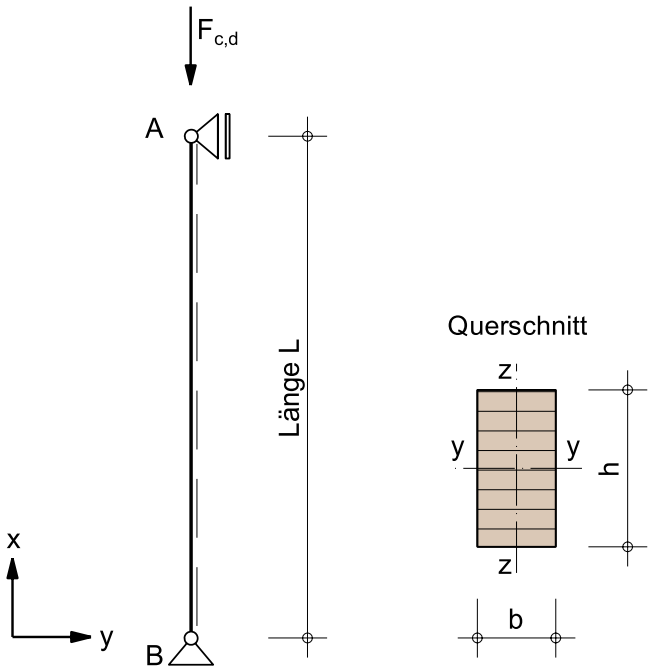
Nachweis Druckstab & Stütze

nach DIN EN 1995-1-1:2010-12 und Nationalem Anhang DIN EN 1995-1-1/NA:2013-08

Anschluss & Geometrie

Pendelstütze

Holzart:	Brettschichtholz
Festigkeit:	GL24h
Rohdichte ρ_k:	385 kg/m^3
Breite b:	160 mm
Höhe h:	160 mm
Länge L:	3.50 m

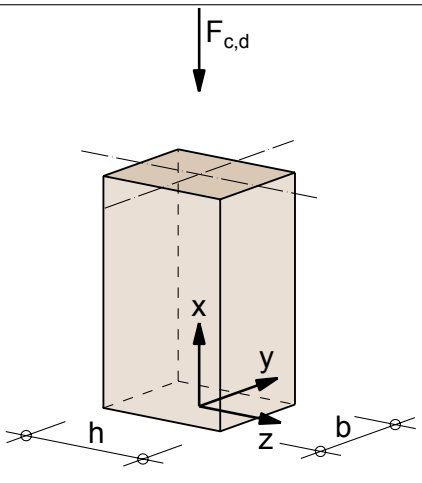


Beanspruchung

$F_{c,d}$:	220.00 kN
Nutzungsklasse:	NKL 1
KLED:	mittel
Ausmitte e_y:	0 mm
Ausmitte e_z:	0 mm

Das Eigengewicht wurde mit ρ_{mean} = 5.00 kN/m³ (entspricht G_k = 0.45 kN) berücksichtigt.

Nachweis:	0.99 $\leq$ 1.00	**Nachweis erfüllt**



Bemessung

Schnittgrößen

Schnittgrößen am Auflager A (x = L = 3.50 m)

$N_d = -F_{c,d} - 1.35 * G_k = -220.00 - 1.35 * 0.45 = -220.60$ kN

$V_{z,d} = \frac{-F_{c,d} * e_z}{L} = \frac{-220.00 * 0}{3.50} * 10^{-3} = 0.00$ kN

$V_{y,d} = \frac{-F_{c,d} * e_y}{L} = \frac{-220.00 * 0}{3.50} * 10^{-3} = 0.00$ kN

$M_{y,d} = -F_{c,d} * e_z = -220.00 * 0 * 10^{-3} = 0.00$ kNm

$M_{z,d} = -F_{c,d} * e_y = -220.00 * 0 * 10^{-3} = 0.00$ kNm

Festigkeits- und Steifigkeitswerte

$f_{c,0,k}$ =	24.00 N/mm²	$E_{0,mean}$ =	11500 N/mm²	k_{mod} :	0.80
$f_{m,k}$ =	24.00 N/mm²	$E_{0,05}$ =	9600 N/mm²	γ_M :	1.30

$$k_{h,z} = min \begin{cases} \left(\frac{600}{h}\right)^{0.1} = \left(\frac{600}{160}\right)^{0.1} = 1.10 \\ 1.1 \end{cases}$$

$$f_{c,0,d} = k_{mod} * \frac{f_{c,0,k}}{\gamma_M} = 0.80 * \frac{24.00}{1.30} = 14.77 \text{ N/mm}^2$$

$$f_{m,y,d} = k_{mod} * \frac{k_{h,z} * f_{m,k}}{\gamma_M} = 0.80 * \frac{1.10 * 24.00}{1.30} = 16.25 \text{ N/mm}^2$$

$$f_{m,z,d} = k_{mod} * \frac{f_{m,k}}{\gamma_M} = 0.80 * \frac{24.00}{1.30} = 14.77 \text{ N/mm}^2$$

Querschnittswerte

$$A = b * h = 160 * 160 * 10^{-2} = 256.00 \text{ cm}^2$$

$$W_y = \frac{b * h^2}{6} = \frac{160 * 160^2}{6} * 10^{-3} = 682.67 \text{ cm}^3$$

$$W_z = \frac{h * b^2}{6} = \frac{160 * 160^2}{6} * 10^{-3} = 682.67 \text{ cm}^3$$

$$i_y = \frac{h}{\sqrt{12}} = \frac{160}{\sqrt{12}} = 46.19 \text{ mm}$$

$$i_z = \frac{b}{\sqrt{12}} = \frac{160}{\sqrt{12}} = 46.19 \text{ mm}$$

Schlankheit und Knicklängenbeiwerte

Stablänge $s = L = 3.50$ m

Knicklängenbeiwert $\beta = 1.00$ (DIN EN 1995-1-1/NA:2013-08, Tabelle NA. 24)

Ersatzstablänge $l_{ef} = \beta * s = 1.00 * 3.50 = 3.50$ m

Knicklänge $s_{ky} = l_{ef} = 3.50$ m

Knicklänge $s_{kz} = l_{ef} = 3.50$ m

Schlankheit

$$\lambda_y = \frac{s_{ky}}{i_y} = \frac{3.50 * 10^3}{46.19} = 75.77$$

$$\lambda_z = \frac{s_{kz}}{i_z} = \frac{3.50 * 10^3}{46.19} = 75.77$$

$$\lambda_{rel,y} = \frac{\lambda_y}{\pi} * \sqrt{\frac{f_{c,0,k}}{E_{0,05}}} = \frac{75.77}{\pi} * \sqrt{\frac{24.00}{9600}} = 1.21 \quad \text{(Gl. 6.21)}$$

$$\lambda_{rel,z} = \frac{\lambda_z}{\pi} * \sqrt{\frac{f_{c,0,k}}{E_{0,05}}} = \frac{75.77}{\pi} * \sqrt{\frac{24.00}{9600}} = 1.21 \quad \text{(Gl. 6.22)}$$

Knickbeiwerte

Imperfektionsbeiwert $\beta_c = 0.10$ (Gl. 6.29)

$$k_y = 0.5\left(1 + \beta_c * (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2\right) = 0.5\left(1 + 0.10 * (1.21 - 0.3) + 1.21^2\right) = 1.28 \quad \text{(Gl. 6.27)}$$

$$k_z = 0.5\left(1 + \beta_c * (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2\right) = 0.5\left(1 + 0.10 * (1.21 - 0.3) + 1.21^2\right) = 1.28 \quad \text{(Gl. 6.28)}$$

$$k_{c,y} = \frac{1}{k_y + \sqrt{k_y^2 - \lambda_{rel,y}^2}} = \frac{1}{1.28 + \sqrt{1.28^2 - 1.21^2}} = 0.59 \quad \text{(Gl. 6.25)}$$

$$k_{c,z} = \frac{1}{k_z + \sqrt{k_z^2 - \lambda_{rel,z}^2}} = \frac{1}{1.28 + \sqrt{1.28^2 - 1.21^2}} = 0.59 \quad \text{(Gl. 6.26)}$$

Beanspruchung

$$\sigma_{c,0,d} = \frac{N_d}{A} * 10 = \frac{-220.60}{256.00} * 10 = -8.62 \text{ N/mm}^2$$

$$\sigma_{m,y,d} = \frac{M_{y,d}}{W_y} * 10^3 = \frac{0.00}{682.67} * 10^3 = 0.00 \text{ N/mm}^2$$

$$\sigma_{m,z,d} = \frac{M_{z,d}}{W_z} * 10^3 = \frac{0.00}{682.67} * 10^3 = 0.00 \text{ N/mm}^2$$

Nachweise

Stabilitätsnachweis

Beiwert $k_m = 0.70$

$$\frac{|\sigma_{c,0,d}|}{k_{c,y} * f_{c,0,d}} + \frac{|\sigma_{m,y,d}|}{f_{m,y,d}} + k_m * \frac{|\sigma_{m,z,d}|}{f_{m,z,d}} = \frac{|-8.62|}{0.59 * 14.77} + \frac{|0.00|}{16.25} + 0.70 * \frac{|0.00|}{14.77} = 0.99 + 0 + 0.70 * 0 = 0.99 \quad \text{(Gl. 6.23)}$$

$$\frac{|\sigma_{c,0,d}|}{k_{c,z} * f_{c,0,d}} + k_m * \frac{|\sigma_{m,y,d}|}{f_{m,y,d}} + \frac{|\sigma_{m,z,d}|}{f_{m,z,d}} = \frac{|-8.62|}{0.59 * 14.77} + 0.70 * \frac{|0.00|}{16.25} + \frac{|0.00|}{14.77} = 0.99 + 0.70 * 0 + 0 = 0.99 \quad \text{(Gl. 6.24)}$$

Stabilitätsnachweis:	$0.99 \leq 1.00$	**Nachweis erfüllt**

verwendete Normen

DIN EN 14080:2013-09	Holzbauwerke - Brettschichtholz und Balkenschichtholz
DIN EN 1995-1-1:2010-12	Eurocode 5: Bemessung und Konstruktion von Holzbauteilen, Teil 1-1
DIN EN 1995-1-1/A2:2014-07	Änderung A2 zu EC5
DIN EN 1995-1-1/NA:2013-08	Nationaler Anhang (EC5)