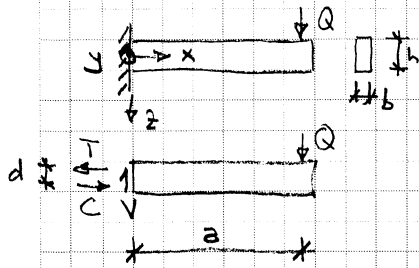


Galilei's Biegebruchproblem



Befreiung

V einführen ... $V = Q$

Moment Qa

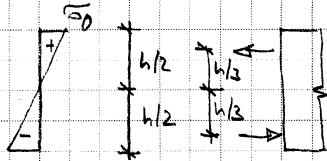
Kräftepaar

$T = C$, $Td = Qa$

Hebelarm $d = ?$

N.B. Wegen $h \ll a$ ist $T \gg V$

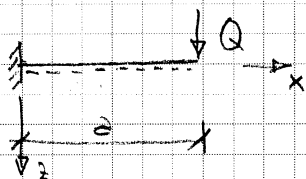
Spannungsverteilung im Einspannquerschnitt $\sigma = -\sigma_0 \cdot \frac{2z}{h}$



$$T = \sigma_0 \cdot \frac{bh}{4} \quad \left. \begin{array}{l} \\ \\ \end{array} \right\} Td = \sigma_0 \cdot \frac{bh^2}{6} = \sigma_0 \cdot W = M$$

Widerstandsmoment

Schnittgrößen

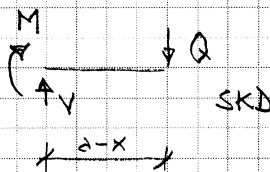


$$\sum F_z = 0: Q - V = 0 \rightarrow V = Q$$

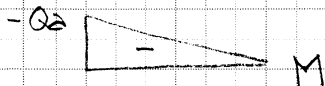
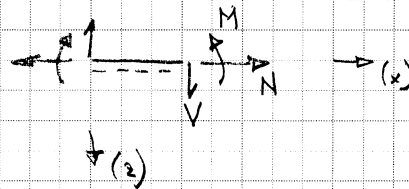
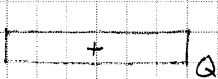
$$\sum M_y = 0: -M - Q(a-x) = 0 \rightarrow M = -Q(a-x)$$

$$\rightarrow V = Q$$

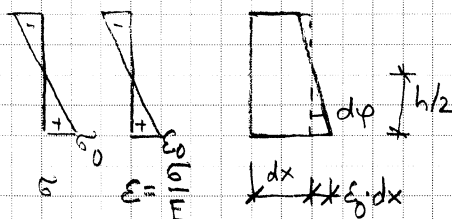
$$\rightarrow M = -Q(a-x)$$



N.B. Vorzeichenkonvention



Verformungen infolge M



$$d\varphi = \frac{\epsilon_0 dx}{h/2} = \chi dx$$

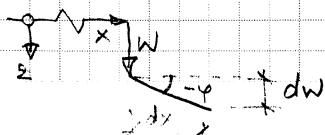
$$\varphi = -w'$$

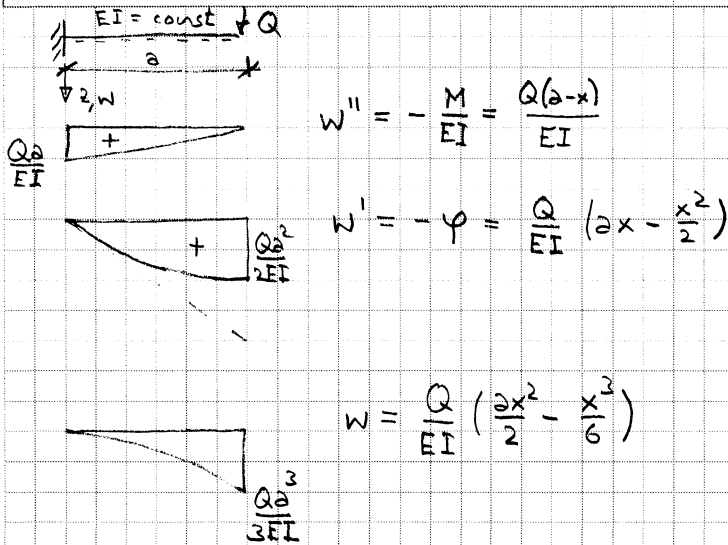
$$\varphi' = -w'' = \chi = \frac{M}{EI}$$

$$\left. \begin{array}{l} \chi = \text{Krümmung} \\ = \frac{2\epsilon_0}{h} = \frac{2}{EI} M \\ I = W \cdot \frac{h}{2} = \frac{bh^3}{12} \end{array} \right\} \frac{M}{EI}$$

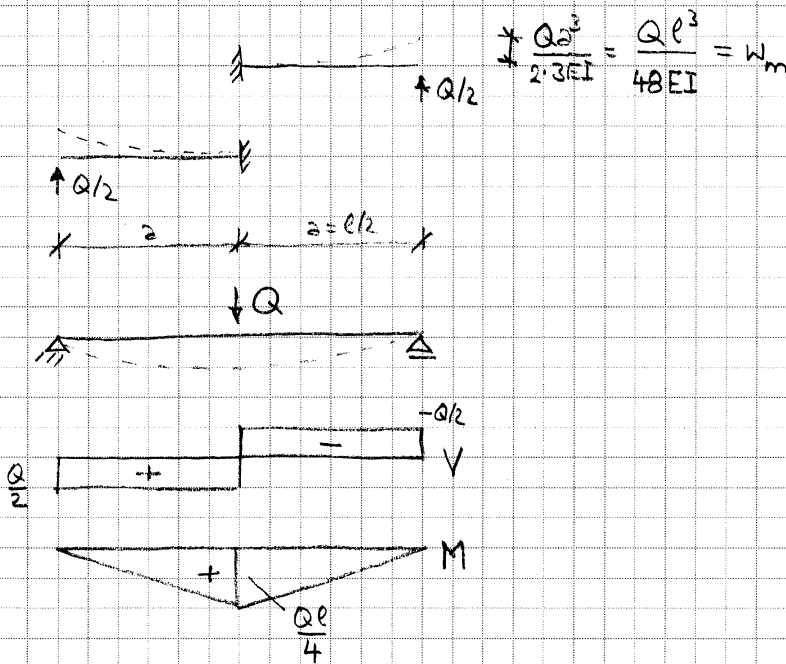
$$\Rightarrow \frac{M}{EI} + w'' = 0$$

DGL der Balkenbiegung

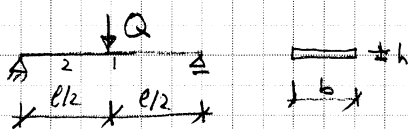




Einfacher Balken



Versuch



$$\begin{aligned}
 Q &= 80 \text{ N} \\
 l &= 800 \text{ mm} \\
 b &= 60 \text{ mm} \\
 h &= 3 \text{ mm} \\
 E &= 205 \text{ kN/mm}^2
 \end{aligned}
 \left. \vphantom{\begin{aligned} Q \\ l \\ b \\ h \\ E \end{aligned}} \right\}
 \begin{aligned}
 W &= \frac{60 \cdot 3^3}{6} = 90 \text{ mm}^3 \\
 I &= \frac{60 \cdot 3^3}{12} = 135 \text{ mm}^4 \\
 w_m &= \frac{80 \cdot 800^3}{48 \cdot 205000 \cdot 135} = 30.8 \text{ mm} \\
 \sigma_{0m} &= \frac{80 \cdot 800}{4 \cdot 90} = 178 \text{ N/mm}^2
 \end{aligned}$$

Feststellungen

1. elastische Rückverformung, $w(x)$
2. $w_m \sim Q$
3. $w_m \sim l^3$
4. $w_m \sim h^{-3}$
5. $w_{12} = w_{21}$

$$h = 6 \text{ mm} \rightarrow \sigma_0 = 44.4 \text{ N/mm}^2$$

$$w_m = 3.85 \text{ mm}$$

N.B. variable Querschnitte
 → bessere Werkstoffausnutzung