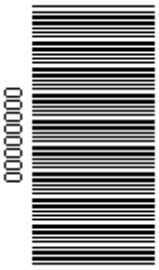


higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

AUGUST EXAMINATION

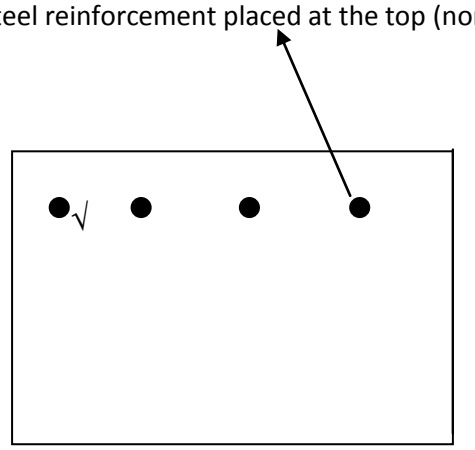
SHTRENGTH OF MATERIALS AND STRUCTURES N5

06 AUGUST 2014

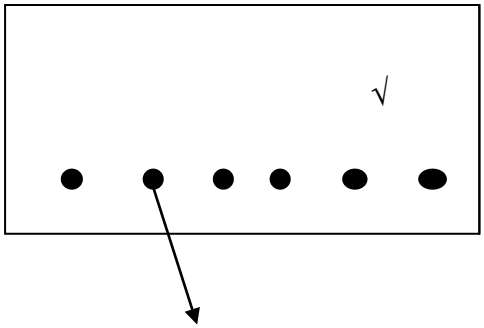
This marking guideline consists of 08 pages.

QUESTION1

Steel reinforcement placed at the top (normally tension at the top fibre) √



(2)



Reinforcement at the bottom for a simply supported beam√ (2)

Tension at the bottom

[4]

QUESTION 2

2.1

$\sigma_{a\ell} = \frac{150}{2}$ = 75 MPa√

$\sigma_s = \frac{450}{2}$ = 225 MPa√

$\sigma_c = \frac{240}{2}$ = 120 MPa √ (3)

2.2

$F_{a\ell} = \sigma_{a\ell} \times A_{a\ell} = 75 \times \frac{\pi}{4}(45^2 - 35^2)$√

= 47,12kN√ (2)

$F_s = \sigma_s \times A_s = 225 \times \frac{\pi}{4}(30^2 - 22^2)$√

= 73,51kN√ (2)

$F_c = \sigma_c \times A_c = 120 \times \frac{\pi}{4} \times 95^2$√

= 850,59kN √ (2)

∴force applicable is 47,12 kN√ (1)

2.3

$\sigma_{a\ell} = \frac{47{,}12 \times 10^3 \times 4}{\pi(45^2 - 35^2)}$ = 74,99MPa√

$\sigma_s = \frac{47{,}12 \times 10^3 \times 4}{\pi(30^2 - 22^2)}$ = 144,22MPa√

$\sigma_c = \frac{47{,}12 \times 10^3 \times 4}{\pi \times 952}$ = 26,59MPa√ (3)

2.4 $X_T = X_{a\ell} + X_{a\ell 2} + X_s + X_c$

$X_T = \frac{FL}{A_1 E_a} + \frac{F(80-L)}{A_2 E_a} + \frac{F100}{A_s E_s} + \frac{F \times 60}{A_c E_c}$

$0{,}128 = \frac{47{,}12\times10^3\times4\times\ell}{\pi(45^2-35^2)\times72\times10^3}\surd + \frac{47{,}12\times10^3\times4(80-\ell)\surd}{\pi\times45^2\times72\times10^3} + \frac{47{,}12\times10^3\times4\times100}{\pi\times(30^2-22^2)\times200\times10^3}\surd + \frac{47{,}12\times10^3\times4\times60}{\pi\times95^2\times110\times10^3}\surd$

$0{,}128 = 1041{,}58\times 10^{-6}\ell + 32919{,}093\times10^{-6} - 411{,}488\times10^{-6}\ell + 72109{,}431\times 10^{-6} + 3625{,}991\times10^{-6}\surd$ (6)

$19345{,}45\text{x}10^{-6} = 630{,}092\times10^{-6}\ell$

$\ell = 30{,}7$ mm√ [19]

QUESTION 3

3.1

$d = 6{,}05\sqrt{14}$

$= 22{,}64$mm√

Say 23 mm

σ_t (p-d)t = n $\frac{\pi d^2}{4}\tau$

$54(p-23)14\surd = 2\times\frac{\pi}{4}\times23^2\times48\surd$

p = 75, 76 mm√ (4)

3.2

$F_t = \sigma_t(p-d)t$

$= 54\surd(75{,}76\surd-23)14 = 39{,}89\ kN\surd$ (3)

$F_s = n\frac{\pi}{4}d^2\tau$

$= 2\times\frac{\pi}{4}\times23^{2\surd}\times48\surd = 39{,}89\ kN\surd$ (3)

$F_c = ndt\sigma_c$

$= 2\surd\times23\times14\surd\times60 = 38{,}64\ kN\surd$ (max applied load) (2)

3.3

$\eta = \frac{38640\surd}{14\times75{,}76\times54}\times100 = 67{,}46\%\surd$ (2)

[14]

QUESTION 4

4.1 $CM_L = ACM_L$

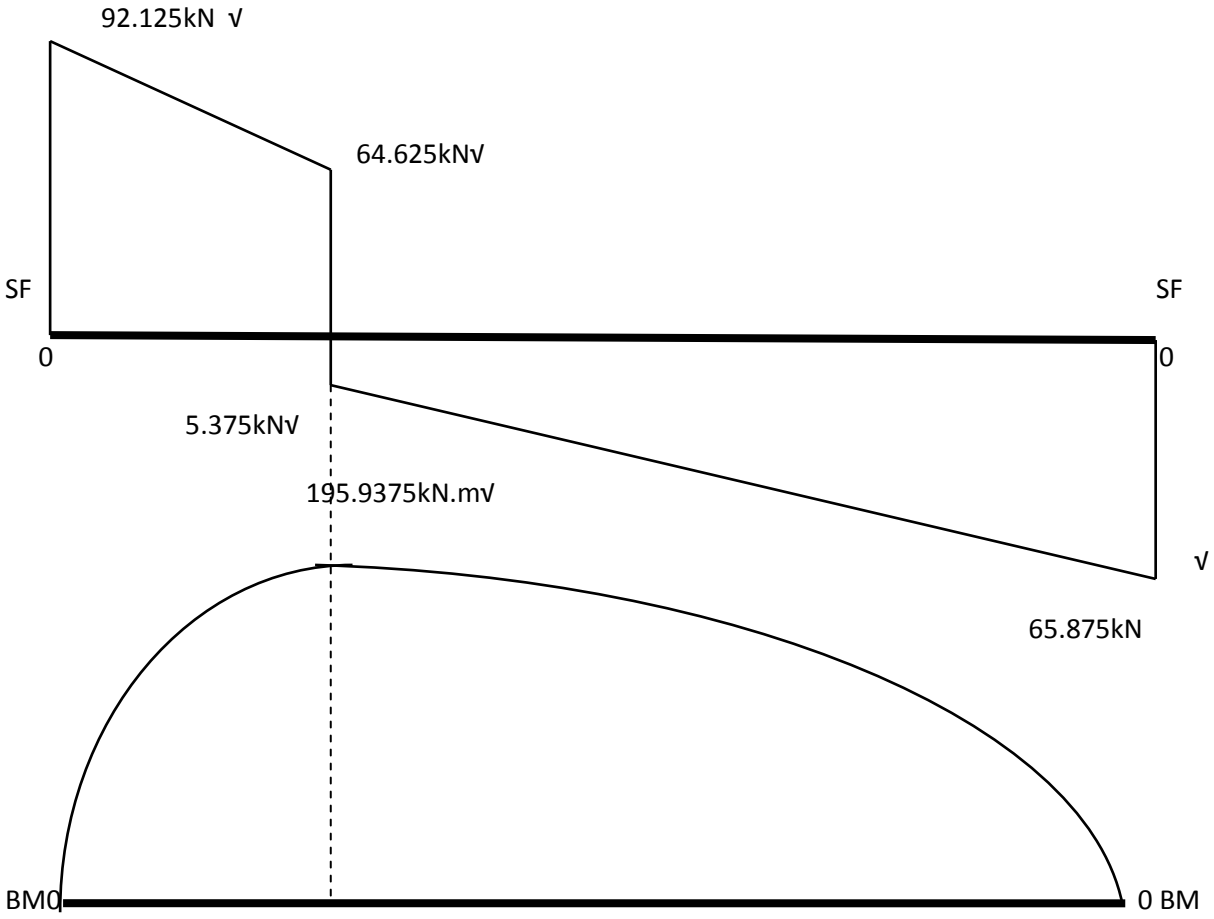
$70X2.5 + 11X\ 8X\ 4 = 8R\surd$

$R = 65.875kN\surd$

$CM_R = ACM_R$

$70X5.5 + 11X8X4 = 8L\surd$

$L = 92.125\ kN\surd$ (4)



BM at 2.5 m = $92.125x\ 2.5\ \surd - (11x\ 2.5^2)/2\surd = 195.9375kN.m\surd$ (8)

4.3

I_{xx}=(√200x 600^3- 570^3**x** 170√)/12 =976,432x$10^{-6}$$m^4$√

M/I= σ/Y

σ=(M x Y_{MAX})/I = (√195.9375x10^3x 0.3)/976.432x10^{-6} √= 60,2MPa√ (6)

4.4 σ=(M x Y_{MAX})/I= (195.9375x 10^3x0.15√)/976,432x10^{-6}= 43.65MPa√ (2)

[20]

QUESTION 5

T = $\frac{p}{2\pi N}$

= $\frac{3,6 \times 10^6 \times 60\sqrt{}}{2\pi \times 210}$ = 163702,23 Nm√

T = $\frac{\pi}{16}\tau\frac{(D^4-d^4)}{D}$

163702,23 = $\frac{\pi}{16} \times 70 \times 10^6 \left(\frac{(1.4d)^4-d^4}{1,4d}\right)\sqrt{}$

d = 180,37 mm√

D = 1,4 × 180,37 mm

= 252,52 mm√

$\theta = \frac{10,2TL}{G(D^4-d^4)} \times \frac{180}{\pi}$ (10)

$= \frac{10,2 \times 163702,23 \times 0,84}{85 \times 10^9(0,25252^4 - \theta, 180,37^4)} \times \frac{180}{\pi}$

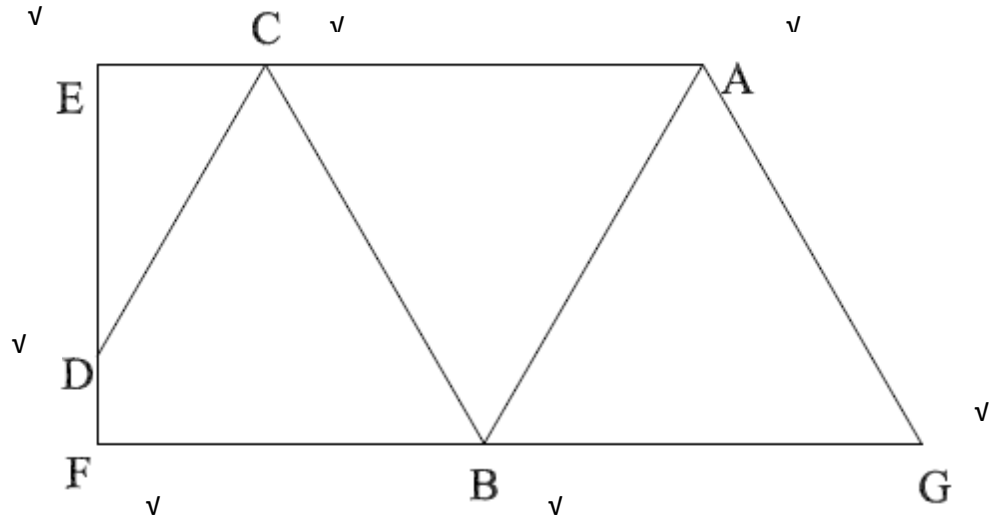
=√ $0,314^0$

1,3× $\frac{\pi}{180}$ = $\frac{10,2\times163702,23\times0,84}{85\times10^9(1,4^4d^4-d^4)}\sqrt{}$

d = 68,29 mm√

D = 95,61 mm√ use 252,52mm and 180,37mm√ [10]

QUESTION 6



(7)

dc=577.4N(S) √

cb=750.6N(t) √

ab=750.6N(S) √

ae=779.47N(t) √

fb=664N(S) √

ec=288.7N(t) √

ga=750.6N(t) √

fg=1154.77N(S) √

(8)

[15]

QUESTION 7

Stresses before temperature rise

7.1 $F_S = F_C$

$\sigma_S A_S = \sigma_C A_C$

$\sigma_S = \sigma_C \times \frac{AC}{AS} = \frac{54^2-38^2}{16^2}\sigma_C$√

$= 5{,}75\sigma_C$√

$X_C = \frac{\sigma_C \ell_C}{100}$ √

$\sqrt{0{,}5 \times 10^{-3}} = \frac{\sigma \times 0{,}8}{100}$√

σ_C = 62,5MPa√ (7)

σ_S = 359,375 MPa√

7.2

$\frac{\sigma_S \ell_S}{E_S} + \frac{\sigma_C \ell_C}{E_C} = \Delta t(\ell_C \propto_C - \ell_S \propto_S)$

$\frac{5{,}75 \times 0{,}84\ \sigma_C}{210 \times 10^9}$√ + $\frac{0{,}8\sigma_C}{100 \times 10^9}$√ = $\sqrt{80}\left(\sqrt{0{,}8 \times 18 \times 10^{-6}} - \sqrt{0{,}84 \times 12 \times 10^{-6}}\right)$

σ_C = 11,148 MPa (c)√

σ_S = 64,1MPa (T)√

Resultant stresses

σ_{RC} = 11,148 + 62,5 √= 73,648 MPa√ (comp) (11)

σ_{RS} = 359,375 + 64,1√ = 423,475 MPa √(tensile)

[18]

Total [100]

