higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T190**(E)**(N11)T
NOVEMBER 2010

NATIONAL CERTIFICATE

BUILDING AND STRUCTURAL CONSTRUCTION N5

(8060015)

11 November (X-Paper)
09:00 – 13:00

REQUIREMENTS: **A2 drawing paper**
Standard hot-rolled structural steel section tables (BOE 8/2)

This question paper consists of 7 pages and a 1-page formula sheet.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
BUILDING AND STRUCTURAL CONSTRUCTION N5
TIME: 4 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Drawings must be done according to the latest building regulations.
5. Drawings must be fully dimensioned and labelled.
6. Use BOTH SIDES of the DRAWING PAPER.
7. Write neatly and legibly.

QUESTION 1

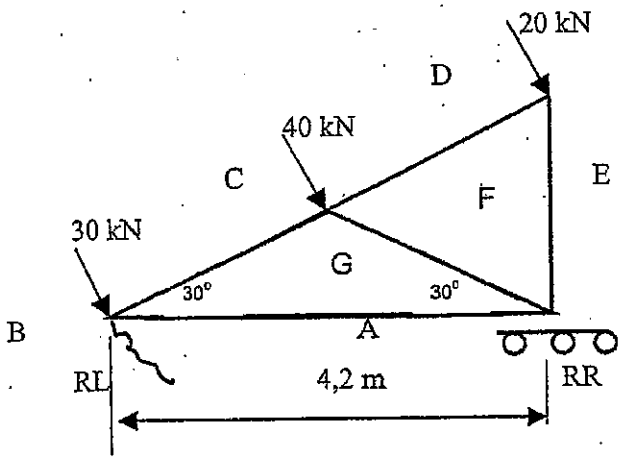


FIGURE 1

FIGURE 1 shows a loaded roof truss. The roof truss is supported on rollers at RR and by means of a hinge RL.

1.1 Determine the magnitude and directions of the reactions, if the roof is loaded, as shown. (8)

1.2 Determine the size of the forces in each member. Distinguish between tension and compression forces in the members.

Tabulate the results. (6)
[14]

QUESTION 2

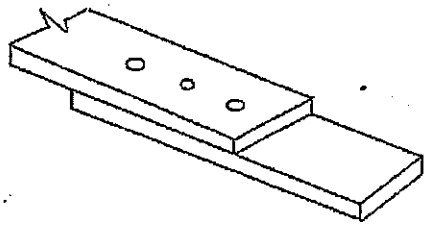


FIGURE 2

FIGURE 2 shows TWO tie bars connected by means of three M10, Grade 4.6 bolts.

Calculate the following:

2.1 The shear stress of the bolts (4)

2.2 The compression stress of the bolts (4)

2.3 The tearing stress of the tie-bars (4)

2.4 In which way will the joint fail first?

Use the following specifications:

Tie-bars	10 x 50 mm
Holes in the tie-bars	ø 12 mm
Tensile force	180 kN

(1)
[13]

QUESTION 3

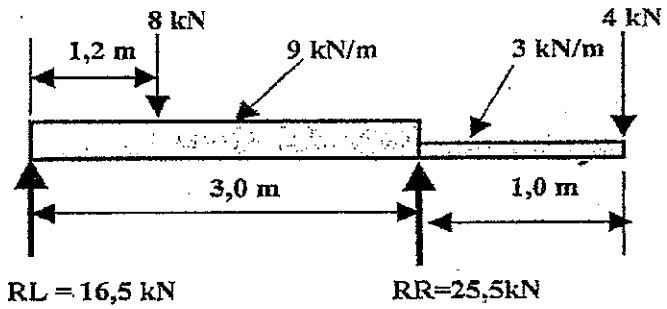


FIGURE 3

FIGURE 3 shows a simply supported loaded beam, with RL = 16,5 kN and RR = 25,5 kN.

3.1 Make the necessary calculations and draw to suitable scales a shear force and bending moment diagrams. (8)

3.2 Select from the tables the smallest suitable I-section steel beam with tapered flanges for the loaded beam.

Investigate with regard to bending ONLY. The maximum bending stress of grade 43 steel is 155 MPa. (5)
[13]

QUESTION 4

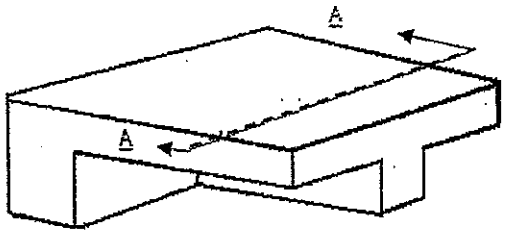


FIGURE 4

FIGURE 4 shows an isometrical drawing of a reinforced concrete structure. Draw to scale 1:10 the vertical section at A-A to clearly show ALL the construction details.

Use the following:

T- BEAM

Size	: 600 mm × 300 mm
Reinforcing	: 3 × Ø 20 mm tensile bars 2 × Ø 12 mm compression bars Ø 6 mm stirrups at 300 mm centres

FLOOR SLAB

Depth	: 200 mm
Reinforcing	: Ø 12 mm main bars at 200 mm centres Ø 6 mm secondary bars at 250 mm centres
AFWERKING	: The floor is covered with clay tiles The soffits of the floor and the beam, as well as, the sides of the beam, are plastered. **[15]**

QUESTION 5

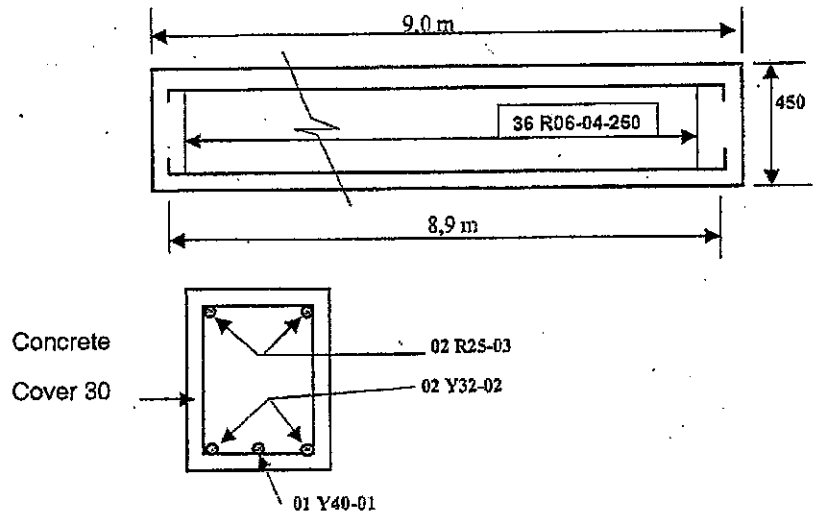


FIGURE 5

FIGURE 5 shows a reinforced concrete beam. Draw up a bending schedule for FOUR similar reinforced concrete beams. **[16]**

QUESTION 6

A steel staircase is equipped with steel and glass balustrades. The balustrades are formed with steel uprights to which glass panels are fixed. Draw to any suitable scale, a partial front view of, and a horizontal section through the balustrade to show how the glass is fixed to the steel uprights. Clearly show ALL the construction details. **[9]**

QUESTION 7

A 1 500 mm × 750 mm reinforced concrete pile cap rests on two 250 mm diameter reinforced concrete piles. The centre of the piles is set back 250 mm from the sides and spaced one metre apart. The pile cap supports a 300 mm × 300 mm reinforced concrete column, which is positioned at the centre.

Draw to scale 1:10, a vertical section through the two piles, the pile cap and the column to show the reinforcement and construction details. Show at least 400 mm of the column and the piles.

Use the following specifications:

COLUMN

Main reinforcing	: 8 × ø 16 mm bars
Binders	: ø 6 mm at 150 mm centres

PILE CAP

Size	: 1 500 mm × 750 mm × 500 mm deep
Tension reinforcement	: ø 20 mm bars at 200 mm centres in both directions

PILES

Main reinforcing	: 8 × ø 25 mm bars
Helical binders	: ø 6 mm at 150 mm centres

[20]

TOTAL: 100

BUILDING AND STRUCTURAL CONSTRUCTION N5

FORMULA SHEET

Any applicable formula may also be used.

$$BM = \frac{wl}{4}$$

$$BM = \frac{wl^2}{8}$$

$$n = 5d$$
$$n = 5.5d$$

$$h = 9d$$
$$h = 11d$$

$$F = f.a$$

$$F = f_s \frac{\pi D^2 n}{4}$$

$$F = f_t\ (W - nd)$$

$$F = f_c D.t.n$$

$$F = \frac{\pi(\phi - 0.9382\rho)^2 n}{4}$$

$$I = \left[\frac{BD^3}{12}\right] + \left[2\ area\ .\ y^2\right]$$

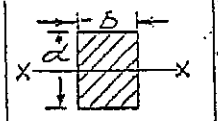
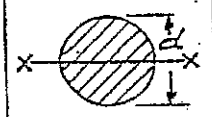
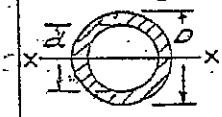
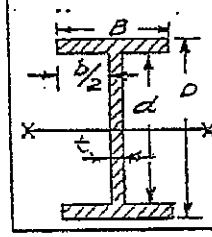
$$\frac{M_r}{I} = \frac{f}{y} = \frac{E}{R}$$

$$M = fZ.$$

$$Z = \frac{I_{NA}}{y}$$

$$M = f\frac{I}{y}$$

$$M = \frac{fbd^2}{6}$$

	$I_{xx} = \frac{bd^3}{12}$	$Z_{xx} = \frac{bd^2}{6}$
	$I_{xx} = \frac{\pi d^4}{64}$	$Z_{xx} = \frac{\pi d^3}{32}$
	$I_{xx} = \frac{\pi}{64}(D^4 - d^4)$	$Z_{xx} = \frac{\pi/64\left[D^4 - d^4\right]}{D/2}$
	$I_{xx} = \frac{BD^3}{12} - \frac{bd^3}{12}$ $b = B - t$	$Z_{xx} = \frac{\frac{BD^3}{12} - \frac{bd^3}{12}}{D/2}$