

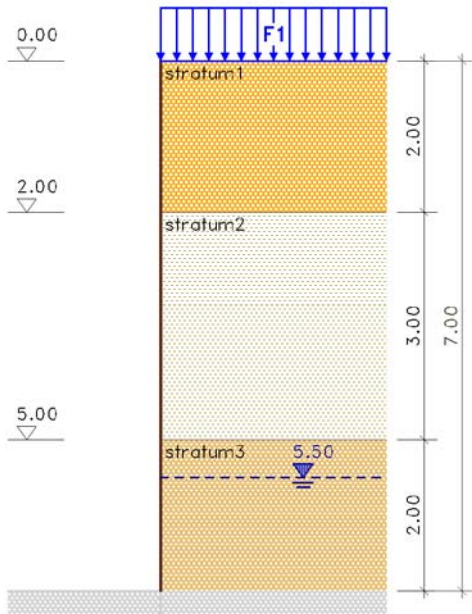
calculation of earth pressures

According to DIN 4084:2017-08 and associated standard specifications

calculation of the active earth pressure

1. system

scale 1:100



wall friction

for a rough wall surface,
angle of wall friction $\delta = 2/3 \cdot \varphi'_{k}$

ground water

behind the wall at $z_{W,right} = 5.50$ m

cohesion

cohesion is fully taken into account
calculated tensile stress from cohesion are not applied
minimum earth pressure is checked in all cohesive strata

soil strata

stratum	notation	soil type	d m	γ kN/m ³	γ' kN/m ³	φ' °	c' kN/m ²
1	stratum1	non-cohesive	2.00	18.00	11.00	35.00	---
2	stratum2	cohesive	3.00	20.00	11.00	22.50	5.00
3	stratum3	non-cohesive	---	19.00	11.00	37.50	---

d - stratum thickness γ - unit weight of soil γ' - unit weight of submerged soil φ' - angle of internal friction of drained soil
 c' - cohesion of the drained soil

2. loading

p - load

2.1. distributed loads

Nr.	notation	p
F1	Flächenlast1	10.00 kN/m ²

2.2. load combinations

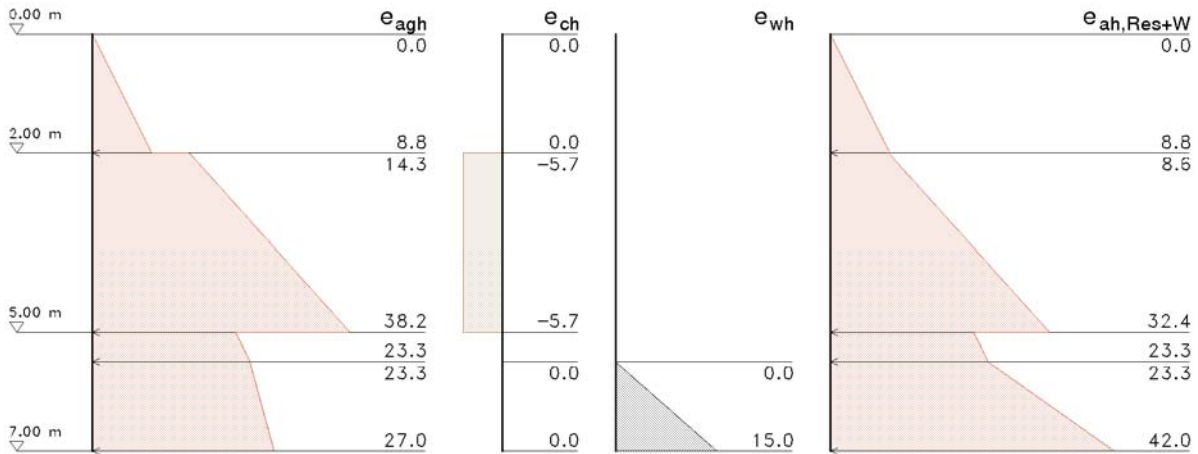
from dead load of the soil (G), water pressure (W) and the external types of loads: distributed (F), strip (S), line (L) or block (B)

LK	notation	factorization
1	load combination1	G+W

3. active earth pressure

3.1. from dead load of the soil

e_{agh} horiz. earth pressure due to soil weight
 e_{ch} horiz. relief due to cohesion
 e_{wh} horiz. water pressure
 $e_{ah,Res+W}$ resulting horiz. earth and water pressure



soil

$\Sigma(\gamma \cdot h)$ total soil weight at the depth considered
 K_{agh} coefficient of earth pressure acc. to [2] section 6.02.3, eqn.(6.02)
 c_{cal} computationally effective cohesion
 K_{ach} coefficient of earth pressure due to cohesion acc. to [2] section 6.02.6, eqn.(6.10)
 e_{ah}/e_{av} horiz. and vertical ordinate of earth pressure
 e_{ares} res. ordinate of earth pressure from horizontal and vertical proportion

Z m	$\Sigma(\gamma \cdot h)$ kN/m ²	K_{agh} -	c_{cal} kN/m ²	K_{ach} -	E_{ah} kN/m ²	E_{av} kN/m ²	E_{ares} kN/m ²
0.00	0.00	0.244	---	---	0.00	0.00	0.00
2.00	36.00	0.244	---	---	8.80	3.80	9.58
2.00	36.00	0.397	5.00	1.149	8.57	2.30	8.87
5.00	96.00	0.397	5.00	1.149	32.41	8.68	33.55
5.00	96.00	0.221	---	---	21.24	9.90	23.43
5.50	105.50	0.221	---	---	23.34	10.88	25.75
7.00	122.00	0.221	---	---	26.99	12.58	29.78

horizontal component of the earth pressure force $E_h = 119.15$ kN/m
 vertical component of the earth pressure force $E_v = 43.06$ kN/m
 earth pressure force $E = 126.69$ kN/m
 point of application of the earth pressure force $z_E = 4.53$ m

water pressure

e_w ordinate of water pressure

Z m	e_w kN/m ²
5.50	0.00
7.00	15.00

horizontal water pressure load $E_h = 11.25$ kN/m
 point of application der water pressure load $z_E = 6.25$ m

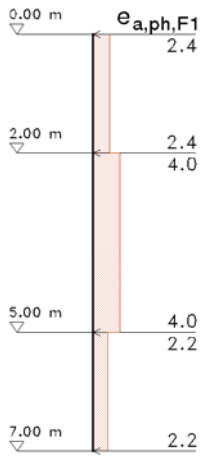
resulting earth pressure of soil including water pressure

Z m	E_{ah} kN/m ²	E_{av} kN/m ²	E_{ares} kN/m ²	Z m	E_{ah} kN/m ²	E_{av} kN/m ²	E_{ares} kN/m ²
0.00	0.00	0.00	0.00	5.00	21.24	9.90	23.43
2.00	8.80	3.80	9.58	5.50	23.34	10.88	25.75
2.00	8.57	2.30	8.87	7.00	41.99	12.58	43.83
5.00	32.41	8.68	33.55				

horizontal component of the earth pressure force $E_h = 130.40$ kN/m
 vertical component of the earth pressure force $E_v = 43.06$ kN/m
 earth pressure force $E = 137.33$ kN/m
 point of application of the earth pressure force $z_E = 4.70$ m

3.2. from external loads

$e_{a,ph,F1}$ horiz. earth pressure from Flächenlast1



F1: Flächenlast1

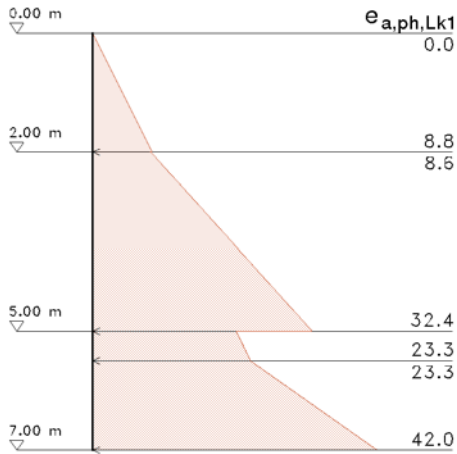
earth pressure distribution: acc. to [1], table C.2

$p(z)$ effective proportion of superimposed load at the depth considered
 K_{aph} coefficient of earth pressure acc. to [2] section 6.02.3, eqn.(6.02)
 e_{ah}/e_{av} horiz. and vertical ordinate of earth pressure
 e_{ares} res. ordinate of earth pressure from horizontal and vertical proportion

z m	$p(z)$ kN/m ²	K_{aph} -	E_{ah} kN/m ²	E_{av} kN/m ²	E_{ares} kN/m ²
0.00	10.00	0.244	2.44	1.05	2.66
2.00	10.00	0.244	2.44	1.05	2.66
2.00	10.00	0.397	3.97	1.06	4.11
5.00	10.00	0.397	3.97	1.06	4.11
5.00	10.00	0.221	2.21	1.03	2.44
7.00	10.00	0.221	2.21	1.03	2.44

horizontal component of the earth pressure force $E_h = 21.24$ kN/m
 vertical component of the earth pressure force $E_v = 7.37$ kN/m
 earth pressure force $E = 22.48$ kN/m
 point of application of the earth pressure force $z_E = 3.45$ m

3.3. Infolge load combinations



LK 1: G+W

z m	E_{ah} kN/m ²	E_{av} kN/m ²	E_{ares} kN/m ²
0.00	0.00	0.00	0.00
2.00	8.80	3.80	9.58
2.00	8.57	2.30	8.87
5.00	32.41	8.68	33.55
5.00	21.24	9.90	23.43
5.50	23.34	10.88	25.75
7.00	41.99	12.58	43.83

horizontal component of the earth pressure force $E_h = 130.40$ kN/m
 vertical component of the earth pressure force $E_v = 43.06$ kN/m
 earth pressure force $E = 137.33$ kN/m
 point of application of the earth pressure force $z_E = 4.70$ m

4. summary

kind of earth pressure	earth pressure force				
	E_h kN/m	E_v kN/m	E kN/m	z_E m	
soil	119.15	43.06	126.69	4.53	
water pressure	11.25	0.00	11.25	6.25	
res. earth pressure from soil + water pressure		130.40	43.06	137.33	4.70
Flächenlast1	21.24	7.37	22.48	3.45	
LK 1: G+W	130.40	43.06	137.33	4.70	

literature and standard specifications:

- [1] DIN 4085: Baugrund, Berechnung des Erddrucks, August 2017
- [2] Dörken/Dehne/Kliesch: Grundbau in Beispielen, Teil 1, Werner Verlag, 5.Aufl., 2013