



SLIATE

SRI LANKA INSTITUTE OF ADVANCED TECHNOLOGICAL EDUCATION

(Established in the Ministry of Higher Education, vide in Act No. 29 of 1995)

Higher National Diploma in Engineering (Civil) SecondYear, SecondSemester Examination – 2016 CE 2212 – Structural Design

Instructions for Candidates:

Answer five (05) questions only
All the questions carry equal marks

No. of questions : 06
No. of pages : 04
Time : Three hours

Q1

- a. Briefly discuss the advantages of using timber as a structural material. (05 marks)
- b. A timber column in strength class D40 is 3.5m in height with a rectangular cross section of 75mm x 100mm. The column is restrained at both ends in position but not in direction and is subjected to service class 2 conditions. Determine the maximum axial long-term load that the column can support. (15 marks)
- (Total 20 marks)

Q2.

A two story hostel building (Fig 1) has a 100mm thick cast in situ one way spanning slabs for roof and floor. Floor to floor has clear height of 2.7m of in each stories. The dead load of the slab with finishes and services etc is 0.75kN/m^2 and imposed load on roof is 0.25kN/m^2 . Calculate the thickness of the typical internal brick wall (AB) at the ground floor level assuming that,

Effective height of the wall = $0.75 \times$ clear height of the wall

Capacity reduction factor, $\beta = 0.8$

The partial factor of safety for normal manufacturing control and normal construction control, $\gamma_m = 3.5$

Characteristic compressive strength of masonry, $f_k = 2.5\text{N/mm}^2$

Ignore lateral load effects

Design strength = $\beta b t f_k / \gamma_m$

(Total 20 marks)

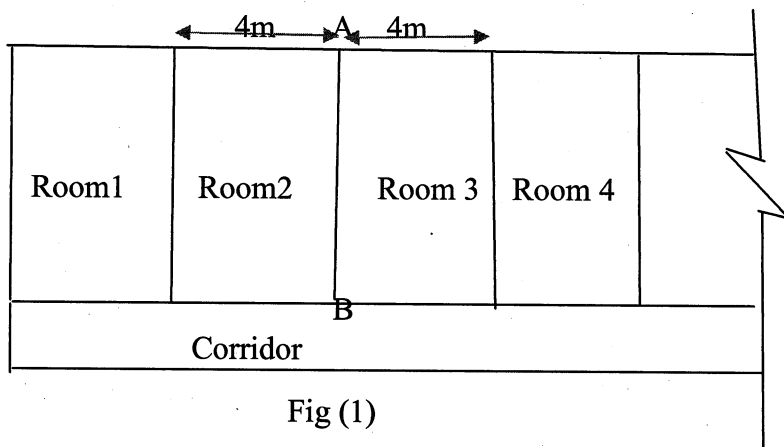


Fig (1)

Q3.

- What are the advantages and disadvantages of pre-stressing of concrete? (04 marks)
- List the various applications of pre-stressed concrete (04 marks)
- Two steel plates (170mmX8mm) with the grade of S275 is connected using 4 nos. of M16 and grade 8.8 bolts. Edge distances and end distances are 50mm. By considering lap length as 170mm show that the single shear bolted lap joint is suitable to resist an ultimate tensile load of 220kN. (12 marks)

(Total 20 marks)

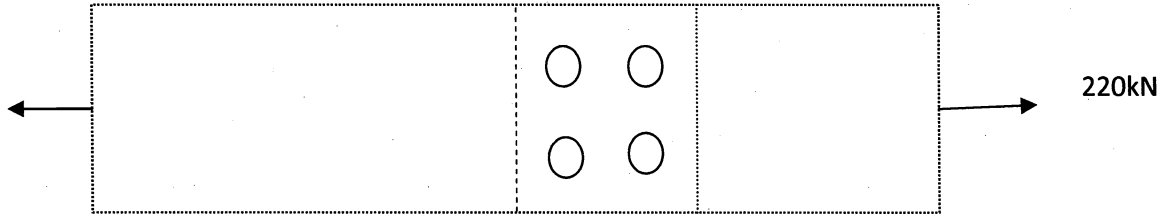


Fig 02

Q4.

There is proposal to construct domestic water tank to supply the water to the house. The height of the concentrated column from the top of the footing to bottom of water tank is 7m and size of the column is 350mmx350mm. Total concentrated dead and imposed loads are 600kN and 300kN respectively. Assume that the width of the square footing is 1.5m and thickness of the base is 500mm Using 20mm diameter tor steel, design the base of the column.

Consider

The density of concrete 23.6kN/m,

$$f_{cu}=30\text{N/mm}^2,$$

$$f_y= 460\text{N/mm}^2.$$

Bearing capacity of soil = 200kN/m².

Soil is Sever condition and maximum free water cement ratio is 0.55.

(Total 20 marks)

Q5.

Using the basic theory, analyze and design a singly reinforced rectangular beam section and

show when $x/d=0.5$, $M=0.156f_{cu}bd^2$ and $Z = d \left[0.5 + \sqrt{0.25 - \frac{k}{0.9}} \right]$.

Q6 Briefly explain the following.

- The procedure of checking the deflection of beam and slab.
- The procedure of checking the shear stress of beam and slab.
- The procedure of checking the crack control of beam and slab.

Shear strength of bolts

Bolt Grade	Shear strength , p_s (N/mm ²)
4.6	160
8.8	375
10.9	400

Bearing Strength of Bolts

Bolt Grade	Bearing Strength
4.6	460
8.8	1000
10.9	1300

Bearing Strength of Connected plates

Steel Grade	S275	S355	S460
Bearing Strength(N/mm ²)	460	550	670

Bearing Capacity of bolt, $P_{bb} = d_t p_{bb}$

Bearing capacity of connected plates, $P_{bs} = k_{bs} d_t p_{bs}$ but $P_{bs} \leq 0.5 k_{bs} e t_p p_{bs}$

$k_{bs} = 1$ for Standard clearance holes

e = End distance

d = Nominal diameter of bolt

t_p = Thickness of the connected plates

Area's of Reinforcement

Cross-sectional areas of groups of bars (mm²)

Bar Size	Number of Bars * Denotes non-preferred sizes									
	1	2	3	4	5	6	7	8	9	10
6mm	28.3	56.5	84.8	113	141	170	198	226	255	283
8mm	50.3	100	151	201	251	302	352	402	452	503
10mm	78.5	157	236	314	339	471	550	628	707	785
12mm	113.1	226	339	452	566	679	792	905	1718	1131
16mm	201.1	402	603	804	1005	1206	1407	1608	1810	2011
20mm	314.2	628	942	1257	1571	1885	2199	2513	2827	3142
25mm	490.9	982	1473	1963	2454	2945	3436	3927	4418	4909
32mm	804.2	1608	2413	3217	4021	4825	5630	6434	7238	8042
40mm	1257.0	2513	3770	5026	6283	7540	8790	10053	11310	12566
50mm*	1963.5	3927	5890	7854	9812	11781	13744	15708	17671	19635

Cross-sectional areas for Specific Spacings in mm² / Metre Width

Bar Size	Spacing of Bars (Millimetres) * Denotes non-preferred sizes									
	75	100	125	150	175	200	225	250	275	300
6mm *	377	283	226	188	162	141	125	113	103	94
8mm	670	503	402	335	287	251	223	201	183	168
10mm	1047	786	628	524	449	393	348	314	285	262
12mm	1508	1131	905	754	646	565	503	452	411	377
16mm	2681	2011	1608	1340	1149	1005	894	801	731	670
20mm	4189	3142	2513	2094	1795	1571	1396	1257	1143	1047
25mm	6545	4909	3927	3272	2805	2454	2182	1963	1785	1636
32mm	-	8042	6434	5362	4596	4021	3574	3217	2924	2681
40mm	-	-	10053	8378	7181	6283	5587	5027	4571	4189
50mm*	-	-	-	13090	11220	9617	8727	7854	7140	6545