higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NASIENRIGLYN

**NASIONALE SERTIFIKAAT
STERKTE- EN STRUKTUURLEER N5**

13 APRIL 2018

Hierdie nasiengids bestaan uit 7 bladsye.

VRAAG 1

1.1   1.1.1

$$\sigma_{LOP} = \frac{F_{LOP}}{A_i} = \frac{72000}{3{,}1416 \times 10^{-4}} = 229{,}183 MPa$$

1.1.2

$$E = \frac{\sigma_{LOP}}{E_{LOP}} = \sigma_{LOP} \times \left(\frac{L_i}{X_{LOP}}\right) = 229{,}183 \times 10^6 \cdot \left(\frac{0{,}085}{110 \times 10^{-6}}\right) = 177{,}096 GPa$$

1.1.3

$$\sigma_Y = \frac{F_Y}{A_i} = \frac{90000}{3{,}1416 \times 10^{-4}} = 286{,}478 MPa$$

1.1.4

$$\sigma_{Max} = \frac{F_{Max}}{A_i} = \frac{145000}{3{,}1416 \times 10^{-4}} = 461{,}548 MPa$$

1.1.5

$$\sigma_F = \frac{F_F}{A_F} = \frac{80000}{5{,}8088 \times 10^{-5}} = 1377{,}221 MPa$$
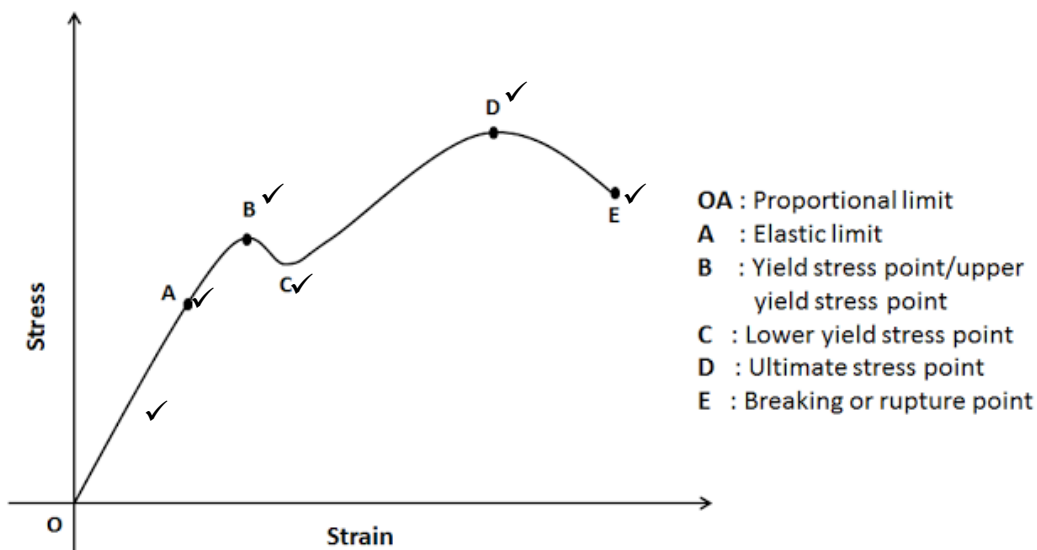
1.1.6

$$\%X = \frac{X_F}{L_i} = \left(\frac{21}{85}\right).100 = 24{,}71\%$$

1.1.7

$$\%\Delta A = \frac{A_i - A_F}{A_i} = \left(\frac{3{,}1416 \times 10^{-4} - 5.8088 \times 10^{-5}}{3{,}1416 \times 10^{-4}}\right).100 = 81{,}51\%$$

(7 × 2)   (14)

1.2

OA : Proportional limit
A : Elastic limit
B : Yield stress point/upper
     yield stress point
C : Lower yield stress point
D : Ultimate stress point
E : Breaking or rupture point

[Bron van tekening: *http://www.mechanicalbooster.com/2016/09/stress-strain-curve-relationship-diagram-explanation.html*]   (6)

[20]

VRAAG 2
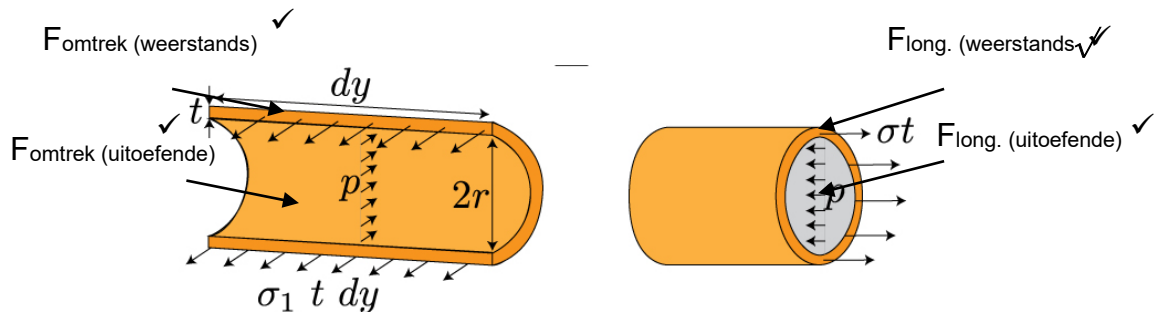
2.1   2.1.1 $F_{cau\sin g} = P_i . D_i . L$

$= 1{,}2 \times 10^6 . (1{,}2) . (2{,}5)$ ✓

$= 3\ 600\ kN$ ✓

2.1.2 $F_{resistnig} = \sigma_T . 2 . t . L$

$= 72 \times 10^6 . (2) . (0{,}010) . (2{,}5)$ ✓

$= 3\ 600\ kN$ ✓

2.1.3

$F_{cau\sin g} = P_i . \dfrac{\pi}{4} . D_i{}^2$

$= 1{,}2 \times 10^6 . (\dfrac{\pi}{4}) . (1{,}2^2)$ ✓

$= 1357{,}168\ kN$ ✓

2.1.4 $F_{resistnig} = \sigma_L . \pi . D_i . t$

$= 36 \times 10^6 . (\pi) . (1{,}2) . (0{,}010)$ ✓

$= 1357{,}168\ kN$ ✓

(4 × 2)   (8)

2.2

[Bron van tekening: http://www.bu.edu/moss/mechanics-of-materials-combined-loading/]   (4)

[12]

VRAAG 3

3.1
$$J_1 = \frac{\pi}{32}.D^4 = \frac{\pi}{32}.(0,048^4) = 5,2115 \times 10^{-7} m^4 \checkmark$$

$$\frac{T_1.L_1}{J_1.G_1} = \frac{T_2.L_2}{J_2.G_2} \quad \checkmark$$

$$\frac{\frac{1}{3}T_2.L_1 \quad \checkmark}{5,2115 \times 10^{-7}.(2,2.G_2)} = \frac{T_2.L_1 \quad \checkmark}{J_2.G_2}$$

$$\therefore J_2 = 3,4396 \times 10^{-6} m^4 \quad \checkmark$$

$$J_2 = 3,4396 \times 10^{-6} = \frac{\pi}{32}.[D^4 - (0,048^4)] \quad \checkmark$$

$$\therefore D = 79,697 \ mm \checkmark$$

(7)

3.2 $T_T = T_1 + T_2 \quad \checkmark$

$$= \frac{\pi}{16}.\tau_1.D^3 + \frac{\pi}{16}.\tau_2.[\frac{(D^4 - d^4)}{D}]$$

$$= \frac{\pi}{16}.(84 \times 10^6).(0,048^3) + \frac{\pi}{16}.(46 \times 10^6).[\frac{(0,0797^4 - 0,048^4)}{0,0797}] \quad \checkmark$$

$$= 1824,034 + 3970,474$$

$$= 5794,508 \ N.m \quad \checkmark$$

(4)

3.3
$$P = 2\pi.\frac{N}{60}.T$$

$$= 2\pi.\frac{388}{60}.(5794,5087) \quad \checkmark$$

$$= 235,438 \ kW \quad \checkmark$$

(2)

[13]

VRAAG 4

4.1
$$L_{\text{Re}aksie}.(7) = 2.(2).(7) + 4.(5) + 1,5.(2).(3) + 7.(2) \quad \checkmark$$
$$\therefore L_{\text{Re}aksie} = 10,143 kN \quad \checkmark$$

$$R_{\text{Re}aksie}.(7) + 2.(1).(\tfrac{1}{2}) = 7.(5) + 3.(4) + 4.(2) + 2.(1).(\tfrac{1}{2}) \quad \checkmark$$
$$\therefore R_{\text{Re}aksie} = 7,857 kN \quad \checkmark$$

$$BEWYS : 2.(2) + 4 + 7 + 1,5.(2) = 10,143 + 7,857$$
$$18kN = 18kN \rightarrow OK \quad \checkmark$$

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(5)

4.2
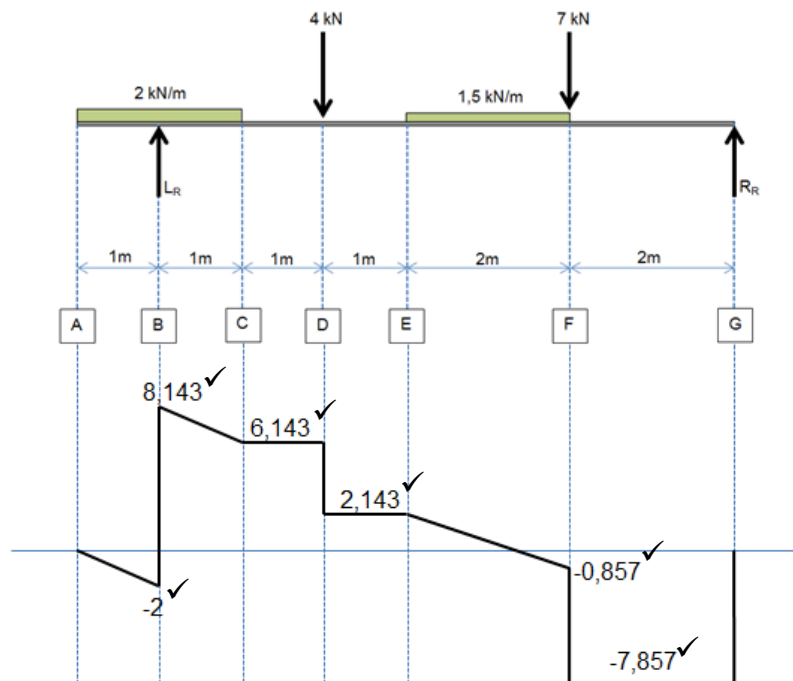
(6)

4.3
$$TP_1 = 1m \text{ van LHS } \sqrt{}$$

$$TP_2 : \frac{X_1}{Y_1} = \frac{2 - X_1}{Y_2} \quad \checkmark$$
$$\frac{X_1}{2,143} = \frac{2 - X_1}{0,857}$$
$$0,857.X_1 = 2,143.(2 - X_1) \quad \checkmark$$
$$\therefore X_1 = 1,429\ m \quad \checkmark$$

$$TP_2 = 2,5713\ m \text{ van RHS} \sqrt{}$$

(4)

4.4 $BM_A = 0$

$BM_B = -2.(1).(\frac{1}{2}) = -1 \ kN.m$ ✓

$BM_C = -2.(2).(\frac{2}{2}) + 10,143.(1) = 6,143 \ kN.m$ ✓

$BM_D = -2.(2).(\frac{2}{2} + 1) + 10,143.(2) = 12,286 \ kN.m$ ✓

$BM_E = 7,857.(4) - 7.(2) - 1,5.(2).(\frac{2}{2}) = 14,429 kN.m$ ✓

$BM_F = 7,857.(2) = 15,714 \ kN.m$ ✓

$BM_G = 0$ (5)

4.5
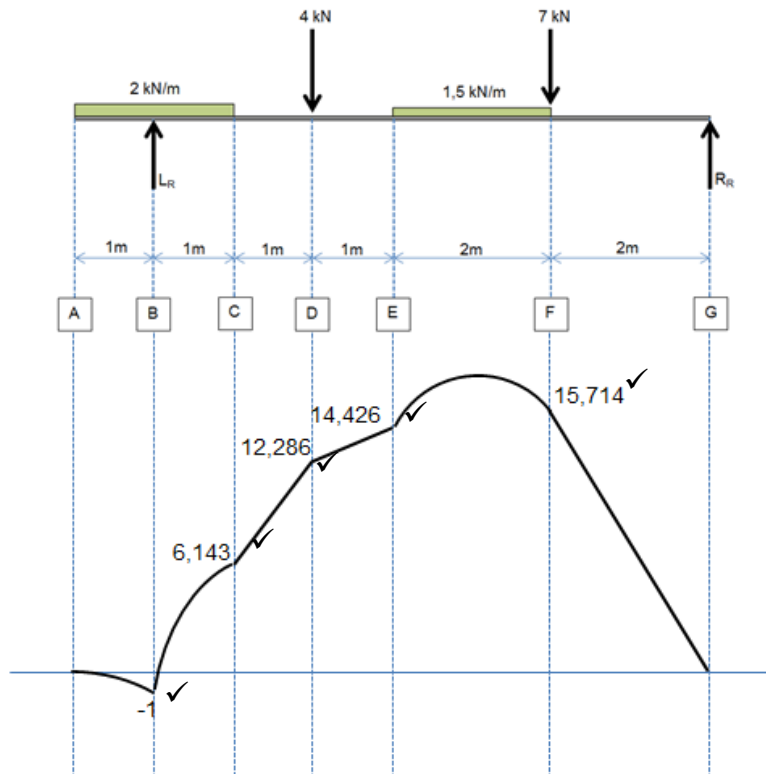
(5)

4.6
$$0 = -2.(x).(\frac{x}{2}) + 10,143.(x - 1) \quad ✓$$

$$-x^2 + 10,143.x - 10,143 = 0 \quad ✓$$

$$x = \frac{-10,143 \pm \sqrt{(10,143^2) - 4.(-1).(-10,143)}}{2.(-1)} \quad ✓$$
                                                             ✓

$$= \frac{-10,143 \pm 7,8935}{-2}$$

$$= 1,12475 \ or \ 9,01825$$

$$= 1,125 \ m \quad ✓$$

(5)

[30]

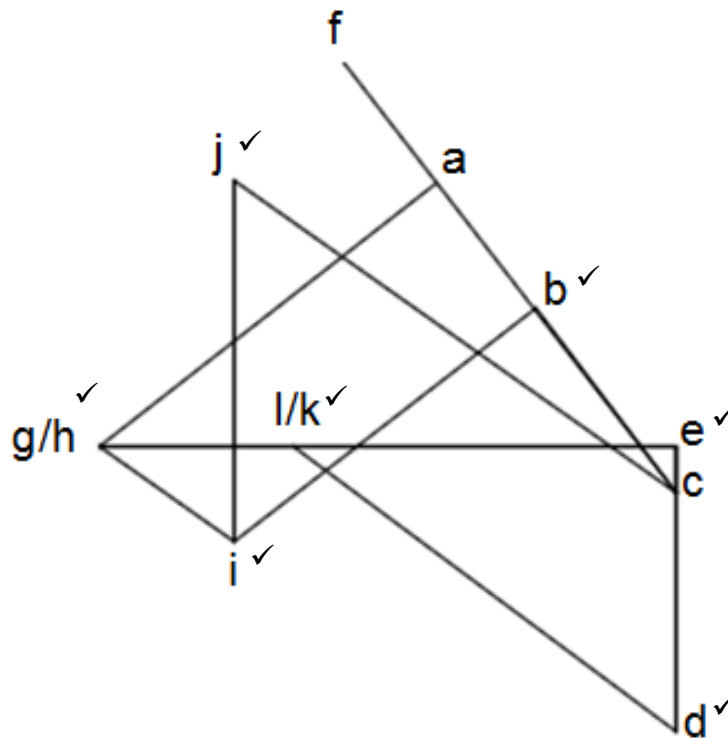## VRAAG 5

5.1 $20\sin 45 = 20\cos 45 = 14,142N$
        $30\sin 45 = 30\cos 45 = 21,213N$

        $DE_{vertikaal}.(8) = 30.(6) + 21,213.(4) + 14,142.(2)$
        $\therefore DE = 36,642N$ ✓   (1)

5.2 $FH_{horisontaal} = 14,142 + 14,142 + 21,213 = 49,497N$ ✓
        $FH_{vertikaal} = 21,213 + 14,142 + 14,142 + 30 - 36,642 = 42,855$ ✓
        $FH = \sqrt{49,497^2 + 42,855^2} = 65,471N$ ✓   (3)

5.3

Onderdeel	Krag (N)	Aard
eg	75✓	Bindbalk (B)✓ 'Tie' (T)
hi	21,5✓	Stut (S) 'Strut' (S)✓
ij	47✓	B✓
kl	0✓	Geen✓
dl	62✓	S✓
jc	70✓	B✓
bi	49✓	S✓

(21)
[25]

TOTAAL: 100