STRENGTH OF MATERIALS I
1st Mid-Term Exam
04/10/2013
Solutions

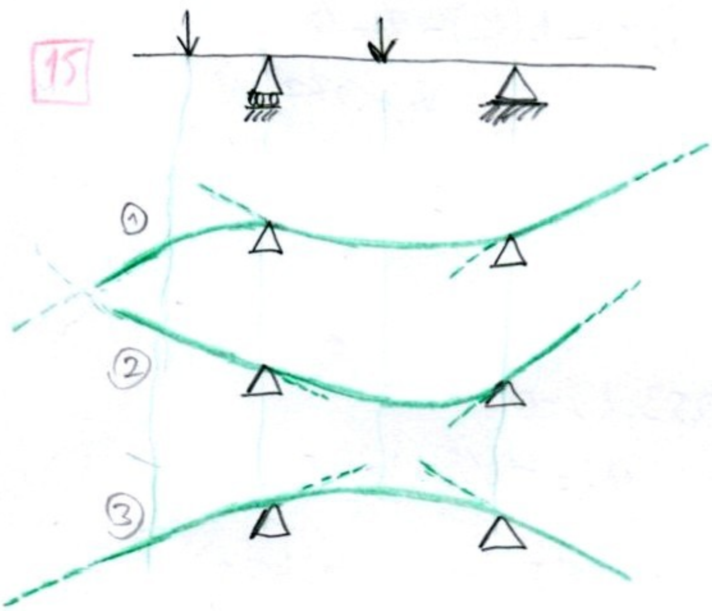
(25) 1) a)

[5]

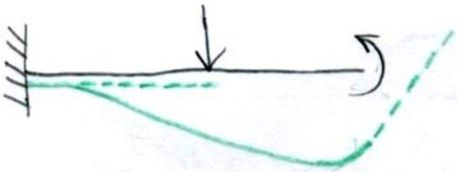
• Displaced state
--- Tangent line at support

b)

[15]



[5] c)



(15) 2) a) [5]

[5]

b) w, h, material, support conditions

[5]

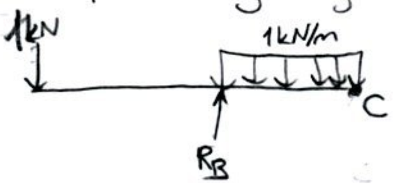
c) You can increase the strength by

- Changing the material
- Increasing the cross-section parameters w, h

(30) 3) a) $\circlearrowleft + \sum M_c = 0$

(15)

Free Body Diagram



$$1.(4) + 1.2,4.(1,2) - R_B.(2,4) = 0$$

$$R_B = 2,87 \, kN$$

$\sum$ Load $= \sum$ support reactions

$$1 + 1.2,4 = 2,87 + R_c$$

$$R_c = 0,53 \, kN$$

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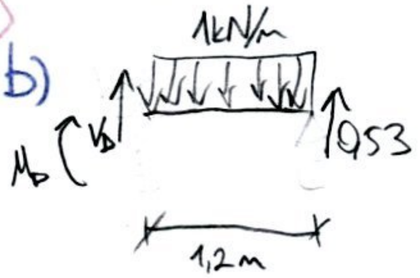
(15)

b)



$+\uparrow \sum F_y = 0$

$$0,53 - 1.(1,2) + V_D = 0$$

$$V_D = 0,67 \, kN$$

$\circlearrowleft + \sum M_{@D} = 0$

$$-M_D - 1.1,2.0,6 + 0,53.1,2 = 0$$

$$M_D = -0,084 \, kN.m$$

4) It is easier to work with SI units (m, kg, s)

(30)

Specimen diameter = 10mm = 0,01m

Gage length = 50mm = 0,05m

$$Area_{\text{specimen cross section}} = \pi.\left(\frac{d}{2}\right)^2 = \pi\left(\frac{0,01}{2}\right)^2 = 7,854.10^{-5} \, m^2$$

P [N]	ΔL [m]	$\sigma = P/A$ [$N/m^2 = Pa$]	$\epsilon = \frac{\Delta L}{L_0}$ [m/m]
0	0	0	0
$8,77.10^3$	$0,15.10^{-3}$	$1,117.10^8$	$3,0.10^{-3}$
$15,3.10^3$	$0,26.10^{-3}$	$1,948.10^8$	$5,2.10^{-3}$
$18,2.10^3$	$0,34.10^{-3}$	$2,317.10^8$	$6,8.10^{-3}$

Apply linear regression to $\epsilon - \sigma$ data

$$y = A + Bx \qquad B = 34,78 \times 10^9$$

$\Rightarrow$ Therefore Modulus of Elasticity $E = 34,78$ GPa