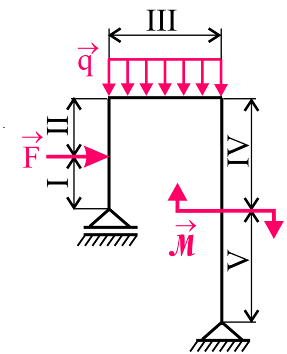
zpět k zadání
angular bar
analysis

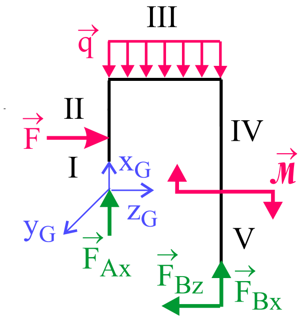
Classification of the bar:
straight per parts, loaded by external forces, supported.



Statical analysis: $s = \mu - \nu = 3 - 3 = 0.$
We divide the bar into five intervals, namely in the points where there is a change in the character of distributed loads and in turning points of the centreline. The bar has no free end, we must first calculate the support reactions using equations of static equilibrium. As the bar is not straight (too complex for differential approach) we use the integral approach only.

The sign convention for components of inner resultants is identical with straight bars, only the orientation of the x axis changes in the turning points because it is tangential to the bar centreline. We locate the origin of the global coordinate system in the point A (left-hand side end L of the bar) and introduce a local coordinate system in the location of the section..

integral approach
local c.s.

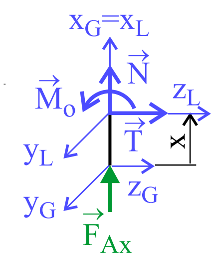


Isolation of the bar as a free body and calculation of support reacti

$$F_x : \quad F_{Ax} + F_{Bx} - qc = 0$$
$$F_z : \quad F_{Bz} - F = 0$$
$$M_{yB}: \quad F_{Ax}c + F(a+d) - \frac{qc^2}{2} + \mathcal{M} = 0$$

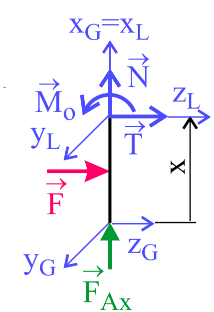
Solution:

$$F_{Ax} = -F\frac{a+d}{c} + \frac{qc}{2} - \frac{\mathcal{M}}{c}$$
$$F_{Bx} = F\frac{a+d}{c} + \frac{qc}{2} + \frac{\mathcal{M}}{c}; \qquad F_{Bz} = F$$



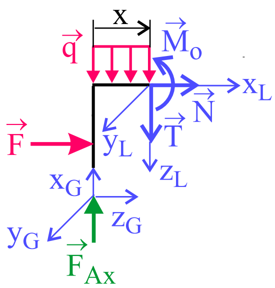
Inner resultants in the interval I: $x \in (0; a)$

$$F_x : \quad N(x) = -F_{Ax} = F\frac{a+d}{c} - \frac{qc}{2} + \frac{\mathcal{M}}{c}$$
$$F_z : \quad T(x) = 0$$
$$M_y : \quad M_o(x) = 0$$



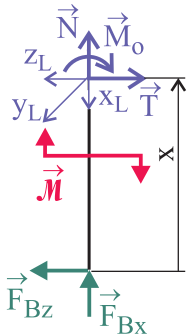
Inner resultants in the interval II: $x \in (a; a+b)$

$$F_x : \quad N(x) = -F_{Ax} = F\frac{a+d}{c} - \frac{qc}{2} + \frac{\mathcal{M}}{c}$$
$$F_z : \quad T(x) = -F$$
$$M_y : \quad M_o(x) = -F(x-a)$$



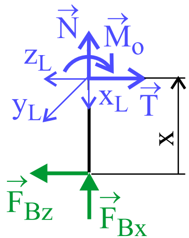
Inner resultants in the interval III: $x \in (0; c)$

$$
\begin{aligned}
F_x: &\quad N(x) = -F \\
F_z: &\quad T(x) = F_{Ax} - qx = -F\frac{a+d}{c} + \frac{qc}{2} - \frac{\mathcal{M}}{c} - qx \\
M_y: &\quad M_o(x) = F_{Ax}x - Fb - \frac{qx^2}{2} = \\
&\quad -F\frac{a+d}{c}x + \frac{qc}{2}x - \frac{\mathcal{M}}{c}x - Fb - \frac{qx^2}{2}
\end{aligned}
$$



Inner resultants in the interval IV: $x \in (d; a+b+d)$

$$
\begin{aligned}
F_x: &\quad N(x) = -F_{Bx} = -F\frac{a+d}{c} - \frac{qc}{2} - \frac{\mathcal{M}}{c} \\
F_z: &\quad T(x) = F_{Bz} = F \\
M_y: &\quad M_o(x) = -F_{Bz}x - \mathcal{M} = -Fx - \mathcal{M}
\end{aligned}
$$



Inner resultants in the interval V: $x \in (0; d)$

$$
\begin{aligned}
F_x: &\quad N(x) = -F_{Bx} = -F\frac{a+d}{c} - \frac{qc}{2} - \frac{\mathcal{M}}{c} \\
F_z: &\quad T(x) = F_{Bz} = F \\
M_y: &\quad M_o(x) = -F_{Bz}x = -Fx
\end{aligned}
$$

Graphical representation of the distribution of components of inner resultants: