






**INTERVENTI DI ADEGUAMENTO DELLA DIGA DI GIUDEA  
A GELLO NEL COMUNE DI PISTOIA (PT)**



**PROGETTO DEFINITIVO**

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## 1 DATI NORMATIVA

Normativa: Norme Tecniche sulle Costruzioni 14/01/2008

Carichi	Effetto	Simbologia	A2 Statico	A2 Sismico
Permanenti	Favorevole	$\gamma_{Gfav}$	1.00	1.00
Permanenti	Sfavorevole	$\gamma_{Gsfav}$	1.00	1.00
Variabili	Favorevole	$\gamma_{Qfav}$	0.00	0.00
Variabili	Sfavorevole	$\gamma_{Qsfav}$	1.30	1.00

Tabella 1-1 – Coefficienti parziali per le azioni o per l'effetto delle azioni.

Parametri	Simbologia	M2 Statico	M2 Sismico
Tangente dell'angolo di attrito	$\gamma_{\tan\phi'}$	1.25	1.25
Coesione efficace	$\gamma_{c'}$	1.25	1.25
Resistenza non drenata	$\gamma_{cu}$	1.40	1.40
Peso dell'unità di volume	$\gamma_{\gamma}$	1.00	1.00

Tabella 1-2 – Coefficienti parziali per i parametri geotecnici del terreno.

## 2 DATI ZONA SISMICA

### Identificazione del sito

Latitudine	43.960117
Longitudine	10.883661
Punti di interpolazione del reticolo	19165 - 19166 - 18944 - 18943
<i>Tipo di opera</i>	
Tipo di costruzione	Opera di importanza strategica
Vita nominale	100 anni
Classe d'uso	IV - Opere strategiche
Vita di riferimento	200 anni

### Stato limite SLO

Accelerazione al suolo $a_g$	1.010 [m/s <sup>2</sup> ]
Massimo fattore amplificazione spettro orizzontale F0	2.42
Periodo inizio tratto spettro a velocità costante Tc*	0.17
Coefficiente di amplificazione per tipo di sottosuolo (Ss)	2.18
Coefficiente di amplificazione topografica (St)	1.00
Coefficiente riduzione ( $\beta_s$ )	1.00
Rapporto intensità sismica verticale/orizzontale	0.50
Coefficiente di intensità sismica orizzontale (per cento)	$k_h=(a_g/g*\beta_s*St*S) = 22.42$
Coefficiente di intensità sismica verticale (per cento)	$k_v=0.50 * k_h = 11.21$

### Stato limite SLD

Accelerazione al suolo $a_g$	1.236 [m/s <sup>2</sup> ]
Massimo fattore amplificazione spettro orizzontale F0	2.41
Periodo inizio tratto spettro a velocità costante Tc*	0.13
Coefficiente di amplificazione per tipo di sottosuolo (Ss)	2.62
Coefficiente di amplificazione topografica (St)	1.00
Coefficiente riduzione ( $\beta_s$ )	1.00
Rapporto intensità sismica verticale/orizzontale	0.50
Coefficiente di intensità sismica orizzontale (per cento)	$k_h=(a_g/g*\beta_s*St*S) = 33.04$
Coefficiente di intensità sismica verticale (per cento)	$k_v=0.50 * k_h = 16.52$

### Stato limite SLV

Accelerazione al suolo $a_g$	2.688 [m/s <sup>2</sup> ]
Massimo fattore amplificazione spettro orizzontale F0	2.40
Periodo inizio tratto spettro a velocità costante Tc*	0.17
Coefficiente di amplificazione per tipo di sottosuolo (Ss)	2.40
Coefficiente di amplificazione topografica (St)	1.00
Coefficiente riduzione pendio naturale ( $\beta_s$ )	1.00
Rapporto intensità sismica verticale/orizzontale	0.50
Coefficiente di intensità sismica orizzontale (per cento)	$k_h=(a_g/g*\beta_s*St*S) = 65.62$
Coefficiente di intensità sismica verticale (per cento)	$k_v=0.50 * k_h = 32.81$

### Stato limite SLC

Accelerazione al suolo $a_g$	2.923 [m/s <sup>2</sup> ]
Massimo fattore amplificazione spettro orizzontale F0	2.40
Periodo inizio tratto spettro a velocità costante Tc*	0.20
Coefficiente di amplificazione per tipo di sottosuolo (Ss)	2.09
Coefficiente di amplificazione topografica (St)	1.00
Coefficiente riduzione ( $\beta_s$ )	1.00
Rapporto intensità sismica verticale/orizzontale	0.50
Coefficiente di intensità sismica orizzontale (per cento)	$k_h=(a_g/g*\beta_s*St*S) = 62.21$
Coefficiente di intensità sismica verticale (per cento)	$k_v=0.50 * k_h = 31.11$

### 3 CONDIZIONI DI VERIFICA

Le verifiche di stabilità sono condotte per entrambi i paramenti di monte e di valle dello sbarramento.

In totale sono individuate n. 29 verifiche, di cui n. 13 per il paramento di valle e n. 16 per il paramento di monte:

- **Verifica 01:** verifica paramento di **valle**; verifica a lungo termine tensioni efficaci; sovraccarico coronamento 2000 kg/m<sup>2</sup>; senza sisma; serbatoio vuoto.
- **Verifica 02:** verifica paramento di **valle**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; senza sisma; serbatoio vuoto.
- **Verifica 03:** verifica paramento di **valle**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; con sisma SLO; serbatoio vuoto.
- **Verifica 04:** verifica paramento di **valle**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; con sisma SLD; serbatoio vuoto.
- **Verifica 05:** verifica paramento di **valle**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; con sisma SLV; serbatoio vuoto.
- **Verifica 06:** verifica paramento di **valle**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; con sisma SLC; serbatoio vuoto.
- **Verifica 07:** verifica paramento di **valle**; verifica a lungo termine tensioni efficaci; sovraccarico coronamento 2000 kg/m<sup>2</sup>; senza sisma; invaso alla quota di massima regolazione.
- **Verifica 08:** verifica paramento di **valle**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; con sisma SLO; invaso alla quota di massima regolazione.
- **Verifica 09:** verifica paramento di **valle**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; con sisma SLD; invaso alla quota di massima regolazione.
- **Verifica 10:** verifica paramento di **valle**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; con sisma SLV; invaso alla quota di massima regolazione.
- **Verifica 11:** verifica paramento di **valle**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; con sisma SLC; invaso alla quota di massima regolazione.
- **Verifica 12:** verifica paramento di **valle**; verifica a lungo termine tensioni efficaci; sovraccarico coronamento 2000 kg/m<sup>2</sup>; senza sisma; invaso alla quota di massima piena.
- **Verifica 13:** verifica paramento di **valle**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; senza sisma; invaso alla quota di massima piena.
- **Verifica 14:** verifica paramento di **monte**; verifica a lungo termine tensioni efficaci; sovraccarico coronamento 2000 kg/m<sup>2</sup>; senza sisma; serbatoio vuoto.
- **Verifica 15:** verifica paramento di **monte**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; senza sisma; serbatoio vuoto.
- **Verifica 16:** verifica paramento di **monte**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; con sisma SLO; serbatoio vuoto.
- **Verifica 17:** verifica paramento di **monte**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; con sisma SLD; serbatoio vuoto.
- **Verifica 18:** verifica paramento di **monte**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; con sisma SLV; serbatoio vuoto.
- **Verifica 19:** verifica paramento di **monte**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; con sisma SLC; serbatoio vuoto.
- **Verifica 20:** verifica paramento di **monte**; verifica a lungo termine tensioni efficaci; sovraccarico coronamento 2000 kg/m<sup>2</sup>; senza sisma; invaso alla quota di massima regolazione.
- **Verifica 21:** verifica paramento di **monte**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; con sisma SLO; invaso alla quota di massima regolazione.
- **Verifica 22:** verifica paramento di **monte**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; con sisma SLD; invaso alla quota di massima regolazione.
- **Verifica 22:** verifica paramento di **monte**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; con sisma SLV; invaso alla quota di massima regolazione.
- **Verifica 24:** verifica paramento di **monte**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; con sisma SLC; invaso alla quota di massima regolazione.
- **Verifica 25:** verifica paramento di **monte**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; senza sisma; rapido svaso del serbatoio.
- **Verifica 26:** verifica paramento di **monte**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; con sisma SLO; rapido svaso del serbatoio.

- **Verifica 27:** verifica paramento di **monte**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; con sisma SLD; rapido svaso del serbatoio.
- **Verifica 28:** verifica paramento di **monte**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; con sisma SLV; rapido svaso del serbatoio.
- **Verifica 29:** verifica paramento di **monte**; verifica a breve termine tensioni totali; sovraccarico coronamento 2000 kg/m<sup>2</sup>; con sisma SLC; rapido svaso del serbatoio.

n. [#]	Paramento	Cond. idrauliche	Sisma	Condizioni	Fs Bishop	Newmark			D.M. 2014
						Vel. max [m/s]	Spost. max [m]	Superficie [#]	$\gamma_R$
01	Valle	Invaso vuoto	Senza	Drenate	2.309	-	-	-	1.2
02	Valle	Invaso vuoto	Senza	Non drenate	1.799	-	-	-	1.1
03	Valle	Invaso vuoto	SLO	Non drenate	0.754	0.009597	0.000361	2	
04	Valle	Invaso vuoto	SLD	Non drenate	0.577	0.022024	0.001609	19	
05	Valle	Invaso vuoto	SLV	Non drenate	0.321	0.149950	0.036715	214	
06	Valle	Invaso vuoto	SLC	Non drenate	0.337	0.167005	0.055804	193	
07	Valle	Esercizio	Senza	Drenate	2.160	-	-	-	1.2
08	Valle	Esercizio	SLO	Non drenate	0.751	0.009918	0.000377	4	
09	Valle	Esercizio	SLD	Non drenate	0.569	0.022368	0.001678	56	
10	Valle	Esercizio	SLV	Non drenate	0.311	0.150843	0.037331	265	
11	Valle	Esercizio	SLC	Non drenate	0.327	0.167953	0.056595	251	
12	Valle	Max piena	Senza	Drenate	2.159	-	-	-	1.2
13	Valle	Max piena	Senza	Non drenate	1.791	-	-	-	1.1
14	Monte	Invaso vuoto	Senza	Drenate	1.865	-	-	-	1.2
15	Monte	Invaso vuoto	Senza	Non drenate	1.244	-	-	-	1.1
16	Monte	Invaso vuoto	SLO	Non drenate	0.597	0.047946	0.011338	76	
17	Monte	Invaso vuoto	SLD	Non drenate	0.451	0.077085	0.028299	8	
18	Monte	Invaso vuoto	SLV	Non drenate	0.264	0.443165	0.272900	189	
19	Monte	Invaso vuoto	SLC	Non drenate	0.277	0.512483	0.334202	175	
20	Monte	Esercizio	Senza	Drenate	2.273	-	-	-	1.2
21	Monte	Esercizio	SLO	Non drenate	0.747	0.006130	0.000210	3	
22	Monte	Esercizio	SLD	Non drenate	0.563	0.018777	0.001005	11	
23	Monte	Esercizio	SLV	Non drenate	0.316	0.141472	0.030981	25	
24	Monte	Esercizio	SLC	Non drenate	0.331	0.158961	0.048516	24	
25	Monte	Rapido svaso	Senza	Non drenate	1.246	-	-	-	1.1
26	Monte	Rapido svaso	SLO	Non drenate	0.602	0.047430	0.011027	64	
27	Monte	Rapido svaso	SLD	Non drenate	0.452	0.076283	0.027500	8	
28	Monte	Rapido svaso	SLV	Non drenate	0.265	0.438714	0.267717	195	
29	Monte	Rapido svaso	SLC	Non drenate	0.278	0.508031	0.328551	176	

Tabella 3-1 – Verifiche di stabilità dello stato di progetto condotte secondo D.M. 26/06/2014 per la sezione CR\_06.

## 4 DESCRIZIONE TERRENO E FALDA

### 4.1 PARAMETRI GEOTECNICI

n°	Descrizione	$\gamma$ [kg/mc]	$\gamma_{sat}$ [kg/mc]	$\phi'$ [°]	$c'$ [kPa]	Retino
1	SUB	2169	2169	23.60	24.0	
2	LA2	2109	2109	23.40	22.0	
3	AL	1936	1936	24.20	23.0	
4	LA1	2045	2045	21.60	24.0	
5	Scogliera	1800	2000	45.00	0.0	

Tabella 4-1 – Parametri geotecnici condizioni drenate.

n°	Descrizione	$\gamma$ [kg/mc]	$\gamma_{sat}$ [kg/mc]	$\phi_u$ [°]	$c_u$ [kPa]	Retino
1	SUB	2169	2169	0.00	146.0	
2	LA2	2109	2109	0.00	73.0	
3	AL	1936	1936	0.00	76.0	
4	LA1	2045	2045	0.00	74.0	
5	Scogliera <sup>1</sup>	1800	2000	27.00	0.0	

Tabella 4-2 – Parametri geotecnici condizioni non drenate.

### 4.2 PARAMENTO DI VALLE

#### 4.2.1 PROFILO TERRENO E DESCRIZIONE STRATIGRAFIA

n°	X [m]	Y [m]	n°	X [m]	Y [m]	n°	X [m]	Y [m]
1	0.00	131.61	11	40.92	128.00	21	114.52	140.70
2	30.74	131.61	12	46.75	127.34	22	125.64	143.30
3	31.82	131.35	13	49.88	127.61	23	131.14	143.30
4	33.66	130.91	14	51.32	127.98	24	188.52	128.00
5	34.16	130.84	15	54.24	128.00	25	193.52	128.00
6	35.01	130.67	16	55.52	128.00	26	208.42	128.00
7	36.25	130.39	17	61.00	129.28	27	238.74	128.00
8	37.46	130.01	18	67.48	130.80	28	254.77	129.09
9	37.99	130.00	19	85.42	135.00	29	260.00	129.21
10	39.90	128.77	20	90.07	135.00	-	-	-

Tabella 4-3 – Profilo del piano campagna.

n°	X [m]	Y [m]	n°	X [m]	Y [m]	n°	X [m]	Y [m]
1	208.42	128.00	18	118.19	117.29	35	37.99	130.00
2	195.65	122.56	19	113.38	117.08	36	37.46	130.01
3	186.09	120.35	20	109.60	118.22	37	36.25	130.39
4	183.96	119.43	21	106.30	119.97	38	35.01	130.67
5	172.30	115.78	22	103.38	121.29	39	34.16	130.84
6	167.96	115.55	23	96.73	120.96	40	33.66	130.91

<sup>1</sup> Nelle verifiche non drenate in cui la scogliera non è immersa (i.e. invaso vuoto e rapido svaso)  $\phi_u$  è assunto pari a 45° come nelle verifiche drenate.

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
7	164.53	116.08	24	93.25	121.10	41	31.82	131.35
8	159.39	116.05	25	88.51	122.54	42	30.74	131.61
9	155.22	117.04	26	86.34	123.68	43	0.00	131.61
10	152.57	118.14	27	81.87	125.48	44	0.00	0.00
11	147.85	119.05	28	75.34	125.86	45	41.00	0.00
12	145.41	119.43	29	65.97	126.16	46	260.00	0.00
13	138.63	119.66	30	60.49	126.08	47	260.00	117.03
14	133.45	120.12	31	49.60	125.97	48	260.00	129.21
15	129.79	120.04	32	47.12	126.00	49	254.77	129.09
16	128.54	119.75	33	40.92	128.00	50	238.74	128.00
17	123.25	118.75	34	39.90	128.77	-	-	-

Tabella 4-4 – Coordinate dei vertici dello strato n° 1 costituito da terreno n° 1 (SUB).

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
1	61.00	129.28	24	138.63	119.66	47	153.49	126.26
2	59.25	128.39	25	145.41	119.43	48	145.74	127.28
3	58.44	128.00	26	147.85	119.05	49	143.50	127.39
4	55.97	127.00	27	152.57	118.14	50	140.38	127.66
5	52.97	127.00	28	155.22	117.04	51	138.76	128.11
6	49.60	125.97	29	159.39	116.05	52	136.68	129.03
7	60.49	126.08	30	164.53	116.08	53	133.06	128.52
8	65.97	126.16	31	167.96	115.55	54	129.40	127.03
9	75.34	125.86	32	172.30	115.78	55	127.52	126.66
10	81.87	125.48	33	183.96	119.43	56	121.81	125.99
11	86.34	123.68	34	186.09	120.35	57	118.28	124.66
12	88.51	122.54	35	195.65	122.56	58	114.85	124.00
13	93.25	121.10	36	208.42	128.00	59	113.39	123.76
14	96.73	120.96	37	193.52	128.00	60	109.83	124.21
15	103.38	121.29	38	193.51	127.00	61	103.85	126.49
16	106.30	119.97	39	192.52	127.00	62	101.10	127.09
17	109.60	118.22	40	192.02	126.50	63	97.34	128.28
18	113.38	117.08	41	188.32	126.50	64	92.93	130.31
19	118.19	117.29	42	185.24	124.95	65	86.99	130.73
20	123.25	118.75	43	181.41	124.48	66	83.98	131.04
21	128.54	119.75	44	170.02	124.58	67	78.71	131.29
22	129.79	120.04	45	165.63	125.32	68	73.14	131.07
23	133.45	120.12	46	159.84	125.88	69	67.48	130.80

Tabella 4-5 – Coordinate dei vertici dello strato n° 2 costituito da terreno n° 2 (LA2).

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
1	188.32	126.50	17	90.07	135.00	33	127.52	126.66
2	169.41	131.54	18	85.42	135.00	34	129.40	127.03
3	164.43	131.14	19	67.48	130.80	35	133.06	128.52
4	159.15	131.01	20	73.14	131.07	36	136.68	129.03
5	150.26	132.49	21	78.71	131.29	37	138.76	128.11
6	147.53	133.54	22	83.98	131.04	38	140.38	127.66
7	145.87	135.34	23	86.99	130.73	39	143.50	127.39
8	145.44	136.10	24	92.93	130.31	40	145.74	127.28
9	145.25	137.35	25	97.34	128.28	41	153.49	126.26
10	139.09	137.98	26	101.10	127.09	42	159.84	125.88

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
11	138.19	138.01	27	103.85	126.49	43	165.63	125.32
12	135.49	139.12	28	109.83	124.21	44	170.02	124.58
13	133.07	139.42	29	113.39	123.76	45	181.41	124.48
14	122.85	141.38	30	114.85	124.00	46	185.24	124.95
15	118.10	140.82	31	118.28	124.66	-	-	-
16	114.52	140.70	32	121.81	125.99	-	-	-

Tabella 4-6 – Coordinate dei vertici dello strato n° 3 costituito da terreno n° 3 (AL).

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
1	169.41	131.54	8	122.85	141.38	15	145.87	135.34
2	166.30	132.37	9	133.07	139.42	16	147.53	133.54
3	132.40	141.41	10	135.49	139.12	17	150.26	132.49
4	131.14	143.30	11	138.19	138.01	18	159.15	131.01
5	125.64	143.30	12	139.09	137.98	19	164.43	131.14
6	114.52	140.70	13	145.25	137.35	-	-	-
7	118.10	140.82	14	145.44	136.10	-	-	-

Tabella 4-7 – Coordinate dei vertici dello strato n° 4 costituito da terreno n° 4 (LA1).

n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]
1	131.14	143.30	6	192.02	126.50
2	132.40	141.41	7	192.52	127.00
3	166.30	132.37	8	193.51	127.00
4	169.41	131.54	9	193.52	128.00
5	188.32	126.50	10	188.52	128.00

Tabella 4-8 – Coordinate dei vertici dello strato n° 5 costituito da terreno n° 5 (Scogliera).

n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]
1	49.60	125.97	8	54.24	128.00
2	52.97	127.00	9	51.32	127.98
3	55.97	127.00	10	49.88	127.61
4	58.44	128.00	11	46.75	127.34
5	59.25	128.39	12	40.92	128.00
6	61.00	129.28	13	47.12	126.00
7	55.52	128.00	-	-	-

Tabella 4-9 – Coordinate dei vertici dello strato n° 6 costituito da terreno n° 4 (LA1).

#### 4.2.2 DESCRIZIONE FALDA

n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]
1	0.00	125.82	6	188.52	128.00
2	41.10	125.82	7	215.31	128.00
3	81.08	127.25	8	238.74	128.00
4	83.23	127.33	9	254.77	129.09
5	183.89	128.00	10	260.00	129.21

Tabella 4-10 – Livello falda serbatoio vuoto.



n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
1	0.00	125.82	10	100.42	130.31	19	128.01	138.61
2	41.10	125.82	11	102.42	130.70	20	129.39	139.04
3	81.08	127.25	12	107.45	131.95	21	131.08	139.37
4	81.40	127.32	13	108.70	132.32	22	135.29	140.02
5	83.54	127.69	14	111.59	133.21	23	136.22	140.00
6	87.15	128.29	15	115.06	134.38	24	136.72	139.99
7	91.24	128.91	16	118.29	135.53	25	143.52	140.00
8	95.04	129.46	17	119.24	135.93	26	260.00	140.00
9	98.51	129.96	18	124.83	137.79	-	-	-

Tabella 4-11 – Livello falda massima regolazione.

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
1	0.00	125.82	9	98.51	129.96	17	119.24	135.93
2	41.10	125.82	10	100.42	130.31	18	124.83	137.79
3	81.08	127.25	11	102.42	130.70	19	127.97	138.77
4	81.40	127.32	12	107.45	131.95	20	129.33	139.29
5	83.54	127.69	13	108.70	132.32	21	131.02	139.71
6	87.15	128.29	14	111.59	133.21	22	134.36	140.28
7	91.24	128.91	15	115.06	134.38	23	136.44	140.34
8	95.04	129.46	16	118.29	135.53	24	260.00	140.34

Tabella 4-12 – Livello falda massimo invaso.

#### 4.2.3 IMPOSTAZIONE DELLE SUPERFICI DI ROTTURA

##### Superfici di rottura circolari

Si considerano delle superfici di rottura circolari generate tramite la seguente maglia dei centri

Origine maglia	[m]	$X_0 = 27.64$	$Y_0 = 140.00$
Passo maglia	[m]	$dX = 2.00$	$dY = 2.00$
Numero passi		$N_x = 50$	$N_y = 40$
Raggio	[m]	$R = 10.00$	

Si utilizza un raggio variabile con passo  $dR=2.00$  [m] ed un numero di incrementi pari a 40

#### 4.2.4 CONDIZIONI DI ESCLUSIONE

Sono state escluse dall'analisi le superfici aventi:

- lunghezza di corda inferiore a	1.00	m
- freccia inferiore a	0.50	m
- volume inferiore a	2.00	mc
- ordinata superficie inferiore a	101.00	m
- pendenza media della superficie inferiore a	1.00	[%]

### 4.3 PARAMENTO DI MONTE

#### 4.3.1 PROFILO TERRENO E DESCRIZIONE STRATIGRAFIA

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
1	0.00	129.21	11	174.58	135.00	21	222.01	130.00
2	5.23	129.09	12	192.52	130.80	22	222.54	130.01
3	21.26	128.00	13	199.00	129.28	23	223.75	130.39
4	51.58	128.00	14	204.48	128.00	24	224.99	130.67
5	66.48	128.00	15	205.76	128.00	25	225.84	130.84
6	71.48	128.00	16	208.68	127.98	26	226.34	130.91

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
7	128.86	143.30	17	210.12	127.61	27	228.18	131.35
8	134.36	143.30	18	213.25	127.34	28	229.26	131.61
9	145.48	140.70	19	219.08	128.00	29	260.00	131.61
10	169.93	135.00	20	220.10	128.77	-	-	-

Tabella 4-13 – Profilo del piano campagna.

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
1	51.58	128.00	18	220.10	128.77	35	136.75	118.75
2	21.26	128.00	19	219.08	128.00	36	131.46	119.75
3	5.23	129.09	20	212.88	126.00	37	130.21	120.04
4	0.00	129.21	21	210.40	125.97	38	126.55	120.12
5	0.00	117.03	22	199.51	126.08	39	121.37	119.66
6	0.00	0.00	23	194.03	126.16	40	114.59	119.43
7	219.00	0.00	24	184.66	125.86	41	112.15	119.05
8	260.00	0.00	25	178.13	125.48	42	107.43	118.14
9	260.00	131.61	26	173.66	123.68	43	104.78	117.04
10	229.26	131.61	27	171.49	122.54	44	100.61	116.05
11	228.18	131.35	28	166.75	121.10	45	95.47	116.08
12	226.34	130.91	29	163.27	120.96	46	92.04	115.55
13	225.84	130.84	30	156.62	121.29	47	87.70	115.78
14	224.99	130.67	31	153.70	119.97	48	76.04	119.43
15	223.75	130.39	32	150.40	118.22	49	73.91	120.35
16	222.54	130.01	33	146.62	117.08	50	64.35	122.56
17	222.01	130.00	34	141.81	117.29	-	-	-

Tabella 4-14 – Coordinate dei vertici dello strato n° 1 costituito da terreno n° 1 (SUB).

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
1	199.00	129.28	24	106.51	126.26	47	121.37	119.66
2	192.52	130.80	25	100.16	125.88	48	126.55	120.12
3	186.86	131.07	26	94.37	125.32	49	130.21	120.04
4	181.29	131.29	27	89.98	124.58	50	131.46	119.75
5	176.02	131.04	28	78.59	124.48	51	136.75	118.75
6	173.01	130.73	29	74.76	124.95	52	141.81	117.29
7	167.07	130.31	30	71.68	126.50	53	146.62	117.08
8	162.66	128.28	31	67.98	126.50	54	150.40	118.22
9	158.90	127.09	32	67.48	127.00	55	153.70	119.97
10	156.15	126.49	33	66.49	127.00	56	156.62	121.29
11	150.17	124.21	34	66.48	128.00	57	163.27	120.96
12	146.61	123.76	35	51.58	128.00	58	166.75	121.10
13	145.15	124.00	36	64.35	122.56	59	171.49	122.54
14	141.72	124.66	37	73.91	120.35	60	173.66	123.68
15	138.19	125.99	38	76.04	119.43	61	178.13	125.48
16	132.48	126.66	39	87.70	115.78	62	184.66	125.86
17	130.60	127.03	40	92.04	115.55	63	194.03	126.16
18	126.94	128.52	41	95.47	116.08	64	199.51	126.08
19	123.32	129.03	42	100.61	116.05	65	210.40	125.97
20	121.24	128.11	43	104.78	117.04	66	207.03	127.00
21	119.62	127.66	44	107.43	118.14	67	204.03	127.00
22	116.50	127.39	45	112.15	119.05	68	201.56	128.00
23	114.26	127.28	46	114.59	119.43	69	200.75	128.39

Tabella 4-15 – Coordinate dei vertici dello strato n° 2 costituito da terreno n° 2 (LA2).

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
1	71.68	126.50	17	141.72	124.66	33	141.90	140.82
2	74.76	124.95	18	145.15	124.00	34	137.15	141.38
3	78.59	124.48	19	146.61	123.76	35	126.93	139.42
4	89.98	124.58	20	150.17	124.21	36	124.51	139.12
5	94.37	125.32	21	156.15	126.49	37	121.81	138.01
6	100.16	125.88	22	158.90	127.09	38	120.91	137.98
7	106.51	126.26	23	162.66	128.28	39	114.75	137.35
8	114.26	127.28	24	167.07	130.31	40	114.56	136.10
9	116.50	127.39	25	173.01	130.73	41	114.13	135.34
10	119.62	127.66	26	176.02	131.04	42	112.47	133.54
11	121.24	128.11	27	181.29	131.29	43	109.74	132.49
12	123.32	129.03	28	186.86	131.07	44	100.85	131.01
13	126.94	128.52	29	192.52	130.80	45	95.57	131.14
14	130.60	127.03	30	174.58	135.00	46	90.59	131.54
15	132.48	126.66	31	169.93	135.00	-	-	-
16	138.19	125.99	32	145.48	140.70	-	-	-

Tabella 4-16 – Coordinate dei vertici dello strato n° 3 costituito da terreno n° 3 (AL).

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
1	90.59	131.54	8	114.75	137.35	15	145.48	140.70
2	95.57	131.14	9	120.91	137.98	16	134.36	143.30
3	100.85	131.01	10	121.81	138.01	17	128.86	143.30
4	109.74	132.49	11	124.51	139.12	18	127.60	141.41
5	112.47	133.54	12	126.93	139.42	19	93.70	132.37
6	114.13	135.34	13	137.15	141.38	-	-	-
7	114.56	136.10	14	141.90	140.82	-	-	-

Tabella 4-17 – Coordinate dei vertici dello strato n° 4 costituito da terreno n° 4 (LA1).

n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]
1	128.86	143.30	6	67.98	126.50
2	71.48	128.00	7	71.68	126.50
3	66.48	128.00	8	90.59	131.54
4	66.49	127.00	9	93.70	132.37
5	67.48	127.00	10	127.60	141.41

Tabella 4-18 – Coordinate dei vertici dello strato n° 5 costituito da terreno n° 5 (Scogliera).

n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]
1	210.40	125.97	8	204.48	128.00
2	212.88	126.00	9	199.00	129.28
3	219.08	128.00	10	200.75	128.39
4	213.25	127.34	11	201.56	128.00
5	210.12	127.61	12	204.03	127.00
6	208.68	127.98	13	207.03	127.00
7	205.76	128.00	-	-	-

Tabella 4-19 – Coordinate dei vertici dello strato n° 6 costituito da terreno n° 4 (LA1).

#### 4.3.2 DESCRIZIONE FALDA

n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]
1	0.00	129.21	6	76.11	128.00
2	5.23	129.09	7	176.77	127.33
3	21.26	128.00	8	178.92	127.25
4	44.69	128.00	9	218.90	125.82
5	71.48	128.00	10	260.00	125.82

Tabella 4-20 – Livello falda serbatoio vuoto.

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
1	0.00	140.00	10	140.76	135.93	19	164.96	129.46
2	116.48	140.00	11	141.71	135.53	20	168.76	128.91
3	123.28	139.99	12	144.94	134.38	21	172.85	128.29
4	123.78	140.00	13	148.41	133.21	22	176.46	127.69
5	124.71	140.02	14	151.30	132.32	23	178.60	127.32
6	128.92	139.37	15	152.55	131.95	24	178.92	127.25
7	130.61	139.04	16	157.58	130.70	25	218.90	125.82
8	131.99	138.61	17	159.58	130.31	26	260.00	125.82
9	135.17	137.79	18	161.49	129.96	-	-	-

Tabella 4-21 – Livello falda massima regolazione.

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
1	0.00	129.21	12	130.61	139.04	23	161.49	129.96
2	5.23	129.09	13	131.99	138.61	24	164.96	129.46
3	21.26	128.00	14	135.17	137.79	25	168.76	128.91
4	44.69	128.00	15	140.76	135.93	26	172.85	128.29
5	71.48	128.00	16	141.71	135.53	27	176.46	127.69
6	77.30	128.00	17	144.94	134.38	28	178.60	127.32
7	122.28	140.00	18	148.41	133.21	29	178.92	127.25
8	123.28	139.99	19	151.30	132.32	30	218.90	125.82
9	123.78	140.00	20	152.55	131.95	31	260.00	125.82
10	124.71	140.02	21	157.58	130.70	-	-	-
11	128.92	139.37	22	159.58	130.31	-	-	-

Tabella 4-22 – Livello falda svasso rapido

#### 4.3.3 IMPOSTAZIONE DELLE SUPERFICI DI ROTTURA

##### Superfici di rottura circolari

Si considerano delle superfici di rottura circolari generate tramite la seguente maglia dei centri

Origine maglia	[m]	$X_0 = 30.86$	$Y_0 = 140.00$
Passo maglia	[m]	$dX = 2.00$	$dY = 2.00$
Numero passi		$N_x = 50$	$N_y = 40$
Raggio	[m]	$R = 10.00$	

Si utilizza un raggio variabile con passo  $dR=2.00$  [m] ed un numero di incrementi pari a 40

#### 4.3.4 CONDIZIONI DI ESCLUSIONE

Sono state escluse dall'analisi le superfici aventi:

- lunghezza di corda inferiore a	1.00	m
- freccia inferiore a	0.50	m
- volume inferiore a	2.00	mc
- ordinata superficie inferiore a	101.00	m
- pendenza media della superficie inferiore a	1.00	[%]

## 5 VERIFICA DI STABILITÀ 01

### 5.1.1 CARICHI SUL PROFILO

n°	Descrizione	X <sub>i</sub>	X <sub>f</sub>	Vy <sub>i</sub>	Vy <sub>f</sub>	Vx <sub>i</sub>	Vx <sub>f</sub>
		[m]	[m]	[kg/m]	[kg/m]	[kg/m]	[kg/m]
1	Strada	Variabile	1.00	125.64 143.30	131.14 143.30	2000 2000	0 0

Tabella 5-1 – Carichi distribuiti verifica di stabilità 01.

### 5.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate in condizioni **statiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di tensioni **efficaci**

Presenza di falda

Presenza di carichi distribuiti

## 5.2 RISULTATI ANALISI

Numero di superfici analizzate 43374

Coefficiente di sicurezza minimo 2.309

Superficie con coefficiente di sicurezza minimo 1

### 5.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO L'ALTO

Numero di strisce 52  
 Coordinate del centro X[m]= 79.64 Y[m]= 186.00  
 Raggio del cerchio R[m]= 68.00  
 Intersezione a valle con il profilo topografico X<sub>v</sub>[m]= 44.89 Y<sub>v</sub>[m]= 127.55  
 Intersezione a monte con il profilo topografico X<sub>m</sub>[m]= 132.31 Y<sub>m</sub>[m]= 142.99  
 Coefficiente di sicurezza F<sub>S</sub>= 2.309

N°	X <sub>s</sub>	Y <sub>ss</sub>	Y <sub>si</sub>	X <sub>d</sub>	Y <sub>ds</sub>	Y <sub>di</sub>	X <sub>g</sub>	Y <sub>g</sub>	L	α	φ	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
1	44.89	127.55	127.55	46.75	127.34	126.48	46.13	127.12	2.15	-29.83	17.58	19
2	46.75	127.34	126.48	47.12	127.37	126.28	46.94	126.87	0.42	-28.75	17.58	19
3	47.12	127.37	126.28	48.36	127.48	125.62	47.79	126.68	1.40	-27.98	18.53	19
4	48.36	127.48	125.62	49.60	127.59	125.00	49.01	126.41	1.39	-26.80	19.27	19
5	49.60	127.59	125.00	49.88	127.61	124.86	49.74	126.26	0.31	-26.09	19.27	19
6	49.88	127.61	124.86	51.32	127.98	124.18	50.64	126.15	1.59	-25.28	19.27	19
7	51.32	127.98	124.18	52.78	127.99	123.53	52.07	125.92	1.60	-23.94	19.27	19
8	52.78	127.99	123.53	54.24	128.00	122.92	53.53	125.61	1.58	-22.60	19.27	19
9	54.24	128.00	122.92	55.52	128.00	122.42	54.89	125.33	1.37	-21.35	19.27	19
10	55.52	128.00	122.42	57.35	128.43	121.76	56.46	125.15	1.94	-19.96	19.27	19
11	57.35	128.43	121.76	59.17	128.85	121.15	58.28	125.05	1.92	-18.33	19.27	19
12	59.17	128.85	121.15	61.00	129.28	120.60	60.10	124.97	1.91	-16.71	19.27	19
13	61.00	129.28	120.60	63.16	129.79	120.03	62.10	124.92	2.24	-14.97	19.27	19
14	63.16	129.79	120.03	65.32	130.29	119.52	64.26	124.91	2.22	-13.09	19.27	19
15	65.32	130.29	119.52	67.48	130.80	119.10	66.41	124.93	2.20	-11.23	19.27	19
16	67.48	130.80	119.10	69.42	131.25	118.77	68.46	124.98	1.97	-9.47	19.27	19

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α [°]	φ [°]	c [kPa]
17	69.42	131.25	118.77	71.37	131.71	118.51	70.40	125.06	1.96	-7.82	19.27	19
18	71.37	131.71	118.51	73.31	132.16	118.30	72.35	125.17	1.95	-6.17	19.27	19
19	73.31	132.16	118.30	75.25	132.62	118.14	74.29	125.31	1.95	-4.52	19.27	19
20	75.25	132.62	118.14	77.19	133.07	118.04	76.23	125.47	1.95	-2.88	19.27	19
21	77.19	133.07	118.04	79.14	133.53	118.00	78.17	125.66	1.94	-1.24	19.27	19
22	79.14	133.53	118.00	81.08	133.98	118.02	80.11	125.88	1.94	0.39	19.27	19
23	81.08	133.98	118.02	83.23	134.49	118.09	82.16	126.15	2.15	2.12	19.27	19
24	83.23	134.49	118.09	84.32	134.74	118.16	83.78	126.37	1.10	3.49	19.27	19
25	84.32	134.74	118.16	85.42	135.00	118.25	84.87	126.54	1.10	4.41	19.27	19
26	85.42	135.00	118.25	86.97	135.00	118.40	86.19	126.66	1.56	5.53	19.27	19
27	86.97	135.00	118.40	88.52	135.00	118.58	87.74	126.74	1.56	6.85	19.27	19
28	88.52	135.00	118.58	90.07	135.00	118.80	89.29	126.85	1.57	8.16	19.27	19
29	90.07	135.00	118.80	91.73	135.39	119.08	90.90	127.07	1.69	9.53	19.27	19
30	91.73	135.39	119.08	93.40	135.78	119.41	92.57	127.41	1.70	10.96	19.27	19
31	93.40	135.78	119.41	95.06	136.16	119.77	94.23	127.78	1.70	12.39	19.27	19
32	95.06	136.16	119.77	96.73	136.55	120.18	95.90	128.17	1.71	13.83	19.27	19
33	96.73	136.55	120.18	98.39	136.94	120.64	97.56	128.58	1.72	15.28	19.27	19
34	98.39	136.94	120.64	100.05	137.33	121.14	99.22	129.01	1.74	16.74	19.26	19
35	100.05	137.33	121.14	101.72	137.72	121.68	100.88	129.47	1.75	18.21	19.10	18
36	101.72	137.72	121.68	103.38	138.10	122.28	102.55	129.94	1.77	19.69	19.10	18
37	103.38	138.10	122.28	105.53	138.60	123.12	104.45	130.53	2.31	21.41	19.10	18
38	105.53	138.60	123.12	107.68	139.11	124.05	106.60	131.22	2.34	23.37	19.10	18
39	107.68	139.11	124.05	109.83	139.61	125.07	108.75	131.96	2.38	25.36	19.41	18
40	109.83	139.61	125.07	111.39	139.97	125.87	110.61	132.63	1.76	27.10	19.78	18
41	111.39	139.97	125.87	112.96	140.34	126.72	112.17	133.22	1.78	28.59	19.78	18
42	112.96	140.34	126.72	114.52	140.70	127.63	113.73	133.84	1.81	30.10	19.78	18
43	114.52	140.70	127.63	116.37	141.13	128.78	115.44	134.56	2.18	31.78	19.78	18
44	116.37	141.13	128.78	118.23	141.57	130.01	117.29	135.37	2.23	33.63	19.78	18
45	118.23	141.57	130.01	120.08	142.00	131.33	119.14	136.22	2.28	35.53	19.78	18
46	120.08	142.00	131.33	121.93	142.43	132.75	120.99	137.12	2.34	37.48	19.78	18
47	121.93	142.43	132.75	123.79	142.87	134.28	122.84	138.07	2.40	39.47	19.78	18
48	123.79	142.87	134.28	125.64	143.30	135.92	124.69	139.08	2.48	41.53	19.78	18
49	125.64	143.30	135.92	127.47	143.30	137.67	126.52	140.03	2.53	43.64	19.78	18
50	127.47	143.30	137.67	129.31	143.30	139.55	128.33	140.92	2.63	45.81	19.78	18
51	129.31	143.30	139.55	131.14	143.30	141.60	130.11	141.87	2.74	48.08	18.12	19
52	131.14	143.30	141.60	132.31	142.99	142.99	131.53	142.63	1.82	50.00	27.24	10

Tabella 5-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 01.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	1631	0	3173	2255	0	0	3534	0	0	
2	737	0	1121	512	0	3534	4522	0	0	
3	3755	0	5130	1935	150	4522	8708	0	0	
4	5743	0	6419	2149	1101	8708	14017	0	0	
5	1567	0	1619	509	374	14017	15351	0	0	
6	9939	0	9712	2820	2611	15351	23165	0	0	
7	12790	0	11614	3112	3762	23165	32248	0	0	
8	14836	0	12625	3252	4798	32248	41945	0	0	
9	14559	0	11788	2949	4998	41945	50804	0	0	
10	23906	0	18758	4487	8304	50804	64258	0	0	
11	28100	0	21660	4910	9567	64258	78738	0	0	
12	32083	0	24387	5308	10705	78738	93914	0	0	

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
13	42739	0	32079	6751	13966	93914	112328	0	0	
14	47581	0	35311	7225	15219	112328	130810	0	0	
15	52071	0	38302	7664	16307	130810	148962	0	0	
16	50325	0	36756	7233	15471	148962	164691	0	0	
17	53304	0	38719	7523	16117	164691	179600	0	0	
18	56043	0	40550	7794	16661	179600	193494	0	0	
19	58541	0	42254	8048	17106	193494	206197	0	0	
20	60797	0	43838	8284	17453	206197	217551	0	0	
21	62814	0	45307	8505	17706	217551	227420	0	0	
22	64559	0	46635	8706	17865	227420	235681	0	0	
23	73149	0	52993	9845	19841	235681	242825	0	0	
24	37831	0	27493	5091	10098	242825	245620	0	0	
25	38148	0	27830	5143	10034	245620	247834	0	0	
26	53902	0	39389	7282	14059	247834	249930	0	0	
27	53228	0	38896	7211	13848	249930	250802	0	0	
28	52452	0	38379	7136	13586	250802	250487	0	0	
29	55981	0	41234	7672	14243	250487	248865	0	0	
30	56054	0	41777	7761	13816	248865	245915	0	0	
31	55864	0	42158	7826	13319	245915	241652	0	0	
32	55487	0	42453	7879	12751	241652	236104	0	0	
33	54888	0	42647	7916	12091	236104	229313	0	0	
34	54268	0	42905	7961	11370	229313	221304	0	0	
35	53512	0	43190	7835	10566	221304	211949	0	0	
36	52644	0	43422	7882	9671	211949	201482	0	0	
37	66477	0	56368	10245	11018	201482	186426	0	0	
38	64245	0	56411	10277	9133	186426	169866	0	0	
39	61685	0	56299	10480	6995	169866	152232	0	0	
40	43340	0	41093	7825	3588	152232	138846	0	0	
41	41944	0	41290	7875	2186	138846	124958	0	0	
42	40386	0	41441	7920	649	124958	110703	0	0	
43	45661	0	47987	9243	0	110703	93289	0	0	
44	43019	0	45729	8928	0	93289	75393	0	0	
45	40044	0	43094	8560	0	75393	57315	0	0	
46	36719	0	40035	8131	0	57315	39409	0	0	
47	33045	0	36519	7637	0	39409	22089	0	0	
48	29063	0	32551	7079	0	22089	5810	0	0	
49	23617	4767	32440	7109	0	5810	-11431	0	0	
50	17238	4767	25317	6079	0	-11431	-25347	0	0	
51	10203	4767	17137	4730	0	-25347	-34937	0	0	
52	1925	0	1580	1187	0	-34937	-35384	0	0	

Tabella 5-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 01.

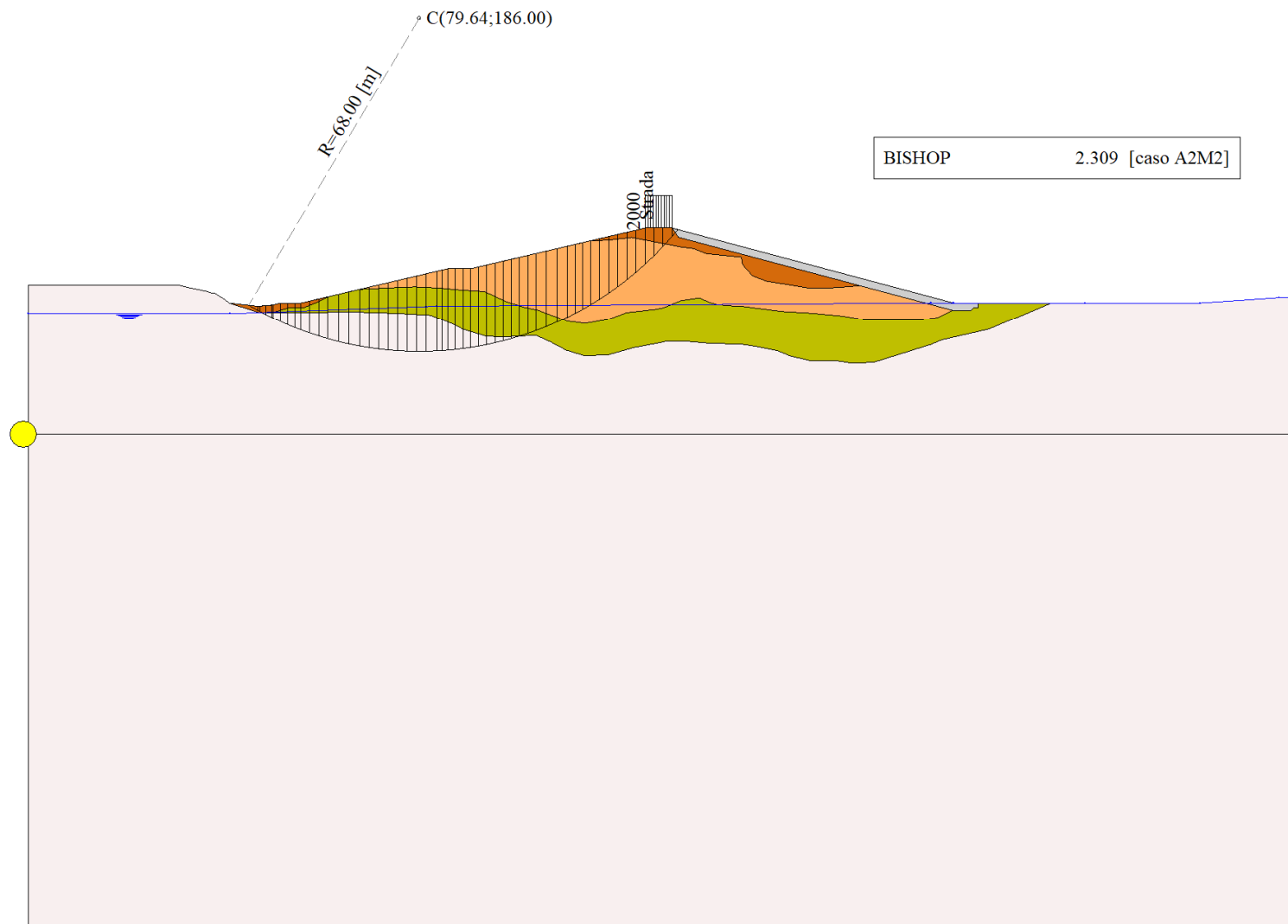


Figura 5-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 01.



## 6 VERIFICA DI STABILITÀ 02

### 6.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	P <sub>i</sub> [m]	P <sub>f</sub> [m]	V <sub>y</sub> [kg/m]	V <sub>x</sub> [kg/m]
1	Strada	Variabile	1.00	125.64 143.30	131.14 143.30	2000 2000	0 0

Tabella 6-1 – Carichi distribuiti verifica di stabilità 02.

### 6.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate in condizioni **statiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];
- Parametri di progetto [A2-M2]
- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 6.2 RISULTATI ANALISI

Numero di superfici analizzate	43374
Coefficiente di sicurezza minimo	1.799
Superficie con coefficiente di sicurezza minimo	1

### 6.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO L'ALTO

Numero di strisce	46
Coordinate del centro	X[m]= 99.64                      Y[m]= 166.00
Raggio del cerchio	R[m]= 44.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 71.91                      Y <sub>v</sub> [m]= 131.84
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 136.44                      Y <sub>m</sub> [m]= 141.89
Coefficiente di sicurezza	F <sub>s</sub> = 1.799

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	71.91	131.84	131.84	73.14	132.13	130.88	72.73	131.61	1.56	-38.05	0.00	54
2	73.14	132.13	130.88	74.73	132.50	129.73	74.03	131.28	1.96	-35.76	0.00	52
3	74.73	132.50	129.73	76.32	132.87	128.69	75.58	130.94	1.90	-33.25	0.00	52
4	76.32	132.87	128.69	77.90	133.24	127.74	77.15	130.63	1.85	-30.81	0.00	52
5	77.90	133.24	127.74	79.49	133.61	126.88	78.72	130.37	1.81	-28.43	0.00	52
6	79.49	133.61	126.88	81.08	133.98	126.11	80.31	130.14	1.77	-26.10	0.00	52
7	81.08	133.98	126.11	81.87	134.17	125.75	81.48	130.00	0.87	-24.38	0.00	52
8	81.87	134.17	125.75	83.23	134.49	125.17	82.56	129.89	1.48	-22.86	0.00	52
9	83.23	134.49	125.17	84.32	134.74	124.75	83.78	129.79	1.17	-21.13	0.00	52
10	84.32	134.74	124.75	85.42	135.00	124.36	84.88	129.71	1.16	-19.61	0.00	52
11	85.42	135.00	124.36	86.34	135.00	124.06	85.88	129.60	0.97	-18.22	0.00	52
12	86.34	135.00	124.06	87.58	135.00	123.68	86.97	129.44	1.30	-16.75	0.00	52
13	87.58	135.00	123.68	88.83	135.00	123.35	88.21	129.26	1.29	-15.06	0.00	52
14	88.83	135.00	123.35	90.07	135.00	123.05	89.45	129.10	1.28	-13.39	0.00	52
15	90.07	135.00	123.05	91.62	135.36	122.74	90.85	129.04	1.59	-11.53	0.00	52
16	91.62	135.36	122.74	93.18	135.72	122.48	92.41	129.08	1.58	-9.47	0.00	52
17	93.18	135.72	122.48	94.73	136.09	122.27	93.96	129.14	1.57	-7.42	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α <sub>s</sub> [°]	α <sub>d</sub> [°]	c [kPa]
18	94.73	136.09	122.27	96.29	136.45	122.13	95.52	129.24	1.56	-5.39	0.00	52
19	96.29	136.45	122.13	97.84	136.81	122.04	97.07	129.36	1.56	-3.35	0.00	52
20	97.84	136.81	122.04	99.40	137.17	122.00	98.62	129.51	1.56	-1.33	0.00	52
21	99.40	137.17	122.00	100.95	137.54	122.02	100.18	129.68	1.55	0.70	0.00	52
22	100.95	137.54	122.02	102.51	137.90	122.09	101.73	129.89	1.56	2.72	0.00	52
23	102.51	137.90	122.09	104.06	138.26	122.22	103.29	130.12	1.56	4.75	0.00	52
24	104.06	138.26	122.22	105.62	138.62	122.41	104.84	130.38	1.57	6.79	0.00	52
25	105.62	138.62	122.41	107.17	138.99	122.65	106.39	130.67	1.57	8.83	0.00	52
26	107.17	138.99	122.65	108.73	139.35	122.95	107.95	130.98	1.58	10.89	0.00	52
27	108.73	139.35	122.95	110.28	139.71	123.31	109.50	131.33	1.60	12.96	0.00	52
28	110.28	139.71	123.31	111.84	140.07	123.72	111.06	131.70	1.61	15.04	0.00	52
29	111.84	140.07	123.72	113.39	140.44	124.20	112.61	132.11	1.63	17.15	0.00	54
30	113.39	140.44	124.20	114.52	140.70	124.59	113.95	132.48	1.20	18.99	0.00	54
31	114.52	140.70	124.59	114.85	140.78	124.71	114.68	132.70	0.35	19.99	0.00	54
32	114.85	140.78	124.71	116.39	141.14	125.31	115.62	132.98	1.65	21.30	0.00	54
33	116.39	141.14	125.31	117.93	141.50	125.98	117.16	133.48	1.68	23.47	0.00	54
34	117.93	141.50	125.98	119.47	141.86	126.72	118.70	134.01	1.71	25.68	0.00	54
35	119.47	141.86	126.72	121.02	142.22	127.54	120.24	134.58	1.74	27.93	0.00	54
36	121.02	142.22	127.54	122.56	142.58	128.44	121.78	135.19	1.78	30.23	0.00	54
37	122.56	142.58	128.44	124.10	142.94	129.42	123.32	135.84	1.83	32.58	0.00	54
38	124.10	142.94	129.42	125.64	143.30	130.50	124.86	136.54	1.88	35.00	0.00	54
39	125.64	143.30	130.50	127.01	143.30	131.55	126.32	137.16	1.73	37.35	0.00	54
40	127.01	143.30	131.55	128.39	143.30	132.69	127.69	137.71	1.79	39.64	0.00	54
41	128.39	143.30	132.69	129.76	143.30	133.93	129.06	138.30	1.85	42.00	0.00	54
42	129.76	143.30	133.93	131.14	143.30	135.28	130.43	138.94	1.93	44.46	0.00	54
43	131.14	143.30	135.28	132.47	142.95	136.70	131.78	139.55	1.94	46.98	0.00	54
44	132.47	142.95	136.70	133.79	142.59	138.26	133.09	140.11	2.04	49.58	0.00	54
45	133.79	142.59	138.26	135.12	142.24	139.97	134.39	140.73	2.17	52.32	0.00	54
46	135.12	142.24	139.97	136.44	141.89	141.89	135.56	141.37	2.33	55.25	26.53	17

Tabella 6-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità O2.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	1491	0	5625	4768	0	0	7222	0	0	
2	6391	0	12042	5785	0	7222	18953	0	0	
3	11210	0	17084	5613	0	18953	33014	0	0	
4	15699	0	21537	5466	0	33014	48739	0	0	
5	19879	0	25495	5338	0	48739	65571	0	0	
6	23749	0	29007	5228	0	65571	83027	0	0	
7	13179	0	15632	2564	0	83027	91817	0	0	
8	24674	0	28617	4363	0	91817	106954	0	0	
9	21615	0	24515	3471	0	106954	119030	0	0	
10	23079	0	25725	3437	0	119030	130902	0	0	
11	20275	0	22288	2863	0	130902	140592	0	0	
12	28265	0	30672	3838	0	140592	153107	0	0	
13	29174	0	31237	3806	0	153107	164901	0	0	
14	29982	0	31720	3778	0	164901	175925	0	0	
15	39014	0	40774	4691	0	175925	188671	0	0	
16	41018	0	42362	4660	0	188671	200236	0	0	
17	42731	0	43696	4635	0	200236	210477	0	0	
18	44202	0	44833	4616	0	210477	219281	0	0	

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
19	45493	0	45841	4604	0	219281	226559	0	0	
20	46646	0	46766	4597	0	226559	232239	0	0	
21	47633	0	47581	4596	0	232239	236256	0	0	
22	48456	0	48292	4601	0	236256	238558	0	0	
23	49122	0	48908	4612	0	238558	239102	0	0	
24	49564	0	49363	4628	0	239102	237864	0	0	
25	49796	0	49670	4651	0	237864	234834	0	0	
26	49841	0	49854	4680	0	234834	230015	0	0	
27	49700	0	49914	4716	0	230015	223420	0	0	
28	49440	0	49916	4759	0	223420	215061	0	0	
29	49046	0	49804	4940	0	215061	205094	0	0	
30	35375	0	36145	3678	0	205094	196812	0	0	
31	10278	0	10544	1081	0	196812	194222	0	0	
32	47618	0	49124	5092	0	194222	181121	0	0	
33	46850	0	48831	5172	0	181121	166416	0	0	
34	45864	0	48360	5264	0	166416	150204	0	0	
35	44645	0	47684	5370	0	150204	132613	0	0	
36	43191	0	46788	5491	0	132613	113803	0	0	
37	41513	0	45667	5630	0	113803	93956	0	0	
38	39617	0	44307	5791	0	93956	73289	0	0	
39	33055	3575	42015	5323	0	73289	52033	0	0	
40	30182	3575	39283	5495	0	52033	31206	0	0	
41	27058	3575	36094	5695	0	31206	11284	0	0	
42	23653	3575	32331	5930	0	11284	-7131	0	0	
43	18546	0	20774	5982	0	-7131	-18239	0	0	
44	13560	0	13524	6294	0	-18239	-24454	0	0	
45	8399	0	5194	6601	0	-24454	-24530	0	0	
46	2739	0	1180	2515	0	-24530	-24065	0	0	

Tabella 6-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 02.

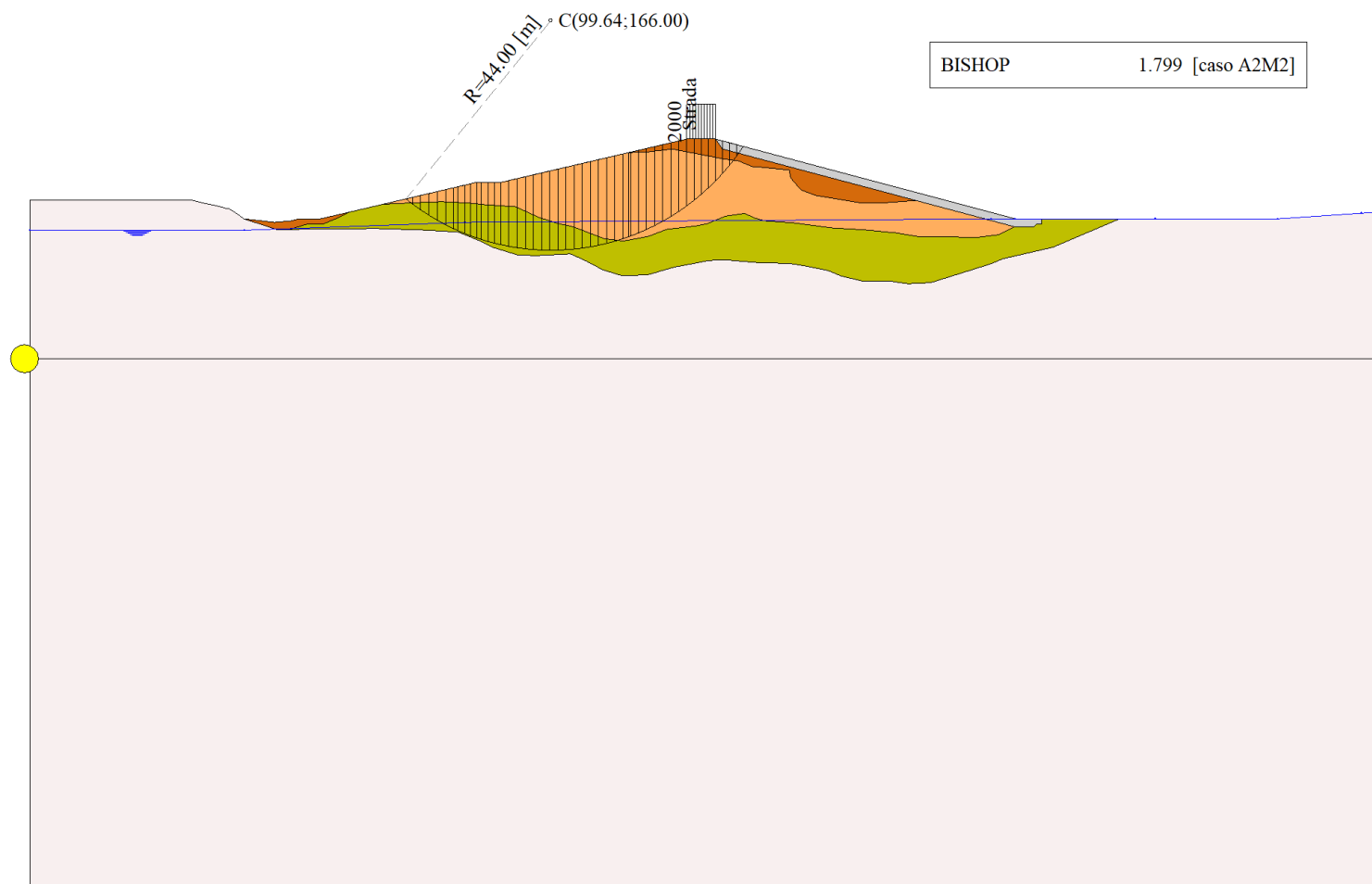


Figura 6-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 02

## 7 VERIFICA DI STABILITÀ 03

### 7.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	125.64 143.30	131.14 143.30	2000 2000	0 0

Tabella 7-1 – Carichi distribuiti verifica di stabilità 03.

### 7.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **sismiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];
- Parametri di progetto [A2-M2]
- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 7.2 RISULTATI ANALISI

Numero di superfici analizzate	86748
Coefficiente di sicurezza minimo	0.754
Superficie con coefficiente di sicurezza minimo	1

### 7.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	48
Coordinate del centro	X[m]= 101.64                      Y[m]= 180.00
Raggio del cerchio	R[m]= 58.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 70.00                      Y <sub>v</sub> [m]= 131.39
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 143.61                      Y <sub>m</sub> [m]= 139.97
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.754</b>

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	70.00	131.39	131.39	71.58	131.76	130.40	71.06	131.18	1.87	-32.14	0.00	53
2	71.58	131.76	130.40	73.17	132.13	129.47	72.46	130.92	1.83	-30.31	0.00	52
3	73.17	132.13	129.47	74.75	132.50	128.61	74.01	130.67	1.80	-28.51	0.00	52
4	74.75	132.50	128.61	76.33	132.87	127.81	75.57	130.44	1.77	-26.75	0.00	52
5	76.33	132.87	127.81	77.91	133.24	127.07	77.15	130.25	1.75	-25.01	0.00	52
6	77.91	133.24	127.07	79.50	133.61	126.39	78.73	130.08	1.72	-23.29	0.00	52
7	79.50	133.61	126.39	81.08	133.98	125.77	80.31	129.94	1.70	-21.60	0.00	52
8	81.08	133.98	125.77	81.87	134.17	125.47	81.48	129.85	0.84	-20.35	0.00	54
9	81.87	134.17	125.47	83.23	134.49	125.00	82.56	129.78	1.44	-19.22	0.00	57
10	83.23	134.49	125.00	84.32	134.74	124.64	83.78	129.72	1.15	-17.94	0.00	52
11	84.32	134.74	124.64	85.42	135.00	124.31	84.88	129.68	1.14	-16.80	0.00	52
12	85.42	135.00	124.31	86.34	135.00	124.05	85.88	129.59	0.96	-15.77	0.00	52
13	86.34	135.00	124.05	87.58	135.00	123.73	86.96	129.45	1.29	-14.66	0.00	52
14	87.58	135.00	123.73	88.83	135.00	123.43	88.21	129.29	1.28	-13.39	0.00	52
15	88.83	135.00	123.43	90.07	135.00	123.17	89.45	129.15	1.27	-12.13	0.00	52
16	90.07	135.00	123.17	91.73	135.39	122.85	90.91	129.10	1.69	-10.67	0.00	52
17	91.73	135.39	122.85	93.40	135.78	122.59	92.57	129.15	1.68	-9.00	0.00	52

N°	X <sub>s</sub>	Y <sub>ss</sub>	Y <sub>si</sub>	X <sub>d</sub>	Y <sub>ds</sub>	Y <sub>di</sub>	X <sub>g</sub>	Y <sub>g</sub>	L	α	β	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
18	93.40	135.78	122.59	95.06	136.16	122.37	94.24	129.23	1.68	-7.34	0.00	52
19	95.06	136.16	122.37	96.72	136.55	122.21	95.90	129.32	1.67	-5.69	0.00	52
20	96.72	136.55	122.21	98.39	136.94	122.09	97.56	129.45	1.67	-4.04	0.00	52
21	98.39	136.94	122.09	100.05	137.33	122.02	99.22	129.60	1.67	-2.39	0.00	52
22	100.05	137.33	122.02	101.72	137.72	122.00	100.89	129.77	1.66	-0.75	0.00	52
23	101.72	137.72	122.00	103.38	138.10	122.03	102.55	129.96	1.66	0.90	0.00	52
24	103.38	138.10	122.03	105.05	138.49	122.10	104.22	130.18	1.67	2.54	0.00	52
25	105.05	138.49	122.10	106.72	138.88	122.22	105.88	130.42	1.67	4.20	0.00	52
26	106.72	138.88	122.22	108.38	139.27	122.39	107.55	130.69	1.68	5.85	0.00	52
27	108.38	139.27	122.39	110.05	139.66	122.61	109.22	130.98	1.68	7.51	0.00	52
28	110.05	139.66	122.61	111.72	140.05	122.88	110.89	131.30	1.69	9.18	0.00	52
29	111.72	140.05	122.88	113.39	140.44	123.20	112.56	131.64	1.70	10.85	0.00	52
30	113.39	140.44	123.20	114.52	140.70	123.45	113.96	131.95	1.16	12.26	0.00	52
31	114.52	140.70	123.45	114.85	140.78	123.52	114.69	132.11	0.34	13.00	0.00	52
32	114.85	140.78	123.52	116.56	141.18	123.95	115.71	132.36	1.77	14.04	0.00	52
33	116.56	141.18	123.95	118.28	141.58	124.44	117.42	132.79	1.78	15.79	0.00	52
34	118.28	141.58	124.44	120.05	141.99	125.00	119.16	133.25	1.85	17.59	0.00	52
35	120.05	141.99	125.00	121.81	142.40	125.62	120.93	133.75	1.87	19.43	0.00	52
36	121.81	142.40	125.62	123.09	142.70	126.11	122.45	134.21	1.37	21.03	0.00	52
37	123.09	142.70	126.11	124.36	143.00	126.64	123.72	134.61	1.38	22.38	0.00	54
38	124.36	143.00	126.64	125.64	143.30	127.20	125.00	135.03	1.39	23.75	0.00	54
39	125.64	143.30	127.20	127.47	143.30	128.07	126.55	135.47	2.03	25.45	0.00	54
40	127.47	143.30	128.07	129.31	143.30	129.02	128.38	135.92	2.07	27.47	0.00	54
41	129.31	143.30	129.02	131.14	143.30	130.06	130.21	136.42	2.11	29.53	0.00	54
42	131.14	143.30	130.06	132.92	142.82	131.16	132.01	136.83	2.09	31.61	0.00	54
43	132.92	142.82	131.16	134.70	142.35	132.35	133.79	137.17	2.14	33.70	0.00	54
44	134.70	142.35	132.35	136.49	141.87	133.63	135.57	137.55	2.20	35.84	0.00	54
45	136.49	141.87	133.63	138.27	141.40	135.03	137.34	137.97	2.26	38.04	0.00	54
46	138.27	141.40	135.03	140.05	140.92	136.54	139.10	138.46	2.34	40.32	0.00	54
47	140.05	140.92	136.54	141.83	140.45	138.18	140.85	138.99	2.42	42.67	0.00	54
48	141.83	140.45	138.18	143.61	139.97	139.97	142.43	139.54	2.53	45.11	26.54	17

Tabella 7-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 03.

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
1	2137	0	11241	13427	0	0	16870	0	0	
2	6469	0	15895	12936	0	16870	34609	0	0	
3	10603	0	20323	12709	0	34609	53100	0	0	
4	14522	0	24388	12506	0	53100	71988	0	0	
5	18238	0	28130	12323	0	71988	90958	0	0	
6	21756	0	31578	12159	0	90958	109736	0	0	
7	25060	0	34731	12012	0	109736	128071	0	0	
8	13691	0	18502	6103	0	128071	137156	0	0	
9	25320	0	33679	11070	0	137156	153018	0	0	
10	21940	0	28276	8121	0	153018	164533	0	0	
11	23256	0	29455	8071	0	164533	175559	0	0	
12	20324	0	25391	6745	0	175559	184393	0	0	
13	28211	0	34802	9068	0	184393	195648	0	0	
14	29006	0	35307	9018	0	195648	206095	0	0	
15	29725	0	35743	8973	0	206095	215716	0	0	
16	41391	0	49092	11946	0	215716	227264	0	0	
17	43611	0	50989	11885	0	227264	237202	0	0	

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
18	45527	0	52575	11836	0	237202	245450	0	0	
19	47222	0	53952	11797	0	245450	251946	0	0	
20	48762	0	55194	11768	0	251946	256637	0	0	
21	50183	0	56348	11749	0	256637	259474	0	0	
22	51444	0	57369	11740	0	259474	260425	0	0	
23	52571	0	58289	11741	0	260425	259463	0	0	
24	53669	0	59222	11783	0	259463	256571	0	0	
25	54399	0	59795	11803	0	256571	251769	0	0	
26	54956	0	60225	11833	0	251769	245079	0	0	
27	55342	0	60514	11873	0	245079	236532	0	0	
28	55631	0	60744	11924	0	236532	226143	0	0	
29	55789	0	60877	11986	0	226143	213946	0	0	
30	37825	0	41275	8159	0	213946	204673	0	0	
31	11051	0	12062	2390	0	204673	201810	0	0	
32	57408	0	62691	12473	0	201810	185831	0	0	
33	57249	0	62608	12575	0	185831	168056	0	0	
34	58566	0	64185	13064	0	168056	147983	0	0	
35	58019	0	63762	13205	0	147983	126220	0	0	
36	41462	0	45690	9650	0	126220	109537	0	0	
37	40957	0	45097	10111	0	109537	92530	0	0	
38	40426	0	44611	10246	0	92530	74873	0	0	
39	56127	3667	66546	14914	0	74873	46340	0	0	
40	52958	3667	63084	15179	0	46340	18010	0	0	
41	49494	3667	59180	15478	0	18010	-9613	0	0	
42	43191	0	46940	15371	0	-9613	-30806	0	0	
43	37333	0	39411	15735	0	-30806	-47953	0	0	
44	31389	0	31398	16149	0	-47953	-60285	0	0	
45	25164	0	22527	16623	0	-60285	-66720	0	0	
46	18492	0	12402	17169	0	-66720	-65800	0	0	
47	11338	0	852	17680	0	-65800	-55920	0	0	
48	3681	0	68	5710	0	-55920	-52764	0	0	

Tabella 7-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 03.

### 7.2.2 ANALISI DELLA SUPERFICIE 2 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	48	
Coordinate del centro	X[m]= 101.64	Y[m]= 178.00
Raggio del cerchio	R[m]= 56.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 70.44	Y <sub>v</sub> [m]= 131.49
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 142.92	Y <sub>m</sub> [m]= 140.16
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.754</b>	

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α <sub>s</sub> [°]	α <sub>d</sub> [°]	c [kPa]
1	70.44	131.49	131.49	72.22	131.91	130.35	71.63	131.25	2.11	-32.77	0.00	53
2	72.22	131.91	130.35	73.99	132.32	129.30	73.20	130.96	2.06	-30.64	0.00	52
3	73.99	132.32	129.30	75.76	132.74	128.34	74.93	130.67	2.02	-28.56	0.00	52
4	75.76	132.74	128.34	77.53	133.15	127.45	76.69	130.42	1.98	-26.51	0.00	52
5	77.53	133.15	127.45	79.31	133.57	126.65	78.45	130.20	1.95	-24.50	0.00	52
6	79.31	133.57	126.65	81.08	133.98	125.91	80.22	130.03	1.92	-22.52	0.00	52
7	81.08	133.98	125.91	81.87	134.17	125.61	81.48	129.92	0.85	-21.11	0.00	52
8	81.87	134.17	125.61	83.23	134.49	125.11	82.56	129.84	1.45	-19.93	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∅ [°]	∅ [°]	c [kPa]
9	83.23	134.49	125.11	84.32	134.74	124.74	83.78	129.77	1.16	-18.60	0.00	52
10	84.32	134.74	124.74	85.42	135.00	124.40	84.88	129.72	1.15	-17.42	0.00	52
11	85.42	135.00	124.40	86.34	135.00	124.13	85.88	129.63	0.96	-16.35	0.00	52
12	86.34	135.00	124.13	87.58	135.00	123.79	86.96	129.48	1.29	-15.20	0.00	52
13	87.58	135.00	123.79	88.83	135.00	123.49	88.21	129.32	1.28	-13.88	0.00	52
14	88.83	135.00	123.49	90.07	135.00	123.21	89.45	129.17	1.27	-12.58	0.00	52
15	90.07	135.00	123.21	91.73	135.39	122.88	90.91	129.12	1.70	-11.06	0.00	52
16	91.73	135.39	122.88	93.40	135.78	122.61	92.57	129.16	1.69	-9.33	0.00	52
17	93.40	135.78	122.61	95.06	136.16	122.39	94.24	129.23	1.68	-7.61	0.00	52
18	95.06	136.16	122.39	96.72	136.55	122.22	95.90	129.33	1.67	-5.89	0.00	52
19	96.72	136.55	122.22	98.39	136.94	122.09	97.56	129.45	1.67	-4.18	0.00	52
20	98.39	136.94	122.09	100.05	137.33	122.02	99.22	129.60	1.67	-2.48	0.00	52
21	100.05	137.33	122.02	101.72	137.72	122.00	100.89	129.77	1.66	-0.77	0.00	52
22	101.72	137.72	122.00	103.38	138.10	122.03	102.55	129.96	1.66	0.93	0.00	52
23	103.38	138.10	122.03	105.05	138.49	122.10	104.22	130.18	1.67	2.63	0.00	52
24	105.05	138.49	122.10	106.72	138.88	122.23	105.88	130.43	1.67	4.35	0.00	52
25	106.72	138.88	122.23	108.38	139.27	122.41	107.55	130.70	1.68	6.06	0.00	52
26	108.38	139.27	122.41	110.05	139.66	122.64	109.22	130.99	1.68	7.78	0.00	52
27	110.05	139.66	122.64	111.72	140.05	122.91	110.89	131.31	1.69	9.51	0.00	52
28	111.72	140.05	122.91	113.39	140.44	123.25	112.56	131.66	1.70	11.24	0.00	52
29	113.39	140.44	123.25	114.52	140.70	123.50	113.96	131.97	1.16	12.70	0.00	52
30	114.52	140.70	123.50	114.85	140.78	123.58	114.68	132.14	0.34	13.47	0.00	52
31	114.85	140.78	123.58	116.56	141.18	124.03	115.71	132.39	1.77	14.55	0.00	52
32	116.56	141.18	124.03	118.28	141.58	124.53	117.42	132.83	1.79	16.37	0.00	52
33	118.28	141.58	124.53	120.05	141.99	125.11	119.16	133.30	1.86	18.24	0.00	52
34	120.05	141.99	125.11	121.81	142.40	125.76	120.93	133.82	1.88	20.15	0.00	52
35	121.81	142.40	125.76	123.09	142.70	126.27	122.45	134.28	1.38	21.81	0.00	53
36	123.09	142.70	126.27	124.36	143.00	126.82	123.72	134.70	1.39	23.23	0.00	54
37	124.36	143.00	126.82	125.64	143.30	127.40	125.00	135.13	1.40	24.66	0.00	54
38	125.64	143.30	127.40	127.01	143.30	128.08	126.32	135.52	1.53	26.16	0.00	54
39	127.01	143.30	128.08	128.39	143.30	128.80	127.70	135.87	1.55	27.74	0.00	54
40	128.39	143.30	128.80	129.76	143.30	129.57	129.07	136.24	1.58	29.34	0.00	54
41	129.76	143.30	129.57	131.14	143.30	130.40	130.45	136.64	1.60	30.97	0.00	54
42	131.14	143.30	130.40	132.82	142.85	131.49	131.96	137.01	2.00	32.81	0.00	54
43	132.82	142.85	131.49	134.51	142.40	132.66	133.64	137.34	2.05	34.89	0.00	54
44	134.51	142.40	132.66	136.19	141.95	133.93	135.32	137.73	2.11	37.01	0.00	54
45	136.19	141.95	133.93	137.87	141.51	135.30	136.99	138.16	2.17	39.20	0.00	54
46	137.87	141.51	135.30	139.55	141.06	136.79	138.66	138.65	2.25	41.46	0.00	54
47	139.55	141.06	136.79	141.24	140.61	138.40	140.31	139.18	2.33	43.81	0.00	54
48	141.24	140.61	138.40	142.92	140.16	140.16	141.80	139.72	2.43	46.24	27.23	16

Tabella 7-4 – Geometria e caratteristiche strisce della superficie 2 della verifica di stabilità 03.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	2727	0	13351	15134	0	0	19341	0	0	
2	8235	0	19247	14521	0	19341	39797	0	0	
3	13447	0	24767	14223	0	39797	61113	0	0	
4	18349	0	29768	13961	0	61113	82779	0	0	
5	22955	0	34311	13729	0	82779	104353	0	0	
6	27248	0	38413	13525	0	104353	125450	0	0	
7	13460	0	18349	5968	0	125450	134607	0	0	
8	24967	0	33233	10196	0	134607	149923	0	0	



N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
9	21695	0	28198	8143	0	149923	161770	0	0	
10	23042	0	29396	8088	0	161770	173123	0	0	
11	20166	0	25354	6757	0	173123	182221	0	0	
12	28028	0	34766	9080	0	182221	193812	0	0	
13	28853	0	35284	9026	0	193812	204570	0	0	
14	29601	0	35731	8978	0	204570	214475	0	0	
15	41262	0	49090	11947	0	214475	226362	0	0	
16	43520	0	50999	11883	0	226362	236594	0	0	
17	45466	0	52592	11830	0	236594	245085	0	0	
18	47186	0	53971	11788	0	245085	251769	0	0	
19	48743	0	55212	11757	0	251769	256591	0	0	
20	50176	0	56361	11737	0	256591	259501	0	0	
21	51442	0	57373	11727	0	259501	260465	0	0	
22	52570	0	58281	11727	0	260465	259458	0	0	
23	53661	0	59199	11770	0	259458	256461	0	0	
24	54379	0	59754	11792	0	256461	251498	0	0	
25	54917	0	60162	11824	0	251498	244590	0	0	
26	55278	0	60426	11867	0	244590	235774	0	0	
27	55535	0	60625	11922	0	235774	225066	0	0	
28	55656	0	60724	11988	0	225066	212506	0	0	
29	37709	0	41149	8164	0	212506	202965	0	0	
30	11013	0	12022	2392	0	202965	200020	0	0	
31	57176	0	62452	12487	0	200020	183596	0	0	
32	56953	0	62314	12598	0	183596	165347	0	0	
33	58186	0	63816	13097	0	165347	144768	0	0	
34	57550	0	63313	13250	0	144768	122493	0	0	
35	41067	0	45258	9835	0	122493	105597	0	0	
36	40537	0	44684	10194	0	105597	88251	0	0	
37	39949	0	44154	10307	0	88251	70238	0	0	
38	41805	2750	49684	11240	0	70238	48431	0	0	
39	39983	2750	47701	11399	0	48431	26735	0	0	
40	38032	2750	45522	11574	0	26735	5373	0	0	
41	35944	2750	43125	11766	0	5373	-15405	0	0	
42	39761	0	43141	14692	0	-15405	-35351	0	0	
43	34350	0	36074	15053	0	-35351	-51339	0	0	
44	28873	0	28555	15464	0	-51339	-62656	0	0	
45	23137	0	20208	15935	0	-62656	-68269	0	0	
46	17024	0	10705	16478	0	-68269	-66826	0	0	
47	10435	0	-177	16948	0	-66826	-56813	0	0	
48	3381	0	42	5166	0	-56813	-54028	0	0	

Tabella 7-5 – Forze applicate sulle strisce [BISHOP] della superficie 2 della verifica di stabilità 03.

### 7.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.000089
2	0.000036
3	0.000064
4	0.000357
5	0.000000
6	0.000019
7	0.000000

Tabella 7-6 – Spostamenti della superficie 1 della verifica di stabilità 04.

Accelerazione sismica critica  $K_c = 0.145$   
Spostamento massimo  $U_{max} = 0.000357$  [m]  
Velocità massima  $V_{max} = 0.009531$  [m/s]

n°	u
	[m]
1	0.000090
2	0.000037
3	0.000066
4	0.000361
5	0.000000
6	0.000019
7	0.000000

Tabella 7-7 – Spostamenti della superficie 2 della verifica di stabilità 04.

Accelerazione sismica critica  $K_c = 0.145$   
Spostamento massimo  $U_{max} = 0.000361$  [m]  
Velocità massima  $V_{max} = 0.009597$  [m/s]

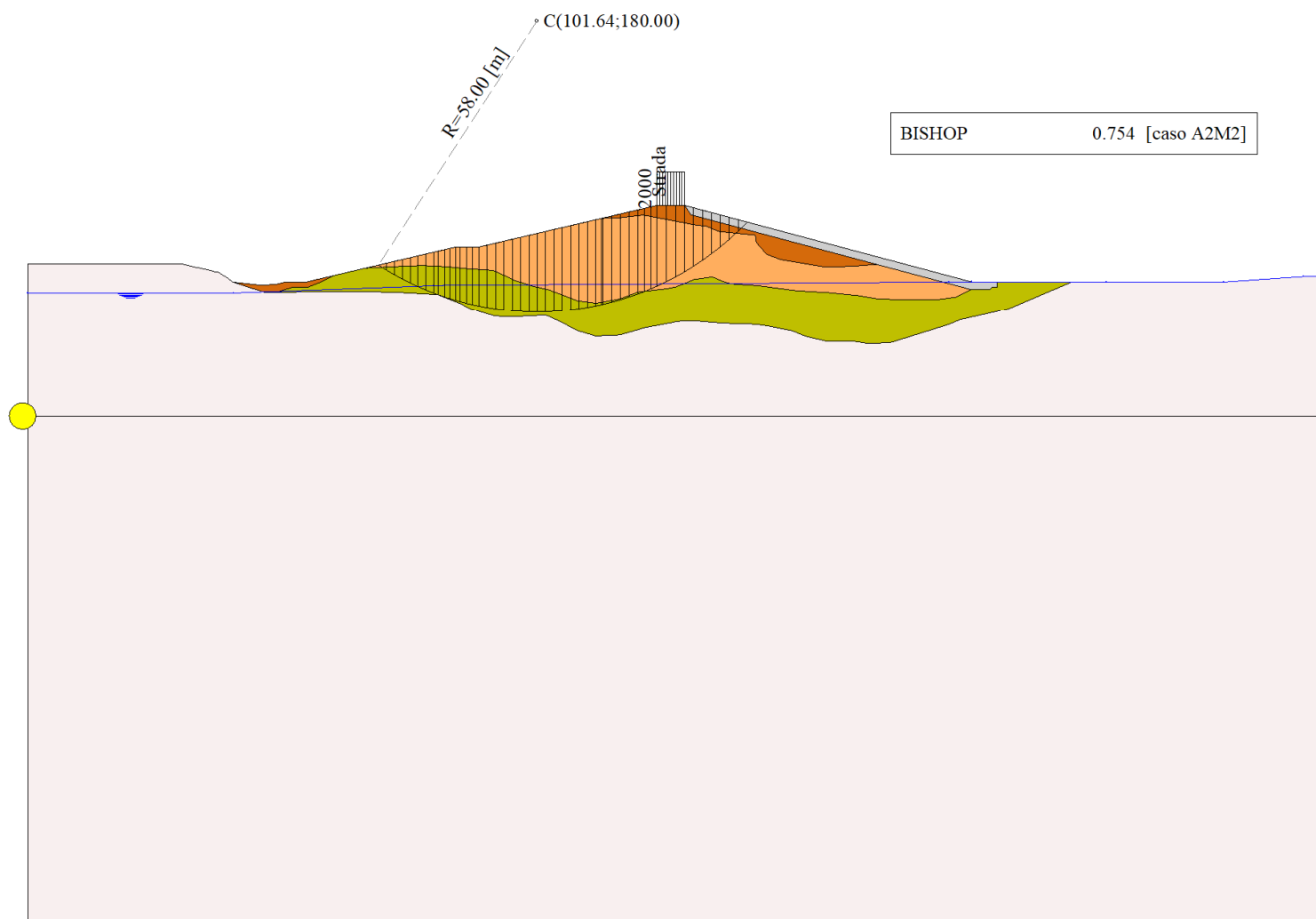


Figura 7-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 03.

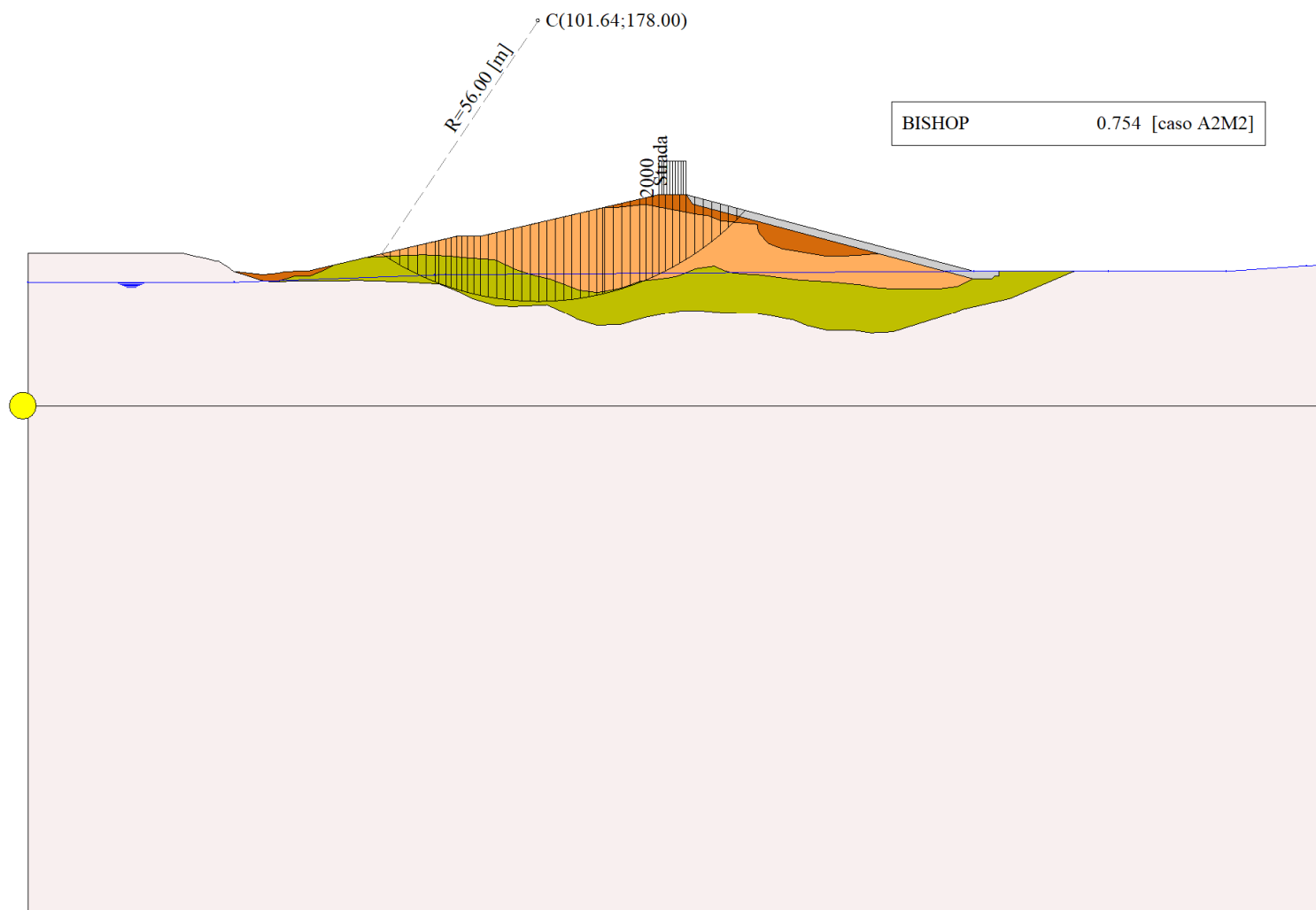


Figura 7-2 – Superficie critica (2) della sezione CR\_06 per la verifica di stabilità 03.

## 8 VERIFICA DI STABILITÀ 04

### 8.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	125.64 143.30	131.14 143.30	2000 2000	0 0

Tabella 8-1 – Carichi distribuiti verifica di stabilità 04.

### 8.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **sismiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 8.2 RISULTATI ANALISI

Numero di superfici analizzate	86748
Coefficiente di sicurezza minimo	0.577
Superficie con coefficiente di sicurezza minimo	1

### 8.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	48
Coordinate del centro	X[m]= 105.64                      Y[m]= 204.00
Raggio del cerchio	R[m]= 82.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 68.30                      Y <sub>v</sub> [m]= 130.99
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 153.42                      Y <sub>m</sub> [m]= 137.36
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.577</b>

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	68.30	130.99	130.99	70.13	131.42	130.09	69.52	130.83	2.04	-26.37	0.00	52
2	70.13	131.42	130.09	71.95	131.85	129.24	71.14	130.64	2.01	-24.96	0.00	52
3	71.95	131.85	129.24	73.78	132.27	128.44	72.92	130.45	1.99	-23.56	0.00	52
4	73.78	132.27	128.44	75.60	132.70	127.70	74.73	130.28	1.97	-22.18	0.00	52
5	75.60	132.70	127.70	77.43	133.13	127.01	76.55	130.13	1.95	-20.80	0.00	52
6	77.43	133.13	127.01	79.25	133.56	126.36	78.37	130.01	1.94	-19.45	0.00	52
7	79.25	133.56	126.36	81.08	133.98	125.76	80.19	129.92	1.92	-18.10	0.00	52
8	81.08	133.98	125.76	81.87	134.17	125.52	81.48	129.86	0.83	-17.14	0.00	52
9	81.87	134.17	125.52	83.23	134.49	125.12	82.56	129.82	1.42	-16.36	0.00	52
10	83.23	134.49	125.12	84.32	134.74	124.82	83.78	129.79	1.14	-15.46	0.00	52
11	84.32	134.74	124.82	85.42	135.00	124.53	84.88	129.77	1.13	-14.67	0.00	52
12	85.42	135.00	124.53	86.34	135.00	124.30	85.88	129.71	0.95	-13.94	0.00	52
13	86.34	135.00	124.30	88.20	135.00	123.87	87.28	129.54	1.91	-12.94	0.00	52
14	88.20	135.00	123.87	90.07	135.00	123.49	89.14	129.34	1.90	-11.61	0.00	52
15	90.07	135.00	123.49	91.97	135.44	123.15	91.03	129.27	1.93	-10.27	0.00	52
16	91.97	135.44	123.15	93.87	135.89	122.85	92.93	129.33	1.92	-8.92	0.00	52
17	93.87	135.89	122.85	95.77	136.33	122.60	94.83	129.42	1.92	-7.58	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α <sub>s</sub> [°]	α <sub>d</sub> [°]	c [kPa]
18	95.77	136.33	122.60	97.68	136.77	122.39	96.73	129.52	1.91	-6.24	0.00	52
19	97.68	136.77	122.39	99.58	137.22	122.22	98.63	129.65	1.91	-4.91	0.00	52
20	99.58	137.22	122.22	101.48	137.66	122.11	100.53	129.80	1.91	-3.57	0.00	52
21	101.48	137.66	122.11	103.38	138.10	122.03	102.43	129.98	1.90	-2.24	0.00	52
22	103.38	138.10	122.03	105.24	138.54	122.00	104.31	130.17	1.86	-0.93	0.00	52
23	105.24	138.54	122.00	107.09	138.97	122.01	106.17	130.38	1.86	0.37	0.00	52
24	107.09	138.97	122.01	108.95	139.40	122.07	108.03	130.61	1.86	1.66	0.00	52
25	108.95	139.40	122.07	110.81	139.83	122.16	109.88	130.87	1.86	2.96	0.00	52
26	110.81	139.83	122.16	112.66	140.27	122.30	111.74	131.14	1.86	4.26	0.00	52
27	112.66	140.27	122.30	114.52	140.70	122.48	113.59	131.44	1.87	5.57	0.00	52
28	114.52	140.70	122.48	116.37	141.13	122.71	115.45	131.76	1.87	6.87	0.00	52
29	116.37	141.13	122.71	118.23	141.57	122.97	117.30	132.09	1.87	8.18	0.00	52
30	118.23	141.57	122.97	120.08	142.00	123.28	119.15	132.46	1.88	9.49	0.00	52
31	120.08	142.00	123.28	121.93	142.43	123.64	121.01	132.84	1.89	10.80	0.00	52
32	121.93	142.43	123.64	123.79	142.87	124.03	122.86	133.24	1.90	12.12	0.00	52
33	123.79	142.87	124.03	125.64	143.30	124.48	124.71	133.67	1.91	13.45	0.00	52
34	125.64	143.30	124.48	127.47	143.30	124.96	126.55	134.01	1.90	14.78	0.00	52
35	127.47	143.30	124.96	129.31	143.30	125.49	128.39	134.26	1.91	16.11	0.00	52
36	129.31	143.30	125.49	131.14	143.30	126.07	130.22	134.54	1.92	17.45	0.00	52
37	131.14	143.30	126.07	132.99	142.81	126.69	132.05	134.72	1.95	18.80	0.00	52
38	132.99	142.81	126.69	134.83	142.32	127.37	133.90	134.80	1.97	20.17	0.00	52
39	134.83	142.32	127.37	136.68	141.82	128.10	135.74	134.90	1.99	21.55	0.00	52
40	136.68	141.82	128.10	138.76	141.27	128.99	137.70	135.04	2.26	23.03	0.00	53
41	138.76	141.27	128.99	140.51	140.80	129.79	139.62	135.21	1.93	24.50	0.00	54
42	140.51	140.80	129.79	142.27	140.33	130.64	141.37	135.39	1.95	25.85	0.00	54
43	142.27	140.33	130.64	144.02	139.87	131.54	143.12	135.59	1.97	27.22	0.00	54
44	144.02	139.87	131.54	145.78	139.40	132.49	144.87	135.82	2.00	28.61	0.00	54
45	145.78	139.40	132.49	147.53	138.93	133.51	146.62	136.08	2.03	30.01	0.00	54
46	147.53	138.93	133.51	149.49	138.41	134.71	148.45	136.38	2.30	31.53	0.00	53
47	149.49	138.41	134.71	151.46	137.88	135.99	150.37	136.73	2.35	33.15	0.00	53
48	151.46	137.88	135.99	153.42	137.36	137.36	152.11	137.08	2.39	34.80	31.82	9

Tabella 8-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 04.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	2466	0	12570	18884	0	0	21688	0	0	
2	7376	0	18110	18544	0	21688	43705	0	0	
3	12079	0	23352	18341	0	43705	65860	0	0	
4	16576	0	28256	18155	0	65860	87861	0	0	
5	20875	0	32853	17985	0	87861	109446	0	0	
6	24980	0	37162	17829	0	109446	130378	0	0	
7	28863	0	41162	17687	0	130378	150442	0	0	
8	13653	0	18996	7615	0	150442	158807	0	0	
9	25076	0	34282	13056	0	158807	172704	0	0	
10	21598	0	29006	10465	0	172704	183389	0	0	
11	22804	0	30196	10426	0	183389	193589	0	0	
12	19871	0	26024	8732	0	193589	201771	0	0	
13	41532	0	53706	17627	0	201771	217260	0	0	
14	43085	0	54854	17538	0	217260	231246	0	0	
15	46158	0	57883	17800	0	231246	243833	0	0	
16	49005	0	60582	17729	0	243833	254555	0	0	
17	51485	0	62870	17669	0	254555	263355	0	0	

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
18	53755	0	64935	17619	0	263355	270171	0	0	
19	55903	0	66885	17579	0	270171	274940	0	0	
20	57903	0	68695	17549	0	274940	277609	0	0	
21	59766	0	70379	17528	0	277609	278135	0	0	
22	59980	0	70175	17105	0	278135	276562	0	0	
23	61347	0	71373	17103	0	276562	272941	0	0	
24	62547	0	72412	17110	0	272941	267278	0	0	
25	63603	0	73321	17125	0	267278	259579	0	0	
26	64607	0	74209	17150	0	259579	249821	0	0	
27	65494	0	75000	17183	0	249821	238014	0	0	
28	66269	0	75702	17195	0	238014	224140	0	0	
29	67056	0	76456	17247	0	224140	208187	0	0	
30	67708	0	77094	17308	0	208187	190185	0	0	
31	68234	0	77622	17380	0	190185	170168	0	0	
32	68514	0	77902	17461	0	170168	148245	0	0	
33	68640	0	78035	17553	0	148245	124489	0	0	
34	67059	3667	80619	17465	0	124489	97446	0	0	
35	65260	3667	78518	17578	0	97446	69778	0	0	
36	63363	3667	76304	17702	0	69778	41645	0	0	
37	60773	0	68684	17969	0	41645	16444	0	0	
38	56552	0	63541	18121	0	16444	-7135	0	0	
39	52103	0	58049	18289	0	-7135	-28659	0	0	
40	52400	0	57316	21235	0	-28659	-48853	0	0	
41	39483	0	42132	18484	0	-48853	-62545	0	0	
42	35039	0	36310	18691	0	-62545	-73131	0	0	
43	30421	0	30131	18916	0	-73131	-80142	0	0	
44	25690	0	23646	19160	0	-80142	-83130	0	0	
45	21153	0	17242	19425	0	-83130	-81922	0	0	
46	17556	0	10798	21519	0	-81922	-75025	0	0	
47	10461	0	256	21899	0	-75025	-60286	0	0	
48	3351	0	1151	5186	0	-60286	-57792	0	0	

Tabella 8-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 04.

### 8.2.2 ANALISI DELLA SUPERFICIE 19 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	48	
Coordinate del centro	X[m]= 101.64	Y[m]= 178.00
Raggio del cerchio	R[m]= 56.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 70.44	Y <sub>v</sub> [m]= 131.49
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 142.92	Y <sub>m</sub> [m]= 140.16
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.585</b>	

N°	X <sub>s</sub>	Y <sub>ss</sub>	Y <sub>si</sub>	X <sub>d</sub>	Y <sub>ds</sub>	Y <sub>di</sub>	X <sub>g</sub>	Y <sub>g</sub>	L	α	β	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
1	70.44	131.49	131.49	72.22	131.91	130.35	71.63	131.25	2.11	-32.77	0.00	53
2	72.22	131.91	130.35	73.99	132.32	129.30	73.20	130.96	2.06	-30.64	0.00	52
3	73.99	132.32	129.30	75.76	132.74	128.34	74.93	130.67	2.02	-28.56	0.00	52
4	75.76	132.74	128.34	77.53	133.15	127.45	76.69	130.42	1.98	-26.51	0.00	52
5	77.53	133.15	127.45	79.31	133.57	126.65	78.45	130.20	1.95	-24.50	0.00	52
6	79.31	133.57	126.65	81.08	133.98	125.91	80.22	130.03	1.92	-22.52	0.00	52
7	81.08	133.98	125.91	81.87	134.17	125.61	81.48	129.92	0.85	-21.11	0.00	52
8	81.87	134.17	125.61	83.23	134.49	125.11	82.56	129.84	1.45	-19.93	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∅ [°]	∅ [°]	c [kPa]
9	83.23	134.49	125.11	84.32	134.74	124.74	83.78	129.77	1.16	-18.60	0.00	52
10	84.32	134.74	124.74	85.42	135.00	124.40	84.88	129.72	1.15	-17.42	0.00	52
11	85.42	135.00	124.40	86.34	135.00	124.13	85.88	129.63	0.96	-16.35	0.00	52
12	86.34	135.00	124.13	87.58	135.00	123.79	86.96	129.48	1.29	-15.20	0.00	52
13	87.58	135.00	123.79	88.83	135.00	123.49	88.21	129.32	1.28	-13.88	0.00	52
14	88.83	135.00	123.49	90.07	135.00	123.21	89.45	129.17	1.27	-12.58	0.00	52
15	90.07	135.00	123.21	91.73	135.39	122.88	90.91	129.12	1.70	-11.06	0.00	52
16	91.73	135.39	122.88	93.40	135.78	122.61	92.57	129.16	1.69	-9.33	0.00	52
17	93.40	135.78	122.61	95.06	136.16	122.39	94.24	129.23	1.68	-7.61	0.00	52
18	95.06	136.16	122.39	96.72	136.55	122.22	95.90	129.33	1.67	-5.89	0.00	52
19	96.72	136.55	122.22	98.39	136.94	122.09	97.56	129.45	1.67	-4.18	0.00	52
20	98.39	136.94	122.09	100.05	137.33	122.02	99.22	129.60	1.67	-2.48	0.00	52
21	100.05	137.33	122.02	101.72	137.72	122.00	100.89	129.77	1.66	-0.77	0.00	52
22	101.72	137.72	122.00	103.38	138.10	122.03	102.55	129.96	1.66	0.93	0.00	52
23	103.38	138.10	122.03	105.05	138.49	122.10	104.22	130.18	1.67	2.63	0.00	52
24	105.05	138.49	122.10	106.72	138.88	122.23	105.88	130.43	1.67	4.35	0.00	52
25	106.72	138.88	122.23	108.38	139.27	122.41	107.55	130.70	1.68	6.06	0.00	52
26	108.38	139.27	122.41	110.05	139.66	122.64	109.22	130.99	1.68	7.78	0.00	52
27	110.05	139.66	122.64	111.72	140.05	122.91	110.89	131.31	1.69	9.51	0.00	52
28	111.72	140.05	122.91	113.39	140.44	123.25	112.56	131.66	1.70	11.24	0.00	52
29	113.39	140.44	123.25	114.52	140.70	123.50	113.96	131.97	1.16	12.70	0.00	52
30	114.52	140.70	123.50	114.85	140.78	123.58	114.68	132.14	0.34	13.47	0.00	52
31	114.85	140.78	123.58	116.56	141.18	124.03	115.71	132.39	1.77	14.55	0.00	52
32	116.56	141.18	124.03	118.28	141.58	124.53	117.42	132.83	1.79	16.37	0.00	52
33	118.28	141.58	124.53	120.05	141.99	125.11	119.16	133.30	1.86	18.24	0.00	52
34	120.05	141.99	125.11	121.81	142.40	125.76	120.93	133.82	1.88	20.15	0.00	52
35	121.81	142.40	125.76	123.09	142.70	126.27	122.45	134.28	1.38	21.81	0.00	53
36	123.09	142.70	126.27	124.36	143.00	126.82	123.72	134.70	1.39	23.23	0.00	54
37	124.36	143.00	126.82	125.64	143.30	127.40	125.00	135.13	1.40	24.66	0.00	54
38	125.64	143.30	127.40	127.01	143.30	128.08	126.32	135.52	1.53	26.16	0.00	54
39	127.01	143.30	128.08	128.39	143.30	128.80	127.70	135.87	1.55	27.74	0.00	54
40	128.39	143.30	128.80	129.76	143.30	129.57	129.07	136.24	1.58	29.34	0.00	54
41	129.76	143.30	129.57	131.14	143.30	130.40	130.45	136.64	1.60	30.97	0.00	54
42	131.14	143.30	130.40	132.82	142.85	131.49	131.96	137.01	2.00	32.81	0.00	54
43	132.82	142.85	131.49	134.51	142.40	132.66	133.64	137.34	2.05	34.89	0.00	54
44	134.51	142.40	132.66	136.19	141.95	133.93	135.32	137.73	2.11	37.01	0.00	54
45	136.19	141.95	133.93	137.87	141.51	135.30	136.99	138.16	2.17	39.20	0.00	54
46	137.87	141.51	135.30	139.55	141.06	136.79	138.66	138.65	2.25	41.46	0.00	54
47	139.55	141.06	136.79	141.24	140.61	138.40	140.31	139.18	2.33	43.81	0.00	54
48	141.24	140.61	138.40	142.92	140.16	140.16	141.80	139.72	2.43	46.24	27.23	16

Tabella 8-4 – Geometria e caratteristiche strisce della superficie 19 della verifica di stabilità 04.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	2727	0	16354	19531	0	0	24374	0	0	
2	8235	0	22254	18740	0	24374	49119	0	0	
3	13447	0	27828	18356	0	49119	74103	0	0	
4	18349	0	32879	18018	0	74103	98840	0	0	
5	22955	0	37468	17719	0	98840	122917	0	0	
6	27248	0	41607	17454	0	122917	145976	0	0	
7	13460	0	19784	7702	0	145976	155839	0	0	
8	24967	0	35717	13158	0	155839	172138	0	0	



N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
9	21695	0	30209	10509	0	172138	184567	0	0	
10	23042	0	31415	10439	0	184567	196321	0	0	
11	20166	0	27045	8720	0	196321	205638	0	0	
12	28028	0	37023	11719	0	205638	217393	0	0	
13	28853	0	37510	11649	0	217393	228170	0	0	
14	29601	0	37923	11587	0	228170	237957	0	0	
15	41262	0	51999	15419	0	237957	249430	0	0	
16	43520	0	53906	15336	0	249430	258922	0	0	
17	45466	0	55485	15267	0	258922	266378	0	0	
18	47186	0	56841	15213	0	266378	271757	0	0	
19	48743	0	58055	15173	0	271757	275021	0	0	
20	50176	0	59173	15147	0	275021	276135	0	0	
21	51442	0	60149	15134	0	276135	275085	0	0	
22	52570	0	61016	15135	0	275085	271861	0	0	
23	53661	0	61892	15191	0	271861	266463	0	0	
24	54379	0	62388	15218	0	266463	258946	0	0	
25	54917	0	62728	15260	0	258946	249357	0	0	
26	55278	0	62915	15315	0	249357	237754	0	0	
27	55535	0	63033	15386	0	237754	224172	0	0	
28	55656	0	63042	15471	0	224172	208670	0	0	
29	37709	0	42666	10536	0	208670	197108	0	0	
30	11013	0	12456	3086	0	197108	193569	0	0	
31	57176	0	64645	16116	0	193569	174039	0	0	
32	56953	0	64389	16258	0	174039	152674	0	0	
33	58186	0	65813	16903	0	152674	128910	0	0	
34	57550	0	65153	17100	0	128910	103508	0	0	
35	41067	0	46461	12692	0	103508	84460	0	0	
36	40537	0	45753	13156	0	84460	65112	0	0	
37	39949	0	45112	13302	0	65112	45183	0	0	
38	41805	2750	50714	14506	0	45183	21125	0	0	
39	39983	2750	48521	14711	0	21125	-2556	0	0	
40	38032	2750	46114	14936	0	-2556	-25604	0	0	
41	35944	2750	43468	15185	0	-25604	-47733	0	0	
42	39761	0	42899	18961	0	-47733	-68180	0	0	
43	34350	0	35246	19427	0	-68180	-83751	0	0	
44	28873	0	27085	19958	0	-83751	-93659	0	0	
45	23137	0	18015	20565	0	-93659	-96754	0	0	
46	17024	0	7679	21266	0	-96754	-91527	0	0	
47	10435	0	-4133	21873	0	-91527	-76328	0	0	
48	3381	0	-640	6067	0	-76328	-72787	0	0	

Tabella 8-5 – Forze applicate sulle strisce [BISHOP] della superficie 19 della verifica di stabilità 04.

### 8.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.000803
2	0.000276
3	0.000920
4	0.000084
5	0.000152
6	0.000068
7	0.000343

Tabella 8-6 – Spostamenti della superficie 1 della verifica di stabilità 04.

Accelerazione sismica critica  $K_c = 0.158$   
Spostamento massimo  $U_{max} = 0.000920$  [m]  
Velocità massima  $V_{max} = 0.017775$  [m/s]

n°	u
	[m]
1	0.001609
2	0.000643
3	0.001340
4	0.000188
5	0.000328
6	0.000277
7	0.000718

Tabella 8-7 – Spostamenti della superficie 19 della verifica di stabilità 04.

Accelerazione sismica critica  $K_c = 0.145$   
Spostamento massimo  $U_{max} = 0.001609$  [m]  
Velocità massima  $V_{max} = 0.022024$  [m/s]

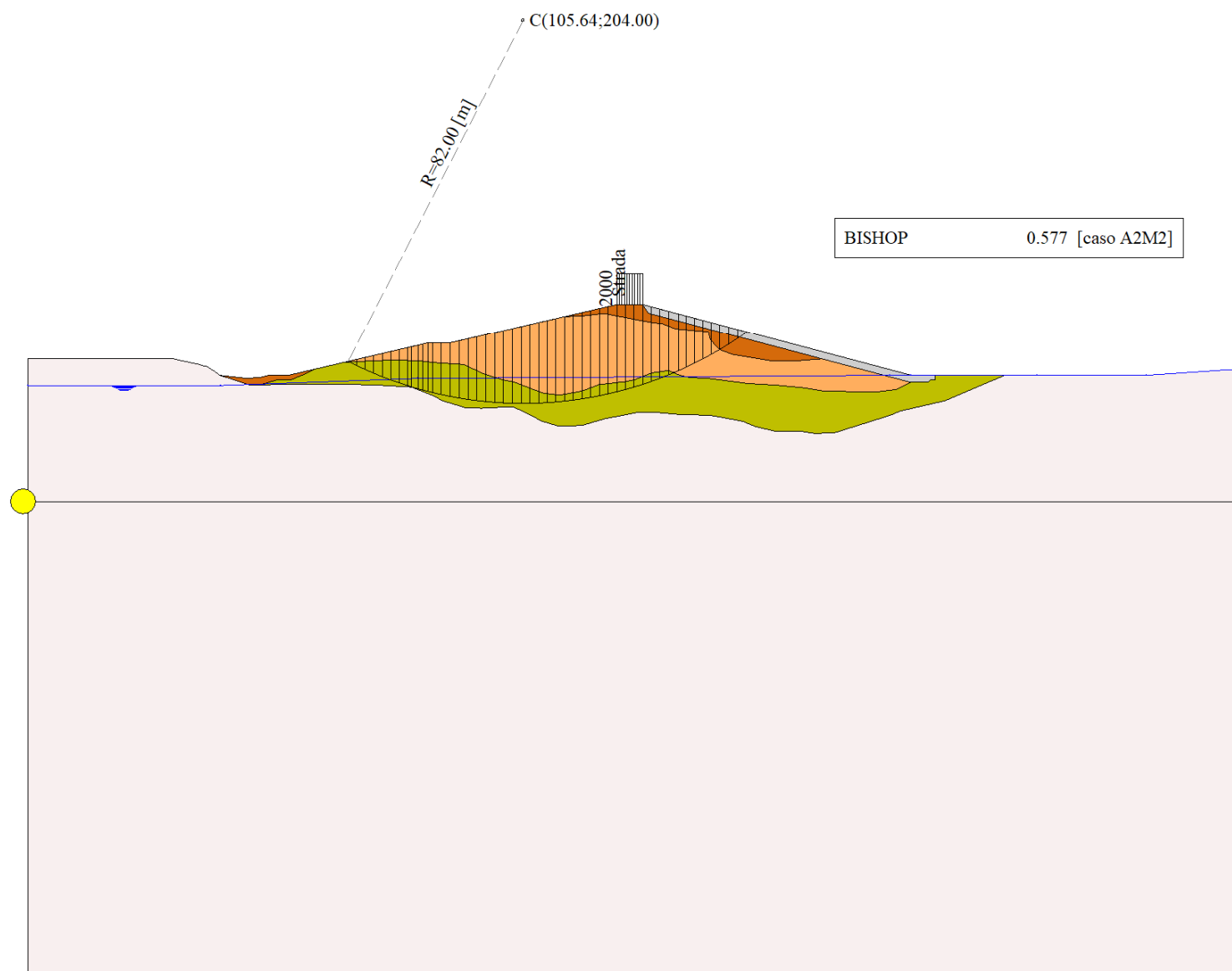


Figura 8-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 04.

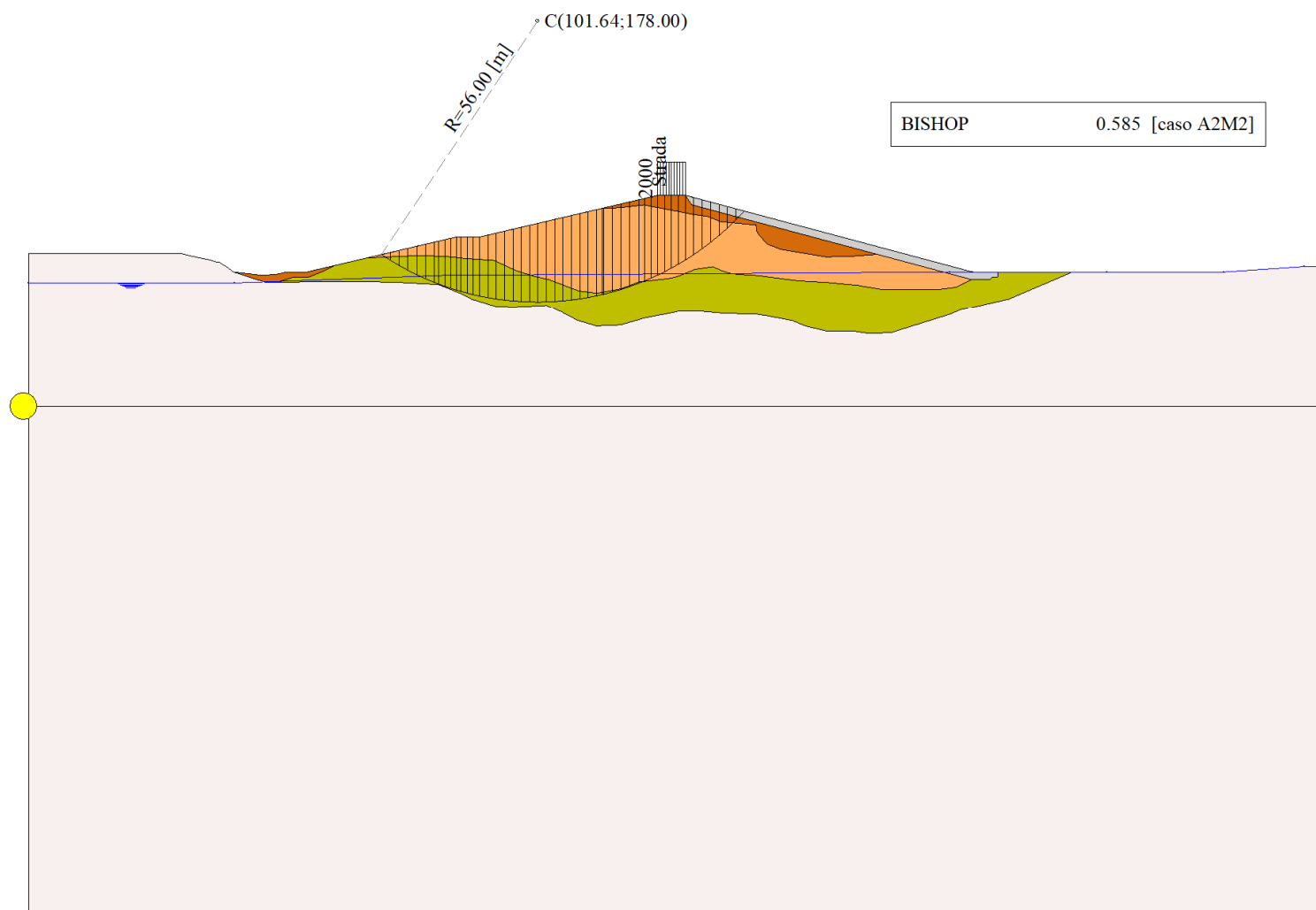


Figura 8-2 – Superficie critica (19) della sezione CR\_06 per la verifica di stabilità 04.

## 9 VERIFICA DI STABILITÀ 05

### 9.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	125.64	131.14	2000	0
				143.30	143.30	2000	0

Tabella 9-1 – Carichi distribuiti verifica di stabilità 05.

### 9.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **sismiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 9.2 RISULTATI ANALISI

Numero di superfici analizzate	86748
Coefficiente di sicurezza minimo	0.321
Superficie con coefficiente di sicurezza minimo	1

### 9.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	47
Coordinate del centro	X[m]= 117.64                      Y[m]= 208.00
Raggio del cerchio	R[m]= 88.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 73.09                      Y <sub>v</sub> [m]= 132.11
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 165.48                      Y <sub>m</sub> [m]= 134.14
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.321</b>

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	73.09	132.11	132.11	73.14	132.13	132.08	73.12	132.11	0.06	-30.40	0.00	54
2	73.14	132.13	132.08	75.13	132.59	130.95	74.45	131.88	2.28	-29.63	0.00	54
3	75.13	132.59	130.95	77.11	133.05	129.89	76.22	131.61	2.25	-28.16	0.00	52
4	77.11	133.05	129.89	79.09	133.52	128.89	78.16	131.33	2.22	-26.70	0.00	52
5	79.09	133.52	128.89	81.08	133.98	127.95	80.13	131.08	2.19	-25.26	0.00	52
6	81.08	133.98	127.95	83.23	134.49	127.01	82.19	130.85	2.35	-23.78	0.00	52
7	83.23	134.49	127.01	85.42	135.00	126.11	84.36	130.65	2.37	-22.25	0.00	52
8	85.42	135.00	126.11	86.97	135.00	125.52	86.20	130.41	1.66	-20.94	0.00	52
9	86.97	135.00	125.52	88.52	135.00	124.96	87.75	130.12	1.65	-19.86	0.00	52
10	88.52	135.00	124.96	90.07	135.00	124.43	89.30	129.85	1.64	-18.79	0.00	52
11	90.07	135.00	124.43	92.29	135.52	123.73	91.20	129.67	2.33	-17.50	0.00	52
12	92.29	135.52	123.73	94.51	136.03	123.10	93.41	129.59	2.31	-15.99	0.00	52
13	94.51	136.03	123.10	96.72	136.55	122.52	95.63	129.55	2.29	-14.50	0.00	52
14	96.72	136.55	122.52	98.94	137.07	122.01	97.85	129.54	2.28	-13.01	0.00	52
15	98.94	137.07	122.01	101.16	137.59	121.56	100.06	129.56	2.26	-11.53	0.00	52
16	101.16	137.59	121.56	103.38	138.10	121.16	102.28	129.60	2.25	-10.06	0.00	65
17	103.38	138.10	121.16	104.84	138.44	120.94	104.11	129.66	1.48	-8.84	0.00	67

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α [°]	β [°]	c [kPa]
18	104.84	138.44	120.94	106.30	138.78	120.73	105.57	129.72	1.47	-7.88	0.00	52
19	106.30	138.78	120.73	108.36	139.26	120.49	107.33	129.82	2.07	-6.73	0.00	52
20	108.36	139.26	120.49	110.41	139.74	120.30	109.39	129.95	2.06	-5.38	0.00	52
21	110.41	139.74	120.30	112.47	140.22	120.15	111.44	130.10	2.06	-4.04	0.00	52
22	112.47	140.22	120.15	114.52	140.70	120.06	113.50	130.28	2.06	-2.70	0.00	52
23	114.52	140.70	120.06	116.74	141.22	120.00	115.64	130.50	2.22	-1.31	0.00	52
24	116.74	141.22	120.00	118.97	141.74	120.01	117.86	130.74	2.22	0.14	0.00	52
25	118.97	141.74	120.01	121.19	142.26	120.07	120.08	131.02	2.22	1.59	0.00	52
26	121.19	142.26	120.07	123.42	142.78	120.19	122.31	131.33	2.23	3.04	0.00	52
27	123.42	142.78	120.19	125.64	143.30	120.36	124.53	131.66	2.23	4.49	0.00	52
28	125.64	143.30	120.36	127.09	143.30	120.51	126.36	131.87	1.46	5.69	0.00	52
29	127.09	143.30	120.51	128.54	143.30	120.68	127.81	131.95	1.46	6.64	0.00	52
30	128.54	143.30	120.68	129.79	143.30	120.84	129.16	132.03	1.26	7.53	0.00	52
31	129.79	143.30	120.84	131.14	143.30	121.04	130.46	132.12	1.36	8.38	0.00	52
32	131.14	143.30	121.04	133.29	142.73	121.40	132.21	132.12	2.18	9.54	0.00	52
33	133.29	142.73	121.40	135.45	142.15	121.82	134.36	132.03	2.19	10.96	0.00	52
34	135.45	142.15	121.82	137.60	141.58	122.29	136.52	131.96	2.21	12.39	0.00	52
35	137.60	141.58	122.29	139.76	141.00	122.83	138.67	131.92	2.22	13.83	0.00	52
36	139.76	141.00	122.83	141.91	140.43	123.41	140.82	131.92	2.23	15.28	0.00	52
37	141.91	140.43	123.41	144.07	139.85	124.06	142.98	131.94	2.25	16.74	0.00	52
38	144.07	139.85	124.06	146.22	139.28	124.77	145.13	131.99	2.27	18.21	0.00	52
39	146.22	139.28	124.77	148.38	138.70	125.54	147.28	132.07	2.29	19.70	0.00	52
40	148.38	138.70	125.54	150.53	138.13	126.38	149.43	132.19	2.31	21.20	0.00	52
41	150.53	138.13	126.38	152.69	137.55	127.28	151.58	132.33	2.34	22.71	0.00	54
42	152.69	137.55	127.28	154.84	136.98	128.25	153.73	132.51	2.36	24.24	0.00	54
43	154.84	136.98	128.25	157.00	136.41	129.29	155.88	132.73	2.39	25.79	0.00	54
44	157.00	136.41	129.29	159.15	135.83	130.41	158.02	132.98	2.43	27.36	0.00	54
45	159.15	135.83	130.41	161.26	135.27	131.57	160.14	133.26	2.41	28.93	0.00	54
46	161.26	135.27	131.57	163.37	134.71	132.82	162.20	133.57	2.45	30.51	0.00	53
47	163.37	134.71	132.82	165.48	134.14	134.14	164.08	133.89	2.49	32.12	31.83	9

Tabella 9-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 05.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	2	0	639	1083	0	0	1256	0	0	
2	3239	0	27222	39155	0	1256	46624	0	0	
3	9494	0	34275	37318	0	46624	89470	0	0	
4	15619	0	41744	36829	0	89470	130879	0	0	
5	21442	0	48658	36382	0	130879	170475	0	0	
6	29475	0	59942	38944	0	170475	210942	0	0	
7	36385	0	68254	39220	0	210942	249207	0	0	
8	28905	0	51628	27508	0	249207	274379	0	0	
9	30753	0	53294	27317	0	274379	297995	0	0	
10	32501	0	54830	27138	0	297995	320019	0	0	
11	50444	0	82404	38554	0	320019	348466	0	0	
12	55645	0	87841	38250	0	348466	372920	0	0	
13	60317	0	92560	37979	0	372920	393274	0	0	
14	64718	0	96935	37738	0	393274	409392	0	0	
15	68922	0	101077	37527	0	409392	421134	0	0	
16	72899	0	106625	46756	0	421134	437955	0	0	
17	50031	0	72176	31674	0	437955	447517	0	0	
18	51515	0	72454	24431	0	447517	447849	0	0	

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
19	74865	0	104167	34299	0	447849	444989	0	0	
20	77445	0	106537	34213	0	444989	438226	0	0	
21	79945	0	108855	34147	0	438226	427498	0	0	
22	82316	0	111056	34100	0	427498	412776	0	0	
23	91757	0	122738	36873	0	412776	392225	0	0	
24	94379	0	125257	36864	0	392225	366845	0	0	
25	96816	0	127610	36878	0	366845	336635	0	0	
26	98966	0	129665	36916	0	336635	301680	0	0	
27	100811	0	131398	36977	0	301680	262101	0	0	
28	66119	2900	89713	24153	0	262101	231947	0	0	
29	65734	2900	88953	24197	0	231947	200655	0	0	
30	56321	2500	76040	20899	0	200655	172814	0	0	
31	60455	2700	81450	22618	0	172814	141875	0	0	
32	94183	0	120756	36214	0	141875	95776	0	0	
33	90112	0	114858	36377	0	95776	50514	0	0	
34	85759	0	108581	36566	0	50514	6643	0	0	
35	80841	0	101516	36781	0	6643	-34969	0	0	
36	75613	0	93989	37023	0	-34969	-73653	0	0	
37	70248	0	86209	37295	0	-73653	-108876	0	0	
38	64804	0	78236	37598	0	-108876	-140145	0	0	
39	59466	0	70306	37933	0	-140145	-167154	0	0	
40	53437	0	61266	38305	0	-167154	-188659	0	0	
41	47111	0	51112	39941	0	-188659	-202461	0	0	
42	40748	0	40992	40776	0	-202461	-208849	0	0	
43	33437	0	29369	41293	0	-208849	-206387	0	0	
44	26493	0	17959	41863	0	-206387	-194844	0	0	
45	18851	0	5874	41128	0	-194844	-174060	0	0	
46	11252	0	-6923	41179	0	-174060	-142453	0	0	
47	3604	0	453	8281	0	-142453	-138046	0	0	

Tabella 9-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 05.

### 9.2.2 ANALISI DELLA SUPERFICIE 214 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	48	
Coordinate del centro	X[m]= 101.64	Y[m]= 178.00
Raggio del cerchio	R[m]= 56.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 70.44	Y <sub>v</sub> [m]= 131.49
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 142.92	Y <sub>m</sub> [m]= 140.16
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.345</b>	

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α <sub>s</sub> [°]	α <sub>d</sub> [°]	c [kPa]
1	70.44	131.49	131.49	72.22	131.91	130.35	71.63	131.25	2.11	-32.77	0.00	53
2	72.22	131.91	130.35	73.99	132.32	129.30	73.20	130.96	2.06	-30.64	0.00	52
3	73.99	132.32	129.30	75.76	132.74	128.34	74.93	130.67	2.02	-28.56	0.00	52
4	75.76	132.74	128.34	77.53	133.15	127.45	76.69	130.42	1.98	-26.51	0.00	52
5	77.53	133.15	127.45	79.31	133.57	126.65	78.45	130.20	1.95	-24.50	0.00	52
6	79.31	133.57	126.65	81.08	133.98	125.91	80.22	130.03	1.92	-22.52	0.00	52
7	81.08	133.98	125.91	81.87	134.17	125.61	81.48	129.92	0.85	-21.11	0.00	52
8	81.87	134.17	125.61	83.23	134.49	125.11	82.56	129.84	1.45	-19.93	0.00	52
9	83.23	134.49	125.11	84.32	134.74	124.74	83.78	129.77	1.16	-18.60	0.00	52
10	84.32	134.74	124.74	85.42	135.00	124.40	84.88	129.72	1.15	-17.42	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∅ [°]	∅ [°]	c [kPa]
11	85.42	135.00	124.40	86.34	135.00	124.13	85.88	129.63	0.96	-16.35	0.00	52
12	86.34	135.00	124.13	87.58	135.00	123.79	86.96	129.48	1.29	-15.20	0.00	52
13	87.58	135.00	123.79	88.83	135.00	123.49	88.21	129.32	1.28	-13.88	0.00	52
14	88.83	135.00	123.49	90.07	135.00	123.21	89.45	129.17	1.27	-12.58	0.00	52
15	90.07	135.00	123.21	91.73	135.39	122.88	90.91	129.12	1.70	-11.06	0.00	52
16	91.73	135.39	122.88	93.40	135.78	122.61	92.57	129.16	1.69	-9.33	0.00	52
17	93.40	135.78	122.61	95.06	136.16	122.39	94.24	129.23	1.68	-7.61	0.00	52
18	95.06	136.16	122.39	96.72	136.55	122.22	95.90	129.33	1.67	-5.89	0.00	52
19	96.72	136.55	122.22	98.39	136.94	122.09	97.56	129.45	1.67	-4.18	0.00	52
20	98.39	136.94	122.09	100.05	137.33	122.02	99.22	129.60	1.67	-2.48	0.00	52
21	100.05	137.33	122.02	101.72	137.72	122.00	100.89	129.77	1.66	-0.77	0.00	52
22	101.72	137.72	122.00	103.38	138.10	122.03	102.55	129.96	1.66	0.93	0.00	52
23	103.38	138.10	122.03	105.05	138.49	122.10	104.22	130.18	1.67	2.63	0.00	52
24	105.05	138.49	122.10	106.72	138.88	122.23	105.88	130.43	1.67	4.35	0.00	52
25	106.72	138.88	122.23	108.38	139.27	122.41	107.55	130.70	1.68	6.06	0.00	52
26	108.38	139.27	122.41	110.05	139.66	122.64	109.22	130.99	1.68	7.78	0.00	52
27	110.05	139.66	122.64	111.72	140.05	122.91	110.89	131.31	1.69	9.51	0.00	52
28	111.72	140.05	122.91	113.39	140.44	123.25	112.56	131.66	1.70	11.24	0.00	52
29	113.39	140.44	123.25	114.52	140.70	123.50	113.96	131.97	1.16	12.70	0.00	52
30	114.52	140.70	123.50	114.85	140.78	123.58	114.68	132.14	0.34	13.47	0.00	52
31	114.85	140.78	123.58	116.56	141.18	124.03	115.71	132.39	1.77	14.55	0.00	52
32	116.56	141.18	124.03	118.28	141.58	124.53	117.42	132.83	1.79	16.37	0.00	52
33	118.28	141.58	124.53	120.05	141.99	125.11	119.16	133.30	1.86	18.24	0.00	52
34	120.05	141.99	125.11	121.81	142.40	125.76	120.93	133.82	1.88	20.15	0.00	52
35	121.81	142.40	125.76	123.09	142.70	126.27	122.45	134.28	1.38	21.81	0.00	53
36	123.09	142.70	126.27	124.36	143.00	126.82	123.72	134.70	1.39	23.23	0.00	54
37	124.36	143.00	126.82	125.64	143.30	127.40	125.00	135.13	1.40	24.66	0.00	54
38	125.64	143.30	127.40	127.01	143.30	128.08	126.32	135.52	1.53	26.16	0.00	54
39	127.01	143.30	128.08	128.39	143.30	128.80	127.70	135.87	1.55	27.74	0.00	54
40	128.39	143.30	128.80	129.76	143.30	129.57	129.07	136.24	1.58	29.34	0.00	54
41	129.76	143.30	129.57	131.14	143.30	130.40	130.45	136.64	1.60	30.97	0.00	54
42	131.14	143.30	130.40	132.82	142.85	131.49	131.96	137.01	2.00	32.81	0.00	54
43	132.82	142.85	131.49	134.51	142.40	132.66	133.64	137.34	2.05	34.89	0.00	54
44	134.51	142.40	132.66	136.19	141.95	133.93	135.32	137.73	2.11	37.01	0.00	54
45	136.19	141.95	133.93	137.87	141.51	135.30	136.99	138.16	2.17	39.20	0.00	54
46	137.87	141.51	135.30	139.55	141.06	136.79	138.66	138.65	2.25	41.46	0.00	54
47	139.55	141.06	136.79	141.24	140.61	138.40	140.31	139.18	2.33	43.81	0.00	54
48	141.24	140.61	138.40	142.92	140.16	140.16	141.80	139.72	2.43	46.24	27.23	16

Tabella 9-4 – Geometria e caratteristiche strisce della superficie 214 della verifica di stabilità 05.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	2727	0	25589	33054	0	0	39855	0	0	
2	8235	0	31500	31715	0	39855	77791	0	0	
3	13447	0	37240	31065	0	77791	114054	0	0	
4	18349	0	42443	30492	0	114054	148243	0	0	
5	22955	0	47169	29986	0	148243	180026	0	0	
6	27248	0	51425	29539	0	180026	209128	0	0	
7	13460	0	24194	13035	0	209128	221167	0	0	
8	24967	0	43348	22269	0	221167	240496	0	0	
9	21695	0	36387	17784	0	240496	254721	0	0	
10	23042	0	37618	17666	0	254721	267719	0	0	



N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
11	20166	0	32240	14758	0	267719	277721	0	0	
12	28028	0	43960	19832	0	277721	289989	0	0	
13	28853	0	44346	19714	0	289989	300833	0	0	
14	29601	0	44654	19609	0	300833	310269	0	0	
15	41262	0	60936	26094	0	310269	320487	0	0	
16	43520	0	62836	25953	0	320487	327721	0	0	
17	45466	0	64370	25837	0	327721	332013	0	0	
18	47186	0	65658	25746	0	332013	333397	0	0	
19	48743	0	66787	25678	0	333397	331890	0	0	
20	50176	0	67810	25634	0	331890	327502	0	0	
21	51442	0	68673	25612	0	327502	320280	0	0	
22	52570	0	69413	25613	0	320280	310266	0	0	
23	53661	0	70161	25708	0	310266	297506	0	0	
24	54379	0	70473	25755	0	297506	282161	0	0	
25	54917	0	70605	25825	0	282161	264349	0	0	
26	55278	0	70557	25919	0	264349	244203	0	0	
27	55535	0	70424	26038	0	244203	221809	0	0	
28	55656	0	70159	26183	0	221809	197288	0	0	
29	37709	0	47320	17831	0	197288	179529	0	0	
30	11013	0	13789	5223	0	179529	174169	0	0	
31	57176	0	71374	27274	0	174169	145115	0	0	
32	56953	0	70754	27515	0	145115	114195	0	0	
33	58186	0	71939	28605	0	114195	80667	0	0	
34	57550	0	70798	28940	0	80667	45681	0	0	
35	41067	0	50152	21480	0	45681	20036	0	0	
36	40537	0	49032	22264	0	20036	-5446	0	0	
37	39949	0	48047	22512	0	-5446	-31248	0	0	
38	41805	2750	53869	24550	0	-31248	-62202	0	0	
39	39983	2750	51032	24896	0	-62202	-91963	0	0	
40	38032	2750	47924	25278	0	-91963	-120174	0	0	
41	35944	2750	44512	25698	0	-120174	-146435	0	0	
42	39761	0	42143	32089	0	-146435	-168397	0	0	
43	34350	0	32691	32878	0	-168397	-182667	0	0	
44	28873	0	22559	33776	0	-182667	-188227	0	0	
45	23137	0	11266	34803	0	-188227	-183563	0	0	
46	17024	0	-1629	35989	0	-183563	-166687	0	0	
47	10435	0	-16302	37017	0	-166687	-135535	0	0	
48	3381	0	-2045	8175	0	-135535	-130624	0	0	

Tabella 9-5 – Forze applicate sulle strisce [BISHOP] della superficie 214 della verifica di stabilità 05.

### 9.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.018423
2	0.008345
3	0.010469
4	0.001468
5	0.011084
6	0.012418
7	0.014167

Tabella 9-6 – Spostamenti della superficie 1 della verifica di stabilità 05.

Accelerazione sismica critica  $K_c = 0.189$   
Spostamento massimo  $U_{max} = 0.018423$  [m]  
Velocità massima  $V_{max} = 0.113820$  [m/s]

n°	u
	[m]
1	0.036715
2	0.025754
3	0.021278
4	0.007105
5	0.019003
6	0.023036
7	0.028933

Tabella 9-7 – Spostamenti della superficie 214 della verifica di stabilità 05.

Accelerazione sismica critica  $K_c = 0.145$   
Spostamento massimo  $U_{max} = 0.036715$  [m]  
Velocità massima  $V_{max} = 0.149950$  [m/s]

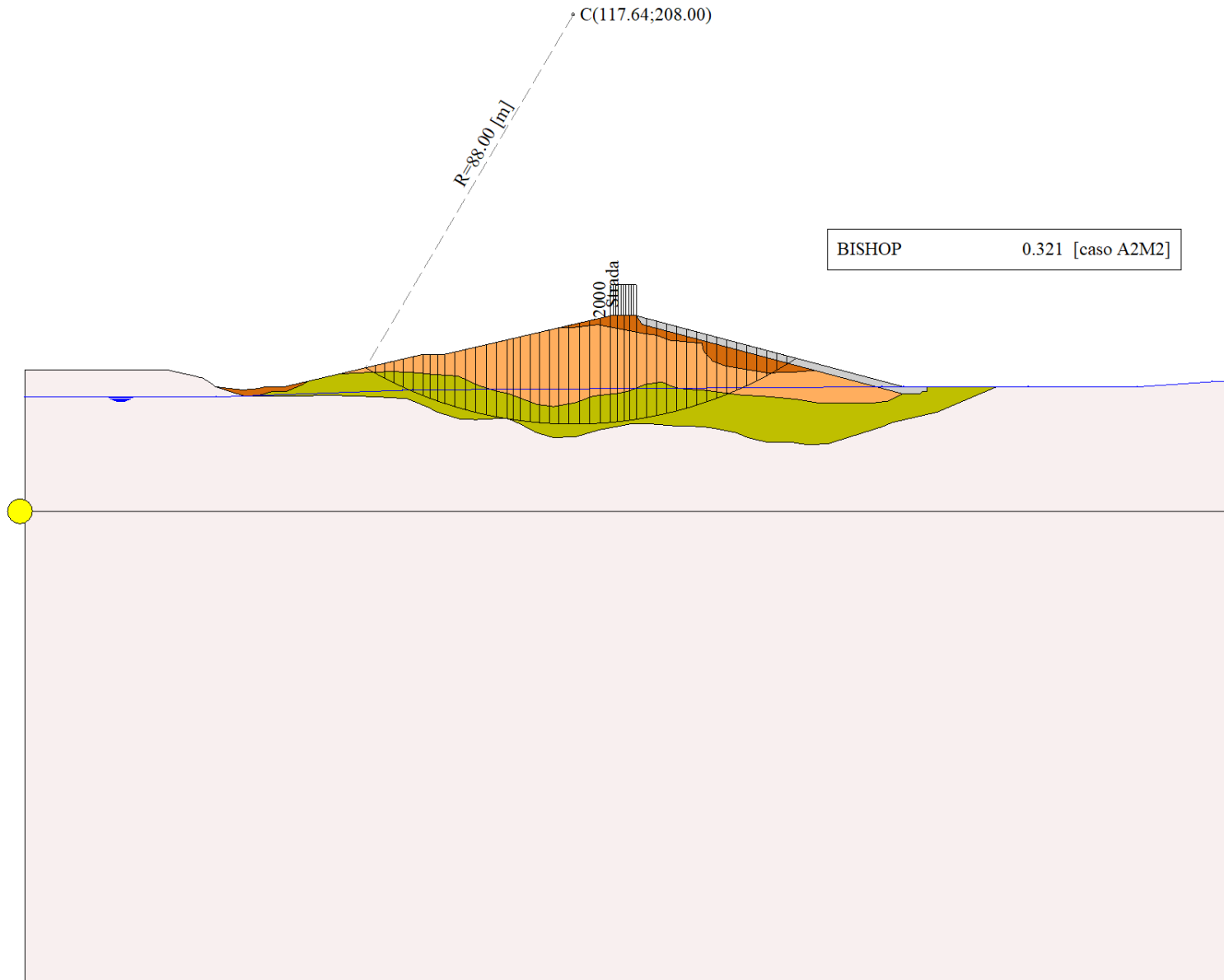


Figura 9-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 05.

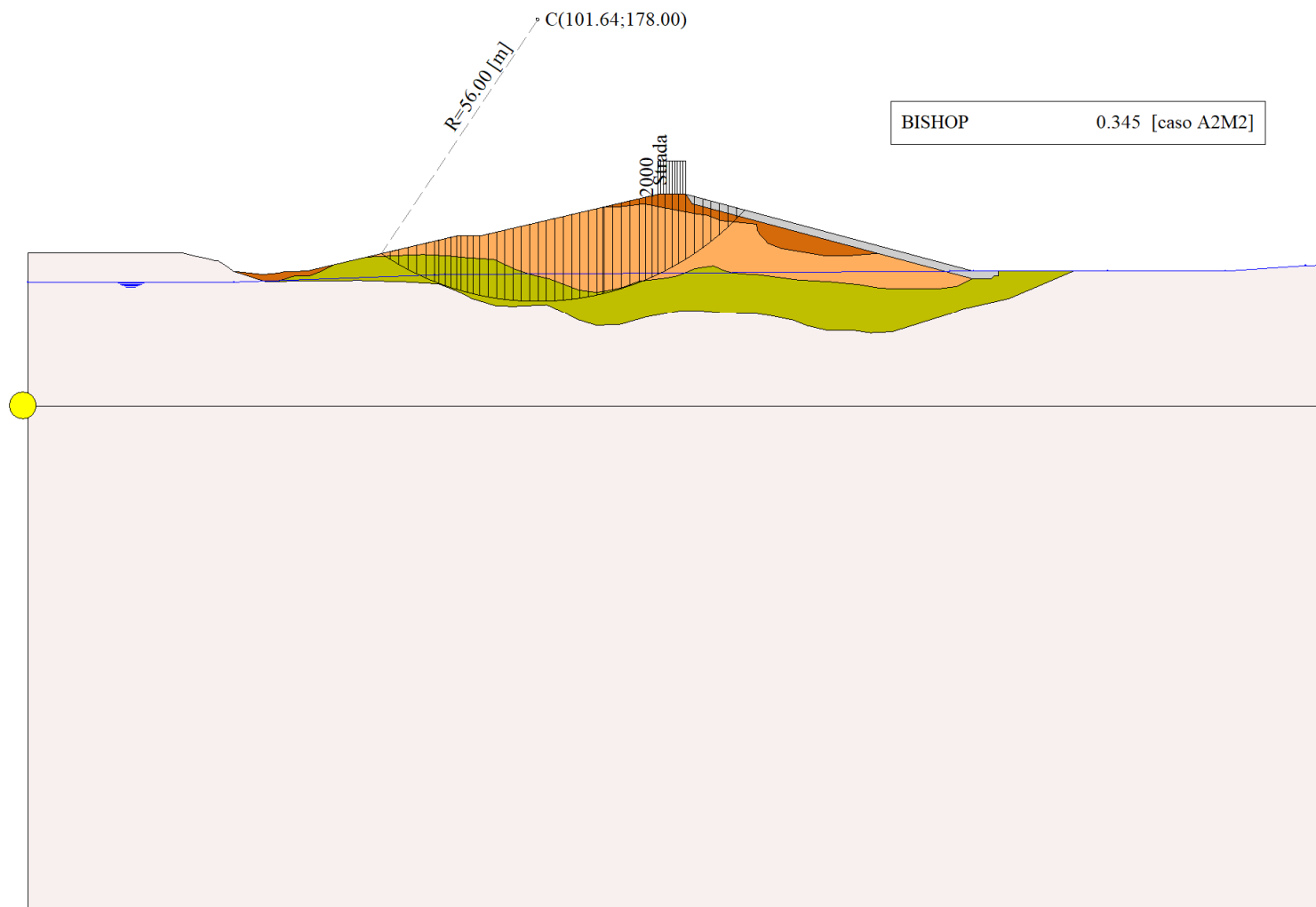


Figura 9-2 – Superficie critica (214) della sezione CR\_06 per la verifica di stabilità 05.

## 10 VERIFICA DI STABILITÀ 06

### 10.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	125.64 143.30	131.14 143.30	2000 2000	0 0

Tabella 10-1 – Carichi distribuiti verifica di stabilità 06.

### 10.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **sismiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 10.2 RISULTATI ANALISI

Numero di superfici analizzate	86748
Coefficiente di sicurezza minimo	0.337
Superficie con coefficiente di sicurezza minimo	1

### 10.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	47
Coordinate del centro	X[m]= 117.64                      Y[m]= 208.00
Raggio del cerchio	R[m]= 88.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 73.09                      Y <sub>v</sub> [m]= 132.11
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 165.48                      Y <sub>m</sub> [m]= 134.14
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.337</b>

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	73.09	132.11	132.11	73.14	132.13	132.08	73.12	132.11	0.06	-30.40	0.00	54
2	73.14	132.13	132.08	75.13	132.59	130.95	74.45	131.88	2.28	-29.63	0.00	54
3	75.13	132.59	130.95	77.11	133.05	129.89	76.22	131.61	2.25	-28.16	0.00	52
4	77.11	133.05	129.89	79.09	133.52	128.89	78.16	131.33	2.22	-26.70	0.00	52
5	79.09	133.52	128.89	81.08	133.98	127.95	80.13	131.08	2.19	-25.26	0.00	52
6	81.08	133.98	127.95	83.23	134.49	127.01	82.19	130.85	2.35	-23.78	0.00	52
7	83.23	134.49	127.01	85.42	135.00	126.11	84.36	130.65	2.37	-22.25	0.00	52
8	85.42	135.00	126.11	86.97	135.00	125.52	86.20	130.41	1.66	-20.94	0.00	52
9	86.97	135.00	125.52	88.52	135.00	124.96	87.75	130.12	1.65	-19.86	0.00	52
10	88.52	135.00	124.96	90.07	135.00	124.43	89.30	129.85	1.64	-18.79	0.00	52
11	90.07	135.00	124.43	92.29	135.52	123.73	91.20	129.67	2.33	-17.50	0.00	52
12	92.29	135.52	123.73	94.51	136.03	123.10	93.41	129.59	2.31	-15.99	0.00	52
13	94.51	136.03	123.10	96.72	136.55	122.52	95.63	129.55	2.29	-14.50	0.00	52
14	96.72	136.55	122.52	98.94	137.07	122.01	97.85	129.54	2.28	-13.01	0.00	52
15	98.94	137.07	122.01	101.16	137.59	121.56	100.06	129.56	2.26	-11.53	0.00	52
16	101.16	137.59	121.56	103.38	138.10	121.16	102.28	129.60	2.25	-10.06	0.00	65
17	103.38	138.10	121.16	104.84	138.44	120.94	104.11	129.66	1.48	-8.84	0.00	67

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α <sub>s</sub> [°]	α <sub>d</sub> [°]	c [kPa]
18	104.84	138.44	120.94	106.30	138.78	120.73	105.57	129.72	1.47	-7.88	0.00	52
19	106.30	138.78	120.73	108.36	139.26	120.49	107.33	129.82	2.07	-6.73	0.00	52
20	108.36	139.26	120.49	110.41	139.74	120.30	109.39	129.95	2.06	-5.38	0.00	52
21	110.41	139.74	120.30	112.47	140.22	120.15	111.44	130.10	2.06	-4.04	0.00	52
22	112.47	140.22	120.15	114.52	140.70	120.06	113.50	130.28	2.06	-2.70	0.00	52
23	114.52	140.70	120.06	116.74	141.22	120.00	115.64	130.50	2.22	-1.31	0.00	52
24	116.74	141.22	120.00	118.97	141.74	120.01	117.86	130.74	2.22	0.14	0.00	52
25	118.97	141.74	120.01	121.19	142.26	120.07	120.08	131.02	2.22	1.59	0.00	52
26	121.19	142.26	120.07	123.42	142.78	120.19	122.31	131.33	2.23	3.04	0.00	52
27	123.42	142.78	120.19	125.64	143.30	120.36	124.53	131.66	2.23	4.49	0.00	52
28	125.64	143.30	120.36	127.09	143.30	120.51	126.36	131.87	1.46	5.69	0.00	52
29	127.09	143.30	120.51	128.54	143.30	120.68	127.81	131.95	1.46	6.64	0.00	52
30	128.54	143.30	120.68	129.79	143.30	120.84	129.16	132.03	1.26	7.53	0.00	52
31	129.79	143.30	120.84	131.14	143.30	121.04	130.46	132.12	1.36	8.38	0.00	52
32	131.14	143.30	121.04	133.29	142.73	121.40	132.21	132.12	2.18	9.54	0.00	52
33	133.29	142.73	121.40	135.45	142.15	121.82	134.36	132.03	2.19	10.96	0.00	52
34	135.45	142.15	121.82	137.60	141.58	122.29	136.52	131.96	2.21	12.39	0.00	52
35	137.60	141.58	122.29	139.76	141.00	122.83	138.67	131.92	2.22	13.83	0.00	52
36	139.76	141.00	122.83	141.91	140.43	123.41	140.82	131.92	2.23	15.28	0.00	52
37	141.91	140.43	123.41	144.07	139.85	124.06	142.98	131.94	2.25	16.74	0.00	52
38	144.07	139.85	124.06	146.22	139.28	124.77	145.13	131.99	2.27	18.21	0.00	52
39	146.22	139.28	124.77	148.38	138.70	125.54	147.28	132.07	2.29	19.70	0.00	52
40	148.38	138.70	125.54	150.53	138.13	126.38	149.43	132.19	2.31	21.20	0.00	52
41	150.53	138.13	126.38	152.69	137.55	127.28	151.58	132.33	2.34	22.71	0.00	54
42	152.69	137.55	127.28	154.84	136.98	128.25	153.73	132.51	2.36	24.24	0.00	54
43	154.84	136.98	128.25	157.00	136.41	129.29	155.88	132.73	2.39	25.79	0.00	54
44	157.00	136.41	129.29	159.15	135.83	130.41	158.02	132.98	2.43	27.36	0.00	54
45	159.15	135.83	130.41	161.26	135.27	131.57	160.14	133.26	2.41	28.93	0.00	54
46	161.26	135.27	131.57	163.37	134.71	132.82	162.20	133.57	2.45	30.51	0.00	53
47	163.37	134.71	132.82	165.48	134.14	134.14	164.08	133.89	2.49	32.12	31.83	9

Tabella 10-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 06.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	2	0	608	1030	0	0	1195	0	0	
2	3239	0	26062	37228	0	1195	44425	0	0	
3	9494	0	33109	35482	0	44425	85425	0	0	
4	15619	0	40534	35017	0	85425	125204	0	0	
5	21442	0	47409	34591	0	125204	163379	0	0	
6	29475	0	58548	37028	0	163379	202536	0	0	
7	36385	0	66795	37290	0	202536	239702	0	0	
8	28905	0	50583	26154	0	239702	264222	0	0	
9	30753	0	52251	25972	0	264222	287268	0	0	
10	32501	0	53790	25803	0	287268	308802	0	0	
11	50444	0	80904	36657	0	308802	336708	0	0	
12	55645	0	86314	36368	0	336708	360829	0	0	
13	60317	0	91015	36110	0	360829	381044	0	0	
14	64718	0	95374	35881	0	381044	397208	0	0	
15	68922	0	99501	35680	0	397208	409177	0	0	
16	72899	0	104954	44455	0	409177	425926	0	0	
17	50031	0	71070	30115	0	425926	435484	0	0	
18	51515	0	71401	23229	0	435484	436237	0	0	

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
19	74865	0	102683	32611	0	436237	434081	0	0	
20	77445	0	105052	32530	0	434081	428143	0	0	
21	79945	0	107370	32467	0	428143	418360	0	0	
22	82316	0	109572	32422	0	418360	404699	0	0	
23	91757	0	121132	35059	0	404699	385426	0	0	
24	94379	0	123652	35050	0	385426	361455	0	0	
25	96816	0	126009	35063	0	361455	332777	0	0	
26	98966	0	128071	35099	0	332777	299467	0	0	
27	100811	0	129816	35157	0	299467	261636	0	0	
28	66119	2900	88649	22965	0	261636	232758	0	0	
29	65734	2900	87914	23006	0	232758	202744	0	0	
30	56321	2500	75164	19871	0	202744	176004	0	0	
31	60455	2700	80526	21505	0	176004	146253	0	0	
32	94183	0	119427	34432	0	146253	101829	0	0	
33	90112	0	113640	34587	0	101829	58114	0	0	
34	85759	0	107479	34766	0	58114	15646	0	0	
35	80841	0	100543	34971	0	15646	-24734	0	0	
36	75613	0	93150	35201	0	-24734	-62376	0	0	
37	70248	0	85510	35460	0	-62376	-96759	0	0	
38	64804	0	77681	35747	0	-96759	-127402	0	0	
39	59466	0	69898	36067	0	-127402	-154003	0	0	
40	53437	0	61020	36420	0	-154003	-175355	0	0	
41	47111	0	51063	37976	0	-175355	-189345	0	0	
42	40748	0	41134	38769	0	-189345	-196231	0	0	
43	33437	0	29718	39261	0	-196231	-194609	0	0	
44	26493	0	18516	39803	0	-194609	-184249	0	0	
45	18851	0	6625	39104	0	-184249	-164957	0	0	
46	11252	0	-5951	39152	0	-164957	-135205	0	0	
47	3604	0	538	8030	0	-135205	-130933	0	0	

Tabella 10-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 06.

### 10.2.2 ANALISI DELLA SUPERFICIE 193 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	48	
Coordinate del centro	X[m]= 101.64	Y[m]= 178.00
Raggio del cerchio	R[m]= 56.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 70.44	Y <sub>v</sub> [m]= 131.49
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 142.92	Y <sub>m</sub> [m]= 140.16
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.361</b>	

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α [°]	β [°]	c [kPa]
1	70.44	131.49	131.49	72.22	131.91	130.35	71.63	131.25	2.11	-32.77	0.00	53
2	72.22	131.91	130.35	73.99	132.32	129.30	73.20	130.96	2.06	-30.64	0.00	52
3	73.99	132.32	129.30	75.76	132.74	128.34	74.93	130.67	2.02	-28.56	0.00	52
4	75.76	132.74	128.34	77.53	133.15	127.45	76.69	130.42	1.98	-26.51	0.00	52
5	77.53	133.15	127.45	79.31	133.57	126.65	78.45	130.20	1.95	-24.50	0.00	52
6	79.31	133.57	126.65	81.08	133.98	125.91	80.22	130.03	1.92	-22.52	0.00	52
7	81.08	133.98	125.91	81.87	134.17	125.61	81.48	129.92	0.85	-21.11	0.00	52
8	81.87	134.17	125.61	83.23	134.49	125.11	82.56	129.84	1.45	-19.93	0.00	52
9	83.23	134.49	125.11	84.32	134.74	124.74	83.78	129.77	1.16	-18.60	0.00	52
10	84.32	134.74	124.74	85.42	135.00	124.40	84.88	129.72	1.15	-17.42	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∅ [°]	∅ [°]	c [kPa]
11	85.42	135.00	124.40	86.34	135.00	124.13	85.88	129.63	0.96	-16.35	0.00	52
12	86.34	135.00	124.13	87.58	135.00	123.79	86.96	129.48	1.29	-15.20	0.00	52
13	87.58	135.00	123.79	88.83	135.00	123.49	88.21	129.32	1.28	-13.88	0.00	52
14	88.83	135.00	123.49	90.07	135.00	123.21	89.45	129.17	1.27	-12.58	0.00	52
15	90.07	135.00	123.21	91.73	135.39	122.88	90.91	129.12	1.70	-11.06	0.00	52
16	91.73	135.39	122.88	93.40	135.78	122.61	92.57	129.16	1.69	-9.33	0.00	52
17	93.40	135.78	122.61	95.06	136.16	122.39	94.24	129.23	1.68	-7.61	0.00	52
18	95.06	136.16	122.39	96.72	136.55	122.22	95.90	129.33	1.67	-5.89	0.00	52
19	96.72	136.55	122.22	98.39	136.94	122.09	97.56	129.45	1.67	-4.18	0.00	52
20	98.39	136.94	122.09	100.05	137.33	122.02	99.22	129.60	1.67	-2.48	0.00	52
21	100.05	137.33	122.02	101.72	137.72	122.00	100.89	129.77	1.66	-0.77	0.00	52
22	101.72	137.72	122.00	103.38	138.10	122.03	102.55	129.96	1.66	0.93	0.00	52
23	103.38	138.10	122.03	105.05	138.49	122.10	104.22	130.18	1.67	2.63	0.00	52
24	105.05	138.49	122.10	106.72	138.88	122.23	105.88	130.43	1.67	4.35	0.00	52
25	106.72	138.88	122.23	108.38	139.27	122.41	107.55	130.70	1.68	6.06	0.00	52
26	108.38	139.27	122.41	110.05	139.66	122.64	109.22	130.99	1.68	7.78	0.00	52
27	110.05	139.66	122.64	111.72	140.05	122.91	110.89	131.31	1.69	9.51	0.00	52
28	111.72	140.05	122.91	113.39	140.44	123.25	112.56	131.66	1.70	11.24	0.00	52
29	113.39	140.44	123.25	114.52	140.70	123.50	113.96	131.97	1.16	12.70	0.00	52
30	114.52	140.70	123.50	114.85	140.78	123.58	114.68	132.14	0.34	13.47	0.00	52
31	114.85	140.78	123.58	116.56	141.18	124.03	115.71	132.39	1.77	14.55	0.00	52
32	116.56	141.18	124.03	118.28	141.58	124.53	117.42	132.83	1.79	16.37	0.00	52
33	118.28	141.58	124.53	120.05	141.99	125.11	119.16	133.30	1.86	18.24	0.00	52
34	120.05	141.99	125.11	121.81	142.40	125.76	120.93	133.82	1.88	20.15	0.00	52
35	121.81	142.40	125.76	123.09	142.70	126.27	122.45	134.28	1.38	21.81	0.00	53
36	123.09	142.70	126.27	124.36	143.00	126.82	123.72	134.70	1.39	23.23	0.00	54
37	124.36	143.00	126.82	125.64	143.30	127.40	125.00	135.13	1.40	24.66	0.00	54
38	125.64	143.30	127.40	127.01	143.30	128.08	126.32	135.52	1.53	26.16	0.00	54
39	127.01	143.30	128.08	128.39	143.30	128.80	127.70	135.87	1.55	27.74	0.00	54
40	128.39	143.30	128.80	129.76	143.30	129.57	129.07	136.24	1.58	29.34	0.00	54
41	129.76	143.30	129.57	131.14	143.30	130.40	130.45	136.64	1.60	30.97	0.00	54
42	131.14	143.30	130.40	132.82	142.85	131.49	131.96	137.01	2.00	32.81	0.00	54
43	132.82	142.85	131.49	134.51	142.40	132.66	133.64	137.34	2.05	34.89	0.00	54
44	134.51	142.40	132.66	136.19	141.95	133.93	135.32	137.73	2.11	37.01	0.00	54
45	136.19	141.95	133.93	137.87	141.51	135.30	136.99	138.16	2.17	39.20	0.00	54
46	137.87	141.51	135.30	139.55	141.06	136.79	138.66	138.65	2.25	41.46	0.00	54
47	139.55	141.06	136.79	141.24	140.61	138.40	140.31	139.18	2.33	43.81	0.00	54
48	141.24	140.61	138.40	142.92	140.16	140.16	141.80	139.72	2.43	46.24	27.23	16

Tabella 10-4 – Geometria e caratteristiche strisce della superficie 193 della verifica di stabilità 06.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	2727	0	24622	31638	0	0	38234	0	0	
2	8235	0	30532	30356	0	38234	74789	0	0	
3	13447	0	36254	29735	0	74789	109870	0	0	
4	18349	0	41442	29186	0	109870	143070	0	0	
5	22955	0	46154	28702	0	143070	174045	0	0	
6	27248	0	50397	28274	0	174045	202514	0	0	
7	13460	0	23732	12477	0	202514	214325	0	0	
8	24967	0	42549	21315	0	214325	233336	0	0	
9	21695	0	35741	17023	0	233336	247373	0	0	
10	23042	0	36969	16909	0	247373	260241	0	0	



N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
11	20166	0	31696	14126	0	260241	270170	0	0	
12	28028	0	43234	18983	0	270170	282384	0	0	
13	28853	0	43630	18870	0	282384	293220	0	0	
14	29601	0	43949	18769	0	293220	302692	0	0	
15	41262	0	60001	24977	0	302692	313041	0	0	
16	43520	0	61902	24841	0	313041	320510	0	0	
17	45466	0	63440	24731	0	320510	325133	0	0	
18	47186	0	64735	24643	0	325133	326934	0	0	
19	48743	0	65873	24578	0	326934	325925	0	0	
20	50176	0	66906	24536	0	325925	322113	0	0	
21	51442	0	67781	24515	0	322113	315536	0	0	
22	52570	0	68534	24516	0	315536	306232	0	0	
23	53661	0	69296	24607	0	306232	294242	0	0	
24	54379	0	69627	24651	0	294242	279715	0	0	
25	54917	0	69781	24719	0	279715	262763	0	0	
26	55278	0	69758	24809	0	262763	243511	0	0	
27	55535	0	69651	24923	0	243511	222037	0	0	
28	55656	0	69415	25061	0	222037	198460	0	0	
29	37709	0	46833	17067	0	198460	181349	0	0	
30	11013	0	13650	5000	0	181349	176179	0	0	
31	57176	0	70670	26105	0	176179	148121	0	0	
32	56953	0	70088	26336	0	148121	118200	0	0	
33	58186	0	71298	27380	0	118200	85693	0	0	
34	57550	0	70208	27700	0	85693	51709	0	0	
35	41067	0	49766	20560	0	51709	26754	0	0	
36	40537	0	48689	21310	0	26754	1913	0	0	
37	39949	0	47740	21548	0	1913	-23275	0	0	
38	41805	2750	53539	23498	0	-23275	-53509	0	0	
39	39983	2750	50769	23830	0	-53509	-82634	0	0	
40	38032	2750	47735	24195	0	-82634	-110305	0	0	
41	35944	2750	44403	24598	0	-110305	-136135	0	0	
42	39761	0	42223	30715	0	-136135	-157939	0	0	
43	34350	0	32959	31469	0	-157939	-172347	0	0	
44	28873	0	23034	32329	0	-172347	-178363	0	0	
45	23137	0	11973	33313	0	-178363	-174512	0	0	
46	17024	0	-654	34447	0	-174512	-158856	0	0	
47	10435	0	-15028	35431	0	-158856	-129375	0	0	
48	3381	0	-1931	7987	0	-129375	-124560	0	0	

Tabella 10-5 – Forze applicate sulle strisce [BISHOP] della superficie 193 della verifica di stabilità 06.

### 10.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.020163
2	0.007391
3	0.013580
4	0.019750
5	0.030603
6	0.009345
7	0.014740

Tabella 10-6 – Spostamenti della superficie 1 della verifica di stabilità 06.

Accelerazione sismica critica  $K_c = 0.189$   
Spostamento massimo  $U_{max} = 0.030603$  [m]  
Velocità massima  $V_{max} = 0.131906$  [m/s]

n°	u
	[m]
1	0.046432
2	0.019715
3	0.038145
4	0.037898
5	0.055804
6	0.018244
7	0.028610

Tabella 10-7 – Spostamenti della superficie 193 della verifica di stabilità 06.

Accelerazione sismica critica  $K_c = 0.145$   
Spostamento massimo  $U_{max} = 0.055804$  [m]  
Velocità massima  $V_{max} = 0.167005$  [m/s]

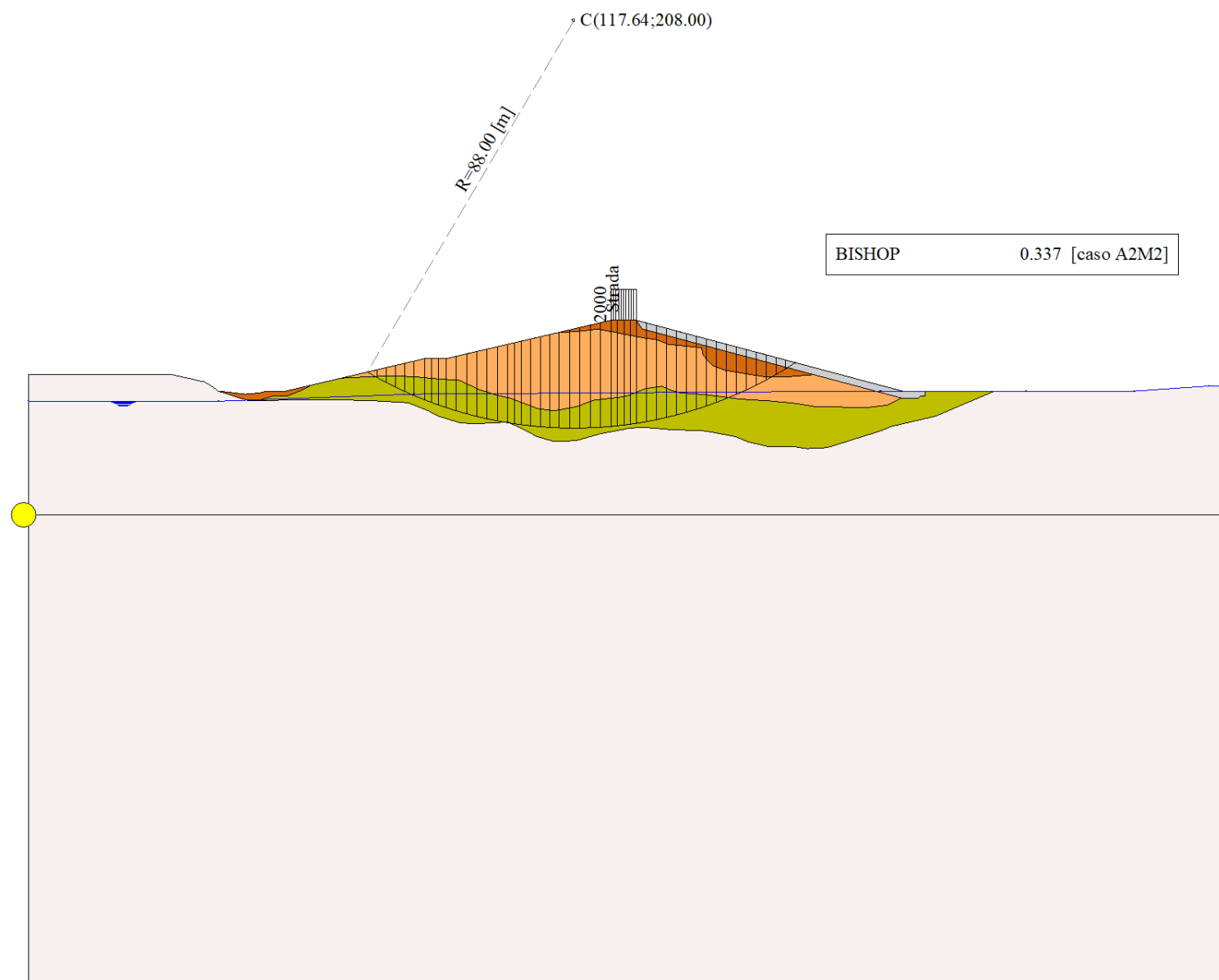


Figura 10-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 06.

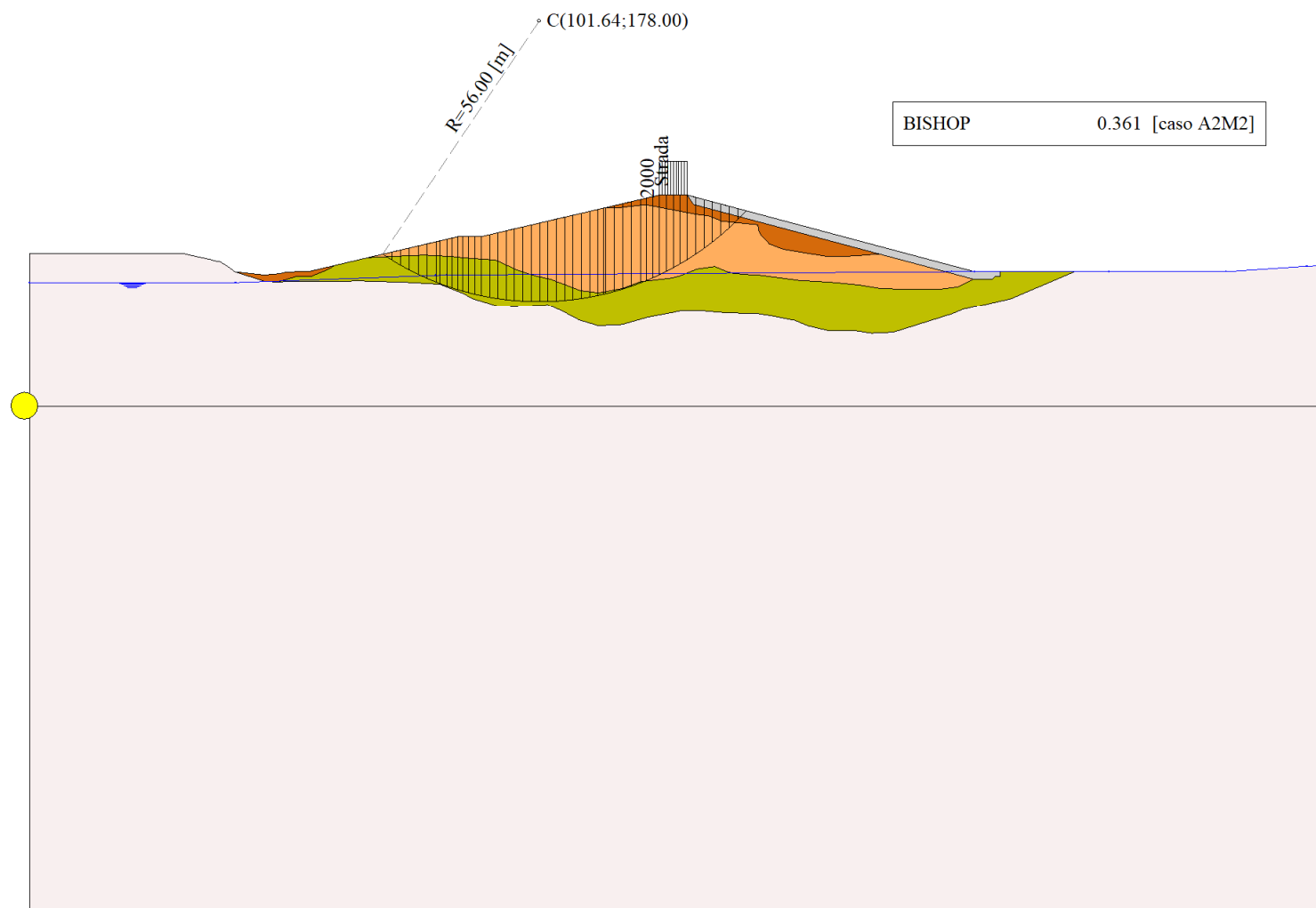


Figura 10-2 – Superficie critica (193) della sezione CR\_06 per la verifica di stabilità 06.

## 11 VERIFICA DI STABILITÀ 07

### 11.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	125.64 143.30	131.14 143.30	2000 2000	0 0

Tabella 11-1 – Carichi distribuiti verifica di stabilità 07.

### 11.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **statiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni efficaci**

Presenza di falda

Presenza di carichi distribuiti

## 11.2 RISULTATI ANALISI

Numero di superfici analizzate 43374

Coefficiente di sicurezza minimo 2.160

Superficie con coefficiente di sicurezza minimo 1

### 11.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO L'ALTO

Numero di strisce 58  
 Coordinate del centro X[m]= 79.64 Y[m]= 188.00  
 Raggio del cerchio R[m]= 70.00  
 Intersezione a valle con il profilo topografico X<sub>v</sub>[m]= 44.21 Y<sub>v</sub>[m]= 127.63  
 Intersezione a monte con il profilo topografico X<sub>m</sub>[m]= 133.08 Y<sub>m</sub>[m]= 142.78  
 Coefficiente di sicurezza F<sub>S</sub>= 2.160

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	44.21	127.63	127.63	45.48	127.48	126.90	45.06	127.34	1.46	-29.81	17.58	19
2	45.48	127.48	126.90	46.75	127.34	126.21	46.18	126.96	1.45	-28.62	17.58	19
3	46.75	127.34	126.21	47.12	127.37	126.01	46.94	126.73	0.42	-27.85	17.58	19
4	47.12	127.37	126.01	48.50	127.49	125.31	47.86	126.53	1.55	-27.05	19.23	19
5	48.50	127.49	125.31	49.88	127.61	124.64	49.23	126.26	1.53	-25.79	19.27	19
6	49.88	127.61	124.64	51.32	127.98	123.98	50.64	126.05	1.58	-24.51	19.27	19
7	51.32	127.98	123.98	52.78	127.99	123.36	52.07	125.82	1.59	-23.21	19.27	19
8	52.78	127.99	123.36	54.24	128.00	122.77	53.52	125.53	1.57	-21.92	19.27	19
9	54.24	128.00	122.77	55.52	128.00	122.29	54.89	125.26	1.37	-20.72	19.27	19
10	55.52	128.00	122.29	57.35	128.43	121.64	56.46	125.09	1.94	-19.36	19.27	19
11	57.35	128.43	121.64	59.17	128.85	121.06	58.28	125.00	1.92	-17.79	19.27	19
12	59.17	128.85	121.06	61.00	129.28	120.53	60.10	124.93	1.90	-16.22	19.27	19
13	61.00	129.28	120.53	63.16	129.79	119.97	62.10	124.89	2.23	-14.53	19.27	19
14	63.16	129.79	119.97	65.32	130.29	119.48	64.26	124.88	2.21	-12.71	19.27	19
15	65.32	130.29	119.48	67.48	130.80	119.06	66.41	124.91	2.20	-10.90	19.27	19
16	67.48	130.80	119.06	69.42	131.25	118.75	68.46	124.97	1.97	-9.20	19.27	19

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∅ [°]	∅ [°]	c [kPa]
17	69.42	131.25	118.75	71.37	131.71	118.49	70.40	125.05	1.96	-7.59	19.27	19
18	71.37	131.71	118.49	73.31	132.16	118.29	72.35	125.16	1.95	-5.99	19.27	19
19	73.31	132.16	118.29	75.25	132.62	118.14	74.29	125.30	1.95	-4.39	19.27	19
20	75.25	132.62	118.14	77.19	133.07	118.04	76.23	125.47	1.95	-2.80	19.27	19
21	77.19	133.07	118.04	79.14	133.53	118.00	78.17	125.66	1.94	-1.21	19.27	19
22	79.14	133.53	118.00	81.08	133.98	118.01	80.11	125.88	1.94	0.38	19.27	19
23	81.08	133.98	118.01	81.40	134.06	118.02	81.24	126.02	0.32	1.31	19.27	19
24	81.40	134.06	118.02	83.54	134.56	118.11	82.47	126.19	2.14	2.32	19.27	19
25	83.54	134.56	118.11	85.42	135.00	118.24	84.48	126.48	1.88	3.97	19.27	19
26	85.42	135.00	118.24	87.15	135.00	118.40	86.28	126.66	1.74	5.45	19.27	19
27	87.15	135.00	118.40	88.61	135.00	118.58	87.88	126.75	1.47	6.76	19.27	19
28	88.61	135.00	118.58	90.07	135.00	118.78	89.34	126.84	1.47	7.97	19.27	19
29	90.07	135.00	118.78	91.24	135.27	118.97	90.66	127.01	1.18	9.05	19.27	19
30	91.24	135.27	118.97	93.14	135.72	119.31	92.19	127.32	1.93	10.33	19.27	19
31	93.14	135.72	119.31	95.04	136.16	119.72	94.09	127.73	1.94	11.91	19.27	19
32	95.04	136.16	119.72	96.73	136.55	120.12	95.88	128.14	1.74	13.42	19.27	19
33	96.73	136.55	120.12	98.51	136.97	120.59	97.62	128.56	1.84	14.88	19.27	19
34	98.51	136.97	120.59	100.42	137.41	121.16	99.46	129.03	1.99	16.45	19.26	19
35	100.42	137.41	121.16	102.42	137.88	121.81	101.42	129.56	2.10	18.13	19.10	18
36	102.42	137.88	121.81	103.38	138.10	122.15	102.90	129.99	1.02	19.41	19.10	18
37	103.38	138.10	122.15	105.41	138.58	122.92	104.39	130.44	2.18	20.72	19.10	18
38	105.41	138.58	122.92	107.45	139.05	123.76	106.43	131.08	2.20	22.51	19.10	18
39	107.45	139.05	123.76	108.70	139.34	124.32	108.07	131.62	1.37	23.97	19.10	18
40	108.70	139.34	124.32	109.83	139.61	124.84	109.26	132.03	1.25	25.04	19.55	18
41	109.83	139.61	124.84	111.59	140.02	125.72	110.71	132.54	1.96	26.35	19.78	18
42	111.59	140.02	125.72	113.06	140.36	126.49	112.32	133.14	1.66	27.83	19.78	18
43	113.06	140.36	126.49	114.52	140.70	127.31	113.78	133.71	1.68	29.20	19.78	18
44	114.52	140.70	127.31	115.06	140.83	127.62	114.79	134.11	0.62	30.14	19.78	18
45	115.06	140.83	127.62	116.67	141.20	128.60	115.86	134.56	1.89	31.17	19.78	18
46	116.67	141.20	128.60	118.29	141.58	129.64	117.48	135.25	1.92	32.73	19.78	18
47	118.29	141.58	129.64	119.24	141.80	130.28	118.76	135.82	1.15	33.98	19.78	18
48	119.24	141.80	130.28	121.10	142.24	131.60	120.16	136.47	2.29	35.39	19.78	18
49	121.10	142.24	131.60	122.97	142.67	133.02	122.02	137.38	2.34	37.28	19.78	18
50	122.97	142.67	133.02	124.83	143.11	134.54	123.88	138.33	2.41	39.22	19.78	18
51	124.83	143.11	134.54	125.64	143.30	135.24	125.23	139.04	1.07	40.65	19.78	18
52	125.64	143.30	135.24	126.82	143.30	136.29	126.22	139.53	1.59	41.73	19.78	18
53	126.82	143.30	136.29	128.01	143.30	137.40	127.40	140.07	1.62	43.05	19.78	18
54	128.01	143.30	137.40	129.39	143.30	138.76	128.67	140.67	1.93	44.50	19.78	18
55	129.39	143.30	138.76	131.08	143.30	140.52	130.17	141.43	2.45	46.29	19.02	19
56	131.08	143.30	140.52	131.14	143.30	140.59	131.11	141.93	0.09	47.33	17.58	19
57	131.14	143.30	140.59	132.40	142.96	142.00	131.67	142.17	1.89	48.14	21.32	16
58	132.40	142.96	142.00	133.08	142.78	142.78	132.63	142.58	1.04	49.34	38.66	0

Tabella 11-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 07.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	757	0	1781	1587	0	0	2263	0	0	
2	2226	0	3533	1829	0	2263	5560	0	0	
3	943	0	1373	581	0	5560	6715	0	0	
4	5055	0	6294	2422	619	6715	12015	0	0	
5	7442	0	7810	2653	1737	12015	18557	0	0	
6	10579	0	10108	3071	2919	18557	26756	0	0	

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
7	13367	0	11963	3376	4030	26756	36162	0	0	
8	15346	0	12929	3519	5028	36162	46131	0	0	
9	14956	0	12023	3186	5172	46131	55194	0	0	
10	24397	0	19047	4838	8513	55194	68896	0	0	
11	28511	0	21900	5283	9736	68896	83590	0	0	
12	32423	0	24586	5704	10841	83590	98963	0	0	
13	43060	0	32270	7245	14091	98963	117608	0	0	
14	47825	0	35462	7747	15311	117608	136337	0	0	
15	52250	0	38420	8212	16373	136337	154765	0	0	
16	50439	0	36839	7746	15512	154765	170780	0	0	
17	53382	0	38782	8053	16145	170780	186018	0	0	
18	56092	0	40596	8341	16678	186018	200290	0	0	
19	58567	0	42286	8610	17115	200290	213423	0	0	
20	60808	0	43857	8861	17457	213423	225267	0	0	
21	62817	0	45316	9095	17707	225267	235688	0	0	
22	64560	0	46633	9308	17865	235688	244565	0	0	
23	10786	0	7922	1572	2831	244565	245891	0	0	
24	73048	0	53051	10527	19630	245891	253471	0	0	
25	65313	0	47086	9329	17738	253471	258295	0	0	
26	60152	0	42997	8534	16615	258295	261131	0	0	
27	50124	0	35395	7061	14243	261131	262300	0	0	
28	49450	0	34631	6941	14329	262300	262389	0	0	
29	39394	0	27491	5523	11520	262389	261704	0	0	
30	64101	0	44777	8997	18740	261704	259167	0	0	
31	63959	0	44811	9013	18655	259167	254883	0	0	
32	56536	0	39761	8010	16451	254883	249628	0	0	
33	59021	0	41732	8424	17100	249628	242657	0	0	
34	62586	0	44743	9041	17846	242657	233599	0	0	
35	64503	0	46565	9213	18291	233599	222173	0	0	
36	30542	0	22348	4428	8474	222173	216108	0	0	
37	63591	0	46729	9299	17741	216108	202001	0	0	
38	61730	0	45687	9154	17339	202001	186332	0	0	
39	36865	0	27683	5574	10183	186332	176043	0	0	
40	32594	0	24575	5107	9014	176043	166455	0	0	
41	49512	0	37572	7961	13739	166455	150812	0	0	
42	39946	0	30769	6562	10939	150812	137140	0	0	
43	38657	0	30048	6460	10626	137140	122937	0	0	
44	13905	0	10886	2355	3826	122937	117586	0	0	
45	40393	0	32010	6969	10983	117586	101296	0	0	
46	38481	0	30928	6817	10434	101296	84668	0	0	
47	21665	0	17837	3965	5617	84668	74846	0	0	
48	40171	0	33048	7488	10907	74846	55496	0	0	
49	36841	0	31206	7230	9592	55496	36536	0	0	
50	33220	0	29197	6950	8011	36536	18391	0	0	
51	13243	0	11942	2916	3009	18391	10865	0	0	
52	17619	3081	19986	4707	3554	10865	-1292	0	0	
53	15166	3081	18350	4464	2449	-1292	-12227	0	0	
54	14408	3588	19133	4866	1317	-12227	-23090	0	0	
55	12565	4394	19099	5205	0	-23090	-33300	0	0	
56	337	156	552	161	0	-33300	-33597	0	0	
57	4516	0	4324	2189	0	-33597	-35356	0	0	
58	590	0	632	234	0	-35356	-35683	0	0	

Tabella 11-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 07.

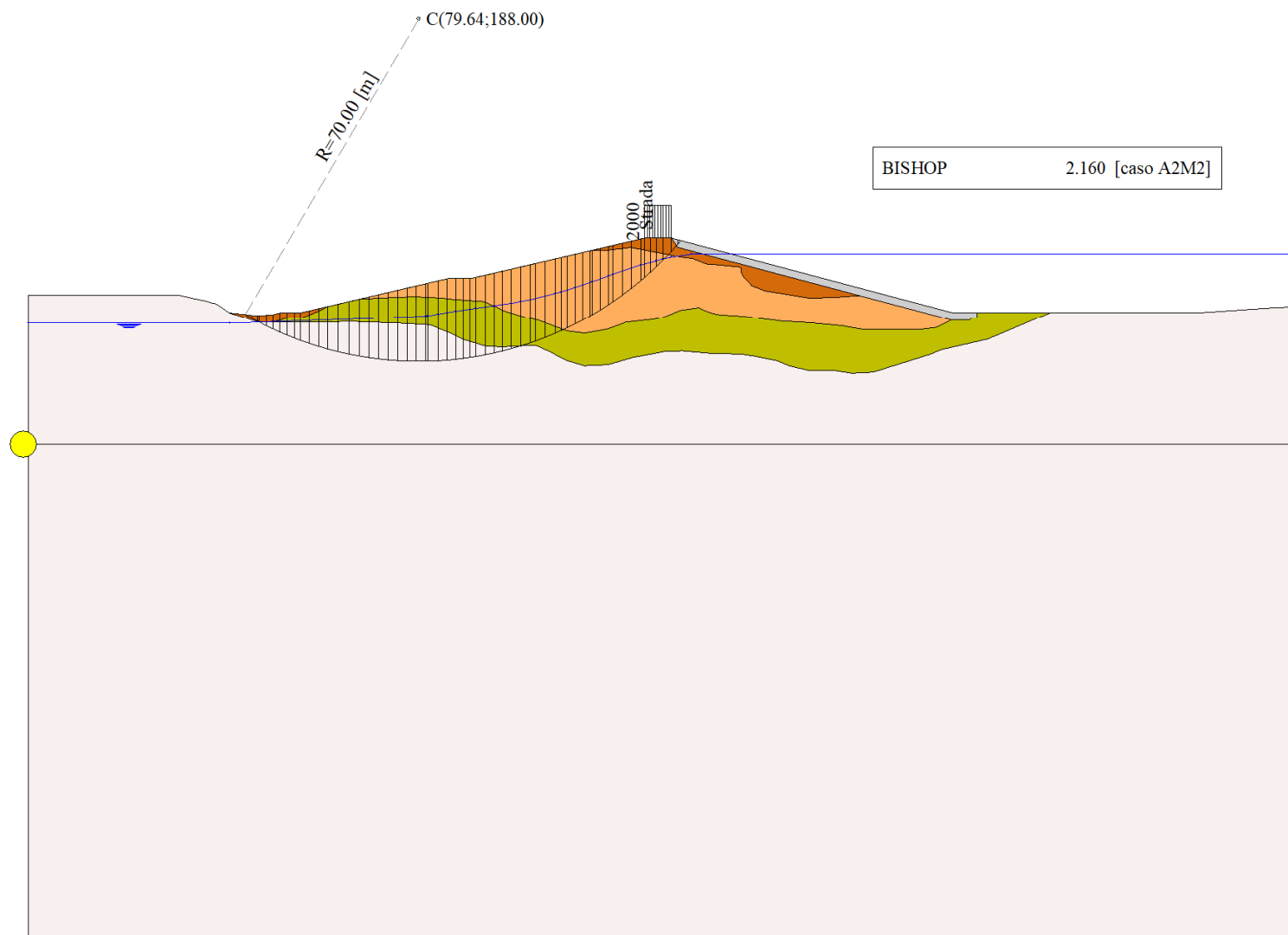


Figura 11-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 07.



## 12 VERIFICA DI STABILITÀ 08

### 12.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	125.64 143.30	131.14 143.30	2000 2000	0 0
2	Azione inerziale acqua 1/4	Variabile	1.00	177.27 131.00	188.52 131.00	743 780	-198 -208
3	Azione inerziale acqua 2/4	Variabile	1.00	166.02 134.00	177.27 134.00	630 743	-168 -198
4	Azione inerziale acqua 3/4	Variabile	1.00	154.77 137.00	166.02 137.00	429 630	-114 -168
5	Azione inerziale acqua 4/4	Variabile	1.00	143.52 140.00	154.77 140.00	0 429	0 -114

Tabella 12-1 – Carichi distribuiti verifica di stabilità 08.

### 12.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **sismiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 12.2 RISULTATI ANALISI

Numero di superfici analizzate	86748
Coefficiente di sicurezza minimo	0.751
Superficie con coefficiente di sicurezza minimo	1

### 12.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	59	
Coordinate del centro	X[m]= 103.64	Y[m]= 192.00
Raggio del cerchio	R[m]= 70.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 69.02	Y <sub>v</sub> [m]= 131.16
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 148.87	Y <sub>m</sub> [m]= 138.57
Coefficiente di sicurezza	F <sub>S</sub> = <b>0.751</b>	

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\bar{\alpha}$ [°]	$\bar{\beta}$ [°]	c [kPa]
1	69.02	131.16	131.16	70.74	131.56	130.21	70.17	130.98	1.97	-28.84	0.00	53
2	70.74	131.56	130.21	72.47	131.97	129.32	71.70	130.75	1.94	-27.24	0.00	52
3	72.47	131.97	129.32	74.19	132.37	128.50	73.38	130.53	1.91	-25.66	0.00	52
4	74.19	132.37	128.50	75.91	132.77	127.73	75.09	130.34	1.89	-24.11	0.00	52
5	75.91	132.77	127.73	77.63	133.18	127.01	76.80	130.17	1.87	-22.57	0.00	52
6	77.63	133.18	127.01	79.36	133.58	126.35	78.52	130.03	1.85	-21.05	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∠ [°]	∠ [°]	c [kPa]
7	79.36	133.58	126.35	81.08	133.98	125.74	80.24	129.91	1.83	-19.55	0.00	52
8	81.08	133.98	125.74	81.40	134.06	125.63	81.24	129.85	0.34	-18.66	0.00	52
9	81.40	134.06	125.63	81.87	134.17	125.47	81.64	129.83	0.50	-18.32	0.00	56
10	81.87	134.17	125.47	83.54	134.56	124.95	82.72	129.79	1.75	-17.40	0.00	55
11	83.54	134.56	124.95	85.42	135.00	124.41	84.50	129.73	1.95	-15.89	0.00	52
12	85.42	135.00	124.41	86.34	135.00	124.17	85.88	129.65	0.95	-14.70	0.00	52
13	86.34	135.00	124.17	87.15	135.00	123.97	86.75	129.54	0.83	-13.97	0.00	52
14	87.15	135.00	123.97	88.61	135.00	123.63	87.88	129.40	1.50	-13.01	0.00	52
15	88.61	135.00	123.63	90.07	135.00	123.33	89.34	129.24	1.49	-11.79	0.00	52
16	90.07	135.00	123.33	91.24	135.27	123.11	90.66	129.18	1.19	-10.69	0.00	52
17	91.24	135.27	123.11	93.14	135.72	122.79	92.20	129.22	1.93	-9.42	0.00	52
18	93.14	135.72	122.79	95.04	136.16	122.53	94.10	129.30	1.92	-7.84	0.00	52
19	95.04	136.16	122.53	96.77	136.56	122.34	95.91	129.40	1.75	-6.34	0.00	52
20	96.77	136.56	122.34	98.51	136.97	122.19	97.65	129.51	1.74	-4.92	0.00	52
21	98.51	136.97	122.19	100.42	137.41	122.07	99.47	129.66	1.91	-3.42	0.00	52
22	100.42	137.41	122.07	101.42	137.65	122.04	100.92	129.79	1.00	-2.23	0.00	52
23	101.42	137.65	122.04	102.42	137.88	122.01	101.92	129.89	1.00	-1.41	0.00	52
24	102.42	137.88	122.01	103.38	138.10	122.00	102.90	130.00	0.96	-0.61	0.00	52
25	103.38	138.10	122.00	104.74	138.42	122.01	104.06	130.13	1.36	0.34	0.00	52
26	104.74	138.42	122.01	106.09	138.74	122.04	105.42	130.30	1.36	1.45	0.00	52
27	106.09	138.74	122.04	107.45	139.05	122.10	106.77	130.48	1.36	2.56	0.00	52
28	107.45	139.05	122.10	108.70	139.34	122.18	108.08	130.67	1.25	3.63	0.00	52
29	108.70	139.34	122.18	110.14	139.68	122.30	109.42	130.88	1.45	4.74	0.00	52
30	110.14	139.68	122.30	111.59	140.02	122.45	110.87	131.11	1.45	5.93	0.00	52
31	111.59	140.02	122.45	113.06	140.36	122.64	112.32	131.37	1.48	7.13	0.00	52
32	113.06	140.36	122.64	114.52	140.70	122.85	113.79	131.64	1.48	8.34	0.00	52
33	114.52	140.70	122.85	115.06	140.83	122.94	114.79	131.83	0.55	9.17	0.00	52
34	115.06	140.83	122.94	116.67	141.20	123.22	115.87	132.05	1.64	10.06	0.00	52
35	116.67	141.20	123.22	118.29	141.58	123.55	117.48	132.39	1.65	11.41	0.00	52
36	118.29	141.58	123.55	119.24	141.80	123.76	118.77	132.67	0.97	12.48	0.00	52
37	119.24	141.80	123.76	121.10	142.24	124.21	120.17	133.00	1.92	13.66	0.00	52
38	121.10	142.24	124.21	122.97	142.67	124.72	122.03	133.46	1.93	15.24	0.00	52
39	122.97	142.67	124.72	124.83	143.11	125.28	123.90	133.95	1.95	16.82	0.00	52
40	124.83	143.11	125.28	125.64	143.30	125.55	125.23	134.31	0.85	17.97	0.00	52
41	125.64	143.30	125.55	127.52	143.30	126.20	126.57	134.59	1.99	19.13	0.00	52
42	127.52	143.30	126.20	128.01	143.30	126.38	127.76	134.79	0.52	20.16	0.00	52
43	128.01	143.30	126.38	129.39	143.30	126.91	128.70	134.97	1.48	20.98	0.00	52
44	129.39	143.30	126.91	129.40	143.30	126.91	129.39	135.11	0.01	21.59	0.00	52
45	129.40	143.30	126.91	131.08	143.30	127.60	130.23	135.28	1.82	22.34	0.00	52
46	131.08	143.30	127.60	131.14	143.30	127.63	131.11	135.46	0.07	23.11	0.00	52
47	131.14	143.30	127.63	133.06	142.79	128.48	132.09	135.55	2.10	23.99	0.00	52
48	133.06	142.79	128.48	134.18	142.49	129.01	133.61	135.69	1.23	25.36	0.00	54
49	134.18	142.49	129.01	135.29	142.19	129.56	134.73	135.81	1.24	26.37	0.00	54
50	135.29	142.19	129.56	136.22	141.95	130.04	135.75	135.94	1.05	27.31	0.00	54
51	136.22	141.95	130.04	136.72	141.81	130.31	136.47	136.03	0.57	27.97	0.00	54
52	136.72	141.81	130.31	138.42	141.36	131.25	137.55	136.18	1.94	29.00	0.00	54
53	138.42	141.36	131.25	140.12	140.91	132.26	139.25	136.44	1.98	30.60	0.00	54
54	140.12	140.91	132.26	141.82	140.45	133.33	140.94	136.73	2.01	32.23	0.00	54
55	141.82	140.45	133.33	143.52	140.00	134.47	142.63	137.06	2.05	33.89	0.00	54
56	143.52	140.00	134.47	145.44	139.49	135.85	144.41	137.44	2.36	35.70	0.00	54
57	145.44	139.49	135.85	145.87	139.37	136.17	145.65	137.72	0.54	36.89	0.00	53
58	145.87	139.37	136.17	147.37	138.97	137.34	146.54	137.94	1.90	37.88	0.00	53
59	147.37	138.97	137.34	148.87	138.57	138.57	147.87	138.30	1.94	39.45	21.35	3

Tabella 12-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 08.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	2335	0	10721	14088	0	0	16988	0	0	
2	7027	0	15855	13723	0	16988	34870	0	0	
3	11512	0	20708	13537	0	34870	53459	0	0	
4	15782	0	25211	13367	0	53459	72419	0	0	
5	19850	0	29400	13214	0	72419	91454	0	0	
6	23718	0	33297	13074	0	91454	110299	0	0	
7	27364	0	36892	12948	0	110299	128709	0	0	
8	5471	0	7230	2392	0	128709	132062	0	0	
9	8249	0	10903	3744	0	132062	137194	0	0	
10	31301	0	40591	13117	0	137194	154833	0	0	
11	38810	0	48815	13843	0	154833	172807	0	0	
12	20115	0	24894	6736	0	172807	181128	0	0	
13	18076	0	22185	5911	0	181128	188165	0	0	
14	33388	0	40562	10612	0	188165	200151	0	0	
15	34350	0	41229	10562	0	200151	211211	0	0	
16	28466	0	33809	8432	0	211211	219386	0	0	
17	48580	0	57026	13640	0	219386	231277	0	0	
18	51173	0	59319	13583	0	231277	241351	0	0	
19	48733	0	55905	12363	0	241351	248886	0	0	
20	50495	0	57424	12333	0	248886	254771	0	0	
21	57494	0	64864	13551	0	254771	259274	0	0	
22	30841	0	34600	7087	0	259274	260785	0	0	
23	31318	0	35014	7084	0	260785	261705	0	0	
24	30489	0	33981	6799	0	261705	262026	0	0	
25	43729	0	48575	9608	0	262026	261538	0	0	
26	44381	0	49129	9611	0	261538	259948	0	0	
27	44954	0	49613	9618	0	259948	257256	0	0	
28	41862	0	46087	8870	0	257256	253801	0	0	
29	48842	0	53653	10269	0	253801	248650	0	0	
30	49300	0	54054	10288	0	248650	242248	0	0	
31	50383	0	55161	10456	0	242248	234483	0	0	
32	50722	0	55475	10486	0	234483	225442	0	0	
33	18786	0	20538	3874	0	225442	221782	0	0	
34	56432	0	61678	11616	0	221782	209790	0	0	
35	56713	0	61989	11668	0	209790	196251	0	0	
36	33451	0	36577	6891	0	196251	187575	0	0	
37	65699	0	71892	13580	0	187575	169059	0	0	
38	65624	0	71915	13677	0	169059	148639	0	0	
39	65283	0	71680	13786	0	148639	126450	0	0	
40	28235	0	31055	6031	0	126450	116274	0	0	
41	64188	3760	75096	14093	0	116274	89739	0	0	
42	16326	980	19145	3697	0	89739	82730	0	0	
43	45017	2760	52893	10467	0	82730	62853	0	0	
44	321	20	378	76	0	62853	62709	0	0	
45	52823	3360	62265	12863	0	62709	38345	0	0	
46	1846	120	2180	462	0	38345	37474	0	0	
47	56369	0	61993	14883	0	37474	13224	0	0	
48	30311	0	33009	9061	0	13224	478	0	0	
49	28483	0	30806	9176	0	478	-11371	0	0	
50	22329	0	23963	7717	0	-11371	-20516	0	0	
51	11465	0	12220	4174	0	-20516	-25132	0	0	

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
52	35541	0	37248	14331	0	-25132	-38624	0	0	
53	30947	0	31373	14562	0	-38624	-49000	0	0	
54	26139	0	25022	14818	0	-49000	-55672	0	0	
55	21107	0	18134	15100	0	-55672	-57983	0	0	
56	17395	530	11955	17432	0	-57983	-54805	0	0	
57	2974	327	1641	3884	0	-54805	-53393	0	0	
58	7301	1359	1419	13634	0	-53393	-45454	0	0	
59	2448	2015	3925	2717	0	-45454	-46881	0	0	

Tabella 12-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 08.

### 12.2.2 ANALISI DELLA SUPERFICIE 4 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	59	
Coordinate del centro	X[m]= 101.64	Y[m]= 178.00
Raggio del cerchio	R[m]= 56.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 70.44	Y <sub>v</sub> [m]= 131.49
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 142.92	Y <sub>m</sub> [m]= 140.16
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.752</b>	

N°	X <sub>s</sub>	Y <sub>ss</sub>	Y <sub>si</sub>	X <sub>d</sub>	Y <sub>ds</sub>	Y <sub>di</sub>	X <sub>g</sub>	Y <sub>g</sub>	L	α	β	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
1	70.44	131.49	131.49	72.22	131.91	130.35	71.63	131.25	2.11	-32.77	0.00	53
2	72.22	131.91	130.35	73.99	132.32	129.30	73.20	130.96	2.06	-30.64	0.00	52
3	73.99	132.32	129.30	75.76	132.74	128.34	74.93	130.67	2.02	-28.56	0.00	52
4	75.76	132.74	128.34	77.53	133.15	127.45	76.69	130.42	1.98	-26.51	0.00	52
5	77.53	133.15	127.45	79.31	133.57	126.65	78.45	130.20	1.95	-24.50	0.00	52
6	79.31	133.57	126.65	81.08	133.98	125.91	80.22	130.03	1.92	-22.52	0.00	52
7	81.08	133.98	125.91	81.40	134.06	125.79	81.24	129.93	0.34	-21.36	0.00	52
8	81.40	134.06	125.79	81.87	134.17	125.61	81.64	129.90	0.50	-20.93	0.00	52
9	81.87	134.17	125.61	83.54	134.56	125.01	82.72	129.83	1.77	-19.77	0.00	52
10	83.54	134.56	125.01	84.48	134.78	124.69	84.01	129.76	0.99	-18.35	0.00	52
11	84.48	134.78	124.69	85.42	135.00	124.40	84.95	129.72	0.98	-17.34	0.00	52
12	85.42	135.00	124.40	86.34	135.00	124.13	85.88	129.63	0.96	-16.35	0.00	52
13	86.34	135.00	124.13	87.15	135.00	123.91	86.75	129.51	0.84	-15.43	0.00	52
14	87.15	135.00	123.91	88.61	135.00	123.54	87.88	129.36	1.51	-14.23	0.00	52
15	88.61	135.00	123.54	90.07	135.00	123.21	89.34	129.19	1.50	-12.69	0.00	52
16	90.07	135.00	123.21	91.24	135.27	122.97	90.66	129.11	1.19	-11.31	0.00	52
17	91.24	135.27	122.97	92.51	135.57	122.75	91.88	129.14	1.29	-10.04	0.00	52
18	92.51	135.57	122.75	93.77	135.86	122.56	93.14	129.18	1.28	-8.73	0.00	52
19	93.77	135.86	122.56	95.04	136.16	122.39	94.41	129.24	1.28	-7.42	0.00	52
20	95.04	136.16	122.39	96.77	136.56	122.21	95.91	129.33	1.74	-5.88	0.00	52
21	96.77	136.56	122.21	98.51	136.97	122.09	97.65	129.46	1.74	-4.09	0.00	52
22	98.51	136.97	122.09	99.46	137.19	122.04	98.99	129.57	0.96	-2.71	0.00	52
23	99.46	137.19	122.04	100.42	137.41	122.01	99.94	129.66	0.96	-1.74	0.00	52
24	100.42	137.41	122.01	101.42	137.65	122.00	100.92	129.77	1.00	-0.74	0.00	52
25	101.42	137.65	122.00	102.42	137.88	122.01	101.92	129.88	1.00	0.29	0.00	52
26	102.42	137.88	122.01	103.38	138.10	122.03	102.90	130.00	0.96	1.29	0.00	52
27	103.38	138.10	122.03	104.74	138.42	122.09	104.06	130.16	1.36	2.48	0.00	52
28	104.74	138.42	122.09	106.09	138.74	122.18	105.42	130.35	1.36	3.87	0.00	52
29	106.09	138.74	122.18	107.45	139.05	122.30	106.77	130.57	1.36	5.26	0.00	52
30	107.45	139.05	122.30	108.70	139.34	122.45	108.08	130.79	1.26	6.60	0.00	52
31	108.70	139.34	122.45	110.14	139.68	122.65	109.42	131.03	1.46	7.99	0.00	52
32	110.14	139.68	122.65	111.59	140.02	122.89	110.87	131.31	1.47	9.49	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∅ [°]	∅ [°]	c [kPa]
33	111.59	140.02	122.89	113.39	140.44	123.25	112.49	131.65	1.83	11.17	0.00	52
34	113.39	140.44	123.25	114.52	140.70	123.50	113.96	131.97	1.16	12.70	0.00	52
35	114.52	140.70	123.50	114.85	140.78	123.58	114.68	132.14	0.34	13.47	0.00	52
36	114.85	140.78	123.58	115.06	140.83	123.63	114.95	132.20	0.22	13.75	0.00	52
37	115.06	140.83	123.63	116.67	141.20	124.05	115.86	132.43	1.66	14.72	0.00	52
38	116.67	141.20	124.05	118.28	141.58	124.53	117.47	132.84	1.68	16.43	0.00	52
39	118.28	141.58	124.53	118.29	141.58	124.53	118.28	133.06	0.01	17.29	0.00	52
40	118.29	141.58	124.53	119.24	141.80	124.84	118.76	133.19	1.00	17.81	0.00	52
41	119.24	141.80	124.84	120.53	142.10	125.28	119.88	133.51	1.36	19.01	0.00	52
42	120.53	142.10	125.28	121.81	142.40	125.76	121.17	133.89	1.37	20.41	0.00	52
43	121.81	142.40	125.76	123.32	142.76	126.37	122.56	134.32	1.63	21.94	0.00	53
44	123.32	142.76	126.37	124.83	143.11	127.03	124.07	134.81	1.65	23.62	0.00	54
45	124.83	143.11	127.03	125.64	143.30	127.40	125.23	135.21	0.89	24.92	0.00	54
46	125.64	143.30	127.40	126.82	143.30	127.98	126.23	135.50	1.32	26.05	0.00	54
47	126.82	143.30	127.98	128.01	143.30	128.60	127.41	135.79	1.33	27.41	0.00	54
48	128.01	143.30	128.60	129.39	143.30	129.36	128.69	136.14	1.58	28.90	0.00	54
49	129.39	143.30	129.36	131.08	143.30	130.36	130.22	136.58	1.97	30.71	0.00	54
50	131.08	143.30	130.36	131.14	143.30	130.40	131.11	136.84	0.07	31.75	0.00	54
51	131.14	143.30	130.40	132.52	142.93	131.29	131.82	136.98	1.64	32.63	0.00	54
52	132.52	142.93	131.29	133.91	142.56	132.23	133.20	137.25	1.68	34.33	0.00	54
53	133.91	142.56	132.23	135.29	142.19	133.24	134.58	137.55	1.71	36.06	0.00	54
54	135.29	142.19	133.24	136.22	141.95	133.95	135.75	137.83	1.17	37.53	0.00	54
55	136.22	141.95	133.95	136.72	141.81	134.35	136.47	138.01	0.64	38.46	0.00	54
56	136.72	141.81	134.35	138.27	141.40	135.64	137.46	138.29	2.02	39.82	0.00	54
57	138.27	141.40	135.64	139.82	140.99	137.03	139.00	138.75	2.08	41.92	0.00	54
58	139.82	140.99	137.03	141.37	140.57	138.53	140.51	139.25	2.16	44.09	0.00	54
59	141.37	140.57	138.53	142.92	140.16	140.16	141.89	139.76	2.25	46.34	17.11	13

Tabella 12-4 – Geometria e caratteristiche strisce della superficie 4 della verifica di stabilità 08.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	2727	0	13378	15176	0	0	19391	0	0	
2	8235	0	19271	14561	0	19391	39894	0	0	
3	13447	0	24789	14263	0	39894	61256	0	0	
4	18349	0	29787	14000	0	61256	82965	0	0	
5	22955	0	34329	13768	0	82965	104581	0	0	
6	27248	0	38428	13562	0	104581	125718	0	0	
7	5358	0	7348	2428	0	125718	129455	0	0	
8	8103	0	11009	3556	0	129455	134892	0	0	
9	30962	0	41095	12541	0	134892	153649	0	0	
10	18876	0	24439	6999	0	153649	163754	0	0	
11	19862	0	25313	6960	0	163754	173488	0	0	
12	20166	0	25360	6776	0	173488	182605	0	0	
13	18164	0	22594	5939	0	182605	190266	0	0	
14	33632	0	41284	10645	0	190266	203188	0	0	
15	34682	0	41917	10577	0	203188	214937	0	0	
16	28777	0	34325	8433	0	214937	223487	0	0	
17	32445	0	38255	9091	0	223487	231836	0	0	
18	33685	0	39292	9057	0	231836	239199	0	0	
19	34768	0	40169	9028	0	239199	245543	0	0	
20	49219	0	56295	12327	0	245543	252532	0	0	
21	50909	0	57642	12293	0	252532	257493	0	0	

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
22	28700	0	32274	6757	0	257493	259336	0	0	
23	29136	0	32623	6752	0	259336	260540	0	0	
24	30942	0	34505	7068	0	260540	261113	0	0	
25	31360	0	34841	7067	0	261113	260974	0	0	
26	30468	0	33739	6786	0	260974	260168	0	0	
27	43581	0	48097	9597	0	260168	257906	0	0	
28	44078	0	48482	9610	0	257906	254342	0	0	
29	44478	0	48787	9629	0	254342	249485	0	0	
30	41253	0	45156	8893	0	249485	243880	0	0	
31	47912	0	52359	10312	0	243880	236071	0	0	
32	48104	0	52509	10354	0	236071	226844	0	0	
33	60043	0	65503	12967	0	226844	213408	0	0	
34	37709	0	41144	8187	0	213408	203890	0	0	
35	11013	0	12020	2398	0	203890	200953	0	0	
36	7008	0	7650	1528	0	200953	199047	0	0	
37	53667	0	58619	11764	0	199047	183499	0	0	
38	53460	0	58486	11863	0	183499	166350	0	0	
39	331	0	363	74	0	166350	166238	0	0	
40	31388	0	34399	7052	0	166238	155394	0	0	
41	42205	0	46336	9606	0	155394	139916	0	0	
42	41833	0	46034	9690	0	139916	123564	0	0	
43	48512	0	53442	11724	0	123564	103589	0	0	
44	47761	0	52670	12126	0	103589	82886	0	0	
45	25276	0	27943	6572	0	82886	71404	0	0	
46	36136	2370	42922	9705	0	71404	52638	0	0	
47	34796	2370	41467	9822	0	52638	33934	0	0	
48	38721	2760	46291	11598	0	33934	12415	0	0	
49	44585	3380	53452	14463	0	12415	-13204	0	0	
50	1524	120	1828	519	0	-13204	-14093	0	0	
51	33336	0	36284	12086	0	-14093	-30954	0	0	
52	29836	0	31762	12325	0	-30954	-45377	0	0	
53	26206	0	26883	12590	0	-45377	-56899	0	0	
54	15504	0	15114	8629	0	-56899	-62740	0	0	
55	7618	0	7088	4698	0	-62740	-65178	0	0	
56	19813	0	16308	14849	0	-65178	-68660	0	0	
57	14633	0	8110	15327	0	-68660	-65954	0	0	
58	9104	0	-1093	15680	0	-65954	-55972	0	0	
59	3051	0	641	4078	0	-55972	-54305	0	0	

Tabella 12-5 – Forze applicate sulle strisce [BISHOP] della superficie 4 della verifica di stabilità 08.

### 12.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u [m]
1	0.000080
2	0.000030
3	0.000043
4	0.000279
5	0.000000
6	0.000014
7	0.000000

Tabella 12-6 – Spostamenti della superficie 1 della verifica di stabilità 08.

Accelerazione sismica critica  $K_c = 0.147$   
Spostamento massimo  $U_{max} = 0.000279$  [m]  
Velocità massima  $V_{max} = 0.007616$  [m/s]

n°	u
	[m]
1	0.000093
2	0.000040
3	0.000076
4	0.000377
5	0.000000
6	0.000021
7	0.000000

Tabella 12-7 – Spostamenti della superficie 4 della verifica di stabilità 08.

Accelerazione sismica critica  $K_c = 0.144$   
Spostamento massimo  $U_{max} = 0.000377$  [m]  
Velocità massima  $V_{max} = 0.009918$  [m/s]

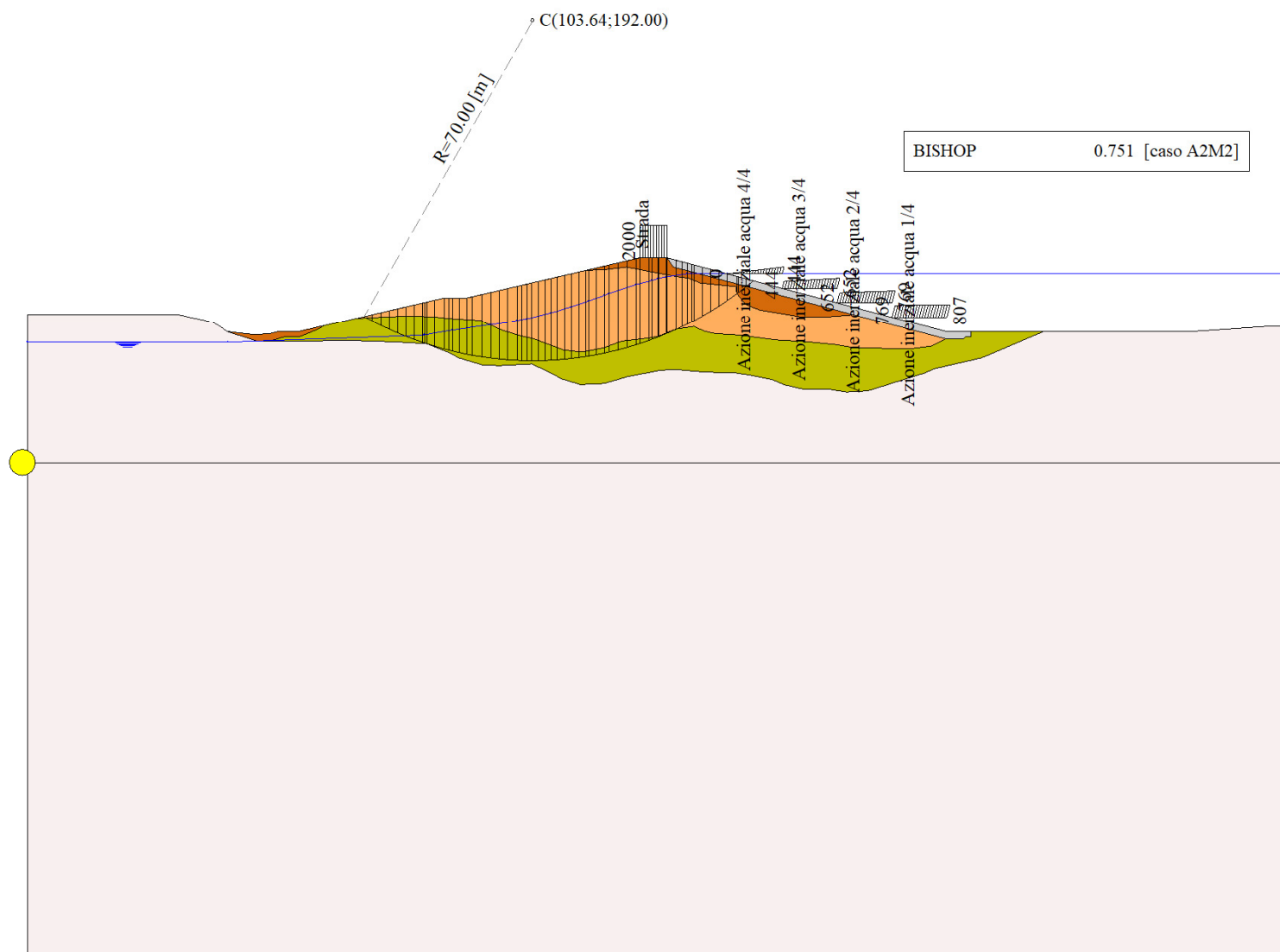


Figura 12-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 08.



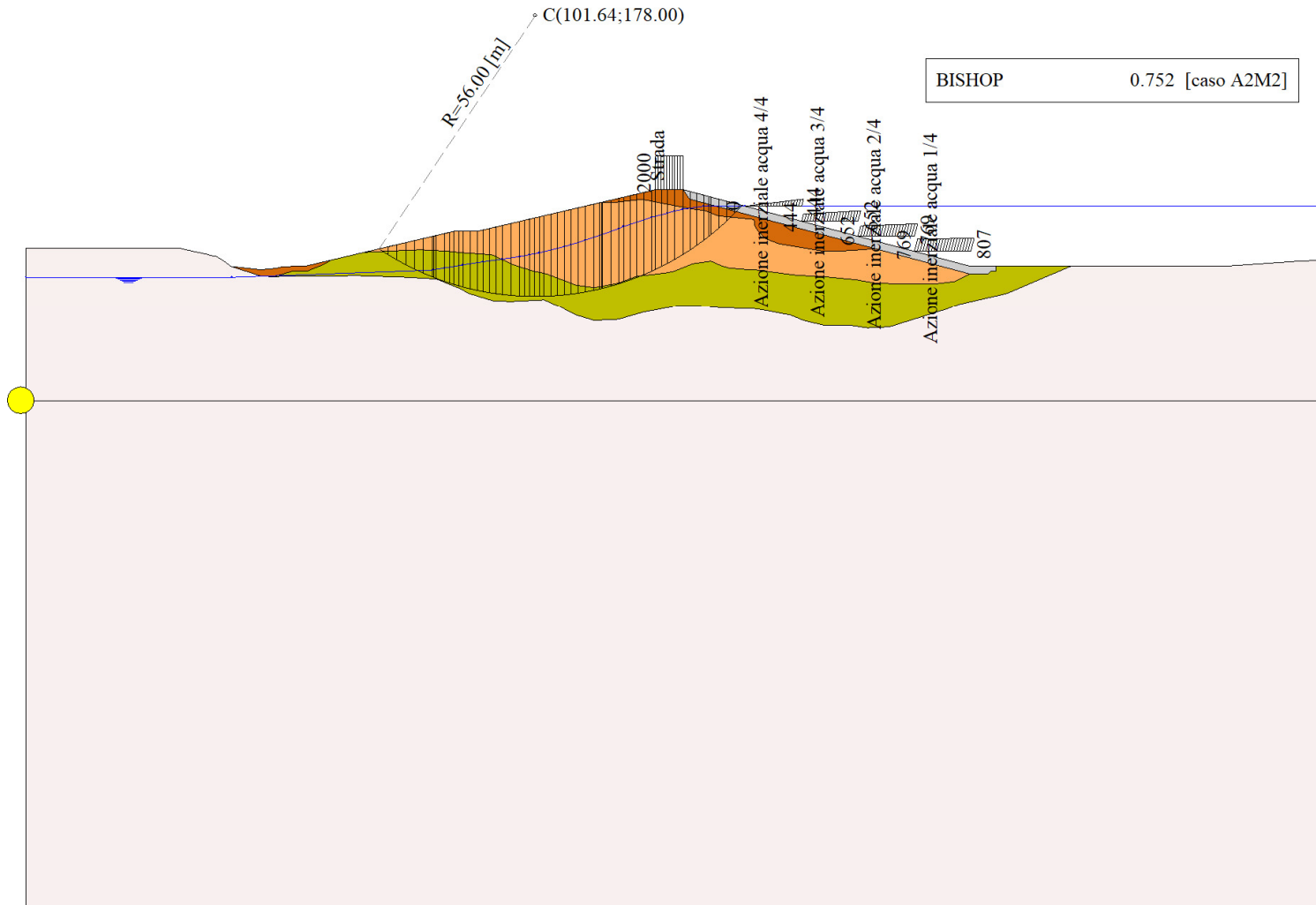


Figura 12-2 – Superficie critica (4) della sezione CR\_06 per la verifica di stabilità 08.

## 13 VERIFICA DI STABILITÀ 09

### 13.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	125.64 143.30	131.14 143.30	2000 2000	0 0
2	Azione inerziale acqua 1/4	Variabile	1.00	177.27 131.00	188.52 131.00	1095 1149	-292 -306
3	Azione inerziale acqua 2/4	Variabile	1.00	166.02 134.00	177.27 134.00	929 1095	-248 -292
4	Azione inerziale acqua 3/4	Variabile	1.00	154.77 137.00	166.02 137.00	631 929	-168 -248
5	Azione inerziale acqua 4/4	Variabile	1.00	143.52 140.00	154.77 140.00	0 631	0 -168

Tabella 13-1 – Carichi distribuiti verifica di stabilità 09.

### 13.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **sismiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 13.2 RISULTATI ANALISI

Numero di superfici analizzate	86748
Coefficiente di sicurezza minimo	0.569
Superficie con coefficiente di sicurezza minimo	1

### 13.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	57	
Coordinate del centro	X[m]= 105.64	Y[m]= 204.00
Raggio del cerchio	R[m]= 82.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 68.30	Y <sub>v</sub> [m]= 130.99
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 153.42	Y <sub>m</sub> [m]= 137.36
Coefficiente di sicurezza	F <sub>S</sub> = <b>0.569</b>	

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	68.30	130.99	130.99	70.13	131.42	130.09	69.52	130.83	2.04	-26.37	0.00	52
2	70.13	131.42	130.09	71.95	131.85	129.24	71.14	130.64	2.01	-24.96	0.00	52
3	71.95	131.85	129.24	73.78	132.27	128.44	72.92	130.45	1.99	-23.56	0.00	52
4	73.78	132.27	128.44	75.60	132.70	127.70	74.73	130.28	1.97	-22.18	0.00	52
5	75.60	132.70	127.70	77.43	133.13	127.01	76.55	130.13	1.95	-20.80	0.00	52
6	77.43	133.13	127.01	79.25	133.56	126.36	78.37	130.01	1.94	-19.45	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∠ [°]	∠ [°]	c [kPa]
7	79.25	133.56	126.36	81.08	133.98	125.76	80.19	129.92	1.92	-18.10	0.00	52
8	81.08	133.98	125.76	81.40	134.06	125.66	81.24	129.87	0.34	-17.31	0.00	52
9	81.40	134.06	125.66	81.87	134.17	125.52	81.64	129.85	0.49	-17.02	0.00	52
10	81.87	134.17	125.52	83.54	134.56	125.03	82.72	129.82	1.74	-16.24	0.00	52
11	83.54	134.56	125.03	85.42	135.00	124.53	84.49	129.78	1.95	-14.96	0.00	52
12	85.42	135.00	124.53	86.34	135.00	124.30	85.88	129.71	0.95	-13.94	0.00	52
13	86.34	135.00	124.30	87.15	135.00	124.11	86.75	129.60	0.83	-13.32	0.00	52
14	87.15	135.00	124.11	88.61	135.00	123.79	87.88	129.47	1.50	-12.51	0.00	52
15	88.61	135.00	123.79	90.07	135.00	123.49	89.34	129.32	1.49	-11.47	0.00	52
16	90.07	135.00	123.49	91.24	135.27	123.27	90.66	129.26	1.19	-10.53	0.00	52
17	91.24	135.27	123.27	93.14	135.72	122.96	92.20	129.31	1.93	-9.44	0.00	52
18	93.14	135.72	122.96	95.04	136.16	122.69	94.10	129.38	1.92	-8.10	0.00	52
19	95.04	136.16	122.69	96.77	136.56	122.48	95.91	129.47	1.75	-6.82	0.00	52
20	96.77	136.56	122.48	98.51	136.97	122.31	97.65	129.58	1.74	-5.60	0.00	52
21	98.51	136.97	122.31	100.42	137.41	122.17	99.47	129.71	1.92	-4.32	0.00	52
22	100.42	137.41	122.17	102.42	137.88	122.06	101.43	129.88	2.00	-2.95	0.00	52
23	102.42	137.88	122.06	103.38	138.10	122.03	102.90	130.02	0.96	-1.91	0.00	52
24	103.38	138.10	122.03	105.41	138.58	122.00	104.40	130.18	2.04	-0.87	0.00	52
25	105.41	138.58	122.00	107.45	139.05	122.02	106.44	130.41	2.04	0.55	0.00	52
26	107.45	139.05	122.02	108.70	139.34	122.06	108.08	130.62	1.25	1.70	0.00	52
27	108.70	139.34	122.06	110.14	139.68	122.12	109.42	130.80	1.45	2.64	0.00	52
28	110.14	139.68	122.12	111.59	140.02	122.22	110.87	131.01	1.45	3.66	0.00	52
29	111.59	140.02	122.22	113.06	140.36	122.34	112.32	131.23	1.47	4.67	0.00	52
30	113.06	140.36	122.34	114.52	140.70	122.48	113.79	131.47	1.47	5.70	0.00	52
31	114.52	140.70	122.48	115.06	140.83	122.54	114.79	131.64	0.54	6.41	0.00	52
32	115.06	140.83	122.54	116.67	141.20	122.75	115.87	131.83	1.63	7.17	0.00	52
33	116.67	141.20	122.75	118.29	141.58	122.98	117.48	132.13	1.63	8.30	0.00	52
34	118.29	141.58	122.98	119.24	141.80	123.14	118.77	132.38	0.96	9.21	0.00	52
35	119.24	141.80	123.14	121.10	142.24	123.47	120.17	132.66	1.89	10.21	0.00	52
36	121.10	142.24	123.47	122.97	142.67	123.85	122.04	133.06	1.90	11.53	0.00	52
37	122.97	142.67	123.85	124.83	143.11	124.28	123.90	133.48	1.91	12.87	0.00	52
38	124.83	143.11	124.28	125.64	143.30	124.48	125.23	133.79	0.83	13.83	0.00	52
39	125.64	143.30	124.48	126.82	143.30	124.78	126.23	133.96	1.22	14.54	0.00	52
40	126.82	143.30	124.78	128.01	143.30	125.11	127.42	134.12	1.23	15.40	0.00	52
41	128.01	143.30	125.11	129.39	143.30	125.51	128.70	134.31	1.44	16.33	0.00	52
42	129.39	143.30	125.51	131.08	143.30	126.05	130.23	134.54	1.77	17.45	0.00	52
43	131.08	143.30	126.05	131.14	143.30	126.07	131.11	134.68	0.06	18.10	0.00	52
44	131.14	143.30	126.07	133.22	142.75	126.78	132.16	134.72	2.19	18.88	0.00	52
45	133.22	142.75	126.78	135.29	142.19	127.55	134.24	134.82	2.21	20.42	0.00	52
46	135.29	142.19	127.55	136.22	141.95	127.92	135.75	134.90	1.00	21.55	0.00	52
47	136.22	141.95	127.92	136.68	141.82	128.10	136.45	134.95	0.50	22.07	0.00	52
48	136.68	141.82	128.10	136.72	141.81	128.12	136.70	134.96	0.04	22.26	0.00	52
49	136.72	141.81	128.12	138.76	141.27	128.99	137.72	135.04	2.22	23.05	0.00	53
50	138.76	141.27	128.99	140.35	140.85	129.71	139.54	135.20	1.74	24.43	0.00	54
51	140.35	140.85	129.71	141.93	140.42	130.47	141.13	135.36	1.76	25.66	0.00	54
52	141.93	140.42	130.47	143.52	140.00	131.27	142.71	135.54	1.78	26.89	0.00	54
53	143.52	140.00	131.27	145.52	139.46	132.35	144.49	135.77	2.28	28.31	0.00	54
54	145.52	139.46	132.35	147.53	138.93	133.51	146.48	136.06	2.31	29.91	0.00	54
55	147.53	138.93	133.51	149.49	138.41	134.71	148.45	136.38	2.30	31.53	0.00	53
56	149.49	138.41	134.71	151.46	137.88	135.99	150.37	136.73	2.35	33.15	0.00	53
57	151.46	137.88	135.99	153.42	137.36	137.36	152.11	137.08	2.39	34.80	18.47	9

Tabella 13-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 09.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	2466	0	12704	19154	0	0	21989	0	0	
2	7376	0	18233	18808	0	21989	44298	0	0	
3	12079	0	23466	18602	0	44298	66738	0	0	
4	16576	0	28362	18414	0	66738	89019	0	0	
5	20875	0	32950	18241	0	89019	110878	0	0	
6	24980	0	37252	18083	0	110878	132079	0	0	
7	28863	0	41245	17939	0	132079	152409	0	0	
8	5448	0	7625	3132	0	152409	155868	0	0	
9	8206	0	11405	4592	0	155868	160887	0	0	
10	31061	0	42431	16251	0	160887	178097	0	0	
11	38402	0	51171	18180	0	178097	196180	0	0	
12	19871	0	26055	8856	0	196180	204490	0	0	
13	17842	0	23205	7777	0	204490	211511	0	0	
14	32930	0	42403	13972	0	211511	223457	0	0	
15	33859	0	43078	13918	0	223457	234475	0	0	
16	28057	0	35318	11118	0	234475	242591	0	0	
17	47911	0	59584	17995	0	242591	254289	0	0	
18	50524	0	62013	17930	0	254289	264085	0	0	
19	48183	0	58492	16325	0	264085	271320	0	0	
20	50009	0	60145	16287	0	271320	276875	0	0	
21	57062	0	68029	17896	0	276875	280992	0	0	
22	61838	0	73112	18710	0	280992	283012	0	0	
23	30405	0	35747	8974	0	283012	283131	0	0	
24	65813	0	76981	19015	0	283131	281569	0	0	
25	67436	0	78395	19013	0	281569	277546	0	0	
26	42139	0	48774	11684	0	277546	273855	0	0	
27	49307	0	56888	13515	0	273855	268442	0	0	
28	49933	0	57435	13528	0	268442	261785	0	0	
29	51212	0	58747	13733	0	261785	253766	0	0	
30	51755	0	59230	13755	0	253766	244471	0	0	
31	19221	0	21967	5077	0	244471	240715	0	0	
32	57919	0	66106	15207	0	240715	228424	0	0	
33	58497	0	66655	15248	0	228424	214561	0	0	
34	34647	0	39439	8992	0	214561	205678	0	0	
35	68385	0	77777	17689	0	205678	186711	0	0	
36	68791	0	78179	17768	0	186711	165762	0	0	
37	68970	0	78353	17857	0	165762	142939	0	0	
38	30010	0	34092	7793	0	142939	132445	0	0	
39	43549	2370	52307	11438	0	132445	115211	0	0	
40	42816	2370	51447	11484	0	115211	97691	0	0	
41	48891	2760	58777	13435	0	97691	76991	0	0	
42	58401	3380	70256	16551	0	76991	51297	0	0	
43	2043	120	2459	590	0	51297	50379	0	0	
44	67996	0	76725	20489	0	50379	22470	0	0	
45	62622	0	70157	20687	0	22470	-3314	0	0	
46	26248	0	29193	9342	0	-3314	-14018	0	0	
47	12562	0	13914	4637	0	-14018	-19098	0	0	
48	1079	0	1193	404	0	-19098	-19533	0	0	
49	51364	0	56048	21134	0	-19533	-38997	0	0	
50	36063	0	38452	16951	0	-38997	-51381	0	0	
51	32576	0	33884	17121	0	-51381	-61380	0	0	

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
52	28960	0	29059	17304	0	-61380	-68657	0	0	
53	31124	594	29945	22151	0	-68657	-73743	0	0	
54	25179	1779	22986	22499	0	-73743	-74442	0	0	
55	18167	2896	14895	21826	0	-74442	-70345	0	0	
56	11071	4034	5796	22211	0	-70345	-59596	0	0	
57	3711	5172	6307	7707	0	-59596	-59417	0	0	

Tabella 13-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 09.

### 13.2.2 ANALISI DELLA SUPERFICIE 56 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	59	
Coordinate del centro	X[m]= 101.64	Y[m]= 178.00
Raggio del cerchio	R[m]= 56.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 70.44	Y <sub>v</sub> [m]= 131.49
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 142.92	Y <sub>m</sub> [m]= 140.16
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.583</b>	

N°	X <sub>s</sub>	Y <sub>ss</sub>	Y <sub>si</sub>	X <sub>d</sub>	Y <sub>ds</sub>	Y <sub>di</sub>	X <sub>g</sub>	Y <sub>g</sub>	L	α	β	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
1	70.44	131.49	131.49	72.22	131.91	130.35	71.63	131.25	2.11	-32.77	0.00	53
2	72.22	131.91	130.35	73.99	132.32	129.30	73.20	130.96	2.06	-30.64	0.00	52
3	73.99	132.32	129.30	75.76	132.74	128.34	74.93	130.67	2.02	-28.56	0.00	52
4	75.76	132.74	128.34	77.53	133.15	127.45	76.69	130.42	1.98	-26.51	0.00	52
5	77.53	133.15	127.45	79.31	133.57	126.65	78.45	130.20	1.95	-24.50	0.00	52
6	79.31	133.57	126.65	81.08	133.98	125.91	80.22	130.03	1.92	-22.52	0.00	52
7	81.08	133.98	125.91	81.40	134.06	125.79	81.24	129.93	0.34	-21.36	0.00	52
8	81.40	134.06	125.79	81.87	134.17	125.61	81.64	129.90	0.50	-20.93	0.00	52
9	81.87	134.17	125.61	83.54	134.56	125.01	82.72	129.83	1.77	-19.77	0.00	52
10	83.54	134.56	125.01	84.48	134.78	124.69	84.01	129.76	0.99	-18.35	0.00	52
11	84.48	134.78	124.69	85.42	135.00	124.40	84.95	129.72	0.98	-17.34	0.00	52
12	85.42	135.00	124.40	86.34	135.00	124.13	85.88	129.63	0.96	-16.35	0.00	52
13	86.34	135.00	124.13	87.15	135.00	123.91	86.75	129.51	0.84	-15.43	0.00	52
14	87.15	135.00	123.91	88.61	135.00	123.54	87.88	129.36	1.51	-14.23	0.00	52
15	88.61	135.00	123.54	90.07	135.00	123.21	89.34	129.19	1.50	-12.69	0.00	52
16	90.07	135.00	123.21	91.24	135.27	122.97	90.66	129.11	1.19	-11.31	0.00	52
17	91.24	135.27	122.97	92.51	135.57	122.75	91.88	129.14	1.29	-10.04	0.00	52
18	92.51	135.57	122.75	93.77	135.86	122.56	93.14	129.18	1.28	-8.73	0.00	52
19	93.77	135.86	122.56	95.04	136.16	122.39	94.41	129.24	1.28	-7.42	0.00	52
20	95.04	136.16	122.39	96.77	136.56	122.21	95.91	129.33	1.74	-5.88	0.00	52
21	96.77	136.56	122.21	98.51	136.97	122.09	97.65	129.46	1.74	-4.09	0.00	52
22	98.51	136.97	122.09	99.46	137.19	122.04	98.99	129.57	0.96	-2.71	0.00	52
23	99.46	137.19	122.04	100.42	137.41	122.01	99.94	129.66	0.96	-1.74	0.00	52
24	100.42	137.41	122.01	101.42	137.65	122.00	100.92	129.77	1.00	-0.74	0.00	52
25	101.42	137.65	122.00	102.42	137.88	122.01	101.92	129.88	1.00	0.29	0.00	52
26	102.42	137.88	122.01	103.38	138.10	122.03	102.90	130.00	0.96	1.29	0.00	52
27	103.38	138.10	122.03	104.74	138.42	122.09	104.06	130.16	1.36	2.48	0.00	52
28	104.74	138.42	122.09	106.09	138.74	122.18	105.42	130.35	1.36	3.87	0.00	52
29	106.09	138.74	122.18	107.45	139.05	122.30	106.77	130.57	1.36	5.26	0.00	52
30	107.45	139.05	122.30	108.70	139.34	122.45	108.08	130.79	1.26	6.60	0.00	52
31	108.70	139.34	122.45	110.14	139.68	122.65	109.42	131.03	1.46	7.99	0.00	52
32	110.14	139.68	122.65	111.59	140.02	122.89	110.87	131.31	1.47	9.49	0.00	52
33	111.59	140.02	122.89	113.39	140.44	123.25	112.49	131.65	1.83	11.17	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∅ [°]	∅ [°]	c [kPa]
34	113.39	140.44	123.25	114.52	140.70	123.50	113.96	131.97	1.16	12.70	0.00	52
35	114.52	140.70	123.50	114.85	140.78	123.58	114.68	132.14	0.34	13.47	0.00	52
36	114.85	140.78	123.58	115.06	140.83	123.63	114.95	132.20	0.22	13.75	0.00	52
37	115.06	140.83	123.63	116.67	141.20	124.05	115.86	132.43	1.66	14.72	0.00	52
38	116.67	141.20	124.05	118.28	141.58	124.53	117.47	132.84	1.68	16.43	0.00	52
39	118.28	141.58	124.53	118.29	141.58	124.53	118.28	133.06	0.01	17.29	0.00	52
40	118.29	141.58	124.53	119.24	141.80	124.84	118.76	133.19	1.00	17.81	0.00	52
41	119.24	141.80	124.84	120.53	142.10	125.28	119.88	133.51	1.36	19.01	0.00	52
42	120.53	142.10	125.28	121.81	142.40	125.76	121.17	133.89	1.37	20.41	0.00	52
43	121.81	142.40	125.76	123.32	142.76	126.37	122.56	134.32	1.63	21.94	0.00	53
44	123.32	142.76	126.37	124.83	143.11	127.03	124.07	134.81	1.65	23.62	0.00	54
45	124.83	143.11	127.03	125.64	143.30	127.40	125.23	135.21	0.89	24.92	0.00	54
46	125.64	143.30	127.40	126.82	143.30	127.98	126.23	135.50	1.32	26.05	0.00	54
47	126.82	143.30	127.98	128.01	143.30	128.60	127.41	135.79	1.33	27.41	0.00	54
48	128.01	143.30	128.60	129.39	143.30	129.36	128.69	136.14	1.58	28.90	0.00	54
49	129.39	143.30	129.36	131.08	143.30	130.36	130.22	136.58	1.97	30.71	0.00	54
50	131.08	143.30	130.36	131.14	143.30	130.40	131.11	136.84	0.07	31.75	0.00	54
51	131.14	143.30	130.40	132.52	142.93	131.29	131.82	136.98	1.64	32.63	0.00	54
52	132.52	142.93	131.29	133.91	142.56	132.23	133.20	137.25	1.68	34.33	0.00	54
53	133.91	142.56	132.23	135.29	142.19	133.24	134.58	137.55	1.71	36.06	0.00	54
54	135.29	142.19	133.24	136.22	141.95	133.95	135.75	137.83	1.17	37.53	0.00	54
55	136.22	141.95	133.95	136.72	141.81	134.35	136.47	138.01	0.64	38.46	0.00	54
56	136.72	141.81	134.35	138.27	141.40	135.64	137.46	138.29	2.02	39.82	0.00	54
57	138.27	141.40	135.64	139.82	140.99	137.03	139.00	138.75	2.08	41.92	0.00	54
58	139.82	140.99	137.03	141.37	140.57	138.53	140.51	139.25	2.16	44.09	0.00	54
59	141.37	140.57	138.53	142.92	140.16	140.16	141.89	139.76	2.25	46.34	17.11	13

Tabella 13-4 – Geometria e caratteristiche strisce della superficie 56 della verifica di stabilità 09.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	2727	0	16380	19571	0	0	24421	0	0	
2	8235	0	22276	18778	0	24421	49211	0	0	
3	13447	0	27849	18394	0	49211	74236	0	0	
4	18349	0	32898	18054	0	74236	99014	0	0	
5	22955	0	37484	17755	0	99014	123131	0	0	
6	27248	0	41622	17490	0	123131	146228	0	0	
7	5358	0	7929	3132	0	146228	150263	0	0	
8	8103	0	11863	4586	0	150263	156107	0	0	
9	30962	0	44146	16173	0	156107	176028	0	0	
10	18876	0	26166	9026	0	176028	186598	0	0	
11	19862	0	27047	8975	0	186598	196665	0	0	
12	20166	0	27050	8738	0	196665	206000	0	0	
13	18164	0	24069	7658	0	206000	213784	0	0	
14	33632	0	43907	13727	0	213784	226770	0	0	
15	34682	0	44493	13640	0	226770	238392	0	0	
16	28777	0	36371	10875	0	238392	246684	0	0	
17	32445	0	40469	11724	0	246684	254568	0	0	
18	33685	0	41503	11680	0	254568	261285	0	0	
19	34768	0	42369	11642	0	261285	266817	0	0	
20	49219	0	59288	15896	0	266817	272439	0	0	
21	50909	0	60604	15853	0	272439	275761	0	0	
22	28700	0	33891	8714	0	275761	276589	0	0	

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
23	29136	0	34229	8708	0	276589	276705	0	0	
24	30942	0	36173	9115	0	276705	276063	0	0	
25	31360	0	36495	9114	0	276063	274634	0	0	
26	30468	0	35312	8752	0	274634	272524	0	0	
27	43581	0	50292	12376	0	272524	268320	0	0	
28	44078	0	50638	12393	0	268320	262709	0	0	
29	44478	0	50901	12417	0	262709	255716	0	0	
30	41253	0	47061	11469	0	255716	248072	0	0	
31	47912	0	54507	13299	0	248072	237838	0	0	
32	48104	0	54595	13352	0	237838	226120	0	0	
33	60043	0	68009	16722	0	226120	209511	0	0	
34	37709	0	42661	10557	0	209511	197970	0	0	
35	11013	0	12454	3093	0	197970	194438	0	0	
36	7008	0	7924	1970	0	194438	192153	0	0	
37	53667	0	60668	15171	0	192153	173685	0	0	
38	53460	0	60431	15298	0	173685	153608	0	0	
39	331	0	374	95	0	153608	153478	0	0	
40	31388	0	35492	9094	0	153478	140913	0	0	
41	42205	0	47746	12387	0	140913	123127	0	0	
42	41833	0	47358	12496	0	123127	104504	0	0	
43	48512	0	54849	15120	0	104504	82005	0	0	
44	47761	0	53900	15638	0	82005	58958	0	0	
45	25276	0	28537	8475	0	58958	46269	0	0	
46	36136	2370	43822	12516	0	46269	25546	0	0	
47	34796	2370	42214	12666	0	25546	5080	0	0	
48	38721	2760	46951	14957	0	5080	-18219	0	0	
49	44585	3380	53925	18651	0	-18219	-45568	0	0	
50	1524	120	1838	670	0	-45568	-46509	0	0	
51	33336	0	36143	15586	0	-46509	-63885	0	0	
52	29836	0	31242	15894	0	-63885	-78233	0	0	
53	26206	0	25948	16237	0	-78233	-89037	0	0	
54	15504	0	14232	11128	0	-89037	-94005	0	0	
55	7618	0	6523	6059	0	-94005	-95835	0	0	
56	19813	0	14092	19149	0	-95835	-96697	0	0	
57	14633	0	5168	19766	0	-96697	-90276	0	0	
58	9104	0	-4819	20221	0	-90276	-75406	0	0	
59	3051	0	-5	4918	0	-75406	-73015	0	0	

Tabella 13-5 – Forze applicate sulle strisce [BISHOP] della superficie 56 della verifica di stabilità 09.

### 13.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u [m]
1	0.001164
2	0.000433
3	0.001101
4	0.000130
5	0.000249
6	0.000143
7	0.000478

Tabella 13-6 – Spostamenti della superficie 1 della verifica di stabilità 09.

Accelerazione sismica critica  $K_c = 0.151$   
Spostamento massimo  $U_{max} = 0.001164$  [m]  
Velocità massima  $V_{max} = 0.019812$  [m/s]

n°	u
	[m]
1	0.001678
2	0.000673
3	0.001393
4	0.000199
5	0.000341
6	0.000302
7	0.000758

Tabella 13-7 – Spostamenti della superficie 56 della verifica di stabilità 09.

Accelerazione sismica critica  $K_c = 0.144$   
Spostamento massimo  $U_{max} = 0.001678$  [m]  
Velocità massima  $V_{max} = 0.022368$  [m/s]



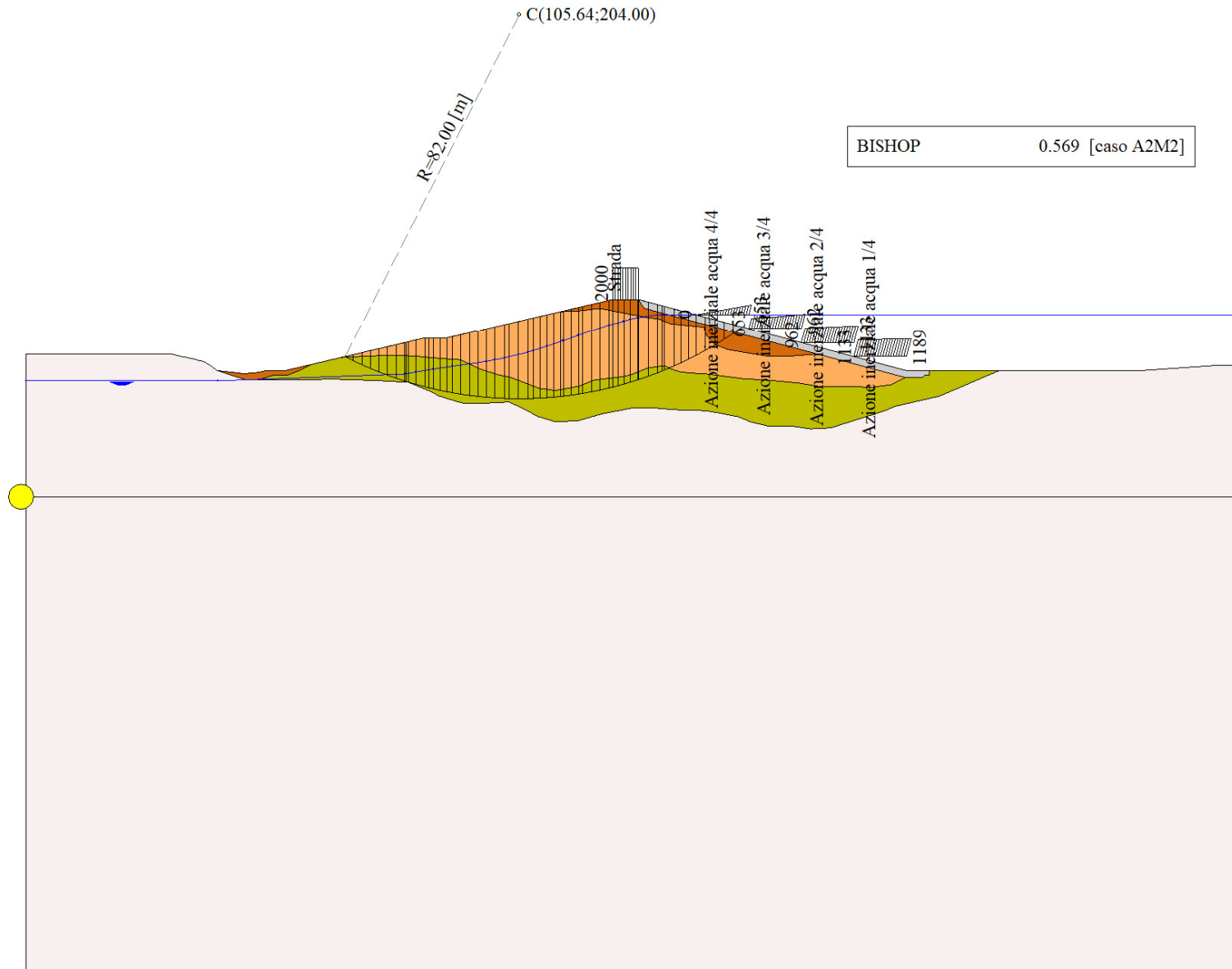


Figura 13-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 09.

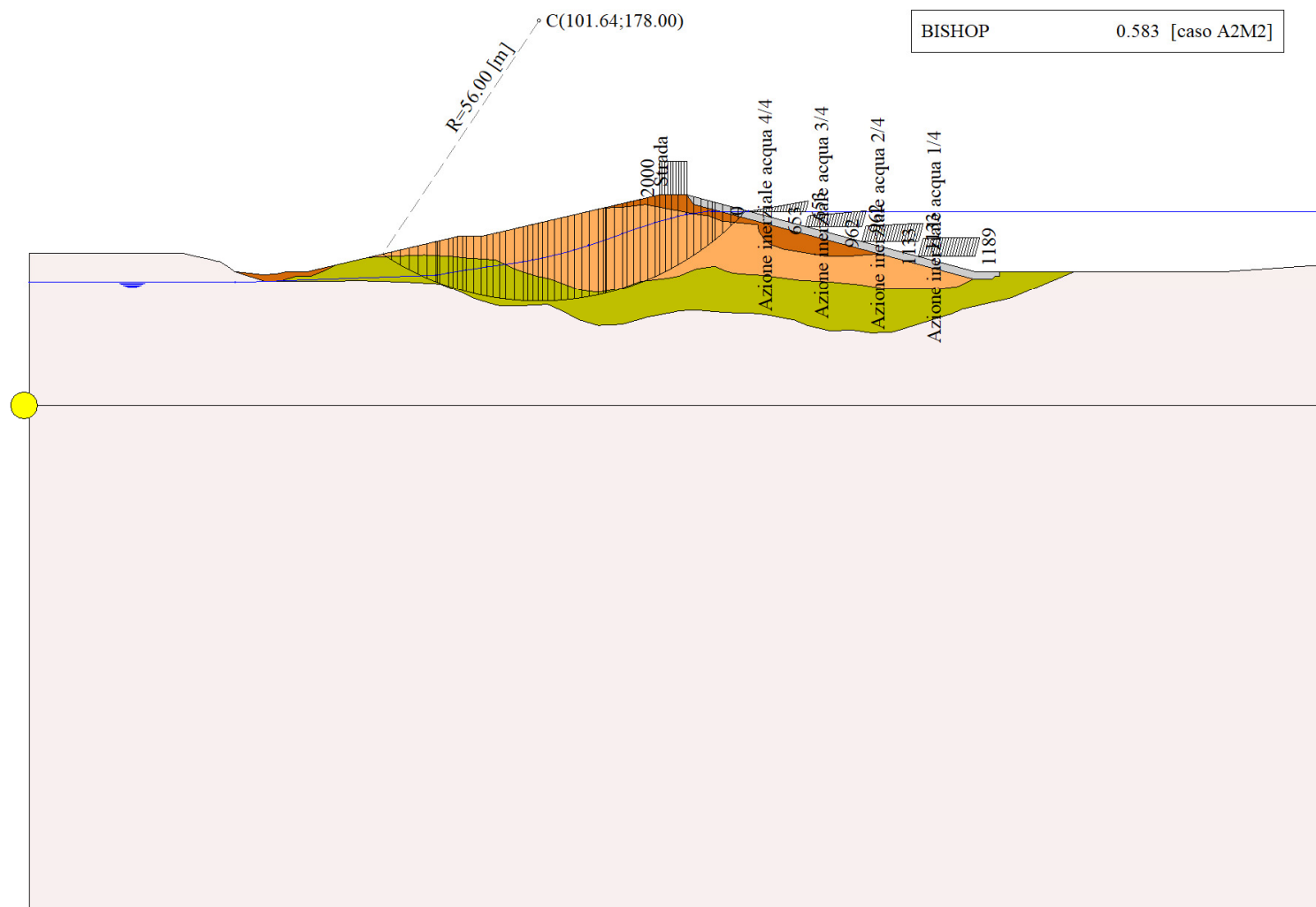


Figura 13-2 – Superficie critica (56) della sezione CR\_06 per la verifica di stabilità 09.

## 14 VERIFICA DI STABILITÀ 10

### 14.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	125.64 143.30	131.14 143.30	2000 2000	0 0
2	Azione inerziale acqua 1/4	Variabile	1.00	177.27 131.00	188.52 131.00	2175 2283	-580 -609
3	Azione inerziale acqua 2/4	Variabile	1.00	166.02 134.00	177.27 134.00	1844 2175	-492 -580
4	Azione inerziale acqua 3/4	Variabile	1.00	154.77 137.00	166.02 137.00	1254 1844	-334 -492
5	Azione inerziale acqua 4/4	Variabile	1.00	143.52 140.00	154.77 140.00	0 1254	0 -334

Tabella 14-1 – Carichi distribuiti verifica di stabilità 10.

### 14.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **sismiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 14.2 RISULTATI ANALISI

Numero di superfici analizzate	86748
Coefficiente di sicurezza minimo	0.311
Superficie con coefficiente di sicurezza minimo	1

### 14.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	59	
Coordinate del centro	X[m]= 119.64	Y[m]= 208.00
Raggio del cerchio	R[m]= 88.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 74.52	Y <sub>v</sub> [m]= 132.45
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 166.90	Y <sub>m</sub> [m]= 133.77
Coefficiente di sicurezza	F <sub>S</sub> = <b>0.311</b>	

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\bar{\alpha}$ [°]	$\bar{\beta}$ [°]	c [kPa]
1	74.52	132.45	132.45	76.77	132.98	131.15	76.02	132.19	2.60	-30.00	0.00	54
2	76.77	132.98	131.15	79.03	133.50	129.93	78.02	131.87	2.56	-28.32	0.00	52
3	79.03	133.50	129.93	81.28	134.03	128.80	80.23	131.56	2.52	-26.66	0.00	52
4	81.28	134.03	128.80	83.54	134.56	127.75	82.46	131.28	2.49	-25.03	0.00	52
5	83.54	134.56	127.75	85.42	135.00	126.93	84.51	131.06	2.05	-23.55	0.00	52
6	85.42	135.00	126.93	87.15	135.00	126.22	86.30	130.78	1.87	-22.28	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∠ [°]	∠ [°]	c [kPa]
7	87.15	135.00	126.22	88.61	135.00	125.65	87.89	130.47	1.57	-21.16	0.00	52
8	88.61	135.00	125.65	90.07	135.00	125.12	89.35	130.19	1.56	-20.14	0.00	52
9	90.07	135.00	125.12	91.24	135.27	124.71	90.66	130.02	1.24	-19.23	0.00	52
10	91.24	135.27	124.71	93.14	135.72	124.08	92.21	129.94	2.00	-18.18	0.00	52
11	93.14	135.72	124.08	95.04	136.16	123.51	94.10	129.87	1.99	-16.88	0.00	52
12	95.04	136.16	123.51	96.77	136.56	123.02	95.92	129.81	1.80	-15.65	0.00	52
13	96.77	136.56	123.02	98.51	136.97	122.57	97.65	129.78	1.79	-14.48	0.00	52
14	98.51	136.97	122.57	100.42	137.41	122.12	99.47	129.77	1.96	-13.25	0.00	52
15	100.42	137.41	122.12	102.42	137.88	121.70	101.43	129.78	2.04	-11.95	0.00	52
16	102.42	137.88	121.70	103.38	138.10	121.52	102.90	129.80	0.98	-10.97	0.00	52
17	103.38	138.10	121.52	104.84	138.44	121.25	104.11	129.83	1.48	-10.17	0.00	52
18	104.84	138.44	121.25	106.30	138.78	121.02	105.57	129.87	1.48	-9.20	0.00	52
19	106.30	138.78	121.02	107.45	139.05	120.85	106.88	129.93	1.16	-8.34	0.00	52
20	107.45	139.05	120.85	108.70	139.34	120.68	108.08	129.98	1.26	-7.55	0.00	52
21	108.70	139.34	120.68	110.14	139.68	120.51	109.43	130.06	1.45	-6.67	0.00	52
22	110.14	139.68	120.51	111.59	140.02	120.37	110.87	130.15	1.45	-5.72	0.00	52
23	111.59	140.02	120.37	113.06	140.36	120.25	112.33	130.25	1.47	-4.77	0.00	52
24	113.06	140.36	120.25	114.52	140.70	120.15	113.79	130.36	1.47	-3.81	0.00	52
25	114.52	140.70	120.15	115.06	140.83	120.12	114.79	130.45	0.54	-3.16	0.00	52
26	115.06	140.83	120.12	116.67	141.20	120.05	115.87	130.55	1.62	-2.46	0.00	52
27	116.67	141.20	120.05	118.29	141.58	120.01	117.49	130.71	1.62	-1.40	0.00	52
28	118.29	141.58	120.01	119.24	141.80	120.00	118.77	130.85	0.95	-0.57	0.00	52
29	119.24	141.80	120.00	121.10	142.24	120.01	120.17	131.01	1.86	0.35	0.00	52
30	121.10	142.24	120.01	122.97	142.67	120.06	122.04	131.25	1.86	1.56	0.00	52
31	122.97	142.67	120.06	124.83	143.11	120.15	123.90	131.50	1.87	2.77	0.00	52
32	124.83	143.11	120.15	125.64	143.30	120.20	125.24	131.69	0.81	3.65	0.00	52
33	125.64	143.30	120.20	126.82	143.30	120.29	126.23	131.77	1.19	4.30	0.00	52
34	126.82	143.30	120.29	128.01	143.30	120.40	127.42	131.82	1.19	5.07	0.00	52
35	128.01	143.30	120.40	128.54	143.30	120.45	128.27	131.86	0.53	5.63	0.00	52
36	128.54	143.30	120.45	129.39	143.30	120.54	128.96	131.90	0.85	6.08	0.00	52
37	129.39	143.30	120.54	129.79	143.30	120.59	129.59	131.93	0.40	6.49	0.00	52
38	129.79	143.30	120.59	131.08	143.30	120.75	130.43	131.98	1.30	7.05	0.00	52
39	131.08	143.30	120.75	131.14	143.30	120.75	131.11	132.03	0.06	7.49	0.00	52
40	131.14	143.30	120.75	132.29	142.99	120.91	131.72	131.99	1.17	7.89	0.00	52
41	132.29	142.99	120.91	133.45	142.68	121.09	132.87	131.92	1.17	8.65	0.00	52
42	133.45	142.68	121.09	135.29	142.19	121.40	134.36	131.84	1.87	9.64	0.00	52
43	135.29	142.19	121.40	136.22	141.95	121.58	135.75	131.78	0.95	10.55	0.00	52
44	136.22	141.95	121.58	136.72	141.81	121.67	136.47	131.75	0.51	11.03	0.00	52
45	136.72	141.81	121.67	138.99	141.21	122.15	137.84	131.71	2.32	11.95	0.00	52
46	138.99	141.21	122.15	141.25	140.60	122.70	140.11	131.67	2.33	13.46	0.00	52
47	141.25	140.60	122.70	143.52	140.00	123.30	142.37	131.65	2.35	14.98	0.00	52
48	143.52	140.00	123.30	145.51	139.47	123.89	144.51	131.66	2.08	16.42	0.00	52
49	145.51	139.47	123.89	147.51	138.94	124.53	146.50	131.71	2.09	17.78	0.00	52
50	147.51	138.94	124.53	149.50	138.40	125.22	148.49	131.77	2.11	19.15	0.00	52
51	149.50	138.40	125.22	151.50	137.87	125.97	150.48	131.87	2.13	20.53	0.00	52
52	151.50	137.87	125.97	153.49	137.34	126.77	152.47	131.99	2.15	21.92	0.00	53
53	153.49	137.34	126.77	155.68	136.76	127.72	154.56	132.14	2.38	23.40	0.00	54
54	155.68	136.76	127.72	157.87	136.17	128.74	156.74	132.34	2.41	24.96	0.00	54
55	157.87	136.17	128.74	160.05	135.59	129.83	158.91	132.58	2.45	26.54	0.00	54
56	160.05	135.59	129.83	162.24	135.01	131.00	161.08	132.85	2.48	28.15	0.00	54
57	162.24	135.01	131.00	164.43	134.42	132.25	163.23	133.15	2.52	29.78	0.00	53
58	164.43	134.42	132.25	166.30	133.92	133.39	165.18	133.46	2.19	31.31	13.97	20
59	166.30	133.92	133.39	166.90	133.77	133.77	166.50	133.69	0.71	32.25	22.44	0

Tabella 14-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 10.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	3995	0	32819	46234	0	0	53827	0	0	
2	12075	0	41802	43772	0	53827	104265	0	0	
3	19949	0	51297	43118	0	104265	152725	0	0	
4	27410	0	60034	42528	0	152725	198671	0	0	
5	28282	0	56248	35042	0	198671	234709	0	0	
6	29495	0	55417	31944	0	234709	265919	0	0	
7	26818	0	48545	26749	0	265919	290787	0	0	
8	28487	0	50043	26571	0	290787	314271	0	0	
9	24283	0	41543	21173	0	314271	332010	0	0	
10	42780	0	71021	34170	0	332010	358555	0	0	
11	46623	0	75004	33926	0	358555	382202	0	0	
12	45690	0	71640	30786	0	382202	401184	0	0	
13	48535	0	74479	30617	0	401184	417597	0	0	
14	56615	0	85147	33528	0	417597	432601	0	0	
15	62690	0	92497	34930	0	432601	444787	0	0	
16	31294	0	45572	16708	0	444787	449323	0	0	
17	48999	0	70658	25344	0	449323	454585	0	0	
18	50590	0	72159	25272	0	454585	457869	0	0	
19	40918	0	57837	19860	0	457869	459056	0	0	
20	45495	0	63808	21545	0	459056	458944	0	0	
21	53855	0	74919	24858	0	458944	456992	0	0	
22	55201	0	76167	24814	0	456992	453049	0	0	
23	57293	0	78453	25119	0	453049	447007	0	0	
24	58587	0	79655	25087	0	447007	438889	0	0	
25	21930	0	29680	9241	0	438889	435360	0	0	
26	66638	0	89770	27620	0	435360	423073	0	0	
27	68148	0	91213	27603	0	423073	408182	0	0	
28	40764	0	54303	16233	0	408182	398203	0	0	
29	81341	0	107840	31839	0	398203	376010	0	0	
30	83031	0	109449	31850	0	376010	350380	0	0	
31	84517	0	110836	31875	0	350380	321391	0	0	
32	37181	0	48598	13868	0	321391	307741	0	0	
33	54497	2370	74214	20305	0	307741	285110	0	0	
34	54314	2370	73775	20327	0	285110	261639	0	0	
35	24228	1060	32851	9100	0	261639	250876	0	0	
36	38760	1700	52484	14606	0	250876	233286	0	0	
37	18199	800	24613	6879	0	233286	224870	0	0	
38	58513	2580	79011	22209	0	224870	197127	0	0	
39	2715	120	3661	1034	0	197127	195815	0	0	
40	51716	0	66581	19924	0	195815	172473	0	0	
41	50654	0	65012	19962	0	172473	149191	0	0	
42	78375	0	100166	31889	0	149191	112430	0	0	
43	38492	0	48990	16164	0	112430	94089	0	0	
44	20381	0	25882	8704	0	94089	84307	0	0	
45	88581	0	111875	39587	0	84307	41749	0	0	
46	83373	0	104325	39823	0	41749	1485	0	0	
47	78048	0	96576	40092	0	1485	-35970	0	0	
48	63973	643	78817	35520	0	-35970	-66267	0	0	
49	59745	1926	73992	35780	0	-66267	-94513	0	0	
50	55012	3208	68408	36066	0	-94513	-119913	0	0	
51	49876	4491	62178	36381	0	-119913	-141719	0	0	

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
52	44481	5773	55186	37450	0	-141719	-158525	0	0	
53	42638	8918	53948	42409	0	-158525	-172239	0	0	
54	35952	9093	43206	42932	0	-172239	-178174	0	0	
55	28948	10484	33503	43507	0	-178174	-176659	0	0	
56	21548	11875	22899	44142	0	-176659	-166526	0	0	
57	13671	13266	11818	43747	0	-166526	-147648	0	0	
58	5074	14545	11851	23779	0	-147648	-142407	0	0	
59	320	5537	4230	5613	0	-142407	-142569	0	0	

Tabella 14-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 10.

#### 14.2.2 ANALISI DELLA SUPERFICIE 265 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	59	
Coordinate del centro	X[m]= 101.64	Y[m]= 178.00
Raggio del cerchio	R[m]= 56.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 70.44	Y <sub>v</sub> [m]= 131.49
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 142.92	Y <sub>m</sub> [m]= 140.16
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.345</b>	

N°	X <sub>s</sub>	Y <sub>ss</sub>	Y <sub>si</sub>	X <sub>d</sub>	Y <sub>ds</sub>	Y <sub>di</sub>	X <sub>g</sub>	Y <sub>g</sub>	L	α	β	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
1	70.44	131.49	131.49	72.22	131.91	130.35	71.63	131.25	2.11	-32.77	0.00	53
2	72.22	131.91	130.35	73.99	132.32	129.30	73.20	130.96	2.06	-30.64	0.00	52
3	73.99	132.32	129.30	75.76	132.74	128.34	74.93	130.67	2.02	-28.56	0.00	52
4	75.76	132.74	128.34	77.53	133.15	127.45	76.69	130.42	1.98	-26.51	0.00	52
5	77.53	133.15	127.45	79.31	133.57	126.65	78.45	130.20	1.95	-24.50	0.00	52
6	79.31	133.57	126.65	81.08	133.98	125.91	80.22	130.03	1.92	-22.52	0.00	52
7	81.08	133.98	125.91	81.40	134.06	125.79	81.24	129.93	0.34	-21.36	0.00	52
8	81.40	134.06	125.79	81.87	134.17	125.61	81.64	129.90	0.50	-20.93	0.00	52
9	81.87	134.17	125.61	83.54	134.56	125.01	82.72	129.83	1.77	-19.77	0.00	52
10	83.54	134.56	125.01	84.48	134.78	124.69	84.01	129.76	0.99	-18.35	0.00	52
11	84.48	134.78	124.69	85.42	135.00	124.40	84.95	129.72	0.98	-17.34	0.00	52
12	85.42	135.00	124.40	86.34	135.00	124.13	85.88	129.63	0.96	-16.35	0.00	52
13	86.34	135.00	124.13	87.15	135.00	123.91	86.75	129.51	0.84	-15.43	0.00	52
14	87.15	135.00	123.91	88.61	135.00	123.54	87.88	129.36	1.51	-14.23	0.00	52
15	88.61	135.00	123.54	90.07	135.00	123.21	89.34	129.19	1.50	-12.69	0.00	52
16	90.07	135.00	123.21	91.24	135.27	122.97	90.66	129.11	1.19	-11.31	0.00	52
17	91.24	135.27	122.97	92.51	135.57	122.75	91.88	129.14	1.29	-10.04	0.00	52
18	92.51	135.57	122.75	93.77	135.86	122.56	93.14	129.18	1.28	-8.73	0.00	52
19	93.77	135.86	122.56	95.04	136.16	122.39	94.41	129.24	1.28	-7.42	0.00	52
20	95.04	136.16	122.39	96.77	136.56	122.21	95.91	129.33	1.74	-5.88	0.00	52
21	96.77	136.56	122.21	98.51	136.97	122.09	97.65	129.46	1.74	-4.09	0.00	52
22	98.51	136.97	122.09	99.46	137.19	122.04	98.99	129.57	0.96	-2.71	0.00	52
23	99.46	137.19	122.04	100.42	137.41	122.01	99.94	129.66	0.96	-1.74	0.00	52
24	100.42	137.41	122.01	101.42	137.65	122.00	100.92	129.77	1.00	-0.74	0.00	52
25	101.42	137.65	122.00	102.42	137.88	122.01	101.92	129.88	1.00	0.29	0.00	52
26	102.42	137.88	122.01	103.38	138.10	122.03	102.90	130.00	0.96	1.29	0.00	52
27	103.38	138.10	122.03	104.74	138.42	122.09	104.06	130.16	1.36	2.48	0.00	52
28	104.74	138.42	122.09	106.09	138.74	122.18	105.42	130.35	1.36	3.87	0.00	52
29	106.09	138.74	122.18	107.45	139.05	122.30	106.77	130.57	1.36	5.26	0.00	52
30	107.45	139.05	122.30	108.70	139.34	122.45	108.08	130.79	1.26	6.60	0.00	52
31	108.70	139.34	122.45	110.14	139.68	122.65	109.42	131.03	1.46	7.99	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∅ [°]	∅ [°]	c [kPa]
32	110.14	139.68	122.65	111.59	140.02	122.89	110.87	131.31	1.47	9.49	0.00	52
33	111.59	140.02	122.89	113.39	140.44	123.25	112.49	131.65	1.83	11.17	0.00	52
34	113.39	140.44	123.25	114.52	140.70	123.50	113.96	131.97	1.16	12.70	0.00	52
35	114.52	140.70	123.50	114.85	140.78	123.58	114.68	132.14	0.34	13.47	0.00	52
36	114.85	140.78	123.58	115.06	140.83	123.63	114.95	132.20	0.22	13.75	0.00	52
37	115.06	140.83	123.63	116.67	141.20	124.05	115.86	132.43	1.66	14.72	0.00	52
38	116.67	141.20	124.05	118.28	141.58	124.53	117.47	132.84	1.68	16.43	0.00	52
39	118.28	141.58	124.53	118.29	141.58	124.53	118.28	133.06	0.01	17.29	0.00	52
40	118.29	141.58	124.53	119.24	141.80	124.84	118.76	133.19	1.00	17.81	0.00	52
41	119.24	141.80	124.84	120.53	142.10	125.28	119.88	133.51	1.36	19.01	0.00	52
42	120.53	142.10	125.28	121.81	142.40	125.76	121.17	133.89	1.37	20.41	0.00	52
43	121.81	142.40	125.76	123.32	142.76	126.37	122.56	134.32	1.63	21.94	0.00	53
44	123.32	142.76	126.37	124.83	143.11	127.03	124.07	134.81	1.65	23.62	0.00	54
45	124.83	143.11	127.03	125.64	143.30	127.40	125.23	135.21	0.89	24.92	0.00	54
46	125.64	143.30	127.40	126.82	143.30	127.98	126.23	135.50	1.32	26.05	0.00	54
47	126.82	143.30	127.98	128.01	143.30	128.60	127.41	135.79	1.33	27.41	0.00	54
48	128.01	143.30	128.60	129.39	143.30	129.36	128.69	136.14	1.58	28.90	0.00	54
49	129.39	143.30	129.36	131.08	143.30	130.36	130.22	136.58	1.97	30.71	0.00	54
50	131.08	143.30	130.36	131.14	143.30	130.40	131.11	136.84	0.07	31.75	0.00	54
51	131.14	143.30	130.40	132.52	142.93	131.29	131.82	136.98	1.64	32.63	0.00	54
52	132.52	142.93	131.29	133.91	142.56	132.23	133.20	137.25	1.68	34.33	0.00	54
53	133.91	142.56	132.23	135.29	142.19	133.24	134.58	137.55	1.71	36.06	0.00	54
54	135.29	142.19	133.24	136.22	141.95	133.95	135.75	137.83	1.17	37.53	0.00	54
55	136.22	141.95	133.95	136.72	141.81	134.35	136.47	138.01	0.64	38.46	0.00	54
56	136.72	141.81	134.35	138.27	141.40	135.64	137.46	138.29	2.02	39.82	0.00	54
57	138.27	141.40	135.64	139.82	140.99	137.03	139.00	138.75	2.08	41.92	0.00	54
58	139.82	140.99	137.03	141.37	140.57	138.53	140.51	139.25	2.16	44.09	0.00	54
59	141.37	140.57	138.53	142.92	140.16	140.16	141.89	139.76	2.25	46.34	17.11	13

Tabella 14-4 – Geometria e caratteristiche strisce della superficie 265 della verifica di stabilità 10.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	2727	0	25607	33081	0	0	39887	0	0	
2	8235	0	31515	31741	0	39887	77854	0	0	
3	13447	0	37254	31091	0	77854	114146	0	0	
4	18349	0	42455	30518	0	114146	148363	0	0	
5	22955	0	47180	30011	0	148363	180173	0	0	
6	27248	0	51435	29564	0	180173	209301	0	0	
7	5358	0	9712	5294	0	209301	214253	0	0	
8	8103	0	14488	7752	0	214253	221351	0	0	
9	30962	0	53519	27338	0	221351	244859	0	0	
10	18876	0	31474	15257	0	244859	256862	0	0	
11	19862	0	32372	15171	0	256862	267957	0	0	
12	20166	0	32244	14770	0	267957	277971	0	0	
13	18164	0	28598	12945	0	277971	286136	0	0	
14	33632	0	51963	23204	0	286136	299327	0	0	
15	34682	0	52406	23055	0	299327	310571	0	0	
16	28777	0	42655	18382	0	310571	318078	0	0	
17	32445	0	47272	19818	0	318078	324545	0	0	
18	33685	0	48294	19743	0	324545	329284	0	0	
19	34768	0	49129	19679	0	329284	332328	0	0	
20	49219	0	68480	26870	0	332328	333768	0	0	
21	50909	0	69704	26797	0	333768	332065	0	0	

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
22	28700	0	38858	14729	0	332065	329784	0	0	
23	29136	0	39161	14719	0	329784	326563	0	0	
24	30942	0	41296	15407	0	326563	322194	0	0	
25	31360	0	41573	15406	0	322194	316812	0	0	
26	30468	0	40142	14793	0	316812	310704	0	0	
27	43581	0	57030	20920	0	310704	300542	0	0	
28	44078	0	57259	20948	0	300542	288656	0	0	
29	44478	0	57390	20989	0	288656	275109	0	0	
30	41253	0	52912	19386	0	275109	261213	0	0	
31	47912	0	61102	22479	0	261213	243540	0	0	
32	48104	0	61002	22570	0	243540	224181	0	0	
33	60043	0	75702	28266	0	224181	197840	0	0	
34	37709	0	47316	17845	0	197840	180095	0	0	
35	11013	0	13788	5228	0	180095	174740	0	0	
36	7008	0	8767	3331	0	174740	171292	0	0	
37	53667	0	66959	25644	0	171292	143865	0	0	
38	53460	0	66399	25859	0	143865	114808	0	0	
39	331	0	410	161	0	114808	114623	0	0	
40	31388	0	38848	15372	0	114623	96780	0	0	
41	42205	0	52073	20939	0	96780	71915	0	0	
42	41833	0	51422	21122	0	71915	46326	0	0	
43	48512	0	59166	25557	0	46326	16085	0	0	
44	47761	0	57673	26433	0	16085	-14147	0	0	
45	25276	0	30361	14325	0	-14147	-30536	0	0	
46	36136	2370	46583	21155	0	-30536	-57258	0	0	
47	34796	2370	44501	21409	0	-57258	-83128	0	0	
48	38721	2760	48972	25282	0	-83128	-111882	0	0	
49	44585	3380	55367	31527	0	-111882	-144530	0	0	
50	1524	120	1867	1132	0	-144530	-145628	0	0	
51	33336	0	35705	26345	0	-145628	-164570	0	0	
52	29836	0	29637	26866	0	-164570	-178675	0	0	
53	26206	0	23069	27445	0	-178675	-187264	0	0	
54	15504	0	11516	18810	0	-187264	-189538	0	0	
55	7618	0	4787	10241	0	-189538	-189495	0	0	
56	19813	0	7274	32368	0	-189495	-182295	0	0	
57	14633	0	-3878	33410	0	-182295	-164446	0	0	
58	9104	0	-16275	34179	0	-164446	-134547	0	0	
59	3051	0	-1471	7005	0	-134547	-130648	0	0	

Tabella 14-5 – Forze applicate sulle strisce [BISHOP] della superficie 265 della verifica di stabilità 10.

#### 14.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u [m]
1	0.024242
2	0.013426
3	0.014078
4	0.002967
5	0.013848
6	0.016169
7	0.018900

Tabella 14-6 – Spostamenti della superficie 1 della verifica di stabilità 10.



Accelerazione sismica critica  $K_c = 0.171$   
Spostamento massimo  $U_{max} = 0.024242$  [m]  
Velocità massima  $V_{max} = 0.127707$  [m/s]

n°	u
	[m]
1	0.037331
2	0.026584
3	0.021613
4	0.007310
5	0.019250
6	0.023345
7	0.029407

Tabella 14-7 – Spostamenti della superficie 265 della verifica di stabilità 10.

Accelerazione sismica critica  $K_c = 0.144$   
Spostamento massimo  $U_{max} = 0.037331$  [m]  
Velocità massima  $V_{max} = 0.150843$  [m/s]

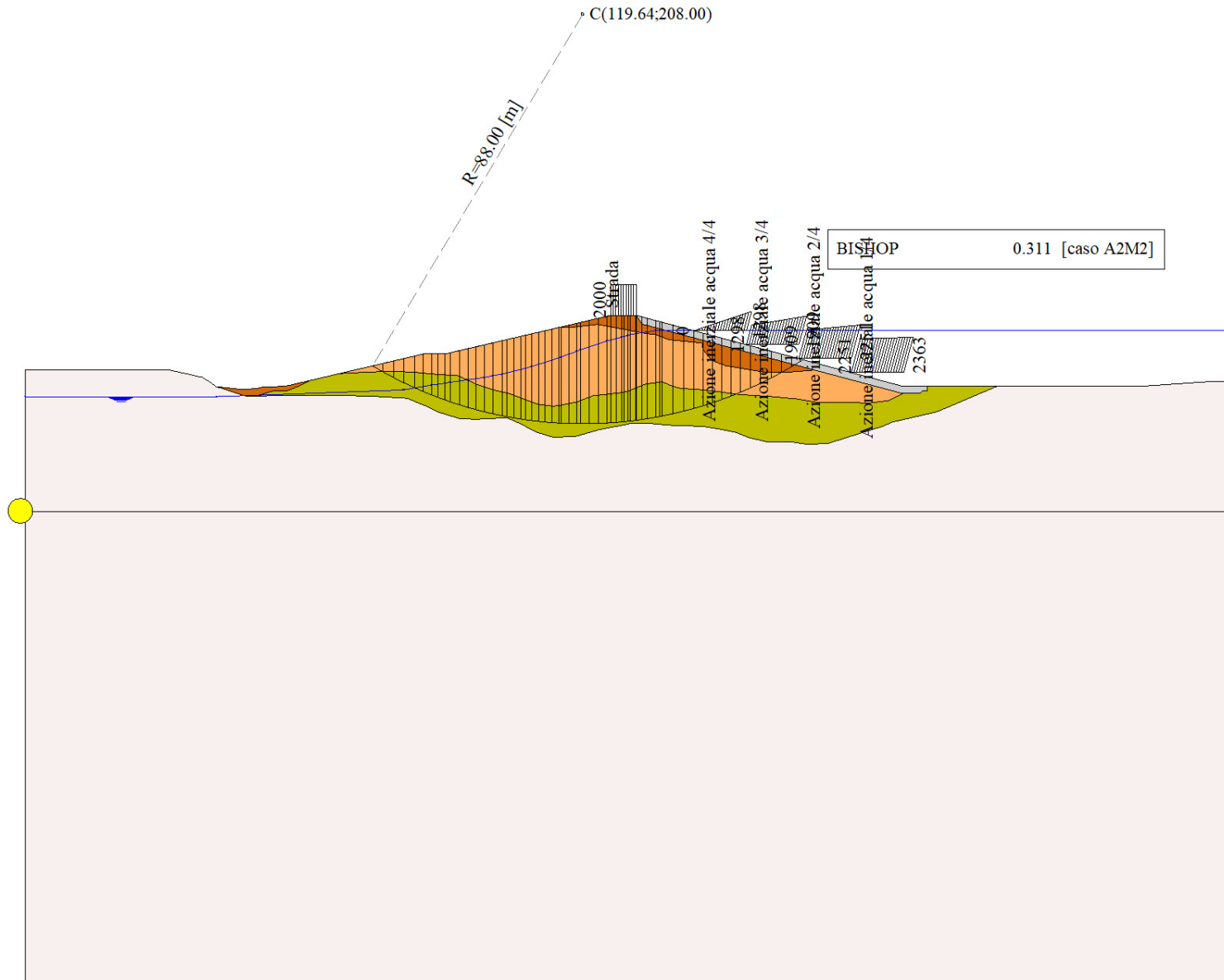


Figura 14-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 10.

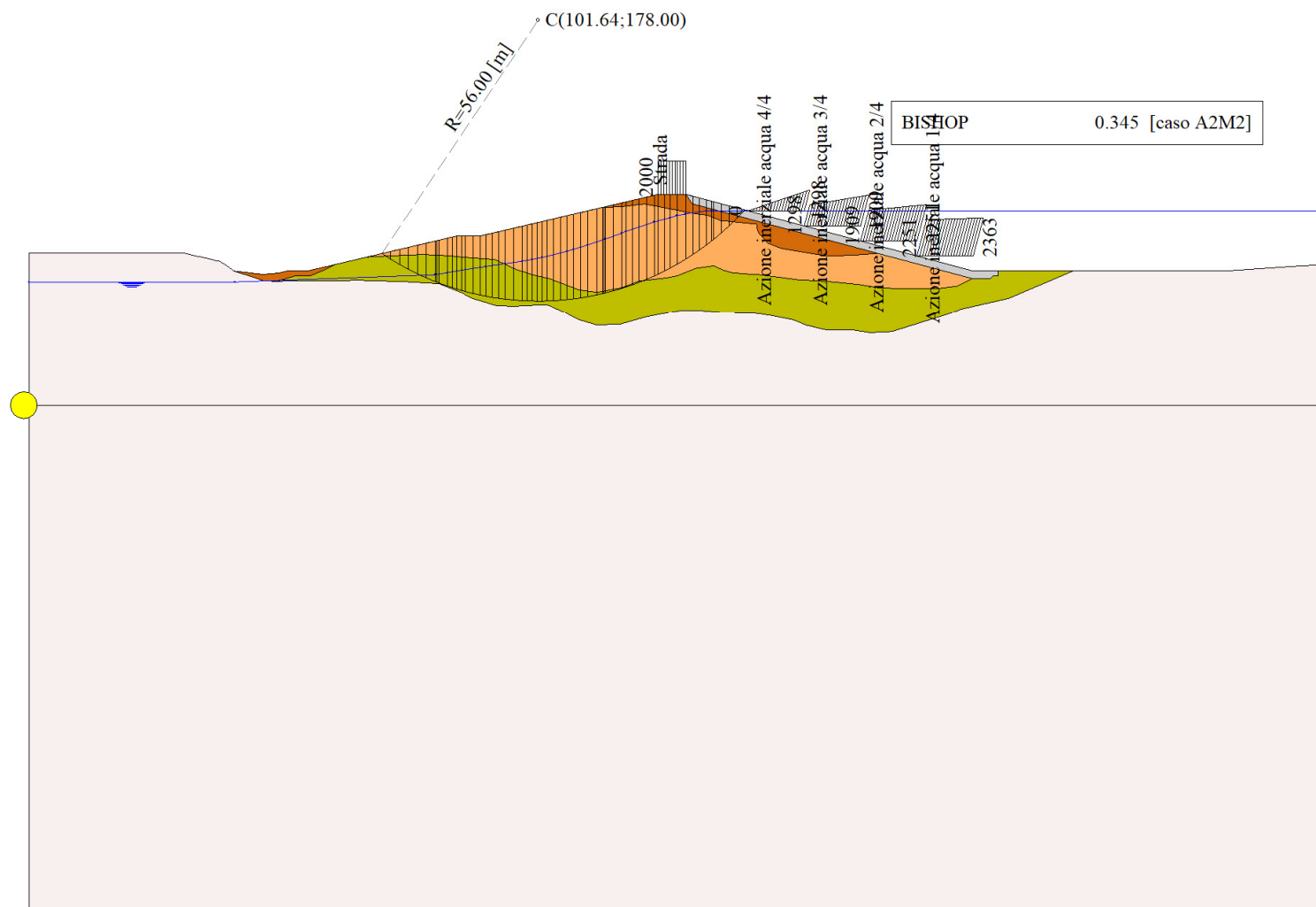


Figura 14-2 – Superficie critica (265) della sezione CR\_06 per la verifica di stabilità 10.

## 15 VERIFICA DI STABILITÀ 11

### 15.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	125.64 143.30	131.14 143.30	2000 2000	0 0
2	Azione inerziale acqua 1/4	Variabile	1.00	177.27 131.00	188.52 131.00	2062 2164	-550 -557
3	Azione inerziale acqua 2/4	Variabile	1.00	166.02 134.00	177.27 134.00	1749 2062	-466 -550
4	Azione inerziale acqua 3/4	Variabile	1.00	154.77 137.00	166.02 137.00	1189 1749	-317 -466
5	Azione inerziale acqua 4/4	Variabile	1.00	143.52 140.00	154.77 140.00	0 1189	0 -317

Tabella 15-1 – Carichi distribuiti verifica di stabilità 11.

### 15.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **sismiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 15.2 RISULTATI ANALISI

Numero di superfici analizzate	86748
Coefficiente di sicurezza minimo	0.327
Superficie con coefficiente di sicurezza minimo	1

### 15.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	59	
Coordinate del centro	X[m]= 117.64	Y[m]= 208.00
Raggio del cerchio	R[m]= 88.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 73.09	Y <sub>v</sub> [m]= 132.11
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 165.48	Y <sub>m</sub> [m]= 134.14
Coefficiente di sicurezza	F <sub>S</sub> = <b>0.327</b>	

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\bar{\alpha}$ [°]	$\bar{\beta}$ [°]	c [kPa]
1	73.09	132.11	132.11	73.14	132.13	132.08	73.12	132.11	0.06	-30.40	0.00	54
2	73.14	132.13	132.08	75.13	132.59	130.95	74.45	131.88	2.28	-29.63	0.00	54
3	75.13	132.59	130.95	77.11	133.05	129.89	76.22	131.61	2.25	-28.16	0.00	52
4	77.11	133.05	129.89	79.09	133.52	128.89	78.16	131.33	2.22	-26.70	0.00	52
5	79.09	133.52	128.89	81.08	133.98	127.95	80.13	131.08	2.19	-25.26	0.00	52
6	81.08	133.98	127.95	81.40	134.06	127.81	81.24	130.95	0.35	-24.43	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∠ [°]	∠ [°]	c [kPa]
7	81.40	134.06	127.81	83.54	134.56	126.88	82.51	130.82	2.33	-23.56	0.00	52
8	83.54	134.56	126.88	85.42	135.00	126.11	84.50	130.63	2.03	-22.14	0.00	52
9	85.42	135.00	126.11	87.15	135.00	125.45	86.30	130.39	1.85	-20.87	0.00	52
10	87.15	135.00	125.45	88.61	135.00	124.93	87.89	130.09	1.55	-19.77	0.00	52
11	88.61	135.00	124.93	90.07	135.00	124.43	89.35	129.84	1.54	-18.76	0.00	52
12	90.07	135.00	124.43	91.24	135.27	124.05	90.66	129.69	1.23	-17.86	0.00	52
13	91.24	135.27	124.05	93.14	135.72	123.48	92.20	129.63	1.98	-16.81	0.00	52
14	93.14	135.72	123.48	95.04	136.16	122.95	94.10	129.58	1.97	-15.52	0.00	52
15	95.04	136.16	122.95	96.77	136.56	122.51	95.92	129.55	1.79	-14.30	0.00	52
16	96.77	136.56	122.51	98.51	136.97	122.10	97.65	129.54	1.78	-13.14	0.00	52
17	98.51	136.97	122.10	100.42	137.41	121.70	99.47	129.55	1.95	-11.92	0.00	52
18	100.42	137.41	121.70	102.42	137.88	121.33	101.43	129.58	2.03	-10.62	0.00	52
19	102.42	137.88	121.33	103.38	138.10	121.16	102.90	129.62	0.97	-9.64	0.00	84
20	103.38	138.10	121.16	104.84	138.44	120.94	104.11	129.66	1.48	-8.84	0.00	67
21	104.84	138.44	120.94	106.30	138.78	120.73	105.57	129.72	1.47	-7.88	0.00	52
22	106.30	138.78	120.73	107.45	139.05	120.59	106.88	129.79	1.16	-7.03	0.00	52
23	107.45	139.05	120.59	108.70	139.34	120.46	108.08	129.86	1.26	-6.24	0.00	52
24	108.70	139.34	120.46	110.14	139.68	120.32	109.43	129.95	1.45	-5.36	0.00	52
25	110.14	139.68	120.32	111.59	140.02	120.21	110.87	130.06	1.45	-4.41	0.00	52
26	111.59	140.02	120.21	113.06	140.36	120.12	112.33	130.18	1.47	-3.46	0.00	52
27	113.06	140.36	120.12	114.52	140.70	120.06	113.79	130.31	1.47	-2.51	0.00	52
28	114.52	140.70	120.06	115.06	140.83	120.04	114.79	130.40	0.54	-1.86	0.00	52
29	115.06	140.83	120.04	116.67	141.20	120.01	115.87	130.52	1.62	-1.15	0.00	52
30	116.67	141.20	120.01	118.29	141.58	120.00	117.48	130.70	1.62	-0.10	0.00	52
31	118.29	141.58	120.00	119.24	141.80	120.01	118.77	130.85	0.95	0.73	0.00	52
32	119.24	141.80	120.01	121.10	142.24	120.07	120.17	131.03	1.86	1.65	0.00	52
33	121.10	142.24	120.07	122.97	142.67	120.16	122.04	131.29	1.87	2.86	0.00	52
34	122.97	142.67	120.16	124.83	143.11	120.29	123.90	131.56	1.87	4.08	0.00	52
35	124.83	143.11	120.29	125.64	143.30	120.36	125.24	131.77	0.81	4.95	0.00	52
36	125.64	143.30	120.36	126.82	143.30	120.48	126.23	131.86	1.19	5.60	0.00	52
37	126.82	143.30	120.48	128.01	143.30	120.61	127.42	131.92	1.19	6.38	0.00	52
38	128.01	143.30	120.61	128.54	143.30	120.68	128.27	131.97	0.53	6.94	0.00	52
39	128.54	143.30	120.68	129.39	143.30	120.79	128.96	132.02	0.86	7.39	0.00	52
40	129.39	143.30	120.79	129.79	143.30	120.84	129.59	132.06	0.40	7.80	0.00	52
41	129.79	143.30	120.84	131.08	143.30	121.03	130.43	132.12	1.30	8.36	0.00	52
42	131.08	143.30	121.03	131.14	143.30	121.04	131.11	132.17	0.06	8.80	0.00	52
43	131.14	143.30	121.04	133.22	142.75	121.39	132.17	132.12	2.10	9.51	0.00	52
44	133.22	142.75	121.39	135.29	142.19	121.79	134.24	132.03	2.11	10.88	0.00	52
45	135.29	142.19	121.79	136.22	141.95	121.98	135.75	131.98	0.95	11.88	0.00	52
46	136.22	141.95	121.98	136.72	141.81	122.09	136.47	131.96	0.51	12.36	0.00	52
47	136.72	141.81	122.09	138.99	141.21	122.63	137.84	131.94	2.33	13.28	0.00	52
48	138.99	141.21	122.63	141.25	140.60	123.23	140.11	131.92	2.34	14.80	0.00	52
49	141.25	140.60	123.23	143.52	140.00	123.89	142.37	131.93	2.36	16.33	0.00	52
50	143.52	140.00	123.89	145.75	139.40	124.61	144.62	131.98	2.35	17.87	0.00	52
51	145.75	139.40	124.61	147.99	138.81	125.40	146.85	132.05	2.37	19.40	0.00	52
52	147.99	138.81	125.40	150.22	138.21	126.25	149.08	132.17	2.39	20.95	0.00	52
53	150.22	138.21	126.25	152.45	137.62	127.18	151.31	132.31	2.42	22.52	0.00	54
54	152.45	137.62	127.18	154.68	137.02	128.18	153.54	132.50	2.45	24.10	0.00	54
55	154.68	137.02	128.18	156.92	136.43	129.25	155.76	132.72	2.48	25.70	0.00	54
56	156.92	136.43	129.25	159.15	135.83	130.41	157.98	132.97	2.51	27.33	0.00	54
57	159.15	135.83	130.41	161.26	135.27	131.57	160.14	133.26	2.41	28.93	0.00	54
58	161.26	135.27	131.57	163.37	134.71	132.82	162.20	133.57	2.45	30.51	0.00	53
59	163.37	134.71	132.82	165.48	134.14	134.14	164.08	133.89	2.49	32.12	18.47	9

Tabella 15-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 11.

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
1	2	0	627	1063	0	0	1232	0	0	
2	3239	0	26729	38400	0	1232	45811	0	0	
3	9494	0	33707	36599	0	45811	88078	0	0	
4	15619	0	41089	36120	0	88078	129091	0	0	
5	21442	0	47923	35680	0	129091	168471	0	0	
6	3986	0	8336	5714	0	168471	174641	0	0	
7	30262	0	59831	37951	0	174641	214516	0	0	
8	31623	0	58183	32994	0	214516	247329	0	0	
9	32381	0	56914	30098	0	247329	275586	0	0	
10	29116	0	49627	25220	0	275586	297989	0	0	
11	30662	0	50968	25065	0	297989	319038	0	0	
12	25938	0	42166	19982	0	319038	334851	0	0	
13	45307	0	71801	32265	0	334851	358316	0	0	
14	48952	0	75513	32056	0	358316	378957	0	0	
15	47648	0	71885	29106	0	378957	395271	0	0	
16	50333	0	74522	28962	0	395271	409096	0	0	
17	58414	0	84972	31733	0	409096	421353	0	0	
18	64373	0	92073	33079	0	421353	430788	0	0	
19	32032	0	46907	25363	0	430788	443721	0	0	
20	50031	0	71218	31063	0	443721	454239	0	0	
21	51515	0	71503	23960	0	454239	455730	0	0	
22	41573	0	57239	18836	0	455730	455562	0	0	
23	46133	0	63079	20441	0	455562	454038	0	0	
24	54497	0	73975	23593	0	454038	450531	0	0	
25	55742	0	75117	23560	0	450531	445123	0	0	
26	57738	0	77282	23859	0	445123	437686	0	0	
27	58928	0	78378	23838	0	437686	428271	0	0	
28	22030	0	29182	8783	0	428271	424289	0	0	
29	66853	0	88196	26259	0	424289	410726	0	0	
30	68237	0	89511	26253	0	410726	394686	0	0	
31	40758	0	53244	15444	0	394686	384092	0	0	
32	81204	0	105636	30303	0	384092	360822	0	0	
33	82728	0	107081	30328	0	360822	334295	0	0	
34	84047	0	108306	30367	0	334295	304594	0	0	
35	36924	0	47447	13217	0	304594	290694	0	0	
36	54064	2370	72445	19356	0	290694	267773	0	0	
37	53813	2370	71951	19383	0	267773	244088	0	0	
38	23982	1060	32017	8679	0	244088	233255	0	0	
39	38337	1700	51123	13933	0	233255	215585	0	0	
40	17988	800	23963	6563	0	215585	207145	0	0	
41	57777	2580	76867	21195	0	207145	179388	0	0	
42	2678	120	3560	987	0	179388	178077	0	0	
43	90774	0	114941	34201	0	178077	136344	0	0	
44	87011	0	109563	34349	0	136344	95257	0	0	
45	37714	0	47278	15449	0	95257	77179	0	0	
46	19945	0	24946	8321	0	77179	67561	0	0	
47	86441	0	107509	37859	0	67561	25932	0	0	
48	80965	0	99724	38112	0	25932	-13070	0	0	
49	75368	0	91716	38397	0	-13070	-48907	0	0	
50	68442	785	82849	38136	0	-48907	-80753	0	0	
51	62795	2350	76341	38482	0	-80753	-109510	0	0	

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
52	56428	3916	68727	38867	0	-109510	-134006	0	0	
53	49652	5481	59964	40327	0	-134006	-152203	0	0	
54	42835	7047	51086	41397	0	-152203	-164004	0	0	
55	35725	9741	43444	41938	0	-164004	-170637	0	0	
56	28280	9995	31479	42536	0	-170637	-168109	0	0	
57	19507	10855	19850	40336	0	-168109	-158022	0	0	
58	11909	12149	8988	40385	0	-158022	-139053	0	0	
59	3990	13443	11031	18527	0	-139053	-135936	0	0	

Tabella 15-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 11.

### 15.2.2 ANALISI DELLA SUPERFICIE 251 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	59	
Coordinate del centro	X[m]= 101.64	Y[m]= 178.00
Raggio del cerchio	R[m]= 56.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 70.44	Y <sub>v</sub> [m]= 131.49
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 142.92	Y <sub>m</sub> [m]= 140.16
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.361</b>	

N°	X <sub>s</sub>	Y <sub>ss</sub>	Y <sub>si</sub>	X <sub>d</sub>	Y <sub>ds</sub>	Y <sub>di</sub>	X <sub>g</sub>	Y <sub>g</sub>	L	α	β	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
1	70.44	131.49	131.49	72.22	131.91	130.35	71.63	131.25	2.11	-32.77	0.00	53
2	72.22	131.91	130.35	73.99	132.32	129.30	73.20	130.96	2.06	-30.64	0.00	52
3	73.99	132.32	129.30	75.76	132.74	128.34	74.93	130.67	2.02	-28.56	0.00	52
4	75.76	132.74	128.34	77.53	133.15	127.45	76.69	130.42	1.98	-26.51	0.00	52
5	77.53	133.15	127.45	79.31	133.57	126.65	78.45	130.20	1.95	-24.50	0.00	52
6	79.31	133.57	126.65	81.08	133.98	125.91	80.22	130.03	1.92	-22.52	0.00	52
7	81.08	133.98	125.91	81.40	134.06	125.79	81.24	129.93	0.34	-21.36	0.00	52
8	81.40	134.06	125.79	81.87	134.17	125.61	81.64	129.90	0.50	-20.93	0.00	52
9	81.87	134.17	125.61	83.54	134.56	125.01	82.72	129.83	1.77	-19.77	0.00	52
10	83.54	134.56	125.01	84.48	134.78	124.69	84.01	129.76	0.99	-18.35	0.00	52
11	84.48	134.78	124.69	85.42	135.00	124.40	84.95	129.72	0.98	-17.34	0.00	52
12	85.42	135.00	124.40	86.34	135.00	124.13	85.88	129.63	0.96	-16.35	0.00	52
13	86.34	135.00	124.13	87.15	135.00	123.91	86.75	129.51	0.84	-15.43	0.00	52
14	87.15	135.00	123.91	88.61	135.00	123.54	87.88	129.36	1.51	-14.23	0.00	52
15	88.61	135.00	123.54	90.07	135.00	123.21	89.34	129.19	1.50	-12.69	0.00	52
16	90.07	135.00	123.21	91.24	135.27	122.97	90.66	129.11	1.19	-11.31	0.00	52
17	91.24	135.27	122.97	92.51	135.57	122.75	91.88	129.14	1.29	-10.04	0.00	52
18	92.51	135.57	122.75	93.77	135.86	122.56	93.14	129.18	1.28	-8.73	0.00	52
19	93.77	135.86	122.56	95.04	136.16	122.39	94.41	129.24	1.28	-7.42	0.00	52
20	95.04	136.16	122.39	96.77	136.56	122.21	95.91	129.33	1.74	-5.88	0.00	52
21	96.77	136.56	122.21	98.51	136.97	122.09	97.65	129.46	1.74	-4.09	0.00	52
22	98.51	136.97	122.09	99.46	137.19	122.04	98.99	129.57	0.96	-2.71	0.00	52
23	99.46	137.19	122.04	100.42	137.41	122.01	99.94	129.66	0.96	-1.74	0.00	52
24	100.42	137.41	122.01	101.42	137.65	122.00	100.92	129.77	1.00	-0.74	0.00	52
25	101.42	137.65	122.00	102.42	137.88	122.01	101.92	129.88	1.00	0.29	0.00	52
26	102.42	137.88	122.01	103.38	138.10	122.03	102.90	130.00	0.96	1.29	0.00	52
27	103.38	138.10	122.03	104.74	138.42	122.09	104.06	130.16	1.36	2.48	0.00	52
28	104.74	138.42	122.09	106.09	138.74	122.18	105.42	130.35	1.36	3.87	0.00	52
29	106.09	138.74	122.18	107.45	139.05	122.30	106.77	130.57	1.36	5.26	0.00	52
30	107.45	139.05	122.30	108.70	139.34	122.45	108.08	130.79	1.26	6.60	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α [°]	β [°]	c [kPa]
31	108.70	139.34	122.45	110.14	139.68	122.65	109.42	131.03	1.46	7.99	0.00	52
32	110.14	139.68	122.65	111.59	140.02	122.89	110.87	131.31	1.47	9.49	0.00	52
33	111.59	140.02	122.89	113.39	140.44	123.25	112.49	131.65	1.83	11.17	0.00	52
34	113.39	140.44	123.25	114.52	140.70	123.50	113.96	131.97	1.16	12.70	0.00	52
35	114.52	140.70	123.50	114.85	140.78	123.58	114.68	132.14	0.34	13.47	0.00	52
36	114.85	140.78	123.58	115.06	140.83	123.63	114.95	132.20	0.22	13.75	0.00	52
37	115.06	140.83	123.63	116.67	141.20	124.05	115.86	132.43	1.66	14.72	0.00	52
38	116.67	141.20	124.05	118.28	141.58	124.53	117.47	132.84	1.68	16.43	0.00	52
39	118.28	141.58	124.53	118.29	141.58	124.53	118.28	133.06	0.01	17.29	0.00	52
40	118.29	141.58	124.53	119.24	141.80	124.84	118.76	133.19	1.00	17.81	0.00	52
41	119.24	141.80	124.84	120.53	142.10	125.28	119.88	133.51	1.36	19.01	0.00	52
42	120.53	142.10	125.28	121.81	142.40	125.76	121.17	133.89	1.37	20.41	0.00	52
43	121.81	142.40	125.76	123.32	142.76	126.37	122.56	134.32	1.63	21.94	0.00	53
44	123.32	142.76	126.37	124.83	143.11	127.03	124.07	134.81	1.65	23.62	0.00	54
45	124.83	143.11	127.03	125.64	143.30	127.40	125.23	135.21	0.89	24.92	0.00	54
46	125.64	143.30	127.40	126.82	143.30	127.98	126.23	135.50	1.32	26.05	0.00	54
47	126.82	143.30	127.98	128.01	143.30	128.60	127.41	135.79	1.33	27.41	0.00	54
48	128.01	143.30	128.60	129.39	143.30	129.36	128.69	136.14	1.58	28.90	0.00	54
49	129.39	143.30	129.36	131.08	143.30	130.36	130.22	136.58	1.97	30.71	0.00	54
50	131.08	143.30	130.36	131.14	143.30	130.40	131.11	136.84	0.07	31.75	0.00	54
51	131.14	143.30	130.40	132.52	142.93	131.29	131.82	136.98	1.64	32.63	0.00	54
52	132.52	142.93	131.29	133.91	142.56	132.23	133.20	137.25	1.68	34.33	0.00	54
53	133.91	142.56	132.23	135.29	142.19	133.24	134.58	137.55	1.71	36.06	0.00	54
54	135.29	142.19	133.24	136.22	141.95	133.95	135.75	137.83	1.17	37.53	0.00	54
55	136.22	141.95	133.95	136.72	141.81	134.35	136.47	138.01	0.64	38.46	0.00	54
56	136.72	141.81	134.35	138.27	141.40	135.64	137.46	138.29	2.02	39.82	0.00	54
57	138.27	141.40	135.64	139.82	140.99	137.03	139.00	138.75	2.08	41.92	0.00	54
58	139.82	140.99	137.03	141.37	140.57	138.53	140.51	139.25	2.16	44.09	0.00	54
59	141.37	140.57	138.53	142.92	140.16	140.16	141.89	139.76	2.25	46.34	17.11	13

Tabella 15-4 – Geometria e caratteristiche strisce della superficie 251 della verifica di stabilità 11.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	2727	0	24641	31667	0	0	38268	0	0	
2	8235	0	30548	30384	0	38268	74855	0	0	
3	13447	0	36269	29762	0	74855	109967	0	0	
4	18349	0	41455	29213	0	109967	143196	0	0	
5	22955	0	46165	28728	0	143196	174200	0	0	
6	27248	0	50408	28299	0	174200	202697	0	0	
7	5358	0	9525	5067	0	202697	207552	0	0	
8	8103	0	14213	7421	0	207552	214519	0	0	
9	30962	0	52538	26169	0	214519	237651	0	0	
10	18876	0	30918	14605	0	237651	249503	0	0	
11	19862	0	31814	14522	0	249503	260491	0	0	
12	20166	0	31700	14139	0	260491	270433	0	0	
13	18164	0	28124	12391	0	270433	278558	0	0	
14	33632	0	51120	22212	0	278558	291727	0	0	
15	34682	0	51578	22070	0	291727	303010	0	0	
16	28777	0	41997	17596	0	303010	310599	0	0	
17	32445	0	46560	18970	0	310599	317214	0	0	
18	33685	0	47584	18899	0	317214	322159	0	0	
19	34768	0	48422	18837	0	322159	325463	0	0	
20	49219	0	67518	25721	0	325463	327340	0	0	



N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
21	50909	0	68752	25651	0	327340	326162	0	0	
22	28700	0	38338	14099	0	326162	324206	0	0	
23	29136	0	38645	14090	0	324206	321334	0	0	
24	30942	0	40760	14748	0	321334	317355	0	0	
25	31360	0	41042	14747	0	317355	312386	0	0	
26	30468	0	39637	14161	0	312386	306696	0	0	
27	43581	0	56325	20025	0	306696	297157	0	0	
28	44078	0	56566	20052	0	297157	285928	0	0	
29	44478	0	56711	20091	0	285928	273066	0	0	
30	41253	0	52300	18557	0	273066	259824	0	0	
31	47912	0	60412	21518	0	259824	242929	0	0	
32	48104	0	60332	21605	0	242929	224369	0	0	
33	60043	0	74897	27057	0	224369	199045	0	0	
34	37709	0	46829	17082	0	199045	181950	0	0	
35	11013	0	13649	5004	0	181950	176785	0	0	
36	7008	0	8679	3188	0	176785	173458	0	0	
37	53667	0	66301	24548	0	173458	146969	0	0	
38	53460	0	65774	24753	0	146969	118851	0	0	
39	331	0	407	154	0	118851	118671	0	0	
40	31388	0	38497	14715	0	118671	101380	0	0	
41	42205	0	51620	20043	0	101380	77255	0	0	
42	41833	0	50997	20219	0	77255	52395	0	0	
43	48512	0	58714	24464	0	52395	22963	0	0	
44	47761	0	57279	25303	0	22963	-6518	0	0	
45	25276	0	30170	13713	0	-6518	-22519	0	0	
46	36136	2370	46294	20251	0	-22519	-48614	0	0	
47	34796	2370	44262	20494	0	-48614	-73920	0	0	
48	38721	2760	48761	24201	0	-73920	-102104	0	0	
49	44585	3380	55216	30179	0	-102104	-134197	0	0	
50	1524	120	1864	1083	0	-134197	-135279	0	0	
51	33336	0	35751	25218	0	-135279	-154058	0	0	
52	29836	0	29805	25717	0	-154058	-168189	0	0	
53	26206	0	23371	26272	0	-168189	-177011	0	0	
54	15504	0	11800	18006	0	-177011	-179567	0	0	
55	7618	0	4968	9803	0	-179567	-179720	0	0	
56	19813	0	7988	30984	0	-179720	-173364	0	0	
57	14633	0	-2931	31982	0	-173364	-156713	0	0	
58	9104	0	-15075	32718	0	-156713	-128387	0	0	
59	3051	0	-1346	6813	0	-128387	-124608	0	0	

Tabella 15-5 – Forze applicate sulle strisce [BISHOP] della superficie 251 della verifica di stabilità 11.

### 15.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u [m]
1	0.030810
2	0.011580
3	0.021365
4	0.026987
5	0.040433
6	0.012778
7	0.020370

Tabella 15-6 – Spostamenti della superficie 1 della verifica di stabilità 11.

Accelerazione sismica critica  $K_c = 0.168$   
Spostamento massimo  $U_{max} = 0.040433$  [m]  
Velocità massima  $V_{max} = 0.148412$  [m/s]

n°	u
	[m]
1	0.047347
2	0.020150
3	0.039517
4	0.038571
5	0.056595
6	0.018522
7	0.029045

Tabella 15-7 – Spostamenti della superficie 251 della verifica di stabilità 11.

Accelerazione sismica critica  $K_c = 0.144$   
Spostamento massimo  $U_{max} = 0.056595$  [m]  
Velocità massima  $V_{max} = 0.167953$  [m/s]

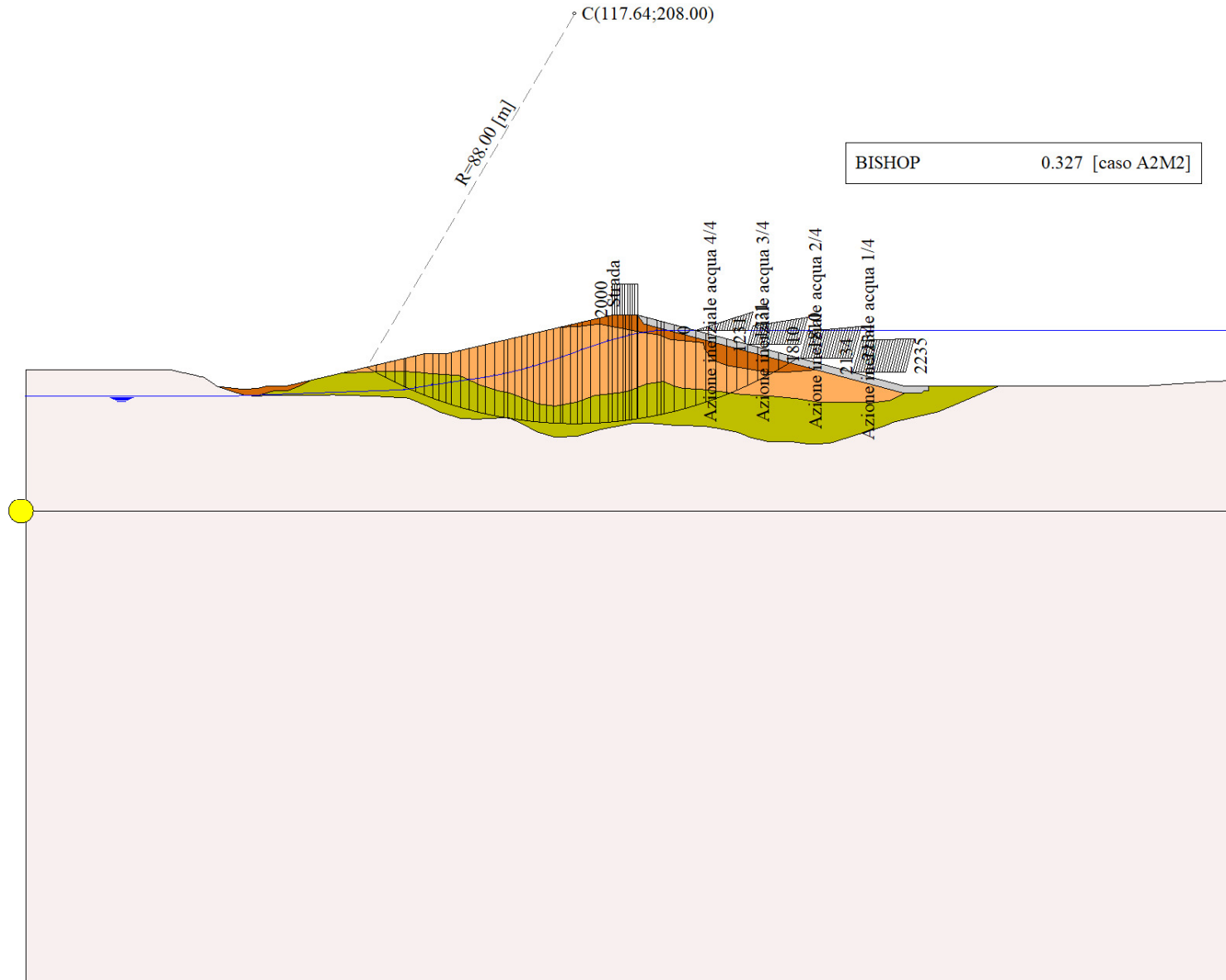


Figura 15-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 11.

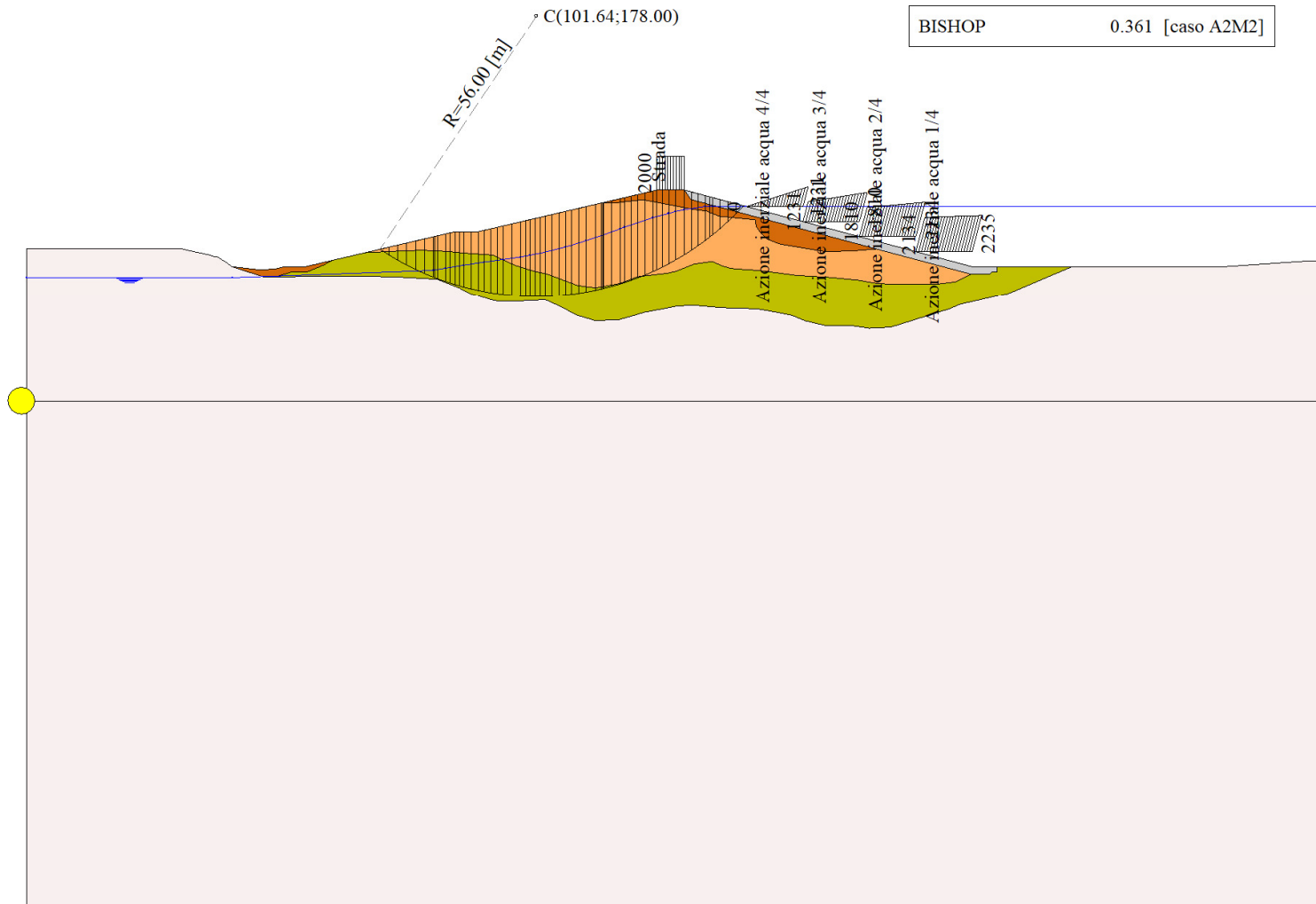


Figura 15-2 – Superficie critica (251) della sezione CR\_06 per la verifica di stabilità 11.

## 16 VERIFICA DI STABILITÀ 12

### 16.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	125.64 143.30	131.14 143.30	2000 2000	0 0

Tabella 16-1 – Carichi distribuiti verifica di stabilità 12.

### 16.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate in condizioni **statiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];
- Parametri di progetto [A2-M2]
- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni efficaci**

Presenza di falda

Presenza di carichi distribuiti

## 16.2 RISULTATI ANALISI

Numero di superfici analizzate	43374
Coefficiente di sicurezza minimo	2.159
Superficie con coefficiente di sicurezza minimo	1

### 16.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO L'ALTO

Numero di strisce	58	
Coordinate del centro	X[m]= 79.64	Y[m]= 188.00
Raggio del cerchio	R[m]= 70.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 44.21	Y <sub>v</sub> [m]= 127.63
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 133.08	Y <sub>m</sub> [m]= 142.78
Coefficiente di sicurezza	F <sub>S</sub> = 2.159	

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	44.21	127.63	127.63	45.48	127.48	126.90	45.06	127.34	1.46	-29.81	17.58	19
2	45.48	127.48	126.90	46.75	127.34	126.21	46.18	126.96	1.45	-28.62	17.58	19
3	46.75	127.34	126.21	47.12	127.37	126.01	46.94	126.73	0.42	-27.85	17.58	19
4	47.12	127.37	126.01	48.50	127.49	125.31	47.86	126.53	1.55	-27.05	19.23	19
5	48.50	127.49	125.31	49.88	127.61	124.64	49.23	126.26	1.53	-25.79	19.27	19
6	49.88	127.61	124.64	51.32	127.98	123.98	50.64	126.05	1.58	-24.51	19.27	19
7	51.32	127.98	123.98	52.78	127.99	123.36	52.07	125.82	1.59	-23.21	19.27	19
8	52.78	127.99	123.36	54.24	128.00	122.77	53.52	125.53	1.57	-21.92	19.27	19
9	54.24	128.00	122.77	55.52	128.00	122.29	54.89	125.26	1.37	-20.72	19.27	19
10	55.52	128.00	122.29	57.35	128.43	121.64	56.46	125.09	1.94	-19.36	19.27	19
11	57.35	128.43	121.64	59.17	128.85	121.06	58.28	125.00	1.92	-17.79	19.27	19
12	59.17	128.85	121.06	61.00	129.28	120.53	60.10	124.93	1.90	-16.22	19.27	19
13	61.00	129.28	120.53	63.16	129.79	119.97	62.10	124.89	2.23	-14.53	19.27	19
14	63.16	129.79	119.97	65.32	130.29	119.48	64.26	124.88	2.21	-12.71	19.27	19
15	65.32	130.29	119.48	67.48	130.80	119.06	66.41	124.91	2.20	-10.90	19.27	19
16	67.48	130.80	119.06	69.42	131.25	118.75	68.46	124.97	1.97	-9.20	19.27	19

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α <sub>1</sub> [°]	α <sub>2</sub> [°]	c [kPa]
17	69.42	131.25	118.75	71.37	131.71	118.49	70.40	125.05	1.96	-7.59	19.27	19
18	71.37	131.71	118.49	73.31	132.16	118.29	72.35	125.16	1.95	-5.99	19.27	19
19	73.31	132.16	118.29	75.25	132.62	118.14	74.29	125.30	1.95	-4.39	19.27	19
20	75.25	132.62	118.14	77.19	133.07	118.04	76.23	125.47	1.95	-2.80	19.27	19
21	77.19	133.07	118.04	79.14	133.53	118.00	78.17	125.66	1.94	-1.21	19.27	19
22	79.14	133.53	118.00	81.08	133.98	118.01	80.11	125.88	1.94	0.38	19.27	19
23	81.08	133.98	118.01	81.40	134.06	118.02	81.24	126.02	0.32	1.31	19.27	19
24	81.40	134.06	118.02	83.54	134.56	118.11	82.47	126.19	2.14	2.32	19.27	19
25	83.54	134.56	118.11	85.42	135.00	118.24	84.48	126.48	1.88	3.97	19.27	19
26	85.42	135.00	118.24	87.15	135.00	118.40	86.28	126.66	1.74	5.45	19.27	19
27	87.15	135.00	118.40	88.61	135.00	118.58	87.88	126.75	1.47	6.76	19.27	19
28	88.61	135.00	118.58	90.07	135.00	118.78	89.34	126.84	1.47	7.97	19.27	19
29	90.07	135.00	118.78	91.24	135.27	118.97	90.66	127.01	1.18	9.05	19.27	19
30	91.24	135.27	118.97	93.14	135.72	119.31	92.19	127.32	1.93	10.33	19.27	19
31	93.14	135.72	119.31	95.04	136.16	119.72	94.09	127.73	1.94	11.91	19.27	19
32	95.04	136.16	119.72	96.73	136.55	120.12	95.88	128.14	1.74	13.42	19.27	19
33	96.73	136.55	120.12	98.51	136.97	120.59	97.62	128.56	1.84	14.88	19.27	19
34	98.51	136.97	120.59	100.42	137.41	121.16	99.46	129.03	1.99	16.45	19.26	19
35	100.42	137.41	121.16	102.42	137.88	121.81	101.42	129.56	2.10	18.13	19.10	18
36	102.42	137.88	121.81	103.38	138.10	122.15	102.90	129.99	1.02	19.41	19.10	18
37	103.38	138.10	122.15	105.41	138.58	122.92	104.39	130.44	2.18	20.72	19.10	18
38	105.41	138.58	122.92	107.45	139.05	123.76	106.43	131.08	2.20	22.51	19.10	18
39	107.45	139.05	123.76	108.70	139.34	124.32	108.07	131.62	1.37	23.97	19.10	18
40	108.70	139.34	124.32	109.83	139.61	124.84	109.26	132.03	1.25	25.04	19.55	18
41	109.83	139.61	124.84	111.59	140.02	125.72	110.71	132.54	1.96	26.35	19.78	18
42	111.59	140.02	125.72	113.06	140.36	126.49	112.32	133.14	1.66	27.83	19.78	18
43	113.06	140.36	126.49	114.52	140.70	127.31	113.78	133.71	1.68	29.20	19.78	18
44	114.52	140.70	127.31	115.06	140.83	127.62	114.79	134.11	0.62	30.14	19.78	18
45	115.06	140.83	127.62	116.67	141.20	128.60	115.86	134.56	1.89	31.17	19.78	18
46	116.67	141.20	128.60	118.29	141.58	129.64	117.48	135.25	1.92	32.73	19.78	18
47	118.29	141.58	129.64	119.24	141.80	130.28	118.76	135.82	1.15	33.98	19.78	18
48	119.24	141.80	130.28	121.10	142.24	131.60	120.16	136.47	2.29	35.39	19.78	18
49	121.10	142.24	131.60	122.97	142.67	133.02	122.02	137.38	2.34	37.28	19.78	18
50	122.97	142.67	133.02	124.83	143.11	134.54	123.88	138.33	2.41	39.22	19.78	18
51	124.83	143.11	134.54	125.64	143.30	135.24	125.23	139.04	1.07	40.65	19.78	18
52	125.64	143.30	135.24	126.80	143.30	136.28	126.21	139.52	1.56	41.72	19.78	18
53	126.80	143.30	136.28	127.97	143.30	137.36	127.37	140.05	1.59	43.01	19.78	18
54	127.97	143.30	137.36	129.33	143.30	138.70	128.62	140.65	1.90	44.44	19.78	18
55	129.33	143.30	138.70	131.02	143.30	140.46	130.11	141.40	2.44	46.22	19.09	19
56	131.02	143.30	140.46	131.14	143.30	140.59	131.08	141.91	0.18	47.30	17.58	19
57	131.14	143.30	140.59	132.40	142.96	142.00	131.67	142.17	1.89	48.14	21.32	16
58	132.40	142.96	142.00	133.08	142.78	142.78	132.63	142.58	1.04	49.34	38.66	0

Tabella 16-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 12.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	757	0	1782	1587	0	0	2263	0	0	
2	2226	0	3533	1829	0	2263	5561	0	0	
3	943	0	1373	581	0	5561	6716	0	0	
4	5055	0	6294	2422	619	6716	12016	0	0	
5	7442	0	7810	2654	1737	12016	18559	0	0	
6	10579	0	10108	3071	2919	18559	26758	0	0	

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
7	13367	0	11963	3377	4030	26758	36165	0	0	
8	15346	0	12930	3520	5028	36165	46135	0	0	
9	14956	0	12023	3187	5172	46135	55198	0	0	
10	24397	0	19047	4839	8513	55198	68900	0	0	
11	28511	0	21901	5284	9736	68900	83596	0	0	
12	32423	0	24586	5704	10841	83596	98970	0	0	
13	43060	0	32270	7247	14091	98970	117616	0	0	
14	47825	0	35463	7748	15311	117616	136346	0	0	
15	52250	0	38420	8213	16373	136346	154776	0	0	
16	50439	0	36839	7747	15512	154776	170792	0	0	
17	53382	0	38782	8055	16145	170792	186031	0	0	
18	56092	0	40596	8342	16678	186031	200304	0	0	
19	58567	0	42286	8611	17115	200304	213439	0	0	
20	60808	0	43857	8863	17457	213439	225284	0	0	
21	62817	0	45316	9097	17707	225284	235707	0	0	
22	64560	0	46633	9310	17865	235707	244585	0	0	
23	10786	0	7922	1573	2831	244585	245911	0	0	
24	73048	0	53051	10529	19630	245911	253493	0	0	
25	65313	0	47086	9330	17738	253493	258318	0	0	
26	60152	0	42997	8535	16615	258318	261155	0	0	
27	50124	0	35395	7062	14243	261155	262325	0	0	
28	49450	0	34631	6942	14329	262325	262416	0	0	
29	39394	0	27491	5524	11520	262416	261732	0	0	
30	64101	0	44777	8999	18740	261732	259196	0	0	
31	63959	0	44811	9014	18655	259196	254914	0	0	
32	56536	0	39761	8011	16451	254914	249660	0	0	
33	59021	0	41732	8425	17100	249660	242689	0	0	
34	62586	0	44743	9042	17846	242689	233633	0	0	
35	64503	0	46565	9215	18291	233633	222209	0	0	
36	30542	0	22348	4429	8474	222209	216144	0	0	
37	63591	0	46728	9300	17741	216144	202039	0	0	
38	61730	0	45687	9156	17339	202039	186371	0	0	
39	36865	0	27682	5575	10183	186371	176083	0	0	
40	32594	0	24574	5108	9014	176083	166496	0	0	
41	49512	0	37571	7962	13739	166496	150854	0	0	
42	39946	0	30769	6563	10939	150854	137183	0	0	
43	38657	0	30047	6461	10626	137183	122981	0	0	
44	13905	0	10886	2355	3826	122981	117630	0	0	
45	40393	0	32010	6970	10983	117630	101342	0	0	
46	38481	0	30927	6818	10434	101342	84715	0	0	
47	21665	0	17837	3965	5617	84715	74893	0	0	
48	40171	0	33048	7489	10907	74893	55544	0	0	
49	36841	0	31205	7231	9592	55544	36586	0	0	
50	33220	0	29196	6951	8011	36586	18442	0	0	
51	13243	0	11997	2925	2945	18442	10928	0	0	
52	17342	3029	19654	4629	3511	10928	-1033	0	0	
53	14973	3029	17968	4376	2569	-1033	-11843	0	0	
54	14328	3536	18684	4766	1664	-11843	-22687	0	0	
55	12773	4394	19333	5250	0	-22687	-33014	0	0	
56	681	312	1113	324	0	-33014	-33613	0	0	
57	4516	0	4323	2189	0	-33613	-35372	0	0	
58	590	0	632	234	0	-35372	-35699	0	0	

Tabella 16-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 12.

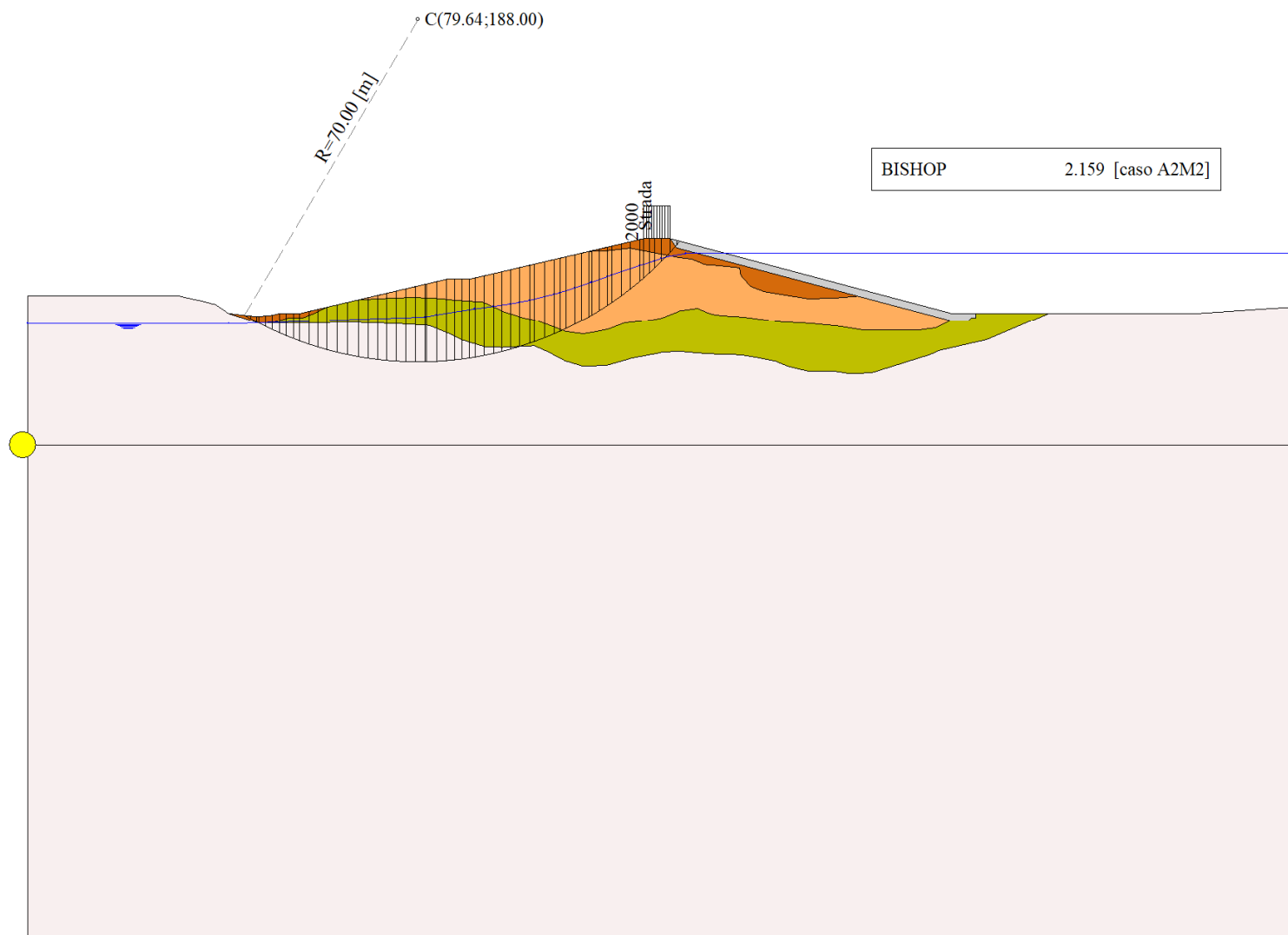


Figura 16-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 12.



## 17 VERIFICA DI STABILITÀ 13

### 17.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{\alpha}_2$	P <sub>i</sub> [m]	P <sub>f</sub> [m]	V <sub>y</sub> [kg/m]	V <sub>x</sub> [kg/m]
1	Strada	Variabile	1.00	125.64	131.14	2000	0
				143.30	143.30	2000	0

Tabella 17-1 – Carichi distribuiti verifica di stabilità 13.

### 17.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate in condizioni **statiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 17.2 RISULTATI ANALISI

Numero di superfici analizzate	43374
Coefficiente di sicurezza minimo	1.791
Superficie con coefficiente di sicurezza minimo	1

### 17.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO L'ALTO

Numero di strisce	59	
Coordinate del centro	X[m]= 99.64	Y[m]= 166.00
Raggio del cerchio	R[m]= 44.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 71.91	Y <sub>v</sub> [m]= 131.84
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 136.44	Y <sub>m</sub> [m]= 141.89
Coefficiente di sicurezza	F <sub>s</sub> = 1.791	

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\alpha'$ [°]	c [kPa]
1	71.91	131.84	131.84	73.14	132.13	130.88	72.73	131.61	1.56	-38.05	0.00	54
2	73.14	132.13	130.88	74.73	132.50	129.73	74.03	131.28	1.96	-35.76	0.00	52
3	74.73	132.50	129.73	76.32	132.87	128.69	75.58	130.94	1.90	-33.25	0.00	52
4	76.32	132.87	128.69	77.90	133.24	127.74	77.15	130.63	1.85	-30.81	0.00	52
5	77.90	133.24	127.74	79.49	133.61	126.88	78.72	130.37	1.81	-28.43	0.00	52
6	79.49	133.61	126.88	81.08	133.98	126.11	80.31	130.14	1.77	-26.10	0.00	52
7	81.08	133.98	126.11	81.40	134.06	125.96	81.24	130.03	0.35	-24.72	0.00	52
8	81.40	134.06	125.96	81.87	134.17	125.75	81.64	129.98	0.52	-24.16	0.00	52
9	81.87	134.17	125.75	82.70	134.36	125.39	82.29	129.92	0.91	-23.23	0.00	52
10	82.70	134.36	125.39	83.54	134.56	125.05	83.13	129.84	0.90	-22.05	0.00	52
11	83.54	134.56	125.05	84.48	134.78	124.69	84.01	129.77	1.01	-20.81	0.00	52
12	84.48	134.78	124.69	85.42	135.00	124.36	84.95	129.71	1.00	-19.50	0.00	52
13	85.42	135.00	124.36	86.34	135.00	124.06	85.88	129.60	0.97	-18.22	0.00	52
14	86.34	135.00	124.06	87.15	135.00	123.81	86.75	129.47	0.85	-17.04	0.00	52
15	87.15	135.00	123.81	88.61	135.00	123.40	87.88	129.30	1.52	-15.50	0.00	52
16	88.61	135.00	123.40	90.07	135.00	123.05	89.34	129.11	1.50	-13.54	0.00	52
17	90.07	135.00	123.05	91.24	135.27	122.81	90.66	129.03	1.20	-11.78	0.00	52
18	91.24	135.27	122.81	92.51	135.57	122.58	91.88	129.06	1.29	-10.17	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α [°]	β [°]	c [kPa]
19	92.51	135.57	122.58	93.77	135.86	122.39	93.14	129.10	1.28	-8.50	0.00	52
20	93.77	135.86	122.39	95.04	136.16	122.24	94.41	129.16	1.28	-6.83	0.00	52
21	95.04	136.16	122.24	96.20	136.43	122.13	95.62	129.24	1.16	-5.24	0.00	52
22	96.20	136.43	122.13	97.35	136.70	122.06	96.78	129.33	1.16	-3.73	0.00	52
23	97.35	136.70	122.06	98.51	136.97	122.01	97.93	129.44	1.16	-2.23	0.00	52
24	98.51	136.97	122.01	99.46	137.19	122.00	98.99	129.54	0.96	-0.85	0.00	52
25	99.46	137.19	122.00	100.42	137.41	122.01	99.94	129.65	0.96	0.39	0.00	52
26	100.42	137.41	122.01	101.42	137.65	122.04	100.92	129.78	1.00	1.67	0.00	52
27	101.42	137.65	122.04	102.42	137.88	122.09	101.92	129.91	1.00	2.97	0.00	52
28	102.42	137.88	122.09	103.68	138.17	122.19	103.05	130.08	1.26	4.44	0.00	52
29	103.68	138.17	122.19	104.93	138.47	122.32	104.31	130.29	1.26	6.09	0.00	52
30	104.93	138.47	122.32	106.19	138.76	122.49	105.56	130.51	1.27	7.74	0.00	52
31	106.19	138.76	122.49	107.45	139.05	122.70	106.82	130.75	1.27	9.39	0.00	52
32	107.45	139.05	122.70	108.70	139.34	122.94	108.08	131.01	1.27	11.05	0.00	52
33	108.70	139.34	122.94	110.14	139.68	123.27	109.42	131.31	1.48	12.85	0.00	52
34	110.14	139.68	123.27	111.59	140.02	123.65	110.87	131.66	1.49	14.79	0.00	52
35	111.59	140.02	123.65	112.49	140.23	123.92	112.04	131.95	0.94	16.37	0.00	52
36	112.49	140.23	123.92	113.39	140.44	124.20	112.94	132.20	0.94	17.60	0.00	54
37	113.39	140.44	124.20	114.52	140.70	124.59	113.95	132.48	1.20	18.99	0.00	54
38	114.52	140.70	124.59	114.85	140.78	124.71	114.68	132.70	0.35	19.99	0.00	54
39	114.85	140.78	124.71	115.06	140.83	124.79	114.95	132.78	0.22	20.37	0.00	54
40	115.06	140.83	124.79	116.14	141.08	125.21	115.60	132.98	1.16	21.27	0.00	54
41	116.14	141.08	125.21	117.21	141.33	125.66	116.67	133.32	1.17	22.78	0.00	54
42	117.21	141.33	125.66	118.29	141.58	126.15	117.75	133.68	1.18	24.31	0.00	54
43	118.29	141.58	126.15	119.24	141.80	126.61	118.76	134.03	1.05	25.77	0.00	54
44	119.24	141.80	126.61	120.64	142.13	127.33	119.94	134.47	1.58	27.48	0.00	54
45	120.64	142.13	127.33	122.04	142.46	128.13	121.33	135.01	1.61	29.55	0.00	54
46	122.04	142.46	128.13	123.43	142.78	128.99	122.73	135.59	1.64	31.66	0.00	54
47	123.43	142.78	128.99	124.83	143.11	129.92	124.13	136.20	1.68	33.83	0.00	54
48	124.83	143.11	129.92	125.64	143.30	130.50	125.23	136.71	1.00	35.57	0.00	54
49	125.64	143.30	130.50	126.80	143.30	131.39	126.22	137.12	1.46	37.17	0.00	54
50	126.80	143.30	131.39	127.97	143.30	132.33	127.38	137.58	1.50	39.10	0.00	54
51	127.97	143.30	132.33	129.33	143.30	133.53	128.64	138.11	1.81	41.26	0.00	54
52	129.33	143.30	133.53	130.18	143.30	134.32	129.75	138.61	1.16	43.19	0.00	54
53	130.18	143.30	134.32	131.02	143.30	135.16	130.59	139.02	1.19	44.72	0.00	54
54	131.02	143.30	135.16	131.14	143.30	135.28	131.08	139.26	0.17	45.61	0.00	54
55	131.14	143.30	135.28	132.75	142.87	137.02	131.90	139.60	2.37	47.26	0.00	54
56	132.75	142.87	137.02	134.36	142.44	138.97	133.49	140.29	2.53	50.45	0.00	54
57	134.36	142.44	138.97	135.40	142.16	140.36	134.83	140.96	1.74	53.23	0.00	53
58	135.40	142.16	140.36	136.44	141.89	141.88	135.75	141.47	1.84	55.56	19.36	7
59	136.44	141.89	141.88	136.44	141.89	141.89	136.44	141.88	0.01	56.76	22.44	0

Tabella 17-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 13.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	1491	0	5641	4789	0	0	7248	0	0	
2	6391	0	12060	5810	0	7248	19010	0	0	
3	11210	0	17099	5638	0	19010	33100	0	0	
4	15699	0	21551	5489	0	33100	48852	0	0	
5	19879	0	25507	5361	0	48852	65709	0	0	
6	23749	0	29018	5250	0	65709	83191	0	0	
7	5234	0	6243	1046	0	83191	86752	0	0	
8	7947	0	9396	1529	0	86752	91992	0	0	
9	14863	0	17331	2698	0	91992	101306	0	0	

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
10	15786	0	18115	2675	0	101306	110586	0	0	
11	18831	0	21279	2986	0	110586	120937	0	0	
12	19901	0	22161	2961	0	120937	131126	0	0	
13	20275	0	22292	2876	0	131126	140830	0	0	
14	18309	0	19921	2515	0	140830	149073	0	0	
15	33985	0	36516	4498	0	149073	163169	0	0	
16	35124	0	37201	4459	0	163169	176213	0	0	
17	29172	0	30540	3548	0	176213	185924	0	0	
18	32889	0	34099	3821	0	185924	195704	0	0	
19	34126	0	35073	3802	0	195704	204647	0	0	
20	35184	0	35889	3788	0	204647	212677	0	0	
21	32964	0	33419	3449	0	212677	219166	0	0	
22	33683	0	33979	3441	0	219166	224812	0	0	
23	34344	0	34504	3437	0	224812	229586	0	0	
24	28816	0	28861	2836	0	229586	232849	0	0	
25	29185	0	29166	2835	0	232849	235484	0	0	
26	30911	0	30838	2970	0	235484	237556	0	0	
27	31235	0	31123	2973	0	237556	238912	0	0	
28	39667	0	39496	3745	0	238912	239586	0	0	
29	39997	0	39823	3755	0	239586	239095	0	0	
30	40202	0	40060	3768	0	239095	237435	0	0	
31	40309	0	40231	3784	0	237435	234601	0	0	
32	40077	0	40096	3781	0	234601	230625	0	0	
33	46207	0	46390	4400	0	230625	224600	0	0	
34	45992	0	46396	4437	0	224600	217050	0	0	
35	28486	0	28868	2798	0	217050	211599	0	0	
36	28350	0	28816	2918	0	211599	205670	0	0	
37	35375	0	36140	3694	0	205670	197403	0	0	
38	10278	0	10543	1085	0	197403	194819	0	0	
39	6527	0	6706	692	0	194819	193134	0	0	
40	33276	0	34318	3571	0	193134	184014	0	0	
41	32918	0	34187	3609	0	184014	174104	0	0	
42	32490	0	34002	3652	0	174104	163435	0	0	
43	28250	0	29795	3261	0	163435	153420	0	0	
44	40717	0	43362	4869	0	153420	137732	0	0	
45	39571	0	42672	4965	0	137732	121006	0	0	
46	38247	0	41807	5075	0	121006	103380	0	0	
47	36778	0	40788	5200	0	103380	84991	0	0	
48	20574	0	23093	3078	0	84991	74061	0	0	
49	28191	3029	35755	4519	0	74061	56058	0	0	
50	26156	3029	33837	4640	0	56058	38317	0	0	
51	27752	3536	36716	5592	0	38317	18308	0	0	
52	15638	2197	21099	3582	0	18308	6479	0	0	
53	14320	2197	19605	3676	0	6479	-4704	0	0	
54	1923	312	2654	530	0	-4704	-6229	0	0	
55	22152	0	24705	7333	0	-6229	-19398	0	0	
56	14988	0	14074	7816	0	-19398	-25274	0	0	
57	5528	0	2202	5256	0	-25274	-23892	0	0	
58	1696	0	1470	1048	0	-23892	-24511	0	0	
59	0	0	0	0	0	-24511	-24511	0	0	

Tabella 17-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 13.

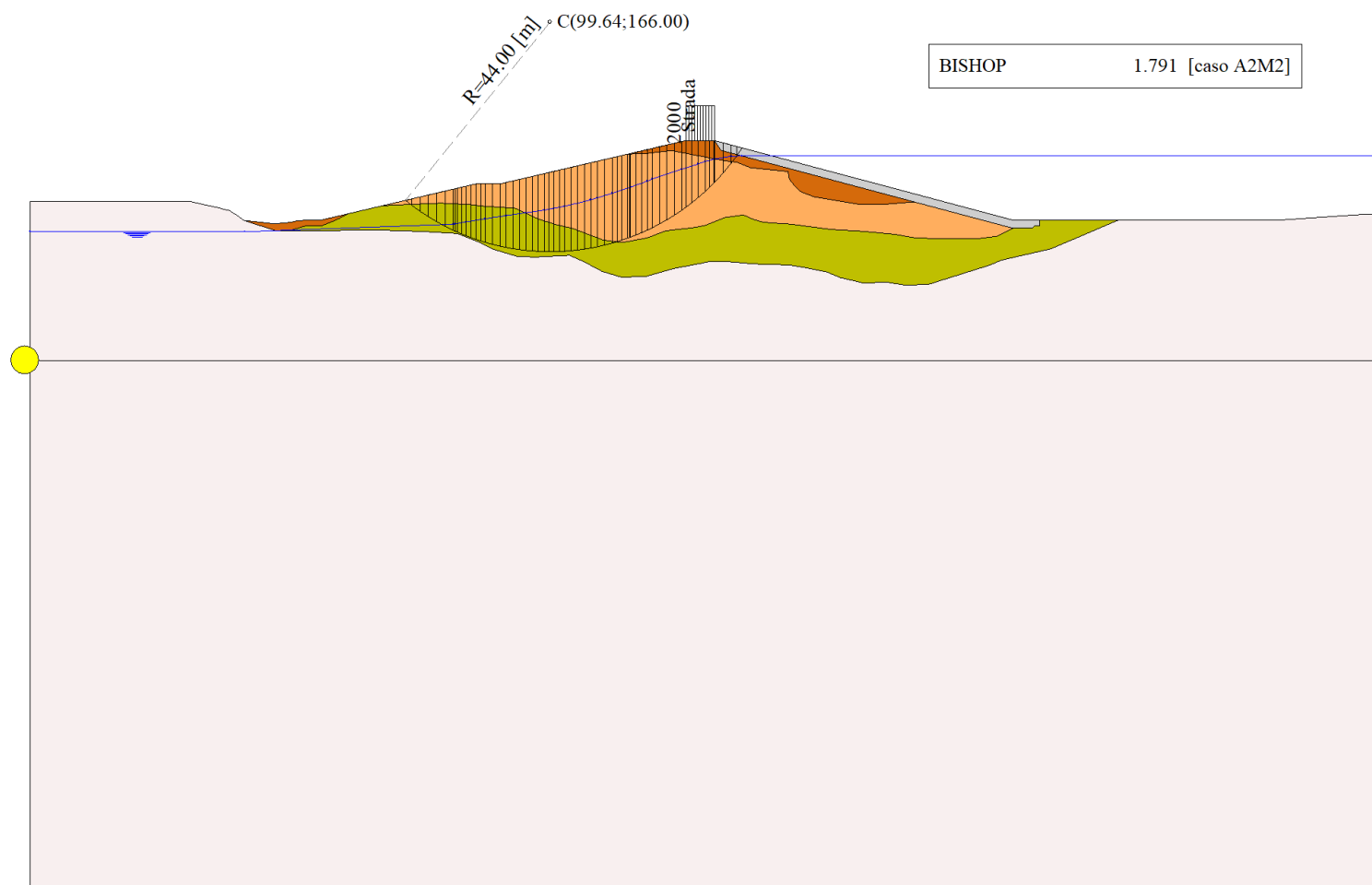


Figura 17-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 13.

## 18 VERIFICA DI STABILITÀ 14

### 18.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	128.86	134.36	2000	0
				143.30	143.30	2000	0

Tabella 18-1 – Carichi distribuiti verifica di stabilità 14.

### 18.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate in condizioni **statiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];
- Parametri di progetto [A2-M2]
- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni efficaci**

Presenza di falda

Presenza di carichi distribuiti

## 18.2 RISULTATI ANALISI

Numero di superfici analizzate	44242
Coefficiente di sicurezza minimo	1.865
Superficie con coefficiente di sicurezza minimo	1

### 18.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO L'ALTO

Numero di strisce	45
Coordinate del centro	X[m]= 90.86                      Y[m]= 176.00
Raggio del cerchio	R[m]= 54.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 66.12                      Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 133.83                      Y <sub>m</sub> [m]= 143.30
Coefficiente di sicurezza	F <sub>S</sub> = 1.865

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	66.12	128.00	128.00	66.48	128.00	127.82	66.36	127.94	0.40	-27.05	19.10	18
2	66.48	128.00	127.82	66.49	128.00	127.81	66.49	127.91	0.01	-26.83	35.06	3
3	66.49	128.00	127.81	67.48	128.00	127.32	67.08	127.76	1.10	-26.24	38.66	0
4	67.48	128.00	127.32	67.98	128.00	127.09	67.74	127.60	0.55	-25.36	38.66	0
5	67.98	128.00	127.09	69.15	128.00	126.56	68.61	127.40	1.28	-24.39	38.66	0
6	69.15	128.00	126.56	70.31	128.00	126.06	69.76	127.15	1.27	-23.04	21.37	16
7	70.31	128.00	126.06	71.48	128.00	125.60	70.92	126.91	1.26	-21.70	19.10	18
8	71.48	128.00	125.60	73.12	128.44	125.00	72.35	126.76	1.75	-20.11	19.10	18
9	73.12	128.44	125.00	74.76	128.87	124.46	73.97	126.69	1.73	-18.26	19.10	18
10	74.76	128.87	124.46	76.11	129.23	124.05	75.45	126.65	1.41	-16.60	19.10	18
11	76.11	129.23	124.05	77.77	129.68	123.61	76.96	126.64	1.72	-14.94	19.10	18
12	77.77	129.68	123.61	79.43	130.12	123.22	78.62	126.66	1.70	-13.13	19.10	18
13	79.43	130.12	123.22	81.09	130.56	122.89	80.27	126.70	1.69	-11.33	19.10	18
14	81.09	130.56	122.89	82.74	131.00	122.61	81.93	126.77	1.68	-9.54	19.10	18
15	82.74	131.00	122.61	84.40	131.45	122.39	83.58	126.86	1.67	-7.76	19.10	18
16	84.40	131.45	122.39	86.06	131.89	122.21	85.24	126.98	1.67	-5.98	19.10	18

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α <sub>1</sub> [°]	α <sub>2</sub> [°]	c [kPa]
17	86.06	131.89	122.21	87.72	132.33	122.09	86.90	127.13	1.66	-4.21	19.10	18
18	87.72	132.33	122.09	89.38	132.77	122.02	88.56	127.30	1.66	-2.45	19.10	18
19	89.38	132.77	122.02	91.04	133.22	122.00	90.21	127.50	1.66	-0.69	19.10	18
20	91.04	133.22	122.00	92.70	133.66	122.03	91.87	127.73	1.66	1.07	19.10	18
21	92.70	133.66	122.03	94.36	134.10	122.11	93.53	127.98	1.66	2.83	19.10	18
22	94.36	134.10	122.11	96.01	134.54	122.25	95.19	128.25	1.66	4.59	19.10	18
23	96.01	134.54	122.25	97.67	134.98	122.43	96.85	128.55	1.67	6.36	19.10	18
24	97.67	134.98	122.43	99.33	135.43	122.67	98.50	128.88	1.68	8.14	19.10	18
25	99.33	135.43	122.67	100.99	135.87	122.96	100.16	129.23	1.68	9.92	19.10	18
26	100.99	135.87	122.96	102.65	136.31	123.30	101.82	129.61	1.69	11.71	19.10	18
27	102.65	136.31	123.30	104.31	136.75	123.70	103.48	130.02	1.71	13.52	19.10	18
28	104.31	136.75	123.70	105.97	137.20	124.16	105.14	130.45	1.72	15.33	19.10	18
29	105.97	137.20	124.16	107.63	137.64	124.67	106.80	130.91	1.74	17.17	19.10	18
30	107.63	137.64	124.67	109.28	138.08	125.24	108.45	131.41	1.75	19.02	19.10	18
31	109.28	138.08	125.24	110.94	138.52	125.87	110.11	131.93	1.78	20.89	19.10	18
32	110.94	138.52	125.87	112.60	138.96	126.57	111.77	132.48	1.80	22.79	19.10	18
33	112.60	138.96	126.57	114.26	139.41	127.33	113.43	133.07	1.83	24.71	19.16	18
34	114.26	139.41	127.33	115.88	139.84	128.15	115.07	133.68	1.81	26.64	19.78	18
35	115.88	139.84	128.15	117.50	140.27	129.03	116.69	134.32	1.85	28.59	19.78	18
36	117.50	140.27	129.03	119.13	140.70	129.99	118.31	135.00	1.88	30.56	19.78	18
37	119.13	140.70	129.99	120.75	141.14	131.03	119.93	135.71	1.93	32.59	19.78	18
38	120.75	141.14	131.03	122.37	141.57	132.15	121.55	136.47	1.97	34.65	19.78	18
39	122.37	141.57	132.15	123.99	142.00	133.36	123.17	137.26	2.03	36.77	19.78	18
40	123.99	142.00	133.36	125.62	142.43	134.67	124.79	138.11	2.09	38.96	19.78	18
41	125.62	142.43	134.67	127.24	142.87	136.09	126.41	139.01	2.16	41.21	19.78	18
42	127.24	142.87	136.09	128.86	143.30	137.63	128.02	139.96	2.24	43.54	19.78	18
43	128.86	143.30	137.63	130.52	143.30	139.35	129.64	140.87	2.39	45.99	19.78	18
44	130.52	143.30	139.35	132.18	143.30	141.23	131.26	141.75	2.51	48.59	18.64	19
45	132.18	143.30	141.23	133.83	143.30	143.30	132.73	142.61	2.65	51.32	17.58	19

Tabella 18-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 14.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	69	0	264	436	37	0	525	0	0	
2	4	0	4	3	2	525	531	0	0	
3	856	0	605	259	477	531	1242	0	0	
4	795	0	552	237	440	1242	1881	0	0	
5	2748	0	1873	803	1509	1881	4009	0	0	
6	3969	0	2885	1683	2143	4009	7525	0	0	
7	5150	0	3561	1869	2725	7525	11585	0	0	
8	9617	0	6584	2902	4720	11585	18196	0	0	
9	12604	0	8701	3276	5653	18196	25805	0	0	
10	12537	0	8691	2968	5276	25805	32640	0	0	
11	17989	0	12535	3978	7145	32640	41557	0	0	
12	21288	0	15119	4444	7776	41557	51085	0	0	
13	23962	0	17086	4798	8313	51085	60777	0	0	
14	26455	0	18927	5131	8760	60777	70424	0	0	
15	28762	0	20646	5442	9123	70424	79833	0	0	
16	30886	0	22252	5734	9404	79833	88835	0	0	
17	32828	0	23754	6008	9606	88835	97278	0	0	
18	34590	0	25160	6266	9731	97278	105032	0	0	
19	36193	0	26495	6513	9780	105032	111981	0	0	

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
20	37746	0	27873	6769	9753	111981	118046	0	0	
21	39153	0	29203	7017	9651	118046	123136	0	0	
22	40364	0	30438	7249	9473	123136	127165	0	0	
23	41365	0	31572	7465	9217	127165	130064	0	0	
24	42180	0	32632	7668	8882	130064	131778	0	0	
25	42810	0	33622	7859	8463	131778	132270	0	0	
26	43206	0	34501	8032	7958	132270	131517	0	0	
27	43386	0	35291	8190	7362	131517	129512	0	0	
28	43372	0	36017	8338	6670	129512	126266	0	0	
29	43167	0	36687	8478	5874	126266	121806	0	0	
30	42782	0	37317	8613	4966	121806	116170	0	0	
31	42170	0	37867	8735	3936	116170	109424	0	0	
32	41293	0	38303	8839	2772	109424	101664	0	0	
33	40066	0	38530	8941	1460	101664	93070	0	0	
34	37664	0	37587	9070	1	93070	84321	0	0	
35	35838	0	36018	8800	0	84321	74815	0	0	
36	34351	0	34813	8604	0	74815	64521	0	0	
37	32624	0	33371	8368	0	64521	53600	0	0	
38	30642	0	31661	8086	0	53600	42248	0	0	
39	28318	0	29571	7736	0	42248	30741	0	0	
40	25690	0	27115	7324	0	30741	19389	0	0	
41	22795	0	24299	6852	0	19389	8536	0	0	
42	19770	0	21243	6345	0	8536	-1497	0	0	
43	16039	4310	22346	6707	0	-1497	-12910	0	0	
44	10174	4310	15746	5425	0	-12910	-21130	0	0	
45	3511	4310	7455	4050	0	-21130	-24419	0	0	

Tabella 18-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 14.

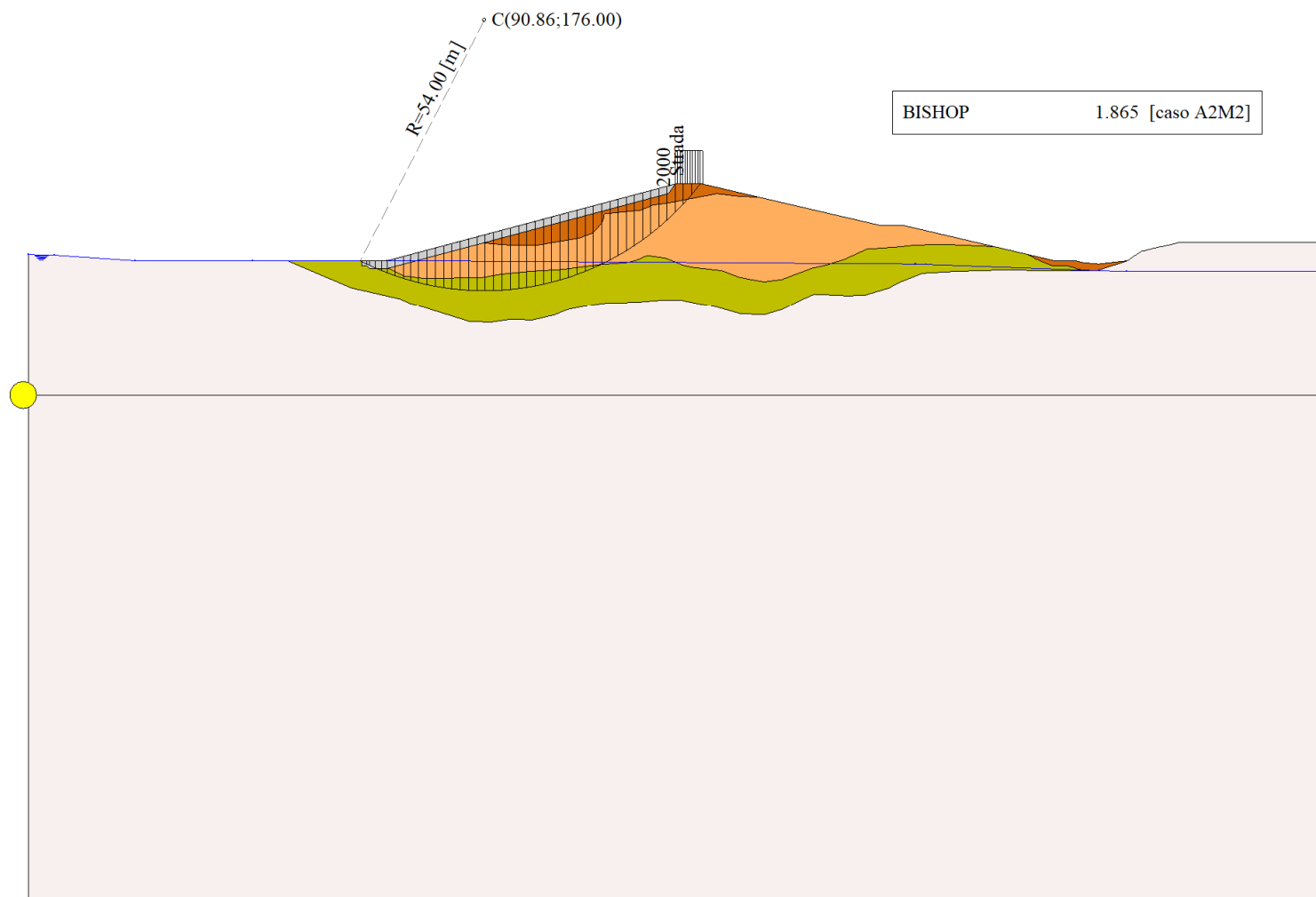


Figura 18-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 14.



## 19 VERIFICA DI STABILITÀ 15

### 19.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	P <sub>i</sub> [m]	P <sub>f</sub> [m]	V <sub>y</sub> [kg/m]	V <sub>x</sub> [kg/m]
1	Strada	Variabile	1.00	128.86	134.36	2000	0
				143.30	143.30	2000	0

Tabella 19-1 – Carichi distribuiti verifica di stabilità 15.

### 19.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate in condizioni **statiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 19.2 RISULTATI ANALISI

Numero di superfici analizzate	44242
Coefficiente di sicurezza minimo	1.244
Superficie con coefficiente di sicurezza minimo	1

### 19.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO L'ALTO

Numero di strisce	45
Coordinate del centro	X[m]= 98.86                      Y[m]= 166.00
Raggio del cerchio	R[m]= 48.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 69.53                      Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 140.37                      Y <sub>m</sub> [m]= 141.90
Coefficiente di sicurezza	F <sub>s</sub> = 1.244

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	69.53	128.00	128.00	70.51	128.00	127.27	70.18	127.76	1.22	-36.93	38.66	0
2	70.51	128.00	127.27	71.48	128.00	126.57	71.05	127.44	1.19	-35.49	38.66	0
3	71.48	128.00	126.57	71.68	128.05	126.44	71.58	127.27	0.24	-34.63	20.97	24
4	71.68	128.05	126.44	73.22	128.46	125.42	72.53	127.08	1.84	-33.39	0.00	52
5	73.22	128.46	125.42	74.76	128.87	124.49	74.04	126.80	1.80	-31.21	0.00	52
6	74.76	128.87	124.49	76.11	129.23	123.73	75.46	126.58	1.55	-29.21	0.00	52
7	76.11	129.23	123.73	77.85	129.70	122.84	77.01	126.37	1.96	-27.12	0.00	52
8	77.85	129.70	122.84	79.59	130.16	122.04	78.74	126.18	1.92	-24.81	0.00	52
9	79.59	130.16	122.04	81.33	130.63	121.32	80.48	126.03	1.88	-22.54	0.00	52
10	81.33	130.63	121.32	83.07	131.09	120.67	82.22	125.93	1.86	-20.31	0.00	52
11	83.07	131.09	120.67	84.81	131.55	120.10	83.95	125.85	1.83	-18.11	0.00	52
12	84.81	131.55	120.10	86.55	132.02	119.61	85.69	125.82	1.81	-15.94	0.00	52
13	86.55	132.02	119.61	88.29	132.48	119.18	87.43	125.82	1.79	-13.79	0.00	52
14	88.29	132.48	119.18	90.03	132.95	118.82	89.17	125.86	1.78	-11.66	0.00	52
15	90.03	132.95	118.82	91.77	133.41	118.53	90.91	125.93	1.76	-9.55	0.00	52
16	91.77	133.41	118.53	93.51	133.87	118.30	92.65	126.03	1.75	-7.45	0.00	52
17	93.51	133.87	118.30	95.25	134.34	118.14	94.39	126.16	1.75	-5.36	0.00	52

N°	X <sub>s</sub>	Y <sub>ss</sub>	Y <sub>si</sub>	X <sub>d</sub>	Y <sub>ds</sub>	Y <sub>di</sub>	X <sub>g</sub>	Y <sub>g</sub>	L	α	β	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
18	95.25	134.34	118.14	96.99	134.80	118.04	96.12	126.33	1.74	-3.27	0.00	52
19	96.99	134.80	118.04	98.73	135.27	118.00	97.86	126.53	1.74	-1.19	0.00	52
20	98.73	135.27	118.00	100.47	135.73	118.03	99.60	126.76	1.74	0.88	0.00	52
21	100.47	135.73	118.03	102.21	136.19	118.12	101.34	127.02	1.74	2.96	0.00	52
22	102.21	136.19	118.12	103.95	136.66	118.27	103.08	127.31	1.75	5.04	0.00	52
23	103.95	136.66	118.27	105.69	137.12	118.49	104.82	127.64	1.75	7.13	0.00	52
24	105.69	137.12	118.49	107.43	137.59	118.77	106.56	127.99	1.76	9.23	0.00	52
25	107.43	137.59	118.77	109.00	138.01	119.08	108.22	128.36	1.60	11.24	0.00	52
26	109.00	138.01	119.08	110.58	138.42	119.45	109.79	128.74	1.62	13.16	0.00	52
27	110.58	138.42	119.45	112.15	138.84	119.88	111.36	129.15	1.63	15.10	0.00	52
28	112.15	138.84	119.88	113.82	139.29	120.39	112.98	129.60	1.75	17.12	0.00	52
29	113.82	139.29	120.39	115.49	139.74	120.97	114.66	130.10	1.77	19.22	0.00	52
30	115.49	139.74	120.97	117.16	140.18	121.63	116.33	130.63	1.79	21.34	0.00	52
31	117.16	140.18	121.63	118.83	140.63	122.35	118.00	131.20	1.82	23.50	0.00	52
32	118.83	140.63	122.35	120.51	141.07	123.16	119.67	131.80	1.85	25.70	0.00	52
33	120.51	141.07	123.16	122.18	141.52	124.04	121.34	132.45	1.89	27.93	0.00	52
34	122.18	141.52	124.04	123.85	141.96	125.02	123.01	133.13	1.93	30.22	0.00	52
35	123.85	141.96	125.02	125.52	142.41	126.08	124.68	133.87	1.98	32.55	0.00	52
36	125.52	142.41	126.08	127.19	142.85	127.25	126.35	134.65	2.04	34.95	0.00	52
37	127.19	142.85	127.25	128.86	143.30	128.53	128.02	135.48	2.10	37.43	0.00	53
38	128.86	143.30	128.53	130.24	143.30	129.67	129.54	136.20	1.79	39.75	0.00	54
39	130.24	143.30	129.67	131.61	143.30	130.91	130.91	136.79	1.85	41.92	0.00	54
40	131.61	143.30	130.91	132.99	143.30	132.24	132.28	137.43	1.92	44.17	0.00	54
41	132.99	143.30	132.24	134.36	143.30	133.69	133.66	138.13	2.00	46.50	0.00	54
42	134.36	143.30	133.69	135.86	142.95	135.42	135.08	138.83	2.29	49.06	0.00	54
43	135.86	142.95	135.42	137.36	142.60	137.34	136.57	139.55	2.43	51.89	0.00	54
44	137.36	142.60	137.34	138.87	142.25	139.48	138.04	140.37	2.61	54.90	0.00	54
45	138.87	142.25	139.48	140.37	141.90	141.90	139.37	141.21	2.85	58.16	0.00	54

Tabella 19-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 15.

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
1	711	0	1723	1108	0	0	1920	0	0	
2	2098	0	4758	3059	0	1920	7174	0	0	
3	608	0	1355	893	0	7174	8679	0	0	
4	7067	0	13659	7882	0	8679	22776	0	0	
5	11122	0	17667	7695	0	22776	38512	0	0	
6	12946	0	18529	6610	0	38512	53325	0	0	
7	20901	0	27764	8354	0	53325	73419	0	0	
8	26026	0	32461	8192	0	73419	94477	0	0	
9	30389	0	36245	8051	0	94477	115810	0	0	
10	34463	0	39684	7929	0	115810	137022	0	0	
11	38257	0	42811	7823	0	137022	157767	0	0	
12	41781	0	45660	7733	0	157767	177742	0	0	
13	45044	0	48260	7656	0	177742	196682	0	0	
14	48054	0	50633	7592	0	196682	214351	0	0	
15	50888	0	52871	7540	0	214351	230556	0	0	
16	53602	0	55038	7499	0	230556	245125	0	0	
17	56079	0	57026	7468	0	245125	257884	0	0	
18	58288	0	58809	7448	0	257884	268677	0	0	
19	60247	0	60415	7437	0	268677	277371	0	0	
20	61974	0	61866	7437	0	277371	283853	0	0	

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
21	63437	0	63136	7446	0	283853	288026	0	0	
22	64619	0	64211	7465	0	288026	289816	0	0	
23	65565	0	65138	7494	0	289816	289162	0	0	
24	66279	0	65924	7533	0	289162	286020	0	0	
25	60372	0	60190	6855	0	286020	281009	0	0	
26	60595	0	60615	6905	0	281009	273928	0	0	
27	60589	0	60877	6964	0	273928	264791	0	0	
28	64052	0	64720	7472	0	264791	252883	0	0	
29	63265	0	64363	7562	0	252883	238839	0	0	
30	62449	0	64051	7667	0	238839	222667	0	0	
31	61548	0	63729	7787	0	222667	204393	0	0	
32	60396	0	63212	7924	0	204393	184125	0	0	
33	59050	0	62551	8082	0	184125	161964	0	0	
34	57398	0	61609	8263	0	161964	138100	0	0	
35	55214	0	60098	8472	0	138100	112903	0	0	
36	52685	0	58190	8712	0	112903	86706	0	0	
37	49785	0	55695	9141	0	86706	60117	0	0	
38	38302	3575	47850	7957	0	60117	35638	0	0	
39	35097	3575	44591	8221	0	35638	11964	0	0	
40	31637	3575	40805	8528	0	11964	-10350	0	0	
41	27891	3575	36348	8887	0	-10350	-30600	0	0	
42	25259	0	26791	10200	0	-30600	-44156	0	0	
43	18832	0	16708	10827	0	-44156	-50619	0	0	
44	11862	0	4094	11622	0	-50619	-47286	0	0	
45	4163	0	-12319	12551	0	-47286	-30199	0	0	

Tabella 19-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 15.

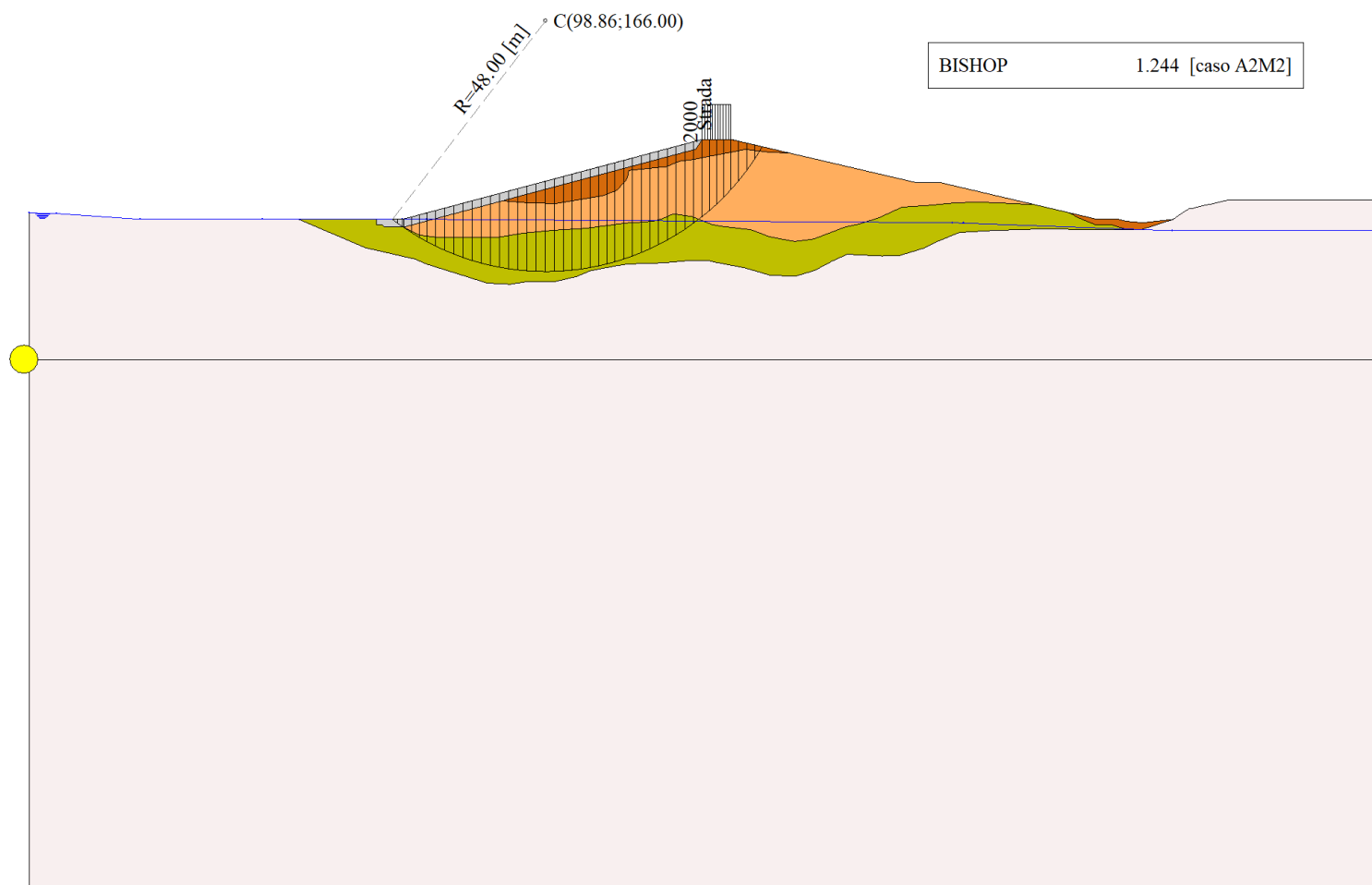


Figura 19-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 15.

## 20 VERIFICA DI STABILITÀ 16

### 20.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	128.86 143.30	134.36 143.30	2000 2000	0 0

Tabella 20-1 – Carichi distribuiti verifica di stabilità 16.

### 20.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **sismiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 20.2 RISULTATI ANALISI

Numero di superfici analizzate	88394
Coefficiente di sicurezza minimo	0.597
Superficie con coefficiente di sicurezza minimo	1

### 20.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	45
Coordinate del centro	X[m]= 100.86                      Y[m]= 162.00
Raggio del cerchio	R[m]= 44.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 72.58                      Y <sub>v</sub> [m]= 128.29
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 140.04                      Y <sub>m</sub> [m]= 141.97
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.597</b>

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	72.58	128.29	128.29	73.76	128.61	127.34	73.36	128.08	1.51	-39.01	38.66	0
2	73.76	128.61	127.34	74.93	128.92	126.45	74.41	127.81	1.48	-37.06	9.20	41
3	74.93	128.92	126.45	76.11	129.23	125.62	75.56	127.55	1.44	-35.17	0.00	54
4	76.11	129.23	125.62	77.35	129.57	124.81	76.76	127.30	1.48	-33.26	0.00	54
5	77.35	129.57	124.81	78.59	129.90	124.05	77.99	127.08	1.45	-31.35	0.00	53
6	78.59	129.90	124.05	80.19	130.32	123.16	79.42	126.85	1.84	-29.21	0.00	52
7	80.19	130.32	123.16	81.79	130.75	122.35	81.01	126.64	1.80	-26.85	0.00	52
8	81.79	130.75	122.35	83.40	131.18	121.61	82.61	126.47	1.76	-24.53	0.00	52
9	83.40	131.18	121.61	85.00	131.60	120.96	84.21	126.34	1.73	-22.26	0.00	52
10	85.00	131.60	120.96	86.60	132.03	120.37	85.81	126.24	1.71	-20.02	0.00	52
11	86.60	132.03	120.37	88.20	132.46	119.86	87.41	126.18	1.68	-17.81	0.00	52
12	88.20	132.46	119.86	89.81	132.89	119.41	89.01	126.15	1.66	-15.63	0.00	52
13	89.81	132.89	119.41	91.41	133.31	119.03	90.61	126.16	1.65	-13.48	0.00	52
14	91.41	133.31	119.03	93.01	133.74	118.71	92.22	126.20	1.63	-11.34	0.00	52
15	93.01	133.74	118.71	94.61	134.17	118.45	93.82	126.27	1.62	-9.22	0.00	52
16	94.61	134.17	118.45	96.21	134.60	118.25	95.42	126.36	1.61	-7.11	0.00	52
17	96.21	134.60	118.25	97.82	135.02	118.11	97.02	126.49	1.61	-5.01	0.00	52

N°	X <sub>s</sub>	Y <sub>ss</sub>	Y <sub>si</sub>	X <sub>d</sub>	Y <sub>ds</sub>	Y <sub>di</sub>	X <sub>g</sub>	Y <sub>g</sub>	L	α	β	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
18	97.82	135.02	118.11	99.42	135.45	118.02	98.62	126.65	1.60	-2.92	0.00	52
19	99.42	135.45	118.02	101.02	135.88	118.00	100.22	126.84	1.60	-0.83	0.00	52
20	101.02	135.88	118.00	102.62	136.30	118.04	101.83	127.05	1.60	1.25	0.00	52
21	102.62	136.30	118.04	104.23	136.73	118.13	103.43	127.30	1.60	3.34	0.00	52
22	104.23	136.73	118.13	105.83	137.16	118.28	105.03	127.58	1.61	5.43	0.00	52
23	105.83	137.16	118.28	107.43	137.59	118.49	106.63	127.88	1.62	7.54	0.00	52
24	107.43	137.59	118.49	109.00	138.01	118.76	108.22	128.21	1.60	9.63	0.00	52
25	109.00	138.01	118.76	110.58	138.42	119.09	109.79	128.57	1.61	11.71	0.00	52
26	110.58	138.42	119.09	112.15	138.84	119.47	111.36	128.96	1.62	13.81	0.00	52
27	112.15	138.84	119.47	113.77	139.17	119.82	112.76	129.33	1.27	15.69	0.00	52
28	113.77	139.17	119.82	114.59	139.49	120.20	113.98	129.67	1.28	17.35	0.00	52
29	114.59	139.49	120.20	116.18	139.92	120.75	115.38	130.09	1.68	19.28	0.00	52
30	116.18	139.92	120.75	117.76	140.34	121.38	116.97	130.60	1.70	21.48	0.00	52
31	117.76	140.34	121.38	119.35	140.76	122.07	118.55	131.14	1.73	23.72	0.00	52
32	119.35	140.76	122.07	120.93	141.19	122.85	120.14	131.72	1.76	25.99	0.00	52
33	120.93	141.19	122.85	122.52	141.61	123.70	121.72	132.33	1.80	28.31	0.00	52
34	122.52	141.61	123.70	124.10	142.03	124.64	123.31	132.99	1.84	30.69	0.00	52
35	124.10	142.03	124.64	125.69	142.45	125.67	124.89	133.70	1.89	33.12	0.00	52
36	125.69	142.45	125.67	127.27	142.88	126.81	126.48	134.45	1.95	35.62	0.00	52
37	127.27	142.88	126.81	128.86	143.30	128.06	128.06	135.26	2.02	38.21	0.00	53
38	128.86	143.30	128.06	130.24	143.30	129.24	129.54	135.97	1.81	40.70	0.00	54
39	130.24	143.30	129.24	131.61	143.30	130.53	130.91	136.59	1.88	43.11	0.00	54
40	131.61	143.30	130.53	132.99	143.30	131.93	132.28	137.26	1.97	45.62	0.00	54
41	132.99	143.30	131.93	134.36	143.30	133.47	133.66	137.99	2.06	48.24	0.00	54
42	134.36	143.30	133.47	135.78	142.97	135.23	135.04	138.73	2.26	51.06	0.00	54
43	135.78	142.97	135.23	137.20	142.64	137.19	136.45	139.48	2.42	54.10	0.00	54
44	137.20	142.64	137.19	138.62	142.30	139.41	137.84	140.34	2.63	57.39	0.00	54
45	138.62	142.30	139.41	140.04	141.97	141.97	139.09	141.23	2.93	61.02	0.00	54

Tabella 20-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 16.

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
1	1397	0	-23139	-31030	0	0	-38989	0	0	
2	4194	0	17263	15117	0	-38989	-17462	0	0	
3	6796	0	18659	13361	0	-17462	2683	0	0	
4	9824	0	22092	13761	0	2683	24104	0	0	
5	12881	0	24754	13096	0	24104	45279	0	0	
6	20583	0	35374	16361	0	45279	72208	0	0	
7	24796	0	39009	16006	0	72208	98545	0	0	
8	28731	0	42286	15697	0	98545	123939	0	0	
9	32403	0	45252	15430	0	123939	148093	0	0	
10	35826	0	47943	15199	0	148093	170752	0	0	
11	39012	0	50390	14999	0	170752	191700	0	0	
12	41968	0	52617	14829	0	191700	210749	0	0	
13	44744	0	54690	14685	0	210749	227743	0	0	
14	47421	0	56710	14565	0	227743	242542	0	0	
15	49900	0	58570	14467	0	242542	255017	0	0	
16	52153	0	60246	14391	0	255017	265062	0	0	
17	54181	0	61744	14335	0	265062	272588	0	0	
18	56006	0	63096	14299	0	272588	277526	0	0	
19	57631	0	64307	14282	0	277526	279819	0	0	
20	59014	0	65333	14284	0	279819	279437	0	0	

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
21	60176	0	66202	14305	0	279437	276365	0	0	
22	61140	0	66938	14345	0	276365	270595	0	0	
23	61910	0	67545	14405	0	270595	262136	0	0	
24	61370	0	66813	14223	0	262136	251224	0	0	
25	61739	0	67152	14321	0	251224	237772	0	0	
26	61865	0	67300	14441	0	237772	221854	0	0	
27	47899	0	52158	11295	0	221854	207879	0	0	
28	47632	0	51938	11392	0	207879	192583	0	0	
29	61212	0	66882	14971	0	192583	170910	0	0	
30	60602	0	66450	15187	0	170910	147120	0	0	
31	59774	0	65827	15435	0	147120	121372	0	0	
32	58726	0	64994	15722	0	121372	93852	0	0	
33	57490	0	63976	16052	0	93852	64748	0	0	
34	55923	0	62568	16433	0	64748	34408	0	0	
35	53871	0	60525	16873	0	34408	3389	0	0	
36	51512	0	58019	17385	0	3389	-27823	0	0	
37	48760	0	54756	18110	0	-27823	-58394	0	0	
38	39504	2750	47508	16830	0	-58394	-86091	0	0	
39	36177	2750	42939	17477	0	-86091	-111406	0	0	
40	32554	2750	37495	18241	0	-111406	-133360	0	0	
41	28595	2750	30884	19157	0	-133360	-150668	0	0	
42	24467	0	17362	20954	0	-150668	-156486	0	0	
43	18354	0	3778	22463	0	-156486	-150491	0	0	
44	11641	0	-14185	24442	0	-150491	-127981	0	0	
45	4109	0	-39198	26937	0	-127981	-81561	0	0	

Tabella 20-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 16.

### 20.2.2 ANALISI DELLA SUPERFICIE 76 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	45	
Coordinate del centro	X[m]= 98.86	Y[m]= 168.00
Raggio del cerchio	R[m]= 50.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 68.86	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 141.36	Y <sub>m</sub> [m]= 141.66
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.633</b>	

N°	X <sub>s</sub>	Y <sub>ss</sub>	Y <sub>si</sub>	X <sub>d</sub>	Y <sub>ds</sub>	Y <sub>di</sub>	X <sub>g</sub>	Y <sub>g</sub>	L	α	β	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
1	68.86	128.00	128.00	70.17	128.00	127.05	69.73	127.68	1.62	-35.94	38.66	0
2	70.17	128.00	127.05	71.48	128.00	126.16	70.89	127.28	1.58	-34.11	23.98	20
3	71.48	128.00	126.16	71.68	128.05	126.03	71.58	127.06	0.24	-33.07	0.00	52
4	71.68	128.05	126.03	73.22	128.46	125.07	72.51	126.89	1.81	-31.89	0.00	52
5	73.22	128.46	125.07	74.76	128.87	124.19	74.03	126.64	1.78	-29.83	0.00	52
6	74.76	128.87	124.19	76.11	129.23	123.48	75.46	126.44	1.53	-27.94	0.00	52
7	76.11	129.23	123.48	77.85	129.70	122.63	77.01	126.26	1.94	-25.96	0.00	52
8	77.85	129.70	122.63	79.59	130.16	121.86	78.74	126.09	1.90	-23.76	0.00	52
9	79.59	130.16	121.86	81.33	130.63	121.17	80.48	125.96	1.87	-21.60	0.00	52
10	81.33	130.63	121.17	83.07	131.09	120.56	82.22	125.86	1.85	-19.47	0.00	52
11	83.07	131.09	120.56	84.81	131.55	120.01	83.95	125.80	1.82	-17.36	0.00	52
12	84.81	131.55	120.01	86.55	132.02	119.54	85.69	125.78	1.80	-15.29	0.00	52
13	86.55	132.02	119.54	88.29	132.48	119.13	87.43	125.79	1.79	-13.23	0.00	52
14	88.29	132.48	119.13	90.03	132.95	118.79	89.17	125.84	1.77	-11.19	0.00	52

N°	X <sub>s</sub>	Y <sub>ss</sub>	Y <sub>si</sub>	X <sub>d</sub>	Y <sub>ds</sub>	Y <sub>di</sub>	X <sub>g</sub>	Y <sub>g</sub>	L	α	β	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
15	90.03	132.95	118.79	91.77	133.41	118.51	90.91	125.91	1.76	-9.16	0.00	52
16	91.77	133.41	118.51	93.51	133.87	118.29	92.65	126.02	1.75	-7.15	0.00	52
17	93.51	133.87	118.29	95.25	134.34	118.13	94.39	126.16	1.75	-5.14	0.00	52
18	95.25	134.34	118.13	96.99	134.80	118.03	96.12	126.33	1.74	-3.14	0.00	52
19	96.99	134.80	118.03	98.73	135.27	118.00	97.86	126.53	1.74	-1.15	0.00	52
20	98.73	135.27	118.00	100.47	135.73	118.03	99.60	126.76	1.74	0.85	0.00	52
21	100.47	135.73	118.03	102.21	136.19	118.11	101.34	127.02	1.74	2.84	0.00	52
22	102.21	136.19	118.11	103.95	136.66	118.26	103.08	127.31	1.75	4.84	0.00	52
23	103.95	136.66	118.26	105.69	137.12	118.47	104.82	127.63	1.75	6.85	0.00	52
24	105.69	137.12	118.47	107.43	137.59	118.74	106.56	127.98	1.76	8.86	0.00	52
25	107.43	137.59	118.74	109.00	138.01	119.04	108.22	128.34	1.60	10.79	0.00	52
26	109.00	138.01	119.04	110.58	138.42	119.39	109.79	128.72	1.61	12.63	0.00	52
27	110.58	138.42	119.39	112.15	138.84	119.80	111.36	129.12	1.62	14.48	0.00	52
28	112.15	138.84	119.80	113.82	139.29	120.29	112.99	129.56	1.74	16.41	0.00	52
29	113.82	139.29	120.29	115.49	139.74	120.85	114.66	130.04	1.76	18.42	0.00	52
30	115.49	139.74	120.85	117.16	140.18	121.47	116.33	130.56	1.78	20.45	0.00	52
31	117.16	140.18	121.47	118.83	140.63	122.16	118.00	131.11	1.81	22.51	0.00	52
32	118.83	140.63	122.16	120.51	141.07	122.93	119.67	131.70	1.84	24.60	0.00	52
33	120.51	141.07	122.93	122.18	141.52	123.77	121.34	132.32	1.87	26.72	0.00	52
34	122.18	141.52	123.77	123.85	141.96	124.69	123.01	132.98	1.91	28.89	0.00	52
35	123.85	141.96	124.69	125.52	142.41	125.70	124.68	133.69	1.95	31.10	0.00	52
36	125.52	142.41	125.70	127.19	142.85	126.80	126.35	134.44	2.00	33.37	0.00	52
37	127.19	142.85	126.80	128.86	143.30	128.00	128.02	135.24	2.06	35.69	0.00	52
38	128.86	143.30	128.00	130.24	143.30	129.07	129.54	135.91	1.74	37.87	0.00	54
39	130.24	143.30	129.07	131.61	143.30	130.22	130.91	136.47	1.79	39.89	0.00	54
40	131.61	143.30	130.22	132.99	143.30	131.46	132.29	137.06	1.85	41.98	0.00	54
41	132.99	143.30	131.46	134.36	143.30	132.79	133.66	137.70	1.92	44.14	0.00	54
42	134.36	143.30	132.79	136.11	142.89	134.65	135.20	138.39	2.55	46.70	0.00	54
43	136.11	142.89	134.65	137.86	142.48	136.71	136.93	139.16	2.71	49.71	0.00	54
44	137.86	142.48	136.71	139.61	142.07	139.03	138.65	140.02	2.90	52.93	0.00	54
45	139.61	142.07	139.03	141.36	141.66	141.66	140.19	140.92	3.16	56.40	0.00	54

Tabella 20-4 – Geometria e caratteristiche strisce della superficie 76 della verifica di stabilità 16.

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
1	1244	0	20592	26044	0	0	32893	0	0	
2	3660	0	15917	16243	0	32893	54447	0	0	
3	779	0	2340	2006	0	54447	57230	0	0	
4	8287	0	20341	15247	0	57230	79063	0	0	
5	12169	0	24158	14923	0	79063	101298	0	0	
6	13737	0	24106	12846	0	101298	120861	0	0	
7	21767	0	34843	16268	0	120861	145857	0	0	
8	26740	0	39526	15981	0	145857	170411	0	0	
9	30971	0	43271	15731	0	170411	194020	0	0	
10	34931	0	46686	15514	0	194020	216372	0	0	
11	38625	0	49799	15325	0	216372	237200	0	0	
12	42063	0	52640	15163	0	237200	256272	0	0	
13	45254	0	55232	15025	0	256272	273391	0	0	
14	48203	0	57596	14910	0	273391	288384	0	0	
15	50988	0	59827	14816	0	288384	301103	0	0	
16	53663	0	61995	14741	0	301103	311410	0	0	
17	56112	0	63976	14686	0	311410	319187	0	0	



N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
18	58301	0	65739	14649	0	319187	324344	0	0	
19	60250	0	67311	14630	0	324344	326806	0	0	
20	61976	0	68715	14628	0	326806	326519	0	0	
21	63447	0	69921	14645	0	326519	323449	0	0	
22	64647	0	70909	14679	0	323449	317594	0	0	
23	65621	0	71733	14732	0	317594	308954	0	0	
24	66372	0	72398	14803	0	308954	297547	0	0	
25	60497	0	65925	13464	0	297547	284868	0	0	
26	60768	0	66220	13554	0	284868	269990	0	0	
27	60818	0	66328	13660	0	269990	252989	0	0	
28	64366	0	70310	14643	0	252989	232736	0	0	
29	63665	0	69695	14805	0	232736	210485	0	0	
30	62946	0	69122	14992	0	210485	186265	0	0	
31	62158	0	68527	15205	0	186265	160139	0	0	
32	61136	0	67704	15449	0	160139	132294	0	0	
33	59937	0	66711	15727	0	132294	102902	0	0	
34	58454	0	65395	16043	0	102902	72247	0	0	
35	56464	0	63440	16405	0	72247	40863	0	0	
36	54157	0	61040	16819	0	40863	9195	0	0	
37	51474	0	57989	17394	0	9195	-22052	0	0	
38	39812	2750	48107	15243	0	-22052	-49092	0	0	
39	36819	2750	44245	15684	0	-49092	-74309	0	0	
40	33603	2750	39821	16187	0	-74309	-97062	0	0	
41	30141	2750	34699	16767	0	-97062	-116567	0	0	
42	32172	0	28469	22335	0	-116567	-129181	0	0	
43	24007	0	13344	23689	0	-129181	-129425	0	0	
44	15140	0	-5699	25410	0	-129425	-112954	0	0	
45	5305	0	-30705	27482	0	-112954	-73361	0	0	

Tabella 20-5 – Forze applicate sulle strisce [BISHOP] della superficie 76 della verifica di stabilità 16.

### 20.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u [m]
1	0.008308
2	0.001915
3	0.007242
4	0.006687
5	0.001912
6	0.002548
7	0.001079

Tabella 20-6 – Spostamenti della superficie 1 della verifica di stabilità 16.

Accelerazione sismica critica       $K_c = 0.068$   
 Spostamento massimo                 $U_{max} = 0.008308$  [m]  
 Velocità massima                         $V_{max} = 0.042338$  [m/s]

n°	u
	[m]
1	0.011338
2	0.002471
3	0.009735
4	0.008661
5	0.003153
6	0.003580
7	0.001709

Tabella 20-7 – Spostamenti della superficie 76 della verifica di stabilità 16.

Accelerazione sismica critica  $K_c = 0.061$   
Spostamento massimo  $U_{max} = 0.011338$  [m]  
Velocità massima  $V_{max} = 0.047946$  [m/s]

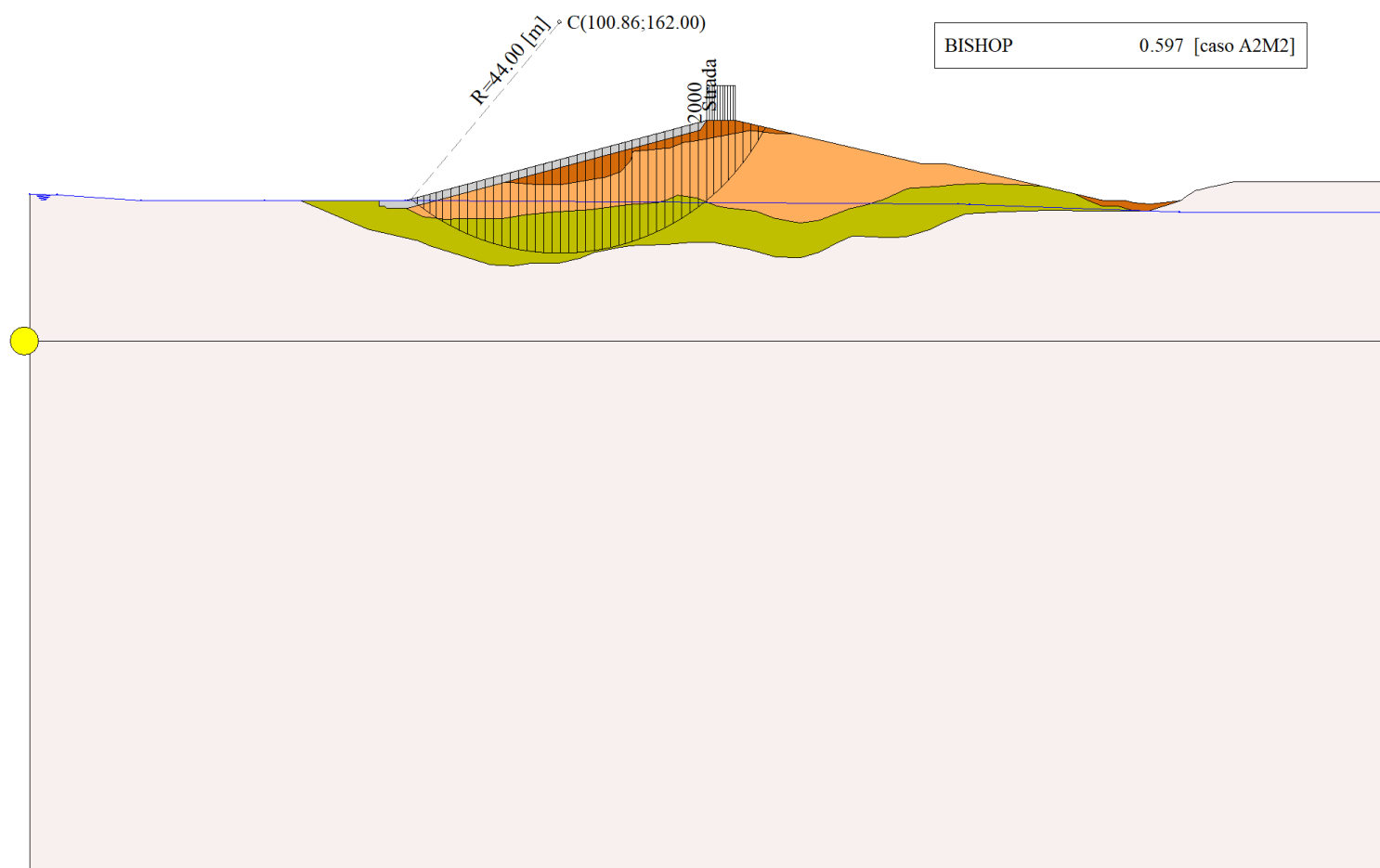


Figura 20-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 16.

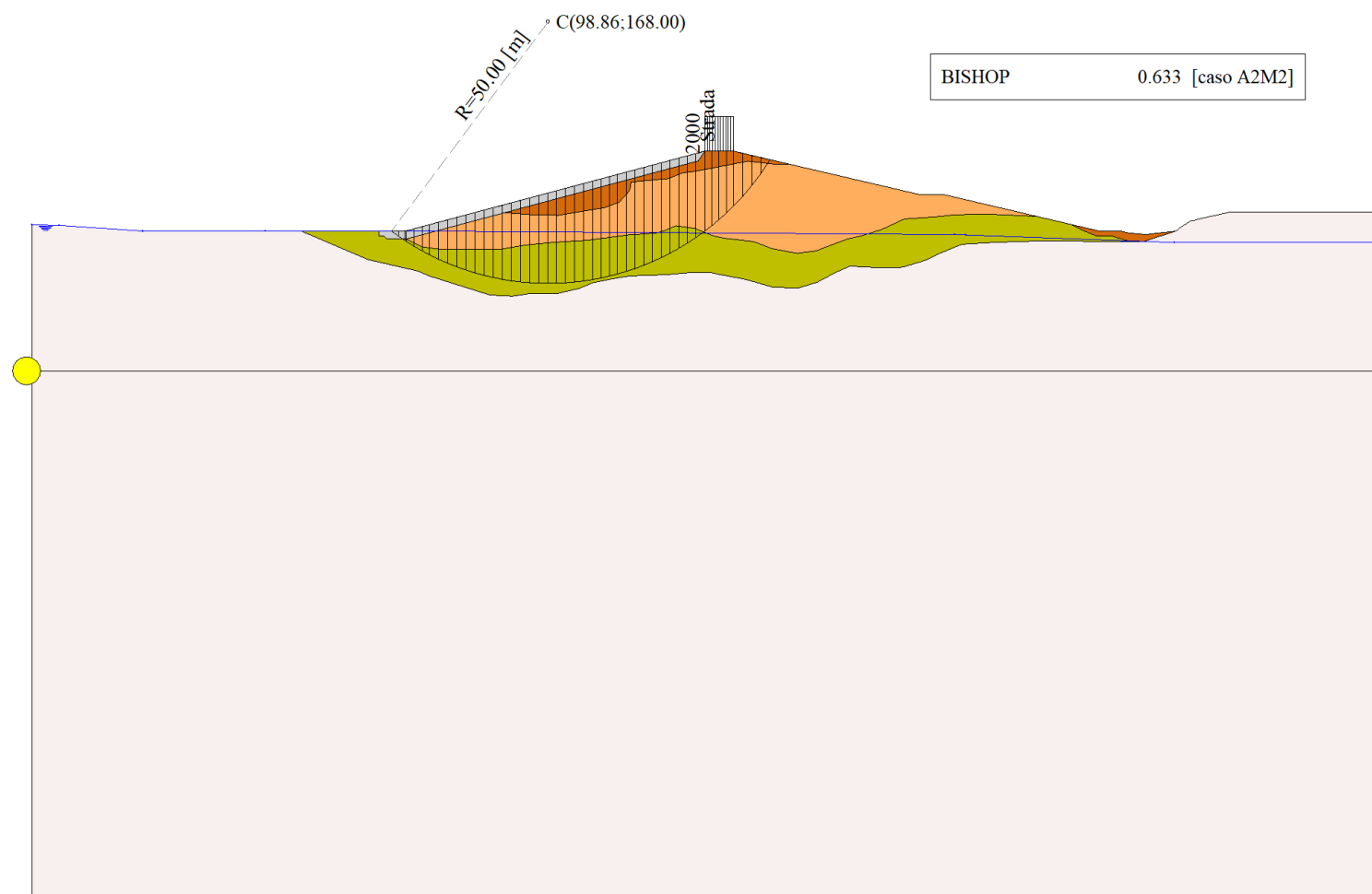


Figura 20-2 – Superficie critica (76) della sezione CR\_06 per la verifica di stabilità 16.

## 21 VERIFICA DI STABILITÀ 17

### 21.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	P <sub>i</sub> [m]	P <sub>f</sub> [m]	V <sub>y</sub> [kg/m]	V <sub>x</sub> [kg/m]
1	Strada	Variabile	1.00	128.86 143.30	134.36 143.30	2000 2000	0 0

Tabella 21-1 – Carichi distribuiti verifica di stabilità 17.

### 21.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **sismiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];
- Parametri di progetto [A2-M2]
- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 21.2 RISULTATI ANALISI

Numero di superfici analizzate	88223
Coefficiente di sicurezza minimo	0.451
Superficie con coefficiente di sicurezza minimo	1

### 21.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	46	
Coordinate del centro	X[m]= 100.86	Y[m]= 178.00
Raggio del cerchio	R[m]= 60.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 67.69	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 147.48	Y <sub>m</sub> [m]= 140.23
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.451</b>	

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	67.69	128.00	128.00	69.59	128.00	126.79	68.96	127.60	2.24	-32.49	38.66	0
2	69.59	128.00	126.79	71.48	128.00	125.69	70.63	127.09	2.19	-30.37	10.27	38
3	71.48	128.00	125.69	71.68	128.05	125.57	71.58	126.83	0.23	-29.21	0.00	52
4	71.68	128.05	125.57	73.22	128.46	124.75	72.50	126.70	1.75	-28.27	0.00	52
5	73.22	128.46	124.75	74.76	128.87	123.97	74.03	126.51	1.72	-26.61	0.00	52
6	74.76	128.87	123.97	76.11	129.23	123.34	75.46	126.35	1.49	-25.07	0.00	52
7	76.11	129.23	123.34	78.07	129.76	122.50	77.12	126.21	2.13	-23.34	0.00	52
8	78.07	129.76	122.50	80.03	130.28	121.73	79.07	126.06	2.10	-21.32	0.00	52
9	80.03	130.28	121.73	81.98	130.80	121.05	81.03	125.96	2.07	-19.33	0.00	52
10	81.98	130.80	121.05	83.94	131.32	120.44	82.98	125.90	2.05	-17.36	0.00	52
11	83.94	131.32	120.44	85.90	131.84	119.90	84.93	125.87	2.03	-15.41	0.00	52
12	85.90	131.84	119.90	87.86	132.37	119.43	86.89	125.88	2.01	-13.48	0.00	52
13	87.86	132.37	119.43	89.81	132.89	119.03	88.84	125.93	2.00	-11.56	0.00	52
14	89.81	132.89	119.03	91.77	133.41	118.69	90.80	126.00	1.99	-9.66	0.00	52
15	91.77	133.41	118.69	93.73	133.93	118.43	92.76	126.12	1.98	-7.77	0.00	52
16	93.73	133.93	118.43	95.69	134.45	118.22	94.71	126.26	1.97	-5.89	0.00	52
17	95.69	134.45	118.22	97.64	134.98	118.09	96.67	126.44	1.96	-4.01	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α [°]	β [°]	c [kPa]
18	97.64	134.98	118.09	99.60	135.50	118.01	98.63	126.64	1.96	-2.14	0.00	52
19	99.60	135.50	118.01	101.56	136.02	118.00	100.58	126.88	1.96	-0.27	0.00	52
20	101.56	136.02	118.00	103.52	136.54	118.06	102.54	127.16	1.96	1.60	0.00	52
21	103.52	136.54	118.06	105.47	137.06	118.18	104.50	127.46	1.96	3.47	0.00	52
22	105.47	137.06	118.18	107.43	137.59	118.36	106.45	127.80	1.97	5.35	0.00	52
23	107.43	137.59	118.36	109.00	138.01	118.56	108.22	128.13	1.59	7.04	0.00	52
24	109.00	138.01	118.56	110.58	138.42	118.79	109.79	128.44	1.59	8.56	0.00	52
25	110.58	138.42	118.79	112.15	138.84	119.07	111.36	128.78	1.60	10.08	0.00	52
26	112.15	138.84	119.07	113.37	139.17	119.32	112.76	129.10	1.24	11.44	0.00	52
27	113.37	139.17	119.32	114.59	139.49	119.59	113.98	129.39	1.25	12.63	0.00	52
28	114.59	139.49	119.59	116.37	139.97	120.04	115.48	129.77	1.84	14.11	0.00	52
29	116.37	139.97	120.04	118.16	140.45	120.55	117.27	130.25	1.85	15.87	0.00	52
30	118.16	140.45	120.55	119.94	140.92	121.11	119.05	130.76	1.87	17.65	0.00	52
31	119.94	140.92	121.11	121.73	141.40	121.74	120.83	131.29	1.89	19.45	0.00	52
32	121.73	141.40	121.74	123.51	141.87	122.44	122.62	131.86	1.91	21.26	0.00	52
33	123.51	141.87	122.44	125.29	142.35	123.20	124.40	132.46	1.94	23.10	0.00	52
34	125.29	142.35	123.20	127.08	142.82	124.03	126.18	133.10	1.97	24.97	0.00	52
35	127.08	142.82	124.03	128.86	143.30	124.93	127.96	133.77	2.00	26.86	0.00	52
36	128.86	143.30	124.93	130.67	143.30	125.93	129.76	134.36	2.07	28.80	0.00	52
37	130.67	143.30	125.93	132.48	143.30	127.01	131.57	134.88	2.11	30.80	0.00	53
38	132.48	143.30	127.01	134.36	143.30	128.22	133.41	135.45	2.24	32.87	0.00	54
39	134.36	143.30	128.22	136.21	142.87	129.52	135.27	135.97	2.26	35.02	0.00	54
40	136.21	142.87	129.52	138.07	142.43	130.93	137.12	136.43	2.33	37.21	0.00	54
41	138.07	142.43	130.93	139.92	142.00	132.46	138.96	136.95	2.40	39.47	0.00	54
42	139.92	142.00	132.46	141.77	141.57	134.11	140.81	137.52	2.49	41.80	0.00	54
43	141.77	141.57	134.11	143.63	141.13	135.92	142.65	138.16	2.59	44.23	0.00	54
44	143.63	141.13	135.92	145.48	140.70	137.89	144.46	138.87	2.71	46.75	0.00	54
45	145.48	140.70	137.89	146.48	140.47	139.03	145.93	139.50	1.52	48.77	0.00	54
46	146.48	140.47	139.03	147.48	140.23	140.23	146.82	139.91	1.57	50.24	0.00	54

Tabella 21-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 17.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	2282	0	-24380	-43240	0	0	-50322	0	0	
2	6725	0	26431	29610	0	-50322	-13634	0	0	
3	977	0	2814	2701	0	-13634	-10226	0	0	
4	9567	0	23738	20611	0	-10226	16008	0	0	
5	13056	0	27185	20304	0	16008	42024	0	0	
6	14235	0	26533	17569	0	42024	64479	0	0	
7	25133	0	42742	25132	0	64479	96187	0	0	
8	30945	0	48375	24770	0	96187	126629	0	0	
9	35921	0	52931	24453	0	126629	155357	0	0	
10	40585	0	57103	24176	0	155357	182061	0	0	
11	44946	0	60920	23935	0	182061	206476	0	0	
12	49012	0	64413	23728	0	206476	228374	0	0	
13	52791	0	67605	23553	0	228374	247561	0	0	
14	56360	0	70600	23407	0	247561	263866	0	0	
15	59823	0	73528	23289	0	263866	277120	0	0	
16	63015	0	76205	23197	0	277120	287194	0	0	
17	65891	0	78586	23131	0	287194	293998	0	0	
18	68489	0	80720	23091	0	293998	297459	0	0	
19	70812	0	82617	23075	0	297459	297528	0	0	

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
20	72794	0	84206	23084	0	297528	294202	0	0	
21	74496	0	85558	23117	0	294202	287484	0	0	
22	75937	0	86698	23176	0	287484	277393	0	0	
23	61930	0	70399	18687	0	277393	266847	0	0	
24	62567	0	70900	18755	0	266847	254171	0	0	
25	63019	0	71231	18837	0	254171	239428	0	0	
26	49055	0	55347	14673	0	239428	226626	0	0	
27	49050	0	55267	14738	0	226626	212718	0	0	
28	71434	0	80372	21680	0	212718	190557	0	0	
29	71363	0	80231	21860	0	190557	166069	0	0	
30	71090	0	79904	22065	0	166069	139384	0	0	
31	70661	0	79441	22299	0	139384	110619	0	0	
32	70049	0	78802	22563	0	110619	79926	0	0	
33	68965	0	77611	22860	0	79926	47716	0	0	
34	67569	0	76047	23195	0	47716	14319	0	0	
35	65868	0	74094	23570	0	14319	-19895	0	0	
36	63879	3620	76365	24349	0	-19895	-57652	0	0	
37	59698	3620	70936	25086	0	-57652	-93339	0	0	
38	57626	3760	67409	27470	0	-93339	-127134	0	0	
39	51406	0	53677	27773	0	-127134	-152176	0	0	
40	44851	0	43932	28560	0	-152176	-170817	0	0	
41	37975	0	33057	29464	0	-170817	-181631	0	0	
42	30666	0	20648	30512	0	-181631	-182781	0	0	
43	22844	0	6250	31740	0	-182781	-171942	0	0	
44	14443	0	-10731	33197	0	-171942	-146153	0	0	
45	4119	0	-13992	18644	0	-146153	-124702	0	0	
46	1393	0	-20559	19214	0	-124702	-97069	0	0	

Tabella 21-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 17.

### 21.2.2 ANALISI DELLA SUPERFICIE 8 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	45	
Coordinate del centro	X[m]= 98.86	Y[m]= 170.00
Raggio del cerchio	R[m]= 52.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 68.20	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 142.31	Y <sub>m</sub> [m]= 141.44
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.472</b>	

N°	X <sub>s</sub>	Y <sub>ss</sub>	Y <sub>si</sub>	X <sub>d</sub>	Y <sub>ds</sub>	Y <sub>di</sub>	X <sub>g</sub>	Y <sub>g</sub>	L	α	β	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
1	68.20	128.00	128.00	69.84	128.00	126.85	69.29	127.62	2.00	-35.03	38.66	0
2	69.84	128.00	126.85	71.48	128.00	125.79	70.75	127.13	1.95	-32.85	12.81	35
3	71.48	128.00	125.79	71.68	128.05	125.67	71.58	126.88	0.23	-31.64	0.00	52
4	71.68	128.05	125.67	73.16	128.45	124.80	72.47	126.73	1.72	-30.57	0.00	52
5	73.16	128.45	124.80	74.63	128.84	123.99	73.93	126.51	1.68	-28.70	0.00	52
6	74.63	128.84	123.99	76.11	129.23	123.24	75.40	126.32	1.66	-26.86	0.00	52
7	76.11	129.23	123.24	77.95	129.73	122.39	77.06	126.14	2.03	-24.83	0.00	52
8	77.95	129.73	122.39	79.79	130.22	121.62	78.90	125.99	2.00	-22.61	0.00	52
9	79.79	130.22	121.62	81.64	130.71	120.94	80.74	125.87	1.97	-20.43	0.00	52
10	81.64	130.71	120.94	83.48	131.20	120.33	82.57	125.79	1.94	-18.27	0.00	52
11	83.48	131.20	120.33	85.32	131.69	119.79	84.41	125.75	1.92	-16.15	0.00	52
12	85.32	131.69	119.79	87.16	132.18	119.33	86.25	125.75	1.90	-14.04	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∅ [°]	∅ [°]	c [kPa]
13	87.16	132.18	119.33	89.01	132.67	118.94	88.10	125.78	1.88	-11.96	0.00	52
14	89.01	132.67	118.94	90.85	133.16	118.62	89.94	125.85	1.87	-9.89	0.00	52
15	90.85	133.16	118.62	92.69	133.66	118.37	91.78	125.95	1.86	-7.84	0.00	52
16	92.69	133.66	118.37	94.53	134.15	118.18	93.62	126.09	1.85	-5.79	0.00	52
17	94.53	134.15	118.18	96.38	134.64	118.06	95.46	126.26	1.85	-3.76	0.00	52
18	96.38	134.64	118.06	98.22	135.13	118.00	97.30	126.46	1.84	-1.72	0.00	52
19	98.22	135.13	118.00	100.06	135.62	118.01	99.14	126.69	1.84	0.31	0.00	52
20	100.06	135.62	118.01	101.90	136.11	118.09	100.99	126.96	1.84	2.34	0.00	52
21	101.90	136.11	118.09	103.75	136.60	118.23	102.83	127.26	1.85	4.37	0.00	52
22	103.75	136.60	118.23	105.59	137.09	118.44	104.67	127.59	1.85	6.41	0.00	52
23	105.59	137.09	118.44	107.43	137.59	118.71	106.51	127.96	1.86	8.46	0.00	52
24	107.43	137.59	118.71	109.00	138.01	119.00	108.22	128.33	1.60	10.37	0.00	52
25	109.00	138.01	119.00	110.58	138.42	119.34	109.79	128.69	1.61	12.14	0.00	52
26	110.58	138.42	119.34	112.15	138.84	119.73	111.36	129.08	1.62	13.91	0.00	52
27	112.15	138.84	119.73	113.82	139.29	120.20	112.99	129.51	1.74	15.76	0.00	52
28	113.82	139.29	120.20	115.49	139.74	120.73	114.66	129.99	1.75	17.69	0.00	52
29	115.49	139.74	120.73	117.16	140.18	121.33	116.33	130.49	1.77	19.63	0.00	52
30	117.16	140.18	121.33	118.83	140.63	121.99	118.00	131.03	1.80	21.60	0.00	52
31	118.83	140.63	121.99	120.51	141.07	122.72	119.67	131.60	1.82	23.59	0.00	52
32	120.51	141.07	122.72	122.18	141.52	123.52	121.34	132.21	1.85	25.62	0.00	52
33	122.18	141.52	123.52	123.85	141.96	124.40	123.01	132.85	1.89	27.68	0.00	52
34	123.85	141.96	124.40	125.52	142.41	125.35	124.68	133.53	1.93	29.78	0.00	52
35	125.52	142.41	125.35	127.19	142.85	126.39	126.35	134.25	1.97	31.93	0.00	52
36	127.19	142.85	126.39	128.86	143.30	127.53	128.02	135.02	2.02	34.12	0.00	52
37	128.86	143.30	127.53	130.69	143.30	128.88	129.76	135.75	2.28	36.49	0.00	54
38	130.69	143.30	128.88	132.53	143.30	130.37	131.59	136.46	2.36	39.05	0.00	54
39	132.53	143.30	130.37	134.36	143.30	132.00	133.42	137.23	2.46	41.70	0.00	54
40	134.36	143.30	132.00	135.87	142.95	133.47	135.09	137.92	2.10	44.21	0.00	54
41	135.87	142.95	133.47	137.38	142.59	135.06	136.59	138.51	2.19	46.58	0.00	54
42	137.38	142.59	135.06	138.88	142.24	136.80	138.09	139.16	2.30	49.06	0.00	54
43	138.88	142.24	136.80	140.39	141.89	138.71	139.57	139.88	2.43	51.67	0.00	54
44	140.39	141.89	138.71	141.90	141.54	140.82	140.99	140.65	2.59	54.43	0.00	54
45	141.90	141.54	140.82	142.31	141.44	141.44	142.04	141.27	0.75	56.27	0.00	53

Tabella 21-4 – Geometria e caratteristiche strisce della superficie 8 della verifica di stabilità 17.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	1884	0	-14285	-24206	0	0	-28644	0	0	
2	5547	0	24937	26709	0	-28644	5488	0	0	
3	934	0	2909	2646	0	5488	8958	0	0	
4	8928	0	23491	19316	0	8958	34587	0	0	
5	12364	0	26802	18960	0	34587	60003	0	0	
6	15667	0	29901	18642	0	60003	84967	0	0	
7	24015	0	41408	22863	0	84967	115169	0	0	
8	29393	0	46459	22477	0	115169	144068	0	0	
9	33969	0	50482	22142	0	144068	171214	0	0	
10	38242	0	54140	21852	0	171214	196306	0	0	
11	42217	0	57465	21602	0	196306	219091	0	0	
12	45906	0	60488	21389	0	219091	239355	0	0	
13	49317	0	63232	21210	0	239355	256917	0	0	
14	52469	0	65731	21063	0	256917	271626	0	0	
15	55505	0	68166	20946	0	271626	283335	0	0	



N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
16	58340	0	70441	20856	0	283335	291922	0	0	
17	60891	0	72466	20795	0	291922	297303	0	0	
18	63153	0	74243	20759	0	297303	299421	0	0	
19	65159	0	75811	20750	0	299421	298238	0	0	
20	66889	0	77154	20767	0	298238	293743	0	0	
21	68300	0	78222	20811	0	293743	285965	0	0	
22	69448	0	79082	20881	0	285965	274941	0	0	
23	70343	0	79744	20978	0	274941	260721	0	0	
24	60613	0	68501	18014	0	260721	246090	0	0	
25	60927	0	68716	18125	0	246090	229237	0	0	
26	61028	0	68735	18256	0	229237	210267	0	0	
27	64654	0	72758	19556	0	210267	187961	0	0	
28	64031	0	72010	19754	0	187961	163750	0	0	
29	63402	0	71306	19981	0	163750	137669	0	0	
30	62716	0	70580	20241	0	137669	109790	0	0	
31	61810	0	69620	20537	0	109790	80325	0	0	
32	60744	0	68485	20872	0	80325	49466	0	0	
33	59411	0	67022	21252	0	49466	17526	0	0	
34	57593	0	64908	21684	0	17526	-14918	0	0	
35	55482	0	62351	22174	0	-14918	-47399	0	0	
36	53017	0	59216	22734	0	-47399	-79312	0	0	
37	54248	3667	64237	26633	0	-79312	-115234	0	0	
38	49129	3667	56757	27680	0	-115234	-146934	0	0	
39	43520	3667	47986	28792	0	-146934	-172948	0	0	
40	30675	0	25865	24670	0	-172948	-183436	0	0	
41	25073	0	15318	25726	0	-183436	-185163	0	0	
42	19123	0	2898	26984	0	-185163	-175988	0	0	
43	12744	0	-12113	28508	0	-175988	-153014	0	0	
44	5823	0	-30851	30400	0	-153014	-112160	0	0	
45	305	0	-12111	8512	0	-112160	-97462	0	0	

Tabella 21-5 – Forze applicate sulle strisce [BISHOP] della superficie 8 della verifica di stabilità 17.

### 21.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u [m]
1	0.019967
2	0.011694
3	0.014179
4	0.006713
5	0.003930
6	0.023644
7	0.018985

Tabella 21-6 – Spostamenti della superficie 1 della verifica di stabilità 17.

Accelerazione sismica critica       $K_c = 0.066$   
 Spostamento massimo                 $U_{max} = 0.023644$  [m]  
 Velocità massima                         $V_{max} = 0.072494$  [m/s]

n°	u
	[m]
1	0.022682
2	0.013793
3	0.016221
4	0.007816
5	0.004461
6	0.028299
7	0.022297

Tabella 21-7 – Spostamenti della superficie 8 della verifica di stabilità 17.

Accelerazione sismica critica  $K_c = 0.061$   
Spostamento massimo  $U_{max} = 0.028299$  [m]  
Velocità massima  $V_{max} = 0.077085$  [m/s]

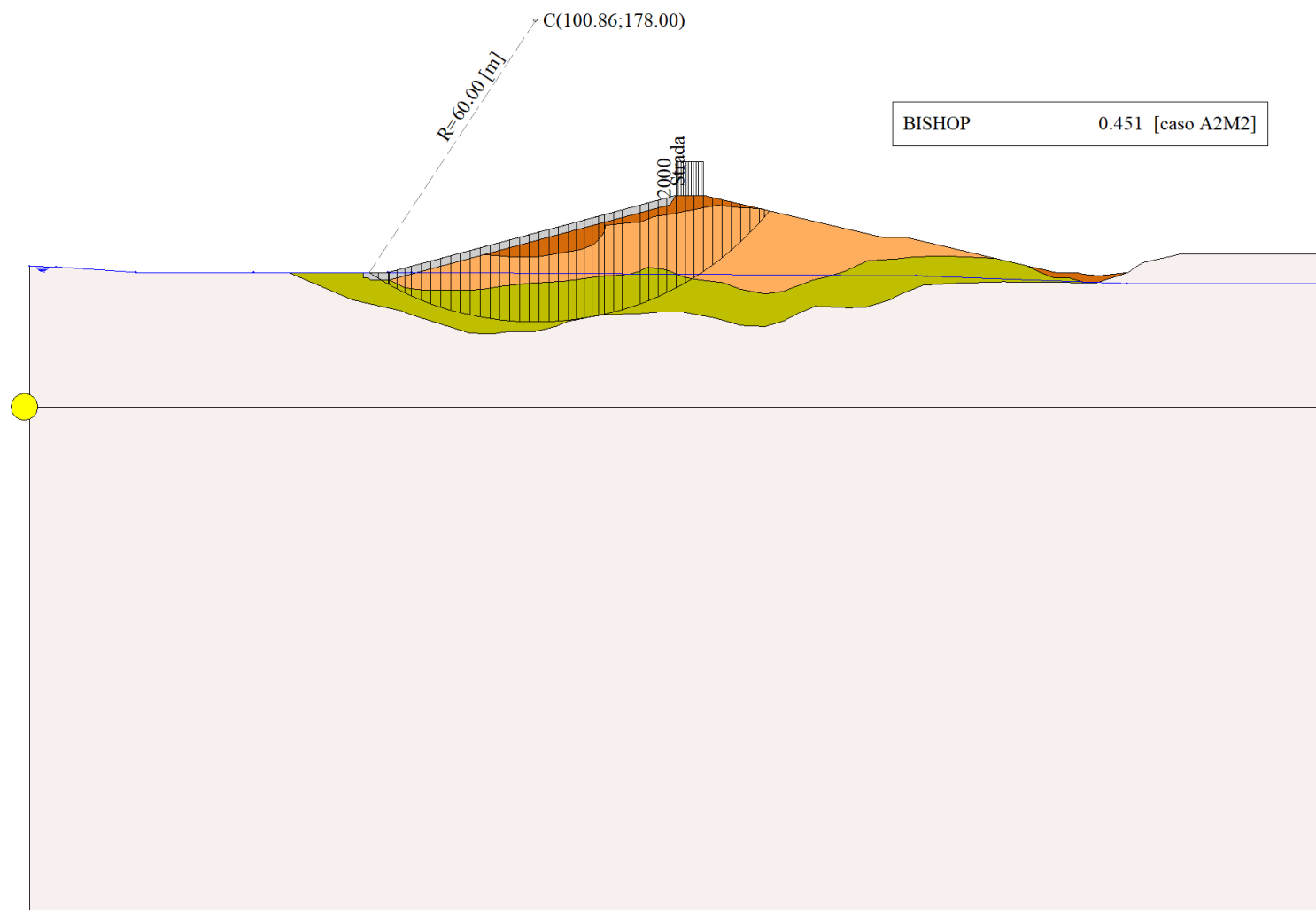


Figura 21-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 17.

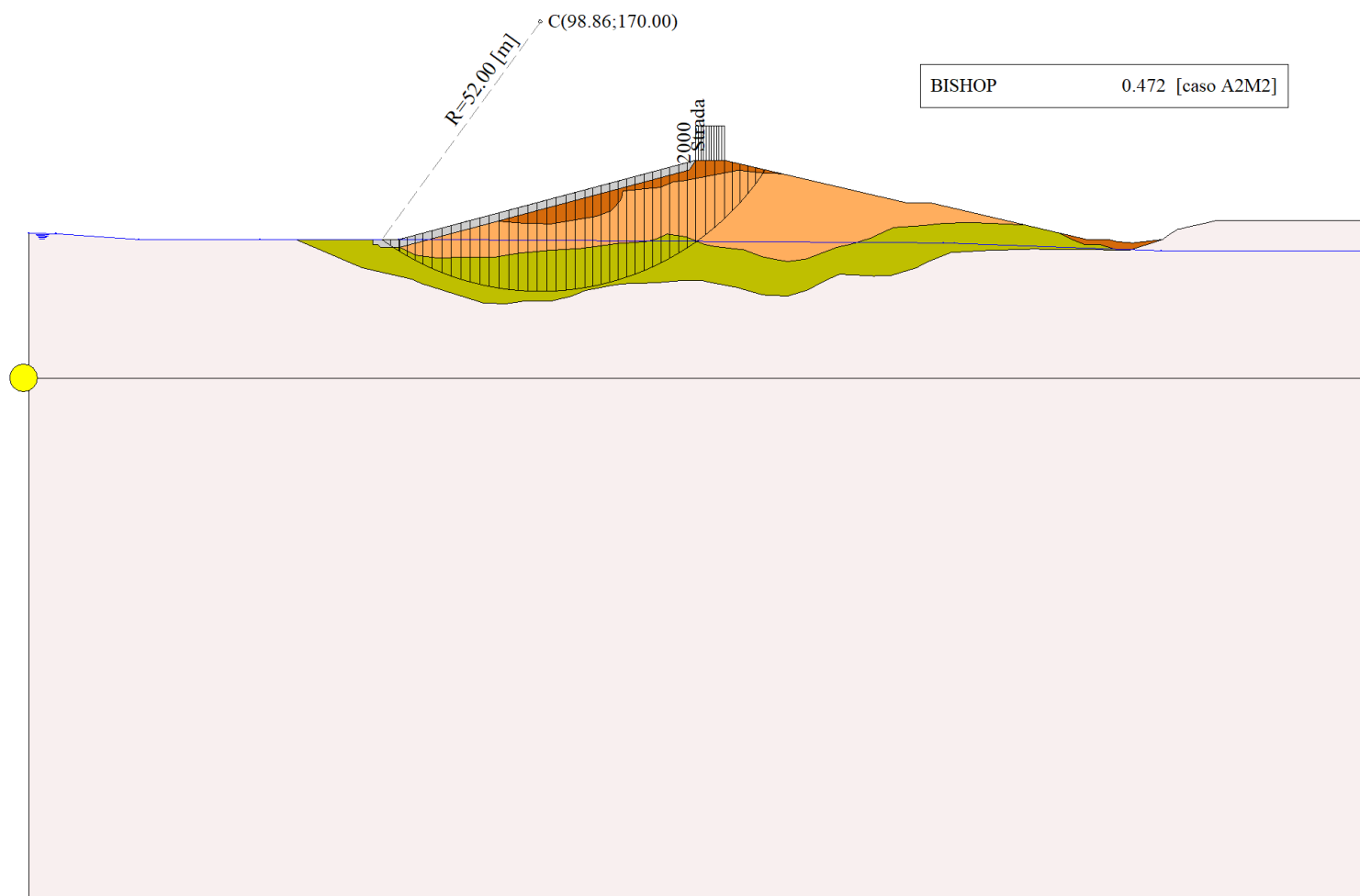


Figura 21-2 – Superficie critica (8) della sezione CR\_06 per la verifica di stabilità 17.

## 22 VERIFICA DI STABILITÀ 18

### 22.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	P <sub>i</sub> [m]	P <sub>f</sub> [m]	V <sub>y</sub> [kg/m]	V <sub>x</sub> [kg/m]
1	Strada	Variabile	1.00	128.86 143.30	134.36 143.30	2000 2000	0 0

Tabella 22-1 – Carichi distribuiti verifica di stabilità 18.

### 22.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **sismiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 22.2 RISULTATI ANALISI

Numero di superfici analizzate	87992
Coefficiente di sicurezza minimo	0.264
Superficie con coefficiente di sicurezza minimo	1

### 22.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	46
Coordinate del centro	X[m]= 102.86                      Y[m]= 200.00
Raggio del cerchio	R[m]= 80.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 67.99                      Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 154.22                      Y <sub>m</sub> [m]= 138.66
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.264</b>

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	67.99	128.00	128.00	69.73	128.00	127.18	69.15	127.73	1.93	-25.15	38.66	0
2	69.73	128.00	127.18	71.48	128.00	126.41	70.70	127.38	1.91	-23.78	34.20	6
3	71.48	128.00	126.41	71.68	128.05	126.33	71.58	127.20	0.22	-23.02	0.00	52
4	71.68	128.05	126.33	73.22	128.46	125.69	72.51	127.13	1.66	-22.34	0.00	52
5	73.22	128.46	125.69	74.76	128.87	125.10	74.03	127.03	1.65	-21.16	0.00	54
6	74.76	128.87	125.10	76.11	129.23	124.60	75.46	126.95	1.44	-20.05	0.00	53
7	76.11	129.23	124.60	77.35	129.57	124.18	76.75	126.89	1.31	-19.06	0.00	52
8	77.35	129.57	124.18	78.59	129.90	123.77	77.98	126.85	1.30	-18.13	0.00	52
9	78.59	129.90	123.77	80.68	130.45	123.13	79.67	126.81	2.19	-16.88	0.00	52
10	80.68	130.45	123.13	82.78	131.01	122.56	81.76	126.79	2.17	-15.32	0.00	52
11	82.78	131.01	122.56	84.87	131.57	122.05	83.85	126.80	2.16	-13.77	0.00	52
12	84.87	131.57	122.05	86.97	132.13	121.59	85.94	126.84	2.14	-12.23	0.00	52
13	86.97	132.13	121.59	89.06	132.69	121.20	88.03	126.90	2.13	-10.69	0.00	52
14	89.06	132.69	121.20	91.16	133.25	120.86	90.12	127.00	2.12	-9.17	0.00	52
15	91.16	133.25	120.86	93.25	133.81	120.58	92.22	127.12	2.11	-7.65	0.00	52
16	93.25	133.81	120.58	95.35	134.36	120.35	94.31	127.28	2.11	-6.14	0.00	52
17	95.35	134.36	120.35	97.44	134.92	120.18	96.40	127.46	2.10	-4.64	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α [°]	β [°]	c [kPa]
18	97.44	134.92	120.18	99.54	135.48	120.07	98.50	127.66	2.10	-3.13	0.00	52
19	99.54	135.48	120.07	101.63	136.04	120.01	100.59	127.90	2.10	-1.63	0.00	52
20	101.63	136.04	120.01	103.73	136.60	120.00	102.68	128.16	2.09	-0.13	0.00	52
21	103.73	136.60	120.00	105.82	137.16	120.05	104.78	128.45	2.10	1.37	0.00	52
22	105.82	137.16	120.05	107.91	137.71	120.16	106.87	128.77	2.10	2.87	0.00	52
23	107.91	137.71	120.16	110.01	138.27	120.32	108.97	129.12	2.10	4.37	0.00	52
24	110.01	138.27	120.32	112.10	138.83	120.54	111.06	129.49	2.11	5.88	0.00	52
25	112.10	138.83	120.54	114.20	139.39	120.81	113.15	129.89	2.11	7.39	0.00	52
26	114.20	139.39	120.81	116.29	139.95	121.14	115.25	130.32	2.12	8.91	0.00	52
27	116.29	139.95	121.14	118.39	140.51	121.52	117.34	130.78	2.13	10.43	0.00	52
28	118.39	140.51	121.52	120.48	141.07	121.96	119.44	131.27	2.14	11.96	0.00	52
29	120.48	141.07	121.96	122.58	141.62	122.47	121.53	131.78	2.15	13.50	0.00	52
30	122.58	141.62	122.47	124.67	142.18	123.03	123.62	132.33	2.17	15.04	0.00	52
31	124.67	142.18	123.03	126.77	142.74	123.66	125.72	132.90	2.19	16.60	0.00	52
32	126.77	142.74	123.66	128.86	143.30	124.34	127.81	133.51	2.20	18.18	0.00	52
33	128.86	143.30	124.34	130.67	143.30	124.99	129.76	133.98	1.92	19.65	0.00	52
34	130.67	143.30	124.99	132.48	143.30	125.69	131.57	134.32	1.94	21.04	0.00	52
35	132.48	143.30	125.69	134.36	143.30	126.46	133.41	134.69	2.03	22.46	0.00	52
36	134.36	143.30	126.46	136.21	142.87	127.28	135.27	134.98	2.03	23.91	0.00	54
37	136.21	142.87	127.28	138.07	142.43	128.16	137.13	135.19	2.05	25.37	0.00	54
38	138.07	142.43	128.16	139.92	142.00	129.10	138.98	135.42	2.08	26.85	0.00	54
39	139.92	142.00	129.10	141.77	141.57	130.10	140.83	135.69	2.11	28.35	0.00	54
40	141.77	141.57	130.10	143.63	141.13	131.17	142.68	135.99	2.14	29.87	0.00	54
41	143.63	141.13	131.17	145.48	140.70	132.30	144.53	136.32	2.17	31.41	0.00	54
42	145.48	140.70	132.30	147.23	140.29	133.43	146.32	136.67	2.08	32.94	0.00	54
43	147.23	140.29	133.43	148.98	139.89	134.63	148.06	137.05	2.12	34.44	0.00	54
44	148.98	139.89	134.63	150.72	139.48	135.90	149.79	137.46	2.16	35.97	0.00	54
45	150.72	139.48	135.90	152.47	139.07	137.24	151.50	137.90	2.20	37.54	0.00	54
46	152.47	139.07	137.24	154.22	138.66	138.66	153.05	138.32	2.25	39.13	0.00	54

Tabella 22-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 18.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	1431	0	-4958	-15029	0	0	-16650	0	0	
2	4205	0	-59788	-149552	0	-16650	-180373	0	0	
3	665	0	2819	4378	0	-180373	-175677	0	0	
4	6805	0	23560	33548	0	-175677	-140158	0	0	
5	9708	0	27137	34398	0	-140158	-104656	0	0	
6	10847	0	26099	29492	0	-104656	-75122	0	0	
7	11869	0	25814	26435	0	-75122	-49495	0	0	
8	14069	0	28269	26290	0	-49495	-24947	0	0	
9	27845	0	52025	44103	0	-24947	14087	0	0	
10	32787	0	57131	43757	0	14087	49864	0	0	
11	37458	0	61865	43452	0	49864	82206	0	0	
12	41866	0	66249	43183	0	82206	110964	0	0	
13	46013	0	70302	42950	0	110964	136018	0	0	
14	49931	0	74075	42750	0	136018	157261	0	0	
15	53802	0	77822	42583	0	157261	174523	0	0	
16	57475	0	81343	42447	0	174523	187715	0	0	
17	60849	0	84514	42342	0	187715	196818	0	0	
18	63955	0	87381	42267	0	196818	201826	0	0	
19	66804	0	89963	42221	0	201826	202750	0	0	

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
20	69324	0	92167	42204	0	202750	199670	0	0	
21	71582	0	94088	42216	0	199670	192649	0	0	
22	73610	0	95767	42257	0	192649	181750	0	0	
23	75433	0	97239	42327	0	181750	167034	0	0	
24	76950	0	98370	42427	0	167034	148661	0	0	
25	78068	0	99032	42557	0	148661	126893	0	0	
26	78571	0	98931	42719	0	126893	102217	0	0	
27	79313	0	99209	42912	0	102217	74414	0	0	
28	79903	0	99339	43140	0	74414	43598	0	0	
29	80366	0	99350	43402	0	43598	9875	0	0	
30	80479	0	98934	43701	0	9875	-26415	0	0	
31	80052	0	97813	44040	0	-26415	-64696	0	0	
32	79325	0	96302	44420	0	-64696	-104589	0	0	
33	66801	3620	85483	38726	0	-104589	-143084	0	0	
34	64004	3620	81198	39074	0	-143084	-180139	0	0	
35	63392	3760	79546	41028	0	-180139	-216680	0	0	
36	58578	0	66246	42528	0	-216680	-243098	0	0	
37	53827	0	58714	43028	0	-243098	-264705	0	0	
38	48953	0	50811	43576	0	-264705	-280905	0	0	
39	43877	0	42380	44176	0	-280905	-290947	0	0	
40	38562	0	33311	44833	0	-290947	-293966	0	0	
41	32992	0	23521	45554	0	-293966	-288999	0	0	
42	25824	0	12565	43685	0	-288999	-276115	0	0	
43	20502	0	2529	44456	0	-276115	-254337	0	0	
44	14949	0	-8351	45303	0	-254337	-222578	0	0	
45	9152	0	-20197	46236	0	-222578	-179616	0	0	
46	3095	0	-33158	47266	0	-179616	-124057	0	0	

Tabella 22-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 18.

### 22.2.2 ANALISI DELLA SUPERFICIE 189 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	45	
Coordinate del centro	X[m]= 98.86	Y[m]= 170.00
Raggio del cerchio	R[m]= 52.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 68.20	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 142.31	Y <sub>m</sub> [m]= 141.44
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.303</b>	

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α [°]	β [°]	c [kPa]
1	68.20	128.00	128.00	69.84	128.00	126.85	69.29	127.62	2.00	-35.03	38.66	0
2	69.84	128.00	126.85	71.48	128.00	125.79	70.75	127.13	1.95	-32.85	12.81	35
3	71.48	128.00	125.79	71.68	128.05	125.67	71.58	126.88	0.23	-31.64	0.00	52
4	71.68	128.05	125.67	73.16	128.45	124.80	72.47	126.73	1.72	-30.57	0.00	52
5	73.16	128.45	124.80	74.63	128.84	123.99	73.93	126.51	1.68	-28.70	0.00	52
6	74.63	128.84	123.99	76.11	129.23	123.24	75.40	126.32	1.66	-26.86	0.00	52
7	76.11	129.23	123.24	77.95	129.73	122.39	77.06	126.14	2.03	-24.83	0.00	52
8	77.95	129.73	122.39	79.79	130.22	121.62	78.90	125.99	2.00	-22.61	0.00	52
9	79.79	130.22	121.62	81.64	130.71	120.94	80.74	125.87	1.97	-20.43	0.00	52
10	81.64	130.71	120.94	83.48	131.20	120.33	82.57	125.79	1.94	-18.27	0.00	52
11	83.48	131.20	120.33	85.32	131.69	119.79	84.41	125.75	1.92	-16.15	0.00	52
12	85.32	131.69	119.79	87.16	132.18	119.33	86.25	125.75	1.90	-14.04	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∅ [°]	∅ [°]	c [kPa]
13	87.16	132.18	119.33	89.01	132.67	118.94	88.10	125.78	1.88	-11.96	0.00	52
14	89.01	132.67	118.94	90.85	133.16	118.62	89.94	125.85	1.87	-9.89	0.00	52
15	90.85	133.16	118.62	92.69	133.66	118.37	91.78	125.95	1.86	-7.84	0.00	52
16	92.69	133.66	118.37	94.53	134.15	118.18	93.62	126.09	1.85	-5.79	0.00	52
17	94.53	134.15	118.18	96.38	134.64	118.06	95.46	126.26	1.85	-3.76	0.00	52
18	96.38	134.64	118.06	98.22	135.13	118.00	97.30	126.46	1.84	-1.72	0.00	52
19	98.22	135.13	118.00	100.06	135.62	118.01	99.14	126.69	1.84	0.31	0.00	52
20	100.06	135.62	118.01	101.90	136.11	118.09	100.99	126.96	1.84	2.34	0.00	52
21	101.90	136.11	118.09	103.75	136.60	118.23	102.83	127.26	1.85	4.37	0.00	52
22	103.75	136.60	118.23	105.59	137.09	118.44	104.67	127.59	1.85	6.41	0.00	52
23	105.59	137.09	118.44	107.43	137.59	118.71	106.51	127.96	1.86	8.46	0.00	52
24	107.43	137.59	118.71	109.00	138.01	119.00	108.22	128.33	1.60	10.37	0.00	52
25	109.00	138.01	119.00	110.58	138.42	119.34	109.79	128.69	1.61	12.14	0.00	52
26	110.58	138.42	119.34	112.15	138.84	119.73	111.36	129.08	1.62	13.91	0.00	52
27	112.15	138.84	119.73	113.82	139.29	120.20	112.99	129.51	1.74	15.76	0.00	52
28	113.82	139.29	120.20	115.49	139.74	120.73	114.66	129.99	1.75	17.69	0.00	52
29	115.49	139.74	120.73	117.16	140.18	121.33	116.33	130.49	1.77	19.63	0.00	52
30	117.16	140.18	121.33	118.83	140.63	121.99	118.00	131.03	1.80	21.60	0.00	52
31	118.83	140.63	121.99	120.51	141.07	122.72	119.67	131.60	1.82	23.59	0.00	52
32	120.51	141.07	122.72	122.18	141.52	123.52	121.34	132.21	1.85	25.62	0.00	52
33	122.18	141.52	123.52	123.85	141.96	124.40	123.01	132.85	1.89	27.68	0.00	52
34	123.85	141.96	124.40	125.52	142.41	125.35	124.68	133.53	1.93	29.78	0.00	52
35	125.52	142.41	125.35	127.19	142.85	126.39	126.35	134.25	1.97	31.93	0.00	52
36	127.19	142.85	126.39	128.86	143.30	127.53	128.02	135.02	2.02	34.12	0.00	52
37	128.86	143.30	127.53	130.69	143.30	128.88	129.76	135.75	2.28	36.49	0.00	54
38	130.69	143.30	128.88	132.53	143.30	130.37	131.59	136.46	2.36	39.05	0.00	54
39	132.53	143.30	130.37	134.36	143.30	132.00	133.42	137.23	2.46	41.70	0.00	54
40	134.36	143.30	132.00	135.87	142.95	133.47	135.09	137.92	2.10	44.21	0.00	54
41	135.87	142.95	133.47	137.38	142.59	135.06	136.59	138.51	2.19	46.58	0.00	54
42	137.38	142.59	135.06	138.88	142.24	136.80	138.09	139.16	2.30	49.06	0.00	54
43	138.88	142.24	136.80	140.39	141.89	138.71	139.57	139.88	2.43	51.67	0.00	54
44	140.39	141.89	138.71	141.90	141.54	140.82	140.99	140.65	2.59	54.43	0.00	54
45	141.90	141.54	140.82	142.31	141.44	141.44	142.04	141.27	0.75	56.27	0.00	53

Tabella 22-4 – Geometria e caratteristiche strisce della superficie 189 della verifica di stabilità 18.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	1884	0	-3587	-9478	0	0	-11057	0	0	
2	5547	0	45750	57279	0	-11057	58238	0	0	
3	934	0	4000	4126	0	58238	63236	0	0	
4	8928	0	31562	30120	0	63236	99362	0	0	
5	12364	0	34904	29565	0	99362	133942	0	0	
6	15667	0	38043	29069	0	133942	166780	0	0	
7	24015	0	51635	35651	0	166780	205057	0	0	
8	29393	0	56883	35050	0	205057	239991	0	0	
9	33969	0	61000	34527	0	239991	271344	0	0	
10	38242	0	64738	34075	0	271344	298903	0	0	
11	42217	0	68125	33685	0	298903	322501	0	0	
12	45906	0	71191	33353	0	322501	342008	0	0	
13	49317	0	73959	33074	0	342008	357328	0	0	
14	52469	0	76465	32845	0	357328	368389	0	0	
15	55505	0	78908	32661	0	368389	375081	0	0	



N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
16	58340	0	81180	32522	0	375081	377346	0	0	
17	60891	0	83173	32426	0	377346	375190	0	0	
18	63153	0	84887	32371	0	375190	368654	0	0	
19	65159	0	86366	32357	0	368654	357787	0	0	
20	66889	0	87588	32383	0	357787	342673	0	0	
21	68300	0	88494	32451	0	342673	323461	0	0	
22	69448	0	89157	32560	0	323461	300285	0	0	
23	70343	0	89587	32712	0	300285	273300	0	0	
24	60613	0	76698	28090	0	273300	247352	0	0	
25	60927	0	76690	28263	0	247352	218880	0	0	
26	61028	0	76450	28467	0	218880	188078	0	0	
27	64654	0	80617	30494	0	188078	153093	0	0	
28	64031	0	79437	30803	0	153093	116286	0	0	
29	63402	0	78288	31158	0	116286	77724	0	0	
30	62716	0	77089	31563	0	77724	37537	0	0	
31	61810	0	75593	32024	0	37537	-3934	0	0	
32	60744	0	73864	32547	0	-3934	-46388	0	0	
33	59411	0	71718	33139	0	-46388	-89344	0	0	
34	57593	0	68780	33812	0	-89344	-131953	0	0	
35	55482	0	65275	34577	0	-131953	-173534	0	0	
36	53017	0	61035	35450	0	-173534	-213218	0	0	
37	54248	3667	64955	41530	0	-213218	-256466	0	0	
38	49129	3667	55275	43163	0	-256466	-292413	0	0	
39	43520	3667	43935	44897	0	-292413	-319086	0	0	
40	30675	0	19413	38469	0	-319086	-325181	0	0	
41	25073	0	6055	40116	0	-325181	-318460	0	0	
42	19123	0	-9745	42077	0	-318460	-296076	0	0	
43	12744	0	-28932	44454	0	-296076	-254172	0	0	
44	5823	0	-53000	47405	0	-254172	-187308	0	0	
45	305	0	-19153	13273	0	-187308	-164208	0	0	

Tabella 22-5 – Forze applicate sulle strisce [BISHOP] della superficie 189 della verifica di stabilità 18.

### 22.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.079578
2	0.105621
3	0.053280
4	0.025586
5	0.037852
6	0.047801
7	0.065591

Tabella 22-6 – Spostamenti della superficie 1 della verifica di stabilità 18.

Accelerazione sismica critica  $K_c = 0.094$   
 Spostamento massimo  $U_{max} = 0.105621$  [m]  
 Velocità massima  $V_{max} = 0.249267$  [m/s]

n°	u
	[m]
1	0.171331
2	0.272900
3	0.101281
4	0.057666
5	0.068773
6	0.092223
7	0.126069

Tabella 22-7 – Spostamenti della superficie 189 della verifica di stabilità 18.

Accelerazione sismica critica  $K_c = 0.061$   
Spostamento massimo  $U_{max} = 0.272900$  [m]  
Velocità massima  $V_{max} = 0.443165$  [m/s]

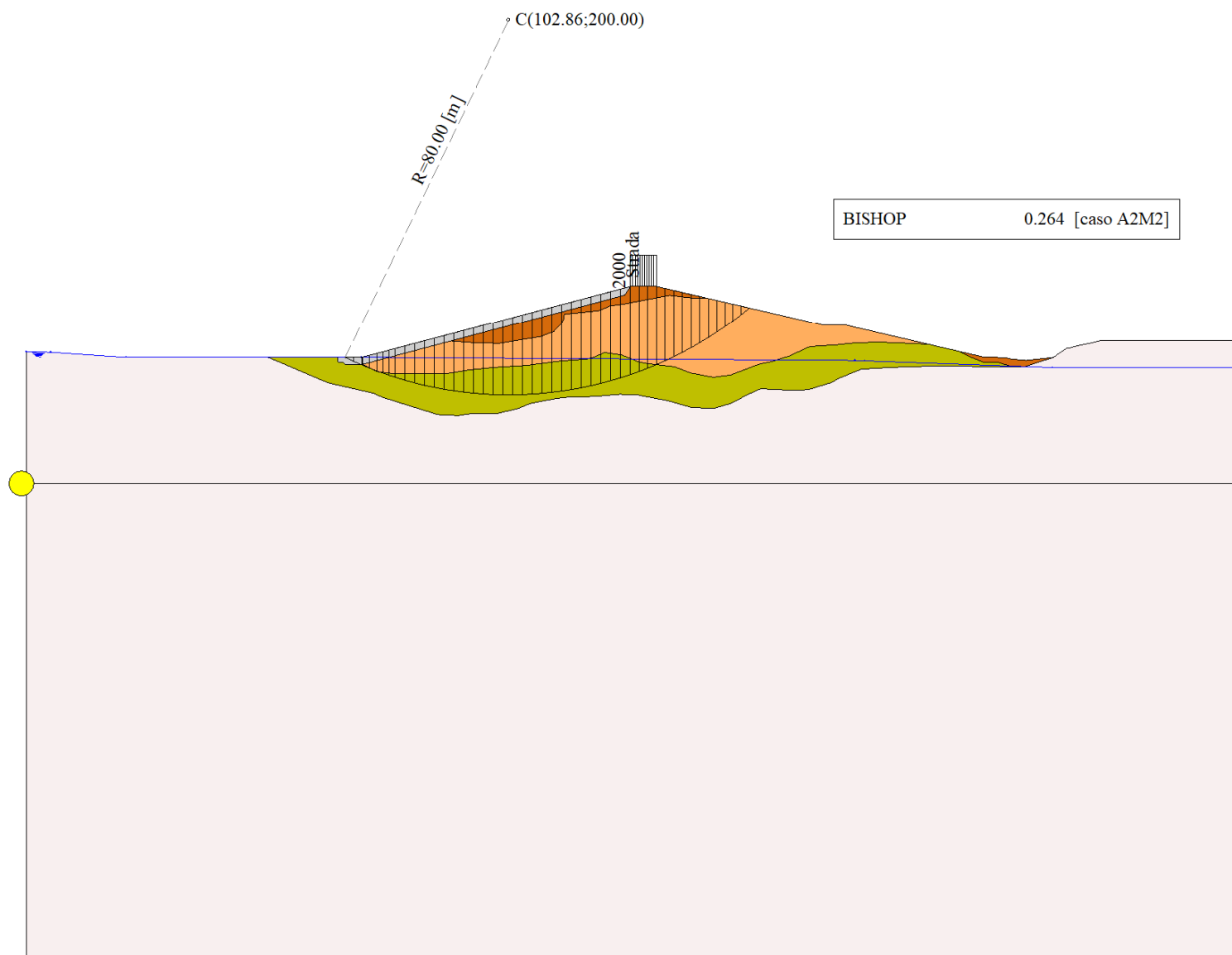


Figura 22-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 18.

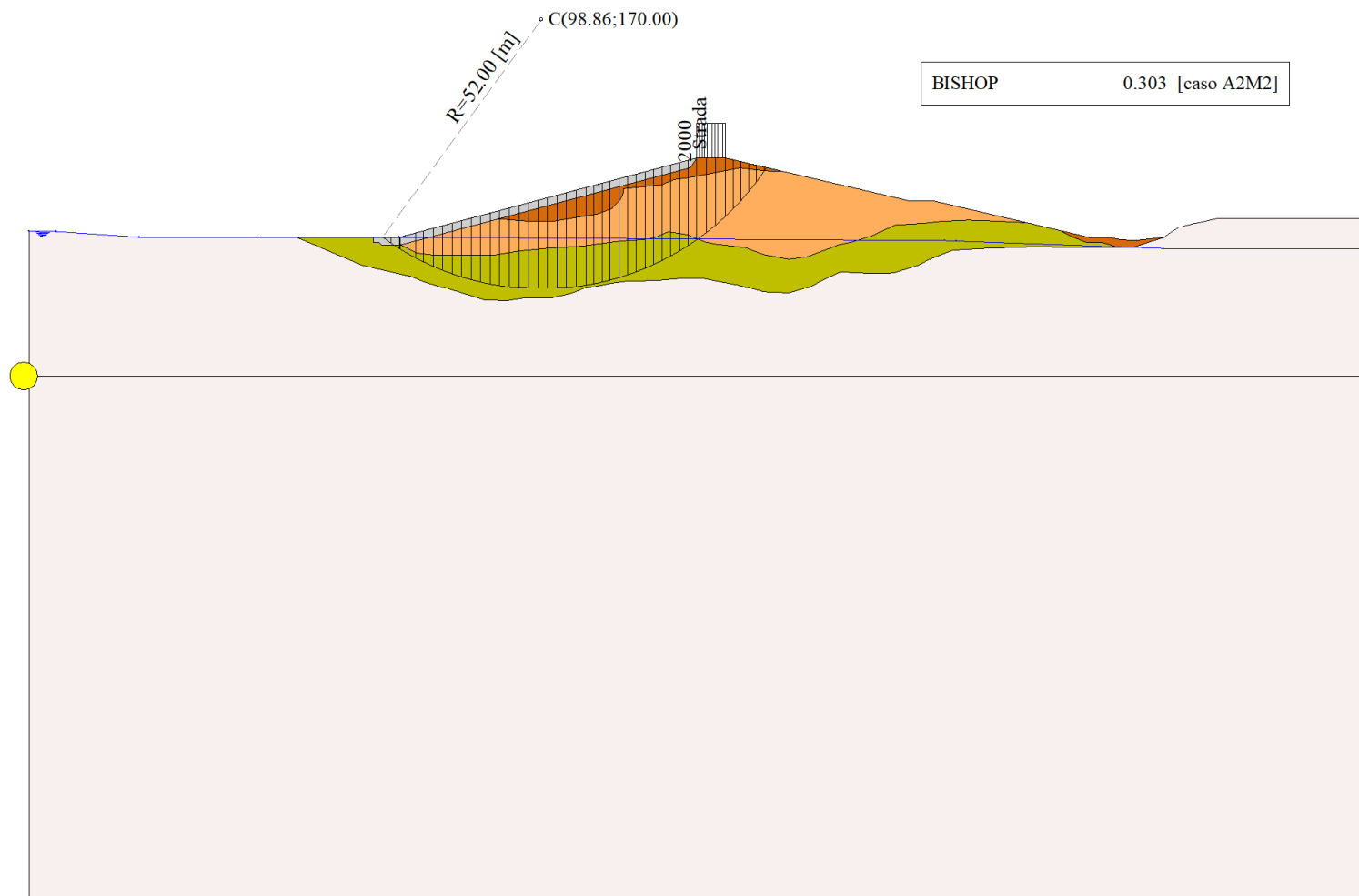


Figura 22-2 – Superficie critica (189) della sezione CR\_06 per la verifica di stabilità 18.

## 23 VERIFICA DI STABILITÀ 19

### 23.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	P <sub>i</sub> [m]	P <sub>f</sub> [m]	V <sub>y</sub> [kg/m]	V <sub>x</sub> [kg/m]
1	Strada	Variabile	1.00	128.86	134.36	2000	0
				143.30	143.30	2000	0

Tabella 23-1 – Carichi distribuiti verifica di stabilità 19.

### 23.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **sismiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 23.2 RISULTATI ANALISI

Numero di superfici analizzate	87974
Coefficiente di sicurezza minimo	0.277
Superficie con coefficiente di sicurezza minimo	1

### 23.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	46
Coordinate del centro	X[m]= 98.86                      Y[m]= 174.00
Raggio del cerchio	R[m]= 56.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 66.92                      Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 144.12                      Y <sub>m</sub> [m]= 141.02
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.277</b>

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	66.92	128.00	128.00	67.48	128.00	127.62	67.29	127.87	0.68	-34.43	38.66	0
2	67.48	128.00	127.62	67.98	128.00	127.28	67.76	127.72	0.60	-33.77	38.66	0
3	67.98	128.00	127.28	69.73	128.00	126.17	68.98	127.32	2.07	-32.40	27.27	15
4	69.73	128.00	126.17	71.48	128.00	125.15	70.67	126.81	2.03	-30.31	0.00	52
5	71.48	128.00	125.15	73.02	128.41	124.32	72.30	126.46	1.75	-28.37	0.00	52
6	73.02	128.41	124.32	74.57	128.82	123.54	73.83	126.27	1.73	-26.59	0.00	52
7	74.57	128.82	123.54	76.11	129.23	122.83	75.36	126.11	1.70	-24.84	0.00	52
8	76.11	129.23	122.83	77.95	129.73	122.05	77.06	125.96	2.00	-22.95	0.00	52
9	77.95	129.73	122.05	79.79	130.22	121.35	78.90	125.83	1.97	-20.91	0.00	52
10	79.79	130.22	121.35	81.64	130.71	120.71	80.73	125.75	1.95	-18.91	0.00	52
11	81.64	130.71	120.71	83.48	131.20	120.15	82.57	125.69	1.93	-16.93	0.00	52
12	83.48	131.20	120.15	85.32	131.69	119.66	84.41	125.68	1.91	-14.97	0.00	52
13	85.32	131.69	119.66	87.16	132.18	119.23	86.25	125.69	1.89	-13.02	0.00	52
14	87.16	132.18	119.23	89.01	132.67	118.87	88.10	125.74	1.88	-11.09	0.00	52
15	89.01	132.67	118.87	90.85	133.16	118.58	89.94	125.82	1.87	-9.18	0.00	52
16	90.85	133.16	118.58	92.69	133.66	118.34	91.78	125.93	1.86	-7.27	0.00	52
17	92.69	133.66	118.34	94.53	134.15	118.17	93.62	126.08	1.85	-5.38	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α [°]	β [°]	c [kPa]
18	94.53	134.15	118.17	96.38	134.64	118.06	95.46	126.25	1.85	-3.49	0.00	52
19	96.38	134.64	118.06	98.22	135.13	118.00	97.30	126.46	1.84	-1.60	0.00	52
20	98.22	135.13	118.00	100.06	135.62	118.01	99.14	126.69	1.84	0.29	0.00	52
21	100.06	135.62	118.01	101.90	136.11	118.08	100.99	126.96	1.84	2.17	0.00	52
22	101.90	136.11	118.08	103.75	136.60	118.21	102.83	127.25	1.85	4.06	0.00	52
23	103.75	136.60	118.21	105.59	137.09	118.41	104.67	127.58	1.85	5.95	0.00	52
24	105.59	137.09	118.41	107.43	137.59	118.66	106.51	127.94	1.86	7.85	0.00	52
25	107.43	137.59	118.66	109.00	138.01	118.93	108.22	128.29	1.60	9.62	0.00	52
26	109.00	138.01	118.93	110.58	138.42	119.24	109.79	128.65	1.60	11.26	0.00	52
27	110.58	138.42	119.24	112.15	138.84	119.60	111.36	129.03	1.61	12.90	0.00	52
28	112.15	138.84	119.60	113.37	139.17	119.91	112.76	129.38	1.26	14.37	0.00	52
29	113.37	139.17	119.91	114.59	139.49	120.25	113.98	129.71	1.27	15.67	0.00	52
30	114.59	139.49	120.25	116.37	139.97	120.81	115.48	130.13	1.87	17.27	0.00	52
31	116.37	139.97	120.81	118.16	140.45	121.43	117.26	130.66	1.89	19.19	0.00	52
32	118.16	140.45	121.43	119.94	140.92	122.12	119.05	131.23	1.91	21.14	0.00	52
33	119.94	140.92	122.12	121.73	141.40	122.88	120.83	131.83	1.94	23.11	0.00	52
34	121.73	141.40	122.88	123.51	141.87	123.72	122.61	132.47	1.97	25.11	0.00	52
35	123.51	141.87	123.72	125.29	142.35	124.63	124.40	133.14	2.00	27.14	0.00	52
36	125.29	142.35	124.63	127.08	142.82	125.63	126.18	133.86	2.04	29.21	0.00	52
37	127.08	142.82	125.63	128.86	143.30	126.71	127.96	134.61	2.09	31.32	0.00	52
38	128.86	143.30	126.71	130.60	143.30	127.86	129.72	135.29	2.09	33.46	0.00	53
39	130.60	143.30	127.86	132.48	143.30	129.22	131.53	135.91	2.32	35.71	0.00	54
40	132.48	143.30	129.22	134.36	143.30	130.69	133.40	136.62	2.39	38.12	0.00	54
41	134.36	143.30	130.69	135.99	142.92	132.08	135.15	137.24	2.14	40.43	0.00	54
42	135.99	142.92	132.08	137.61	142.54	133.57	136.77	137.77	2.21	42.66	0.00	54
43	137.61	142.54	133.57	139.24	142.16	135.20	138.39	138.35	2.30	44.97	0.00	54
44	139.24	142.16	135.20	140.86	141.78	136.97	140.00	139.00	2.40	47.37	0.00	54
45	140.86	141.78	136.97	142.49	141.40	138.90	141.59	139.72	2.52	49.89	0.00	54
46	142.49	141.40	138.90	144.12	141.02	141.02	143.03	140.44	2.67	52.55	0.00	54

Tabella 23-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 19.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	213	0	-345	-997	0	0	-1150	0	0	
2	549	0	-928	-2683	0	-1150	-4237	0	0	
3	4461	0	-78704	-134909	0	-4237	-163091	0	0	
4	8345	0	35443	38955	0	-163091	-116766	0	0	
5	10859	0	34386	33709	0	-116766	-77522	0	0	
6	14370	0	37673	33168	0	-77522	-39939	0	0	
7	17745	0	40766	32683	0	-39939	-4195	0	0	
8	25473	0	52543	38448	0	-4195	35848	0	0	
9	30588	0	57415	37903	0	35848	72718	0	0	
10	34934	0	61233	37425	0	72718	106232	0	0	
11	39007	0	64719	37009	0	106232	136213	0	0	
12	42810	0	67894	36649	0	136213	162518	0	0	
13	46352	0	70780	36340	0	162518	185035	0	0	
14	49639	0	73395	36080	0	185035	203682	0	0	
15	52689	0	75770	35865	0	203682	218395	0	0	
16	55643	0	78100	35693	0	218395	229073	0	0	
17	58416	0	80274	35562	0	229073	235658	0	0	
18	60924	0	82185	35471	0	235658	238159	0	0	
19	63162	0	83831	35420	0	238159	236609	0	0	

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
20	65161	0	85255	35406	0	236609	231050	0	0	
21	66903	0	86434	35431	0	231050	221557	0	0	
22	68344	0	87310	35495	0	221557	208262	0	0	
23	69541	0	87956	35598	0	208262	191282	0	0	
24	70504	0	88382	35741	0	191282	170750	0	0	
25	60818	0	75677	30667	0	170750	150503	0	0	
26	61209	0	75688	30829	0	150503	127883	0	0	
27	61401	0	75480	31019	0	127883	103065	0	0	
28	47611	0	58237	24203	0	103065	82433	0	0	
29	47434	0	57759	24350	0	82433	60772	0	0	
30	68741	0	83220	35898	0	60772	27580	0	0	
31	68257	0	82122	36297	0	27580	-7601	0	0	
32	67541	0	80730	36752	0	-7601	-44451	0	0	
33	66635	0	79082	37269	0	-44451	-82662	0	0	
34	65510	0	77111	37856	0	-82662	-121857	0	0	
35	63871	0	74354	38521	0	-121857	-161231	0	0	
36	61873	0	70980	39274	0	-161231	-200084	0	0	
37	59516	0	66922	40129	0	-200084	-237624	0	0	
38	54656	3480	64384	40820	0	-237624	-275235	0	0	
39	54338	3760	60509	46324	0	-275235	-309086	0	0	
40	49121	3760	50611	47810	0	-309086	-335612	0	0	
41	37295	0	27816	42746	0	-335612	-344319	0	0	
42	31438	0	15282	44243	0	-344319	-341697	0	0	
43	25269	0	894	45986	0	-341697	-325513	0	0	
44	18701	0	-15987	48041	0	-325513	-292849	0	0	
45	11649	0	-36245	50502	0	-292849	-239840	0	0	
46	4015	0	-60968	53330	0	-239840	-161508	0	0	

Tabella 23-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 19.

### 23.2.2 ANALISI DELLA SUPERFICIE 175 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	45	
Coordinate del centro	X[m]= 98.86	Y[m]= 170.00
Raggio del cerchio	R[m]= 52.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 68.20	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 142.31	Y <sub>m</sub> [m]= 141.44
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.315</b>	

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α [°]	β [°]	c [kPa]
1	68.20	128.00	128.00	69.84	128.00	126.85	69.29	127.62	2.00	-35.03	38.66	0
2	69.84	128.00	126.85	71.48	128.00	125.79	70.75	127.13	1.95	-32.85	12.81	35
3	71.48	128.00	125.79	71.68	128.05	125.67	71.58	126.88	0.23	-31.64	0.00	52
4	71.68	128.05	125.67	73.16	128.45	124.80	72.47	126.73	1.72	-30.57	0.00	52
5	73.16	128.45	124.80	74.63	128.84	123.99	73.93	126.51	1.68	-28.70	0.00	52
6	74.63	128.84	123.99	76.11	129.23	123.24	75.40	126.32	1.66	-26.86	0.00	52
7	76.11	129.23	123.24	77.95	129.73	122.39	77.06	126.14	2.03	-24.83	0.00	52
8	77.95	129.73	122.39	79.79	130.22	121.62	78.90	125.99	2.00	-22.61	0.00	52
9	79.79	130.22	121.62	81.64	130.71	120.94	80.74	125.87	1.97	-20.43	0.00	52
10	81.64	130.71	120.94	83.48	131.20	120.33	82.57	125.79	1.94	-18.27	0.00	52
11	83.48	131.20	120.33	85.32	131.69	119.79	84.41	125.75	1.92	-16.15	0.00	52
12	85.32	131.69	119.79	87.16	132.18	119.33	86.25	125.75	1.90	-14.04	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α <sub>s</sub> [°]	α <sub>d</sub> [°]	c [kPa]
13	87.16	132.18	119.33	89.01	132.67	118.94	88.10	125.78	1.88	-11.96	0.00	52
14	89.01	132.67	118.94	90.85	133.16	118.62	89.94	125.85	1.87	-9.89	0.00	52
15	90.85	133.16	118.62	92.69	133.66	118.37	91.78	125.95	1.86	-7.84	0.00	52
16	92.69	133.66	118.37	94.53	134.15	118.18	93.62	126.09	1.85	-5.79	0.00	52
17	94.53	134.15	118.18	96.38	134.64	118.06	95.46	126.26	1.85	-3.76	0.00	52
18	96.38	134.64	118.06	98.22	135.13	118.00	97.30	126.46	1.84	-1.72	0.00	52
19	98.22	135.13	118.00	100.06	135.62	118.01	99.14	126.69	1.84	0.31	0.00	52
20	100.06	135.62	118.01	101.90	136.11	118.09	100.99	126.96	1.84	2.34	0.00	52
21	101.90	136.11	118.09	103.75	136.60	118.23	102.83	127.26	1.85	4.37	0.00	52
22	103.75	136.60	118.23	105.59	137.09	118.44	104.67	127.59	1.85	6.41	0.00	52
23	105.59	137.09	118.44	107.43	137.59	118.71	106.51	127.96	1.86	8.46	0.00	52
24	107.43	137.59	118.71	109.00	138.01	119.00	108.22	128.33	1.60	10.37	0.00	52
25	109.00	138.01	119.00	110.58	138.42	119.34	109.79	128.69	1.61	12.14	0.00	52
26	110.58	138.42	119.34	112.15	138.84	119.73	111.36	129.08	1.62	13.91	0.00	52
27	112.15	138.84	119.73	113.82	139.29	120.20	112.99	129.51	1.74	15.76	0.00	52
28	113.82	139.29	120.20	115.49	139.74	120.73	114.66	129.99	1.75	17.69	0.00	52
29	115.49	139.74	120.73	117.16	140.18	121.33	116.33	130.49	1.77	19.63	0.00	52
30	117.16	140.18	121.33	118.83	140.63	121.99	118.00	131.03	1.80	21.60	0.00	52
31	118.83	140.63	121.99	120.51	141.07	122.72	119.67	131.60	1.82	23.59	0.00	52
32	120.51	141.07	122.72	122.18	141.52	123.52	121.34	132.21	1.85	25.62	0.00	52
33	122.18	141.52	123.52	123.85	141.96	124.40	123.01	132.85	1.89	27.68	0.00	52
34	123.85	141.96	124.40	125.52	142.41	125.35	124.68	133.53	1.93	29.78	0.00	52
35	125.52	142.41	125.35	127.19	142.85	126.39	126.35	134.25	1.97	31.93	0.00	52
36	127.19	142.85	126.39	128.86	143.30	127.53	128.02	135.02	2.02	34.12	0.00	52
37	128.86	143.30	127.53	130.69	143.30	128.88	129.76	135.75	2.28	36.49	0.00	54
38	130.69	143.30	128.88	132.53	143.30	130.37	131.59	136.46	2.36	39.05	0.00	54
39	132.53	143.30	130.37	134.36	143.30	132.00	133.42	137.23	2.46	41.70	0.00	54
40	134.36	143.30	132.00	135.87	142.95	133.47	135.09	137.92	2.10	44.21	0.00	54
41	135.87	142.95	133.47	137.38	142.59	135.06	136.59	138.51	2.19	46.58	0.00	54
42	137.38	142.59	135.06	138.88	142.24	136.80	138.09	139.16	2.30	49.06	0.00	54
43	138.88	142.24	136.80	140.39	141.89	138.71	139.57	139.88	2.43	51.67	0.00	54
44	140.39	141.89	138.71	141.90	141.54	140.82	140.99	140.65	2.59	54.43	0.00	54
45	141.90	141.54	140.82	142.31	141.44	141.44	142.04	141.27	0.75	56.27	0.00	53

Tabella 23-4 – Geometria e caratteristiche strisce della superficie 175 della verifica di stabilità 19.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	1884	0	-3857	-9807	0	0	-11417	0	0	
2	5547	0	42926	53079	0	-11417	53007	0	0	
3	934	0	3885	3970	0	53007	57845	0	0	
4	8928	0	30714	28985	0	57845	92867	0	0	
5	12364	0	34054	28451	0	92867	126482	0	0	
6	15667	0	37189	27974	0	126482	158492	0	0	
7	24015	0	50562	34307	0	158492	195917	0	0	
8	29393	0	55790	33729	0	195917	230215	0	0	
9	33969	0	59898	33226	0	230215	261121	0	0	
10	38242	0	63627	32790	0	261121	288417	0	0	
11	42217	0	67008	32416	0	288417	311924	0	0	
12	45906	0	70070	32096	0	311924	331505	0	0	
13	49317	0	72836	31828	0	331505	347054	0	0	
14	52469	0	75341	31607	0	347054	358492	0	0	
15	55505	0	77783	31430	0	358492	365704	0	0	



N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
16	58340	0	80055	31297	0	365704	368626	0	0	
17	60891	0	82052	31204	0	368626	367254	0	0	
18	63153	0	83773	31151	0	367254	361619	0	0	
19	65159	0	85261	31137	0	361619	351759	0	0	
20	66889	0	86496	31163	0	351759	337752	0	0	
21	68300	0	87419	31228	0	337752	319731	0	0	
22	69448	0	88103	31333	0	319731	297822	0	0	
23	70343	0	88557	31479	0	297822	272167	0	0	
24	60613	0	75841	27032	0	272167	247400	0	0	
25	60927	0	75857	27198	0	247400	220138	0	0	
26	61028	0	75644	27394	0	220138	190570	0	0	
27	64654	0	79796	29345	0	190570	156908	0	0	
28	64031	0	78662	29642	0	156908	121413	0	0	
29	63402	0	77559	29984	0	121413	84152	0	0	
30	62716	0	76409	30374	0	84152	45248	0	0	
31	61810	0	74970	30817	0	45248	5028	0	0	
32	60744	0	73303	31320	0	5028	-36218	0	0	
33	59411	0	71230	31890	0	-36218	-78027	0	0	
34	57593	0	68378	32538	0	-78027	-119579	0	0	
35	55482	0	64972	33274	0	-119579	-160214	0	0	
36	53017	0	60849	34114	0	-160214	-199091	0	0	
37	54248	3667	64885	39964	0	-199091	-241580	0	0	
38	49129	3667	55435	41536	0	-241580	-277091	0	0	
39	43520	3667	44365	43205	0	-277091	-303704	0	0	
40	30675	0	20094	37019	0	-303704	-310267	0	0	
41	25073	0	7031	38604	0	-310267	-304439	0	0	
42	19123	0	-8415	40491	0	-304439	-283447	0	0	
43	12744	0	-27163	42779	0	-283447	-243535	0	0	
44	5823	0	-50673	45618	0	-243535	-179405	0	0	
45	305	0	-18413	12773	0	-179405	-157189	0	0	

Tabella 23-5 – Forze applicate sulle strisce [BISHOP] della superficie 175 della verifica di stabilità 19.

### 23.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u [m]
1	0.149919
2	0.106811
3	0.326333
4	0.149628
5	0.190673
6	0.077221
7	0.141098

Tabella 23-6 – Spostamenti della superficie 1 della verifica di stabilità 19.

Accelerazione sismica critica  $K_c = 0.062$   
 Spostamento massimo  $U_{max} = 0.326333$  [m]  
 Velocità massima  $V_{max} = 0.506217$  [m/s]

n°	u
	[m]
1	0.152419
2	0.108901
3	0.334202
4	0.152957
5	0.194562
6	0.078981
7	0.147420

Tabella 23-7 – Spostamenti della superficie 175 della verifica di stabilità 19.

Accelerazione sismica critica  $K_c = 0.061$   
Spostamento massimo  $U_{max} = 0.334202$  [m]  
Velocità massima  $V_{max} = 0.512483$  [m/s]

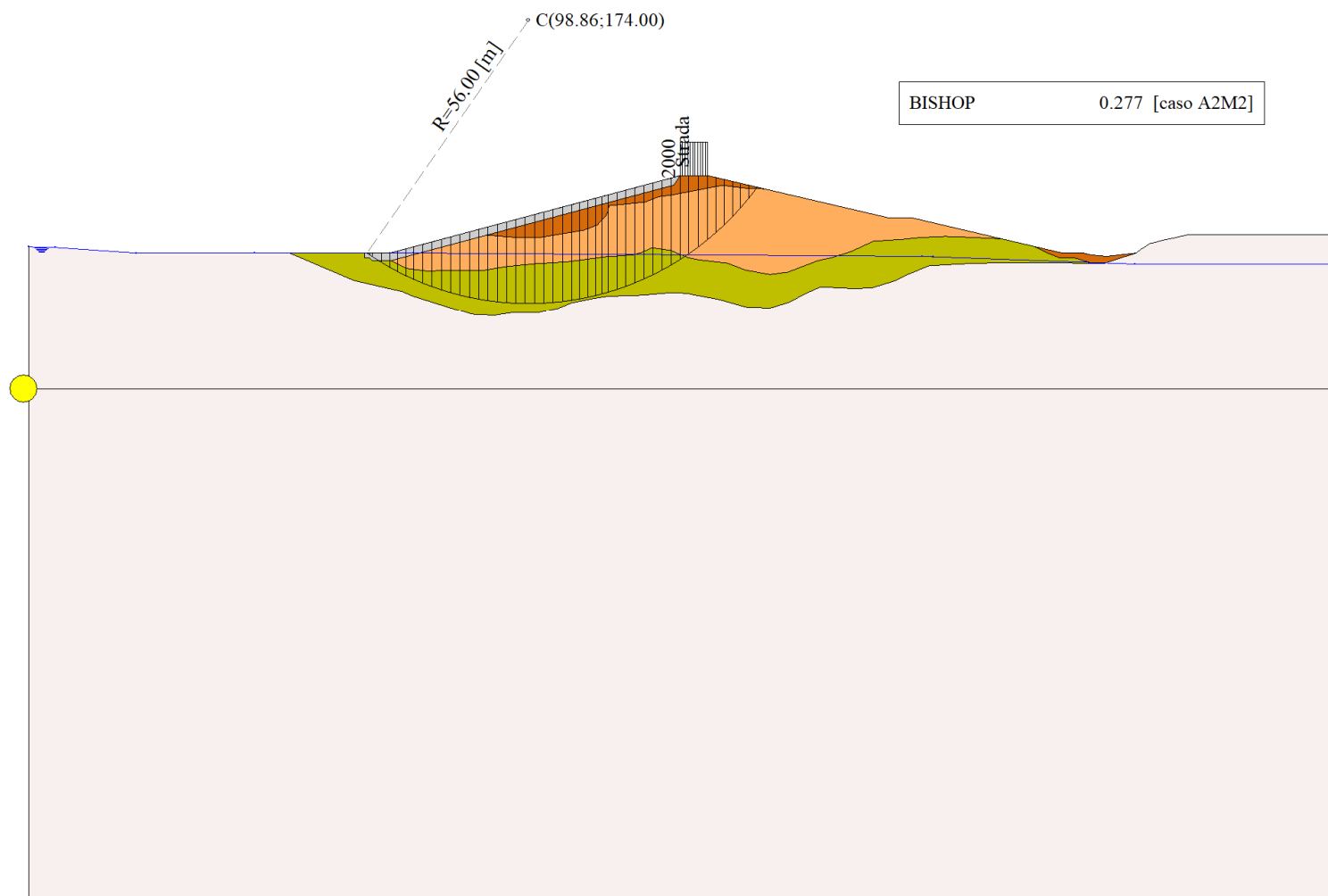


Figura 23-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 19.

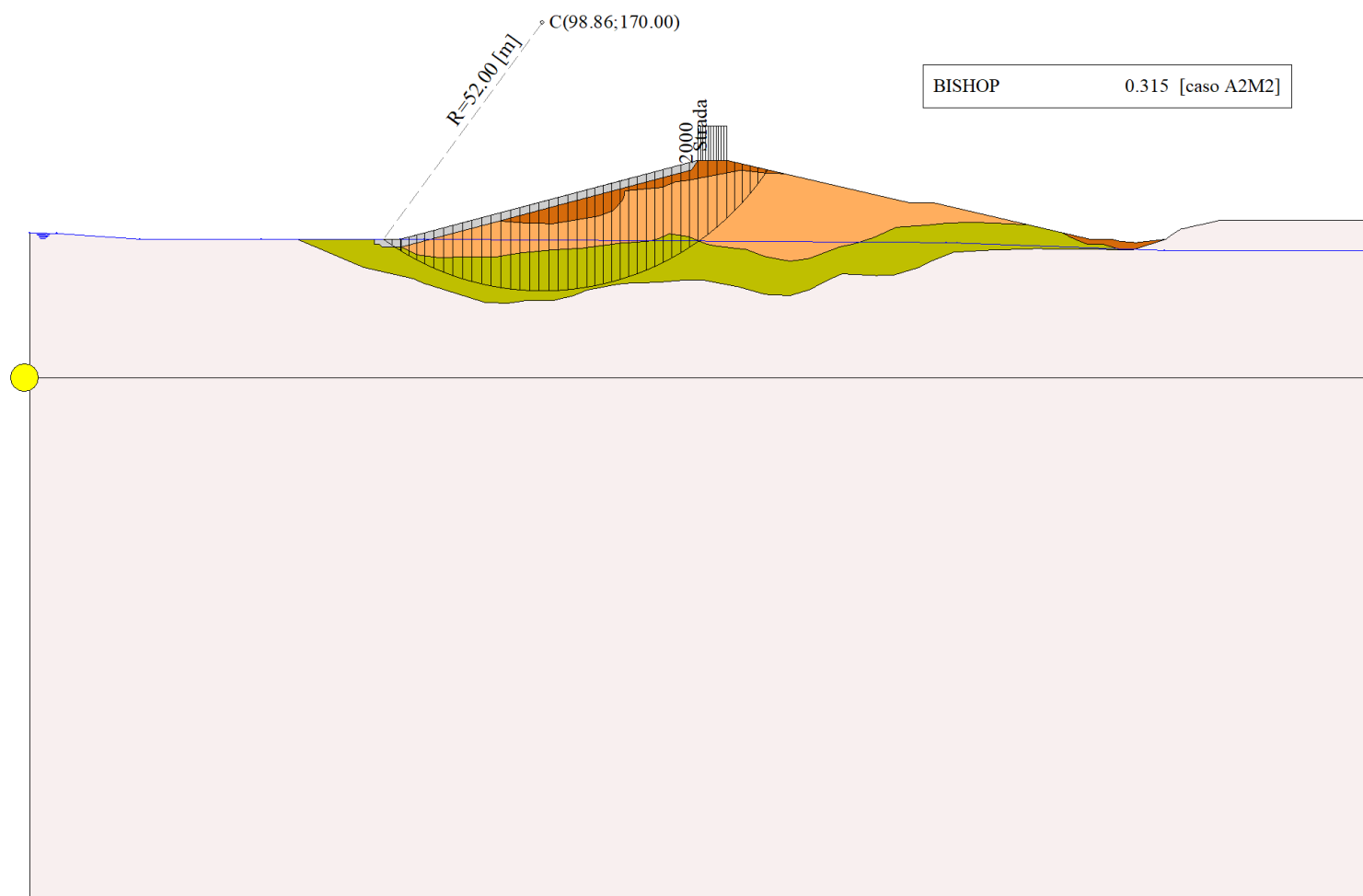


Figura 23-2 – Superficie critica (175) della sezione CR\_06 per la verifica di stabilità 19.

## 24 VERIFICA DI STABILITÀ 20

### 24.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	128.86 143.30	134.36 143.30	2000 2000	0 0

Tabella 24-1 – Carichi distribuiti verifica di stabilità 20.

### 24.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **statiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni efficaci**

Presenza di falda

Presenza di carichi distribuiti

## 24.2 RISULTATI ANALISI

Numero di superfici analizzate 44242

Coefficiente di sicurezza minimo 2.273

Superficie con coefficiente di sicurezza minimo 1

### 24.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO L'ALTO

Numero di strisce 47

Coordinate del centro X[m]= 92.86 Y[m]= 180.00

Raggio del cerchio R[m]= 56.00

Intersezione a valle con il profilo topografico X<sub>v</sub>[m]= 71.84 Y<sub>v</sub>[m]= 128.10

Intersezione a monte con il profilo topografico X<sub>m</sub>[m]= 135.02 Y<sub>m</sub>[m]= 143.15

Coefficiente di sicurezza F<sub>S</sub>= 2.273

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	71.84	128.10	128.10	73.35	128.50	127.51	72.85	128.03	1.62	-21.22	38.66	0
2	73.35	128.50	127.51	74.86	128.90	126.97	74.19	127.97	1.60	-19.57	31.09	7
3	74.86	128.90	126.97	76.37	129.30	126.48	75.66	127.91	1.59	-17.93	19.78	18
4	76.37	129.30	126.48	77.89	129.71	126.04	77.16	127.88	1.58	-16.32	19.78	18
5	77.89	129.71	126.04	79.40	130.11	125.64	78.67	127.88	1.56	-14.71	19.78	18
6	79.40	130.11	125.64	80.91	130.51	125.29	80.17	127.89	1.55	-13.12	19.78	18
7	80.91	130.51	125.29	82.42	130.92	124.98	81.68	127.93	1.54	-11.53	19.78	18
8	82.42	130.92	124.98	83.93	131.32	124.72	83.19	127.98	1.53	-9.96	19.78	18
9	83.93	131.32	124.72	85.44	131.72	124.49	84.70	128.06	1.53	-8.39	19.64	18
10	85.44	131.72	124.49	86.96	132.13	124.31	86.21	128.16	1.52	-6.83	19.10	18
11	86.96	132.13	124.31	88.47	132.53	124.17	87.72	128.29	1.52	-5.27	19.10	18
12	88.47	132.53	124.17	89.98	132.93	124.07	89.23	128.43	1.52	-3.72	19.10	18
13	89.98	132.93	124.07	91.48	133.33	124.02	90.74	128.59	1.50	-2.18	19.10	18
14	91.48	133.33	124.02	92.99	133.73	124.00	92.24	128.77	1.50	-0.64	19.10	18
15	92.99	133.73	124.00	94.49	134.13	124.02	93.74	128.97	1.50	0.90	19.10	18
16	94.49	134.13	124.02	95.99	134.54	124.09	95.24	129.20	1.50	2.44	19.10	18

N°	X <sub>s</sub>	Y <sub>ss</sub>	Y <sub>si</sub>	X <sub>d</sub>	Y <sub>ds</sub>	Y <sub>di</sub>	X <sub>g</sub>	Y <sub>g</sub>	L	∅	∅	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
17	95.99	134.54	124.09	97.49	134.94	124.19	96.75	129.44	1.51	3.98	19.10	18
18	97.49	134.94	124.19	99.00	135.34	124.34	98.25	129.70	1.51	5.52	19.10	18
19	99.00	135.34	124.34	100.50	135.74	124.52	99.75	129.98	1.51	7.07	19.10	18
20	100.50	135.74	124.52	102.00	136.14	124.75	101.25	130.29	1.52	8.62	19.10	18
21	102.00	136.14	124.75	103.50	136.54	125.02	102.75	130.61	1.53	10.18	19.10	18
22	103.50	136.54	125.02	105.01	136.94	125.33	104.26	130.96	1.53	11.74	19.10	18
23	105.01	136.94	125.33	106.51	137.34	125.69	105.76	131.33	1.54	13.32	19.10	18
24	106.51	137.34	125.69	107.93	137.72	126.07	107.22	131.70	1.47	14.86	19.10	18
25	107.93	137.72	126.07	109.36	138.10	126.49	108.65	132.09	1.48	16.38	19.10	18
26	109.36	138.10	126.49	110.78	138.48	126.95	110.07	132.50	1.50	17.90	19.40	18
27	110.78	138.48	126.95	112.21	138.86	127.45	111.49	132.93	1.51	19.44	19.78	18
28	112.21	138.86	127.45	113.63	139.24	127.99	112.92	133.38	1.53	20.99	19.78	18
29	113.63	139.24	127.99	115.06	139.62	128.59	114.34	133.86	1.54	22.56	19.78	18
30	115.06	139.62	128.59	116.48	140.00	129.23	115.77	134.36	1.56	24.15	19.78	18
31	116.48	140.00	129.23	117.84	140.36	129.88	117.16	134.87	1.51	25.72	19.78	18
32	117.84	140.36	129.88	119.20	140.72	130.58	118.52	135.39	1.53	27.27	19.78	18
33	119.20	140.72	130.58	120.56	141.09	131.33	119.88	135.93	1.55	28.85	19.78	18
34	120.56	141.09	131.33	121.92	141.45	132.13	121.23	136.50	1.58	30.45	19.78	18
35	121.92	141.45	132.13	123.28	141.81	132.98	122.59	137.09	1.61	32.08	19.78	18
36	123.28	141.81	132.98	123.78	141.95	133.31	123.53	137.51	0.60	33.21	19.78	18
37	123.78	141.95	133.31	124.71	142.19	133.94	124.24	137.85	1.12	34.09	19.78	18
38	124.71	142.19	133.94	126.09	142.56	134.93	125.39	138.40	1.70	35.53	19.78	18
39	126.09	142.56	134.93	127.48	142.93	135.98	126.77	139.09	1.74	37.29	19.78	18
40	127.48	142.93	135.98	128.86	143.30	137.10	128.16	139.82	1.78	39.09	19.78	18
41	128.86	143.30	137.10	128.92	143.30	137.16	128.89	140.21	0.08	40.05	19.78	18
42	128.92	143.30	137.16	129.76	143.30	137.88	129.33	140.41	1.11	40.66	19.78	18
43	129.76	143.30	137.88	130.61	143.30	138.64	130.18	140.77	1.13	41.80	19.78	18
44	130.61	143.30	138.64	131.99	143.30	139.94	131.26	141.28	1.90	43.36	19.78	18
45	131.99	143.30	139.94	133.18	143.30	141.13	132.54	141.90	1.68	45.19	18.60	19
46	133.18	143.30	141.13	134.36	143.30	142.40	133.69	142.49	1.74	46.93	17.58	19
47	134.36	143.30	142.40	135.02	143.15	143.15	134.58	142.95	1.00	48.33	17.58	19

Tabella 24-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 20.

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
1	1497	17693	930	327	19782	0	12519	0	0	
2	4408	17083	2787	1270	20474	12519	26062	0	0	
3	7107	16474	4340	1998	21092	26062	40187	0	0	
4	9651	15865	5582	2183	21643	40187	54162	0	0	
5	12059	15255	6726	2354	22132	54162	67834	0	0	
6	14335	14646	7782	2513	22561	67834	81072	0	0	
7	16482	14036	8755	2659	22935	81072	93756	0	0	
8	18502	13427	9651	2794	23256	93756	105779	0	0	
9	20398	12817	10475	2896	23527	105779	117023	0	0	
10	22206	12208	11260	2918	23749	117023	127338	0	0	
11	23900	11598	12005	3028	23924	127338	136749	0	0	
12	25463	10989	12679	3128	24054	136749	145185	0	0	
13	26775	10319	13250	3206	23993	145185	152556	0	0	
14	28202	9717	13926	3308	24032	152556	158879	0	0	
15	29509	9115	14546	3403	24029	158879	164108	0	0	
16	30670	8512	15088	3486	23982	164108	168200	0	0	
17	31682	7910	15550	3558	23891	168200	171124	0	0	

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
18	32562	7308	15950	3622	23756	171124	172860	0	0	
19	33312	6706	16292	3677	23576	172860	173393	0	0	
20	33907	6104	16554	3722	23349	173393	172721	0	0	
21	34334	5502	16723	3753	23075	172721	170851	0	0	
22	34625	4900	16834	3776	22751	170851	167798	0	0	
23	34780	4298	16886	3792	22374	167798	163590	0	0	
24	32996	3517	16011	3603	20810	163590	158566	0	0	
25	32915	2976	15976	3606	20373	158566	152572	0	0	
26	32705	2436	15861	3664	19883	152572	145721	0	0	
27	32390	1895	15703	3731	19338	145721	138084	0	0	
28	31914	1354	15478	3708	18731	138084	129652	0	0	
29	31150	813	15035	3652	18060	129652	120543	0	0	
30	30331	272	14607	3599	17317	120543	110840	0	0	
31	28221	0	13896	3445	15769	110840	101069	0	0	
32	27324	0	14005	3479	14944	101069	90895	0	0	
33	26303	0	14064	3507	14035	90895	80408	0	0	
34	25157	0	14072	3529	13035	80408	69710	0	0	
35	23867	0	14014	3542	11933	69710	58930	0	0	
36	8590	0	5304	1332	4091	58930	54900	0	0	
37	15450	0	9811	2479	7167	54900	47437	0	0	
38	21654	0	14833	3750	9098	47437	36581	0	0	
39	19937	0	14955	3801	7210	36581	26175	0	0	
40	18071	0	15033	3850	5124	26175	16453	0	0	
41	740	156	833	196	172	16453	15957	0	0	
42	9774	2197	11525	2743	1898	15957	9292	0	0	
43	8547	2197	11068	2687	943	9292	3288	0	0	
44	11176	3588	16380	4158	0	3288	-4933	0	0	
45	6685	3081	10814	3022	0	-4933	-10476	0	0	
46	3717	3081	7272	2508	0	-10476	-14075	0	0	
47	610	0	-41	853	0	-14075	-13477	0	0	

Tabella 24-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 20.

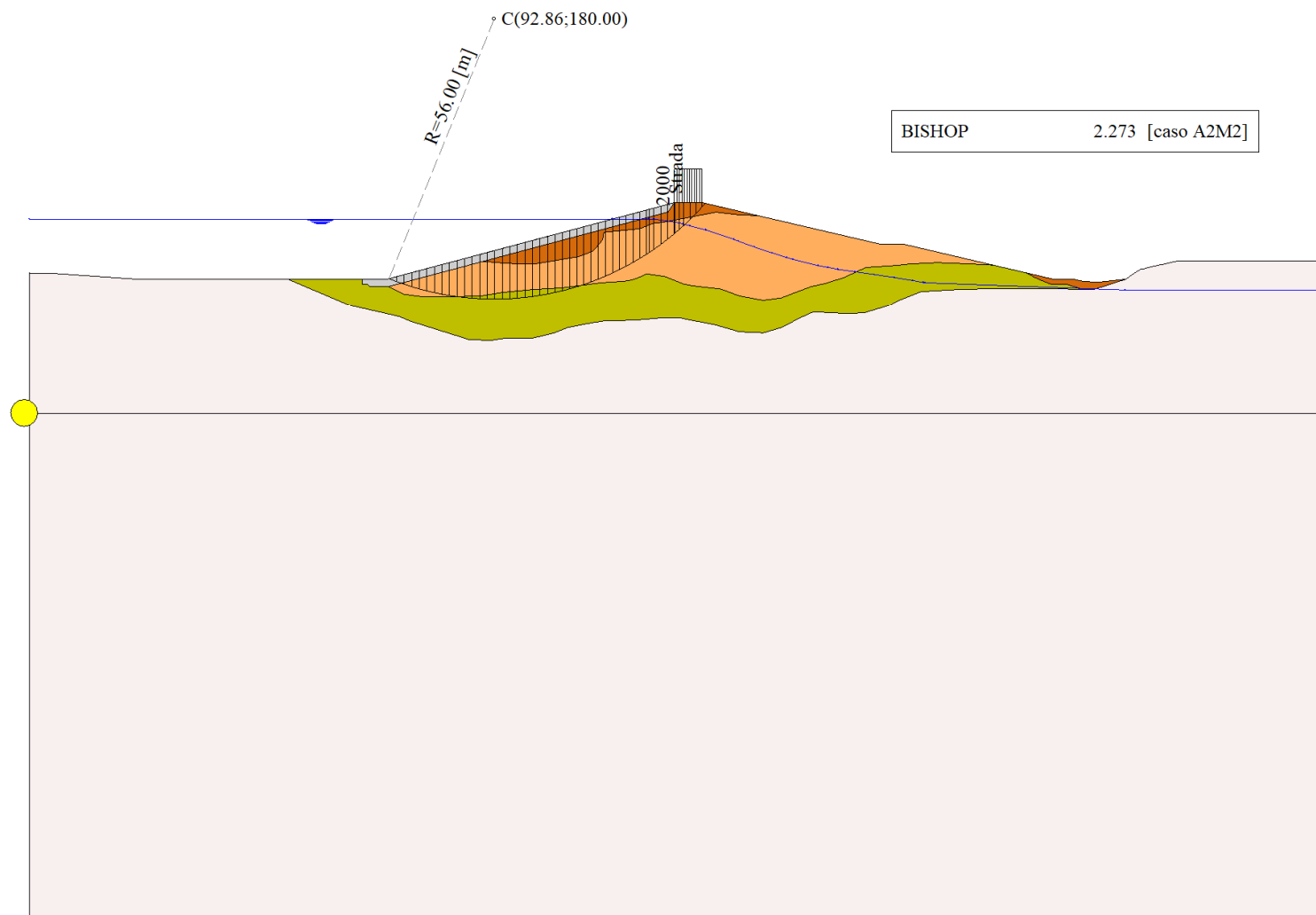


Figura 24-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 20.



## 25 VERIFICA DI STABILITÀ 21

### 25.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	P <sub>i</sub> [m]	P <sub>f</sub> [m]	V <sub>y</sub> [kg/m]	V <sub>x</sub> [kg/m]
1	Strada	Variabile	1.00	128.86 143.30	134.36 143.30	2000 2000	0 0

Tabella 25-1 – Carichi distribuiti verifica di stabilità 21.

### 25.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **sismiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];
- Parametri di progetto [A2-M2]
- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 25.2 RISULTATI ANALISI

Numero di superfici analizzate	85608
Coefficiente di sicurezza minimo	0.747
Superficie con coefficiente di sicurezza minimo	1

### 25.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	53
Coordinate del centro	X[m]= 98.86                      Y[m]= 184.00
Raggio del cerchio	R[m]= 66.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 63.93                      Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 148.13                      Y <sub>m</sub> [m]= 140.08
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.747</b>

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	63.93	128.00	128.00	65.21	128.00	127.23	64.78	127.74	1.49	-31.31	0.00	52
2	65.21	128.00	127.23	66.48	128.00	126.49	65.91	127.41	1.47	-30.02	0.00	52
3	66.48	128.00	126.49	66.49	128.00	126.48	66.49	127.24	0.01	-29.38	0.00	52
4	66.49	128.00	126.48	67.98	128.00	125.67	67.29	127.02	1.70	-28.63	0.00	52
5	67.98	128.00	125.67	69.73	128.00	124.78	68.90	126.60	1.96	-27.04	0.00	52
6	69.73	128.00	124.78	71.48	128.00	123.95	70.64	126.17	1.94	-25.35	0.00	52
7	71.48	128.00	123.95	73.48	128.53	123.08	72.53	125.88	2.18	-23.56	0.00	52
8	73.48	128.53	123.08	75.47	129.07	122.28	74.51	125.74	2.15	-21.69	0.00	52
9	75.47	129.07	122.28	77.47	129.60	121.56	76.50	125.63	2.12	-19.83	0.00	52
10	77.47	129.60	121.56	79.47	130.13	120.91	78.49	125.55	2.10	-18.00	0.00	52
11	79.47	130.13	120.91	81.47	130.66	120.33	80.49	125.51	2.08	-16.18	0.00	52
12	81.47	130.66	120.33	83.46	131.20	119.82	82.48	125.50	2.06	-14.39	0.00	52
13	83.46	131.20	119.82	85.46	131.73	119.37	84.48	125.53	2.05	-12.60	0.00	52
14	85.46	131.73	119.37	87.46	132.26	118.99	86.47	125.59	2.03	-10.83	0.00	52
15	87.46	132.26	118.99	89.46	132.79	118.67	88.47	125.68	2.02	-9.07	0.00	52
16	89.46	132.79	118.67	91.45	133.33	118.42	90.46	125.80	2.01	-7.32	0.00	52
17	91.45	133.33	118.42	93.45	133.86	118.22	92.46	125.96	2.01	-5.57	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∅ [°]	∅ [°]	c [kPa]
18	93.45	133.86	118.22	95.45	134.39	118.09	94.46	126.14	2.00	-3.83	0.00	52
19	95.45	134.39	118.09	97.44	134.92	118.02	96.45	126.35	2.00	-2.10	0.00	52
20	97.44	134.92	118.02	99.44	135.46	118.00	98.45	126.60	2.00	-0.36	0.00	52
21	99.44	135.46	118.00	101.44	135.99	118.05	100.44	126.87	2.00	1.37	0.00	52
22	101.44	135.99	118.05	103.44	136.52	118.16	102.44	127.18	2.00	3.11	0.00	52
23	103.44	136.52	118.16	105.43	137.05	118.33	104.44	127.52	2.00	4.85	0.00	52
24	105.43	137.05	118.33	107.43	137.59	118.56	106.43	127.88	2.01	6.59	0.00	52
25	107.43	137.59	118.56	109.00	138.01	118.78	108.22	128.23	1.59	8.15	0.00	52
26	109.00	138.01	118.78	110.58	138.42	119.05	109.79	128.57	1.60	9.53	0.00	52
27	110.58	138.42	119.05	112.15	138.84	119.35	111.36	128.92	1.60	10.92	0.00	52
28	112.15	138.84	119.35	113.37	139.17	119.61	112.76	129.25	1.25	12.16	0.00	52
29	113.37	139.17	119.61	114.59	139.49	119.90	113.98	129.55	1.25	13.24	0.00	52
30	114.59	139.49	119.90	116.48	140.00	120.40	115.54	129.95	1.95	14.64	0.00	52
31	116.48	140.00	120.40	118.18	140.45	120.89	117.33	130.43	1.77	16.25	0.00	52
32	118.18	140.45	120.89	119.88	140.91	121.44	119.03	130.92	1.79	17.80	0.00	52
33	119.88	140.91	121.44	121.58	141.36	122.03	120.73	131.43	1.80	19.35	0.00	52
34	121.58	141.36	122.03	123.28	141.81	122.68	122.43	131.97	1.82	20.93	0.00	52
35	123.28	141.81	122.68	123.78	141.95	122.89	123.53	132.33	0.54	21.95	0.00	52
36	123.78	141.95	122.89	124.71	142.19	123.27	124.24	132.57	1.01	22.62	0.00	52
37	124.71	142.19	123.27	126.78	142.75	124.20	125.74	133.10	2.27	24.04	0.00	52
38	126.78	142.75	124.20	128.86	143.30	125.21	127.82	133.86	2.31	26.03	0.00	52
39	128.86	143.30	125.21	128.92	143.30	125.24	128.89	134.26	0.07	27.06	0.00	52
40	128.92	143.30	125.24	130.60	143.30	126.13	129.75	134.49	1.90	27.92	0.00	52
41	130.60	143.30	126.13	130.61	143.30	126.14	130.60	134.72	0.01	28.75	0.00	52
42	130.61	143.30	126.14	131.99	143.30	126.92	131.29	134.91	1.58	29.44	0.00	52
43	131.99	143.30	126.92	132.48	143.30	127.20	132.23	135.18	0.57	30.38	0.00	54
44	132.48	143.30	127.20	134.36	143.30	128.36	133.41	135.54	2.21	31.58	0.00	54
45	134.36	143.30	128.36	135.17	143.11	128.89	134.76	135.91	0.97	32.96	0.00	54
46	135.17	143.11	128.89	137.03	142.67	130.16	136.08	136.20	2.26	34.36	0.00	54
47	137.03	142.67	130.16	138.90	142.24	131.53	137.94	136.64	2.31	36.34	0.00	54
48	138.90	142.24	131.53	140.76	141.80	133.01	139.80	137.14	2.38	38.38	0.00	54
49	140.76	141.80	133.01	141.71	141.58	133.80	141.23	137.55	1.24	39.95	0.00	54
50	141.71	141.58	133.80	143.59	141.14	135.47	142.60	137.98	2.52	41.58	0.00	54
51	143.59	141.14	135.47	145.48	140.70	137.28	144.46	138.62	2.61	43.81	0.00	54
52	145.48	140.70	137.28	146.80	140.39	138.64	146.07	139.23	1.90	45.76	0.00	54
53	146.80	140.39	138.64	148.13	140.08	140.08	147.24	139.71	1.96	47.44	0.00	54

Tabella 25-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 21.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	1041	15291	25704	10610	0	0	22188	0	0	
2	3072	15291	27655	10470	0	22188	44400	0	0	
3	31	120	224	82	0	44400	44574	0	0	
4	5869	17880	34401	12077	0	44574	70343	0	0	
5	9963	21000	43154	13978	0	70343	100180	0	0	
6	13142	21000	45937	13777	0	100180	129351	0	0	
7	19474	23435	55955	15501	0	129351	167811	0	0	
8	24712	22371	59732	15291	0	167811	204515	0	0	
9	29822	21308	63354	15104	0	204515	239210	0	0	
10	34689	20244	66702	14940	0	239210	271647	0	0	
11	39327	19180	69806	14795	0	271647	301607	0	0	
12	43692	18117	72629	14669	0	301607	328893	0	0	

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
13	47776	17053	75174	14559	0	328893	353337	0	0	
14	51587	15990	77458	14466	0	353337	374797	0	0	
15	55128	14926	79498	14389	0	374797	393157	0	0	
16	58449	13862	81352	14325	0	393157	408318	0	0	
17	61698	12799	83194	14276	0	408318	420184	0	0	
18	64709	11735	84842	14241	0	420184	428684	0	0	
19	67417	10672	86225	14218	0	428684	433776	0	0	
20	69850	9608	87381	14209	0	433776	435436	0	0	
21	72020	8544	88324	14213	0	435436	433659	0	0	
22	73857	7481	88978	14230	0	433659	428478	0	0	
23	75416	6417	89404	14260	0	428478	419935	0	0	
24	76723	5353	89629	14303	0	419935	408084	0	0	
25	61222	3468	70665	11307	0	408084	396455	0	0	
26	61762	2808	70590	11350	0	396455	382856	0	0	
27	62129	2148	70358	11400	0	382856	367360	0	0	
28	48313	1211	54289	8879	0	367360	354095	0	0	
29	48270	815	53887	8917	0	354095	339822	0	0	
30	74417	478	82402	13897	0	339822	315887	0	0	
31	66743	0	73643	12598	0	315887	292404	0	0	
32	66309	0	73372	12702	0	292404	267204	0	0	
33	65757	0	73007	12819	0	267204	240359	0	0	
34	65105	0	72566	12948	0	240359	211937	0	0	
35	19158	0	21426	3835	0	211937	203189	0	0	
36	35374	0	39632	7168	0	203189	186630	0	0	
37	77615	0	87306	16165	0	186630	148415	0	0	
38	75502	0	85423	16429	0	148415	108755	0	0	
39	2148	120	2588	479	0	108755	107496	0	0	
40	58383	3360	70543	13526	0	107496	72572	0	0	
41	337	20	409	81	0	72572	72366	0	0	
42	45357	2760	55044	11345	0	72366	44399	0	0	
43	15558	980	18853	4207	0	44399	34787	0	0	
44	57018	3760	69295	16345	0	34787	-1208	0	0	
45	23069	0	25940	7150	0	-1208	-14494	0	0	
46	48580	0	54016	16718	0	-14494	-42070	0	0	
47	42128	0	45560	17133	0	-42070	-64714	0	0	
48	35378	0	36247	17605	0	-64714	-81350	0	0	
49	15327	0	14547	9178	0	-81350	-87091	0	0	
50	24652	0	20092	18664	0	-87091	-91991	0	0	
51	16616	0	7049	19346	0	-91991	-86635	0	0	
52	6622	0	-3877	14054	0	-86635	-75539	0	0	
53	2242	0	-12096	14495	0	-75539	-57328	0	0	

Tabella 25-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 21.

### 25.2.2 ANALISI DELLA SUPERFICIE 3 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	53	
Coordinate del centro	X[m]= 98.86	Y[m]= 182.00
Raggio del cerchio	R[m]= 64.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 64.51	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 147.37	Y <sub>m</sub> [m]= 140.26
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.748</b>	

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∠ [°]	∠ [°]	c [kPa]
1	64.51	128.00	128.00	66.48	128.00	126.80	65.82	127.60	2.31	-31.43	0.00	52
2	66.48	128.00	126.80	66.49	128.00	126.79	66.49	127.40	0.01	-30.39	0.00	52
3	66.49	128.00	126.79	67.48	128.00	126.22	67.02	127.24	1.14	-29.87	0.00	52
4	67.48	128.00	126.22	67.98	128.00	125.94	67.74	127.04	0.57	-29.10	0.00	52
5	67.98	128.00	125.94	69.73	128.00	125.01	68.91	126.72	1.98	-27.96	0.00	52
6	69.73	128.00	125.01	71.48	128.00	124.15	70.64	126.28	1.95	-26.20	0.00	52
7	71.48	128.00	124.15	73.48	128.53	123.25	72.53	125.98	2.19	-24.35	0.00	52
8	73.48	128.53	123.25	75.47	129.07	122.43	74.51	125.82	2.16	-22.40	0.00	52
9	75.47	129.07	122.43	77.47	129.60	121.68	76.50	125.69	2.13	-20.48	0.00	52
10	77.47	129.60	121.68	79.47	130.13	121.01	78.49	125.60	2.11	-18.58	0.00	52
11	79.47	130.13	121.01	81.47	130.66	120.41	80.49	125.55	2.09	-16.70	0.00	52
12	81.47	130.66	120.41	83.46	131.20	119.88	82.48	125.54	2.07	-14.85	0.00	52
13	83.46	131.20	119.88	85.46	131.73	119.42	84.48	125.56	2.05	-13.00	0.00	52
14	85.46	131.73	119.42	87.46	132.26	119.02	86.47	125.61	2.04	-11.17	0.00	52
15	87.46	132.26	119.02	89.46	132.79	118.69	88.47	125.69	2.02	-9.36	0.00	52
16	89.46	132.79	118.69	91.45	133.33	118.43	90.46	125.81	2.01	-7.55	0.00	52
17	91.45	133.33	118.43	93.45	133.86	118.23	92.46	125.96	2.01	-5.75	0.00	52
18	93.45	133.86	118.23	95.45	134.39	118.09	94.46	126.14	2.00	-3.95	0.00	52
19	95.45	134.39	118.09	97.44	134.92	118.02	96.45	126.36	2.00	-2.16	0.00	52
20	97.44	134.92	118.02	99.44	135.46	118.00	98.45	126.60	2.00	-0.37	0.00	52
21	99.44	135.46	118.00	101.44	135.99	118.05	100.44	126.88	2.00	1.41	0.00	52
22	101.44	135.99	118.05	103.44	136.52	118.16	102.44	127.18	2.00	3.20	0.00	52
23	103.44	136.52	118.16	105.43	137.05	118.34	104.44	127.52	2.00	5.00	0.00	52
24	105.43	137.05	118.34	107.43	137.59	118.58	106.43	127.89	2.01	6.80	0.00	52
25	107.43	137.59	118.58	109.00	138.01	118.81	108.22	128.24	1.59	8.41	0.00	52
26	109.00	138.01	118.81	110.58	138.42	119.08	109.79	128.58	1.60	9.83	0.00	52
27	110.58	138.42	119.08	112.15	138.84	119.40	111.36	128.94	1.60	11.27	0.00	52
28	112.15	138.84	119.40	113.37	139.17	119.67	112.76	129.27	1.25	12.54	0.00	52
29	113.37	139.17	119.67	114.59	139.49	119.96	113.98	129.57	1.26	13.67	0.00	52
30	114.59	139.49	119.96	116.48	140.00	120.47	115.53	129.98	1.96	15.10	0.00	52
31	116.48	140.00	120.47	118.18	140.45	120.99	117.33	130.48	1.78	16.78	0.00	52
32	118.18	140.45	120.99	119.88	140.91	121.55	119.03	130.97	1.79	18.37	0.00	52
33	119.88	140.91	121.55	121.58	141.36	122.17	120.73	131.50	1.81	19.98	0.00	52
34	121.58	141.36	122.17	123.28	141.81	122.84	122.43	132.04	1.83	21.61	0.00	52
35	123.28	141.81	122.84	123.78	141.95	123.05	123.53	132.41	0.54	22.67	0.00	52
36	123.78	141.95	123.05	124.71	142.19	123.45	124.24	132.66	1.01	23.37	0.00	52
37	124.71	142.19	123.45	126.09	142.56	124.08	125.40	133.07	1.52	24.50	0.00	52
38	126.09	142.56	124.08	127.48	142.93	124.75	126.78	133.58	1.54	25.87	0.00	52
39	127.48	142.93	124.75	128.86	143.30	125.47	128.17	134.11	1.56	27.26	0.00	52
40	128.86	143.30	125.47	128.92	143.30	125.50	128.89	134.39	0.07	27.98	0.00	52
41	128.92	143.30	125.50	130.60	143.30	126.43	129.75	134.63	1.92	28.87	0.00	52
42	130.60	143.30	126.43	130.61	143.30	126.43	130.60	134.86	0.01	29.74	0.00	52
43	130.61	143.30	126.43	131.99	143.30	127.24	131.29	135.07	1.60	30.46	0.00	53
44	131.99	143.30	127.24	132.48	143.30	127.54	132.23	135.35	0.57	31.43	0.00	54
45	132.48	143.30	127.54	134.36	143.30	128.75	133.41	135.72	2.23	32.69	0.00	54
46	134.36	143.30	128.75	135.17	143.11	129.30	134.76	136.11	0.98	34.13	0.00	54
47	135.17	143.11	129.30	137.03	142.67	130.63	136.08	136.42	2.29	35.59	0.00	54
48	137.03	142.67	130.63	138.90	142.24	132.07	137.94	136.90	2.35	37.67	0.00	54
49	138.90	142.24	132.07	140.76	141.80	133.62	139.79	137.42	2.43	39.81	0.00	54
50	140.76	141.80	133.62	141.71	141.58	134.46	141.22	137.86	1.27	41.46	0.00	54
51	141.71	141.58	134.46	143.59	141.14	136.23	142.59	138.33	2.59	43.19	0.00	54
52	143.59	141.14	136.23	145.48	140.70	138.15	144.44	139.02	2.69	45.55	0.00	54
53	145.48	140.70	138.15	147.37	140.26	140.26	146.11	139.70	2.83	48.02	0.00	54

Tabella 25-4 – Geometria e caratteristiche strisce della superficie 3 della verifica di stabilità 21.

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
1	2504	23654	41022	16429	0	0	34847	0	0	
2	25	120	220	82	0	34847	35023	0	0	
3	3013	11880	22228	8120	0	35023	52460	0	0	
4	1955	6000	11621	4070	0	52460	61230	0	0	
5	9021	21000	42615	14091	0	61230	91634	0	0	
6	12325	21000	45508	13871	0	91634	121409	0	0	
7	18679	23435	55578	15591	0	121409	160587	0	0	
8	24046	22371	59454	15363	0	160587	198019	0	0	
9	29271	21308	63156	15162	0	198019	233436	0	0	
10	34239	20244	66567	14985	0	233436	266570	0	0	
11	38967	19180	69720	14830	0	266570	297190	0	0	
12	43409	18117	72580	14695	0	297190	325086	0	0	
13	47560	17053	75153	14578	0	325086	350082	0	0	
14	51428	15990	77457	14478	0	350082	372028	0	0	
15	55017	14926	79510	14396	0	372028	390801	0	0	
16	58377	13862	81372	14328	0	390801	406300	0	0	
17	61656	12799	83215	14276	0	406300	418426	0	0	
18	64689	11735	84861	14238	0	418426	427104	0	0	
19	67410	10672	86237	14214	0	427104	432292	0	0	
20	69849	9608	87383	14204	0	432292	433965	0	0	
21	72016	8544	88311	14208	0	433965	432119	0	0	
22	73843	7481	88947	14226	0	432119	426787	0	0	
23	75384	6417	89350	14258	0	426787	418015	0	0	
24	76664	5353	89550	14305	0	418015	405860	0	0	
25	61151	3468	70580	11311	0	405860	393942	0	0	
26	61666	2808	70484	11356	0	393942	380014	0	0	
27	62002	2148	70226	11409	0	380014	364153	0	0	
28	48191	1211	54168	8889	0	364153	350581	0	0	
29	48125	815	53747	8929	0	350581	335984	0	0	
30	74140	478	82141	13922	0	335984	311524	0	0	
31	66433	0	73359	12628	0	311524	287545	0	0	
32	65936	0	73036	12740	0	287545	261830	0	0	
33	65312	0	72610	12865	0	261830	234460	0	0	
34	64580	0	72099	13004	0	234460	205513	0	0	
35	18987	0	21275	3854	0	205513	196610	0	0	
36	35035	0	39332	7205	0	196610	179767	0	0	
37	51407	0	57901	10812	0	179767	154064	0	0	
38	50471	0	57080	10934	0	154064	127677	0	0	
39	49385	0	56081	11067	0	127677	100758	0	0	
40	2116	120	2559	483	0	100758	99482	0	0	
41	57413	3360	69657	13644	0	99482	64168	0	0	
42	331	20	403	82	0	64168	63960	0	0	
43	44482	2760	54131	11596	0	63960	35922	0	0	
44	15244	980	18547	4252	0	35922	26240	0	0	
45	55699	3760	67957	16539	0	26240	-9875	0	0	
46	22442	0	25240	7245	0	-9875	-23071	0	0	
47	46988	0	52118	16966	0	-23071	-50143	0	0	
48	40306	0	43173	17430	0	-50143	-71769	0	0	
49	33294	0	33233	17960	0	-71769	-86715	0	0	
50	14153	0	12710	9386	0	-86715	-91271	0	0	
51	22066	0	15688	19142	0	-91271	-92999	0	0	
52	13645	0	1352	19930	0	-92999	-83067	0	0	
53	4671	0	-15543	20971	0	-83067	-58534	0	0	

Tabella 25-5 – Forze applicate sulle strisce [BISHOP] della superficie 3 della verifica di stabilità 21.

### 25.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.000056
2	0.000010
3	0.000001
4	0.000207
5	0.000000
6	0.000001
7	0.000000

Tabella 25-6 – Spostamenti della superficie 1 della verifica di stabilità 21.

Accelerazione sismica critica  $K_c = 0.155$   
Spostamento massimo  $U_{max} = 0.000207$  [m]  
Velocità massima  $V_{max} = 0.006062$  [m/s]

n°	u
	[m]
1	0.000058
2	0.000010
3	0.000001
4	0.000210
5	0.000000
6	0.000001
7	0.000000

Tabella 25-7 – Spostamenti della superficie 3 della verifica di stabilità 21.

Accelerazione sismica critica  $K_c = 0.155$   
Spostamento massimo  $U_{max} = 0.000210$  [m]  
Velocità massima  $V_{max} = 0.006130$  [m/s]

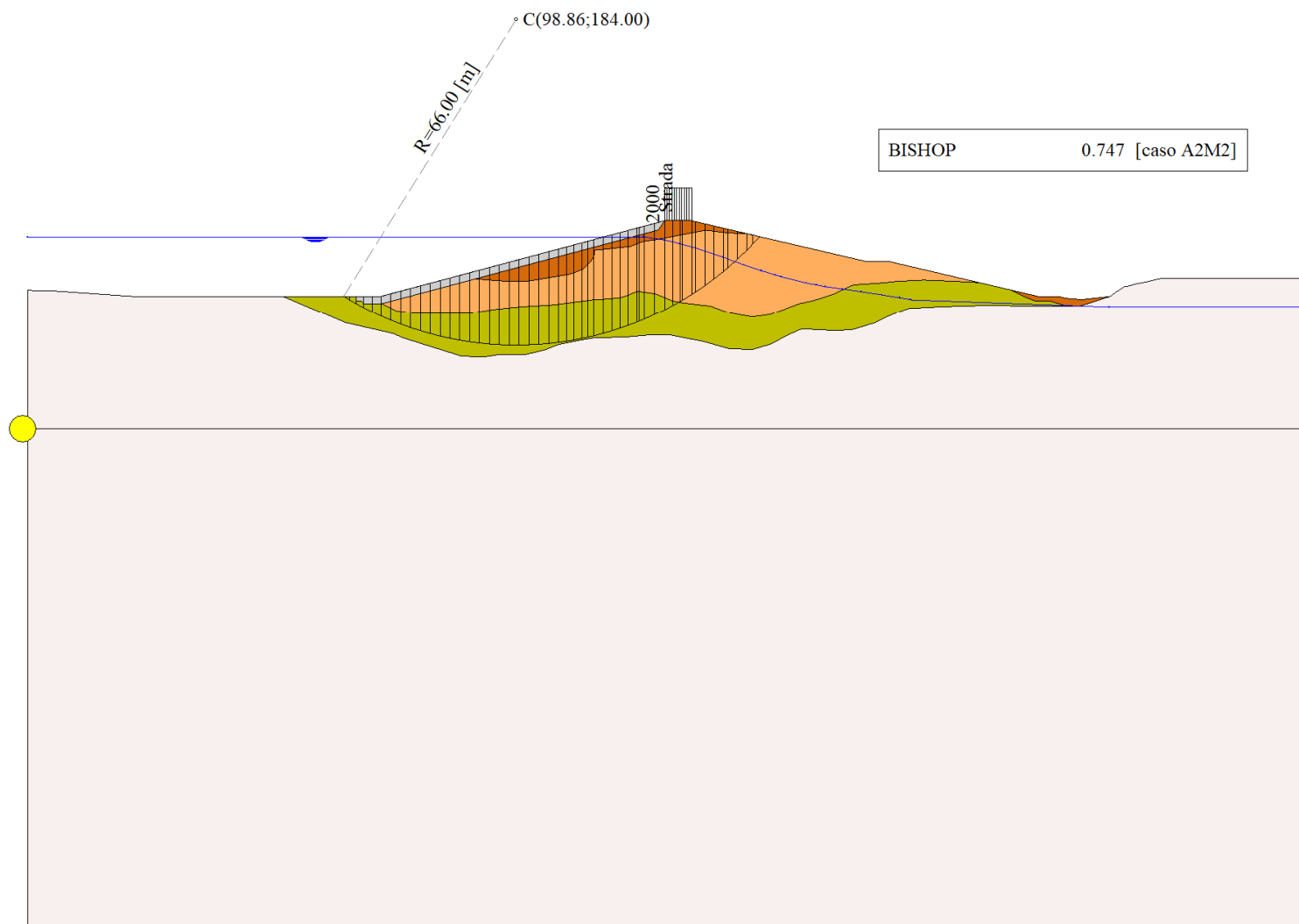


Figura 25-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 21.

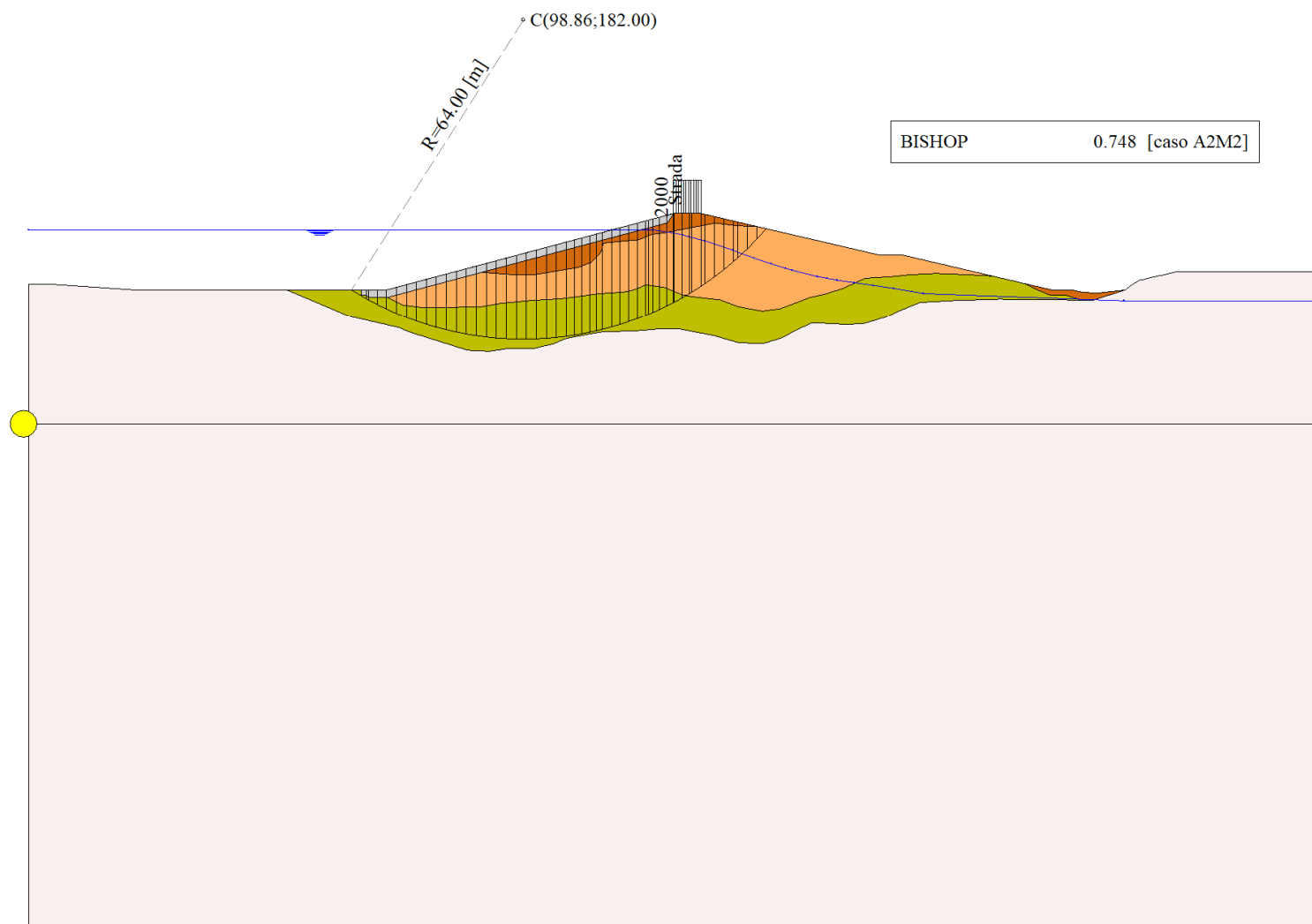


Figura 25-2 – Superficie critica (3) della sezione CR\_06 per la verifica di stabilità 21.



## 26 VERIFICA DI STABILITÀ 22

### 26.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	128.86	134.36	2000	0
				143.30	143.30	2000	0

Tabella 26-1 – Carichi distribuiti verifica di stabilità 22.

### 26.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **sismiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 26.2 RISULTATI ANALISI

Numero di superfici analizzate	85607
Coefficiente di sicurezza minimo	0.563
Superficie con coefficiente di sicurezza minimo	1

### 26.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	51
Coordinate del centro	X[m]= 98.86                      Y[m]= 196.00
Raggio del cerchio	R[m]= 78.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 60.65                      Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 152.24                      Y <sub>m</sub> [m]= 139.12
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.563</b>

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	60.65	128.00	128.00	62.59	128.00	126.94	61.95	127.65	2.21	-28.52	0.00	52
2	62.59	128.00	126.94	64.54	128.00	125.96	63.67	127.20	2.18	-26.91	0.00	52
3	64.54	128.00	125.96	66.48	128.00	125.04	65.57	126.73	2.15	-25.32	0.00	52
4	66.48	128.00	125.04	68.15	128.00	124.30	67.34	126.33	1.82	-23.86	0.00	52
5	68.15	128.00	124.30	69.81	128.00	123.61	69.00	125.97	1.80	-22.53	0.00	52
6	69.81	128.00	123.61	71.48	128.00	122.96	70.67	125.64	1.79	-21.21	0.00	52
7	71.48	128.00	122.96	73.73	128.60	122.16	72.65	125.43	2.39	-19.67	0.00	52
8	73.73	128.60	122.16	75.97	129.20	121.43	74.89	125.35	2.36	-17.93	0.00	52
9	75.97	129.20	121.43	78.22	129.80	120.78	77.13	125.30	2.34	-16.20	0.00	52
10	78.22	129.80	120.78	80.47	130.40	120.20	79.37	125.29	2.32	-14.49	0.00	52
11	80.47	130.40	120.20	82.71	131.00	119.69	81.61	125.32	2.30	-12.79	0.00	52
12	82.71	131.00	119.69	84.96	131.59	119.25	83.85	125.38	2.29	-11.11	0.00	52
13	84.96	131.59	119.25	87.21	132.19	118.88	86.10	125.48	2.28	-9.43	0.00	52
14	87.21	132.19	118.88	89.46	132.79	118.57	88.34	125.61	2.27	-7.76	0.00	52
15	89.46	132.79	118.57	91.70	133.39	118.33	90.59	125.77	2.26	-6.10	0.00	52
16	91.70	133.39	118.33	93.95	133.99	118.15	92.83	125.97	2.25	-4.44	0.00	52
17	93.95	133.99	118.15	96.20	134.59	118.05	95.08	126.20	2.25	-2.78	0.00	52

N°	X <sub>s</sub>	Y <sub>ss</sub>	Y <sub>si</sub>	X <sub>d</sub>	Y <sub>ds</sub>	Y <sub>di</sub>	X <sub>g</sub>	Y <sub>g</sub>	L	∅	∅	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
18	96.20	134.59	118.05	98.44	135.19	118.00	97.33	126.46	2.25	-1.13	0.00	52
19	98.44	135.19	118.00	100.69	135.79	118.02	99.57	126.75	2.25	0.52	0.00	52
20	100.69	135.79	118.02	102.94	136.39	118.11	101.82	127.08	2.25	2.17	0.00	52
21	102.94	136.39	118.11	105.18	136.99	118.26	104.06	127.44	2.25	3.82	0.00	52
22	105.18	136.99	118.26	107.43	137.59	118.47	106.31	127.83	2.26	5.48	0.00	52
23	107.43	137.59	118.47	109.00	138.01	118.66	108.22	128.18	1.58	6.89	0.00	52
24	109.00	138.01	118.66	110.58	138.42	118.89	109.79	128.49	1.59	8.06	0.00	52
25	110.58	138.42	118.89	112.15	138.84	119.14	111.36	128.82	1.59	9.22	0.00	52
26	112.15	138.84	119.14	113.37	139.17	119.36	112.76	129.13	1.24	10.27	0.00	52
27	113.37	139.17	119.36	114.59	139.49	119.60	113.98	129.41	1.24	11.18	0.00	52
28	114.59	139.49	119.60	116.48	140.00	120.02	115.54	129.78	1.93	12.35	0.00	52
29	116.48	140.00	120.02	118.75	140.60	120.58	117.61	130.30	2.34	13.91	0.00	52
30	118.75	140.60	120.58	121.01	141.21	121.21	119.88	130.90	2.35	15.64	0.00	52
31	121.01	141.21	121.21	123.28	141.81	121.92	122.15	131.54	2.38	17.37	0.00	52
32	123.28	141.81	121.92	123.78	141.95	122.09	123.53	131.94	0.53	18.44	0.00	52
33	123.78	141.95	122.09	124.71	142.19	122.41	124.24	132.16	0.98	18.99	0.00	52
34	124.71	142.19	122.41	126.78	142.75	123.17	125.75	132.63	2.21	20.17	0.00	52
35	126.78	142.75	123.17	128.86	143.30	124.00	127.82	133.30	2.23	21.80	0.00	52
36	128.86	143.30	124.00	128.92	143.30	124.03	128.89	133.66	0.07	22.64	0.00	52
37	128.92	143.30	124.03	130.61	143.30	124.75	129.76	133.84	1.84	23.34	0.00	52
38	130.61	143.30	124.75	131.99	143.30	125.39	131.30	134.18	1.52	24.58	0.00	52
39	131.99	143.30	125.39	132.48	143.30	125.62	132.23	134.40	0.54	25.33	0.00	52
40	132.48	143.30	125.62	134.36	143.30	126.55	133.41	134.69	2.10	26.30	0.00	52
41	134.36	143.30	126.55	135.17	143.11	126.97	134.76	134.98	0.91	27.41	0.00	54
42	135.17	143.11	126.97	137.03	142.67	127.98	136.09	135.18	2.12	28.52	0.00	54
43	137.03	142.67	127.98	138.90	142.24	129.06	137.95	135.49	2.15	30.09	0.00	54
44	138.90	142.24	129.06	140.76	141.80	130.21	139.81	135.82	2.19	31.69	0.00	54
45	140.76	141.80	130.21	141.71	141.58	130.82	141.23	136.10	1.13	32.91	0.00	54
46	141.71	141.58	130.82	143.32	141.20	131.92	142.50	136.38	1.95	34.04	0.00	54
47	143.32	141.20	131.92	144.94	140.83	133.07	144.11	136.75	1.98	35.48	0.00	54
48	144.94	140.83	133.07	145.48	140.70	133.47	145.21	137.01	0.67	36.46	0.00	54
49	145.48	140.70	133.47	147.73	140.17	135.21	146.54	137.37	2.85	37.75	0.00	54
50	147.73	140.17	135.21	149.99	139.65	137.09	148.74	138.00	2.94	39.88	0.00	54
51	149.99	139.65	137.09	152.24	139.12	139.12	150.74	138.62	3.03	42.07	0.00	54

Tabella 26-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 22.

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
1	2164	23320	40770	20905	0	0	37119	0	0	
2	6349	23320	44900	20598	0	37119	73709	0	0	
3	10254	23320	48627	20320	0	73709	109484	0	0	
4	11501	20000	44140	17225	0	109484	139291	0	0	
5	13943	20000	46313	17054	0	139291	168181	0	0	
6	16294	20000	48374	16898	0	168181	196050	0	0	
7	26530	26289	68812	22554	0	196050	238699	0	0	
8	32374	24943	73085	22321	0	238699	278392	0	0	
9	38107	23597	77238	22116	0	278392	314885	0	0	
10	43569	22251	81085	21935	0	314885	347952	0	0	
11	48766	20905	84649	21778	0	347952	377397	0	0	
12	53633	19559	87865	21643	0	377397	403055	0	0	
13	58176	18213	90750	21528	0	403055	424795	0	0	
14	62399	16866	93320	21434	0	424795	442514	0	0	

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
15	66371	15520	95663	21358	0	442514	456122	0	0	
16	70269	14174	97992	21301	0	456122	465507	0	0	
17	73863	12828	100043	21262	0	465507	470622	0	0	
18	77087	11482	101742	21242	0	470622	471465	0	0	
19	79994	10136	103155	21238	0	471465	468045	0	0	
20	82527	8790	104219	21253	0	468045	460417	0	0	
21	84684	7444	104929	21285	0	460417	448668	0	0	
22	86536	6097	105372	21335	0	448668	432883	0	0	
23	61567	3468	73942	14979	0	432883	419469	0	0	
24	62235	2808	73948	15019	0	419469	404166	0	0	
25	62751	2148	73803	15066	0	404166	387049	0	0	
26	48911	1211	57026	11719	0	387049	372583	0	0	
27	48981	815	56683	11754	0	372583	357162	0	0	
28	75770	478	86862	18287	0	357162	331552	0	0	
29	90964	0	103725	22072	0	331552	297985	0	0	
30	90683	0	103496	22248	0	297985	261557	0	0	
31	90238	0	103145	22448	0	261557	222374	0	0	
32	19981	0	22880	4982	0	222374	213263	0	0	
33	37004	0	42399	9296	0	213263	196030	0	0	
34	81758	0	93811	20894	0	196030	156292	0	0	
35	80405	0	92453	21123	0	156292	115010	0	0	
36	2302	120	2801	614	0	115010	113699	0	0	
37	63357	3380	77185	17398	0	113699	77041	0	0	
38	49597	2760	60523	14343	0	77041	47616	0	0	
39	17140	980	20933	5124	0	47616	37304	0	0	
40	63361	3760	77405	19898	0	37304	-1331	0	0	
41	25995	0	29464	8979	0	-1331	-15511	0	0	
42	55973	0	62886	20869	0	-15511	-45695	0	0	
43	50518	0	55751	21192	0	-45695	-72000	0	0	
44	44880	0	48152	21548	0	-72000	-93784	0	0	
45	20637	0	21435	11135	0	-93784	-102899	0	0	
46	31442	0	31256	19178	0	-102899	-114890	0	0	
47	26700	0	24293	19517	0	-114890	-121919	0	0	
48	7841	0	6478	6607	0	-121919	-123045	0	0	
49	26602	0	17494	28035	0	-123045	-120377	0	0	
50	16405	0	778	28884	0	-120377	-104129	0	0	
51	5578	0	-18195	29860	0	-104129	-71614	0	0	

Tabella 26-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 22.

### 26.2.2 ANALISI DELLA SUPERFICIE 11 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	53	
Coordinate del centro	X[m]= 98.86	Y[m]= 182.00
Raggio del cerchio	R[m]= 64.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 64.51	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 147.37	Y <sub>m</sub> [m]= 140.26
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.567</b>	

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α <sub>s</sub> [°]	α <sub>d</sub> [°]	c [kPa]
1	64.51	128.00	128.00	66.48	128.00	126.80	65.82	127.60	2.31	-31.43	0.00	52
2	66.48	128.00	126.80	66.49	128.00	126.79	66.49	127.40	0.01	-30.39	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∅ [°]	∅ [°]	c [kPa]
3	66.49	128.00	126.79	67.48	128.00	126.22	67.02	127.24	1.14	-29.87	0.00	52
4	67.48	128.00	126.22	67.98	128.00	125.94	67.74	127.04	0.57	-29.10	0.00	52
5	67.98	128.00	125.94	69.73	128.00	125.01	68.91	126.72	1.98	-27.96	0.00	52
6	69.73	128.00	125.01	71.48	128.00	124.15	70.64	126.28	1.95	-26.20	0.00	52
7	71.48	128.00	124.15	73.48	128.53	123.25	72.53	125.98	2.19	-24.35	0.00	52
8	73.48	128.53	123.25	75.47	129.07	122.43	74.51	125.82	2.16	-22.40	0.00	52
9	75.47	129.07	122.43	77.47	129.60	121.68	76.50	125.69	2.13	-20.48	0.00	52
10	77.47	129.60	121.68	79.47	130.13	121.01	78.49	125.60	2.11	-18.58	0.00	52
11	79.47	130.13	121.01	81.47	130.66	120.41	80.49	125.55	2.09	-16.70	0.00	52
12	81.47	130.66	120.41	83.46	131.20	119.88	82.48	125.54	2.07	-14.85	0.00	52
13	83.46	131.20	119.88	85.46	131.73	119.42	84.48	125.56	2.05	-13.00	0.00	52
14	85.46	131.73	119.42	87.46	132.26	119.02	86.47	125.61	2.04	-11.17	0.00	52
15	87.46	132.26	119.02	89.46	132.79	118.69	88.47	125.69	2.02	-9.36	0.00	52
16	89.46	132.79	118.69	91.45	133.33	118.43	90.46	125.81	2.01	-7.55	0.00	52
17	91.45	133.33	118.43	93.45	133.86	118.23	92.46	125.96	2.01	-5.75	0.00	52
18	93.45	133.86	118.23	95.45	134.39	118.09	94.46	126.14	2.00	-3.95	0.00	52
19	95.45	134.39	118.09	97.44	134.92	118.02	96.45	126.36	2.00	-2.16	0.00	52
20	97.44	134.92	118.02	99.44	135.46	118.00	98.45	126.60	2.00	-0.37	0.00	52
21	99.44	135.46	118.00	101.44	135.99	118.05	100.44	126.88	2.00	1.41	0.00	52
22	101.44	135.99	118.05	103.44	136.52	118.16	102.44	127.18	2.00	3.20	0.00	52
23	103.44	136.52	118.16	105.43	137.05	118.34	104.44	127.52	2.00	5.00	0.00	52
24	105.43	137.05	118.34	107.43	137.59	118.58	106.43	127.89	2.01	6.80	0.00	52
25	107.43	137.59	118.58	109.00	138.01	118.81	108.22	128.24	1.59	8.41	0.00	52
26	109.00	138.01	118.81	110.58	138.42	119.08	109.79	128.58	1.60	9.83	0.00	52
27	110.58	138.42	119.08	112.15	138.84	119.40	111.36	128.94	1.60	11.27	0.00	52
28	112.15	138.84	119.40	113.37	139.17	119.67	112.76	129.27	1.25	12.54	0.00	52
29	113.37	139.17	119.67	114.59	139.49	119.96	113.98	129.57	1.26	13.67	0.00	52
30	114.59	139.49	119.96	116.48	140.00	120.47	115.53	129.98	1.96	15.10	0.00	52
31	116.48	140.00	120.47	118.18	140.45	120.99	117.33	130.48	1.78	16.78	0.00	52
32	118.18	140.45	120.99	119.88	140.91	121.55	119.03	130.97	1.79	18.37	0.00	52
33	119.88	140.91	121.55	121.58	141.36	122.17	120.73	131.50	1.81	19.98	0.00	52
34	121.58	141.36	122.17	123.28	141.81	122.84	122.43	132.04	1.83	21.61	0.00	52
35	123.28	141.81	122.84	123.78	141.95	123.05	123.53	132.41	0.54	22.67	0.00	52
36	123.78	141.95	123.05	124.71	142.19	123.45	124.24	132.66	1.01	23.37	0.00	52
37	124.71	142.19	123.45	126.09	142.56	124.08	125.40	133.07	1.52	24.50	0.00	52
38	126.09	142.56	124.08	127.48	142.93	124.75	126.78	133.58	1.54	25.87	0.00	52
39	127.48	142.93	124.75	128.86	143.30	125.47	128.17	134.11	1.56	27.26	0.00	52
40	128.86	143.30	125.47	128.92	143.30	125.50	128.89	134.39	0.07	27.98	0.00	52
41	128.92	143.30	125.50	130.60	143.30	126.43	129.75	134.63	1.92	28.87	0.00	52
42	130.60	143.30	126.43	130.61	143.30	126.43	130.60	134.86	0.01	29.74	0.00	52
43	130.61	143.30	126.43	131.99	143.30	127.24	131.29	135.07	1.60	30.46	0.00	53
44	131.99	143.30	127.24	132.48	143.30	127.54	132.23	135.35	0.57	31.43	0.00	54
45	132.48	143.30	127.54	134.36	143.30	128.75	133.41	135.72	2.23	32.69	0.00	54
46	134.36	143.30	128.75	135.17	143.11	129.30	134.76	136.11	0.98	34.13	0.00	54
47	135.17	143.11	129.30	137.03	142.67	130.63	136.08	136.42	2.29	35.59	0.00	54
48	137.03	142.67	130.63	138.90	142.24	132.07	137.94	136.90	2.35	37.67	0.00	54
49	138.90	142.24	132.07	140.76	141.80	133.62	139.79	137.42	2.43	39.81	0.00	54
50	140.76	141.80	133.62	141.71	141.58	134.46	141.22	137.86	1.27	41.46	0.00	54
51	141.71	141.58	134.46	143.59	141.14	136.23	142.59	138.33	2.59	43.19	0.00	54
52	143.59	141.14	136.23	145.48	140.70	138.15	144.44	139.02	2.69	45.55	0.00	54
53	145.48	140.70	138.15	147.37	140.26	140.26	146.11	139.70	2.83	48.02	0.00	54

Tabella 26-4 – Geometria e caratteristiche strisce della superficie 11 della verifica di stabilità 22.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	2504	23654	44387	21680	0	0	40817	0	0	
2	25	120	237	109	0	40817	41022	0	0	
3	3013	11880	23903	10715	0	41022	61224	0	0	
4	1955	6000	12464	5371	0	61224	71333	0	0	
5	9021	21000	45548	18595	0	71333	106134	0	0	
6	12325	21000	48418	18305	0	106134	139865	0	0	
7	18679	23435	58921	20575	0	139865	182979	0	0	
8	24046	22371	62858	20274	0	182979	223698	0	0	
9	29271	21308	66624	20009	0	223698	261762	0	0	
10	34239	20244	70093	19775	0	261762	296928	0	0	
11	38967	19180	73301	19570	0	296928	328982	0	0	
12	43409	18117	76208	19392	0	328982	357742	0	0	
13	47560	17053	78819	19238	0	357742	383056	0	0	
14	51428	15990	81153	19107	0	383056	404801	0	0	
15	55017	14926	83226	18997	0	404801	422881	0	0	
16	58377	13862	85103	18909	0	422881	437217	0	0	
17	61656	12799	86963	18839	0	437217	447716	0	0	
18	64689	11735	88616	18789	0	447716	454329	0	0	
19	67410	10672	89988	18758	0	454329	457045	0	0	
20	69849	9608	91118	18745	0	457045	455871	0	0	
21	72016	8544	92021	18750	0	455871	450832	0	0	
22	73843	7481	92616	18774	0	450832	442000	0	0	
23	75384	6417	92967	18816	0	442000	429454	0	0	
24	76664	5353	93101	18877	0	429454	413284	0	0	
25	61151	3468	73326	14927	0	413284	398052	0	0	
26	61666	2808	73176	14986	0	398052	380698	0	0	
27	62002	2148	72854	15056	0	380698	361320	0	0	
28	48191	1211	56155	11730	0	361320	344976	0	0	
29	48125	815	55681	11784	0	344976	327590	0	0	
30	74140	478	85014	18373	0	327590	298810	0	0	
31	66433	0	75824	16664	0	298810	270934	0	0	
32	65936	0	75369	16812	0	270934	241352	0	0	
33	65312	0	74802	16977	0	241352	210167	0	0	
34	64580	0	74138	17162	0	210167	177481	0	0	
35	18987	0	21852	5086	0	177481	167478	0	0	
36	35035	0	40361	9508	0	167478	148623	0	0	
37	51407	0	59323	14268	0	148623	120020	0	0	
38	50471	0	58361	14429	0	120020	90863	0	0	
39	49385	0	57206	14605	0	90863	61332	0	0	
40	2116	120	2611	638	0	61332	59932	0	0	
41	57413	3360	70934	18006	0	59932	21371	0	0	
42	331	20	409	108	0	21371	21145	0	0	
43	44482	2760	54859	15302	0	21145	-9080	0	0	
44	15244	980	18725	5611	0	-9080	-19416	0	0	
45	55699	3760	68312	21827	0	-19416	-57584	0	0	
46	22442	0	25109	9561	0	-57584	-71170	0	0	
47	46988	0	51302	22389	0	-71170	-98343	0	0	
48	40306	0	41573	23002	0	-98343	-118858	0	0	
49	33294	0	30747	23701	0	-118858	-131336	0	0	
50	14153	0	11061	12387	0	-131336	-134053	0	0	
51	22066	0	11550	25262	0	-134053	-130829	0	0	
52	13645	0	-4109	26302	0	-130829	-113985	0	0	
53	4671	0	-22624	27674	0	-113985	-80200	0	0	

Tabella 26-5 – Forze applicate sulle strisce [BISHOP] della superficie 11 della verifica di stabilità 22.

### 26.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.000769
2	0.000255
3	0.000895
4	0.000071
5	0.000145
6	0.000059
7	0.000317

Tabella 26-6 – Spostamenti della superficie 1 della verifica di stabilità 22.

Accelerazione sismica critica  $K_c = 0.159$   
Spostamento massimo  $U_{max} = 0.000895$  [m]  
Velocità massima  $V_{max} = 0.017465$  [m/s]

n°	u
	[m]
1	0.000966
2	0.000348
3	0.001005
4	0.000108
5	0.000174
6	0.000102
7	0.000405

Tabella 26-7 – Spostamenti della superficie 11 della verifica di stabilità 22.

Accelerazione sismica critica  $K_c = 0.155$   
Spostamento massimo  $U_{max} = 0.001005$  [m]  
Velocità massima  $V_{max} = 0.018777$  [m/s]

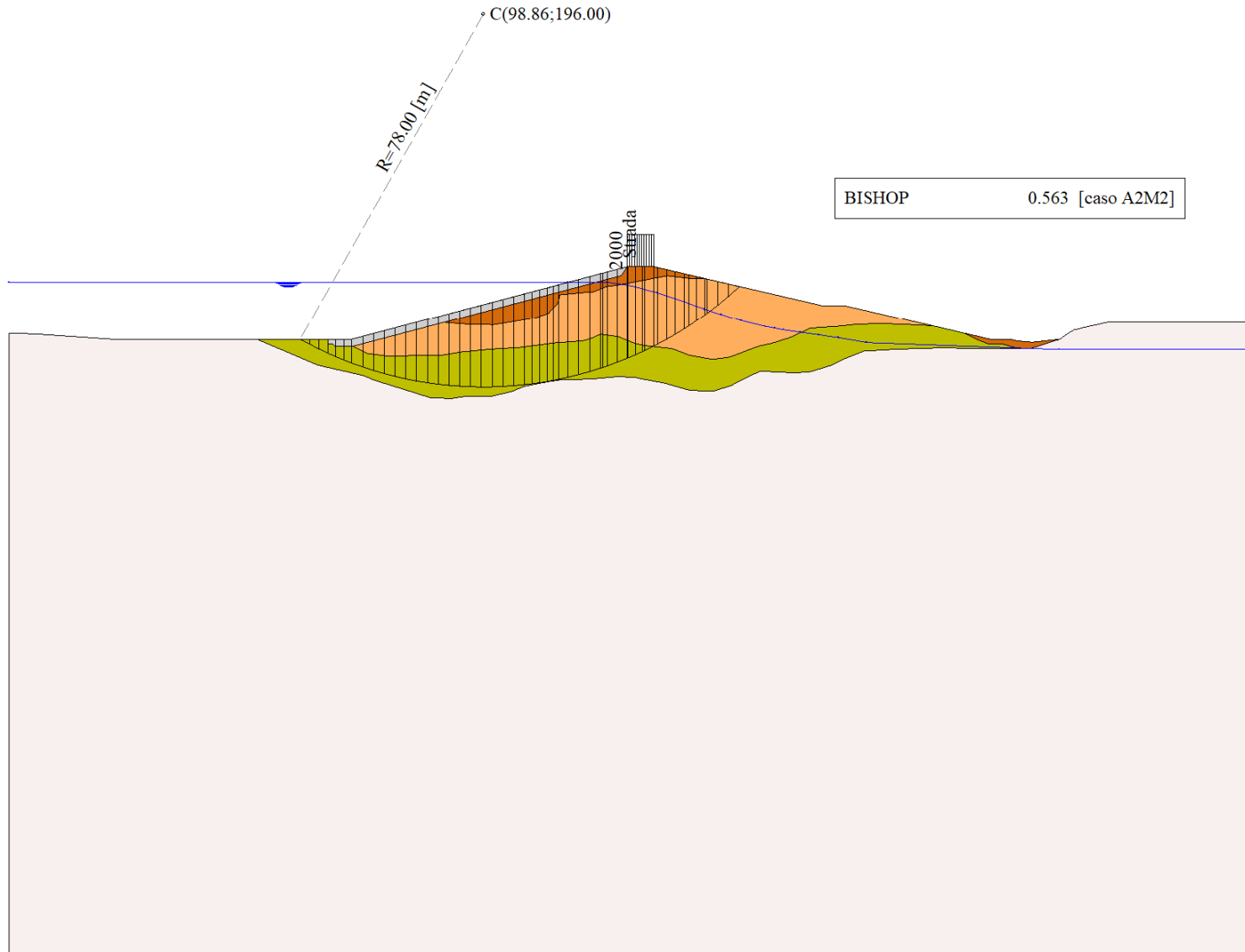


Figura 26-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 22.

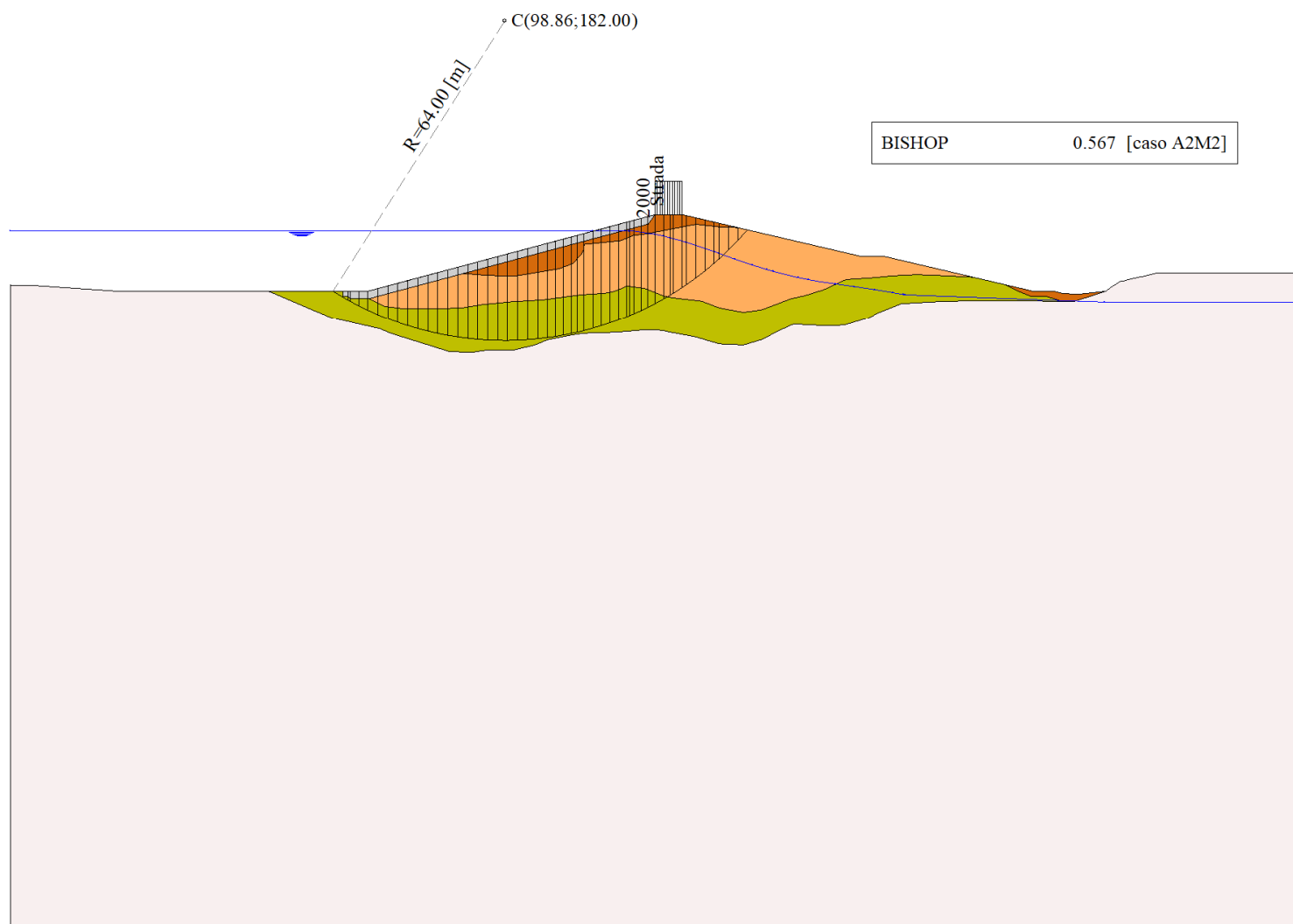


Figura 26-2 – Superficie critica (11) della sezione CR\_06 per la verifica di stabilità 22.



## 27 VERIFICA DI STABILITÀ 23

### 27.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	P <sub>i</sub> [m]	P <sub>f</sub> [m]	V <sub>y</sub> [kg/m]	V <sub>x</sub> [kg/m]
1	Strada	Variabile	1.00	128.86	134.36	2000	0
				143.30	143.30	2000	0

Tabella 27-1 – Carichi distribuiti verifica di stabilità 23.

### 27.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **sismiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 27.2 RISULTATI ANALISI

Numero di superfici analizzate 85518

Coefficiente di sicurezza minimo 0.316

Superficie con coefficiente di sicurezza minimo 1

### 27.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce 53

Coordinate del centro X[m]= 98.86 Y[m]= 202.00

Raggio del cerchio R[m]= 84.00

Intersezione a valle con il profilo topografico X<sub>v</sub>[m]= 59.11 Y<sub>v</sub>[m]= 128.00

Intersezione a monte con il profilo topografico X<sub>m</sub>[m]= 154.07 Y<sub>m</sub>[m]= 138.70

Coefficiente di sicurezza F<sub>s</sub>= **0.316**

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	59.11	128.00	128.00	60.95	128.00	127.04	60.34	127.68	2.08	-27.53	0.00	52
2	60.95	128.00	127.04	62.80	128.00	126.14	61.97	127.27	2.05	-26.13	0.00	52
3	62.80	128.00	126.14	64.64	128.00	125.29	63.77	126.84	2.03	-24.73	0.00	52
4	64.64	128.00	125.29	66.48	128.00	124.49	65.60	126.44	2.01	-23.36	0.00	52
5	66.48	128.00	124.49	68.15	128.00	123.82	67.34	126.07	1.80	-22.06	0.00	52
6	68.15	128.00	123.82	69.81	128.00	123.18	69.00	125.75	1.78	-20.84	0.00	52
7	69.81	128.00	123.18	71.48	128.00	122.59	70.66	125.44	1.77	-19.63	0.00	52
8	71.48	128.00	122.59	73.70	128.59	121.86	72.63	125.26	2.34	-18.23	0.00	52
9	73.70	128.59	121.86	75.92	129.18	121.19	74.84	125.21	2.32	-16.64	0.00	52
10	75.92	129.18	121.19	78.14	129.78	120.60	77.06	125.19	2.30	-15.06	0.00	52
11	78.14	129.78	120.60	80.36	130.37	120.06	79.27	125.20	2.28	-13.50	0.00	52
12	80.36	130.37	120.06	82.58	130.96	119.59	81.49	125.25	2.27	-11.95	0.00	52
13	82.58	130.96	119.59	84.80	131.55	119.19	83.71	125.32	2.26	-10.41	0.00	52
14	84.80	131.55	119.19	87.02	132.14	118.84	85.92	125.43	2.25	-8.87	0.00	52
15	87.02	132.14	118.84	89.24	132.74	118.55	88.14	125.57	2.24	-7.34	0.00	52
16	89.24	132.74	118.55	91.46	133.33	118.33	90.36	125.74	2.23	-5.82	0.00	52
17	91.46	133.33	118.33	93.68	133.92	118.16	92.58	125.93	2.23	-4.29	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α <sub>1</sub> [°]	α <sub>2</sub> [°]	c [kPa]
18	93.68	133.92	118.16	95.90	134.51	118.05	94.80	126.16	2.22	-2.78	0.00	52
19	95.90	134.51	118.05	98.12	135.10	118.00	97.02	126.42	2.22	-1.26	0.00	52
20	98.12	135.10	118.00	100.34	135.70	118.01	99.24	126.70	2.22	0.25	0.00	52
21	100.34	135.70	118.01	102.56	136.29	118.08	101.46	127.02	2.22	1.77	0.00	52
22	102.56	136.29	118.08	104.78	136.88	118.21	103.67	127.36	2.22	3.28	0.00	52
23	104.78	136.88	118.21	106.11	137.23	118.31	105.44	127.66	1.33	4.49	0.00	52
24	106.11	137.23	118.31	107.43	137.59	118.44	106.77	127.89	1.33	5.40	0.00	52
25	107.43	137.59	118.44	109.79	138.22	118.71	108.61	128.24	2.38	6.67	0.00	52
26	109.79	138.22	118.71	112.15	138.84	119.06	110.97	128.71	2.38	8.29	0.00	52
27	112.15	138.84	119.06	113.37	139.17	119.26	112.76	129.08	1.24	9.53	0.00	52
28	113.37	139.17	119.26	114.59	139.49	119.49	113.98	129.35	1.24	10.37	0.00	52
29	114.59	139.49	119.49	116.48	140.00	119.87	115.54	129.71	1.93	11.45	0.00	52
30	116.48	140.00	119.87	118.75	140.60	120.39	117.61	130.21	2.33	12.90	0.00	52
31	118.75	140.60	120.39	121.01	141.21	120.97	119.88	130.79	2.34	14.49	0.00	52
32	121.01	141.21	120.97	123.28	141.81	121.63	122.15	131.41	2.36	16.10	0.00	52
33	123.28	141.81	121.63	123.78	141.95	121.78	123.53	131.79	0.52	17.08	0.00	52
34	123.78	141.95	121.78	124.71	142.19	122.08	124.24	132.00	0.98	17.59	0.00	52
35	124.71	142.19	122.08	126.78	142.75	122.78	125.75	132.45	2.19	18.67	0.00	52
36	126.78	142.75	122.78	128.86	143.30	123.54	127.82	133.09	2.21	20.17	0.00	52
37	128.86	143.30	123.54	128.92	143.30	123.56	128.89	133.43	0.06	20.95	0.00	52
38	128.92	143.30	123.56	130.61	143.30	124.23	129.76	133.60	1.82	21.59	0.00	52
39	130.61	143.30	124.23	131.99	143.30	124.81	131.30	133.91	1.50	22.72	0.00	52
40	131.99	143.30	124.81	134.36	143.30	125.87	133.16	134.32	2.60	24.11	0.00	52
41	134.36	143.30	125.87	135.17	143.11	126.25	134.76	134.63	0.90	25.31	0.00	52
42	135.17	143.11	126.25	137.03	142.67	127.17	136.09	134.80	2.08	26.32	0.00	54
43	137.03	142.67	127.17	138.90	142.24	128.16	137.95	135.06	2.11	27.75	0.00	54
44	138.90	142.24	128.16	140.76	141.80	129.20	139.81	135.35	2.13	29.19	0.00	54
45	140.76	141.80	129.20	141.71	141.58	129.75	141.23	135.58	1.10	30.30	0.00	54
46	141.71	141.58	129.75	143.32	141.20	130.73	142.50	135.81	1.89	31.32	0.00	54
47	143.32	141.20	130.73	144.94	140.83	131.77	144.11	136.13	1.92	32.62	0.00	54
48	144.94	140.83	131.77	145.48	140.70	132.12	145.21	136.35	0.65	33.49	0.00	54
49	145.48	140.70	132.12	146.94	140.36	133.12	146.19	136.57	1.77	34.32	0.00	54
50	146.94	140.36	133.12	148.41	140.02	134.17	147.65	136.91	1.80	35.53	0.00	54
51	148.41	140.02	134.17	150.30	139.58	135.59	149.29	137.32	2.36	36.95	0.00	54
52	150.30	139.58	135.59	152.19	139.14	137.10	151.14	137.82	2.42	38.58	0.00	54
53	152.19	139.14	137.10	154.07	138.70	138.70	152.82	138.31	2.47	40.25	0.00	54

Tabella 27-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 23.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	1866	22108	45972	35000	0	0	51063	0	0	
2	5487	22108	49694	34567	0	51063	100380	0	0	
3	8891	22108	53083	34170	0	100380	147791	0	0	
4	12086	22108	56165	33806	0	147791	193163	0	0	
5	13315	20000	52937	30295	0	193163	232384	0	0	
6	15548	20000	54930	30042	0	232384	269798	0	0	
7	17708	20000	56832	29809	0	269798	305344	0	0	
8	27791	25983	79180	39374	0	305344	356197	0	0	
9	33217	24669	83456	39033	0	356197	402272	0	0	
10	38571	23355	87661	38729	0	402272	443369	0	0	
11	43693	22041	91581	38461	0	443369	479352	0	0	
12	48590	20726	95238	38227	0	479352	510108	0	0	

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
13	53196	19412	98551	38024	0	510108	535573	0	0	
14	57513	18098	101533	37851	0	535573	555708	0	0	
15	61545	16784	104194	37707	0	555708	570504	0	0	
16	65340	15470	106607	37592	0	570504	579950	0	0	
17	69092	14156	109033	37504	0	579950	583947	0	0	
18	72594	12842	111200	37442	0	583947	582518	0	0	
19	75757	11528	112994	37407	0	582518	575764	0	0	
20	78632	10213	114482	37399	0	575764	563779	0	0	
21	81183	8899	115622	37416	0	563779	546709	0	0	
22	83376	7585	116365	37460	0	546709	524751	0	0	
23	50702	3901	69699	22390	0	524751	509378	0	0	
24	51330	3433	69805	22421	0	509378	492358	0	0	
25	92817	4955	124422	40027	0	492358	458082	0	0	
26	94268	3470	124174	40177	0	458082	418997	0	0	
27	49144	1211	63914	20840	0	418997	397045	0	0	
28	49258	815	63512	20894	0	397045	374057	0	0	
29	76296	478	97296	32486	0	374057	336639	0	0	
30	91770	0	116065	39173	0	336639	288685	0	0	
31	91706	0	115606	39440	0	288685	237756	0	0	
32	91508	0	115024	39742	0	237756	183999	0	0	
33	20297	0	25493	8812	0	183999	171615	0	0	
34	37630	0	47218	16435	0	171615	148318	0	0	
35	83342	0	104370	36897	0	148318	95170	0	0	
36	82271	0	102725	37240	0	95170	40715	0	0	
37	2360	120	3113	1082	0	40715	38985	0	0	
38	65113	3380	85714	30618	0	38985	-9031	0	0	
39	51197	2760	67137	25203	0	-9031	-47121	0	0	
40	83610	4740	108978	43743	0	-47121	-109699	0	0	
41	27132	0	32723	15094	0	-109699	-127846	0	0	
42	58713	0	69018	36345	0	-127846	-164401	0	0	
43	53600	0	61011	36926	0	-164401	-195300	0	0	
44	48338	0	52624	37435	0	-195300	-220010	0	0	
45	22555	0	23419	19297	0	-220010	-229964	0	0	
46	34967	0	34188	33155	0	-229964	-242356	0	0	
47	30578	0	26696	33627	0	-242356	-248487	0	0	
48	9221	0	7171	11356	0	-248487	-249024	0	0	
49	22420	0	14818	31108	0	-249024	-246397	0	0	
50	18549	0	7723	31574	0	-246397	-237365	0	0	
51	17970	0	-1311	41441	0	-237365	-215254	0	0	
52	11011	0	-15092	42364	0	-215254	-179951	0	0	
53	3726	0	-30250	43390	0	-179951	-129735	0	0	

Tabella 27-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 23.

### 27.2.2 ANALISI DELLA SUPERFICIE 25 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	53	
Coordinate del centro	X[m]= 98.86	Y[m]= 182.00
Raggio del cerchio	R[m]= 64.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 64.51	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 147.37	Y <sub>m</sub> [m]= 140.26
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.325</b>	

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∠ [°]	∠ [°]	c [kPa]
1	64.51	128.00	128.00	66.48	128.00	126.80	65.82	127.60	2.31	-31.43	0.00	52
2	66.48	128.00	126.80	66.49	128.00	126.79	66.49	127.40	0.01	-30.39	0.00	52
3	66.49	128.00	126.79	67.48	128.00	126.22	67.02	127.24	1.14	-29.87	0.00	52
4	67.48	128.00	126.22	67.98	128.00	125.94	67.74	127.04	0.57	-29.10	0.00	52
5	67.98	128.00	125.94	69.73	128.00	125.01	68.91	126.72	1.98	-27.96	0.00	52
6	69.73	128.00	125.01	71.48	128.00	124.15	70.64	126.28	1.95	-26.20	0.00	52
7	71.48	128.00	124.15	73.48	128.53	123.25	72.53	125.98	2.19	-24.35	0.00	52
8	73.48	128.53	123.25	75.47	129.07	122.43	74.51	125.82	2.16	-22.40	0.00	52
9	75.47	129.07	122.43	77.47	129.60	121.68	76.50	125.69	2.13	-20.48	0.00	52
10	77.47	129.60	121.68	79.47	130.13	121.01	78.49	125.60	2.11	-18.58	0.00	52
11	79.47	130.13	121.01	81.47	130.66	120.41	80.49	125.55	2.09	-16.70	0.00	52
12	81.47	130.66	120.41	83.46	131.20	119.88	82.48	125.54	2.07	-14.85	0.00	52
13	83.46	131.20	119.88	85.46	131.73	119.42	84.48	125.56	2.05	-13.00	0.00	52
14	85.46	131.73	119.42	87.46	132.26	119.02	86.47	125.61	2.04	-11.17	0.00	52
15	87.46	132.26	119.02	89.46	132.79	118.69	88.47	125.69	2.02	-9.36	0.00	52
16	89.46	132.79	118.69	91.45	133.33	118.43	90.46	125.81	2.01	-7.55	0.00	52
17	91.45	133.33	118.43	93.45	133.86	118.23	92.46	125.96	2.01	-5.75	0.00	52
18	93.45	133.86	118.23	95.45	134.39	118.09	94.46	126.14	2.00	-3.95	0.00	52
19	95.45	134.39	118.09	97.44	134.92	118.02	96.45	126.36	2.00	-2.16	0.00	52
20	97.44	134.92	118.02	99.44	135.46	118.00	98.45	126.60	2.00	-0.37	0.00	52
21	99.44	135.46	118.00	101.44	135.99	118.05	100.44	126.88	2.00	1.41	0.00	52
22	101.44	135.99	118.05	103.44	136.52	118.16	102.44	127.18	2.00	3.20	0.00	52
23	103.44	136.52	118.16	105.43	137.05	118.34	104.44	127.52	2.00	5.00	0.00	52
24	105.43	137.05	118.34	107.43	137.59	118.58	106.43	127.89	2.01	6.80	0.00	52
25	107.43	137.59	118.58	109.00	138.01	118.81	108.22	128.24	1.59	8.41	0.00	52
26	109.00	138.01	118.81	110.58	138.42	119.08	109.79	128.58	1.60	9.83	0.00	52
27	110.58	138.42	119.08	112.15	138.84	119.40	111.36	128.94	1.60	11.27	0.00	52
28	112.15	138.84	119.40	113.37	139.17	119.67	112.76	129.27	1.25	12.54	0.00	52
29	113.37	139.17	119.67	114.59	139.49	119.96	113.98	129.57	1.26	13.67	0.00	52
30	114.59	139.49	119.96	116.48	140.00	120.47	115.53	129.98	1.96	15.10	0.00	52
31	116.48	140.00	120.47	118.18	140.45	120.99	117.33	130.48	1.78	16.78	0.00	52
32	118.18	140.45	120.99	119.88	140.91	121.55	119.03	130.97	1.79	18.37	0.00	52
33	119.88	140.91	121.55	121.58	141.36	122.17	120.73	131.50	1.81	19.98	0.00	52
34	121.58	141.36	122.17	123.28	141.81	122.84	122.43	132.04	1.83	21.61	0.00	52
35	123.28	141.81	122.84	123.78	141.95	123.05	123.53	132.41	0.54	22.67	0.00	52
36	123.78	141.95	123.05	124.71	142.19	123.45	124.24	132.66	1.01	23.37	0.00	52
37	124.71	142.19	123.45	126.09	142.56	124.08	125.40	133.07	1.52	24.50	0.00	52
38	126.09	142.56	124.08	127.48	142.93	124.75	126.78	133.58	1.54	25.87	0.00	52
39	127.48	142.93	124.75	128.86	143.30	125.47	128.17	134.11	1.56	27.26	0.00	52
40	128.86	143.30	125.47	128.92	143.30	125.50	128.89	134.39	0.07	27.98	0.00	52
41	128.92	143.30	125.50	130.60	143.30	126.43	129.75	134.63	1.92	28.87	0.00	52
42	130.60	143.30	126.43	130.61	143.30	126.43	130.60	134.86	0.01	29.74	0.00	52
43	130.61	143.30	126.43	131.99	143.30	127.24	131.29	135.07	1.60	30.46	0.00	53
44	131.99	143.30	127.24	132.48	143.30	127.54	132.23	135.35	0.57	31.43	0.00	54
45	132.48	143.30	127.54	134.36	143.30	128.75	133.41	135.72	2.23	32.69	0.00	54
46	134.36	143.30	128.75	135.17	143.11	129.30	134.76	136.11	0.98	34.13	0.00	54
47	135.17	143.11	129.30	137.03	142.67	130.63	136.08	136.42	2.29	35.59	0.00	54
48	137.03	142.67	130.63	138.90	142.24	132.07	137.94	136.90	2.35	37.67	0.00	54
49	138.90	142.24	132.07	140.76	141.80	133.62	139.79	137.42	2.43	39.81	0.00	54
50	140.76	141.80	133.62	141.71	141.58	134.46	141.22	137.86	1.27	41.46	0.00	54
51	141.71	141.58	134.46	143.59	141.14	136.23	142.59	138.33	2.59	43.19	0.00	54
52	143.59	141.14	136.23	145.48	140.70	138.15	144.44	139.02	2.69	45.55	0.00	54
53	145.48	140.70	138.15	147.37	140.26	140.26	146.11	139.70	2.83	48.02	0.00	54

Tabella 27-4 – Geometria e caratteristiche strisce della superficie 25 della verifica di stabilità 23.

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
1	2504	23654	54720	37808	0	0	59151	0	0	
2	25	120	289	190	0	59151	59445	0	0	
3	3013	11880	29048	18686	0	59445	88139	0	0	
4	1955	6000	15052	9366	0	88139	102361	0	0	
5	9021	21000	54555	32428	0	102361	150664	0	0	
6	12325	21000	57358	31923	0	150664	196544	0	0	
7	18679	23435	69188	35880	0	196544	251748	0	0	
8	24046	22371	73312	35357	0	251748	302558	0	0	
9	29271	21308	77274	34894	0	302558	348753	0	0	
10	34239	20244	80924	34486	0	348753	390156	0	0	
11	38967	19180	84299	34129	0	390156	426617	0	0	
12	43409	18117	87349	33818	0	426617	458030	0	0	
13	47560	17053	90077	33549	0	458030	484322	0	0	
14	51428	15990	92503	33321	0	484322	505451	0	0	
15	55017	14926	94640	33130	0	505451	521401	0	0	
16	58377	13862	96562	32975	0	521401	532162	0	0	
17	61656	12799	98471	32854	0	532162	537665	0	0	
18	64689	11735	100147	32767	0	537665	537936	0	0	
19	67410	10672	101507	32712	0	537936	533063	0	0	
20	69849	9608	102591	32690	0	533063	523146	0	0	
21	72016	8544	103415	32699	0	523146	508300	0	0	
22	73843	7481	103886	32740	0	508300	488718	0	0	
23	75384	6417	104073	32814	0	488718	464582	0	0	
24	76664	5353	104008	32920	0	464582	436082	0	0	
25	61151	3468	81757	26031	0	436082	410674	0	0	
26	61666	2808	81441	26135	0	410674	382796	0	0	
27	62002	2148	80924	26257	0	382796	352621	0	0	
28	48191	1211	62258	20456	0	352621	327764	0	0	
29	48125	815	61620	20550	0	327764	301809	0	0	
30	74140	478	93838	32041	0	301809	259765	0	0	
31	66433	0	83393	29061	0	259765	219924	0	0	
32	65936	0	82537	29319	0	219924	178463	0	0	
33	65312	0	81533	29607	0	178463	135563	0	0	
34	64580	0	80399	29928	0	135563	91395	0	0	
35	18987	0	23625	8869	0	91395	78011	0	0	
36	35035	0	43524	16582	0	78011	52977	0	0	
37	51407	0	63690	24882	0	52977	15468	0	0	
38	50471	0	62296	25163	0	15468	-22195	0	0	
39	49385	0	60660	25469	0	-22195	-59744	0	0	
40	2116	120	2772	1112	0	-59744	-61530	0	0	
41	57413	3360	74857	31400	0	-61530	-110060	0	0	
42	331	20	429	188	0	-110060	-110340	0	0	
43	44482	2760	57095	26686	0	-110340	-147281	0	0	
44	15244	980	19272	9785	0	-147281	-159629	0	0	
45	55699	3760	69405	38064	0	-159629	-204098	0	0	
46	22442	0	24706	16674	0	-204098	-218884	0	0	
47	46988	0	48797	39045	0	-218884	-246368	0	0	
48	40306	0	36660	40113	0	-246368	-263471	0	0	
49	33294	0	23114	41333	0	-263471	-268368	0	0	
50	14153	0	5996	21602	0	-268368	-265439	0	0	
51	22066	0	-1158	44054	0	-265439	-247006	0	0	
52	13645	0	-20879	45868	0	-247006	-208935	0	0	
53	4671	0	-44369	48262	0	-208935	-146737	0	0	

Tabella 27-5 – Forze applicate sulle strisce [BISHOP] della superficie 25 della verifica di stabilità 23.

### 27.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.028109
2	0.016880
3	0.016386
4	0.004097
5	0.015587
6	0.018447
7	0.022120

Tabella 27-6 – Spostamenti della superficie 1 della verifica di stabilità 23.

Accelerazione sismica critica  $K_c = 0.161$   
Spostamento massimo  $U_{max} = 0.028109$  [m]  
Velocità massima  $V_{max} = 0.135960$  [m/s]

n°	u
	[m]
1	0.030982
2	0.019583
3	0.018105
4	0.005200
5	0.016856
6	0.019994
7	0.024675

Tabella 27-7 – Spostamenti della superficie 25 della verifica di stabilità 23.

Accelerazione sismica critica  $K_c = 0.155$   
Spostamento massimo  $U_{max} = 0.030982$  [m]  
Velocità massima  $V_{max} = 0.141472$  [m/s]

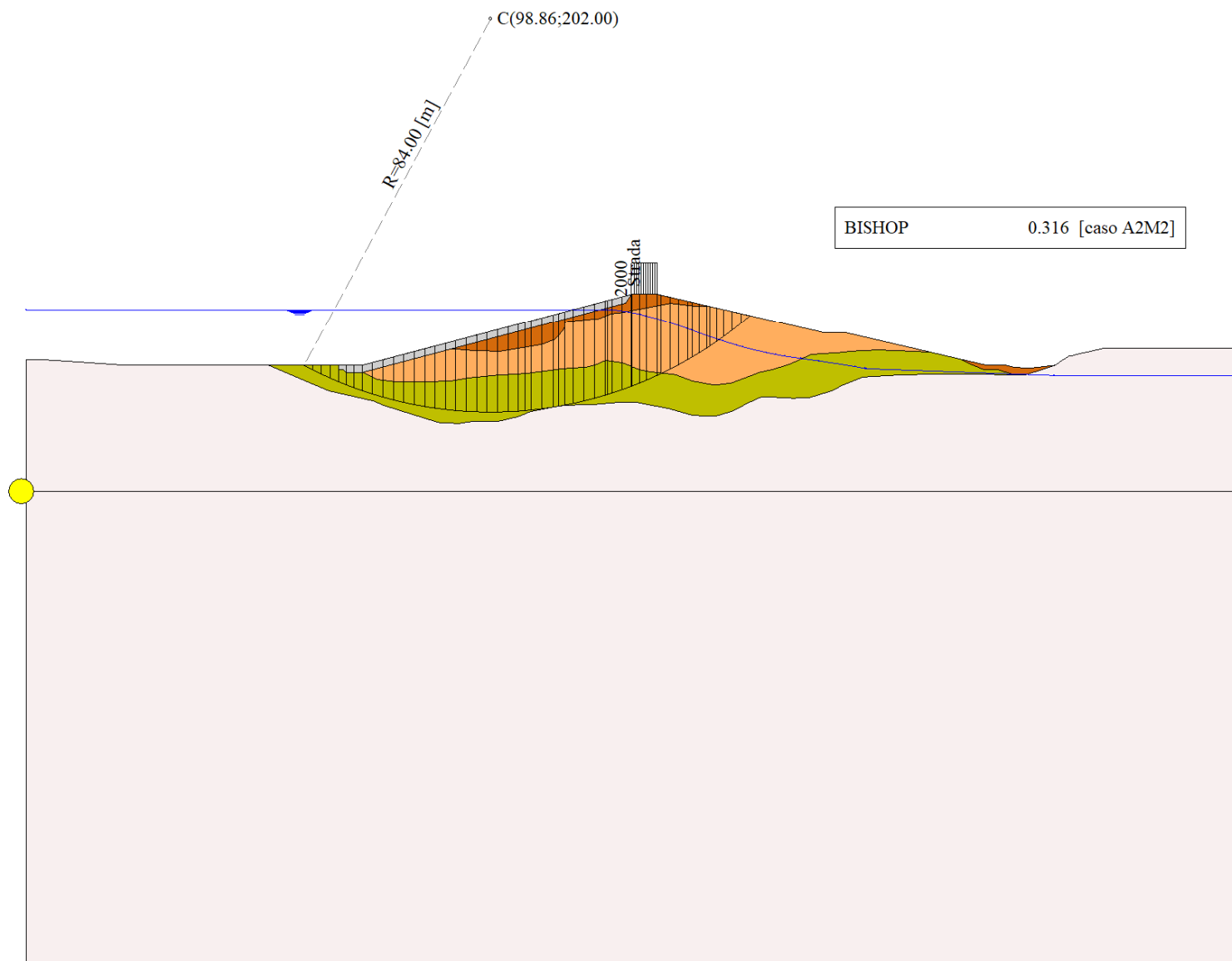


Figura 27-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 23.

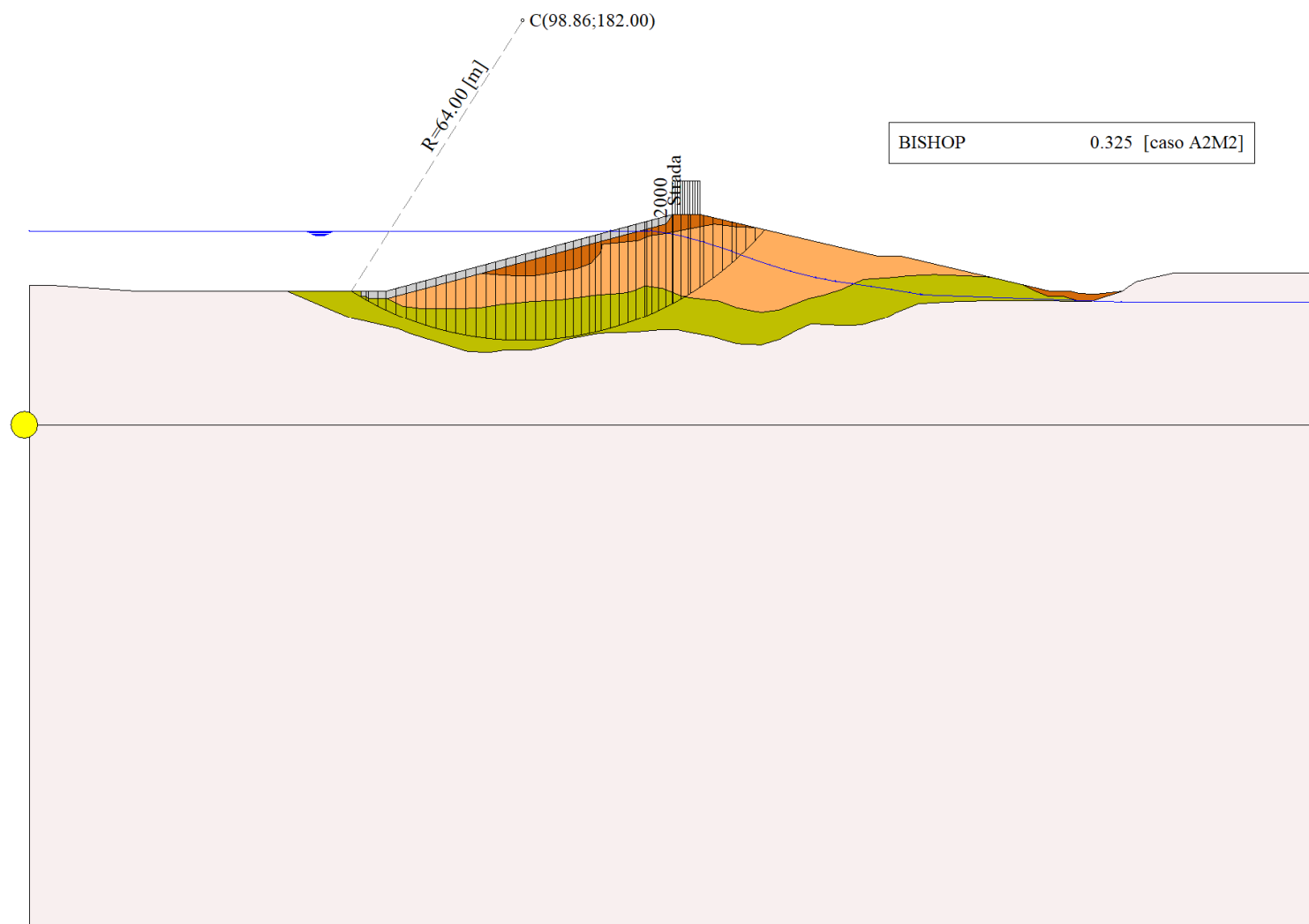


Figura 27-2 – Superficie critica (25) della sezione CR\_06 per la verifica di stabilità 23.



## 28 VERIFICA DI STABILITÀ 24

### 28.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	128.86	134.36	2000	0
				143.30	143.30	2000	0

Tabella 28-1 – Carichi distribuiti verifica di stabilità 24.

### 28.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **sismiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 28.2 RISULTATI ANALISI

Numero di superfici analizzate	85556
Coefficiente di sicurezza minimo	0.331
Superficie con coefficiente di sicurezza minimo	1

### 28.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	53
Coordinate del centro	X[m]= 98.86                      Y[m]= 202.00
Raggio del cerchio	R[m]= 84.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 59.11                      Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 154.07                      Y <sub>m</sub> [m]= 138.70
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.331</b>

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	59.11	128.00	128.00	60.95	128.00	127.04	60.34	127.68	2.08	-27.53	0.00	52
2	60.95	128.00	127.04	62.80	128.00	126.14	61.97	127.27	2.05	-26.13	0.00	52
3	62.80	128.00	126.14	64.64	128.00	125.29	63.77	126.84	2.03	-24.73	0.00	52
4	64.64	128.00	125.29	66.48	128.00	124.49	65.60	126.44	2.01	-23.36	0.00	52
5	66.48	128.00	124.49	68.15	128.00	123.82	67.34	126.07	1.80	-22.06	0.00	52
6	68.15	128.00	123.82	69.81	128.00	123.18	69.00	125.75	1.78	-20.84	0.00	52
7	69.81	128.00	123.18	71.48	128.00	122.59	70.66	125.44	1.77	-19.63	0.00	52
8	71.48	128.00	122.59	73.70	128.59	121.86	72.63	125.26	2.34	-18.23	0.00	52
9	73.70	128.59	121.86	75.92	129.18	121.19	74.84	125.21	2.32	-16.64	0.00	52
10	75.92	129.18	121.19	78.14	129.78	120.60	77.06	125.19	2.30	-15.06	0.00	52
11	78.14	129.78	120.60	80.36	130.37	120.06	79.27	125.20	2.28	-13.50	0.00	52
12	80.36	130.37	120.06	82.58	130.96	119.59	81.49	125.25	2.27	-11.95	0.00	52
13	82.58	130.96	119.59	84.80	131.55	119.19	83.71	125.32	2.26	-10.41	0.00	52
14	84.80	131.55	119.19	87.02	132.14	118.84	85.92	125.43	2.25	-8.87	0.00	52
15	87.02	132.14	118.84	89.24	132.74	118.55	88.14	125.57	2.24	-7.34	0.00	52
16	89.24	132.74	118.55	91.46	133.33	118.33	90.36	125.74	2.23	-5.82	0.00	52
17	91.46	133.33	118.33	93.68	133.92	118.16	92.58	125.93	2.23	-4.29	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α [°]	β [°]	c [kPa]
18	93.68	133.92	118.16	95.90	134.51	118.05	94.80	126.16	2.22	-2.78	0.00	52
19	95.90	134.51	118.05	98.12	135.10	118.00	97.02	126.42	2.22	-1.26	0.00	52
20	98.12	135.10	118.00	100.34	135.70	118.01	99.24	126.70	2.22	0.25	0.00	52
21	100.34	135.70	118.01	102.56	136.29	118.08	101.46	127.02	2.22	1.77	0.00	52
22	102.56	136.29	118.08	104.78	136.88	118.21	103.67	127.36	2.22	3.28	0.00	52
23	104.78	136.88	118.21	106.11	137.23	118.31	105.44	127.66	1.33	4.49	0.00	52
24	106.11	137.23	118.31	107.43	137.59	118.44	106.77	127.89	1.33	5.40	0.00	52
25	107.43	137.59	118.44	109.79	138.22	118.71	108.61	128.24	2.38	6.67	0.00	52
26	109.79	138.22	118.71	112.15	138.84	119.06	110.97	128.71	2.38	8.29	0.00	52
27	112.15	138.84	119.06	113.37	139.17	119.26	112.76	129.08	1.24	9.53	0.00	52
28	113.37	139.17	119.26	114.59	139.49	119.49	113.98	129.35	1.24	10.37	0.00	52
29	114.59	139.49	119.49	116.48	140.00	119.87	115.54	129.71	1.93	11.45	0.00	52
30	116.48	140.00	119.87	118.75	140.60	120.39	117.61	130.21	2.33	12.90	0.00	52
31	118.75	140.60	120.39	121.01	141.21	120.97	119.88	130.79	2.34	14.49	0.00	52
32	121.01	141.21	120.97	123.28	141.81	121.63	122.15	131.41	2.36	16.10	0.00	52
33	123.28	141.81	121.63	123.78	141.95	121.78	123.53	131.79	0.52	17.08	0.00	52
34	123.78	141.95	121.78	124.71	142.19	122.08	124.24	132.00	0.98	17.59	0.00	52
35	124.71	142.19	122.08	126.78	142.75	122.78	125.75	132.45	2.19	18.67	0.00	52
36	126.78	142.75	122.78	128.86	143.30	123.54	127.82	133.09	2.21	20.17	0.00	52
37	128.86	143.30	123.54	128.92	143.30	123.56	128.89	133.43	0.06	20.95	0.00	52
38	128.92	143.30	123.56	130.61	143.30	124.23	129.76	133.60	1.82	21.59	0.00	52
39	130.61	143.30	124.23	131.99	143.30	124.81	131.30	133.91	1.50	22.72	0.00	52
40	131.99	143.30	124.81	134.36	143.30	125.87	133.16	134.32	2.60	24.11	0.00	52
41	134.36	143.30	125.87	135.17	143.11	126.25	134.76	134.63	0.90	25.31	0.00	52
42	135.17	143.11	126.25	137.03	142.67	127.17	136.09	134.80	2.08	26.32	0.00	54
43	137.03	142.67	127.17	138.90	142.24	128.16	137.95	135.06	2.11	27.75	0.00	54
44	138.90	142.24	128.16	140.76	141.80	129.20	139.81	135.35	2.13	29.19	0.00	54
45	140.76	141.80	129.20	141.71	141.58	129.75	141.23	135.58	1.10	30.30	0.00	54
46	141.71	141.58	129.75	143.32	141.20	130.73	142.50	135.81	1.89	31.32	0.00	54
47	143.32	141.20	130.73	144.94	140.83	131.77	144.11	136.13	1.92	32.62	0.00	54
48	144.94	140.83	131.77	145.48	140.70	132.12	145.21	136.35	0.65	33.49	0.00	54
49	145.48	140.70	132.12	146.94	140.36	133.12	146.19	136.57	1.77	34.32	0.00	54
50	146.94	140.36	133.12	148.41	140.02	134.17	147.65	136.91	1.80	35.53	0.00	54
51	148.41	140.02	134.17	150.30	139.58	135.59	149.29	137.32	2.36	36.95	0.00	54
52	150.30	139.58	135.59	152.19	139.14	137.10	151.14	137.82	2.42	38.58	0.00	54
53	152.19	139.14	137.10	154.07	138.70	138.70	152.82	138.31	2.47	40.25	0.00	54

Tabella 28-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 24.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	1866	22108	45097	33390	0	0	49295	0	0	
2	5487	22108	48810	32978	0	49295	96982	0	0	
3	8891	22108	52192	32599	0	96982	142897	0	0	
4	12086	22108	55269	32251	0	142897	186899	0	0	
5	13315	20000	52128	28902	0	186899	224979	0	0	
6	15548	20000	54120	28660	0	224979	261344	0	0	
7	17708	20000	56023	28438	0	261344	295930	0	0	
8	27791	25983	78085	37563	0	295930	345669	0	0	
9	33217	24669	82328	37238	0	345669	390834	0	0	
10	38571	23355	86500	36948	0	390834	431224	0	0	
11	43693	22041	90390	36693	0	431224	466700	0	0	
12	48590	20726	94020	36469	0	466700	497141	0	0	

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
13	53196	19412	97308	36275	0	497141	522475	0	0	
14	57513	18098	100268	36110	0	522475	542658	0	0	
15	61545	16784	102913	35973	0	542658	557669	0	0	
16	65340	15470	105311	35863	0	557669	567491	0	0	
17	69092	14156	107722	35779	0	567491	572026	0	0	
18	72594	12842	109877	35720	0	572026	571290	0	0	
19	75757	11528	111664	35687	0	571290	565370	0	0	
20	78632	10213	113149	35679	0	565370	554353	0	0	
21	81183	8899	114290	35695	0	554353	538372	0	0	
22	83376	7585	115040	35737	0	538372	517614	0	0	
23	50702	3901	68913	21360	0	517614	503004	0	0	
24	51330	3433	69023	21390	0	503004	486782	0	0	
25	92817	4955	123043	38187	0	486782	454003	0	0	
26	94268	3470	122819	38329	0	454003	416500	0	0	
27	49144	1211	63225	19881	0	416500	395393	0	0	
28	49258	815	62834	19933	0	395393	373261	0	0	
29	76296	478	96271	30992	0	373261	337184	0	0	
30	91770	0	114872	37372	0	337184	290871	0	0	
31	91706	0	114459	37626	0	290871	241600	0	0	
32	91508	0	113928	37915	0	241600	189511	0	0	
33	20297	0	25255	8406	0	189511	177502	0	0	
34	37630	0	46784	15680	0	177502	154899	0	0	
35	83342	0	103443	35200	0	154899	103282	0	0	
36	82271	0	101859	35527	0	103282	50323	0	0	
37	2360	120	3087	1033	0	50323	48641	0	0	
38	65113	3380	85016	29210	0	48641	1908	0	0	
39	51197	2760	66625	24044	0	1908	-35213	0	0	
40	83610	4740	108228	41731	0	-35213	-96308	0	0	
41	27132	0	32539	14400	0	-96308	-114078	0	0	
42	58713	0	68728	34673	0	-114078	-150001	0	0	
43	53600	0	60872	35228	0	-150001	-180510	0	0	
44	48338	0	52642	35713	0	-180510	-205083	0	0	
45	22555	0	23493	18410	0	-205083	-215071	0	0	
46	34967	0	34418	31630	0	-215071	-227693	0	0	
47	30578	0	27066	32081	0	-227693	-234283	0	0	
48	9221	0	7328	10834	0	-234283	-235028	0	0	
49	22420	0	15331	29678	0	-235028	-233107	0	0	
50	18549	0	8372	30122	0	-233107	-225001	0	0	
51	17970	0	-260	39535	0	-225001	-204431	0	0	
52	11011	0	-13778	40416	0	-204431	-171096	0	0	
53	3726	0	-28644	41395	0	-171096	-123313	0	0	

Tabella 28-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 24.

### 28.2.2 ANALISI DELLA SUPERFICIE 24 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	53	
Coordinate del centro	X[m]= 98.86	Y[m]= 182.00
Raggio del cerchio	R[m]= 64.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 64.51	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 147.37	Y <sub>m</sub> [m]= 140.26
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.340</b>	

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∠ [°]	∠ [°]	c [kPa]
1	64.51	128.00	128.00	66.48	128.00	126.80	65.82	127.60	2.31	-31.43	0.00	52
2	66.48	128.00	126.80	66.49	128.00	126.79	66.49	127.40	0.01	-30.39	0.00	52
3	66.49	128.00	126.79	67.48	128.00	126.22	67.02	127.24	1.14	-29.87	0.00	52
4	67.48	128.00	126.22	67.98	128.00	125.94	67.74	127.04	0.57	-29.10	0.00	52
5	67.98	128.00	125.94	69.73	128.00	125.01	68.91	126.72	1.98	-27.96	0.00	52
6	69.73	128.00	125.01	71.48	128.00	124.15	70.64	126.28	1.95	-26.20	0.00	52
7	71.48	128.00	124.15	73.48	128.53	123.25	72.53	125.98	2.19	-24.35	0.00	52
8	73.48	128.53	123.25	75.47	129.07	122.43	74.51	125.82	2.16	-22.40	0.00	52
9	75.47	129.07	122.43	77.47	129.60	121.68	76.50	125.69	2.13	-20.48	0.00	52
10	77.47	129.60	121.68	79.47	130.13	121.01	78.49	125.60	2.11	-18.58	0.00	52
11	79.47	130.13	121.01	81.47	130.66	120.41	80.49	125.55	2.09	-16.70	0.00	52
12	81.47	130.66	120.41	83.46	131.20	119.88	82.48	125.54	2.07	-14.85	0.00	52
13	83.46	131.20	119.88	85.46	131.73	119.42	84.48	125.56	2.05	-13.00	0.00	52
14	85.46	131.73	119.42	87.46	132.26	119.02	86.47	125.61	2.04	-11.17	0.00	52
15	87.46	132.26	119.02	89.46	132.79	118.69	88.47	125.69	2.02	-9.36	0.00	52
16	89.46	132.79	118.69	91.45	133.33	118.43	90.46	125.81	2.01	-7.55	0.00	52
17	91.45	133.33	118.43	93.45	133.86	118.23	92.46	125.96	2.01	-5.75	0.00	52
18	93.45	133.86	118.23	95.45	134.39	118.09	94.46	126.14	2.00	-3.95	0.00	52
19	95.45	134.39	118.09	97.44	134.92	118.02	96.45	126.36	2.00	-2.16	0.00	52
20	97.44	134.92	118.02	99.44	135.46	118.00	98.45	126.60	2.00	-0.37	0.00	52
21	99.44	135.46	118.00	101.44	135.99	118.05	100.44	126.88	2.00	1.41	0.00	52
22	101.44	135.99	118.05	103.44	136.52	118.16	102.44	127.18	2.00	3.20	0.00	52
23	103.44	136.52	118.16	105.43	137.05	118.34	104.44	127.52	2.00	5.00	0.00	52
24	105.43	137.05	118.34	107.43	137.59	118.58	106.43	127.89	2.01	6.80	0.00	52
25	107.43	137.59	118.58	109.00	138.01	118.81	108.22	128.24	1.59	8.41	0.00	52
26	109.00	138.01	118.81	110.58	138.42	119.08	109.79	128.58	1.60	9.83	0.00	52
27	110.58	138.42	119.08	112.15	138.84	119.40	111.36	128.94	1.60	11.27	0.00	52
28	112.15	138.84	119.40	113.37	139.17	119.67	112.76	129.27	1.25	12.54	0.00	52
29	113.37	139.17	119.67	114.59	139.49	119.96	113.98	129.57	1.26	13.67	0.00	52
30	114.59	139.49	119.96	116.48	140.00	120.47	115.53	129.98	1.96	15.10	0.00	52
31	116.48	140.00	120.47	118.18	140.45	120.99	117.33	130.48	1.78	16.78	0.00	52
32	118.18	140.45	120.99	119.88	140.91	121.55	119.03	130.97	1.79	18.37	0.00	52
33	119.88	140.91	121.55	121.58	141.36	122.17	120.73	131.50	1.81	19.98	0.00	52
34	121.58	141.36	122.17	123.28	141.81	122.84	122.43	132.04	1.83	21.61	0.00	52
35	123.28	141.81	122.84	123.78	141.95	123.05	123.53	132.41	0.54	22.67	0.00	52
36	123.78	141.95	123.05	124.71	142.19	123.45	124.24	132.66	1.01	23.37	0.00	52
37	124.71	142.19	123.45	126.09	142.56	124.08	125.40	133.07	1.52	24.50	0.00	52
38	126.09	142.56	124.08	127.48	142.93	124.75	126.78	133.58	1.54	25.87	0.00	52
39	127.48	142.93	124.75	128.86	143.30	125.47	128.17	134.11	1.56	27.26	0.00	52
40	128.86	143.30	125.47	128.92	143.30	125.50	128.89	134.39	0.07	27.98	0.00	52
41	128.92	143.30	125.50	130.60	143.30	126.43	129.75	134.63	1.92	28.87	0.00	52
42	130.60	143.30	126.43	130.61	143.30	126.43	130.60	134.86	0.01	29.74	0.00	52
43	130.61	143.30	126.43	131.99	143.30	127.24	131.29	135.07	1.60	30.46	0.00	53
44	131.99	143.30	127.24	132.48	143.30	127.54	132.23	135.35	0.57	31.43	0.00	54
45	132.48	143.30	127.54	134.36	143.30	128.75	133.41	135.72	2.23	32.69	0.00	54
46	134.36	143.30	128.75	135.17	143.11	129.30	134.76	136.11	0.98	34.13	0.00	54
47	135.17	143.11	129.30	137.03	142.67	130.63	136.08	136.42	2.29	35.59	0.00	54
48	137.03	142.67	130.63	138.90	142.24	132.07	137.94	136.90	2.35	37.67	0.00	54
49	138.90	142.24	132.07	140.76	141.80	133.62	139.79	137.42	2.43	39.81	0.00	54
50	140.76	141.80	133.62	141.71	141.58	134.46	141.22	137.86	1.27	41.46	0.00	54
51	141.71	141.58	134.46	143.59	141.14	136.23	142.59	138.33	2.59	43.19	0.00	54
52	143.59	141.14	136.23	145.48	140.70	138.15	144.44	139.02	2.69	45.55	0.00	54
53	145.48	140.70	138.15	147.37	140.26	140.26	146.11	139.70	2.83	48.02	0.00	54

Tabella 28-4 – Geometria e caratteristiche strisce della superficie 24 della verifica di stabilità 24.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	2504	23654	53639	36121	0	0	57233	0	0	
2	25	120	283	181	0	57233	57517	0	0	
3	3013	11880	28509	17852	0	57517	85322	0	0	
4	1955	6000	14782	8948	0	85322	99114	0	0	
5	9021	21000	53613	30981	0	99114	146004	0	0	
6	12325	21000	56423	30498	0	146004	190613	0	0	
7	18679	23435	68114	34278	0	190613	244552	0	0	
8	24046	22371	72218	33778	0	244552	294306	0	0	
9	29271	21308	76160	33336	0	294306	339650	0	0	
10	34239	20244	79791	32947	0	339650	380400	0	0	
11	38967	19180	83148	32606	0	380400	416400	0	0	
12	43409	18117	86183	32308	0	416400	447535	0	0	
13	47560	17053	88899	32052	0	447535	473725	0	0	
14	51428	15990	91315	31833	0	473725	494919	0	0	
15	55017	14926	93446	31651	0	494919	511092	0	0	
16	58377	13862	95363	31503	0	511092	522227	0	0	
17	61656	12799	97267	31388	0	522227	528253	0	0	
18	64689	11735	98941	31304	0	528253	529187	0	0	
19	67410	10672	100301	31252	0	529187	525109	0	0	
20	69849	9608	101391	31230	0	525109	516106	0	0	
21	72016	8544	102222	31239	0	516106	502286	0	0	
22	73843	7481	102706	31279	0	502286	483829	0	0	
23	75384	6417	102911	31349	0	483829	460906	0	0	
24	76664	5353	102867	31451	0	460906	433696	0	0	
25	61151	3468	80875	24869	0	433696	409353	0	0	
26	61666	2808	80576	24968	0	409353	382577	0	0	
27	62002	2148	80080	25085	0	382577	353531	0	0	
28	48191	1211	61620	19543	0	353531	329565	0	0	
29	48125	815	60998	19632	0	329565	304507	0	0	
30	74140	478	92915	30611	0	304507	263851	0	0	
31	66433	0	82601	27764	0	263851	225261	0	0	
32	65936	0	81787	28010	0	225261	185044	0	0	
33	65312	0	80829	28285	0	185044	143370	0	0	
34	64580	0	79744	28592	0	143370	100403	0	0	
35	18987	0	23439	8473	0	100403	87373	0	0	
36	35035	0	43193	15842	0	87373	62986	0	0	
37	51407	0	63233	23772	0	62986	26409	0	0	
38	50471	0	61884	24040	0	26409	-10365	0	0	
39	49385	0	60299	24332	0	-10365	-47074	0	0	
40	2116	120	2755	1062	0	-47074	-48820	0	0	
41	57413	3360	74446	29999	0	-48820	-96307	0	0	
42	331	20	427	180	0	-96307	-96581	0	0	
43	44482	2760	56861	25495	0	-96581	-132820	0	0	
44	15244	980	19215	9349	0	-132820	-144957	0	0	
45	55699	3760	69290	36365	0	-144957	-188767	0	0	
46	22442	0	24748	15929	0	-188767	-203427	0	0	
47	46988	0	49059	37302	0	-203427	-230879	0	0	
48	40306	0	37174	38322	0	-230879	-248339	0	0	
49	33294	0	23913	39488	0	-248339	-254029	0	0	
50	14153	0	6526	20637	0	-254029	-251690	0	0	
51	22066	0	171	42087	0	-251690	-234849	0	0	
52	13645	0	-19124	43820	0	-234849	-198999	0	0	
53	4671	0	-42094	46107	0	-198999	-139774	0	0	

Tabella 28-5 – Forze applicate sulle strisce [BISHOP] della superficie 24 della verifica di stabilità 24.

### 28.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.035002
2	0.013481
3	0.025099
4	0.029814
5	0.044155
6	0.014152
7	0.022434

Tabella 28-6 – Spostamenti della superficie 1 della verifica di stabilità 24.

Accelerazione sismica critica  $K_c = 0.161$   
Spostamento massimo  $U_{max} = 0.044155$  [m]  
Velocità massima  $V_{max} = 0.153733$  [m/s]

n°	u
	[m]
1	0.039324
2	0.015723
3	0.030036
4	0.032766
5	0.048516
6	0.015654
7	0.024667

Tabella 28-7 – Spostamenti della superficie 24 della verifica di stabilità 24.

Accelerazione sismica critica  $K_c = 0.155$   
Spostamento massimo  $U_{max} = 0.048516$  [m]  
Velocità massima  $V_{max} = 0.158961$  [m/s]

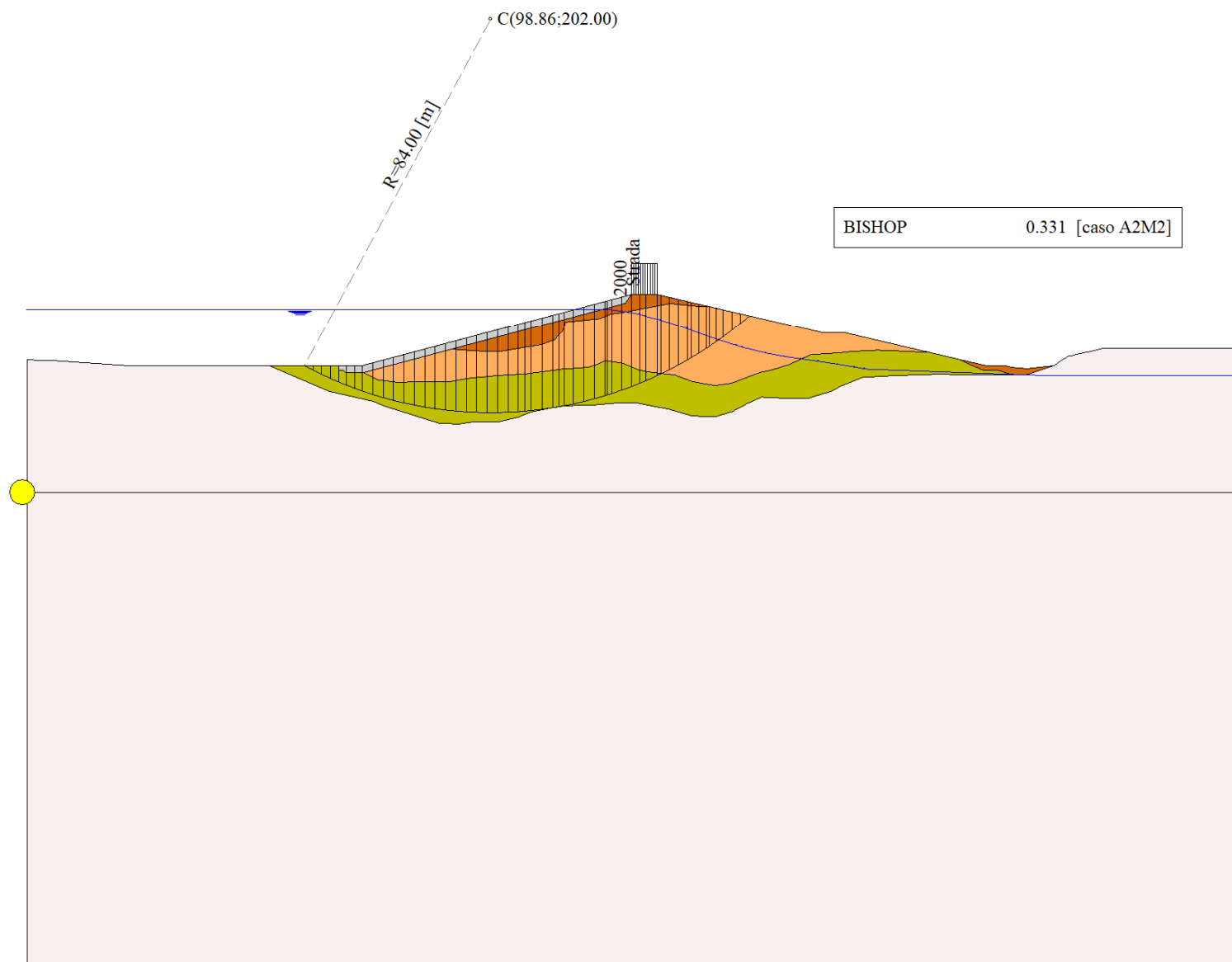


Figura 28-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 24.

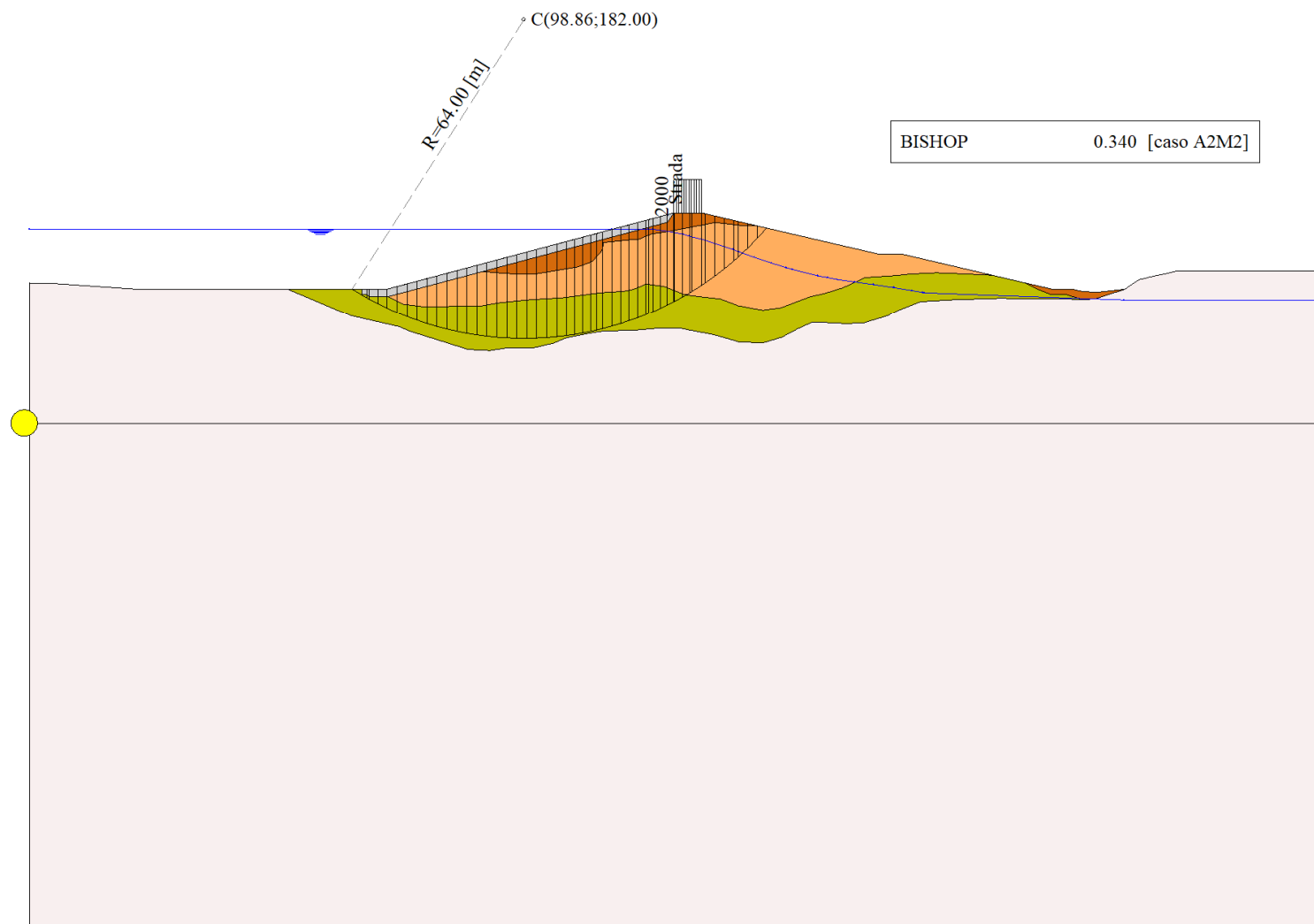


Figura 28-2 – Superficie critica (24) della sezione CR\_06 per la verifica di stabilità 24.



## 29 VERIFICA DI STABILITÀ 25

### 29.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	128.86	134.36	2000	0
				143.30	143.30	2000	0

Tabella 29-1 – Carichi distribuiti verifica di stabilità 25.

### 29.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate in condizioni **statiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 29.2 RISULTATI ANALISI

Numero di superfici analizzate	44242
Coefficiente di sicurezza minimo	1.246
Superficie con coefficiente di sicurezza minimo	1

### 29.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO L'ALTO

Numero di strisce	49
Coordinate del centro	X[m]= 98.86                      Y[m]= 166.00
Raggio del cerchio	R[m]= 48.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 69.53                      Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 140.37                      Y <sub>m</sub> [m]= 141.90
Coefficiente di sicurezza	F <sub>s</sub> = 1.246

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	69.53	128.00	128.00	70.51	128.00	127.27	70.18	127.76	1.22	-36.93	38.66	0
2	70.51	128.00	127.27	71.48	128.00	126.57	71.05	127.44	1.19	-35.49	38.66	0
3	71.48	128.00	126.57	71.68	128.05	126.44	71.58	127.27	0.24	-34.63	20.97	24
4	71.68	128.05	126.44	73.22	128.46	125.42	72.53	127.08	1.84	-33.39	0.00	52
5	73.22	128.46	125.42	74.76	128.87	124.49	74.04	126.80	1.80	-31.21	0.00	52
6	74.76	128.87	124.49	76.03	129.21	123.78	75.42	126.59	1.46	-29.27	0.00	52
7	76.03	129.21	123.78	77.30	129.55	123.11	76.68	126.41	1.43	-27.55	0.00	52
8	77.30	129.55	123.11	78.97	130.00	122.31	78.16	126.24	1.86	-25.58	0.00	52
9	78.97	130.00	122.31	80.65	130.44	121.59	79.83	126.08	1.82	-23.39	0.00	52
10	80.65	130.44	121.59	82.32	130.89	120.94	81.50	125.96	1.80	-21.23	0.00	52
11	82.32	130.89	120.94	84.00	131.34	120.36	83.17	125.88	1.77	-19.10	0.00	52
12	84.00	131.34	120.36	85.67	131.78	119.85	84.84	125.83	1.75	-16.99	0.00	52
13	85.67	131.78	119.85	87.34	132.23	119.40	86.52	125.82	1.73	-14.92	0.00	52
14	87.34	132.23	119.40	89.02	132.68	119.02	88.19	125.83	1.72	-12.86	0.00	52
15	89.02	132.68	119.02	90.69	133.12	118.70	89.86	125.88	1.70	-10.82	0.00	52
16	90.69	133.12	118.70	92.37	133.57	118.44	91.53	125.96	1.69	-8.79	0.00	52
17	92.37	133.57	118.44	94.04	134.02	118.24	93.21	126.07	1.69	-6.77	0.00	52

N°	X <sub>s</sub>	Y <sub>ss</sub>	Y <sub>si</sub>	X <sub>d</sub>	Y <sub>ds</sub>	Y <sub>di</sub>	X <sub>g</sub>	Y <sub>g</sub>	L	α	β	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
18	94.04	134.02	118.24	95.71	134.46	118.10	94.88	126.21	1.68	-4.76	0.00	52
19	95.71	134.46	118.10	97.39	134.91	118.02	96.55	126.37	1.68	-2.76	0.00	52
20	97.39	134.91	118.02	99.06	135.35	118.00	98.23	126.57	1.67	-0.76	0.00	52
21	99.06	135.35	118.00	100.73	135.80	118.04	99.90	126.80	1.67	1.24	0.00	52
22	100.73	135.80	118.04	102.41	136.25	118.13	101.57	127.05	1.68	3.24	0.00	52
23	102.41	136.25	118.13	104.08	136.69	118.28	103.25	127.34	1.68	5.24	0.00	52
24	104.08	136.69	118.28	105.76	137.14	118.50	104.92	127.65	1.69	7.25	0.00	52
25	105.76	137.14	118.50	107.43	137.59	118.77	106.59	128.00	1.70	9.27	0.00	52
26	107.43	137.59	118.77	109.00	138.01	119.08	108.22	128.36	1.60	11.24	0.00	52
27	109.00	138.01	119.08	110.58	138.42	119.45	109.79	128.74	1.62	13.16	0.00	52
28	110.58	138.42	119.45	112.15	138.84	119.88	111.36	129.15	1.63	15.10	0.00	52
29	112.15	138.84	119.88	113.84	139.29	120.40	112.99	129.60	1.77	17.13	0.00	52
30	113.84	139.29	120.40	115.53	139.74	120.99	114.68	130.11	1.79	19.25	0.00	52
31	115.53	139.74	120.99	117.22	140.19	121.65	116.37	130.64	1.81	21.40	0.00	52
32	117.22	140.19	121.65	118.90	140.65	122.39	118.06	131.22	1.84	23.58	0.00	52
33	118.90	140.65	122.39	120.59	141.10	123.20	119.74	131.83	1.88	25.80	0.00	52
34	120.59	141.10	123.20	122.28	141.55	124.10	121.43	132.48	1.91	28.06	0.00	52
35	122.28	141.55	124.10	123.28	141.81	124.68	122.78	133.03	1.15	29.89	0.00	52
36	123.28	141.81	124.68	123.78	141.95	124.98	123.53	133.35	0.58	30.93	0.00	52
37	123.78	141.95	124.98	124.71	142.19	125.56	124.24	133.67	1.10	31.93	0.00	52
38	124.71	142.19	125.56	126.09	142.56	126.47	125.40	134.19	1.66	33.58	0.00	52
39	126.09	142.56	126.47	127.48	142.93	127.46	126.78	134.86	1.70	35.58	0.00	52
40	127.48	142.93	127.46	128.86	143.30	128.53	128.16	135.55	1.75	37.64	0.00	53
41	128.86	143.30	128.53	128.92	143.30	128.58	128.89	135.93	0.08	38.73	0.00	54
42	128.92	143.30	128.58	130.61	143.30	130.00	129.75	136.29	2.21	40.09	0.00	54
43	130.61	143.30	130.00	131.99	143.30	131.27	131.29	136.96	1.87	42.53	0.00	54
44	131.99	143.30	131.27	133.18	143.30	132.44	132.57	137.57	1.67	44.64	0.00	54
45	133.18	143.30	132.44	134.36	143.30	133.69	133.76	138.18	1.73	46.67	0.00	54
46	134.36	143.30	133.69	135.17	143.11	134.61	134.76	138.67	1.22	48.42	0.00	54
47	135.17	143.11	134.61	136.90	142.71	136.73	135.99	139.26	2.74	50.79	0.00	54
48	136.90	142.71	136.73	138.64	142.30	139.13	137.68	140.17	2.96	54.19	0.00	54
49	138.64	142.30	139.13	140.37	141.90	141.90	139.21	141.11	3.26	57.91	0.00	54

Tabella 29-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 25.

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
1	711	0	1720	1105	0	0	1917	0	0	
2	2098	0	4752	3051	0	1917	7160	0	0	
3	608	0	1354	891	0	7160	8663	0	0	
4	7067	0	13651	7870	0	8663	22746	0	0	
5	11122	0	17660	7684	0	22746	38470	0	0	
6	12099	0	17351	6212	0	38470	52372	0	0	
7	14651	0	19712	6112	0	52372	66907	0	0	
8	23059	0	29357	7919	0	66907	86726	0	0	
9	27183	0	32982	7782	0	86726	106960	0	0	
10	31059	0	36296	7663	0	106960	127244	0	0	
11	34681	0	39317	7559	0	127244	147250	0	0	
12	38057	0	42078	7469	0	147250	166692	0	0	
13	41198	0	44604	7392	0	166692	185316	0	0	
14	44110	0	46917	7326	0	185316	202899	0	0	
15	46807	0	49043	7272	0	202899	219245	0	0	
16	49403	0	51107	7228	0	219245	234195	0	0	

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
17	51845	0	53063	7193	0	234195	247593	0	0	
18	54065	0	54849	7167	0	247593	259290	0	0	
19	56043	0	56453	7151	0	259290	269150	0	0	
20	57807	0	57907	7143	0	269150	277060	0	0	
21	59364	0	59223	7144	0	277060	282923	0	0	
22	60676	0	60368	7154	0	282923	286655	0	0	
23	61743	0	61345	7173	0	286655	288192	0	0	
24	62602	0	62191	7200	0	288192	287483	0	0	
25	63255	0	62911	7237	0	287483	284489	0	0	
26	59885	0	59696	6845	0	284489	279564	0	0	
27	60108	0	60118	6895	0	279564	272587	0	0	
28	60102	0	60376	6954	0	272587	263571	0	0	
29	64190	0	64846	7539	0	263571	251677	0	0	
30	63385	0	64474	7631	0	251677	237625	0	0	
31	62553	0	64153	7738	0	237625	221422	0	0	
32	61625	0	63809	7861	0	221422	203099	0	0	
33	60441	0	63265	8002	0	203099	182768	0	0	
34	59055	0	62570	8164	0	182768	160538	0	0	
35	34211	0	36631	4922	0	160538	146549	0	0	
36	17006	0	18334	2487	0	146549	139260	0	0	
37	31086	0	33714	4676	0	139260	125398	0	0	
38	44853	0	49132	7085	0	125398	104129	0	0	
39	43033	0	47720	7258	0	104129	82265	0	0	
40	41011	0	45927	7603	0	82265	60239	0	0	
41	1736	156	2151	342	0	60239	59160	0	0	
42	46455	4394	58206	9814	0	59160	29181	0	0	
43	34298	3588	43779	8319	0	29181	5719	0	0	
44	26625	3081	34443	7399	0	5719	-13219	0	0	
45	23813	3081	31058	7671	0	-13219	-30545	0	0	
46	14403	0	15591	5423	0	-30545	-38610	0	0	
47	24618	0	24017	12177	0	-38610	-49520	0	0	
48	15565	0	8365	13158	0	-49520	-48606	0	0	
49	5477	0	-12614	14375	0	-48606	-30283	0	0	

Tabella 29-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 25.

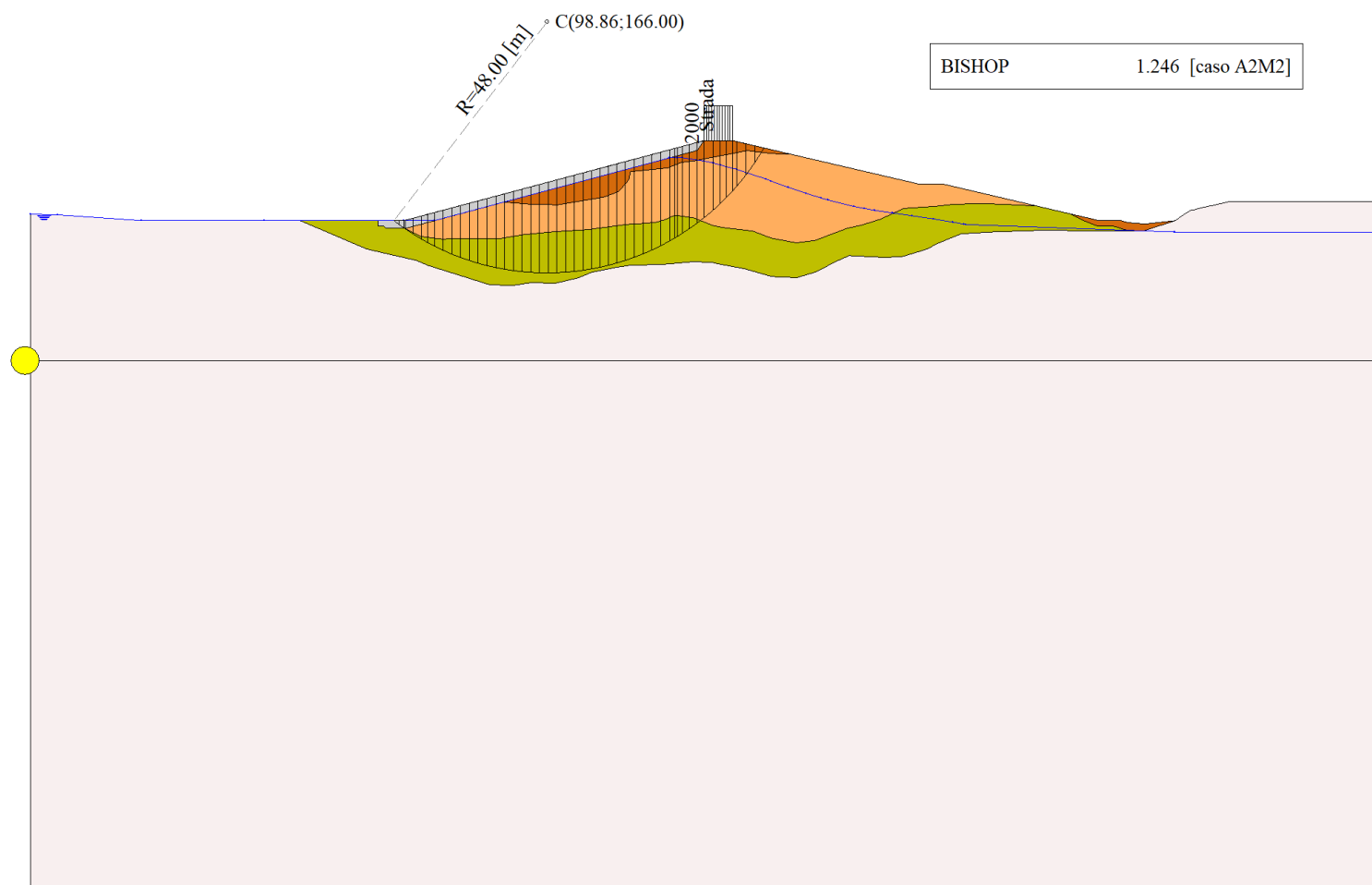


Figura 29-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 25.

## 30 VERIFICA DI STABILITÀ 26

### 30.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	P <sub>i</sub> [m]	P <sub>f</sub> [m]	V <sub>y</sub> [kg/m]	V <sub>x</sub> [kg/m]
1	Strada	Variabile	1.00	128.86	134.36	2000	0
				143.30	143.30	2000	0

Tabella 30-1 – Carichi distribuiti verifica di stabilità 26.

### 30.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **sismiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 30.2 RISULTATI ANALISI

Numero di superfici analizzate	88393
Coefficiente di sicurezza minimo	0.602
Superficie con coefficiente di sicurezza minimo	1

### 30.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	48
Coordinate del centro	X[m]= 100.86                      Y[m]= 160.00
Raggio del cerchio	R[m]= 42.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 73.14                      Y <sub>v</sub> [m]= 128.44
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 138.92                      Y <sub>m</sub> [m]= 142.23
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.602</b>

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	73.14	128.44	128.44	74.53	128.81	127.28	74.07	128.18	1.81	-40.06	38.66	0
2	74.53	128.81	127.28	75.91	129.18	126.21	75.30	127.85	1.75	-37.63	0.52	54
3	75.91	129.18	126.21	77.30	129.55	125.23	76.65	127.53	1.70	-35.28	0.00	54
4	77.30	129.55	125.23	78.59	129.90	124.39	77.97	127.26	1.54	-33.07	0.00	54
5	78.59	129.90	124.39	80.19	130.32	123.44	79.42	127.01	1.86	-30.75	0.00	52
6	80.19	130.32	123.44	81.79	130.75	122.58	81.02	126.77	1.82	-28.24	0.00	52
7	81.79	130.75	122.58	83.40	131.18	121.80	82.61	126.57	1.78	-25.78	0.00	52
8	83.40	131.18	121.80	85.00	131.60	121.11	84.21	126.42	1.75	-23.38	0.00	52
9	85.00	131.60	121.11	86.60	132.03	120.49	85.81	126.31	1.72	-21.02	0.00	52
10	86.60	132.03	120.49	88.20	132.46	119.95	87.41	126.23	1.69	-18.69	0.00	52
11	88.20	132.46	119.95	89.81	132.89	119.48	89.01	126.19	1.67	-16.40	0.00	52
12	89.81	132.89	119.48	91.41	133.31	119.08	90.61	126.19	1.65	-14.13	0.00	52
13	91.41	133.31	119.08	93.01	133.74	118.74	92.22	126.22	1.64	-11.89	0.00	52
14	93.01	133.74	118.74	94.61	134.17	118.47	93.82	126.28	1.63	-9.66	0.00	52
15	94.61	134.17	118.47	96.21	134.60	118.26	95.42	126.37	1.62	-7.45	0.00	52
16	96.21	134.60	118.26	97.82	135.02	118.11	97.02	126.50	1.61	-5.25	0.00	52
17	97.82	135.02	118.11	99.42	135.45	118.02	98.62	126.65	1.60	-3.06	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∅ [°]	∅ [°]	c [kPa]
18	99.42	135.45	118.02	101.02	135.88	118.00	100.22	126.84	1.60	-0.87	0.00	52
19	101.02	135.88	118.00	102.62	136.30	118.04	101.83	127.06	1.60	1.31	0.00	52
20	102.62	136.30	118.04	104.23	136.73	118.14	103.43	127.30	1.61	3.50	0.00	52
21	104.23	136.73	118.14	105.83	137.16	118.29	105.03	127.58	1.61	5.69	0.00	52
22	105.83	137.16	118.29	107.43	137.59	118.52	106.63	127.89	1.62	7.90	0.00	52
23	107.43	137.59	118.52	109.00	138.01	118.80	108.22	128.23	1.60	10.09	0.00	52
24	109.00	138.01	118.80	110.58	138.42	119.14	109.79	128.59	1.61	12.28	0.00	52
25	110.58	138.42	119.14	112.15	138.84	119.55	111.36	128.99	1.62	14.48	0.00	52
26	112.15	138.84	119.55	113.60	139.23	119.98	112.87	129.40	1.51	16.62	0.00	52
27	113.60	139.23	119.98	115.04	139.62	120.47	114.32	129.82	1.53	18.70	0.00	52
28	115.04	139.62	120.47	116.49	140.00	121.02	115.77	130.28	1.55	20.79	0.00	52
29	116.49	140.00	121.02	117.94	140.39	121.63	117.21	130.76	1.57	22.92	0.00	52
30	117.94	140.39	121.63	119.39	140.77	122.31	118.66	131.27	1.60	25.08	0.00	52
31	119.39	140.77	122.31	120.83	141.16	123.05	120.11	131.82	1.63	27.28	0.00	52
32	120.83	141.16	123.05	122.28	141.55	123.87	121.55	132.41	1.66	29.53	0.00	52
33	122.28	141.55	123.87	123.28	141.81	124.48	122.78	132.93	1.17	31.46	0.00	52
34	123.28	141.81	124.48	123.78	141.95	124.81	123.53	133.26	0.59	32.67	0.00	52
35	123.78	141.95	124.81	124.71	142.19	125.43	124.24	133.59	1.12	33.84	0.00	52
36	124.71	142.19	125.43	126.09	142.56	126.43	125.40	134.15	1.70	35.76	0.00	52
37	126.09	142.56	126.43	127.48	142.93	127.51	126.78	134.85	1.76	38.13	0.00	52
38	127.48	142.93	127.51	128.86	143.30	128.70	128.16	135.61	1.82	40.57	0.00	53
39	128.86	143.30	128.70	128.92	143.30	128.75	128.89	136.01	0.08	41.87	0.00	54
40	128.92	143.30	128.75	129.76	143.30	129.53	129.34	136.22	1.15	42.70	0.00	54
41	129.76	143.30	129.53	130.61	143.30	130.35	130.18	136.62	1.18	44.29	0.00	54
42	130.61	143.30	130.35	131.99	143.30	131.81	131.29	137.18	2.00	46.47	0.00	54
43	131.99	143.30	131.81	133.18	143.30	133.17	132.57	137.89	1.81	49.07	0.00	54
44	133.18	143.30	133.17	134.36	143.30	134.67	133.75	138.60	1.91	51.60	0.00	54
45	134.36	143.30	134.67	135.17	143.11	135.78	134.75	139.21	1.37	53.84	0.00	54
46	135.17	143.11	135.78	136.42	142.82	137.65	135.76	139.82	2.25	56.31	0.00	54
47	136.42	142.82	137.65	137.67	142.53	139.77	136.98	140.65	2.46	59.53	0.00	54
48	137.67	142.53	139.77	138.92	142.23	142.23	138.08	141.51	2.76	63.09	0.00	54

Tabella 30-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 26.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	1975	0	-24478	-32524	0	0	-41090	0	0	
2	5905	0	20766	16180	0	-41090	-16921	0	0	
3	9540	0	24036	15603	0	-16921	7560	0	0	
4	12000	0	25095	14080	0	7560	30361	0	0	
5	19040	0	34433	16464	0	30361	57846	0	0	
6	23433	0	38206	16061	0	57846	84817	0	0	
7	27524	0	41584	15714	0	84817	110882	0	0	
8	31331	0	44624	15415	0	110882	135713	0	0	
9	34870	0	47367	15158	0	135713	159031	0	0	
10	38155	0	49850	14937	0	159031	180600	0	0	
11	41197	0	52100	14749	0	180600	200221	0	0	
12	44045	0	54187	14591	0	200221	217725	0	0	
13	46782	0	56212	14459	0	217725	232964	0	0	
14	49310	0	58072	14353	0	232964	245804	0	0	
15	51600	0	59741	14270	0	245804	256132	0	0	
16	53656	0	61230	14209	0	256132	263855	0	0	
17	55499	0	62568	14169	0	263855	268900	0	0	

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
18	57132	0	63761	14151	0	268900	271210	0	0	
19	58515	0	64768	14153	0	271210	270754	0	0	
20	59667	0	65613	14176	0	270754	267516	0	0	
21	60611	0	66323	14219	0	267516	261493	0	0	
22	61351	0	66901	14285	0	261493	252694	0	0	
23	60782	0	66148	14112	0	252694	241370	0	0	
24	61103	0	66450	14219	0	241370	227432	0	0	
25	61169	0	66554	14350	0	227432	210962	0	0	
26	56085	0	61112	13337	0	210962	193683	0	0	
27	55558	0	60664	13492	0	193683	174559	0	0	
28	54896	0	60114	13670	0	174559	153687	0	0	
29	54267	0	59658	13875	0	153687	131063	0	0	
30	53450	0	59027	14110	0	131063	106834	0	0	
31	52451	0	58217	14380	0	106834	81165	0	0	
32	51297	0	57246	14688	0	81165	54227	0	0	
33	34654	0	38847	10353	0	54227	35011	0	0	
34	17196	0	19355	5245	0	35011	25123	0	0	
35	31377	0	35382	9888	0	25123	6598	0	0	
36	45108	0	50980	15055	0	6598	-21096	0	0	
37	43034	0	48651	15529	0	-21096	-48567	0	0	
38	40718	0	45533	16444	0	-48567	-74819	0	0	
39	1716	120	2078	741	0	-74819	-76066	0	0	
40	23481	1690	28337	10572	0	-76066	-93160	0	0	
41	22154	1690	26458	10854	0	-93160	-109215	0	0	
42	33107	2760	38524	18420	0	-109215	-132498	0	0	
43	25164	2370	27562	16629	0	-132498	-148600	0	0	
44	21852	2370	21237	17541	0	-148600	-159781	0	0	
45	12722	0	6708	12621	0	-159781	-160602	0	0	
46	15371	0	-242	20707	0	-160602	-152362	0	0	
47	9764	0	-17083	22649	0	-152362	-128343	0	0	
48	3455	0	-40984	25107	0	-128343	-81209	0	0	

Tabella 30-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 26.

### 30.2.2 ANALISI DELLA SUPERFICIE 64 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	50	
Coordinate del centro	X[m]= 98.86	Y[m]= 170.00
Raggio del cerchio	R[m]= 52.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 68.20	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 142.31	Y <sub>m</sub> [m]= 141.44
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.630</b>	

N°	X <sub>s</sub>	Y <sub>ss</sub>	Y <sub>si</sub>	X <sub>d</sub>	Y <sub>ds</sub>	Y <sub>di</sub>	X <sub>r</sub>	Y <sub>r</sub>	L	α	β	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
1	68.20	128.00	128.00	69.84	128.00	126.85	69.29	127.62	2.00	-35.03	38.66	0
2	69.84	128.00	126.85	71.48	128.00	125.79	70.75	127.13	1.95	-32.85	12.81	35
3	71.48	128.00	125.79	71.68	128.05	125.67	71.58	126.88	0.23	-31.64	0.00	52
4	71.68	128.05	125.67	73.09	128.43	124.84	72.43	126.74	1.63	-30.61	0.00	52
5	73.09	128.43	124.84	74.49	128.80	124.06	73.82	126.53	1.60	-28.83	0.00	52
6	74.49	128.80	124.06	75.89	129.18	123.35	75.22	126.34	1.58	-27.08	0.00	52
7	75.89	129.18	123.35	77.30	129.55	122.68	76.62	126.19	1.55	-25.35	0.00	52
8	77.30	129.55	122.68	79.07	130.02	121.91	78.21	126.04	1.93	-23.43	0.00	52

N°	X <sub>s</sub>	Y <sub>ss</sub>	Y <sub>si</sub>	X <sub>d</sub>	Y <sub>ds</sub>	Y <sub>di</sub>	X <sub>g</sub>	Y <sub>g</sub>	L	∠	∠	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
9	79.07	130.02	121.91	80.84	130.50	121.22	79.98	125.91	1.90	-21.32	0.00	52
10	80.84	130.50	121.22	82.62	130.97	120.60	81.75	125.82	1.88	-19.24	0.00	52
11	82.62	130.97	120.60	84.39	131.44	120.05	83.52	125.77	1.86	-17.18	0.00	52
12	84.39	131.44	120.05	86.16	131.91	119.57	85.29	125.75	1.84	-15.15	0.00	52
13	86.16	131.91	119.57	87.93	132.39	119.16	87.06	125.76	1.82	-13.13	0.00	52
14	87.93	132.39	119.16	89.71	132.86	118.81	88.83	125.81	1.81	-11.13	0.00	52
15	89.71	132.86	118.81	91.48	133.33	118.53	90.60	125.88	1.80	-9.15	0.00	52
16	91.48	133.33	118.53	93.25	133.81	118.30	92.37	125.99	1.79	-7.18	0.00	52
17	93.25	133.81	118.30	95.02	134.28	118.14	94.14	126.13	1.78	-5.21	0.00	52
18	95.02	134.28	118.14	96.80	134.75	118.04	95.91	126.30	1.78	-3.25	0.00	52
19	96.80	134.75	118.04	98.57	135.22	118.00	97.69	126.50	1.77	-1.30	0.00	52
20	98.57	135.22	118.00	100.34	135.70	118.02	99.46	126.74	1.77	0.66	0.00	52
21	100.34	135.70	118.02	102.11	136.17	118.10	101.23	127.00	1.77	2.61	0.00	52
22	102.11	136.17	118.10	103.89	136.64	118.24	103.00	127.29	1.78	4.57	0.00	52
23	103.89	136.64	118.24	105.66	137.11	118.45	104.77	127.61	1.78	6.53	0.00	52
24	105.66	137.11	118.45	107.43	137.59	118.71	106.55	127.96	1.79	8.50	0.00	52
25	107.43	137.59	118.71	109.00	138.01	119.00	108.22	128.33	1.60	10.37	0.00	52
26	109.00	138.01	119.00	110.58	138.42	119.34	109.79	128.69	1.61	12.14	0.00	52
27	110.58	138.42	119.34	112.15	138.84	119.73	111.36	129.08	1.62	13.91	0.00	52
28	112.15	138.84	119.73	113.84	139.29	120.20	112.99	129.52	1.75	15.77	0.00	52
29	113.84	139.29	120.20	115.53	139.74	120.74	114.68	130.00	1.77	17.72	0.00	52
30	115.53	139.74	120.74	117.22	140.19	121.35	116.37	130.51	1.79	19.68	0.00	52
31	117.22	140.19	121.35	118.90	140.65	122.02	118.06	131.05	1.82	21.67	0.00	52
32	118.90	140.65	122.02	120.59	141.10	122.76	119.75	131.63	1.84	23.69	0.00	52
33	120.59	141.10	122.76	122.28	141.55	123.57	121.43	132.24	1.87	25.74	0.00	52
34	122.28	141.55	123.57	123.28	141.81	124.09	122.78	132.75	1.13	27.39	0.00	52
35	123.28	141.81	124.09	123.78	141.95	124.36	123.53	133.05	0.57	28.32	0.00	52
36	123.78	141.95	124.36	124.71	142.19	124.88	124.24	133.34	1.07	29.22	0.00	52
37	124.71	142.19	124.88	126.09	142.56	125.70	125.40	133.83	1.61	30.70	0.00	52
38	126.09	142.56	125.70	127.48	142.93	126.58	126.78	134.44	1.64	32.49	0.00	52
39	127.48	142.93	126.58	128.86	143.30	127.53	128.16	135.08	1.67	34.31	0.00	52
40	128.86	143.30	127.53	128.92	143.30	127.57	128.89	135.42	0.07	35.27	0.00	52
41	128.92	143.30	127.57	130.61	143.30	128.82	129.75	135.74	2.10	36.47	0.00	54
42	130.61	143.30	128.82	131.99	143.30	129.92	131.29	136.33	1.77	38.60	0.00	54
43	131.99	143.30	129.92	133.18	143.30	130.93	132.57	136.86	1.56	40.43	0.00	54
44	133.18	143.30	130.93	134.36	143.30	132.00	133.76	137.38	1.60	42.17	0.00	54
45	134.36	143.30	132.00	135.17	143.11	132.78	134.76	137.80	1.12	43.67	0.00	54
46	135.17	143.11	132.78	136.85	142.72	134.50	135.98	138.26	2.41	45.61	0.00	54
47	136.85	142.72	134.50	138.53	142.32	136.39	137.65	138.96	2.53	48.33	0.00	54
48	138.53	142.32	136.39	140.22	141.93	138.48	139.30	139.74	2.69	51.21	0.00	54
49	140.22	141.93	138.48	141.90	141.54	140.82	140.87	140.59	2.88	54.27	0.00	54
50	141.90	141.54	140.82	142.31	141.44	141.44	142.04	141.27	0.75	56.27	0.00	53

Tabella 30-4 – Geometria e caratteristiche strisce della superficie 64 della verifica di stabilità 26.

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
1	1884	0	23235	29499	0	0	37070	0	0	
2	5547	0	18843	17812	0	37070	61010	0	0	
3	934	0	2442	1982	0	61010	63769	0	0	
4	8415	0	19026	13776	0	63769	83427	0	0	
5	11535	0	22092	13533	0	83427	103349	0	0	
6	14529	0	24954	13315	0	103349	123306	0	0	



N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
7	17449	0	27689	13119	0	123306	143105	0	0	
8	26021	0	38603	16300	0	143105	167576	0	0	
9	30357	0	42505	16054	0	167576	191177	0	0	
10	34432	0	46084	15840	0	191177	213595	0	0	
11	38238	0	49351	15654	0	213595	234553	0	0	
12	41785	0	52336	15494	0	234553	253813	0	0	
13	45081	0	55064	15357	0	253813	271170	0	0	
14	48132	0	57555	15243	0	271170	286446	0	0	
15	50990	0	59878	15148	0	286446	299489	0	0	
16	53757	0	62154	15074	0	299489	310155	0	0	
17	56306	0	64248	15018	0	310155	318321	0	0	
18	58592	0	66118	14980	0	318321	323889	0	0	
19	60630	0	67785	14959	0	323889	326785	0	0	
20	62441	0	69276	14957	0	326785	326947	0	0	
21	63998	0	70565	14971	0	326947	324340	0	0	
22	65274	0	71625	15003	0	324340	318956	0	0	
23	66319	0	72513	15053	0	318956	310796	0	0	
24	67138	0	73235	15122	0	310796	299874	0	0	
25	60126	0	65508	13497	0	299874	287879	0	0	
26	60440	0	65833	13580	0	287879	273763	0	0	
27	60541	0	65975	13678	0	273763	257598	0	0	
28	64800	0	70704	14804	0	257598	238093	0	0	
29	64161	0	70129	14956	0	238093	216610	0	0	
30	63522	0	69615	15131	0	216610	193167	0	0	
31	62814	0	69078	15330	0	193167	167820	0	0	
32	61882	0	68327	15557	0	167820	140740	0	0	
33	60784	0	67419	15815	0	140740	112082	0	0	
34	35386	0	39398	9504	0	112082	94462	0	0	
35	17639	0	19701	4793	0	94462	85379	0	0	
36	32351	0	36195	8992	0	85379	68302	0	0	
37	46963	0	52680	13575	0	68302	42552	0	0	
38	45444	0	51103	13838	0	42552	16588	0	0	
39	43714	0	49212	14132	0	16588	-9282	0	0	
40	1855	120	2251	620	0	-9282	-10518	0	0	
41	50042	3380	60274	18409	0	-10518	-43525	0	0	
42	37676	2760	45159	15513	0	-43525	-68645	0	0	
43	29899	2370	35494	13677	0	-68645	-88491	0	0	
44	27480	2370	32067	14047	0	-88491	-106303	0	0	
45	17162	0	16995	9838	0	-106303	-114771	0	0	
46	30542	0	26971	21131	0	-114771	-126113	0	0	
47	23283	0	13966	22234	0	-126113	-126987	0	0	
48	15477	0	-1878	23593	0	-126987	-114212	0	0	
49	6940	0	-21977	25314	0	-114212	-83147	0	0	
50	305	0	-8942	6377	0	-83147	-72237	0	0	

Tabella 30-5 – Forze applicate sulle strisce [BISHOP] della superficie 64 della verifica di stabilità 26.

### 30.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.006936
2	0.001639
3	0.006005
4	0.005644
5	0.001377
6	0.002033
7	0.000855

Tabella 30-6 – Spostamenti della superficie 1 della verifica di stabilità 26.

Accelerazione sismica critica  $K_c = 0.073$   
Spostamento massimo  $U_{max} = 0.006936$  [m]  
Velocità massima  $V_{max} = 0.039123$  [m/s]

n°	u
	[m]
1	0.011027
2	0.002419
3	0.009419
4	0.008465
5	0.003019
6	0.003484
7	0.001651

Tabella 30-7 – Spostamenti della superficie 64 della verifica di stabilità 26.

Accelerazione sismica critica  $K_c = 0.062$   
Spostamento massimo  $U_{max} = 0.011027$  [m]  
Velocità massima  $V_{max} = 0.047430$  [m/s]

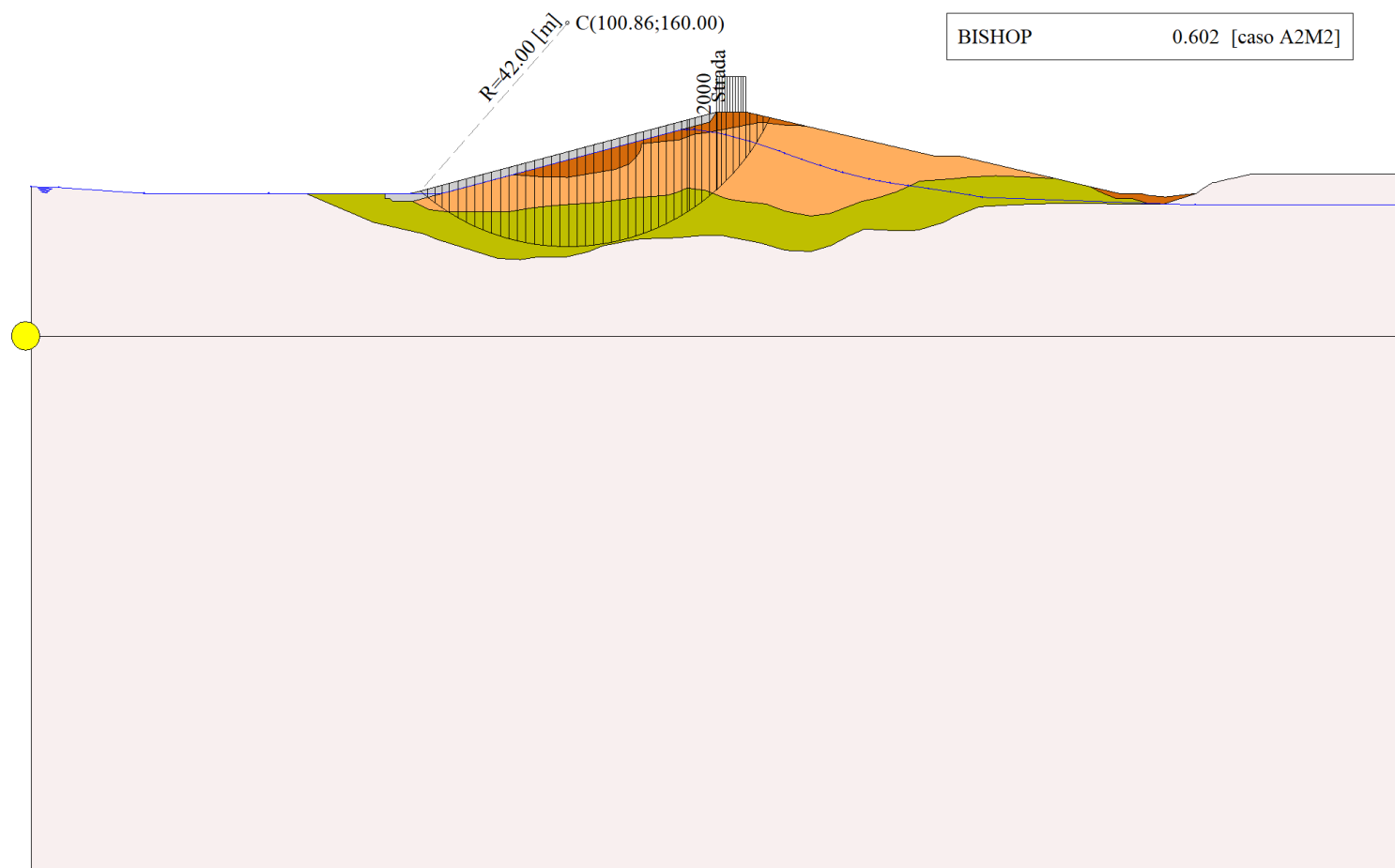


Figura 30-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 26.

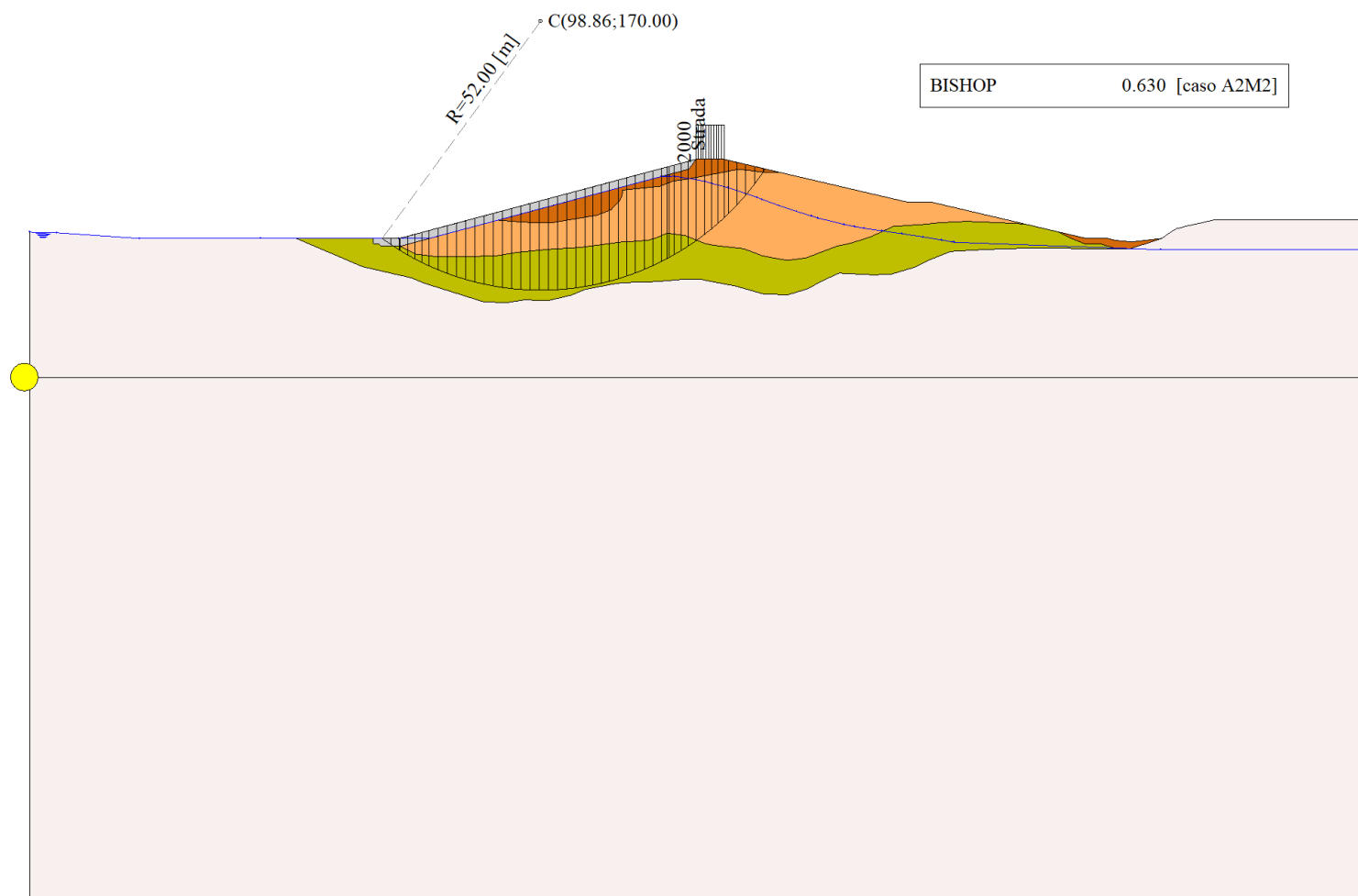


Figura 30-2 – Superficie critica (64) della sezione CR\_06 per la verifica di stabilità 26.

## 31 VERIFICA DI STABILITÀ 27

### 31.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	P <sub>i</sub> [m]	P <sub>f</sub> [m]	V <sub>y</sub> [kg/m]	V <sub>x</sub> [kg/m]
1	Strada	Variabile	1.00	128.86 143.30	134.36 143.30	2000 2000	0 0

Tabella 31-1 – Carichi distribuiti verifica di stabilità 27.

### 31.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **sismiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 31.2 RISULTATI ANALISI

Numero di superfici analizzate	88221
Coefficiente di sicurezza minimo	0.452
Superficie con coefficiente di sicurezza minimo	1

### 31.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	52
Coordinate del centro	X[m]= 100.86                      Y[m]= 178.00
Raggio del cerchio	R[m]= 60.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 67.69                      Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 147.48                      Y <sub>m</sub> [m]= 140.23
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.452</b>

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	67.69	128.00	128.00	69.59	128.00	126.79	68.96	127.60	2.24	-32.49	38.66	0
2	69.59	128.00	126.79	71.48	128.00	125.69	70.63	127.09	2.19	-30.37	10.27	38
3	71.48	128.00	125.69	71.68	128.05	125.57	71.58	126.83	0.23	-29.21	0.00	52
4	71.68	128.05	125.57	73.22	128.46	124.75	72.50	126.70	1.75	-28.27	0.00	52
5	73.22	128.46	124.75	74.76	128.87	123.97	74.03	126.51	1.72	-26.61	0.00	52
6	74.76	128.87	123.97	76.03	129.21	123.38	75.41	126.36	1.40	-25.12	0.00	52
7	76.03	129.21	123.38	77.30	129.55	122.82	76.68	126.24	1.39	-23.78	0.00	52
8	77.30	129.55	122.82	79.18	130.05	122.05	78.27	126.12	2.03	-22.15	0.00	52
9	79.18	130.05	122.05	81.07	130.56	121.36	80.15	126.00	2.01	-20.22	0.00	52
10	81.07	130.56	121.36	82.95	131.06	120.74	82.03	125.93	1.98	-18.32	0.00	52
11	82.95	131.06	120.74	84.83	131.56	120.18	83.91	125.88	1.96	-16.43	0.00	52
12	84.83	131.56	120.18	86.72	132.06	119.69	85.79	125.87	1.95	-14.56	0.00	52
13	86.72	132.06	119.69	88.60	132.56	119.27	87.67	125.90	1.93	-12.71	0.00	52
14	88.60	132.56	119.27	90.48	133.07	118.90	89.55	125.95	1.92	-10.88	0.00	52
15	90.48	133.07	118.90	92.37	133.57	118.60	91.43	126.04	1.91	-9.05	0.00	52
16	92.37	133.57	118.60	94.25	134.07	118.37	93.31	126.15	1.90	-7.23	0.00	52
17	94.25	134.07	118.37	96.13	134.57	118.19	95.20	126.30	1.89	-5.42	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∅ [°]	∅ [°]	c [kPa]
18	96.13	134.57	118.19	98.01	135.08	118.07	97.08	126.48	1.89	-3.62	0.00	52
19	98.01	135.08	118.07	99.90	135.58	118.01	98.96	126.68	1.88	-1.82	0.00	52
20	99.90	135.58	118.01	101.78	136.08	118.01	100.84	126.92	1.88	-0.02	0.00	52
21	101.78	136.08	118.01	103.66	136.58	118.07	102.73	127.18	1.88	1.78	0.00	52
22	103.66	136.58	118.07	105.55	137.08	118.18	104.61	127.48	1.89	3.58	0.00	52
23	105.55	137.08	118.18	107.43	137.59	118.36	106.49	127.80	1.89	5.38	0.00	52
24	107.43	137.59	118.36	109.00	138.01	118.56	108.22	128.13	1.59	7.04	0.00	52
25	109.00	138.01	118.56	110.58	138.42	118.79	109.79	128.44	1.59	8.56	0.00	52
26	110.58	138.42	118.79	112.15	138.84	119.07	111.36	128.78	1.60	10.08	0.00	52
27	112.15	138.84	119.07	113.37	139.17	119.32	112.76	129.10	1.24	11.44	0.00	52
28	113.37	139.17	119.32	114.59	139.49	119.59	113.98	129.39	1.25	12.63	0.00	52
29	114.59	139.49	119.59	116.51	140.01	120.08	115.55	129.79	1.98	14.18	0.00	52
30	116.51	140.01	120.08	118.44	140.52	120.63	117.47	130.31	2.00	16.08	0.00	52
31	118.44	140.52	120.63	120.36	141.03	121.26	119.40	130.86	2.02	18.00	0.00	52
32	120.36	141.03	121.26	122.28	141.55	121.95	121.32	131.45	2.05	19.94	0.00	52
33	122.28	141.55	121.95	123.28	141.81	122.35	122.78	131.91	1.07	21.43	0.00	52
34	123.28	141.81	122.35	123.78	141.95	122.55	123.53	132.16	0.54	22.20	0.00	52
35	123.78	141.95	122.55	124.71	142.19	122.94	124.24	132.41	1.01	22.94	0.00	52
36	124.71	142.19	122.94	126.09	142.56	123.56	125.40	132.82	1.52	24.15	0.00	52
37	126.09	142.56	123.56	127.48	142.93	124.23	126.78	133.32	1.53	25.60	0.00	52
38	127.48	142.93	124.23	128.86	143.30	124.93	128.17	133.85	1.55	27.08	0.00	52
39	128.86	143.30	124.93	128.92	143.30	124.97	128.89	134.12	0.07	27.85	0.00	52
40	128.92	143.30	124.97	130.61	143.30	125.89	129.76	134.36	1.93	28.80	0.00	52
41	130.61	143.30	125.89	131.99	143.30	126.71	131.29	134.80	1.60	30.49	0.00	52
42	131.99	143.30	126.71	132.48	143.30	127.01	132.23	135.08	0.57	31.53	0.00	54
43	132.48	143.30	127.01	134.36	143.30	128.22	133.41	135.45	2.24	32.87	0.00	54
44	134.36	143.30	128.22	135.17	143.11	128.78	134.76	135.85	0.98	34.41	0.00	54
45	135.17	143.11	128.78	137.03	142.67	130.13	136.08	136.17	2.30	35.98	0.00	54
46	137.03	142.67	130.13	138.90	142.24	131.60	137.94	136.65	2.37	38.21	0.00	54
47	138.90	142.24	131.60	140.76	141.80	133.19	139.80	137.20	2.45	40.51	0.00	54
48	140.76	141.80	133.19	141.71	141.58	134.05	141.22	137.65	1.28	42.30	0.00	54
49	141.71	141.58	134.05	143.59	141.14	135.88	142.60	138.14	2.63	44.16	0.00	54
50	143.59	141.14	135.88	145.48	140.70	137.89	144.44	138.86	2.75	46.73	0.00	54
51	145.48	140.70	137.89	146.48	140.47	139.03	145.93	139.50	1.52	48.77	0.00	54
52	146.48	140.47	139.03	147.48	140.23	140.23	146.82	139.91	1.57	50.24	0.00	54

Tabella 31-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 27.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	2282	0	-24982	-44186	0	0	-51443	0	0	
2	6725	0	26369	29503	0	-51443	-14879	0	0	
3	977	0	2810	2694	0	-14879	-11480	0	0	
4	9567	0	23707	20554	0	-11480	14690	0	0	
5	13056	0	27157	20248	0	14690	40643	0	0	
6	13321	0	24871	16488	0	40643	61728	0	0	
7	15580	0	27028	16315	0	61728	82410	0	0	
8	27145	0	43878	23901	0	82410	112122	0	0	
9	31862	0	48252	23591	0	112122	140411	0	0	
10	36313	0	52288	23318	0	140411	166983	0	0	
11	40490	0	55993	23079	0	166983	191582	0	0	
12	44400	0	59394	22872	0	191582	213986	0	0	
13	48052	0	62515	22693	0	213986	234007	0	0	

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
14	51453	0	65380	22542	0	234007	251482	0	0	
15	54735	0	68150	22416	0	251482	266256	0	0	
16	57873	0	70805	22314	0	266256	278189	0	0	
17	60751	0	73215	22236	0	278189	287177	0	0	
18	63350	0	75365	22181	0	287177	293143	0	0	
19	65708	0	77303	22148	0	293143	296026	0	0	
20	67813	0	79022	22137	0	296026	295788	0	0	
21	69614	0	80464	22147	0	295788	292430	0	0	
22	71170	0	81701	22180	0	292430	285955	0	0	
23	72496	0	82749	22235	0	285955	276379	0	0	
24	61443	0	69834	18636	0	276379	266012	0	0	
25	62080	0	70334	18703	0	266012	253530	0	0	
26	62532	0	70664	18785	0	253530	238996	0	0	
27	48677	0	54906	14632	0	238996	226366	0	0	
28	48672	0	54825	14697	0	226366	212639	0	0	
29	76392	0	85918	23309	0	212639	188963	0	0	
30	76293	0	85734	23520	0	188963	162616	0	0	
31	75942	0	85318	23762	0	162616	133766	0	0	
32	75408	0	84746	24041	0	133766	102553	0	0	
33	38932	0	43776	12628	0	102553	85454	0	0	
34	19513	0	21966	6348	0	85454	76586	0	0	
35	36025	0	40556	11871	0	76586	59810	0	0	
36	52906	0	59567	17821	0	59810	34227	0	0	
37	51998	0	58543	18032	0	34227	8013	0	0	
38	50931	0	57313	18263	0	8013	-18638	0	0	
39	2183	120	2614	798	0	-18638	-19915	0	0	
40	59648	3380	71343	22672	0	-19915	-55244	0	0	
41	46014	2760	54865	18826	0	-55244	-82972	0	0	
42	15751	980	18576	7001	0	-82972	-92245	0	0	
43	57626	3760	67458	27394	0	-92245	-126130	0	0	
44	23261	0	24622	12016	0	-126130	-137815	0	0	
45	48827	0	49845	28180	0	-137815	-160424	0	0	
46	42060	0	39524	29022	0	-160424	-175961	0	0	
47	34927	0	27899	29995	0	-175961	-182819	0	0	
48	14926	0	9212	15718	0	-182819	-182323	0	0	
49	23443	0	6844	32159	0	-182323	-171766	0	0	
50	14763	0	-10660	33657	0	-171766	-145812	0	0	
51	4119	0	-13933	18593	0	-145812	-124440	0	0	
52	1393	0	-20495	19161	0	-124440	-96889	0	0	

Tabella 31-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 27.

31.2.2 ANALISI DELLA SUPERFICIE 8 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	50	
Coordinate del centro	X[m]= 98.86	Y[m]= 170.00
Raggio del cerchio	R[m]= 52.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 68.20	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 142.31	Y <sub>m</sub> [m]= 141.44
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.474</b>	

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α [°]	β [°]	c [kPa]
1	68.20	128.00	128.00	69.84	128.00	126.85	69.29	127.62	2.00	-35.03	38.66	0
2	69.84	128.00	126.85	71.48	128.00	125.79	70.75	127.13	1.95	-32.85	12.81	35
3	71.48	128.00	125.79	71.68	128.05	125.67	71.58	126.88	0.23	-31.64	0.00	52
4	71.68	128.05	125.67	73.09	128.43	124.84	72.43	126.74	1.63	-30.61	0.00	52
5	73.09	128.43	124.84	74.49	128.80	124.06	73.82	126.53	1.60	-28.83	0.00	52
6	74.49	128.80	124.06	75.89	129.18	123.35	75.22	126.34	1.58	-27.08	0.00	52
7	75.89	129.18	123.35	77.30	129.55	122.68	76.62	126.19	1.55	-25.35	0.00	52
8	77.30	129.55	122.68	79.07	130.02	121.91	78.21	126.04	1.93	-23.43	0.00	52
9	79.07	130.02	121.91	80.84	130.50	121.22	79.98	125.91	1.90	-21.32	0.00	52
10	80.84	130.50	121.22	82.62	130.97	120.60	81.75	125.82	1.88	-19.24	0.00	52
11	82.62	130.97	120.60	84.39	131.44	120.05	83.52	125.77	1.86	-17.18	0.00	52
12	84.39	131.44	120.05	86.16	131.91	119.57	85.29	125.75	1.84	-15.15	0.00	52
13	86.16	131.91	119.57	87.93	132.39	119.16	87.06	125.76	1.82	-13.13	0.00	52
14	87.93	132.39	119.16	89.71	132.86	118.81	88.83	125.81	1.81	-11.13	0.00	52
15	89.71	132.86	118.81	91.48	133.33	118.53	90.60	125.88	1.80	-9.15	0.00	52
16	91.48	133.33	118.53	93.25	133.81	118.30	92.37	125.99	1.79	-7.18	0.00	52
17	93.25	133.81	118.30	95.02	134.28	118.14	94.14	126.13	1.78	-5.21	0.00	52
18	95.02	134.28	118.14	96.80	134.75	118.04	95.91	126.30	1.78	-3.25	0.00	52
19	96.80	134.75	118.04	98.57	135.22	118.00	97.69	126.50	1.77	-1.30	0.00	52
20	98.57	135.22	118.00	100.34	135.70	118.02	99.46	126.74	1.77	0.66	0.00	52
21	100.34	135.70	118.02	102.11	136.17	118.10	101.23	127.00	1.77	2.61	0.00	52
22	102.11	136.17	118.10	103.89	136.64	118.24	103.00	127.29	1.78	4.57	0.00	52
23	103.89	136.64	118.24	105.66	137.11	118.45	104.77	127.61	1.78	6.53	0.00	52
24	105.66	137.11	118.45	107.43	137.59	118.71	106.55	127.96	1.79	8.50	0.00	52
25	107.43	137.59	118.71	109.00	138.01	119.00	108.22	128.33	1.60	10.37	0.00	52
26	109.00	138.01	119.00	110.58	138.42	119.34	109.79	128.69	1.61	12.14	0.00	52
27	110.58	138.42	119.34	112.15	138.84	119.73	111.36	129.08	1.62	13.91	0.00	52
28	112.15	138.84	119.73	113.84	139.29	120.20	112.99	129.52	1.75	15.77	0.00	52
29	113.84	139.29	120.20	115.53	139.74	120.74	114.68	130.00	1.77	17.72	0.00	52
30	115.53	139.74	120.74	117.22	140.19	121.35	116.37	130.51	1.79	19.68	0.00	52
31	117.22	140.19	121.35	118.90	140.65	122.02	118.06	131.05	1.82	21.67	0.00	52
32	118.90	140.65	122.02	120.59	141.10	122.76	119.75	131.63	1.84	23.69	0.00	52
33	120.59	141.10	122.76	122.28	141.55	123.57	121.43	132.24	1.87	25.74	0.00	52
34	122.28	141.55	123.57	123.28	141.81	124.09	122.78	132.75	1.13	27.39	0.00	52
35	123.28	141.81	124.09	123.78	141.95	124.36	123.53	133.05	0.57	28.32	0.00	52
36	123.78	141.95	124.36	124.71	142.19	124.88	124.24	133.34	1.07	29.22	0.00	52
37	124.71	142.19	124.88	126.09	142.56	125.70	125.40	133.83	1.61	30.70	0.00	52
38	126.09	142.56	125.70	127.48	142.93	126.58	126.78	134.44	1.64	32.49	0.00	52
39	127.48	142.93	126.58	128.86	143.30	127.53	128.16	135.08	1.67	34.31	0.00	52
40	128.86	143.30	127.53	128.92	143.30	127.57	128.89	135.42	0.07	35.27	0.00	52
41	128.92	143.30	127.57	130.61	143.30	128.82	129.75	135.74	2.10	36.47	0.00	54
42	130.61	143.30	128.82	131.99	143.30	129.92	131.29	136.33	1.77	38.60	0.00	54
43	131.99	143.30	129.92	133.18	143.30	130.93	132.57	136.86	1.56	40.43	0.00	54



N°	X <sub>s</sub>	Y <sub>ss</sub>	Y <sub>si</sub>	X <sub>d</sub>	Y <sub>ds</sub>	Y <sub>di</sub>	X <sub>g</sub>	Y <sub>g</sub>	L	∅	∅	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
44	133.18	143.30	130.93	134.36	143.30	132.00	133.76	137.38	1.60	42.17	0.00	54
45	134.36	143.30	132.00	135.17	143.11	132.78	134.76	137.80	1.12	43.67	0.00	54
46	135.17	143.11	132.78	136.85	142.72	134.50	135.98	138.26	2.41	45.61	0.00	54
47	136.85	142.72	134.50	138.53	142.32	136.39	137.65	138.96	2.53	48.33	0.00	54
48	138.53	142.32	136.39	140.22	141.93	138.48	139.30	139.74	2.69	51.21	0.00	54
49	140.22	141.93	138.48	141.90	141.54	140.82	140.87	140.59	2.88	54.27	0.00	54
50	141.90	141.54	140.82	142.31	141.44	141.44	142.04	141.27	0.75	56.27	0.00	53

Tabella 31-4 – Geometria e caratteristiche strisce della superficie 8 della verifica di stabilità 27.

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
1	1884	0	-14651	-24730	0	0	-29283	0	0	
2	5547	0	24838	26556	0	-29283	4667	0	0	
3	934	0	2903	2635	0	4667	8125	0	0	
4	8415	0	22230	18314	0	8125	32427	0	0	
5	11535	0	25245	17992	0	32427	56552	0	0	
6	14529	0	28063	17702	0	56552	80288	0	0	
7	17449	0	30761	17441	0	80288	103456	0	0	
8	26021	0	42435	21669	0	103456	131616	0	0	
9	30357	0	46298	21343	0	131616	158302	0	0	
10	34432	0	49839	21058	0	158302	183230	0	0	
11	38238	0	53069	20811	0	183230	206155	0	0	
12	41785	0	56015	20598	0	206155	226870	0	0	
13	45081	0	58701	20416	0	226870	245196	0	0	
14	48132	0	61146	20264	0	245196	260985	0	0	
15	50990	0	63422	20139	0	260985	274107	0	0	
16	53757	0	65654	20040	0	274107	284433	0	0	
17	56306	0	67699	19965	0	284433	291864	0	0	
18	58592	0	69512	19915	0	291864	296335	0	0	
19	60630	0	71114	19888	0	296335	297799	0	0	
20	62441	0	72533	19884	0	297799	296224	0	0	
21	63998	0	73739	19903	0	296224	291608	0	0	
22	65274	0	74705	19946	0	291608	283980	0	0	
23	66319	0	75487	20012	0	283980	273371	0	0	
24	67138	0	76092	20103	0	273371	259828	0	0	
25	60126	0	67937	17943	0	259828	245390	0	0	
26	60440	0	68151	18053	0	245390	228746	0	0	
27	60541	0	68168	18184	0	228746	210003	0	0	
28	64800	0	72899	19681	0	210003	187719	0	0	
29	64161	0	72129	19883	0	187719	163512	0	0	
30	63522	0	71411	20115	0	163512	137417	0	0	
31	62814	0	70658	20380	0	137417	109514	0	0	
32	61882	0	69664	20683	0	109514	80024	0	0	
33	60784	0	68487	21026	0	80024	49145	0	0	
34	35386	0	39890	12634	0	49145	30323	0	0	
35	17639	0	19913	6372	0	30323	20657	0	0	
36	32351	0	36504	11954	0	20657	2581	0	0	
37	46963	0	52923	18047	0	2581	-24431	0	0	
38	45444	0	51058	18397	0	-24431	-51348	0	0	
39	43714	0	48843	18788	0	-51348	-77803	0	0	
40	1855	120	2235	824	0	-77803	-79073	0	0	
41	50042	3380	59316	24473	0	-79073	-112302	0	0	

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
42	37676	2760	43824	20624	0	-112302	-136886	0	0	
43	29899	2370	33904	18183	0	-136886	-155696	0	0	
44	27480	2370	30012	18674	0	-155696	-171866	0	0	
45	17162	0	15160	13079	0	-171866	-178544	0	0	
46	30542	0	22176	28092	0	-178544	-184831	0	0	
47	23283	0	7594	29558	0	-184831	-178545	0	0	
48	15477	0	-10237	31365	0	-178545	-156029	0	0	
49	6940	0	-32941	33654	0	-156029	-111929	0	0	
50	305	0	-12060	8478	0	-111929	-97292	0	0	

Tabella 31-5 – Forze applicate sulle strisce [BISHOP] della superficie 8 della verifica di stabilità 27.

### 31.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.019756
2	0.011537
3	0.014010
4	0.006622
5	0.003887
6	0.023258
7	0.018722

Tabella 31-6 – Spostamenti della superficie 1 della verifica di stabilità 27.

Accelerazione sismica critica  $K_c = 0.066$   
 Spostamento massimo  $U_{max} = 0.023258$  [m]  
 Velocità massima  $V_{max} = 0.072108$  [m/s]

n°	u
	[m]
1	0.022156
2	0.013453
3	0.015843
4	0.007598
5	0.004366
6	0.027500
7	0.021712

Tabella 31-7 – Spostamenti della superficie 8 della verifica di stabilità 27.

Accelerazione sismica critica  $K_c = 0.062$   
 Spostamento massimo  $U_{max} = 0.027500$  [m]  
 Velocità massima  $V_{max} = 0.076283$  [m/s]

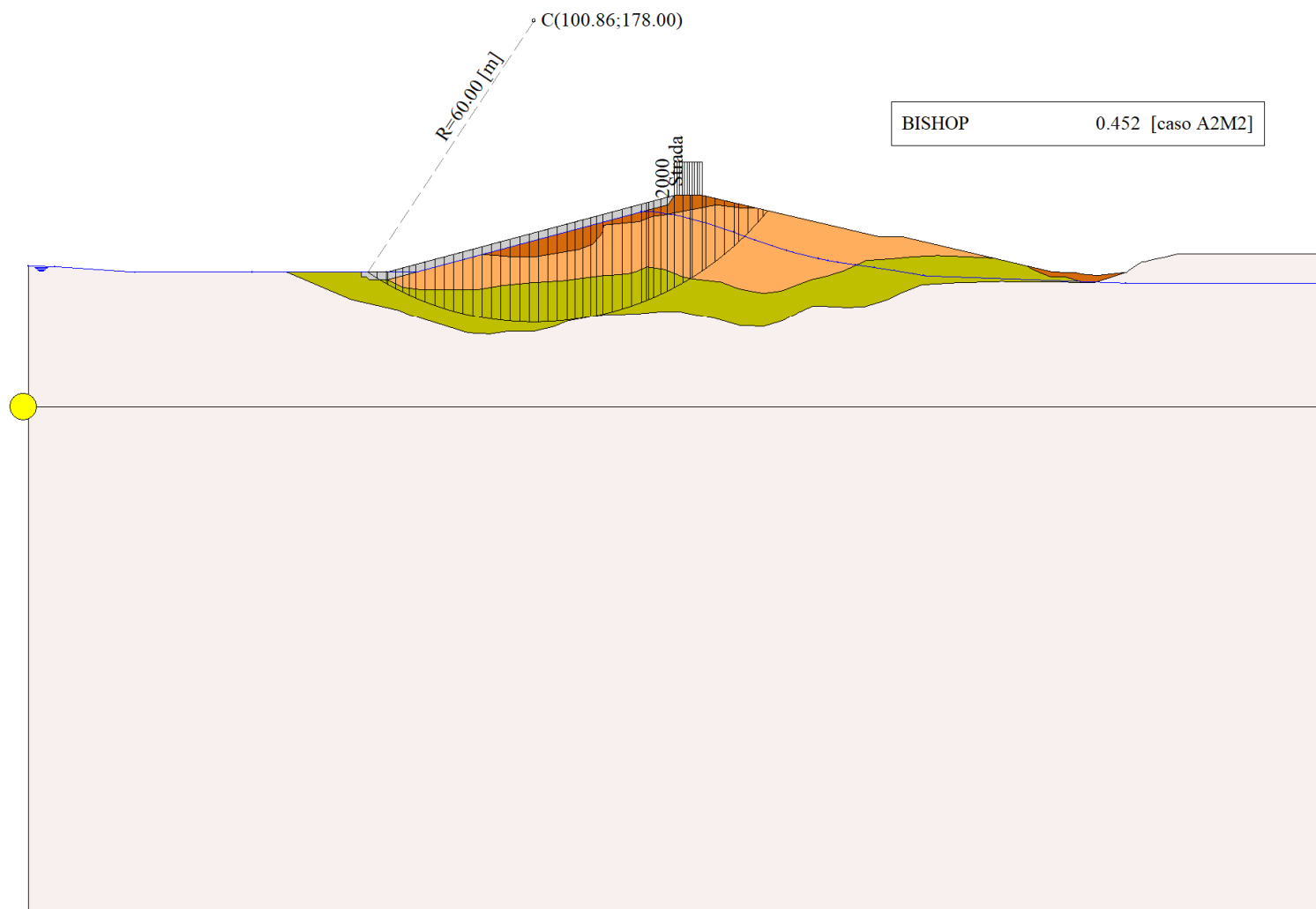


Figura 31-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 27.

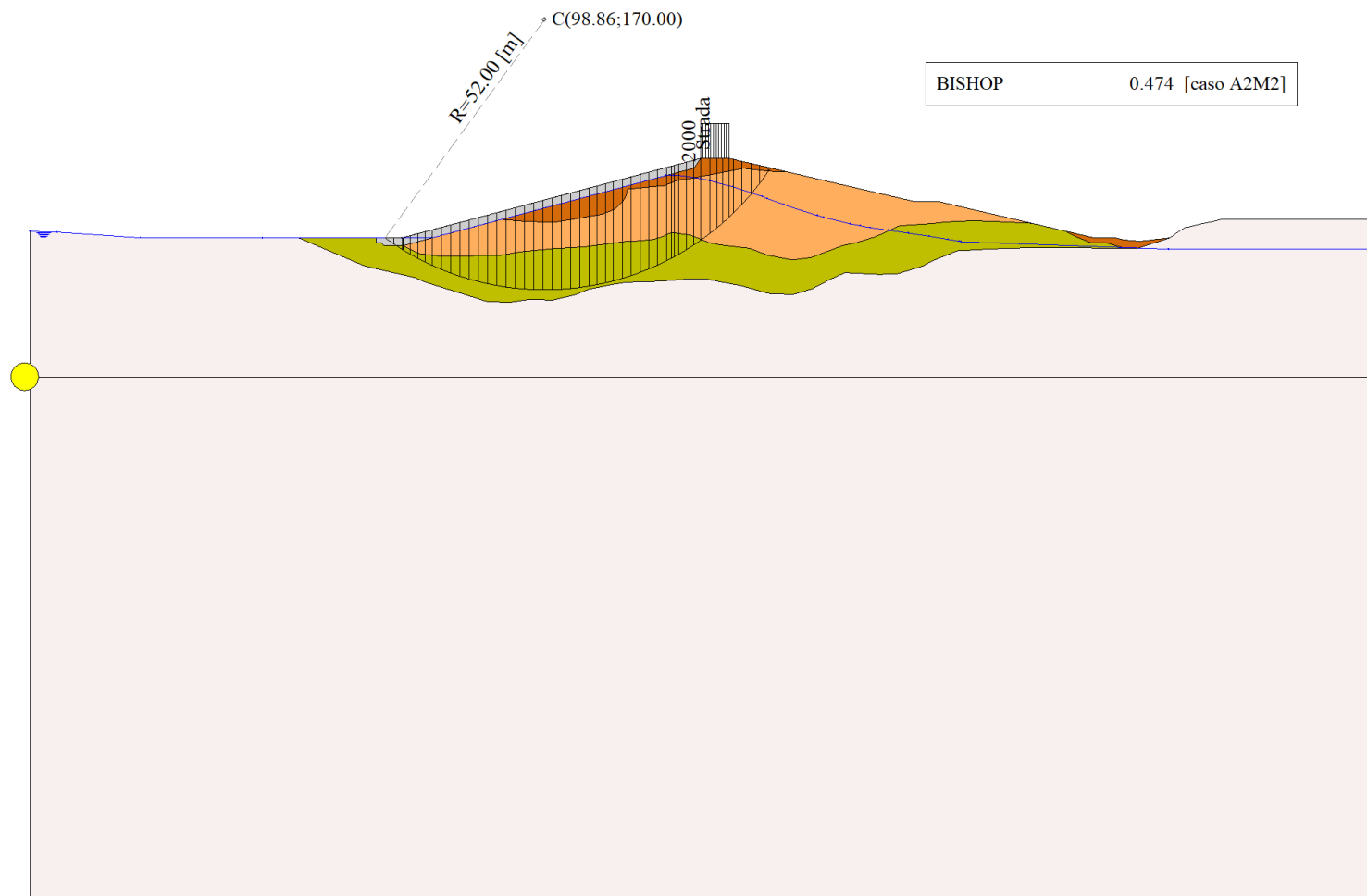


Figura 31-2 – Superficie critica (8) della sezione CR\_06 per la verifica di stabilità 27.

## 32 VERIFICA DI STABILITÀ 28

### 32.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	P <sub>i</sub> [m]	P <sub>f</sub> [m]	V <sub>y</sub> [kg/m]	V <sub>x</sub> [kg/m]
1	Strada	Variabile	1.00	128.86 143.30	134.36 143.30	2000 2000	0 0

Tabella 32-1 – Carichi distribuiti verifica di stabilità 28.

### 32.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **sismiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

## 32.2 RISULTATI ANALISI

Numero di superfici analizzate	87953
Coefficiente di sicurezza minimo	0.265
Superficie con coefficiente di sicurezza minimo	1

### 32.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	52
Coordinate del centro	X[m]= 102.86                      Y[m]= 200.00
Raggio del cerchio	R[m]= 80.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 67.99                      Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 154.22                      Y <sub>m</sub> [m]= 138.66
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.265</b>

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	$\alpha$ [°]	$\beta$ [°]	c [kPa]
1	67.99	128.00	128.00	69.73	128.00	127.18	69.15	127.73	1.93	-25.15	38.66	0
2	69.73	128.00	127.18	71.48	128.00	126.41	70.70	127.38	1.91	-23.78	34.20	6
3	71.48	128.00	126.41	71.68	128.05	126.33	71.58	127.20	0.22	-23.02	0.00	52
4	71.68	128.05	126.33	73.22	128.46	125.69	72.51	127.13	1.66	-22.34	0.00	52
5	73.22	128.46	125.69	74.76	128.87	125.10	74.03	127.03	1.65	-21.16	0.00	54
6	74.76	128.87	125.10	76.03	129.21	124.63	75.42	126.95	1.35	-20.08	0.00	53
7	76.03	129.21	124.63	77.30	129.55	124.19	76.68	126.90	1.34	-19.11	0.00	52
8	77.30	129.55	124.19	78.59	129.90	123.77	77.96	126.85	1.36	-18.15	0.00	52
9	78.59	129.90	123.77	80.67	130.45	123.14	79.66	126.81	2.17	-16.88	0.00	52
10	80.67	130.45	123.14	82.75	131.01	122.57	81.74	126.79	2.16	-15.33	0.00	52
11	82.75	131.01	122.57	84.83	131.56	122.06	83.81	126.80	2.14	-13.79	0.00	52
12	84.83	131.56	122.06	86.91	132.11	121.61	85.89	126.84	2.13	-12.26	0.00	52
13	86.91	132.11	121.61	88.99	132.67	121.21	87.97	126.90	2.12	-10.74	0.00	52
14	88.99	132.67	121.21	91.07	133.22	120.87	90.05	127.00	2.11	-9.23	0.00	52
15	91.07	133.22	120.87	93.15	133.78	120.59	92.12	127.12	2.10	-7.72	0.00	52
16	93.15	133.78	120.59	95.23	134.33	120.36	94.20	127.27	2.09	-6.22	0.00	52
17	95.23	134.33	120.36	97.31	134.89	120.19	96.28	127.45	2.09	-4.72	0.00	52

N°	X <sub>s</sub>	Y <sub>ss</sub>	Y <sub>si</sub>	X <sub>d</sub>	Y <sub>ds</sub>	Y <sub>di</sub>	X <sub>g</sub>	Y <sub>g</sub>	L	∅	∅	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
18	97.31	134.89	120.19	99.39	135.44	120.08	98.36	127.65	2.08	-3.23	0.00	52
19	99.39	135.44	120.08	101.48	136.00	120.01	100.44	127.88	2.08	-1.74	0.00	52
20	101.48	136.00	120.01	103.56	136.55	120.00	102.52	128.14	2.08	-0.25	0.00	52
21	103.56	136.55	120.00	105.64	137.11	120.05	104.60	128.43	2.08	1.24	0.00	52
22	105.64	137.11	120.05	107.72	137.66	120.15	106.68	128.74	2.08	2.73	0.00	52
23	107.72	137.66	120.15	109.80	138.22	120.30	108.76	129.08	2.09	4.23	0.00	52
24	109.80	138.22	120.30	111.88	138.77	120.51	110.84	129.45	2.09	5.72	0.00	52
25	111.88	138.77	120.51	113.96	139.33	120.77	112.92	129.85	2.10	7.22	0.00	52
26	113.96	139.33	120.77	116.04	139.88	121.09	115.00	130.27	2.10	8.73	0.00	52
27	116.04	139.88	121.09	118.12	140.44	121.47	117.08	130.72	2.11	10.24	0.00	52
28	118.12	140.44	121.47	120.20	140.99	121.90	119.16	131.20	2.13	11.76	0.00	52
29	120.20	140.99	121.90	122.28	141.55	122.39	121.24	131.71	2.14	13.28	0.00	52
30	122.28	141.55	122.39	123.28	141.81	122.65	122.78	132.10	1.03	14.42	0.00	52
31	123.28	141.81	122.65	123.78	141.95	122.78	123.53	132.30	0.52	14.97	0.00	52
32	123.78	141.95	122.78	124.71	142.19	123.04	124.24	132.49	0.97	15.50	0.00	52
33	124.71	142.19	123.04	126.78	142.75	123.66	125.75	132.91	2.17	16.63	0.00	52
34	126.78	142.75	123.66	128.86	143.30	124.34	127.82	133.51	2.18	18.18	0.00	52
35	128.86	143.30	124.34	128.92	143.30	124.36	128.89	133.83	0.06	18.99	0.00	52
36	128.92	143.30	124.36	130.61	143.30	124.97	129.76	133.98	1.79	19.65	0.00	52
37	130.61	143.30	124.97	131.99	143.30	125.49	131.30	134.26	1.48	20.83	0.00	52
38	131.99	143.30	125.49	132.48	143.30	125.69	132.23	134.44	0.53	21.54	0.00	52
39	132.48	143.30	125.69	134.36	143.30	126.46	133.41	134.69	2.03	22.46	0.00	52
40	134.36	143.30	126.46	135.17	143.11	126.81	134.76	134.92	0.88	23.50	0.00	54
41	135.17	143.11	126.81	137.03	142.67	127.67	136.09	135.07	2.05	24.55	0.00	54
42	137.03	142.67	127.67	138.90	142.24	128.58	137.95	135.29	2.07	26.03	0.00	54
43	138.90	142.24	128.58	140.76	141.80	129.55	139.81	135.54	2.10	27.53	0.00	54
44	140.76	141.80	129.55	141.71	141.58	130.07	141.23	135.75	1.08	28.67	0.00	54
45	141.71	141.58	130.07	143.32	141.20	130.99	142.50	135.96	1.86	29.72	0.00	54
46	143.32	141.20	130.99	144.94	140.83	131.96	144.11	136.24	1.89	31.06	0.00	54
47	144.94	140.83	131.96	145.48	140.70	132.30	145.21	136.45	0.64	31.96	0.00	54
48	145.48	140.70	132.30	146.94	140.36	133.24	146.19	136.65	1.74	32.82	0.00	54
49	146.94	140.36	133.24	148.41	140.02	134.23	147.65	136.96	1.77	34.07	0.00	54
50	148.41	140.02	134.23	150.35	139.57	135.62	149.32	137.34	2.38	35.56	0.00	54
51	150.35	139.57	135.62	152.28	139.11	137.09	151.21	137.82	2.43	37.28	0.00	54
52	152.28	139.11	137.09	154.22	138.66	138.66	152.93	138.29	2.49	39.05	0.00	54

Tabella 32-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 28.

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
1	1431	0	-5001	-15123	0	0	-16754	0	0	
2	4205	0	-61095	-152518	0	-16754	-183717	0	0	
3	665	0	2815	4367	0	-183717	-179034	0	0	
4	6805	0	23524	33460	0	-179034	-143609	0	0	
5	9708	0	27102	34308	0	-143609	-108204	0	0	
6	10144	0	24473	27708	0	-108204	-80435	0	0	
7	12060	0	26313	27011	0	-80435	-54211	0	0	
8	14197	0	28784	27281	0	-54211	-28639	0	0	
9	26995	0	50727	43693	0	-28639	10187	0	0	
10	31872	0	55777	43352	0	10187	45827	0	0	
11	36485	0	60462	43051	0	45827	78107	0	0	
12	40839	0	64803	42786	0	78107	106879	0	0	
13	44937	0	68819	42555	0	106879	132025	0	0	

N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
14	48807	0	72553	42358	0	132025	153439	0	0	
15	52630	0	76259	42192	0	153439	170956	0	0	
16	56266	0	79754	42057	0	170956	184482	0	0	
17	59611	0	82906	41952	0	184482	193999	0	0	
18	62690	0	85755	41876	0	193999	199498	0	0	
19	65521	0	88329	41829	0	199498	200988	0	0	
20	68030	0	90533	41810	0	200988	198543	0	0	
21	70277	0	92450	41820	0	198543	192228	0	0	
22	72295	0	94127	41857	0	192228	182104	0	0	
23	74116	0	95604	41924	0	182104	168228	0	0	
24	75647	0	96760	42019	0	168228	150745	0	0	
25	76804	0	97480	42144	0	150745	129897	0	0	
26	77340	0	97427	42300	0	129897	106169	0	0	
27	78048	0	97660	42486	0	106169	79401	0	0	
28	78655	0	97814	42706	0	79401	49664	0	0	
29	79128	0	97839	42959	0	49664	17066	0	0	
30	38149	0	46979	20750	0	17066	429	0	0	
31	19230	0	23655	10401	0	429	-8254	0	0	
32	35700	0	43824	19395	0	-8254	-24708	0	0	
33	79297	0	96916	43519	0	-24708	-62775	0	0	
34	78580	0	95432	43892	0	-62775	-102424	0	0	
35	2259	120	2902	1275	0	-102424	-103723	0	0	
36	62375	3380	79853	36064	0	-103723	-139770	0	0	
37	49133	2760	62452	29671	0	-139770	-168294	0	0	
38	17049	980	21564	10587	0	-168294	-178196	0	0	
39	63392	3760	79590	40921	0	-178196	-214853	0	0	
40	26181	0	29880	18480	0	-214853	-227004	0	0	
41	56812	0	63374	42861	0	-227004	-251637	0	0	
42	51954	0	55602	43386	0	-251637	-271147	0	0	
43	46945	0	47398	43961	0	-271147	-284875	0	0	
44	21942	0	20828	22652	0	-284875	-289390	0	0	
45	34076	0	29901	38907	0	-289390	-292786	0	0	
46	29876	0	22563	39445	0	-292786	-290244	0	0	
47	9029	0	5825	13317	0	-290244	-287955	0	0	
48	22006	0	11257	36471	0	-287955	-277846	0	0	
49	18292	0	4301	37004	0	-277846	-261608	0	0	
50	18239	0	-5822	49798	0	-261608	-229680	0	0	
51	11189	0	-20086	50916	0	-229680	-184344	0	0	
52	3790	0	-35831	52163	0	-184344	-123748	0	0	

Tabella 32-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 28.

### 32.2.2 ANALISI DELLA SUPERFICIE 195 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	50	
Coordinate del centro	X[m]= 98.86	Y[m]= 170.00
Raggio del cerchio	R[m]= 52.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 68.20	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 142.31	Y <sub>m</sub> [m]= 141.44
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.304</b>	

N°	X <sub>s</sub>	Y <sub>ss</sub>	Y <sub>si</sub>	X <sub>d</sub>	Y <sub>ds</sub>	Y <sub>di</sub>	X <sub>g</sub>	Y <sub>g</sub>	L	∅	∅	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
1	68.20	128.00	128.00	69.84	128.00	126.85	69.29	127.62	2.00	-35.03	38.66	0
2	69.84	128.00	126.85	71.48	128.00	125.79	70.75	127.13	1.95	-32.85	12.81	35
3	71.48	128.00	125.79	71.68	128.05	125.67	71.58	126.88	0.23	-31.64	0.00	52
4	71.68	128.05	125.67	73.09	128.43	124.84	72.43	126.74	1.63	-30.61	0.00	52
5	73.09	128.43	124.84	74.49	128.80	124.06	73.82	126.53	1.60	-28.83	0.00	52
6	74.49	128.80	124.06	75.89	129.18	123.35	75.22	126.34	1.58	-27.08	0.00	52
7	75.89	129.18	123.35	77.30	129.55	122.68	76.62	126.19	1.55	-25.35	0.00	52
8	77.30	129.55	122.68	79.07	130.02	121.91	78.21	126.04	1.93	-23.43	0.00	52
9	79.07	130.02	121.91	80.84	130.50	121.22	79.98	125.91	1.90	-21.32	0.00	52
10	80.84	130.50	121.22	82.62	130.97	120.60	81.75	125.82	1.88	-19.24	0.00	52
11	82.62	130.97	120.60	84.39	131.44	120.05	83.52	125.77	1.86	-17.18	0.00	52
12	84.39	131.44	120.05	86.16	131.91	119.57	85.29	125.75	1.84	-15.15	0.00	52
13	86.16	131.91	119.57	87.93	132.39	119.16	87.06	125.76	1.82	-13.13	0.00	52
14	87.93	132.39	119.16	89.71	132.86	118.81	88.83	125.81	1.81	-11.13	0.00	52
15	89.71	132.86	118.81	91.48	133.33	118.53	90.60	125.88	1.80	-9.15	0.00	52
16	91.48	133.33	118.53	93.25	133.81	118.30	92.37	125.99	1.79	-7.18	0.00	52
17	93.25	133.81	118.30	95.02	134.28	118.14	94.14	126.13	1.78	-5.21	0.00	52
18	95.02	134.28	118.14	96.80	134.75	118.04	95.91	126.30	1.78	-3.25	0.00	52
19	96.80	134.75	118.04	98.57	135.22	118.00	97.69	126.50	1.77	-1.30	0.00	52
20	98.57	135.22	118.00	100.34	135.70	118.02	99.46	126.74	1.77	0.66	0.00	52
21	100.34	135.70	118.02	102.11	136.17	118.10	101.23	127.00	1.77	2.61	0.00	52
22	102.11	136.17	118.10	103.89	136.64	118.24	103.00	127.29	1.78	4.57	0.00	52
23	103.89	136.64	118.24	105.66	137.11	118.45	104.77	127.61	1.78	6.53	0.00	52
24	105.66	137.11	118.45	107.43	137.59	118.71	106.55	127.96	1.79	8.50	0.00	52
25	107.43	137.59	118.71	109.00	138.01	119.00	108.22	128.33	1.60	10.37	0.00	52
26	109.00	138.01	119.00	110.58	138.42	119.34	109.79	128.69	1.61	12.14	0.00	52
27	110.58	138.42	119.34	112.15	138.84	119.73	111.36	129.08	1.62	13.91	0.00	52
28	112.15	138.84	119.73	113.84	139.29	120.20	112.99	129.52	1.75	15.77	0.00	52
29	113.84	139.29	120.20	115.53	139.74	120.74	114.68	130.00	1.77	17.72	0.00	52
30	115.53	139.74	120.74	117.22	140.19	121.35	116.37	130.51	1.79	19.68	0.00	52
31	117.22	140.19	121.35	118.90	140.65	122.02	118.06	131.05	1.82	21.67	0.00	52
32	118.90	140.65	122.02	120.59	141.10	122.76	119.75	131.63	1.84	23.69	0.00	52
33	120.59	141.10	122.76	122.28	141.55	123.57	121.43	132.24	1.87	25.74	0.00	52
34	122.28	141.55	123.57	123.28	141.81	124.09	122.78	132.75	1.13	27.39	0.00	52
35	123.28	141.81	124.09	123.78	141.95	124.36	123.53	133.05	0.57	28.32	0.00	52
36	123.78	141.95	124.36	124.71	142.19	124.88	124.24	133.34	1.07	29.22	0.00	52
37	124.71	142.19	124.88	126.09	142.56	125.70	125.40	133.83	1.61	30.70	0.00	52
38	126.09	142.56	125.70	127.48	142.93	126.58	126.78	134.44	1.64	32.49	0.00	52
39	127.48	142.93	126.58	128.86	143.30	127.53	128.16	135.08	1.67	34.31	0.00	52
40	128.86	143.30	127.53	128.92	143.30	127.57	128.89	135.42	0.07	35.27	0.00	52
41	128.92	143.30	127.57	130.61	143.30	128.82	129.75	135.74	2.10	36.47	0.00	54
42	130.61	143.30	128.82	131.99	143.30	129.92	131.29	136.33	1.77	38.60	0.00	54
43	131.99	143.30	129.92	133.18	143.30	130.93	132.57	136.86	1.56	40.43	0.00	54
44	133.18	143.30	130.93	134.36	143.30	132.00	133.76	137.38	1.60	42.17	0.00	54
45	134.36	143.30	132.00	135.17	143.11	132.78	134.76	137.80	1.12	43.67	0.00	54
46	135.17	143.11	132.78	136.85	142.72	134.50	135.98	138.26	2.41	45.61	0.00	54
47	136.85	142.72	134.50	138.53	142.32	136.39	137.65	138.96	2.53	48.33	0.00	54
48	138.53	142.32	136.39	140.22	141.93	138.48	139.30	139.74	2.69	51.21	0.00	54
49	140.22	141.93	138.48	141.90	141.54	140.82	140.87	140.59	2.88	54.27	0.00	54
50	141.90	141.54	140.82	142.31	141.44	141.44	142.04	141.27	0.75	56.27	0.00	53

Tabella 32-4 – Geometria e caratteristiche strisce della superficie 195 della verifica di stabilità 28.



N°	W	Q	N	T	U	E <sub>s</sub>	E <sub>d</sub>	X <sub>s</sub>	X <sub>d</sub>	ID
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	
1	1884	0	-3628	-9537	0	0	-11129	0	0	
2	5547	0	45377	56702	0	-11129	57480	0	0	
3	934	0	3987	4104	0	57480	62453	0	0	
4	8415	0	29864	28522	0	62453	96685	0	0	
5	11535	0	32910	28020	0	96685	129532	0	0	
6	14529	0	35766	27568	0	129532	160824	0	0	
7	17449	0	38514	27163	0	160824	190411	0	0	
8	26021	0	52290	33747	0	190411	225092	0	0	
9	30357	0	56250	33239	0	225092	256585	0	0	
10	34432	0	59877	32796	0	256585	284682	0	0	
11	38238	0	63177	32411	0	284682	309213	0	0	
12	41785	0	66176	32079	0	309213	330047	0	0	
13	45081	0	68899	31796	0	330047	347080	0	0	
14	48132	0	71363	31559	0	347080	360239	0	0	
15	50990	0	73645	31364	0	360239	369452	0	0	
16	53757	0	75889	31209	0	369452	374619	0	0	
17	56306	0	77927	31093	0	374619	375712	0	0	
18	58592	0	79706	31015	0	375712	372749	0	0	
19	60630	0	81247	30973	0	372749	365766	0	0	
20	62441	0	82581	30967	0	365766	354810	0	0	
21	63998	0	83673	30997	0	354810	339967	0	0	
22	65274	0	84487	31063	0	339967	321370	0	0	
23	66319	0	85087	31167	0	321370	299139	0	0	
24	67138	0	85479	31308	0	299139	273412	0	0	
25	60126	0	76067	27944	0	273412	247754	0	0	
26	60440	0	76061	28116	0	247754	219589	0	0	
27	60541	0	75821	28319	0	219589	189114	0	0	
28	64800	0	80772	30651	0	189114	154128	0	0	
29	64161	0	79564	30966	0	154128	117307	0	0	
30	63522	0	78394	31327	0	117307	78715	0	0	
31	62814	0	77158	31740	0	78715	38498	0	0	
32	61882	0	75617	32210	0	38498	-2994	0	0	
33	60784	0	73833	32745	0	-2994	-45446	0	0	
34	35386	0	42735	19677	0	-45446	-70856	0	0	
35	17639	0	21264	9923	0	-70856	-83784	0	0	
36	32351	0	38817	18617	0	-83784	-107717	0	0	
37	46963	0	55851	28106	0	-107717	-142879	0	0	
38	45444	0	53308	28651	0	-142879	-177164	0	0	
39	43714	0	50320	29260	0	-177164	-210047	0	0	
40	1855	120	2304	1284	0	-210047	-211625	0	0	
41	50042	3380	60058	38114	0	-211625	-251736	0	0	
42	37676	2760	43077	32120	0	-251736	-280049	0	0	
43	29899	2370	32176	28318	0	-280049	-300540	0	0	
44	27480	2370	27146	29083	0	-300540	-316800	0	0	
45	17162	0	12066	20369	0	-316800	-321661	0	0	
46	30542	0	13293	43750	0	-321661	-320601	0	0	
47	23283	0	-5212	46033	0	-320601	-301385	0	0	
48	15477	0	-27961	48847	0	-301385	-259145	0	0	
49	6940	0	-57084	52411	0	-259145	-186755	0	0	
50	305	0	-19050	13204	0	-186755	-163780	0	0	

Tabella 32-5 – Forze applicate sulle strisce [BISHOP] della superficie 195 della verifica di stabilità 28.

### 32.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.078972
2	0.104280
3	0.052861
4	0.025337
5	0.037629
6	0.047486
7	0.065155

Tabella 32-6 – Spostamenti della superficie 1 della verifica di stabilità 28.

Accelerazione sismica critica  $K_c = 0.095$   
Spostamento massimo  $U_{max} = 0.104280$  [m]  
Velocità massima  $V_{max} = 0.246923$  [m/s]

n°	u
	[m]
1	0.168102
2	0.267717
3	0.099831
4	0.056615
5	0.067806
6	0.090620
7	0.123994

Tabella 32-7 – Spostamenti della superficie 195 della verifica di stabilità 28.

Accelerazione sismica critica  $K_c = 0.062$   
Spostamento massimo  $U_{max} = 0.267717$  [m]  
Velocità massima  $V_{max} = 0.438714$  [m/s]

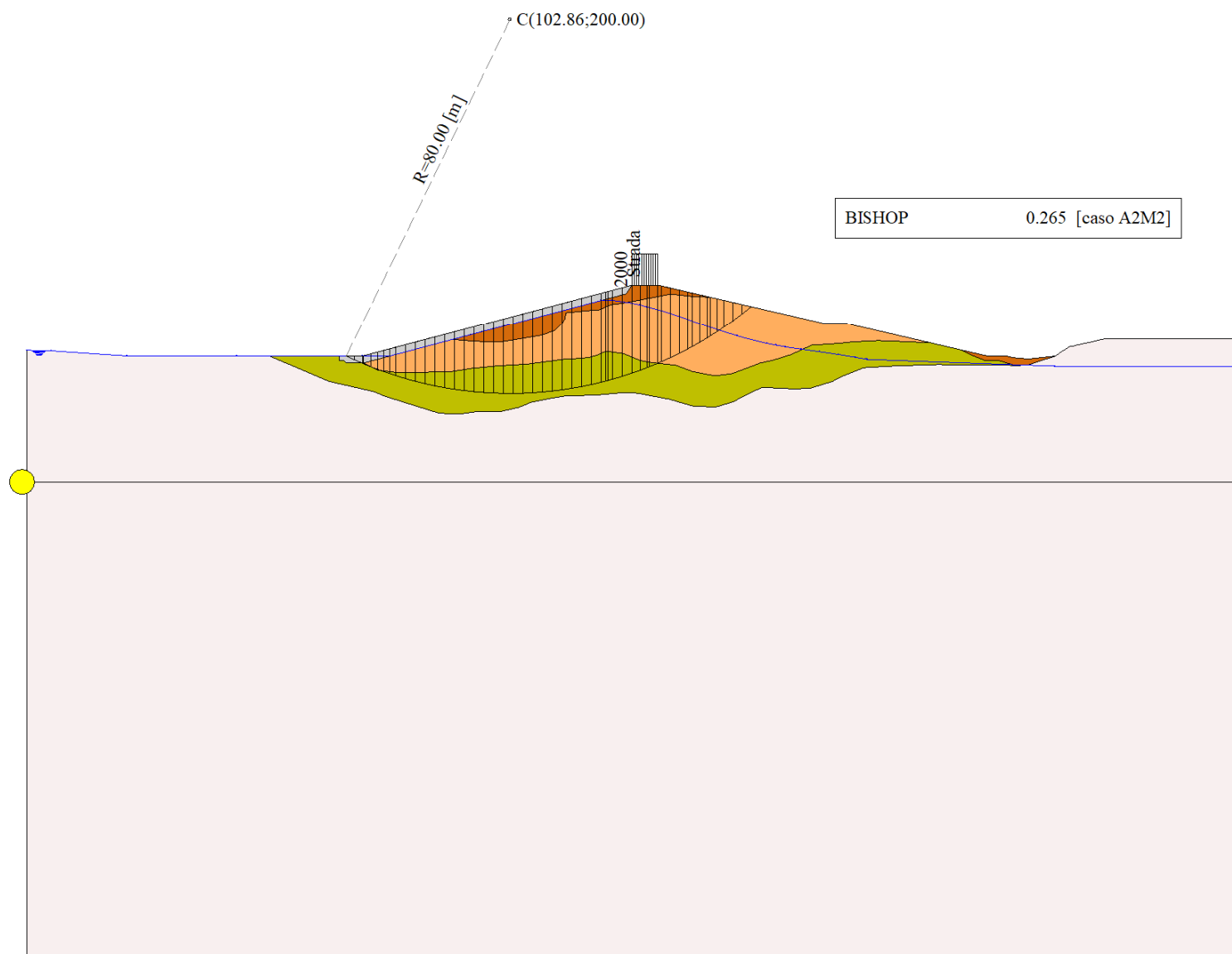


Figura 32-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 28.

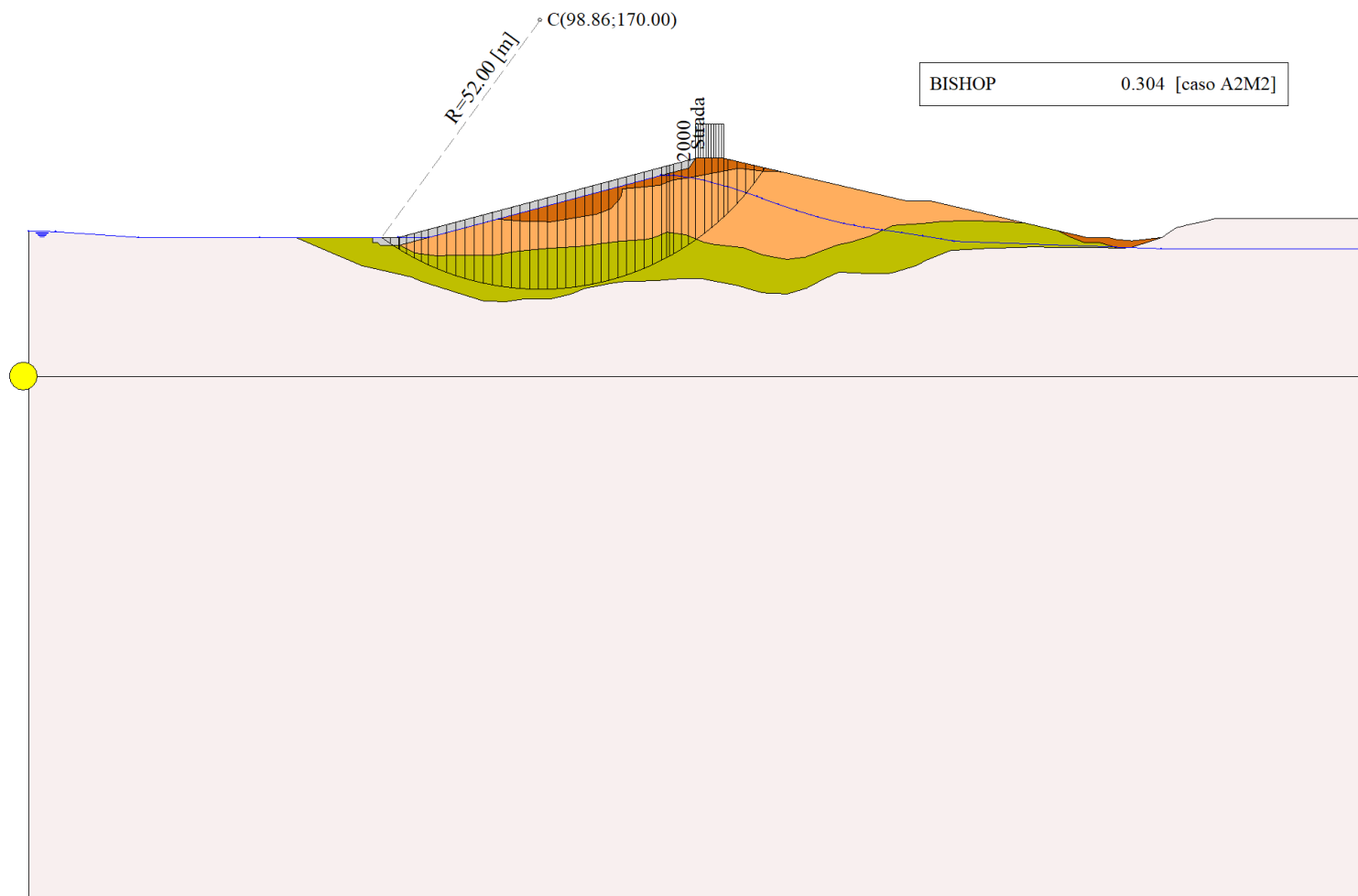


Figura 32-2 – Superficie critica (195) della sezione CR\_06 per la verifica di stabilità 28.

### 33 VERIFICA DI STABILITÀ 29

#### 33.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{E}_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	128.86	134.36	2000	0
				143.30	143.30	2000	0

Tabella 33-1 – Carichi distribuiti verifica di stabilità 29.

#### 33.1.2 OPZIONI DI CALCOLO

Per l'analisi sono stati utilizzati i seguenti metodi di calcolo:

- BISHOP

Le superfici sono state analizzate solo in condizioni **sismiche**.

Le superfici sono state analizzate per i casi:

- Parametri caratteristici [PC];

- Parametri di progetto [A2-M2]

- Sisma orizzontale e Sisma verticale (verso il basso e verso l'alto)

Analisi condotta in termini di **tensioni totali**

Presenza di carichi distribuiti

### 33.2 RISULTATI ANALISI

Numero di superfici analizzate	87975
Coefficiente di sicurezza minimo	0.278
Superficie con coefficiente di sicurezza minimo	1

#### 33.2.1 ANALISI DELLA SUPERFICIE 1 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	51	
Coordinate del centro	X[m]= 98.86	Y[m]= 174.00
Raggio del cerchio	R[m]= 56.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 66.92	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 144.12	Y <sub>m</sub> [m]= 141.02
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.278</b>	

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	• [°]	• [°]	c [kPa]
1	66.92	128.00	128.00	67.48	128.00	127.62	67.29	127.87	0.68	-34.43	38.66	0
2	67.48	128.00	127.62	67.98	128.00	127.28	67.76	127.72	0.60	-33.77	38.66	0
3	67.98	128.00	127.28	69.73	128.00	126.17	68.98	127.32	2.07	-32.40	27.27	15
4	69.73	128.00	126.17	71.48	128.00	125.15	70.67	126.81	2.03	-30.31	0.00	52
5	71.48	128.00	125.15	72.94	128.39	124.36	72.25	126.47	1.65	-28.42	0.00	52
6	72.94	128.39	124.36	74.39	128.78	123.63	73.69	126.29	1.63	-26.74	0.00	52
7	74.39	128.78	123.63	75.84	129.16	122.95	75.14	126.13	1.61	-25.09	0.00	52
8	75.84	129.16	122.95	77.30	129.55	122.32	76.59	125.99	1.59	-23.46	0.00	52
9	77.30	129.55	122.32	79.18	130.05	121.57	78.27	125.87	2.03	-21.61	0.00	52
10	79.18	130.05	121.57	81.07	130.56	120.90	80.14	125.77	2.00	-19.55	0.00	52
11	81.07	130.56	120.90	82.95	131.06	120.31	82.02	125.71	1.97	-17.52	0.00	52
12	82.95	131.06	120.31	84.83	131.56	119.79	83.91	125.68	1.95	-15.51	0.00	52
13	84.83	131.56	119.79	86.72	132.06	119.33	85.79	125.69	1.94	-13.52	0.00	52
14	86.72	132.06	119.33	88.60	132.56	118.95	87.67	125.73	1.92	-11.54	0.00	52
15	88.60	132.56	118.95	90.48	133.07	118.63	89.55	125.80	1.91	-9.58	0.00	52
16	90.48	133.07	118.63	92.37	133.57	118.38	91.43	125.91	1.90	-7.63	0.00	52
17	92.37	133.57	118.38	94.25	134.07	118.19	93.31	126.05	1.89	-5.69	0.00	52

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∅ [°]	∅ [°]	c [kPa]
18	94.25	134.07	118.19	96.13	134.57	118.07	95.20	126.23	1.89	-3.76	0.00	52
19	96.13	134.57	118.07	98.01	135.08	118.01	97.08	126.43	1.88	-1.83	0.00	52
20	98.01	135.08	118.01	99.90	135.58	118.01	98.96	126.67	1.88	0.10	0.00	52
21	99.90	135.58	118.01	101.78	136.08	118.08	100.84	126.94	1.88	2.03	0.00	52
22	101.78	136.08	118.08	103.66	136.58	118.21	102.73	127.24	1.89	3.96	0.00	52
23	103.66	136.58	118.21	105.55	137.08	118.40	104.61	127.57	1.89	5.89	0.00	52
24	105.55	137.08	118.40	107.43	137.59	118.66	106.49	127.93	1.90	7.83	0.00	52
25	107.43	137.59	118.66	109.00	138.01	118.93	108.22	128.29	1.60	9.62	0.00	52
26	109.00	138.01	118.93	110.58	138.42	119.24	109.79	128.65	1.60	11.26	0.00	52
27	110.58	138.42	119.24	112.15	138.84	119.60	111.36	129.03	1.61	12.90	0.00	52
28	112.15	138.84	119.60	113.37	139.17	119.91	112.76	129.38	1.26	14.37	0.00	52
29	113.37	139.17	119.91	114.59	139.49	120.25	113.98	129.71	1.27	15.67	0.00	52
30	114.59	139.49	120.25	116.51	140.01	120.86	115.55	130.15	2.01	17.34	0.00	52
31	116.51	140.01	120.86	118.44	140.52	121.53	117.47	130.73	2.04	19.42	0.00	52
32	118.44	140.52	121.53	120.36	141.03	122.29	119.39	131.34	2.07	21.52	0.00	52
33	120.36	141.03	122.29	122.28	141.55	123.13	121.32	132.00	2.10	23.65	0.00	52
34	122.28	141.55	123.13	123.28	141.81	123.60	122.78	132.52	1.11	25.29	0.00	52
35	123.28	141.81	123.60	123.78	141.95	123.85	123.53	132.80	0.56	26.14	0.00	52
36	123.78	141.95	123.85	124.71	142.19	124.32	124.24	133.08	1.04	26.96	0.00	52
37	124.71	142.19	124.32	126.09	142.56	125.07	125.40	133.54	1.57	28.29	0.00	52
38	126.09	142.56	125.07	127.48	142.93	125.86	126.78	134.11	1.60	29.91	0.00	52
39	127.48	142.93	125.86	128.86	143.30	126.71	128.17	134.70	1.62	31.56	0.00	52
40	128.86	143.30	126.71	128.92	143.30	126.75	128.89	135.02	0.07	32.43	0.00	52
41	128.92	143.30	126.75	130.60	143.30	127.86	129.75	135.30	2.01	33.50	0.00	53
42	130.60	143.30	127.86	130.61	143.30	127.87	130.60	135.58	0.01	34.53	0.00	54
43	130.61	143.30	127.87	131.99	143.30	128.85	131.29	135.83	1.69	35.40	0.00	54
44	131.99	143.30	128.85	133.18	143.30	129.75	132.58	136.30	1.48	37.03	0.00	54
45	133.18	143.30	129.75	134.36	143.30	130.69	133.76	136.76	1.52	38.57	0.00	54
46	134.36	143.30	130.69	135.17	143.11	131.37	134.76	137.12	1.06	39.88	0.00	54
47	135.17	143.11	131.37	137.03	142.67	133.03	136.07	137.53	2.50	41.70	0.00	54
48	137.03	142.67	133.03	138.90	142.24	134.85	137.92	138.18	2.60	44.31	0.00	54
49	138.90	142.24	134.85	140.76	141.80	136.85	139.77	138.91	2.73	47.04	0.00	54
50	140.76	141.80	136.85	142.44	141.41	138.83	141.51	139.68	2.60	49.77	0.00	54
51	142.44	141.41	138.83	144.12	141.02	141.02	143.00	140.42	2.76	52.51	0.00	54

Tabella 33-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 29.

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	213	0	-347	-1001	0	0	-1154	0	0	
2	549	0	-935	-2693	0	-1154	-4254	0	0	
3	4461	0	-80374	-137540	0	-4254	-166224	0	0	
4	8345	0	35364	38819	0	-166224	-120056	0	0	
5	10142	0	32268	31684	0	-120056	-83143	0	0	
6	13273	0	35210	31202	0	-83143	-47692	0	0	
7	16278	0	37969	30767	0	-47692	-13855	0	0	
8	19222	0	40650	30374	0	-13855	18231	0	0	
9	29100	0	56399	38789	0	18231	56959	0	0	
10	33726	0	60510	38269	0	56959	92287	0	0	
11	38070	0	64275	37817	0	92287	124011	0	0	
12	42124	0	67697	37426	0	124011	151966	0	0	
13	45896	0	70802	37090	0	151966	176023	0	0	
14	49395	0	73613	36808	0	176023	196084	0	0	

N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
15	52629	0	76150	36573	0	196084	212079	0	0	
16	55729	0	78593	36386	0	212079	223910	0	0	
17	58671	0	80915	36242	0	223910	231497	0	0	
18	61337	0	82965	36141	0	231497	234838	0	0	
19	63710	0	84723	36082	0	234838	233969	0	0	
20	65826	0	86241	36063	0	233969	228931	0	0	
21	67672	0	87502	36086	0	228931	219800	0	0	
22	69197	0	88440	36149	0	219800	206712	0	0	
23	70459	0	89127	36255	0	206712	189794	0	0	
24	71471	0	89579	36403	0	189794	169189	0	0	
25	60331	0	75047	30560	0	169189	149244	0	0	
26	60722	0	75059	30722	0	149244	126945	0	0	
27	60914	0	74850	30911	0	126945	102465	0	0	
28	47234	0	57747	24119	0	102465	82108	0	0	
29	47056	0	57269	24265	0	82108	60732	0	0	
30	73472	0	88870	38571	0	60732	25347	0	0	
31	72890	0	87567	39038	0	25347	-12295	0	0	
32	72018	0	85892	39575	0	-12295	-51787	0	0	
33	70922	0	83908	40192	0	-51787	-92750	0	0	
34	36362	0	42719	21180	0	-92750	-114470	0	0	
35	18164	0	21293	10666	0	-114470	-125575	0	0	
36	33397	0	38962	19981	0	-125575	-146205	0	0	
37	48700	0	56317	30087	0	-146205	-176707	0	0	
38	47416	0	54136	30564	0	-176707	-206713	0	0	
39	45947	0	51600	31091	0	-206713	-235815	0	0	
40	1958	120	2362	1361	0	-235815	-237226	0	0	
41	52701	3360	62118	39316	0	-237226	-273598	0	0	
42	302	20	346	242	0	-273598	-273795	0	0	
43	40370	2760	45382	33756	0	-273795	-299406	0	0	
44	32483	2370	34913	29595	0	-299406	-318490	0	0	
45	30345	2370	30764	30217	0	-318490	-334395	0	0	
46	19297	0	15384	21045	0	-334395	-340115	0	0	
47	38933	0	24035	49755	0	-340115	-343174	0	0	
48	30977	0	6080	51914	0	-343174	-329543	0	0	
49	22472	0	-15303	54511	0	-329543	-295174	0	0	
50	12385	0	-36103	51816	0	-295174	-241849	0	0	
51	4271	0	-62247	54811	0	-241849	-161757	0	0	

Tabella 33-3 – Forze applicate sulle strisce [BISHOP] della superficie 1 della verifica di stabilità 29.

### 33.2.2 ANALISI DELLA SUPERFICIE 176 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	50	
Coordinate del centro	X[m]= 98.86	Y[m]= 170.00
Raggio del cerchio	R[m]= 52.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 68.20	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 142.31	Y <sub>m</sub> [m]= 141.44
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.316</b>	

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	α <sub>s</sub> [°]	α <sub>d</sub> [°]	c [kPa]
1	68.20	128.00	128.00	69.84	128.00	126.85	69.29	127.62	2.00	-35.03	38.66	0
2	69.84	128.00	126.85	71.48	128.00	125.79	70.75	127.13	1.95	-32.85	12.81	35

N°	X <sub>s</sub> [m]	Y <sub>ss</sub> [m]	Y <sub>si</sub> [m]	X <sub>d</sub> [m]	Y <sub>ds</sub> [m]	Y <sub>di</sub> [m]	X <sub>g</sub> [m]	Y <sub>g</sub> [m]	L [m]	∅ [°]	∅ [°]	c [kPa]
3	71.48	128.00	125.79	71.68	128.05	125.67	71.58	126.88	0.23	-31.64	0.00	52
4	71.68	128.05	125.67	73.09	128.43	124.84	72.43	126.74	1.63	-30.61	0.00	52
5	73.09	128.43	124.84	74.49	128.80	124.06	73.82	126.53	1.60	-28.83	0.00	52
6	74.49	128.80	124.06	75.89	129.18	123.35	75.22	126.34	1.58	-27.08	0.00	52
7	75.89	129.18	123.35	77.30	129.55	122.68	76.62	126.19	1.55	-25.35	0.00	52
8	77.30	129.55	122.68	79.07	130.02	121.91	78.21	126.04	1.93	-23.43	0.00	52
9	79.07	130.02	121.91	80.84	130.50	121.22	79.98	125.91	1.90	-21.32	0.00	52
10	80.84	130.50	121.22	82.62	130.97	120.60	81.75	125.82	1.88	-19.24	0.00	52
11	82.62	130.97	120.60	84.39	131.44	120.05	83.52	125.77	1.86	-17.18	0.00	52
12	84.39	131.44	120.05	86.16	131.91	119.57	85.29	125.75	1.84	-15.15	0.00	52
13	86.16	131.91	119.57	87.93	132.39	119.16	87.06	125.76	1.82	-13.13	0.00	52
14	87.93	132.39	119.16	89.71	132.86	118.81	88.83	125.81	1.81	-11.13	0.00	52
15	89.71	132.86	118.81	91.48	133.33	118.53	90.60	125.88	1.80	-9.15	0.00	52
16	91.48	133.33	118.53	93.25	133.81	118.30	92.37	125.99	1.79	-7.18	0.00	52
17	93.25	133.81	118.30	95.02	134.28	118.14	94.14	126.13	1.78	-5.21	0.00	52
18	95.02	134.28	118.14	96.80	134.75	118.04	95.91	126.30	1.78	-3.25	0.00	52
19	96.80	134.75	118.04	98.57	135.22	118.00	97.69	126.50	1.77	-1.30	0.00	52
20	98.57	135.22	118.00	100.34	135.70	118.02	99.46	126.74	1.77	0.66	0.00	52
21	100.34	135.70	118.02	102.11	136.17	118.10	101.23	127.00	1.77	2.61	0.00	52
22	102.11	136.17	118.10	103.89	136.64	118.24	103.00	127.29	1.78	4.57	0.00	52
23	103.89	136.64	118.24	105.66	137.11	118.45	104.77	127.61	1.78	6.53	0.00	52
24	105.66	137.11	118.45	107.43	137.59	118.71	106.55	127.96	1.79	8.50	0.00	52
25	107.43	137.59	118.71	109.00	138.01	119.00	108.22	128.33	1.60	10.37	0.00	52
26	109.00	138.01	119.00	110.58	138.42	119.34	109.79	128.69	1.61	12.14	0.00	52
27	110.58	138.42	119.34	112.15	138.84	119.73	111.36	129.08	1.62	13.91	0.00	52
28	112.15	138.84	119.73	113.84	139.29	120.20	112.99	129.52	1.75	15.77	0.00	52
29	113.84	139.29	120.20	115.53	139.74	120.74	114.68	130.00	1.77	17.72	0.00	52
30	115.53	139.74	120.74	117.22	140.19	121.35	116.37	130.51	1.79	19.68	0.00	52
31	117.22	140.19	121.35	118.90	140.65	122.02	118.06	131.05	1.82	21.67	0.00	52
32	118.90	140.65	122.02	120.59	141.10	122.76	119.75	131.63	1.84	23.69	0.00	52
33	120.59	141.10	122.76	122.28	141.55	123.57	121.43	132.24	1.87	25.74	0.00	52
34	122.28	141.55	123.57	123.28	141.81	124.09	122.78	132.75	1.13	27.39	0.00	52
35	123.28	141.81	124.09	123.78	141.95	124.36	123.53	133.05	0.57	28.32	0.00	52
36	123.78	141.95	124.36	124.71	142.19	124.88	124.24	133.34	1.07	29.22	0.00	52
37	124.71	142.19	124.88	126.09	142.56	125.70	125.40	133.83	1.61	30.70	0.00	52
38	126.09	142.56	125.70	127.48	142.93	126.58	126.78	134.44	1.64	32.49	0.00	52
39	127.48	142.93	126.58	128.86	143.30	127.53	128.16	135.08	1.67	34.31	0.00	52
40	128.86	143.30	127.53	128.92	143.30	127.57	128.89	135.42	0.07	35.27	0.00	52
41	128.92	143.30	127.57	130.61	143.30	128.82	129.75	135.74	2.10	36.47	0.00	54
42	130.61	143.30	128.82	131.99	143.30	129.92	131.29	136.33	1.77	38.60	0.00	54
43	131.99	143.30	129.92	133.18	143.30	130.93	132.57	136.86	1.56	40.43	0.00	54
44	133.18	143.30	130.93	134.36	143.30	132.00	133.76	137.38	1.60	42.17	0.00	54
45	134.36	143.30	132.00	135.17	143.11	132.78	134.76	137.80	1.12	43.67	0.00	54
46	135.17	143.11	132.78	136.85	142.72	134.50	135.98	138.26	2.41	45.61	0.00	54
47	136.85	142.72	134.50	138.53	142.32	136.39	137.65	138.96	2.53	48.33	0.00	54
48	138.53	142.32	136.39	140.22	141.93	138.48	139.30	139.74	2.69	51.21	0.00	54
49	140.22	141.93	138.48	141.90	141.54	140.82	140.87	140.59	2.88	54.27	0.00	54
50	141.90	141.54	140.82	142.31	141.44	141.44	142.04	141.27	0.75	56.27	0.00	53

Tabella 33-4 – Geometria e caratteristiche strisce della superficie 176 della verifica di stabilità 29.



N°	W [kg]	Q [kg]	N [kg]	T [kg]	U [kg]	E <sub>s</sub> [kg]	E <sub>d</sub> [kg]	X <sub>s</sub> [kg]	X <sub>d</sub> [kg]	ID
1	1884	0	-3903	-9873	0	0	-11497	0	0	
2	5547	0	42595	52567	0	-11497	52317	0	0	
3	934	0	3873	3950	0	52317	57131	0	0	
4	8415	0	29061	27448	0	57131	90317	0	0	
5	11535	0	32105	26965	0	90317	122245	0	0	
6	14529	0	34957	26531	0	122245	152741	0	0	
7	17449	0	37700	26140	0	152741	181650	0	0	
8	26021	0	51256	32477	0	181650	215641	0	0	
9	30357	0	55206	31988	0	215641	246624	0	0	
10	34432	0	58825	31561	0	246624	274382	0	0	
11	38238	0	62117	31191	0	274382	298739	0	0	
12	41785	0	65111	30871	0	298739	319554	0	0	
13	45081	0	67830	30599	0	319554	336716	0	0	
14	48132	0	70292	30371	0	336716	350143	0	0	
15	50990	0	72574	30183	0	350143	359759	0	0	
16	53757	0	74817	30034	0	359759	365460	0	0	
17	56306	0	76856	29923	0	365460	367210	0	0	
18	58592	0	78639	29847	0	367210	365019	0	0	
19	60630	0	80187	29807	0	365019	358913	0	0	
20	62441	0	81530	29801	0	358913	348933	0	0	
21	63998	0	82634	29830	0	348933	335154	0	0	
22	65274	0	83464	29894	0	335154	317699	0	0	
23	66319	0	84083	29993	0	317699	296678	0	0	
24	67138	0	84498	30130	0	296678	272220	0	0	
25	60126	0	75218	26892	0	272220	247730	0	0	
26	60440	0	75234	27057	0	247730	220765	0	0	
27	60541	0	75021	27252	0	220765	191511	0	0	
28	64800	0	79950	29497	0	191511	157848	0	0	
29	64161	0	78788	29800	0	157848	122341	0	0	
30	63522	0	77665	30148	0	122341	85050	0	0	
31	62814	0	76480	30545	0	85050	46115	0	0	
32	61882	0	74997	30998	0	46115	5872	0	0	
33	60784	0	73277	31512	0	5872	-35376	0	0	
34	35386	0	42440	18936	0	-35376	-60101	0	0	
35	17639	0	21124	9550	0	-60101	-72690	0	0	
36	32351	0	38577	17916	0	-72690	-96014	0	0	
37	46963	0	55548	27048	0	-96014	-130330	0	0	
38	45444	0	53076	27573	0	-130330	-163850	0	0	
39	43714	0	50169	28158	0	-163850	-196069	0	0	
40	1855	120	2297	1236	0	-196069	-197615	0	0	
41	50042	3380	59986	36679	0	-197615	-237014	0	0	
42	37676	2760	43160	30910	0	-237014	-264945	0	0	
43	29899	2370	32361	27252	0	-264945	-285268	0	0	
44	27480	2370	27451	27988	0	-285268	-301526	0	0	
45	17162	0	12394	19602	0	-301526	-306583	0	0	
46	30542	0	14232	42103	0	-306583	-306304	0	0	
47	23283	0	-3862	44300	0	-306304	-288455	0	0	
48	15477	0	-26094	47008	0	-288455	-248294	0	0	
49	6940	0	-54543	50438	0	-248294	-178882	0	0	
50	305	0	-18314	12707	0	-178882	-156784	0	0	

Tabella 33-5 – Forze applicate sulle strisce [BISHOP] della superficie 176 della verifica di stabilità 29.

### 33.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.148311
2	0.105343
3	0.321219
4	0.147429
5	0.188058
6	0.076074
7	0.136530

Tabella 33-6 – Spostamenti della superficie 1 della verifica di stabilità 29.

Accelerazione sismica critica  $K_c = 0.063$   
Spostamento massimo  $U_{max} = 0.321219$  [m]  
Velocità massima  $V_{max} = 0.502021$  [m/s]

n°	u
	[m]
1	0.150641
2	0.107414
3	0.328551
4	0.150587
5	0.191795
6	0.077719
7	0.142921

Tabella 33-7 – Spostamenti della superficie 176 della verifica di stabilità 29.

Accelerazione sismica critica  $K_c = 0.062$   
Spostamento massimo  $U_{max} = 0.328551$  [m]  
Velocità massima  $V_{max} = 0.508031$  [m/s]

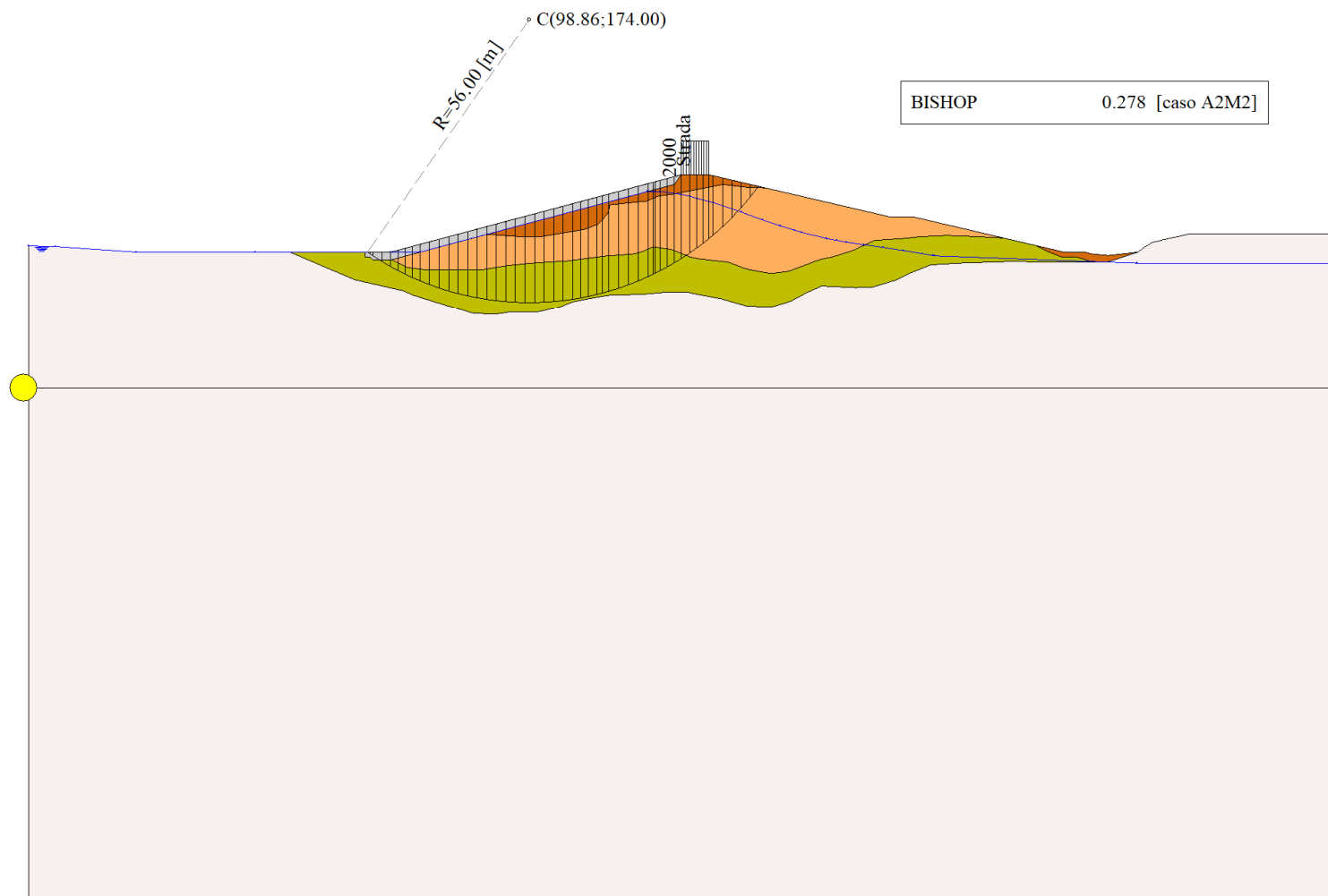


Figura 33-1 – Superficie critica (1) della sezione CR\_06 per la verifica di stabilità 29.

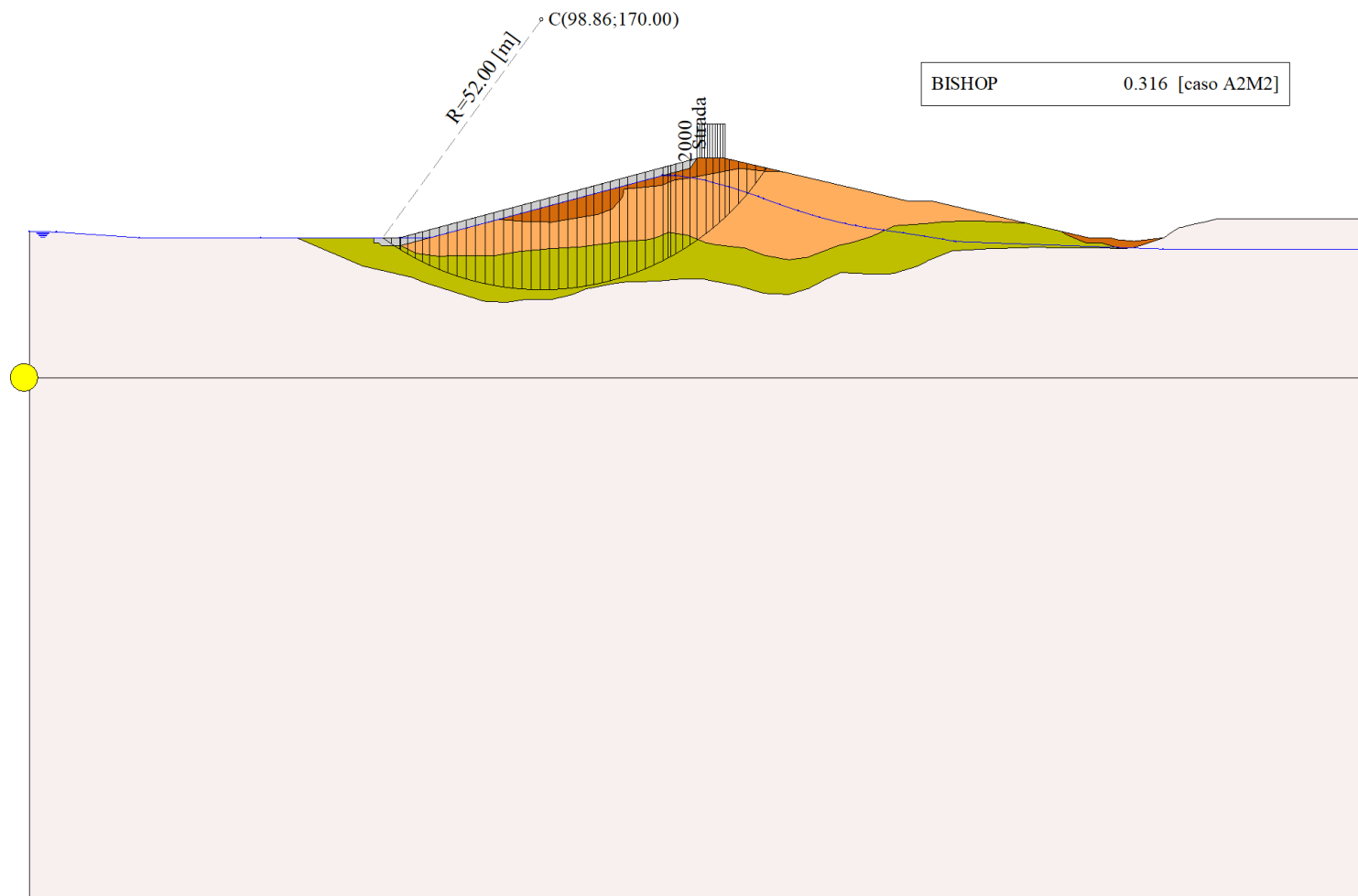


Figura 33-2 – Superficie critica (176) della sezione CR\_06 per la verifica di stabilità 29.

## 34 DICHIARAZIONI SECONDO N.T.C. 2018 (PUNTO 10.2)

### **Analisi e verifiche svolte con l'ausilio di codici di calcolo**

Il sottoscritto, in qualità di calcolatore delle opere in progetto, dichiara quanto segue.

#### **Tipo di analisi svolta**

L'analisi e le verifiche di stabilità sono condotte con l'ausilio di un codice di calcolo automatico.

I metodi di calcolo implementati sono i classici metodi delle strisce, basati sul concetto dell'equilibrio limite globale. La superficie di rottura è suddivisa in un determinato numero di strisce che consentono di calcolare le grandezze che entrano in gioco nelle equazioni risolutive.

Nel modulo terreni si adotta il criterio di rottura di Mohr-Coulomb. Nel modulo rocce si può adottare il criterio di rottura di Hoek-Brown o di Barton.

Il programma consente di inserire degli interventi di stabilizzazione, che possono intervenire secondo sue modalità diverse: variazione delle forze di interstriscia o resistenza a taglio equivalente.

L'analisi sotto le azioni sismiche è condotta con il metodo dell'analisi statica equivalente secondo le disposizioni del capitolo 7 del DM 17/01/2018.

#### **Origine e caratteristiche dei codici di calcolo**

Titolo	STAP - Stabilità Pendii Terreni
Versione	14.0
Produttore	Aztec Informatica srl. Casali del Manco - Loc. Casole Bruzio (CS)
Utente	WEST SYSTEMS S.R.L.
Licenza	AIU11705Y

#### **Affidabilità dei codici di calcolo**

Un attento esame preliminare della documentazione a corredo del software ha consentito di valutarne l'affidabilità. La documentazione fornita dal produttore del software contiene un'esauriente descrizione delle basi teoriche, degli algoritmi impiegati e l'individuazione dei campi d'impiego. La società produttrice Aztec Informatica srl ha verificato l'affidabilità e la robustezza del codice di calcolo attraverso un numero significativo di casi prova in cui i risultati dell'analisi numerica sono stati confrontati con soluzioni teoriche.

#### **Modalità di presentazione dei risultati**

La relazione di calcolo strutturale presenta i dati di calcolo tale da garantirne la leggibilità, la corretta interpretazione e la riproducibilità. La relazione di calcolo illustra in modo esaustivo i dati in ingresso ed i risultati delle analisi in forma tabellare.

#### **Informazioni generali sull'elaborazione**

Il software prevede una serie di controlli automatici che consentono l'individuazione di errori di modellazione, di non rispetto di limitazioni geometriche e di armatura e di presenza di elementi non verificati. Il codice di calcolo consente di visualizzare e controllare, sia in forma grafica che tabellare, i dati del modello strutturale, in modo da avere una visione consapevole del comportamento corretto del modello strutturale.

#### **Giudizio motivato di accettabilità dei risultati**

I risultati delle elaborazioni sono stati sottoposti a controlli dal sottoscritto utente del software. Tale valutazione ha compreso il confronto con i risultati di semplici calcoli, eseguiti con metodi tradizionali. Inoltre sulla base di considerazioni riguardanti gli stati tensionali e deformativi determinati, si è valutata la validità delle scelte operate in sede di schematizzazione e di modellazione della struttura e delle azioni.

In base a quanto sopra, io sottoscritto asserisco che l'elaborazione è corretta ed idonea al caso specifico, pertanto i risultati di calcolo sono da ritenersi validi ed accettabili.