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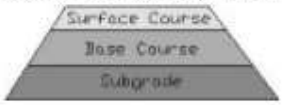
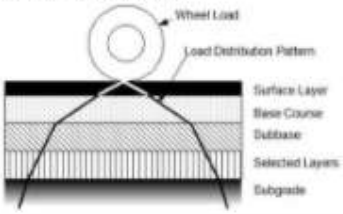
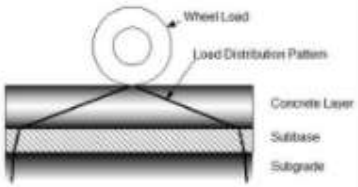
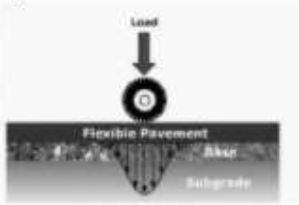
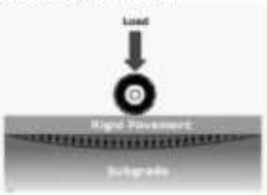
Internal Assessment Test 3 – January 2022

Sub	Pavement Materials and Construction					SubCode:	18CV733	Branch:	CIVIL
Date:	27/01/2022	Duration:	90 mins	Maxmarks	50	Sem/Sec:	VII		OBE

Answer any five questions - Provide neat sketches wherever necessary

		MARKS	CO	RBT
1	Compare flexible and rigid pavements.	[10]	CO1	L2
2	Explain the construction steps involved in subgrade preparation. What are the quality control checks conducted?	[10]	CO1	L2
3	Write short notes on (i) Seal Coat (ii) Prime coat (iii) Tack coat	[10]	CO2	L2
4	Write the specification of materials and construction procedure for WMM roads.	[10]	CO2	L2
5	With the help of neat sketches show the following types of joints in cement concrete pavements. (i) Contraction joint (ii) Expansion joint.	[10]	CO1	L2
6	Explain in detail the construction steps of a cement concrete pavement.	[10]	CO1	L2

1	Compare flexible and rigid pavements.			[10]	CO1	L2

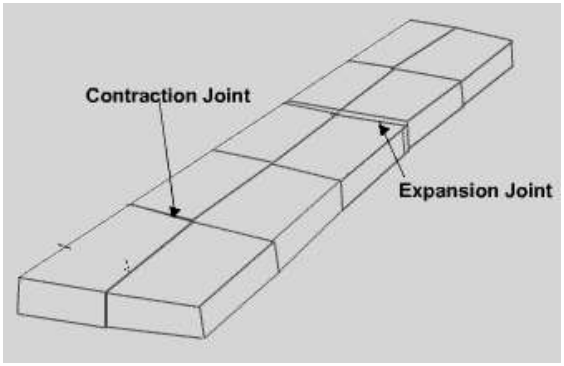
Sl No	Characteristic	Flexible pavement	Rigid pavement
1	Structure	Has a layered structure. 	Do not have layers. Comprises of a Slal and subgrade. To prevent mudpimping an optional base course may be provided. 
2	Load transfer	Grain to grain contact. 	Slab action. 
3	Stress distribution	Top layers will carry higher load stress which diminishes with depth. Therefore, in flexible pavement deflection basin is very deep, because of its dependency on the underlying layers. 	Load is carried by the stiffness of slab itself. In case of rigid pavement, deflection basin is shallow, this is because of independency of rigid pavement on the underlying layers. 
4	Modulus of Elasticity	Flexible pavement has very low modulus of elasticity (less strength).	Modulus of elasticity of rigid pavement is very high, because of high strength concrete and more load bearing capacity of the pavement itself.
5	Design criterion	CBR value of the subgrade soil and traffic intensity	Modulus of subgrade reaction, traffic intensity, modulus of elasticity and poisson's ratio of concrete.
6	Structural capacity of lower layers	In flexible pavements, underlying layers play very important role. Hence lower layers also should be structurally sound.	In case of rigid pavements, top slab carries maximum load and very minute part is taking by sub layers.
7	Stresses induced	Only load stresses are present whose design is based on CBR of subgrade	Temperature stresses such as warpinf stresses and frictional stresses are also critical in its design along with flexible and rigid pavements.
8	Joints	No temperature stresses, hence no joints and joint fillers are present.	To relieve temperature stresses. Joints are provided which forms a source of weakness of rigid pavements if not properly designed.
9	Design life	Design life ranges from 10-20 years based on the type of road.	Normally have a design life of 30 years as per IRC.
10	Stage construction	Stage construction is possible. which enables repair work also easy	Stage construction is difficult
11	Cost of construction	Low cost of construction	High cost of construction and requires skilled labour
12	Maintenance	Frequent maintenance which proves to be expensive in long run	Low maintenance and hence prove to cheap in long run.
13	Fuel spillage	Gets effected by fuel spillage hence not recommended for airfield pavements	Resistant to fuel spillage which increases its application in airfield pavements.

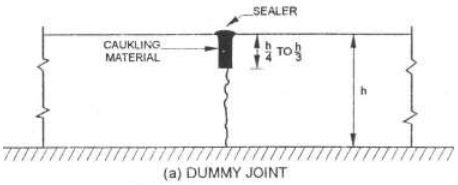
2	Explain the construction steps involved in subgrade preparation. What are the quality control checks conducted? Steps involved in embankment/subgrade construction– 1) Spreading material in layers and bringing to appropriate moisture content. • The embankment & subgrade material - spread in layers of uniform thickness not exceeding 200mm compacted thickness. • Moisture content of the material shall be checked - water shall be sprinkled. • Clods or hard lumps – broken to max size of 75mm (embankment) & max size of 50 mm (subgrade). • Embankments & other areas of unsupported fills - not be constructed with steeper side slopes, or to greater widths. • Benching of natural slope (steeper than 1 vertical on 4 horizontal) - Whenever fills is to be deposited against the face of a natural slope 2) Compaction • Smooth wheeled, vibratory, pneumatic tyred, sheep foot or pad foot rollers are used. • Vibratory roller of 80 to 100KN static weight or heavy pneumatic tyred roller. • Each layer thoroughly compacted to the densities in table –1 • Subsequent layers should be laid only after the finished layer has been tested. • The measurement of field dry density is recorded by nuclear moisture / density guage. • Density measurement reveals any soft areas in embankment, further compaction is carried out. 3) Drainage – • Proper drainage to be ensured through out the construction. 4) Repairing of damages caused by rain / Spillage of water - • Affected area is locally removed and refilled in layers and compacted using small vibratory roller • Density check to be carried out for the repaired area. 5 Finishing - • Shaping and dressing the shoulders/ road bed and side slopes **Sl. No. | Type of test | Frequency of tests** 1 | Sand content | 2 tests per 3000 cubic meter of soil. 2 | Plasticity test | 2 tests per 3000 cubic meter of soil. 3 | Density test | 2 tests per 3000 cubic meter of soil. 4 | Deleterious content | As & when required. 5 | Moisture content | 1 test for 250 cubic meter of soil. 6 | CBR test [soaked & unsoaked] | 1 test per 3000 cubic meter of soil. Compaction Control test – Atleast one measurement of density for each 1000sqm of compacted area	[10]	CO1	L2

3	Write short notes on (i) Seal Coat (ii) Prime coat (iii) Tack coat	[10]	CO2	L2

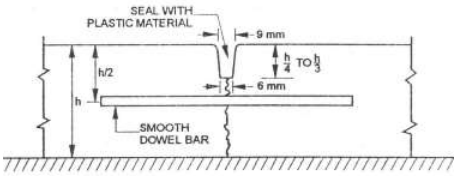
Seal Coat	Prime coat	Tack coat
Seal coat is a thin surface treatment used to water-proof the surface and to provide skid resistance. Seal coat is a layer of liquid binder applied over a pervious bituminous surfacing. They can be of two types (i) Type A-Seal coat or (ii) Type B-Seal coat. In Type A seal coat, the heated bituminous binder is applied on open graded carpet. After that aggregates of nominal size 6.7 mm is spread over it and rolled. In Type B seal coat, aggregates passing 2.36 mm and retained on 0.18 mm sieve are mixed with the heated binder, spread and rolled on the open graded surface course.	*Tack coat is a very light application of asphalt, usually* ***asphalt emulsion diluted with water.*** This involves application of liquid bituminous binder of low viscosity over a granular or non-bituminous surface. The application process is called as priming. Objectives are (i) penetrates deep into the surface and plug or seal the voids. (ii) coat and bond the loose soil particles on the surface. (iii) render the surface of the base course water resistant. (iv) permit the tack coat to be applied over the promed surface to provide proper adhesion between the base and bituminous layer.	*Prime coat is an application of* ***low viscous cutback bitumen*** *to an absorbent surface like granular bases on which binder layer is placed.* This involves application of low viscosity over either a primed granular surface or over an existing bituminous surface or cement concrete surface. Objectives are (i) To provide adequate interface bond between the receiving surface and the new bituminous layer being overlaid. (ii) the layer do not penetrtae into the surface and plug the voids. (iii) the bituminous layer is placed immediately over the tack coat.

4	Write the specification of materials and construction procedure for WMM roads. Function:- • Used as base course of flexible pavement. • Uniform and strong support • High resistance to deformation Material Requirement:- • Crused Gravel • Crushed stone • Material free from organic or other deleterious constituents • Material confirming to grading requirements as per MORTH Value Requirement Los Angeles abrasion value < 40% Aggregate impact value < 30% Combined flakiness and elongation index < 30 % PI of material finer than 0.425 mm sieve < 6 % 1. Preparation of Base Surface of GSB shall be prepared – camber, free of dust or other undesirable matters. 2. Compaction test is carried out in the laboratory for WMM mix. Optimum moisture content is determined. 3. Preparation of Mix Prepared in approved mixing plant – pugmill or pan type mixer. Small quantity of wet mix work – concrete mix. Water added – allowance for evaporation 4. Spreading of Mix Transported to site immediately after mixing Spread uniformly – paver finisher or motor grader No segregation of coarse or fine particles 5. Compaction Single compacted layer - < 100 mm – Smooth wheel roller(8 to 10 tonnes)	[10]	CO2	L2

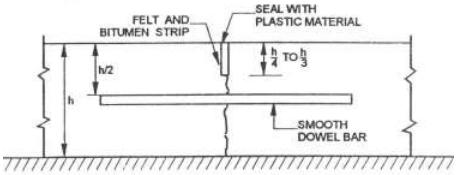
	< 200 mm – vibratory roller speed of roller < 5 km/hr Total design thickness – 250mm – constructed in two layers 6. WMM surface is checked for defects – no traffic load before laying of surface course. 7. Dried for at least 24 hours. Quality control i. Samples of CA – laboratory test (Los angeles abrasion value, impact value, combined flakiness and elongation index) ii. Check for PI for fraction of mixed aggregate passing 0.425 mm sieve. iii. Gradation of combined mix is checked. iv. Laboratory compaction test – mixed aggregate – OMC and maximum dry density v. Moisture content of WMM – while feeding to mechanical paver. vi. Field density and moisture content – after compaction dry density – 98% to be achieved vii. Step (v) and (vi) are repeated for each subsequent layer. viii.Checked for finished surface level – tolerance (+10mm and - 10 mm) Atleast one set of test in (i) per 200m3 of aggregate. Grading of the mixed aggregate – one test per 100m3 . Density check – one per 500 m2 on each compacted layer.			
5	With the help of neat sketches show the following types of joints in cement concrete pavements. (i) Contraction joint (ii) Expansion joint.  ***Contraction joint:*** Contraction joints are provided along the transverse direction to take care of the contraction of concrete slab due to its natural shrinkage. ***Expansion joint:*** Expansion joints are provided along the transverse direction to allow movement (expansion/ contraction) of the concrete slab due to temperature and subgrade moisture variation. *The spacing of the contraction joint is estimated from the shrinkage potential of concrete. The spacing of the expansion joint is estimated from the coefficient of thermal expansion of concrete, maximum change of temperature and the acceptable joint gap. Since, the concrete is good in compression, the experience over last few decades indicates that concrete pavement can be constructed without any provision of expansion joint (ACPA 1992). The dowel bars are designed by assuming that they participate in the load transfer, when the vehicle moves from one slab to other.* **Types of contraction joints**	[10]	CO1	L2



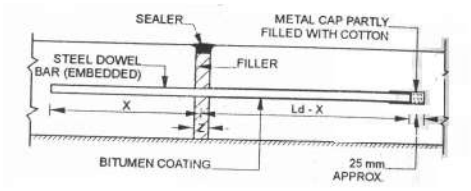
(a) DUMMY JOINT

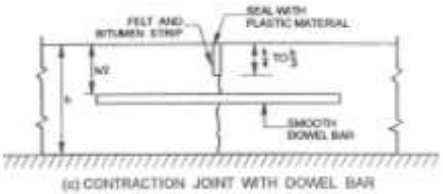


(b) CONTRACTION JOINT WITH DOWEL BAR



(c) CONTRACTION JOINT WITH DOWEL BAR





(c) CONTRACTION JOINT WITH DOWEL BAR

Contraction joints
• Initial period of curing – shrinkage and contraction of concrete
• Fine shrinkage cracks – start from the bottom of the slab and
• progress upward
• To prevent development of shrinkage cracks in an irregular pattern. • Construction joints at intervals of 4.5m or closer • Dummy joints – cutting narrow grooves on the top pavement in transverse direction
• One –fourth to one- third depth of slab thickness
• Shrinkage cracks develop only at these pre determined locations
• Constructed with or without steel dowel bars
• Prevent widening of the fine shrinkage cracks • Decrease the magnitude of warping stresses

Expansion joints
• Through transverse joints – 20 to 25 mm pre determined gap between two slabs
• Space for pavement to expand longitudinally
• Preventing buckling of long CC slabs
• Provided at intervals of 60 to 120 m.
• Steel dowel bars – load transfer from one slab to the adjoining one.

6	Explain in detail the construction steps of a cement concrete pavement. a) Preparation of subgrade and sub base – • No soft pots are present in subgrade or sub base. • It should extend atleast 30cm on either side of width to be connected. • Subgrade is properly drained; minimum modulus of subgrade reaction is 5.54 kg/cm2. • The layers should be kept moist when cement concrete is placed. • Water proof layer may also be used when CC is laid directly. b) Placing of Forms – • The steel or wooden forms are used. • The steel forms are M.S. Channel sections and their depth is equal to thickness of pavement and length atleast 3m except on curves < 45m radius. • Wooden forms are dressed on side, these have minimum base width of 100n for slab thickness or 20cm. c) Batching of Material & Mixing –	[10]	CO1	L2

	• The proportioned mixture is placed into hopper in weigh batching plant. • All batching of material is done on the basis of one or more whole bags of cement, wt of one bag is 50 kg or unit wt of cement is taken as 1440Kg/m3. • The mixing of concrete is done in batch mixer. So that uniformily distributed, uniform color and homogenous mix is obtained. • The batch of cement, fine aggregate and coarse aggregate is led together into the mixer. Water for mixing is introduced into the drum within fifteen seconds of mixing. d) Transportation & Placing of Concrete – • The cement concrete is mixed in quantities required for immediate use. • It should be seen that no segregation of materials results while transporting. • Spreading is done uniformly; certain amount of redistribution is done with shovels. e) Compaction & Finishing – • The surface of pavement is compacted either by means of power driven finishing machine or by vibrating hand screed. • Areas where width of slab is small, hand consolidation and finishing is adopted. • The concrete is further compacted by longitudinal float. It is help parallel to carriage way and passed gradually from one site to other. • The slab surface is tested for its grade and level with straight edge. • Just before the concrete becomes hard, the surface is belted with two ply canvas belt. • Broom finish is given with fibre broom brush and it is done perpendicular to centerline of pavement. • Before concrete develop initial set, the edges of slab are carefully finished with an edging tool. f) Curing of cement concrete – • Initial curing – The surface of pavement is entirely covered with burlap cotton or jute mats prior to placing it is saturated with water and wet side is placed on pavement. • Final curing – Curing with wet soil exposed edges of slabs are banked with soil berm. A blanket of sandy soil free from stones is placed. The soils is thoroughly kept saturated with water for 14 days. Quality Control during construction of CC Pavements 1. Sample of CA – specified tests in the laboratory to decide suitability 2. Grading of CA and FA for the PQC mix – checked 3. Cube and beam specimen of CC mix – tested for 7 days and 28 days strength 4. Workability of CC mix – checked 5. Honeycombed surface on sides of laid CC pavement slab are checked and finished with cement mortar 6. Regularity of finished surface is checked 7. CC pavement cured for 7 days – core samples taken to check density, degree of compaction and voids content 8. Sealant materials – specified tests are done 9. Presence of different types of cracks and their locations – checked and recorded.			