higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T140**(E)**(A7)T

NATIONAL CERTIFICATE

BUILDING AND STRUCTURAL CONSTRUCTION N5

(8060015)

7 August 2018 (X-Paper)
09:00–13:00

OPEN-BOOK EXAMINATION

REQUIREMENTS: **A2 drawing sheet**
Answer book (8/13)
BOE8/6 hot-rolled structural steel sections (red book)

This question paper consists of 5 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. QUESTIONS 2, 3 and 5 must be done on the DRAWING SHEET. QUESTIONS 1, 4 and 6 must be answered in the ANSWER BOOK.
5. ALL drawings must be done in pencil with bold outlines.
6. ALL drawings must be done in accordance with National Standards and be fully labelled with descriptive notes and dimensions (where applicable).
7. ALL calculations must conform to the relevant SABS/SANS Codes of Practice.
8. Write neatly and legibly.

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QUESTION 1

FIGURE 1 shows a built-up work steel beam to be used as a hanger for a set of overhead lights.

Calculate:

1.1 The distance of the neutral axis about the x-x axis (5)

1.2 The second moment of area for the given figure (9)

1.3 The profile modulus about the x-x axis (3)

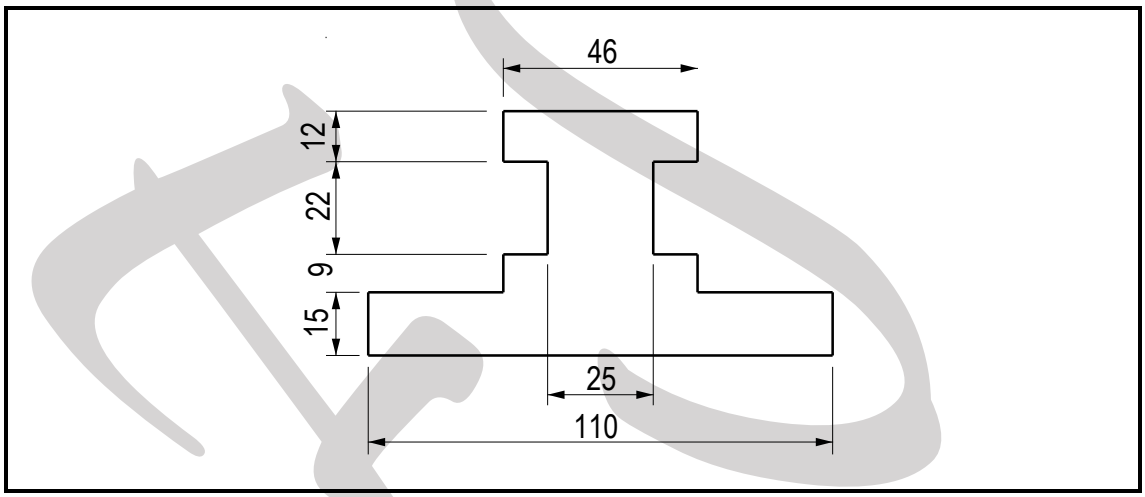

FIGURE 1 **[17]**

QUESTION 2

A 450 mm × 400 mm × 20 mm thick steel plate supports a 200 × 150 mm rectangular hollow steel column. The wall thickness of the steel column is 6 mm. TWO 400 × 200 × 8 mm thick gusset plates are welded to the 200 mm sides of the column to add support to the connection. The connection is further strengthened by TWO 75 × 50 × 8 mm rolled steel angle cleats welded to the gusset plate and base plate. ALL welding is done with 8 mm fillet welds.

The base plate has FOUR ϕ26 mm holes drilled 50 mm from the edges of the plate where M20 holding-down hook bolts will be used to secure the base plate and steel column.

Draw, to scale 1 : 5, an isometric view of the steel column to show the base plate, gussets and angle cleats. The drawing must also include the 200 mm-long holding-down hook bolts and nuts with washers in place.

Show at least 400 mm of the column length and supply the drawing with ALL necessary labels and welding symbols. Do NOT show the concrete base. **[18]**

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QUESTION 3

A straight-flight staircase must be erected up to an emergency exit door of a recreational hall. The stair ends at an open landing 1 100 mm from the door.

Draw, to scale 1 : 10, a vertical longitudinal sectional view of the top FOUR steps of the reinforced concrete staircase and landing to show the positioning of the reinforcement. The landing will be supported in the middle by a round reinforced concrete column.

Use the following specifications:

Steps:	215 mm treads and 165 mm risers
Waist:	150 mm thick
Landing:	900 mm × 150 mm thick
Column:	Φ200 mm

Reinforcement

Column:	6Y12 equally spaced main bars
Binder:	R8 helical binder at 150 mm pitch
Waist and landing:	Y10 tension reinforcement at 150 centres and R8 distribution steel at 175 centres
Finishes:	15 mm cement screed to the treads and risers

The completed drawing must include ALL labels, dimensions, key symbols and correct positioning of the reinforcement. **[20]**

QUESTION 4

FIGURE 2 on the DIAGRAM SHEET (attached) shows a half-lap joint made up from TWO built-up tie bars. The tie bars are connected by THREE rows of M10 bolts.

Calculate:

4.1 The force of the bolts if the thread of the bolts is within the shearing plane (the pitch of the thread is 1,75 mm) (4)

4.2 The force of the bolts if the thread of the bolts is outside the shearing plane (4)

4.3 The tearing force of the tie bar (4)

Shear stress: 100 MPa
Tearing stress: 155 MPa **[12]**

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QUESTION 5

Make neat drawings of each of the following types of reinforced concrete foundations:

5.1 A pad foundation with a stub column showing the position of the steel reinforcement (5)

5.2 A cantilever foundation to be constructed between TWO existing buildings showing the positions of the existing boundary walls (5)

[10]

QUESTION 6

FIGURE 3 on the DIAGRAM SHEET (attached), shows a steel beam loaded with THREE point loads and a uniformly distributed load at the left overhang. Use a bending stress of 165 MPa.

6.1 Calculate the reaction at RL and RR. (4)

6.2 Calculate and draw the shear-force diagram. Insert ALL values on the diagram. (6)

6.3 Calculate and draw the bending-moment diagram. Insert the value of the bending moment maximum on the diagram. (7)

6.4 Calculate the section modulus for the loaded beam. (2)

6.5 Select from the tables a suitable I-section parallel flange for the loaded beam. (1)

6.6 Calculate the maximum shear stress of the chosen beam. (3)

Use the following scales:

Load diagram: 150 mm = 9,5 m
Shear force: 1 mm = 1 kN
Bending moment: 1 mm = 1 kN.m **[23]**

TOTAL: 100

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DIAGRAM SHEET

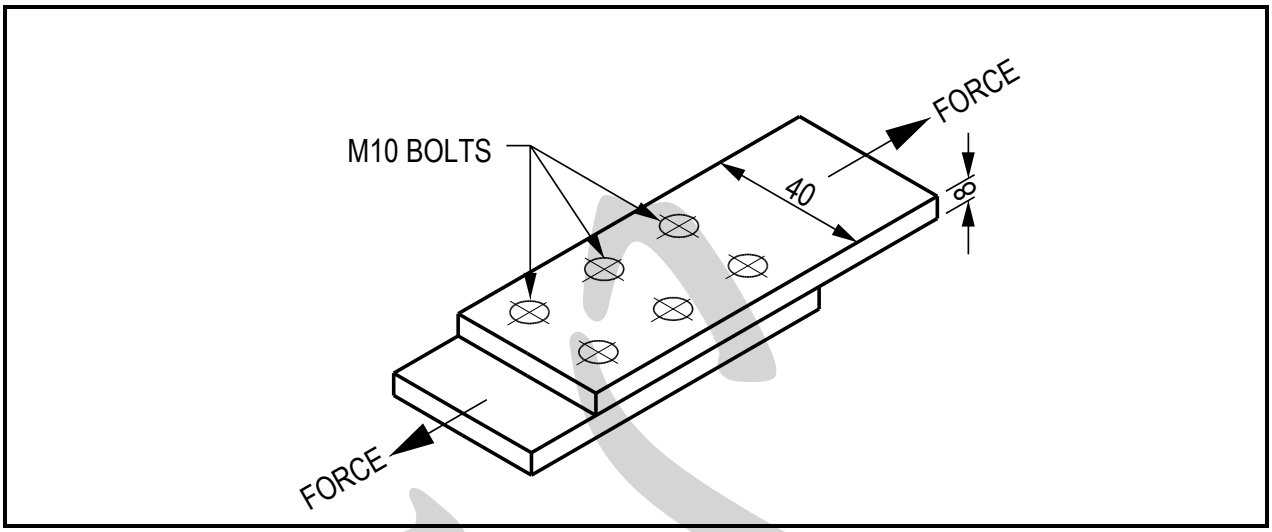

FIGURE 2

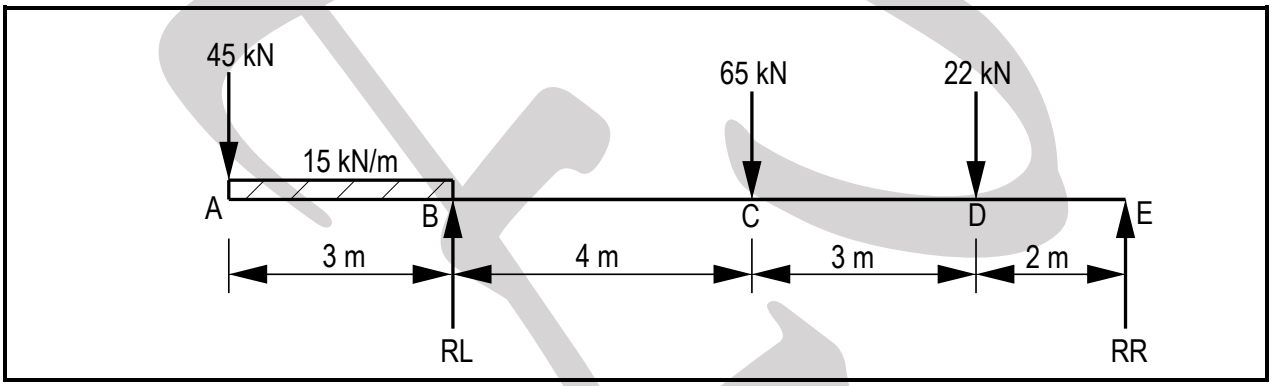

FIGURE 3

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FORMULA SHEET

Any other applicable formula is also accepted.

$A = \frac{1}{2} bh$

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

$\sum CWM = \sum ACWM$

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

Moment = Force × distance

BM = Reaction moment – load moment

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

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

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

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

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

$Fs = As \times fs \times n$

$F_t = A_t \times f_t \times n$

$F_c = A_c \times f_c \times n$

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

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

$A_c = (d \times t)$

$HC = F \times \cos \theta$

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

$VC = F \times \sin \theta$

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

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

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

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

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

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

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

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

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

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