higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

BUILDING AND STRUCTURAL CONSTRUCTION N5

(8060015)

17 April 2020 (X-paper)
09:00–13:00

REQUIREMENTS: **Answer book (BOE 8/13)**
A2 drawing sheet
Hot-rolled steel sections (BOE 8/2)

Nonprogrammable calculators may be used.

This question paper consists of 6 pages, 1 diagram sheet and 1 formula sheet.

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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 according to the numbering system used in this question paper.
4. Answer QUESTIONS 1, 2, 3, 4 and 7 on the supplied DRAWING SHEET. Answer QUESTIONS 5 and 6 in the ANSWER BOOK.
5. Make all drawings in pencil with bold outlines.
6. Make all drawings in accordance with National Standards and fully label it with descriptive notes and dimensions where applicable.
7. All calculations must conform to the relevant SABS/SANS Codes of Practice.
8. Work neatly.

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QUESTION 1

A 152 × 152 × 23,4 kg/m H-profile parallel flange universal column is welded in the centre of a 300 × 300 × 25 mm thick base plate and further stabilised by TWO 300 × 150 × 6 mm flange (gusset) plates.

The base plate has FOUR Ø26 mm holes drilled 35 mm from the edges of the plate where M20 holding-down bolts are used to secure the steel column structure to a 400 × 400 mm isolated concrete pad foundation.

Draw, to scale 1:5, an isometric view of the structure to show the following:

Isometric view:	Draw the flanges and flange plates on the left-hand side of the drawing.
Pad foundation:	Show only part of the concrete depth.
Holding down bolts (L-shaped):	Show TWO complete bolts, nuts and washers on the left-hand side of the drawing.
Welding symbols:	6 mm fillet weld between the flange plate and column. 6 mm fillet weld between the flange plate and base plate. 8 mm fillet weld between the column and base plate.

Show at least 400 mm of column length and supply the drawing with all necessary labels and welding symbols. **[18]**

QUESTION 2

2.1 A 150 mm thick reinforced concrete slab is cast 110 mm into a one-brick wide supporting wall. A 270 mm cavity wall is built on top of the slab in line with the external brick wall. The brick wall below the slab has THREE courses brick force while the cavity wall is held together with tie wires.

The slab is reinforced with Y12 main bars at 250 mm centres and R8 secondary steel at 200 centres. The underside of the slab and the internal walls are plastered to a thickness of 19 mm. The top of the slab is finished off with 25 mm screed and 150 × 150 × 15 mm clay tiles.

Draw, to scale 1:10, a vertical section through both the walls and floor. Clearly show the correct position of the reinforcement, damp-proof course, brick force and tie wire on the drawing. Insert all the labelling, dimensions and hatching key symbols. (12)

2.2 Draw an isometric view of a square column supported on a pile cap and TWO piles. The drawing must be drawn within a 1 000 mm × 1 000 mm square frame. (3)

[15]

QUESTION 3

Draw, to scale 1:10, an isometric view to explain the method of constructing a timber floor on a concrete floor slab. The flooring will be nailed to timber fillets which is fixed to the concrete floor. A weak cement fill screed will be laid in between the fillets to allow for stability to the strip flooring. Fully label the completed drawing.

Specifications:

Concrete floor: 1 300 × 600 × 100 mm thick

Timber fillets: 30 × 50 mm spaced at 450 mm apart

Flooring: 100 × 22 mm tongue-and-groove strip flooring

Half-brick wall: On the 600 mm side of the floor and FOUR courses high plastered internally

Timber skirting: 75 × 22 mm nailed against the half-brick wall **[12]**

QUESTION 4

Draw, to scale 1:5, the top and sectional front view of a 400 mm diameter circular reinforced concrete column. The column is reinforced with evenly spaced 8Y20 longitudinal bars with a R8 helical binder at 150 mm pitch. The cover of the steel reinforcement is 30 mm. Show at least 500 mm of the sectional front view. Fully label and dimension the completed drawing.

HINT: Draw the top view first. **[12]**

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QUESTION 5

FIGURE 1 shows a butt joint formed by TWO tie bars that must be connected by means of a cover strap and SIX grade 4, 6 bolts.

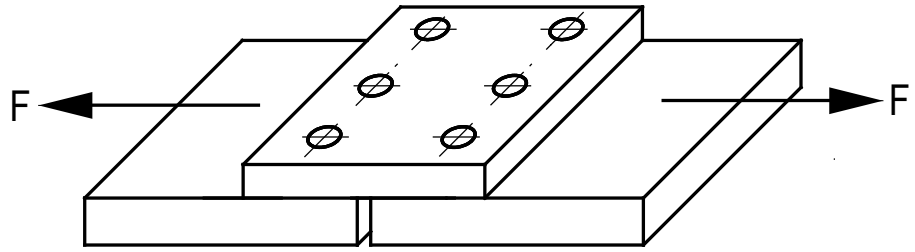

FIGURE 1

Calculate the following by the using the information supplied at each subsection:

5.1 The diameter of the bolts

- Load of 96 kN
- Bearing stress of 315 MPa (4)

5.2 The bearing stress that the tie bars must be able to resist

- Tie bars and connector plate 148 mm × 8 mm
- Tie bars must be able to withstand a force of 210 kN
- M12 bolts in 14 mm holes (4)

5.3 The maximum load that the bolts can withstand

- Tie bars 144 mm × 8 mm
- Connector plate 6 mm thick
- Tearing stress of 160 MPa
- M16 bolt (4)

[12]

QUESTION 6

FIGURE 2 on the DIAGRAM SHEET (attached) shows a U-shaped figure supporting a triangle.

Calculate the following:

6.1 The distance of the neutral axis about A–B (5)

6.2 The second moment of area for the given figure (7)

6.3 The profile modulus about the x-x axis (2)

6.4 Select a suitable I-taper flange beam to replace the given figure (1)

[15]

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QUESTION 7

FIGURE 3 on the DIAGRAM SHEET (attached) shows the front view of a steel frame supporting TWO wind loads and THREE point loads.

Use the graphical method to obtain the magnitude and direction of the forces in each of the members to distinguish between *tension* and *compression forces*.

Use the following scales: Space diagram: 140 mm = 3 m
Vector diagram: 1 mm = 1kN **[16]**

TOTAL: 100

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DIAGRAM SHEET

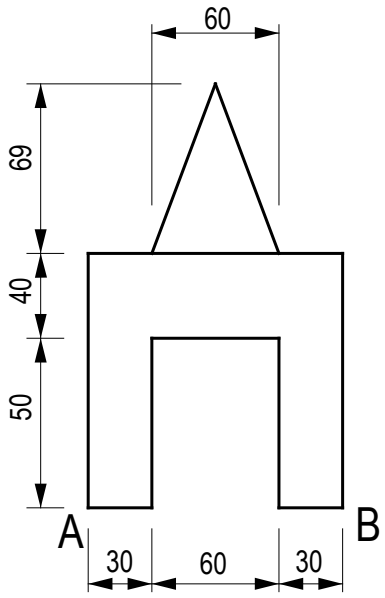

FIGURE 2

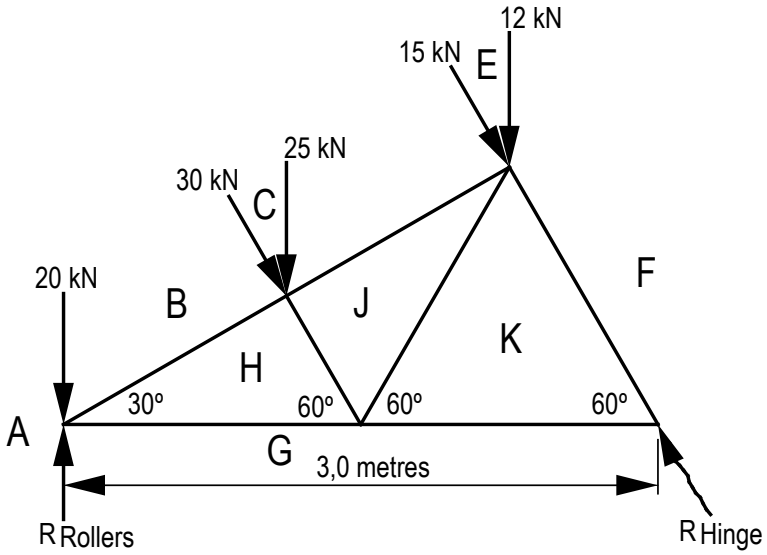

FIGURE 3

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FORMULA SHEET

Any other applicable formula is also accepted.

$A = ½bh$

$HC = F \times \cos\theta$

$A = \frac{\pi d^2}{4}$

$R = \sqrt{VC^2 + HC^2}$

$\sum CWM = \sum ACWM$

$VC = F \times \sin\theta$

$\sum \uparrow F = \sum \downarrow F$

$D = \frac{\text{Mass}}{\text{Volume}}$

$\text{Moment} = \text{Force} \times \text{distance}$

$W = \text{mass} \times ga$

$BM = \text{reaction moment} - \text{load moment}$

$\text{Stress} = \frac{\text{Load}}{\text{Area}}$

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

$Z = \frac{m}{f}$

$Z = \frac{I}{y}$

$X = \frac{\sum Ax}{\sum A}$

$I_{xx} = \frac{bd^3}{12}$

$I_{yy} = \frac{db^3}{12}$

$I_{xx} = \frac{bd^3}{36}$

$I_{xx} = \frac{\pi D^4}{64}$

$I_{xx} = \frac{bd^3}{12} + al^2$

$I_{xx} = \frac{BD^3}{12} - \frac{bd^3}{12}$

$F_s = A_s \times f_s \times n$

$F_t = A_t \times f_t \times n$

$F_c = A_c \times f_c \times n$

$A_s = \frac{\pi d^2}{4}$ $\qquad$ $A_s = \frac{\pi(\emptyset - 0{,}9382\ p)^2}{4}$

$A_t = [(B \times T) - n\ (d \times t)]$

$A_c = (d \times t)$

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