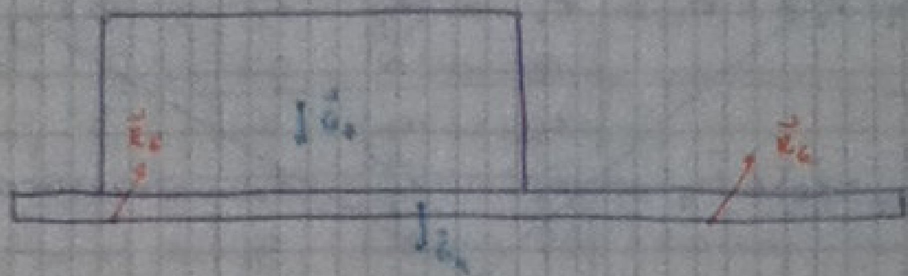
Examen augustus 2010

(1) 1)



krachtenevenwicht

$\vec{K}_5 + \vec{K}_6 + \vec{G}_7 + \vec{G}_4 = \vec{0}$

(x) $K_{5x} + K_{6x}$ ~~$- 200000 N - 250000 N$~~ $= 0$

K_{5x} ~~$= K_{6x} = 450000 N$~~ $K_{5x} = -K_{6x}$

(y) $K_{5y} + K_{6y} - 450\,000 N = 0$

$K_{5y} + K_{6y} = 450\,000 N$

momentenevenwicht tov 5

$\vec{M}_5 = (\vec{r}_6 - \vec{r}_5) \times \vec{K}_6 + (\vec{r}_4 - \vec{r}_5) \times \vec{G}_4 + (\vec{r}_7 - \vec{r}_5) \times \vec{G}_7$

$$(\vec{r}_6 - \vec{r}_5) \times \vec{K}_6 = \begin{vmatrix} \vec{e}_x & \vec{e}_y & \vec{e}_z \\ 18 & 0 & 0 \\ K_{6x} & K_{6y} & 0 \end{vmatrix} = 18 K_{6y} \vec{e}_z$$

$$(\vec{r}_4 - \vec{r}_5) \times \vec{G}_4 = \begin{vmatrix} \vec{e}_x & \vec{e}_y & \vec{e}_z \\ 9 & 0 & 0 \\ 0 & G_4 & 0 \end{vmatrix} = -2250000 N \vec{e}_z$$

$$(\vec{r}_7 - \vec{r}_5) \times \vec{G}_7 = \begin{vmatrix} \vec{e}_x & \vec{e}_y & \vec{e}_z \\ \cancel{10}\, 3 & 0 & 0 \\ 0 & 200000 & 0 \end{vmatrix} = -600\,000 N \vec{e}_z$$

$\Rightarrow M_5 = 18 K_{6y} - 2250\,000 N - 600\,000 N = 0$

$K_{6y} = 158333 N$

$$(\vec{r}_4 - \vec{r}_0) \times \vec{G}_4 = \begin{vmatrix} \vec{e}_x & \vec{e}_y & \vec{e}_z \\ 0 & 0 & 0 \\ 0 & G_4 & 0 \end{vmatrix} = -2250000\,N\,\vec{e}_z$$

$$(\vec{r}_7 - \vec{r}_0) \times \vec{G}_7 = \begin{vmatrix} \vec{e}_x & \vec{e}_y & \vec{e}_z \\ 12 & 0 & 0 \\ 0 & G_7 & 0 \end{vmatrix} = -3000000\,N\,\vec{e}_z$$

$$\Rightarrow M_6 = -18\,R_{5y} - 2250000\,N - 3000000\,N = 0$$

$$R_{5y} = 291666\,N$$

$$\Rightarrow R_{5y} = 291667\,N$$

enkel overkend krachten G_4 en G_7 volgens $\vec{e}_y$

$\Rightarrow$ reactiekrachten ook enkel volgens $\vec{e}_y$

$\Rightarrow \vec{R}_5 = 291667\,N\,\vec{e}_y \qquad \vec{R}_6 = 118333\,N\,\vec{e}_y$

2)

3) krachtenevenwicht

$$\vec{R}_{51} + \vec{R}_{52} + \vec{R}_5 + \vec{G}_5 = \vec{0}$$

(x) /

(y) $R_{51} + R_{52} - 291667\,N - 250000\,N = 0$

$R_{51} + R_{52} = 541667\,N$

momentenevenwicht

$$\vec{M}_{51} = (\vec{r}_{52} - \vec{r}_{51}) \times \vec{R}_{52} + (\vec{r}_5 - \vec{r}_{51}) \times \vec{G}_5 + (\vec{r}_5 - \vec{r}_{51}) \times \vec{R}_5$$

$$(\vec{r}_{S2} - \vec{r}_{31}) \times \vec{K}_{S2} = \begin{vmatrix} \vec{e}_x & \vec{e}_y & \vec{e}_z \\ 2 & 0 & 0 \\ 0 & K_{T2} & 0 \end{vmatrix} = 2K_{T2}\,\vec{e}_z$$

$$(\vec{r}_S - \vec{r}_{31}) \times \vec{G}_S = -21000\,N\,\vec{e}_z$$

$$(\vec{r}_1 - \vec{r}_{31}) \times \vec{K}_1 = -281667\,N\,\vec{e}_z$$

$$\Rightarrow \vec{M}_{31} = 2K_{T2} - 21000N - 281667N = 0$$

$$K_{T2} = 118\,334\,N$$

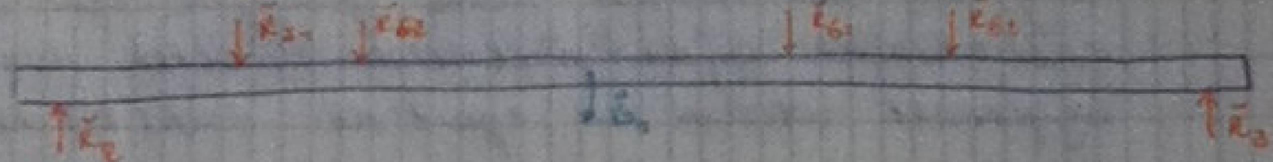
$$K_{S1} = 158\,339\,N$$

b) zelfde werkwijze

$$K_{61} = 81\,667\,N$$

$$K_{62} = 81\,666\,N$$

3)



krachtenevenwicht

$$\vec{K}_2 + \vec{K}_3 + \vec{K}_{31} + \vec{K}_{32} + \vec{K}_{61} + \vec{K}_{62} + \vec{G}_1 = \vec{0}$$

(x) ✓

(y) $K_2 + K_3 = 1700000\,N$

momentenevenwicht:

$$\vec{M}_2 = (\vec{r}_{31} - \vec{r}_2) \times \vec{K}_{31} + (\vec{r}_{32} - \vec{r}_2) \times \vec{K}_{32} + (\vec{r}_1 - \vec{r}_2) \times \vec{G}_1 + (\vec{r}_{61} - \vec{r}_2) \times \vec{K}_{61} + (\vec{r}_{62} - \vec{r}_2) \times \vec{K}_{62} + (\vec{r}_3 - \vec{r}_2) \times \vec{K}_3$$

$$(\vec{r}_{31} - \vec{r}_2) \times \vec{K}_{T1} = -12{,}4\,K_{T1}\,\vec{e}_z = -1963329\,Nm\,\vec{e}_z$$

$$(\vec{r}_{32} - \vec{r}_2) \times \vec{K}_{32} = -14{,}4\,K_{T2}\,\vec{e}_z = -1\,280\,0010\,Nm\,\vec{e}_z$$

$$(\vec{r}_1 - \vec{r}_2) \times \vec{K}_{12} = 27\,G_1\,\vec{e}_z = -30\,000\,000\,Nm\,\vec{e}_z$$

$$(\vec{r}_{61} - \vec{r}_2) \times \vec{K}_{61} = -30{,}4\,K_{61}\,\vec{e}_z = -2786677\,Nm\,\vec{e}_z$$

$$(\vec{r}_{62} - \vec{r}_2) \times \vec{K}_{62} = -32{,}4\,K_{62}\,\vec{e}_z = -2368978\,Nm\,\vec{e}_z$$

$$(\vec{r}_3 - \vec{r}_2) \times \vec{K}_3 = 30\,K_3\,\vec{e}_z$$

$\rightarrow \vec{M}_2 = 50\,R_3 - 39999994\,Nm = 0$

$R_3 = 800\,000\,N$

$\rightarrow R_2 = 800\,000\,N$

4) $\vec{r}_c = \dfrac{\sum m_i \vec{r}_i}{m}$

$= \dfrac{1}{170} \cdot 120 \cdot 25\,\vec{e}_x + 27 \cdot 19{,}4\,\vec{e}_y + 2{,}5 \cdot 13{,}4\,\vec{e}_y + 1{,}5 \cdot 31{,}4\,\vec{e}_y + 20 \cdot 16{,}4\,\vec{e}_y$

$= 23\,\vec{e}_y$

5) Nee, het rijtuig staat niet in het midden van de brug, en dus hebben beide opleggers een andere reactiekracht. Beide wielstellen moeten dus apart vrijgemaakt worden en apart de reactiekracht berekenen