



## Gabion analysis

### Input data

#### Project

Date : 26.10.2015

#### Settings

(input for current task)

#### Wall analysis

Active earth pressure calculation : Coulomb  
Passive earth pressure calculation : Caquot-Kerisel  
Earthquake analysis : Mononobe-Okabe  
Shape of earth wedge : Calculate as skew  
Allowable eccentricity : 0,333  
Verification methodology : Limit states (LSD)

Reduction coeff. of soil parameters			
Permanent design situation			
Reduction coeff. of internal friction :	$\gamma_{m\phi} =$	1,10	[-]
Reduction coeff. of cohesion :	$\gamma_{mc} =$	1,40	[-]
Reduction coeff. of Poisson's ratio :	$\gamma_{mv} =$	0,90	[-]
Coefficient of unit weight behind construction :	$\gamma_{m\gamma} =$	1,00	[-]
Coefficient of unit weight in front of constr. :	$\gamma_{m\gamma} =$	1,00	[-]

Reduction coeff. of bearing capacity			
Permanent design situation			
Reduction coeff. of overturning :	$\gamma_o =$	1,11	[-]
Reduction coeff. of sliding resistance :	$\gamma_s =$	1,11	[-]
Reduction coeff. of bearing capacity :	$\gamma_b =$	1,00	[-]
Reduction coeff. of friction between blocks :	$\gamma_f =$	1,52	[-]

#### Material of blocks - filling

No.	Name	$\gamma$ [kN/m <sup>3</sup> ]	$\phi$ [°]	c [kPa]
1	Výplň gabionů kamenivem	17,00	30,00	0,00

#### Material of blocks - mesh

No.	Name	Strength overh. $R_t$ [kN/m]	Spacing of vert. meshes v [m]	Bear.cap. of front joint $R_s$ [kN/m]
1	Výplň gabionů kamenivem	40,00	1,00	40,00

#### Geometry of structure

No.	Width b [m]	Height h [m]	Offset a [m]	Material
6	1,00	1,00	0,00	Výplň gabionů kamenivem
5	2,00	1,00	0,00	Výplň gabionů kamenivem
4	2,50	1,00	0,00	Výplň gabionů kamenivem
3	2,50	1,00	0,00	Výplň gabionů kamenivem
2	3,50	1,00	0,00	Výplň gabionů kamenivem
1	3,50	1,00	-	Výplň gabionů kamenivem

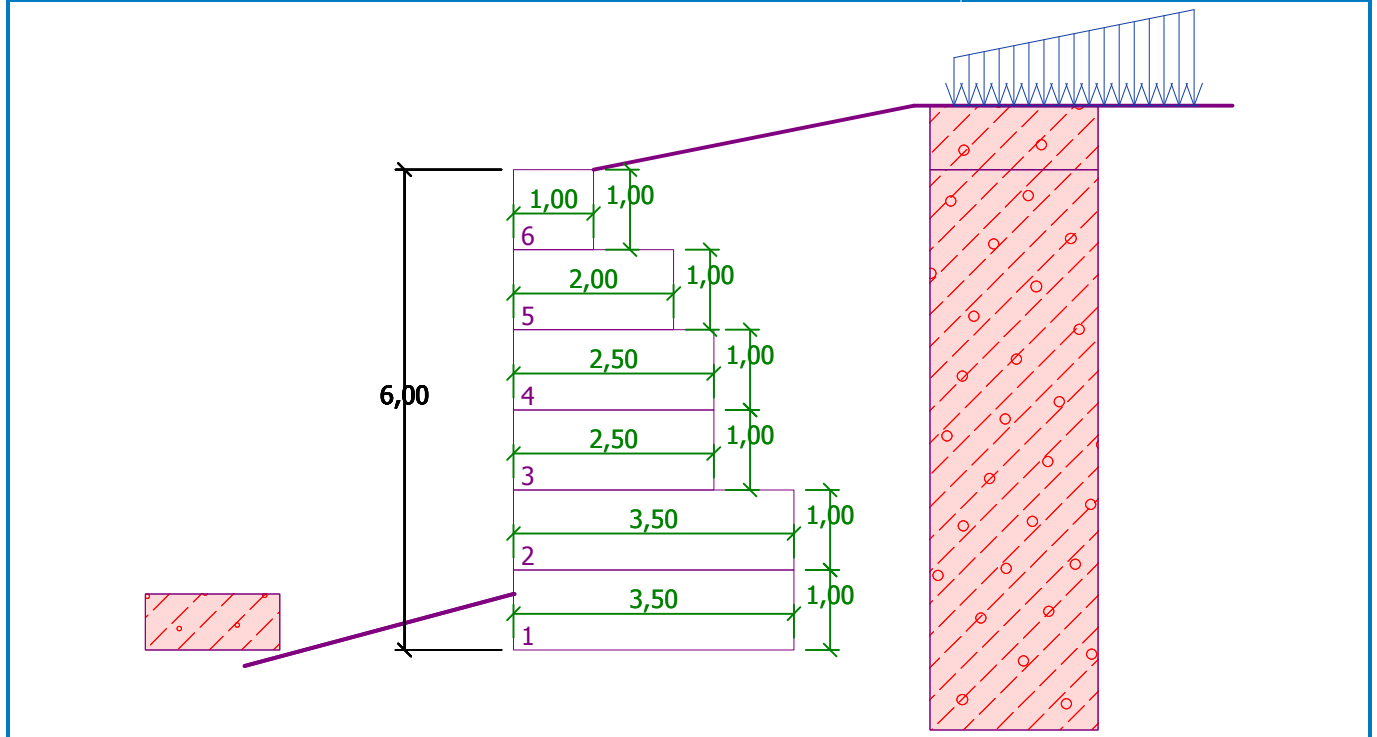
Gabion slope = 0,00 °



Overall height = 6,00 m  
Overall wall volume = 15,00 m<sup>3</sup>/m

Name : Geometry

Stage - analysis : 1 - 0



### Soil parameters

#### Spraše F6

Unit weight :  $\gamma = 20,00 \text{ kN/m}^3$   
 Stress-state : effective  
 Angle of internal friction :  $\varphi_{\text{ef}} = 25,00^\circ$   
 Cohesion of soil :  $c_{\text{ef}} = 9,00 \text{ kPa}$   
 Angle of friction struc.-soil :  $\delta = 16,00^\circ$   
 Soil : cohesionless  
 Solid unit weight :  $\gamma_s = 25,00 \text{ kN/m}^3$   
 Porosity <0.0 - 1.0> :  $n = 0,30$

#### Přední zásyp

Unit weight :  $\gamma = 19,00 \text{ kN/m}^3$   
 Stress-state : effective  
 Angle of internal friction :  $\varphi_{\text{ef}} = 30,00^\circ$   
 Cohesion of soil :  $c_{\text{ef}} = 5,00 \text{ kPa}$   
 Angle of friction struc.-soil :  $\delta = 16,00^\circ$   
 Soil : cohesionless  
 Saturated unit weight :  $\gamma_{\text{sat}} = 20,00 \text{ kN/m}^3$

### Geological profile and assigned soils

No.	Layer [m]	Assigned soil	Pattern
1	-	Spraše F6	

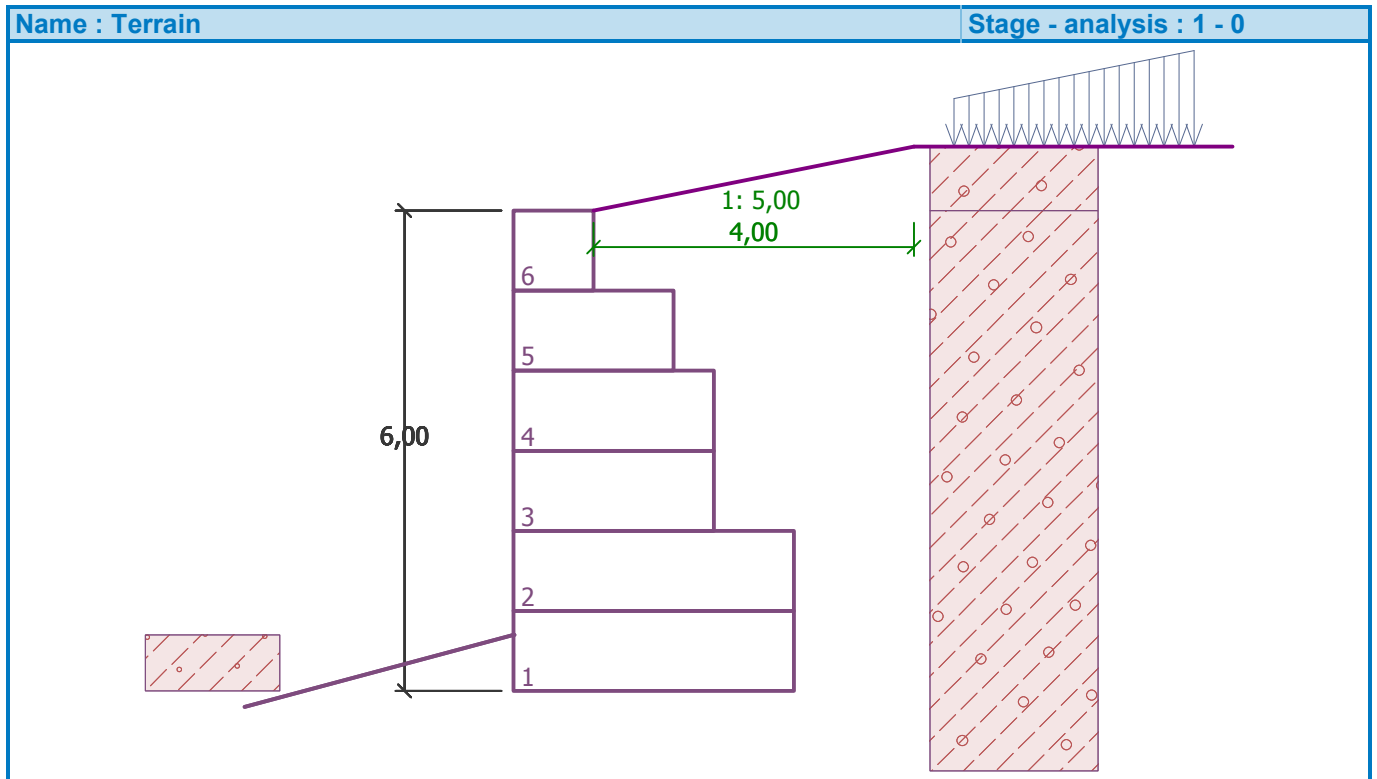


## Foundation

Type of foundation : soil from geological profile

## Terrain profile

Terrain behind construction has the slope 1: 5,00 (slope angle is 11,31 °).  
Embankment height is 0,80 m, embankment length is 4,00 m.



## Water influence

Ground water table is located below the structure.

## Input surface surcharges

No.	Surcharge		Action	Mag.1 [kN/m <sup>2</sup> ]	Mag.2 [kN/m <sup>2</sup> ]	Ord.x x [m]	Length l [m]	Depth z [m]
	new	change						
1	Yes		permanent	10,00	20,00	4,50	3,00	on terrain

## Resistance on front face of the structure

Resistance on front face of the structure: at rest

Soil on front face of the structure - Přední zásyp

Soil thickness in front of structure  $h = 0,70$  m

Soil slope in front of structure  $\beta = -15,00$  °

## Settings of the stage of construction

Design situation : permanent

## Verification No. 1

### Forces acting on construction

Name	$F_{hor}$ [kN/m]	App.Pt. z [m]	$F_{vert}$ [kN/m]	App.Pt. x [m]	Design coefficient
Weight - wall	0,00	-2,43	255,00	1,40	1,000
FF resistance	-2,19	-0,23	0,00	0,00	1,000



Name	$F_{hor}$ [kN/m]	App.Pt. z [m]	$F_{vert}$ [kN/m]	App.Pt. x [m]	Design coefficient
Weight - earth wedge	0,00	-3,95	40,99	2,20	1,000
Active pressure	149,30	-2,10	105,90	2,99	0,500
Surch.1 - trapez.	12,49	-2,32	9,10	2,88	1,000

### Verification of complete wall

#### Check for overturning stability

Resisting moment  $M_{res} = 568,81$  kNm/m

Overturning moment  $M_{ovr} = 185,54$  kNm/m

Wall for overturning is **SATISFACTORY**

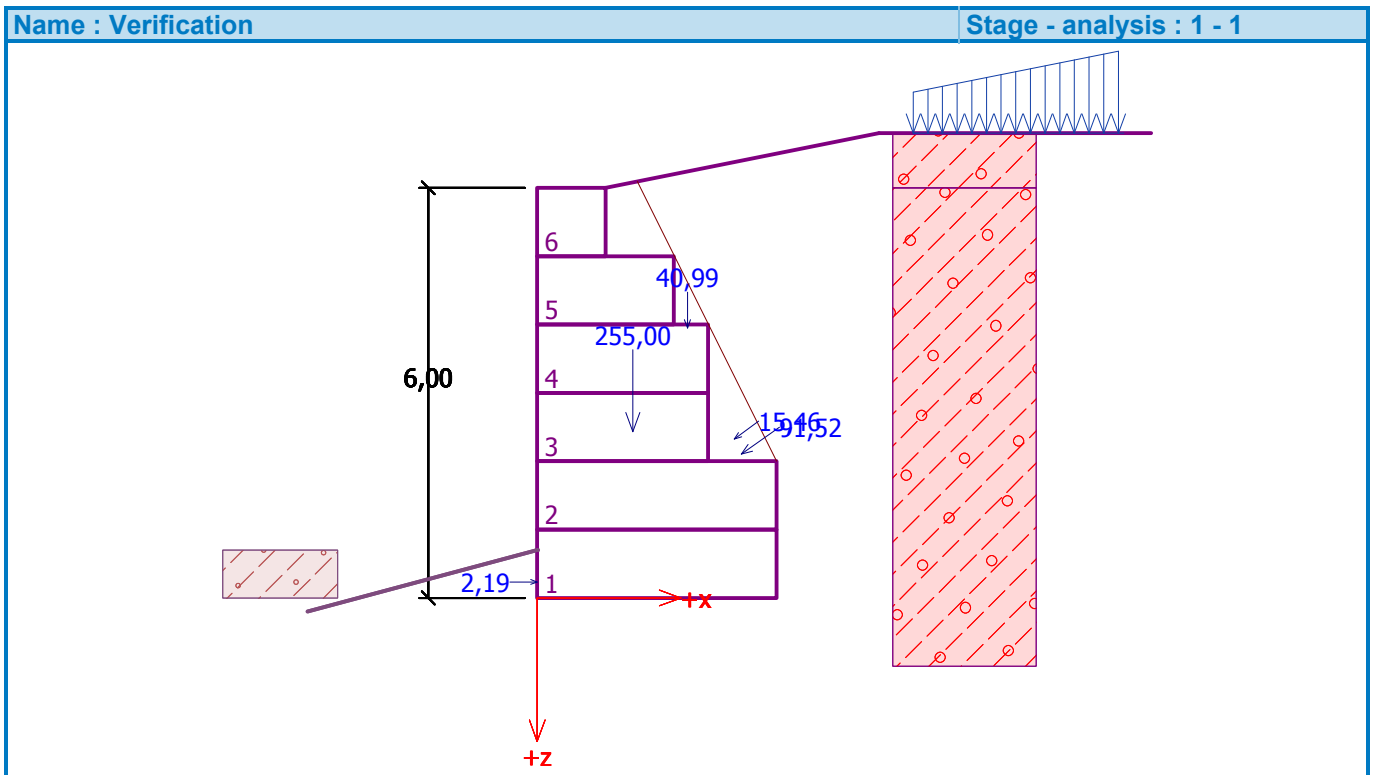
#### Check for slip

Resisting horizontal force  $H_{res} = 149,53$  kN/m

Active horizontal force  $H_{act} = 84,95$  kN/m

Wall for slip is **SATISFACTORY**

Overall check - **WALL is SATISFACTORY**



### Bearing capacity of foundation soil

#### Design load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]	Eccentricity [-]	Stress [kPa]
1	180,73	358,04	84,95	0,144	143,77

#### Service load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]
1	153,14	352,61	71,26



### Verification of foundation soil

#### Eccentricity verification

Max. eccentricity of normal force  $e = 0,144$   
Maximum allowable eccentricity  $e_{alw} = 0,333$

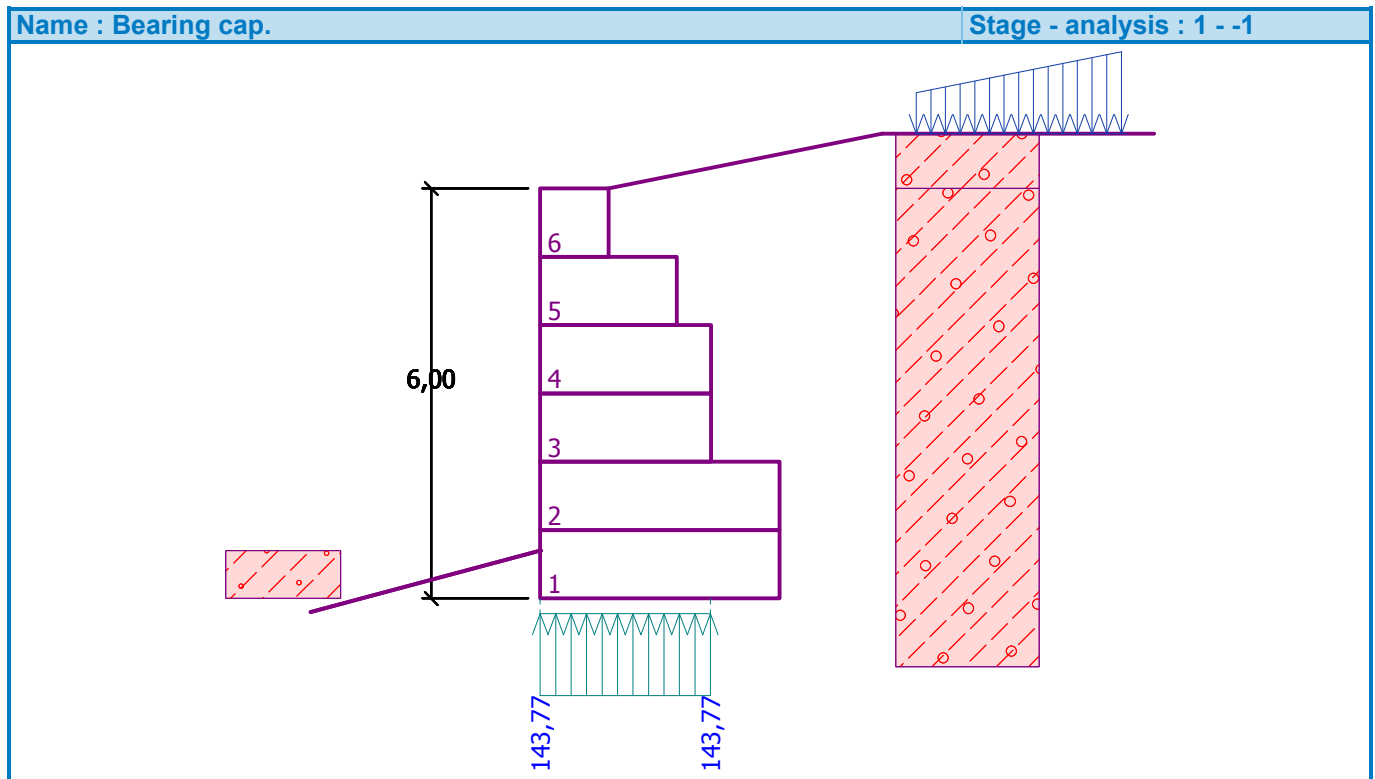
**Eccentricity of the normal force is SATISFACTORY**

#### Verification of bearing capacity

Max. stress at footing bottom  $\sigma = 143,77$  kPa  
Bearing capacity of foundation soil  $R_d = 210,00$  kPa

**Bearing capacity of foundation soil is SATISFACTORY**

**Overall verification - bearing capacity of found. soil is SATISFACTORY**



### Dimensioning No. 1

#### Forces acting on construction

Name	$F_{hor}$ [kN/m]	App.Pt. z [m]	$F_{vert}$ [kN/m]	App.Pt. x [m]	Design coefficient
Weight - wall	0,00	-2,02	195,50	1,29	1,000
Weight - earth wedge	0,00	-2,95	40,99	2,20	1,000
Active pressure	108,27	-1,72	95,26	2,93	1,000
Surch.1 - trapez.	9,71	-1,85	8,38	2,83	1,000

#### Verification of construction joint above the block No.: 1

##### Check for overturning stability

Resisting moment  $M_{res} = 645,53$  kNm/m  
Overturning moment  $M_{ovr} = 203,78$  kNm/m

**Joint for overturning stability is SATISFACTORY**

##### Check for slip



Resisting horizontal force  $H_{res} = 175,34 \text{ kN/m}$   
Active horizontal force  $H_{act} = 117,98 \text{ kN/m}$

**Joint for slip is SATISFACTORY**

Maximum pressure on the bottom block = 130,94 kPa  
Red.Coeff. by offset of top block = 1,00  
Average value of pressure on face = 63,67 kPa  
Shear force transmitted by friction = 115,36 kN/m

**Bearing capacity against transverse pressure:**

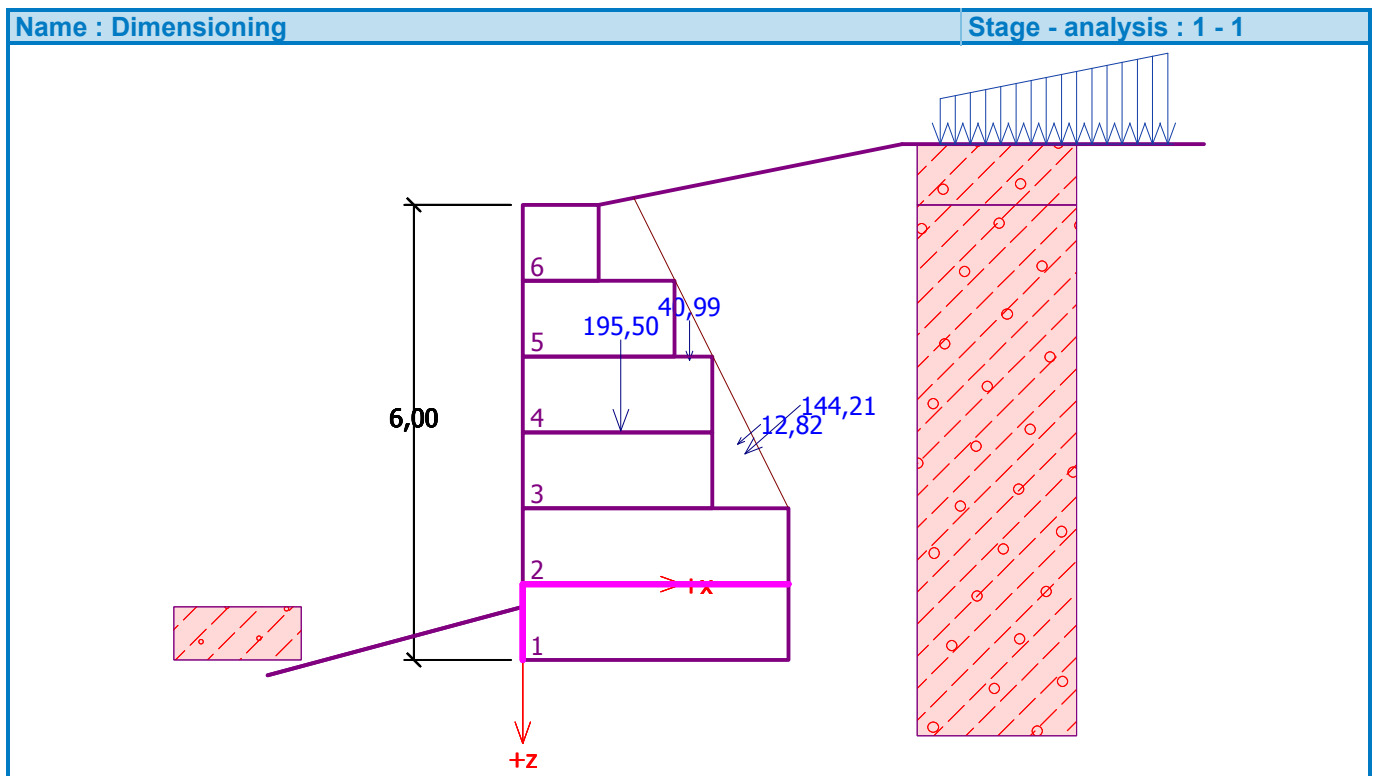
Joint bear.capacity = 40,00 kN/m  
Computed stress-state = 31,84 kN/m

**Transverse pressure check is SATISFACTORY**

**Joint btw. blocks check:**

Mesh material bear.capacity = 40,00 kN/m  
Computed stress-state = 34,46 kN/m

**Joint between blocks is SATISFACTORY**



## Slope stability analysis

### Input data

#### Project

#### Settings

(input for current task)

#### Stability analysis

Earthquake analysis : Standard  
Verification methodology : according to EN 1997  
Design approach : 2 - reduction of actions and resistances



### Partial factors on actions (A)

#### Permanent design situation

		Unfavourable	Favourable
Permanent actions :	$\gamma_G =$	1,35 [-]	1,00 [-]
Variable actions :	$\gamma_Q =$	1,50 [-]	0,00 [-]
Water load :	$\gamma_w =$	1,35 [-]	

### Partial factors for resistances (R)

#### Permanent design situation

Partial factor on sliding resistance (on slip surface) :	$\gamma_{Rs} =$	1,10 [-]
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### Interface


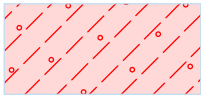
No.	Interface location	Coordinates of interface points [m]					
		x	z	x	z	x	z
1		-15,00	90,95	-3,61	94,00	-1,00	94,70
		-1,00	95,00	-1,00	96,00	-1,00	97,00
		-1,00	98,00	-1,00	99,00	-1,00	100,00
		0,00	100,00	4,00	100,80	18,00	100,80
2		0,00	100,00	0,00	99,00	1,00	99,00
		1,00	98,00	1,50	98,00	1,50	97,00
		1,50	96,00	2,50	96,00		
3		-1,00	94,00	2,50	94,00	2,50	95,00
		2,50	96,00	18,00	96,00		
4		-3,61	94,00	-1,00	94,00	-1,00	94,70

### Soil parameters - effective stress state

No.	Name	Pattern	$\Phi_{ef}$ [°]	$C_{ef}$ [kPa]	$\gamma$ [kN/m <sup>3</sup> ]
1	Spraše F6		25,00	9,00	20,00
2	Přední zásyp		30,00	5,00	19,00



### Soil parameters - uplift

No.	Name	Pattern	$\gamma_{sat}$ [kN/m <sup>3</sup> ]	$\gamma_s$ [kN/m <sup>3</sup> ]	n [-]
1	Spraše F6			25,00	0,30
2	Přední zásyp		20,00		

### Soil parameters

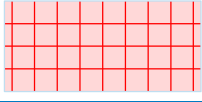
#### Spraše F6

Unit weight :  $\gamma = 20,00 \text{ kN/m}^3$   
 Stress-state : effective  
 Angle of internal friction :  $\varphi_{ef} = 25,00^\circ$   
 Cohesion of soil :  $c_{ef} = 9,00 \text{ kPa}$   
 Solid unit weight :  $\gamma_s = 25,00 \text{ kN/m}^3$   
 Porosity <0.0 - 1.0> :  $n = 0,30$

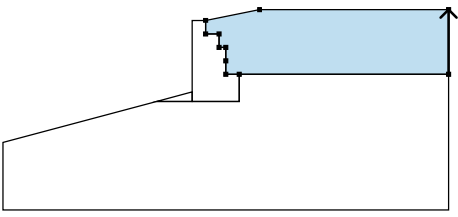
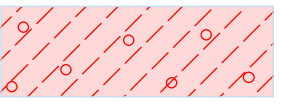
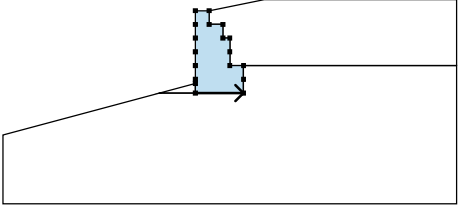
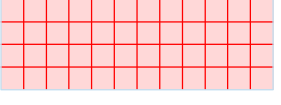
#### Přední zásyp

Unit weight :  $\gamma = 19,00 \text{ kN/m}^3$   
 Stress-state : effective  
 Angle of internal friction :  $\varphi_{ef} = 30,00^\circ$   
 Cohesion of soil :  $c_{ef} = 5,00 \text{ kPa}$   
 Saturated unit weight :  $\gamma_{sat} = 20,00 \text{ kN/m}^3$

### Rigid bodies

No.	Name	Sample	$\gamma$ [kN/m <sup>3</sup> ]
1	Wall material		17,00

### Assigning and surfaces

No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
1		18,00	96,00	18,00	100,80	Spraše F6 
		4,00	100,80	0,00	100,00	
		0,00	99,00	1,00	99,00	
		1,00	98,00	1,50	98,00	
		1,50	97,00	1,50	96,00	
		2,50	96,00			
2		-1,00	94,00	2,50	94,00	Wall material 
		2,50	95,00	2,50	96,00	
		1,50	96,00	1,50	97,00	
		1,50	98,00	1,00	98,00	
		1,00	99,00	0,00	99,00	
		0,00	100,00	-1,00	100,00	
		-1,00	99,00	-1,00	98,00	
		-1,00	97,00	-1,00	96,00	
-1,00	95,00	-1,00	94,70			





No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
3		-1,00	94,00	-1,00	94,70	Přední zásyp 
		-3,61	94,00			
4		-3,61	94,00	-15,00	90,95	Spraše F6 
		-15,00	85,95	18,00	85,95	
		18,00	96,00	2,50	96,00	
		2,50	95,00	2,50	94,00	
		-1,00	94,00			

### Surcharge

No.	Type	Type of action	Location z [m]	Origin x [m]	Length l [m]	Width b [m]	Slope $\alpha$ [°]	Magnitude		
								q, q <sub>1</sub> , f, F	q <sub>2</sub>	unit
1	trapezoid	permanent	on terrain	x = 4,50	l = 3,00		0,00	10,00	20,00	kN/m <sup>2</sup>

### Water

Water type : No water

### Tensile crack

Tensile crack not inputted.

### Earthquake

Earthquake not included.

### Settings of the stage of construction

Design situation : permanent

## Results (Stage of construction 1)

### Analysis 1

#### Circular slip surface

Slip surface parameters							
Center :	x =	-3,98	[m]	Angles :	$\alpha_1 =$	-19,79	[°]
	z =	104,07	[m]		$\alpha_2 =$	74,13	[°]
Radius :	R =	11,96	[m]				
Analysis of the slip surface without optimization.							

#### Slope stability verification (Bishop)

Sum of active forces :  $F_a = 659,08$  kN/m

Sum of passive forces :  $F_p = 765,73$  kN/m

Sliding moment :  $M_a = 7882,64$  kNm/m

Resisting moment :  $M_p = 8325,61$  kNm/m

Utilization : 94,7 %

**Slope stability ACCEPTABLE**