



**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)**

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR**

FOURTH YEAR SEMESTER ONE EXAMINATIONS

**FOR THE DEGREE
OF
BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL
ENGINEERING**

COURSE CODE: CSE 411

COURSE TITLE: STRUCTURAL STEEL DESIGN

DATE: MONDAY 25TH APRIL 2022 TIME: 3.00 – 5.00 PM

INSTRUCTIONS:

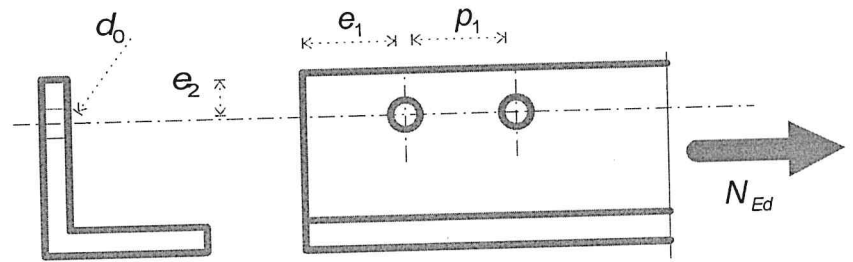
1. This paper contains FIVE questions
 2. Attempt any THREE questions
 3. Assume all steel sections to be Hot Rolled steel sections
 4. BS EN 1993 and BS EN 1992 and steel tables are permitted in this exam
 5. Useful formulas and tables have been provided.
- Examination duration is **2 Hour**

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 5 Printed Pages. Please Turn Over.

Question One**(20 marks)**

FIG. Q1



Given the single angle $60 \times 60 \times 6\text{mm}$ steel grade S275 with a two M16 bolts in Fig.Q1 where $p_1 = 45\text{mm}$, $e_1 = 50\text{mm}$, $e_2 = 30\text{mm}$, $d = 16\text{mm}$, Applied force $N_{Ed} = 75\text{ kN}$. Check for the adequacy for the following

- (a) The bolt spacing requirements (minimum, max, spacings, edge, end distances) (6 mks)
- (b) The adequacy of the tension capacity of the member (12 mks)

Question Two**(20 marks)**

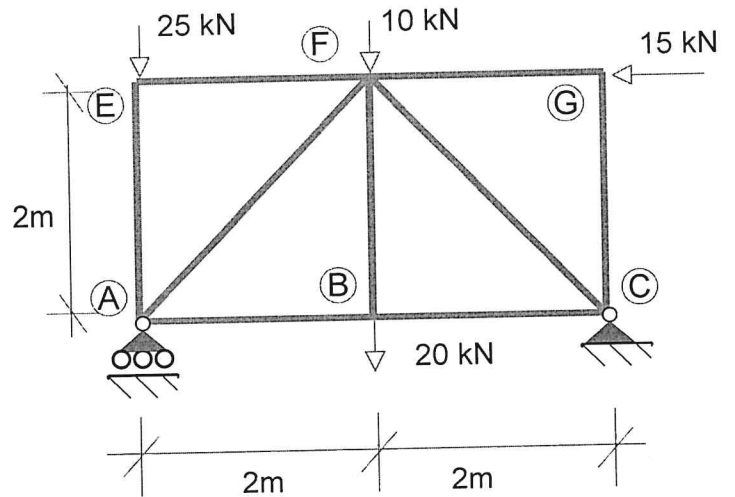
Given a 3m tall column of section Universal column 203x203 UC 46 in steel grade S275. The column is supporting an axial load $N_{Ed} = 500\text{ kN}$. The column is pinned at the top and Pinned at the bottom. Take the root radius of the section as 10.2mm. Design and check the adequacy of the column for the following;

- (a) Classify the section accordingly (6mks)
- (b) Determine the plastic resistance ($N_{pl,Rd}$) and show $\frac{N_{Ed}}{N_{pl,Rd}} \leq 1.0$ (6 mks)
- (c) Determine the buckling resistance ($N_{b,Rd}$) and show $\frac{N_{Ed}}{N_{b,Rd}} \leq 1.0$ (8 mks)

Question Three

(20 marks)

FIG. Q3



Given the truss structure in Fig.Q3 determine the following.

- a) The reactions at the supports (3 marks)
- b) The forces in the members and show if the forces are Tensile or Compressive (10 marks)

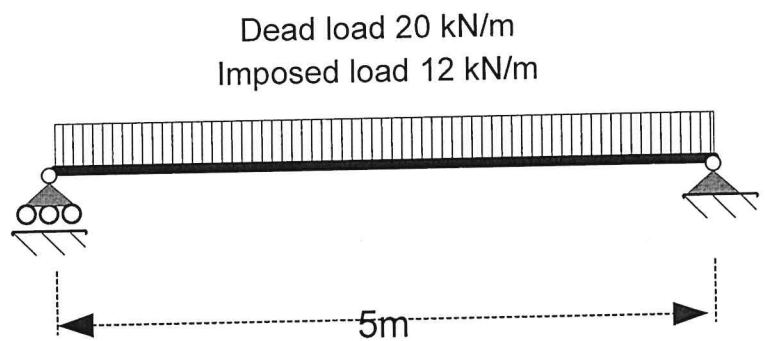
	1	2	3	4	5
MEMBER	F-G	F-C	B-C	F-B	C-G
FORCE (kN)					
Tensile/Compressive					

- c) Determine the adequacy of a CHS 88.9 x 4.05mm thick grade S275 section as member F-B (7 marks)

Question Four

(20 marks)

Fig. Q4



Given the simply supported 5m long beam (Universal beam 497x191 UB 67) in Fig. Q4 in grade S355 steel determine the following

- (a) Calculate and draw the shear force diagram and bending moment diagram (2 mks)
- (b) Classify the section accordingly (3 mks)
- (c) Check the adequacy of Moment capacity of the section (5 mks)
- (d) Check the adequacy of shear capacity of the section (5 mks)
- (e) Check the shear buckling of the section (2 mks)
- (f) Check the deflection of the member (3 marks)

Question Five (20 marks)

Given the following column base resisting a column ultimate load $N_{ED}=1400\text{kN}$ and a horizontal force $V_{ED}=100\text{kN}$. The base is cast from class $f_{ck}=30\text{ N/mm}^2$ concrete. Take the design bearing strength of the concrete base as $f_{jd} = 17 \frac{\text{N}}{\text{mm}^2}$

Fig. Q5.a

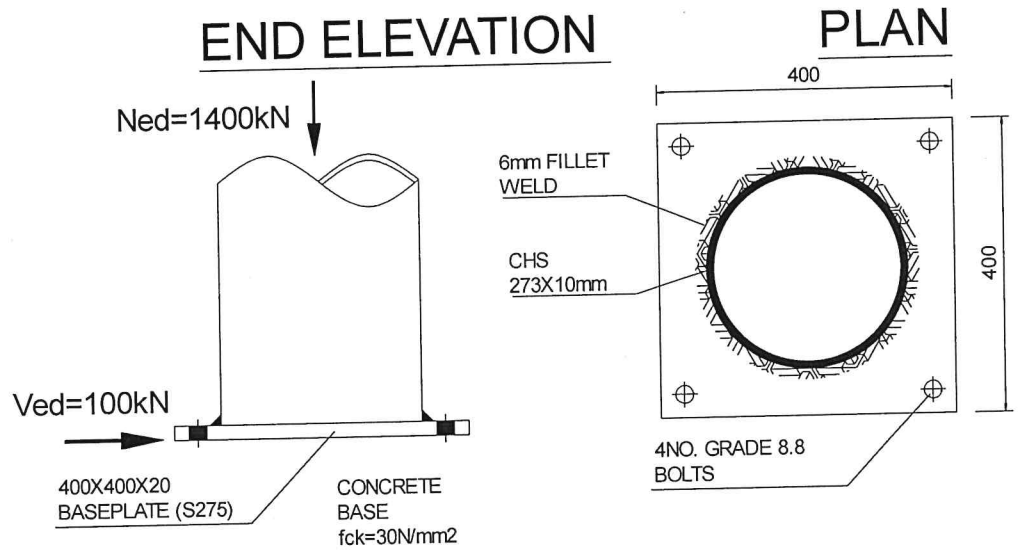


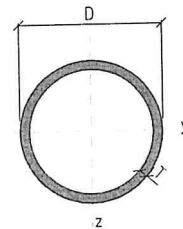
Fig.Q5.b

Section CHS 273x10 properties

$D = 273\text{ mm}$

$T = 10\text{ mm}$

$A = 8260\text{ mm}^2$



Check for the following:

- a) the required area for the baseplate (5 mks)
- b) the effective area of the base plate (6 mks)
- c) the adequacy of the plate thickness (4 mks)
- d) the adequacy of the welds (5 mks)

---end---

MEMORY AIDE/ REFERENCE

i) Calculation of deflections for simple supported beams

Deflection due to point load (P kN) at midspan of beam L m long

$$\delta = \frac{PL^3}{48EI}$$

Deflection due to a uniformly distributed load (ω kN/m) of a simply supported beam L meters long

$$\delta = \frac{5\omega L^4}{384EI}$$

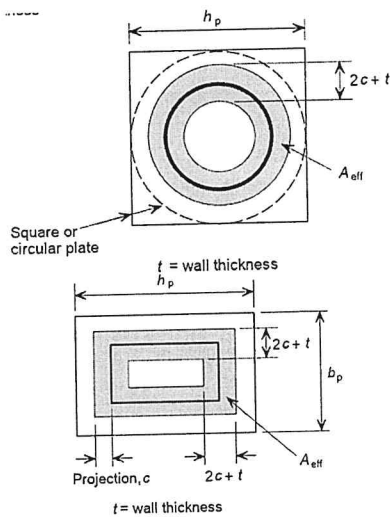
ii) Bolt Areas

Diameter of bolt=d (mm)	12	16	20	24	30
Area=A_s (mm²)	84.3	157	245	353	561

iii) vii) Loading

BS EN 1990-A1.3.2(4) $UDL_{Ultimate} = 1.35 \times G_k + 1.5 \times Q_k$

vi) Steel column baseplates



For CHS column: Effective area
 $A_{eff} = \pi(d - t)(t + 2c)$

Overlap
 $c \geq \frac{d - 2t}{2}$

For SHS, RHS column:
 Effective area
 $A_{eff} = P_{col}(t + 2c)$

Overlap
 $c \geq \frac{h - 2t_f}{2}$

v) Angle connected with one leg

With 2 bolts

$$N_{u,Rd} = \frac{\beta_2 A_{net} f_u}{\gamma_{M2}}$$

EC3-1-8
 3.10.3

With 3 or more bolts

$$N_{u,Rd} = \frac{\beta_3 A_{net} f_u}{\gamma_{M2}}$$

Pitch	p_1	$\leq 2.5 d_o$	$\geq 5.0 d_o$
2 bolts	β_2	0.4	0.7
3 bolts or more	β_3	0.5	0.7

vi) Concrete compressive strength

Concrete class	C25/30	C30/37	C35/40	C40/50
f_{ck} (N/mm ²)	30	37	40	50
f_{cd} (N/mm ²) Design compressive strength	14.2	16.8	17	22.7