higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE: MULTI-DISCIPLINARY DRAWING OFFICE PRACTICE

STRUCTURAL STEEL DETAILING

(8090225)

17 November 2022 (X-paper)
09:00–13:00

REQUIREMENTS: **A2, A3 and A4 drawing paper**
Hot-rolled steel profiles

Drawing instruments, nonprogrammable calculators, and computer software may be used.

This question paper consists of 5 pages, 2 diagram sheets, and 2 information sheets.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE: MULTI-DISCIPLINARY
DRAWING OFFICE PRACTICE
STRUCTURAL STEEL DETAILING N5
TIME: 4 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer all the questions.
2. Read all the questions carefully.
3. Each drawing question must be answered on a separate A3 or A4 drawing sheet when using the computer.
4. Plot the answers on ONE side of the drawing paper only.
5. All candidate information must be plotted in the title block.
6. Candidates are responsible, under suitable supervision, for the plotting of their own answers.
7. All the standard symbols (STRUCTURAL STEEL) may be obtained from the symbols' directory.
8. Before any drawing work is commenced, a border must be retrieved from the symbols' directory and displayed on the screen.
9. Number the answers according to the numbering system used in this question paper.
10. Computers may be used as drawing aids.

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QUESTION 1: INTRODUCTION

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (1.1–1.10) in the ANSWER BOOK.

1.1 Steel is a man-made metal derived from iron.

1.2 The term *structural steel* refers to the various products of a steel mill, such as sections, plates and bars.

1.3 The hot-rolled sections are produced by passing a heated billet between successive pairs of rolls that squeeze the steel, stage by stage, into the final shape.

1.4 Cold-formed sections are not made by passing a thin steel strip (not preheated) through sets of rolls that form the strip into the desired section by a bending process.

1.5 Structural steel is not produced in a number of different-strength grades.

1.6 The different forms in which steel is used for steel structures are I-sections, H-sections, channels, angles, flats, bars, plates, sheets, cold-formed sections and hollow sections.

1.7 We distinguish between two main classes, namely hot-rolled sections and cold-formed sections.

1.8 A structural-steel detailer produces detail drawings for shop fabrication.

1.9 In structural-steelwork detailing, dimensions are usually given in whole numbers.

1.10 Steel production starts with mining raw materials in an open-cast mine.

(10 × 1) **[10]**

QUESTION 2: BEAMS

FIGURE 1, DIAGRAM SHEET 1 shows a view on a steel structure.

As a structural-steel detailer, make fully detailed drawings (scale 1:10) of the beams marked B1 and B2 and supply enough information for the manufacturing of the beams in a steel fabrication workshop. All plates are 10 mm thick and all bolts are M20.

Show the following information:

2.1 The column centres

2.2 Lengths and sizes of beams

2.3 Dimensions of the beams over end plates

2.4 Dimensions for the drilling of the bolt holes

2.5 View with dimensions of end plates

2.6 Item marks, number of beams required and diameter of bolt holes

2.7 Top of beams

Information not given is left to your own discretion.

[25]

QUESTION 3: COLUMNS

Refer to FIGURE 1, DIAGRAM SHEET 1. As a structural-steel detailer, make fully detailed drawings (scale 1:10) of the columns marked C1 and C2 and supply enough information for the manufacturing of the columns in a workshop. All plates are 10 mm thick and bolts are M20.

Show the following information:

3.1 Lengths and sizes of columns

3.2 Dimensions of the columns over cap and base plates

3.3 Dimensions for the drilling of the bolt holes

3.4 View with dimensions of cap and base plates

[25]

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QUESTION 4: LATTICED GIRDERS

FIGURE 2, DIAGRAM SHEET 2 shows a line diagram of a typical WELDED latticed girder. Draw, to scale 1:5, typical details of the following:

4.1 Detail A

4.2 Detail B

4.3 Detail C

Specifications:

- Top and bottom booms: Rolled steel angle profiles, 120 × 120 × 10.
- All internal members: Rolled steel angle profiles, 90 × 90 × 8.
- All gusset plates are 10 mm thick.
- Do not insert any dimensions.
- Gusset plate sizes as well as information not given are left to your own discretion.
- Print a suitable title and scale centrally below the details.

[15]

QUESTION 5: TRUSSES

5.1 Refer to FIGURE 1, DIAGRAM SHEET 1, and draw to scale 1:20 a line diagram of the BOLTED steel roof truss. (5)

5.2 Draw to scale 1:5 typical bolted details at A and B.

Use the following specifications:

- Top and bottom boom: 100 × 100 × 10 hot-rolled steel angle profiles
- All internal members: 80 × 80 × 10 hot-rolled steel angle profiles
- Gusset plates: 10 mm thick
- Use bolt-hole centres of 100 mm and edge distances of 35 mm.
- All bolt holes are drilled on the centre lines of the angles, and all bolts are M20.
- Insert suitable dimensions. (20)

[25]

TOTAL: 100

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DIAGRAM SHEET 1

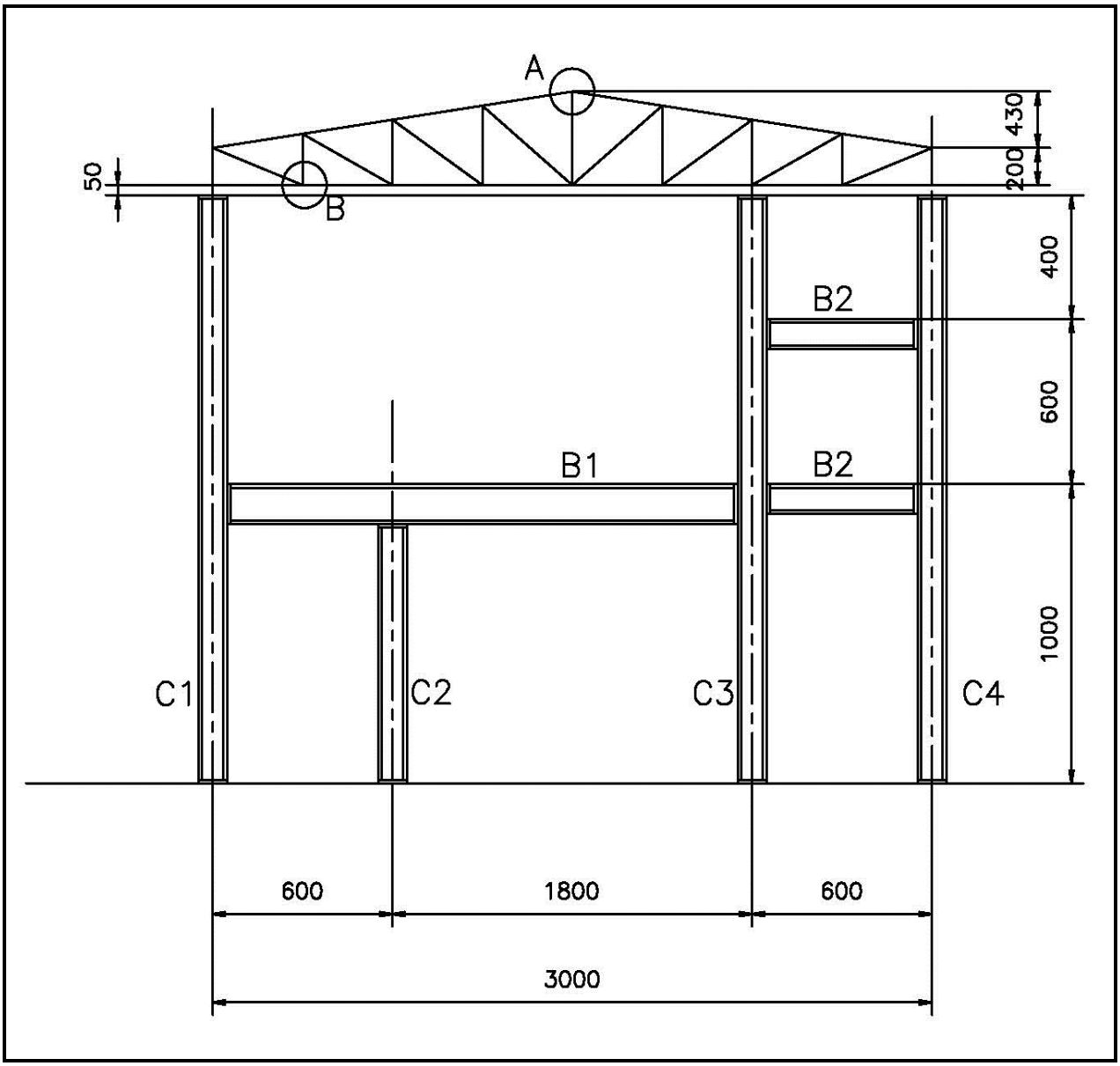


FIGURE 1

B1	**UB 254 × 146 × 31 kg/m**	**C1**	**UC 203 × 203 × 46 kg/m**
B2	**UB 203 × 133 × 25 kg/m**	**C2**	**UC 203 × 203 × 46 kg/m**
		C3	**UC 203 × 203 × 46 kg/m**
		C4	**UC 203 × 203 × 46 kg/m**

END PLATES	**10 mm WITH 4 × M20 BOLTS**
BASE PLATES	**20 mm WITH 2 × M20 BOLTS**

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DIAGRAM SHEET 2

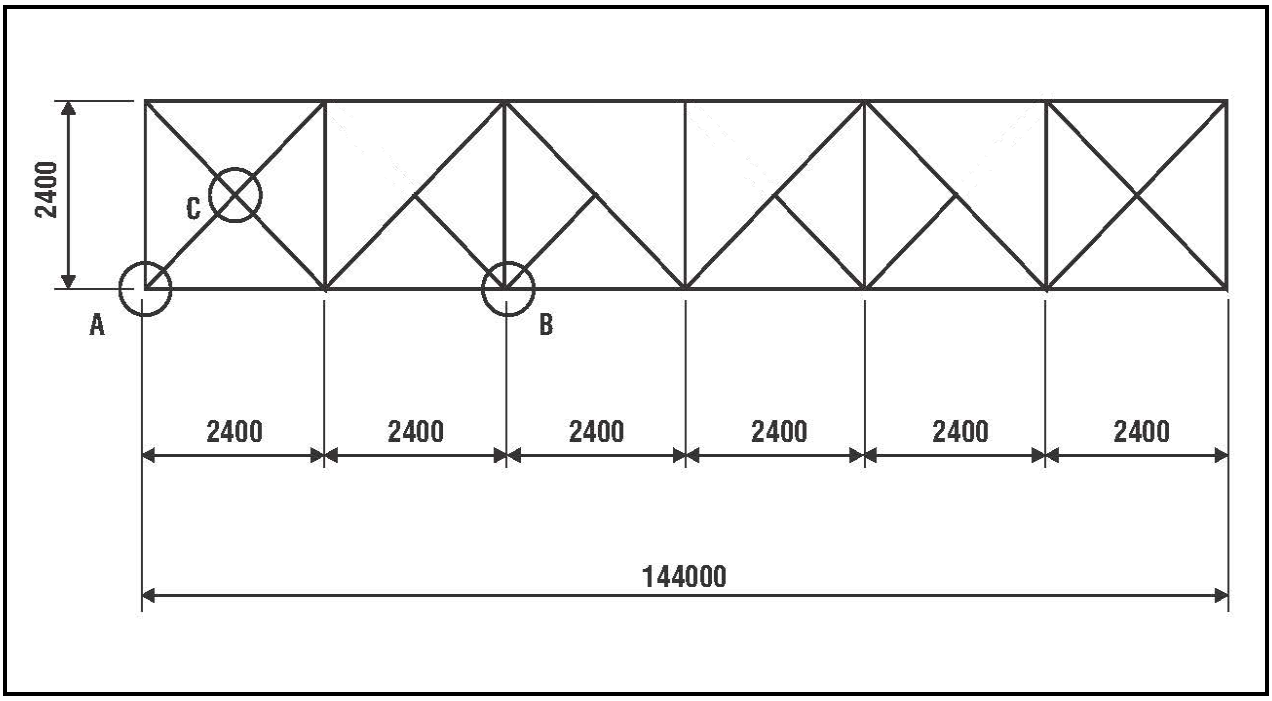
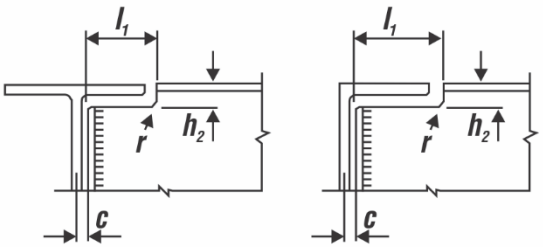


FIGURE 2

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INFORMATION SHEET 1



Dimension c is to face of end plate or angle cleat.
r = 10mm minimum
Dimensions are in mm.

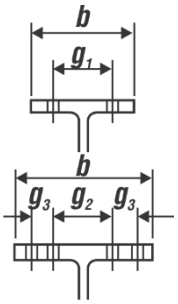
	Section	c	Notch			Section	c	Notch	
			l_1	h_1				l_1	h_1
I - Sections (parallel flange)	100 x 55 x 8	4	33	15	I - Sections (parallel flange)	533 x 210 x 82	4	33	15
	120 x 64 x 19	4	37	15		93	4	37	15
	140 x 73 x 13	4	42	20		101	4	42	20
	160 x 82 x 16	5	47	20		109	5	47	20
	180 x 91 x 19	5	51	20		122	5	51	20
	200 x 100 x 22	5	56	25		610 x 229 x 101	5	56	25
	203 x 133 x 25	5	74	20		113	5	74	20
	30	5	74	20		125	5	74	20
	254 x 146 x 31	5	81	20		140	5	81	20
	37	5	81	25	I - Sections (taper flange)	127 x 76 x 13	5	81	25
	43	6	81	25		152 x 89 x 17	6	81	25
	305 x 102 x 25	5	57	25		178 x 102 x 22	5	57	25
	29	5	57	20		203 x 102 x 25	5	57	20
	33	5	57	20		52	5	57	20
	41	5	91	25		254 x 152 x 59	5	91	25
	46	5	91	25		305 x 152 x 66	5	91	25
	54	6	91	25	Channels	100 x 50 x 11	6	91	25
	356 x 171 x 45	5	94	25		120 x 55 x 13	5	94	25
	51	5	94	25		140 x 60 x 16	5	94	25
	57	6	94	30		160x 65 x 19	6	94	30
	67	7	94	30		180 x 70 x 22	7	94	30
	104 x 140 x 39	5	78	25		200 x 75 x 25	5	78	25
	46	5	78	25		220 x 80 x 29	5	78	25
	54	6	97	25		240 x 85 x 32	6	97	25
	60	6	97	30		260 x 90 x 38	6	97	30
	67	6	97	30		280 x 95 x 42	6	97	30
	457 x 191 x 67	6	103	25		300 x 100 x 46	6	103	25
	75	7	103	30		76 x 38 x 7	7	103	30
	82	7	103	30		127 x 64 x 15	7	103	30
	90	7	103	30		152 x 75 x 18	7	103	30
	98	8	103	35		178 x 54 x 15	8	103	35
H - Sections	152 x 152 x 23	5	84	20		381 x 102 x 55	5	84	20
	30	5	84	20	H - Sections	254 x 254 x 107	5	84	20
	37	6	84	20		132	6	84	20
	203 x 203 x 45	6	111	25		167	6	111	25
	52	6	111	25		305 x 305 x 97	6	111	25
	60	7	111	30		118	7	111	30
	72	7	111	30		137	7	111	30
	86	8	111	35		158	8	111	35
	254 x 254 x 73	6	138	30		198	6	138	30
	89	7	138	35		240	7	138	35

DIMENSIONS OF BEAM NOTCHES

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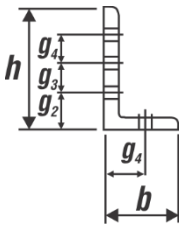
INFORMATION SHEET 2

Recommended gauges and back marks for I- and H-sections



b (mm)	Gauge (mm)			Ø max. (mm)
	g_1	g_2	g_3	
64	32	120	60	12
73-82	40	140	75	12
89-91	50			12
102	54			16
133-146	70			20
152	90			20
165-191	90			24
203-254	140			24
305	140			24
368-406	140			24

Recommended gauges and back marks for angles



h or *b* (mm)	Back mark g_1 (mm)	Ø max. (mm)	*h* or *b* (mm)	Back mark (mm)				*h* or *b* (mm)
				g_1	g_2	g_3	g_4	
25	15	8	90	50	45	45		24
30	17	10	100	50				24
35	20		120	60				24
40	22		120					16
45	25		125	65				24

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