Engineering Services Examination-201 2

Sl. No.

C-FTF-M-DJA

CIVIL ENGINEERING

Paper I

(Conventional)

Time Allowed : Three Hours	Maximum Marks : 200

INSTRUCTIONS

Candidates should attempt any FIVE questions.

The number of marks carried by each subdivision of a question is indicated at the end of the subdivision.

The total number of marks for each question will be 40.

Answers must be written only in ENGLISH.

Notations used are standard and will have their usual meanings, unless otherwise indicated.

Assume suitable data, if found necessary, and indicate them clearly. Newton may be converted to kgf using the relation 1 kilonewton (1 kN) = 100 kgf, if found necessary.

Important : Candidates are to note that all parts and sub-parts of a question are to be attempted contiguously in the answer-book. That is, all parts and sub-parts of a question being attempted must be completed before attempting the next question.

Any pages left blank in the answer-book must be clearly struck out. Answers that follow pages left blank may not be given credit.

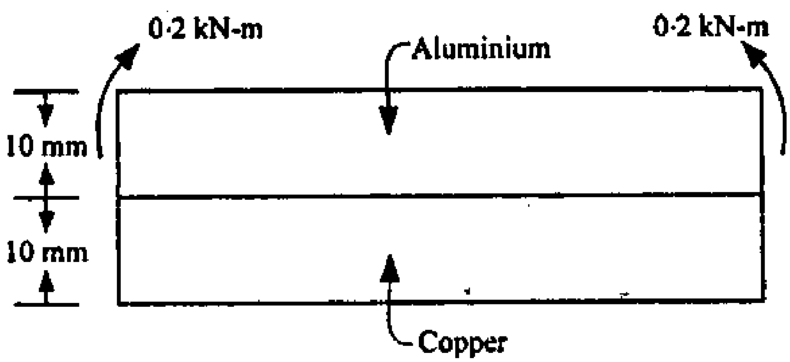
1. (a) List the principal constituents of fly ash. Explain its pozzolanic action when used in concrete. 10

(b) For a mix design of proportion 1 : 2 : 3·6 (by mass) with w/c ratio of 0·45 and air content 3% of the concrete volume, calculate the weights of water, cement, fine aggregate and coarse aggregate to make 1 m^3 of concrete. The specific gravities of cement, F.A. and C.A. are 3·15, 2·65 and 2·6 respectively. 10

(c) What are the varieties of industrial timber ? Indicate the procedure followed for making fibre boards. 10

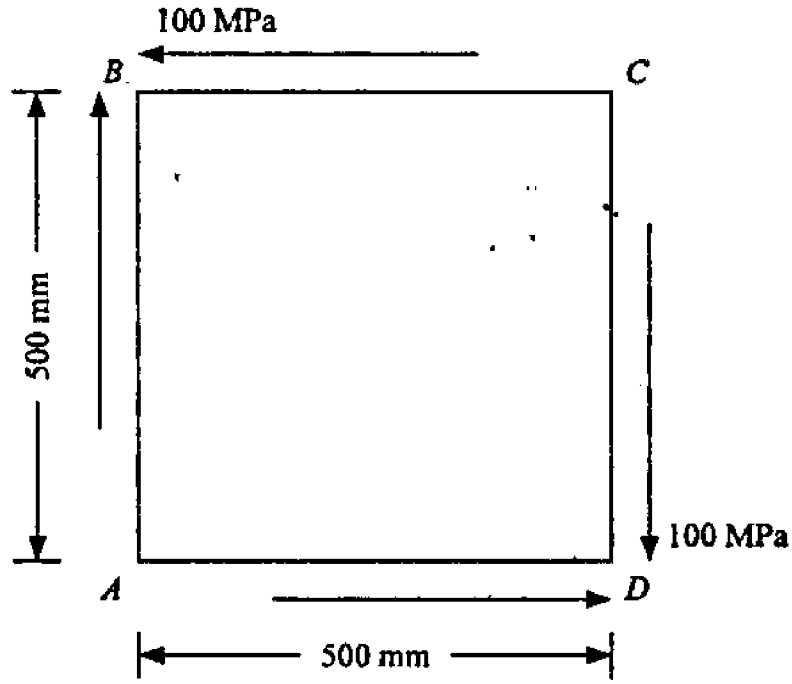
(d) Discuss the properties imparted to brick-earth by its constituents alumina and silica. 10

2. (a)



A strip of copper 40 mm wide and 10 mm thick is bonded with another strip of aluminium of same size to form a bimetallic strip of 40 mm × 20 mm. The strip is subjected to a pure bending moment of 0·2 kN-m as shown in the above figure. Calculate the radius of curvature of the strip and the maximum tensile and compressive stresses. $E_c = 1 \times 10^5$ MPa, $E_{al} = 0{\cdot}6 \times 10^5$ MPa. 20

(b)

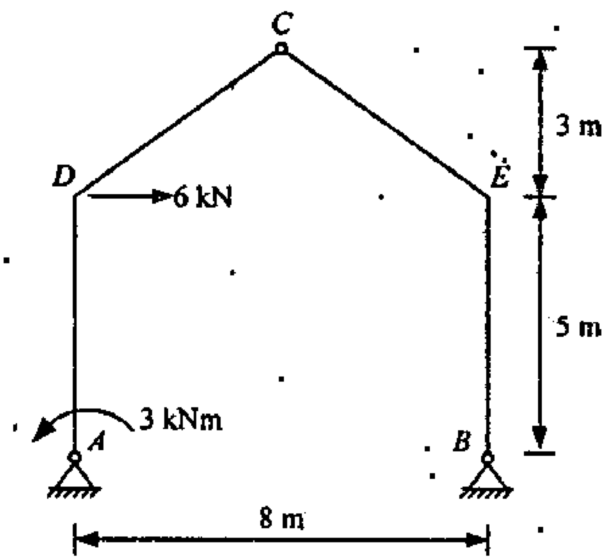


A square plate of side 500 mm is subjected to pure shear of intensity 100 MPa as shown in the above figure. Young's modulus of the material is 2×10^5 MPa and Poisson's ratio is 0·2. Find the principal stresses, their directions and the change in lengths of the diagonals of the plate. 10

(c) A thin walled tube of circular cross-section with outer diameter 100 mm, thickness 2 mm and length 1000 mm is fixed at one end. It is subjected to a twisting moment of 1 kN-m at the free end. Find the shear stress in the wall of the tube and the angle of twist at the free end. $E = 2 \times 10^5$ MPa and Poisson's ratio = 0·25.

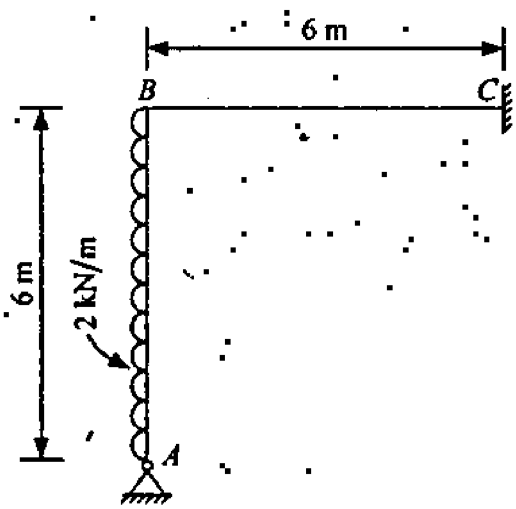
What will be the shear stress in the wall of the tube if the cross-section of the tube is square with outside dimensions 100 mm × 100 mm and wall thickness 2 mm ? 10

3. (a)



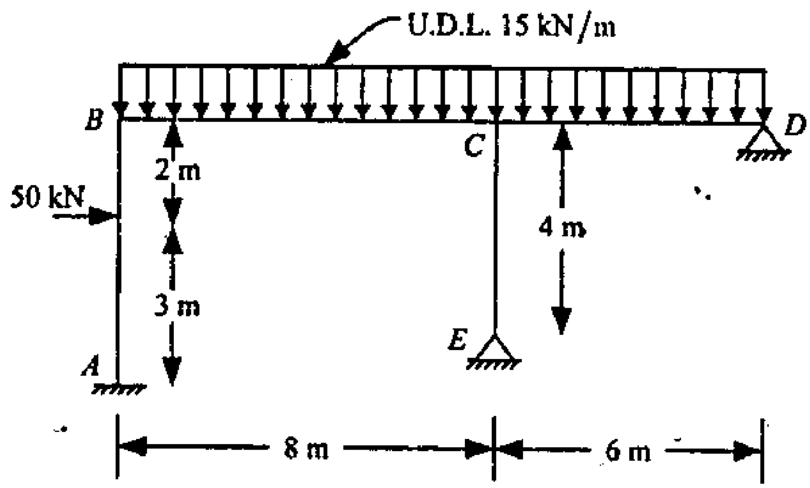
Find all the support reactions and draw BM diagram for the frame shown above. Frame has hinged supports at A & B and internal hinge at C. 15

(b)



Analyse the frame shown above by compatibility method. EI is constant. Draw BM and SF diagrams. 25

4. (a)



Analyse the rigid frame shown in the above figure by moment distribution method, taking flexural rigidity EI to be uniform for all members. 20

(b) ISMB 450 is used as a propped cantilever beam of span 12 m. Assuming $\sigma_y = 250$ MPa determine the factored uniformly distributed load q_u the beam can carry including self weight, if the load is to be applied over the entire span.

The properties of ISMB 450 are as follows :

weight/metre	:	72·4 kg
area of cross-section	:	9227 mm^2
width of flange	:	150 mm
thickness of flange	:	17·4 mm
I_{xx}		$= 3{\cdot}039 \times 10^8$ mm^4
I_{yy}		$= 8{\cdot}34 \times 10^6$ mm^4

20

5. (a) Rolled steel section ISWB 300 is used as a column of height 6 m, fixed at base and pinned at top. Find the permissible compressive load on the column using the table of permissible compressive stresses as given in the table below :

Cross-section properties of ISWB 300 section are as follows :

Area of cross-section = 6133 mm^2

Flange width = 200 mm

Flange thickness = 10 mm

Web thickness = 7·4 mm

$I_{xx} = 98{\cdot}216 \times 10^6 \text{ mm}^4$

$I_{yy} = 9{\cdot}9 \times 10^6 \text{ mm}^4$

λ	50	60	70	80	90	100	110	120
σ_{ac}	132	122	112	101	90	80	72	64

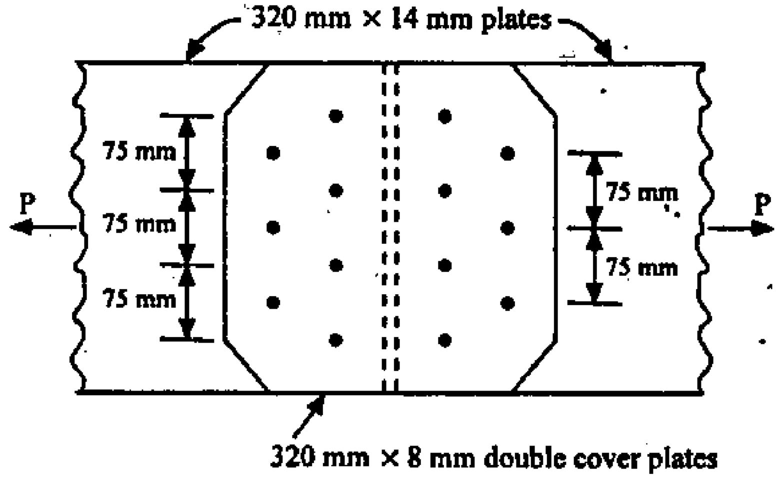
λ	130	140	150	160	170	180	190	200
σ_{ac}	57	51	45	41	37	33	30	28

λ = slenderness ratio

σ_{ac} = allowable compressive stress in MPa

Use linear interpolation for intermediate values of λ. 15

(b)



A double cover butt joint is provided with the following details :

Size of plates to be spliced 320 mm × 14 mm

Size of cover plates 320 mm × 8 mm

No. of 20 mm dia rivets provided = 7
(as shown in the above figure)

Allowable stress in tension 125 MPa

Allowable stress in shear 80 MPa

Allowable stress in bearing 250 MPa

(i) Determine the strength of the connection.

(ii) Find the force on the extreme rivet when the connection is subjected to a pull of 280 kN with an eccentricity of 20 mm.

(iii) Find the limiting value of eccentricity if force on any rivet is not to exceed its strength. 25

6. (a) Distinguish clearly between pretensioned and post-tensioned prestressed concrete bringing out all the operations involved. 8

(b) A simply supported T-beam of span 9 m in reinforced concrete has the following dimensions :

Flange width	=	2000 mm
Flange thickness	=	150 mm
Overall depth	=	750 mm
Rib width	=	300 mm

The beam is provided with 6 No. 32 mm diameter HSD bars of grade Fe 500.

Concrete used is of grade M 25.

Find the moment of resistance of the beam using limit state method.

Also find the magnitude of two point loads at 3 m distance from the ends. 12

(c) A rectangular simply supported prestressed concrete beam of cross-section 200 mm wide and 300 mm deep is prestressed by 15 No. 5 mm diameter wires located at 65 mm from soffit and 3 No. 5 mm diameter wires at 25 mm from the top. Assuming effective stress in steel wires as 840 N/mm^2,

(i) calculate the stresses in concrete at the extreme fibres at midspan section due to prestress and its own self weight over a span of 6 m.

(ii) if a uniformly distributed working load of 6 kN/m is imposed on the beam, obtain the maximum compressive stress in concrete.

(iii) if the modulus of rupture of concrete is 6·5 N/mm^2, estimate the load factor against cracking.

Assume density of concrete = 24 kN/m^3. 20

7. (a) (i) Calculate the time required to grade and finish 30 km of road formation of 9·0 m width for two-lane road with motor-grader having width of 3·0 m, using six passes with speed for each of the successive two passes as 5 kmph, 7 kmph and 9 kmph respectively. Assume machine efficiency based on operator skill, machine characteristics and working conditions as 80%. 6

(ii) Enlist major concreting equipments required to carry out following operations :

Mixing, transportation delivery and compacting equipment. 4

(b) (i) Calculate number of transit mixers (TM) required for transporting concrete from central batching plant to site. The cycle time data of a 6 m^3 typical transit mixer is given below :

Loading time of TM = 6·0 minutes.

Travel time of loaded TM to site = 30·0 minutes

Average waiting time at site = 5·0 minutes

Discharge time of concrete at site through concrete pump = 15 minutes

Travel time for return trip = 24 minutes

If the central batching plant having average output of 60 m^3/hr is to run continuously, work out the requirement of no. of concrete pumps and TM. 6

(ii) Name various types of Earth Excavating Equipments and give their corresponding digging depth. 4

(c) The data for planning a certain Civil Engineering project by CPM-Network analysis is given below. Draw the network and establish the critical path.

Also determine the following :

(i) Prepare a CPM schedule and calculate total float, free float and independent float.

(ii) Compute the project duration :

Activity	*Duration in weeks*	*Activity immediately*	
		Preceding	*Following*
A	03	–	E
B	04	–	D, F, G
C	14	–	H
D	03	B	H
E	05	A	–
F	06	B	–
G	04	B	I
H	01	C, D	I
I	01	G, H	–

10

(d) (i) PERT calculations indicate that duration of a given project is 72 weeks. With the variance of 15, work out number of weeks within which the project is expected to be completed with probability of 50%, 80% and 98%. Take Z-values of 0·89 and 2·1 for probability of 80% and 98% respectively. 5

(ii) For an activity of casting a raft foundation of a High rise building, three engineers A, B and C have given the time estimates as follows. State who is more certain about the time of completion of job. Also calculate expected time of completion of each engineer.

Engineer	Times in week		
	Optimistic	*Most likely*	*Pessimistic*
A	05	07	09
B	04	06	07
C	03	05	08

5
