higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

BUILDING AND STRUCTURAL CONSTRUCTION N5

(8060015)

03 August 2021 (X-paper)
09:00–13:00

CLOSED BOOK EXAMINATION

REQUIREMENTS: **ONE A2 and ONE A3 drawing sheet**
Hot-rolled steel sections (BOE 8/2)
Answer book (8/13)

Drawing instruments and nonprogrammable calculators may be used.

This question paper consists of 7 pages 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. Answer QUESTION 4 on the A3 drawing paper. Answer QUESTIONS 5 and 6 on the A2 drawing paper. Answer all the other questions in the ANSWER BOOK.
4. Number the answers according to the numbering system used in the question paper.
5. Do all drawings in pencil with bold outlines.
6. Do all drawings in accordance with the National Standards.
7. All drawings must be fully labelled with descriptive notes and dimensions where applicable.
8. All calculations must conform to the relevant SABS/SANS Code of Practices.
9. Write neatly and legibly.

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QUESTION 1

FIGURE 1 below shows two tie bars connected by means of two connector plates. The joint is held together by means of six bolts.

Calculate the following:

1.1 The diameter of the bolts

SPECIFICATIONS:

- Shear stress of 104 MPa with a 96 kN load (4)

1.2 The maximum load that the bolts can safely withstand if M16 bolts are used to connect the plates

SPECIFICATIONS:

- Bearing stress of 248 MPa
- 125 × 8 mm tie bars
- 6 mm thick connector plates (3)

1.3 The tearing stress if M12 bolts are used

SPECIFICATIONS:

130 × 8 mm thick tie bars
295 kN applied force (3)

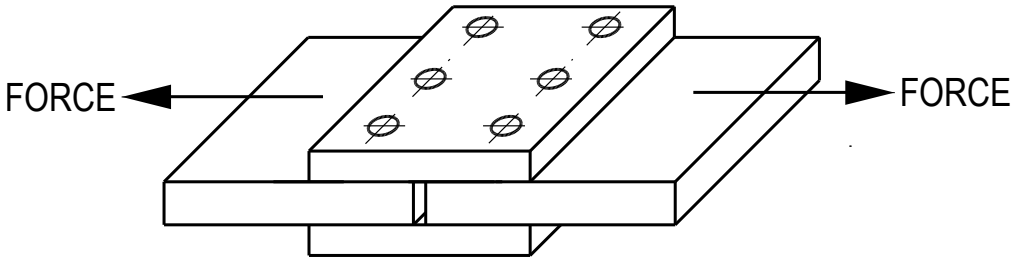

FIGURE 1

[10]

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QUESTION 2

An edge beam is 450 mm deep and 270 mm wide. It is supported by a 270 × 270 mm reinforced concrete column. A 270 mm cavity brick wall is built on the edge of the edge beam.

Draw to scale 1:10 a vertical section of the edge beam to show the method of construction.

Use the following specifications:

Reinforced concrete column:	270 × 270 mm Reinforced with 4Y12 main bars and R8 binders at 150 centres
Edge beam:	270 × 450 mm Reinforced with 3Y16 tension bars, 2Y10 compression bars and R6 binders. Show the position of the cranked bar.
Cavity brick wall:	5 courses high with one wire tie and damp-proof course in position
Slab:	120 mm thick with 250 mm × 250 mm wide ceramic tiles laid on cement screed and vinyl skirting in position

The inside wall and underside of the slab is finished with 19 mm plaster. The completed drawing must include all the labels and dimensions.

[20]

QUESTION 3

Draw to scale 1:5 a vertical, longitudinal sectional view through three steps of a steel staircase.

The staircase will consist of two channel stringers with wooden treads fixed to a rolled steel angle, which is welded to the inside of the stringer.

SPECIFICATIONS:

Channel stringer:	240 × 85 × 33,2 kg/m
Timber tread:	265 × 50 mm
Going:	240 mm
Rise (open):	165 mm
Angle cleats:	50 × 50 × 6 mm
Balusters:	16 × 16 square rods, welded to 50 × 6 mm cleats at the top of the channel stringer

The nosing line of the timber tread must be 5 mm below the top of the steel stringer. The completed drawing must include all the labels and welding symbols.

[15]

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QUESTION 4

Study the Warren-type steel frame in FIGURE 2 below and answer the questions.

The frame is loaded as indicated and supported by two vertical reactions.

NOTE: Use the A3 drawing sheet.

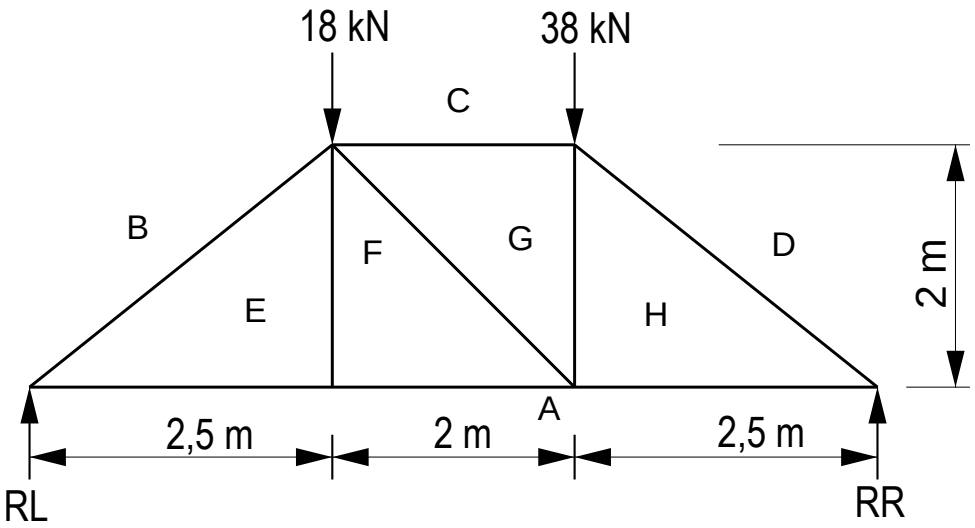

FIGURE 2

4.1 Calculate the value of the TWO reactions. (2)

4.2 Use the graphical method to determine the forces in each member of the frame and distinguish between compression force and tension force. (15)

4.3 Draw a neat table and tabulate the answers. (3)

Use the following scales:

Space diagram: 20 mm = 1 m
Vector diagram: 2 mm = 1 kN

[20]

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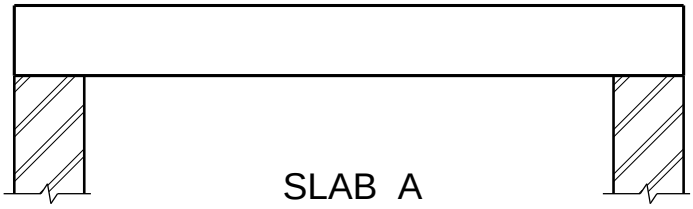
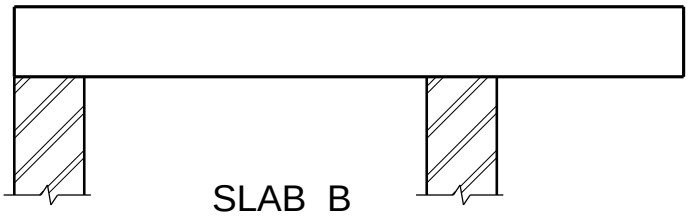
QUESTION 5

FIGURE 3 below shows two concrete slabs, each cast over two brick walls.

COPY these drawings on your A2-DRAWING SHEET. Then, insert the required steel reinforcement in the correct positions. Clearly indicate where the tension and compression occur in each of the slabs.





[10]

FIGURE 3

QUESTION 6

Draw to scale 1:10 the horizontal cross-sectional views of the following reinforced concrete columns:

NOTE: Use the A2 drawing sheet.

6.1 A round column with a diameter of 600 mm reinforced with SIX 25 mm mild steel bars and a 10 mm binder (5)

6.2 An L-shaped column with external dimensions of 460 × 460 mm. The smaller dimension is 230 mm. The column is reinforced with 8Y20 and 10 mm high yield tensile binders. (5)

[10]

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QUESTION 7

FIGURE 4 below shows a compound sectional view of five rectangular parts. The total area of the sectional view is 14 400 mm^2. The neutral axis is 172,5 mm measured from the bottom.

7.1 Draw a large, neat drawing of FIGURE 4.

Then calculate the missing dimensions. (9)

7.2 Calculate the second moment of area. (4)

7.3 Calculate the section modulus about the x-x axis. (2)

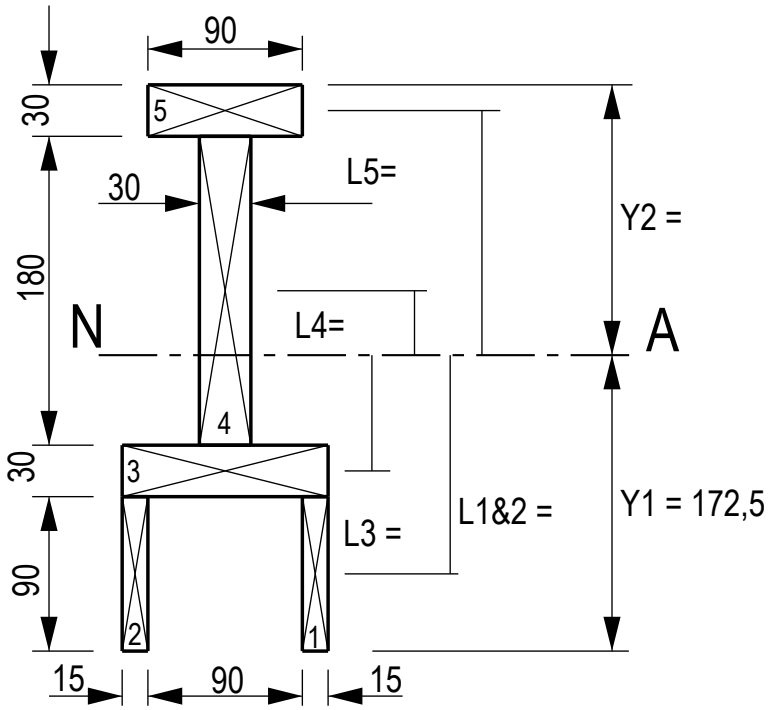

FIGURE 4

[15]

TOTAL: 100

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BUILDING AND STRUCTURAL CONSTRUCTION N5

FORMULA SHEET

Any other applicable formula is also accepted.

$A = ½\ bh$

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

$\sum CWM = \sum ACWM$

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

$Moment = Force\ x\ distance$

$BM = Reaction\ moment - Load\ moment$

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

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

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

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

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

$F_s = A_s\ x\ f_s\ x\ n$

$F_t = A_t\ x\ f_t\ x\ n$

$F_c = A_c\ x\ f_c\ x\ n$

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

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

$A_c = (d\ x\ t)$

$HC = F\ x \cos \theta$

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

$VC = F\ x \sin\ \theta$

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

$W = mass\ x\ ga$

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

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

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

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

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

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

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