

# SPW

Alle Angaben beziehen sich auf einen Meter laufende Wand

## 1. Eingabedaten für Spundwand DIN EN 1997-1 und DIN EN 1993-1

Erdwiderstand nach Sokolovsky/Pregl bei  $\varphi \geq 30^\circ$

Ausbreitungswinkel für Blocklasten: 45.00

Mindesterddruckbeiwert vorgeben mit  $k_{gh \min} = 0.00$

Wandreibungswinkel Aktivseite  $\delta = 2/3 \varphi$ , Passivseite  $\delta = -\varphi$

Theoretischer Fußpunkt bei:  $z_0 = 6.28$  m, theoretische Einbindetiefe  $t_1 = 1.28$

Rammtiefenzuschlag nach Lackner (EAU 8.2.9)

### 1.1. Statische Werte für Spundwand: Larssen 21 (pro lfd. m), S 240 GP

| A                  | I <sub>y</sub>     | W <sub>y</sub>     | A <sub>Querkraft</sub> | Höhe  | G                 |
|--------------------|--------------------|--------------------|------------------------|-------|-------------------|
| cm <sup>2</sup> /m | cm <sup>4</sup> /m | cm <sup>3</sup> /m | cm <sup>2</sup> /m     | mm    | KG/m <sup>2</sup> |
| 121.00             | 7700.00            | 700.00             | 32.58                  | 220.0 | 95.00             |

### 1.2. Bodenparameter

| Nr | Name | h<br>m | z<br>m | $\varphi$<br>° | $\gamma$<br>kN/m <sup>3</sup> | $\gamma'$<br>kN/m <sup>3</sup> | C<br>kN/m <sup>2</sup> | $\delta_a$<br>° | $\delta_p$<br>° | K <sub>ah</sub><br>- | K <sub>ph</sub><br>- | K <sub>ch</sub><br>- |
|----|------|--------|--------|----------------|-------------------------------|--------------------------------|------------------------|-----------------|-----------------|----------------------|----------------------|----------------------|
| 1  | SU   | 3.00   | 3.00   | 30.00          | 19.00                         | 10.00                          | 0.00                   | auto            | auto            | auto                 | auto                 | auto                 |
| 2  | SW   | ∞      | ∞      | 32.50          | 20.00                         | 9.00                           | 0.00                   | auto            | auto            | auto                 | auto                 | auto                 |


Geländeabschluss :  $y_\beta = 0.00$  m,  $\beta = 50^\circ$ ,  $\gamma = 19.00$  kN/m<sup>3</sup>

### 1.3. Einwirkungsstruktur

Auf der linken Seite sind die Beziehungen der Einwirkungen, Lastfallordner und Lastfälle zueinander in einer Baumstruktur dargestellt. Auf der rechten Seite sind die überlagerungsspezifischen Eigenschaften den links stehenden Objekten zugeordnet angegeben. Ein Lastfallordner entspricht überlagerungstechnisch einer Extremierung der in ihm definierten Objekte und kann seinerseits wiederum additiv oder alternativ überlagert werden.

verwendete Symbole:  Einwirkung  Lastfallordner  Lastfall  Imperfektionsfälle

#### 1: ständige Lasten

 1: Boden

#### 2: Verkehr

 2: Verkehrslast

#### ständige Lasten

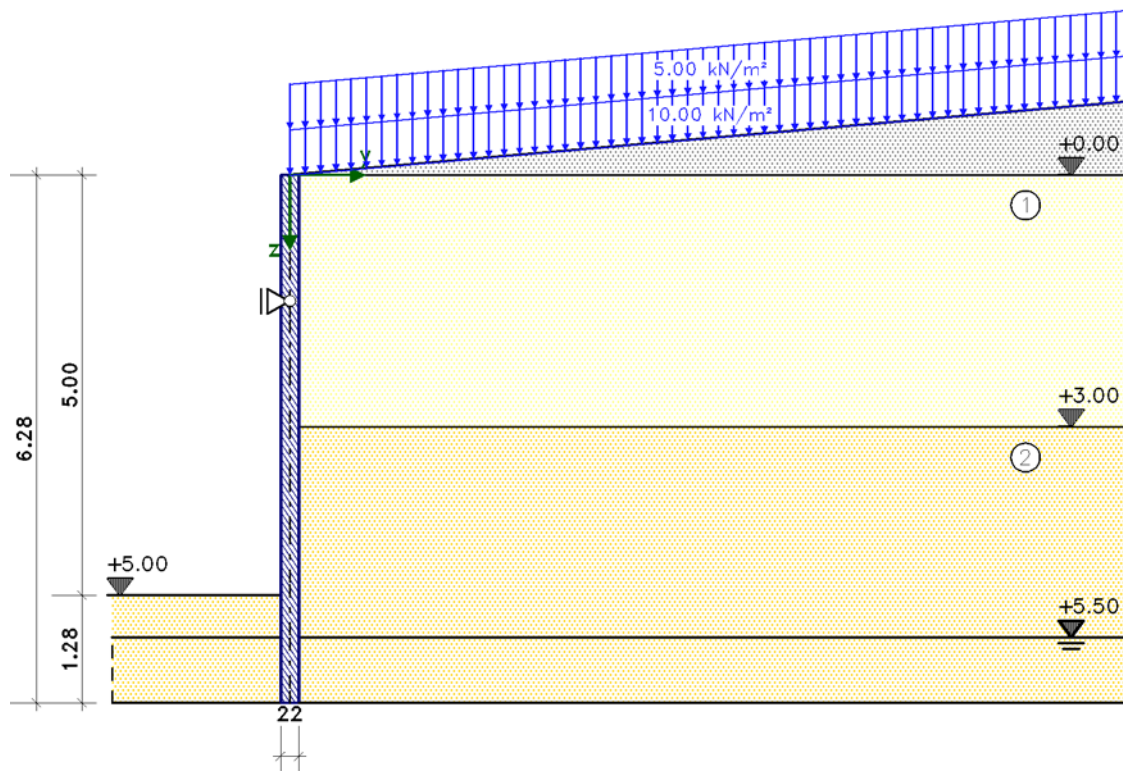
additiv

#### sonstige veränderliche Einwirkungen

additiv

## 2. Aushubzustand 1: A1

### 2.1. Systemplot Maßstab 1:90



## 2.2. Angaben zum Aushubzustand

Berechnung erfolgt in BS-T

Grundwasserstand :  $z = 5.50$  m (erd- und luftseitig)

Aushubtiefe vor der Wand:  $z = 5.00$  m

Fußlagerung: Frei beweglich (gelenkig) Einbindetiefe berechnen, Einspanngrad = 0.00

Theoretischer Fußpunkt bei:  $z_0 = 6.28$  m, theoretische Einbindetiefe  $t_1 = 1.28$

Rammtiefenzuschlag nach Lackner (EAU 8.2.9)

Fußpunkt bei:  $z_F = 5.00 + 1.28 + 0.00 = 6.28$  m

Bemessungserddruck: Aktiver Erddruck  $E_a$

Erddruckumlagerung Rechteck

## 2.3. Lager

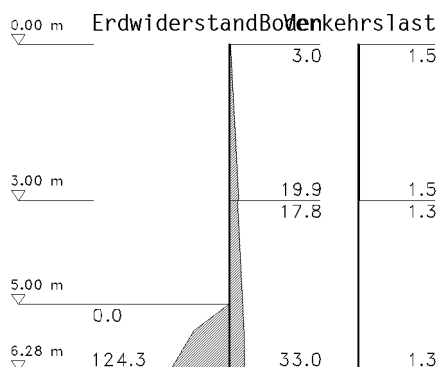
| Name   | z<br>m | $\alpha$<br>° | $C_y$<br>KN/m | $C_z$<br>KN/m | $C_m$<br>KN/- |
|--------|--------|---------------|---------------|---------------|---------------|
| Steife | 1.50   | 0.00          | $\infty$      | 0.00          | 0.00          |

## 2.4. Flächenlasten

| Nr | Lastfall     | Ort      | $y_A$<br>m | $\Delta z$<br>m | $l$<br>m | $b$<br>m | $q$<br>kN/m <sup>2</sup> | $H$<br>kN/m | Ansatz |
|----|--------------|----------|------------|-----------------|----------|----------|--------------------------|-------------|--------|
| 1  | Boden        | Wandkopf | 0.00       | 0.00            | $\infty$ | $\infty$ | 10.00                    | 0.00        | E/s    |
| 2  | Verkehrslast | Wandkopf | 0.00       | 0.00            | $\infty$ | $\infty$ | 5.00                     | 0.00        | E/s    |

T = Trapezförmig, R = Rechteckförmig, E = gemäß EAB 2006 EB 7-1a, s = schichtweise, m = mitteln

## 2.5. Charakteristische horizontale Erddrucklasten



## 2.6. Charakteristische Erddrucklasten

### Erdwiderstand

| z<br>m | $\Sigma g$<br>kN/m <sup>2</sup> | K <sub>pgH</sub><br>- | E <sub>ph</sub><br>kN/m <sup>2</sup> | E <sub>pv</sub><br>kN/m <sup>2</sup> | E <sub>pres</sub><br>kN/m <sup>2</sup> |
|--------|---------------------------------|-----------------------|--------------------------------------|--------------------------------------|--|
| 5.00   | 0.00                            | 7.296                 | 0.00                                 | 0.00                                 | 0.00                                   |
| 5.50   | 10.00                           | 7.296                 | 72.96                                | -46.48                               | 86.51                                  |
| 6.28   | 17.04                           | 7.296                 | 124.30                               | -79.18                               | 147.38                                 |

E<sub>h</sub> = 95.34 kN/m, z<sub>s</sub> = 5.81 m, E<sub>v</sub> = -60.74 kN/m, E<sub>res</sub> = 113.05 kN/m

### Boden

| z<br>m | $\Sigma g$<br>kN/m <sup>2</sup> | $\Sigma g_{ca1}$<br>kN/m <sup>2</sup> | K <sub>agH</sub><br>- | K <sub>agH,min</sub><br>- | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> |
|--------|---------------------------------|---------------------------------------|-----------------------|---------------------------|--------------------------------------|--------------------------------------|--|
| 0.00   | 10.00                           | 10.00                                 | 0.297                 | 0.000                     | 2.97                                 | 1.08                                 | 3.16                                   |
| 3.00   | 70.67                           | 67.00                                 | 0.297                 | 0.000                     | 19.92                                | 7.25                                 | 21.20                                  |
| 3.00   | 70.45                           | 67.00                                 | 0.266                 | 0.000                     | 17.81                                | 7.07                                 | 19.16                                  |
| 5.00   | 112.87                          | 107.00                                | 0.266                 | 0.000                     | 28.44                                | 11.30                                | 30.60                                  |
| 5.50   | 123.47                          | 117.00                                | 0.266                 | 0.000                     | 31.10                                | 12.35                                | 33.46                                  |
| 6.28   | 130.93                          | 124.04                                | 0.266                 | 0.000                     | 32.97                                | 13.10                                | 35.47                                  |

E<sub>h</sub> = 120.52 kN/m, z<sub>s</sub> = 3.97 m, E<sub>v</sub> = 46.74 kN/m, E<sub>res</sub> = 129.27 kN/m

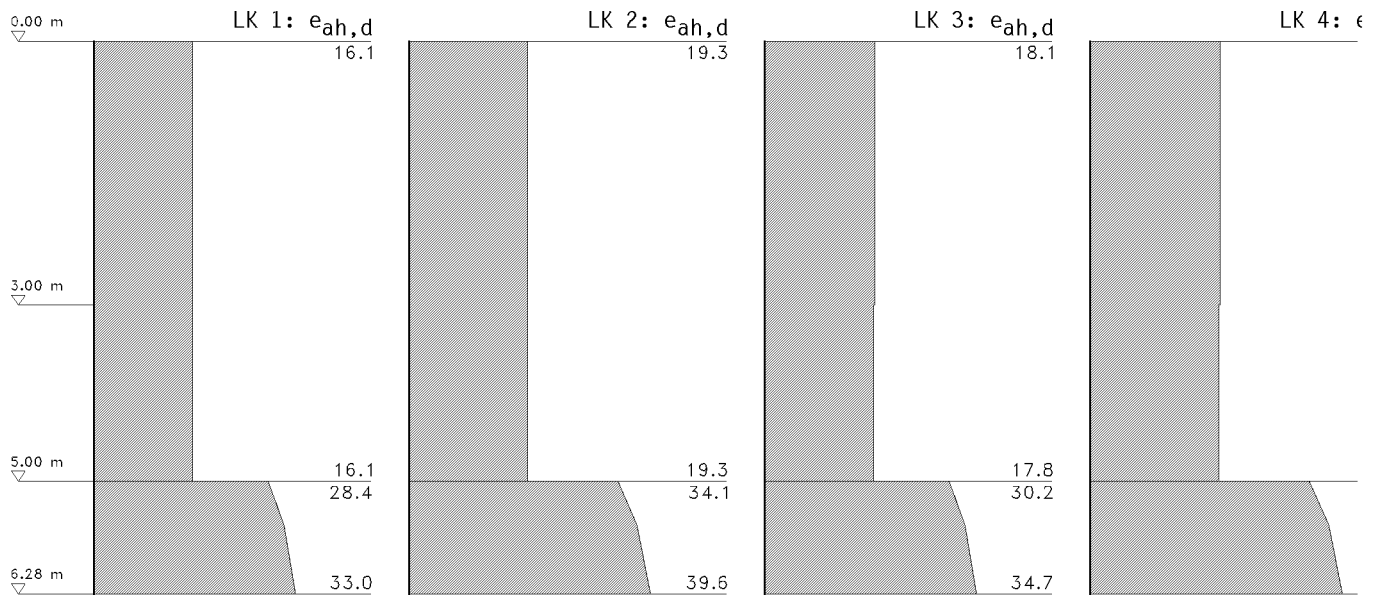
### Verkehrslast

| z<br>m | $\Sigma g$<br>kN/m <sup>2</sup> | K <sub>aph</sub><br>- | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> |
|--------|---------------------------------|-----------------------|--------------------------------------|--------------------------------------|--|
| 0.00   | 5.00                            | 0.297                 | 1.49                                 | 0.54                                 | 1.58                                   |
| 3.00   | 5.00                            | 0.297                 | 1.49                                 | 0.54                                 | 1.58                                   |
| 3.00   | 5.00                            | 0.266                 | 1.33                                 | 0.53                                 | 1.43                                   |
| 5.00   | 5.00                            | 0.266                 | 1.33                                 | 0.53                                 | 1.43                                   |
| 6.28   | 5.00                            | 0.266                 | 1.33                                 | 0.53                                 | 1.43                                   |

E<sub>h</sub> = 8.82 kN/m, z<sub>s</sub> = 3.05 m, E<sub>v</sub> = 3.36 kN/m, E<sub>res</sub> = 9.44 kN/m

## 2.7. Stahlnachweis

### 2.7.1. Überlagerte horizontale Erddrucklasten (aktiv)



### 2.7.2. Überlagerte Erddrucklasten (aktiv)

#### LK 1, Aktivseite

| z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> | z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|--------|--------------------------------------|--------------------------------------|--|
| 0.00   | 16.12                                | 6.18                                 | 17.26                                  | 5.50   | 31.10                                | 12.35                                | 33.46                                  |
| 5.00   | 16.12                                | 6.18                                 | 17.26                                  | 6.28   | 32.97                                | 13.10                                | 35.47                                  |
| 5.00   | 28.44                                | 11.30                                | 30.60                                  |        |                                      |                                      |  |

E<sub>h</sub> = 120.52 kN/m, z<sub>s</sub> = 3.55 m, E<sub>v</sub> = 46.74 kN/m, E<sub>res</sub> = 129.27 kN/m

### 2.7.3. Überlagerte Erddrucklasten (aktiv)

LK 2, Aktivseite

| Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> | Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|--------|--------------------------------------|--------------------------------------|--|
| 0.00   | 19.34                                | 7.41                                 | 20.71                                  | 5.50   | 37.32                                | 14.83                                | 40.16                                  |
| 5.00   | 19.34                                | 7.41                                 | 20.71                                  | 6.28   | 39.56                                | 15.72                                | 42.57                                  |
| 5.00   | 34.13                                | 13.56                                | 36.72                                  |        |                                      |                                      |  |

E<sub>h</sub> = 144.63 kN/m, z<sub>s</sub> = 3.55 m, E<sub>v</sub> = 56.08 kN/m, E<sub>res</sub> = 155.12 kN/m

### 2.7.4. Überlagerte Erddrucklasten (aktiv)

LK 3, Aktivseite

| Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> | Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|--------|--------------------------------------|--------------------------------------|--|
| 0.00   | 18.05                                | 6.57                                 | 19.21                                  | 5.00   | 30.17                                | 11.99                                | 32.46                                  |
| 3.00   | 18.05                                | 6.57                                 | 19.21                                  | 5.50   | 32.83                                | 13.04                                | 35.32                                  |
| 3.00   | 17.85                                | 7.09                                 | 19.20                                  | 6.28   | 34.70                                | 13.78                                | 37.33                                  |
| 5.00   | 17.85                                | 7.09                                 | 19.20                                  |        |                                      |                                      |  |

E<sub>h</sub> = 131.99 kN/m, z<sub>s</sub> = 3.50 m, E<sub>v</sub> = 50.63 kN/m, E<sub>res</sub> = 141.37 kN/m

### 2.7.5. Überlagerte Erddrucklasten (aktiv)

LK 4, Aktivseite

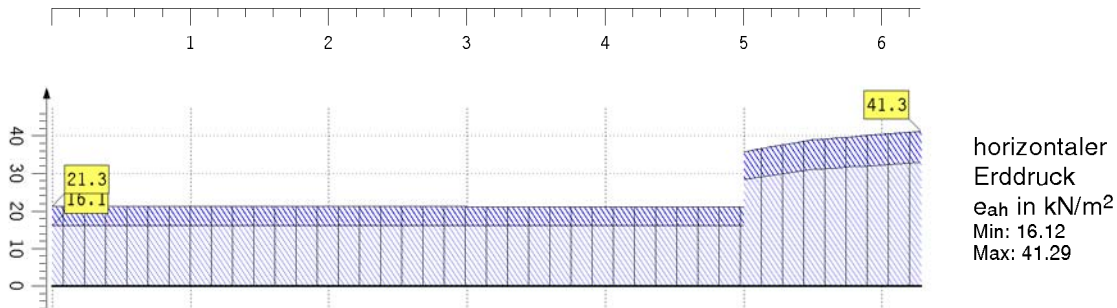
| Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> | Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|--------|--------------------------------------|--------------------------------------|--|
| 0.00   | 21.28                                | 7.74                                 | 22.64                                  | 5.00   | 35.86                                | 14.24                                | 38.58                                  |
| 3.00   | 21.28                                | 7.74                                 | 22.64                                  | 5.50   | 39.05                                | 15.51                                | 42.01                                  |
| 3.00   | 21.07                                | 8.37                                 | 22.67                                  | 6.28   | 41.29                                | 16.40                                | 44.43                                  |
| 5.00   | 21.07                                | 8.37                                 | 22.67                                  |        |                                      |                                      |  |

E<sub>h</sub> = 156.10 kN/m, z<sub>s</sub> = 3.51 m, E<sub>v</sub> = 59.89 kN/m, E<sub>res</sub> = 167.19 kN/m

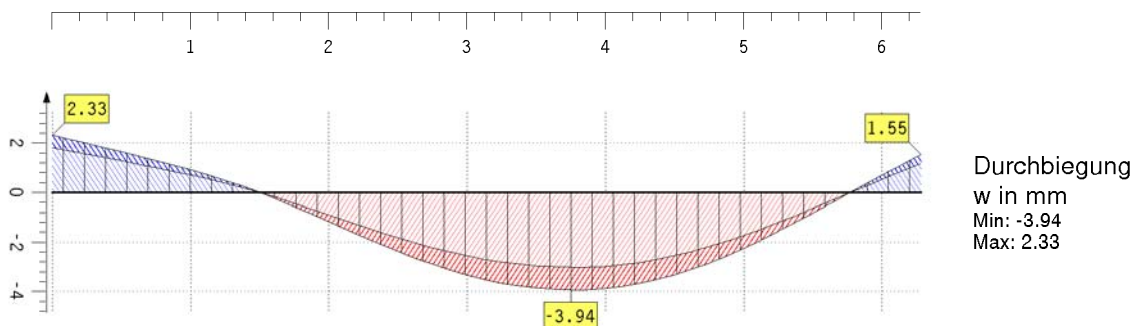
### 2.7.6. Auflagerreaktionen

| LK | Name        | Typ                 | z<br>m | α<br>° | V <sub>y</sub><br>KN/m | V <sub>z</sub><br>KN/m | M <sub>x</sub><br>KNm/m |
|----|-------------|---------------------|--------|--------|------------------------|------------------------|-------------------------|
| 1  | Steife      | Lager               | 1.50   | 0.00   | 62.78                  | 0.00                   | -0.00                   |
| 1  | Fußauflager | Einspanngrad = 0.00 | 5.77   | 0.00   | 57.75                  | -0.00                  | -0.00                   |
| 2  | Steife      | Lager               | 1.50   | 0.00   | 75.33                  | -0.00                  | -0.00                   |
| 2  | Fußauflager | Einspanngrad = 0.00 | 5.77   | 0.00   | 69.30                  | -0.00                  | 0.00                    |
| 3  | Steife      | Lager               | 1.50   | 0.00   | 70.07                  | -0.00                  | -0.00                   |
| 3  | Fußauflager | Einspanngrad = 0.00 | 5.77   | 0.00   | 61.92                  | -0.00                  | -0.00                   |
| 4  | Steife      | Lager               | 1.50   | 0.00   | 82.63                  | 0.00                   | -0.00                   |
| 4  | Fußauflager | Einspanngrad = 0.00 | 5.77   | 0.00   | 73.47                  | 0.00                   | -0.00                   |

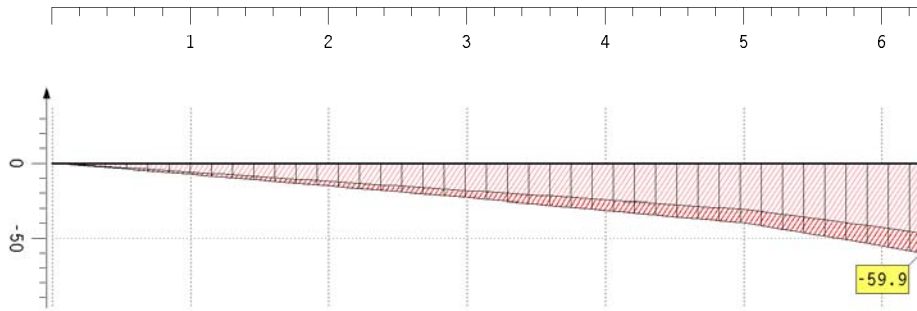
extremaler Erddruck



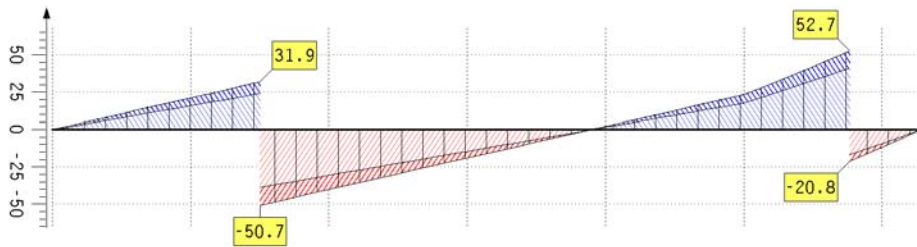
extremale Verformungen



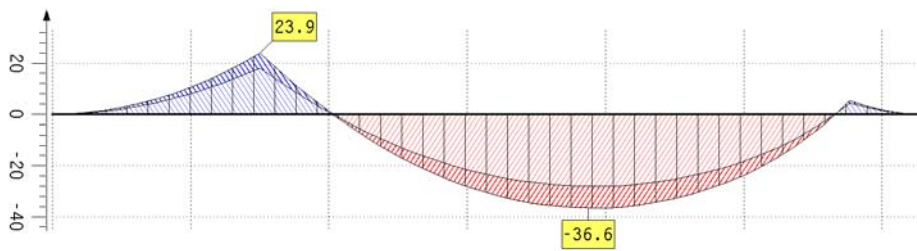
### extremale Schnittgrößen



Normalkraft  
 $N$  in  $\text{kN/m}$   
 Min:  $-59.89$   
 Max:  $0.00$

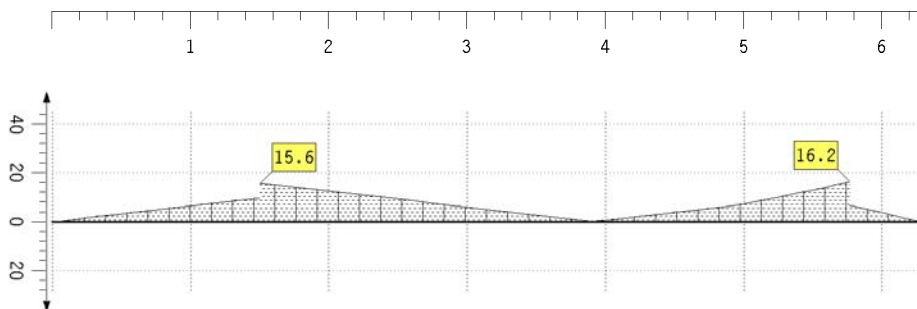


Querkraft  
 $V$  in  $\text{kN/m}$   
 Min:  $-50.72$   
 Max:  $52.68$

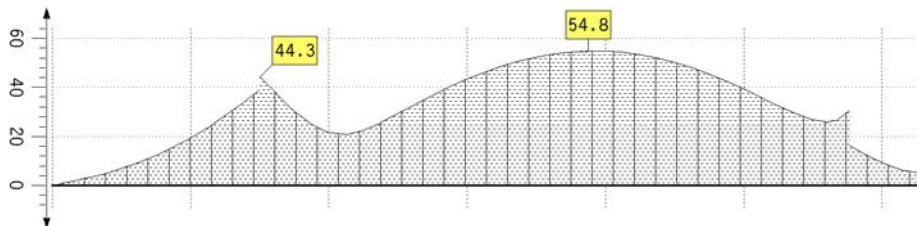


Moment  
 $M$  in  $\text{kNm/m}$   
 Min:  $-36.59$   
 Max:  $23.94$

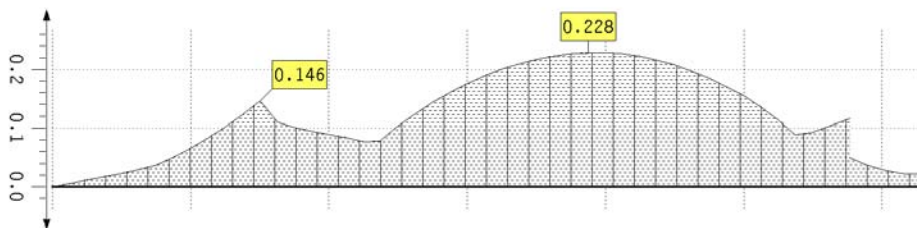
### Stahlnachweisergebnisse



Schubspannung  
 $\tau$  in  $\text{MN/m}^2$   
 Max:  $16.17$



Vergleichsspannung  
 $\sigma_v$  in  $\text{MN/m}^2$   
 Max:  $54.79$



Ausnutzung  
 Max:  $0.23$

## Stahlnachweisergebnisse

| Z<br>m  | min $\sigma_x$<br>MN/m <sup>2</sup> | max $\sigma_x$<br>MN/m <sup>2</sup> | $\tau$<br>MN/m <sup>2</sup> | $\sigma_y$<br>MN/m <sup>2</sup> | $\sigma_{e1}$<br>MN/m <sup>2</sup> | $U_{\sigma,e1}$<br>- | 0-0<br>- | --0<br>- | U<br>- |
|---------|-------------------------------------|-------------------------------------|-----------------------------|---------------------------------|------------------------------------|----------------------|----------|----------|--------|
| 0.000   | -0.00                               | 0.00                                | 0.00                        | 0.00                            | 0.00                               | 0.000                | ----     | ----     | 0.000  |
| 0.750   | -9.03                               | 8.07                                | 4.90                        | 12.39                           | 9.03                               | 0.038                | ----     | ----     | 0.038  |
| 1.500   | -35.15                              | 33.23                               | 9.80                        | 39.03                           | 35.15                              | 0.146                | ----     | ----     | 0.146  |
| 1.500   | -35.15                              | 33.23                               | 15.57                       | 44.30                           | 35.15                              | 0.146                | ----     | ----     | 0.146  |
| 2.000   | -3.05                               | 0.49                                | 12.30                       | 21.52                           | 21.31                              | 0.089                | ----     | ----     | 0.089  |
| 2.375   | -19.09                              | 16.05                               | 9.85                        | 25.60                           | 19.09                              | 0.080                | ----     | ----     | 0.080  |
| 3.000   | -42.21                              | 38.37                               | 5.77                        | 43.38                           | 42.21                              | 0.176                | ----     | ----     | 0.176  |
| 3.875   | -54.79                              | 49.74                               | 0.12                        | 54.79                           | 54.79                              | 0.228                | ----     | ----     | 0.228  |
| 4.625   | -47.24                              | 41.15                               | 4.74                        | 47.94                           | 47.24                              | 0.197                | ----     | ----     | 0.197  |
| 5.375   | -21.38                              | 13.86                               | 11.43                       | 29.14                           | 21.38                              | 0.089                | ----     | ----     | 0.089  |
| 5.679   | -5.29                               | -2.20                               | 15.08                       | 26.64                           | 26.11                              | 0.109                | ----     | ----     | 0.109  |
| 5.769   | -11.93                              | 3.39                                | 16.17                       | 30.44                           | 28.00                              | 0.117                | ----     | ----     | 0.117  |
| 5.769   | -11.93                              | 3.39                                | 6.38                        | 16.26                           | 11.93                              | 0.050                | ----     | ----     | 0.050  |
| 6.282   | -4.95                               | -3.86                               | 0.00                        | 4.95                            | 4.95                               | 0.021                | ----     | ----     | 0.021  |
| Minimum | -54.79                              | -3.86                               | 0.00                        | 0.00                            | 0.00                               | 0.000                | 0.000    | 0.000    | 0.000  |
| Maximum | -0.00                               | 49.74                               | 16.17                       | 54.79                           | 54.79                              | 0.228                | 0.000    | 0.000    | 0.228  |

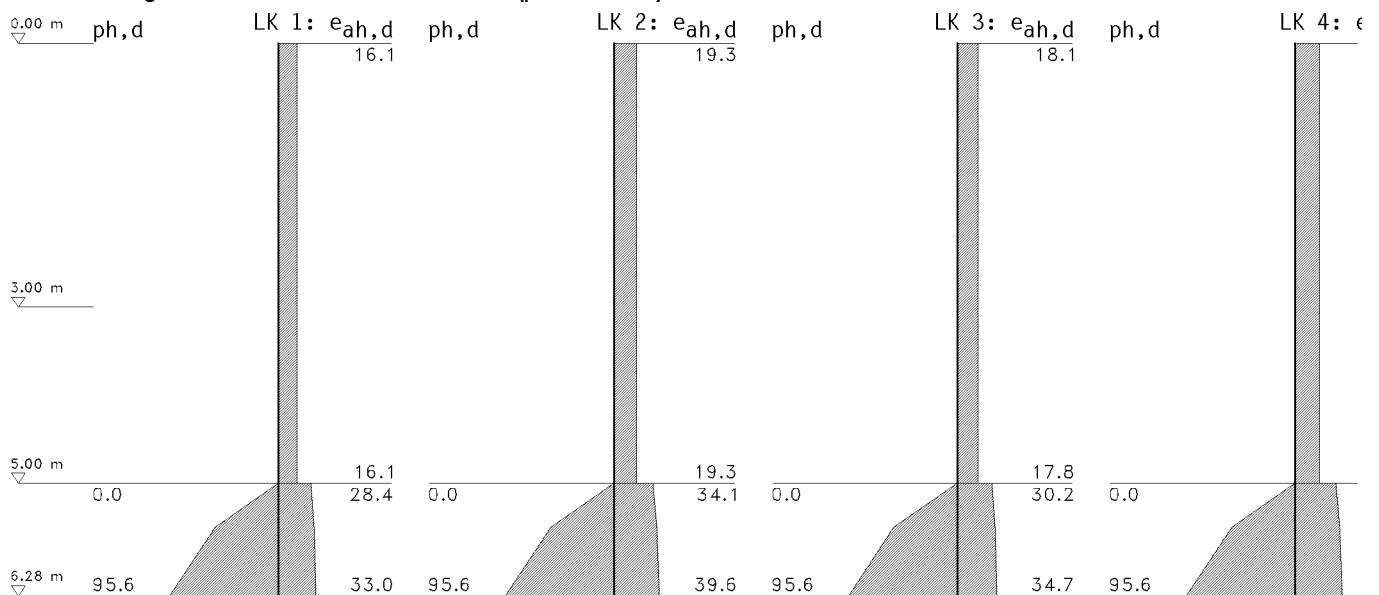
## Lagerreaktionen ( $\gamma_F$ -fach)

| Z<br>m | Typ | AP <sub>y</sub><br>kN/m | AP <sub>z</sub><br>kN/m | AM <sub>x</sub><br>kNm/m | Z<br>m | Typ | AP <sub>y</sub><br>kN/m | AP <sub>z</sub><br>kN/m | AM <sub>x</sub><br>kNm/m |
|--------|-----|-------------------------|-------------------------|--------------------------|--------|-----|-------------------------|-------------------------|--------------------------|
| 1.500  | Min | 62.78                   | -0.00                   | -0.00                    | 6.154  | Min | -0.00                   | 0.00                    | -0.00                    |
|        | Max | 82.63                   | 0.00                    | -0.00                    |        | Max | 0.00                    | 0.00                    | 0.00                     |
| 5.769  | Min | 57.75                   | -0.00                   | -0.00                    | 6.282  | Min | -0.00                   | -59.89                  | -0.00                    |
|        | Max | 73.47                   | 0.00                    | 0.00                     |        | Max | 0.00                    | -46.74                  | 0.00                     |

Maximale Ausnutzung  $u_{max} = 0.23 \leq 1$  bei  $z = 3.88$  m  $\Rightarrow$  **Nachweis erfüllt**

## 2.8. Nachweis des Erdwiderlagers gemäß DIN 1054:2010-12, A(9.5)

### 2.8.1. Überlagerte horizontale Erddrucklasten (passiv/aktiv)



### 2.8.2. Überlagerte Erddrucklasten (passiv/aktiv)

#### LK 1, Passivseite

Erdwiderstand zu 100.00 mobilisiert

| Z<br>m | $E_{ph}$<br>kN/m <sup>2</sup> | $E_{pv}$<br>kN/m <sup>2</sup> | $E_{pres}$<br>kN/m <sup>2</sup> |
|--------|-------------------------------|-------------------------------|---------------------------------|
| 5.00   | 0.00                          | 0.00                          | 0.00                            |
| 5.50   | 56.12                         | -35.75                        | 66.55                           |
| 6.28   | 95.61                         | -60.91                        | 113.37                          |

$E_h = 73.34$  kN/m,  $z_s = 5.81$  m,  $E_v = -46.72$  kN/m,  $E_{res} = 86.96$  kN/m

#### LK 1, Aktivseite



| Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> | Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|--------|--------------------------------------|--------------------------------------|--|
| 0.00   | 16.12                                | 6.18                                 | 17.26                                  | 5.50   | 31.10                                | 12.35                                | 33.46                                  |
| 5.00   | 16.12                                | 6.18                                 | 17.26                                  | 6.28   | 32.97                                | 13.10                                | 35.47                                  |
| 5.00   | 28.44                                | 11.30                                | 30.60                                  |        |                                      |                                      |  |

E<sub>h</sub> = 120.52 kN/m, z<sub>s</sub> = 3.55 m, E<sub>v</sub> = 46.74 kN/m, E<sub>res</sub> = 129.27 kN/m

### 2.8.3. Überlagerte Erddrucklasten (passiv/aktiv)

LK 2, Passivseite

Erdwiderstand zu 100.00 mobilisiert

| Z<br>m | E <sub>ph</sub><br>kN/m <sup>2</sup> | E <sub>pv</sub><br>kN/m <sup>2</sup> | E <sub>pres</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|
| 5.00   | 0.00                                 | 0.00                                 | 0.00                                   |
| 5.50   | 56.12                                | -35.75                               | 66.55                                  |
| 6.28   | 95.61                                | -60.91                               | 113.37                                 |

E<sub>h</sub> = 73.34 kN/m, z<sub>s</sub> = 5.81 m, E<sub>v</sub> = -46.72 kN/m, E<sub>res</sub> = 86.96 kN/m

LK 2, Aktivseite

| Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> | Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|--------|--------------------------------------|--------------------------------------|--|
| 0.00   | 19.34                                | 7.41                                 | 20.71                                  | 5.50   | 37.32                                | 14.83                                | 40.16                                  |
| 5.00   | 19.34                                | 7.41                                 | 20.71                                  | 6.28   | 39.56                                | 15.72                                | 42.57                                  |
| 5.00   | 34.13                                | 13.56                                | 36.72                                  |        |                                      |                                      |  |

E<sub>h</sub> = 144.63 kN/m, z<sub>s</sub> = 3.55 m, E<sub>v</sub> = 56.08 kN/m, E<sub>res</sub> = 155.12 kN/m

### 2.8.4. Überlagerte Erddrucklasten (passiv/aktiv)

LK 3, Passivseite

Erdwiderstand zu 100.00 mobilisiert

| Z<br>m | E <sub>ph</sub><br>kN/m <sup>2</sup> | E <sub>pv</sub><br>kN/m <sup>2</sup> | E <sub>pres</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|
| 5.00   | 0.00                                 | 0.00                                 | 0.00                                   |
| 5.50   | 56.12                                | -35.75                               | 66.55                                  |
| 6.28   | 95.61                                | -60.91                               | 113.37                                 |

E<sub>h</sub> = 73.34 kN/m, z<sub>s</sub> = 5.81 m, E<sub>v</sub> = -46.72 kN/m, E<sub>res</sub> = 86.96 kN/m

LK 3, Aktivseite

| Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> | Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|--------|--------------------------------------|--------------------------------------|--|
| 0.00   | 18.05                                | 6.57                                 | 19.21                                  | 5.00   | 30.17                                | 11.99                                | 32.46                                  |
| 3.00   | 18.05                                | 6.57                                 | 19.21                                  | 5.50   | 32.83                                | 13.04                                | 35.32                                  |
| 3.00   | 17.85                                | 7.09                                 | 19.20                                  | 6.28   | 34.70                                | 13.78                                | 37.33                                  |
| 5.00   | 17.85                                | 7.09                                 | 19.20                                  |        |                                      |                                      |  |

E<sub>h</sub> = 131.99 kN/m, z<sub>s</sub> = 3.50 m, E<sub>v</sub> = 50.63 kN/m, E<sub>res</sub> = 141.37 kN/m

### 2.8.5. Überlagerte Erddrucklasten (passiv/aktiv)

LK 4, Passivseite

Erdwiderstand zu 100.00 mobilisiert

| Z<br>m | E <sub>ph</sub><br>kN/m <sup>2</sup> | E <sub>pv</sub><br>kN/m <sup>2</sup> | E <sub>pres</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|
| 5.00   | 0.00                                 | 0.00                                 | 0.00                                   |
| 5.50   | 56.12                                | -35.75                               | 66.55                                  |
| 6.28   | 95.61                                | -60.91                               | 113.37                                 |

E<sub>h</sub> = 73.34 kN/m, z<sub>s</sub> = 5.81 m, E<sub>v</sub> = -46.72 kN/m, E<sub>res</sub> = 86.96 kN/m

LK 4, Aktivseite

| Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> | Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|--------|--------------------------------------|--------------------------------------|--|
| 0.00   | 21.28                                | 7.74                                 | 22.64                                  | 5.00   | 35.86                                | 14.24                                | 38.58                                  |
| 3.00   | 21.28                                | 7.74                                 | 22.64                                  | 5.50   | 39.05                                | 15.51                                | 42.01                                  |
| 3.00   | 21.07                                | 8.37                                 | 22.67                                  | 6.28   | 41.29                                | 16.40                                | 44.43                                  |
| 5.00   | 21.07                                | 8.37                                 | 22.67                                  |        |                                      |                                      |  |

E<sub>h</sub> = 156.10 kN/m, z<sub>s</sub> = 3.51 m, E<sub>v</sub> = 59.89 kN/m, E<sub>res</sub> = 167.19 kN/m

## 2.8.6. Auflagerreaktionen

| LK | Name        | Typ                 | z<br>m | $\alpha$<br>° | V <sub>y</sub><br>kN/m | V <sub>z</sub><br>kN/m | M <sub>x</sub><br>kNm/m |
|----|-------------|---------------------|--------|---------------|------------------------|------------------------|-------------------------|
| 1  | Steife      | Lager               | 1.50   | 0.00          | 63.35                  | 0.00                   | 0.00                    |
| 1  | Fußauflager | Einspanngrad = 0.00 | 5.81   | 0.00          | -16.16                 | 0.00                   | 0.00                    |
| 2  | Steife      | Lager               | 1.50   | 0.00          | 76.02                  | 0.00                   | 0.00                    |
| 2  | Fußauflager | Einspanngrad = 0.00 | 5.81   | 0.00          | -4.73                  | 0.00                   | -0.00                   |
| 3  | Steife      | Lager               | 1.50   | 0.00          | 70.69                  | -0.00                  | 0.00                    |
| 3  | Fußauflager | Einspanngrad = 0.00 | 5.81   | 0.00          | -12.03                 | 0.00                   | -0.00                   |
| 4  | Steife      | Lager               | 1.50   | 0.00          | 83.36                  | 0.00                   | -0.00                   |
| 4  | Fußauflager | Einspanngrad = 0.00 | 5.81   | 0.00          | -0.60                  | 0.00                   | -0.00                   |

## 2.8.7. Nachweis des Erdwiderlagers (Horizontalkräfte)

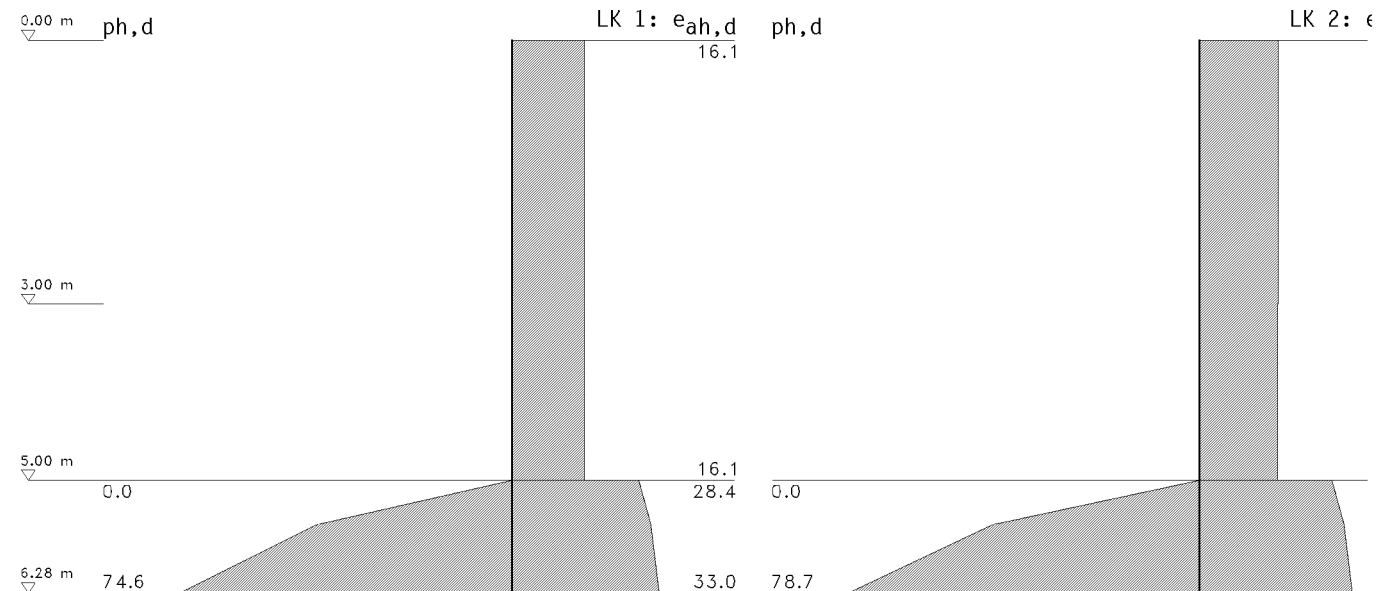
mit  $\gamma_{ep} = 1.30$

| LK | E <sub>a</sub><br>kN/m | Ch,d<br>kN/m | ΣV <sub>Lager</sub><br>kN/m | E <sub>a</sub> - ΣV <sub>Anker</sub> | -ΣV <sub>Lager</sub> + Ch,d<br>kN/m | zu1 Ep<br>kN/m | u<br>- |
|----|------------------------|--------------|-----------------------------|--------------------------------------|-------------------------------------|----------------|--------|
| 1  | 120.52                 | 0.00         | 63.35                       |                                      | 57.18                               | 73.34          | 0.78   |
| 2  | 144.63                 | -0.00        | 76.02                       |                                      | 68.61                               | 73.34          | 0.94   |
| 3  | 131.99                 | 0.00         | 70.69                       |                                      | 61.31                               | 73.34          | 0.84   |
| 4  | 156.10                 | 0.00         | 83.36                       |                                      | 72.74                               | 73.34          | 0.99   |

Maximale Ausnutzung  $u_{max} = 0.99 \leq 1 \Rightarrow$  Nachweis erfüllt

## 2.9. Nachweis der Vertikalkomponente der Auflagerkraft gemäß DIN 1054:2010-12, A(9.8)

### 2.9.1. Überlagerte horizontale Erddrucklasten (passiv/aktiv)



### 2.9.2. Überlagerte Erddrucklasten (passiv/aktiv)

LK 1, Passivseite

Erdwiderstand zu 59.98 mobilisiert

| z<br>m | e <sub>ph</sub><br>kN/m <sup>2</sup> | e <sub>pv</sub><br>kN/m <sup>2</sup> | e <sub>pres</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|
| 5.00   | 0.00                                 | 0.00                                 | 0.00                                   |
| 5.50   | 43.76                                | -27.88                               | 51.89                                  |
| 6.28   | 74.55                                | -47.49                               | 88.39                                  |

$E_h = 57.19$  kN/m,  $z_s = 5.81$  m,  $E_v = -36.43$  kN/m,  $E_{res} = 67.80$  kN/m

LK 1, Aktivseite

| z<br>m | e <sub>ah</sub><br>kN/m <sup>2</sup> | e <sub>av</sub><br>kN/m <sup>2</sup> | e <sub>ares</sub><br>kN/m <sup>2</sup> | z<br>m | e <sub>ah</sub><br>kN/m <sup>2</sup> | e <sub>av</sub><br>kN/m <sup>2</sup> | e <sub>ares</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|--------|--------------------------------------|--------------------------------------|--|
| 0.00   | 16.12                                | 6.18                                 | 17.26                                  | 5.50   | 31.10                                | 12.35                                | 33.46                                  |
| 5.00   | 16.12                                | 6.18                                 | 17.26                                  | 6.28   | 32.97                                | 13.10                                | 35.47                                  |
| 5.00   | 28.44                                | 11.30                                | 30.60                                  |        |                                      |                                      |  |

$E_h = 120.52$  kN/m,  $z_s = 3.55$  m,  $E_v = 46.74$  kN/m,  $E_{res} = 129.27$  kN/m



### 2.9.3. Überlagerte Erddrucklasten (passiv/aktiv)

LK 2, Passivseite

Erdwiderstand zu 63.31 mobilisiert

| Z<br>m | E <sub>ph</sub><br>kN/m <sup>2</sup> | E <sub>pv</sub><br>kN/m <sup>2</sup> | E <sub>pres</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|
| 5.00   | 0.00                                 | 0.00                                 | 0.00                                   |
| 5.50   | 46.19                                | -29.43                               | 54.77                                  |
| 6.28   | 78.69                                | -50.13                               | 93.30                                  |

E<sub>h</sub> = 60.36 kN/m, z<sub>s</sub> = 5.81 m, E<sub>v</sub> = -38.45 kN/m, E<sub>res</sub> = 71.57 kN/m

LK 2, Aktivseite

| Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> | Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|--------|--------------------------------------|--------------------------------------|--|
| 0.00   | 17.61                                | 6.41                                 | 18.74                                  | 5.00   | 29.77                                | 11.83                                | 32.03                                  |
| 3.00   | 17.61                                | 6.41                                 | 18.74                                  | 5.50   | 32.43                                | 12.88                                | 34.89                                  |
| 3.00   | 17.45                                | 6.93                                 | 18.77                                  | 6.28   | 34.30                                | 13.63                                | 36.91                                  |
| 5.00   | 17.45                                | 6.93                                 | 18.77                                  |        |                                      |                                      |  |

E<sub>h</sub> = 129.35 kN/m, z<sub>s</sub> = 3.51 m, E<sub>v</sub> = 49.63 kN/m, E<sub>res</sub> = 138.54 kN/m

### 2.9.4. Auflagerreaktionen

| LK | Name        | Typ                 | z<br>m | α<br>° | V <sub>y</sub><br>KN/m | V <sub>z</sub><br>KN/m | M <sub>x</sub><br>KNm/m |
|----|-------------|---------------------|--------|--------|------------------------|------------------------|-------------------------|
| 1  | Steife      | Lager               | 1.50   | 0.00   | 63.35                  | -0.00                  | -0.00                   |
| 1  | Fußauflager | Einspanngrad = 0.00 | 5.81   | 0.00   | -0.01                  | -0.00                  | -0.00                   |
| 2  | Steife      | Lager               | 1.50   | 0.00   | 68.99                  | 0.00                   | -0.00                   |
| 2  | Fußauflager | Einspanngrad = 0.00 | 5.81   | 0.00   | -0.01                  | -0.00                  | -0.00                   |

### 2.9.5. Nachweis der Vertikalkomponente der Auflagerkraft

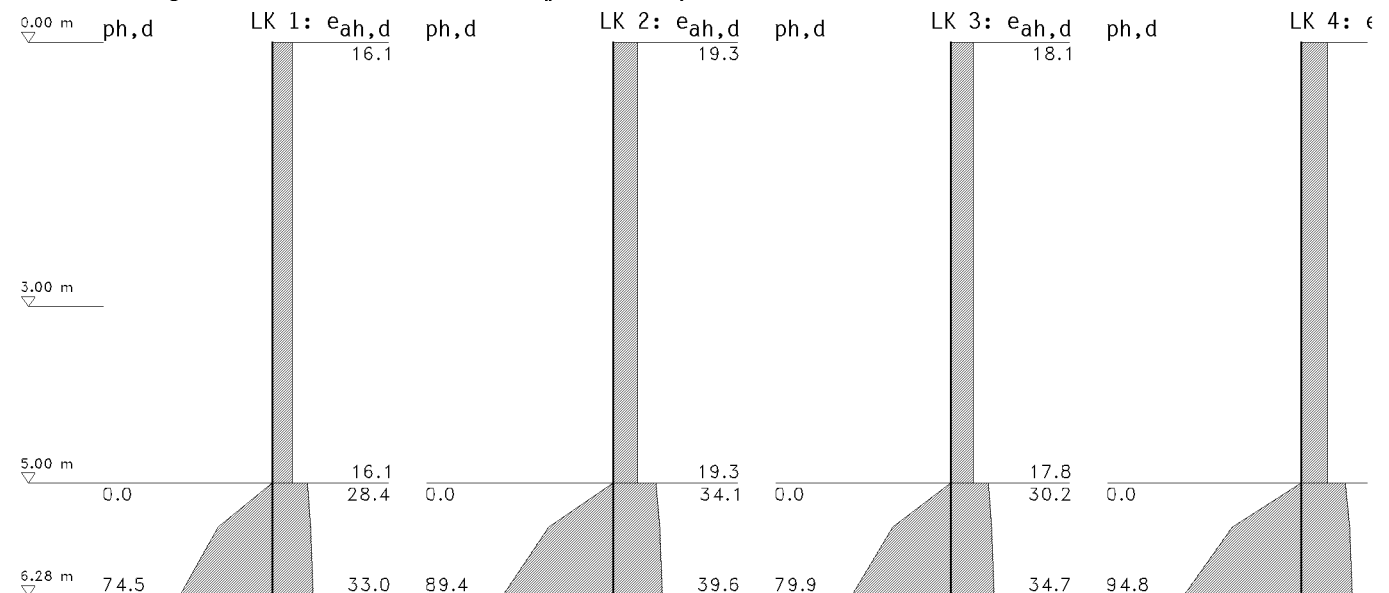
Wandeingewicht G = 5.97 kN/m, δ<sub>p,k,Fuß</sub> = 10.83

| LK | E <sub>av,k</sub><br>kN/m | ΣV <sub>Lager</sub><br>kN/m | B <sub>v,k</sub><br>kN/m | ΣV<br>kN/m | u<br>- |
|----|---------------------------|-----------------------------|--------------------------|------------|--------|
| 1  | 46.74                     | -0.00                       | -36.43                   | 16.27      | 0.69   |
| 2  | 49.63                     | 0.00                        | -38.45                   | 17.14      | 0.69   |

Maximale Ausnutzung u<sub>max</sub> = 0.69 ≤ 1 ⇒ Nachweis erfüllt

### 2.10. Nachweis gegen Versinken der Bauteile gemäß DIN 1054:2010-12, A(9.6)

#### 2.10.1. Überlagerte horizontale Erddrucklasten (passiv/aktiv)



#### 2.10.2. Überlagerte Erddrucklasten (passiv/aktiv)

LK 1, Passivseite

Erdwiderstand zu 83.97 mobilisiert

| Z<br>m | E <sub>ph</sub><br>kN/m <sup>2</sup> | E <sub>pv</sub><br>kN/m <sup>2</sup> | E <sub>pres</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|
| 5.00   | 0.00                                 | 0.00                                 | 0.00                                   |
| 5.50   | 43.76                                | -27.88                               | 51.89                                  |
| 6.28   | 74.55                                | -47.49                               | 88.39                                  |



$E_h = 57.18 \text{ kN/m}$ ,  $z_s = 5.81 \text{ m}$ ,  $E_v = -36.43 \text{ kN/m}$ ,  $E_{res} = 67.80 \text{ kN/m}$

LK 1, Aktivseite

| Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> | Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|--------|--------------------------------------|--------------------------------------|--|
| 0.00   | 16.12                                | 6.18                                 | 17.26                                  | 5.50   | 31.10                                | 12.35                                | 33.46                                  |
| 5.00   | 16.12                                | 6.18                                 | 17.26                                  | 6.28   | 32.97                                | 13.10                                | 35.47                                  |
| 5.00   | 28.44                                | 11.30                                | 30.60                                  |        |                                      |                                      |  |

$E_h = 120.52 \text{ kN/m}$ ,  $z_s = 3.55 \text{ m}$ ,  $E_v = 46.74 \text{ kN/m}$ ,  $E_{res} = 129.27 \text{ kN/m}$

2.10.3. Überlagerte Erddrucklasten (passiv/aktiv)

LK 2, Passivseite

Erdwiderstand zu 100.74 mobilisiert

| Z<br>m | E <sub>ph</sub><br>kN/m <sup>2</sup> | E <sub>pv</sub><br>kN/m <sup>2</sup> | E <sub>pres</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|
| 5.00   | 0.00                                 | 0.00                                 | 0.00                                   |
| 5.50   | 52.50                                | -33.45                               | 62.25                                  |
| 6.28   | 89.44                                | -56.98                               | 106.04                                 |

$E_h = 68.60 \text{ kN/m}$ ,  $z_s = 5.81 \text{ m}$ ,  $E_v = -43.71 \text{ kN/m}$ ,  $E_{res} = 81.34 \text{ kN/m}$

LK 2, Aktivseite

| Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> | Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|--------|--------------------------------------|--------------------------------------|--|
| 0.00   | 19.34                                | 7.41                                 | 20.71                                  | 5.50   | 37.32                                | 14.83                                | 40.16                                  |
| 5.00   | 19.34                                | 7.41                                 | 20.71                                  | 6.28   | 39.56                                | 15.72                                | 42.57                                  |
| 5.00   | 34.13                                | 13.56                                | 36.72                                  |        |                                      |                                      |  |

$E_h = 144.63 \text{ kN/m}$ ,  $z_s = 3.55 \text{ m}$ ,  $E_v = 56.08 \text{ kN/m}$ ,  $E_{res} = 155.12 \text{ kN/m}$

2.10.4. Überlagerte Erddrucklasten (passiv/aktiv)

LK 3, Passivseite

Erdwiderstand zu 90.01 mobilisiert

| Z<br>m | E <sub>ph</sub><br>kN/m <sup>2</sup> | E <sub>pv</sub><br>kN/m <sup>2</sup> | E <sub>pres</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|
| 5.00   | 0.00                                 | 0.00                                 | 0.00                                   |
| 5.50   | 46.91                                | -29.88                               | 55.62                                  |
| 6.28   | 79.91                                | -50.91                               | 94.75                                  |

$E_h = 61.30 \text{ kN/m}$ ,  $z_s = 5.81 \text{ m}$ ,  $E_v = -39.05 \text{ kN/m}$ ,  $E_{res} = 72.68 \text{ kN/m}$

LK 3, Aktivseite

| Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> | Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|--------|--------------------------------------|--------------------------------------|--|
| 0.00   | 18.05                                | 6.57                                 | 19.21                                  | 5.00   | 30.17                                | 11.99                                | 32.46                                  |
| 3.00   | 18.05                                | 6.57                                 | 19.21                                  | 5.50   | 32.83                                | 13.04                                | 35.32                                  |
| 3.00   | 17.85                                | 7.09                                 | 19.20                                  | 6.28   | 34.70                                | 13.78                                | 37.33                                  |
| 5.00   | 17.85                                | 7.09                                 | 19.20                                  |        |                                      |                                      |  |

$E_h = 131.99 \text{ kN/m}$ ,  $z_s = 3.50 \text{ m}$ ,  $E_v = 50.63 \text{ kN/m}$ ,  $E_{res} = 141.37 \text{ kN/m}$

2.10.5. Überlagerte Erddrucklasten (passiv/aktiv)

LK 4, Passivseite

Erdwiderstand zu 106.82 mobilisiert

| Z<br>m | E <sub>ph</sub><br>kN/m <sup>2</sup> | E <sub>pv</sub><br>kN/m <sup>2</sup> | E <sub>pres</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|
| 5.00   | 0.00                                 | 0.00                                 | 0.00                                   |
| 5.50   | 55.67                                | -35.47                               | 66.01                                  |
| 6.28   | 94.84                                | -60.42                               | 112.45                                 |

$E_h = 72.75 \text{ kN/m}$ ,  $z_s = 5.81 \text{ m}$ ,  $E_v = -46.35 \text{ kN/m}$ ,  $E_{res} = 86.26 \text{ kN/m}$

LK 4, Aktivseite

| Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> | Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|--------|--------------------------------------|--------------------------------------|--|
| 0.00   | 21.28                                | 7.74                                 | 22.64                                  | 5.00   | 35.86                                | 14.24                                | 38.58                                  |
| 3.00   | 21.28                                | 7.74                                 | 22.64                                  | 5.50   | 39.05                                | 15.51                                | 42.01                                  |
| 3.00   | 21.07                                | 8.37                                 | 22.67                                  | 6.28   | 41.29                                | 16.40                                | 44.43                                  |
| 5.00   | 21.07                                | 8.37                                 | 22.67                                  |        |                                      |                                      |  |

$E_h = 156.10 \text{ kN/m}$ ,  $z_s = 3.51 \text{ m}$ ,  $E_v = 59.89 \text{ kN/m}$ ,  $E_{res} = 167.19 \text{ kN/m}$

## 2.10.6. Auflagerreaktionen

| LK | Name        | Typ                 | z<br>m | $\alpha$<br>° | V <sub>y</sub><br>KN/m | V <sub>z</sub><br>KN/m | M <sub>x</sub><br>KNm/m |
|----|-------------|---------------------|--------|---------------|------------------------|------------------------|-------------------------|
| 1  | Steife      | Lager               | 1.50   | 0.00          | 63.35                  | 0.00                   | -0.00                   |
| 1  | Fußauflager | Einspanngrad = 0.00 | 5.81   | 0.00          | -0.01                  | 0.00                   | -0.00                   |
| 2  | Steife      | Lager               | 1.50   | 0.00          | 76.02                  | 0.00                   | -0.00                   |
| 2  | Fußauflager | Einspanngrad = 0.00 | 5.81   | 0.00          | 0.01                   | -0.00                  | -0.00                   |
| 3  | Steife      | Lager               | 1.50   | 0.00          | 70.69                  | 0.00                   | -0.00                   |
| 3  | Fußauflager | Einspanngrad = 0.00 | 5.81   | 0.00          | 0.01                   | 0.00                   | -0.00                   |
| 4  | Steife      | Lager               | 1.50   | 0.00          | 83.36                  | 0.00                   | -0.00                   |
| 4  | Fußauflager | Einspanngrad = 0.00 | 5.81   | 0.00          | -0.01                  | 0.00                   | -0.00                   |

### 2.10.6.1. Nachweis gegen Versagen durch Vertikalbewegung gemäß DIN 1054:2010-12, A(9.6)

Nachweis erfolgt entsprechend Hoesch, Spundwandhandbuch 2007, 6.7.2

Wandeingengewicht  $G = 5.97 \text{ kN/m}$

Spitzenwiderstand  $R_{1b,k} = -A_b * q_{b,k} = 726.000 * 5.000 / 10 = -363.00 \text{ kN/m}$

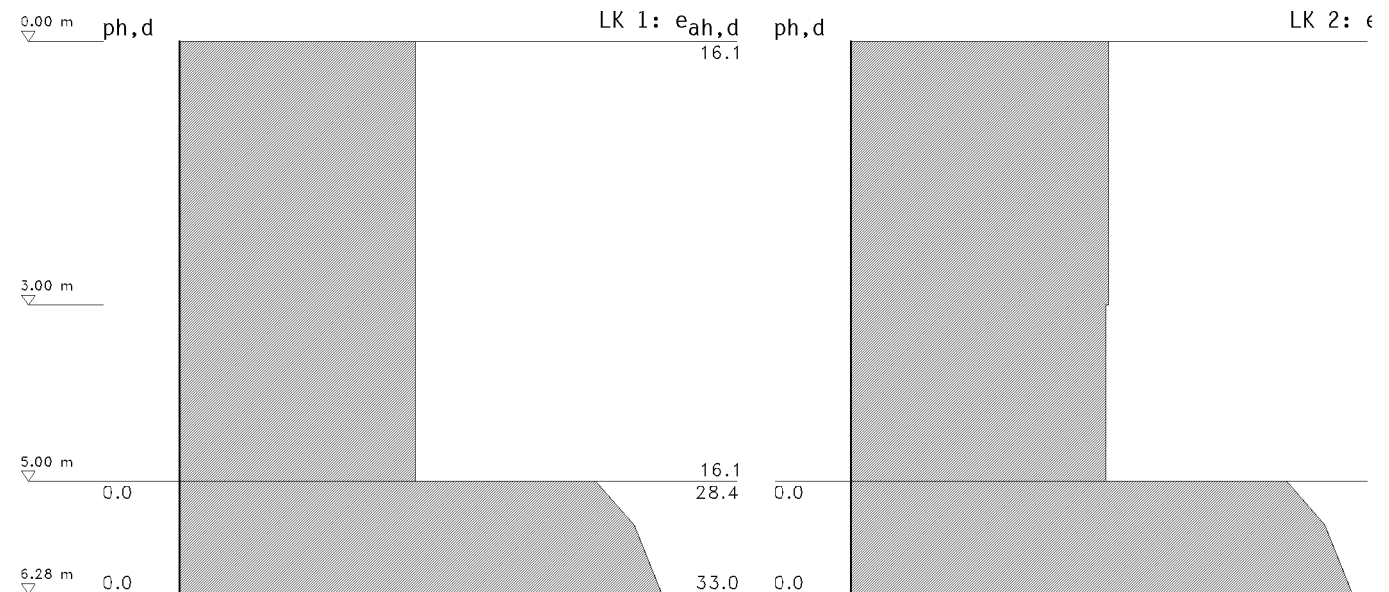
Teilsicherheitsbeiwert für den Widerstand  $\gamma_p = 1.40$

| LK | E <sub>av,k</sub><br>kN/m | ΣP <sub>v</sub><br>kN/m | ΣV <sub>Lager</sub><br>kN/m | E <sub>pv,k</sub><br>kN/m | ΣV <sub>d</sub><br>kN/m | ΣR <sub>d</sub><br>kN/m | u    |
|----|---------------------------|-------------------------|-----------------------------|---------------------------|-------------------------|-------------------------|------|
| 1  | 46.74                     | 0.00                    | 0.00                        | -36.43                    | 52.70                   | -295.72                 | 0.18 |
| 2  | 56.08                     | 0.00                    | 0.00                        | -43.71                    | 62.05                   | -302.99                 | 0.20 |
| 3  | 50.63                     | 0.00                    | 0.00                        | -39.05                    | 56.60                   | -298.34                 | 0.19 |
| 4  | 59.89                     | 0.00                    | 0.00                        | -46.35                    | 65.86                   | -305.63                 | 0.22 |

Maximale Ausnutzung  $u_{max} = 0.22 \leq 1 \Rightarrow$  **Nachweis erfüllt**

## 2.11. Nachweis der Verformungen

### 2.11.1. Überlagerte horizontale Erddrucklasten (passiv/aktiv)



### 2.11.2. Überlagerte Erddrucklasten (passiv/aktiv)

LK 1, Passivseite

Erdwiderstand zu 100.00 mobilisiert

| Z<br>m | E <sub>ph</sub><br>kN/m <sup>2</sup> | E <sub>pv</sub><br>kN/m <sup>2</sup> | E <sub>pres</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|
| 5.00   | 0.00                                 | 0.00                                 | 0.00                                   |
| 5.50   | 0.00                                 | -0.00                                | 0.00                                   |
| 6.28   | 0.00                                 | -0.00                                | 0.00                                   |

$E_h = 0.00 \text{ kN/m}$ ,  $z_s = 0.00 \text{ m}$ ,  $E_v = 0.00 \text{ kN/m}$ ,  $E_{res} = 0.00 \text{ kN/m}$

LK 1, Aktivseite

| Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> | Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|--------|--------------------------------------|--------------------------------------|--|
| 0.00   | 16.12                                | 6.18                                 | 17.26                                  | 5.50   | 31.10                                | 12.35                                | 33.46                                  |
| 5.00   | 16.12                                | 6.18                                 | 17.26                                  | 6.28   | 32.97                                | 13.10                                | 35.47                                  |
| 5.00   | 28.44                                | 11.30                                | 30.60                                  |        |                                      |                                      |  |

$E_h = 120.52 \text{ kN/m}$ ,  $z_s = 3.55 \text{ m}$ ,  $E_v = 46.74 \text{ kN/m}$ ,  $E_{res} = 129.27 \text{ kN/m}$

### 2.11.3. Überlagerte Erddrucklasten (passiv/aktiv)

LK 2, Passivseite

Erdwiderstand zu 100.00 mobilisiert

| Z<br>m | E <sub>ph</sub><br>kN/m <sup>2</sup> | E <sub>pv</sub><br>kN/m <sup>2</sup> | E <sub>pres</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|
| 5.00   | 0.00                                 | 0.00                                 | 0.00                                   |
| 5.50   | 0.00                                 | -0.00                                | 0.00                                   |
| 6.28   | 0.00                                 | -0.00                                | 0.00                                   |

E<sub>h</sub> = 0.00 kN/m, z<sub>s</sub> = 0.00 m, E<sub>v</sub> = 0.00 kN/m, E<sub>res</sub> = 0.00 kN/m

LK 2, Aktivseite

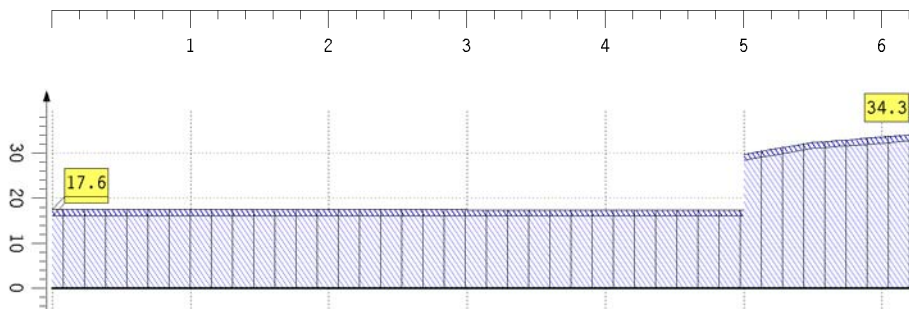
| Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> | Z<br>m | E <sub>ah</sub><br>kN/m <sup>2</sup> | E <sub>av</sub><br>kN/m <sup>2</sup> | E <sub>ares</sub><br>kN/m <sup>2</sup> |
|--------|--------------------------------------|--------------------------------------|--|--------|--------------------------------------|--------------------------------------|--|
| 0.00   | 17.61                                | 6.41                                 | 18.74                                  | 5.00   | 29.77                                | 11.83                                | 32.03                                  |
| 3.00   | 17.61                                | 6.41                                 | 18.74                                  | 5.50   | 32.43                                | 12.88                                | 34.89                                  |
| 3.00   | 17.45                                | 6.93                                 | 18.77                                  | 6.28   | 34.30                                | 13.63                                | 36.91                                  |
| 5.00   | 17.45                                | 6.93                                 | 18.77                                  |        |                                      |                                      |  |

E<sub>h</sub> = 129.35 kN/m, z<sub>s</sub> = 3.51 m, E<sub>v</sub> = 49.63 kN/m, E<sub>res</sub> = 138.54 kN/m

### 2.11.4. Auflagerreaktionen

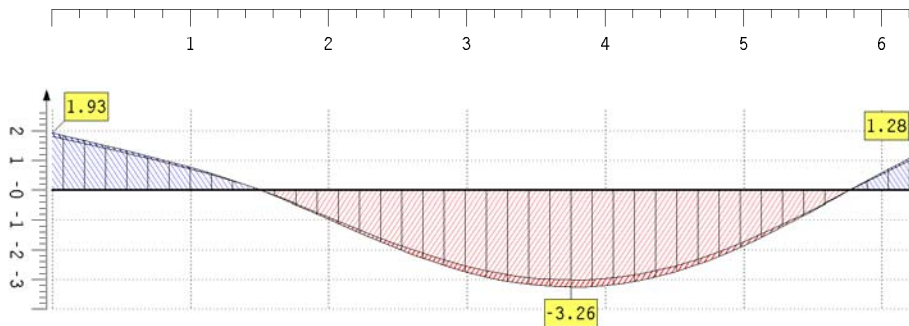
| LK | Name        | Typ                 | z<br>m | α<br>° | V <sub>y</sub><br>KN/m | V <sub>z</sub><br>KN/m | M <sub>x</sub><br>KNm/m |
|----|-------------|---------------------|--------|--------|------------------------|------------------------|-------------------------|
| 1  | Steife      | Lager               | 1.50   | 0.00   | 62.78                  | 0.00                   | -0.00                   |
| 1  | Fußauflager | Einspanngrad = 0.00 | 5.77   | 0.00   | 57.75                  | -0.00                  | -0.00                   |
| 2  | Steife      | Lager               | 1.50   | 0.00   | 68.39                  | 0.00                   | -0.00                   |
| 2  | Fußauflager | Einspanngrad = 0.00 | 5.77   | 0.00   | 60.96                  | -0.00                  | 0.00                    |

extremaler Erddruck



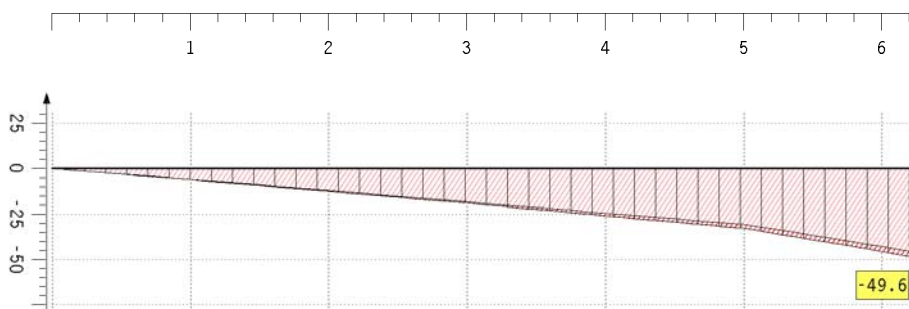
horizontaler  
Erddruck  
e<sub>ah</sub> in kN/m<sup>2</sup>  
Min: 16.12  
Max: 34.30

extremale Verformungen



Durchbiegung  
w in mm  
Min: -3.26  
Max: 1.93

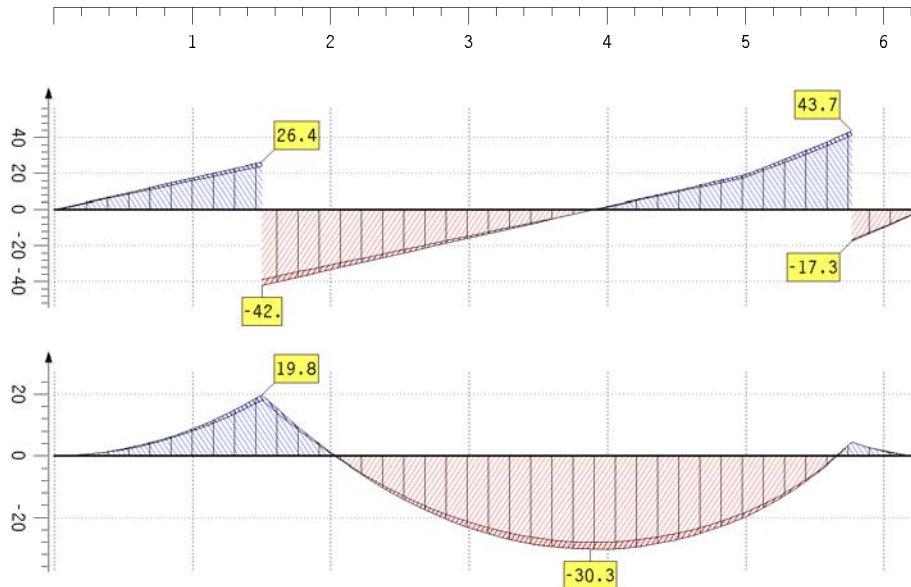
extremale Schnittgrößen



Normalkraft  
N in kN/m  
Min: -49.63  
Max: 0.00



## extremale Schnittgrößen



Querkraft  
V in kN/m  
Min: -41.98  
Max: 43.69

Moment  
M in kNm/m  
Min: -30.30  
Max: 19.81

## Lagerreaktionen ( $\gamma_F$ -fach)

| Z<br>m | Typ | AP <sub>Y</sub><br>kN/m | AP <sub>Z</sub><br>kN/m | AM <sub>X</sub><br>kNm/m | Z<br>m | Typ | AP <sub>Y</sub><br>kN/m | AP <sub>Z</sub><br>kN/m | AM <sub>X</sub><br>kNm/m |
|--------|-----|-------------------------|-------------------------|--------------------------|--------|-----|-------------------------|-------------------------|--------------------------|
| 1.500  | Min | 62.78                   | 0.00                    | -0.00                    | 6.154  | Min | -0.00                   | 0.00                    | -0.00                    |
|        | Max | 68.39                   | 0.00                    | -0.00                    |        | Max | -0.00                   | 0.00                    | -0.00                    |
| 5.769  | Min | 57.75                   | -0.00                   | -0.00                    | 6.282  | Min | 0.00                    | -49.63                  | 0.00                     |
|        | Max | 60.96                   | -0.00                   | 0.00                     |        | Max | 0.00                    | -46.74                  | 0.00                     |

## 2.11.5. Nachweis der Verformungen

Maximale Durchbiegung  $w_{max} = 0.00 \text{ mm} \leq w_{zul} = 100.00 \text{ mm}$  bei  $z = 3.88 \text{ m} \Rightarrow$  **Nachweis erfüllt**

## 3. Zusammenfassung aller Nachweise

| Aushub<br>Nachweis/Ausnutzung    | A1    | Aushub<br>Nachweis/Ausnutzung | A1    |
|----------------------------------|-------|-------------------------------|-------|
| Tragfähigkeit nach DIN 18800 E-E | 0.228 | Nachweis gegen Versinken      | 0.215 |
| Nachweis des Erdwiderlagers      | 0.992 | Nachweis der Verformungen     | 0.000 |
| Nachweis der Vertikalkomponente  | 0.692 |                               |       |