PART-A

Ch.1 Concrete mix design:-

a. Introduction:-

Concrete is the most widely used man-made construction material in the world and is second only to water as the most utilized substance on the planet.

↳ It is obtained by mixing cementitious materials, water and aggregates (and sometimes admixtures) in required proportion.

↳ The mixture a when placed in forms and allowed to cure, hardens in to a rock like mass known as concrete.

↳ The hardening is the caused by chemical reaction between water & cement & it continues for a long time & consequently the concrete grows stronger with age.

↳ The hardened concrete may also be considered as an artificial stone in which the voids of larger particles (coarse aggregate) are filled ~~with cement~~ by the smaller particles (fine aggregate) & the voids of fine aggregate are filled with cement.

↳ In a concrete mix the cementitious material & water form a paste called cement water paste which in addition to filling the void of fine aggregate coats the surface of fine coarse aggregate & binds them together as it cures the cementing the particles of the aggregate together in a compact mass.

↳ The strength durability & other characteristic of concrete depend up on the properties of the ingridients on the proportions of mix, the method of compaction & other controls during placing. compaction & curing

↳ The popularity of the concrete is due to the fact that from the common ingredients it is possible to tailor the properties of concrete to meet the demands of any particular situation.

↳ The key to producing a strong durable & uniform concrete, i.e high performance concrete lies in the careful control of its basic & process components.

↳ These are Cement :- Portland cement the most widely used cementitious ingredients in present day concrete comprises phases that consist of compounds of calcium silicon, aluminium, iron & oxygen

Aggregate :-

These are primarily naturally occour find, inert granular materials such as sand, gravel or, crushed stone, However technology is broading to include the use of recycled materials & synthetic Products

Water :-

The water cement & the minerals & chemicals dissolve in it are crucial to achieving quality concrete.

Chemical Admixture :-

These are the ingredients in concrete other than portland cement water & aggregate that are added to the mixture, immdiately before or during mixing to reduce the water requirement accelireate / retard setting or, improve specific durability characteristic

...tary Cementitious Materials:-

S.C.M are also called minerel additives contribute to the propeties of hardened concrete thorought hydrolic activity.

→ Typical examples are natural Pozzolane fly ash, ground granulated blast furnace slag & silica fums.

↳ After concrete is placed thes components must be cured at a statisfactory moisture content and temprature must be carefully maintained for a sufficiently long time to allow adequate development of the strength of the concrete.

- Concrete has high in compression & it's tensile strength is very low.
- In situations where tensile stresses are developed the concrete is strengthened by steel bars or short randomly distributed fibers forming a composite construction called reinforced cement concrete (R.C.C) or fiber reinforced concrete.

* Properties of concrete :-

concrete making is not just a matter of mixing ingredient to produce a plastic mass, but good concrete has to satisfy performance requirement in the plastic or green state also the harden state.

↳ In the plastic state the concrete should be workable & free from segregation & building.

↳ Segregation is the separation of coarse aggregate & building is the separation of cement paste from the main mass.

↳ The segrigation a building result in a poor quality concrete.

↳ In it's hardened state concrete should be strong, durable, impermeable, & it should have minimum dimensional changes.

↳ Among the various properties of concrete, it's compressive strength is considered to be the most important & is taken as an index of it's overall quality.

↳ Many other properties of concrete appear to be generally related to it's compressive strength.

*. Nominal mix concrete & Designed mix concrete :-

The main ingredients are of concrete are cement, fine aggregate (sand) & coarse aggregate (gravel or crush box)

↳ It is usual to specify a particular concrete by the propotion (by wt.) of these constituent & their characteristic i.e a 1:2:4 concrete refers to a particular concrete manufactured by mixing cement sand & broken stone in 1:2:4 ratio (with a specified type of cement, water-cement ratio, max? size of aggregate - etc.)

↳ This classification specifying the propotions of constituents & their characteristi termed as prescriptive specification & is based

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on the hope that adherence to such prescriptive specification will result in satisfactory performance.

↳ Alternatively, the specification specifying the requirements of the desirable properties of concrete such as strength, workability...etc are stipulated, & these are termed as performance oriented specifications.

→ Based on these consideration concrete can be classified either as nominal mix concrete as design mixed concrete.

* Designed mix concrete :-

Concrete prepared determining the properties of cement, sand, aggregate & finishing the proportion from these properties.

→ Trial mixes prepared & tested in laboratory for getting desired strength.

→ Preparation is fixed by weight.

↳ The difference material, required from mix are determined mathematically trial mix are prepared as tested in laboratory.

* Nominal mixed concrete:-

If we mix the cement, sand, aggregate by approximately volume then it is known as nominal mix concrete.

ex:→1 → 1:5:3 for M20 concrete etc

This mix is used in field.

* The ACI method of mix proportioning

↳ The ACI method is based on the fact that for a given maximum size of well shaped aggregate, the water content (kg/m3) defer the workability of mix, i.e it is largely independent of mix proportion.

↳ The method further assumed that the optimum ratio of the bulk volume of coarse aggregate to the total value of concrete depends only and the max^{m} size of aggregate on the gradient of fine aggregate.

→ The water cement ratio is determing as in other ; methods the satisfy both strength durability, requirement.

→ The air content in concrete is taking into account for calculating the valume of fine aggregate.

→ The step-by-step procedure adopted for the selection of mix proportion as following.

(i) The water cement ratio is selected from the following table for the average strength.

*. Relationship bet.ⁿ water-cement ratio & avarage compressive strength

Compressive Strength of 28 day, MPa	Water-cement ratio by mass	
	Non-air entraine density	Air-entrained concrete
45	0.38	—
40	0.42	—
35	0.47	0.39
30	0.54	0.45
25	0.61	0.52
20	0.69	0.60
15	0.79	0.71

(ii). The max^m size of course aggregate to be used is determined by seive Seive analysis the degree of workability is decided depending upon the placing condition etc.

(iii) The water cement is select form the following table for the desired workability & max^m size of e aggregate.

Approximate water requirement s for Different slumps a max^m size coarse Aggregate.

slump (cm)	compacting factor	Relative water content %.	Mixing water (max^m size of) 10	12.5	20	25	37.5	50
Non air entrained concrete								
stiff plastic 25-50	0.85	92	207	199	190	179	156	187
plastic 75-100	0.91	100	228	216	205	193	181	161
Flowing 150-175	0.95	106	243	228	216	202	190	186
Approximate Meantrained air %.			3.0	2.5	2.0	1.5	1.0	0.5

Air entrained concrete

Stiff plastic 25-50	0.85	92	182	177	162	152	143	12[illegible]
Plastic 75-100	0.91	1.00	203	192	177	162	158	14[illegible]
Flowing 150-175	0.95	1.06	312	205	188	177	168	15[illegible]
Recommended avarage total air content percent	mild exposure		4.5	4.0	3.5	3.0	2.5	2.0
	moderate exposure		6.0	5.5	5.0	4.5	4.5	4.0
	extreme exposure		7.5	7.0	6.0	6.0	5.5	5.0

(iv) The cement concrete is calculated from the water content & water cement ratio required for strength & durability

(v) The coarse aggregate content is estimated from the following table for max^m size of aggregate finess modulus of sand.

(vi) The coarse aggregate ~~content is~~ determined by subtracting the sum of absolute volume of the coarse aggregate, cement water & entrained air from unit volume of concrete. Trial batches are tested & final proportion are obtained by adjustments.

* Concept of quality control :-

↳ Quality in general terms is totality feature & characteristic of a product service that bear on its ability to the stated or implied needs.

↳ The stated or implied needs are those derived by balanced excellence a equity with in the sustainable regime & in the socio-techno-economic scenario.

↳ The quality management has evolved also the period throught.

- Policing quality :- acceptance & rejection through inspection & assement by use
- Judging quality :- confidence building through third-party judgement
- Fostering quality :- ensuring quality of the final product by attending to quality at all intermediary stages such as in certification marketing schemes.

↳ The quality magnitude of the vibration depend on several factors such as the variation in the quality of constituent materials variation in the quality of constituent variation in mix proportion due to Batching process, variation in the quality of batching & mixing equipment available the quality of overall workmanship & supervision at the site, variation due to sampling & testing of concrete specimens.

↳ The quality control of concrete is thus to reduce this variation & to produce concrete of uniform quality consistent with specifed performance requirement which can be achived by good workmanship & maintaince of plant at peak efficiency

↳ The concrete industry strives at making quality i.e way of life & way management through quality Approach covering at aspect of IS 9000 seires.

* Quality Control:-

The strength of concrete. varies from batch to batch over a period time.

→ The source of variability in the strength of concrete may be considered due to variation in the quality of the constitute material in the quality of the constitute materials due to variation in mix proportions due to batching process, variations in the quality of batching & mixed equipment available the quality of supervision & workmanship.

→ These variation are inevitable during production to varying degrees

→ Controlling these variations is impt. in lowering the different between the minimum strength & characteristic mean strength of the mix & hence reducing the cement content.

→ The factor controlling difference is quality control.

→ The degree of control ultimately evaluated the variation is test results usually expressed beams of the coefficient of variation,

→ Most of the design procedure are primarly base on the water cement ratio low & absolute value ... calculated

ACT

① Advantage & dis - Advantage of concrete.

② Quality control of concrete.

③ Retrofitting

⑤ Hot water & cold water distribution

⑥ ventilation

2mark

construction equipment

① drag

- ① Nominal Mix design

① water cement ratio

② concrete workability

surface.
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Refrofitting PART-B

* How restrofitting techniques are classified describe in detail.

Ans. Classification or refrofitting tecanique.

→ There are 2 way to enhance the seismic capacity of existing structure. The first is a structural-level approach of refrofitting which involves global modifications to the structural system.

→ The second is a member level approach of refrafitting or local refrofitting which deals with an increse of the dutility of components with adquate capacities to satisfy their specific limit states.

→ Based on the above concept the refroffitting of reinforced concrete buildings may be classified as in fig →

Retrofitting techniques

- Global
  - Adding shearwall
  - Adding in fill wall
  - Adding bracing
  - Adding will wall buttresses
  - wall thickeing
  - Mass reduction
  - Supplemental damping & base isolation
- local
  - Jacketing of beams
  - Jeeketing of columns
  - Jeeketing of beam
  - Column Points
  - strength ening individual Footing

→ Generally structural level retrofittings are applied when the entire structural lateral load resisting system is deemed to be deficient.

→ common approches in this regard are employes to increse stiffness, & strength with limited ductility.

→ Achieving desired ratio between the additional stiffening & strengthening is the art of seismic retrofitting.

→ The most common modifications include the addition of structural walls, steel braces, infill walls, base isolators or supplemental energy dissipation devices.

→ The addition of new reinforced concrete shear wall is the most oftenly practised device which has proved to be effective for controlling global lateral drifts & for reducing damage in frame members. Steel braces are used to make the existing buildings stiffen.

→ Concentric or eccentric bracing schemes may be used in the selected bays of an RC frame contributing to increase the

→ Infill wall may be employed for strengthening of reinforced concrete buildings, which has been effective in the case of one to three storey buildings that may be extended upto five stories.

→ The lateral strength of existing column can be increased by adding wing walls (side walls) or buttresses similar to infilling these techniques arenot so popular because of may require a vacant site around the building & enough resistance from piles or foundation of the buttress cell

→ At some occasions it might be possible to achive the retrofitting objectives by means of global mass reduction.

→ Mass reduction can be accompeised by removal of upper stories heavy ladding partitions & stored goods

→ Increasing the strength or stiffness of structural member such as slabs & shear wall can be achived by thickeing of member

→ The concept of sesmic base isolation is based on decoupling of structure by introducing low horizontal stiffness bearing between the structure and the foundation.

→ This is to be efficient for seismic protection of horizental buildings where super structure has a limited seismic resistance and intervention is required only at foundation level.

→ The supplemental damping devices such as addition of viscous damper, visco-elastic damper, frictional damper in diagonals of bays of frame. Substantially reduces the earthquake response by dissipation of energy.

→ Locally retrofitting are typically used either when the retrofit objectives are limited or direct treatment of the ~~vul~~ vulnerable components is needed.

→ The most popular & frequently used method in local retrofitting is Jacketing or confinement by the Jackets of reinforced concrete steel, Fibre reinforced polymer (FRP), carbon fibre etc.

→ Jacketing around the existing members increse lateral load capacity of the structure in a uniformly distribute way with a minimal increase in loading of any single foundation & with no alternative on the basic geometry of the building.