SCG.'

Department:

Higher Education and Training

# REPUBLIC OF SOUTH AFRICA

APRIL EXAMINATION

NATIONAL CERTIFICATE

# STRENGTH OF MATERIALS AND STRUCTURES N5

(8060065)

## 9 April 2014 (Y-Paper)

Requirements: 1. Hot rolled structural steel sections BOE8/2 Calculators may be used.

This question paper consists of 5 pages and 4 diagram sheets\*

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NATIONAL CERTIFICATE

STRENGTH OF MATERIALS AND STRUCTURES N5

TIME: 3 HOURS

MARKS: 100

INSTRUCTIONS AND INFORMATION Answer ALL the questions.

Read ALL the questions carefully.

Number the answers according to the numbering system used in this question paper.

Write neatly and legibly,

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The following results were recorded during a tensile test on a mild-steel specimen:

|  |  |  |
| --- | --- | --- |
| Diameter of test piece |  |  |
| Gauge length | 56,3 mm |  |
| Load at yield point | 20,5 kN |  |
| MaxiiTiurn load | 48,6 kN |  |
| Distance between gauge marks after fracture | 72,9 mm |  |
| Minimum diameter of fractured test piece  Calculate the following:  Tensile strength  Yield stress  Percentage elongation  Percentage reduction in area  QUESTION 2 | 7,98 mm |  |
| The stepped bar shown in FIGURE 1 DIAGRAM SHEET 1 (attached) is fixed securely to a rigid support at its upper enq and has a rigid collar at its lower end. Through what height can a load of kN be allowed to fall if the maximum permissible stress in the bar is 64 MPa.AFÖ,öd42 m?and AF 0,0026 m 2? | |
| E = 200 GPa.  QUESTION 3  A column NIC) m longis formed by lacing four 120 mmx 120 mm x 10 mm angles as shown in FIGURE 2 DIAGRAM SHEET 2 (attached) to form a square cross-section. Using,Rankine formulae for pinned ends, determine the safe axial load for the column. Take the yield stress as 245 MPa, the factor of safety as 5 and a — 1 The | | [13] |
| contribUtjon of the lacing bars to the strength of the column may be disregarded. | | [12] |

### QUESTION 4

A rectangular strip of aluminium 50 mm wide and 15 mm thick is clad on both the 50 mm sides by brass strips 5 mm thick (parallel coupling). The three strips are bonded together so that under all conditions they have the same length.

At 40 o c the length of the composite bar is 630 mm. The temperature of the composite bar is then raised to 1 10 Q C, Eal = 80 GPa; = 22x10-6/0c; Ebrass — 108 GPa and 5<10 6/0 c.

Calculate the following:

The stresses set up in the two metals

The final length of the composite bar

[12]

|  |  |
| --- | --- |
| QUESTION 5  A symmetrical built-up beam of I-sectional profile is as shown in FIGURE 3 DIAGRAM SHEET 3(attached).  Calculate the following: |  |
| 5.1 The position ot the neutral axis | (5) |
| 52 The second moment of area of the section about the neutral axis (Ixx) | (7) |
| 5.3 The least section modulus about the neutral axis (Zxx)  5.4 The mä\*jmum span which can be used if the beam is to be simply supported to carry a uniformly distributed load of 5,6 kN/m and the maximum permissible | (2) |
| stress is 60 MPa. | (5) |

[19]

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"FRT!ON 6

A shaft is to be used with a marine engine delivering 1 300 kW at 1 18 rpm. The maximum allowable shear stress for the shaft material is 56 MPa and the maximum torque to be transmitted by the shaft is 34% more than the mean torque. G = 80 GPa.

Calculate the following:

6.1 The internal and external diameters for a diameter ratio of 2 : 1

6.2 The twist in the shaft over a length of 2,5 m in degrees when transmitting the maximum torque

### QUESTION 7

Graphically determine the magnitude and nature of forces in the pin-jointed framework shown in FIGURE 4 DIAGRAM SHEET 1 (attached).

### QUESTION 8

A boiler drum must withstand an internal, pressure of 2,6 MPa and has a wall thickness of 20 mm. The drum is riveted along its length as well as around the circumference. The joint efficiencies of the longitudinal and circumferential joints are 82% and 44% respectively. The allowable Stress in the material must not exceed 120 MPa. Calculate the allowable internal diameter of the boiler drum.

TOTAL: 100

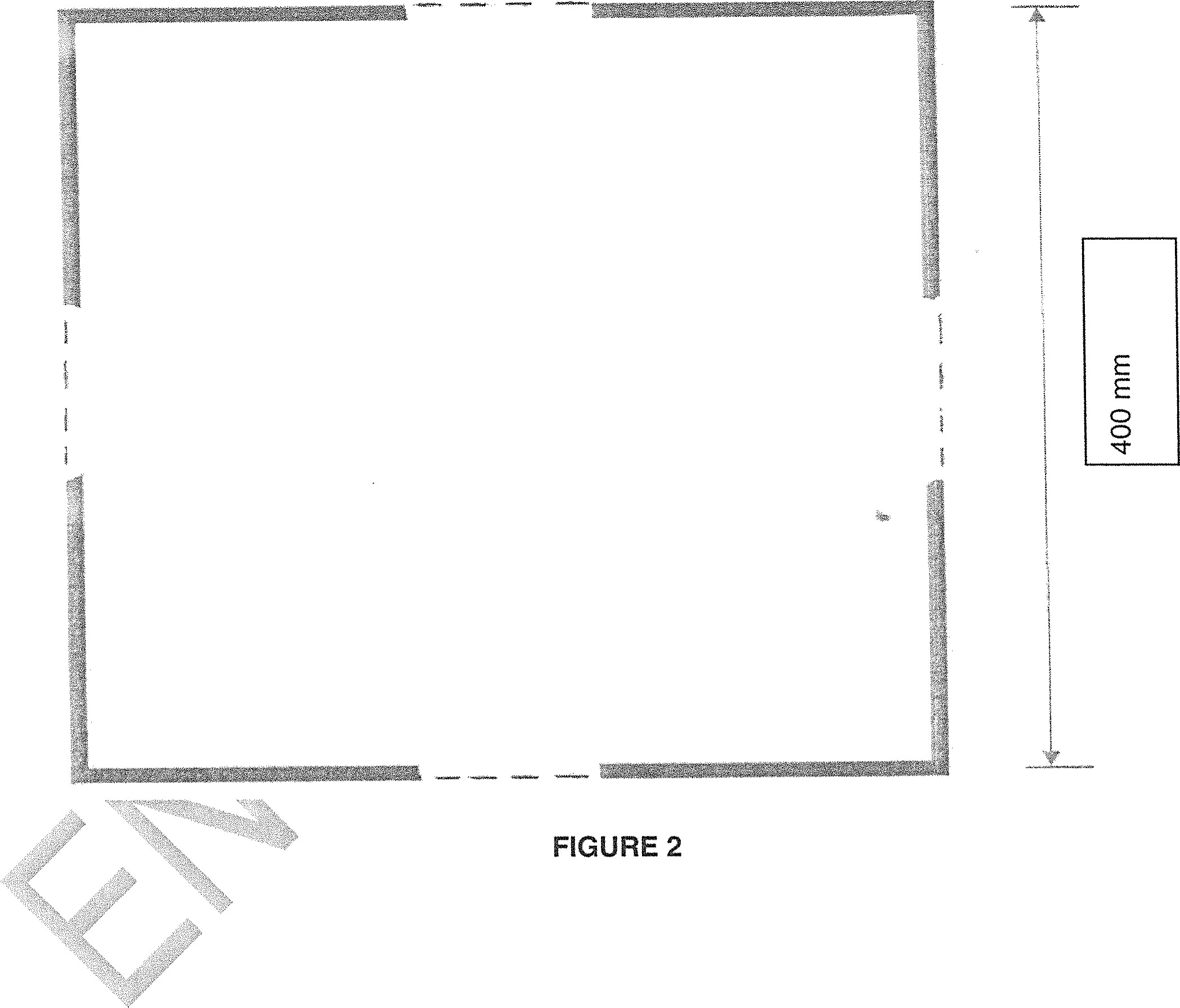
FIGURE 1





400 mm

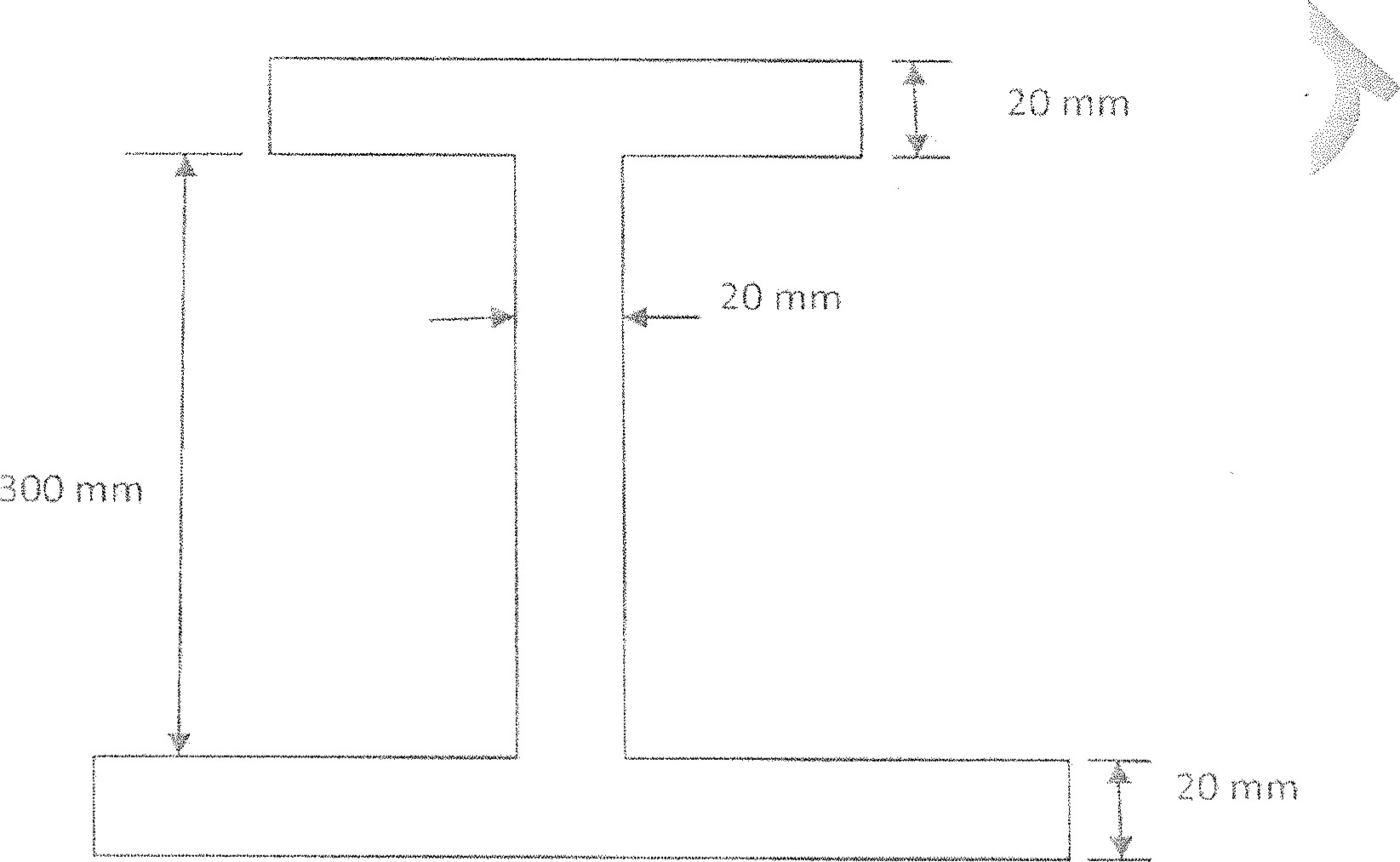


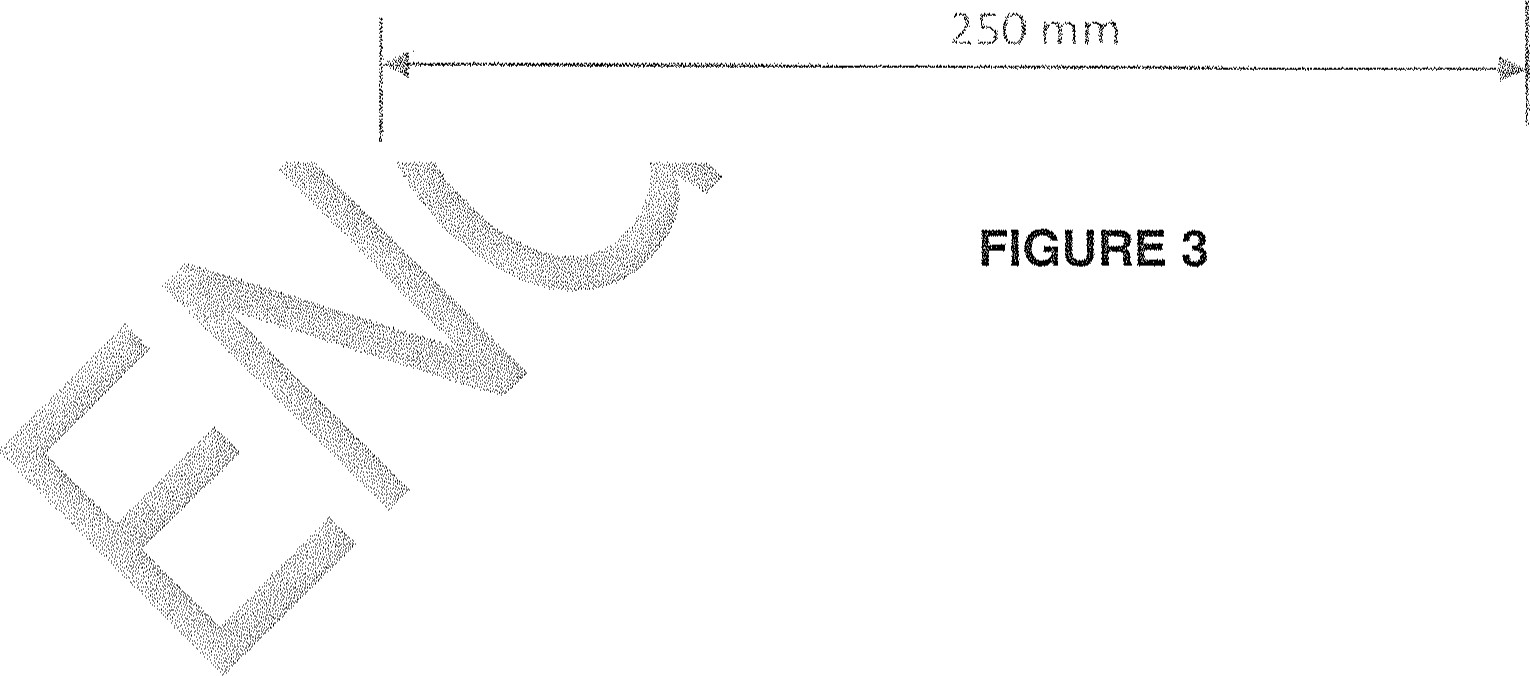












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4 kN

20 m

FIGURE 4