higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

BUILDING AND STRUCTURAL CONSTRUCTION N5

03 AUGUST 2021

This marking guideline consists of 9 pages.

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QUESTION 1

1.1 **Diameter of the bolts**

Force = 96 kN; Shear stress = 104 MPa

$$\text{Stress} = \frac{Load}{Area}$$

$$\text{Force} = \text{area x stress x n x 2} \quad \checkmark \qquad \text{(Double shear)}$$

$$96 \text{ x } 10^3 = \frac{\pi d^2}{4} \text{ x } 104 \text{ x } 3 \text{ x } 2$$

$$96 \text{ x } 10^3 \text{ x } 4 = \pi \text{ x } d^2 \text{ x } 3 \text{ x } 2$$

$$d = \sqrt{\frac{96\ x\ 10^3\ x\ 4}{104\ x\ \pi\ x\ 3\ x\ 2}} \quad \checkmark$$

$$d = 13{,}99 \text{ mm} \quad \checkmark$$

Use = 6M16 bolts ✓ (4)

1.2 **Maximum load**

Bearing stress = 248 MPa; Tie bars = 125 x 8 mm Connector plates = 6 mm thick and M16 bolts.

$$\text{Stress} = \frac{Load}{Area}$$

$$\text{Force} = \text{area x stress x } \eta$$

$$\text{Force} = (\text{d x t}) \text{ x stress x } \eta \quad \checkmark$$

$$= (16 \text{ x } 6{+}6) \text{ x } 248 \text{ x } 3 \quad \checkmark$$

Force = 142,848 kN ✓ (3)

1.3 **Tearing stress**

Force = 295 kN; Tie bars = 130 × 8 mm and M12 bolts.

$$\text{Stress} = \frac{Load}{Area}$$

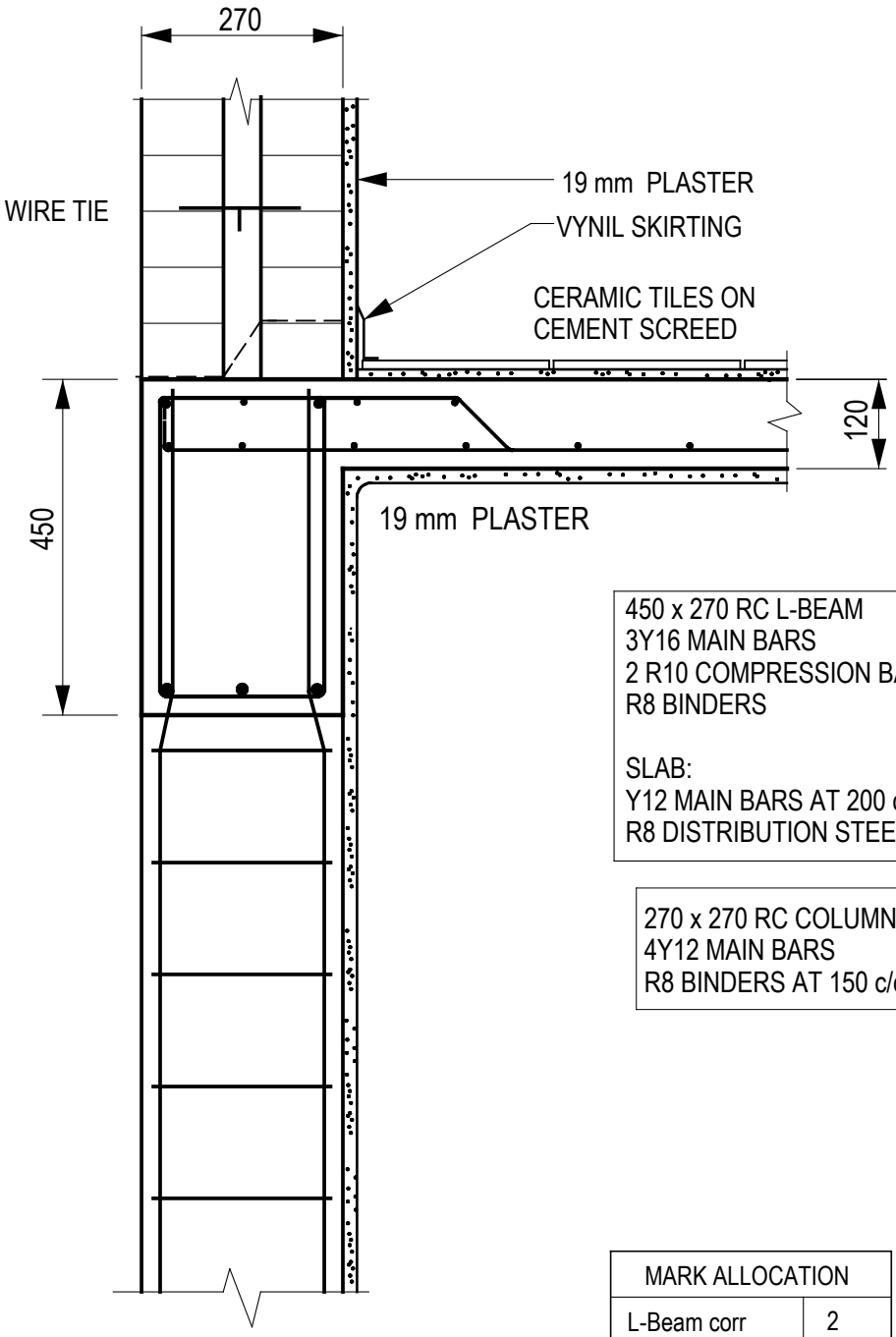
$$\text{Tearing stress} = \frac{Load}{(B\ x\ T) - \eta\ (d\ x\ t)} \quad \checkmark$$

$$\text{Tearing stress} = \frac{295\ x\ 10^3}{(130\ x\ 8) - 3\ (14\ x\ 8)} \quad \checkmark$$

Tearing stress = 419,03 MPa ✓ (3)

[10]

QUESTION 2



450 x 270 RC L-BEAM
3Y16 MAIN BARS
2 R10 COMPRESSION BARS
R8 BINDERS

SLAB:
Y12 MAIN BARS AT 200 c/c
R8 DISTRIBUTION STEEL

270 x 270 RC COLUMN
4Y12 MAIN BARS
R8 BINDERS AT 150 c/c

MARK ALLOCATION	
L-Beam corr	2
Column	1
Brick wall	2
All reinforcement	5
Floor & details	4
Accuray	3
Labels	2
Dimensions	1
	20

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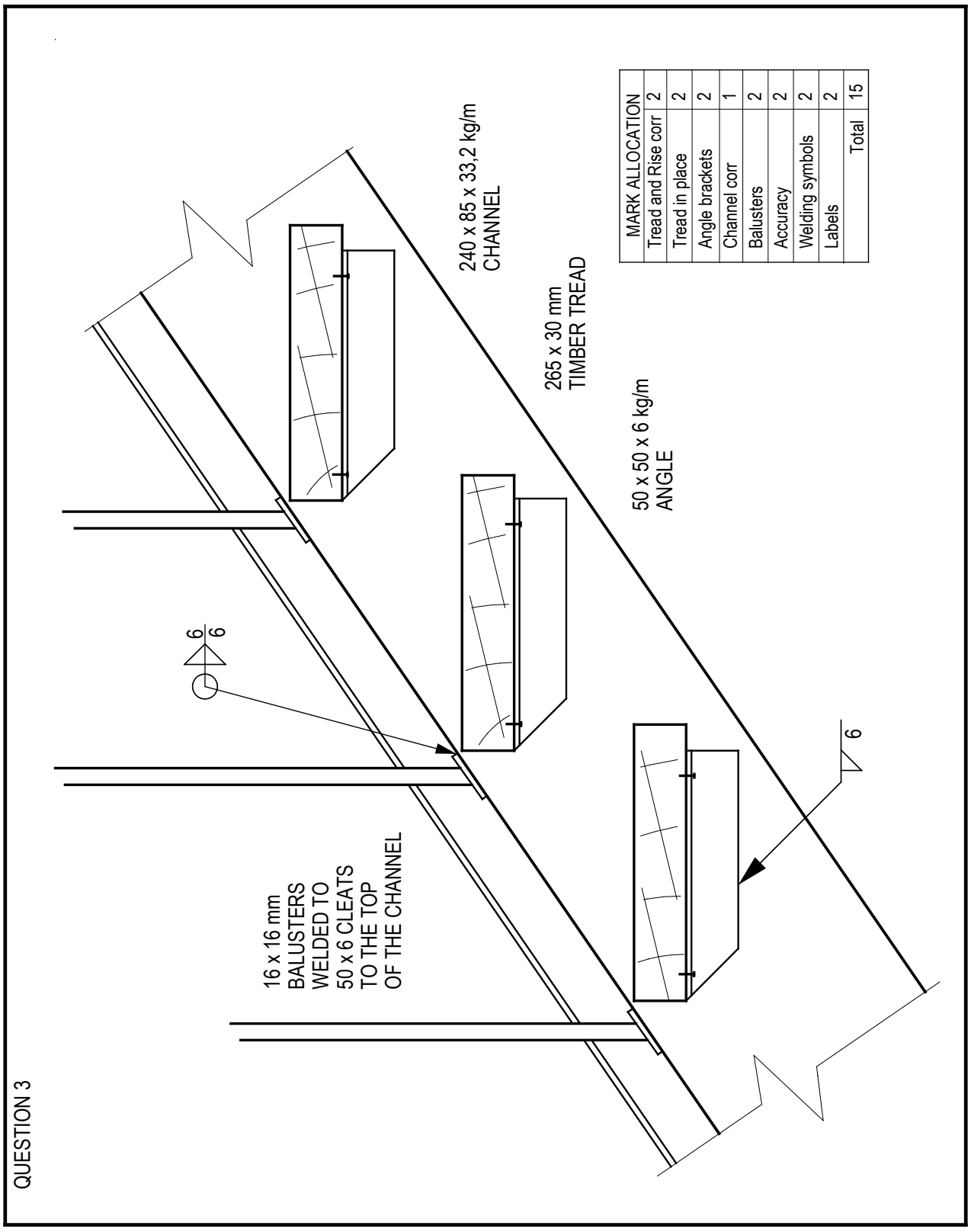
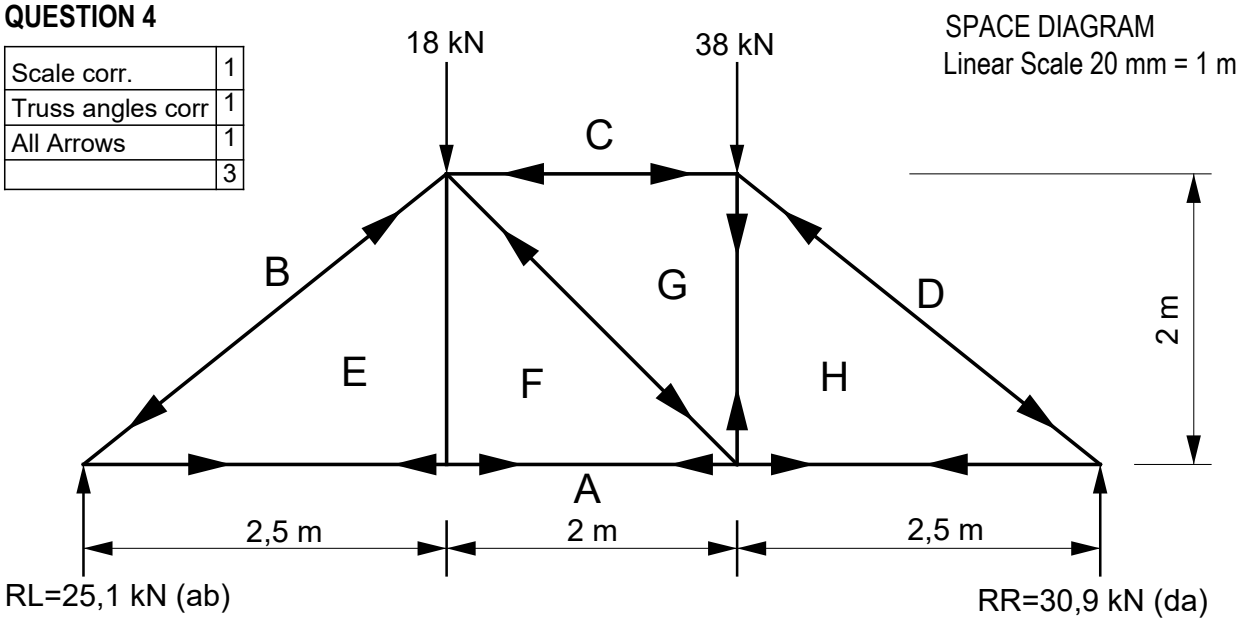
QUESTION 3


QUESTION 3
240 x 85 x 33,2 kg/m
CHANNEL
265 x 30 mm
TIMBER TREAD
50 x 50 x 6 kg/m
ANGLE
16 x 16 mm
BALUSTERS
WELDED TO
50 x 6 CLEATS
TO THE TOP
OF THE CHANNEL
6
6
6
MARK ALLOCATION
Tread and Rise corr 2
Tread in place 2
Angle brackets 2
Channel corr 1
Balusters 2
Accuracy 2
Welding symbols 2
Labels 2
Total 15

QUESTION 4

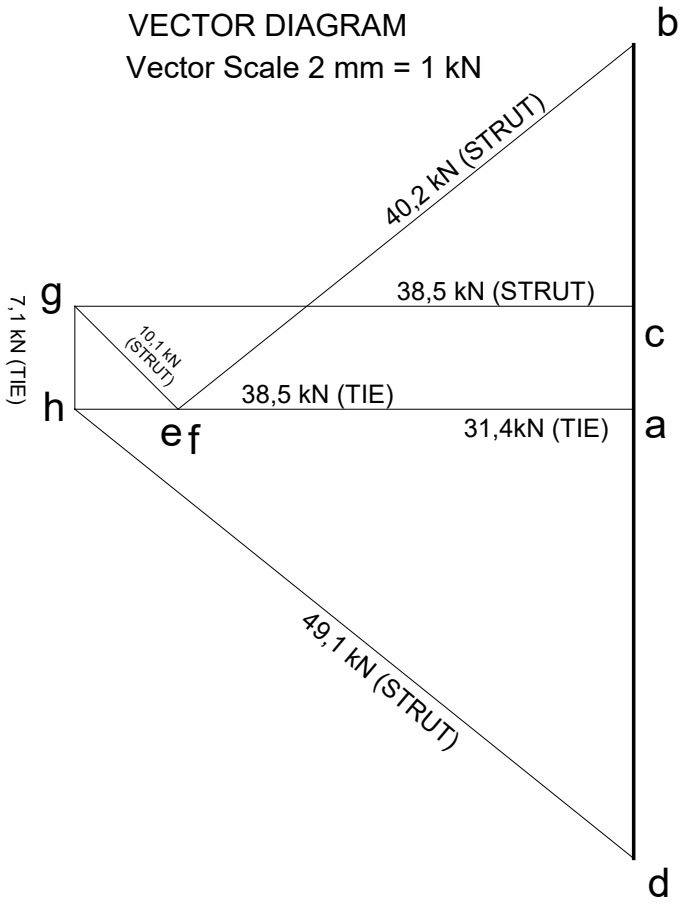
Scale corr.	1
Truss angles corr	1
All Arrows	1
	3



Calculate Reactions

RR x 7 = (38 x 4,5) + (18 x 2,5)
RR = 216 / 7
RR = 30,9 kN (1 mark)

RL x 7 = (18 x 4,5) + (38 x 2,5)
RL = 176 / 7
RL = 25,1 kN (1 mark)



MEMBER	MAGNITUDE	TYPE
AE	31,4 kN	Tie
AF	31,4 kN	Tie
AH	38,5 kN	Tie
BE	40,2 kN	Strut
CG	38,5 kN	Strut
DH	49,1 kN	Strut
EF	00,00	Redundant
FG	10,1 kN	Strut
GH	7,1 kN	Tie

(15 marks)

18 answers corr = 15 marks; 14 corr = 10 marks; 10 corr = 8 marks; 8 corr = 6 marks; 6 corr = 4 marks; 4 corr = 2 marks; 2 corr = 1 mark

[Total = 20]

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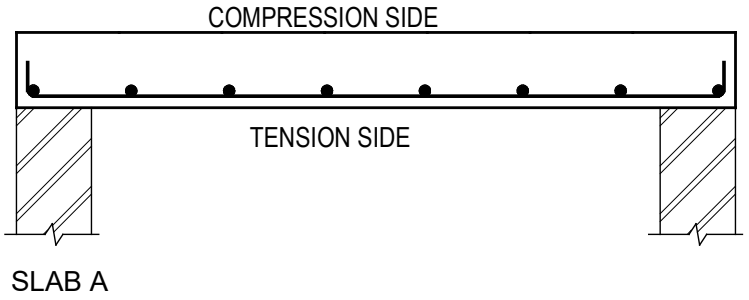
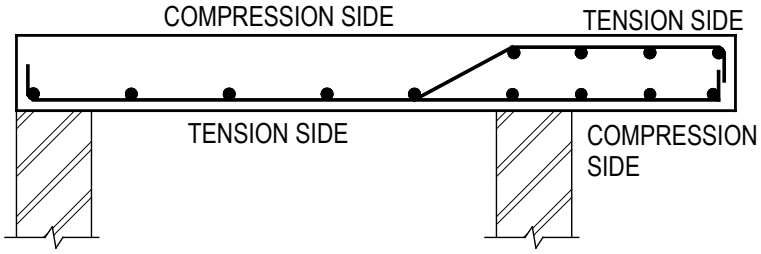
QUESTION 5

QUESTION 5



SLAB A

MARK ALLOCATION (SLAB A)	
Tension steel corr	1
Distribution steel corr	1
Tension & compression indicated	2
Total	4



SLAB B

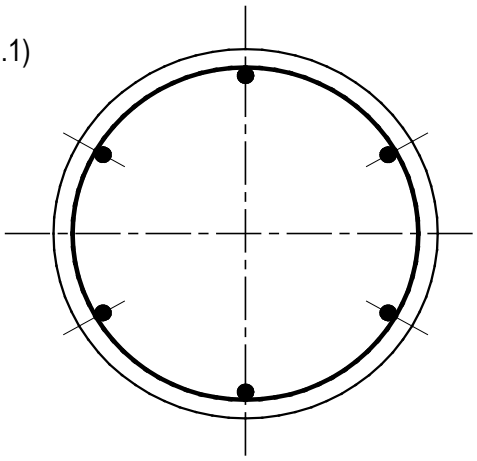
MARK ALLOCATION (SLAB A)	
Tension steel corr	2
Distribution steel corr	2
Tension & compression indicated	2
Total	6

[Total = 10]

QUESTION 6

QUESTION 6

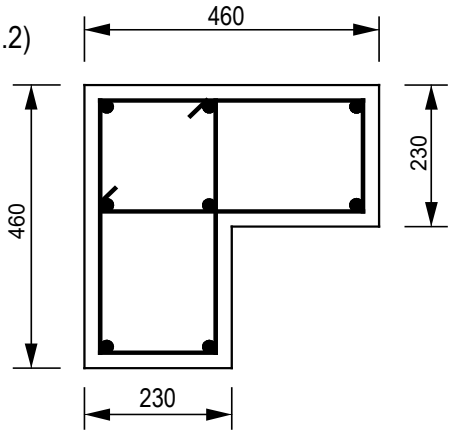
(6.1)



CIRCULAR COLUMN
Ø600 with 6Y25 main bars
and R10 helical binder

MARK ALLOCATION (6.1)	
Diameter corr.	1
Steel bars spacing corr	1
Binder in place	1
Centre lines	1
Title	1
Total	5

(6.2)



L-SHAPED COLUMN
460 x 230 with 8Y20 main bars
and Y10 Stirrups at 150 c/c

MARK ALLOCATION (6.2)	
Size & Shape corr.	2
Steel bars spacing corr	1
Binder in place	1
Title	1
Total	5

[Total = 10]

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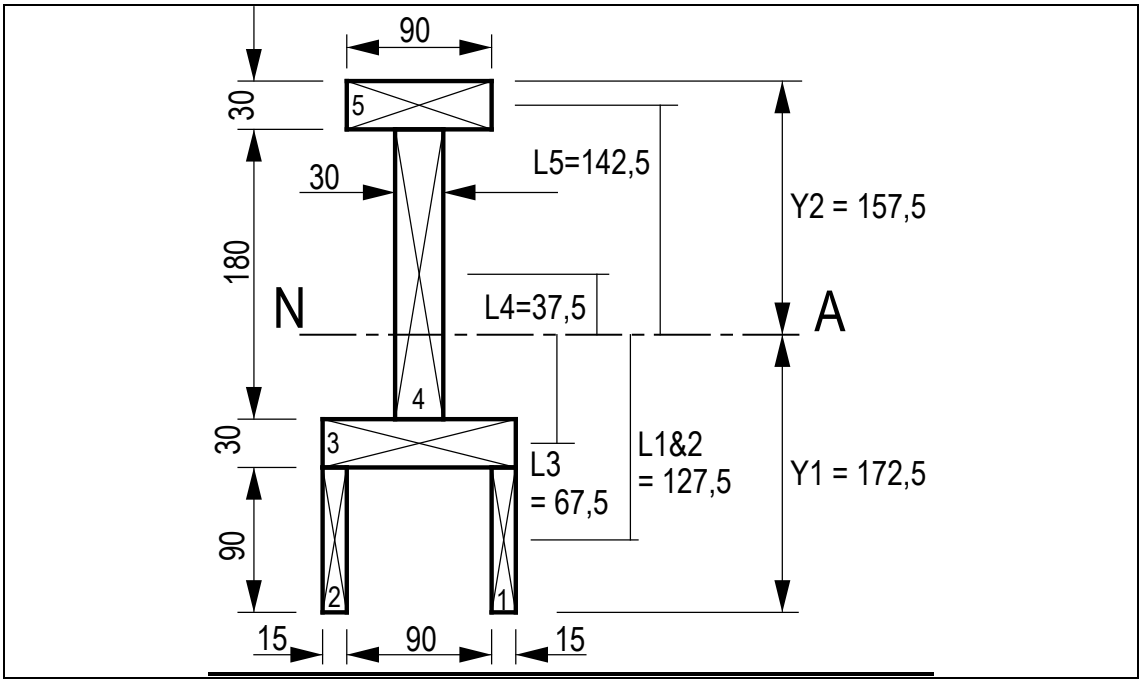
QUESTION 7

7.1



Missing dimensions:

Y_2: 330 – 172,5 = 157,5 ✓

$L_{1\&2}$: $172,5 - (30/2 + 90) = 127,5$ ✓

L_3: $172,5 - (90 + 30/2) = 67,5$ ✓

L_4: $(90 + 30 + 180/2) - 172,5 = 37,5$ OR

L_4: $157,5 - (30 + 180/2) = 37,5$ ✓

L_5: $157,5 - (30/2 + 180) = 37,5$

(9)

7.2 **Calculate second moment of area**

$I_{xx\ Total} = 2\left(\frac{bd^3}{12} + AL^2\right) + \left(\frac{bd^3}{12} + AL^2\right) + \left(\frac{b\,d^3}{12} + AL^2\right) + \left(\frac{b\,d^3}{12} + AL^2\right)$

$I_{xx\ 1\&2} = 2\left(\frac{15\ x\ 90^3}{12} + 15\ x\ 90\ x\ 127{,}5^2\right)$

$= 2\ (911\ 250 + 21\ 945\ 937{,}5) = 45\ 714\ 375\ mm^4$ ✓✓

$I_{xx\ 3} = \left(\frac{120\ x\ 30^3}{12} + 120\ x\ 30\ x\ 67{,}5^2\right)$

$= (270\ 000 + 16\ 402\ 500) = 16\ 672\ 500\ mm^4$ ✓✓

$I_{xx\ 4} = \left(\frac{30\ x\ 180^3}{12} + 30\ x\ 180\ x\ 37{,}5^2\right)$

$= (14\ 580\ 000 + 7\ 593\ 750) = 22\ 173\ 750\ mm^4$ ✓✓

$I_{xx\ 5} = \left(\frac{90\ x\ 30^3}{12} + 90\ x\ 30\ x\ 37{,}5^2\right)$

$= (202\ 500 + 3\ 796\ 875) = 3\ 999\ 375\ mm^4$ ✓✓

I_{xx} TOTAL = 88 560 000 mm⁴ ✓ (4)

7.3 **Section modulus (Z) about the x-x axis**

$Z = \frac{I}{Y}$

$Z = \frac{88\ 560\ 000\ mm4}{172{,}5\ mm}$ ✓

$Z = 513\ 391{,}3\ mm^3$ ✓ $Z = 513{,}4 \times 10^{-6}\ m^3$ (2)

[15]

TOTAL: 100

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