CHAPTER X - Quality Control Measures in Buildings

The construction of structures should result in satisfactory strength serviceability and long term durability so as to lower the overall life-cycle maintenance cost.

Quality assurance in construction activity
1. Proper design.
2. Use of adequate qualitative materials.
3. Proper workmanship in the execution of works.
4. Ultimate care during the use of structure properly including timely maintenance and repair.

Proper Design

The following points to be taken into consideration while designing the structure:
(a) Ensure Safe bearing capacity of soil by proper soil test conducted at site for design of footings of structures
(b) Ensure correct orientation of the building for obtaining proper ventilation and natural light.
(c) Reinforcement details and size of the RCC members should be arrived based on the calculation of actual loads coming on the structure and on design of structures as per codal provisions.
(d) Proper planning of shelves, cupboards, electrical points and necessary amenities required.

Use of Adequate Qualitative Materials

The two ways of testing the material quality are:
a) Physical test at the site (Rough methods).
b) Lab test.

Physical Tests at the Site

a. Cement

1. If one's hand is plunged into the bag of cement he should feel cool and not warm.
2. When a handful of cement is thrown into a bucket of water it would not float but sink.
3. A thin paste of Portland cement with water should be felt sticky between the fingers.
4. Reddish/blackish colour of cement will indicate adulteration of foreign materials.
5. If the cement is found in the form of impalpable powder (felt between fingers by rubbing) the cement may be trusted. The quality of cement is suspected, if it is felt gritty.
6. The cement paste will give an earthy smell, if it contains too much of pounded clay and silt as an adulterant.
7. A thick paste of cement with water on a glass plate, kept under water for 24 hours should not crack, but set.
8. Initial setting time may be observed in the field by preparing a thin cement paste in a ware and inserting a very thin stick or wire into it after 30 min. If the paste resists penetration of the stick or wire, that is the good quality of cement.

b. Bricks

1.**Physical Test**: The bricks should be of standard size and its shape should be truly rectangular with sharp edges. When dropped at a height of 10 cm from the ground, the brick should not be broken.

2.**Hardness Test:** A scratch made on the brick surface with a finger nail leaves no impression is the significance for a hard and good brick.

3.**Soundness Test:** The brick should give a metallic ring sound when struck with a small hammer or another brick.

4.**Structure:** The structure of the brick when broken should not have any defects such as holes, lumps, etc. and should be homogeneous.

c. Coarse Aggregates

1. Aggregates should be free from dust, lumps, soft or flaky materials, mica or deleterious materials.
2. Elongated and flaky aggregates to be avoided. Required size of the aggregate should be strictly adhered.

d. Fine Aggregates

1. The size and sharpness of grains may be examined by the touch and feel and by eye.
2. The presence of salts may be detected simply by taste.
3. When rubbed between moist fingers, clean sand will leave no stain.
4. Colour of the sand will indicate the purity of sand.
5. Sea sand owing to the presence of salts is unsuitable for masonry, plastering & concrete work and to be discarded. If used in masonry and plastering, the walls will be subjected to efflorescence and permanent dampness. It will ultimately cause peeling off the plaster by disintegration.

e. Water

1. Water should be free from oil, grease, acid, salt, organic materials, etc. with normal PH value.
2. It should be free from colour & odour.
3. Mixing or curing of concrete with seawater is not recommended because of presence of harmful salts.

f. Steel

1. Shall be free from loose mill scales, loose rust and coats of paints, oil, mud or any other substances which may destroy or reduce the bond.
2. It should conform to standard weights per metre length.
3. Use of re-rolled steel should be avoided.

g. Stones

1. It should be hard, strong and durable to resist wear and tear due to atmospheric actions and actions of acids, fumes and smokes.

2. It should be close-grained and homogeneous, and free from cracks, cavities, flaws, soft material, patches, loose organic matters, iron oxides, etc, with proper size and shape.
3. Uniform colour and compact texture.
4. Water absorption not more than 5%.

h. Formwork

1. Props should be vertical and rested on firm surface.
2. Cross bracing should be done wherever necessary.
3. Shall be free from all rubbish, particularly chippings, shavings and saw dust.
4. Jointing of one prop with another may be avoided.
5. Worn-out props, formwork, roughly after 5 to 6 uses of operation since procurement may be discarded.
6. Adequacy of props, supporting the roof, may be ensured by AEE in relation with size of the building.
7. Props over sunshade, lofts may be avoided.
8. Formwork may be removed, after the required days as specified in IS Code.

Mechanical Testing of Steel at Lab

1. Tension test.
2. Torsion test.
3. Impact test.
4. Bond test.
5. Hardness test.

Proper Workmanship in the Execution of the Works

1. Skilled masons and mazdoors should be engaged.
2. Periodic interval to be ensured between the successive stages of construction.

Brick Work

Vertical to plumb line to be checked and vertical straight joints to be avoided.

Centering

Props should be placed on the flooring concrete. No brick should be used.

Placing of Reinforcement

Provision for necessary cover for RCC works (exclusive of plaster or other decorative finish) shall be as follows:

1.At each end of reinforcement bar not less than 25 mm, nor less than twice the diameter of such bar ;

i)	Slabs	-	15 mm or dia of bar whichever is greater
ii)	Beams	-	25 mm or dia of bar whichever is greater
iii)	Columns	-	40 mm or dia of bar whichever is greater

2.Footings & Surfaces in contact with earth
Surface – 50 mm or dia of bar whichever is greater

3.Reinforcement should be placed and tied in such a way that it should allow the compaction of concrete without segregation of the mix.

4.Overlapping should be minimized and avoided in the maximum Bending Moment location and adjacent to it.

Mixing of Concrete

1. Concrete shall be mixed in a concrete mixer. Hand mixing may be avoided as far as possible.
2. Mixing shall be continued till materials are uniformly distributed and a uniform colour of the entire mass is obtained.
3. Mixing plant shall be thoroughly cleaned before changing from one type of cement mortar to another.
4. Correct water/cement ratio to be followed to avoid bleeding of the concrete.
5. In no case shall mixing be done for less than 2 minutes in the concrete mixer machine.

Placing of Concrete

1. Placing and Compaction of concrete to be completed before initial setting time.
2. Care should be taken to avoid displacement of reinforcement or movement of form work.
3. The maximum permissible free fall of concrete may be taken as 1.5 m.

Compaction

1. Concrete should be thoroughly compacted and fully worked around the reinforcement, around embedded fixtures and into the corner of the formwork.
2. Mechanical vibrators complying with IS 2505, IS 2506, IS 2514 and IS 4656 are recommended.
3. Good finishing practices are essential for durable concrete.
4. Over vibration and under vibration of concrete are harmful and should be avoided.
5. Vibration of very wet mixes should also be avoided.
6. Over working the surface and the addition of water or cement to aid in finishing should be avoided.

Curing

1. Concrete exposed to dry and hot weather conditions – 28 days for RCC structures.
2. It is essential to use proper and adequate curing technique to reduce the permeability of the concrete and enhance its durability by extending the hydration of the cement.

Weathering Course/Floor finish

1. Proper slope to be maintained to drain out water and to avoid dampness.
2. Rain water pipes should be provided properly to drain out water.

Plastering

The comers and edges in plastering must be proper to plumb.

Ultimate Care in Use of Structure

Buildings in need of servicing in many an instances, their symptoms of sickness or malfunctioning are so pronounced, they do not get proper attention for rectification. It has to be waited for sometimes, in the unfortunate incidence they cannot wait any longer and just fall apart, may be also causing casualties to occupiers or neighbours or even the innocent passers by and necessitate emergency treatment.

Not all distortions and cracks in buildings are necessarily due to ground movement. Symptoms of distress can also be caused by inadequate strength of materials, inadequate structural togetherness, material decay, dimensional instability caused by thermal and moisture movement, overall instability, alteration, misuse and accidental works. It is essential to thoroughly examine every part of the structure and every possible cause of failure consulting with geological maps, recording all individual symptoms by trial pits, bore holes and testing.

Cracks upto 1 mm in width even though closely spaced and greater in number are less damaging than a fewer number of wide cracks more than 2 mm width.

Horizontal cracks at the base of a brick parapet wall over an RCC slab are very common. It occurs due to differential expansion and contraction of RCC and brick works. It can be overcome by having RCC parapet instead of Brick Wall. Plaster should be discontinued by V groove at the joint of the slab and the brick parapet.