



education

Department:
Education
REPUBLIC OF SOUTH AFRICA

**T160(E)(M26)T
APRIL 2010**

NATIONAL CERTIFICATE

BUILDING AND STRUCTURAL CONSTRUCTION N6

(8060026)

**26 March (X-Paper)
09:00 – 13:00**

REQUIREMENTS: Answer book/s
Tables BOE 8/2

Candidates may use personal notes and text books.

Calculators may be used.

OPEN-BOOK EXAMINATION

This question paper consists of 4 pages, 2 schedules and 1 diagram sheet.

**DEPARTMENT OF EDUCATION
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BUILDING AND STRUCTURAL CONSTRUCTION N6
TIME: 4 HOURS
MARKS: 100**

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
 2. ALL the work must be according to the latest building regulations.
 3. ALL the calculations must be shown.
 4. Show ALL the code references.
 5. Use the attached SCHEDULES A and B to simplify your calculations.
 6. 100 marks: 100%
 7. Write neatly and legibly.
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QUESTION 1

A steel pipe column must support an axial load of 42,5 kN. The pipe column has a length of 2,800 m and is effectively held in position. The pipe column is effectively held in position at both ends and restrained against rotation at one end only. Make the necessary calculations and select the most suitable column from the given table.

Size mm	M kg/m	Ø mm	t mm	A 10^3mm^2	I 10^6mm^4	Z 10^3mm^3	I mm
76	4,01	76,5	2,2	0,5108	0,3490	9,1716	26,1
89	6,39	89,3	3,0	0,8096	0,7476	16,8197	30,4
101	8,47	101,6	3,5	1,0787	1,2992	25,575	34,7

[13]

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QUESTION 2

A simply supported beam, 533 x 210 x 109 kg/m (PF), is required to support a point load of 460 kN at mid-span. Determine the maximum effective span of the beam if the self weight is taken into consideration and the maximum bending stress = 190 MPa.

[13]

QUESTION 3

A simply supported reinforced concrete slab has an effective span of 5,200 m and supports a live load of 110 kNm². Determine the minimum effective depth of the slab if grade 25 concrete is used.

Ignore the self weight of the beam.

[8]

QUESTION 4

FIGURE 1, DIAGRAM SHEET 1 (attached), shows a connection of a steel roof truss with the direction of the forces shown in each member. Parts marked 'A' and 'B' are single discontinuous angle iron profiles, fixed both sides to a 12 mm gusset plate.

- 4.1 The part marked 'A' is fixed to the gusset by means of grade 4.6, M 22 bolts. Determine the number of M 22 bolts required to fix the part marked 'A' to the gussets safely. (The thread of the bolts is in the shearing plane). (7)
- 4.2 The part marked 'B' is fixed to the gusset by means of a fillet welding joint with a leg size of 12 mm. Calculate the minimum effective length of welding joint. (7)
- 4.3 Select a suitable equal-leg angle for the parts marked:
 - 4.3.1 'A'; of length 2,100 m (8)
 - 4.3.2 'B' (8)

Use grade 43 steel.

[30]

QUESTION 5

An axially loaded reinforced concrete column with a diameter of 725 mm has to safely support an ultimate load of 5 215 kN. Grade 30 concrete with high-yield longitudinal reinforcing bars and mild steel links are used.

- 5.1 Calculate the minimum cross sectional area of the longitudinal reinforcement and select suitable bars. (10)
- 5.2 Calculate the pitch and diameter of the links required. (5)
- 5.3 Draw, to any suitable scale, a cross-sectional view of the column to show the positioning of the reinforcement in the column. (5)

[20]

QUESTION 6

A simply supported L-beam has an effective span of 6,250 m. The total dead load is 30 kN/m² and the imposed load is 12 kN/m². Grade 30 concrete with high-yield steel reinforcement is used. Calculate suitable tension reinforcement for the beam.

(HINT: Assume that the neutral axis would be within the flange of the flanged beam).

[16]

TOTAL: 100

DIAGRAM SHEET 1

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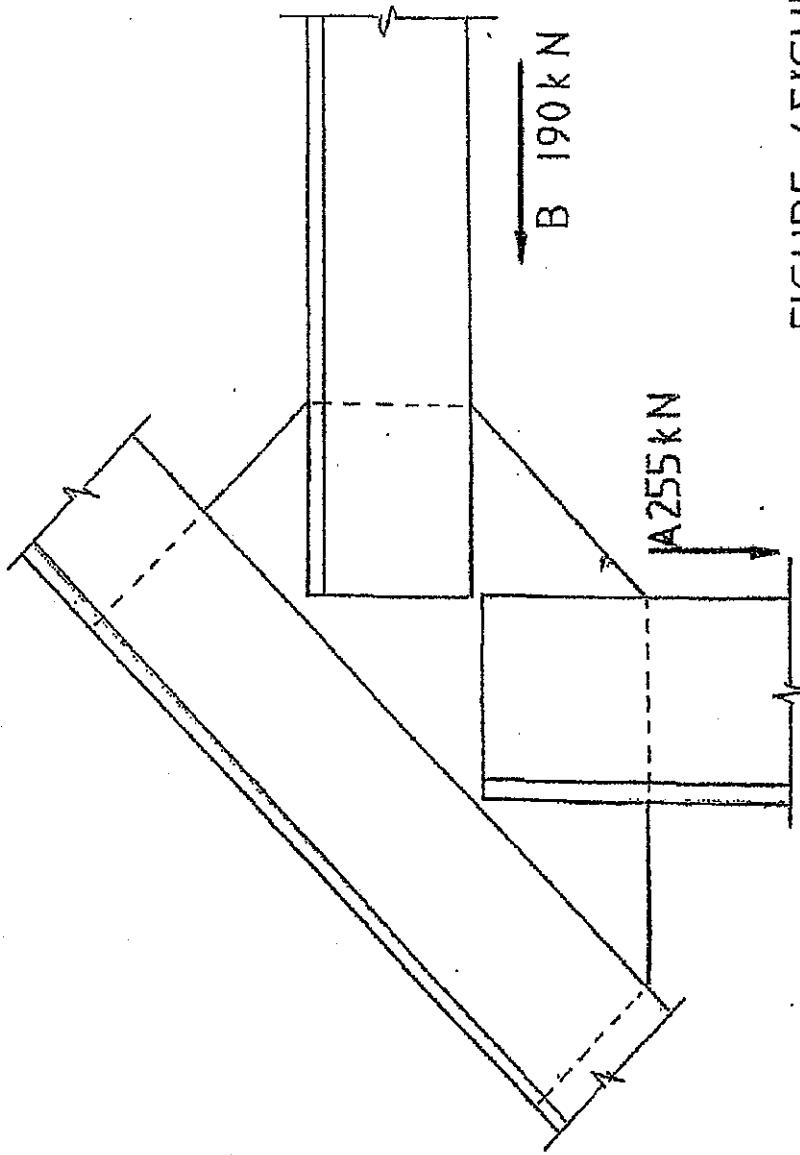


FIGURE / FIGUUR 1

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SCHEDULE A

CROSS-SECTIONAL AREAS OF REINFORCING RODS

Quantity of rods	Rod diameter (mm)									
	Ø6	Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32	Ø40	Ø50
1	28,3	50,3	78,5	113,1	314,2	314,2	490,9	805,3	1256,6	1963,5
2	57	101	157	226	402	628	982	1608	2513	3927
3	85	151	236	339	603	942	1473	2413	3779	5890
4	113	201	314	452	804	1257	1963	3217	5027	7854
5	141	251	393	565	1005	1571	2454	4021	6283	9817
6	170	302	471	679	1206	1885	2945	4825	7540	11781
7	198	352	550	792	1407	2199	3436	5630	8796	13744
8	226	402	628	905	1608	2513	3927	6434	10053	15708
9	254	452	707	1917	1810	2827	4418	7238	11310	17671
10	283	503	785	1131	2011	3142	4909	8042	12566	19635
11	311	553	864	1244	2212	3456	5400	8847	13823	21598
12	339	603	942	1357	2413	3770	5890	9651	15080	23562

CROSS-SECTIONAL AREAS OF REINFORCING RODS PER/M WIDTH OF FLOOR SLAB

Total area/m - in square mm

Spacing of rods centre to centre	Rod diameter (mm)									
	Ø6	Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32	Ø40	Ø50
50	565	1005	1571	2262	4021	6283	9817	16085	25133	39270
75	377	670	1048	1508	2681	4189	6545	10723	16755	26180
100	283	503	785	1131	2011	3142	4909	8042	12566	19635
125	226	402	628	905	1608	2513	3927	6434	10053	15708
150	188	335	524	754	1340	2094	3272	5362	8378	13090
175	162	387	449	646	1149	1795	2805	4596	7181	11220
200	141	251	393	565	1005	1571	2454	4021	6283	9817
250	113	201	314	452	804	1257	1963	3217	5027	7854
300	94	168	262	377	670	1047	1636	2681	4189	6545
350	81	144	224	323	574	898	1402	2298	3590	5610
400	71	125	196	283	503	786	1227	2011	3142	4909
500	57	101	157	226	402	620	982	1608	2513	3927
	Typical secondary reinforcement				Typical main reinforcement (floor slabs)					

SCHEDULE B

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ISOMETRIC BLACK HEXAGON BOLTS AND NUTS

Nominal size and thread diameter	Pitch of thread coarse pitch series	DIMENSIONS IN MILLIMETRES						Minimum distance between centres
		Maximum width of head and nut		Maximum height of head		Maximum thickness of nut		
Across flats	Across corners	Black	Faced on underside	Black	Faced one side	area in mm ²		
M6	1	10.00	11.5	4.375	4.25	5.375	5	20.1
M8	1.25	13.00	15.0	5.875	5.74	6.875	6.5	36.6
M10	1.5	17.00	19.6	7.45	7.29	8.45	8	58.0
M12	1.75	19.00	21.9	8.45	8.29	10.45	10	84.3
M16	2	24.00	27.7	10.45	10.29	13.55	13	157
M20	2.5	30.00	34.6	13.90	13.35	16.55	16	24.5
(M22)	2.5	32.00	36.9	14.90	14.35	18.55	18	30.3
M24	3	35.00	41.6	15.90	15.35	19.65	19	35.3
(M27)	3	41.00	47.3	17.90	17.35	22.65	22	45.9
M30	3.5	46.00	53.1	20.05	19.42	24.65	24	56.1
(M33)	3.5	50.00	57.7	22.05	21.42	26.65	26	69.4
M36	4	55.00	63.5	24.05	23.42	29.65	29	81.7
(M39)	4	60.00	69.3	26.05	25.42	31.80	31	97.6
M42	4.5	65.00	75.1	27.05	26.42	34.80	34	112.0
(M45)	4.5	70.00	80.8	29.05	28.42	36.80	36	130.0
M48	5.0	75.00	86.6	31.05	30.42	38.80	38	147.0
(M52)	5.0	80.00	92.4	34.25	33.50	42.80	42	176.0
M56	5.5	85.00	98.1	36.25	35.50	45.80	45	203.0