higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T80**(E)**(N21)T
NOVEMBER EXAMINATION

NATIONAL CERTIFICATE

BUILDING AND STRUCTURAL CONSTRUCTION N5

(8060015)

21 November 2016 (X-Paper)
09:00–12:00

This question paper consists of 7 pages, 1 formula sheet and shape-code profiles.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
BUILDING AND STRUCTURAL CONSTRUCTION N5
TIME: 3 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. Drawings must be done according to the latest building regulations.
5. Drawings must be fully dimensioned, labelled and steel coded where necessary.
6. Use BOTH sides of the drawing paper.
7. Calculations must be done to the nearest three decimals.
8. Labelling must be done horizontally and in printing.
9. Write neatly and legibly.

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QUESTION 1: FRAMES

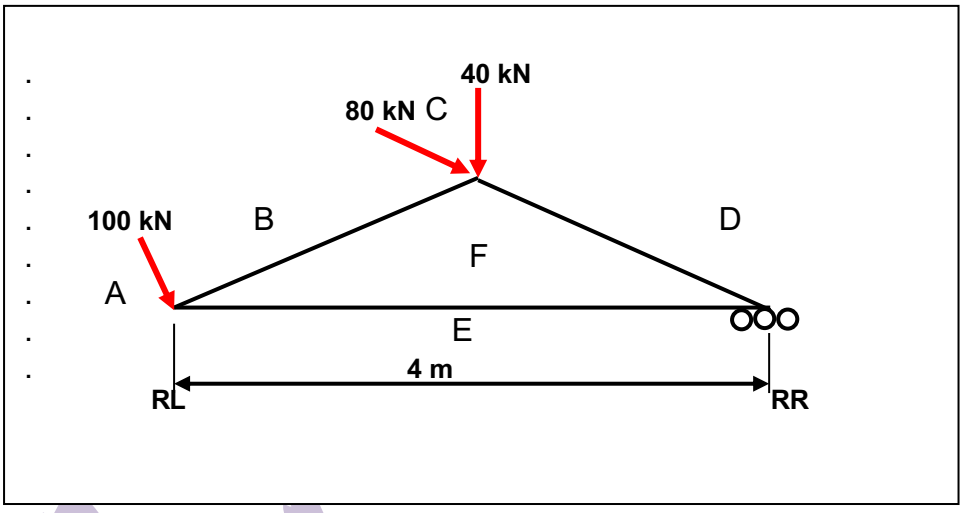

FIGURE 1

FIGURE 1 shows a loaded roof truss, with three forces and a pitch of 30° at both sides. The 100 kN force is perpendicular with the rafter BF, and the 80 kN force is in line with rafter DF. The roof truss is supported on a hinge at RL and by means of rollers at RR.

1.1 Determine the magnitude and directions of the reactions of the roof truss as shown. (8)

1.2 Determine the force in each member, and distinguish between tension and compression forces in the members.

Tabulate the results. (6)
[14]

QUESTION 2: BOLT CONNECTIONS

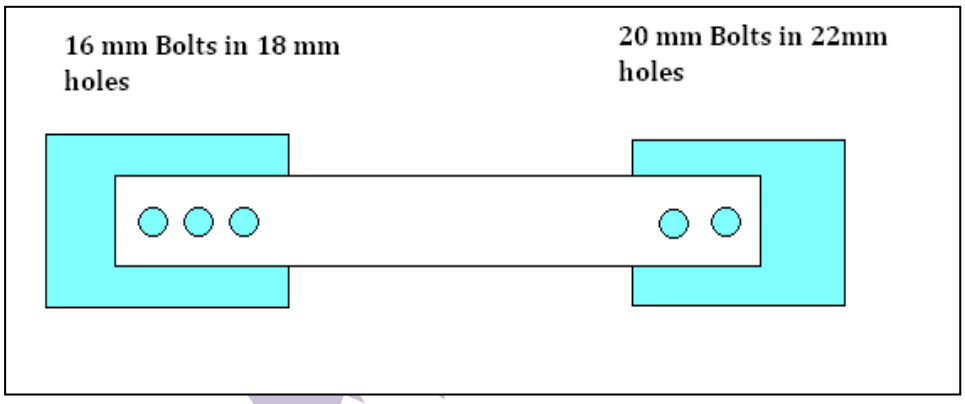

FIGURE 2

FIGURE 2 shows a tie-bar connection between two connecter plates by means of grade 4,6 bolts.

2.1 Calculate the safe load that the tie-bar connections can withhold in bearing, if the bearing stress is 150 MPa. (7)

2.2 Calculate the shear stress at the weakest side of the connection. (3)

2.3 Calculate the tearing stress at the weakest side of the connection. (4)

SPECIFICATIONS

Tie bar = 60 x 8 mm
Connecter plates are 10 mm thick.

[14]

QUESTION 3: BEAM DESIGN

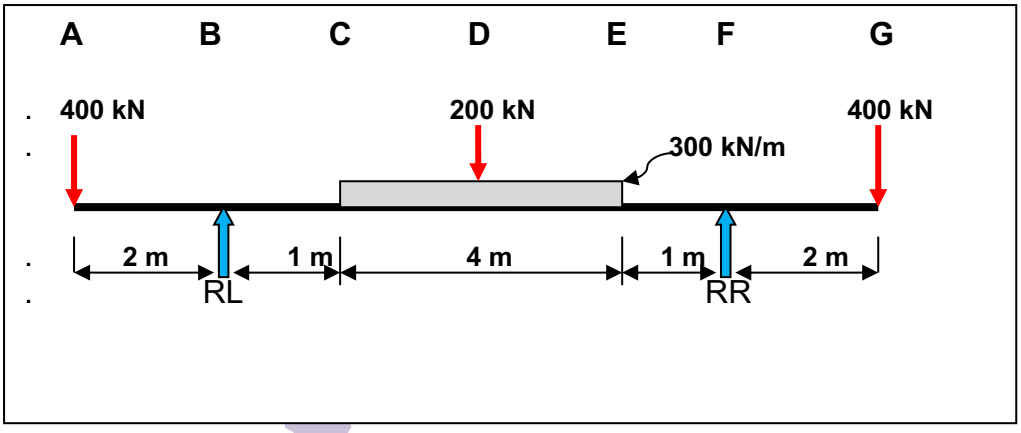

FIGURE 3

FIGURE 3 shows a symmetrical loaded beam, with supports at RL and RR.

3.1 Calculate the reactions at RL and RR. (2)

3.2 Make the necessary calculations to determine the maximum shear force and bending moment values of the loaded beam. Do NOT draw the diagrams. (5 + 5) (10)

3.3 Also do the necessary calculations and select a beam from the structural steel tables, the smallest suitable H-section with parallel flanges. (3 + 1) (4)

3.4 Investigate and check with regard to bending and shearing. The maximum bending stress for this steel beam is 465 MPa and shear stress is 200 MPa. (4)

NOTE: Ignore the self-weight of the beam.

[20]

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QUESTION 4: STEEL STRUCTURES

The apex of a steel roof is constructed with angle irons. The rafter beams at 30°, and the struts at 60°, are connected to an 8 mm gusset plate, with three and two M12 bolts respectively. A wooden purlin is bolted/fixed 200 mm from the top, down each side on the rafter beams, to a steel angle-iron cleat, which is welded to the rafter beams. The roof is covered with cement-fibre sheeting, and the top with two adjustable ridge sheeting.

Draw this steel-view structure to a scale of 1 : 5.

HINT: The roof is a fink roof.

Use the following details:

Rafters:	65 x 65 x 6 mm
Struts:	55 x 55 x 5 mm
Steel purlins:	50 x 75 x 5 mm
Wooden purlins:	50 x 75 mm
Roof cover:	Big six
Welding:	Fillet weld

NOTE: The labelling and welding symbols must be shown. **[15]**

QUESTION 5: CONCRETE STRUCTURES

5.1 Draw a pictorial view of a ground beam which connects two pad foundations together. The pad foundations support a round column and a square column, respectively. The drawing must fit inside a grid of 150 x 150 mm. (5)

5.2 Draw to scale 1 : 10 a vertical sectional view of the pad foundations, ground beam and columns, asked in QUESTION 5.1.

The pad foundations are 1 m x 1 m x 500 mm each, and 1 m apart.
Round column is 400 mm in diameter.
Square column is 400 x 400 mm.
Ground beam is 400 high and 300 mm wide.
ALL the different steel reinforcements must be shown, and labelled in their respective positions. (10)
[15]

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QUESTION 6: BENDING

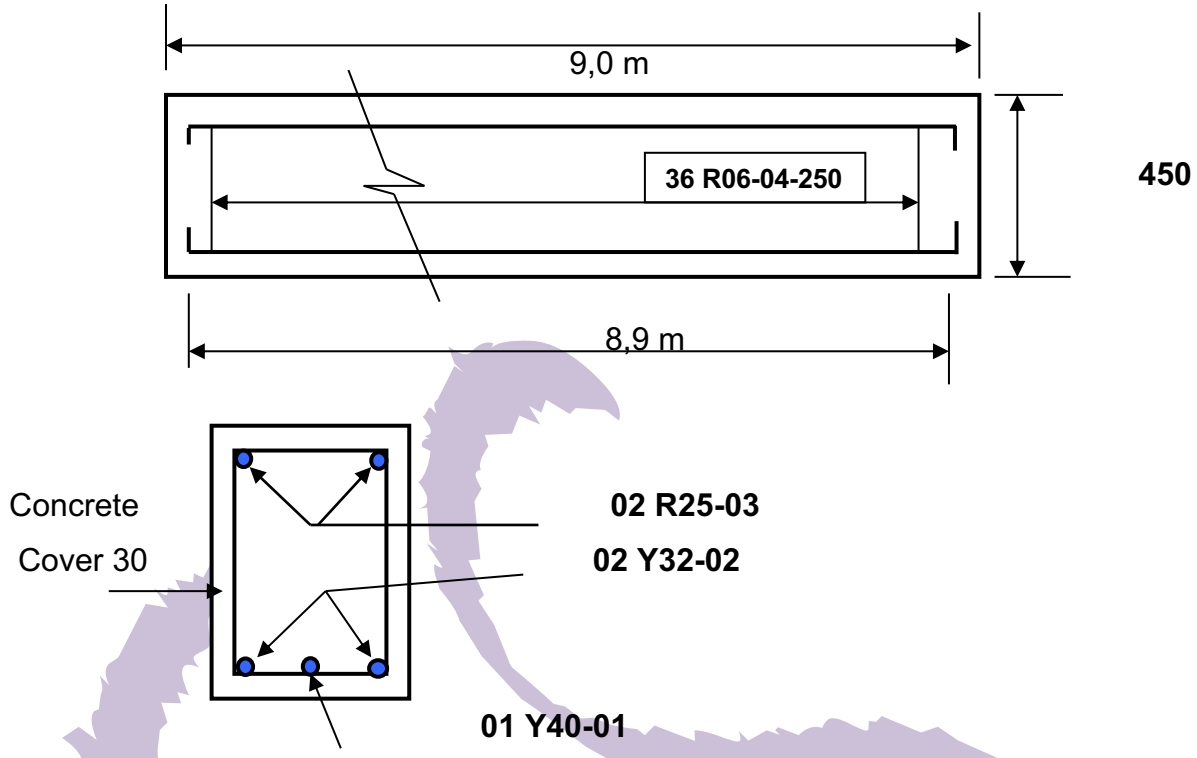

FIGURE 4

FIGURE 4 shows a reinforced concrete beam. Draw up a bending schedule for SEVEN, similar reinforced concrete beams.

The following shape-code profiles must be used for the bar numbers:

1 use 42
2 use 33
3 use 35
4 use 60 **[16]**

QUESTION 7

Make simple freehand drawings to explain the difference between:

7.1 an open-well staircase, and

7.2 a transverse staircase.

(2 x 3) **[6]**

TOTAL: 100

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

F = ft (W - n.d)

F = f_cD.t.n

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

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

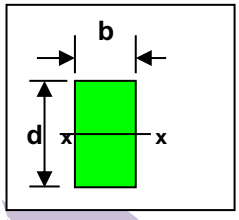
$\frac{M_r}{I} = \frac{f}{y} = \frac{E}{R}$

M = fZ

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

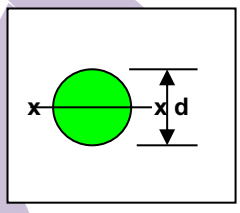
M = f$\frac{I}{y}$

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



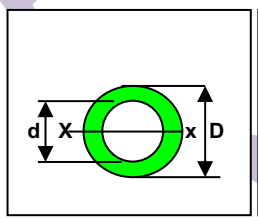
$I_{xx} = \frac{bd^3}{12}$

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



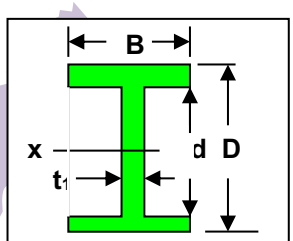
$I_{xx} = {}^1/_4\ \pi\ r^4$

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

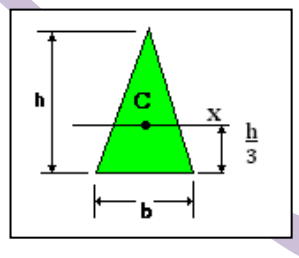


$I_{xx} = \frac{\pi}{64}(D^4 - d^4)$

$Z_{xx} = \frac{\frac{\pi}{64}(D^4 - d^4)}{D/2}$



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



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

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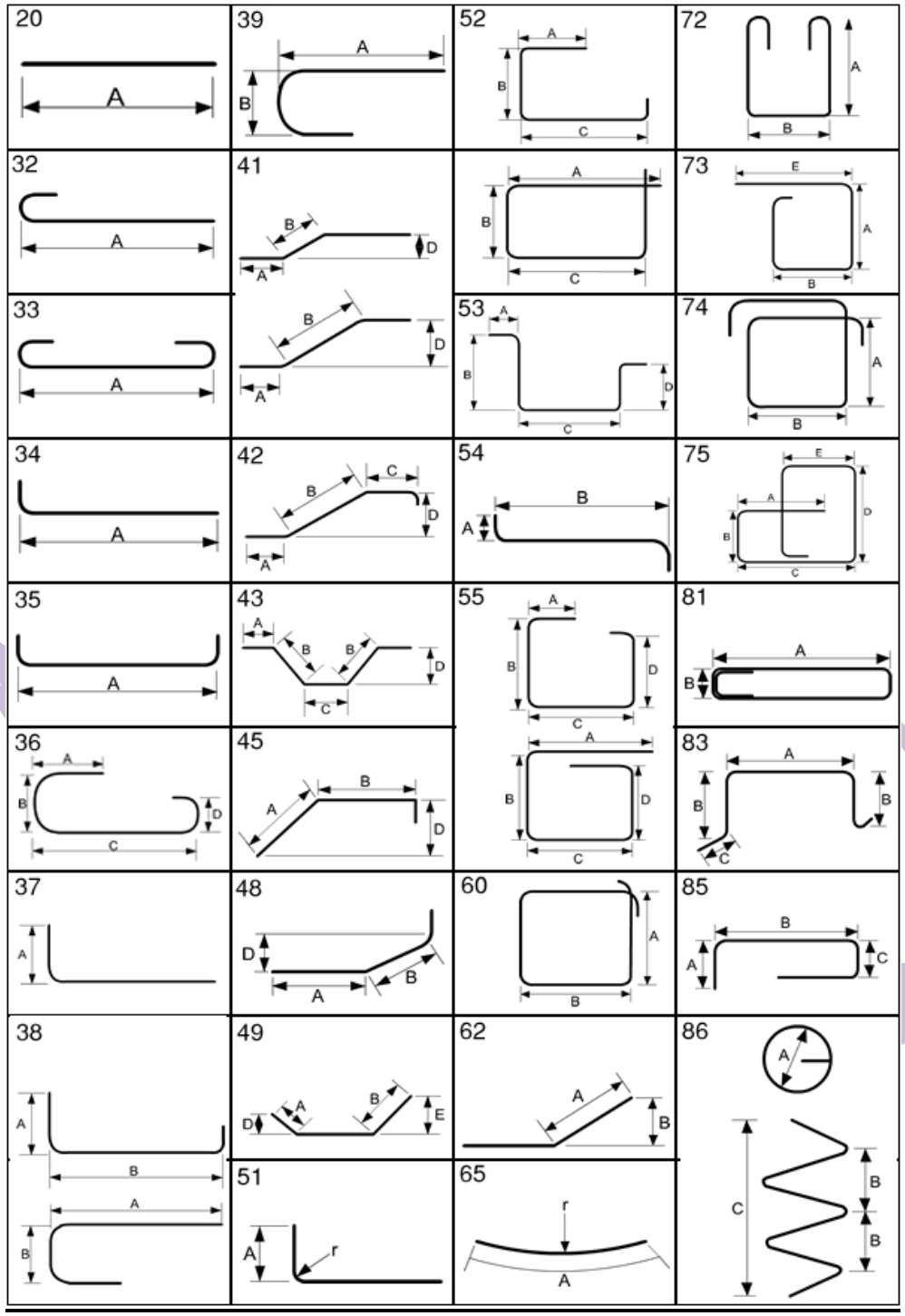
SABS 82 SHAPE CODES



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