higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

CIVIL AND STRUCTURAL STEEL WORK DETAILING

(First paper)

NQF LEVEL 4

(12050674)

7 November 2022 (X-paper)
09:00–11:00

REQUIREMENTS: **A3 drawing sheet**
Standard hot-rolled structural steel sections (BOE 8/1)

Calculators and drawing instruments may be used.

This question paper consists of 5 pages and 1 formula sheet.

077Q1N2207

Copyright reserved

TIME: 2 HOURS
MARKS: 75

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. Use only a black or blue pen.
6. Write neatly and legibly.

Copyright reserved

QUESTION 1: INTRODUCTION TO CIVIL AND STRUCTURAL STEEL WORK

1.1 Name TWO types of reinforcement bars. (2)

1.2 List FOUR types of forces. (4)

1.3 Name THREE methods to calculate resultant forces. (3)

1.4 Explain the term *moment of force*. (2)

1.5 Name THREE types of footings. (3)

1.6 Which types of drawing are required for reinforced concrete? (2)

1.7 Simply supported beams are subjected to point loads and uniformly distributed loads.

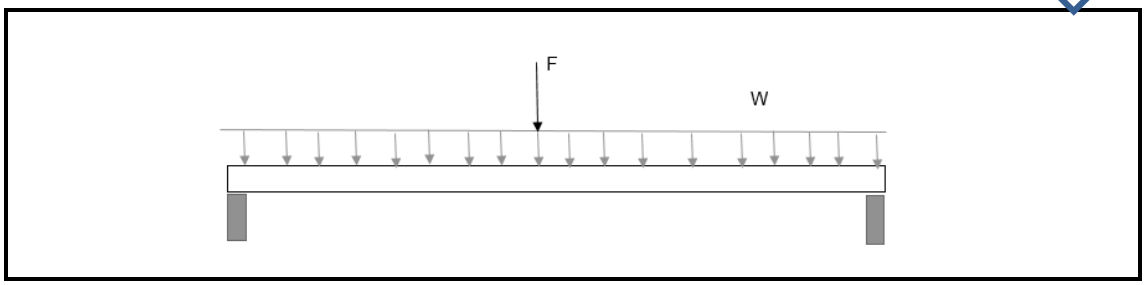

FIGURE 1

1.7.1 Explain the effect that F and W will have on the beam. (2)

1.7.2 Illustrate the effect explained in QUESTION 1.7.1 by means of a sketch and label the following, top, bottom and neutral. (4)

1.8 Explain the forces acting on the beam. (2)

1.9 Name a composite material that results from combining concrete and steel. (1)

1.10 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (1.10.1–1.10.5) in the ANSWER BOOK.

1.10.1 Beams and columns with too much steel will result in concrete failure.

1.10.2 Concrete strength is always tested in laboratories.

1.10.3 The strength of concrete is always measured in newton.

1.10.4 Concrete is more expensive than steel.

1.10.5 Using too much concrete in reinforced beams and columns will result in concrete failure.

(5 × 1) (5)

[30]

QUESTION 2

2.1 Differentiate between *tread plates* and *rectangular grids*. (2 + 2) (4)

2.2 Differentiate between *angle cleats* and *gusset plates*. (2 + 2) (4)

2.3 What is a joint on a truss? (2)

[10]

QUESTION 3

3.1 Choose an item from COLUMN B that matches an item in COLUMN A. Write only the letter (A–J) next to the question number (3.1.1–3.1.10) in the ANSWER BOOK.

COLUMN A		COLUMN B	
3.1.1	Point load	A	unaligned forces pushing one part of the body in one direction and the other part of the body in an opposite direction
3.1.2	Moment	B	stress
3.1.3	Distributed load	C	millimetres (mm)
3.1.4	Load and force	D	bar with a designation R
3.1.5	Ribbed reinforcement bar	E	newton-millimetres (N.mm)
3.1.6	Dimensions	F	load that does not act at one point on the beam but spreads across the beam
3.1.7	Plain bar	G	steel reinforcement bar with a designation of Y
3.1.8	Strength and stress	H	newton (N)
3.1.9	Shear forces	I	megapascal (MPa)
3.1.10	Pushing force	J	load that acts on or from a single point

(10 × 1) (10)

3.2 FIGURE 2 shows a loaded roof truss.

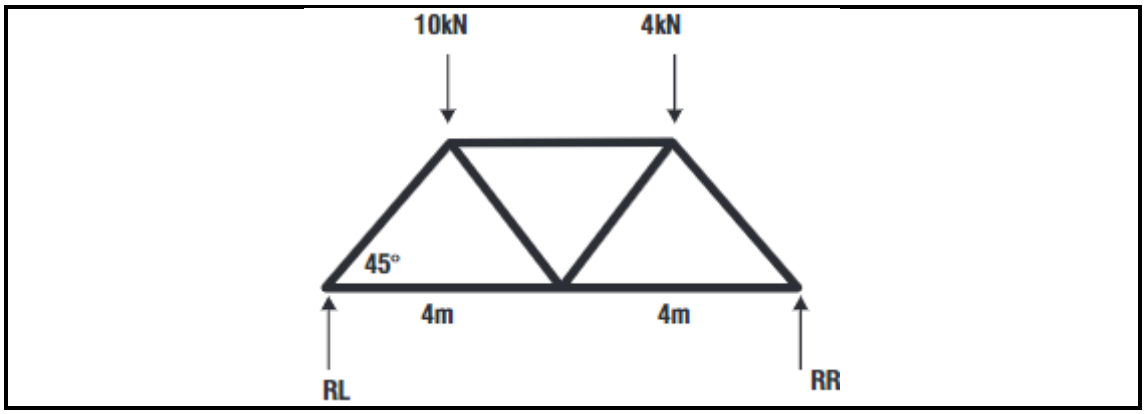

FIGURE 2

Determine the reactions RL and RR. (10)
[20]

QUESTION 4

4.1 Explain the procedure of conducting a slump test in the correct sequence. (10)

4.2 Use the following slumps to indicate whether the concrete is sloppy, stiff or unacceptable:

4.2.1 30

4.2.2 120

4.2.3 200

4.2.4 65

4.2.5 90

(5 × 1) (5)
[15]

TOTAL 75

Copyright reserved

FORMULA SHEET

$F = ma$

$W = mg$

$M_B = F_A d_{AB}$

$\sum Fy = 0$

$\sum Fx = 0$

$\sum M = 0$

$\sigma = \frac{F}{A}$

$F_C = F_S$

$M = F_S \times$ perpendicular distance

$M = F_C \times$ perpendicular distance

$ax^2 + bx + c = 0$

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$UDL = Y_{CON} \times$ cross-sectional area

$F_C = 0{,}45\sigma cb(0{,}9x)$

$F_C = 0{,}45\sigma bh$

$F_S = 0{,}87\sigma y A_{st}$

$F_S = 0{,}73\sigma y A_{sc}$

$N = F_C + F_S$

$Q_B A - N - Y_S(1)(A) - Y_C(h)(A) = 0$

$A = \frac{N}{QB - YS(1) - YC(h)}$

$Q_U = \frac{UDL}{A}$

$M_r = \emptyset Z_{Pl} f_y$

$M_r = \emptyset Z_e f_y$

Self-weight of a beam $= m \times a$

$\lambda = \frac{KL}{r}\sqrt{\frac{fy}{\pi^2 E}}$

$C_r = \emptyset A f_y (1 + \lambda^{2,68})^{-1/1,34}$

$T_r = \emptyset A fy$

$F_{AE}\cos\theta + F_{AC} = 0$

$F_{AE} = -\frac{100}{\sin 30}$

$F_{AB}\sin\theta - F_{BE} = 0$

Maximum compressive force $= M_{MAX}/h$

Maximum tensile force $= F_{SMAX}/\cos\emptyset$

$F_R = F_1 + F_2 + F_3$

$0{,}405\sigma_C cbx = 0{,}87\sigma_y A_{st}$

Copyright reserved