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INTRODUCTION OF BUILDING CONSTRUCTION SITE

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Abstract

In a day's internship is very important for all Engineers. Without internship they are faces types of difficulties during the working on site. In this research we will study about the various methods & steps involved in construction site. In this report we will know the what's kind of skills required for a civil engineer in building site construction. How to check building materials in construction site.

This project is taken out by the Construction of Sarguja university ambikapur (Administrative building, Science & arts department, Library & staff quarters). Different types of problems I 'd seen during the construction they have discussed in this report.

Keywords: *Building Construction, Construction.*

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1. INTRODUCTION

Sarguja university building is being constructed in Bhakura. Bhakura is 12km away from the city of Ambikapur in Chhattisgarh. It is being constructed between natural beauty. University has been given 88.793 hectares of land in Bhakura area. Its budget is around 50 Crores.

Fig.1(a) - Entry gate of Sarguja university

Fig.1(b) – Academic building of Sarguja university

Here are the names of the buildings being constructed - Admin building, Academic building, Registrar Banglow, VC Banglow, Staff quarter, Library & Auditorium etc. In this paper we will know the all the steps used in any building construction (step by step). We will know the Auto level, different tyeps of material testing, estimates calculations etc. Here are the Some design photos.

Fig.1(c) – Administrative building of Sarguja university

Fig.1(d) – VC bunglow of Sarguja university

Fig.1(e) – Registrar bunglow of Sarguja university

Objectives

- To know about the skills required as a civil site engineer in construction site.
- To understand the site management in construction site.
- To understanding the site supervision work.
- To understand the what problems we are facing in construction site as a role of site engineer.
- To understand the whats kind of material testing is required in construction site.

2. LITERATURE REVIEW

Bhumeshwar Dongarwar and et al, 2020 have discuss the estimation of building, Bill of quantities (BOQ), and Overall Tendering process of any Building. They have used to Centre line method to calculate the quantities of different items of work. The Rate Analysis is carried out as per CSR 2018-19 for Nagpur division excluding GST. The effect of GST has been applied to the total cost Calculated for whole structure as 18%.

The Estimate of total of fifty-five quantities has Been carried out that are being used in the Structure by the centerline method.

The layout was then prepared using AutoCAD. The various layouts were prepared and then later discussed with the architect for error correction. The cost estimate for the project has been calculated using Centre Line Method in Microsoft Excel. For the cost estimation they have used Microsoft excel.

Desalegn Disasa Daba and et al, 2018 have have discuss the residential building construction projects in the Vadodara town only. The data for this study are collected through field survey. They have collect data on the basis of various parameter. They have divided the causes of delay in three groups:

1. Major causes: are those causes, which have great contribution to delay.
2. Minor causes: are those causes that have some contribution to cause delay
3. Supportive causes are those, which cannot be considered as causes but have some contribution to delay

Manisha Jamgade and et al, 2021 have discuss the focuses safety application in India in field of construction. They have focus based on various parameters and they have also found that what actions are required against any accidents. The accidents was caused due to poor safety culture among the sub-contractors workers and our site engineers. This accidents could have been averted if there was proper fall prevention measures were taken and insisted wearing safety belt by the worker.

3. PROCEDURE & METHODOLOGY

Procedure –

General Surveys -

- Site selection
- Knowledge of topography
- We will Check the water level of that area.
- Know about the route to travel and its distance from the main road.
- We also have to take care that environment is not harmed while doing the construction and the trees have to be cut to a minimum.
- We will also see the population of that area.
- We will see if labour can be found around.

Planning of Map – After the site selection and survey of that area, we do map study with the help of architecture The Plan and reinforcement details of that building are also include In this map.

Levelling – After doing the map study, we do the levelling of the site area with the help of auto level by cleaning it, and checking the level will find out about the earth work and cutting Details.

Fig.2 – Auto level machine

Layout - To do the layout we first mark the outer points, then using the Pythagorean theorem with the help of those outer points, determine the line of the sides. And we also check how much earthwork will have to be done.

Excavation – Normally for 4 story building dig 8-10 feet till we get hard strata we should keep digging.

Fig.3 – Layout work

Footing and Foundation –

- When we get the hard strata, We prepare foundation for the structure, In which we first prepare the footing.
- To prepare the footing we will first prepare the PCC in it.
- To prepare the PCC, we first fix its shuttering according to the size given in the drawing. Then after that we prepare its base and level it equally, we will use sand and stone crush to prepare the base.
- With the help of auto level, all the footings in it will be kept at an equal accurate level.
- For that, after preparing the base of the footing, we check its level with auto level. And in this reading we subtract the thickness of the footing (For example 150 mm) and We mark this reading on the shuttering by keeping the staff at the at least 8 point of shuttering and We get the accurate level before filling the concrete in it.

- In PCC, we use M-15 grade of concrete and the aggregate size is 40 mm.

Fig.4(a) – PCC Work

RCC work in footing – The description of RCC work of footing is given below –

Sr.N0.	Type of column	Type of Footing	Footing Size(B×b)	Excavation Size	Depth (D) mm	Depth (d) mm
1.	C1	F1	1300×1200	1400×1200	400	150
2.	C2	F2	1400×1200	1600×1200	500	200

Sr.N0.	Type of column	Type of Footing	Main steel to long side, mm×Nos	Main steel to short side, mm×Nos
1.	C1	F1	#10×10Nos	#10×10Nos
2.	C2	F2	#12×14Nos	#12×12Nos

- Pedestal Reinforcement - #16 × 4 WITH 2 Legged #8mm Stirrups @300 mm c/c.
- To make the column stand, We fold each number of the column into a bar in L shape & fix it.

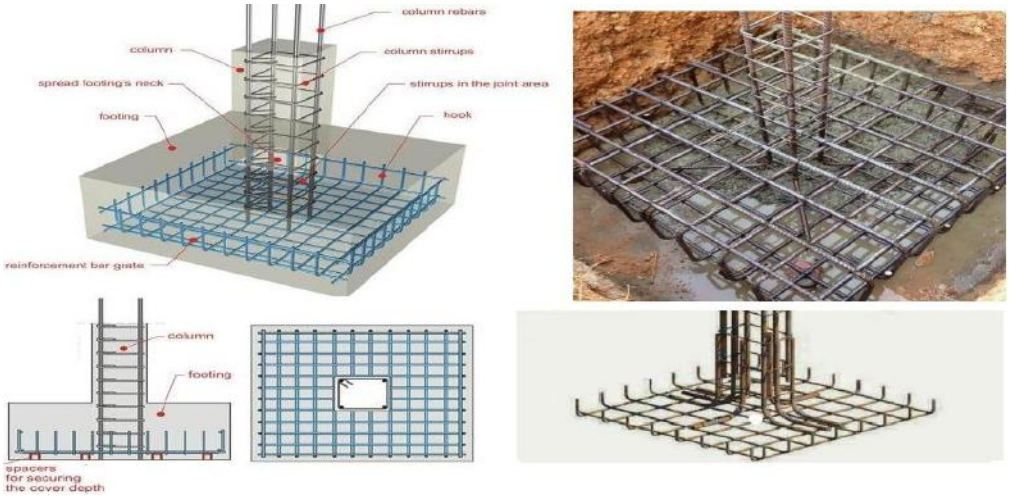


Fig.4(b) – Footing (Plan & Elevation)

Pedestal - After the footing is ready , We complete the structure up to the plinth level using a pedestal.

Fig.5 – pedestal

Soling - Basically we do soling work so that the particular soil inside that area does not come out from under the plinth beam. In soling we do brick masonry work under plinth beam and tie beam. (Fig.6)

Retaining Wall - Whenever there is a high probability of the soil moving out inside the site, then we construct the retaining wall. It does not allow the soil inside the site to leak out

Fig.6 – Soling

Fig.7 – Retaining wall

Plinth Beam - Plinth work is the last working step of Foundation after that we do PCC and RCC work to level the floor. After preparation of Plinth beam, we will prepare PCC of 150 mm thickness using M-15 Grade of concrete in the particular areas.

Fig.8 – Plinth Beam

Super Structure work – Inside the Super structure, we will learn about the members and working steps after the construction of the building foundation. After the Plinth beam is ready, we start stiffening the columns and along with that the brick work also starts. Where the pedestal ends on the plinth beam, from there we start calling it a column and the column is fixed on top of it.

RCC and PCC Work – After the plinth beam is made, we do RCC and PCC work to bring the floor to the same level.

Fig.9 – RCC & PCC work

Brick Work - Normally the techniques we use for doing Brick masonry are –

1. English Bond
2. Flemish Bond
3. Stretcher Bond
4. Header Bond

- Of these, We use English Bond and Flemish Bond only for Brick Masonry.
- We use the Stretcher Bond to construct the partition wall and We use the Header Bond for this curvature shaped masonry.
- We use ¾ Brick , Queen closer and King closer to cut joints in Masonry.

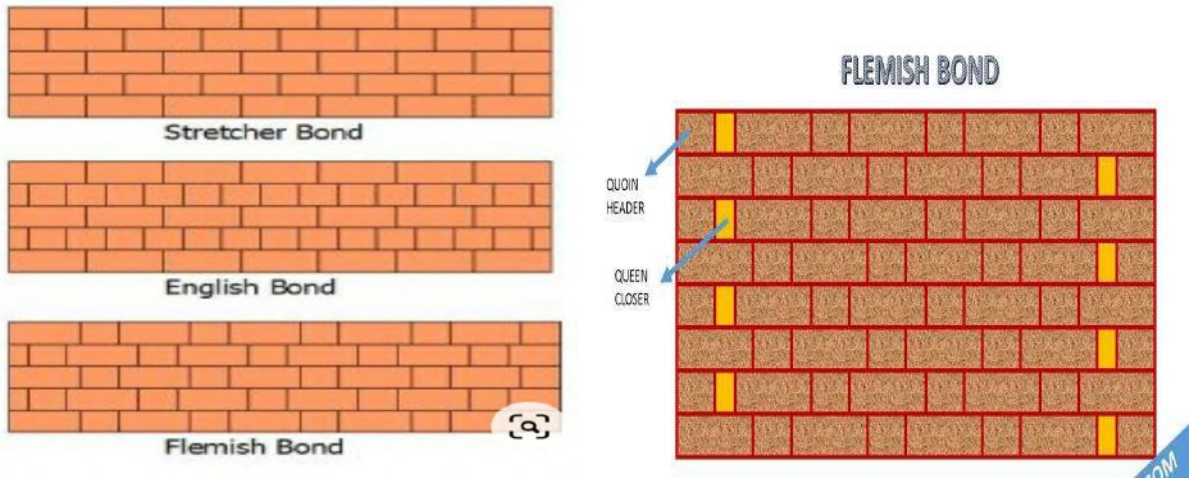


Fig.10 – Types of Brick masonry

Pointing - After completing the Masonry work, we fill the Masonry joints well with mortar, We call this process Pointing, **Important Terms –** Mortar Ratio = 1:6

Fig.11 – Pointing

Sill Level - The Sill level is reached after the Buildings Plinth level is ready. We placed the window only at the Sill level.

Lintel Level - Our Lintel level is reached after the windows and doors are placed. We Construct the Lintel beam only at the Lintel level and only at the Lintel level We build Chhazzas for doors and windows.

Fig.12 – Sill level & Lintel level

Slab Level and Slab Casting - Slab level is the top level of any Floor and at this level we do slab casting. The height of the Slab level should be minimum 10 feet (3.048 m) from the Plinth level.

- Grade of Concrete = M-25 Mix Design. , Cover Block – 20 mm, 25 mm.

Procedure –

Firstly We do RCC work before casting the Slab, The details of RCC Slab is shown in the Table. After doing RCC work and Shuttering properly We will do Slab casting. Before casting the Slab, we will put the cover block at a certain distance. Before We start casting, we are involved in Water, Cement and Aggregates etc. We will put the materials on the site in advance. Use a Concrete mixture and Lift machine for mixing, placing, and transporting of Concrete. Then with the help of Vibrator, We will do the Finishing by casting it in a proper way.

Fig.13(a) – Concrete placing by lift machine

Fig.13(b) – Mixture machine & Lift machine set-up

Fig.13(c) – Concrete casting

Plastering Work - After casting the Slab, Curing is done properly for a certain time. After Curing of slab, we will do Plaster work.

- Thickness = 12 mm (In Slab = 6 mm) , Mortar Ratio = 1:6

Procedure –

To Plaster We will first moisturize the face well with water. After that We will make a paste of cement and water and sprinkle it on the face of the wall. We will use a 1:6 mortar with a Gauging Towel to place the mortar on the wall. In a particular area we will placed. After that we will finish it in, proper way with aluminium channel and after sometime we will keep checking the level of plaster with plumb bob as well. [Fig.14(a)]

Floor Finish – In the last step now we will finish the floor. Floor finish we can do in proper way using tiles. [Fig.14(b)]

Fig14(a) – Plastering work

Fig.14(b) – Floor finish

4. Methodology

1. How to use Auto level -

- First of all we spread the tripod and keep it in the ground.
- We try to bring the tripod to the level as possible.
- The auto level machine is the placed on the top of the tripod and We will try to bring the bubble to the centre to level it.
- Bring the one leg of the tripod between any two levelling screws and We will see where the bubble is.
- Whichever side the bubble is on, that part will be raised upwards and Its opposite side will be bent down.
- We will try to raise the part which is bent down.
- To up, Rotate the levelling screw in a clockwise direction.
- The bubble will move to the other side of Auto level machine.
- We will repeat the same process again by placing any two levelling screws along the leg on the other side of the tripod.
- After this the bubble will come right in the centre and Our auto level machine will come to the accurate level.
- We will try to clear the Cross - hair.

 # How to find elevations of the all points in the site -

- To check the elevation of all the points on the site, We will select Temporary Bench Mark (TBM). TBM will be a fixed point.
- We will try to see all the points of the site from TBM.
- We will note the readings by keeping the staff in TBM and This reading will come in "Back Sight" in our calculation.
- After this, before changing the instrument station, whatever readings come(Last reading must be skipped). They will have to be written in the "Intermediate Sight".
- The last reading before changing the instrument station will go to "Fore Sight".
- After changing the instrument station, We will again note the reading by placing the staff in the last point and This reading will come on the "Back Sight".
- After that We will follow the same process again.

 # Calculation by "HI Method" –

Station	BS	IS	FS	HI	RL	Remarks
1	0.450			481.100	480.650	
2		1.860			479.240	
3		2.755			478.345	
4		3.250			477.850	

5		3.675			477.425	
6	0.885		3.930	478.055	477.170	CP1
7		1.150			476.905	
8		1.945			476.110	
9		2.850			475.205	
10	0.975		3.635	475.395	474.420	CP2
11		1.950			473.445	
12			2.585		472.810	

Check -

ΣFS - ΣBS = First RL – Last RL

10.150 – 2.310 = 480.650 – 472.810

7.84 = 7.84

So our calculation is right.

Fig.15(a) – Auto level & Levelling staff

Fig.15(b) – Levelling staff on site

2. Sieve Analysis of 20 mm aggregate –

- First we take 5 Kg aggregate (20mm) sample from the site.
- Then we put the pan in Weighing machine and set the machine to 0Kg.
- We put the sample in the pan and take 5Kg weight.
- We take 40mm, 20mm, 10mm and 4.75mm IS Sieves and Pan. We collect all these in order.
- We will put the aggregate sample in the top of 40mm IS Sieve and shake it. We see that the entire sample passes through this 40mm IS Sieve.
- Now we will put the sample in the 20mm sieve and shake it well. Then we take the weight of the retained aggregate in the sieve.
- Then we will stir well the sample remaining in the 10mm IS Sieve. Then we will also take the weight of retained aggregate in this.
- Similarly we will repeat the same process in 4.75 mm IS Sieve and Will take the weight of the retained aggregate on it.

- We will weight the remaining dust in the pan.
- According to the table given below, we will check the percentage of passing of all sieves –

IS Sieve (mm)	Retained Weight (gm)	Cumulative Retaining Weight (gm)	%of Cumula-tive Retaining Weight	% of Passing	IS Limit
40	0	0	0	100	100
20	1738	1738	35.66	64.34	85 - 100
10	3147	4885	97.70	2.3	0 - 20
4.75	87	4972	99.44	0.56	0 - 5
PAN	27	4999	99.98	0.02	0

Fig.16(a) – Sieve Analysis of 20mm aggregate

Fig.16(b) – Sieves series in a proper way

Fig.16(c) – Weighing machine

3. **Compressivee Strength Test of Concrete -**
   - Normally we do Compressive strength test of concrete in 7 days and 28 days.
   - The mould we use to test the Compressive strength of concrete is 150mm × 150mm in size.

- First of all we check the nuts of the mould are tight. We apply lubricant to the inside of the mould. We can use Mobil oil as a lubricant.
- We fill the concrete mix in the mould in 3 layers. Each layer is tempered 35 Strokes from the tamping rod. The size of the tamping rod is 16mm in a diameter and 600mm in a length.
- After that we have to leave it for 24 hours. and In it we will mark all the details in the proper way.
- After 24 hours we will soak it in clean water for curing.
- After the concrete cube is ready, We fit it proper way in the compressive strength testing machine for strength test.
- Now we start loading, When the concrete cube breaks, The needle will stop on it. We note down this reading.
- Similarly, We keep the cubes in the machine and apply the load and note the readings.

Number of sample on the basis of it's Volume -

(0 - 5) m^3 = 1 No. of Sample(6 Nos.)

(6 - 15) m^3 = 2 No. of Sample(2×6 Nos.)

(16 - 30) m^3 = 3 No. of Sample

(31 - 50) m^3 = 4 No. of Sample

More than 50m^3 = 4×6 = 24 + One add for each 50m^3(i.e. 6)

Check –

We assume that The readings are - 600 N/mm², 650 N/mm², 675N/mm²

Load/Area = 600/22.5 = 26.6 N/mm²

We know strength of the Concrete is –

1day = 16%, 3day = 40%, 7day = 65%, 14day = 90%, 28day = 99%

For M-30 Grade in a 7days = 30×65/100

7days = 20N/mm² , 26.6 @ 20 N/mm², So structure will safe.

Fig.17(a) – Cube mould

Fig.17(b) – Moulds after concrete is placed

Fig.17(c) – Compressive strength testing machine

4. **How to check Manufacturing and Expiry date of Cement –**

- We check ISI mark in Cement bag.
- Cement bag should have BSI certified written on it.
- Company name should be spelled correctly.
- The Weight and Grade of the Cement should be checked.
- How to check Manufacturing date -

24	8	2	20	25	22
Date	Week	Month	Year	Fly ash%	Slag%

Strength Reduction of Cement –

Days	**Strength Reduction**
Fresh	0%
3 Month	20%
6 Month	30%
12 Month	40%

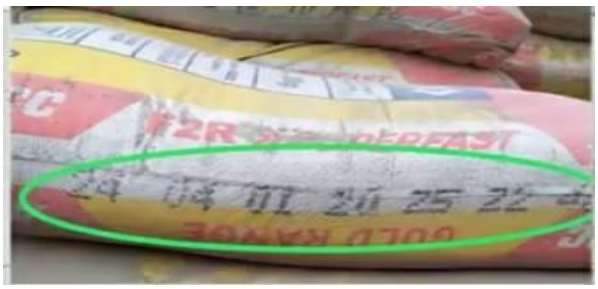


Fig.18 – Details of cement manufacturing date

5. How to check Quality of Sand at Site –

When Sand is rubbed by hand, Silt should not stick to hand.

 # In a practical way -

- First of all, We take a glass in which at least 250ml of water can come.
- We mark the value in the glass.
- Now let's fill the sand upto the range of 100ml.
- Then we add water to it. The glass is filled with sand and water upto 150ml.
- Now we add salt to it and shake the glass in a proper way.

- After sometime we see that some part of the silt is deposited.
- We check the silt quantity.
- Let's say the sand was upto the range of 100mm and Silt quantity is upto 4mm.
- Percentage of Silt = 4×100 / 100 = 4%
- Percentage of silt is not more than 6% of the sample to be taken.

In other words –

Assume Dia of glass is 60mm, Then Radius = 20mm

Volume of Sand = $\pi r^2 h = 3.14 \times 20^2 \times 100 = 125600\ mm^3$

Volume of Silt = $\pi r^2 h = 3.14 \times 20^2 \times 4 = 5024 mm^3$

Percentage of Silt = 5024/125600 × 100 = 4%

(Silt is not more than 6% of the sample to be taken).

6. Aggregate quality check on the Site -

- The surface of the aggregate must be rough type.
- There should not be much dust on the aggregate.
- Red stone should not be in excess.
- The aggregate should have an angular and cubic shape.
- Flaky and long aggregate should not exceed 35% of its total weight (10mm Aggregates).

7. Steel quality check at Construction site -

- We will know his grade and company name, by looking its tag.
- Take out steel from a steel bundle and cut it into a length of 1m and we take the weight of 1m length. It should be equal to $D^2/162$ Kg/m.
- The steel should not be heavily rusted.

8. Brick quality check at Site -

- The shape and size of brick should be perfect. Brick should be a uniform color.
- Metallic sound should come from the collision of two bricks.
- If we drop a brick from a height of 1meter, It should not break.
- Brick should not absorb more than 20% of its weight, When soaked in water for 24 hours.
- Compressive strength test of first class brick can give its strength to 70N/mm² or more.

5. Calculations & Results

1. Bar Bending Schedule of Footing – [Fig.4(b)]

Size of Footing = 2000 × 2000 mm (According to Drawing)

Cover = 50 mm (According to Drawing)

Total length of steel = 1900 + 150 +150 = 2200 mm

Bend deduction = 2×2d (d = Dia of bar)

∴ Cutting Length = 2200 – 2×2×12 = 2200 – 48 = 2152 mm = 2.152 m

No. of Bar = Length / Spacing = 1900 / 150 + 1 = 12.7 = 13 Nos.

Total Cutting Length = 1 Bar Cutting Length × No. of Mesh × No. of Bar = 2.152×2×13

Total Cutting Length = 55.952 m

Weight of Bar = $D^2/162$ in 1 m Length = $12^2/162$

Weight of Bar = 0.88 Kg/m

Total Weight = 0.88 × 55.952 = 49.735 Kg.

2. Calculate Numbers and Weight of the Stirrups -

Here in L/4 = 9/4 = 2.25 m = 2250 mm

= 2250 / Spacing = 2250 / 100 = 22.5 Nos.

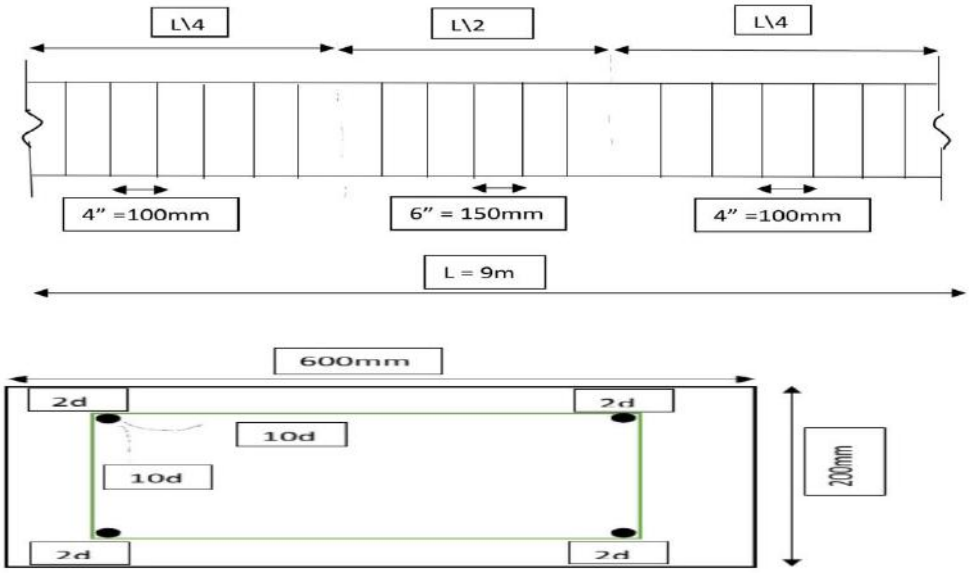
Here both sides are including , Then

= 22.5 + 22.5 = 45 Nos. Bar

Here in L/2 Length = 9/2 = 4.5 m = 4500 mm

= 4500 / 150 = 30 Nos. Bar

Total Number of Stirrups = 45 + 30 = 75 Nos. Bar



s Fig.19 – Stirrups (Plan & Elevation)

Calculate Weight of the Stirrups –

So, Cover = 40 mm

Then 1 side of Length is 600 – 80 = 520 mm And 200 – 80 = 120 mm

Stirrups Cutting Length = 120 + 120 + 520 + 520 – 10d + 20d

(Assuming Dia of Bar is 8 mm)

= 120 + 120 + 520 + 520 – 10×8 + 20×8

Stirrups Cutting Length = 1360 mm = 1.36 × 75 = 102 m

Weight of the 8 mm Bar in 1 m Length = 0.39 Kg.

Then, Total Weight of the Stirrups = 102 × 0.39

= 39.78 Kg.

3. **Calculation of Cement , Sand, aggregate and water in Concrete for M-20 -**

 # Density -

Cement = 1440 Kg/m^3, Sand = 1450-1600 Kg/m^3, Aggregate = 1450 - 1500 Kg/ m^3,

Water = 1000 Lit/ m^3

Wet volume of Concrete = $1m^3$

Wet Volume (54% Increase) = Dry Volume

Dry Volume = 54% of Wet Volume = 1 + 54/100 = 1.54 m^3

Grade of Concrete (M-20) = 1:1.5:3

Total Ratio = 1+1.5+3 = 5.5

Cement = Dry Volume × Cement Ratio/Total Ratio

Cement = 1.54 × 1/5.5 = 0.28 m^3 = $0.28m^3$ × 1440 Kg/ m^3 = 403.2 Kg

∵ 50 Kg = 1 Bag Cement

403.2 / 50 = 8.064 = 8 Bag Cement

Sand = 1.54 × 1.5/5.5 = 0.42 m^3 = 0.42 × 1500 Kg/ m^3 = 630 Kg

Aggregate = 1.54 × 3/5.5 = 0.84 m^3 = 0.84 × 1500 Kg/ m^3 = 1260 Kg

Water = 0.45 × Quantity of Cement = 0.45 × 403.2 Kg = 181.44 = 182 Lit.

4. **Calculation of Quantity of Cement & Sand in plaster –**

Of Area wall = 6m × 3m

Thicknesss of Plaster = 0.012m

Volume of Plaster = L×B×H = 6m × 3m × 0.012m = $0.216m^3$

Wet Volume = $0.216m^3$

Dry Volume = Wet Volume × 1.33 = 0.216 × 1.33 = $0.287m^3$

Cement Sand Ratio for Plaster = 1:6

Cement = Ratio of Cement / Sum of Cement Sand Ratio × Dry Volume

Cement = 1/7 × 0.287

Cement = $0.041m^3$

We Know,

Density of Cement = 1440 Kg/ m^3 = 1440 × 0.041 = 59.04 Kg

= 1.18 Bag of Cement

 # Sand = Ratio of Sand / Sum of Cement Sand Ratio = Dry Volume

= 6/7 × 0.287

Sand = 0.246m^3

We Know,

Density of Sand = 1450 - 1600 Kg/m^3

= 1500 Kg/m^3 × 0.246 = 369 Kg

5. Calculate Number of Bricks in a Wall -

We Know that Size of the Brick is (190mm × 90mm × 90mm) And With including mortar is (200mm × 100mm × 100mm)

Volume of 1 Brick = (0.2m × 0.1m × 0.1m)

= 0.002 m^3

To Find out Numbers of Brick We identify Size of the wall,

Assume The Length of the wall = (280×153×90) cm.

= (2.8 × 1.53 × 0.9) = 0.86m^3

We Know that Number of Bricks in 1 m^3 = 500 Nos

∵ 1m^3 = 1000 × 1000 × 1000

So number of Bricks in 1m^3 = 1000×1000×1000 / 100×100×200 = 500 Nos.

Then in 0.86m^3 = 0.86 × 500 = 430 Nos.

6. CONCLUSION

Finally, we see that a civil engineer faces lots of challenges in the site. Practical knowledge is most important things for a fresher civil engineer. According this we have find that every civil engineers have fulfil some skills, Some of those things We' re going to tell here are those –

- **Drawing study and Analysis –** A Civil engineer should be able to read and understand building drawings such as plans, elevations, Bar bending schedule drawings etc.
- **Execution and Layout –** We should come to layout according to the drawings and to fix the columns and door, windows etc. And we should come to find out the right points.

- **Critical thinking and Problems solving skills –** Before doing any work, an engineer should understood it throughly and estimate its result. The problems arising during the work should also be solved properly.
- **Good Mathematical understanding –** An engineer should come to the site to find out the points and come up with mathematical solutions to generate estimates.
- **Better at Site management work –** Management should be well versed for smooth functioning of the site.
- **Good relations with government organisations -** A Civil engineer should have good relations with government organisations. Site work may stop in case of dispute, and the work is not completed on time.
- **Teamwork –** There should be a sense of teamwork among the employees working in any project.
- **Leadership quality –** A Civil engineer should have leadership quality, only then he can complete that work in a good way through his team.
- **Good Physical features of the human body –** The human body should be good to work on a site for a long time.
- **Good in Estimates calculations –** Building estimates like Bar bending schedules, quantity of materials to an engineer. Should come to calculate.
- **AUTO–CAD Drawings –** An engineer should be able to understand and create drawings on AUTO-CAD software.

These were some qualities a Civil engineer should have. Apart from this there are many other things that a Civil engineer should know.

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