(8)

higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T140(E)(J28)T
AUGUST 2010

NATIONAL CERTIFICATE

BUILDING AND STRUCTURAL CONSTRUCTION N6

(8060026)

28 July (X-Paper)
09:00 – 13:00

OPEN-BOOK EXAMINATION

REQUIREMENTS: Tables BOE 8/2

The candidates may use personal notes and text books.

Calculators may be used.

This question paper consists of 4 pages, 2 diagram sheets and 2 schedules.

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. ALL the calculations must comply with the latest building regulations.
4. ALL the calculations must be shown.
5. Show ALL the code references.
6. Use the enclosed SCHEDULES A and B to assist with your calculations.
7. Number the answers correctly according to the numbering system used in this question paper.
8. Full marks: 100%
9. Write neatly and legibly.

QUESTION 1

FIGURE 1 on the attached DIAGRAM SHEET 1, shows a built-up beam consisting of a parallel flange, I-beam 610 mm x 305 mm x 149 kg/m, and a channel iron profile 300 mm x 100 mm x 46,2 kg/m. The effective length of the beam is 4 800 mm and the maximum bending stress may not exceed 210 MPa. A uniformly distributed load of 85 kN/m is carried by the beam. Determine the maximum point load that the beam can safely carry at midpoint. The self weight of the beam must be included in the calculation. **[14]**

QUESTION 2

FIGURE 2 on the attached DIAGRAM SHEET 2, shows a vertical cross-section of a reinforced concrete staircase with supporting beams at both ends. The staircase is 2 metres wide and is monolithically cast in concrete. All dimensions are given in millimetres.
The imposed load is 12 kN/m^2 and the density of the concrete is 2 400 kg/m^3. Use grade 25 concrete with mild steel reinforcement.

2.1 Calculate the ultimate design moment. (8)

2.2 Determine whether compression reinforcement is required. (4)

2.3 Calculate the lever arm length. (4)

2.4 Determine size and spacing of suitable main reinforcement per metre. (4)

2.5 Determine size and spacing of suitable secondary reinforcement per metre. (4)
[24]

QUESTION 3

A simply supported rectangular reinforced concrete beam with an effective span of 4 300 mm is to carry an imposed load of 75 kN/m. The width of the beam must be 370 mm. Grade 30 concrete with high yield steel is used in the construction.

3.1 Determine a suitable depth for the beam as well as the cross sectional area required for main reinforcement. The self weight of the beam must be taken into consideration. (20)

3.2 Draw, to any suitable scale, a cross-sectional drawing through the beam to show the size and position of the reinforcement. (4)
[24]

QUESTION 4

FIGURE 3 on the attached DIAGRAM SHEET 2, shows a simply supported reinforced concrete slab with an effective span of 6,5 m, a width of 4,75 m and a total depth of 325 mm, supported by two I-sections with parallel flanges. The slab supports a live load of 10 kN/m^2. Use grade 30 concrete with high yield steel reinforcement with σ_y = 450 MPa. The density of reinforced concrete is 2 400 kg/m^3. The self weight of the concrete needs to be taken into consideration during calculations.

4.1 Determine, by means of calculations, the size and spacing of the main and secondary reinforcement in the slab. (14)

4.2 Make the necessary calculations and select suitable I-sections with parallel flanges from the tables to support the slab. The maximum bending stress may not exceed 240 MPa. (10)

4.3 Draw, to any suitable scale, the necessary view and section to show the reinforcement in the slab. (6)

[30]

QUESTION 5

A short, axially loaded concrete column with a diameter of 950 mm supports a design load of 11 300 kN safely. Grade 25 concrete is used with mild steel reinforcement.

Determine the minimum longitudinal reinforcement required. **[8]**

TOTAL: 100

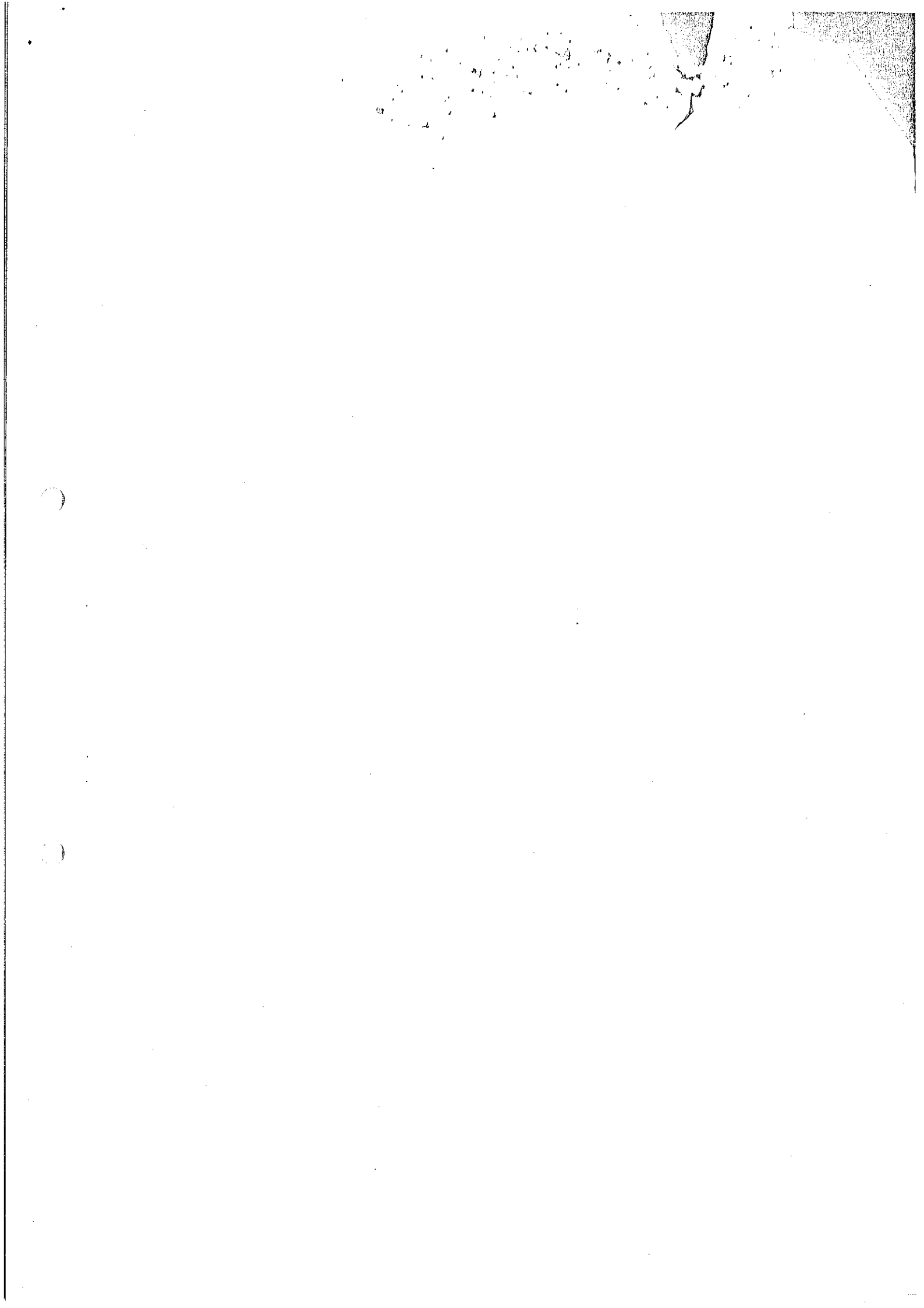

DIAGRAM SHEET 1

BUILDING AND STRUCTURAL CONSTRUCTION N6
BOU EN STRUKTUUR KONSTRUKSIE N6

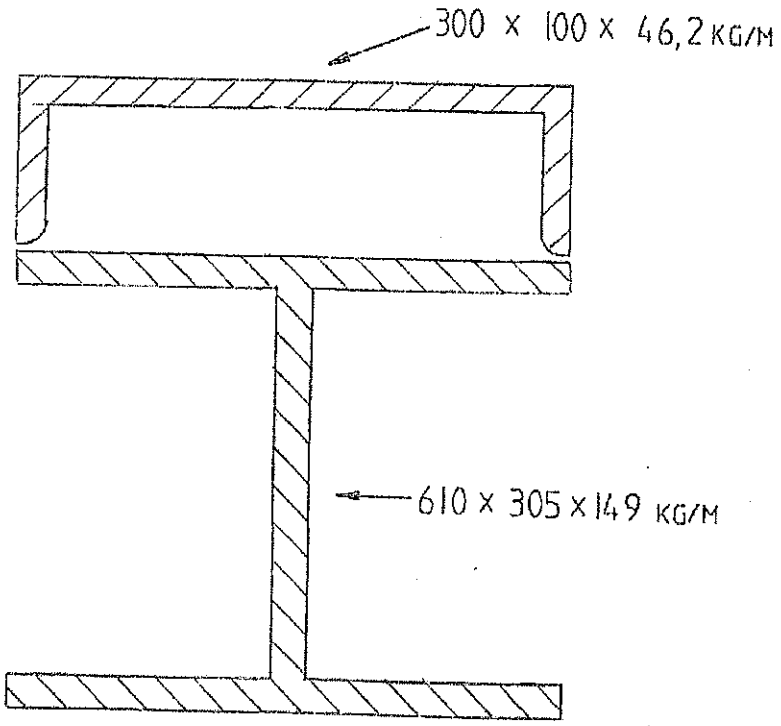

FIGURE / FIGUUR 1

DIAGRAM SHEET 2

BUILDING AND STRUCTURAL CONSTRUCTION N6
BOU EN STRUKTUURKONSTRUKSIE N6

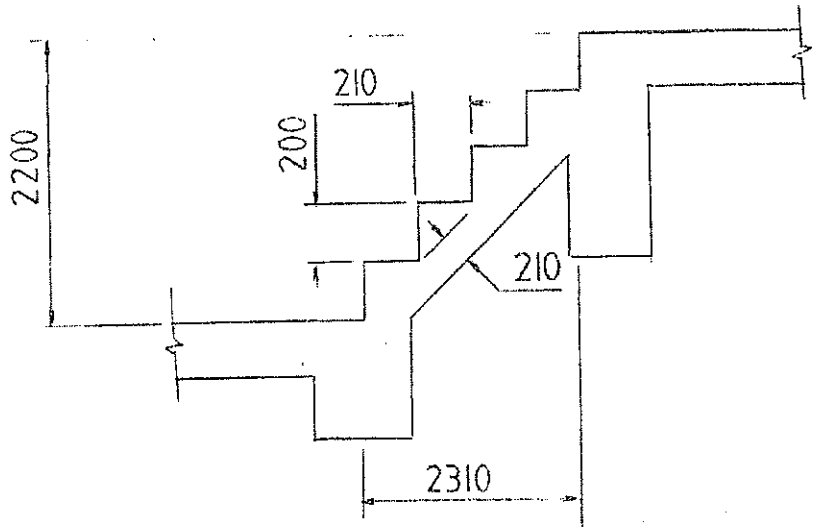

FIGURE / FIGUUR 2

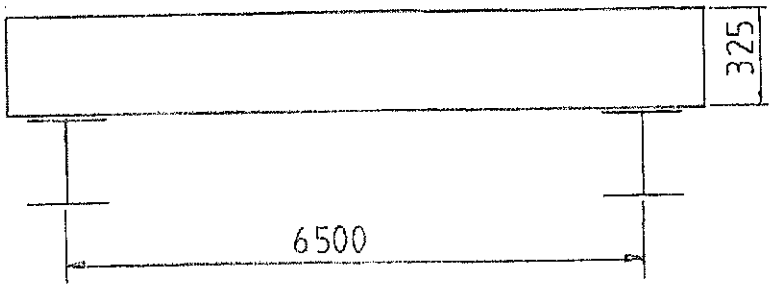

FIGURE / FIGUUR 3

SCHEDULE A

CROSS SECTIONAL AREA OF REINFORCING RODS
SCHEDULE A

Quantity of rods	Rod Diameter (mm)									
	ϕ 6	ϕ 8	ϕ 10	ϕ 12	ϕ 16	ϕ 20	ϕ 25	ϕ 32	ϕ 40	ϕ 50
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

CROSS SECTIONAL AREA OF REINFORCING RODS PER METER WIDTH OF FLOOR SLAB

Spacing of rods, Centre to centre	Rod Diameter (mm)									
	ϕ 6	ϕ 8	ϕ 10	ϕ 12	ϕ 16	ϕ 20	ϕ 25	ϕ 32	ϕ 40	ϕ 50
50	565	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 (floor slabs)						

SCHEDULE B

ISOMETRIC BLACKHEXAGON BOLTS AND NUTS — **SCHEDULE B**

Nominal Size and thread Diameter	DIMENSIONS IN MILLIMETER								
	Pitch of thread coarse pitch series	Max. width of head and nut		Max height of head		Max. thickness of nut		Tensile stress area in mm^2	Minimum distance between centers
		Across flats	Across corners	Black	Faced on underside	Black Swart	Faced 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	13,55	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	24,05	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	33,50	42,80	42	1 760	130
M 56	5,5	85,00	98,1	36,25	35,50	45,80	45	2 030	140