



| e) | <p>Removal time for form work of slab and column as per IS</p> <table> <tr> <th>Sr.No.</th><th>Types of form work</th><th>Min.Period before striking form work</th></tr> <tr> <td>1</td><td>Vertical form work for column</td><td>16 to 24 Hrs</td></tr> <tr> <td>2</td><td>Sofit form work to slab (Prop to be refixed immediately after removal formwork)</td><td>3 days</td></tr> <tr> <td>3</td><td>Props to slab:- 1) Spanning up to 4.5m 2) Spanning over 4.5m</td><td>7 days 14 ays</td></tr> </table> | Sr.No. | Types of form work | Min.Period before striking form work | 1 | Vertical form work for column | 16 to 24 Hrs | 2 | Sofit form work to slab (Prop to be refixed immediately after removal formwork) | 3 days | 3 | Props to slab:- 1) Spanning up to 4.5m 2) Spanning over 4.5m | 7 days 14 ays | <p>2</p> <p>1</p> |
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| 3 | Props to slab:- 1) Spanning up to 4.5m 2) Spanning over 4.5m | 7 days 14 ays | | | | | | | | | | | | |
| f) | <p>i) Apparent specific gravity of aggregate is defined as the ratio of the mass of solid to the weight of an equal volume of water at a standard temperature here volume of aggregate includes void.</p> <p>ii) Absolute sp.gravity of aggregate The absolute sp.gravity refers to the volume of solids material excluding the voids is defined as, the ratio of the mass of solid to the weight of unequal voids free volume of water at standard temperature.</p> | <p>1</p> <p>1</p> | | | | | | | | | | | | |
| g) | <p>i) Ingredients of concrete with their proportion:- 1:2:4 means 1 part of cement, 2 parts of fine aggregate and 4 parts of coarse aggregate.</p> <p>ii) Types of batching:- 1) Weigh batching 2) Volume batching.</p> | <p>1</p> <p>1</p> | | | | | | | | | | | | |
| h) | <p>Water cement ratio:- the ratio of weight of water to the weight of cement in a concrete mix is called as water cement ratio Water cement ratio law:- the strength of concrete is only dependant upon water cement ratio provided the mix is workable.</p> | 1 | | | | | | | | | | | | |
| i) | <p>Importance of NDT: - 1) The failure of concrete member does not take place since it is not subjected to failure stress. These tests, therefore, are non-destructive in nature. 2) Since these tests are non-destructive, no wastage of concrete takes place. 3) The strength of existing old-concrete structures can also be evaluated by these methods. 4) These are simple in nature. 5) Hair cracks, micro cracks and deep cracks in a concrete structures can be detected. 6) Moisture content, density, thickness and cement content of a concrete member can be estimated by these methods</p> | <p>½ for each any four</p> | | | | | | | | | | | | |

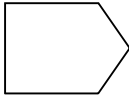
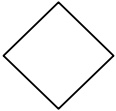
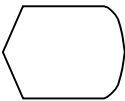
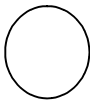


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| j) | Objectives of curing: - 1) To maintain sufficient moisture content in the concrete for complete hydration of cement. 2) To maintain a uniform temperature of the concrete. 3) To reduce shrinkage of the concrete. 4) To preserve the properties of concrete, such as impermeability, durability and strength etc. | 1/2 Mark for Each | | | | | | | | | | |
| k | Effect of hot weather on concreting:- 1) Rapid rate of hydration of cement, quick setting and early stiffening. 2) Rapid evaporation of mixing water. 3) Greater plastic shrinkage. 4) Less time for finishing. 5) Reduced relative humidity. 6) Absorption of water from the concrete by the subgrade and formwork. 7) Difficulty in continuous and uninterrupted curing. 8) Difficulty in corporation of air entrainment. | 1 Mark for Each | | | | | | | | | | |
| l | Types of vibrators:-1) Internal vibrators- needle vibrators 3) External vibrators- Form vibrators, vibrating tables, platform vibrators, Surface vibrators, vibrating rollers | ½ mark for each | | | | | | | | | | |
| m | Workability: - The property of fresh mixed concrete or mortar which determines the ease and homogeneity with it can be mixed, placed, compacted and finished. Methods of Workability:- 1) Slump cone test 2) Compacting factor test 3) Flow test 4) Vee-Bee test 5) Split tensile test. | 1 Mark 1 Mark | | | | | | | | | | |
| n | Bulking of sand: - The free moisture content in the fine aggregate results in bulking of volume. Free moisture forms a film around each particle. This film of moisture exerts what is known as surface tension which keeps the neighbouring particles away from it; Similarly, the force exerted by surface tension keeps away every particle away from each other. Therefore, no point contact is possible between the particles. This causes bulking of the volume. | 2 Mark | | | | | | | | | | |
| Q-2 a | A higher fineness of cement particles expose greater surface area for action of water and also higher proportion of C ₃ S results in quicker hydration. Therefore, rapid hardening cement gives out much greater heat of hydration during the early period. Therefore, rapid hardening cement should not be used in mass concrete construction. | 2 Mark | | | | | | | | | | |
| b | The high strength at early stage is due to finer grinding, burning at high temperature and increased lime contents in the composition | 2 Mark | | | | | | | | | | |
| | Effect of storage of cement on its strength:- The following table shows the percentage of compressive strength for normal storage conditions. | 2 Mark | | | | | | | | | | |
| | <table><tr><td>Cement as received from factory</td><td>100%</td></tr><tr><td>After 3 months</td><td>85%</td></tr><tr><td>After 6 months</td><td>75%</td></tr><tr><td>After 1 year</td><td>60%</td></tr><tr><td>After 2 years</td><td>48%</td></tr></table> | Cement as received from factory | 100% | After 3 months | 85% | After 6 months | 75% | After 1 year | 60% | After 2 years | 48% | |
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| | <p>Precautions to be taken while storing the cement:-</p> <ul style="list-style-type: none">i) Bags should not be stacked more than 8 bags high. If adequate storage area is available. If storage area is not adequate, then higher stacking, but not more than 25 bags high can be permitted.ii) If the stack is more than 8 bags high, the bags should be arranged in layers with alternate layer of bags arranged in header (length-wise) and stretcher (cross-wise) fashion to give the stack better quality.iii) All bags must be stored at least 300 mm away from the walls, for better and easy handling 1 m wide passages are required to be kept in such manner that old stock of cement can be removed without disturbing the fresher stock stored in the godown.iv) Wooden planks or sleepers covered with plastic sheet should be kept on the floor and then the cement bags are stored on top of it. This is must, if godown has a low plinth.v) To reduce the air circulation, the stacks of cement bags must be stored as close as possible.vi) Install strip heaters on walls at suitable locations, if humidity is very high.vii) Install exhaust fans on blank walls to improve ventilations.viii) It is absolutely necessary that the old stock (with earlier week number) should be removed for consumption first and fresh stock later.ix) Truck should not be allowed to enter the storage shed, if the plinth of the shed is at the road level. Dirt and moisture or even water (during monsoon) will create problems of cement contamination and damage.x) Loading and unloading of cement bags on to the trucks should be done under proper cover during the monsoon.xi) Open storage must be avoided during monsoon in any case. | 2 Mark |
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| c. | I.S. sieve size in mm | Weight retained (gm) | Cumulative weight retained (gm) | Cumulative percentage retained | Cumulative percentage passing | | 2 | |
| | 4.75 | 22 | 22 | 2.2 | 97.8 | | | |
| | 2.36 | 115 | 137 | 13.7 | 86.3 | | | |
| | 1.18 | 225 | 362 | 36.2 | 63.8 | | | |
| | 0.60 | 240 | 602 | 60.2 | 39.8 | | | |
| | 0.30 | 280 | 882 | 88.2 | 11.8 | | | |
| | 0.15 | 105 | 987 | 98.7 | 1.3 | | | |
| | Below 0.15 | 13 | 1000 | 100 | 0 | | | |
| Total | 1000 | - | 299.2 | - | | | | |
| <p>Fineness modulus of sand = Total % cumulative weight retained / 100 = 299.2 / 100 = 2.99</p> | | | | | | | 2 | |
| <p>Typical Sketch of Aggregate</p> <div></div> <p>Rounded Sub Rounded Angular Sub angular</p> | | | | | | | | 1 Mark for each |
| d | <p>As surface smoothness increase, contact area decreases, hence highly polished particle will have less bonding area with matrix than rough particle of the same volume. A smooth particle however will require a thinner layer at paste to lubricate its movements with respect to other particles. It will therefore permit denser packing for equal workability & hence will require lower paste content than rough particles. It has been also shown by experiments that rough textured aggregate develops higher bond strength in tension than smooth texture aggregate.</p> | | | | | | | |
| e | <p>Curing by infrared radiation: curing of concrete by infrared radiation has been plasticized in very cold climatic regions in Russia. It has been claimed that much more rapid gain of strength can be obtained than with steam curing & that rapid initial temperature does not cause a decrease in the ultimate strength as in the case of steam curing at ordinary pressure. The system is very often adopted for the curing of hollow concrete products the normal operative temperature is kept at about 90°C.</p> | | | | | | | 4 Mark |
| f | | | | | | | | 4 Mark |



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| Q3. | | |
| a | <p>Defination :- The normal consistency of cement paste is defined as that consistency which will permit the Vicat Plunger having 10mm diameter and 50mm length to penetrate to a depth of 33-35mm from top of the mould.</p> <p>Setting Time Test:- The amount of water required for setting time test is (0.85P) i.e 0.85 times the water required to produce cement paste of standard consistency .</p> <p>Soundness Test:- The amount of water required for Soundness Test is (0.78P) i.e 0.85 times the water required to produce cement paste of standard consistency in standard manner.</p> | 2 1 1 |
| b | <p>Bleeding is autogenously flow of mixing water within or its emergence to the surface from freshly placed concrete usually as a result of sedimentation of solids due to compaction and self weight of solids. Bleeding results in formation of a series of water channels some of which will extend to the surface. A layer of water will emerge at the surface of concrete often bringing the quantity of cement with it. The formation of this layer of neat cement particle is called as laitance.</p> <p>Reduction of Bleeding: - 1) Air Entraining Admixtures 2) By Proper Compaction.</p> | 2 2 |
| c | <p>The capacity to resist force of disintegration due to natural or other causes such as temperature change , variation in moisture content ,attack of chemical or weather is called as durability of concrete. Durability depends on quality of ingredients as well as method of mixing , placing and compacting concrete.</p> <p>Factors affecting durability:-</p> <p>1) Optimum Water cement ratio 2) Sound cement 3) Durable Aggregate 4) Proper grading of aggregate 5) Careful batching and mixing 6) proper compaction 7) long period of curing</p> | 2 2 |
| d | <p>1) Mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative proportion with the object of producing concrete of certain minimum strength and durability as economically as possible.</p> <p>2) to make concrete in most economical manner</p> <p>3) To achieve required strength and durability.</p> <p>4) Increase quality of concrete without wastage of material and using consistent cement as per required.</p> | 1 1 1 1 |
| e | <p>1) Maximum density method. 2) Fineness Modulus Method 3) Surface Area Method. 4) American Concrete Institute Method (ACI Committee Method) 5) High Strength Concrete Mix-Design.6) Indian Standard Method 7) Design based on Flexural strength. 8) Indian Road Congress , IRC 44 Method.</p> | ½ mark each |



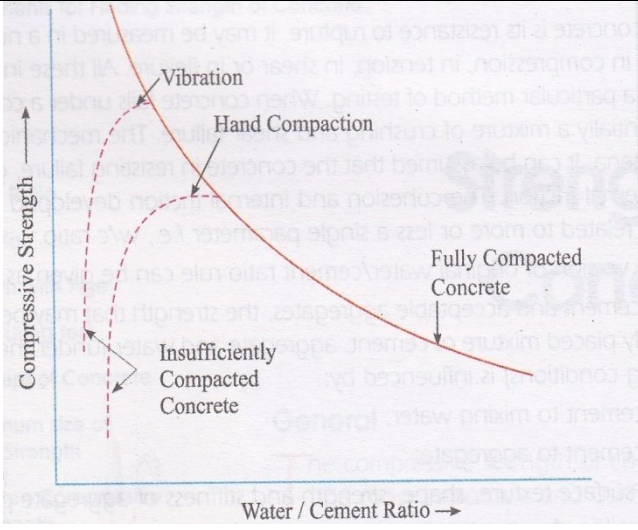
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| f | <p>In Pre-stressed concrete the compressive stress are induced in the concrete section before the member is subjected to bending due to external loads. The magnitude of the compressive forces leading to distribution of the stress is decided in such a way that the tensile stress produced in the section due to external loads are eliminated or reduced to permissible value. Pre-stressing eliminates cracking of concrete at all stages of loading. Requires smaller section than in reinforced concrete.</p> <p>Use of Pre-stressed concrete:-</p> <ol style="list-style-type: none">1. Used in bridges2. Used in high rise construction3. Used where section are required to be reduced. | 2 |
| Q.4 | | 2 |
| a | <p>Precaution to be observed in cold weather concreting:</p> <ol style="list-style-type: none">1. Temperature control of ingredients:- The temperature at the time of setting can be raised by heating the ingredients of the concrete mix. The temperature of water should not exceed 65 °C as the flash set of cement will occur when the hot water and cement will come in contact in the mixer.2. Use of Insulating Formwork:- Insulating formwork can be used to maintain temperature of concrete. The formwork cover can be of timber, clean straw, blanket, plastic sheeting etc.3. Proportioning of concrete ingredients:- Use of high alumina cement can be used for concreting as it produces high heat of hydration during first 24hrs and at that time sufficient strength is developed generally 10 to 15 MPA. Rapid hardening cement or accelerators can also be used.4. Placement and curing:- Before placing of concrete all ice, snow and frost should be removed. Care should be taken that the area where the concrete is place should be kept warm.5. Delayed removal of formwork:- Before of slower rate of strength gain during cold weather, the formwork have to be kept in place for longer time than in usual concreting practice. | 1 Mark for Each (any Four) |
| b | <p>Different methods of curing :-</p> <ol style="list-style-type: none">1. Ponding method2. Curing by infra-red radiation3. Steam curing4. Membrane Curing5. Sprinkling of Water | 2 Marks (Any Four) |



| | <p>Membrane Curing:-</p> <ol style="list-style-type: none">1. The process of applying a membrane forming compound on concrete surface is termed as membrane curing.2. The membrane curing serves as a physical barrier to prevent loss of moisture from the concrete to be cured.3. Membrane curing may not assure full hydration as in moist curing but is adequate and particularly suitable for concrete members in contact with soil. | 2 Marks | | | | | | | | | | |
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| c | <p>Factors affecting bulk density:</p> <ol style="list-style-type: none">1. The bulk density depends upon particle size of aggregates.2. The bulk density depends upon shape, grading of aggregate and moisture content.3. The bulk density of aggregate depends upon how densely the aggregate is packed.4. In case of coarse aggregates of given specific gravity, higher bulk density indicates fewer voids to be filled by sand and cement.5. The sample which gives minimum voids or one which give maximum bulk density is taken as right sample of aggregate for making economical mix. | 1 Mark each (Any Four) | | | | | | | | | | |
| d | <table><tr><th>Steel Frame work</th><th>Timber Frame Work</th></tr><tr><td>1. Steel form work are commonly used for big projects where forms are to be repeatedly used.</td><td>1. Timber form work can be used for large projects.</td></tr><tr><td>2. Steel form work can be easily fabricated and do not require much adjustment.</td><td>2 Adjustment of height cannot be made in timber formwork</td></tr><tr><td>3 Steel form work are costly as compared to timber formwork .</td><td>Timber form work are generally easily available in the market and are cheap.</td></tr><tr><td>4 Steel form work are generally economical and best suited for circular column and for flat slab.</td><td>4 Timber form work does not provide smooth finish as compared to steel form work.</td></tr></table> | Steel Frame work | Timber Frame Work | 1. Steel form work are commonly used for big projects where forms are to be repeatedly used. | 1. Timber form work can be used for large projects. | 2. Steel form work can be easily fabricated and do not require much adjustment. | 2 Adjustment of height cannot be made in timber formwork | 3 Steel form work are costly as compared to timber formwork . | Timber form work are generally easily available in the market and are cheap. | 4 Steel form work are generally economical and best suited for circular column and for flat slab. | 4 Timber form work does not provide smooth finish as compared to steel form work. | 1 Mark Each |
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| e | <p>Objective of Ultra sonic Pulse Velocity Test :-</p> <ol style="list-style-type: none">1. It is used to evaluate durability of concrete.2. It is used to evaluate uniformity of concrete and to estimate its strength and elastic properties. <p>Principle of Ultra Sonic Pulse Velocity Test:</p> <ol style="list-style-type: none">1. Ultra Sonic pulse velocity method consists of measuring time of travel of an ultra sonic pulse passing through the concrete to be tested.2. The Pulse generator consists of electronic circuit for generating pulses and a transducer for transforming these electronic pulses into mechanical energy vibration frequency in the range of 15 to 50 khz.3. The time of travel between initial onset and reception of pulse is measured electronically.4. The path length between transducer divided by the time of travel gives the average velocity of the wave propagation. | <p>2 Mark</p> <p>2 Mark</p> |
| f | <p>Grading of Aggregates: -</p> <ol style="list-style-type: none">1. The particle size distribution of an aggregate as determined by sieve analysis is termed grading of aggregate.2. If all the particle of an aggregate is of uniform size, the compacted mass will contain more voids whereas if aggregates containing various sizes are compacted then it will contain fewer voids.3. The proper grading of aggregate produces dense concrete and requires less quantity of fine aggregate and cement paste.4. The grading of aggregate affects the workability which in turn controls the water and cement requirements, segregation and influences the placing and finishing of concrete. | <p>1 Mark Each</p> |
| Q5 a | <p>a) Duff Abram's water cement ratio law states that the strength of concrete is only dependent upon water cement ratio provided mix is workable.</p> $S = \frac{A}{Bx}$ <p>where x = water cement ratio</p> <p>A & B are constant S = strength of concrete at 28 days curing</p> <p>Thus strength of concrete increases with decrease in water cement ratio.</p> | <p>1</p> |

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| | <p>Total 38% of water by weight of cement is required for complete chemical reaction and fill up gel in pores. Thus 0.4 water cement ratio is required for complete hydration of cement. As w/c increases compressive strength decreases because of pores created by excess water.</p> <p>Generally 0.5 to 0.6 w/c is used for hand compacted concrete & when vibrator is used w/c is 0.4 to 0.35</p> | 2 |
| b | <p>i) Mortar pan ii) Wheel borrow hand cart iii) crane, bucket, ropeway iv) truck mixer dumper v) belt conveyer vi) chute vii) skip & hoist viii) transit mixer ix) pump & pipe line x) helicopter are the methods of transportation of concrete</p> | 2 Marks |
| | <p>Truck Mixer & Dumper For large concrete works when concrete to be placed at ground level trucks & dumpers or ordinary tipping lorries can be used.</p> <p>Dumpers are of 2 to 3 cubic meter capacity or more. When haul is long agitators are used as it prevents segregation & stiffing</p> | 2 Marks |
| c | <p>When concrete is used for R.C.C work impermeability of concrete is important because of which structure is durable & its strength & life increases. If concrete is permeable corrosion of steel takes place which reduces life of R.C.C. structure. It is also important when R.C.C. structure is used as water tank, concrete dam etc where concrete is subjected to pressure of water on one side. Concrete should not absorb surface water by capillary action for this reason water proofing is essential.</p> | 4 Marks |
| d | <p>Before placing the concrete the surface of previous lift is cleaned thoroughly with water jet and scrubbing by wire brush. In case of dam even surface sand blasting is also adopted. The old surface is hacked and made rough by removing laitance & loose material. The surface is wetted a neat cement slurry or a very thin layer of rich mortar with fine sand is dashed against old surface & then fresh concrete is placed. Generally when concrete is laid in layers leave the top of layer rough so that succeeding layer can have a good bond with previous layer where concrete is subjected to horizontal thrust bond bars or bond stones are provided to obtain good bond.</p> | 4 Marks |



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| e | <p>Admixture is material other than cement water & aggregate that is used as an ingredient of concrete.</p> <p>Admixture are plasticizer, retarder, accelerator, air entraining agent etc.</p> <p>Additive is material which is added at the time of grinding cement clinker at the cement factory. Flyash, gypsum, blast furnace slag, pozzolona are additive</p> | 2 Marks |
| f | <p>Effect of cold weather on concrete.</p> <p>i) Delay in setting & hardening- As temp is low concrete takes a long time to set & a longer time to harden i.e. for development of strength, concrete is subjected to frost attack. Delay in removal of formwork result in slow work & uneconomical concreting.</p> <p>ii) Freezing of concrete in early age- When temp is below freezing point water contained in plastic concrete freeze which prevents hydration of cement & makes concrete expand thus strength decreases.</p> <p>iii) Freezing & thawing- concrete subjected to freezing of thawing cycles results in decreasing durability of concrete & exert fatigue in concrete.</p> | 4 Marks |
| Q 6 | <p>Plasticizers are admixtures which allow a reduction in water content for the given workability. It gives higher workability at same water content. Plasticizers are organic substances or combinations of organic & inorganic substances which fluidify the mix and improve workability of concrete, mortar or grout.</p> | 2 Mark |
| a | <p>Retarding plasticizers : are often used in ready mixed concrete industry for purposes of retaining slump loss during high temperature, along transportation to avoid construction or cold joint, slip form construction and regulation of heat of hydration.</p> | 1 Mark |
| | <p>Accelerating plasticizers: are added to accelerate strength development of concrete which permit earlier removal of formwork, reduce curing period thus structure can be placed in service as early as possible. It is also used for emergency repair work.</p> | 1 Mark |
| b | <p>i) Preparation for concreting in cold weather completed before severe condition. Wind breakers erected to shield mixing batching plants. Plastic sheets should be available on site & steam generating plant may be installed.</p> <p>ii) Concrete should not be placed below 5°C & concrete is quickly placed & covered at top by insulating material.</p> <p>iii) All ice, snow & frost should be completely removed before placing the concrete.</p> <p>iv) Concrete must be protected by heated enclosure</p> <p>v) Low pressure wet steam should be used for heating enclosure & curing of concrete.</p> | 1 Marks for Each (Any Four) |



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| c | <p>vi) Select suitable type of cement admixtures of anti-freezing material & make use of air entrain agents.</p> <p>vii) Preheating of aggregate & water</p> <p>A retarder is an admixture that's slow down chemical process of hydration so that concrete remains plastic & workable for longer time.</p> <p>Retarders are use in hot weather concrete they are also use in grouting oil wells. Retarders are use in ready mix concrete to avoid setting of concrete when transportation time is more it is also use to obtained exposed aggregate look in concrete</p> <p>Trade names of retarders i) Ray lig binder ii) ASTM Type D Iii) ASTM Type G</p> | 2 Marks |
| d | <p>Advantages of RMC.</p> <p>i) High quality control is possible due to correct proportion of ingredient of concrete</p> <p>ii) Large quantity of concrete is manufacture at high speed within short duration</p> <p>iii) Automatic moisture measuring system & weight batching achieve optimum quality & Excellent mixing result.</p> <p>iv) Quick assessment of workability superior mixers are use for infrastructural developments & work in congested area.</p> <p>Limitations of RMC</p> <p>i) It is suitable for bulk production & mass concreting operation. Not for small consumer</p> <p>ii) Required skilled operator</p> <p>iii) It has low profit margin</p> <p>iv) Establishment cost of plant is more</p> | 2 Marks |
| e | <p>Fiber reinforced concrete can be defined as a composite material consisting of mixture of cement, mortar or concrete & discontinuous discrete, uniformly dispersed suitable fibers.</p> <p>Continuous mesh, woven fabrics & long wires or rods are not conceder as discrete fibers. Fiber reinforced concrete has more static & dynamic tensile strength, energy absorbing characteristics & better fatigue strength. It is used for bridge decks, canal lining, pipes, wall& roof panel's industrial flooring, road pavements & airfield fiber is small pieces of reinforced material.</p> <p>Possessing certain properties.fiber may be circular or flat & it is describe by aspect ratio.Steel, poly propylene, nylon, asbestos, glass & carbon fiber are use for this concrete.</p> | 4 Marks |



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| f | Advantages of pre-cast concrete. i) As manufactured in factory uniform & high quality product is manufactured ii) Are useful for large & repetitive type project iii) Easy to assemble in congested areas. iv) As mass production takes place it is economical. | 1 Mark Each |
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