

## Analysis using finite element method

### Topology

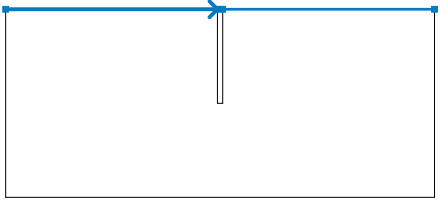
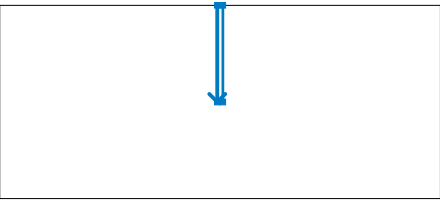
#### Project

Date : 12.6.2010

#### Global settings

Project type : Plane strain  
 Analysis type : Flow  
 Tunnels : no  
 Advanced input : no  
 Detailed results : no  
 Statistic : no  
 Concrete structures : EN 1992 1-1 (EC2)  
 Steel structures : EN 1993-1-1 (EC3)

#### Interface

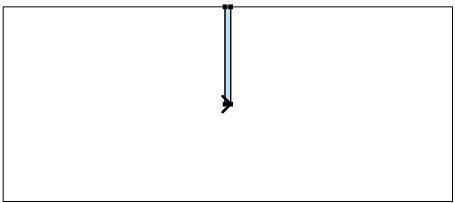
Number	Interface location	Coordinates of interface points [m]					
		x	z	x	z	x	z
1		-10,00	7,00	5,80	7,00	6,20	7,00
		22,00	7,00				
2		5,80	7,00	5,80	0,00	6,20	0,00
		6,20	7,00				

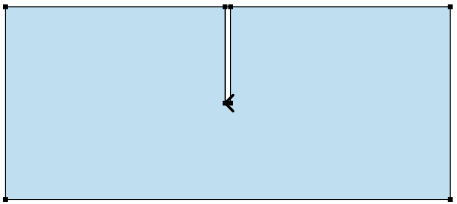
#### Soil parameters

##### Zemina\_1

Permeability coeff. in X-direction :  $k_{x,sat} = 2,700E-01$  m/day  
 Permeability coeff. in Z-direction :  $k_{z,sat} = 2,700E-01$  m/day  
 Initial void ratio :  $e_0 = 0,60$   
 Transition zone model : Log - linear  
 Transition zone width :  $PTZ = 0,10$  m

#### Assigning and surfaces

Number	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
1		5,80	0,00	6,20	0,00	(not assigned)
		6,20	7,00	5,80	7,00	

Number	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
2		6,20	0,00	5,80	0,00	(not assigned)
		5,80	7,00	-10,00	7,00	
		-10,00	-7,00	22,00	-7,00	
		22,00	7,00	6,20	7,00	

### Free points

Number	Location		Number	Location		Number	Location		Number	Location	
	x [m]	z [m]		x [m]	z [m]		x [m]	z [m]			
1	6,00	7,00	2	6,00	-1,00						

### Free lines

Number	Type of line	Mode of input	Lines topology
1	segment		Origin (6,00; 7,00) [m] , end (6,00; -1,00) [m]

### Lines refinement

Number	Location	Radius r [m]	Length l [m]
1	Free line No. 1	3,00	0,10

### Mesh generation

#### Mesh generation parameters

Element edge length : 0,60 [m]

Mesh smoothing : yes

Generate multinode elements : yes

#### Mesh generation result

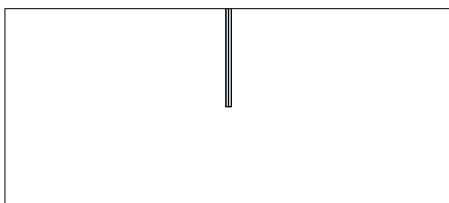
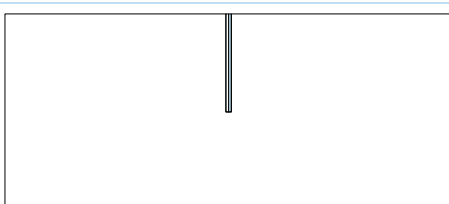
**Finite element mesh was successfully generated.**

Number of nodes 9637

Number of elements 5416 (region 4032, beam 346, interface 1038)

### Input data (Stage of construction 1)

#### Assignment and activation

Number	Region	Active / inactive	Assigned soil
1		Inactive	
2		Inactive	

Number	Region	Active / inactive	Assigned soil
3		Active	Zemina_1 

### Line flows

Number	Location	Boundary type	Parameters
1	Mesh line No. 1	seepage	
2	Mesh line No. 2	seepage	
3	Mesh line No. 4	seepage	
4	Mesh line No. 5	impermeable	
5	Mesh line No. 6	pore pressure	ZGWT = 6,00 m
6	Mesh line No. 7	impermeable	
7	Mesh line No. 8	pore pressure	ZGWT = 6,00 m
8	Mesh line No. 9	impermeable	
9	Mesh line No. 12	seepage	

### Analysis settings

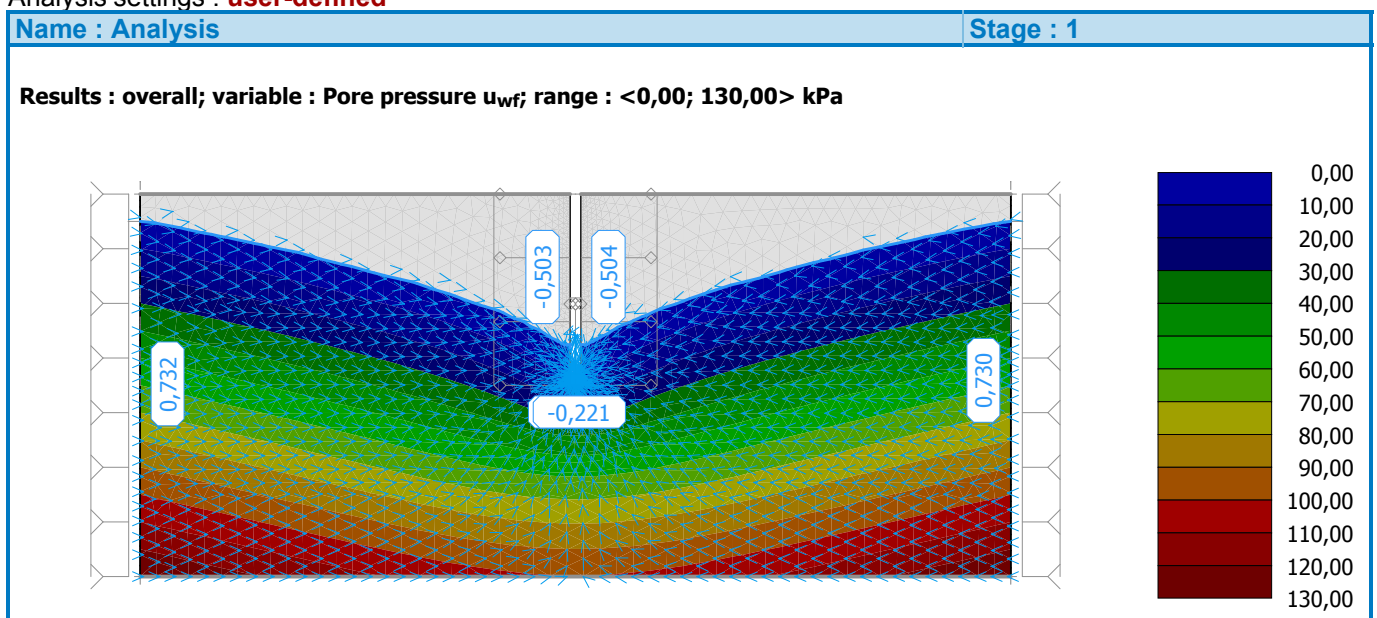
#### Flow

Method :	Newton - Raphson
Stiffness matrix change :	keep elastic
Max. number of iterations for one calc. step :	100
Initial calculation step :	1,00
Imbalanced pore pressures error :	0,0100
Imbalanced fluxes error :	0,0100
Respect material interfaces :	no
Relaxation factor :	2
Max. number of relaxations for one calc. step :	10
Min. number of iterations for one calc. step :	1

### Results (Stage of construction 1)

#### Water flow analysis succeeded.

Analysis settings : **user-defined**





**Calculated point inflow / outflow**

Location		Inflow [m <sup>3</sup> /day/m]	Outflow [m <sup>3</sup> /day/m]
x [m]	z [m]		
6,20	0,00		-0,121
6,07	0,00		-0,029
6,00	0,00		-0,012
5,93	0,00		-0,029
5,80	0,00		-0,127
5,80	0,12		-0,029
5,80	0,22		-0,024
5,80	0,36		-0,024
5,80	0,51		-0,016
5,80	0,62		-0,013
5,80	0,75		-0,014
5,80	0,92		-0,012
5,80	1,10		-0,010
5,80	1,28		-0,006
5,80	1,49	0,007	
5,80	1,70	0,008	
-10,00	5,57	0,007	
-10,00	4,93	0,009	
-10,00	4,28	0,011	
-10,00	3,61	0,013	
-10,00	2,81	0,015	
-10,00	1,97	0,014	
-10,00	1,33	0,011	
-10,00	0,82	0,010	
-10,00	0,31	0,010	
-10,00	-0,21	0,010	
-10,00	-0,70	0,010	
-10,00	-1,28	0,013	
-10,00	-2,03	0,015	
-10,00	-2,76	0,013	
-10,00	-3,34	0,012	
-10,00	-3,89	0,011	
-10,00	-4,42	0,011	
-10,00	-4,96	0,012	
-10,00	-5,56	0,013	
-10,00	-6,20	0,015	
-10,00	-7,00	0,008	
22,00	-7,00	0,007	
22,00	-6,35	0,013	
22,00	-5,75	0,012	
22,00	-5,15	0,012	
22,00	-4,55	0,012	
22,00	-3,94	0,013	
22,00	-3,33	0,012	
22,00	-2,72	0,014	
22,00	-1,97	0,015	
22,00	-1,17	0,014	
22,00	-0,54	0,011	
22,00	-0,04	0,009	
22,00	0,40	0,009	
22,00	0,85	0,009	
22,00	1,31	0,010	
22,00	1,85	0,012	
22,00	2,59	0,014	



Location		Inflow	Outflow
x [m]	z [m]	[m <sup>3</sup> /day/m]	[m <sup>3</sup> /day/m]
22,00	3,41	0,014	
22,00	4,13	0,012	
22,00	4,83	0,010	
22,00	5,48	0,008	
6,20	1,71	0,020	
6,20	1,49	0,001	
6,20	1,28		-0,007
6,20	1,07		-0,012
6,20	0,89		-0,013
6,20	0,73		-0,013
6,20	0,61		-0,013
6,20	0,49		-0,017
6,20	0,35		-0,023
6,20	0,22		-0,021
6,20	0,12		-0,029
6,14	0,00		-0,087
6,04	0,00		-0,039
5,96	0,00		-0,039
5,86	0,00		-0,083
5,80	0,06		-0,080
5,80	0,17		-0,045
5,80	0,29		-0,049
5,80	0,44		-0,042
5,80	0,69		-0,026
5,80	0,84		-0,028
5,80	1,01		-0,023
5,80	1,19		-0,016
5,80	1,39		-0,006
5,80	1,60	0,014	
-10,00	5,86	0,010	
-10,00	5,25	0,017	
-10,00	4,61	0,020	
-10,00	3,95	0,023	
-10,00	3,21	0,029	
-10,00	2,39	0,031	
-10,00	1,65	0,024	
-10,00	1,08	0,020	
-10,00	0,57	0,020	
-10,00	0,05	0,020	
-10,00	-0,46	0,019	
-10,00	-0,99	0,023	
-10,00	-1,65	0,030	
-10,00	-2,39	0,029	
-10,00	-3,05	0,023	
-10,00	-3,62	0,022	
-10,00	-4,16	0,022	
-10,00	-4,69	0,022	
-10,00	-5,26	0,024	
-10,00	-5,88	0,026	
-10,00	-6,60	0,033	
22,00	-6,67	0,027	
22,00	-6,05	0,024	
22,00	-5,45	0,024	
22,00	-4,85	0,024	
22,00	-4,25	0,025	



Location		Inflow	Outflow
x [m]	z [m]	[m <sup>3</sup> /day/m]	[m <sup>3</sup> /day/m]
22,00	-3,63	0,025	
22,00	-3,02	0,025	
22,00	-2,34	0,030	
22,00	-1,57	0,032	
22,00	-0,85	0,025	
22,00	-0,29	0,020	
22,00	0,18	0,017	
22,00	0,63	0,018	
22,00	1,08	0,018	
22,00	1,58	0,021	
22,00	2,22	0,028	
22,00	3,00	0,030	
22,00	3,77	0,025	
22,00	4,48	0,023	
22,00	5,15	0,018	
22,00	5,78	0,011	
6,20	1,79	0,015	
6,20	1,60	0,014	
6,20	1,39		-0,007
6,20	1,18		-0,019
6,20	0,98		-0,024
6,20	0,81		-0,027
6,20	0,55		-0,029
6,20	0,42		-0,040
6,20	0,28		-0,046
6,20	0,17		-0,046
6,20	0,06		-0,083
6,20	0,67		-0,024
5,80	1,79	0,021	
5,80	0,57		-0,026
Total		1,562	-1,550

**Calculated total inflow / outflow**

Location	Inflow	Outflow
	[m <sup>3</sup> /day/m]	[m <sup>3</sup> /day/m]
Lines - flow No. 1		-0,221
Lines - flow No. 2		-0,504
Lines - flow No. 3		-0,503
Lines - flow No. 5	0,732	
Lines - flow No. 7	0,730	
Lines - flow No. 9		-0,221
Total	1,462	-1,449