higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T150**(E)**(J27)T

NATIONAL CERTIFICATE

BUILDING AND STRUCTURAL CONSTRUCTION N6

(8060026)

27 July 2018 (X-Paper)
09:00–13:00

OPEN-BOOK EXAMINATION

REQUIREMENTS: BOE 8/6 hot-rolled structural steel sections (red book)

Personal notes, textbooks and calculators may be used.

This question paper consists of 6 pages, 1 diagram sheet and 3 schedules.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
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NATIONAL CERTIFICATE
BUILDING AND STRUCTURAL CONSTRUCTION N6
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. Start each question on a NEW page.
5. Draw a line after each question.
6. ALL calculations must conform to the relevant SABS/SANS Codes of Practice.
7. Indicate ALL relevant code/clause references.
8. Complement answers with neat sketches.
9. Use the attached SCHEDULES A, B and C to assist with answers.
10. Write neatly and legibly.

QUESTION 1

1.1 Define each of the following building construction terms:

1.1.1 Curing of concrete

1.1.2 Bulking of sand

(2 × 2) (4)

1.2 Explain the characteristics of nonferrous metals. (2)

1.3 Name TWO types of nonferrous metals used in the construction industry. (2)

1.4 Name TWO main materials used to manufacture steel. (2)

[10]

QUESTION 2

A double reinforced-concrete beam must be cast as a simply supported beam over a wide panoramic sliding door and window.

The following specifications are given to design the RC beam:

Width of beam:	330 mm
Effective span:	8 m
Fcu:	25 MPa
Fy:	450 MPa
Density of concrete:	2 425 kg/m³

Calculate:

2.1 The effective depth of the beam (1)

2.2 The design dead load (7)

2.3 The bending moment maximum (5)

2.4 The lever arm distance (2)

2.5 The required compression reinforcement (5)

2.6 The required tension reinforcement (4)

2.7 Check for minimum and maximum reinforcement (2)

Consider the self-weight of the beam in the calculations. Indicate the relevant code and clauses. **[26]**

QUESTION 3

FIGURE 1 shows the front view of a loaded steel roof truss for a small motor garage workshop.

3.1 Ignore the self-weight of the roof truss and calculate:

3.1.1 The upward forces of the reactions RR and RL (4)

3.1.2 The magnitude of the forces in parts AB, CD and BD (9)

3.2 Distinguish between tension and compression forces in the members. NO marks will be awarded for graphical solutions.

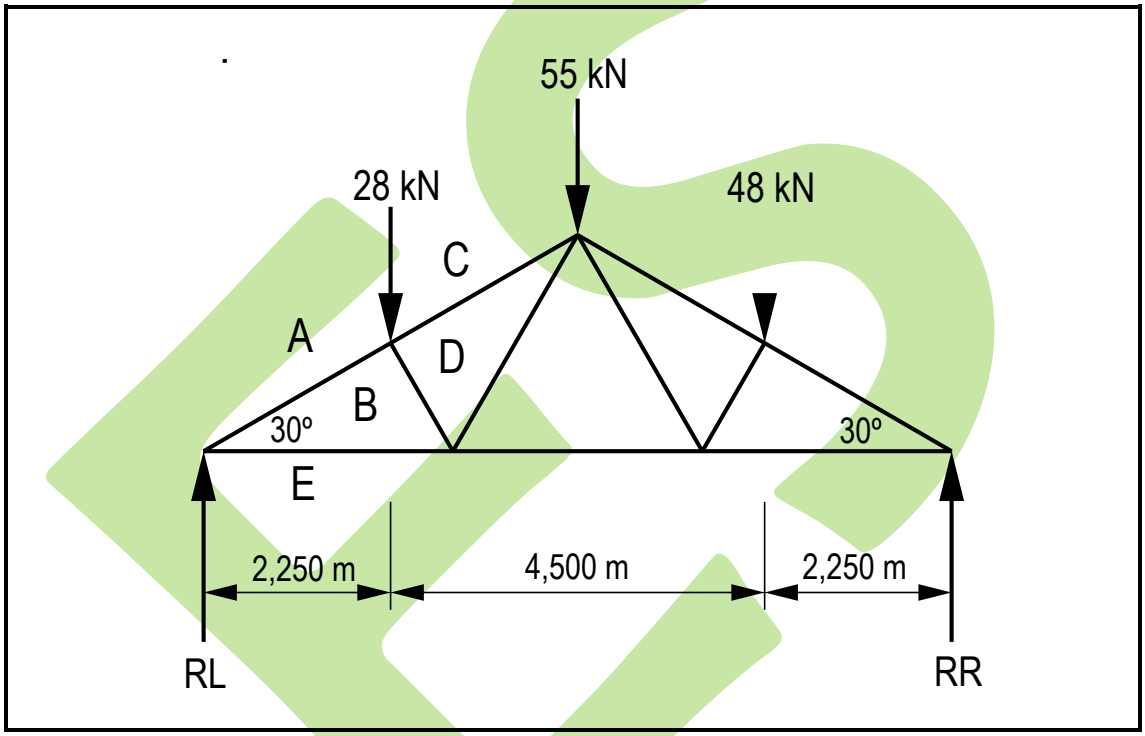

FIGURE 1

(5)
[18]

QUESTION 4

Design a round reinforced-concrete column suitable to support a load of 1 850 kN. Assume the short column is axially loaded. Use Grade 30 concrete with mild-steel main bars and mild-steel helical binder.

Calculate:

4.1 The diameter of the column (7)

4.2 The number and diameter of the main longitudinal reinforcement (3)

4.3 The pitch and diameter of the helical binder

NOTE: Asc = 0,4% Ac (Table 23) (5)

[15]

QUESTION 5

FIGURE 2 on the DIAGRAM SHEET (attached) shows a horizontal sectional view of THREE plates built-up to form a steel column. The overall height of the column will be 5,60 metres. The column will be effectively held in position and restrained against rotation at both ends.

Calculate:

5.1 The effective height of the column (2)

5.2 The cross-sectional area of the steel section (2)

5.3 The second moment of area about the x-x axis (3)

5.4 The second moment of area about the y-y axis (2)

5.5 The minimum second moment of area (1)

5.6 The minimum radius of gyration (2)

5.7 The slenderness ratio (2)

5.8 The maximum axial load the column can support (1)

[15]

QUESTION 6

FIGURE 3 on the DIAGRAM SHEET (attached) shows TWO methods of arranging TWO I-section parallel flange steel beams to form simply supported beams. The beams will span a distance of 5,25 metres across an opening.

Use the following information and show by means of calculations which of the TWO arrangements will carry the highest point load in the centre of the beam. Give a reason why the loads are different.

I-section parallel flange beams:	305 × 102 × 28,6 kg/m
Bending stress:	175 MPa

Do NOT consider the self-weight of the beams. **[16]**

TOTAL: 100

DIAGRAM SHEET

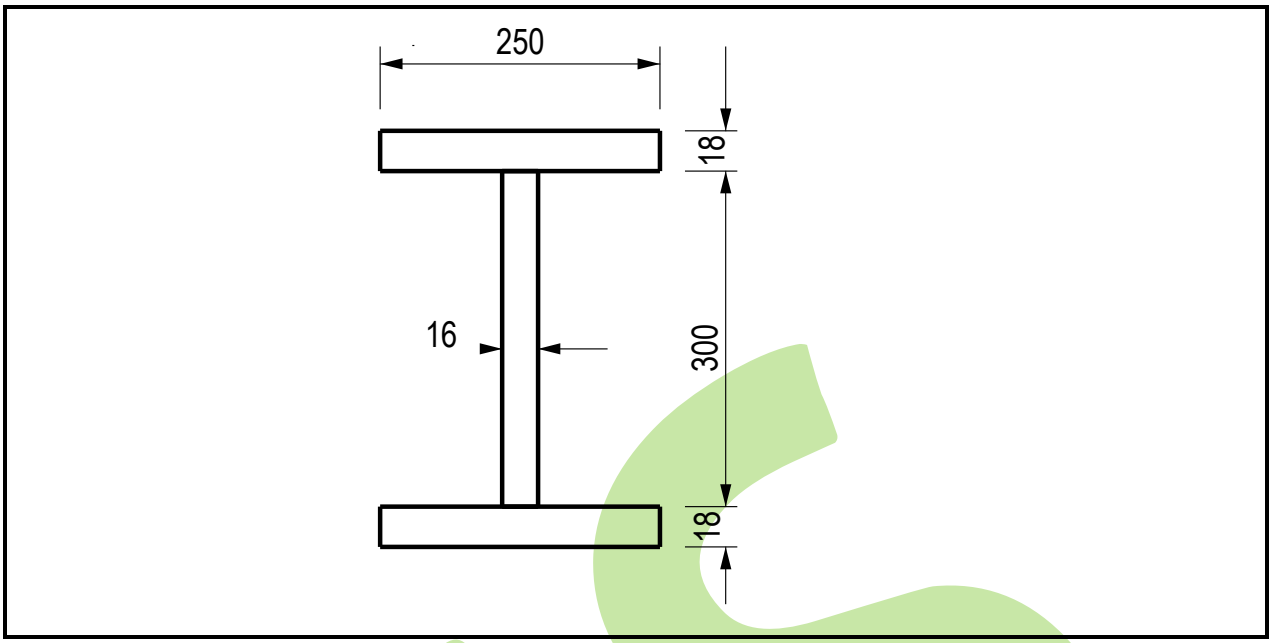

FIGURE 2

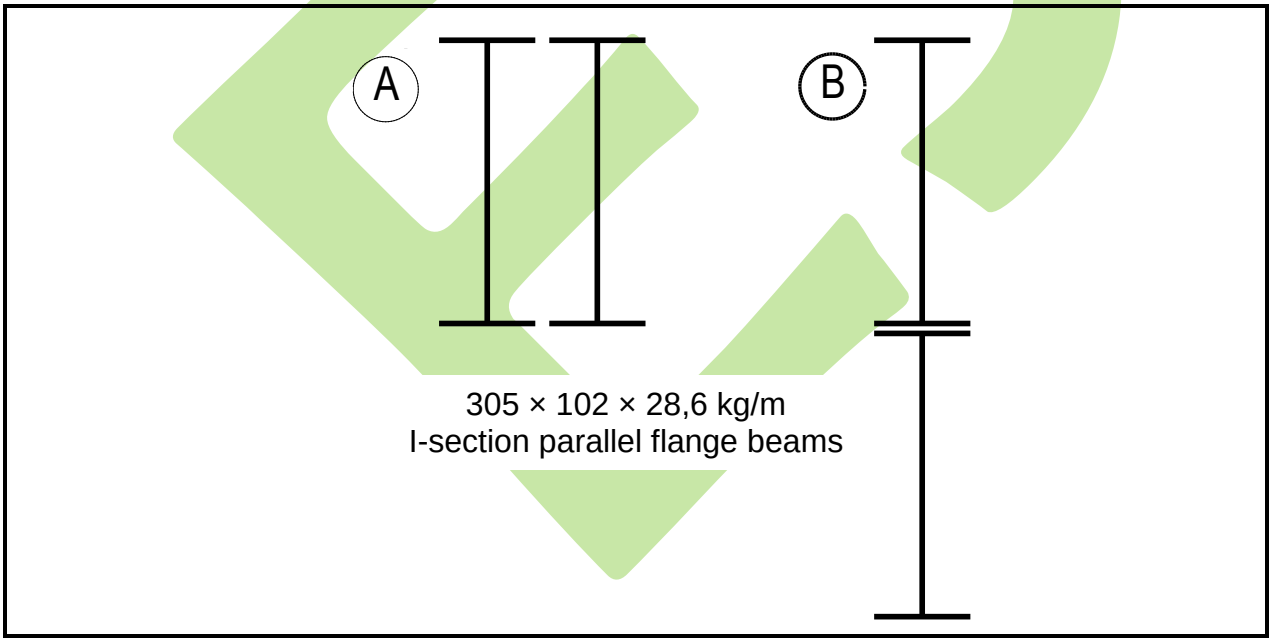

FIGURE 3

SCHEDULE A

CROSS-SECTIONAL AREA OF REINFORCEMENT RODS FOR BEAMS AND COLUMNS										
Number of rods	Rod diameter (mm)									
	Ø6	Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32	Ø40	Ø50
1	28,3	50,3	78,5	113,1	201,1	314,2	490,9	804,2	1 256,6	1 963,5
2	57	101	157	226	402	628	982	1 608	2 513	3 927
3	85	151	236	339	603	943	1 473	2 413	3 770	5 891
4	113	201	314	452	804	1 257	1 964	3 217	5 026	7 854
5	141	251	393	566	1 006	1 571	2 455	4 021	6 283	9 818
6	170	302	471	679	1 207	1 885	2 945	4 825	7 540	11 781
7	198	352	550	792	1 408	2 199	3 436	5 629	8 796	13 745
8	226	402	628	905	1 609	2 514	3 927	6 434	10 053	15 708
9	255	453	707	1 018	1 810	2 828	4 418	7 238	11 309	17 672
10	283	503	785	1 131	2 011	3 142	4 909	8 042	12 566	19 635
11	311	553	864	1 244	2 212	3 456	5 400	8 846	13 823	21 599
12	339	603	942	1 357	2 413	3 770	5 891	9 650	15 079	23 562
	Typical secondary reinforcement			Typical main reinforcement						

SCHEDULE B

CROSS-SECTIONAL AREA OF REINFORCEMENT RODS PER METRE WIDTH FOR SLABS AND STAIRCASES										
Spacing of rods centre to centre	Rod diameter (mm)									
	Ø6	Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32	Ø40	Ø50
50	566	1 005	1 571	2 262	4 021	6 283	9 817	16 085	25 133	39 270
75	377	670	1 048	1 508	2 681	4 189	6 545	10 723	16 755	26 180
100	283	503	785	1 131	2 011	3 142	4 909	8 042	12 566	19 635
125	226	402	628	905	1 608	2 513	3 927	6 434	10 053	15 708
150	188	335	524	754	1 340	2 094	3 272	5 362	8 378	13 090
175	162	387	449	646	1 149	1 795	2 805	4 596	7 181	11 220
200	141	251	393	565	1 005	1 571	2 454	4 021	6 283	9 817
250	113	201	314	452	804	1 257	1 963	3 217	5 027	7 854
300	94	168	262	377	670	1 047	1 636	2 681	4 189	6 545
350	81	144	224	323	574	898	1 402	2 298	3 590	5 610
400	71	125	196	283	503	786	1 227	2 011	3 142	4 909
500	57	101	157	226	402	620	982	1 608	2 513	3 927
	Typical secondary reinforcement				Typical main reinforcement					

SCHEDULE C

ISOMETRIC BLACK HEXAGON BOLTS AND NUTS									
Normal size and thread diameter	DIMENSION IN MILLIMETRE								
	Pitch of thread coarse pitch series	Maximum width of head and nut		Maximum height of head		Maximum thickness of nut		Tensile stress area in mm²	Minimum distance between centres
		Across flats	Across corners	Black	Face on underside	Black	Face one side		
M 6	1	10,00	11,5	4,375	4,25	5,375	5	20,1	15
M 8	1,25	13,00	15,0	5,875	5,74	6,875	6,5	36,6	20
M 10	1,5	17,00	19,6	7,45	7,29	8,45	8,	58,0	25
M 12	1,75	19,00	21,9	8,45	8,29	10,45	10	84,3	30
M 16	2	24,00	27,7	10,45	10,29	13,45	13	157	40
M 20	2,5	30,00	34,6	13,90	13,35	16,55	16	245	50
M 22	2,5	32,00	36,9	14,90	14,35	18,55	18	303	55
M 24	3	35,00	41,6	15,90	15,35	19,65	19	353	60
M 27	3	41,00	47,3	17,90	17,35	22,65	22	459	67,5
M 30	3,5	46,00	53,1	20,05	19,42	24,65	24	561	75
M 33	3,5	50,00	57,7	22,05	21,42	26,65	26	694	82,5
M 36	4	55,00	63,5	25,05	23,42	29,65	29	817	90
M 39	4	60,00	69,3	26,05	25,42	31,80	31	976	97,5
M 42	4,5	65,00	75,1	27,05	26,42	34,80	34	1 120	105
M 45	4,5	70,00	80,8	29,05	28,42	36,80	36	1 300	112,5
M 48	5,0	75,00	86,6	31,05	30,42	38,80	38	1 470	120
M 52	5,0	80,00	92,4	34,25	33,42	42,80	42	1 760	130
M 56	5,5	85,00	98,1	36,25	35,50	45,80	45	2 030	140