

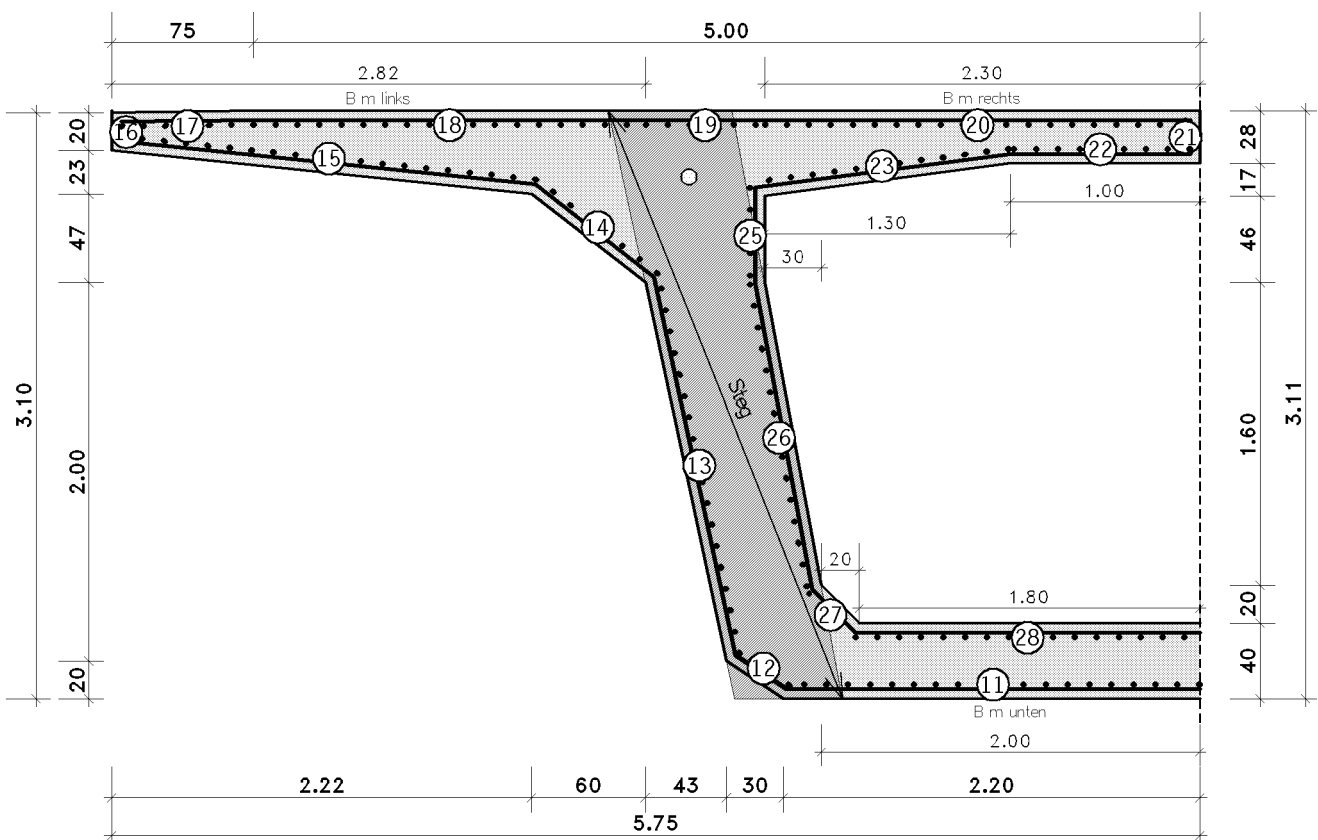
POS. 97: HOHLKASTEN (SPB.)

Querschnittsbeschreibung (4H-BETON Version: 11/2007-5a)

Name: Voreinstellung HK , Straßenbrücke

Materialdaten

| | f_{ck} N/mm ² | α - | ϵ_{c2} ‰ | ϵ_{c2u} ‰ | n - | E_c N/mm ² | | f_{yk} N/mm ² | f_{tk} N/mm ² | ϵ_{su} ‰ | E_s N/mm ² |
|--------|-------------------------------|---------------|----------------------|-----------------------|----------|----------------------------|--------------|-------------------------------|-------------------------------|----------------------|----------------------------|
| C30/37 | 30.0 | 0.850 | -2.0 | -3.5 | 2.00 | 28309.4 | BSt 500 S(B) | 500.0 | 525.0 | 25.0 | 200000.0 |



Mitwirkende Breiten

| Zustand | Seite | System | l cm | s cm | b ₁ cm | b _v cm | b _{eff,1} cm |
|------------|---------|---------|---------|---------|----------------------|----------------------|--------------------------|
| Endzustand | li oben | Einfeld | 3000.00 | 1500.00 | 282.00 | 70.00 | 282.00 |
| Endzustand | re oben | Einfeld | 3000.00 | 1500.00 | 230.00 | 17.00 | 230.00 |
| Endzustand | li unt. | Einfeld | 3000.00 | 1500.00 | 200.00 | 20.00 | 200.00 |

Stegkoordinaten

| Pkt. | y cm | z cm |
|------|---------|---------|
| - | | |
| 1 | -312.6 | 0.0 |
| 2 | -247.1 | 0.0 |
| 3 | -188.8 | 311.0 |
| 4 | -245.7 | 311.0 |



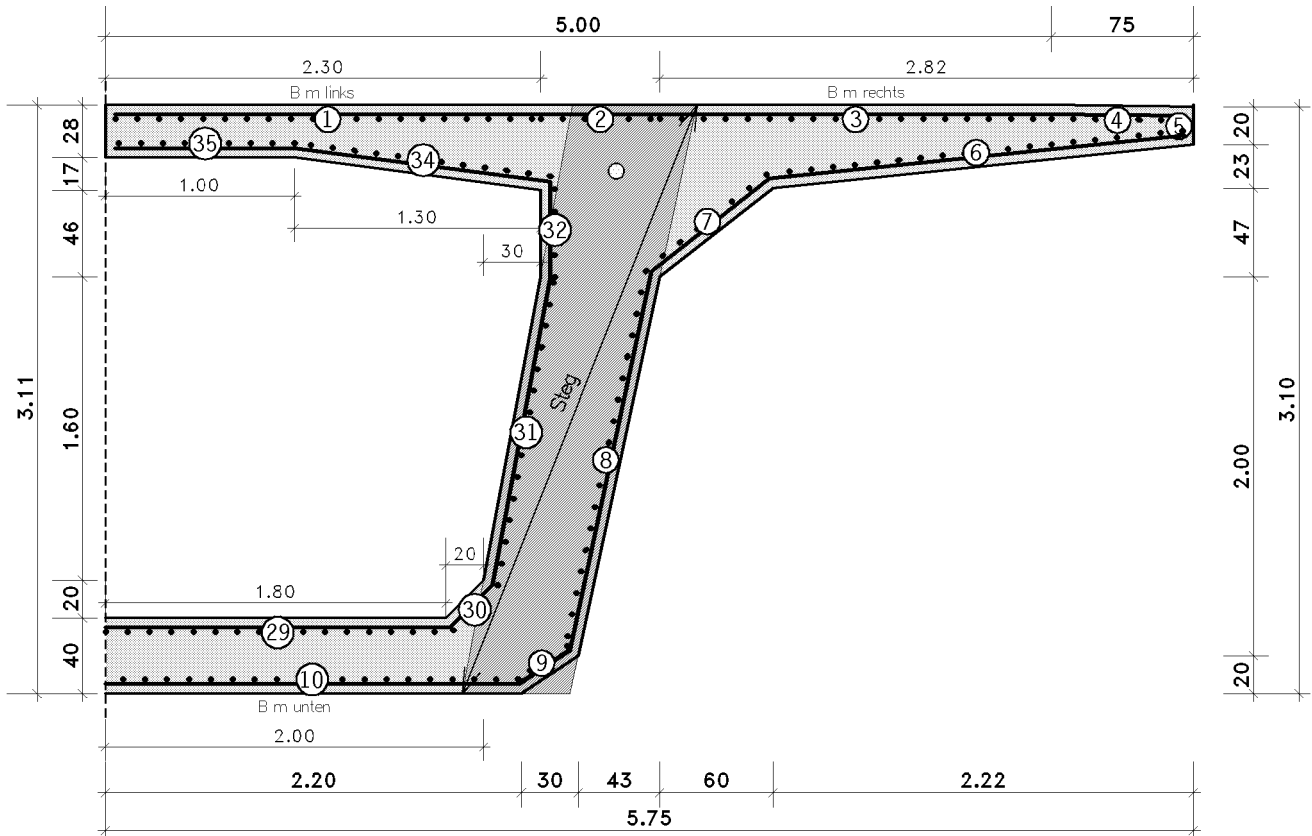
Betonstahlbewehrung

Mindestbügelbewehrung gemäß DIN EN 1992, 9.2.2:

linker Steg $a_{sBü} = 6.25 \text{ cm}^2/\text{m}$

rechter Steg $a_{sBü} = 6.25 \text{ cm}^2/\text{m}$

| Pos. | \emptyset / s | c | vorh A_s | min A_s | Pos. | \emptyset / s | c | vorh A_s | min A_s |
|------|-----------------|-----|-----------------|-----------------|------|-----------------|-----|-----------------|-----------------|
| - | mm/ cm | cm | cm ² | cm ² | - | mm/ cm | cm | cm ² | cm ² |
| 11 | 20/15.0 | 5.0 | 45.74 | ≥ 8.58 | 20 | 20/15.0 | 5.0 | 47.10 | ≥ 8.83 |
| 12 | 20/15.0 | 5.0 | 6.81 | ≥ 1.28 | 21 | 20/15.0 | 5.0 | 3.77 | ≥ 0.71 |
| 13 | 20/15.0 | 5.0 | 42.78 | ≥ 8.02 | 22 | 20/15.0 | 5.0 | 19.95 | ≥ 3.74 |
| 14 | 20/15.0 | 5.0 | 16.64 | ≥ 3.12 | 23 | 20/15.0 | 5.0 | 28.43 | ≥ 5.33 |
| 15 | 20/15.0 | 5.0 | 46.08 | ≥ 8.64 | 25 | 20/15.0 | 5.0 | 10.65 | ≥ 2.00 |
| 16 | 20/15.0 | 5.0 | 2.21 | ≥ 0.41 | 26 | 20/15.0 | 5.0 | 34.50 | ≥ 6.47 |
| 17 | 20/15.0 | 5.0 | 14.66 | ≥ 2.75 | 27 | 20/15.0 | 5.0 | 6.68 | ≥ 1.25 |
| 18 | 20/15.0 | 5.0 | 43.33 | ≥ 8.12 | 28 | 20/15.0 | 5.0 | 38.11 | ≥ 7.15 |
| 19 | 20/15.0 | 5.0 | 13.19 | ≥ 2.47 | | | | | |



Mitwirkende Breiten

| Zustand | Seite | System | l | s | b ₁ | b _v | b _{eff,1} |
|------------|---------|---------|---------|---------|----------------|----------------|--------------------|
| - | | | cm | cm | cm | cm | cm |
| Endzustand | li oben | Einfeld | 3000.00 | 1500.00 | 282.00 | 70.00 | 282.00 |
| Endzustand | re oben | Einfeld | 3000.00 | 1500.00 | 230.00 | 17.00 | 230.00 |
| Endzustand | li unt. | Einfeld | 3000.00 | 1500.00 | 200.00 | 20.00 | 200.00 |

Stegkoordinaten

| Pkt. | y | z |
|------|-------|-------|
| - | cm | cm |
| 1 | 247.1 | 0.0 |
| 2 | 312.6 | 0.0 |
| 3 | 245.7 | 311.0 |
| 4 | 188.8 | 311.0 |

Betonstahlbewehrung

Mindestbügelbewehrung gemäß DIN EN 1992, 9.2.2:

linker Steg $a_{sBü} = 6.25 \text{ cm}^2/\text{m}$

rechter Steg $a_{sBü} = 6.25 \text{ cm}^2/\text{m}$

| Pos. | Ø / s | c | vorh A_s | min A_s | Pos. | Ø / s | c | vorh A_s | min A_s |
|------|---------|-----|-----------------|-----------------|------|---------|-----|-----------------|-----------------|
| - | mm/ cm | cm | cm ² | cm ² | - | mm/ cm | cm | cm ² | cm ² |
| 1 | 20/15.0 | 5.0 | 47.10 | ≥ 8.83 | 9 | 20/15.0 | 5.0 | 6.81 | ≥ 1.28 |
| 2 | 20/15.0 | 5.0 | 13.19 | ≥ 2.47 | 10 | 20/15.0 | 5.0 | 45.74 | ≥ 8.58 |
| 3 | 20/15.0 | 5.0 | 43.33 | ≥ 8.12 | 29 | 20/15.0 | 5.0 | 38.11 | ≥ 7.15 |
| 4 | 20/15.0 | 5.0 | 14.66 | ≥ 2.75 | 30 | 20/15.0 | 5.0 | 6.68 | ≥ 1.25 |
| 5 | 20/15.0 | 5.0 | 2.21 | ≥ 0.41 | 31 | 20/15.0 | 5.0 | 34.50 | ≥ 6.47 |
| 6 | 20/15.0 | 5.0 | 46.08 | ≥ 8.64 | 32 | 20/15.0 | 5.0 | 10.65 | ≥ 2.00 |
| 7 | 20/15.0 | 5.0 | 16.64 | ≥ 3.12 | 34 | 20/15.0 | 5.0 | 28.43 | ≥ 5.33 |
| 8 | 20/15.0 | 5.0 | 42.78 | ≥ 8.02 | 35 | 20/15.0 | 5.0 | 19.95 | ≥ 3.74 |

Bezeichnung der Eckpunkte des Querschnitts für die Spannungsberechnungen

σ_1 = oben links; σ_2 = oben rechts; σ_3 = unten rechts; σ_4 = unten links

Spanngliedtypen

| Hersteller | Typ | Spanndraht | Verbund | P _{zul} | A _p | d _p | E-Mod | f _{p01} / f _{pk} | Δσ _{Rs} |
|------------|------------------|------------------|------------|------------------|-----------------|----------------|-------------------|------------------------------------|-------------------|
| - | - | - | - | KN | cm ² | mm | N/mm ² | N/mm ² | N/mm ² |
| BBV EC2 | BBV L12/140/St17 | Bündelspannglied | nachträgl. | 2171 | 16.80 | 5.0 | 195000 | 1520/1770 | 71. |
| BBV EC2 | BBV L12/140/St17 | Bündelspannglied | nachträgl. | 2171 | 16.80 | 5.0 | 195000 | 1520/1770 | 71. |

Hüllrohre

| Spanngliedtyp | Hüllrohr | Form | Ø/b | (h) | A | β _o | schwache | | (starke) Achse | |
|------------------|----------|-------|-----|------|-----------------|----------------|----------|-------|----------------|---|
| | | | | | | | min R | μ | min R | μ |
| - | - | - | mm | (mm) | cm ² | °/m | m | - | m | - |
| BBV L12/140/St17 | TYP I | Kreis | 82 | - | 52.8 | 0.300 | 6.10 | 0.190 | | |
| BBV L12/140/St17 | TYP I | Kreis | 82 | - | 52.8 | 0.300 | 6.10 | 0.190 | | |

Spanngliedlagen

| Name | Anzahl | y | z | h | Exz. | Typ | ε _{vo} | V _o | σ _{vo} |
|--------|--------|--------|------|-------|------|------------------|-----------------|----------------|-------------------|
| - | - | cm | cm | cm | cm | - | ‰ | KN | N/mm ² |
| Lage 1 | 1.0 | -270.0 | 35.0 | 276.0 | 0 | BBV L12/140/St17 | 4.00 | 1310.4 | 780.0 |
| Lage 2 | 1.0 | 270.0 | 35.0 | 276.0 | 0 | BBV L12/140/St17 | 4.00 | 1310.4 | 780.0 |

Eckpunktkoordinaten

| Pkt. | y | z | Pkt. | y | z | Pkt. | y | z |
|------|--------|-------|------|--------|-------|------|--------|-------|
| - | cm | cm | - | cm | cm | - | cm | cm |
| 1 | 0.0 | 0.0 | 13 | -250.0 | 291.0 | 25 | -230.0 | 45.0 |
| 2 | 230.0 | 0.0 | 14 | -293.0 | 91.0 | 26 | -230.0 | 91.0 |
| 3 | 293.0 | 0.0 | 15 | -353.0 | 44.0 | 27 | -200.0 | 251.0 |
| 4 | 500.0 | 0.0 | 16 | -575.0 | 21.0 | 28 | -180.0 | 271.0 |
| 5 | 575.0 | 1.0 | 17 | -575.0 | 1.0 | 29 | 0.0 | 271.0 |
| 6 | 575.0 | 21.0 | 18 | -500.0 | 0.0 | 30 | 180.0 | 271.0 |
| 7 | 353.0 | 44.0 | 19 | -293.0 | 0.0 | 31 | 200.0 | 251.0 |
| 8 | 293.0 | 91.0 | 20 | -230.0 | 0.0 | 32 | 230.0 | 91.0 |
| 9 | 250.0 | 291.0 | 21 | 0.0 | 0.0 | 33 | 230.0 | 45.0 |
| 10 | 220.0 | 311.0 | 22 | 0.0 | 28.0 | 34 | 230.0 | 45.0 |
| 11 | 0.0 | 311.0 | 23 | -100.0 | 28.0 | 35 | 100.0 | 28.0 |
| 12 | -220.0 | 311.0 | 24 | -230.0 | 45.0 | 36 | 0.0 | 28.0 |

| Quer-schnittsw. | Vollquerschnitt | | | | | | Mitwirkender Querschnitt | | | | | |
|-----------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----|--------------------------|-----------------|-----------------|-----------------|-----------------|-----|
| | y _{sy} | I _y | Z _{sz} | I _z | A | α | y _{sy} | I _y | Z _{sz} | I _z | A | α |
| - | cm | dm ⁴ | cm | dm ⁴ | cm ² | ° | cm | dm ⁴ | cm | dm ⁴ | cm ² | ° |
| Brutto | 0.0 | 659319.44 | 121.1 | 116214.93 | 90611 | 0.0 | 0.0 | 659319.44 | 121.1 | 116214.93 | 90611 | 0.0 |
| Netto | 0.0 | 658549.47 | 121.2 | 116136.61 | 90505 | 0.0 | 0.0 | 658549.47 | 121.2 | 116136.61 | 90505 | 0.0 |
| IdeeI _{lz} | -0.0 | 660761.72 | 120.9 | 116361.14 | 90809 | 0.0 | -0.0 | 660761.72 | 120.9 | 116361.14 | 90809 | 0.0 |
| IdeeI _{ls} | 0.0 | 699706.31 | 120.6 | 123375.40 | 95713 | 0.0 | 0.0 | 699706.31 | 120.6 | 123375.40 | 95713 | 0.0 |
| IdeeI _{lz+s} | 0.0 | 701148.59 | 120.4 | 123520.10 | 95911 | 0.0 | 0.0 | 701148.59 | 120.4 | 123520.10 | 95911 | 0.0 |

Werte gemäß DIN EN 1992, 6.3.2 Abb 6.11: $t = 10.0 \text{ cm}$, $A_k = 91979.3 \text{ cm}^2$, $u_k = 1394.3 \text{ cm}^2$

Kriech- und Schwindparameter

Relative Luftfeuchte RH = 70 %, Zement N,R ⇒ normal, schnell erh., Schwindbeginn nach 1.0 Tagen

Aufbringen der Vorspannung nach 10.0 Tagen, $t = 365 \text{ Tage} \Rightarrow \varphi_t = 1.33$, $\epsilon_{cs} = -12.83 \cdot 10^{-5}$

Aufbringen der Vorspannung nach 10.0 Tagen, $t = 36500 \text{ Tage} \Rightarrow \varphi_t = 2.08$, $\epsilon_{cs} = -42.19 \cdot 10^{-5}$



Querschnittswerte für Spannungsberechnungen nach Zustand I

| Querschnittswerte | Lastfall |
|-------------------|--|
| idee11 Ap+As | G1 |
| idee11 Ap+As | G2 |
| idee11 Ap+As | G3 |
| Brutto | Vorspannung mit sofortigem Verbund |
| Brutto | Vorspannung mit nachträglichem Verbund |
| idee11 Ap+As | Vorspannung mit ohne Verbund |
| idee11 Ap+As | Verkehr |
| idee11 Ap+As | Stützensenkung |
| idee11 Ap+As | Temperatur |
| idee11 Ap+As | Horizontaler Erddruck |
| idee11 Ap+As | Wind |
| idee11 Ap+As | Außergewöhnliche Einwirkung |

| | Normalkraft | Moment |
|--------------------------|-------------|--------|
| Vollquerschnitt | o | |
| Mitwirkender Querschnitt | | o |

Abminderungsfaktor für Tragfähigkeitsnachweise infolge: Setzung = 0.600, Temperatur = 0.600

Lastfallergebnisse

| Nr | N kN | Q _η kN | Q _ξ kN | T kNm | M _η kNm | M _ξ kNm | Bezeichnung |
|---------------------------------------|---------|----------------------|----------------------|----------|-----------------------|-----------------------|--|
| Einwirkung 1: ständige Lasten | | | | | | | |
| 1 | 0.0 | 0.00 | -1381.07 | 0.00 | -8978.58 | 0.00 | Eg Hauptträger |
| 2 | 0.0 | 0.00 | -205.35 | 0.00 | -1740.20 | 0.00 | Eg Kappen |
| 3 | 0.0 | 0.00 | -154.79 | 0.00 | -558.01 | 0.00 | Eg Belag |
| Einwirkung 2: Vorspannung | | | | | | | |
| 4 | 0.0 | 0.00 | 1631.63 | 0.00 | 4915.97 | 0.00 | P [^] : Vorsp.m.ntr.Verbund 1 |
| 5 | 0.0 | 0.00 | -15.23 | 0.00 | -368.48 | 0.00 | P [^] : Vorspannung extern 1 |
| 68 | 0.0 | 0.00 | 1417.75 | 0.00 | 4271.57 | 0.00 | P [^] +K _∞ zu LF 4: Vorsp.m.ntr.Verbund 1 |
| 69 | 0.0 | 0.00 | 1564.77 | 0.00 | 4714.53 | 0.00 | P [^] +K _{S1} zu LF 4: Vorsp.m.ntr.Verbund 1 |
| 70 | -2620.8 | 0.00 | 1631.63 | 0.00 | 7171.43 | 0.00 | P zu LF 4: Vorsp.m.ntr.Verbund 1 |
| 71 | -2277.3 | 0.00 | 1417.75 | 0.00 | 6231.38 | 0.00 | P+K _∞ zu LF 4: Vorsp.m.ntr.Verbund 1 |
| 72 | -2513.4 | 0.00 | 1564.77 | 0.00 | 6877.57 | 0.00 | P+K _{S1} zu LF 4: Vorsp.m.ntr.Verbund 1 |
| 73 | 0.0 | 0.00 | -13.24 | 0.00 | -320.26 | 0.00 | P [^] +K _∞ zu LF 5: Vorspannung extern 1 |
| 74 | 0.0 | 0.00 | -14.61 | 0.00 | -353.41 | 0.00 | P [^] +K _{S1} zu LF 5: Vorspannung extern 1 |
| 75 | 0.0 | 0.00 | -15.23 | 0.00 | -368.48 | 0.00 | P zu LF 5: Vorspannung extern 1 |
| 76 | 0.0 | 0.00 | -13.24 | 0.00 | -320.26 | 0.00 | P+K _∞ zu LF 5: Vorspannung extern 1 |
| 77 | 0.0 | 0.00 | -14.61 | 0.00 | -353.41 | 0.00 | P+K _{S1} zu LF 5: Vorspannung extern 1 |
| Einwirkung 3: Stützensenkung | | | | | | | |
| 6 | 0.0 | 0.00 | 30.47 | 0.00 | 736.97 | 0.00 | wahrsch. Δs (Achse 1) |
| 7 | 0.0 | 0.00 | -15.23 | 0.00 | -368.48 | 0.00 | mögliche Δs (Achse 1) |
| Einwirkung 4: Temperaturlasten | | | | | | | |
| 8 | 0.0 | 0.00 | -30.47 | 0.00 | -736.97 | 0.00 | Temperatur T+ |
| 9 | 0.0 | 0.00 | 60.93 | 0.00 | 1473.93 | 0.00 | Temperatur T- |
| 10 | 0.0 | 0.00 | -30.47 | 0.00 | -736.97 | 0.00 | Temperatur ΔT+ |
| 11 | 0.0 | 0.00 | 15.23 | 0.00 | 368.48 | 0.00 | Temperatur ΔT- |
| Einwirkung 5: Verkehrslasten | | | | | | | |
| 12 | 0.0 | 0.00 | -30.47 | 0.00 | -736.97 | 0.00 | p=2.5 HT1, Feld1, links |
| 13 | 0.0 | 0.00 | 15.23 | 0.00 | 368.48 | 0.00 | p=2.5 HT1, Feld1, rechts |
| 14 | 35.3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | p=2.5 HT1, Feld2, links |
| 15 | -35.3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | p=2.5 HT1, Feld2, rechts |
| 16 | 0.0 | 0.00 | 113.82 | 0.00 | 2753.24 | 0.00 | Gehweg (Feld 1, links) |
| 17 | 0.0 | 0.00 | -68.98 | 0.00 | -1668.63 | 0.00 | Gehweg (Feld 1, rechts) |
| 18 | 0.0 | 18.73 | 0.00 | 16.85 | 0.00 | -4726.31 | Gehweg (Feld 2, links) |
| 19 | 0.0 | -18.73 | 0.00 | 0.00 | 0.00 | 4726.31 | Gehweg (Feld 2, rechts) |
| 20 | 0.0 | 0.00 | -78.45 | 33.13 | -69.17 | 0.00 | Überlast HS1 (Feld 1) |
| 21 | 0.0 | 0.00 | -10.39 | 51.96 | -251.35 | 0.00 | Überlast HS1 (Feld 2) |
| 22 | 0.0 | 0.00 | -78.45 | 33.13 | -69.17 | 0.00 | HS1 (Tandem 1) |
| 23 | 0.0 | 0.00 | -10.39 | -51.96 | -251.35 | 0.00 | HS1 (Tandem 2) |
| 24 | 0.0 | 0.00 | -244.77 | -82.68 | -215.81 | 0.00 | HS1 (Tandem 3) |
| 25 | 0.0 | 0.00 | -32.42 | 129.68 | -784.21 | 0.00 | HS1 (Tandem 4) |
| 26 | 0.0 | 0.00 | -24.80 | -9.92 | -71.81 | 0.00 | HS1 (Tandem 5) |
| 27 | 0.0 | 0.00 | -150.68 | -61.08 | -395.39 | 0.00 | HS1 (Tandem 6) |



Lastfallergebnisse

| Nr | N kN | Q _η kN | Q _ξ kN | T kNm | M _η kNm | M _ξ kNm | Bezeichnung |
|----|---------|----------------------|----------------------|----------|-----------------------|-----------------------|-----------------------|
| 28 | 0.0 | 0.00 | -268.24 | -112.24 | -517.56 | 0.00 | HS1 (Tandem 7) |
| 29 | 0.0 | 0.00 | -370.50 | -163.40 | -269.64 | 0.00 | HS1 (Tandem 8) |
| 30 | 0.0 | 0.00 | -210.49 | 25.44 | 471.46 | 0.00 | HS1 (Tandem 9) |
| 31 | 0.0 | 0.00 | -21.57 | 214.29 | -521.67 | 0.00 | HS1 (Tandem 10) |
| 32 | 0.0 | 0.00 | -43.76 | 163.13 | -1058.50 | 0.00 | HS1 (Tandem 11) |
| 33 | 0.0 | 0.00 | -43.71 | 111.97 | -1557.44 | 0.00 | HS1 (Tandem 12) |
| 34 | 0.0 | 0.00 | -28.41 | 60.81 | -687.18 | 0.00 | HS1 (Tandem 13) |
| 35 | 0.0 | 0.00 | -4.81 | 9.65 | -116.40 | 0.00 | HS1 (Tandem 14) |
| 36 | 0.0 | 0.00 | -241.58 | -100.15 | -515.81 | 0.00 | HS1 (Tandem 15) |
| 37 | 0.0 | 0.00 | -77.78 | 0.00 | -201.54 | 0.00 | HS1 (Tandem 16) |
| 38 | 0.0 | 0.00 | -99.80 | 0.00 | -253.59 | 0.00 | HS1 (Tandem 17) |
| 39 | 0.0 | 0.00 | -121.60 | 0.00 | -301.46 | 0.00 | HS1 (Tandem 18) |
| 40 | 0.0 | 0.00 | -143.21 | 0.00 | -344.24 | 0.00 | HS1 (Tandem 19) |
| 41 | 0.0 | 0.00 | -164.57 | 0.00 | -381.00 | 0.00 | HS1 (Tandem 20) |
| 42 | 0.0 | 0.00 | -186.65 | 0.00 | -410.83 | 0.00 | HS1 (LM3 1) |
| 43 | 0.0 | 0.00 | -206.40 | 0.00 | -432.79 | 0.00 | HS1 (LM3 2) |
| 44 | 0.0 | 0.00 | -226.79 | 0.00 | -445.96 | 0.00 | HS1 (LM3 3) |
| 45 | 0.0 | 0.00 | -246.77 | 0.00 | -449.41 | 0.00 | HS1 (LM3 4) |
| 46 | 0.0 | 0.00 | -266.00 | 0.00 | -442.22 | 0.00 | HS1 (LM3 5) |
| 47 | 0.0 | 0.00 | -285.38 | 0.00 | -423.46 | 0.00 | HS1 (LM3 6) |
| 48 | 0.0 | 0.00 | -304.02 | 0.00 | -391.78 | 0.00 | HS1 (LM3 7) |
| 49 | 0.0 | 0.00 | -321.93 | 0.00 | -347.54 | 0.00 | HS1 (LM3 8) |
| 50 | 0.0 | 0.00 | -339.34 | 0.00 | -288.53 | 0.00 | HS1 (LM3 9) |
| 51 | 0.0 | 0.00 | -356.10 | 0.00 | -214.25 | 0.00 | HS1 (LM3 10) |
| 52 | 0.0 | 0.00 | -372.21 | 0.00 | -123.77 | 0.00 | HS1 (LM3 11) |
| 53 | 0.0 | 0.00 | -387.61 | 0.00 | -16.18 | 0.00 | HS1 (LM3 12) |
| 54 | 0.0 | 0.00 | -282.30 | 0.00 | 48.45 | 0.00 | HS1 (LM3 13) |
| 55 | 0.0 | 0.00 | -176.12 | 0.00 | 35.67 | 0.00 | HS1 (LM3 14) |
| 56 | 0.0 | 0.00 | -189.16 | 0.00 | -39.82 | 0.00 | HS1 (LM3 15) |
| 57 | 0.0 | 0.00 | -201.35 | 0.00 | -94.60 | 0.00 | HS1 (LM3 16) |
| 58 | 0.0 | 0.00 | -212.66 | 0.00 | -128.19 | 0.00 | HS1 (LM3 17) |
| 59 | 0.0 | 0.00 | -223.09 | 0.00 | -140.50 | 0.00 | HS1 (LM3 18) |
| 60 | 0.0 | 0.00 | -232.64 | 0.00 | -131.53 | 0.00 | HS1 (LM3 19) |
| 61 | 0.0 | 0.00 | -121.31 | 0.00 | -138.47 | 0.00 | HS1 (LM3 20) |
| 62 | 0.0 | 0.00 | -9.10 | 0.00 | -220.13 | 0.00 | Überlast HS2 (Feld 1) |
| 63 | 0.0 | 0.00 | -16.01 | 0.00 | -387.30 | 0.00 | Überlast HS2 (Feld 2) |
| 64 | 0.0 | 0.00 | -22.04 | 0.00 | -533.25 | 0.00 | HS2 (Tandem 1) |
| 65 | 0.0 | 0.00 | -27.23 | 0.00 | -658.78 | 0.00 | HS2 (Tandem 2) |
| 66 | 0.0 | 0.00 | -31.56 | 0.00 | -763.38 | 0.00 | HS2 (LM3 1) |
| 67 | 0.0 | 0.00 | -35.11 | 0.00 | -849.25 | 0.00 | HS2 (LM3 2) |

Betoneckspannungen der Lastfälle

| Nr | σ ₁ MN/m ² | σ ₂ MN/m ² | σ ₃ MN/m ² | σ ₄ MN/m ² | Bezeichnung |
|---------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--|
| Einwirkung 1: ständige Lasten | | | | | |
| 1 | 0.87 | 0.87 | -1.39 | -1.39 | Eg Hauptträger |
| 2 | 0.17 | 0.17 | -0.27 | -0.27 | Eg Kappen |
| 3 | 0.05 | 0.05 | -0.09 | -0.09 | Eg Belag |
| Einwirkung 2: Vorspannung | | | | | |
| 4 | -0.51 | -0.51 | 0.80 | 0.80 | P [∞] : Vorsp.m.ntr.Verbund 1 |
| 5 | 0.04 | 0.04 | -0.06 | -0.06 | P [∞] : Vorspannung extern 1 |
| 68 | -0.44 | -0.44 | 0.70 | 0.70 | P [∞] +KS [∞] zu LF 4: Vorsp.m.ntr.Verbund 1 |
| 69 | -0.49 | -0.49 | 0.77 | 0.77 | P [∞] +KS1 zu LF 4: Vorsp.m.ntr.Verbund 1 |
| 70 | -1.03 | -1.03 | 0.88 | 0.88 | P zu LF 4: Vorsp.m.ntr.Verbund 1 |
| 71 | -0.90 | -0.90 | 0.77 | 0.77 | P+KS [∞] zu LF 4: Vorsp.m.ntr.Verbund 1 |
| 72 | -0.99 | -0.99 | 0.85 | 0.85 | P+KS1 zu LF 4: Vorsp.m.ntr.Verbund 1 |
| 73 | 0.03 | 0.03 | -0.05 | -0.05 | P [∞] +KS [∞] zu LF 5: Vorspannung extern 1 |
| 74 | 0.03 | 0.03 | -0.05 | -0.05 | P [∞] +KS1 zu LF 5: Vorspannung extern 1 |
| 75 | 0.04 | 0.04 | -0.06 | -0.06 | P zu LF 5: Vorspannung extern 1 |
| 76 | 0.03 | 0.03 | -0.05 | -0.05 | P+KS [∞] zu LF 5: Vorspannung extern 1 |
| 77 | 0.03 | 0.03 | -0.05 | -0.05 | P+KS1 zu LF 5: Vorspannung extern 1 |
| Einwirkung 3: Stützensenkung | | | | | |
| 6 | -0.07 | -0.07 | 0.11 | 0.11 | wahrsch. Δs (Achse 1) |
| 7 | 0.04 | 0.04 | -0.06 | -0.06 | mögliche Δs (Achse 1) |
| Einwirkung 4: Temperaturlasten | | | | | |



Betoneckspannungen der Lastfälle

| Nr | σ_1 MN/m ² | σ_2 MN/m ² | σ_3 MN/m ² | σ_4 MN/m ² | Bezeichnung |
|-------------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|--------------------------|
| 8 | 0.07 | 0.07 | -0.11 | -0.11 | Temperatur T+ |
| 9 | -0.14 | -0.14 | 0.23 | 0.23 | Temperatur T- |
| 10 | 0.07 | 0.07 | -0.11 | -0.11 | Temperatur $\Delta T+$ |
| 11 | -0.04 | -0.04 | 0.06 | 0.06 | Temperatur $\Delta T-$ |
| Einwirkung 5: Verkehrslasten | | | | | |
| 12 | 0.07 | 0.07 | -0.11 | -0.11 | p=2.5 HT1, Feld1, links |
| 13 | -0.04 | -0.04 | 0.06 | 0.06 | p=2.5 HT1, Feld1, rechts |
| 14 | 0.00 | 0.00 | 0.00 | 0.00 | p=2.5 HT1, Feld2, links |
| 15 | -0.00 | -0.00 | -0.00 | -0.00 | p=2.5 HT1, Feld2, rechts |
| 16 | -0.27 | -0.27 | 0.42 | 0.42 | Gehweg (Feld 1, links) |
| 17 | 0.16 | 0.16 | -0.26 | -0.26 | Gehweg (Feld 1, rechts) |
| 18 | 0.39 | -0.39 | -0.15 | 0.15 | Gehweg (Feld 2, links) |
| 19 | -0.39 | 0.39 | 0.15 | -0.15 | Gehweg (Feld 2, rechts) |
| 20 | 0.01 | 0.01 | -0.01 | -0.01 | Überlast HS1 (Feld 1) |
| 21 | 0.02 | 0.02 | -0.04 | -0.04 | Überlast HS1 (Feld 2) |
| 22 | 0.01 | 0.01 | -0.01 | -0.01 | HS1 (Tandem 1) |
| 23 | 0.02 | 0.02 | -0.04 | -0.04 | HS1 (Tandem 2) |
| 24 | 0.02 | 0.02 | -0.03 | -0.03 | HS1 (Tandem 3) |
| 25 | 0.08 | 0.08 | -0.12 | -0.12 | HS1 (Tandem 4) |
| 26 | 0.01 | 0.01 | -0.01 | -0.01 | HS1 (Tandem 5) |
| 27 | 0.04 | 0.04 | -0.06 | -0.06 | HS1 (Tandem 6) |
| 28 | 0.05 | 0.05 | -0.08 | -0.08 | HS1 (Tandem 7) |
| 29 | 0.03 | 0.03 | -0.04 | -0.04 | HS1 (Tandem 8) |
| 30 | -0.05 | -0.05 | 0.07 | 0.07 | HS1 (Tandem 9) |
| 31 | 0.05 | 0.05 | -0.08 | -0.08 | HS1 (Tandem 10) |
| 32 | 0.10 | 0.10 | -0.16 | -0.16 | HS1 (Tandem 11) |
| 33 | 0.15 | 0.15 | -0.24 | -0.24 | HS1 (Tandem 12) |
| 34 | 0.07 | 0.07 | -0.11 | -0.11 | HS1 (Tandem 13) |
| 35 | 0.01 | 0.01 | -0.02 | -0.02 | HS1 (Tandem 14) |
| 36 | 0.05 | 0.05 | -0.08 | -0.08 | HS1 (Tandem 15) |
| 37 | 0.02 | 0.02 | -0.03 | -0.03 | HS1 (Tandem 16) |
| 38 | 0.02 | 0.02 | -0.04 | -0.04 | HS1 (Tandem 17) |
| 39 | 0.03 | 0.03 | -0.05 | -0.05 | HS1 (Tandem 18) |
| 40 | 0.03 | 0.03 | -0.05 | -0.05 | HS1 (Tandem 19) |
| 41 | 0.04 | 0.04 | -0.06 | -0.06 | HS1 (Tandem 20) |
| 42 | 0.04 | 0.04 | -0.06 | -0.06 | HS1 (LM3 1) |
| 43 | 0.04 | 0.04 | -0.07 | -0.07 | HS1 (LM3 2) |
| 44 | 0.04 | 0.04 | -0.07 | -0.07 | HS1 (LM3 3) |
| 45 | 0.04 | 0.04 | -0.07 | -0.07 | HS1 (LM3 4) |
| 46 | 0.04 | 0.04 | -0.07 | -0.07 | HS1 (LM3 5) |
| 47 | 0.04 | 0.04 | -0.07 | -0.07 | HS1 (LM3 6) |
| 48 | 0.04 | 0.04 | -0.06 | -0.06 | HS1 (LM3 7) |
| 49 | 0.03 | 0.03 | -0.05 | -0.05 | HS1 (LM3 8) |
| 50 | 0.03 | 0.03 | -0.04 | -0.04 | HS1 (LM3 9) |
| 51 | 0.02 | 0.02 | -0.03 | -0.03 | HS1 (LM3 10) |
| 52 | 0.01 | 0.01 | -0.02 | -0.02 | HS1 (LM3 11) |
| 53 | 0.00 | 0.00 | -0.00 | -0.00 | HS1 (LM3 12) |
| 54 | -0.00 | -0.00 | 0.01 | 0.01 | HS1 (LM3 13) |
| 55 | -0.00 | -0.00 | 0.01 | 0.01 | HS1 (LM3 14) |
| 56 | 0.00 | 0.00 | -0.01 | -0.01 | HS1 (LM3 15) |
| 57 | 0.01 | 0.01 | -0.01 | -0.01 | HS1 (LM3 16) |
| 58 | 0.01 | 0.01 | -0.02 | -0.02 | HS1 (LM3 17) |
| 59 | 0.01 | 0.01 | -0.02 | -0.02 | HS1 (LM3 18) |
| 60 | 0.01 | 0.01 | -0.02 | -0.02 | HS1 (LM3 19) |
| 61 | 0.01 | 0.01 | -0.02 | -0.02 | HS1 (LM3 20) |
| 62 | 0.02 | 0.02 | -0.03 | -0.03 | Überlast HS2 (Feld 1) |
| 63 | 0.04 | 0.04 | -0.06 | -0.06 | Überlast HS2 (Feld 2) |
| 64 | 0.05 | 0.05 | -0.08 | -0.08 | HS2 (Tandem 1) |
| 65 | 0.06 | 0.06 | -0.10 | -0.10 | HS2 (Tandem 2) |
| 66 | 0.07 | 0.07 | -0.12 | -0.12 | HS2 (LM3 1) |
| 67 | 0.08 | 0.08 | -0.13 | -0.13 | HS2 (LM3 2) |

Nachweis 1: EC2 Tragfähigkeit Biegung S/V

Nach EC2 6.1, Ständige und vorübergehende Situation gemäß EC0 6.4.3.2 (6.10) a), mit $\gamma_c = 1.50$ und $\gamma_s = 1.15$



Ergebnisse der Lastkombinationen

| Typ | N kN | Q _η kN | Q _ξ kN | T kNm | M _η kNm | M _ξ kNm | Faktorisierung |
|--|---|----------------------|----------------------|----------|-----------------------|-----------------------|---|
| Extremierung 1: Standardkombination | | | | | | | |
| min N | -47.7 | 0.00 | -336.70 | 0.00 | -7325.48 | 0.00 | Lf1+Lf2+Lf3+Lf68+Lf76+1.35*Lf15 |
| max N | 47.7 | -0.00 | -1210.73 | 172.23 | -12736.02 | 0.00 | 1.35*(Lf1+Lf2+Lf3)+Lf68+Lf76+0.81*Lf7+0.8*0.81*(Lf8+Lf10)..... |
| | ...+1.35*(Lf12+Lf13+Lf14)+0.75*(Lf16+Lf17+Lf18+Lf19)+1.35*(Lf20+Lf21+Lf22) | | | | | | |
| min Q _η | 0.0 | -14.05 | -336.70 | 0.00 | -7325.48 | 3544.73 | Lf1+Lf2+Lf3+Lf68+Lf76+0.75*Lf19 |
| max Q _η | -0.0 | 14.05 | -1210.73 | 172.23 | -12736.02 | -3544.73 | 1.35*(Lf1+Lf2+Lf3)+Lf68+Lf76+0.81*Lf7+0.8*0.81*(Lf8+Lf10)..... |
| | ...+1.35*(Lf12+Lf13+Lf14+Lf15)+0.75*(Lf16+Lf17+Lf18)+1.35*(Lf20+Lf21+Lf22) | | | | | | |
| min Q _ξ | 0.0 | 0.00 | -1712.29 | -105.72 | -15602.18 | 0.00 | 1.35*(Lf1+Lf2+Lf3)+Lf68+Lf77+0.81*Lf7+0.8*0.81*(Lf8+Lf10)..... |
| max Q _ξ | -0.0 | -0.00 | -34.40 | 12.64 | -3126.26 | 0.00 | Lf1+Lf2+Lf3+Lf69+Lf76+0.8*0.81*(Lf9+Lf11)+1.35*(Lf13+Lf14+Lf15).. |
| | ...+0.75*(Lf16+Lf18+Lf19) | | | | | | |
| min T | 0.0 | 0.00 | -836.87 | -220.59 | -7689.49 | 0.00 | Lf1+Lf2+Lf3+Lf68+Lf76+1.35*Lf29 |
| max T | -0.0 | -0.00 | -1133.94 | 416.80 | -13346.90 | 0.00 | 1.35*(Lf1+Lf2+Lf3)+Lf68+Lf76+0.81*Lf7+0.8*0.81*(Lf8+Lf10)..... |
| | ...+1.35*(Lf12+Lf13+Lf14+Lf15)+0.75*(Lf16+Lf17+Lf18+Lf19)+1.35*(Lf20+Lf21+Lf31) | | | | | | |
| min M _η | 0.0 | 0.00 | -1271.13 | 266.03 | -17340.71 | 0.00 | 1.35*(Lf1+Lf2+Lf3)+Lf68+Lf77+0.81*Lf7+0.8*0.81*(Lf8+Lf10)..... |
| max M _η | -0.0 | -0.00 | -318.56 | 46.98 | -2489.79 | 0.00 | Lf1+Lf2+Lf3+Lf69+Lf76+0.8*0.81*(Lf9+Lf11)+1.35*(Lf13+Lf14+Lf15).. |
| | ...+0.75*(Lf16+Lf18+Lf19)+1.35*Lf30 | | | | | | |
| min M _ξ | 0.0 | 14.05 | -336.70 | 12.64 | -7325.48 | -3544.73 | Lf1+Lf2+Lf3+Lf68+Lf76+0.75*Lf18 |
| max M _ξ | -0.0 | -14.05 | -1210.73 | 159.60 | -12736.02 | 3544.73 | 1.35*(Lf1+Lf2+Lf3)+Lf68+Lf76+0.81*Lf7+0.8*0.81*(Lf8+Lf10)..... |
| | ...+1.35*(Lf12+Lf13+Lf14+Lf15)+0.75*(Lf16+Lf17+Lf19)+1.35*(Lf20+Lf21+Lf22) | | | | | | |

Betoneckspannungen der Lastkombinationen

| Typ | σ ₁ MN/m ² | σ ₂ MN/m ² | σ ₃ MN/m ² | σ ₄ MN/m ² | Faktorisierung |
|--|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|---|
| Extremierung 1: Standardkombination | | | | | |
| min σ ₁ | -0.09 | 0.50 | -0.23 | -0.46 | Lf1+Lf2+Lf3+Lf69+Lf76+0.8*0.81*(Lf9+Lf11)+1.35*(Lf13+Lf15)+0.75*(Lf16+Lf19)+1.35*Lf30 |
| max σ ₁ | 1.94 | 1.36 | -2.74 | -2.52 | 1.35*(Lf1+Lf2+Lf3)+Lf68+Lf77+0.81*Lf7+0.8*0.81*(Lf8+Lf10)+1.35*(Lf12+Lf14)+0.75*(Lf17.. |
| | ...+Lf18)+1.35*(Lf20+Lf21+Lf33) | | | | |
| min σ ₂ | 0.50 | -0.09 | -0.46 | -0.23 | Lf1+Lf2+Lf3+Lf69+Lf76+0.8*0.81*(Lf9+Lf11)+1.35*(Lf13+Lf15)+0.75*(Lf16+Lf18)+1.35*Lf30 |
| max σ ₂ | 1.36 | 1.94 | -2.52 | -2.74 | 1.35*(Lf1+Lf2+Lf3)+Lf68+Lf77+0.81*Lf7+0.8*0.81*(Lf8+Lf10)+1.35*(Lf12+Lf14)+0.75*(Lf17.. |
| | ...+Lf19)+1.35*(Lf20+Lf21+Lf33) | | | | |
| min σ ₃ | 1.93 | 1.35 | -2.75 | -2.53 | 1.35*(Lf1+Lf2+Lf3)+Lf68+Lf77+0.81*Lf7+0.8*0.81*(Lf8+Lf10)+1.35*(Lf12+Lf15)+0.75*(Lf17.. |
| | ...+Lf18)+1.35*(Lf20+Lf21+Lf33) | | | | |
| max σ ₃ | -0.08 | 0.51 | -0.22 | -0.45 | Lf1+Lf2+Lf3+Lf69+Lf76+0.8*0.81*(Lf9+Lf11)+1.35*(Lf13+Lf14)+0.75*(Lf16+Lf19)+1.35*Lf30 |
| min σ ₄ | 1.35 | 1.93 | -2.53 | -2.75 | 1.35*(Lf1+Lf2+Lf3)+Lf68+Lf77+0.81*Lf7+0.8*0.81*(Lf8+Lf10)+1.35*(Lf12+Lf15)+0.75*(Lf17.. |
| | ...+Lf19)+1.35*(Lf20+Lf21+Lf33) | | | | |
| max σ ₄ | 0.51 | -0.08 | -0.45 | -0.22 | Lf1+Lf2+Lf3+Lf69+Lf76+0.8*0.81*(Lf9+Lf11)+1.35*(Lf13+Lf14)+0.75*(Lf16+Lf18)+1.35*Lf30 |

Bruchsicherheitsnachweis

| Typ | ε _b ‰ | ε _s ‰ | Dbu kN | h _{Dbu} cm | Z _{vu} kN | Z cm | N _{Ed} kN | M _{mEd} kNm | M _{nEd} kNm | M _{Ed} / M _{Eds} - |
|--|---------------------|---------------------|-----------|------------------------|-----------------------|---------|-----------------------|-------------------------|-------------------------|---|
| Extremierung 1: Standardkombination | | | | | | | | | | |
| min N | -3.50 | 21.36 | -32849.2 | 43.1 | 33677.3 | 243.7 | -47.7 | -7325.5 | 0.0 | 0.09 |
| max N | -3.50 | 21.97 | -32235.8 | 42.0 | 33790.8 | 243.7 | 47.7 | -12736.0 | 0.0 | 0.16 |
| min M _η | -3.50 | 21.75 | -32459.0 | 42.4 | 33750.0 | 243.7 | 0.0 | -17340.7 | 0.0 | 0.21 |
| max M _η | -3.50 | 21.75 | -32459.0 | 42.4 | 33750.0 | 243.7 | -0.0 | -2489.8 | 0.0 | 0.03 |
| min M _ξ | -3.50 | 12.90 | -28297.9 | 65.5 | 31474.3 | 267.6 | 0.0 | -7325.5 | -3544.7 | 0.10 |
| max M _ξ | -3.50 | 15.24 | -29241.7 | 57.3 | 32279.7 | 254.0 | -0.0 | -12736.0 | 3544.7 | 0.16 |

max M_{Ed} / M_{Eds} = 0.21 ≤ 1 ⇒ Nachweis der Tragfähigkeit Biegung ständige u. vorüberg. Situation erfüllt

Nachweis 2: EC2 Betonrandsp. seltene EK (charakteristisch)

Nach EC2, Spannungen unter der seltenen EK (charakteristisch) in Zustand I

Ergebnisse der Lastkombinationen

| Typ | N kN | Q _η kN | Q _ξ kN | T kNm | M _η kNm | M _ξ kNm | Faktorisierung |
|--|--|----------------------|----------------------|----------|-----------------------|-----------------------|---|
| Extremierung 1: Standardkombination | | | | | | | |
| min N | -2800.1 | 0.00 | -33.20 | 0.00 | -4031.72 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf15 |
| max N | -2014.2 | 0.00 | -656.86 | 126.65 | -6646.87 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf71+Lf76+Lf6+0.8*(Lf8+Lf10)+Lf12+Lf13+Lf14..... |
| | ...+0.5*(Lf16+Lf17+Lf18+Lf19)+Lf20+Lf21+Lf22 | | | | | | |
| min Q _η | -2049.5 | -9.37 | -478.47 | 0.00 | -5988.81 | 2363.16 | Lf1+Lf2+Lf3+0.9*Lf71+Lf76+0.5*Lf19 |
| max Q _η | -2505.0 | 9.37 | -373.31 | 126.65 | -5400.59 | -2363.16 | Lf1+Lf2+Lf3+1.1*Lf71+Lf76+Lf6+0.8*(Lf8+Lf10)+Lf12+Lf13+Lf14+Lf15. |
| | ...+0.5*(Lf16+Lf17+Lf18)+Lf20+Lf21+Lf22 | | | | | | |
| min Q _ξ | -2049.5 | 0.00 | -1052.89 | -78.31 | -9362.55 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf71+Lf77+0.8*(Lf8+Lf10)+Lf12+0.5*Lf17+Lf20+Lf21. |
| | ...+Lf29 | | | | | | |
| max Q _ξ | -2764.8 | 0.00 | 130.34 | 8.43 | -75.72 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.8*(Lf9+Lf11)+Lf13+Lf14+Lf15..... |
| | ...+0.5*(Lf16+Lf18+Lf19) | | | | | | |
| min T | -2049.5 | 0.00 | -848.97 | -163.40 | -6258.45 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf71+Lf76+Lf29 |
| max T | -2505.0 | 0.00 | -316.43 | 307.81 | -5853.09 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf71+Lf76+Lf6+0.8*(Lf8+Lf10)+Lf12+Lf13+Lf14+Lf15. |
| | ...+0.5*(Lf16+Lf17+Lf18+Lf19)+Lf20+Lf21+Lf31 | | | | | | |



Ergebnisse der Lastkombinationen

| Typ | N kN | Q _η kN | Q _ζ kN | T kNm | M _η kNm | M _ζ kNm | Faktorisierung |
|--------------------|---------|----------------------|----------------------|----------|-----------------------|-----------------------|--|
| min M _η | -2049.5 | 0.00 | -726.10 | 197.06 | -10650.35 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf71+Lf77+0.8*(Lf8+Lf10)+Lf12+0.5*Lf17+Lf20+Lf21. ...+Lf33 |
| max M _η | -2764.8 | 0.00 | -80.15 | 33.87 | 395.74 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.8*(Lf9+Lf11)+Lf13+Lf14+Lf15..... ...+0.5*(Lf16+Lf18+Lf19)+Lf30 |
| min M _ζ | -2049.5 | 9.37 | -478.47 | 8.43 | -5988.81 | -2363.16 | Lf1+Lf2+Lf3+0.9*Lf71+Lf76+0.5*Lf18 |
| max M _ζ | -2764.8 | -9.37 | -211.59 | 118.22 | -4689.78 | 2363.16 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.8*(Lf8+Lf10)+Lf12+Lf13+Lf14+Lf15. ...+0.5*(Lf16+Lf17+Lf19)+Lf20+Lf21+Lf22 |

Betoneckspannungen der Lastkombinationen

| Typ | σ ₁ MN/m ² | σ ₂ MN/m ² | σ ₃ MN/m ² | σ ₄ MN/m ² | Faktorisierung |
|--|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|---|
| Extremierung 1: Standardkombination | | | | | |
| min σ ₁ | -0.59 | -0.20 | -0.10 | -0.25 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.8*(Lf9+Lf11)+Lf13+Lf15+0.5*(Lf16+Lf19)+Lf30 |
| max σ ₁ | 0.96 | 0.58 | -1.89 | -1.74 | Lf1+Lf2+Lf3+0.9*Lf71+Lf77+0.8*(Lf8+Lf10)+Lf12+Lf14+0.5*(Lf17+Lf18)+Lf20+Lf21+Lf33 |
| min σ ₂ | -0.20 | -0.59 | -0.25 | -0.10 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.8*(Lf9+Lf11)+Lf13+Lf15+0.5*(Lf16+Lf18)+Lf30 |
| max σ ₂ | 0.58 | 0.96 | -1.74 | -1.89 | Lf1+Lf2+Lf3+0.9*Lf71+Lf77+0.8*(Lf8+Lf10)+Lf12+Lf14+0.5*(Lf17+Lf19)+Lf20+Lf21+Lf33 |
| min σ ₃ | 0.96 | 0.57 | -1.90 | -1.75 | Lf1+Lf2+Lf3+0.9*Lf71+Lf77+0.8*(Lf8+Lf10)+Lf12+Lf15+0.5*(Lf17+Lf18)+Lf20+Lf21+Lf33 |
| max σ ₃ | -0.58 | -0.20 | -0.10 | -0.25 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.8*(Lf9+Lf11)+Lf13+Lf14+0.5*(Lf16+Lf19)+Lf30 |
| min σ ₄ | 0.57 | 0.96 | -1.75 | -1.90 | Lf1+Lf2+Lf3+0.9*Lf71+Lf77+0.8*(Lf8+Lf10)+Lf12+Lf15+0.5*(Lf17+Lf19)+Lf20+Lf21+Lf33 |
| max σ ₄ | -0.20 | -0.58 | -0.25 | -0.10 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.8*(Lf9+Lf11)+Lf13+Lf14+0.5*(Lf16+Lf18)+Lf30 |

Betonrandspannungen seltene Einwirkungskombination

Aus seltener Einwirkungskombination: $\sigma_{\max} = 0.96 \text{ MN/m}^2 \leq f_{ctm} = 2.9 \text{ MN/m}^2 \Rightarrow$ Querschnitt ist in **Zustand I**

| Typ | σ ₁ MN/m ² | σ ₂ MN/m ² | σ ₃ MN/m ² | σ ₄ MN/m ² | σ _{max} MN/m ² |
|--|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|---------------------------------------|
| Extremierung 1: Standardkombination | | | | | |
| min σ ₁ | -0.59 | -0.20 | -0.10 | -0.25 | -0.10 ≤ 2.9 |
| max σ ₁ | 0.96 | 0.58 | -1.89 | -1.74 | 0.96 ≤ 2.9 |
| min σ ₂ | -0.20 | -0.59 | -0.25 | -0.10 | -0.10 ≤ 2.9 |
| max σ ₂ | 0.58 | 0.96 | -1.74 | -1.89 | 0.96 ≤ 2.9 |
| min σ ₃ | 0.96 | 0.57 | -1.90 | -1.75 | 0.96 ≤ 2.9 |
| max σ ₃ | -0.58 | -0.20 | -0.10 | -0.25 | -0.10 ≤ 2.9 |
| min σ ₄ | 0.57 | 0.96 | -1.75 | -1.90 | 0.96 ≤ 2.9 |
| max σ ₄ | -0.20 | -0.58 | -0.25 | -0.10 | -0.10 ≤ 2.9 |

Nachweis 3: EC2 Rissbreite

Nach EC2, 7.3.1 (105) und 7.3.2 (102)

Ergebnisse der Lastkombinationen

| Typ | N kN | Q _η kN | Q _ζ kN | T kNm | M _η kNm | M _ζ kNm | Faktorisierung |
|--|---------|----------------------|----------------------|----------|-----------------------|-----------------------|--|
| Extremierung 1: Standardkombination | | | | | | | |
| min N | -2778.9 | 0.00 | -33.20 | 0.00 | -4031.72 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+0.4*Lf15 |
| max N | -2035.4 | -0.00 | -569.97 | 62.25 | -6099.37 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf71+Lf76+Lf6+0.5*(Lf8+Lf10)+0.4*(Lf12+Lf13..... ...+Lf14)+0.4*0.5*(Lf16+Lf17+Lf18+Lf19)+0.4*(Lf20+Lf21)+0.75*Lf22 |
| min Q _η | -2049.5 | -3.75 | -478.47 | 0.00 | -5988.81 | 945.26 | Lf1+Lf2+Lf3+0.9*Lf71+Lf76+0.4*0.5*Lf19 |
| max Q _η | -2505.0 | 3.75 | -286.42 | 62.25 | -4853.09 | -945.26 | Lf1+Lf2+Lf3+1.1*Lf71+Lf76+Lf6+0.5*(Lf8+Lf10)+0.4*(Lf12+Lf13+Lf14. ...+Lf15)+0.4*0.5*(Lf16+Lf17+Lf18)+0.4*(Lf20+Lf21)+0.75*Lf22 |
| min Q _ζ | -2049.5 | 0.00 | -849.71 | -88.51 | -7717.88 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf71+Lf77+0.5*(Lf8+Lf10)+0.4*Lf12+0.4*0.5*Lf17... ...+0.4*(Lf20+Lf21)+0.75*Lf29 |
| max Q _ζ | -2764.8 | -0.00 | 64.21 | 3.37 | -1675.51 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.5*(Lf9+Lf11)+0.4*(Lf13+Lf14..... ...+Lf15)+0.4*0.5*(Lf16+Lf18+Lf19) |
| min T | -2049.5 | 0.00 | -756.35 | -122.55 | -6191.04 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf71+Lf76+0.75*Lf29 |
| max T | -2505.0 | -0.00 | -243.76 | 198.12 | -5192.47 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf71+Lf76+Lf6+0.5*(Lf8+Lf10)+0.4*(Lf12+Lf13+Lf14. ...+Lf15)+0.4*0.5*(Lf16+Lf17+Lf18+Lf19)+0.4*(Lf20+Lf21)+0.75*Lf31 |
| min M _η | -2049.5 | 0.00 | -604.61 | 118.01 | -8683.73 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf71+Lf77+0.5*(Lf8+Lf10)+0.4*Lf12+0.4*0.5*Lf17... ...+0.4*(Lf20+Lf21)+0.75*Lf33 |
| max M _η | -2764.8 | -0.00 | -93.66 | 22.45 | -1321.91 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.5*(Lf9+Lf11)+0.4*(Lf13+Lf14..... ...+Lf15)+0.4*0.5*(Lf16+Lf18+Lf19)+0.75*Lf30 |
| min M _ζ | -2049.5 | 3.75 | -478.47 | 3.37 | -5988.81 | -945.26 | Lf1+Lf2+Lf3+0.9*Lf71+Lf76+0.4*0.5*Lf18 |
| max M _ζ | -2764.8 | -3.75 | -124.70 | 58.88 | -4142.28 | 945.26 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.5*(Lf8+Lf10)+0.4*(Lf12+Lf13+Lf14. ...+Lf15)+0.4*0.5*(Lf16+Lf17+Lf19)+0.4*(Lf20+Lf21)+0.75*Lf22 |

Betoneckspannungen der Lastkombinationen

| Typ | σ ₁ MN/m ² | σ ₂ MN/m ² | σ ₃ MN/m ² | σ ₄ MN/m ² | Faktorisierung |
|--|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--|
| Extremierung 1: Standardkombination | | | | | |
| min σ ₁ | -0.31 | -0.15 | -0.41 | -0.47 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.5*(Lf9+Lf11)+0.4*(Lf13+Lf15)+0.4*0.5*(Lf16+Lf19)..... ...+0.75*Lf30 |
| max σ ₁ | 0.66 | 0.50 | -1.54 | -1.48 | Lf1+Lf2+Lf3+0.9*Lf71+Lf77+0.5*(Lf8+Lf10)+0.4*(Lf12+Lf14)+0.4*0.5*(Lf17+Lf18)+0.4*(Lf20. |



Betoneckspannungen der Lastkombinationen

| Typ | σ_1 MN/m ² | σ_2 MN/m ² | σ_3 MN/m ² | σ_4 MN/m ² | Faktorisierung |
|----------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---|
| min σ_2 | ...+Lf21)+0.75*Lf33 -0.15 | -0.31 | -0.47 | -0.41 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.5*(Lf9+Lf11)+0.4*(Lf13+Lf15)+0.4*0.5*(Lf16+Lf18)..... |
| max σ_2 | ...+0.75*Lf33 0.50 | 0.66 | -1.48 | -1.54 | Lf1+Lf2+Lf3+0.9*Lf71+Lf77+0.5*(Lf8+Lf10)+0.4*(Lf12+Lf14)+0.4*0.5*(Lf17+Lf19)+0.4*(Lf20. |
| min σ_3 | ...+Lf21)+0.75*Lf33 0.65 | 0.50 | -1.55 | -1.49 | Lf1+Lf2+Lf3+0.9*Lf71+Lf77+0.5*(Lf8+Lf10)+0.4*(Lf12+Lf15)+0.4*0.5*(Lf17+Lf18)+0.4*(Lf20. |
| max σ_3 | ...+Lf21)+0.75*Lf33 -0.30 | -0.15 | -0.41 | -0.47 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.5*(Lf9+Lf11)+0.4*(Lf13+Lf14)+0.4*0.5*(Lf16+Lf19)..... |
| min σ_4 | ...+0.75*Lf33 0.50 | 0.65 | -1.49 | -1.55 | Lf1+Lf2+Lf3+0.9*Lf71+Lf77+0.5*(Lf8+Lf10)+0.4*(Lf12+Lf15)+0.4*0.5*(Lf17+Lf19)+0.4*(Lf20. |
| max σ_4 | ...+Lf21)+0.75*Lf33 -0.15 | -0.30 | -0.47 | -0.41 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.5*(Lf9+Lf11)+0.4*(Lf13+Lf14)+0.4*0.5*(Lf16+Lf18)..... |
| | ...+0.75*Lf30 | | | | |

Nachweis der Mindestbewehrung zur Begrenzung der Rissbreite

$k_{z,t} = 1.00 \Rightarrow f_{ct,eff} = 2.90$, Biegezug

| Ort | σ_{st} MN/m ² | h _{ct} cm | A _{ct} cm ² | σ_c MN/m ² | k ₁ - | k _c - | k - | σ_s MN/m ² | ξ_1 - | A _p cm ² | erf A _s cm ² | vorh A _s cm ² |
|--|------------------------------------|-----------------------|------------------------------------|---------------------------------|---------------------|---------------------|--------|---------------------------------|--------------|-----------------------------------|---------------------------------------|--|
| Extremierung 1: Standardkombination | | | | | | | | | | | | |
| Kragarm links | +0.0 | 112.4 | 11227.5 | 2.3 | 0.67 | 0.87 | 0.93 | 186.5 | 0.39 | 33.60 | 128.99 > | 122.91 |
| Platte links oben | +0.0 | 112.4 | 7545.0 | 2.5 | 0.67 | 0.91 | 0.98 | 186.5 | 0.00 | 0.00 | 104.62 ≤ | 108.67 |
| Platte li. unten | +0.0 | 176.3 | 8200.0 | -1.8 | 1.50 | 0.23 | 0.92 | 186.5 | 0.00 | 0.00 | 27.28 ≤ | 90.66 |
| Platte re. oben | +0.0 | 112.4 | 4463.3 | 2.5 | 0.67 | 0.91 | 0.98 | 186.5 | 0.00 | 0.00 | 61.89 ≤ | 88.72 |
| Kragarm rechts | +0.0 | 112.4 | 11227.5 | 2.3 | 0.67 | 0.87 | 0.93 | 186.5 | 0.00 | 0.00 | 142.11 > | 122.91 |
| Platte re. unten | +0.0 | 176.3 | 13800.0 | -1.9 | 1.50 | 0.22 | 0.73 | 186.5 | 0.00 | 0.00 | 34.59 ≤ | 90.66 |

Nachweis der Mindestbewehrung zur Rissbreitenbeschränkung nicht erfüllt!

Berechnung der Rissbreite mit $k_{z,t} = 1.00 \Rightarrow f_{ct,eff} = 2.90$

| Typ | Ort | h _w cm | σ_s MN/m ² | eff ρ % | ρ tot % | $\epsilon_{sm} - \epsilon_{cm}$ ‰ | S _{r,max} mm | W _k mm | zul W _k mm |
|--|-------------------|----------------------|---------------------------------|-----------------|-----------------|--------------------------------------|--------------------------|----------------------|--------------------------|
| Extremierung 1: Standardkombination | | | | | | | | | |
| min N | Kragarm links | 13.7 | 20.0 | +1.9 | 1.562 | 1.562 | 0.006 | 3.7 | 0.00 ≤ 0.20 |
| min N | Platte links oben | 12.5 | 20.0 | +2.0 | 2.097 | 2.097 | 0.006 | 3.8 | 0.00 ≤ 0.20 |
| min N | Platte li. unten | 12.5 | 20.0 | -7.3 | 0.852 | 0.852 | 0.000 | 0.0 | 0.00 ≤ 0.20 |
| min N | Platte re. oben | 12.5 | 20.0 | +2.0 | 3.065 | 3.065 | 0.006 | 3.8 | 0.00 ≤ 0.20 |
| min N | Kragarm rechts | 13.7 | 20.0 | +1.9 | 1.562 | 1.562 | 0.006 | 3.7 | 0.00 ≤ 0.20 |
| min N | Platte re. unten | 12.5 | 20.0 | -7.3 | 0.352 | 0.352 | 0.000 | 0.0 | 0.00 ≤ 0.20 |
| max N | Kragarm links | 13.7 | 20.0 | +20.9 | 1.562 | 1.562 | 0.063 | 40.0 | 0.00 ≤ 0.20 |
| max N | Platte links oben | 12.5 | 20.0 | +20.9 | 2.097 | 2.097 | 0.063 | 40.1 | 0.00 ≤ 0.20 |
| max N | Platte li. unten | 12.5 | 20.0 | -11.6 | 0.852 | 0.852 | 0.000 | 0.0 | 0.00 ≤ 0.20 |
| max N | Platte re. oben | 12.5 | 20.0 | +20.9 | 3.065 | 3.065 | 0.063 | 40.1 | 0.00 ≤ 0.20 |
| max N | Kragarm rechts | 13.7 | 20.0 | +20.9 | 1.562 | 1.562 | 0.063 | 40.0 | 0.00 ≤ 0.20 |
| max N | Platte re. unten | 12.5 | 20.0 | -11.6 | 0.352 | 0.352 | 0.000 | 0.0 | 0.00 ≤ 0.20 |
| min M _η | Kragarm links | 13.7 | 20.0 | +38.9 | 1.562 | 1.562 | 0.117 | 74.6 | 0.01 ≤ 0.20 |
| min M _η | Platte links oben | 12.5 | 20.0 | +39.0 | 2.097 | 2.097 | 0.117 | 74.7 | 0.01 ≤ 0.20 |
| min M _η | Platte li. unten | 12.5 | 20.0 | -16.5 | 0.852 | 0.852 | 0.000 | 0.0 | 0.00 ≤ 0.20 |
| min M _η | Platte re. oben | 12.5 | 20.0 | +39.0 | 3.065 | 3.065 | 0.117 | 74.7 | 0.01 ≤ 0.20 |
| min M _η | Kragarm rechts | 13.7 | 20.0 | +38.9 | 1.562 | 1.562 | 0.117 | 74.6 | 0.01 ≤ 0.20 |
| min M _η | Platte re. unten | 12.5 | 20.0 | -16.5 | 0.352 | 0.352 | 0.000 | 0.0 | 0.00 ≤ 0.20 |
| max M _η | Kragarm links | 13.7 | 20.0 | -1.3 | 1.562 | 1.562 | 0.000 | 0.0 | 0.00 ≤ 0.20 |
| max M _η | Platte links oben | 12.5 | 20.0 | -1.3 | 2.097 | 2.097 | 0.000 | 0.0 | 0.00 ≤ 0.20 |
| max M _η | Platte li. unten | 12.5 | 20.0 | -3.8 | 0.852 | 0.852 | 0.000 | 0.0 | 0.00 ≤ 0.20 |
| max M _η | Platte re. oben | 12.5 | 20.0 | -1.3 | 3.065 | 3.065 | 0.000 | 0.0 | 0.00 ≤ 0.20 |
| max M _η | Kragarm rechts | 13.7 | 20.0 | -1.3 | 1.562 | 1.562 | 0.000 | 0.0 | 0.00 ≤ 0.20 |
| max M _η | Platte re. unten | 12.5 | 20.0 | -3.8 | 0.352 | 0.352 | 0.000 | 0.0 | 0.00 ≤ 0.20 |
| min M _ξ | Kragarm links | 13.7 | 20.0 | +17.2 | 1.562 | 1.562 | 0.052 | 32.9 | 0.00 ≤ 0.20 |
| min M _ξ | Platte links oben | 12.5 | 20.0 | +19.4 | 2.097 | 2.097 | 0.058 | 37.2 | 0.00 ≤ 0.20 |
| min M _ξ | Platte li. unten | 12.5 | 20.0 | -11.9 | 0.852 | 0.852 | 0.000 | 0.0 | 0.00 ≤ 0.20 |
| min M _ξ | Platte re. oben | 12.5 | 20.0 | +20.7 | 3.065 | 3.065 | 0.062 | 39.6 | 0.00 ≤ 0.20 |
| min M _ξ | Kragarm rechts | 13.7 | 20.0 | +22.8 | 1.562 | 1.562 | 0.068 | 43.7 | 0.00 ≤ 0.20 |
| min M _ξ | Platte re. unten | 12.5 | 20.0 | -10.8 | 0.352 | 0.352 | 0.000 | 0.0 | 0.00 ≤ 0.20 |
| max M _ξ | Kragarm links | 13.7 | 20.0 | +4.3 | 1.562 | 1.562 | 0.013 | 8.2 | 0.00 ≤ 0.20 |
| max M _ξ | Platte links oben | 12.5 | 20.0 | +3.0 | 2.097 | 2.097 | 0.009 | 5.7 | 0.00 ≤ 0.20 |
| max M _ξ | Platte li. unten | 12.5 | 20.0 | -7.2 | 0.852 | 0.852 | 0.000 | 0.0 | 0.00 ≤ 0.20 |
| max M _ξ | Platte re. oben | 12.5 | 20.0 | +2.2 | 3.065 | 3.065 | 0.007 | 4.3 | 0.00 ≤ 0.20 |



Berechnung der Rissbreite mit $k_{z,t} = 1.00 \Rightarrow f_{ct,eff} = 2.90$

| Typ | Ort | h_w cm | \varnothing_s mm | σ_s MN/m ² | eff ρ % | ρ tot % | $\epsilon_{sm} - \epsilon_{cm}$ ‰ | S_r, max mm | W_k mm | zul W_k mm |
|---------------|------------------|-------------|-----------------------|---------------------------------|-----------------|-----------------|--------------------------------------|------------------|-------------|-----------------|
| max M_{ξ} | Kragarm rechts | 13.7 | 20.0 | +0.9 | 1.562 | 1.562 | 0.003 | 1.7 | 0.00 | ≤ 0.20 |
| max M_{ξ} | Platte re. unten | 12.5 | 20.0 | -7.9 | 0.352 | 0.352 | 0.000 | 0.0 | 0.00 | ≤ 0.20 |

Nachweis der Beschränkung der Rissbreite erfüllt

Nachweis 4: EC2 Dekompression mit Verbund

Ergebnisse der Lastkombinationen

| Typ | N kN | Q_{η} kN | Q_{ξ} kN | T kNm | M_{η} kNm | M_{ξ} kNm | Faktorisierung |
|--|---------|------------------|-----------------|----------|-------------------|------------------|---|
| Extremierung 1: Standardkombination | | | | | | | |
| min N | -2771.8 | 0.00 | -33.20 | 0.00 | -4031.72 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+0.2*Lf15 |
| max N | -2042.5 | 0.00 | -514.98 | 23.64 | -6140.44 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf71+Lf76+Lf6+0.5*(Lf8+Lf10)+0.2*(Lf12+Lf13+Lf14+...+Lf20+Lf21+Lf22) |
| min Q_{η} | -2049.5 | 0.00 | -478.47 | 0.00 | -5988.81 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf71+Lf76 |
| max Q_{η} | -2505.0 | 0.00 | -231.43 | 23.64 | -4894.17 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf71+Lf76+Lf6+0.5*(Lf8+Lf10)+0.2*(Lf12+Lf13+Lf14+...+Lf15+Lf20+Lf21+Lf22) |
| min Q_{ξ} | -2049.5 | 0.00 | -608.27 | -15.66 | -7024.35 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf71+Lf77+0.5*(Lf8+Lf10)+0.2*(Lf12+Lf20+Lf21+...+Lf29) |
| max Q_{ξ} | -2764.8 | 0.00 | 38.40 | 0.00 | -2299.85 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.5*(Lf9+Lf11)+0.2*(Lf13+Lf14+Lf15) |
| min T | -2049.5 | 0.00 | -552.57 | -32.68 | -6042.74 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf71+Lf76+0.2*Lf29 |
| max T | -2505.0 | 0.00 | -220.05 | 59.88 | -4984.67 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf71+Lf76+Lf6+0.5*(Lf8+Lf10)+0.2*(Lf12+Lf13+Lf14+...+Lf15+Lf20+Lf21+Lf31) |
| min M_{η} | -2049.5 | 0.00 | -542.91 | 39.41 | -7281.91 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf71+Lf77+0.5*(Lf8+Lf10)+0.2*(Lf12+Lf20+Lf21+...+Lf33) |
| max M_{η} | -2764.8 | 0.00 | -3.70 | 5.09 | -2205.56 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.5*(Lf9+Lf11)+0.2*(Lf13+Lf14+...+Lf15)+0.2*Lf30 |
| min M_{ξ} | -2049.5 | 0.00 | -478.47 | 0.00 | -5988.81 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf71+Lf76 |
| max M_{ξ} | -2764.8 | 0.00 | -69.70 | 23.64 | -4183.36 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.5*(Lf8+Lf10)+0.2*(Lf12+Lf13+Lf14+...+Lf15+Lf20+Lf21+Lf22) |

Betoneckspannungen der Lastkombinationen

| Typ | σ_1 MN/m ² | σ_2 MN/m ² | σ_3 MN/m ² | σ_4 MN/m ² | Faktorisierung |
|--|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---|
| Extremierung 1: Standardkombination | | | | | |
| min σ_1 | -0.14 | -0.14 | -0.58 | -0.58 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.5*(Lf9+Lf11)+0.2*(Lf13+Lf15)+0.2*Lf30 |
| max σ_1 | 0.44 | 0.44 | -1.30 | -1.30 | Lf1+Lf2+Lf3+0.9*Lf71+Lf77+0.5*(Lf8+Lf10)+0.2*(Lf12+Lf14+Lf20+Lf21+Lf33) |
| min σ_2 | -0.14 | -0.14 | -0.58 | -0.58 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.5*(Lf9+Lf11)+0.2*(Lf13+Lf15)+0.2*Lf30 |
| max σ_2 | 0.44 | 0.44 | -1.30 | -1.30 | Lf1+Lf2+Lf3+0.9*Lf71+Lf77+0.5*(Lf8+Lf10)+0.2*(Lf12+Lf14+Lf20+Lf21+Lf33) |
| min σ_3 | 0.44 | 0.44 | -1.30 | -1.30 | Lf1+Lf2+Lf3+0.9*Lf71+Lf77+0.5*(Lf8+Lf10)+0.2*(Lf12+Lf15+Lf20+Lf21+Lf33) |
| max σ_3 | -0.14 | -0.14 | -0.58 | -0.58 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.5*(Lf9+Lf11)+0.2*(Lf13+Lf14)+0.2*Lf30 |
| min σ_4 | 0.44 | 0.44 | -1.30 | -1.30 | Lf1+Lf2+Lf3+0.9*Lf71+Lf77+0.5*(Lf8+Lf10)+0.2*(Lf12+Lf15+Lf20+Lf21+Lf33) |
| max σ_4 | -0.14 | -0.14 | -0.58 | -0.58 | Lf1+Lf2+Lf3+1.1*Lf72+Lf76+Lf6+0.5*(Lf9+Lf11)+0.2*(Lf13+Lf14)+0.2*Lf30 |

Nachweis der Dekompression

Schwerpunkt Spannstahl: $y_s = 0.0$ cm, $z_s = 35.0$ cm \Rightarrow Rand oben liegt dem Spannstahl am nächsten

| Typ | σ_1 MN/m ² | σ_2 MN/m ² | σ_3 MN/m ² | σ_4 MN/m ² | $\sigma_{c,max}$ MN/m ² |
|--|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------------|
| Extremierung 1: Standardkombination | | | | | |
| min σ_1 | -0.14 | -0.14 | -0.58 | -0.58 | -0.14 \leq 0.00 |
| max σ_1 | +0.44 | +0.44 | -1.30 | -1.30 | +0.44 $>$ 0.00 |
| min σ_2 | -0.14 | -0.14 | -0.58 | -0.58 | -0.14 \leq 0.00 |
| max σ_2 | +0.44 | +0.44 | -1.30 | -1.30 | +0.44 $>$ 0.00 |
| min σ_3 | +0.44 | +0.44 | -1.30 | -1.30 | +0.44 $>$ 0.00 |
| max σ_3 | -0.14 | -0.14 | -0.58 | -0.58 | -0.14 \leq 0.00 |
| min σ_4 | +0.44 | +0.44 | -1.30 | -1.30 | +0.44 $>$ 0.00 |
| max σ_4 | -0.14 | -0.14 | -0.58 | -0.58 | -0.14 \leq 0.00 |

$\sigma_{c,max} = 0.44$ MN/m² $>$ 0 MN/m² \Rightarrow Nachweis der Dekompression nicht erfüllt

Nachweis 5: EC2 Robustheitsbewehrung

Nach EC2, 6.1 (109) und Gl. (6.101a)

Ergebnisse der Lastkombinationen

| Typ | N kN | Q _η kN | Q _ζ kN | T kNm | M _η kNm | M _ζ kNm | Faktorisierung |
|--|--|----------------------|----------------------|----------|-----------------------|-----------------------|---|
| Extremierung 1: Standardkombination | | | | | | | |
| min N | -28.2 | 0.00 | -336.70 | 0.00 | -7325.48 | 0.00 | Lf1+Lf2+Lf3+Lf68+Lf73+0.8*Lf15 |
| max N | 28.2 | -0.00 | -470.88 | 101.32 | -7645.57 | 0.00 | Lf1+Lf2+Lf3+Lf68+Lf73+Lf6+0.6*(Lf8+Lf10)+0.8*(Lf12+Lf13+Lf14).... |
| | ...+0.8*0.5*(Lf16+Lf17+Lf18+Lf19)+0.8*(Lf20+Lf21+Lf22) | | | | | | |
| min Q _η | 0.0 | -7.49 | -336.70 | 0.00 | -7325.48 | 1890.52 | Lf1+Lf2+Lf3+Lf68+Lf73+0.8*0.5*Lf19 |
| max Q _η | 0.0 | 7.49 | -470.88 | 101.32 | -7645.57 | -1890.52 | Lf1+Lf2+Lf3+Lf68+Lf73+Lf6+0.6*(Lf8+Lf10)+0.8*(Lf12+Lf13+Lf14).... |
| | ...+Lf15)+0.8*0.5*(Lf16+Lf17+Lf18)+0.8*(Lf20+Lf21+Lf22) | | | | | | |
| min Q _ζ | 0.0 | 0.00 | -794.07 | -62.65 | -9972.15 | 0.00 | Lf1+Lf2+Lf3+Lf68+Lf74+0.6*(Lf8+Lf10)+0.8*Lf12+0.8*0.5*Lf17..... |
| | ...+0.8*(Lf20+Lf21+Lf29) | | | | | | |
| max Q _ζ | 0.0 | -0.00 | -55.80 | 6.74 | -3644.02 | 0.00 | Lf1+Lf2+Lf3+Lf69+Lf73+Lf6+0.6*(Lf9+Lf11)+0.8*(Lf13+Lf14+Lf15).... |
| | ...+0.8*0.5*(Lf16+Lf18+Lf19) | | | | | | |
| min T | 0.0 | 0.00 | -633.10 | -130.72 | -7541.19 | 0.00 | Lf1+Lf2+Lf3+Lf68+Lf73+0.8*Lf29 |
| max T | 0.0 | -0.00 | -425.37 | 246.24 | -8007.57 | 0.00 | Lf1+Lf2+Lf3+Lf68+Lf73+Lf6+0.6*(Lf8+Lf10)+0.8*(Lf12+Lf13+Lf14).... |
| | ...+Lf15)+0.8*0.5*(Lf16+Lf17+Lf18+Lf19)+0.8*(Lf20+Lf21+Lf31) | | | | | | |
| min M _η | 0.0 | 0.00 | -532.64 | 157.65 | -11002.39 | 0.00 | Lf1+Lf2+Lf3+Lf68+Lf74+0.6*(Lf8+Lf10)+0.8*Lf12+0.8*0.5*Lf17..... |
| | ...+0.8*(Lf20+Lf21+Lf33) | | | | | | |
| max M _η | 0.0 | -0.00 | -224.19 | 27.09 | -3266.85 | 0.00 | Lf1+Lf2+Lf3+Lf69+Lf73+Lf6+0.6*(Lf9+Lf11)+0.8*(Lf13+Lf14+Lf15).... |
| | ...+0.8*0.5*(Lf16+Lf18+Lf19)+0.8*Lf30 | | | | | | |
| min M _ζ | 0.0 | 7.49 | -336.70 | 6.74 | -7325.48 | -1890.52 | Lf1+Lf2+Lf3+Lf68+Lf73+0.8*0.5*Lf18 |
| max M _ζ | 0.0 | -7.49 | -470.88 | 94.58 | -7645.57 | 1890.52 | Lf1+Lf2+Lf3+Lf68+Lf73+Lf6+0.6*(Lf8+Lf10)+0.8*(Lf12+Lf13+Lf14).... |
| | ...+Lf15)+0.8*0.5*(Lf16+Lf17+Lf19)+0.8*(Lf20+Lf21+Lf22) | | | | | | |

Betoneckspannungen der Lastkombinationen

| Typ | σ ₁ MN/m ² | σ ₂ MN/m ² | σ ₃ MN/m ² | σ ₄ MN/m ² | Faktorisierung |
|--|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|---|
| Extremierung 1: Standardkombination | | | | | |
| min σ ₁ | 0.13 | 0.44 | -0.40 | -0.52 | Lf1+Lf2+Lf3+Lf69+Lf73+Lf6+0.6*(Lf9+Lf11)+0.8*(Lf13+Lf15)+0.8*0.5*(Lf16+Lf19)+0.8*Lf30 |
| max σ ₁ | 1.19 | 0.88 | -1.71 | -1.60 | Lf1+Lf2+Lf3+Lf68+Lf74+0.6*(Lf8+Lf10)+0.8*(Lf12+Lf14)+0.8*0.5*(Lf17+Lf18)+0.8*(Lf20).... |
| | ...+Lf21+Lf33) | | | | |
| min σ ₂ | 0.44 | 0.13 | -0.52 | -0.40 | Lf1+Lf2+Lf3+Lf69+Lf73+Lf6+0.6*(Lf9+Lf11)+0.8*(Lf13+Lf15)+0.8*0.5*(Lf16+Lf18)+0.8*Lf30 |
| max σ ₂ | 0.88 | 1.19 | -1.60 | -1.71 | Lf1+Lf2+Lf3+Lf68+Lf74+0.6*(Lf8+Lf10)+0.8*(Lf12+Lf14)+0.8*0.5*(Lf17+Lf19)+0.8*(Lf20).... |
| | ...+Lf21+Lf33) | | | | |
| min σ ₃ | 1.19 | 0.88 | -1.72 | -1.60 | Lf1+Lf2+Lf3+Lf68+Lf74+0.6*(Lf8+Lf10)+0.8*(Lf12+Lf15)+0.8*0.5*(Lf17+Lf18)+0.8*(Lf20).... |
| | ...+Lf21+Lf33) | | | | |
| max σ ₃ | 0.13 | 0.44 | -0.40 | -0.52 | Lf1+Lf2+Lf3+Lf69+Lf73+Lf6+0.6*(Lf9+Lf11)+0.8*(Lf13+Lf14)+0.8*0.5*(Lf16+Lf19)+0.8*Lf30 |
| min σ ₄ | 0.88 | 1.19 | -1.60 | -1.72 | Lf1+Lf2+Lf3+Lf68+Lf74+0.6*(Lf8+Lf10)+0.8*(Lf12+Lf15)+0.8*0.5*(Lf17+Lf19)+0.8*(Lf20).... |
| | ...+Lf21+Lf33) | | | | |
| max σ ₄ | 0.44 | 0.13 | -0.52 | -0.40 | Lf1+Lf2+Lf3+Lf69+Lf73+Lf6+0.6*(Lf9+Lf11)+0.8*(Lf13+Lf14)+0.8*0.5*(Lf16+Lf18)+0.8*Lf30 |

Nachweis der Robustheitsbewehrung

σ_{nH,P'} = Spannung am Mittelpunkt des Randes unter nicht häufiger Einwirkungskombination und P'

| Typ | Rand | σ ₁ MN/m ² | σ _{i+1} MN/m ² | σ _{nH,P'} MN/m ² | zul σ MN/m ² | Z _s cm | f _{ctk0,05} MN/m ² | M _{r,ep} MNm | erf A _s cm ² | vorh A _s cm ² |
|--|-------|-------------------------------------|---------------------------------------|---|----------------------------|----------------------|---|--------------------------|---------------------------------------|--|
| Extremierung 1: Standardkombination | | | | | | | | | | |
| min σ ₁ | oben | 0.20 | 0.37 | 0.28 | > 0.0 | 275.4 | 2.03 | 19.488 | 141.52 | > 13.19 |
| min σ ₁ | unten | -0.40 | -0.52 | -0.46 | ≤ 0.0 | ⇒ Nachweis erfüllt | | | | |
| max σ ₁ | oben | 1.13 | 0.96 | 1.05 | > 0.0 | 275.4 | 2.03 | 19.488 | 141.52 | > 13.19 |
| max σ ₁ | unten | -1.71 | -1.60 | -1.66 | ≤ 0.0 | ⇒ Nachweis erfüllt | | | | |
| min σ ₂ | oben | 0.37 | 0.20 | 0.28 | > 0.0 | 275.4 | 2.03 | 19.488 | 141.52 | > 13.19 |
| min σ ₂ | unten | -0.52 | -0.40 | -0.46 | ≤ 0.0 | ⇒ Nachweis erfüllt | | | | |
| max σ ₂ | oben | 0.96 | 1.13 | 1.05 | > 0.0 | 275.4 | 2.03 | 19.488 | 141.52 | > 13.19 |
| max σ ₂ | unten | -1.60 | -1.71 | -1.66 | ≤ 0.0 | ⇒ Nachweis erfüllt | | | | |
| min σ ₃ | oben | 1.13 | 0.96 | 1.04 | > 0.0 | 275.4 | 2.03 | 19.488 | 141.52 | > 13.19 |
| min σ ₃ | unten | -1.72 | -1.60 | -1.66 | ≤ 0.0 | ⇒ Nachweis erfüllt | | | | |
| max σ ₃ | oben | 0.21 | 0.37 | 0.29 | > 0.0 | 275.4 | 2.03 | 19.488 | 141.52 | > 13.19 |
| max σ ₃ | unten | -0.40 | -0.52 | -0.46 | ≤ 0.0 | ⇒ Nachweis erfüllt | | | | |
| min σ ₄ | oben | 0.96 | 1.13 | 1.04 | > 0.0 | 275.4 | 2.03 | 19.488 | 141.52 | > 13.19 |
| min σ ₄ | unten | -1.60 | -1.72 | -1.66 | ≤ 0.0 | ⇒ Nachweis erfüllt | | | | |
| max σ ₄ | oben | 0.37 | 0.21 | 0.29 | > 0.0 | 275.4 | 2.03 | 19.488 | 141.52 | > 13.19 |
| max σ ₄ | unten | -0.52 | -0.40 | -0.46 | ≤ 0.0 | ⇒ Nachweis erfüllt | | | | |

vorh A_s = 13.19 cm² < erf A_s = 141.52 cm² ⇒ **Nachweis der Robustheitsbewehrung nicht erfüllt!**

Nachweis 6: EC2 Tragfähigkeit Schub S/V

Nach EC2 6.2, Ständige und vorübergehende Situation gemäß EC0 6.4.3.2 (6.10) a), mit γ_c = 1.50 und γ_s = 1.15



Ergebnisse der Lastkombinationen

| Typ | N kN | Q _η kN | Q _ξ kN | T kNm | M _η kNm | M _ξ kNm | Faktorisierung |
|--|---------|----------------------|----------------------|----------|-----------------------|-----------------------|---|
| Extremierung 1: Standardkombination | | | | | | | |
| min N | -2561.1 | 0.00 | -189.67 | 0.00 | -4719.48 | 0.00 | Lf1+Lf2+Lf3+Lf72+Lf76+1.35*Lf15 |
| max N | -2229.6 | -0.00 | -1210.73 | 172.23 | -10776.21 | 0.00 | 1.35*(Lf1+Lf2+Lf3)+Lf71+Lf76+0.81*Lf7+0.8*0.81*(Lf8+Lf10)..... |
| min Q _η | -2277.3 | -14.05 | -336.70 | 0.00 | -5365.67 | 3544.73 | Lf1+Lf2+Lf3+Lf71+Lf76+0.75*Lf19 |
| max Q _η | -2277.3 | 14.05 | -1210.73 | 172.23 | -10776.21 | -3544.73 | 1.35*(Lf1+Lf2+Lf3)+Lf71+Lf76+0.81*Lf7+0.8*0.81*(Lf8+Lf10)..... |
| min Q _ξ | -2277.3 | 0.00 | -1712.29 | -105.72 | -13642.38 | 0.00 | 1.35*(Lf1+Lf2+Lf3)+Lf71+Lf77+0.81*Lf7+0.8*0.81*(Lf8+Lf10)..... |
| max Q _ξ | -2513.4 | -0.00 | -34.40 | 12.64 | -963.22 | 0.00 | Lf1+Lf2+Lf3+Lf72+Lf76+0.8*0.81*(Lf9+Lf11)+1.35*(Lf13+Lf14+Lf15).. |
| min T | -2277.3 | 0.00 | -836.87 | -220.59 | -5729.68 | 0.00 | Lf1+Lf2+Lf3+Lf71+Lf76+1.35*Lf29 |
| max T | -2277.3 | -0.00 | -1133.94 | 416.80 | -11387.09 | 0.00 | 1.35*(Lf1+Lf2+Lf3)+Lf71+Lf76+0.81*Lf7+0.8*0.81*(Lf8+Lf10)..... |
| min M _η | -2277.3 | 0.00 | -1271.13 | 266.03 | -15380.91 | 0.00 | 1.35*(Lf1+Lf2+Lf3)+Lf71+Lf77+0.81*Lf7+0.8*0.81*(Lf8+Lf10)..... |
| max M _η | -2513.4 | -0.00 | -318.56 | 46.98 | -326.75 | 0.00 | Lf1+Lf2+Lf3+Lf72+Lf76+0.8*0.81*(Lf9+Lf11)+1.35*(Lf13+Lf14+Lf15).. |
| min M _ξ | -2277.3 | 14.05 | -336.70 | 12.64 | -5365.67 | -3544.73 | Lf1+Lf2+Lf3+Lf71+Lf76+0.75*Lf18 |
| max M _ξ | -2513.4 | -14.05 | -1063.71 | 159.60 | -10130.02 | 3544.73 | 1.35*(Lf1+Lf2+Lf3)+Lf72+Lf76+0.81*Lf7+0.8*0.81*(Lf8+Lf10)..... |

Betoneckspannungen der Lastkombinationen

| Typ | σ ₁ MN/m ² | σ ₂ MN/m ² | σ ₃ MN/m ² | σ ₄ MN/m ² | Faktorisierung |
|--|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|---|
| Extremierung 1: Standardkombination | | | | | |
| min σ ₁ | -0.59 | -0.01 | -0.16 | -0.38 | Lf1+Lf2+Lf3+Lf72+Lf76+0.8*0.81*(Lf9+Lf11)+1.35*(Lf13+Lf15)+0.75*(Lf16+Lf19)+1.35*Lf30 |
| max σ ₁ | 1.49 | 0.91 | -2.67 | -2.45 | 1.35*(Lf1+Lf2+Lf3)+Lf71+Lf77+0.81*Lf7+0.8*0.81*(Lf8+Lf10)+1.35*(Lf12+Lf14)+0.75*(Lf17.. |
| min σ ₂ | -0.01 | -0.59 | -0.38 | -0.16 | Lf1+Lf2+Lf3+Lf72+Lf76+0.8*0.81*(Lf9+Lf11)+1.35*(Lf13+Lf15)+0.75*(Lf16+Lf18)+1.35*Lf30 |
| max σ ₂ | 0.91 | 1.49 | -2.45 | -2.67 | 1.35*(Lf1+Lf2+Lf3)+Lf71+Lf77+0.81*Lf7+0.8*0.81*(Lf8+Lf10)+1.35*(Lf12+Lf14)+0.75*(Lf17.. |
| min σ ₃ | 1.48 | 0.90 | -2.68 | -2.46 | 1.35*(Lf1+Lf2+Lf3)+Lf71+Lf77+0.81*Lf7+0.8*0.81*(Lf8+Lf10)+1.35*(Lf12+Lf15)+0.75*(Lf17.. |
| max σ ₃ | -0.58 | 0.00 | -0.15 | -0.37 | Lf1+Lf2+Lf3+Lf72+Lf76+0.8*0.81*(Lf9+Lf11)+1.35*(Lf13+Lf14)+0.75*(Lf16+Lf19)+1.35*Lf30 |
| min σ ₄ | 0.90 | 1.48 | -2.46 | -2.68 | 1.35*(Lf1+Lf2+Lf3)+Lf71+Lf77+0.81*Lf7+0.8*0.81*(Lf8+Lf10)+1.35*(Lf12+Lf15)+0.75*(Lf17.. |
| max σ ₄ | 0.00 | -0.58 | -0.37 | -0.15 | Lf1+Lf2+Lf3+Lf72+Lf76+0.8*0.81*(Lf9+Lf11)+1.35*(Lf13+Lf14)+0.75*(Lf16+Lf18)+1.35*Lf30 |

Nachweis der Tragsicherheit für Querkraft und Torsion linker Steg

nom_c = 4.5 ⇒ z = 0.90 d = 275.4 cm, Mindestquerkräftbewehrung gemäß EC2, 6.2.1(4)

| Typ | d cm | hbz cm | bw cm | ρ _l x 100 | V _{red} kN | V _{rd,ct} kN | erf asbQ cm ² /m | T _{Ed} kNm | erf asbT cm ² /m | erf A _{sl} cm ² | NA.6.29.1 - | Σ asb cm ² /m | θ |
|--|---------|-----------|----------|-------------------------|--------------------------|--------------------------|--------------------------------|------------------------|--------------------------------|--|----------------|-----------------------------|------|
| Extremierung 1: Standardkombination | | | | | | | | | | | | | |
| min N | 306.0 | 98.2 | 62.8 | 0.2526 | 189.7 ≤ | 465.4 | 6.25 | 172.2 | 0.12 | 5.21 | 0.08 ≤ 1 | 6.25 | 30.0 |
| max N | 306.0 | 223.2 | 59.4 | 0.5249 | 1210.7 > | 449.4 | 6.25 | 172.2 | 0.12 | 5.21 | 0.08 ≤ 1 | 6.37 | 30.0 |
| min Q _η | 306.0 | 180.1 | 60.5 | 0.4725 | 337.3 ≤ | 458.8 | 6.25 | 172.2 | 0.12 | 5.21 | 0.08 ≤ 1 | 6.37 | 30.0 |
| max Q _η | 306.0 | 217.0 | 59.5 | 0.4029 | 1210.9 > | 455.0 | 6.25 | 105.7 | 0.07 | 3.20 | 0.10 ≤ 1 | 6.32 | 30.0 |
| min Q _ξ | 306.0 | 240.4 | 58.9 | 0.5761 | 1712.3 > | 444.6 | 6.25 | 12.6 | 0.01 | 0.38 | 0.00 ≤ 1 | 6.25 | 30.0 |
| max Q _ξ | 306.0 | 0.0 | 65.4 | 0.0659 | 34.4 ≤ | 451.9 | 6.25 | 220.6 | 0.15 | 6.67 | 0.04 ≤ 1 | 6.40 | 30.0 |
| min T | 306.0 | 129.1 | 62.0 | 0.3068 | 836.9 > | 463.5 | 6.25 | 416.8 | 0.29 | 12.60 | 0.08 ≤ 1 | 6.54 | 30.0 |
| max T | 306.0 | 226.5 | 59.3 | 0.5343 | 1133.9 > | 449.2 | 6.25 | 266.0 | 0.19 | 8.04 | 0.08 ≤ 1 | 6.43 | 30.0 |
| min M _η | 306.0 | 247.0 | 58.7 | 0.5970 | 1271.1 > | 442.2 | 6.25 | 47.0 | 0.03 | 1.42 | 0.02 ≤ 1 | 6.28 | 30.0 |
| max M _η | 306.0 | 0.0 | 65.4 | 0.0659 | 318.6 ≤ | 451.9 | 6.25 | 12.6 | 0.01 | 0.38 | 0.02 ≤ 1 | 6.25 | 30.0 |
| min M _ξ | 306.0 | 180.1 | 60.5 | 0.2078 | 337.3 ≤ | 430.5 | 6.25 | 159.6 | 0.11 | 4.83 | 0.07 ≤ 1 | 6.36 | 30.0 |
| max M _ξ | 306.0 | 208.5 | 59.8 | 0.5700 | 1063.9 > | 453.0 | 6.25 | | | | | | |

V_{red,max} = 856.1 kN ≤ V_{rd,max} = 8679.9 kN ⇒ Querkrafttragf. ständige u. vorüberg. Situation erfüllt
 T_{Ed,max} = 416.8 kN ≤ T_{rd,max} = 31991.9 kN ⇒ Torsionstragf. ständige u. vorüberg. Situation erfüllt
 max (NA.6.29.1) = 0.10 ≤ 1 ⇒ Nachweis nach Gleichung NA.6.29.1 ständige u. vorüberg. Situation erfüllt

Druckstrebenneigung θ = 30°, Schubdügelneigung β = 90°, Mindestschubbewehrung min asbQ = 6.25 cm²/m
 ⇒ Bügelbew. erf asb = 6.54 cm²/m (3.27 cm²/m je Stegseite), Längsbew. erf A_{s1T} = 12.60 cm²

Nachweis der Tragsicherheit für Querkraft und Torsion rechter Steg

nom_c = 4.5 ⇒ z = 0.90 d = 275.4 cm, Mindestquerkräftbewehrung gemäß EC2, 6.2.1(4)

| Typ | d cm | hbz cm | bw cm | ρ _l x 100 | V _{red} kN | V _{rd,ct} kN | erf asbQ cm ² /m | T _{Ed} kNm | erf asbT cm ² /m | erf A _{sl} cm ² | NA.6.29.1 - | Σ asb cm ² /m | θ |
|--------------------|---------|-----------|----------|-------------------------|--------------------------|--------------------------|--------------------------------|------------------------|--------------------------------|--|----------------|-----------------------------|------|
| ° | | | | | | | | | | | | | |
| min N | 306.0 | 98.2 | 62.8 | 0.1612 | 189.7 ≤ | 418.7 | 6.25 | 172.2 | 0.12 | 5.21 | 0.08 ≤ 1 | 6.37 | 30.0 |
| max N | 306.0 | 223.2 | 59.4 | 0.7120 | 1210.7 > | 428.9 | 6.25 | 172.2 | 0.12 | 5.21 | 0.08 ≤ 1 | 6.37 | 30.0 |
| min Q _η | 306.0 | 180.1 | 60.5 | 0.1393 | 337.3 ≤ | 393.2 | 6.25 | 105.7 | 0.07 | 3.20 | 0.10 ≤ 1 | 6.32 | 30.0 |
| max Q _η | 306.0 | 217.0 | 59.5 | 0.9234 | 1210.9 > | 422.4 | 6.25 | 12.6 | 0.01 | 0.38 | 0.00 ≤ 1 | 6.25 | 30.0 |
| min Q _ξ | 306.0 | 240.4 | 58.9 | 0.8231 | 1712.3 > | 423.8 | 6.25 | 220.6 | 0.15 | 6.67 | 0.04 ≤ 1 | 6.40 | 30.0 |
| max Q _ξ | 306.0 | 0.0 | 65.4 | 0.0659 | 34.4 ≤ | 451.9 | 6.25 | 416.8 | 0.29 | 12.60 | 0.08 ≤ 1 | 6.54 | 30.0 |
| min T | 306.0 | 129.1 | 62.0 | 0.2655 | 836.9 > | 429.6 | 6.25 | 266.0 | 0.19 | 8.04 | 0.08 ≤ 1 | 6.43 | 30.0 |
| max T | 306.0 | 226.5 | 59.3 | 0.7323 | 1133.9 > | 428.6 | 6.25 | 47.0 | 0.03 | 1.42 | 0.02 ≤ 1 | 6.28 | 30.0 |

Nachweis der Tragsicherheit für Querkraft und Torsion rechter Steg
 $nom_c = 4.5 \Rightarrow z = 0.90 \text{ d} = 275.4 \text{ cm}$, Mindestquerkraftbewehrung gemäß EC2, 6.2.1(4)

| Typ | d cm | hbz cm | b _w cm | ρ _l x 100 | V _{red} kN | V _{rd,ct} kN | erf a _{sbQ} cm ² /m | T _{Ed} kNm | erf a _{sbT} cm ² /m | erf A _{sl} cm ² | NA.6.29.1 - | Σ a _{sb} cm ² /m | θ |
|--------------------|---------|-----------|----------------------|-------------------------|--------------------------|--------------------------|--|------------------------|--|--|----------------|---|------|
| min M _η | 306.0 | 247.0 | 58.7 | 0.8692 | 1271.1 > | 421.3 | 6.25 | 266.0 | 0.19 | 8.04 | 0.08 ≤ 1 | 6.43 | 30.0 |
| max M _η | 306.0 | 0.0 | 65.4 | 0.0659 | 318.6 ≤ | 451.9 | 6.25 | 47.0 | 0.03 | 1.42 | 0.02 ≤ 1 | 6.28 | 30.0 |
| min M _ξ | 306.0 | 180.1 | 60.5 | 0.6379 | 337.3 ≤ | 436.7 | 6.25 | 12.6 | 0.01 | 0.38 | 0.02 ≤ 1 | 6.25 | 30.0 |
| max M _ξ | 306.0 | 208.5 | 59.8 | 0.3610 | 1063.9 > | 431.9 | 6.25 | 159.6 | 0.11 | 4.83 | 0.07 ≤ 1 | 6.36 | 30.0 |

V_{red,max} = 856.1 kN ≤ V_{rd,max} = 8679.9 kN ⇒ Querkrafttragf. ständige u. vorüberg. Situation erfüllt
T_{Ed,max} = 416.8 kN ≤ T_{rd,max} = 31991.9 kN ⇒ Torsionstragf. ständige u. vorüberg. Situation erfüllt
max (NA.6.29.1) = 0.10 ≤ 1 ⇒ Nachweis nach Gleichung NA.6.29.1 ständige u. vorüberg. Situation erfüllt

Druckstrebenneigung θ = 30°, Schubbugelneigung β = 90°, Mindestschubbewehrung min a_{sbQ} = 6.25 cm²/m
⇒ Bügelbew. erf a_{sb} = 6.54 cm²/m (3.27 cm²/m je Stegseite), Längsbew. erf A_{s1T} = 12.60 cm²

Nachweis 7: EC2 Betondruck- u. Betonstahlspannungen

Nach EC2, 7.2 unter seltener Einwirkungskombination mit 1,0 x P

Ergebnisse der Lastkombinationen

| Typ | N kN | Q _η kN | Q _ξ kN | T kNm | M _η kNm | M _ξ kNm | Faktorisierung |
|--|--|----------------------|----------------------|----------|-----------------------|-----------------------|---|
| Extremierung 1: Standardkombination | | | | | | | |
| min N | -2548.7 | 0.00 | -189.67 | 0.00 | -4719.48 | 0.00 | Lf1+Lf2+Lf3+Lf72+Lf76+Lf15 |
| max N | -2242.0 | 0.00 | -515.09 | 126.65 | -6023.73 | 0.00 | Lf1+Lf2+Lf3+Lf71+Lf76+Lf6+0.8*(Lf8+Lf10)+Lf12+Lf13+Lf14+..... |
| | ...+0.5*(Lf16+Lf17+Lf18+Lf19)+Lf20+Lf21+Lf22 | | | | | | |
| min Q _η | -2277.3 | -9.37 | -336.70 | 0.00 | -5365.67 | 2363.16 | Lf1+Lf2+Lf3+Lf71+Lf76+0.5*Lf19 |
| max Q _η | -2277.3 | 9.37 | -515.09 | 126.65 | -6023.73 | -2363.16 | Lf1+Lf2+Lf3+Lf71+Lf76+Lf6+0.8*(Lf8+Lf10)+Lf12+Lf13+Lf14+Lf15+.... |
| | ...+0.5*(Lf16+Lf17+Lf18)+Lf20+Lf21+Lf22 | | | | | | |
| min Q _ξ | -2277.3 | 0.00 | -911.12 | -78.31 | -8739.42 | 0.00 | Lf1+Lf2+Lf3+Lf71+Lf77+0.8*(Lf8+Lf10)+Lf12+0.5*Lf17+Lf20+Lf21+Lf29 |
| max Q _ξ | -2513.4 | 0.00 | -26.14 | 8.43 | -763.48 | 0.00 | Lf1+Lf2+Lf3+Lf72+Lf76+Lf6+0.8*(Lf9+Lf11)+Lf13+Lf14+Lf15+..... |
| | ...+0.5*(Lf16+Lf18+Lf19) | | | | | | |
| min T | -2277.3 | 0.00 | -707.20 | -163.40 | -5635.31 | 0.00 | Lf1+Lf2+Lf3+Lf71+Lf76+Lf29 |
| max T | -2277.3 | 0.00 | -458.21 | 307.81 | -6476.23 | 0.00 | Lf1+Lf2+Lf3+Lf71+Lf76+Lf6+0.8*(Lf8+Lf10)+Lf12+Lf13+Lf14+Lf15+.... |
| | ...+0.5*(Lf16+Lf17+Lf18+Lf19)+Lf20+Lf21+Lf31 | | | | | | |
| min M _η | -2277.3 | 0.00 | -584.33 | 197.06 | -10027.22 | 0.00 | Lf1+Lf2+Lf3+Lf71+Lf77+0.8*(Lf8+Lf10)+Lf12+0.5*Lf17+Lf20+Lf21+Lf33 |
| max M _η | -2513.4 | 0.00 | -236.63 | 33.87 | -292.02 | 0.00 | Lf1+Lf2+Lf3+Lf72+Lf76+Lf6+0.8*(Lf9+Lf11)+Lf13+Lf14+Lf15+..... |
| | ...+0.5*(Lf16+Lf18+Lf19)+Lf30 | | | | | | |
| min M _ξ | -2277.3 | 9.37 | -336.70 | 8.43 | -5365.67 | -2363.16 | Lf1+Lf2+Lf3+Lf71+Lf76+0.5*Lf18 |
| max M _ξ | -2513.4 | -9.37 | -368.07 | 118.22 | -5377.53 | 2363.16 | Lf1+Lf2+Lf3+Lf72+Lf76+Lf6+0.8*(Lf8+Lf10)+Lf12+Lf13+Lf14+Lf15+.... |
| | ...+0.5*(Lf16+Lf17+Lf19)+Lf20+Lf21+Lf22 | | | | | | |

Betoneckspannungen der Lastkombinationen

| Typ | σ ₁ MN/m ² | σ ₂ MN/m ² | σ ₃ MN/m ² | σ ₄ MN/m ² | Faktorisierung |
|--|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|---|
| Extremierung 1: Standardkombination | | | | | |
| min σ ₁ | -0.49 | -0.10 | -0.19 | -0.34 | Lf1+Lf2+Lf3+Lf72+Lf76+Lf6+0.8*(Lf9+Lf11)+Lf13+Lf15+0.5*(Lf16+Lf19)+Lf30 |
| max σ ₁ | 0.87 | 0.49 | -1.81 | -1.66 | Lf1+Lf2+Lf3+Lf71+Lf77+0.8*(Lf8+Lf10)+Lf12+Lf14+0.5*(Lf17+Lf18)+Lf20+Lf21+Lf33 |
| min σ ₂ | -0.10 | -0.49 | -0.34 | -0.19 | Lf1+Lf2+Lf3+Lf72+Lf76+Lf6+0.8*(Lf9+Lf11)+Lf13+Lf15+0.5*(Lf16+Lf18)+Lf30 |
| max σ ₂ | 0.49 | 0.87 | -1.66 | -1.81 | Lf1+Lf2+Lf3+Lf71+Lf77+0.8*(Lf8+Lf10)+Lf12+Lf14+0.5*(Lf17+Lf19)+Lf20+Lf21+Lf33 |
| min σ ₃ | 0.87 | 0.48 | -1.82 | -1.67 | Lf1+Lf2+Lf3+Lf71+Lf77+0.8*(Lf8+Lf10)+Lf12+Lf15+0.5*(Lf17+Lf18)+Lf20+Lf21+Lf33 |
| max σ ₃ | -0.48 | -0.10 | -0.18 | -0.33 | Lf1+Lf2+Lf3+Lf72+Lf76+Lf6+0.8*(Lf9+Lf11)+Lf13+Lf14+0.5*(Lf16+Lf19)+Lf30 |
| min σ ₄ | 0.48 | 0.87 | -1.67 | -1.82 | Lf1+Lf2+Lf3+Lf71+Lf77+0.8*(Lf8+Lf10)+Lf12+Lf15+0.5*(Lf17+Lf19)+Lf20+Lf21+Lf33 |
| max σ ₄ | -0.10 | -0.48 | -0.33 | -0.18 | Lf1+Lf2+Lf3+Lf72+Lf76+Lf6+0.8*(Lf9+Lf11)+Lf13+Lf14+0.5*(Lf16+Lf18)+Lf30 |

Betondruck- u. Betonstahlspannungen in Zustand II mit 0.60 x f_{ck} = 18.0 MN/m², 0.80 x f_{yk} = 400.0 MN/m²
Aus seltener Einwirkungskombination: σ_{max} = 0.96 MN/m² ≤ f_{ctm} = 2.9 MN/m² ⇒ Querschnitt ist in Zustand I

| Typ | σ ₁ MN/m ² | σ ₂ MN/m ² | σ ₃ MN/m ² | σ ₄ MN/m ² | σ _{min} MN/m ² | | | | |
|--|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|---------------------------------------|---------------|----|-------------|----|
| Extremierung 1: Standardkombination | | | | | | | | | |
| min σ ₁ | -0.49 | -0.10 | -0.19 | -0.34 | -0.49 ≥ -18.0 | -3.46 ≥ -400 | 17 | -0.74 ≤ 400 | 6 |
| max σ ₁ | 0.87 | 0.49 | -1.81 | -1.66 | -1.81 ≥ -18.0 | -12.52 ≥ -400 | 9 | 5.89 ≤ 400 | 16 |
| min σ ₂ | -0.10 | -0.49 | -0.34 | -0.19 | -0.49 ≥ -18.0 | -3.46 ≥ -400 | 5 | -0.74 ≤ 400 | 16 |
| max σ ₂ | 0.49 | 0.87 | -1.66 | -1.81 | -1.81 ≥ -18.0 | -12.52 ≥ -400 | 11 | 5.89 ≤ 400 | 4 |
| min σ ₃ | 0.87 | 0.48 | -1.82 | -1.67 | -1.82 ≥ -18.0 | -12.57 ≥ -400 | 9 | 5.84 ≤ 400 | 16 |
| max σ ₃ | -0.48 | -0.10 | -0.18 | -0.33 | -0.48 ≥ -18.0 | -3.41 ≥ -400 | 17 | -0.69 ≤ 400 | 6 |
| min σ ₄ | 0.48 | 0.87 | -1.67 | -1.82 | -1.82 ≥ -18.0 | -12.57 ≥ -400 | 11 | 5.84 ≤ 400 | 4 |
| max σ ₄ | -0.10 | -0.48 | -0.33 | -0.18 | -0.48 ≥ -18.0 | -3.41 ≥ -400 | 5 | -0.69 ≤ 400 | 16 |

σ_{c,min} = -1.82 MN/m² ≥ f_c = -18.0 MN/m² ⇒ Nachweis der zulässigen Betondruckspannungen erfüllt
|σ_{s,max}| = 12.57 MN/m² ≤ f_{yk} = 400.0 MN/m² ⇒ Nachweis der zulässigen Betonstahlspannungen erfüllt

Nachweis 8: EC2 Spannstahlspannungen

Nach EC2 7.2 (5) unter quasi-ständiger Einwirkungskombination mit 1,0 x P

Ergebnisse der Lastkombinationen

| Typ | N kN | Q _η kN | Q _ζ kN | T kNm | M _η kNm | M _ζ kNm | Faktorisierung |
|--|---------|----------------------|----------------------|----------|-----------------------|-----------------------|--|
| Extremierung 1: Standardkombination | | | | | | | |
| min N | -7.1 | 0.00 | -373.38 | 0.00 | -2618.47 | 0.00 | Lf2+Lf3+Lf73+0.2*Lf15 |
| max N | 7.1 | 0.00 | -409.88 | 23.64 | -2770.11 | 0.00 | Lf2+Lf3+Lf73+Lf6+0.5*(Lf8+Lf10)+0.2*(Lf12+Lf13+Lf14+Lf20+Lf21+...+Lf22) |
| min Q _η | 0.0 | 0.00 | -373.38 | 0.00 | -2618.47 | 0.00 | Lf2+Lf3+Lf73 |
| max Q _η | 0.0 | 0.00 | -409.88 | 23.64 | -2770.11 | 0.00 | Lf2+Lf3+Lf73+Lf6+0.5*(Lf8+Lf10)+0.2*(Lf12+Lf13+Lf14+Lf15+Lf20+...+Lf21+Lf22) |
| min Q _ζ | 0.0 | 0.00 | -503.18 | -15.66 | -3654.01 | 0.00 | Lf2+Lf3+Lf74+0.5*(Lf8+Lf10)+0.2*(Lf12+Lf20+Lf21+Lf29) |
| max Q _ζ | 0.0 | 0.00 | -301.78 | 0.00 | -886.60 | 0.00 | Lf2+Lf3+Lf73+Lf6+0.5*(Lf9+Lf11)+0.2*(Lf13+Lf14+Lf15) |
| min T | 0.0 | 0.00 | -447.48 | -32.68 | -2672.40 | 0.00 | Lf2+Lf3+Lf73+0.2*Lf29 |
| max T | 0.0 | 0.00 | -398.51 | 59.88 | -2860.61 | 0.00 | Lf2+Lf3+Lf73+Lf6+0.5*(Lf8+Lf10)+0.2*(Lf12+Lf13+Lf14+Lf15+Lf20+...+Lf21+Lf31) |
| min M _η | 0.0 | 0.00 | -437.82 | 39.41 | -3911.57 | 0.00 | Lf2+Lf3+Lf74+0.5*(Lf8+Lf10)+0.2*(Lf12+Lf20+Lf21+Lf33) |
| max M _η | 0.0 | 0.00 | -343.88 | 5.09 | -792.31 | 0.00 | Lf2+Lf3+Lf73+Lf6+0.5*(Lf9+Lf11)+0.2*(Lf13+Lf14+Lf15)+0.2*Lf30 |
| min M _ζ | 0.0 | 0.00 | -373.38 | 0.00 | -2618.47 | 0.00 | Lf2+Lf3+Lf73 |
| max M _ζ | 0.0 | 0.00 | -409.88 | 23.64 | -2770.11 | 0.00 | Lf2+Lf3+Lf73+Lf6+0.5*(Lf8+Lf10)+0.2*(Lf12+Lf13+Lf14+Lf15+Lf20+...+Lf21+Lf22) |

Betoneckspannungen der Lastkombinationen

| Typ | σ ₁ MN/m ² | σ ₂ MN/m ² | σ ₃ MN/m ² | σ ₄ MN/m ² | Faktorisierung |
|--|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--|
| Extremierung 1: Standardkombination | | | | | |
| min σ ₁ | 0.08 | 0.08 | -0.12 | -0.12 | Lf2+Lf3+Lf73+Lf6+0.5*(Lf9+Lf11)+0.2*(Lf13+Lf15)+0.2*Lf30 |
| max σ ₁ | 0.38 | 0.38 | -0.60 | -0.60 | Lf2+Lf3+Lf74+0.5*(Lf8+Lf10)+0.2*(Lf12+Lf14+Lf20+Lf21+Lf33) |
| min σ ₂ | 0.08 | 0.08 | -0.12 | -0.12 | Lf2+Lf3+Lf73+Lf6+0.5*(Lf9+Lf11)+0.2*(Lf13+Lf15)+0.2*Lf30 |
| max σ ₂ | 0.38 | 0.38 | -0.60 | -0.60 | Lf2+Lf3+Lf74+0.5*(Lf8+Lf10)+0.2*(Lf12+Lf14+Lf20+Lf21+Lf33) |
| min σ ₃ | 0.38 | 0.38 | -0.60 | -0.60 | Lf2+Lf3+Lf74+0.5*(Lf8+Lf10)+0.2*(Lf12+Lf15+Lf20+Lf21+Lf33) |
| max σ ₃ | 0.08 | 0.08 | -0.12 | -0.12 | Lf2+Lf3+Lf73+Lf6+0.5*(Lf9+Lf11)+0.2*(Lf13+Lf14)+0.2*Lf30 |
| min σ ₄ | 0.38 | 0.38 | -0.60 | -0.60 | Lf2+Lf3+Lf74+0.5*(Lf8+Lf10)+0.2*(Lf12+Lf15+Lf20+Lf21+Lf33) |
| max σ ₄ | 0.08 | 0.08 | -0.12 | -0.12 | Lf2+Lf3+Lf73+Lf6+0.5*(Lf9+Lf11)+0.2*(Lf13+Lf14)+0.2*Lf30 |

Nachweis der zulässigen Spannstahlspannungen

Aus seltener Einwirkungskombination: $\sigma_{\max} = 0.96 \text{ MN/m}^2 \leq f_{ctm} = 2.9 \text{ MN/m}^2 \Rightarrow$ Querschnitt ist in **Zustand I**

| Typ | Lage | σ _{po} MN/m ² | Δσ _p MN/m ² | σ _p MN/m ² | Typ | Lage | σ _{po} MN/m ² | Δσ _p MN/m ² | σ _p MN/m ² |
|--|------|--------------------------------------|--------------------------------------|-------------------------------------|--------------------|------|--------------------------------------|--------------------------------------|-------------------------------------|
| Extremierung 1: Standardkombination | | | | | min σ ₃ | 1 | 677.9 | 1.9 | 679.8 ≤ 1150.5 |
| min σ ₁ | 1 | 677.9 | 0.4 | 678.3 ≤ 1150.5 | min σ ₃ | 2 | 677.9 | 1.9 | 679.8 ≤ 1150.5 |
| min σ ₁ | 2 | 677.9 | 0.4 | 678.3 ≤ 1150.5 | max σ ₃ | 1 | 677.9 | 0.4 | 678.3 ≤ 1150.5 |
| max σ ₁ | 1 | 677.9 | 1.9 | 679.8 ≤ 1150.5 | max σ ₃ | 2 | 677.9 | 0.4 | 678.3 ≤ 1150.5 |
| max σ ₁ | 2 | 677.9 | 1.9 | 679.8 ≤ 1150.5 | min σ ₄ | 1 | 677.9 | 1.9 | 679.8 ≤ 1150.5 |
| min σ ₂ | 1 | 677.9 | 0.4 | 678.3 ≤ 1150.5 | min σ ₄ | 2 | 677.9 | 1.9 | 679.8 ≤ 1150.5 |
| min σ ₂ | 2 | 677.9 | 0.4 | 678.3 ≤ 1150.5 | max σ ₄ | 1 | 677.9 | 0.4 | 678.3 ≤ 1150.5 |
| max σ ₂ | 1 | 677.9 | 1.9 | 679.8 ≤ 1150.5 | max σ ₄ | 2 | 677.9 | 0.4 | 678.3 ≤ 1150.5 |
| max σ ₂ | 2 | 677.9 | 1.9 | 679.8 ≤ 1150.5 | | | | | |

$\sigma_{p,\max} = 679.79 \text{ MN/m}^2 \leq f_{pk} = 1150.5 \text{ MN/m}^2 \Rightarrow$ **Nachweis der zulässigen Spannstahlspannungen erfüllt**

Nachweis 9: EC2 Ermüdungsnachweis Betonstahl

Nach EC2, 6.8.5, Nachweis mit schadensäquivalenten Schwingbreiten für Beton- und Spannstahl mit Lastmodell 3

Ergebnisse der Lastkombinationen

| Typ | N kN | Q _η kN | Q _ζ kN | T kNm | M _η kNm | M _ζ kNm | Faktorisierung |
|--|---------|----------------------|----------------------|----------|-----------------------|-----------------------|--|
| Extremierung 1: Standardkombination | | | | | | | |
| min N | -2049.5 | 0.00 | -155.32 | 0.00 | -4176.44 | 0.00 | Lf1+Lf2+Lf3+0.2*Lf68+0.9*Lf71+0.1*Lf73+0.9*Lf76+Lf6+0.6*(Lf8+Lf9+...+Lf10+Lf11) |
| max N | -2049.5 | 0.00 | -341.97 | 0.00 | -4587.27 | 0.00 | Lf1+Lf2+Lf3+0.2*Lf68+0.9*Lf71+0.1*Lf73+0.9*Lf76+Lf6+0.6*(Lf8+Lf9+...+Lf10+Lf11)+Lf42 |
| min Q _η | -2049.5 | 0.00 | -155.32 | 0.00 | -4176.44 | 0.00 | Lf1+Lf2+Lf3+0.2*Lf68+0.9*Lf71+0.1*Lf73+0.9*Lf76+Lf6+0.6*(Lf8+Lf9+...+Lf10+Lf11) |
| max Q _η | -2049.5 | 0.00 | -341.97 | 0.00 | -4587.27 | 0.00 | Lf1+Lf2+Lf3+0.2*Lf68+0.9*Lf71+0.1*Lf73+0.9*Lf76+Lf6+0.6*(Lf8+Lf9+...+Lf10+Lf11)+Lf42 |
| min Q _ζ | -2049.5 | 0.00 | -542.93 | 0.00 | -4192.62 | 0.00 | Lf1+Lf2+Lf3+0.2*Lf68+0.9*Lf71+0.1*Lf73+0.9*Lf76+Lf6+0.6*(Lf8+Lf9+...+Lf10+Lf11)+Lf53 |
| max Q _ζ | -2049.5 | 0.00 | -155.32 | 0.00 | -4176.44 | 0.00 | Lf1+Lf2+Lf3+0.2*Lf68+0.9*Lf71+0.1*Lf73+0.9*Lf76+Lf6+0.6*(Lf8+Lf9+...+Lf10+Lf11) |

Ergebnisse der Lastkombinationen

| Typ | N kN | Q _η kN | Q _ζ kN | T kNm | M _η kNm | M _ζ kNm | Faktorisierung |
|--------------------|--------------------------------|----------------------|----------------------|----------|-----------------------|-----------------------|---|
| min T | ...+Lf10+Lf11) -2049.5 | 0.00 | -155.32 | 0.00 | -4176.44 | 0.00 | Lf1+Lf2+Lf3+0.2*Lf68+0.9*Lf71+0.1*Lf73+0.9*Lf76+Lf6+0.6*(Lf8+Lf9. |
| max T | ...+Lf10+Lf11) -2049.5 | 0.00 | -341.97 | 0.00 | -4587.27 | 0.00 | Lf1+Lf2+Lf3+0.2*Lf68+0.9*Lf71+0.1*Lf73+0.9*Lf76+Lf6+0.6*(Lf8+Lf9. |
| min M _η | ...+Lf10+Lf11)+Lf42 -2049.5 | 0.00 | -190.43 | 0.00 | -5025.69 | 0.00 | Lf1+Lf2+Lf3+0.2*Lf68+0.9*Lf71+0.1*Lf73+0.9*Lf76+Lf6+0.6*(Lf8+Lf9. |
| max M _η | ...+Lf10+Lf11)+Lf67 -2049.5 | 0.00 | -437.62 | 0.00 | -4127.99 | 0.00 | Lf1+Lf2+Lf3+0.2*Lf68+0.9*Lf71+0.1*Lf73+0.9*Lf76+Lf6+0.6*(Lf8+Lf9. |
| min M _ζ | ...+Lf10+Lf11)+Lf54 -2049.5 | 0.00 | -155.32 | 0.00 | -4176.44 | 0.00 | Lf1+Lf2+Lf3+0.2*Lf68+0.9*Lf71+0.1*Lf73+0.9*Lf76+Lf6+0.6*(Lf8+Lf9. |
| max M _ζ | ...+Lf10+Lf11) -2049.5 | 0.00 | -341.97 | 0.00 | -4587.27 | 0.00 | Lf1+Lf2+Lf3+0.2*Lf68+0.9*Lf71+0.1*Lf73+0.9*Lf76+Lf6+0.6*(Lf8+Lf9. |

Betoneckspannungen der Lastkombinationen

| Typ | σ ₁ MN/m ² | σ ₂ MN/m ² | σ ₃ MN/m ² | σ ₄ MN/m ² | Faktorisierung |
|--|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--|
| Extremierung 1: Standardkombination | | | | | |
| min σ ₁ | 0.13 | 0.13 | -0.80 | -0.80 | Lf1+Lf2+Lf3+0.2*Lf68+0.9*Lf71+0.1*Lf73+0.9*Lf76+Lf6+0.6*(Lf8+Lf9+Lf10+Lf11)+Lf54 |
| max σ ₁ | 0.22 | 0.22 | -0.94 | -0.94 | Lf1+Lf2+Lf3+0.2*Lf68+0.9*Lf71+0.1*Lf73+0.9*Lf76+Lf6+0.6*(Lf8+Lf9+Lf10+Lf11)+Lf67 |
| min σ ₂ | 0.13 | 0.13 | -0.80 | -0.80 | Lf1+Lf2+Lf3+0.2*Lf68+0.9*Lf71+0.1*Lf73+0.9*Lf76+Lf6+0.6*(Lf8+Lf9+Lf10+Lf11)+Lf54 |
| max σ ₂ | 0.22 | 0.22 | -0.94 | -0.94 | Lf1+Lf2+Lf3+0.2*Lf68+0.9*Lf71+0.1*Lf73+0.9*Lf76+Lf6+0.6*(Lf8+Lf9+Lf10+Lf11)+Lf67 |
| min σ ₃ | 0.22 | 0.22 | -0.94 | -0.94 | Lf1+Lf2+Lf3+0.2*Lf68+0.9*Lf71+0.1*Lf73+0.9*Lf76+Lf6+0.6*(Lf8+Lf9+Lf10+Lf11)+Lf67 |
| max σ ₃ | 0.13 | 0.13 | -0.80 | -0.80 | Lf1+Lf2+Lf3+0.2*Lf68+0.9*Lf71+0.1*Lf73+0.9*Lf76+Lf6+0.6*(Lf8+Lf9+Lf10+Lf11)+Lf54 |
| min σ ₄ | 0.22 | 0.22 | -0.94 | -0.94 | Lf1+Lf2+Lf3+0.2*Lf68+0.9*Lf71+0.1*Lf73+0.9*Lf76+Lf6+0.6*(Lf8+Lf9+Lf10+Lf11)+Lf67 |
| max σ ₄ | 0.13 | 0.13 | -0.80 | -0.80 | Lf1+Lf2+Lf3+0.2*Lf68+0.9*Lf71+0.1*Lf73+0.9*Lf76+Lf6+0.6*(Lf8+Lf9+Lf10+Lf11)+Lf54 |

Ermüdungsnachweis Stufe 2 mit λ_s Betonstahl = 1.300 und λ_s Spannstahl = 1.500

σ_{max} = 0.22 MN/m² > 0.00 MN/m² ⇒ Querschnitt ist in **Zustand II**

| Pos | η _a | min σ _{sa} | η _a | max σ _{sa} | Δσ _{sa} MN/m ² | η _e | min σ _{se} | η _e | max σ _{se} | Δσ _{se} MN/m ² |
|-----|----------------|---------------------|----------------|---------------------|---------------------------------------|----------------|---------------------|----------------|---------------------|---------------------------------------|
| | - | MN/m ² | - | MN/m ² | | - | MN/m ² | - | MN/m ² | |
| 1 | 1.02 | 9.74 | 1.03 | 17.38 | 7.89 ≤ 152 | 1.02 | 9.74 | 1.03 | 17.38 | 7.89 ≤ 152 |
| 2 | 1.02 | 9.74 | 1.03 | 17.38 | 7.89 ≤ 152 | 1.02 | 9.74 | 1.03 | 17.38 | 7.89 ≤ 152 |
| 3 | 1.02 | 9.74 | 1.03 | 17.38 | 7.89 ≤ 152 | 1.02 | 9.74 | 1.03 | 17.38 | 7.89 ≤ 152 |
| 4 | 1.02 | 9.74 | 1.03 | 17.38 | 7.89 ≤ 152 | 1.02 | 9.68 | 1.03 | 17.28 | 7.86 ≤ 152 |
| 5 | 1.02 | 9.68 | 1.03 | 17.28 | 7.86 ≤ 152 | 1.02 | 8.99 | 1.03 | 16.24 | 7.50 ≤ 152 |
| 6 | 1.02 | 8.99 | 1.03 | 16.24 | 7.50 ≤ 152 | 1.02 | 7.50 | 1.03 | 14.00 | 6.72 ≤ 152 |
| 7 | 1.02 | 7.50 | 1.03 | 14.00 | 6.72 ≤ 152 | 1.02 | 4.29 | 1.03 | 9.17 | 5.04 ≤ 152 |
| 8 | 1.02 | 4.29 | 1.03 | 9.17 | 5.04 ≤ 152 | 1.00 | -10.53 | 1.00 | -8.80 | 1.73 ≤ 152 |
| 9 | 1.00 | -10.53 | 1.00 | -8.80 | 1.73 ≤ 152 | 1.00 | -12.31 | 1.00 | -9.98 | 2.33 ≤ 152 |
| 10 | 1.00 | -12.31 | 1.00 | -9.98 | 2.33 ≤ 152 | 1.00 | -12.31 | 1.00 | -9.98 | 2.33 ≤ 152 |
| 11 | 1.00 | -12.31 | 1.00 | -9.98 | 2.33 ≤ 152 | 1.00 | -12.31 | 1.00 | -9.98 | 2.33 ≤ 152 |
| 12 | 1.00 | -12.31 | 1.00 | -9.98 | 2.33 ≤ 152 | 1.00 | -10.53 | 1.00 | -8.80 | 1.73 ≤ 152 |
| 13 | 1.00 | -10.53 | 1.00 | -8.80 | 1.73 ≤ 152 | 1.02 | 4.29 | 1.03 | 9.17 | 5.04 ≤ 152 |
| 14 | 1.02 | 4.29 | 1.03 | 9.17 | 5.04 ≤ 152 | 1.02 | 7.50 | 1.03 | 14.00 | 6.72 ≤ 152 |
| 15 | 1.02 | 7.50 | 1.03 | 14.00 | 6.72 ≤ 152 | 1.02 | 8.99 | 1.03 | 16.24 | 7.50 ≤ 152 |
| 16 | 1.02 | 8.99 | 1.03 | 16.24 | 7.50 ≤ 152 | 1.02 | 9.68 | 1.03 | 17.28 | 7.86 ≤ 152 |
| 17 | 1.02 | 9.68 | 1.03 | 17.28 | 7.86 ≤ 152 | 1.02 | 9.74 | 1.03 | 17.38 | 7.89 ≤ 152 |
| 18 | 1.02 | 9.74 | 1.03 | 17.38 | 7.89 ≤ 152 | 1.02 | 9.74 | 1.03 | 17.38 | 7.89 ≤ 152 |
| 19 | 1.02 | 9.74 | 1.03 | 17.38 | 7.89 ≤ 152 | 1.02 | 9.74 | 1.03 | 17.38 | 7.89 ≤ 152 |
| 20 | 1.02 | 9.74 | 1.03 | 17.38 | 7.89 ≤ 152 | 1.02 | 9.74 | 1.03 | 17.38 | 7.89 ≤ 152 |
| 21 | 1.02 | 9.74 | 1.03 | 17.38 | 7.89 ≤ 152 | 1.02 | 8.56 | 1.03 | 15.60 | 7.27 ≤ 152 |
| 22 | 1.02 | 8.56 | 1.03 | 15.60 | 7.27 ≤ 152 | 1.02 | 8.56 | 1.03 | 15.60 | 7.27 ≤ 152 |
| 23 | 1.02 | 8.56 | 1.03 | 15.60 | 7.27 ≤ 152 | 1.02 | 7.41 | 1.03 | 13.86 | 6.67 ≤ 152 |
| 25 | 1.02 | 7.41 | 1.03 | 13.86 | 6.67 ≤ 152 | 1.02 | 4.08 | 1.03 | 8.85 | 4.93 ≤ 152 |
| 26 | 1.02 | 4.08 | 1.03 | 8.85 | 4.93 ≤ 152 | 1.00 | -7.13 | 1.00 | -6.54 | 0.59 ≤ 152 |
| 27 | 1.00 | -7.13 | 1.00 | -6.54 | 0.59 ≤ 152 | 1.00 | -9.35 | 1.00 | -8.02 | 1.34 ≤ 152 |
| 28 | 1.00 | -9.35 | 1.00 | -8.02 | 1.34 ≤ 152 | 1.00 | -9.35 | 1.00 | -8.02 | 1.34 ≤ 152 |
| 29 | 1.00 | -9.35 | 1.00 | -8.02 | 1.34 ≤ 152 | 1.00 | -9.35 | 1.00 | -8.02 | 1.34 ≤ 152 |
| 30 | 1.00 | -9.35 | 1.00 | -8.02 | 1.34 ≤ 152 | 1.00 | -7.13 | 1.00 | -6.54 | 0.59 ≤ 152 |
| 31 | 1.00 | -7.13 | 1.00 | -6.54 | 0.59 ≤ 152 | 1.02 | 4.08 | 1.03 | 8.85 | 4.93 ≤ 152 |
| 32 | 1.02 | 4.08 | 1.03 | 8.85 | 4.93 ≤ 152 | 1.02 | 7.41 | 1.03 | 13.86 | 6.67 ≤ 152 |
| 34 | 1.02 | 7.41 | 1.03 | 13.86 | 6.67 ≤ 152 | 1.02 | 8.56 | 1.03 | 15.60 | 7.27 ≤ 152 |
| 35 | 1.02 | 8.56 | 1.03 | 15.60 | 7.27 ≤ 152 | 1.02 | 8.56 | 1.03 | 15.60 | 7.27 ≤ 152 |
| 36 | 1.02 | 8.56 | 1.03 | 15.60 | 7.27 ≤ 152 | 1.02 | 9.74 | 1.03 | 17.38 | 7.89 ≤ 152 |

Δσ_{s,max} = 7.89 MN/m² ≤ zul Δσ_s = 152 MN/m² ⇒ **Nachweis der Betonstahlermüdung erfüllt**



| Lage | $\Delta\sigma_p$ MN/m ² |
|------|---------------------------------------|
| 1 | 7.47 ≤ 104 |
| 2 | 7.47 ≤ 104 |

$\Delta\sigma_{p,max} = 7.47 \text{ MN/m}^2 \leq \text{zul } \Delta\sigma_p = 104 \text{ MN/m}^2 \Rightarrow$ Nachweis der Spannstahlermüdung erfüllt

Zusammenfassung aller Nachweise

Schubbewehrung: $a_{sbQ} = 12.49 \text{ cm}^2/\text{m}$, $a_{sbT} = 0.29 \text{ cm}^2/\text{m}$, $A_{sT} = 12.60 \text{ cm}^2$
 max. Ausnutzung: $U = 1.442$