higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T140**(E)**(A13)T

NATIONAL CERTIFICATE

BUILDING AND STRUCTURAL CONSTRUCTION N5

(8060015)

13 August 2019 (X-Paper)
09:00–13:00

OPEN-BOOK EXAMINATION

REQUIREMENTS: **ONE A2 drawing sheet**
Hot-rolled structural steel sections (BOE 8/2)

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. Number the answers according to the numbering system used in this question paper.
4. Draw a 20 mm border line around the DRAWING SHEET on both sides.
5. Use only pencil on the DRAWING SHEET.
6. Use both sides of the DRAWING SHEET.
7. Draw ALL drawings to the required scale.
8. Approximate calculations to THREE decimals.
9. Use your discretion where dimensions are NOT given.
10. Write neatly and legibly.

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SECTION A: DESIGN

QUESTION 1: BOLT CONNECTION

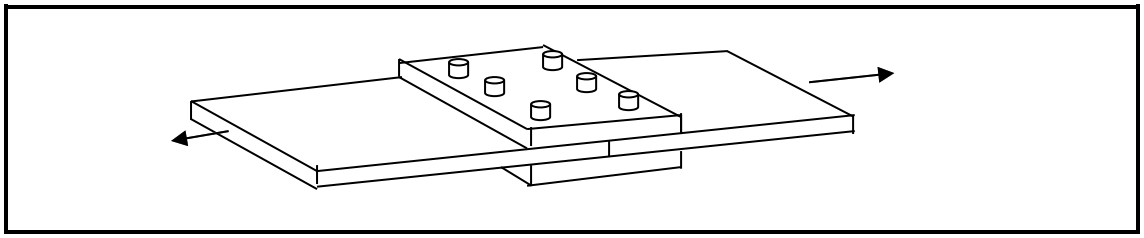

FIGURE 1

FIGURE 1 shows two tie bars connected by means of grade 4,5 bolts and two 6 mm thick connector plates.

Calculate the:

1.1 Resistance of the bolts to shearing (4)

1.2 Resistance of the bolts to crushing (4)

1.3 Resistance of the bolts to tearing (4)

1.4 Maximum force this connection can withstand safely (1)

Use the following specifications:

Bolts:	M12 (12 mm)
Tie bars:	60 × 8 mm
Holes in the tie bars:	14 mm
Maximum shear stress of the bolts:	100 MPa
Maximum tensile stress of the tie bars:	155 MPa
Maximum crushing stress between bolts and tie bars:	240 MPa **[13]**

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QUESTION 2: LOADED BEAM

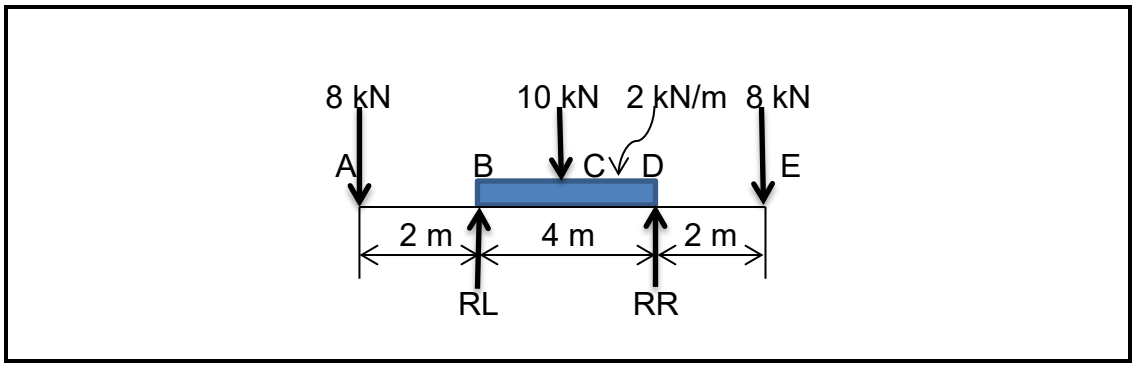

FIGURE 2

FIGURE 2 shows a simply loaded supported beam.

2.1 Calculate the reactions RL and RR. (4)

2.2 Make the necessary calculations and draw, to a suitable scale, a shear-force diagram. (6)

2.3 Make the necessary calculations and draw, to a suitable scale, a bending-moment diagram. (6)

2.4 Calculate the section module and select from the steel table the suitable I-section steel beam with tapered flange from the loaded beam if the bending stress is 165 MPa. (3)

2.5 Investigate the safety factor regarding shearing. The allowable shear stress of grade-43 steel is 100 MPa. (3)

[22]

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QUESTION 3: FRAME

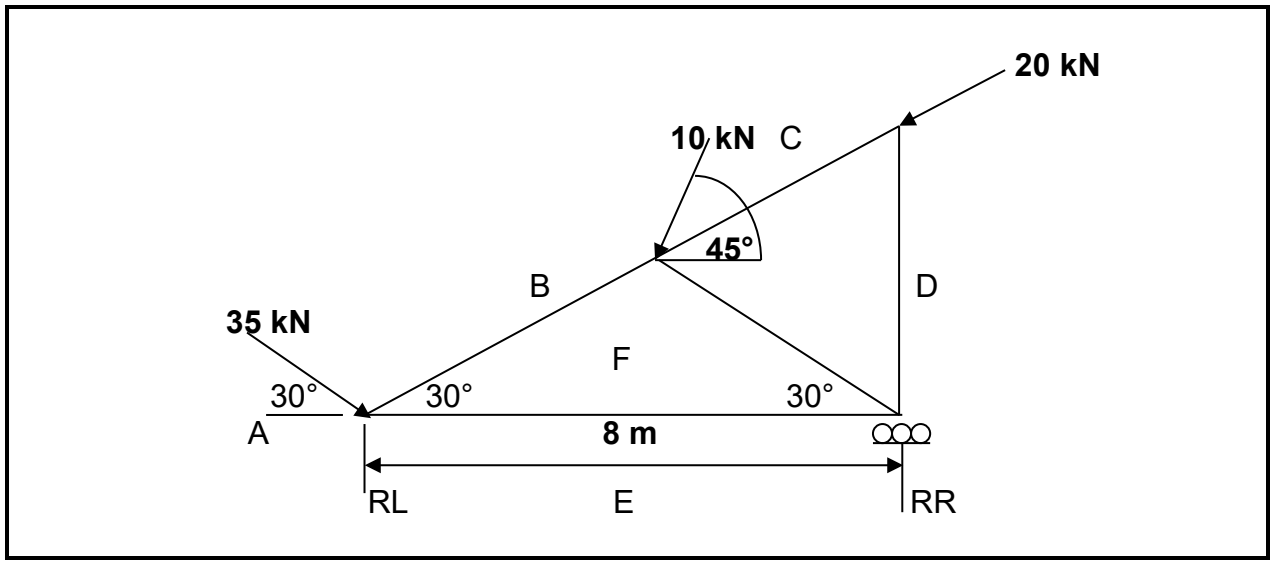

FIGURE 3

FIGURE 3 shows a loaded roof truss.

3.1 Determine the magnitude and nature of each member of the truss graphically if the roof is loaded as shown. (8)

3.2 Tabulate the results obtained in QUESTION 3.1 as follows in the ANSWER BOOK:

Member	Magnitude	Nature
BF		
FE		
CG		
GF		

(9)
[17]

TOTAL SECTION A: 52

SECTION B: DRAUGHTING

QUESTION 4: CONCRETE FOUNDATION

A reinforced concrete pad foundation supports a reinforced concrete circular column.

Draw, to scale 1:10, the following to show the position of the reinforcement and other constructional details:

4.1 A vertical section through the reinforced concrete pad foundation and the reinforced concrete column (10)

4.2 A horizontal cross section through the column on the centre of the foundation – show approximately 500 mm length of the column

Use the following specifications:

Pad foundation:

Size: 900 mm × 900 mm × 400 mm deep
Reinforcement: YØ20 mm tensile bars at 150 mm centres in both directions

Column:

Size: 300 mm diameter
Reinforcement: Ø Y20 mm longitudinal bars
Binders: Ø R 6 mm helical binders at 200 mm centre to centre (10)
[20]

QUESTION 5: WOODEN STAIRCASE

Draw, to scale 1:10, a vertical longitudinal section through a wooden staircase with landing to show the construction method.

Show only THREE steps and use the specifications below:

Anchor block: 152 mm × 38 mm
Rough carriage: 114 mm × 76 mm
Rough bracket: 114 mm × 25 mm
Tread: 310 mm × 30 mm thick
Going: 280 mm
Rise: 170 mm

Wedge and corners fillet to support the housing joist **[14]**

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QUESTION 6: CONCRETE FLOORS

Explain, by means of neat sectional drawings, the method of construction of fixing the following typical floor coverings to a reinforced concrete floor:

6.1 Timber floor with tongued and grooved jointed floor boards (7)

6.2 Glazing floor tiles (7)
[14]

TOTAL SECTION B: 48
GRAND TOTAL: 100

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FORMULA SHEET

Any applicable formula may also be used.

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

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

$n = 5d$
$n = 5{,}5d$

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

$F = f.a$

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

$F = ft\ (W - n.d)$

$F = f_c D.t.n$

$F = \frac{\pi.(\phi - 0{,}9382\rho)^2 n}{4}$

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

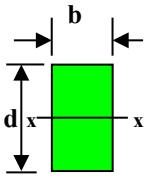
$\frac{M_r}{I} = \frac{f}{y} = \frac{E}{R}$

$M = fZ$

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

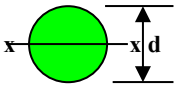
$M = f\frac{I}{y}$

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



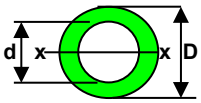
$I_{xx} = \frac{bd^3}{12}$

$Z_{xx} = \frac{bd^2}{6}$



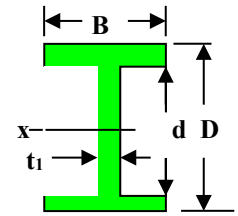
$I_{xx} = 1/4\ \pi\ r4$

$Z_{xx} = \frac{\pi.d^3}{32}$

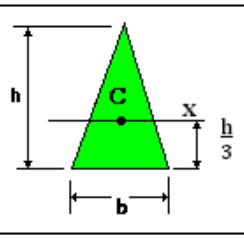


$I_{xx} = \frac{\pi}{64}(D4 - d4)$

$Z_{xx} = \frac{\frac{\pi}{64}(D4 - d4)}{D/2}$



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



$x = \frac{bh^3}{36}$

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