Specifications, Quality/Requirement of Building Materials & Field Checks

Specifications

Why specification is crucial to construction?

- It provides clear instructions on the intent, performance and construction of the project.
- It can reference the quality and standards which should be applied.
- Materials and manufacturer's products can be clearly defined.
- The requirements for installation, testing and handover can be identified.
- Classification in the specification can be used to support handover and running of the asset.

Specifications

- The drawing or model does not need to be overloaded with detailed information, which can sometimes be difficult to identify.
- It can be used to support the costing of a project: not only the materials and products but also the performance and workmanship
- The specification forms part of the contractual documents, along with the drawings, and therefore can help to minimise project risk and provide support in case any legal disputes.

Specifications

- It is not only essential for the construction phase but also used as subsequent asset management and the lifecycle plan.

- By being a clear and concise and containing all the information, it saves the project team, the client and the contractor's time and money by providing answers to many of the on-site construction questions.

REFERENCES

- CPWD SPECIFICATIONS
- NBC (National Building Code)-2016
- IS CODES
- ECBC(Energy Conservation Building Code)-2017

DEFINITIONS

FLOOR AND LEVELS

Building

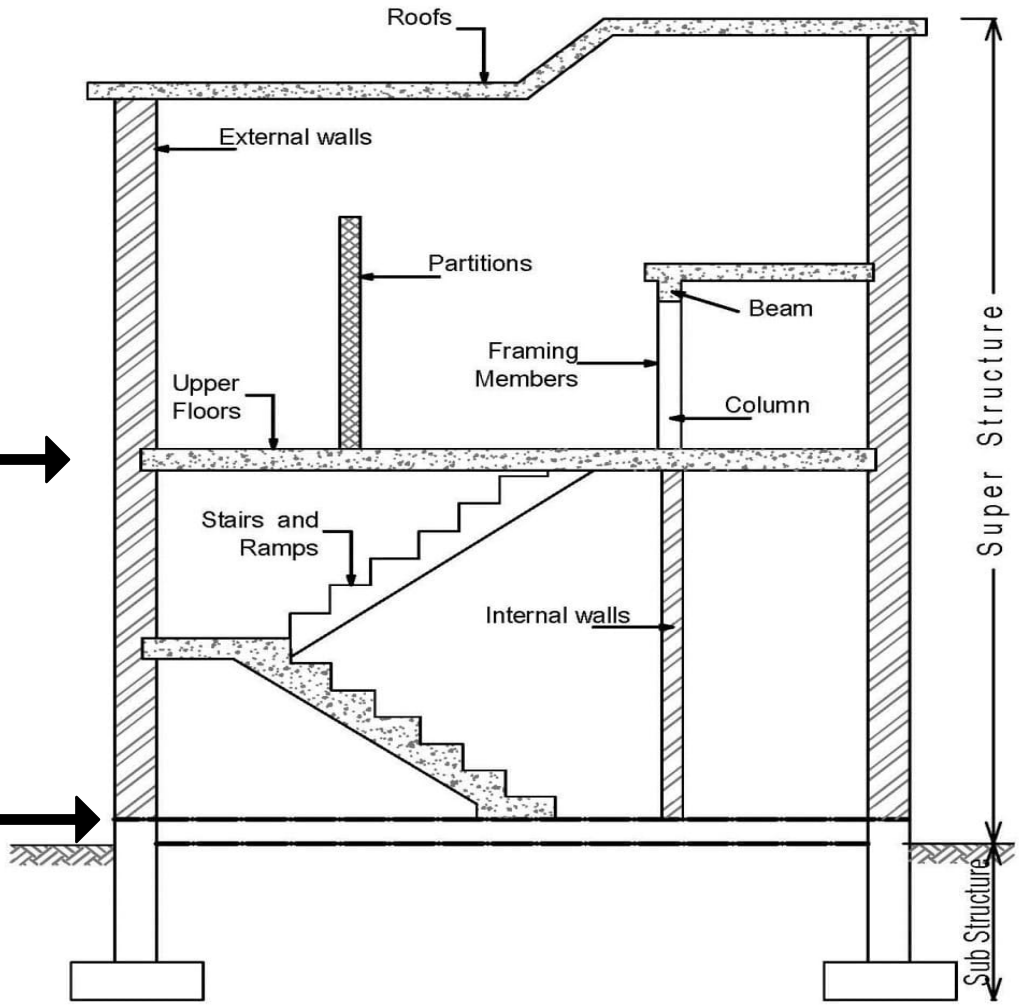
Floor 1 is the lowest floor above the ground level in the building unless otherwise specified in a particular case. The floors above floor 1 shall be numbered in sequence as floor 2, floor 3 and so on. The number shall increase upwards.

- **Floor level:** For floor 1, top level of finished floor shall be the floor level and for all other floors above floor 1, top level of the structural slabs shall be the floor level.
- **Plinth level:** Floor 1 level or 1.2 m above the ground level whichever is lower shall be the plinth level. Generally normal building Plinth height is kept 45 cm to 60 cm.

FLOOR AND LEVELS

Floor 2 level

Floor 1/Plinth level



Plinth level for Special Structures

- For structures like Retaining walls, Wing walls, Chimneys, Over Head Reservoirs/ Tanks and other Elevated Structures, Where Elevations/ heights above a defined datum level have not been specified and identification of floors cannot be done as in case of building.
- Level, at 1.2 m above the ground level shall be the floor 1 level as well as Plinth level.

Special Structures

- Level at a height of 3.5 m above floor 1 level (Plinth level) will be reckoned as floor 2 level.

- Level at a height of 3.5 m above the floor 2 level will be floor 3 level and so on,

FOUNDATION AND PLINTH

The work in foundation and plinth shall include:

(a) **For buildings:** All works upto 1.2 metre above ground level or upto floor 1 level (Plinth level) whichever is lower:

(b) **For abutments, piers and well staining**: all works upto 1.2 m above the bed level:

(c) **For retaining wall, wing walls, compound walls, chimneys, over head reservoirs/ tanks and other elevated structures**: All works upto 1.2 metre above the ground level:

FOUNDATION AND PLINTH

The work in foundation and plinth shall include:

(d) **For reservoirs/ tanks (other than overhead reservoirs/ tanks):** All works upto 1.2 metre above the ground level.

(e**) For basements**: All works upto 1.2 m above ground level or upto floor 1 level (Plinth level) whichever is lower.

Items required for construction of Building (Civil work)

- Carriage of Materials (Transportation of materials)
- Earth Work (Excavation for foundation)
- Mortars (For Brick/Stone Masonry, Plastering)
- Concrete Work (For base/levelling course for foundation, Pavement/CC Road)
- Reinforced Cement Concrete Work (For Structural members i.e. Foundation, Beams, Columns, Slabs etc.)
- Brick Work & Stone Work (For masonry work)

Items required for execution of Building (Civil work)

- Wood Work (For window, doors)
- Steel Work (For structural member & grill/railing)
- Flooring (Tiles on wall & flooring, stone flooring)
- Roofing (RCC roof, GI sheet roofing, false ceiling)
- Finishing (Plastering, POP, wall putty, Painting,)
- Sanitary Installation (Soil waste pipe, sanitary fittings etc.)

Items required for execution of Building (Civil work)

- Water Supply (Internal & external water supply system)
- Drainage (Soil waste drainage, storm water drainage)
- Aluminium Work (aluminium door, windows & Grills)
- Water Proofing (For roofs, toilets & water tanks)
- Development work (Road Work & approach)

CARRIAGE OF MATERIALS

VOIDS CONSIDERATION FOR STACKING

Earth:-

- In loose stacks such as cart loads, lorry loads, etc. – 20% voids.

- In fills consolidated by light mechanical machinery – 10% voids.

CARRIAGE OF MATERIALS

Earth:-

- In fills consolidated by heavy mechanical machinery but not under OMC (Optimum Moisture Content) – 5%

- In fills consolidated by heavy mechanical machinery at OMC – Nil

- Consolidated fills in confined situation such as under floors. etc. – Nil

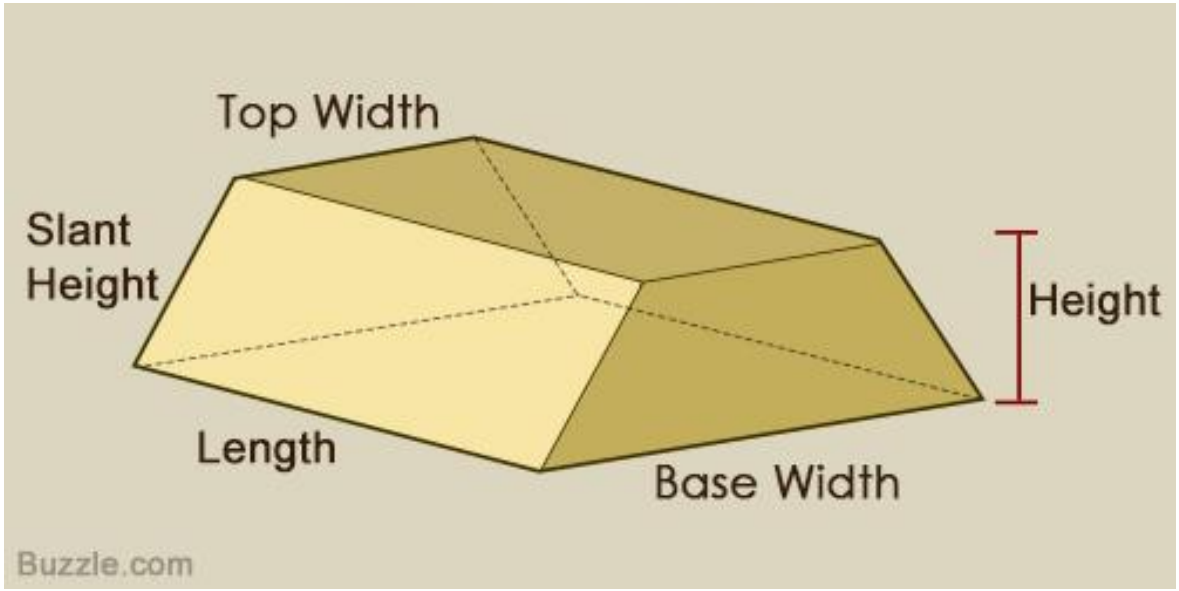
Other Materials

VOIDS CONSIDERATION FOR STACKING

- Manure or sludge – 8%
- Moorum, building rubbish Lime and sand – Nil
- Stone metal, 40 mm nominal size and above – 7.5%
- Coarse aggregate/ stone metal below 40 mm nominal size – Nil
- Soling stone/ Boulder 100 mm and above – 15%
- Excavated rocks – 50%

Shape of Stack for Stone Aggregate or Earth

- Quantity = $\frac{(BL+TL)}{2} \times \frac{(BW+TW)}{2} \times H$



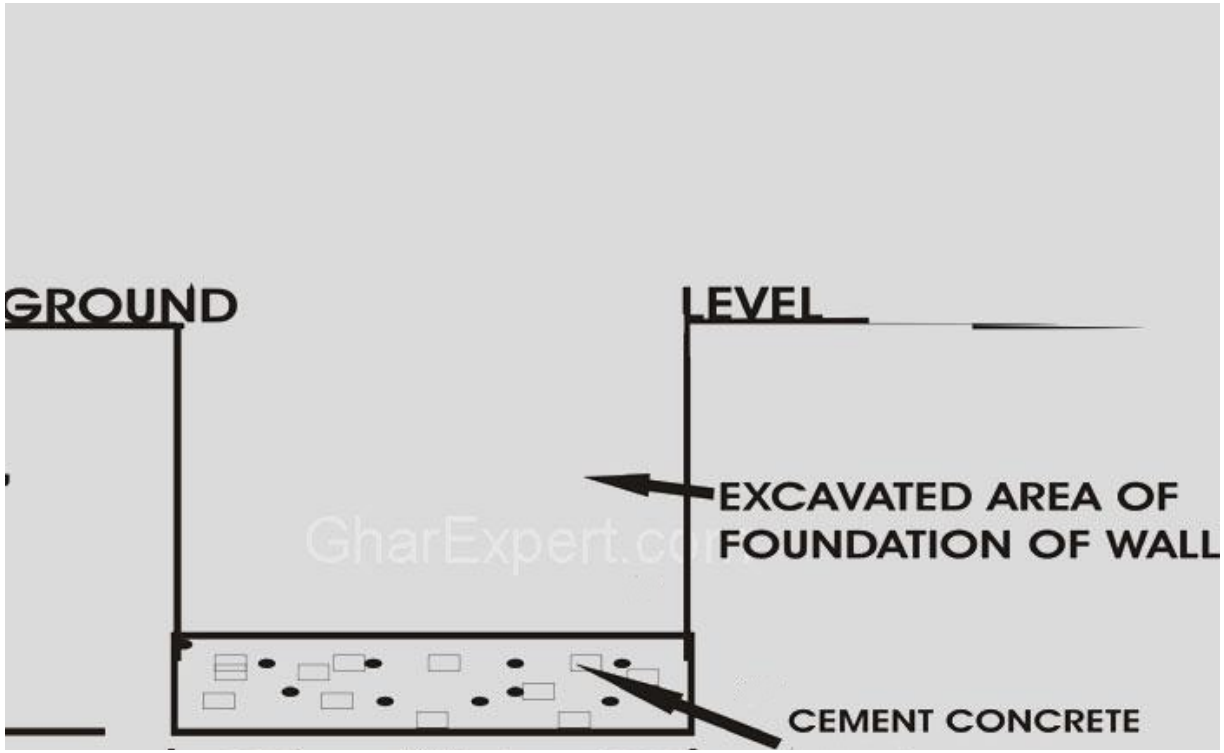
EARTH WORK

- **EXCAVATION IN ALL KINDS OF SOILS**
- All excavation operations manually or by mechanical means shall include excavation and 'getting out' the excavated materials.
- Excavation shall be done from top to bottom.
- Undermining or undercutting shall not be done.

EARTH WORK

- In firm soils, the sides of the trenches shall be kept vertical upto a depth of 2 metres from the bottom.

Upto 2 m depth from GL.



EARTH WORK

- For greater depths, the excavation profiles shall be widened by allowing steps of 50 cms on either side after every 2 metres from the bottom.

- Alternatively, the excavation can be done so as to give slope of 1:4 (1 horizontal : 4 vertical).

FILLING

- The earth used for filling shall be free from all roots, grass, shrubs, rank vegetation, brushwood, tress, sapling and rubbish.

- Filling with excavated earth shall be done in regular horizontal layers each not exceeding 20 cm in depth.

- All lumps and clods exceeding 8 cm in any direction shall be broken. Each layer shall be watered and consolidated with steel rammer or ½ tonne roller. Where specified, every third and top must layer shall also be consolidated with power roller of minimum 8 tonnes

FILLING

- Wherever depth of filling exceeds 1.5 metre vibratory power roller shall be used to consolidate the filing.

- The top and sides of filling shall be neatly dressed.

SAND FILLING IN PLINTH

- Sand shall be clean and free from dust organic and foreign matter and its grading shall be within the limits of grading zone IV

ANTI-TERMITE TREATMENT

- Sub-terranean termites are responsible for most of the termite damage in buildings.
- Typically, they form nests or colonies underground.
- The termites find access to the super-structure of the building either through the timber buried in the ground or by means of mud shelter tubes constructed over unprotected foundations

ANTI-TERMITE TREATMENT

- Termite control in existing as well as new building structures is very important as the damage likely to be caused by the termites to wooden members of building and other household article like furniture, clothing, stationery etc. is considerable.

- Anti-termite treatment can be either during the time of construction i.e. pre-constructional chemical treatment or after the building has been constructed i.e. treatment for existing building

ANTI-TERMITE TREATMENT

- Prevention of the termite from reaching the super-structure of the building and its contents can be achieved by creating a chemical barrier between the ground, from where the termites come and other contents of the building which may form food for the termites.

- This is achieved by treating the soil beneath the building and around the foundation with a suitable insecticide

ANTI-TERMITE MATERIALS

Chemicals: Any one of the following chemicals in water emulsion to achieve the percentage concentration specified against each chemical shall be used:

- (i) Chlorphriphos emulsifiable concentrate of 20%
- (ii) Lindane emulsifiable concentrate of 20%

Anti-termite treatment chemical is available in concentrated form in the market and concentration is indicated on the sealed containers.

ANTI-TERMITE MATERIALS

- To achieve the specified percentage of concentration, Chemical should be diluted with water in required quantity before it is used.

- For example, to dilute chemical of 20% concentration. 19 parts of water shall be added to one part of chemical for achieving 1% concentration.

Safety Precautions

- Chemical used for anti-termite treatment are insecticides with a persistent action and are highly poisonous.

- This chemical can have an adverse effect upon health when absorbed through the skin, inhaled as vapours or spray mists or swallowed.

Safety Precautions

- Storage and mixing of concentrates shall not be done near any fire source or flame. Persons using these chemical shall be warned that absorption though skin is the most likely source of accidental poisoning.

- Particular care shall be taken to prevent skin contact with concentrates and prolonged exposure to dilute emulsion shall also be avoided

MORTARS

Materials

- Cement
- Fine aggregate (Sand)
- Water

MORTARS

MATERIALS

Water

- Water used for mixing and curing shall be clean and free from injurious quantities of alkalies, acids, oils, salts, sugar, organic materials, vegetable growth or other substance that may be deleterious to bricks, stone, concrete or steel.
- Potable water is generally considered satisfactory for mixing.
- **The Ph value of water shall be not less than 6.**

WATER

- ***Percentage of Solids:*** Maximum permissible limits of solids

Solids	Maximum permissible limits
Organic	200mg/ litre
Inorganic	3000 mg/ litre
Sulphates	400 mg/ litre
Chlorides	2000 mg/ litre. for PCC and 500 mg./ltr. for RCC
Suspended matter	2000 mg/ litre

WATER

- Water found satisfactory for mixing is also suitable for curing. However, water used for curing shall not produce any objectionable stain or unsightly deposit on the surface.

- **Sea water shall not be used for mixing or curing**

- **Water from each source shall be tested before the commencement of the work and thereafter once in every three months till the completion of the work.**

- In case of ground water, testing shall also be done for different points of drawdown. Water from each source shall be got tested during the dry season before monsoon and again after monsoon.

Cement

- The cement used shall be any of the following type/grade cements are generally available in market.
- 43 grade ordinary Portland cement conforming to IS 8112.
- 53 grade ordinary Portland cement conforming to IS 12269.
- Portland slag cement conforming to IS 455.
- Portland Pozzolana cement (fly ash based) conforming to IS 1489 (Part 1). – **Now a days Portland Pozzolana cement is mostly used as per government policy as fly ash is used for manufacturing of PPC & it is cheap compare to OPC.**

Cement

- ***Compressive Strength :*** Compressive strength requirement of each type of cement for various grades when tested in accordance with IS 4031 shall be as under:

Sample	Strength in N/mm^2 not less than for	
Age at testing	Gr. 43	Gr .53
72 + 1 hr	23	27
168 + 2 hrs	33	37
672 + 4 hrs	43	53

Cement

- Different types of cement shall not be mixed together.

- In case more than one type of cement is used in any work, a record shall be kept showing the location and the types of cement used.

Cement

- ***Caution in Use of Cement Grade 53 in Construction*:** Because of the faster hydration process, the concrete releases heat of hydration at a much faster rate initially and release of heat is the higher in case of Grade. 53.

- The heat of hydration being higher, the chances of micro-cracking of concrete is much greater.

- Thus, during initial setting period of concrete, the higher heat of hydration can lead to damaging micro-cracking within the concrete which may not be visible at surface

Cement

- This cracking is different from shrinkage cracks which occurs due to faster drying of concrete in windy conditions.
- The situation can be worse when we tend to increase the quantity of the cement in the concrete with a belief that such increases are better for both strength and durability of concrete.
- Thus, it is very essential to be forewarned that higher grade cement specially grade 53 should be used only where such use is warranted for making higher strength concrete and also where good Quality Assurance measures are in place, by which proper precaution are taken to relieve the higher heat of hydration through chilling of aggregates or by proper curing of concrete.

Cement

- There are instances where higher grade cement is being used even for low strength concrete, as, mortar or even for plastering.

- **This can lead to unnecessary cracking of concrete/ surfaces. Another issue to be cautioned against is the tendency of the manufacturers to project Grade 53 cement as stronger cement, whereas Grade 43 are enough to produce the concrete of desired characteristic strength.**

Cement

Setting Time:

(a) **Initial setting time:** Initial setting time test is important for transportation, placing and compaction of cement concrete. Initial setting time duration is required to delay the process of hydration or hardening **Not less than 30 minutes (1/2 Hrs.).** ***Thus cement mortar shall be used within 30 minutes after mixing with water.***

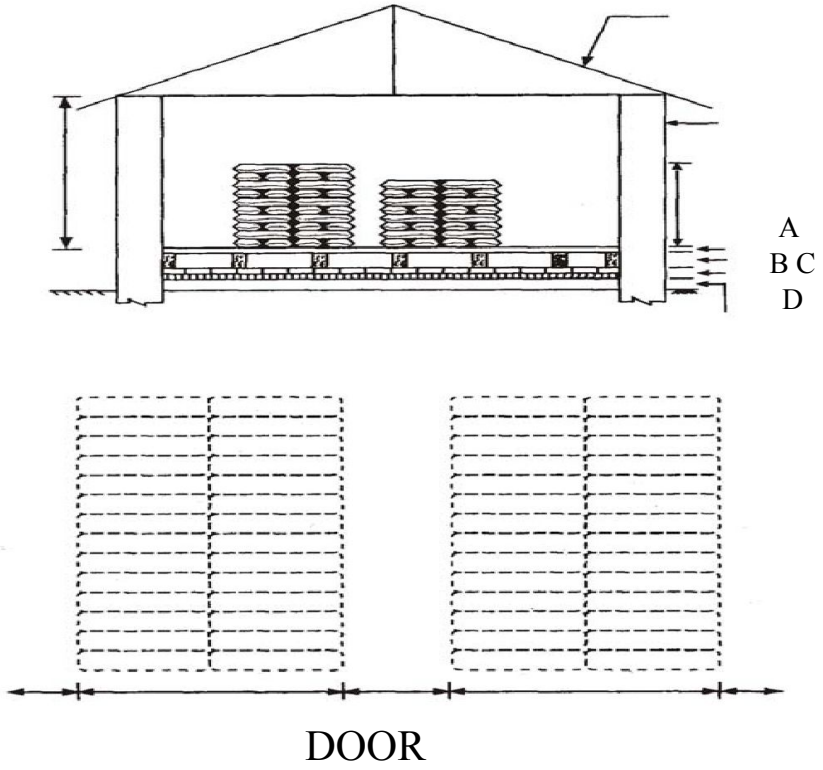
(b) **Final setting time:** Final setting time is the time when the paste completely loses its plasticity. It is the time taken for the cement paste or cement concrete to harden sufficiently and attain the shape of the mould in which it is cast **Not more than 600 minutes (10 Hrs.)** ***Final setting time period facilitates safe removal of scaffolding or form***

Cement

Stacking and Storage

- Cement in bags shall be stored and stacked in a shed which is dry, leak-proof and as moisture-proof as possible.
- Cement bags shall be stacked at least 450 mm clear off the walls and in rows of two bags leaving in a space of at least 600 mm between two consecutive rows.
- In each row the cement bags shall be kept close together so as to reduce air circulation

TYPICAL SKETCH FOR CEMENT GODOWN



A = Planks

B = Wooden Battens

C = 150mm Dry Bricks in two Layers or Lean Cement Concrete

D = 150mm Consolidated Earth

Cement

- Stacking shall not be more than 10 bags high to avoid lumping under pressure.
- Different types of cement shall be stacked and stored separately.
- Cement bags shall be stacked in a manner to facilitate their removal and use in the order in which they are received **(First come, first use)**

Cement

- In case, the cement remains in storage for more than 3 months, the cement shall be retested before use and shall be rejected, if it fails to conform to any of the requirements given in the relevant Indian Standard.

Cement

- **EFFECT OF STORAGE ON STRENGTH OF CEMENT**

Period of Storage	Relative Strength (percent) at 28 days
3 months	80
6 months	70

Fine Aggregate (Sand)

- Aggregate most of which passes through 4.75 mm IS sieve is known as **Fine Aggregate.**

IS sieve 4.7.5 mm

Fine Aggregate (Sand)

- Fine aggregate shall consist of natural sand, crushed stone sand, crushed gravel sand & stone dust.

- It shall be hard, durable, chemically inert, clean and free from adherent coatings, organic matter etc.

Fine Aggregate (Sand)

- And shall not contain any appreciable amount of clay balls, alkalies, salts, coal, mica, shale or similar laminated materials in such form or in such quantities as to cause corrosion of metal or affect adversely the hardening, the strength, the durability or the appearance of mortar, plaster or concrete

- The sum of the percentages of all deleterious material shall not exceed 5%.

Fine Aggregate

Silt Content : A good quality construction **sand** has a particle size measuring about 75 microns to 4.75mm. Particles smaller than 75 micron are classified as **silt**. The presence of excess quantity (> 8%) of **silt** in **sand** reduces the bonding capacity of raw materials and affects the strength and durability of work.

The maximum quantity of silt in sand shall not exceed 8%.

- Fine aggregate containing more than allowable percentage of silt shall be washed as many times to bring the silt content within allowable limits

- ***Grading :*** On the basis of particle size, fine aggregate is graded in to four zones

Fine Aggregate

IS Sieve	Percentage passing for			
	Grading Zone I	Grading Zone II	Grading Zone III	Grading Zone IV
10 mm	100	100	100	100
4.75 mm	90-100	90-100	90-100	95-100
2.36 mm	60-95	75-100	85-100	95-100
1.18 mm	30-70	55-90	75-100	90-100
600 microns	15-34	35-59	60-79	80-100
300 microns	5-20	8-30	12-40	15-50
150 microns	0-10	0-10	0-10	0-15

Fine Aggregate

- **Note** : Fine aggregate conforming to Grading Zone IV shall not be used in Reinforced Cement Concrete.

- **Note :** ***Use of sea sand shall not be allowed,***

Fine Aggregate (Sand)

(a) Fine sand shall be either river sand or pit sand or a combination of the two. Its grading shall fall within the limits of Grading zone IV of Table.

(b) Stone dust shall be obtained by crushing hard stones or gravel. Its grading shall fall within the limits of grading Zone, I, II, or III of Table

(c) ***Sand for Masonry Mortar and for Plaster-*** Sand shall consist of natural sand, crushed stone sand or crushed gravel sand or a combination of any of these. Sand shall be hard durable, clean and free from adherent coating and organic matter and shall not contain the amount of clay, silt and fine dust more than specified as under.

Fine Aggregate

- Grading of sand for use in masonry mortar shall be conforming to IS 216 Grading of sand for use in plaster shall be conforming to IS 1542

Fine Aggregate

Grading of Sand for use in Masonry Mortar and Plaster

Grading of sand for use in masonry mortar		Grading sand for use in plaster	
IS Sieve Designation	Percentage passing by	IS Sieve Designation	Percentage passing by mass
10 mm	100	10 mm	100
4.75 mm	100	4.75 mm	95 to 100
2.36 mm	90 to 100	2.36 mm	95 to 100
1.18 mm	70 to 100	1.18 mm	90-100
600 microns	40-100	600 microns	80-100
300 microns	5-70	300 microns	20-65
150 microns	0-15	150 microns	0-50

Fine Aggregate

Bulking:

- Fine aggregate, when dry or saturated, has almost the same Volume but dampness causes increase in volume.

- In case fine aggregate is damp at the time of proportioning the ingredients for mortar or concrete, its quantity shall be increased suitably to allow for bulkage, which shall be determined by the method prescribed in IS code

- Following table gives the relation between moisture content and percentage of bulking for **guidance only**.

Fine Aggregate

Moisture content % age	Bulking % age (by volume)
Fully dry	Nil
2	15
3	20
4	25
5	30
Fully saturated	Nil

Fine Aggregate

Measurements:

- As the fine aggregate bulks to a substantial extent when partially wet, measurements shall be taken when the stacks are dry or appropriate allowance made for bulking.

Cement Mortar

- This shall be prepared by mixing cement and sand with or without the addition of pozzolana (Fly ash).

Fine Aggregate

Proportioning: Proportioning on weight basis shall be preferred taking into account specific gravity of sand and moisture content.

- Boxes of suitable size shall be prepared to facilitate proportioning on weight basis. Cement bag weighting 50 kg shall be taken as 0.035 cubic metre.
- Other ingredients in specified proportion shall be measured using boxes of size 40 x 35 x 25 cm (.035 cum).
- Sand shall be measured on the basis of its dry volume in the case of volumetric proportioning.

Preparation of Mortar

Mixing

(a) ***Mechanical Mixing:*** Cement and sand in the specified proportions shall be mixed dry thoroughly in a mixer.

- Water shall then be added gradually and wet mixing continued for at least three minutes.
- Only the required quantity of water shall be added which will produce mortar of workable consistency but not stiff paste.
- Only the quantity of mortar, which can be used within 30 minutes of its mixing shall be prepared at a time. Mixer shall be cleaned with water each time before suspending the work.

Preparation of Mortar

(b) ***Hand Mixing:*** The measured quantity of sand shall be levelled on a clean masonry platform and cement bags emptied on top.

- The cement and sand shall be thoroughly mixed dry by being turned over and over, backwards and forwards, several times till the mixture is of a uniform colour.

- The quantity of dry mix which can be used within 30 minutes shall then be mixed in a masonry trough with just sufficient quantity of water to bring the mortar to a stiff paste of necessary working consistency

Preparation of Mortar

- ***Precautions:*** mortar shall be used as soon as possible after mixing and before it begins to set, and in any case within half hour, after the water is added to the dry mixture.

CONCRETE WORK

MATERIAL

- Water, cement, fine aggregate or sand is already explain under Mortar.

- **Coarse Aggregate**

- ***General:*** Aggregate most of which is retained on 4.75 mm IS Sieve and contains only as much fine material as is permitted in IS 383 for various sizes and grading is known as coarse aggregate. Coarse aggregate shall be specified as stone aggregate, gravel or brick aggregate and it shall be obtained from approved/ authorized sources

CONCRETE WORK

Stone Aggregate: It shall consist of naturally occurring (uncrushed, crushed or broken) stones.

- It shall be hard, strong, dense, durable and clean.
- It shall be free from adherent coating, injurious amounts of disintegrated pieces, alkali, vegetable matter and other deleterious substances.
- It shall be roughly cubical in shape. Flaky and elongated pieces shall be avoided.
- It shall conform to IS 383 unless otherwise specified.

CONCRETE WORK

Gravel:

- It shall consist of naturally occurring river bed or pit gravel.
- It shall be sound, hard and clean.
- It shall be free from flat particles of shale or similar laminated material, powdered clay, silt, loam, adherent coating, alkali, vegetable matter and other deleterious substances.
- Pit gravel shall be washed if it contains soil materials adhering to it.
- These shall conform to IS 383 unless otherwise specified.

CONCRETE WORK

Deleterious Material: Coarse aggregate shall not contain any deleterious material, such as coal, lignite, mica, shale or similar laminated material, clay, alkali, soft fragments, sea shells and organic impurities in such quantity as to affect the strength or durability of the concrete.

- Coarse aggregate to be used for Reinforced Cement Concrete shall not contain any material liable to attack the steel reinforcement.
- The maximum quantity of deleterious material shall not be more than 5% of the weight of coarse aggregate.

CONCRETE WORK

Size and Grading

- (i) *Stone aggregate and gravel:* It shall be graded.

- (a) Nominal sizes of graded stone aggregate or gravel shall be 40, 20, 16, or 12.5 mm as specified.

CONCRETE WORK

Grading of Stone Aggregate as per IS 383

IS Sieve Designation	Percentage passing (by weight) for nominal size of			
	40mm	20mm	16 mm	12.5 mm
80mm	100	-	-	-
63mm	-	-	-	-
40mm	95 to 100	100	-	-
20mm	30 to 70	95 to 100	100	100
16mm	-	-	90 to 100	-
12.5mm	-	-	-	90 to 100
10mm	10 to 35	25 to 55	30 to 70	40 to 85
4.75mm	0 to 75	0 to 10	0 to 10	0 to 10

CONCRETE WORK

Admixtures

- When required, admixtures of approved quality shall be mixed with concrete, as specified. The admixtures shall conform to IS 9103.

- Dosage of these admixtures may vary according to manufacturers specification.

- Admixture manufacturer's recommendation shall be carefully followed so as to ensure complete solution of the product or to prepare a standard solution of uniform strength for easier use

CONCRETE WORK

Group	Grade Designation	Specified characteristic compressive strength of 150 mm Cube at 28 Days in N/mm2
Ordinary Concrete	M10	10
	M15	15
	M20	20
Standard Concrete	M25	25
	M30	30
	M35	35
	M40	40
	M45	45
	M50	50
	M55	55
High Strength Concrete	M60	60
	M65	65
	M70	70
	M75	75
	M80	80

Notes : ***In the designation of concrete mix M refers to the mix and the number to the specified compressive strength of 150 mm size cube at 28 days, expressed in*** N/mm^2.

CONCRETE WORK

Minimum Cement Content, Maximum Water-Cement Ratio and Minimum Grade of Concrete for Different Exposures as per IS code 456

Exposure	Plain Concrete			Reinforced Concrete		
	Minimum Cement Content kg/m3	Maximum Free Water Cement Ratio	Minimum Grade of Concrete	Minimum Cement Content kg/m3	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete
Mild	220	0.6	-	300	0.55	M20
Moderate	240	0.6	M15	300	0.5	M25
Severe	250	0.5	M20	320	0.45	M30
Very Severe	260	0.45	M20	340	0.45	M35
Extreme	280	0.4	M25	360	0.4	M40

CONCRETE WORK

Environmental Exposure Conditions

Environment	Exposure Conditions
Mild	Concrete surfaces protected against weather or aggressive conditions, except those situated in coastal area.
Moderate	Concrete surfaces sheltered from severe rain or freezing, Concrete exposed to condensation and rain. Concrete continuously under water. Concrete in contact or buried under non-aggressive soil / ground water. Concrete surface sheltered form saturated salt air in coastal area.
Severe	Concrete surfaces exposed to severe rain, alternate wetting and drying or occasional freezing or severe condensation. Concrete completely immersed in sea water. Concrete exposed to coastal environment

CONCRETE WORK

Environmental Exposure Conditions

Environment	Exposure Conditions
Very severe	Concrete surface exposed to sea water spray, corrosive fumes or severe freezing conditions. Concrete in contact with or buried under aggressive sub-soil/ ground water.
Extreme	Surface of members in tidal zone. Members in direct contact with liquid / solid aggressive chemicals.

Note: ***For the purpose of determining exposure conditions, all places within a distance of 10 kms. of coastal line, sea front would be treated as Coastal Area.***

CONCRETE WORK

Workability of Concrete

- The concrete mix proportion chosen should be such that the concrete is of adequate workability for the placing conditions of the concrete and can properly be compacted with the means available.

CONCRETE WORK

Suggested ranges of workability of concrete measured in accordance with IS 1199 are given in table below:-

CONCRETE WORK

Placing Conditions	Degree of Workability	Slump (mm)
landing concrete: shallow sections: Pavements using pavers	Very low	See note
Mass concrete: Lightly reinforced sections in slabs, beams, wall, columns, : floors	Low	25-75
Hand placed pavements: canal lining; Strip footing	Medium	
Heavily reinforced sections in slabs, beams, walls, columns:		50-100
Slip form work: Pumped concrete	Medium	75-100
Trench fill	High	100-150
Tremie concrete	Very High	See note

CONCRETE WORK

Note:

- In the ‘very low’ category of workability where strict control is necessary, for example, pavement quality concrete, measurement of workability be determination of compacting factor will be more appropriate than slump (IS 1199) and a value of compacting factor of 0.75 to 0.80 is suggested. (The compacting factor is defined as the ratio of the weight of partially compacted concrete to the weight of fully compacted concrete.)
- In the ‘very high’ category of workability, measurement of workability by determination of flow will be appropriate (IS 9103).

CONCRETE WORK

Concrete Mix Proportioning

- The determination of the proportion of cement, aggregate and water to attain the required strength shall be made as follows:

(a) *By designing the concrete mix: such concrete shall be called 'Design mix concrete'.*

(b) *By adopting nominal concrete mix: such concrete shall be called 'Nominal mix concrete'.*

CONCRETE WORK

- **Design Mix**
- It can be defined as the process of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible.
- Design mix is a mix considering all ratio of mix is by weight where strength of concrete is constant cost of concrete can be reduced.
- It is Performance based concrete.
- It is adopted for higher grade concrete.

CONCRETE WORK

- **Nominal Mix**
- When the concrete is produced by taking standard arbitrary proportions of concrete ingredients, it is known as nominal mix concrete.

For example:

a- Cement concrete 1:2:4 (1 Cement : 2 Coarse Sand : 4 Graded stone aggregate) **Equivalent to M-15 grade concrete (Mix design)**

b- Cement 1:1.5:3 (1 Cement : 1.5 Coarse Sand : 3 Graded stone aggregate) **equivalent to M-20 grade concrete. (Mix design)**

CONCRETE WORK

- **Nominal Mix**
- It is used in ordinary concrete involving concrete grade not higher than M20.
- There is no quality control.
- Water cement ratio is based on durability criteria, experience & practical trials.

CONCRETE WORK

- Design mix concrete is preferred to nominal mix. If design mix concrete cannot be used for any reason on the work for grades of M20 or lower, nominal mixes may be used with the permission of Engineer-in-Charge, which, however, is likely to involve a higher cement content.

CONCRETE WORK

- ***Nominal Mix Concrete:*** *Nominal Mix Concrete may be used for concrete of M20 or lower.*

- The cement content of the mix specified in for any nominal mix shall be proportionately increased if the quantity of water in the mix has to be increased to overcome the difficulty or placement and compaction, so that the water cement ratio as specified is not exceeded.

CONCRETE WORK

DAMP PROOF COURSE

A **damp-proof course** (**DPC**) is a barrier through the structure designed to prevent moisture rising by capillary action such as through a phenomenon known as rising **damp**.

CONCRETE WORK

DAMP PROOF COURSE

- **Cement Concrete Layer**
- This shall consist of cement concrete of specified proportions and thickness.
- The surface of brick or stone masonry work shall be levelled and prepared before laying the cement concrete.
- Edge of damp proof course shall be straight, even and vertical.
- Side shuttering shall consist of steel forms and shall be strong and properly fixed so that it does not get disturbed during compaction and the mortar does not leak through.
- The concrete mix shall be of workable consistency and shall be tamped thoroughly to make a dense mass.

CONCRETE WORK

DAMP PROOF COURSE

- **Cement Concrete Layer**

- When the sides are removed, the surface should come out smooth without honey coming.

- Continuity shall be maintained while laying the cement concrete layer and laying shall be terminated only at the predetermined location where damp proof course is to be discontinued i.e. on door opening, passage opening.

- There shall be no construction joints in the Damp Proof Course

CONCRETE WORK

DAMP PROOF COURSE

Application of Hot Bitumen

- Where so directed, hot bitumen in specified quantity shall be applied over the dried up surface of cement concrete, properly cleaned with brushes and finally with a piece of cloth soaked in kerosene oil.
- Bitumen shall be heated to a temperature of 160º ± 5ºC.
- The hot bitumen shall be applied uniformly all over, so that no blank spaces are left anywhere.

CONCRETE WORK

DAMP PROOF COURSE

Water Proofing Materials

- Where so specified, water proofing material of approved quality shall be added to the concrete mixture in accordance with the manufacturer's specification stating the quantity of water proofing material in litres or kg per 50 kg or cement.

Thank You