REGIONE UMBRIA

PROVINCIA DI PERUGIA

COMUNE DI MASSA MARTANA

INTERVENTI PER IL CONSOLIDAMENTO DELLA RUPE DI MASSA MARTANA

OPERA:

COMPLETAMENTO DEGLI INTERVENTI IN PARETE
E DEL CIGLIO SUPERIORE NEL TRATTO COMPRESO
TRA VIA DELLE PIAGGE E VIA DEL MATTATOIO VECCHIO

DESCRIZIONE:

PROGETTO ESECUTIVO

PROGETTISTI:

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REGIONE UMBRIA:

TAVOLA:

ALLEGATO A ALLA RELAZIONE GEOTECNICA:

VERIFICHE STATICHE

REVISIONE	DATA	DESCRIZIONE	REDATTO	CONTR.	APPROV.
0	SETT_2014	1° EMISSIONE	FF	CC	CC

-	-	C_RGT_02	2014_04	E0	A	PE

P. Gen.	Tipo doc	Formato	scala	Redatto	Controllato	Approvato	Responsabile	
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REGIONE UMBRIA
PROVINCIA DI PERUGIA

COMUNE DI MASSA MARTANA

CONSOLIDAMENTO DELLA RUPE DI MASSA MARTANA

PROGETTO PER IL CONSOLIDAMENTO DEL VERSANTE N-NW AL PIEDE DELLA RUPE DI MASSA MARTANA

ALLEGATO A

THESISENGINEERING
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A		Prima emissione	F.Forlani	E.Comastri	C.Comastri
Rev.	Data	Descrizione	Redazione	Controllo	Approvazione

SEZIONE 48

1 Project Settings

Length(L) Units: meters
Time(t) Units: Seconds
Force(F) Units: kN
Pressure(p) Units: kPa
Strength Units: kPa
Unit Weight of Water: 9.807 kN/m³
View: 2D

2 Analysis Settings

2.1 SLOPE/W Analysis

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
    Apply Phreatic Correction: No
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Piezometric Line
    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
    Optimize Critical Slip Surface Location: No
    Tension Crack
        Tension Crack Option: (none)
FOS Distribution
    FOS Calculation Option: Constant
Advanced
    Number of Slices: 30
    Optimization Tolerance: 0.01
    Minimum Slip Surface Depth: 0.1 m
    Optimization Maximum Iterations: 2000
    Optimization Convergence Tolerance: 1e-007
    Starting Optimization Points: 8
    Ending Optimization Points: 16

Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

3 Materials

3.1 cfr

Model: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 5 kPa
Phi: 23 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

3.2 UA

Model: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 30 kPa
Phi: 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

3.3 USMC

Model: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 30 kPa
Phi: 28 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

3.4 dt1

Model: Mohr-Coulomb
Unit Weight: 19 kN/m³
Cohesion: 22 kPa
Phi: 25 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

3.5 muro

Model: Mohr-Coulomb
Unit Weight: 25 kN/m³
Cohesion: 14170 kPa
Phi: 45 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

3.6 cuscino ghiaia

Model: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 10 kPa
Phi: 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

4 Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (267.5, 131.0171) m
Left-Zone Right Coordinate: (282.5, 140.14319) m
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (300, 154.5) m
Right-Zone Right Coordinate: (314.79711, 156) m
Right-Zone Increment: 4
Radius Increments: 4

5 Slip Surface Limits

Left Coordinate: (208.63073, 110.11479) m
Right Coordinate: (347.9971, 156.24498) m

6 Piezometric Lines

6.1 Piezometric Line 1

6.1.1 Coordinates

	X (m)	Y (m)

	208.63075	101.5
	225.5	101.5
	238.5	106.97727
	254	112.33836
	269.3766	119
	278	123.06809
	287.21576	130.04088
	304	142
	315.5	147.5
	341.5	148
	350	148

7 Surcharge Loads

7.1 Surcharge Load 1

Surcharge (Unit Weight): 5 kN/m³
Direction: Vertical

7.1.1 Coordinates

	X (m)	Y (m)
	290.26464	154.14899
	290.5	155.5
	305.5	156

8 Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

9 Reinforcements

9.1 Reinforcement 1

Type: Nail
Outside Point: (289.26464, 153.48571) m
Inside Point: (310.51501, 147.79169) m
Slip Surface Intersection: (312.93, 147.14) m
Total Length: 22.000002 m
Reinforcement Direction: 165 °

Applied Load Option: Variable
F of S Dependent: No
Bond Diameter: 0.31830989 m
Bond Safety Factor: 1
Bond Skin Friction: 344 kPa
Bond Resistance: 137.6 kN/m
Nail Spacing: 2.5 m
Bar Capacity: 760 kN
Bar Safety Factor: 1
Bar Load: 304 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 760 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 304 kN
Applied Load: 304 kN
Nail Load Used: 0 kN
Resisting Force Used: 137.6 kN/m
Available Bond Length: 0 m
Required Bond Length: 0 m
Governing Component: Bond

9.2 Reinforcement 2

Type: Nail
Outside Point: (289.5, 153) m
Inside Point: (310.75037, 147.30598) m
Slip Surface Intersection: (312.85, 146.74) m
Total Length: 22.000002 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Diameter: 0.31830989 m
Bond Safety Factor: 1
Bond Skin Friction: 345 kPa
Bond Resistance: 138 kN/m
Nail Spacing: 2.5 m
Bar Capacity: 760 kN
Bar Safety Factor: 1
Bar Load: 304 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 900 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 360 kN
Applied Load: 304 kN
Nail Load Used: 0 kN
Resisting Force Used: 138 kN/m
Available Bond Length: 0 m

Required Bond Length: 0 m
Governing Component: Bond

9.3 Reinforcement 3

Type: Nail
Outside Point: (289, 151) m
Inside Point: (310.25037, 145.30598) m
Slip Surface Intersection: (312.15, 144.8) m
Total Length: 22.000002 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Diameter: 0.31830989 m
Bond Safety Factor: 1
Bond Skin Friction: 345 kPa
Bond Resistance: 138 kN/m
Nail Spacing: 2.5 m
Bar Capacity: 760 kN
Bar Safety Factor: 1
Bar Load: 304 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 760 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 304 kN
Applied Load: 304 kN
Nail Load Used: 0 kN
Resisting Force Used: 138 kN/m
Available Bond Length: 0 m
Required Bond Length: 0 m
Governing Component: Bond

9.4 Reinforcement 4

Type: Nail
Outside Point: (289, 147.5) m
Inside Point: (310.25037, 141.80598) m
Slip Surface Intersection: (310.58, 141.72) m
Total Length: 22.000002 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Diameter: 0.31830989 m
Bond Safety Factor: 1
Bond Skin Friction: 345 kPa
Bond Resistance: 138 kN/m
Nail Spacing: 2.5 m
Bar Capacity: 760 kN

Bar Safety Factor: 1
Bar Load: 304 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 760 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 304 kN
Applied Load: 304 kN
Nail Load Used: 0 kN
Resisting Force Used: 138 kN/m
Available Bond Length: 0 m
Required Bond Length: 0 m
Governing Component: Bond

9.5 Reinforcement 5

Type: Nail
Outside Point: (288.5, 146) m
Inside Point: (309.75037, 140.30598) m
Slip Surface Intersection: (309.67, 140.33) m
Total Length: 22.000002 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Diameter: 0.31830989 m
Bond Safety Factor: 1
Bond Skin Friction: 345 kPa
Bond Resistance: 138 kN/m
Nail Spacing: 2.5 m
Bar Capacity: 760 kN
Bar Safety Factor: 1
Bar Load: 304 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 760 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 304 kN
Applied Load: 304 kN
Nail Load Used: 11.516 kN
Resisting Force Used: 138 kN/m
Available Bond Length: 0.08345 m
Required Bond Length: 0.08345 m
Governing Component: Bond

9.6 Reinforcement 6

Type: Nail
Outside Point: (288.5, 144.5) m
Inside Point: (309.75037, 138.80598) m

Slip Surface Intersection: (308.81, 139.06) m
Total Length: 22.000002 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Diameter: 0.31830989 m
Bond Safety Factor: 1
Bond Skin Friction: 345 kPa
Bond Resistance: 138 kN/m
Nail Spacing: 2.5 m
Bar Capacity: 760 kN
Bar Safety Factor: 1
Bar Load: 304 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 760 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 304 kN
Applied Load: 304 kN
Nail Load Used: 134.09 kN
Resisting Force Used: 138 kN/m
Available Bond Length: 0.97165 m
Required Bond Length: 0.97165 m
Governing Component: Bond

9.7 Reinforcement 7

Type: Anchor
Outside Point: (288.5254, 143) m
Inside Point: (317.50317, 135.23543) m
Slip Surface Intersection: (307.82, 137.83) m
Total Length: 29.999995 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Length: 18 m
Bond Diameter: 0.2 m
Bond Safety Factor: 1
Bond Skin Friction: 55 kPa
Bond Resistance: 13.823008 kN/m
Anchor Spacing: 2.5 m
Bar Capacity: 900 kN
Bar Safety Factor: 1
Bar Load: 360 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 0 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 0 kN

Applied Load: 248.81414 kN
Anchor Load Used: 138.53 kN
Resisting Force Used: 13.823 kN/m
Available Bond Length: 10.022 m
Required Bond Length: 10.022 m
Governing Component: Bond

9.8 Reinforcement 8

Type: Pile
Outside Point: (284, 141.6496) m
Inside Point: (284, 110.1496) m
Slip Surface Intersection: (284, 126.38) m
Total Length: 31.5 m
Reinforcement Direction: 90 °
Applied Load Option: Variable
F of S Dependent: No
Pile Spacing: 2.5 m
Shear Capacity: 500 kN
Shear Safety Factor: 1
Shear Load Used: 200 kN
Shear Option: Perp. to Reinf.
Resisting Force Used: 0 kN/m

9.9 Reinforcement 9

Type: Pile
Outside Point: (288, 141.6496) m
Inside Point: (288, 110.1496) m
Slip Surface Intersection: (288, 126.67) m
Total Length: 31.5 m
Reinforcement Direction: 90 °
Applied Load Option: Variable
F of S Dependent: No
Pile Spacing: 2.5 m
Shear Capacity: 500 kN
Shear Safety Factor: 1
Shear Load Used: 200 kN
Shear Option: Perp. to Reinf.
Resisting Force Used: 0 kN/m

10 Regions

	Material	Points	Area (m²)
Region 1	UA	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17	1492.3802
Region 2	dt1	18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33	150.72685
Region 3	USMC	17,16,34,35,36,32,31,37,38	4526.5645

Region 4	cfr	34,16,15,39,40,41,42,43,44,45,46,18,33,32,36,35	626.6631
Region 5	muro	47,48,49,50,51,52,53,42,41,40	21.078869
Region 6	cuscino ghiaia	40,39,15,14,13,50,49,48,47	57.870313

11 Points

	X (m)	Y (m)
Point 1	350	156.25279
Point 2	319.31895	156.13317
Point 3	318.10196	156.09094
Point 4	312.08171	155.92528
Point 5	311.99001	155.92278
Point 6	310.66784	155.92278
Point 7	310.34255	155.91723
Point 8	308.62424	155.49757
Point 9	306.35296	154.94459
Point 10	306.19216	154.78721
Point 11	306.06853	154.70474
Point 12	305.62306	154.77202
Point 13	300	154.5
Point 14	294	147.5
Point 15	291	144
Point 16	287.21576	130.04088
Point 17	350	130.04088
Point 18	238.09407	115.2085
Point 19	230.96605	112.23244
Point 20	226.18155	110.46722
Point 21	225.92537	110.39527
Point 22	225.26635	110.15034
Point 23	220.09259	108.42914
Point 24	219.11265	108.26378
Point 25	214.73023	108.01739
Point 26	213.81266	108.16537
Point 27	212.39162	108.3764
Point 28	210.58442	108.95701
Point 29	210.44888	108.9665
Point 30	208.63073	110.11479
Point 31	208.63075	103.30608
Point 32	224.13517	102.13654
Point 33	232.49413	108.94505

Point 34	277.26828	122.51446
Point 35	261.55071	115.51484
Point 36	252.35333	111.64563
Point 37	208.63075	87.84275
Point 38	350	87.84275
Point 39	290	142.5
Point 40	289.39535	141.6496
Point 41	289.39535	140.1496
Point 42	282.59535	140.1496
Point 43	282.17532	140.12138
Point 44	279.02512	138.28931
Point 45	247.46854	118.37748
Point 46	244.26122	117.0434
Point 47	290.09535	148.6496
Point 48	289.79684	148.67945
Point 49	290.26464	153.34899
Point 50	290.26464	154.14899
Point 51	289.6403	154.14899
Point 52	288.39036	141.6496
Point 53	282.59535	141.6496

12 Critical Slip Surfaces

	Slip Surface	FOS	Center (m)	Radius (m)	Entry (m)	Exit (m)
1	25	2.097	(283.817, 157.389)	31.011	(314.797, 156)	(267.5, 131.017)

12.1 Slices of Slip Surface: 25

	Slip Surface	X (m)	Y (m)	PWP (kPa)	Base Normal Stress (kPa)	Frictional Strength (kPa)	Cohesive Strength (kPa)
1	25	268.4383	130.48085	-116.57866	28.398411	12.05441	5
2	25	270.23895	129.5244	-99.221179	79.95655	33.939542	5
3	25	271.96365	128.7473	-83.625452	128.02854	54.344889	5
4	25	273.6883	128.0923	-69.222431	173.51639	73.653339	5
5	25	275.41295	127.5513	-55.933144	215.17685	91.337152	5
6	25	277.13765	127.11815	-43.708285	251.95282	106.94763	5
7	25	278.51255	126.8389	-33.176768	277.50306	117.79306	5
8	25	279.81265	126.6473	-21.651279	296.89531	126.02458	5
9	25	281.38775	126.4828	-8.3502273	315.3377	133.85291	5
10	25	282.2955	126.415	-	322.69844	136.97736	5

				0.94988283			
11	25	282.50555	126.4053	0.70363421	333.80487	177.11307	30
12	25	283.36545	126.3903	7.2310589	419.65851	219.29156	30
13	25	284.90555	126.40615	18.503822	358.35096	180.69993	30
14	25	286.4457	126.49875	29.023668	341.24904	166.01317	30
15	25	287.8031	126.64045	37.452646	390.86345	187.91186	30
16	25	288.8929	126.79995	43.503057	435.69807	208.53379	30
17	25	289.51785	126.9062	46.826369	565.09463	275.56812	30
18	25	289.71855	126.9443	47.857002	581.239	283.60424	30
19	25	289.8984	126.9798	48.76363	563.94561	273.92712	30
20	25	290.0477	127.0099	49.513571	546.46364	264.23304	30
21	25	290.18	127.03745	50.168121	535.17827	257.88447	30
22	25	290.3823	127.08065	51.158754	526.6611	252.82908	30
23	25	290.75	127.16345	52.913766	522.97764	249.9374	30
24	25	291.75	127.41935	57.393261	503.99475	237.46222	30
25	25	293.25	127.85745	63.575306	475.90349	219.23879	30
26	25	294.73975	128.37555	68.910202	448.49826	201.83055	30
27	25	296.21925	128.977	73.348815	422.03599	185.40026	30
28	25	297.6988	129.6704	76.884167	396.48346	169.93396	30
29	25	299.2193	130.4879	79.49335	369.90557	167.66957	30
30	25	300.66665	131.3666	80.991107	346.38257	153.22383	30
31	25	302	132.2811	81.335876	325.31313	140.86034	30
32	25	303.33335	133.3041	80.623075	304.51002	129.26119	30
33	25	304.75	134.53115	76.765788	281.99898	118.49144	30
34	25	305.56155	135.2785	73.244411	264.77953	110.58285	30
35	25	305.8458	135.56385	71.77611	259.42411	108.33862	30
36	25	306.13035	135.85275	70.277554	254.59675	106.41673	30
37	25	306.2726	136.0012	69.490909	253.74347	106.37826	30
38	25	307.4886	137.43265	61.155414	251.96598	110.16453	30
39	25	309.4834	140.05165	44.826864	42.924467	-1.0983496	30
40	25	310.5052	141.5985	34.449588	163.5835	74.555496	30
41	25	311.3289	143.1508	23.088841	137.81903	66.239504	30
42	25	312.03585	144.5288	12.890671	114.65711	58.754879	30
43	25	312.40575	145.40225	6.0595104	99.412724	53.897503	30
44	25	313.76345	151.08755	-43.328513	11.9631	6.9068989	30

13 Project Settings

Length(L) Units: meters
Time(t) Units: Seconds
Force(F) Units: kN
Pressure(p) Units: kPa
Strength Units: kPa
Unit Weight of Water: 9.807 kN/m³
View: 2D

14 Analysis Settings

14.1 SLOPE/W Analysis

Kind: SLOPE/W
Method: Bishop, Ordinary and Janbu
Settings
    Apply Phreatic Correction: No
    PWP Conditions Source: Piezometric Line
    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
    Optimize Critical Slip Surface Location: No
    Tension Crack
        Tension Crack Option: (none)
FOS Distribution
    FOS Calculation Option: Constant
Advanced
    Number of Slices: 30
    Optimization Tolerance: 0.01
    Minimum Slip Surface Depth: 0.1 m
    Optimization Maximum Iterations: 2000
    Optimization Convergence Tolerance: 1e-007
    Starting Optimization Points: 8
    Ending Optimization Points: 16
    Complete Passes per Insertion: 1
    Driving Side Maximum Convex Angle: 5 °
    Resisting Side Maximum Convex Angle: 1 °

15 Materials

15.1 cfr

Model: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 5 kPa
Phi: 23 °
Phi-B: 0 °
Pore Water Pressure
    Piezometric Line: 1

15.2 UA

Model: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 30 kPa
Phi: 30 °
Phi-B: 0 °
Pore Water Pressure
    Piezometric Line: 1

15.3 USMC

Model: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 30 kPa
Phi: 28 °
Phi-B: 0 °
Pore Water Pressure
    Piezometric Line: 1

15.4 dt1

Model: Mohr-Coulomb
Unit Weight: 19 kN/m³
Cohesion: 22 kPa
Phi: 25 °
Phi-B: 0 °
Pore Water Pressure
    Piezometric Line: 1

15.5 muro

Model: Mohr-Coulomb
Unit Weight: 25 kN/m³
Cohesion: 14170 kPa
Phi: 45 °
Phi-B: 0 °

Pore Water Pressure
Piezometric Line: 1

15.6 cuscino ghiaia

Model: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 10 kPa
Phi: 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

16 Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (267.5, 131.0171) m
Left-Zone Right Coordinate: (282.5, 140.14319) m
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (300, 154.5) m
Right-Zone Right Coordinate: (314.79711, 156) m
Right-Zone Increment: 4
Radius Increments: 4

17 Slip Surface Limits

Left Coordinate: (208.63073, 110.11479) m
Right Coordinate: (347.9971, 156.24498) m

18 Piezometric Lines

18.1 Piezometric Line 1

18.1.1 Coordinates

	X (m)	Y (m)
	208.63075	101.5
	225.5	101.5
	238.5	106.97727
	254	112.33836
	269.3766	119

	278	123.06809
	287.21576	130.04088
	304	142
	315.5	147.5
	341.5	148
	350	148

19 Surcharge Loads

19.1 Surcharge Load 1

Surcharge (Unit Weight): 5 kN/m³
Direction: Vertical

19.1.1 Coordinates

	X (m)	Y (m)
	290.26464	154.14899
	290.5	155.5
	305.5	156

20 Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

21 Reinforcements

21.1 Reinforcement 1

Type: Nail
Outside Point: (289.26464, 153.48571) m
Inside Point: (310.51501, 147.79169) m
Slip Surface Intersection: (312.93, 147.14) m
Total Length: 22.000002 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Diameter: 0.31830989 m
Bond Safety Factor: 1
Bond Skin Friction: 344 kPa
Bond Resistance: 137.6 kN/m

Nail Spacing: 2.5 m
Bar Capacity: 760 kN
Bar Safety Factor: 1
Bar Load: 304 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 760 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 304 kN
Applied Load: 304 kN
Nail Load Used: 0 kN
Resisting Force Used: 137.6 kN/m
Available Bond Length: 0 m
Required Bond Length: 0 m
Governing Component: Bond

21.2 Reinforcement 2

Type: Nail
Outside Point: (289.5, 153) m
Inside Point: (310.75037, 147.30598) m
Slip Surface Intersection: (312.85, 146.74) m
Total Length: 22.000002 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Diameter: 0.31830989 m
Bond Safety Factor: 1
Bond Skin Friction: 345 kPa
Bond Resistance: 138 kN/m
Nail Spacing: 2.5 m
Bar Capacity: 760 kN
Bar Safety Factor: 1
Bar Load: 304 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 900 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 360 kN
Applied Load: 304 kN
Nail Load Used: 0 kN
Resisting Force Used: 138 kN/m
Available Bond Length: 0 m
Required Bond Length: 0 m
Governing Component: Bond

21.3 Reinforcement 3

Type: Nail

Outside Point: (289, 151) m
Inside Point: (310.25037, 145.30598) m
Slip Surface Intersection: (312.15, 144.8) m
Total Length: 22.000002 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Diameter: 0.31830989 m
Bond Safety Factor: 1
Bond Skin Friction: 345 kPa
Bond Resistance: 138 kN/m
Nail Spacing: 2.5 m
Bar Capacity: 760 kN
Bar Safety Factor: 1
Bar Load: 304 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 760 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 304 kN
Applied Load: 304 kN
Nail Load Used: 0 kN
Resisting Force Used: 138 kN/m
Available Bond Length: 0 m
Required Bond Length: 0 m
Governing Component: Bond

21.4 Reinforcement 4

Type: Nail
Outside Point: (289, 147.5) m
Inside Point: (310.25037, 141.80598) m
Slip Surface Intersection: (310.58, 141.72) m
Total Length: 22.000002 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Diameter: 0.31830989 m
Bond Safety Factor: 1
Bond Skin Friction: 345 kPa
Bond Resistance: 138 kN/m
Nail Spacing: 2.5 m
Bar Capacity: 760 kN
Bar Safety Factor: 1
Bar Load: 304 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 760 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip

Shear Load: 304 kN
Applied Load: 304 kN
Nail Load Used: 0 kN
Resisting Force Used: 138 kN/m
Available Bond Length: 0 m
Required Bond Length: 0 m
Governing Component: Bond

21.5 Reinforcement 5

Type: Nail
Outside Point: (288.5, 146) m
Inside Point: (309.75037, 140.30598) m
Slip Surface Intersection: (309.67, 140.33) m
Total Length: 22.000002 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Diameter: 0.31830989 m
Bond Safety Factor: 1
Bond Skin Friction: 345 kPa
Bond Resistance: 138 kN/m
Nail Spacing: 2.5 m
Bar Capacity: 760 kN
Bar Safety Factor: 1
Bar Load: 304 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 760 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 304 kN
Applied Load: 304 kN
Nail Load Used: 11.516 kN
Resisting Force Used: 138 kN/m
Available Bond Length: 0.08345 m
Required Bond Length: 0.08345 m
Governing Component: Bond

21.6 Reinforcement 6

Type: Nail
Outside Point: (288.5, 144.5) m
Inside Point: (309.75037, 138.80598) m
Slip Surface Intersection: (308.81, 139.06) m
Total Length: 22.000002 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Diameter: 0.31830989 m

Bond Safety Factor: 1
Bond Skin Friction: 345 kPa
Bond Resistance: 138 kN/m
Nail Spacing: 2.5 m
Bar Capacity: 760 kN
Bar Safety Factor: 1
Bar Load: 304 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 760 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 304 kN
Applied Load: 304 kN
Nail Load Used: 134.09 kN
Resisting Force Used: 138 kN/m
Available Bond Length: 0.97165 m
Required Bond Length: 0.97165 m
Governing Component: Bond

21.7 Reinforcement 7

Type: Anchor
Outside Point: (288.5254, 143) m
Inside Point: (317.50317, 135.23543) m
Slip Surface Intersection: (307.82, 137.83) m
Total Length: 29.999995 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Length: 18 m
Bond Diameter: 0.2 m
Bond Safety Factor: 1
Bond Skin Friction: 55 kPa
Bond Resistance: 13.823008 kN/m
Anchor Spacing: 2.5 m
Bar Capacity: 900 kN
Bar Safety Factor: 1
Bar Load: 360 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 0 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 0 kN
Applied Load: 248.81414 kN
Anchor Load Used: 138.53 kN
Resisting Force Used: 13.823 kN/m
Available Bond Length: 10.022 m
Required Bond Length: 10.022 m
Governing Component: Bond

21.8 Reinforcement 8

Type: Pile
Outside Point: (284, 141.6496) m
Inside Point: (284, 110.1496) m
Slip Surface Intersection: (284, 126.38) m
Total Length: 31.5 m
Reinforcement Direction: 90 °
Applied Load Option: Variable
F of S Dependent: No
Pile Spacing: 2.5 m
Shear Capacity: 500 kN
Shear Safety Factor: 1
Shear Load Used: 200 kN
Shear Option: Perp. to Reinf.
Resisting Force Used: 0 kN/m

21.9 Reinforcement 9

Type: Pile
Outside Point: (288, 141.6496) m
Inside Point: (288, 110.1496) m
Slip Surface Intersection: (288, 126.67) m
Total Length: 31.5 m
Reinforcement Direction: 90 °
Applied Load Option: Variable
F of S Dependent: No
Pile Spacing: 2.5 m
Shear Capacity: 500 kN
Shear Safety Factor: 1
Shear Load Used: 200 kN
Shear Option: Perp. to Reinf.
Resisting Force Used: 0 kN/m

22 Regions

	Material	Points	Area (m²)
Region 1	UA	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17	1492.3802
Region 2	dt1	18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33	150.72685
Region 3	USMC	17,16,34,35,36,32,31,37,38	4526.5645
Region 4	cfr	34,16,15,39,40,41,42,43,44,45,46,18,33,32,36,35	626.6631
Region 5	muro	47,48,49,50,51,52,53,42,41,40	21.078869
Region 6	cuscino ghiaia	40,39,15,14,13,50,49,48,47	57.870313

23 Points

	X (m)	Y (m)
Point 1	350	156.25279
Point 2	319.31895	156.13317
Point 3	318.10196	156.09094
Point 4	312.08171	155.92528
Point 5	311.99001	155.92278
Point 6	310.66784	155.92278
Point 7	310.34255	155.91723
Point 8	308.62424	155.49757
Point 9	306.35296	154.94459
Point 10	306.19216	154.78721
Point 11	306.06853	154.70474
Point 12	305.62306	154.77202
Point 13	300	154.5
Point 14	294	147.5
Point 15	291	144
Point 16	287.21576	130.04088
Point 17	350	130.04088
Point 18	238.09407	115.2085
Point 19	230.96605	112.23244
Point 20	226.18155	110.46722
Point 21	225.92537	110.39527
Point 22	225.26635	110.15034
Point 23	220.09259	108.42914
Point 24	219.11265	108.26378
Point 25	214.73023	108.01739
Point 26	213.81266	108.16537
Point 27	212.39162	108.3764
Point 28	210.58442	108.95701
Point 29	210.44888	108.9665
Point 30	208.63073	110.11479
Point 31	208.63075	103.30608
Point 32	224.13517	102.13654
Point 33	232.49413	108.94505
Point 34	277.26828	122.51446
Point 35	261.55071	115.51484
Point 36	252.35333	111.64563
Point 37	208.63075	87.84275
Point 38	350	87.84275

Point 39	290	142.5
Point 40	289.39535	141.6496
Point 41	289.39535	140.1496
Point 42	282.59535	140.1496
Point 43	282.17532	140.12138
Point 44	279.02512	138.28931
Point 45	247.46854	118.37748
Point 46	244.26122	117.0434
Point 47	290.09535	148.6496
Point 48	289.79684	148.67945
Point 49	290.26464	153.34899
Point 50	290.26464	154.14899
Point 51	289.6403	154.14899
Point 52	288.39036	141.6496
Point 53	282.59535	141.6496

24 Critical Slip Surfaces

	Slip Surface	FOS	Center (m)	Radius (m)	Entry (m)	Exit (m)
1	25	1.857	(283.817, 157.389)	31.011	(314.797, 156)	(267.5, 131.017)

24.1 Slices of Slip Surface: 25

	Slip Surface	X (m)	Y (m)	PWP (kPa)	Base Normal Stress (kPa)	Frictional Strength (kPa)	Cohesive Strength (kPa)
1	25	268.4383	130.48085	-116.57866	17.010269	7.220431	5
2	25	270.23895	129.5244	-99.221179	52.058282	22.09743	5
3	25	271.96365	128.7473	-83.625452	86.850676	36.865925	5
4	25	273.6883	128.0923	-69.222431	122.01056	51.790411	5
5	25	275.41295	127.5513	-55.933144	156.7434	66.533625	5
6	25	277.13765	127.11815	-43.708285	190.33906	80.794139	5
7	25	278.51255	126.8389	-33.176768	216.03007	91.699325	5
8	25	279.81265	126.6473	-21.651279	237.96198	101.00887	5
9	25	281.38775	126.4828	-8.3502273	261.99447	111.21006	5
10	25	282.2955	126.415	-0.94988283	273.62774	116.14808	5
11	25	282.50555	126.4053	0.70363421	274.27215	145.45896	30
12	25	283.36545	126.3903	7.2310589	310.73168	161.37414	30
13	25	284.90555	126.40615	18.503822	311.98109	156.04463	30
14	25	286.4457	126.49875	29.023668	308.28671	148.48679	30

15	25	287.8031	126.64045	37.452646	324.30817	152.52379	30
16	25	288.8929	126.79995	43.503057	418.58858	199.43651	30
17	25	289.51785	126.9062	46.826369	551.33043	268.24957	30
18	25	289.71855	126.9443	47.857002	569.04741	277.12186	30
19	25	289.8984	126.9798	48.76363	553.47178	268.35809	30
20	25	290.0477	127.0099	49.513571	537.41242	259.42042	30
21	25	290.18	127.03745	50.168121	527.28097	253.6854	30
22	25	290.3823	127.08065	51.158754	520.39083	249.49512	30
23	25	290.75	127.16345	52.913766	519.42979	248.05097	30
24	25	291.75	127.41935	57.393261	506.8433	238.97683	30
25	25	293.25	127.85745	63.575306	485.15624	224.15856	30
26	25	294.73975	128.37555	68.910202	460.13089	208.01573	30
27	25	296.21925	128.977	73.348815	432.04007	190.71952	30
28	25	297.6988	129.6704	76.884167	400.97371	172.32147	30
29	25	299.2193	130.4879	79.49335	366.21519	165.53893	30
30	25	300.66665	131.3666	80.991107	331.04682	144.36973	30
31	25	302	132.2811	81.335876	296.98833	124.507	30
32	25	303.33335	133.3041	80.623075	261.66372	104.52386	30
33	25	304.75	134.53115	76.765788	223.08982	84.480217	30
34	25	305.56155	135.2785	73.244411	198.15736	72.118525	30
35	25	305.8458	135.56385	71.77611	189.95469	68.230437	30
36	25	306.13035	135.85275	70.277554	182.23519	64.638769	30
37	25	306.2726	136.0012	69.490909	179.46171	63.491671	30
38	25	307.4886	137.43265	61.155414	183.3953	70.575229	30
39	25	309.4834	140.05165	44.826864	142.9404	56.645874	30
40	25	310.5052	141.5985	34.449588	74.268473	22.989443	30
41	25	311.3289	143.1508	23.088841	53.96168	17.824442	30
42	25	312.03585	144.5288	12.890671	39.192073	15.185121	30
43	25	312.40575	145.40225	6.0595104	31.492032	14.683473	30
44	25	313.76345	151.08755	-43.328513	4.1415174	2.3911062	30

SEZIONE 52

25 Project Settings

Length(L) Units: meters
Time(t) Units: Seconds
Force(F) Units: kN
Pressure(p) Units: kPa
Strength Units: kPa
Unit Weight of Water: 9.807 kN/m³
View: 2D

26 Analysis Settings

26.1 SLOPE/W Analysis

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
    Apply Phreatic Correction: No
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Piezometric Line
    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
    Optimize Critical Slip Surface Location: No
    Tension Crack
        Tension Crack Option: (none)
FOS Distribution
    FOS Calculation Option: Constant
Advanced
    Number of Slices: 30
    Optimization Tolerance: 0.01
    Minimum Slip Surface Depth: 0.1 m
    Optimization Maximum Iterations: 2000
    Optimization Convergence Tolerance: 1e-007
    Starting Optimization Points: 8

Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

27 Materials

27.1 cfr

Model: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 5 kPa
Phi: 23 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

27.2 UA

Model: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 30 kPa
Phi: 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

27.3 USMC

Model: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 30 kPa
Phi: 28 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

27.4 dt1

Model: Mohr-Coulomb
Unit Weight: 19 kN/m³
Cohesion: 22 kPa
Phi: 25 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

27.5 muro

Model: Mohr-Coulomb
Unit Weight: 25 kN/m³
Cohesion: 14170 kPa
Phi: 45 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

27.6 cuscino ghiaia

Model: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 10 kPa
Phi: 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

28 Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-117.92495, 147.5) m
Left-Zone Right Coordinate: (-101.95163, 155.22591) m
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (-67.27677, 173.55602) m
Right-Zone Right Coordinate: (-55.99688, 175.8652) m
Right-Zone Increment: 4
Radius Increments: 4

29 Slip Surface Limits

Left Coordinate: (-142.52094, 140.05379) m
Right Coordinate: (-55.265053, 175.87156) m

30 Piezometric Lines

30.1 Piezometric Line 1

30.1.1 Coordinates

	X (m)	Y (m)

	-142.52094	132.5
	-131	132.5
	-120.5	137
	-104	143.5
	-88	152.5
	-75.5	159
	-64	162
	-53	166
	-40.30392	166

31 Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

32 Reinforcements

32.1 Reinforcement 1

Type: Nail
Outside Point: (-78, 172.8504) m
Inside Point: (-56.74963, 167.15638) m
Slip Surface Intersection: (-57.75, 167.42) m
Total Length: 22.000002 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Diameter: 0.31830989 m
Bond Safety Factor: 1
Bond Skin Friction: 345 kPa
Bond Resistance: 138 kN/m
Nail Spacing: 2.5 m
Bar Capacity: 760 kN
Bar Safety Factor: 1
Bar Load: 304 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 760 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 304 kN
Applied Load: 304 kN
Nail Load Used: 142.87 kN
Resisting Force Used: 138 kN/m
Available Bond Length: 1.0353 m

Required Bond Length: 1.0353 m
Governing Component: Bond

32.2 Reinforcement 2

Type: Nail
Outside Point: (-78, 171.3504) m
Inside Point: (-56.74963, 165.65638) m
Slip Surface Intersection: (-58.045, 166) m
Total Length: 22.000002 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Diameter: 0.31830989 m
Bond Safety Factor: 1
Bond Skin Friction: 345 kPa
Bond Resistance: 138 kN/m
Nail Spacing: 2.5 m
Bar Capacity: 760 kN
Bar Safety Factor: 1
Bar Load: 304 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 760 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 304 kN
Applied Load: 304 kN
Nail Load Used: 185.03 kN
Resisting Force Used: 138 kN/m
Available Bond Length: 1.3408 m
Required Bond Length: 1.3408 m
Governing Component: Bond

32.3 Reinforcement 3

Type: Nail
Outside Point: (-78, 169.3504) m
Inside Point: (-56.74963, 163.65638) m
Slip Surface Intersection: (-58.438, 164.11) m
Total Length: 22.000002 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Diameter: 0.31830989 m
Bond Safety Factor: 1
Bond Skin Friction: 345 kPa
Bond Resistance: 138 kN/m
Nail Spacing: 2.5 m
Bar Capacity: 760 kN

Bar Safety Factor: 1
Bar Load: 304 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 760 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 304 kN
Applied Load: 304 kN
Nail Load Used: 241.23 kN
Resisting Force Used: 138 kN/m
Available Bond Length: 1.7481 m
Required Bond Length: 1.7481 m
Governing Component: Bond

32.4 Reinforcement 4

Type: Nail
Outside Point: (-78.5, 166.8504) m
Inside Point: (-57.24963, 161.15638) m
Slip Surface Intersection: (-59.424, 161.74) m
Total Length: 22.000002 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Diameter: 0.31830989 m
Bond Safety Factor: 1
Bond Skin Friction: 345 kPa
Bond Resistance: 138 kN/m
Nail Spacing: 2.5 m
Bar Capacity: 760 kN
Bar Safety Factor: 1
Bar Load: 304 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 760 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 304 kN
Applied Load: 304 kN
Nail Load Used: 304 kN
Resisting Force Used: 138 kN/m
Available Bond Length: 2.2507 m
Required Bond Length: 2.2029 m
Governing Component: Bar

32.5 Reinforcement 5

Type: Anchor
Outside Point: (-78.4746, 164.8504) m
Inside Point: (-49.49683, 157.08583) m

Slip Surface Intersection: (-60.275, 159.97) m
Total Length: 29.999995 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Length: 18 m
Bond Diameter: 0.2 m
Bond Safety Factor: 1
Bond Skin Friction: 55 kPa
Bond Resistance: 13.823008 kN/m
Anchor Spacing: 2.5 m
Bar Capacity: 900 kN
Bar Safety Factor: 1
Bar Load: 360 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 0 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 0 kN
Applied Load: 248.81414 kN
Anchor Load Used: 154.24 kN
Resisting Force Used: 13.823 kN/m
Available Bond Length: 11.159 m
Required Bond Length: 11.159 m
Governing Component: Bond

32.6 Reinforcement 6

Type: Pile
Outside Point: (-83, 164.5) m
Inside Point: (-83, 133) m
Slip Surface Intersection: (-83, 141.03) m
Total Length: 31.5 m
Reinforcement Direction: 90 °
Applied Load Option: Variable
F of S Dependent: No
Pile Spacing: 2.5 m
Shear Capacity: 500 kN
Shear Safety Factor: 1
Shear Load Used: 200 kN
Shear Option: Perp. to Reinf.
Resisting Force Used: 0 kN/m

32.7 Reinforcement 7

Type: Pile
Outside Point: (-79, 164.5) m
Inside Point: (-79, 133) m
Slip Surface Intersection: (-79, 142.51) m

Total Length: 31.5 m
Reinforcement Direction: 90 °
Applied Load Option: Variable
F of S Dependent: No
Pile Spacing: 2.5 m
Shear Capacity: 500 kN
Shear Safety Factor: 1
Shear Load Used: 200 kN
Shear Option: Perp. to Reinf.
Resisting Force Used: 0 kN/m

33 Regions

	Material	Points	Area (m²)
Region 1	dt1	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	104.38986
Region 2	USMC	17,18,19,20,21,22,23,1,16,15,24,25	3387.3302
Region 3	UA	42,43,44,45,46,47,48,28,27,26,18,17	788.14976
Region 4	cfr	2,41,40,39,38,37,36,35,34,33,32,31,30,29,28,27,26,18,19,20,21,22,23,1	936.08454
Region 5	muro	51,31,30,29,50,49,53,52	19.063976
Region 6	cuscino ghiaia	49,50,29,28,48	40.837285

34 Points

	X (m)	Y (m)
Point 1	-129.85017	137.23696
Point 2	-118.87924	147.09768
Point 3	-121.7583	146.21577
Point 4	-121.99236	146.03738
Point 5	-122.56036	145.99772
Point 6	-124.61185	144.24241
Point 7	-125.85903	143.31684
Point 8	-127.05586	142.39193
Point 9	-129.45612	140.86356
Point 10	-132.34559	140.81594
Point 11	-132.50931	140.80511
Point 12	-133.09425	140.61674

Point 13	-135.31503	140.48405
Point 14	-142.52094	140.05379
Point 15	-142.52094	133.54013
Point 16	-133.30025	133.54013
Point 17	-40	150.5
Point 18	-74.44762	150.41625
Point 19	-82.06496	144.90097
Point 20	-89.30255	140.04252
Point 21	-97.08536	135.8203
Point 22	-110.87638	133.69697
Point 23	-124.7034	135.02855
Point 24	-142.52094	108.82885
Point 25	-40	108.5
Point 26	-72.50319	157.43402
Point 27	-71.27913	166.88443
Point 28	-70.70601	170.60772
Point 29	-77.49807	164.67918
Point 30	-77.49807	163.17918
Point 31	-84.29807	163.17918
Point 32	-85.05487	163.08441
Point 33	-92.52094	159.61202
Point 34	-104.1277	154.21384
Point 35	-105.70589	153.48061
Point 36	-106.8808	153.05112
Point 37	-110.88547	150.68051
Point 38	-112.59347	149.53671
Point 39	-114.43719	148.88182
Point 40	-115.81246	148.14091
Point 41	-118.11058	147.44368
Point 42	-40.5	176
Point 43	-59.20631	175.83728
Point 44	-60.35886	175.63395
Point 45	-61.57157	175.41322
Point 46	-64.91642	175.34715
Point 47	-65.22455	175.33308
Point 48	-67.31953	173.519
Point 49	-76.61602	173.49917
Point 50	-76.68607	172.79917
Point 51	-84.29807	164.67918
Point 52	-78.50305	164.67918
Point 53	-77.62106	173.49917

35 Critical Slip Surfaces

	Slip Surface	FOS	Center (m)	Radius (m)	Entry (m)	Exit (m)
1	25	1.968	(-94.266, 177.632)	38.31	(-55.9969, 175.865)	(-117.925, 147.5)

35.1 Slices of Slip Surface: 25

	Slip Surface	X (m)	Y (m)	PWP (kPa)	Base Normal Stress (kPa)	Frictional Strength (kPa)	Cohesive Strength (kPa)
1	25	-116.8687	146.7275	-81.369371	27.023526	11.470806	5
2	25	-115.12485	145.5085	-62.673462	66.73501	28.327331	5
3	25	-113.51535	144.52595	-46.822551	98.371432	41.756196	5
4	25	-111.7395	143.55205	-30.410749	131.58663	55.855209	5
5	25	-109.47885	142.505	-11.408853	173.20895	73.522835	5
6	25	-107.4765	141.67695	4.4478497	205.89869	85.510808	5
7	25	-106.29335	141.2638	13.070781	221.05176	88.282686	5
8	25	-104.9168	140.84105	22.534498	236.62319	90.875256	5
9	25	-104.06385	140.5957	28.23541	246.96237	92.844085	5
10	25	-103.0434	140.3536	36.13341	258.81025	94.520712	5
11	25	-101.1302	139.9541	50.605579	281.11754	97.846521	5
12	25	-99.217035	139.6551	64.09356	303.16161	101.47837	5
13	25	-97.30388	139.4543	76.614298	324.99594	105.43175	5
14	25	-95.390705	139.3501	88.192175	346.60883	109.69136	5
15	25	-93.47753	139.3417	98.825135	367.89644	114.21399	5
16	25	-91.380705	139.44755	109.35406	390.55521	119.36281	5
17	25	-89.77151	139.5891	116.84175	396.19254	148.53345	30
18	25	-88.651275	139.741	121.53186	406.39472	151.46427	30
19	25	-86.527435	140.1415	128.71024	424.07938	157.05056	30
20	25	-84.67647	140.5433	134.20949	436.32476	160.63754	30

21	25	-83.181515	140.9788	137.56137	442.99281	162.40077	30
22	25	-81.174485	141.6404	141.30533	462.86349	170.9755	30
23	25	-79.39353	142.33955	143.53453	423.48378	148.85166	30
24	25	-78.062055	142.92065	144.62236	549.40471	215.22659	30
25	25	-77.559565	143.1563	144.8743	648.4808	267.77232	30
26	25	-77.09207	143.38975	144.96795	618.26865	251.65845	30
27	25	-76.651045	143.61155	145.04971	593.56036	238.47734	30
28	25	-76.05801	143.9312	144.93542	585.66208	234.33852	30
29	25	-74.97381	144.53945	143.15853	572.77369	228.43043	30
30	25	-73.475405	145.47475	137.82285	550.73861	219.5512	30
31	25	-72.345825	146.2131	133.47033	532.21359	212.01555	30
32	25	-71.733795	146.6536	130.71419	520.74014	207.38048	30
33	25	-70.99257	147.2035	127.2199	506.05235	201.42879	30
34	25	-69.85939	148.12295	121.10403	480.84822	191.27938	30
35	25	-68.16615	149.6118	110.833	438.80309	174.38479	30
36	25	-66.27204	151.52355	96.928992	392.36497	170.57004	30
37	25	-65.070485	152.82805	87.209803	369.71292	163.10325	30
38	25	-64.45821	153.5772	81.431406	348.49736	154.1906	30
39	25	-62.785785	155.9043	64.1118	284.61906	127.30993	30
40	25	-60.965215	158.73195	42.870609	211.42256	97.313512	30
41	25	-59.782585	160.9948	24.898008	52.333321	15.839785	30
42	25	-58.83191	163.1024	7.619533	117.48237	63.429337	30
43	25	-57.227195	169.94035	-53.717694	-121.1317	-69.935418	30

36 Project Settings

Length(L) Units: meters
Time(t) Units: Seconds
Force(F) Units: kN
Pressure(p) Units: kPa
Strength Units: kPa
Unit Weight of Water: 9.807 kN/m³
View: 2D

37 Analysis Settings

37.1 SLOPE/W Analysis

Kind: SLOPE/W
Method: Bishop, Ordinary and Janbu
Settings
    Apply Phreatic Correction: No
    PWP Conditions Source: Piezometric Line
    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
    Optimize Critical Slip Surface Location: No
    Tension Crack
        Tension Crack Option: (none)
FOS Distribution
    FOS Calculation Option: Constant
Advanced
    Number of Slices: 30
    Optimization Tolerance: 0.01
    Minimum Slip Surface Depth: 0.1 m
    Optimization Maximum Iterations: 2000
    Optimization Convergence Tolerance: 1e-007
    Starting Optimization Points: 8
    Ending Optimization Points: 16
    Complete Passes per Insertion: 1
    Driving Side Maximum Convex Angle: 5 °
    Resisting Side Maximum Convex Angle: 1 °

38 Materials

38.1 cfr

Model: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 5 kPa
Phi: 23 °
Phi-B: 0 °
Pore Water Pressure
    Piezometric Line: 1

38.2 UA

Model: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 30 kPa
Phi: 30 °
Phi-B: 0 °
Pore Water Pressure
    Piezometric Line: 1

38.3 USMC

Model: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 30 kPa
Phi: 28 °
Phi-B: 0 °
Pore Water Pressure
    Piezometric Line: 1

38.4 dt1

Model: Mohr-Coulomb
Unit Weight: 19 kN/m³
Cohesion: 22 kPa
Phi: 25 °
Phi-B: 0 °
Pore Water Pressure
    Piezometric Line: 1

38.5 muro

Model: Mohr-Coulomb
Unit Weight: 25 kN/m³
Cohesion: 14170 kPa
Phi: 45 °
Phi-B: 0 °

Pore Water Pressure
Piezometric Line: 1

38.6 cuscino ghiaia

Model: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 10 kPa
Phi: 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

39 Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-117.92495, 147.5) m
Left-Zone Right Coordinate: (-101.95163, 155.22591) m
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (-67.27677, 173.55602) m
Right-Zone Right Coordinate: (-55.99688, 175.8652) m
Right-Zone Increment: 4
Radius Increments: 4

40 Slip Surface Limits

Left Coordinate: (-142.52094, 140.05379) m
Right Coordinate: (-55.265053, 175.87156) m

41 Piezometric Lines

41.1 Piezometric Line 1

41.1.1 Coordinates

	X (m)	Y (m)
	-142.52094	132.5
	-131	132.5
	-120.5	137
	-104	143.5
	-88	152.5

	-75.5	159
	-64	162
	-53	166
	-40.30392	166

42 Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

43 Reinforcements

43.1 Reinforcement 1

Type: Nail
Outside Point: (-78, 172.8504) m
Inside Point: (-56.74963, 167.15638) m
Slip Surface Intersection: (-67.858, 170.13) m
Total Length: 22.000002 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Diameter: 0.31830989 m
Bond Safety Factor: 1
Bond Skin Friction: 345 kPa
Bond Resistance: 138 kN/m
Nail Spacing: 2.5 m
Bar Capacity: 760 kN
Bar Safety Factor: 1
Bar Load: 304 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 760 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 304 kN
Applied Load: 304 kN
Nail Load Used: 304 kN
Resisting Force Used: 138 kN/m
Available Bond Length: 11.5 m
Required Bond Length: 2.2029 m
Governing Component: Bar

43.2 Reinforcement 2

Type: Nail

Outside Point: (-78, 171.3504) m
Inside Point: (-56.74963, 165.65638) m
Slip Surface Intersection: (-68.145, 168.71) m
Total Length: 22.000002 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Diameter: 0.31830989 m
Bond Safety Factor: 1
Bond Skin Friction: 345 kPa
Bond Resistance: 138 kN/m
Nail Spacing: 2.5 m
Bar Capacity: 760 kN
Bar Safety Factor: 1
Bar Load: 304 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 760 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 304 kN
Applied Load: 304 kN
Nail Load Used: 304 kN
Resisting Force Used: 138 kN/m
Available Bond Length: 11.797 m
Required Bond Length: 2.2029 m
Governing Component: Bar

43.3 Reinforcement 3

Type: Nail
Outside Point: (-78, 169.3504) m
Inside Point: (-56.74963, 163.65638) m
Slip Surface Intersection: (-68.527, 166.81) m
Total Length: 22.000002 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Diameter: 0.31830989 m
Bond Safety Factor: 1
Bond Skin Friction: 345 kPa
Bond Resistance: 138 kN/m
Nail Spacing: 2.5 m
Bar Capacity: 760 kN
Bar Safety Factor: 1
Bar Load: 304 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 760 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip

Shear Load: 304 kN
Applied Load: 304 kN
Nail Load Used: 304 kN
Resisting Force Used: 138 kN/m
Available Bond Length: 12.193 m
Required Bond Length: 2.2029 m
Governing Component: Bar

43.4 Reinforcement 4

Type: Nail
Outside Point: (-78.5, 166.8504) m
Inside Point: (-57.24963, 161.15638) m
Slip Surface Intersection: (-69.049, 164.32) m
Total Length: 22.000002 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Diameter: 0.31830989 m
Bond Safety Factor: 1
Bond Skin Friction: 345 kPa
Bond Resistance: 138 kN/m
Nail Spacing: 2.5 m
Bar Capacity: 760 kN
Bar Safety Factor: 1
Bar Load: 304 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 760 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 304 kN
Applied Load: 304 kN
Nail Load Used: 304 kN
Resisting Force Used: 138 kN/m
Available Bond Length: 12.216 m
Required Bond Length: 2.2029 m
Governing Component: Bar

43.5 Reinforcement 5

Type: Anchor
Outside Point: (-78.4746, 164.8504) m
Inside Point: (-49.49683, 157.08583) m
Slip Surface Intersection: (-69.804, 162.53) m
Total Length: 29.999995 m
Reinforcement Direction: 165 °
Applied Load Option: Variable
F of S Dependent: No
Bond Length: 18 m

Bond Diameter: 0.2 m
Bond Safety Factor: 1
Bond Skin Friction: 55 kPa
Bond Resistance: 13.823008 kN/m
Anchor Spacing: 2.5 m
Bar Capacity: 900 kN
Bar Safety Factor: 1
Bar Load: 360 kN
Load Distribution: Conc. in 1 slice
Shear Capacity: 0 kN
Shear Safety Factor: 1
Shear Option: Parallel to Slip
Shear Load: 0 kN
Applied Load: 248.81414 kN
Anchor Load Used: 248.81 kN
Resisting Force Used: 13.823 kN/m
Available Bond Length: 18 m
Required Bond Length: 18 m
Governing Component: Bond

43.6 Reinforcement 6

Type: Pile
Outside Point: (-83, 164.5) m
Inside Point: (-83, 133) m
Slip Surface Intersection: (-83, 147.02) m
Total Length: 31.5 m
Reinforcement Direction: 90 °
Applied Load Option: Variable
F of S Dependent: No
Pile Spacing: 2.5 m
Shear Capacity: 500 kN
Shear Safety Factor: 1
Shear Load Used: 200 kN
Shear Option: Perp. to Reinf.
Resisting Force Used: 0 kN/m

43.7 Reinforcement 7

Type: Pile
Outside Point: (-79, 164.5) m
Inside Point: (-79, 133) m
Slip Surface Intersection: (-79, 149.89) m
Total Length: 31.5 m
Reinforcement Direction: 90 °
Applied Load Option: Variable
F of S Dependent: No
Pile Spacing: 2.5 m
Shear Capacity: 500 kN

Shear Safety Factor: 1
Shear Load Used: 200 kN
Shear Option: Perp. to Reinf.
Resisting Force Used: 0 kN/m

44 Regions

	Material	Points	Area (m²)
Region 1	dt1	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	104.38986
Region 2	USMC	17,18,19,20,21,22,23,1,16,15,24,25	3387.3302
Region 3	UA	42,43,44,45,46,47,48,28,27,26,18,17	788.14976
Region 4	cfr	2,41,40,39,38,37,36,35,34,33,32,31,30,29,28,27,26,18,19,20,21,22,23,1	936.08454
Region 5	muro	51,31,30,29,50,49,53,52	19.063976
Region 6	cuscino ghiaia	49,50,29,28,48	40.837285

45 Points

	X (m)	Y (m)
Point 1	-129.85017	137.23696
Point 2	-118.87924	147.09768
Point 3	-121.7583	146.21577
Point 4	-121.99236	146.03738
Point 5	-122.56036	145.99772
Point 6	-124.61185	144.24241
Point 7	-125.85903	143.31684
Point 8	-127.05586	142.39193
Point 9	-129.45612	140.86356
Point 10	-132.34559	140.81594
Point 11	-132.50931	140.80511
Point 12	-133.09425	140.61674
Point 13	-135.31503	140.48405
Point 14	-142.52094	140.05379
Point 15	-142.52094	133.54013
Point 16	-133.30025	133.54013
Point 17	-40	150.5

Point 18	-74.44762	150.41625
Point 19	-82.06496	144.90097
Point 20	-89.30255	140.04252
Point 21	-97.08536	135.8203
Point 22	-110.87638	133.69697
Point 23	-124.7034	135.02855
Point 24	-142.52094	108.82885
Point 25	-40	108.5
Point 26	-72.50319	157.43402
Point 27	-71.27913	166.88443
Point 28	-70.70601	170.60772
Point 29	-77.49807	164.67918
Point 30	-77.49807	163.17918
Point 31	-84.29807	163.17918
Point 32	-85.05487	163.08441
Point 33	-92.52094	159.61202
Point 34	-104.1277	154.21384
Point 35	-105.70589	153.48061
Point 36	-106.8808	153.05112
Point 37	-110.88547	150.68051
Point 38	-112.59347	149.53671
Point 39	-114.43719	148.88182
Point 40	-115.81246	148.14091
Point 41	-118.11058	147.44368
Point 42	-40.5	176
Point 43	-59.20631	175.83728
Point 44	-60.35886	175.63395
Point 45	-61.57157	175.41322
Point 46	-64.91642	175.34715
Point 47	-65.22455	175.33308
Point 48	-67.31953	173.519
Point 49	-76.61602	173.49917
Point 50	-76.68607	172.79917
Point 51	-84.29807	164.67918
Point 52	-78.50305	164.67918
Point 53	-77.62106	173.49917

46 Critical Slip Surfaces

	Slip	FOS	Center (m)	Radius	Entry (m)	Exit (m)

	Surface			(m)		
1	5	1.688	(-100.064, 175.035)	32.82	(-67.2768, 173.556)	(-117.925, 147.5)

46.1 Slices of Slip Surface: 5

	Slip Surface	X (m)	Y (m)	PWP (kPa)	Base Normal Stress (kPa)	Frictional Strength (kPa)	Cohesive Strength (kPa)
1	5	-116.8687	146.8698	-82.761946	24.448088	10.377598	5
2	5	-115.12485	145.8843	-66.363649	62.144619	26.378826	5
3	5	-113.51535	145.11455	-52.595076	93.832149	39.829384	5
4	5	-111.7395	144.3749	-38.480436	128.06568	54.360654	5
5	5	-109.8843	143.73555	-25.043065	164.67286	69.899483	5
6	5	-107.88195	143.1757	-11.817174	198.63756	84.316643	5
7	5	-106.40275	142.8359	-2.769929	219.23816	93.061077	5
8	5	-105.8153	142.7223	0.61362696	224.93205	95.217523	5
9	5	-104.9168	142.5848	5.4331465	234.29853	97.14759	5
10	5	-104.06385	142.45895	9.9627621	243.25524	99.026781	5
11	5	-103.18005	142.3729	15.576275	251.57939	100.17738	5
12	5	-101.5402	142.25775	25.75221	266.04464	101.99809	5
13	5	-99.90035	142.2249	35.120734	278.78157	103.42789	5
14	5	-98.26047	142.2741	43.683799	289.79851	104.4695	5
15	5	-96.620605	142.40575	51.439352	299.10775	105.129	5
16	5	-94.98074	142.6209	58.37556	306.68586	105.40147	5
17	5	-93.340875	142.92115	64.479547	312.51362	105.28422	5
18	5	-91.76745	143.2897	69.543154	316.45602	104.80829	5
19	5	-90.26047	143.7225	73.610991	318.60311	103.99299	5
20	5	-88.75349	144.2351	76.897777	319.12733	102.82035	5
21	5	-87.263715	144.82375	79.035269	317.96064	101.4178	5
22	5	-85.79115	145.4914	79.998435	315.03473	99.766988	5
23	5	-84.67647	146.048	80.223262	309.50444	97.324087	5
24	5	-83.332235	146.82165	79.490003	326.12185	104.68901	5

25	5	-81.40056	148.06275	77.172345	299.16204	94.229033	5
26	5	-79.468885	149.5104	72.82631	268.74343	83.161882	5
27	5	-78.062055	150.68825	68.448325	334.45213	112.91192	5
28	5	-77.559565	151.1447	66.53445	413.68306	147.35584	5
29	5	-77.09207	151.6006	64.447106	380.88177	134.31855	5
30	5	-76.651045	152.03425	62.443382	353.53937	123.56292	5
31	5	-76.05801	152.6688	59.24398	338.17927	118.40101	5
32	5	-74.777385	154.1423	49.48874	305.67637	108.7452	5
33	5	-73.33216	156.03355	34.637815	264.1181	97.408602	5
34	5	-72.55637	157.1319	25.851374	205.71239	103.84281	30
35	5	-72.345825	157.4618	23.154741	198.389	101.17155	30
36	5	-71.733795	158.4885	14.651872	175.70267	92.982722	30
37	5	-71.024675	159.75045	4.0902318	147.97026	83.069173	30
38	5	-69.891495	162.31895	-18.200316	57.270569	33.065179	30
39	5	-68.16615	168.6026	-75.410474	-140.36589	-81.040282	30
40	5	-67.29815	173.1786	-118.067	-43.556914	-25.147596	30