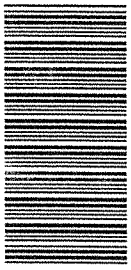

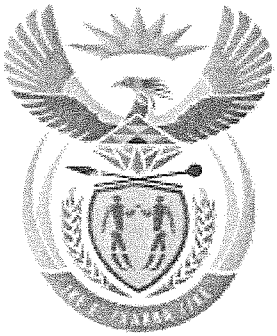

higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

APRIL EXAMINATION

STRENGTH OF MATERIALS AND STRUCTURES N6

3 APRIL 2013

This marking guideline consists of 7 pages.

QUESTION 1

Calculate power to be transmitted

1.1 $$M = \frac{Wab}{L} = \frac{5k \times 0,3 \times 0,5}{0,8} = 937,5\ Nm$$ √√

$$M_e = \frac{\pi(D^4 - d^4)\sigma_N}{32D} = \frac{\pi(0,08^4 - 0,07^4)85M}{32 \times 0,08} = 1768,06\ Nm$$ √√

$$M_e = 1768,06 = \frac{1}{2}\left[937,5 + \sqrt{937,5^2 + T^2}\right]$$ √

$$T = \sqrt{2598,62^2 - 937,5^2} = 2423,61\ Nm$$ √√

$$T_e = \frac{\pi(0,08^4 - 0,07^4)65M}{16 \times 0,08} = 2704,1Nm$$ √√

$$T_e = 2704,1 = \sqrt{937,5^2 + T^2}$$ √

$$T = \sqrt{2704,1^2 - 937,5^2} = 2536,39Nm$$ √

Max Torque = 2423,61 Nm√

$$\frac{Mean}{Gemid}T = \frac{2423,61}{1,13} = 2144,788Nm$$ √

$$\frac{Power}{Drywing} = P = \frac{2\pi \times 200 \times 2144,788}{60} = 44,92\ kW$$ √√ **[15]**

QUESTION 2

2.1 Magnitude force F

$$A = \frac{F + W}{\sigma_1} = 9 = \frac{F + 5k}{220k} \surd$$

$$\therefore \quad 1{,}98M = F + 5k \surd$$

$$F = 1{,}975\ MN \surd$$

(3)

2.2 H-Section

$$\sigma = \frac{F}{A} \quad \therefore A = \frac{1{,}975M}{85M} = 23{,}235 \times 10^{-3}\ m^2 \surd\surd$$

$$\therefore \quad 305\ by\ 305\ by\ 198\ \frac{kg}{m} \surd$$

(3)

2.3 Actual stress in column

$$\sigma = \frac{1{,}975M}{25{,}24 \times 10^{-3}} = 78{,}249\ MPa \surd\surd$$

(2)
[8]

QUESTION 3

3.1 $6R = (300k \times 2) + (8k \times 6 \times 6/2$
$R = 124\ kN$

OR

$$6L = (330k \times 4) + \left(8k \times 6 \times \frac{6}{2}\right)$$
$$L = 224\ kN$$

(THREE marks for any one)

OR

$$\therefore \quad M = (224k \times 2) - \left(8k \times 2 \times \frac{2}{2}\right) = 432\ kNm$$
$$M = (124k \times 4) - \left(8k \times 4 \times \frac{4}{2}\right) = 432\ kNm$$

(THREE marks for any one) (6)

3.2 Depth and breadth of beam

$B = 0{,}5D$ ✓ & $d = D - 0{,}15D = 0{,}85D$ ✓

$\frac{\sigma_S}{\sigma_C} = \frac{m(d-n)}{n} = \frac{140}{8} = \frac{15\left(0{,}85D - n\right)}{n}$ √

$17{,}5n = 15(0{,}85D - n)$ √

$n = 0{,}392D$ √

$l_a = d - \frac{n}{3} = 0{,}85D - \frac{0{,}392D}{3} = 0{,}719D$ √

$M_C = \frac{1}{2}\sigma_C B n l_a = 432k = \frac{1}{2} \times 8M \times 0{,}5D \times 0{,}392D \times 0{,}719D$ √

$0{,}108 = 0{,}141D^3$ √

$D = \sqrt[3]{0{,}766} = 915\ mm$ √

$B = 457{,}5\ mm$ √

(9)
[15]

QUESTION 4

4.1 Max tensile stress

$\sigma_D = \frac{F}{A} = \frac{200k}{3{,}219 \times 10^{-3}} = 62{,}13\ MPa(T)$ √√

$M = \frac{WL}{4} = \frac{100k \times 3}{4} = 75\ kNm$ √

$\sigma_B = \frac{My}{I} = \frac{75k \times 0{,}203}{23{,}49 \times 10^{-6} \times 2} = 324{,}393\ MPa$ √√

$\frac{Tensile\ Stress\ Max}{Trekspanning\ Mak} = -\sigma_D - \sigma_B = -62{,}13M - 324{,}393M = 386{,}523\ MPa\ (T)$ √ (6)

4.2 Position of NA

$\sigma_D = \sigma_B$

$\therefore \quad 62{,}13M = \frac{75k \times y_o}{23{,}49 \times 10^{-6}}$ √

$\therefore \quad y_o = 19{,}46\ mm\ \frac{from\ G}{Vanaf\ G}$ √

(2)
[8]

QUESTION 5

5.1 Allowable length

$$M = \frac{wL^2}{8} + \frac{wL^2}{8} = \frac{30k \times L^2}{8} + \frac{283 \times gL^2}{8} = 4097{,}029L^2 \ldots.(1) \quad \surd\surd\surd$$

$$M = \sigma Z = 120M \times 4314 \times 10^{-6} = 517{,}68\ kNm \quad \surd$$

$$\therefore \quad 517{,}68k = 4097{,}029L^2 \quad \surd$$

$$\therefore \quad L = \sqrt{126{,}355} = 11{,}241\ m \quad \surd$$

- $\Delta = \frac{5wL^4}{384EI} + \frac{5wL^4}{384EI} = \frac{L}{250} = \frac{5 \times 30k \times L^4}{384 \times 200G \times 788 \times 10^{-6}} + \frac{5 \times 283 \times g \times L^4}{384EI}$ $\surd\surd$
- $\frac{1}{250} = \frac{150k \times L^3}{384EI} + \frac{13881{,}15L^3}{384EI}$ $\surd$
- $\frac{1}{250} = 2{,}479 \times 10^{-6} \times L^3 + 2{,}294 \times 10^{-7} \times L^3$ $\surd$
- $L = \sqrt[3]{\frac{1}{6{,}7711{,}193 \times 10^{-4}}} = 11{,}388\ m$ $\surd$

Use the length = 11,241 m$\surd$ (12)

5.2 Max slope

- $\theta = \frac{wL^3}{24EI} + \frac{wL^3}{24EI} = \frac{30k \times 11{,}241^3}{24 \times 200G \times 788 \times 10^{-6}} + \frac{283g \times 11{,}241^3}{24EI}$ $\surd\surd$
- $\theta = 0{,}011 + 1{,}043 \times 10^{-3}$
- $= 0{,}012\ Rad$ $\surd$

(3)
[15]

QUESTION 6

6.1 Outside diameter

$$p_i = \frac{F}{A} = \frac{1M}{\frac{\pi}{4}0{,}15^2} = 56{,}588\ MPa \quad \surd$$

$$d_1 = 150: \quad \sigma_R = 56{,}588M = A + \frac{B}{0{,}15^2} \ldots.(1) \surd$$

$$\sigma_H = -120M = A - \frac{B}{0{,}15^2} \ldots.(2) \surd$$

$$(1) + (2) \therefore \quad -63{,}412m = 2A$$

$$A = -31{,}706M \surd$$

$$\therefore \quad 56{,}588M = -31{,}706M + 44{,}444B \surd$$

$$B = 1{,}987M \surd$$

$$d_1 = D: \quad \sigma_R = 0 = A + \frac{B}{D^2} \surd$$

$$\therefore \quad D = \sqrt{\frac{1{,}1987}{31{,}76}} = 250\ mm \quad \surd$$

(8)

6.2 Longitudinal stress

$$\sigma_L = \frac{p_i d^2}{D^2 - d^2} = \frac{56{,}588M \times 0{,}15^2}{0{,}25^2 - 0{,}15^2} = 31{,}83\ MPa \quad \surd\surd$$ (2)

6.3 Strain at D

$$\epsilon = \frac{\sigma_H - \gamma\sigma_R}{E} = \frac{120M}{200G} = 6 \times 10^{-4} \surd$$ (1)

[11]

QUESTION 7

7.1 Position of RGR

$$F_w = \frac{1}{2} \times 1100g \times 3^2 = 48559{,}5\ N$$

$$F_w \times \frac{H}{3} = F_w \times \frac{3}{3} = 48559{,}4\ Nm = \sum Fm \surd$$

$$W_1 = \frac{1}{2} \times 1 \times 1 \times 3 \times 2400g = 35316 \surd$$

$$W_2 = 0{,}6 \times 1 \times 3 \times 2400g = 42379{,}2 \surd$$

$$\therefore \quad V = 77695{,}2\ N \surd$$

$$W_1 x_1 = W_1 \times \frac{2}{3} \times 1 = 23544 \surd$$

$$W_2 x_2 = W_2 \times 1{,}3 = 55092{,}96 \surd$$

$$\sum Wm = 78636{,}96\ Nm \surd$$

$$Vx + \sum Fm = \sum Wm \surd$$

$$77695{,}2x + 48559{,}4 = 78636{,}96 \surd$$

$$x = 387{,}124\ mm\ \frac{from\ toe}{vanaf\ toon} \surd$$

$$e = \frac{B}{2} - x = \frac{1600}{2} - 387{,}124 = 412{,}876\ mm \frac{From\ G}{Vanaf\ G} \surd$$ (11)

7.2 Depth of water

$$x = \frac{B}{2} - e = \frac{1{,}6}{2} - 0{,}3 = 0{,}5\ m \surd$$

$$Vx + \sum Fm = \sum Wm \surd$$

$$77695{,}2 \times 0{,}5 + \sum Fm = 78636{,}96 \surd$$

$$\therefore \quad \sum Fm = 39789{,}36\ Nm \ldots\ldots\ldots\ldots(1) \surd$$

$$F_w = \frac{1}{2} \times 1100g \times H^2 = 5395{,}5H^2 \surd$$

$$\therefore \quad F_w \frac{H}{3} = 5395{,}5H^2 \times \frac{H}{3} = 1798{,}5\ H^3 = \sum Fm \ldots\ldots\ldots(2) \surd$$

$$(2) = (1) \quad \therefore \quad 1798{,}5H^3 = 39789{,}36 \surd$$

$$H = \sqrt[3]{22{,}124} = 2{,}81\ m \surd$$ (7)

[18]

QUESTION 8

8.1 Length of rope on ground:

$$F_{max} = wy_B \quad \therefore \quad y_B = \frac{20k}{130} = 153{,}846\ m \quad \surd\surd$$

$$\sin 60^0 = \frac{l_o}{y_B} \quad \therefore l_o = 153{,}846 \sin 60^0 = 133{,}235\ m \quad \surd\surd$$

$$\frac{Length\ on\ ground}{Lengte\ op\ grond} = 160 - 133{,}235 = 26{,}765\ m \quad \surd\surd$$

(6)

8.2 Height of tower

$$\cos 60^0 = \frac{y_o}{y_B} \quad \therefore \quad y_o = 153{,}846 \times \cos 60^0 = 76{,}923\ m \quad \surd\surd$$

$$\frac{Height}{Hoogte} = 153{,}846 - 76{,}923 = 76{,}923\ m \quad \surd$$

(3)

8.3 Max tension in rope

$$F_{t-min} = wy_o = 130k \times 76{,}923 = 10\ kN \quad \surd$$

(1)
[10]

TOTAL: 100