you make a success of the job.

- **Choose a pre-hung door if possible:** If you choose a pre-hung door, it will make the job slightly easier. With a pre-hung door, you just need to concentrate on making sure everything lines up and taking care of the shimming, making it easier to achieve a successful fit.
- **Insulate external doors with expansion foam:** It is a good idea to insulate external doors by filling the gap between the rough opening and the doorframe with expansion foam. Apply the foam with a specially-designed expansion foam gun. The trick is to use just enough so that it fills the gap but not too much so that it expands and spills out of the gap. This is something that will probably take a bit of practice, so start off slowly until you get used to it.
- **Caulk the joints:** When fitting the trim, you may also consider adding caulking to hold everything more securely in place and also to create a seal between the trim and the wall.

RESULT:

- process manual for installation of doors, windows and Ventilator has been prepared

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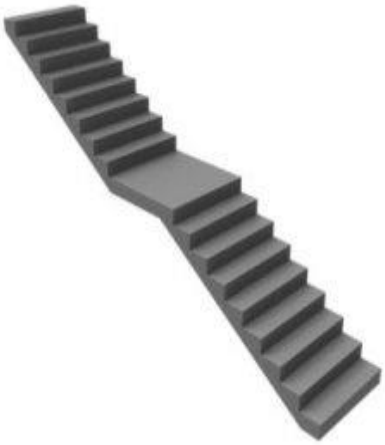
WEEK 06 PRACTICE 01

AIM: Study and present different types of stairs.

STRAIGHT STAIRS

These are continuous stairs along which there is no change in direction on any flight between two successive floors. The stair may consist of either one single flight or more than one flight (usually two) with a landing. These types of stairs sometimes have only 1 flight of stairs. These stairs are used for houses where there are restrictions in available width for its location, but enough length is available. As there is no change in direction, risers facing the ascending person cause uneasiness and monotony. Straight flight stairs with a landing may further increase the length of stairs and had very little advantage.



Advantages of Straight Stairs:

- Straight stairs tend to be the easiest to go up and down, or, ascend/descend, as we say in the industry.
- They are typically the easiest to build, however, this depends a lot on the level of detail in the design.
- Straight stairs only need to be connected at the top and the bottom (no intermediate supporting structure is required).
- They work well with minimalist designed homes due to their inherent simplicity.
- By selecting thinner treads, open risers, and thin metal stringers, straight stairs can be made more transparent than other types of stairs, allowing less obstruction to the view beyond.
- No landing is required if the number of risers is kept under 16 or the overall vertical height is less than 12 feet.
- It's relatively easy to build railings and handrails for straight stairs.

- Measuring for railings for straight stairs is simpler than for other stair designs.

Disadvantages of Straight Stairs:

- Straight stairs use up a fair amount of linear space, which has to be planned for in your design.
- Some of the other stair types create a privacy barrier between the floors of your home. Straight stairs do not offer this privacy.
- A stair 12-feet high requires a landing to break up the span. The addition of a landing will use up a lot more space and therefore these types of stairs are seldom used in residential construction. You will see these more frequently in large commercial buildings.

L SHAPED STAIRS:

The L shaped stair is a variation of the straight stair with a bend in some portion of the stair. This bend is usually achieved by adding a landing at the transition point. The bend is often 90 degrees, however, it does not have to be. If the landing is closer to the top or bottom of the stairs it is sometimes referred to as a long L stair or a quarter turn stair.

Advantages of L Shaped Stairs:

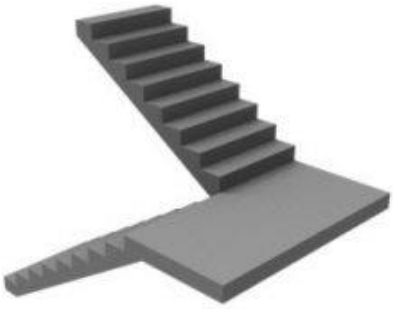
- L shaped stairs can be more visually interesting.
- They provide a visual barrier between floors so, they can add some privacy.
- L shaped stairs can help somewhat with sound transmission between floors if the stairs are contained within walls.
- Some believe they are safer than straight stairs as the central landing reduces the number of treads one could fall in a given flight.
- The landing can provide a place to stop and rest while ascending.
- They can be located in a corner of a room if this works better for your design.

Disadvantages of L Shaped Stairs:

- L shaped stairs are a bit more difficult to build than straight stairs.
- A support is typically required for the landing in an L type stair. Often, this is built into the surrounding walls so it goes unnoticed. In modern dwellings, however, it is usually desirable to open up the space by leaving the stair structure visible. In these cases, the supporting structure can be visually minimized by taking advantage of the strength of steel to create slim supporting members. Through careful engineering, it is possible to eliminate the landing support altogether.
- Handrails for these types of stairs require more skill and planning to construct than handrails for straight stairs.
- In climates where basements are used, stairs are typically stacked over each other for efficient use of space. Since basements are often used for storage, large items can be difficult to move in and out of the basement.

U SHAPED STAIRS

U shaped stairs are essentially two parallel flights of straight stairs joined by a landing that creates a 180-degree turn in the walk line.



Advantages of U Shaped Stairs:

- U shaped stairs can be easier to fit into an architectural plan.
- They offer some architectural interest.
- The landing(s) can offer a resting point partway up the stairs.

Disadvantages of U Shaped Stairs:

- These types of stairs are a bit more difficult to build than simpler stair types.

WINDER STAIRS

Winder stairs are a variation of an L shaped stair but instead of a flat landing, they have pie-shaped or triangular steps at the corner transition.

Advantages of Winder Stairs:

- The main advantage of winder stairs is that they require less space than many other types of stairs. They are very common in older homes and often used as a secondary staircase. For example, they are common in homes where the grand staircase is in the entryway. In these cases, the winder stair is often used as an access to the kitchen.
- They have more visual interest than other stair types. Winder stairs seem to create a more seamless transition, visually, as they meander around corners. For this reason, they have gained popularity in modern homes. Their compactness has also made them attractive in sustainable home designs.

Disadvantages of Winder Stairs:

- Winder stairs are a little harder to navigate than L stairs.
- It can be more difficult to add a handrail to these than some of the other types of stairs.
- Like with L shaped stairs, a center support is typically required

SPIRAL STAIRS:

Spiral stairs follow a helical arc. They usually have a very compact design and the treads radiate around a central pole.

Advantages of Spiral Stairs:

- One of the key advantages of spiral stairs is their compactness. They are very popular on beach front decks where space is at a premium. They are also used extensively on city lofts for the same reason.
- Spiral stairs can be attractive and there are many variations on railings styles which can have a major impact on the overall appearance of the stair.

- Since the center pole and landing typically provide the structural support for the stairs, they do not need much in the way of extra support structures, making installation easier than with many other types of stairs.

Disadvantages of Spiral Stairs:

- Spiral stairs are more difficult to navigate than other types of stairs. It is for this reason that codes do not allow them to be used as the primary access to a full second floor of a home. Walk ability improves as the outside diameter gets larger, so if you have space, you may want to consider going a bit larger. We recommend going 5 feet in diameter if you can.
- It is difficult to carry large items up spiral stairs.
- Only one person can go up or down the stairs at the same time.

CURVED STAIRS:

Like spiral stairs, curved stairs follow a helical arc. However, they tend to have a much larger radius and typically do not make a full circle. Curved stairs add elegance to any home or business. For this reason, they are almost always located at the entry where they make the best first impression.

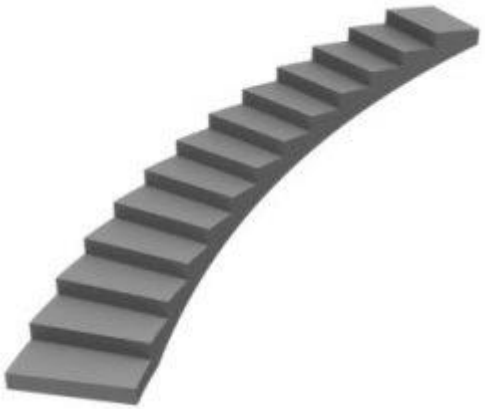
Advantages of Curved Stairs:

Curved staircases are often very elegant and traditional but this type of design can equally be adapted to contemporary architecture.

They are relatively easy to walk up if the radius is large.

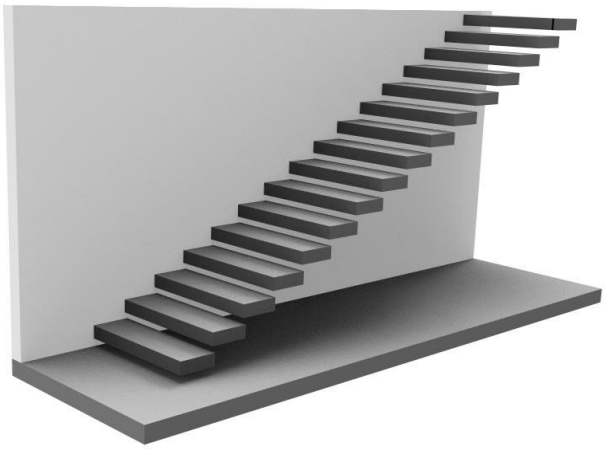
Disadvantages of Curved Stairs:

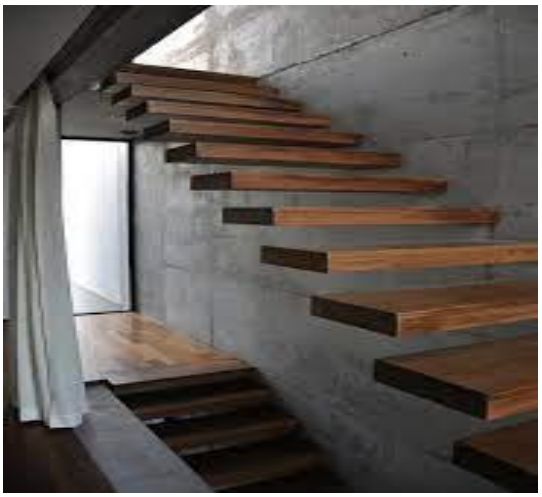
Curved stairs are by far the most difficult to build of the various types of stairs. In fact, building curved stairs represents a pinnacle of achievement for any stair builder or fabricator. For this reason, they are the most costly to build.



CANTILEVER STAIRS:

Cantilever stairs are made to have the stair treads appear to be floating in the air without support. The stair stringer will be attached to one end of the treads and can be hidden or exposed. Cantilever stairs add interest and spaciousness to any room.





Advantages of Cantilever Stairs:

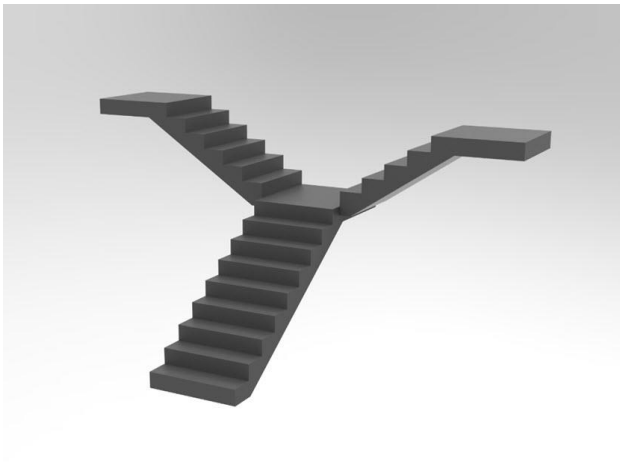
- Cantilever stairs create more visual interest and are more unique than other types of stairs
- The stringer is typically located to one side or hidden in the wall which can allow for more headroom
- Cantilever stairs create a more open and spacious aesthetic to the room

Disadvantages of Cantilever Stairs:

- The design of the structure needs to be taken into consideration to support the cantilever stairs.
- Tread supports need to be designed to handle the weight and potential torque.
- Cantilever stairs are more costly than a typical mono-stringer stair due to additional structural requirements.

SPLIT STAIRS:

Split Stairs are also known as bifurcated stairs typically have a wide set of stairs starting at the bottom that ends at a landing partway up the flight. The stairs split at the landing into two narrower sets of stairs leading in opposite directions. .



Advantages of Split Staircases:

- Split stairs allow one staircase to function as two, by leading up to different sections of the building making each end of the upper level easily accessible.
- They add an impressive architectural design statement to the building.
- Typically used in large homes or commercial buildings as a Grand Entry. They are suitable for interior or exterior locations.

Disadvantages of Split Staircases:

- Split stairs require a significant amount of space. This space requirement will need to be considered in the design of the building.
- Split staircases are more expensive than most stairs.

LADDERS

Ladders, like stairs, can serve as a means of access. However, building codes do not allow ladders to serve as a primary means of access. Keuka Studios can design custom ladders for applications such as libaries, lofts, and docks.

Advantages of Ladders:

- Ladders are the most compact way to get from one floor to another.
- They are very cost-effective due to their simple design.
- Ladders may have wheels or fold up to move them out of the way when not in use or to prevent access.

They can be used to access shelves that would be too high to reach normally.

Disadvantages of Ladders:

- Ladders are the most difficult to navigate than stairs, especially while descending.
- Ladders cannot be used as a primary staircase.

RESULT:

- Study and present different types of stairs has been done

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WEEK 06 PRACTICE 02

AIM: Prepare a process manual for construction of stair cases, ramps and lift pit

Ramps are of great importance in any high-rise building. Ramps provide safe access to the building for heavy materials such as heavy machineries. In many countries the construction of a ramp in a building is made compulsory by law abiding bodies to provide safe and convenient access to people with disabilities as by the help of ramps carrying people on wheel chair is much more convenient. While it provides a multitude array of benefits as ramps are useful for strollers, wheelchairs, and any moving device with wheels, it may sometimes cumbersome and looks irrelevant with the design of the building that cause challenges for the architectures.

There are different principles of constructing a ramp, but for a very long period of time one of the most durable, is the concrete ramp. Due to the toughness of concrete it provides strong cohesion that supports heavy materials load and provides a surface that controls traction and maintains grip for the wheels to move over.

When it comes to high rise building and other skyscrapers the role of a concrete ramp is of great assistance. A concrete ramp can offer comprehensive solution for moving heavy materials in and out of the building and creating assistance for disable people to get their wheelchairs in or out. The mechanism for constructing a ramp may sound very simple but it is surely the most effective.

The construction process is based on the principle of pouring concrete in the mold which is ramp shaped. The mold takes the shape of a slab that is used to create ramps. A wooden frame is made and kept over compacted gravel. The wooden frame is filled up to the top level and then removed after drying. Pieces of plywood are used to cut an angle along the top of the frame those results in slop construction.

One of the most crucial factors of concrete shaping is the use of a stiff mixture. The perfect proportion of water in concrete is very crucial. Is the water level gets high the concrete will slump down and makes the surface uneven. Best Practices is to flatten the form while filling and pouring into the mold. It minimizes the chance of slumping and provides an even texture and uniformity. Flattening the concrete by the help of a float in a bottom up direction reduces granules to form making the concrete uneven. The amount of concrete and water in the mixture may vary according to the length of the concrete. The length of the ramp is based on the requirements, longer the length of the slope the more gently it is. Ramp that are designed for disable people and are made with non-slip, traction control characteristic for easy, safe and convenient movement of wheel chair.

THE CONSTRUCTION PROCESS

- **THE SUB-BASE OF THE RAMP:** The sub-base is the most important building block of ramp. It supports the entire load and hence it should be strong enough to support the overall weight of the ramp. If your ramp is consuming 4 inches of compacted gravel the appropriate proportion will be ¾ Inch of plywood and 2 x4 lumber. It is important that the side pieces are identical and applied to the same level with each other.

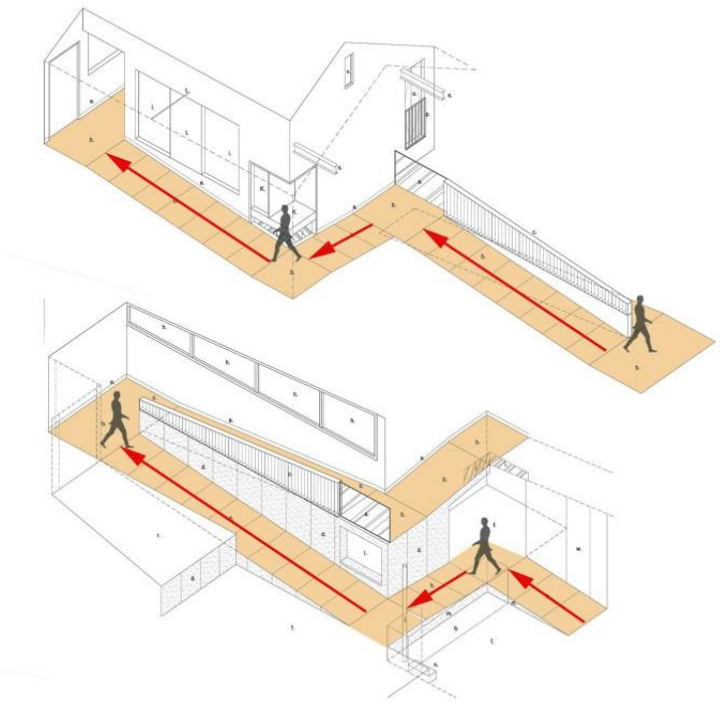
- **BRACING THE FORM:** Make sure that the level remains identical. If any of the ramp walkways meet with any slab, or other structures. It very important to isolate it by a wooden piece that acts as a juncture.

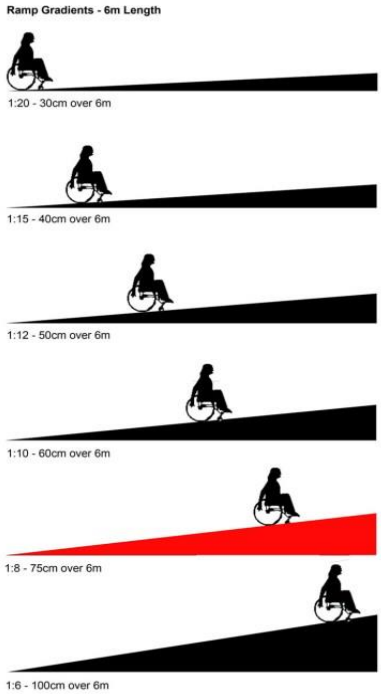
- **ADEQUATE MIXING OF THE CONCRETE:** The concrete should be mixed with proper amount of water. IT should not be dry or wet more than the recommended level. Fill the form in the mold and by the help of a float spread the mixture evenly. By the help of shovel settle the concrete to avoid any slumping.

- **A GENTLE ROUNDING OF THE EDGES:** The best looking ramp is one that has smooth edges. By the help of a edger smoothen and brooms the edges of the ramps making it non-slippery. To make the ramp strong moist cure it for at least a week, the wooden form can be removed after 4 days.

SOME IMPORTANT FACTORS

- **SLOPE:** Slope is the backbone of any ramp. A ramp can only be accessible by the help of slope. The optimum ratio of the slope with the ground should be 1:20; this representation shows that the slope should be inclined one inch for every twenty inches of a flat surface to provide maximum convenience.





- **THE DIMENSIONS:** The length of the ramp should be long enough to provide gentle movement and the width should be enough to easily accommodate moving objects. The minimum width for a small ramp is 36 inches inside the handrails. The optimum width for a ramp is 48 inches.

- **LANDINGS:** An ideal ramp should have an identical ramp inclination at both the sides. Every opening and closing door of a ramp should also have a landing. These landings are of great importance to maintain balance while opening doors and manipulating materials.

- **HANDRAILS:** When it comes to support and safety handrails provides safety barriers to the user of the ramp. Moreover it serves as a balancing aide and offers means of propulsion for wheel chairs that are manual. For maximum support handrails should be smooth and continuous. Handrails should be provided on both side of the ramp to facilitate many users at one time.

- **EDGE FINISHING:** It is very important for ramp to get it edges finished. Edge protection is also commonly known as crutch stop that allows safety of people against getting of the ramp. The optimum edge protection of the ramp should be minimum four inches.

RESULT:

- Process manual for construction of ramp has been prepared

REFERENCES

1. https://theconstructor.org/practical-guide/ramps-design/164670/
2. https://civilblog.org/2016/06/28/insight-concrete-ramps-buildings/

WEEK 07 PRACTICE 01

AIM: Prepare a check list & Process manual for scaffolding.

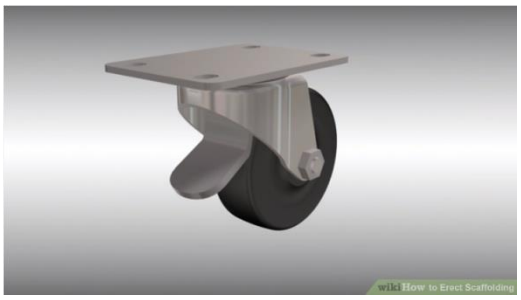
OBJECTIVE:

Objective of this procedure is to provide the mandatory requirements and safe practices required for scaffold erection, modification, dismantling, use and storage. This Procedure should be used in conjunction with local regulations, consensus standards which help to achieve safe scaffold erection and use. Scaffolding is often a necessary part of building and home maintenance. Set up scaffolding properly to make sure you and anyone else using the equipment stay safe. An oversight in erecting scaffolding could lead to a serious accident. Setting up scaffolding is an alternative to using ladders. A benefit of using scaffolding is the larger work area and mobility it offers over that of a ladder. It provides a platform for walking and for setting all your tools. This cuts work time drastically.

PROCESS MANUAL

- **SELECT A SECURE FOUNDATION ON WHICH TO BUILD AND SET YOUR SCAFFOLD:** Obtain mud sills or base plates to attach the scaffolding to make the footing more stable. One of the main concerns here is to have the scaffolding level and on secure ground. If you are on unlevel ground, you may need to dig down to make the dirt level in any high corner. Also, use the adjusting screws on the scaffolding to level the structure. If the surface is on a drastic slope, obtain leg extensions.
- **OPT FOR CASTERS:** If you plan on moving your scaffolding to work on various spots, include casters in your scaffolding setup. Remember to lock the casters when you get it into place.
- **ASSEMBLE THE SCAFFOLDING FRAME:** Lay out the ends of the scaffolding. Lift one end piece, and attach the upper cross brace. The far end of this brace should support the end piece while you lift the second end piece and attach its upper cross brace. Secure the ends of the cross braces to the bottom of the opposite end frame.
- **MAKE SURE THE SCAFFOLD IS STABLE:** Move the scaffold into your desired position, and make sure it is level and secure.
- **PLACE THE PLANKS:** Lift the planks through the scaffold bars and into place. Hardware should be included to fasten the planks into place.
- **SECURE ACCESS TO THE SCAFFOLD**: If ladders are used to access the scaffold, use ones that are designed for that specific scaffold. Stair-like ladders can be used to access the scaffold but must have handrails and treading. A concern with the access point is to make it safe to manoeuvre and to prevent the scaffold from tipping over.

- **ATTACH THE GUARDRAILS**: Guardrails are highly recommended for all scaffolding due to the height of the equipment and the risk of falls. Also consider using tie offs and other fall protection.
- **INSPECT THE SCAFFOLDING TO ENSURE SAFETY:** Thoroughly examine the scaffolding setup to make sure all pieces are secure. Reinspect the scaffold system every time you leave the site and return to it to make sure it is still safe.

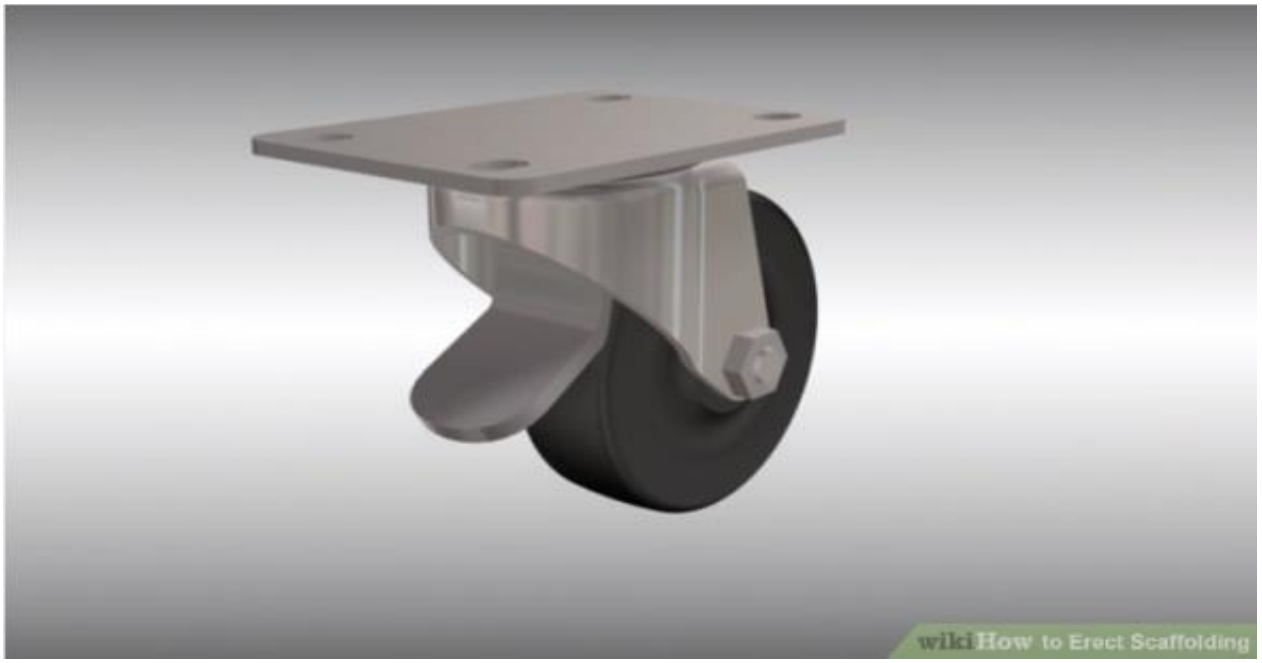









wikiHow to Erect Scaffolding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wikiHow to Erect Scaffolding


wikiHow to Erect Scaffolding

CHECKLIST FOR ON-SITE INSPECTION			ACTIVITY:SCAFFOLDING	
SN	**ITEM**	**YES**	**NA**	**REMARKS**
1	Name, Date & Number of drawing			
2	Has this work location been examined before the start of work operations and have all the appropriate precautions been taken? (e.g., checking for overhead objects, falling or tripping hazards, uneven ground)			
3	Has the scaffold been setup according to manufacturer's instructions?			
	GENERAL RULES FOR ALL SCAFFOLDS			
4	Scaffold components can support at least four times their maximum intended load.			
5	Scaffold is fully planked with no more than 1" gap between planks.			
6	Platform is at least 18 inches wide.			
7	Guardrails are used if work height is >6 feet. Guardrail system includes: Toprail / Midrail / Toeboard / Posts			
8	Scaffold is 14" or less from face of work (if guardrails are removed).			
9	Planks do not extend past the ends of the scaffold frames more than 6 inches unless cleated.			
10	Work platform is free of clutter, mud, oil, or any tripping hazard.			
11	Scaffolding is more than 10' from any power line.			
12	If any piece of scaffold is defective, it has been removed from serve and tagged.			
	RULES FOR SUPPORTED SCAFFOLDS			
13	Height to base with ratio is less than 4:1 (no braces required)			
14	If ratio is more than 4:1, scaffolds are restrained from tipping by tying or bracing.			
15	All scaffold frames and uprights use base plates, (mudsills if on dirt).			
16	Footings are level, sound, and rigid. No settling has occurred.			
17	Unstable objects such as blocks, bricks, buckets, etc. are not used as work platforms or to support scaffolds.			
	GENERAL RULES FOR ACCESS			
18	End frames used for access have rungs lined up vertically for the entire height of the scaffold.			
19	There is no more than 2' step up or down or a 14" step across to get on or off a platform.			
20	First rung of the ladder is not more than 24" above the ground.			
21	Ladder's rung length is at least 8".			
22	Cross braces are not used for climbing up or down from the scaffold.			

CHECKED BY **APPROVED BY**

RESULT:

- Check list & process manual for scaffolding has been prepared.

REFERENCES:

1. **https://www.tatapower.com/pdf/sustainability/safety/Scaffold-safety-procedure.pdf**
2. **https://www.wikihow.com/Erect-Scaffolding**
3. **https://www.youtube.com/watch?v=HjZhPOF4ukM&t=62s**
4. **https://www.mvhabitat.org/clientuploads/pdf/Safety/Scaffold%20Inspection%20Checklist.pdf**

WEEK 08 PRACTICE 01

AIM: Study and present the tools and components used for form work.

Formwork is temporary support given to concrete until it gains strength to withstand its self weight. Formwork shall be so designed to support safely the worst combined effects of all loads within acceptable dimensional tolerance and without causing bulging or deflection. Formwork should be:

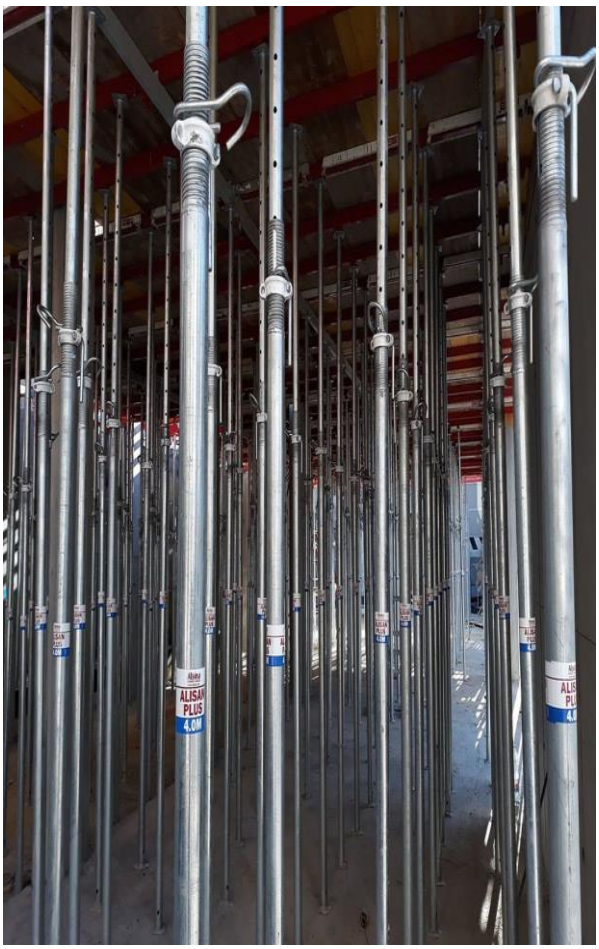
- Strong enough to bear the self-weight of formwork, wet concrete, reinforcement, and dynamic effects of placing and compacting, construction traffic and wind load. Water tight to avoid grout loss.
- Easily removable without any damage and should be re-usable.
- It should be dimensionally accurate and give the desired finish to the contact surface.
- Always use staging of MS tubes with timber runners. The staging should be placed on hard even surface. If placed on ground compact it and use planks under the base plate to distribute load. Base plates should not be placed on concrete blocks or bricks, which are likely to get crushed when wet.
- Staging shall be true, rigid and thoroughly braced, shuttered and propped.
- To achieve desired rigidity ample studs, braces, bolts, spacer blocks and stay wire to be given to avoid distortion.
- Check the shuttering work for vertical and horizontal alignment, level, surface cleanliness, water tightness, and ability to withstand loads without distortion.

TOOLS TO BE USED BY TRADESMEN

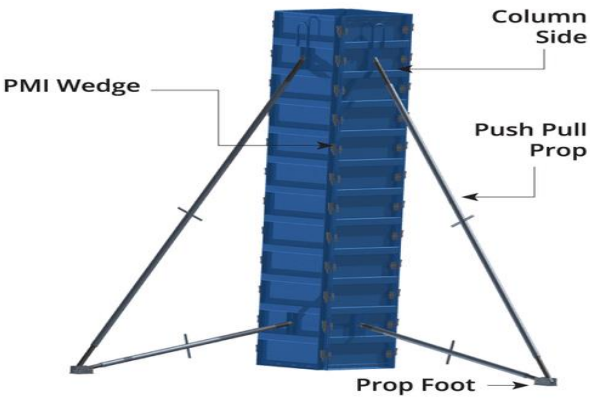
Required tools must be available at site to ensure correct work. Basic tools of the shuttering gang are:

- Shuttering material - Props, Cup locks, C-clamps, Base plates, U-heads, Tie rods, Arco-spans,
- Runners, Jacks and Column boxes
- Hammer
- Line dori
- Hand saw
- Spirit levels
- Tube levels
- Plumb bobs

- Measurement Tape
- Aluminum straight edge
- Right angle
- Chipping Tools
- Crowbar



Props are auxiliary elements that support a horizontal formwork system and position it at the required height in each case. As load-bearing elements, they are responsible for transmitting to the ground the loads they receive when the structure is concreted, and act as support until it is put into service, once it has reached the necessary strength to absorb the necessary stresses. They are height-adjustable and telescopic. They are generally comprised of two hollow cylindrical bodies which facilitate regulation, one inside the other (body and shaft). In some cases, as a complement, they may have a locking system to prevent the shaft from separating from the body, as well as an unloading system to facilitate removal and disassembly.



Column box shutters are specifically designed to withstand the higher pressure associated with the vibration of concrete in a confined space.

There are basically three types of columns boxes, A-Type, C-Type and Circular boxes. Corner Chamfers can be built into the shutter.

Curved Claw Solid Steel **Hammer** provides unsurpassed balance and temper. The head and handle are fully polished and forged in one piece. Exclusive Nylon Shock Reduction Grip is moulded on, and offers the utmost in both comfort and durability, while reducing vibrations caused by impact. Its longer handle gives greater striking power

Line Dori is a wire or thread used to align the wall, beam, and other building elements during construction

A **spirit level**, bubble level or simply a level is an instrument designed to indicate whether a surface is horizontal (level) or vertical (plumb). Different types of spirit levels may be used by carpenters, stonemasons, bricklayers, other building trades workers, surveyors, millwrights, and other metalworkers, and in some photographic or video graphic work

It is used to place the object at the right angle (90 degrees). It is also used in the layout of the wall to set the corresponding wall at the right angle to each other. It is also used to set the Skirting at the right angle with respect to Floor.

It is used to provide vertical datum lines for the building measurements. It is used to check the Verticality of Column, Wall or any other Flat Vertical Surface. A plumb bob can be used to mark a reference point above or below a given point

Level pipe tube is used to transfer the existing level from one place to another. It is also used to check all points of the wall are at the same level or not

Hand Saw offers superior performance with its hard point, razor sharp, triple ground teeth, for fast and accurate cutting on both push and pull strokes. Ergonomic handle for added comfort

A **crowbar**, also be known as a pry bar, wrecking bar, gorilla bar or pinch bar, is a metal bar tool that has flatted points at each end, often with a small fissure to help remove nails or prise two materials or objects apart. One end of the bar is curved into a hook shape, which is a first-class lever and is usually the end most commonly used, and the straighter flat end is a second-class lever.

Crowbars are usually made from medium carbon steel to offer sustained strength and durability, but can also be made from titanium, which creates a lighter tool.

A short steel tape measure or steel **measuring tape** is a flexible ruler and used to measure distance. It consists of a metal blade with linear-measurement markings, pocket protective case, stopper button, belt clip, end hook and hand stripe. It is a common measuring tool

RESULT:

- Study of tools & components used for form work has been done.

REFERENCES:

1. Technology manual by Shobha construction Pvt.Ltd.
2. **https://www.alsina.com/in/props-for-construction-3-questions-to-choose-the-most-optimal/#:~:text=Props%20are%20auxiliary%20elements%20that,required%20height%20in%20each%20case.**
3. **https://staluform.co.za/products/column-boxes-push-pull-props.html**
4. **https://learningtechnologyofficial.com/basic-instrument-used-in-civil-construction/**
5. **https://ph.rs-online.com/web/c/hand-tools/hammers-demolition/crow-bars/**

WEEK 8 PRACTICE 02

AIM: Prepare check list & process manual for different types of form works.

PROCESS MANUAL:

- Formwork is temporary support given to concrete until it gains strength to withstand its self- weight.
- Formwork shall be so designed to support safely the worst combined effects of all loads within acceptable dimensional tolerance and without causing bulging or deflection. Formwork should be:
    - Strong enough to bear the self-weight of formwork, wet concrete, reinforcement, and dynamic effects of placing and compacting, construction traffic and wind load.
    - Water tight to avoid grout loss.
    - Easily removable without any damage and should be re-usable.
- It should be dimensionally accurate and give the desired finish to the contact surface.
- Always use staging of MS tubes with timber runners. The staging should be placed on hard even surface. If placed on ground compact it and use planks under the base plate to distribute load. Base plates should not be placed on concrete blocks or bricks, which are likely to get crushed when wet.
- Staging shall be true, rigid and thoroughly braced, shuttered and propped.
- To achieve desired rigidity ample studs, braces, bolts, spacer blocks and stay wire to be given to avoid distortion.
- Check the shuttering work for vertical and horizontal alignment, level, surface cleanliness, water tightness, and ability to withstand loads without distortion.
- **SCAFFOLDING:** At the ground level, walk round the perimeter of the scaffold and check for
    - Subsidence of the ground
    - Cavities underneath sole plates
    - Dislocation of base plates

  Rectify with adjustable base plates or fill with concrete. Do not use Casarino poles/ Bamboo as struts or supports.
- **GUARDRAILS AND TOE BOARDS:** Both guardrails and toe boards should be fixed to the inside of the outer standards and remain in position before decking is removed. Guardrails should be fitted at not less than 0.9m and not more than 1.15m above the

decking. Toe boards should be at least 150mm high above the decking and the clear spacing between the guardrails and the boards should not exceed 0.75m.

- **FORMWORK OIL:**
  - The formwork oil basically serves the purpose of a separation medium. It acts as an intermediary that avoids any damage to the concrete. It also helps keep the formwork clean and ensures easy maintenance. The application of oil should be done with the help of foam or a similar soft medium and should be applied within 48 hours prior to concreting.
  - Machine oil or used oil is totally unsuitable and is unacceptable at any cost due to the chemical reaction this type of oil has on concrete. Clefts created will have a telling effect on the external and internal plastering, with the plastering tending to peel off.
  - It is recommended to use formwork oil of a reliable manufacturer. There are also alternative sources available that serve the purpose, which maybe an expensive proposition e.g., Natural oils such as Rapeseed oil, Sunflower oil, etc.
- All spans in excess of 5 meters for beams and slabs should be kept within a pre camber of 2mm per 1 meter. For cantilever, give a camber at the end of span of 4mm per 1 meter.
- The quality of finished concrete is dependent on the quality of formwork.
- Erection of casing and shifting of formwork shall be done under the personnel supervision of a competent foreman.
- Striking time for formwork is as follows under normal conditions. Walls, Columns, Starters etc – 24 hours
  - Slab (span< 6mts) – 7 days Beam (span < 6mts) – 14 days
  - Slab beam (span > 6mts) – 21 days Props to cantilever – 28 days
- For balcony and other rib beams, duct beams support should be continuous for at least 3 floors.
- Due to weather conditions if the concrete is not sufficiently hardened, the striking time to be extended after discussing with the project in charge.
- Obtain the 7th day cube test result before the removal of formwork.

CHECKLIST FOR ON-SITE INSPECTION			ACTIVITY: FORM WORK	
SN	**ITEM**	**YES**	**NA**	**REMARKS**
1	Name, Date & Number of drawing			
2	Are the latest "Good for Construction" drawings available?			
3	Is adequate quantity of shuttering material available?			
4	Has the required barricading and safety measures been taken?			
5	Are safety measures required for the neighbouring construction activities?			
6	Is the area compatible with the drawings that areprovided?			
7	Has the shuttering material been properly cleaned beforeuse?			
8	Is the foam strip around the column starter in place to avoid slurry leakages?			
9	Does the level of the slab and beam shutteringcorrespond to the levels given in the drawing?			
10	Has the shuttering been checked for proper fixing andsufficient support for concreting?			
11	Is the shuttering checked for vertical and horizontalalignment?			
12	Are the required tools available?			
13	Are the beam bottoms of inverted beams fixed at rightangles?			
14	Are all the required cut outs and shaft openings in place and checked for correct measurement?			
15	Have the peripheral areas and cut outs been provided with sufficient cover blocks?			
16	Is the brown tape in place and the oil properly applied?			
17	Is the deshuttering time as per specification and done in an orderly and safe manner?			
18	Has the consultant inspected the formwork beforeconcreting?			

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RESULT:

- Check list & process manual for cement plastering has been prepared.

REFERENCES:

1. Technology manual by Sobha construction Pvt.Ltd.

WEEK 9 PRACTICE 01

AIM: Prepare a checklist & process manual for construction of different types of RCC roof.

PROCESS MANUAL FOR REINFORCEMENT:

GENERAL INSTRUCTIONS

- Start reinforcement works with proper "Good for Construction" drawings and general specifications as issued by the consultant.
- Make a stage-wise BBS (Bar Bending schedule) on the computer before indenting for steel.
- IS codes such as IS 456, IS 1786, IS 2502, SP 34 should be available at site office at any given time for ready reference.
- Earmark the reinforcement work yard and stack yard. Care should be taken to ensure accessibility for trailers and availability of sufficient working space.
- In case of extreme site constraints, the cutting and bending can be done elsewhere and transported to site.

MATERIALS

- Mild steel bar should comply with IS 432.
- Cold worked steel high strength deformed bars should comply with IS 1786.
- Steel weighment should be done at site by the storekeeper by taking it to the nearest weigh bridge.
- Stack steel 300 mm clear of ground on SSM walls.
- Stack steel - Grade wise, consignment wise, diameter wise and length wise.
- Protect stored steel from rusting, oil, grease and distortion.
- Ensure Mill Certificate is delivered with each load.
- Binding wire shall be 16 - gauge soft annealed iron wire or 18 gauge GI annealed wire.
- Collect the rings used for bundling rods in bags and store them.
- Cut pieces/ scrap should be stored separately in an enclosed area with dunnage.
- If steel is going to be exposed to weather for a long time, give cement wash to protect it from corrosion.
- Surface rusting is good as it ensures proper bonding and should not be a cause of worry.
- Steel is tested for its chemical and physical properties. Chemical tests check for the Carbon, Sulphur and Phosphorous content, while the physical tests check the Ultimate tensile strength, Elongation, Bend and Re-bend test.
- Test frequency should be as per ISO procedure manual of SDPL.

CUTTING BENDING AND PLACING REINFORCEMENT

- Cut the rods economically to reduce wastage as per the BBS. Start laying rods only after shuttering is totally cleaned and oiled and checked for levels etc.
- Pitted, deformed, defective, corroded, cracks; splits on bend bars should not be used and rejected, removed from site.
- Neither the size nor length of the bars should vary with respect to drawings.
- Tolerance for cutting of reinforcement = +75 or –25mm, Bending Tolerance = + or – 10mm & Bar spacing = + or – 10mm
- Take extreme care while bending steel already cast partially in concrete so as not to damage the concrete around the bars.
- All laps should be 50d or as specified.
- Laps are staggered and not more than 33% of bars shall be lapped in a particular section.
- Mechanical splicing and welding of rods should be done only after proper details and instructions are available from the structural consultant.
- At time of concreting, reinforcement shall be free from mud, oil, grease, mortar dropping, mill scale or other foreign matter.
- Give spacer blocks in CM 1:2 and cured for at least 7 days immersed in water.
- Give spacers as per specifications. Generally 15mm for slab, 25mm for beam and 40mm for the footing is provided. It depends on the maximum size of aggregate, the reinforcement size and the element concreted.
- Proper end bearing of rods with required development length are the main points to check. Chairs should be placed as last operation before concreting to avoid distortion of top rod due to traffic.
- Check if dowels for columns, beams and slabs are given correctly and is of required minimum length.
- For slab reinforcement, the structural consultant should check and certify each work before concreting.
- Highlight areas of reinforcement congestion and get the bar arrangement revised to facilitate easy flow of concrete all around.
- Spacer bars shall maintain vertical distance between successive layers of bars.
- Binding wire ends after tying should be turned inside and should not stick out to the surface.
- Work should be neat, correct as per drawing and specification. A separate engineer with prior experience in reinforcement works is required to supervise works.

CHECKLIST FOR ON-SITE INSPECTION		ACTIVITY:REINFORCEMENT		
SN	**ITEM**	**YES**	**NA**	**REMARKS**
1	Name, Date & Number of drawing			
2	Is the latest "Good for Construction" drawing available?			
3	Is the area prepared for starting reinforcement (shuttering complete, cleaned, oiled, and taped)?			
4	Are test results of bars available at site before starting the fabrication work?			
5	Has the required barricading and safety measures been taken?			
6	Is the area to be reinforced compatible with the drawings that areprovided?			
7	Are the required tools available at site to ensure correct work?			
8	Is the reinforcement kept ready on wooden runners to keep themclean?			
9	Is the reinforcement free from oil, mud, grease and other forms ofcontamination?			
10	Is the overlapping ensured and the laps are staggered?			
11	Has the anchoring been checked?			
12	Are the dowels for columns, beams and slabs in place and checked for proper length?			
13	Are the required hooks fixed and is the chair height for the upper layer of reinforcement correct?			
14	Is the reinforcement done as per specification and drawing?			
15	Are cover blocks provided and fixed in a systematically correct manner and as per specifications?			
16	Have beam and column joints checked for sufficient cover blocks?			
17	Are the lock set properly mixed and the reinforcement turned intothe fresh lock set?			
18	Has the consultant inspected the reinforcement before the concreting has started?			
19	Has adequate lap lengths been provided for all the column bars?			
20	Are the steel scrap and the rings used for bundling collected in a safeplace to avoid any accidents?			

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PROCESS MANUAL FOR CONCRETING:

INGREDIENTS

CEMENT

- ✓ Use appropriate grade of cement as recommended by the consultant and confirming to IS 456:2000.
- ✓ Manufacturers test certificate should accompany each consignment and cement should be consumed within 1 month of their manufacturing date.
- ✓ Cement should be stored properly in stacks not more than 10 bags, clear from the walls by 1 meter and protected at all time from moisture. However, do not wrap the bag with polythene sheets, sweating may occur.
- ✓ Identify each lot / consignment of cement and follow a first in first out (FIFO) method of issue of bags.
- ✓ Each consignment of cement should be tested in-house for consistency, setting time, and strength.

AGGREGATE FOR CONCRETE

- ✓ For RCC works coarse aggregates confirming to IS 383 and IS 2386 having maximum size of 20mm and down.
- ✓ It should be obtained from crushed granite, trap, and basalt quarry. It should be chemically inert, rounded or angular in shape and free from dust, foreign matter and not thin, porous, laminated or flaky.
- ✓ Fine aggregate shall be gritty sand with FM range between 2.6 to 3.2, silt content should not be more than 5% and there should be no traces of salt. Aggregate with specific gravity less than 2.6 should not be used.
- ✓ If dirty, wash sand before use. Sand should be clear of organic materials.

WATER

- ✓ Water should be clean, fresh and free from oil, acid, alkali and organic matter.
- ✓ Potable water is considered good for concreting and curing.
- ✓ IS 456:2000 gives permissible limits of solids.

ADMIXTURES

- ✓ Use of admixture / additive should be done only after obtaining technical clearances from technical consultant.
- ✓ Dosage, point of application, the desired results should be clearly understood.
- ✓ Accelerators, retarders, plasticizers, integral-waterproofing compound are the additives commonly used.
- ✓ Expiry date of the chemical should be checked before use.

MIXING OF CONCRETE

IN-SITU MIXING

- ✓ Ensure adequate stock of all ingredients of concrete i.e., cement, aggregate, water and any admixture if used for the day's work.
- ✓ Use calibrated farma (calibration done once in a month) for measurement or in case of weigh batching, uses a weigh batcher machine.
- ✓ Charge the rotating drum with 25% of required water to rotate 3-4 times.
- ✓ Generally 20 to 25 litres is recommended for 1 bag of cement. The water cement ratio is kept 0.4 to 0.5. The moisture content of aggregates has to be checked at frequent intervals
- ✓ Load the hopper with ½ the coarse aggregate followed by ½ the fine aggregate. Above this the entire quantity of cement should be spread. Then half the quantity of fine aggregate followed by balanced coarse aggregate should be loaded. This type of sandwiching is done to avoid spilling of cement while discharging into the drum. Immediately after loading the drum balance quantity of water is added.
- ✓ The drum should be rotated for at least 1 ½ to 2 minutes. The rotation of the drum is about 15 to 20 revolutions per minute.
- ✓ If plasticizer is used, one litre of water should be held back. Add requisite quantity of plasticizer to the water and mix it thoroughly. This mixture is poured into the drum after the drum has rotated for about one minute. The drum should be rotated for at least 1 minute after adding the plasticizer mixture to ensure proper dispersion.
- ✓ Minimum cement content per cum of concrete is as given below:

GRADE	Characteristic strength after 7days N/mm^2	Characteristic strength after 28days N/mm^2	Minimum cement content per Cum
M10	**7**	**10**	**220 Kg**
M15	**10**	**15**	**280 Kg**
M20	**13.5**	**20**	**320 Kg**
M25	**17**	**25**	**360 Kg**
M30	**20**	**30**	**390 Kg**

- ✓ No grade below M 20 shall be used for RCC works.
- ✓ Concrete should be placed in position and compacted within half an hour of mixing of the same.
- ✓ Always keep a supervisor on the mixer to monitor the works.
- ✓ Use large bandlies, wheelbarrows, hoist machine to expedite transporting process. Wet the surface of the carrier to avoid moisture loss due to adsorption.

- ✓ Be careful to avoid segregation and wastage during transportation. In case of segregation, remix the concrete before placing.
- ✓ Concrete by vision should be homogeneous in colour, well graded, fluffy and it should form a shape of ball when rounded in the hands.

BATCHING PLANT MIX (RMC)

- ✓ Preference for ready-mix concrete from reputed companies possessing automated batching plant, of at least 30 cum per hour capacity supported by adequate number of transit mixers.
- ✓ The logistics should be worked out so as to receive at least 1 load of 6 cum every 10 to 15 minutes.
- ✓ Check the empty transit mixer for preset concrete in the drum. Preset quantity affects the quantum of concrete received.
- ✓ Concrete should be received with a delivery challan and data cycle sheet showing grade, quantity, water cement ratio, slump, cement content, time of manufacturing, dosage of additive added, weight of various ingredients of concrete.
- ✓ Go through the cycle data before accepting the concrete.
- ✓ Do not accept concrete after 3 hours of mixing.
- ✓ Do not recharge the concrete by adding additive, water and cement without prior permission from the project in-charge.
- ✓ Slump recommended for RMC mix is 100mm to 125mm
- ✓ Place the concrete pump on horizontal, hard even surface and keep the approach area free of materials to facilitate easy manoeuvrability of transit mixers. The approach should not slope towards the concrete pump.
- ✓ The horizontal section of pipe should be at least 7 metres before the vertical bend is put
- ✓ Reduce the length of pipe to the minimum to reduce frictional losses and excessive strain on the pump.
- ✓ The pipeline should be independently supported on vertical segment and not on the shuttering. The vibrations due to pumping should not affect or displace shuttering works.
- ✓ Pump rich slurry (one bag) before pumping concrete to lubricate the inner surface of the pipes.
- ✓ In case of intermittent supply keep the current transit mixers unloading in progress until the next mixer arrives at site. This avoids choking of pipeline due to non-pumping for long duration. Avoid reverse stroke to clear a choke. The fluid gets flushed out and the problem gets compounded.

- ✓ Do not bend the flexible end pipe by more than 135o while concreting.
- ✓ In constricted areas do not unload directly from the pipe. Use bandly and mumty to shift and place concrete in such areas.
- ✓ Be excessively careful while passing the ball while clearing the concrete in the pipeline after the day's work is over. Due to negligence somebody could get hurt.
- ✓ Employ professional hands for connecting pipeline. They will do a neater and faster job without any safety problems.
- ✓ Leave the pipeline, under the pump and adjacent areas clean of concrete dumping after the work is completed.

PLACING AND COMPACTION

- ✓ Do not use chutes longer than 4.5m or inclined at more than 45 to horizontal to pour concrete.
- ✓ Place cement concrete to the required depth and vibrate it until entrapped air inside concrete is released.
- ✓ Pour concrete first into beams and then over the slab portion.
- ✓ BOND NEW CONCRETE TO PREVIOUSLY POURED CONCRETE.
- ✓ If the previous pour was less than 4 hours prior, the laitance film and porous layer shall be removed from the surface of previous pour.
- ✓ If the previous pour was more than 4 hours prior but less than 30 days old observe the above process and expose aggregate with wire mesh and wash with clean water.
- ✓ If the joint is more than a month old use bonding agents as per specification of the manufacturer.
- ✓ If the beam is more than 500mm deep, concrete it in layers.
- ✓ Columns, beam, slab level of concrete top should be pre-marked before start of concreting works.
- ✓ Check the slab level during concreting with line dori method and also the levelling instrument.
- ✓ Use appropriate needles for vibration depending on the aggregate size, reinforcement spacing and element to concrete. For big footings use 60mm needle, for slabs use 40mm needle, and for starters and precast lintels use 25mm needle. Vibrators should operate for a speed not less than 10,000 rpm. Ensure that just adequate vibration is only done. Over vibration is very bad.
- ✓ Use wooden runner to ram so as to form slurry on top of the concrete surface.
- ✓ Clean the shuttering works of all spilled concrete immediately after concreting.

- ✓ Leave vertical construction joints after consultation with the structural engineer.
- ✓ Match the vibrators, masons to the rate of concreting.
- ✓ All surfaces of shuttering shall be moistened before placing of concrete to reduce water loss due to absorption.
- ✓ Slab should be sprayed with water after covering with hessian cloth 3 hours after concreting, i.e. initial setting is over and ensures that hessian cloth will remain wet till ponding of water.
- ✓ Pond water to a depth of 25mm using bunds the next day and keep water standing for 7 days at a stretch.
- ✓ In case ponding is not possible, cover it with hessian cloth and keep it moist throughout.
- ✓ DO NOT IGNORE CURING OF SLAB TO FACILITATE MARKING OF COLUMNS FOR THE UPPER SLAB.
- ✓ The beam bottoms should be cleaned using high-pressure cleaners.

TESTING OF CONCRETE

SLUMP TEST

- ✓ Conduct slump cone test, one during the start, one at midday and one towards the close of day's work.
- ✓ Again any load under suspect can be checked for slump on case-to-case basis.

CUBE TEST

- ✓ The sample is made at point of discharge of mixture.
- ✓ Take 3 samples after 7 days and 3 samples after 28 days strength.
- ✓ Every 100 cum or 10 batches of concrete (whichever is smaller) should be represented by a sample of test cubes.
- ✓ For concrete manufactured at site, there must be representative samples for the day's work and for different elements like footing, slab, column and wall.
- ✓ Test results should be discussed with the project in-charge even if the results are satisfactory.
- ✓ In case of cube failure, the element to be identified and non-destructive test to be conducted. Cube results of the RMC supplier for the same batch may be checked.

CHECKLIST FOR ON-SITE INSPECTION ACTIVITY:CONCRETING SLAB/BEAM				
SN	**ITEM**	**YES**	**NA**	**REMARKS**
1	Name, Date & Number of drawing			
	PRE POUR CHECKS			
2	Are the latest "Good for Construction" drawings available?			
3	Have the required barricading and safety measures been taken?			
4	Are the required number of cement bags available on site? (or adequate quantity of RMC been ordered)			
5	Are the required tools available at site to ensure correct work?			
6	Have the vibrators been checked before start of the concrete?			
7	Are calibrated farma available for measurement (weigh batcher in case of weigh batching)?			
8	Is the platform and scaffolding material secured?			
9	Is the necessary shuttering and reinforcement complete and in place?			
10	Has the shuttering material been properly aligned using appropriate equipment?			
11	Is the dimensional accuracy of shuttering material correct?			
12	Have markings been made on the column dowels for concrete level?			
13	Is the test report of cement and steel available at site office?			
14	Has the aggregate been checked? (In case of Site – Mix)			
15	Has the diameter and spacing of reinforcement been checked?			
16	In case of screed-concrete, have bull marks been installed			
17	Are spare hessian cloth or tarpaulin sheet available as protection from the elements?			
18	Has the sequence of concreting been planned and sufficient labour deployed?			
	CHECKS DURING EXECUTION			
19	Are all the labourers wearing gum boots while concreting?			
20	Is the concrete been properly compacted with a vibrator or manually?			
21	If the depth to be concreted is more than 500 mm, then is concreting being done in layers?			
22	Is the right grade of cement and water-cement ratio been followed?			
23	Are the markings on the column dowels done and a line dori being used to maintain correct concrete level?			
24	Have the admixtures, if any been added?			
25	Has the slump cone test been conducted on fresh concrete?			
26	Have test cubes been cast (site lab)?			
	POST POUR CHECKS			
27	Is curing been ensured?			
28	Has deshuttering been done carefully without damaging the concrete surface?			
29	Have high pressure water cleaners been used to clean the beam bottoms of inverted beams?			

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RESULT:

- Check list & Process manual for RCC roof has been prepared.

REFERENCES:

1. Technology Manual by Sobha Developers Pvt. Ltd

WEEK 9 PRACTICE 02

AIM: Study and present the technique of laying roof truss.

GENERAL:

These days, it seems roof trusses have surpassed rafters as the most popular way to create roof frames, and for many reasons. They aren't just more affordable – roof trusses are also extremely versatile and convenient, allowing builders to traverse large distances between walls without additional center support.

With so many homes adopting open spaces and large floor plans, it's no wonder that contractors and homeowners alike are choosing roof trusses over traditional, stick-framed roofs. Another bonus: roof trusses are quick and easy to configure, which reduces the cost of manual labour. However, even though roof trusses are relatively simple to install, you need to know what you're doing. There's still substantial room for error, especially if you aren't hiring professional roofers or builders to help with the job

TECHNIQUES OF LAYING ROOF TRUSS:

- **UNDERSTAND WHAT KIND OF ROOF TRUSSES YOU'RE USING**

  This might sound like a no-brainer, but it's an important tip. Different styles of roof trusses require different strategies during installation. For example, hip roof trusses (often used in locations with heavy rain or snowfall) slope downward at every point. These trusses are relatively easy to install – so much so that they don't even require the use of a crane in most situations.

  However, not every truss design will be as simple. Today, it's not uncommon to see a vaulted scissor truss with a coffer and an attic room, all in the same truss design. When you branch out from a straightforward, easy truss setup, the need for further planning and guidance increases. Make sure you understand exactly what your truss design entails – and if you're up for the job of properly handling each installation step.

❖ FIT THE ROOF TRUSS MEMBERS PRIOR TO LIFTING

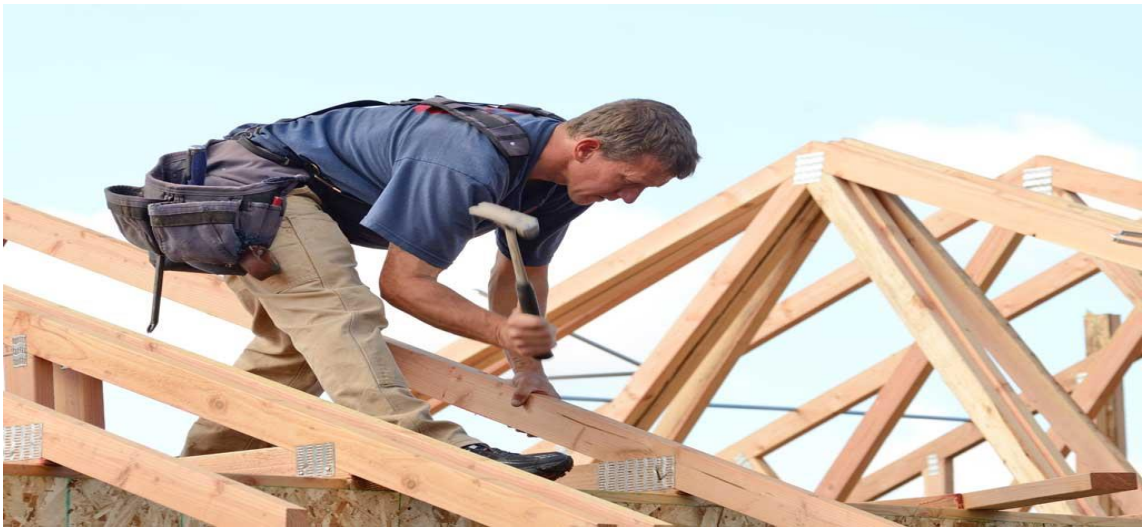
This tip will prevent you from getting ahead of yourself during the roof truss installation. For example, you don't want to begin lifting trusses to the top floor of the building, only to realize that the members don't all fit together like carefully laid-out puzzle pieces. If you use prefabricated trusses, you will receive a diagram and layout of the truss configuration from the manufacturer. This makes it fairly easy to understand how the trusses should fit together. Usually, each piece is numbered, and you can follow the instructions. Once you know how the trusses will fit together, you and your team will need to match the trusses to their corresponding numbers on wall plates. Only then can you begin nailing the first truss to the wall and attaching the brace needed for support.

❖ ATTACH RIDGE BEAMS TO EACH TRUSS

After you have the first truss nailed and attached to its brace, you can move onto the second truss in a similar manner. At the apex of each truss, you'll need to attach a ridge beam that will transfer the loads to post or gable end walls. This beam serves as a prop for opposing rafters to rest against. It will extend to the far end of the roof and hang over the trusses. In some cases, additional supports beyond this ridge beam may be needed.

❖ **ONLY NAIL WHERE THE MANUFACTURER INDICATES**

If you're installing prefabricated roof trusses, you should have detailed instructions from the manufacturers – including designated spots for nailing the trusses. Don't ignore those instructions – this can result in truss members cracking, and nailing in other spots can void the manufacturer's warranty on the trusses.



❖ **KEEP THE TRUSSES ALIGNED AT ALL TIMES**

Note the instructions for roof truss directions. Even if the webbing looks the same, there is a specific direction in which each truss should face. If you ignore the designated directions, you could wind up with trusses that need extra support but don't have proper load-bearing capabilities.

RESULT:

- The technique of laying roof truss has been studied.

REFERENCES:

1. https://www.hitektruss.com/blog/roof-truss-installation-tips/

WEEK 10 PRACTICE 01

AIM: Visit a construction site during plastering activity and prepare check list & process manual for cement plastering.

GENERAL:

Plaster is a thin layer of mortar applied over the masonry surface and it acts as a damp-proof coat over the brick masonry work. Plastering also provides a finished surface over the masonry that is firm and smooth hence it enhances the appearance of the building. The primary objectives of plastering are to protect the surface from atmospheric influences, to cover the defective workmanship in masonry, to conceal porous materials, and to provide a suitable surface for painting.

PROCESS MANUAL:

Preparation of Surface for Plastering

- Keep all the mortar joints of wall rough, so as to give a good bonding to hold plaster.
- Roughen the entire wall to be plastered.
- Clean all the joints and surfaces of the wall with a wire brush, there should be no oil or grease etc. left on wall surface.
- If there exist any cavities or holes on the surface, then fill it in advance with appropriate material.
- If the surface is smooth or the wall to be plastered is old one, then rake out the mortar joint to a depth of at least 12 mm to give a better bonding to the plaster.
- Wash the mortar joints and entire wall to be plastered, and keep it wet for at least 6 hours before applying cement plaster.
- If the projection on the wall surface is more than 12 mm, then knock it off, so as to obtain a uniform surface of wall. This will reduce the consumption of plaster.

GROUNDWORK FOR PLASTER

- In order to get uniform thickness of plastering throughout the wall surface, first fix dots on the wall. A dot means patch of plaster of size 15 mm * 15 mm and having thickness of about 10 mm.
- Dots are fixed on the wall first horizontally and then vertically at a distance of about 2 meters covering the entire wall surface.
- Check the verticality of dots, one over the other, by means of plumb-bob.
- After fixing dots, the vertical strips of plaster, known as screeds, are formed in between the dots. These screeds serve as the gauges for maintaining even thickness of plastering being applied.

APPLYING UNDER COAT OR BASE COAT

- In case of brick masonry the thickness of first coat plaster is in general 12 mm and in case of concrete masonry this thickness varies from 9 to 15 mm.
- The ratio of cement and sand for first coat plaster varies from 1:3 to 1:6.
- Apply the first coat of plaster between the spaces formed by the screeds on the wall surface. This is done by means of trowel.
- Level the surface by means of flat wooden floats and wooden straight edges.
- After levelling, left the first coat to set but not to dry and then roughen it with a scratching tool to form a key to the second coat of plaster.

APPLYING FINISHING COAT

- The thickness of second coat or finishing coat may vary between 2 to 3 mm.
- The ratio of cement and sand for second coat plaster varies from 1:4 to 1:6.
- Before applying the second coat, damp the first coat evenly.
- Apply the finishing coat with wooden floats to a true even surface and using a steel trowel, give it a finishing touch.
- As far as possible, the finishing coat should be applied starting from top towards bottom and completed in one operation to eliminate joining marks.

CURING OF PLASTERING WORKS

- After completion of the plastering work, it is kept wet by sprinkling water for at least 7 days in order to develop strength and hardness.
- Use of gunny bags or other materials is used to keep the plastering works wet in external works.
- Improper curing may lead to cracks formation or efflorescence in plaster work.

CARE BE TAKEN AFTER COMPLETION OF PLASTER WORK

- Cleaning of doors or frame and floor area is necessary at the completion of work.
- Curing should be started as soon as the plaster has hardened sufficiently and must be cured for at least 7 days.
- Curing shall commence, 24 hours after the plaster is laid.

CHECKLIST FOR ON-SITE INSPECTION		ACTIVITY:LIME RENDERING		
SN	**ITEM**	**YES**	**NA**	**REMARKS**
1	Name, Date & Number of drawing			
PRE EXECUTION CHECKS				
2	Has it been ensured that wall and ceiling surfaces are completely dry?			
3	Have all the loose particles, dirt and dust been scrubbed off from the surface?			
	Has proper scaffolding arrangement been done with safety measures?			
4	Are the required tools available?			
5	Are there any specific requirements of theclient?			
6	Has it been ensured that wall and ceiling surfaces are completely dry?			
CHECKS DURING EXECUTION				
7	Is the lime plastering being done 3 to 4 hoursafter the cement plastering?			
8	Has the first coat been trowel finished?			
9	Has a thickness of 2mm been maintained?			
10	Has the second coat of lime applied after thefirst coat had been completely dried?			
11	Is the second coat smooth finished with steelfloat?			
POST EXECUTION CHECKS				
12	Has the surface been checked for anyundulations?			
13	Has the curing been done after 24 hours oflime plastering?			

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CHECKLIST FOR ON-SITE INSPECTION	ACTIVITY:CEILING PLASTERING			
SN	**ITEM**	**YES**	**NA**	**REMARKS**
1	Name, Date & Number of drawing			
PRE EXECUTION CHECKS				
2	Is the latest "Good for Construction" drawing available?			
3	Is sufficient place available for starting plastering?			
4	Has the required barricading and safety measures been taken?			
5	Is the concrete surface hacked with a minimum of 80 indents/sq.ft?			
6	Are button marks placed at appropriate intervals?			
7	Has the GI mesh been nailed between all RCC & masonry members?			
8	Is the electrical conduiting works completed?			
9	Is the PHE piping works in toilets & kitchen completed?			
10	Has proper scaffolding arrangement been made?			
11	Are all boxes covered by dummy plates?			
12	Are the A/c works, access control and fire alarms systems in place?			
13	Is the surface wet & free from dust, oil & all forms of contamination?			
14	Has the dried mortar been cleaned off the surface?			
15	Are there any specific requirements of the client?			
16	Are the required tools available?			
17	Are the required materials available?			
18	Have the increased requirements (renova painting) been included in the total tolence?			
19	Has the proper roughing of first coat been done?			
CHECKS DURING EXECUTION				
20	Is the mixing of cement mortar being done correctly, on MS sheet?			
21	Is the plaster in proper line?			
22	Is plastering done above & below all platforms and lofts?			
23	Is the kind of finishing required been achieved?			
24	Normal sponge finishes (for POP application)?			
25	Rough finish (tile application/first coat)?			
26	Smooth, even finish (textured coatings)?			
POST EXECUTION CHECKS				
27	Is curing carried out for a min.of 10 days, with the date of plastering on wall with permanent marker			
28	Has lime been properly applied, if required?			
29	Has all mortar spillage been cleaned?			

CHECKLIST FOR ON-SITE INSPECTION ACTIVITY:EXTERNAL PLASTERING				
SN	**ITEM**	**YES**	**NA**	**REMARKS**
1	Name, Date & Number of drawing			
PRE EXECUTION CHECKS				
2	Is the latest "Good for Construction" drawing available?			
3	Is access available for starting plastering?			
4	Has the required barricading and safety measures been taken?			
5	Is the concrete surface beam/column hacked with a minimum of 80 hackings/sq.ft?			
6	Are Button marks placed at appropriate intervals?			
7	Has the GI mesh been nailed between all RCC & masonry members?			
8	Are the corner beadings in place and plumb?			
9	Have openings of doors & windows been fixed using aluminium templates?			
10	Is the electrical conduiting works completed?			
11	Is the PHE piping works in toilets & kitchen completed?			
12	Has proper scaffolding arrangement been made?			
13	Is the height of switch boxes fixed correctly?			
14	Are all boxes covered by dummy plates?			
15	Are the access control and fire alarm systems in place?			
16	Is the block work cured for at least 7 days?			
17	Is the surface wet & free from dust, oil & all forms of contamination?			
18	Has the dried mortar been cleaned off the surface?			
19	Are there any specific requirements of the client?			
20	Are the required tools available?			
21	Are the required materials available?			
22	Has the proper roughening of first coat done?			
CHECKS DURING EXECUTION				
23	Is the mixing of cement mortar being done correctly, on MS sheet?			
24	Is the plaster in proper line & verticality?			
25	Is the wall being plastered to given specifications to plumb and even?			
26	Is plastering done above & below all platforms and lofts?			
27	Are the edges of window frames & door frames perfectly vertical?			
28	Are all corners in line and finished properly?			
29	Are switch boxes in position and properly finished?			
30	Is the plaster surface cut properly for skirting?			
31	Is the kind of finishing required been achieved?			
	Rough finish (tile application/first coat)?			
	Smooth, even finish (textured coatings)?			
POST EXECUTION CHECKS				
32	Is curing been carried out for a minimum of 10 days, with the date of Plastering on the wall?			
33	Are grooves, drip mould and mortar bands given as per design?			
34	Has all mortar spillage been cleaned?			

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CHECKLIST FOR ON-SITE INSPECTION ACTIVITY:INTERNAL PLASTERING				
SN	**ITEM**	**YES**	**NA**	**REMARKS**
1	Name, Date & Number of drawing			
PRE EXECUTION CHECKS				
2	Is the latest "Good for Construction" drawing available?			
3	Is sufficient place available for starting plastering?			
4	Has the required barricading and safety measures been taken?			
5	Is the concrete surface beam/column hacked with a minimum of 80 indents/sq.ft?			
6	Are button marks placed at appropriate intervals?			
7	Has the GI mesh been nailed between all RCC & masonrymembers?			
8	Are the corner beadings in place and plumb?			
9	Are openings of doors & windows been fixed using aluminium templates?			
10	Is the electrical conduiting works completed?			
11	Is the PHE piping works in toilets & kitchen completed?			
12	Has proper scaffolding arrangement been made?			
13	Is the height of switch boxes fixed correctly?			
14	Are all boxes covered by dummy plates?			
15	Are the A/c works, access control and fire alarms systems inplace?			
16	Is the block work cured for at least 7 days?			
17	Is the surface wet & free from dust, oil & all forms of Contaminations?			
18	Has the dried mortar been cleaned off the surface?			
19	Are there any specific requirements of the client?			
20	Are the required tools available?			
21	Are the required materials available?			
22	Have the increased requirements (renova painting) been included in the total tolence?			
CHECKS DURING EXECUTION				
23	Is the mixing of cement mortar being done correctly, on MS sheet?			
24	Is the plaster in proper line & verticality?			
25	Is the wall being plastered to given specifications to plumb and even?			
26	Is plastering done above & below all platforms and lofts?			
27	Are the edges of window frames & door frames perfectly vertical?			
28	Are all corners in line and finished properly?			
29	Are switch boxes in position and properly finished?			
30	Is the plaster surface cut properly for skirting?			
31	Is the kind of finishing required been achieved?			
	Rough finish (tile application/first coat)?			
	Smooth, even finish (textured coatings)?			
	Normal sponge finish (for POP application) ?			
POST EXECUTION CHECKS				
32	Is curing been carried out for a minimum of 10 days, with the date of Plastering on the wall?			
33	Are grooves, drip mould and mortar bands given as per design?			
34	Has lime been properly applied, if required?			
35	Has all mortar spillage been cleaned?			

RESULT:

- Check list & process manual for cement plastering has been prepared.

REFERENCES:

1. Technology manual by Sobha construction Pvt.Ltd.
2. **https://theconstructor.org/practical-guide/plastering-work-procedure/26276/**

WEEK 10 PRACTICE 02

AIM: Prepare a check list & process manual for Gypsum / POP plastering.

PROCESS MANUAL:

PREPARATION TO BE DONE

- ✓ The brick masonry should cured thoroughly for 36 hours before back coat plastering.
- ✓ There should be one day gap after curing of BBM and starting of Back Coat.
- ✓ Curing of back coat to done for 3 days.
- ✓ Back coat plastered surface should be totally dry for starting of gypsum work.
- ✓ Chicken mesh should applied on joints of BBM and concrete. Also on the mortar used for sealing the chases for electrical pipes .Chicken mesh should drilled and nailed at spacing of 9". Minimum 6" to 9" wide strips of chicken mesh (24 gauge 12mm holes) should be use.
- ✓ Masonry chiselling for electric pipes or any other purpose to be seal with non-shrink materials well before the back coat plastering of the surface.
- ✓ Curing of sealed chases to done for 3 days.
- ✓ Masonry chiselling for electric pipes or any other purpose to done before back coat plaster/gypsum plaster work.
- ✓ Remove all the nails, binding wire, concrete projections, and wooden pieces from concrete surface and masonry.
- ✓ Clean all the dust, oily spots, and green algae if any from concrete and brick masonry surface.
- ✓ The concrete surfaces should be hack properly (60 /70 hacks per sft of concrete surface and having minimum depth of 5 mm)
- ✓ Curing of back coat plaster to done for minimum 4 to 7.
- ✓ Thiyya strips – at spacing of 3'to 4' inline, level, right angle and plumb, having 1" wide and throughout the height of the room.
- ✓ Gypsum Plaster thickness with back coat – 6 to 10 mm without back coat – 8 to 15 mm
- ✓ For ceiling thinness should not be 6 to 10 thick.

DURING PLASTERING

- ✓ Rough surface is made on back coat plaster for proper bonding with gypsum.
- ✓ Thiyyas of gypsum to be check by site supervisor for Plumb, line, level, right angle, measurement of openings, before starting of gypsum work.

- ✓ Window frames, sills, doorframes, electric switch boxes, fan boxes, taps, plumbing fittings, glass etc to be clean immediately.
- ✓ Along the window jams a 3" wide band of 5 mm thick plaster to given along the internal periphery of the openings of the window as applicable.
- ✓ Gypsum Plaster and back coat plaster to cut at a level above floor slab for fixing of skirting as per site engineers instructions.
- ✓ Window sills shall given smooth finish and an outward slope to drain off rainwater smoothly.
- ✓ Internal plaster not to done before external plaster.
- ✓ Gap of minimum 14 days to kept between completion of brickwork and starting of plastering activity. Gypsum Plaster Work

CHECKLIST FOR ON-SITE INSPECTION

ACTIVITY:GYPSUM WORK – WALLS & CEILING

SN	ITEM	YES	NA	REMARKS
1	Name, Date & Number of drawing			
PRE EXECUTION CHECKS				
2	Is the design of the channels plumb and horizontal?			
3	In case of ceilings, are sufficient supports in place?			
4	Are the openings for doors and windows perfect?			
5	Has proper scaffolding arrangement done with safety measures?			
6	Are the electrical, a/c ducts, fire alarm and access control works complete?			
7	No undulations on the gypsum board			
8	Are the required tools available on-site?			
9	Are there any specific requirements of the client?			
CHECKS DURING EXECUTION				
10	Is the fibre tape being fixed during the joint filling?			
11	Is the distance between channels exactly 2 feet?			
12	Is the distance between ceiling supports less than 4 feet?			
13	Are the joints between the boards perfect?			
14	Is the work being carried out by trained personnel?			
POST EXECUTION CHECKS				
15	Is the alignment perfect?			
16	Are the wall and ceiling surfaces at right angles?			
17	Check for undulations			
18	Is the distance between the floor and ceiling perfect?			

CHECKED BY **APPROVED BY**

RESULT:

- Check list & process manual for Gypsum / POP plastering has been prepared.

REFERENCES:

1. Technology manual by Sobha construction Pvt.Ltd.
2. https://civilsiteengineer.in/gypsum-plaster-work-procedure-for-residential-commercial-project/

WEEK 11 PRACTICE 01

AIM: Prepare a check list & Process manual for water proofing and laying procedure for different areas of buildings.

PROCESS MANUAL

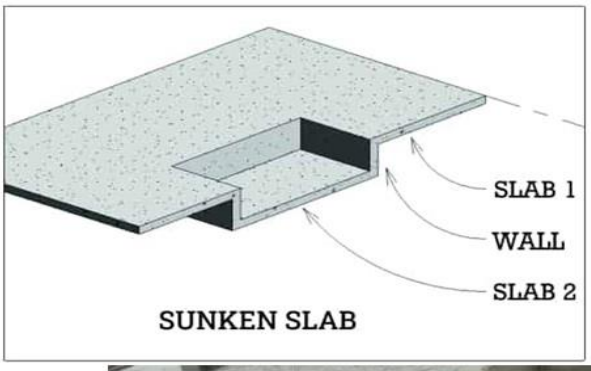
FLAT ROOFS AND SLOPED ROOFS

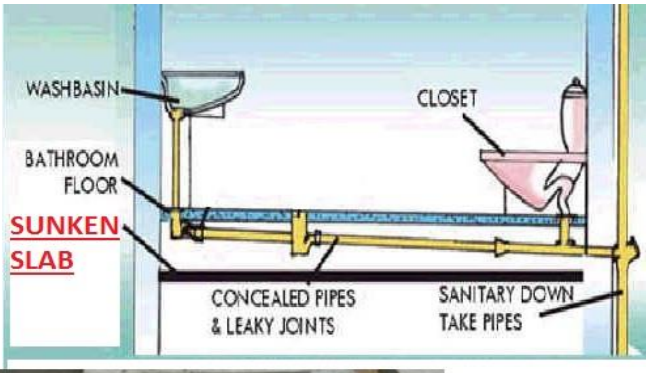
- ✓ The surface to be waterproofed should be prepared thoroughly by chipping all cement mortar deposits/ loose material, dust etc. using a chisel, wire and coir brush.
- ✓ The surface, which is to be waterproofed, should be ponded with water and any dampness / leakage should be marked in the ceiling below the terrace. Wherever leakage persists, 12mm diameter GI nipples should be fixed depending on the depth of dampness, on such weak locations in the ceiling, and is pressure grouted with neat cement slurry admixed with expansive grouting.
- ✓ 'V' grooves should be cut along the concrete / brickwork junctions on joints. Surface cracks if any should be filled with polymer modified diluted solution and also in cut-outs, around the sleeves, drain pipe joints and filled with sealant.
- ✓ Every upturn and pipe outlet should be reinforced with fibre mat between the two coats.
- ✓ Two coats of Acrylic polymer based waterproofing system or equivalent should be applied on terrace and parapet walls. One coat of neat cement mixed with polymer additive should be applied as bonding coat.
- ✓ A protective screed of 20-25mm thick should be provided with proper slopes. The treated area should be plastered to required slope as per drawing and cured for a minimum of 3-4 days.
- ✓ To ensure water tightness, the treated area shall be filled with water and tested.
- ✓ Over the treated surface, weathering course tiles should be laid on the terrace maintaining a proper slope.

SUNKEN AREAS/ SLABS

- ➢ The surface, which is to be waterproofed, should be cleaned thoroughly from all loose material, and dust, using wire and coir brush.
- ➢ The surface, which is to be waterproofed, should be ponded with water and any dampness/ leakage should be marked in the ceiling below the terrace. Whenever leakage persists, 12mm diameter GI nipples should be fixed depending on the depth of dampness, on such weak locations in the ceiling and it is pressure grouted with neat cement slurry admixed with expansive grouting.

- 'V' grooves should be cut along the concrete / brickwork junctions on joints. Surface cracks if any should be filled with polymer modified diluted solution and also in cut-outs, around the sleeves, drain pipe joints and should be filled with sealant.
- Two coats of Acrylic polymer based waterproofing system should be applied as a bonding coat on the treated surface.
- All joints between the beam and blockwork should be covered with the fibre mat.
- Plaster the treated area with neat cement and high grade waterproofing additive to the required slope as per drawing to protect the coating from wear and tear.
- The treated area should be subjected for testing by ponding water at least for a depth of 150mm for 24hrs.
- The chasing for concealed plumbing, and electrical works should be completed before the start of waterproofing and the chasing must be treated with an agent such as FORMDEX.
- Over the treated area, stone dust should be filled and roughly finished with 75mm thick screed concrete 1:2:4 to facilitate laying of tiles. The screed concrete floor level should be 20mm below the main floor, to facilitate a level difference between main area and toilet after tiling and to prevent toilet water entering the main area.





METHODOLOGY OF W.P. IN TOILET AND SHOWER / WASH AREAS USING MUREXIN COMPOUND

- Ensure the cement plastering for all toilet and shower areas are plumb, and at right angles to the facing walls, ceiling and floor levels. Further the plaster should have an even surface and a slightly rough texture. The flooring during the finishing stage must be adjusted to the slope of screed level set towards water-outlets.

- After sufficient time for setting of plaster, clean the plastered surface using a mason's brush of all dirt and dust particles. Before each application, the base must be dry and free of all dustparticles and foreign materials.
- Mark out the areas to be waterproofed, with the help of a pencil, measuring tape and spirit levels. Separate this area from the rest using masking tape.
- Apply the base coat MUREXIN LF as the first coat. This coat is done uniformly using the Masons brush over the entire area. Allow this coat to dry for about 20 minutes. Let the drying process be natural and do not subject the area to any wind-draft.
- During the drying period of the base-coat, the two component sealing material MUREXIN, made up of the powder component and the liquid component should be mixed slowly and evenly in the ratio of 2:1, using the mechanical stirrer (imported from Germany for the purpose). For example, for every 2 Kg of Powder component mix with 1 Litre of the liquid compound. Stir this mixture slowly and uniformly into a homogenous mass free of any knots or nodules (Mixing time- 3 minutes).
- Now the well-mixed sealing medium maybe applied uniformly using the 6mm teethed trowels first vertically in all the corners, in the spray areas of the shower area up to a height of 2 meters and in the rest of the toilet area to a height of 0.30 meters. Subsequently the MUREXIN sealing strip (caulking strip) will be placed along the corners and fixed uniformly using the right edged trowel and pressed firmly along the corners. Now please ensure that the sealing strip – also called the caulking strip, is fixed firmly in the corner ensuring there is no air gap.
- Subsequently the sealing compound is applied uniformly using the 6 mm-teethed trowel ensuring the thickness of the applied layer is maintained evenly at 1 mm. In the region where the pipe connections project from the plastered area, overlap such areas with the strips and apply the compound to fix them. After sufficient time for drying (About 24 hours), the second layer of 1 mm layer is to be applied thus bringing the total thickness of the application to 2 mm. Now remove the masking tape.
- After allowing about 24 hours for drying, the walls are tiled, using "MUREXIN-Flexi-mortar" adhesive using the 6 mm teeth trowels.
- After the walls are completely tiled, the flooring tiling is also taken up in a similar fashion. This means repetition of the procedures 1 to 8 before the floor tiles are brought on, so that the flooring is also well water proofed and sealed.

CHECKLIST FOR ON-SITE INSPECTION

ACTIVITY:WATER PROOFING – TOILET AND SHOWER AREA

SN	ITEM	YES	NA	REMARKS
	PRE EXECUTION CHECKS			
1	Is the cement plastering plumb and at right angles to the facing walls, ceiling and floor levels?			
2	Does the plaster have an even surface and slightly rough finished in its structure?			
3	Is the flooring in its finishing stage with the required screed level set towards the water-outlets?			
4	Is the plastered surface free from all dirt, dust particles, fats and other foreign particles?			
5	Has the waterproofing area, marked out to a height of 2 meters, width 1 meter in shower area and in the rest of toilet area to a height of 0.30 meters from the floor level?			
6	Is the marking done using a pencil, measuring tape and spirit levels?			
7	Has the waterproofing area bordered using a masking tape?			
8	Are the necessary tools available?			
	CHECKS DURING EXECUTION			
9	Has the base coat been applied uniformly on the entire waterproofing area?			
10	Has the drying process been natural for about 20 minutes and not subjected to any wind-draft?			
11	Has the sealing medium been applied uniformly, firstly, vertically at all the corners and in the spray areas of the showering area?			
12	Has the sealing strip (caulking strip) been placed subsequently along the corners and fixed uniformly and pressed firmly ensuring that there is no airspace in-between?			
13	Has the sealing compound applied subsequently with a uniform thickness of 1mm?			
14	Has the area of pipe connections jetting out from the plastered surface overlapped with the strips and the compound is applied uniformly?			
15	Has the second layer of sealing compound of 1 mm thick applied after a drying period of 24 hours of first layer?			
	POST EXECUTION CHECKS			
16	Has the masking tape been removed?			
17	Are the walls tiled after a drying period of 24 hours?			

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CHECKLIST FOR ON-SITE INSPECTION ACTIVITY:WATER PROOFING – SLOPED ROOF				
SN	**ITEM**	**YES**	**NA**	**REMARKS**
1	Name, date and number of the drawing			
PRE EXECUTION CHECKS				
2	Is the surface clean and free from all laitance?			
3	Has the surface been pre-wet?			
4	Are the necessary tools available on-site?			
CHECKS DURING EXECUTION				
5	Is the waterproofing material/ compound, fresh?			
6	Has the ridge and eaves been treated separately, by reinforcing with fibre mat betweentwo coats?			
POST EXECUTION CHECKS				
7	Has air curing been done for 3 days?			
8	Has protective screed of 20-25mm thickprovided?			
9	Has tiling work carried within 7 days ofwaterproofing?			
10	Has the mechanical stirrer been cleaned?			

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CHECKLIST FOR ON-SITE INSPECTION ACTIVITY:WATER PROOFING – SUNKEN AREA				
SN	**ITEM**	**YES**	**NA**	**REMARKS**
1	Name, date and number of the drawing			
PRE EXECUTION CHECKS				
2	Is the surface clean and free from all laitance?			
3	Has the surface been pre-wet?			
4	Has cement mortar covering been done at the upturns?			
5	Are the necessary tools available?			
6	Has the joint between the beam and block work been treated with fibre mat?			
7	Has the opening left for sleeves been treated to fullthickness of section pipe?			
8	Has chasing for concealed plumbing, electrical etc. been done?			
9	Has the surface been pre-wet?			
CHECKS DURING EXECUTION				
10	Is the material in fresh condition?			
11	Has the coating been done in two coats?			
12	Has chasing been treated with FORMDEX?			
POST EXECUTION CHECKS				
13	Has protective screed of 20-25mm thick provided with proper slopes?			
14	Has air curing been done for 3 days?			
15	Has the floor been treated with two coats?			
16	Has the treatment been done upto 2' above FFL and shower areas upto 7'?			
17	Has the opening been covered with concrete after fixingof pipes and also covered with fibre reinforcement?			
18	Has the mechanical stirrer been cleaned?			

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CHECKLIST FOR ON-SITE INSPECTION ACTIVITY:WATER PROOFING – FLAT ROOF				
SN	**ITEM**	**YES**	**NA**	**REMARKS**
1	Name, date and number of the drawing			
PRE EXECUTION CHECKS				
2	Is the surface clean and free from all laitance?			
3	Has the cement mortar covering done at theupturns?			
4	Has the surface been pre-wet?			
5	Are the necessary tools available?			
CHECKS DURING EXECUTION				
6	Have the upturns and pipe outlets been reinforcedwith fibre mat between two coats?			
7	Is the material in fresh condition?			
8	Has the coating been done in two coats?			
POST EXECUTION CHECKS				
9	Has protective screed of 20-25 mm thick providedwith proper slopes?			
10	Has air curing been done for 3 days?			
11	Has the mechanical stirrer been cleaned?			

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RESULT:

- Check list & Process manual for water proofing and laying procedure for different areas of buildings has been prepared.

REFERENCES:

1. Technology manual by Sobha Developers Pvt, Ltd.

WEEK 11 PRACTICE 02

AIM: Study the laying procedure of grouts.

GENERAL:

Grout is a flowable plastic material and should have negligible shrinkage to fill the gap or voids completely and should remain stable without cracking, de-lamination or crumbling. There are different types of grouts such as cement grout, polymer-cement slurry, epoxy, urethane, and high-molecular-weight methacrylate (HMWM).

These grout materials are selected for particular type of concrete or masonry repair work based on the compatibility of the grout with the original material. If Proper grouting material is not selected, the desired objectives of the grouting process would not be achieved.

Injection grouting is a process of filling the cracks, open joints, voids, or honeycombs, in concrete or masonry structural members, under pressure with a material that cures in place to produce the desired results like strengthening a structure and prevent water movement.

GROUTING MATERIAL PREPARATION

Only that quantity of epoxy is mixed which can be used before gelling of the material, otherwise pressure injection becomes considerably difficult. During the batch mixing process, the components of the epoxy are mixed in a fixed quantity using a mechanical stirrer, such as a paint mixing paddle.

In the more advanced continuous mixing system, the two liquid adhesive components are passed through an automatic mixing head after the pumping just before leaving the gun. This system allows the use of fast setting adhesives that have a short working life. After the injected epoxy has cured, the projected part of surface seal is removed by grinding or other appropriate means.

GROUTING PROCEDURES

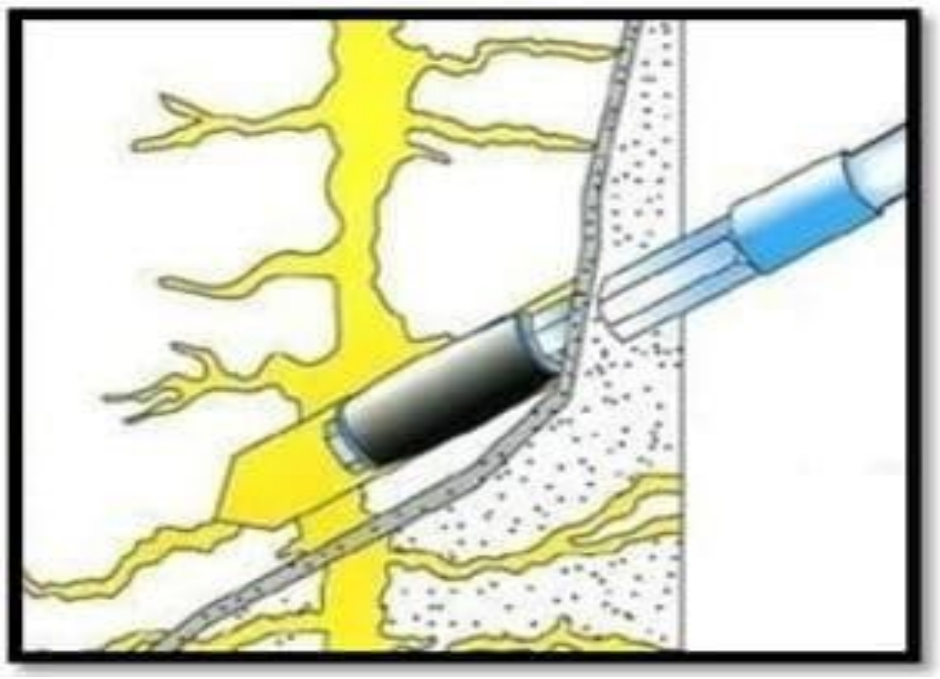
1. **DRILL PORTS:** Drill short holes, which is also known as ports, into the cracks/ openings in order to be used as entry and venting terminals. Minimum diameter and depth of ports are 2.5cm and 5cm, respectively. Spacing between holes is 150 mm c/c for finer cracks to 300 mm c/c for others. The spacing of ports is usually kept greater than the desired depth of grout penetration, but it may be adjusted based on judgment and requirements for a particular project.

2. **SEAL CRACKS BETWEEN PORTS:** The crack /opening surfaces between ports are sealed by applying epoxy, polyester, strippable plastic surface sealer for low injection pressures, or cementitious seals if surface appearance is important to the surface of the crack. Time required for hardening of seal depends upon the type of material used. To stiffen the surface seal, the cracks are usually routed 6 mm in width and 13 mm in depth. Sometimes, the crack can be cut out to a depth of 13 mm and width of about 20 mm in a V-shape, which is then filled with an epoxy to get a flush surface. If cracks pass through the structure, such as a wall, the surface seals and ports are applied on both sides. Openings may be sealed by plugging with cloth or fabric that allows passing of water or air but retaining of solids. Paper and other materials that remain plastic are not suitable for this purpose.

3. **CLEANING PORTS AND CRACKS:** Before grouting, flushing is done with clean water to obtain the following objectives: To wet the interior surfaces for better grout flow and penetration. To check the effectiveness of the surface sealing and port system. To gather information on grout flow patterns and details of interconnections of voids / discontinuities in the mass. To familiarize the grouting crew with the situation. Full crack cleaning may not be possible in practical situations and judgment must be used to decide the extent of this cleaning.
4. **MAKE GROUTING HOSE CONNECTIONS:** When the ports are drilled after sealing the openings and the grout pressure is up to 350 kPa, a hand-held, cone-shaped fitting on the grout hose is sufficient. For larger grout pressures, short pipe nipples are connected in to the holes to obtain grout hose connections. The method of installing entry and vent ports in case of V-grooving of the cracks is to drill holes 20 mm in diameter and 13 to 25 mm deep below the groove at the required spacing. A pipe nipple or tire valve stem is usually bonded with an epoxy adhesive. The method commonly used in case of rectangular grooves is to use a flush fitting has an opening at the top for the adhesive to enter and a flange at the bottom that is bonded to the concrete face. Third method is to use special gasket devices which can be directly fitted on to the discontinuities / openings in the surface seals.

5. **GROUTING PROCESS:** Grouting is started at one end of a horizontal opening or at the bottom of a vertical opening. It is continued until grout appears at the next port or the surface seals of cracks bulge out, after which the grouting operation is shifted to the next port. The port valves from where the grout is coming out are plugged before moving to

the next injection location. Grouting is usually started with a relatively thin grout, thickened as quickly as possible to the heaviest consistency that can be pumped without blockage. Extreme caution must be exercised when injecting cracks that are not visible on all surfaces. For injection of the epoxy, hydraulic pumps, paint pressure pots, or air-actuated caulking guns are generally used. The pressure used for injection must be selected carefully and it must not be excessive. For vertical or inclined cracks, the injection process must begin by pumping epoxy at the lowest level until the epoxy level reaches the entry port above. The lower injection port is then capped, and the process is repeated until the crack has been completely filled.



6. **END OF GROUTING PROCESS:** An indication of full filling of the crack is that the pressure does not drop. Epoxy injection requires a high degree of skill for satisfactory application of the technique. The atmospheric temperature at the repair site is also an important consideration.

INJECTION GROUTING OF MASSIVE STRUCTURES

For massive structures, the procedure consists of drilling a series of holes, 20 to 100-mm diameter, at a spacing of 1.5 m along the crack. In a recently developed method, a bag is wrapped all along the member and the liquid adhesive is introduced at the bottom and is sucked by a vacuum pump at the top, or epoxy is injected in the cracks from one side and pulled from the other side.

RESULT:

- Laying procedure of pressure grouting has been studied.

REFERENCES:

1. https://theconstructor.org/practical-guide/injection-grouting/5750/

WEEK 12 PRACTICE 01

AIM: Prepare a check list & Process manual for different types of flooring.

PROCESS MANUAL FOR VETRIFIED TILE FLOORING

SURFACE PREPARATION: Before laying the tiles, prepare the floor by means of removing dust and other particles. Level the surface to flat by filling any low spots and cracks in a concrete with concrete catching compound. Make sure that the floor is clean, dry and levelled evenly.

LAYOUT THE PATTERN: The tile should be laid out in the best way to create aesthetics appeal with the shapely cutting. Begin by measuring each length of the wall and also consider diagonals of the room. Take chalk and note down the lines on the floor parallel to the walls that help to place tiles in order.

PREPARE THE ADHESIVE: Adhesives are used as a bonding material to attach the tile to the background concrete floors. Mixup the adhesives with sufficient water not too less and not too many thick like a tooth paste to avoid short working life.

LAYING THE TILE: before applying adhesive if you want your floor to look more flawless, then layout some tiles and see how the polished floor is going to look like. Now spread the mortar with a notched trowel evenly on the surface depending on the size of the tile. Place the first tile on the adhesive or mortar and press it gently. Position the next tile by aligning the edge and corners using plastic spacers to place the joints uniformly.

CUTTING THE TILE: Once full tile are laid leaving corners the next step is to fill the gap between the laid tile and the wall. A scoring cutter or wet saw equipped with a diamond tripped blade can be used to mark both partial and straight cut on the tiles. Place the tile on the cutter and run the blade, break it by pressing it down and lay it on the adhesive. Repeat this process to fill the entire gap between the laid tiles.

APPLYING GROUT: grout fills the gap between the tiles. Ensure that joints are free from dust and debris before filling. After the mortar has set and tiles are laid, the joints are filled with grout. Apply the grout with a rubber float and allow it to set up for a few minutes. Wipe out any excess adhesive to make them level using sponge and bucket of water, sponge out frequency to keep it clean.

SEALING GROUT: After the grout has settled for some time, use applicator bottle or foam brush to apply the sealants. Wipe off the extra sealants with in 10min.

CHECKLIST FOR ON-SITE INSPECTION		ACTIVITY: FLOOR TILING		
SN	**ITEM**	**YES**	**NA**	**REMARKS**
1	Name, date and number of the drawing			
PRE EXECUTION CHECKS				
2	Has the surface been prepared for tiling?			
3	Is the surface smooth, free from dust and other contamination?			
4	Has the setting out been done?			
5	Are all pre cursory works completed?			
6	If tiles are used, have they been soaked for at least 30 minutes?			
7	Has the thickness of mortar bed checked?			
8	Are the required tools available?			
9	Are there any specific requirements of the client?			
10	Has the tile code number and tile name ensured?			
CHECKS DURING EXECUTION				
11	Has slope been provided wherever required?			
12	Has the laying procedure been followed?			
13	Has it been ensured that back of the ceramic tiles is completely coated with cement slurry?			
14	Have the tiles been gently tapped after laying on the mortar bed?			
POST EXECUTION CHECKS				
15	Have the joints been cleaned to remove loose mortar?			
16	Are the joints properly aligned?			
17	No hollow sound on the tile when tapped			
18	Is the finished floor, level?			
19	Is the entire laid floor tiles properly covered?			
20	Has it been ensured that grouting is only done after 24hrs of laying of tiles?			
21	Has the area been barricaded so as not to allow foot movement?			

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PROCESS MANUAL FOR GRANITE & MARBLE FLOORING

STORAGE OF GRANITE AND MARBLE

- The slabs/ tiles shall be stacked on edges on regular platforms under cover. During unloading, care shall be exercised to avoid breakage.
- Tiles of different quality, size and thickness shall be stacked separately.
- Within the site, the tiles shall be transported on platform trolleys.

CHECKS PRIOR TO START OF WORK

- ☞ The marble / granite tiles shall be ordered in sizes as determined by site dimensions to avoid cutting at site.
- ☞ The material received at site shall be checked for the following defects prior to acceptance.
    - Tiles of same type but with distinctly different colour or texture shall be rejected outright.
    - Tiles shall be free from holes, seams, shakes, pockets, stains and other effects and shall be of uniform colour and texture.
    - Dimensional tolerances shall be restricted to Length + 0.5mm, Width + 0.5mm, Aries + 0.5mm & Plane + 1 / 500
- ☞ Ensure that the site is cleaned, taking care to remove any loose concrete, mortar or other substances.
- ☞ All chasing for the concealed piping and electrical conduiting etc. shall be carried out before commencement of work.
- ☞ Make bull mark levels according to architectural specifications.
- ☞ Design mix of Cement Mortar (1:6 or 1:8) to be followed.
- ☞ Ensure that the tiles to be laid are matched, numbered and available in the required number for laying on the site.
- ☞ Tiles are dry matched in the yard. They are then cut to the exact size required, and numbered in the sequence and are laid at site in exactly the same order.
- ☞ For marble works, coat the bottom with sealant before laying. It is good practice to seal the top also after laying and polishing. This is done due to the high porosity of marble.

CHECKS DURING EXECUTION OF WORK

- ✓ As per drawing, work should be started by taking right angles for existing walls.
- ✓ Laying starts as per the previously numbered tiles.
- ✓ The surface on which granite or marble is to be laid is watered. A bed of mortar is placed on the floor, and tiles are put into position with white cement slurry.
- ✓ Levelling is done with an aluminium straight edge and rubber hammer.

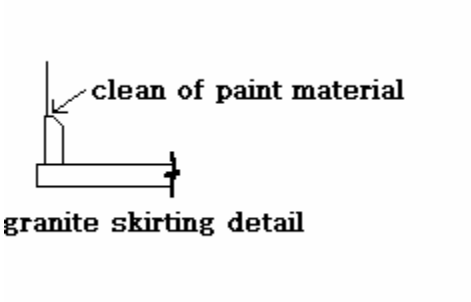
- ✓ If there is any slope, it has to be decided in the bull itself.
- ✓ Joint filler should make a joint filling material as per colour of the tiles.
- ✓ Putty blade is used to rake all joints and fill the joint material neatly as the joints will be paper joints.
- ✓ For fixing tiles to wall, suitable stainless steel mechanical anchors shall be used.

POST-EXECUTION CHECKS

- ✓ Stick the name of the tile mason on the job done by him.
- ✓ All surfaces & edges, which will remain exposed after installation, shall be polished.
- ✓ Cure all tiling works and joint filling works for 3 days.
- ✓ After work is complete, ensure that it is covered with plastic sheet and Plaster of Paris.

SKIRTING

- ✓ 10 mm tiles are used for skirting, and the height of the tile is 100 mm.
- ✓ Skirting is chamfered at the edge to 4 mm. and fixed so that after fixing the tile 4 mm of straight edge and 4 mm chamfered edge is seen outside. The skirting goes into the plaster by about 2 mm.
- ✓ Check the right angle that the skirting makes with the floor tile.
- ✓ For skirting with granite the skirting will be pushed out as following



CHECKLIST FOR ON-SITE INSPECTION

ACTIVITY: GRANITE / MARBLE FLOORING

SN	ITEM	YES	NA	REMARKS
1	Name, date and number of the drawing			
	PRE EXECUTION CHECKS			
2	Has floor slab been prepared for granite work?			
3	Is the floor free from dust and other contamination?			
4	Are all pre cursory works completed?			
5	Have the bull markings been done according to architectural specifications?			
6	Have the tiles been matched, numbered and available in required number for laying?			
7	Are the required tools available on-site?			
8	Are there any specific requirements of the client?			
9	Are the tiles dry matched and cut to exact size?			
10	Has the tile code number and tile name ensured?			
	CHECKS DURING EXECUTION			
11	Has the work been started by taking right angles for existing walls?			
12	Has the laying procedure been followed?			
13	Has the laying been started as per the previously numbered tiles?			
14	Is the floor moist and provided with cement slurry for bonding?			
15	Has the levelling been done with an aluminium straight edge and rubber hammer?			
16	Has the joint filling been done as per colour of the Granite / marble?			
17	Have the tiles been gently tapped after laying on the mortar bed?			
	POST EXECUTION CHECKS			
18	Have the joints been cleaned to remove loose mortar?			
19	Are the joints properly aligned?			
20	Is work carried out to plump and horizontally to line?			
21	Is the finished floor level?			
22	Is all the laid floor surfaces properly covered?			
23	Has it been ensured that grouting is done after 24hrs of laying of tiles?			
24	Has the area been barricaded so as not to allow foot movement?			

CHECKED BY **APPROVED BY**

RESULT:

- Check list & Process manual for different types of flooring has been prepared.

REFERENCES:

1. https://www.buildersmart.in/blogs/How-to-tile-a-floor/
2. Technology manual by Sobha Developers Pvt, Ltd.

WEEK 13 PRACTICE 01

AIM: Visit a construction site during painting activity, Prepare a check list & Process manual for painting on different surfaces (Anyone Method).

PROCESS MANUAL FOR VETRIFIED TILE FLOORING

STORAGE OF PAINT

All containers of paint, thinners and allied materials shall be stored preferably in a separate room. The room shall be well ventilated and free from excessive heat, sparking and direct rays of the sun. The lids of containers shall not be opened except when using the paint. The paint shall be used before the expiry of its shelf life marked on the containers.

CHECKS PRIOR TO START OF WORK

- The approved and duly certified shade and type of paint shall be made available at site in sufficient quantity.
- Ensure that the wall and ceiling surfaces are completely dry prior to the application of paint.
- Ensure that all furniture and the flooring is protected before starting the painting works.
- Proper scaffolding arrangement with safety measures to be taken.
- All loose particles, dirt and dust must be thoroughly scrubbed from the surface using sandpaper.
- All painting accessories like brush, roller, mixing tray etc to be thoroughly cleaned and washed outside the working premises before starting the works.
- Primer application with brush dilution ratio not to exceed 1:1 with water as thinner solvent.
- A drying period of 24 hours is required before the putty application.
- Application of 2 putty coats, ensure the first coat is thoroughly dried before applying the final coat.
- Putty to be applied uniformly to cover all undulations.
- Proper sanding of surfaces to render a smooth surface prior to the application of paints. Ensure that the dust on the surface is thoroughly wiped off after sanding the puttied surface.

GUIDELINES TO OBSERVE WHILE PAINTING

- First coat paint to be applied with brush and finished with roller preferably with single mix and dilution ratios not to exceed the below said criteria. i.e., 2 parts of paint to 1 part of water.
- Ensure a drying period of 4 to 6 hours before application of the final coat of paint.
- All external walls and semi-exposed areas such as balconies and utility walls, to be given a textured finish.

CHECKLIST FOR ON-SITE INSPECTION				ACTIVITY: PAINTING
SN	**ITEM**	**YES**	**NA**	**REMARKS**
1	Name, date and number of the drawing			
	PRE EXECUTION CHECKS			
2	Has the shade, type of paint been approved bythe architect and duly certified?			
3	Has it been ensured that wall and ceiling surfaces are completely dry?			
4	Have all the loose particles, dirt and dust been scrubbed off from the surface?			
5	Has proper scaffolding arrangement been done With safety measures?			
6	Are the required tools available?			
7	Are there any specific requirements of the client?			
	CHECKS DURING EXECUTION			
8	Is the primer application done?			
9	Has the putty been applied after 24 hours ofprimer application?			
10	Has the 2nd coat of putty been applied after the 1st coat has completely dried?			
11	Have all undulations been covered using putty?			
12	Has sanding of the surfaces been done properly to render a smooth surface?			
13	Has the dust from the surface been thoroughly Wiped off after sanding the puttied surface?			
14	Has it been ensured that the first coat of paint is applied and finished with roller?			
15	Has it been ensured that the final coat is applied after 4 to 6 hours of first coat?			
	POST EXECUTION CHECKS			
16	Has it been ensured that the area which ispainted is protected?			
17	Has the quality of the work been certified by concerned authority?			

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RESULT:

- Check list & Process manual for painting on different surfaces has been prepared.

REFERENCES:

1. Technology manual by Sobha Developers Pvt, Ltd.

WEEK 13 PRACTICE 02A

AIM: To Assessing the likely compressive strength of concrete with the help of suitable correlations between rebound index and compressive strength IS: 13311 (Part 2): 1992

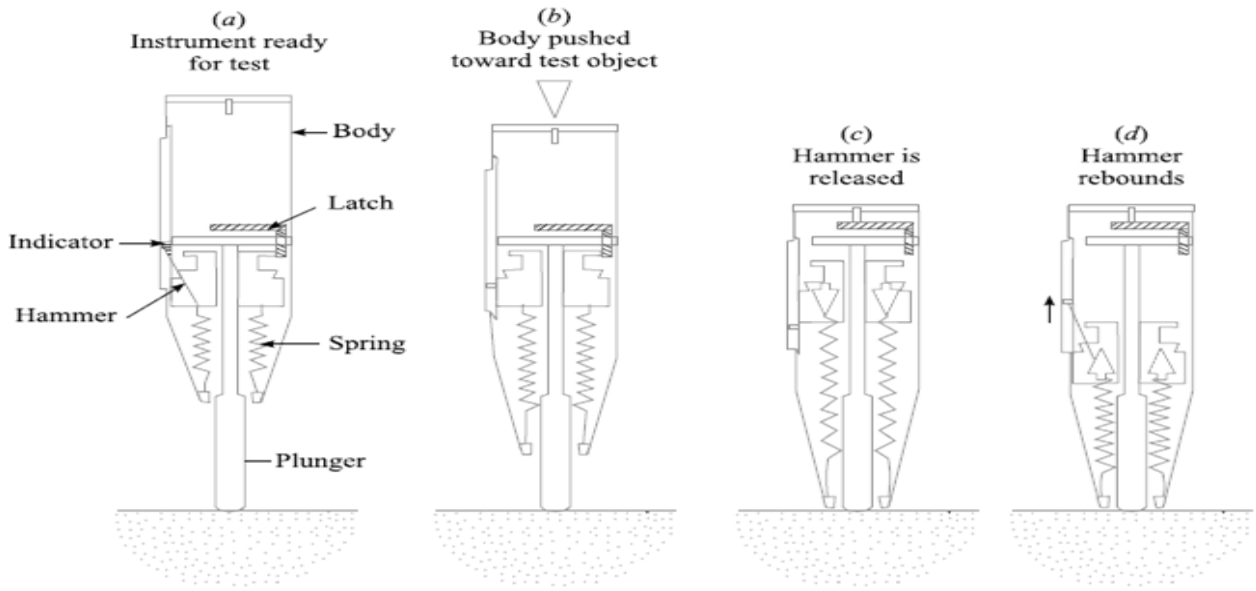
APPARATUS:

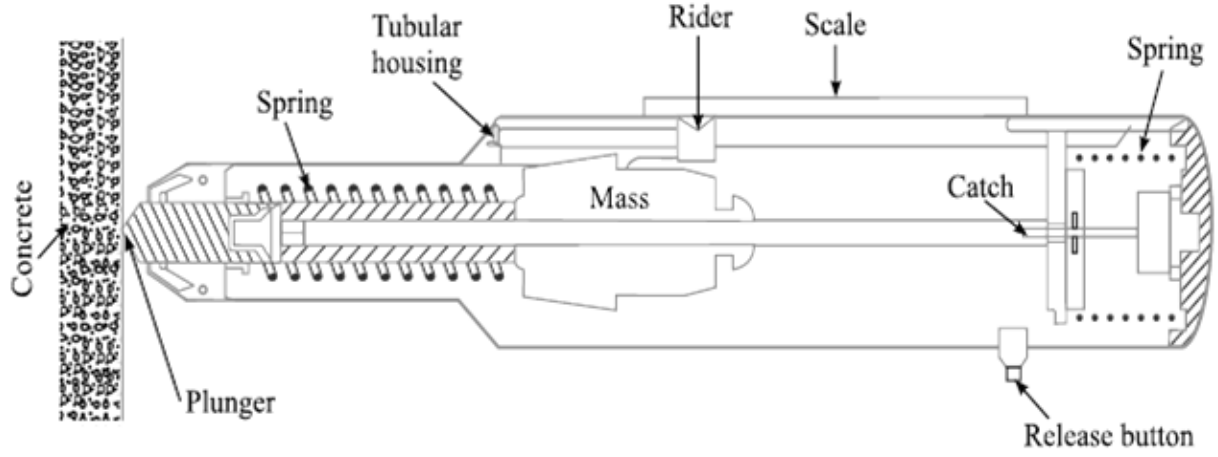
- The Rebound Hammer consisting of a spring controlled mass that slides on a plunger within a tubular housing.

THEORY:

When the plunger of rebound hammer is pressed against the surface of the concrete, the spring controlled mass rebounds and the extent of such rebound depends upon the surface hardness of concrete. The surface hardness and both the properties simultaneously on concrete therefore the rebound is taken to be related to the compressive strength of concrete. The rebound is read off along a graduated scale and is designated as the rebound number or rebound index.

OBSERVATIONS:





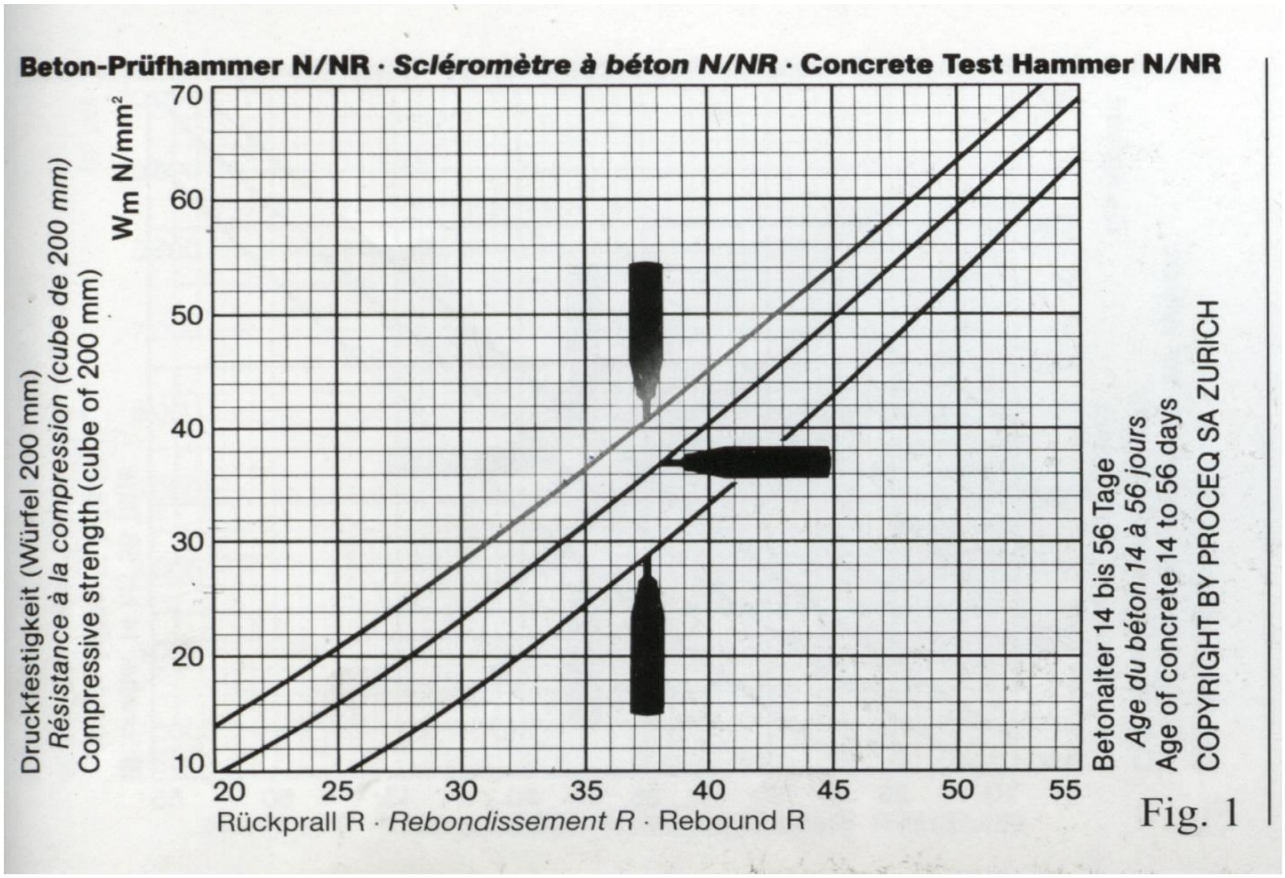


Fig. 1

PROCEDURE:

- For testing, smooth, clean and dry surface is to be selected. Rough surfaces resulting from incomplete compaction, loss of grout, spalled or tooled surfaces do not give reliable results and should be avoided.
- Operate the test hammer in a horizontal position, whenever feasible. The point of impact should be at least 20mm away from any edge or shape discontinuity.
- Press the test hammer plunger at exactly right angles to the surface of the concrete being tested. Press the plunger slowly and uniformly until released. Do not jerk or try to anticipate the plunger release.
- After impact, press the lock button and read the rebound value shown on the rider. Record the reading.
- Take a minimum of 5 rebound readings. Take only one reading at a given point. Very high readings may be caused by rock or steel near the surface at the point of impact, and very low readings may be caused by trapped air pockets near the surface at the point of impact.
- Convert the average of the reading (C) to compressive strength (D) in (KPa) by using the Central Lab calibration chart for that particular test hammer. (Do not use the calibration curves on the test hammer.)

TECHNICAL DISCUSSION

It is also pointed out that rebound indices are indicative of compressive strength of concrete to a limited depth from the surface. If the concrete in a particular member has internal micro cracking, flaws or heterogeneity across the cross-section, rebound hammer indices will not indicate the same.

As such, the estimation of strength of concrete by rebound hammer method cannot be held to be very accurate and probable accuracy of prediction of concrete strength in a structure is of ± 25 percent. If the relationship between rebound index and compressive strength can be checked by tests on core samples obtained from the structure or standard specimens made with the same concrete materials and mix proportion, then the accuracy of results and confidence thereon are greatly increased.

Average Rebound Reading with condition of concrete (BS 1881-202)

AVERAGE REBOUND READING	QUALITY OF CONCRETE
>40	VERY GOOD, HARD LAYER
30 TO 40	GOOD LAYER
20 TO 30	FAIR
< 20	POOR CONCRETE
0	DELAMINATED

RESULT & CONCLUSION:

The rebound number increases as the strength increases.

- Rebound Number =
- Compressive strength of Concrete =