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Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T150**(E)**(A3)T

NATIONAL CERTIFICATE

BUILDING AND STRUCTURAL CONSTRUCTION N6

(8060026)

3 April 2018 (X-Paper)
09:00–13:00

OPEN-BOOK EXAMINATION

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

Candidates may use calculators, personal notes and textbooks.

This question paper consists of 5 pages, 1 diagram sheet and 3 addenda.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

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. Rule off on completion of each question.
6. ALL calculations must conform to the relevant SABS/SANS Codes of Practice.
7. Indicate ALL relevant code/clause references.
8. Complement your answers with neat sketches.
9. Use the attached ADDENDA A, B and C to assist with your answers.
10. Write neatly and legibly.

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QUESTION 1

FIGURE 1 shows a simply supported, reinforced concrete L-beam. The dead load of the L-beam is 7,5 kN/m with an additional imposed dead load of 3,75 kN/m^2. The L-beam will be spanned effectively over a distance of 6,25 meters.

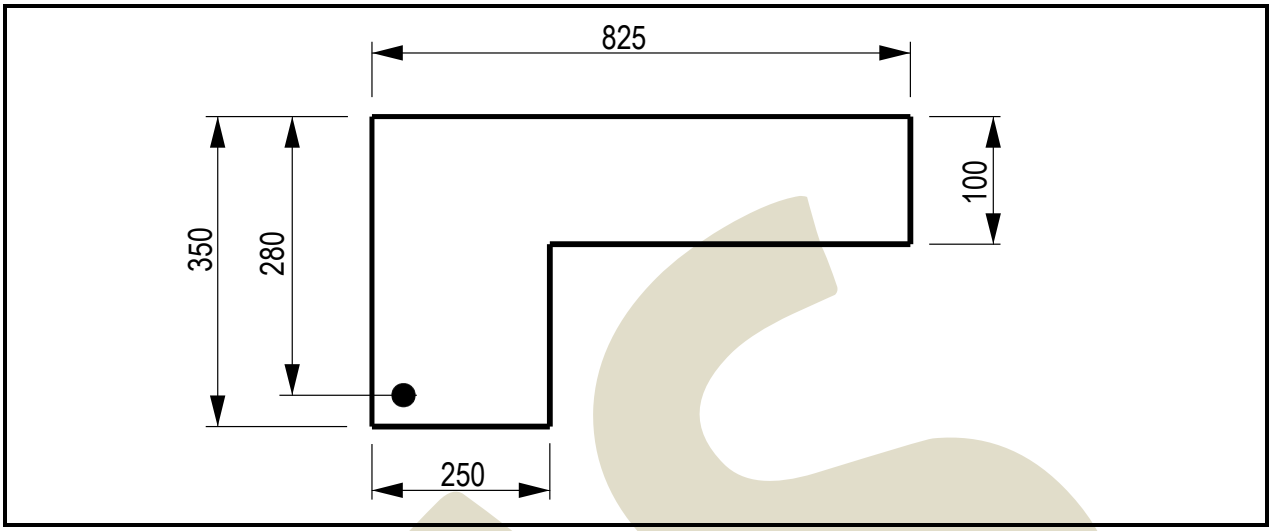


FIGURE 1

Use Grade 25 concrete with mild-steel reinforcement and calculate the suitable tension reinforcement for the L-beam. **[13]**

QUESTION 2

FIGURE 2 on the DIAGRAM SHEET (attached) shows a simply supported steel beam consisting of a 105 mm × 8 mm plate supported by a 152 × 89 × 17,1 kg/m taper flange steel beam. The density of structural steel must be 7 860 kg/m^3.

2.1 Calculate the maximum point load the beam can safely support at P. (15)

2.2 Include the value of P and calculate the TWO reactions at RL and RR. (4)

Do NOT include the self-weight of the compound beam. The bending stress must not exceed 115 MPa. **[19]**

QUESTION 3

A circular hollow section is to be used as a steel column. The external cross-sectional diameter of the column is 220 mm with a wall thickness of 5 mm. The overall height of the column is 2,75 m and will be held in position and restrained against rotation at both ends. **[13]**

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QUESTION 4

4.1 A short, axially loaded, 450 mm × 550 mm, reinforced-concrete column must support a design load of 3 400 kN. Mild-steel reinforcement and Grade 30 will be used in the construction of the column. (10)

4.2 Calculate the minimum area of a square isolated pad foundation for the column mentioned in QUESTION 4.1. The foundation must resist the following loads: (4)

Imposed load: 600 kN
Mass of foundation concrete: 85 kN

Use a safe bearing upward soil pressure of 220 kN/m². **[14]**

QUESTION 5

FIGURE 3 on the DIAGRAM SHEET (attached) shows a vertical section through a simply supported, reinforced-concrete staircase. The staircase is 1,25 metres wide and supported at both ends. The staircase will be subjected to an imposed load of 6,3 kN/m² and will be cast monolithically.

The density of the concrete is 2 410 kg/m³. Use Grade 25 concrete with mild-steel reinforcement and calculate the following:

5.1 The total design dead and imposed loads

5.2 The maximum bending moment

5.3 The value of the constant K

5.4 The size and spacing of suitable tension reinforcement

5.5 The size and spacing of suitable secondary reinforcement

Indicate ALL relevant code references. **[23]**

QUESTION 6

6.1 Name TWO methods of producing steel. (2)

6.2 Explain how one would ensure adequate moisture content during the curing of a concrete column or wall. (2)
[4]

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QUESTION 7

FIGURE 4 shows an eccentrically loaded connection consisting of a plate connected to the flange of an I-beam with FOUR bolts. The connection is required to support a load of 25 kN.

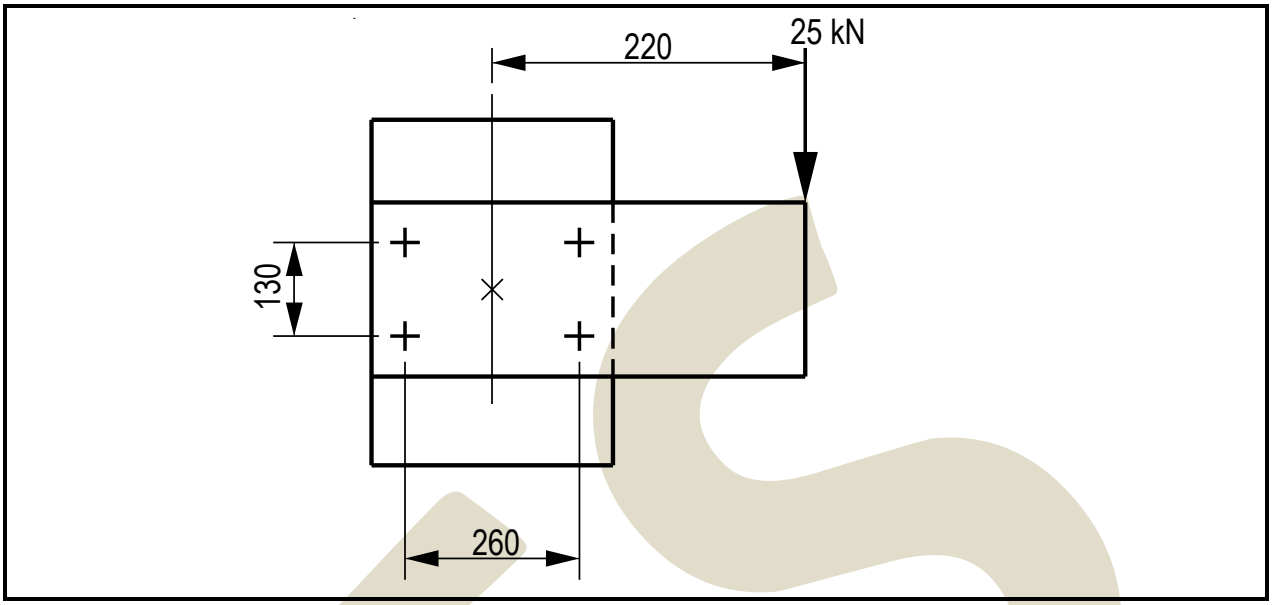


FIGURE 4

Calculate the diameter of the bolts to hold the connection in place. Use a shear stress of 95 MPa. **[14]**

TOTAL: 100

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DIAGRAM SHEET

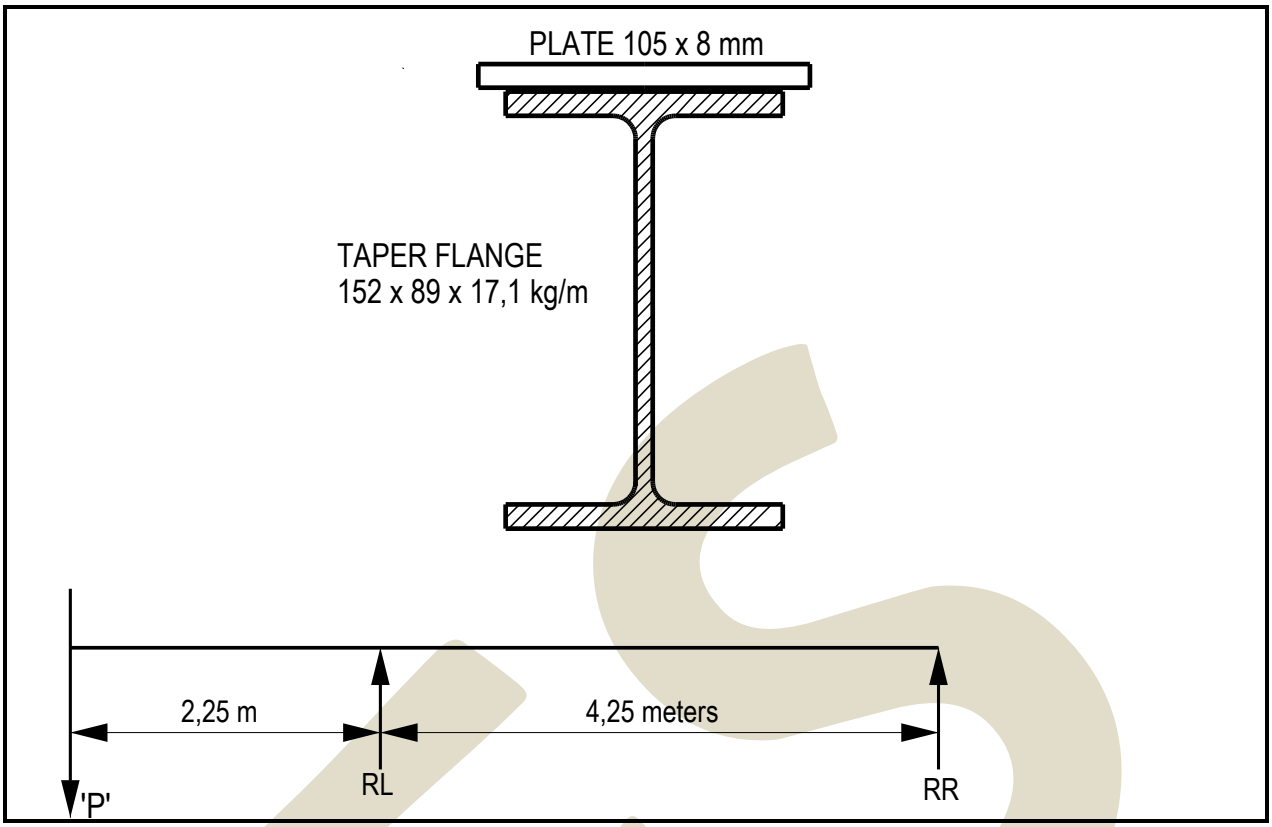


FIGURE 2

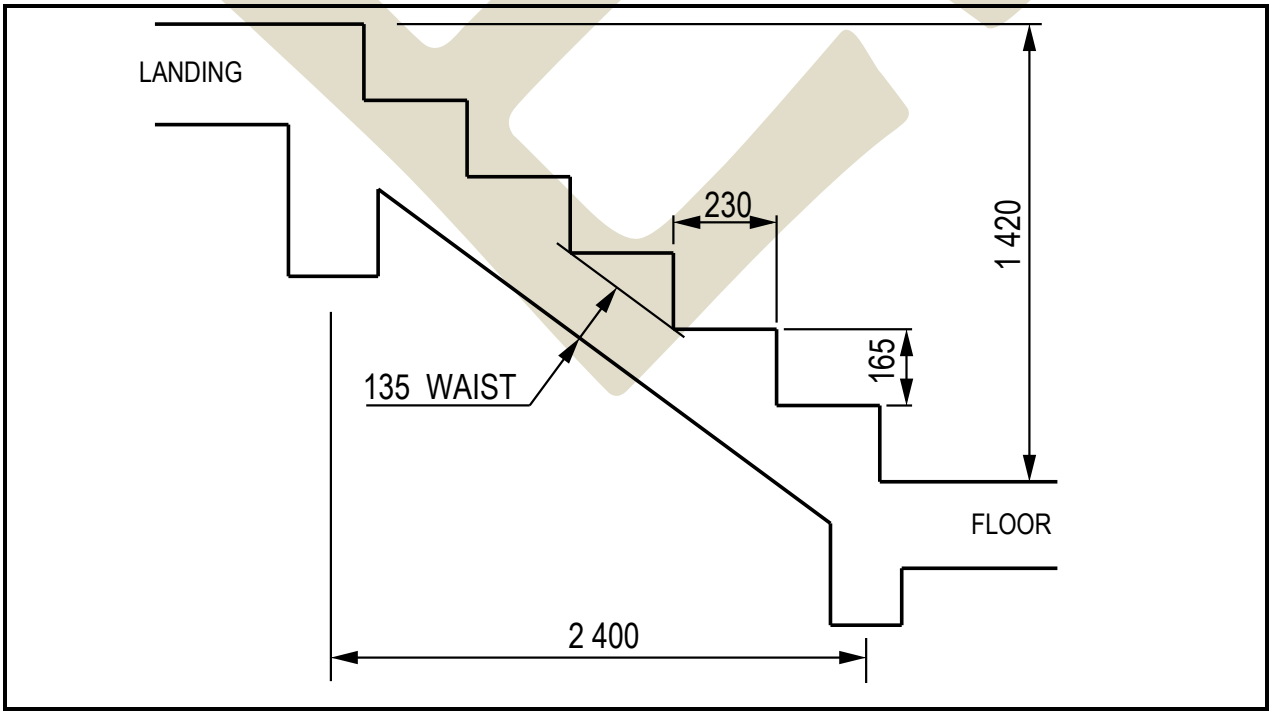


FIGURE 3

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ADDENDUM 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						

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ADDENDUM 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					

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ADDENDUM 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

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