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ARTICLE

# INVESTIGATION ON QUALITY ASSURANCE & QUALITY CONTROL IN HIGH RISE BUILDINGS

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## ABSTRACT

*Quality control in construction typically involves insuring compliance with minimum standards of material and workmanship in order to insure the performance of the facility according to the design. These minimum standards are contained in the specifications described in the previous section. For the purpose of insuring compliance, random samples and statistical methods are commonly used as the basis for accepting or rejecting work completed and batches of materials. Constructions of high rise building provide the comfort living standard for the people and also help in the planning of the cities. Defects or failures in constructed facilities can result in very large costs. Even with minor defects, re-construction may be required and facility operations impaired. Increased costs and delays are the result. In the worst case, failures may cause personal injuries or fatalities. The main purpose of this paper is to present the Quality Assurance & Quality Control in High Rise Buildings. Specifications of work quality are an important feature of facility designs. Also for the high rise building the requirements and laboratory tests that are essential for it are mentioned. This chapter also shows the importance of analytical quality assurance during the construction process and presents an introduction to successful and economic method development.*

**KEY WORDS**
*Schistosoma nasale, cross H.F cow, Anthioma line*

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## INTRODUCTION

Infection Quality is an important factor when it comes to any product or service. With the high market competition, quality has become the market differentiator for almost all products and services. Therefore, all manufacturers and service providers out there constantly look for enhancing their product or the service quality. In order to maintain or enhance the quality of the offerings, manufacturers use two techniques, quality control and quality assurance. These two practices make sure that the end product or the service meets the quality requirements and standards defined for the product or the service. There are many methods followed by organizations to achieve and maintain required level of quality. Some organizations believe in the concepts of Total Quality Management (TQM) and some others believe in internal and external standards. The standards usually define the processes and procedures for organizational activities and assist to maintain the quality in every aspect of organizational functioning. When it comes to standards for quality, there are many. ISO (International Standards Organization) is one of the prominent bodies for defining quality standards for different industries. Therefore, many organizations try to adhere to the quality requirements of ISO. In addition to that, there are many other standards that are specific to various industries.

As an example, SEI-CMM is one such standard followed in the field of software development. Since standards have become a symbol for products and service quality, the customers are now keen on buying their product or the service from a certified manufacturer or a service provider. Therefore, complying with standards such as ISO has become a necessity when it comes to attracting the customers.

- A high standard or level
- Degree of excellence
- Distinguishing feature
- Satisfaction of a customer's needs or requirements
- Quality is "totally of characteristics of an entity that bear on its ability to satisfy stated and implied

Quality inspections on site (Site Supervision):

- Attend contractor(s) progress meetings
- Review and check the contractor(s) methods and techniques
- Monitor the contractor(s) QA/QC procedures
- Review and witness all fields tests and inspections

Quality Control:

The operational techniques and activities that are used to fulfill requirements for quality and various statistical analyses used to verify continued system performance.

For the (whole) project execution, the contractor shall maintain a quality system that is based upon international accepted standards. This quality system is described (by the contractor) in a specific "Project Quality Plan", which should include subjects as project organization, procedures to be applied during engineering, procurement, fabrication, construction and commissioning and a summary of quality control plans.

Many people get confused between quality control (QC) and quality assurance (QA). Let's take a look at quality control function in high-level. As we have already discussed, organizations can define their own internal quality standards, processes and procedures; the organization will develop these over time and then relevant stakeholders will be required to adhere by them. The process of making sure that the stakeholders are adhered to the defined standards and procedures is called quality control. In quality control, a verification process takes place. Certain activities and products are verified against a defined set

of rules or standards. Every organization that practices QC needs to have a Quality Manual. The quality manual outlines the quality focus and the objectives in the organization. The quality manual gives the quality guidance to different departments and functions. Therefore, everyone in the organization needs to be aware of his or her responsibilities mentioned in the quality manual.
Quality Assurance:

In order to deliver products which continuously meet the require¬ments, (sub) contractors have to produce according to a quality its control plan. These quality control plans have to include all certified material deliveries, component manufacturing steps, factory acceptance tests and site acceptance tests. Quality Assurance is a broad practice used for assuring the quality of products or services.

There are many differences between quality control and quality assurance. In quality assur-ance, a constant effort is made to enhance the quality practices in the organization. Therefore, continuous improvements are expected in quality functions in the company. For this, there is a dedicated quality assurance team commissioned. Sometimes, in larger organizations, a 'Process' team is also allocated for enhancing the processes and procedures in addition to the quality assurance team. Quality assurance team of the organization has many responsibilities. First and foremost responsibility is to define a process for achieving and improving quality. Some organizations come up with their own process and others adopt a standard processes such as ISO or CMMi. Processes such as CMMi allow the organizations to define their own internal processes and adhere by them. Quality assurance function of an organization uses a number of tools for enhancing the quality practices. These tools vary from simple techniques to sophisticated software systems. The quality assurance professionals also should go through formal industrial trainings and get them certified. This is especially applicable for quality assurance functions in software development houses. Since quality is a relative term, there is plenty of opportunity to enhance the quality of products and services. The quality assurance teams of organizations constantly work to enhance the existing quality of products and services by optimizing the existing production processes and introducing new process

## ABOUT MY HOME ABHRA

- Heart Of Modern Hyderabad
- Well Connected To Other Parts Of The City Through A Network Of Wide Roads Bustling Shopping And Entertainment Hub
- A Host Of Hospitals, Schools, Banks, ATM's And Sports Institutions In Close Proximity
- Swift Access To Airport Via Outer Ring Road
- Investment Goldmine

### Expanse

- Private Home Theater Lounge
- Marble Flooring Of Premium Quality
- Serene And Safe Ground Level With Minimal Vehicular Movement
- Floor To Floor Height Of 10'4"
- Dry And Wet Kitchen In Selected Apartment
- Accommodation For Domestic Help In Select Apartments
- 73% Open Space

### Comfort

- Jogging track
- Indoor air-conditioned squash & shuttle courts
- Basketball court
- Indoor swimming pool
- Gym & spa
- Library & secured
- Outdoor & indoor children's play area
- Landscaped central plaza
- Reticulated pipe gas system
- Metered water and electricity
- Garbage disposal system and servant toilets at every alternate mid-landing level

- Provision for centralized VRV system for air-conditioning
- Car wash area and centralized laundry
- 24x7 security system
- Access ramps at all entrances provided for physically challenged
- Sewage treatment plant
-

## Home features

- Living, Dining and family room
- Amalgamated/ imported marble flooring of reputed make
- Smooth putty finish with 2 coats of premium acrylic emulsion paint of reputed make over a coat of primer
- Teak wood/granite door frames with veneered flush door shutters, melamine finish & reputed hardware
- UPVC door frames with clear float glass paneled shutters and designer hardware of reputed make for French doors
- UPVC window site with clear float glass with suitable finishes as per design, with provision for mosquito mesh track
- Aesthetically designed mild steel (M.S) grills with enamel paint finish

## Bed room

- 600 x 600 mm size double charged vitrified tiles / wooden flooring
- Smooth putty finish with 2 coats of premium acrylic emulsion paint off reputed make over a coat of primer
- Teak wood / granite door frames with veneered flush door shutters, with melamine finish & reputed hardware
- UPVC window system with clear float glass that are equipped with sliding shutters and a provision for mosquito mesh track

## Bath rooms

- Acid resistant, anti-skid ceramic tiles of reputed make. Glazed ceramic tile dado of reputed make up to 7'-4" height
- Kohler, Roca, Depravity or equivalent fittings
- Vanity type counter top
- EWC with flush valve of best brands
- Single lever with wall mixer cum shower of best brands
- Provision for geysers in all bathrooms

## Kitchen

- 600 x 600 mm size double charged vitrified tiles
- Smooth putty finish with 2 coats of premium acrylic emulsion paint of reputed make over a coat of primer
- Glazed ceramic tiles dado up to 2'-0" height above kitchen platform of reputed make
- Supply of gas from centralized gas bank to all individual flats with pre-paid gas meters
- Granite platform with stainless steel sink
- Provision for fixing of water purifier, exhaust fan & chimney
- Provision for geyser for hot water near the sink
- Basketball Courts, Children's Play Area
- Indoor Air-Conditioned Badminton And Squash Courts
- Fully-Equipped State-Of-The-Air Gym / Spa
- Indoor Swimming Pool

## Specifications

- Number of towers 5
- Number of floors per tower G+17
- Number of flats 387
- Number of flats per floor 2 and 5
- Land area 5 Acres
- Sizes:
- 3 & 4 BHK lifestyle apartments ranging from 2310 to 4650 S.ft
- Parking: 2 level parking (Basement I and Basement II)
- Number of lifts per tower 3
- Earthquake resistance structure
- Vaastu compliant and eco-friendly building

**Structure**

- R.C.C framed structure : R.C.C framed structure to withstand wind and seismic loads
- Superstructure: 8" thick solid blocks for external walls and 4" thick blocks for internal walls

**Plastering**

- Internal : 1 coat of plastering for walls
- External : 2 coats of plastering for external walls

**Doors**

- Main door: Teak wood / granite door frames with veneered flush door shutters, melamine finished & reputed hardware
- Internal doors: Teak wood / granite door frames with veneered flush door shutters, melamine finished & reputed hardware
- French doors (if any): UPVC door frames with clear float glass paneled shutters and designer hardware of reputed make
- Windows: UPVC windows system with clear float glass with suitable finishes as per design, with provision for mosquito mesh track
- Grills: Aesthetically designed, mild steel (M.S) grills with enamel paint finish

**Paintings**

- External: Textured / smooth finish with two coats of exterior emulsion paint of reputed make
- Internal: smooth putty finish with 2 coats of premium Acrylic emulsion paint of reputed make over a coat of primer

**Flooring**

- Living, dining: Amalgamated marble / imported marble flooring of reputed make
- All Bedrooms & kitchen: 600 x 600 mm size double charged vitrified tiles
- Bathrooms: Anti-skid ceramic tiles – of reputed make
- All Balconies: Rustic vitrified file to reputed make
- Staircase/corridor: Marble

**Dadoing**

- Dadoing in kitchen: Glazed ceramic tiles dado up to 2'-0" height above kitchen platform of reputed make
- Bathrooms: Glazed ceramic tile dado of reputed make up to 7'-4" height
- Servants' rooms & utility: Rustic vitrified tile of reputed make

Parking management

- Entire parking is well designed to suit the number of cars parks, provision of parking signage's at required places for ease of driving

Fire and Safety

- Fire hydrant and fire sprinkler system in all floors and basements
- Fire alarm and public address system in all floors and parking areas (basements)
- Control panel will be kept at main security

## Facilities for physically Challenged

- Access ramps at all entrances shall be provided for physically challenged

Kitchen:

- Tiles dado up to 3' height in utility wash areas
- Granite platform with stainless steel sink
- Provision for fixing of water purifiers, exhaust fan & chimney
- Provision for geyser for hot water near the sink

## Utilities / wash

- Dish washer and washing machine provision in the utility area

## Bathrooms

- Vanity type wash basin / counter top
- EWC with flush tank of best brands
- Single lever fixtures with wall mixer cum shower of best brands
- Provision for geysers in all bathrooms
- All C.P fittings are chrome plated of best brands

## Electrical

- Concealed copper wiring of best brands
- Power outlets for air-conditioners in all rooms
- Power outlets for geysers in all bathrooms
- Power plug for cooking range chimney, refrigerator, microwaves ovens, mixer / grinders in kitchen, washing machine and dish washer in utility are
- Three phase supply for each unit and individual meter boards
- Miniature circuit breakers (MCB) for each distribution boards are of best brands

Telecom / Internet / Cable TV:

- FTH with Wi-Fi internet DTH, Telephone & intercom.

## Lifts

- High speed automatic passenger lifts with rescuer device with V3F for energy efficiency
- One service lifts with V3F for energy efficiency for each tower. Entrance with granite / marble cladding.

## WTP & STP

- Fully treated water made available through exclusive water softening and purification plant in case of bore-well water, water meters for each unit
- A sewage treatment plant of adequate capacity as per norms will be provided inside the project, treated sewage water will be used for the landscaping and flushing purpose

## Generator

- D.G set backup with acoustic enclosure & A.M.F

## Security / BMS

- Sophisticated round-the-clock security system
- Panic button and intercom is provided in the lifts connected to the security room
- Solar power fencing around the compound
- Surveillance cameras at the main security and entrance of each block & in all lifts
- Video door phone for each apartment connected to security for screening for the visitors

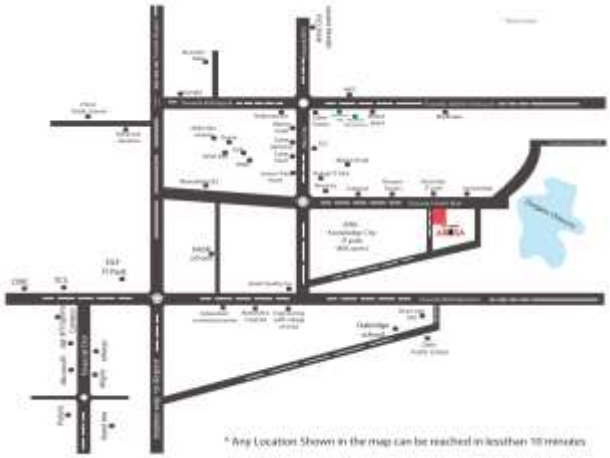

**Fig. 1:** Location map

**LPG:**

- Supply of gas from centralized gas bank to all individual flats with pre-paid gs meters
- Centralized Air-Conditioning:
- Provision for centralized VRV system for all rooms as per the requirement of approved make.

| S.No | Trial No | Amount of cement | Amount of water | Depth of penetration |
|---|---|---|---|---|
| 1 | 1 | 500 grams | 150 mm3 | 16 mm |
| 2 | 2 | 500 grams | 155 mm3 | 9 mm |
| 3 | 3 | 500 grams | 160 mm3 | 5 mm |

## METHODOLOGY

### CONCRETE

Building material in use since Roman times, made up of four main ingredients: coarse aggregate (gravel, usually more than 4.75 mm), fine aggregate (sand, usually less than 4.75 mm), Portland cement, and water. Air too plays an important part, and often special additives (called admixtures) are also added to improve or modify the concrete's properties.

Concrete in various forms is being commonly used in the constructional field these days. The use of cement concrete is becoming more and more popular in construction engineering where strength and durability are of prime importance. Plain cement concrete, Reinforced cement concrete and per-stressed cement concrete are replacing other construction material due to their better appearance, high crushing strength, more durability, imperviousness, quickness and ease of monolithic construction, less maintains cost etc.

### QUALITY ASSURANCE

For the quality assurance we are conducted laboratory tests on cement, aggregate and hardened concrete. The tests on Cement conducted are Fineness, Consistency, Initial and final setting time, Soundness. The tests on Aggregates conducted are Sieve analysis, Water absorption, Aggregate abrasion value, Aggregate impact value, Aggregate crushing value. The tests on Hardened Concrete conducted are Non-destructive tests, Rebound hammer, Ultrasonic pulse velocity, and Compression test.

## RESULTS

The following tests are conducted on cement for the quality assurance.

**Tests on cement**

### FINENESS:

W1=Total weight of cement

W2=Total weight of residue
Total weight of cement w1=100grm
Total weight of residue w2=13.4grm
% of fines=86.6%

**CONSISTENCY:**

Taking fresh samples of cement and different quantities of water until the reading on the Vicat apparatus gauge 5 to 7mm.
We made three trials to achieve our result of the normal consistency using fresh cement in each trial.

**Table 1:** Determination of consistency of cement

| S.No | Details | Trail |
|---|---|---|
| 1 | Weight of aggregate sample in cylindrical measure, W1 g (excluding empty weight of cylindrical measure) | 0.350 |
| 2 | Weight of crushed aggregates after passing through 2.36mm sieve W2 g | 0.030 |
| 3 | Aggregate Impact Value [W2/W1 * 100] | 8.57% |

Express the amount of water as a percentage of the weight of dry cement to the first place of decimal.

**INITIAL AND FINAL SETTING TIME:**

**Table 2:** Determination of Initial & Final setting time

| S.No | Time | Penetration |
|---|---|---|
| 1 | 5 min | 0 mm |
| 2 | 20 min | 1 mm |
| 3 | 35 min | 5 mm |
| 4 | 55 min | 6 mm |
| 5 | 70 min | 7 mm |

The initial setting time is 35 min
The final setting time is 10 hours.

## TESTS ON AGGREGATES

The results of the sieve analysis may be recorded graphically on a semi-log graph with particle size as abscissa (log scale) and the percentage smaller than the specified diameter as ordinate.
The results should be calculated and reported as:

- The cumulative percentage by weight of the total sample
- The percentage by weight of the total sample passing through one sieves and retained on the next smaller sieve, to the nearest 0.1 percent.

**Table 3:** Sieve Analysis

| S. No | Sieve Size | Mass Retained(g) | % Retained | Cumulative % Retained | Cumulative % Passing |
|---|---|---|---|---|---|
| 1 | 13.20mm | 0 | 0 | 0 | 100 |
| 2 | 9.50mm | 371.80 | 18.60 | 18.60 | 81.40 |
| 3 | 6.70mm | 392.50 | 19.60 | 38.20 | 61.80 |
| 4 | 4.75mm | 222.10 | 11.10 | 49.30 | 50.70 |
| 5 | 2.36mm | 387.50 | 19.40 | 68.70 | 31.30 |
| 6 | 1.70mm | 97.90 | 4.90 | 73.60 | 26.40 |
| 7 | 1.18mm | 109.10 | 5.50 | 79.10 | 20.90 |
| 8 | 4.25µm | 170.80 | 8.60 | 87.70 | 12.30 |
| 9 | 300µm | 45.80 | 2.30 | 90.00 | 10.00 |
| 10 | 150µm | 76.70 | 3.80 | 93.80 | 6.20 |
| 11 | <150µm | 123.00 | 0.00 | 0.00 | 0.00 |
| | Total | 1992.20 | 100 | | |

**AGGREGATE ABRASION VALUE:**
Grade of the material = B
Number of Spheres Used = 11
Weight of charge = 4580
Size of the aggregate = Passing through 20 & retained on 12.5mm
Number of revolutions = 500
Speed of rotation= 30-33 rpm

**AGGREGATE IMPACT VALUE:**
The Impact value of the given aggregate is 8.57% . Which lies <10%. Hence, the aggregates are exceptionally strong.
Table 4: Determination of aggregate impact value

**Aggregate Crushing Value:**
Size of the aggregate: passing through 12.5mm & retained on 10mm IS sieve. Rate of application of load: 4 tons/min
Total load applied: 40 tons

Table 5: Determination of aggregate crushing value

| S.No | Details | Trail |
|---|---|---|
| 1 | Weight of aggregate sample in the cylindrical measure. W1 gm | 3.250kg |
| 2 | Weight of crushed aggregates after passing through2.36mm seive , W2g | 0.610kg |
| 3 | Aggregate crushing value [W2/W1 * 100] | 8.76kg |

**TESTS ON HARDENED CONCRETE:**

**NON-DESTRUCTIVE TESTS:**

**REBOUND HAMMER:**
The rebound reading on the indicator scale has been calibrated by the manufacturer of the rebound hammer for horizontal impact, that is, on a vertical surface, to indicate the compressive strength. When used in any other position, appropriate correction as given by the manufacturer is to be taken into account.

**ULTRASONIC PULSE VELOCITY:**
The quality of concrete in terms of uniformity, incidence or absence of internal flaws, cracks and segregation, etc., indicative of the level of workmanship employed, can thus be assessed using the guidelines given below, which have been evolved for characterizing the quality of concrete in structures in terms of the ultrasonic pulse velocity.
Table 6: Determination of concrete quality

| S.No | Pulse Velocity (km/second) | Concrete Quality (Grading) |
|---|---|---|
| 1 | Above 4.5 | Excellent |
| 2 | 3.5 to 4.5 | Good |
| 3 | 3.0 to 3.5 | Medium |
| 4 | Below 3.0 | Doubtful |

**QUALITY CONTROLLING:**
For the quality controlling the Workability test, Slump cone test, Compacting factor test, Vee-Bee test, Compressive strength, Split Tensile Strength, Flow Test tests are conducted on Fresh Concrete.

**FRESH CONCRETE:**
When the binding material (Cement or lime), fine aggregate (generally sand), Coarse aggregate (such as crushed stones, broken bricks etc) and water are mixed together in suitable proportions, they form an easily workable mix, known as plastic, were or green concrete. Which is easy with which concrete will flow
Following are the important properties of fresh concrete

- Workability
- Bleeding and segregation
    a) Bleeding
    b) Segregation
    c) laitance
- Hydration
- Air entrainment

**4 SITE OBSERVATION**
The following observations are noted in field for the quality control and quality assurance

**5.1 P.C.C: Plain Cement Concrete:**

Plain cement concrete (PCC) is used to provide rigid impervious bed to RCC in foundation where the earth is soft and yielding. PCC can be used over brick flat soling or without brick flat soling. Plain cement concrete can also called only "cement concrete (CC)" or "binding concrete"

- Check the dimensions of form work of PCC before mixing concrete.
- Check polythene sheet is laid over PCC bed.
- Check the concrete slump (maximum slump should be 75mm)
- Check the thickness level of PCC before casting by putting steel pegs in concreting area or putting level pillar of fresh concrete at suitable distance
- Check the finish level of PCC by thread fixing with nails in form work.
- Inspect if the concrete is placing gently

### 5.2 RCC: Reinforced Cement Concrete

The following observations assurance Footing, Column Starters Columns, Beams, Slabs, Shear walls, Stair Cases are noted in field for the quality control and quality.

**Footings:**

Footings are structural elements that transmit column or wall loads to the underlying soil below the structure. Footings are designed to transmit these loads to the soil without exceeding its safe bearing capacity, to prevent excessive settlement of the structure to a tolerable limit, to minimize differential settlement, and to prevent sliding and overturning.

Footings are laid above the PCC to support the structure according to the dimensions given in the plan with Reinforcement

- Marking of Footings
- Laying of footings
- Checking of Footings

**Marking of footing:**

According to the grid lines marked on the site the PCC is laid, that grids are transferred to the PPC and by that reference the marking of the footing is done

**Laying of Footing:**

Laying of footing is done on PPC, it required all the shuttering works and the reinforcement works

**hecking of Footings:**

1. Reinforcement check
2. Shuttering checks

**Reinforcement Checks:**

1. Steel Placing: The steel has to be placed in a proper way as per the drawings
2. Spacing: After placing the steel the spacing should be checked properly with the reference of the markings and weather there are as per the drawings or not
3. Number of Bars: Check whether the given number of bars is placed or not
4. Diameter of Bars: This is the important factor that will consider mainly while laying of the reinforcement. The diameter of the bars has to be placed in the same direction as given in the drawings.
5. Chair height calculations: Mainly chairs are provided to avoid the contact of the top mat to the bottom mat. The height of the chairs is dependent on the depth of footing
6. Alignments: In this reinforcement checks the alignments are checked by considering the covers on the all sides of the footing

### 5.3 Shuttering Checks:

1. Profile (level): Weather the top of the footing is level or not has to be checked in these checks.
2. Alignments: T he footings are to be laid in the same alignments, if not there may be a chances of changing the position of the footing
3. Plumb: The vertical of the footing is checked by using the plump
4. Dimensions: The dimensions of footing as to be laid same in the site as per the drawings given. For that, the dimensions of the footings can be accurately checked
5. Diagonal : After marking the footing dimensions on the PCC it has to be checked diagonally
   Supports: After providing the shuttering works it has to support by some supports, so that can avoid the leakage of the concrete when it is poured. For providing this supports the excavations has to be done 1 feet extra excluding the dimension of the footing not in the depth.
6. Gaps: The gaps between the shuttering works has to be avoided, so when the concrete is poured the leakage can be arrested
7. Covers: After laying of the reinforcement the covers has to be checked. If it is not, there may be chances of increasing the cover at one side and decreasing the cover at other side

**COLUMN STARTERS:**

This work is done immediately after the completion of the footing. It is done just to support the column shuttering. The height of the column starters are in between 3'' to 6"

Advantages of Column Starters:

- It will support the shuttering in the proper position
- Leakage of the concrete is controlled by using this starters

COLUMN: Column or pillar in architecture and structural engineering is a structural element that transmits, through compression, the weight of the structure above to other structural elements below

Checks conducted for the columns

- Reinforcement Checks
- Shuttering Checks

**Reinforcement Checks:**

1. Steel Placing: The steel has to be placed in a proper way as per the drawings
2. Spacing: After placing the steel the spacing should be checked properly with the reference of the markings and weather there are as per the drawings or not.
3. Number of Bars Check whether the given number of bars are placed or not.
4. Diameter of Bars: This is the important factor that will consider mainly while laying of the reinforcement. The diameter of the bars has to be placed in the same direction as given in the drawings

## Lapping:

- Steel reinforcement usually comes in 6m (200 ft) and 12m (40ft) lengths. In such cases where the steel reinforcement is required to exceed these lengths, or other cut lengths then a splice is required. This lap length as we would discuss varies depending on the bars sizes as there are various bar sizes and where the bars are lapped and/or which structural member or element the lapping occurs.

**Shuttering Checks**

**Alignments:** The footings are to be laid in the same alignments; if not there may be chances of changing the position of the footing
**Plumb:** The vertical of the footing is checked by using the plump
**Dimensions:** The dimensions of footing as to be laid same in the site as per the drawings given. For that, the dimensions of the footings can be accurately checked
**Diagonal:** After marking the footing dimensions on the pcc it has to be checked diagonally
**Supports:** After providing the shuttering works it has to supported by some supports, so that can avoid the leakage of the concrete when it is poured. For providing this supports the excavations has to be done 1 feet extra excluding the dimension of the footing not in the depth
**Gaps:** The gaps between the shuttering works has to be avoided, so when the concrete is poured the leakage can be arrested
**Covers:** After laying of the reinforcement the covers has to be checked. If it is not, there may be chances of increasing the cover at one side and decreasing the cover at other side.
**BEAMS:** A beam is a structural member which spans horizontally between supports and carries loads which act at right angles to the length of the beam. Furthermore, the width and depth of the beam are "small" compared with the span. Typically, the width and depth are less than span/10

**Types of beams used in these constructions**:

1. Inverted beam
2. Concealed beam
3. T- beams

**Inverted beam:** The beam whose bottom level is same that of slab called inverted beam, likely to be used only in top slab of the building to give good view for inner face of the building
Concealed beam: The Hidden beam is a means to describe the load dispersion on to supporting slab. Hidden beams are generally inserted within the suspended slabs where slab thickness is considerable. The hidden beam is not a beam and the only means to spread the concentrated load of the walls on the slab area. Hidden beam between balcony and room is very common to facilitate easy inclusion of balcony into room space later. It is also known as "Concealed Beam".

**T-beam:**

Concrete alone is brittle and thus overly subject to the shear stresses a T-beam faces where the web and flange meet. This is the reason that steel is combined with concrete in T-beams.
SLAB: A slab is structural member, whose dimensions are small compared to its length. A concrete slab is a common structural element of modern buildings. Horizontal slabs of steel reinforced concrete, typically between 100 and 500 millimeters thick, are most often used to construct floors and ceilings, while thinner slabs are also used for exterior paving.
Types of Slabs:

1. PT Slabs
2. RCC slab
3. Flat Slabs
4. Grade Slabs

**PT Slabs:**

Post-tensioned concrete is a term heard more and more in the construction industry today. This method of reinforcing concrete enables a designer to take advantage of the considerable benefits provided by pre stressed concrete while retaining the flexibility afforded by the cast-in-place method of building concrete structures

- PT slabs are used for longer span instead of using beams
- PT slab consist of tendons as per design
- Tendon consist of number of stand as per design
- The diameter of each tendon is 12.7mm
- Tendons are laid along/parallel with the longer span
- In PT slab we consider live load only
- At the supports, tendons will be placed over the top reinforcement and in the middle, tendons will be laid over the bottom reinforcement
- After laying tendons concreting is done
- After attaining 100% strength, stressing of tendons is done. Later grouting is done

Fig 2: Reinforcement System

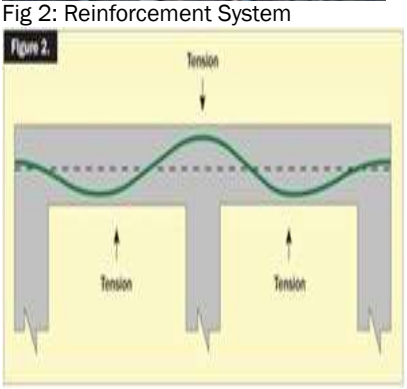


Fig. 3: Tension line of acting in a beam

### 5.4 Rcc slabs:

Reinforced concreted can be in-situ concreted or precast concrete.

For understanding behavior of reinforced concrete, we shall consider a plain concrete beam subjected to external load.

**Flat Slab:**

Fast and cheap construction using simple form work. Reinforced concrete flat slabs are commonly used in construction as they provide a number of benefits to the designer including:

- Thin sections allowing for greater roof heights and lighter floors.
- Exposed ceilings
- Flexible column arrangements, this is more difficult to achieve for a beam-column design

However, flat slabs have a lower stiffness in comparison to a beam-column floor plan which can lead to relatively large deflections. In addition to this, the shear capacity can also be reduced in particular around the column head where large shear forces can develop.

There are two main failure modes of flat slabs:

- Flexural Failure
- Punching Shear Failure

**Grade Slab:** The slab foundation commonly used for sheds is called a slab-on-grade foundation. This combines a 3 1/2"-to 4"-thick floor slab with a 8"-to 12"-thick perimeter footing that provides extra support for the walls of the building.

### 5.5 Shear walls:

- Shear walls are vertical elements of the horizontal force resisting system. Shear walls are typically wood frame stud walls covered with a structural sheathing material like plywood.
- Shear walls have four parts:
- Framing members
- Sheathing
- Nails
- Hold-downs

### 5.6 STAIRCASES:

Staircases provide means of movement from one floor to another in a structure. Staircases consist of a number of steps with landings at suitable intervals to provide comfort and safety for the users.

Some common types of stairs are shown. These include straight-flight stairs, quarter-turn stairs, half-turn stairs, branching stairs, and geometrical stairs.

**PRINCIPLES TO BE OBSERVED WHILE PLANNING AND DESIGNING A STAIR**

1. Width of Stair: It should not be less than 1.00m.
2. Length of flight: The number of steps in a single flight should not be more than 12.
3. Pitch of the stair: It should be 25 to 40
4. Width of landing: It should be 150mm, more than the width of stair.
5. Winders or kite steps: Odd shaped steps should be avoided and incase found necessary. These should be provided at the start of a stair.

6. Han-rails: It should be 750 to 850 mm in height from the top of respective step or landing.
7. Step proportions: The size of rise and tread in a stair should be kept uniform throughout the whole stair.
8. Headroom: Minimum of 2000mm of clear headroom is required above the pitch line
Following proportions are recommended:
(I) Residential buildings- Tread=250 mm
Rise=160 mm

(ii) Public buildings - Tread=300 mm
Rise=150 mm
(iii) Industrial buildings, Railway station,
etc Tread =not less than 250 mm
=250 to 300 mm
Rise =not less than 150 mm
=150 to 190 mm
Otherwise work out the sizes of rise and tread by using any one of the following proportions
(I) (2xRise) + (Going), In mm=550 to 600 mm
(ii) Rise x tread, both in cm = 400 to 410 cm2.
(iii) With basic proportion of going 300 mm and rise 150 mm, add 10 mm to rise for every 20 mm deduction from going e.g. For a going of 280 mm the rise will be 160 mm.
The above rules act as guide but the actual sizes depend upon the availability of space, while planning stairs practical-field.

- Balusters: The smaller posts fitted between the stair and the handrail, usually decorative, and in timber or steel.
- Bull nose Step: The step at the base of a stair which usually has a protruding semi-circular end
Capping: The piece of timber that forms the edge or border for the carpet or other floor coverings, located at the edge of the floor on upper level
- Closed Stair: A stair that has treads and risers
- Cut Stringer: Stringers that are cut to follow the profile of the treads and risers.
- Handrail: The shaped or molded piece of timber you hold on to as you walk up or down the stair.
- Handrail Scroll: The decorative handrail piece at the start of the stair that curls around and sits above the bullnose step
- Handrail Wreaths: The sections that curve around corners to form a continuous handrail
- Landing: The flat platforms usually located where a stair changes direction.
- Newel Posts: The larger square posts at the start and the corners of a stair. They are usually turned, fluted, paneled or decorated in some way.
- Open Stair: A stair that has no risers
- Risers: The vertical pieces which are the solid infill between the treads
- Stringers: The main beams that support treads and risers
- Tread Bracket: The decorative pieces that fit to the face of a cut stringer in the more traditional type of stair
- Tread Nose: The rounded leading edge of a step
- Treads: These are simply the steps you walk on
- Winder Steps: The triangular treads used to change the direction of the stair, usually around right-angle corners

## 5.7 INTERIORS:

Brick Work
Plastering Plaster Of Paris
Tiling
Fall ceiling

**Brick Work:** Brickwork is masonry produced by a bricklayer, using bricks and mortar in a variety of patterns with a variety of mortar joints. Typically, rows of bricks called courses are laid on top of one another to build up a structure such as a brick wall

## 5.8 AAC:

Autoclaved Aerated Concrete (AAC) is a certified green building material, which can be used for commercial, industrial and residential construction. It is porous, non-toxic, reusable, renewable and recyclable.

**QUALITY CHECKS FOR AAC:**

Dimension, Plumb, Drop test, Color test, Damages, Should be free from oil, Black spots

**Plastering:** Plaster is a building material used for coating walls and ceilings. Plaster is manufactured as a dry powder and is mixed with water to form a paste when used. The reaction with water liberates heat through crystallization and the hydrated plaster then hardens. Plaster can be relatively easily worked with metal tools or even sandpaper. These characteristics make plaster suitable for a finishing, rather than a load-bearing material.

## 5.9 CHECK LIST FOR PLASTERING WORK

- Check sand quality: Check the fineness of sand as recommended in construction manual.
- Check sand are dust or dirt free.

- Check cement quality: Check the grade of cement as specified in your construction manual.
- Cleanness of mortar-mixing platform: Check the platform, on which plaster mortar will be mixed, is properly cleaned. The platform should not be wetted. It should be plain and dry.
- Screening of sand: Check sand is screened before mixing with cement. So that any big particles from the sand can be removed.
- Cement-Sand Ratio: Check cement and sand ratio is maintained for mixing as recommended in construction manual.
- Mortar Mixing: Cement and sand should be mixed in dry condition. Check the dry mix is properly mixed before adding water. There is a tendency of masons to add water before mixing the mortar properly in dry condition.
- Water content in mortar: Water content in mix should not be less or more. It should be appropriate as needed.
- Mortar using time: Cement's initial setting time is 45 minutes. So, check the mortar is being used within 45 minutes after adding water. If necessary, separate some cement sand mix in dry condition. If you need it later you can add water with that. You can maintain a resister for tracking mortar mixing time.
- Thickness of plaster: Suggested plaster thickness is 1/2 inch. But due to size variation of masonry block it can be 3/4 to 1 inch and above. If above one inch thick plaster is required in anywhere that should be done in two coats. After doing 1st coat that should be roughed. And 2nd coat should be done next day.
- Lighting availability: When plastering inside a building, check enough lighting is available there.
- Make a level mark: Before doing plaster inside a room, make level marks with fresh mortar on all four walls. So that, after plastering room size is truly square or truly rectangular. Otherwise, when you'll fix floor tiles you'll face difficulties.
- If you plan to plaster on ceiling, do the same for that also. In this case, make the level mark on beams around the ceiling portion.
- Smoothness of plaster surface: after plastering check the smoothness of plaster surface. If you plan to fix tiles on plaster then make it scratched.
- Level of plaster: check the level of plaster with an aluminum bar. If you need you can use torch light.
- Reduce mortar wastage: During plaster work some mortar can be fallen down. To collect them, lay empty cement bag or polythene sheet below. So that you can reuse fallen mortar. These should be collected and reuse every 30 minutes.
- Sharpness of Edges and corners: Check all edges and corners are sharp and straight.
- Groove and other design work: Check the drawing if there is any groove work or design work on plaster surface. Make the grooving sharp and straight.
- Window border: Check the window border with plumb bob or spirit level that those are straight.
- Check the sharpness of window-opening edges. Check the borders are in right angle.
- Window sill: Check the window sill is plain and even.
- Water proofing admixture: During outside plastering, make sure water proofing agent is mixed with mortar.

### 5.10 Dadoing:

- In architectural terminology, the dado is the lower part of a wall, below the dado rail and above the skirting board. The word is borrowed from Italian meaning "die" (as an architectural term) or plinth.
- **False ceiling:** A false ceiling is actually a secondary ceiling that hangs below the main ceiling to increase the aesthetics of the room. There should be approximately 1 feet distance between the false ceiling and the primary ceiling. The false ceiling should have at least a height of 8 ½ feet from the floor level.

### 5.11 MEP: Mechanical Electrical and Plumbing

MEP systems must satisfy multiple objectives and criteria for design, installation, commissioning, operation, and maintenance. Different types of specialty contractors (e-g., process piping, HVAC piping, WAC ductwork, plumbing, electrical, fire protection, controls) are responsible for these systems. Example of diverse criteria for system design include spatial (avoiding interferences), functional within a system (flow or gravity drainage), adjacency or segregation, system installation (layout dimensions, space and access for installation productivity), and testing (ability to isolate).

### 5.12 Tower Crane:

Tower cranes are a modern form of balance crane that consist of the same basic parts. Fixed to the ground on a concrete slab (and sometimes attached to the sides of structures as well), tower cranes often give the best combination of height and lifting capacity and are used in the construction of tall buildings. The base is then attached to the mast which gives the crane its height. Further the mast is attached to the slewing unit (gear and motor) that allows the crane to rotate. On top of the slewing unit there are three main parts which are: the long horizontal jib (working arm), shorter counter-jib, and the operator's cab.

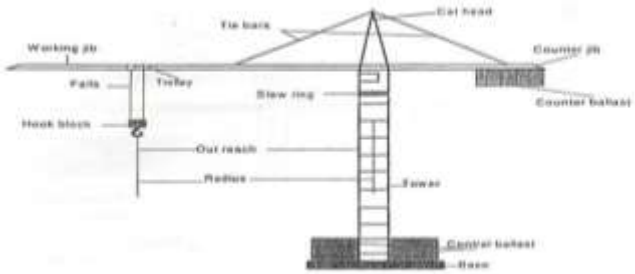


Fig 4: A modern form of balance crane

**Fire protection system:**

The purpose of fire protection systems is to make the building fire resistant and to facilitate the speedy evacuation of occupants in the event of a fire. For fire protection systems, the design parameters are set in accordance with NFPA-13 (National Fire Protection Association). These are the minimum requirements. Fire protection systems designers must also contact local jurisdiction officials, and the owner's insurance rating agency (Factory Mutual, Industrial Risk Insurer etc.) for requirements beyond the minimum standard required by NFPA and Uniform Building Code (UBC) as amended by that jurisdiction.

**Electrical system:**

For electrical system designers, the design parameters are set in accordance with the National Electric Code (NEC). These are the minimum requirements that must be met. Electrical system designers must also adhere to NFPA 13, and the UBC for requirements beyond the minimum set forth by the NEC. The major categories of the electrical system are supply, distribution, and lighting.

**Plumbing system:**

The plumbing system consists of three major categories - gravity drained waste systems, pressure driven systems, and pumped waste. Plumbing design must meet the Uniform Plumbing Code (LPC). The gravity drain systems include sloped lines which must have a natural grade line. In addition, the gravity drained systems require vent lines for the entire system, to allow for open channel flow in the drainage network. The pressure driven systems include hot and cold water supply lines the various locations in the building. Lastly, pumped waste systems include all waste lines that must be driven by pressure rather than by gravity. All pumped waste systems must run in double contained piping systems.

## Objectives of Work Permit

- Ensuring proper authorization of designated work
- Provide recommendations on how to plan and execute potentially hazardous jobs in a safe manner.
- Achieve the desired degree of safety when carrying out work
- Making clear to people carrying out work about
  - Nature of job, Hazards involved & Control measures
  - Scope of the specific work
- Time during in which the job may be carried out.
- Ensuring the Project Site In charge is aware of the work being done
- Providing a formal procedure to ensure safe completion of work
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## Permit is applicable

- Working at Heights
- Hot work [ Welding , Cutting Wrapping coating etc ]
- Working with Electricity
- Ground Disturbance [ Excavation]
- Confined Space Entry [ Shaft work / Networking

## CONCLUSION

Our project deals with Quality control and Quality assurance on the high rise buildings which gives the total description of how the control is done in the each and every activity of the construction. This is done based on the ISO 9001-2008.

In high rise buildings the construction process includes quality control and quality assurances. The present construction practices in India is still adopt the methodology of as a when required resources management. Lack of professionalism leading to lack of detail when meticulous planning and decision making as per site management is concerned leading to under utilization of resources to a great extend. Still now project resources planning is only limited to planning and scheduling with time but resources mobilization and usages planning according to their capacity and availability ahead of timing the planning stage is still now nobody concern. In order to assess capabilities for utilization of resources and track their productivity the first step should be to keep and maintain their real time record from the ongoing project this is already done project their four planning and scheduling will be same type of project which nearly equal Total Quality Managements.

### CONFLICT OF INTEREST
There is no conflict of interest.

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