



$$U = \frac{1}{2} \left[\int_L \frac{Q_y^2}{GA_s} dx + \int_L \frac{M_z^2}{EI_z} dx \right]$$

→ Beanspruchungen u. Differentialbeziehungen



$$\sum F_y: A_y + B_y = \frac{1}{2} w_0 L$$

$$\sum M_z^{in A}: B_y L = \frac{1}{2} w_0 L \frac{2}{3} L$$

$$L \cdot B_y = \frac{w_0 L^2}{3}$$

$$L \cdot A_y = \frac{w_0 L}{6}$$



$$Q_y = - \int q(x) dx = - \int w(x) dx = - \int \frac{w_0}{L} x dx$$

$$= - \frac{w_0 x^2}{2L} + C_1$$

$$M_z = - \int Q_y dx = - \int - \frac{w_0 x^2}{2L} + C_1 dx$$

$$= \frac{w_0 x^3}{6L} - C_1 x + C_2$$

$$Q_2 = - \int q_2 dx = - \int \omega(x) dx = - \int \frac{\omega_0}{L} x dx$$

$$= - \frac{\omega_0 x^2}{2L} + C_1$$

$$M_2 = - \int Q_2 dx = - \int - \frac{\omega_0 x^2}{2L} + C_1 dx$$

$$= \frac{\omega_0 x^3}{6L} - C_1 x + C_2$$

RL: $M_Z(x=0)=0 \rightarrow C_2=0$ BL
 $M_Z(x=L)=0 \rightarrow -\frac{w_0 L}{6} - C_1 = 0 \rightarrow C_1 = \frac{w_0 L}{6}$

$$M_z = \frac{\omega_0 x^3}{6L} - \frac{\omega_0 L}{6} x$$

$$U = \frac{1}{2} \left[\frac{1}{GA_s} \int_0^L \left(-\frac{\omega_0 x^2}{2L} + \frac{\omega_0 L}{6} \right)^2 dx + \frac{1}{EI_x} \int_0^L \left(\frac{\omega_0 x^3}{6L} - \frac{\omega_0 L x}{6} \right)^2 dx \right]$$

$$\textcircled{a}: \int_0^L \frac{w_0^2 x^4}{4L^2} + \frac{v_0^2 L^2}{36} - \frac{\cancel{2} w_0^2 x^2 L}{\cancel{2} \cdot 6L} dx = \frac{w_0^2 L^5}{20 \cancel{2}} + \frac{w_0^2 L^3}{36} - \frac{w_0^2 L^3}{18}$$

$$\textcircled{b}: \int_0^L \frac{w_0^2 x^6}{36 L^2} + \frac{w_0^2 L^2}{36} x^2 - \frac{2 w_0^2 x^4 L}{36 L} dx$$

$$U = \frac{W_o L^3}{45} \left[\frac{1}{2GA_s} + \frac{1}{21EI_z} \right]$$

Diagram of a semi-circular arch with a hinge at the crown. The arch is supported by a fixed support on the left and a roller support on the right. A vertical force F is applied at the right support. The arch has a radius a and a height $2a$. The hinge is at the crown. The arch is labeled with EI and IT .

1.) Beanspruchung:

$$\begin{aligned} \sum M_r \text{ im Schnittpunkt: } & M_B(\varphi) = F a \sin(\varphi) \\ \sum M_\varphi \text{ im Schnittpunkt: } & M_{+|l}(\varphi) = F(a \cos(\varphi) + a) \\ & = F a (\cos(\varphi) + 1) \end{aligned}$$

A diagram of a beam of length l with a triangular load of peak intensity M_T and a point load M_B at the center. The beam is supported by a pin support at the left end and a roller support at the right end. The triangular load is represented by a green line with a peak at the center. The point load is represented by a red dot at the center. The beam is divided into two segments of length a by the point load. The distance from the left support to the point load is $a \cos(\theta)$, and the distance from the point load to the right support is $a \sin(\theta)$. The angle θ is shown at the right support.

2.) Berechnung von U:

$$u = \frac{1}{2} \left[\underbrace{\frac{1}{EI} \int_e M_B(\varphi)^2 d\varphi}_{(a)} + \underbrace{\frac{1}{GI_T} \int_e M_T(\varphi)^2 d\varphi}_{(b)} \right]$$

②: $\int_0^{\pi} F^2 a^2 \sin^2(\varphi) a \, d\varphi = F^2 a^3 \int_0^{\pi} \sin^2(\varphi) \, d\varphi = F^2 a^3 \pi/2$

Integraltafel: $\pi/2$

$$\begin{aligned} \textcircled{b}: \int_0^\pi F^2 a^2 (\cos(\varphi) + 1)^2 a \, d\varphi &= F^2 a^3 \int_0^\pi \cos^2(\varphi) + 2\cos(\varphi) + 1 \, d\varphi \\ &= F^2 a^3 \left[\int_0^\pi \cos^2(\varphi) \, d\varphi + 2 \int_0^\pi \cos(\varphi) \, d\varphi + \int_0^\pi 1 \, d\varphi \right] = F^2 a^3 \left(\frac{\pi}{2} + \pi \right) \\ &= F^2 a^3 \frac{3\pi}{2} \end{aligned}$$

3.] Definition :

$$v_F = \frac{24}{F} = \frac{1}{F} \left[\frac{1}{E I_z} F a^3 \frac{\pi}{2} + \frac{1}{G I_T} F a^3 \frac{3\pi}{2} \right]$$

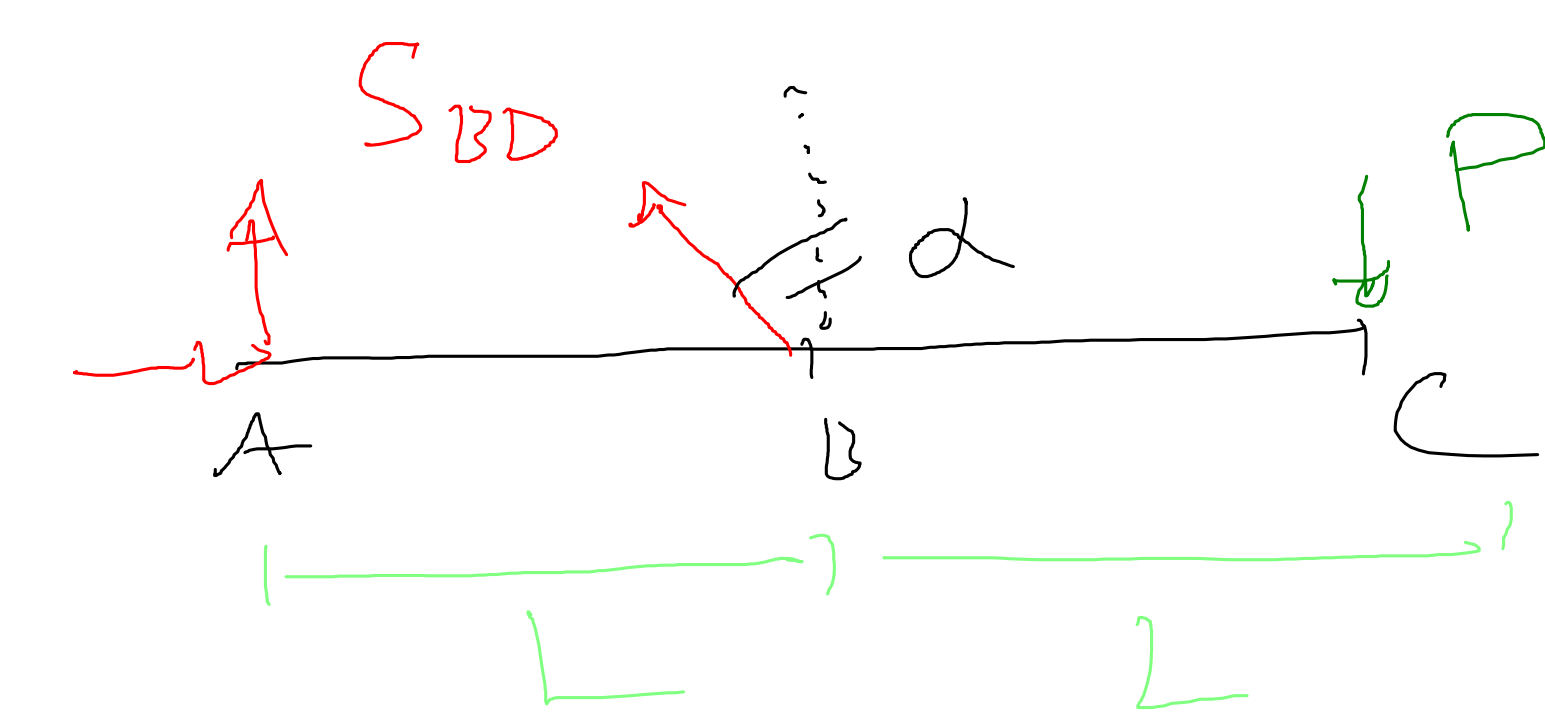
$$= \frac{\pi F a^3}{2} \left[\frac{1}{EI_z} + \frac{3}{4IT} \right]$$

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1.) Beanspruchung:

$$\sum M_z^{\text{in A}}: L \cos(\alpha) S_{BD} = 2LP$$

$$L \gg S_{BD} = \frac{2P}{\cos|\alpha|} = 2.5P$$



2.) U berechnen:

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$$u = 1/2 \left[\int_L \frac{N^2}{EA} dx \right] = \frac{1}{2EA} \int_{BD} |2.5P|^2 dx = \frac{1}{2EA} 6.25 P^2 \cdot L_{BD}$$

3.) Arbeitsatz:

3.) Arbeitssatz:

$$V_C = V_F = \frac{2U}{P} = \frac{1}{EA} \cdot 6.25 P^2 \cdot L_{BD} = 5.98 \text{ mm}$$

$$V_D = V_C = 2.98 \text{ mm}$$

$$\sqrt{0,3^2 + 1,2^2}$$