

ΠΠΜ 220: Στατική Ανάλυση των Κατασκευών Ι

Διάλεξη 33

8^η Άσκηση

Τρίτη 23 Νοεμβρίου, 2004

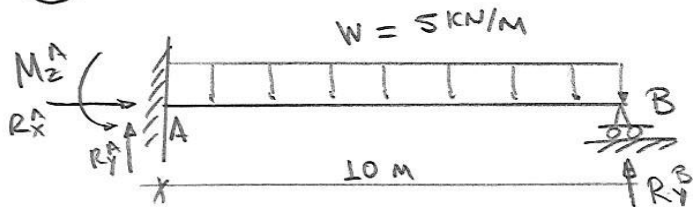
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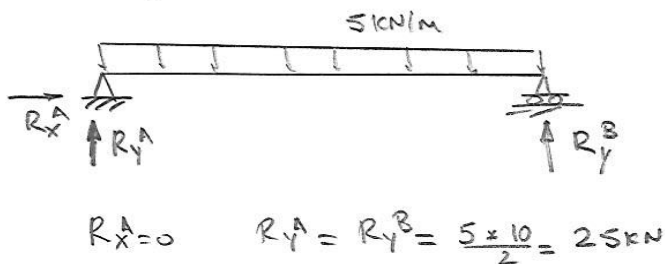
8η Σειρά Ασκήσεων

①



→ Ο φορέας είναι για φορέα υπερστατικός

→ ορίζοντας την θέση του σημείου του υπερστατικού γιγασμού $X_1 = M_z^A$:



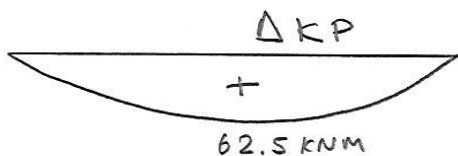
Σύστημα "0"

$$\begin{aligned}
 & \text{SKN/M} \\
 & \downarrow M = 25x - \frac{5x^2}{2} \\
 & \uparrow 25\text{kN} \quad \downarrow V = 25 - 5x \\
 & \xrightarrow{x}
 \end{aligned}$$

$$x = 5\text{m} \rightarrow M_{\text{max}} = 62.5 \text{ kNm}$$



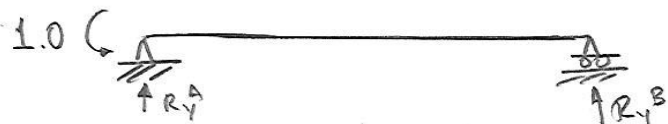
$$V(x) = 25 - 5x \quad [\text{kN}]$$



$$M(x) = 25x - \frac{5x^2}{2} \quad [\text{kN}]$$

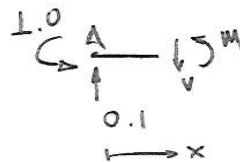
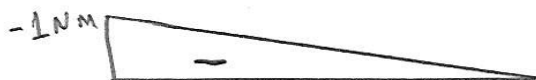
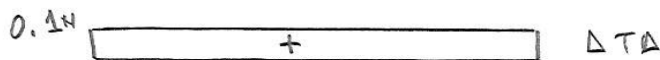
Σύστημα "1"

Εφαρμόζουμε μοναδιαία φορτίο γενν διευθύν του υπερστατικού γιγασμού



Από ισορροπία φορτίου ως προς A.

$$R_y^B = -\frac{1.0}{10} = -0.1 \rightarrow R_y^A = 0.1$$



$$V(x) = 0.1 \text{ (N)}$$

$$M(x) = 0.1 \times x - 1 \text{ (N)}$$

$$\delta_{10} = \int_0^{10} \frac{62500}{EI} * \frac{-1}{3} dx = \frac{1}{3} * 10 * \frac{62500}{EI} * (-1)$$

$$\hookrightarrow \delta_{10} = -\frac{625000}{3EI}$$

$$\delta_{11} = \int_0^{10} \frac{-1}{3EI} * \frac{-1}{3} dx = \frac{1}{3} * 10 * \left(\frac{-1}{EI}\right) * (-1)$$

$$\hookrightarrow \delta_{11} = \frac{10}{3EI}$$

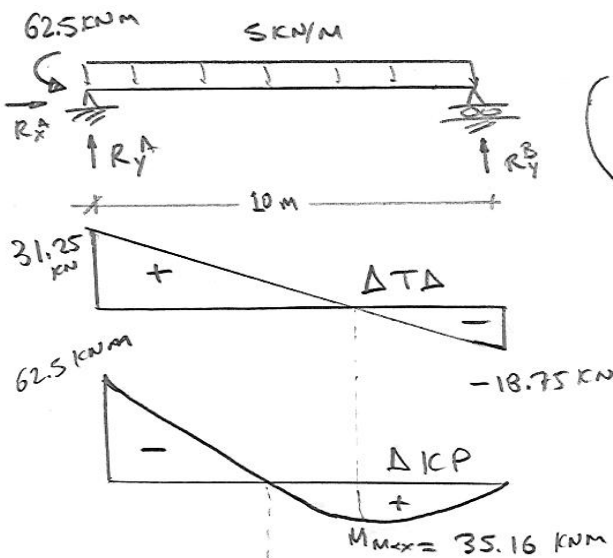
Συμβιβαστική ζων

$$\hookrightarrow X_1 = -\frac{\delta_{10}}{\delta_{11}} =$$

υφ'ακινθότων: $\delta_{10} + \delta_{11} X_1 = 0$

$$\frac{625000}{3EI} = \frac{10}{3EI} X_1$$

$$\hookrightarrow M_z^A = 62.5 \text{ kNm}$$



$$R_y^A + R_y^B = 50 \text{ kN}$$

$$R_y^B = \frac{5 * 10 * \frac{10}{2} - 62.5}{10} = 18.75 \text{ kN}$$

$$R_y^A = 31.25 \text{ kN} \quad R_y^B = 18.75 \text{ kN}$$

$$V(x) = 31.25 - 5 * x$$

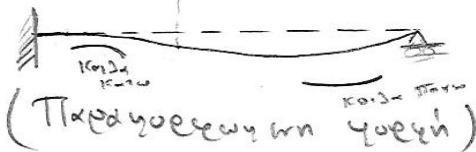
$$(31.25 \rightarrow -18.25)$$

$$M(x) = 31.25 * x - 5 \frac{x^2}{2} - 62.5$$

$$(-62.5 \rightarrow 0)$$

$$M = M_{max} \text{ όταν } V(x) = 0$$

$$\hookrightarrow X = \frac{31.25}{5} = 6.25 \rightarrow M_{max} = M(6.25) = 35.16$$

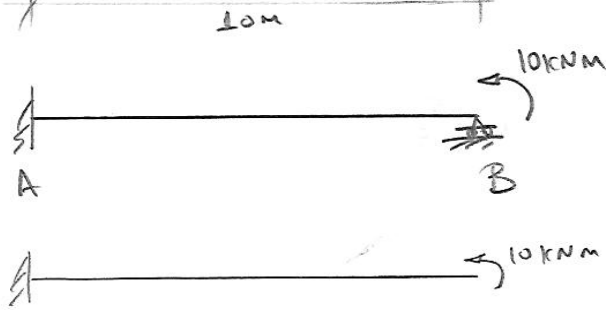


Τα ίδια αποτελέσματα (ΔΤΑ, ΔΚΡ, κλπ) προκύπτουν από την ελαστικότητα των επιπέδων ανομοιογενών:

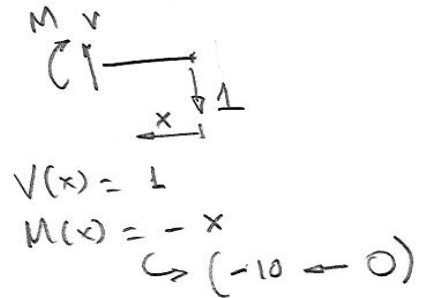
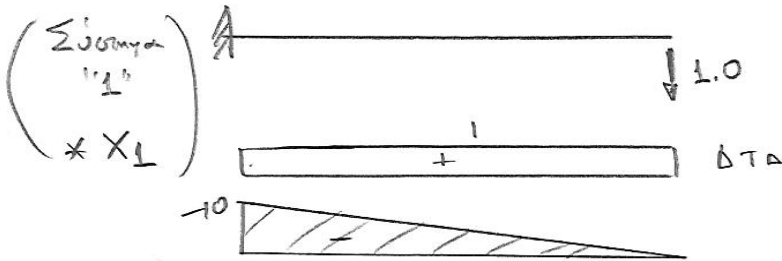
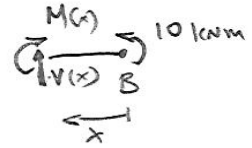
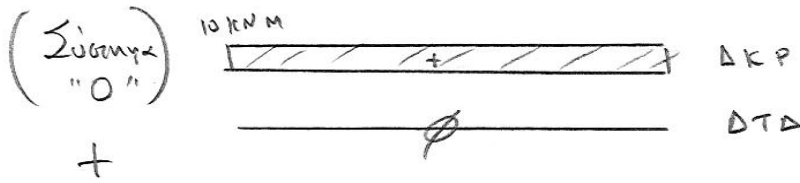
$$\text{π.χ. } R_y^B = R_y^{B0} + R_y^{B1} * X_1 = 25 - 0.1 * 62.5$$

$$\hookrightarrow R_y^B = 18.75 \text{ kN} //$$

2



1 γάρ υποστηρίξις
 Θέτουμε το R_y^B ως
 υποστηρίξις $x_1 = R_y^B$



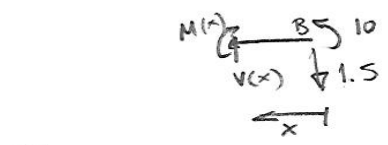
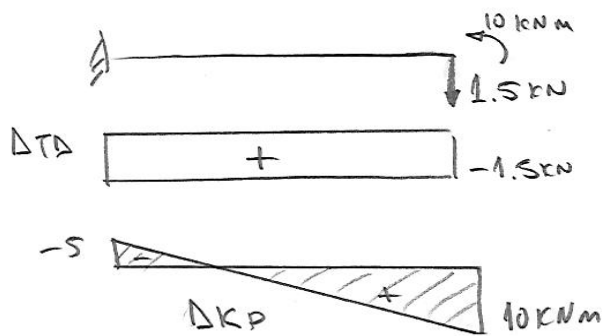
$\delta_{10} = \int_0^{10} \frac{10}{EI} \times \frac{-10}{x} dx = \frac{1}{2} \cdot 10 \cdot \left(\frac{10000}{EI} \cdot (-10) \right)$

$\delta_{10} = -\frac{500,000}{EI}$

$\delta_{11} = \int_0^{10} \frac{-10}{EI} \times \frac{10}{x} dx = \frac{1}{3} \cdot 10 \cdot \frac{(-10) \cdot (-10)}{EI} = \frac{1000}{3EI}$

Συμβατότητα των παραμορφώσεων: $\delta_{10} + \delta_{11} \cdot x_1 = 0$

$x_1 = R_y^B = -\frac{-500,000}{\frac{1000}{3EI}} = +1500 \text{ N} = 1.5 \text{ kN}$



$M(0) = 10$, $M(10) = -5 \text{ kNm}$

Τα ίδια βγαίνουν για φέρουσα.