MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

(Autonomous)

(ISO/IEC-27001-2005 Certified)

WINTER-12 EXAMINATION

Model Answer

Concrete technology – 12038

Q.No.1. a) i.) Types of cement

Ordinary Portland cement ii)Rapid hardening cement iii)Low heat cement iv) Pozzolana Portland cement v) Sulphate resisting cement vi) Blast furnace slag cement vii) White or color cement (4x1/2=02)

b) Consistency of cement For performing tests for setting time , soundness & compressive strength of cement standard consistency test has to be used. Standard or normal consistency of cement paste is defined as that consistency which will permit a vicat plunger having 10mm diameter & 50mm length to penetrate to a point 5 to 7mmfrom the bottom (or 33 to 35mm from the top) of the vicat mould when the cement paste is tested within 3 to 5 minutes after the cement is thoroughly mixed with water. (02)

c) Two qualities of good sand i) should be chemically inert ii) less silt content iii) free from inorganic & organic impurities (any two 2x1)

d) Flackness index – of aggregate is the percentage by weight of particles in it, whose least dimension (thickness) is less than three fifth of their mean dimensions. (02)

e) Water cement ratio the ratio of weight of water to the weight of cement in a concrete mix is called W.C. ratio. It is usually expressed in liters of water required per bag of cement. (02**)**

f) Two methods of mix design i) Indian standard method ii) IRC-44 method iii) ACT-method iv) Road No-4 method v) Fineness modulus method vi) surface area method vii)Maximum density method (any 02x01))

g) NDT – Non destructive test on concrete are said so because these tests can be performed in-situ as well as in laboratory without destructing concrete member & results about strength & durability can be obtained. (02)

h) Striping time of formwork Form stripping also know as striking of form or removal of forms after concrete has adequately harden. Formwork must support the concrete until it has become so hard that it will not collapse. This time is called concrete supporting period. (02)

i) Weight batching is the process of measurement of cement, coarse aggregate, fine aggregate, water for each operation of concrete making. In weight batching the ingredients are measured by weight using a balance or weight machine. (02)

j)Joints in concrete -i) construction joints ii) Expansion joints iii) contraction joints (2x1**)**

k) Superplastisizer- are chemically different from normal plastisizers. Use of Superplastisizer permits the reduction of water to the extend up to 30% without reducing workability in contrast to the possible reduction up to 15% in case of normal plastisizer**s.**

l) Function of retarders is to slow down the chemical process of hydrogen. so that concrete remains plastic and workable for a longer time than concrete without retarder. (02)

m) Four types of concrete i) Precast concrete ii) prestressed concrete iii) ready-mix iv) Ferro-cement v) light weight vi) aerated vii) reinforced viii) fiber reinforced ix) high performance x) vacuum concrete

n) Advantages:

i) It is possible to take full advantage of high compressive strength of concrete as well as high tensile strength of steel.

ii) Safely recommended for structures having longer spans and which are subjected to heavy loads, impact and vibrations. i.e. bridges, high rises, huge construction etc.

iii) Eliminates cracks in concrete

iv) Savings in material cost – requires 1/3 of concrete, steel ¼ of RCC (Any two 2x1=2)

Q2 a. The following are the field tests on cement

i. Open the bag & take a good look of the cement. There should not be any visible lumps and should not feel oily when touched. The colour of the cement should normally be greenish grey.
ii. Thrust the hand into cement bag It must give a cool feeling
iii. Take a pinch of cement & feel between fingers. It should give a smooth & not a gritty feeling.
iv. Take a hand full of cement & through it on bucket full of water, the particles should float for some time before it sink if the cement is of a good quality. **4x1= 4**

Laboratory test- any one

Apparatus & material with figure 1 mark

Procedure steps 2 marks

Standard IS code provision to be given 1 mark

b.

Sieve size in mm	Weight retained in gm.	Cumulative Weight retained in gm.	% Cumulative Weight retained in gm.
150	154	154	7.49
100	134	288	14.02
80	87	375	18.26
63	392	767	37.34
40	416	1183	57.62
20	160	1343	65.41
12.5	202	1545	75.25
10	385	1930	94.00
4.75	105	2035	99.2
Pan (2.36)	18	2053	100.00
Total 1.8	2053		568.48

600 +400.00 968.48

300

+ add 150

Fineness modulus = Total % of Cumulative Weight retained/100

= 968.48/100 =9.68 8 marks

c. i) Properties of fine aggregate

i. Source v Specific gravity

ii. Size & shape vi. Moisture content

iii. Texture vii. Bulking & silt content

iv. Bulk density viii. Soundness

Durability, cleanliness, thermal properties etc. Any four (04x1=04)

ii) Factors affecting bulk density

i. Shape – Due to less void rounded particles have greater bulk density
ii. Grater compaction gives greater density
iii. Increase in grading increases the bulk density, as graded aggregates have less voids
iv. Specific gravity (04x1=04)

Q.3.

a) Determination of silt in fine sand (Each step 01 mark)

Steps-i) Prepare 1% (10gm in 1000ml water) salt solution &stir it.

ii) Take 50 ml of salt solution in measuring jar& add sand which is to be tested in it to reach level up to 100ml.

iii) Add solution in jar till jar level reaches to 150ml mark & cover it tightly with palm & shake it till silt goes into suspension

iv) Keep the jar in undisturbed for 3 hours.

v) Measure thickness of silt layer & calculate volume of silt

% of silt by volume = (Volume of silt after 3 hours/volume of fine sand particle) x100

vi) According to IS recommendations silt content in fine sand should not exceed 5%

(Fig. 02 marks)

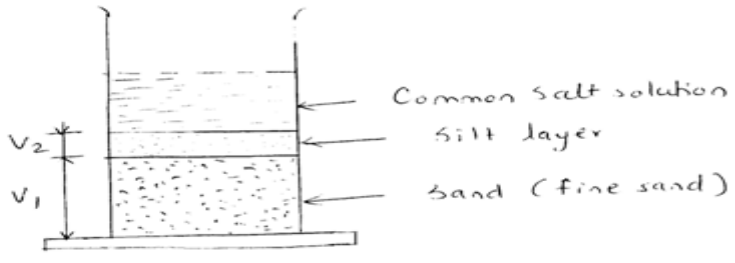

Fig:- Measuring jar after 3 hr. setting

Q.N.3.b) Workability of concrete- "The property of concrete which determines the amount of useful internal work necessary to produce full compaction **or**

The ease with which concrete can be compacted 100% having regard to mode of compaction & place of compaction (02)

Tests for workability-i) Slump cone test ii) compaction factor test iii) Vee-Bee consistency test

iv) Flow test (02)

Explanation for procedure of conducting workability test from any one above method (04)

Q.N.3.c)

1) Objectives of concrete mix design- (any four 4x1)

i) To achieve specified characteristic compressive strength of 28 days period ii) To achieve the specified workability iii) To have sufficient durability iv)To have desired strength in harden stage v) To have economy as much as possible vi) To have satisfactory appearance vii) to avoid honeycombing & bleeding, segregation viii) to comply with various standards.

2) Factors affecting concrete mix design

i) water cement ratio ii) Cement aggregate ratio iii) compressive strength iv) workability v) consistency vi) gradation of aggregate vii) quality control viii)type & grade of cement

x)durability x) grading of combined aggregates. (any four 4x1)

Q. No. 4 Attempt any **FOUR** **16**

a) i) **Fineness of Cement-**

Any four points related to fineness of cement from the following

1. The fineness of cement is a measure of the size of particles of cement and is expressed in terms of specific surface of cement.
2. It can be calculated from particle size distribution or one of the air permeability methods.
3. It is important factor in determining the rate of gain of strength and uniformity of quality.
4. For given weight of cement, the surface area is more for finer cement than coarser cement
5. For finer cement higher is the rate of hydration as more surface area is available for chemical reaction. This results in early development of strength.
6. If cement is grind beyond certain limit, its cementive properties may be adversely affected due to prehydration of atmospheric moisture.
7. As per Indian standard specifications the residue of cement should not exceed 10 % when sieved on 90 micron IS sieve.
8. The amount of water required for constant slump, concrete decrease with increase in fineness of cement. (2)

ii) **Soundness of cement-**

Any four points related to soundness of cement from the following

1. The unsoundness of cement is caused by the undesirable expansion of some of its constituents, sometimes after setting.
2. The large change in volume accompanying expansion results in disintegration and severe cracking.
3. The unsoundness is due to presence of free lime and magnesia in cement.
4. Unsoundness may be reduce by limiting MgO content to less than 0.5%, fine grinding, through mixing and allowing the cement to aerate for several days.
5. The Lechatelier and Autoclave are the two test carried out for soundness testing. As per IS 269-1989 expansion of cement should not be more than 10 mm in Lechatelier's test and 0.8 % in Autoclave test.
6. The free lime hydrates very slowly because it is covered by the thin film of cement which prevent direct contact between lime and water
7. After setting of cement the moisture penetrates into the free lime resulting its hydration. Since slaked lime occupies a larger volume, the expansion takes place resulting in severe cracking (2)

Q. 4 b) Test procedure for Initial setting time of cement using Vicat apparatus

I. Take 400 gms of sieved cement (through IS sieve no. 9) and water is added to it at rate of 0.85(P) by weight of cement. [0.85(p) x $\frac{400}{100}$ =weight of water to be added where p is % of water required for normal consistency]
II. At the instant of adding water, stop watch is started.
III. Prepared test block is placed under the rod, now fitted with a needle.
IV. It is brought into contact with the top surface of the paste in the mould and reading on the scale is noted.
V. The rod is then released quickly, without any jerk, allowing it to penetrate in to the test block and time is noted on the stop watch.
VI. The procedure is repeated until the needle fails to pierce the block about 5mm from the bottom of the mould.
VII. Care should be taken that each time needle should be cleaned and released at a new place from the top surface of the paste.

Time from the stop watch was recorded up to the reading measuring is denoted as **initial setting time** of cement.

Q.4 C)

I. This test gives a relative measure of the resistance of aggregate to compressive stress.
II. Take aggregate passing through 12.5 mm IS sieve and retained on 10 mm sieve. About 6.5 kg of surface dry aggregate is filled in the standard cylinder in 3 layers, tamping each layer 25 times by standard tamping rod.
III. It is leveled off. Its weight is found out (A)
IV. The plunger is placed on the aggregate taking care that it does not jam the cylinder by becoming tilted.
V. The assembly is then kept under compression testing machine and total load of 40 tonnes is applied uniformly during 10 minutes.
VI. The load is released; the aggregate is taken out and sieved on 2.36 mm sieve. The fraction passing through is weighed (B)
VII. The aggregate crushing value = $\frac{B}{A}$ x 100
VIII. The aggregate crushing value should not be more than 45 % for ordinary concrete.

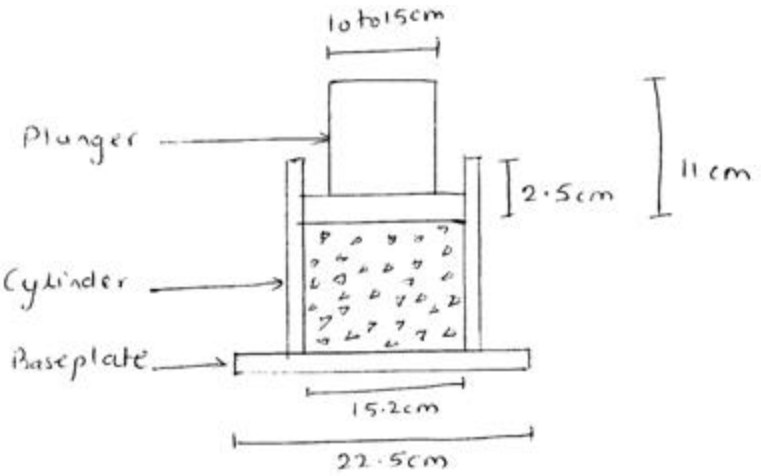

Fig:- Crushing Value Apparatus.

(4)

Q.4.d) NDT Limitations (4x1)

i) Concrete have initial temperature between 15ºC to 26ºC & no loss of moisture by drying during curing

ii)Calibration curve based on project-specific material & new calibration curve required for changes in mix design.

iii) The effect of early age concrete temperature on long term ultimate strength may not be fully characterized. In some cases when concrete is cured high temperature , it may develop higher early age strength but reduced long term strength

iv) some factors affecting concrete strength e.g. consolidation may not be reflected in NDT measurements

Q.4.e) Factors affecting creep – i)mixing proportion ii)Quality of aggregate iii) Age of concrete iv) Thermal expansion v) Fire resistance (4x1/2)

Factors affecting shrinkage of concrete - i)Water cement ratio, ii)cement content, iii)Temperature, iv) Curing v)Relative humidity vi)rapid drying vii) water saturated aggregate, properly design concrete, moist & cool conditions. (4x1/2)

Q.4.f) Weather concreting- concreting done at atmospheric temperature above 40ºC. OR

The temperature of concrete at the time of placement is expected to be beyond 40ºC may be cauterized as hot weather concreting (02)

Special Problems

i) Accelerated setting ii)Reduction in strength iii)Increased tendency to cracking iv) rapid evaporation during curing v) Difficulty in controlling the air content (Any 4x1/2)

Q5.a) Compressive strength –it is the most important property of concrete meant to resist compressive stress.

Durability –the capacity to resist the process of disintegration due to natural or other causes such as temp .changes, variation in moisture content, attack of chemicals or weather is called the durability of concrete.

Impermeability-resistance to leakage of water through the concrete is called Impermeability.

Modulus of elasticity-it is the ratio of compressive stress to strain in concrete. (1x4=4)

b) Requirement of good formwork-

1. It should be strong enough to resist weight of concrete, workers and machinery.
2. It should be rigid enough to retain its shape without deformation.
3. It should be economical compared to total cost of construction.
4. It should be used for more no. of times.
5. It should give smooth finish and shape to concrete faces.
6. It should be easy to erect and dismantled.
7. It should be easily possible to give the required geometrical shape to the form work.
8. It should be leak proof.

c) Volume batching	weight batching
1. The ingredients are measured by volume.	1. The ingredients are measured by weight.
2 for measurement the gauge boxes (forma) are used	2 for measurement balance/ /weighing m/c is used
3. Batching is done per bag of cement i.e. 35 lits.	3. Batching is done per bag of cement i.e 50kg.
4. Accuracy is less.	4. Accuracy is high.
5. It is used for ordinary construction where nominal mix is used	5 It is used for important quality construction where design mix is adopted.

(any 04 points carries 01 mark each)

d) accelerators – these admixtures accelerate the rate of hydration reaction and hence accelerate the rate of development of strength.construction speed increases . 2MARKS

accelerating materials –fluosilicates ,triethenolamine ,cacl2 ,M-C-Schnell OC MC-Schnell SDS (any two)

Air entraining admixtures –these admixtures react with water and gas is evolved in the form of millions of tiny air bubbles. These bubbles act as ball bearings and modify the proper ties of fresh concrete like workability, segregation.

Air entraining agents- natural wood resins, animal and vegetable fats, oils, soaps (any two)

e)fibre reinforced concrete is a composite material consisiting of mixture of cement concrete an d discontinuous descrete uniformly dispersed suitable fibers.

Fibers made from steel,glass,carbon .vegetale jute, bamboo etc are used.these fibres act as crack arresters.

02 marks

Applications-

1. Due to fibers ,tensile strength of concrete is improved.therefore such type of concrete is used where small tensile strength required for fabrication of precast products like pipes.
2. This has high resisting power against shocks and dynamic loading, so in workshops it can be used for flooring.
   (any other two applications may be considered related to fiber reinforced concrete)

02 marks

f) Admixtures- the materials sometimes used in concrete to improve few properties and to get required results are known as admixturs.

Purposes

1. It helps to resist corrosion of steel in RCC work.
2. It helps in improving durability's by improving resistance to natural attack.
3. Accelarators, MC Schnell SDS are used to accelerate the rate of hydration reaction.
4. Retarders are used to retard the rate of hydration reaction.
5. Pozzolonic materials like fly ash used to improve workability.
6. Water proofer are used like Dr.FIXIT to make concrete impermeable.

(other any two may be considered.)

Q6.a) Mix concrete given 1:2:4 by volume

i. Cement----35 lits
ii. Sand ----70 lits
iii. Coarse aggregate=140 lits

iv. Water 2 marks

1. For w/c ratio of 0.6 quantity of water 30 lits by weight.
2. Quantity of water to be deducted for moisture present in fine aggregate=6/100x70=4.2 lits
3. Quantity of water to be deducted for moisture present in coarse aggregate=2/100x140=2.8 lits
4. Actual quantity of water =30-4.2-2.8=23 lits----------2 marks
5. Quantity of sand to be added due to moisture content=4.2 lits
6. Quantity of sand to be added due to bulkage=20/100x70=14 lits
7. Actual sand=70+4.2+14=88.2 lits ----------2 marks
8. Actual coarse aggregate=140+2.8=142.8 lits----------2 marks

Q6 b) curing is defined as the process in which freshly cast concrete is kept in sufficiently wet condition for certain period after compaction, so that the hydration reaction is achieved completely .usually curing is done for 28 days .

2 marks

Methods of curing-

1. Spraying water-this is the simplest method adopted where water is available in plenty. After removal of formwork, water is sprayed on the concrete through a pipe or by bucket number of times during eachday.it is suitable for small work.
2. Steam curing-it is used for pre cast concrete products manufactured in any factory. due to steam ,the ingredients are heated uniformly and the strength is gained at very fast rate. Steam can penetrate even in small gaps of stacked products and cure evenly from all sides. There are two methods –low pressure and high pressure steam curing.
   -02 marks
3. Ponding methods- this is for slabs or road pavements on the top of slab ,with cement mortar or clayey soil.small bunds are prepared and in the resulting grid of ponds, water is stored upto a depth of 50 mm for 28 days.the potable water is used.

Q6. C. RMC-Ready Mix concrete: In RMC every ingredients of concrete in concrete proportion is mixed by machine. There is no chance of error & better quality is effected. Also large amount of concrete is produced in short time. The concrete is transported by trucks. Automatic moisture measuring system, process control system is used to achieve optimum quality (4 marks)

Applications: (2 marks)

i. It is used in large size projects like high rise buildings
ii. It is used in urban areas where space for storage limited.

Advantages: (2 marks)

i. Quality of concrete uniform & high
ii. No need to invest money for raw materials & machinery
iii. Can be available in required quantity on site
iv. Useful in congested urban areas