higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

# NASIENRIGLYN

## NASIONALE SERTIFIKAAT

## BOU- EN STRUKTUURKONSTRUKSIE N5

## 7 Desember 2023

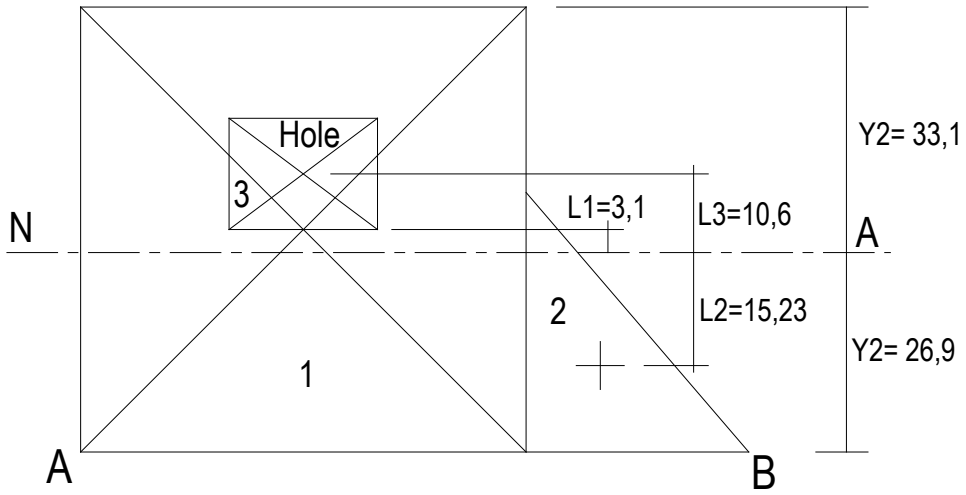
**Hierdie nasienriglyn bestaan uit 9 bladsye.**

Kopiereg voorbehou

## VRAAG 1

1.1 Bereken oppervlaktes:
Oppervlakte 1: 60 × 60 = 3 600
Oppervlakte 2: ½ 35 × 30 = 525
Oppervlakte 3: 20 × 15 = -300✓
Totale oppervlakte = 3 825✓ (2)

Bereken neutrale as vanaf AB:
3 825 × $y_1$ = (3 600 × 30) + (525 × 11,667) − (300 x 37,5)✓
$y_1 = \frac{108\,000 + 6\,125{,}175 - 11\,250}{3\,825}$
$y_1 = \frac{11\,4125{,}175 - 11\,250}{3\,825}$
$y_1$ = 26,90 mm✓ (2)




| | | |
|---|---|---|
| NA | 60 - **26,9**($Y_1$) = **33,1**($Y_2$) | |
| L1 | 60/2 – 26,9 | = 3,1 |
| L2 | 26,9 – 35/3 | = 15,23 |
| | | |

| | | |
|---|---|---|
| | | |
| L1 | 33,1 - 30 | = 3,1 |
| L2 | 33,1 - 25 - (35 × 2/3) | = 15,23 |
| L3 | 33,1 – 15 + 15/2 | = 10,6 |

1.2 Bereken tweede oppervlaktemoment:
$I_{xx\ totaal} = \left(\frac{bd^3}{12} + AL^2\right) + \left(\frac{bd^3}{12} + AL^2\right) - \left(\frac{\pi d^4}{64} + AL^2\right)$

$I_{xx\ 1} = \left(\frac{60 \times 60^3}{12} + 60 \times 60 \times 3{,}1^2\right)$
$= (108\,0000 + 3\,4596) =$ 11 1459 mm⁴✓✓

$I_{xx\ 2} = \left(\frac{30\,x\,35^3}{36} + ½ \times 30 \times 35 \times 15{,}233^2\right)$
$= (35\,729{,}167 + 121\,823{,}252)$ = 157 552,419 mm⁴✓✓

$I_{xx\ 3} = \left(\frac{20\,x\,15^3}{12} + 20\,x\,15 \times 10{,}6^2\right)$
$= (5\,625 + 33\,708) =$ -39 333 mm⁴✓✓
$I_{xx}$ TOTAAL = 123 2815,419 mm⁴✓ (7)

1.3 Bereken die profielmodulus (Z): (3)

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

$Z = \frac{123\ 2815{,}419\ \text{mm4}}{26{,}90\ mm}$ ✓✓

$Z = 45\ 829{,}569\ \text{mm}^3$ $45{,}83 \times 10^{-6}\ \text{m}^3$✓

1.4 Buigmoment (buigspanning = 154 MPa):

$\frac{m}{I} = \frac{f}{Y}$

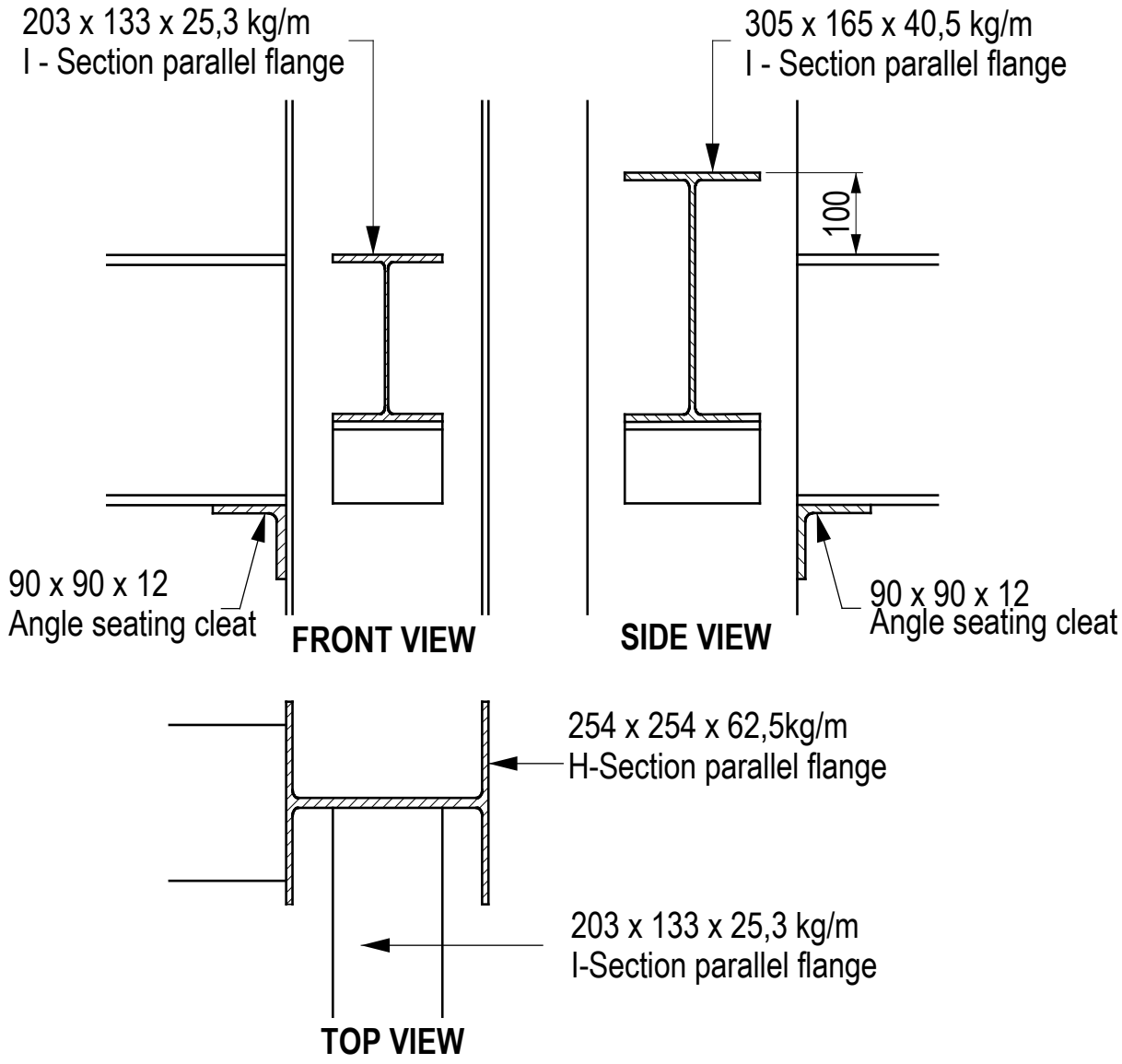
$M = \frac{123\ 2815{,}419 \times 154}{26{,}90\ \text{mm}}$ ✓

M = 705 7753,7 N.mm

M = 7,06 kN.m✓ (2)

**[16]**

**VRAAG 2**




| QUESTION 2 | | |
|---|---|---|
| FRONT VIEW | | |
| CORRECTNESS: | | 5 |
| Column | 1 | |
| 2 Beams | 2 | |
| Seating cleats | 2 | |
| Total | | 5 |

| QUESTION 2 | | |
|---|---|---|
| SIDE VIEW | | |
| CORRECTNESS: | | 5 |
| Column | 1 | |
| 2 Beams | 2 | |
| Seating cleats | 2 | |
| Total | | 5 |

| QUESTION 2 | | |
|---|---|---|
| TOP VIEW | | |
| CORRECTNESS: | | 4 |
| Column | 2 | |
| 2 Beams | 2 | |
| Total | | 4 |

| | |
|---|---|
| Accuracy | 3 |
| Lables & Dim | 2 |
| Hatching | 2 |
| Total | 7 |
| 5 + 5 + 4 + 7<br>Total = 21 marks | |

**[21]**

## VRAAG 3

3.1 Weerstandkrag van die boute teen afskuiwing:
Skuifspanning = las/oppervlakte
Las = oppervlakte × spanning
Skuifkrag = $\frac{\pi d^2}{4}$ × f × n (deursnee = 12 mm)
= $\frac{\pi 12^2}{4}$ × 110 N/mm² × 6✓
= 74 644, 24 N
= 74, 644 kN✓✓ (Korrekte antwoord en eenheid) (3)

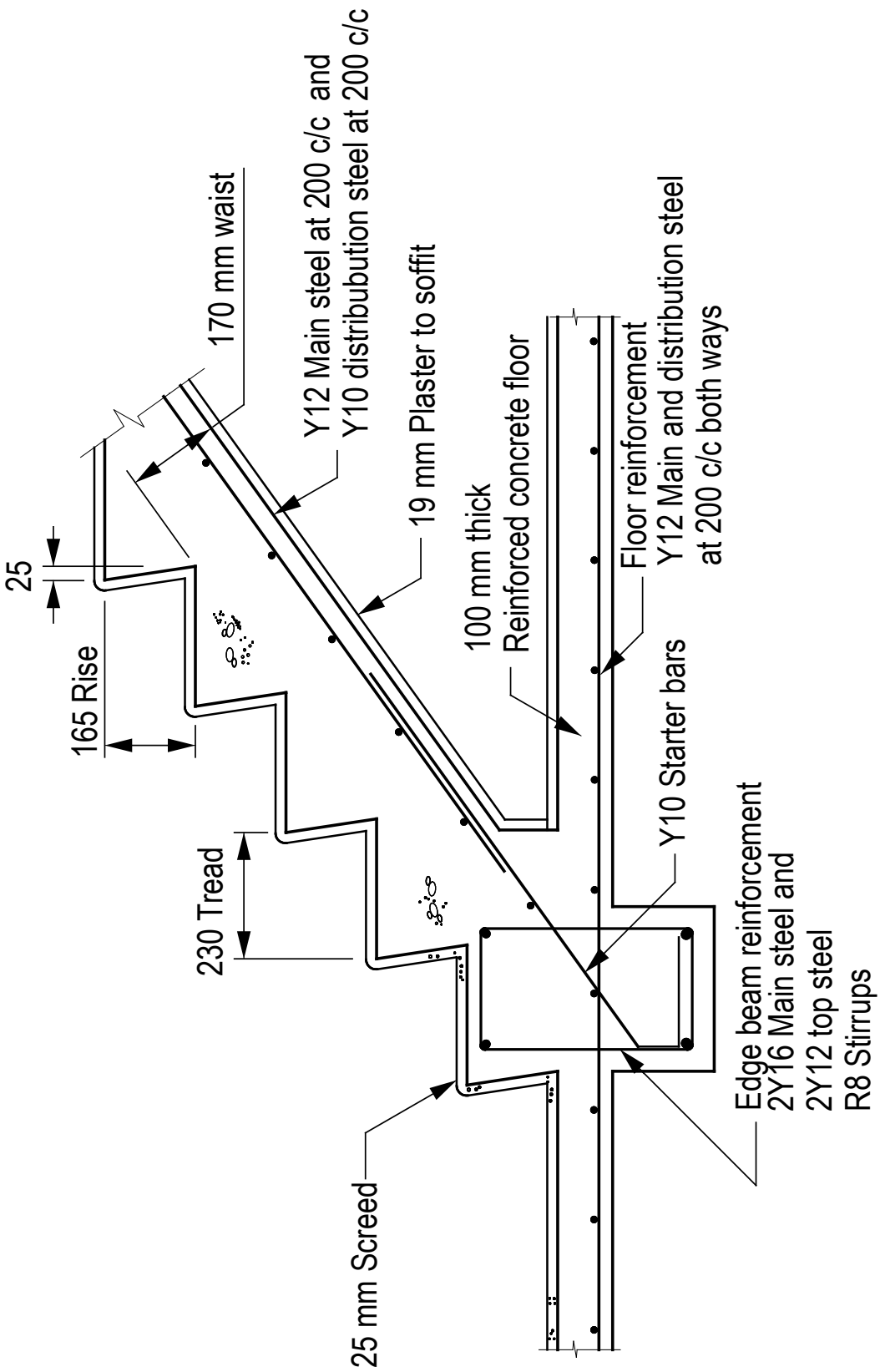
3.2 Weerstandkrag van die boute teen breking:
Las = oppervlakte × spanning
Breekkrag = (d × t) × spanning × n
= (12 × 10) × 230 N/mm² × 6✓
= 165 600 N
Breekkrag = 165, 6 kN✓✓ (Korrekte antwoord en eenheid) (3)

3.3 Weerstandkrag van die bind teen skeuring:
Las = oppervlakte × spanning
$F_s = A_t \times f_t \times n$
Skeurkrag = [(B x T) – n (d × t)] × $f_t$
= [(100 × 10) – 3(12 × 10)] x 140 N/mm²✓
= [(1000) – 3(120)] × 140 N/mm²
= 1000 – 360] × 140 N/mm²
= 640 × 140 N/mm²✓
= 89 600 N
Skeurkrag = 89,4 kN✓✓ (Korrekte antwoord en eenheid) (4)

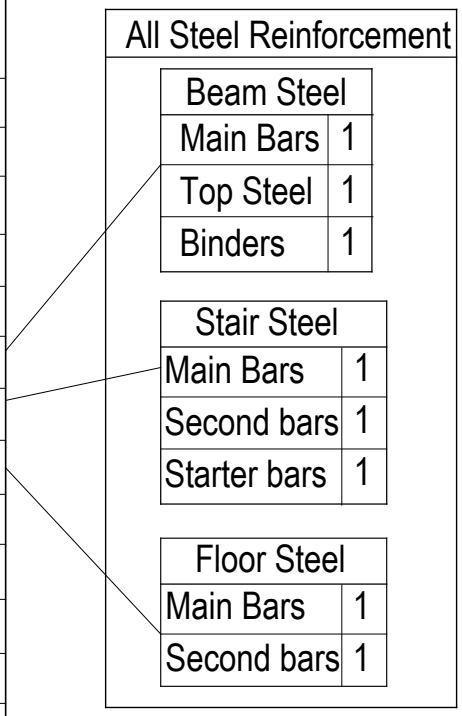
3.4 Die maksimum veilige las teen skeuring = 89,4 kN✓✓
(Korrekte antwoord en eenheid) (2)
**[12]**

**VRAAG 4**

4.1


170 mm waist
Y12 Main steel at 200 c/c and
Y10 distribubution steel at 200 c/c
19 mm Plaster to soffit
100 mm thick
Reinforced concrete floor
Floor reinforcement
Y12 Main and distribution steel
at 200 c/c both ways
25
165 Rise
230 Tread
Y10 Starter bars
Edge beam reinforcement
2Y16 Main steel and
2Y12 top steel
R8 Stirrups
25 mm Screed

| QUESTION 4<br>Mark Allocation | |
|---|---|
| Steps corr. | 2 |
| Waist | 1 |
| Edge beam corr. | 2 |
| Floor | 1 |
| Screed & Plaster | 2 |
| Beam Reinforcement | 3 |
| Stair Reinforcement | 3 |
| Floor Reinforcement | 2 |
| | |
| Accuracy | 3 |
| Labels | 2 |
| Dimensions | 1 |
| **TOTAL** | **22** |




4.2 Beginstawe word gebruik om die afwaartse krag van die trap te verbind en te veranker.✓ Beginstawe word in die betonvloer aangebring✓ waar die trap gebou gaan word.✓ Die stawe word dan aan die hoofstawe van die trap verbind.✓ Waar daar nie 'n soliede voet vir die trap is nie, word 'n reghoekige (rand-) balk gegiet✓ waar die beginstawe veranker is.✓ Die een punt van die staaf word aan die trap se hoofstaal verbind✓ terwyl die ander punt aan die hoofstaaf van die randbalkstaal verbind word.✓ (8)

**[30]**

**VRAAG 5**

5.1 Bereken momente om RL:

$(RR \times 8) = (3 \times 2,5 \times 8,25) + (7 \times 7) + (6 \times 5 \times 2,5) + (5 \times 1)$✓

$RR = \frac{(61,875 + 49 + 75 + 5)}{8}$

$RR = 23,86$ kN✓ (2)

Bereken momente om RR:

$(RL \times 8) + (3 \times 1,5 \times 0,75) = (6 \times 5 \times 5,5) + (5 \times 7) + (7 \times 1) + (3 \times 1 \times 0,5)$✓

$RL = \frac{(165 + 35 + 7 + 1,5) - 3,375}{8}$

$RL = 25,64$ kN✓ (2)

5.2

| | |
|---|---|
| SF @ A: 25,64 kN | 25,64 kN maks |
| SF @ A tot C: 25,64 – (6 × 1) | 19,64 kN |
| SF @ C: 19,64 − 5 | 14,64 kN |
| SF @ C tot D: 14,64 - (6 × 4) | - 9,36 kN |
| SF @ D: -9,36 | - 9,36 kN |
| SF @ D tot E: -9,36 | - 9,36 kN |
| SF @ E: -9,36 − 7 | - 16,36 kN |
| SF @ E tot F: 16,36 − (3 × 1) | - 19,36 kN |
| SF @ F: - 19,36 +23,86 | 4,5 kN |
| SF @ F tot B: 4,5 – (3 × 1,5) | 0 kN |
| SF @ B: | 0 kN |

Ken punte lukraak toe vir enige 2 korrekte antwoorde.
Skuifkragmaksimum = 1 punt
Skuifkragdiagram = 3 punte

(6)

5.3

| | |
|---|---|
| BM C: (25,64 × 1) – (6 × 1 × 0,5) = | 20,86 kNm |
| BM D: (25,64 × 5) – (6 × 5 × 2,5) – (5 × 4) = | 24,3 kNm |
| BM E: (25,64 × 7) – (6 × 5 × 4,5) – (5 × 6) = | 2,02 kNm |
| BM F: - (3 × 1,5 × 0,75) = | 3,375 kNm |
| BM R: (25,64 × 3) – (5 x 2) – [6 × 3 × $\frac{3}{2}$] | 40,82 kNm (maks) |

Ken punte lukraak toe vir enige 2 korrekte antwoorde.
Buigmomentmaksimum = 1 punt
Buigmomentdiagram = 3 punte

(6)

5.4 Ze = $\frac{BM\ maks}{spanning}$ = $\frac{40{,}82\ x\ 10^6}{166}$ = 245 903,6 mm³✓

Ze = 245,9 ×$10^{-6}$ m³✓

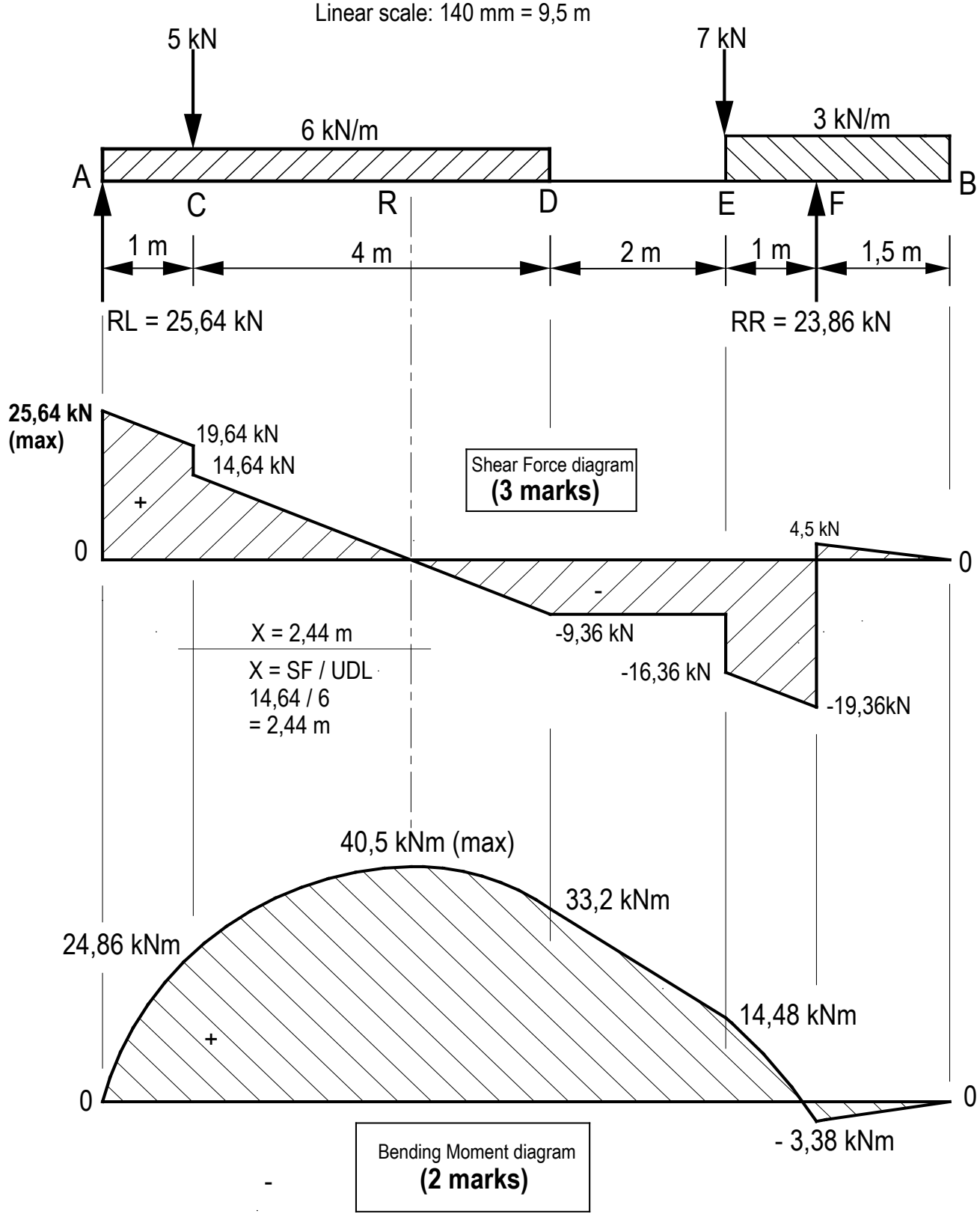
Kies: 203 × 133 × 29,8 kg/m I-profielparallelflens✓
(Ze = 270,3 × $10^{-6}$) (3)

5.6 Skuifspanning = $\frac{SF\ maks}{D\ x\ t}$ = $\frac{25{,}64\ x\ 10^3}{206{,}8\ x\ 6{,}3}$ = 19,68 MPa✓ (1)

Ze = 19,68 MPa < 100 MPa✓ (1)

**[21]**

QUESTION 5




**TOTAAL: 100**

Kopiereg voorbehou