

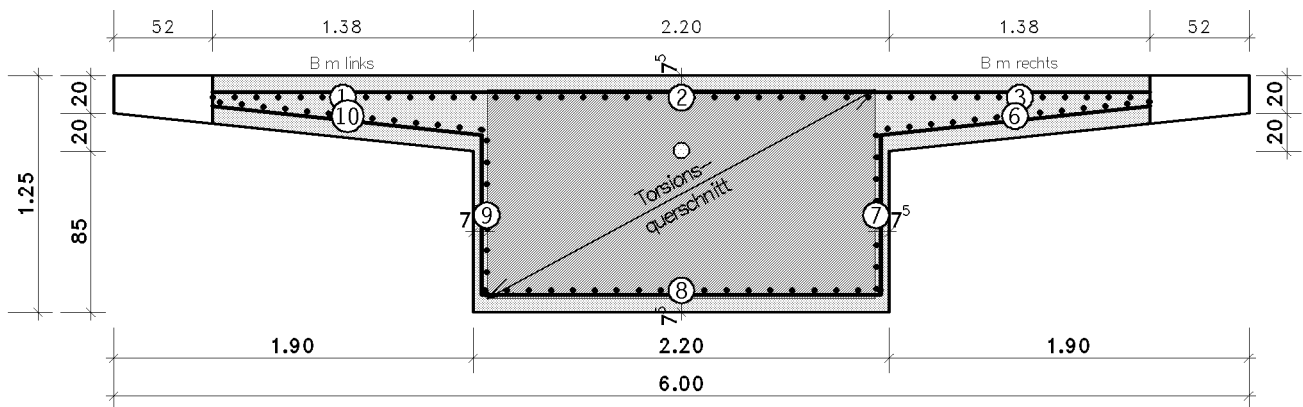
POS. 53: PLATTENBALKEN (SPB.)

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

Name: Voreinstellung PB , 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 |
|--------|-------------------------------|----------|----------------------|-----------------------|------|----------------------------|--------------|-------------------------------|-------------------------------|----------------------|----------------------------|
| C35/45 | 35.0 | 0.850 | -2.0 | -3.5 | 2.00 | 29878.4 | 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 | Endfeld | 2660.00 | 2660.00 | 190.00 | 20.00 | 137.80 |
| Endzustand | re oben | Endfeld | 2660.00 | 2660.00 | 190.00 | 20.00 | 137.80 |

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} KN | A _p cm ² | d _p mm | E-Mod N/mm ² | f _{p01} / f _{pk} N/mm ² | $\Delta\sigma_{Rs}$ N/mm ² |
|------------------|---------------|------------------|------------|------------------------|-----------------------------------|----------------------|----------------------------|---|--|
| SUSPA Fb102/1045 | 6-12/140/St17 | Bündelspannglied | nachträgl. | 2142 | 16.80 | 5.0 | 195000 | 1500/1770 | 71.1 |
| SUSPA Fb102/1045 | 6-12/140/St17 | Bündelspannglied | nachträgl. | 2142 | 16.80 | 5.0 | 195000 | 1500/1770 | 71.1 |

Hüllrohre

schwache (starke) Achse

| Spanngliedtyp | Hüllrohr | Form | Ø/b mm | (h) (mm) | A cm ² | β_0 °/m | min R m | μ | min R m | μ |
|---------------|----------|-------|-----------|-------------|----------------------|------------------|------------|-------|------------|-------|
| 6-12/140/St17 | TYP I | Kreis | 82 | - | 52.8 | 0.300 | 5.50 | 0.200 | - | - |
| 6-12/140/St17 | TYP I | Kreis | 82 | - | 52.8 | 0.300 | 5.50 | 0.200 | - | - |

Spanngliedlagen

| Name | Anzahl | y cm | z cm | h cm | Exz. cm | Typ | ϵ_{vo} ‰ | V _o KN | σ_{vo} N/mm ² |
|--------|--------|---------|---------|---------|------------|---------------|----------------------|----------------------|------------------------------------|
| Lage 1 | 4.0 | 300.0 | 39.5 | 85.5 | 0 | 6-12/140/St17 | 4.65 | 6099.0 | 907.6 |
| Lage 2 | 5.0 | 300.0 | 39.5 | 85.5 | 0 | 6-12/140/St17 | 4.72 | 7737.9 | 921.2 |



Betonstahlbewehrung

Mindestbügelbewehrung gemäß DIN EN 1992, 9.2.2: $a_{sBü} = 24.64 \text{ cm}^2/\text{m}$

| 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 | 12/15.0 | 9.0 | 13.64 ≥ | 7.10 | 7 | 12/15.0 | 4.5 | 6.37 ≥ | 3.32 |
| 2 | 12/15.0 | 9.0 | 16.57 ≥ | 8.63 | 8 | 16/12.4 | 9.0 | 34.20 ≥ | 8.28 |
| 3 | 12/15.0 | 9.0 | 13.64 ≥ | 7.10 | 9 | 12/15.0 | 4.5 | 6.37 ≥ | 3.32 |
| 4 | 12/15.0 | 9.0 | 0.22 ≥ | 0.11 | 10 | 12/15.0 | 9.0 | 14.05 ≥ | 7.32 |
| 6 | 12/15.0 | 9.0 | 14.05 ≥ | 7.32 | 12 | 12/15.0 | 9.0 | 0.22 ≥ | 0.11 |

| Quer- schnittsw. | Vollquerschnitt | | | | | | Mitwirkender Querschnitt | | | | | |
|---------------------|-----------------|--------------------------|----------------|--------------------------|----------------------|---------------|--------------------------|--------------------------|----------------|--------------------------|----------------------|---------------|
| | y_{sy} cm | I_y dm ⁴ | z_{sz} cm | I_z dm ⁴ | A cm ² | α ° | y_{sy} cm | I_y dm ⁴ | z_{sz} cm | I_z dm ⁴ | A cm ² | α ° |
| Brutto | 300.0 | 57496.00 | 48.7 | 5460.93 | 38900 | 0.0 | 300.0 | 39762.55 | 51.2 | 5098.25 | 36525 | 0.0 |
| Netto | 300.0 | 57496.00 | 48.9 | 5456.82 | 38425 | 0.0 | 300.0 | 39762.55 | 51.3 | 5091.69 | 36050 | 0.0 |
| Idee l_z | 300.0 | 57496.00 | 48.5 | 5467.92 | 39736 | 0.0 | 300.0 | 39762.55 | 50.9 | 5109.37 | 37361 | 0.0 |
| Idee l_s | 300.0 | 59049.49 | 48.8 | 5609.90 | 39579 | 0.0 | 300.0 | 40754.36 | 51.2 | 5235.23 | 37128 | 0.0 |
| Idee l_{z+s} | 300.0 | 59049.49 | 48.6 | 5616.92 | 40415 | 0.0 | 300.0 | 40754.36 | 51.0 | 5246.46 | 37963 | 0.0 |

Werte gemäß DIN EN 1992, 6.3.2 Abb 6.11: $t = 15.0 \text{ cm}$ (gewählt), $A_k = 22550.0 \text{ cm}^2$, $u_k = 630.0 \text{ cm}^2$

Kriech- und Schwindparameter

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

$t = 90$ Tage, Spannkraftverlust gewählt: 4.87 %

$t = 36500$ Tage, Spannkraftverlust gewählt: 12.08 %

Querschnittswerte für Spannungsberechnungen nach Zustand I

| Querschnittswerte | Lastfall |
|-------------------|--|
| Brutto | G ₁ |
| Brutto | G ₂ |
| Brutto | G ₃ |
| Brutto | Vorspannung mit sofortigem Verbund |
| Brutto | Vorspannung mit nachträglichem Verbund |
| Brutto | Vorspannung mit ohne Verbund |
| Brutto | Verkehr |
| Brutto | Stützensenkung |
| Brutto | Temperatur |
| Brutto | Horizontaler Erddruck |
| Brutto | Wind |
| Brutto | 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_ζ kN | T kNm | M_η kNm | M_ζ kNm | Bezeichnung |
|--------------------------------------|----------|----------------|-----------------|----------|-----------------|------------------|--|
| Einwirkung 1: ständige Lasten | | | | | | | |
| 1 | 0.0 | 0.00 | -1381.07 | 0.00 | -4978.58 | 0.00 | Eg Hauptträger |
| 2 | 0.0 | 0.00 | -205.35 | 0.00 | -740.26 | 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 |
| 100 | 0.0 | 0.00 | 1434.53 | 0.00 | 4322.12 | 0.00 | P [^] +K _∞ zu LF 4: Vorsp.m.ntr.Verbund 1 |
| 101 | 0.0 | 0.00 | 1552.17 | 0.00 | 4676.56 | 0.00 | P [^] +K _{S1} zu LF 4: Vorsp.m.ntr.Verbund 1 |
| 102 | -13836.9 | 0.00 | 1631.63 | 0.00 | 6194.85 | 0.00 | P zu LF 4: Vorsp.m.ntr.Verbund 1 |
| 103 | -12165.4 | 0.00 | 1434.53 | 0.00 | 5446.51 | 0.00 | P+K _∞ zu LF 4: Vorsp.m.ntr.Verbund 1 |
| 104 | -13163.0 | 0.00 | 1552.17 | 0.00 | 5893.16 | 0.00 | P+K _{S1} zu LF 4: Vorsp.m.ntr.Verbund 1 |
| Einwirkung 3: Stützensenkung | | | | | | | |
| 5 | 0.0 | 0.00 | -15.23 | 0.00 | -368.48 | 0.00 | wahrsch. Δ_s (Achse 1) |
| 6 | 0.0 | 0.00 | 30.47 | 0.00 | 736.97 | 0.00 | wahrsch. Δ_s (Achse 2) |
| 7 | 0.0 | 0.00 | -15.23 | 0.00 | -368.48 | 0.00 | wahrsch. Δ_s (Achse 3) |
| 8 | 0.0 | 0.00 | -30.47 | 0.00 | -736.97 | 0.00 | mögliche Δ_s (Achse 1) |



Lastfallergebnisse

| Nr | N kN | Q _η kN | Q _ξ kN | T kNm | M _η kNm | M _ξ kNm | Bezeichnung |
|---------------------------------------|---------|----------------------|----------------------|----------|-----------------------|-----------------------|--------------------------|
| 9 | 0.0 | 0.00 | 60.93 | 0.00 | 1473.93 | 0.00 | mögliche Δs (Achse 2) |
| 10 | 0.0 | 0.00 | -30.47 | 0.00 | -736.97 | 0.00 | mögliche Δs (Achse 3) |
| 11 | 0.0 | 0.00 | 15.23 | 0.00 | 368.48 | 0.00 | Lagerwechsel (Achse 1) |
| 12 | 0.0 | 0.00 | -30.47 | 0.00 | -736.97 | 0.00 | Lagerwechsel (Achse 2) |
| 13 | 0.0 | 0.00 | 15.23 | 0.00 | 368.48 | 0.00 | Lagerwechsel (Achse 3) |
| Einwirkung 4: Temperaturlasten | | | | | | | |
| 14 | 35.3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | Temperatur T+ |
| 15 | -35.3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | Temperatur T- |
| 16 | 0.0 | 0.00 | 113.82 | 0.00 | 2753.24 | 0.00 | Temperatur ΔT+ |
| 17 | 0.0 | 0.00 | -68.98 | 0.00 | -1668.63 | 0.00 | Temperatur ΔT- |
| Einwirkung 5: Windlasten | | | | | | | |
| 18 | 0.0 | 18.73 | 0.00 | 16.85 | 0.00 | -2726.31 | Wind von links |
| 19 | 0.0 | -18.73 | 0.00 | 0.00 | 0.00 | 2726.31 | Wind von rechts |
| Einwirkung 6: Verkehrslasten | | | | | | | |
| 20 | 0.0 | 0.00 | -78.45 | 33.13 | -69.17 | 0.00 | p=2.5 HT1, Feld1, links |
| 21 | 0.0 | 0.00 | -10.39 | 51.96 | -251.35 | 0.00 | p=2.5 HT1, Feld1, rechts |
| 22 | 0.0 | 0.00 | -78.45 | 33.13 | -69.17 | 0.00 | p=2.5 HT1, Feld2, links |
| 23 | 0.0 | 0.00 | -10.39 | -51.96 | -251.35 | 0.00 | p=2.5 HT1, Feld2, rechts |
| 24 | 0.0 | 0.00 | -244.77 | -82.68 | -215.81 | 0.00 | Überlast HS1 (Feld 1) |
| 25 | 0.0 | 0.00 | -32.42 | 129.68 | -784.21 | 0.00 | Überlast HS1 (Feld 2) |
| 26 | 0.0 | 0.00 | -24.80 | -9.92 | -71.81 | 0.00 | HS1 (Tandem 1) |
| 27 | 0.0 | 0.00 | -150.68 | -61.08 | -395.39 | 0.00 | HS1 (Tandem 2) |
| 28 | 0.0 | 0.00 | -268.24 | -112.24 | -517.56 | 0.00 | HS1 (Tandem 3) |
| 29 | 0.0 | 0.00 | -370.50 | -163.40 | -269.64 | 0.00 | HS1 (Tandem 4) |
| 30 | 0.0 | 0.00 | -210.49 | 25.44 | 471.46 | 0.00 | HS1 (Tandem 5) |
| 31 | 0.0 | 0.00 | -21.57 | 214.29 | -521.67 | 0.00 | HS1 (Tandem 6) |
| 32 | 0.0 | 0.00 | -43.76 | 163.13 | -1058.50 | 0.00 | HS1 (Tandem 7) |
| 33 | 0.0 | 0.00 | -43.71 | 111.97 | -1057.44 | 0.00 | HS1 (Tandem 8) |
| 34 | 0.0 | 0.00 | -28.41 | 60.81 | -687.18 | 0.00 | HS1 (Tandem 9) |
| 35 | 0.0 | 0.00 | -4.81 | 9.65 | -116.40 | 0.00 | HS1 (Tandem 10) |
| 36 | 0.0 | 0.00 | -241.58 | -100.15 | -515.81 | 0.00 | HS1 (Tandem 11) |
| 37 | 0.0 | 0.00 | -77.78 | 0.00 | -201.54 | 0.00 | HS1 (LM3 1) |
| 38 | 0.0 | 0.00 | -99.80 | 0.00 | -253.59 | 0.00 | HS1 (LM3 2) |
| 39 | 0.0 | 0.00 | -121.60 | 0.00 | -301.46 | 0.00 | HS1 (LM3 3) |
| 40 | 0.0 | 0.00 | -143.21 | 0.00 | -344.24 | 0.00 | HS1 (LM3 4) |
| 41 | 0.0 | 0.00 | -164.57 | 0.00 | -381.00 | 0.00 | HS1 (LM3 5) |
| 42 | 0.0 | 0.00 | -186.65 | 0.00 | -410.83 | 0.00 | HS1 (LM3 6) |
| 43 | 0.0 | 0.00 | -206.40 | 0.00 | -432.79 | 0.00 | HS1 (LM3 7) |
| 44 | 0.0 | 0.00 | -226.79 | 0.00 | -445.96 | 0.00 | HS1 (LM3 8) |
| 45 | 0.0 | 0.00 | -246.77 | 0.00 | -449.41 | 0.00 | HS1 (LM3 9) |
| 46 | 0.0 | 0.00 | -266.00 | 0.00 | -442.22 | 0.00 | HS1 (LM3 10) |
| 47 | 0.0 | 0.00 | -285.38 | 0.00 | -423.46 | 0.00 | HS1 (LM3 11) |
| 48 | 0.0 | 0.00 | -304.02 | 0.00 | -391.78 | 0.00 | HS1 (LM3 12) |
| 49 | 0.0 | 0.00 | -321.93 | 0.00 | -347.54 | 0.00 | HS1 (LM3 13) |
| 50 | 0.0 | 0.00 | -339.34 | 0.00 | -288.53 | 0.00 | HS1 (LM3 14) |
| 51 | 0.0 | 0.00 | -356.10 | 0.00 | -214.25 | 0.00 | HS1 (LM3 15) |
| 52 | 0.0 | 0.00 | -372.21 | 0.00 | -123.77 | 0.00 | HS1 (LM3 16) |
| 53 | 0.0 | 0.00 | -387.61 | 0.00 | -16.18 | 0.00 | HS1 (LM3 17) |
| 54 | 0.0 | 0.00 | -282.30 | 0.00 | 48.45 | 0.00 | HS1 (LM3 18) |
| 55 | 0.0 | 0.00 | -176.12 | 0.00 | 35.67 | 0.00 | HS1 (LM3 19) |
| 56 | 0.0 | 0.00 | -189.16 | 0.00 | -39.82 | 0.00 | HS1 (LM3 20) |
| 57 | 0.0 | 0.00 | -201.35 | 0.00 | -94.60 | 0.00 | HS1 (LM3 21) |
| 58 | 0.0 | 0.00 | -212.66 | 0.00 | -128.19 | 0.00 | HS1 (LM3 22) |
| 59 | 0.0 | 0.00 | -223.09 | 0.00 | -140.50 | 0.00 | HS1 (LM3 23) |
| 60 | 0.0 | 0.00 | -232.64 | 0.00 | -131.53 | 0.00 | HS1 (LM3 24) |
| 61 | 0.0 | 0.00 | -121.31 | 0.00 | -138.47 | 0.00 | HS1 (LM3 25) |
| 62 | 0.0 | 0.00 | -9.10 | 0.00 | -220.13 | 0.00 | HS1 (LM3 26) |
| 63 | 0.0 | 0.00 | -16.01 | 0.00 | -387.30 | 0.00 | HS1 (LM3 27) |
| 64 | 0.0 | 0.00 | -22.04 | 0.00 | -533.25 | 0.00 | HS1 (LM3 28) |
| 65 | 0.0 | 0.00 | -27.23 | 0.00 | -658.78 | 0.00 | HS1 (LM3 29) |
| 66 | 0.0 | 0.00 | -31.56 | 0.00 | -763.38 | 0.00 | HS1 (LM3 30) |
| 67 | 0.0 | 0.00 | -35.11 | 0.00 | -849.25 | 0.00 | HS1 (LM3 31) |
| 68 | 0.0 | 0.00 | -37.90 | 0.00 | -916.89 | 0.00 | HS1 (LM3 32) |
| 69 | 0.0 | 0.00 | -39.98 | 0.00 | -967.23 | 0.00 | HS1 (LM3 33) |
| 70 | 0.0 | 0.00 | -41.39 | 0.00 | -1001.19 | 0.00 | HS1 (LM3 34) |
| 71 | 0.0 | 0.00 | -42.16 | 0.00 | -1019.95 | 0.00 | HS1 (LM3 35) |

Lastfallergebnisse

| Nr | N kN | Q _η kN | Q _ξ kN | T kNm | M _η kNm | M _ξ kNm | Bezeichnung |
|----|---------|----------------------|----------------------|----------|-----------------------|-----------------------|-----------------------|
| 72 | 0.0 | 0.00 | -42.32 | 0.00 | -1023.66 | 0.00 | HS1 (LM3 36) |
| 73 | 0.0 | 0.00 | -41.92 | 0.00 | -1014.03 | 0.00 | HS1 (LM3 37) |
| 74 | 0.0 | 0.00 | -41.00 | 0.00 | -991.73 | 0.00 | HS1 (LM3 38) |
| 75 | 0.0 | 0.00 | -39.59 | 0.00 | -957.67 | 0.00 | HS1 (LM3 39) |
| 76 | 0.0 | 0.00 | -37.73 | 0.00 | -912.78 | 0.00 | HS1 (LM3 40) |
| 77 | 0.0 | 0.00 | -35.47 | 0.00 | -858.00 | 0.00 | HS1 (LM3 41) |
| 78 | 0.0 | 0.00 | -32.83 | 0.00 | -794.23 | 0.00 | HS1 (LM3 42) |
| 79 | 0.0 | 0.00 | -29.86 | 0.00 | -722.42 | 0.00 | HS1 (LM3 43) |
| 80 | 0.0 | 0.00 | -26.60 | 0.00 | -643.48 | 0.00 | HS1 (LM3 44) |
| 81 | 0.0 | 0.00 | -23.08 | 0.00 | -558.34 | 0.00 | HS1 (LM3 45) |
| 82 | 0.0 | 0.00 | -19.34 | 0.00 | -467.92 | 0.00 | HS1 (LM3 46) |
| 83 | 0.0 | 0.00 | -15.43 | 0.00 | -373.15 | 0.00 | HS1 (LM3 47) |
| 84 | 0.0 | 0.00 | -244.77 | 82.68 | -215.81 | 0.00 | Überlast HS2 (Feld 1) |
| 85 | 0.0 | 0.00 | -32.42 | -129.68 | -784.21 | 0.00 | Überlast HS2 (Feld 2) |
| 86 | 0.0 | 0.00 | -24.80 | 9.92 | -71.81 | 0.00 | HS2 (Tandem 1) |
| 87 | 0.0 | 0.00 | -150.68 | 61.08 | -395.39 | 0.00 | HS2 (Tandem 2) |
| 88 | 0.0 | 0.00 | -268.24 | 112.24 | -517.56 | 0.00 | HS2 (Tandem 3) |
| 89 | 0.0 | 0.00 | -370.50 | 163.40 | -269.64 | 0.00 | HS2 (Tandem 4) |
| 90 | 0.0 | 0.00 | -210.49 | -25.44 | 471.46 | 0.00 | HS2 (Tandem 5) |
| 91 | 0.0 | 0.00 | -21.57 | -214.29 | -521.67 | 0.00 | HS2 (Tandem 6) |
| 92 | 0.0 | 0.00 | -43.76 | -163.13 | -1058.50 | 0.00 | HS2 (Tandem 7) |
| 93 | 0.0 | 0.00 | -43.71 | 111.97 | -1057.44 | 0.00 | HS2 (Tandem 8) |
| 94 | 0.0 | 0.00 | -28.41 | -60.81 | -687.18 | 0.00 | HS2 (Tandem 9) |
| 95 | 0.0 | 0.00 | -4.81 | -9.65 | -116.40 | 0.00 | HS2 (Tandem 10) |
| 96 | 0.0 | 0.00 | -31.38 | -29.15 | -27.67 | 0.00 | qfk=2.5 HS1 (Feld 1) |
| 97 | 0.0 | 0.00 | -4.16 | 45.72 | -100.54 | 0.00 | qfk=2.5 HS1 (Feld 2) |
| 98 | 0.0 | 0.00 | -31.38 | 29.15 | -27.67 | 0.00 | qfk=2.5 HS2 (Feld 1) |
| 99 | 0.0 | 0.00 | -4.16 | -45.72 | -100.54 | 0.00 | qfk=2.5 HS2 (Feld 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 | 5.00 | 5.00 | -7.21 | -7.21 | Eg Hauptträger |
| 2 | 0.74 | 0.74 | -1.07 | -1.07 | Eg Kappen |
| 3 | 0.56 | 0.56 | -0.81 | -0.81 | Eg Belag |
| Einwirkung 2: Vorspannung | | | | | |
| 4 | -4.93 | -4.93 | 7.12 | 7.12 | P [∞] : Vorsp.m.ntr.Verbund 1 |
| 100 | -4.34 | -4.34 | 6.26 | 6.26 | P [∞] +KS [∞] zu LF 4: Vorsp.m.ntr.Verbund 1 |
| 101 | -4.69 | -4.69 | 6.77 | 6.77 | P [∞] +KS1 zu LF 4: Vorsp.m.ntr.Verbund 1 |
| 102 | -9.77 | -9.77 | 5.41 | 5.41 | P zu LF 4: Vorsp.m.ntr.Verbund 1 |
| 103 | -8.59 | -8.59 | 4.76 | 4.76 | P+KS [∞] zu LF 4: Vorsp.m.ntr.Verbund 1 |
| 104 | -9.30 | -9.30 | 5.15 | 5.15 | P+KS1 zu LF 4: Vorsp.m.ntr.Verbund 1 |
| Einwirkung 3: Stützensenkung | | | | | |
| 5 | 0.37 | 0.37 | -0.53 | -0.53 | wahrsch. Δs (Achse 1) |
| 6 | -0.74 | -0.74 | 1.07 | 1.07 | wahrsch. Δs (Achse 2) |
| 7 | 0.37 | 0.37 | -0.53 | -0.53 | wahrsch. Δs (Achse 3) |
| 8 | 0.74 | 0.74 | -1.07 | -1.07 | mögliche Δs (Achse 1) |
| 9 | -1.48 | -1.48 | 2.13 | 2.13 | mögliche Δs (Achse 2) |
| 10 | 0.74 | 0.74 | -1.07 | -1.07 | mögliche Δs (Achse 3) |
| 11 | -0.37 | -0.37 | 0.53 | 0.53 | Lagerwechsel (Achse 1) |
| 12 | 0.74 | 0.74 | -1.07 | -1.07 | Lagerwechsel (Achse 2) |
| 13 | -0.37 | -0.37 | 0.53 | 0.53 | Lagerwechsel (Achse 3) |
| Einwirkung 4: Temperaturlasten | | | | | |
| 14 | 0.01 | 0.01 | 0.01 | 0.01 | Temperatur T+ |
| 15 | -0.01 | -0.01 | -0.01 | -0.01 | Temperatur T- |
| 16 | -2.76 | -2.76 | 3.99 | 3.99 | Temperatur ΔT+ |
| 17 | 1.67 | 1.67 | -2.42 | -2.42 | Temperatur ΔT- |
| Einwirkung 5: Windlasten | | | | | |
| 18 | 1.70 | -1.70 | -0.75 | 0.75 | Wind von links |
| 19 | -1.70 | 1.70 | 0.75 | -0.75 | Wind von rechts |
| Einwirkung 6: Verkehrslasten | | | | | |
| 20 | 0.07 | 0.07 | -0.10 | -0.10 | p=2.5 HT1, Feld1, links |
| 21 | 0.25 | 0.25 | -0.36 | -0.36 | p=2.5 HT1, Feld1, rechts |
| 22 | 0.07 | 0.07 | -0.10 | -0.10 | p=2.5 HT1, Feld2, links |

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 |
|----|---------------------------------|---------------------------------|---------------------------------|---------------------------------|--------------------------|
| 23 | 0.25 | 0.25 | -0.36 | -0.36 | p=2.5 HT1, Feld2, rechts |
| 24 | 0.22 | 0.22 | -0.31 | -0.31 | Überlast HS1 (Feld 1) |
| 25 | 0.79 | 0.79 | -1.14 | -1.14 | Überlast HS1 (Feld 2) |
| 26 | 0.07 | 0.07 | -0.10 | -0.10 | HS1 (Tandem 1) |
| 27 | 0.40 | 0.40 | -0.57 | -0.57 | HS1 (Tandem 2) |
| 28 | 0.52 | 0.52 | -0.75 | -0.75 | HS1 (Tandem 3) |
| 29 | 0.27 | 0.27 | -0.39 | -0.39 | HS1 (Tandem 4) |
| 30 | -0.47 | -0.47 | 0.68 | 0.68 | HS1 (Tandem 5) |
| 31 | 0.52 | 0.52 | -0.76 | -0.76 | HS1 (Tandem 6) |
| 32 | 1.06 | 1.06 | -1.53 | -1.53 | HS1 (Tandem 7) |
| 33 | 1.06 | 1.06 | -1.53 | -1.53 | HS1 (Tandem 8) |
| 34 | 0.69 | 0.69 | -1.00 | -1.00 | HS1 (Tandem 9) |
| 35 | 0.12 | 0.12 | -0.17 | -0.17 | HS1 (Tandem 10) |
| 36 | 0.52 | 0.52 | -0.75 | -0.75 | HS1 (Tandem 11) |
| 37 | 0.20 | 0.20 | -0.29 | -0.29 | HS1 (LM3 1) |
| 38 | 0.25 | 0.25 | -0.37 | -0.37 | HS1 (LM3 2) |
| 39 | 0.30 | 0.30 | -0.44 | -0.44 | HS1 (LM3 3) |
| 40 | 0.35 | 0.35 | -0.50 | -0.50 | HS1 (LM3 4) |
| 41 | 0.38 | 0.38 | -0.55 | -0.55 | HS1 (LM3 5) |
| 42 | 0.41 | 0.41 | -0.59 | -0.59 | HS1 (LM3 6) |
| 43 | 0.43 | 0.43 | -0.63 | -0.63 | HS1 (LM3 7) |
| 44 | 0.45 | 0.45 | -0.65 | -0.65 | HS1 (LM3 8) |
| 45 | 0.45 | 0.45 | -0.65 | -0.65 | HS1 (LM3 9) |
| 46 | 0.44 | 0.44 | -0.64 | -0.64 | HS1 (LM3 10) |
| 47 | 0.43 | 0.43 | -0.61 | -0.61 | HS1 (LM3 11) |
| 48 | 0.39 | 0.39 | -0.57 | -0.57 | HS1 (LM3 12) |
| 49 | 0.35 | 0.35 | -0.50 | -0.50 | HS1 (LM3 13) |
| 50 | 0.29 | 0.29 | -0.42 | -0.42 | HS1 (LM3 14) |
| 51 | 0.22 | 0.22 | -0.31 | -0.31 | HS1 (LM3 15) |
| 52 | 0.12 | 0.12 | -0.18 | -0.18 | HS1 (LM3 16) |
| 53 | 0.02 | 0.02 | -0.02 | -0.02 | HS1 (LM3 17) |
| 54 | -0.05 | -0.05 | 0.07 | 0.07 | HS1 (LM3 18) |
| 55 | -0.04 | -0.04 | 0.05 | 0.05 | HS1 (LM3 19) |
| 56 | 0.04 | 0.04 | -0.06 | -0.06 | HS1 (LM3 20) |
| 57 | 0.09 | 0.09 | -0.14 | -0.14 | HS1 (LM3 21) |
| 58 | 0.13 | 0.13 | -0.19 | -0.19 | HS1 (LM3 22) |
| 59 | 0.14 | 0.14 | -0.20 | -0.20 | HS1 (LM3 23) |
| 60 | 0.13 | 0.13 | -0.19 | -0.19 | HS1 (LM3 24) |
| 61 | 0.14 | 0.14 | -0.20 | -0.20 | HS1 (LM3 25) |
| 62 | 0.22 | 0.22 | -0.32 | -0.32 | HS1 (LM3 26) |
| 63 | 0.39 | 0.39 | -0.56 | -0.56 | HS1 (LM3 27) |
| 64 | 0.54 | 0.54 | -0.77 | -0.77 | HS1 (LM3 28) |
| 65 | 0.66 | 0.66 | -0.95 | -0.95 | HS1 (LM3 29) |
| 66 | 0.77 | 0.77 | -1.11 | -1.11 | HS1 (LM3 30) |
| 67 | 0.85 | 0.85 | -1.23 | -1.23 | HS1 (LM3 31) |
| 68 | 0.92 | 0.92 | -1.33 | -1.33 | HS1 (LM3 32) |
| 69 | 0.97 | 0.97 | -1.40 | -1.40 | HS1 (LM3 33) |
| 70 | 1.00 | 1.00 | -1.45 | -1.45 | HS1 (LM3 34) |
| 71 | 1.02 | 1.02 | -1.48 | -1.48 | HS1 (LM3 35) |
| 72 | 1.03 | 1.03 | -1.48 | -1.48 | HS1 (LM3 36) |
| 73 | 1.02 | 1.02 | -1.47 | -1.47 | HS1 (LM3 37) |
| 74 | 1.00 | 1.00 | -1.44 | -1.44 | HS1 (LM3 38) |
| 75 | 0.96 | 0.96 | -1.39 | -1.39 | HS1 (LM3 39) |
| 76 | 0.92 | 0.92 | -1.32 | -1.32 | HS1 (LM3 40) |
| 77 | 0.86 | 0.86 | -1.24 | -1.24 | HS1 (LM3 41) |
| 78 | 0.80 | 0.80 | -1.15 | -1.15 | HS1 (LM3 42) |
| 79 | 0.73 | 0.73 | -1.05 | -1.05 | HS1 (LM3 43) |
| 80 | 0.65 | 0.65 | -0.93 | -0.93 | HS1 (LM3 44) |
| 81 | 0.56 | 0.56 | -0.81 | -0.81 | HS1 (LM3 45) |
| 82 | 0.47 | 0.47 | -0.68 | -0.68 | HS1 (LM3 46) |
| 83 | 0.37 | 0.37 | -0.54 | -0.54 | HS1 (LM3 47) |
| 84 | 0.22 | 0.22 | -0.31 | -0.31 | Überlast HS2 (Feld 1) |
| 85 | 0.79 | 0.79 | -1.14 | -1.14 | Überlast HS2 (Feld 2) |
| 86 | 0.07 | 0.07 | -0.10 | -0.10 | HS2 (Tandem 1) |
| 87 | 0.40 | 0.40 | -0.57 | -0.57 | HS2 (Tandem 2) |
| 88 | 0.52 | 0.52 | -0.75 | -0.75 | HS2 (Tandem 3) |

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 |
|----|---------------------------------|---------------------------------|---------------------------------|---------------------------------|----------------------|
| 89 | 0.27 | 0.27 | -0.39 | -0.39 | HS2 (Tandem 4) |
| 90 | -0.47 | -0.47 | 0.68 | 0.68 | HS2 (Tandem 5) |
| 91 | 0.52 | 0.52 | -0.76 | -0.76 | HS2 (Tandem 6) |
| 92 | 1.06 | 1.06 | -1.53 | -1.53 | HS2 (Tandem 7) |
| 93 | 1.06 | 1.06 | -1.53 | -1.53 | HS2 (Tandem 8) |
| 94 | 0.69 | 0.69 | -1.00 | -1.00 | HS2 (Tandem 9) |
| 95 | 0.12 | 0.12 | -0.17 | -0.17 | HS2 (Tandem 10) |
| 96 | 0.03 | 0.03 | -0.04 | -0.04 | qfk=2.5 HS1 (Fe1d 1) |
| 97 | 0.10 | 0.10 | -0.15 | -0.15 | qfk=2.5 HS1 (Fe1d 2) |
| 98 | 0.03 | 0.03 | -0.04 | -0.04 | qfk=2.5 HS2 (Fe1d 1) |
| 99 | 0.10 | 0.10 | -0.15 | -0.15 | qfk=2.5 HS2 (Fe1d 2) |

Nachweis 1: 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 _ζ kN | T kNm | M _η kNm | M _ζ kNm | Faktorisierung |
|--|----------|----------------------|----------------------|----------|-----------------------|-----------------------|--|
| Extremierung 1: Standardkombination | | | | | | | |
| min N | -14514.6 | 0.00 | -33.82 | 0.00 | 205.62 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf104+Lf15 |
| max N | -10913.6 | 11.24 | -551.07 | 47.97 | 616.69 | -1635.79 | Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf6+Lf7+Lf14+Lf16+0.6*Lf18+0.4*(Lf20... ...+Lf21+Lf22+Lf23+Lf24+Lf25)+0.75*Lf26+0.4*0.5*(Lf96+Lf97+Lf98+Lf99) |
| min Q _η | -10948.9 | -18.73 | -450.13 | 0.00 | -1374.99 | 2726.31 | Lf1+Lf2+Lf3+0.9*Lf103+Lf19 |
| max Q _η | -13353.7 | 18.73 | -286.93 | 54.71 | 1155.35 | -2726.31 | Lf1+Lf2+Lf3+1.1*Lf103+Lf5+Lf6+Lf7+0.8*(Lf14+Lf16)+Lf18+0.4*(Lf20... ...+Lf21+Lf22+Lf23+Lf24+Lf25)+0.75*Lf26+0.4*0.5*(Lf96+Lf97+Lf98+Lf99) |
| min Q _ζ | -10948.9 | 0.00 | -1396.69 | -50.14 | -5485.77 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf7+0.8*Lf17+Lf20+Lf21+Lf22+Lf23+Lf24... ...+Lf25+Lf29+0.5*(Lf96+Lf97+Lf98+Lf99) |
| max Q _ζ | -14444.0 | 11.24 | 110.47 | 10.11 | 3695.83 | -1635.79 | Lf1+Lf2+Lf3+1.1*Lf104+Lf6+Lf14+Lf16+0.6*Lf18 |
| min T | -10948.9 | 0.00 | -532.28 | -433.37 | -2996.33 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf103+Lf23+Lf85+Lf91+0.5*(Lf96+Lf99) |
| max T | -13353.7 | 11.24 | -311.21 | 509.74 | 157.24 | -1635.79 | Lf1+Lf2+Lf3+1.1*Lf103+Lf5+Lf6+Lf7+0.8*(Lf14+Lf16)+0.6*Lf18+Lf20... ...+Lf21+Lf22+Lf25+Lf31+0.5*(Lf97+Lf98) |
| min M _η | -10948.9 | 0.00 | -1069.95 | 276.39 | -6274.63 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf7+0.8*Lf17+Lf20+Lf21+Lf22+Lf23+Lf24... ...+Lf25+Lf32+0.5*(Lf96+Lf97+Lf98+Lf99) |
| max M _η | -14444.0 | 11.24 | -47.40 | 29.19 | 4049.43 | -1635.79 | Lf1+Lf2+Lf3+1.1*Lf104+Lf6+Lf14+Lf16+0.6*Lf18+0.75*Lf30 |
| min M _ζ | -10948.9 | 18.73 | -450.13 | 16.85 | -1374.99 | -2726.31 | Lf1+Lf2+Lf3+0.9*Lf103+Lf18 |
| max M _ζ | -13353.7 | -18.73 | -286.93 | 37.86 | 1155.35 | 2726.31 | Lf1+Lf2+Lf3+1.1*Lf103+Lf5+Lf6+Lf7+0.8*(Lf14+Lf16)+Lf19+0.4*(Lf20... ...+Lf21+Lf22+Lf23+Lf24+Lf25)+0.75*Lf26+0.4*0.5*(Lf96+Lf97+Lf98+Lf99) |

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 | -8.94 | -5.54 | 2.09 | 0.58 | Lf1+Lf2+Lf3+1.1*Lf104+Lf6+0.8*(Lf15+Lf16)+Lf19+0.75*Lf30 |
| max σ_1 | 4.51 | 2.47 | -12.35 | -11.44 | Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf7+0.8*(Lf14+Lf17)+0.6*Lf18+Lf20+Lf21+Lf22+Lf23+Lf24+Lf25... ...+Lf32+0.5*(Lf96+Lf97+Lf98+Lf99) |
| min σ_2 | -5.54 | -8.94 | 0.58 | 2.09 | Lf1+Lf2+Lf3+1.1*Lf104+Lf6+0.8*(Lf15+Lf16)+Lf18+0.75*Lf30 |
| max σ_2 | 2.47 | 4.51 | -11.44 | -12.35 | Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf7+0.8*(Lf14+Lf17)+0.6*Lf19+Lf20+Lf21+Lf22+Lf23+Lf24+Lf25... ...+Lf32+0.5*(Lf96+Lf97+Lf98+Lf99) |
| min σ_3 | 4.50 | 2.46 | -12.36 | -11.46 | Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf7+0.8*(Lf15+Lf17)+0.6*Lf18+Lf20+Lf21+Lf22+Lf23+Lf24+Lf25... ...+Lf32+0.5*(Lf96+Lf97+Lf98+Lf99) |
| max σ_3 | -8.80 | -6.76 | 2.60 | 1.70 | Lf1+Lf2+Lf3+1.1*Lf104+Lf6+Lf14+Lf16+0.6*Lf19+0.75*Lf30 |
| min σ_4 | 2.46 | 4.50 | -11.46 | -12.36 | Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf7+0.8*(Lf15+Lf17)+0.6*Lf19+Lf20+Lf21+Lf22+Lf23+Lf24+Lf25... ...+Lf32+0.5*(Lf96+Lf97+Lf98+Lf99) |
| max σ_4 | -6.76 | -8.80 | 1.70 | 2.60 | Lf1+Lf2+Lf3+1.1*Lf104+Lf6+Lf14+Lf16+0.6*Lf18+0.75*Lf30 |

Betonrandspannungen seltene Einwirkungskombination

Aus seltener Einwirkungskombination: $\sigma_{max} = 4.51 \text{ MN/m}^2 > f_{ctm} = 3.2 \text{ MN/m}^2 \Rightarrow$ Querschnitt ist in **Zustand II**

| 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 | -8.94 | -5.54 | 2.09 | 0.58 | 2.09 ≤ 3.2 |
| max σ_1 | 4.51 | 2.47 | -12.35 | -11.44 | 4.51 > 3.2 |
| min σ_2 | -5.54 | -8.94 | 0.58 | 2.09 | 2.09 ≤ 3.2 |
| max σ_2 | 2.47 | 4.51 | -11.44 | -12.35 | 4.51 > 3.2 |
| min σ_3 | 4.50 | 2.46 | -12.36 | -11.46 | 4.50 > 3.2 |
| max σ_3 | -8.80 | -6.76 | 2.60 | 1.70 | 2.60 ≤ 3.2 |
| min σ_4 | 2.46 | 4.50 | -11.46 | -12.36 | 4.50 > 3.2 |
| max σ_4 | -6.76 | -8.80 | 1.70 | 2.60 | 2.60 ≤ 3.2 |



Nachweis 2: EC2 Rissbreite

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

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 | -14500.5 | 0.00 | -33.82 | 0.00 | 205.62 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf104+0.6*Lf15 |
| max N | -10927.7 | 0.00 | -477.77 | 20.67 | -65.61 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf6+Lf7+0.6*(Lf14+Lf16)+0.2*(Lf20+Lf21+...+Lf22+Lf23+Lf24+Lf25+Lf26) |
| min Q _η | -10948.9 | -3.75 | -450.13 | 0.00 | -1374.99 | 545.26 | Lf1+Lf2+Lf3+0.9*Lf103+0.2*Lf19 |
| max Q _η | -13364.3 | 3.75 | -202.24 | 24.04 | 748.37 | -545.26 | Lf1+Lf2+Lf3+1.1*Lf103+Lf5+Lf6+Lf7+0.5*(Lf14+Lf16)+0.2*(Lf18+Lf20+...+Lf21+Lf22+Lf23+Lf24+Lf25+Lf26) |
| min Q _ξ | -10948.9 | 0.00 | -989.12 | -77.25 | -3856.21 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf7+0.5*Lf17+0.4*(Lf20+Lf21+Lf22+Lf23+...+Lf24+Lf25)+0.75*Lf29+0.4*0.5*(Lf96+Lf97+Lf98+Lf99) |
| max Q _ξ | -14458.2 | 0.00 | 64.94 | 0.00 | 2594.54 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf104+Lf6+0.6*(Lf14+Lf16) |
| min T | -10948.9 | 0.00 | -490.54 | -248.35 | -2206.11 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf103+0.4*Lf23+0.4*Lf85+0.75*Lf91+0.4*0.5*(Lf96+...+Lf99) |
| max T | -13364.3 | 0.00 | -209.48 | 274.85 | 204.48 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf103+Lf5+Lf6+Lf7+0.5*(Lf14+Lf16)+0.4*(Lf20+Lf21+...+Lf22)+0.4*Lf25+0.75*Lf31+0.4*0.5*(Lf97+Lf98) |
| min M _η | -10948.9 | 0.00 | -744.07 | 167.65 | -4447.85 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf7+0.5*Lf17+0.4*(Lf20+Lf21+Lf22+Lf23+...+Lf24+Lf25)+0.75*Lf32+0.4*0.5*(Lf96+Lf97+Lf98+Lf99) |
| max M _η | -14458.2 | 0.00 | 22.84 | 5.09 | 2688.83 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf104+Lf6+0.6*(Lf14+Lf16)+0.2*Lf30 |
| min M _ξ | -10948.9 | 3.75 | -450.13 | 3.37 | -1374.99 | -545.26 | Lf1+Lf2+Lf3+0.9*Lf103+0.2*Lf18 |
| max M _ξ | -13364.3 | -3.75 | -202.24 | 20.67 | 748.37 | 545.26 | Lf1+Lf2+Lf3+1.1*Lf103+Lf5+Lf6+Lf7+0.5*(Lf14+Lf16)+0.2*(Lf19+Lf20+...+Lf21+Lf22+Lf23+Lf24+Lf25+Lf26) |

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 | -6.49 | -5.81 | -0.08 | -0.38 | Lf1+Lf2+Lf3+1.1*Lf104+Lf6+0.5*(Lf15+Lf16)+0.2*Lf19+0.2*Lf30 |
| max σ ₁ | 1.65 | 1.65 | -9.25 | -9.25 | Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf7+0.5*(Lf14+Lf17)+0.4*(Lf20+Lf21+Lf22+Lf23+Lf24+Lf25)+...+0.75*Lf32+0.4*0.5*(Lf96+Lf97+Lf98+Lf99) |
| min σ ₂ | -5.81 | -6.49 | -0.38 | -0.08 | Lf1+Lf2+Lf3+1.1*Lf104+Lf6+0.5*(Lf15+Lf16)+0.2*Lf18+0.2*Lf30 |
| max σ ₂ | 1.65 | 1.65 | -9.25 | -9.25 | Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf7+0.5*(Lf14+Lf17)+0.4*(Lf20+Lf21+Lf22+Lf23+Lf24+Lf25)+...+0.75*Lf32+0.4*0.5*(Lf96+Lf97+Lf98+Lf99) |
| min σ ₃ | 1.64 | 1.64 | -9.26 | -9.26 | Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf7+0.5*(Lf15+Lf17)+0.4*(Lf20+Lf21+Lf22+Lf23+Lf24+Lf25)+...+0.75*Lf32+0.4*0.5*(Lf96+Lf97+Lf98+Lf99) |
| max σ ₃ | -6.42 | -6.42 | 0.18 | 0.18 | Lf1+Lf2+Lf3+1.1*Lf104+Lf6+0.6*(Lf14+Lf16)+0.2*Lf30 |
| min σ ₄ | 1.64 | 1.64 | -9.26 | -9.26 | Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf7+0.5*(Lf15+Lf17)+0.4*(Lf20+Lf21+Lf22+Lf23+Lf24+Lf25)+...+0.75*Lf32+0.4*0.5*(Lf96+Lf97+Lf98+Lf99) |
| max σ ₄ | -6.42 | -6.42 | 0.18 | 0.18 | Lf1+Lf2+Lf3+1.1*Lf104+Lf6+0.6*(Lf14+Lf16)+0.2*Lf30 |

Nachweis der Mindestbewehrung zur Begrenzung der Rissbreite

k_{z,t} = 1.00 ⇒ f_{ct,eff} = 3.20, Biegezwang

| Ort | σ _{s,t} 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 | | | | | | | | | | | | |
| Steg oben | +0.0 | 26.4 | 5817.8 | -4.4 | 1.88 | 0.11 | 0.65 | 253.0 | 0.00 | 0.00 | 5.22 ≤ | 16.57 |
| Steg unten | +0.0 | 38.2 | 8394.5 | -2.0 | 1.88 | 0.26 | 0.65 | 219.1 | 0.00 | 0.00 | 21.03 ≤ | 34.20 |
| Gurt links oben | +0.0 | 26.4 | 3639.8 | 1.2 | 0.67 | 0.62 | 0.98 | 253.0 | 0.00 | 0.00 | 28.11 > | 17.58 |
| Gurt rechts oben | +0.0 | 26.4 | 3639.8 | 1.2 | 0.67 | 0.62 | 0.98 | 253.0 | 0.00 | 0.00 | 28.11 > | 17.58 |

Nachweis der Mindestbewehrung zur Rissbreitenbeschränkung nicht erfüllt!

Berechnung der Rissbreite mit k_{z,t} = 1.00 ⇒ f_{ct,eff} = 3.20

| Typ | Ort | h _w cm | Ø _s mm | σ _s MN/m ² | eff ρ % | ρ _{tot} % | ε _{sm} - ε _{cm} ‰ | S _{r,max} mm | W _k mm | zul W _k mm |
|--|------------------|----------------------|----------------------|-------------------------------------|------------|-----------------------|--|--------------------------|----------------------|--------------------------|
| Extremierung 1: Standardkombination | | | | | | | | | | |
| min N | Steg oben | 22.5 | 12.0 | -25.9 | 0.335 | 0.335 | 0.000 | 0.0 | 0.00 ≤ | 0.20 |
| min N | Steg unten | 22.5 | 16.0 | -23.4 | 0.691 | 0.691 | 0.000 | 0.0 | 0.00 ≤ | 0.20 |
| min N | Gurt links oben | 22.5 | 12.0 | -25.9 | 0.475 | 0.475 | 0.000 | 0.0 | 0.00 ≤ | 0.20 |
| min N | Gurt rechts oben | 22.5 | 12.0 | -25.9 | 0.475 | 0.475 | 0.000 | 0.0 | 0.00 ≤ | 0.20 |
| max N | Steg oben | 22.5 | 12.0 | -18.3 | 0.335 | 0.335 | 0.000 | 0.0 | 0.00 ≤ | 0.20 |
| max N | Steg unten | 22.5 | 16.0 | -19.3 | 0.691 | 0.691 | 0.000 | 0.0 | 0.00 ≤ | 0.20 |
| max N | Gurt links oben | 22.5 | 12.0 | -18.3 | 0.475 | 0.475 | 0.000 | 0.0 | 0.00 ≤ | 0.20 |
| max N | Gurt rechts oben | 22.5 | 12.0 | -18.3 | 0.475 | 0.475 | 0.000 | 0.0 | 0.00 ≤ | 0.20 |
| min M _η | Steg oben | 22.5 | 12.0 | +8.0 | 0.335 | 0.335 | 0.024 | 8.3 | 0.00 ≤ | 0.20 |
| min M _η | Steg unten | 22.5 | 16.0 | -59.7 | 0.691 | 0.691 | 0.000 | 0.0 | 0.00 ≤ | 0.20 |
| min M _η | Gurt links oben | 22.5 | 12.0 | +8.0 | 0.475 | 0.475 | 0.024 | 8.3 | 0.00 ≤ | 0.20 |



Berechnung der Rissbreite mit $k_{z,t} = 1.00 \Rightarrow f_{ct,eff} = 3.20$

| Typ | Ort | h_w cm | σ_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 |
|----------------|------------------|-------------|------------------|---------------------------------|-----------------|-----------------|--------------------------------------|------------------|-------------|-----------------|
| min M_{η} | Gurt rechts oben | 22.5 | 12.0 | +8.0 | 0.475 | 0.475 | 0.024 | 8.3 | 0.00 | ≤ 0.20 |
| max M_{η} | Steg oben | 22.5 | 12.0 | -38.4 | 0.335 | 0.335 | 0.000 | 0.0 | 0.00 | ≤ 0.20 |
| max M_{η} | Steg unten | 22.5 | 16.0 | -2.4 | 0.691 | 0.691 | 0.000 | 0.0 | 0.00 | ≤ 0.20 |
| max M_{η} | Gurt links oben | 22.5 | 12.0 | -38.4 | 0.475 | 0.475 | 0.000 | 0.0 | 0.00 | ≤ 0.20 |
| max M_{η} | Gurt rechts oben | 22.5 | 12.0 | -38.4 | 0.475 | 0.475 | 0.000 | 0.0 | 0.00 | ≤ 0.20 |
| min M_{ξ} | Steg oben | 22.5 | 12.0 | -11.9 | 0.335 | 0.335 | 0.000 | 0.0 | 0.00 | ≤ 0.20 |
| min M_{ξ} | Steg unten | 22.5 | 16.0 | -30.5 | 0.691 | 0.691 | 0.000 | 0.0 | 0.00 | ≤ 0.20 |
| min M_{ξ} | Gurt links oben | 22.5 | 12.0 | -13.2 | 0.475 | 0.475 | 0.000 | 0.0 | 0.00 | ≤ 0.20 |
| min M_{ξ} | Gurt rechts oben | 22.5 | 12.0 | -10.6 | 0.475 | 0.475 | 0.000 | 0.0 | 0.00 | ≤ 0.20 |
| max M_{ξ} | Steg oben | 22.5 | 12.0 | -26.6 | 0.335 | 0.335 | 0.000 | 0.0 | 0.00 | ≤ 0.20 |
| max M_{ξ} | Steg unten | 22.5 | 16.0 | -16.8 | 0.691 | 0.691 | 0.000 | 0.0 | 0.00 | ≤ 0.20 |
| max M_{ξ} | Gurt links oben | 22.5 | 12.0 | -25.3 | 0.475 | 0.475 | 0.000 | 0.0 | 0.00 | ≤ 0.20 |
| max M_{ξ} | Gurt rechts oben | 22.5 | 12.0 | -28.0 | 0.475 | 0.475 | 0.000 | 0.0 | 0.00 | ≤ 0.20 |

Nachweis der Beschränkung der Rissbreite erfüllt

Nachweis 3: 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 | -28.6 | 0.00 | -306.68 | 0.00 | -1954.73 | 0.00 | $Lf1+Lf2+Lf3+Lf100+0.81*Lf15$ |
| max N | 28.6 | 16.86 | -1115.98 | 66.28 | -2957.32 | -2453.68 | $1.35*(Lf1+Lf2+Lf3)+Lf100+0.81*(Lf8+Lf9+Lf10+Lf14+Lf16)+\dots$ |
| min Q_{η} | 0.0 | -28.09 | -306.68 | 0.00 | -1954.73 | 4089.47 | $Lf1+Lf2+Lf3+Lf100+1.5*Lf19$ |
| max Q_{η} | 22.9 | 28.09 | -1134.42 | 76.39 | -3403.34 | -4089.47 | $1.35*(Lf1+Lf2+Lf3)+Lf100+0.81*(Lf8+Lf9+Lf10)+0.8*0.81*(Lf14+\dots$ |
| min Q_{ξ} | 0.0 | 0.00 | -2177.72 | -67.69 | -9198.55 | 0.00 | $1.35*(Lf1+Lf2+Lf3)+Lf100+0.81*(Lf8+Lf10)+0.8*0.81*Lf17+\dots$ |
| max Q_{ξ} | 28.6 | 16.86 | -47.49 | 15.17 | 1823.72 | -2453.68 | $Lf1+Lf2+Lf3+Lf101+0.81*(Lf9+Lf14+Lf16)+0.6*1.5*Lf18$ |
| min T | 0.0 | 0.00 | -420.25 | -590.66 | -4153.15 | 0.00 | $Lf1+Lf2+Lf3+Lf100+1.35*Lf23+1.35*(Lf85+Lf91)+0.75*(Lf96+Lf99)$ |
| max T | 22.9 | 16.86 | -1167.74 | 695.27 | -4752.71 | -2453.68 | $1.35*(Lf1+Lf2+Lf3)+Lf100+0.81*(Lf8+Lf9+Lf10)+0.8*0.81*(Lf14+\dots$ |
| min M_{η} | 0.0 | 0.00 | -1736.63 | 373.13 | -10263.51 | 0.00 | $1.35*(Lf1+Lf2+Lf3)+Lf100+0.81*(Lf8+Lf10)+0.8*0.81*Lf17+\dots$ |
| max M_{η} | 28.6 | 16.86 | -260.61 | 40.92 | 2301.07 | -2453.68 | $Lf1+Lf2+Lf3+Lf101+0.81*(Lf9+Lf14+Lf16)+0.6*1.5*Lf18+\dots$ |
| min M_{ξ} | 0.0 | 28.09 | -306.68 | 25.28 | -1954.73 | -4089.47 | $Lf1+Lf2+Lf3+Lf100+1.5*Lf18$ |
| max M_{ξ} | 22.9 | -28.09 | -1134.42 | 51.12 | -3403.34 | 4089.47 | $1.35*(Lf1+Lf2+Lf3)+Lf100+0.81*(Lf8+Lf9+Lf10)+0.8*0.81*(Lf14+\dots$ |

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 | -4.42 | 0.68 | 3.81 | 1.55 | $Lf1+Lf2+Lf3+Lf101+0.81*Lf9+0.8*0.81*(Lf15+Lf16)+1.5*Lf19+0.75*1.35*Lf30$ |
| max σ_1 | 11.84 | 8.78 | -15.54 | -14.18 | $1.35*(Lf1+Lf2+Lf3)+Lf100+0.81*(Lf8+Lf10)+0.8*0.81*(Lf14+Lf17)+0.6*1.5*Lf18+1.35*(Lf20+\dots$ |
| min σ_2 | 0.68 | -4.42 | 1.55 | 3.81 | $Lf1+Lf2+Lf3+Lf101+0.81*Lf9+0.8*0.81*(Lf15+Lf16)+1.5*Lf18+0.75*1.35*Lf30$ |
| max σ_2 | 8.78 | 11.84 | -14.18 | -15.54 | $1.35*(Lf1+Lf2+Lf3)+Lf100+0.81*(Lf8+Lf10)+0.8*0.81*(Lf14+Lf17)+0.6*1.5*Lf19+1.35*(Lf20+\dots$ |
| min σ_3 | 11.82 | 8.77 | -15.55 | -14.19 | $1.35*(Lf1+Lf2+Lf3)+Lf100+0.81*(Lf8+Lf10)+0.8*0.81*(Lf15+Lf17)+0.6*1.5*Lf18+1.35*(Lf20+\dots$ |
| max σ_3 | -3.83 | -0.77 | 4.02 | 2.66 | $Lf1+Lf2+Lf3+Lf101+0.81*(Lf9+Lf14+Lf16)+0.6*1.5*Lf19+0.75*1.35*Lf30$ |
| min σ_4 | 8.77 | 11.82 | -14.19 | -15.55 | $1.35*(Lf1+Lf2+Lf3)+Lf100+0.81*(Lf8+Lf10)+0.8*0.81*(Lf15+Lf17)+0.6*1.5*Lf19+1.35*(Lf20+\dots$ |
| max σ_4 | -0.77 | -3.83 | 2.66 | 4.02 | $Lf1+Lf2+Lf3+Lf101+0.81*(Lf9+Lf14+Lf16)+0.6*1.5*Lf18+0.75*1.35*Lf30$ |

Bruchsicherheitsnachweis

| Typ | ϵ_b ‰ | ϵ_s ‰ | D_{bu} 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 | 3.61 | -21748.3 | 57.1 | 21654.8 | 65.7 | -28.6 | -1954.7 | 0.0 | 0.14 |
| max N | -3.50 | 5.38 | -18520.4 | 47.3 | 19386.2 | 77.2 | 28.6 | -2957.3 | -2453.7 | 0.26 |
| min M_{η} | -3.50 | 3.65 | -21631.5 | 56.8 | 21747.1 | 65.8 | 0.0 | -10263.5 | 0.0 | 0.72 |
| max M_{η} | -3.50 | 9.63 | -19030.4 | 31.1 | 20155.7 | 53.0 | 28.6 | 2301.1 | -2453.7 | 0.32 |

Bruchsicherheitsnachweis

| Typ | ϵ_b ‰ | ϵ_s ‰ | D_{bu} kN | h_{dbu} cm | Z_{vu} kN | Z cm | N_{Ed} kN | M_{mEd} kNm | M_{nEd} kNm | M_{Ed} / M_{Eds} - |
|---------------|-------------------|-------------------|----------------|-----------------|----------------|-----------|----------------|------------------|------------------|-------------------------|
| min M_{ξ} | -3.50 | 6.39 | -18759.4 | 42.8 | 19627.4 | 100.5 | 0.0 | -1954.7 | -4089.5 | 0.23 |
| max M_{ξ} | -3.50 | 5.71 | -18552.1 | 45.7 | 19415.6 | 84.5 | 22.9 | -3403.3 | 4089.5 | 0.33 |

max $M_{Ed} / M_{Eds} = 0.72 \leq 1 \Rightarrow$ Nachweis der Tragfähigkeit Biegung ständige u. vorüberg. Situation erfüllt

Nachweis 4: EC2 Robustheitsbewehrung

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

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 | -28.2 | 0.00 | -306.68 | 0.00 | -1954.73 | 0.00 | Lf1+Lf2+Lf3+Lf100+0.8*Lf15 |
| max N | 28.2 | 9.37 | -430.38 | 46.29 | -513.69 | -1363.16 | Lf1+Lf2+Lf3+Lf100+Lf5+Lf6+Lf7+0.6*(Lf14+Lf16)+0.5*Lf18+0.4*(Lf20+...+Lf21+Lf22+Lf23+Lf24+Lf25)+0.75*Lf26+0.4*0.5*(Lf96+Lf97+Lf98+Lf99) |
| min Q_{η} | 0.0 | -11.24 | -306.68 | 0.00 | -1954.73 | 1635.79 | Lf1+Lf2+Lf3+Lf100+0.6*Lf19 |
| max Q_{η} | 21.2 | 11.24 | -453.14 | 47.97 | -1064.34 | -1635.79 | Lf1+Lf2+Lf3+Lf100+Lf5+Lf6+Lf7+0.6*(Lf14+Lf16+Lf18)+0.4*(Lf20+...+Lf21+Lf22+Lf23+Lf24+Lf25)+0.75*Lf26+0.4*0.5*(Lf96+Lf97+Lf98+Lf99) |
| min Q_{ξ} | 0.0 | 0.00 | -1067.26 | -40.11 | -5324.00 | 0.00 | Lf1+Lf2+Lf3+Lf100+Lf5+Lf7+0.6*Lf17+0.8*(Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+Lf29)+0.8*0.5*(Lf96+Lf97+Lf98+Lf99) |
| max Q_{ξ} | 28.2 | 9.37 | -67.51 | 8.43 | 1339.27 | -1363.16 | Lf1+Lf2+Lf3+Lf101+Lf6+0.8*(Lf14+Lf16)+0.5*Lf18 |
| min T | 0.0 | 0.00 | -372.40 | -346.69 | -3251.80 | 0.00 | Lf1+Lf2+Lf3+Lf100+0.8*Lf23+0.8*(Lf85+Lf91)+0.8*0.5*(Lf96+Lf99) |
| max T | 21.2 | 9.37 | -429.62 | 408.13 | -1710.52 | -1363.16 | Lf1+Lf2+Lf3+Lf100+Lf5+Lf6+Lf7+0.6*(Lf14+Lf16)+0.5*Lf18+0.8*(Lf20+...+Lf21+Lf22)+0.8*(Lf25+Lf31)+0.8*0.5*(Lf97+Lf98) |
| min M_{η} | 0.0 | 0.00 | -805.86 | 221.11 | -5955.08 | 0.00 | Lf1+Lf2+Lf3+Lf100+Lf5+Lf7+0.6*Lf17+0.8*(Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+Lf32)+0.8*0.5*(Lf96+Lf97+Lf98+Lf99) |
| max M_{η} | 28.2 | 9.37 | -225.38 | 27.51 | 1692.87 | -1363.16 | Lf1+Lf2+Lf3+Lf101+Lf6+0.8*(Lf14+Lf16)+0.5*Lf18+0.75*Lf30 |
| min M_{ξ} | 0.0 | 11.24 | -306.68 | 10.11 | -1954.73 | -1635.79 | Lf1+Lf2+Lf3+Lf100+0.6*Lf18 |
| max M_{ξ} | 21.2 | -11.24 | -453.14 | 37.86 | -1064.34 | 1635.79 | Lf1+Lf2+Lf3+Lf100+Lf5+Lf6+Lf7+0.6*(Lf14+Lf16+Lf19)+0.4*(Lf20+...+Lf21+Lf22+Lf23+Lf24+Lf25)+0.75*Lf26+0.4*0.5*(Lf96+Lf97+Lf98+Lf99) |

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 | -2.56 | -0.86 | 2.82 | 2.07 | Lf1+Lf2+Lf3+Lf101+Lf6+0.8*(Lf15+Lf16)+0.5*Lf19+0.75*Lf30 |
| max σ_1 | 6.83 | 5.13 | -9.00 | -8.24 | Lf1+Lf2+Lf3+Lf100+Lf5+Lf7+0.6*(Lf14+Lf17)+0.5*Lf18+0.8*(Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+...+Lf32)+0.8*0.5*(Lf96+Lf97+Lf98+Lf99) |
| min σ_2 | -0.86 | -2.56 | 2.07 | 2.82 | Lf1+Lf2+Lf3+Lf101+Lf6+0.8*(Lf15+Lf16)+0.5*Lf18+0.75*Lf30 |
| max σ_2 | 5.13 | 6.83 | -8.24 | -9.00 | Lf1+Lf2+Lf3+Lf100+Lf5+Lf7+0.6*(Lf14+Lf17)+0.5*Lf19+0.8*(Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+...+Lf32)+0.8*0.5*(Lf96+Lf97+Lf98+Lf99) |
| min σ_3 | 6.82 | 5.12 | -9.01 | -8.25 | Lf1+Lf2+Lf3+Lf100+Lf5+Lf7+0.6*(Lf15+Lf17)+0.5*Lf18+0.8*(Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+...+Lf32)+0.8*0.5*(Lf96+Lf97+Lf98+Lf99) |
| max σ_3 | -2.54 | -0.84 | 2.84 | 2.08 | Lf1+Lf2+Lf3+Lf101+Lf6+0.8*(Lf14+Lf16)+0.5*Lf19+0.75*Lf30 |
| min σ_4 | 5.12 | 6.82 | -8.25 | -9.01 | Lf1+Lf2+Lf3+Lf100+Lf5+Lf7+0.6*(Lf15+Lf17)+0.5*Lf19+0.8*(Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+...+Lf32)+0.8*0.5*(Lf96+Lf97+Lf98+Lf99) |
| max σ_4 | -0.84 | -2.54 | 2.08 | 2.84 | Lf1+Lf2+Lf3+Lf101+Lf6+0.8*(Lf14+Lf16)+0.5*Lf18+0.75*Lf30 |

Nachweis der Robustheitsbewehrung

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

| Typ | Rand | σ_1 MN/m ² | σ_{i+1} MN/m ² | $\sigma_{nH,P'}$ 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 | -2.08 | -1.33 | -1.71 | ≤ 0.0 | | | | | ⇒ Nachweis erfüllt |
| min σ_1 | unten | 2.82 | 2.07 | 2.44 | > 0.0 | 104.4 | 2.24 | 1.547 | 29.63 | ≤ 34.20 |
| max σ_1 | oben | 6.36 | 5.61 | 5.98 | > 0.0 | 104.4 | 2.24 | 2.232 | 42.76 | > 16.57 |
| max σ_1 | unten | -9.00 | -8.24 | -8.62 | ≤ 0.0 | | | | | ⇒ Nachweis erfüllt |
| min σ_2 | oben | -1.33 | -2.08 | -1.71 | ≤ 0.0 | | | | | ⇒ Nachweis erfüllt |
| min σ_2 | unten | 2.07 | 2.82 | 2.44 | > 0.0 | 104.4 | 2.24 | 1.547 | 29.63 | ≤ 34.20 |
| max σ_2 | oben | 5.61 | 6.36 | 5.98 | > 0.0 | 104.4 | 2.24 | 2.232 | 42.76 | > 16.57 |
| max σ_2 | unten | -8.24 | -9.00 | -8.62 | ≤ 0.0 | | | | | ⇒ Nachweis erfüllt |
| min σ_3 | oben | 6.35 | 5.59 | 5.97 | > 0.0 | 104.4 | 2.24 | 2.232 | 42.76 | > 16.57 |
| min σ_3 | unten | -9.01 | -8.25 | -8.63 | ≤ 0.0 | | | | | ⇒ Nachweis erfüllt |
| max σ_3 | oben | -2.07 | -1.31 | -1.69 | ≤ 0.0 | | | | | ⇒ Nachweis erfüllt |
| max σ_3 | unten | 2.84 | 2.08 | 2.46 | > 0.0 | 104.4 | 2.24 | 1.547 | 29.63 | ≤ 34.20 |
| min σ_4 | oben | 5.59 | 6.35 | 5.97 | > 0.0 | 104.4 | 2.24 | 2.232 | 42.76 | > 16.57 |
| min σ_4 | unten | -8.25 | -9.01 | -8.63 | ≤ 0.0 | | | | | ⇒ Nachweis erfüllt |
| max σ_4 | oben | -1.31 | -2.07 | -1.69 | ≤ 0.0 | | | | | ⇒ Nachweis erfüllt |



Nachweis der Robustheitsbewehrung

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

| Typ | Rand | σ_1 MN/m ² | σ_{i+1} MN/m ² | $\sigma_{nH,P'}$ MN/m ² | zul σ MN/m ² | Zs cm | $f_{ctk0,05}$ MN/m ² | $M_{r,ep}$ MNm | erf As cm ² | vorh As cm ² |
|----------------|-------|---------------------------------|-------------------------------------|---------------------------------------|-----------------------------------|----------|------------------------------------|-------------------|---------------------------|----------------------------|
| max σ_4 | unten | 2.08 | 2.84 | 2.46 | > 0.0 | 104.4 | 2.24 | 1.547 | 29.63 | ≤ 34.20 |

vorh As = 16.57 cm² < erf As = 42.76 cm² ⇒ **Nachweis der Robustheitsbewehrung nicht erfüllt!**

Nachweis 5: 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_{ζ} kN | T kNm | M_{η} kNm | M_{ζ} kNm | Faktorisierung |
|--|----------|------------------|-------------------|----------|-------------------|--------------------|--|
| Extremierung 1: Standardkombination | | | | | | | |
| min N | -13198.3 | 0.00 | -189.04 | 0.00 | -383.69 | 0.00 | Lf1+Lf2+Lf3+Lf104+Lf15 |
| max N | -12130.1 | 11.24 | -407.61 | 47.97 | 1161.34 | -1635.79 | Lf1+Lf2+Lf3+Lf103+Lf5+Lf6+Lf7+Lf14+Lf16+0.6*Lf18+0.4*(Lf20+Lf21+...+Lf22+Lf23+Lf24+Lf25)+0.75*Lf26+0.4*0.5*(Lf96+Lf97+Lf98+Lf99) |
| min Q_{η} | -12165.4 | -18.73 | -306.68 | 0.00 | -830.34 | 2726.31 | Lf1+Lf2+Lf3+Lf103+Lf19 |
| max Q_{η} | -12137.2 | 18.73 | -430.38 | 54.71 | 610.69 | -2726.31 | Lf1+Lf2+Lf3+Lf103+Lf5+Lf6+Lf7+0.8*(Lf14+Lf16)+Lf18+0.4*(Lf20+...+Lf21+Lf22+Lf23+Lf24+Lf25)+0.75*Lf26+0.4*0.5*(Lf96+Lf97+Lf98+Lf99) |
| min Q_{ζ} | -12165.4 | 0.00 | -1253.23 | -50.14 | -4941.12 | 0.00 | Lf1+Lf2+Lf3+Lf103+Lf5+Lf7+0.8*Lf17+Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+...+Lf29+0.5*(Lf96+Lf97+Lf98+Lf99) |
| max Q_{ζ} | -13127.7 | 11.24 | -44.75 | 10.11 | 3106.52 | -1635.79 | Lf1+Lf2+Lf3+Lf104+Lf6+Lf14+Lf16+0.6*Lf18 |
| min T | -12165.4 | 0.00 | -388.83 | -433.37 | -2451.68 | 0.00 | Lf1+Lf2+Lf3+Lf103+Lf23+Lf85+Lf91+0.5*(Lf96+Lf99) |
| max T | -12137.2 | 11.24 | -454.66 | 509.74 | -387.41 | -1635.79 | Lf1+Lf2+Lf3+Lf103+Lf5+Lf6+Lf7+0.8*(Lf14+Lf16)+0.6*Lf18+Lf20+Lf21+...+Lf22+Lf25+Lf31+0.5*(Lf97+Lf98) |
| min M_{η} | -12165.4 | 0.00 | -926.49 | 276.39 | -5729.98 | 0.00 | Lf1+Lf2+Lf3+Lf103+Lf5+Lf7+0.8*Lf17+Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+...+Lf32+0.5*(Lf96+Lf97+Lf98+Lf99) |
| max M_{η} | -13127.7 | 11.24 | -202.62 | 29.19 | 3460.11 | -1635.79 | Lf1+Lf2+Lf3+Lf104+Lf6+Lf14+Lf16+0.6*Lf18+0.75*Lf30 |
| min M_{ζ} | -12165.4 | 18.73 | -306.68 | 16.85 | -830.34 | -2726.31 | Lf1+Lf2+Lf3+Lf103+Lf18 |
| max M_{ζ} | -12137.2 | -18.73 | -430.38 | 37.86 | 610.69 | 2726.31 | Lf1+Lf2+Lf3+Lf103+Lf5+Lf6+Lf7+0.8*(Lf14+Lf16)+Lf19+0.4*(Lf20+...+Lf21+Lf22+Lf23+Lf24+Lf25)+0.75*Lf26+0.4*0.5*(Lf96+Lf97+Lf98+Lf99) |

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 | -8.01 | -4.61 | 1.58 | 0.07 | Lf1+Lf2+Lf3+Lf104+Lf6+0.8*(Lf15+Lf16)+Lf19+0.75*Lf30 |
| max σ_1 | 3.65 | 1.61 | -11.87 | -10.97 | Lf1+Lf2+Lf3+Lf103+Lf5+Lf7+0.8*(Lf14+Lf17)+0.6*Lf18+Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+Lf32+...+0.5*(Lf96+Lf97+Lf98+Lf99) |
| min σ_2 | -4.61 | -8.01 | 0.07 | 1.58 | Lf1+Lf2+Lf3+Lf104+Lf6+0.8*(Lf15+Lf16)+Lf18+0.75*Lf30 |
| max σ_2 | 1.61 | 3.65 | -10.97 | -11.87 | Lf1+Lf2+Lf3+Lf103+Lf5+Lf7+0.8*(Lf14+Lf17)+0.6*Lf19+Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+Lf32+...+0.5*(Lf96+Lf97+Lf98+Lf99) |
| min σ_3 | 3.64 | 1.60 | -11.89 | -10.98 | Lf1+Lf2+Lf3+Lf103+Lf5+Lf7+0.8*(Lf15+Lf17)+0.6*Lf18+Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+Lf32+...+0.5*(Lf96+Lf97+Lf98+Lf99) |
| max σ_3 | -7.87 | -5.83 | 2.09 | 1.18 | Lf1+Lf2+Lf3+Lf104+Lf6+Lf14+Lf16+0.6*Lf19+0.75*Lf30 |
| min σ_4 | 1.60 | 3.64 | -10.98 | -11.89 | Lf1+Lf2+Lf3+Lf103+Lf5+Lf7+0.8*(Lf15+Lf17)+0.6*Lf19+Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+Lf32+...+0.5*(Lf96+Lf97+Lf98+Lf99) |
| max σ_4 | -5.83 | -7.87 | 1.18 | 2.09 | Lf1+Lf2+Lf3+Lf104+Lf6+Lf14+Lf16+0.6*Lf18+0.75*Lf30 |

Betondruck- u. Betonstahlspannungen in Zustand II mit 0.60 x $f_{ck} = 21.0$ MN/m², 0.80 x $f_{yk} = 400.0$ MN/m²

Aus seltener Einwirkungskombination: $\sigma_{max} = 4.51$ MN/m² > $\sigma_{ctm} = 3.2$ MN/m² ⇒ Querschnitt ist in **Zustand II**

| 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 N | -3.11 | -3.11 | -4.05 | -4.05 | -4.05 | ≥ -21.0 | -27.71 | ≥ -400 | 8 | -21.94 ≤ 400 |
| max N | -5.28 | -3.33 | -1.13 | -2.04 | -5.28 | ≥ -21.0 | -35.84 | ≥ -400 | 1 | -9.18 ≤ 400 |
| min M_{η} | 0.00 | 0.00 | -12.49 | -12.49 | -12.49 | ≥ -21.0 | -85.06 | ≥ -400 | 7 | 36.56 ≤ 400 |
| max M_{η} | -8.01 | -5.97 | 0.00 | 0.00 | -8.01 | ≥ -21.0 | -53.27 | ≥ -400 | 1 | 15.03 ≤ 400 |
| min M_{ξ} | -4.04 | -0.72 | -3.68 | -5.10 | -5.10 | ≥ -21.0 | -34.64 | ≥ -400 | 9 | -5.88 ≤ 400 |
| max M_{ξ} | -2.13 | -5.41 | -3.11 | -1.62 | -5.41 | ≥ -21.0 | -37.44 | ≥ -400 | 3 | -11.97 ≤ 400 |

$\sigma_{c,min} = -12.49$ MN/m² ≥ $f_c = -21.0$ MN/m² ⇒ **Nachweis der zulässigen Betondruckspannungen erfüllt**

$|\sigma_{s,max}| = 85.06$ MN/m² ≤ $f_{yk} = 400.0$ MN/m² ⇒ **Nachweis der zulässigen Betonstahlspannungen erfüllt**

Nachweis 6: 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 _ξ kN | T kNm | M _η kNm | M _ξ kNm | Faktorisierung |
|--|---------|----------------------|----------------------|----------|-----------------------|-----------------------|---|
| Extremierung 1: Standardkombination | | | | | | | |
| min N | -17.6 | 0.00 | -360.14 | 0.00 | -1298.27 | 0.00 | Lf2+Lf3+0.5*Lf15 |
| max N | 17.6 | 0.00 | -399.15 | 20.67 | -264.21 | 0.00 | Lf2+Lf3+Lf5+Lf6+Lf7+0.5*(Lf14+Lf16)+0.2*(Lf20+Lf21+Lf22+Lf23+... ...+Lf24+Lf25+Lf26) |
| min Q _η | 0.0 | 0.00 | -360.14 | 0.00 | -1298.27 | 0.00 | Lf2+Lf3 |
| max Q _η | 17.6 | 0.00 | -399.15 | 20.67 | -264.21 | 0.00 | Lf2+Lf3+Lf5+Lf6+Lf7+0.5*(Lf14+Lf16)+0.2*(Lf20+Lf21+Lf22+Lf23+... ...+Lf24+Lf25+Lf26) |
| min Q _ξ | 0.0 | 0.00 | -590.16 | -10.03 | -3251.69 | 0.00 | Lf2+Lf3+Lf5+Lf7+0.5*Lf17+0.2*(Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+Lf29) |
| max Q _ξ | 17.6 | 0.00 | -272.76 | 0.00 | 815.32 | 0.00 | Lf2+Lf3+Lf6+0.5*(Lf14+Lf16) |
| min T | 0.0 | 0.00 | -373.02 | -79.19 | -1609.72 | 0.00 | Lf2+Lf3+0.2*Lf23+0.2*(Lf85+Lf91) |
| max T | 17.6 | 0.00 | -347.48 | 92.44 | -260.75 | 0.00 | Lf2+Lf3+Lf5+Lf6+Lf7+0.5*(Lf14+Lf16)+0.2*(Lf20+Lf21+Lf22)+... ...+0.2*(Lf25+Lf31) |
| min M _η | 0.0 | 0.00 | -524.82 | 55.28 | -3409.46 | 0.00 | Lf2+Lf3+Lf5+Lf7+0.5*Lf17+0.2*(Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+Lf32) |
| max M _η | 17.6 | 0.00 | -314.86 | 5.09 | 909.61 | 0.00 | Lf2+Lf3+Lf6+0.5*(Lf14+Lf16)+0.2*Lf30 |
| min M _ξ | 0.0 | 0.00 | -360.14 | 0.00 | -1298.27 | 0.00 | Lf2+Lf3 |
| max M _ξ | 17.6 | 0.00 | -399.15 | 20.67 | -264.21 | 0.00 | Lf2+Lf3+Lf5+Lf6+Lf7+0.5*(Lf14+Lf16)+0.2*(Lf20+Lf21+Lf22+Lf23+... ...+Lf24+Lf25+Lf26) |

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 | -0.92 | -0.92 | 1.31 | 1.31 | Lf2+Lf3+Lf6+0.5*(Lf15+Lf16)+0.2*Lf30 |
| max σ ₁ | 3.43 | 3.43 | -4.93 | -4.93 | Lf2+Lf3+Lf5+Lf7+0.5*(Lf14+Lf17)+0.2*(Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+Lf32) |
| min σ ₂ | -0.92 | -0.92 | 1.31 | 1.31 | Lf2+Lf3+Lf6+0.5*(Lf15+Lf16)+0.2*Lf30 |
| max σ ₂ | 3.43 | 3.43 | -4.93 | -4.93 | Lf2+Lf3+Lf5+Lf7+0.5*(Lf14+Lf17)+0.2*(Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+Lf32) |
| min σ ₃ | 3.42 | 3.42 | -4.94 | -4.94 | Lf2+Lf3+Lf5+Lf7+0.5*(Lf15+Lf17)+0.2*(Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+Lf32) |
| max σ ₃ | -0.91 | -0.91 | 1.32 | 1.32 | Lf2+Lf3+Lf6+0.5*(Lf14+Lf16)+0.2*Lf30 |
| min σ ₄ | 3.42 | 3.42 | -4.94 | -4.94 | Lf2+Lf3+Lf5+Lf7+0.5*(Lf15+Lf17)+0.2*(Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+Lf32) |
| max σ ₄ | -0.91 | -0.91 | 1.32 | 1.32 | Lf2+Lf3+Lf6+0.5*(Lf14+Lf16)+0.2*Lf30 |

Nachweis der zulässigen Spannstahlspannungen

Aus seltener Einwirkungskombination: $\sigma_{\max} = 4.51 \text{ MN/m}^2 > f_{ctm} = 3.2 \text{ MN/m}^2 \Rightarrow$ Querschnitt ist in **Zustand II**

| 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 | | | | | max M _η | 1 | 798.0 | 38.7 | 836.7 ≤ 1150.5 |
| min N | 1 | 798.0 | 62.2 | 860.2 ≤ 1150.5 | max M _η | 2 | 809.9 | 38.7 | 848.6 ≤ 1150.5 |
| min N | 2 | 809.9 | 62.2 | 872.1 ≤ 1150.5 | min M _ξ | 1 | 798.0 | 62.8 | 860.7 ≤ 1150.5 |
| max N | 1 | 798.0 | 13.3 | 811.3 ≤ 1150.5 | min M _ξ | 2 | 809.9 | 62.8 | 872.7 ≤ 1150.5 |
| max N | 2 | 809.9 | 13.3 | 823.2 ≤ 1150.5 | max M _ξ | 1 | 798.0 | 13.3 | 811.3 ≤ 1150.5 |
| min M _η | 1 | 798.0 | 165.2 | 963.1 ≤ 1150.5 | max M _ξ | 2 | 809.9 | 13.3 | 823.2 ≤ 1150.5 |
| min M _η | 2 | 809.9 | 165.2 | 975.1 ≤ 1150.5 | | | | | |

$\sigma_{p,\max} = 975.10 \text{ MN/m}^2 \leq f_{pk} = 1150.5 \text{ MN/m}^2 \Rightarrow$ **Nachweis der zulässigen Spannstahlspannungen erfüllt**

Nachweis 7: 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 | -14497.0 | 0.00 | -33.82 | 0.00 | 205.62 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf104+0.5*Lf15 |
| max N | -10931.2 | 0.00 | -489.15 | 20.67 | -340.94 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf6+Lf7+0.5*(Lf14+Lf16)+0.2*(Lf20+Lf21+... ...+Lf22+Lf23+Lf24+Lf25+Lf26) |
| min Q _η | -10948.9 | 0.00 | -450.13 | 0.00 | -1374.99 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf103 |
| max Q _η | -13364.3 | 0.00 | -202.24 | 20.67 | 748.37 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf103+Lf5+Lf6+Lf7+0.5*(Lf14+Lf16)+0.2*(Lf20+Lf21+... ...+Lf22+Lf23+Lf24+Lf25+Lf26) |
| min Q _ξ | -10948.9 | 0.00 | -680.16 | -10.03 | -3328.41 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf7+0.5*Lf17+0.2*(Lf20+Lf21+Lf22+Lf23+... ...+Lf24+Lf25+Lf29) |
| max Q _ξ | -14461.7 | 0.00 | 53.56 | 0.00 | 2319.21 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf104+Lf6+0.5*(Lf14+Lf16) |
| min T | -10948.9 | 0.00 | -463.01 | -79.19 | -1686.44 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf103+0.2*Lf23+0.2*(Lf85+Lf91) |
| max T | -13364.3 | 0.00 | -150.56 | 92.44 | 751.83 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf103+Lf5+Lf6+Lf7+0.5*(Lf14+Lf16)+0.2*(Lf20+Lf21+... ...+Lf22)+0.2*(Lf25+Lf31) |
| min M _η | -10948.9 | 0.00 | -614.81 | 55.28 | -3486.18 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf7+0.5*Lf17+0.2*(Lf20+Lf21+Lf22+Lf23+... ...+Lf24+Lf25+Lf32) |
| max M _η | -14461.7 | 0.00 | 11.46 | 5.09 | 2413.50 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf104+Lf6+0.5*(Lf14+Lf16)+0.2*Lf30 |
| min M _ξ | -10948.9 | 0.00 | -450.13 | 0.00 | -1374.99 | 0.00 | Lf1+Lf2+Lf3+0.9*Lf103 |
| max M _ξ | -13364.3 | 0.00 | -202.24 | 20.67 | 748.37 | 0.00 | Lf1+Lf2+Lf3+1.1*Lf103+Lf5+Lf6+Lf7+0.5*(Lf14+Lf16)+0.2*(Lf20+Lf21+... ...+Lf22+Lf23+Lf24+Lf25+Lf26) |



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 | -6.15 | -6.15 | -0.23 | -0.23 | $Lf1+Lf2+Lf3+1.1*Lf104+Lf6+0.5*(Lf15+Lf16)+0.2*Lf30$ |
| max σ_1 | 0.69 | 0.69 | -7.86 | -7.86 | $Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf7+0.5*(Lf14+Lf17)+0.2*(Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+Lf32)$ |
| min σ_2 | -6.15 | -6.15 | -0.23 | -0.23 | $Lf1+Lf2+Lf3+1.1*Lf104+Lf6+0.5*(Lf15+Lf16)+0.2*Lf30$ |
| max σ_2 | 0.69 | 0.69 | -7.86 | -7.86 | $Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf7+0.5*(Lf14+Lf17)+0.2*(Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+Lf32)$ |
| min σ_3 | 0.68 | 0.68 | -7.87 | -7.87 | $Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf7+0.5*(Lf15+Lf17)+0.2*(Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+Lf32)$ |
| max σ_3 | -6.14 | -6.14 | -0.22 | -0.22 | $Lf1+Lf2+Lf3+1.1*Lf104+Lf6+0.5*(Lf14+Lf16)+0.2*Lf30$ |
| min σ_4 | 0.68 | 0.68 | -7.87 | -7.87 | $Lf1+Lf2+Lf3+0.9*Lf103+Lf5+Lf7+0.5*(Lf15+Lf17)+0.2*(Lf20+Lf21+Lf22+Lf23+Lf24+Lf25+Lf32)$ |
| max σ_4 | -6.14 | -6.14 | -0.22 | -0.22 | $Lf1+Lf2+Lf3+1.1*Lf104+Lf6+0.5*(Lf14+Lf16)+0.2*Lf30$ |

Nachweis der Dekompression

Schwerpunkt Spannstahl: $y_s = 300.0$ cm, $z_s = 39.5$ 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 | -6.15 | -6.15 | -0.23 | -0.23 | $-6.15 \leq 0.00$ |
| max σ_1 | +0.69 | +0.69 | -7.86 | -7.86 | $+0.69 > 0.00$ |
| min σ_2 | -6.15 | -6.15 | -0.23 | -0.23 | $-6.15 \leq 0.00$ |
| max σ_2 | +0.69 | +0.69 | -7.86 | -7.86 | $+0.69 > 0.00$ |
| min σ_3 | +0.68 | +0.68 | -7.87 | -7.87 | $+0.68 > 0.00$ |
| max σ_3 | -6.14 | -6.14 | -0.22 | -0.22 | $-6.14 \leq 0.00$ |
| min σ_4 | +0.68 | +0.68 | -7.87 | -7.87 | $+0.68 > 0.00$ |
| max σ_4 | -6.14 | -6.14 | -0.22 | -0.22 | $-6.14 \leq 0.00$ |

$\sigma_{c,max} = 0.69$ MN/m² > 0 MN/m² \Rightarrow Nachweis der Dekompression nicht erfüllt

Zusammenfassung aller Nachweise

Zulagebewehrung: Steg oben $\Delta A_{s1} = 26.18$ cm², Steg unten $\Delta A_{s2} = 0.00$ cm²

Gurt links $\Delta A_{s3} = 10.53$ cm², Gurt rechts $\Delta A_{s4} = 10.53$ cm²

max. Ausnutzung: $U = 1.689$