






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



**PROGETTO DEFINITIVO**

Elaborato	Nome Elaborato:	Scala:
<b>ET08c</b>	<b>ALLEGATI RELAZIONE VERIFICHE DI STABILITÀ STATICHE E SISMICHE MODELLO DI NEWMARK</b>	-
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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	2.021	-	-	-	1.2
02	Valle	Invaso vuoto	Senza	Non drenate	1.499	-	-	-	1.1
03	Valle	Invaso vuoto	SLO	Non drenate	0.645	0.025459	0.002298	9	
04	Valle	Invaso vuoto	SLD	Non drenate	0.502	0.044650	0.008424	27	
05	Valle	Invaso vuoto	SLV	Non drenate	0.294	0.235429	0.097730	59	
06	Valle	Invaso vuoto	SLC	Non drenate	0.307	0.304624	0.135347	55	
07	Valle	Esercizio	Senza	Drenate	1.874			-	1.2
08	Valle	Esercizio	SLO	Non drenate	0.644	0.025734	0.002352	9	
09	Valle	Esercizio	SLD	Non drenate	0.500	0.045185	0.008609	33	
10	Valle	Esercizio	SLV	Non drenate	0.292	0.239919	0.100299	64	
11	Valle	Esercizio	SLC	Non drenate	0.305	0.309040	0.138142	60	
12	Valle	Max piena	Senza	Drenate	1.874	-	-	-	1.2
13	Valle	Max piena	Senza	Non drenate	1.495	-	-	-	1.1
14	Monte	Invaso vuoto	Senza	Drenate	1.872	-	-	-	1.2
15	Monte	Invaso vuoto	Senza	Non drenate	1.367	-	-	-	1.1
16	Monte	Invaso vuoto	SLO	Non drenate	0.676	0.026371	0.002523	37	
17	Monte	Invaso vuoto	SLD	Non drenate	0.532	0.046379	0.009028	107	
18	Monte	Invaso vuoto	SLV	Non drenate	0.293	0.230262	0.094844	145	
19	Monte	Invaso vuoto	SLC	Non drenate	0.309	0.299726	0.132272	37	
20	Monte	Esercizio	Senza	Drenate	2.255	-	-	-	1.2
21	Monte	Esercizio	SLO	Non drenate	0.834	0.000863	0.000010	1	
22	Monte	Esercizio	SLD	Non drenate	0.633	0.008429	0.000298	38	
23	Monte	Esercizio	SLV	Non drenate	0.355	0.115800	0.019186	116	
24	Monte	Esercizio	SLC	Non drenate	0.372	0.133814	0.031686	117	
25	Monte	Rapido svaso	Senza	Non drenate	1.369	-	-	-	1.1
26	Monte	Rapido svaso	SLO	Non drenate	0.679	0.025901	0.002419	42	
27	Monte	Rapido svaso	SLD	Non drenate	0.528	0.045508	0.008721	116	
28	Monte	Rapido svaso	SLV	Non drenate	0.292	0.227016	0.093046	109	
29	Monte	Rapido svaso	SLC	Non drenate	0.305	0.296280	0.130120	117	

Tabella 3-1 – Verifiche di stabilità dello stato di progetto condotte secondo D.M. 26/06/2014 per la sezione CR\_08.

## 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	
6	Dreno	1800	2000	30.00	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	
6	Dreno	1800	2000	16.60	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	118.00	9	54.35	127.00	17	195.79	128.00
2	11.15	118.00	10	59.00	127.00	18	200.79	128.00
3	14.95	118.20	11	67.19	128.93	19	214.10	128.00
4	14.99	118.21	12	93.00	135.00	20	222.58	128.00
5	18.46	119.00	13	97.64	135.00	21	231.65	129.02
6	19.61	119.26	14	124.57	141.34	22	249.90	130.00
7	22.83	120.00	15	132.91	143.30	23	254.95	130.50
8	24.60	120.00	16	138.41	143.30	24	260.00	131.00

Tabella 4-3 – Profilo del piano campagna.

n°	X [m]	Y [m]	n°	X [m]	Y [m]	n°	X [m]	Y [m]
1	214.10	128.00	13	105.42	116.45	25	27.79	117.03
2	206.20	125.27	14	100.16	117.87	26	17.41	117.03
3	196.12	120.26	15	93.45	117.87	27	0.00	117.03
4	192.23	119.54	16	90.10	119.47	28	0.00	0.00
5	180.32	119.30	17	80.82	121.01	29	260.00	0.00
6	171.03	120.10	18	69.60	119.85	30	260.00	131.00

<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	157.93	120.42	19	63.14	119.26	31	254.95	130.50
8	144.83	121.34	20	57.84	118.77	32	249.90	130.00
9	121.27	120.85	21	55.72	118.59	33	231.65	129.02
10	118.14	120.62	22	54.96	118.21	34	222.58	128.00
11	109.83	118.62	23	51.27	118.21	-	-	-
12	109.52	117.36	24	43.76	117.53	-	-	-

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	63.84	125.99	18	157.93	120.42	35	142.22	129.58
2	63.41	123.31	19	171.03	120.10	36	137.16	129.72
3	63.40	122.41	20	180.32	119.30	37	133.98	129.58
4	55.72	118.59	21	192.23	119.54	38	132.15	129.34
5	57.84	118.77	22	196.12	120.26	39	128.21	128.71
6	63.14	119.26	23	206.20	125.27	40	125.61	127.84
7	69.60	119.85	24	200.02	124.84	41	119.71	127.50
8	80.82	121.01	25	192.00	124.49	42	114.62	128.38
9	90.10	119.47	26	188.46	124.54	43	109.68	129.48
10	93.45	117.87	27	183.37	124.95	44	105.73	130.06
11	100.16	117.87	28	178.93	125.07	45	101.71	130.41
12	105.42	116.45	29	171.97	126.01	46	99.81	130.38
13	109.52	117.36	30	165.34	127.12	47	92.48	129.99
14	109.83	118.62	31	161.14	128.23	48	88.13	128.97
15	118.14	120.62	32	156.30	128.87	49	81.06	127.41
16	121.27	120.85	33	152.50	129.20	50	75.07	127.18
17	144.83	121.34	34	144.79	129.34	51	70.23	126.61

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	173.57	132.37	19	63.84	125.99	37	144.79	129.34
2	169.43	132.46	20	70.23	126.61	38	152.50	129.20
3	162.58	133.05	21	75.07	127.18	39	156.30	128.87
4	156.23	133.94	22	81.06	127.41	40	161.14	128.23
5	149.58	135.43	23	88.13	128.97	41	165.34	127.12
6	145.59	137.10	24	92.48	129.99	42	171.97	126.01
7	145.44	138.11	25	99.81	130.38	43	178.93	125.07
8	142.51	140.05	26	101.71	130.41	44	183.37	124.95
9	137.13	140.59	27	105.73	130.06	45	188.46	124.54
10	134.09	140.69	28	109.68	129.48	46	192.00	124.49
11	132.75	140.49	29	114.62	128.38	47	200.02	124.84
12	128.48	141.04	30	119.71	127.50	48	206.20	125.27
13	124.57	141.34	31	125.61	127.84	49	214.10	128.00
14	97.64	135.00	32	128.21	128.71	50	200.79	128.00
15	93.00	135.00	33	132.15	129.34	51	200.78	127.00
16	67.19	128.93	34	133.98	129.58	52	199.79	127.00
17	65.35	128.00	35	137.16	129.72	53	199.29	126.50
18	57.13	126.00	36	142.22	129.58	54	195.59	126.50

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	57.13	126.00	6	24.60	120.00	11	38.43	122.01
2	65.35	128.00	7	32.78	120.00	12	45.06	122.88
3	67.19	128.93	8	35.72	121.24	13	52.85	123.99
4	59.00	127.00	9	36.48	121.50	-	-	-
5	54.35	127.00	10	37.68	122.00	-	-	-

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	138.41	143.30	6	199.79	127.00
2	139.67	141.41	7	200.78	127.00
3	173.57	132.37	8	200.79	128.00
4	195.59	126.50	9	195.79	128.00
5	199.29	126.50	-	-	-

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	124.57	141.34	9	149.58	135.43
2	128.48	141.04	10	156.23	133.94
3	132.75	140.49	11	162.58	133.05
4	134.09	140.69	12	169.43	132.46
5	137.13	140.59	13	173.57	132.37
6	142.51	140.05	14	139.67	141.41
7	145.44	138.11	15	138.41	143.30
8	145.59	137.10	16	132.91	143.30

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

n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]
1	51.27	118.21	5	0.00	117.03
2	14.95	118.20	6	17.41	117.03
3	11.15	118.00	7	27.79	117.03
4	0.00	118.00	8	43.76	117.53

Tabella 4-10 – Coordinate dei vertici dello strato n° 7 costituito da terreno n° 2 (LA2).

n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]
1	63.41	123.31	6	51.27	118.21
2	54.78	119.01	7	54.96	118.21
3	18.46	119.00	8	55.72	118.59
4	14.99	118.21	9	63.40	122.41
5	14.95	118.20	-	-	-

Tabella 4-11 – Coordinate dei vertici dello strato n° 8 costituito da terreno n° 6 (Dreno).

n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]
1	18.46	119.00	9	37.68	122.00
2	54.78	119.01	10	36.48	121.50
3	63.41	123.31	11	35.72	121.24



n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]
4	63.84	125.99	12	32.78	120.00
5	57.13	126.00	13	24.60	120.00
6	52.85	123.99	14	22.83	120.00
7	45.06	122.88	15	19.61	119.26
8	38.43	122.01	-	-	-

Tabella 4-12 – Coordinate dei vertici dello strato n° 9 costituito da terreno n° 2 (LA2).

#### 4.2.2 DESCRIZIONE FALDA

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
1	0.00	116.00	14	94.95	122.78	27	156.67	127.13
2	7.70	117.02	15	98.51	123.01	28	163.22	127.33
3	14.95	118.20	16	108.78	123.70	29	168.86	127.56
4	54.97	118.21	17	114.10	124.11	30	172.42	127.67
5	56.22	118.45	18	118.35	124.50	31	178.42	127.82
6	57.59	118.70	19	123.20	124.98	32	182.09	127.88
7	62.96	119.35	20	129.46	125.56	33	188.66	127.98
8	68.03	119.94	21	133.51	125.87	34	191.16	128.00
9	73.79	120.62	22	136.69	126.09	35	195.79	128.00
10	80.36	121.42	23	139.33	126.26	36	222.58	128.00
11	83.86	121.82	24	144.74	126.58	37	231.65	129.02
12	87.76	122.20	25	148.73	126.80	38	249.90	130.00
13	91.12	122.49	26	152.79	126.98	39	260.00	131.00

Tabella 4-13 – Livello falda serbatoio vuoto.

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
1	0.00	116.00	14	84.88	126.53	27	125.56	135.53
2	7.70	117.02	15	88.67	127.32	28	126.52	135.93
3	14.95	118.20	16	90.82	127.69	29	132.10	137.79
4	54.96	118.21	17	94.42	128.29	30	135.28	138.61
5	56.50	118.86	18	98.52	128.91	31	136.66	139.04
6	57.12	119.18	19	102.31	129.46	32	138.35	139.37
7	57.48	119.30	20	105.78	129.96	33	142.60	140.02
8	61.09	120.29	21	107.69	130.31	34	143.49	140.00
9	66.85	121.80	22	109.69	130.70	35	143.99	140.00
10	70.05	122.66	23	114.72	131.95	36	150.79	140.00
11	73.81	123.67	24	115.97	132.32	37	260.00	140.00
12	77.12	124.55	25	118.86	133.21	-	-	-
13	81.14	125.61	26	122.34	134.38	-	-	-

Tabella 4-14 – Livello falda massima regolazione.

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
1	0.00	116.00	13	81.14	125.61	25	118.86	133.21
2	7.70	117.02	14	84.88	126.53	26	122.34	134.38
3	14.95	118.20	15	88.67	127.32	27	125.56	135.53
4	54.96	118.21	16	90.82	127.69	28	126.52	135.93
5	56.50	118.86	17	94.42	128.29	29	132.10	137.79
6	57.12	119.18	18	98.52	128.91	30	135.24	138.77
7	57.48	119.30	19	102.31	129.46	31	136.60	139.29

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
8	61.09	120.29	20	105.78	129.96	32	138.29	139.71
9	66.85	121.80	21	107.69	130.31	33	141.63	140.28
10	70.05	122.66	22	109.69	130.70	34	143.71	140.34
11	73.81	123.67	23	114.72	131.95	35	260.00	140.34
12	77.12	124.55	24	115.97	132.32	-	-	-

Tabella 4-15 – 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]	$X_0 = 4.92$	$Y_0 = 140.00$
Passo maglia	[m]	$dX = 2.00$	$dY = 2.00$
Numero passi		$N_x = 65$	$N_y = 40$
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	100.50	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	131.00	9	121.59	143.30	17	235.40	120.00
2	5.05	130.50	10	127.09	143.30	18	237.17	120.00
3	10.10	130.00	11	135.43	141.34	19	240.39	119.26
4	28.35	129.02	12	162.36	135.00	20	241.54	119.00
5	37.42	128.00	13	167.00	135.00	21	245.01	118.21
6	45.90	128.00	14	192.81	128.93	22	245.05	118.20
7	59.21	128.00	15	201.00	127.00	23	248.85	118.00
8	64.21	128.00	16	205.65	127.00	24	260.00	118.00

Tabella 4-16 – Profilo del piano campagna.

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
1	45.90	128.00	13	208.73	118.21	25	150.17	118.62
2	37.42	128.00	14	205.04	118.21	26	141.86	120.62
3	28.35	129.02	15	204.28	118.59	27	138.73	120.85
4	10.10	130.00	16	202.16	118.77	28	115.17	121.34
5	5.05	130.50	17	196.86	119.26	29	102.07	120.42
6	0.00	131.00	18	190.40	119.85	30	88.97	120.10
7	0.00	0.00	19	179.18	121.01	31	79.68	119.30
8	260.00	0.00	20	169.90	119.47	32	67.77	119.54
9	260.00	117.03	21	166.55	117.87	33	63.88	120.26

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
10	242.59	117.03	22	159.84	117.87	34	53.80	125.27
11	232.21	117.03	23	154.58	116.45	-	-	-
12	216.24	117.53	24	150.48	117.36	-	-	-

Tabella 4-17 – 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	196.16	125.99	18	117.78	129.58	35	102.07	120.42
2	189.77	126.61	19	115.21	129.34	36	115.17	121.34
3	184.93	127.18	20	107.50	129.20	37	138.73	120.85
4	178.94	127.41	21	103.70	128.87	38	141.86	120.62
5	171.87	128.97	22	98.86	128.23	39	150.17	118.62
6	167.52	129.99	23	94.66	127.12	40	150.48	117.36
7	160.19	130.38	24	88.03	126.01	41	154.58	116.45
8	158.29	130.41	25	81.07	125.07	42	159.84	117.87
9	154.27	130.06	26	76.63	124.95	43	166.55	117.87
10	150.32	129.48	27	71.54	124.54	44	169.90	119.47
11	145.38	128.38	28	68.00	124.49	45	179.18	121.01
12	140.29	127.50	29	59.98	124.84	46	190.40	119.85
13	134.39	127.84	30	53.80	125.27	47	196.86	119.26
14	131.79	128.71	31	63.88	120.26	48	202.16	118.77
15	127.85	129.34	32	67.77	119.54	49	204.28	118.59
16	126.02	129.58	33	79.68	119.30	50	196.60	122.41
17	122.84	129.72	34	88.97	120.10	51	196.59	123.31

Tabella 4-18 – 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	86.43	132.37	19	115.21	129.34	37	196.16	125.99
2	64.41	126.50	20	117.78	129.58	38	202.87	126.00
3	60.71	126.50	21	122.84	129.72	39	194.65	128.00
4	60.21	127.00	22	126.02	129.58	40	192.81	128.93
5	59.22	127.00	23	127.85	129.34	41	167.00	135.00
6	59.21	128.00	24	131.79	128.71	42	162.36	135.00
7	45.90	128.00	25	134.39	127.84	43	135.43	141.34
8	53.80	125.27	26	140.29	127.50	44	131.52	141.04
9	59.98	124.84	27	145.38	128.38	45	127.25	140.49
10	68.00	124.49	28	150.32	129.48	46	125.91	140.69
11	71.54	124.54	29	154.27	130.06	47	122.87	140.59
12	76.63	124.95	30	158.29	130.41	48	117.49	140.05
13	81.07	125.07	31	160.19	130.38	49	114.56	138.11
14	88.03	126.01	32	167.52	129.99	50	114.41	137.10
15	94.66	127.12	33	171.87	128.97	51	110.42	135.43
16	98.86	128.23	34	178.94	127.41	52	103.77	133.94
17	103.70	128.87	35	184.93	127.18	53	97.42	133.05
18	107.50	129.20	36	189.77	126.61	54	90.57	132.46

Tabella 4-19 – 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	202.87	126.00	6	223.52	121.50	11	201.00	127.00
2	207.15	123.99	7	224.28	121.24	12	192.81	128.93
3	214.94	122.88	8	227.22	120.00	13	194.65	128.00
4	221.57	122.01	9	235.40	120.00	-	-	-
5	222.32	122.00	10	205.65	127.00	-	-	-

Tabella 4-20 – Coordinate dei vertici dello strato n° 4 costituito da terreno n° 4 (LA1).

n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]
1	121.59	143.30	6	60.71	126.50
2	64.21	128.00	7	64.41	126.50
3	59.21	128.00	8	86.43	132.37
4	59.22	127.00	9	120.33	141.41
5	60.21	127.00	-	-	-

Tabella 4-21 – Coordinate dei vertici dello strato n° 5 costituito da terreno n° 5 (Scogliera).

n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]
1	135.43	141.34	9	110.42	135.43
2	127.09	143.30	10	114.41	137.10
3	121.59	143.30	11	114.56	138.11
4	120.33	141.41	12	117.49	140.05
5	86.43	132.37	13	122.87	140.59
6	90.57	132.46	14	125.91	140.69
7	97.42	133.05	15	127.25	140.49
8	103.77	133.94	16	131.52	141.04

Tabella 4-22 – Coordinate dei vertici dello strato n° 6 costituito da terreno n° 4 (LA1).

n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]
1	208.73	118.21	5	260.00	117.03
2	216.24	117.53	6	260.00	118.00
3	232.21	117.03	7	248.85	118.00
4	242.59	117.03	8	245.05	118.20

Tabella 4-23 – Coordinate dei vertici dello strato n° 7 costituito da terreno n° 2 (LA2).

n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]
1	196.59	123.31	6	245.05	118.20
2	196.60	122.41	7	245.01	118.21
3	204.28	118.59	8	241.54	119.00
4	205.04	118.21	9	205.22	119.01
5	208.73	118.21	-	-	-

Tabella 4-24 – Coordinate dei vertici dello strato n° 8 costituito da terreno n° 6 (Dreno).

n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]
1	241.54	119.00	9	221.57	122.01
2	240.39	119.26	10	214.94	122.88
3	237.17	120.00	11	207.15	123.99
4	235.40	120.00	12	202.87	126.00

n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]
5	227.22	120.00	13	196.16	125.99
6	224.28	121.24	14	196.59	123.31
7	223.52	121.50	15	205.22	119.01
8	222.32	122.00	-	-	-

Tabella 4-25 – Coordinate dei vertici dello strato n° 9 costituito da terreno n° 2 (LA2).

#### 4.3.2 DESCRIZIONE FALDA

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
1	0.00	131.00	14	107.21	126.98	27	168.88	122.49
2	10.10	130.00	15	111.27	126.80	28	172.24	122.20
3	28.35	129.02	16	115.26	126.58	29	176.14	121.82
4	37.42	128.00	17	120.67	126.26	30	179.64	121.42
5	64.21	128.00	18	123.31	126.09	31	186.21	120.62
6	68.84	128.00	19	126.49	125.87	32	191.97	119.94
7	71.34	127.98	20	130.54	125.56	33	197.04	119.35
8	77.91	127.88	21	136.80	124.98	34	202.41	118.70
9	81.58	127.82	22	141.65	124.50	35	203.78	118.45
10	87.58	127.67	23	145.90	124.11	36	205.03	118.21
11	91.14	127.56	24	151.22	123.70	37	245.05	118.20
12	96.78	127.33	25	161.49	123.01	38	252.30	117.02
13	103.33	127.13	26	165.05	122.78	39	260.00	116.00

Tabella 4-26 – Livello falda serbatoio vuoto.

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
1	0.00	140.00	14	144.03	132.32	27	186.19	123.67
2	109.21	140.00	15	145.28	131.95	28	189.95	122.66
3	116.01	140.00	16	150.31	130.70	29	193.15	121.80
4	116.51	140.00	17	152.31	130.31	30	198.91	120.29
5	117.40	140.02	18	154.22	129.96	31	202.52	119.30
6	121.65	139.37	19	157.69	129.46	32	202.88	119.18
7	123.34	139.04	20	161.48	128.91	33	203.50	118.86
8	124.72	138.61	21	165.58	128.29	34	205.04	118.21
9	127.90	137.79	22	169.18	127.69	35	245.05	118.20
10	133.48	135.93	23	171.33	127.32	36	252.30	117.02
11	134.44	135.53	24	175.12	126.53	37	260.00	116.00
12	137.66	134.38	25	178.86	125.61	-	-	-
13	141.14	133.21	26	182.88	124.55	-	-	-

Tabella 4-27 – Livello falda massima regolazione.

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
1	0.00	131.00	15	137.66	134.38	29	182.88	124.55
2	10.10	130.00	16	141.14	133.21	30	186.19	123.67
3	28.35	129.02	17	144.03	132.32	31	189.95	122.66
4	37.42	128.00	18	145.28	131.95	32	193.15	121.80
5	70.03	128.00	19	150.31	130.70	33	198.91	120.29
6	115.01	140.00	20	152.31	130.31	34	202.52	119.30
7	116.51	140.00	21	154.22	129.96	35	202.88	119.18
8	117.40	140.02	22	157.69	129.46	36	203.50	118.86

n°	X	Y	n°	X	Y	n°	X	Y
	[m]	[m]		[m]	[m]		[m]	[m]
9	121.65	139.37	23	161.48	128.91	37	205.04	118.21
10	123.34	139.04	24	165.58	128.29	38	245.05	118.20
11	124.72	138.61	25	169.18	127.69	39	252.30	117.02
12	127.90	137.79	26	171.33	127.32	40	260.00	116.00
13	133.48	135.93	27	175.12	126.53	-	-	-
14	134.44	135.53	28	178.86	125.61	-	-	-

Tabella 4-28 – Livello falda svaso 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]	$X_0 = 3.58$	$Y_0 = 140.00$
Passo maglia	[m]	$dX = 2.00$	$dY = 2.00$
Numero passi		$N_x = 60$	$N_y = 40$
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	100.50	m
- pendenza media della superficie inferiore a	1.00	[%]

## 5 VERIFICA DI STABILITÀ 01

### 5.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{B}_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	132.91 143.30	138.41 143.30	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	53508
Coefficiente di sicurezza minimo	2.021
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	61	
Coordinate del centro	X[m]= 60.92	Y[m]= 190.00
Raggio del cerchio	R[m]= 88.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 10.32	Y <sub>v</sub> [m]= 118.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 135.51	Y <sub>m</sub> [m]= 143.30
Coefficiente di sicurezza	F <sub>s</sub> = 2.021	

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	10.32	118.00	118.00	11.15	118.00	117.43	10.87	117.81	1.01	-34.77	19.10	18
2	11.15	118.00	117.43	13.05	118.10	116.16	12.27	117.37	2.28	-33.70	19.21	19
3	13.05	118.10	116.16	14.95	118.20	114.96	14.08	116.83	2.25	-32.22	19.27	19
4	14.95	118.20	114.96	14.99	118.21	114.93	14.97	116.58	0.05	-31.48	19.27	19
5	14.99	118.21	114.93	16.73	118.60	113.90	15.91	116.40	2.02	-30.80	19.27	19
6	16.73	118.60	113.90	18.46	119.00	112.92	17.63	116.10	1.99	-29.50	19.27	19
7	18.46	119.00	112.92	19.61	119.26	112.30	19.05	115.87	1.31	-28.42	19.27	19
8	19.61	119.26	112.30	21.22	119.63	111.46	20.44	115.66	1.81	-27.41	19.27	19
9	21.22	119.63	111.46	22.83	120.00	110.67	22.04	115.44	1.79	-26.23	19.27	19
10	22.83	120.00	110.67	24.60	120.00	109.84	23.73	115.13	1.95	-25.01	19.27	19
11	24.60	120.00	109.84	27.57	120.70	108.56	26.13	114.77	3.24	-23.32	19.27	19
12	27.57	120.70	108.56	30.55	121.40	107.41	29.10	114.51	3.19	-21.23	19.27	19
13	30.55	121.40	107.41	33.52	122.10	106.37	32.07	114.32	3.15	-19.16	19.27	19
14	33.52	122.10	106.37	36.50	122.80	105.46	35.04	114.18	3.11	-17.12	19.27	19
15	36.50	122.80	105.46	39.47	123.50	104.65	38.01	114.10	3.08	-15.11	19.27	19
16	39.47	123.50	104.65	42.45	124.20	103.96	40.98	114.08	3.05	-13.11	19.27	19
17	42.45	124.20	103.96	45.42	124.90	103.37	43.95	114.11	3.03	-11.13	19.27	19
18	45.42	124.90	103.37	48.40	125.60	102.90	46.93	114.19	3.01	-9.16	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]
19	48.40	125.60	102.90	51.37	126.30	102.52	49.90	114.33	3.00	-7.20	19.27	19
20	51.37	126.30	102.52	54.35	127.00	102.25	52.87	114.52	2.99	-5.25	19.27	19
21	54.35	127.00	102.25	54.97	127.00	102.20	54.66	114.61	0.62	-4.08	19.27	19
22	54.97	127.00	102.20	56.22	127.00	102.13	55.60	114.58	1.25	-3.47	19.27	19
23	56.22	127.00	102.13	57.59	127.00	102.06	56.91	114.55	1.37	-2.62	19.27	19
24	57.59	127.00	102.06	59.00	127.00	102.02	58.30	114.52	1.41	-1.71	19.27	19
25	59.00	127.00	102.02	60.98	127.47	102.00	59.99	114.62	1.98	-0.61	19.27	19
26	60.98	127.47	102.00	62.96	127.93	102.02	61.97	114.86	1.98	0.68	19.27	19
27	62.96	127.93	102.02	65.08	128.43	102.10	64.02	115.12	2.12	2.02	19.27	19
28	65.08	128.43	102.10	67.19	128.93	102.22	66.13	115.42	2.12	3.40	19.27	19
29	67.19	128.93	102.22	68.03	129.13	102.29	67.61	115.64	0.84	4.36	19.27	19
30	68.03	129.13	102.29	70.91	129.80	102.57	69.47	115.95	2.89	5.58	19.27	19
31	70.91	129.80	102.57	73.79	130.48	102.95	72.35	116.45	2.90	7.46	19.27	19
32	73.79	130.48	102.95	75.98	131.00	103.30	74.89	116.93	2.22	9.13	19.27	19
33	75.98	131.00	103.30	78.17	131.51	103.71	77.08	117.38	2.23	10.58	19.27	19
34	78.17	131.51	103.71	80.36	132.03	104.17	79.27	117.86	2.24	12.03	19.27	19
35	80.36	132.03	104.17	82.11	132.44	104.59	81.23	118.31	1.80	13.35	19.27	19
36	82.11	132.44	104.59	83.86	132.85	105.04	82.98	118.73	1.81	14.52	19.27	19
37	83.86	132.85	105.04	85.81	133.31	105.59	84.83	119.20	2.03	15.77	19.27	19
38	85.81	133.31	105.59	87.76	133.77	106.19	86.78	119.72	2.04	17.09	19.27	19
39	87.76	133.77	106.19	89.44	134.16	106.75	88.60	120.22	1.77	18.33	19.27	19
40	89.44	134.16	106.75	91.12	134.56	107.34	90.28	120.70	1.78	19.49	19.27	19
41	91.12	134.56	107.34	93.00	135.00	108.06	92.06	121.24	2.01	20.73	19.27	19
42	93.00	135.00	108.06	94.95	135.00	108.85	93.97	121.72	2.10	22.06	19.27	19
43	94.95	135.00	108.85	97.64	135.00	110.03	96.28	122.22	2.94	23.71	19.27	19
44	97.64	135.00	110.03	98.51	135.20	110.43	98.07	122.67	0.96	24.97	19.27	19
45	98.51	135.20	110.43	101.08	135.81	111.70	99.79	123.28	2.86	26.22	19.27	19
46	101.08	135.81	111.70	103.64	136.41	113.07	102.35	124.24	2.91	28.10	19.27	19
47	103.64	136.41	113.07	106.21	137.02	114.55	104.92	125.26	2.97	30.01	19.27	19
48	106.21	137.02	114.55	108.78	137.62	116.15	107.49	126.33	3.03	31.96	19.27	19
49	108.78	137.62	116.15	109.52	137.80	116.64	109.15	127.05	0.88	33.24	19.27	19
50	109.52	137.80	116.64	111.81	138.34	118.21	110.66	127.74	2.78	34.43	19.27	19
51	111.81	138.34	118.21	114.10	138.88	119.89	112.94	128.82	2.84	36.26	19.23	19
52	114.10	138.88	119.89	116.22	139.38	121.55	115.15	129.92	2.70	38.06	19.10	18
53	116.22	139.38	121.55	118.35	139.88	123.32	117.27	131.02	2.77	39.84	19.10	18
54	118.35	139.88	123.32	121.46	140.61	126.13	119.87	132.47	4.19	42.10	19.10	18
55	121.46	140.61	126.13	124.57	141.34	129.23	122.97	134.30	4.39	44.90	19.43	18
56	124.57	141.34	129.23	127.30	141.98	132.22	125.88	136.16	4.05	47.64	19.78	18
57	127.30	141.98	132.22	130.02	142.62	135.51	128.59	138.03	4.27	50.35	19.78	18
58	130.02	142.62	135.51	132.75	143.26	139.16	131.26	140.04	4.55	53.23	19.78	18
59	132.75	143.26	139.16	132.91	143.30	139.39	132.83	141.28	0.28	54.80	19.78	18
60	132.91	143.30	139.39	134.09	143.30	141.11	133.44	141.73	2.09	55.57	19.18	19
61	134.09	143.30	141.11	135.51	143.30	143.30	134.56	142.57	2.61	57.10	17.58	19

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	500	0	1395	1132	0	0	1725	0	0	
2	5072	0	6140	3213	2099	1725	8970	0	0	
3	10544	0	9426	3805	5437	8970	20114	0	0	
4	307	0	249	93	167	20114	20411	0	0	
5	14814	0	12020	4033	7631	20411	33937	0	0	
6	19967	0	16067	4707	9536	33937	50641	0	0	
7	16018	0	12785	3477	7311	50641	63264	0	0	
8	26039	0	20630	5324	11462	63264	82763	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	30139	0	23667	5831	12805	82763	104114	0	0	
10	36932	0	28412	6805	15517	104114	128854	0	0	
11	71007	0	53512	12391	29155	128854	172960	0	0	
12	83140	0	61938	13801	32615	172960	220060	0	0	
13	94487	0	69639	15092	35636	220060	268874	0	0	
14	105225	0	76870	16307	38261	268874	318359	0	0	
15	115239	0	83545	17431	40525	318359	367525	0	0	
16	124419	0	89587	18450	42459	367525	415445	0	0	
17	132898	0	95175	19394	44085	415445	461353	0	0	
18	140716	0	100382	20276	45421	461353	504583	0	0	
19	147864	0	105223	21099	46484	504583	544537	0	0	
20	154345	0	109723	21867	47284	544537	580690	0	0	
21	32851	0	23329	4636	9937	580690	587681	0	0	
22	66441	0	47610	9445	19525	587681	601172	0	0	
23	73089	0	51761	10279	21874	601172	614799	0	0	
24	75365	0	52432	10433	23278	614799	627486	0	0	
25	106840	0	73865	14690	33137	627486	643306	0	0	
26	108640	0	74868	14864	33602	643306	656875	0	0	
27	117993	0	81142	16081	36357	656875	668809	0	0	
28	119659	0	82200	16266	36704	668809	678003	0	0	
29	47919	0	32904	6506	14658	678003	680874	0	0	
30	165776	0	113906	22499	50462	680874	687294	0	0	
31	167707	0	115472	22780	50683	687294	688297	0	0	
32	128464	0	88764	17497	38536	688297	685370	0	0	
33	128913	0	89396	17616	38456	685370	679213	0	0	
34	129079	0	89928	17719	38274	679213	669815	0	0	
35	103089	0	72150	14218	30427	669815	659967	0	0	
36	102915	0	72449	14279	30164	659967	648059	0	0	
37	114298	0	80948	15960	33314	648059	632364	0	0	
38	113704	0	81267	16028	32763	632364	614167	0	0	
39	97330	0	70186	13851	27759	614167	596505	0	0	
40	96594	0	70359	13892	27190	596505	577054	0	0	
41	106994	0	78803	15573	29702	577054	553221	0	0	
42	108626	0	80891	16025	29824	553221	526482	0	0	
43	144150	0	108643	21632	39293	526482	486812	0	0	
44	45311	0	34579	6909	12188	486812	473329	0	0	
45	131111	0	101831	20380	34279	473329	431478	0	0	
46	126683	0	101216	20321	31543	431478	386876	0	0	
47	121546	0	100262	20209	28431	386876	340007	0	0	
48	115857	0	99143	20075	24891	340007	291380	0	0	
49	32260	0	28346	5758	6450	291380	277126	0	0	
50	96395	0	86985	17730	17726	277126	232552	0	0	
51	90605	0	85510	17458	14044	232552	187755	0	0	
52	78509	0	78031	15761	9338	187755	146305	0	0	
53	72730	0	76362	15536	5395	146305	105860	0	0	
54	94939	0	107898	22202	0	105860	49989	0	0	
55	80222	0	93086	20235	0	49989	-1382	0	0	
56	57837	0	68384	15920	0	-1382	-41190	0	0	
57	44900	0	53993	13571	0	-41190	-74106	0	0	
58	30258	0	36258	10677	0	-74106	-96758	0	0	
59	1289	0	1494	523	0	-96758	-97677	0	0	
60	7307	3068	12383	4091	0	-97677	-105578	0	0	
61	3170	3682	7013	3624	0	-105578	-109497	0	0	

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

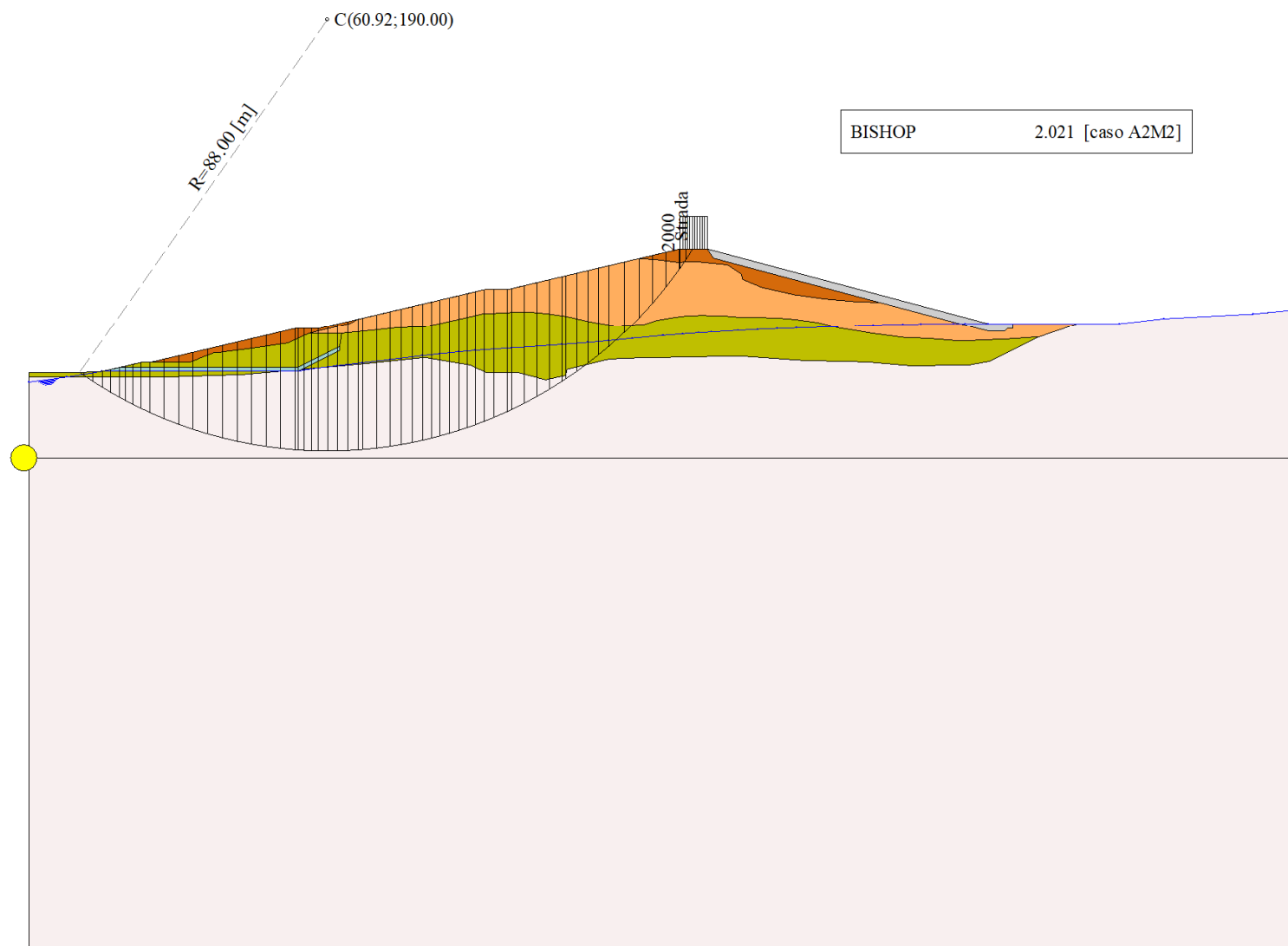


Figura 5-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 01.

## 6 VERIFICA DI STABILITÀ 02

### 6.1.1 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	132.91 143.30	138.41 143.30	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	53508
Coefficiente di sicurezza minimo	1.499
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	51
Coordinate del centro	X[m]= 92.92                      Y[m]= 188.00
Raggio del cerchio	R[m]= 68.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 61.64                      Y <sub>v</sub> [m]= 127.62
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 143.06                      Y <sub>m</sub> [m]= 142.06
Coefficiente di sicurezza	F <sub>s</sub> = 1.499

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	61.64	127.62	127.62	62.74	127.88	127.06	62.37	127.52	1.23	-26.87	0.00	53
2	62.74	127.88	127.06	63.84	128.14	126.53	63.35	127.40	1.22	-25.83	0.00	54
3	63.84	128.14	126.53	65.52	128.54	125.77	64.75	127.24	1.84	-24.54	0.00	53
4	65.52	128.54	125.77	67.19	128.93	125.06	66.40	127.07	1.82	-23.00	0.00	52
5	67.19	128.93	125.06	69.07	129.37	124.32	68.17	126.92	2.02	-21.38	0.00	52
6	69.07	129.37	124.32	70.95	129.81	123.65	70.04	126.79	2.00	-19.69	0.00	52
7	70.95	129.81	123.65	72.83	130.26	123.03	71.92	126.69	1.98	-18.01	0.00	52
8	72.83	130.26	123.03	74.72	130.70	122.48	73.80	126.62	1.96	-16.35	0.00	52
9	74.72	130.70	122.48	76.60	131.14	121.99	75.67	126.58	1.95	-14.71	0.00	52
10	76.60	131.14	121.99	78.48	131.58	121.55	77.55	126.57	1.93	-13.08	0.00	52
11	78.48	131.58	121.55	80.36	132.03	121.17	79.43	126.58	1.92	-11.45	0.00	52
12	80.36	132.03	121.17	80.82	132.14	121.09	80.59	126.60	0.47	-10.45	0.00	52
13	80.82	132.14	121.09	82.34	132.49	120.83	81.59	126.64	1.54	-9.60	0.00	52
14	82.34	132.49	120.83	83.86	132.85	120.61	83.11	126.69	1.54	-8.30	0.00	52
15	83.86	132.85	120.61	85.81	133.31	120.37	84.84	126.79	1.96	-6.83	0.00	52
16	85.81	133.31	120.37	87.76	133.77	120.20	86.79	126.91	1.96	-5.18	0.00	52
17	87.76	133.77	120.20	88.93	134.04	120.12	88.35	127.03	1.17	-3.86	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	88.93	134.04	120.12	90.10	134.32	120.06	89.52	127.13	1.17	-2.87	0.00	52
19	90.10	134.32	120.06	91.12	134.56	120.02	90.61	127.24	1.02	-1.95	0.00	52
20	91.12	134.56	120.02	93.00	135.00	120.00	92.06	127.40	1.88	-0.72	0.00	52
21	93.00	135.00	120.00	94.95	135.00	120.03	93.97	127.51	1.95	0.89	0.00	52
22	94.95	135.00	120.03	96.29	135.00	120.08	95.62	127.53	1.35	2.28	0.00	52
23	96.29	135.00	120.08	97.64	135.00	120.16	96.97	127.56	1.35	3.41	0.00	52
24	97.64	135.00	120.16	98.51	135.20	120.23	98.08	127.65	0.87	4.35	0.00	52
25	98.51	135.20	120.23	100.22	135.61	120.39	99.37	127.86	1.72	5.44	0.00	52
26	100.22	135.61	120.39	101.93	136.01	120.60	101.08	128.15	1.72	6.89	0.00	52
27	101.93	136.01	120.60	103.64	136.41	120.85	102.79	128.47	1.73	8.35	0.00	52
28	103.64	136.41	120.85	105.36	136.82	121.15	104.50	128.81	1.74	9.81	0.00	52
29	105.36	136.82	121.15	107.07	137.22	121.49	106.21	129.17	1.75	11.27	0.00	52
30	107.07	137.22	121.49	108.78	137.62	121.88	107.92	129.55	1.75	12.75	0.00	52
31	108.78	137.62	121.88	110.55	138.04	122.33	109.67	129.97	1.83	14.26	0.00	52
32	110.55	138.04	122.33	112.33	138.46	122.83	111.44	130.41	1.84	15.81	0.00	52
33	112.33	138.46	122.83	114.10	138.88	123.38	113.21	130.89	1.86	17.37	0.00	52
34	114.10	138.88	123.38	115.52	139.21	123.86	114.81	131.33	1.50	18.78	0.00	52
35	115.52	139.21	123.86	116.93	139.54	124.38	116.22	131.75	1.51	20.04	0.00	52
36	116.93	139.54	124.38	118.35	139.88	124.93	117.64	132.18	1.52	21.32	0.00	52
37	118.35	139.88	124.93	119.91	140.24	125.58	119.13	132.66	1.69	22.67	0.00	52
38	119.91	140.24	125.58	121.46	140.61	126.28	120.68	133.18	1.70	24.10	0.00	52
39	121.46	140.61	126.28	123.01	140.97	127.02	122.23	133.72	1.72	25.54	0.00	52
40	123.01	140.97	127.02	124.57	141.34	127.81	123.79	134.29	1.75	27.00	0.00	52
41	124.57	141.34	127.81	125.61	141.58	128.37	125.09	134.78	1.18	28.24	0.00	54
42	125.61	141.58	128.37	127.44	142.01	129.41	126.52	135.34	2.10	29.62	0.00	54
43	127.44	142.01	129.41	129.26	142.44	130.52	128.34	136.09	2.14	31.40	0.00	54
44	129.26	142.44	130.52	131.09	142.87	131.72	130.16	136.89	2.18	33.22	0.00	54
45	131.09	142.87	131.72	132.91	143.30	133.00	131.99	137.72	2.23	35.08	0.00	54
46	132.91	143.30	133.00	134.74	143.30	134.38	133.80	138.49	2.30	36.99	0.00	54
47	134.74	143.30	134.38	136.58	143.30	135.86	135.63	139.20	2.36	38.95	0.00	54
48	136.58	143.30	135.86	138.41	143.30	137.46	137.46	139.96	2.43	40.96	0.00	54
49	138.41	143.30	137.46	139.96	142.89	138.89	139.14	140.62	2.11	42.88	0.00	54
50	139.96	142.89	138.89	141.51	142.47	140.43	140.65	141.14	2.18	44.69	0.00	54
51	141.51	142.47	140.43	143.06	142.06	142.06	142.02	141.65	2.25	46.55	29.34	13

Tabella 6-2 – Geometria e caratteristiche strisce della superficie 1 della verifica di stabilità 02.

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	912	0	3292	4478	0	0	5483	0	0	
2	2645	0	5124	4514	0	5483	11779	0	0	
3	7212	0	10982	6687	0	11779	22423	0	0	
4	11050	0	14744	6453	0	22423	34124	0	0	
5	16818	0	20867	7166	0	34124	48405	0	0	
6	21288	0	25145	7087	0	48405	63549	0	0	
7	25518	0	29115	7016	0	63549	79226	0	0	
8	29511	0	32796	6954	0	79226	95133	0	0	
9	33254	0	36192	6899	0	95133	110995	0	0	
10	36737	0	39306	6850	0	110995	126559	0	0	
11	39996	0	42187	6808	0	126559	141609	0	0	
12	10254	0	10732	1659	0	141609	145186	0	0	
13	35150	0	36574	5467	0	145186	156676	0	0	
14	37057	0	38245	5448	0	156676	167590	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	50146	0	51339	6965	0	167590	180611	0	0	
16	52866	0	53712	6944	0	180611	192373	0	0	
17	32937	0	33292	4159	0	192373	198762	0	0	
18	33785	0	34036	4155	0	198762	204616	0	0	
19	30108	0	30248	3620	0	204616	209261	0	0	
20	56956	0	57045	6668	0	209261	216650	0	0	
21	59963	0	59862	6917	0	216650	222637	0	0	
22	41260	0	41103	4774	0	222637	225774	0	0	
23	41087	0	40875	4779	0	225774	228111	0	0	
24	26624	0	26466	3094	0	228111	229190	0	0	
25	52994	0	52653	6098	0	229190	230269	0	0	
26	53675	0	53327	6115	0	230269	229941	0	0	
27	54160	0	53839	6135	0	229941	228197	0	0	
28	54464	0	54206	6160	0	228197	225035	0	0	
29	54596	0	54436	6190	0	225035	220464	0	0	
30	54542	0	54513	6224	0	220464	214505	0	0	
31	56265	0	56405	6489	0	214505	206902	0	0	
32	55802	0	56144	6536	0	206902	197899	0	0	
33	55138	0	55710	6590	0	197899	187561	0	0	
34	43447	0	44085	5307	0	187561	178394	0	0	
35	42808	0	43617	5348	0	178394	168468	0	0	
36	42065	0	43050	5393	0	168468	157841	0	0	
37	45186	0	46473	5977	0	157841	145443	0	0	
38	44069	0	45575	6041	0	145443	132350	0	0	
39	42836	0	44556	6112	0	132350	118654	0	0	
40	41445	0	43356	6202	0	118654	104494	0	0	
41	26935	0	28232	4359	0	104494	94977	0	0	
42	45724	0	48190	7751	0	94977	77900	0	0	
43	43553	0	46208	7895	0	77900	60561	0	0	
44	41118	0	43876	8055	0	60561	43260	0	0	
45	38389	0	41128	8234	0	43260	26360	0	0	
46	34635	4767	42945	8475	0	26360	7291	0	0	
47	29552	4767	37093	8704	0	7291	-9257	0	0	
48	24116	4767	30466	8964	0	-9257	-22461	0	0	
49	14854	0	13024	7803	0	-22461	-25605	0	0	
50	8876	0	4564	8008	0	-25605	-23121	0	0	
51	2877	0	1521	2522	0	-23121	-22490	0	0	

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

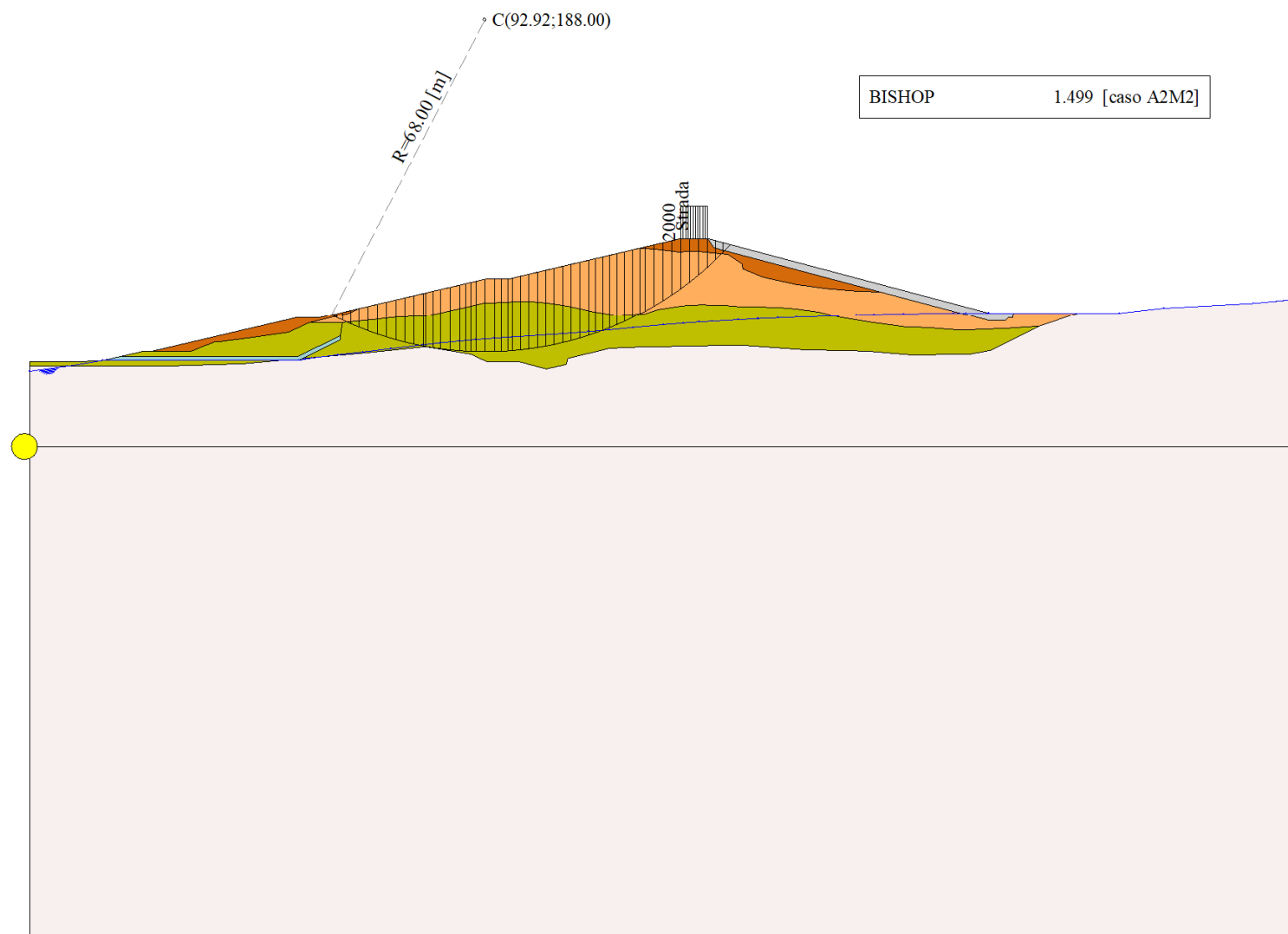


Figura 6-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 02

## 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	132.91 143.30	138.41 143.30	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	107016
Coefficiente di sicurezza minimo	0.645
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	52
Coordinate del centro	X[m]= 96.92                      Y[m]= 208.00
Raggio del cerchio	R[m]= 88.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 61.28                      Y <sub>v</sub> [m]= 127.54
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 152.29                      Y <sub>m</sub> [m]= 139.60
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.645</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	61.28	127.54	127.54	62.56	127.84	126.98	62.14	127.45	1.39	-23.43	0.00	53
2	62.56	127.84	126.98	63.84	128.14	126.45	63.27	127.35	1.38	-22.53	0.00	54
3	63.84	128.14	126.45	65.52	128.54	125.79	64.74	127.23	1.80	-21.49	0.00	53
4	65.52	128.54	125.79	67.19	128.93	125.17	66.40	127.11	1.79	-20.33	0.00	52
5	67.19	128.93	125.17	69.39	129.45	124.42	68.34	126.99	2.32	-18.99	0.00	52
6	69.39	129.45	124.42	71.58	129.96	123.73	70.52	126.89	2.30	-17.48	0.00	52
7	71.58	129.96	123.73	73.78	130.48	123.10	72.71	126.82	2.28	-15.99	0.00	52
8	73.78	130.48	123.10	75.97	130.99	122.53	74.90	126.78	2.27	-14.51	0.00	52
9	75.97	130.99	122.53	78.17	131.51	122.02	77.09	126.76	2.25	-13.04	0.00	52
10	78.17	131.51	122.02	80.36	132.03	121.57	79.28	126.78	2.24	-11.58	0.00	52
11	80.36	132.03	121.57	80.82	132.14	121.49	80.59	126.81	0.47	-10.69	0.00	52
12	80.82	132.14	121.49	82.34	132.49	121.22	81.59	126.83	1.54	-10.04	0.00	52
13	82.34	132.49	121.22	83.86	132.85	120.97	83.11	126.88	1.54	-9.04	0.00	52
14	83.86	132.85	120.97	85.81	133.31	120.70	84.84	126.96	1.97	-7.89	0.00	52
15	85.81	133.31	120.70	87.76	133.77	120.48	86.79	127.07	1.96	-6.61	0.00	52
16	87.76	133.77	120.48	88.93	134.04	120.36	88.35	127.16	1.18	-5.59	0.00	52
17	88.93	134.04	120.36	90.10	134.32	120.26	89.52	127.25	1.17	-4.83	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	90.10	134.32	120.26	91.12	134.56	120.19	90.61	127.33	1.02	-4.11	0.00	52
19	91.12	134.56	120.19	93.00	135.00	120.09	92.07	127.46	1.88	-3.17	0.00	52
20	93.00	135.00	120.09	94.95	135.00	120.02	93.98	127.53	1.95	-1.92	0.00	52
21	94.95	135.00	120.02	96.29	135.00	120.00	95.62	127.51	1.35	-0.84	0.00	52
22	96.29	135.00	120.00	97.64	135.00	120.00	96.97	127.50	1.35	0.03	0.00	52
23	97.64	135.00	120.00	98.51	135.20	120.01	98.08	127.56	0.87	0.75	0.00	52
24	98.51	135.20	120.01	100.56	135.69	120.08	99.54	127.75	2.05	1.70	0.00	52
25	100.56	135.69	120.08	102.62	136.17	120.18	101.60	128.03	2.06	3.04	0.00	52
26	102.62	136.17	120.18	104.67	136.66	120.34	103.65	128.34	2.06	4.38	0.00	52
27	104.67	136.66	120.34	106.73	137.14	120.55	105.70	128.67	2.06	5.73	0.00	52
28	106.73	137.14	120.55	108.78	137.62	120.80	107.76	129.03	2.07	7.07	0.00	52
29	108.78	137.62	120.80	110.55	138.04	121.06	109.67	129.38	1.79	8.33	0.00	52
30	110.55	138.04	121.06	112.33	138.46	121.36	111.44	129.73	1.80	9.50	0.00	52
31	112.33	138.46	121.36	114.10	138.88	121.69	113.21	130.10	1.80	10.67	0.00	52
32	114.10	138.88	121.69	116.22	139.38	122.14	115.16	130.52	2.17	11.97	0.00	52
33	116.22	139.38	122.14	118.35	139.88	122.65	117.29	131.01	2.18	13.38	0.00	52
34	118.35	139.88	122.65	119.97	140.26	123.07	119.16	131.46	1.67	14.64	0.00	52
35	119.97	140.26	123.07	121.58	140.64	123.53	120.77	131.87	1.68	15.73	0.00	52
36	121.58	140.64	123.53	123.20	141.02	124.02	122.39	132.30	1.69	16.83	0.00	52
37	123.20	141.02	124.02	124.57	141.34	124.46	123.88	132.71	1.44	17.84	0.00	52
38	124.57	141.34	124.46	126.20	141.72	125.01	125.38	133.13	1.72	18.87	0.00	52
39	126.20	141.72	125.01	127.83	142.11	125.61	127.01	133.61	1.73	20.00	0.00	52
40	127.83	142.11	125.61	129.46	142.49	126.24	128.64	134.11	1.75	21.13	0.00	52
41	129.46	142.49	126.24	131.19	142.89	126.95	130.32	134.64	1.86	22.31	0.00	52
42	131.19	142.89	126.95	132.91	143.30	127.70	132.04	135.21	1.88	23.53	0.00	52
43	132.91	143.30	127.70	135.03	143.30	128.68	133.96	135.74	2.34	24.90	0.00	52
44	135.03	143.30	128.68	137.16	143.30	129.74	136.08	136.25	2.37	26.44	0.00	52
45	137.16	143.30	129.74	138.41	143.30	130.39	137.78	136.68	1.41	27.67	0.00	54
46	138.41	143.30	130.39	140.39	142.77	131.49	139.38	136.99	2.26	28.87	0.00	54
47	140.39	142.77	131.49	142.37	142.24	132.65	141.36	137.28	2.30	30.35	0.00	54
48	142.37	142.24	132.65	144.36	141.71	133.88	143.33	137.62	2.33	31.86	0.00	54
49	144.36	141.71	133.88	146.34	141.19	135.19	145.30	137.98	2.37	33.39	0.00	54
50	146.34	141.19	135.19	148.32	140.66	136.57	147.27	138.39	2.42	34.95	0.00	54
51	148.32	140.66	136.57	150.30	140.13	138.04	149.21	138.82	2.47	36.54	0.00	53
52	150.30	140.13	138.04	152.29	139.60	139.60	150.96	139.26	2.52	38.17	28.80	13

Tabella 7-2 – Geometria e caratteristiche strisce della superficie 1 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	1108	0	6438	11753	0	0	13096	0	0	
2	3215	0	8793	11865	0	13096	26704	0	0	
3	7292	0	14691	15174	0	26704	44570	0	0	
4	10792	0	18250	14715	0	44570	62288	0	0	
5	19280	0	29256	19123	0	62288	85567	0	0	
6	24906	0	35012	18958	0	85567	108583	0	0	
7	30253	0	40391	18810	0	108583	131009	0	0	
8	35311	0	45398	18678	0	131009	152548	0	0	
9	40039	0	50005	18561	0	152548	172934	0	0	
10	44482	0	54278	18457	0	172934	191933	0	0	
11	9864	0	11893	3856	0	191933	195718	0	0	
12	33887	0	40523	12716	0	195718	207705	0	0	
13	35845	0	42381	12679	0	207705	218844	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
14	48708	0	56936	16217	0	218844	231805	0	0	
15	51605	0	59651	16171	0	231805	243168	0	0	
16	32285	0	37024	9684	0	243168	249174	0	0	
17	33227	0	37900	9673	0	249174	254551	0	0	
18	29706	0	33727	8424	0	254551	258711	0	0	
19	56451	0	63734	15511	0	258711	265060	0	0	
20	59800	0	67080	16073	0	265060	269959	0	0	
21	41388	0	46197	11081	0	269959	272439	0	0	
22	41432	0	46071	11080	0	272439	274204	0	0	
23	26970	0	29902	7168	0	274204	274930	0	0	
24	64911	0	71717	16928	0	274930	275162	0	0	
25	66475	0	73131	16944	0	275162	273295	0	0	
26	67768	0	74287	16970	0	273295	269342	0	0	
27	68835	0	75232	17005	0	269342	263321	0	0	
28	69659	0	75948	17050	0	263321	255271	0	0	
29	60634	0	65990	14764	0	255271	246724	0	0	
30	60911	0	66204	14811	0	246724	236749	0	0	
31	61044	0	66282	14865	0	236749	225397	0	0	
32	73131	0	79344	17894	0	225397	210054	0	0	
33	72911	0	79068	17994	0	210054	192908	0	0	
34	55177	0	59827	13765	0	192908	178734	0	0	
35	54861	0	59489	13836	0	178734	163623	0	0	
36	54469	0	59078	13913	0	163623	147626	0	0	
37	45768	0	49655	11856	0	147626	133433	0	0	
38	53929	0	58532	14191	0	133433	115834	0	0	
39	53378	0	57972	14289	0	115834	97466	0	0	
40	52708	0	57279	14396	0	97466	78423	0	0	
41	54858	0	59643	15360	0	78423	57692	0	0	
42	53757	0	58457	15499	0	57692	36512	0	0	
43	63285	4250	73846	19300	0	36512	7777	0	0	
44	58752	4250	68521	19566	0	7777	-19339	0	0	
45	32402	2500	37480	12105	0	-19339	-33850	0	0	
46	46479	0	48323	19414	0	-33850	-50601	0	0	
47	39815	0	39776	19702	0	-50601	-62627	0	0	
48	33228	0	31069	20017	0	-62627	-69476	0	0	
49	26572	0	21971	20363	0	-69476	-70525	0	0	
50	19558	0	12145	20591	0	-70525	-64992	0	0	
51	11754	0	999	20605	0	-64992	-51669	0	0	
52	3756	0	653	5928	0	-51669	-48254	0	0	

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

### 7.2.2 ANALISI DELLA SUPERFICIE 9 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	51	
Coordinate del centro	X[m]= 94.92	Y[m]= 204.00
Raggio del cerchio	R[m]= 84.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 60.53	Y <sub>v</sub> [m]= 127.36
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 149.67	Y <sub>m</sub> [m]= 140.30
Coefficiente di sicurezza	F <sub>s</sub> = 0.647	

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	60.53	127.36	127.36	62.19	127.75	126.64	61.64	127.25	1.80	-23.55	0.00	54
2	62.19	127.75	126.64	63.84	128.14	125.96	63.10	127.12	1.79	-22.33	0.00	54
3	63.84	128.14	125.96	65.52	128.54	125.31	64.73	126.98	1.80	-21.10	0.00	52
4	65.52	128.54	125.31	67.19	128.93	124.71	66.39	126.87	1.78	-19.88	0.00	52
5	67.19	128.93	124.71	69.39	129.45	123.98	68.33	126.76	2.31	-18.49	0.00	52
6	69.39	129.45	123.98	71.58	129.96	123.31	70.52	126.67	2.29	-16.91	0.00	52
7	71.58	129.96	123.31	73.78	130.48	122.70	72.71	126.61	2.28	-15.36	0.00	52
8	73.78	130.48	122.70	75.97	130.99	122.17	74.90	126.59	2.26	-13.81	0.00	52
9	75.97	130.99	122.17	78.17	131.51	121.69	77.09	126.59	2.25	-12.27	0.00	52
10	78.17	131.51	121.69	80.36	132.03	121.27	79.28	126.62	2.23	-10.74	0.00	52
11	80.36	132.03	121.27	80.82	132.14	121.19	80.59	126.66	0.47	-9.82	0.00	52
12	80.82	132.14	121.19	82.34	132.49	120.95	81.59	126.69	1.54	-9.14	0.00	52
13	82.34	132.49	120.95	83.86	132.85	120.73	83.11	126.76	1.54	-8.09	0.00	52
14	83.86	132.85	120.73	85.81	133.31	120.50	84.84	126.85	1.96	-6.90	0.00	52
15	85.81	133.31	120.50	87.76	133.77	120.31	86.79	126.97	1.96	-5.56	0.00	52
16	87.76	133.77	120.31	88.93	134.04	120.21	88.35	127.08	1.17	-4.49	0.00	52
17	88.93	134.04	120.21	90.10	134.32	120.14	89.52	127.18	1.17	-3.69	0.00	52
18	90.10	134.32	120.14	91.12	134.56	120.09	90.61	127.28	1.02	-2.94	0.00	52
19	91.12	134.56	120.09	93.00	135.00	120.02	92.07	127.42	1.88	-1.95	0.00	52
20	93.00	135.00	120.02	94.95	135.00	120.00	93.98	127.51	1.95	-0.64	0.00	52
21	94.95	135.00	120.00	96.29	135.00	120.01	95.62	127.50	1.35	0.48	0.00	52
22	96.29	135.00	120.01	97.64	135.00	120.04	96.97	127.51	1.35	1.40	0.00	52
23	97.64	135.00	120.04	98.51	135.20	120.08	98.08	127.58	0.87	2.15	0.00	52
24	98.51	135.20	120.08	100.56	135.69	120.19	99.54	127.79	2.06	3.15	0.00	52
25	100.56	135.69	120.19	102.62	136.17	120.35	101.59	128.10	2.06	4.56	0.00	52
26	102.62	136.17	120.35	104.67	136.66	120.57	103.65	128.44	2.07	5.96	0.00	52
27	104.67	136.66	120.57	106.73	137.14	120.83	105.70	128.80	2.07	7.37	0.00	52
28	106.73	137.14	120.83	108.78	137.62	121.15	107.75	129.19	2.08	8.79	0.00	52
29	108.78	137.62	121.15	110.55	138.04	121.47	109.67	129.57	1.80	10.11	0.00	52
30	110.55	138.04	121.47	112.33	138.46	121.82	111.44	129.95	1.81	11.34	0.00	52
31	112.33	138.46	121.82	114.10	138.88	122.22	113.21	130.34	1.82	12.58	0.00	52
32	114.10	138.88	122.22	116.22	139.38	122.75	115.16	130.80	2.19	13.95	0.00	52
33	116.22	139.38	122.75	118.35	139.88	123.33	117.29	131.33	2.20	15.44	0.00	52
34	118.35	139.88	123.33	119.97	140.26	123.82	119.16	131.82	1.69	16.77	0.00	52
35	119.97	140.26	123.82	121.58	140.64	124.34	120.77	132.26	1.70	17.93	0.00	52
36	121.58	140.64	124.34	123.20	141.02	124.90	122.39	132.73	1.71	19.09	0.00	52
37	123.20	141.02	124.90	124.57	141.34	125.41	123.88	133.17	1.46	20.17	0.00	52
38	124.57	141.34	125.41	126.47	141.79	126.15	125.51	133.67	2.03	21.36	0.00	52
39	126.47	141.79	126.15	128.36	142.23	126.94	127.41	134.28	2.05	22.76	0.00	52
40	128.36	142.23	126.94	130.25	142.68	127.79	129.30	134.91	2.08	24.17	0.00	52
41	130.25	142.68	127.79	132.15	143.12	128.70	131.20	135.57	2.10	25.59	0.00	52
42	132.15	143.12	128.70	132.91	143.30	129.08	132.53	136.05	0.85	26.60	0.00	52
43	132.91	143.30	129.08	133.98	143.30	129.63	133.44	136.33	1.20	27.30	0.00	52
44	133.98	143.30	129.63	136.19	143.30	130.84	135.07	136.76	2.52	28.57	0.00	54
45	136.19	143.30	130.84	138.41	143.30	132.13	137.28	137.39	2.57	30.31	0.00	54
46	138.41	143.30	132.13	140.20	142.82	133.25	139.28	137.87	2.11	31.90	0.00	54
47	140.20	142.82	133.25	142.00	142.34	134.43	141.07	138.21	2.15	33.36	0.00	54
48	142.00	142.34	134.43	143.80	141.86	135.68	142.86	138.57	2.19	34.83	0.00	54
49	143.80	141.86	135.68	145.59	141.39	137.00	144.64	138.97	2.23	36.34	0.00	54
50	145.59	141.39	137.00	147.63	140.84	138.60	146.50	139.43	2.59	37.98	0.00	53
51	147.63	140.84	138.60	149.67	140.30	140.30	148.31	139.91	2.66	39.77	26.78	16

Tabella 7-4 – Geometria e caratteristiche strisce della superficie 9 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	1850	0	8882	15229	0	0	17095	0	0	
2	5359	0	12708	15258	0	17095	34835	0	0	
3	8972	0	16385	14744	0	34835	52477	0	0	
4	12461	0	20026	14627	0	52477	70249	0	0	
5	21383	0	31428	19006	0	70249	93444	0	0	
6	26904	0	37003	18840	0	93444	116202	0	0	
7	32135	0	42194	18692	0	116202	138195	0	0	
8	37065	0	47010	18561	0	138195	159128	0	0	
9	41656	0	51422	18446	0	159128	178742	0	0	
10	45951	0	55496	18346	0	178742	196808	0	0	
11	10153	0	12123	3834	0	196808	200377	0	0	
12	34788	0	41220	12642	0	200377	211605	0	0	
13	36666	0	42978	12607	0	211605	221912	0	0	
14	49637	0	57555	16130	0	221912	233705	0	0	
15	52388	0	60103	16089	0	233705	243792	0	0	
16	32682	0	37215	9637	0	243792	248984	0	0	
17	33567	0	38029	9628	0	248984	253512	0	0	
18	29955	0	33788	8387	0	253512	256905	0	0	
19	56789	0	63720	15447	0	256905	261778	0	0	
20	59980	0	66889	16014	0	261778	265094	0	0	
21	41406	0	45958	11045	0	265094	266469	0	0	
22	41360	0	45742	11048	0	266469	267125	0	0	
23	26875	0	29640	7149	0	267125	267129	0	0	
24	64528	0	70942	16893	0	267129	265627	0	0	
25	65861	0	72130	16920	0	265627	261996	0	0	
26	66913	0	73049	16959	0	261996	256271	0	0	
27	67727	0	73748	17008	0	256271	248487	0	0	
28	68285	0	74205	17067	0	248487	238704	0	0	
29	59225	0	64266	14792	0	238704	228703	0	0	
30	59286	0	64267	14852	0	228703	217331	0	0	
31	59193	0	64119	14920	0	217331	204655	0	0	
32	70601	0	76437	17980	0	204655	187852	0	0	
33	70025	0	75792	18104	0	187852	169416	0	0	
34	52732	0	57071	13866	0	169416	154399	0	0	
35	52190	0	56489	13953	0	154399	138583	0	0	
36	51562	0	55818	14048	0	138583	122041	0	0	
37	43112	0	46676	11985	0	122041	107528	0	0	
38	58664	0	63519	16709	0	107528	86796	0	0	
39	57532	0	62305	16875	0	86796	65354	0	0	
40	56154	0	60796	17056	0	65354	43433	0	0	
41	54517	0	58961	17254	0	43433	21300	0	0	
42	21357	0	23068	6980	0	21300	12423	0	0	
43	29226	2140	34124	9941	0	12423	-1427	0	0	
44	56656	4430	65612	21562	0	-1427	-27567	0	0	
45	51317	4430	58990	21934	0	-27567	-50898	0	0	
46	36110	0	36052	18076	0	-50898	-62701	0	0	
47	30154	0	28054	18372	0	-62701	-69542	0	0	
48	24259	0	19858	18696	0	-69542	-70980	0	0	
49	18269	0	11208	19051	0	-70980	-66372	0	0	
50	13053	0	1565	21584	0	-66372	-53250	0	0	
51	4176	0	234	6977	0	-53250	-48974	0	0	

Tabella 7-5 – Forze applicate sulle strisce [BISHOP] della superficie 9 della verifica di stabilità 03.

### 7.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.001938
2	0.000654
3	0.002005
4	0.002130
5	0.000208
6	0.000580
7	0.000061

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

Accelerazione sismica critica  $K_c = 0.099$   
Spostamento massimo  $U_{max} = 0.002130$  [m]  
Velocità massima  $V_{max} = 0.024627$  [m/s]

n°	u
	[m]
1	0.002194
2	0.000715
3	0.002174
4	0.002298
5	0.000270
6	0.000643
7	0.000118

Tabella 7-7 – Spostamenti della superficie 9 della verifica di stabilità 04.

Accelerazione sismica critica  $K_c = 0.097$   
Spostamento massimo  $U_{max} = 0.002298$  [m]  
Velocità massima  $V_{max} = 0.025459$  [m/s]

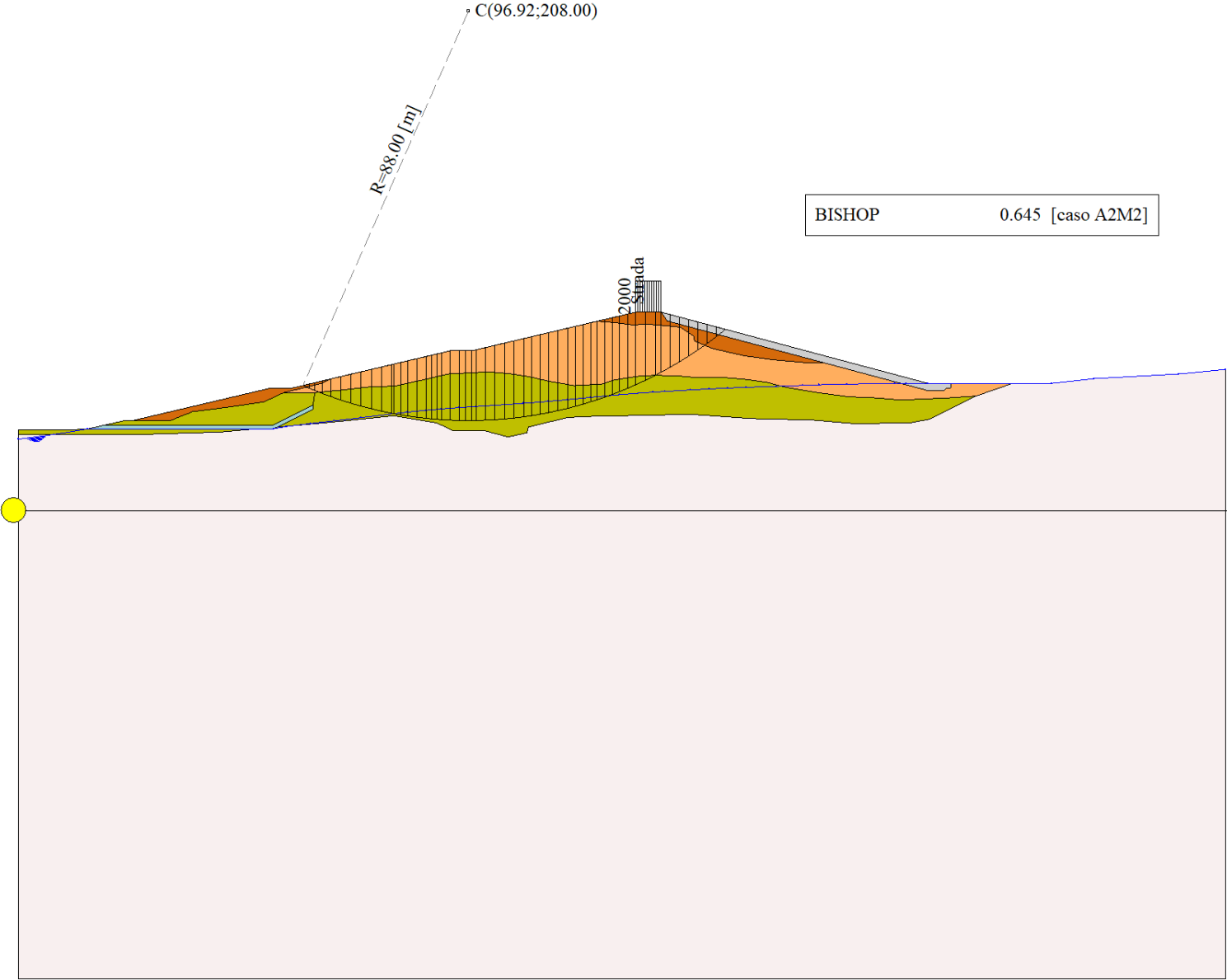


Figura 7-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 03.

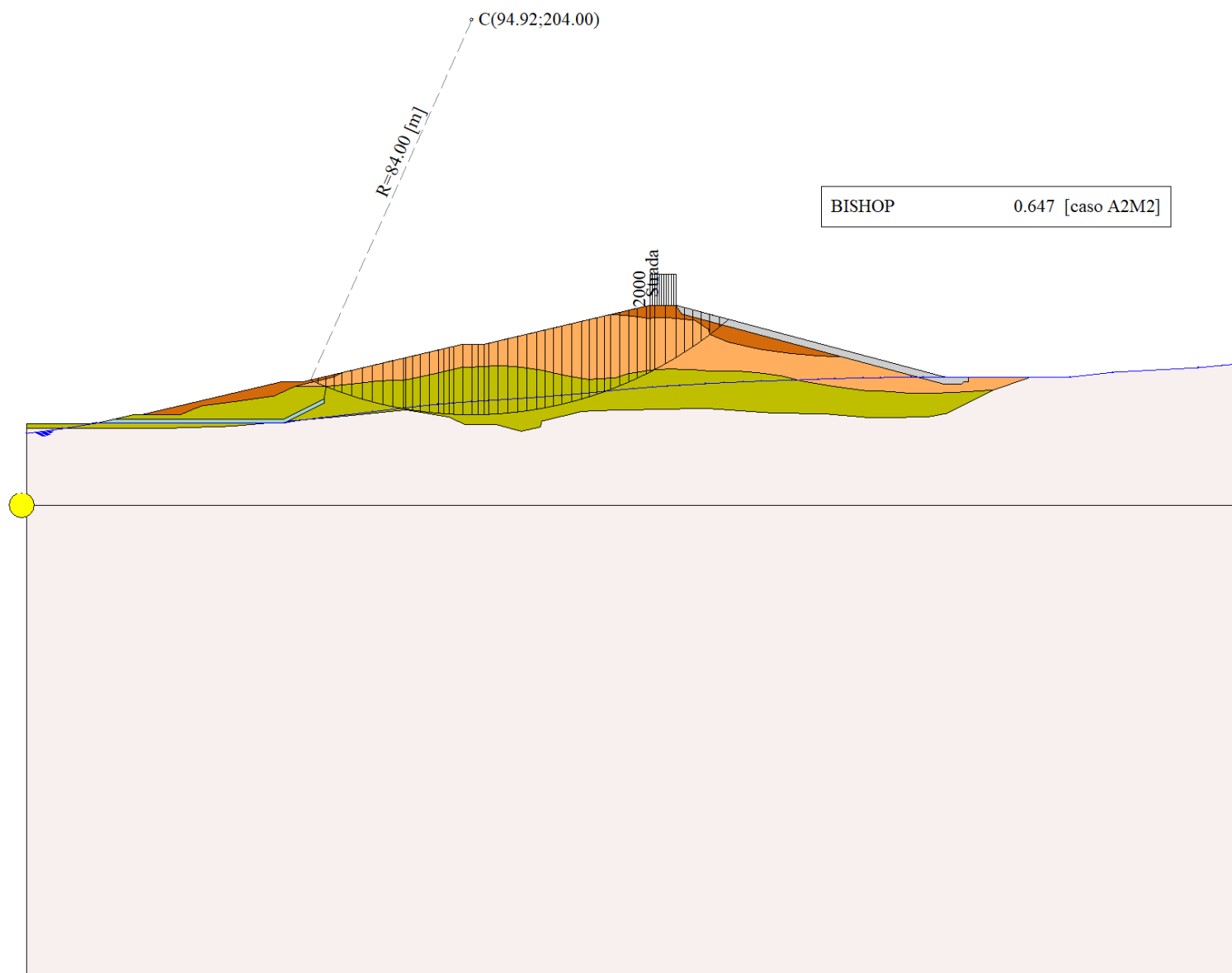


Figura 7-2 – Superficie critica (9) della sezione CR\_08 per la verifica di stabilità 03.

## 8 VERIFICA DI STABILITÀ 04

### 8.1.1 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	132.91	138.41	2000	0
				143.30	143.30	2000	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	107016
Coefficiente di sicurezza minimo	0.502
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	51
Coordinate del centro	X[m]= 98.92                      Y[m]= 208.00
Raggio del cerchio	R[m]= 88.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 62.59                      Y <sub>v</sub> [m]= 127.85
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 153.79                      Y <sub>m</sub> [m]= 139.20
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.502</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	62.59	127.85	127.85	64.13	128.21	127.17	63.62	127.74	1.67	-23.83	0.00	54
2	64.13	128.21	127.17	65.66	128.57	126.53	64.98	127.61	1.66	-22.75	0.00	54
3	65.66	128.57	126.53	67.19	128.93	125.92	66.47	127.48	1.65	-21.67	0.00	53
4	67.19	128.93	125.92	69.39	129.45	125.10	68.35	127.35	2.34	-20.37	0.00	52
5	69.39	129.45	125.10	71.58	129.96	124.35	70.53	127.21	2.32	-18.86	0.00	52
6	71.58	129.96	124.35	73.78	130.48	123.67	72.71	127.11	2.30	-17.35	0.00	52
7	73.78	130.48	123.67	75.97	130.99	123.05	74.90	127.05	2.28	-15.86	0.00	52
8	75.97	130.99	123.05	78.17	131.51	122.48	77.09	127.01	2.27	-14.38	0.00	52
9	78.17	131.51	122.48	80.36	132.03	121.98	79.28	127.00	2.25	-12.91	0.00	52
10	80.36	132.03	121.98	80.82	132.14	121.88	80.59	127.01	0.47	-12.02	0.00	52
11	80.82	132.14	121.88	82.34	132.49	121.58	81.59	127.02	1.55	-11.36	0.00	52
12	82.34	132.49	121.58	83.86	132.85	121.30	83.11	127.05	1.55	-10.36	0.00	52
13	83.86	132.85	121.30	85.81	133.31	120.98	84.85	127.11	1.98	-9.21	0.00	52
14	85.81	133.31	120.98	87.76	133.77	120.71	86.79	127.19	1.97	-7.93	0.00	52
15	87.76	133.77	120.71	88.93	134.04	120.57	88.35	127.27	1.18	-6.90	0.00	52
16	88.93	134.04	120.57	90.10	134.32	120.44	89.52	127.34	1.18	-6.14	0.00	52
17	90.10	134.32	120.44	91.12	134.56	120.35	90.61	127.42	1.02	-5.42	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	91.12	134.56	120.35	93.00	135.00	120.20	92.07	127.53	1.89	-4.47	0.00	52
19	93.00	135.00	120.20	94.95	135.00	120.09	93.98	127.57	1.95	-3.22	0.00	52
20	94.95	135.00	120.09	96.29	135.00	120.04	95.62	127.53	1.35	-2.15	0.00	52
21	96.29	135.00	120.04	97.64	135.00	120.01	96.97	127.51	1.35	-1.27	0.00	52
22	97.64	135.00	120.01	98.51	135.20	120.00	98.08	127.55	0.87	-0.55	0.00	52
23	98.51	135.20	120.00	100.56	135.69	120.02	99.54	127.73	2.05	0.40	0.00	52
24	100.56	135.69	120.02	102.62	136.17	120.08	101.60	127.99	2.05	1.74	0.00	52
25	102.62	136.17	120.08	104.67	136.66	120.19	103.65	128.27	2.06	3.08	0.00	52
26	104.67	136.66	120.19	106.73	137.14	120.35	105.70	128.58	2.06	4.42	0.00	52
27	106.73	137.14	120.35	108.78	137.62	120.55	107.76	128.92	2.06	5.76	0.00	52
28	108.78	137.62	120.55	110.55	138.04	120.77	109.67	129.25	1.79	7.01	0.00	52
29	110.55	138.04	120.77	112.33	138.46	121.03	111.44	129.57	1.79	8.18	0.00	52
30	112.33	138.46	121.03	114.10	138.88	121.32	113.21	129.92	1.80	9.35	0.00	52
31	114.10	138.88	121.32	116.22	139.38	121.72	115.16	130.32	2.16	10.64	0.00	52
32	116.22	139.38	121.72	118.35	139.88	122.17	117.29	130.79	2.17	12.05	0.00	52
33	118.35	139.88	122.17	119.97	140.26	122.55	119.16	131.21	1.66	13.30	0.00	52
34	119.97	140.26	122.55	121.58	140.64	122.97	120.77	131.60	1.67	14.38	0.00	52
35	121.58	140.64	122.97	123.20	141.02	123.42	122.39	132.01	1.68	15.47	0.00	52
36	123.20	141.02	123.42	124.57	141.34	123.82	123.88	132.40	1.43	16.48	0.00	52
37	124.57	141.34	123.82	126.20	141.72	124.34	125.38	132.80	1.71	17.50	0.00	52
38	126.20	141.72	124.34	127.83	142.11	124.88	127.01	133.26	1.72	18.62	0.00	52
39	127.83	142.11	124.88	129.46	142.49	125.47	128.64	133.74	1.73	19.74	0.00	52
40	129.46	142.49	125.47	131.19	142.89	126.13	130.32	134.24	1.85	20.91	0.00	52
41	131.19	142.89	126.13	132.91	143.30	126.83	132.04	134.79	1.86	22.12	0.00	52
42	132.91	143.30	126.83	135.03	143.30	127.75	133.96	135.29	2.32	23.48	0.00	52
43	135.03	143.30	127.75	137.16	143.30	128.74	136.09	135.77	2.34	24.99	0.00	52
44	137.16	143.30	128.74	138.41	143.30	129.36	137.78	136.17	1.39	26.21	0.00	52
45	138.41	143.30	129.36	140.64	142.70	130.52	139.50	136.47	2.52	27.48	0.00	54
46	140.64	142.70	130.52	142.88	142.11	131.77	141.73	136.77	2.56	29.14	0.00	54
47	142.88	142.11	131.77	145.11	141.51	133.10	143.96	137.11	2.60	30.82	0.00	54
48	145.11	141.51	133.10	147.35	140.92	134.52	146.18	137.50	2.65	32.52	0.00	54
49	147.35	140.92	134.52	149.58	140.32	136.04	148.39	137.94	2.70	34.27	0.00	54
50	149.58	140.32	136.04	151.68	139.76	137.57	150.52	138.40	2.60	35.99	0.00	53
51	151.68	139.76	137.57	153.79	139.20	139.20	152.39	138.84	2.66	37.71	27.47	15

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

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	1603	0	10100	18242	0	0	20238	0	0	
2	4647	0	13557	18331	0	20238	40851	0	0	
3	7552	0	16548	17816	0	40851	61024	0	0	
4	15967	0	29064	24822	0	61024	89137	0	0	
5	21867	0	35321	24589	0	89137	116597	0	0	
6	27480	0	41163	24379	0	116597	143065	0	0	
7	32797	0	46600	24190	0	143065	168235	0	0	
8	37780	0	51603	24022	0	168235	191839	0	0	
9	42473	0	56243	23873	0	191839	213642	0	0	
10	9475	0	12349	4986	0	213642	217961	0	0	
11	32675	0	42137	16436	0	217961	231583	0	0	
12	34749	0	44153	16381	0	231583	244155	0	0	
13	47471	0	59430	20942	0	244155	258658	0	0	
14	50556	0	62381	20872	0	258658	271232	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	31745	0	38770	12494	0	271232	277807	0	0	
16	32753	0	39724	12475	0	277807	283636	0	0	
17	29347	0	35378	10862	0	283636	288095	0	0	
18	55922	0	66921	19991	0	288095	294768	0	0	
19	59431	0	70522	20705	0	294768	299770	0	0	
20	41240	0	48620	14269	0	299770	302227	0	0	
21	41370	0	48532	14262	0	302227	303895	0	0	
22	26976	0	31522	9223	0	303895	304509	0	0	
23	65070	0	75668	21775	0	304509	304257	0	0	
24	66836	0	77251	21785	0	304257	301607	0	0	
25	68333	0	78563	21806	0	301607	296589	0	0	
26	69604	0	79656	21840	0	296589	289233	0	0	
27	70633	0	80510	21885	0	289233	279592	0	0	
28	61642	0	70035	18941	0	279592	269474	0	0	
29	62074	0	70341	18993	0	269474	257759	0	0	
30	62364	0	70507	19052	0	257759	244503	0	0	
31	74922	0	84519	22921	0	244503	226678	0	0	
32	74934	0	84361	23035	0	226678	206842	0	0	
33	56873	0	63931	17611	0	206842	190488	0	0	
34	56696	0	63661	17693	0	190488	173086	0	0	
35	56443	0	63317	17783	0	173086	154689	0	0	
36	47552	0	53300	15146	0	154689	138382	0	0	
37	56188	0	62933	18119	0	138382	118173	0	0	
38	55787	0	62449	18234	0	118173	97085	0	0	
39	55270	0	61832	18359	0	97085	75219	0	0	
40	57741	0	64542	19576	0	75219	51398	0	0	
41	56819	0	63441	19739	0	51398	27030	0	0	
42	67312	4250	80241	24560	0	27030	-6048	0	0	
43	63070	4250	74957	24855	0	-6048	-37430	0	0	
44	35003	2500	41435	14770	0	-37430	-54868	0	0	
45	56550	0	59967	27499	0	-54868	-76828	0	0	
46	48424	0	48862	28228	0	-76828	-91959	0	0	
47	40382	0	37662	28709	0	-91959	-99936	0	0	
48	32199	0	25849	29243	0	-99936	-99816	0	0	
49	23358	0	12739	29639	0	-99816	-90211	0	0	
50	13106	0	-1425	27946	0	-90211	-71092	0	0	
51	4190	0	-125	8143	0	-71092	-65958	0	0	

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

### 8.2.2 ANALISI DELLA SUPERFICIE 27 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	51	
Coordinate del centro	X[m]= 94.92	Y[m]= 204.00
Raggio del cerchio	R[m]= 84.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 60.53	Y <sub>v</sub> [m]= 127.36
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 149.67	Y <sub>m</sub> [m]= 140.30
Coefficiente di sicurezza	F <sub>s</sub> = 0.507	

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	60.53	127.36	127.36	62.19	127.75	126.64	61.64	127.25	1.80	-23.55	0.00	54
2	62.19	127.75	126.64	63.84	128.14	125.96	63.10	127.12	1.79	-22.33	0.00	54
3	63.84	128.14	125.96	65.52	128.54	125.31	64.73	126.98	1.80	-21.10	0.00	52
4	65.52	128.54	125.31	67.19	128.93	124.71	66.39	126.87	1.78	-19.88	0.00	52
5	67.19	128.93	124.71	69.39	129.45	123.98	68.33	126.76	2.31	-18.49	0.00	52
6	69.39	129.45	123.98	71.58	129.96	123.31	70.52	126.67	2.29	-16.91	0.00	52
7	71.58	129.96	123.31	73.78	130.48	122.70	72.71	126.61	2.28	-15.36	0.00	52
8	73.78	130.48	122.70	75.97	130.99	122.17	74.90	126.59	2.26	-13.81	0.00	52
9	75.97	130.99	122.17	78.17	131.51	121.69	77.09	126.59	2.25	-12.27	0.00	52
10	78.17	131.51	121.69	80.36	132.03	121.27	79.28	126.62	2.23	-10.74	0.00	52
11	80.36	132.03	121.27	80.82	132.14	121.19	80.59	126.66	0.47	-9.82	0.00	52
12	80.82	132.14	121.19	82.34	132.49	120.95	81.59	126.69	1.54	-9.14	0.00	52
13	82.34	132.49	120.95	83.86	132.85	120.73	83.11	126.76	1.54	-8.09	0.00	52
14	83.86	132.85	120.73	85.81	133.31	120.50	84.84	126.85	1.96	-6.90	0.00	52
15	85.81	133.31	120.50	87.76	133.77	120.31	86.79	126.97	1.96	-5.56	0.00	52
16	87.76	133.77	120.31	88.93	134.04	120.21	88.35	127.08	1.17	-4.49	0.00	52
17	88.93	134.04	120.21	90.10	134.32	120.14	89.52	127.18	1.17	-3.69	0.00	52
18	90.10	134.32	120.14	91.12	134.56	120.09	90.61	127.28	1.02	-2.94	0.00	52
19	91.12	134.56	120.09	93.00	135.00	120.02	92.07	127.42	1.88	-1.95	0.00	52
20	93.00	135.00	120.02	94.95	135.00	120.00	93.98	127.51	1.95	-0.64	0.00	52
21	94.95	135.00	120.00	96.29	135.00	120.01	95.62	127.50	1.35	0.48	0.00	52
22	96.29	135.00	120.01	97.64	135.00	120.04	96.97	127.51	1.35	1.40	0.00	52
23	97.64	135.00	120.04	98.51	135.20	120.08	98.08	127.58	0.87	2.15	0.00	52
24	98.51	135.20	120.08	100.56	135.69	120.19	99.54	127.79	2.06	3.15	0.00	52
25	100.56	135.69	120.19	102.62	136.17	120.35	101.59	128.10	2.06	4.56	0.00	52
26	102.62	136.17	120.35	104.67	136.66	120.57	103.65	128.44	2.07	5.96	0.00	52
27	104.67	136.66	120.57	106.73	137.14	120.83	105.70	128.80	2.07	7.37	0.00	52
28	106.73	137.14	120.83	108.78	137.62	121.15	107.75	129.19	2.08	8.79	0.00	52
29	108.78	137.62	121.15	110.55	138.04	121.47	109.67	129.57	1.80	10.11	0.00	52
30	110.55	138.04	121.47	112.33	138.46	121.82	111.44	129.95	1.81	11.34	0.00	52
31	112.33	138.46	121.82	114.10	138.88	122.22	113.21	130.34	1.82	12.58	0.00	52
32	114.10	138.88	122.22	116.22	139.38	122.75	115.16	130.80	2.19	13.95	0.00	52
33	116.22	139.38	122.75	118.35	139.88	123.33	117.29	131.33	2.20	15.44	0.00	52
34	118.35	139.88	123.33	119.97	140.26	123.82	119.16	131.82	1.69	16.77	0.00	52
35	119.97	140.26	123.82	121.58	140.64	124.34	120.77	132.26	1.70	17.93	0.00	52
36	121.58	140.64	124.34	123.20	141.02	124.90	122.39	132.73	1.71	19.09	0.00	52
37	123.20	141.02	124.90	124.57	141.34	125.41	123.88	133.17	1.46	20.17	0.00	52
38	124.57	141.34	125.41	126.47	141.79	126.15	125.51	133.67	2.03	21.36	0.00	52
39	126.47	141.79	126.15	128.36	142.23	126.94	127.41	134.28	2.05	22.76	0.00	52
40	128.36	142.23	126.94	130.25	142.68	127.79	129.30	134.91	2.08	24.17	0.00	52
41	130.25	142.68	127.79	132.15	143.12	128.70	131.20	135.57	2.10	25.59	0.00	52
42	132.15	143.12	128.70	132.91	143.30	129.08	132.53	136.05	0.85	26.60	0.00	52
43	132.91	143.30	129.08	133.98	143.30	129.63	133.44	136.33	1.20	27.30	0.00	52
44	133.98	143.30	129.63	136.19	143.30	130.84	135.07	136.76	2.52	28.57	0.00	54
45	136.19	143.30	130.84	138.41	143.30	132.13	137.28	137.39	2.57	30.31	0.00	54
46	138.41	143.30	132.13	140.20	142.82	133.25	139.28	137.87	2.11	31.90	0.00	54
47	140.20	142.82	133.25	142.00	142.34	134.43	141.07	138.21	2.15	33.36	0.00	54
48	142.00	142.34	134.43	143.80	141.86	135.68	142.86	138.57	2.19	34.83	0.00	54
49	143.80	141.86	135.68	145.59	141.39	137.00	144.64	138.97	2.23	36.34	0.00	54
50	145.59	141.39	137.00	147.63	140.84	138.60	146.50	139.43	2.59	37.98	0.00	53
51	147.63	140.84	138.60	149.67	140.30	140.30	148.31	139.91	2.66	39.77	26.78	16

Tabella 8-4 – Geometria e caratteristiche strisce della superficie 27 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	1850	0	10828	19450	0	0	21545	0	0	
2	5359	0	14752	19486	0	21545	43403	0	0	
3	8972	0	18472	18829	0	43403	64656	0	0	
4	12461	0	22195	18680	0	64656	85655	0	0	
5	21383	0	34385	24272	0	85655	112513	0	0	
6	26904	0	40082	24060	0	112513	138307	0	0	
7	32135	0	45385	23872	0	138307	162729	0	0	
8	37065	0	50299	23705	0	162729	185509	0	0	
9	41656	0	54796	23558	0	185509	206414	0	0	
10	45951	0	58942	23430	0	206414	225241	0	0	
11	10153	0	12853	4896	0	225241	228904	0	0	
12	34788	0	43653	16146	0	228904	240285	0	0	
13	36666	0	45440	16101	0	240285	250507	0	0	
14	49637	0	60749	20599	0	250507	261853	0	0	
15	52388	0	63330	20547	0	261853	271130	0	0	
16	32682	0	39164	12308	0	271130	275669	0	0	
17	33567	0	39986	12296	0	275669	279423	0	0	
18	29955	0	35499	10711	0	279423	282046	0	0	
19	56789	0	66880	19727	0	282046	285278	0	0	
20	59980	0	70122	20451	0	285278	286703	0	0	
21	41406	0	48129	14106	0	286703	286727	0	0	
22	41360	0	47863	14110	0	286727	286002	0	0	
23	26875	0	30993	9130	0	286002	285083	0	0	
24	64528	0	74113	21573	0	285083	281233	0	0	
25	65861	0	75262	21609	0	281233	275038	0	0	
26	66913	0	76128	21658	0	275038	266566	0	0	
27	67727	0	76762	21720	0	266566	255882	0	0	
28	68285	0	77140	21797	0	255882	243078	0	0	
29	59225	0	66727	18891	0	243078	230395	0	0	
30	59286	0	66650	18968	0	230395	216299	0	0	
31	59193	0	66414	19055	0	216299	200877	0	0	
32	70601	0	79059	22962	0	200877	180785	0	0	
33	70025	0	78261	23120	0	180785	159096	0	0	
34	52732	0	58835	17708	0	159096	141653	0	0	
35	52190	0	58149	17820	0	141653	123467	0	0	
36	51562	0	57366	17941	0	123467	104625	0	0	
37	43112	0	47893	15306	0	104625	88235	0	0	
38	58664	0	65050	21340	0	88235	65032	0	0	
39	57532	0	63654	21551	0	65032	41275	0	0	
40	56154	0	61941	21782	0	41275	17238	0	0	
41	54517	0	59878	22035	0	17238	-6764	0	0	
42	21357	0	23367	8914	0	-6764	-16312	0	0	
43	29226	2140	34575	12696	0	-16312	-31249	0	0	
44	56656	4430	66049	27537	0	-31249	-58833	0	0	
45	51317	4430	58864	28012	0	-58833	-82769	0	0	
46	36110	0	35190	23085	0	-82769	-93697	0	0	
47	30154	0	26619	23463	0	-93697	-98696	0	0	
48	24259	0	17821	23877	0	-98696	-97292	0	0	
49	18269	0	8528	24330	0	-97292	-88783	0	0	
50	13053	0	-2227	27565	0	-88783	-69998	0	0	
51	4176	0	-488	8191	0	-69998	-64769	0	0	

Tabella 8-5 – Forze applicate sulle strisce [BISHOP] della superficie 27 della verifica di stabilità 04.

### 8.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.007162
2	0.003387
3	0.004705
4	0.001705
5	0.001420
6	0.005365
7	0.005245

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

Accelerazione sismica critica  $K_c = 0.102$   
Spostamento massimo  $U_{max} = 0.007162$  [m]  
Velocità massima  $V_{max} = 0.040807$  [m/s]

n°	u
	[m]
1	0.008424
2	0.003954
3	0.005491
4	0.002046
5	0.001624
6	0.006723
7	0.006500

Tabella 8-7 – Spostamenti della superficie 27 della verifica di stabilità 04.

Accelerazione sismica critica  $K_c = 0.097$   
Spostamento massimo  $U_{max} = 0.008424$  [m]  
Velocità massima  $V_{max} = 0.044650$  [m/s]

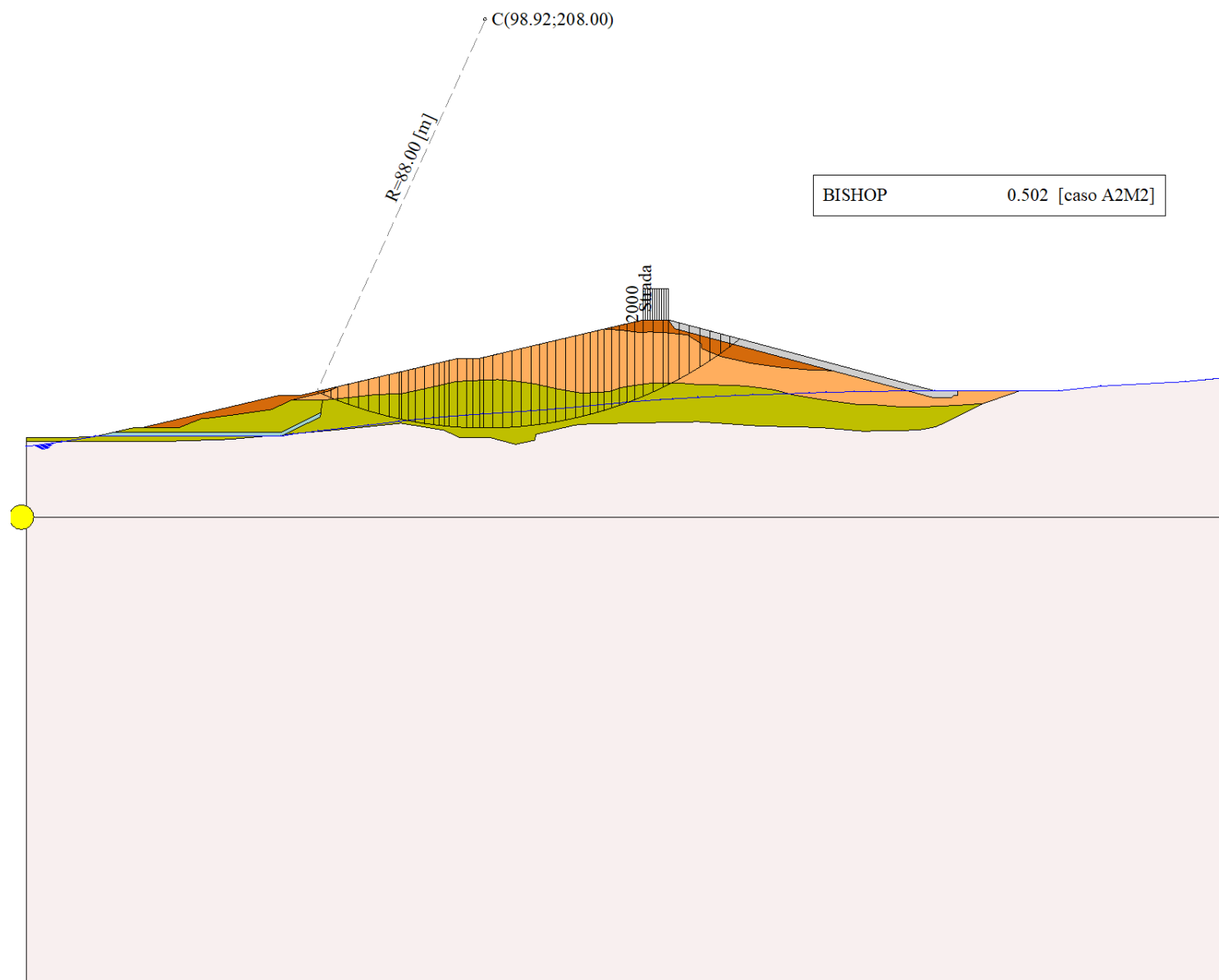


Figura 8-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 04.

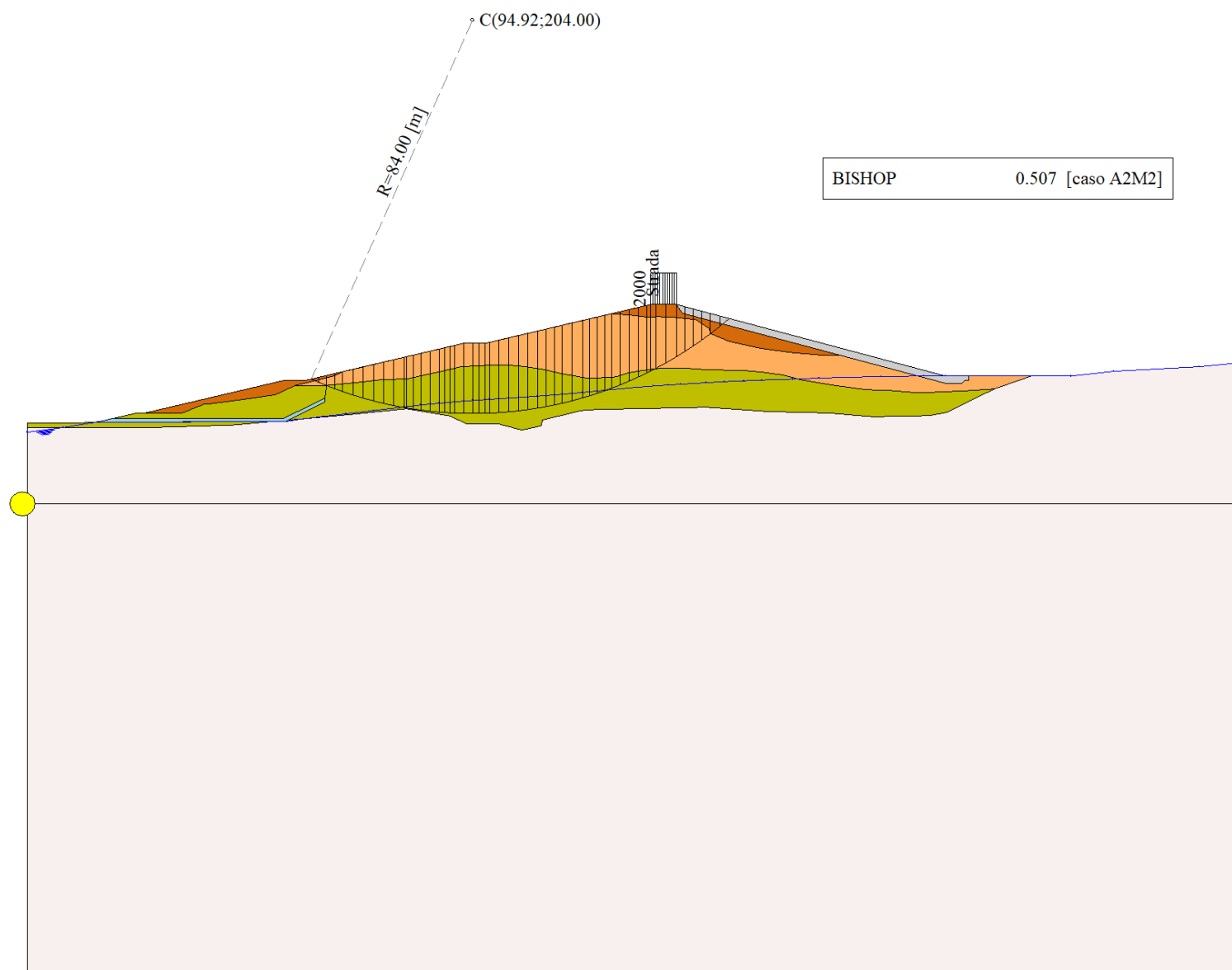


Figura 8-2 – Superficie critica (27) della sezione CR\_08 per la verifica di stabilità 04.

## 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	132.91	138.41	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	107016
Coefficiente di sicurezza minimo	0.294
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	52	
Coordinate del centro	X[m]= 104.92	Y[m]= 208.00
Raggio del cerchio	R[m]= 88.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 66.59	Y <sub>v</sub> [m]= 128.79
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 158.26	Y <sub>m</sub> [m]= 138.01
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.294</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	66.59	128.79	128.79	67.19	128.93	128.50	66.99	128.74	0.67	-25.61	0.00	54
2	67.19	128.93	128.50	68.71	129.29	127.80	68.09	128.61	1.67	-24.84	0.00	54
3	68.71	129.29	127.80	70.23	129.64	127.13	69.53	128.46	1.66	-23.76	0.00	54
4	70.23	129.64	127.13	72.50	130.18	126.19	71.45	128.28	2.46	-22.42	0.00	53
5	72.50	130.18	126.19	74.77	130.71	125.32	73.69	128.10	2.43	-20.83	0.00	52
6	74.77	130.71	125.32	77.05	131.25	124.53	75.95	127.95	2.41	-19.25	0.00	52
7	77.05	131.25	124.53	79.32	131.78	123.81	78.21	127.84	2.38	-17.69	0.00	52
8	79.32	131.78	123.81	81.59	132.32	123.15	80.48	127.76	2.36	-16.14	0.00	52
9	81.59	132.32	123.15	83.86	132.85	122.56	82.75	127.72	2.35	-14.61	0.00	52
10	83.86	132.85	122.56	85.81	133.31	122.10	84.85	127.70	2.00	-13.19	0.00	52
11	85.81	133.31	122.10	87.76	133.77	121.69	86.80	127.72	1.99	-11.89	0.00	52
12	87.76	133.77	121.69	89.44	134.16	121.37	88.61	127.75	1.71	-10.69	0.00	52
13	89.44	134.16	121.37	91.12	134.56	121.09	90.29	127.80	1.70	-9.58	0.00	52
14	91.12	134.56	121.09	93.00	135.00	120.81	92.07	127.86	1.90	-8.40	0.00	52
15	93.00	135.00	120.81	94.95	135.00	120.57	93.98	127.84	1.97	-7.15	0.00	52
16	94.95	135.00	120.57	96.29	135.00	120.42	95.62	127.75	1.35	-6.06	0.00	52
17	96.29	135.00	120.42	97.64	135.00	120.30	96.97	127.68	1.35	-5.19	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	97.64	135.00	120.30	98.51	135.20	120.23	98.08	127.69	0.87	-4.46	0.00	52
19	98.51	135.20	120.23	100.56	135.69	120.11	99.54	127.81	2.06	-3.51	0.00	52
20	100.56	135.69	120.11	102.62	136.17	120.03	101.60	128.00	2.06	-2.17	0.00	52
21	102.62	136.17	120.03	104.67	136.66	120.00	103.65	128.22	2.05	-0.83	0.00	52
22	104.67	136.66	120.00	106.73	137.14	120.02	105.70	128.45	2.05	0.51	0.00	52
23	106.73	137.14	120.02	108.78	137.62	120.08	107.76	128.72	2.06	1.84	0.00	52
24	108.78	137.62	120.08	110.55	138.04	120.18	109.67	128.98	1.78	3.09	0.00	52
25	110.55	138.04	120.18	112.33	138.46	120.31	111.44	129.25	1.78	4.25	0.00	52
26	112.33	138.46	120.31	114.10	138.88	120.48	113.22	129.53	1.78	5.41	0.00	52
27	114.10	138.88	120.48	116.12	139.35	120.72	115.11	129.86	2.03	6.65	0.00	52
28	116.12	139.35	120.72	118.14	139.83	121.00	117.13	130.22	2.04	7.98	0.00	52
29	118.14	139.83	121.00	118.35	139.88	121.03	118.25	130.43	0.21	8.71	0.00	52
30	118.35	139.88	121.03	119.81	140.22	121.27	119.08	130.60	1.48	9.26	0.00	52
31	119.81	140.22	121.27	121.27	140.56	121.53	120.54	130.90	1.48	10.22	0.00	52
32	121.27	140.56	121.53	123.20	141.02	121.92	122.24	131.26	1.97	11.35	0.00	52
33	123.20	141.02	121.92	124.57	141.34	122.22	123.89	131.62	1.40	12.45	0.00	52
34	124.57	141.34	122.22	126.20	141.72	122.61	125.38	131.97	1.68	13.45	0.00	52
35	126.20	141.72	122.61	127.83	142.11	123.03	127.01	132.37	1.68	14.54	0.00	52
36	127.83	142.11	123.03	129.46	142.49	123.49	128.64	132.78	1.69	15.64	0.00	52
37	129.46	142.49	123.49	131.19	142.89	124.01	130.32	133.22	1.80	16.78	0.00	52
38	131.19	142.89	124.01	132.91	143.30	124.57	132.05	133.69	1.81	17.96	0.00	52
39	132.91	143.30	124.57	133.51	143.30	124.77	133.21	133.99	0.63	18.75	0.00	52
40	133.51	143.30	124.77	135.10	143.30	125.34	134.30	134.18	1.69	19.51	0.00	52
41	135.10	143.30	125.34	136.69	143.30	125.93	135.89	134.47	1.70	20.61	0.00	52
42	136.69	143.30	125.93	138.41	143.30	126.62	137.54	134.79	1.85	21.77	0.00	52
43	138.41	143.30	126.62	139.33	143.05	127.01	138.87	135.00	1.00	22.69	0.00	52
44	139.33	143.05	127.01	141.15	142.57	127.80	140.23	135.11	1.99	23.67	0.00	52
45	141.15	142.57	127.80	142.97	142.08	128.65	142.05	135.28	2.01	24.97	0.00	52
46	142.97	142.08	128.65	144.79	141.60	129.55	143.86	135.47	2.03	26.28	0.00	53
47	144.79	141.60	129.55	147.03	141.00	130.73	145.88	135.72	2.54	27.77	0.00	54
48	147.03	141.00	130.73	149.28	140.40	132.00	148.12	136.03	2.58	29.43	0.00	54
49	149.28	140.40	132.00	151.52	139.80	133.35	150.35	136.38	2.62	31.12	0.00	54
50	151.52	139.80	133.35	153.77	139.20	134.80	152.58	136.78	2.67	32.85	0.00	54
51	153.77	139.20	134.80	156.01	138.61	136.35	154.77	137.22	2.73	34.61	0.00	53
52	156.01	138.61	136.35	158.26	138.01	138.01	156.76	137.66	2.79	36.40	26.66	16

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	256	0	6375	12517	0	0	13875	0	0	
2	2830	0	18759	31571	0	13875	48549	0	0	
3	5902	0	22343	31302	0	48549	82326	0	0	
4	14391	0	39350	45272	0	82326	129740	0	0	
5	21117	0	46743	44002	0	129740	173627	0	0	
6	27515	0	53921	43563	0	173627	214476	0	0	
7	33536	0	60520	43169	0	214476	251987	0	0	
8	39235	0	66643	42816	0	251987	285898	0	0	
9	44727	0	72468	42502	0	285898	315953	0	0	
10	42583	0	66590	36261	0	315953	338511	0	0	
11	46244	0	70364	36078	0	338511	357969	0	0	
12	42637	0	63469	30953	0	357969	372176	0	0	
13	45100	0	65950	30846	0	372176	383967	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	53237	0	76556	34406	0	383967	394255	0	0	
15	57192	0	81013	35580	0	394255	402103	0	0	
16	40018	0	56049	24488	0	402103	406114	0	0	
17	40410	0	56109	24451	0	406114	409017	0	0	
18	26494	0	36528	15799	0	409017	410222	0	0	
19	64366	0	87929	37257	0	410222	410548	0	0	
20	66739	0	90110	37213	0	410548	407347	0	0	
21	68843	0	91981	37191	0	407347	400689	0	0	
22	70722	0	93603	37188	0	400689	390635	0	0	
23	72361	0	94956	37206	0	390635	377278	0	0	
24	63626	0	82890	32152	0	377278	363158	0	0	
25	64518	0	83532	32194	0	363158	346734	0	0	
26	65270	0	84021	32249	0	346734	328088	0	0	
27	75098	0	96122	36819	0	328088	304245	0	0	
28	75730	0	96387	36928	0	304245	277744	0	0	
29	7903	0	10029	3846	0	277744	274841	0	0	
30	55047	0	69708	26782	0	274841	253933	0	0	
31	55231	0	69693	26859	0	253933	231750	0	0	
32	73210	0	92018	35639	0	231750	200541	0	0	
33	52024	0	65152	25400	0	200541	177162	0	0	
34	61899	0	77272	30342	0	177162	148081	0	0	
35	61929	0	77064	30487	0	148081	117600	0	0	
36	61850	0	76723	30645	0	117600	85836	0	0	
37	65191	0	80597	32619	0	85836	51018	0	0	
38	64781	0	79803	32829	0	51018	15135	0	0	
39	22317	1200	29089	11472	0	15135	1214	0	0	
40	57865	3180	75194	30539	0	1214	-35171	0	0	
41	55945	3180	72328	30755	0	-35171	-70644	0	0	
42	58217	3440	74786	33530	0	-70644	-107698	0	0	
43	29749	0	35276	18054	0	-107698	-124174	0	0	
44	54815	0	63720	35976	0	-124174	-152773	0	0	
45	49858	0	56121	36346	0	-152773	-176229	0	0	
46	44843	0	48129	37046	0	-176229	-193750	0	0	
47	48620	0	47800	47818	0	-193750	-205613	0	0	
48	40862	0	34902	48581	0	-205613	-207267	0	0	
49	32606	0	20742	49427	0	-207267	-197075	0	0	
50	23882	0	5373	50152	0	-197075	-173528	0	0	
51	14420	0	-11269	50054	0	-173528	-135393	0	0	
52	4613	0	-1813	12782	0	-135393	-127057	0	0	

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

### 9.2.2 ANALISI DELLA SUPERFICIE 59 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	51	
Coordinate del centro	X[m]= 94.92	Y[m]= 204.00
Raggio del cerchio	R[m]= 84.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 60.53	Y <sub>v</sub> [m]= 127.36
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 149.67	Y <sub>m</sub> [m]= 140.30
Coefficiente di sicurezza	F <sub>s</sub> = 0.304	

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	60.53	127.36	127.36	62.19	127.75	126.64	61.64	127.25	1.80	-23.55	0.00	54
2	62.19	127.75	126.64	63.84	128.14	125.96	63.10	127.12	1.79	-22.33	0.00	54
3	63.84	128.14	125.96	65.52	128.54	125.31	64.73	126.98	1.80	-21.10	0.00	52
4	65.52	128.54	125.31	67.19	128.93	124.71	66.39	126.87	1.78	-19.88	0.00	52
5	67.19	128.93	124.71	69.39	129.45	123.98	68.33	126.76	2.31	-18.49	0.00	52
6	69.39	129.45	123.98	71.58	129.96	123.31	70.52	126.67	2.29	-16.91	0.00	52
7	71.58	129.96	123.31	73.78	130.48	122.70	72.71	126.61	2.28	-15.36	0.00	52
8	73.78	130.48	122.70	75.97	130.99	122.17	74.90	126.59	2.26	-13.81	0.00	52
9	75.97	130.99	122.17	78.17	131.51	121.69	77.09	126.59	2.25	-12.27	0.00	52
10	78.17	131.51	121.69	80.36	132.03	121.27	79.28	126.62	2.23	-10.74	0.00	52
11	80.36	132.03	121.27	80.82	132.14	121.19	80.59	126.66	0.47	-9.82	0.00	52
12	80.82	132.14	121.19	82.34	132.49	120.95	81.59	126.69	1.54	-9.14	0.00	52
13	82.34	132.49	120.95	83.86	132.85	120.73	83.11	126.76	1.54	-8.09	0.00	52
14	83.86	132.85	120.73	85.81	133.31	120.50	84.84	126.85	1.96	-6.90	0.00	52
15	85.81	133.31	120.50	87.76	133.77	120.31	86.79	126.97	1.96	-5.56	0.00	52
16	87.76	133.77	120.31	88.93	134.04	120.21	88.35	127.08	1.17	-4.49	0.00	52
17	88.93	134.04	120.21	90.10	134.32	120.14	89.52	127.18	1.17	-3.69	0.00	52
18	90.10	134.32	120.14	91.12	134.56	120.09	90.61	127.28	1.02	-2.94	0.00	52
19	91.12	134.56	120.09	93.00	135.00	120.02	92.07	127.42	1.88	-1.95	0.00	52
20	93.00	135.00	120.02	94.95	135.00	120.00	93.98	127.51	1.95	-0.64	0.00	52
21	94.95	135.00	120.00	96.29	135.00	120.01	95.62	127.50	1.35	0.48	0.00	52
22	96.29	135.00	120.01	97.64	135.00	120.04	96.97	127.51	1.35	1.40	0.00	52
23	97.64	135.00	120.04	98.51	135.20	120.08	98.08	127.58	0.87	2.15	0.00	52
24	98.51	135.20	120.08	100.56	135.69	120.19	99.54	127.79	2.06	3.15	0.00	52
25	100.56	135.69	120.19	102.62	136.17	120.35	101.59	128.10	2.06	4.56	0.00	52
26	102.62	136.17	120.35	104.67	136.66	120.57	103.65	128.44	2.07	5.96	0.00	52
27	104.67	136.66	120.57	106.73	137.14	120.83	105.70	128.80	2.07	7.37	0.00	52
28	106.73	137.14	120.83	108.78	137.62	121.15	107.75	129.19	2.08	8.79	0.00	52
29	108.78	137.62	121.15	110.55	138.04	121.47	109.67	129.57	1.80	10.11	0.00	52
30	110.55	138.04	121.47	112.33	138.46	121.82	111.44	129.95	1.81	11.34	0.00	52
31	112.33	138.46	121.82	114.10	138.88	122.22	113.21	130.34	1.82	12.58	0.00	52
32	114.10	138.88	122.22	116.22	139.38	122.75	115.16	130.80	2.19	13.95	0.00	52
33	116.22	139.38	122.75	118.35	139.88	123.33	117.29	131.33	2.20	15.44	0.00	52
34	118.35	139.88	123.33	119.97	140.26	123.82	119.16	131.82	1.69	16.77	0.00	52
35	119.97	140.26	123.82	121.58	140.64	124.34	120.77	132.26	1.70	17.93	0.00	52
36	121.58	140.64	124.34	123.20	141.02	124.90	122.39	132.73	1.71	19.09	0.00	52
37	123.20	141.02	124.90	124.57	141.34	125.41	123.88	133.17	1.46	20.17	0.00	52
38	124.57	141.34	125.41	126.47	141.79	126.15	125.51	133.67	2.03	21.36	0.00	52
39	126.47	141.79	126.15	128.36	142.23	126.94	127.41	134.28	2.05	22.76	0.00	52
40	128.36	142.23	126.94	130.25	142.68	127.79	129.30	134.91	2.08	24.17	0.00	52
41	130.25	142.68	127.79	132.15	143.12	128.70	131.20	135.57	2.10	25.59	0.00	52
42	132.15	143.12	128.70	132.91	143.30	129.08	132.53	136.05	0.85	26.60	0.00	52
43	132.91	143.30	129.08	133.98	143.30	129.63	133.44	136.33	1.20	27.30	0.00	52
44	133.98	143.30	129.63	136.19	143.30	130.84	135.07	136.76	2.52	28.57	0.00	54
45	136.19	143.30	130.84	138.41	143.30	132.13	137.28	137.39	2.57	30.31	0.00	54
46	138.41	143.30	132.13	140.20	142.82	133.25	139.28	137.87	2.11	31.90	0.00	54
47	140.20	142.82	133.25	142.00	142.34	134.43	141.07	138.21	2.15	33.36	0.00	54
48	142.00	142.34	134.43	143.80	141.86	135.68	142.86	138.57	2.19	34.83	0.00	54
49	143.80	141.86	135.68	145.59	141.39	137.00	144.64	138.97	2.23	36.34	0.00	54
50	145.59	141.39	137.00	147.63	140.84	138.60	146.50	139.43	2.59	37.98	0.00	53
51	147.63	140.84	138.60	149.67	140.30	140.30	148.31	139.91	2.66	39.77	26.78	16

Tabella 9-4 – Geometria e caratteristiche strisce della superficie 59 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	1850	0	16813	32426	0	0	35229	0	0	
2	5359	0	21034	32486	0	35229	69753	0	0	
3	8972	0	24887	31391	0	69753	102111	0	0	
4	12461	0	28861	31142	0	102111	133036	0	0	
5	21383	0	43473	40465	0	133036	171166	0	0	
6	26904	0	49546	40113	0	171166	206303	0	0	
7	32135	0	55189	39798	0	206303	238207	0	0	
8	37065	0	60406	39520	0	238207	266678	0	0	
9	41656	0	65161	39275	0	266678	291569	0	0	
10	45951	0	69529	39062	0	291569	312752	0	0	
11	10153	0	15098	8162	0	312752	316708	0	0	
12	34788	0	51127	26917	0	316708	328574	0	0	
13	36666	0	53001	26843	0	328574	338546	0	0	
14	49637	0	70558	34342	0	338546	348538	0	0	
15	52388	0	73240	34255	0	348538	355345	0	0	
16	32682	0	45150	20519	0	355345	357888	0	0	
17	33567	0	45996	20499	0	357888	359276	0	0	
18	29955	0	40754	17857	0	359276	359543	0	0	
19	56789	0	76588	32889	0	359543	357753	0	0	
20	59980	0	80049	34096	0	357753	353386	0	0	
21	41406	0	54798	23517	0	353386	349271	0	0	
22	41360	0	54374	23523	0	349271	344319	0	0	
23	26875	0	35146	15222	0	344319	340573	0	0	
24	64528	0	83851	35967	0	340573	329530	0	0	
25	65861	0	84879	36026	0	329530	315480	0	0	
26	66913	0	85581	36107	0	315480	298591	0	0	
27	67727	0	86014	36212	0	298591	279019	0	0	
28	68285	0	86151	36339	0	279019	256956	0	0	
29	59225	0	74282	31494	0	256956	236054	0	0	
30	59286	0	73964	31623	0	236054	213606	0	0	
31	59193	0	73460	31768	0	213606	189767	0	0	
32	70601	0	87109	38282	0	189767	159596	0	0	
33	70025	0	85837	38545	0	159596	127937	0	0	
34	52732	0	64249	29522	0	127937	103057	0	0	
35	52190	0	63241	29708	0	103057	77607	0	0	
36	51562	0	62114	29911	0	77607	51721	0	0	
37	43112	0	51625	25518	0	51721	29580	0	0	
38	58664	0	69746	35577	0	29580	-1193	0	0	
39	57532	0	67788	35929	0	-1193	-32040	0	0	
40	56154	0	65449	36315	0	-32040	-62554	0	0	
41	54517	0	62687	36736	0	-62554	-92277	0	0	
42	21357	0	24281	14861	0	-92277	-103876	0	0	
43	29226	2140	35955	21166	0	-103876	-122142	0	0	
44	56656	4430	67378	45909	0	-122142	-154133	0	0	
45	51317	4430	58462	46700	0	-154133	-179899	0	0	
46	36110	0	32534	38487	0	-179899	-188115	0	0	
47	30154	0	22197	39117	0	-188115	-187435	0	0	
48	24259	0	11551	39807	0	-187435	-177280	0	0	
49	18269	0	282	40563	0	-177280	-156763	0	0	
50	13053	0	-13888	45956	0	-156763	-120560	0	0	
51	4176	0	-2027	11103	0	-120560	-113470	0	0	

Tabella 9-5 – Forze applicate sulle strisce [BISHOP] della superficie 59 della verifica di stabilità 05.

### 9.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.058499
2	0.058869
3	0.035983
4	0.015497
5	0.028517
6	0.034996
7	0.047289

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

Accelerazione sismica critica  $K_c = 0.114$   
Spostamento massimo  $U_{max} = 0.058869$  [m]  
Velocità massima  $V_{max} = 0.176552$  [m/s]

n°	u
	[m]
1	0.075434
2	0.097730
3	0.050826
4	0.024152
5	0.036557
6	0.045851
7	0.063066

Tabella 9-7 – Spostamenti della superficie 59 della verifica di stabilità 05.

Accelerazione sismica critica  $K_c = 0.097$   
Spostamento massimo  $U_{max} = 0.097730$  [m]  
Velocità massima  $V_{max} = 0.235429$  [m/s]

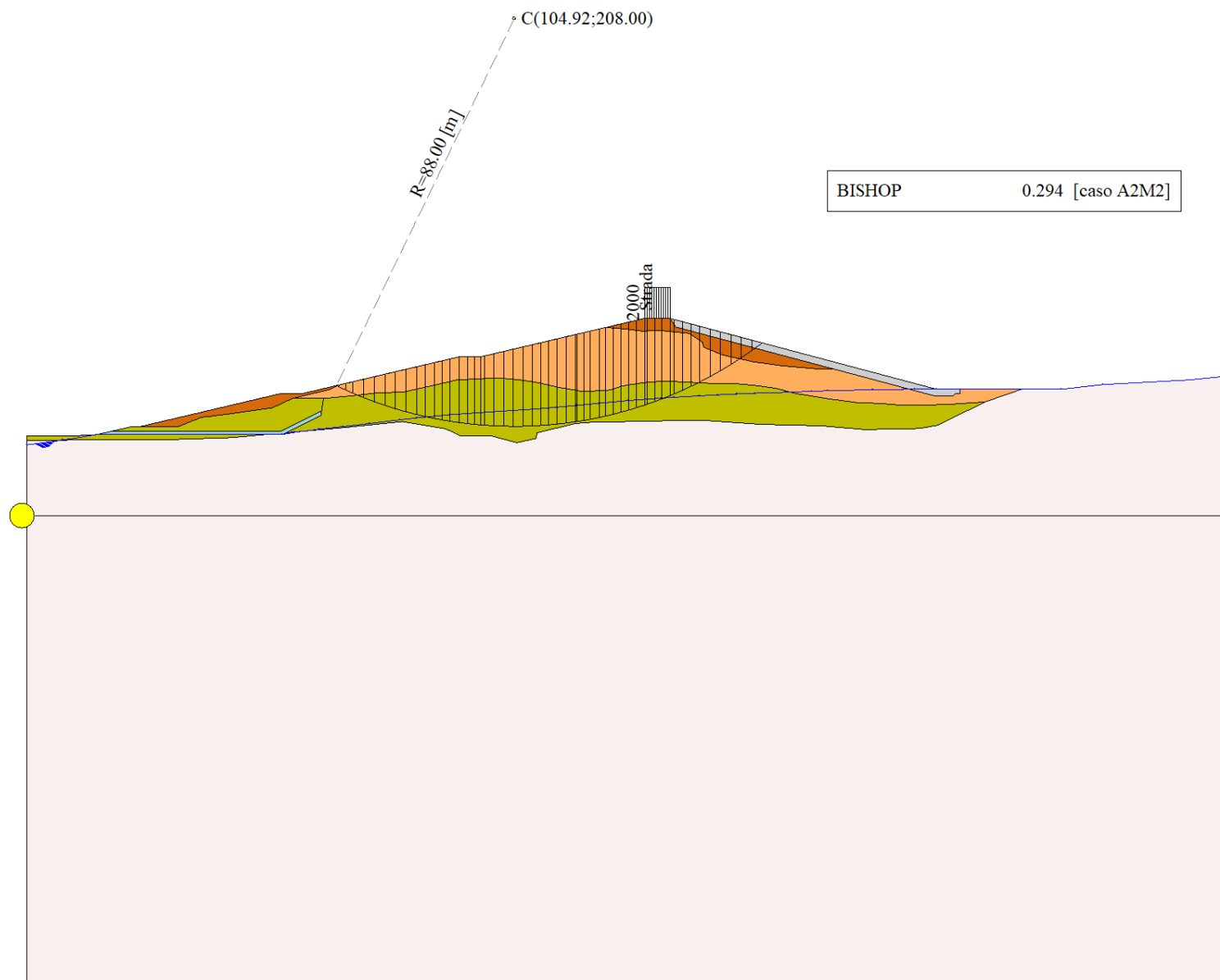


Figura 9-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 05.

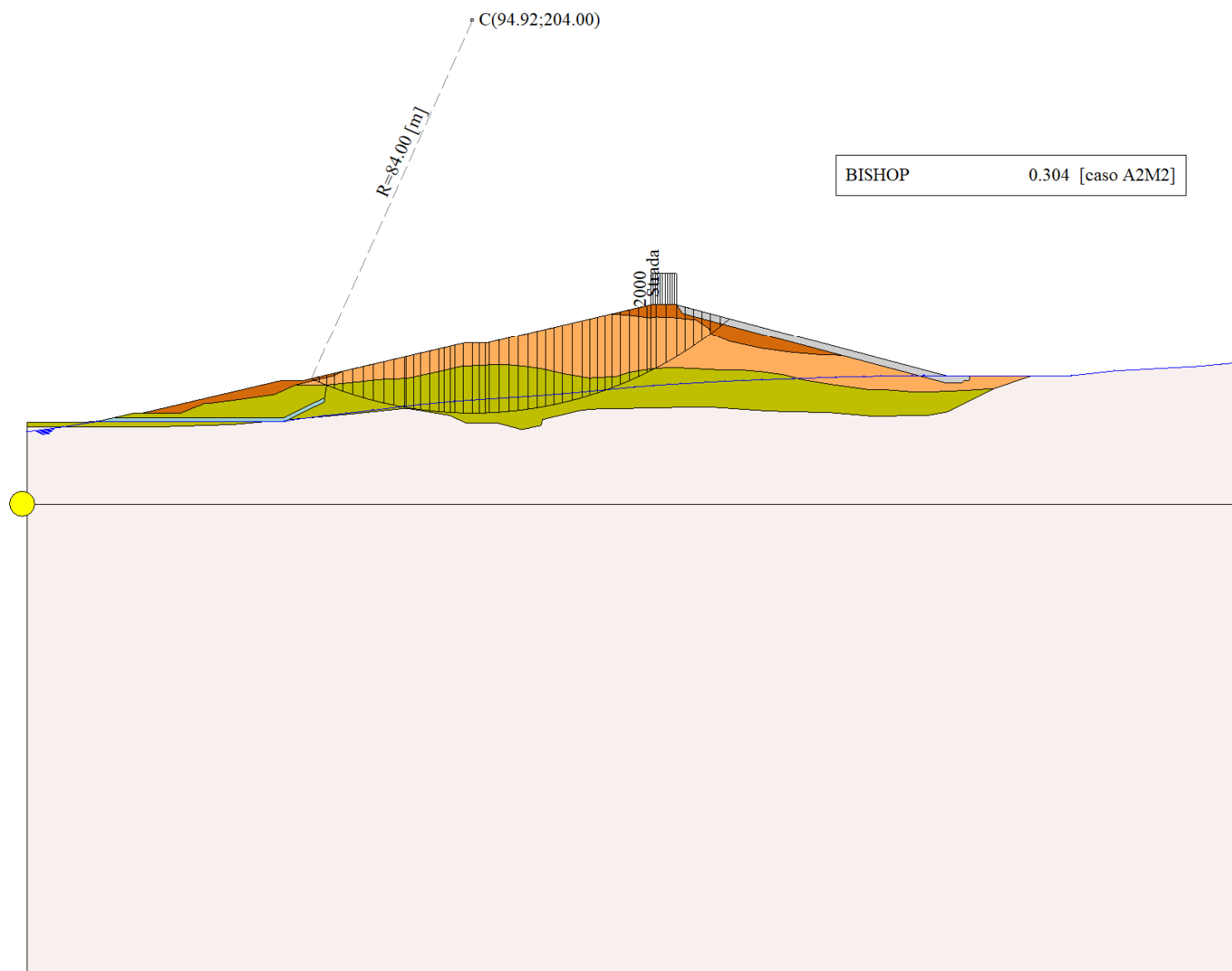


Figura 9-2 – Superficie critica (59) della sezione CR\_08 per la verifica di stabilità 05.

## 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	132.91	138.41	2000	0
				143.30	143.30	2000	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	107016
Coefficiente di sicurezza minimo	0.307
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	52
Coordinate del centro	X[m]= 104.92      Y[m]= 208.00
Raggio del cerchio	R[m]= 88.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 66.59      Y <sub>v</sub> [m]= 128.79
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 158.26      Y <sub>m</sub> [m]= 138.01
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.307</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	66.59	128.79	128.79	67.19	128.93	128.50	66.99	128.74	0.67	-25.61	0.00	54
2	67.19	128.93	128.50	68.71	129.29	127.80	68.09	128.61	1.67	-24.84	0.00	54
3	68.71	129.29	127.80	70.23	129.64	127.13	69.53	128.46	1.66	-23.76	0.00	54
4	70.23	129.64	127.13	72.50	130.18	126.19	71.45	128.28	2.46	-22.42	0.00	53
5	72.50	130.18	126.19	74.77	130.71	125.32	73.69	128.10	2.43	-20.83	0.00	52
6	74.77	130.71	125.32	77.05	131.25	124.53	75.95	127.95	2.41	-19.25	0.00	52
7	77.05	131.25	124.53	79.32	131.78	123.81	78.21	127.84	2.38	-17.69	0.00	52
8	79.32	131.78	123.81	81.59	132.32	123.15	80.48	127.76	2.36	-16.14	0.00	52
9	81.59	132.32	123.15	83.86	132.85	122.56	82.75	127.72	2.35	-14.61	0.00	52
10	83.86	132.85	122.56	85.81	133.31	122.10	84.85	127.70	2.00	-13.19	0.00	52
11	85.81	133.31	122.10	87.76	133.77	121.69	86.80	127.72	1.99	-11.89	0.00	52
12	87.76	133.77	121.69	89.44	134.16	121.37	88.61	127.75	1.71	-10.69	0.00	52
13	89.44	134.16	121.37	91.12	134.56	121.09	90.29	127.80	1.70	-9.58	0.00	52
14	91.12	134.56	121.09	93.00	135.00	120.81	92.07	127.86	1.90	-8.40	0.00	52
15	93.00	135.00	120.81	94.95	135.00	120.57	93.98	127.84	1.97	-7.15	0.00	52
16	94.95	135.00	120.57	96.29	135.00	120.42	95.62	127.75	1.35	-6.06	0.00	52
17	96.29	135.00	120.42	97.64	135.00	120.30	96.97	127.68	1.35	-5.19	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	97.64	135.00	120.30	98.51	135.20	120.23	98.08	127.69	0.87	-4.46	0.00	52
19	98.51	135.20	120.23	100.56	135.69	120.11	99.54	127.81	2.06	-3.51	0.00	52
20	100.56	135.69	120.11	102.62	136.17	120.03	101.60	128.00	2.06	-2.17	0.00	52
21	102.62	136.17	120.03	104.67	136.66	120.00	103.65	128.22	2.05	-0.83	0.00	52
22	104.67	136.66	120.00	106.73	137.14	120.02	105.70	128.45	2.05	0.51	0.00	52
23	106.73	137.14	120.02	108.78	137.62	120.08	107.76	128.72	2.06	1.84	0.00	52
24	108.78	137.62	120.08	110.55	138.04	120.18	109.67	128.98	1.78	3.09	0.00	52
25	110.55	138.04	120.18	112.33	138.46	120.31	111.44	129.25	1.78	4.25	0.00	52
26	112.33	138.46	120.31	114.10	138.88	120.48	113.22	129.53	1.78	5.41	0.00	52
27	114.10	138.88	120.48	116.12	139.35	120.72	115.11	129.86	2.03	6.65	0.00	52
28	116.12	139.35	120.72	118.14	139.83	121.00	117.13	130.22	2.04	7.98	0.00	52
29	118.14	139.83	121.00	118.35	139.88	121.03	118.25	130.43	0.21	8.71	0.00	52
30	118.35	139.88	121.03	119.81	140.22	121.27	119.08	130.60	1.48	9.26	0.00	52
31	119.81	140.22	121.27	121.27	140.56	121.53	120.54	130.90	1.48	10.22	0.00	52
32	121.27	140.56	121.53	123.20	141.02	121.92	122.24	131.26	1.97	11.35	0.00	52
33	123.20	141.02	121.92	124.57	141.34	122.22	123.89	131.62	1.40	12.45	0.00	52
34	124.57	141.34	122.22	126.20	141.72	122.61	125.38	131.97	1.68	13.45	0.00	52
35	126.20	141.72	122.61	127.83	142.11	123.03	127.01	132.37	1.68	14.54	0.00	52
36	127.83	142.11	123.03	129.46	142.49	123.49	128.64	132.78	1.69	15.64	0.00	52
37	129.46	142.49	123.49	131.19	142.89	124.01	130.32	133.22	1.80	16.78	0.00	52
38	131.19	142.89	124.01	132.91	143.30	124.57	132.05	133.69	1.81	17.96	0.00	52
39	132.91	143.30	124.57	133.51	143.30	124.77	133.21	133.99	0.63	18.75	0.00	52
40	133.51	143.30	124.77	135.10	143.30	125.34	134.30	134.18	1.69	19.51	0.00	52
41	135.10	143.30	125.34	136.69	143.30	125.93	135.89	134.47	1.70	20.61	0.00	52
42	136.69	143.30	125.93	138.41	143.30	126.62	137.54	134.79	1.85	21.77	0.00	52
43	138.41	143.30	126.62	139.33	143.05	127.01	138.87	135.00	1.00	22.69	0.00	52
44	139.33	143.05	127.01	141.15	142.57	127.80	140.23	135.11	1.99	23.67	0.00	52
45	141.15	142.57	127.80	142.97	142.08	128.65	142.05	135.28	2.01	24.97	0.00	52
46	142.97	142.08	128.65	144.79	141.60	129.55	143.86	135.47	2.03	26.28	0.00	53
47	144.79	141.60	129.55	147.03	141.00	130.73	145.88	135.72	2.54	27.77	0.00	54
48	147.03	141.00	130.73	149.28	140.40	132.00	148.12	136.03	2.58	29.43	0.00	54
49	149.28	140.40	132.00	151.52	139.80	133.35	150.35	136.38	2.62	31.12	0.00	54
50	151.52	139.80	133.35	153.77	139.20	134.80	152.58	136.78	2.67	32.85	0.00	54
51	153.77	139.20	134.80	156.01	138.61	136.35	154.77	137.22	2.73	34.61	0.00	53
52	156.01	138.61	136.35	158.26	138.01	138.01	156.76	137.66	2.79	36.40	26.66	16

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	256	0	6107	11967	0	0	13272	0	0	
2	2830	0	18064	30184	0	13272	46491	0	0	
3	5902	0	21627	29927	0	46491	78923	0	0	
4	14391	0	38264	43283	0	78923	124574	0	0	
5	21117	0	45622	42069	0	124574	166977	0	0	
6	27515	0	52756	41649	0	166977	206572	0	0	
7	33536	0	59315	41272	0	206572	243054	0	0	
8	39235	0	65402	40935	0	243054	276150	0	0	
9	44727	0	71193	40635	0	276150	305602	0	0	
10	42583	0	65471	34668	0	305602	327806	0	0	
11	46244	0	69224	34493	0	327806	347055	0	0	
12	42637	0	62472	29593	0	347055	361194	0	0	
13	45100	0	64941	29490	0	361194	373019	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
14	53237	0	75415	32894	0	373019	383461	0	0	
15	57192	0	79834	34017	0	383461	391562	0	0	
16	40018	0	55249	23412	0	391562	395783	0	0	
17	40410	0	55320	23376	0	395783	398922	0	0	
18	26494	0	36020	15105	0	398922	400300	0	0	
19	64366	0	86729	35620	0	400300	401114	0	0	
20	66739	0	88910	35578	0	401114	398509	0	0	
21	68843	0	90783	35557	0	398509	392547	0	0	
22	70722	0	92411	35554	0	392547	383282	0	0	
23	72361	0	93774	35571	0	383282	370797	0	0	
24	63626	0	81880	30740	0	370797	357491	0	0	
25	64518	0	82534	30779	0	357491	341930	0	0	
26	65270	0	83037	30832	0	341930	324192	0	0	
27	75098	0	95022	35201	0	324192	301431	0	0	
28	75730	0	95311	35306	0	301431	276055	0	0	
29	7903	0	9919	3677	0	276055	273271	0	0	
30	55047	0	68949	25605	0	273271	253201	0	0	
31	55231	0	68949	25679	0	253201	231872	0	0	
32	73210	0	91060	34073	0	231872	201813	0	0	
33	52024	0	64489	24284	0	201813	179261	0	0	
34	61899	0	76505	29009	0	179261	151172	0	0	
35	61929	0	76320	29148	0	151172	121694	0	0	
36	61850	0	76005	29299	0	121694	90936	0	0	
37	65191	0	79868	31186	0	90936	57180	0	0	
38	64781	0	79109	31387	0	57180	22347	0	0	
39	22317	1200	28837	10968	0	22347	8831	0	0	
40	57865	3180	74565	29198	0	8831	-26526	0	0	
41	55945	3180	71759	29403	0	-26526	-61048	0	0	
42	58217	3440	74242	32057	0	-61048	-97166	0	0	
43	29749	0	35058	17261	0	-97166	-113275	0	0	
44	54815	0	63392	34395	0	-113275	-141320	0	0	
45	49858	0	55927	34750	0	-141320	-164442	0	0	
46	44843	0	48080	35418	0	-164442	-181871	0	0	
47	48620	0	47969	45717	0	-181871	-194014	0	0	
48	40862	0	35306	46447	0	-194014	-196333	0	0	
49	32606	0	21404	47255	0	-196333	-187230	0	0	
50	23882	0	6311	47949	0	-187230	-165228	0	0	
51	14420	0	-10050	47855	0	-165228	-129104	0	0	
52	4613	0	-1669	12455	0	-129104	-120958	0	0	

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

#### 10.2.2 ANALISI DELLA SUPERFICIE 55 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	51	
Coordinate del centro	X[m]= 94.92	Y[m]= 204.00
Raggio del cerchio	R[m]= 84.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 60.53	Y <sub>v</sub> [m]= 127.36
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 149.67	Y <sub>m</sub> [m]= 140.30
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.317</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	60.53	127.36	127.36	62.19	127.75	126.64	61.64	127.25	1.80	-23.55	0.00	54
2	62.19	127.75	126.64	63.84	128.14	125.96	63.10	127.12	1.79	-22.33	0.00	54
3	63.84	128.14	125.96	65.52	128.54	125.31	64.73	126.98	1.80	-21.10	0.00	52
4	65.52	128.54	125.31	67.19	128.93	124.71	66.39	126.87	1.78	-19.88	0.00	52
5	67.19	128.93	124.71	69.39	129.45	123.98	68.33	126.76	2.31	-18.49	0.00	52
6	69.39	129.45	123.98	71.58	129.96	123.31	70.52	126.67	2.29	-16.91	0.00	52
7	71.58	129.96	123.31	73.78	130.48	122.70	72.71	126.61	2.28	-15.36	0.00	52
8	73.78	130.48	122.70	75.97	130.99	122.17	74.90	126.59	2.26	-13.81	0.00	52
9	75.97	130.99	122.17	78.17	131.51	121.69	77.09	126.59	2.25	-12.27	0.00	52
10	78.17	131.51	121.69	80.36	132.03	121.27	79.28	126.62	2.23	-10.74	0.00	52
11	80.36	132.03	121.27	80.82	132.14	121.19	80.59	126.66	0.47	-9.82	0.00	52
12	80.82	132.14	121.19	82.34	132.49	120.95	81.59	126.69	1.54	-9.14	0.00	52
13	82.34	132.49	120.95	83.86	132.85	120.73	83.11	126.76	1.54	-8.09	0.00	52
14	83.86	132.85	120.73	85.81	133.31	120.50	84.84	126.85	1.96	-6.90	0.00	52
15	85.81	133.31	120.50	87.76	133.77	120.31	86.79	126.97	1.96	-5.56	0.00	52
16	87.76	133.77	120.31	88.93	134.04	120.21	88.35	127.08	1.17	-4.49	0.00	52
17	88.93	134.04	120.21	90.10	134.32	120.14	89.52	127.18	1.17	-3.69	0.00	52
18	90.10	134.32	120.14	91.12	134.56	120.09	90.61	127.28	1.02	-2.94	0.00	52
19	91.12	134.56	120.09	93.00	135.00	120.02	92.07	127.42	1.88	-1.95	0.00	52
20	93.00	135.00	120.02	94.95	135.00	120.00	93.98	127.51	1.95	-0.64	0.00	52
21	94.95	135.00	120.00	96.29	135.00	120.01	95.62	127.50	1.35	0.48	0.00	52
22	96.29	135.00	120.01	97.64	135.00	120.04	96.97	127.51	1.35	1.40	0.00	52
23	97.64	135.00	120.04	98.51	135.20	120.08	98.08	127.58	0.87	2.15	0.00	52
24	98.51	135.20	120.08	100.56	135.69	120.19	99.54	127.79	2.06	3.15	0.00	52
25	100.56	135.69	120.19	102.62	136.17	120.35	101.59	128.10	2.06	4.56	0.00	52
26	102.62	136.17	120.35	104.67	136.66	120.57	103.65	128.44	2.07	5.96	0.00	52
27	104.67	136.66	120.57	106.73	137.14	120.83	105.70	128.80	2.07	7.37	0.00	52
28	106.73	137.14	120.83	108.78	137.62	121.15	107.75	129.19	2.08	8.79	0.00	52
29	108.78	137.62	121.15	110.55	138.04	121.47	109.67	129.57	1.80	10.11	0.00	52
30	110.55	138.04	121.47	112.33	138.46	121.82	111.44	129.95	1.81	11.34	0.00	52
31	112.33	138.46	121.82	114.10	138.88	122.22	113.21	130.34	1.82	12.58	0.00	52
32	114.10	138.88	122.22	116.22	139.38	122.75	115.16	130.80	2.19	13.95	0.00	52
33	116.22	139.38	122.75	118.35	139.88	123.33	117.29	131.33	2.20	15.44	0.00	52
34	118.35	139.88	123.33	119.97	140.26	123.82	119.16	131.82	1.69	16.77	0.00	52
35	119.97	140.26	123.82	121.58	140.64	124.34	120.77	132.26	1.70	17.93	0.00	52
36	121.58	140.64	124.34	123.20	141.02	124.90	122.39	132.73	1.71	19.09	0.00	52
37	123.20	141.02	124.90	124.57	141.34	125.41	123.88	133.17	1.46	20.17	0.00	52
38	124.57	141.34	125.41	126.47	141.79	126.15	125.51	133.67	2.03	21.36	0.00	52
39	126.47	141.79	126.15	128.36	142.23	126.94	127.41	134.28	2.05	22.76	0.00	52
40	128.36	142.23	126.94	130.25	142.68	127.79	129.30	134.91	2.08	24.17	0.00	52
41	130.25	142.68	127.79	132.15	143.12	128.70	131.20	135.57	2.10	25.59	0.00	52
42	132.15	143.12	128.70	132.91	143.30	129.08	132.53	136.05	0.85	26.60	0.00	52
43	132.91	143.30	129.08	133.98	143.30	129.63	133.44	136.33	1.20	27.30	0.00	52
44	133.98	143.30	129.63	136.19	143.30	130.84	135.07	136.76	2.52	28.57	0.00	54
45	136.19	143.30	130.84	138.41	143.30	132.13	137.28	137.39	2.57	30.31	0.00	54
46	138.41	143.30	132.13	140.20	142.82	133.25	139.28	137.87	2.11	31.90	0.00	54
47	140.20	142.82	133.25	142.00	142.34	134.43	141.07	138.21	2.15	33.36	0.00	54
48	142.00	142.34	134.43	143.80	141.86	135.68	142.86	138.57	2.19	34.83	0.00	54
49	143.80	141.86	135.68	145.59	141.39	137.00	144.64	138.97	2.23	36.34	0.00	54
50	145.59	141.39	137.00	147.63	140.84	138.60	146.50	139.43	2.59	37.98	0.00	53
51	147.63	140.84	138.60	149.67	140.30	140.30	148.31	139.91	2.66	39.77	26.78	16

Tabella 10-4 – Geometria e caratteristiche strisce della superficie 55 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	1850	0	16186	31067	0	0	33796	0	0	
2	5359	0	20376	31125	0	33796	66994	0	0	
3	8972	0	24215	30076	0	66994	98189	0	0	
4	12461	0	28164	29837	0	98189	128074	0	0	
5	21383	0	42522	38770	0	128074	165024	0	0	
6	26904	0	48556	38432	0	165024	199182	0	0	
7	32135	0	54162	38131	0	199182	230302	0	0	
8	37065	0	59348	37864	0	230302	258177	0	0	
9	41656	0	64076	37629	0	258177	282649	0	0	
10	45951	0	68421	37425	0	282649	303585	0	0	
11	10153	0	14863	7820	0	303585	307510	0	0	
12	34788	0	50345	25789	0	307510	319324	0	0	
13	36666	0	52210	25718	0	319324	329322	0	0	
14	49637	0	69531	32903	0	329322	339455	0	0	
15	52388	0	72203	32820	0	339455	346520	0	0	
16	32682	0	44524	19659	0	346520	349271	0	0	
17	33567	0	45367	19640	0	349271	350906	0	0	
18	29955	0	40204	17109	0	350906	351419	0	0	
19	56789	0	75572	31511	0	351419	350154	0	0	
20	59980	0	79010	32667	0	350154	346392	0	0	
21	41406	0	54100	22531	0	346392	342709	0	0	
22	41360	0	53693	22537	0	342709	338199	0	0	
23	26875	0	34712	14584	0	338199	334749	0	0	
24	64528	0	82832	34459	0	334749	324458	0	0	
25	65861	0	83873	34516	0	324458	311228	0	0	
26	66913	0	84592	34595	0	311228	295219	0	0	
27	67727	0	85046	34694	0	295219	276576	0	0	
28	68285	0	85208	34816	0	276576	255482	0	0	
29	59225	0	73492	30174	0	255482	235439	0	0	
30	59286	0	73199	30298	0	235439	213864	0	0	
31	59193	0	72723	30436	0	213864	190905	0	0	
32	70601	0	86267	36678	0	190905	161787	0	0	
33	70025	0	85044	36930	0	161787	131171	0	0	
34	52732	0	63682	28285	0	131171	107069	0	0	
35	52190	0	62708	28463	0	107069	82378	0	0	
36	51562	0	61617	28658	0	82378	57228	0	0	
37	43112	0	51235	24449	0	57228	35688	0	0	
38	58664	0	69255	34086	0	35688	5706	0	0	
39	57532	0	67356	34424	0	5706	-24400	0	0	
40	56154	0	65082	34793	0	-24400	-54237	0	0	
41	54517	0	62393	35197	0	-54237	-83362	0	0	
42	21357	0	24185	14238	0	-83362	-94747	0	0	
43	29226	2140	35811	20279	0	-94747	-112665	0	0	
44	56656	4430	67240	43985	0	-112665	-144197	0	0	
45	51317	4430	58505	44744	0	-144197	-169772	0	0	
46	36110	0	32813	36874	0	-169772	-178274	0	0	
47	30154	0	22660	37478	0	-178274	-178189	0	0	
48	24259	0	12208	38139	0	-178189	-168951	0	0	
49	18269	0	1146	38863	0	-168951	-149691	0	0	
50	13053	0	-12667	44030	0	-149691	-115313	0	0	
51	4176	0	-1900	10839	0	-115313	-108364	0	0	

Tabella 10-5 – Forze applicate sulle strisce [BISHOP] della superficie 55 della verifica di stabilità 06.

### 10.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.072715
2	0.038539
3	0.080689
4	0.059790
5	0.084771
6	0.030793
7	0.046751

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

Accelerazione sismica critica  $K_c = 0.114$   
Spostamento massimo  $U_{max} = 0.084771$  [m]  
Velocità massima  $V_{max} = 0.210758$  [m/s]

n°	u
	[m]
1	0.092045
2	0.055338
3	0.135347
4	0.078501
5	0.107678
6	0.041960
7	0.063164

Tabella 10-7 – Spostamenti della superficie 55 della verifica di stabilità 06.

Accelerazione sismica critica  $K_c = 0.097$   
Spostamento massimo  $U_{max} = 0.135347$  [m]  
Velocità massima  $V_{max} = 0.304624$  [m/s]

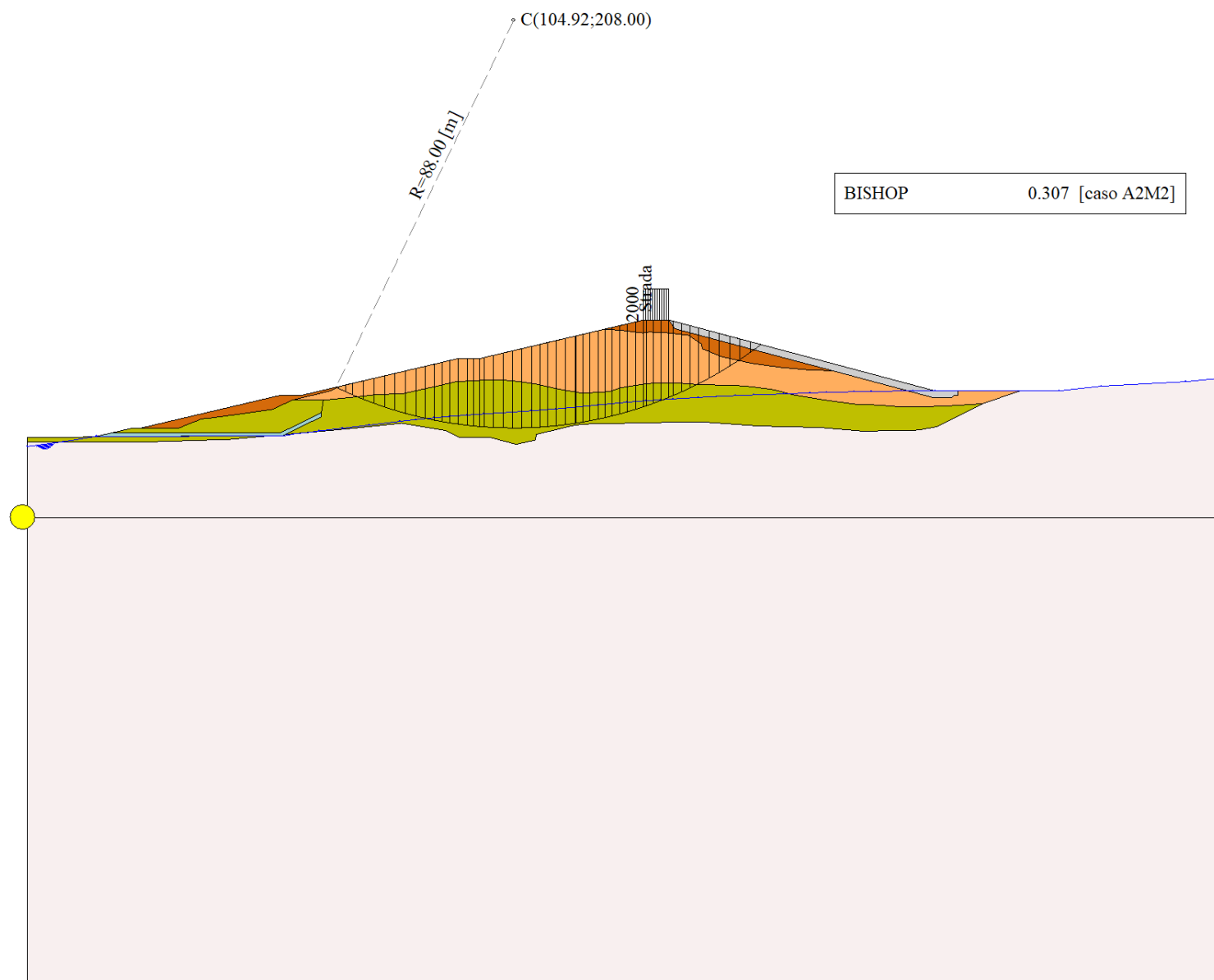


Figura 10-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 06.

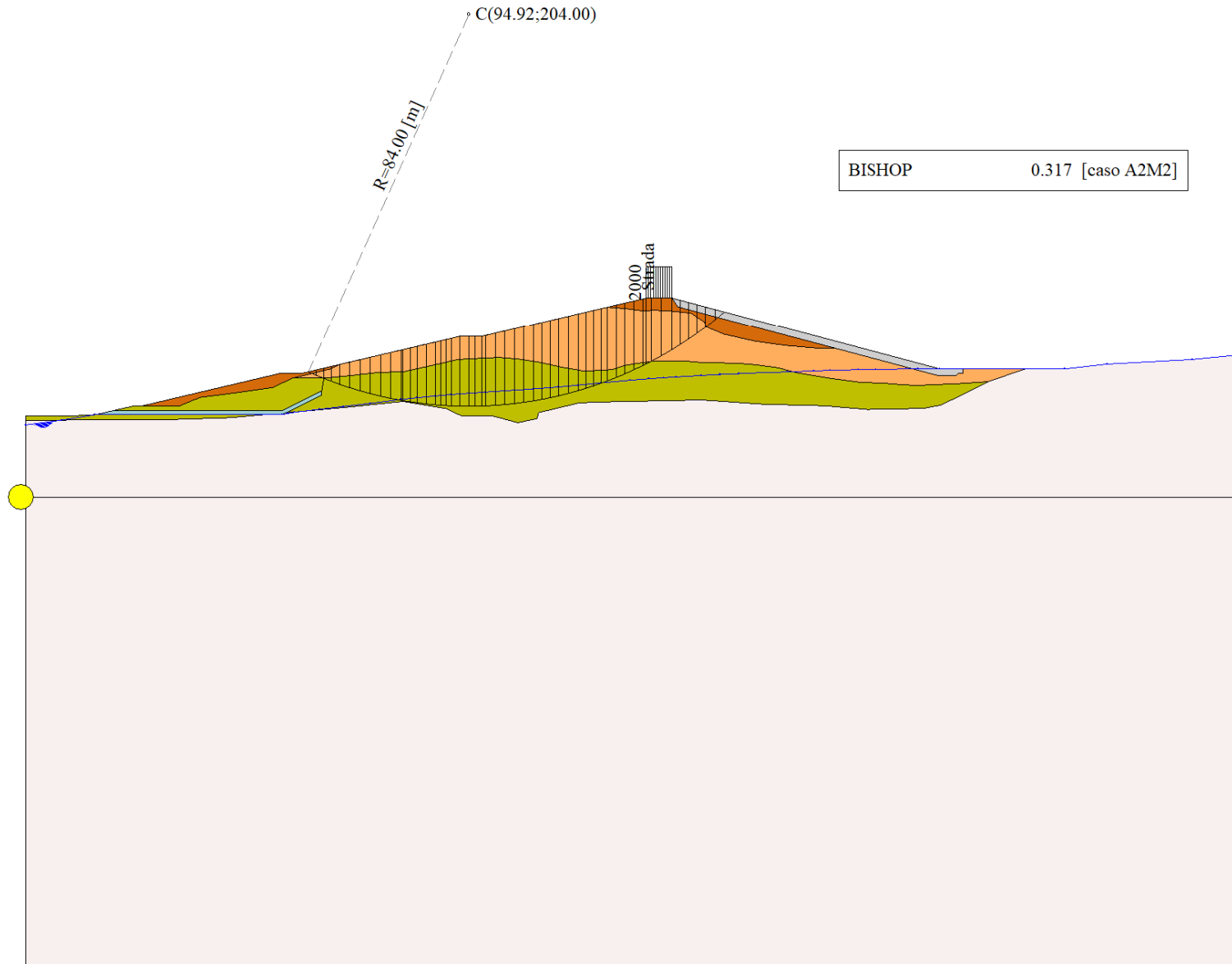


Figura 10-2 – Superficie critica (55) della sezione CR\_08 per la verifica di stabilità 06.

## 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	132.91 143.30	138.41 143.30	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	53508
Coefficiente di sicurezza minimo	1.874
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	66
Coordinate del centro	X[m]= 62.92                      Y[m]= 190.00
Raggio del cerchio	R[m]= 88.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 12.24                      Y <sub>v</sub> [m]= 118.06
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 137.51                      Y <sub>m</sub> [m]= 143.30
Coefficiente di sicurezza	F <sub>S</sub> = 1.874

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	12.24	118.06	118.06	14.95	118.20	116.22	14.05	117.49	3.27	-34.10	19.17	18
2	14.95	118.20	116.22	14.99	118.21	116.20	14.97	117.21	0.05	-33.02	19.27	19
3	14.99	118.21	116.20	16.73	118.60	115.10	15.94	117.01	2.05	-32.33	19.27	19
4	16.73	118.60	115.10	18.46	119.00	114.06	17.64	116.68	2.02	-31.00	19.27	19
5	18.46	119.00	114.06	19.61	119.26	113.40	19.05	116.43	1.33	-29.91	19.27	19
6	19.61	119.26	113.40	21.22	119.63	112.51	20.44	116.19	1.84	-28.88	19.27	19
7	21.22	119.63	112.51	22.83	120.00	111.66	22.05	115.95	1.82	-27.69	19.27	19
8	22.83	120.00	111.66	24.60	120.00	110.78	23.73	115.61	1.98	-26.46	19.27	19
9	24.60	120.00	110.78	27.57	120.70	109.41	26.14	115.22	3.28	-24.75	19.27	19
10	27.57	120.70	109.41	30.55	121.40	108.17	29.10	114.92	3.22	-22.63	19.27	19
11	30.55	121.40	108.17	33.52	122.10	107.05	32.07	114.68	3.18	-20.55	19.27	19
12	33.52	122.10	107.05	36.50	122.80	106.06	35.04	114.50	3.14	-18.49	19.27	19
13	36.50	122.80	106.06	39.47	123.50	105.18	38.01	114.38	3.10	-16.46	19.27	19
14	39.47	123.50	105.18	42.45	124.20	104.41	40.98	114.32	3.07	-14.45	19.27	19
15	42.45	124.20	104.41	45.42	124.90	103.76	43.95	114.32	3.05	-12.46	19.27	19
16	45.42	124.90	103.76	48.40	125.60	103.21	46.93	114.37	3.03	-10.48	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	48.40	125.60	103.21	51.37	126.30	102.76	49.90	114.47	3.01	-8.52	19.27	19
18	51.37	126.30	102.76	54.35	127.00	102.42	52.87	114.62	2.99	-6.56	19.27	19
19	54.35	127.00	102.42	54.96	127.00	102.36	54.66	114.69	0.61	-5.39	19.27	19
20	54.96	127.00	102.36	56.50	127.00	102.23	55.73	114.65	1.55	-4.69	19.27	19
21	56.50	127.00	102.23	57.12	127.00	102.19	56.81	114.61	0.62	-3.98	19.27	19
22	57.12	127.00	102.19	57.48	127.00	102.17	57.30	114.59	0.36	-3.66	19.27	19
23	57.48	127.00	102.17	59.00	127.00	102.09	58.24	114.56	1.52	-3.05	19.27	19
24	59.00	127.00	102.09	61.09	127.49	102.02	60.05	114.65	2.09	-1.87	19.27	19
25	61.09	127.49	102.02	63.97	128.17	102.01	62.54	114.92	2.88	-0.25	19.27	19
26	63.97	128.17	102.01	66.85	128.85	102.09	65.42	115.28	2.88	1.62	19.27	19
27	66.85	128.85	102.09	67.19	128.93	102.10	67.02	115.49	0.34	2.67	19.27	19
28	67.19	128.93	102.10	70.05	129.60	102.29	68.62	115.73	2.87	3.71	19.27	19
29	70.05	129.60	102.29	71.93	130.04	102.46	70.99	116.10	1.89	5.26	19.27	19
30	71.93	130.04	102.46	73.81	130.49	102.68	72.87	116.42	1.89	6.49	19.27	19
31	73.81	130.49	102.68	75.47	130.88	102.90	74.64	116.73	1.67	7.65	19.27	19
32	75.47	130.88	102.90	77.12	131.27	103.15	76.29	117.05	1.67	8.74	19.27	19
33	77.12	131.27	103.15	79.13	131.74	103.51	78.13	117.42	2.04	9.95	19.27	19
34	79.13	131.74	103.51	81.14	132.21	103.91	80.14	117.84	2.05	11.28	19.27	19
35	81.14	132.21	103.91	83.01	132.65	104.32	82.08	118.27	1.92	12.57	19.27	19
36	83.01	132.65	104.32	84.88	133.09	104.78	83.94	118.71	1.93	13.82	19.27	19
37	84.88	133.09	104.78	86.77	133.54	105.29	85.83	119.18	1.96	15.09	19.27	19
38	86.77	133.54	105.29	88.67	133.98	105.85	87.72	119.67	1.98	16.37	19.27	19
39	88.67	133.98	105.85	90.82	134.49	106.54	89.74	120.21	2.26	17.75	19.27	19
40	90.82	134.49	106.54	93.00	135.00	107.30	91.91	120.83	2.31	19.24	19.27	19
41	93.00	135.00	107.30	94.42	135.00	107.83	93.71	121.28	1.52	20.48	19.27	19
42	94.42	135.00	107.83	96.03	135.00	108.47	95.22	121.57	1.73	21.54	19.27	19
43	96.03	135.00	108.47	97.64	135.00	109.14	96.83	121.90	1.74	22.67	19.27	19
44	97.64	135.00	109.14	98.52	135.21	109.52	98.08	122.22	0.96	23.55	19.27	19
45	98.52	135.21	109.52	100.42	135.65	110.39	99.46	122.69	2.08	24.54	19.27	19
46	100.42	135.65	110.39	102.31	136.10	111.31	101.36	123.36	2.11	25.90	19.27	19
47	102.31	136.10	111.31	104.05	136.51	112.20	103.17	124.03	1.95	27.23	19.27	19
48	104.05	136.51	112.20	105.78	136.92	113.14	104.91	124.69	1.97	28.50	19.27	19
49	105.78	136.92	113.14	107.69	137.37	114.24	106.73	125.41	2.20	29.86	19.27	19
50	107.69	137.37	114.24	109.69	137.84	115.46	108.68	126.22	2.34	31.34	19.27	19
51	109.69	137.84	115.46	112.20	138.43	117.10	110.94	127.20	3.00	33.08	19.27	19
52	112.20	138.43	117.10	114.72	139.02	118.86	113.45	128.35	3.07	35.06	19.27	19
53	114.72	139.02	118.86	115.97	139.32	119.79	115.34	129.24	1.56	36.57	19.27	19
54	115.97	139.32	119.79	118.14	139.83	121.48	117.04	130.10	2.75	37.97	19.14	18
55	118.14	139.83	121.48	118.86	140.00	122.07	118.50	130.84	0.93	39.17	19.10	18
56	118.86	140.00	122.07	120.60	140.41	123.54	119.72	131.50	2.28	40.21	19.10	18
57	120.60	140.41	123.54	122.34	140.82	125.09	121.46	132.46	2.33	41.71	19.10	18
58	122.34	140.82	125.09	124.57	141.34	127.20	123.44	133.60	3.07	43.47	19.10	18
59	124.57	141.34	127.20	125.56	141.57	128.19	125.06	134.57	1.40	44.93	19.35	18
60	125.56	141.57	128.19	125.61	141.58	128.24	125.58	134.90	0.07	45.41	19.78	18
61	125.61	141.58	128.24	126.52	141.80	129.18	126.06	135.20	1.31	45.85	19.78	18
62	126.52	141.80	129.18	129.31	142.45	132.24	127.87	136.39	4.14	47.63	19.78	18
63	129.31	142.45	132.24	132.10	143.11	135.61	130.63	138.30	4.38	50.40	19.78	18
64	132.10	143.11	135.61	132.91	143.30	136.66	132.50	139.66	1.32	52.26	19.78	18
65	132.91	143.30	136.66	135.28	143.30	139.92	133.97	140.71	4.03	54.00	19.78	18
66	135.28	143.30	139.92	137.51	143.30	143.30	136.02	142.17	4.05	56.63	18.04	19

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	5671	0	7298	4611	2672	0	9408	0	0	
2	187	0	175	87	104	9408	9633	0	0	
3	10194	0	9279	3873	5236	9633	20669	0	0	
4	15582	0	13655	4659	7325	20669	35469	0	0	
5	13233	0	11346	3502	5937	35469	47124	0	0	
6	22303	0	18813	5430	9653	47124	65629	0	0	
7	26585	0	22059	6014	11122	65629	86374	0	0	
8	33231	0	26837	7071	13801	86374	110810	0	0	
9	65250	0	51277	12986	26557	110810	155187	0	0	
10	77942	0	60187	14593	30342	155187	203492	0	0	
11	89824	0	68294	16057	33652	203492	254310	0	0	
12	101078	0	75871	17428	36539	254310	306492	0	0	
13	111590	0	82840	18691	39043	306492	358955	0	0	
14	121253	0	89130	19833	41196	358955	410684	0	0	
15	130202	0	94931	20889	43026	410684	460844	0	0	
16	138481	0	100323	21872	44555	460844	508709	0	0	
17	146082	0	105323	22787	45801	508709	553628	0	0	
18	153009	0	109962	23638	46776	553628	595027	0	0	
19	32002	0	22915	4914	9693	595027	602982	0	0	
20	81142	0	61186	13026	21296	602982	622704	0	0	
21	32918	0	25121	5335	8248	622704	630342	0	0	
22	19142	0	13832	2957	5539	630342	634530	0	0	
23	80963	0	57125	12245	24605	634530	651104	0	0	
24	112635	0	78334	16795	34911	651104	671589	0	0	
25	158815	0	108648	23273	50272	671589	695566	0	0	
26	162691	0	109857	23499	52234	695566	714469	0	0	
27	19420	0	13041	2788	6269	714469	716354	0	0	
28	164901	0	110050	23520	53671	716354	729219	0	0	
29	109800	0	72671	15526	36163	729219	734698	0	0	
30	110713	0	72864	15567	36793	734698	737766	0	0	
31	98089	0	64214	13721	32912	737766	738431	0	0	
32	98526	0	64255	13733	33317	738431	737177	0	0	
33	120061	0	77974	16675	40995	737177	733044	0	0	
34	120309	0	77887	16668	41468	733044	726040	0	0	
35	111991	0	72051	15440	39248	726040	716881	0	0	
36	111903	0	71955	15432	39489	716881	705239	0	0	
37	113128	0	72191	15515	40794	705239	690805	0	0	
38	112671	0	72087	15508	40789	690805	673869	0	0	
39	127035	0	81069	17479	46721	673869	651558	0	0	
40	127602	0	81908	17689	47067	651558	625767	0	0	
41	81826	0	52694	11412	30391	625767	607386	0	0	
42	90758	0	58279	12678	34288	607386	585196	0	0	
43	88498	0	56853	12426	33864	585196	561698	0	0	
44	47550	0	30631	6716	18313	561698	548299	0	0	
45	101050	0	65555	14403	38953	548299	517995	0	0	
46	98992	0	64978	14320	38117	517995	485836	0	0	
47	88573	0	58832	13011	34083	485836	454897	0	0	
48	86401	0	58116	12902	33196	454897	422659	0	0	
49	92422	0	63421	14130	35040	422659	385885	0	0	
50	93494	0	65248	14616	35320	385885	346057	0	0	
51	112432	0	80681	18184	41658	346057	294514	0	0	
52	105882	0	77439	17653	39526	294514	241775	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
53	49999	0	37524	8625	18331	241775	215425	0	0	
54	82306	0	62977	14363	30219	215425	169410	0	0	
55	26019	0	20192	4620	9605	169410	154172	0	0	
56	60032	0	47453	10948	21901	154172	117756	0	0	
57	55882	0	44995	10545	20466	117756	82069	0	0	
58	65062	0	53902	12901	23521	82069	38164	0	0	
59	26416	0	22292	5541	9493	38164	19640	0	0	
60	1295	0	1112	285	444	19640	18732	0	0	
61	22914	0	19810	5109	7825	18732	2459	0	0	
62	61985	0	54735	14646	21183	2459	-43758	0	0	
63	48456	0	46536	13311	13394	-43758	-81450	0	0	
64	11324	0	11703	3570	2184	-81450	-90246	0	0	
65	23681	6162	35723	10891	59	-90246	-112794	0	0	
66	7676	5788	14332	6682	0	-112794	-121088	0	0	

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

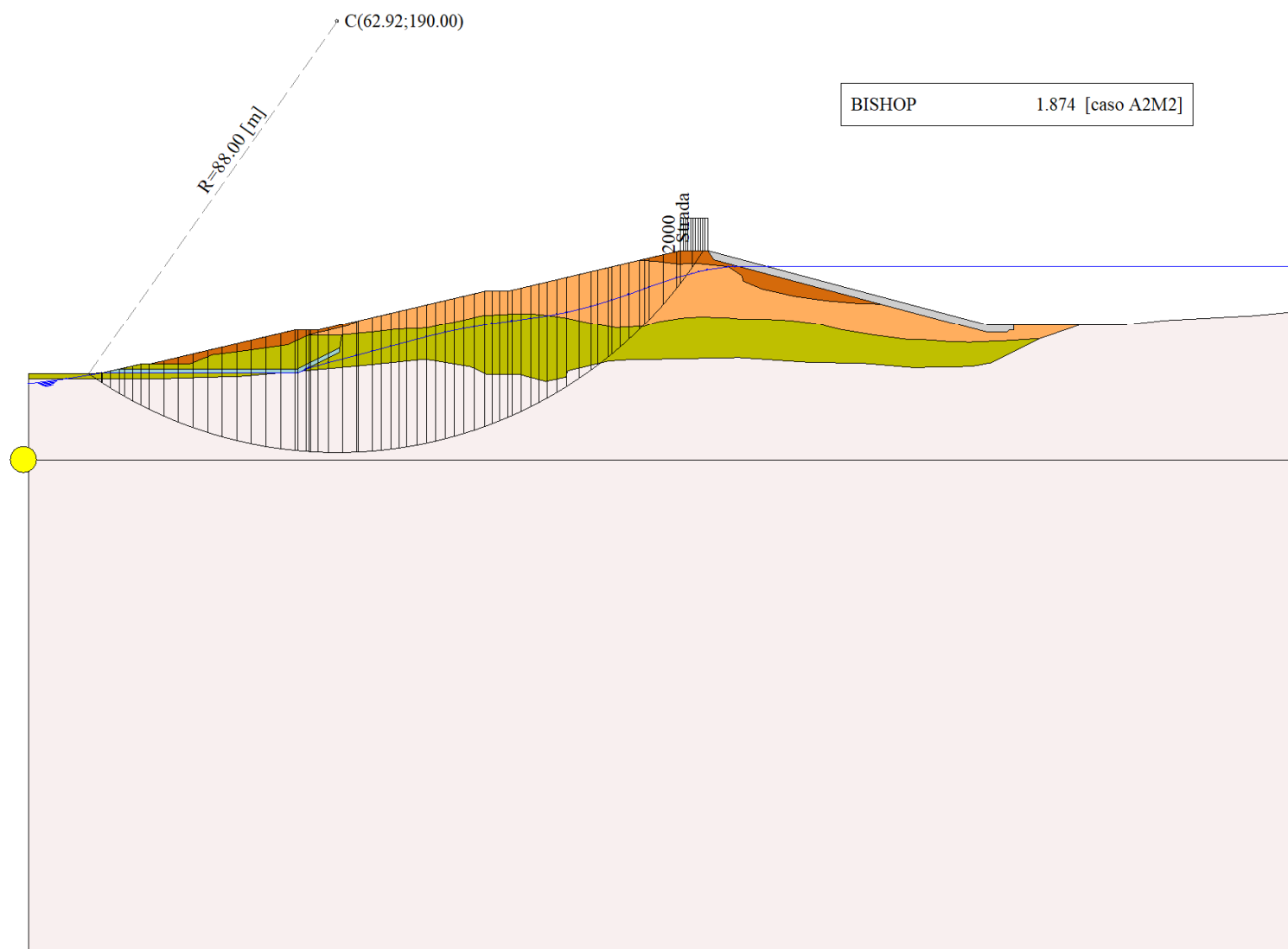


Figura 11-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 07.

## 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	132.91 143.30	138.41 143.30	2000 2000	0 0
2	Azione inerziale acqua 1/4	Variabile	1.00	184.54 131.00	195.79 131.00	743 780	-198 -208
3	Azione inerziale acqua 2/4	Variabile	1.00	173.29 134.00	184.54 134.00	630 743	-168 -198
4	Azione inerziale acqua 3/4	Variabile	1.00	162.04 137.00	173.29 137.00	429 630	-114 -168
5	Azione inerziale acqua 4/4	Variabile	1.00	150.79 140.00	162.04 140.00	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	107016
Coefficiente di sicurezza minimo	0.644
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]= 96.92	Y[m]= 206.00
Raggio del cerchio	R[m]= 86.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 61.56	Y <sub>v</sub> [m]= 127.60
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 151.75	Y <sub>m</sub> [m]= 139.74
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.644</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	61.56	127.60	127.60	62.70	127.87	127.10	62.32	127.53	1.24	-23.86	0.00	53
2	62.70	127.87	127.10	63.84	128.14	126.62	63.33	127.43	1.24	-23.03	0.00	54
3	63.84	128.14	126.62	65.52	128.54	125.94	64.75	127.30	1.81	-22.02	0.00	54
4	65.52	128.54	125.94	67.19	128.93	125.30	66.40	127.17	1.79	-20.82	0.00	52
5	67.19	128.93	125.30	69.40	129.45	124.52	68.35	127.05	2.34	-19.44	0.00	52
6	69.40	129.45	124.52	71.60	129.97	123.81	70.54	126.94	2.32	-17.89	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	71.60	129.97	123.81	73.81	130.49	123.16	72.74	126.86	2.30	-16.35	0.00	52
8	73.81	130.49	123.16	75.47	130.88	122.72	74.65	126.81	1.71	-15.02	0.00	52
9	75.47	130.88	122.72	77.12	131.27	122.31	76.31	126.79	1.70	-13.88	0.00	52
10	77.12	131.27	122.31	78.97	131.70	121.89	78.06	126.79	1.90	-12.68	0.00	52
11	78.97	131.70	121.89	80.82	132.14	121.52	79.91	126.81	1.89	-11.42	0.00	52
12	80.82	132.14	121.52	81.14	132.21	121.46	80.98	126.83	0.33	-10.68	0.00	52
13	81.14	132.21	121.46	83.01	132.65	121.13	82.09	126.86	1.90	-9.94	0.00	52
14	83.01	132.65	121.13	84.88	133.09	120.85	83.95	126.93	1.89	-8.68	0.00	52
15	84.88	133.09	120.85	86.77	133.54	120.60	85.84	127.02	1.91	-7.41	0.00	52
16	86.77	133.54	120.60	88.67	133.98	120.40	87.73	127.13	1.91	-6.14	0.00	52
17	88.67	133.98	120.40	90.10	134.32	120.27	89.39	127.24	1.44	-5.03	0.00	52
18	90.10	134.32	120.27	90.82	134.49	120.22	90.46	127.32	0.72	-4.31	0.00	52
19	90.82	134.49	120.22	93.00	135.00	120.09	91.92	127.45	2.18	-3.34	0.00	52
20	93.00	135.00	120.09	94.42	135.00	120.04	93.71	127.53	1.42	-2.14	0.00	52
21	94.42	135.00	120.04	96.03	135.00	120.00	95.23	127.51	1.61	-1.13	0.00	52
22	96.03	135.00	120.00	97.64	135.00	120.00	96.84	127.50	1.61	-0.06	0.00	52
23	97.64	135.00	120.00	98.52	135.21	120.01	98.08	127.56	0.88	0.77	0.00	52
24	98.52	135.21	120.01	100.42	135.65	120.07	99.47	127.74	1.90	1.70	0.00	52
25	100.42	135.65	120.07	102.31	136.10	120.17	101.37	128.00	1.90	2.96	0.00	52
26	102.31	136.10	120.17	104.05	136.51	120.30	103.18	128.27	1.74	4.17	0.00	52
27	104.05	136.51	120.30	105.78	136.92	120.46	104.91	128.54	1.74	5.33	0.00	52
28	105.78	136.92	120.46	107.69	137.37	120.68	106.74	128.85	1.92	6.55	0.00	52
29	107.69	137.37	120.68	109.69	137.84	120.95	108.69	129.21	2.02	7.87	0.00	52
30	109.69	137.84	120.95	111.37	138.23	121.22	110.53	129.56	1.70	9.10	0.00	52
31	111.37	138.23	121.22	113.04	138.63	121.52	112.21	129.90	1.70	10.24	0.00	52
32	113.04	138.63	121.52	114.72	139.02	121.86	113.88	130.26	1.71	11.38	0.00	52
33	114.72	139.02	121.86	115.97	139.32	122.14	115.35	130.58	1.28	12.37	0.00	52
34	115.97	139.32	122.14	117.42	139.66	122.48	116.69	130.90	1.48	13.29	0.00	52
35	117.42	139.66	122.48	118.86	140.00	122.85	118.14	131.24	1.49	14.28	0.00	52
36	118.86	140.00	122.85	120.60	140.41	123.32	119.73	131.64	1.80	15.38	0.00	52
37	120.60	140.41	123.32	122.34	140.82	123.84	121.47	132.10	1.82	16.59	0.00	52
38	122.34	140.82	123.84	124.57	141.34	124.57	123.45	132.64	2.34	17.97	0.00	52
39	124.57	141.34	124.57	125.56	141.57	124.91	125.06	133.10	1.05	19.10	0.00	52
40	125.56	141.57	124.91	126.52	141.80	125.25	126.04	133.38	1.02	19.79	0.00	52
41	126.52	141.80	125.25	128.38	142.24	125.96	127.45	133.81	1.99	20.79	0.00	52
42	128.38	142.24	125.96	130.24	142.67	126.72	129.31	134.40	2.01	22.13	0.00	52
43	130.24	142.67	126.72	132.10	143.11	127.52	131.17	135.00	2.03	23.47	0.00	52
44	132.10	143.11	127.52	132.91	143.30	127.89	132.50	135.46	0.89	24.44	0.00	52
45	132.91	143.30	127.89	134.09	143.30	128.45	133.50	135.73	1.31	25.18	0.00	52
46	134.09	143.30	128.45	135.28	143.30	129.03	134.68	136.02	1.32	26.05	0.00	52
47	135.28	143.30	129.03	136.66	143.30	129.73	135.96	136.34	1.55	27.01	0.00	52
48	136.66	143.30	129.73	137.16	143.30	130.00	136.91	136.58	0.56	27.71	0.00	54
49	137.16	143.30	130.00	138.35	143.30	130.64	137.75	136.81	1.35	28.35	0.00	54
50	138.35	143.30	130.64	138.41	143.30	130.67	138.38	136.98	0.07	28.82	0.00	54
51	138.41	143.30	130.67	140.50	142.74	131.86	139.43	137.14	2.41	29.65	0.00	54
52	140.50	142.74	131.86	142.60	142.18	133.13	141.52	137.47	2.45	31.27	0.00	54
53	142.60	142.18	133.13	143.49	141.95	133.70	143.04	137.74	1.05	32.44	0.00	54
54	143.49	141.95	133.70	143.99	141.81	134.02	143.74	137.87	0.60	32.99	0.00	54
55	143.99	141.81	134.02	145.69	141.36	135.17	144.81	138.08	2.05	33.87	0.00	54
56	145.69	141.36	135.17	147.39	140.91	136.37	146.50	138.44	2.08	35.24	0.00	54
57	147.39	140.91	136.37	149.09	140.45	137.63	148.17	138.82	2.12	36.64	0.00	53
58	149.09	140.45	137.63	150.79	140.00	138.96	149.81	139.23	2.16	38.07	6.51	38
59	150.79	140.00	138.96	151.75	139.74	139.74	151.11	139.57	1.24	39.20	22.44	0

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	893	0	5731	10503	0	0	11723	0	0	
2	2593	0	7651	10625	0	11723	23914	0	0	
3	6779	0	14347	15366	0	23914	42018	0	0	
4	10310	0	17891	14787	0	42018	59886	0	0	
5	18847	0	29045	19310	0	59886	83537	0	0	
6	24620	0	34949	19134	0	83537	106962	0	0	
7	30099	0	40454	18976	0	106962	129812	0	0	
8	25998	0	33729	14139	0	129812	146378	0	0	
9	28763	0	36426	14067	0	146378	162322	0	0	
10	35259	0	43713	15647	0	162322	179275	0	0	
11	38381	0	46692	15573	0	179275	195177	0	0	
12	6946	0	8368	2687	0	195177	197811	0	0	
13	42360	0	50573	15665	0	197811	212473	0	0	
14	45295	0	53339	15609	0	212473	225794	0	0	
15	48724	0	56695	15768	0	225794	237818	0	0	
16	51396	0	59180	15727	0	237818	248259	0	0	
17	40459	0	46211	11845	0	248259	255035	0	0	
18	20891	0	23748	5958	0	255035	258075	0	0	
19	65235	0	73724	18019	0	258075	265731	0	0	
20	43519	0	48870	11725	0	265731	269513	0	0	
21	49508	0	55332	13287	0	269513	272787	0	0	
22	49589	0	55162	13285	0	272787	275007	0	0	
23	27281	0	30245	7262	0	275007	275743	0	0	
24	59833	0	66107	15643	0	275743	276004	0	0	
25	61174	0	67314	15657	0	276004	274445	0	0	
26	56999	0	62511	14354	0	274445	271432	0	0	
27	57798	0	63216	14379	0	271432	266912	0	0	
28	64374	0	70240	15864	0	266912	260220	0	0	
29	68045	0	74091	16660	0	260220	251324	0	0	
30	57388	0	62392	14011	0	251324	242417	0	0	
31	57551	0	62500	14059	0	242417	232238	0	0	
32	57592	0	62493	14112	0	232238	220833	0	0	
33	42901	0	46530	10560	0	220833	211558	0	0	
34	49485	0	53654	12252	0	211558	200049	0	0	
35	49294	0	53437	12304	0	200049	187734	0	0	
36	59000	0	63956	14891	0	187734	171898	0	0	
37	58566	0	63498	14981	0	171898	154995	0	0	
38	74201	0	80478	19345	0	154995	131924	0	0	
39	32586	0	35358	8645	0	131924	121214	0	0	
40	31389	0	34070	8419	0	121214	110560	0	0	
41	60187	0	65364	16417	0	110560	89206	0	0	
42	59157	0	64284	16568	0	89206	67075	0	0	
43	57897	0	62931	16732	0	67075	44376	0	0	
44	24772	0	26924	7342	0	44376	34364	0	0	
45	35332	2370	41251	10804	0	34364	18140	0	0	
46	33922	2370	39605	10884	0	18140	2386	0	0	
47	37658	2760	43923	12809	0	2386	-15210	0	0	
48	13154	1000	15231	4852	0	-15210	-21171	0	0	
49	30272	2380	34994	11616	0	-21171	-34887	0	0	
50	1488	120	1717	588	0	-34887	-35560	0	0	
51	48180	0	49867	20708	0	-35560	-53034	0	0	
52	40793	0	40290	21055	0	-53034	-65096	0	0	
53	15066	0	14095	9059	0	-65096	-68389	0	0	
54	7869	0	7109	5121	0	-68389	-69729	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]	
55	22961	0	18949	17588	0	-69729	-70833	0	0	
56	17977	0	11850	17876	0	-70833	-67101	0	0	
57	12443	0	4066	17721	0	-67101	-58099	0	0	
58	6515	0	-735	12690	0	-58099	-49006	0	0	
59	993	142	1057	678	0	-49006	-49298	0	0	

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

### 12.2.2 ANALISI DELLA SUPERFICIE 9 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	58	
Coordinate del centro	X[m]= 94.92	Y[m]= 204.00
Raggio del cerchio	R[m]= 84.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 60.53	Y <sub>v</sub> [m]= 127.36
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 149.67	Y <sub>m</sub> [m]= 140.30
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.646</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	60.53	127.36	127.36	62.19	127.75	126.64	61.64	127.25	1.80	-23.55	0.00	54
2	62.19	127.75	126.64	63.84	128.14	125.96	63.10	127.12	1.79	-22.33	0.00	54
3	63.84	128.14	125.96	65.52	128.54	125.31	64.73	126.98	1.80	-21.10	0.00	52
4	65.52	128.54	125.31	67.19	128.93	124.71	66.39	126.87	1.78	-19.88	0.00	52
5	67.19	128.93	124.71	69.40	129.45	123.97	68.34	126.76	2.33	-18.48	0.00	52
6	69.40	129.45	123.97	71.60	129.97	123.30	70.54	126.67	2.31	-16.90	0.00	52
7	71.60	129.97	123.30	73.81	130.49	122.70	72.74	126.61	2.29	-15.34	0.00	52
8	73.81	130.49	122.70	75.47	130.88	122.28	74.65	126.59	1.71	-13.97	0.00	52
9	75.47	130.88	122.28	77.12	131.27	121.91	76.30	126.58	1.70	-12.81	0.00	52
10	77.12	131.27	121.91	78.97	131.70	121.53	78.06	126.60	1.89	-11.59	0.00	52
11	78.97	131.70	121.53	80.82	132.14	121.19	79.91	126.64	1.88	-10.30	0.00	52
12	80.82	132.14	121.19	81.14	132.21	121.14	80.98	126.67	0.32	-9.55	0.00	52
13	81.14	132.21	121.14	83.01	132.65	120.85	82.08	126.71	1.89	-8.80	0.00	52
14	83.01	132.65	120.85	84.88	133.09	120.60	83.95	126.80	1.89	-7.51	0.00	52
15	84.88	133.09	120.60	86.77	133.54	120.40	85.84	126.91	1.91	-6.21	0.00	52
16	86.77	133.54	120.40	88.67	133.98	120.23	87.73	127.04	1.90	-4.92	0.00	52
17	88.67	133.98	120.23	90.10	134.32	120.14	89.39	127.17	1.43	-3.78	0.00	52
18	90.10	134.32	120.14	90.82	134.49	120.10	90.46	127.26	0.72	-3.04	0.00	52
19	90.82	134.49	120.10	93.00	135.00	120.02	91.92	127.40	2.18	-2.05	0.00	52
20	93.00	135.00	120.02	94.42	135.00	120.00	93.71	127.51	1.42	-0.83	0.00	52
21	94.42	135.00	120.00	96.03	135.00	120.01	95.22	127.50	1.61	0.21	0.00	52
22	96.03	135.00	120.01	97.64	135.00	120.04	96.83	127.51	1.61	1.31	0.00	52
23	97.64	135.00	120.04	98.52	135.21	120.08	98.08	127.58	0.88	2.16	0.00	52
24	98.52	135.21	120.08	100.42	135.65	120.18	99.47	127.78	1.90	3.10	0.00	52
25	100.42	135.65	120.18	102.31	136.10	120.33	101.37	128.07	1.90	4.40	0.00	52
26	102.31	136.10	120.33	104.05	136.51	120.50	103.18	128.36	1.74	5.64	0.00	52
27	104.05	136.51	120.50	105.78	136.92	120.70	104.91	128.66	1.75	6.83	0.00	52
28	105.78	136.92	120.70	107.69	137.37	120.98	106.74	128.99	1.93	8.09	0.00	52
29	107.69	137.37	120.98	109.69	137.84	121.31	108.69	129.37	2.03	9.44	0.00	52
30	109.69	137.84	121.31	111.37	138.23	121.63	110.53	129.75	1.71	10.71	0.00	52
31	111.37	138.23	121.63	113.04	138.63	121.98	112.21	130.12	1.71	11.88	0.00	52
32	113.04	138.63	121.98	114.72	139.02	122.37	113.88	130.50	1.72	13.05	0.00	52
33	114.72	139.02	122.37	115.97	139.32	122.68	115.34	130.85	1.29	14.07	0.00	52
34	115.97	139.32	122.68	117.42	139.66	123.07	116.69	131.18	1.50	15.02	0.00	52
35	117.42	139.66	123.07	118.86	140.00	123.48	118.14	131.55	1.50	16.05	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]
36	118.86	140.00	123.48	120.60	140.41	124.02	119.73	131.98	1.82	17.18	0.00	52
37	120.60	140.41	124.02	122.34	140.82	124.60	121.47	132.46	1.83	18.43	0.00	52
38	122.34	140.82	124.60	123.45	141.08	125.00	122.90	132.87	1.18	19.46	0.00	52
39	123.45	141.08	125.00	124.57	141.34	125.41	124.01	133.20	1.19	20.26	0.00	52
40	124.57	141.34	125.41	125.56	141.57	125.79	125.06	133.53	1.06	21.03	0.00	52
41	125.56	141.57	125.79	126.52	141.80	126.17	126.04	133.83	1.03	21.75	0.00	52
42	126.52	141.80	126.17	128.38	142.24	126.95	127.45	134.29	2.02	22.79	0.00	52
43	128.38	142.24	126.95	130.24	142.67	127.79	129.31	134.91	2.04	24.17	0.00	52
44	130.24	142.67	127.79	132.10	143.11	128.68	131.17	135.56	2.06	25.57	0.00	52
45	132.10	143.11	128.68	132.15	143.12	128.70	132.12	135.90	0.06	26.29	0.00	52
46	132.15	143.12	128.70	132.91	143.30	129.08	132.53	136.05	0.85	26.60	0.00	52
47	132.91	143.30	129.08	133.98	143.30	129.63	133.44	136.33	1.20	27.30	0.00	52
48	133.98	143.30	129.63	135.28	143.30	130.33	134.62	136.64	1.48	28.21	0.00	54
49	135.28	143.30	130.33	136.66	143.30	131.10	135.96	137.01	1.58	29.26	0.00	54
50	136.66	143.30	131.10	138.35	143.30	132.10	137.49	137.45	1.96	30.46	0.00	54
51	138.35	143.30	132.10	138.41	143.30	132.13	138.38	137.71	0.07	31.16	0.00	54
52	138.41	143.30	132.13	140.50	142.74	133.45	139.43	137.90	2.47	32.02	0.00	54
53	140.50	142.74	133.45	142.60	142.18	134.84	141.51	138.29	2.52	33.73	0.00	54
54	142.60	142.18	134.84	143.49	141.95	135.47	143.04	138.61	1.09	34.95	0.00	54
55	143.49	141.95	135.47	143.99	141.81	135.82	143.74	138.76	0.61	35.53	0.00	54
56	143.99	141.81	135.82	145.59	141.39	137.00	144.75	139.00	1.99	36.42	0.00	54
57	145.59	141.39	137.00	147.63	140.84	138.60	146.50	139.43	2.59	37.98	0.00	53
58	147.63	140.84	138.60	149.67	140.30	140.30	148.31	139.91	2.66	39.77	15.54	16

Tabella 12-4 – Geometria e caratteristiche strisce della superficie 9 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	1850	0	8895	15260	0	0	17129	0	0	
2	5359	0	12721	15289	0	17129	34902	0	0	
3	8972	0	16396	14773	0	34902	52576	0	0	
4	12461	0	20037	14656	0	52576	70379	0	0	
5	21511	0	31623	19145	0	70379	93738	0	0	
6	27090	0	37254	18977	0	93738	116652	0	0	
7	32373	0	42495	18828	0	116652	138788	0	0	
8	27574	0	35092	14033	0	138788	154697	0	0	
9	30225	0	37649	13966	0	154697	169886	0	0	
10	36759	0	44918	15539	0	169886	185890	0	0	
11	39736	0	47729	15472	0	185890	200740	0	0	
12	7165	0	8530	2670	0	200740	203182	0	0	
13	43555	0	51425	15570	0	203182	216667	0	0	
14	46337	0	54024	15520	0	216667	228722	0	0	
15	49622	0	57220	15685	0	228722	239382	0	0	
16	52133	0	59538	15650	0	239382	248386	0	0	
17	40906	0	46370	11792	0	248386	254035	0	0	
18	21080	0	23792	5933	0	254035	256496	0	0	
19	65658	0	73710	17949	0	256496	262352	0	0	
20	43672	0	48742	11685	0	262352	264946	0	0	
21	49563	0	55072	13248	0	264946	266880	0	0	
22	49514	0	54778	13251	0	266880	267776	0	0	
23	27185	0	29982	7246	0	267776	267793	0	0	
24	59491	0	65412	15616	0	267793	266504	0	0	
25	60643	0	66439	15639	0	266504	263402	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
26	56344	0	61549	14346	0	263402	258993	0	0	
27	56977	0	62096	14378	0	258993	253105	0	0	
28	63273	0	68818	15874	0	253105	244953	0	0	
29	66664	0	72383	16682	0	244953	234595	0	0	
30	56046	0	60780	14041	0	234595	224529	0	0	
31	56035	0	60716	14098	0	224529	213265	0	0	
32	55898	0	60531	14162	0	213265	200863	0	0	
33	41519	0	44945	10604	0	200863	190909	0	0	
34	47757	0	51687	12311	0	190909	178692	0	0	
35	47422	0	51319	12372	0	178692	165763	0	0	
36	56550	0	61194	14986	0	165763	149325	0	0	
37	55895	0	60493	15091	0	149325	131987	0	0	
38	35414	0	38333	9730	0	131987	120453	0	0	
39	35046	0	37936	9780	0	120453	108630	0	0	
40	30792	0	33332	8727	0	108630	97909	0	0	
41	29572	0	32016	8504	0	97909	87316	0	0	
42	56447	0	61116	16600	0	87316	66293	0	0	
43	55116	0	59657	16775	0	66293	44813	0	0	
44	53541	0	57890	16966	0	44813	23128	0	0	
45	1416	0	1530	459	0	23128	22544	0	0	
46	21357	0	23061	6994	0	22544	13683	0	0	
47	29226	2140	34114	9961	0	13683	-144	0	0	
48	33890	2600	39272	12638	0	-144	-15756	0	0	
49	34017	2760	39290	13550	0	-15756	-31383	0	0	
50	38783	3380	44521	16796	0	-31383	-48932	0	0	
51	1318	120	1505	601	0	-48932	-49519	0	0	
52	42001	0	41855	21168	0	-49519	-63185	0	0	
53	34119	0	31217	21578	0	-63185	-70221	0	0	
54	12073	0	9879	9302	0	-70221	-70964	0	0	
55	6144	0	4638	5264	0	-70964	-70754	0	0	
56	16006	0	9553	17034	0	-70754	-66308	0	0	
57	13233	0	1784	21628	0	-66308	-53327	0	0	
58	4369	0	482	7016	0	-53327	-49223	0	0	

Tabella 12-5 – Forze applicate sulle strisce [BISHOP] della superficie 9 della verifica di stabilità 08.

### 12.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u [m]
1	0.002073
2	0.000685
3	0.002093
4	0.002216
5	0.000223
6	0.000613
7	0.000102

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

Accelerazione sismica critica  $K_c = 0.098$   
 Spostamento massimo  $U_{max} = 0.002216$  [m]  
 Velocità massima  $V_{max} = 0.025066$  [m/s]

n°	u
	[m]
1	0.002275
2	0.000736
3	0.002233
4	0.002352
5	0.000285
6	0.000668
7	0.000130

Tabella 12-7 – Spostamenti della superficie 9 della verifica di stabilità 08.

Accelerazione sismica critica  $K_c = 0.096$   
Spostamento massimo  $U_{max} = 0.002352$  [m]  
Velocità massima  $V_{max} = 0.025734$  [m/s]

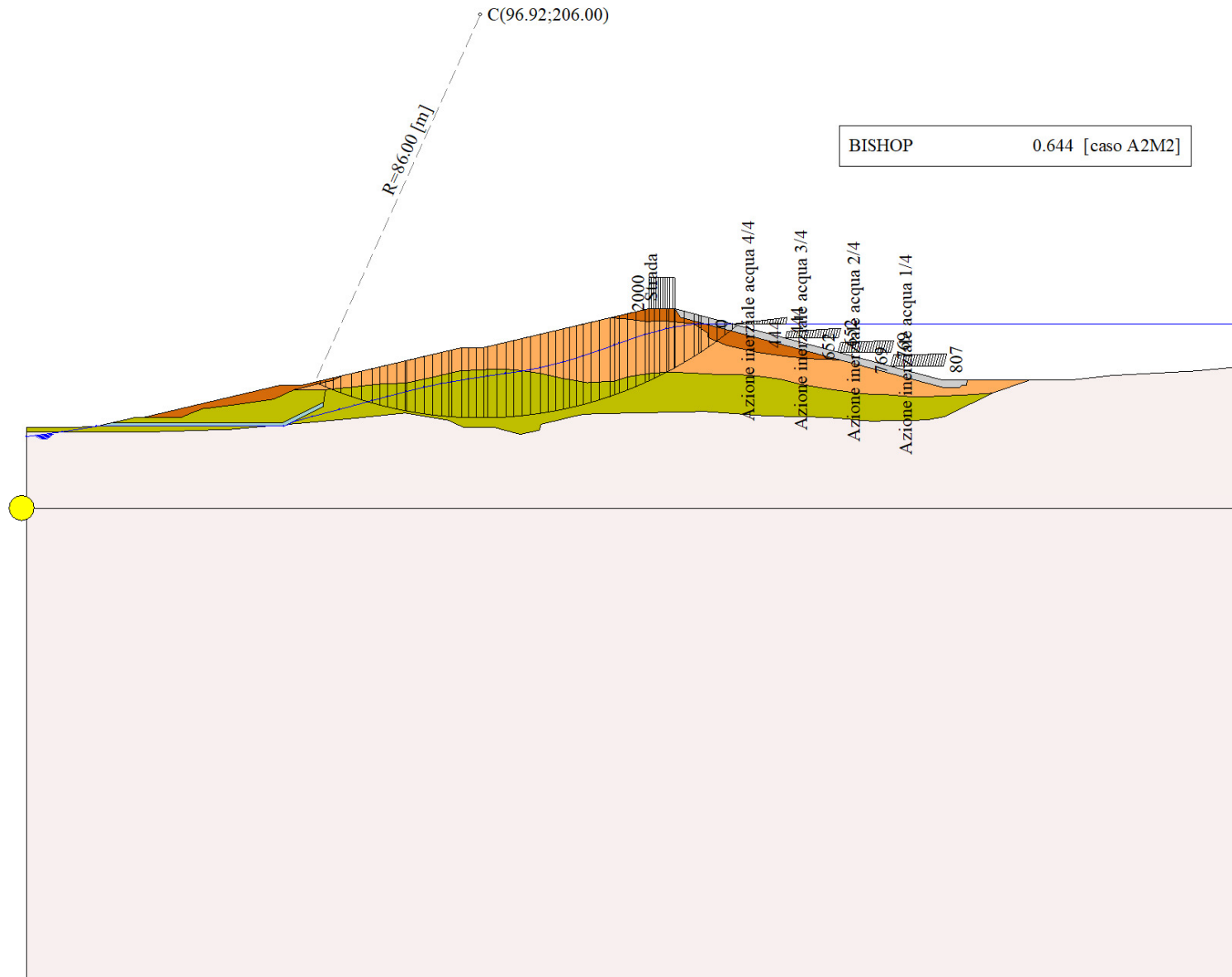


Figura 12-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 08.

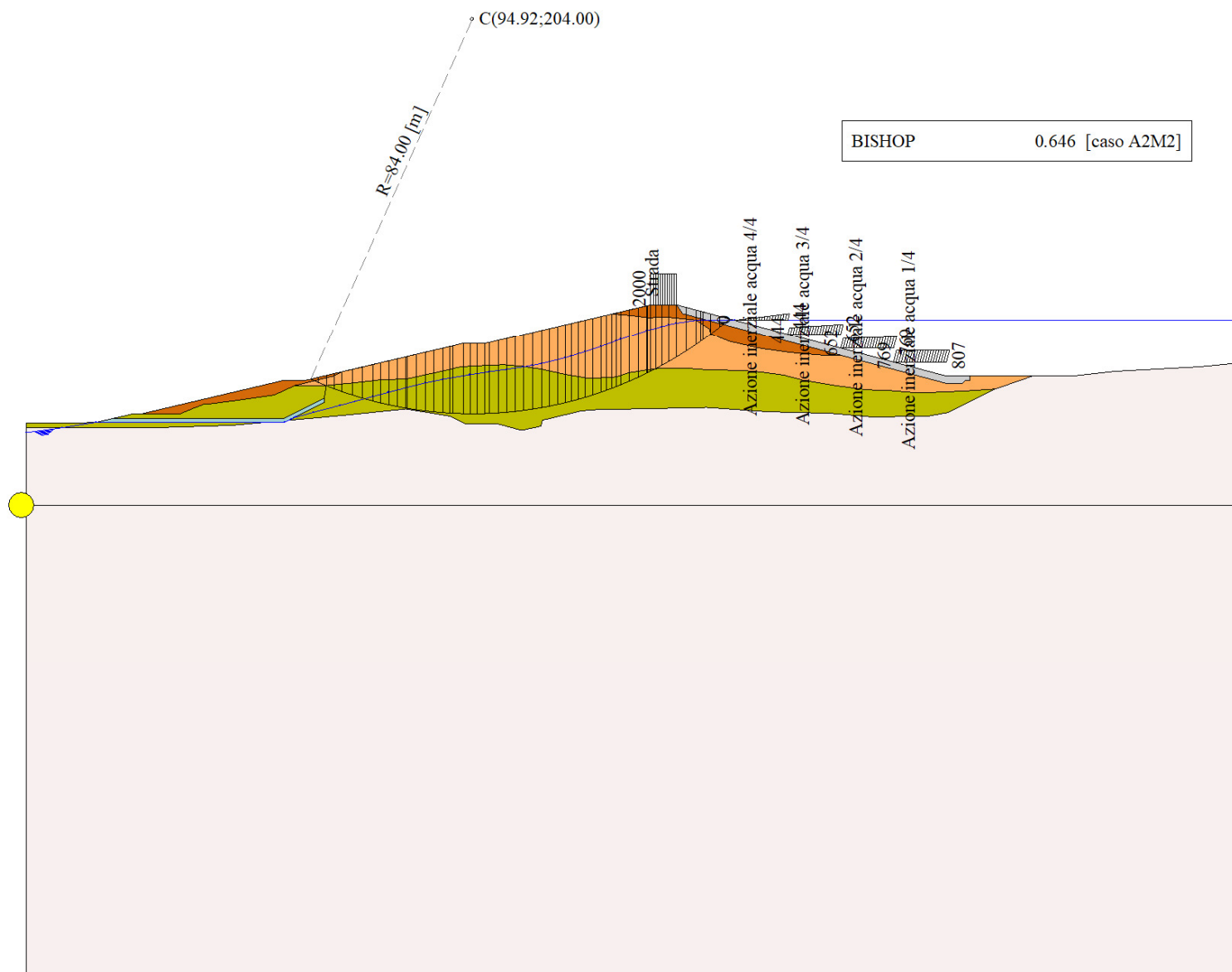


Figura 12-2 – Superficie critica (9) della sezione CR\_08 per la verifica di stabilità 08.

## 13 VERIFICA DI STABILITÀ 09

### 13.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{\alpha}_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	132.91 143.30	138.41 143.30	2000 2000	0 0
2	Azione inerziale acqua 1/4	Variabile	1.00	184.54 131.00	195.79 131.00	1095 1149	-292 -306
3	Azione inerziale acqua 2/4	Variabile	1.00	173.29 134.00	184.54 134.00	929 1095	-248 -292
4	Azione inerziale acqua 3/4	Variabile	1.00	162.04 137.00	173.29 137.00	631 929	-168 -248
5	Azione inerziale acqua 4/4	Variabile	1.00	150.79 140.00	162.04 140.00	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	107016
Coefficiente di sicurezza minimo	0.500
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]= 100.92	Y[m]= 208.00
Raggio del cerchio	R[m]= 88.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 63.92	Y <sub>v</sub> [m]= 128.16
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 155.28	Y <sub>m</sub> [m]= 138.80
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.500</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]	$\bar{\alpha}$ [°]	$\bar{\alpha}'$ [°]	c [kPa]
1	63.92	128.16	128.16	65.35	128.50	127.51	64.87	128.05	1.57	-24.35	0.00	54
2	65.35	128.50	127.51	67.19	128.93	126.72	66.39	127.90	2.00	-23.19	0.00	54
3	67.19	128.93	126.72	68.71	129.29	126.11	68.00	127.76	1.64	-22.00	0.00	53
4	68.71	129.29	126.11	70.23	129.64	125.53	69.50	127.64	1.63	-20.94	0.00	52
5	70.23	129.64	125.53	72.02	130.07	124.88	71.16	127.53	1.90	-19.79	0.00	52
6	72.02	130.07	124.88	73.81	130.49	124.28	72.94	127.43	1.89	-18.56	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	73.81	130.49	124.28	75.47	130.88	123.76	74.66	127.35	1.73	-17.38	0.00	52
8	75.47	130.88	123.76	77.12	131.27	123.28	76.31	127.30	1.72	-16.25	0.00	52
9	77.12	131.27	123.28	79.13	131.74	122.74	78.14	127.26	2.08	-15.01	0.00	52
10	79.13	131.74	122.74	81.14	132.21	122.25	80.15	127.24	2.07	-13.66	0.00	52
11	81.14	132.21	122.25	83.01	132.65	121.84	82.09	127.24	1.91	-12.37	0.00	52
12	83.01	132.65	121.84	84.88	133.09	121.47	83.96	127.26	1.91	-11.12	0.00	52
13	84.88	133.09	121.47	86.77	133.54	121.14	85.84	127.31	1.92	-9.88	0.00	52
14	86.77	133.54	121.14	88.67	133.98	120.86	87.73	127.38	1.92	-8.63	0.00	52
15	88.67	133.98	120.86	90.82	134.49	120.58	89.76	127.48	2.17	-7.30	0.00	52
16	90.82	134.49	120.58	93.00	135.00	120.36	91.92	127.61	2.19	-5.88	0.00	52
17	93.00	135.00	120.36	94.42	135.00	120.24	93.71	127.65	1.42	-4.70	0.00	52
18	94.42	135.00	120.24	96.03	135.00	120.14	95.23	127.59	1.61	-3.71	0.00	52
19	96.03	135.00	120.14	97.64	135.00	120.06	96.84	127.55	1.61	-2.66	0.00	52
20	97.64	135.00	120.06	98.52	135.21	120.03	98.08	127.58	0.88	-1.85	0.00	52
21	98.52	135.21	120.03	100.42	135.65	120.00	99.47	127.72	1.90	-0.95	0.00	52
22	100.42	135.65	120.00	102.31	136.10	120.01	101.37	127.94	1.90	0.29	0.00	52
23	102.31	136.10	120.01	104.05	136.51	120.06	103.18	128.17	1.74	1.47	0.00	52
24	104.05	136.51	120.06	105.78	136.92	120.13	104.92	128.40	1.74	2.60	0.00	52
25	105.78	136.92	120.13	107.69	137.37	120.26	106.74	128.67	1.91	3.79	0.00	52
26	107.69	137.37	120.26	109.69	137.84	120.44	108.69	128.98	2.01	5.07	0.00	52
27	109.69	137.84	120.44	111.37	138.23	120.62	110.53	129.28	1.69	6.27	0.00	52
28	111.37	138.23	120.62	113.04	138.63	120.84	112.21	129.58	1.69	7.37	0.00	52
29	113.04	138.63	120.84	114.72	139.02	121.09	113.88	129.89	1.70	8.47	0.00	52
30	114.72	139.02	121.09	115.97	139.32	121.30	115.35	130.18	1.27	9.43	0.00	52
31	115.97	139.32	121.30	118.14	139.83	121.70	117.06	130.54	2.21	10.57	0.00	52
32	118.14	139.83	121.70	118.86	140.00	121.85	118.50	130.84	0.73	11.52	0.00	52
33	118.86	140.00	121.85	120.60	140.41	122.23	119.73	131.12	1.78	12.34	0.00	52
34	120.60	140.41	122.23	122.34	140.82	122.65	121.47	131.52	1.79	13.51	0.00	52
35	122.34	140.82	122.65	124.57	141.34	123.24	123.45	132.01	2.31	14.84	0.00	52
36	124.57	141.34	123.24	125.56	141.57	123.52	125.06	132.42	1.03	15.93	0.00	52
37	125.56	141.57	123.52	126.52	141.80	123.81	126.04	132.67	1.00	16.59	0.00	52
38	126.52	141.80	123.81	128.38	142.24	124.39	127.45	133.06	1.95	17.55	0.00	52
39	128.38	142.24	124.39	130.24	142.67	125.03	129.31	133.58	1.97	18.82	0.00	52
40	130.24	142.67	125.03	132.10	143.11	125.71	131.17	134.13	1.98	20.11	0.00	52
41	132.10	143.11	125.71	132.91	143.30	126.02	132.50	134.53	0.87	21.03	0.00	52
42	132.91	143.30	126.02	134.09	143.30	126.49	133.50	134.78	1.28	21.73	0.00	52
43	134.09	143.30	126.49	135.28	143.30	126.99	134.68	135.02	1.28	22.57	0.00	52
44	135.28	143.30	126.99	136.66	143.30	127.58	135.97	135.29	1.50	23.47	0.00	52
45	136.66	143.30	127.58	138.35	143.30	128.36	137.50	135.63	1.86	24.57	0.00	52
46	138.35	143.30	128.36	138.41	143.30	128.39	138.38	135.84	0.07	25.19	0.00	52
47	138.41	143.30	128.39	140.31	142.79	129.31	139.35	135.95	2.12	25.90	0.00	52
48	140.31	142.79	129.31	142.22	142.28	130.29	141.25	136.17	2.14	27.29	0.00	54
49	142.22	142.28	130.29	142.60	142.18	130.50	142.41	136.31	0.43	28.13	0.00	54
50	142.60	142.18	130.50	143.49	141.95	130.98	143.04	136.40	1.01	28.60	0.00	54
51	143.49	141.95	130.98	143.99	141.81	131.26	143.74	136.50	0.57	29.12	0.00	54
52	143.99	141.81	131.26	145.85	141.32	132.34	144.90	136.68	2.15	30.00	0.00	54
53	145.85	141.32	132.34	147.72	140.82	133.47	146.75	136.98	2.18	31.42	0.00	54
54	147.72	140.82	133.47	149.58	140.32	134.68	148.61	137.32	2.22	32.85	0.00	54
55	149.58	140.32	134.68	150.79	140.00	135.49	150.16	137.62	1.46	34.05	0.00	54
56	150.79	140.00	135.49	153.04	139.40	137.09	151.79	137.97	2.76	35.42	0.00	53
57	153.04	139.40	137.09	155.28	138.80	138.80	153.79	138.43	2.82	37.23	15.12	17

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	1429	0	9614	17202	0	0	19164	0	0	
2	5743	0	16776	22168	0	19164	44250	0	0	
3	7952	0	17195	17821	0	44250	64588	0	0	
4	10931	0	20263	17312	0	64588	84387	0	0	
5	16591	0	27827	20236	0	84387	107369	0	0	
6	20466	0	31897	20085	0	107369	129800	0	0	
7	22230	0	32914	18447	0	129800	149892	0	0	
8	25252	0	35993	18337	0	149892	169228	0	0	
9	34535	0	47599	22136	0	169228	191530	0	0	
10	38580	0	51610	22003	0	191530	212357	0	0	
11	39400	0	51464	20364	0	212357	230253	0	0	
12	42659	0	54643	20272	0	230253	246593	0	0	
13	46384	0	58421	20461	0	246593	261448	0	0	
14	49390	0	61300	20388	0	261448	274483	0	0	
15	59466	0	72806	23057	0	274483	286954	0	0	
16	63781	0	77108	23312	0	286954	296968	0	0	
17	42812	0	51298	15156	0	296968	302133	0	0	
18	48939	0	58255	17162	0	302133	306862	0	0	
19	49267	0	58263	17144	0	306862	310417	0	0	
20	27211	0	32024	9366	0	310417	311822	0	0	
21	59937	0	70179	20160	0	311822	313337	0	0	
22	61629	0	71708	20158	0	313337	312775	0	0	
23	57728	0	66812	18462	0	312775	310445	0	0	
24	58829	0	67778	18475	0	310445	306391	0	0	
25	65864	0	75562	20362	0	306391	299956	0	0	
26	70009	0	80000	21358	0	299956	291039	0	0	
27	59360	0	67610	17942	0	291039	281882	0	0	
28	59824	0	67960	17984	0	281882	271238	0	0	
29	60172	0	68199	18032	0	271238	259149	0	0	
30	45028	0	50945	13479	0	259149	249219	0	0	
31	78347	0	88483	23481	0	249219	230195	0	0	
32	26020	0	29348	7816	0	230195	223395	0	0	
33	62840	0	70807	18947	0	223395	206008	0	0	
34	62771	0	70647	19035	0	206008	187281	0	0	
35	80137	0	90094	24539	0	187281	161455	0	0	
36	35424	0	39797	10951	0	161455	149364	0	0	
37	34262	0	38480	10655	0	149364	137273	0	0	
38	66101	0	74217	20751	0	137273	112845	0	0	
39	65543	0	73559	20903	0	112845	87245	0	0	
40	64771	0	72655	21069	0	87245	60656	0	0	
41	27922	0	31307	9231	0	60656	48811	0	0	
42	40117	2370	47884	13570	0	48811	29651	0	0	
43	38922	2370	46429	13650	0	29651	10799	0	0	
44	43758	2760	52142	16004	0	10799	-10658	0	0	
45	51169	3380	60849	19766	0	-10658	-36001	0	0	
46	1766	120	2097	705	0	-36001	-36878	0	0	
47	53098	0	57839	22527	0	-36878	-59424	0	0	
48	47346	0	49978	23448	0	-59424	-77144	0	0	
49	8773	0	9040	4772	0	-77144	-80096	0	0	
50	19681	0	19998	11226	0	-80096	-86315	0	0	
51	10523	0	10504	6338	0	-86315	-89365	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	35204	0	33607	23828	0	-89365	-97165	0	0	
53	29821	0	25948	24180	0	-97165	-99906	0	0	
54	24049	0	17496	24562	0	-99906	-96706	0	0	
55	12398	0	6596	16041	0	-96706	-91042	0	0	
56	15491	739	1925	29732	0	-91042	-73081	0	0	
57	5196	2211	2038	11029	0	-73081	-67677	0	0	

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

### 13.2.2 ANALISI DELLA SUPERFICIE 33 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	58	
Coordinate del centro	X[m]= 94.92	Y[m]= 204.00
Raggio del cerchio	R[m]= 84.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 60.53	Y <sub>v</sub> [m]= 127.36
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 149.67	Y <sub>m</sub> [m]= 140.30
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.506</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	60.53	127.36	127.36	62.19	127.75	126.64	61.64	127.25	1.80	-23.55	0.00	54
2	62.19	127.75	126.64	63.84	128.14	125.96	63.10	127.12	1.79	-22.33	0.00	54
3	63.84	128.14	125.96	65.52	128.54	125.31	64.73	126.98	1.80	-21.10	0.00	52
4	65.52	128.54	125.31	67.19	128.93	124.71	66.39	126.87	1.78	-19.88	0.00	52
5	67.19	128.93	124.71	69.40	129.45	123.97	68.34	126.76	2.33	-18.48	0.00	52
6	69.40	129.45	123.97	71.60	129.97	123.30	70.54	126.67	2.31	-16.90	0.00	52
7	71.60	129.97	123.30	73.81	130.49	122.70	72.74	126.61	2.29	-15.34	0.00	52
8	73.81	130.49	122.70	75.47	130.88	122.28	74.65	126.59	1.71	-13.97	0.00	52
9	75.47	130.88	122.28	77.12	131.27	121.91	76.30	126.58	1.70	-12.81	0.00	52
10	77.12	131.27	121.91	78.97	131.70	121.53	78.06	126.60	1.89	-11.59	0.00	52
11	78.97	131.70	121.53	80.82	132.14	121.19	79.91	126.64	1.88	-10.30	0.00	52
12	80.82	132.14	121.19	81.14	132.21	121.14	80.98	126.67	0.32	-9.55	0.00	52
13	81.14	132.21	121.14	83.01	132.65	120.85	82.08	126.71	1.89	-8.80	0.00	52
14	83.01	132.65	120.85	84.88	133.09	120.60	83.95	126.80	1.89	-7.51	0.00	52
15	84.88	133.09	120.60	86.77	133.54	120.40	85.84	126.91	1.91	-6.21	0.00	52
16	86.77	133.54	120.40	88.67	133.98	120.23	87.73	127.04	1.90	-4.92	0.00	52
17	88.67	133.98	120.23	90.10	134.32	120.14	89.39	127.17	1.43	-3.78	0.00	52
18	90.10	134.32	120.14	90.82	134.49	120.10	90.46	127.26	0.72	-3.04	0.00	52
19	90.82	134.49	120.10	93.00	135.00	120.02	91.92	127.40	2.18	-2.05	0.00	52
20	93.00	135.00	120.02	94.42	135.00	120.00	93.71	127.51	1.42	-0.83	0.00	52
21	94.42	135.00	120.00	96.03	135.00	120.01	95.22	127.50	1.61	0.21	0.00	52
22	96.03	135.00	120.01	97.64	135.00	120.04	96.83	127.51	1.61	1.31	0.00	52
23	97.64	135.00	120.04	98.52	135.21	120.08	98.08	127.58	0.88	2.16	0.00	52
24	98.52	135.21	120.08	100.42	135.65	120.18	99.47	127.78	1.90	3.10	0.00	52
25	100.42	135.65	120.18	102.31	136.10	120.33	101.37	128.07	1.90	4.40	0.00	52
26	102.31	136.10	120.33	104.05	136.51	120.50	103.18	128.36	1.74	5.64	0.00	52
27	104.05	136.51	120.50	105.78	136.92	120.70	104.91	128.66	1.75	6.83	0.00	52
28	105.78	136.92	120.70	107.69	137.37	120.98	106.74	128.99	1.93	8.09	0.00	52
29	107.69	137.37	120.98	109.69	137.84	121.31	108.69	129.37	2.03	9.44	0.00	52
30	109.69	137.84	121.31	111.37	138.23	121.63	110.53	129.75	1.71	10.71	0.00	52
31	111.37	138.23	121.63	113.04	138.63	121.98	112.21	130.12	1.71	11.88	0.00	52
32	113.04	138.63	121.98	114.72	139.02	122.37	113.88	130.50	1.72	13.05	0.00	52
33	114.72	139.02	122.37	115.97	139.32	122.68	115.34	130.85	1.29	14.07	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	115.97	139.32	122.68	117.42	139.66	123.07	116.69	131.18	1.50	15.02	0.00	52
35	117.42	139.66	123.07	118.86	140.00	123.48	118.14	131.55	1.50	16.05	0.00	52
36	118.86	140.00	123.48	120.60	140.41	124.02	119.73	131.98	1.82	17.18	0.00	52
37	120.60	140.41	124.02	122.34	140.82	124.60	121.47	132.46	1.83	18.43	0.00	52
38	122.34	140.82	124.60	123.45	141.08	125.00	122.90	132.87	1.18	19.46	0.00	52
39	123.45	141.08	125.00	124.57	141.34	125.41	124.01	133.20	1.19	20.26	0.00	52
40	124.57	141.34	125.41	125.56	141.57	125.79	125.06	133.53	1.06	21.03	0.00	52
41	125.56	141.57	125.79	126.52	141.80	126.17	126.04	133.83	1.03	21.75	0.00	52
42	126.52	141.80	126.17	128.38	142.24	126.95	127.45	134.29	2.02	22.79	0.00	52
43	128.38	142.24	126.95	130.24	142.67	127.79	129.31	134.91	2.04	24.17	0.00	52
44	130.24	142.67	127.79	132.10	143.11	128.68	131.17	135.56	2.06	25.57	0.00	52
45	132.10	143.11	128.68	132.15	143.12	128.70	132.12	135.90	0.06	26.29	0.00	52
46	132.15	143.12	128.70	132.91	143.30	129.08	132.53	136.05	0.85	26.60	0.00	52
47	132.91	143.30	129.08	133.98	143.30	129.63	133.44	136.33	1.20	27.30	0.00	52
48	133.98	143.30	129.63	135.28	143.30	130.33	134.62	136.64	1.48	28.21	0.00	54
49	135.28	143.30	130.33	136.66	143.30	131.10	135.96	137.01	1.58	29.26	0.00	54
50	136.66	143.30	131.10	138.35	143.30	132.10	137.49	137.45	1.96	30.46	0.00	54
51	138.35	143.30	132.10	138.41	143.30	132.13	138.38	137.71	0.07	31.16	0.00	54
52	138.41	143.30	132.13	140.50	142.74	133.45	139.43	137.90	2.47	32.02	0.00	54
53	140.50	142.74	133.45	142.60	142.18	134.84	141.51	138.29	2.52	33.73	0.00	54
54	142.60	142.18	134.84	143.49	141.95	135.47	143.04	138.61	1.09	34.95	0.00	54
55	143.49	141.95	135.47	143.99	141.81	135.82	143.74	138.76	0.61	35.53	0.00	54
56	143.99	141.81	135.82	145.59	141.39	137.00	144.75	139.00	1.99	36.42	0.00	54
57	145.59	141.39	137.00	147.63	140.84	138.60	146.50	139.43	2.59	37.98	0.00	53
58	147.63	140.84	138.60	149.67	140.30	140.30	148.31	139.91	2.66	39.77	15.54	16

Tabella 13-4 – Geometria e caratteristiche strisce della superficie 33 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	1850	0	10842	19480	0	0	21578	0	0	
2	5359	0	14764	19516	0	21578	43470	0	0	
3	8972	0	18483	18859	0	43470	64755	0	0	
4	12461	0	22206	18709	0	64755	85785	0	0	
5	21511	0	34596	24439	0	85785	112824	0	0	
6	27090	0	40351	24225	0	112824	138785	0	0	
7	32373	0	45704	24034	0	138785	163356	0	0	
8	27574	0	37566	17914	0	163356	180702	0	0	
9	30225	0	40172	17828	0	180702	197009	0	0	
10	36759	0	47790	19836	0	197009	213899	0	0	
11	39736	0	50650	19751	0	213899	229264	0	0	
12	7165	0	9040	3408	0	229264	231758	0	0	
13	43555	0	54429	19876	0	231758	245335	0	0	
14	46337	0	57069	19812	0	245335	257126	0	0	
15	49622	0	60341	20022	0	257126	267170	0	0	
16	52133	0	62686	19978	0	267170	275224	0	0	
17	40906	0	48760	15053	0	275224	279944	0	0	
18	21080	0	25000	7573	0	279944	281870	0	0	
19	65658	0	77374	22913	0	281870	285851	0	0	
20	43672	0	51106	14917	0	285851	287075	0	0	
21	49563	0	57688	16911	0	287075	287403	0	0	
22	49514	0	57322	16915	0	287403	286650	0	0	
23	27185	0	31350	9250	0	286650	285733	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
24	59491	0	68339	19934	0	285733	282285	0	0	
25	60643	0	69333	19963	0	282285	276838	0	0	
26	56344	0	64162	18313	0	276838	270141	0	0	
27	56977	0	64664	18354	0	270141	261849	0	0	
28	63273	0	71586	20264	0	261849	250939	0	0	
29	66664	0	75202	21296	0	250939	237595	0	0	
30	56046	0	63072	17924	0	237595	224971	0	0	
31	56035	0	62935	17997	0	224971	211120	0	0	
32	55898	0	62668	18078	0	211120	196118	0	0	
33	41519	0	46481	13536	0	196118	184229	0	0	
34	47757	0	53397	15715	0	184229	169790	0	0	
35	47422	0	52953	15793	0	169790	154665	0	0	
36	56550	0	63053	19130	0	154665	135635	0	0	
37	55895	0	62229	19264	0	135635	115777	0	0	
38	35414	0	39375	12421	0	115777	102675	0	0	
39	35046	0	38920	12484	0	102675	89329	0	0	
40	30792	0	34155	11141	0	89329	77298	0	0	
41	29572	0	32767	10856	0	77298	65473	0	0	
42	56447	0	62436	21191	0	65473	42182	0	0	
43	55116	0	60781	21414	0	42182	18625	0	0	
44	53541	0	58795	21658	0	18625	-4900	0	0	
45	1416	0	1551	586	0	-4900	-5530	0	0	
46	21357	0	23360	8928	0	-5530	-15061	0	0	
47	29226	2140	34565	12716	0	-15061	-29977	0	0	
48	33890	2600	39594	16133	0	-29977	-46534	0	0	
49	34017	2760	39428	17297	0	-46534	-62861	0	0	
50	38783	3380	44384	21441	0	-62861	-80812	0	0	
51	1318	120	1494	767	0	-80812	-81403	0	0	
52	42001	0	40822	27022	0	-81403	-94016	0	0	
53	34119	0	29411	27545	0	-94016	-98707	0	0	
54	12073	0	8862	11875	0	-98707	-98040	0	0	
55	6144	0	3999	6719	0	-98040	-96926	0	0	
56	16006	0	7132	21744	0	-96926	-88952	0	0	
57	13233	0	-1995	27609	0	-88952	-70335	0	0	
58	4369	0	-420	8460	0	-70335	-65007	0	0	

Tabella 13-5 – Forze applicate sulle strisce [BISHOP] della superficie 33 della verifica di stabilità 09.

### 13.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u [m]
1	0.006850
2	0.003219
3	0.004487
4	0.001616
5	0.001361
6	0.004963
7	0.004960

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

Accelerazione sismica critica       $K_c = 0.103$   
 Spostamento massimo                 $U_{max} = 0.006850$  [m]  
 Velocità massima                         $V_{max} = 0.039578$  [m/s]

n°	u
	[m]
1	0.008609
2	0.004041
3	0.005613
4	0.002150
5	0.001657
6	0.006944
7	0.006680

Tabella 13-7 – Spostamenti della superficie 33 della verifica di stabilità 09.

Accelerazione sismica critica  $K_c = 0.096$   
Spostamento massimo  $U_{max} = 0.008609$  [m]  
Velocità massima  $V_{max} = 0.045185$  [m/s]

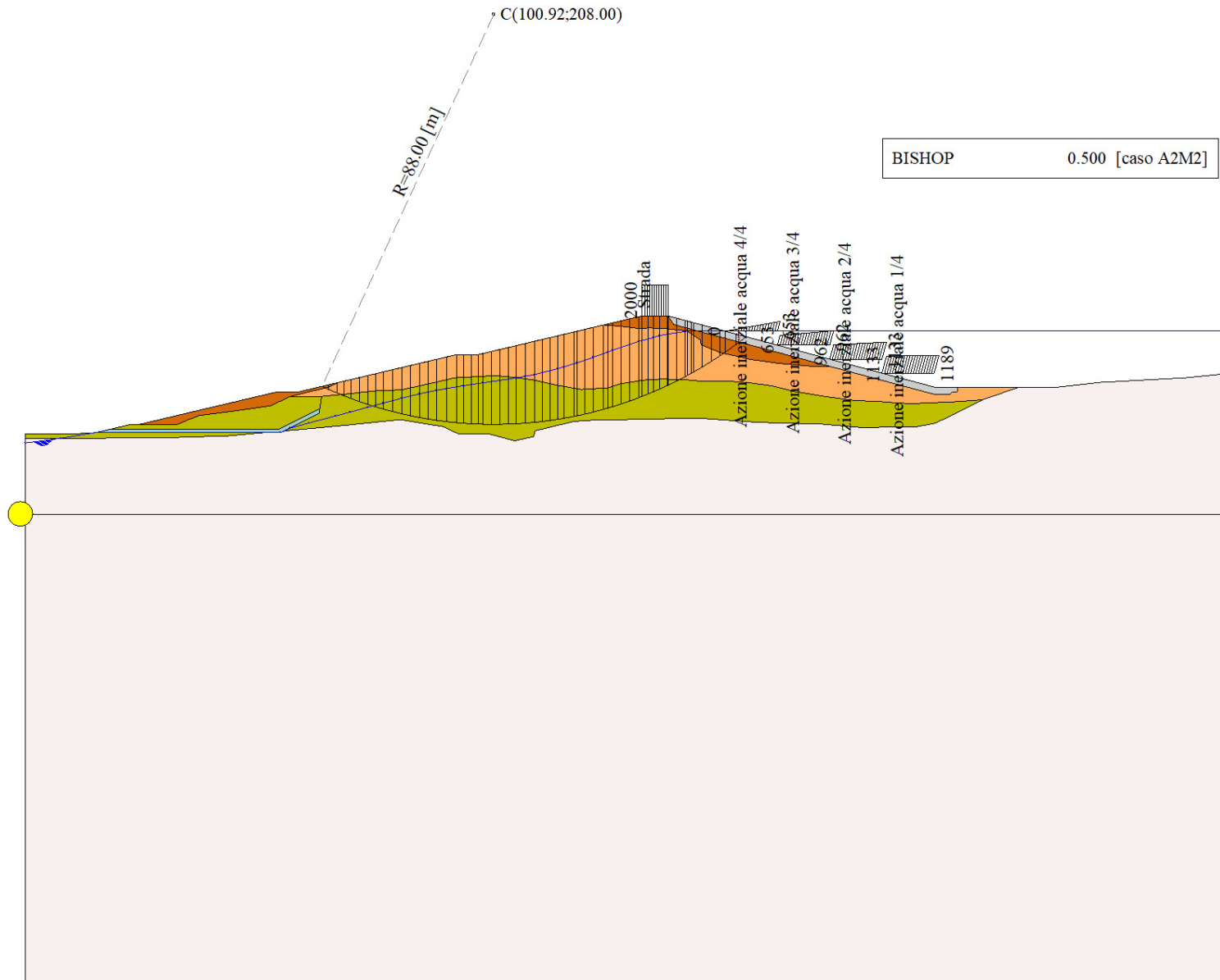


Figura 13-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 09.

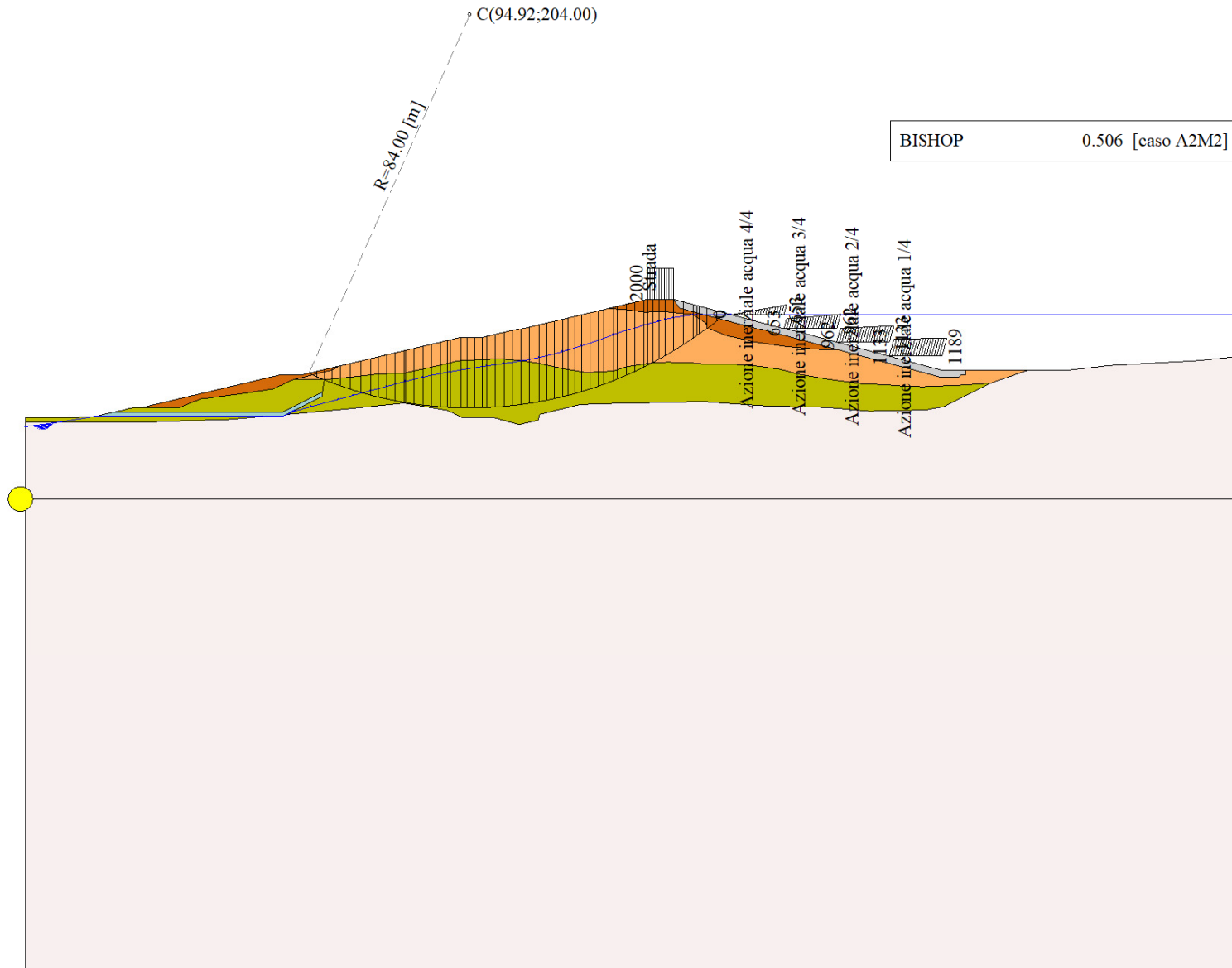


Figura 13-2 – Superficie critica (33) della sezione CR\_08 per la verifica di stabilità 09.

## 14 VERIFICA DI STABILITÀ 10

### 14.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\bar{\sigma}_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	132.91 143.30	138.41 143.30	2000 2000	0 0
2	Azione inerziale acqua 1/4	Variabile	1.00	184.54 131.00	195.79 131.00	2175 2283	-580 -609
3	Azione inerziale acqua 2/4	Variabile	1.00	173.29 134.00	184.54 134.00	1844 2175	-492 -580
4	Azione inerziale acqua 3/4	Variabile	1.00	162.04 137.00	173.29 137.00	1254 1844	-334 -492
5	Azione inerziale acqua 4/4	Variabile	1.00	150.79 140.00	162.04 140.00	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	107016
Coefficiente di sicurezza minimo	0.292
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	56	
Coordinate del centro	X[m]= 106.92	Y[m]= 208.00
Raggio del cerchio	R[m]= 88.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 67.94	Y <sub>v</sub> [m]= 129.11
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 159.74	Y <sub>m</sub> [m]= 137.61
Coefficiente di sicurezza	F <sub>S</sub> = <b>0.292</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	67.94	129.11	129.11	69.77	129.54	128.22	69.16	128.96	2.04	-25.63	0.00	54
2	69.77	129.54	128.22	71.61	129.97	127.39	70.79	128.77	2.02	-24.31	0.00	54
3	71.61	129.97	127.39	73.45	130.40	126.61	72.59	128.59	2.00	-23.01	0.00	53
4	73.45	130.40	126.61	75.28	130.83	125.88	74.41	128.43	1.98	-21.71	0.00	52
5	75.28	130.83	125.88	77.12	131.27	125.20	76.23	128.29	1.96	-20.43	0.00	52
6	77.12	131.27	125.20	79.13	131.74	124.50	78.15	128.17	2.13	-19.10	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	79.13	131.74	124.50	81.14	132.21	123.86	80.16	128.08	2.11	-17.72	0.00	52
8	81.14	132.21	123.86	83.01	132.65	123.31	82.09	128.01	1.95	-16.40	0.00	52
9	83.01	132.65	123.31	84.88	133.09	122.80	83.96	127.96	1.94	-15.14	0.00	52
10	84.88	133.09	122.80	86.77	133.54	122.34	85.84	127.94	1.95	-13.87	0.00	52
11	86.77	133.54	122.34	88.67	133.98	121.91	87.73	127.94	1.94	-12.60	0.00	52
12	88.67	133.98	121.91	90.82	134.49	121.49	89.76	127.97	2.19	-11.26	0.00	52
13	90.82	134.49	121.49	93.00	135.00	121.11	91.92	128.02	2.21	-9.82	0.00	52
14	93.00	135.00	121.11	94.42	135.00	120.89	93.71	128.00	1.44	-8.63	0.00	52
15	94.42	135.00	120.89	96.03	135.00	120.68	95.23	127.89	1.62	-7.64	0.00	52
16	96.03	135.00	120.68	97.64	135.00	120.49	96.84	127.79	1.62	-6.58	0.00	52
17	97.64	135.00	120.49	98.52	135.21	120.40	98.08	127.78	0.88	-5.77	0.00	52
18	98.52	135.21	120.40	100.42	135.65	120.24	99.47	127.88	1.90	-4.86	0.00	52
19	100.42	135.65	120.24	102.31	136.10	120.12	101.37	128.03	1.90	-3.62	0.00	52
20	102.31	136.10	120.12	104.05	136.51	120.05	103.18	128.19	1.74	-2.44	0.00	52
21	104.05	136.51	120.05	105.78	136.92	120.01	104.92	128.37	1.74	-1.31	0.00	52
22	105.78	136.92	120.01	107.69	137.37	120.00	106.74	128.57	1.91	-0.12	0.00	52
23	107.69	137.37	120.00	109.69	137.84	120.04	108.69	128.81	2.00	1.15	0.00	52
24	109.69	137.84	120.04	111.37	138.23	120.11	110.53	129.06	1.68	2.35	0.00	52
25	111.37	138.23	120.11	113.04	138.63	120.21	112.21	129.30	1.68	3.44	0.00	52
26	113.04	138.63	120.21	114.72	139.02	120.35	113.88	129.55	1.68	4.54	0.00	52
27	114.72	139.02	120.35	115.97	139.32	120.47	115.35	129.79	1.26	5.49	0.00	52
28	115.97	139.32	120.47	118.14	139.83	120.72	117.06	130.08	2.18	6.61	0.00	52
29	118.14	139.83	120.72	118.86	140.00	120.81	118.50	130.34	0.73	7.56	0.00	52
30	118.86	140.00	120.81	120.07	140.28	120.99	119.46	130.52	1.22	8.19	0.00	52
31	120.07	140.28	120.99	121.27	140.56	121.18	120.67	130.75	1.22	8.99	0.00	52
32	121.27	140.56	121.18	122.34	140.82	121.36	121.81	130.98	1.09	9.74	0.00	52
33	122.34	140.82	121.36	124.57	141.34	121.79	123.46	131.33	2.27	10.83	0.00	52
34	124.57	141.34	121.79	125.56	141.57	122.00	125.07	131.67	1.01	11.90	0.00	52
35	125.56	141.57	122.00	126.52	141.80	122.21	126.04	131.89	0.98	12.55	0.00	52
36	126.52	141.80	122.21	128.38	142.24	122.66	127.45	132.23	1.91	13.49	0.00	52
37	128.38	142.24	122.66	130.24	142.67	123.15	129.31	132.68	1.92	14.74	0.00	52
38	130.24	142.67	123.15	132.10	143.11	123.68	131.17	133.15	1.93	16.00	0.00	52
39	132.10	143.11	123.68	132.91	143.30	123.93	132.50	133.50	0.85	16.90	0.00	52
40	132.91	143.30	123.93	134.09	143.30	124.30	133.50	133.71	1.24	17.58	0.00	52
41	134.09	143.30	124.30	135.28	143.30	124.70	134.69	133.90	1.25	18.39	0.00	52
42	135.28	143.30	124.70	136.66	143.30	125.18	135.97	134.12	1.46	19.28	0.00	52
43	136.66	143.30	125.18	138.35	143.30	125.80	137.50	134.39	1.80	20.34	0.00	52
44	138.35	143.30	125.80	138.41	143.30	125.83	138.38	134.56	0.06	20.95	0.00	52
45	138.41	143.30	125.83	140.50	142.74	126.66	139.44	134.63	2.25	21.70	0.00	52
46	140.50	142.74	126.66	142.60	142.18	127.56	141.54	134.78	2.28	23.18	0.00	52
47	142.60	142.18	127.56	143.49	141.95	127.96	143.04	134.91	0.98	24.24	0.00	52
48	143.49	141.95	127.96	143.99	141.81	128.19	143.74	134.98	0.55	24.73	0.00	52
49	143.99	141.81	128.19	144.79	141.60	128.57	144.39	135.04	0.88	25.20	0.00	52
50	144.79	141.60	128.57	146.79	141.07	129.55	145.77	135.19	2.23	26.21	0.00	53
51	146.79	141.07	129.55	148.79	140.53	130.60	147.77	135.43	2.26	27.68	0.00	54
52	148.79	140.53	130.60	150.79	140.00	131.71	149.76	135.71	2.29	29.16	0.00	54
53	150.79	140.00	131.71	153.03	139.40	133.05	151.86	136.03	2.60	30.75	0.00	54
54	153.03	139.40	133.05	155.26	138.81	134.47	154.07	136.42	2.65	32.46	0.00	54
55	155.26	138.81	134.47	157.50	138.21	135.99	156.26	136.84	2.70	34.20	0.00	53
56	157.50	138.21	135.99	159.74	137.61	137.61	158.25	137.27	2.76	35.98	15.71	16

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	2335	0	21967	38617	0	0	42788	0	0	
2	6912	0	27334	38205	0	42788	84322	0	0	
3	11332	0	32174	37265	0	84322	123762	0	0	
4	15801	0	36924	35997	0	123762	160495	0	0	
5	20119	0	41810	35688	0	160495	195330	0	0	
6	26730	0	50982	38732	0	195330	231072	0	0	
7	31433	0	56105	38423	0	231072	264122	0	0	
8	33331	0	56592	35495	0	264122	292278	0	0	
9	37140	0	60639	35274	0	292278	317788	0	0	
10	41342	0	65332	35542	0	317788	340823	0	0	
11	44896	0	69004	35357	0	340823	360920	0	0	
12	55022	0	82453	39917	0	360920	380055	0	0	
13	59977	0	87816	40286	0	380055	395370	0	0	
14	40712	0	58661	26153	0	395370	403316	0	0	
15	46914	0	66832	29579	0	403316	410727	0	0	
16	47620	0	67069	29511	0	410727	416479	0	0	
17	26470	0	36960	16105	0	416479	418845	0	0	
18	58721	0	81213	34630	0	418845	421694	0	0	
19	60931	0	83274	34575	0	421694	421473	0	0	
20	57543	0	77839	31621	0	421473	418614	0	0	
21	59077	0	79203	31600	0	418614	413244	0	0	
22	66638	0	88576	34779	0	413244	404478	0	0	
23	71384	0	94093	36425	0	404478	392158	0	0	
24	60959	0	79775	30556	0	392158	379413	0	0	
25	61832	0	80428	30585	0	379413	364536	0	0	
26	62591	0	80960	30626	0	364536	347586	0	0	
27	47101	0	60645	22866	0	347586	333631	0	0	
28	82496	0	105687	39778	0	333631	306834	0	0	
29	27551	0	35157	13225	0	306834	297237	0	0	
30	46265	0	58887	22168	0	297237	280424	0	0	
31	46464	0	58963	22214	0	280424	262662	0	0	
32	41403	0	52400	19768	0	262662	246112	0	0	
33	86567	0	109148	41342	0	246112	209398	0	0	
34	38527	0	48410	18423	0	209398	192159	0	0	
35	37419	0	46926	17908	0	192159	174888	0	0	
36	72638	0	90853	34830	0	174888	139891	0	0	
37	72642	0	90546	35021	0	139891	103050	0	0	
38	72443	0	89988	35233	0	103050	64578	0	0	
39	31445	0	38964	15415	0	64578	47363	0	0	
40	45474	2370	59484	22635	0	47363	19575	0	0	
41	44523	2370	58071	22739	0	19575	-7945	0	0	
42	50593	2760	65758	26621	0	-7945	-39538	0	0	
43	60007	3380	77619	32819	0	-39538	-77341	0	0	
44	2090	120	2695	1170	0	-77341	-78662	0	0	
45	69788	0	83417	41058	0	-78662	-117158	0	0	
46	63553	0	74051	41497	0	-117158	-149862	0	0	
47	25086	0	28537	17772	0	-149862	-161833	0	0	
48	13590	0	15255	10024	0	-161833	-168030	0	0	
49	20978	0	23216	16099	0	-168030	-177116	0	0	
50	47817	0	50602	40995	0	-177116	-194069	0	0	
51	42072	0	40642	42812	0	-194069	-202642	0	0	
52	36080	0	30651	43415	0	-202642	-203018	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]	
53	32714	794	22173	49342	0	-203018	-193349	0	0	
54	24139	2378	9128	50042	0	-193349	-172299	0	0	
55	14844	3961	-5059	49923	0	-172299	-138842	0	0	
56	4978	5545	2507	17723	0	-138842	-130677	0	0	

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

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

Numero di strisce	58	
Coordinate del centro	X[m]= 94.92	Y[m]= 204.00
Raggio del cerchio	R[m]= 84.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 60.53	Y <sub>v</sub> [m]= 127.36
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 149.67	Y <sub>m</sub> [m]= 140.30
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	α	β	c
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	[kPa]
1	60.53	127.36	127.36	62.19	127.75	126.64	61.64	127.25	1.80	-23.55	0.00	54
2	62.19	127.75	126.64	63.84	128.14	125.96	63.10	127.12	1.79	-22.33	0.00	54
3	63.84	128.14	125.96	65.52	128.54	125.31	64.73	126.98	1.80	-21.10	0.00	52
4	65.52	128.54	125.31	67.19	128.93	124.71	66.39	126.87	1.78	-19.88	0.00	52
5	67.19	128.93	124.71	69.40	129.45	123.97	68.34	126.76	2.33	-18.48	0.00	52
6	69.40	129.45	123.97	71.60	129.97	123.30	70.54	126.67	2.31	-16.90	0.00	52
7	71.60	129.97	123.30	73.81	130.49	122.70	72.74	126.61	2.29	-15.34	0.00	52
8	73.81	130.49	122.70	75.47	130.88	122.28	74.65	126.59	1.71	-13.97	0.00	52
9	75.47	130.88	122.28	77.12	131.27	121.91	76.30	126.58	1.70	-12.81	0.00	52
10	77.12	131.27	121.91	78.97	131.70	121.53	78.06	126.60	1.89	-11.59	0.00	52
11	78.97	131.70	121.53	80.82	132.14	121.19	79.91	126.64	1.88	-10.30	0.00	52
12	80.82	132.14	121.19	81.14	132.21	121.14	80.98	126.67	0.32	-9.55	0.00	52
13	81.14	132.21	121.14	83.01	132.65	120.85	82.08	126.71	1.89	-8.80	0.00	52
14	83.01	132.65	120.85	84.88	133.09	120.60	83.95	126.80	1.89	-7.51	0.00	52
15	84.88	133.09	120.60	86.77	133.54	120.40	85.84	126.91	1.91	-6.21	0.00	52
16	86.77	133.54	120.40	88.67	133.98	120.23	87.73	127.04	1.90	-4.92	0.00	52
17	88.67	133.98	120.23	90.10	134.32	120.14	89.39	127.17	1.43	-3.78	0.00	52
18	90.10	134.32	120.14	90.82	134.49	120.10	90.46	127.26	0.72	-3.04	0.00	52
19	90.82	134.49	120.10	93.00	135.00	120.02	91.92	127.40	2.18	-2.05	0.00	52
20	93.00	135.00	120.02	94.42	135.00	120.00	93.71	127.51	1.42	-0.83	0.00	52
21	94.42	135.00	120.00	96.03	135.00	120.01	95.22	127.50	1.61	0.21	0.00	52
22	96.03	135.00	120.01	97.64	135.00	120.04	96.83	127.51	1.61	1.31	0.00	52
23	97.64	135.00	120.04	98.52	135.21	120.08	98.08	127.58	0.88	2.16	0.00	52
24	98.52	135.21	120.08	100.42	135.65	120.18	99.47	127.78	1.90	3.10	0.00	52
25	100.42	135.65	120.18	102.31	136.10	120.33	101.37	128.07	1.90	4.40	0.00	52
26	102.31	136.10	120.33	104.05	136.51	120.50	103.18	128.36	1.74	5.64	0.00	52
27	104.05	136.51	120.50	105.78	136.92	120.70	104.91	128.66	1.75	6.83	0.00	52
28	105.78	136.92	120.70	107.69	137.37	120.98	106.74	128.99	1.93	8.09	0.00	52
29	107.69	137.37	120.98	109.69	137.84	121.31	108.69	129.37	2.03	9.44	0.00	52
30	109.69	137.84	121.31	111.37	138.23	121.63	110.53	129.75	1.71	10.71	0.00	52
31	111.37	138.23	121.63	113.04	138.63	121.98	112.21	130.12	1.71	11.88	0.00	52
32	113.04	138.63	121.98	114.72	139.02	122.37	113.88	130.50	1.72	13.05	0.00	52
33	114.72	139.02	122.37	115.97	139.32	122.68	115.34	130.85	1.29	14.07	0.00	52
34	115.97	139.32	122.68	117.42	139.66	123.07	116.69	131.18	1.50	15.02	0.00	52
35	117.42	139.66	123.07	118.86	140.00	123.48	118.14	131.55	1.50	16.05	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]
36	118.86	140.00	123.48	120.60	140.41	124.02	119.73	131.98	1.82	17.18	0.00	52
37	120.60	140.41	124.02	122.34	140.82	124.60	121.47	132.46	1.83	18.43	0.00	52
38	122.34	140.82	124.60	123.45	141.08	125.00	122.90	132.87	1.18	19.46	0.00	52
39	123.45	141.08	125.00	124.57	141.34	125.41	124.01	133.20	1.19	20.26	0.00	52
40	124.57	141.34	125.41	125.56	141.57	125.79	125.06	133.53	1.06	21.03	0.00	52
41	125.56	141.57	125.79	126.52	141.80	126.17	126.04	133.83	1.03	21.75	0.00	52
42	126.52	141.80	126.17	128.38	142.24	126.95	127.45	134.29	2.02	22.79	0.00	52
43	128.38	142.24	126.95	130.24	142.67	127.79	129.31	134.91	2.04	24.17	0.00	52
44	130.24	142.67	127.79	132.10	143.11	128.68	131.17	135.56	2.06	25.57	0.00	52
45	132.10	143.11	128.68	132.15	143.12	128.70	132.12	135.90	0.06	26.29	0.00	52
46	132.15	143.12	128.70	132.91	143.30	129.08	132.53	136.05	0.85	26.60	0.00	52
47	132.91	143.30	129.08	133.98	143.30	129.63	133.44	136.33	1.20	27.30	0.00	52
48	133.98	143.30	129.63	135.28	143.30	130.33	134.62	136.64	1.48	28.21	0.00	54
49	135.28	143.30	130.33	136.66	143.30	131.10	135.96	137.01	1.58	29.26	0.00	54
50	136.66	143.30	131.10	138.35	143.30	132.10	137.49	137.45	1.96	30.46	0.00	54
51	138.35	143.30	132.10	138.41	143.30	132.13	138.38	137.71	0.07	31.16	0.00	54
52	138.41	143.30	132.13	140.50	142.74	133.45	139.43	137.90	2.47	32.02	0.00	54
53	140.50	142.74	133.45	142.60	142.18	134.84	141.51	138.29	2.52	33.73	0.00	54
54	142.60	142.18	134.84	143.49	141.95	135.47	143.04	138.61	1.09	34.95	0.00	54
55	143.49	141.95	135.47	143.99	141.81	135.82	143.74	138.76	0.61	35.53	0.00	54
56	143.99	141.81	135.82	145.59	141.39	137.00	144.75	139.00	1.99	36.42	0.00	54
57	145.59	141.39	137.00	147.63	140.84	138.60	146.50	139.43	2.59	37.98	0.00	53
58	147.63	140.84	138.60	149.67	140.30	140.30	148.31	139.91	2.66	39.77	15.54	16

Tabella 14-4 – Geometria e caratteristiche strisce della superficie 64 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	1850	0	16826	32455	0	0	35261	0	0	
2	5359	0	21046	32515	0	35261	69817	0	0	
3	8972	0	24898	31419	0	69817	102206	0	0	
4	12461	0	28872	31170	0	102206	133160	0	0	
5	21511	0	43733	40716	0	133160	171524	0	0	
6	27090	0	49867	40360	0	171524	206861	0	0	
7	32373	0	55564	40042	0	206861	238927	0	0	
8	27574	0	45164	29845	0	238927	260700	0	0	
9	30225	0	47923	29702	0	260700	280455	0	0	
10	36759	0	56614	33048	0	280455	300081	0	0	
11	39736	0	59622	32905	0	300081	317044	0	0	
12	7165	0	10606	5679	0	317044	319702	0	0	
13	43555	0	63659	33114	0	319702	333579	0	0	
14	46337	0	66424	33008	0	333579	344574	0	0	
15	49622	0	69926	33358	0	344574	352741	0	0	
16	52133	0	72357	33285	0	352741	357892	0	0	
17	40906	0	56102	25079	0	357892	359769	0	0	
18	21080	0	28708	12618	0	359769	360059	0	0	
19	65658	0	88626	38174	0	360059	358298	0	0	
20	43672	0	58366	24852	0	358298	355329	0	0	
21	49563	0	65723	28175	0	355329	350739	0	0	
22	49514	0	65135	28182	0	350739	344936	0	0	
23	27185	0	35551	15411	0	344936	341158	0	0	
24	59491	0	77327	33211	0	341158	331093	0	0	
25	60643	0	78221	33260	0	331093	318458	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
26	56344	0	72182	30510	0	318458	304748	0	0	
27	56977	0	72550	30579	0	304748	289089	0	0	
28	63273	0	80082	33760	0	289089	269726	0	0	
29	66664	0	83856	35480	0	269726	247231	0	0	
30	56046	0	70108	29861	0	247231	226764	0	0	
31	56035	0	69744	29983	0	226764	204980	0	0	
32	55898	0	69227	30119	0	204980	182011	0	0	
33	41519	0	51196	22552	0	182011	164190	0	0	
34	47757	0	58645	26182	0	164190	142936	0	0	
35	47422	0	57968	26312	0	142936	121080	0	0	
36	56550	0	68759	31872	0	121080	94109	0	0	
37	55895	0	67554	32095	0	94109	66525	0	0	
38	35414	0	42573	20694	0	66525	48617	0	0	
39	35046	0	41937	20800	0	48617	30606	0	0	
40	30792	0	36677	18561	0	30606	14561	0	0	
41	29572	0	35071	18087	0	14561	-1039	0	0	
42	56447	0	66483	35305	0	-1039	-31280	0	0	
43	55116	0	64224	35677	0	-31280	-61196	0	0	
44	53541	0	61564	36083	0	-61196	-90352	0	0	
45	1416	0	1615	976	0	-90352	-91122	0	0	
46	21357	0	24274	14874	0	-91122	-102706	0	0	
47	29226	2140	35945	21185	0	-102706	-120950	0	0	
48	33890	2600	40577	26878	0	-120950	-140394	0	0	
49	34017	2760	39843	28818	0	-140394	-158859	0	0	
50	38783	3380	43955	35722	0	-158859	-178023	0	0	
51	1318	120	1459	1277	0	-178023	-178628	0	0	
52	42001	0	37638	45019	0	-178628	-187981	0	0	
53	34119	0	23848	45892	0	-187981	-185443	0	0	
54	12073	0	5734	19784	0	-185443	-180436	0	0	
55	6144	0	2033	11194	0	-180436	-176540	0	0	
56	16006	0	-313	36227	0	-176540	-157708	0	0	
57	13233	0	-13617	45998	0	-157708	-121757	0	0	
58	4369	0	-2556	12140	0	-121757	-113658	0	0	

Tabella 14-5 – Forze applicate sulle strisce [BISHOP] della superficie 64 della verifica di stabilità 10.

#### 14.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u [m]
1	0.058007
2	0.057916
3	0.035522
4	0.015292
5	0.028290
6	0.034605
7	0.046830

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

Accelerazione sismica critica  $K_c = 0.115$   
 Spostamento massimo  $U_{max} = 0.058007$  [m]  
 Velocità massima  $V_{max} = 0.176032$  [m/s]

n°	u
	[m]
1	0.077168
2	0.100299
3	0.051613
4	0.024601
5	0.036971
6	0.046556
7	0.063870

Tabella 14-7 – Spostamenti della superficie 64 della verifica di stabilità 10.

Accelerazione sismica critica       $K_c = 0.096$   
Spostamento massimo                 $U_{max} = 0.100299$  [m]  
Velocità massima                         $V_{max} = 0.239919$  [m/s]

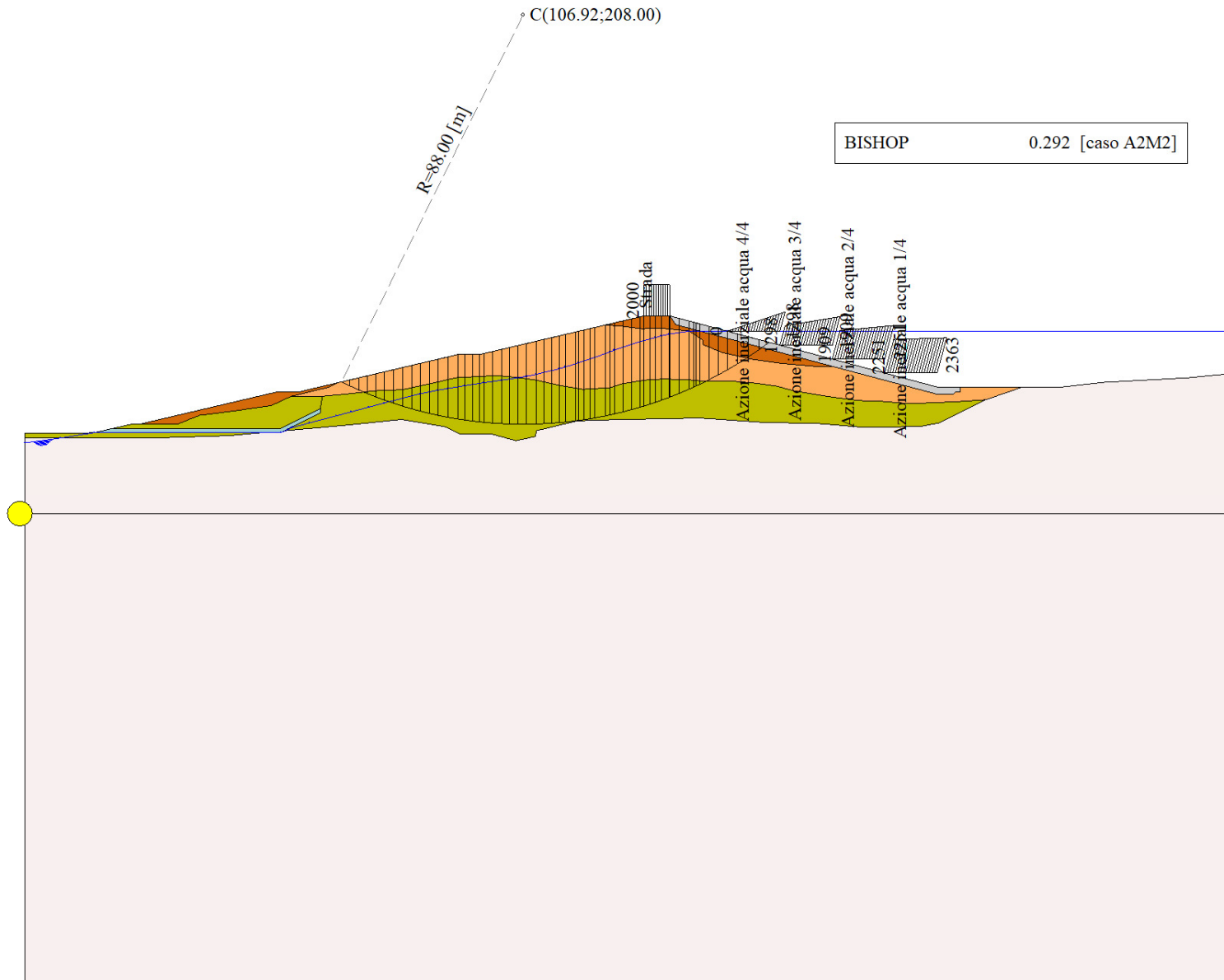


Figura 14-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 10.

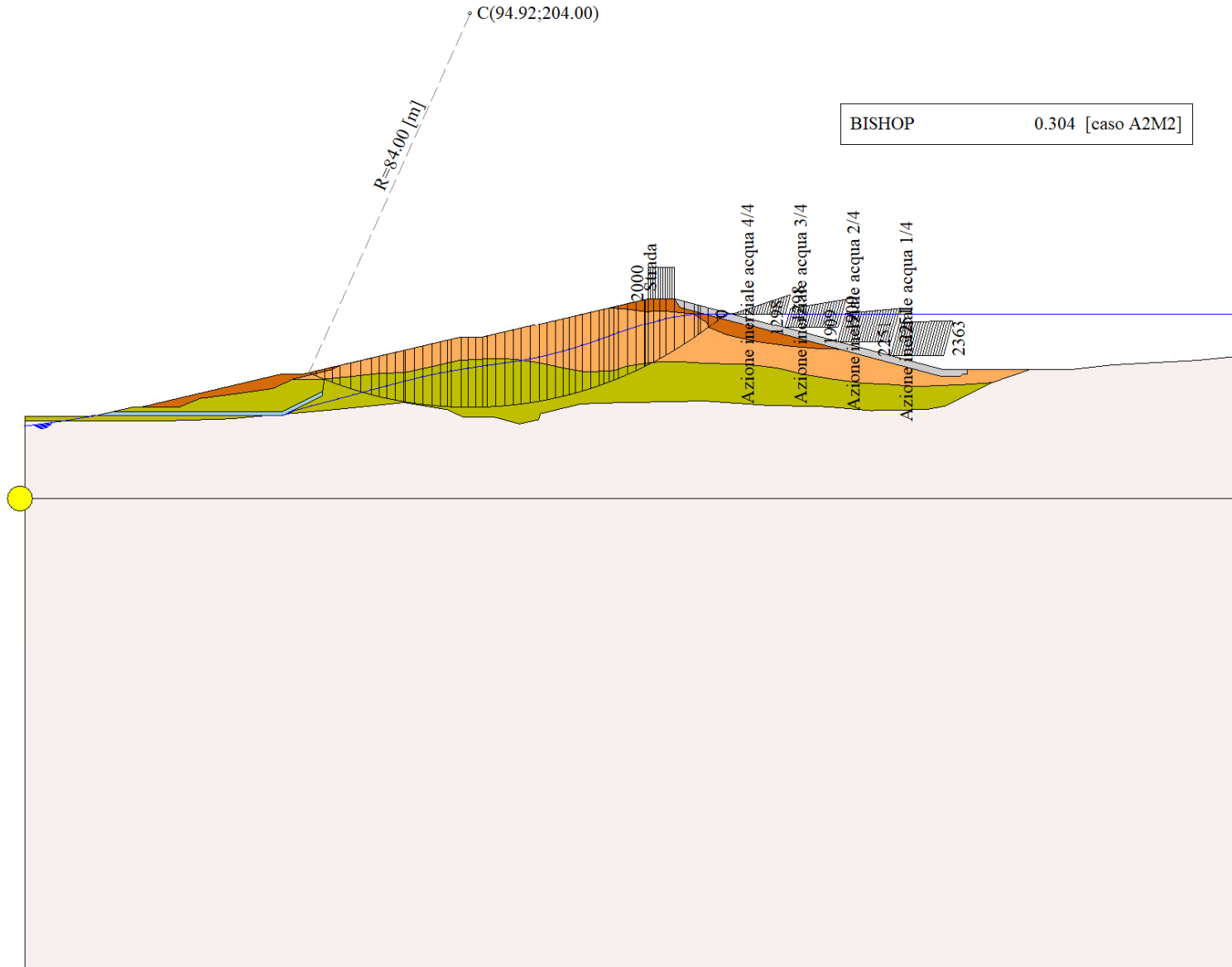


Figura 14-2 – Superficie critica (64) della sezione CR\_08 per la verifica di stabilità 10.

## 15 VERIFICA DI STABILITÀ 11

### 15.1.1 CARICHI SUL PROFILO

n°	Descrizione	Tipo	$\Psi_2$	$P_i$ [m]	$P_f$ [m]	$V_y$ [kg/m]	$V_x$ [kg/m]
1	Strada	Variabile	1.00	132.91 143.30	138.41 143.30	2000 2000	0 0
2	Azione inerziale acqua 1/4	Variabile	1.00	184.54 131.00	195.79 131.00	2062 2164	-550 -577
3	Azione inerziale acqua 2/4	Variabile	1.00	173.29 134.00	184.54 134.00	1749 2062	-466 -550
4	Azione inerziale acqua 3/4	Variabile	1.00	162.04 137.00	173.29 137.00	1189 1749	-317 -466
5	Azione inerziale acqua 4/4	Variabile	1.00	150.79 140.00	162.04 140.00	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	53508
Coefficiente di sicurezza minimo	0.305
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	56	
Coordinate del centro	X[m]= 106.92	Y[m]= 208.00
Raggio del cerchio	R[m]= 88.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 67.94	Y <sub>v</sub> [m]= 129.11
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 159.74	Y <sub>m</sub> [m]= 137.61
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.305</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	67.94	129.11	129.11	69.77	129.54	128.22	69.16	128.96	2.04	-25.63	0.00	54
2	69.77	129.54	128.22	71.61	129.97	127.39	70.79	128.77	2.02	-24.31	0.00	54
3	71.61	129.97	127.39	73.45	130.40	126.61	72.59	128.59	2.00	-23.01	0.00	53
4	73.45	130.40	126.61	75.28	130.83	125.88	74.41	128.43	1.98	-21.71	0.00	52
5	75.28	130.83	125.88	77.12	131.27	125.20	76.23	128.29	1.96	-20.43	0.00	52
6	77.12	131.27	125.20	79.13	131.74	124.50	78.15	128.17	2.13	-19.10	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]
7	79.13	131.74	124.50	81.14	132.21	123.86	80.16	128.08	2.11	-17.72	0.00	52
8	81.14	132.21	123.86	83.01	132.65	123.31	82.09	128.01	1.95	-16.40	0.00	52
9	83.01	132.65	123.31	84.88	133.09	122.80	83.96	127.96	1.94	-15.14	0.00	52
10	84.88	133.09	122.80	86.77	133.54	122.34	85.84	127.94	1.95	-13.87	0.00	52
11	86.77	133.54	122.34	88.67	133.98	121.91	87.73	127.94	1.94	-12.60	0.00	52
12	88.67	133.98	121.91	90.82	134.49	121.49	89.76	127.97	2.19	-11.26	0.00	52
13	90.82	134.49	121.49	93.00	135.00	121.11	91.92	128.02	2.21	-9.82	0.00	52
14	93.00	135.00	121.11	94.42	135.00	120.89	93.71	128.00	1.44	-8.63	0.00	52
15	94.42	135.00	120.89	96.03	135.00	120.68	95.23	127.89	1.62	-7.64	0.00	52
16	96.03	135.00	120.68	97.64	135.00	120.49	96.84	127.79	1.62	-6.58	0.00	52
17	97.64	135.00	120.49	98.52	135.21	120.40	98.08	127.78	0.88	-5.77	0.00	52
18	98.52	135.21	120.40	100.42	135.65	120.24	99.47	127.88	1.90	-4.86	0.00	52
19	100.42	135.65	120.24	102.31	136.10	120.12	101.37	128.03	1.90	-3.62	0.00	52
20	102.31	136.10	120.12	104.05	136.51	120.05	103.18	128.19	1.74	-2.44	0.00	52
21	104.05	136.51	120.05	105.78	136.92	120.01	104.92	128.37	1.74	-1.31	0.00	52
22	105.78	136.92	120.01	107.69	137.37	120.00	106.74	128.57	1.91	-0.12	0.00	52
23	107.69	137.37	120.00	109.69	137.84	120.04	108.69	128.81	2.00	1.15	0.00	52
24	109.69	137.84	120.04	111.37	138.23	120.11	110.53	129.06	1.68	2.35	0.00	52
25	111.37	138.23	120.11	113.04	138.63	120.21	112.21	129.30	1.68	3.44	0.00	52
26	113.04	138.63	120.21	114.72	139.02	120.35	113.88	129.55	1.68	4.54	0.00	52
27	114.72	139.02	120.35	115.97	139.32	120.47	115.35	129.79	1.26	5.49	0.00	52
28	115.97	139.32	120.47	118.14	139.83	120.72	117.06	130.08	2.18	6.61	0.00	52
29	118.14	139.83	120.72	118.86	140.00	120.81	118.50	130.34	0.73	7.56	0.00	52
30	118.86	140.00	120.81	120.07	140.28	120.99	119.46	130.52	1.22	8.19	0.00	52
31	120.07	140.28	120.99	121.27	140.56	121.18	120.67	130.75	1.22	8.99	0.00	52
32	121.27	140.56	121.18	122.34	140.82	121.36	121.81	130.98	1.09	9.74	0.00	52
33	122.34	140.82	121.36	124.57	141.34	121.79	123.46	131.33	2.27	10.83	0.00	52
34	124.57	141.34	121.79	125.56	141.57	122.00	125.07	131.67	1.01	11.90	0.00	52
35	125.56	141.57	122.00	126.52	141.80	122.21	126.04	131.89	0.98	12.55	0.00	52
36	126.52	141.80	122.21	128.38	142.24	122.66	127.45	132.23	1.91	13.49	0.00	52
37	128.38	142.24	122.66	130.24	142.67	123.15	129.31	132.68	1.92	14.74	0.00	52
38	130.24	142.67	123.15	132.10	143.11	123.68	131.17	133.15	1.93	16.00	0.00	52
39	132.10	143.11	123.68	132.91	143.30	123.93	132.50	133.50	0.85	16.90	0.00	52
40	132.91	143.30	123.93	134.09	143.30	124.30	133.50	133.71	1.24	17.58	0.00	52
41	134.09	143.30	124.30	135.28	143.30	124.70	134.69	133.90	1.25	18.39	0.00	52
42	135.28	143.30	124.70	136.66	143.30	125.18	135.97	134.12	1.46	19.28	0.00	52
43	136.66	143.30	125.18	138.35	143.30	125.80	137.50	134.39	1.80	20.34	0.00	52
44	138.35	143.30	125.80	138.41	143.30	125.83	138.38	134.56	0.06	20.95	0.00	52
45	138.41	143.30	125.83	140.50	142.74	126.66	139.44	134.63	2.25	21.70	0.00	52
46	140.50	142.74	126.66	142.60	142.18	127.56	141.54	134.78	2.28	23.18	0.00	52
47	142.60	142.18	127.56	143.49	141.95	127.96	143.04	134.91	0.98	24.24	0.00	52
48	143.49	141.95	127.96	143.99	141.81	128.19	143.74	134.98	0.55	24.73	0.00	52
49	143.99	141.81	128.19	144.79	141.60	128.57	144.39	135.04	0.88	25.20	0.00	52
50	144.79	141.60	128.57	146.79	141.07	129.55	145.77	135.19	2.23	26.21	0.00	53
51	146.79	141.07	129.55	148.79	140.53	130.60	147.77	135.43	2.26	27.68	0.00	54
52	148.79	140.53	130.60	150.79	140.00	131.71	149.76	135.71	2.29	29.16	0.00	54
53	150.79	140.00	131.71	153.03	139.40	133.05	151.86	136.03	2.60	30.75	0.00	54
54	153.03	139.40	133.05	155.26	138.81	134.47	154.07	136.42	2.65	32.46	0.00	54
55	155.26	138.81	134.47	157.50	138.21	135.99	156.26	136.84	2.70	34.20	0.00	53
56	157.50	138.21	135.99	159.74	137.61	137.61	158.25	137.27	2.76	35.98	15.71	16

Tabella 15-2 – Geometria e caratteristiche strisce della superficie 1 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	2335	0	21106	36913	0	0	40958	0	0	
2	6912	0	26443	36519	0	40958	80824	0	0	
3	11332	0	31266	35620	0	80824	118781	0	0	
4	15801	0	36001	34408	0	118781	154236	0	0	
5	20119	0	40857	34113	0	154236	187949	0	0	
6	26730	0	49908	37023	0	187949	222635	0	0	
7	31433	0	55001	36727	0	222635	254805	0	0	
8	33331	0	55539	33928	0	254805	282297	0	0	
9	37140	0	59562	33717	0	282297	307290	0	0	
10	41342	0	64218	33973	0	307290	329945	0	0	
11	44896	0	67870	33797	0	329945	349803	0	0	
12	55022	0	81146	38155	0	349803	368831	0	0	
13	59977	0	86470	38508	0	368831	384210	0	0	
14	40712	0	57784	24999	0	384210	392271	0	0	
15	46914	0	65850	28273	0	392271	399858	0	0	
16	47620	0	66102	28208	0	399858	405829	0	0	
17	26470	0	36434	15394	0	405829	408338	0	0	
18	58721	0	80079	33102	0	408338	411570	0	0	
19	60931	0	82136	33049	0	411570	411832	0	0	
20	57543	0	76797	30225	0	411832	409496	0	0	
21	59077	0	78163	30206	0	409496	404723	0	0	
22	66638	0	87437	33244	0	404723	396693	0	0	
23	71384	0	92908	34817	0	396693	385223	0	0	
24	60959	0	78790	29207	0	385223	373250	0	0	
25	61832	0	79453	29235	0	373250	359192	0	0	
26	62591	0	79996	29274	0	359192	343105	0	0	
27	47101	0	59935	21857	0	343105	329820	0	0	
28	82496	0	104474	38022	0	329820	304232	0	0	
29	27551	0	34761	12642	0	304232	295048	0	0	
30	46265	0	58231	21190	0	295048	278938	0	0	
31	46464	0	58316	21234	0	278938	261894	0	0	
32	41403	0	51833	18896	0	261894	245991	0	0	
33	86567	0	107994	39517	0	245991	210653	0	0	
34	38527	0	47910	17609	0	210653	194036	0	0	
35	37419	0	46449	17118	0	194036	177373	0	0	
36	72638	0	89948	33292	0	177373	143570	0	0	
37	72642	0	89672	33475	0	143570	107933	0	0	
38	72443	0	89149	33678	0	107933	70668	0	0	
39	31445	0	38611	14735	0	70668	53977	0	0	
40	45474	2370	58944	21636	0	53977	27031	0	0	
41	44523	2370	57562	21736	0	27031	319	0	0	
42	50593	2760	65205	25446	0	319	-30381	0	0	
43	60007	3380	77003	31371	0	-30381	-67167	0	0	
44	2090	120	2674	1118	0	-67167	-68454	0	0	
45	69788	0	82857	39245	0	-68454	-106046	0	0	
46	63553	0	73656	39665	0	-106046	-138112	0	0	
47	25086	0	28421	16988	0	-138112	-149895	0	0	
48	13590	0	15204	9582	0	-149895	-156009	0	0	
49	20978	0	23156	15389	0	-156009	-164996	0	0	
50	47817	0	50584	39186	0	-164996	-181935	0	0	
51	42072	0	40823	40923	0	-181935	-190830	0	0	
52	36080	0	31015	41499	0	-190830	-191843	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]	
53	32714	788	22807	47164	0	-191843	-183263	0	0	
54	24139	2358	10008	47833	0	-183263	-163718	0	0	
55	14844	3929	-3931	47720	0	-163718	-132188	0	0	
56	4978	5499	2730	17145	0	-132188	-124413	0	0	

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

### 15.2.2 ANALISI DELLA SUPERFICIE 60 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	58	
Coordinate del centro	X[m]= 94.92	Y[m]= 204.00
Raggio del cerchio	R[m]= 84.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 60.53	Y <sub>v</sub> [m]= 127.36
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 149.67	Y <sub>m</sub> [m]= 140.30
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.317</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	60.53	127.36	127.36	62.19	127.75	126.64	61.64	127.25	1.80	-23.55	0.00	54
2	62.19	127.75	126.64	63.84	128.14	125.96	63.10	127.12	1.79	-22.33	0.00	54
3	63.84	128.14	125.96	65.52	128.54	125.31	64.73	126.98	1.80	-21.10	0.00	52
4	65.52	128.54	125.31	67.19	128.93	124.71	66.39	126.87	1.78	-19.88	0.00	52
5	67.19	128.93	124.71	69.40	129.45	123.97	68.34	126.76	2.33	-18.48	0.00	52
6	69.40	129.45	123.97	71.60	129.97	123.30	70.54	126.67	2.31	-16.90	0.00	52
7	71.60	129.97	123.30	73.81	130.49	122.70	72.74	126.61	2.29	-15.34	0.00	52
8	73.81	130.49	122.70	75.47	130.88	122.28	74.65	126.59	1.71	-13.97	0.00	52
9	75.47	130.88	122.28	77.12	131.27	121.91	76.30	126.58	1.70	-12.81	0.00	52
10	77.12	131.27	121.91	78.97	131.70	121.53	78.06	126.60	1.89	-11.59	0.00	52
11	78.97	131.70	121.53	80.82	132.14	121.19	79.91	126.64	1.88	-10.30	0.00	52
12	80.82	132.14	121.19	81.14	132.21	121.14	80.98	126.67	0.32	-9.55	0.00	52
13	81.14	132.21	121.14	83.01	132.65	120.85	82.08	126.71	1.89	-8.80	0.00	52
14	83.01	132.65	120.85	84.88	133.09	120.60	83.95	126.80	1.89	-7.51	0.00	52
15	84.88	133.09	120.60	86.77	133.54	120.40	85.84	126.91	1.91	-6.21	0.00	52
16	86.77	133.54	120.40	88.67	133.98	120.23	87.73	127.04	1.90	-4.92	0.00	52
17	88.67	133.98	120.23	90.10	134.32	120.14	89.39	127.17	1.43	-3.78	0.00	52
18	90.10	134.32	120.14	90.82	134.49	120.10	90.46	127.26	0.72	-3.04	0.00	52
19	90.82	134.49	120.10	93.00	135.00	120.02	91.92	127.40	2.18	-2.05	0.00	52
20	93.00	135.00	120.02	94.42	135.00	120.00	93.71	127.51	1.42	-0.83	0.00	52
21	94.42	135.00	120.00	96.03	135.00	120.01	95.22	127.50	1.61	0.21	0.00	52
22	96.03	135.00	120.01	97.64	135.00	120.04	96.83	127.51	1.61	1.31	0.00	52
23	97.64	135.00	120.04	98.52	135.21	120.08	98.08	127.58	0.88	2.16	0.00	52
24	98.52	135.21	120.08	100.42	135.65	120.18	99.47	127.78	1.90	3.10	0.00	52
25	100.42	135.65	120.18	102.31	136.10	120.33	101.37	128.07	1.90	4.40	0.00	52
26	102.31	136.10	120.33	104.05	136.51	120.50	103.18	128.36	1.74	5.64	0.00	52
27	104.05	136.51	120.50	105.78	136.92	120.70	104.91	128.66	1.75	6.83	0.00	52
28	105.78	136.92	120.70	107.69	137.37	120.98	106.74	128.99	1.93	8.09	0.00	52
29	107.69	137.37	120.98	109.69	137.84	121.31	108.69	129.37	2.03	9.44	0.00	52
30	109.69	137.84	121.31	111.37	138.23	121.63	110.53	129.75	1.71	10.71	0.00	52
31	111.37	138.23	121.63	113.04	138.63	121.98	112.21	130.12	1.71	11.88	0.00	52
32	113.04	138.63	121.98	114.72	139.02	122.37	113.88	130.50	1.72	13.05	0.00	52
33	114.72	139.02	122.37	115.97	139.32	122.68	115.34	130.85	1.29	14.07	0.00	52
34	115.97	139.32	122.68	117.42	139.66	123.07	116.69	131.18	1.50	15.02	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]
35	117.42	139.66	123.07	118.86	140.00	123.48	118.14	131.55	1.50	16.05	0.00	52
36	118.86	140.00	123.48	120.60	140.41	124.02	119.73	131.98	1.82	17.18	0.00	52
37	120.60	140.41	124.02	122.34	140.82	124.60	121.47	132.46	1.83	18.43	0.00	52
38	122.34	140.82	124.60	123.45	141.08	125.00	122.90	132.87	1.18	19.46	0.00	52
39	123.45	141.08	125.00	124.57	141.34	125.41	124.01	133.20	1.19	20.26	0.00	52
40	124.57	141.34	125.41	125.56	141.57	125.79	125.06	133.53	1.06	21.03	0.00	52
41	125.56	141.57	125.79	126.52	141.80	126.17	126.04	133.83	1.03	21.75	0.00	52
42	126.52	141.80	126.17	128.38	142.24	126.95	127.45	134.29	2.02	22.79	0.00	52
43	128.38	142.24	126.95	130.24	142.67	127.79	129.31	134.91	2.04	24.17	0.00	52
44	130.24	142.67	127.79	132.10	143.11	128.68	131.17	135.56	2.06	25.57	0.00	52
45	132.10	143.11	128.68	132.15	143.12	128.70	132.12	135.90	0.06	26.29	0.00	52
46	132.15	143.12	128.70	132.91	143.30	129.08	132.53	136.05	0.85	26.60	0.00	52
47	132.91	143.30	129.08	133.98	143.30	129.63	133.44	136.33	1.20	27.30	0.00	52
48	133.98	143.30	129.63	135.28	143.30	130.33	134.62	136.64	1.48	28.21	0.00	54
49	135.28	143.30	130.33	136.66	143.30	131.10	135.96	137.01	1.58	29.26	0.00	54
50	136.66	143.30	131.10	138.35	143.30	132.10	137.49	137.45	1.96	30.46	0.00	54
51	138.35	143.30	132.10	138.41	143.30	132.13	138.38	137.71	0.07	31.16	0.00	54
52	138.41	143.30	132.13	140.50	142.74	133.45	139.43	137.90	2.47	32.02	0.00	54
53	140.50	142.74	133.45	142.60	142.18	134.84	141.51	138.29	2.52	33.73	0.00	54
54	142.60	142.18	134.84	143.49	141.95	135.47	143.04	138.61	1.09	34.95	0.00	54
55	143.49	141.95	135.47	143.99	141.81	135.82	143.74	138.76	0.61	35.53	0.00	54
56	143.99	141.81	135.82	145.59	141.39	137.00	144.75	139.00	1.99	36.42	0.00	54
57	145.59	141.39	137.00	147.63	140.84	138.60	146.50	139.43	2.59	37.98	0.00	53
58	147.63	140.84	138.60	149.67	140.30	140.30	148.31	139.91	2.66	39.77	15.54	16

Tabella 15-4 – Geometria e caratteristiche strisce della superficie 60 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	1850	0	16199	31096	0	0	33828	0	0	
2	5359	0	20389	31154	0	33828	67058	0	0	
3	8972	0	24226	30104	0	67058	98284	0	0	
4	12461	0	28174	29866	0	98284	128199	0	0	
5	21511	0	42776	39012	0	128199	165377	0	0	
6	27090	0	48871	38670	0	165377	199731	0	0	
7	32373	0	54532	38366	0	199731	231012	0	0	
8	27574	0	44369	28596	0	231012	252321	0	0	
9	30225	0	47112	28458	0	252321	271714	0	0	
10	36759	0	55691	31665	0	271714	291053	0	0	
11	39736	0	58683	31528	0	291053	307848	0	0	
12	7165	0	10442	5441	0	307848	310489	0	0	
13	43555	0	62693	31728	0	310489	324334	0	0	
14	46337	0	65445	31626	0	324334	335411	0	0	
15	49622	0	68923	31962	0	335411	343774	0	0	
16	52133	0	71345	31891	0	343774	349227	0	0	
17	40906	0	55334	24029	0	349227	351402	0	0	
18	21080	0	28320	12089	0	351402	351863	0	0	
19	65658	0	87449	36576	0	351863	350701	0	0	
20	43672	0	57606	23812	0	350701	348170	0	0	
21	49563	0	64883	26995	0	348170	344095	0	0	
22	49514	0	64318	27002	0	344095	338819	0	0	
23	27185	0	35111	14766	0	338819	335340	0	0	
24	59491	0	76387	31821	0	335340	325966	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
25	60643	0	77291	31868	0	325966	314083	0	0	
26	56344	0	71343	29233	0	314083	301106	0	0	
27	56977	0	71725	29299	0	301106	286217	0	0	
28	63273	0	79193	32347	0	286217	267738	0	0	
29	66664	0	82950	33994	0	267738	246199	0	0	
30	56046	0	69372	28611	0	246199	226552	0	0	
31	56035	0	69032	28728	0	226552	205598	0	0	
32	55898	0	68541	28858	0	205598	183462	0	0	
33	41519	0	50702	21608	0	183462	166261	0	0	
34	47757	0	58096	25086	0	166261	145719	0	0	
35	47422	0	57443	25211	0	145719	124566	0	0	
36	56550	0	68162	30538	0	124566	98426	0	0	
37	55895	0	66997	30752	0	98426	71650	0	0	
38	35414	0	42238	19828	0	71650	54244	0	0	
39	35046	0	41622	19929	0	54244	36720	0	0	
40	30792	0	36413	17784	0	36720	21095	0	0	
41	29572	0	34830	17330	0	21095	5890	0	0	
42	56447	0	66060	33827	0	5890	-23626	0	0	
43	55116	0	63864	34184	0	-23626	-52877	0	0	
44	53541	0	61275	34573	0	-52877	-81445	0	0	
45	1416	0	1609	935	0	-81445	-82200	0	0	
46	21357	0	24179	14251	0	-82200	-93570	0	0	
47	29226	2140	35801	20298	0	-93570	-111466	0	0	
48	33890	2600	40474	25753	0	-111466	-130609	0	0	
49	34017	2760	39800	27612	0	-130609	-148851	0	0	
50	38783	3380	44000	34226	0	-148851	-167889	0	0	
51	1318	120	1463	1224	0	-167889	-168493	0	0	
52	42001	0	37972	43135	0	-168493	-178188	0	0	
53	34119	0	24431	43971	0	-178188	-176408	0	0	
54	12073	0	6062	18956	0	-176408	-171856	0	0	
55	6144	0	2239	10726	0	-171856	-168252	0	0	
56	16006	0	467	34710	0	-168252	-150557	0	0	
57	13233	0	-12400	44072	0	-150557	-116421	0	0	
58	4369	0	-2368	11797	0	-116421	-108557	0	0	

Tabella 15-5 – Forze applicate sulle strisce [BISHOP] della superficie 60 della verifica di stabilità 11.

### 15.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u [m]
1	0.072156
2	0.038078
3	0.079636
4	0.059268
5	0.084092
6	0.030453
7	0.003151

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

Accelerazione sismica critica       $K_c = 0.115$   
 Spostamento massimo                 $U_{max} = 0.084092$  [m]  
 Velocità massima                         $V_{max} = 0.209356$  [m/s]

n°	u
	[m]
1	0.092988
2	0.056204
3	0.138142
4	0.079476
5	0.108825
6	0.042512
7	0.006680

Tabella 15-7 – Spostamenti della superficie 60 della verifica di stabilità 11.

Accelerazione sismica critica  $K_c = 0.096$   
Spostamento massimo  $U_{max} = 0.138142$  [m]  
Velocità massima  $V_{max} = 0.309040$  [m/s]

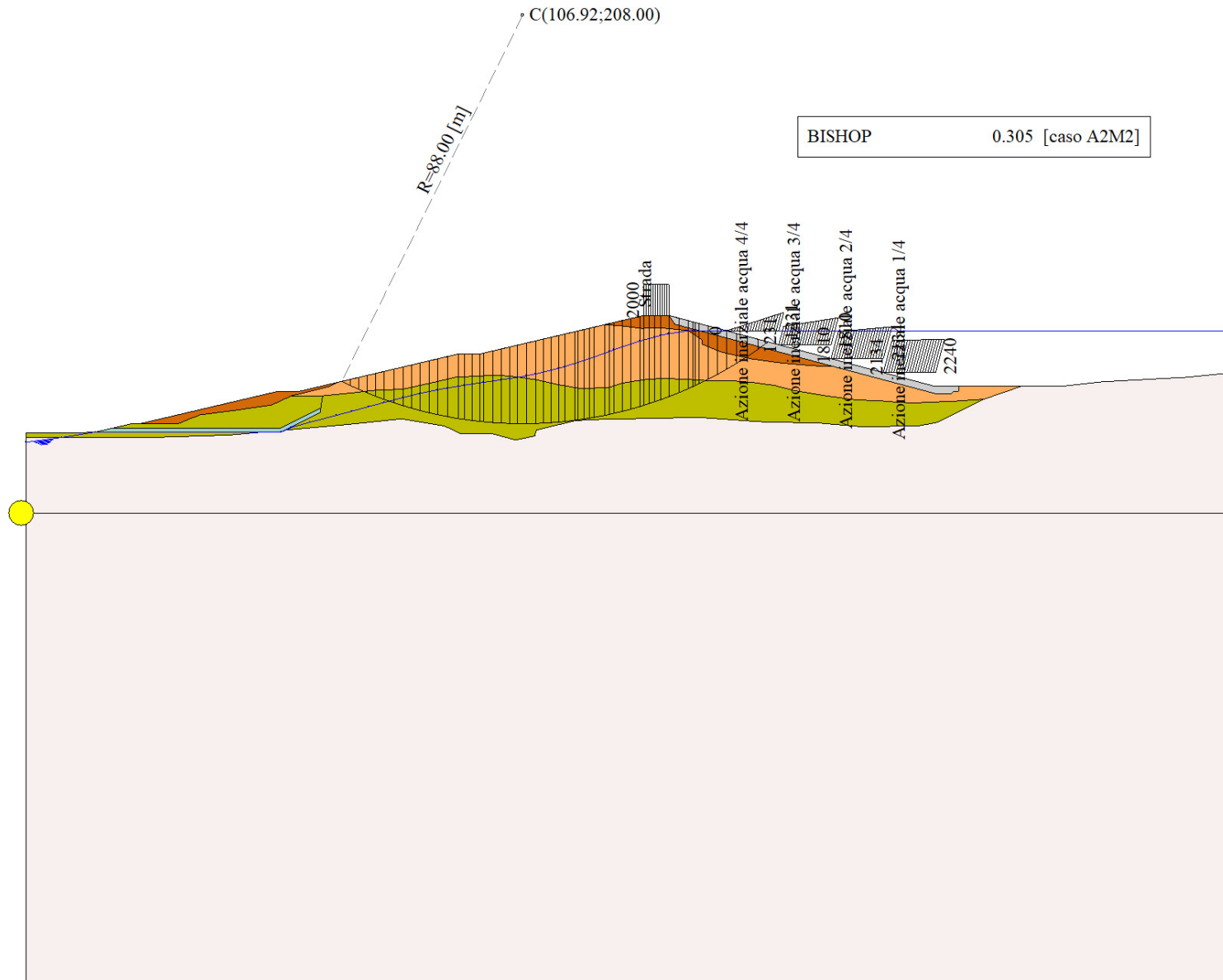


Figura 15-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 11.

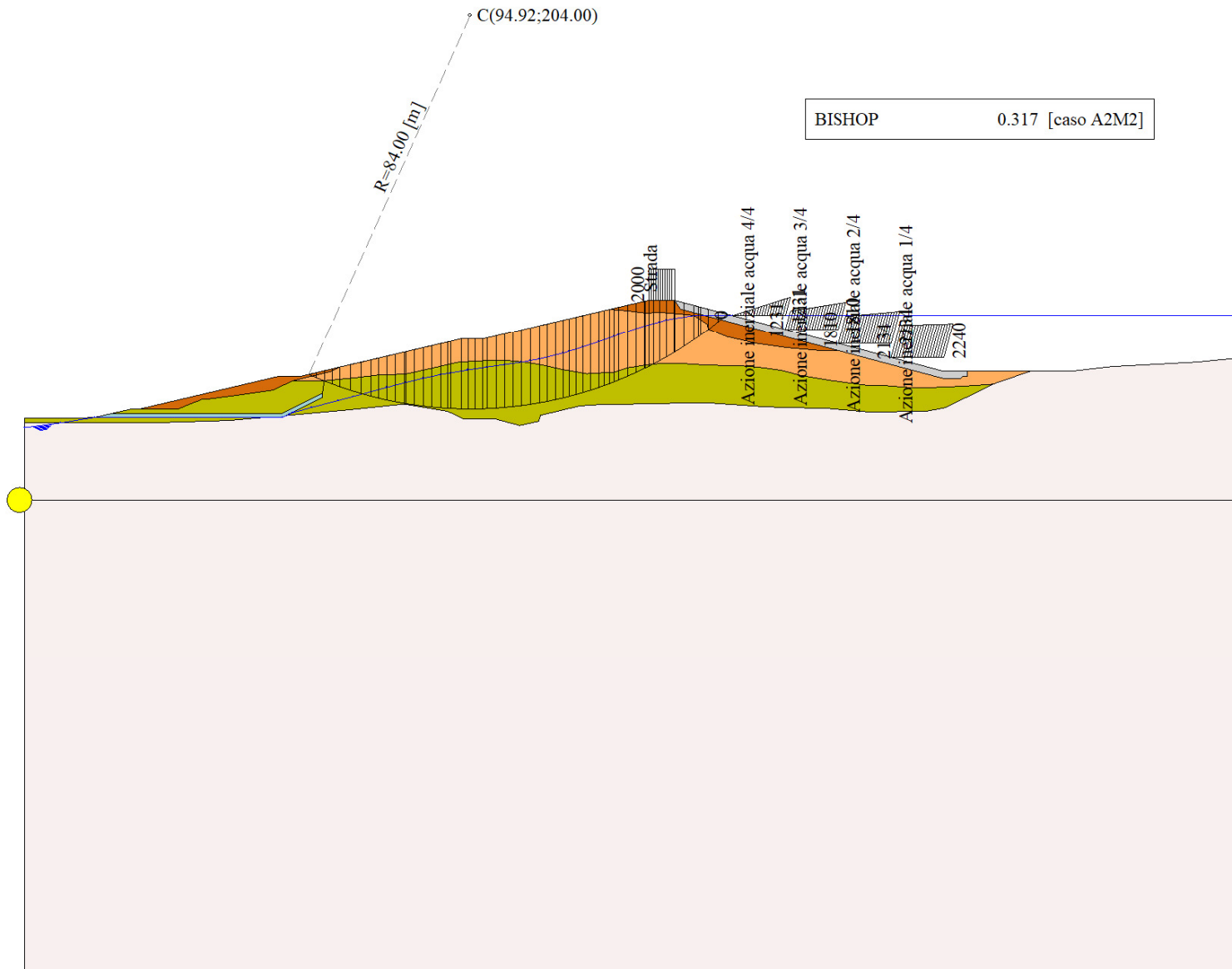


Figura 15-2 – Superficie critica (60) della sezione CR\_08 per la verifica di stabilità 11.

## 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	132.91 143.30	138.41 143.30	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	53508
Coefficiente di sicurezza minimo	1.874
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	66
Coordinate del centro	X[m]= 62.92                      Y[m]= 190.00
Raggio del cerchio	R[m]= 88.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 12.24                      Y <sub>v</sub> [m]= 118.06
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 137.51                      Y <sub>m</sub> [m]= 143.30
Coefficiente di sicurezza	F <sub>S</sub> = 1.874

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	12.24	118.06	118.06	14.95	118.20	116.22	14.05	117.49	3.27	-34.10	19.17	18
2	14.95	118.20	116.22	14.99	118.21	116.20	14.97	117.21	0.05	-33.02	19.27	19
3	14.99	118.21	116.20	16.73	118.60	115.10	15.94	117.01	2.05	-32.33	19.27	19
4	16.73	118.60	115.10	18.46	119.00	114.06	17.64	116.68	2.02	-31.00	19.27	19
5	18.46	119.00	114.06	19.61	119.26	113.40	19.05	116.43	1.33	-29.91	19.27	19
6	19.61	119.26	113.40	21.22	119.63	112.51	20.44	116.19	1.84	-28.88	19.27	19
7	21.22	119.63	112.51	22.83	120.00	111.66	22.05	115.95	1.82	-27.69	19.27	19
8	22.83	120.00	111.66	24.60	120.00	110.78	23.73	115.61	1.98	-26.46	19.27	19
9	24.60	120.00	110.78	27.57	120.70	109.41	26.14	115.22	3.28	-24.75	19.27	19
10	27.57	120.70	109.41	30.55	121.40	108.17	29.10	114.92	3.22	-22.63	19.27	19
11	30.55	121.40	108.17	33.52	122.10	107.05	32.07	114.68	3.18	-20.55	19.27	19
12	33.52	122.10	107.05	36.50	122.80	106.06	35.04	114.50	3.14	-18.49	19.27	19
13	36.50	122.80	106.06	39.47	123.50	105.18	38.01	114.38	3.10	-16.46	19.27	19
14	39.47	123.50	105.18	42.45	124.20	104.41	40.98	114.32	3.07	-14.45	19.27	19
15	42.45	124.20	104.41	45.42	124.90	103.76	43.95	114.32	3.05	-12.46	19.27	19
16	45.42	124.90	103.76	48.40	125.60	103.21	46.93	114.37	3.03	-10.48	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 [°]	β [°]	c [kPa]
17	48.40	125.60	103.21	51.37	126.30	102.76	49.90	114.47	3.01	-8.52	19.27	19
18	51.37	126.30	102.76	54.35	127.00	102.42	52.87	114.62	2.99	-6.56	19.27	19
19	54.35	127.00	102.42	54.96	127.00	102.36	54.66	114.69	0.61	-5.39	19.27	19
20	54.96	127.00	102.36	56.50	127.00	102.23	55.73	114.65	1.55	-4.69	19.27	19
21	56.50	127.00	102.23	57.12	127.00	102.19	56.81	114.61	0.62	-3.98	19.27	19
22	57.12	127.00	102.19	57.48	127.00	102.17	57.30	114.59	0.36	-3.66	19.27	19
23	57.48	127.00	102.17	59.00	127.00	102.09	58.24	114.56	1.52	-3.05	19.27	19
24	59.00	127.00	102.09	61.09	127.49	102.02	60.05	114.65	2.09	-1.87	19.27	19
25	61.09	127.49	102.02	63.97	128.17	102.01	62.54	114.92	2.88	-0.25	19.27	19
26	63.97	128.17	102.01	66.85	128.85	102.09	65.42	115.28	2.88	1.62	19.27	19
27	66.85	128.85	102.09	67.19	128.93	102.10	67.02	115.49	0.34	2.67	19.27	19
28	67.19	128.93	102.10	70.05	129.60	102.29	68.62	115.73	2.87	3.71	19.27	19
29	70.05	129.60	102.29	71.93	130.04	102.46	70.99	116.10	1.89	5.26	19.27	19
30	71.93	130.04	102.46	73.81	130.49	102.68	72.87	116.42	1.89	6.49	19.27	19
31	73.81	130.49	102.68	75.47	130.88	102.90	74.64	116.73	1.67	7.65	19.27	19
32	75.47	130.88	102.90	77.12	131.27	103.15	76.29	117.05	1.67	8.74	19.27	19
33	77.12	131.27	103.15	79.13	131.74	103.51	78.13	117.42	2.04	9.95	19.27	19
34	79.13	131.74	103.51	81.14	132.21	103.91	80.14	117.84	2.05	11.28	19.27	19
35	81.14	132.21	103.91	83.01	132.65	104.32	82.08	118.27	1.92	12.57	19.27	19
36	83.01	132.65	104.32	84.88	133.09	104.78	83.94	118.71	1.93	13.82	19.27	19
37	84.88	133.09	104.78	86.77	133.54	105.29	85.83	119.18	1.96	15.09	19.27	19
38	86.77	133.54	105.29	88.67	133.98	105.85	87.72	119.67	1.98	16.37	19.27	19
39	88.67	133.98	105.85	90.82	134.49	106.54	89.74	120.21	2.26	17.75	19.27	19
40	90.82	134.49	106.54	93.00	135.00	107.30	91.91	120.83	2.31	19.24	19.27	19
41	93.00	135.00	107.30	94.42	135.00	107.83	93.71	121.28	1.52	20.48	19.27	19
42	94.42	135.00	107.83	96.03	135.00	108.47	95.22	121.57	1.73	21.54	19.27	19
43	96.03	135.00	108.47	97.64	135.00	109.14	96.83	121.90	1.74	22.67	19.27	19
44	97.64	135.00	109.14	98.52	135.21	109.52	98.08	122.22	0.96	23.55	19.27	19
45	98.52	135.21	109.52	100.42	135.65	110.39	99.46	122.69	2.08	24.54	19.27	19
46	100.42	135.65	110.39	102.31	136.10	111.31	101.36	123.36	2.11	25.90	19.27	19
47	102.31	136.10	111.31	104.05	136.51	112.20	103.17	124.03	1.95	27.23	19.27	19
48	104.05	136.51	112.20	105.78	136.92	113.14	104.91	124.69	1.97	28.50	19.27	19
49	105.78	136.92	113.14	107.69	137.37	114.24	106.73	125.41	2.20	29.86	19.27	19
50	107.69	137.37	114.24	109.69	137.84	115.46	108.68	126.22	2.34	31.34	19.27	19
51	109.69	137.84	115.46	112.20	138.43	117.10	110.94	127.20	3.00	33.08	19.27	19
52	112.20	138.43	117.10	114.72	139.02	118.86	113.45	128.35	3.07	35.06	19.27	19
53	114.72	139.02	118.86	115.97	139.32	119.79	115.34	129.24	1.56	36.57	19.27	19
54	115.97	139.32	119.79	118.14	139.83	121.48	117.04	130.10	2.75	37.97	19.14	18
55	118.14	139.83	121.48	118.86	140.00	122.07	118.50	130.84	0.93	39.17	19.10	18
56	118.86	140.00	122.07	120.60	140.41	123.54	119.72	131.50	2.28	40.21	19.10	18
57	120.60	140.41	123.54	122.34	140.82	125.09	121.46	132.46	2.33	41.71	19.10	18
58	122.34	140.82	125.09	124.57	141.34	127.20	123.44	133.60	3.07	43.47	19.10	18
59	124.57	141.34	127.20	125.56	141.57	128.19	125.06	134.57	1.40	44.93	19.35	18
60	125.56	141.57	128.19	125.61	141.58	128.24	125.58	134.90	0.07	45.41	19.78	18
61	125.61	141.58	128.24	126.52	141.80	129.18	126.06	135.20	1.31	45.85	19.78	18
62	126.52	141.80	129.18	129.31	142.45	132.24	127.87	136.39	4.14	47.63	19.78	18
63	129.31	142.45	132.24	132.10	143.11	135.61	130.63	138.30	4.38	50.40	19.78	18
64	132.10	143.11	135.61	132.91	143.30	136.66	132.50	139.66	1.32	52.26	19.78	18
65	132.91	143.30	136.66	135.24	143.30	139.86	133.95	140.70	3.96	53.98	19.78	18
66	135.24	143.30	139.86	137.51	143.30	143.30	136.00	142.15	4.12	56.61	18.07	19

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	5671	0	7298	4611	2672	0	9408	0	0	
2	187	0	175	87	104	9408	9634	0	0	
3	10194	0	9279	3874	5236	9634	20670	0	0	
4	15582	0	13655	4660	7325	20670	35471	0	0	
5	13233	0	11346	3503	5937	35471	47126	0	0	
6	22303	0	18814	5430	9653	47126	65631	0	0	
7	26585	0	22059	6014	11122	65631	86377	0	0	
8	33231	0	26837	7072	13801	86377	110814	0	0	
9	65250	0	51278	12987	26557	110814	155192	0	0	
10	77942	0	60187	14594	30342	155192	203498	0	0	
11	89824	0	68294	16058	33652	203498	254318	0	0	
12	101078	0	75872	17430	36539	254318	306502	0	0	
13	111590	0	82840	18693	39043	306502	358966	0	0	
14	121253	0	89131	19835	41196	358966	410698	0	0	
15	130202	0	94932	20891	43026	410698	460859	0	0	
16	138481	0	100323	21874	44555	460859	508726	0	0	
17	146082	0	105324	22789	45801	508726	553647	0	0	
18	153009	0	109962	23640	46776	553647	595048	0	0	
19	32002	0	22915	4914	9693	595048	603004	0	0	
20	81142	0	61186	13027	21296	603004	622727	0	0	
21	32918	0	25121	5335	8248	622727	630366	0	0	
22	19142	0	13832	2957	5539	630366	634554	0	0	
23	80963	0	57125	12246	24605	634554	651129	0	0	
24	112635	0	78334	16796	34911	651129	671616	0	0	
25	158815	0	108648	23275	50272	671616	695595	0	0	
26	162691	0	109857	23501	52234	695595	714499	0	0	
27	19420	0	13041	2788	6269	714499	716385	0	0	
28	164901	0	110050	23522	53671	716385	729251	0	0	
29	109800	0	72671	15528	36163	729251	734732	0	0	
30	110713	0	72864	15568	36793	734732	737801	0	0	
31	98089	0	64214	13722	32912	737801	738468	0	0	
32	98526	0	64255	13735	33317	738468	737215	0	0	
33	120061	0	77974	16676	40995	737215	733083	0	0	
34	120309	0	77887	16669	41468	733083	726080	0	0	
35	111991	0	72051	15441	39248	726080	716923	0	0	
36	111903	0	71955	15433	39489	716923	705282	0	0	
37	113128	0	72191	15516	40794	705282	690849	0	0	
38	112671	0	72087	15510	40789	690849	673915	0	0	
39	127035	0	81068	17480	46721	673915	651605	0	0	
40	127602	0	81908	17690	47067	651605	625816	0	0	
41	81826	0	52694	11412	30391	625816	607436	0	0	
42	90758	0	58278	12679	34288	607436	585246	0	0	
43	88498	0	56852	12427	33864	585246	561750	0	0	
44	47550	0	30631	6716	18313	561750	548351	0	0	
45	101050	0	65555	14404	38953	548351	518048	0	0	
46	98992	0	64977	14321	38117	518048	485890	0	0	
47	88573	0	58831	13012	34083	485890	454952	0	0	
48	86401	0	58115	12903	33196	454952	422716	0	0	
49	92422	0	63420	14131	35040	422716	385943	0	0	
50	93494	0	65247	14617	35320	385943	346116	0	0	
51	112432	0	80681	18185	41658	346116	294575	0	0	
52	105882	0	77438	17654	39526	294575	241838	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
53	49999	0	37524	8625	18331	241838	215489	0	0	
54	82306	0	62976	14364	30219	215489	169475	0	0	
55	26019	0	20191	4620	9605	169475	154237	0	0	
56	60032	0	47452	10949	21901	154237	117822	0	0	
57	55882	0	44995	10545	20466	117822	82137	0	0	
58	65062	0	53901	12902	23521	82137	38233	0	0	
59	26416	0	22291	5541	9493	38233	19709	0	0	
60	1295	0	1112	285	444	19709	18801	0	0	
61	22914	0	19810	5109	7825	18801	2529	0	0	
62	61985	0	54734	14647	21183	2529	-43686	0	0	
63	48456	0	46535	13312	13394	-43686	-81378	0	0	
64	11324	0	11731	3576	2149	-81378	-90164	0	0	
65	23412	6058	34913	10666	529	-90164	-112557	0	0	
66	7945	5892	14773	6834	0	-112557	-121130	0	0	

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

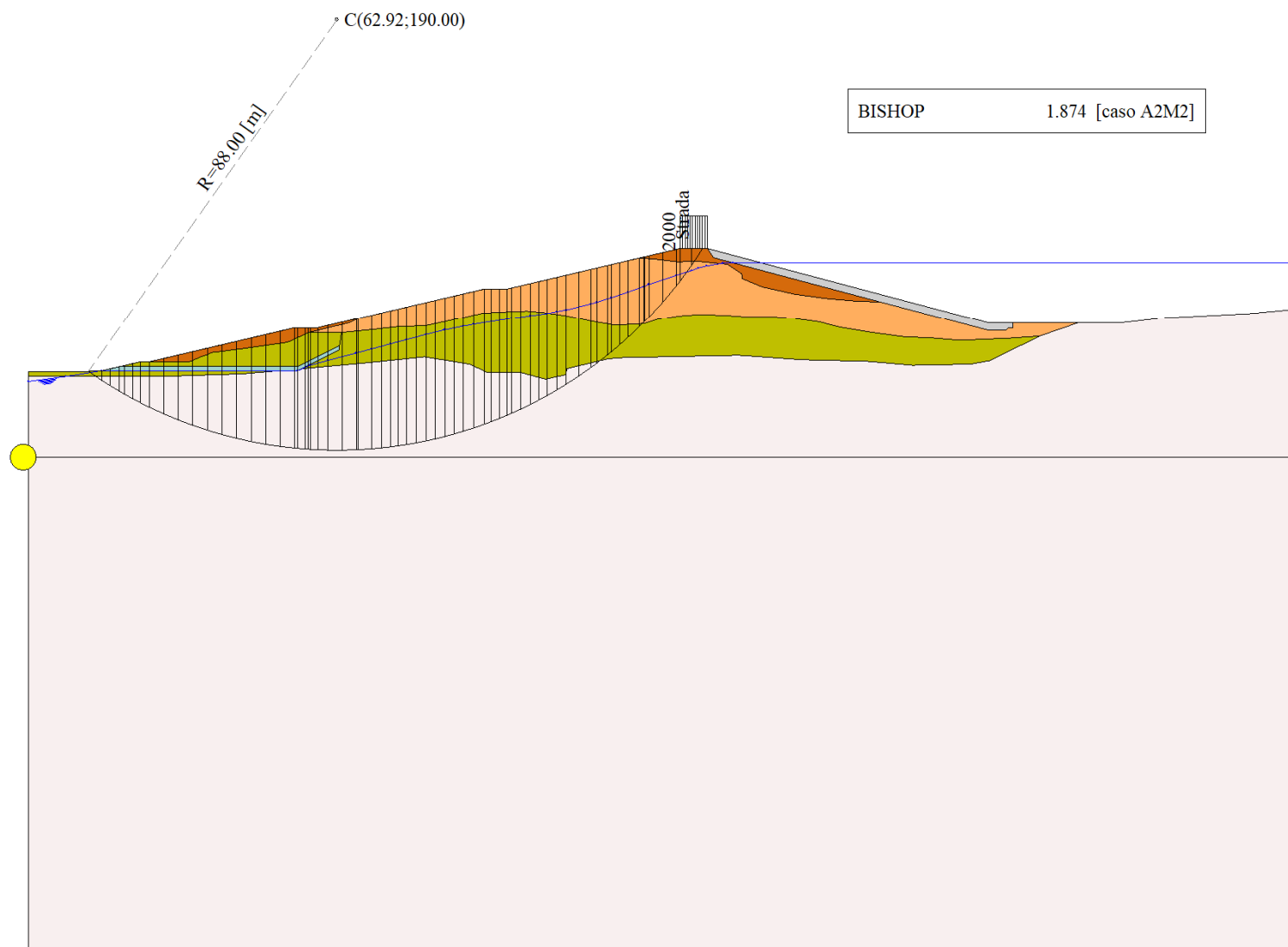


Figura 16-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 12.

## 17 VERIFICA DI STABILITÀ 13

### 17.1.1 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	132.91	138.41	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	53508
Coefficiente di sicurezza minimo	1.495
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	58
Coordinate del centro	X[m]= 92.92                      Y[m]= 192.00
Raggio del cerchio	R[m]= 72.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 60.99                      Y <sub>v</sub> [m]= 127.47
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 144.43                      Y <sub>m</sub> [m]= 141.69
Coefficiente di sicurezza	F <sub>s</sub> = 1.495

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	60.99	127.47	127.47	62.41	127.80	126.78	61.94	127.35	1.58	-25.70	0.00	54
2	62.41	127.80	126.78	63.84	128.14	126.13	63.20	127.21	1.57	-24.44	0.00	54
3	63.84	128.14	126.13	65.52	128.54	125.42	64.74	127.05	1.82	-23.10	0.00	52
4	65.52	128.54	125.42	67.19	128.93	124.75	66.39	126.91	1.80	-21.66	0.00	52
5	67.19	128.93	124.75	68.84	129.32	124.14	68.05	126.79	1.76	-20.24	0.00	52
6	68.84	129.32	124.14	70.50	129.71	123.58	69.70	126.69	1.75	-18.84	0.00	52
7	70.50	129.71	123.58	72.16	130.10	123.06	71.35	126.61	1.73	-17.45	0.00	52
8	72.16	130.10	123.06	73.81	130.49	122.58	73.00	126.56	1.72	-16.08	0.00	52
9	73.81	130.49	122.58	75.47	130.88	122.15	74.65	126.52	1.71	-14.71	0.00	52
10	75.47	130.88	122.15	77.12	131.27	121.76	76.30	126.51	1.70	-13.35	0.00	52
11	77.12	131.27	121.76	78.97	131.70	121.36	78.06	126.52	1.89	-11.92	0.00	52
12	78.97	131.70	121.36	80.82	132.14	121.02	79.91	126.56	1.88	-10.42	0.00	52
13	80.82	132.14	121.02	81.14	132.21	120.97	80.98	126.59	0.32	-9.55	0.00	52
14	81.14	132.21	120.97	83.01	132.65	120.69	82.08	126.63	1.89	-8.66	0.00	52
15	83.01	132.65	120.69	84.88	133.09	120.45	83.95	126.72	1.88	-7.16	0.00	52
16	84.88	133.09	120.45	86.77	133.54	120.26	85.84	126.84	1.90	-5.65	0.00	52
17	86.77	133.54	120.26	88.67	133.98	120.13	87.73	126.98	1.90	-4.14	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	88.67	133.98	120.13	90.10	134.32	120.06	89.39	127.12	1.43	-2.81	0.00	52
19	90.10	134.32	120.06	90.82	134.49	120.03	90.46	127.22	0.72	-1.96	0.00	52
20	90.82	134.49	120.03	91.91	134.74	120.01	91.37	127.32	1.09	-1.24	0.00	52
21	91.91	134.74	120.01	93.00	135.00	120.00	92.46	127.44	1.09	-0.37	0.00	52
22	93.00	135.00	120.00	94.42	135.00	120.02	93.71	127.50	1.42	0.63	0.00	52
23	94.42	135.00	120.02	96.03	135.00	120.07	95.22	127.52	1.61	1.83	0.00	52
24	96.03	135.00	120.07	97.64	135.00	120.15	96.83	127.56	1.61	3.12	0.00	52
25	97.64	135.00	120.15	98.52	135.21	120.22	98.08	127.65	0.88	4.11	0.00	52
26	98.52	135.21	120.22	100.42	135.65	120.39	99.47	127.87	1.90	5.22	0.00	52
27	100.42	135.65	120.39	102.31	136.10	120.61	101.36	128.19	1.91	6.73	0.00	52
28	102.31	136.10	120.61	104.05	136.51	120.86	103.18	128.52	1.75	8.19	0.00	52
29	104.05	136.51	120.86	105.78	136.92	121.16	104.91	128.86	1.76	9.59	0.00	52
30	105.78	136.92	121.16	107.69	137.37	121.53	106.74	129.24	1.95	11.06	0.00	52
31	107.69	137.37	121.53	109.69	137.84	121.98	108.69	129.68	2.05	12.65	0.00	52
32	109.69	137.84	121.98	111.37	138.23	122.40	110.53	130.11	1.73	14.16	0.00	52
33	111.37	138.23	122.40	113.04	138.63	122.87	112.20	130.53	1.74	15.54	0.00	52
34	113.04	138.63	122.87	114.72	139.02	123.38	113.88	130.97	1.75	16.93	0.00	52
35	114.72	139.02	123.38	115.97	139.32	123.79	115.34	131.38	1.32	18.15	0.00	52
36	115.97	139.32	123.79	117.42	139.66	124.29	116.69	131.76	1.53	19.28	0.00	52
37	117.42	139.66	124.29	118.86	140.00	124.84	118.14	132.19	1.54	20.50	0.00	52
38	118.86	140.00	124.84	120.60	140.41	125.53	119.73	132.69	1.87	21.86	0.00	52
39	120.60	140.41	125.53	122.34	140.82	126.28	121.47	133.26	1.90	23.36	0.00	52
40	122.34	140.82	126.28	123.45	141.08	126.80	122.90	133.74	1.23	24.61	0.00	52
41	123.45	141.08	126.80	124.57	141.34	127.33	124.01	134.14	1.24	25.59	0.00	52
42	124.57	141.34	127.33	125.56	141.57	127.82	125.06	134.52	1.11	26.52	0.00	52
43	125.56	141.57	127.82	125.61	141.58	127.85	125.58	134.71	0.06	26.98	0.00	53
44	125.61	141.58	127.85	126.52	141.80	128.32	126.06	134.89	1.03	27.41	0.00	54
45	126.52	141.80	128.32	128.21	142.20	129.24	127.36	135.39	1.92	28.58	0.00	54
46	128.21	142.20	129.24	130.16	142.65	130.38	129.17	136.11	2.25	30.25	0.00	54
47	130.16	142.65	130.38	132.10	143.11	131.59	131.12	136.93	2.29	32.05	0.00	54
48	132.10	143.11	131.59	132.91	143.30	132.13	132.50	137.53	0.97	33.35	0.00	54
49	132.91	143.30	132.13	134.07	143.30	132.92	133.49	137.91	1.41	34.30	0.00	54
50	134.07	143.30	132.92	135.24	143.30	133.75	134.65	138.32	1.43	35.43	0.00	54
51	135.24	143.30	133.75	136.60	143.30	134.76	135.91	138.77	1.70	36.67	0.00	54
52	136.60	143.30	134.76	138.29	143.30	136.09	137.42	139.35	2.15	38.20	0.00	54
53	138.29	143.30	136.09	138.41	143.30	136.19	138.35	139.72	0.15	39.12	0.00	54
54	138.41	143.30	136.19	140.02	142.87	137.54	139.18	139.97	2.10	40.02	0.00	54
55	140.02	142.87	137.54	141.63	142.44	138.98	140.77	140.44	2.16	41.71	0.00	54
56	141.63	142.44	138.98	142.51	142.21	139.80	142.04	140.85	1.20	43.05	0.00	54
57	142.51	142.21	139.80	143.71	141.89	140.97	143.02	141.18	1.67	44.20	9.57	30
58	143.71	141.89	140.97	144.43	141.69	141.69	143.95	141.52	1.02	45.27	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	1472	0	4415	5779	0	0	7122	0	0	
2	4262	0	7317	5799	0	7122	15429	0	0	
3	8486	0	12005	6518	0	15429	26134	0	0	
4	12196	0	15666	6408	0	26134	37870	0	0	
5	15537	0	18871	6271	0	37870	50282	0	0	
6	18880	0	22070	6217	0	50282	63293	0	0	
7	22073	0	25078	6168	0	63293	76699	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]	
8	25117	0	27904	6124	0	76699	90310	0	0	
9	28009	0	30556	6084	0	90310	103954	0	0	
10	30729	0	33019	6048	0	103954	117464	0	0	
11	37376	0	39620	6723	0	117464	132228	0	0	
12	40383	0	42291	6688	0	132228	146456	0	0	
13	7279	0	7575	1154	0	146456	148850	0	0	
14	44208	0	45743	6725	0	148850	162390	0	0	
15	46959	0	48170	6701	0	162390	175044	0	0	
16	50192	0	51107	6771	0	175044	186816	0	0	
17	52613	0	53240	6755	0	186816	197397	0	0	
18	41193	0	41493	5090	0	197397	204519	0	0	
19	21196	0	21296	2561	0	204519	207806	0	0	
20	32633	0	32725	3876	0	207806	212388	0	0	
21	33253	0	33279	3876	0	212388	216479	0	0	
22	43684	0	43631	5049	0	216479	221049	0	0	
23	49437	0	49279	5727	0	221049	225195	0	0	
24	49224	0	48985	5733	0	225195	228256	0	0	
25	26952	0	26796	3137	0	228256	229464	0	0	
26	58787	0	58414	6766	0	229464	230889	0	0	
27	59643	0	59257	6784	0	230889	230678	0	0	
28	55143	0	54814	6232	0	230678	229037	0	0	
29	55476	0	55205	6256	0	229037	226010	0	0	
30	61243	0	61050	6919	0	226010	221086	0	0	
31	64077	0	64036	7288	0	221086	214170	0	0	
32	53485	0	53609	6148	0	214170	207019	0	0	
33	53086	0	53379	6187	0	207019	198682	0	0	
34	52532	0	53015	6231	0	198682	189208	0	0	
35	38723	0	39217	4677	0	189208	181437	0	0	
36	44198	0	44920	5443	0	181437	171743	0	0	
37	43494	0	44384	5485	0	171743	161334	0	0	
38	51296	0	52597	6666	0	161334	147934	0	0	
39	50032	0	51589	6739	0	147934	133662	0	0	
40	31318	0	32449	4360	0	133662	124116	0	0	
41	30669	0	31899	4395	0	124116	114304	0	0	
42	26659	0	27831	3934	0	114304	105399	0	0	
43	1332	0	1391	203	0	105399	104948	0	0	
44	24018	0	25087	3794	0	104948	96767	0	0	
45	43400	0	45542	7124	0	96767	81233	0	0	
46	47816	0	50491	8334	0	81233	63000	0	0	
47	45259	0	48081	8495	0	63000	44682	0	0	
48	18027	0	19219	3589	0	44682	37113	0	0	
49	24647	3029	29941	5220	0	37113	24553	0	0	
50	22807	3029	27942	5292	0	24553	12666	0	0	
51	24206	3536	29915	6277	0	12666	-167	0	0	
52	26261	4394	32746	7961	0	-167	-14163	0	0	
53	1700	312	2128	573	0	-14163	-15062	0	0	
54	19789	0	19306	7782	0	-15062	-21517	0	0	
55	14016	0	11660	7984	0	-21517	-23316	0	0	
56	5153	0	2887	4458	0	-23316	-22030	0	0	
57	4003	0	1982	3703	0	-22030	-20757	0	0	
58	597	0	663	183	0	-20757	-21099	0	0	

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

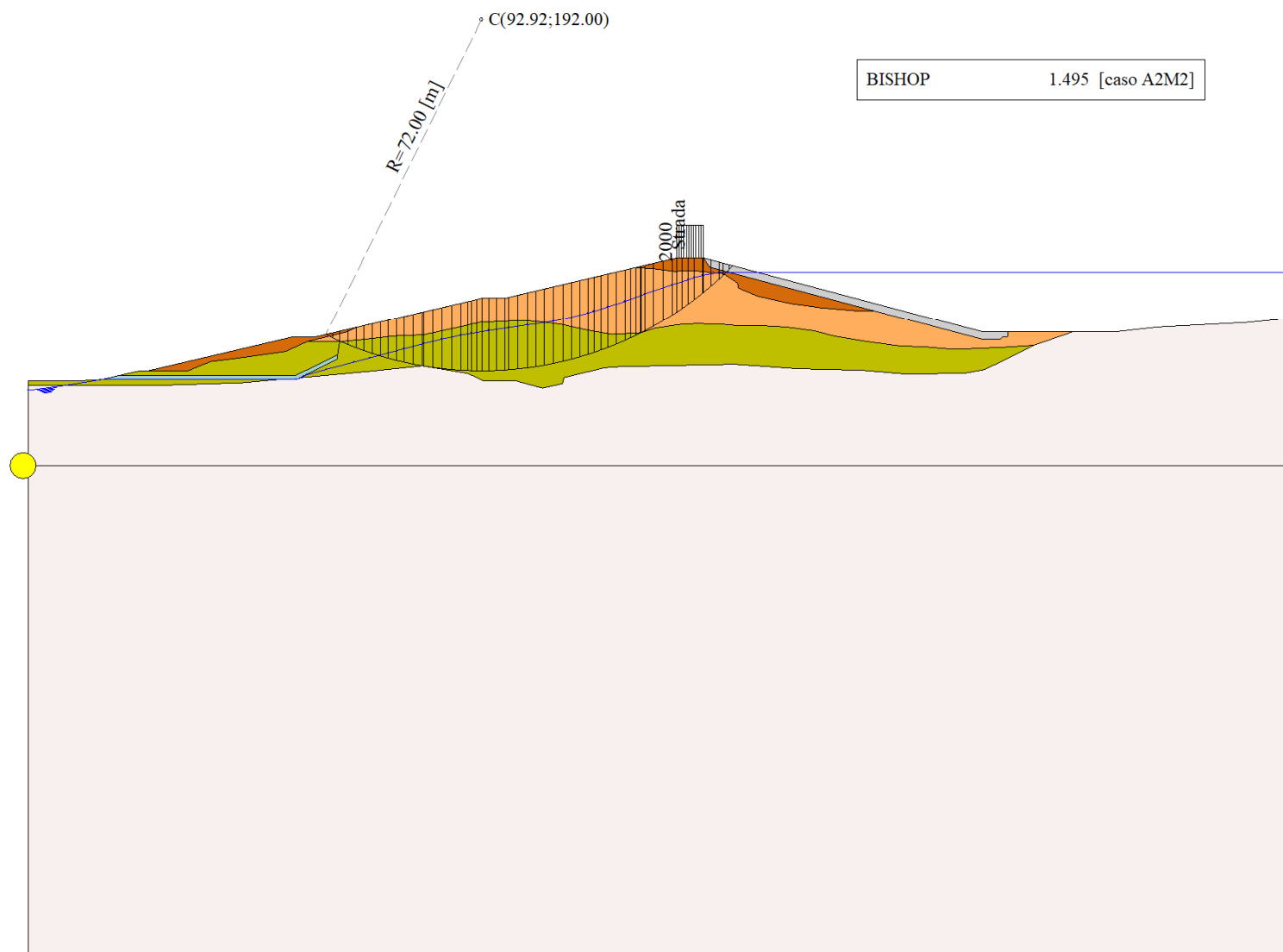


Figura 17-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 13.



## 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	121.59 143.30	127.09 143.30	2000 2000	0 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 41950

Coefficiente di sicurezza minimo 1.872

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 49

Coordinate del centro X[m]= 83.58 Y[m]= 172.00

Raggio del cerchio R[m]= 52.00

Intersezione a valle con il profilo topografico X<sub>v</sub>[m]= 55.87 Y<sub>v</sub>[m]= 128.00

Intersezione a monte con il profilo topografico X<sub>m</sub>[m]= 126.94 Y<sub>m</sub>[m]= 143.30

Coefficiente di sicurezza F<sub>S</sub>= 1.872

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	55.87	128.00	128.00	57.54	128.00	126.99	56.98	127.66	1.95	-31.13	19.78	18
2	57.54	128.00	126.99	59.21	128.00	126.06	58.46	127.24	1.91	-29.00	19.78	18
3	59.21	128.00	126.06	59.98	128.00	125.66	59.61	126.93	0.87	-27.47	19.78	18
4	59.98	128.00	125.66	61.39	128.00	124.97	60.72	126.65	1.57	-26.13	19.78	18
5	61.39	128.00	124.97	62.80	128.00	124.33	62.12	126.32	1.55	-24.41	19.32	18
6	62.80	128.00	124.33	64.21	128.00	123.74	63.52	126.02	1.53	-22.71	19.10	18
7	64.21	128.00	123.74	65.75	128.41	123.15	65.01	125.82	1.65	-20.96	19.10	18
8	65.75	128.41	123.15	67.30	128.82	122.62	66.55	125.75	1.63	-19.15	19.10	18
9	67.30	128.82	122.62	68.84	129.23	122.13	68.09	125.70	1.62	-17.36	19.10	18
10	68.84	129.23	122.13	70.09	129.57	121.78	69.47	125.68	1.30	-15.75	19.10	18
11	70.09	129.57	121.78	71.34	129.90	121.46	70.72	125.68	1.29	-14.33	19.10	18
12	71.34	129.90	121.46	72.98	130.34	121.09	72.17	125.70	1.68	-12.69	19.10	18
13	72.98	130.34	121.09	74.63	130.78	120.78	73.81	125.75	1.67	-10.84	19.10	18
14	74.63	130.78	120.78	76.27	131.22	120.52	75.46	125.82	1.66	-9.00	19.10	18
15	76.27	131.22	120.52	77.91	131.65	120.31	77.10	125.92	1.66	-7.17	19.10	18
16	77.91	131.65	120.31	79.68	132.12	120.15	78.80	126.06	1.78	-5.28	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>s</sub> [°]	α <sub>d</sub> [°]	c [kPa]
17	79.68	132.12	120.15	80.63	132.38	120.08	80.16	126.18	0.95	-3.78	19.10	18
18	80.63	132.38	120.08	81.58	132.63	120.04	81.11	126.28	0.95	-2.73	19.10	18
19	81.58	132.63	120.04	83.08	133.03	120.00	82.33	126.43	1.50	-1.38	19.10	18
20	83.08	133.03	120.00	84.58	133.43	120.01	83.83	126.62	1.50	0.28	19.10	18
21	84.58	133.43	120.01	86.08	133.83	120.06	85.33	126.83	1.50	1.93	19.10	18
22	86.08	133.83	120.06	87.58	134.23	120.15	86.83	127.07	1.50	3.58	19.10	18
23	87.58	134.23	120.15	88.97	134.60	120.28	88.28	127.32	1.40	5.18	19.10	18
24	88.97	134.60	120.28	90.06	134.89	120.40	89.51	127.54	1.09	6.55	19.10	18
25	90.06	134.89	120.40	91.14	135.18	120.55	90.60	127.76	1.10	7.76	19.10	18
26	91.14	135.18	120.55	92.55	135.56	120.78	91.85	128.02	1.43	9.15	19.10	18
27	92.55	135.56	120.78	93.96	135.93	121.05	93.26	128.33	1.44	10.72	19.10	18
28	93.96	135.93	121.05	95.37	136.31	121.35	94.67	128.66	1.44	12.31	19.10	18
29	95.37	136.31	121.35	96.78	136.68	121.70	96.08	129.01	1.45	13.90	19.10	18
30	96.78	136.68	121.70	98.42	137.12	122.16	97.60	129.42	1.70	15.64	19.10	18
31	98.42	137.12	122.16	100.06	137.56	122.68	99.24	129.88	1.72	17.53	19.10	18
32	100.06	137.56	122.68	101.69	137.99	123.26	100.87	130.37	1.74	19.43	19.10	18
33	101.69	137.99	123.26	103.33	138.43	123.90	102.51	130.89	1.76	21.35	19.10	18
34	103.33	138.43	123.90	104.62	138.78	124.45	103.98	131.39	1.41	23.10	19.10	18
35	104.62	138.78	124.45	105.92	139.12	125.04	105.27	131.85	1.42	24.66	19.10	18
36	105.92	139.12	125.04	107.21	139.47	125.68	106.56	132.33	1.44	26.23	19.10	18
37	107.21	139.47	125.68	108.81	139.89	126.53	108.00	132.89	1.81	28.03	19.10	18
38	108.81	139.89	126.53	110.41	140.32	127.45	109.60	133.55	1.85	30.04	19.10	18
39	110.41	140.32	127.45	112.00	140.74	128.46	111.20	134.24	1.89	32.10	19.10	18
40	112.00	140.74	128.46	113.60	141.17	129.54	112.79	134.97	1.93	34.20	19.24	18
41	113.60	141.17	129.54	115.20	141.60	130.72	114.39	135.75	1.98	36.36	19.78	18
42	115.20	141.60	130.72	116.80	142.02	131.99	115.99	136.58	2.04	38.58	19.78	18
43	116.80	142.02	131.99	118.39	142.45	133.37	117.58	137.45	2.11	40.87	19.78	18
44	118.39	142.45	133.37	119.99	142.87	134.88	119.18	138.38	2.19	43.24	19.78	18
45	119.99	142.87	134.88	121.59	143.30	136.51	120.77	139.38	2.29	45.71	19.78	18
46	121.59	143.30	136.51	122.93	143.30	138.00	122.23	140.26	2.00	48.07	19.78	18
47	122.93	143.30	138.00	124.27	143.30	139.62	123.56	141.03	2.10	50.33	19.78	18
48	124.27	143.30	139.62	125.60	143.30	141.37	124.87	141.85	2.21	52.70	18.88	19
49	125.60	143.30	141.37	126.94	143.30	143.30	126.05	142.66	2.35	55.21	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	1633	0	2381	2415	985	0	3807	0	0	
2	4765	0	4137	2711	2814	3807	9548	0	0	
3	3233	0	2491	1349	1854	9548	12749	0	0	
4	7441	0	5352	2603	4212	12749	19297	0	0	
5	9305	0	6250	2678	5183	19297	26460	0	0	
6	11111	0	7155	2789	6057	26460	34134	0	0	
7	14623	0	9407	3325	7525	34134	43296	0	0	
8	17542	0	11492	3692	8359	43296	53296	0	0	
9	20287	0	13419	4033	9097	53296	63863	0	0	
10	18341	0	12203	3503	7842	63863	72675	0	0	
11	20389	0	13800	3790	8210	72675	81793	0	0	
12	29228	0	19888	5293	11263	81793	93799	0	0	
13	31843	0	21782	5633	11718	93799	105630	0	0	
14	34268	0	23550	5951	12088	105630	117083	0	0	
15	36500	0	25195	6248	12378	117083	127973	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	41598	0	28854	7042	13572	127973	138890	0	0	
17	23226	0	16179	3906	7356	138890	144337	0	0	
18	23807	0	16639	3990	7385	144337	149466	0	0	
19	38707	0	27207	6472	11667	149466	156870	0	0	
20	39967	0	28306	6674	11629	156870	163353	0	0	
21	41090	0	29345	6868	11536	163353	168840	0	0	
22	42093	0	30346	7055	11388	168840	173272	0	0	
23	39822	0	29015	6706	10362	173272	176395	0	0	
24	31565	0	23229	5344	7930	176395	178149	0	0	
25	31925	0	23714	5437	7765	178149	179288	0	0	
26	41926	0	31518	7200	9788	179288	179830	0	0	
27	42314	0	32276	7346	9399	179830	179293	0	0	
28	42587	0	32999	7488	8956	179293	177665	0	0	
29	42763	0	33711	7629	8454	177665	174937	0	0	
30	49716	0	39974	9025	9127	174937	170389	0	0	
31	49560	0	40776	9189	8294	170389	164376	0	0	
32	49155	0	41478	9338	7351	164376	156940	0	0	
33	48535	0	42121	9477	6286	156940	148141	0	0	
34	37750	0	33689	7580	4117	148141	140283	0	0	
35	37085	0	34009	7656	3282	140283	131685	0	0	
36	36303	0	34296	7727	2368	131685	122409	0	0	
37	43569	0	42710	9636	1518	122409	110134	0	0	
38	41918	0	42818	9690	0	110134	97089	0	0	
39	39488	0	40749	9346	0	97089	83355	0	0	
40	37260	0	38853	9118	0	83355	69059	0	0	
41	34869	0	36650	9030	0	69059	54605	0	0	
42	32208	0	34307	8640	0	54605	39967	0	0	
43	29332	0	31687	8205	0	39967	25441	0	0	
44	26220	0	28733	7719	0	25441	11381	0	0	
45	22967	0	25514	7195	0	11381	-1856	0	0	
46	16054	3479	22240	6280	0	-1856	-14205	0	0	
47	12022	3479	17658	5494	0	-14205	-24290	0	0	
48	7630	3479	12400	4519	0	-24290	-31415	0	0	
49	2635	3479	5777	3431	0	-31415	-34201	0	0	

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

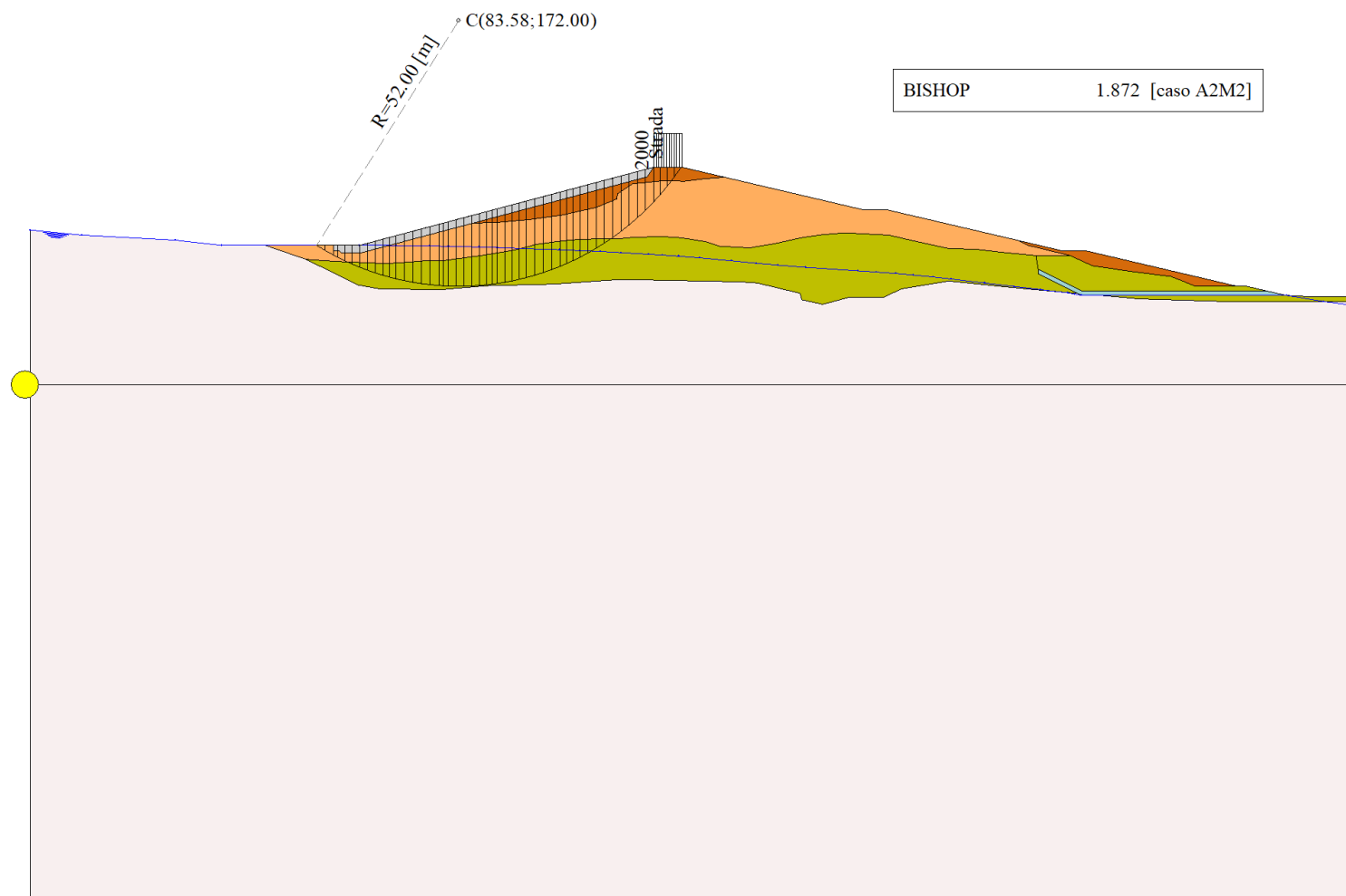


Figura 18-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 14.

## 19 VERIFICA DI STABILITÀ 15

### 19.1.1 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	121.59	127.09	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	41950
Coefficiente di sicurezza minimo	1.367
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	50
Coordinate del centro	X[m]= 85.58                      Y[m]= 168.00
Raggio del cerchio	R[m]= 48.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 59.05                      Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 126.74                      Y <sub>m</sub> [m]= 143.30
Coefficiente di sicurezza	F <sub>s</sub> = 1.367

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	59.05	128.00	128.00	59.21	128.00	127.89	59.16	127.96	0.20	-33.44	0.00	54
2	59.21	128.00	127.89	60.21	128.00	127.25	59.83	127.75	1.19	-32.62	38.62	0
3	60.21	128.00	127.25	60.71	128.00	126.95	60.47	127.55	0.59	-31.56	38.66	0
4	60.71	128.00	126.95	61.88	128.00	126.26	61.34	127.29	1.35	-30.40	25.16	19
5	61.88	128.00	126.26	63.04	128.00	125.62	62.49	126.96	1.33	-28.80	0.00	54
6	63.04	128.00	125.62	64.21	128.00	125.02	63.65	126.65	1.31	-27.22	0.00	54
7	64.21	128.00	125.02	65.75	128.41	124.29	65.02	126.42	1.71	-25.42	0.00	53
8	65.75	128.41	124.29	67.30	128.82	123.62	66.55	126.28	1.68	-23.39	0.00	52
9	67.30	128.82	123.62	68.84	129.23	123.01	68.09	126.17	1.66	-21.40	0.00	52
10	68.84	129.23	123.01	70.09	129.57	122.57	69.48	126.10	1.33	-19.62	0.00	52
11	70.09	129.57	122.57	71.34	129.90	122.16	70.73	126.05	1.31	-18.04	0.00	52
12	71.34	129.90	122.16	72.98	130.34	121.68	72.18	126.02	1.71	-16.24	0.00	52
13	72.98	130.34	121.68	74.63	130.78	121.27	73.82	126.02	1.69	-14.20	0.00	52
14	74.63	130.78	121.27	76.27	131.22	120.91	75.46	126.04	1.68	-12.19	0.00	52
15	76.27	131.22	120.91	77.91	131.65	120.62	77.10	126.10	1.67	-10.19	0.00	52
16	77.91	131.65	120.62	79.13	131.98	120.43	78.53	126.17	1.24	-8.46	0.00	52
17	79.13	131.98	120.43	80.36	132.31	120.29	79.75	126.25	1.23	-6.98	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	80.36	132.31	120.29	81.58	132.63	120.17	80.97	126.35	1.23	-5.51	0.00	52
19	81.58	132.63	120.17	83.08	133.03	120.07	82.33	126.47	1.50	-3.88	0.00	52
20	83.08	133.03	120.07	84.58	133.43	120.01	83.83	126.64	1.50	-2.09	0.00	52
21	84.58	133.43	120.01	86.08	133.83	120.00	85.33	126.82	1.50	-0.30	0.00	52
22	86.08	133.83	120.00	87.58	134.23	120.04	86.83	127.03	1.50	1.49	0.00	52
23	87.58	134.23	120.04	88.97	134.60	120.12	88.28	127.25	1.39	3.22	0.00	52
24	88.97	134.60	120.12	90.06	134.89	120.21	89.51	127.46	1.09	4.70	0.00	52
25	90.06	134.89	120.21	91.14	135.18	120.32	90.60	127.65	1.09	6.00	0.00	52
26	91.14	135.18	120.32	92.55	135.56	120.51	91.85	127.89	1.42	7.50	0.00	52
27	92.55	135.56	120.51	93.96	135.93	120.74	93.26	128.18	1.43	9.20	0.00	52
28	93.96	135.93	120.74	95.37	136.31	121.01	94.67	128.50	1.44	10.91	0.00	52
29	95.37	136.31	121.01	96.78	136.68	121.32	96.08	128.83	1.44	12.63	0.00	52
30	96.78	136.68	121.32	98.42	137.12	121.75	97.60	129.22	1.69	14.50	0.00	52
31	98.42	137.12	121.75	100.06	137.56	122.23	99.24	129.67	1.71	16.53	0.00	52
32	100.06	137.56	122.23	101.69	137.99	122.79	100.87	130.14	1.73	18.58	0.00	52
33	101.69	137.99	122.79	103.33	138.43	123.40	102.51	130.65	1.75	20.66	0.00	52
34	103.33	138.43	123.40	104.62	138.78	123.94	103.98	131.14	1.40	22.54	0.00	52
35	104.62	138.78	123.94	105.92	139.12	124.52	105.27	131.59	1.42	24.22	0.00	52
36	105.92	139.12	124.52	107.21	139.47	125.15	106.56	132.06	1.44	25.93	0.00	52
37	107.21	139.47	125.15	108.56	139.83	125.86	107.88	132.57	1.53	27.70	0.00	52
38	108.56	139.83	125.86	109.92	140.19	126.63	109.24	133.12	1.56	29.54	0.00	52
39	109.92	140.19	126.63	111.27	140.55	127.45	110.59	133.70	1.59	31.41	0.00	52
40	111.27	140.55	127.45	112.74	140.94	128.43	112.00	134.34	1.77	33.41	0.00	52
41	112.74	140.94	128.43	114.22	141.33	129.48	113.47	135.04	1.81	35.55	0.00	52
42	114.22	141.33	129.48	115.69	141.73	130.62	114.95	135.79	1.86	37.74	0.00	54
43	115.69	141.73	130.62	117.17	142.12	131.86	116.42	136.58	1.92	40.00	0.00	54
44	117.17	142.12	131.86	118.64	142.51	133.20	117.89	137.42	1.99	42.34	0.00	54
45	118.64	142.51	133.20	120.12	142.91	134.66	119.36	138.31	2.08	44.77	0.00	54
46	120.12	142.91	134.66	121.59	143.30	136.26	120.83	139.27	2.17	47.31	0.00	54
47	121.59	143.30	136.26	122.88	143.30	137.78	122.21	140.15	1.99	49.80	0.00	54
48	122.88	143.30	137.78	124.16	143.30	139.45	123.48	140.93	2.10	52.24	0.00	54
49	124.16	143.30	139.45	125.45	143.30	141.27	124.74	141.78	2.23	54.83	0.00	54
50	125.45	143.30	141.27	126.74	143.30	143.30	125.88	142.62	2.40	57.60	0.00	53

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

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	17	0	543	791	0	0	959	0	0	
2	855	0	1627	956	0	959	2642	0	0	
3	901	0	1651	966	0	2642	4330	0	0	
4	3256	0	6135	4022	0	4330	10903	0	0	
5	4764	0	8401	5392	0	10903	19675	0	0	
6	6166	0	9667	5314	0	19675	28823	0	0	
7	10724	0	15103	6797	0	28823	41444	0	0	
8	14062	0	18152	6542	0	41444	54655	0	0	
9	17221	0	21024	6449	0	54655	68331	0	0	
10	16142	0	18977	5163	0	68331	79566	0	0	
11	18428	0	21047	5115	0	79566	90948	0	0	
12	26992	0	30051	6656	0	90948	105740	0	0	
13	29970	0	32584	6592	0	105740	120126	0	0	
14	32735	0	34903	6538	0	120126	133886	0	0	
15	35284	0	37017	6493	0	133886	146825	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	27808	0	28830	4812	0	146825	155824	0	0	
17	29016	0	29820	4795	0	155824	164209	0	0	
18	30144	0	30745	4782	0	164209	171922	0	0	
19	38405	0	38890	5849	0	171922	180392	0	0	
20	39867	0	40106	5840	0	180392	187690	0	0	
21	41180	0	41210	5836	0	187690	193740	0	0	
22	42362	0	42224	5838	0	193740	198477	0	0	
23	40222	0	39981	5416	0	198477	201639	0	0	
24	31972	0	31732	4235	0	201639	203261	0	0	
25	32412	0	32144	4244	0	203261	204122	0	0	
26	42669	0	42309	5533	0	204122	204085	0	0	
27	43177	0	42839	5557	0	204085	202720	0	0	
28	43560	0	43285	5587	0	202720	200012	0	0	
29	43838	0	43666	5622	0	200012	195949	0	0	
30	51083	0	51062	6580	0	195949	189532	0	0	
31	51041	0	51269	6645	0	189532	181314	0	0	
32	50736	0	51267	6721	0	181314	171348	0	0	
33	50202	0	51084	6809	0	171348	159696	0	0	
34	39117	0	40091	5448	0	159696	149361	0	0	
35	38490	0	39723	5517	0	149361	138096	0	0	
36	37735	0	39238	5595	0	138096	125973	0	0	
37	38528	0	40392	5947	0	125973	112465	0	0	
38	37380	0	39534	6052	0	112465	98240	0	0	
39	36058	0	38483	6169	0	98240	83449	0	0	
40	37077	0	39885	6871	0	83449	67222	0	0	
41	35023	0	37976	7094	0	67222	50915	0	0	
42	32741	0	35559	7551	0	50915	35121	0	0	
43	30349	0	33078	7796	0	35121	19828	0	0	
44	27735	0	30162	8079	0	19828	5483	0	0	
45	24889	0	26714	8412	0	5483	-7360	0	0	
46	21922	0	22784	8807	0	-7360	-18136	0	0	
47	16025	3346	20455	8075	0	-18136	-28547	0	0	
48	12047	3346	14148	8512	0	-28547	-34520	0	0	
49	7683	3346	6418	8969	0	-34520	-34600	0	0	
50	2668	3346	-3700	9470	0	-34600	-26402	0	0	

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

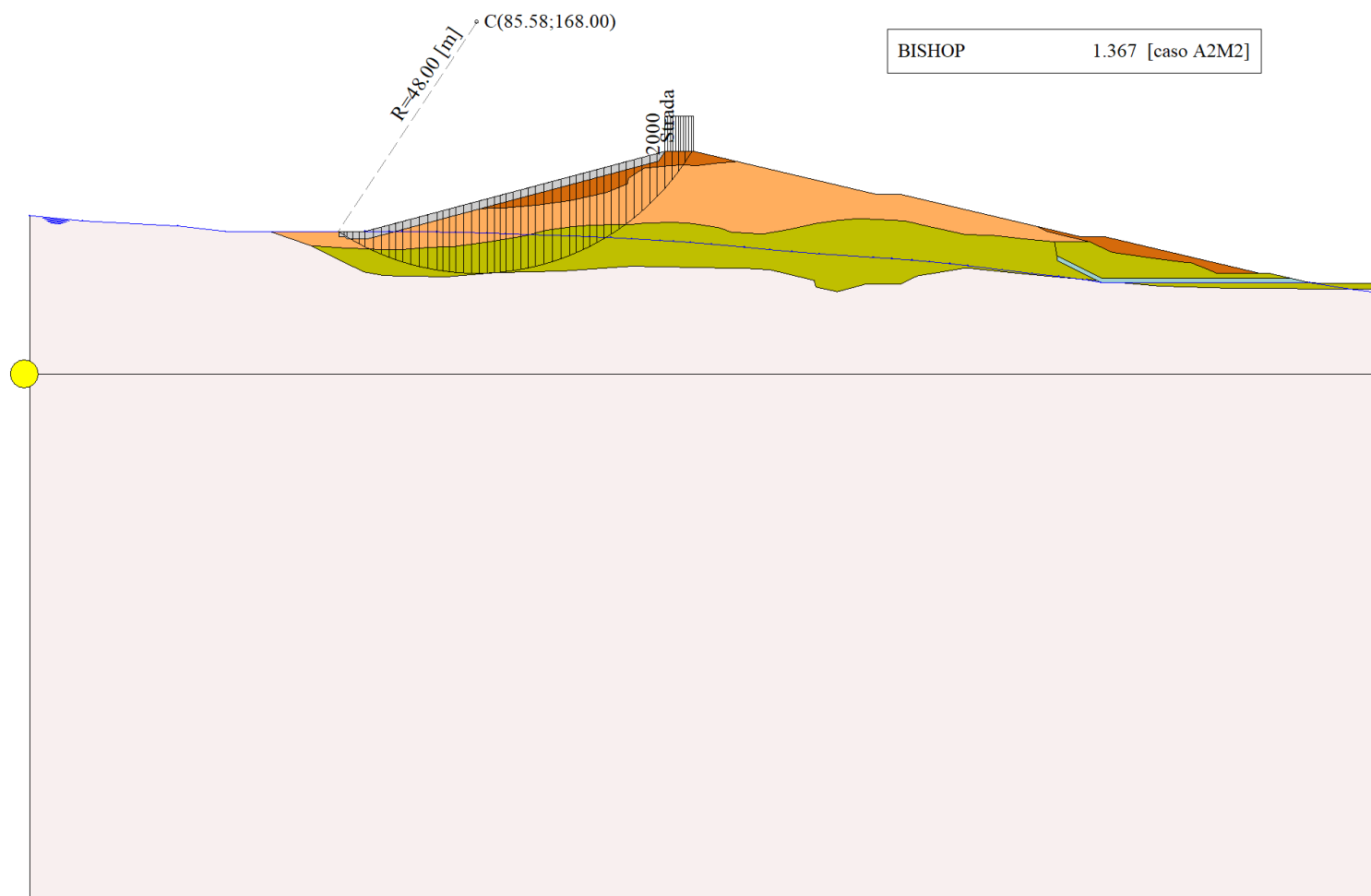


Figura 19-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 15.



## 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	121.59 143.30	127.09 143.30	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	83850
Coefficiente di sicurezza minimo	0.676
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	51
Coordinate del centro	X[m]= 93.58                      Y[m]= 198.00
Raggio del cerchio	R[m]= 76.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 63.98                      Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 142.35                      Y <sub>m</sub> [m]= 139.71
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.676</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	63.98	128.00	128.00	64.21	128.00	127.90	64.13	127.97	0.25	-22.83	38.66	0
2	64.21	128.00	127.90	65.75	128.41	127.28	65.20	127.88	1.67	-22.11	38.66	0
3	65.75	128.41	127.28	67.30	128.82	126.69	66.60	127.80	1.65	-20.86	16.22	32
4	67.30	128.82	126.69	68.84	129.23	126.14	68.12	127.72	1.64	-19.62	0.00	54
5	68.84	129.23	126.14	70.09	129.57	125.72	69.49	127.67	1.32	-18.50	0.00	54
6	70.09	129.57	125.72	71.34	129.90	125.33	70.73	127.63	1.31	-17.51	0.00	54
7	71.34	129.90	125.33	71.54	129.95	125.27	71.44	127.61	0.21	-16.94	0.00	54
8	71.54	129.95	125.27	73.13	130.38	124.80	72.36	127.60	1.66	-16.23	0.00	54
9	73.13	130.38	124.80	74.72	130.80	124.38	73.95	127.59	1.65	-14.99	0.00	53
10	74.72	130.80	124.38	76.32	131.23	123.99	75.54	127.60	1.64	-13.75	0.00	52
11	76.32	131.23	123.99	77.91	131.65	123.63	77.13	127.63	1.63	-12.51	0.00	52
12	77.91	131.65	123.63	79.75	132.14	123.27	78.84	127.68	1.87	-11.19	0.00	52
13	79.75	132.14	123.27	81.58	132.63	122.95	80.68	127.75	1.86	-9.79	0.00	52
14	81.58	132.63	122.95	83.08	133.03	122.73	82.34	127.84	1.52	-8.51	0.00	52
15	83.08	133.03	122.73	84.58	133.43	122.53	83.84	127.93	1.51	-7.37	0.00	52
16	84.58	133.43	122.53	86.08	133.83	122.37	85.34	128.04	1.51	-6.23	0.00	52
17	86.08	133.83	122.37	87.58	134.23	122.24	86.84	128.17	1.51	-5.10	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	87.58	134.23	122.24	89.36	134.71	122.12	88.48	128.32	1.78	-3.86	0.00	52
19	89.36	134.71	122.12	91.14	135.18	122.04	90.26	128.51	1.78	-2.51	0.00	52
20	91.14	135.18	122.04	93.02	135.68	122.00	92.09	128.73	1.88	-1.13	0.00	52
21	93.02	135.68	122.00	94.90	136.18	122.01	93.97	128.97	1.88	0.29	0.00	52
22	94.90	136.18	122.01	96.78	136.68	122.07	95.84	129.24	1.88	1.70	0.00	52
23	96.78	136.68	122.07	98.42	137.12	122.15	97.60	129.51	1.64	3.03	0.00	52
24	98.42	137.12	122.15	100.06	137.56	122.28	99.24	129.78	1.64	4.27	0.00	52
25	100.06	137.56	122.28	101.69	137.99	122.43	100.88	130.07	1.65	5.51	0.00	52
26	101.69	137.99	122.43	103.33	138.43	122.63	102.51	130.37	1.65	6.75	0.00	52
27	103.33	138.43	122.63	105.27	138.95	122.90	104.30	130.73	1.96	8.11	0.00	52
28	105.27	138.95	122.90	107.21	139.47	123.23	106.24	131.14	1.97	9.59	0.00	52
29	107.21	139.47	123.23	108.56	139.83	123.49	107.89	131.50	1.38	10.85	0.00	52
30	108.56	139.83	123.49	109.92	140.19	123.78	109.24	131.82	1.38	11.89	0.00	52
31	109.92	140.19	123.78	111.27	140.55	124.09	110.59	132.15	1.39	12.94	0.00	52
32	111.27	140.55	124.09	112.60	140.90	124.42	111.94	132.49	1.37	13.98	0.00	52
33	112.60	140.90	124.42	113.93	141.26	124.78	113.26	132.84	1.38	15.01	0.00	52
34	113.93	141.26	124.78	115.26	141.61	125.16	114.59	133.20	1.38	16.05	0.00	52
35	115.26	141.61	125.16	117.06	142.09	125.72	116.16	133.65	1.89	17.29	0.00	52
36	117.06	142.09	125.72	118.87	142.57	126.33	117.96	134.18	1.90	18.72	0.00	52
37	118.87	142.57	126.33	120.67	143.05	126.99	119.77	134.74	1.92	20.16	0.00	52
38	120.67	143.05	126.99	121.59	143.30	127.35	121.13	135.17	0.99	21.25	0.00	52
39	121.59	143.30	127.35	123.07	143.30	127.95	122.32	135.47	1.60	22.23	0.00	52
40	123.07	143.30	127.95	124.54	143.30	128.59	123.80	135.79	1.61	23.44	0.00	52
41	124.54	143.30	128.59	126.02	143.30	129.27	125.28	136.11	1.62	24.65	0.00	52
42	126.02	143.30	129.27	127.09	143.30	129.79	126.55	136.41	1.19	25.71	0.00	53
43	127.09	143.30	129.79	127.85	143.12	130.17	127.47	136.59	0.85	26.48	0.00	54
44	127.85	143.12	130.17	129.75	142.68	131.16	128.78	136.78	2.14	27.61	0.00	54
45	129.75	142.68	131.16	131.64	142.23	132.22	130.67	137.07	2.17	29.23	0.00	54
46	131.64	142.23	132.22	133.53	141.79	133.35	132.56	137.39	2.21	30.88	0.00	54
47	133.53	141.79	133.35	135.43	141.34	134.56	134.45	137.75	2.25	32.56	0.00	54
48	135.43	141.34	134.56	137.16	140.93	135.74	136.26	138.13	2.09	34.20	0.00	54
49	137.16	140.93	135.74	138.89	140.53	136.98	137.97	138.53	2.13	35.79	0.00	54
50	138.89	140.53	136.98	140.62	140.12	138.31	139.66	138.96	2.18	37.42	0.00	54
51	140.62	140.12	138.31	142.35	139.71	139.71	141.20	139.38	2.23	39.08	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	22	0	52	62	0	0	72	0	0	
2	1834	0	4239	5016	0	72	5903	0	0	
3	4836	0	10459	12348	0	5903	20082	0	0	
4	7647	0	13809	13414	0	20082	35638	0	0	
5	8172	0	13195	10791	0	35638	48226	0	0	
6	10314	0	15413	10731	0	48226	60784	0	0	
7	1813	0	2629	1712	0	60784	62781	0	0	
8	15983	0	22466	13579	0	62781	78515	0	0	
9	18708	0	25043	13093	0	78515	93444	0	0	
10	21418	0	27676	12892	0	93444	107741	0	0	
11	24003	0	30190	12828	0	107741	121423	0	0	
12	30683	0	37696	14710	0	121423	136291	0	0	
13	33754	0	40619	14643	0	136291	150056	0	0	
14	29784	0	35278	11927	0	150056	160396	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	31660	0	37042	11894	0	160396	169844	0	0	
16	33440	0	38707	11866	0	169844	178343	0	0	
17	35143	0	40294	11843	0	178343	185838	0	0	
18	43835	0	49806	14029	0	185838	193355	0	0	
19	46017	0	51840	14011	0	193355	199305	0	0	
20	50780	0	56776	14787	0	199305	203823	0	0	
21	52831	0	58682	14784	0	203823	206467	0	0	
22	54735	0	60459	14791	0	206467	207179	0	0	
23	49101	0	53999	12895	0	207179	206191	0	0	
24	50268	0	55096	12913	0	206191	203695	0	0	
25	51270	0	56035	12937	0	203695	199697	0	0	
26	52145	0	56861	12967	0	199697	194199	0	0	
27	62714	0	68255	15410	0	194199	185764	0	0	
28	63497	0	69003	15472	0	185764	175286	0	0	
29	44644	0	48477	10836	0	175286	166791	0	0	
30	44828	0	48657	10876	0	166791	157355	0	0	
31	44930	0	48760	10920	0	157355	147007	0	0	
32	44154	0	47921	10778	0	147007	135991	0	0	
33	44079	0	47850	10829	0	135991	124171	0	0	
34	43845	0	47608	10883	0	124171	111634	0	0	
35	58952	0	64041	14852	0	111634	93566	0	0	
36	58365	0	63460	14973	0	93566	74296	0	0	
37	57698	0	62809	15107	0	74296	53894	0	0	
38	29057	0	31653	7763	0	53894	43139	0	0	
39	45706	2953	53332	12545	0	43139	23665	0	0	
40	43748	2953	51121	12656	0	23665	4473	0	0	
41	41672	2953	48742	12777	0	4473	-14254	0	0	
42	28856	2140	33665	9542	0	-14254	-27215	0	0	
43	19696	0	21009	6952	0	-27215	-34777	0	0	
44	45354	0	47764	17508	0	-34777	-51569	0	0	
45	39815	0	40791	17779	0	-51569	-64904	0	0	
46	34025	0	33280	18078	0	-64904	-74102	0	0	
47	27970	0	25152	18409	0	-74102	-78398	0	0	
48	20053	0	15327	17122	0	-78398	-77348	0	0	
49	14633	0	7474	17459	0	-77348	-70840	0	0	
50	8965	0	-1088	17830	0	-70840	-58028	0	0	
51	3034	0	-10468	18242	0	-58028	-37948	0	0	

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

## 20.2.2 ANALISI DELLA SUPERFICIE 37 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	50	
Coordinate del centro	X[m]= 85.58	Y[m]= 180.00
Raggio del cerchio	R[m]= 60.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 55.65	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 132.11	Y <sub>m</sub> [m]= 142.12
Coefficiente di sicurezza	F <sub>s</sub> = 0.681	

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	55.65	128.00	128.00	57.43	128.00	127.01	56.83	127.67	2.04	-28.95	0.00	54
2	57.43	128.00	127.01	59.21	128.00	126.11	58.41	127.26	2.00	-27.03	0.00	54
3	59.21	128.00	126.11	59.22	128.00	126.10	59.22	127.05	0.01	-26.07	0.00	54
4	59.22	128.00	126.10	59.98	128.00	125.74	59.61	126.96	0.84	-25.66	0.00	54
5	59.98	128.00	125.74	61.39	128.00	125.09	60.71	126.70	1.55	-24.52	0.00	54
6	61.39	128.00	125.09	62.80	128.00	124.49	62.12	126.39	1.53	-23.04	0.00	53
7	62.80	128.00	124.49	64.21	128.00	123.93	63.52	126.10	1.52	-21.59	0.00	52
8	64.21	128.00	123.93	65.75	128.41	123.37	65.01	125.93	1.64	-20.08	0.00	52
9	65.75	128.41	123.37	67.30	128.82	122.85	66.55	125.86	1.63	-18.52	0.00	52
10	67.30	128.82	122.85	68.84	129.23	122.38	68.09	125.82	1.61	-16.97	0.00	52
11	68.84	129.23	122.38	70.09	129.57	122.03	69.47	125.80	1.30	-15.58	0.00	52
12	70.09	129.57	122.03	71.34	129.90	121.71	70.72	125.80	1.29	-14.35	0.00	52
13	71.34	129.90	121.71	72.98	130.34	121.34	72.17	125.82	1.69	-12.92	0.00	52
14	72.98	130.34	121.34	74.63	130.78	121.01	73.81	125.87	1.68	-11.32	0.00	52
15	74.63	130.78	121.01	76.27	131.22	120.73	75.46	125.93	1.67	-9.72	0.00	52
16	76.27	131.22	120.73	77.91	131.65	120.49	77.10	126.02	1.66	-8.14	0.00	52
17	77.91	131.65	120.49	79.75	132.14	120.28	78.84	126.14	1.85	-6.46	0.00	52
18	79.75	132.14	120.28	81.58	132.63	120.13	80.67	126.30	1.84	-4.70	0.00	52
19	81.58	132.63	120.13	83.08	133.03	120.05	82.33	126.46	1.50	-3.11	0.00	52
20	83.08	133.03	120.05	84.58	133.43	120.01	83.83	126.63	1.50	-1.67	0.00	52
21	84.58	133.43	120.01	86.08	133.83	120.00	85.33	126.82	1.50	-0.24	0.00	52
22	86.08	133.83	120.00	87.58	134.23	120.03	86.83	127.03	1.50	1.19	0.00	52
23	87.58	134.23	120.03	88.97	134.60	120.10	88.28	127.24	1.39	2.57	0.00	56
24	88.97	134.60	120.10	90.06	134.89	120.17	89.51	127.44	1.09	3.76	0.00	57
25	90.06	134.89	120.17	91.14	135.18	120.26	90.60	127.62	1.09	4.80	0.00	52
26	91.14	135.18	120.26	93.02	135.68	120.46	92.08	127.90	1.89	6.22	0.00	52
27	93.02	135.68	120.46	94.90	136.18	120.73	93.96	128.26	1.90	8.03	0.00	52
28	94.90	136.18	120.73	96.78	136.68	121.05	95.84	128.66	1.91	9.85	0.00	52
29	96.78	136.68	121.05	98.42	137.12	121.39	97.60	129.06	1.67	11.56	0.00	52
30	98.42	137.12	121.39	100.06	137.56	121.77	99.24	129.46	1.68	13.16	0.00	52
31	100.06	137.56	121.77	101.69	137.99	122.20	100.87	129.88	1.69	14.77	0.00	52
32	101.69	137.99	122.20	103.33	138.43	122.69	102.51	130.33	1.71	16.39	0.00	52
33	103.33	138.43	122.69	104.62	138.78	123.10	103.98	130.75	1.36	17.86	0.00	52
34	104.62	138.78	123.10	105.92	139.12	123.55	105.27	131.14	1.37	19.16	0.00	52
35	105.92	139.12	123.55	107.21	139.47	124.03	106.56	131.54	1.38	20.47	0.00	52
36	107.21	139.47	124.03	108.56	139.83	124.58	107.89	131.98	1.46	21.83	0.00	52
37	108.56	139.83	124.58	109.92	140.19	125.16	109.24	132.44	1.47	23.23	0.00	52
38	109.92	140.19	125.16	111.27	140.55	125.78	110.59	132.92	1.49	24.64	0.00	52
39	111.27	140.55	125.78	112.90	140.98	126.58	112.08	133.47	1.81	26.22	0.00	52
40	112.90	140.98	126.58	114.53	141.42	127.44	113.71	134.10	1.84	27.96	0.00	52
41	114.53	141.42	127.44	116.15	141.85	128.37	115.33	134.77	1.87	29.74	0.00	52
42	116.15	141.85	128.37	117.78	142.28	129.37	116.96	135.47	1.91	31.55	0.00	52
43	117.78	142.28	129.37	119.69	142.79	130.64	118.72	136.27	2.29	33.55	0.00	54
44	119.69	142.79	130.64	121.59	143.30	132.01	120.63	137.18	2.35	35.76	0.00	54
45	121.59	143.30	132.01	123.42	143.30	133.44	122.49	138.00	2.33	37.99	0.00	54
46	123.42	143.30	133.44	125.26	143.30	134.99	124.31	138.75	2.40	40.25	0.00	54
47	125.26	143.30	134.99	127.09	143.30	136.68	126.14	139.55	2.49	42.59	0.00	54
48	127.09	143.30	136.68	128.57	142.95	138.14	127.79	140.25	2.08	44.77	0.00	54
49	128.57	142.95	138.14	130.04	142.61	139.71	129.24	140.83	2.16	46.79	0.00	54
50	130.04	142.61	139.71	131.52	142.26	141.41	130.65	141.43	2.25	48.89	0.00	54
51	131.52	142.26	141.41	132.11	142.12	142.12	131.72	141.93	0.93	50.41	0.00	53

Tabella 20-4 – Geometria e caratteristiche strisce della superficie 37 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	1700	0	11321	16557	0	0	19587	0	0	
2	4967	0	14498	16264	0	19587	39549	0	0	
3	37	0	90	91	0	39549	39661	0	0	
4	3112	0	7133	6856	0	39661	48232	0	0	
5	7179	0	14523	12602	0	48232	64114	0	0	
6	8902	0	15972	12255	0	64114	79647	0	0	
7	10587	0	17348	11844	0	79647	94669	0	0	
8	13953	0	21213	12835	0	94669	110878	0	0	
9	16797	0	23959	12713	0	110878	126776	0	0	
10	19493	0	26512	12603	0	126776	142198	0	0	
11	17678	0	23236	10136	0	142198	154238	0	0	
12	19720	0	25214	10078	0	154238	165827	0	0	
13	28363	0	35384	13162	0	165827	180210	0	0	
14	31016	0	37796	13083	0	180210	193503	0	0	
15	33503	0	40033	13016	0	193503	205581	0	0	
16	35820	0	42094	12959	0	205581	216336	0	0	
17	42537	0	49243	14424	0	216336	226672	0	0	
18	44988	0	51383	14381	0	226672	235129	0	0	
19	38478	0	43492	11733	0	235129	240572	0	0	
20	39890	0	44724	11721	0	240572	244648	0	0	
21	41184	0	45850	11716	0	244648	247320	0	0	
22	42376	0	46893	11718	0	247320	248556	0	0	
23	40269	0	44305	11657	0	248556	249182	0	0	
24	32048	0	35108	9281	0	249182	248956	0	0	
25	32534	0	35595	8504	0	248956	247158	0	0	
26	57361	0	62561	14771	0	247158	242201	0	0	
27	58426	0	63528	14829	0	242201	234910	0	0	
28	59287	0	64333	14904	0	234910	225297	0	0	
29	52170	0	56550	13055	0	225297	215060	0	0	
30	52459	0	56843	13135	0	215060	203147	0	0	
31	52538	0	56937	13227	0	203147	189642	0	0	
32	52443	0	56872	13332	0	189642	174622	0	0	
33	41237	0	44762	10613	0	174622	161751	0	0	
34	40953	0	44500	10694	0	161751	148065	0	0	
35	40578	0	44145	10783	0	148065	133628	0	0	
36	41951	0	45697	11387	0	133628	117801	0	0	
37	41309	0	45056	11503	0	117801	101340	0	0	
38	40547	0	44276	11629	0	101340	84359	0	0	
39	47543	0	51959	14170	0	84359	63455	0	0	
40	46012	0	50294	14392	0	63455	42266	0	0	
41	43568	0	47439	14640	0	42266	21676	0	0	
42	41553	0	45068	14916	0	21676	1492	0	0	
43	45998	0	49139	18461	0	1492	-20593	0	0	
44	43312	0	45611	19090	0	-20593	-41470	0	0	
45	38090	3667	44149	18917	0	-41470	-63101	0	0	
46	32776	3667	36565	19533	0	-63101	-79991	0	0	
47	27033	3667	27761	20248	0	-79991	-90753	0	0	
48	16757	0	9473	16913	0	-90753	-89174	0	0	
49	11338	0	-253	17538	0	-89174	-79524	0	0	
50	5586	0	-11348	18147	0	-79524	-60296	0	0	
51	515	0	-7975	7339	0	-60296	-49588	0	0	

Tabella 20-5 – Forze applicate sulle strisce [BISHOP] della superficie 37 della verifica di stabilità 16.

### 20.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.001414
2	0.000532
3	0.001623
4	0.001792
5	0.000146
6	0.000419
7	0.000028

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

Accelerazione sismica critica  $K_c = 0.104$   
Spostamento massimo  $U_{max} = 0.001792$  [m]  
Velocità massima  $V_{max} = 0.022797$  [m/s]

n°	u
	[m]
1	0.002465
2	0.000791
3	0.002369
4	0.002523
5	0.000327
6	0.000720
7	0.000158

Tabella 20-7 – Spostamenti della superficie 37 della verifica di stabilità 16.

Accelerazione sismica critica  $K_c = 0.094$   
Spostamento massimo  $U_{max} = 0.002523$  [m]  
Velocità massima  $V_{max} = 0.026371$  [m/s]

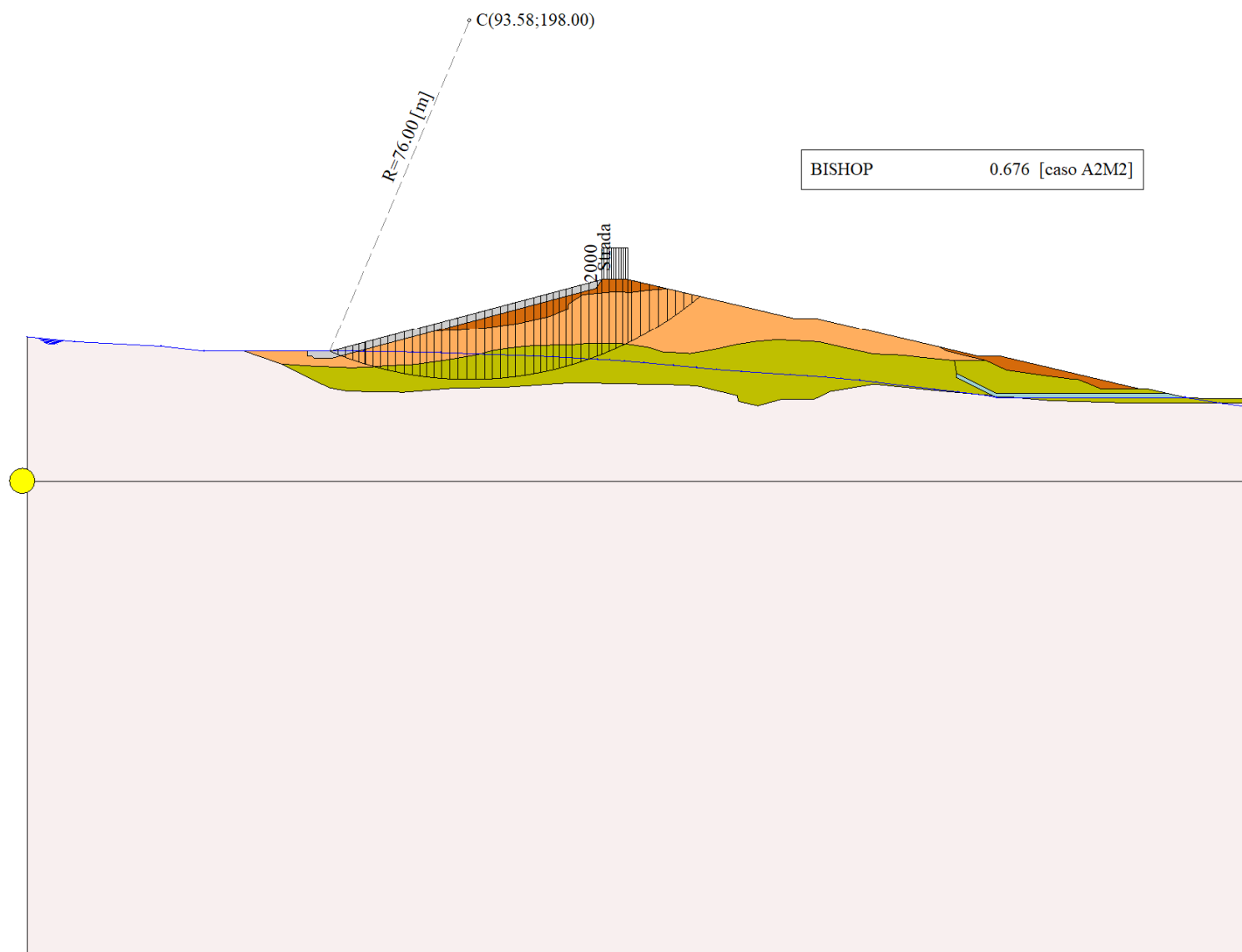


Figura 20-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 16.

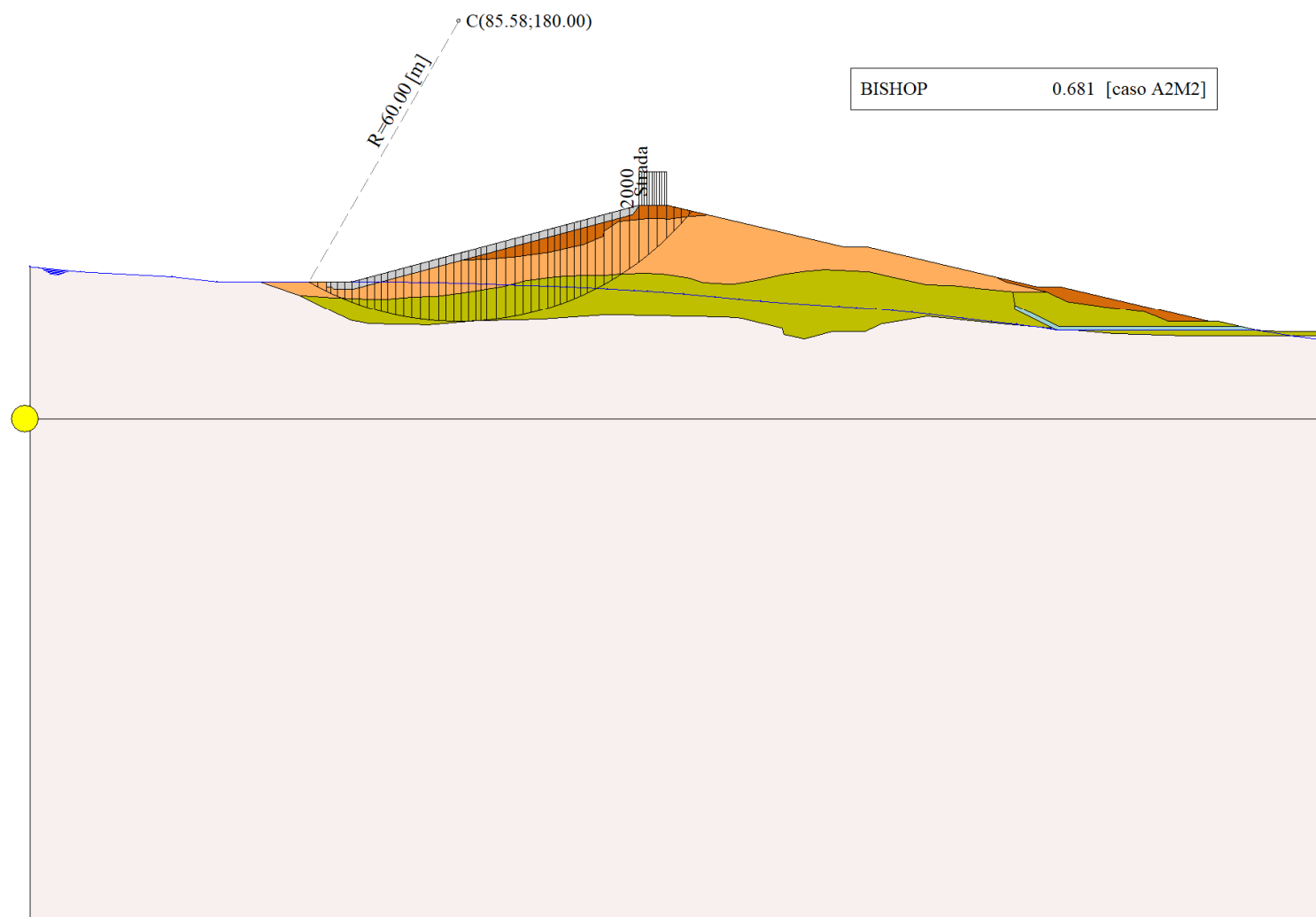


Figura 20-2 – Superficie critica (37) della sezione CR\_08 per la verifica di stabilità 16.



## 21 VERIFICA DI STABILITÀ 17

### 21.1.1 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	121.59	127.09	2000	0
				143.30	143.30	2000	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	83712
Coefficiente di sicurezza minimo	0.532
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	47
Coordinate del centro	X[m]= 101.58                      Y[m]= 166.00
Raggio del cerchio	R[m]= 44.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 75.06                      Y <sub>v</sub> [m]= 130.89
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 137.66                      Y <sub>m</sub> [m]= 140.82
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.532</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	75.06	130.89	130.89	76.48	131.27	129.86	76.01	130.67	1.76	-35.92	38.66	0
2	76.48	131.27	129.86	77.91	131.65	128.91	77.27	130.41	1.71	-33.66	4.08	49
3	77.91	131.65	128.91	79.13	131.98	128.16	78.56	130.17	1.44	-31.61	0.00	54
4	79.13	131.98	128.16	80.36	132.31	127.46	79.77	129.97	1.41	-29.76	0.00	54
5	80.36	132.31	127.46	81.58	132.63	126.81	80.99	129.80	1.38	-27.94	0.00	54
6	81.58	132.63	126.81	83.08	133.03	126.08	82.35	129.63	1.67	-25.95	0.00	54
7	83.08	133.03	126.08	84.58	133.43	125.42	83.85	129.49	1.64	-23.80	0.00	54
8	84.58	133.43	125.42	86.08	133.83	124.82	85.34	129.37	1.61	-21.68	0.00	52
9	86.08	133.83	124.82	87.58	134.23	124.29	86.84	129.29	1.59	-19.59	0.00	52
10	87.58	134.23	124.29	88.77	134.55	123.91	88.18	129.24	1.25	-17.74	0.00	52
11	88.77	134.55	123.91	89.95	134.86	123.56	89.37	129.22	1.24	-16.13	0.00	52
12	89.95	134.86	123.56	91.14	135.18	123.26	90.55	129.22	1.23	-14.52	0.00	52
13	91.14	135.18	123.26	92.55	135.56	122.94	91.85	129.23	1.45	-12.78	0.00	52
14	92.55	135.56	122.94	93.96	135.93	122.66	93.26	129.27	1.44	-10.91	0.00	52
15	93.96	135.93	122.66	95.37	136.31	122.44	94.67	129.34	1.43	-9.04	0.00	52
16	95.37	136.31	122.44	96.78	136.68	122.26	96.08	129.42	1.42	-7.19	0.00	52
17	96.78	136.68	122.26	98.09	137.03	122.14	97.44	129.53	1.32	-5.41	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	98.09	137.03	122.14	99.40	137.38	122.05	98.75	129.65	1.31	-3.69	0.00	52
19	99.40	137.38	122.05	100.71	137.73	122.01	100.06	129.79	1.31	-1.99	0.00	52
20	100.71	137.73	122.01	102.02	138.08	122.00	101.37	129.96	1.31	-0.28	0.00	52
21	102.02	138.08	122.00	103.33	138.43	122.03	102.68	130.14	1.31	1.43	0.00	52
22	103.33	138.43	122.03	104.62	138.78	122.11	103.98	130.34	1.30	3.12	0.00	52
23	104.62	138.78	122.11	105.92	139.12	122.21	105.27	130.55	1.30	4.81	0.00	52
24	105.92	139.12	122.21	107.21	139.47	122.36	106.56	130.79	1.30	6.50	0.00	52
25	107.21	139.47	122.36	108.56	139.83	122.56	107.89	131.05	1.37	8.24	0.00	52
26	108.56	139.83	122.56	109.92	140.19	122.80	109.24	131.34	1.37	10.03	0.00	52
27	109.92	140.19	122.80	111.27	140.55	123.08	110.59	131.65	1.38	11.82	0.00	52
28	111.27	140.55	123.08	112.60	140.90	123.40	111.94	131.98	1.37	13.61	0.00	52
29	112.60	140.90	123.40	113.93	141.26	123.77	113.26	132.33	1.38	15.40	0.00	52
30	113.93	141.26	123.77	115.26	141.61	124.18	114.59	132.70	1.39	17.21	0.00	52
31	115.26	141.61	124.18	116.61	141.97	124.65	115.94	133.10	1.43	19.05	0.00	52
32	116.61	141.97	124.65	117.97	142.33	125.16	117.29	133.53	1.45	20.92	0.00	52
33	117.97	142.33	125.16	119.32	142.69	125.73	118.64	133.98	1.47	22.82	0.00	52
34	119.32	142.69	125.73	120.67	143.05	126.36	119.99	134.46	1.49	24.74	0.00	52
35	120.67	143.05	126.36	121.59	143.30	126.81	121.13	134.88	1.03	26.38	0.00	52
36	121.59	143.30	126.81	123.07	143.30	127.60	122.32	135.25	1.67	28.14	0.00	52
37	123.07	143.30	127.60	124.54	143.30	128.47	123.80	135.67	1.71	30.35	0.00	52
38	124.54	143.30	128.47	126.02	143.30	129.41	125.27	136.12	1.75	32.60	0.00	52
39	126.02	143.30	129.41	127.09	143.30	130.15	126.55	136.54	1.30	34.59	0.00	54
40	127.09	143.30	130.15	128.48	142.97	131.18	127.77	136.90	1.73	36.56	0.00	54
41	128.48	142.97	131.18	129.87	142.65	132.30	129.16	137.27	1.78	38.85	0.00	54
42	129.87	142.65	132.30	131.26	142.32	133.52	130.55	137.69	1.85	41.22	0.00	54
43	131.26	142.32	133.52	132.65	141.99	134.84	131.93	138.16	1.92	43.67	0.00	54
44	132.65	141.99	134.84	134.04	141.67	136.30	133.31	138.69	2.01	46.23	0.00	54
45	134.04	141.67	136.30	135.43	141.34	137.89	134.68	139.28	2.12	48.92	0.00	54
46	135.43	141.34	137.89	136.54	141.08	139.29	135.93	139.87	1.79	51.46	0.00	54
47	136.54	141.08	139.29	137.66	140.82	140.82	136.92	140.39	1.89	53.85	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	1815	0	-29166	-43862	0	0	-53231	0	0	
2	5440	0	20026	18636	0	-53231	-28417	0	0	
3	7518	0	19484	14947	0	-28417	-7959	0	0	
4	10390	0	22328	14663	0	-7959	12420	0	0	
5	12759	0	24469	14409	0	12420	32398	0	0	
6	18701	0	32681	17359	0	32398	56129	0	0	
7	21885	0	35348	16960	0	56129	78680	0	0	
8	25007	0	37768	16133	0	78680	99362	0	0	
9	28027	0	40326	15914	0	99362	118616	0	0	
10	24218	0	33612	12453	0	118616	132718	0	0	
11	25927	0	35017	12347	0	132718	145740	0	0	
12	27545	0	36329	12252	0	145740	157612	0	0	
13	34698	0	44736	14451	0	157612	170141	0	0	
14	36701	0	46316	14352	0	170141	180874	0	0	
15	38566	0	47773	14270	0	180874	189735	0	0	
16	40316	0	49139	14205	0	189735	196658	0	0	
17	38908	0	46782	13152	0	196658	201306	0	0	
18	40182	0	47764	13121	0	201306	204203	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	41318	0	48626	13101	0	204203	205332	0	0	
20	42338	0	49396	13094	0	205332	204680	0	0	
21	43251	0	50084	13097	0	204680	202239	0	0	
22	43484	0	50035	12946	0	202239	198075	0	0	
23	44137	0	50517	12973	0	198075	192184	0	0	
24	44684	0	50918	13011	0	192184	184582	0	0	
25	47220	0	53614	13668	0	184582	174824	0	0	
26	47559	0	53845	13736	0	174824	163264	0	0	
27	47765	0	53968	13820	0	163264	149954	0	0	
28	46992	0	53025	13678	0	149954	135243	0	0	
29	46916	0	52903	13789	0	135243	118986	0	0	
30	46627	0	52565	13916	0	118986	101326	0	0	
31	46987	0	52981	14301	0	101326	82033	0	0	
32	46485	0	52454	14472	0	82033	61465	0	0	
33	45906	0	51860	14666	0	61465	39706	0	0	
34	45195	0	51124	14885	0	39706	16895	0	0	
35	30193	0	34179	10264	0	16895	929	0	0	
36	47087	2953	57169	16738	0	929	-27806	0	0	
37	44490	2953	54044	17102	0	-27806	-56023	0	0	
38	41649	2953	50484	17520	0	-56023	-83199	0	0	
39	28324	2140	33861	13422	0	-83199	-101435	0	0	
40	33951	0	35896	18008	0	-101435	-119570	0	0	
41	30103	0	30078	18572	0	-119570	-133918	0	0	
42	26002	0	23434	19228	0	-133918	-143485	0	0	
43	21627	0	15748	19996	0	-143485	-147040	0	0	
44	16944	0	6713	20909	0	-147040	-143021	0	0	
45	11902	0	-4141	22009	0	-143021	-129368	0	0	
46	5653	0	-12797	18616	0	-129368	-109626	0	0	
47	1930	0	-23108	19664	0	-109626	-80004	0	0	

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

### 21.2.2 ANALISI DELLA SUPERFICIE 107 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	50	
Coordinate del centro	X[m]= 85.58	Y[m]= 180.00
Raggio del cerchio	R[m]= 60.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 55.65	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 132.11	Y <sub>m</sub> [m]= 142.12
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.548</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]	β [°]	α [°]	c [kPa]
1	55.65	128.00	128.00	57.43	128.00	127.01	56.83	127.67	2.04	-28.95	0.00	54
2	57.43	128.00	127.01	59.21	128.00	126.11	58.41	127.26	2.00	-27.03	0.00	54
3	59.21	128.00	126.11	59.22	128.00	126.10	59.22	127.05	0.01	-26.07	0.00	54
4	59.22	128.00	126.10	59.98	128.00	125.74	59.61	126.96	0.84	-25.66	0.00	54
5	59.98	128.00	125.74	61.39	128.00	125.09	60.71	126.70	1.55	-24.52	0.00	54
6	61.39	128.00	125.09	62.80	128.00	124.49	62.12	126.39	1.53	-23.04	0.00	53
7	62.80	128.00	124.49	64.21	128.00	123.93	63.52	126.10	1.52	-21.59	0.00	52
8	64.21	128.00	123.93	65.75	128.41	123.37	65.01	125.93	1.64	-20.08	0.00	52
9	65.75	128.41	123.37	67.30	128.82	122.85	66.55	125.86	1.63	-18.52	0.00	52
10	67.30	128.82	122.85	68.84	129.23	122.38	68.09	125.82	1.61	-16.97	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	68.84	129.23	122.38	70.09	129.57	122.03	69.47	125.80	1.30	-15.58	0.00	52
12	70.09	129.57	122.03	71.34	129.90	121.71	70.72	125.80	1.29	-14.35	0.00	52
13	71.34	129.90	121.71	72.98	130.34	121.34	72.17	125.82	1.69	-12.92	0.00	52
14	72.98	130.34	121.34	74.63	130.78	121.01	73.81	125.87	1.68	-11.32	0.00	52
15	74.63	130.78	121.01	76.27	131.22	120.73	75.46	125.93	1.67	-9.72	0.00	52
16	76.27	131.22	120.73	77.91	131.65	120.49	77.10	126.02	1.66	-8.14	0.00	52
17	77.91	131.65	120.49	79.75	132.14	120.28	78.84	126.14	1.85	-6.46	0.00	52
18	79.75	132.14	120.28	81.58	132.63	120.13	80.67	126.30	1.84	-4.70	0.00	52
19	81.58	132.63	120.13	83.08	133.03	120.05	82.33	126.46	1.50	-3.11	0.00	52
20	83.08	133.03	120.05	84.58	133.43	120.01	83.83	126.63	1.50	-1.67	0.00	52
21	84.58	133.43	120.01	86.08	133.83	120.00	85.33	126.82	1.50	-0.24	0.00	52
22	86.08	133.83	120.00	87.58	134.23	120.03	86.83	127.03	1.50	1.19	0.00	52
23	87.58	134.23	120.03	88.97	134.60	120.10	88.28	127.24	1.39	2.57	0.00	56
24	88.97	134.60	120.10	90.06	134.89	120.17	89.51	127.44	1.09	3.76	0.00	57
25	90.06	134.89	120.17	91.14	135.18	120.26	90.60	127.62	1.09	4.80	0.00	52
26	91.14	135.18	120.26	93.02	135.68	120.46	92.08	127.90	1.89	6.22	0.00	52
27	93.02	135.68	120.46	94.90	136.18	120.73	93.96	128.26	1.90	8.03	0.00	52
28	94.90	136.18	120.73	96.78	136.68	121.05	95.84	128.66	1.91	9.85	0.00	52
29	96.78	136.68	121.05	98.42	137.12	121.39	97.60	129.06	1.67	11.56	0.00	52
30	98.42	137.12	121.39	100.06	137.56	121.77	99.24	129.46	1.68	13.16	0.00	52
31	100.06	137.56	121.77	101.69	137.99	122.20	100.87	129.88	1.69	14.77	0.00	52
32	101.69	137.99	122.20	103.33	138.43	122.69	102.51	130.33	1.71	16.39	0.00	52
33	103.33	138.43	122.69	104.62	138.78	123.10	103.98	130.75	1.36	17.86	0.00	52
34	104.62	138.78	123.10	105.92	139.12	123.55	105.27	131.14	1.37	19.16	0.00	52
35	105.92	139.12	123.55	107.21	139.47	124.03	106.56	131.54	1.38	20.47	0.00	52
36	107.21	139.47	124.03	108.56	139.83	124.58	107.89	131.98	1.46	21.83	0.00	52
37	108.56	139.83	124.58	109.92	140.19	125.16	109.24	132.44	1.47	23.23	0.00	52
38	109.92	140.19	125.16	111.27	140.55	125.78	110.59	132.92	1.49	24.64	0.00	52
39	111.27	140.55	125.78	112.90	140.98	126.58	112.08	133.47	1.81	26.22	0.00	52
40	112.90	140.98	126.58	114.53	141.42	127.44	113.71	134.10	1.84	27.96	0.00	52
41	114.53	141.42	127.44	116.15	141.85	128.37	115.33	134.77	1.87	29.74	0.00	52
42	116.15	141.85	128.37	117.78	142.28	129.37	116.96	135.47	1.91	31.55	0.00	52
43	117.78	142.28	129.37	119.69	142.79	130.64	118.72	136.27	2.29	33.55	0.00	54
44	119.69	142.79	130.64	121.59	143.30	132.01	120.63	137.18	2.35	35.76	0.00	54
45	121.59	143.30	132.01	123.42	143.30	133.44	122.49	138.00	2.33	37.99	0.00	54
46	123.42	143.30	133.44	125.26	143.30	134.99	124.31	138.75	2.40	40.25	0.00	54
47	125.26	143.30	134.99	127.09	143.30	136.68	126.14	139.55	2.49	42.59	0.00	54
48	127.09	143.30	136.68	128.57	142.95	138.14	127.79	140.25	2.08	44.77	0.00	54
49	128.57	142.95	138.14	130.04	142.61	139.71	129.24	140.83	2.16	46.79	0.00	54
50	130.04	142.61	139.71	131.52	142.26	141.41	130.65	141.43	2.25	48.89	0.00	54
51	131.52	142.26	141.41	132.11	142.12	142.12	131.72	141.93	0.93	50.41	0.00	53

Tabella 21-4 – Geometria e caratteristiche strisce della superficie 107 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	1700	0	13640	20562	0	0	24033	0	0	
2	4967	0	16800	20197	0	24033	48018	0	0	
3	37	0	103	112	0	48018	48152	0	0	
4	3112	0	8113	8514	0	48152	58312	0	0	
5	7179	0	16331	15650	0	58312	76956	0	0	
6	8902	0	17747	15219	0	76956	94966	0	0	
7	10587	0	19086	14709	0	94966	112168	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
8	13953	0	23136	15939	0	112168	130472	0	0	
9	16797	0	25929	15787	0	130472	148129	0	0	
10	19493	0	28524	15652	0	148129	164985	0	0	
11	17678	0	24894	12587	0	164985	177956	0	0	
12	19720	0	26918	12515	0	177956	190235	0	0	
13	28363	0	37658	16346	0	190235	205220	0	0	
14	31016	0	40108	16248	0	205220	218779	0	0	
15	33503	0	42376	16164	0	218779	230800	0	0	
16	35820	0	44462	16094	0	230800	241192	0	0	
17	42537	0	51909	17913	0	241192	250781	0	0	
18	44988	0	54065	17859	0	250781	258150	0	0	
19	38478	0	45691	14571	0	258150	262463	0	0	
20	39890	0	46924	14556	0	262463	265204	0	0	
21	41184	0	48047	14550	0	265204	266348	0	0	
22	42376	0	49083	14553	0	266348	265876	0	0	
23	40269	0	46317	14477	0	265876	264955	0	0	
24	32048	0	36664	11526	0	264955	263466	0	0	
25	32534	0	37155	10561	0	263466	260135	0	0	
26	57361	0	65233	18344	0	260135	252354	0	0	
27	58426	0	66153	18416	0	252354	242047	0	0	
28	59287	0	66900	18508	0	242047	229256	0	0	
29	52170	0	58730	16212	0	229256	216139	0	0	
30	52459	0	58959	16312	0	216139	201272	0	0	
31	52538	0	58977	16426	0	201272	184765	0	0	
32	52443	0	58824	16556	0	184765	166722	0	0	
33	41237	0	46234	13180	0	166722	151468	0	0	
34	40953	0	45902	13281	0	151468	135419	0	0	
35	40578	0	45469	13391	0	135419	118656	0	0	
36	41951	0	46992	14141	0	118656	100452	0	0	
37	41309	0	46247	14285	0	100452	81695	0	0	
38	40547	0	45352	14442	0	81695	62518	0	0	
39	47543	0	53083	17597	0	62518	39148	0	0	
40	46012	0	51210	17873	0	39148	15721	0	0	
41	43568	0	48078	18181	0	15721	-6734	0	0	
42	41553	0	45441	18524	0	-6734	-28449	0	0	
43	45998	0	49106	22926	0	-28449	-51675	0	0	
44	43312	0	45118	23707	0	-51675	-73113	0	0	
45	38090	3667	43387	23492	0	-73113	-95101	0	0	
46	32776	3667	35099	24257	0	-95101	-111305	0	0	
47	27033	3667	25472	25146	0	-111305	-120170	0	0	
48	16757	0	6667	21004	0	-120170	-115489	0	0	
49	11338	0	-3891	21780	0	-115489	-101487	0	0	
50	5586	0	-15927	22536	0	-101487	-76515	0	0	
51	515	0	-10079	9114	0	-76515	-63109	0	0	

Tabella 21-5 – Forze applicate sulle strisce [BISHOP] della superficie 107 della verifica di stabilità 17.

### 21.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.003794
2	0.001719
3	0.002537
4	0.000688
5	0.000769
6	0.001409
7	0.002272

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

Accelerazione sismica critica  $K_c = 0.123$   
Spostamento massimo  $U_{max} = 0.003794$  [m]  
Velocità massima  $V_{max} = 0.029511$  [m/s]

n°	u
	[m]
1	0.009028
2	0.004315
3	0.005938
4	0.002292
5	0.001735
6	0.007447
7	0.007093

Tabella 21-7 – Spostamenti della superficie 107 della verifica di stabilità 17.

Accelerazione sismica critica  $K_c = 0.094$   
Spostamento massimo  $U_{max} = 0.009028$  [m]  
Velocità massima  $V_{max} = 0.046379$  [m/s]

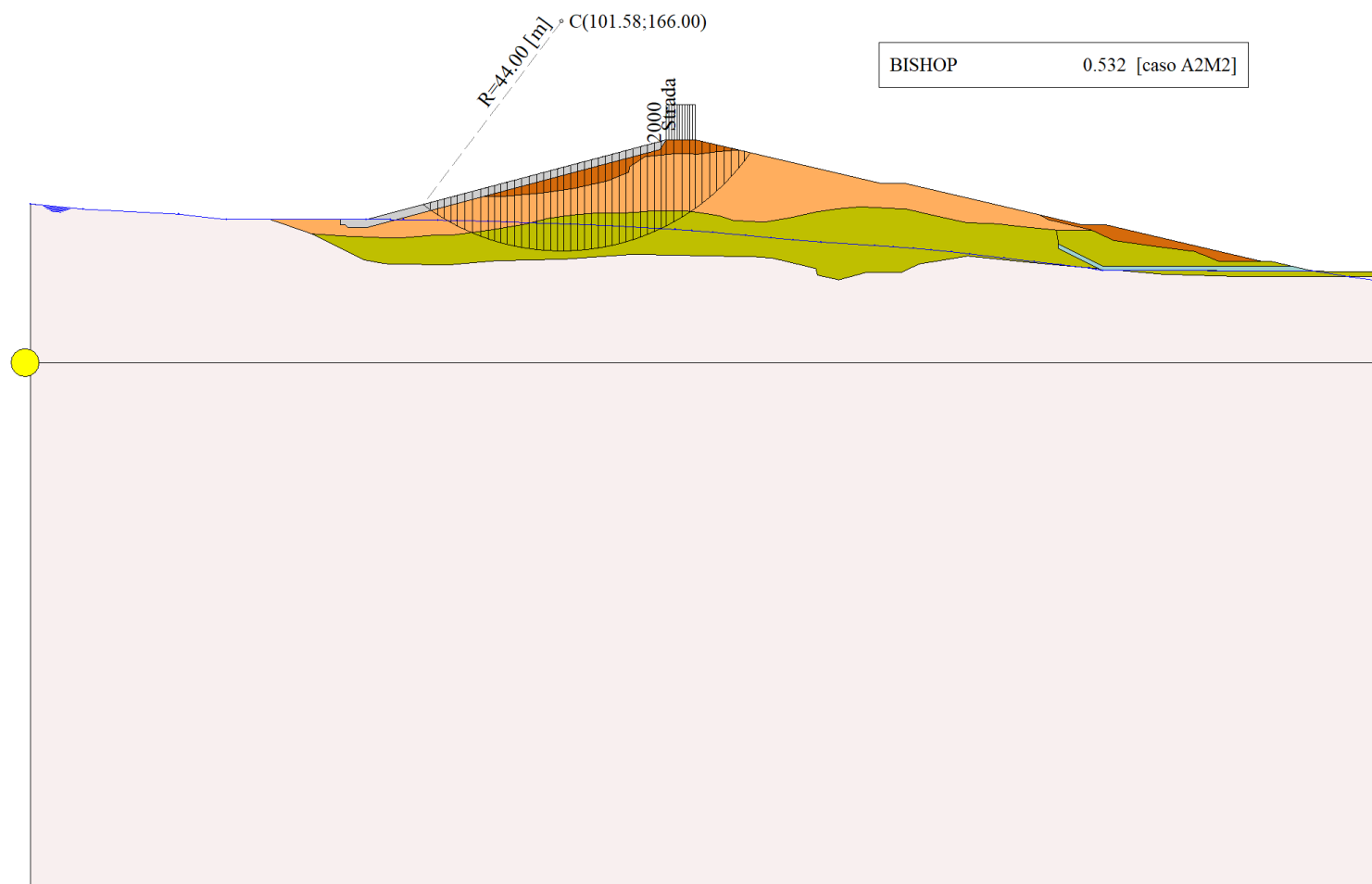


Figura 21-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 17.

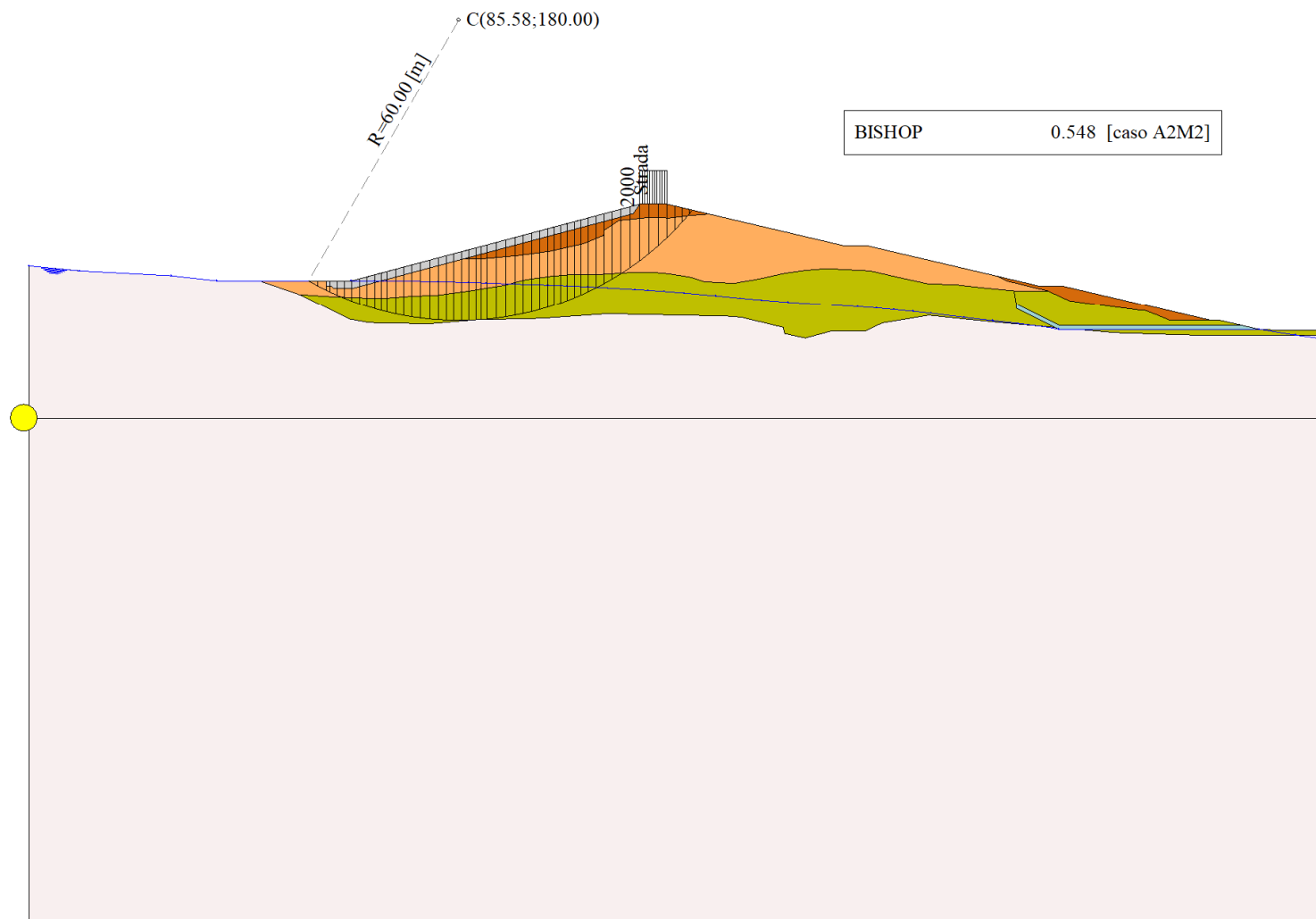


Figura 21-2 – Superficie critica (107) della sezione CR\_08 per la verifica di stabilità 17.



## 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	121.59	127.09	2000	0
				143.30	143.30	2000	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	80235
Coefficiente di sicurezza minimo	0.293
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	49
Coordinate del centro	X[m]= 99.58                      Y[m]= 206.00
Raggio del cerchio	R[m]= 84.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 66.76                      Y <sub>v</sub> [m]= 128.68
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 149.07                      Y <sub>m</sub> [m]= 138.13
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.293</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	66.76	128.68	128.68	67.80	128.96	128.24	67.45	128.63	1.13	-22.62	38.66	0
2	67.80	128.96	128.24	68.84	129.23	127.83	68.38	128.56	1.12	-21.85	38.66	0
3	68.84	129.23	127.83	70.09	129.57	127.35	69.51	128.49	1.34	-21.01	6.93	45
4	70.09	129.57	127.35	71.34	129.90	126.89	70.75	128.42	1.33	-20.10	0.00	54
5	71.34	129.90	126.89	73.10	130.37	126.28	72.27	128.36	1.87	-19.01	0.00	54
6	73.10	130.37	126.28	74.87	130.84	125.72	74.02	128.30	1.85	-17.74	0.00	54
7	74.87	130.84	125.72	76.63	131.31	125.20	75.77	128.27	1.84	-16.48	0.00	54
8	76.63	131.31	125.20	77.91	131.65	124.84	77.28	128.25	1.33	-15.40	0.00	54
9	77.91	131.65	124.84	79.49	132.07	124.44	78.72	128.25	1.63	-14.39	0.00	52
10	79.49	132.07	124.44	81.07	132.50	124.06	80.29	128.27	1.62	-13.28	0.00	52
11	81.07	132.50	124.06	81.58	132.63	123.95	81.33	128.29	0.52	-12.55	0.00	52
12	81.58	132.63	123.95	83.58	133.16	123.54	82.60	128.32	2.04	-11.68	0.00	52
13	83.58	133.16	123.54	85.58	133.70	123.17	84.59	128.39	2.03	-10.29	0.00	52
14	85.58	133.70	123.17	87.58	134.23	122.86	86.59	128.49	2.02	-8.90	0.00	52
15	87.58	134.23	122.86	89.36	134.71	122.62	88.48	128.61	1.80	-7.60	0.00	52
16	89.36	134.71	122.62	91.14	135.18	122.43	90.26	128.73	1.79	-6.38	0.00	52
17	91.14	135.18	122.43	93.02	135.68	122.26	92.09	128.89	1.89	-5.12	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	93.02	135.68	122.26	94.90	136.18	122.13	93.97	129.06	1.88	-3.84	0.00	52
19	94.90	136.18	122.13	96.78	136.68	122.05	95.85	129.26	1.88	-2.55	0.00	52
20	96.78	136.68	122.05	98.42	137.12	122.01	97.60	129.47	1.64	-1.35	0.00	52
21	98.42	137.12	122.01	100.06	137.56	122.00	99.24	129.67	1.64	-0.23	0.00	52
22	100.06	137.56	122.00	101.69	137.99	122.03	100.88	129.90	1.64	0.88	0.00	52
23	101.69	137.99	122.03	103.33	138.43	122.08	102.51	130.13	1.64	2.00	0.00	52
24	103.33	138.43	122.08	105.27	138.95	122.19	104.30	130.41	1.94	3.22	0.00	52
25	105.27	138.95	122.19	107.21	139.47	122.35	106.24	130.74	1.95	4.55	0.00	52
26	107.21	139.47	122.35	109.24	140.01	122.56	108.23	131.09	2.04	5.91	0.00	52
27	109.24	140.01	122.56	111.27	140.55	122.82	110.26	131.48	2.05	7.30	0.00	52
28	111.27	140.55	122.82	113.27	141.08	123.12	112.27	131.89	2.02	8.69	0.00	52
29	113.27	141.08	123.12	115.26	141.61	123.48	114.26	132.32	2.03	10.07	0.00	52
30	115.26	141.61	123.48	117.06	142.09	123.84	116.16	132.76	1.84	11.39	0.00	52
31	117.06	142.09	123.84	118.87	142.57	124.24	117.97	133.19	1.85	12.64	0.00	52
32	118.87	142.57	124.24	120.67	143.05	124.69	119.77	133.64	1.86	13.91	0.00	52
33	120.67	143.05	124.69	121.59	143.30	124.93	121.13	134.00	0.95	14.87	0.00	52
34	121.59	143.30	124.93	123.31	143.30	125.42	122.45	134.24	1.79	15.80	0.00	52
35	123.31	143.30	125.42	124.90	143.30	125.91	124.10	134.48	1.66	16.98	0.00	52
36	124.90	143.30	125.91	126.49	143.30	126.43	125.69	134.73	1.67	18.11	0.00	52
37	126.49	143.30	126.43	127.09	143.30	126.63	126.79	134.91	0.63	18.90	0.00	52
38	127.09	143.30	126.63	128.66	142.93	127.19	127.87	135.01	1.66	19.68	0.00	52
39	128.66	142.93	127.19	130.22	142.56	127.79	129.43	135.12	1.68	20.82	0.00	52
40	130.22	142.56	127.79	131.79	142.20	128.42	131.00	135.24	1.69	21.97	0.00	52
41	131.79	142.20	128.42	133.61	141.77	129.20	132.69	135.40	1.98	23.22	0.00	54
42	133.61	141.77	129.20	135.43	141.34	130.03	134.50	135.58	2.00	24.58	0.00	54
43	135.43	141.34	130.03	137.38	140.88	130.99	136.38	135.81	2.17	26.00	0.00	54
44	137.38	140.88	130.99	139.33	140.42	132.00	138.33	136.07	2.20	27.49	0.00	54
45	139.33	140.42	132.00	141.28	139.96	133.08	140.27	136.36	2.23	29.00	0.00	54
46	141.28	139.96	133.08	143.23	139.50	134.23	142.21	136.69	2.26	30.53	0.00	54
47	143.23	139.50	134.23	145.17	139.05	135.45	144.14	137.05	2.30	32.09	0.00	54
48	145.17	139.05	135.45	147.12	138.59	136.75	146.04	137.44	2.34	33.67	0.00	54
49	147.12	138.59	136.75	149.07	138.13	138.13	147.77	137.82	2.39	35.29	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	668	0	-7070	-19276	0	0	-20950	0	0	
2	1996	0	-30620	-83486	0	-20950	-111145	0	0	
3	4163	0	16513	27575	0	-111145	-82214	0	0	
4	6456	0	18320	25112	0	-82214	-56573	0	0	
5	12297	0	29395	35186	0	-56573	-21801	0	0	
6	15902	0	33349	34929	0	-21801	11193	0	0	
7	19360	0	37080	34693	0	11193	42276	0	0	
8	16148	0	29047	24688	0	42276	63195	0	0	
9	22352	0	38234	29560	0	63195	86663	0	0	
10	24949	0	40992	29419	0	86663	108341	0	0	
11	8595	0	13803	9468	0	108341	114942	0	0	
12	36171	0	56704	37009	0	114942	138925	0	0	
13	39967	0	60634	36835	0	138925	159768	0	0	
14	43569	0	64318	36685	0	159768	177374	0	0	
15	41712	0	60232	32542	0	177374	190223	0	0	
16	44342	0	62885	32457	0	190223	200366	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
17	49510	0	69085	34205	0	200366	208112	0	0	
18	52091	0	71628	34145	0	208112	212789	0	0	
19	54540	0	74028	34102	0	212789	214362	0	0	
20	49389	0	66313	29682	0	214362	213189	0	0	
21	50996	0	67850	29674	0	213189	209675	0	0	
22	52448	0	69209	29677	0	209675	203864	0	0	
23	53788	0	70444	29692	0	203864	195781	0	0	
24	65283	0	84860	35211	0	195781	183327	0	0	
25	66763	0	86144	35267	0	183327	167839	0	0	
26	71221	0	91269	36983	0	167839	148494	0	0	
27	72367	0	92146	37087	0	148494	126079	0	0	
28	71964	0	91098	36572	0	126079	101245	0	0	
29	72492	0	91265	36718	0	101245	73871	0	0	
30	65723	0	82328	33335	0	73871	47167	0	0	
31	65906	0	82194	33491	0	47167	18605	0	0	
32	66041	0	82024	33666	0	18605	-11770	0	0	
33	33737	0	41779	17249	0	-11770	-27956	0	0	
34	62208	3440	81445	32393	0	-27956	-62044	0	0	
35	55850	3180	72774	30126	0	-62044	-93218	0	0	
36	54137	3180	70177	30316	0	-93218	-123837	0	0	
37	19966	1200	25778	11493	0	-123837	-135205	0	0	
38	50235	0	60072	30152	0	-135205	-160015	0	0	
39	47045	0	55295	30374	0	-160015	-182155	0	0	
40	43734	0	50282	30614	0	-182155	-201278	0	0	
41	46584	0	51423	37057	0	-201278	-218071	0	0	
42	42112	0	44232	37758	0	-218071	-229770	0	0	
43	39997	0	39148	40908	0	-229770	-236414	0	0	
44	34559	0	30173	41448	0	-236414	-236254	0	0	
45	28877	0	20547	42038	0	-236254	-228399	0	0	
46	22939	0	10194	42686	0	-228399	-211865	0	0	
47	16735	0	-978	43397	0	-211865	-185560	0	0	
48	10249	0	-13077	44179	0	-185560	-148269	0	0	
49	3467	0	-26233	45042	0	-148269	-98624	0	0	

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

### 22.2.2 ANALISI DELLA SUPERFICIE 145 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	51	
Coordinate del centro	X[m]= 89.58	Y[m]= 186.00
Raggio del cerchio	R[m]= 64.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 62.52	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 135.42	Y <sub>m</sub> [m]= 141.34
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.326</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	62.52	128.00	128.00	64.21	128.00	127.24	63.65	127.75	1.85	-24.18	38.66	0
2	64.21	128.00	127.24	64.41	128.05	127.16	64.31	127.61	0.22	-23.26	38.66	0
3	64.41	128.05	127.16	65.89	128.45	126.55	65.24	127.54	1.60	-22.44	25.32	19
4	65.89	128.45	126.55	67.36	128.84	125.98	66.67	127.45	1.58	-21.02	0.00	54

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]
5	67.36	128.84	125.98	68.84	129.23	125.45	68.14	127.38	1.57	-19.61	0.00	54
6	68.84	129.23	125.45	70.09	129.57	125.04	69.48	127.32	1.32	-18.32	0.00	54
7	70.09	129.57	125.04	71.34	129.90	124.65	70.73	127.29	1.31	-17.14	0.00	54
8	71.34	129.90	124.65	71.54	129.95	124.60	71.44	127.28	0.21	-16.47	0.00	54
9	71.54	129.95	124.60	73.13	130.38	124.15	72.36	127.27	1.65	-15.63	0.00	52
10	73.13	130.38	124.15	74.72	130.80	123.75	73.95	127.27	1.64	-14.16	0.00	52
11	74.72	130.80	123.75	76.32	131.23	123.39	75.54	127.29	1.63	-12.69	0.00	52
12	76.32	131.23	123.39	77.91	131.65	123.07	77.13	127.34	1.62	-11.23	0.00	52
13	77.91	131.65	123.07	79.13	131.98	122.86	78.53	127.39	1.24	-9.95	0.00	52
14	79.13	131.98	122.86	80.36	132.31	122.67	79.75	127.45	1.24	-8.84	0.00	52
15	80.36	132.31	122.67	81.58	132.63	122.50	80.97	127.53	1.23	-7.73	0.00	52
16	81.58	132.63	122.50	83.08	133.03	122.33	82.34	127.62	1.51	-6.50	0.00	52
17	83.08	133.03	122.33	84.58	133.43	122.20	83.84	127.75	1.51	-5.15	0.00	52
18	84.58	133.43	122.20	86.08	133.83	122.10	85.34	127.89	1.50	-3.81	0.00	52
19	86.08	133.83	122.10	87.58	134.23	122.03	86.83	128.05	1.50	-2.46	0.00	52
20	87.58	134.23	122.03	89.36	134.71	122.00	88.48	128.24	1.78	-0.99	0.00	52
21	89.36	134.71	122.00	91.14	135.18	122.02	90.26	128.48	1.78	0.60	0.00	52
22	91.14	135.18	122.02	92.55	135.56	122.07	91.85	128.71	1.41	2.03	0.00	52
23	92.55	135.56	122.07	93.96	135.93	122.15	93.26	128.93	1.41	3.29	0.00	52
24	93.96	135.93	122.15	95.37	136.31	122.26	94.67	129.16	1.41	4.56	0.00	52
25	95.37	136.31	122.26	96.78	136.68	122.41	96.08	129.42	1.42	5.83	0.00	52
26	96.78	136.68	122.41	98.42	137.12	122.61	97.60	129.71	1.65	7.20	0.00	52
27	98.42	137.12	122.61	100.06	137.56	122.86	99.24	130.04	1.66	8.68	0.00	52
28	100.06	137.56	122.86	101.69	137.99	123.16	100.88	130.39	1.66	10.16	0.00	52
29	101.69	137.99	123.16	103.33	138.43	123.49	102.51	130.77	1.67	11.66	0.00	52
30	103.33	138.43	123.49	104.62	138.78	123.79	103.98	131.12	1.33	13.00	0.00	52
31	104.62	138.78	123.79	105.92	139.12	124.12	105.27	131.45	1.33	14.19	0.00	52
32	105.92	139.12	124.12	107.21	139.47	124.48	106.56	131.80	1.34	15.39	0.00	52
33	107.21	139.47	124.48	108.56	139.83	124.88	107.89	132.16	1.41	16.62	0.00	52
34	108.56	139.83	124.88	109.92	140.19	125.32	109.24	132.55	1.42	17.89	0.00	52
35	109.92	140.19	125.32	111.27	140.55	125.79	110.59	132.96	1.43	19.17	0.00	52
36	111.27	140.55	125.79	112.60	140.90	126.28	111.93	133.38	1.42	20.45	0.00	52
37	112.60	140.90	126.28	113.93	141.26	126.81	113.26	133.81	1.43	21.72	0.00	52
38	113.93	141.26	126.81	115.26	141.61	127.38	114.59	134.26	1.44	23.01	0.00	52
39	115.26	141.61	127.38	116.84	142.03	128.10	116.05	134.78	1.74	24.43	0.00	52
40	116.84	142.03	128.10	118.43	142.46	128.87	117.63	135.36	1.76	26.00	0.00	52
41	118.43	142.46	128.87	120.01	142.88	129.70	119.21	135.97	1.79	27.59	0.00	52
42	120.01	142.88	129.70	121.59	143.30	130.58	120.79	136.61	1.81	29.20	0.00	54
43	121.59	143.30	130.58	122.97	143.30	131.40	122.27	137.14	1.60	30.73	0.00	54
44	122.97	143.30	131.40	124.34	143.30	132.26	123.64	137.56	1.62	32.17	0.00	54
45	124.34	143.30	132.26	125.72	143.30	133.18	125.02	138.01	1.65	33.64	0.00	54
46	125.72	143.30	133.18	127.09	143.30	134.14	126.39	138.48	1.68	35.13	0.00	54
47	127.09	143.30	134.14	128.76	142.91	135.39	127.90	138.93	2.08	36.81	0.00	54
48	128.76	142.91	135.39	130.42	142.52	136.73	129.55	139.38	2.14	38.70	0.00	54
49	130.42	142.52	136.73	132.09	142.12	138.16	131.20	139.87	2.20	40.64	0.00	54
50	132.09	142.12	138.16	133.76	141.73	139.69	132.83	140.40	2.27	42.64	0.00	54
51	133.76	141.73	139.69	135.42	141.34	141.34	134.31	140.92	2.34	44.70	0.00	54

Tabella 22-4 – Geometria e caratteristiche strisce della superficie 145 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	1276	0	-18211	-44695	0	0	-49070	0	0	
2	330	0	-8704	-21360	0	-49070	-72347	0	0	
3	4049	0	24183	44459	0	-72347	-24680	0	0	
4	6762	0	19944	26864	0	-24680	3112	0	0	
5	9334	0	22645	26620	0	3112	29663	0	0	
6	9827	0	21151	22360	0	29663	51089	0	0	
7	11952	0	23465	22214	0	51089	71390	0	0	
8	2073	0	3918	3542	0	71390	74536	0	0	
9	18088	0	32523	27080	0	74536	97508	0	0	
10	20854	0	35322	26789	0	97508	118437	0	0	
11	23476	0	37955	26626	0	118437	137345	0	0	
12	25946	0	40392	26483	0	137345	154162	0	0	
13	21514	0	32563	20259	0	154162	165625	0	0	
14	22815	0	33807	20194	0	165625	175802	0	0	
15	24057	0	34979	20137	0	175802	184676	0	0	
16	31128	0	44417	24625	0	184676	193747	0	0	
17	32826	0	45990	24566	0	193747	200804	0	0	
18	34412	0	47437	24521	0	200804	205839	0	0	
19	35904	0	48782	24490	0	205839	208840	0	0	
20	44441	0	59536	29038	0	208840	209743	0	0	
21	46274	0	61157	29036	0	209743	207769	0	0	
22	37828	0	49457	23013	0	207769	204194	0	0	
23	38756	0	50233	23037	0	204194	198874	0	0	
24	39596	0	50916	23072	0	198874	191843	0	0	
25	40367	0	51532	23118	0	191843	183121	0	0	
26	47723	0	60485	26922	0	183121	170934	0	0	
27	48463	0	60986	27019	0	170934	156638	0	0	
28	49009	0	61263	27136	0	156638	140375	0	0	
29	49401	0	61366	27272	0	140375	122265	0	0	
30	39191	0	48421	21651	0	122265	106749	0	0	
31	39236	0	48248	21760	0	106749	90268	0	0	
32	39201	0	47977	21881	0	90268	72907	0	0	
33	40888	0	49795	23037	0	72907	53905	0	0	
34	40648	0	49240	23196	0	53905	34178	0	0	
35	40305	0	48548	23370	0	34178	13862	0	0	
36	39155	0	46867	23153	0	13862	-6511	0	0	
37	38606	0	45889	23352	0	-6511	-27135	0	0	
38	37460	0	44043	23569	0	-27135	-47240	0	0	
39	43482	0	50549	28352	0	-47240	-70872	0	0	
40	42244	0	48415	28719	0	-70872	-94006	0	0	
41	40919	0	46056	29207	0	-94006	-116302	0	0	
42	39783	0	43323	30785	0	-116302	-136670	0	0	
43	33188	2750	39379	27163	0	-136670	-157025	0	0	
44	30936	2750	35503	27585	0	-157025	-174684	0	0	
45	28560	2750	31288	28045	0	-174684	-189212	0	0	
46	26062	2750	26702	28549	0	-189212	-200134	0	0	
47	27357	0	18923	35352	0	-200134	-201123	0	0	
48	21816	0	8072	36266	0	-201123	-192183	0	0	
49	15981	0	-4043	37299	0	-192183	-171735	0	0	
50	9836	0	-17667	38473	0	-171735	-137920	0	0	
51	3341	0	-33162	39818	0	-137920	-88484	0	0	

Tabella 22-5 – Forze applicate sulle strisce [BISHOP] della superficie 145 della verifica di stabilità 18.

### 22.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.050086
2	0.044427
3	0.029974
4	0.012368
5	0.024904
6	0.030179
7	0.040001

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

Accelerazione sismica critica  $K_c = 0.124$   
Spostamento massimo  $U_{max} = 0.050086$  [m]  
Velocità massima  $V_{max} = 0.167719$  [m/s]

n°	u
	[m]
1	0.074164
2	0.094844
3	0.049854
4	0.023642
5	0.036085
6	0.045165
7	0.062153

Tabella 22-7 – Spostamenti della superficie 145 della verifica di stabilità 18.

Accelerazione sismica critica  $K_c = 0.098$   
Spostamento massimo  $U_{max} = 0.094844$  [m]  
Velocità massima  $V_{max} = 0.230262$  [m/s]

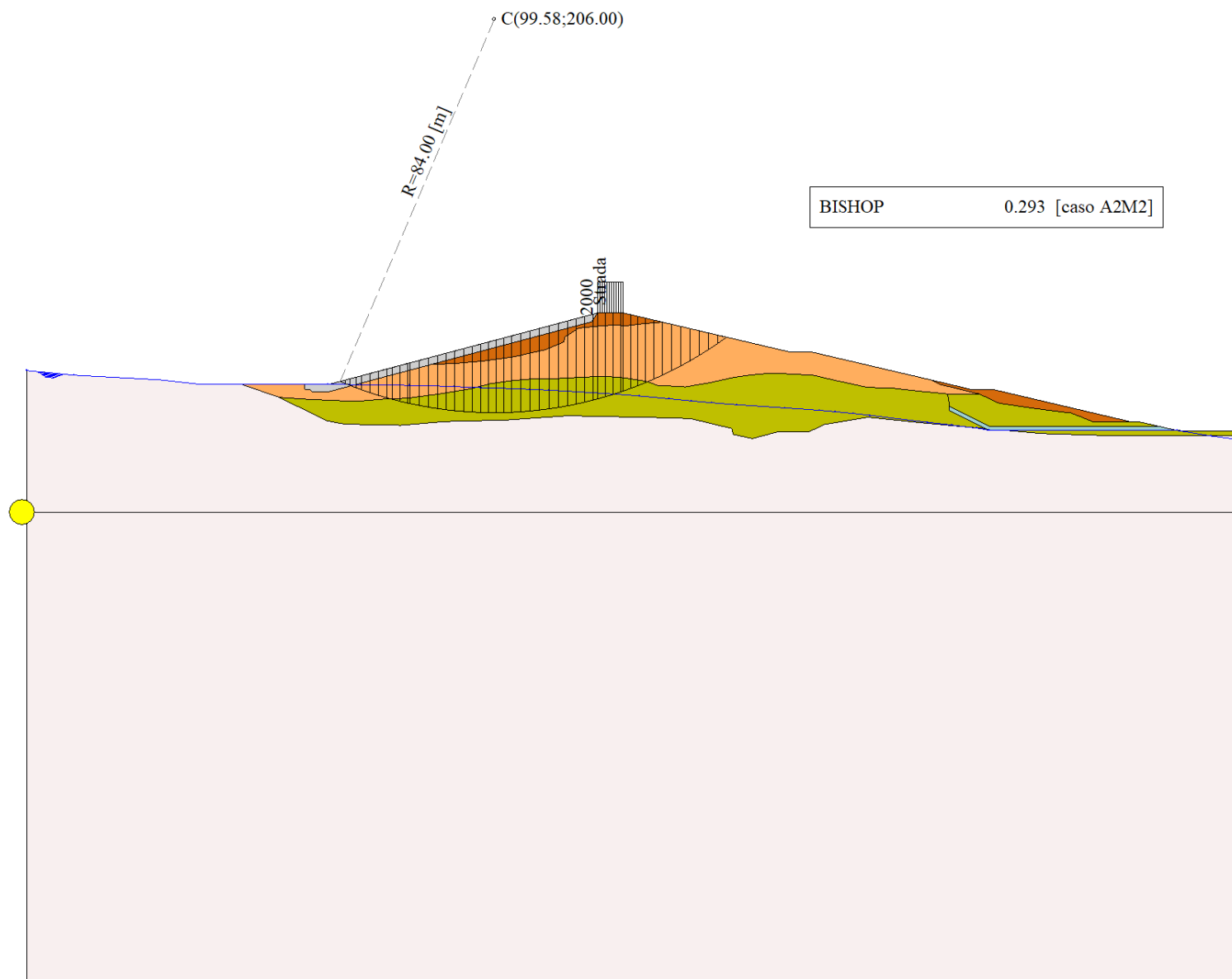


Figura 22-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 18.

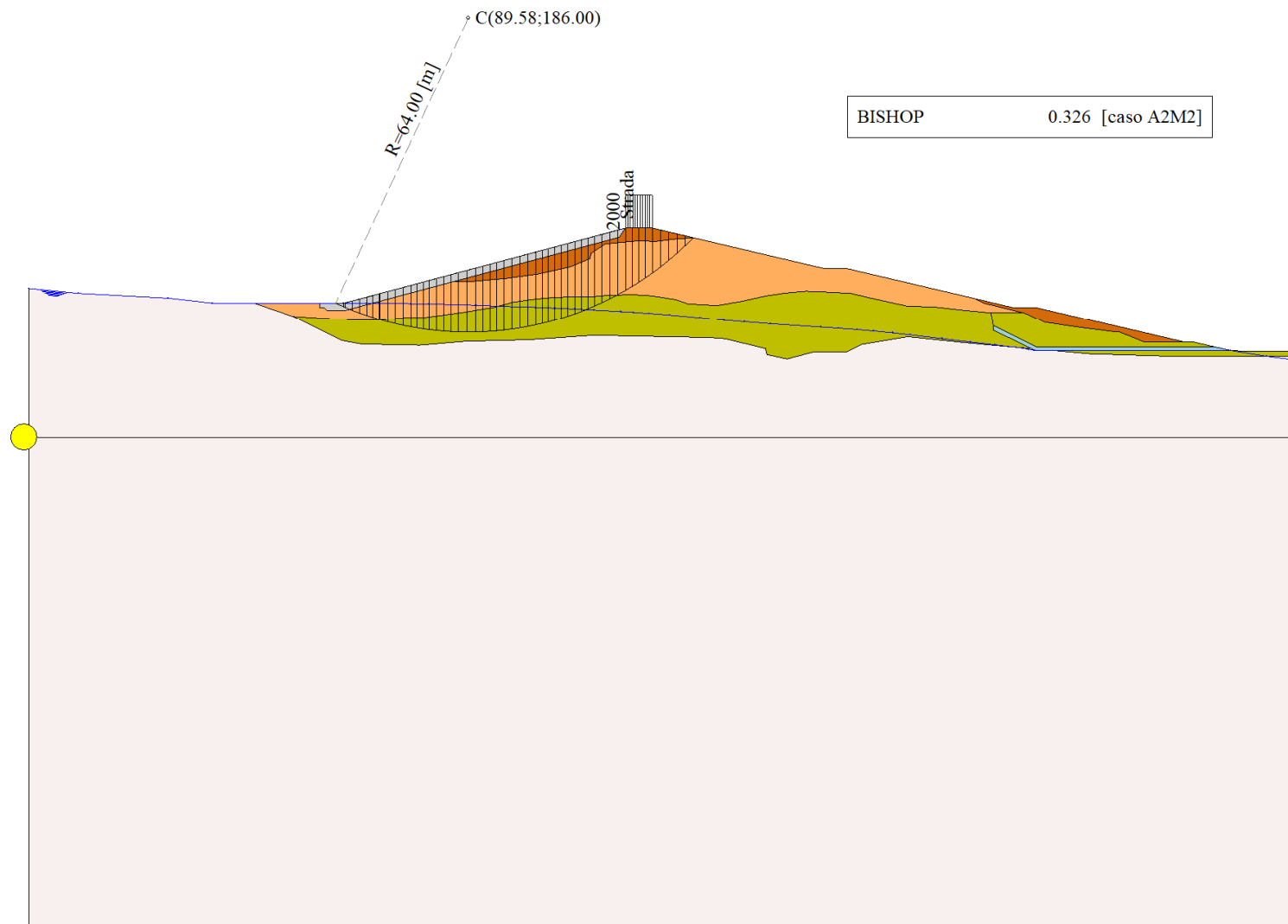


Figura 22-2 – Superficie critica (145) della sezione CR\_08 per la verifica di stabilità 18.



## 23 VERIFICA DI STABILITÀ 19

### 23.1.1 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	121.59	127.09	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	80218
Coefficiente di sicurezza minimo	0.309
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	49
Coordinate del centro	X[m]= 103.58                      Y[m]= 206.00
Raggio del cerchio	R[m]= 84.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 69.24                      Y <sub>v</sub> [m]= 129.34
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 152.08                      Y <sub>m</sub> [m]= 137.42
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.309</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	69.24	129.34	129.34	70.29	129.62	128.88	69.94	129.28	1.15	-23.74	38.66	0
2	70.29	129.62	128.88	71.34	129.90	128.43	70.87	129.20	1.14	-22.96	38.66	0
3	71.34	129.90	128.43	72.98	130.34	127.77	72.24	129.11	1.77	-21.97	3.02	50
4	72.98	130.34	127.77	74.63	130.78	127.15	73.85	129.01	1.76	-20.76	0.00	54
5	74.63	130.78	127.15	76.27	131.22	126.56	75.48	128.92	1.74	-19.57	0.00	54
6	76.27	131.22	126.56	77.91	131.65	126.02	77.11	128.86	1.73	-18.38	0.00	54
7	77.91	131.65	126.02	79.49	132.07	125.53	78.72	128.82	1.65	-17.23	0.00	54
8	79.49	132.07	125.53	81.07	132.50	125.07	80.30	128.79	1.64	-16.10	0.00	54
9	81.07	132.50	125.07	81.58	132.63	124.93	81.33	128.78	0.53	-15.36	0.00	52
10	81.58	132.63	124.93	83.58	133.16	124.42	82.60	128.79	2.07	-14.48	0.00	52
11	83.58	133.16	124.42	85.58	133.70	123.95	84.60	128.81	2.05	-13.07	0.00	52
12	85.58	133.70	123.95	87.58	134.23	123.54	86.60	128.86	2.04	-11.68	0.00	52
13	87.58	134.23	123.54	89.36	134.71	123.21	88.48	128.92	1.81	-10.36	0.00	52
14	89.36	134.71	123.21	91.14	135.18	122.93	90.26	129.01	1.80	-9.13	0.00	52
15	91.14	135.18	122.93	93.02	135.68	122.67	92.09	129.11	1.90	-7.87	0.00	52
16	93.02	135.68	122.67	94.90	136.18	122.45	93.97	129.25	1.89	-6.58	0.00	52
17	94.90	136.18	122.45	96.78	136.68	122.28	95.85	129.40	1.89	-5.29	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]	∅ [°]	∅ [°]	c [kPa]
18	96.78	136.68	122.28	98.42	137.12	122.16	97.60	129.56	1.64	-4.08	0.00	52
19	98.42	137.12	122.16	100.06	137.56	122.07	99.24	129.73	1.64	-2.96	0.00	52
20	100.06	137.56	122.07	101.69	137.99	122.02	100.88	129.91	1.64	-1.85	0.00	52
21	101.69	137.99	122.02	103.33	138.43	122.00	102.52	130.11	1.64	-0.73	0.00	52
22	103.33	138.43	122.00	105.27	138.95	122.02	104.30	130.35	1.94	0.49	0.00	52
23	105.27	138.95	122.02	107.21	139.47	122.08	106.24	130.63	1.94	1.81	0.00	52
24	107.21	139.47	122.08	109.24	140.01	122.19	108.23	130.94	2.03	3.17	0.00	52
25	109.24	140.01	122.19	111.27	140.55	122.35	110.26	131.28	2.04	4.56	0.00	52
26	111.27	140.55	122.35	113.27	141.08	122.56	112.27	131.64	2.01	5.94	0.00	52
27	113.27	141.08	122.56	115.26	141.61	122.82	114.26	132.02	2.01	7.31	0.00	52
28	115.26	141.61	122.82	117.06	142.09	123.09	116.16	132.40	1.82	8.61	0.00	52
29	117.06	142.09	123.09	118.87	142.57	123.40	117.97	132.79	1.83	9.86	0.00	52
30	118.87	142.57	123.40	120.67	143.05	123.76	119.77	133.20	1.84	11.11	0.00	52
31	120.67	143.05	123.76	121.59	143.30	123.95	121.13	133.52	0.94	12.06	0.00	52
32	121.59	143.30	123.95	123.31	143.30	124.35	122.45	133.73	1.77	12.98	0.00	52
33	123.31	143.30	124.35	124.90	143.30	124.75	124.10	133.92	1.64	14.14	0.00	52
34	124.90	143.30	124.75	126.49	143.30	125.18	125.69	134.13	1.65	15.27	0.00	52
35	126.49	143.30	125.18	127.09	143.30	125.36	126.79	134.29	0.62	16.04	0.00	52
36	127.09	143.30	125.36	128.81	142.89	125.88	127.94	134.36	1.80	16.87	0.00	52
37	128.81	142.89	125.88	130.54	142.49	126.44	129.67	134.43	1.81	18.10	0.00	52
38	130.54	142.49	126.44	132.46	142.04	127.12	131.49	134.52	2.04	19.42	0.00	52
39	132.46	142.04	127.12	134.39	141.58	127.85	133.41	134.65	2.06	20.82	0.00	52
40	134.39	141.58	127.85	135.43	141.34	128.27	134.91	134.76	1.12	21.90	0.00	54
41	135.43	141.34	128.27	137.28	140.90	129.06	136.34	134.89	2.01	22.97	0.00	54
42	137.28	140.90	129.06	139.13	140.47	129.89	138.19	135.08	2.03	24.35	0.00	54
43	139.13	140.47	129.89	140.98	140.03	130.79	140.04	135.29	2.05	25.74	0.00	54
44	140.98	140.03	130.79	142.83	139.60	131.74	141.88	135.53	2.08	27.15	0.00	54
45	142.83	139.60	131.74	144.68	139.16	132.74	143.73	135.80	2.11	28.58	0.00	54
46	144.68	139.16	132.74	146.53	138.73	133.81	145.57	136.10	2.14	30.02	0.00	54
47	146.53	138.73	133.81	148.38	138.29	134.95	147.40	136.43	2.17	31.49	0.00	54
48	148.38	138.29	134.95	150.23	137.85	136.15	149.21	136.79	2.21	32.99	0.00	54
49	150.23	137.85	136.15	152.08	137.42	137.42	150.85	137.14	2.25	34.50	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	702	0	-7190	-18635	0	0	-20390	0	0	
2	2090	0	-30382	-78745	0	-20390	-106049	0	0	
3	6580	0	22675	33157	0	-106049	-70911	0	0	
4	10016	0	25987	31502	0	-70911	-38474	0	0	
5	13327	0	29657	31262	0	-38474	-7376	0	0	
6	16516	0	33135	31040	0	-7376	22255	0	0	
7	18786	0	34988	29666	0	22255	49266	0	0	
8	21522	0	37885	29493	0	49266	74720	0	0	
9	7526	0	12737	9115	0	74720	82201	0	0	
10	32251	0	52858	35581	0	82201	109804	0	0	
11	36478	0	57312	35368	0	109804	134525	0	0	
12	40506	0	61499	35180	0	134525	156223	0	0	
13	39338	0	58131	31170	0	156223	172868	0	0	
14	42297	0	61157	31055	0	172868	186921	0	0	
15	47704	0	67656	32692	0	186921	198889	0	0	
16	50646	0	70598	32599	0	198889	207851	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	53453	0	73390	32523	0	207851	213742	0	0	
18	48733	0	66074	28279	0	213742	216336	0	0	
19	50610	0	67905	28245	0	216336	216568	0	0	
20	52332	0	69556	28222	0	216568	214458	0	0	
21	53942	0	71086	28209	0	214458	210010	0	0	
22	65814	0	86003	33419	0	210010	201745	0	0	
23	67672	0	87708	33435	0	201745	190283	0	0	
24	72581	0	93365	35022	0	190283	174933	0	0	
25	74146	0	94723	35079	0	174933	156244	0	0	
26	74124	0	94113	34551	0	156244	134759	0	0	
27	75064	0	94778	34647	0	134759	110370	0	0	
28	68406	0	85949	31418	0	110370	86001	0	0	
29	68933	0	86250	31530	0	86001	59407	0	0	
30	69417	0	86532	31657	0	59407	30606	0	0	
31	35595	0	44258	16205	0	30606	15062	0	0	
32	65931	3440	86327	30405	0	15062	-17862	0	0	
33	59585	3180	77745	28245	0	-17862	-48520	0	0	
34	58159	3180	75613	28391	0	-48520	-79201	0	0	
35	21559	1200	27955	10754	0	-79201	-90749	0	0	
36	59949	0	72716	31050	0	-90749	-119431	0	0	
37	56419	0	67603	31262	0	-119431	-145822	0	0	
38	58600	0	69068	35159	0	-145822	-172081	0	0	
39	53731	0	61872	35490	0	-172081	-194322	0	0	
40	26996	0	30066	20102	0	-194322	-203681	0	0	
41	44630	0	48276	36043	0	-203681	-217099	0	0	
42	40164	0	41317	36425	0	-217099	-225933	0	0	
43	35506	0	33917	36841	0	-225933	-229566	0	0	
44	30647	0	26031	37295	0	-229566	-227326	0	0	
45	25581	0	17608	37789	0	-227326	-218478	0	0	
46	20299	0	8588	38329	0	-218478	-202218	0	0	
47	14792	0	-1099	38918	0	-202218	-177661	0	0	
48	9050	0	-11534	39563	0	-177661	-143826	0	0	
49	3059	0	-22815	40270	0	-143826	-99619	0	0	

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

### 23.2.2 ANALISI DELLA SUPERFICIE 37 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	50	
Coordinate del centro	X[m]= 89.58	Y[m]= 182.00
Raggio del cerchio	R[m]= 60.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 63.43	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 134.01	Y <sub>m</sub> [m]= 141.67
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.325</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	63.43	128.00	128.00	64.21	128.00	127.63	63.95	127.88	0.87	-25.43	38.66	0
2	64.21	128.00	127.63	65.75	128.41	126.93	65.14	127.73	1.69	-24.21	38.66	0
3	65.75	128.41	126.93	67.30	128.82	126.29	66.59	127.61	1.67	-22.60	2.78	50
4	67.30	128.82	126.29	68.84	129.23	125.70	68.11	127.51	1.65	-21.01	0.00	54
5	68.84	129.23	125.70	70.09	129.57	125.25	69.49	127.44	1.33	-19.59	0.00	54
6	70.09	129.57	125.25	71.34	129.90	124.84	70.73	127.39	1.32	-18.33	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]
7	71.34	129.90	124.84	71.54	129.95	124.78	71.44	127.37	0.21	-17.60	0.00	54
8	71.54	129.95	124.78	73.13	130.38	124.30	72.36	127.35	1.66	-16.70	0.00	53
9	73.13	130.38	124.30	74.72	130.80	123.87	73.95	127.34	1.65	-15.12	0.00	52
10	74.72	130.80	123.87	76.32	131.23	123.48	75.54	127.35	1.64	-13.55	0.00	52
11	76.32	131.23	123.48	77.91	131.65	123.15	77.13	127.38	1.63	-11.99	0.00	52
12	77.91	131.65	123.15	79.13	131.98	122.92	78.53	127.42	1.24	-10.62	0.00	52
13	79.13	131.98	122.92	80.36	132.31	122.71	79.75	127.48	1.24	-9.43	0.00	52
14	80.36	132.31	122.71	81.58	132.63	122.54	80.97	127.55	1.24	-8.25	0.00	52
15	81.58	132.63	122.54	83.08	133.03	122.35	82.34	127.64	1.51	-6.94	0.00	52
16	83.08	133.03	122.35	84.58	133.43	122.21	83.84	127.76	1.51	-5.50	0.00	52
17	84.58	133.43	122.21	86.08	133.83	122.10	85.34	127.89	1.50	-4.06	0.00	52
18	86.08	133.83	122.10	87.58	134.23	122.03	86.83	128.05	1.50	-2.63	0.00	52
19	87.58	134.23	122.03	88.77	134.55	122.01	88.18	128.20	1.19	-1.34	0.00	52
20	88.77	134.55	122.01	89.95	134.86	122.00	89.36	128.36	1.19	-0.21	0.00	52
21	89.95	134.86	122.00	91.14	135.18	122.02	90.55	128.52	1.19	0.92	0.00	52
22	91.14	135.18	122.02	92.55	135.56	122.07	91.85	128.71	1.41	2.16	0.00	52
23	92.55	135.56	122.07	93.96	135.93	122.16	93.26	128.93	1.41	3.51	0.00	52
24	93.96	135.93	122.16	95.37	136.31	122.28	94.67	129.17	1.42	4.86	0.00	52
25	95.37	136.31	122.28	96.78	136.68	122.43	96.08	129.43	1.42	6.21	0.00	52
26	96.78	136.68	122.43	98.42	137.12	122.65	97.60	129.72	1.65	7.68	0.00	52
27	98.42	137.12	122.65	100.06	137.56	122.92	99.24	130.06	1.66	9.26	0.00	52
28	100.06	137.56	122.92	101.69	137.99	123.24	100.87	130.43	1.67	10.85	0.00	52
29	101.69	137.99	123.24	103.33	138.43	123.60	102.51	130.81	1.68	12.45	0.00	52
30	103.33	138.43	123.60	104.62	138.78	123.92	103.98	131.18	1.33	13.88	0.00	52
31	104.62	138.78	123.92	105.92	139.12	124.27	105.27	131.52	1.34	15.16	0.00	52
32	105.92	139.12	124.27	107.21	139.47	124.65	106.56	131.88	1.35	16.44	0.00	52
33	107.21	139.47	124.65	108.56	139.83	125.08	107.89	132.26	1.42	17.77	0.00	52
34	108.56	139.83	125.08	109.92	140.19	125.55	109.24	132.66	1.43	19.13	0.00	52
35	109.92	140.19	125.55	111.27	140.55	126.06	110.59	133.09	1.44	20.50	0.00	52
36	111.27	140.55	126.06	112.90	140.98	126.72	112.08	133.58	1.76	22.03	0.00	52
37	112.90	140.98	126.72	114.53	141.42	127.43	113.71	134.14	1.78	23.72	0.00	52
38	114.53	141.42	127.43	116.15	141.85	128.20	115.34	134.72	1.80	25.43	0.00	52
39	116.15	141.85	128.20	117.78	142.28	129.04	116.96	135.34	1.83	27.16	0.00	52
40	117.78	142.28	129.04	119.05	142.62	129.74	118.41	135.92	1.45	28.73	0.00	53
41	119.05	142.62	129.74	120.32	142.96	130.47	119.68	136.45	1.47	30.12	0.00	54
42	120.32	142.96	130.47	121.59	143.30	131.25	120.95	136.99	1.49	31.53	0.00	54
43	121.59	143.30	131.25	122.97	143.30	132.15	122.27	137.50	1.64	33.03	0.00	54
44	122.97	143.30	132.15	124.34	143.30	133.09	123.64	137.96	1.67	34.61	0.00	54
45	124.34	143.30	133.09	125.72	143.30	134.10	125.02	138.44	1.70	36.22	0.00	54
46	125.72	143.30	134.10	127.09	143.30	135.17	126.39	138.96	1.74	37.86	0.00	54
47	127.09	143.30	135.17	128.82	142.89	136.61	127.92	139.48	2.25	39.77	0.00	54
48	128.82	142.89	136.61	130.55	142.49	138.16	129.63	140.02	2.33	41.95	0.00	54
49	130.55	142.49	138.16	132.28	142.08	139.85	131.32	140.61	2.41	44.22	0.00	54
50	132.28	142.08	139.85	134.01	141.67	141.67	132.85	141.20	2.52	46.57	0.00	54

Tabella 23-4 – Geometria e caratteristiche strisce della superficie 37 della verifica di stabilità 19.

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	292	0	-2509	-6169	0	0	-6830	0	0	
2	2792	0	-38165	-93827	0	-6830	-109793	0	0	
3	5953	0	20726	29483	0	-109793	-78312	0	0	
4	8901	0	23303	28123	0	-78312	-49241	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
5	9272	0	20934	22570	0	-49241	-26727	0	0	
6	11469	0	23259	22400	0	-26727	-5285	0	0	
7	2002	0	3886	3569	0	-5285	-1954	0	0	
8	17546	0	32300	27602	0	-1954	22851	0	0	
9	20403	0	34993	26954	0	22851	45307	0	0	
10	23115	0	37625	26766	0	45307	65764	0	0	
11	25664	0	40049	26601	0	65764	84140	0	0	
12	21345	0	32286	20337	0	84140	96799	0	0	
13	22682	0	33513	20263	0	96799	108170	0	0	
14	23956	0	34665	20198	0	108170	118230	0	0	
15	31039	0	44000	24690	0	118230	128746	0	0	
16	32770	0	45534	24622	0	128746	137231	0	0	
17	34381	0	46935	24571	0	137231	143675	0	0	
18	35891	0	48230	24535	0	143675	148066	0	0	
19	29417	0	39034	19395	0	148066	150069	0	0	
20	30262	0	39747	19390	0	150069	150776	0	0	
21	31048	0	40399	19392	0	150776	150198	0	0	
22	37819	0	48748	23055	0	150198	147868	0	0	
23	38734	0	49463	23082	0	147868	143778	0	0	
24	39555	0	50079	23122	0	143778	137963	0	0	
25	40300	0	50625	23175	0	137963	130449	0	0	
26	47604	0	59337	26998	0	130449	119657	0	0	
27	48291	0	59728	27109	0	119657	106756	0	0	
28	48772	0	59886	27243	0	106756	91895	0	0	
29	49089	0	59860	27400	0	91895	75208	0	0	
30	38884	0	47133	21768	0	75208	60839	0	0	
31	38867	0	46863	21894	0	60839	45535	0	0	
32	38765	0	46489	22033	0	45535	29390	0	0	
33	40353	0	48115	23220	0	29390	11716	0	0	
34	40025	0	47424	23405	0	11716	-6613	0	0	
35	39585	0	46580	23608	0	-6613	-25443	0	0	
36	46828	0	54623	28687	0	-25443	-48473	0	0	
37	45292	0	52099	29046	0	-48473	-71015	0	0	
38	43878	0	49699	29445	0	-71015	-93060	0	0	
39	42412	0	47162	29888	0	-93060	-114383	0	0	
40	32009	0	34789	23841	0	-114383	-130110	0	0	
41	31061	0	32590	24976	0	-130110	-144184	0	0	
42	30299	0	31054	25346	0	-144184	-157671	0	0	
43	31297	2750	35106	27897	0	-157671	-174596	0	0	
44	28832	2750	30698	28418	0	-174596	-188289	0	0	
45	26222	2750	25849	28992	0	-188289	-198197	0	0	
46	23466	2750	20503	29627	0	-198197	-203702	0	0	
47	24603	0	10112	38275	0	-203702	-196057	0	0	
48	18112	0	-3631	39559	0	-196057	-175478	0	0	
49	11214	0	-19426	41048	0	-175478	-139488	0	0	
50	3862	0	-37528	42499	0	-139488	-85421	0	0	

Tabella 23-5 – Forze applicate sulle strisce [BISHOP] della superficie 37 della verifica di stabilità 19.

### 23.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.051457
2	0.022625
3	0.044532
4	0.041516
5	0.060674
6	0.020110
7	0.031234

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

Accelerazione sismica critica  $K_c = 0.138$   
Spostamento massimo  $U_{max} = 0.060674$  [m]  
Velocità massima  $V_{max} = 0.172694$  [m/s]

n°	u
	[m]
1	0.091030
2	0.054381
3	0.132272
4	0.077450
5	0.106364
6	0.041352
7	0.062254

Tabella 23-7 – Spostamenti della superficie 37 della verifica di stabilità 19.

Accelerazione sismica critica  $K_c = 0.098$   
Spostamento massimo  $U_{max} = 0.132272$  [m]  
Velocità massima  $V_{max} = 0.299726$  [m/s]

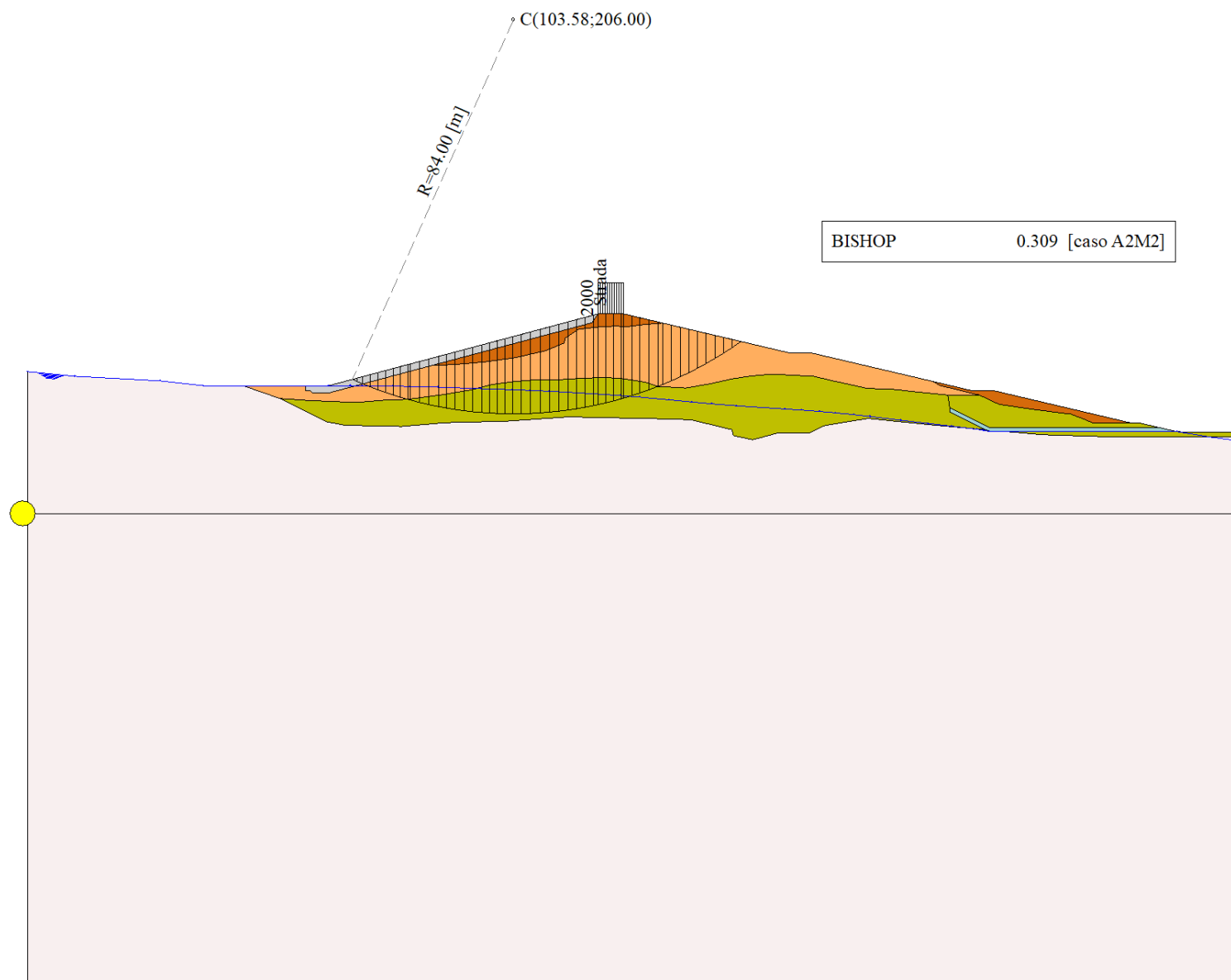


Figura 23-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 19.

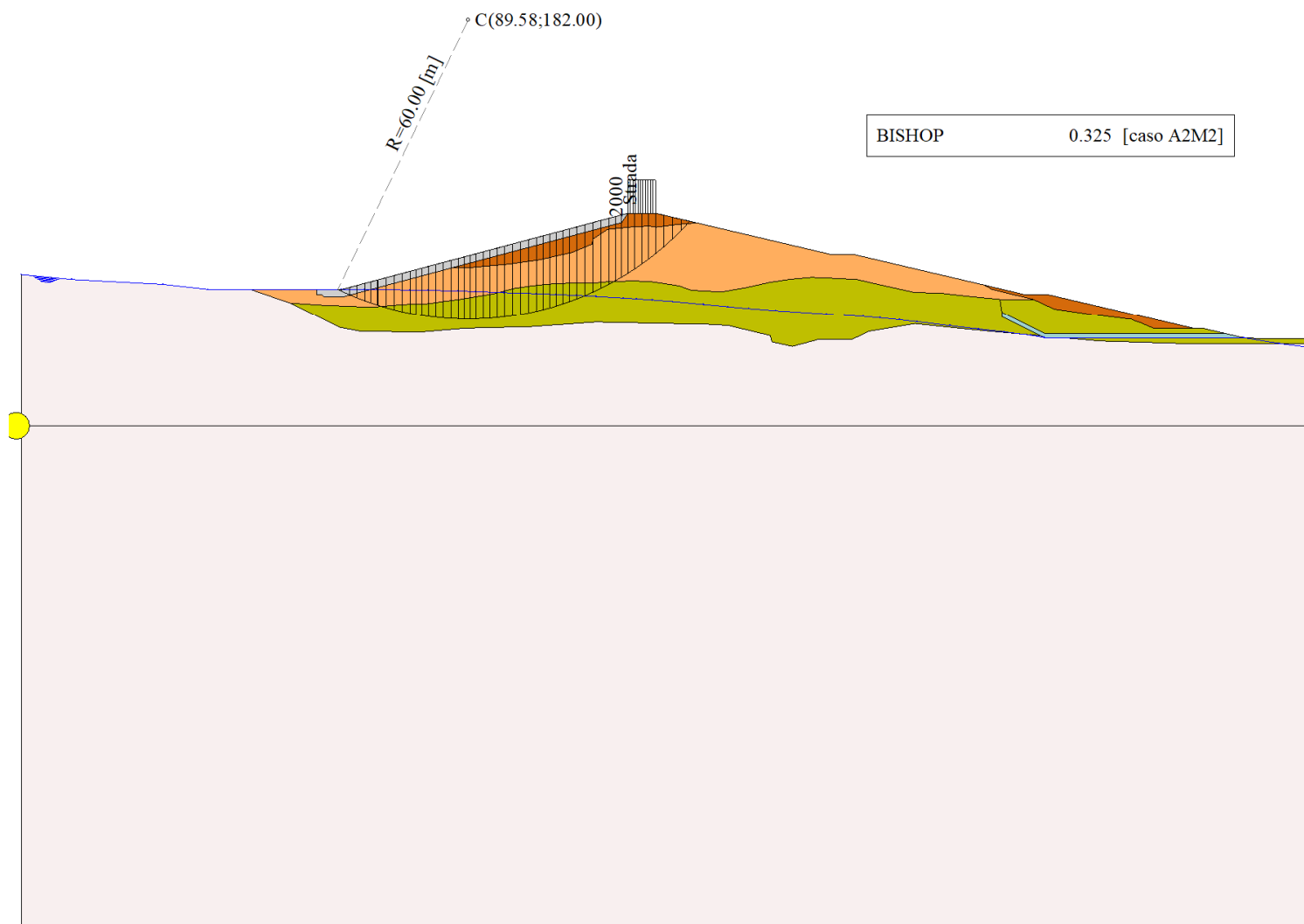


Figura 23-2 – Superficie critica (37) della sezione CR\_08 per la verifica di stabilità 19.



## 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	121.59 143.30	127.09 143.30	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	41952
Coefficiente di sicurezza minimo	2.255
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]= 85.58                      Y[m]= 180.00
Raggio del cerchio	R[m]= 56.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 64.56                      Y <sub>v</sub> [m]= 128.09
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 127.74                      Y <sub>m</sub> [m]= 143.15
Coefficiente di sicurezza	F <sub>S</sub> = 2.255

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	64.56	128.09	128.09	66.07	128.50	127.51	65.57	128.03	1.62	-21.22	38.66	0
2	66.07	128.50	127.51	67.58	128.90	126.97	66.91	127.97	1.60	-19.57	31.16	7
3	67.58	128.90	126.97	69.09	129.30	126.48	68.38	127.91	1.59	-17.94	19.78	18
4	69.09	129.30	126.48	70.60	129.70	126.04	69.87	127.88	1.57	-16.32	19.78	18
5	70.60	129.70	126.04	72.10	130.11	125.65	71.37	127.87	1.56	-14.72	19.78	18
6	72.10	130.11	125.65	73.61	130.51	125.29	72.88	127.89	1.55	-13.13	19.78	18
7	73.61	130.51	125.29	75.12	130.91	124.99	74.38	127.92	1.54	-11.55	19.78	18
8	75.12	130.91	124.99	76.63	131.31	124.72	75.89	127.98	1.53	-9.98	19.37	18
9	76.63	131.31	124.72	78.17	131.72	124.49	77.41	128.06	1.56	-8.40	19.10	18
10	78.17	131.72	124.49	79.72	132.13	124.31	78.96	128.17	1.55	-6.80	19.10	18
11	79.72	132.13	124.31	81.26	132.55	124.17	80.50	128.29	1.55	-5.22	19.10	18
12	81.26	132.55	124.17	82.80	132.96	124.07	82.04	128.44	1.55	-3.63	19.10	18
13	82.80	132.96	124.07	84.35	133.37	124.01	83.58	128.60	1.54	-2.05	19.10	18
14	84.35	133.37	124.01	85.89	133.78	124.00	85.12	128.79	1.54	-0.47	19.10	18
15	85.89	133.78	124.00	87.43	134.19	124.03	86.67	129.00	1.54	1.11	19.10	18
16	87.43	134.19	124.03	88.98	134.60	124.10	88.21	129.23	1.55	2.69	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>s</sub> [°]	α <sub>d</sub> [°]	c [kPa]
17	88.98	134.60	124.10	90.52	135.02	124.22	89.75	129.49	1.55	4.27	19.10	18
18	90.52	135.02	124.22	92.06	135.43	124.38	91.30	129.76	1.55	5.86	19.10	18
19	92.06	135.43	124.38	93.61	135.84	124.58	92.84	130.06	1.56	7.45	19.10	18
20	93.61	135.84	124.58	95.15	136.25	124.82	94.38	130.37	1.56	9.04	19.10	18
21	95.15	136.25	124.82	96.70	136.66	125.11	95.93	130.71	1.57	10.65	19.10	18
22	96.70	136.66	125.11	98.24	137.07	125.45	97.47	131.08	1.58	12.26	19.10	18
23	98.24	137.07	125.45	99.78	137.49	125.83	99.01	131.46	1.59	13.88	19.10	18
24	99.78	137.49	125.83	101.33	137.90	126.26	100.55	131.87	1.60	15.51	19.10	18
25	101.33	137.90	126.26	102.87	138.31	126.74	102.10	132.30	1.62	17.16	19.10	18
26	102.87	138.31	126.74	104.41	138.72	127.26	103.64	132.76	1.63	18.82	19.10	18
27	104.41	138.72	127.26	105.96	139.13	127.84	105.18	133.24	1.65	20.49	19.10	18
28	105.96	139.13	127.84	107.50	139.54	128.47	106.73	133.74	1.67	22.19	19.10	18
29	107.50	139.54	128.47	108.35	139.77	128.84	107.93	134.16	0.93	23.52	19.10	18
30	108.35	139.77	128.84	109.21	140.00	129.23	108.78	134.46	0.94	24.48	19.10	18
31	109.21	140.00	129.23	110.57	140.36	129.89	109.89	134.87	1.51	25.73	19.77	18
32	110.57	140.36	129.89	111.93	140.72	130.59	111.25	135.39	1.53	27.29	19.78	18
33	111.93	140.72	130.59	113.29	141.09	131.34	112.61	135.93	1.55	28.86	19.78	18
34	113.29	141.09	131.34	114.65	141.45	132.14	113.96	136.50	1.58	30.47	19.78	18
35	114.65	141.45	132.14	116.01	141.81	132.99	115.32	137.09	1.61	32.09	19.78	18
36	116.01	141.81	132.99	116.51	141.95	133.32	116.26	137.52	0.60	33.22	19.78	18
37	116.51	141.95	133.32	117.40	142.18	133.92	116.95	137.84	1.07	34.08	19.78	18
38	117.40	142.18	133.92	118.80	142.56	134.92	118.09	138.39	1.72	35.50	19.78	18
39	118.80	142.56	134.92	120.19	142.93	135.98	119.48	139.09	1.76	37.28	19.78	18
40	120.19	142.93	135.98	121.59	143.30	137.11	120.88	139.82	1.80	39.10	19.78	18
41	121.59	143.30	137.11	121.65	143.30	137.16	121.62	140.22	0.08	40.06	19.78	18
42	121.65	143.30	137.16	122.50	143.30	137.89	122.06	140.41	1.11	40.67	19.78	18
43	122.50	143.30	137.89	123.34	143.30	138.65	122.91	140.78	1.13	41.82	19.78	18
44	123.34	143.30	138.65	124.72	143.30	139.95	123.99	141.28	1.90	43.37	19.78	18
45	124.72	143.30	139.95	125.91	143.30	141.15	125.27	141.90	1.69	45.21	18.91	19
46	125.91	143.30	141.15	127.09	143.30	142.41	126.42	142.50	1.73	46.95	17.58	19
47	127.09	143.30	142.41	127.74	143.15	143.15	127.31	142.95	0.98	48.34	17.58	19

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

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	1490	17657	927	329	19740	0	12494	0	0	
2	4389	17050	2778	1274	20428	12494	26013	0	0	
3	7076	16443	4328	2009	21044	26013	40124	0	0	
4	9609	15837	5564	2195	21593	40124	54087	0	0	
5	12008	15230	6704	2367	22080	54087	67751	0	0	
6	14275	14623	7756	2525	22508	67751	80985	0	0	
7	16414	14016	8725	2672	22880	80985	93669	0	0	
8	18444	13410	9625	2742	23201	93669	105634	0	0	
9	20904	13093	10775	2896	24018	105634	117072	0	0	
10	22816	12457	11635	3023	24250	117072	127648	0	0	
11	24587	11822	12416	3140	24431	127648	137277	0	0	
12	26244	11187	13149	3250	24563	137277	145892	0	0	
13	27779	10552	13827	3352	24648	145892	153433	0	0	
14	29175	9917	14435	3445	24686	153433	159843	0	0	
15	30446	9281	14990	3530	24676	159843	165080	0	0	
16	31627	8646	15528	3614	24620	165080	169113	0	0	
17	32683	8011	16016	3691	24516	169113	171911	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	33592	7376	16434	3758	24364	171911	173453	0	0	
19	34352	6740	16781	3815	24163	173453	173727	0	0	
20	34972	6105	17068	3864	23911	173727	172730	0	0	
21	35476	5470	17322	3909	23606	172730	170470	0	0	
22	35842	4835	17520	3947	23247	170470	166961	0	0	
23	36039	4199	17636	3973	22831	166961	162232	0	0	
24	36042	3564	17644	3984	22354	162232	156324	0	0	
25	35887	2929	17581	3985	21812	156324	149292	0	0	
26	35568	2294	17445	3976	21201	149292	141202	0	0	
27	35056	1658	17204	3953	20515	141202	132140	0	0	
28	34369	1023	16878	3918	19748	132140	122207	0	0	
29	18680	293	9177	2151	10579	122207	116374	0	0	
30	18377	98	9028	2134	10301	116374	110333	0	0	
31	28547	0	14226	3524	15765	110333	100487	0	0	
32	27602	0	14284	3551	14942	100487	90244	0	0	
33	26517	0	14275	3568	14036	90244	79703	0	0	
34	25285	0	14193	3576	13039	79703	68978	0	0	
35	23808	0	13933	3557	11939	68978	58245	0	0	
36	8556	0	5260	1336	4092	58245	54239	0	0	
37	14721	0	9300	2377	6865	54239	47151	0	0	
38	21748	0	14799	3787	9214	47151	36288	0	0	
39	20006	0	14925	3840	7295	36288	25885	0	0	
40	18121	0	15016	3892	5171	25885	16174	0	0	
41	734	156	826	197	171	16174	15683	0	0	
42	9702	2197	11435	2750	1890	15683	9085	0	0	
43	8483	2197	10985	2695	934	9085	3146	0	0	
44	11095	3588	16258	4172	0	3146	-4986	0	0	
45	6668	3094	10769	3065	0	-4986	-10468	0	0	
46	3669	3068	7183	2510	0	-10468	-14004	0	0	
47	594	0	-57	846	0	-14004	-13399	0	0	

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

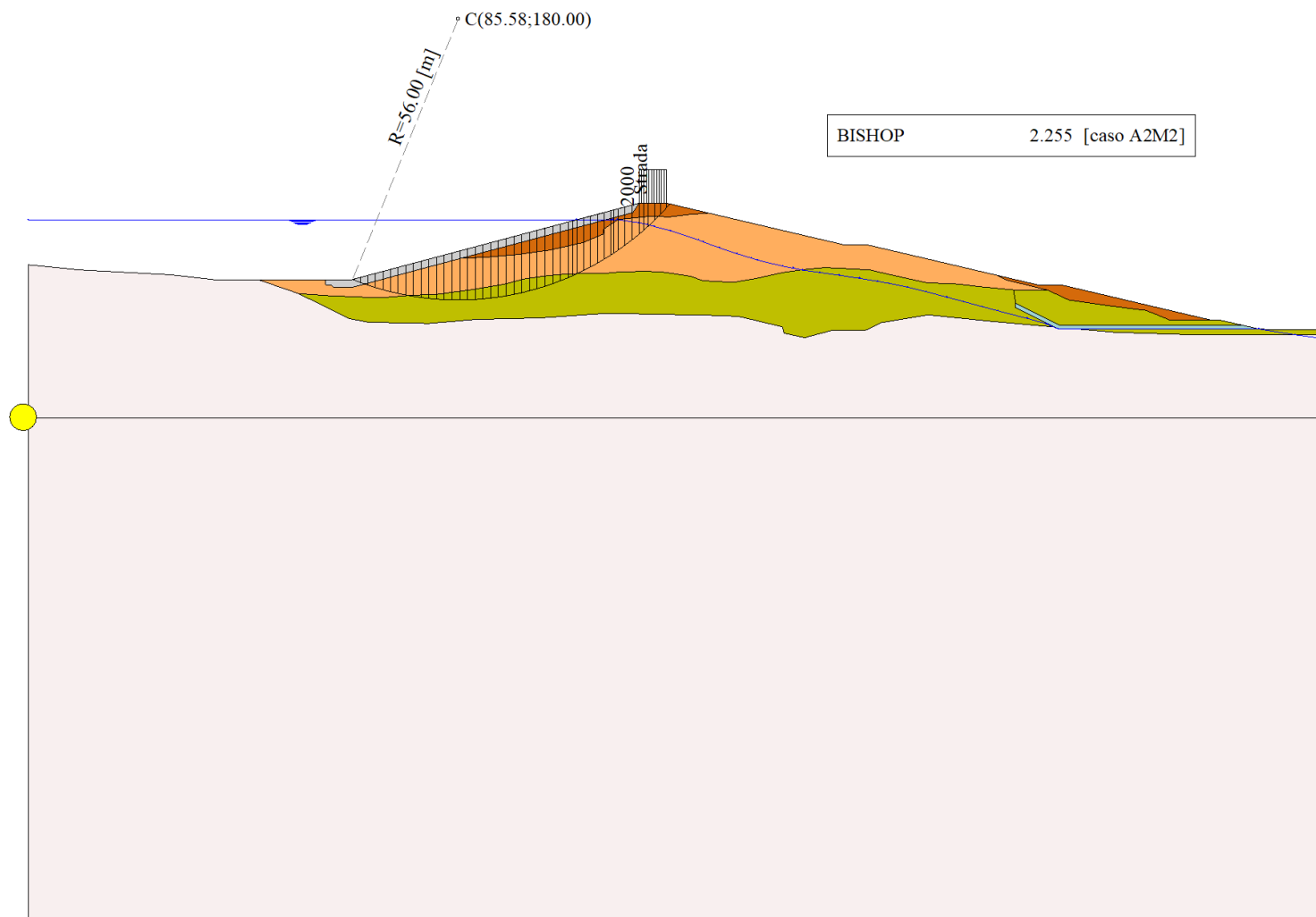


Figura 24-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 20.

## 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	121.59	127.09	2000	0
				143.30	143.30	2000	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 80956

Coefficiente di sicurezza minimo 0.834

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 51

Coordinate del centro X[m]= 85.58 Y[m]= 192.00

Raggio del cerchio R[m]= 72.00

Intersezione a valle con il profilo topografico X<sub>v</sub>[m]= 52.60 Y<sub>v</sub>[m]= 128.00

Intersezione a monte con il profilo topografico X<sub>m</sub>[m]= 136.49 Y<sub>m</sub>[m]= 141.09

Coefficiente di sicurezza F<sub>s</sub>= **0.834**

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	52.60	128.00	128.00	54.25	128.00	127.17	53.70	127.72	1.85	-26.53	0.00	54
2	54.25	128.00	127.17	55.90	128.00	126.40	55.16	127.37	1.83	-25.07	0.00	54
3	55.90	128.00	126.40	57.56	128.00	125.68	56.78	127.01	1.80	-23.62	0.00	54
4	57.56	128.00	125.68	59.21	128.00	125.00	58.42	126.66	1.79	-22.20	0.00	54
5	59.21	128.00	125.00	59.98	128.00	124.70	59.60	126.43	0.83	-21.16	0.00	53
6	59.98	128.00	124.70	61.39	128.00	124.19	60.70	126.22	1.50	-20.23	0.00	52
7	61.39	128.00	124.19	62.80	128.00	123.70	62.11	125.97	1.49	-19.04	0.00	52
8	62.80	128.00	123.70	64.21	128.00	123.24	63.52	125.73	1.48	-17.86	0.00	52
9	64.21	128.00	123.24	66.14	128.52	122.67	65.21	125.61	2.02	-16.46	0.00	52
10	66.14	128.52	122.67	68.08	129.03	122.16	67.14	125.59	2.00	-14.87	0.00	52
11	68.08	129.03	122.16	70.01	129.55	121.70	69.07	125.61	1.99	-13.28	0.00	52
12	70.01	129.55	121.70	71.94	130.06	121.30	71.00	125.65	1.97	-11.70	0.00	52
13	71.94	130.06	121.30	73.88	130.58	120.96	72.93	125.73	1.96	-10.13	0.00	52
14	73.88	130.58	120.96	75.81	131.09	120.67	74.86	125.82	1.96	-8.57	0.00	52
15	75.81	131.09	120.67	77.75	131.61	120.43	76.79	125.95	1.95	-7.02	0.00	52
16	77.75	131.61	120.43	79.68	132.12	120.24	78.72	126.10	1.94	-5.47	0.00	52
17	79.68	132.12	120.24	81.54	132.62	120.11	80.62	126.28	1.86	-3.96	0.00	52
18	81.54	132.62	120.11	83.40	133.12	120.03	82.47	126.47	1.86	-2.48	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]
19	83.40	133.12	120.03	85.25	133.61	120.00	84.33	126.69	1.86	-1.00	0.00	52
20	85.25	133.61	120.00	87.11	134.11	120.02	86.19	126.93	1.86	0.48	0.00	52
21	87.11	134.11	120.02	88.97	134.60	120.08	88.05	127.20	1.86	1.96	0.00	63
22	88.97	134.60	120.08	90.99	135.14	120.20	89.99	127.51	2.03	3.51	0.00	66
23	90.99	135.14	120.20	93.02	135.68	120.39	92.01	127.85	2.03	5.12	0.00	52
24	93.02	135.68	120.39	95.04	136.22	120.62	94.03	128.23	2.04	6.74	0.00	52
25	95.04	136.22	120.62	97.07	136.76	120.92	96.06	128.63	2.05	8.37	0.00	52
26	97.07	136.76	120.92	99.09	137.30	121.28	98.08	129.07	2.06	10.00	0.00	52
27	99.09	137.30	121.28	101.11	137.84	121.70	100.10	129.53	2.07	11.64	0.00	52
28	101.11	137.84	121.70	103.14	138.38	122.17	102.13	130.02	2.08	13.29	0.00	52
29	103.14	138.38	122.17	105.16	138.92	122.71	104.15	130.55	2.09	14.95	0.00	52
30	105.16	138.92	122.71	107.19	139.46	123.32	106.17	131.10	2.11	16.62	0.00	52
31	107.19	139.46	123.32	109.21	140.00	123.99	108.20	131.69	2.13	18.31	0.00	52
32	109.21	140.00	123.99	110.91	140.45	124.60	110.06	132.26	1.81	19.88	0.00	52
33	110.91	140.45	124.60	112.61	140.91	125.27	111.76	132.81	1.82	21.32	0.00	52
34	112.61	140.91	125.27	114.31	141.36	125.98	113.46	133.38	1.84	22.78	0.00	52
35	114.31	141.36	125.98	116.01	141.81	126.75	115.16	133.97	1.86	24.26	0.00	52
36	116.01	141.81	126.75	116.51	141.95	126.98	116.26	134.37	0.55	25.22	0.00	52
37	116.51	141.95	126.98	117.40	142.18	127.41	116.95	134.63	0.99	25.83	0.00	52
38	117.40	142.18	127.41	119.50	142.74	128.49	118.44	135.20	2.35	27.16	0.00	52
39	119.50	142.74	128.49	121.59	143.30	129.65	120.53	136.04	2.40	29.06	0.00	52
40	121.59	143.30	129.65	121.65	143.30	129.69	121.62	136.48	0.07	30.04	0.00	52
41	121.65	143.30	129.69	122.84	143.30	130.39	122.24	136.67	1.38	30.61	0.00	54
42	122.84	143.30	130.39	123.34	143.30	130.70	123.09	136.92	0.59	31.40	0.00	54
43	123.34	143.30	130.70	124.72	143.30	131.57	124.02	137.21	1.63	32.28	0.00	54
44	124.72	143.30	131.57	125.91	143.30	132.35	125.31	137.63	1.42	33.50	0.00	54
45	125.91	143.30	132.35	127.09	143.30	133.17	126.49	138.03	1.44	34.63	0.00	54
46	127.09	143.30	133.17	127.90	143.11	133.75	127.49	138.33	1.00	35.60	0.00	54
47	127.90	143.11	133.75	129.78	142.67	135.17	128.81	138.66	2.36	36.94	0.00	54
48	129.78	142.67	135.17	131.67	142.22	136.68	130.68	139.17	2.42	38.84	0.00	54
49	131.67	142.22	136.68	133.55	141.78	138.31	132.53	139.73	2.49	40.79	0.00	54
50	133.55	141.78	138.31	135.43	141.34	140.05	134.34	140.32	2.57	42.80	0.00	54
51	135.43	141.34	140.05	136.49	141.09	141.09	135.78	140.83	1.49	44.41	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	1322	19845	29945	12263	0	0	24051	0	0	
2	3882	19845	32340	12113	0	24051	47855	0	0	
3	6278	19845	34518	11975	0	47855	71251	0	0	
4	8516	19845	36496	11850	0	71251	94100	0	0	
5	4744	9240	17639	5358	0	94100	104399	0	0	
6	9913	16920	33311	9576	0	104399	122680	0	0	
7	11409	16920	34602	9505	0	122680	140394	0	0	
8	12793	16920	35765	9440	0	140394	157477	0	0	
9	20584	22706	51345	12850	0	157477	185790	0	0	
10	24698	21709	54264	12750	0	185790	212285	0	0	
11	28598	20712	56947	12662	0	212285	236798	0	0	
12	32285	19715	59408	12585	0	236798	259188	0	0	
13	35776	18718	61670	12518	0	259188	279331	0	0	
14	39058	17721	63729	12462	0	279331	297123	0	0	
15	42115	16724	65570	12416	0	297123	312477	0	0	
16	44929	15727	67181	12380	0	312477	325327	0	0	
17	45621	14172	65885	11869	0	325327	335265	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	47876	13251	67070	11852	0	335265	342804	0	0	
19	49959	12331	68108	11842	0	342804	347916	0	0	
20	51861	11410	68989	11841	0	347916	350592	0	0	
21	53645	10490	69701	14322	0	350592	353291	0	0	
22	60282	10379	76559	16415	0	353291	354244	0	0	
23	61952	9287	77338	12950	0	354244	348824	0	0	
24	63370	8195	77682	12988	0	348824	340579	0	0	
25	64584	7102	77859	13037	0	340579	329562	0	0	
26	65561	6010	77830	13097	0	329562	315850	0	0	
27	66212	4918	77490	13169	0	315850	299581	0	0	
28	66567	3825	76868	13253	0	299581	280906	0	0	
29	66642	2733	75974	13350	0	280906	259992	0	0	
30	66397	1641	74755	13461	0	259992	237055	0	0	
31	65856	548	73227	13586	0	237055	212326	0	0	
32	54591	0	60393	11520	0	212326	190383	0	0	
33	53614	0	59467	11630	0	190383	167569	0	0	
34	52443	0	58324	11750	0	167569	144057	0	0	
35	50933	0	56774	11883	0	144057	120143	0	0	
36	14866	0	16616	3522	0	120143	112915	0	0	
37	26138	0	29246	6301	0	112915	99981	0	0	
38	59837	0	67096	15006	0	99981	69281	0	0	
39	57301	0	64415	15273	0	69281	38499	0	0	
40	1602	120	1957	442	0	38499	37516	0	0	
41	30912	2380	37596	9168	0	37516	18795	0	0	
42	12496	1000	15212	3886	0	18795	11161	0	0	
43	32911	2760	40082	10829	0	11161	-9089	0	0	
44	26356	2370	32070	9428	0	-9089	-25366	0	0	
45	24526	2370	29754	9555	0	-25366	-40445	0	0	
46	15517	0	16492	6610	0	-40445	-48152	0	0	
47	31175	0	31628	15626	0	-48152	-61659	0	0	
48	24081	0	21473	16034	0	-61659	-68036	0	0	
49	16619	0	10178	16495	0	-68036	-65921	0	0	
50	8750	0	-2498	17021	0	-65921	-53697	0	0	
51	1329	0	-7603	9873	0	-53697	-41622	0	0	

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

## 25.2.2 ANALISI DEGLI SPOSTAMENTI

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

Tabella 25-4 – Spostamenti della superficie 1 della verifica di stabilità 21.

Accelerazione sismica critica  $K_c = 0.186$   
 Spostamento massimo  $U_{max} = 0.000010$  [m]  
 Velocità massima  $V_{max} = 0.000864$  [m/s]

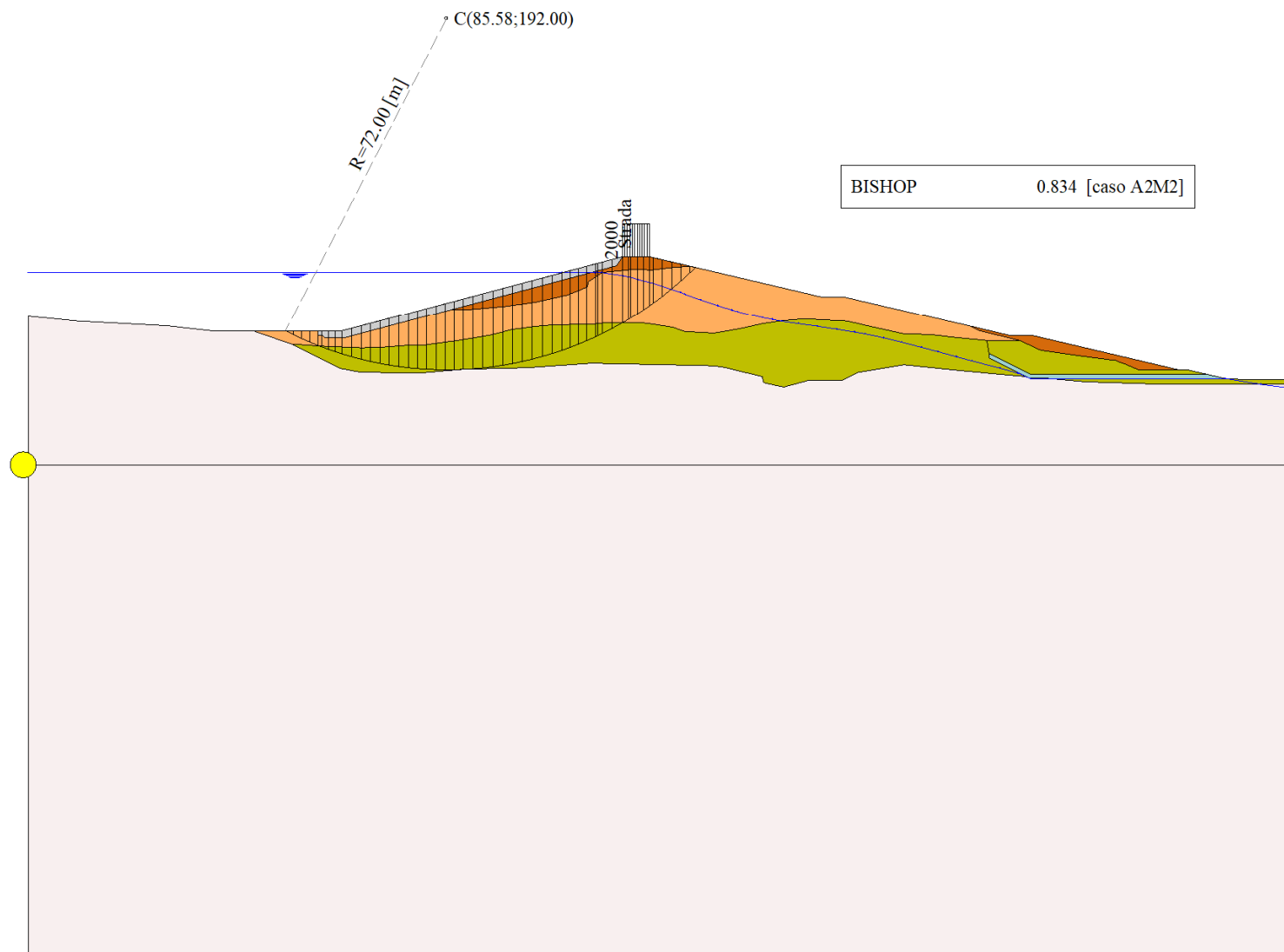


Figura 25-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 21.



## 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	121.59 143.30	127.09 143.30	2000 2000	0 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	80955
Coefficiente di sicurezza minimo	0.633
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]= 95.58                      Y[m]= 206.00
Raggio del cerchio	R[m]= 84.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 64.33                      Y <sub>v</sub> [m]= 128.03
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 146.04                      Y <sub>m</sub> [m]= 138.84
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.633</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	64.33	128.03	128.03	66.13	128.51	127.33	65.53	127.96	1.93	-21.18	22.44	0
2	66.13	128.51	127.33	67.93	128.99	126.68	67.13	127.87	1.92	-19.87	7.40	36
3	67.93	128.99	126.68	69.74	129.47	126.07	68.89	127.80	1.90	-18.57	0.00	54
4	69.74	129.47	126.07	71.54	129.95	125.51	70.68	127.75	1.89	-17.27	0.00	54
5	71.54	129.95	125.51	73.24	130.41	125.03	72.42	127.72	1.77	-16.03	0.00	54
6	73.24	130.41	125.03	74.93	130.86	124.58	74.11	127.72	1.76	-14.83	0.00	53
7	74.93	130.86	124.58	76.63	131.31	124.17	75.80	127.73	1.75	-13.63	0.00	52
8	76.63	131.31	124.17	78.67	131.85	123.72	77.67	127.76	2.08	-12.33	0.00	52
9	78.67	131.85	123.72	80.70	132.40	123.33	79.70	127.83	2.07	-10.91	0.00	52
10	80.70	132.40	123.33	82.74	132.94	122.99	81.74	127.91	2.06	-9.50	0.00	52
11	82.74	132.94	122.99	84.77	133.48	122.70	83.77	128.03	2.06	-8.09	0.00	52
12	84.77	133.48	122.70	86.81	134.03	122.46	85.80	128.17	2.05	-6.69	0.00	52
13	86.81	134.03	122.46	88.85	134.57	122.27	87.84	128.33	2.04	-5.29	0.00	52
14	88.85	134.57	122.27	90.88	135.11	122.13	89.87	128.52	2.04	-3.90	0.00	52
15	90.88	135.11	122.13	92.92	135.66	122.04	91.91	128.74	2.04	-2.51	0.00	52
16	92.92	135.66	122.04	94.96	136.20	122.00	93.95	128.98	2.04	-1.12	0.00	52
17	94.96	136.20	122.00	96.99	136.74	122.01	95.98	129.24	2.04	0.27	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	96.99	136.74	122.01	99.03	137.28	122.07	98.02	129.53	2.04	1.66	0.00	52
19	99.03	137.28	122.07	101.06	137.83	122.18	100.05	129.84	2.04	3.05	0.00	52
20	101.06	137.83	122.18	103.10	138.37	122.34	102.09	130.18	2.04	4.44	0.00	52
21	103.10	138.37	122.34	105.14	138.91	122.55	104.12	130.54	2.05	5.84	0.00	52
22	105.14	138.91	122.55	107.17	139.46	122.80	106.16	130.93	2.05	7.23	0.00	52
23	107.17	139.46	122.80	109.21	140.00	123.11	108.19	131.34	2.06	8.64	0.00	52
24	109.21	140.00	123.11	110.91	140.45	123.41	110.06	131.74	1.73	9.93	0.00	52
25	110.91	140.45	123.41	112.61	140.91	123.74	111.76	132.13	1.73	11.11	0.00	52
26	112.61	140.91	123.74	114.31	141.36	124.11	113.46	132.53	1.74	12.29	0.00	52
27	114.31	141.36	124.11	116.01	141.81	124.52	115.16	132.95	1.75	13.48	0.00	52
28	116.01	141.81	124.52	116.51	141.95	124.65	116.26	133.23	0.52	14.25	0.00	52
29	116.51	141.95	124.65	117.40	142.18	124.88	116.96	133.42	0.92	14.74	0.00	52
30	117.40	142.18	124.88	118.80	142.56	125.27	118.10	133.72	1.45	15.55	0.00	52
31	118.80	142.56	125.27	120.19	142.93	125.69	119.49	134.11	1.46	16.54	0.00	52
32	120.19	142.93	125.69	121.59	143.30	126.13	120.89	134.51	1.46	17.54	0.00	52
33	121.59	143.30	126.13	121.65	143.30	126.15	121.62	134.72	0.06	18.06	0.00	52
34	121.65	143.30	126.15	123.34	143.30	126.72	122.49	134.87	1.78	18.69	0.00	52
35	123.34	143.30	126.72	124.72	143.30	127.22	124.03	135.13	1.47	19.80	0.00	52
36	124.72	143.30	127.22	125.91	143.30	127.66	125.31	135.37	1.27	20.73	0.00	52
37	125.91	143.30	127.66	127.09	143.30	128.13	126.49	135.60	1.27	21.60	0.00	52
38	127.09	143.30	128.13	127.85	143.12	128.45	127.47	135.75	0.82	22.31	0.00	52
39	127.85	143.12	128.45	127.90	143.11	128.47	127.87	135.79	0.05	22.61	0.00	52
40	127.90	143.11	128.47	129.76	142.67	129.27	128.82	135.88	2.03	23.32	0.00	53
41	129.76	142.67	129.27	131.62	142.24	130.12	130.67	136.07	2.05	24.71	0.00	54
42	131.62	142.24	130.12	133.48	141.80	131.04	132.53	136.30	2.07	26.11	0.00	54
43	133.48	141.80	131.04	134.44	141.57	131.53	133.95	136.48	1.08	27.19	0.00	54
44	134.44	141.57	131.53	135.43	141.34	132.05	134.93	136.62	1.12	27.94	0.00	54
45	135.43	141.34	132.05	136.55	141.08	132.67	135.98	136.78	1.27	28.75	0.00	54
46	136.55	141.08	132.67	137.66	140.82	133.30	137.09	136.96	1.28	29.63	0.00	54
47	137.66	140.82	133.30	139.34	140.42	134.30	138.47	137.20	1.95	30.73	0.00	54
48	139.34	140.42	134.30	141.01	140.03	135.35	140.14	137.51	1.98	32.07	0.00	54
49	141.01	140.03	135.35	142.69	139.63	136.45	141.80	137.85	2.01	33.43	0.00	54
50	142.69	139.63	136.45	144.36	139.24	137.62	143.43	138.21	2.04	34.81	0.00	54
51	144.36	139.24	137.62	146.04	138.84	138.84	144.92	138.57	2.08	36.21	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	2128	21153	33925	22138	0	0	37839	0	0	
2	6269	20286	36077	18649	0	37839	70977	0	0	
3	10151	19418	38553	16644	0	70977	100855	0	0	
4	13867	18551	41486	16523	0	100855	129317	0	0	
5	16300	16660	41531	15443	0	129317	154685	0	0	
6	19338	15893	43748	15110	0	154685	178336	0	0	
7	22373	15125	45947	14671	0	178336	200065	0	0	
8	30686	17139	57969	17514	0	200065	223984	0	0	
9	34644	16033	60796	17426	0	223984	245431	0	0	
10	38404	14928	63407	17348	0	245431	264297	0	0	
11	41993	13822	65840	17283	0	264297	280488	0	0	
12	45367	12716	68048	17228	0	280488	293931	0	0	
13	48599	11611	70122	17184	0	293931	304554	0	0	
14	51669	10505	72042	17150	0	304554	312298	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	54511	9400	73735	17127	0	312298	317136	0	0	
16	57131	8294	75211	17114	0	317136	319054	0	0	
17	59582	7188	76533	17111	0	319054	318039	0	0	
18	61839	6083	77673	17118	0	318039	314095	0	0	
19	63812	4977	78530	17135	0	314095	307276	0	0	
20	65532	3872	79137	17162	0	307276	297643	0	0	
21	67021	2766	79521	17200	0	297643	285266	0	0	
22	68245	1661	79640	17248	0	285266	270247	0	0	
23	69231	555	79524	17307	0	270247	252694	0	0	
24	58296	0	66420	14502	0	252694	236270	0	0	
25	58479	0	66581	14558	0	236270	218411	0	0	
26	58516	0	66596	14620	0	218411	199189	0	0	
27	58264	0	66290	14690	0	199189	178773	0	0	
28	17268	0	19659	4335	0	178773	172430	0	0	
29	30701	0	34955	7733	0	172430	160872	0	0	
30	48090	0	54772	12182	0	160872	142038	0	0	
31	47959	0	54657	12243	0	142038	122369	0	0	
32	47793	0	54513	12308	0	122369	101889	0	0	
33	2049	120	2485	530	0	101889	100907	0	0	
34	56647	3380	68764	14992	0	100907	73243	0	0	
35	44680	2760	54312	12325	0	73243	50771	0	0	
36	37169	2370	45229	10647	0	50771	31657	0	0	
37	36011	2370	43858	10709	0	31657	12792	0	0	
38	22321	0	25280	6903	0	12792	2207	0	0	
39	1440	0	1629	455	0	2207	1525	0	0	
40	51053	0	57377	17169	0	1525	-22288	0	0	
41	46248	0	51076	17912	0	-22288	-42644	0	0	
42	41365	0	44793	18122	0	-42644	-59753	0	0	
43	19382	0	20539	9442	0	-59753	-67142	0	0	
44	18540	0	19254	9803	0	-67142	-73627	0	0	
45	19101	0	19281	11126	0	-73627	-79458	0	0	
46	17190	0	16660	11221	0	-79458	-83618	0	0	
47	22120	0	19849	17051	0	-83618	-86410	0	0	
48	17524	0	13258	17296	0	-86410	-84581	0	0	
49	12749	0	6207	17562	0	-84581	-77555	0	0	
50	7787	0	-1359	17851	0	-77555	-64694	0	0	
51	2629	0	-9504	18166	0	-64694	-45291	0	0	

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

### 26.2.2 ANALISI DELLA SUPERFICIE 38 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	50	
Coordinate del centro	X[m]= 85.58	Y[m]= 192.00
Raggio del cerchio	R[m]= 72.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 52.60	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 136.49	Y <sub>m</sub> [m]= 141.09
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.636</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	52.60	128.00	128.00	54.25	128.00	127.17	53.70	127.72	1.85	-26.53	0.00	54
2	54.25	128.00	127.17	55.90	128.00	126.40	55.16	127.37	1.83	-25.07	0.00	54

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]
3	55.90	128.00	126.40	57.56	128.00	125.68	56.78	127.01	1.80	-23.62	0.00	54
4	57.56	128.00	125.68	59.21	128.00	125.00	58.42	126.66	1.79	-22.20	0.00	54
5	59.21	128.00	125.00	59.98	128.00	124.70	59.60	126.43	0.83	-21.16	0.00	53
6	59.98	128.00	124.70	61.39	128.00	124.19	60.70	126.22	1.50	-20.23	0.00	52
7	61.39	128.00	124.19	62.80	128.00	123.70	62.11	125.97	1.49	-19.04	0.00	52
8	62.80	128.00	123.70	64.21	128.00	123.24	63.52	125.73	1.48	-17.86	0.00	52
9	64.21	128.00	123.24	66.14	128.52	122.67	65.21	125.61	2.02	-16.46	0.00	52
10	66.14	128.52	122.67	68.08	129.03	122.16	67.14	125.59	2.00	-14.87	0.00	52
11	68.08	129.03	122.16	70.01	129.55	121.70	69.07	125.61	1.99	-13.28	0.00	52
12	70.01	129.55	121.70	71.94	130.06	121.30	71.00	125.65	1.97	-11.70	0.00	52
13	71.94	130.06	121.30	73.88	130.58	120.96	72.93	125.73	1.96	-10.13	0.00	52
14	73.88	130.58	120.96	75.81	131.09	120.67	74.86	125.82	1.96	-8.57	0.00	52
15	75.81	131.09	120.67	77.75	131.61	120.43	76.79	125.95	1.95	-7.02	0.00	52
16	77.75	131.61	120.43	79.68	132.12	120.24	78.72	126.10	1.94	-5.47	0.00	52
17	79.68	132.12	120.24	81.54	132.62	120.11	80.62	126.28	1.86	-3.96	0.00	52
18	81.54	132.62	120.11	83.40	133.12	120.03	82.47	126.47	1.86	-2.48	0.00	52
19	83.40	133.12	120.03	85.25	133.61	120.00	84.33	126.69	1.86	-1.00	0.00	52
20	85.25	133.61	120.00	87.11	134.11	120.02	86.19	126.93	1.86	0.48	0.00	52
21	87.11	134.11	120.02	88.97	134.60	120.08	88.05	127.20	1.86	1.96	0.00	63
22	88.97	134.60	120.08	90.99	135.14	120.20	89.99	127.51	2.03	3.51	0.00	66
23	90.99	135.14	120.20	93.02	135.68	120.39	92.01	127.85	2.03	5.12	0.00	52
24	93.02	135.68	120.39	95.04	136.22	120.62	94.03	128.23	2.04	6.74	0.00	52
25	95.04	136.22	120.62	97.07	136.76	120.92	96.06	128.63	2.05	8.37	0.00	52
26	97.07	136.76	120.92	99.09	137.30	121.28	98.08	129.07	2.06	10.00	0.00	52
27	99.09	137.30	121.28	101.11	137.84	121.70	100.10	129.53	2.07	11.64	0.00	52
28	101.11	137.84	121.70	103.14	138.38	122.17	102.13	130.02	2.08	13.29	0.00	52
29	103.14	138.38	122.17	105.16	138.92	122.71	104.15	130.55	2.09	14.95	0.00	52
30	105.16	138.92	122.71	107.19	139.46	123.32	106.17	131.10	2.11	16.62	0.00	52
31	107.19	139.46	123.32	109.21	140.00	123.99	108.20	131.69	2.13	18.31	0.00	52
32	109.21	140.00	123.99	110.91	140.45	124.60	110.06	132.26	1.81	19.88	0.00	52
33	110.91	140.45	124.60	112.61	140.91	125.27	111.76	132.81	1.82	21.32	0.00	52
34	112.61	140.91	125.27	114.31	141.36	125.98	113.46	133.38	1.84	22.78	0.00	52
35	114.31	141.36	125.98	116.01	141.81	126.75	115.16	133.97	1.86	24.26	0.00	52
36	116.01	141.81	126.75	116.51	141.95	126.98	116.26	134.37	0.55	25.22	0.00	52
37	116.51	141.95	126.98	117.40	142.18	127.41	116.95	134.63	0.99	25.83	0.00	52
38	117.40	142.18	127.41	119.50	142.74	128.49	118.44	135.20	2.35	27.16	0.00	52
39	119.50	142.74	128.49	121.59	143.30	129.65	120.53	136.04	2.40	29.06	0.00	52
40	121.59	143.30	129.65	121.65	143.30	129.69	121.62	136.48	0.07	30.04	0.00	52
41	121.65	143.30	129.69	122.84	143.30	130.39	122.24	136.67	1.38	30.61	0.00	54
42	122.84	143.30	130.39	123.34	143.30	130.70	123.09	136.92	0.59	31.40	0.00	54
43	123.34	143.30	130.70	124.72	143.30	131.57	124.02	137.21	1.63	32.28	0.00	54
44	124.72	143.30	131.57	125.91	143.30	132.35	125.31	137.63	1.42	33.50	0.00	54
45	125.91	143.30	132.35	127.09	143.30	133.17	126.49	138.03	1.44	34.63	0.00	54
46	127.09	143.30	133.17	127.90	143.11	133.75	127.49	138.33	1.00	35.60	0.00	54
47	127.90	143.11	133.75	129.78	142.67	135.17	128.81	138.66	2.36	36.94	0.00	54
48	129.78	142.67	135.17	131.67	142.22	136.68	130.68	139.17	2.42	38.84	0.00	54
49	131.67	142.22	136.68	133.55	141.78	138.31	132.53	139.73	2.49	40.79	0.00	54
50	133.55	141.78	138.31	135.43	141.34	140.05	134.34	140.32	2.57	42.80	0.00	54
51	135.43	141.34	140.05	136.49	141.09	141.09	135.78	140.83	1.49	44.41	0.00	54

Tabella 26-4 – Geometria e caratteristiche strisce della superficie 38 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	1322	19845	31927	16076	0	0	28207	0	0	
2	3882	19845	34329	15879	0	28207	55853	0	0	
3	6278	19845	36510	15699	0	55853	82793	0	0	
4	8516	19845	38487	15534	0	82793	108902	0	0	
5	4744	9240	18553	7024	0	108902	120582	0	0	
6	9913	16920	34968	12554	0	120582	141178	0	0	
7	11409	16920	36262	12461	0	141178	161016	0	0	
8	12793	16920	37423	12375	0	161016	180044	0	0	
9	20584	22706	53664	16845	0	180044	210662	0	0	
10	24698	21709	56672	16714	0	210662	238985	0	0	
11	28598	20712	59435	16598	0	238985	264866	0	0	
12	32285	19715	61968	16498	0	264866	288180	0	0	
13	35776	18718	64294	16411	0	288180	308821	0	0	
14	39058	17721	66409	16337	0	308821	326699	0	0	
15	42115	16724	68297	16277	0	326699	341749	0	0	
16	44929	15727	69944	16229	0	341749	353926	0	0	
17	45621	14172	68566	15559	0	353926	362890	0	0	
18	47876	13251	69772	15536	0	362890	369146	0	0	
19	49959	12331	70823	15524	0	369146	372686	0	0	
20	51861	11410	71710	15522	0	372686	373517	0	0	
21	53645	10490	72396	18776	0	373517	374882	0	0	
22	60282	10379	79451	21519	0	374882	374356	0	0	
23	61952	9287	80278	16976	0	374356	366109	0	0	
24	63370	8195	80590	17026	0	366109	354809	0	0	
25	64584	7102	80727	17090	0	354809	340531	0	0	
26	65561	6010	80644	17169	0	340531	323383	0	0	
27	66212	4918	80234	17264	0	323383	303545	0	0	
28	66567	3825	79524	17374	0	303545	281206	0	0	
29	66642	2733	78525	17501	0	281206	256573	0	0	
30	66397	1641	77182	17646	0	256573	229905	0	0	
31	65856	548	75510	17810	0	229905	201481	0	0	
32	54591	0	62178	15102	0	201481	176507	0	0	
33	53614	0	61109	15246	0	176507	150775	0	0	
34	52443	0	59807	15404	0	150775	124491	0	0	
35	50933	0	58073	15578	0	124491	98007	0	0	
36	14866	0	16972	4617	0	98007	90041	0	0	
37	26138	0	29838	8261	0	90041	75839	0	0	
38	59837	0	68270	19672	0	75839	42404	0	0	
39	57301	0	65255	20022	0	42404	9284	0	0	
40	1602	120	1983	579	0	9284	8224	0	0	
41	30912	2380	37961	12018	0	8224	-11763	0	0	
42	12496	1000	15313	5095	0	-11763	-19851	0	0	
43	32911	2760	40194	14197	0	-19851	-41098	0	0	
44	26356	2370	31957	12359	0	-41098	-57918	0	0	
45	24526	2370	29436	12526	0	-57918	-73226	0	0	
46	15517	0	16033	8665	0	-73226	-80642	0	0	
47	31175	0	30045	20484	0	-80642	-92622	0	0	
48	24081	0	19100	21019	0	-92622	-96182	0	0	
49	16619	0	6918	21624	0	-96182	-89819	0	0	
50	8750	0	-6765	22313	0	-89819	-71740	0	0	
51	1329	0	-10511	12943	0	-71740	-55578	0	0	

Tabella 26-5 – Forze applicate sulle strisce [BISHOP] della superficie 38 della verifica di stabilità 22.

### 26.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.000057
2	0.000000
3	0.000252
4	0.000000
5	0.000011
6	0.000000
7	0.000065

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

Accelerazione sismica critica  $K_c = 0.190$   
Spostamento massimo  $U_{max} = 0.000252$  [m]  
Velocità massima  $V_{max} = 0.007529$  [m/s]

n°	u
	[m]
1	0.000107
2	0.000000
3	0.000298
4	0.000001
5	0.000026
6	0.000000
7	0.000083

Tabella 26-7 – Spostamenti della superficie 38 della verifica di stabilità 22.

Accelerazione sismica critica  $K_c = 0.186$   
Spostamento massimo  $U_{max} = 0.000298$  [m]  
Velocità massima  $V_{max} = 0.008430$  [m/s]

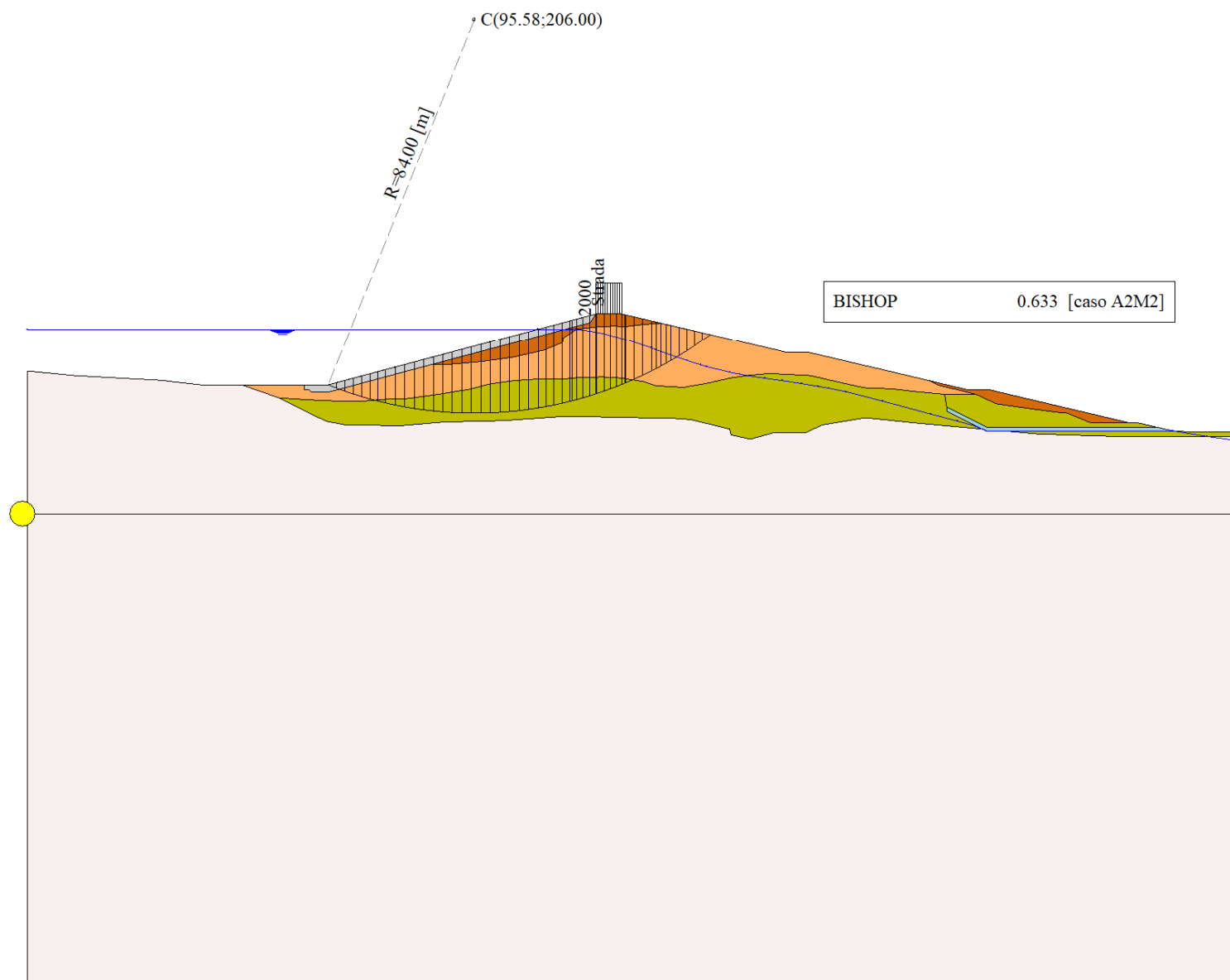


Figura 26-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 22.

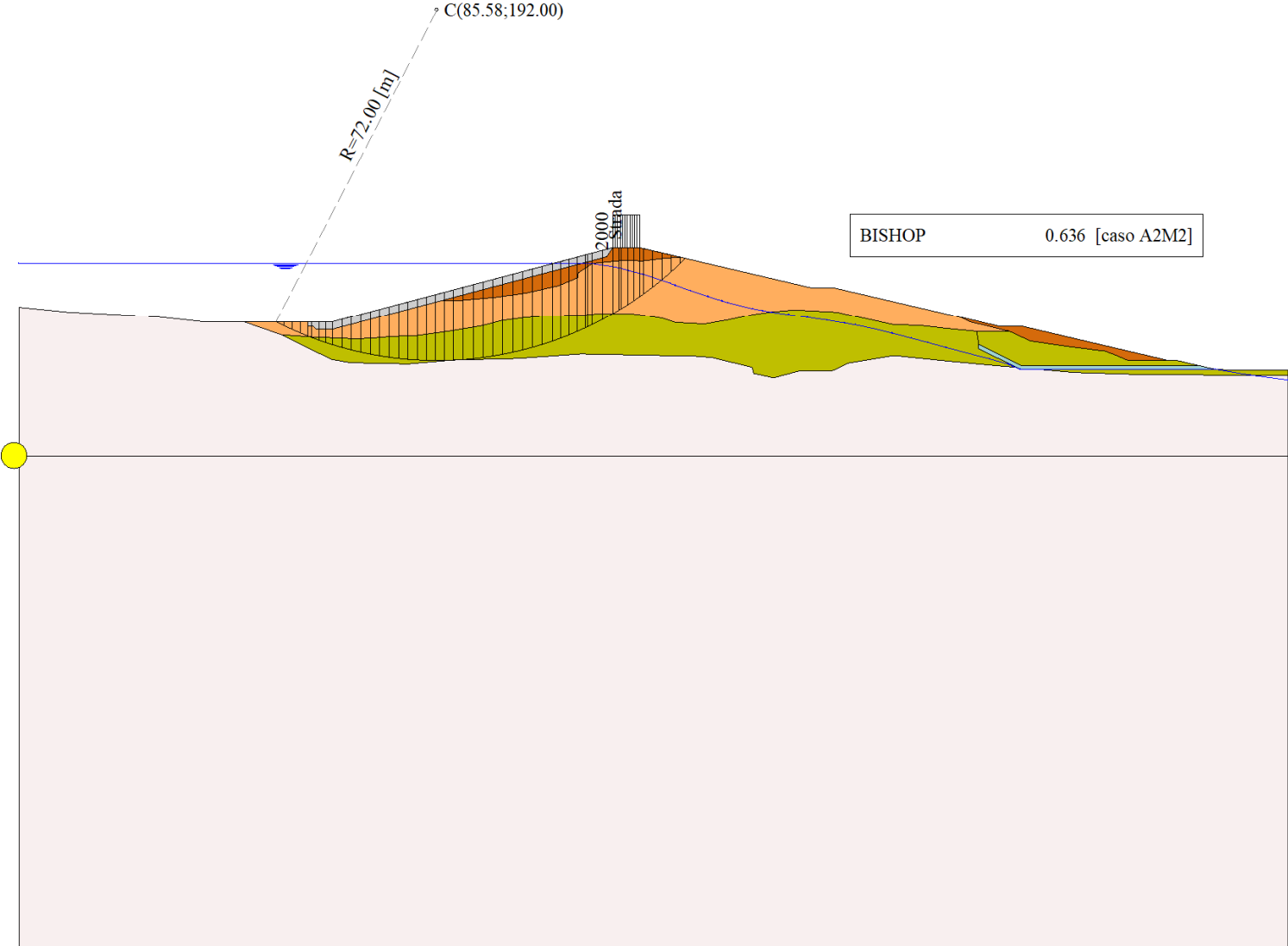


Figura 26-2 – Superficie critica (38) della sezione CR\_08 per la verifica di stabilità 22.



## 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	121.59	127.09	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	80906
Coefficiente di sicurezza minimo	0.355
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	52
Coordinate del centro	X[m]= 101.58                      Y[m]= 210.00
Raggio del cerchio	R[m]= 88.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 67.49                      Y <sub>v</sub> [m]= 128.87
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 151.53                      Y <sub>m</sub> [m]= 137.55
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.355</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	67.49	128.87	128.87	69.31	129.36	128.13	68.70	128.79	1.97	-22.15	22.44	0
2	69.31	129.36	128.13	71.14	129.85	127.43	70.33	128.69	1.96	-20.87	6.08	40
3	71.14	129.85	127.43	72.97	130.34	126.78	72.12	128.60	1.94	-19.60	0.00	54
4	72.97	130.34	126.78	74.80	130.82	126.17	73.93	128.53	1.93	-18.34	0.00	54
5	74.80	130.82	126.17	76.63	131.31	125.61	75.75	128.48	1.91	-17.09	0.00	54
6	76.63	131.31	125.61	78.11	131.71	125.19	77.39	128.45	1.54	-15.97	0.00	54
7	78.11	131.71	125.19	79.59	132.10	124.79	78.86	128.45	1.53	-14.97	0.00	53
8	79.59	132.10	124.79	81.07	132.50	124.42	80.34	128.45	1.53	-13.97	0.00	52
9	81.07	132.50	124.42	83.08	133.03	123.97	82.09	128.48	2.06	-12.81	0.00	52
10	83.08	133.03	123.97	85.09	133.57	123.56	84.10	128.53	2.05	-11.47	0.00	52
11	85.09	133.57	123.56	87.10	134.10	123.20	86.11	128.61	2.04	-10.14	0.00	52
12	87.10	134.10	123.20	89.11	134.64	122.89	88.12	128.71	2.03	-8.81	0.00	52
13	89.11	134.64	122.89	91.12	135.18	122.62	90.13	128.83	2.03	-7.49	0.00	52
14	91.12	135.18	122.62	93.13	135.71	122.41	92.13	128.98	2.02	-6.17	0.00	52
15	93.13	135.71	122.41	95.14	136.25	122.24	94.14	129.15	2.02	-4.85	0.00	52
16	95.14	136.25	122.24	97.15	136.78	122.11	96.15	129.35	2.01	-3.54	0.00	52
17	97.15	136.78	122.11	99.16	137.32	122.03	98.16	129.56	2.01	-2.23	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	99.16	137.32	122.03	101.17	137.86	122.00	100.17	129.80	2.01	-0.92	0.00	52
19	101.17	137.86	122.00	103.18	138.39	122.01	102.18	130.07	2.01	0.39	0.00	52
20	103.18	138.39	122.01	105.19	138.93	122.07	104.19	130.35	2.01	1.70	0.00	52
21	105.19	138.93	122.07	107.20	139.46	122.18	106.20	130.66	2.01	3.01	0.00	52
22	107.20	139.46	122.18	109.21	140.00	122.33	108.21	130.99	2.02	4.32	0.00	52
23	109.21	140.00	122.33	110.91	140.45	122.50	110.06	131.32	1.71	5.53	0.00	52
24	110.91	140.45	122.50	112.61	140.91	122.69	111.76	131.64	1.71	6.64	0.00	52
25	112.61	140.91	122.69	114.31	141.36	122.93	113.46	131.97	1.72	7.76	0.00	52
26	114.31	141.36	122.93	116.01	141.81	123.19	115.16	132.32	1.72	8.88	0.00	52
27	116.01	141.81	123.19	116.51	141.95	123.28	116.26	132.56	0.51	9.60	0.00	52
28	116.51	141.95	123.28	117.40	142.18	123.43	116.96	132.71	0.90	10.06	0.00	52
29	117.40	142.18	123.43	119.50	142.74	123.84	118.45	133.05	2.13	11.05	0.00	52
30	119.50	142.74	123.84	121.59	143.30	124.31	120.54	133.55	2.15	12.44	0.00	52
31	121.59	143.30	124.31	121.65	143.30	124.32	121.62	133.81	0.06	13.16	0.00	52
32	121.65	143.30	124.32	123.34	143.30	124.73	122.49	133.91	1.74	13.75	0.00	52
33	123.34	143.30	124.73	124.72	143.30	125.10	124.03	134.11	1.43	14.78	0.00	52
34	124.72	143.30	125.10	125.91	143.30	125.43	125.31	134.28	1.23	15.65	0.00	52
35	125.91	143.30	125.43	127.09	143.30	125.78	126.50	134.45	1.24	16.45	0.00	52
36	127.09	143.30	125.78	127.90	143.11	126.03	127.49	134.55	0.85	17.13	0.00	52
37	127.90	143.11	126.03	129.76	142.67	126.63	128.82	134.61	1.96	18.04	0.00	52
38	129.76	142.67	126.63	131.62	142.24	127.29	130.68	134.71	1.97	19.32	0.00	52
39	131.62	142.24	127.29	133.48	141.80	127.99	132.54	134.83	1.99	20.61	0.00	52
40	133.48	141.80	127.99	134.39	141.58	128.35	133.93	134.93	0.98	21.57	0.00	54
41	134.39	141.58	128.35	134.44	141.57	128.37	134.41	134.97	0.05	21.91	0.00	54
42	134.44	141.57	128.37	135.43	141.34	128.77	134.93	135.01	1.07	22.27	0.00	54
43	135.43	141.34	128.77	136.55	141.08	129.24	135.98	135.11	1.21	23.02	0.00	54
44	136.55	141.08	129.24	137.66	140.82	129.74	137.10	135.22	1.22	23.81	0.00	54
45	137.66	140.82	129.74	139.40	140.41	130.54	138.51	135.37	1.92	24.83	0.00	54
46	139.40	140.41	130.54	141.14	140.00	131.39	140.25	135.58	1.94	26.08	0.00	54
47	141.14	140.00	131.39	142.58	139.66	132.14	141.85	135.79	1.63	27.24	0.00	54
48	142.58	139.66	132.14	144.03	139.32	132.92	143.29	136.00	1.64	28.31	0.00	54
49	144.03	139.32	132.92	145.90	138.87	133.98	144.93	136.26	2.16	29.54	0.00	54
50	145.90	138.87	133.98	147.78	138.43	135.10	146.78	136.59	2.19	30.96	0.00	54
51	147.78	138.43	135.10	149.65	137.99	136.29	148.62	136.93	2.22	32.39	0.00	54
52	149.65	137.99	136.29	151.53	137.55	137.55	150.28	137.28	2.26	33.85	0.00	54

Tabella 27-2 – Geometria e caratteristiche strisce della superficie 1 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	2254	19904	46936	54561	0	0	72060	0	0	
2	6638	19012	43205	35197	0	72060	121054	0	0	
3	10758	18120	45178	30256	0	121054	162486	0	0	
4	14712	17229	48693	30028	0	162486	201252	0	0	
5	18508	16337	51979	29820	0	201252	237243	0	0	
6	17653	12567	44323	23990	0	237243	264267	0	0	
7	19974	11983	46110	23359	0	264267	288831	0	0	
8	22296	11399	47943	22829	0	288831	310970	0	0	
9	33895	14545	68095	30855	0	310970	337786	0	0	
10	37907	13468	71342	30700	0	337786	360772	0	0	
11	41719	12391	74338	30564	0	360772	379867	0	0	
12	45408	11313	77194	30446	0	379867	394993	0	0	
13	48935	10236	79863	30346	0	394993	406102	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
14	52245	9159	82275	30262	0	406102	413186	0	0	
15	55351	8082	84453	30196	0	413186	416250	0	0	
16	58307	7004	86470	30145	0	416250	415282	0	0	
17	61076	5927	88283	30110	0	415282	410305	0	0	
18	63578	4850	89785	30091	0	410305	401406	0	0	
19	65852	3773	91030	30088	0	401406	388669	0	0	
20	67912	2695	92041	30100	0	388669	372183	0	0	
21	69730	1618	92776	30129	0	372183	352076	0	0	
22	71332	541	93272	30173	0	352076	328473	0	0	
23	61337	0	79369	25566	0	328473	306019	0	0	
24	62002	0	79919	25619	0	306019	281532	0	0	
25	62531	0	80317	25682	0	281532	255100	0	0	
26	62782	0	80371	25755	0	255100	226943	0	0	
27	18694	0	23897	7591	0	226943	218173	0	0	
28	33351	0	42585	13530	0	218173	202168	0	0	
29	78890	0	100514	31952	0	202168	162489	0	0	
30	79375	0	100870	32114	0	162489	120022	0	0	
31	2280	120	3058	922	0	120022	118649	0	0	
32	63447	3380	85000	26044	0	118649	79888	0	0	
33	50656	2760	67734	21364	0	79888	48211	0	0	
34	42611	2370	56880	18421	0	48211	21090	0	0	
35	41749	2370	55635	18495	0	21090	-5878	0	0	
36	27856	0	34803	12687	0	-5878	-22283	0	0	
37	60995	0	75660	29281	0	-22283	-57899	0	0	
38	56721	0	69485	29503	0	-57899	-90267	0	0	
39	52231	0	62927	29745	0	-90267	-118849	0	0	
40	23879	0	28131	15105	0	-118849	-130815	0	0	
41	1282	0	1497	840	0	-130815	-131435	0	0	
42	24719	0	28648	16672	0	-131435	-143087	0	0	
43	26338	0	29985	18879	0	-143087	-154720	0	0	
44	24729	0	27518	18992	0	-154720	-164680	0	0	
45	35274	0	37795	29878	0	-164680	-176583	0	0	
46	31103	0	31213	30191	0	-176583	-183602	0	0	
47	22549	0	20643	25329	0	-183602	-185330	0	0	
48	19468	0	15591	25577	0	-185330	-182980	0	0	
49	20500	0	12261	33585	0	-182980	-173260	0	0	
50	14928	0	2683	34071	0	-173260	-155219	0	0	
51	9126	0	-7597	34602	0	-155219	-127920	0	0	
52	3083	0	-18664	35181	0	-127920	-90328	0	0	

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

### 27.2.2 ANALISI DELLA SUPERFICIE 116 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	50	
Coordinate del centro	X[m]= 85.58	Y[m]= 192.00
Raggio del cerchio	R[m]= 72.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 52.60	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 136.49	Y <sub>m</sub> [m]= 141.09
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.368</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	52.60	128.00	128.00	54.25	128.00	127.17	53.70	127.72	1.85	-26.53	0.00	54
2	54.25	128.00	127.17	55.90	128.00	126.40	55.16	127.37	1.83	-25.07	0.00	54
3	55.90	128.00	126.40	57.56	128.00	125.68	56.78	127.01	1.80	-23.62	0.00	54
4	57.56	128.00	125.68	59.21	128.00	125.00	58.42	126.66	1.79	-22.20	0.00	54
5	59.21	128.00	125.00	59.98	128.00	124.70	59.60	126.43	0.83	-21.16	0.00	53
6	59.98	128.00	124.70	61.39	128.00	124.19	60.70	126.22	1.50	-20.23	0.00	52
7	61.39	128.00	124.19	62.80	128.00	123.70	62.11	125.97	1.49	-19.04	0.00	52
8	62.80	128.00	123.70	64.21	128.00	123.24	63.52	125.73	1.48	-17.86	0.00	52
9	64.21	128.00	123.24	66.14	128.52	122.67	65.21	125.61	2.02	-16.46	0.00	52
10	66.14	128.52	122.67	68.08	129.03	122.16	67.14	125.59	2.00	-14.87	0.00	52
11	68.08	129.03	122.16	70.01	129.55	121.70	69.07	125.61	1.99	-13.28	0.00	52
12	70.01	129.55	121.70	71.94	130.06	121.30	71.00	125.65	1.97	-11.70	0.00	52
13	71.94	130.06	121.30	73.88	130.58	120.96	72.93	125.73	1.96	-10.13	0.00	52
14	73.88	130.58	120.96	75.81	131.09	120.67	74.86	125.82	1.96	-8.57	0.00	52
15	75.81	131.09	120.67	77.75	131.61	120.43	76.79	125.95	1.95	-7.02	0.00	52
16	77.75	131.61	120.43	79.68	132.12	120.24	78.72	126.10	1.94	-5.47	0.00	52
17	79.68	132.12	120.24	81.54	132.62	120.11	80.62	126.28	1.86	-3.96	0.00	52
18	81.54	132.62	120.11	83.40	133.12	120.03	82.47	126.47	1.86	-2.48	0.00	52
19	83.40	133.12	120.03	85.25	133.61	120.00	84.33	126.69	1.86	-1.00	0.00	52
20	85.25	133.61	120.00	87.11	134.11	120.02	86.19	126.93	1.86	0.48	0.00	52
21	87.11	134.11	120.02	88.97	134.60	120.08	88.05	127.20	1.86	1.96	0.00	63
22	88.97	134.60	120.08	90.99	135.14	120.20	89.99	127.51	2.03	3.51	0.00	66
23	90.99	135.14	120.20	93.02	135.68	120.39	92.01	127.85	2.03	5.12	0.00	52
24	93.02	135.68	120.39	95.04	136.22	120.62	94.03	128.23	2.04	6.74	0.00	52
25	95.04	136.22	120.62	97.07	136.76	120.92	96.06	128.63	2.05	8.37	0.00	52
26	97.07	136.76	120.92	99.09	137.30	121.28	98.08	129.07	2.06	10.00	0.00	52
27	99.09	137.30	121.28	101.11	137.84	121.70	100.10	129.53	2.07	11.64	0.00	52
28	101.11	137.84	121.70	103.14	138.38	122.17	102.13	130.02	2.08	13.29	0.00	52
29	103.14	138.38	122.17	105.16	138.92	122.71	104.15	130.55	2.09	14.95	0.00	52
30	105.16	138.92	122.71	107.19	139.46	123.32	106.17	131.10	2.11	16.62	0.00	52
31	107.19	139.46	123.32	109.21	140.00	123.99	108.20	131.69	2.13	18.31	0.00	52
32	109.21	140.00	123.99	110.91	140.45	124.60	110.06	132.26	1.81	19.88	0.00	52
33	110.91	140.45	124.60	112.61	140.91	125.27	111.76	132.81	1.82	21.32	0.00	52
34	112.61	140.91	125.27	114.31	141.36	125.98	113.46	133.38	1.84	22.78	0.00	52
35	114.31	141.36	125.98	116.01	141.81	126.75	115.16	133.97	1.86	24.26	0.00	52
36	116.01	141.81	126.75	116.51	141.95	126.98	116.26	134.37	0.55	25.22	0.00	52
37	116.51	141.95	126.98	117.40	142.18	127.41	116.95	134.63	0.99	25.83	0.00	52
38	117.40	142.18	127.41	119.50	142.74	128.49	118.44	135.20	2.35	27.16	0.00	52
39	119.50	142.74	128.49	121.59	143.30	129.65	120.53	136.04	2.40	29.06	0.00	52
40	121.59	143.30	129.65	121.65	143.30	129.69	121.62	136.48	0.07	30.04	0.00	52
41	121.65	143.30	129.69	122.84	143.30	130.39	122.24	136.67	1.38	30.61	0.00	54
42	122.84	143.30	130.39	123.34	143.30	130.70	123.09	136.92	0.59	31.40	0.00	54
43	123.34	143.30	130.70	124.72	143.30	131.57	124.02	137.21	1.63	32.28	0.00	54
44	124.72	143.30	131.57	125.91	143.30	132.35	125.31	137.63	1.42	33.50	0.00	54
45	125.91	143.30	132.35	127.09	143.30	133.17	126.49	138.03	1.44	34.63	0.00	54
46	127.09	143.30	133.17	127.90	143.11	133.75	127.49	138.33	1.00	35.60	0.00	54
47	127.90	143.11	133.75	129.78	142.67	135.17	128.81	138.66	2.36	36.94	0.00	54
48	129.78	142.67	135.17	131.67	142.22	136.68	130.68	139.17	2.42	38.84	0.00	54
49	131.67	142.22	136.68	133.55	141.78	138.31	132.53	139.73	2.49	40.79	0.00	54
50	133.55	141.78	138.31	135.43	141.34	140.05	134.34	140.32	2.57	42.80	0.00	54
51	135.43	141.34	140.05	136.49	141.09	141.09	135.78	140.83	1.49	44.41	0.00	54

Tabella 27-4 – Geometria e caratteristiche strisce della superficie 116 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	1322	19845	38014	27785	0	0	40972	0	0	
2	3882	19845	40437	27445	0	40972	80417	0	0	
3	6278	19845	42628	27133	0	80417	118239	0	0	
4	8516	19845	44602	26849	0	118239	154359	0	0	
5	4744	9240	21362	12141	0	154359	170278	0	0	
6	9913	16920	40059	21697	0	170278	197983	0	0	
7	11409	16920	41361	21537	0	197983	224347	0	0	
8	12793	16920	42517	21389	0	224347	249347	0	0	
9	20584	22706	60788	29115	0	249347	287042	0	0	
10	24698	21709	64067	28888	0	287042	320980	0	0	
11	28598	20712	67076	28688	0	320980	351064	0	0	
12	32285	19715	69829	28514	0	351064	377218	0	0	
13	35776	18718	72353	28364	0	377218	399384	0	0	
14	39058	17721	74639	28237	0	399384	417528	0	0	
15	42115	16724	76672	28132	0	417528	431643	0	0	
16	44929	15727	78432	28049	0	431643	441755	0	0	
17	45621	14172	76802	26892	0	441755	447725	0	0	
18	47876	13251	78070	26853	0	447725	450044	0	0	
19	49959	12331	79162	26832	0	450044	448754	0	0	
20	51861	11410	80066	26829	0	448754	443920	0	0	
21	53645	10490	80675	32451	0	443920	441187	0	0	
22	60282	10379	88332	37193	0	441187	436118	0	0	
23	61952	9287	89305	29342	0	436118	419191	0	0	
24	63370	8195	89522	29428	0	419191	398507	0	0	
25	64584	7102	89533	29539	0	398507	374217	0	0	
26	65561	6010	89287	29675	0	374217	346519	0	0	
27	66212	4918	88659	29838	0	346519	315719	0	0	
28	66567	3825	87681	30028	0	315719	282128	0	0	
29	66642	2733	86361	30248	0	282128	246072	0	0	
30	66397	1641	84636	30499	0	246072	207950	0	0	
31	65856	548	82520	30783	0	207950	168178	0	0	
32	54591	0	67660	26102	0	168178	133893	0	0	
33	53614	0	66153	26350	0	133893	99199	0	0	
34	52443	0	64363	26624	0	99199	64405	0	0	
35	50933	0	62063	26924	0	64405	30028	0	0	
36	14866	0	18065	7980	0	30028	19794	0	0	
37	26138	0	31657	14278	0	19794	1696	0	0	
38	59837	0	71876	34000	0	1696	-40137	0	0	
39	57301	0	67834	34605	0	-40137	-80435	0	0	
40	1602	120	2063	1001	0	-80435	-81732	0	0	
41	30912	2380	39085	20772	0	-81732	-105607	0	0	
42	12496	1000	15624	8806	0	-105607	-115087	0	0	
43	32911	2760	40537	24537	0	-115087	-139400	0	0	
44	26356	2370	31613	21361	0	-139400	-157884	0	0	
45	24526	2370	28461	21650	0	-157884	-173896	0	0	
46	15517	0	14624	14976	0	-173896	-180417	0	0	
47	31175	0	25183	35404	0	-180417	-187710	0	0	
48	24081	0	11813	36329	0	-187710	-182622	0	0	
49	16619	0	-3095	37375	0	-182622	-163208	0	0	
50	8750	0	-19870	38566	0	-163208	-127152	0	0	
51	1329	0	-19443	22371	0	-127152	-98438	0	0	

Tabella 27-5 – Forze applicate sulle strisce [BISHOP] della superficie 116 della verifica di stabilità 23.

### 27.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.015455
2	0.005910
3	0.008677
4	0.000840
5	0.009632
6	0.010387
7	0.011961

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

Accelerazione sismica critica  $K_c = 0.199$   
Spostamento massimo  $U_{max} = 0.015455$  [m]  
Velocità massima  $V_{max} = 0.106039$  [m/s]

n°	u
	[m]
1	0.019188
2	0.008996
3	0.011009
4	0.001637
5	0.011475
6	0.012963
7	0.014755

Tabella 27-7 – Spostamenti della superficie 116 della verifica di stabilità 23.

Accelerazione sismica critica  $K_c = 0.186$   
Spostamento massimo  $U_{max} = 0.019188$  [m]  
Velocità massima  $V_{max} = 0.115804$  [m/s]

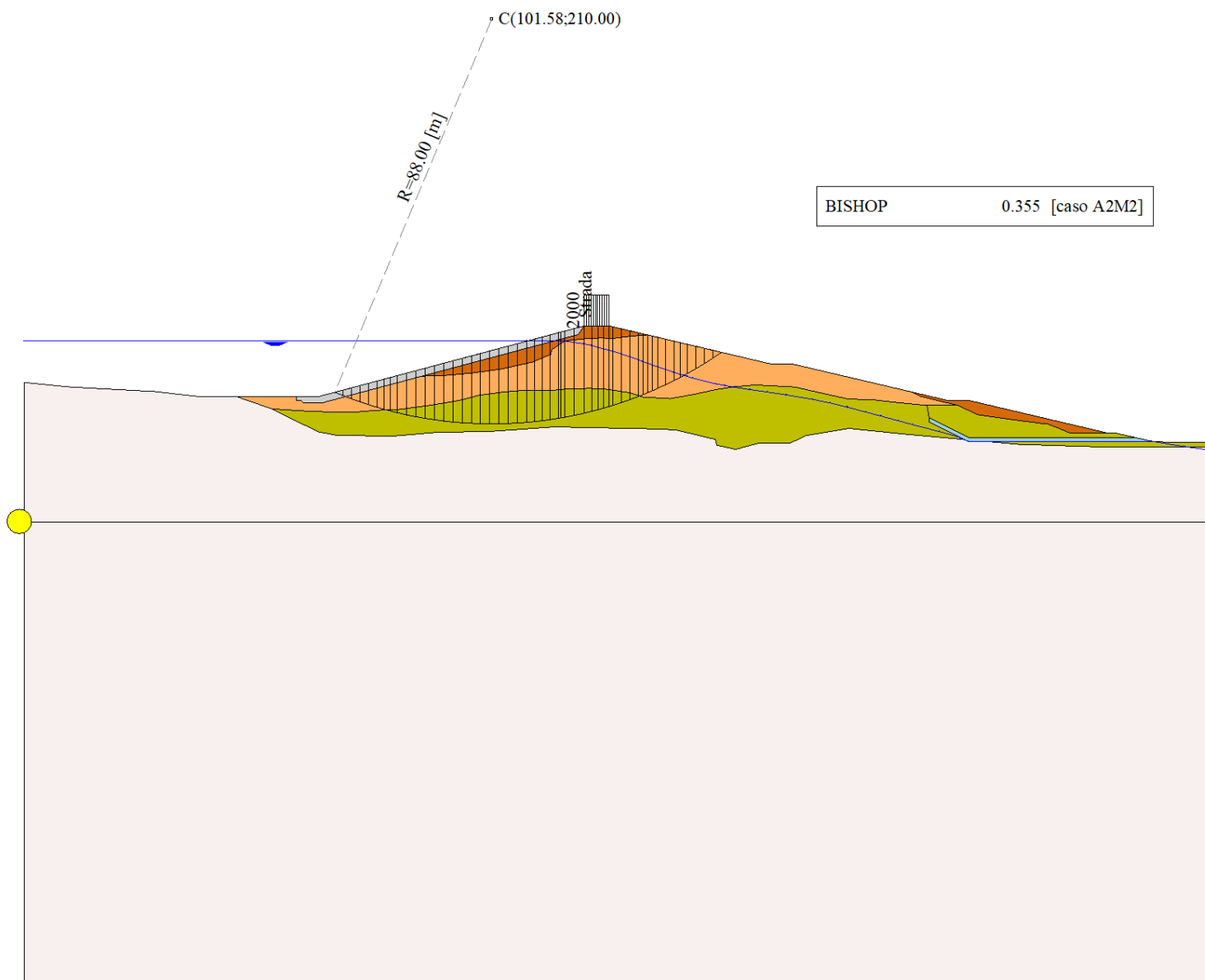


Figura 27-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 23.

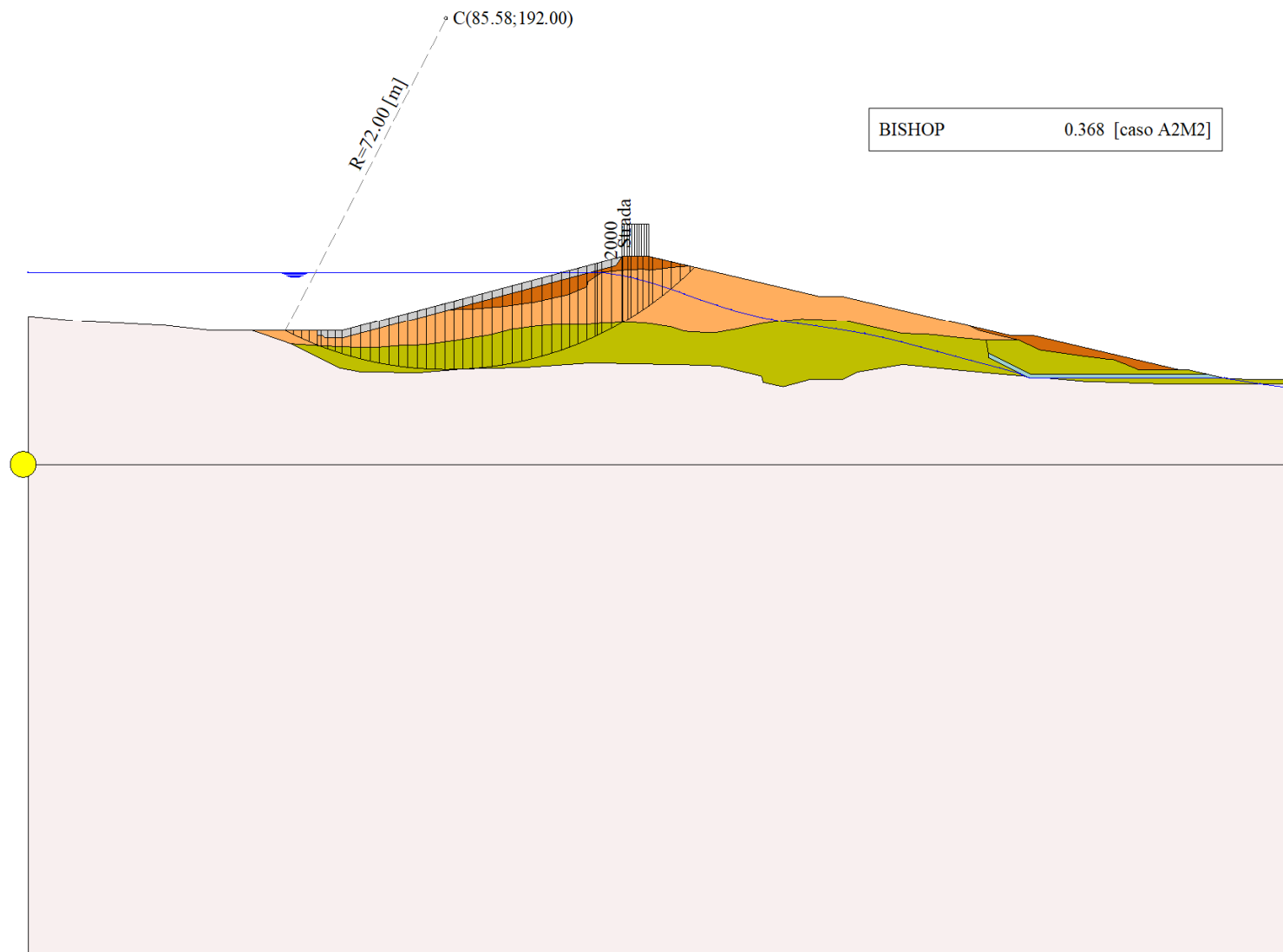


Figura 27-2 – Superficie critica (116) della sezione CR\_08 per la verifica di stabilità 23.



## 28 VERIFICA DI STABILITÀ 24

### 28.1.1 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	121.59	127.09	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	80915
Coefficiente di sicurezza minimo	0.372
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	52
Coordinate del centro	X[m]= 101.58                      Y[m]= 210.00
Raggio del cerchio	R[m]= 88.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 67.49                      Y <sub>v</sub> [m]= 128.87
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 151.53                      Y <sub>m</sub> [m]= 137.55
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.372</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	67.49	128.87	128.87	69.31	129.36	128.13	68.70	128.79	1.97	-22.15	22.44	0
2	69.31	129.36	128.13	71.14	129.85	127.43	70.33	128.69	1.96	-20.87	6.08	40
3	71.14	129.85	127.43	72.97	130.34	126.78	72.12	128.60	1.94	-19.60	0.00	54
4	72.97	130.34	126.78	74.80	130.82	126.17	73.93	128.53	1.93	-18.34	0.00	54
5	74.80	130.82	126.17	76.63	131.31	125.61	75.75	128.48	1.91	-17.09	0.00	54
6	76.63	131.31	125.61	78.11	131.71	125.19	77.39	128.45	1.54	-15.97	0.00	54
7	78.11	131.71	125.19	79.59	132.10	124.79	78.86	128.45	1.53	-14.97	0.00	53
8	79.59	132.10	124.79	81.07	132.50	124.42	80.34	128.45	1.53	-13.97	0.00	52
9	81.07	132.50	124.42	83.08	133.03	123.97	82.09	128.48	2.06	-12.81	0.00	52
10	83.08	133.03	123.97	85.09	133.57	123.56	84.10	128.53	2.05	-11.47	0.00	52
11	85.09	133.57	123.56	87.10	134.10	123.20	86.11	128.61	2.04	-10.14	0.00	52
12	87.10	134.10	123.20	89.11	134.64	122.89	88.12	128.71	2.03	-8.81	0.00	52
13	89.11	134.64	122.89	91.12	135.18	122.62	90.13	128.83	2.03	-7.49	0.00	52
14	91.12	135.18	122.62	93.13	135.71	122.41	92.13	128.98	2.02	-6.17	0.00	52
15	93.13	135.71	122.41	95.14	136.25	122.24	94.14	129.15	2.02	-4.85	0.00	52
16	95.14	136.25	122.24	97.15	136.78	122.11	96.15	129.35	2.01	-3.54	0.00	52
17	97.15	136.78	122.11	99.16	137.32	122.03	98.16	129.56	2.01	-2.23	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	99.16	137.32	122.03	101.17	137.86	122.00	100.17	129.80	2.01	-0.92	0.00	52
19	101.17	137.86	122.00	103.18	138.39	122.01	102.18	130.07	2.01	0.39	0.00	52
20	103.18	138.39	122.01	105.19	138.93	122.07	104.19	130.35	2.01	1.70	0.00	52
21	105.19	138.93	122.07	107.20	139.46	122.18	106.20	130.66	2.01	3.01	0.00	52
22	107.20	139.46	122.18	109.21	140.00	122.33	108.21	130.99	2.02	4.32	0.00	52
23	109.21	140.00	122.33	110.91	140.45	122.50	110.06	131.32	1.71	5.53	0.00	52
24	110.91	140.45	122.50	112.61	140.91	122.69	111.76	131.64	1.71	6.64	0.00	52
25	112.61	140.91	122.69	114.31	141.36	122.93	113.46	131.97	1.72	7.76	0.00	52
26	114.31	141.36	122.93	116.01	141.81	123.19	115.16	132.32	1.72	8.88	0.00	52
27	116.01	141.81	123.19	116.51	141.95	123.28	116.26	132.56	0.51	9.60	0.00	52
28	116.51	141.95	123.28	117.40	142.18	123.43	116.96	132.71	0.90	10.06	0.00	52
29	117.40	142.18	123.43	119.50	142.74	123.84	118.45	133.05	2.13	11.05	0.00	52
30	119.50	142.74	123.84	121.59	143.30	124.31	120.54	133.55	2.15	12.44	0.00	52
31	121.59	143.30	124.31	121.65	143.30	124.32	121.62	133.81	0.06	13.16	0.00	52
32	121.65	143.30	124.32	123.34	143.30	124.73	122.49	133.91	1.74	13.75	0.00	52
33	123.34	143.30	124.73	124.72	143.30	125.10	124.03	134.11	1.43	14.78	0.00	52
34	124.72	143.30	125.10	125.91	143.30	125.43	125.31	134.28	1.23	15.65	0.00	52
35	125.91	143.30	125.43	127.09	143.30	125.78	126.50	134.45	1.24	16.45	0.00	52
36	127.09	143.30	125.78	127.90	143.11	126.03	127.49	134.55	0.85	17.13	0.00	52
37	127.90	143.11	126.03	129.76	142.67	126.63	128.82	134.61	1.96	18.04	0.00	52
38	129.76	142.67	126.63	131.62	142.24	127.29	130.68	134.71	1.97	19.32	0.00	52
39	131.62	142.24	127.29	133.48	141.80	127.99	132.54	134.83	1.99	20.61	0.00	52
40	133.48	141.80	127.99	134.39	141.58	128.35	133.93	134.93	0.98	21.57	0.00	54
41	134.39	141.58	128.35	134.44	141.57	128.37	134.41	134.97	0.05	21.91	0.00	54
42	134.44	141.57	128.37	135.43	141.34	128.77	134.93	135.01	1.07	22.27	0.00	54
43	135.43	141.34	128.77	136.55	141.08	129.24	135.98	135.11	1.21	23.02	0.00	54
44	136.55	141.08	129.24	137.66	140.82	129.74	137.10	135.22	1.22	23.81	0.00	54
45	137.66	140.82	129.74	139.40	140.41	130.54	138.51	135.37	1.92	24.83	0.00	54
46	139.40	140.41	130.54	141.14	140.00	131.39	140.25	135.58	1.94	26.08	0.00	54
47	141.14	140.00	131.39	142.58	139.66	132.14	141.85	135.79	1.63	27.24	0.00	54
48	142.58	139.66	132.14	144.03	139.32	132.92	143.29	136.00	1.64	28.31	0.00	54
49	144.03	139.32	132.92	145.90	138.87	133.98	144.93	136.26	2.16	29.54	0.00	54
50	145.90	138.87	133.98	147.78	138.43	135.10	146.78	136.59	2.19	30.96	0.00	54
51	147.78	138.43	135.10	149.65	137.99	136.29	148.62	136.93	2.22	32.39	0.00	54
52	149.65	137.99	136.29	151.53	137.55	137.55	150.28	137.28	2.26	33.85	0.00	54

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

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	2254	19904	45012	49937	0	0	67128	0	0	
2	6638	19012	42381	33356	0	67128	114335	0	0	
3	10758	18120	44492	28876	0	114335	154602	0	0	
4	14712	17229	47974	28658	0	154602	192344	0	0	
5	18508	16337	51230	28459	0	192344	227445	0	0	
6	17653	12567	43697	22895	0	227445	253847	0	0	
7	19974	11983	45472	22293	0	253847	277898	0	0	
8	22296	11399	47292	21788	0	277898	299629	0	0	
9	33895	14545	67182	29447	0	299629	326026	0	0	
10	37907	13468	70398	29299	0	326026	348745	0	0	
11	41719	12391	73366	29170	0	348745	367718	0	0	
12	45408	11313	76195	29057	0	367718	382867	0	0	
13	48935	10236	78839	28961	0	382867	394138	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
14	52245	9159	81230	28882	0	394138	401519	0	0	
15	55351	8082	83388	28818	0	401519	405007	0	0	
16	58307	7004	85389	28769	0	405007	404588	0	0	
17	61076	5927	87187	28736	0	404588	400279	0	0	
18	63578	4850	88679	28718	0	400279	392157	0	0	
19	65852	3773	89917	28715	0	392157	380301	0	0	
20	67912	2695	90923	28727	0	380301	364791	0	0	
21	69730	1618	91657	28754	0	364791	345748	0	0	
22	71332	541	92156	28796	0	345748	323289	0	0	
23	61337	0	78432	24399	0	323289	301856	0	0	
24	62002	0	78991	24450	0	301856	278429	0	0	
25	62531	0	79400	24510	0	278429	253093	0	0	
26	62782	0	79471	24580	0	253093	226054	0	0	
27	18694	0	23632	7244	0	226054	217624	0	0	
28	33351	0	42117	12913	0	217624	202231	0	0	
29	78890	0	99429	30494	0	202231	164019	0	0	
30	79375	0	99807	30649	0	164019	123057	0	0	
31	2280	120	3026	880	0	123057	121732	0	0	
32	63447	3380	84118	24855	0	121732	84306	0	0	
33	50656	2760	67049	20389	0	84306	53682	0	0	
34	42611	2370	56319	17580	0	53682	27437	0	0	
35	41749	2370	55100	17651	0	27437	1316	0	0	
36	27856	0	34485	12108	0	1316	-14599	0	0	
37	60995	0	75002	27945	0	-14599	-49201	0	0	
38	56721	0	68932	28157	0	-49201	-80722	0	0	
39	52231	0	62486	28388	0	-80722	-108638	0	0	
40	23879	0	27965	14416	0	-108638	-120369	0	0	
41	1282	0	1489	802	0	-120369	-120979	0	0	
42	24719	0	28504	15911	0	-120979	-132437	0	0	
43	26338	0	29863	18018	0	-132437	-143916	0	0	
44	24729	0	27439	18126	0	-143916	-153795	0	0	
45	35274	0	37763	28515	0	-153795	-165718	0	0	
46	31103	0	31297	28813	0	-165718	-172951	0	0	
47	22549	0	20805	24173	0	-172951	-175012	0	0	
48	19468	0	15843	24410	0	-175012	-173145	0	0	
49	20500	0	12727	32052	0	-173145	-164289	0	0	
50	14928	0	3318	32517	0	-164289	-147399	0	0	
51	9126	0	-6780	33023	0	-147399	-121559	0	0	
52	3083	0	-17651	33576	0	-121559	-85761	0	0	

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

### 28.2.2 ANALISI DELLA SUPERFICIE 117 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	51	
Coordinate del centro	X[m]= 85.58	Y[m]= 192.00
Raggio del cerchio	R[m]= 72.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 52.60	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 136.49	Y <sub>m</sub> [m]= 141.09
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.385</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	52.60	128.00	128.00	54.25	128.00	127.17	53.70	127.72	1.85	-26.53	0.00	54
2	54.25	128.00	127.17	55.90	128.00	126.40	55.16	127.37	1.83	-25.07	0.00	54
3	55.90	128.00	126.40	57.56	128.00	125.68	56.78	127.01	1.80	-23.62	0.00	54
4	57.56	128.00	125.68	59.21	128.00	125.00	58.42	126.66	1.79	-22.20	0.00	54
5	59.21	128.00	125.00	59.98	128.00	124.70	59.60	126.43	0.83	-21.16	0.00	53
6	59.98	128.00	124.70	61.39	128.00	124.19	60.70	126.22	1.50	-20.23	0.00	52
7	61.39	128.00	124.19	62.80	128.00	123.70	62.11	125.97	1.49	-19.04	0.00	52
8	62.80	128.00	123.70	64.21	128.00	123.24	63.52	125.73	1.48	-17.86	0.00	52
9	64.21	128.00	123.24	66.14	128.52	122.67	65.21	125.61	2.02	-16.46	0.00	52
10	66.14	128.52	122.67	68.08	129.03	122.16	67.14	125.59	2.00	-14.87	0.00	52
11	68.08	129.03	122.16	70.01	129.55	121.70	69.07	125.61	1.99	-13.28	0.00	52
12	70.01	129.55	121.70	71.94	130.06	121.30	71.00	125.65	1.97	-11.70	0.00	52
13	71.94	130.06	121.30	73.88	130.58	120.96	72.93	125.73	1.96	-10.13	0.00	52
14	73.88	130.58	120.96	75.81	131.09	120.67	74.86	125.82	1.96	-8.57	0.00	52
15	75.81	131.09	120.67	77.75	131.61	120.43	76.79	125.95	1.95	-7.02	0.00	52
16	77.75	131.61	120.43	79.68	132.12	120.24	78.72	126.10	1.94	-5.47	0.00	52
17	79.68	132.12	120.24	81.54	132.62	120.11	80.62	126.28	1.86	-3.96	0.00	52
18	81.54	132.62	120.11	83.40	133.12	120.03	82.47	126.47	1.86	-2.48	0.00	52
19	83.40	133.12	120.03	85.25	133.61	120.00	84.33	126.69	1.86	-1.00	0.00	52
20	85.25	133.61	120.00	87.11	134.11	120.02	86.19	126.93	1.86	0.48	0.00	52
21	87.11	134.11	120.02	88.97	134.60	120.08	88.05	127.20	1.86	1.96	0.00	63
22	88.97	134.60	120.08	90.99	135.14	120.20	89.99	127.51	2.03	3.51	0.00	66
23	90.99	135.14	120.20	93.02	135.68	120.39	92.01	127.85	2.03	5.12	0.00	52
24	93.02	135.68	120.39	95.04	136.22	120.62	94.03	128.23	2.04	6.74	0.00	52
25	95.04	136.22	120.62	97.07	136.76	120.92	96.06	128.63	2.05	8.37	0.00	52
26	97.07	136.76	120.92	99.09	137.30	121.28	98.08	129.07	2.06	10.00	0.00	52
27	99.09	137.30	121.28	101.11	137.84	121.70	100.10	129.53	2.07	11.64	0.00	52
28	101.11	137.84	121.70	103.14	138.38	122.17	102.13	130.02	2.08	13.29	0.00	52
29	103.14	138.38	122.17	105.16	138.92	122.71	104.15	130.55	2.09	14.95	0.00	52
30	105.16	138.92	122.71	107.19	139.46	123.32	106.17	131.10	2.11	16.62	0.00	52
31	107.19	139.46	123.32	109.21	140.00	123.99	108.20	131.69	2.13	18.31	0.00	52
32	109.21	140.00	123.99	110.91	140.45	124.60	110.06	132.26	1.81	19.88	0.00	52
33	110.91	140.45	124.60	112.61	140.91	125.27	111.76	132.81	1.82	21.32	0.00	52
34	112.61	140.91	125.27	114.31	141.36	125.98	113.46	133.38	1.84	22.78	0.00	52
35	114.31	141.36	125.98	116.01	141.81	126.75	115.16	133.97	1.86	24.26	0.00	52
36	116.01	141.81	126.75	116.51	141.95	126.98	116.26	134.37	0.55	25.22	0.00	52
37	116.51	141.95	126.98	117.40	142.18	127.41	116.95	134.63	0.99	25.83	0.00	52
38	117.40	142.18	127.41	119.50	142.74	128.49	118.44	135.20	2.35	27.16	0.00	52
39	119.50	142.74	128.49	121.59	143.30	129.65	120.53	136.04	2.40	29.06	0.00	52
40	121.59	143.30	129.65	121.65	143.30	129.69	121.62	136.48	0.07	30.04	0.00	52
41	121.65	143.30	129.69	122.84	143.30	130.39	122.24	136.67	1.38	30.61	0.00	54
42	122.84	143.30	130.39	123.34	143.30	130.70	123.09	136.92	0.59	31.40	0.00	54
43	123.34	143.30	130.70	124.72	143.30	131.57	124.02	137.21	1.63	32.28	0.00	54
44	124.72	143.30	131.57	125.91	143.30	132.35	125.31	137.63	1.42	33.50	0.00	54
45	125.91	143.30	132.35	127.09	143.30	133.17	126.49	138.03	1.44	34.63	0.00	54
46	127.09	143.30	133.17	127.90	143.11	133.75	127.49	138.33	1.00	35.60	0.00	54
47	127.90	143.11	133.75	129.78	142.67	135.17	128.81	138.66	2.36	36.94	0.00	54
48	129.78	142.67	135.17	131.67	142.22	136.68	130.68	139.17	2.42	38.84	0.00	54
49	131.67	142.22	136.68	133.55	141.78	138.31	132.53	139.73	2.49	40.79	0.00	54
50	133.55	141.78	138.31	135.43	141.34	140.05	134.34	140.32	2.57	42.80	0.00	54
51	135.43	141.34	140.05	136.49	141.09	141.09	135.78	140.83	1.49	44.41	0.00	54

Tabella 28-4 – Geometria e caratteristiche strisce della superficie 117 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	1322	19845	37377	26560	0	0	39636	0	0	
2	3882	19845	39798	26234	0	39636	77847	0	0	
3	6278	19845	41988	25937	0	77847	114530	0	0	
4	8516	19845	43962	25665	0	114530	149602	0	0	
5	4744	9240	21068	11605	0	149602	165078	0	0	
6	9913	16920	39527	20741	0	165078	192039	0	0	
7	11409	16920	40827	20587	0	192039	217720	0	0	
8	12793	16920	41984	20446	0	217720	242095	0	0	
9	20584	22706	60042	27831	0	242095	279050	0	0	
10	24698	21709	63293	27614	0	279050	312400	0	0	
11	28598	20712	66276	27423	0	312400	342044	0	0	
12	32285	19715	69006	27257	0	342044	367901	0	0	
13	35776	18718	71510	27113	0	367901	389907	0	0	
14	39058	17721	73778	26992	0	389907	408023	0	0	
15	42115	16724	75795	26892	0	408023	422237	0	0	
16	44929	15727	77543	26812	0	422237	432564	0	0	
17	45621	14172	75941	25706	0	432564	438848	0	0	
18	47876	13251	77201	25669	0	438848	441579	0	0	
19	49959	12331	78290	25649	0	441579	440794	0	0	
20	51861	11410	79192	25646	0	440794	436553	0	0	
21	53645	10490	79809	31020	0	436553	434249	0	0	
22	60282	10379	87402	35553	0	434249	429655	0	0	
23	61952	9287	88360	28048	0	429655	413637	0	0	
24	63370	8195	88588	28130	0	413637	393935	0	0	
25	64584	7102	88612	28236	0	393935	370692	0	0	
26	65561	6010	88383	28367	0	370692	344098	0	0	
27	66212	4918	87778	28522	0	344098	314446	0	0	
28	66567	3825	86827	28704	0	314446	282031	0	0	
29	66642	2733	85541	28914	0	282031	247171	0	0	
30	66397	1641	83856	29154	0	247171	210247	0	0	
31	65856	548	81786	29426	0	210247	171663	0	0	
32	54591	0	67086	24951	0	171663	138352	0	0	
33	53614	0	65625	25188	0	138352	104596	0	0	
34	52443	0	63886	25450	0	104596	70693	0	0	
35	50933	0	61646	25737	0	70693	37141	0	0	
36	14866	0	17951	7628	0	37141	27145	0	0	
37	26138	0	31467	13648	0	27145	9455	0	0	
38	59837	0	71499	32501	0	9455	-31500	0	0	
39	57301	0	67564	33079	0	-31500	-71047	0	0	
40	1602	120	2055	957	0	-71047	-72319	0	0	
41	30912	2380	38967	19856	0	-72319	-95787	0	0	
42	12496	1000	15592	8417	0	-95787	-105121	0	0	
43	32911	2760	40501	23455	0	-105121	-129114	0	0	
44	26356	2370	31649	20419	0	-129114	-147424	0	0	
45	24526	2370	28563	20695	0	-147424	-163362	0	0	
46	15517	0	14772	14315	0	-163362	-169976	0	0	
47	31175	0	25692	33843	0	-169976	-177760	0	0	
48	24081	0	12575	34727	0	-177760	-173577	0	0	
49	16619	0	-2047	35727	0	-173577	-155529	0	0	
50	8750	0	-18499	36865	0	-155529	-121354	0	0	
51	1329	0	-18509	21384	0	-121354	-93953	0	0	

Tabella 28-5 – Forze applicate sulle strisce [BISHOP] della superficie 117 della verifica di stabilità 24.

### 28.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.016289
2	0.006006
3	0.010355
4	0.016705
5	0.026402
6	0.007816
7	0.012481

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

Accelerazione sismica critica  $K_c = 0.199$   
Spostamento massimo  $U_{max} = 0.026402$  [m]  
Velocità massima  $V_{max} = 0.123509$  [m/s]

n°	u
	[m]
1	0.021344
2	0.007786
3	0.014432
4	0.020539
5	0.031686
6	0.009745
7	0.015334

Tabella 28-7 – Spostamenti della superficie 117 della verifica di stabilità 24.

Accelerazione sismica critica  $K_c = 0.186$   
Spostamento massimo  $U_{max} = 0.031686$  [m]  
Velocità massima  $V_{max} = 0.133814$  [m/s]

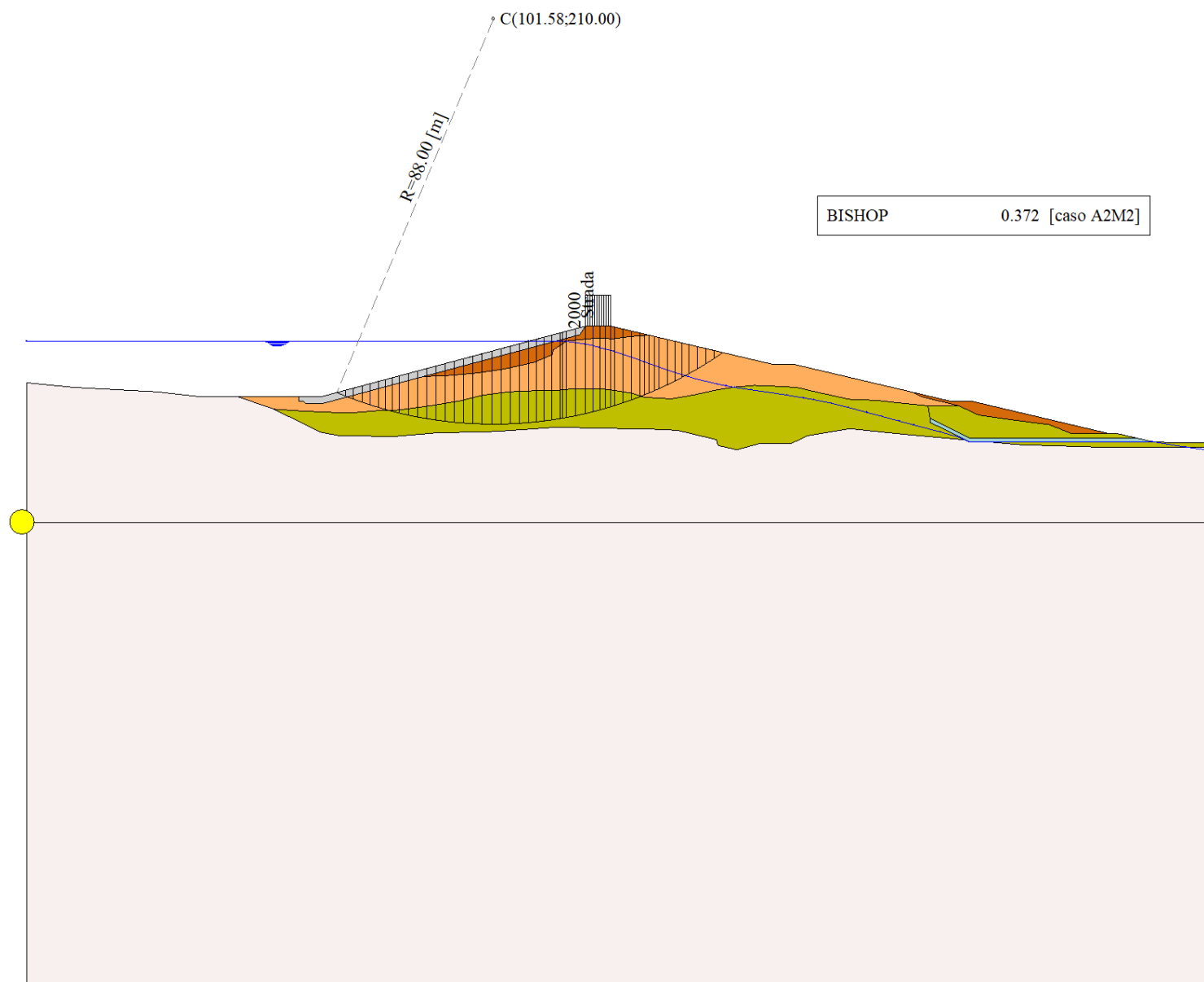


Figura 28-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 24.

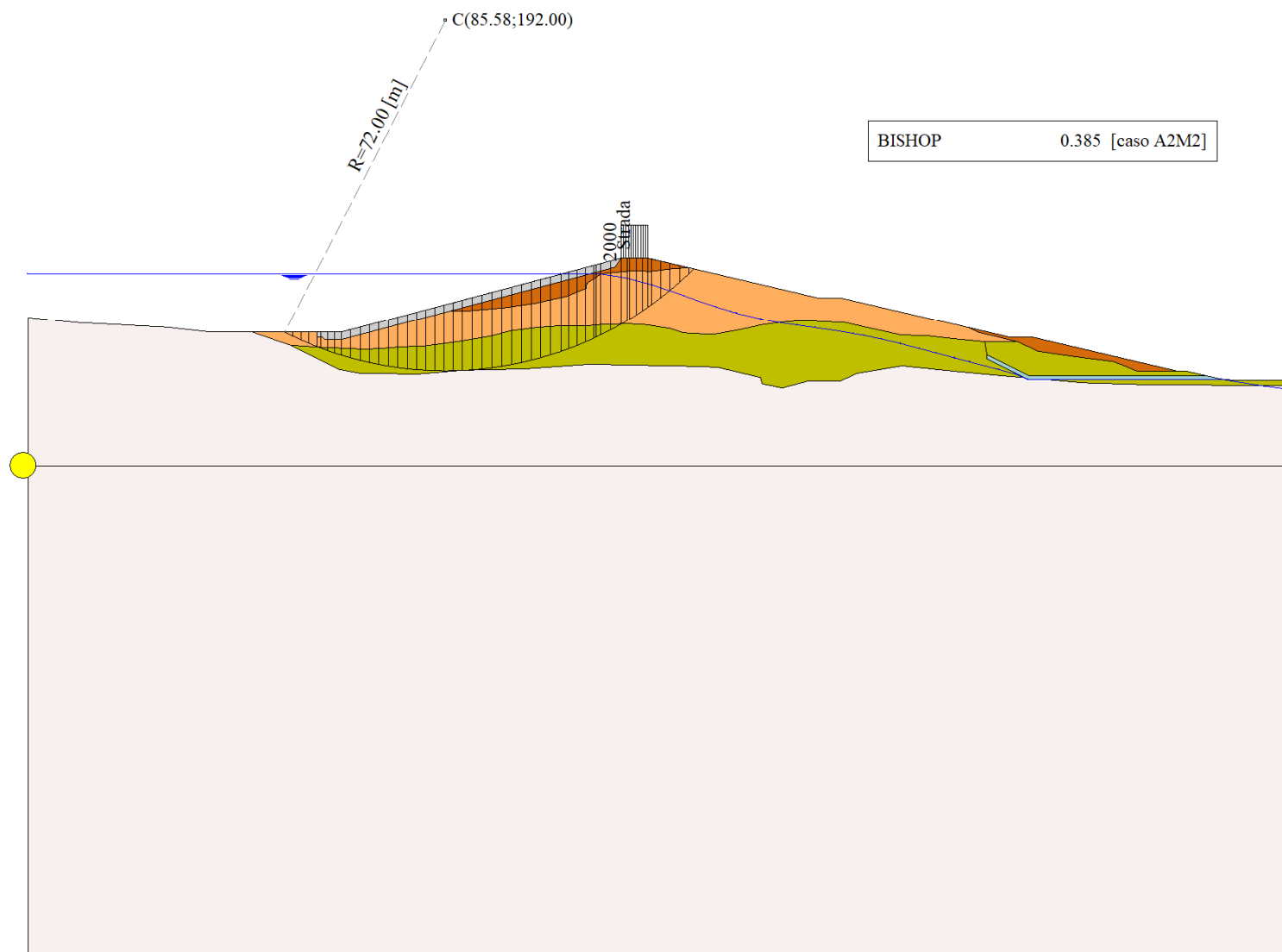


Figura 28-2 – Superficie critica (117) della sezione CR\_08 per la verifica di stabilità 24.



## 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	121.59	127.09	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	41952
Coefficiente di sicurezza minimo	1.369
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	48
Coordinate del centro	X[m]= 85.58                      Y[m]= 168.00
Raggio del cerchio	R[m]= 48.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 59.05                      Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 126.74                      Y <sub>m</sub> [m]= 143.30
Coefficiente di sicurezza	F <sub>s</sub> = 1.368

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	59.05	128.00	128.00	59.21	128.00	127.89	59.16	127.96	0.20	-33.44	0.00	54
2	59.21	128.00	127.89	60.21	128.00	127.25	59.83	127.75	1.19	-32.62	38.62	0
3	60.21	128.00	127.25	60.71	128.00	126.95	60.47	127.55	0.59	-31.56	38.66	0
4	60.71	128.00	126.95	61.88	128.00	126.26	61.34	127.29	1.35	-30.40	25.16	19
5	61.88	128.00	126.26	63.04	128.00	125.62	62.49	126.96	1.33	-28.80	0.00	54
6	63.04	128.00	125.62	64.21	128.00	125.02	63.65	126.65	1.31	-27.22	0.00	54
7	64.21	128.00	125.02	65.66	128.39	124.33	64.97	126.43	1.61	-25.47	0.00	53
8	65.66	128.39	124.33	67.12	128.78	123.69	66.42	126.29	1.59	-23.57	0.00	52
9	67.12	128.78	123.69	68.58	129.16	123.11	67.87	126.18	1.57	-21.68	0.00	52
10	68.58	129.16	123.11	70.03	129.55	122.59	69.32	126.10	1.55	-19.83	0.00	52
11	70.03	129.55	122.59	71.61	129.97	122.08	70.84	126.05	1.66	-17.91	0.00	52
12	71.61	129.97	122.08	73.19	130.39	121.63	72.41	126.02	1.64	-15.94	0.00	52
13	73.19	130.39	121.63	74.77	130.81	121.23	73.99	126.02	1.63	-13.99	0.00	52
14	74.77	130.81	121.23	76.34	131.24	120.90	75.56	126.05	1.61	-12.06	0.00	52
15	76.34	131.24	120.90	77.92	131.66	120.61	77.14	126.10	1.60	-10.14	0.00	52
16	77.92	131.66	120.61	79.50	132.08	120.39	78.72	126.18	1.59	-8.23	0.00	52
17	79.50	132.08	120.39	81.08	132.50	120.21	80.30	126.29	1.59	-6.33	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	81.08	132.50	120.21	82.66	132.92	120.09	81.87	126.43	1.58	-4.44	0.00	52
19	82.66	132.92	120.09	84.23	133.34	120.02	83.45	126.59	1.58	-2.55	0.00	52
20	84.23	133.34	120.02	85.81	133.76	120.00	85.03	126.78	1.58	-0.66	0.00	52
21	85.81	133.76	120.00	87.39	134.18	120.03	86.61	126.99	1.58	1.22	0.00	52
22	87.39	134.18	120.03	88.97	134.60	120.12	88.18	127.23	1.58	3.11	0.00	52
23	88.97	134.60	120.12	90.60	135.04	120.26	89.79	127.51	1.63	5.03	0.00	52
24	90.60	135.04	120.26	92.22	135.47	120.46	91.41	127.81	1.64	6.98	0.00	52
25	92.22	135.47	120.46	93.85	135.90	120.72	93.04	128.14	1.65	8.94	0.00	52
26	93.85	135.90	120.72	95.48	136.34	121.03	94.67	128.50	1.66	10.91	0.00	52
27	95.48	136.34	121.03	97.11	136.77	121.40	96.29	128.89	1.67	12.90	0.00	52
28	97.11	136.77	121.40	98.73	137.21	121.84	97.92	129.31	1.68	14.90	0.00	52
29	98.73	137.21	121.84	100.36	137.64	122.33	99.55	129.75	1.70	16.92	0.00	52
30	100.36	137.64	122.33	101.99	138.07	122.89	101.18	130.23	1.72	18.96	0.00	52
31	101.99	138.07	122.89	103.62	138.51	123.52	102.80	130.75	1.74	21.03	0.00	52
32	103.62	138.51	123.52	105.25	138.94	124.21	104.43	131.29	1.77	23.13	0.00	52
33	105.25	138.94	124.21	106.87	139.38	124.98	106.06	131.88	1.80	25.26	0.00	52
34	106.87	139.38	124.98	108.50	139.81	125.83	107.68	132.50	1.83	27.43	0.00	52
35	108.50	139.81	125.83	110.13	140.24	126.75	109.31	133.16	1.87	29.64	0.00	52
36	110.13	140.24	126.75	111.76	140.68	127.76	110.94	133.86	1.92	31.90	0.00	52
37	111.76	140.68	127.76	113.38	141.11	128.87	112.56	134.60	1.97	34.22	0.00	52
38	113.38	141.11	128.87	115.01	141.55	130.08	114.19	135.40	2.03	36.61	0.00	53
39	115.01	141.55	130.08	116.51	141.95	131.29	115.75	136.21	1.93	38.97	0.00	54
40	116.51	141.95	131.29	117.40	142.18	132.06	116.95	136.87	1.18	40.82	0.00	54
41	117.40	142.18	132.06	118.80	142.56	133.35	118.09	137.53	1.90	42.66	0.00	54
42	118.80	142.56	133.35	120.19	142.93	134.74	119.48	138.39	1.97	44.97	0.00	54
43	120.19	142.93	134.74	121.59	143.30	136.26	120.87	139.30	2.06	47.38	0.00	54
44	121.59	143.30	136.26	121.65	143.30	136.33	121.62	139.80	0.09	48.66	0.00	54
45	121.65	143.30	136.33	123.34	143.30	138.37	122.45	140.30	2.65	50.30	0.00	54
46	123.34	143.30	138.37	124.72	143.30	140.21	123.98	141.26	2.31	53.25	0.00	54
47	124.72	143.30	140.21	125.73	143.30	141.69	125.17	142.09	1.79	55.70	0.00	53
48	125.73	143.30	141.69	126.74	143.30	143.30	126.06	142.76	1.90	57.90	0.00	53

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

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	17	0	542	790	0	0	958	0	0	
2	855	0	1626	954	0	958	2638	0	0	
3	901	0	1650	964	0	2638	4324	0	0	
4	3256	0	6131	4015	0	4324	10889	0	0	
5	4764	0	8397	5385	0	10889	19653	0	0	
6	6166	0	9664	5307	0	19653	28793	0	0	
7	10020	0	14154	6411	0	28793	40668	0	0	
8	12996	0	16868	6168	0	40668	53065	0	0	
9	15823	0	19446	6084	0	53065	65903	0	0	
10	18496	0	21828	6009	0	65903	78960	0	0	
11	22967	0	26220	6445	0	78960	93157	0	0	
12	25874	0	28731	6378	0	93157	107181	0	0	
13	28600	0	31049	6320	0	107181	120820	0	0	
14	31136	0	33178	6271	0	120820	133884	0	0	
15	33480	0	35125	6230	0	133884	146199	0	0	
16	35628	0	36894	6196	0	146199	157612	0	0	
17	37597	0	38512	6170	0	157612	167990	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	39413	0	40009	6151	0	167990	177217	0	0	
19	41078	0	41392	6139	0	177217	185190	0	0	
20	42570	0	42644	6133	0	185190	191816	0	0	
21	43901	0	43780	6134	0	191816	197016	0	0	
22	45110	0	44843	6141	0	197016	200718	0	0	
23	47614	0	47239	6348	0	200718	202904	0	0	
24	48532	0	48114	6371	0	202904	203382	0	0	
25	49246	0	48845	6401	0	203382	202114	0	0	
26	49770	0	49445	6440	0	202114	199076	0	0	
27	50127	0	49939	6487	0	199076	194251	0	0	
28	50280	0	50288	6544	0	194251	187643	0	0	
29	50187	0	50447	6610	0	187643	179283	0	0	
30	49842	0	50405	6686	0	179283	169227	0	0	
31	49273	0	50184	6775	0	169227	157540	0	0	
32	48451	0	49748	6876	0	157540	144322	0	0	
33	47359	0	49067	6992	0	144322	129707	0	0	
34	46006	0	48135	7124	0	129707	113859	0	0	
35	44357	0	46895	7275	0	113859	96990	0	0	
36	42398	0	45305	7449	0	96990	79371	0	0	
37	40093	0	43286	7647	0	79371	61352	0	0	
38	37459	0	40660	8081	0	61352	43593	0	0	
39	32006	0	34853	7804	0	43593	27742	0	0	
40	18063	0	19759	4757	0	27742	18426	0	0	
41	26374	0	28784	7682	0	18426	4572	0	0	
42	23790	0	25649	7985	0	4572	-7906	0	0	
43	20939	0	21855	8343	0	-7906	-18338	0	0	
44	832	156	1078	367	0	-18338	-18905	0	0	
45	19980	4394	25267	10701	0	-18905	-31508	0	0	
46	11115	3588	12080	9330	0	-31508	-35605	0	0	
47	4833	2622	2813	7106	0	-35605	-33924	0	0	
48	1658	2622	-3861	7475	0	-33924	-26681	0	0	

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

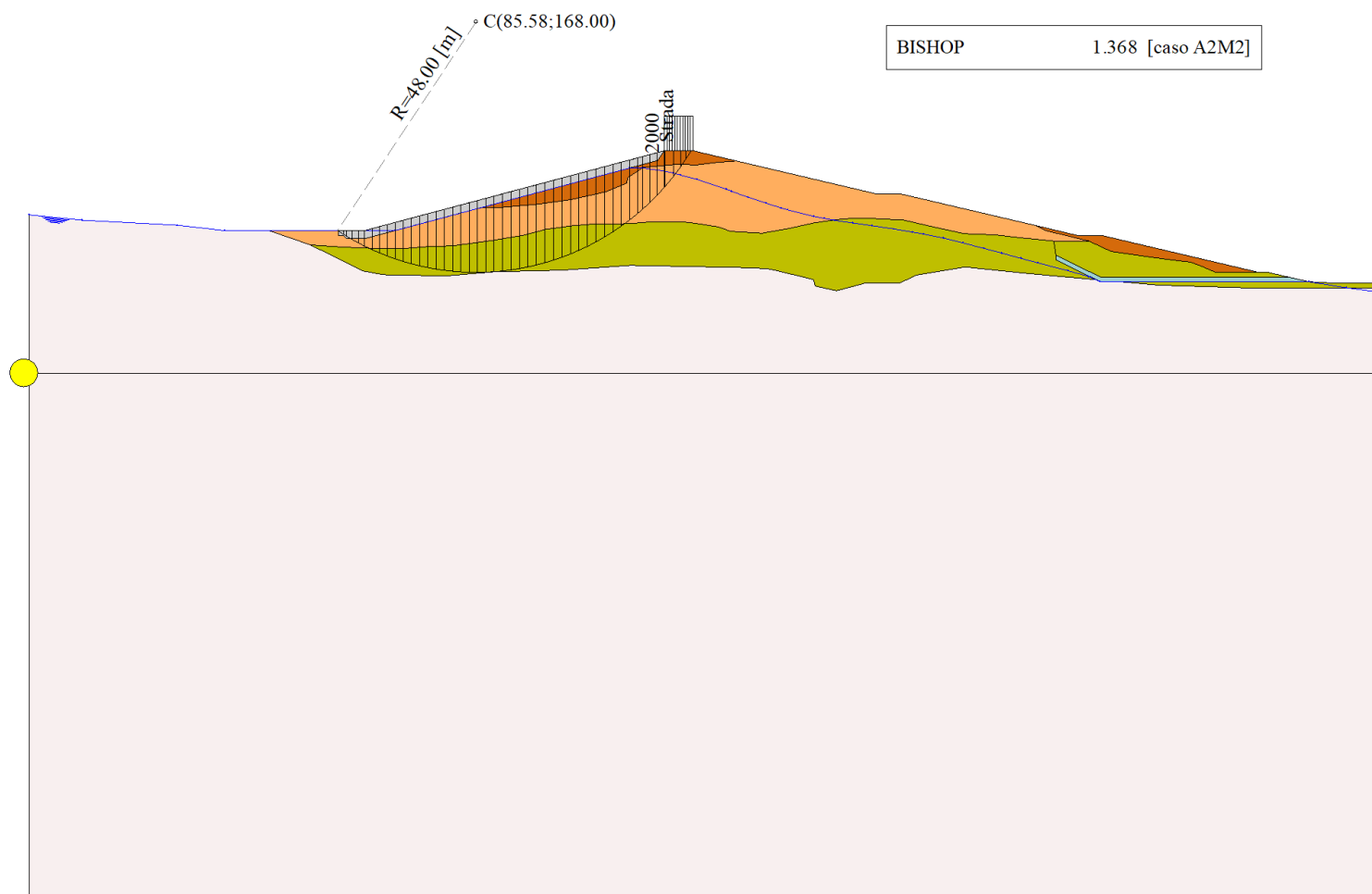


Figura 29-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 25.

## 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	121.59	127.09	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	83861
Coefficiente di sicurezza minimo	0.679
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]= 93.58                      Y[m]= 194.00
Raggio del cerchio	R[m]= 72.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 64.58                      Y <sub>v</sub> [m]= 128.10
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 141.19                      Y <sub>m</sub> [m]= 139.98
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.679</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	64.58	128.10	128.10	66.40	128.58	127.33	65.79	128.00	1.97	-22.97	38.66	0
2	66.40	128.58	127.33	68.21	129.07	126.62	67.40	127.89	1.95	-21.41	9.67	41
3	68.21	129.07	126.62	70.03	129.55	125.96	69.18	127.80	1.93	-19.86	0.00	54
4	70.03	129.55	125.96	71.54	129.95	125.46	70.81	127.73	1.59	-18.46	0.00	54
5	71.54	129.95	125.46	73.24	130.41	124.93	72.42	127.69	1.78	-17.12	0.00	54
6	73.24	130.41	124.93	74.93	130.86	124.46	74.11	127.66	1.76	-15.71	0.00	53
7	74.93	130.86	124.46	76.63	131.31	124.02	75.80	127.66	1.75	-14.31	0.00	52
8	76.63	131.31	124.02	78.46	131.80	123.61	77.56	127.69	1.87	-12.87	0.00	52
9	78.46	131.80	123.61	80.29	132.29	123.24	79.39	127.73	1.86	-11.38	0.00	52
10	80.29	132.29	123.24	82.11	132.77	122.92	81.21	127.80	1.86	-9.90	0.00	52
11	82.11	132.77	122.92	83.94	133.26	122.65	83.04	127.90	1.85	-8.43	0.00	52
12	83.94	133.26	122.65	85.77	133.75	122.43	84.86	128.02	1.84	-6.96	0.00	52
13	85.77	133.75	122.43	87.60	134.24	122.25	86.69	128.17	1.84	-5.50	0.00	52
14	87.60	134.24	122.25	89.42	134.72	122.12	88.52	128.33	1.83	-4.04	0.00	52
15	89.42	134.72	122.12	91.25	135.21	122.04	90.34	128.52	1.83	-2.58	0.00	52
16	91.25	135.21	122.04	93.08	135.70	122.00	92.17	128.74	1.83	-1.13	0.00	52
17	93.08	135.70	122.00	94.91	136.18	122.01	94.00	128.97	1.83	0.33	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	94.91	136.18	122.01	96.73	136.67	122.07	95.82	129.24	1.83	1.78	0.00	52
19	96.73	136.67	122.07	98.56	137.16	122.17	97.65	129.52	1.83	3.24	0.00	52
20	98.56	137.16	122.17	100.39	137.65	122.32	99.48	129.83	1.83	4.70	0.00	52
21	100.39	137.65	122.32	102.22	138.13	122.52	101.31	130.16	1.84	6.16	0.00	52
22	102.22	138.13	122.52	104.04	138.62	122.76	103.13	130.51	1.84	7.62	0.00	52
23	104.04	138.62	122.76	105.87	139.11	123.06	104.96	130.89	1.85	9.09	0.00	52
24	105.87	139.11	123.06	107.70	139.60	123.40	106.79	131.29	1.86	10.57	0.00	52
25	107.70	139.60	123.40	109.53	140.08	123.79	108.61	131.72	1.87	12.05	0.00	52
26	109.53	140.08	123.79	111.35	140.57	124.23	110.44	132.17	1.88	13.54	0.00	52
27	111.35	140.57	124.23	113.18	141.06	124.72	112.27	132.64	1.89	15.05	0.00	52
28	113.18	141.06	124.72	115.01	141.55	125.26	114.10	133.15	1.91	16.56	0.00	52
29	115.01	141.55	125.26	116.51	141.95	125.75	115.76	133.63	1.58	17.94	0.00	52
30	116.51	141.95	125.75	117.40	142.18	126.05	116.95	133.98	0.94	18.94	0.00	52
31	117.40	142.18	126.05	118.80	142.56	126.56	118.10	134.34	1.49	19.91	0.00	52
32	118.80	142.56	126.56	120.19	142.93	127.10	119.49	134.79	1.50	21.10	0.00	52
33	120.19	142.93	127.10	121.59	143.30	127.67	120.89	135.25	1.51	22.29	0.00	52
34	121.59	143.30	127.67	121.65	143.30	127.70	121.62	135.49	0.07	22.92	0.00	52
35	121.65	143.30	127.70	123.34	143.30	128.44	122.49	135.68	1.85	23.68	0.00	52
36	123.34	143.30	128.44	124.72	143.30	129.08	124.02	136.03	1.52	25.02	0.00	52
37	124.72	143.30	129.08	126.02	143.30	129.72	125.37	136.35	1.45	26.20	0.00	53
38	126.02	143.30	129.72	127.09	143.30	130.27	126.55	136.65	1.20	27.26	0.00	54
39	127.09	143.30	130.27	127.90	143.11	130.71	127.49	136.85	0.92	28.10	0.00	54
40	127.90	143.11	130.71	129.76	142.67	131.75	128.81	137.06	2.13	29.32	0.00	54
41	129.76	142.67	131.75	131.62	142.24	132.87	130.67	137.38	2.17	31.03	0.00	54
42	131.62	142.24	132.87	133.48	141.80	134.07	132.52	137.74	2.21	32.77	0.00	54
43	133.48	141.80	134.07	134.44	141.57	134.72	133.95	138.04	1.16	34.11	0.00	54
44	134.44	141.57	134.72	135.43	141.34	135.41	134.92	138.26	1.21	35.06	0.00	54
45	135.43	141.34	135.41	136.87	141.00	136.47	136.12	138.55	1.78	36.25	0.00	54
46	136.87	141.00	136.47	138.31	140.66	137.58	137.54	138.91	1.82	37.68	0.00	54
47	138.31	140.66	137.58	139.75	140.32	138.75	138.95	139.31	1.86	39.14	0.00	54
48	139.75	140.32	138.75	141.19	139.98	139.98	140.23	139.69	1.90	40.64	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	2157	0	5205	6134	0	0	7195	0	0	
2	6392	0	13657	15359	0	7195	25045	0	0	
3	10331	0	17905	15750	0	25045	43625	0	0	
4	11506	0	17823	12980	0	43625	59001	0	0	
5	16019	0	23099	14476	0	59001	76043	0	0	
6	19178	0	26105	14042	0	76043	92328	0	0	
7	22316	0	29113	13714	0	92328	107810	0	0	
8	27370	0	34578	14683	0	107810	123689	0	0	
9	30624	0	37680	14601	0	123689	138572	0	0	
10	33698	0	40580	14531	0	138572	152308	0	0	
11	36631	0	43328	14470	0	152308	164760	0	0	
12	39386	0	45888	14420	0	164760	175804	0	0	
13	41976	0	48282	14380	0	175804	185331	0	0	
14	44454	0	50575	14350	0	185331	193239	0	0	
15	46770	0	52713	14329	0	193239	199440	0	0	
16	48890	0	54663	14317	0	199440	203866	0	0	
17	50826	0	56444	14314	0	203866	206459	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	52618	0	58100	14321	0	206459	207167	0	0	
19	54248	0	59616	14337	0	207167	205948	0	0	
20	55657	0	60926	14362	0	205948	202793	0	0	
21	56836	0	62021	14397	0	202793	197709	0	0	
22	57830	0	62955	14442	0	197709	190704	0	0	
23	58605	0	63685	14496	0	190704	181812	0	0	
24	59174	0	64227	14561	0	181812	171076	0	0	
25	59530	0	64572	14637	0	171076	158558	0	0	
26	59671	0	64713	14724	0	158558	144336	0	0	
27	59564	0	64609	14822	0	144336	128522	0	0	
28	59192	0	64237	14933	0	128522	111257	0	0	
29	48061	0	52184	12349	0	111257	96152	0	0	
30	28571	0	31064	7370	0	96152	86630	0	0	
31	44468	0	48384	11634	0	86630	71121	0	0	
32	43982	0	47904	11725	0	71121	54954	0	0	
33	43441	0	47367	11823	0	54954	38183	0	0	
34	1853	120	2167	510	0	38183	37367	0	0	
35	50823	3380	59484	14453	0	37367	14558	0	0	
36	39464	2760	46254	11928	0	14558	-3664	0	0	
37	35400	2600	41469	11443	0	-3664	-20229	0	0	
38	27871	2140	32489	9815	0	-20229	-33114	0	0	
39	20176	0	21439	7487	0	-33114	-41132	0	0	
40	42443	0	44367	17394	0	-41132	-57207	0	0	
41	36837	0	37161	17699	0	-57207	-69456	0	0	
42	30966	0	29345	18038	0	-69456	-77118	0	0	
43	13603	0	11868	9455	0	-77118	-78997	0	0	
44	12268	0	9747	9862	0	-78997	-79274	0	0	
45	14575	0	9430	14550	0	-79274	-76384	0	0	
46	10612	0	3461	14827	0	-76384	-69145	0	0	
47	6488	0	-3011	15130	0	-69145	-56965	0	0	
48	2192	0	-10058	15463	0	-56965	-39172	0	0	

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

### 30.2.2 ANALISI DELLA SUPERFICIE 42 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	48	
Coordinate del centro	X[m]= 85.58	Y[m]= 180.00
Raggio del cerchio	R[m]= 60.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 55.65	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 132.11	Y <sub>m</sub> [m]= 142.12
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.684</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>r</sub> [m]	Y <sub>r</sub> [m]	L [m]	α <sub>s</sub> [°]	α <sub>d</sub> [°]	c [kPa]
1	55.65	128.00	128.00	57.43	128.00	127.01	56.83	127.67	2.04	-28.95	0.00	54
2	57.43	128.00	127.01	59.21	128.00	126.11	58.41	127.26	2.00	-27.03	0.00	54
3	59.21	128.00	126.11	59.22	128.00	126.10	59.22	127.05	0.01	-26.07	0.00	54
4	59.22	128.00	126.10	59.98	128.00	125.74	59.61	126.96	0.84	-25.66	0.00	54
5	59.98	128.00	125.74	61.39	128.00	125.09	60.71	126.70	1.55	-24.52	0.00	54
6	61.39	128.00	125.09	62.80	128.00	124.49	62.12	126.39	1.53	-23.04	0.00	53
7	62.80	128.00	124.49	64.21	128.00	123.93	63.52	126.10	1.52	-21.59	0.00	52
8	64.21	128.00	123.93	65.66	128.39	123.40	64.96	125.93	1.55	-20.13	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	65.66	128.39	123.40	67.12	128.78	122.91	66.41	125.87	1.54	-18.65	0.00	52
10	67.12	128.78	122.91	68.58	129.16	122.46	67.86	125.83	1.52	-17.19	0.00	52
11	68.58	129.16	122.46	70.03	129.55	122.05	69.32	125.81	1.51	-15.74	0.00	52
12	70.03	129.55	122.05	71.92	130.06	121.57	71.00	125.81	1.95	-14.09	0.00	52
13	71.92	130.06	121.57	73.82	130.56	121.16	72.89	125.84	1.94	-12.23	0.00	52
14	73.82	130.56	121.16	75.71	131.07	120.82	74.78	125.90	1.93	-10.39	0.00	52
15	75.71	131.07	120.82	77.61	131.57	120.53	76.67	126.00	1.92	-8.55	0.00	52
16	77.61	131.57	120.53	79.50	132.08	120.31	78.56	126.12	1.91	-6.73	0.00	52
17	79.50	132.08	120.31	81.39	132.58	120.15	80.46	126.28	1.90	-4.91	0.00	52
18	81.39	132.58	120.15	83.29	133.09	120.04	82.35	126.47	1.90	-3.09	0.00	52
19	83.29	133.09	120.04	85.18	133.59	120.00	84.24	126.68	1.89	-1.28	0.00	52
20	85.18	133.59	120.00	87.08	134.10	120.02	86.13	126.93	1.89	0.52	0.00	52
21	87.08	134.10	120.02	88.97	134.60	120.10	88.03	127.20	1.90	2.33	0.00	55
22	88.97	134.60	120.10	90.83	135.10	120.23	89.90	127.51	1.86	4.13	0.00	55
23	90.83	135.10	120.23	92.69	135.59	120.42	91.76	127.84	1.87	5.91	0.00	52
24	92.69	135.59	120.42	94.55	136.09	120.67	93.62	128.20	1.88	7.70	0.00	52
25	94.55	136.09	120.67	96.41	136.59	120.99	95.48	128.58	1.89	9.50	0.00	52
26	96.41	136.59	120.99	98.27	137.08	121.36	97.34	129.00	1.90	11.30	0.00	52
27	98.27	137.08	121.36	100.13	137.58	121.79	99.20	129.45	1.91	13.12	0.00	52
28	100.13	137.58	121.79	101.99	138.07	122.29	101.06	129.93	1.93	14.95	0.00	52
29	101.99	138.07	122.29	103.85	138.57	122.85	102.92	130.44	1.94	16.80	0.00	52
30	103.85	138.57	122.85	105.71	139.07	123.48	104.78	130.99	1.96	18.67	0.00	52
31	105.71	139.07	123.48	107.57	139.56	124.17	106.64	131.57	1.99	20.55	0.00	52
32	107.57	139.56	124.17	109.43	140.06	124.94	108.50	132.18	2.01	22.46	0.00	52
33	109.43	140.06	124.94	111.29	140.55	125.79	110.36	132.83	2.04	24.40	0.00	52
34	111.29	140.55	125.79	113.15	141.05	126.71	112.22	133.52	2.08	26.36	0.00	52
35	113.15	141.05	126.71	115.01	141.55	127.71	114.07	134.25	2.11	28.36	0.00	52
36	115.01	141.55	127.71	116.51	141.95	128.59	115.76	134.95	1.74	30.20	0.00	52
37	116.51	141.95	128.59	117.40	142.18	129.13	116.95	135.46	1.04	31.53	0.00	52
38	117.40	142.18	129.13	117.78	142.28	129.37	117.59	135.74	0.45	32.24	0.00	52
39	117.78	142.28	129.37	119.69	142.79	130.64	118.72	136.27	2.29	33.55	0.00	54
40	119.69	142.79	130.64	121.59	143.30	132.01	120.63	137.18	2.35	35.76	0.00	54
41	121.59	143.30	132.01	121.65	143.30	132.05	121.62	137.67	0.08	36.92	0.00	54
42	121.65	143.30	132.05	123.34	143.30	133.37	122.48	138.00	2.14	37.98	0.00	54
43	123.34	143.30	133.37	124.72	143.30	134.52	124.02	138.62	1.80	39.86	0.00	54
44	124.72	143.30	134.52	125.91	143.30	135.57	125.30	139.17	1.58	41.47	0.00	54
45	125.91	143.30	135.57	127.09	143.30	136.68	126.48	139.70	1.62	43.00	0.00	54
46	127.09	143.30	136.68	127.90	143.11	137.47	127.48	140.13	1.13	44.32	0.00	54
47	127.90	143.11	137.47	129.71	142.68	139.35	128.73	140.62	2.61	46.10	0.00	54
48	129.71	142.68	139.35	131.52	142.26	141.41	130.44	141.34	2.74	48.66	0.00	54
49	131.52	142.26	141.41	132.11	142.12	142.12	131.72	141.93	0.93	50.41	0.00	53

Tabella 30-4 – Geometria e caratteristiche strisce della superficie 42 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	1700	0	11278	16479	0	0	19498	0	0	
2	4967	0	14459	16187	0	19498	39374	0	0	
3	37	0	90	90	0	39374	39486	0	0	
4	3112	0	7118	6824	0	39486	48022	0	0	
5	7179	0	14496	12543	0	48022	63838	0	0	
6	8902	0	15948	12197	0	63838	79309	0	0	
7	10587	0	17326	11788	0	79309	94272	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
8	13077	0	19904	12047	0	94272	109499	0	0	
9	15613	0	22356	11938	0	109499	124458	0	0	
10	18023	0	24644	11840	0	124458	139012	0	0	
11	20324	0	26797	11752	0	139012	153036	0	0	
12	29797	0	37976	15181	0	153036	170322	0	0	
13	33456	0	41336	15066	0	170322	186301	0	0	
14	36871	0	44431	14969	0	186301	200767	0	0	
15	40030	0	47258	14889	0	200767	213542	0	0	
16	42918	0	49809	14826	0	213542	224476	0	0	
17	45559	0	52122	14778	0	224476	233443	0	0	
18	48001	0	54258	14745	0	233443	240333	0	0	
19	50226	0	56201	14728	0	240333	245054	0	0	
20	52217	0	57940	14725	0	245054	247539	0	0	
21	54042	0	59521	15449	0	247539	248433	0	0	
22	54651	0	59841	15175	0	248433	247005	0	0	
23	55973	0	61076	14537	0	247005	242622	0	0	
24	57056	0	62057	14591	0	242622	235971	0	0	
25	57932	0	62870	14661	0	235971	227065	0	0	
26	58602	0	63515	14746	0	227065	215933	0	0	
27	58999	0	63912	14847	0	215933	202653	0	0	
28	59091	0	64023	14966	0	202653	187342	0	0	
29	58928	0	63897	15104	0	187342	170119	0	0	
30	58474	0	63485	15262	0	170119	151149	0	0	
31	57728	0	62775	15442	0	151149	130626	0	0	
32	56684	0	61746	15647	0	130626	108785	0	0	
33	55326	0	60361	15877	0	108785	85905	0	0	
34	53614	0	58548	16138	0	85905	62343	0	0	
35	51519	0	56240	16432	0	62343	38532	0	0	
36	39697	0	43228	13492	0	38532	19545	0	0	
37	23018	0	25053	8117	0	19545	8202	0	0	
38	9634	0	10464	3493	0	8202	3413	0	0	
39	46590	0	49986	18374	0	3413	-19345	0	0	
40	43708	0	46219	19000	0	-19345	-40739	0	0	
41	1328	120	1557	607	0	-40739	-41513	0	0	
42	35148	3380	40812	17352	0	-41513	-61589	0	0	
43	25388	2760	28632	14550	0	-61589	-75082	0	0	
44	19272	2370	20808	12800	0	-75082	-84125	0	0	
45	16811	2370	16939	13114	0	-84125	-90388	0	0	
46	9854	0	6370	9162	0	-90388	-90491	0	0	
47	16165	0	3971	21128	0	-90491	-82329	0	0	
48	7637	0	-12215	22060	0	-82329	-60299	0	0	
49	515	0	-7933	7305	0	-60299	-49646	0	0	

Tabella 30-5 – Forze applicate sulle strisce [BISHOP] della superficie 42 della verifica di stabilità 26.

### 30.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.001481
2	0.000551
3	0.001687
4	0.001844
5	0.000157
6	0.000434
7	0.000031

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

Accelerazione sismica critica  $K_c = 0.104$   
Spostamento massimo  $U_{max} = 0.001844$  [m]  
Velocità massima  $V_{max} = 0.023099$  [m/s]

n°	u
	[m]
1	0.002326
2	0.000748
3	0.002269
4	0.002419
5	0.000300
6	0.000682
7	0.000137

Tabella 30-7 – Spostamenti della superficie 42 della verifica di stabilità 26.

Accelerazione sismica critica  $K_c = 0.096$   
Spostamento massimo  $U_{max} = 0.002419$  [m]  
Velocità massima  $V_{max} = 0.025901$  [m/s]

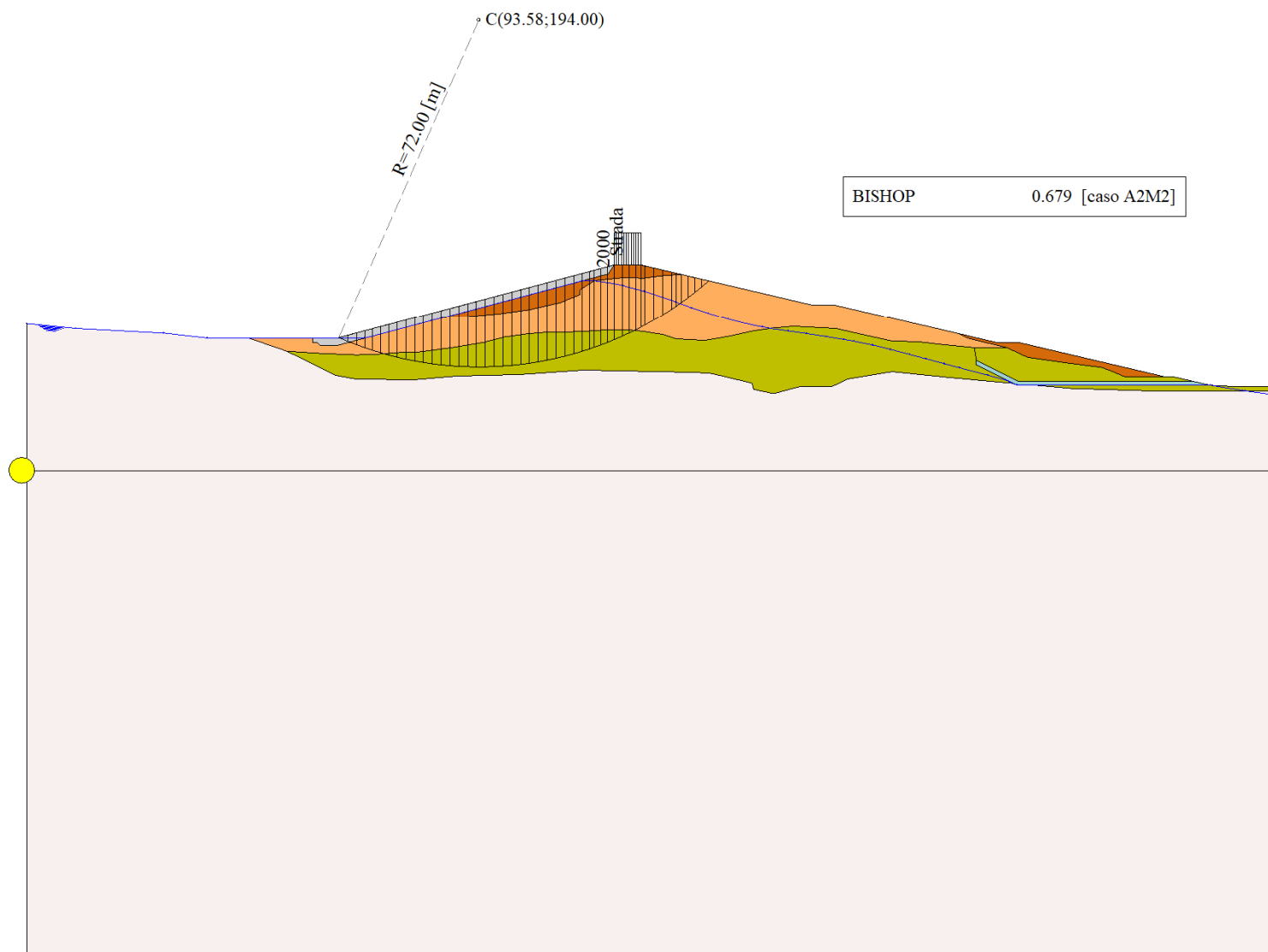


Figura 30-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 26.

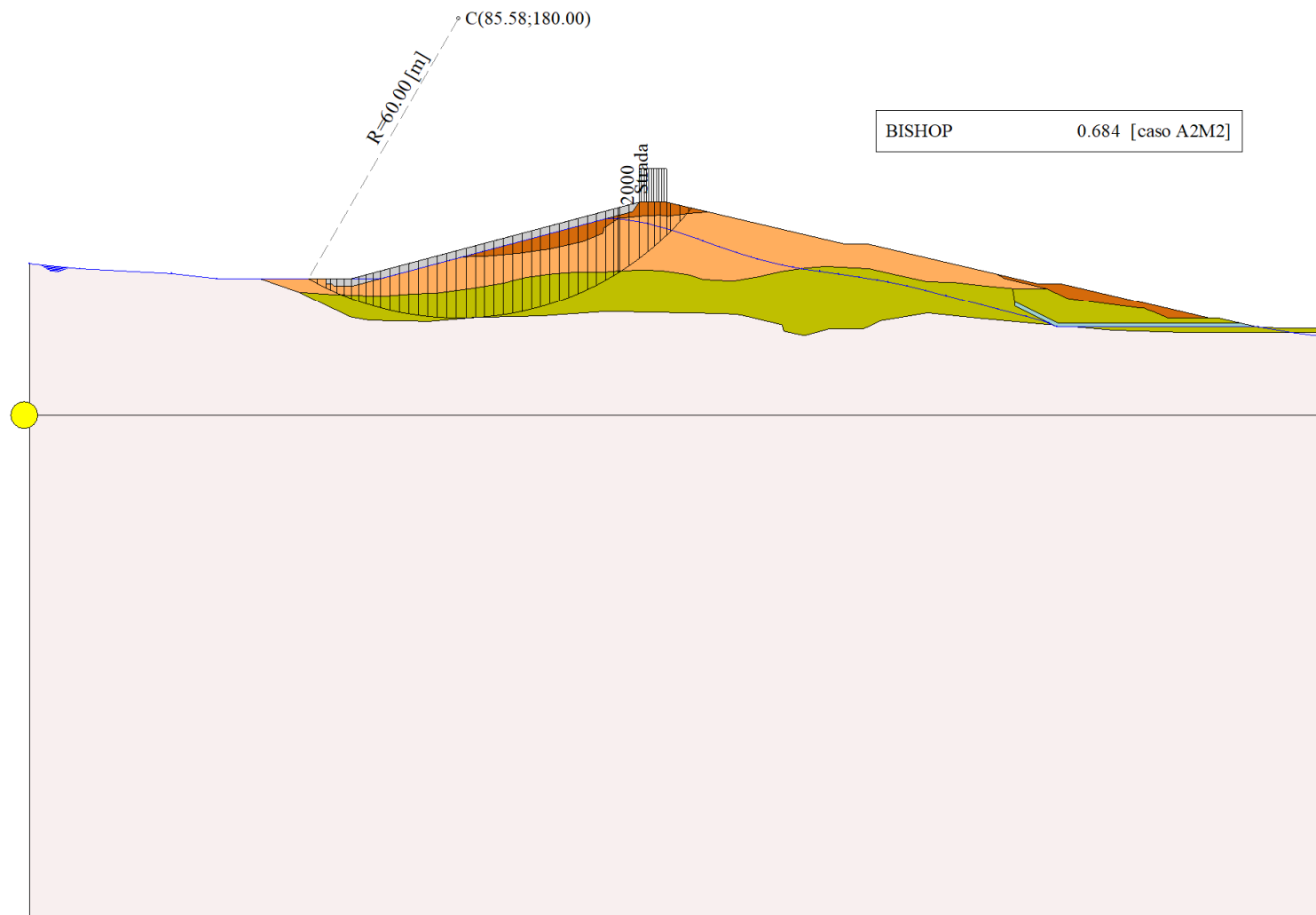


Figura 30-2 – Superficie critica (42) della sezione CR\_08 per la verifica di stabilità 26.

## 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	121.59 143.30	127.09 143.30	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	83727
Coefficiente di sicurezza minimo	0.528
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	46
Coordinate del centro	X[m]= 101.58                      Y[m]= 166.00
Raggio del cerchio	R[m]= 44.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 75.06                      Y <sub>v</sub> [m]= 130.89
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 137.66                      Y <sub>m</sub> [m]= 140.82
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.528</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	75.06	130.89	130.89	76.59	131.30	129.78	76.08	130.66	1.90	-35.84	38.66	0
2	76.59	131.30	129.78	78.13	131.71	128.77	77.44	130.38	1.84	-33.40	0.94	53
3	78.13	131.71	128.77	79.67	132.12	127.84	78.95	130.10	1.79	-31.04	0.00	54
4	79.67	132.12	127.84	81.20	132.53	127.00	80.47	129.87	1.75	-28.73	0.00	54
5	81.20	132.53	127.00	82.74	132.94	126.24	82.00	129.68	1.72	-26.47	0.00	54
6	82.74	132.94	126.24	84.28	133.35	125.54	83.53	129.52	1.69	-24.25	0.00	54
7	84.28	133.35	125.54	85.81	133.76	124.92	85.06	129.39	1.66	-22.08	0.00	52
8	85.81	133.76	124.92	87.35	134.17	124.36	86.60	129.30	1.63	-19.93	0.00	52
9	87.35	134.17	124.36	88.89	134.58	123.87	88.13	129.25	1.61	-17.82	0.00	52
10	88.89	134.58	123.87	90.42	134.99	123.44	89.67	129.22	1.60	-15.73	0.00	52
11	90.42	134.99	123.44	91.96	135.40	123.06	91.20	129.22	1.58	-13.66	0.00	52
12	91.96	135.40	123.06	93.50	135.81	122.75	92.74	129.26	1.57	-11.61	0.00	52
13	93.50	135.81	122.75	95.03	136.22	122.49	94.27	129.32	1.56	-9.57	0.00	52
14	95.03	136.22	122.49	96.57	136.63	122.29	95.81	129.41	1.55	-7.55	0.00	52
15	96.57	136.63	122.29	98.11	137.04	122.14	97.34	129.52	1.54	-5.53	0.00	52
16	98.11	137.04	122.14	99.64	137.45	122.04	98.88	129.67	1.54	-3.52	0.00	52
17	99.64	137.45	122.04	101.18	137.86	122.00	100.42	129.84	1.54	-1.52	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	101.18	137.86	122.00	102.72	138.27	122.01	101.95	130.04	1.54	0.48	0.00	52
19	102.72	138.27	122.01	104.25	138.68	122.08	103.49	130.26	1.54	2.48	0.00	52
20	104.25	138.68	122.08	105.79	139.09	122.20	105.02	130.51	1.54	4.49	0.00	52
21	105.79	139.09	122.20	107.33	139.50	122.38	106.56	130.79	1.55	6.50	0.00	52
22	107.33	139.50	122.38	108.86	139.91	122.61	108.10	131.10	1.55	8.52	0.00	52
23	108.86	139.91	122.61	110.40	140.32	122.89	109.63	131.43	1.56	10.55	0.00	52
24	110.40	140.32	122.89	111.94	140.73	123.24	111.17	131.79	1.57	12.59	0.00	52
25	111.94	140.73	123.24	113.47	141.14	123.64	112.71	132.18	1.59	14.65	0.00	52
26	113.47	141.14	123.64	115.01	141.55	124.10	114.24	132.60	1.60	16.73	0.00	52
27	115.01	141.55	124.10	116.51	141.95	124.61	115.76	133.05	1.58	18.80	0.00	52
28	116.51	141.95	124.61	117.40	142.18	124.94	116.95	133.42	0.95	20.45	0.00	52
29	117.40	142.18	124.94	118.80	142.56	125.51	118.10	133.80	1.51	22.05	0.00	52
30	118.80	142.56	125.51	120.19	142.93	126.13	119.49	134.28	1.53	24.03	0.00	52
31	120.19	142.93	126.13	121.59	143.30	126.81	120.89	134.79	1.55	26.04	0.00	52
32	121.59	143.30	126.81	121.65	143.30	126.84	121.62	135.06	0.07	27.09	0.00	52
33	121.65	143.30	126.84	122.50	143.30	127.29	122.07	135.18	0.95	27.76	0.00	52
34	122.50	143.30	127.29	123.34	143.30	127.76	122.92	135.41	0.97	29.01	0.00	52
35	123.34	143.30	127.76	124.72	143.30	128.58	124.02	135.73	1.60	30.68	0.00	52
36	124.72	143.30	128.58	126.02	143.30	129.41	125.36	136.15	1.55	32.74	0.00	52
37	126.02	143.30	129.41	127.09	143.30	130.15	126.55	136.54	1.30	34.59	0.00	54
38	127.09	143.30	130.15	127.90	143.11	130.74	127.49	136.82	1.00	36.09	0.00	54
39	127.90	143.11	130.74	129.30	142.78	131.83	128.58	137.11	1.77	37.89	0.00	54
40	129.30	142.78	131.83	130.69	142.45	133.01	129.98	137.51	1.83	40.23	0.00	54
41	130.69	142.45	133.01	132.08	142.13	134.29	131.37	137.96	1.90	42.66	0.00	54
42	132.08	142.13	134.29	133.48	141.80	135.70	132.75	138.47	1.98	45.18	0.00	54
43	133.48	141.80	135.70	134.44	141.57	136.74	133.94	138.94	1.42	47.39	0.00	54
44	134.44	141.57	136.74	135.43	141.34	137.89	134.91	139.37	1.52	49.30	0.00	54
45	135.43	141.34	137.89	136.54	141.08	139.29	135.93	139.87	1.79	51.46	0.00	54
46	136.54	141.08	139.29	137.66	140.82	140.82	136.92	140.39	1.89	53.85	0.00	54

Tabella 31-2 – Geometria e caratteristiche strisce della superficie 1 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	2101	0	-32205	-48777	0	0	-59093	0	0	
2	6313	0	21668	19495	0	-59093	-32975	0	0	
3	10415	0	25472	18795	0	-32975	-7179	0	0	
4	14262	0	29016	18364	0	-7179	18161	0	0	
5	17872	0	32220	17990	0	18161	42721	0	0	
6	21259	0	35127	17663	0	42721	66232	0	0	
7	24535	0	37633	16727	0	66232	87771	0	0	
8	27733	0	40340	16454	0	87771	107830	0	0	
9	30770	0	42881	16248	0	107830	126255	0	0	
10	33621	0	45223	16070	0	126255	142874	0	0	
11	36271	0	47360	15918	0	142874	157543	0	0	
12	38721	0	49302	15791	0	157543	170139	0	0	
13	40987	0	51077	15687	0	170139	180559	0	0	
14	43099	0	52724	15603	0	180559	188714	0	0	
15	45042	0	54233	15541	0	188714	194531	0	0	
16	46792	0	55578	15498	0	194531	197959	0	0	
17	48323	0	56736	15474	0	197959	198969	0	0	
18	49674	0	57751	15469	0	198969	197544	0	0	
19	50848	0	58632	15483	0	197544	193675	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	51819	0	59347	15516	0	193675	187381	0	0	
21	52606	0	59918	15568	0	187381	178690	0	0	
22	53204	0	60341	15641	0	178690	167646	0	0	
23	53605	0	60603	15734	0	167646	154314	0	0	
24	53798	0	60689	15849	0	154314	138782	0	0	
25	53779	0	60588	15988	0	138782	121162	0	0	
26	53510	0	60250	16152	0	121162	101613	0	0	
27	51702	0	58208	15951	0	101613	80870	0	0	
28	30683	0	34590	9562	0	80870	67605	0	0	
29	47655	0	53765	15169	0	67605	45734	0	0	
30	46957	0	53042	15393	0	45734	22681	0	0	
31	46131	0	52178	15647	0	22681	-1404	0	0	
32	1962	120	2377	678	0	-1404	-2571	0	0	
33	27199	1690	32979	9612	0	-2571	-18969	0	0	
34	26380	1690	32005	9726	0	-18969	-35257	0	0	
35	41191	2760	49964	16153	0	-35257	-61383	0	0	
36	36516	2600	44181	15557	0	-61383	-85110	0	0	
37	28324	2140	33795	13518	0	-85110	-103230	0	0	
38	20246	0	21535	10504	0	-103230	-114114	0	0	
39	31845	0	32601	18525	0	-114114	-130037	0	0	
40	27823	0	26263	19150	0	-130037	-141571	0	0	
41	23532	0	18967	19879	0	-141571	-147577	0	0	
42	18947	0	10448	20740	0	-147577	-146628	0	0	
43	10212	0	1419	14861	0	-146628	-140985	0	0	
44	7955	0	-4286	15912	0	-140985	-129989	0	0	
45	5653	0	-12964	18748	0	-129989	-110035	0	0	
46	1930	0	-23300	19805	0	-110035	-80175	0	0	

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

### 31.2.2 ANALISI DELLA SUPERFICIE 116 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	48	
Coordinate del centro	X[m]= 85.58	Y[m]= 180.00
Raggio del cerchio	R[m]= 60.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 55.65	Y <sub>v</sub> [m]= 128.00
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 132.11	Y <sub>m</sub> [m]= 142.12
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.551</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	55.65	128.00	128.00	57.43	128.00	127.01	56.83	127.67	2.04	-28.95	0.00	54
2	57.43	128.00	127.01	59.21	128.00	126.11	58.41	127.26	2.00	-27.03	0.00	54
3	59.21	128.00	126.11	59.22	128.00	126.10	59.22	127.05	0.01	-26.07	0.00	54
4	59.22	128.00	126.10	59.98	128.00	125.74	59.61	126.96	0.84	-25.66	0.00	54
5	59.98	128.00	125.74	61.39	128.00	125.09	60.71	126.70	1.55	-24.52	0.00	54
6	61.39	128.00	125.09	62.80	128.00	124.49	62.12	126.39	1.53	-23.04	0.00	53
7	62.80	128.00	124.49	64.21	128.00	123.93	63.52	126.10	1.52	-21.59	0.00	52
8	64.21	128.00	123.93	65.66	128.39	123.40	64.96	125.93	1.55	-20.13	0.00	52
9	65.66	128.39	123.40	67.12	128.78	122.91	66.41	125.87	1.54	-18.65	0.00	52
10	67.12	128.78	122.91	68.58	129.16	122.46	67.86	125.83	1.52	-17.19	0.00	52
11	68.58	129.16	122.46	70.03	129.55	122.05	69.32	125.81	1.51	-15.74	0.00	52
12	70.03	129.55	122.05	71.92	130.06	121.57	71.00	125.81	1.95	-14.09	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	71.92	130.06	121.57	73.82	130.56	121.16	72.89	125.84	1.94	-12.23	0.00	52
14	73.82	130.56	121.16	75.71	131.07	120.82	74.78	125.90	1.93	-10.39	0.00	52
15	75.71	131.07	120.82	77.61	131.57	120.53	76.67	126.00	1.92	-8.55	0.00	52
16	77.61	131.57	120.53	79.50	132.08	120.31	78.56	126.12	1.91	-6.73	0.00	52
17	79.50	132.08	120.31	81.39	132.58	120.15	80.46	126.28	1.90	-4.91	0.00	52
18	81.39	132.58	120.15	83.29	133.09	120.04	82.35	126.47	1.90	-3.09	0.00	52
19	83.29	133.09	120.04	85.18	133.59	120.00	84.24	126.68	1.89	-1.28	0.00	52
20	85.18	133.59	120.00	87.08	134.10	120.02	86.13	126.93	1.89	0.52	0.00	52
21	87.08	134.10	120.02	88.97	134.60	120.10	88.03	127.20	1.90	2.33	0.00	55
22	88.97	134.60	120.10	90.83	135.10	120.23	89.90	127.51	1.86	4.13	0.00	55
23	90.83	135.10	120.23	92.69	135.59	120.42	91.76	127.84	1.87	5.91	0.00	52
24	92.69	135.59	120.42	94.55	136.09	120.67	93.62	128.20	1.88	7.70	0.00	52
25	94.55	136.09	120.67	96.41	136.59	120.99	95.48	128.58	1.89	9.50	0.00	52
26	96.41	136.59	120.99	98.27	137.08	121.36	97.34	129.00	1.90	11.30	0.00	52
27	98.27	137.08	121.36	100.13	137.58	121.79	99.20	129.45	1.91	13.12	0.00	52
28	100.13	137.58	121.79	101.99	138.07	122.29	101.06	129.93	1.93	14.95	0.00	52
29	101.99	138.07	122.29	103.85	138.57	122.85	102.92	130.44	1.94	16.80	0.00	52
30	103.85	138.57	122.85	105.71	139.07	123.48	104.78	130.99	1.96	18.67	0.00	52
31	105.71	139.07	123.48	107.57	139.56	124.17	106.64	131.57	1.99	20.55	0.00	52
32	107.57	139.56	124.17	109.43	140.06	124.94	108.50	132.18	2.01	22.46	0.00	52
33	109.43	140.06	124.94	111.29	140.55	125.79	110.36	132.83	2.04	24.40	0.00	52
34	111.29	140.55	125.79	113.15	141.05	126.71	112.22	133.52	2.08	26.36	0.00	52
35	113.15	141.05	126.71	115.01	141.55	127.71	114.07	134.25	2.11	28.36	0.00	52
36	115.01	141.55	127.71	116.51	141.95	128.59	115.76	134.95	1.74	30.20	0.00	52
37	116.51	141.95	128.59	117.40	142.18	129.13	116.95	135.46	1.04	31.53	0.00	52
38	117.40	142.18	129.13	117.78	142.28	129.37	117.59	135.74	0.45	32.24	0.00	52
39	117.78	142.28	129.37	119.69	142.79	130.64	118.72	136.27	2.29	33.55	0.00	54
40	119.69	142.79	130.64	121.59	143.30	132.01	120.63	137.18	2.35	35.76	0.00	54
41	121.59	143.30	132.01	121.65	143.30	132.05	121.62	137.67	0.08	36.92	0.00	54
42	121.65	143.30	132.05	123.34	143.30	133.37	122.48	138.00	2.14	37.98	0.00	54
43	123.34	143.30	133.37	124.72	143.30	134.52	124.02	138.62	1.80	39.86	0.00	54
44	124.72	143.30	134.52	125.91	143.30	135.57	125.30	139.17	1.58	41.47	0.00	54
45	125.91	143.30	135.57	127.09	143.30	136.68	126.48	139.70	1.62	43.00	0.00	54
46	127.09	143.30	136.68	127.90	143.11	137.47	127.48	140.13	1.13	44.32	0.00	54
47	127.90	143.11	137.47	129.71	142.68	139.35	128.73	140.62	2.61	46.10	0.00	54
48	129.71	142.68	139.35	131.52	142.26	141.41	130.44	141.34	2.74	48.66	0.00	54
49	131.52	142.26	141.41	132.11	142.12	142.12	131.72	141.93	0.93	50.41	0.00	53

Tabella 31-4 – Geometria e caratteristiche strisce della superficie 116 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	1700	0	13581	20456	0	0	23912	0	0	
2	4967	0	16747	20093	0	23912	47780	0	0	
3	37	0	103	112	0	47780	47913	0	0	
4	3112	0	8092	8470	0	47913	58024	0	0	
5	7179	0	16295	15569	0	58024	76579	0	0	
6	8902	0	17713	15140	0	76579	94504	0	0	
7	10587	0	19056	14633	0	94504	111624	0	0	
8	13077	0	21708	14953	0	111624	128814	0	0	
9	15613	0	24203	14819	0	128814	145436	0	0	
10	18023	0	26529	14697	0	145436	161364	0	0	
11	20324	0	28716	14587	0	161364	176481	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
12	29797	0	40525	18843	0	176481	194778	0	0	
13	33456	0	43941	18701	0	194778	211311	0	0	
14	36871	0	47082	18581	0	211311	225895	0	0	
15	40030	0	49946	18482	0	225895	238374	0	0	
16	42918	0	52524	18403	0	238374	248625	0	0	
17	45559	0	54855	18344	0	248625	256544	0	0	
18	48001	0	57001	18303	0	256544	262041	0	0	
19	50226	0	58947	18281	0	262041	265047	0	0	
20	52217	0	60678	18277	0	265047	265518	0	0	
21	54042	0	62239	19177	0	265518	264291	0	0	
22	54651	0	62484	18837	0	264291	260525	0	0	
23	55973	0	63698	18044	0	260525	253421	0	0	
24	57056	0	64636	18112	0	253421	243859	0	0	
25	57932	0	65395	18198	0	243859	231877	0	0	
26	58602	0	65974	18304	0	231877	217534	0	0	
27	58999	0	66292	18430	0	217534	200941	0	0	
28	59091	0	66304	18578	0	200941	182260	0	0	
29	58928	0	66063	18749	0	182260	161647	0	0	
30	58474	0	65516	18945	0	161647	139310	0	0	
31	57728	0	64649	19168	0	139310	115492	0	0	
32	56684	0	63440	19422	0	115492	90477	0	0	
33	55326	0	61847	19708	0	90477	64602	0	0	
34	53614	0	59793	20032	0	64602	38287	0	0	
35	51519	0	57206	20397	0	38287	12039	0	0	
36	39697	0	43770	16748	0	12039	-8620	0	0	
37	23018	0	25284	10076	0	-8620	-20858	0	0	
38	9634	0	10537	4335	0	-20858	-25995	0	0	
39	46590	0	50012	22808	0	-25995	-50017	0	0	
40	43708	0	45775	23585	0	-50017	-72069	0	0	
41	1328	120	1543	754	0	-72069	-72872	0	0	
42	35148	3380	40137	21539	0	-72872	-93320	0	0	
43	25388	2760	27646	18061	0	-93320	-106473	0	0	
44	19272	2370	19611	15889	0	-106473	-114706	0	0	
45	16811	2370	15379	16278	0	-114706	-119626	0	0	
46	9854	0	4942	11373	0	-119626	-118197	0	0	
47	16165	0	-90	26225	0	-118197	-105289	0	0	
48	7637	0	-17651	27383	0	-105289	-76472	0	0	
49	515	0	-10022	9067	0	-76472	-63141	0	0	

Tabella 31-5 – Forze applicate sulle strisce [BISHOP] della superficie 116 della verifica di stabilità 27.

### 31.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u [m]
1	0.003740
2	0.001714
3	0.002530
4	0.000685
5	0.000767
6	0.001402
7	0.002262

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

Accelerazione sismica critica  $K_c = 0.123$   
Spostamento massimo  $U_{max} = 0.003740$  [m]  
Velocità massima  $V_{max} = 0.029478$  [m/s]

n°	u
	[m]
1	0.008721
2	0.004146
3	0.005728
4	0.002188
5	0.001679
6	0.007078
7	0.006790

Tabella 31-7 – Spostamenti della superficie 116 della verifica di stabilità 27.

Accelerazione sismica critica  $K_c = 0.096$   
Spostamento massimo  $U_{max} = 0.008721$  [m]  
Velocità massima  $V_{max} = 0.045508$  [m/s]

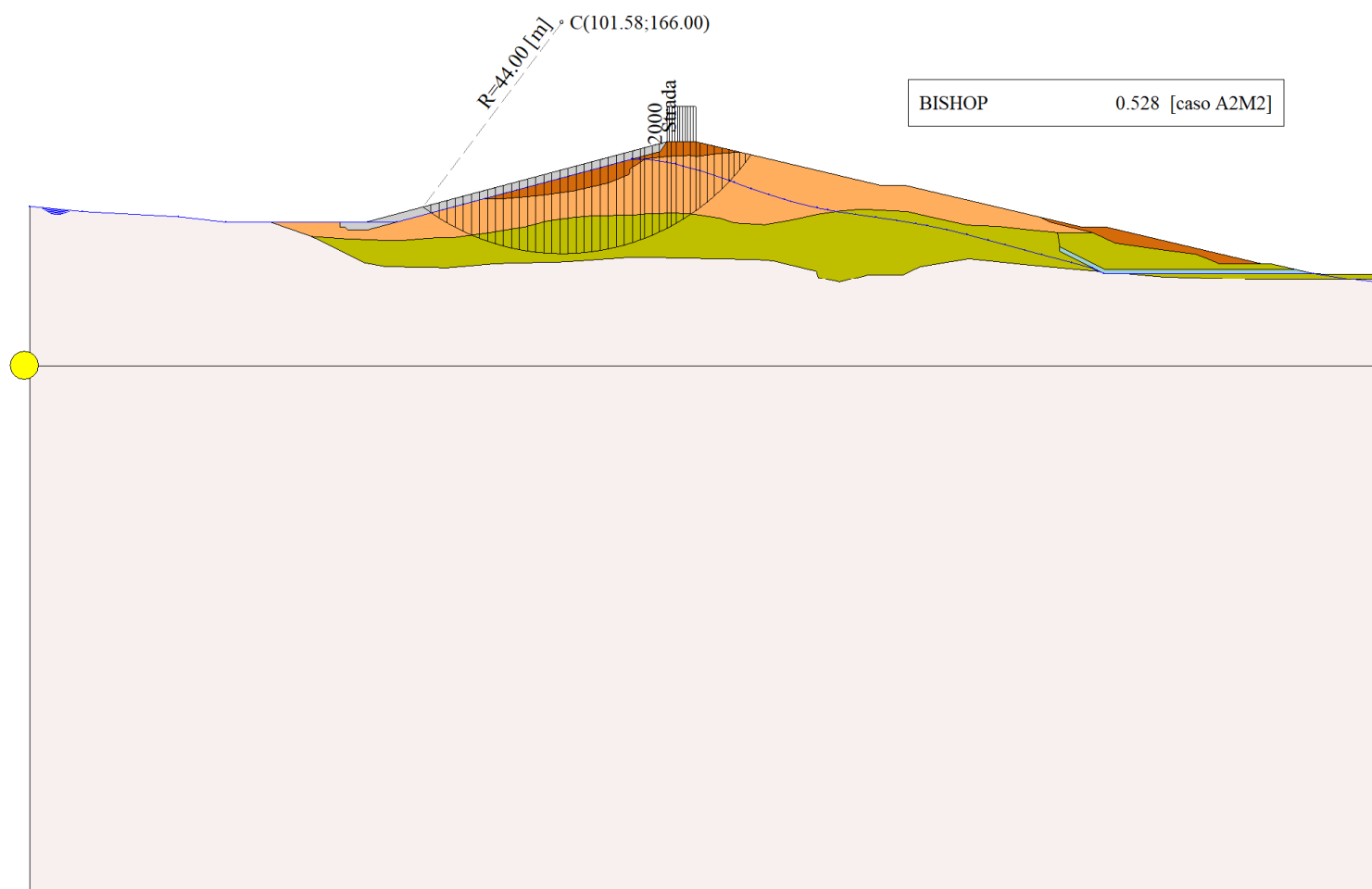


Figura 31-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 27.

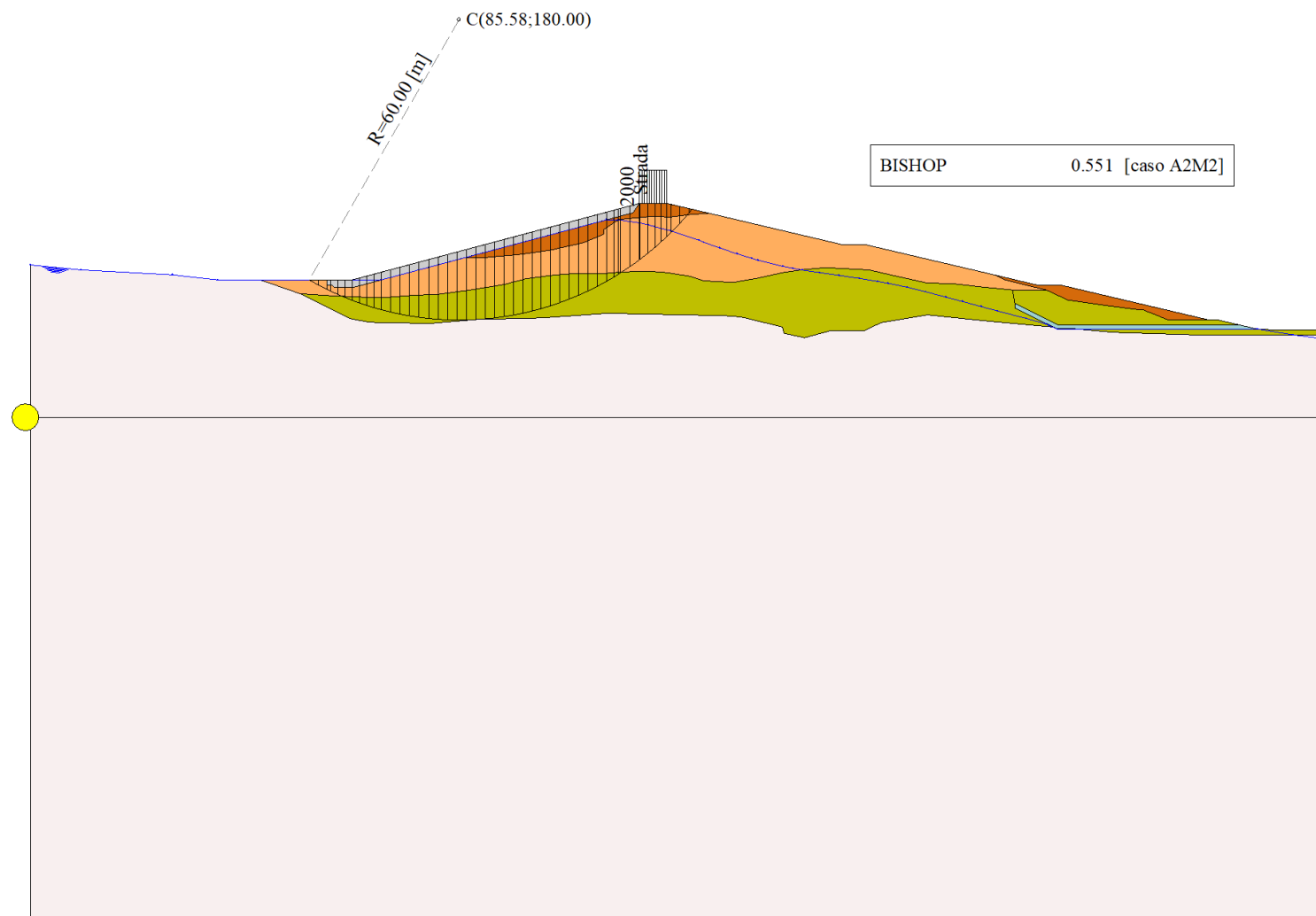


Figura 31-2 – Superficie critica (116) della sezione CR\_08 per la verifica di stabilità 27.

## 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	121.59	127.09	2000	0
				143.30	143.30	2000	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	83309
Coefficiente di sicurezza minimo	0.292
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	53	
Coordinate del centro	X[m]= 101.58	Y[m]= 208.00
Raggio del cerchio	R[m]= 86.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 67.73	Y <sub>v</sub> [m]= 128.94
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 151.06	Y <sub>m</sub> [m]= 137.66
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.292</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	67.73	128.94	128.94	68.88	129.25	128.46	68.50	128.88	1.24	-22.76	38.66	0
2	68.88	129.25	128.46	70.03	129.55	128.00	69.52	128.81	1.24	-21.93	38.56	0
3	70.03	129.55	128.00	71.68	129.99	127.37	70.93	128.72	1.77	-20.93	0.00	54
4	71.68	129.99	127.37	73.33	130.43	126.77	72.55	128.64	1.75	-19.76	0.00	54
5	73.33	130.43	126.77	74.98	130.87	126.22	74.19	128.57	1.74	-18.60	0.00	54
6	74.98	130.87	126.22	76.63	131.31	125.70	75.83	128.52	1.73	-17.44	0.00	54
7	76.63	131.31	125.70	78.11	131.71	125.26	77.39	128.50	1.54	-16.35	0.00	54
8	78.11	131.71	125.26	79.59	132.10	124.86	78.86	128.48	1.53	-15.33	0.00	53
9	79.59	132.10	124.86	81.07	132.50	124.48	80.34	128.48	1.53	-14.31	0.00	52
10	81.07	132.50	124.48	83.07	133.03	124.02	82.09	128.51	2.05	-13.11	0.00	52
11	83.07	133.03	124.02	85.06	133.56	123.60	84.08	128.55	2.04	-11.75	0.00	52
12	85.06	133.56	123.60	87.06	134.09	123.23	86.08	128.62	2.03	-10.40	0.00	52
13	87.06	134.09	123.23	89.06	134.62	122.92	88.07	128.72	2.02	-9.05	0.00	52
14	89.06	134.62	122.92	91.05	135.16	122.65	90.07	128.84	2.01	-7.70	0.00	52
15	91.05	135.16	122.65	93.05	135.69	122.42	92.06	128.98	2.01	-6.36	0.00	52
16	93.05	135.69	122.42	95.05	136.22	122.25	94.06	129.15	2.00	-5.03	0.00	52
17	95.05	136.22	122.25	97.04	136.75	122.12	96.05	129.34	2.00	-3.69	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	97.04	136.75	122.12	99.04	137.29	122.04	98.05	129.55	2.00	-2.36	0.00	52
19	99.04	137.29	122.04	101.03	137.82	122.00	100.04	129.79	2.00	-1.03	0.00	52
20	101.03	137.82	122.00	103.03	138.35	122.01	102.04	130.05	2.00	0.30	0.00	52
21	103.03	138.35	122.01	105.03	138.88	122.07	104.03	130.33	2.00	1.63	0.00	52
22	105.03	138.88	122.07	107.02	139.42	122.17	106.03	130.64	2.00	2.96	0.00	52
23	107.02	139.42	122.17	109.02	139.95	122.32	108.03	130.97	2.00	4.30	0.00	52
24	109.02	139.95	122.32	111.02	140.48	122.52	110.02	131.32	2.01	5.63	0.00	52
25	111.02	140.48	122.52	113.01	141.01	122.76	112.02	131.69	2.01	6.97	0.00	52
26	113.01	141.01	122.76	115.01	141.55	123.06	114.01	132.09	2.02	8.31	0.00	52
27	115.01	141.55	123.06	116.51	141.95	123.31	115.76	132.46	1.52	9.49	0.00	52
28	116.51	141.95	123.31	117.40	142.18	123.47	116.96	132.73	0.90	10.30	0.00	52
29	117.40	142.18	123.47	118.80	142.56	123.74	118.10	132.99	1.42	11.07	0.00	52
30	118.80	142.56	123.74	120.19	142.93	124.04	119.50	133.32	1.43	12.02	0.00	52
31	120.19	142.93	124.04	121.59	143.30	124.36	120.89	133.66	1.43	12.98	0.00	52
32	121.59	143.30	124.36	121.65	143.30	124.37	121.62	133.83	0.06	13.48	0.00	52
33	121.65	143.30	124.37	123.34	143.30	124.80	122.49	133.94	1.74	14.08	0.00	52
34	123.34	143.30	124.80	124.72	143.30	125.17	124.03	134.14	1.43	15.13	0.00	52
35	124.72	143.30	125.17	125.91	143.30	125.51	125.31	134.32	1.23	16.02	0.00	52
36	125.91	143.30	125.51	127.09	143.30	125.87	126.50	134.50	1.24	16.84	0.00	52
37	127.09	143.30	125.87	127.90	143.11	126.13	127.49	134.60	0.85	17.54	0.00	52
38	127.90	143.11	126.13	129.76	142.67	126.75	128.82	134.66	1.96	18.47	0.00	52
39	129.76	142.67	126.75	131.62	142.24	127.42	130.68	134.77	1.98	19.79	0.00	52
40	131.62	142.24	127.42	133.48	141.80	128.14	132.54	134.90	1.99	21.11	0.00	52
41	133.48	141.80	128.14	134.39	141.58	128.50	133.93	135.01	0.98	22.10	0.00	54
42	134.39	141.58	128.50	134.44	141.57	128.53	134.41	135.05	0.05	22.45	0.00	54
43	134.44	141.57	128.53	135.43	141.34	128.94	134.93	135.09	1.07	22.82	0.00	54
44	135.43	141.34	128.94	136.55	141.08	129.43	135.98	135.20	1.22	23.58	0.00	54
45	136.55	141.08	129.43	137.66	140.82	129.93	137.10	135.31	1.22	24.40	0.00	54
46	137.66	140.82	129.93	139.40	140.41	130.76	138.51	135.48	1.93	25.45	0.00	54
47	139.40	140.41	130.76	141.14	140.00	131.64	140.25	135.70	1.95	26.74	0.00	54
48	141.14	140.00	131.64	142.58	139.66	132.41	141.85	135.92	1.64	27.93	0.00	54
49	142.58	139.66	132.41	144.03	139.32	133.21	143.29	136.14	1.65	29.03	0.00	54
50	144.03	139.32	133.21	145.79	138.90	134.23	144.87	136.41	2.03	30.26	0.00	54
51	145.79	138.90	134.23	147.55	138.49	135.31	146.61	136.72	2.06	31.62	0.00	54
52	147.55	138.49	135.31	149.30	138.07	136.46	148.33	137.06	2.10	33.01	0.00	54
53	149.30	138.07	136.46	151.06	137.66	137.66	149.89	137.40	2.13	34.41	0.00	54

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

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	813	0	-7754	-21272	0	0	-23149	0	0	
2	2420	0	-34519	-94325	0	-23149	-125129	0	0	
3	6332	0	21833	33537	0	-125129	-90161	0	0	
4	9692	0	25635	33283	0	-90161	-56531	0	0	
5	12931	0	29241	33049	0	-56531	-24369	0	0	
6	16052	0	32661	32833	0	-24369	6210	0	0	
7	16958	0	32063	29280	0	6210	32203	0	0	
8	19301	0	34442	28690	0	32203	56311	0	0	
9	21642	0	36765	27851	0	56311	78180	0	0	
10	32813	0	53456	37379	0	78180	105180	0	0	
11	36818	0	57681	37184	0	105180	129171	0	0	
12	40620	0	61639	37012	0	129171	150043	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	44295	0	65440	36863	0	150043	167669	0	0	
14	47809	0	69043	36736	0	167669	181953	0	0	
15	51106	0	72380	36630	0	181953	192840	0	0	
16	54197	0	75472	36545	0	192840	200289	0	0	
17	57134	0	78393	36480	0	200289	204246	0	0	
18	59889	0	81109	36435	0	204246	204688	0	0	
19	62380	0	83515	36410	0	204688	201655	0	0	
20	64637	0	85655	36405	0	201655	195190	0	0	
21	66685	0	87564	36419	0	195190	185339	0	0	
22	68488	0	89195	36453	0	185339	172187	0	0	
23	70077	0	90590	36507	0	172187	155817	0	0	
24	71433	0	91724	36581	0	155817	136343	0	0	
25	72530	0	92562	36675	0	136343	113918	0	0	
26	73349	0	93075	36791	0	113918	88732	0	0	
27	55418	0	69987	27731	0	88732	68176	0	0	
28	33291	0	41941	16494	0	68176	55059	0	0	
29	52430	0	65876	25951	0	55059	33466	0	0	
30	52642	0	65937	26039	0	33466	10651	0	0	
31	52825	0	65975	26135	0	10651	-13363	0	0	
32	2273	120	2999	1125	0	-13363	-14538	0	0	
33	63231	3380	83240	31770	0	-14538	-47680	0	0	
34	50452	2760	66161	26067	0	-47680	-74708	0	0	
35	42414	2370	55427	22481	0	-74708	-97786	0	0	
36	41530	2370	54083	22576	0	-97786	-120657	0	0	
37	27693	0	33678	15490	0	-120657	-134210	0	0	
38	60579	0	72880	35759	0	-134210	-163143	0	0	
39	56240	0	66414	36044	0	-163143	-188616	0	0	
40	51680	0	59540	36355	0	-188616	-210058	0	0	
41	23603	0	26267	18635	0	-210058	-218164	0	0	
42	1266	0	1395	1027	0	-218164	-218579	0	0	
43	24401	0	26580	20390	0	-218579	-226108	0	0	
44	25954	0	27529	23096	0	-226108	-232987	0	0	
45	24316	0	24920	23242	0	-232987	-238072	0	0	
46	34568	0	33437	36581	0	-238072	-242092	0	0	
47	30317	0	26453	36987	0	-242092	-240857	0	0	
48	21831	0	16355	31048	0	-240857	-235414	0	0	
49	18686	0	10973	31372	0	-235414	-225569	0	0	
50	18337	0	5662	38628	0	-225569	-207089	0	0	
51	13343	0	-3314	39183	0	-207089	-180742	0	0	
52	8152	0	-12935	39787	0	-180742	-145680	0	0	
53	2753	0	-23277	40445	0	-145680	-100964	0	0	

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

### 32.2.2 ANALISI DELLA SUPERFICIE 109 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	47	
Coordinate del centro	X[m]= 91.58	Y[m]= 184.00
Raggio del cerchio	R[m]= 62.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 64.70	Y <sub>v</sub> [m]= 128.13
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 136.36	Y <sub>m</sub> [m]= 141.12
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.322</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	64.70	128.13	128.13	66.48	128.60	127.31	65.88	128.01	1.96	-24.79	38.66	0
2	66.48	128.60	127.31	68.25	129.08	126.56	67.46	127.88	1.93	-22.99	8.15	43
3	68.25	129.08	126.56	70.03	129.55	125.87	69.20	127.76	1.91	-21.22	0.00	54
4	70.03	129.55	125.87	71.54	129.95	125.33	70.81	127.67	1.60	-19.60	0.00	54
5	71.54	129.95	125.33	73.28	130.42	124.76	72.44	127.61	1.83	-18.01	0.00	54
6	73.28	130.42	124.76	75.02	130.88	124.25	74.17	127.58	1.81	-16.33	0.00	52
7	75.02	130.88	124.25	76.76	131.35	123.80	75.91	127.57	1.80	-14.66	0.00	52
8	76.76	131.35	123.80	78.50	131.81	123.40	77.64	127.59	1.78	-13.01	0.00	52
9	78.50	131.81	123.40	80.23	132.27	123.05	79.38	127.63	1.77	-11.36	0.00	52
10	80.23	132.27	123.05	81.97	132.74	122.75	81.11	127.70	1.76	-9.73	0.00	52
11	81.97	132.74	122.75	83.71	133.20	122.50	82.85	127.80	1.76	-8.10	0.00	52
12	83.71	133.20	122.50	85.45	133.66	122.30	84.59	127.92	1.75	-6.48	0.00	52
13	85.45	133.66	122.30	87.19	134.13	122.16	86.33	128.06	1.75	-4.87	0.00	52
14	87.19	134.13	122.16	88.93	134.59	122.06	88.07	128.23	1.74	-3.26	0.00	52
15	88.93	134.59	122.06	90.67	135.05	122.01	89.80	128.43	1.74	-1.65	0.00	52
16	90.67	135.05	122.01	92.41	135.52	122.01	91.54	128.65	1.74	-0.04	0.00	52
17	92.41	135.52	122.01	94.14	135.98	122.05	93.28	128.89	1.74	1.57	0.00	52
18	94.14	135.98	122.05	95.88	136.45	122.15	95.02	129.16	1.74	3.18	0.00	52
19	95.88	136.45	122.15	97.62	136.91	122.30	96.76	129.45	1.74	4.79	0.00	52
20	97.62	136.91	122.30	99.36	137.37	122.49	98.49	129.77	1.75	6.40	0.00	52
21	99.36	137.37	122.49	101.10	137.84	122.74	100.23	130.11	1.76	8.02	0.00	52
22	101.10	137.84	122.74	102.84	138.30	123.03	101.97	130.48	1.76	9.65	0.00	52
23	102.84	138.30	123.03	104.58	138.76	123.38	103.71	130.87	1.77	11.28	0.00	52
24	104.58	138.76	123.38	106.32	139.23	123.78	105.45	131.29	1.78	12.93	0.00	52
25	106.32	139.23	123.78	108.05	139.69	124.23	107.19	131.73	1.80	14.58	0.00	52
26	108.05	139.69	124.23	109.79	140.15	124.74	108.92	132.20	1.81	16.25	0.00	52
27	109.79	140.15	124.74	111.53	140.62	125.30	110.66	132.70	1.83	17.93	0.00	52
28	111.53	140.62	125.30	113.27	141.08	125.92	112.40	133.23	1.85	19.63	0.00	52
29	113.27	141.08	125.92	115.01	141.55	126.60	114.14	133.79	1.87	21.34	0.00	52
30	115.01	141.55	126.60	116.51	141.95	127.23	115.76	134.33	1.63	22.96	0.00	52
31	116.51	141.95	127.23	117.40	142.18	127.63	116.95	134.75	0.98	24.16	0.00	52
32	117.40	142.18	127.63	118.80	142.56	128.29	118.10	135.16	1.55	25.32	0.00	52
33	118.80	142.56	128.29	120.19	142.93	129.00	119.49	135.69	1.56	26.76	0.00	52
34	120.19	142.93	129.00	121.59	143.30	129.75	120.89	136.24	1.59	28.22	0.00	52
35	121.59	143.30	129.75	121.65	143.30	129.78	121.62	136.53	0.07	28.98	0.00	54
36	121.65	143.30	129.78	122.84	143.30	130.46	122.24	136.71	1.37	29.65	0.00	54
37	122.84	143.30	130.46	123.34	143.30	130.75	123.09	136.95	0.58	30.55	0.00	54
38	123.34	143.30	130.75	124.72	143.30	131.60	124.02	137.24	1.62	31.56	0.00	54
39	124.72	143.30	131.60	125.91	143.30	132.37	125.31	137.64	1.41	32.96	0.00	54
40	125.91	143.30	132.37	127.09	143.30	133.18	126.49	138.03	1.43	34.28	0.00	54
41	127.09	143.30	133.18	127.90	143.11	133.75	127.49	138.33	0.99	35.40	0.00	54
42	127.90	143.11	133.75	129.41	142.76	134.88	128.63	138.62	1.88	36.73	0.00	54
43	129.41	142.76	134.88	130.91	142.40	136.07	130.13	139.02	1.92	38.49	0.00	54
44	130.91	142.40	136.07	132.42	142.05	137.35	131.63	139.46	1.97	40.29	0.00	54
45	132.42	142.05	137.35	133.92	141.69	138.71	133.11	139.93	2.03	42.14	0.00	54
46	133.92	141.69	138.71	135.43	141.34	140.17	134.57	140.44	2.10	44.04	0.00	54
47	135.43	141.34	140.17	136.36	141.12	141.12	135.74	140.88	1.33	45.63	0.00	54

Tabella 32-4 – Geometria e caratteristiche strisce della superficie 109 della verifica di stabilità 28.



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	2173	0	-21582	-53615	0	0	-59150	0	0	
2	6440	0	25150	37374	0	-59150	-19147	0	0	
3	10389	0	27524	32767	0	-19147	14543	0	0	
4	11832	0	26491	27552	0	14543	41620	0	0	
5	16940	0	33877	31430	0	41620	70869	0	0	
6	20384	0	37022	30073	0	70869	96762	0	0	
7	23754	0	40375	29676	0	96762	120103	0	0	
8	26912	0	43490	29465	0	120103	140941	0	0	
9	29864	0	46341	29283	0	140941	159183	0	0	
10	32634	0	48969	29128	0	159183	174752	0	0	
11	35259	0	51430	28999	0	174752	187571	0	0	
12	37707	0	53685	28894	0	187571	197596	0	0	
13	39980	0	55744	28813	0	197596	204799	0	0	
14	42135	0	57686	28756	0	204799	209134	0	0	
15	44135	0	59467	28721	0	209134	210590	0	0	
16	45946	0	61042	28709	0	210590	209190	0	0	
17	47569	0	62416	28720	0	209190	204976	0	0	
18	49025	0	63617	28753	0	204976	197989	0	0	
19	50338	0	64677	28810	0	197989	188268	0	0	
20	51458	0	65530	28889	0	188268	175902	0	0	
21	52340	0	66116	28993	0	175902	161038	0	0	
22	53021	0	66478	29121	0	161038	143812	0	0	
23	53509	0	66626	29275	0	143812	124372	0	0	
24	53768	0	66507	29456	0	124372	102920	0	0	
25	53826	0	66150	29664	0	102920	79655	0	0	
26	53660	0	65517	29903	0	79655	54820	0	0	
27	53271	0	64598	30174	0	54820	28685	0	0	
28	52627	0	63337	30480	0	28685	1585	0	0	
29	51708	0	61687	30823	0	1585	-26088	0	0	
30	43603	0	51498	26897	0	-26088	-50022	0	0	
31	25697	0	30181	16105	0	-50022	-64543	0	0	
32	39592	0	46101	25512	0	-64543	-87184	0	0	
33	38634	0	44441	25827	0	-87184	-109488	0	0	
34	37589	0	42563	26263	0	-109488	-131138	0	0	
35	1591	120	1945	1179	0	-131138	-132172	0	0	
36	30727	2380	37198	23536	0	-132172	-151842	0	0	
37	12436	1000	14831	9980	0	-151842	-159602	0	0	
38	32793	2760	38314	27840	0	-159602	-179266	0	0	
39	26299	2370	29638	24278	0	-179266	-193837	0	0	
40	24500	2370	26386	24651	0	-193837	-205962	0	0	
41	15511	0	13134	17081	0	-205962	-209826	0	0	
42	25500	0	18156	32299	0	-209826	-211531	0	0	
43	20995	0	9330	33072	0	-211531	-205228	0	0	
44	16269	0	-441	33936	0	-205228	-189731	0	0	
45	11312	0	-11326	34910	0	-189731	-163668	0	0	
46	6093	0	-23575	36014	0	-163668	-125390	0	0	
47	1056	0	-21394	22893	0	-125390	-94780	0	0	

Tabella 32-5 – Forze applicate sulle strisce [BISHOP] della superficie 109 della verifica di stabilità 28.

### 32.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u
	[m]
1	0.044738
2	0.036706
3	0.026285
4	0.010191
5	0.022493
6	0.027279
7	0.035508

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

Accelerazione sismica critica  $K_c = 0.132$   
Spostamento massimo  $U_{max} = 0.044738$  [m]  
Velocità massima  $V_{max} = 0.160905$  [m/s]

n°	u
	[m]
1	0.073374
2	0.093046
3	0.049281
4	0.023326
5	0.035792
6	0.044761
7	0.061579

Tabella 32-7 – Spostamenti della superficie 109 della verifica di stabilità 28.

Accelerazione sismica critica  $K_c = 0.098$   
Spostamento massimo  $U_{max} = 0.093046$  [m]  
Velocità massima  $V_{max} = 0.227016$  [m/s]

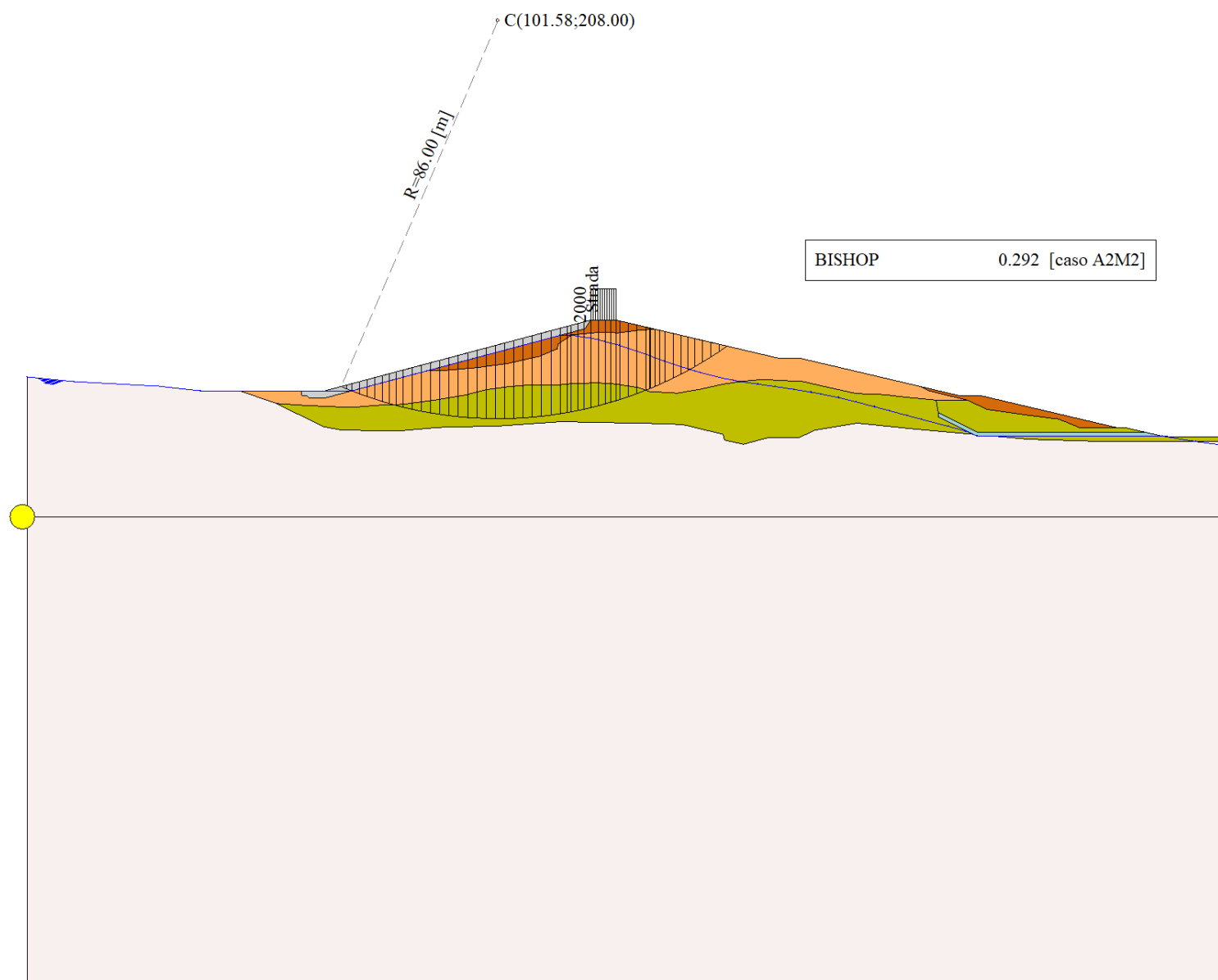


Figura 32-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 28.

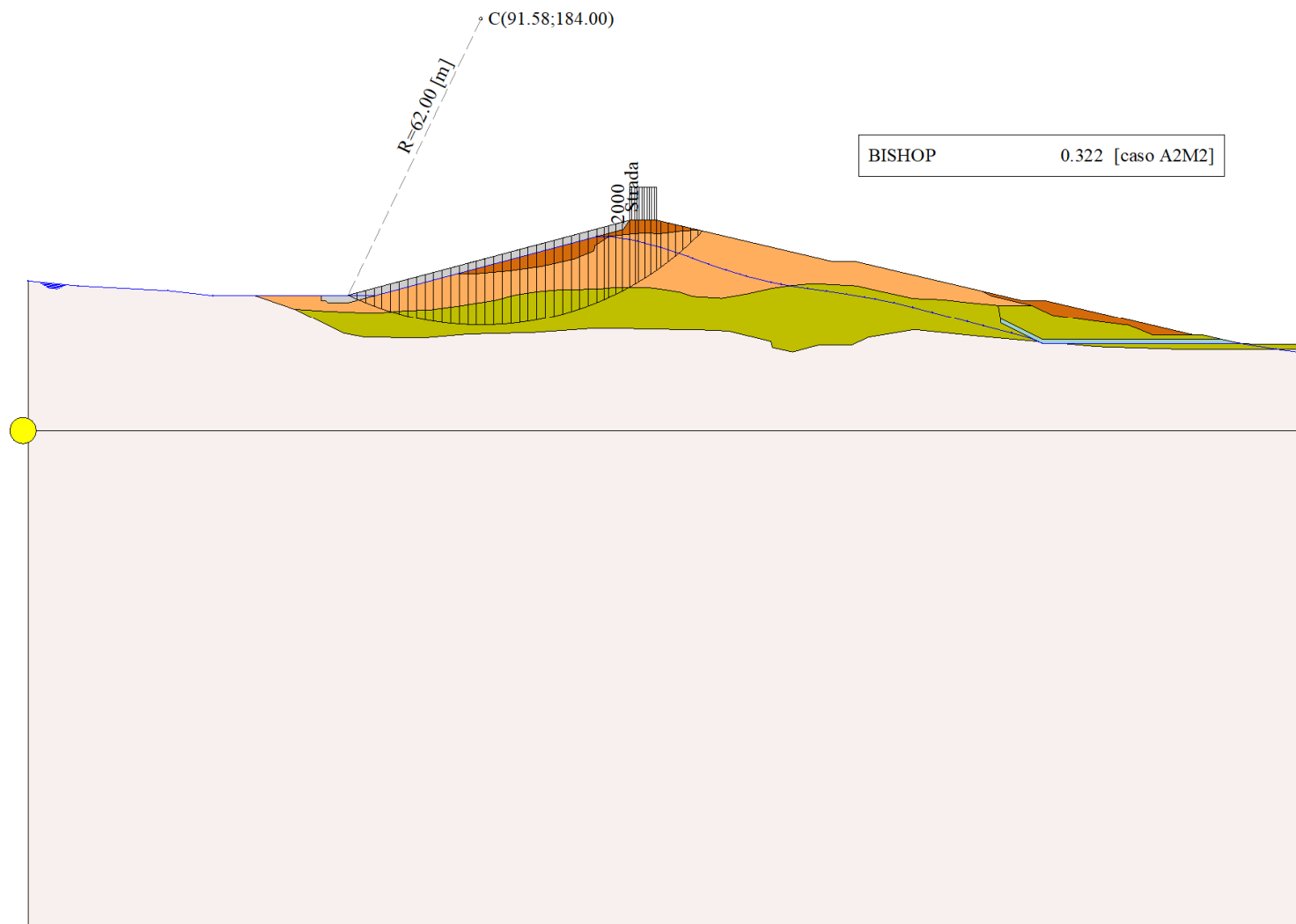


Figura 32-2 – Superficie critica (109) della sezione CR\_08 per la verifica di stabilità 28.

### 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	121.59	127.09	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	83356
Coefficiente di sicurezza minimo	0.305
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	50
Coordinate del centro	X[m]= 99.58                      Y[m]= 198.00
Raggio del cerchio	R[m]= 76.00
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 67.81                      Y <sub>v</sub> [m]= 128.96
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 147.01                      Y <sub>m</sub> [m]= 138.61
Coefficiente di sicurezza	F <sub>s</sub> = <b>0.305</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	67.81	128.96	128.96	68.92	129.26	128.46	68.55	128.89	1.22	-24.25	38.66	0
2	68.92	129.26	128.46	70.03	129.55	127.98	69.54	128.81	1.21	-23.34	37.76	1
3	70.03	129.55	127.98	71.68	129.99	127.31	70.93	128.70	1.78	-22.21	0.00	54
4	71.68	129.99	127.31	73.33	130.43	126.68	72.55	128.60	1.77	-20.87	0.00	54
5	73.33	130.43	126.68	74.98	130.87	126.09	74.19	128.52	1.75	-19.55	0.00	54
6	74.98	130.87	126.09	76.63	131.31	125.55	75.83	128.45	1.74	-18.23	0.00	54
7	76.63	131.31	125.55	78.11	131.71	125.10	77.39	128.42	1.55	-16.99	0.00	54
8	78.11	131.71	125.10	79.59	132.10	124.68	78.86	128.39	1.54	-15.83	0.00	53
9	79.59	132.10	124.68	81.07	132.50	124.29	80.34	128.39	1.53	-14.67	0.00	52
10	81.07	132.50	124.29	82.96	133.00	123.84	82.03	128.41	1.94	-13.37	0.00	52
11	82.96	133.00	123.84	84.84	133.50	123.44	83.91	128.45	1.93	-11.91	0.00	52
12	84.84	133.50	123.44	86.73	134.00	123.09	85.80	128.51	1.92	-10.46	0.00	52
13	86.73	134.00	123.09	88.61	134.51	122.80	87.68	128.60	1.91	-9.02	0.00	52
14	88.61	134.51	122.80	90.50	135.01	122.54	89.56	128.71	1.90	-7.58	0.00	52
15	90.50	135.01	122.54	92.38	135.51	122.34	91.45	128.85	1.90	-6.15	0.00	52
16	92.38	135.51	122.34	94.27	136.02	122.19	93.33	129.01	1.89	-4.72	0.00	52
17	94.27	136.02	122.19	96.15	136.52	122.08	95.22	129.20	1.89	-3.30	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	96.15	136.52	122.08	98.04	137.02	122.02	97.10	129.41	1.89	-1.87	0.00	52
19	98.04	137.02	122.02	99.93	137.52	122.00	98.99	129.64	1.89	-0.45	0.00	52
20	99.93	137.52	122.00	101.81	138.03	122.03	100.87	129.90	1.89	0.97	0.00	52
21	101.81	138.03	122.03	103.70	138.53	122.11	102.76	130.18	1.89	2.39	0.00	52
22	103.70	138.53	122.11	105.58	139.03	122.24	104.64	130.48	1.89	3.82	0.00	52
23	105.58	139.03	122.24	107.47	139.53	122.41	106.53	130.80	1.89	5.24	0.00	52
24	107.47	139.53	122.41	109.35	140.04	122.63	108.41	131.15	1.90	6.67	0.00	52
25	109.35	140.04	122.63	111.24	140.54	122.90	110.30	131.53	1.90	8.11	0.00	52
26	111.24	140.54	122.90	113.12	141.04	123.22	112.18	131.93	1.91	9.55	0.00	52
27	113.12	141.04	123.22	115.01	141.55	123.58	114.07	132.35	1.92	10.99	0.00	52
28	115.01	141.55	123.58	116.51	141.95	123.91	115.76	132.75	1.54	12.29	0.00	52
29	116.51	141.95	123.91	117.40	142.18	124.12	116.96	133.04	0.91	13.22	0.00	52
30	117.40	142.18	124.12	118.80	142.56	124.47	118.10	133.33	1.44	14.10	0.00	52
31	118.80	142.56	124.47	120.19	142.93	124.85	119.49	133.70	1.45	15.19	0.00	52
32	120.19	142.93	124.85	121.59	143.30	125.26	120.89	134.08	1.46	16.29	0.00	52
33	121.59	143.30	125.26	121.65	143.30	125.28	121.62	134.28	0.06	16.86	0.00	52
34	121.65	143.30	125.28	123.34	143.30	125.81	122.49	134.42	1.77	17.55	0.00	52
35	123.34	143.30	125.81	124.72	143.30	126.28	124.03	134.67	1.46	18.77	0.00	52
36	124.72	143.30	126.28	125.91	143.30	126.70	125.31	134.90	1.26	19.79	0.00	52
37	125.91	143.30	126.70	127.09	143.30	127.15	126.49	135.11	1.27	20.74	0.00	52
38	127.09	143.30	127.15	127.90	143.11	127.47	127.49	135.26	0.87	21.55	0.00	52
39	127.90	143.11	127.47	129.84	142.65	128.29	128.86	135.38	2.11	22.67	0.00	52
40	129.84	142.65	128.29	131.79	142.20	129.16	130.80	135.57	2.13	24.27	0.00	53
41	131.79	142.20	129.16	133.48	141.80	129.98	132.62	135.78	1.88	25.78	0.00	54
42	133.48	141.80	129.98	134.44	141.57	130.47	133.96	135.95	1.08	26.90	0.00	54
43	134.44	141.57	130.47	135.43	141.34	130.99	134.93	136.09	1.12	27.72	0.00	54
44	135.43	141.34	130.99	136.55	141.08	131.60	135.98	136.25	1.27	28.62	0.00	54
45	136.55	141.08	131.60	137.66	140.82	132.23	137.09	136.43	1.28	29.59	0.00	54
46	137.66	140.82	132.23	139.40	140.41	133.27	138.50	136.67	2.03	30.83	0.00	54
47	139.40	140.41	133.27	141.14	140.00	134.37	140.24	137.00	2.06	32.37	0.00	54
48	141.14	140.00	134.37	143.10	139.54	135.69	142.06	137.38	2.36	34.04	0.00	54
49	143.10	139.54	135.69	145.05	139.07	137.10	143.97	137.83	2.41	35.84	0.00	54
50	145.05	139.07	137.10	147.01	138.61	138.61	145.70	138.26	2.47	37.68	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	796	0	-6301	-16527	0	0	-18152	0	0	
2	2367	0	-37716	-95257	0	-18152	-122030	0	0	
3	6452	0	22343	32347	0	-122030	-87651	0	0	
4	9938	0	26165	32051	0	-87651	-54564	0	0	
5	13284	0	29763	31779	0	-54564	-22924	0	0	
6	16493	0	33152	31530	0	-22924	7134	0	0	
7	17416	0	32460	28088	0	7134	32647	0	0	
8	19831	0	34701	27072	0	32647	55821	0	0	
9	22229	0	37110	26672	0	55821	77193	0	0	
10	31667	0	50702	33787	0	77193	102084	0	0	
11	35267	0	54340	33595	0	102084	124228	0	0	
12	38670	0	57727	33427	0	124228	143521	0	0	
13	41937	0	60953	33283	0	143521	159856	0	0	
14	45060	0	64011	33162	0	159856	173138	0	0	
15	47985	0	66837	33062	0	173138	183315	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	50706	0	69430	32984	0	183315	190354	0	0	
17	53259	0	71838	32926	0	190354	194221	0	0	
18	55663	0	74092	32890	0	194221	194884	0	0	
19	57854	0	76111	32873	0	194884	192360	0	0	
20	59793	0	77847	32877	0	192360	186713	0	0	
21	61538	0	79376	32901	0	186713	177984	0	0	
22	63068	0	80673	32945	0	177984	166248	0	0	
23	64380	0	81732	33010	0	166248	151597	0	0	
24	65482	0	82565	33096	0	151597	134136	0	0	
25	66365	0	83158	33204	0	134136	113993	0	0	
26	67001	0	83471	33333	0	113993	91339	0	0	
27	67373	0	83478	33486	0	91339	66381	0	0	
28	53628	0	66128	26764	0	66381	45088	0	0	
29	32113	0	39505	15938	0	45088	31593	0	0	
30	50398	0	61821	25106	0	31593	9523	0	0	
31	50375	0	61586	25231	0	9523	-13607	0	0	
32	50311	0	61308	25367	0	-13607	-37752	0	0	
33	2159	120	2791	1093	0	-37752	-38933	0	0	
34	59824	3380	77138	30901	0	-38933	-72052	0	0	
35	47370	2760	60780	25409	0	-72052	-98736	0	0	
36	39540	2370	50496	21956	0	-98736	-121249	0	0	
37	38436	2370	48841	22091	0	-121249	-143277	0	0	
38	25447	0	29874	15182	0	-143277	-155960	0	0	
39	57386	0	66187	36748	0	-155960	-183267	0	0	
40	51975	0	57714	37779	0	-183267	-204887	0	0	
41	40815	0	42972	34065	0	-204887	-218298	0	0	
42	21352	0	21479	19537	0	-218298	-223874	0	0	
43	20582	0	19816	20299	0	-223874	-227929	0	0	
44	21409	0	19394	23055	0	-227929	-230302	0	0	
45	19502	0	16190	23272	0	-230302	-230191	0	0	
46	26486	0	18487	36779	0	-230191	-224564	0	0	
47	21499	0	9667	37393	0	-224564	-211534	0	0	
48	17928	0	-573	42838	0	-211534	-186870	0	0	
49	11009	0	-13822	43788	0	-186870	-150128	0	0	
50	3731	0	-28460	44852	0	-150128	-99556	0	0	

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

### 33.2.2 ANALISI DELLA SUPERFICIE 117 - COEFFICIENTI PARZIALI CASO A2M2 E SISMA VERSO IL BASSO

Numero di strisce	46	
Coordinate del centro	X[m]= 91.58	Y[m]= 182.00
Raggio del cerchio	R[m]= 60.00	
Intersezione a valle con il profilo topografico	X <sub>v</sub> [m]= 65.00	Y <sub>v</sub> [m]= 128.21
Intersezione a monte con il profilo topografico	X <sub>m</sub> [m]= 135.65	Y <sub>m</sub> [m]= 141.29
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]	α <sub>1</sub> [°]	α <sub>2</sub> [°]	c [kPa]
1	65.00	128.21	128.21	66.67	128.66	127.41	66.12	128.09	1.86	-25.41	38.66	0
2	66.67	128.66	127.41	68.35	129.10	126.68	67.60	127.96	1.83	-23.65	10.12	40
3	68.35	129.10	126.68	70.03	129.55	126.00	69.24	127.83	1.81	-21.91	0.00	54
4	70.03	129.55	126.00	71.76	130.01	125.37	70.93	127.73	1.84	-20.17	0.00	54

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]
5	71.76	130.01	125.37	73.49	130.47	124.79	72.65	127.66	1.82	-18.42	0.00	54
6	73.49	130.47	124.79	75.22	130.94	124.27	74.38	127.62	1.81	-16.69	0.00	52
7	75.22	130.94	124.27	76.95	131.40	123.81	76.10	127.60	1.79	-14.97	0.00	52
8	76.95	131.40	123.81	78.68	131.86	123.40	77.83	127.62	1.78	-13.26	0.00	52
9	78.68	131.86	123.40	80.41	132.32	123.05	79.56	127.66	1.77	-11.57	0.00	52
10	80.41	132.32	123.05	82.14	132.78	122.75	81.29	127.72	1.76	-9.89	0.00	52
11	82.14	132.78	122.75	83.87	133.24	122.50	83.01	127.82	1.75	-8.22	0.00	52
12	83.87	133.24	122.50	85.60	133.70	122.30	84.74	127.94	1.74	-6.55	0.00	52
13	85.60	133.70	122.30	87.33	134.16	122.15	86.47	128.08	1.74	-4.89	0.00	52
14	87.33	134.16	122.15	89.06	134.63	122.05	88.20	128.25	1.73	-3.23	0.00	52
15	89.06	134.63	122.05	90.79	135.09	122.01	89.93	128.44	1.73	-1.58	0.00	52
16	90.79	135.09	122.01	92.52	135.55	122.01	91.66	128.66	1.73	0.07	0.00	52
17	92.52	135.55	122.01	94.25	136.01	122.06	93.39	128.91	1.73	1.72	0.00	52
18	94.25	136.01	122.06	95.98	136.47	122.16	95.12	129.18	1.73	3.38	0.00	52
19	95.98	136.47	122.16	97.71	136.93	122.31	96.85	129.47	1.74	5.03	0.00	52
20	97.71	136.93	122.31	99.44	137.39	122.52	98.58	129.79	1.74	6.70	0.00	52
21	99.44	137.39	122.52	101.17	137.86	122.77	100.31	130.13	1.75	8.36	0.00	52
22	101.17	137.86	122.77	102.90	138.32	123.08	102.04	130.51	1.76	10.04	0.00	52
23	102.90	138.32	123.08	104.63	138.78	123.44	103.77	130.90	1.77	11.72	0.00	52
24	104.63	138.78	123.44	106.36	139.24	123.85	105.50	131.33	1.78	13.41	0.00	52
25	106.36	139.24	123.85	108.09	139.70	124.32	107.22	131.78	1.79	15.12	0.00	52
26	108.09	139.70	124.32	109.82	140.16	124.84	108.95	132.25	1.81	16.83	0.00	52
27	109.82	140.16	124.84	111.55	140.62	125.42	110.68	132.76	1.83	18.57	0.00	52
28	111.55	140.62	125.42	113.28	141.08	126.06	112.41	133.30	1.84	20.32	0.00	52
29	113.28	141.08	126.06	115.01	141.55	126.76	114.14	133.86	1.87	22.09	0.00	52
30	115.01	141.55	126.76	116.51	141.95	127.42	115.76	134.42	1.64	23.77	0.00	52
31	116.51	141.95	127.42	117.40	142.18	127.84	116.95	134.85	0.98	25.02	0.00	52
32	117.40	142.18	127.84	118.80	142.56	128.53	118.10	135.28	1.56	26.23	0.00	52
33	118.80	142.56	128.53	120.19	142.93	129.26	119.49	135.82	1.58	27.73	0.00	52
34	120.19	142.93	129.26	121.59	143.30	130.04	120.89	136.38	1.60	29.25	0.00	53
35	121.59	143.30	130.04	121.65	143.30	130.08	121.62	136.68	0.07	30.04	0.00	54
36	121.65	143.30	130.08	123.34	143.30	131.10	122.48	136.94	1.97	31.02	0.00	54
37	123.34	143.30	131.10	124.72	143.30	131.98	124.02	137.42	1.64	32.74	0.00	54
38	124.72	143.30	131.98	125.91	143.30	132.79	125.31	137.84	1.43	34.21	0.00	54
39	125.91	143.30	132.79	127.09	143.30	133.64	126.49	138.25	1.46	35.59	0.00	54
40	127.09	143.30	133.64	127.90	143.11	134.24	127.49	138.57	1.01	36.77	0.00	54
41	127.90	143.11	134.24	129.41	142.76	135.43	128.63	138.88	1.92	38.17	0.00	54
42	129.41	142.76	135.43	130.91	142.40	136.69	130.13	139.31	1.97	40.02	0.00	54
43	130.91	142.40	136.69	132.42	142.05	138.04	131.62	139.78	2.02	41.93	0.00	54
44	132.42	142.05	138.04	133.92	141.69	139.49	133.10	140.29	2.09	43.89	0.00	54
45	133.92	141.69	139.49	135.43	141.34	141.05	134.49	140.82	2.16	45.92	0.00	54
46	135.43	141.34	141.05	135.65	141.29	141.29	135.50	141.22	0.33	47.11	0.00	54

Tabella 33-4 – Geometria e caratteristiche strisce della superficie 117 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	1951	0	-22431	-53177	0	0	-58872	0	0	
2	5827	0	23493	34600	0	-58872	-21379	0	0	
3	9423	0	25247	29660	0	-21379	9698	0	0	
4	13356	0	29759	30232	0	9698	40027	0	0	
5	16930	0	33355	29910	0	40027	68411	0	0	
6	20380	0	36474	28625	0	68411	93624	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	23754	0	39781	28215	0	93624	116377	0	0	
8	26910	0	42850	28005	0	116377	136725	0	0	
9	29860	0	45658	27824	0	136725	154565	0	0	
10	32626	0	48245	27669	0	154565	169812	0	0	
11	35243	0	50663	27541	0	169812	182385	0	0	
12	37676	0	52872	27437	0	182385	192235	0	0	
13	39935	0	54889	27358	0	192235	199328	0	0	
14	42072	0	56790	27301	0	199328	203615	0	0	
15	44047	0	58524	27268	0	203615	205084	0	0	
16	45829	0	60051	27258	0	205084	203755	0	0	
17	47421	0	61379	27270	0	203755	199663	0	0	
18	48845	0	62539	27305	0	199663	192848	0	0	
19	50120	0	63554	27363	0	192848	183347	0	0	
20	51197	0	64361	27445	0	183347	171249	0	0	
21	52032	0	64901	27551	0	171249	156697	0	0	
22	52664	0	65221	27681	0	156697	139824	0	0	
23	53099	0	65324	27838	0	139824	120779	0	0	
24	53302	0	65160	28022	0	120779	99762	0	0	
25	53299	0	64756	28235	0	99762	76973	0	0	
26	53067	0	64073	28478	0	76973	52659	0	0	
27	52607	0	63100	28755	0	52659	27094	0	0	
28	51887	0	61778	29067	0	27094	616	0	0	
29	50885	0	60059	29418	0	616	-26374	0	0	
30	43037	0	50281	25824	0	-26374	-49781	0	0	
31	25322	0	29415	15475	0	-49781	-63953	0	0	
32	38941	0	44827	24533	0	-63953	-85987	0	0	
33	37898	0	43065	24861	0	-85987	-107597	0	0	
34	36782	0	40866	25721	0	-107597	-128004	0	0	
35	1556	120	1881	1137	0	-128004	-129005	0	0	
36	42102	3380	50129	32348	0	-129005	-155411	0	0	
37	31824	2760	36601	26913	0	-155411	-174087	0	0	
38	25379	2370	28013	23505	0	-174087	-187663	0	0	
39	23491	2370	24587	23904	0	-187663	-198624	0	0	
40	14767	0	11774	16587	0	-198624	-201572	0	0	
41	23985	0	15300	31421	0	-201572	-201246	0	0	
42	19294	0	5944	32258	0	-201246	-192368	0	0	
43	14359	0	-4516	33204	0	-192368	-173580	0	0	
44	9166	0	-16303	34279	0	-173580	-143276	0	0	
45	3677	0	-29745	35513	0	-143276	-99491	0	0	
46	63	0	-5680	5389	0	-99491	-91702	0	0	

Tabella 33-5 – Forze applicate sulle strisce [BISHOP] della superficie 117 della verifica di stabilità 29.

### 33.2.3 ANALISI DEGLI SPOSTAMENTI

n°	u [m]
1	0.066197
2	0.033423
3	0.068997
4	0.053910
5	0.077122
6	0.027066

n°	u
	[m]
7	0.041058

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

Accelerazione sismica critica  $K_c = 0.121$   
Spostamento massimo  $U_{max} = 0.077122$  [m]  
Velocità massima  $V_{max} = 0.194583$  [m/s]

n°	u
	[m]
1	0.090331
2	0.053719
3	0.130120
4	0.076681
5	0.105497
6	0.040907
7	0.061634

Tabella 33-7 – Spostamenti della superficie 117 della verifica di stabilità 29.

Accelerazione sismica critica  $K_c = 0.098$   
Spostamento massimo  $U_{max} = 0.130120$  [m]  
Velocità massima  $V_{max} = 0.296280$  [m/s]

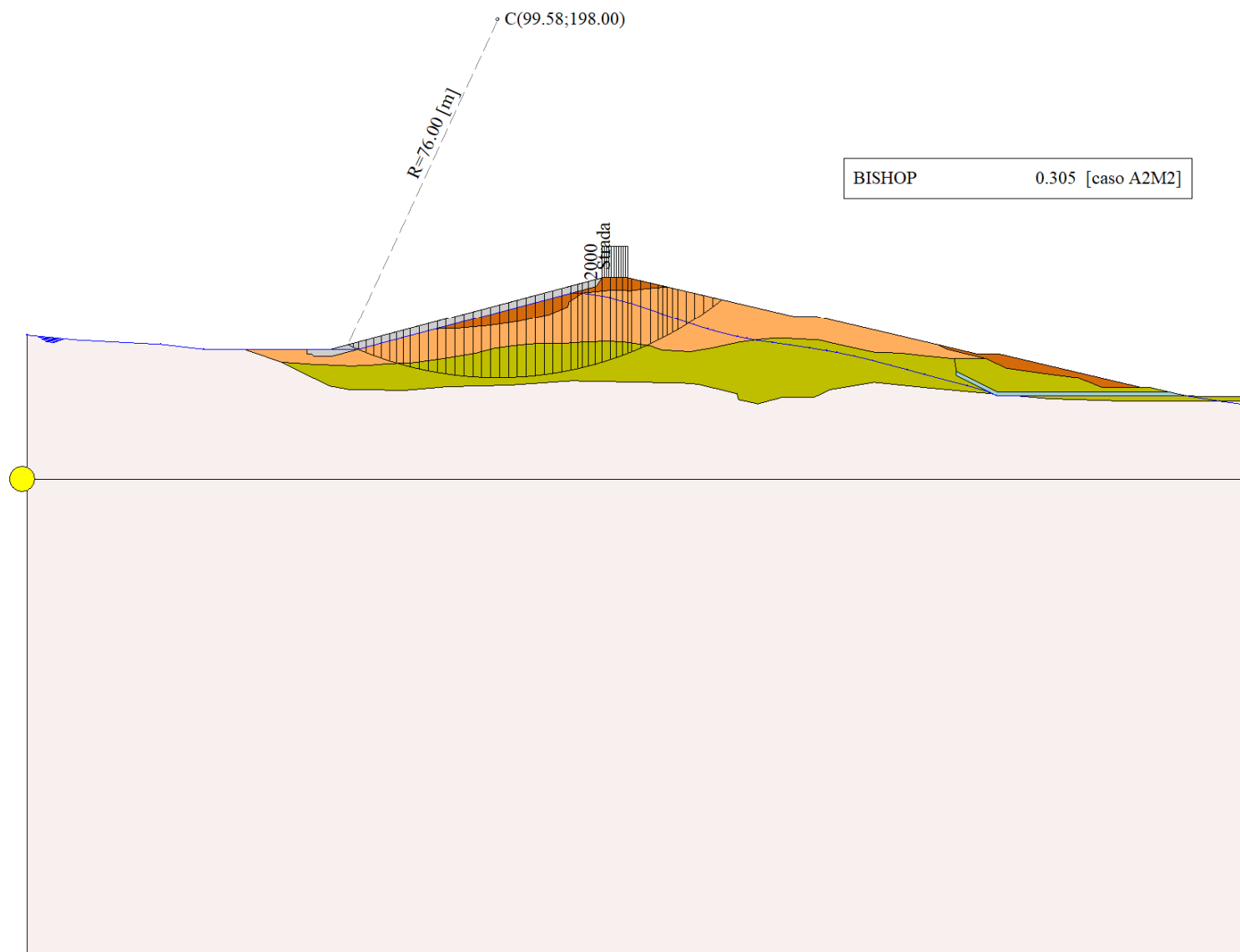


Figura 33-1 – Superficie critica (1) della sezione CR\_08 per la verifica di stabilità 29.

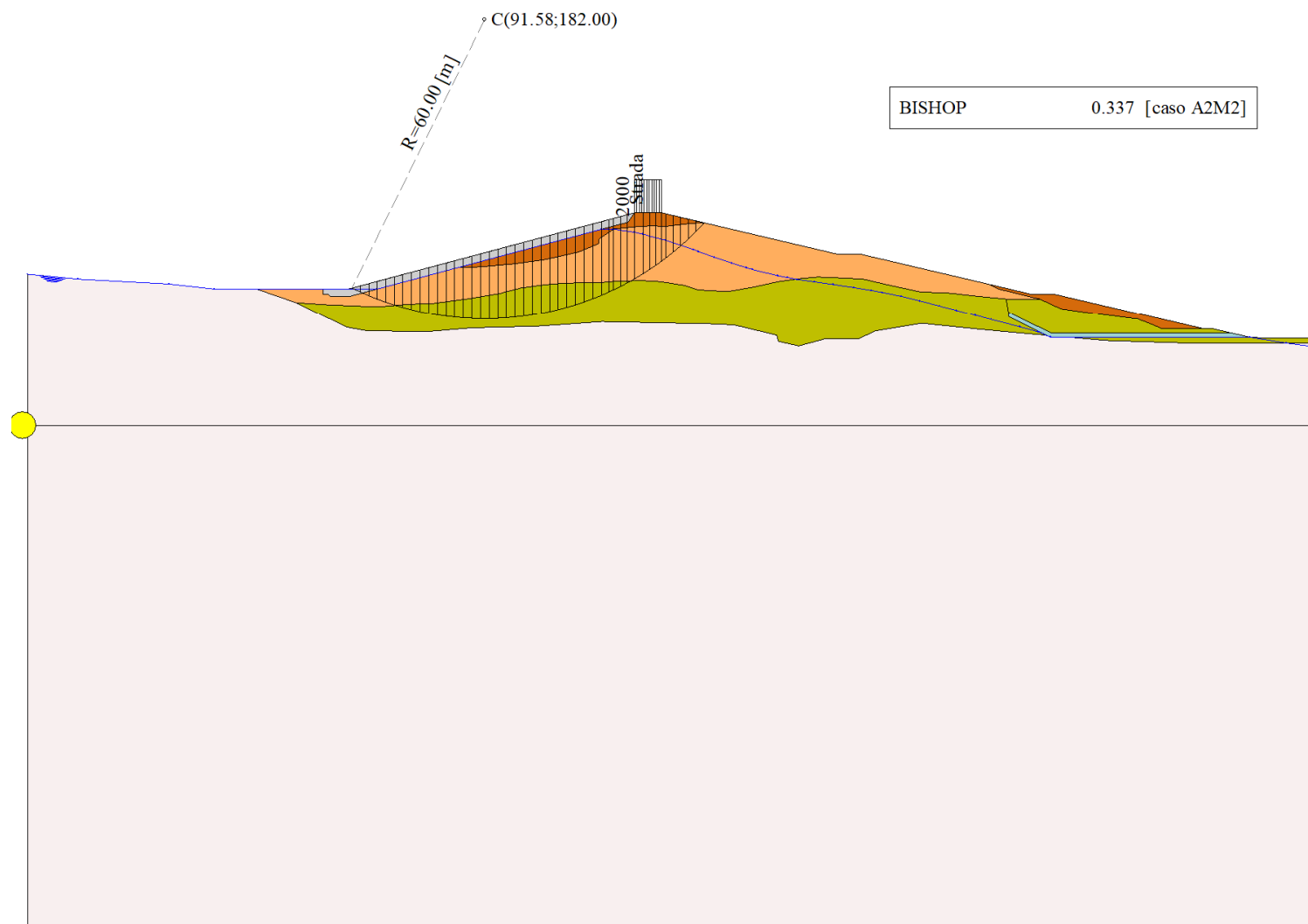


Figura 33-2 – Superficie critica (117) della sezione CR\_08 per la verifica di stabilità 29.

## 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.