Subjective Paper-I

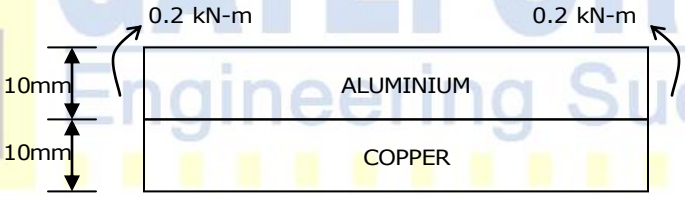
1. **a** List the principal constituents of fly ash. Explain its pozzolanic action when used in concrete. [10]

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 $1m^3$ of concrete. The specific gravities of cement, F.A and C.A are 3.15, 2.65 and 2.6 respectively. [10]

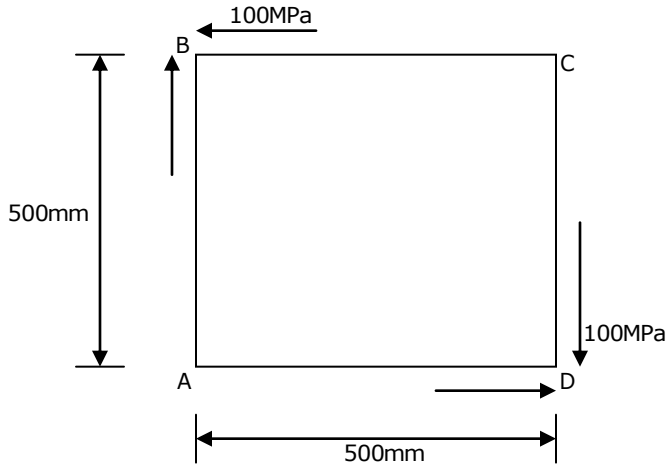
c. What are the varieties of industrial timber? Indicate the procedure followed for making fibre boards. [10]

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 40mm x 20mm. The strip is subjected to a pure bending moment of 0.2kN-m as shown in the figure. Calculate the radius of curvature of the strip and the maximum tensile and compressive stresses. $E_c = 1\times10^5 MPa$; $E_{al} = 0.6\times10^5 MPa$. [20]



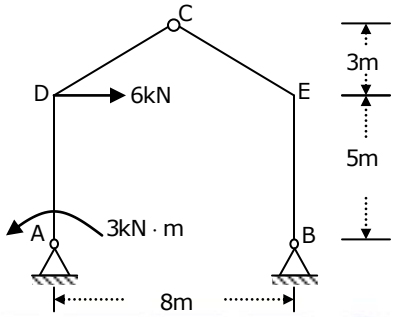
2. **b.** A square plate of side 500mm is subjected to pure shear of intensity 100Mpa as shown in the figure. Young's Modulus of the material is $2\times10^5 MPa$ and Poisson's ratio is 0.2. Find the principal stresses, their directions and the change in lengths of the diagonals of the plate. [10]



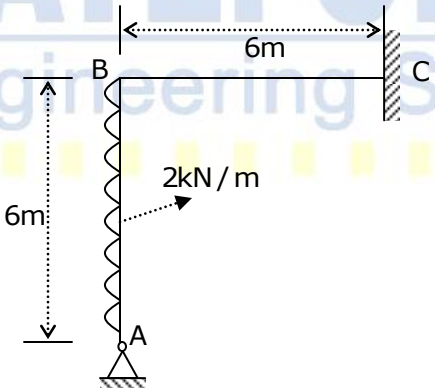
2. **c.** A thin walled tube of circular cross-section with outer diameter 100mm, thickness 2mm and length 1000mm is fixed at one end. It is subjected to a twisting moment of 1 kN-m at the free end. Find the shear stress in the wall of the tube and the angle of twist at the free end. E = 2×10^5 MPa and Poisson's ratio is 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 100mm x 100mm and wall thickness 2mm? [10]

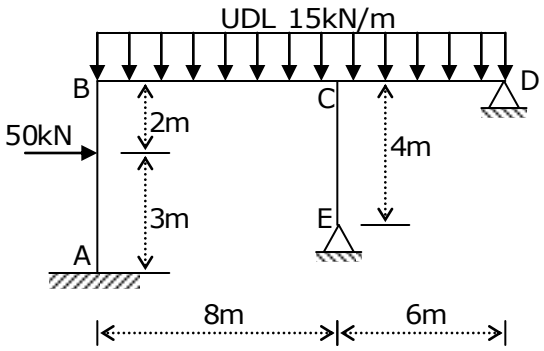
3. **a.** Find all the support reactions and draw BM diagram for the frame shown below. Frame has hinged supports at A and B and internal hinge at C. [15]



3. **b.** Analyse the frame shown below by compatibility method. EI is constant. Draw BM and SF diagrams.[25]



4. **a.** Analyse the rigid frame shown in the figure below by moment distribution method, taking flexural rigidity EI to be uniform for all members. [20]



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

The properties of ISMB 450 are as follows:

Weight / meter	:	72.4kg
Area of cross-section	:	9227 mm^2
Width of flange	:	150mm
Thickness of flange	:	17.4mm

$I_{xx} = 3.039\times10^8\ mm^4 ; I_{yy} = 8.34\times10^6\ mm^4$ [20]

5. **a** Rolled steel section ISWB 300 is used as a column of height 6m, 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: [15]

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

Area of Cross-section = 6133 mm^2

Flange width = 200mm

Flange thickness = 10mm

Web thickness = 7.4mm

$I_{xx} = 98.216\times10^6\ mm^4 ; I_{yy} = 9.9\times10^6\ mm^4$

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

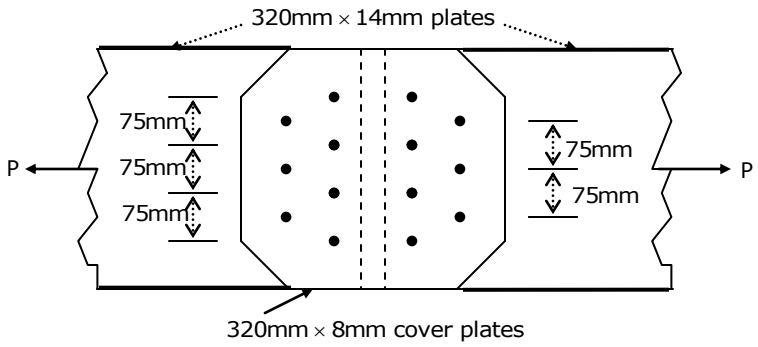
5. **b.** A double cover butt joint is provided with the following details: [25]

Size of plates to be spliced 320mm x 14mm

Size of cover plates 320mm x 8mm

Number of 20mm diameter rivets provided = 7 [as shown in figure]

Allowable stress in tension	125Mpa
Allowable stress in shear	80Mpa
Allowable stress in bearing	240Mpa



(i) Determine the strength of the connection.

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

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

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

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

Flange width = 2000mm

Fling thickness = 150mm

Overall depth = 750mm

Rib width = 300mm

The beam is provided with 6 No. of 32 mm diameter HSD bars of grade Fe500.

Concrete used is of grade M25:

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

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

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

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

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

iii. If the modulus of rupture of concrete is $6.5N/mm^2$, estimate the load factor against cracking.

Assume density of concrete = $24kN/m^3$ [20]

7. a i. Calculate the time required to grade and finish 30km of road formation of 9.0m width for two-lane road with motor-grader having width of 3.0m, 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]

7. b i. Calculate number of transit mixers (TM) required for transporting concrete form central batching plant to site. The cycle time data of $6\,m^3$ typical transit mixer is given below: [6]

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 $60m^3$/hr is to run continuously, work out the requirement of number of concrete pumps and TM. [6]

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

7. 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: [10]

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	--

7. 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. [5]

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