



*Sito impiantistico  
Galliera (BO)*

Denuncia di Deposito Sismico  
L.R. 30 ottobre 2008, n. 19 e ss.mm.ii.

**PROGETTO ESECUTIVO**

Ottimizzazione di utilizzo del sito impiantistico esistente  
attraverso il ridimensionamento dell'area dedicata al  
servizio di deposito finale dei rifiuti

**ELABORATO 04.01**

Tabulati di calcolo di stabilità globale

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<b>Controllato</b>	L. Savigni F. Crociati		
<b>Redatto</b>	P. Parla		
<b>Rev.</b>	00	<b>Data</b>	30/04/2025
<b>Cod. Doc.</b>	DS 03 BO SM 00 E1 RS 04.01	<b>Pagine</b>	1 di 40



# Slope Stability

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## File Information

File Version: 8.15  
Created By: paolo  
Last Edited By: paolo  
Revision Number: 57  
Date: 07/05/2025  
Time: 16:21:37  
Tool Version: 8.15.6.13446  
File Name: ST Cap port\_PROGETTO.gsz  
Directory: \\192.168.100.1\commesse\393-2025\_HERA Galliera\WORK\03-PFTE\STABILITA\  
Last Solved Date: 07/05/2025  
Last Solved Time: 16:29:06

## Project Settings

Length(L) Units: Meters  
Time(t) Units: Seconds  
Force(F) Units: Kilonewtons  
Pressure(p) Units: kPa  
Strength Units: kPa  
Unit Weight of Water: 9,807 kN/m<sup>3</sup>  
View: 2D  
Element Thickness: 1

## Analysis Settings

### Slope Stability

Kind: SLOPE/W  
Method: Morgenstern-Price  
Settings  
Side Function  
Interslice force function option: Half-Sine  
PWP Conditions Source: Piezometric Line  
Apply Phreatic Correction: No  
Use Staged Rapid Drawdown: No  
Slip Surface  
Direction of movement: Right to Left  
Use Passive Mode: No  
Slip Surface Option: Entry and Exit  
Critical slip surfaces saved: 1  
Resisting Side Maximum Convex Angle: 1 °  
Driving Side Maximum Convex Angle: 5 °  
Optimize Critical Slip Surface Location: Yes  
Critical Slip Surface Optimizations  
Maximum Iterations: 2 000  
Convergence Tolerance: 1e-007  
Starting Points: 8  
Ending Points: 16  
Complete Passes per Insertion: 1  
Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0,001

Minimum Slip Surface Depth: 0,1 m

Search Method: Root Finder

Tolerable difference between starting and converged F of S: 3

Maximum iterations to calculate converged lambda: 20

Max Absolute Lambda: 2

## Materials

### 01 Argine

Model: Mohr-Coulomb

Unit Weight: 18,5 kN/m<sup>3</sup>

Cohesion': 0 kPa

Phi': 26,56 °

Phi-B: 0 °

### 02 unità 1

Model: S=f(depth)

Unit Weight: 18,5 kN/m<sup>3</sup>

C-Top of Layer: 21,4 kPa

C-Rate of Change: 3,5 (kN/m<sup>2</sup>)/m

C-Maximum: 42,9 kPa

Pore Water Pressure

Piezometric Line: 1

### 03 unità 2

Model: S=f(depth)

Unit Weight: 19,5 kN/m<sup>3</sup>

C-Top of Layer: 42,9 kPa

C-Rate of Change: 4,75 (kN/m<sup>2</sup>)/m

C-Maximum: 71,4 kPa

Pore Water Pressure

Piezometric Line: 1

### 04 unità 3

Model: Mohr-Coulomb

Unit Weight: 19 kN/m<sup>3</sup>

Cohesion': 0 kPa

Phi': 31,08 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

### 06 unità 5

Model: Mohr-Coulomb

Unit Weight: 19,5 kN/m<sup>3</sup>

Cohesion': 0 kPa

Phi': 31,08 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

## 05 unità 4

Model:  $S=f(\text{depth})$

Unit Weight: 19,5 kN/m<sup>3</sup>

C-Top of Layer: 39,3 kPa

C-Rate of Change: 2,5 (kN/m<sup>2</sup>)/m

C-Maximum: 71,4 kPa

Pore Water Pressure

Piezometric Line: 1

## 06 Argilla

Model: Undrained (Phi=0)

Unit Weight: 19 kN/m<sup>3</sup>

Cohesion': 42,9 kPa

Pore Water Pressure

Piezometric Line: 1

## Slip Surface Entry and Exit

Left Projection: Range

Left-Zone Left Coordinate: (15,16667; 0) m

Left-Zone Right Coordinate: (81,5; 0) m

Left-Zone Increment: 20

Right Projection: Point

Right Coordinate: (117,38301; 0,74466) m

Right-Zone Increment: 20

Radius Increments: 20

## Slip Surface Limits

Left Coordinate: (0; 0) m

Right Coordinate: (219,9595; 3,1722) m

## Piezometric Lines

### Piezometric Line 1

#### Coordinates

	X (m)	Y (m)
Coordinate 1	0	-0,5
Coordinate 2	219,9595	-0,5

## Reinforcements

### Reinforcement 1

Type: Geosynthetic

Outside Point: (81,5; 0) m

Inside Point: (219,95; 0) m

Slip Surface Intersection: (116,54397; 0) m

Length: 138,45 m

Direction: 180 °

F of S Dependent: Yes

Interface Adhesion: 0 kPa

Interface Shear Angle: 21,4 °

Surface Area Factor: 2  
 Resistance Reduction Factor: 1  
 Force Distribution: Distributed  
 Anchorage: Yes  
 Tensile Capacity: 1 450 kN  
 Reduction Factor: 1,6  
 Force Orientation: 0  
 Max. Pullout Force: 906,25 kN  
 Pullout Force: 397,86931 kN  
 Pullout Force per Length: 11,088306 kN/m  
 Available Length: 103,40603 m  
 Required Length: 35,881884 m  
 Governing Component: Tensile Capacity

## Points

	X (m)	Y (m)
Point 1	0	0
Point 2	81,5	0
Point 3	94,75	9,5
Point 4	104,25	9,5
Point 5	118,5	0
Point 6	219,9595	0
Point 7	0	-6
Point 8	219,9595	-6
Point 9	0	-12
Point 10	219,9595	-12
Point 11	0	-13,5
Point 12	219,9595	-13,5
Point 13	0	-26
Point 14	219,9595	-26
Point 15	0	-100
Point 16	219,9595	-100
Point 17	219,9595	3,1722
Point 18	117,56801	0,62132

## Regions

	Material	Points	Area (m <sup>2</sup> )
Region 1	01 Argine	2;3;4;18;5	220,87
Region 2	02 unità 1	1;2;5;6;8;7	1 319,8
Region 3	03 unità 2	7;8;10;9	1 319,8
Region 4	04 unità 3	9;10;12;11	329,94
Region 5	05 unità 4	11;12;14;13	2 749,5
Region 6	06 unità 5	13;14;16;15	16 277
Region 7	06 Argilla	17;6;5;18	193,92

## Current Slip Surface

Slip Surface: 442  
 F of S: 2,278  
 Volume: 1 142,2016 m<sup>3</sup>  
 Weight: 21 630,576 kN  
 Resisting Moment: 190 307,86 kN-m

Activating Moment: 83 550,581 kN-m

Resisting Force: 4 606,0378 kN

Activating Force: 2 022,1791 kN

F of S Rank (Analysis): 1 of 442 slip surfaces

F of S Rank (Query): 1 of 442 slip surfaces

Exit: (45,374537; 0) m

Entry: (117,38301; 0,74465545) m

Radius: 30,769006 m

Center: (80,989754; 20,788422) m

## Slip Slices

	X (m)	Y (m)	PWP (kPa)	Base Normal Stress (kPa)	Frictional Strength (kPa)	Cohesive Strength (kPa)
Slice 1	45,590892	-0,25	-2,45175	15,913995	0	22,275
Slice 2	47,548034	-2,51149	19,726682	61,46853	0	30,190215
Slice 3	50,019945	-5,26149	46,695932	114,07922	0	39,815215
Slice 4	51,9293	-7,19013	65,610105	154,08279	0	48,553117
Slice 5	54,258675	-8,983105	83,193811	180,4643	0	57,069749
Slice 6	56,560965	-10,188795	95,018013	204,72302	0	62,796776
Slice 7	58,836773	-11,39582	106,85531	229,34666	0	68,530145
Slice 8	61,357539	-12,75	120,13575	258,06208	83,13683	0
Slice 9	62,893541	-13,575155	128,22805	263,44047	0	39,487887
Slice 10	64,085435	-14,022853	132,61861	269,73397	0	40,607131
Slice 11	66,189425	-14,767938	139,92566	284,335	0	42,469844
Slice 12	68,623338	-15,589653	147,98422	300,07907	0	44,524131
Slice 13	71,387173	-16,487997	156,79429	317,8145	0	46,769994
Slice 14	73,96664	-17,316675	164,92113	334,14319	0	48,841687
Slice 15	76,36174	-18,075685	172,36474	349,29508	0	50,739212
Slice 16	78,544467	-18,687337	178,36322	360,35404	0	52,268343
Slice 17	80,514822	-19,151632	182,91655	369,78018	0	53,42908
Slice 18	82,64187	-19,65285	187,832	394,89756	0	54,682124
Slice 19	84,783845	-19,833268	189,60135	422,12293	0	55,133169
Slice 20	86,784055	-19,655963	187,86252	445,63674	0	54,689906
Slice 21	89,124975	-19,457358	185,91481	473,45995	0	54,193394
Slice 22	91,806605	-19,237453	183,7582	505,27389	0	53,643631

Slice 23	93,94871	-18,644352	177,94166	515,18737	0	52,16088
Slice 24	95,662392	-17,611066	167,80822	506,07824	0	49,577664
Slice 25	97,487178	-16,510789	157,0178	484,83949	0	46,826971
Slice 26	99,67807	-15,202805	144,19041	459,69087	0	43,557012
Slice 27	101,47658	-13,97248	132,12461	431,85047	0	40,4812
Slice 28	102,82203	-12,75	120,13575	364,08644	147,04435	0
Slice 29	103,94874	-11,726272	110,09605	375,06628	0	70,099791
Slice 30	105,84416	-10,004087	93,206578	324,20509	0	61,919412
Slice 31	108,69148	-7,277815	66,470032	237,21404	0	48,969621
Slice 32	110,48585	-5,44815	48,526507	182,7678	0	40,468525
Slice 33	112,26543	-3,797225	32,335886	134,22575	0	34,690288
Slice 34	114,7422	-1,599075	10,778629	65,515671	0	26,996763
Slice 35	116,26228	-0,25	-2,45175	23,497134	0	22,275
Slice 36	116,96349	0,37232772	0	10,084115	5,0409465	0

# Arginello

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## File Information

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Tool Version: 8.15.6.13446  
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Directory: \\192.168.100.1\commesse\393-2025\_HERA Galliera\WORK\03-PFTE\STABILITA\  
Last Solved Date: 08/05/2025  
Last Solved Time: 10:46:56

## Project Settings

Length(L) Units: Meters  
Time(t) Units: Seconds  
Force(F) Units: Kilonewtons  
Pressure(p) Units: kPa  
Strength Units: kPa  
Unit Weight of Water: 9,807 kN/m<sup>3</sup>  
View: 2D  
Element Thickness: 1

## Analysis Settings

### Arginello

Kind: SLOPE/W  
Method: Morgenstern-Price  
Settings  
Side Function  
Interslice force function option: Half-Sine  
PWP Conditions Source: Piezometric Line  
Apply Phreatic Correction: No  
Use Staged Rapid Drawdown: No  
Slip Surface  
Direction of movement: Left to Right  
Use Passive Mode: No  
Slip Surface Option: Entry and Exit  
Critical slip surfaces saved: 1  
Resisting Side Maximum Convex Angle: 1 °  
Driving Side Maximum Convex Angle: 5 °  
Optimize Critical Slip Surface Location: No  
Tension Crack  
Tension Crack Option: (none)  
F of S Distribution  
F of S Calculation Option: Constant  
Advanced  
Number of Slices: 30  
F of S Tolerance: 0,001



Minimum Slip Surface Depth: 0,1 m  
Search Method: Root Finder  
Tolerable difference between starting and converged F of S: 3  
Maximum iterations to calculate converged lambda: 20  
Max Absolute Lambda: 2

## Materials

### 01 Argine

Model: Mohr-Coulomb  
Unit Weight: 18,5 kN/m<sup>3</sup>  
Cohesion': 0 kPa  
Phi': 26,56 °  
Phi-B: 0 °

### 02 unità 1

Model:  $S=f(\text{depth})$   
Unit Weight: 18,5 kN/m<sup>3</sup>  
C-Top of Layer: 35,7 kPa  
C-Rate of Change: 1,2 (kN/m<sup>2</sup>)/m  
C-Maximum: 42,9 kPa  
Pore Water Pressure  
Piezometric Line: 1

### 03 unità 2

Model:  $S=f(\text{depth})$   
Unit Weight: 19,5 kN/m<sup>3</sup>  
C-Top of Layer: 42,9 kPa  
C-Rate of Change: 4,75 (kN/m<sup>2</sup>)/m  
C-Maximum: 71,4 kPa  
Pore Water Pressure  
Piezometric Line: 1

### 04 unità 3

Model: Mohr-Coulomb  
Unit Weight: 19 kN/m<sup>3</sup>  
Cohesion': 0 kPa  
Phi': 31,08 °  
Phi-B: 0 °  
Pore Water Pressure  
Piezometric Line: 1

### 06 unità 5

Model: Mohr-Coulomb  
Unit Weight: 19,5 kN/m<sup>3</sup>  
Cohesion': 0 kPa  
Phi': 31,08 °  
Phi-B: 0 °  
Pore Water Pressure  
Piezometric Line: 1

### 05 unità 4

Model:  $S=f(\text{depth})$   
Unit Weight: 19,5 kN/m<sup>3</sup>  
C-Top of Layer: 39,3 kPa  
C-Rate of Change: 2,5 (kN/m<sup>2</sup>)/m

C-Maximum: 71,4 kPa  
Pore Water Pressure  
Piezometric Line: 1

## 05 Rifiuti

Model: Mohr-Coulomb  
Unit Weight: 18 kN/m<sup>3</sup>  
Cohesion': 8,5 kPa  
Phi': 21,4 °  
Phi-B: 0 °  
Pore Water Pressure  
Piezometric Line: 1

## 06 Argilla

Model: Undrained (Phi=0)  
Unit Weight: 19 kN/m<sup>3</sup>  
Cohesion': 42,9 kPa  
Pore Water Pressure  
Piezometric Line: 1

## Slip Surface Entry and Exit

Left Projection: Range  
Left-Zone Left Coordinate: (94,54563; 9,35347) m  
Left-Zone Right Coordinate: (123,3617; 8,94823) m  
Left-Zone Increment: 20  
Right Projection: Range  
Right-Zone Left Coordinate: (127,91651; 6,79359) m  
Right-Zone Right Coordinate: (136,06216; 3,07339) m  
Right-Zone Increment: 20  
Radius Increments: 20

## Slip Surface Limits

Left Coordinate: (0; 0) m  
Right Coordinate: (226,903; 5,5) m

## Piezometric Lines

### Piezometric Line 1

#### Coordinates

	X (m)	Y (m)
Coordinate 1	0	-0,5
Coordinate 2	226,903	-0,5

## Seismic Coefficients

Horz Seismic Coef.: 0  
Vert Seismic Coef.: 0

# Reinforcements

## Reinforcement 1

Type: Geosynthetic  
 Outside Point: (81,5; 0) m  
 Inside Point: (226,903; 0) m  
 Slip Surface Intersection: () m  
 Length: 145,403 m  
 Direction: 180 °  
 F of S Dependent: Yes  
 Interface Adhesion: 0 kPa  
 Interface Shear Angle: 21,4 °  
 Surface Area Factor: 2  
 Resistance Reduction Factor: 1  
 Force Distribution: Distributed  
 Anchorage: Yes  
 Tensile Capacity: 1 450 kN  
 Reduction Factor: 1,6  
 Force Orientation: 0  
 Max. Pullout Force: 906,25 kN  
 Pullout Force: 0 kN  
 Pullout Force per Length: 0 kN/m  
 Available Length: 0 m  
 Required Length: 0 m  
 Governing Component: (none)

## Points

	X (m)	Y (m)
Point 1	0	0
Point 2	81,5	0
Point 3	94,75	9,5
Point 4	104,25	9,5
Point 5	118,5	0
Point 6	226,903	0
Point 7	0	-6
Point 8	226,903	-6
Point 9	0	-12
Point 10	226,903	-12
Point 11	0	-13,5
Point 12	226,903	-13,5
Point 13	0	-26
Point 14	226,903	-26
Point 15	0	-100
Point 16	226,903	-100
Point 17	132,3503	0
Point 18	132,3503	-6
Point 19	132,3503	-12
Point 20	132,3503	-13,5
Point 21	132,3503	-26
Point 22	132,3503	-100
Point 23	214,1206	5,1758
Point 24	216,2676	7,25
Point 25	217,8125	7,25

Point 26	219,9595	5,1758
Point 27	114,7509	2,49939
Point 28	123,25226	9
Point 29	226,903	5,5
Point 30	135,796	3,06622

Regions

	Material	Points	Area (m²)
Region 1	01 Argine	2;3;4;27;5	220,87
Region 2	02 unità 1	1;2;5;17;18;7	794,1
Region 3	03 unità 2	7;18;19;9	794,1
Region 4	04 unità 3	9;19;20;11	198,53
Region 5	05 unità 4	11;13;21;20	1 654,4
Region 6	06 unità 5	13;21;22;15	9 793,9
Region 7	06 Argilla	6;17;5;27;30;23;24;25;26;29	451,6
Region 8	02 unità 1	6;8;18;17	567,32
Region 9	03 unità 2	18;8;10;19	567,32
Region 10	04 unità 3	19;20;12;10	141,83
Region 11	05 unità 4	20;21;14;12	1 181,9
Region 12	06 unità 5	21;22;16;14	6 996,9
Region 13	05 Rifiuti	4;27;30;28	129,88

Current Slip Surface

Slip Surface: 8 768  
F of S: 1,794  
Volume: 26,990485 m³  
Weight: 485,82873 kN  
Resisting Moment: 3 844,1231 kN-m  
Activating Moment: 2 143,1395 kN-m  
Resisting Force: 279,46862 kN  
Activating Force: 155,81426 kN  
F of S Rank (Analysis): 1 of 9 261 slip surfaces  
F of S Rank (Query): 1 of 9 261 slip surfaces  
Exit: (135,22467; 3,336487) m  
Entry: (121,92972; 9,0347996) m  
Radius: 12,160679 m  
Center: (132,42853; 15,171338) m

Slip Slices

	X (m)	Y (m)	PWP (kPa)	Base Normal Stress (kPa)	Frictional Strength (kPa)	Cohesive Strength (kPa)
Slice 1	122,15014	8,6854851	-90,082052	-0,80009836	-0,31355512	8,5
Slice 2	122,59099	8,0324228	-83,67747	8,4654161	3,3175603	8,5
Slice 3	123,03184	7,4600737	-78,064443	16,284356	6,3817694	8,5
Slice 4	123,47397	6,9499882	-73,062035	21,841952	8,5597673	8,5
Slice 5	123,91739	6,4911119	-68,561834	25,43724	9,9687452	8,5
Slice 6	124,36082	6,0770358	-64,50099	28,544046	11,186289	8,5

Slice 7	124,80424	5,701843	-60,821474	31,284493	12,260259	8,5
Slice 8	125,24766	5,3610474	-57,479292	33,7431	13,223776	8,5
Slice 9	125,69108	5,051158	-54,440207	35,976908	14,099196	8,5
Slice 10	126,13451	4,7694019	-51,677024	38,02161	14,900506	8,5
Slice 11	126,57793	4,5135401	-49,167788	39,89533	15,634809	8,5
Slice 12	127,02135	4,2817421	-46,894545	41,600971	16,303242	8,5
Slice 13	127,46477	4,0724962	-44,842471	43,12773	16,901573	8,5
Slice 14	127,9082	3,8845452	-42,999235	44,452176	17,420617	8,5
Slice 15	128,35162	3,7168386	-41,354536	45,53925	17,846637	8,5
Slice 16	128,79504	3,5684968	-39,899748	46,343466	18,161806	8,5
Slice 17	129,23846	3,4387839	-38,627654	46,810605	18,344876	8,5
Slice 18	129,68189	3,327087	-37,532242	46,880118	18,372117	8,5
Slice 19	130,12531	3,2328994	-36,608544	46,488413	18,21861	8,5
Slice 20	130,56873	3,1558088	-35,852517	45,573095	17,859901	8,5
Slice 21	131,01215	3,0954874	-35,260945	44,078034	17,273993	8,5
Slice 22	131,45558	3,0516843	-34,831368	41,958943	16,44353	8,5
Slice 23	131,899	3,0242206	-34,562031	39,188936	15,357976	8,5
Slice 24	132,34242	3,0129854	-34,451848	35,763321	14,015492	8,5
Slice 25	132,78584	3,0179338	-34,500377	31,702817	12,424198	8,5
Slice 26	133,22927	3,0390854	-34,707811	27,054467	10,60253	8,5
Slice 27	133,67269	3,0765255	-35,074985	21,889755	8,5785012	8,5
Slice 28	134,11611	3,1304061	-35,603392	16,299912	6,3878656	8,5
Slice 29	134,55953	3,2009496	-36,295213	10,388827	4,0713366	8,5
Slice 30	135,00296	3,2884532	-37,15336	4,2644651	1,6712256	8,5

# Arginello

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## File Information

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Directory: \\192.168.100.1\commesse\393-2025\_HERA Galliera\WORK\03-PFTE\STABILITA\  
Last Solved Date: 07/05/2025  
Last Solved Time: 17:45:08

## Project Settings

Length(L) Units: Meters  
Time(t) Units: Seconds  
Force(F) Units: Kilonewtons  
Pressure(p) Units: kPa  
Strength Units: kPa  
Unit Weight of Water: 9,807 kN/m<sup>3</sup>  
View: 2D  
Element Thickness: 1

## Analysis Settings

### Arginello

Kind: SLOPE/W  
Method: Morgenstern-Price  
Settings  
Side Function  
Interslice force function option: Half-Sine  
PWP Conditions Source: Piezometric Line  
Apply Phreatic Correction: No  
Use Staged Rapid Drawdown: No  
Slip Surface  
Direction of movement: Right to Left  
Use Passive Mode: No  
Slip Surface Option: Entry and Exit  
Critical slip surfaces saved: 1  
Resisting Side Maximum Convex Angle: 1 °  
Driving Side Maximum Convex Angle: 5 °  
Optimize Critical Slip Surface Location: No  
Tension Crack  
Tension Crack Option: (none)  
F of S Distribution  
F of S Calculation Option: Constant  
Advanced  
Number of Slices: 30  
F of S Tolerance: 0,001

Minimum Slip Surface Depth: 0,1 m  
Search Method: Root Finder  
Tolerable difference between starting and converged F of S: 3  
Maximum iterations to calculate converged lambda: 20  
Max Absolute Lambda: 2

## Materials

### 01 Argine

Model: Mohr-Coulomb  
Unit Weight: 18,5 kN/m<sup>3</sup>  
Cohesion': 0 kPa  
Phi': 26,56 °  
Phi-B: 0 °

### 02 unità 1

Model:  $S=f(\text{depth})$   
Unit Weight: 18,5 kN/m<sup>3</sup>  
C-Top of Layer: 35,7 kPa  
C-Rate of Change: 1,2 (kN/m<sup>2</sup>)/m  
C-Maximum: 42,9 kPa  
Pore Water Pressure  
Piezometric Line: 1

### 03 unità 2

Model:  $S=f(\text{depth})$   
Unit Weight: 19,5 kN/m<sup>3</sup>  
C-Top of Layer: 42,9 kPa  
C-Rate of Change: 4,75 (kN/m<sup>2</sup>)/m  
C-Maximum: 71,4 kPa  
Pore Water Pressure  
Piezometric Line: 1

### 04 unità 3

Model: Mohr-Coulomb  
Unit Weight: 19 kN/m<sup>3</sup>  
Cohesion': 0 kPa  
Phi': 31,08 °  
Phi-B: 0 °  
Pore Water Pressure  
Piezometric Line: 1

### 06 unità 5

Model: Mohr-Coulomb  
Unit Weight: 19,5 kN/m<sup>3</sup>  
Cohesion': 0 kPa  
Phi': 31,08 °  
Phi-B: 0 °  
Pore Water Pressure  
Piezometric Line: 1

### 05 unità 4

Model:  $S=f(\text{depth})$   
Unit Weight: 19,5 kN/m<sup>3</sup>  
C-Top of Layer: 39,3 kPa  
C-Rate of Change: 2,5 (kN/m<sup>2</sup>)/m

C-Maximum: 71,4 kPa  
Pore Water Pressure  
Piezometric Line: 1

## 05 Rifiuti

Model: Mohr-Coulomb  
Unit Weight: 18 kN/m<sup>3</sup>  
Cohesion': 8,5 kPa  
Phi': 21,4 °  
Phi-B: 0 °  
Pore Water Pressure  
Piezometric Line: 1

## 06 Argilla

Model: Undrained (Phi=0)  
Unit Weight: 19 kN/m<sup>3</sup>  
Cohesion': 42,9 kPa  
Pore Water Pressure  
Piezometric Line: 1

## Slip Surface Entry and Exit

Left Projection: Range  
Left-Zone Left Coordinate: (0; 0) m  
Left-Zone Right Coordinate: (91,58882; 7,2335) m  
Left-Zone Increment: 20  
Right Projection: Range  
Right-Zone Left Coordinate: (104,28181; 9,50024) m  
Right-Zone Right Coordinate: (129,58537; 9,68873) m  
Right-Zone Increment: 20  
Radius Increments: 20

## Slip Surface Limits

Left Coordinate: (0; 0) m  
Right Coordinate: (226,903; 5,5) m

## Piezometric Lines

### Piezometric Line 1

#### Coordinates

	X (m)	Y (m)
Coordinate 1	0	-0,5
Coordinate 2	226,903	-0,5

## Seismic Coefficients

Horz Seismic Coef.: 0  
Vert Seismic Coef.: 0



# Reinforcements

## Reinforcement 1

Type: Geosynthetic  
 Outside Point: (81,5; 0) m  
 Inside Point: (226,903; 0) m  
 Slip Surface Intersection: () m  
 Length: 145,403 m  
 Direction: 180 °  
 F of S Dependent: Yes  
 Interface Adhesion: 0 kPa  
 Interface Shear Angle: 30 °  
 Surface Area Factor: 2  
 Resistance Reduction Factor: 1  
 Force Distribution: Distributed  
 Anchorage: Yes  
 Tensile Capacity: 1 450 kN  
 Reduction Factor: 1,6  
 Force Orientation: 0  
 Max. Pullout Force: 906,25 kN  
 Pullout Force: 0 kN  
 Pullout Force per Length: 0 kN/m  
 Available Length: 0 m  
 Required Length: 0 m  
 Governing Component: (none)

## Points

	X (m)	Y (m)
Point 1	0	0
Point 2	81,5	0
Point 3	94,75	9,5
Point 4	104,25	9,5
Point 5	118,5	0
Point 6	226,903	0
Point 7	0	-6
Point 8	226,903	-6
Point 9	0	-12
Point 10	226,903	-12
Point 11	0	-13,5
Point 12	226,903	-13,5
Point 13	0	-26
Point 14	226,903	-26
Point 15	0	-100
Point 16	226,903	-100
Point 17	132,3503	0
Point 18	132,3503	-6
Point 19	132,3503	-12
Point 20	132,3503	-13,5
Point 21	132,3503	-26
Point 22	132,3503	-100
Point 23	214,1206	5,1758
Point 24	216,2676	7,25
Point 25	217,8125	7,25

Point 26	219,9595	5,1758
Point 27	114,7509	2,49939
Point 28	203,7352	10,2411
Point 29	226,903	5,5

Regions

	Material	Points	Area (m²)
Region 1	01 Argine	2;3;4;27;5	220,87
Region 2	02 unità 1	1;2;5;17;18;7	794,1
Region 3	03 unità 2	7;18;19;9	794,1
Region 4	04 unità 3	9;19;20;11	198,53
Region 5	05 unità 4	11;13;21;20	1 654,4
Region 6	06 unità 5	13;21;22;15	9 793,9
Region 7	06 Argilla	6;17;5;27;23;24;25;26;29	451,6
Region 8	02 unità 1	6;8;18;17	567,32
Region 9	03 unità 2	18;8;10;19	567,32
Region 10	04 unità 3	19;20;12;10	141,83
Region 11	05 unità 4	20;21;14;12	1 181,9
Region 12	06 unità 5	21;22;16;14	6 996,9
Region 13	05 Rifiuti	4;27;23;28	617,69

Current Slip Surface

Slip Surface: 4 415  
F of S: 1,210  
Volume: 59,805527 m³  
Weight: 1 106,4022 kN  
Resisting Moment: 39 623,69 kN-m  
Activating Moment: 32 748,614 kN-m  
Resisting Force: 472,51935 kN  
Activating Force: 390,6117 kN  
F of S Rank (Analysis): 3 of 9 261 slip surfaces  
F of S Rank (Query): 3 of 9 261 slip surfaces  
Exit: (81,809089; 0,22161089) m  
Entry: (104,28181; 9,500237) m  
Radius: 77,321099 m  
Center: (63,904053; 75,441037) m

Slip Slices

	X (m)	Y (m)	PWP (kPa)	Base Normal Stress (kPa)	Frictional Strength (kPa)	Cohesive Strength (kPa)
Slice 1	82,189704	0,31425153	0	3,0539754	1,5266512	0
Slice 2	82,950934	0,50363331	0	9,1411147	4,5695501	0
Slice 3	83,712164	0,70124795	0	15,144115	7,5703885	0
Slice 4	84,473394	0,90716095	0	21,027283	10,511324	0
Slice 5	85,234624	1,1214413	0	26,753521	13,373812	0
Slice 6	85,995854	1,3441616	0	32,286567	16,139726	0

Slice 7	86,757084	1,5753982	0	37,593145	18,79243	0
Slice 8	87,518314	1,8152313	0	42,644838	21,31772	0
Slice 9	88,279544	2,0637453	0	47,419593	23,704571	0
Slice 10	89,040775	2,3210287	0	51,902743	25,945652	0
Slice 11	89,802005	2,5871744	0	56,087536	28,037588	0
Slice 12	90,563235	2,8622798	0	59,97516	29,980971	0
Slice 13	91,324465	3,1464474	0	63,574334	31,780161	0
Slice 14	92,085695	3,4397844	0	66,900532	33,442894	0
Slice 15	92,846925	3,7424033	0	69,974955	34,979767	0
Slice 16	93,608155	4,0544223	0	72,823322	36,403636	0
Slice 17	94,369385	4,3759652	0	75,474607	37,728986	0
Slice 18	95,115385	4,7003439	0	73,856292	36,920008	0
Slice 19	95,846154	5,0273055	0	68,103114	34,044052	0
Slice 20	96,576923	5,3634129	0	62,367531	31,176893	0
Slice 21	97,307692	5,7087983	0	56,651245	28,31938	0
Slice 22	98,038462	6,0636005	0	50,949442	25,469106	0
Slice 23	98,769231	6,4279645	0	45,251227	22,620627	0
Slice 24	99,5	6,8020429	0	39,540139	19,765713	0
Slice 25	100,23077	7,1859952	0	33,794728	16,89364	0
Slice 26	100,96154	7,5799891	0	27,989162	13,991497	0
Slice 27	101,69231	7,9842006	0	22,093875	11,044503	0
Slice 28	102,42308	8,3988146	0	16,076248	8,0363524	0
Slice 29	103,15385	8,8240252	0	9,9013384	4,9495781	0
Slice 30	103,88462	9,2600369	0	3,5327018	1,7659616	0
Slice 31	104,25752	9,4853707	0	0,22190028	0,11092569	0
Slice 32	104,27343	9,4951045	-98,02199	-3,5043092	-1,3733237	8,5

# Argine

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## File Information

File Version: 8.15  
Created By: paolo  
Last Edited By: paolo  
Revision Number: 108  
Date: 08/05/2025  
Time: 09:23:11  
Tool Version: 8.15.6.13446  
File Name: ST Fase 1\_INTERF.gsz  
Directory: \\192.168.100.1\commesse\393-2025\_HERA Galliera\WORK\03-PFTE\STABILITA\  
Last Solved Date: 08/05/2025  
Last Solved Time: 09:23:14

## Project Settings

Length(L) Units: Meters  
Time(t) Units: Seconds  
Force(F) Units: Kilonewtons  
Pressure(p) Units: kPa  
Strength Units: kPa  
Unit Weight of Water: 9,807 kN/m<sup>3</sup>  
View: 2D  
Element Thickness: 1

## Analysis Settings

### Argine

Kind: SLOPE/W  
Method: Morgenstern-Price  
Settings  
Side Function  
Interslice force function option: Half-Sine  
PWP Conditions Source: Piezometric Line  
Apply Phreatic Correction: No  
Use Staged Rapid Drawdown: No  
Slip Surface  
Direction of movement: Left to Right  
Use Passive Mode: No  
Slip Surface Option: Fully-Specified  
Critical slip surfaces saved: 1  
Resisting Side Maximum Convex Angle: 1 °  
Driving Side Maximum Convex Angle: 5 °  
Optimize Critical Slip Surface Location: Yes  
Critical Slip Surface Optimizations  
Maximum Iterations: 2 000  
Convergence Tolerance: 1e-007  
Starting Points: 8  
Ending Points: 16  
Complete Passes per Insertion: 1  
Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0,001

Minimum Slip Surface Depth: 0,1 m

Search Method: Root Finder

Tolerable difference between starting and converged F of S: 3

Maximum iterations to calculate converged lambda: 20

Max Absolute Lambda: 2

## Materials

### 05 Rifiuti

Model: Mohr-Coulomb

Unit Weight: 18 kN/m<sup>3</sup>

Cohesion': 8,5 kPa

Phi': 21,4 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

### 07 Impermeabilizzazione

Model: Mohr-Coulomb

Unit Weight: 18,5 kN/m<sup>3</sup>

Cohesion': 0 kPa

Phi': 11,28 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

## Slip Surface Limits

Left Coordinate: (0; 0) m

Right Coordinate: (226,903; 5,5) m

## Fully Specified Slip Surfaces

### Fully Specified Slip Surface 1

	X (m)	Y (m)
	132,77468	10,65867
	142,09824	3,00641
	214,09008	5,10497
	220,63487	12,95127

### Fully Specified Slip Surface 2

	X (m)	Y (m)
	144,9529	10,84482
	152,65979	3,28022
	214,08385	5,09727
	220,60221	12,98393

**Fully Specified Slip Surface 3**

	X (m)	Y (m)
	158,95806	10,97464
	168,59946	3,74372
	214,09357	5,10782
	220,63759	12,91861

**Fully Specified Slip Surface 4**

	X (m)	Y (m)
	170,72182	10,8755
	177,93865	4,07962
	214,1206	5,1758

**Fully Specified Slip Surface 5**

	X (m)	Y (m)
	181,44131	10,60067
	187,43479	4,33892
	214,10143	5,14123
	220,62285	12,90047

**Fully Specified Slip Surface 6**

	X (m)	Y (m)
	190,80924	10,33261
	196,70047	4,62679
	214,10803	5,13463
	220,59404	12,95944

**Fully Specified Slip Surface 7**

	X (m)	Y (m)
	198,77024	10,33536
	204,89136	4,89984
	214,123	5,153
	220,63693	12,82671

**Fully Specified Slip Surface 8**

	X (m)	Y (m)
	197,16797	10,03419
	204,89424	4,89552
	214,1112	5,1516
	220,07804	11,42704

**Fully Specified Slip Surface 9**

	X (m)	Y (m)
	200,25794	10,66695
	204,89568	4,8912
	214,1235	5,154
	220,11374	11,42831

**Fully Specified Slip Surface 10**

	X (m)	Y (m)
	202,08521	10,85183
	204,91405	4,86453
	214,1196	5,14896

	219,82913	11,4572
--	-----------	---------

## Piezometric Lines

### Piezometric Line 1

#### Coordinates

	X (m)	Y (m)
Coordinate 1	0	-0,5
Coordinate 2	226,903	-0,5

## Seismic Coefficients

Horz Seismic Coef.: 0

Vert Seismic Coef.: 0

## Reinforcements

### Reinforcement 1

Type: Geosynthetic

Outside Point: (81,5; 0) m

Inside Point: (226,903; 0) m

Slip Surface Intersection: () m

Length: 145,403 m

Direction: 180 °

F of S Dependent: Yes

Interface Adhesion: 0 kPa

Interface Shear Angle: 30 °

Surface Area Factor: 2

Resistance Reduction Factor: 1

Force Distribution: Distributed

Anchorage: Yes

Tensile Capacity: 100 kN

Reduction Factor: 1,6

Force Orientation: 0

Max. Pullout Force: 62,5 kN

Pullout Force: 0 kN

Pullout Force per Length: 0 kN/m

Available Length: 0 m

Required Length: 0 m

Governing Component: (none)

## Points

	X (m)	Y (m)
Point 1	0	0
Point 2	81,5	0
Point 3	94,75	9,5
Point 4	104,25	9,5
Point 5	118,5	0
Point 6	226,903	0
Point 7	0	-6

Point 8	226,903	-6
Point 9	0	-12
Point 10	226,903	-12
Point 11	0	-13,5
Point 12	226,903	-13,5
Point 13	0	-26
Point 14	226,903	-26
Point 15	0	-100
Point 16	226,903	-100
Point 17	132,3503	0
Point 18	132,3503	-6
Point 19	132,3503	-12
Point 20	132,3503	-13,5
Point 21	132,3503	-26
Point 22	132,3503	-100
Point 23	214,1206	5,1758
Point 24	216,2676	7,25
Point 25	217,8125	7,25
Point 26	219,9595	5,1758
Point 27	114,7509	2,49939
Point 28	206,48	9
Point 29	226,903	5,5

## Regions

	Material	Points	Area (m²)
Region 1	07 Impermeabilizzazione	2;3;4;27;5	220,87
Region 2	07 Impermeabilizzazione	1;2;5;17;18;7	794,1
Region 3	07 Impermeabilizzazione	7;18;19;9	794,1
Region 4	07 Impermeabilizzazione	9;19;20;11	198,53
Region 5	07 Impermeabilizzazione	11;13;21;20	1 654,4
Region 6	07 Impermeabilizzazione	13;21;22;15	9 793,9
Region 7	07 Impermeabilizzazione	6;17;5;27;23;24;25;26;29	451,6
Region 8	07 Impermeabilizzazione	6;8;18;17	567,32
Region 9	07 Impermeabilizzazione	18;8;10;19	567,32
Region 10	07 Impermeabilizzazione	19;20;12;10	141,83
Region 11	07 Impermeabilizzazione	20;21;14;12	1 181,9
Region 12	07 Impermeabilizzazione	21;22;16;14	6 996,9
Region 13	05 Rifiuti	4;27;23;28	555,44

## Current Slip Surface

Slip Surface: 11

F of S: 1,398

Volume: 26,016422 m³

Weight: 469,13714 kN

Resisting Moment: 876,07347 kN-m

Activating Moment: 626,73088 kN-m

Resisting Force: 140,04548 kN

Activating Force: 100,1917 kN

F of S Rank (Analysis): 1 of 11 slip surfaces

F of S Rank (Query): 1 of 11 slip surfaces

Exit: (214,17809; 5,2313445) m



Entry: (202,2024; 9,0209214) m

Radius: 6,3993441 m

Center: (208,73852; 9,9122649) m

**Slip Slices**

	X (m)	Y (m)	PWP (kPa)	Base Normal Stress (kPa)	Frictional Strength (kPa)	Cohesive Strength (kPa)
Slice 1	202,30755	8,9007357	-92,193015	-3,5471929	-1,3901297	8,5
Slice 2	202,58421	8,60373	-89,28028	1,1492397	0,45038213	8,5
Slice 3	202,92721	8,25009	-85,812133	6,0738231	2,3803053	8,5
Slice 4	203,29479	7,8873808	-82,255044	11,58153	4,5387519	8,5
Slice 5	203,68692	7,5156025	-78,609014	16,541752	6,4826417	8,5
Slice 6	204,07906	7,1438242	-74,962984	21,359261	8,3706028	8,5
Slice 7	204,47119	6,7720458	-71,316953	26,057598	10,211861	8,5
Slice 8	204,86333	6,4002675	-67,670923	30,663018	12,016705	8,5
Slice 9	205,25546	6,0284892	-64,024893	35,203845	13,796236	8,5
Slice 10	205,62158	5,70998	-60,901274	42,106423	16,501327	8,5
Slice 11	205,96372	5,432357	-58,178625	44,432243	17,412806	8,5
Slice 12	206,30791	5,142351	-55,334536	48,108707	18,853596	8,5
Slice 13	206,49572	4,984102	-53,782588	50,022468	19,603591	8,5
Slice 14	206,5138	4,968868	-53,633188	56,783432	11,325838	0
Slice 15	206,68115	4,934675	-53,297858	67,943475	13,551784	0
Slice 16	207,03383	4,87336	-52,696542	67,028047	13,369196	0
Slice 17	207,4092	4,81514	-52,125578	64,983291	12,961355	0
Slice 18	207,81089	4,77354	-51,717607	64,612562	12,887411	0
Slice 19	208,2389	4,74856	-51,472628	61,442613	12,255143	0
Slice 20	208,65241	4,7470933	-51,458244	60,371567	12,041516	0
Slice 21	209,0514	4,76914	-51,674456	56,258818	11,2212	0
Slice 22	209,45039	4,7911867	-51,890668	52,074432	10,386596	0
Slice 23	209,84939	4,8132333	-52,106879	47,831857	9,5403862	0
Slice 24	210,24838	4,83528	-52,323091	43,545378	8,6854191	0
Slice 25	210,64737	4,8573267	-52,539303	39,229635	7,8246151	0

Slice 26	210,94052	4,872165	-52,684822	35,911877	7,1628659	0
Slice 27	211,25901	4,8814183	-52,77557	32,48516	6,4793842	0
Slice 28	211,70872	4,892295	-52,882237	27,958671	5,5765453	0
Slice 29	212,15842	4,9031717	-52,988905	23,448525	4,6769664	0
Slice 30	212,43954	4,909165	-53,047681	20,586306	4,1060774	0
Slice 31	212,71676	4,9083783	-53,039966	17,930872	3,5764333	0
Slice 32	213,15867	4,905695	-53,013651	13,874158	2,7672943	0
Slice 33	213,60057	4,9030117	-52,987335	9,8512582	1,9648998	0
Slice 34	213,93845	4,96496	-53,594863	6,1159406	1,2198656	0
Slice 35	214,08798	5,0822281	-54,744911	2,6973768	0,53800998	0
Slice 36	214,14935	5,1837753	-55,740784	0,48303537	0,09634466	0

# Slope Stability

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## File Information

File Version: 8.15  
Created By: paolo  
Last Edited By: paolo  
Revision Number: 88  
Date: 07/05/2025  
Time: 18:44:52  
Tool Version: 8.15.6.13446  
File Name: ST Fase 2\_PROGETTO\_Lungo termine.gsz  
Directory: \\192.168.100.1\commesse\393-2025\_HERA Galliera\WORK\03-PFTE\STABILITA\  
Last Solved Date: 07/05/2025  
Last Solved Time: 18:45:04

## Project Settings

Length(L) Units: Meters  
Time(t) Units: Seconds  
Force(F) Units: Kilonewtons  
Pressure(p) Units: kPa  
Strength Units: kPa  
Unit Weight of Water: 9,807 kN/m<sup>3</sup>  
View: 2D  
Element Thickness: 1

## Analysis Settings

### Slope Stability

Kind: SLOPE/W  
Method: Morgenstern-Price  
Settings  
Side Function  
Interslice force function option: Half-Sine  
PWP Conditions Source: Piezometric Line  
Apply Phreatic Correction: No  
Use Staged Rapid Drawdown: No  
Slip Surface  
Direction of movement: Right to Left  
Use Passive Mode: No  
Slip Surface Option: Entry and Exit  
Critical slip surfaces saved: 1  
Resisting Side Maximum Convex Angle: 1 °  
Driving Side Maximum Convex Angle: 5 °  
Optimize Critical Slip Surface Location: No  
Tension Crack  
Tension Crack Option: (none)  
F of S Distribution  
F of S Calculation Option: Constant  
Advanced  
Number of Slices: 30  
F of S Tolerance: 0,001

Minimum Slip Surface Depth: 0,1 m

Search Method: Root Finder

Tolerable difference between starting and converged F of S: 3

Maximum iterations to calculate converged lambda: 20

Max Absolute Lambda: 2

## Materials

### 01 Argine

Model: Mohr-Coulomb

Unit Weight: 18,5 kN/m<sup>3</sup>

Cohesion': 0 kPa

Phi': 26,6 °

Phi-B: 0 °

### 02 unità 1

Model:  $S=f(\text{depth})$

Unit Weight: 18,5 kN/m<sup>3</sup>

C-Top of Layer: 21,4 kPa

C-Rate of Change: 3,57 (kN/m<sup>2</sup>)/m

C-Maximum: 42,9 kPa

Pore Water Pressure

Piezometric Line: 1

### 03 unità 2

Model:  $S=f(\text{depth})$

Unit Weight: 19,5 kN/m<sup>3</sup>

C-Top of Layer: 42,9 kPa

C-Rate of Change: 5,57 (kN/m<sup>2</sup>)/m

C-Maximum: 71,4 kPa

Pore Water Pressure

Piezometric Line: 1

### 04 unità 3

Model: Mohr-Coulomb

Unit Weight: 19 kN/m<sup>3</sup>

Cohesion': 0 kPa

Phi': 31,1 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

### 06 unità 5

Model: Mohr-Coulomb

Unit Weight: 19,5 kN/m<sup>3</sup>

Cohesion': 0 kPa

Phi': 31,1 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

### 05 unità 4

Model:  $S=f(\text{depth})$

Unit Weight: 19,5 kN/m<sup>3</sup>

C-Top of Layer: 39,3 kPa

C-Rate of Change: 2,57 (kN/m<sup>2</sup>)/m

C-Maximum: 71,4 kPa  
Pore Water Pressure  
Piezometric Line: 1

## 05 Rifiuti

Model: Mohr-Coulomb  
Unit Weight: 18 kN/m<sup>3</sup>  
Cohesion': 10,6 kPa  
Phi': 30 °  
Phi-B: 0 °  
Pore Water Pressure  
Piezometric Line: 1

## 06 Argilla

Model: Undrained (Phi=0)  
Unit Weight: 19 kN/m<sup>3</sup>  
Cohesion': 60 kPa  
Pore Water Pressure  
Piezometric Line: 1

## 02 unità 1 \*

Model:  $S=f(\text{depth})$   
Unit Weight: 18,5 kN/m<sup>3</sup>  
C-Top of Layer: 39,3 kPa  
C-Rate of Change: 2,05 (kN/m<sup>2</sup>)/m  
C-Maximum: 51,6 kPa  
Pore Water Pressure  
Piezometric Line: 1

## 03 unità 2\*

Model:  $S=f(\text{depth})$   
Unit Weight: 19,5 kN/m<sup>3</sup>  
C-Top of Layer: 51,6 kPa  
C-Rate of Change: 2,05 (kN/m<sup>2</sup>)/m  
C-Maximum: 89,46 kPa  
Pore Water Pressure  
Piezometric Line: 1

## 05 unità 4\*

Model:  $S=f(\text{depth})$   
Unit Weight: 19,5 kN/m<sup>3</sup>  
C-Top of Layer: 67 kPa  
C-Rate of Change: 2,05 (kN/m<sup>2</sup>)/m  
C-Maximum: 92,7 kPa  
Pore Water Pressure  
Piezometric Line: 1

## Slip Surface Entry and Exit

Left Projection: Range  
Left-Zone Left Coordinate: (15,16667; 0) m  
Left-Zone Right Coordinate: (93,82783; 8,83882) m  
Left-Zone Increment: 20  
Right Projection: Range  
Right-Zone Left Coordinate: (134,02714; 17,0462) m  
Right-Zone Right Coordinate: (219,9595; 19,4138) m  
Right-Zone Increment: 20

Radius Increments: 20

## Slip Surface Limits

Left Coordinate: (0; 0) m

Right Coordinate: (219,9595; 19,4138) m

## Piezometric Lines

### Piezometric Line 1

#### Coordinates

	X (m)	Y (m)
Coordinate 1	0	-0,5
Coordinate 2	219,9595	-0,5

## Seismic Coefficients

Horz Seismic Coef.: 0

Vert Seismic Coef.: 0

## Reinforcements

### Reinforcement 1

Type: Geosynthetic

Outside Point: (81,5; 0) m

Inside Point: (219,95; 0) m

Slip Surface Intersection: (140,85995; 0) m

Length: 138,45 m

Direction: 180 °

F of S Dependent: Yes

Interface Adhesion: 0 kPa

Interface Shear Angle: 26 °

Surface Area Factor: 2

Resistance Reduction Factor: 1

Force Distribution: Distributed

Anchorage: Yes

Tensile Capacity: 1 450 kN

Reduction Factor: 1,6

Force Orientation: 0

Max. Pullout Force: 906,25 kN

Pullout Force: 670,0988 kN

Pullout Force per Length: 227,87623 kN/m

Available Length: 79,090052 m

Required Length: 2,9406262 m

Governing Component: Tensile Capacity

## Points

	X (m)	Y (m)
Point 1	0	0
Point 2	81,5	0

Point 3	94,75	9,5
Point 4	104,25	9,5
Point 5	118,5	0
Point 6	219,9595	0
Point 7	0	-6
Point 8	219,9595	-6
Point 9	0	-12
Point 10	219,9595	-12
Point 11	0	-13,5
Point 12	219,9595	-13,5
Point 13	0	-26
Point 14	219,9595	-26
Point 15	0	-100
Point 16	219,9595	-100
Point 17	116,5701	13,5
Point 18	124,8093	13,74
Point 19	219,9595	16,1538
Point 20	219,9595	3,1722
Point 21	117,56801	0,62132
Point 22	132,3503	17
Point 23	219,9595	19,4138
Point 24	132,3503	0
Point 25	132,3503	-100
Point 26	104,25	-6
Point 27	104,25	-12
Point 28	104,25	-13,5
Point 29	104,25	-26
Point 30	104,25	0

## Regions

	Material	Points	Area (m²)
Region 1	01 Argine	2;3;4;21;5;30	220,87
Region 2	02 unità 1	1;2;30;26;7	625,5
Region 3	03 unità 2	7;26;27;9	625,5
Region 4	04 unità 3	10;27;9;11;28;12	329,94
Region 5	05 unità 4	11;28;29;13	1 303,1
Region 6	06 unità 5	13;29;14;16;25;15	16 277
Region 7	05 Rifiuti	4;17;18;22;23;19;20;21	1 703,3
Region 8	06 Argilla	20;6;24;5;21	193,92
Region 9	02 unità 1 *	6;8;26;30;5;24	694,26
Region 10	03 unità 2*	26;8;10;27	694,26
Region 11	05 unità 4*	28;29;14;12	1 446,4

## Current Slip Surface

Slip Surface: 4 068

F of S: 1,352

Volume: 2 032,4711 m³

Weight: 38 068,507 kN

Resisting Moment: 466 969,82 kN-m

Activating Moment: 345 347,63 kN-m

Resisting Force: 7 087,0244 kN

Activating Force: 5 239,3564 kN

F of S Rank (Analysis): 1 of 9 261 slip surfaces

F of S Rank (Query): 1 of 9 261 slip surfaces

Exit: (51,842742; 0) m

Entry: (151,21361; 17,51972) m

Radius: 58,603288 m

Center: (96,351345; 38,12256) m

## Slip Slices

	X (m)	Y (m)	PWP (kPa)	Base Normal Stress (kPa)	Frictional Strength (kPa)	Cohesive Strength (kPa)
Slice 1	52,05933	-0,25	-2,45175	23,712838	0	22,2925
Slice 2	53,652599	-1,9663054	14,380057	59,690878	0	28,41971
Slice 3	56,405959	-4,7163054	41,349307	117,04701	0	38,23721
Slice 4	59,833397	-7,6366001	69,988637	181,43483	0	52,015862
Slice 5	63,934911	-10,6366	99,409637	248,91423	0	68,725862
Slice 6	67,298966	-12,75	120,13575	310,92032	115,08861	0
Slice 7	70,223231	-14,302884	135,36488	306,48113	0	41,363411
Slice 8	73,445165	-15,790226	149,95125	336,34375	0	45,185882
Slice 9	76,667099	-17,049446	162,30041	360,38788	0	48,422076
Slice 10	79,889033	-18,095941	172,56339	378,95733	0	51,111569
Slice 11	83,15625	-18,950595	180,94498	415,68552	0	53,308029
Slice 12	86,46875	-19,616994	187,48036	469,02425	0	55,020675
Slice 13	89,78125	-20,087414	192,09377	517,09866	0	56,229654
Slice 14	93,09375	-20,366599	194,83174	560,14195	0	56,94716
Slice 15	96,333333	-20,459332	195,74117	576,70341	0	57,185483
Slice 16	99,5	-20,374595	194,91015	567,5356	0	56,967708
Slice 17	102,66667	-20,117681	192,39059	554,98414	0	56,307439
Slice 18	105,79001	-19,694583	188,24128	546,78833	0	79,698895
Slice 19	108,87004	-19,106301	182,472	544,17459	0	78,492917
Slice 20	111,95006	-18,344003	174,99614	538,60643	0	76,930206
Slice 21	115,03009	-17,400497	165,74317	530,1634	0	74,996019
Slice 22	117,06906	-16,693836	158,81295	522,4669	0	73,547364
Slice 23	118,034	-16,319666	155,14347	514,11889	0	72,780316



Slice 24	119,89761	-15,520606	147,30708	495,10299	0	71,142242
Slice 25	122,69282	-14,203569	134,3909	467,41618	0	68,442316
Slice 26	124,44986	-13,303609	125,56499	415,18212	174,70822	0
Slice 27	125,76316	-12,553609	118,20974	402,92924	171,75378	0
Slice 28	128,12534	-11,090735	103,86334	429,0989	0	62,036006
Slice 29	130,94198	-9,1509846	84,840206	412,26372	0	58,059518
Slice 30	133,63518	-7,0602499	64,336371	383,94065	0	53,773512
Slice 31	136,29673	-4,7163054	41,349307	343,26848	0	48,968426
Slice 32	139,05009	-1,9663054	14,380057	297,6369	0	43,330926
Slice 33	140,64336	-0,25	-2,45175	271,25709	0	39,8125
Slice 34	141,37112	0,61353101	-10,920399	237,22447	0	60
Slice 35	143,43752	3,3319188	-37,579628	149,39351	86,252384	10,6
Slice 36	146,54795	8,0310898	-83,664398	89,376355	51,601462	10,6
Slice 37	149,65839	14,072562	-142,91312	22,392406	12,928262	10,6

# Slope Stability

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## File Information

File Version: 8.15  
Created By: paolo  
Last Edited By: paolo  
Revision Number: 86  
Date: 07/05/2025  
Time: 18:24:45  
Tool Version: 8.15.6.13446  
File Name: PST Fase 2\_PROGETTO\_Lungo termine.gsz  
Directory: \\192.168.100.1\commesse\393-2025\_HERA Galliera\WORK\03-PFTE\STABILITA\  
Last Solved Date: 07/05/2025  
Last Solved Time: 18:24:50

## Project Settings

Length(L) Units: Meters  
Time(t) Units: Seconds  
Force(F) Units: Kilonewtons  
Pressure(p) Units: kPa  
Strength Units: kPa  
Unit Weight of Water: 9,807 kN/m<sup>3</sup>  
View: 2D  
Element Thickness: 1

## Analysis Settings

### Slope Stability

Kind: SLOPE/W  
Method: Morgenstern-Price  
Settings  
Side Function  
Interslice force function option: Half-Sine  
PWP Conditions Source: Piezometric Line  
Apply Phreatic Correction: No  
Use Staged Rapid Drawdown: No  
Slip Surface  
Direction of movement: Right to Left  
Use Passive Mode: No  
Slip Surface Option: Entry and Exit  
Critical slip surfaces saved: 1  
Resisting Side Maximum Convex Angle: 1 °  
Driving Side Maximum Convex Angle: 5 °  
Optimize Critical Slip Surface Location: No  
Tension Crack  
Tension Crack Option: (none)  
F of S Distribution  
F of S Calculation Option: Constant  
Advanced  
Number of Slices: 30  
F of S Tolerance: 0,001

Minimum Slip Surface Depth: 0,1 m

Search Method: Root Finder

Tolerable difference between starting and converged F of S: 3

Maximum iterations to calculate converged lambda: 20

Max Absolute Lambda: 2

## Materials

### 01 Argine

Model: Mohr-Coulomb

Unit Weight: 18,5 kN/m<sup>3</sup>

Cohesion': 0 kPa

Phi': 32 °

Phi-B: 0 °

### 02 unità 1

Model:  $S=f(\text{depth})$

Unit Weight: 18,5 kN/m<sup>3</sup>

C-Top of Layer: 30 kPa

C-Rate of Change: 5 (kN/m<sup>2</sup>)/m

C-Maximum: 60 kPa

Pore Water Pressure

Piezometric Line: 1

### 03 unità 2

Model:  $S=f(\text{depth})$

Unit Weight: 19,5 kN/m<sup>3</sup>

C-Top of Layer: 60 kPa

C-Rate of Change: 6,6 (kN/m<sup>2</sup>)/m

C-Maximum: 100 kPa

Pore Water Pressure

Piezometric Line: 1

### 04 unità 3

Model: Mohr-Coulomb

Unit Weight: 19 kN/m<sup>3</sup>

Cohesion': 0 kPa

Phi': 37 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

### 06 unità 5

Model: Mohr-Coulomb

Unit Weight: 19,5 kN/m<sup>3</sup>

Cohesion': 0 kPa

Phi': 37 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

### 05 unità 4

Model:  $S=f(\text{depth})$

Unit Weight: 19,5 kN/m<sup>3</sup>

C-Top of Layer: 55 kPa

C-Rate of Change: 3,6 (kN/m<sup>2</sup>)/m

C-Maximum: 100 kPa  
Pore Water Pressure  
Piezometric Line: 1

## 05 Rifiuti

Model: Mohr-Coulomb  
Unit Weight: 18 kN/m<sup>3</sup>  
Cohesion': 10,6 kPa  
Phi': 30 °  
Phi-B: 0 °  
Pore Water Pressure  
Piezometric Line: 1

## 06 Argilla

Model: Undrained (Phi=0)  
Unit Weight: 19 kN/m<sup>3</sup>  
Cohesion': 60 kPa  
Pore Water Pressure  
Piezometric Line: 1

## 02 unità 1 \*

Model:  $S=f(\text{depth})$   
Unit Weight: 18,5 kN/m<sup>3</sup>  
C-Top of Layer: 55 kPa  
C-Rate of Change: 2,875 (kN/m<sup>2</sup>)/m  
C-Maximum: 72,25 kPa  
Pore Water Pressure  
Piezometric Line: 1

## 03 unità 2\*

Model:  $S=f(\text{depth})$   
Unit Weight: 19,5 kN/m<sup>3</sup>  
C-Top of Layer: 72,25 kPa  
C-Rate of Change: 2,875 (kN/m<sup>2</sup>)/m  
C-Maximum: 89,5 kPa  
Pore Water Pressure  
Piezometric Line: 1

## 05 unità 4\*

Model:  $S=f(\text{depth})$   
Unit Weight: 19,5 kN/m<sup>3</sup>  
C-Top of Layer: 93,8 kPa  
C-Rate of Change: 2,875 (kN/m<sup>2</sup>)/m  
C-Maximum: 129,75 kPa  
Pore Water Pressure  
Piezometric Line: 1

## Slip Surface Entry and Exit

Left Projection: Range  
Left-Zone Left Coordinate: (15,16667; 0) m  
Left-Zone Right Coordinate: (93,82783; 8,83882) m  
Left-Zone Increment: 20  
Right Projection: Range  
Right-Zone Left Coordinate: (134,02714; 17,0462) m  
Right-Zone Right Coordinate: (219,9595; 19,4138) m  
Right-Zone Increment: 20

Radius Increments: 20

## Slip Surface Limits

Left Coordinate: (0; 0) m

Right Coordinate: (219,9595; 19,4138) m

## Piezometric Lines

### Piezometric Line 1

#### Coordinates

	X (m)	Y (m)
Coordinate 1	0	-0,5
Coordinate 2	219,9595	-0,5

## Seismic Coefficients

Horz Seismic Coef.: 0,133

Vert Seismic Coef.: 0,066

## Reinforcements

### Reinforcement 1

Type: Geosynthetic

Outside Point: (81,5; 0) m

Inside Point: (219,95; 0) m

Slip Surface Intersection: (127,06499; 0) m

Length: 138,45 m

Direction: 180 °

F of S Dependent: Yes

Interface Adhesion: 0 kPa

Interface Shear Angle: 26 °

Surface Area Factor: 2

Resistance Reduction Factor: 1

Force Distribution: Distributed

Anchorage: Yes

Tensile Capacity: 1 450 kN

Reduction Factor: 1,6

Force Orientation: 0

Max. Pullout Force: 906,25 kN

Pullout Force: 754,31742 kN

Pullout Force per Length: 216,76518 kN/m

Available Length: 92,885009 m

Required Length: 3,4798829 m

Governing Component: Tensile Capacity

## Points

	X (m)	Y (m)
Point 1	0	0
Point 2	81,5	0

Point 3	94,75	9,5
Point 4	104,25	9,5
Point 5	118,5	0
Point 6	219,9595	0
Point 7	0	-6
Point 8	219,9595	-6
Point 9	0	-12
Point 10	219,9595	-12
Point 11	0	-13,5
Point 12	219,9595	-13,5
Point 13	0	-26
Point 14	219,9595	-26
Point 15	0	-100
Point 16	219,9595	-100
Point 17	116,5701	13,5
Point 18	124,8093	13,74
Point 19	219,9595	16,1538
Point 20	219,9595	3,1722
Point 21	117,56801	0,62132
Point 22	132,3503	17
Point 23	219,9595	19,4138
Point 24	132,3503	0
Point 25	132,3503	-100
Point 26	104,25	-6
Point 27	104,25	-12
Point 28	104,25	-13,5
Point 29	104,25	-26
Point 30	104,25	0

## Regions

	Material	Points	Area (m²)
Region 1	01 Argine	2;3;4;21;5;30	220,87
Region 2	02 unità 1	1;2;30;26;7	625,5
Region 3	03 unità 2	7;26;27;9	625,5
Region 4	04 unità 3	10;27;9;11;28;12	329,94
Region 5	05 unità 4	11;28;29;13	1 303,1
Region 6	06 unità 5	13;29;14;16;25;15	16 277
Region 7	05 Rifiuti	4;17;18;22;23;19;20;21	1 703,3
Region 8	06 Argilla	20;6;24;5;21	193,92
Region 9	02 unità 1 *	6;8;26;30;5;24	694,26
Region 10	03 unità 2 *	26;8;10;27	694,26
Region 11	05 unità 4 *	28;29;14;12	1 446,4

## Current Slip Surface

Slip Surface: 4 483

F of S: 1,201

Volume: 1 086,7613 m³

Weight: 20 021,342 kN

Resisting Moment: 547 403,07 kN-m

Activating Moment: 455 609,9 kN-m

Resisting Force: 7 300,9648 kN

Activating Force: 6 077,2421 kN

F of S Rank (Analysis): 1 693 of 9 261 slip surfaces

F of S Rank (Query): 1 693 of 9 261 slip surfaces

Exit: (55,917861; 0) m

Entry: (146,91699; 17,40134) m

Radius: 70,276677 m

Center: (91,491426; 60,608026) m

## Slip Slices

	X (m)	Y (m)	PWP (kPa)	Base Normal Stress (kPa)	Frictional Strength (kPa)	Cohesive Strength (kPa)
Slice 1	56,350822	-0,25	-2,45175	20,257913	0	31,25
Slice 2	58,32106	-1,3233637	8,0747281	44,70085	0	36,616819
Slice 3	61,395615	-2,8755088	23,296615	80,678698	0	44,377544
Slice 4	64,470171	-4,2448045	36,725298	112,89788	0	51,224023
Slice 5	67,544726	-5,4426594	48,472661	141,04417	0	57,213297
Slice 6	70,634253	-6,4825645	58,67101	165,79356	0	63,184926
Slice 7	73,738752	-7,3705008	67,379002	186,75157	0	69,045306
Slice 8	76,843251	-8,1067712	74,599605	202,73091	0	73,90469
Slice 9	79,94775	-8,6962204	80,380334	213,76758	0	77,795055
Slice 10	83,15625	-9,1526639	84,856675	246,57434	0	80,807582
Slice 11	86,46875	-9,4692657	87,961589	294,35128	0	82,897153
Slice 12	89,78125	-9,6283025	89,521263	335,89521	0	83,946797
Slice 13	93,09375	-9,6308472	89,546218	371,62108	0	83,963591
Slice 14	96,333333	-9,4836879	88,103027	380,51112	0	82,99234
Slice 15	99,5	-9,1926483	85,248802	363,97964	0	81,071479
Slice 16	102,66667	-8,7558934	80,965546	344,95095	0	78,188896
Slice 17	105,85847	-8,1647822	75,168519	332,47044	0	78,473749
Slice 18	109,07542	-7,4129579	67,795379	326,11537	0	76,312254
Slice 19	112,29237	-6,4985768	58,828043	317,777	0	73,683408
Slice 20	115,23547	-5,5207925	49,238912	309,78453	0	70,872279
Slice 21	117,06905	-4,846609	42,627195	307,48811	0	68,934001
Slice 22	118,03401	-4,4615486	38,850907	300,11392	0	67,826952
Slice 23	120,07733	-3,5688867	30,096572	276,14603	0	65,260549

Slice 24	123,23198	-2,0675101	15,372572	248,87844	0	60,944092
Slice 25	125,50418	-0,88435552	3,7693746	236,08041	0	57,542522
Slice 26	126,63203	-0,25	-2,45175	235,92762	0	55,71875
Slice 27	127,80621	0,44742528	-9,2913997	226,67071	0	60
Slice 28	130,44887	2,1622632	-26,108815	187,64064	108,33437	10,6
Slice 29	133,80697	4,5288314	-49,31775	161,8205	93,427109	10,6
Slice 30	136,72031	6,8536267	-72,117017	128,32593	74,089013	10,6
Slice 31	139,63365	9,4500659	-97,580296	92,888252	53,629057	10,6
Slice 32	142,54699	12,362374	-126,1413	54,976924	31,740942	10,6
Slice 33	145,46032	15,652611	-158,40866	13,982196	8,0726245	10,6