RESEARCH ARTICLE OPEN ACCESS

PROJECT REPORT

ON

Signature Tower - III

Unitech

UNDER CONSTRUCTION AT

SEC. 15, GURGAON(HARYANA)

SUBMITTED IN PARTIAL FULFILLMENT FOR AWARD OF DEGREE OF

BACHELOR OF TECHNOLOGY

Department of Civil Engineering

Swami Vivekanand Institute of Engineering & Technology, Banur

PUNJAB

Submitted By:

Manpreet Singh (Roll No. 99150120779)

Satgur Singh (99150120784)

DECLARATION

I hereby certify that the work which is being presented in the report entitled "SIGNATURE TOWER-**III**" by Manpreet Singh & Satgur Singh in partial fulfilment of requirements for the award of degree of B. Tech. (Civil Engineering) submitted to Swami Vivekanand Institute Of Engineering & Technology, Department of Civil Engineering is an authentic record of my own work carried out during a period from 1th May 2018 to 30th July 2018 under the Project Manager of **Mr. Mohit Sharma(PM)**

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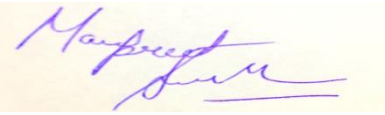
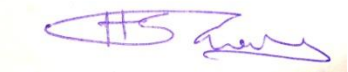


Signature of the Student

Manpreet Singh

Satgur Singh

This is to certify that the above statement made by the candidate is correct to the best of my/our knowledge.



Signature of H.O.D.

ABSTRACT

I have done my four month industrial training in SIGNATURE TOWER-**III** at SEC 15,GURGAON. In that time, the cpmpany was working on the construction of SIGNATURE TOWER-**III**. I was working as a trainee engineer on the project. My task was to check the quality of work, progress of work, study the architecture drawings, structural drawings, beams, columns, slab etc. I have to supervised the work, to check the steel in beams, columns, slab and my duty was on field area like on basements, steel yard.

My responsibilities towards the training was to maintain the team work between the workers and to motivate them towards their work, provide all requirements that they need on the site. My experience in this training is very crucial, that was a life time experience. I learned many things on the site like work management, work as a leader, self expression, creativity & originality, gain experience from experienced engineers. After taking training in this, I have learnt a lot about theoretical background and achieve practical experience. It seems to me that the practical knowledge is essential to be an efficient civil engineer.

ACKNOWLEDGEMENT

It is always a pleasure to remind the fine people in the engineering program for their sincere guidance. I received to uphold my practical as well as theoretical skills in engineering.

I would also like to thank Mr.Mohit Sharma (PM) and for the positive attitude he showed for my work, always allowing me to question him and giving prompt replies for my uncertainties in this field. I am indebted to Mr. Sahil Narula (Site Engineer) for spending his valuable time with me and guiding me during the course of the training.

I would also like to acknowledge and extend my heartfelt gratitude to Er.Prince chawla(training coordinator) who continuously supported me in every possible way, from initial advice to encouragement till this date.

Manpreet singh

Satgur singh

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SITE PLAN :

2.2 CONSTRUCTION SPECIFICATIONS

Given below are few specifications of the said project:

1. Client : UNITECH GROUP
2. Contractor : UNITECH GROUP
3. Project manager : Mr. MANOJ SHARMA
4. Built up Area : 25000 sq. Ft
5. Expected Cost : 180 crores
6. Foundation type : RAFT
7. Waterproofing agent : sica & plastocrete
8. PCC Ratio : 1:4:8(under foundation)

9. Grade of concrete : M25,M30,M40
10. Steel grade : Fe500
11. Mix ratio : 1:1:2, 1:1:1.5, 1:1.62:2.96
12. Steel used : JSW STEEL LIMITED
13. Maximum column size : 1400x1400 mm
14. Minimum column size : 750x350 mm
15. Minimum diameter of bars used : 8 mm
16. Maximum diameter of bars used : 32mm
17. Cement used : ULTRA TECH

2.3 PARTS OF THE PROJECT

1. Reinforced concrete piles
2. Substructure:- Part of structure beneath soil(Foundation)
3. Strap beam: - Foundations of all columns are connected by strap beam.
4. Superstructure: - Part of structure visible to eyes. It includes following:-
   - **i.** Basement
   - **ii.** Columns
   - **iii.** Beams
   - **iv.** Slab
   - **v.** Ramp
   - **vi.** staircase

CHAPTER: 3 THE CONSTRUCTION PROCESS

Fig: 3a Actual image of the construction site of the project

Listed below is the process chart of the construction of the said project

3.1 Site clearance

3.2 Demarcation of Site

3.3 Positioning of Central coordinate ie (0,0,0) as per grid plan

3.4 Layout of columns

3.5 Excavation

3.6 Laying of PCC

3.7 Reinforcements

3.8 Shuttering and Scaffolding

3.9 Concreting

3.10 De-shuttering

3.11 Brickwork

3.12 Doors and windows frames along with lintels

3.14 Plastering

3.16 Painting

3.17 Final Completion and handing over the project

3.5 EXCAVATION

Excavation was carried out both manually as well as mechanically. Normally 1-2 earth excavators (JCB's) were used for excavating the soil. Adequate precautions are taken to see that the excavation operations do not damage the adjoining structures. Excavation is carried out providing adequate side slopes and dressing of excavation bottom. The filling is done in layer not exceeding 20 cm layer and then it is compacted. Depth of excavation was 15.200m from Ground Level.

Excavation at the site

3.6 LAYING OF PCC (PLAIN CEMENT CONCRETE)

After the process of excavation, laying of plain cement concrete that is PCC is done. A layer of 4 inches was made in such a manner that it was not mixed with the soil. It provides a solid base for the foundation and a mix of 1:5:10 that is, 1 part of cement to 5 parts of fine aggregates and 10 parts of coarse aggregates by volume were used in it. Plain concrete is vibrated to achieve full compaction. Concrete placed below ground should be protected from falling earth during and after placing. Concrete placed in ground containing deleterious substances should be kept free from contact with such a ground and with water draining there from during placing and for a period of seven days. When joint in a layer of concrete are unavoidable, and end is sloped at an angle of 30 and junctions of different layers break joint in laying upper layer of concrete. The lower surface is made rough and clean watered before upper layer is laid.

LAYOUT WORK

Layout is the positioning of columns and retaining wall according to the requirements. This is the next after the laying of PCC. It is a work of prime importance , so should be done carefully. There we are showing the layout of piles and retaining wall

Layout of pile &retaining wall

FOOTING &FOUNDATION

Foundation is the base of a building. Foundation provided for a particular column or a wall is known as footing. Foundation is laid directly over the PCC .Various types of foundations are used according to soil and construction requirements .In our site there is footing in non- tower area and raft foundation in tower A&B

Footing of column

PILE FOUNDATION

It is a type of deep foundation .This type of foundation is used when the bearing capacity of soil is low .Different types of piles are used according to their function .The function of the pile is to transfer the load to the hardest strata below it . The type

of pile had been used on site is END BEARING pile

The depth of piles bored was:

- 3.5m
- 10m

Diameter of piles

- 400mm
- 1000mm(bulb)

RETAINING WALL:

Retaining wall is a structure used to retain the pressure of earth. RCC retaining walls are commonly used. To control the dampness, special treatment

should be done on back side of the wall .The height of retaining wall at site is 15.200m and the base of wall is 2.200m. Fig given below show the actual image of the wall foundation

DAMP FROOF TREATMENT OF RETAINING WALL:

To control the entry of water to seepage through retaining wall from soil the back side of wall is plastered. A special chemical is added for this purpose is

- SICA

- PLASTOCRETE

3.7 REINFORCEMENTS

Steel reinforcements are used, generally, in the form of bars of circular cross section in concrete structure. They are like a skeleton in human body. Plain concrete without steel or any other reinforcement is strong in compression but weak in tension. Steel is one of the best forms of reinforcements, to take care of those stresses and to strengthen concrete to bear all kinds of loads.

Mild steel bars conforming to IS: 432 (Part I) and Cold-worked steel high strength deformed bars conforming to IS: 1786 (grade Fe 415 and grade Fe 500, where 415 and 500 indicate yield stresses 415 N/mm2 and 500 N/mm2 respectively) are commonly used. Grade Fe 415 is being used most commonly nowadays. This has limited the use of plain mild steel bars because of higher yield stress and bond strength resulting in saving of steel quantity. Some companies have brought thermos-mechanically treated (TMT) and corrosion resistant steel (CRS) bars with added features.

Bars range in diameter from 6 to 50 mm. Cold-worked steel high strength deformed bars start from 8 mm diameter. For general house constructions, bars of diameter 6 to 20 mm are used.

Transverse reinforcements are very important. They not only take care of structural requirements but also help main reinforcements to remain in desired position. They play a very significant role while abrupt changes or reversal of stresses like earthquake etc.

They should be closely spaced as per the drawing and properly tied to the main/longitudinal reinforcement.

3.7.1 TERMS USED IN REINFORCEMENT

3.7.1a BAR-BENDING SCHEDULE

Bar bending schedule or bar scheme diagram is the detailed representation of bend and cut bars upon the designers discretion. This will aide as in determining the materials quantity, strength and for economic and practical purposes as well. Structural members such as beams, girders, columns, footings, walls are usually done with bar bend schedule as a guide in positioning them upon casting in place. Some examples are the proper bending of ties and stirrups, bending of hooks, point where the top and bottom bars terminate, bend for anchorages, bend for development, bend for splicing if necessary, U straps, bend of bars in slabs and bend for longitudinal position of re bars. Remember that a thorough structural analysis must be done before making a bar bend schedule for safety purposes.

Bar bending is a schedule should be prepared as per structural drawings. It indicates that what type of diameter of steel reinforcement to be used, how many numbers of bars is to be used and what will be the length of dia. of bar to be used. Bar bending schedule gives we total quantity of steel reinforcement to be used in the building and also for preparation of estimate and also checking the steel during construction process.

BBS is very important part of detailing and should include the following information:-

1. Type of bar and its diameter
2. Shape and bending

3. Numbers of bars of each type
4. Length of each bar
5. Total weight of each bars required for a particular structural member
6. Remarks if any

Reinforcement used at this site is generally of following dimension:-

- 8mm ϕ
- 10mm ϕ
- 12mm ϕ
- 16mm ϕ
- 20mm ϕ
- 25mm ϕ
- 32mm ϕ

Reinforcement provides the tensile as well as compressive strength of the structure, and the use of different dia of structure in design is strictly on the basses of the load on the particular portion of the building. Generally heavy dia bars i.e. of 32mm ϕ are used in column or beams of heavy dimensions or core beams which are subjected to have heavy loads. whereas the bars of small dia such as 8 or 10mm ϕ are used either as stirrups, or face bars or as extra steel where the load is not so heavy. All steel used at site are **Fe 500** steel except that of 8 & 10 mm ϕ which is of **Fe 415**.

3.7.1b LAP LENGTH

Lap length is the length overlap of bars tied to extend the reinforcement length. Lap length about 50 times the diameter of the bar is considered safe. Laps of neighbouring bar lengths should be staggered and should not be provided at one level/line. At one cross section, a maximum of 50% bars should be lapped. In case, required lap length is not available at junction because of space and other constraints, bars can be joined with couplers or welded (with correct choice of method of welding).

Concrete Mix	Development Length
M20	57D
M25	49D
M30	46D
M35	43D
M40	39D

3.7.1C ANCHORAGE LENGTH

This is the additional length of steel of one structure required to be inserted in other at the junction. For example, main bars of beam in column at beam column junction, column bars in footing etc. The length requirement is similar to the lap length mentioned in previous sub-part or as per the design instructions.

Fig: 3.7a Reinforcements in progress

3.7.2 THINGS TO NOTE (FOR REINFORCEMENT)

Reinforcement should be free from loose rust, oil paints, mud etc. it should be cut, bent and fixed properly. The reinforcement shall be placed and maintained in position by providing proper cover blocks, spacers, supporting bars, laps etc. Reinforcements shall be placed and tied such that concrete placement is possible without segregation, and compaction possible by an immersion vibrator.

For any steel reinforcement bar, weight per running meter is equal to d*d/162 Kg, where d is diameter of the bar in mm. For example, 10 mm diameter bar will weigh 10×10/162 = 0.617 Kg/m.

Three types of bars were used in reinforcement of a slab. These include straight bars, crank bar and an extra bar. The main steel is placed in which the straight steel is bonded first, then the crank steel is placed and extra steel is placed in the end. The

extra steel comes over the support while crank is encountered at distance of ¼(1-distance between the supports) from the surroundings supports.

For providing nominal cover to the steel in beam, cover blocks were used which were made of concrete and were casted with a thin steel wire in the center which projects outward. These keep the reinforcement at a distance from bottom of shuttering. For maintaining the gap between the main steel and the distribution steel, steel chairs are placed between them.

3.7.3 CHAIRS

Chairs are also known as Spacer. Used in between top & bottom reinforcements to maintain constant distance between the two and to keep intact. According to code, the chairs should be spaced at 1m apart.

Spacers between reinforcements

3.7.4 LABORS WORKING IN REINFORCEMENT YARD

1. Foreman – For Supervision purposes
2. Fitter – The Perfect man in yard
3. Bender – For Bending the bars
4. Cutter – For Cutting the bars
5. Helper – For helping them all and transporting the bars from one place to other

3.7.5 MACHINES IN REINFORCMENT YARD

1. Iron Rod cutting machine
2. Iron Rod bending machine

Iron rod cutting machine

8 SHUTTERING AND SCAFFOLDING

3.8.1 DEFINITION

The term 'SHUTTERING' or 'FORMWORK' includes all forms, moulds, sheeting, shuttering planks, walrus, poles, posts, standards, leizers, V-Heads, struts, and structure, ties, prights, walling steel rods, bolts, wedges, and all other temporary supports to the concrete during the process of sheeting.

Fig: 3.8a Shuttering planks

Forms or moulds or shutters are the receptacles in which concrete is placed, so that it will have the desired shape or outline when hardened. Once the concrete develops adequate strength, the forms are removed. Forms are generally made of the materials like timber, plywood, steel, etc.

Generally camber is provided in the formwork for horizontal members to counteract the effect of deflection caused due to the weight of reinforcement and concrete placed over that. A proper lubrication of shuttering plates is also done before the placement

of reinforcement. The oil film sandwiched between concrete and formwork surface not only helps in easy removal of shuttering but also prevents loss of moisture from the concrete through absorption and evaporation.

The steel form work was designed and constructed to the shapes, lines and dimensions shown on the drawings. All forms were sufficiently water tight to prevent leakage of mortar. Forms were so constructed as to be removable in sections. One side of the column forms were left open and the open side filled in board by board successively as the concrete is placed and compacted except when vibrators are used. A key was made at the end of each casting in concrete columns of appropriate size to give proper bonding to columns and walls as per relevance.

Fig: 3.8b Form work in progress at the site

3.8.2 CLEANING AND TREATMENT OF FORMS

All rubbish, particularly chippings, shavings and saw dust, was removed from the interior of the forms (steel) before the concrete is placed. The form work in contact with the concrete was cleaned and thoroughly wetted or treated with an approved composition to prevent adhesion between form work and concrete. Care was taken that such approved composition is kept out of contact with the reinforcement.

Fig: 3.8c Cleaning of form work

3.8.3 DESIGN OF FORM WORK

The form-work should be designed and constructed such that the concrete can be properly placed and thoroughly compacted to obtain the required shape, position, and levels subject.

3.8.4 ERECTION OF FORMWORK

The following applies to all formwork:

a) Care should be taken that all formwork is set to plumb and true to line and level.

b) When reinforcement passes through the formwork care should be taken to ensure close fitting joints against the steel bars so as to avoid loss of fines during the compaction of concrete.

c) If formwork is held together by bolts or wires, these should be so fixed that no iron is exposed on surface against which concrete is to be laid.

d) Provision is made in the shuttering for beams, columns and walls for a port hole of convenient size so that all extraneous materials that may be collected could be removed just prior to concreting.

e) Formwork is so arranged as to permit removal of forms without jarring the concrete. Wedges, clamps, and bolts should be used where practicable instead of nails.

f) Surfaces of forms in contact with concrete are oiled with a mould oil of approved quality. The use of oil, which darkens the surface of the concrete, is not allowed. Oiling is done before reinforcement is placed and care taken that no oil comes in contact with the reinforcement while it is placed in position. The formwork is kept thoroughly wet during concreting and the whole time that it is left in place.

Immediately before concreting is commenced, the formwork is carefully examined to ensure the following:

a) Removal of all dirt, shavings, sawdust and other refuse by brushing and washing.

b) The tightness of joint between panels of sheathing and between these and any hardened core.

c) The correct location of tie bars bracing and spacers, and especially connections of bracing.

d) That all wedges are secured and firm in position.

e) That provision is made for traffic on formwork not to bear directly on reinforcement steel.

3.8.5 CHECKING OF SHUTTERING WORK

1. CHECK FOR COLUMN SHUTTERING:-

- Size of column should be checked as per drawing.

- Corner should be checked with the help of tray square i.e. it should be 90° otherwise it must be corrected by loosening and tightening of screws.
- It should be vertical. It can be checked with the help of a plumb bob suspended from the top of the framework touching its face and if there is any difference in the distance at the top, bottom or any intermediate point, it should be corrected with the help of props.
- The 2nd face checked in the same way.
- The oiling of the form work for columns should be properly done.

2. CHECK FOR BEAM AND SLAB SHUTTERING:-

- Size of the beam as per drawing.
- Oiling of slab shuttering should be proper.
- The open space between two consecutive plates should not be more than 1.5 mm and if it is, then it should be fitted with either sand or some steel strip should be fixed there.
- Centering and propping should be tight and proper
- The complete supervision of shuttering is required during casting of different R.C.C units on a floor as shuttering can sometimes fail due repeated use. Stability and strength is the main check for shuttering.

3. CHECK FOR LEVEL:-

Leveling is very indispensable for whole building and before the casting of any unit i.e. slabs, landing of stairs etc. the following steps for leveling are followed:-

- A bench mark is already fixed at site. It is transferred from the one floor to another.
- After setting the levels of the floor, levels are marked with the help of water level because there will be no fluctuation in the water level due to undulation in the slab.

3.8.6 VERTICALITY OF THE STRUCTURE

All the outer columns of the frame were checked for plumb by plumb-bob as the work proceeds to upper floors. Internal columns were checked by taking measurements from outer row of columns for their exact position. Jacks were used to lift the supporting rods called props.

Fig: 3.8d Props at the site

3.8.7 ADVANTAGES OF STEEL FORMWORK

- It provides ease of stripping.
- It ensures an even and smooth concrete surface.
- It possesses greater rigidity.
- It is not liable to shrinkage and distortion.

3.8.8 ADVANTAGES OF PLYWOOD FORM WORK

- It ensures even smoother concrete surface as compared to steel form work.
- It provides ease of stripping.
- It can be made of desired shape and size.

3.8.9 PROPPING AND CENTERING

Props are used for centering and transferring the load of a floor being casted to the ground. It should be remembered that in a building having more than two floors, the load of the upper floor being casted should be suitably supported on a floor below the topmost already casted. Formwork and concrete should not be done unless concrete of the lower floor has set for at least 14 days.

COLUMN

Column is vertical member used to transfer the load from beam to the underneath soil. Site specifications for columns

- **Cover : 40mm**
- **Concrete: M45**

BEAM

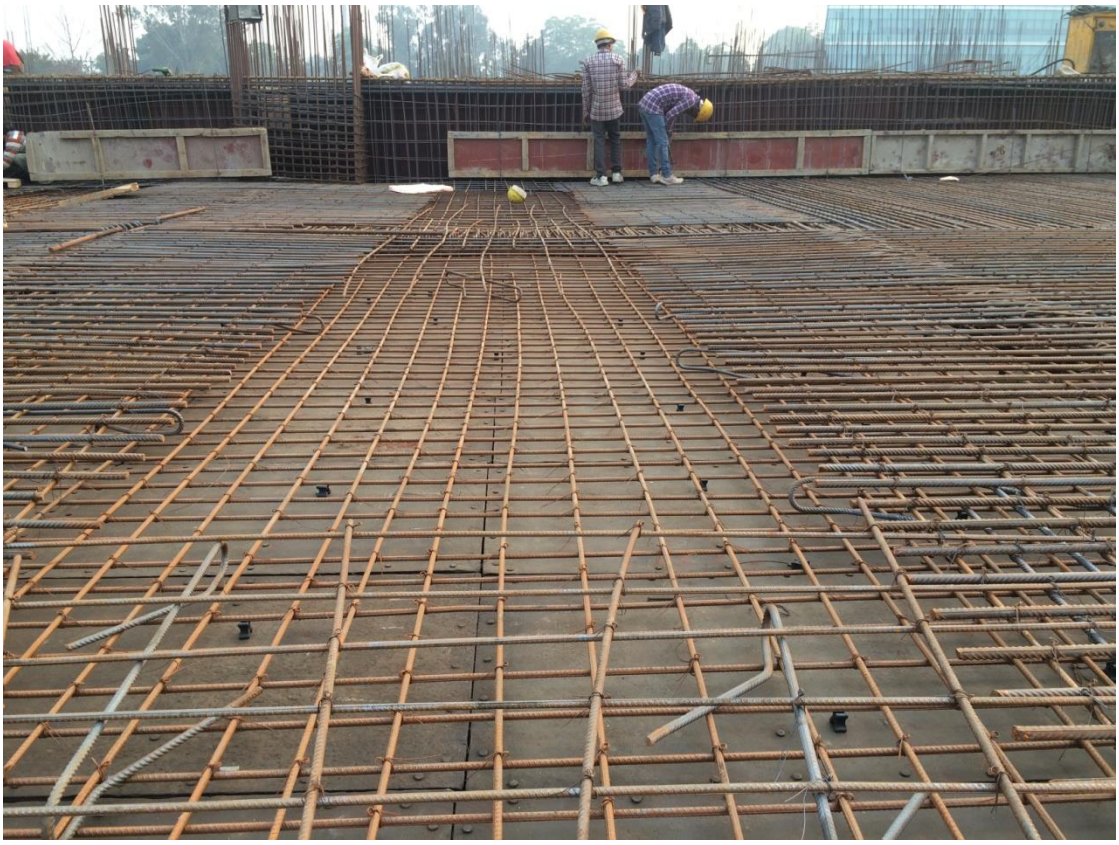
Beam is a horizontal member used to transfer the load from slab to column. Simply supported beams are used at site .Specifications fof beams at site are

- Size : 600mm*350mm
- Cover : 25mm
- Type : simply supported

SLAB

A **concrete slab** is common structural element of modern buildings. Horizontal slabs of steel reinforced concrete, typically between 4 and 20 inches (100 and 500 millimeters) thick, are most often used to construct floors and ceilings, while thinner slabs are also used for exterior paving. Sometimes these thinner slabs, ranging from 2 inches (51 mm) to 6 inches (150 mm) thick, are called *mud slabs*, particularly when used under the main floor slabs[1] or in crawl space .Specification for slab are

- Cover : 25mm
- Thickness : 150mm



3.9 CONCRETING

3.9.1 INTRODUCTION TO CONCRETING

The concrete is a mixture of cement, sand, brick or stone ballast and water, which when placed in forms and allowed to cure, becomes hard like stone. It is much stronger in compression than tension. In order to enable it to resist tensile stresses, it is reinforced or strengthened with steel in the form of steel bars or wire netting etc. the concrete so obtained is called reinforced concrete.

a) For concreting Batching plant and transit mixers are used.

- Capacity of each mixer is 7 cubic meter
- Concreting is done with line concreting method
- In this method pipe of diameter 130mm connected in series and concrete is pushed in pipes with help of pump.

Fig: 3.9b Concrete being pumped through pipes

3.9.2 BATCHING OF MATERIALS

In order to ensure uniformity on the quality of concrete it is necessary that all materials that go into its production are measured accurately within permissible tolerances. Batching of material can be done manually or by using batching plant. The choice of system is too adopted for batching depends upon the magnitude word involved and the rate at which concrete is required to be produced.

While batching cement is always measure by weight, the weight of one bag of cement is taken as 50 kg. Fine and course aggregate are measure by volume in case of manual batching and by weight in case of mechanical batching.

In case of manual batching the quantity of course and fine aggregates are so adjusted as to require one bag of cement for 1 batch. In this case wooden frames are normally used for gauging aggregates by volume.

In case of manual batching the quantity of coarse and fine aggregates are so adjusted as to require one bag of cement for one batch. In this case wooden frames are normally used for gauging aggregates by volume. Use of batching plant is carried out for all important works involving large amount of concreting work and requiring controlled condition for production. Depending upon the size of work the batching

equipment can vary from a small wheel borrow scale, feeding a portable mixer to a complicated automatic or semi-automatic.

The correct measurement of the carious materials used in the concrete mix is called batching. It has been observed that batching errors are partly responsible for the variation in the quality of the concrete. This operation can be properly and better controlled that other factors responsible for the variation in the quality of concrete. It has been observe that poor batching is responsible for more variation to an insignificant amount. Thus batching operation is very important operation.

3.9.2a TYPES OF BATCHING:

Batching can be done in two ways as follow

- volume batching
- Weight batching

1. VOLUME BATCHING:

In this system of batching, the material are measured by volume, the gauging of cement is most inadvisable as it is difficult to secure accuracy in its measurement as the actual volume of given weight of cement depends upon how it is filled into gauge box and whether it is shaken down, the density of cement may vary from 1.12 g/cum if it is lightly poured into container to 1.6 g/cum if tamped down sufficiently hard. Therefore it is convenient to use complete bag of cement is required, then it should be weighted into a bucket suspended from and ordinary spring balance.

Aggregate can be gauged by volume and for this purpose wooden batch boxes are used the size of those boxes should be such ass to measure the corrected quantity of aggregate to be used with bag of cement for the required mix. They should not be made as large as to unwieldy.

Each cement bag as delivered by factories is packed to contain a net weight of 50 kg. As one liters of cement weights 1.44 kg, the volume of 50 kg will be 50/1.44 – 34.72 liters, but for sake it is taken as 35 litres, The wooden batch boxes should be convenient size, to measure of multiples of 35 liters. Tall and narrow woo=den batch boxes should be preferred than shallow and wide ones. In India the dimensions of wooden batch boxes is 40*35*25 cm. The wooden batch boxes should be made of

3cm thick prepared timber, so that it may be strong enough. Water is usually measured by volume, provided the equipment is reliable. The water contained is course and wet sand is difficult to measure.

2. WEIGHT BATCHING:

Now a day for the production of good concrete, all materials are measured by weight. The mixes are incorporated with weight batching devices, such that the weight of any material placed in the load skip is clearly shown on the dial gauge fitted in it. There are several forms of weight batching equipment available covering a wide range of capacities to suit jobs of different sizes.

3.9.3 MIXING OF CONCRETE

Mixing of concrete is an important process. Method of mixing should be decided properly and following points should be adopted. The volume of the unmixed ingredients can be 50% greater that compacted volume

The object of mixing of concrete is to coat the surface of all aggregate particles with cement paste and to blend all ingredients of concrete into a uniform area. During the process of mixing great care is taken to ensure that the materials are in maintained condition.

3.9.4 TRANSPORTATION OF CONCRETE

Concrete should be transported from place of mixing to place of final deposit in shortest possible time, so that there is no segregation or loss of ingredients and the remains workable while placed in position. Different methods adopted are: by steel pans, by wheel barrows, dumpers, trippers, truck mixer, hoist, cableways, cranes, pumping.

The method adopted at our site was by mixer trucks. Hence transportation of concrete of fresh concrete is an important operation. Segregation occurs because concrete is not a homogenous combination, but a mixture of materials of differing in size and specific gravity. Thus as soon as concrete is discharged from mixer, internal as well as external forces start acting to separate the dissimilar constituents. If over wet concrete is

confined in restricting forms, the courser and heavier particles tend to settle and finer and lighter materials tend to rise.

Thus the equipment for conveying concrete from mixer to form should be such as to result in uniform concrete of all desired consistency at the form. The method of converting should not require wetter concrete than is required at form for placing nor should it produce segregation or excessive drying or stiffening etc. to avoid segregation, when concrete is to be transferred from one conveyance to another. This belief is not correct that segregation produced during conveyance can be rectified by compaction.

At our site the concrete was transported by pumps through pipes from the mixer truck to the site where it is to be placed.

Transportation of concrete by pumps has been found useful in following circumstances.

- At congested sites where mixing plant cannot be taken close to the point of placing concrete.
- At the sites where storing of aggregates is not possible due to non-availability of the working space.
- when mass concreting is to be done.(at site 300 cum concreting is done in single day during slab casting)

Concrete by this method can be delivered to points over a wide area otherwise not easily accessible.

This mode of transportation has been found very useful for tunnel large mass concrete structure, densely reinforced concrete structures, etc.

This method is more economical where large quantities of concretes are required at the site.

Pumped concrete is free from segregation. Pumping delivers the concrete directly from the truck mixer to the site and thus avoids double handling .placing can be proceed at the rate of output of the mixer and is not help back by the limitation of transporting and placing equipment.

The selection of the mode of transportation of concrete is made keeping in view of size of the work as well as the rate at which concrete is required . Transportation by mode of pumping is restored to when concrete work is to be carried out on the large

areas or a height. The pipeline is made up of steel tube of 3m in length and 100 to 125 mm in diameter. It is very fast and efficient method.

3.9.5 PLACING OF CONCRETE

Concrete should be placed and compacted immediately after mixing. Placing and compaction are the most critical field activities. Unless care is exercised in these operation, a very poor job may result even through concrete is prepared best. To avoid segregation is the most important, if it occurs. When concrete is placed in deep forms, it is usually allowed to drop regardless of the height. This result in segregation,damage to form and embedded fixtures. Reinforcement and forms above the level of placement become coated with mortar which may dry before the concrete comes to that level. This condition should be avoided by dropping the concrete into an outside pocket and allowing it to flow over into form without segregation. In case of horizontal lawyers, it should be deposited close to its final location., in case of placing concrete is a slab, it should be dumped into face of previously placed concrete, when concrete is to be placed on a slight slope vibration tends to shift it down the slope.

The arrangement for placing should be planned so that mixed mass is used within 30 min. This is necessary to prevent initial set. Before laying concrete shuttering should be cleaned of the dust. Concrete should be laid in layer and compacted properly. Precaution to be taken while placing concrete:-

1. In case of reinforced concrete, thickness of concrete may vary from 15 to 30 cm , it should be laid in horizontal and uniform layers.
2. Concrete should not be thrown from a height of more than 1 m to prevent segregation.
3. No person should be allowed to walk on freshly prepared concrete.
4. Placement of concrete should be stopped during rainfall.
5. In order to prevent formation of irregular surface, concrete should be laid continuously
6. The alignment of reinforcement and concrete should not be disturbed
7. In RCC slab concrete in should start from width wise from the end.

8. In order to prevent better bond between concrete and reinforcement, grease, oil, dry cement should be removed.

3.9.6 COMPACTION OF CONCRETE

Consolidation of concrete should proceed immediately after placing. The function of consolidation of concrete is to expel the air bubbles in the mass and make it impermeable enough to attain desired strength. Thus the object of compacting is to obtain a dense mass of concrete without voids, to get the concrete to surround all reinforcement and to fill all the corners. Compaction of concrete affects the strength, durability, non-permeability of concrete to great extent. Each one percent less compaction reduces the strength of concrete by about 5%on a average. During the process of manufacturing of concrete a considerable amount of air in entrapped forming voids in it. The concrete mass should be consolidated or compaction till the cream of the cement starts appearing on the surface. Over compaction may lead to segregation of concrete while under compaction may leave air voids in the concrete. Consolidation may be done by hand or by mechanical devices. Voids present in concrete in the form of small pores reduce the strength and desist of the concrete.

Various types of voids are-

1. **WATER VOIDS**:- these voids are present due to water in excess of that needed for hydration
2. **AIR VOIDS**: these are either due to insufficient compaction or due to deliberate entrainment of the air in the mix. Concreting containing air voids left due to insufficient compaction of freshly prepared placed concrete lowers the strength very much. Experimental results have shown that 10% of air voids left in concrete reduces its strength by 50%.

Thus freshly laid concrete should be compacted sufficiently so that air voids are completely removed. Voids due to poor compaction can be seen readily when they are at the surface.

3.9.6a METHOD OF COMPACTION

The method of compaction depends on its workability, so that it can be fully compacted. In other words, the required workability of the concrete depends on how much it is to be compacted and by which method. It will also depend on the job condition. Usually following methods are adopted for compaction.

1. **HAND COMPACTION:** hand compaction may be done by Roding, tamping or hammering. Tamping is usually adopted for compacting concrete for slabs or other such surfaces, Roding is done for thin vertical members while hammering is done for massive plain concrete works. This method is adopted for members having reinforcement pavements, narrow and deep member etc. Rammers and iron rods are used for this purpose. Mass concrete should be compacted in layers not less than 30 cm in the thickness while templates or light rammers. For compacting reinforced concrete work iron rods are used. In case the thickness of concrete layers should be more than 15 cm. The most satisfactory method for compacting concrete properly is to consolidate each layer separately so that its top surface becomes level and fairy smooth before the next layer is placed. While tamping is carried out, care should be taken that the rod should be penetrate the full depth of the last layer placed and to some extend into the lying to ensure proper bond between them. Secondly the reinforcement and form work should not be disturbed from their positions.
2. **MECHANICAL COMPACTION:** mechanical compaction is done by the use of vibrators. Compaction of concrete by vibration is considered essential for all important works especially in situations where reinforcements are congested or the member is required is to have exposed to concrete surface finish. When vibrators are used leaner but stiff, concrete mix should be used to obtain greater durability and higher strength. Mixes which are too stiff to consolidate by hand compaction can be easily compacted by mechanical compaction. In case the concrete is compacted by vibration, during which the vibrator communicates rapid vibration to the particles, increases the fluidity of concrete. Due to vibrations the particles occupy a more stable position and the concrete fills all the

space and present is forced out to the surface, resulting in dense and durable concrete. Vibrated concrete has many advantages over the un-vibrated concrete.

3.9.8 CURING OF CONCRETE

Curing of concrete is one of the essential requirements of the process of concreting. Curing is the process of keeping the set concrete continuously damp for some days in order to enable the concrete gain more strength. It has been established that the strength of concrete increases with the age provided it has kept damp. During the process of curing the concrete absorbs the water necessary for its complete chemical action to reach its required strength. The strength of concrete increases more rapidly in the first few days after setting and afterwards the rate of increase the strength go on retarding. The period for which curing should be continued depends upon the atmosphere condition. In general the process of curing should be there for at least 7 days.

Correct curing also increases resistance of concrete to abrasion and reduces shrinkage. Curing is the name given to procedures used for promoting the hydration of cement, and consists of a cantor of temperature and of the moisture movement from and into the concrete. As the hydration of the cement takes place only in the presence of moisture and at favourable temperatures, these conditions must be maintained for suitable interval called the curing period.

3.9.8a OBJECTIVES OF CURING

Following are the objectives of curing:-

1. The main objective of curing is to keep the concrete saturated or as nearly saturated possible until the originally water filled space in the fresh cement has been filled to the desired extent by the product of hydration of cement.
2. To prevent the loss of water by evaporation and to maintain the process of hydration. In case of site concrete the active curing stops long before the maximum possible hydration has taken place.
3. To reduce the shrinkage of concrete

4. To prevent the properties of concrete.

3.9.8b NECESSITY OF CURING

The necessity of curing arises from the fact that hydration of cement can take place only in water filled capillaries. For this reason, loss of water by evaporation from the capillaries must be prevented. Further water lost internally by self-desiccation has to be replaced by water from outside.

Water required for chemical reaction with cement i.e. for hydration is about 25 to 30% of the water added to the cement or less than 50 % of weight of cement, rest of water is used for providing workability and help to continue hydration, thus hydration of sealed specimens can proceed only if the amount of water present in the pastes is at least twice that of the water already combined. Self-desiccation is thus of importance in mixes with water/cement ratio less than 0.5 for higher water/cement ratios the rate of curing of sealed specimens is same as that of saturated specimens. It has been observed that only half the water present in the paste can be used for chemical combination, even if the total amount of water present is less than the water required for combination.

Main concrete elements which are required to be cured are Columns, Slabs and Retaining walls.

CLOUMNS: Wet jute bags are used for the curing of concrete columns. Jute bags are wrapped around columns and made wet in suitable intervals of time.

Fig: 3.9d Column curing with wet Jute bags

SLAB: For curing of slab the entire slab was divided in number of channels. The mix which is used for the boundary of the channel is 1:8. This boundary is in the form of camber which provides support to the stagnant water.

Fig: 3.9e Curing of slabs

STAIRCASE

A stairway, staircase, stairwell, flight of stairs, or simply stairs is a construction designed to bridge a large vertical distance by dividing it into smaller vertical distances, called **steps**. Stairs may be straight, round, or may consist of two or more straight pieces connected at angles.

10 DESHUTTERING (REMOVAL OF FORMWORK)

Forms were not struck until the concrete has attained a strength at least twice the stress to which the concrete may be subjected at the time of removal of form work. The strength referred is that of concrete using the same cement and aggregates with the same proportions and cured under conditions of temperature and moisture similar to those existing on the work. Where so required, form work was left longer in normal circumstances

Form work was removed in such a manner as would not cause any shock or vibration that would damage the concrete. Before removal of props, concrete surface was exposed to ascertain that the concrete has sufficiently hardened. Where the shape of element is such that form work has re-entrant angles, the form work was removed as soon as possible after the concrete has set, to avoid shrinkage cracking occurring due to the restraint imposed. As a guideline, with temperature above 20 degree following time limits should be followed:

Structural Component	Age
Footings	1 day
Sides of beams, columns, lintels, wall	2 days
Underside of beams spanning less than 6m	14 days
Underside of beams spanning over 6m	21 days
Underside of slabs spanning less than 4m	7 days
Underside of slabs spanning more than 4m	14 days
Flat slab bottom	21 days

3.10.1 REPROPPING IN SLABS

After the removal of shuttering or formwork there are some chances of undesired deflection in the beams due to self-weight and overburden loads. in order to avoid deflection in the beams, repropping in don

Fig: 310a Repropping of shutters

3.11 BRICKWORK

3.11.1 INTRODUCTION TO BRICKWORK

Brickwork is masonry done with bricks and mortar and is generally used to build partition walls. In our site, all the external walls were of concrete and most of the internal walls were made of bricks. English bond was used and a ratio of 1:4 (1 cement: 4 coarse sand) and 1:6 were used depending upon whether the wall is 4.5 inches or 9 inches. The reinforcement shall be 2 nos. M.S. round bars or as indicated. The diameter of bars was 8mm. The first layer of reinforcement was used at second course and then at every fourth course of brick work. The bars were properly anchored

at their ends where the portions and or where these walls join with other walls. The in-laid steel reinforcement was completely embedded in mortar.

Bricks can be of two types. These are:

1) TRADITIONAL BRICKS-The dimension if traditional bricks vary from 21 cm to 25cm in length,10 to 13 cm in width and 7.5 cm in height in different parts of country .The commonly adopted normal size of traditional brick is 23 * 11.5*7.5 cm with a view to achieve uniformity in size of bricks all over country.

2) MODULAR BRICKS- Indian standard institution has established a standard size of bricks such a brick is known as a modular brick. The normal size of brick is taken as 20*10*10 cm whereas its actual dimensions are 19*9*9 cm masonry with modular bricks workout to be cheaper there is saving in the consumption of bricks, mortar and labour as compared with masonry with traditional bricks.

3.11.2 STRENGTH OF BRICK MASONRY

The permissible compressive stress in brick masonry depends upon the following factors:

1. Type and strength of brick.
2. Mix of motor.
3. Size and shape of masonry construction.

The strength of brick masonry depends upon the strength of bricks used in the masonry construction. The strength of bricks depends upon the nature of soil used for making and the method adopted for molding and burning of bricks .since the nature of soil varies from region to region ,the average strength of bricks varies from as low as 30kg/sq cm to 150 kg /sq cm the basic compressive stress are different crushing strength.

Fig: 3.11a Brickwork at the site

There are many checks that can be applied to see the quality of bricks used on the site. Normally the bricks are tested for Compressive strength, water absorption, dimensional tolerances and efflorescence. However at small construction sites the quality of bricks can be assessed based on following, which is prevalent in many sites.

• Visual check – Bricks should be well burnt and of uniform size and color.

• Striking of two bricks together should produce a metallic ringing sound.

• It should have surface so hard that can't be scratched by the fingernails.

• A good brick should not break if dropped in standing position from one meter above ground level.

• A good brick shouldn't absorb moisture of more than 15-20% by weight, when soaked in water For example; a good brick of 2 kg shouldn't weigh more than 2.3 to 2.4 kg if immersed in water for 24 hours.

3.11.3 PRECAUTIONS TO BE TAKEN IN BRICK MASONRY WORK

• Bricks should be soaked in water for adequate period so that the water penetrates to its full thickness. Normally 6 to 8 hours of wetting is sufficient.

• A systematic bond must be maintained throughout the brickwork. Vertical joints shouldn't be continuous but staggered.

• The joint thickness shouldn't exceed 1 cm. It should be thoroughly filled with the cement mortar 1:4 to 1:6 (Cement: Sand by volume)

• All bricks should be placed on their bed with frogs on top (depression on top of the brick for providing bond with mortar).

• Thread, plumb bob and spirit level should be used for alignment, verticality and horizontality of construction.

• Joints should be raked and properly finished with trowel or float, to provide good bond.

• A maximum of one metre wall height should be constructed in a day.

• Brickwork should be properly cured for at least 10 days

CHAPTER: 4 EQUIPMENTS AND MACHINERY USED

The following are the major machineries used at the construction site of the Student welfare Center at NIT, Jalandhar

4.1 Concrete pump

4.2 Poclain

4.3 Transit mixer

4.4 Bar bending machine

4.5 Needle vibrator

4.6 Concrete mixer

4.7 Hilti machine

4.1 CONCRETE PUMP

A concrete pump is used for transferring concrete mix at desired location by pumping. Generally such methodology for casting is used in congested sites where mass concrete works in operation. Concrete pump consists of a powerful engine fitted with a long pipe whose end is of rubber and rest length is of steel.

Fig: 4.1a Concrete Pump

4.2 POCLAIN

It is used for excavating and leveling at site. It is fitted with a short length boom. It can dig tougher material than lies within the possibilities of longer boom machine. The bucket capacity of Poclain is .3m^3.

Structure of Poclain provides basic operations:-

- Movement of the machine known as 'CRAWLING'
- Revolving action of super structure known as 'SWINGING'.
- The total amount of earthwork is **15,868 m^3**

fig: 4.2a Poclain

4.3 TRANSIT MIXER

Concrete shall be transported to the location from the place of production or from the batching plant by transit mixers. The r.p.m of transit mixer is 1.5 approx to avoid setting of concrete.

fig: 4.3a Transit mixer

4.4 BAR-BENDING MACHINE

It is used for bending the bars and making stirrups.

fig: 4.4a Bar-bending Machine

4.5 NEEDLE VIBRATOR

For proper compaction of concrete vibrators are set up at the site. These vibrators are run with the help of electricity. Some can even run on fuel (diesel). These vibrators are small round equipment made of iron. These produce very strong vibrations which are transferred to the concrete through nozzle which is of different sizes according to diameter. These vibrations helps in proper compaction of concrete as the air voids are expelled out completely.

fig: 4.5a Needle Vibrator

4.6 CONCRETE MIXER

It homogeneously combines cement, aggregates such as sand and gravel, and water to form concrete. For smaller volume works portable concrete mixers are often used so that concrete can be made on construction site, giving the workers ample time to use the concrete before it hardens.

fig: 4.6a Concrete Mixer

4.7 HILTI MACHINE

It is machine which has been used on site for the cutting of concrete. It induces vibrations in the concrete and breaks it.

fig: 4.7a Hilti Machine

CHAPTER: 5 MATERIALS USED AT SITE

Following materials are used at site:-

- Cement
- Aggregates
- Concrete (already covered)
- Bricks (already covered)
- Steel
- Water

5.1 CEMENT

Cement is binder which is use to bind aggregates. When gypsum is added to the clinker, it forms a lump. This lump is then pulverized into very fine powder. This fine powder is known as cement.

Cement used at site has following details:-

Cement- ultra tech

fig: 5.1a Bags of cement at the site

5.1.1 STORAGE OF CEMENT

It needs extra care or else can lead to loss not only in terms of financial loss but also in terms of loss in the quality. Following are the don't that should be followed -

(i) Do not store bags in a building or a godown in which the walls, roof and floor are not completely weatherproof.

(ii) Do not store bags in a new warehouse until the interior has thoroughly dried out.

(iii) Do not store the content with badly fitting windows and doors, make sure they fit properly and ensure that they are kept shut.

(iv) Do not stack bags against the wall. Similarly, don't pile them on the floor unless it is a dry concrete floor. If not, bags should be stacked on wooden planks or sleepers.

(v) Do not forget to pile the bags close together

(vi) Do not pile more than 15 bags high and arrange the bags in a header-and-stretcher fashion.

(vii) Do not disturb the stored cement until it is to be taken out for use.

(viii) Do not take out bags from one tier only. Step back two or three tiers.

(ix) Do not keep dead storage. The principle of first-in first-out should be followed in removing bags.

(x) Do not stack bags on the ground for temporary storage at work site. Pile them on a raised, dry platform and cover with tarpaulin or polythene sheet.

fig: 5.1b Storage of cement

5.2 AGGREGATE

5.2.1 COARSE AGGREGATE

Coarse aggregate for the works should be river gravel or crushed stone .It should be hard, strong, dense, durable, clean, and free from clay or loamy admixtures or quarry refuse or vegetable matter. The pieces of aggregates should be cubical, or rounded shaped and should have granular or crystalline or smooth (but not glossy) non-powdery surfaces. Aggregates should be properly screened and if necessary washed clean before use.

Coarse aggregates containing flat, elongated or flaky pieces or mica should be rejected. The grading of coarse aggregates should be as per specifications of IS-383.

After 24-hrs immersion in water, a previously dried sample of the coarse aggregate should not gain in weight more than 5%.

Aggregates should be stored in such a way as to prevent segregation of sizes and avoid contamination with fines.

Depending upon the coarse aggregate color, there quality can be determined as:

Black => very good quality

Blue => good

Whitish =>bad quality

5.2.2 FINE AGGREGATE

Aggregate which is passed through 4.75 IS Sieve is termed as fine aggregate. Fine aggregate is added to concrete to assist workability and to bring uniformity in mixture. Usually, the natural river sand is used as fine aggregate. Important thing to be considered is that fine aggregates should be free from coagulated lumps.

Grading of natural sand or crushed stone i.e. fine aggregates shall be such that not more than 5 percent shall exceed 5 mm in size, not more than 10% shall IS sieve No. 150 not less than 45% or more than 85% shall pass IS sieve No. 1.18 mm and not less than 25% or more than 60% shall pass IS sieve No. 600 micron.

5.3 STEEL

The steel used for reinforcement shall be any of the following types:

(a) Mild steel and medium tensile bars conforming to IS 432 (Part I)
(b) High strength deformed steel bars conforming to IS 1786
(c) Hard drawn steel wire fabric conforming to IS 1566
(d) Structural steel conforming to Grade A of IS 2062
(e) Thermo-mechanically treated (TMT) Bars.

Elongation percent on gauge length is 5.65 A where A is the cross sectional areas of the test piece.

Mild steel is not recommended for the use in structures located in earthquake zone subjected to severe damage and for structures subjected to dynamic loading (other than wind loading) such as railway and highway bridges.

Welding of reinforcement bars covered in this specification shall be done in accordance with the requirements of IS 2751.

CHAPTER: 6 MIX DESIGN OF CONCRETE

Description: Coarse aggregates (20mm, 10mm crushed), Sand (natural), Cement PPC (make : ultrtech) have been tested for their suitability as per relevant IS: specifications and concrete mix design for **M-25** grade of concrete has been worked out using clean drinking water. The detail study as per IS: 10262 & SP-23 given below:

A. TEST DATA OF MATERIALS:

S.No.	Parameters	Test Method	Results
1.	Initial setting time(minutes)	IS: 4031	120
2.	Final setting time(minutes)	IS: 4031	275
3.	Fineness (%)	IS: 4031	6.0
4.	Compressive strength(168 hours-MPa)	IS: 4031	37.84
5.	Specific gravity	IS: 4031	3.13
6.	Soundness (mm)	IS: 4031	2.00

COARSE AND FINE AGGREGATE

S.No.	Parameters	Test method	20mm	10mm	sand

1.	Specific gravity	IS: 2386	2.72	2.72	2.61
2.	Water absorption	IS: 2386	0.43	0.48	0.84
3.	Surface moisture in lab (%)	IS: 2386	Nil	Nil	Nil
4.	Bulk density kg/cum	IS: 2386	1550	1540	1780
5.	Abrasion value (%)	IS: 2386	24.2	24.6	…
6.	Crushing value (%)	IS: 2386	21.6	20.8	…
7.	Elongation index (%)	IS: 2386	8.1	10.6	…
8.	Flakiness index (%)	IS: 2386	10.9	15.0	…
9.	Sieve analysis	IS: 2386			

The gradation of coarse aggregates (20mm & 100mm), combined aggregate(as graded 20 mm) & fine aggregate is given below :

Sieve size (mm)	% passing			
	Coarse aggregate		Combined As graded 20mm=60% 10mm=40%	Fine aggregate
	20 mm	10 mm		
40.0	100	100	100	...
20.0	93.3	100	96.0	
10.0	12.1	82.9	40.4	
4.75	2.6	19.7	9.4	
2.36	…	0.7	…	
1.18	…	…	…	
0.60	…	…	…	
0.30	…	…	…	
0.15	…	…	…	

The cement, 20 mm and 10 mm aggregates(mixed in ratio 60:40 to get well graded aaggregates) fulfil the IS codal provisions.

B. DESIGN STIPULATIONS:

a) Grade designation M-25
b) Type of cement ultatech(PPC)
c) Maximum nominal size of aggregate 20mm
d) Maximum water-cement ratio 0.50
e) Workability Good
f) Exposure condition Moderate
g) Degree of supervision Good
h) Type of aggregate crushed

i) Maximum cement content 450kg/m3

C. TARGET MEAN STRENGTH OF CONCRETE:

The target mean strength for the cub (N/sq.mm) 31.6

D. SELECTION OF WATER CEMENT RATIO:

From IS: 456 table – 5,maximum water – cement ration 0.50

Based on experience adopted water cement ratio 0.45

0.45<0.50 ok

E. SELECTION OF WATER CONTENT:

Maximum water content for 20mm aggregate for 25 to 50mm slump 186 kg

F. DETERMINATION OF CEMENT CONTENT:

Water – cement ratio	=	0.45
Water (kg)	=	186
Therefore cement (kg/m3)	=	412

G. CONCRETE MIX DESIGN FOR M25 GRADE CONCRETE:

As per IS code 10262-2009,concrete mix proportions for M25 grade for a target strength of 32.6 N/Sq. mm are given as under. The mix proportion is decided on the basis of three trial mixes to achieve the required compressive strength and workability. The trial with 412 kg/m3 of cement is recommended and actual quantities required for the mix is:

Material **Quantity (kg/cu.m)**

Water	186
Cement	412
Fine aggregates	640
Coarse aggregates	1180
	20 mm (60%) = 708
	10 mm (40%) = 472

Compressive strength has been checked in 7 days and 28 days and found satisfactory.

Compressive strength at 7 days = 23.5 N/sq.mm

Compressive strength at 28 days = 33.0 N/sq.mm

The ratio of materials to be used is as under:

Water	:	cement	:	fine aggregate	:	coarse aggregates
0.45	**:**	**1**	**:**	**1.55**	**:**	**2.86**

CHAPTER: 7 TESTS PERFORMED ON SITE

7.1 SILT CONTENT TEST

The sand shall not contain more than 8% of silt as determined by field test with measuring cylinder. The method of determining silt contents by field test is given below:

A sample of sand to be tested shall be placed without drying in a 200 ml measuring cylinder. The volume of the sample shall be such that it fills the cylinder upto 100 ml mark Clean water shall be added upto 150 ml mark. Dissolve a little salt in the water in the proportion one tea spoon to half a litre. The mixture shall be shaken vigorously, the last few shakes being sidewise direction to level off the sand and the contents allowed to settle for three hours.

The height of the silt visible as settled layer above the sand shall be expressed as a percentage of the height of sand below. The sand containing more than the above allowable percentage of silt, shall be washed so as to bring the silt contents within allowable limits.

7.2 BULKING OF FINE AGGREGATES/SAND

In a 250 ml measuring cylinder, pour the damp sand, consolidate it by staking until it reached the 200 ml mark.

Then fill the cylinder with the water and stir the sand well (the water shall be sufficient to submerge the sand completely). It will be seen that the sand surface is now below its original level. Suppose the surface is at the mark of Y ml, the percentage of bulking of sand due to moisture shall be calculated from the formula.

Percentage bulking= (200/Y – 1) x 100

7.3 SLUMP TEST

Apparatus: Mould shall consist of a metal frustum of cone having the following internal dimensions:

Bottom diameter……..20 cm

Top diameter……10 cm

Height……30 cm

The mould shall be of a metal other than brass and aluminium of at least 1.6 mm thickness. The top and bottom shall be open and at right angles to the axis of the cone. The mould shall have a smooth internal surface. It shall be provided with suitable foot pieces and handles to facilitate lifting it from the moulded concrete test specimen in a vertical direction as required by the test. A mould provided with a suitable guide attachment may be used.

Tamping rod shall be of steel or other suitable material 16 mm in diameter 60 mm long and rounded at one end.

Procedure: The internal surface of the mould shall be thoroughly cleaned and free form superfluous moisture and any set concrete before commencing the test. The mould shall be placed on a smooth horizontal, rigid and non-absorbent surface viz. levelled metal plate. The operator shall hold the mould firmly in place while it is being filled with test specimen of concrete. The mould shall be filled in four layers, each approximately one quarter of height of mould. Each layer shall be tamped with twenty five strikes of the rounded end of the tamping rod. The strokes shall be distributed in a uniform manner over the cross section of the mould and for the second and subsequent layers shall penetrate into the underlying layer. The bottom layer shall be tamped throughout its depth. After the top layer has been rodded, the concrete shall be struck off level with trowel or the tamping rod, so that the mould is exactly filled.Any mortar which shall leak out between the mould and the base plate shall be cleaned away. The mould shall be removed from the concrete immediately after filling by raising it slowly and carefully in a vertical direction. The moulded concrete shall then be allowed to subside and the slump shall be measured immediately by determining the difference between the height of the mould and that of the highest point of specimen.

The above operations shall be carried out at a place free from vibration or shock, and within a period of two minutes after sampling.

Result: The slump shall be recorded in terms of millimeters of subsidence of the specimen during the test. Any slump specimen which collapses or shears off laterally give incorrect result. If this occurs, the test shall be repeated with another sample. The slump test shall not be used for very dry mixes as the results obtained are not accurate

7.4 BRICK TEST FOR WATER ABSORPTION

No. of Specimen

Five whole bricks shall be taken from samples as specimen for this test.

Apparatus

A balance required for this test shall be sensitive to weigh 0.1 percent of the weight of the specimen.

Procedure

(a) Pre-conditioning*:* The specimen shall be allowed to dry in a ventilated oven at a 110°C to 115°C till it attains a substantially constant weight. If the specimen is known to be relatively dry, this would be accomplished in 48 hours, if the specimen is wet, several additional hours may be required to attain a constant weight. It shall be allowed to cool at room temperature. In a ventilated room, properly separated bricks will require four hours for cooling, unless electric fan passes air over them continuously in which case two hours may suffice. The cooled specimen shall be weight (W1) a warm specimen shall not be used for this purpose.

(b) Actual Testing*:* Specimen shall be completely dried before immersion in the water. It shall be kept in clean water at a temperature of 27°C ± 2°C for 24 hours. Specimen shall be wiped out of the traces of water with a damp cloth after removing from the water and then shall be weighed within three minutes after removing from water (W2).

Reporting the Test Results

The water absorption of each specimen shall be calculated as follows and the average of five tests shall be reported.

$$\text{Water Absorption} = \frac{(W_2 - W_1)}{W_1} \times 100$$

Criteria for Conformity

A lot shall be considered having satisfied the requirements of water absorption if the average water absorption is not more than 20% by weight.

7.5 BRICK TEST FOR COMPRESSIVE STRENGTH

Specimen

Five whole bricks shall be taken from the samples as specimens for this test. Length and width of each specimen shall be measured correct to 1 mm.

Apparatus

The apparatus consists of compression testing machine, the compression plate of which shall have a ball seating in the form of portion of a sphere the centre of which shall coincide with the centre of the plate.

Procedure

(a) *Pre-conditioning:* The specimen shall be immersed in the water for 24 hours at 25º to 29ºC. Any surplus moisture shall be allowed to drain at room temperature. The frog of the bricks should be filled flush with mortar 1:3 (1 cement : 3 clean coarse sand of grade 3 mm and down) and shall be kept under damp jute bags for 24 hours, after that these shall be immersed in clean water for three days. After removal from water, the bricks shall be wiped out of any traces of moisture.

(b) *Actual Testing:* Specimen shall be placed with flat faces horizontal and mortar filled face upward between three 3 ply plywood sheets each of thickness 3 mm and carefully centred between plates of the testing machine. Plaster of Paris can also be used in place of plywood sheets to ensure a uniform surface. Load shall be applied carefully axially at uniform rate of 14 N/mm2 per minute till the failure of the specimen occurs.

Reporting the Test Results

The compressive strength of each specimen shall be calculated in N/mm2 as under :

Maximum load at failure (in N)

$$\text{Compressive Strength} = \frac{\text{Maximum load at failure}}{\text{Area of Specimen (in sq. mm)}}$$

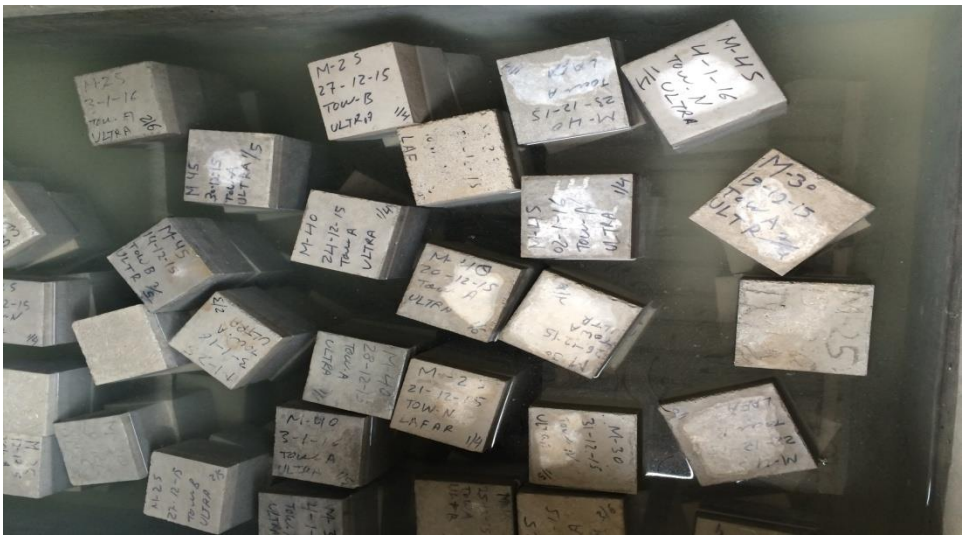
In case the compressive strength of any individual brick tested exceeds the upper limit of the average compressive strength specified for the corresponding class of brick, the same shall be limited to the upper limit of the class specified in 6.1.2 for the purpose of calculating the average compressive strength. Compressive strength of all the individual bricks comprising the sample shall be averaged and reported.

Criteria for Conformity

A lot shall be considered having satisfied the requirements of average compressive strength if the average compressive strength specified in 6.1.2 for the corresponding class of brick tested is not below the minimum average compressive strength specified for the corresponding class of bricks by more than 20 per cent

7.6 CONCRETE CUBE TEST AT SITE

To check the strength of the concrete cube test is done. In cube test we filled the cubes before placing. Generally 6 to 7 cubes are filled. And they are immersed in water for 28 days. The compressive strength is an indication of the strength of concrete. Other strengths are generally prescribed in terms of percentage of compressive strength.



cube test on concrete

Materials used in testing are:-

- Cubical molds of 150mm size.
- Tamping rod
- Trowel

- Compression testing machine

The procedure adopted for cube testing is given below:-

1. Place the cube mold on a non-porous base plate. Apply oil to the inside of the mold.
2. Fill the concrete into the mold in layers approximately 50 mm dept. Compact the concrete with tamping rod 25 strokes per layer.
3. Leave the concrete in mold for about 2-4 hours. Scrap the surface of the concrete a little applies on it, cement paste of stiff consistency.
4. Place the steel cover plates or glass plates on the mold.
5. Allow the cubes to set and harden for 24 hours. The time is counted from the time of addition of water to dry ingredients.
6. Remove the specimens from the moulds and submerged them in clean and fresh water for curing.
7. Remove the specimens from the water after 28 days and wipe off the surface water.
8. Place the specimen in compression testing machine in such manner that the load should be applied to opposite sides of cubes as cast i.e. not to top and bottom.
9. Apply load slowly till the cubes breaks.
10. Note down the maximum load.

It should be noted that load is applied in centre. Even a small eccentricity can cause serious deviation of results.

The grade of concrete used on our site was M25 and strength obtained from the cube test was approx. 27-28 N/mm^2.

CHAPTER: 8 CONCLUSION

- Durability of a building depend mainly on proper construction process and proper use of materials.

- I have supervised slab work, brick work, beams and columns, plaster work etc.

- After supervision of my construction, I have learnt a lot about theoretical background and achieve practical experience. It seems to me that the practical knowledge is essential to be an efficient civil engineer.

