$kN := 1000 \cdot N$ $MN := 1000 \cdot kN$ $\gamma_b := 25 \cdot \frac{kN}{m^3}$ $\gamma_w := 12 \cdot \frac{kN}{m^3}$ $\gamma_e := 19 \cdot \frac{kN}{m^3}$

Mauerwerk: Nachweise für eine Windscheibe

Material SFK 20/DM: $f_k := 10.0 \cdot \frac{MN}{m^2}$ $\eta := 0.85$ $f_{bk} := 20 \cdot \frac{MN}{m^2}$ unvermörtelte Stoßfugen

Faktor Endauflager: $f_{end} := wenn\left(f_k < 1.8 \cdot \frac{MN}{m^2}, 5, 6\right)$ $f_{end} = 6$

Sicherheitsfaktoren: $k_0 := 1.0$ $\gamma_M := 1.5 \cdot k_0$ $\gamma_M = 1.5$ $\gamma_{ginf} := 1.0$ $\gamma_{gsup} := 1.35$ $\gamma_{qq} := 1.5$

Abmessungen: $d_w := 24 \cdot cm$ $l_w := 2.60 \cdot m$ $h_w := 2.90 \cdot m$ $h_{wges} := 5.90 \cdot m$

$A_w := l_w \cdot d_w$ $A_w = 6240\,cm^2$

Normalkraft am Wandkopf: $F_{gk} := 760 \cdot kN$ $F_{qk} := 270 \cdot kN$ $e_N := 0.48 \cdot m$

Querkräfte am Wandkopf (Wind+Schiefst.): $H_{wk} := 21 \cdot kN$ $H_{sgk} := 4 \cdot kN$ $H_{sqk} := 3 \cdot kN$

Momente am Wandkopf (Wind+Schiefst.): $M_{wk} := 63 \cdot kN \cdot m$ $M_{sgk} := 9 \cdot kN \cdot m$ $M_{sqk} := 6 \cdot kN \cdot m$

Kombinationsbeiwerte: $\psi_{0q} := 0.7$ $\psi_{0w} := 0.6$

$\psi_{1q} := 0.5$ $\psi_{1w} := 0.5$

$\psi_{2q} := 0.3$ $\psi_{2w} := 0.0$

Bemessungswert Druckfestigkeit: $f_d := \eta \cdot \frac{f_k}{\gamma_M}$ $f_d = 5.667 \frac{MN}{m^2}$

Knicklänge/Schlankheit: $\beta := 0.90$ Halterung (2/3/4): $halt := 2$ Wandabstand: $b := 4.10 \cdot m$

$$h_k := \begin{cases} \max\left[0.3 \cdot h_w, \left[\frac{\beta \cdot h_w}{1 + \left(\frac{\beta \cdot h_w}{3 \cdot b}\right)^2}\right]\right] & \text{if } halt = 3 \\ \left[\frac{\beta \cdot h_w}{1 + \left(\frac{\beta \cdot h_w}{b}\right)^2}\right] & \text{if } halt = 4 \wedge h_w > b \\ (b \cdot 0.5) & \text{if } halt = 4 \wedge h_w \le b \\ (\beta \cdot h_w) & \text{otherwise} \end{cases}$$

$h_k = 2.61\,m$

$\lambda_w := \frac{h_k}{d_w}$ $\lambda_w = 10.875$ <= 25 !!

Eigengewicht der Wand: $G_k := \gamma_w \cdot d_w \cdot l_w \cdot h_w$ $G_k = 21.715\,kN$

1) LF maxN + zug M, Leiteinwirkung Verkehr $\gamma_g := \gamma_{gsup}$ $\gamma_q := \gamma_{qq}$

$N_{Edo} := \gamma_g \cdot F_{gk} + \gamma_q \cdot F_{qk}$ $N_{Edo} = 1431\,kN$

$V_{Edo} := \gamma_q \cdot H_{wk} \cdot \psi_{0w} + \gamma_g \cdot H_{sgk} + \gamma_q \cdot H_{sqk}$ $V_{Edo} = 28.8\,kN$

$M_{Edo} := N_{Edo} \cdot e_N + \gamma_q \cdot (M_{wk} \cdot \psi_{0w} + M_{sqk}) + \gamma_g \cdot M_{sgk}$ $M_{Edo} = 764.73\,kN \cdot m$ $e_o := \frac{M_{Edo}}{N_{Edo}}$ $e_o = 0.534\,m$

$N_{Edm} := N_{Edo} + \gamma_g \cdot G_k \cdot 0.5$ $N_{Edm} = 1445.7\,kN$

$V_{Edm} := V_{Edo}$ $V_{Edm} = 28.8\,kN$

$M_{Edm} := M_{Edo} + V_{Edo} \cdot h_w \cdot 0.5$ $M_{Edm} = 806.49\,kN \cdot m$ $e_m := \frac{M_{Edm}}{N_{Edm}}$ $e_m = 0.558\,m$

$N_{Edu} := N_{Edo} + \gamma_g \cdot G_k$ $N_{Edu} = 1460.3\,kN$

$V_{Edu} := V_{Edo}$ $V_{Edu} = 28.8\,kN$

$M_{Edu} := M_{Edo} + V_{Edo} \cdot h_w$ $M_{Edu} = 848.25\,kN \cdot m$ $e_u := \frac{M_{Edu}}{N_{Edu}}$ $e_u = 0.581\,m$

Wandkopf: Endauflager(0/1/2=Dach): $end := 0$ Deckenspannweite: $l_d := 5.20 \cdot m$

$$\phi_3 := \begin{cases} 1.0 & \text{if } end = 0 \\ 0.3333 & \text{if } end = 2 \\ 0.90 & \text{if } l_d \le 4.20 \cdot m \\ \min\left[0.9, \left(1.6 - \frac{l_d}{f_{end} \cdot m}\right)\right] & \text{otherwise} \end{cases} \qquad \phi_3 = 1$$

$\phi_1 := \max\left(1 - \frac{2\,|e_o|}{l_w}, 0.0\right)$ $\phi_1 = 0.589$ $N_{Rd} := \min(\phi_1, \phi_3) \cdot A_w \cdot f_d$ $N_{Rd} = 2082.4\,kN$ >= $N_{Edo} = 1431\,kN$

Wandmitte: $\phi_2 := 0.85 - 0.0011 \cdot (\lambda_w)^2$ $\phi_2 = 0.72$

$\phi_1 := \max\left(1 - \frac{2\,|e_m|}{l_w}, 0.0\right)$ $\phi_1 = 0.571$ $N_{Rd} := \phi_1 \cdot \phi_2 \cdot A_w \cdot f_d$ $N_{Rd} = 1453.2\,kN$ >= $N_{Edm} = 1445.7\,kN$

Wandfuß: Endauflager(0/1/2=Dach): $end := 0$ Deckenspannweite: $l_d := 5.20 \cdot m$

$$\phi_3 := \begin{cases} 1.0 & \text{if } end = 0 \\ 0.3333 & \text{if } end = 2 \\ 0.90 & \text{if } l_d \le 4.20 \cdot m \\ \min\left[0.9, \left(1.6 - \frac{l_d}{f_{end} \cdot m}\right)\right] & \text{otherwise} \end{cases} \qquad \phi_3 = 1$$

$\phi_1 := \max\left(1 - \frac{2\,|e_u|}{l_w}, 0.0\right)$ $\phi_1 = 0.553$ $N_{Rd} := \min(\phi_1, \phi_3) \cdot A_w \cdot f_d$ $N_{Rd} = 1956\,kN$ >= $N_{Edu} = 1460.3\,kN$

Schubnachweis: $f_{vk0} := 0.11 \cdot \frac{MN}{m^2}$ $maxf_{vk} := 0.016 \cdot f_{bk}$ $maxf_{vk} = 0.32 \frac{MN}{m^2}$ $f_{bz} := 0.033 \cdot f_{bk}$ $f_{bz} = 0.66 \frac{MN}{m^2}$

Formfaktor: $c := \begin{cases} 1.0 & \text{if } \frac{h_{wges}}{l_w} \le 1.0 \\ 1.5 & \text{if } \frac{h_{wges}}{l_w} \ge 2.0 \\ \left[\left[1.0 + \left(\frac{h_{wges}}{2 \cdot l_w} - 0.5\right)\right]\right] & \text{otherwise} \end{cases}$ $c = 1.5$

$e6 := \frac{l_w}{6}$ $e6 = 0.433\,m$

$e3 := \frac{l_w}{3}$ $e3 = 0.867\,m$

Wandkopf: $e := e_o$ $e = 0.534\,m$ $c_s := l_w \cdot 0.5 - e$ $c_s = 0.766\,m$

$N_{Ed} := N_{Edo}$ $N_{Ed} = 1431\,kN$

$A_s := \begin{cases} (l_w \cdot d_w) & \text{if } e \le e6 \\ (3 \cdot c_s \cdot d_w) & \text{otherwise} \end{cases}$ $A_s = 0.55123\,m^2$

$\sigma_{dm} := \frac{N_{Ed}}{A_s}$ $\sigma_{dm} = 2.596 \frac{MN}{m^2}$

$f_{vk} := \min(f_{vk0} + 0.4 \cdot \sigma_{dm}, maxf_{vk})$ $f_{vk} = 0.32 \frac{MN}{m^2}$

$V_{Rd} := \min\left(\frac{4}{3} \frac{A_s}{c} \cdot \frac{f_{vk}}{\gamma_M}, \frac{9}{8} \frac{A_w}{c} \cdot \frac{f_{vk}}{\gamma_M}\right)$ $V_{Rd} = 99.84\,kN$ >= $V_{Edo} = 28.8\,kN$

Wandmitte: $e := e_m$ $e = 0.558\,m$ $c_s := l_w \cdot 0.5 - e$ $c_s = 0.742\,m$

$N_{Ed} := N_{Edm}$ $N_{Ed} = 1445.658\,kN$

$A_s := \begin{cases} (l_w \cdot d_w) & \text{if } e \le e6 \\ (3 \cdot c_s \cdot d_w) & \text{otherwise} \end{cases}$ $A_s = 0.534333\,m^2$

$\sigma_{dm} := \frac{N_{Ed}}{A_s}$ $\sigma_{dm} = 2.706 \frac{MN}{m^2}$

$f_{vk} := \min(f_{vk0} + 0.4 \cdot \sigma_{dm}, maxf_{vk})$ $f_{vk} = 0.32 \frac{MN}{m^2}$

$V_{Rd} := \min\left(\frac{4}{3} \frac{A_s}{c} \cdot \frac{f_{vk}}{\gamma_M}, \frac{9}{8} \frac{A_w}{c} \cdot \frac{f_{vk}}{\gamma_M}\right)$ $V_{Rd} = 99.84\,kN$ >= $V_{Edm} = 28.8\,kN$

Wandfuß: $e := e_u$ $e = 0.581\,m$ $c_s := l_w \cdot 0.5 - e$ $c_s = 0.719\,m$

$N_{Ed} := N_{Edu}$ $N_{Ed} = 1460.316\,kN$

$A_s := \begin{cases} (l_w \cdot d_w) & \text{if } e \le e6 \\ (3 \cdot c_s \cdot d_w) & \text{otherwise} \end{cases}$ $A_s = 0.517775\,m^2$

$\sigma_{dm} := \frac{N_{Ed}}{A_s}$ $\sigma_{dm} = 2.82 \frac{MN}{m^2}$

$f_{vk} := \min(f_{vk0} + 0.4 \cdot \sigma_{dm}, maxf_{vk})$ $f_{vk} = 0.32 \frac{MN}{m^2}$

$V_{Rd} := \min\left(\frac{4}{3} \frac{A_s}{c} \cdot \frac{f_{vk}}{\gamma_M}, \frac{9}{8} \frac{A_w}{c} \cdot \frac{f_{vk}}{\gamma_M}\right)$ $V_{Rd} = 98.186\,kN$ >= $V_{Edu} = 28.8\,kN$

zum Verlgeich genau: $f_{vk} := \min\left[f_{vk0} + 0.4 \cdot \sigma_{dm}, 0.45 \cdot f_{bz} \cdot \left(1 + \frac{\sigma_{dm}}{f_{bz}}\right)^{0.5}, f_d - \sigma_{dm}\right]$ $f_{vk} = 0.682 \frac{MN}{m^2}$

2) LF maxM + zug N, Leiteinwirkung Wind $\gamma_g := \gamma_{gsup}$ $\gamma_q := \gamma_{qq}$

$N_{Edo} := \gamma_g \cdot F_{gk} + \gamma_q \cdot F_{qk} \cdot \psi_{0q}$ $N_{Edo} = 1309.5\,kN$

$V_{Edo} := \gamma_q \cdot H_{wk} + \gamma_g \cdot H_{sgk} + \gamma_q \cdot H_{sqk} \cdot \psi_{0q}$ $V_{Edo} = 40.05\,kN$

$M_{Edo} := N_{Edo} \cdot e_N + \gamma_q \cdot (M_{wk} + M_{sqk} \cdot \psi_{0q}) + \gamma_g \cdot M_{sgk}$ $M_{Edo} = 741.5\,kN \cdot m$ $e_o := \frac{M_{Edo}}{N_{Edo}}$ $e_o = 0.566\,m$

$N_{Edm} := N_{Edo} + \gamma_g \cdot G_k \cdot 0.5$ $N_{Edm} = 1324.2\,kN$

$V_{Edm} := V_{Edo}$ $V_{Edm} = 40.05\,kN$

$M_{Edm} := M_{Edo} + V_{Edo} \cdot h_w \cdot 0.5$ $M_{Edm} = 799.6\,kN \cdot m$ $e_m := \frac{M_{Edm}}{N_{Edm}}$ $e_m = 0.604\,m$

$N_{Edu} := N_{Edo} + \gamma_g \cdot G_k$ $N_{Edu} = 1338.8\,kN$

$V_{Edu} := V_{Edo}$ $V_{Edu} = 40.05\,kN$

$M_{Edu} := M_{Edo} + V_{Edo} \cdot h_w$ $M_{Edu} = 857.7\,kN \cdot m$ $e_u := \frac{M_{Edu}}{N_{Edu}}$ $e_u = 0.641\,m$

Wandkopf: Endauflager(0/1/2=Dach): $end := 0$ Deckenspannweite: $l_d := 5.20 \cdot m$

$$\phi_3 := \begin{cases} 1.0 & \text{if } end = 0 \\ 0.3333 & \text{if } end = 2 \\ 0.90 & \text{if } l_d \le 4.20 \cdot m \\ \min\left[0.9, \left(1.6 - \frac{l_d}{f_{end} \cdot m}\right)\right] & \text{otherwise} \end{cases} \qquad \phi_3 = 1$$

$\phi_1 := \max\left(1 - \frac{2\,|e_o|}{l_w}, 0.0\right)$ $\phi_1 = 0.564$ $N_{Rd} := \min(\phi_1, \phi_3) \cdot A_w \cdot f_d$ $N_{Rd} = 1995.8\,kN$ >= $N_{Edo} = 1309.5\,kN$

Wandmitte: $\phi_2 := 0.85 - 0.0011 \cdot (\lambda_w)^2$ $\phi_2 = 0.72$

$\phi_1 := \max\left(1 - \frac{2\,|e_m|}{l_w}, 0.0\right)$ $\phi_1 = 0.536$ $N_{Rd} := \phi_1 \cdot \phi_2 \cdot A_w \cdot f_d$ $N_{Rd} = 1363.18\,kN$ >= $N_{Edm} = 1324.2\,kN$

Wandfuß: Endauflager(0/1/2=Dach): $end := 0$ Deckenspannweite: $l_d := 5.20 \cdot m$

$$\phi_3 := \begin{cases} 1.0 & \text{if } end = 0 \\ 0.3333 & \text{if } end = 2 \\ 0.90 & \text{if } l_d \le 4.20 \cdot m \\ \min\left[0.9, \left(1.6 - \frac{l_d}{f_{end} \cdot m}\right)\right] & \text{otherwise} \end{cases} \qquad \phi_3 = 1$$

$\phi_1 := \max\left(1 - \frac{2\,|e_u|}{l_w}, 0.0\right)$ $\phi_1 = 0.507$ $N_{Rd} := \min(\phi_1, \phi_3) \cdot A_w \cdot f_d$ $N_{Rd} = 1793.5\,kN$ >= $N_{Edu} = 1338.8\,kN$

Schubnachweis: $f_{vk0} = 0.11\,\frac{MN}{m^2}$ $\max f_{vk} = 0.32\,\frac{MN}{m^2}$ $f_{bz} = 0.66\,\frac{MN}{m^2}$

Formfaktor: $c := \begin{cases} 1.0 & \text{if } \frac{h_{wges}}{l_w} \le 1.0 \\ 1.5 & \text{if } \frac{h_{wges}}{l_w} \ge 2.0 \\ \left[\left[1.0 + \left(\frac{h_{wges}}{2 \cdot l_w} - 0.5\right)\right]\right] & \text{otherwise} \end{cases}$ $c = 1.5$

$e6 := \frac{l_w}{6}$ $e6 = 0.433\,m$

$e3 := \frac{l_w}{3}$ $e3 = 0.867\,m$

Wandkopf: $e := e_o$ $e = 0.566\,m$ $c_s := l_w \cdot 0.5 - e$ $c_s = 0.734\,m$

$N_{Ed} := N_{Edo}$ $N_{Ed} = 1309.5\,kN$

$A_s := \begin{cases} (l_w \cdot d_w) & \text{if } e \le e6 \\ (3 \cdot c_s \cdot d_w) & \text{otherwise} \end{cases}$ $A_s = 0.528297\,m^2$

$\sigma_{dm} := \frac{N_{Ed}}{A_s}$ $\sigma_{dm} = 2.479\,\frac{MN}{m^2}$

$f_{vk} := \min(f_{vk0} + 0.4 \cdot \sigma_{dm}, \max f_{vk})$ $f_{vk} = 0.32\,\frac{MN}{m^2}$

$V_{Rd} := \min\left(\frac{4}{3}\frac{A_s}{c} \cdot \frac{f_{vk}}{\gamma_M}, \frac{9}{8}\frac{A_w}{c} \cdot \frac{f_{vk}}{\gamma_M}\right)$ $V_{Rd} = 99.84\,kN$ >= $V_{Edo} = 40.05\,kN$

Wandmitte: $e := e_m$ $e = 0.604\,m$ $c_s := l_w \cdot 0.5 - e$ $c_s = 0.696\,m$

$N_{Ed} := N_{Edm}$ $N_{Ed} = 1324.158\,kN$

$A_s := \begin{cases} (l_w \cdot d_w) & \text{if } e \le e6 \\ (3 \cdot c_s \cdot d_w) & \text{otherwise} \end{cases}$ $A_s = 0.501234\,m^2$

$\sigma_{dm} := \frac{N_{Ed}}{A_s}$ $\sigma_{dm} = 2.642\,\frac{MN}{m^2}$

$f_{vk} := \min(f_{vk0} + 0.4 \cdot \sigma_{dm}, \max f_{vk})$ $f_{vk} = 0.32\,\frac{MN}{m^2}$

$V_{Rd} := \min\left(\frac{4}{3}\frac{A_s}{c} \cdot \frac{f_{vk}}{\gamma_M}, \frac{9}{8}\frac{A_w}{c} \cdot \frac{f_{vk}}{\gamma_M}\right)$ $V_{Rd} = 95.049\,kN$ >= $V_{Edm} = 40.05\,kN$

Wandfuß: $e := e_u$ $e = 0.641\,m$ $c_s := l_w \cdot 0.5 - e$ $c_s = 0.659\,m$

$N_{Ed} := N_{Edu}$ $N_{Ed} = 1338.816\,kN$

$A_s := \begin{cases} (l_w \cdot d_w) & \text{if } e \le e6 \\ (3 \cdot c_s \cdot d_w) & \text{otherwise} \end{cases}$ $A_s = 0.474763\,m^2$

$\sigma_{dm} := \frac{N_{Ed}}{A_s}$ $\sigma_{dm} = 2.82\,\frac{MN}{m^2}$

$f_{vk} := \min(f_{vk0} + 0.4 \cdot \sigma_{dm}, \max f_{vk})$ $f_{vk} = 0.32\,\frac{MN}{m^2}$

$V_{Rd} := \min\left(\frac{4}{3}\frac{A_s}{c} \cdot \frac{f_{vk}}{\gamma_M}, \frac{9}{8}\frac{A_w}{c} \cdot \frac{f_{vk}}{\gamma_M}\right)$ $V_{Rd} = 90.029\,kN$ >= $V_{Edu} = 40.05\,kN$

zum Verlgeich genau: $f_{vk} := \min\left[f_{vk0} + 0.4 \cdot \sigma_{dm}, 0.45 \cdot f_{bz} \cdot \left(1 + \frac{\sigma_{dm}}{f_{bz}}\right)^{0.5}, f_d - \sigma_{dm}\right]$ $f_{vk} = 0.682\,\frac{MN}{m^2}$

3) LF maxM + min N, Leiteinwirkung Wind $\gamma_g := \gamma_{ginf}$ $\gamma_q := \gamma_{qq}$

$N_{Edo} := \gamma_g \cdot F_{gk}$ $N_{Edo} = 760\,kN$

$V_{Edo} := \gamma_q \cdot H_{wk} + \gamma_g \cdot H_{sgk}$ $V_{Edo} = 35.5\,kN$

$M_{Edo} := N_{Edo} \cdot e_N + \gamma_q \cdot M_{wk} + \gamma_g \cdot M_{sgk}$ $M_{Edo} = 468.3\,kN \cdot m$ $e_o := \frac{M_{Edo}}{N_{Edo}}$ $e_o = 0.616\,m$

$N_{Edm} := N_{Edo} + \gamma_g \cdot G_k \cdot 0.5$ $N_{Edm} = 770.9\,kN$

$V_{Edm} := V_{Edo}$ $V_{Edm} = 35.5\,kN$

$M_{Edm} := M_{Edo} + V_{Edo} \cdot h_w \cdot 0.5$ $M_{Edm} = 519.8\,kN \cdot m$ $e_m := \frac{M_{Edm}}{N_{Edm}}$ $e_m = 0.674\,m$

$N_{Edu} := N_{Edo} + \gamma_g \cdot G_k$ $N_{Edu} = 781.7\,kN$

$V_{Edu} := V_{Edo}$ $V_{Edu} = 35.5\,kN$

$M_{Edu} := M_{Edo} + V_{Edo} \cdot h_w$ $M_{Edu} = 571.3\,kN \cdot m$ $e_u := \frac{M_{Edu}}{N_{Edu}}$ $e_u = 0.731\,m$

Wandkopf: Endauflager(0/1/2=Dach): $end := 0$ Deckenspannweite: $l_d := 5.20 \cdot m$

$$\phi_3 := \begin{cases} 1.0 & \text{if } end = 0 \\ 0.3333 & \text{if } end = 2 \\ 0.90 & \text{if } l_d \le 4.20 \cdot m \\ \min\left[0.9, \left(1.6 - \frac{l_d}{f_{end} \cdot m}\right)\right] & \text{otherwise} \end{cases} \qquad \phi_3 = 1$$

$\phi_1 := \max\left(1 - \frac{2\,|e_o|}{l_w}, 0.0\right)$ $\phi_1 = 0.526$ $N_{Rd} := \min(\phi_1, \phi_3) \cdot A_w \cdot f_d$ $N_{Rd} = 1860\,kN$ >= $N_{Edo} = 760\,kN$

Wandmitte: $\phi_2 := 0.85 - 0.0011 \cdot (\lambda_w)^2$ $\phi_2 = 0.72$

$\phi_1 := \max\left(1 - \frac{2\,|e_m|}{l_w}, 0.0\right)$ $\phi_1 = 0.481$ $N_{Rd} := \phi_1 \cdot \phi_2 \cdot A_w \cdot f_d$ $N_{Rd} = 1225.25\,kN$ >= $N_{Edm} = 770.9\,kN$

Wandfuß: Endauflager(0/1/2=Dach): $end := 0$ Deckenspannweite: $l_d := 5.20 \cdot m$

$$\phi_3 := \begin{cases} 1.0 & \text{if } end = 0 \\ 0.3333 & \text{if } end = 2 \\ 0.90 & \text{if } l_d \le 4.20 \cdot m \\ \min\left[0.9, \left(1.6 - \frac{l_d}{f_{end} \cdot m}\right)\right] & \text{otherwise} \end{cases} \qquad \phi_3 = 1$$

$\phi_1 := \max\left(1 - \frac{2\,|e_u|}{l_w}, 0.0\right)$ $\phi_1 = 0.438$ $N_{Rd} := \min(\phi_1, \phi_3) \cdot A_w \cdot f_d$ $N_{Rd} = 1548.3\,kN$ >= $N_{Edu} = 781.7\,kN$

Schubnachweis: $f_{vk0} = 0.11 \frac{MN}{m^2}$ $\max f_{vk} = 0.32 \frac{MN}{m^2}$ $f_{bz} = 0.66 \frac{MN}{m^2}$

Formfaktor: $c := \begin{cases} 1.0 \text{ if } \frac{h_{wges}}{l_w} \le 1.0 \\ 1.5 \text{ if } \frac{h_{wges}}{l_w} \ge 2.0 \\ \left[\left[1.0 + \left(\frac{h_{wges}}{2 \cdot l_w} - 0.5\right)\right]\right] \text{ otherwise} \end{cases}$ $c = 1.5$

$e6 := \frac{l_w}{6}$ $e6 = 0.433\,m$

$e3 := \frac{l_w}{3}$ $e3 = 0.867\,m$

Wandkopf: $e := e_o$ $e = 0.616\,m$ $c_s := l_w \cdot 0.5 - e$ $c_s = 0.684\,m$

$N_{Ed} := N_{Edo}$ $N_{Ed} = 760\,kN$

$A_s := \begin{cases} (l_w \cdot d_w) \text{ if } e \le e6 \\ (3 \cdot c_s \cdot d_w) \text{ otherwise} \end{cases}$ $A_s = 0.492347\,m^2$

$\sigma_{dm} := \frac{N_{Ed}}{A_s}$ $\sigma_{dm} = 1.544 \frac{MN}{m^2}$

$f_{vk} := \min(f_{vk0} + 0.4 \cdot \sigma_{dm}, \max f_{vk})$ $f_{vk} = 0.32 \frac{MN}{m^2}$

$V_{Rd} := \min\left(\frac{4}{3} \frac{A_s}{c} \cdot \frac{f_{vk}}{\gamma_M}, \frac{9}{8} \frac{A_w}{c} \cdot \frac{f_{vk}}{\gamma_M}\right)$ $V_{Rd} = 93.364\,kN$ >= $V_{Edo} = 35.5\,kN$

Wandmitte: $e := e_m$ $e = 0.674\,m$ $c_s := l_w \cdot 0.5 - e$ $c_s = 0.626\,m$

$N_{Ed} := N_{Edm}$ $N_{Ed} = 770.858\,kN$

$A_s := \begin{cases} (l_w \cdot d_w) \text{ if } e \le e6 \\ (3 \cdot c_s \cdot d_w) \text{ otherwise} \end{cases}$ $A_s = 0.450517\,m^2$

$\sigma_{dm} := \frac{N_{Ed}}{A_s}$ $\sigma_{dm} = 1.711 \frac{MN}{m^2}$

$f_{vk} := \min(f_{vk0} + 0.4 \cdot \sigma_{dm}, \max f_{vk})$ $f_{vk} = 0.32 \frac{MN}{m^2}$

$V_{Rd} := \min\left(\frac{4}{3} \frac{A_s}{c} \cdot \frac{f_{vk}}{\gamma_M}, \frac{9}{8} \frac{A_w}{c} \cdot \frac{f_{vk}}{\gamma_M}\right)$ $V_{Rd} = 85.431\,kN$ >= $V_{Edm} = 35.5\,kN$

Wandfuß: $e := e_u$ $e = 0.731\,m$ $c_s := l_w \cdot 0.5 - e$ $c_s = 0.569\,m$

$N_{Ed} := N_{Edu}$ $N_{Ed} = 781.715\,kN$

$A_s := \begin{cases} (l_w \cdot d_w) \text{ if } e \le e6 \\ (3 \cdot c_s \cdot d_w) \text{ otherwise} \end{cases}$ $A_s = 0.409849\,m^2$

$\sigma_{dm} := \frac{N_{Ed}}{A_s}$ $\sigma_{dm} = 1.907 \frac{MN}{m^2}$

$f_{vk} := \min(f_{vk0} + 0.4 \cdot \sigma_{dm}, \max f_{vk})$ $f_{vk} = 0.32 \frac{MN}{m^2}$

$V_{Rd} := \min\left(\frac{4}{3} \frac{A_s}{c} \cdot \frac{f_{vk}}{\gamma_M}, \frac{9}{8} \frac{A_w}{c} \cdot \frac{f_{vk}}{\gamma_M}\right)$ $V_{Rd} = 77.72\,kN$ >= $V_{Edu} = 35.5\,kN$

zum Verlgeich genau: $f_{vk} := \min\left[f_{vk0} + 0.4 \cdot \sigma_{dm}, 0.45 \cdot f_{bz} \cdot \left(1 + \frac{\sigma_{dm}}{f_{bz}}\right)^{0.5}, f_d - \sigma_{dm}\right]$ $f_{vk} = 0.586 \frac{MN}{m^2}$

Nachweis der Randdehnung nur für LF minN + maxM, am Wandfuss, GZG, selten Kombination:

$N_{Edu} := F_{gk} + G_k$ $N_{Edu} = 781.7\,kN$ $e6 = 0.433\,m$

$V_{Edu} := H_{wk} + H_{sgk}$ $V_{Edu} = 25\,kN$

$M_{Edu} := N_{Edu}\cdot e_N + M_{wk} + M_{sgk} + V_{Edu}\cdot h_w$ $M_{Edu} = 519.7\,kN\cdot m$ $e_u := \frac{M_{Edu}}{N_{Edu}}$ $e_u = 0.665\,m$

klaffende Fuge, Nachweis der Randdehnung erforderlich $c_s := l_w\cdot 0.5 - e_u$ $c_s = 0.635\,m$

$\sigma_{dr} := \frac{2\cdot N_{Edu}}{3\cdot c_s\cdot d_w}$ $\sigma_{dr} = 3.419\,\frac{MN}{m^2}$ $\varepsilon_r := \frac{\sigma_{dr}}{1100\cdot f_k}\cdot\left(\frac{l_w}{3\cdot c_s} - 1\right)$ $\varepsilon_r = 0.0001133$ <= 0.0001

Der Nachweis ist nicht erfüllt, d.h. der Querkraftnachweis darf NICHT mit fvk0 geführt werden !

In diesem Beispiel hat dies keine Auswirkungen, da das Versagen der Lagerfuge nicht maßgebend war, sondern das Versagen der Steinzugfestigkeit.

Dafür darf der Nachweis der Randdehnung im GZG, häufige Kombination, geführt werden.

$N_{Edu} := F_{gk} + G_k$ $N_{Edu} = 781.7\,kN$ $e6 = 0.433\,m$

$V_{Edu} := H_{wk}\cdot\psi_{1w} + H_{sgk}$ $V_{Edu} = 14.5\,kN$

$M_{Edu} := N_{Edu}\cdot e_N + M_{wk}\cdot\psi_{1w} + M_{sgk} + V_{Edu}\cdot h_w$ $M_{Edu} = 457.8\,kN\cdot m$ $e_u := \frac{M_{Edu}}{N_{Edu}}$ $e_u = 0.586\,m$

klaffende Fuge, Nachweis der Randdehnung erforderlich $c_s := l_w\cdot 0.5 - e_u$ $c_s = 0.714\,m$

$\sigma_{dr} := \frac{2\cdot N_{Edu}}{3\cdot c_s\cdot d_w}$ $\sigma_{dr} = 3.04\,\frac{MN}{m^2}$ $\varepsilon_r := \frac{\sigma_{dr}}{1100\cdot f_k}\cdot\left(\frac{l_w}{3\cdot c_s} - 1\right)$ $\varepsilon_r = 0.0000589$ <= 0.0001

Nachweis erfüllt.