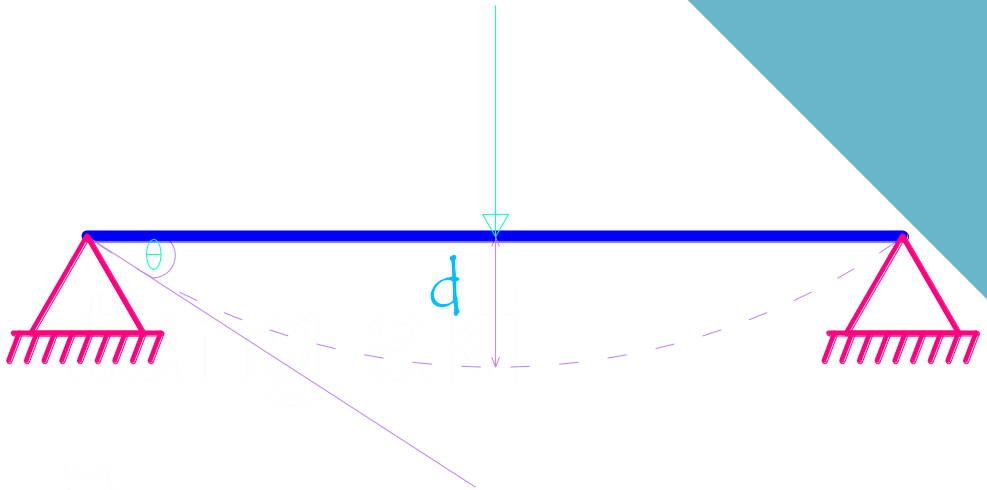
LENDUTAN BALOK AKIBAT MOMEN

BY: Lilis Trianingsih

Lendutan Batang akibat adanya Pembebanan



d = Lendutan

$$d = \frac{\text{L. Bidang Momen x Titik Berat Bidang Momen}}{Kekauan\ Lentur\ Bahan}$$

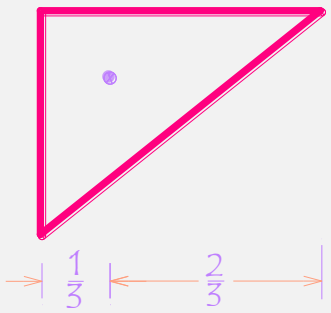
$$d = \frac{\text{A.bd . x } (titik\ pusat\ berat)}{E.I}$$

$d = < \frac{L}{300}$ Syarat lendutan SNI

Ex. = $\frac{800}{300}$, jika d melebihi syarat, maka harus diperkuat (kayu diperbesar)

PUSAT BERAT

1.



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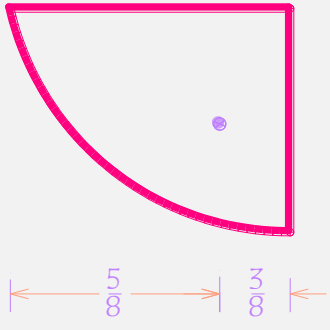

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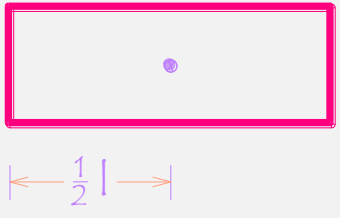

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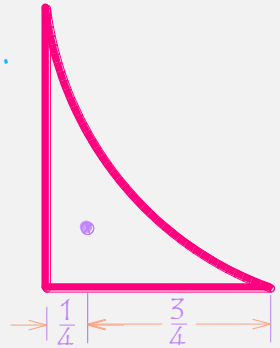
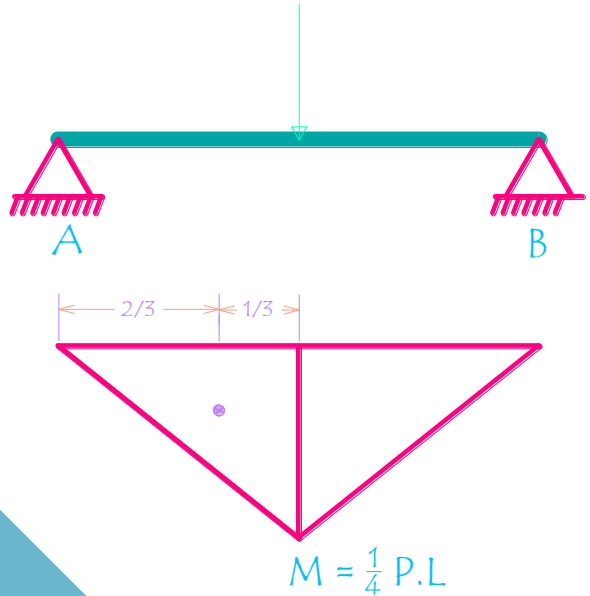
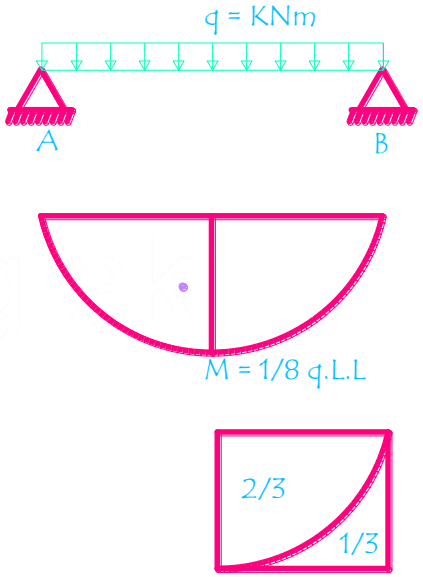


Lendutan Batang akibat adanya Pembebanan

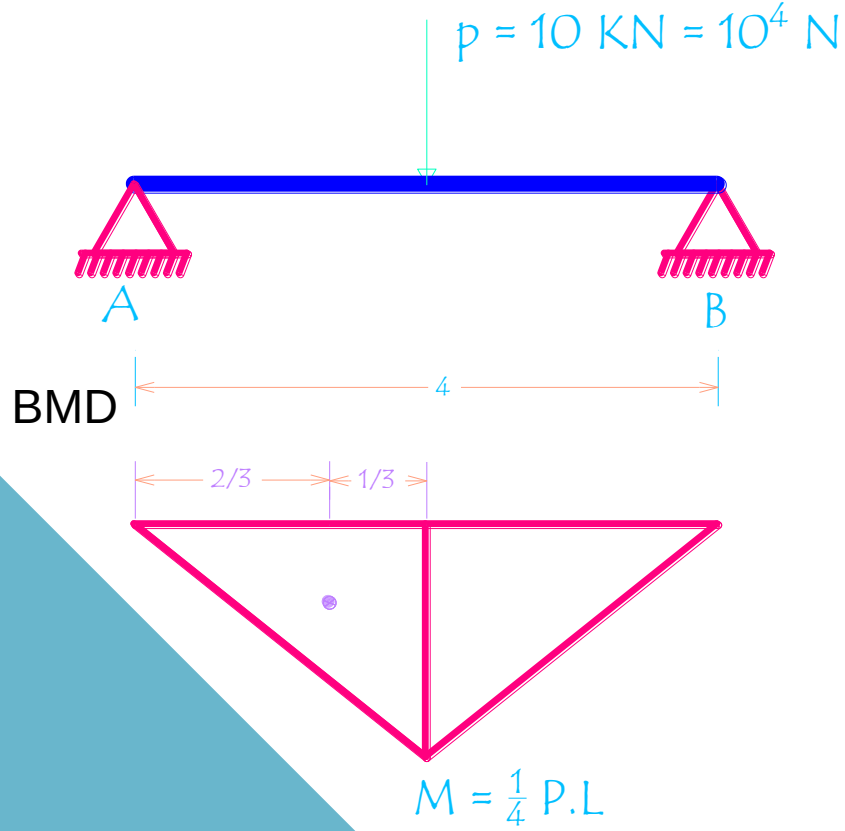




$$d = \frac{\frac{1}{2}.\frac{1}{2}l.\left(\frac{1}{4}p.l\right).\left(\frac{2}{3}.\frac{1}{2}l\right)}{E.I} = \frac{p.l^3}{48\ E.I}$$

$$d = \frac{\frac{2}{3}.\frac{1}{2}l\left(\frac{1}{8}.q.l^2\right)\left(\frac{5}{8}.\frac{1}{2}l\right)}{E.I} = \frac{5.q.l^4}{384\ E.I}$$

Contoh Soal



F'c = 24 Mpa
Dimensi Balok 300/400 (mm)

Hitunglah lendutan!

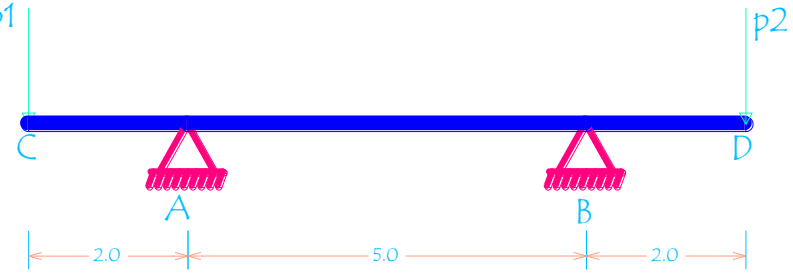
$E_{beton} = 4700.\sqrt{fc'} = 4700.\sqrt{24}$

$I = \frac{1}{12} b. h^3 = \frac{1}{12} 300. 400^3$

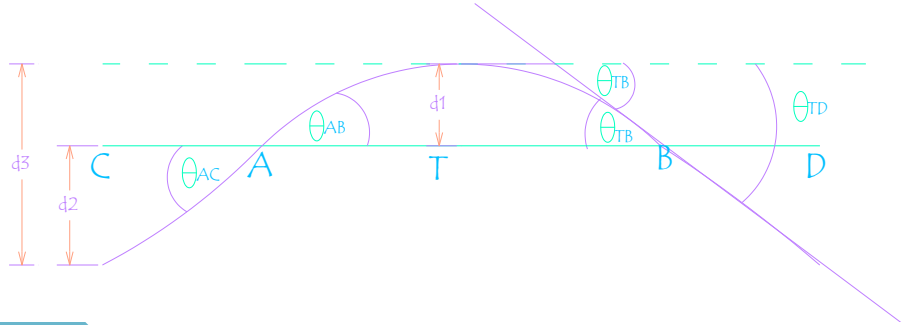
$d = \frac{pl^3}{24EI}$ Silahkan ganti jdi $\frac{pl^3}{48EI}$

$= \frac{10^4.4000^3}{48.4700\sqrt{24}.\frac{1}{12}.300.400^3}$

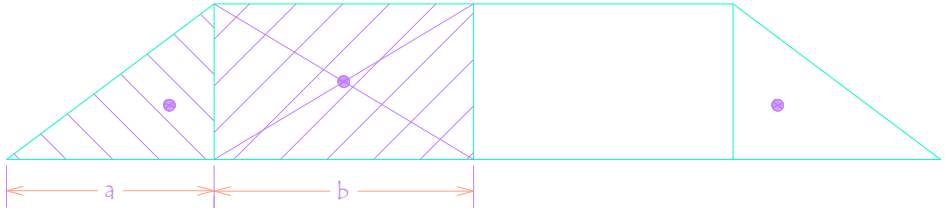
= ....**mm**



MODUL KELENGKUNGAN



BMD



Sudut lengkung

$$\theta_{AB} = \frac{A}{E.I} = \frac{b.Mmax}{E.I}$$

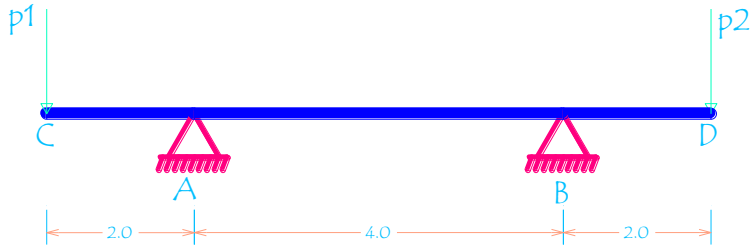
$$\theta_{AC} = \frac{A}{E.I} = \frac{\frac{1}{2}.a.Mmax + b.Mmax}{E.I}$$

Lendutan Balok

$$d1 = \frac{A.x}{E.I} = \frac{b.Mmax.(\frac{1}{2}.b)}{E.I}$$

$$d2 = d3 - d1$$

$$d3 = \frac{A.x}{E.I} = \frac{\{b.Mmax.((\frac{1}{2}.b)+a))+(\frac{1}{2}a.Mmax).\frac{2}{3}a\}}{E.I}$$



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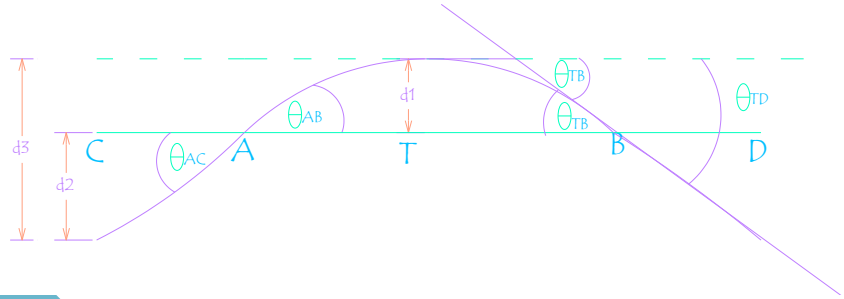

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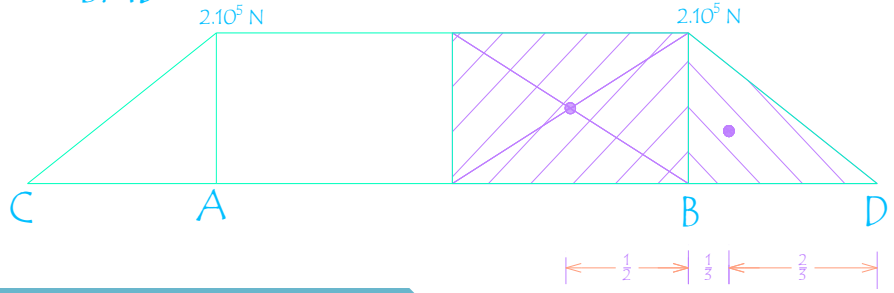


Diketahui

$E = 10^5$

Balok 300/400

Ditanyakan

a. *Sudut lengkung?*

b. *Lendutan?*

Jawaban:

$$I = \frac{1}{12} b.\ h^3 = \frac{1}{12} 300.\ 400^3 = 16.10^8$$

$$\theta_{TB} = \frac{A}{E.I} = \frac{b.Mmax}{E.I} = \frac{2.10^3.2.10^5}{10^5.16.10^8}$$

$$= \frac{4.10^8}{16.10^{13}} = \mathbf{0{,}25.\ 10^{-5}\ rad}$$

$$\theta_{TD} = \frac{A}{E.I}$$

$$= \frac{2.10^3.2.10^5 + (\frac{1}{2}.2.10^3.2.10^5)}{10^5.16.10^8}$$

$$= \frac{4.10^8 + 2.10^8}{16.10^{13}} = \frac{16.10^8}{16.10^{13}} = \mathbf{0,375.10^{-5}\ rad}$$

$$d1 = \frac{A.x}{E.I} = \frac{(2.10^3.2.10^5).(\frac{1}{2}.2.10^3)}{10^5.16.10^8}$$

$$= \frac{(4.10^8).(10^3)}{16.10^{13}}$$

$$= \mathbf{0{,}25.\ 10^{-2}\ mm}$$

$$d3 = \frac{A.x}{E.I}$$

$$= \frac{\{2.10^3.2.10^5.((\frac{1}{2}.2.10^3+2.10^3))+(\frac{1}{2}2.10^3.2.10^5.(\frac{2}{3}.2.10^3)\}}{10^5.16.10^8}$$

$$= \frac{\{4.10^8.(2.10^6)+2.10^8(1{,}33.10^3)\}}{16.10^{13}}$$

$$= \frac{8.10^{14}+2{,}66.10^{11}}{16.10^{13}}$$

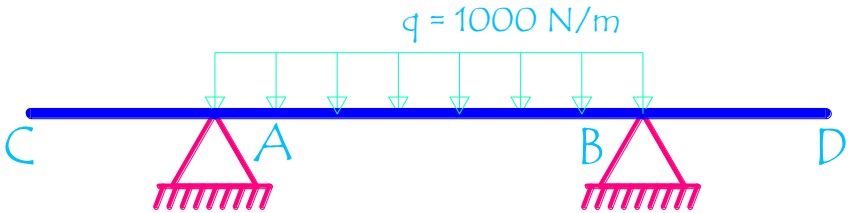
$$= \frac{8.10^{14}+2{,}66.10^{11}}{16.10^{13}} = \frac{8.10^{14}+0{,}00266.10^{14}}{16.10^{13}}$$

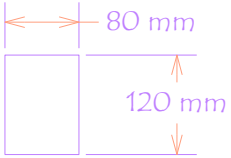
$$= 0{,}791.\ 10^{-2} = \mathbf{0{,}00791\ mm}$$

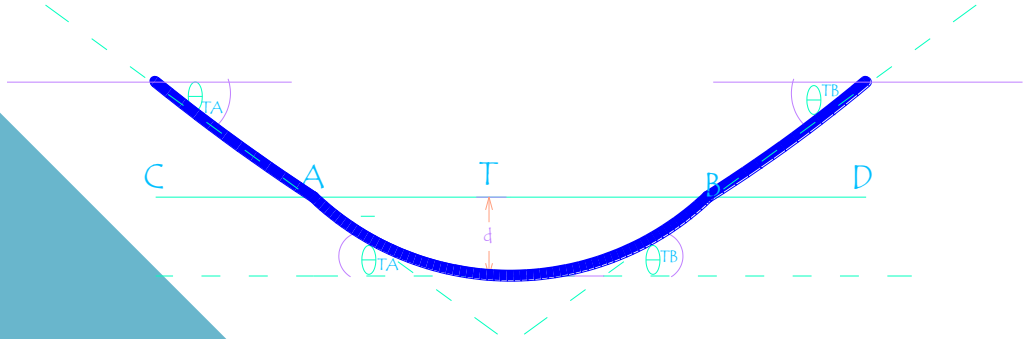
$$d2 = d3\text{-}d1 = 0{,}791.10^{-2} - 0{,}25\ .10^{-2} = \mathbf{0{,}541.\ 10^{-2}\ mm}$$

Kesimpulan : Batang T naik sebesar 0,0025 mm

Batang D naik sebesar 0,00541 mm







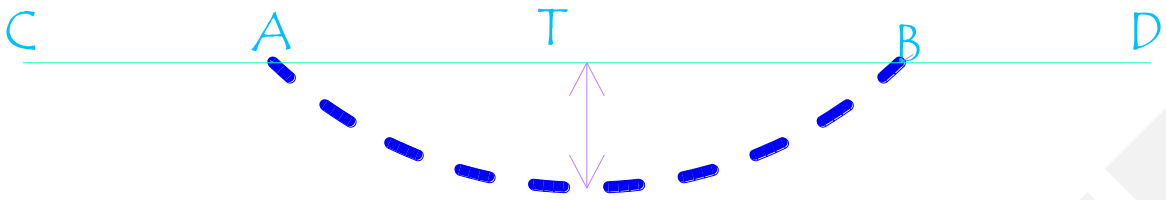
Diketahui

$E = 2{,}5.10^4\ MPa = 25\ KN/mm2$

Balok kayu 8/12 cm

Ditanyakan

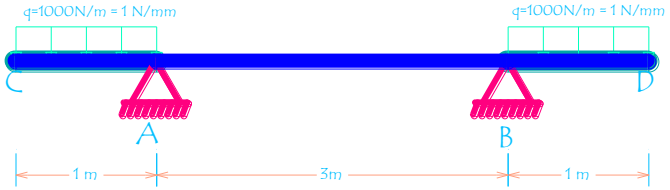
a. *Sudut lengkung?*
b. *Lendutan?*



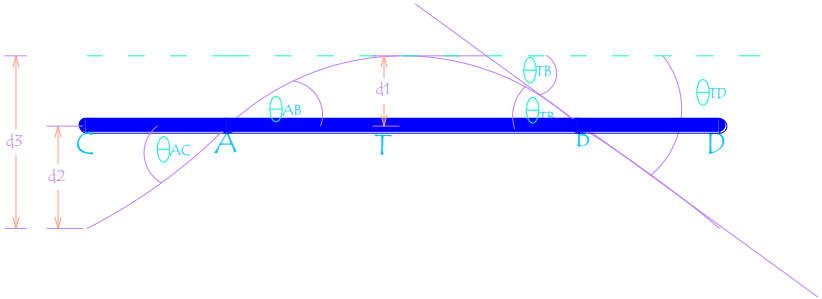
$$\text{Mmax} = \frac{QL^2}{8} = \frac{1.3000^2}{8} = 1{,}125\ .10^6\ Nmm = 1{,}125\ .10^3\ kNmm$$

$$\theta_A = \frac{A}{E.I} = \frac{\frac{2}{3}.Mmax\ .\frac{l}{2}}{E.I} = \frac{M.l}{3.E.I} = \frac{1{,}125\ .10^3.3\ .10^3}{3.25.1{,}152.10^7} = 0{,}244 \text{Derajad}$$

$$d = \frac{\frac{2}{3}.Mmax\ .\frac{l}{2}.(.\frac{5}{16}.l)}{E.I} = \frac{\frac{2}{3}.1{,}125\ .10^3.1{,}5\ .10^3.(.\frac{5}{16}.3.10^3)}{25.1{,}152.10^7} = 3{,}7\ \text{mm}$$



MODUL KELENGKUNGAN



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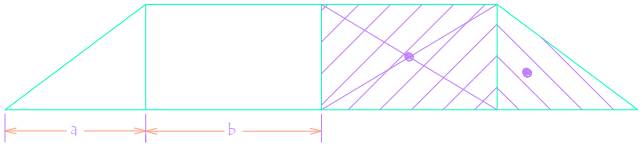


Diketahui

$E = 2{,}5.10^4\ MPa = 25\ KN/mm2$

Balok kayu 8/12 cm

Ditanyakan

a. *Sudut lengkung?*

b. *Lendutan?*

Jawaban:

$$I = \frac{1}{12}\, b.\, h^3 = \frac{1}{12}\, 80.120^3 = 1{,}152.10^4\ mm^4$$

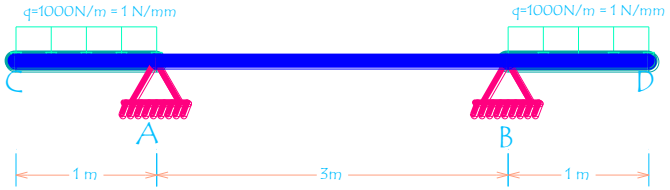
$$Mmax = \frac{1}{2}\, q.\, l^2 = \frac{1}{2}\, 1.\, 1000^2$$

$$= 5.\, 10^5\ Nmm = 5.\, 10^2\ KNmm$$

$$\theta_{TB} = \frac{A}{E.I} = \frac{\frac{1}{2}Mmax.l}{EI} = \frac{Mmax.l}{2EI}$$

$$= \frac{5.10^2.1{,}5.10^3}{2.25.1{,}152.10^4} = 0{,}13.\, 10^{-2}\ rad$$

$$= 0{,}74°$$



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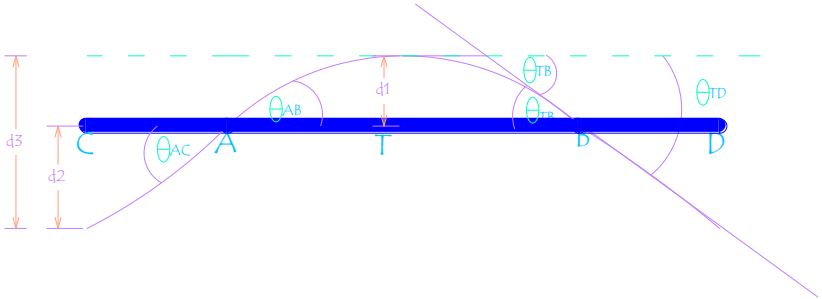

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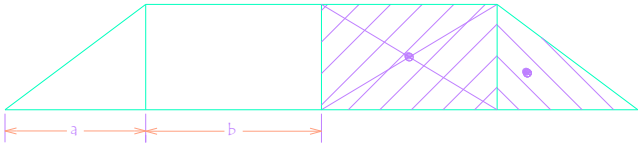


Lanjutan

$$\theta_{TD} = \frac{A}{E.I} = \frac{\frac{1}{2}Mmax.l + \frac{1}{3}Mmax.l}{EI}$$

$$= \frac{\left(\frac{1}{2}.5.10^2.1{,}5.10^3\right) + \left(\frac{1}{3}.5.10^2.1.10^3\right)}{25.1{,}152.10^4}$$

$$= 0{,}188.\ 10^{-2}\ rad$$

$$= 1{,}07°$$

$$d1 = \frac{\frac{1}{2}.Mmax\ .l.\left(\frac{l}{4}.l\right)}{E.I} = \frac{\frac{1}{2}.5.10^2.3.10^3.\left(\frac{l}{4}.3.10^3\right)}{25.1{,}152.10^4}$$

$$= 1{,}95\ mm$$

$$d3 = \frac{\left(\frac{1}{2}.Mmax\ .l1 + \frac{l}{3}.Mmax.l2\right).x}{E.I} =$$

$$\frac{\left(\frac{1}{2}.Mmax\ .l1 + \frac{l}{3}.Mmax.l2\right).\left(\frac{1}{4}.l1 + l2\right)}{E.I}$$

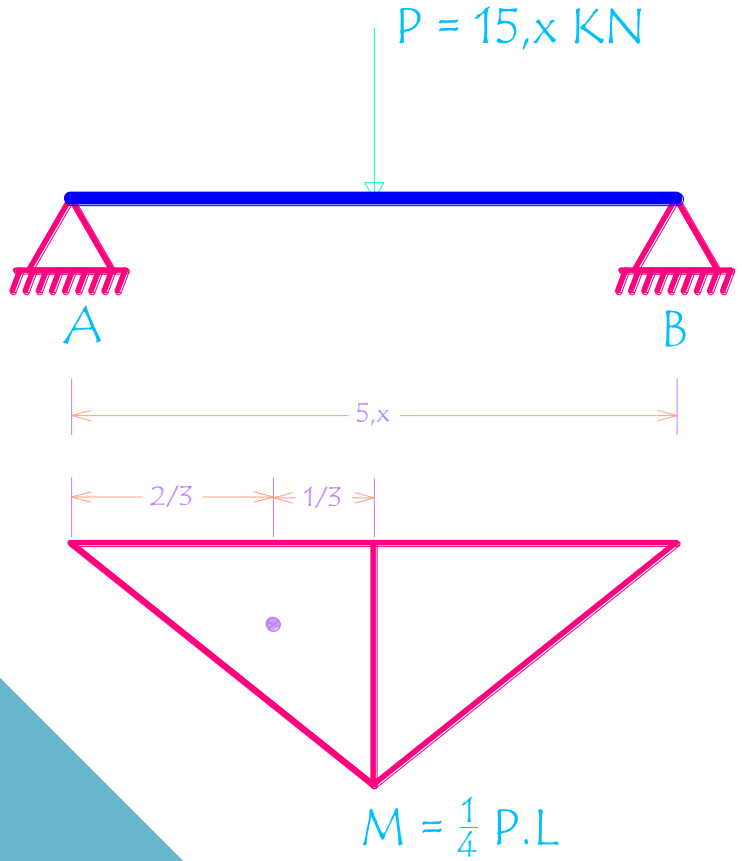
$$\frac{\left(\frac{1}{2}.5.10^2.3.10^3 + \frac{1}{3}.5.10^2.10^3\right).\left(\frac{l}{4}.3.10^3 + 10^3\right)}{25.1{,}152.10^4}$$

$$= 5{,}6\ mm$$

$$d2 = d3 - d1 = 5{,}6 - 1{,}95 = 3{,}65\ mm$$

Tugas

1.



Diketahui:
F’c = 30 Mpa
Dimensi Balok 3**x**/5**x** (mm)

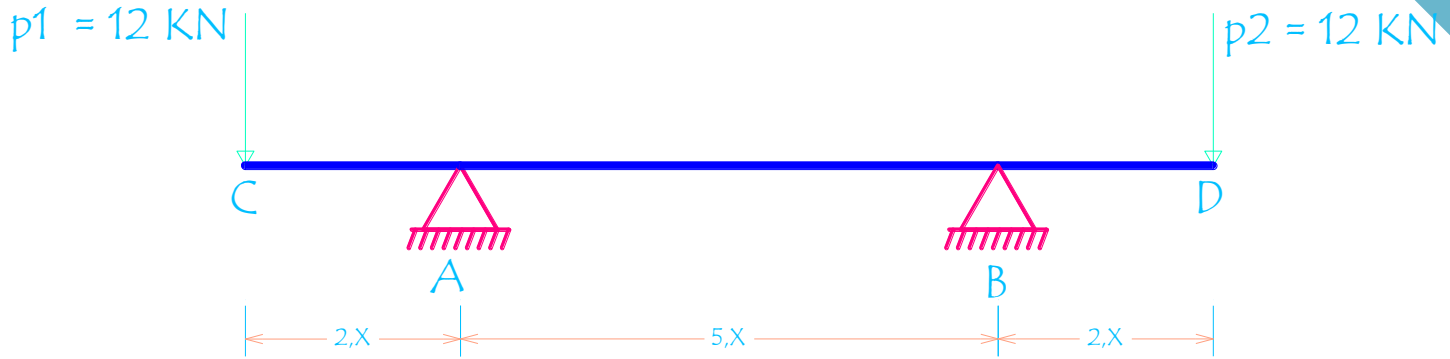
X merupakan dua digit NIM

Hitunglah

a. **Sudut lengkung!**
b. **Lendutan Balok tersebut!**

Tugas

2.



Diketahui:

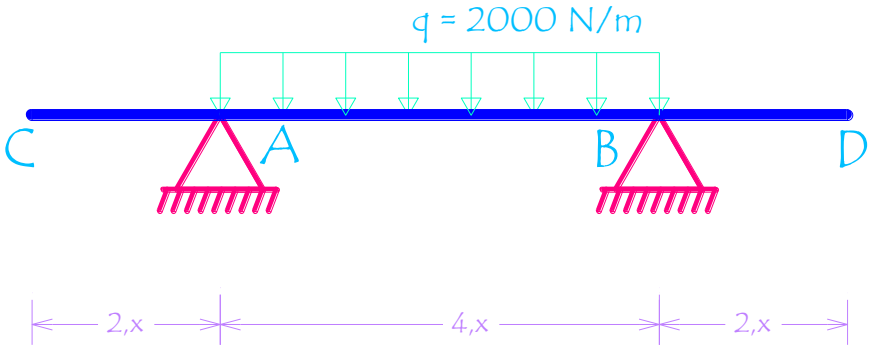
Fc’ = 30 Mpa

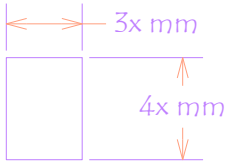
Balok 350/450

x merupakan dua digit NIM

Ditanyakan:

a. Sudut lengkung?
b. Lendutan?





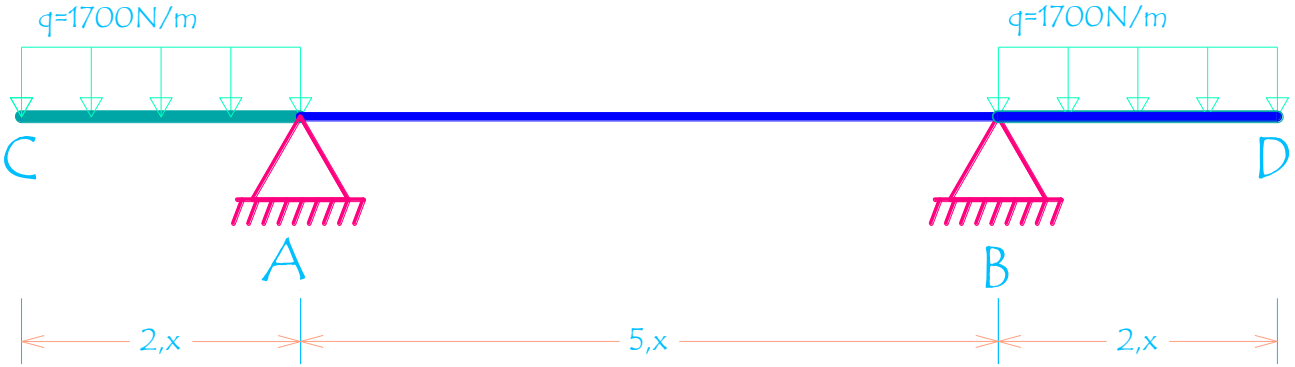
Diketahui

$E = 2{,}5.10^4\ MPa = 25\ KN/mm2$

Balok 3x/4x

Ditanyakan

a. *Sudut lengkung?*
b. *Lendutan?*



Diketahui

$Fc' = 35\,MPa$

Balok 350/450

Ditanyakan

a. *Sudut lengkung?*
b. *Lendutan?*