Model Set Questions with Answers

MODEL - 1

(CET - 605)

Full Marks : 70 **Time : 3 Hours**

Answer any **five** questions.

The figures in the right-hand margin indicate marks.

1. (a) What do you mean by a Accelerator ? [2
   (b) Write down advantages and disadvantages of concrete. [5
   (c) Briefly explain the procedure of concrete mix design. [7
2. (a) List different types of non-destructive tests of inside hardended concrete. [2
   (b) Outline classification and characteristics of admixtures. [5
   (c) Briefly describe, how a distribution box is designed ? [7
3. (a) What are the different types of mixers used for mixing concrete. [2
   (b) Write down the a dvantages of quality control of concrete. [5
   (c) Briefly describe, the classification of bulldozers and it's uses ? [7
4. (a) List different earth moving equipments. [2
   (b) Describe the types of wiring. [5
   (c) What are the Air Cleaning Devices ? [7
5. (a) Calculate modulus of Elasticity for M_{20} grade concrete. [2
   (b) Describe about the systems of ventilation. [5
   (c) Explain different admixtures used in concrete and their fuctions. [7
6. (a) What do you mean by liquefaction ? [2
   (b) Describe the Water Distribution System. [5
   (c) Explain the factors influening the choice of mix proportions. [7
7. (a) What do you mean by natural period of a structure ? [2
   (b) Describe about an Electric Water Heaters. [5
   (c) What are the advantages of quality control in concrete ? [7

MODEL - 1 (ANSWER)

1. (a) What do you mean by a Accelerator ?

Ans. An admixtures used to speed up the final user of concrete is called an acceleration. These are added to concrete either (a) to increase the rate of hydration of hydraulic cement and hence to increase the rate of development of strength or (b) to shorten the setting time.

(b) Write down advantages and disadvantages of concrete.

Ans. Advantages of Concrete

Concrete as a construction material has the following advantages.

(i) Concrete is economical in the long run as compared to other engineering materials. Except cement, it can be made from locally available coarse and fine aggregates.

(ii) Concrete possesses a high compressive strength and the corrosive and weathering effects are minimal. When properly prepared its strength is equal to that of a hard natural stone.

(iii) The green or newly mixed concrete can be easily handle and moulded or formed into virtually any shape or size according to specifications. The formwork can be reused a number of times for similar jobs resulting in economy.

(iv) It is strong in compression and has unlimited structural applications in combination with steel reinforcement. Concrete and steel have approximately equal coefficients of thermal expansion.

(v) Concrete can even be sprayed on and filled into fine cracks for repairs by the guniting process.

(vi) Concrete can be pumped and hence it can be laid in difficult positions also.

(vii) It is durable and fire resistant and requires very little maintenance.

These qualities explain why concrete is extensively used in the construction of skyscrapers, superhighways, railways, airfield, building, water-retaining structures, docks and harbours, dams, bridges, bunkers and silos, etc.

(c) Briefly explain the procedure of concrete mix design.

Ans. Methods of concrete mix design for medium strength concretes – Most of the available mix design methdos are based on empirical relationships, charts and graphs developed from extensive experimental investigations. Basically they follow the same principles enunciated in the preceding section and only minor variations exist in different mix design methods in the process of selection the mix proportions. The requirements of the concrete mix are usually ditacted by the general experience with regard to the structural design conditions durability and conditions of placing. Some of the commonly used mix design methods for medium strength concrete are following

(i) Trial and adustment method of mix design

(ii) DOE (British)

(iii) ACI mix design method

(iv) Mix design according to Indian Standard Recommended Guidelines.

(v) Rapid method for mix design.

The general step-by-step procedure for proportioning of concrete mixes is summarized below.

(i) The maximum nominal size of the aggregate, which is economically available is determined as per the specified requirements. The gradings of desired size aggregates is determined. The proportions of different size aggregates to obtain a desired combined grading are determined.

(ii) The degree of workability in terms of slump, compacting factor or Vee-Bee time is selected as per job requirements. The water content for the required workability is computed.

(iii) The mean target strength is estimated from the specified characteristic strength and the level of quality control.

(iv) A suitable water-cement ratio to obtain a concrete mix of desired strength is selected from the generalized curves given in fig. or cement grade specific curves of fig. The water-cement ratio so chosen is compared with that required for durability the lower value is adopted.

(v) The cement content is calculated and its quantity is checked for the requirements of durability.

(vi) The percentage of fine aggregate in the total aggregate is determined from the characteristics of coarse and fine aggregates. Alternatively the aggregate cement ratio may be determined.

(vii) The concrete mix proportions for the first trial mix are computed and concrete cubes are cast in the laboratory as per standard codal procedure. After the required period of curing the cubes are tested for the compressive strength of the mix.

(viii) The trial batches, obtained by making suitable adjustment in water-cement ratio or aggregate cement ratio or in proportions of cement, sand and aggregate are tested till the final mix composition is arrived at

(ix) The final proportions are expressed either on mass or volume basis.

Most of the available mix design methods are essentially based on the above procedure and due consideration should be given for the moisture content of aggregate and the moisture content of aggregate and the entrained air.

2.(a) List different types of non-destructive tests of inside hardended concrete.

Ans. The tests are rebound hardness test, ultrasonic pulse velocity test.

(b) Outline classification and characteristics of admixtures.

Ans. Admixture – Chemical admixtures are added to the batch immediately before or during its mixing to modify one or more of the properties of concrete. The admixture is used not to improve the quality of concrete but to modify the properties of concrete as per special requirements. A good concrete can always be prepared without the use of admixtures. According to the effects produced in concrete, the admixtures are classified as

1. Accelerators
2. Retarders
3. Water reducing admixtures (plasticizers)
4. Air-entraining angents.

Each of these are briefly discussed below. The specifications for admixtures are given in IS : 9103-1999 (specification for admixtures for concrete) which may be consulted for further details.

1. Accelerators – These are the substances which when added to concrete mortar or grout increase the rate of hydration of a hydraulic cement, shorten the time of set or increase the rate of hardening or strength development. These are particularly useful in cold weather. Calcium chloride is the most commonly used substance for this purpose. Some of the soluble carbonates silicates flusoilicates and some of the orfanic compounds are used as accelerators. Modern admixtures can make the cement set within a few minutes which makes it possible to use the concrete for under-water constructon.

2. Retarders – These are the substances which retard the setting of cement. These are particularly useful in hot weather or for ready mixed concrete, where it is required to delay the setting of cement. The quantity of these additives must be controlled as these can totally inhibit the setting and hardening of concrete. Sugar, carbohydrate derivatives soluble zinc salts, etc are used as retarders.

3. Water reducing admixtures (plasticizers) – These are the substances which when added to concrete, increase workability without increasing the water content i.e. the concrete made using these admixtures is a flowing concrete. Concrete with increased workability without adding more water is called flowing concrete. It is possible with flowing concrete to place it in inaccessible locations where quick placing is required. It is particularly useful for very heavily reinforced sections or where rapid placing or concrete is desired. They are also useful for reducing water cement ratio when an extremely high strength concrete is required. For this purpose now-a-days super-plasticizers are also available. It may be noted here that reducing water-available. It may be noted here that reducing water-cement ratio in concrete mix increases its strength. Thus, super plasticizer do not increase the strength of the concrete but its use helps in reducing water amount which in turn increase the strength of the concrete.

4. Air-entraining agents – These are the admixtures which cause air to be incorporated in the form of minute bubbles in concrete during mixing to increase the workability and resistance to freezing and thawing and disruptive action of deicing salts, they can stop resin, animal/vegetable fat, etc are the substances to be used for this purpose.

(c) Briefly describe, how a distribution box is designed ?

Ans. At first, we should have to calculate the power, current and circuits.

$$P = V \times I$$

Where, P = power in watts

V = voltage

and I = current in amperes.

The total power requirements should be calculated after estimating the number of light points, fan points and the 5A socket outlet points.

Then the voltage should be determined, i.e., whether it is single phase of 220V or three of 400 V.

Having determined the power and voltage the total current of the instalation can be calculated.

I = P/V, once the current capacity is known the rating of the main switch can be determined.

No circuit should have more than 8-points and the maximum power on these 8-points should not exceed 1000 W.

$$\text{Number of circuits} = \frac{\text{Total points}}{8}$$

Having found out the number of circuits, the distribution box can be designed.

3.(a) What are the different types of mixers used for mixing concrete.

Ans. The different types of mixers used for mixing concretes are

(i) Tilting type mixer.

(ii) Non-tilting type mixer.

(iii) Pan or stirring mixer.

(b) Write down the a dvantages of quality control of concrete.

Ans. Advantages of quality control : The general feeling that quality means extra cost is not correct, the advantages due to quality control offset the extra-cost. Some of the advantages of quality concrete are the following.

(i) Quality control means a retional use of the available sesources after testing their characterstics and reduction in the materials costs.

(ii) In the absence of quality control there is no guarantee that over- spending in one area will compensate for the weakness in another, e.g. an extra bag of cement will not compensate for incomplete compaction or inadequate curing. Proper control at all the stages is the only guarantee.

(iii) In the absence of quality control at the site, the designer is tempted to overdesign. So as to minimeze the risks. This adds to the overall cost.

(iv) Checks at every stage of the production of concrete and rectification of the faults at the right time expedites completion and resuces delay.

(v) Quality control reduces the maintenance costs.

It should be realized that if the good quality concrete is made with cement, aggregates and water, the ingredients of ban concrete are exactly the same. The difference lies in the few essential steps collectively down as quality control.

(c) Briefly describe, the classification of bulldozers and it's uses ?

Ans. The bulldozers are classified as follows

→ The bulldozers may be either cable controlled or hydraulic controlled.

→ Depending upon the mountings, a bulldozers may be crawler tractor mounted bulldozers or wheel tractor mounted bulldozer. The latter can attain higher travelk speeds on the job and can be moved on paved floors without causing damage to the floors.

→ Depending on the nature of blade, the bulldozer may be front-casting dozer or angle dozer. In the former case, the blade is fixed perpendicular to the direction of travel. In case of angle-dozers, the blade is fixed at an anglee with the direction of travel. The front casting dozer will move the earth on one side in the forward direction. A bulldozer may be provided with blades of such arrangement that it can be converted into either or the two types,

Utility of Bulldozer : By suitable attachments to the bulldozer, it can be utilized to remove trees, rocks, boulders etc. In order to increase the output, two bulldozers working side by side with their blades in contact, can be used. A bulldozer can be used on wet ground and in all conditions of weather.

4.(a) List different earth moving equipments.

Ans. Earth moving equipments like, drag line, bulldozer, tractor, power shovel etc.

(b) Describe the types of wiring.

Ans. There are three types of wiring,

(a) C.T.S. (Cotton/P.V.C Toughened / Sheathed) Wiring : The conductor is provided with insullation which is not water or heat proof. Over the insulation of the conductor and tough rubber shealth is provided for additional insulation and protection against wear, tear and moisture.

This types of wiring is suitable for damp circuits, but can not sustain much heat and is noit suitable for places in very hot weather. There is also the danger of

mechanical hatred. It is also not suitable for outdoor wiring. It should not be exposed to direct sunlight a areas where there are corrosive acids or alkali fumes.

(b) Conduit wiring : In this system wires with single insulation are used. The wires are run in steel/ p.v.i conduits giving good protection from mechanical injury or fire risks. This types of wiring is used for industries.

(c) Concealed conduit wiring : This system is same as conduit wiring except that the conduits are buried in the chase made on the walls. This system is wed where aesthetics is the main consideration and not the additional cost of conduit.

(c) What are the Air Cleaning Devices ?

Ans. Air clearners may be classified depending upon the principle employed as follows.

(i) Impingement filters : These filters use the principle of adhesive impingement by which impurities are trapped and retained in the filter element. Usual materals used for filter elements are expanded metal, glass fibre, steel wool, bronze or copper wool, hemp fibre etc.

(ii) Dry strawner filters : These have collecting surfaces made of cellulose, cloth, felt, glass fibre etc.

(iii) Electrostatic precipitators : These remove dirt by electrically charging the particles and then attracting them to a plate.

(iv) Air washers : A fine spray of water in the inlet removes all watteble dirt.

(v) Sterilisation of air : Some organisms are removed by air washing, ultraviolate light is used for sterilisation which can be used on the air duct leading to the conditional space.

(vi) Odour Control : The first method is by deluting with outdoor air. The present method is to use a number of chemical deodorants to reduce odour.

5.(a) Calculate modulus of Elasticity for M_{20} grade concrete.

Ans. Modulus of Elasicity for M_{20} grade concrete

$$= 500\sqrt{fck} = 5000\sqrt{20} = 22360.68 \text{ N/mm}^2.$$

(b) Describe about the systems of ventilation.

Ans. Three different system may be employed.

(i) Exhaust System : This is most widely used. The interior air is renewed by exhaustion from the occupied space, which causes fresh outside air to enter. An exhaust fan creates an area of low pressure adjacent to it and air from outside flows in through any avilable apperture to fill the depression within.

(ii) Air Supply System : This system is direct opposite of the exhaustion system. Fresh air is blown intoi an occupied space by means of fans and with a plain supply system, the interior air flows out through any available outlets.

(iii) Combined supply and exhaust system

The fullest control of ventilation is achieved by using both supply and exhaust fans. A uniform distribution of fresh air can then be ensured. Fresh air can be introduced where it is required and its distribution throughout the occupied space can be governed by a positive flow between supply inlet and exhaust outlet.

(c) Explain different admixtures used in concrete and their fuctions.

Ans. Admixture – Chemical admixtures are added to the batch immediately before or during its mixing to modify one or more of the properties of concrete. The admixture is used not to improve the quality of concrete but to modify the properties of concrete as per special requirements. A good concrete can always be prepared without the use of admixtures. According to the effects produced in concrete, the admixtures are classified as

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Each of these are briefly discussed below. The specifications for admixtures are given in IS : 9103-1999 (specification for admixtures for concrete) which may be consulted for further details.

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3. Water reducing admixtures (plasticizers) – These are the substances which when added to concrete, increase workability without increasing the water content i.e. the concrete made using these admixtures is a flowing concrete. Concrete with increased workability without adding more water is called flowing concrete. It is possible with flowing concrete to place it in inaccessible locations where quick placing is required. It is particularly useful for very heavily reinforced sections or where rapid placing or concrete is desired. They are also useful for reducing water cement ratio when an extremely high strength concrete is required. For this purpose now-a-days super-plasticizers are also available. It may be noted here that reducing water-available. It may be noted here that reducing water-cement ratio in concrete mix increases its strength. Thus, super plasticizer do not increase the strength of the concrete but its use helps in reducing water amount which in turn increase the strength of the concrete.

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6.(a) What do you mean by liquefaction ?

Ans. Liquefaction is a state in saturated cohesionless soil where in the effective shear strength is reduced to negligible value for all engineering purpose due to pore pressure caused by vibrations during an earthquake when they a pproach the total confining pressure. In this condition the soil tends to behave like a fluid mass.

(b) Describe the Water Distribution System.

Ans. The layout of water distribution piping may be basically a horizontal or vertical underground mains under pressure supply water to fixture inlets.

In tall buidling water is pumped to elevated tanks where it can flow down and feed the fixtures. Systems from public mains are supplied through a service main. This starts at a top on the steel main known as lateral. The size of laterals varies from 10 to 22.5 cm. A water-meter is connected to the service main. Service pipes are subjected to expansion and contraction and minor earth movement.

Inside a building at the service valve, the building main extends to each fixture group in single-storey buildings or to the foot of each upfeed riser in taller buildings. The service pipe may supply an upfeed system for as great a height as the available pressure allows. In addition, it supplies a pump from which pumps can draw for the elevated house tanks. A house tank serves downfeed rivers to a number of floors. The washers and other valves withstand pressure upto about 5kg/ cm^2.

(c) Explain the factors influening the choice of mix proportions.

Ans. Factors Influencing the choice of Mix Proportions

According to IS : 456 - 2000 and IS : 1343 - 1980, the design of concrete mix should be based on the following factors.

(i) Grade designation

(ii) Type and grade of cement

(iii) Maximum nominal size of aggregates

(iv) Grading of combined aggregates

(v) Water-cement ratio

(vi) Workability

(vii) Durability

(viii) Quality control

(i) Grade Designation

The grade designation gives characteristic compressive strength requirements of the concrete. As per IS : 456-2000, the characteristic compressive strength is defined as that value below which not more than 5 per cent of the test resutls are expected to fall. It is the major factor influencing the mix design. Depending upon the degree of control available at the site the concrete mix has to be designed for a target mean compressive strength with is somewhat higher than the characterstic strength.

(ii) Type and Grade of Cement

The type of cement is important mainly through

its influence on the rate of development of compressive strength of concrete. The choice of type of cement depends upon the requirements of performance at head. Where very high compressive strength is required, e.g. in prestressed concrete railway sllepers high strength portland cement of grades 43 and 53 conforming to IS : 8112-1989 and IS : 12269-1987, respectively, will be found suitable. In situations where an early strength development is required, rapid-hardening portland cement conforming to IS : 8041-1990 is preferable and for mass concrete construction, low-heat portland cement conforming to IS : 12600 - 1989 is preferred. The blended cements such as portland pozzolana cement and portland slag cement are permitted for use in reinforced concrete construction. While portland slag cement is also permitted for prestressed concrete construction, the rate of development of early strength may be somewhat slower with blended cements.

The cement content in concrete varies almost inversely with the strength of cement used in the preparation concrete, i.e. higher the strength of cement, lesser will be the cement coment content. If the 33 grade cement is considered as a base then savings in cement consumption with the use of cement of grades of 43 and 53 can be as much as 15 and 25 per cent, respectively. The saving is also affected by the quality of locally available materials, which vary from site to site. For concretes of grade M 25 and above, it is advisable to use 43 and 53 grades of cement. The concrete of specified grade using cement having low strength may require more quantity of cement than the permissible maximum of 450 kg/m^3 specified by IS : 456-2000 and as such would tend to develop shrinkage cracks in the concrete. On the other hadn use of high strength cement permits higher water-cement ratio, which offers increased workability of fresh concrete moreover, greater fineness of 43 and 53 grade cements is another factor, which increases the workability. Fine particles reduce friction between aggregates, thus making concrete more workable. In a given quantity of cement, a finely ground cement has more number of particles and hence gives better surface finish.

A cement of consistent quality which exhibits minimum variation i.e. minimum standard deviation, in the quality which expressed in terms of its compressive strength makes it easier to determine the most economical proportion of cement required to obtain a particular grade concrete mix only by changing the ratio of fine to coarse aggregates. The currently available good brands of cement have been reported to maintain standard deviations as low as 2.5, 1.5 and 1.0 MPa, respectively, for 33, 43 and 53 grades of cement.

(iii) Maximum Nominal Size of Coarse Aggregate

The maximum nominal size of the coarse aggregate is determined by sieve analysis and is designated by the sieve size higher than the largest size on which 15 per cent or more of the aggregate to be used in concrete is governed by the size of the section and the spacing of the reinforcement. According to IS : 456-2000 and IS : 1343-1980, the maximum nominal size of the aggregate should not be more than one fourth of the minimum thickness of the member and it should be restricted to 5 mm less than the minimum clear distace between the main bars of 5 mm less than the minimum cover to the reinforcement or 5 mm less than the spacing between the prestressing cables. Within these limits, the nominal maximum size of aggregate may be as large as possible, because larger the maximum size of aggregate smaller is the cement requirement for a particular water-cement ratio. The workability also increase with an increase in the maximum size of aggregate. However, the smaller size aggregates provide larger surface area for reduces the stress concentration in the mortar-aggregate interface. For the concrete with higher water cement ratio, the larger maximum size of aggregate may be beneficial whereas for high strength concrete, 10-20 mm size of aggregate is preferable.

(iv) Grading of Combined Aggregate

The The relative proportions of the fine and coarse aggregates in a concrete mix is one of the important factors affecting the strength of concrete. For dense concrete it is essential that the coarse and the fine aggregates be well graded. Generally, the locally available aggregated do not conform to the standard gradings. In such cases the aggregates need to be combined in suitable proportions so that the resultant (combined) grading approximates to a continuous grading close to the desired (or standard) grading. The process of combining aggregates is aimed at obtaining a grading close to the coarsest grading of standard grading curves, the most economical mix having highest permissible aggregate-cement ratio. IS : 383 - 1963 has recommended limits to the coarsest and finest gradings. The aggregates can be combined either by analytical calculations or graphically.

(v) Water-Cement Ratio

The compressive strength of concrete at a given

age and under normal temperature depends primarily on the water-cement ratio, lower the water-cement ratio greater is the compressive strength and vice-versa. A number of relationships between compressive strength and water-cement ratio are available which are supposed to be valid for a wide range of conditions. In so far as the selection of the water-cement ratio for the target compressive strength at 28 days is concerned, figure is applicable for both ordinary Portland and portland pozzolana cements with comparable validity. For air-entrained concretes, the compressive strengths are approximately 80 per cent of that of non-entrained concretes.

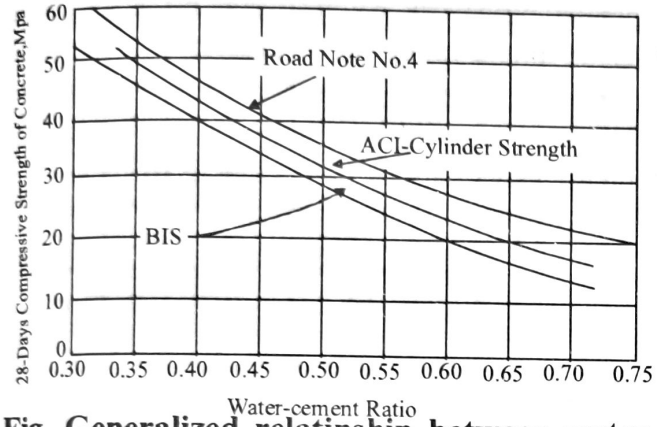


Fig. Generalized relatinship between water-cement ratio and compressive strength of concrete

The cement normally available have 7 day compressive strength between 17.5 MPa to 40 MPa.

(vi) Workability

The workability of concrete for satisfactory placing and compaction is controlled by the size and shape of the section to be concreted, the quantity and spacing of reinforcement, and the methods to be employed for transporation, placing and compaction of concrete. The situation should be properly assessed to arrive at the desired workability. The aim should be to have the minimum possible workability consistent with satisfactory placing and compaction of concrete. It should be kept in mind that insufficient workability resulting in incomplete compaction may severly affect the strength, durability and surface finish of concrete and may thus prove to be uneconomical in the long run. For different placing conditions the recommended workabilities are given in Table.

Placing conditions	Degree of workability	Compacing factor or slump. mm
Blinding concrete	Very low	Strict control
Shallow sections		required with C.F.
Pavements using pavers		of 0.75 to 0.80
Mass concrete		
Lightly reinforced sections in slabs, beams, walls, columns	Low	25-75
Canal lining		
Strip footings		
Heavily reinforced section in slabs, beams,walls columns	Medium	50-100
Slip form work		75-100
Pumped concrete		
Trench fill	High	100-150
In-situ piling		
Tremle concrete	Very high (flowable)	200

There is no rigid correlation between workabilities of concrete as measured by different test methods. It is desirable that for a given concrete, the test method be identified before-hand workability be measured accordingly. The workability measured by different test methods for comparable concretes are given in Table.

(vii) Durability

The durability of concrete can be defined and interpreted to mean its resistance to deteriorating influences which may reside inside the concrete itself, or to the aggressive environments. The requirements of durability are achieved by restricting the minimum cement content and the maximum water-cement ratio and the type of cement. The permeability of cement paste increases exponments. For a given water-cement ratio, the cement content in the concrete mix should correspond to the required workability, keeping in view the placing conditions and the concentration of reinforcement. In addition, the cement content 1 in the concrete mix should correspond to the required worability, keeping in view the placing conditions and the concentration of reinforcement. In addition, the cement content is chosen to ensure sufficient alkalinity to provide a passive environment against corrosion of steel, e.g. in concrete for marine environment or sea water a minimum cement content of 350 kg/m^3 or more is required.

Moreover, the cement content and water-cement ratio are chosen as to provide a sufficient volume of cement paste to overfill the voids in the compacted aggregates. The blended cements like portland pozzolana cement and portland slag cement render greate rdurability to the concrete in sulphatic environments and sea water. Resistance to alternate freezing and thawing is not so important for Indian conditions, but wherever situations demand, air-entrained concrete could be employed using an air-entraining admixture. Air-entrainment lowers the compressive strength but increases workability which may permit certain reduction in the water content to make up the loss in compressive strength.

(viii) Quality Control

The strength of concrete varies from batch to batch over a period of time. The sources of variability in the strength of concrete may be considered due to variation in the quality of the constituent materials, variations in mix proportions due to batching process, variations in the quality of batching and mixing equipment available, the quality of supervision and workmanship. These variations are inevitable during production to varying degrees. Controlling these variations is important in lowering the difference between the minimum strength and characteristic mean strength of the mix and hence reducing the cement content. The factor controlling this difference is quality control. The degree of control is ultimately evaluated by the variation in test results usually expressed in terms of the coefficient of variation.

It can be summarized that the aim of mix design is to obtain a most practical economical combination of materials that will produce a concrete mix of necessary plasticity (workability) and at the same time, produce hardened concrete of required strength and durability. Most of the mix design procedures are primarily based on the water-cement ratio law and absolute volume system of calculating the amount of materials. As explained earlier, according to the water-cement ratio law, the strength of hardened concrete is approximately inversely proportional to the water content per cubic metre of cement. The calculation of the quantities of the aggregates to be used with a given cement paste is based on the absolute volume method. The absolute volume of loose material is the actual volume of the solid matter in all the particles ignoring the space occupied by the voids ignoring the space occupied by the voids between the particles. The absolute volumeis calculated as given in Eq.

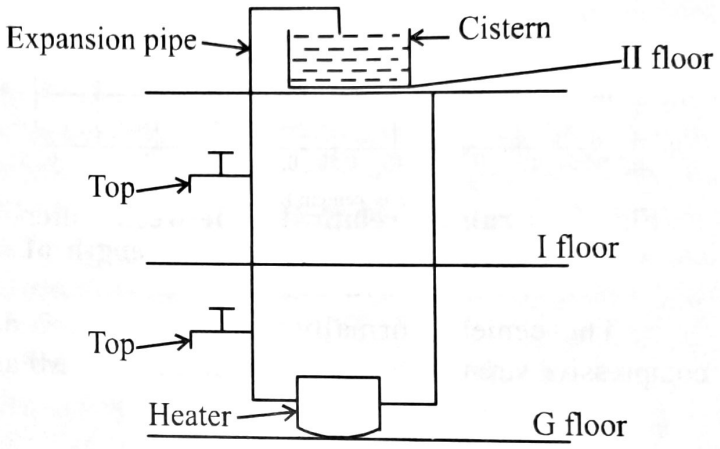
$$\text{Absolute volume} = \frac{\text{Mass of loosedry material}}{\text{Specific gravity} \times \text{Mass of unit volume of water}}$$

7.(a) What do you mean by natural period of a structure ?

Ans. Natural period of a structure is its time period oa undamped free vibration.

(b) Describe about an Electric Water Heaters.

Ans. An electric water heater usually consists of a well insulated storage tank or cylinder with an electric immersion heater placed in it and controlled by a thermostat. The immersion heater usually consists of a metal rod which is heated by an electric element and around which water circulates.It is necessary to insulate the storage tank carefully and prevent circulation onany associated pipe work. Such storage heaters are avialable either as single point heaters directly over the sink or wash basin, or as multipoint heaters to provide the whole hot water system for the house or as eistern type heaters which are especially useful in blocks of flats.



(Multipoint electric heater)

(c) What are the advantages of quality control in concrete ?

Ans. Advantages of quality control – The general feeling that quality control means extra cost is not correct, the advantages due to quality control offset the extra-cost. Some of the advantages of quality concrete are the following.

(i) Quality control means a rational use of the available resources after testing their characteristics and reduction in the materials costs.

(ii) In the absence of quality control there is no guarantee that over- spending in one area will compensate for the weakness in another, e.g. an extra bag of cement will not compensate for incomplete compaction or inadequate curing. Proper control at all the stages is the only guarantee.

(iii) In the absence of quality control at the site, the designer is tempted to overdesign. So as to minimize the risks. This adds to the overall cost.

(iv) Checks at every stage of the production of concrete and rectification of the faults at the right time expedites completion and reduces delay.

(v) Quality control reduces the maintenance costs.

It should be realised that if the good quality concrete is made with cement, aggregates and water, the ingredients of ban concrete are exactly the same. The difference lies in the few essential steps collectively down as quality control.

MODEL - 2

(CET - 605)

Full Marks : 70 **Time : 3 Hours**

Answer any **five** questions.

The figures in the right-hand margin indicate marks.

1. (a) What is curvature ductility ? [2

(b) What are the guidelines for provision on openings to afford good lighting ? [5

(c) Explain the factors influencing the choince of mix proportions. [7

2. (a) What is design basis earthquake ? [2

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(c) Briefly describe, how a distribution box is designed ? [7

3. (a) Name minimum grade of concrete that is used for R.C.C. work as per 1S : 456 – 2000. [2

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(c) A four-storey reinforced concrete frame building as shown is situated at Roorkee. The height between the floor is 3m and total height of building is 12m. The dead load and normal live load is lumped at respective floor. The soil beloiw the foundation is assumed to be hard rock. Assume building is intended to be used as a hospital. Determine the total base shear as per IS 1983 ; 2002. Distribute the base shear along the height of the building. [7

4. (a) What do you mean by Accelaration ? [2

(b) What are the factorsd affecting ductility ? [5

(c) Briefly explain the procedure of concrete mix design. [7

5. (a) List different non-destructive tests of infite hardened concrete. [2

(b) What are the points to be considered for selection of wiring ? [5

(c) Briefly describe the layout of venting. [7

6. (a) What is creep in concrete ? [2

(b) What is the meaning earthing and it's uses ? [5

(c) Describe about the systems of ventilation. [7

7. (a) What do you mean by critical damping ? [2

(b) What are the refrigerants used now-a-days ? [5

(c) Define the workability of concrete and also state the factors affecting workability. [7

MODEL - 2 (ANSWER)

1.(a) What is curvature ductility ?

Ans. It is the ratio of curvature at the ultimate strength of the section to the curvature at first yield of t ension steel in the section.

(b) What are the guidelines for provision on openings to afford good lighting ?

Ans. The guidelines are

→ Broader openings give better distributing of light.

→ Openings on two opposite sides will give greater uniformity of internal daylight illumination.

→ Cross-lighting with openings on adjacent walls tends to increase the diffused light with in a room.

→ Openings in deep reveals tend to minimise glare.

→ Openings provided with sun shades, louvers, baffles or other shading devices to exclude, as far as possible, direct sunlight from the room.

(c) Explain the factors influencing the choince of mix proportions.

Ans. Factors Influencing the choice of Mix Proportions

According to IS : 456 - 2000 and IS : 1343 - 1980, the design of concrete mix should be based on the following factors.

(i) Grade designation
(ii) Type and grade of cement
(iii) Maximum nominal size of aggregates
(iv) Grading of combined aggregates
(v) Water-cement ratio
(vi) Workability
(vii) Durability
(viii) Quality control

(i) Grade Designation

The grade designation gives characteristic compressive strength requirements of the concrete. As per IS : 456-2000, the characteristic compressive strength is defined as that value below which not more than 5 per cent of the test resutls are expected to fall. It is the major

factor influencing the mix design. Depending upon the degree of control available at the site the concrete mix has to be designed for a target mean compressive strength with is somewhat higher than the characterstic strength.

(ii) Type and Grade of Cement

The type of cement is important mainly through its influence on the rate of development of compressive strength of concrete. The choice of type of cement depends upon the requirements of performance at head. Where very high compressive strength is required, e.g. in prestressed concrete railway sllepers high strength portland cement of grades 43 and 53 conforming to IS : 8112-1989 and IS : 12269-1987, respectively, will be found suitable. In situations where an early strength development is required, rapid-hardening portland cement conforming to IS : 8041-1990 is preferable and for mass concrete construction, low-heat portland cement conforming to IS : 12600 - 1989 is preferred. The blended cements such as portland pozzolana cement and portland slag cement are permitted for use in reinforced concrete construction. While portland slag cement is also permitted for prestressed concrete construction, the rate of development of early strength may be somewhat slower with blended cements.

The cement content in concrete varies almost inversely with the strength of cement used in the preparation concrete, i.e. higher the strength of cement, lesser will be the cement coment content. If the 33 grade cement is considered as a base then savings in cement consumption with the use of cement of grades of 43 and 53 can be as much as 15 and 25 per cent, respectively. The saving is also affected by the quality of locally available materials, which vary from site to site. For concretes of grade M 25 and above, it is advisable to use 43 and 53 grades of cement. The concrete of specified grade using cement having low strength may require more quantity of cement than the permissible maximum of 450 kg/m^3 specified by IS : 456-2000 and as such would tend to develop shrinkage cracks in the concrete. On the other hadn use of high strength cement permits higher water-cement ratio, which offers increased workability of fresh concrete moreover, greater fineness of 43 and 53 grade cements is another factor, which increases the workability. Fine particles reduce friction between aggregates, thus making concrete more workable. In a given quantity of cement, a finely ground cement has more number of particles and hence gives better surface finish.

A cement of consistent quality which exhibits minimum variation i.e. minimum standard deviation, in the quality which expressed in terms of its compressive strength makes it easier to determine the most economical proportion of cement required to obtain a particular grade concrete mix only by changing the ratio of fine to coarse aggregates. The currently available good brands of cement have been reported to maintain standard deviations as low as 2.5, 1.5 and 1.0 MPa, respectively, for 33, 43 and 53 grades of cement.

(iii) Maximum Nominal Size of Coarse Aggregate

The maximum nominal size of the coarse aggregate is determined by sieve analysis and is designated by the sieve size higher than the largest size on which 15 per cent or more of the aggregate to be used in concrete is governed by the size of the section and the spacing of the reinforcement. According to IS : 456-2000 and IS : 1343-1980, the maximum nominal size of the aggregate should not be more than one fourth of the minimum thickness of the member and it should be restricted to 5 mm less than the minimum clear distace between the main bars of 5 mm less than the minimum cover to the reinforcement or 5 mm less than the spacing between the prestressing cables. Within these limits, the nominal maximum size of aggregate may be as large as possible, because larger the maximum size of aggregate smaller is the cement requirement for a particular water-cement ratio. The workability also increase with an increase in the maximum size of aggregate. However, the smaller size aggregates provide larger surface area for reduces the stress concentration in the mortar-aggregate interface. For the concrete with higher water cement ratio, the larger maximum size of aggregate may be beneficial whereas for high strength concrete, 10-20 mm size of aggregate is preferable.

(iv) Grading of Combined Aggregate

The The relative proportions of the fine and coarse aggregates in a concrete mix is one of the important factors affecting the strength of concrete. For dense concrete it is essential that the coarse and the fine aggregates be well graded. Generally, the locally available aggregated do not conform to the standard gradings. In such cases the aggregates need to be combined in suitable proportions so that the resultant (combined) grading approximates to a continuous grading close to the desired (or standard) grading. The process of combining aggregates is aimed at obtaining a grading close to the coarsest grading of standard grading curves, the most economical mix having highest permissible aggregate-cement ratio. IS : 383 - 1963 has recommended limits to the coarsest and finest gradings. The aggregates can be combined either by analytical calculations or graphically.

(v) Water-Cement Ratio

The compressive strength of concrete at a given age and under normal temperature depends primarily on the water-cement ratio, lower the water-cement ratio

greater is the compressive strength and vice-versa. A number of relationships between compressive strength and water-cement ratio are available which are supposed to be valid for a wide range of conditions. In so far as the selection of the water-cement ratio for the target compressive strength at 28 days is concerned, figure is applicable for both ordinary Portland and portland pozzolana cements with comparable validity. For air-entrained concretes, the compressive strengths are approximately 80 per cent of that of non-entrained concretes.

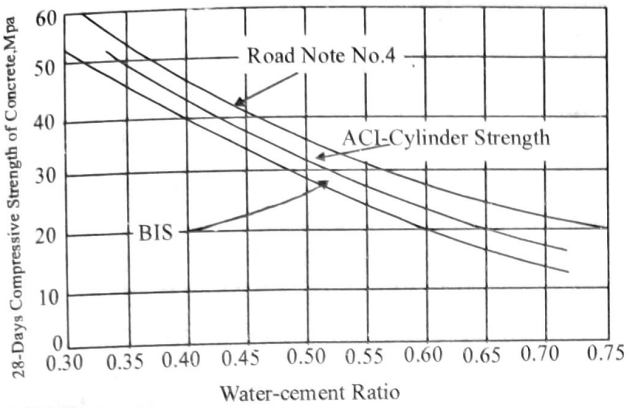


Fig. Generalized relatinship between water-cement ratio and compressive strength of concrete

The cement normally available have 7 day compressive strength between 17.5 MPa to 40 MPa.

(vi) Workability

The workability of concrete for satisfactory placing and compaction is controlled by the size and shape of the section to be concreted, the quantity and spacing of reinforcement, and the methods to be employed for transporation, placing and compaction of concrete. The situation should be properly assessed to arrive at the desired workability. The aim should be to have the minimum possible workability consistent with satisfactory placing and compaction of concrete. It should be kept in mind that insufficient workability resulting in incomplete compaction may severly affect the strength, durability and surface finish of concrete and may thus prove to be uneconomical in the long run. For different placing conditions the recommended workabilities are given in Table.

Placing conditions	Degree of workability	Compacing factor or slump. mm
Blinding concrete Shallow sections Pavements using pavers	Very low	Strict control required with C.F. of 0.75 to 0.80
Mass concrete Lightly reinforced sections in slabs, beams, walls, columns	Low	25-75
Canal lining Strip footings Heavily reinforced section in slabs, beams,walls columns	Medium	50-100
Slip form work Pumped concrete		75-100
Trench fill In-situ piling	High	100-150
Tremle concrete	Very high (flowable)	200

There is no rigid correlation between workabilities of concrete as measured by different test methods. It is desirable that for a given concrete, the test method be identified before-hand workability be measured accordingly. The workability measured by different test methods for comparable concretes are given in Table.

(vii) Durability

The durability of concrete can be defined and interpreted to mean its resistance to deteriorating influences which may reside inside the concrete itself, or to the aggressive environments. The requirements of durability are achieved by restricting the minimum cement content and the maximum water-cement ratio and the type of cement. The permeability of cement paste increases exponments. For a given water-cement ratio, the cement content in the concrete mix should correspond to the required workability, keeping in view the placing conditions and the concentration of reinforcement. In addition, the cement content 1 in the concrete mix should correspond to the required worability, keeping in view the placing conditions and the concentration of reinforcement. In addition, the cement content is chosen to ensure sufficient alkalinity to provide a passive environment against corrosion of steel, e.g. in concrete for marine environment or sea water a minimum cement content of 350 kg/m^3 or more is required.

Moreover, the cement content and water-cement ratio are chosen as to provide a sufficient volume of cement paste to overfill the voids in the compacted aggregates. The blended cements like portland pozzolana cement and portland slag cement render greate rdurability to the concrete in sulphatic environments and sea water. Resistance to alternate freezing and thawing is not so important for Indian conditions, but wherever situations demand, air-entrained concrete could be employed using an air-entraining admixture. Air-entrainment lowers the compressive strength but increases workability which may permit certain reduction in the water content to make up the loss in compressive strength.

(viii) Quality Control

The strength of concrete varies from batch to batch over a period of time. The sources of variability in the strength of concrete may be considered due to variation in the quality of the constituent materials, variations in mix proportions due to batching process, variations in the quality of batching and mixing equipment available, the quality of supervision and workmanship. These variations are inevitable during production to varying degrees. Controlling these variations is important in lowering the difference between the minimum strength and characteristic mean strength of the mix and hence reducing the cement content. The factor controlling this difference is quality control. The degree of control is ultimately evaluated by the variation in test results usually expressed in terms of the coefficient of variation.

It can be summarized that the aim of mix design is to obtain a most practical economical combination of materials that will produce a concrete mix of necessary plasticity (workability) and at the same time, produce hardened concrete of required strength and durability. Most of the mix design procedures are primarily based on the water-cement ratio law and absolute volume system of calculating the amount of materials. As explained earlier, according to the water-cement ratio law, the strength of hardened concrete is approximately inversely proportional to the water content per cubic metre of cement. The calculation of the quantities of the aggregates to be used with a given cement paste is based on the absolute volume method. The absolute volume of loose material is the actual volume of the solid matter in all the particles ignoring the space occupied by the voids ignoring the space occupied by the voids between the particles. The absolute volumeis calculated as given in Eq.

$$\text{Absolute volume} = \frac{\text{Mass of loosedry material}}{\text{Specific gravity} \times \text{Mass of unit volume of water}}$$

2.(a) What is design basis earthquake ?

Ans. It is the earthquake which can reasonably be expected to occur at least once during the design life of the structure.

(b) Describe the assumptions made in the earthquake resistant design of structures.

Ans. The following assumptions shall be made in the earthquake resistant design of structure.

(i) Earthquake causes impulsive ground motions which are complex and iorregular in character, changing in period and amplitude each lasting for a small duration. Therefore, resonance of the type as visualized under steady state sinusoiodal excitations, will not occur as it would need time to build up such amplitudes.

(ii) Earthquake is not likely to occur simultaneously with wind or maximum flood or maximum sea waves.

(iii) The value of elastic modulus of materials, wherever required, may be taken as for static analysis unless a more definite value is available for use in such condition.

(c) Briefly describe, how a distribution box is designed ?

Ans. At first, we should have to calculate the power, current and circuits.

$$P = V \times I$$

Where, P = power in watts

V = voltage

and I = current in amperes.

The total power requirements should be calculated after estimating the number of light points, fan points and the 5A socket outlet points.

Then the voltage should be determined, i.e., whether it is single phase of 220V or three of 400 V.

Having determined the power and voltage the total current of the instalation can be calculated.

I = P/V, once the current capacity is known the rating of the main switch can be determined.

No circuit should have more than 8-points and the maximum power on these 8-points should not exceed 1000 W.

$$\text{Number of circuits} = \frac{\text{Total points}}{8}$$

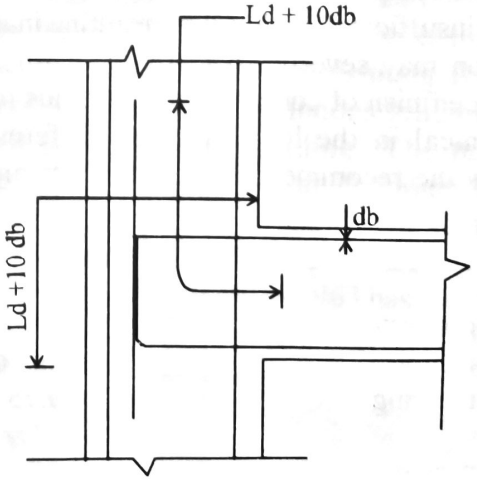
Having found out the number of circuits, the distribution box can be designed.

3.(a) Name minimum grade of concrete that is used for R.C.C. work as per 1S : 456 – 2000.

Ans. M_{15} grade concrete that is used for R.C.C. work as per IS : 456 – 2000.

(b) Draw an anchorage joint of beam.

Ans.



Where, L_d = Development length in tension.

D_b = Bar diameter.

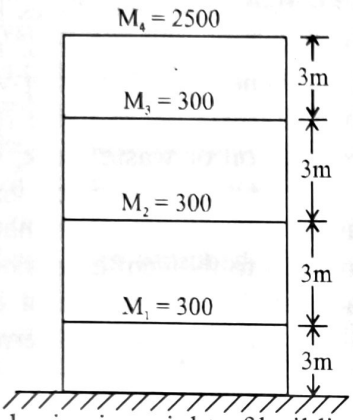
(c) A four-storey reinforced concrete frame building as shown is situated at Roorkee. The height between the floor is 3m and total height of building is 12m. The dead load and normal live load is lumped at respective floor. The soil beloiw the foundation is assumed to be hard rock. Assume building is intended to be used as a hospital. Determine the total base shear as per IS 1983 ; 2002. Distribute the base shear along the height of the building.

Ans. The total seismic base shear is given by

$$V_B = A_h W$$

$$A_h = \frac{7}{2} \cdot \frac{I}{R} \cdot \frac{S_a}{g}$$

$$= \frac{0.24}{2} \times \frac{1.5}{5} \times 2.06 = 0.074 .$$



The total seismic weight of building (W).

$= 3 \times 3000 + 2500 = 11{,}500$ KN.

$\therefore$ Total base shear $(V_B) = 0.074 \times 11500 = 851$ KN.

The design base shear (V_B) computed shall be distributed along the height of the building as per the following expression.

$$Q_i = V_B \frac{W_i h_i^2}{\sum_{i=1}^{n} W_i h_i^2}$$

Using the above equation, base shear is distributed as follows,

$$Q_1 = V_B \left(\frac{W_1 h_1^2}{W_1 h_1^2 + W_2 h_2^2 + W_3 h_3^2 + W_4 h_4^2} \right)$$

$$= 851 \left[\frac{3000 \times 3^2}{3000 \times 3^2 + 3000 \times 6^2 + 3000 \times 9^2 + 2500 \times 12^2} \right] = 31.13 \text{KN}.$$

$$Q_2 = 851 \left[\frac{3000 \times 6^2}{3000 \times 3^2 + 3000 \times 6^2 + 3000 \times 9^2 + 2500 \times 12^2} \right] = 124.53 \text{KN}.$$

$$Q_3 = 851 \left[\frac{3000 \times 9^2}{3000 \times 3^2 + 3000 \times 6^2 + 3000 \times 9^2 + 2500 \times 12^2} \right] = 208.18 \text{KN}.$$

$$Q_4 = 851 \left[\frac{2500 \times 12^2}{3000 \times 3^2 + 3000 \times 6^2 + 3000 \times 9^2 + 2500 \times 12^2} \right] = 415.08 \text{KN}.$$

4.(a) What do you mean by Accelaration ?

Ans. An admixture used to speed up the final user of concrete is called an accelerlation. These are added to concrete either to increase the rate of hydration of hydraulic cement and hence to increase the rate of development of strength or to shorten the setting time.

(b) What are the factorsd affecting ductility ?

Ans. Some important factors which the ductility will depend are

- → Dunctility increases linearly with an increase in the shear strength carred by concrete for small value of axial compressive stress.
- → Ductility linearly reduces upto the point where axial compressive stress becomes equal to the axial compressive stress of balanced failure.
- → With the increase of ultimate strain of concrete the ductility factors increases.
- → An increase in yield strength of steel with all other variables constantly decreases ductility.
- → The lateral reinforcement tends to improve dectility by preventing shear failures, restraining the compression steel against backling.
- → Ductility i ncreases as the stirrups in the specimen increases.

(c) Briefly explain the procedure of concrete mix design.

Ans. Methods of concrete mix design for medium strength concretes – Most of the available mix design methdos are based on empirical relationships, charts and graphs developed from extensive experimental investigations. Basically they follow the same principles enunciated in the preceding section and only minor variations exist in different mix design methods in the process of selection the mix proportions. The requirements of the concrete mix are usually ditacted by the general experience with regard to the structural design conditions durability and conditions of placing. Some of the commonly used mix design methods for medium strength concrete are following

(i) Trial and adustment method of mix design
(ii) DOE (British)
(iii) ACI mix design method
(iv) Mix design according to Indian Standard Recommended Guidelines.
(v) Rapid method for mix design.

The general step-by-step procedure for proportioning of concrete mixes is summarized below.

(i) The maximum nominal size of the aggregate, which is economically available is determined as per the specified requirements. The gradings of desired size aggregates is determined. The proportions of different size aggregates to obtain a desired combined grading are determined.

(ii) The degree of workability in terms of slump, compacting factor or Vee-Bee time is selected as per job requirements. The water content for the required workability is computed.

(iii) The mean target strength is estimated from the specified characteristic strength and the level of quality control.

(iv) A suitable water-cement ratio to obtain a concrete mix of desired strength is selected from the generalized curves given in fig. or cement grade specific curves of fig. The water-cement ratio so chosen is compared with that required for durability the lower value is adopted.

(v) The cement content is calculated and its quantity is checked for the requirements of durability.

(vi) The percentage of fine aggregate in the total aggregate is determined from the characteristics of coarse and fine aggregates. Alternatively the aggregate cement ratio may be determined.

(vii) The concrete mix proportions for the first trial mix are computed and concrete cubes are cast in the laboratory as per standard codal procedure. After the required period of curing the cubes are tested for the compressive strength of the mix.

(viii) The trial batches, obtained by making suitable adjustment in water-cement ratio or aggregate cement ratio or in proportions of cement, sand and aggregate are tested till the final mix composition is arrived at

ix) The final proportions are expressed either on mass or volume basis.

Most of the available mix design methods are essentially based on the above procedure and due consideration should be given for the moisture content of aggregate and the moisture content of aggregate and the entrained air

5.(a) List different non-destructive tests of infite hardened concrete.

Ans. The tests are Rebound hardness test, ultrasonic pulse velocity test.

(b) What are the points to be considered for selection of wiring ?

Ans. The points to be considered are

Durability : The wiring to be selected must be able to withstand wear and tear due to the action of weather, fuffles, dampness etc.

Safety : It is the most important point to be considered. The system selected should be such that even with poor workmanship, no dangerous result may be produced.

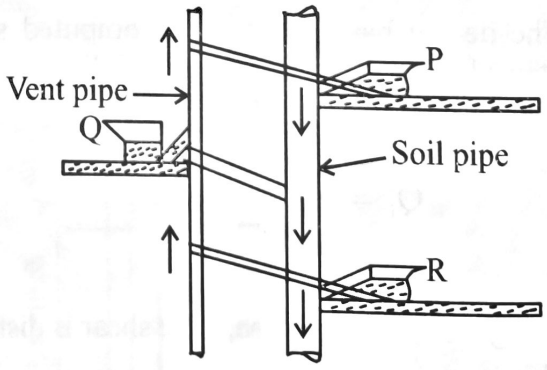
Mechanical : The wiring must be protected from damage of a physical protection nature, during its use in building.

Appearance : Appearance is an important consideration from the architectural point of view.

(c) Briefly describe the layout of venting.

Ans. Usually vent piping is installed to accommodate air flow only. Sometimes large pipes are used as fixture branches and vents. A pipe which functions in this manner is called a wet-vent.

Whenever fixtures from more than one floor drawn into a single soil or waste stack, vents from the fixtures must connect to a vent stack installed next to the soil or waste stack. It must terminate through the roof or be connected to the vent extension at the top of the soil or waste stack. Its base must connect to the base of the soil or waste stack. Vent terminals through the roof should be 3m away from windows or other openings and must be 1.5m above occupied roof decks. Otherwise, vent terminals should be 60cm above openings or at least 15cm above a roof.



(Vent Q soil pipes)

6.(a) What is creep in concrete ?

Ans. Creep is that property of concrete by which it continues to deform with time under sustained stress.

(b) What is the meaning earthing and it's uses ?

Ans. As the earth potential is taken as zero for all

practical purposes any electrical applicances when connected to earth attain zero potential and are said to be 'earthed'. The voltage os these earthed appliances will fall or increase to zero if their voltage is higher or lower respectively than the earth potential.

Uses of earthing

→ To save human life from the dange of shock.
→ To maintain the line voltage current.
→ To protect large building from atmospheric lighting.
→ To protect all machines fed from overhead lines.

(c) Describe about the systems of ventilation.

Ans. Three different system may be employed.

(i) Exhaust System : This is most widely used. The interior air is renewed by exhaustion from the occupied space, which causes fresh outside air to enter. An exhaust fan creates an area of low pressure adjacent to it and air from outside flows in through any avilable apperture to fill the depression within.

(ii) Air Supply System : This system is direct opposite of the exhaustion system. Fresh air is blown intoi an occupied space by means of fans and with a plain supply system, the interior air flows out through any available outlets.

(iii) Combined supply and exhaust system

The fullest control of ventilation is achieved by using both supply and exhaust fans. A uniform distribution of fresh air can then be ensured. Fresh air can be introduced where it is required and its distribution throughout the occupied space can be governed by a positive flow between supply inlet and exhaust outlet.

7.(a) What do you mean by critical damping ?

Ans. The effect of internal friction, imperfect elasticity of materials, slipping, sliding etc in reducing the amplitude of vibration and is expressed as a percentage of critical damping.

(b) What are the refrigerants used now-a-days ?

Ans. The most common refrigerants used today are

→ **Ammonia (NH_3) :** used in industrial applications only. Due to toxicity it is not used in comfort air-conditioning.
→ **Freon 12** (Dichlorodifluoromethare ($CCl_2 f_2$) : a safe refrigerant in reciprocating compresses in refrigeration system.
→ **Freon 11** ($CCl_3 f$) : a safe refrigerant used in centrifugal compressors.
→ **Freon 22** ($CHClF_2$) : a safe refrigerant used in reciprocating compressors for higher pressure.

(c) Define the workability of concrete and also state the factors affecting workability.

Ans. Workability - Workability is the case with which a concrete can be mixed, placed and compacted so that a dense concrete is obtained (full compaction). The workable mix should not show any segregation or bleeding of concrete.

Workability as explained here does not give its correct definition. The desired workability depends on the tools available to compact the concrete. Similarly the workability of concrete for one condition, say mass concrete, may not be sufficient for the heavily reinforced section.

The work done on concrete while compaction consists of useful work and wasted work as vibrating the mould or already compacted concrete etc. Workability is defined as a property of concrete. It is the amount of useful internal work necessary to produce full compaction.

Factors Affecting Workability - The workability of fresh concrete depends primarily on the properties of constituent materials, mix proportions, and environmental conditions. Workable concrete exhibits very little internal friction between particles and overcomes the frictional resistance offered by the formwork surface or reinforcement contained in the concrete with an appropriate amount of compacting efforts.

Influence of Mix Proportions - In the concrete comprising a cement - aggregate-water system, the aggregate occupy approximately 70 to 75 per cent of the total volume of concrete and economy demands that the volume of aggregates should be as large aspossible.

The total specific area of the aggregate is to be minimized to the extent possible by proper choice of size, shape and proportions of fine and coarse aggregates. In a well graded aggregate different size fractions are so chosen as to minimize the void content, and such a mixture will need more water for lubricating effects to overcome the reduction in mobility due to dense packing of particles. However, when the total voids are less for the given amount of paste volume, excess paste is available to given better lubricating effect. With excess amount of paste, the mixture becomes cohessive and fatty which prevents segregation of particles and lubricated aggregate particles slide past each other with the least amount of compacting effort.

It has been noticed that the change in the measured value of workability of concrete due to relative change in water content is independent of the composition of concrete within wide limits. An increase of water content results in monotonous increase in workability but eventually a state is reached where segregation and bleding occur and use of higher water content will result in the more serious problems of shrinkage and creep of hardened concrete. However the water content is limited to some maximum value given by the water-cement ratio

which is dependent on the target design strength of hardened concrete. The water-cement ratio in itself determines the intrinsic properties of cement paste. The requirements of workability state that there is sufficient cement paste to surround or lubricate the aggregate particles as well as fill the voids in the aggregate. In a lean concrete, i.e. a concrete with high aggregate-cement ratio, less quantity of cement paste per unit surface area of aggregate is available for providing lubrication, and hence the mobility of aggregates is restrained. On the other hand in case of rich concrete with low aggregate-cement ratio, more paste is available to make the mix cohesive and fatty to give better workability.

Influence of Aggregate Properties - The effect of aggregate properties on the workability of fresh concrete can be summarized as follows.

(i) For the same volume of aggregate in concrete the use of coarse aggregate of larger size and/or rounded aggregate gives higher workability because of reduction in total specific surface area and inter-particle frictional resistance. The lesser the surface area the lesser will be the amount of water require for wetting the surface and consequently losser cement paste will be required for lubricating the surface of aggregates to reduce internal friction. The influence of surface texture on workability is due to the fact that the total surface area of rough irregular aggregate is more than the surface area of smooth rounded aggregate of same volume. The use of angular, elongated or flaky aggregates results in low workability, primarily due to increase in the void content and inter-particle interference. This explains the reasons why river sand and gravel provide greater workability to concrete than crushed sand and aggregate. The size and shape of the aggregate is of paramount importance in the case of present day high strength and high performance concrete where very low water-cement ratio of the order of about 0.25 are used.

(ii) The use of finer sand increase the specific surface area, thereby increasing the water cement for the same workability. In the other words, for the same water content, the use of finer sand decreases workability.

(iii) Because of the greater contribution to the total specific surface area, the grading of fine aggregate is more critical than the grading of coarse aggregate. Nevertheless, the proportion of fine to coarse agregates should be so chosen as neither to increase the total specific surface area (by excess of fine aggregate) nor to increase the particle interference (due to deficiency in fine aggregate). An unsuitable choice of overall grading can produce honeycombing or segregation. In normal range of mixes though an increase in fines content decreases workability, but in practice there is an optimum fines content for maximum workability, such that either an increase or decrease of fines reduces workability.

(iv) Generally, the mixes with higher water-cement ratio would require a somewhat finer grading and for mixes with low water-cement ratio (as in case of high-strength concrete) a coarser grading is preferable. The effect of water content and aggregate size is shown in fig.

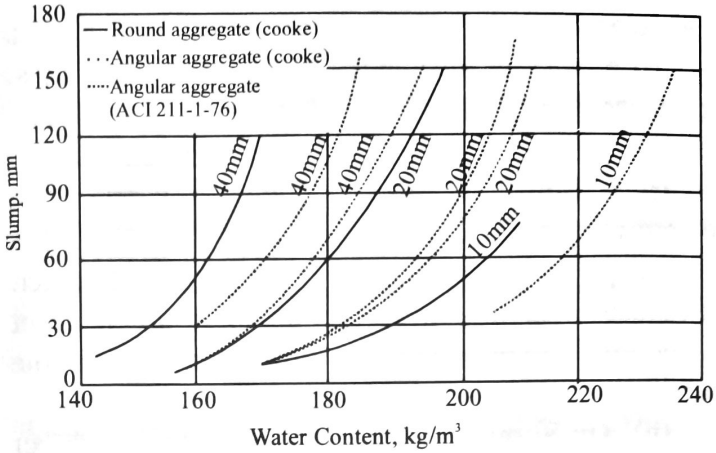


Fig. Effect of water content and aggregate size on the workability

Workability as compared to ordinary Portland cement because of its higher specific surface and the fact that it hydrates more rapidly and also the fineness of cement has an influence on bleeding.

Influence of Admixtures -The presence and nature of admixtures, and mineral additives effect the workability considerably. The plasticizers and superplasticizers improve the workability many folds. It is to be noted that inland slump of concrete mix, also called the slump of reference mix should be about 20-30 mm to enhance the slump many fold at a minimum dosage.

Use of air-entraining agents which are normally surface active, reduces the internal friction between the particles, the air bubbles may be considered as artificial fine aggregates of very smooth surface. They also act as a sort of bearing between the particles to slide past each other and give easy mobility of the particles. Similarly the fine glassy pozzolanic materials in spite of increasing the surface area offer better lubrication effects for giving better workability.

Effect of Environmental Conditions - The workability of a concrete mix is also affected by the temperature of concrete and therefore by the ambient temperature. On a hot day it becomes necessary to increase the water content of the concrete mix in order to maintain the desired workability. The amount of mixing water required to bring about a cement change in workability also increases with temperature.

Effect of Time - The fresh concrete loses workability with time mainly because of the loss of moisture due to evaporation. A part of mixing water is absorbed by aggregate or lost by evaporation in the

presence of sun and wind and part of it is utilized in the chemical reaction of hydration of cement. The loss of workability varies with the type of cement, the concrete mix proportions, the initial workability and the temperature of the concrete. On an average a 125 mm slump concrete may lose about 50 mm slump in the first one hour. The workability in terms of compactiong factor decreases by about 0.10 during the period of one hour the time of mixing. The decrease in workability with time after mixing may be more pronounced in concrete with admixtures like plasticizers. For same particular total time after mixing, the loss in workability is small and intial level could be regained without loss in the strength of hardend concrete simply adding extra water. The effect of placing time on the workability is illustration the fig.

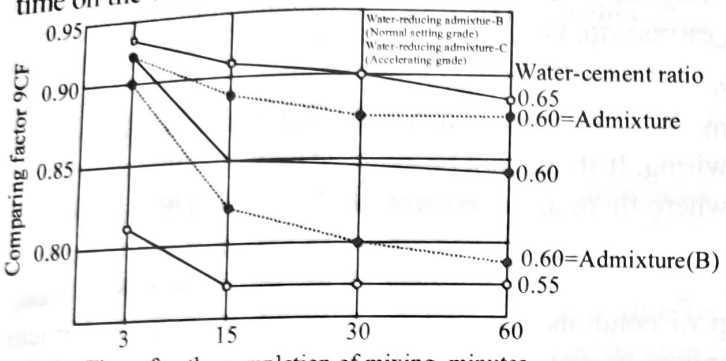


Fig. Effect of placing time on the workability

MODEL - 3

(CET - 605)

Full Marks : 70 **Time : 3 Hours**

Answer any **five** questions.

The figures in the right-hand margin indicate marks.

1. (a) What do you mean by liquefaction ? [2
   (b) Write the advantages and disadvantages of concrete. [5
   (c) What do you mean by the term 'mix design of concrete'. Describe in brief the various factors influencing the choice of mix-proportions in design mix ? [7
2. (a) What is Importance Factor ? [2
   (b) Briefly describe the types of wiring. [5
   (c) Describe the various steps involved in manufacture of concrete. [7
3. (a) What do you mean by natural period of a structure ? [2
   (b) Write the grading limits for zone-III fine aggregate. [5
   (c) What are the factors affecting workability of concrete ? [7
4. (a) What is curvature ductility ? [2
   (b) Draw the Lap, Splice in beam diagram. [5
   (c) What are the considerations in planning and selection of construction equipments ? [7
5. (a) What do you mean by hoop ? [2
   (b) Enumerate safety consideration during additional construction and a alteration of existing buildings. [5
   (c) Give an account of sources of weakness in RC framed building in seismic retrofitting of reinforced concrete buildings. [7
6. (a) What is shear wall ? [2
   (b) Describe the different additional strengthening measures that are adopted in masonry buildings for earthquake resistance. [5
   (c) Discuss the building characteristics in Earthquake resistant construction. [7
7. (a) What is shell concrete ? [2
   (b) State general principles for central plants layout for hot water supply. [5
   (c) Describe different methods and systems of ventillation ? [7

MODEL - 3 (ANSWER)

1.(a) What do you mean by liquefaction ?

Ans. Liquefaction is a state in saturated cohesionless soil where in the effective shear strength is reduced to negligible value for all engineering purpose due to pore pressure caused by vibrations during an earthquake when they a pproach the total confining pressure. In this condition the soil tends to behave like a fluid mass.

(b) Write the advantages and disadvantages of concrete.

Ans. Advantages of Concrete

Concrete as a construction material has the following advantages.

(i) Concrete is economical in the long run as compared to other engineering materials. Except cement, it can be made from locally available coarse and fine aggregates.

(ii) Concrete possesses a high compressive strength and the corrosive and weathering effects are minimal. When properly prepared its strength is equal to that of a hard natural stone.

(iii) The green or newly mixed concrete can be easily handle and moulded or formed into virtually any shape or size according to specifications. The formwork can be reused a number of times for similar jobs resulting in economy.

(iv) It is strong in compression and has unlimited structural applications in combination with steel reinforcement. Concrete and steel have approximately equal coefficients of thermal expansion.

(v) Concrete can even be sprayed on and filled into fine cracks for repairs by the guniting process.

(vi) Concrete can be pumped and hence it can be laid in difficult positions also.

(vii) It is durable and fire resistant and requires very little maintenance.

These qualities explain why concrete is extensively used in the construction of skyscrapers, superhighways, railways, airfield, building, water-retaining structures, docks and harbours, dams, bridges, bunkers and silos, etc.

Disadvantages of Concrete

Following are the disadvantages of concrete.

(i) Concrete has low tensile strength and hence cracks easily. Therefore, concrete is to be reinforced with steel bars or meshers or fibers.

(ii) Fresh concrete shrinks on drying and hardened concrete expands on wetting. Provision for contraction joints has to be made to avoid the development of cracks due to drying shrinkage and moisture movement.

(iii) Concrete expands and contracts with the changes in temperature. Hence expansion joints have to be provided to avoid the formation of cracks due to thermal movement.

(iv) Concrete under sustained loading undergoes creep, resulting in the reduction of prestress in the prestressed concrete construction.

(v) Concrete is not entirely impervious to moisture and contains soluble salts which may cause affloescence.

(vi) Concrete is liable to disintegrate by alkali and sulphate attack.

(vii) The lack of ductility inherent in concrete as a material is disadvant ageous with respect to earthquake resistant design.

(c) What do you mean by the term 'mix design of concrete'. Describe in brief the various factors influencing the choice of mix-proportions in design mix ?

Ans. Refer to 2017(S), Q. No. 1.(b)

2.(a) What is Importance Factor ?

Ans. It is a factor used to obtain the design seismic force depending on the functional use of structure, characterised by hazardous consequences of its failure, its post earthquake functional need, historic value, or economic importance.

(b) Briefly describe the types of wiring.

Ans. C.T.S. (Cotton/P.V.C Toughened / Sheathed) Wiring : The conductor is provided with insullation which is not water or heat proof. Over the insulation of the conductor and tough rubber shealth is provided for additional insulation and protection against wear, tear and moisture.

This types of wiring is suitable for damp circuits, but can not sustain much heat and is noit suitable for places in very hot weather. There is also the danger of mechanical hatred. It is also not suitable for outdoor wiring. It should not be exposed to direct sunlight a areas where there are corrosive acids or alkali fumes.

(b) Conduit wiring : In this system wires with single insulation are used. The wires are run in steel/ p.v.i conduits giving good protection from mechanical injury or fire risks. This types of wiring is used for industries.

(c) Concealed conduit wiring : This system is same as conduit wiring except that the conduits are buried in the chase made on the walls. This system is wed where aesthetics is the main consideration and not the additional cost of conduit.

(c) Describe the various steps involved in manufacture of concrete.

Ans. The manufacture of concrete consists of the following operations.

1. Proportioning of ingredients
2. Measurement of materials
3. Mixing and placing of concrete.
4. Compaction.
5. Curing.

1. Proportioning of ingredients means determining the relative amounts of ingredients to get the required strength of concrete. The required strength of concrete depends on many factors like the stresses it has to resist the weathering conditions it has to bear etc.
2. Measurement of material - in general, all materials are measured by mass. However for liquid admitures and water volume batching may be established.

3. Mixing and placing concrete - The ingredients of concrete should be throughly mixed such that the cement paste is coated to the surface of all aggregates and a uniform mass in obtained. The mines concrete should be transported to the place of laying as early as possible. During transport, care should be taken to see that segregation does not take place and concrete should be placed before it starts setting.

4. Compaction - Immediately upon placing the concrete should be compacted so as to get a dense mass without voids. Compaction is extremely important as 5% of vaids can give a loss of 30% in strength. Other properties of concrete like durability impermeability etc also greatly depend on the compaction of concrete.

5. Curing - The hydration of cement takes place only in water-filled capillaries. The products of hydration are filled in these capillaries. The water in capillaries may get lost due to evaporation. If this water is retained by some means or in other words if the water is continuously available the chemical action can be continued as long as all the cement iws hydrated. The process by which the loss of water from concrete is prevented is known as curing.

3.(a) What do you mean by natural period of a structure ?

Ans. Natural period of a structure is its time period of undamped free vibration.

(b) Write the grading limits for zone-III fine aggregate.

Ans. Gravity limits of zone-III fine aggregate is sieve designation percentaage passing by wt.

IS seive designation	Percentage passing by wt
10 mm	100
4.75 mm	90 – 100
2.36 mm	85 – 100
1.18 mm	75 – 100
600 μ	60 – 79
300 μ	12 – 40
150 μ	0 – 10

(c) What are the factors affecting workability of concrete ?

Ans. Factors Affecting Workability : Workable concrete is the one which exhibits very little internal friction between particle and particle or which overcomes the frictional resistance offered by the formwork surface or reinforcement contained in the concrete with just the amount of compacting efforts forthcoming. The factors helping concrete to have more lubricating effect to reduce internal friction for helping easy compaction are given below :

(i) Water Content
(ii) Mix Proportions
(iii) Size of Aggregates
(iv) Shape of Aggregates
(v) Surface Texture of Aggregates
(vi) Grading of Aggregates
(vii) Use of Admixtures

(i) Water Content : Water content in a given volume of concrete, will have significant influences on the workability. The higher the water content per cubic meter of concrete, the higher will be the fluidity of concrete, which is one of the important factors affecting workability. At the work site, supervisors who are not well versed with the practice of making good concrete, resort to adding more water for incrasing workability. This practice is often resorted to because this is one of the easiest corrective measures that can be taken at site. It should be noted that from the desirability point of view, increase of water content is the last recourse to be taken for improving the workability even in the case of uncontrolled concrete. For controlled concrete one cannot arbitrarily increase the water content. In case, all other steps to improve workability fail, only as last recourse the addition of more water can be considered. More water can be added, provided a correspondingly higher quantity of cement is also added to keep the water/cement ratio constant, so that the strength remains the same.

(ii) Mix Proportions : Aggregate/cement ratio is an important factor influencing workability. The higher the Aggregate/cement ratio, the learner is the concrete. In lean concrete, less quantity of paste is available for providing lubrication, per unit surface area of Aggregate and hence the mobility of Aggregate is restrained. On the other hand, in case of rich concrete with lower Aggregate/cemen ratio, more paste is available to make the mix cohesive and fatty to give better workablity.

(iii) Size of Aggregates : The bigger the size of the Aggregate, the less is the surface area and hence less amount of water is required for wetting the surface and less matrix of paste is required for lubricating the surface to reduce internal friction. For a given quantity of water ad paste, bigger size of Aggregates will give higher workability. The above, of course will be true within certain limits.

(iv) Shape of Aggregates : The shape of Aggregates influences workability in good measure. Angular, elongated or flasky Aggregate makes the corcrete very harsh when compred to rounded Aggregates or cubical shaped Aggregates. Contribution to better workability of rounded Aggregate will come from the fact that for the given volume or weight it will have less surface area and less voids than angular or flasky Aggregate. Not only that, being round in shape, the frictional resistanceis also greatey reduced. This explains the reason why river sand the gravel provide greater workability to concrete than crushed sand and Aggregate.

The important of shape of the Aggregate will be of great significance in the case of present day high strength and high performance concrete when we use very low w/c in the order of about 0.25. We have already talked about that in the years to come natural sand will be exhausted or costly. One has to go for manufactured sand. Shape of crushed sand as available today is unsuitable but the modern crushers are designed to yield well shaped and well grade Aggregates.

(v) Surface Texture of Aggregates : The influence of surface texture on workability is again due to the fact that the total surface area of rough textured Aggregate is more than the surface area of smooth ruded Aggregate of same volume. From the earlier discussions it can be inferred that rough rextured Aggregate will show poor workability and smooth or glassy textured Aggregate will give better workability. A reduction of inter particle frictional resistace offered by smooth Aggregate also contributes to higher workability.

(vi) Grading of Aggregates : This is one of the factors which will have maximum influence on workability. A well greaded Aggregate is the one which has least amount of voids in a given volume. Other factors beign constant, when the total voids are less, excess paste is available to give better lubricating effect. With excess amount of paste, the mixture becomes cohesive and fatty which prevents segregation of particles. Aggregate particles will slide past each other with the least amount of compacting efforts. The better the grading, the less is the void content and higher the workability. The above is true for the given amount of paste volume.

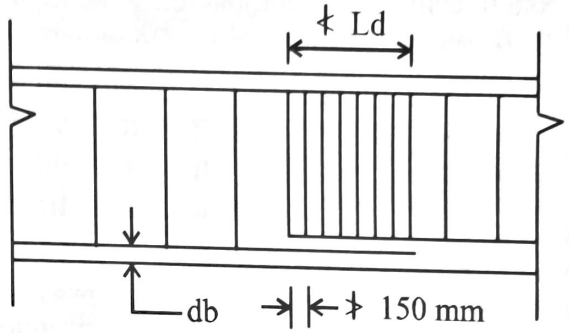
(vii) Use of Admixtures : Of all the factors mentioned above, the most important factor which affects the workability is the use of admixtures. In later, it is amply described that the plasticizers and super-plasticizers greatly improve th owrkability many folds. It is to be noted that initial slump of concrete mix or what is called the slump of reference mix should be about 2 to 3 cm to enhance are slump many folt at a minimum doze. One should manupulte other factors to obtain initial slump of 2 to 3 cm in the reference mix. Without initial slump of 2-3 cm, the workability can be increased to higher level but it requires higher dsage - hence uneconomical.

4.(a) What is curvature ductility ?

Ans. It is the ratio of curvature at the ultimate strength of the section to the curvature at first yield of t ension steel in the section.

(b) Draw the Lap, Splice in beam diagram.

Ans.



Where, L_d = Development length in tension.
D_b = Bar diameter.

(c) What are the considerations in planning and selection of construction equipments ?

Ans. Equipment Selection Factors :

Most construction operations can be performed by more than one kind of equipment or combinations or kinds of equipment. The best choice of equipment for a given job is the one that can complete the work. According to the plans and specifications, within the time allowed for the least total cost. The equipment selected must satisfy several constraints imposed by the job and the contractual obligations. The constraints or factors include the following :

(i) Specific construction operation.
(ii) Job specification requirements.
(iii) Conditions of the job site.
(iv) Locations of the job site.
(v) Time allowed to do the job.
(vi) Balance of independent equipment.
(vii) Monthly required of the equipment.
(viii) Versality of the equipment.

A feasible solution to the equipment selection problem for actual field conditions requires that a number of these factors be considered. Infact, is would be an unusual construction if the choice dependent on only one factor.

5.(a) What do you mean by hoop ?

Ans. It is a closed stirrup having a 135° hook with a 10 diameter extension at each end, that is embedded in the confined core of he section. It may also be made of two pieces of reinforcement, a U-stirrup with a 135° hook and a 10 diameter extension at each end, embeded in the confined core and a corsstie.

(b) Enumerate safety consideration during additional construction and a alteration of existing buildings.

Ans. If sufficient precautions w.r.t safety of work aren't taken, therre are chances of serious accidents involving heavy loss of men and materials. Some of the safety rules to be observed during the erection process of structures are as follows.

→ All guys and ancharages should be closely viewed regularly so as to ascertain their bearing capacity of load.

→ Suitable packing pieces must be provided at the required points so as to avoid the slipping of load.

→ The chains should not be dropped from a height, but should be lowered gradually.

→ The equipment and devices employed in the erection procedure should never be over-loaded.

→ The legs of brother chains should not be opened out to such as angle so as to endanger the stability of the work.

→ The levels of panel points on the falsework should be maintained as per the desired camber for truss to avoid strain or distartion during assemebly.

→ The lifting devices and mechanisms should be maintained in perfect running order so as to avoid their sudden failure without notice.

→ The lifting should be carriedout smoothly without sudden shocks.

(c) Give an account of sources of weakness in RC framed building in seismic retrofitting of reinforced concrete buildings.

Ans. Sources of Weakness in RC-Frame Buildings : Earthquake engineering is not a pure science rather it has been developed through the observation of failure of structure during earthquake. Damage survey reports of past earthquakes reveal the following main sources of weakness in reinforced concrete moment resisting frame buildings.

(i) Discontinues load path / interrupted load path / irregular load path.

(ii) Lack of deformation compatibility of structural members.

(iii) Quality of workmanship and poor quality of materials.

Structural Damage due to Discontinuous load path:

Every structure must have two load resisting systems (a) vertical load resisting sytem for transferring the vertical load to the ground and (b) horizontal load resisting system for transferring the horizontal load to the vertical load system. It is imperative that the seismic forces should be properly collected by the horizontal framing system and properly transferred into vertical lateral resisting system. Any discontinuity in this load path or load transfer may cause one of the major contributions to structural damage during strong earthquakes. In addition it must be ensured that eachmember both of horizontal or vertical load resisting system must be strong enough and not fail during on earthquake. Therefore, all the structural and non-structural elements must have sufficient strength and ductility and should be well connected to the structural system so that the load path must be complete and sufficiently strong.

Structural Damage due to lack of Deformation :

The main problems in the structural members of moment resisting frame building are the limited amount of ductility and the inability to redistribute load in order to safely with stand the deformations imposed upon in response to seismic loads. The most common regions of failure in an existing reinforced concrete frame. The regions of failure may be in columns, beams, walls and beam-column jonts. It is important to consider the consequences of member failure or structural performance. Inadequate strength and ductility of the structural member can and will result in local or complete failure of the system.

6.(a) What is shear wall ?

Ans. A wall that is primarily designed to resist lateral forces in its own plane.

(b) Describe the different additional strengthening measures that are adopted in masonry buildings for earthquake resistance.

Ans. The earthquake force shall be calculated for the full dead load plus the percentage of imposed load.

→ The proportions of imposed load indicated above for calculating the lateral design forces for earthquakes are applicable to average conditions.

→ Lateral design force for earthquakes shall not be calculated on contribution of impact effects from imposed loads.

→ When the lateral load resisting elements are oriented along orthogonal horizontal direction the structure shall be designed for the effects due to full design earthquake load in the horizontal direction at time.

→ When the lateral load resisting elements are not oriente along the orthogonal horizontal directions, the structure shall be designed for the effects due to full design earthquake load in one horizontal direction plus 30 percent of the design earthquake load in the other direction.

→ When effects due to vertical earthquake loads are to be considered the design vertical force shall be calculated.

→ Ofther loads apart from those given above shall be considered as appropriate.

(c) Discuss the building characteristics in Earthquake resistant construction.

Ans. The following assumptions shall be made in the earthquake resistant design of structure.

(i) Earthquake causes impulsive ground motions which are complex and iorregular in character, changing in period and amplitude each lasting for a small duration. Therefore, resonance of the type as visualized under steady state sinusoiodal excitations, will not occur as it would need time to build up such amplitudes.

(ii) Earthquake is not likely to occur simultaneously with wind or maximum flood or maximum sea waves.

(iii) The value of elastic modulus of materials, wherever required, may be taken as for static analysis unless a more definite value is available for use in such condition.

7.(a) What is shell concrete ?

Ans. Concrete that is noit confined by transverse reinforcement is called shell concrete. It is also called concrete cover.

(b) State general principles for central plants layout for hot water supply.

Ans. Layout of Hot Water Supply : The sequence of units to be installed in the layout of any water supply project starting from the source of water to the distribution is as follows :

→ Location of intakes including pumpint plant.

→ Plain sedimentation tanks.

→ Coagulation sedimentation tanks.

→ Filter units.

→ Water sofeting and other miscellaneous treatment plants.

→ Disinfection plant.

→ Storage of clear water in underground and overhead reservoir tanks and

→ Distribution of water.

(c) Describe different methods and systems of ventillation ?

Ans. Refer to 2017, Q. No. 2.(c)

PRACTICE SETS

SET – 1

(CET - 605)

Full Marks : 70 **Time : 3 hours**

Answer any **five** questions

The figures in the right-hand margin indicate marks.

1. (a) What are the functions of dragline and bulldozer ? [2
   (b) What are the electrical services requirements in high rise buildings ? [5
   (c) What is ventilation ? Describe the different methods of ventilation ? [7
2. (a) Where and why vibrating compactors are used ?[2
   (b) Enumerate the different earth-moving and compacting equipments indicating their specific use ? [5
   (c) Given an account of sources of weakness in RC framed building in seismic retrofitting of reinforced concrete buildings. [7
3. (a) What do you mean by target strength in concrete mix design ? [2
   (b) What are the durability requirements of concrete as per I.S. 456 ? [5
   (c) What are the properties of concrete ? [7
4. (a) What do you mean by shear wall ? [2
   (b) Explain nominal mix concrete and design mix concrete ? [5
   (c) Explain the quality control in concrete as per I.S. 456 ? [7
5. (a) What do you mean by curing of concrete ? List the different methods of curing of concrete. [2
   (b) What are the different bands used in addition strengthening measures in masonry buildings ?[5
   (c) Discuss the building characteristics in earthquake resistance construction ? [7
6. (a) What do you mean by Gable band ? [2
   (b) Classify techniques used in retrofitting of buildings ? [5
   (c) Describe the structural irregularities in buildings ? [7
7. (a) What is the unit of measurement of intensity of light ? [2
   (b) Explain the building configuration briefly. [5
   (c) What do you mean by earthing ? Describe their uses ? [7

SET – 2

(CET - 605)

Full Marks : 70 **Time : 3 hours**

Answer any **five** questions

The figures in the right-hand margin indicate marks.

1. (a) What are the different types of mixers used for mixing concrete. [2
   (b) Write down the a dvantages of quality control of concrete. [5
   (c) Briefly describe, the classification of bulldozers and it's uses ? [7
2. (a) List different earth moving equipments. [2
   (b) Describe the types of wiring. [5
   (c) What are the Air Cleaning Devices ? [7
3. (a) Calculate modulus of Elasticity for M_{20} grade concrete. [2
   (b) Describe about the systems of ventilation. [5
   (c) Explain different admixtures used in concrete and their fuctions. [7
4. (a) What do you mean by liquefaction ? [2
   (b) Describe the Water Distribution System. [5
   (c) Explain the factors influening the choice of mix proportions. [7
5. (a) What do you mean by natural period of a structure ? [2
   (b) Describe about an Electric Water Heaters. [5
   (c) What are the advantages of quality control in concrete ? [7
6. (a) What do you mean by a Accelerator ? [2
   (b) Write down advantages and disadvantages of concrete. [5

(c) Briefly explain the procedure of concrete mix design. [7

7. (a) List different types of non-destructive tests of inside hardended concrete. [2

(b) Outline classification and characteristics of admixtures. [5

(c) Briefly describe, how a distribution box is designed ? [7

SET – 3

(CET - 605)

Full Marks : 70 **Time : 3 hours**

Answer any **five** questions

The figures in the right-hand margin indicate marks.

1. (a) What is retrofitting of structures ? [2

(b) Describe briefly about the sources of weakness in RC frame building. [5

(c) Describe the classification of retrofitting techniques and their uses. [7

2. (a) What is earthing and fuse ? [2

(b) State general principles for central plants layout for hot water supply. [5

(c) Describe about the Electrical services for a high rise building including wiring, fuses fitting and earthing. [7

3. (a) What is ventilation ? [2

(b) Write short notes on : [5

(i) Escalator

(ii) Elevator

(iii) Lifts

(c) What are the systems and problems on ventilation ? Describe with sketches. [7

4. (a) What is dragline ? [2

(b) What are the vertical irregularities in structural building ? [5

(c) Describe different earth-moving and compacting equipments indicating their specific use and draw the sketches. [7

5. (a) What do you mean by workability and segregation of concrete ? [2

(b) What are the factors affecting workability of concrete ? [5

(c) Write down the steps to be followed for preparation of a Design Mix of M 30 grade of concrete by A.C.I. method. [7

6. (a) What is curing ? [2

(b) What are the steps to be followed for finishing of concrete surface - Describe briefly ? [5

(c) Describe about the steps of quality control to be used for concrete as per IS : 456. [7

7. (a) What do you mean by Earthquake ? [2

(b) Enumerate safety consideration during additional construction and a alteration of existing buildings. [5

(c) Describe the different additional strengthening measures that are adopted in masonry buildings for earthquake resistance. [7