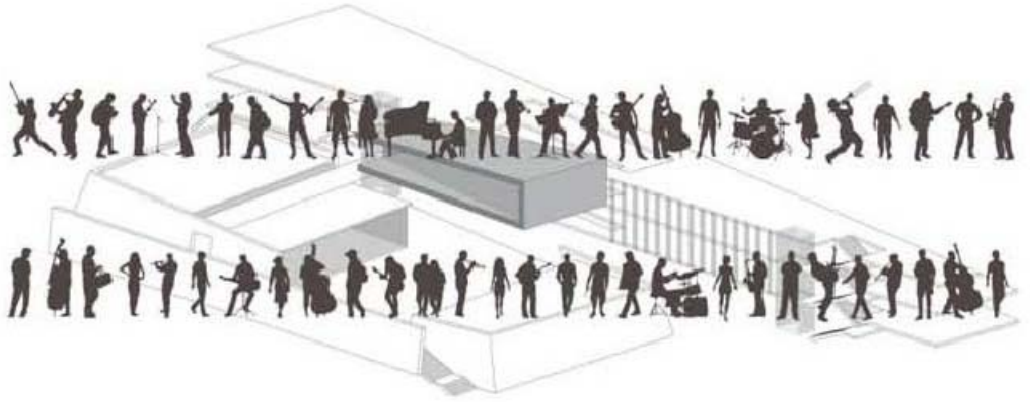


ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΙΟΝΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ
ΔΙΕΥΘΥΝΣΗ ΤΕΧΝΙΚΩΝ ΥΠΗΡΕΣΙΩΝ

ΕΡΓΟ :

ΚΤΙΡΙΟ ΤΜΗΜΑΤΟΣ ΜΟΥΣΙΚΩΝ ΣΠΟΥΔΩΝ ΣΤΟ ΟΙΚΟΠΕΔΟ Ε.Α.Σ.Κ.

ΘΕΣΗ ΕΡΓΟΥ :

9η ΠΑΡΟΔΟΣ Δ. ΘΕΟΤΟΚΗ,
ΠΕΡΙΟΧΗ ΠΑΛΛΑΔΑ - Ο.Τ. 379, ΚΕΡΚΥΡΑ

ΣΤΑΔΙΟ ΜΕΛΕΤΗΣ : **ΟΡΙΣΤΙΚΗ - ΜΕΛΕΤΗ ΕΦΑΡΜΟΓΗΣ ΑΝΤΙΣΤΗΡΙΞΗΣ**

ΠΑΡΑΡΤΗΜΑ - ΤΕΥΧΟΣ ΙΙ Α

ΑΡΧΙΤΕΚΤΟΝΙΚΗ ΜΕΛΕΤΗ	ΣΤΑΤΙΚΗ ΜΕΛΕΤΗ	ΜΕΛΕΤΗ Η/Μ ΕΓΚΑΤΑΣΤΑΣΕΩΝ	ΗΜΕΡΟΜΗΝΙΑ
Δ. ΒΑΣΙΛΟΠΟΥΛΟΣ & ΣΥΝΕΡΓΑΤΕΣ Ε.Ε. ΣΥΝΕΡΓΑΤΕΣ ΑΡΧΙΤΕΚΤΟΝΕΣ : Σ. ΚΟΛΟΒΟΥ	ΑΡΤΕΜΙΣ ΣΥΜΒΟΥΛΟΙ ΜΗΧΑΝΙΚΟΙ Ε.Π.Ε.	Η-Μ ΣΧΕΔΙΑΣΜΟΣ Κ. ΓΕΩΡΓΑΚΟΠΟΥΛΟΣ- Σ. ΤΣΑΝΤΕΣ & ΣΙΑ Ε.Ε.	ΟΚΤΩΒΡΙΟΣ 2018
ΣΥΜΒΟΥΛΟΣ ΑΚΟΥΣΤΙΚΗΣ ΜΕΛΕΤΗΣ: Ι. ΜΑΡΙΝΟΣ	ΓΕΩΤΕΧΝΙΚΗ ΜΕΛΕΤΗ: Ν. ΔΕΡΕΚΑΣ		

ΣΦΡΑΓΙΔΕΣ ΥΠΟΓΡΑΦΕΣ

Κεφ.	Υποκ.	Παρ.	***ΠΕΡΙΕΧΟΜΕΝΑ***
8.			***ΠΑΡΑΡΤΗΜΑ – ΤΕΥΧΟΣ ΙΙ Α***
	8.1		*Οριζοντιογραφία θέσεων γεωτεχνικής έρευνας*
	8.2		*Γενικευμένη τομή σχεδιασμού εδάφους*
	8.3		*Μητρώα γεωτρήσεων*
	8.4		*Συγκεντρωτικός πίνακας εργαστηριακών δοκιμών*
	8.5		*Αποτελέσματα ανάλυσης*
		8.5.1	*Στατικές Συνθήκες*
			i) Αντιστηριζόμενο ύψος 6,35m
			ii) Αντιστηριζόμενο ύψος 7,65m
			iii) Αντιστηριζόμενο ύψος 9,85m
			iv) Αντιστηριζόμενο ύψος 3,50m
		8.5.2	*Σεισμικές Συνθήκες*
			i) Αντιστηριζόμενο ύψος 6,35m
			ii) Αντιστηριζόμενο ύψος 7,65m
			iii) Αντιστηριζόμενο ύψος 9,85m
			iv) Αντιστηριζόμενο ύψος 3,50m

ΠΑΡΑΡΤΗΜΑ

8.1 Οριζοντιογραφία θέσεων γεωτεχνικής έρευνας

ΟΡΙΖΟΝΤΙΟΓΡΑΦΙΑ ΘΕΣΕΩΝ ΓΕΩΤΡΗΣΕΩΝ

ΠΙΝΑΚΑΣ ΓΕΩΤΡΗΣΕΩΝ		
ΑΡΙΘΜΟΣ ΓΕΩΤΡΗΣΗΣ	ΒΑΘΟΣ ΓΕΩΤΡΗΣΗΣ	ΥΨΟΜΕΤΡΟ ΚΕΦΑΛΗΣ ΓΕΩΤΡΗΣΗΣ
Γ-1	15.00 m	6.02
Γ-2	15.00 m	6.22
Γ-3	12.00 m	6.08
Γ-4	15.00 m	6.38
Γ-5	15.00 m	6.41
Γ-6	15.50 m	6.38
Γ-7	10.13 m	6.23

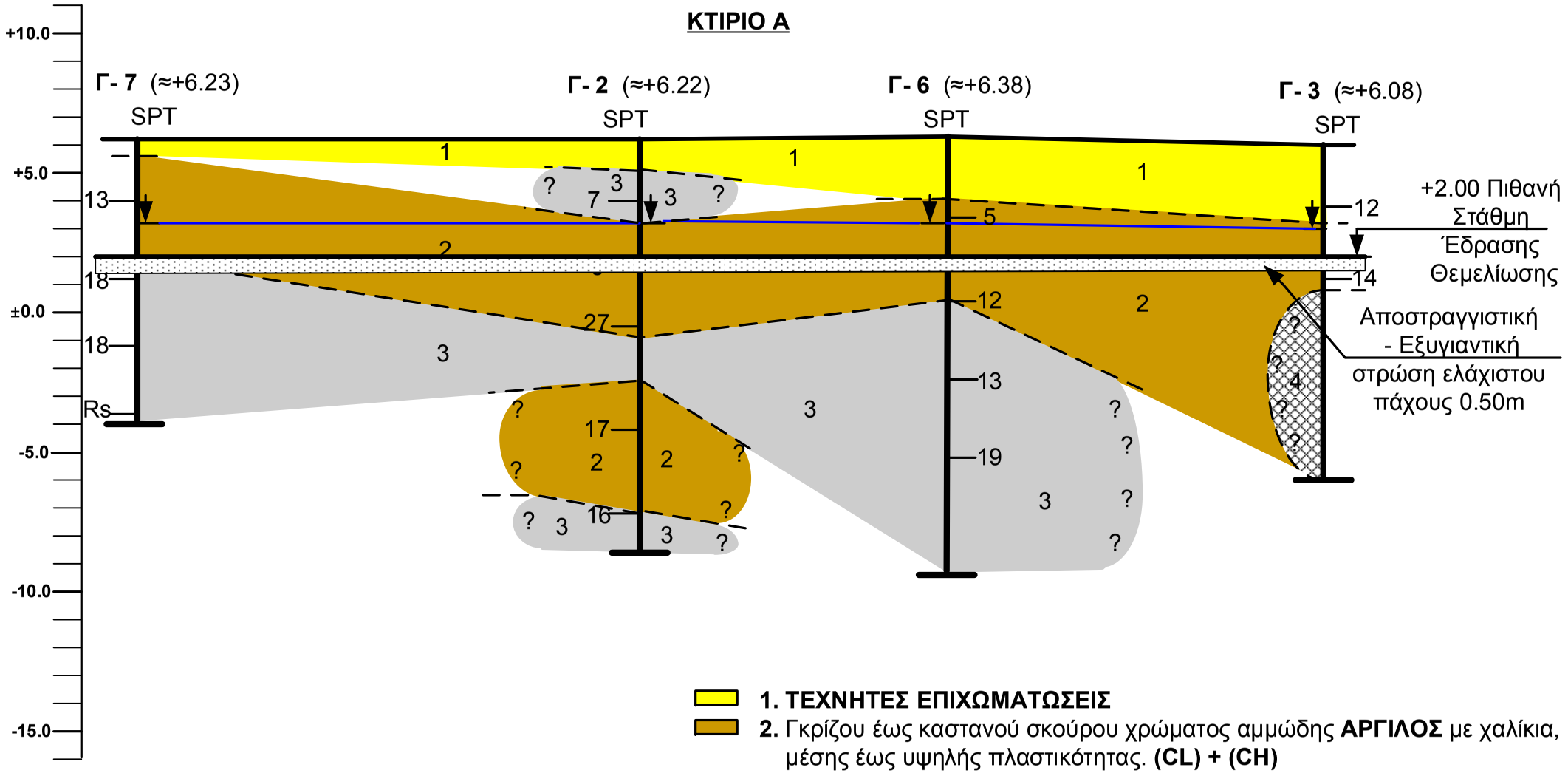


ΚΛΙΜΑΚΑ 1:500

ΠΑΡΑΡΤΗΜΑ

8.2 *Γενικευμένη τομή σχεδιασμού εδάφους*

ΚΤΙΡΙΟ Α



1. ΤΕΧΝΗΤΕΣ ΕΠΙΧΩΜΑΤΩΣΕΙΣ

2. Γκρίζου έως καστανού σκούρου χρώματος αμμώδης **ΑΡΓΙΛΟΣ** με χαλίκια, μέσης έως υψηλής πλαστικότητας. **(CL) + (CH)**

3. Καστανού έως γκρίζου χρώματος ιλυώδης, αργιλώδης **ΑΜΜΟΣ** με χαλίκια, ασβεστολιθικής σύστασης, και αργιλώδη **ΧΑΛΙΚΙΑ** με άμμο.**(SC) + (SC-SM) + (SW-SM) + (GC)**

4. Λευκού κίτρινου έως ανοιχτού γκρίζου χρώματος μαργαϊκός **ΑΣΒΕΣΤΟΛΙΘΟΣ**, ισχυρά έως ολοκληρωτικά αποσαθρωμένος, κατακερματισμένος **(WH-WC)**.

Γ - 3 ΓΕΩΤΡΗΣΗ No

ΟΙ ΓΕΩΤΡΗΣΕΙΣ Γ-2 & Γ-6 ΔΙΝΟΝΤΑΙ ΣΕ ΠΡΟΒΟΛΗ

(+6.08) ΥΨΟΜΕΤΡΟ ΓΕΩΤΡΗΣΗΣ

ΥΠΟΓΕΙΟΣ ΥΔΡΟΦΟΡΟΣ ΟΡΙΖΟΝΤΑΣ

ΣΤΑΘΜΗ ΥΥΟ

ΣΗΜΕΙΩΣΗ :Οι γεωτεχνικές συνθήκες του υπεδάφους έχουν ληφθεί στις θέσεις των δειγματοληπτικών γεωτρήσεων. Οι γεωτεχνικές συνθήκες σε θέσεις μεταξύ των γεωτρήσεων δύναται να διαφέρουν από την γενικευμένη τομή υπεδάφους.

ΣΧΗΜΑ 3

ΓΕΝΙΚΕΥΜΕΝΗ ΤΟΜΗ ΥΠΕΔΑΦΟΥΣ

ΚΛΙΜΑΚΑ ΟΡ 1 : 200, ΚΑΤ 1 : 200

ΠΑΡΑΡΤΗΜΑ

8.3 *Μητρώα γεωτρήσεων*

ΜΗΤΡΩΟ ΓΕΩΤΡΗΣΗΣ

ΕΡΓΟ: Ε-540/07 ΙΟΝΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ	**ΘΕΣΗ** : 9Η ΠΑΡΟΔΟΣ Ι.ΘΕΟΤΟΚΗ - Ο.Τ 379	**ΦΥΛΛΟ**: 1/1
1. ΑΡΙΘΜΟΣ ΓΕΩΤΡΗΣΗΣ: Γ - 1 **X=959.24 / Y=1188.87**	**7. ΕΝΑΡΞΗ ΓΕΩΤΡΗΣΗΣ:**	**8. ΛΗΞΗ ΓΕΩΤΡΗΣΗΣ:**
2. ΟΛΙΚΟ ΒΑΘΟΣ ΓΕΩΤΡΗΣΗΣ (m): 15.00	17 / 07 / 07	17 / 07 / 07
3. ΟΝΟΜΑ ΓΕΩΤΡΥΠΑΝΙΣΤΗ: Δ.Τ.	**9. ΥΨΟΜΕΤΡΙΚΗ ΑΦΕΤΗΡΙΑ:** ± 0.00 (Μ.Σ.Θ.)	
4. ΜΟΝΤΕΛΟ ΓΕΩΤΡΥΠΑΝΟΥ: CRAELIUS D-750	**10. ΥΨΟΜΕΤΡΟ ΕΠΙΦΑΝΕΙΑΣ ΕΔΑΦΟΥΣ ΓΕΩΤΡΗΣΗΣ:** ≈ + 6.02	
5. ΜΕΓΕΘΟΣ & ΤΥΠΟΣ ΚΟΡΩΝΑΣ: T-101(W)	**11. ΤΟΠΟΘΕΤΗΣΗ ΠΙΕΖΟΜΕΤΡΟΥ**: ΟΧΙ	**ΥΠΕΥΘΥΝΟΣ ΠΕΔΙΟΥ**
6. ΣΩΛΗΝΩΣΗ: 104/114 έως 8.00 m	**12. ΣΤΑΘΜΗ ΥΠΟΓΕΙΩΝ ΥΔΑΤΩΝ (m):** 3.00	Μουζακίτη Σπυριδούλα

ΒΑΘΟΣ m	ΠΕΡΙΓΡΑΦΗ ΥΛΙΚΩΝ	ΠΑΧΟΣ ΣΤΡΩΣΗΣ	ΕΙΔΟΣ ΔΕΙΓΜΑΤΟΛΗΨΙΑΣ	ΠΡΟΣΩΡΙΝΗ ΣΩΛΗΝΩΣΗ	N_{SPT}	TCR %	RQD %	ΕΙΔΟΣ ΔΕΙΓΜΑΤΟΛΗΨΙΑΣ	ΠΑΡΑΤΗΡΗΣΕΙΣ Βάθος	ΒΑΘΟΣ m
0,00	ΤΕΧΝΗΤΕΣ ΕΠΙΧΩΜΑΤΩΣΕΙΣ	2.00 m						Φ	0.00 - 1.00	0,00
1,00										1,00
2,00	Γκρίζου έως καστανού χρώματος αμμώδης ΑΡΓΙΛΟΣ με λ-χ γωνιώδη ασβεστολιθικά χαλίκια, μέση στιφρή.	1.50 m			4 4 6 2			Φ SPT	1.00 - 2.30 2.30 - 2.75	2,00
3,00										3,00
4,00	Καστανού έως τοπικά γκρίζου χρώματος ιλυώδης, αργιλώδης ΑΜΜΟΣ με λ-χ γωνιώδη ασβεστολιθικά χαλίκια, χαλαρή.	4.10 m	T-101(W)	104/114						4,00
5,00					2 3 8 5			Φ SPT	2.75 - 4.80 4.80 - 5.25	5,00
6,00								Φ	5.25 - 6.40	6,00
7,00	(SC) + (SW - SM)									7,00
8,00	Καστανού έως τοπικά γκρίζου χρώματος αργιλώδη ΧΑΛΙΚΙΑ με άμμο, πυκνής απόθεσης.	1.20 m						Φ	6.40 - 7.60	8,00
9,00					8 18 38 20			Φ SPT	7.60 - 8.30 8.30 - 8.75	9,00
10,00	Καστανού έως τοπικά γκρίζου χρώματος αργιλώδης ΑΜΜΟΣ με λ-χ γωνιώδη ασβεστολιθικά χαλίκια, πολύ πυκνής απόθεσης.	3.20 m						Φ	8.75 - 9.50	10,00
11,00	(SC)				15 25 55 30			Φ SPT	9.50 - 10.80 10.80 - 11.25	11,00
12,00										12,00
13,00	Ανοιχτού καστανού χρώματος παχιά αμμώδης ΑΡΓΙΛΟΣ. Κατά θέσεις περιέχει λίγα λ-χ χαλίκια.	3.00 m						Φ Φ	11.25 - 12.60 12.60 - 13.40	13,00
14,00								Φ	13.40 - 14.20	14,00
15,00	(CH)							Φ	14.20 - 15.00	15,00
16,00	**ΤΕΛΟΣ ΔΙΑΤΡΗΣΗΣ ΣΤΑ 15.00 m**									16,00

συμπράττοντα γραφεία γεωτεχνικών μελετών : «ΧΑΡΗΣ ΛΑΜΑΡΗΣ - ΓΙΩΡΓΟΣ ΑΡΜΕΝΗΣ»

ΜΗΤΡΩΟ ΓΕΩΤΡΗΣΗΣ

ΕΡΓΟ: Ε-540/07 ΙΟΝΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ	**ΘΕΣΗ :** 9Η ΠΑΡΟΔΟΣ Ι.ΘΕΟΤΟΚΗ - Ο.Τ 379	**ΦΥΛΛΟ**: 1/1
1. ΑΡΙΘΜΟΣ ΓΕΩΤΡΗΣΗΣ: **Γ - 2** **X=976.94 / Y=1196.79**	**7. ΕΝΑΡΞΗ ΓΕΩΤΡΗΣΗΣ:**	**8. ΛΗΞΗ ΓΕΩΤΡΗΣΗΣ:**
2. ΟΛΙΚΟ ΒΑΘΟΣ ΓΕΩΤΡΗΣΗΣ (m): 15.00	18 / 07 / 07	19 / 07 / 2007
3. ΟΝΟΜΑ ΓΕΩΤΡΥΠΑΝΙΣΤΗ: Δ.Τ.	**9. ΥΨΟΜΕΤΡΙΚΗ ΑΦΕΤΗΡΙΑ:** ± 0.00 (Μ.Σ.Θ.)	
4. ΜΟΝΤΕΛΟ ΓΕΩΤΡΥΠΑΝΟΥ: CRAELIUS D-750	**10. ΥΨΟΜΕΤΡΟ ΕΠΙΦΑΝΕΙΑΣ ΕΔΑΦΟΥΣ ΓΕΩΤΡΗΣΗΣ:** ≈ + 6.22	
5. ΜΕΓΕΘΟΣ & ΤΥΠΟΣ ΚΟΡΩΝΑΣ: T-101(W), T-86(W)	**11. ΤΟΠΟΘΕΤΗΣΗ ΠΙΕΖΟΜΕΤΡΟΥ**: ΟΧΙ	**ΥΠΕΥΘΥΝΟΣ ΠΕΔΙΟΥ**
6. ΣΩΛΗΝΩΣΗ: 104/114 έως 14.00 m	**12. ΣΤΑΘΜΗ ΥΠΟΓΕΙΩΝ ΥΔΑΤΩΝ (m):** 3.00	Μουζακίτη Σπυριδούλα

ΒΑΘΟΣ m	ΠΕΡΙΓΡΑΦΗ ΥΛΙΚΩΝ	ΠΑΧΟΣ ΣΤΡΩΣΗΣ	ΕΙΔΟΣ ΔΕΙΓΜΑΤΟΛΗΠΤΗ	ΠΡΟΣΩΡΙΝΗ ΣΩΛΗΝΩΣΗ	N_{SPT}	TCR %	RQD %	ΕΙΔΟΣ ΔΕΙΓΜΑΤΟΛΗΨΙΑΣ	ΠΑΡΑΤΗΡΗΣΕΙΣ Βάθος	ΒΑΘΟΣ m
0,00										0,00
	ΤΕΧΝΗΤΕΣ ΕΠΙΧΩΜΑΤΩΣΕΙΣ	1.30 m						Φ	0.00 - 1.00	
1,00										1,00
2,00	Καστανού χρώματος αργιλώδης ΑΜΜΟΣ με λ-χ χαλίκια, χαλαρή. (SC)	2.00 m			2 3 7 4			Φ SPT	1.00 - 2.20 2.20 - 2.65	2,00
3,00								Φ	2.65 - 3.30	3,00
4,00										4,00
5,00	Καστανού έως τοπικά γκρίζου χρώματος ισχνή αμμώδης ΑΡΓΙΛΟΣ με λ-χ γωνιώδη ασβεστολιθικά χαλίκια, μέση στιφρή έως πολύ στιφρή. (CL)	3.85 m	T-101(W)	104/114	3 2 5 3			Φ SPT	3.30 - 4.80 4.80 - 5.25	5,00
6,00										6,00
7,00					8 12 27 15			Φ SPT	5.25 - 6.70 6.70 - 7.15	7,00
8,00	Καστανού χρώματος αργιλώδης ΑΜΜΟΣ με λ-χ χαλίκια. (SC)	1.55 m						Φ	7.15 - 8.60	8,00
9,00										9,00
10,00								Φ	8.60 - 10.40	10,00
11,00	Καστανού έως τοπικά γκρίζου χρώματος ισχνή αμμώδης ΑΡΓΙΛΟΣ με λ-χ γωνιώδη ασβεστολιθικά χαλίκια, πολύ στιφρή. (CL)	4.70 m	T - 86 (W)		5 7 17 10			SPT	10.40 - 10.85	11,00
12,00								Φ	10.85 - 12.20	12,00
13,00								Φ	12.20 - 13.40	13,00
14,00	Καστανού χρώματος αργιλώδης ΑΜΜΟΣ με λ-χ χαλίκια, μέσης πυκνότητας. (SC)	1.60 m			4 7 16 9			SPT	13.40 - 13.85	14,00
15,00								Φ	13.85 - 15.00	15,00
	ΤΕΛΟΣ ΔΙΑΤΡΗΣΗΣ ΣΤΑ 15.00 m									
16,00										16,00

συμπράττοντα γραφεία γεωτεχνικών μελετών : «ΧΑΡΗΣ ΛΑΜΑΡΗΣ - ΓΙΩΡΓΟΣ ΑΡΜΕΝΗΣ»

ΜΗΤΡΩΟ ΓΕΩΤΡΗΣΗΣ

ΕΡΓΟ: Ε-540/07 ΙΟΝΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ	**ΘΕΣΗ :** 9Η ΠΑΡΟΔΟΣ Ι.ΘΕΟΤΟΚΗ - Ο.Τ 379	**ΦΥΛΛΟ**: 1/1
1. ΑΡΙΘΜΟΣ ΓΕΩΤΡΗΣΗΣ: **Γ - 3** **X=967.36 / Y=1221.72**	**7. ΕΝΑΡΞΗ ΓΕΩΤΡΗΣΗΣ:**	**8. ΛΗΞΗ ΓΕΩΤΡΗΣΗΣ:**
2. ΟΛΙΚΟ ΒΑΘΟΣ ΓΕΩΤΡΗΣΗΣ (m): 12.00	19 / 07 / 07	20 / 07 / 2007
3. ΟΝΟΜΑ ΓΕΩΤΡΥΠΑΝΙΣΤΗ: Δ.Τ.	**9. ΥΨΟΜΕΤΡΙΚΗ ΑΦΕΤΗΡΙΑ:** ± 0.00 (Μ.Σ.Θ.)	
4. ΜΟΝΤΕΛΟ ΓΕΩΤΡΥΠΑΝΟΥ: CRAELIUS D-750	**10. ΥΨΟΜΕΤΡΟ ΕΠΙΦΑΝΕΙΑΣ ΕΔΑΦΟΥΣ ΓΕΩΤΡΗΣΗΣ:** ≈ + 6.08	
5. ΜΕΓΕΘΟΣ & ΤΥΠΟΣ ΚΟΡΩΝΑΣ: T-101(W), T6s - 101(D)	**11. ΤΟΠΟΘΕΤΗΣΗ ΠΙΕΖΟΜΕΤΡΟΥ**: ΟΧΙ	**ΥΠΕΥΘΥΝΟΣ ΠΕΔΙΟΥ**
6. ΣΩΛΗΝΩΣΗ: 104/114 έως 7.70 m	**12. ΣΤΑΘΜΗ ΥΠΟΓΕΙΩΝ ΥΔΑΤΩΝ (m):** 3.00	Μουζακίτη Σπυριδούλα

ΒΑΘΟΣ m	ΠΕΡΙΓΡΑΦΗ ΥΛΙΚΩΝ	ΠΑΧΟΣ ΣΤΡΩΣΗΣ	ΕΙΔΟΣ ΔΕΙΓΜΑΤΟΛΗΠΤΗ	ΠΡΟΣΩΡΙΝΗ ΣΩΛΗΝΩΣΗ	N_{SPT}	TCR %	RQD %	ΕΙΔΟΣ ΔΕΙΓΜΑΤΟΛΗΨΙΑΣ	ΠΑΡΑΤΗΡΗΣΕΙΣ Βάθος	ΒΑΘΟΣ m
0,00										0,00
1,00	ΤΕΧΝΗΤΕΣ ΕΠΙΧΩΜΑΤΩΣΕΙΣ	2.85 m	T-101(W)	104/114				Φ	0.00 - 1.20	1,00
2,00								Φ	1.20 - 2.40	2,00
3,00					4 7 12 5			SPT	2.40 - 2.85	3,00
4,00	Καστανού χρώματος ισχνή αμμώδης ΑΡΓΙΛΟΣ με χαλίκια και ίχνη οργανικών, στιφρή. (CL)	2.40 m								4,00
5,00					5 6 14 8			Φ	2.85 - 4.80	5,00
								SPT	4.80 - 5.25	
6,00	Λευκοκίτρινου χρώματος αργιλώδη ασβεστολιθικά ΧΑΛΙΚΙΑ με άμμο. (GW) (ΑΣΒΕΣΤΟΛΙΘΟΣ ο οποίος έχει μετατραπεί σε υπολειμματικό έδαφος) (Rs)	1.05 m						Φ	5.25 - 5.80	6,00
7,00		5.70 m	T6s-101(D)			65	0	Δ	5.80 - 7.00	7,00
8,00	Ανοιχτού γκρίζου έως λευκού χρώματος μαργαικός ΑΣΒΕΣΤΟΛΙΘΟΣ,με ποικίλο βαθμό αποσάθρωσης, κατακερματισμένος. (6.30 -7.00) (WH) (7.00 - 8.50) (WC) (8.50 - 9.20) (WH) 9.20 - 9.80) (WC) (9.80 - 12.00) (WH-WM)					65	0	Δ	7.00 - 7.70	8,00
						70	0	Δ	7.70 - 8.50	
9,00						75	0	Δ	8.50 - 9.20	9,00
10,00						65	0	Δ	9.20 - 10.20	10,00
11,00						85	15	Δ	10.20 - 11.30	11,00
12,00	**ΤΕΛΟΣ ΔΙΑΤΡΗΣΗΣ ΣΤΑ 12.00 m**					75	0	Δ	11.30 - 12.00	12,00
13,00										13,00
14,00										14,00
15,00										15,00
16,00										16,00

συμπράττοντα γραφεία γεωτεχνικών μελετών : «ΧΑΡΗΣ ΛΑΜΑΡΗΣ - ΓΙΩΡΓΟΣ ΑΡΜΕΝΗΣ»

ΜΗΤΡΩΟ ΓΕΩΤΡΗΣΗΣ

ΕΡΓΟ: Ε-540/07 ΙΟΝΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ	**ΘΕΣΗ** : 9Η ΠΑΡΟΔΟΣ Ι.ΘΕΟΤΟΚΗ - Ο.Τ. 378	**ΦΥΛΛΟ**: 1/1
1. ΑΡΙΘΜΟΣ ΓΕΩΤΡΗΣΗΣ: Γ - 4 **X=941.69 / Y=1139.43**	**7. ΕΝΑΡΞΗ ΓΕΩΤΡΗΣΗΣ:**	**8. ΛΗΞΗ ΓΕΩΤΡΗΣΗΣ:**
2. ΟΛΙΚΟ ΒΑΘΟΣ ΓΕΩΤΡΗΣΗΣ (m): 15.00	20 / 07 / 07	21 / 07 / 2007
3. ΟΝΟΜΑ ΓΕΩΤΡΥΠΑΝΙΣΤΗ: Δ.Τ.	**9. ΥΨΟΜΕΤΡΙΚΗ ΑΦΕΤΗΡΙΑ:** ± 0.00 (Μ.Σ.Θ.)	
4. ΜΟΝΤΕΛΟ ΓΕΩΤΡΥΠΑΝΟΥ: CRAELIUS D-750	**10. ΥΨΟΜΕΤΡΟ ΕΠΙΦΑΝΕΙΑΣ ΕΔΑΦΟΥΣ ΓΕΩΤΡΗΣΗΣ:** ≈ + 6.38	
5. ΜΕΓΕΘΟΣ & ΤΥΠΟΣ ΚΟΡΩΝΑΣ: T-101(W), T-86 (W)	**11. ΤΟΠΟΘΕΤΗΣΗ ΠΙΕΖΟΜΕΤΡΟΥ**: ΟΧΙ	**ΥΠΕΥΘΥΝΟΣ ΠΕΔΙΟΥ**
6. ΣΩΛΗΝΩΣΗ: 104/114 έως 14.70 m	**12. ΣΤΑΘΜΗ ΥΠΟΓΕΙΩΝ ΥΔΑΤΩΝ (m):** 3.30	Μουζακίτη Σπυριδούλα

ΒΑΘΟΣ m	ΠΕΡΙΓΡΑΦΗ ΥΛΙΚΩΝ	ΠΑΧΟΣ ΣΤΡΩΣΗΣ	ΕΙΔΟΣ ΔΕΙΓΜΑΤΟΛΗΠΤΗ	ΠΡΟΣΩΡΙΝΗ ΣΩΛΗΝΩΣΗ	N_{SPT}	TCR %	RQD %	ΕΙΔΟΣ ΔΕΙΓΜΑΤΟΛΗΨΙΑΣ	ΠΑΡΑΤΗΡΗΣΕΙΣ Βάθος	ΒΑΘΟΣ m
0,00										0,00
1,00	ΤΕΧΝΗΤΕΣ ΕΠΙΧΩΜΑΤΩΣΕΙΣ	2.75 m						Φ	0.00 - 1.20	1,00
2,00					19			Φ	1.20 - 2.30	2,00
3,00					7 12 5			SPT	2.30 - 2.75	3,00
4,00	Σκούρου καστανού χρώματος ισχνή αμμώδης ΑΡΓΙΛΟΣ, μέση στιφρή. Κατά θέσεις περιέχει λίγα λ-χ χαλίκια.	3.25 m								4,00
5,00	(CL)				1 2 4 2			Φ SPT	2.75 - 4.30 4.30 - 4.75	5,00
6,00			T-101(W)					Φ	4.75 - 5.80	6,00
7,00				104/114	8 15 33 18			Φ SPT	5.80 - 7.00 7.00 - 7.45	7,00
8,00										8,00
9,00	Καστανού χρώματος αργιλώδης ΑΜΜΟΣ με χαλίκια, πυκνής απόθεσης.	9.00 m								9,00
10,00					10 16 35 19			Φ SPT	7.45 - 9.70 9.70 - 10.15	10,00
11,00										11,00
12,00					13			Φ	10.15 - 12.30	12,00
13,00	Ως ανωτέρω.				20 45 25			SPT	12.30 - 12.75	13,00
14,00	(SC)		T-86(W)					Φ	12.75 - 14.00	14,00
15,00	**ΤΕΛΟΣ ΔΙΑΤΡΗΣΗΣ ΣΤΑ 15.00 m**							Φ	14.00 - 15.00	15,00
16,00										16,00

συμπράττοντα γραφεία γεωτεχνικών μελετών : «ΧΑΡΗΣ ΛΑΜΑΡΗΣ - ΓΙΩΡΓΟΣ ΑΡΜΕΝΗΣ»

ΜΗΤΡΩΟ ΓΕΩΤΡΗΣΗΣ

ΕΡΓΟ: Ε-540/07 ΙΟΝΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ	**ΘΕΣΗ** : 9Η ΠΑΡΟΔΟΣ Ι.ΘΕΟΤΟΚΗ - Ο.Τ. 378	**ΦΥΛΛΟ**: 1/1
1. ΑΡΙΘΜΟΣ ΓΕΩΤΡΗΣΗΣ: **Γ - 5** **X=968.73 / Y=1158.41**	**7. ΕΝΑΡΞΗ ΓΕΩΤΡΗΣΗΣ:**	**8. ΛΗΞΗ ΓΕΩΤΡΗΣΗΣ:**
2. ΟΛΙΚΟ ΒΑΘΟΣ ΓΕΩΤΡΗΣΗΣ (m): 15.00	21/ 07 / 07	22 / 07 / 2007
3. ΟΝΟΜΑ ΓΕΩΤΡΥΠΑΝΙΣΤΗ: Δ.Τ.	**9. ΥΨΟΜΕΤΡΙΚΗ ΑΦΕΤΗΡΙΑ:** ± 0.00 (Μ.Σ.Θ.)	
4. ΜΟΝΤΕΛΟ ΓΕΩΤΡΥΠΑΝΟΥ: CRAELIUS D-750	**10. ΥΨΟΜΕΤΡΟ ΕΠΙΦΑΝΕΙΑΣ ΕΔΑΦΟΥΣ ΓΕΩΤΡΗΣΗΣ:** ≈ + 6.41	
5. ΜΕΓΕΘΟΣ & ΤΥΠΟΣ ΚΟΡΩΝΑΣ: T-101(W)	**11. ΤΟΠΟΘΕΤΗΣΗ ΠΙΕΖΟΜΕΤΡΟΥ**: ΟΧΙ	**ΥΠΕΥΘΥΝΟΣ ΠΕΔΙΟΥ**
6. ΣΩΛΗΝΩΣΗ: 104/114 έως 12.00 m	**12. ΣΤΑΘΜΗ ΥΠΟΓΕΙΩΝ ΥΔΑΤΩΝ (m):** 3.20	Μουζακίτη Σπυριδούλα

ΒΑΘΟΣ m	ΠΕΡΙΓΡΑΦΗ ΥΛΙΚΩΝ	ΠΑΧΟΣ ΣΤΡΩΣΗΣ	ΕΙΔΟΣ ΔΕΙΓΜΑΤΟΛΗΠΤΗ	ΠΡΟΣΩΡΙΝΗ ΣΩΛΗΝΩΣΗ	N_{SPT}	TCR %	RQD %	ΕΙΔΟΣ ΔΕΙΓΜΑΤΟΛΗΨΙΑΣ	ΠΑΡΑΤΗΡΗΣΕΙΣ Βάθος	ΒΑΘΟΣ m
0,00										0,00
	ΤΕΧΝΗΤΕΣ ΕΠΙΧΩΜΑΤΩΣΕΙΣ	1.40 m						Φ	0.00 - 1.20	
1,00										1,00
2,00	Ανοιχτού έως σκούρου καστανού χρώματος ισχνή αμμώδης ΑΡΓΙΛΟΣ με λ-χ γωνιώδη χαλίκια, ασβεστολιθικής σύστασης, στιφρή.	2.50 m						Φ	1.20 - 2.20	2,00
					3 4 10 6			SPT	2.20 - 2.65	
3,00	(CL)									3,00
4,00								Φ	2.65 - 4.00	4,00
5,00								Φ	4.00 - 5.00	5,00
					8 12 27 15			SPT	5.00 - 5.45	
6,00	Καστανού χρώματος αργιλώδης ΑΜΜΟΣ με λ-χ χαλίκια, μέσης πυκνότητας έως πολύ πυκνής απόθεσης.	6.10 m	T-101(W)	104/114				Φ	5.45 - 6.50	6,00
7,00										7,00
								Φ	6.50 - 7.70	
8,00					15 20 45 25			SPT	7.70 - 8.15	8,00
9,00								Φ	8.15 - 9.00	9,00
	(SC)									
10,00								Φ	9.00 - 10.50	10,00
					17 25 57 32			SPT	10.50 - 10.95	
11,00										11,00
12,00	Καστανού έως τοπικά γκρίζου χρώματος αργιλώδη ΧΑΛΙΚΙΑ με άμμο, πολύ πυκνής απόθεσης.	5.00 m			50/7cm Rs			Φ	10.95 - 12.00	12,00
					Rs			SPT	12.00 - 12.07	
13,00								Φ	12.07 - 13.00	13,00
14,00	(GC)							Φ	13.00 - 14.00	14,00
15,00								Φ	14.00 - 15.00	15,00
	ΤΕΛΟΣ ΔΙΑΤΡΗΣΗΣ ΣΤΑ 15.00 m									
16,00										16,00

συμπράττοντα γραφεία γεωτεχνικών μελετών : «ΧΑΡΗΣ ΛΑΜΑΡΗΣ - ΓΙΩΡΓΟΣ ΑΡΜΕΝΗΣ»

ΜΗΤΡΩΟ ΓΕΩΤΡΗΣΗΣ

ΕΡΓΟ: Ε-540/07 ΙΟΝΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ	**ΘΕΣΗ :** 9Η ΠΑΡΟΔΟΣ Ι.ΘΕΟΤΟΚΗ - Ο.Τ 379	**ΦΥΛΛΟ**: 1/1
1. ΑΡΙΘΜΟΣ ΓΕΩΤΡΗΣΗΣ: **Γ - 6** **X=984.97 / Y=1213.17**	**7. ΕΝΑΡΞΗ ΓΕΩΤΡΗΣΗΣ:**	**8. ΛΗΞΗ ΓΕΩΤΡΗΣΗΣ:**
2. ΟΛΙΚΟ ΒΑΘΟΣ ΓΕΩΤΡΗΣΗΣ (m): 15.50	23 / 07 / 07	23 / 07 / 2007
3. ΟΝΟΜΑ ΓΕΩΤΡΥΠΑΝΙΣΤΗ: Δ.Τ.	**9. ΥΨΟΜΕΤΡΙΚΗ ΑΦΕΤΗΡΙΑ:** ± 0.00 (Μ.Σ.Θ.)	
4. ΜΟΝΤΕΛΟ ΓΕΩΤΡΥΠΑΝΟΥ: CRAELIUS D-750	**10. ΥΨΟΜΕΤΡΟ ΕΠΙΦΑΝΕΙΑΣ ΕΔΑΦΟΥΣ ΓΕΩΤΡΗΣΗΣ:** ≈ + 6.38	
5. ΜΕΓΕΘΟΣ & ΤΥΠΟΣ ΚΟΡΩΝΑΣ: T-101(W)	**11. ΤΟΠΟΘΕΤΗΣΗ ΠΙΕΖΟΜΕΤΡΟΥ**: ΟΧΙ	**ΥΠΕΥΘΥΝΟΣ ΠΕΔΙΟΥ**
6. ΣΩΛΗΝΩΣΗ: 104/114 έως 14.50 m	**12. ΣΤΑΘΜΗ ΥΠΟΓΕΙΩΝ ΥΔΑΤΩΝ (m):** 3.00	Μουζακίτη Σπυριδούλα

ΒΑΘΟΣ m	ΠΕΡΙΓΡΑΦΗ ΥΛΙΚΩΝ	ΠΑΧΟΣ ΣΤΡΩΣΗΣ	ΕΙΔΟΣ ΔΕΙΓΜΑΤΟΛΗΠΤΗ	ΠΡΟΣΩΡΙΝΗ ΣΩΛΗΝΩΣΗ	N_{SPT}	TCR %	RQD %	ΕΙΔΟΣ ΔΕΙΓΜΑΤΟΛΗΨΙΑΣ	ΠΑΡΑΤΗΡΗΣΕΙΣ Βάθος	ΒΑΘΟΣ m
0,00										0,00
1,00	ΤΕΧΝΗΤΕΣ ΕΠΙΧΩΜΑΤΩΣΕΙΣ	2.20 m						Φ	0.00 - 1.50	1,00
2,00								Φ	1.50 - 2.00	2,00
3,00					2 3 5			Φ	2.00 - 3.00	3,00
4,00	Ανοιχτού έως σκούρου καστανού χρώματος ισχνή αμμώδης ΑΡΓΙΛΟΣ με λ-χ γωνιώδη χαλίκια, ασβεστολιθικής σύστασης, μέση στιφρή.	3.45 m			2			SPT	3.00 - 3.45	4,00
5,00	(CL)									5,00
6,00								Φ	3.45 - 6.00	6,00
7,00			T-101(W)	104/114	3 5 12 7			SPT	6.00 - 6.45	7,00
8,00	Καστανού έως τοπικά γκρίζου χρώματος αργιλώδη ΧΑΛΙΚΙΑ με άμμο, μέσης πυκνότητας.	5.35 m						Φ	6.45 - 8.70	8,00
9,00					5 6 13 7			SPT	8.70 - 9.15	9,00
10,00	(GC)									10,00
11,00								Φ	9.15 - 11.50	11,00
12,00	Καστανού χρώματος αργιλώδης ΑΜΜΟΣ με λ-χ χαλίκια, μέσης πυκνότητας.				4 7 19 12			SPT	11.50 - 11.95	12,00
13,00		4.50 m								13,00
14,00	Ως ανωτέρω.							Φ	11.95 - 13.70	14,00
15,00	(SC)									15,00
16,00	**ΤΕΛΟΣ ΔΙΑΤΡΗΣΗΣ ΣΤΑ 15.50 m**							Φ	13.70 - 15.50	16,00

συμπράττοντα γραφεία γεωτεχνικών μελετών : «ΧΑΡΗΣ ΛΑΜΑΡΗΣ - ΓΙΩΡΓΟΣ ΑΡΜΕΝΗΣ»

ΜΗΤΡΩΟ ΓΕΩΤΡΗΣΗΣ

ΕΡΓΟ: Ε-540/07 ΙΟΝΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ	**ΘΕΣΗ :** 9Η ΠΑΡΟΔΟΣ Ι.ΘΕΟΤΟΚΗ - Ο.Τ 379	**ΦΥΛΛΟ**: 1/1
1. ΑΡΙΘΜΟΣ ΓΕΩΤΡΗΣΗΣ: **Γ - 7** **X=981.45 / Y=1181.42**	**7. ΕΝΑΡΞΗ ΓΕΩΤΡΗΣΗΣ:**	**8. ΛΗΞΗ ΓΕΩΤΡΗΣΗΣ:**
2. ΟΛΙΚΟ ΒΑΘΟΣ ΓΕΩΤΡΗΣΗΣ (m): 10.15	24 / 07 / 07	24 / 07 / 2007
3. ΟΝΟΜΑ ΓΕΩΤΡΥΠΑΝΙΣΤΗ: Δ.Τ.	**9. ΥΨΟΜΕΤΡΙΚΗ ΑΦΕΤΗΡΙΑ:** ± 0.00 (Μ.Σ.Θ.)	
4. ΜΟΝΤΕΛΟ ΓΕΩΤΡΥΠΑΝΟΥ: CRAELIUS D-750	**10. ΥΨΟΜΕΤΡΟ ΕΠΙΦΑΝΕΙΑΣ ΕΔΑΦΟΥΣ ΓΕΩΤΡΗΣΗΣ:** ≈ + 6.23	
5. ΜΕΓΕΘΟΣ & ΤΥΠΟΣ ΚΟΡΩΝΑΣ: T-101(W)	**11. ΤΟΠΟΘΕΤΗΣΗ ΠΙΕΖΟΜΕΤΡΟΥ**: ΟΧΙ	**ΥΠΕΥΘΥΝΟΣ ΠΕΔΙΟΥ**
6. ΣΩΛΗΝΩΣΗ: 104/114 έως 6.00 m	**12. ΣΤΑΘΜΗ ΥΠΟΓΕΙΩΝ ΥΔΑΤΩΝ (m):** 3.00	Μουζακίτη Σπυριδούλα

ΒΑΘΟΣ m	ΠΕΡΙΓΡΑΦΗ ΥΛΙΚΩΝ	ΠΑΧΟΣ ΣΤΡΩΣΗΣ	ΕΙΔΟΣ ΔΕΙΓΜΑΤΟΛΗΠΤΗ	ΠΡΟΣΩΡΙΝΗ ΣΩΛΗΝΩΣΗ	N_{SPT}	TCR %	RQD %	ΕΙΔΟΣ ΔΕΙΓΜΑΤΟΛΗΨΙΑΣ	ΠΑΡΑΤΗΡΗΣΕΙΣ Βάθος	ΒΑΘΟΣ m
0,00	ΤΕΧΝΗΤΕΣ ΕΠΙΧΩΜΑΤΩΣΕΙΣ	0.50 m								0,00
1,00								Φ	0.00 - 1.20	1,00
2,00	Ανοιχτού έως σκούρου καστανού χρώματος παχιά αμμώδης ΑΡΓΙΛΟΣ με λ-χ γωνιώδη χαλίκια, ασβεστολιθικής σύστασης, στιφρή .	3.50 m		104/114				Φ	1.20 - 2.20	2,00
3,00	(CH)				5 6 13 7			SPT	2.20 - 2.65	3,00
4,00								Φ	2.65 - 3.80	4,00
5,00								Φ	3.80 - 5.00	5,00
6,00	Σκούρου γκρι έως ανοιχτού καστανού χρώματος ιλυώδης, αργιλώδης ΑΜΜΟΣ, μέσης πυκνότητας. Κατά θέσεις περιέχει λίγα χαλίκια.	3.95 m	T-101(W)		6 8 18 10			SPT	5.00 - 5.45	6,00
7,00								Φ	5.45 - 6.50	7,00
8,00	(SM - SC)				6 8 18 10			Φ SPT	6.50 - 7.50 7.50 - 7.95	8,00
9,00	Καστανού έως τοπικά γκρίζου χρώματος αργιλώδη ΧΑΛΙΚΙΑ με άμμο, μέσης πυκνότητας έως πολύ πυκνής απόθεσης	2.18 m			50/13cm Rs			Φ	7.95 - 9.00	9,00
10,00	(GC)				Rs			Φ SPT	9.00 - 10.00 10.00 - 10.13	10,00
11,00	**ΤΕΛΟΣ ΔΙΑΤΡΗΣΗΣ ΣΤΑ 10.13 m**									11,00
12,00										12,00
13,00										13,00
14,00										14,00
15,00										15,00
16,00										16,00

συμπράττοντα γραφεία γεωτεχνικών μελετών : «ΧΑΡΗΣ ΛΑΜΑΡΗΣ - ΓΙΩΡΓΟΣ ΑΡΜΕΝΗΣ»

ΠΑΡΑΡΤΗΜΑ

8.4 *Συγκεντρωτικός πίνακας εργαστηριακών δοκιμών*

ΕΡΓΟΔΟΤΗΣ : ΙΟΝΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ - Δ/ΝΣΗ ΤΕΧΝΙΚΩΝ ΕΡΓΩΝ

ΕΡΓΟ : ΕΚΠΟΝΗΣΗ ΓΕΩΤΕΧΝΙΚΗΣ ΜΕΛΕΤΗΣ ΤΩΝ ΝΕΩΝ ΚΤΙΡΙΑΚΩΝ ΕΓΚ/ΣΕΩΝ ΤΟΥ ΙΟΝΙΟΥ ΠΑΝΕΠΙΣΤΗΜΙΟΥ ΣΤΟ ΟΙΚΟΠΕΔΟ Ε.Α.Σ.Κ. ΣΤΗΝ ΚΕΡΚΥΡΑ

ΑΡΙΘΜΟΣ ΕΡΓΟΥ : Ε- 540/07

ΠΙΝΑΚΑΣ 1. ΣΥΓΚΕΝΤΡΩΤΙΚΟΣ ΠΙΝΑΚΑΣ ΑΠΟΤΕΛΕΣΜΑΤΩΝ ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ - ΦΥΣΙΚΑ & ΜΗΧΑΝΙΚΑ ΧΑΡΑΚΤΗΡΙΣΤΙΚΑ

ΓΕΩΤΡΗΣΗ No	ΕΝΟΤΗΤΑ	ΒΑΘΟΣ ΔΕΙΓΜΑΤΟΣ	ΧΑΡΑΚΤΗΡΙΣΜΟΣ USCS	ΕΙΔΙΚΟ ΒΑΡΟΣ Gs	ΚΟΚΚΟΜΕΤΡΙΑ%						ΦΥΣΙΚΗ ΥΓΡΑΣΙΑ ΔΕΙΓΜΑΤΟΣ, w %	ΟΡΙΑ ATTERBERG			ΦΑΙΝΟΜΕΝΑ ΒΑΡΗ		ΑΝΤΟΧΗ ΣΕ ΑΝΕΜΠΟΔΙΣΤΗ ΘΛΙΨΗ q_u kPa	ΔΟΚΙΜΗ ΣΤΕΡΕΟΠΟΙΗΣΗΣ		
					ΧΑΛΙΚΙΑ	ΑΜΜΟΣ	ΛΕΠΤ/ΚΑ	ΙΛΥΣ	ΑΡΓΙΛΟΣ	D_{50} (mm)		LL %	PL%	PI%	ΥΓΡΟ γ_{wet} kN/m^3	ΞΗΡΟ γ_{dry} kN/m^3		Cc	Cs	ΛΟΓΟΣ ΚΕΝΩΝ e_0
Γ - 1	2η	4,30 - 4,60	**SC**		26,1	28,9	45,0				20,8	46	22	24	24,24	19,35	79			
Γ - 1	2η	5,50 - 5,80	**SW - SM**		37,9	52,1	10,0				12,6	N.P.	N.P.	N.P.						
Γ - 1	2η	9,30 - 9,80	**SC**		15,3	40,8	43,9				14,6	64	23	41						
Γ - 1	3η	12,30 - 12,60	**CH**		6,3	24,2	69,5				26,2	81	28	54						
Γ - 2	2η	2,65 - 2,95	**SC**		21,2	29,8	49,0	29,7	19,3		17,3	26	16	10	22,02	18,68	165			
Γ - 2	3η	5,60 - 6,30	**CL**	2,67	19,8	30,0	50,2	30,9	19,3		11,0	25	15	10	20,87	18,82	405	0,050	0,005	0,42
Γ - 2	2η	7,35 - 7,65	**SC**		22,8	35,4	41,8				11,0	23	15	8						
Γ - 2	3η	9,70 - 10,00	**CL**		14,2	34,5	51,3				13,2	24	14	10						
Γ - 2	2η	13,85 - 14,20	**SC**		34,0	34,1	31,9				16,4	26	15	11						
Γ - 3	3η	3,50 - 3,80	**CL**		15,8	25,2	59,0	31,0	28,0		19,3	41	24	17	19,53	16,55	397			
Γ - 3	4η	6,00 - 6,20	**GW**		65,6	30,0	4,4				7,4									
Γ - 3	4η	8,00 - 8,30	**GW**		66,7	31,7	1,6													
Γ - 4	3η	2,75 - 3,10	**CL**		7,7	30,7	61,6	33,6	28,0		15,4	40	20	20						
Γ - 4	3η	5,35 - 5,80	**CL**		11,7	25,3	63,0					47	25	22	19,81*	18,09*	1620*			
Γ - 4	2η	9,10 - 9,50	**SC**		29,8	45,9	24,3					46	21	25						

συμπράττοντα γραφεία γεωτεχνικών μελετών : «ΧΑΡΗΣ ΛΑΜΑΡΗΣ - ΓΙΩΡΓΟΣ ΑΡΜΕΝΗΣ»
ΛΕΩΦΟΡΟΣ ΚΗΦΙΣΙΑΣ 172 ΜΑΡΟΥΣΙ ΤΗΛ 210 61 48 618, email info@lamaris.g
ΠΛ. ΗΡΩΩΝ ΚΥΠΡΙΑΚΟΥ ΑΓΩΝΑ 2 ΚΕΡΚΥΡΑ 491 00 ΤΗΛ. 26610 36661, E-mail garme@tee.gr

ΕΡΓΟΔΟΤΗΣ : ΙΟΝΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ - Δ/ΝΣΗ ΤΕΧΝΙΚΩΝ ΕΡΓΩΝ

ΕΡΓΟ : ΕΚΠΟΝΗΣΗ ΓΕΩΤΕΧΝΙΚΗΣ ΜΕΛΕΤΗΣ ΤΩΝ ΝΕΩΝ ΚΤΙΡΙΑΚΩΝ ΕΓΚ/ΣΕΩΝ ΤΟΥ ΙΟΝΙΟΥ ΠΑΝΕΠΙΣΤΗΜΙΟΥ ΣΤΟ ΟΙΚΟΠΕΔΟ Ε.Α.Σ.Κ. ΣΤΗΝ ΚΕΡΚΥΡΑ

ΑΡΙΘΜΟΣ ΕΡΓΟΥ : Ε- 540/07

ΠΙΝΑΚΑΣ 1. ΣΥΓΚΕΝΤΡΩΤΙΚΟΣ ΠΙΝΑΚΑΣ ΑΠΟΤΕΛΕΣΜΑΤΩΝ ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ - ΦΥΣΙΚΑ & ΜΗΧΑΝΙΚΑ ΧΑΡΑΚΤΗΡΙΣΤΙΚΑ (ΣΥΝΕΧΕΙΑ)

ΓΕΩΤΡΗΣΗ No	ΕΝΟΤΗΤΑ	ΒΑΘΟΣ ΔΕΙΓΜΑΤΟΣ	ΧΑΡΑΚΤΗΡΙΣΜΟΣ USCS	ΕΙΔΙΚΟ ΒΑΡΟΣ Gs	ΚΟΚΚΟΜΕΤΡΙΑ%						ΦΥΣΙΚΗ ΥΓΡΑΣΙΑ ΔΕΙΓΜΑΤΟΣ, w %	ΟΡΙΑ ATTERBERG			ΦΑΙΝΟΜΕΝΑ ΒΑΡΗ		ΑΝΤΟΧΗ ΣΕ ΑΝΕΜΠΟΔΙΣΤΗ ΘΛΙΨΗ q_u kPa	ΔΟΚΙΜΗ ΣΤΕΡΕΟΠΟΙΗΣΗΣ		
					ΧΑΛΙΚΙΑ	ΑΜΜΟΣ	ΛΕΠΤ/ΚΑ	ΙΛΥΣ	ΑΡΓΙΛΟΣ	D_{50} (mm)		LL %	PL%	PI%	ΥΓΡΟ γ_{wet} kN/m^3	ΞΗΡΟ γ_{dry} kN/m^3		Cc	Cs	ΛΟΓΟΣ ΚΕΝΩΝ e_0
Γ - 5	3η	2,65 - 3,05	**CL**		17,7	24,0	58,3				15,5	38	18	20						
Γ - 5	2η	4,75 - 5,00	**SC**		30,8	34,7	34,5				10,3	48	18	30	21,18*	19,85*	1101*			
Γ - 5	2η	10,20 - 10,50	**SC**		22,3	30,0	47,7				13,0	51	20	31						
Γ - 5	2η	13,00 - 13,50	**GC**		50,2	39,6	10,2				11,9	53	20	33						
Γ - 6	3η	2,70 - 3,00	**CL**		15,5	29,7	54,8				13,2	30	16	14						
Γ - 6	2η	5,65 - 6,00	**GC**		38,8	29,1	32,1				10,3	35	18	17						
Γ - 6	2η	7,95 - 8,30	**GC**		30,2	29,8	40,0					25	16	9						
Γ - 6	2η	11,10 - 11,50	**SC**		34,4	36,0	29,6					27	16	11						
Γ - 7	3η	2,65 - 2,95	**CH**		11,2	34,8	54,0				10,4	54	27	27						
Γ - 7	2η	5,00 - 5,25	**SC - SM**		18,8	40,9	40,3					53	29	24						
Γ - 7	2η	9,60 - 9,80	**SC**		33,1	45,7	21,2				12,3	23	14	9						

*Μη αντιπροσωπευτικές τιμές.

συμπράττοντα γραφεία γεωτεχνικών μελετών : «ΧΑΡΗΣ ΛΑΜΑΡΗΣ - ΓΙΩΡΓΟΣ ΑΡΜΕΝΗΣ»
ΛΕΩΦΟΡΟΣ ΚΗΦΙΣΙΑΣ 172 ΜΑΡΟΥΣΙ ΤΗΛ 210 61 48 618, email info@lamaris.g
ΠΛ. ΗΡΩΩΝ ΚΥΠΡΙΑΚΟΥ ΑΓΩΝΑ 2 ΚΕΡΚΥΡΑ 491 00 ΤΗΛ. 26610 36661, E-mail garme@tee.gr

ΕΡΓΟΔΟΤΗΣ : **ΙΟΝΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ - Δ/ΝΣΗ ΤΕΧΝΙΚΩΝ ΕΡΓΩΝ**

ΕΡΓΟ : **ΕΚΠΟΝΗΣΗ ΓΕΩΤΕΧΝΙΚΗΣ ΜΕΛΕΤΗΣ ΤΩΝ ΝΕΩΝ ΚΤΙΡΙΑΚΩΝ ΕΓΚ/ΣΕΩΝ ΤΟΥ ΙΟΝΙΟΥ ΠΑΝΕΠΙΣΤΗΜΙΟΥ ΣΤΟ ΟΙΚΟΠΕΔΟ Ε.Α.Σ.Κ. ΣΤΗΝ ΚΕΡΚΥΡΑ**

ΑΡΙΘΜΟΣ ΕΡΓΟΥ : **Ε- 540/07**

ΠΙΝΑΚΑΣ 1. ΣΥΓΚΕΝΤΡΩΤΙΚΟΣ ΠΙΝΑΚΑΣ ΑΠΟΤΕΛΕΣΜΑΤΩΝ ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ - ΦΥΣΙΚΑ & ΜΗΧΑΝΙΚΑ ΧΑΡΑΚΤΗΡΙΣΤΙΚΑ (ΣΥΝΕΧΕΙΑ)

ΓΕΩΤΡΗΣΗ No	ΕΝΟΤΗΤΑ	ΒΑΘΟΣ ΔΕΙΓΜΑΤΟΣ	ΧΑΡΑΚΤΗΡΙΣΜΟΣ USCS	ΕΙΔΙΚΟ ΒΑΡΟΣ Gs	ΚΟΚΚΟΜΕΤΡΙΑ%						ΦΥΣΙΚΗ ΥΓΡΑΣΙΑ ΔΕΙΓΜΑΤΟΣ, w %	ΟΡΙΑ ATTERBERG			ΦΑΙΝΟΜΕΝΑ ΒΑΡΗ		ΑΝΤΟΧΗ ΣΕ ΑΝΕΜΠΟΔΙΣΤΗ ΘΛΙΨΗ q_u kPa	ΔΟΚΙΜΗ ΣΤΕΡΕΟΠΟΙΗΣΗΣ		
					ΧΑΛΙΚΙΑ	ΑΜΜΟΣ	ΛΕΠΤ/ΚΑ	ΙΛΥΣ	ΑΡΓΙΛΟΣ	D_{50} (mm)		LL %	PL%	PI%	ΥΓΡΟ γ_{wet} kN/m^3	ΞΗΡΟ γ_{dry} kN/m^3		Cc	Cs	ΛΟΓΟΣ ΚΕΝΩΝ e_0
2η Ενότητα		MIN			15,3	29,1	10,0	29,7	19,3		10,3	23	14	8	22,02	18,68	79			
		MAX			50,2	52,1	49,0	29,7	19,3		20,8	64	29	41	24,24	19,35	165			
		Μ.Ο.			29,7	36,9	33,4	29,7	19,3		13,7	39	19	20	23,13	19,02	122			
3η Ενότητα		MIN		2,670	6,3	24,0	50,2	30,9	19,3		11,0	24	14	10	19,53	16,55	397	0,050	0,005	0,45
		MAX		2,670	19,8	34,8	69,5	33,6	28,0		26,2	81	28	54	20,87	18,82	405	0,050	0,005	0,45
		Μ.Ο.		2,670	13,1	29,1	57,8	31,8	25,1		15,5	42	21	22	20,20	17,69	401	0,050	0,005	0,45
4η Ενότητα		MIN			65,6	30,0	1,6				7,4									
		MAX			66,7	31,7	4,4													
		Μ.Ο.			66,2	30,9	3,0				7,4									

συμπράττοντα γραφεία γεωτεχνικών μελετών : «ΧΑΡΗΣ ΛΑΜΑΡΗΣ - ΓΙΩΡΓΟΣ ΑΡΜΕΝΗΣ»
ΛΕΩΦΟΡΟΣ ΚΗΦΙΣΙΑΣ 172 ΜΑΡΟΥΣΙ ΤΗΛ 210 61 48 618, email info@lamaris.g
ΠΛ. ΗΡΩΩΝ ΚΥΠΡΙΑΚΟΥ ΑΓΩΝΑ 2 ΚΕΡΚΥΡΑ 491 00 ΤΗΛ. 26610 36661, E-mail garme@tee.gr

ΠΑΡΑΡΤΗΜΑ

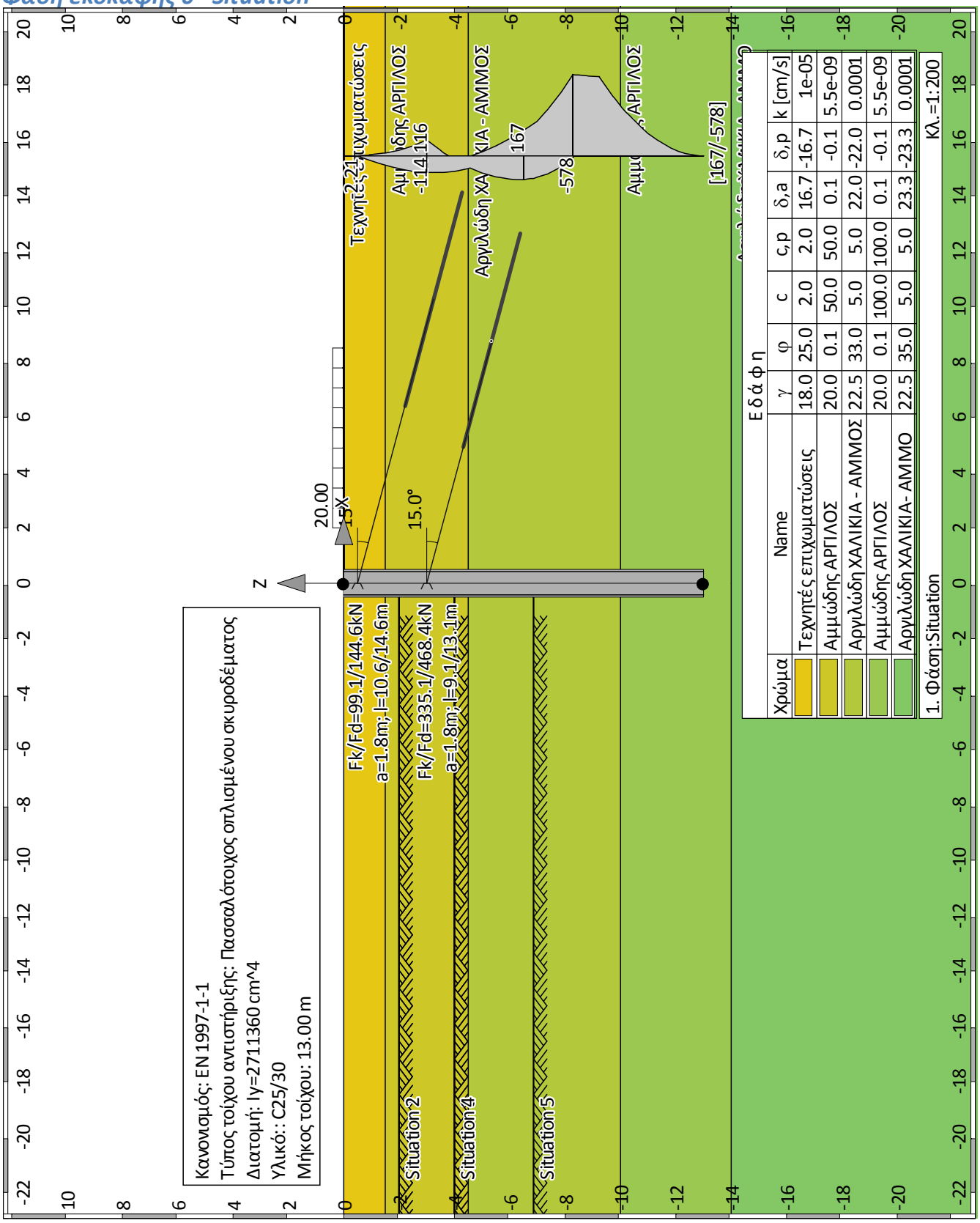
8.5 Αποτελέσματα ανάλυσης

8.5.1 Στατικές Συνθήκες

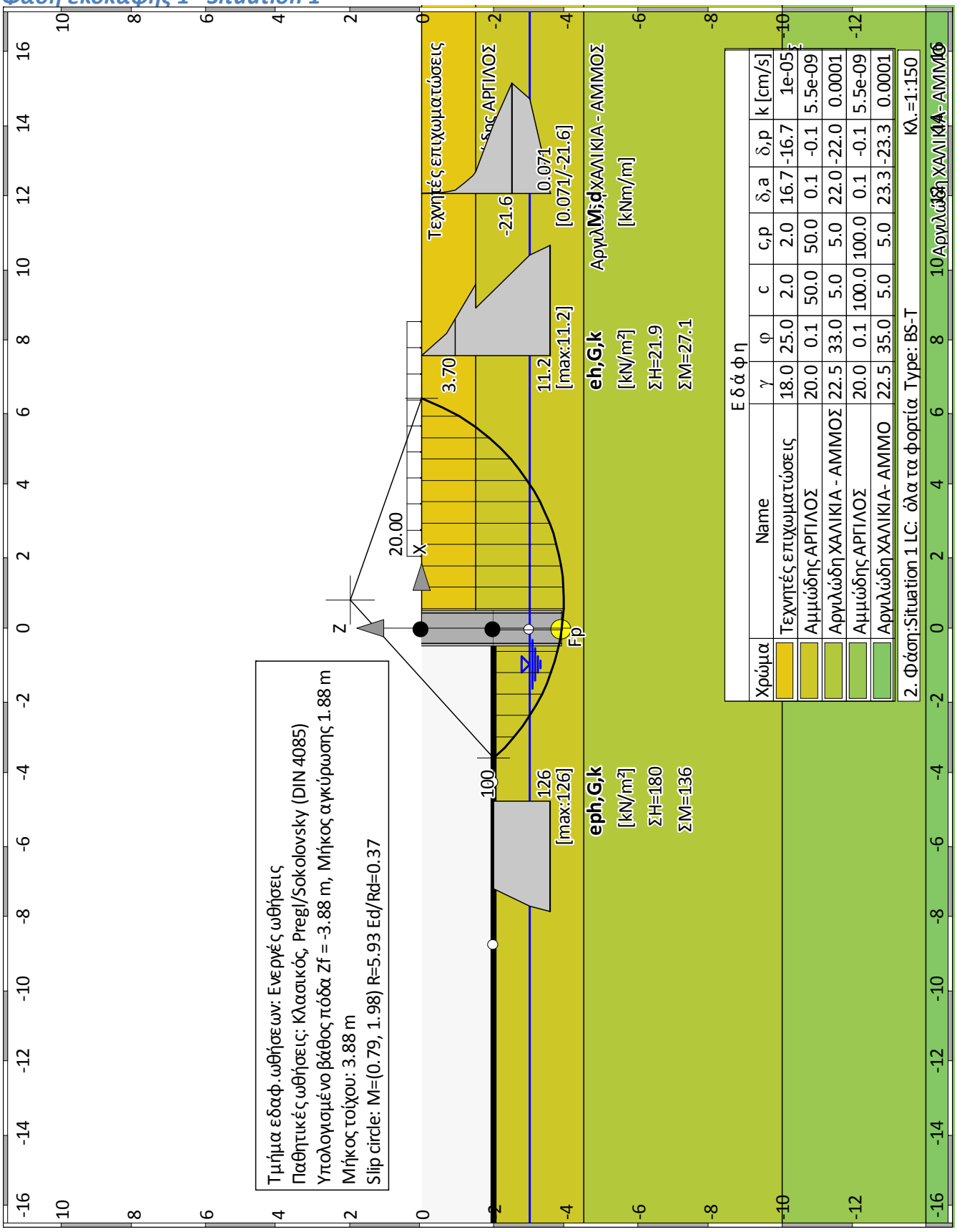
i) Αντιστηριζόμενο ύψος 6,35m

Summary of all stages

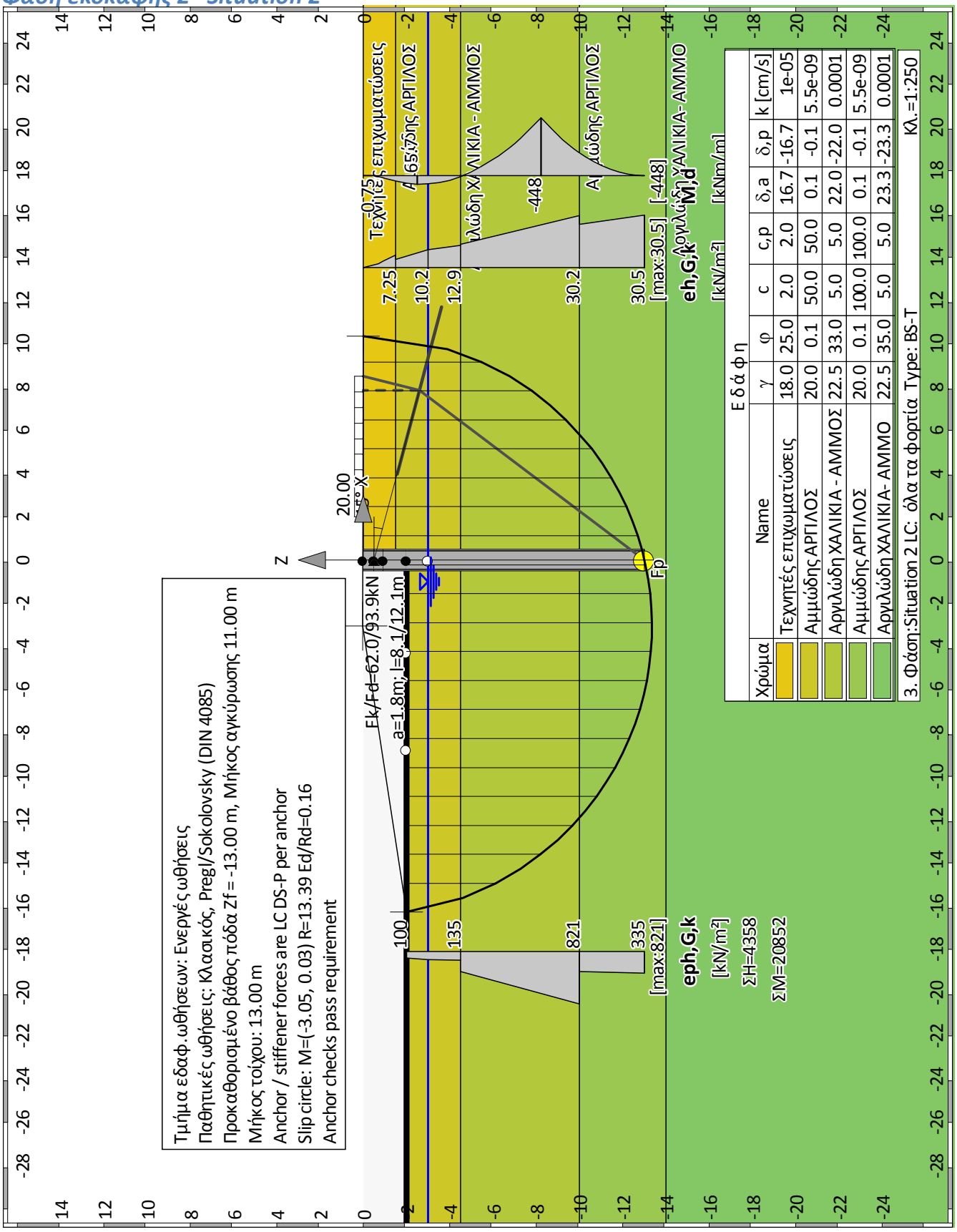
Φάση εκσκαφής 0 "Situation"



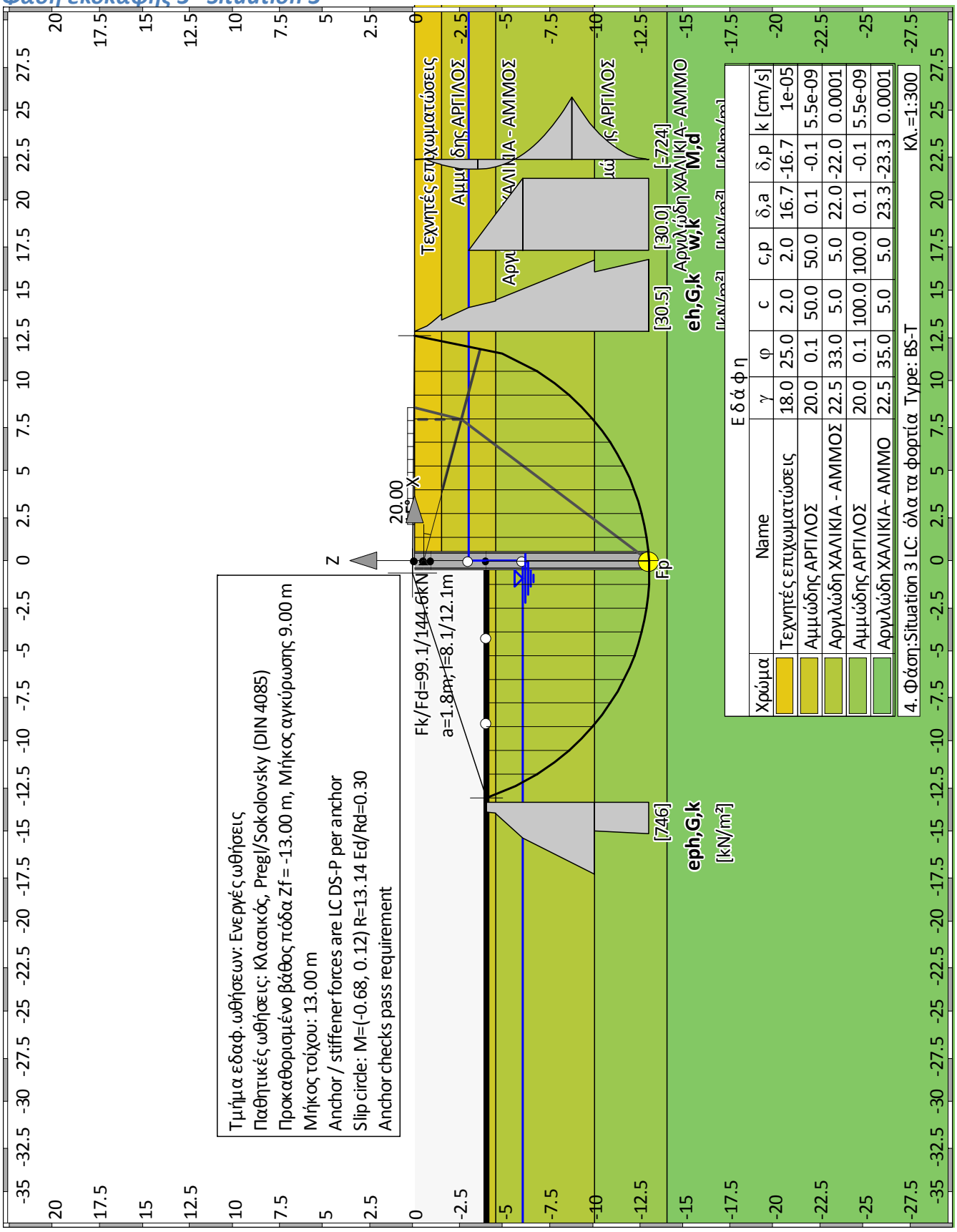
Φάση εκσκαφής 1 "Situation 1"



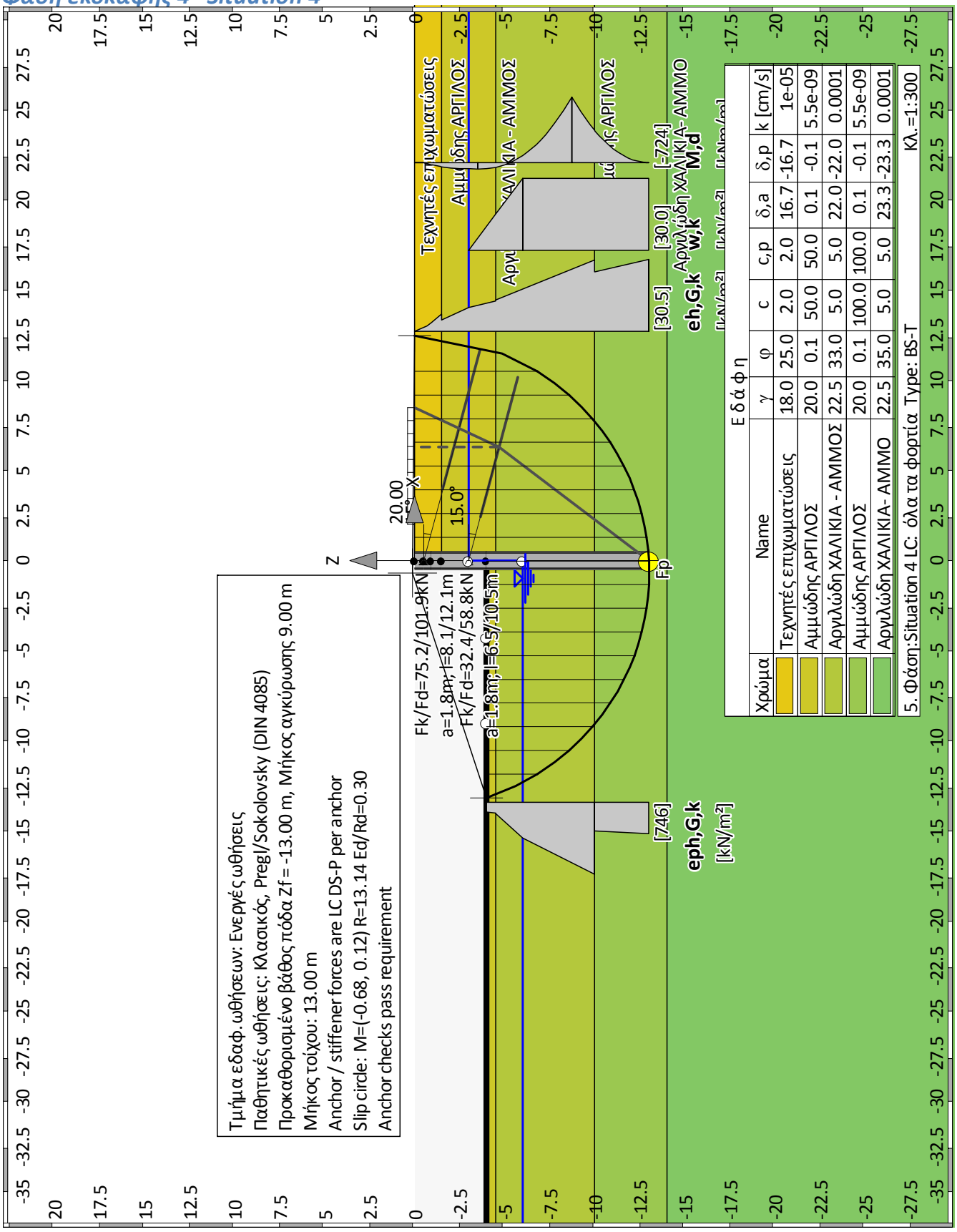
Φάση εκσκαφής 2 "Situation 2"



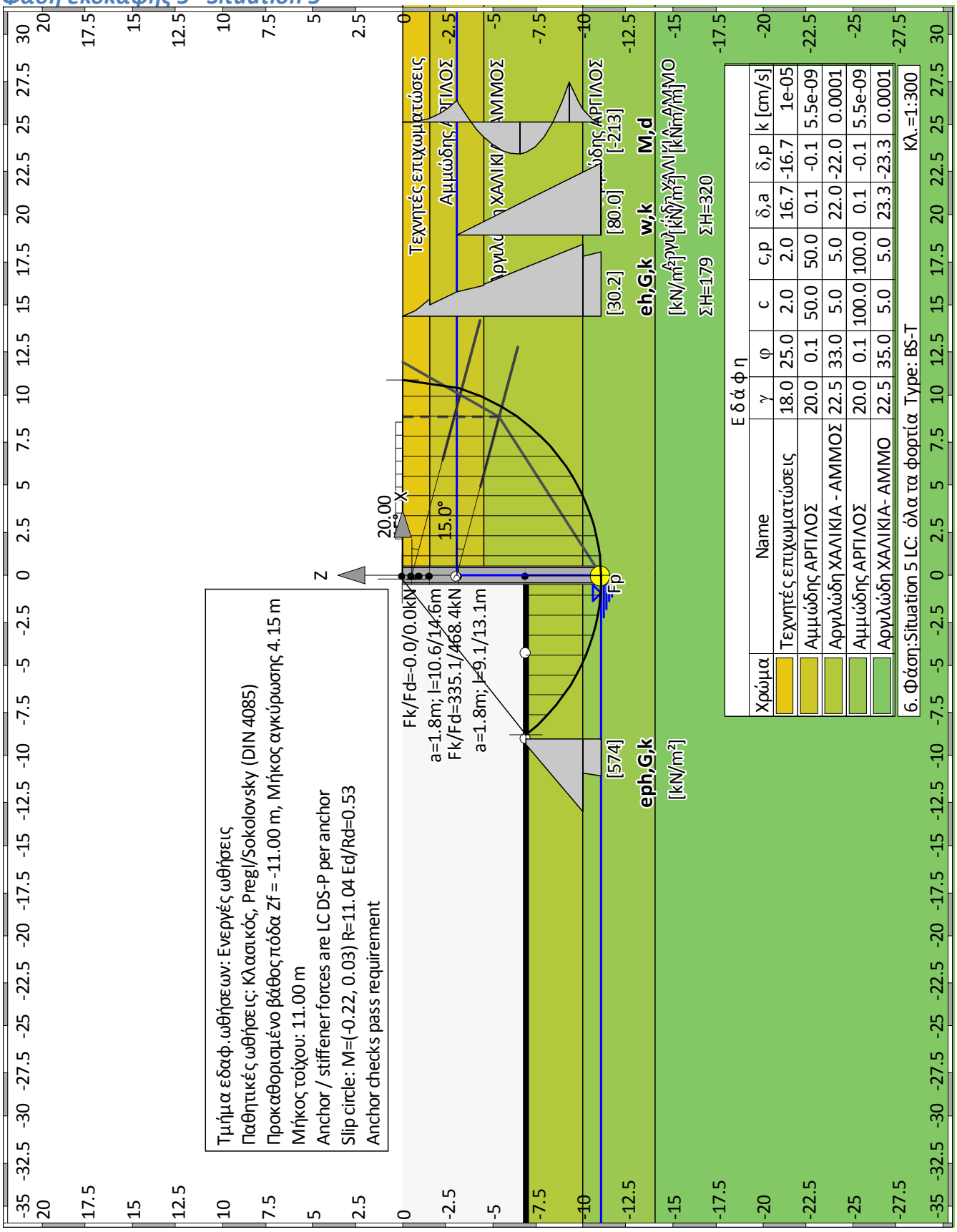
Φάση εκσκαφής 3 "Situation 3"



Φάση εκσκαφής 4 "Situation 4"



Φάση εκσκαφής 5 "Situation 5"



Κανονισμόςγια Ανάλυση και Διαστασιολόγηση

Διαστασ. ωπλισμ.σκυροδ.: EN 1992-1-1
Γεωτεχν.Κανονισμός : EN 1997 (rev.12)_user
National Annex: EN 1997-1

Safety factors:

Earth pressure onto wall: [GEO] A1 M1 R2

γ-	G,dst	E0G	G,stb	Q,dst	Q,stb	phi	coe	cu	g
BS-P	1.350	1.350	1	1.500	0	1	1	1	1
BS-T	1.350	1.350	1	1.500	0	1	1	1	1
BS-T/A	1.350	1.350	1	1.500	0	1	1	1	1
BS-E	1	1	1	1	0	1	1	1	1

ΚΕ-μηχανισμός: [GEO] A2 M2 R3

γ-	G,dst g	G,stb a,t	W a,p	Q,dst Gt	Q,stb N	phi	coe	cu
BS-P	1	1	1	1.300	0	1.250	1.400	1.400
	1	1	1	1	1			
BS-T	1	1	1	1.300	0	1.250	1.400	1.400
	1	1	1	1	1			
BS-T/A	1	1	1	1.300	0	1.250	1.250	1.400
	1	1	1	1	1			
BS-E	1	1	1	1	0	1.250	1.400	1.400
	1	1	1	1	1			

Θραύση εδάφους: [GEO] A1 M1 R2

γ-	G,dst cu	E0G g	W Re	G,stb	Q,dst	Q,stb	phi	coe
BS-P	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.400					
BS-T	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.400					
BS-T/A	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.400					
BS-E	1	1	1	1	1	0	1	1
	1	1	1					

Ολίσθηση: [GEO] A1 M1 R2

γ-	G,dst cu	E0G g	W Rh	G,stb	Q,dst	Q,stb	phi	coe
BS-P	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.100					
BS-T	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.100					
BS-T/A	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.100					
BS-E	1	1	1	1	1	0	1	1
	1	1	1					

Θραύση εδάφους: [GEO] A1 M1 R2

γ-	G,dst cu	E0G g	W Rv	G,stb	Q,dst	Q,stb	phi	coe
BS-P	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.400					
BS-T	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.400					
BS-T/A	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.400					
BS-E	1	1	1	1	1	0	1	1
	1	1	1					

Κύκλος ολίσθησης: [GEO] A2 M2 R3

	γ-g	G,dst Re	G,stb a,t	Q,dst a,p	Q,stb Gt	W N	phi	coe	cu
BS-P	1	1	1.300	0	1	1.250	1.400	1.400
	1	1	1	1	1	1			
BS-T	1	1	1.300	0	1	1.250	1.400	1.400
	1	1	1	1	1	1			
BS-T/A	1	1	1.300	0	1	1.250	1.250	1.400
	1	1	1	1	1	1			
BS-E	1	1	1	0	1	1.250	1.400	1.400
	1	1	1	1	1	1			

Hydraulic heave: [HYD] A1 M1 R1

	γ-	G,dst	G,stb	Q,dst	H
BS-P	1.350	0.900	1.500	1.800
BS-T	1.350	0.900	1.500	1.600
BS-T/A	1.350	0.900	1.500	1.500
BS-E	1	1	1	1

Failure of structural elements: [STR] A1 M1 R1

	γ-	M	Gtf	cd	N
BS-P	1.150	1.400	1.400	1.150
BS-T	1.150	1.300	1.300	1.150
BS-T/A	1.150	1.250	1.250	1.150
BS-E	1	1	1	1

Stability: [EQU] A1 M1 R1

	γ-	G,dst	G,stb	Q,dst	Q,stb	phi	coe	cu	g
BS-P	1	0.900	1.500	0	1.250	1.250	1.400	1
BS-T	1	0.900	1.500	0	1.250	1.250	1.400	1
BS-T/A	1	0.900	1.500	0	1.250	1.250	1.400	1
BS-E	1	1	1	0	1.250	1.400	1.400	1

γ,Re,red (EAB EB14-3): Ναι, η=0.80
γ,Re,red (EAB EB22-6): Ναι, E0h > 0%: η = 0.60 / 0.80

System values

Τοίχος

Τύπος τοίχου αντιστήριξης: Πασσαλότοιχος οπλισμένου σκυροδέματος
Διατομή: Iy=2711360 cm^4
Υλικό:: C25/30
Ίδιο βάρος: 25.000 [kN/m3]

Σημεία τοίχου

z [m]	d [m]	E [MN/m2]	Iy [cm4/m]	E*Iy [MNm2]	A [cm2/m]
0.00	100.0	31500.0	2711360	854.1	8400
-13.00	100.0	31500.0	2711360	854.1	8400

Φάση εκσκαφής 1 "[1] Situation 1"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 5 Στρώσεις

Name		Τεχνητές επιχωματώσεις	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
γ	[kN/m3]	18	20	22.5
γ,R	[kN/m3]	18	20	22.5
γ'	[kN/m3]	8	10	12.5
γ,p	[kN/m3]	18	20	22.5
γ,R,passive	[kN/m3]	18	20	22.5
γ,pw	[kN/m3]	8	10	12.5
φ	[°]	25	0.1	33
c	[kN/m2]	2	50	5
c,u	[kN/m2]	10	50	5
c παθητικό	[kN/m2]	2	50	5
δ,a	[°]	16.66667	0.06666667	22
δ,p	[°]	-16.66667	-0.06666667	-22
δ,c	[°]	8.333333	0.03333333	11
k,agh	[-]	0.3456501	0.9955057	0.2452023
K,ach	[-]	1.043051	1.994195	0.8549058
K,0h	[-]	0.5773817	0.9982547	0.455361
K,pgh	[-]	3.908103	1.004519	7.495617
K,pch	[-]	5.180327	2.00583	8.599509
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	10e-06	5.5e-09	100e-06

Name		Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20	22.5
γ,R	[kN/m3]	20	22.5
γ'	[kN/m3]	10	12.5
γ,p	[kN/m3]	20	22.5
γ,R,passive	[kN/m3]	20	22.5
γ,pw	[kN/m3]	10	12.5
φ	[°]	0.1	35
c	[kN/m2]	100	5
c,u	[kN/m2]	100	5
c παθητικό	[kN/m2]	100	5
δ,a	[°]	0.06666667	23.33333
δ,p	[°]	-0.06666667	-23.33333
δ,c	[°]	0.03333333	11.66667
k,agh	[-]	0.9955057	0.2244207
K,ach	[-]	1.994195	0.8126539
K,0h	[-]	0.9982547	0.4264236
K,pgh	[-]	1.004519	9.146943
K,pch	[-]	2.00583	10.104
τ,gr	[kN/m2]	110	110
Ψ,A,max	[°]	90	90
k	[cm/s]	5.5e-09	100e-06

Πορεία πρανούς:
x [m] 0.00 0.00
z [m] -2.00 0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
x [m] 0.00 0.00
z [m] -2.00 -1.50

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:
z= -4.50

Πορεία ανώτερου 4. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
z= -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -14.00

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
2.00	0.00	8.50	0.00	0.00	20.00	0.00	20.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Στάθμη νερού:

x [m] 0.00
z [m] -3.00

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Ενεργές ωθήσεις.
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: No redistribution of earth pressure.
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Κλασικός, Pregl/Sokolovsky (DIN 4085).

Options for water pressure

Στήριξη πόδα

Πακτωμένη στήριξη κατά Blum

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

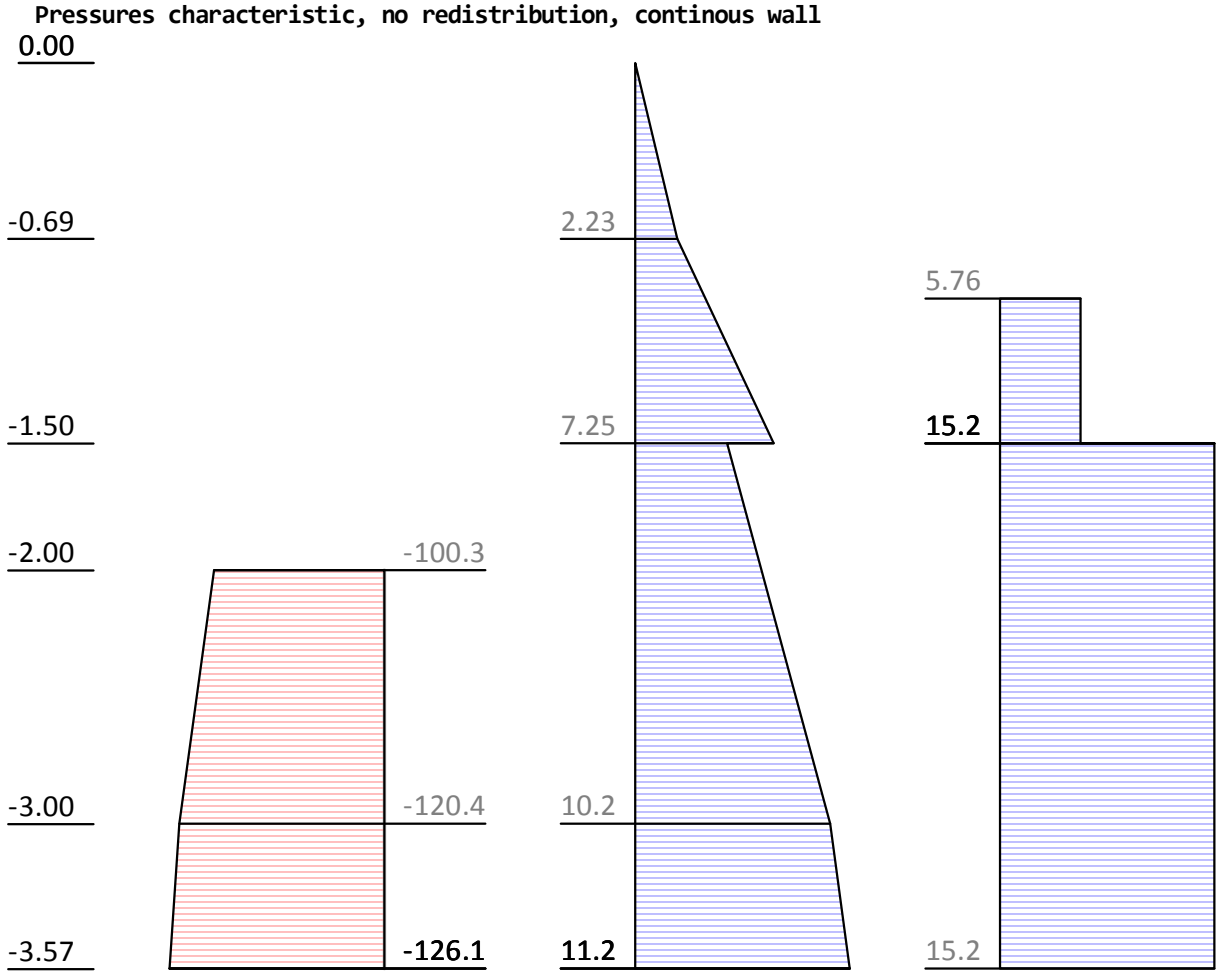
Μήκος τοίχου

N: 1 Z: -3.000 M,Στήριξη πόδα,d: 18.43. Wall too short? Ναι
N: 2 Z: -6.000 M,Στήριξη πόδα,d: -467.02. Wall too short? Όχι
N: 3 Z: -3.990 M,Στήριξη πόδα,d: -24.59. Wall too short? Όχι
N: 4 Z: -3.327 M,Στήριξη πόδα,d: 9.81. Wall too short? Ναι
N: 5 Z: -3.771 M,Στήριξη πόδα,d: -10.67. Wall too short? Όχι
N: 6 Z: -3.473 M,Στήριξη πόδα,d: 4.18. Wall too short? Ναι
N: 7 Z: -3.673 M,Στήριξη πόδα,d: -5.26. Wall too short? Όχι
N: 8 Z: -3.539 M,Στήριξη πόδα,d: 1.30. Wall too short? Ναι
N: 9 Z: -3.629 M,Στήριξη πόδα,d: -2.99. Wall too short? Όχι
N: 10 Z: -3.569 M,Στήριξη πόδα,d: -0.07. Wall too short? Όχι
Foot depth for statics: zf = -3.569

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall

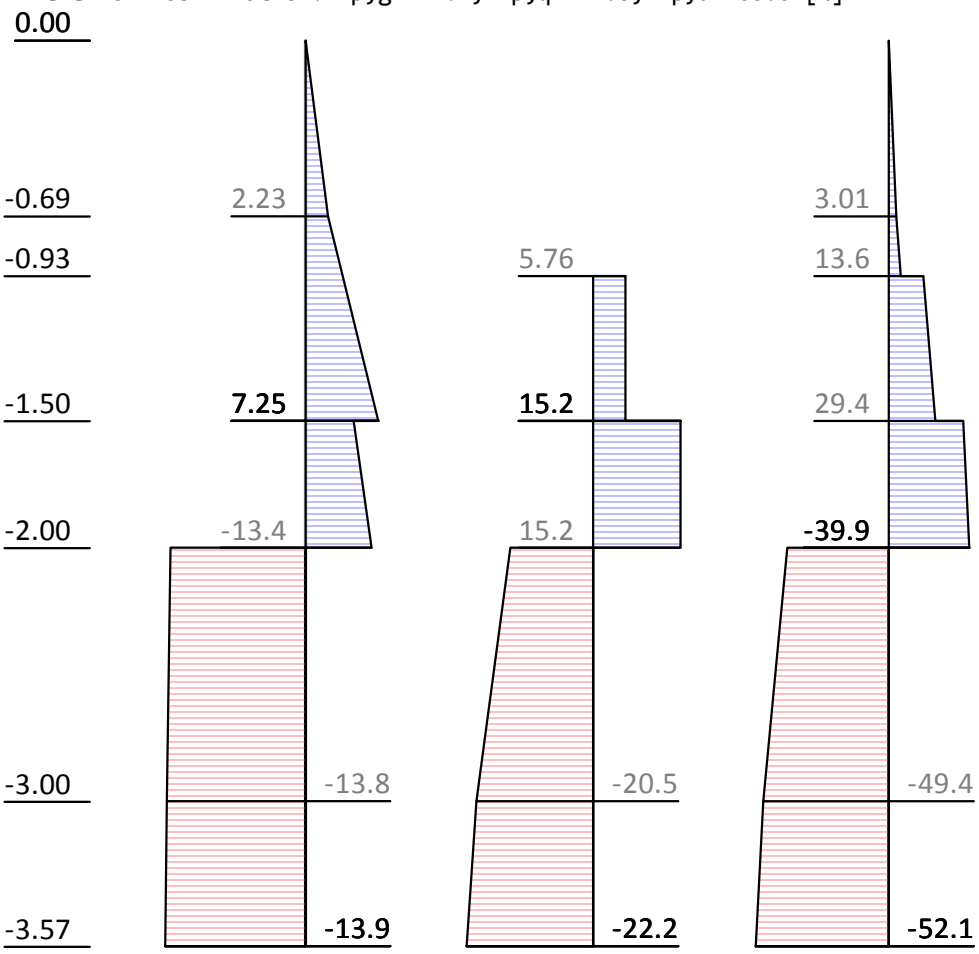


z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.93		3.72	0.00	5.00
-0.93		3.72	5.76	13.64
-1.50		7.25	5.76	18.43
-1.50		4.82	15.23	29.36
-2.00	-0.00	6.61	15.23	31.77
-2.00	-100.29	6.61	15.23	31.77
-3.57	-126.10	11.20	15.23	37.96

Eph,G,k: -180.43, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 21.92, Eah,PG,k: 0.00, Eah,PQ,k: 34.80, Eah,d: 81.80

H-pressure on static system

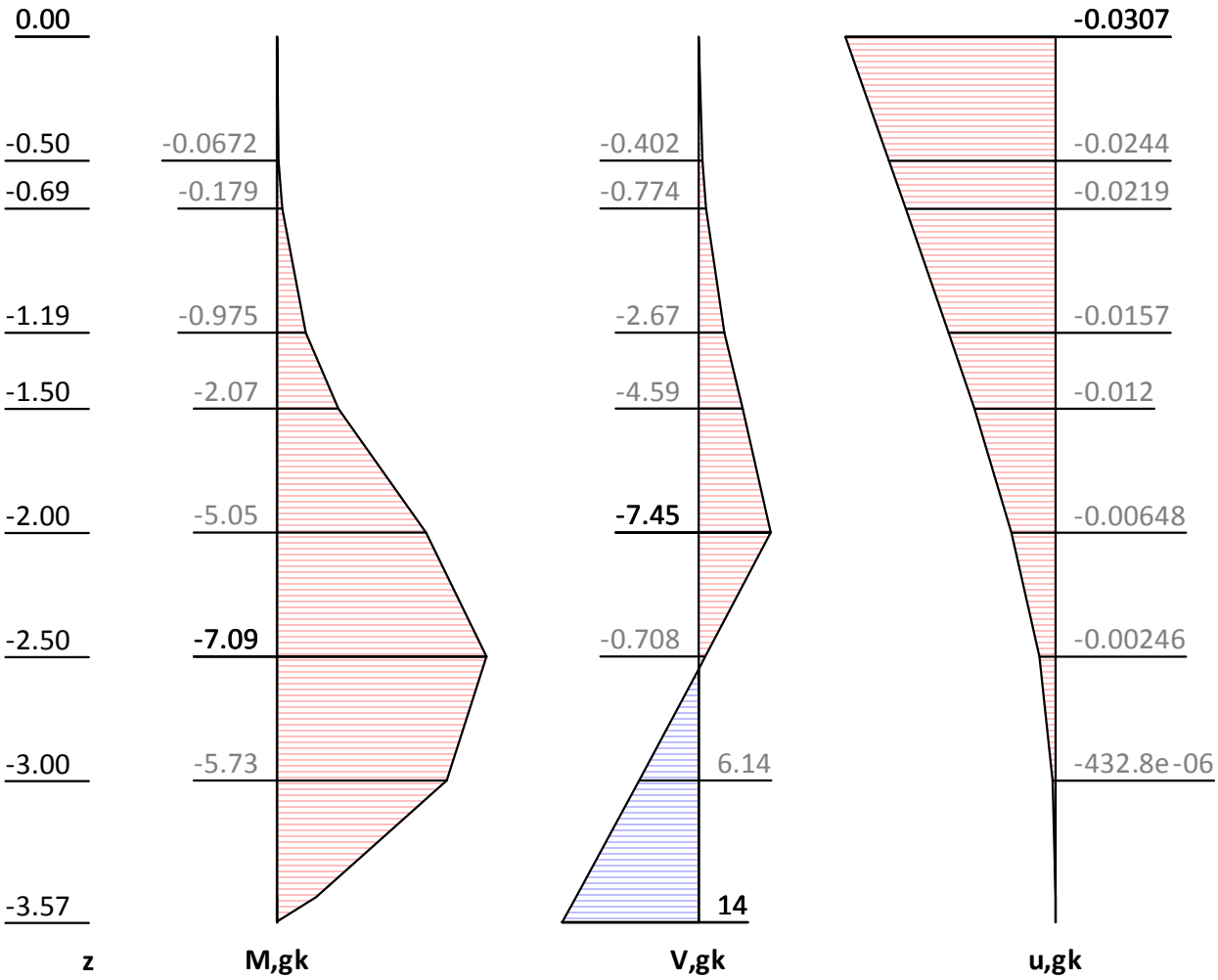
Level of mobilization: Ep,gk 19.9, Ep,qk 29.6, Ep,d 100.0 [%]



z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	0.00		0.00
-0.93	3.72	0.00	5.00
-0.93	3.72	5.76	13.64
-1.50	7.25	5.76	18.43
-1.50	4.82	15.23	29.36
-2.00	6.61	15.23	31.77
-2.00	-13.38	-14.50	-39.87
-3.57	-13.93	-22.15	-52.10

V-pressure on static system

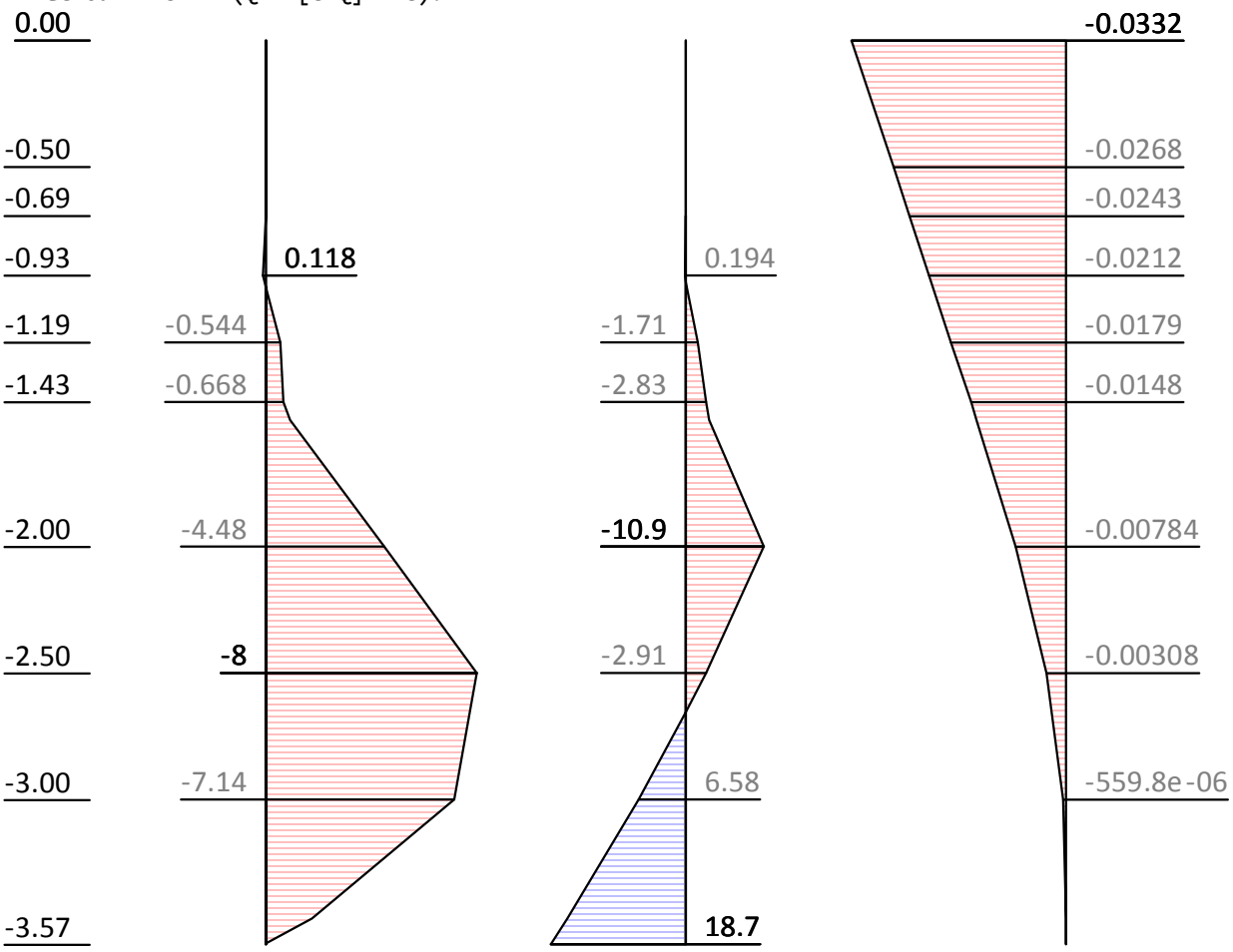
Internal forces: Permanent, characteristically



z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	0.00	0.00	0.00	0.00	-0.03
-1.50	7.25	-2.07	-4.59	-33.13	-0.01
-1.50	4.82	-2.07	-4.59	-33.13	-0.01
-2.00	6.61	-5.05	-7.45	-43.63	-0.01
-2.00	-13.38	-5.05	-7.45	-43.63	-0.01
-2.50	-13.60	-7.09	-0.71	-54.12	-0.00
-2.55	-13.62	-6.95	-0.00	-55.21	-0.00
-3.57	-13.93	0.00	14.03	-71.77	-0.00
-3.57	-13.93	0.00	14.03	-71.77	0.00

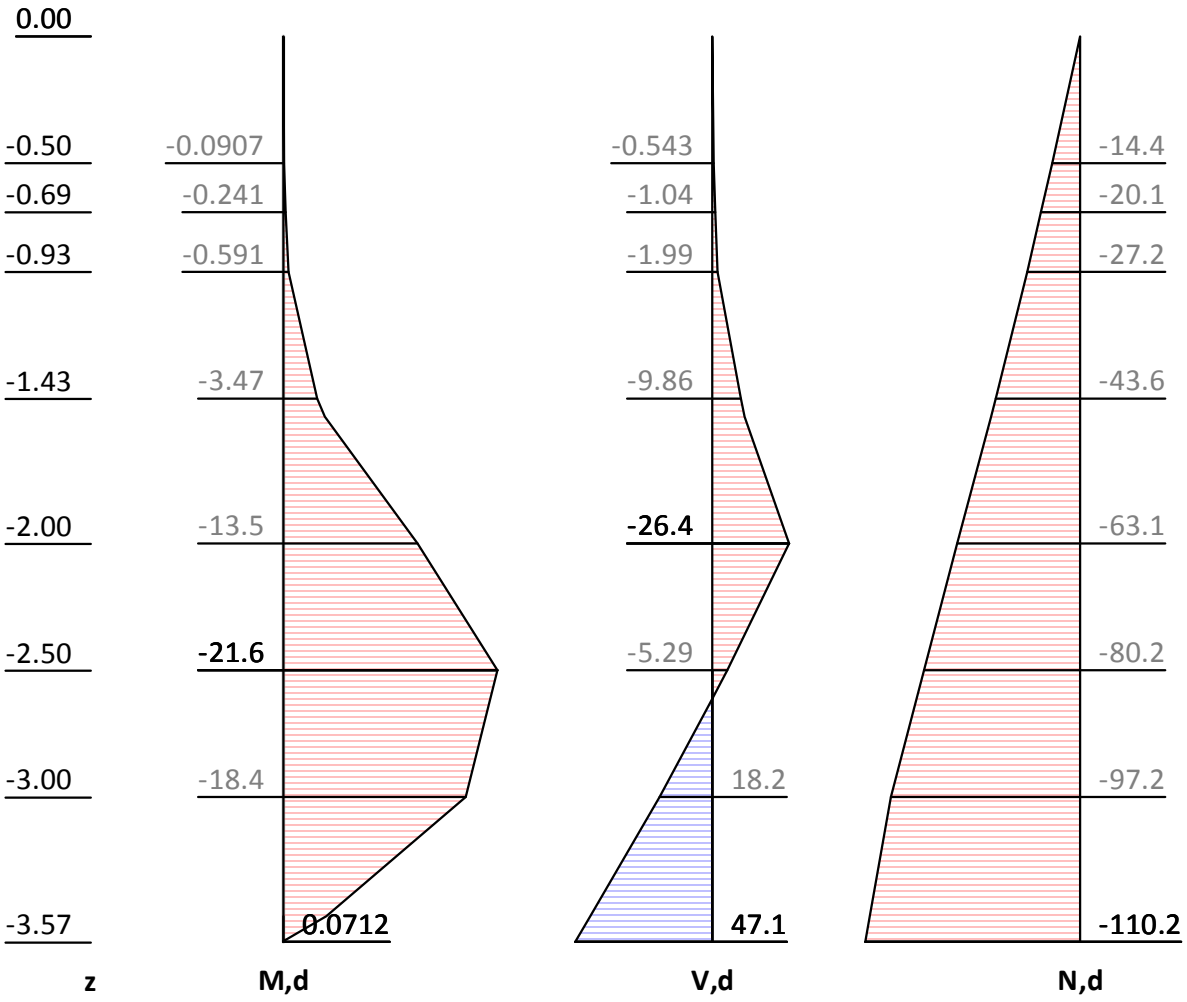
Internal forces: Variable, characteristically

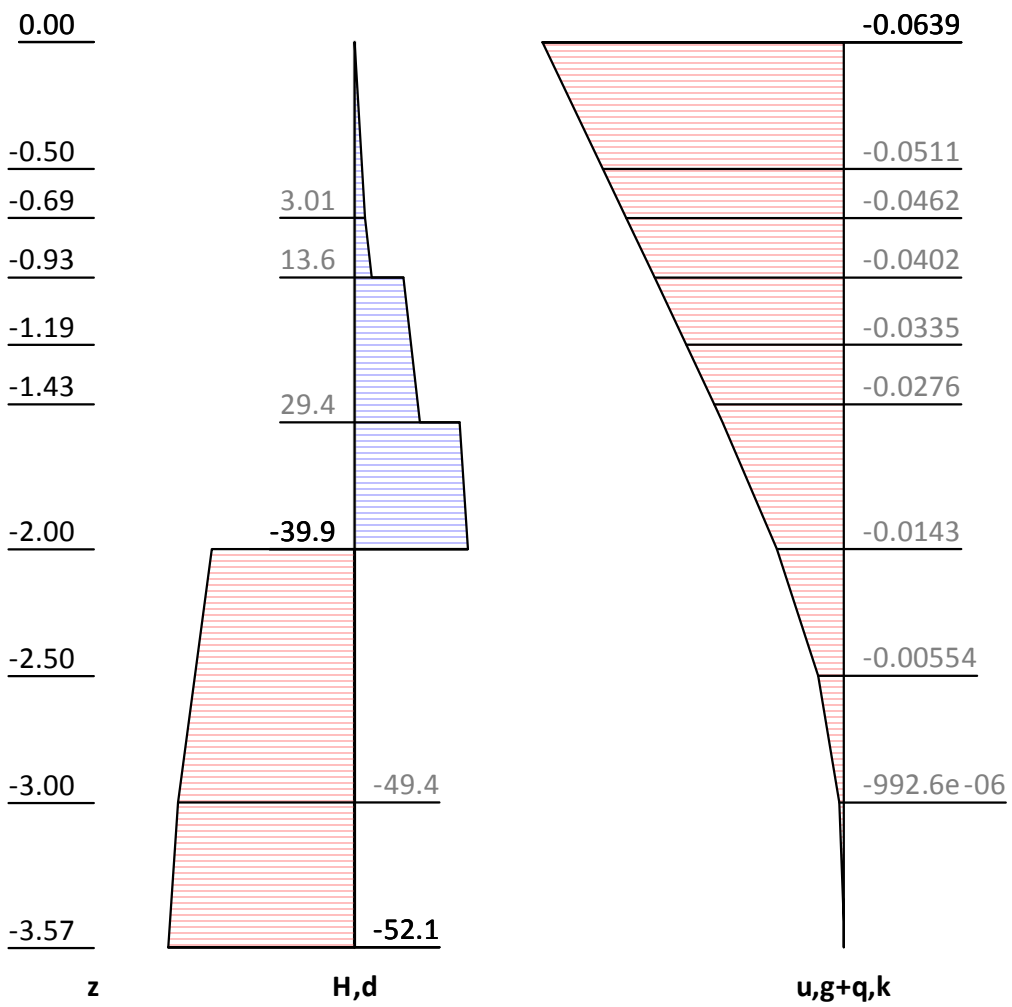
Method EB 82-4 (Q = [G+Q] - G).



z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00	0.00		-0.03
-0.69		0.00	-0.00	0.00	-0.02
-0.69		-0.00	0.00	0.00	-0.02
-0.93	0.00	0.12	0.19	0.05	-0.02
-0.93	5.76	0.12	0.19	0.05	-0.02
-0.95	5.76	0.06	0.01	0.00	-0.02
-0.96	5.76	0.05	-0.00	-0.00	-0.02
-0.98	5.76	0.00	-0.14	-0.04	-0.02
-1.50	5.76	-0.94	-3.28	-0.84	-0.01
-1.50	15.23	-0.94	-3.28	-0.84	-0.01
-2.00	15.23	-4.48	-10.90	-2.79	-0.01
-2.00	-14.50	-4.48	-10.90	-2.79	-0.01
-2.50	-17.48	-8.00	-2.91	-4.72	-0.00
-2.65	-18.39	-7.73	-0.00	-5.32	-0.00
-3.57	-22.15	-0.00	18.69	-8.85	-0.00
-3.57	-22.15	0.00	18.69	-8.85	0.00

Internal forces: Design

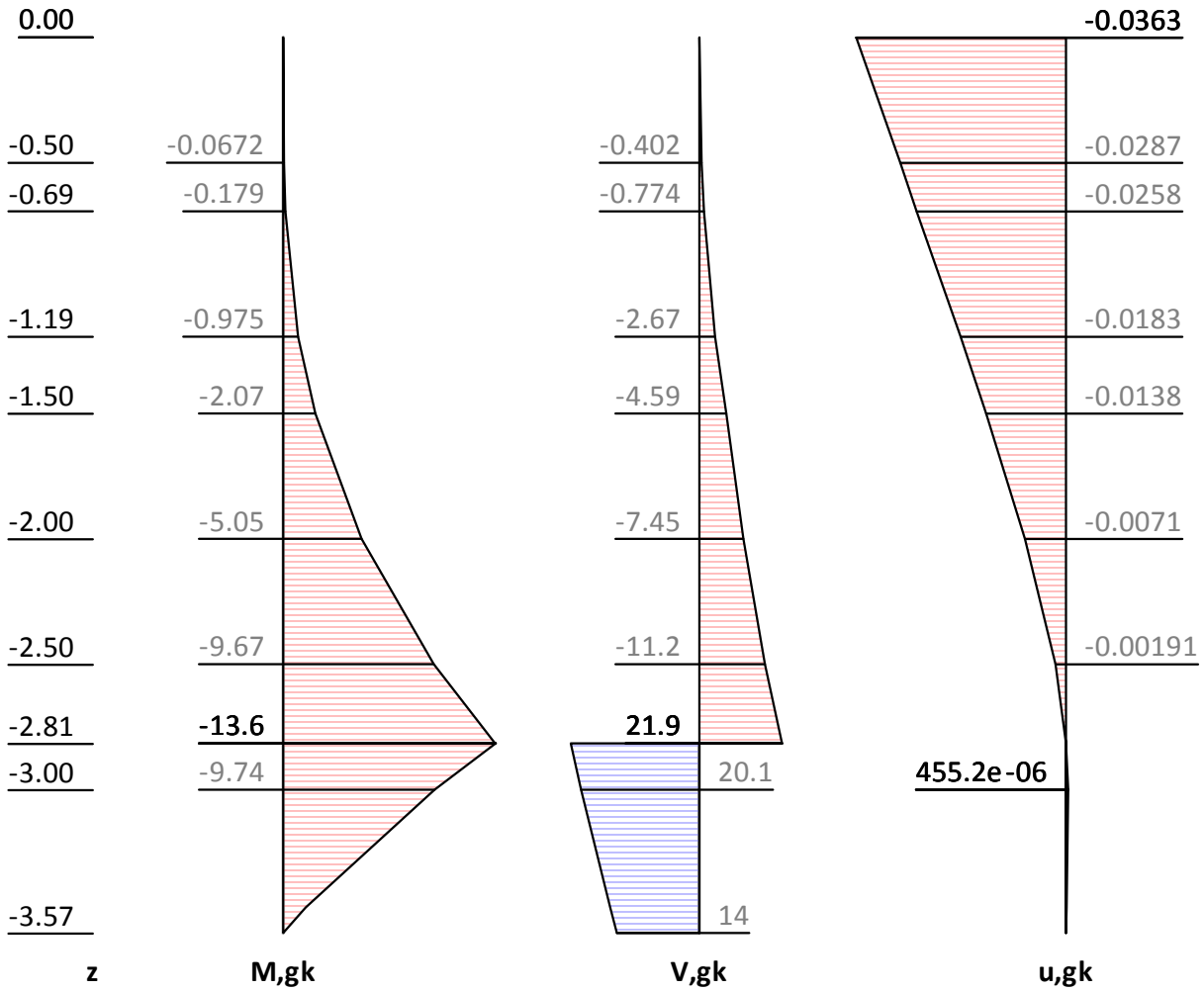




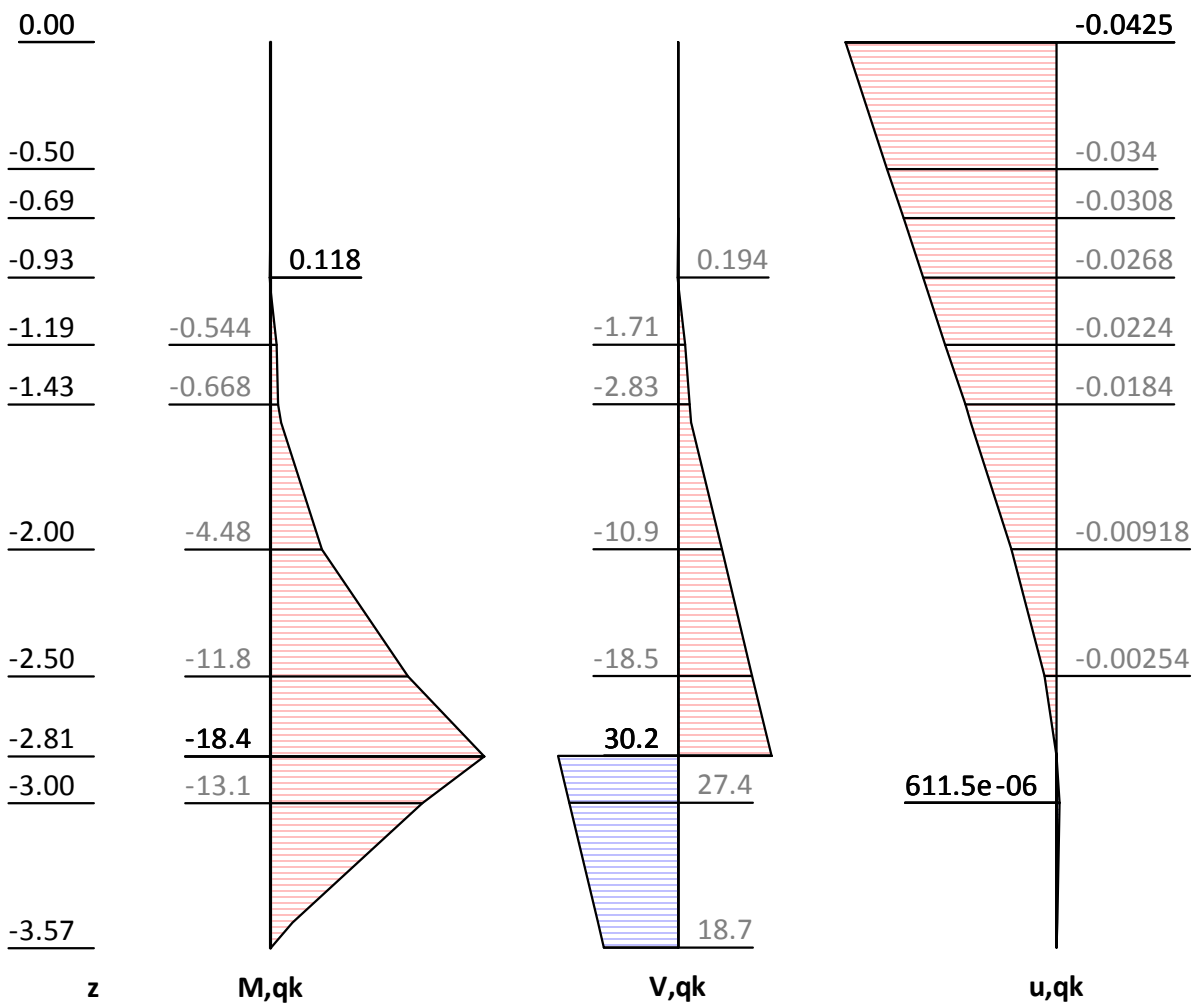
z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	0.00	0.00	0.00	0.00	-0.06
-0.93	5.00	-0.59	-1.99	-27.21	-0.04
-0.93	13.64	-0.59	-1.99	-27.21	-0.04
-1.50	18.43	-4.20	-11.13	-45.99	-0.03
-1.50	29.36	-4.20	-11.13	-45.99	-0.03
-2.00	31.77	-13.53	-26.41	-63.09	-0.01
-2.00	-39.87	-13.53	-26.41	-63.09	-0.01
-2.50	-44.63	-21.56	-5.29	-80.15	-0.01
-2.61	-45.68	-20.87	-0.00	-83.91	-0.00
-3.57	-52.10	-0.00	47.00	-110.13	-0.00
-3.57	-52.10	0.07	47.08	-110.17	0.00

Checks of earth statics

Substitute system according to Blum



z [m]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [kN/m2]
0.00	0.00	0.00	0.00	-0.04
-2.81	-13.63	-14.02	-60.75	-0.00
-2.81	-13.63	-14.02	-60.75	0.00
-2.81	-13.63	21.94	-60.75	0.00
-3.00	-9.74	20.11	-64.64	0.00
-3.57	0.00	14.03	-71.82	0.00



z [m]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [kN/m2]
0.00	0.00	0.00	0.00	-0.04
-0.69	-0.00	-0.00	0.00	-0.03
-0.69	0.00	0.00	0.00	-0.03
-0.93	0.12	0.19	0.05	-0.03
-0.95	0.06	0.01	0.00	-0.03
-0.96	0.05	0.00	-0.00	-0.03
-0.98	-0.00	-0.14	-0.04	-0.03
-2.81	-18.42	-23.31	-5.97	0.00
-2.81	-18.42	30.18	-5.97	0.00
-3.00	-13.10	27.36	-6.69	0.00
-3.57	0.00	18.69	-8.91	0.00

Bh,gk = -35.96; Ch,gk = 14.03 [kN/m]
Bh,qk = -53.49; Ch,qk = 18.69 [kN/m]
Bh,d = -128.78; Ch,d = 46.99 [kN/m]

Check of C-force (foot support)

```
z(C)                                          =   -3.57 [kN/m]
G,k = sum(γ*h)                                =   62.69 [kN/m]
P,k = sum(Pz,k(x=  0.1))                      =    0.00 [kN/m]
kpgh,C(phi=  0.1; δ,C=  0.0°)                 =   1.002 [-]
kpch,C                                        =   2.003 [-]
eph,C,gk =(G,k+P,k)*kpgh,C+2*c*sqrt(kpch,C)=  204.34 [kN/m2]
         = (62.69+0.00)*1.002+2*50.0*1.415
Ed = Ch,d                                     =   46.99 [kN/m2]
δ,t,EAU          = Ed/(2*eph,C,d)             =    0.16 [m]
δ,t,EAB          =  0.20 * t                  =    0.31 [m]
δ,t = δ,t,EAB                                 =    0.31 [m]
Rd = 2*δ,t*eph,C,gk/γ,Re
   = 2*0.31*204.34/1.4
                                              =   91.59 [kN/m2]
```

Ed/Rd = 0.513 [-]. Passes requirement

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -2.81 m
Rd = Eph,k/γ,Re = 180.43 / 1.400 = 128.88 [kN/m]

Ed(Bh,d)/Rd = 128.78 / 128.88 = 0.999 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-3.57

Pos.	H	V
H/V pressure G+P+W,k	21.92	1.65
Wall weight		74.12
H/V pressure passive		0.00
Bh,g,k z=-2.81	-35.96	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.04
Ch,g	14.03	
Cv,g = Ch*tan(δ,C=0.0°)		0.01
Σ	-0.00	75.74 (downwards)

Simple check, EAB R 9-3a

Vk >= Bvk: 75.78 >= 0.04 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-3.57

Pos.	H	V
H/V pressure G+P+W,k	56.72	10.56
Wall weight		74.12
H/V pressure passive		0.00
Bh,g,k z=-2.81	-35.96	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.04
Bh,q,k z=-2.81	-53.49	
Bv,q,k = Bh,k * tan(δ,p=-0.07°)		-0.06
Ch,g	14.03	
Cv,g = Ch*tan(δ,C=0.0°)		0.01
Ch,q	18.69	
Cv,q = Ch*tan(δ,C=0.0°)		0.01
Σ	0.00	84.60 (downwards)

Simple check, EAB R 9-3a

Vk >= Bvk: 84.70 >= 0.10 Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)
Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (0.79, 1.98), Ακτίνα = 5.93
Αρχ.σημ.= (-3.61, -2.00), Τελ.σημ. = (6.37, 0.00)

Γεωμετρία λωρίδων:

No	x	Width b	dxM	Weight	Load z-κατ.	Water-φορτ.	u*b	φ	c	θ
	[m]	[m]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[°]	[kN/m²]	[°]
1	-3.31	0.59	-4.09	3.6	0.0	0.0	-0.0	0.08	35.71	-43.68
2	-2.72	0.59	-3.50	9.5	0.0	0.0	-0.0	0.08	35.71	-36.20
3	-2.12	0.59	-2.91	14.0	0.0	0.0	-1.0	0.08	35.71	-29.38
4	-1.53	0.59	-2.32	17.5	0.0	0.0	-2.8	0.08	35.71	-22.99
5	-0.94	0.59	-1.72	20.0	0.0	0.0	-4.0	0.08	35.71	-16.89
6	-0.34	0.59	-1.13	21.8	0.0	0.0	-4.9	0.08	35.71	-10.99
7	0.25	0.59	-0.54	42.9	0.0	0.0	-5.4	0.08	35.71	-5.20
8	0.84	0.59	0.06	45.0	0.0	0.0	-5.6	0.08	35.71	0.54
9	1.43	0.59	0.65	44.6	0.0	0.0	-5.3	0.08	35.71	6.28
10	2.03	0.59	1.24	43.4	8.4	0.0	-4.8	0.08	35.71	12.09
11	2.62	0.59	1.83	41.5	15.4	0.0	-3.8	0.08	35.71	18.02
12	3.21	0.59	2.43	38.8	15.4	0.0	-2.5	0.08	35.71	24.17
13	3.81	0.59	3.02	35.2	15.4	0.0	-0.8	0.08	35.71	30.63
14	4.40	0.59	3.61	30.4	15.4	0.0	-0.0	0.08	35.71	37.55
15	4.99	0.59	4.21	24.2	15.4	0.0	-0.0	0.08	35.71	45.19
16	5.58	0.59	4.80	16.0	15.4	0.0	-0.0	20.46	1.43	54.04
17	6.13	0.49	5.34	5.2	12.8	0.0	-0.0	20.46	1.43	64.28

Συνεισφ. κατακόρυφων φορτίων:

No	Weight	G*sin(θ)	(G-u*b)*tan(φ) + c*b	μ*sin(θ)* tan(φ)+cos(θ)	T
	[kN/m]	[kN/m]	[kN/m]	[-]	[kN/m]
1	3.61	-2.49	21.18	0.722903	29.30
2	9.49	-5.60	21.19	0.806677	26.26
3	14.02	-6.88	21.19	0.871145	24.33
4	17.48	-6.83	21.19	0.920369	23.03
5	20.03	-5.82	21.20	0.956702	22.15
6	21.77	-4.15	21.20	0.981574	21.59
7	42.92	-3.89	21.23	0.995843	21.31
8	44.99	0.42	21.23	0.999960	21.23
9	44.57	4.88	21.23	0.994052	21.35
10	51.84	10.86	21.24	0.977933	21.72
11	56.96	17.62	21.25	0.951084	22.34
12	54.25	22.21	21.25	0.912555	23.28
13	50.60	25.78	21.24	0.860778	24.68
14	45.85	27.94	21.24	0.793159	26.78
15	39.66	28.13	21.23	0.705148	30.11
16	31.40	25.41	12.56	0.698375	17.98
17	18.00	16.22	7.42	0.557759	13.30
		143.82			390.74

Δράση Ed = (143.8*5.93)
Αντίσταση Rd = (390.7*5.93 +0.0)

SLIP-CIRCLE μ = Ed/Rd = 0.37 < 1.0: Έλεγχος εκπληρώθηκε.

Φάση εκσκαφής 2 "[2] Situation 2"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 5 Στρώσεις

Name		Τεχνητές επιχωματώσεις	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
γ	[kN/m3]	18	20	22.5
γ,R	[kN/m3]	18	20	22.5
γ'	[kN/m3]	8	10	12.5
γ,p	[kN/m3]	18	20	22.5
γ,R,passive	[kN/m3]	18	20	22.5
γ,pw	[kN/m3]	8	10	12.5
φ	[°]	25	0.1	33
c	[kN/m2]	2	50	5
c,u	[kN/m2]	10	50	5
c παθητικό	[kN/m2]	2	50	5
δ,a	[°]	16.66667	0.06666667	22
δ,p	[°]	-16.66667	-0.06666667	-22
δ,c	[°]	8.333333	0.03333333	11
k,agh	[-]	0.3456501	0.9955057	0.2452023
K,ach	[-]	1.043051	1.994195	0.8549058
K,0h	[-]	0.5773817	0.9982547	0.455361
K,pgh	[-]	3.908103	1.004519	7.495617
K,pch	[-]	5.180327	2.00583	8.599509
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	10e-06	5.5e-09	100e-06

Name		Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20	22.5
γ,R	[kN/m3]	20	22.5
γ'	[kN/m3]	10	12.5
γ,p	[kN/m3]	20	22.5
γ,R,passive	[kN/m3]	20	22.5
γ,pw	[kN/m3]	10	12.5
φ	[°]	0.1	35
c	[kN/m2]	100	5
c,u	[kN/m2]	100	5
c παθητικό	[kN/m2]	100	5
δ,a	[°]	0.06666667	23.33333
δ,p	[°]	-0.06666667	-23.33333
δ,c	[°]	0.03333333	11.66667
k,agh	[-]	0.9955057	0.2244207
K,ach	[-]	1.994195	0.8126539
K,0h	[-]	0.9982547	0.4264236
K,pgh	[-]	1.004519	9.146943
K,pch	[-]	2.00583	10.104
τ,gr	[kN/m2]	110	110
Ψ,A,max	[°]	90	90
k	[cm/s]	5.5e-09	100e-06

Πορεία πρανούς:
x [m] 0.00 0.00
z [m] -2.00 0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
x [m] 0.00 0.00
z [m] -2.00 -1.50

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:
z= -4.50

Πορεία ανώτερου 4. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
z= -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -14.00

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
2.00	0.00	8.50	0.00	0.00	20.00	0.00	20.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Στάθμη νερού:

x [m] 0.00
z [m] -3.00

Αγκύρια

z[m]	min.l[m]	Alpha[°]	C-H[kN/m]	P0[kN]	u0[m]
-0.50	0.00	15.00	αόριστ.	0.00	0.0000

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Ενεργές ωθήσεις.
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: Trapezoid.
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
Levels of redistribution Z1: 0.000, Z2: -1.000 [m].
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Κλασικός, Pregl/Sokolovsky (DIN 4085).

Options for water pressure

Στήριξη πόδα

Πόδας οριζοντίως μετακινούμενος

Αγκύρια

Anchor checks (lower failure plane): Ναι
Anchor forces with safety level of DS-P: Ναι
Verification of grout body pull out forces: Ναι
δ,a,Anchoring wall : used from soil layer.
δ,p,Anchoring wall : used from soil layer.

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

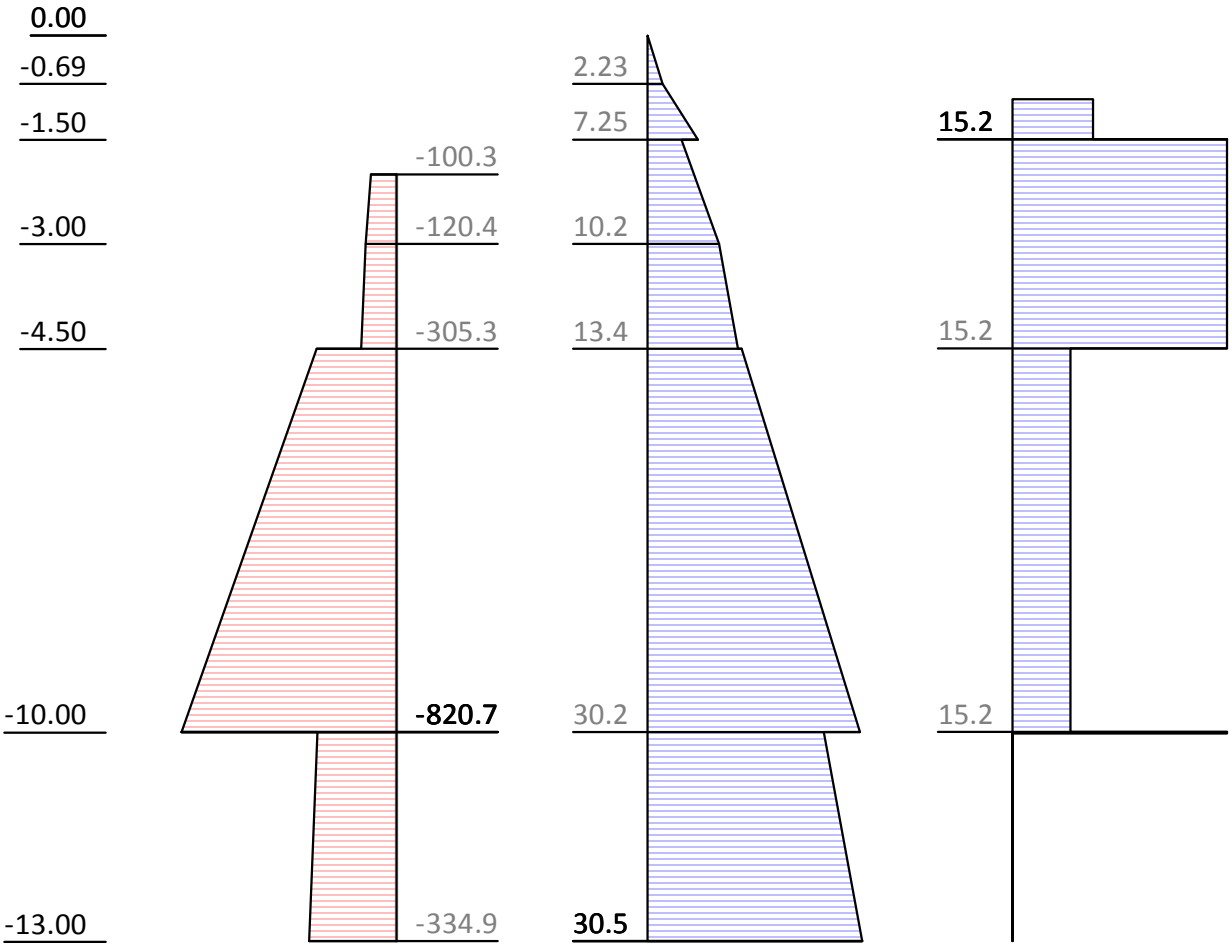
Μήκος τοίχου

Foot depth for statics: zf = -13.000

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall

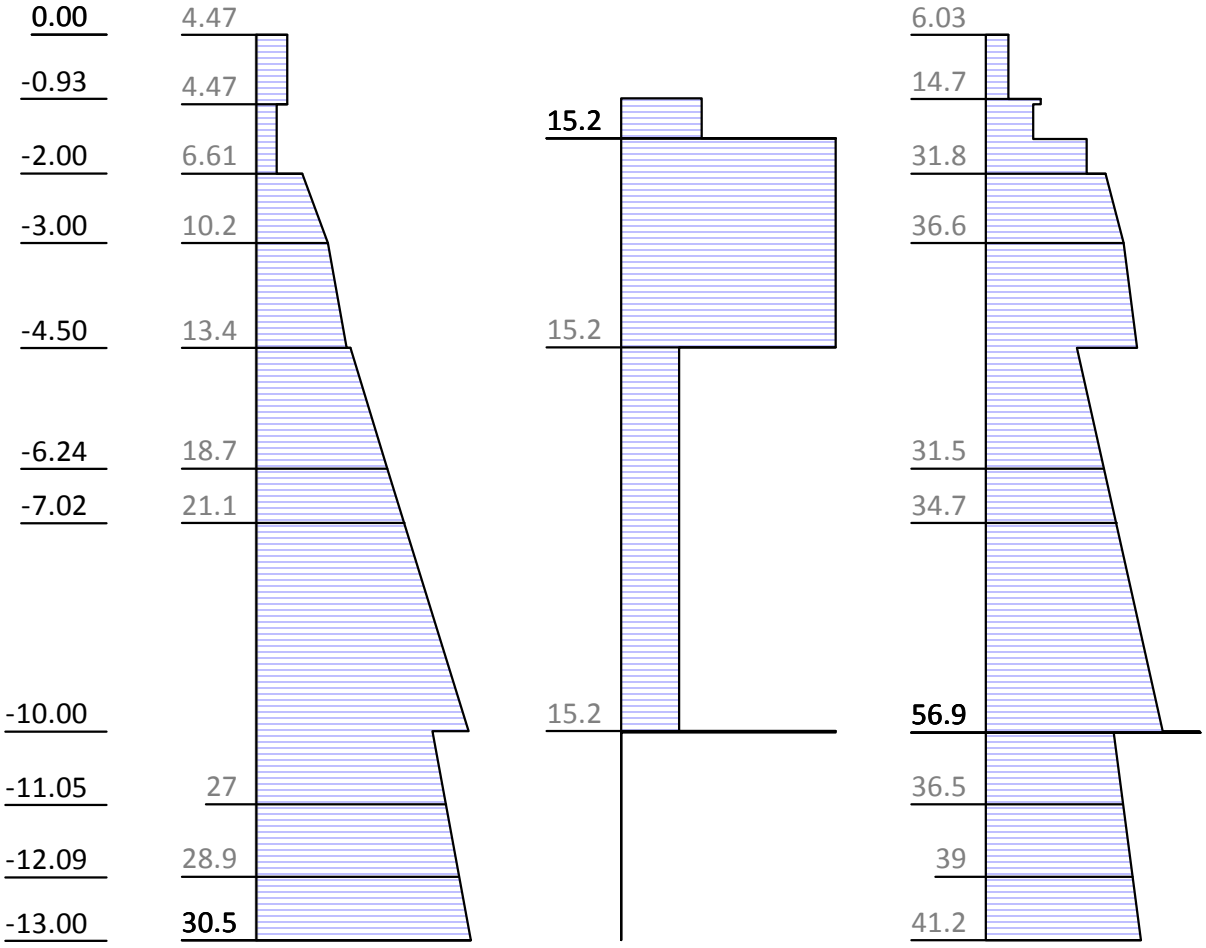


z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.93		3.72	0.00	5.00
-0.93		3.72	5.76	13.64
-1.50		7.25	5.76	18.43
-1.50		4.82	15.23	29.36
-2.00	-0.00	6.61	15.23	31.77
-2.00	-100.29	6.61	15.23	31.77
-4.50	-135.45	12.86	15.23	40.21
-4.50	-305.34	13.38	4.15	24.29
-10.00	-820.67	30.24	4.15	47.05
-10.00	-304.80	25.14	15.23	56.78
-10.03	-305.10	25.19	15.23	56.86
-10.03	-305.10	25.19	0.00	34.01
-13.00	-334.94	30.49	0.00	41.17

Eph,G,k:-4358.35, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 236.52, Eah,PG,k: 0.00, Eah,PQ,k: 72.27, Eah,d: 427.70

H-pressure on static system

Level of mobilization: Ep,gk 100.0, Ep,qk 100.0, Ep,d 100.0 [%]

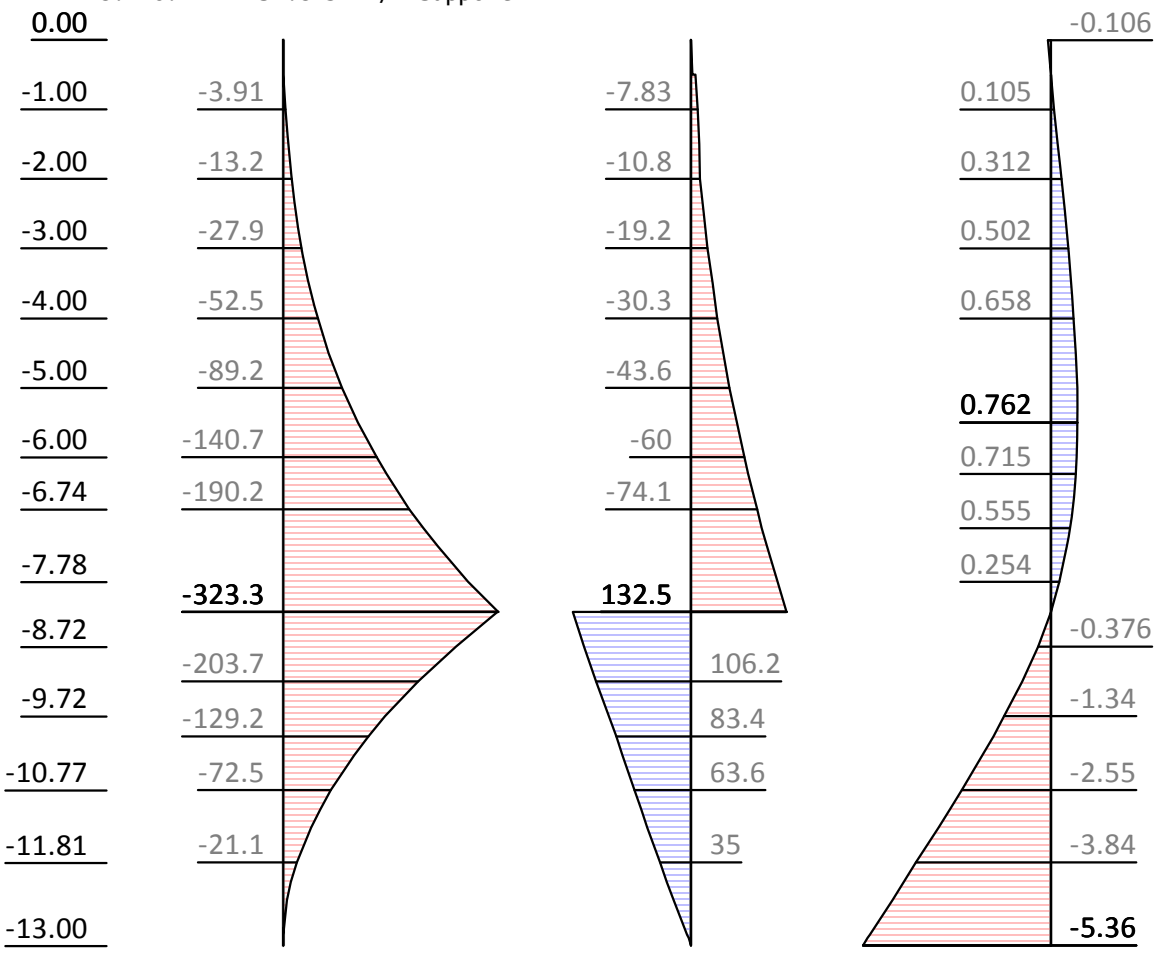


z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	4.47		6.03
-0.93	4.47	0.00	6.03
-0.93	4.47	5.76	14.68
-1.00	4.47	5.76	14.68
-1.00	2.98	5.76	12.67
-1.50	2.98	5.76	12.67
-1.50	2.98	15.23	26.88
-2.00	2.98	15.23	26.88
-2.00	6.61	15.23	31.77
-4.50	12.86	15.23	40.21
-4.50	13.38	4.15	24.29
-10.00	30.24	4.15	47.05
-10.00	25.14	15.23	56.78
-10.03	25.19	15.23	56.86
-10.03	25.19	0.00	34.01
-13.00	30.49	0.00	41.17

V-pressure on static system

Internal forces: Permanent, characteristically

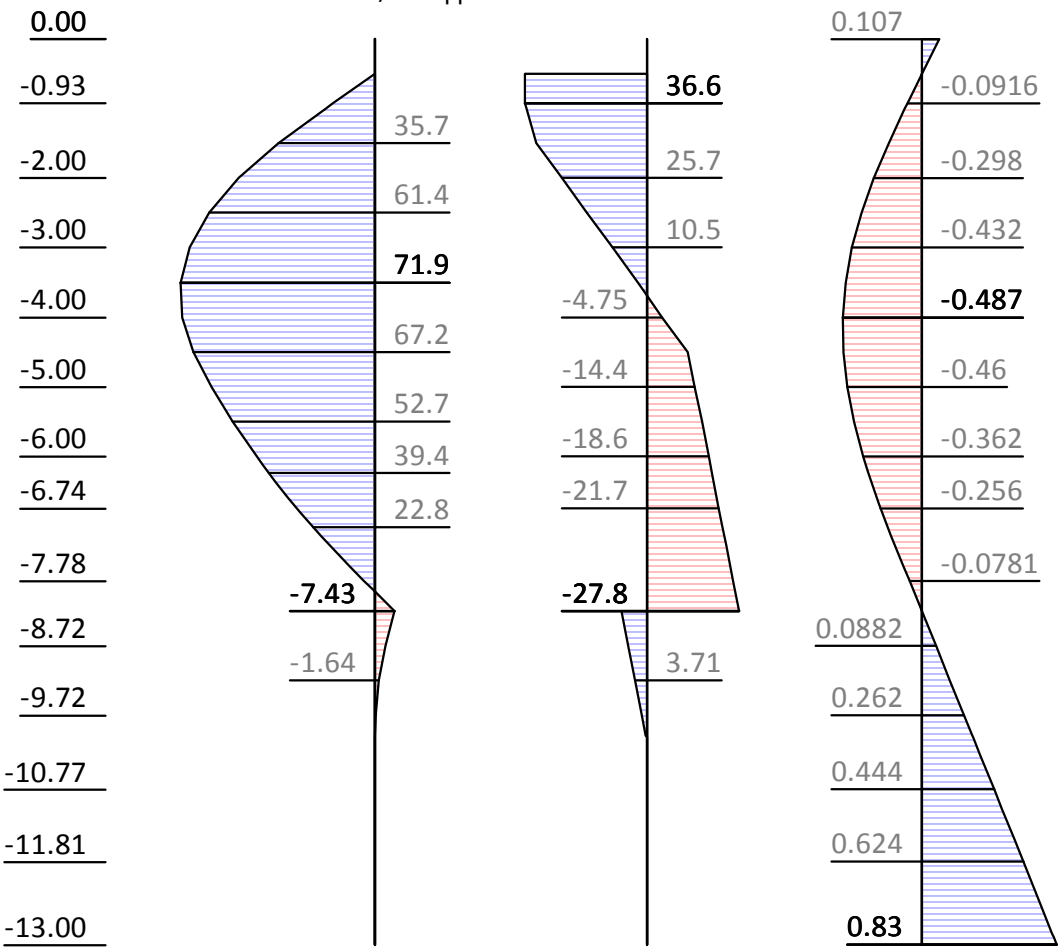
z= -0.500. Fx= 3.356 kN/m Support
z= -8.216. Fx=-239.875 kN/m Support



z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	4.47	0.00	0.00	0.00	-0.11
-0.00	4.47	-0.00	0.00	-0.00	-0.11
-0.50	4.47	-0.56	-2.23	-10.91	0.00
-0.50	4.47	-0.56	-5.59	-10.01	0.00
-1.00	4.47	-3.91	-7.83	-20.93	0.11
-1.00	2.98	-3.91	-7.83	-20.93	0.11
-2.00	2.98	-13.23	-10.81	-42.48	0.31
-2.00	6.61	-13.23	-10.81	-42.48	0.31
-4.50	12.86	-69.20	-36.48	-82.41	0.72
-4.50	13.38	-69.20	-36.48	-82.41	0.72
-5.50	16.45	-112.89	-51.40	-101.04	0.76
-8.22	24.78	-323.32	-107.35	-157.87	0.00
-8.22	24.78	-323.32	132.52	-157.87	0.00
-10.00	30.24	-129.19	83.45	-200.18	-1.65
-10.00	25.14	-129.19	83.45	-200.18	-1.65
-13.00	30.49	-0.00	0.00	-238.08	-5.36

Internal forces: Variable, characteristically

Method EB 82-4 (Q = [G+Q] - G).
z= -0.500. Fx= -36.623 kN/m Support
z= -8.216. Fx= -35.644 kN/m Support

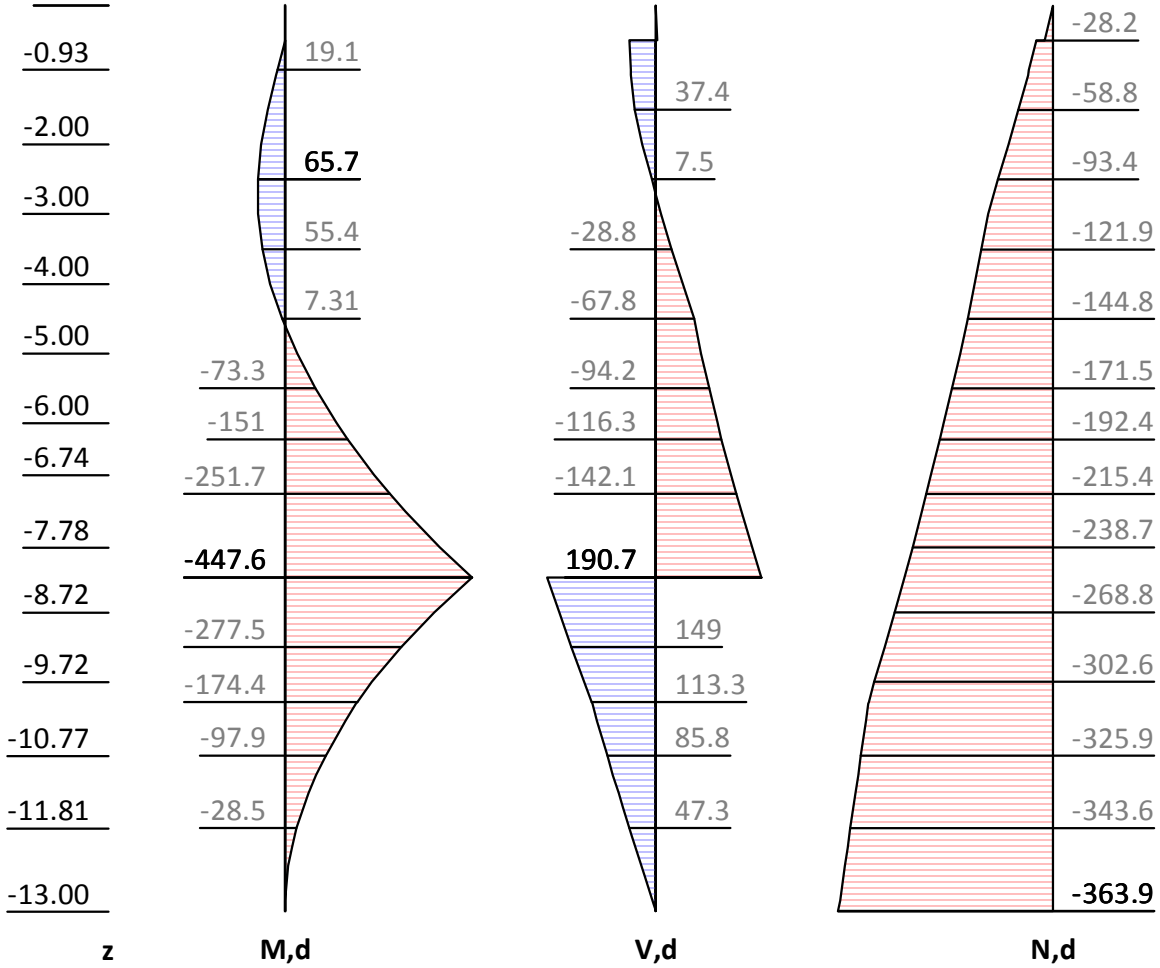


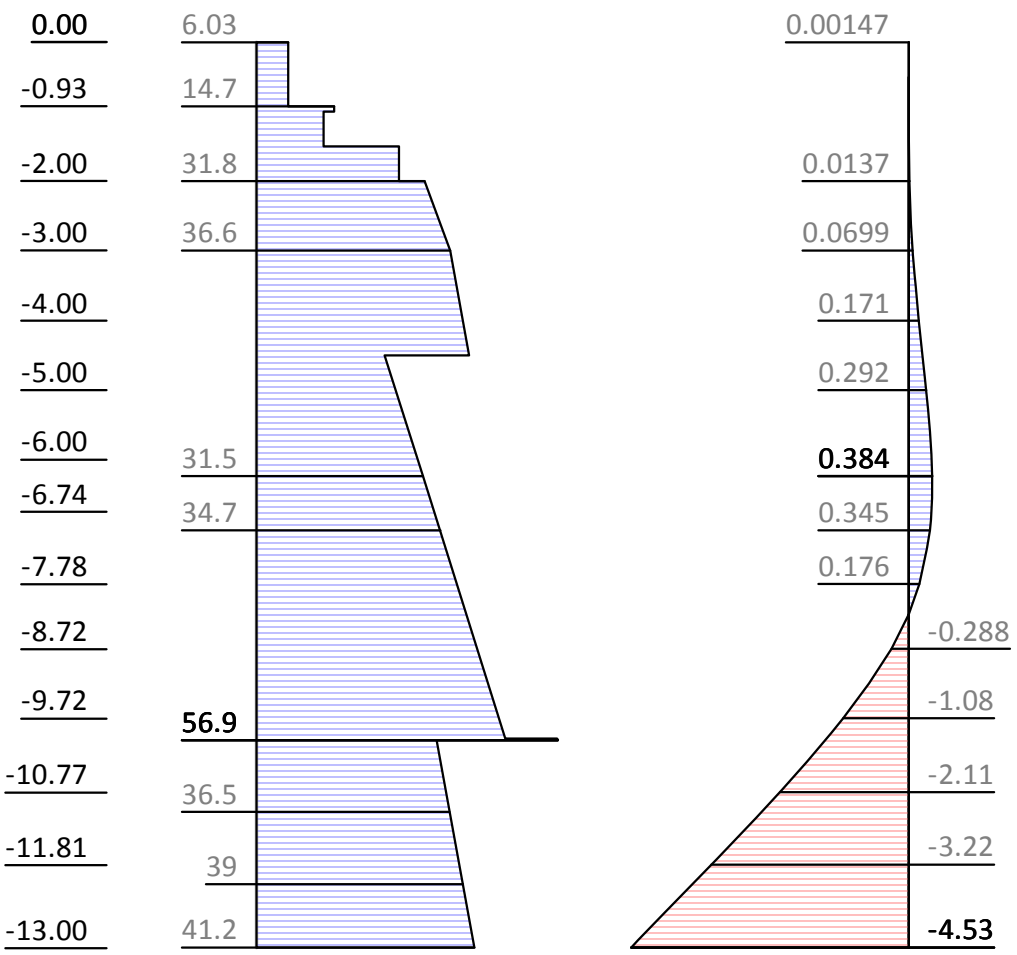
z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00	-0.00		0.11
-0.50		-0.00	-0.00		0.00
-0.50		-0.00	36.62	-9.81	-0.00
-0.93	0.00	15.82	36.62	-9.81	-0.09
-0.93	5.76	15.82	36.62	-9.81	-0.09
-1.50	5.76	35.69	33.34	-10.65	-0.21
-1.50	15.23	35.69	33.34	-10.65	-0.21
-3.50	15.23	71.89	2.87	-18.46	-0.47
-3.69	15.23	71.71	0.00	-19.19	-0.48
-4.00	15.23	71.42	-4.75	-20.41	-0.49
-4.50	15.23	67.15	-12.36	-22.36	-0.48
-4.50	4.15	67.15	-12.36	-22.36	-0.48
-7.94	4.15	-0.00	-26.64	-26.01	-0.05
-8.22	4.15	-7.43	-27.78	-26.31	0.00
-8.22	4.15	-7.43	7.86	-26.31	0.00
-10.00	4.15	-0.01	0.46	-28.20	0.31
-10.00	15.23	-0.01	0.46	-28.20	0.31
-10.00	15.23	0.00	0.43	-28.21	0.31
-10.03	15.23	0.09	0.01	-28.32	0.32
-10.03	0.00	0.09	0.01	-28.32	0.32
-10.27	0.00	0.00	0.00	-28.32	0.36
-10.27	0.00	0.00	-0.00	-28.32	0.36

z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
-11.31	0.00	0.00	-0.00	-28.32	0.54
-12.85	0.00	0.00	-0.00	-28.32	0.80
-12.87	0.00	-0.00	-0.00	-28.32	0.81
-12.90	0.00	-0.00	-0.00	-28.32	0.81
-13.00	0.00	-0.00	0.00	-28.32	0.83

Internal forces: Design

z= -0.500. Fx= -50.404 kN/m Support
z= -8.216. Fx=-377.298 kN/m Support





z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	6.03	0.00	0.00	0.00	0.00
-0.50	6.03	-0.75	-3.02	-14.73	0.00
-0.50	6.03	-0.75	-3.02	-14.73	-0.00
-0.50	6.03	-0.75	47.39	-28.24	-0.00
-0.52	6.03	0.00	47.29	-28.72	-0.00
-0.93	6.03	19.06	44.79	-40.91	-0.00
-0.93	14.68	19.06	44.79	-40.91	-0.00
-1.00	14.68	22.16	43.76	-43.13	-0.00
-1.00	12.67	22.16	43.76	-43.13	-0.00
-1.13	12.67	27.40	42.13	-47.16	-0.00
-1.50	12.67	42.46	37.43	-58.78	0.00
-1.50	26.88	42.46	37.43	-58.78	0.00
-2.00	26.88	57.82	23.99	-76.26	0.01
-2.00	31.77	57.82	23.99	-76.26	0.01
-2.50	34.18	65.74	7.50	-93.36	0.04
-2.71	35.20	65.48	0.00	-100.62	0.05
-4.50	40.21	7.31	-67.79	-144.79	0.23
-4.50	24.29	7.31	-67.79	-144.79	0.23
-4.60	24.70	-0.00	-70.29	-147.39	0.24
-6.24	31.49	-151.04	-116.32	-192.40	0.38
-8.22	39.68	-447.62	-186.60	-252.58	0.00
-8.22	39.68	-447.62	190.70	-252.58	0.00
-10.00	47.05	-174.41	113.34	-312.55	-1.34
-10.00	56.78	-174.41	113.34	-312.55	-1.34
-10.03	56.86	-171.04	111.63	-313.23	-1.37
-10.03	34.01	-171.04	111.63	-313.23	-1.37
-13.00	41.17	-0.00	0.00	-363.88	-4.53

z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
-13.00	41.17	-0.00	-0.00	-363.88	-4.53

Anchor forces with safety level of DS-P

z[m]	A,d[kN]	Fx,d[kN/m]
-0.50	93.9	-50.4

Checks of earth statics

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -8.22 m
Rd = Eph,k/γ,Re = 4358.35 / 1.400 = 3113.11 [kN/m]

Ed(Uh,d)/Rd = 377.30 / 3113.11 = 0.121 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-13.00

Pos.	H	V
H/V pressure G+P+W,k	236.52	49.97
Wall weight		189.01
H/V pressure passive		0.00
Support z: -0.50	3.36	-0.90
Bh,g,k z=-8.22	-239.88	
Bv,g,k = Bh,k * tan(δ,p=-22.00°)		-96.92
Σ	-0.00	141.16 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.

Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1
Vertical component of earth resistance is less than the downwards pointing vertical forces.

Vk >= Bvk: 238.08 >= 96.92 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-13.00

Pos.	H	V
H/V pressure G+P+W,k	308.79	68.48
Wall weight		189.01
H/V pressure passive		0.00
Support z: -0.50	-33.27	8.91
Bh,g,k z=-8.22	-239.88	
Bv,g,k = Bh,k * tan(δ,p=-22.00°)		-96.92
Bh,q,k z=-8.22	-35.64	
Bv,q,k = Bh,k * tan(δ,p=-22.00°)		-14.40
Σ	0.00	155.08 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.

Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1
Vertical component of earth resistance is less than the downwards pointing vertical forces.

Vk >= Bvk: 266.40 >= 111.32 Passes requirement

Anchor verification

Anchor - Stability of lower failure plane

Περίπτ.Φόρτισης: όλα τα φορτία BS-P
Αυτόμ. υπολογ. μήκους αγκυρίων:
All anchors are extended (if necessary)
Favourable variable loads in main failure body are not being considered.
Bottom of lower failure plane: z=-13.00 m

Iteration of failure mechanisms:
lA .....: Length of anchor from head to center of grout body.
W,k .....: Res. force from dead weight, loads, cohesion, ...
Q,k .....: Force in lower failure plane.
Ea1,k.....: Earth pressure onto vertical separation plane.
Ea2,k.....: Earth pressure between wall and main failure body.
Ra_cal,d ...: Dimesioning force of the resistance from the equilibrium of forces. Ra_cal,d corresponds to the max. possible anchor force of the force polygon.
Sum(A,d) ...: Acting anchor forces along the grout body fractions within the failure body. Sum(A,d) is gained from the anchor pull forces of the wall analysis.

z [m]	ϑ1 [°]	ϑ2 [°]	lA [m]	W,k [kN/m]	Q,k [kN/m]	Ea1,k [kN/m]	Ea2,k [kN/m]	Ra_cal,d [kN/m]	Sum(A,d) [kN/m]	Ed/Rd [-]
-0.50	53.0	75.8	8.12	657.7	503.9	11.2	316.3	246.9	52.2	0.21

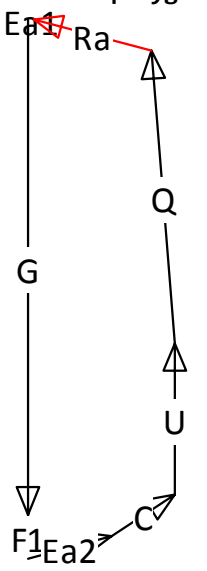
Decisive failure body:
Γεωμετρία:

Foot point of lower failure plane	x/z =	0.01/-13.00 m
Intersection lower/upper slid. plane	x/z =	7.84/ -2.60 m
Intersection upper slid. plane/surface	x/z =	8.50/ 0.00 m
Intersection separation plane/surface	x/z =	7.84/ 0.00 m
Inclination lower failure plane	ϑ1 =	53.02°
Inclination upper failure plane	ϑ2 =	75.76°
Inclination separation plane	ϑ12 =	90.00°

Loads / forces (char.)

		Fx [kN/m]	Fz [kN/m]	F [kN/m]	
Weight of main failure body	G,k:	0.0	-1257.6	1257.6	
Area loads on/in main failure body	F1,k:	0.0	-116.8	116.8	
Cohesion of lower failure plane	C,k:	318.1	422.5	528.8	
Pore water pressure on main body	U,k:	0.1	376.4	376.4	
Earth pres. on separation plane	Ea1,k:	-11.2	-0.0	11.2	δ= 0.0°
Earth pr. between wall<->main body	Ea2,k:	308.8	68.5	316.3	
Force in lower failure plane	Q,k:	-282.0	417.6	503.9	
Sum = possible anchor forces:	Ra_cal,k:	333.8	-89.4	345.6	

Force polygon



Acting anchor forces	Ed: Sum(A,d)	= 52.2 kN/m
Possible anchor forces	Rd: Ra_cal,d = 345.6/1.400	= 246.9 kN/m
Verif. of lower failure plane	Ed/Rd = 0.21 < 1.0: Έλεγχος εκπληρώθηκε.	

Check of steel tension

l,tot ...[m]: Total length of anchor incl. excess length at head
As ....[mm2]: X-section are of steel member
Ri,d ...[kN]: Ultimate strength of tension member (γ,M=1.15)
A,d ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	l,tot	As	Ri,d		A,d	
-0.50	Strand;3x0.60";1570/1770	12.12	420	573.4	>	93.9	Passes requirement

Check of steel tension: Passes requirement

Check of anchor's soil friction

lVk .....: Length of grout body
DmVk ....: Diameter of grout body
τGr,k ...: Average applied skin friction along the grout body (from soil parameters)
Ra,k ....: Charact. pullout resistance of the anchor
γA ......: Partial safety factor of anchor pullout
Ra,d ....: = Ra,k / γA
A,d .....: Dimensioning force of the anchor from wall analysis

z [m]	lVk [m]	DmVk [mm]	τGr,k [kN/m²]	Ra,k [kN]	γA [-]	Ra,d [kN]		A,d [kN]	A,d/Ra,d [-]
-0.50	8.00	318	110	879.1	1.100	799.2	>	93.9	0.1

Check of anchor's soil friction: Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)
Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (-3.05, 0.03), Ακτίνα = 13.39
Αρχ.σημ.= (-16.29, -2.00), Τελ.σημ. = (10.34, 0.00)

Γεωμετρία λωρίδων:

No	x	Width b	dxM	Weight	Load z-κατ.	Water-φορτ.	u*b	φ	c	θ
	[m]	[m]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[°]	[kN/m²]	[°]
1	-15.62	1.34	-12.57	69.8	0.0	0.0	-20.9	27.45	3.57	-31.27*
2	-14.28	1.34	-11.23	150.4	0.0	0.0	-55.7	27.45	3.57	-31.27*
3	-12.94	1.34	-9.89	202.6	0.0	0.0	-79.6	27.45	3.57	-31.27*
4	-11.60	1.34	-8.55	240.1	0.0	0.0	-97.0	0.08	71.43	-39.67
5	-10.26	1.34	-7.21	266.3	0.0	0.0	-110.2	0.08	71.43	-32.58
6	-8.92	1.34	-5.87	286.4	0.0	0.0	-120.3	0.08	71.43	-26.00
7	-7.58	1.34	-4.53	301.6	0.0	0.0	-127.9	0.08	71.43	-19.78
8	-6.24	1.34	-3.19	312.4	0.0	0.0	-133.4	0.08	71.43	-13.79
9	-4.90	1.34	-1.85	319.3	0.0	0.0	-136.8	0.08	71.43	-7.96
10	-3.56	1.34	-0.51	322.5	0.0	0.0	-138.4	0.08	71.43	-2.20
11	-2.22	1.34	0.82	322.1	0.0	0.0	-138.2	0.08	71.43	3.53
12	-0.88	1.34	2.16	318.0	0.0	0.0	-136.2	0.08	71.43	9.30
13	0.45	1.34	3.50	351.9	0.0	0.0	-132.3	0.08	71.43	15.16
14	1.79	1.34	4.84	348.0	12.1	0.0	-126.4	0.08	71.43	21.20
15	3.13	1.34	6.18	331.8	34.8	0.0	-118.2	0.08	71.43	27.49
16	4.47	1.34	7.52	310.4	34.8	0.0	-107.4	0.08	71.43	34.16
17	5.81	1.34	8.86	282.6	34.8	0.0	-93.4	0.08	71.43	41.42
18	7.15	1.34	10.20	241.5	34.8	0.0	-74.8	27.45	3.57	49.60
19	8.49	1.34	11.54	184.8	17.7	0.0	-48.7	27.45	3.57	59.49
20	9.75	1.18	12.80	89.0	0.0	0.0	-14.7	0.08	35.71	72.90

*** Σημείωση: Στις λωρίδες σημειωμένες με '*'
περιορίστηκε το theta στο 45°-Phi/2.

Συνεισφ. κατακόρυφων φορτίων:

No	Weight	G*sin(θ)	(G-u*b)*tan(φ) + c*b	μ*sin(θ)* tan(φ)+cos(θ)	T
	[kN/m]	[kN/m]	[kN/m]	[-]	[kN/m]
1	69.84	-65.54	30.23	0.811437	37.25
2	150.38	-126.08	53.95	0.811437	66.49
3	202.57	-149.58	68.66	0.811437	84.61
4	240.13	-153.30	95.87	0.769541	124.58
5	266.31	-143.39	95.89	0.842552	113.80
6	286.44	-125.58	95.90	0.898669	106.71
7	301.59	-102.07	95.91	0.940917	101.93
8	312.41	-74.49	95.92	0.971107	98.77
9	319.31	-44.20	95.92	0.990342	96.86
10	322.49	-12.39	95.92	0.999253	96.00
11	322.08	19.83	95.92	0.998116	96.11
12	318.04	51.39	95.92	0.986897	97.20
13	351.87	92.04	95.97	0.965242	99.43
14	360.10	130.20	95.99	0.932424	102.95
15	366.63	169.23	96.01	0.887205	108.22
16	345.22	193.87	96.00	0.827552	116.00
17	317.40	209.99	95.98	0.750028	127.97
18	276.35	210.46	109.49	0.711545	153.87
19	202.49	174.46	84.70	0.579433	146.18
20	88.98	85.05	42.40	0.294278	144.08
		339.89			2119.01

Συνεισφ. αγκυρίων: Αθρ. ροπών ανατροπής : 0.0 kN*m/m
" " resisting : 0.0 kN*m/m
Καμία συνεισφορά αγκυρίων.

Δράση Ed = (339.9*13.39)
Αντίσταση Rd = (2119.0*13.39 +0.0)

SLIP-CIRCLE μ = Ed/Rd = 0.16 < 1.0: Έλεγχος εκπληρώθηκε.

Φάση εκσκαφής 3 "[3] Situation 3"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 5 Στρώσεις

Name		Τεχνητές επιχωματώσεις	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
γ	[kN/m3]	18	20	22.5
γ,R	[kN/m3]	18	20	22.5
γ'	[kN/m3]	8	10	12.5
γ,p	[kN/m3]	18	20	22.5
γ,R,passive	[kN/m3]	18	20	22.5
γ,pw	[kN/m3]	8	10	12.5
φ	[°]	25	0.1	33
c	[kN/m2]	2	50	5
c,u	[kN/m2]	10	50	5
c παθητικό	[kN/m2]	2	50	5
δ,a	[°]	16.66667	0.06666667	22
δ,p	[°]	-16.66667	-0.06666667	-22
δ,c	[°]	8.333333	0.03333333	11
k,agh	[-]	0.3456501	0.9955057	0.2452023
K,ach	[-]	1.043051	1.994195	0.8549058
K,0h	[-]	0.5773817	0.9982547	0.455361
K,pgh	[-]	3.908103	1.004519	7.495617
K,pch	[-]	5.180327	2.00583	8.599509
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	10e-06	5.5e-09	100e-06

Name		Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20	22.5
γ,R	[kN/m3]	20	22.5
γ'	[kN/m3]	10	12.5
γ,p	[kN/m3]	20	22.5
γ,R,passive	[kN/m3]	20	22.5
γ,pw	[kN/m3]	10	12.5
φ	[°]	0.1	35
c	[kN/m2]	100	5
c,u	[kN/m2]	100	5
c παθητικό	[kN/m2]	100	5
δ,a	[°]	0.06666667	23.33333
δ,p	[°]	-0.06666667	-23.33333
δ,c	[°]	0.03333333	11.66667
k,agh	[-]	0.9955057	0.2244207
K,ach	[-]	1.994195	0.8126539
K,0h	[-]	0.9982547	0.4264236
K,pgh	[-]	1.004519	9.146943
K,pch	[-]	2.00583	10.104
τ,gr	[kN/m2]	110	110
Ψ,A,max	[°]	90	90
k	[cm/s]	5.5e-09	100e-06

Πορεία πρανούς:
x [m] 0.00 0.00
z [m] -4.00 0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
x [m] 0.00 0.00
z [m] -4.00 -1.50

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:
z= -4.50

Πορεία ανώτερου 4. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
z= -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -14.00

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
2.00	0.00	8.50	0.00	0.00	20.00	0.00	20.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Στάθμη νερού:

x [m]	0.00	0.00
z [m]	-6.00	-3.00

Αγκύρια

z[m]	min.l[m]	Alpha[°]	C-H[kN/m]	P0[kN]	u0[m]
-0.50	0.00	15.00	αόριστ.	0.00	0.0000

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Ενεργές ωθήσεις.
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: Trapezoid.
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
Levels of redistribution Z1: 0.000, Z2: -2.000 [m].
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Κλασικός, Pregl/Sokolovsky (DIN 4085).

Options for water pressure

Στήριξη πόδα

Πόδας οριζοντίως μετακινούμενος

Αγκύρια

Anchor checks (lower failure plane): Ναι
Anchor forces with safety level of DS-P: Ναι
Verification of grout body pull out forces: Ναι
δ,a,Anchoring wall : used from soil layer.
δ,p,Anchoring wall : used from soil layer.

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

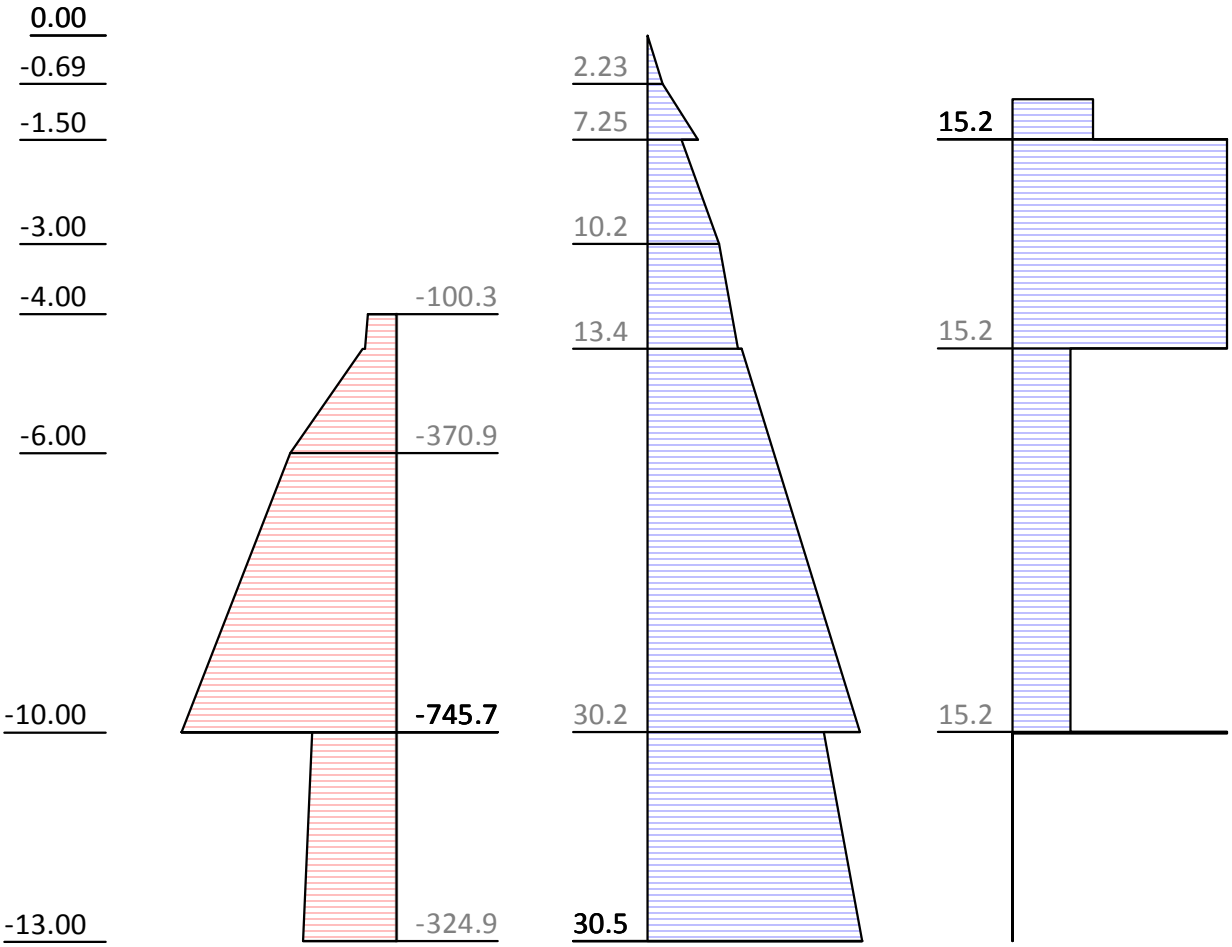
Μήκος τοίχου

Foot depth for statics: zf = -13.000

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall



z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.93		3.72	0.00	5.00
-0.93		3.72	5.76	13.64
-1.50		7.25	5.76	18.43
-1.50		4.82	15.23	29.36
-4.00	-0.00	11.97	15.23	39.00
-4.00	-100.29	11.97	15.23	39.00
-4.50	-110.34	12.86	15.23	40.21
-4.50	-117.95	13.38	4.15	24.29
-10.00	-745.71	30.24	4.15	47.05
-10.00	-294.76	25.14	15.23	56.78
-10.03	-295.06	25.19	15.23	56.86
-10.03	-295.06	25.19	0.00	34.01
-13.00	-324.89	30.49	0.00	41.17

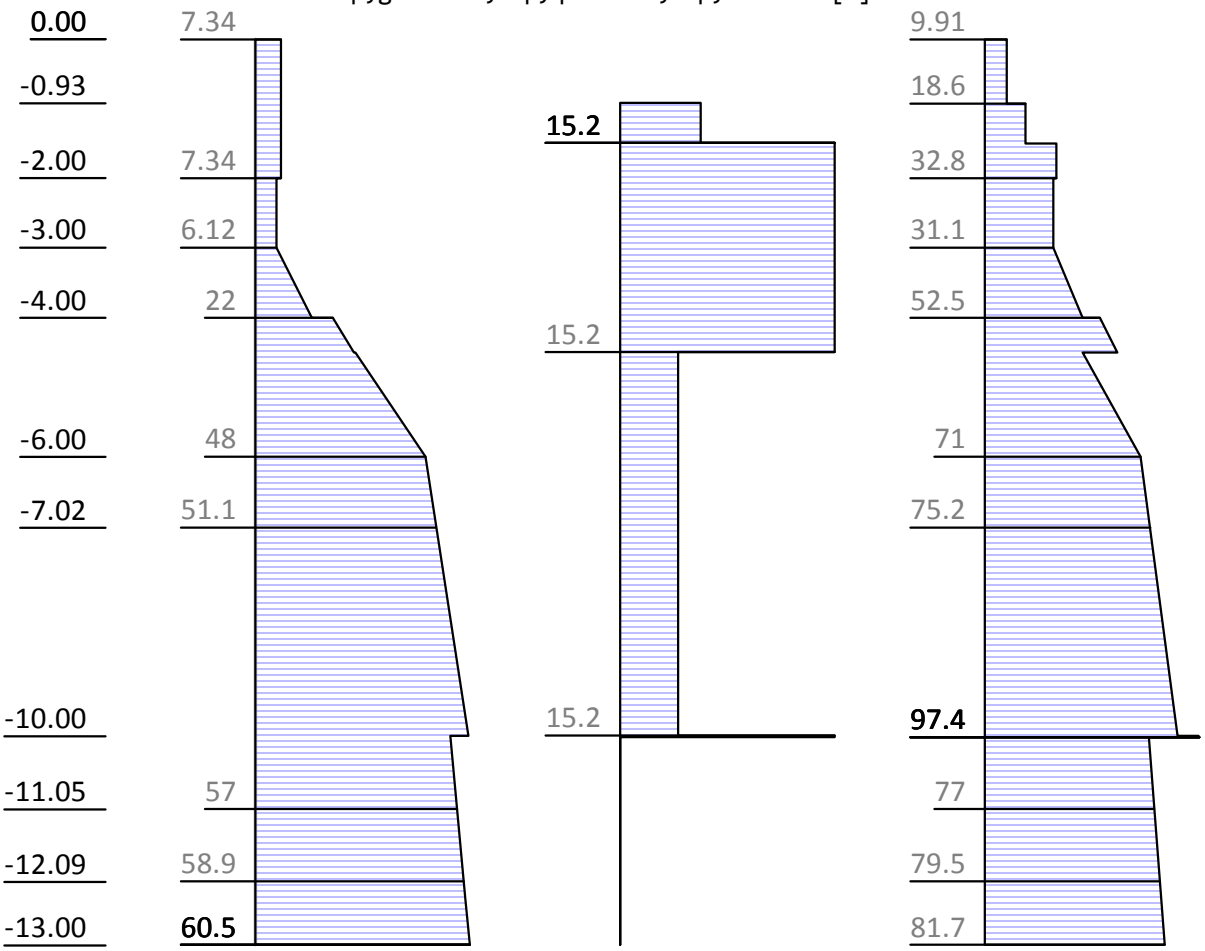
Eph,G,k:-3582.08, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 236.52, Eah,PG,k: 0.00, Eah,PQ,k: 72.27, Eah,d: 427.70

Πίεση νερού

z [m]	Wp,k [kN/m2]	Wa,k [kN/m2]	W,k [kN/m2]
-3.00		0.00	0.00
-6.00	0.00	30.00	30.00
-6.24	-2.40	32.40	30.00
-13.00	-70.00	100.00	30.00

H-pressure on static system

Level of mobilization: Ep,gk 100.0, Ep,qk 100.0, Ep,d 100.0 [%]

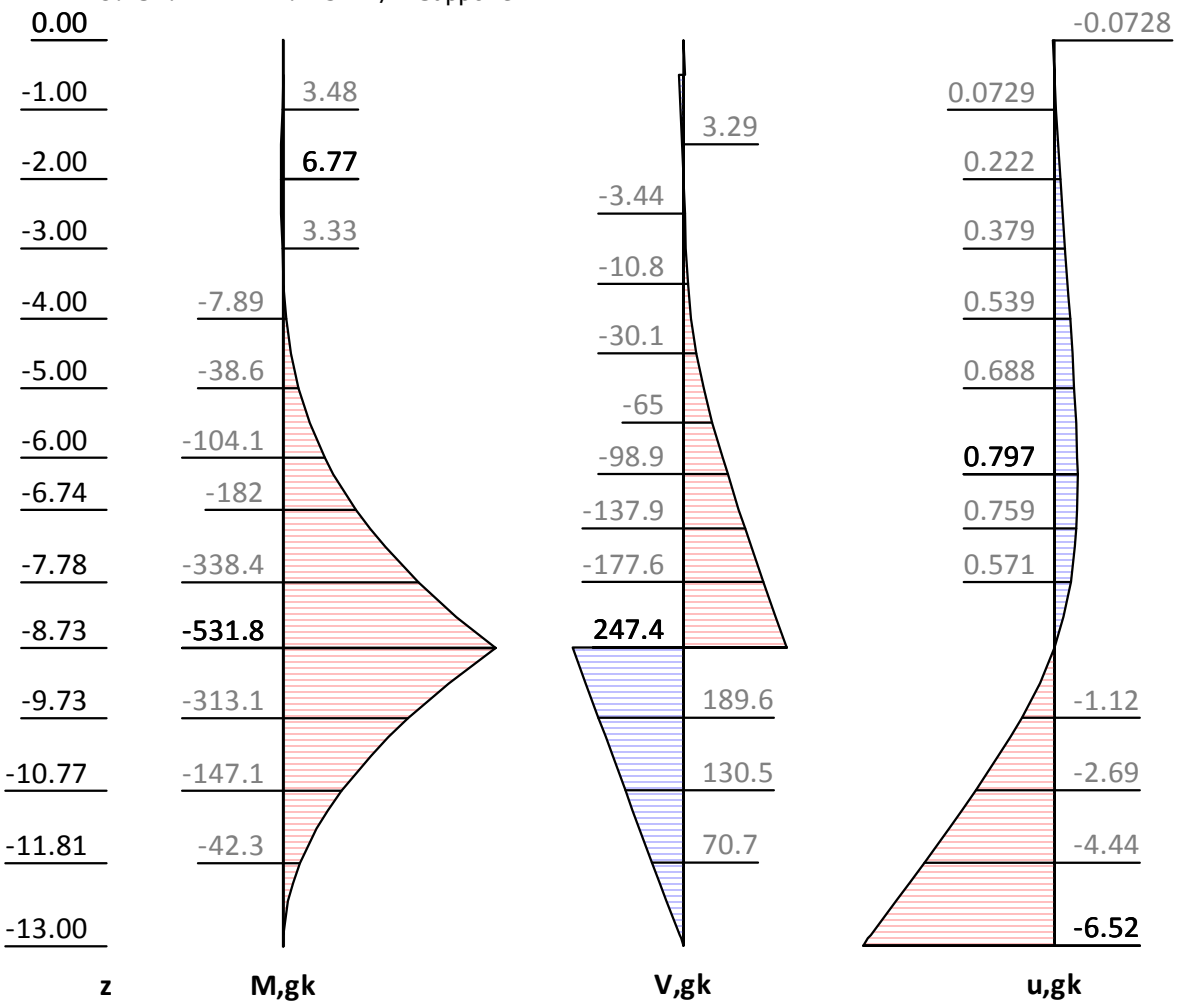


z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	7.34		9.91
-0.93	7.34	0.00	9.91
-0.93	7.34	5.76	18.56
-1.50	7.34	5.76	18.56
-1.50	7.34	15.23	32.76
-2.00	7.34	15.23	32.76
-2.00	6.12	15.23	31.11
-4.00	16.12	15.23	44.61
-4.00	21.97	15.23	52.50
-4.50	27.86	15.23	60.46
-4.50	28.38	4.15	44.54
-10.00	60.24	4.15	87.55
-10.00	55.14	15.23	97.28
-10.03	55.19	15.23	97.36
-10.03	55.19	0.00	74.51
-13.00	60.49	0.00	81.67

V-pressure on static system

Internal forces: Permanent, characteristically

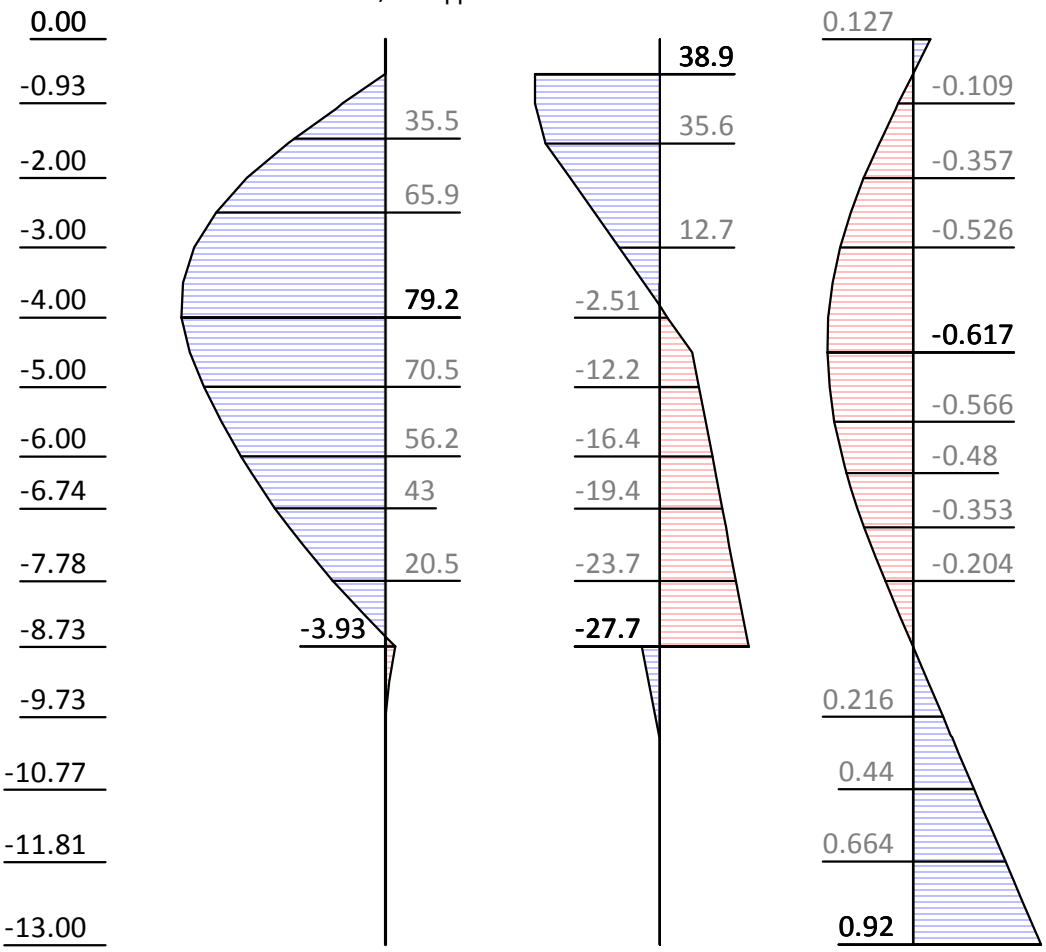
z= -0.500. Fx= -14.305 kN/m Support
z= -8.731. Fx=-477.215 kN/m Support



z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	7.34	0.00	-0.00	0.00	-0.07
-0.50	7.34	-0.92	-3.67	-10.69	-0.00
-0.50	7.34	-0.92	10.63	-14.52	-0.00
-0.60	7.34	0.00	9.87	-16.76	0.02
-1.95	7.34	6.70	0.00	-45.49	0.21
-2.00	7.34	6.77	-0.38	-46.60	0.22
-2.00	6.12	6.77	-0.38	-46.60	0.22
-3.39	10.06	-0.00	-9.90	-76.34	0.44
-4.00	16.12	-7.89	-17.61	-89.24	0.54
-4.00	21.97	-7.89	-17.61	-89.24	0.54
-4.50	27.86	-19.69	-30.07	-99.75	0.62
-4.50	28.38	-19.69	-30.07	-99.75	0.62
-6.24	48.71	-126.42	-98.94	-132.95	0.80
-8.73	56.35	-531.83	-229.78	-187.01	0.00
-8.73	56.35	-531.83	247.44	-187.01	0.00
-10.00	60.24	-264.19	173.45	-217.51	-1.50
-10.00	55.14	-264.19	173.45	-217.51	-1.50
-13.00	60.49	0.00	0.00	-255.41	-6.52

Internal forces: Variable, characteristically

Method EB 82-4 (Q = [G+Q] - G).
z= -0.500. Fx= -38.854 kN/m Support
z= -8.731. Fx= -33.414 kN/m Support

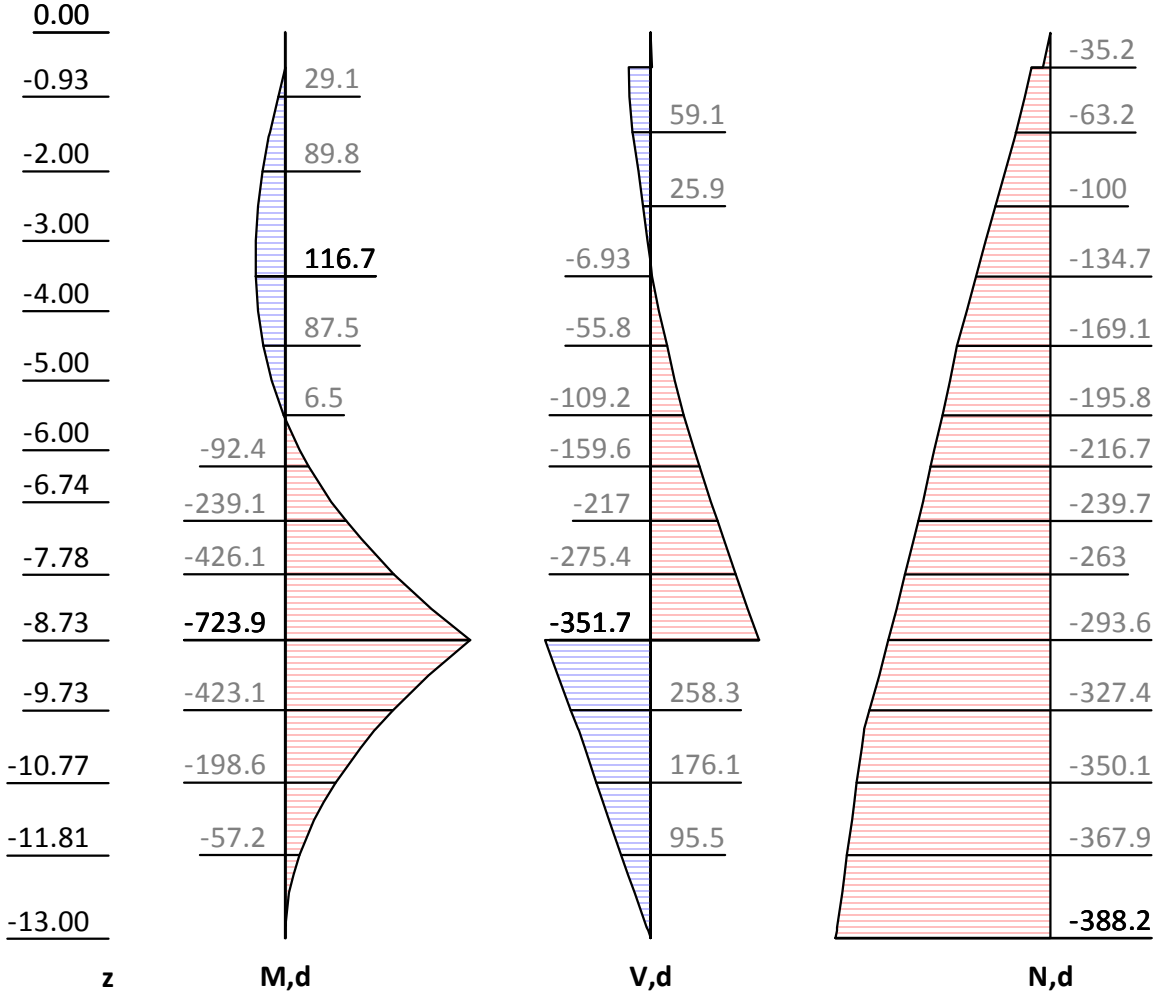


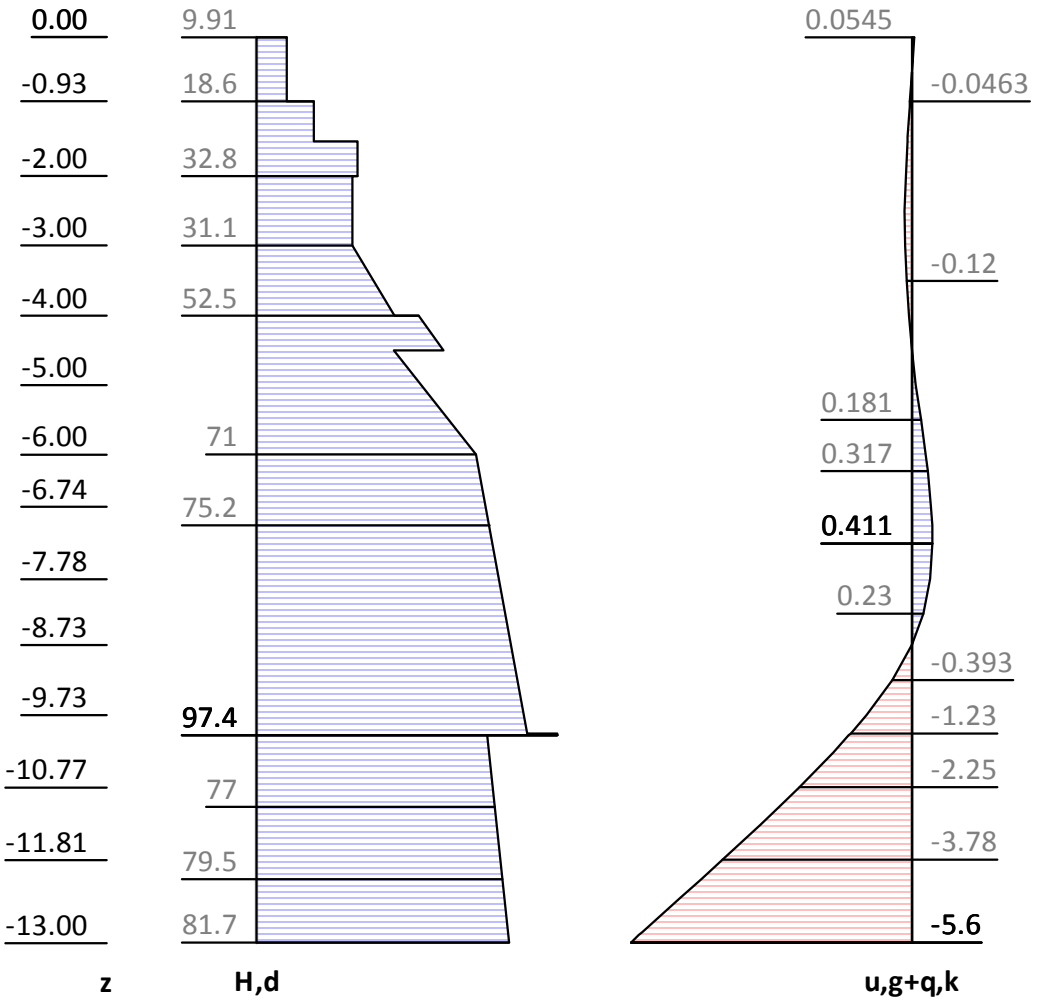
z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00	0.00	0.00	0.13
-0.50		0.00	0.00	-0.00	0.00
-0.50		0.00	0.00	-0.00	-0.00
-0.50		0.00	38.85	-10.41	-0.00
-0.93	0.00	16.82	38.85	-10.41	-0.11
-0.93	5.76	16.82	38.85	-10.41	-0.11
-1.50	5.76	37.92	35.57	-11.25	-0.25
-1.50	15.23	37.92	35.57	-11.25	-0.25
-3.83	15.23	79.02	-0.00	-20.36	-0.60
-4.00	15.23	79.23	-2.51	-21.00	-0.61
-4.50	15.23	76.07	-10.13	-22.96	-0.62
-4.50	4.15	76.07	-10.13	-22.96	-0.62
-8.58	4.15	0.00	-27.08	-27.30	-0.03
-8.73	4.15	-3.93	-27.69	-27.45	0.00
-8.73	4.15	-3.93	5.72	-27.45	0.00
-10.00	4.15	-0.01	0.46	-28.80	0.27
-10.00	15.23	-0.01	0.46	-28.80	0.27
-10.00	15.23	0.00	0.44	-28.80	0.27
-10.03	15.23	0.20	0.01	-28.92	0.28
-10.03	0.00	0.20	0.01	-28.92	0.28
-10.27	0.00	0.00	0.00	-28.92	0.33
-10.27	0.00	-0.00	0.00	-28.92	0.33

z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
-12.85	0.00	-0.00	0.00	-28.92	0.89
-12.86	0.00	0.00	0.00	-28.92	0.89
-12.90	0.00	0.00	0.00	-28.92	0.90
-12.95	0.00	0.00	-0.00	-28.92	0.91
-13.00	0.00	-0.00	-0.00	-28.92	0.92

Internal forces: Design

z= -0.500. Fx= -77.592 kN/m Support
z= -8.731. Fx=-694.361 kN/m Support





z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	9.91	0.00	0.00	0.00	0.05
-0.00	9.91	-0.00	0.00	-0.00	0.05
-0.50	9.91	-1.24	-4.96	-14.43	-0.00
-0.50	9.91	-1.24	72.64	-35.22	-0.00
-0.52	9.91	0.00	72.46	-35.73	-0.00
-0.93	9.91	29.08	68.37	-47.64	-0.05
-0.93	18.56	29.08	68.37	-47.64	-0.05
-1.50	18.56	65.04	57.80	-65.35	-0.10
-1.50	32.76	65.04	57.80	-65.35	-0.10
-2.00	32.76	89.84	41.41	-82.71	-0.13
-2.00	31.11	89.84	41.41	-82.71	-0.13
-2.50	31.11	106.66	25.86	-100.03	-0.15
-3.30	35.14	116.29	-0.00	-127.70	-0.13
-3.50	37.86	116.68	-6.93	-134.66	-0.12
-4.00	44.61	108.20	-27.55	-151.98	-0.07
-4.00	52.50	108.20	-27.55	-151.98	-0.07
-4.50	60.46	87.53	-55.79	-169.09	-0.00
-4.50	44.54	87.53	-55.79	-169.09	-0.00
-4.50	44.59	87.32	-55.95	-169.17	-0.00
-5.55	63.09	-0.00	-112.61	-197.28	0.19
-7.28	76.29	-298.11	-236.70	-247.56	0.41
-8.73	82.29	-723.87	-351.73	-293.64	0.00
-8.73	82.29	-723.87	342.63	-293.64	0.00
-10.00	87.55	-356.66	234.84	-336.84	-1.23
-10.00	97.28	-356.66	234.84	-336.84	-1.23
-10.03	97.36	-349.66	231.92	-337.53	-1.26
-10.03	74.51	-349.66	231.92	-337.53	-1.26

z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
-13.00	81.67	-0.00	0.00	-388.18	-5.60
-13.00	81.67	-0.00	-0.00	-388.18	-5.60

Anchor forces with safety level of DS-P

z[m]	A,d[kN]	Fx,d[kN/m]
-0.50	144.6	-77.6

Checks of earth statics

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -8.73 m
Rd = Eph,k/γ,Re = 3582.08 / 1.400 = 2558.63 [kN/m]

Ed(Uh,d)/Rd = 694.36 / 2558.63 = 0.271 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-13.00

Pos.	H	V
H/V pressure G+P+W,k	491.52	49.97
Wall weight		201.61
H/V pressure passive		0.00
Support z: -0.50	-14.30	3.83
Bh,g,k z=-8.73	-477.21	
Bv,g,k = Bh,k * tan(δ,p=-22.00°)		-192.81
Σ	0.00	62.60 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.

Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1
Vertical component of earth resistance is less than the downwards pointing vertical forces.

Vk >= Bvk: 255.41 >= 192.81 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-13.00

Pos.	H	V
H/V pressure G+P+W,k	563.79	68.48
Wall weight		201.61
H/V pressure passive		0.00
Support z: -0.50	-53.16	14.24
Bh,g,k z=-8.73	-477.21	
Bv,g,k = Bh,k * tan(δ,p=-22.00°)		-192.81
Bh,q,k z=-8.73	-33.41	
Bv,q,k = Bh,k * tan(δ,p=-22.00°)		-13.50
Σ	-0.00	78.02 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.

Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1
Vertical component of earth resistance is less than the downwards pointing vertical forces.

Vk >= Bvk: 284.33 >= 206.31 Passes requirement

Anchor verification

Anchor - Stability of lower failure plane

Περίπτ.Φόρτισης: όλα τα φορτία BS-P
Αυτόμ. υπολογ. μήκους αγκυρίων:
All anchors are extended (if necessary)
Favourable variable loads in main failure body are not being considered.
Bottom of lower failure plane: z=-13.00 m

Iteration of failure mechanisms:
lA .....: Length of anchor from head to center of grout body.
W,k .....: Res. force from dead weight, loads, cohesion, ...
Q,k .....: Force in lower failure plane.
Ea1,k.....: Earth pressure onto vertical separation plane.
Ea2,k.....: Earth pressure between wall and main failure body.
Ra_cal,d ...: Dimesioning force of the resistance from the equilibrium of forces. Ra_cal,d corresponds to the max. possible anchor force of the force polygon.
Sum(A,d) ...: Acting anchor forces along the grout body fractions within the failure body. Sum(A,d) is gained from the anchor pull forces of the wall analysis.

z [m]	ϑ1 [°]	ϑ2 [°]	lA [m]	W,k [kN/m]	Q,k [kN/m]	Ea1,k [kN/m]	Ea2,k [kN/m]	Ra_cal,d [kN/m]	Sum(A,d) [kN/m]	Ed/Rd [-]
-0.50	53.0	75.8	8.12	657.7	503.9	11.2	316.3	246.9	80.3	0.33

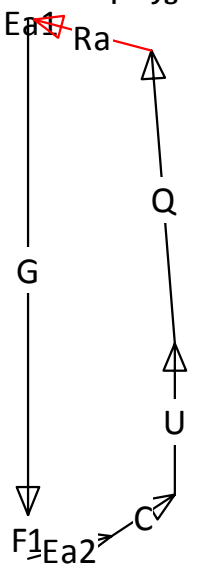
Decisive failure body:
Γεωμετρία:

Foot point of lower failure plane	x/z =	0.01/-13.00 m
Intersection lower/upper slid. plane	x/z =	7.84/ -2.60 m
Intersection upper slid. plane/surface	x/z =	8.50/ 0.00 m
Intersection separation plane/surface	x/z =	7.84/ 0.00 m
Inclination lower failure plane	ϑ1 =	53.02°
Inclination upper failure plane	ϑ2 =	75.76°
Inclination separation plane	ϑ12 =	90.00°

Loads / forces (char.)

		Fx [kN/m]	Fz [kN/m]	F [kN/m]	
Weight of main failure body	G,k:	0.0	-1257.6	1257.6	
Area loads on/in main failure body	F1,k:	0.0	-116.8	116.8	
Cohesion of lower failure plane	C,k:	318.1	422.5	528.8	
Pore water pressure on main body	U,k:	0.1	376.4	376.4	
Earth pres. on separation plane	Ea1,k:	-11.2	-0.0	11.2	δ= 0.0°
Earth pr. between wall<->main body	Ea2,k:	308.8	68.5	316.3	
Force in lower failure plane	Q,k:	-282.0	417.6	503.9	
Sum = possible anchor forces:	Ra_cal,k:	333.8	-89.4	345.6	

Force polygon



Acting anchor forces	Ed: Sum(A,d)	= 80.3 kN/m
Possible anchor forces	Rd: Ra_cal,d = 345.6/1.400 =	246.9 kN/m
Verif. of lower failure plane	Ed/Rd = 0.33 < 1.0: Έλεγχος εκπληρώθηκε.	

Check of steel tension

l,tot ...[m]: Total length of anchor incl. excess length at head
As ....[mm2]: X-section are of steel member
Ri,d ...[kN]: Ultimate strength of tension member (γ,M=1.15)
A,d ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	l,tot	As	Ri,d		A,d	
-0.50	Strand;3x0.60";1570/1770	12.12	420	573.4	>	144.6	Passes requirement

Check of steel tension: Passes requirement

Check of anchor's soil friction

lVk .....: Length of grout body
DmVk ....: Diameter of grout body
τGr,k ...: Average applied skin friction along the grout body (from soil parameters)
Ra,k ....: Charact. pullout resistance of the anchor
γA ......: Partial safety factor of anchor pullout
Ra,d ....: = Ra,k / γA
A,d .....: Dimensioning force of the anchor from wall analysis

z [m]	lVk [m]	DmVk [mm]	τGr,k [kN/m²]	Ra,k [kN]	γA [-]	Ra,d [kN]		A,d [kN]	A,d/Ra,d [-]
-0.50	8.00	318	110	879.1	1.100	799.2	>	144.6	0.2

Check of anchor's soil friction: Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)
Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (-0.68, 0.12), Ακτίνα = 13.14
Αρχ.σημ.= (-13.16, -4.00), Τελ.σημ. = (12.47, 0.00)

Γεωμετρία λωρίδων:

No	x	Width b	dxM	Weight	Load z-κατ.	Water-φορτ.	u*b	φ	c	θ
	[m]	[m]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[°]	[kN/m²]	[°]
1	-12.50	1.31	-11.83	46.3	0.0	0.0	-5.3	27.45	3.57	-31.27*
2	-11.19	1.31	-10.51	110.0	0.0	0.0	-22.3	27.45	3.57	-31.27*
3	-9.87	1.31	-9.20	154.3	0.0	0.0	-42.4	27.45	3.57	-31.27*
4	-8.56	1.31	-7.88	186.4	0.0	0.0	-57.4	0.08	71.43	-36.85
5	-7.25	1.31	-6.57	209.2	0.0	0.0	-68.9	0.08	71.43	-29.98
6	-5.93	1.31	-5.25	226.6	0.0	0.0	-77.7	0.08	71.43	-23.56
7	-4.62	1.31	-3.94	239.5	0.0	0.0	-84.2	0.08	71.43	-17.44
8	-3.30	1.31	-2.62	248.4	0.0	0.0	-88.7	0.08	71.43	-11.52
9	-1.99	1.31	-1.31	253.7	0.0	0.0	-91.3	0.08	71.43	-5.72
10	-0.67	1.31	0.00	255.4	0.0	0.0	-92.2	0.08	71.43	0.02
11	0.64	1.31	1.32	353.6	0.0	0.0	-111.0	0.08	71.43	5.76
12	1.96	1.31	2.63	349.6	15.9	0.0	-128.1	0.08	71.43	11.56
13	3.27	1.31	3.95	340.6	34.2	0.0	-123.6	0.08	71.43	17.48
14	4.58	1.31	5.26	327.7	34.2	0.0	-117.1	0.08	71.43	23.60
15	5.90	1.31	6.58	310.2	34.2	0.0	-108.3	0.08	71.43	30.02
16	7.21	1.31	7.89	287.4	34.2	0.0	-96.8	0.08	71.43	36.89
17	8.53	1.31	9.20	255.3	16.4	0.0	-81.8	27.45	3.57	44.45
18	9.84	1.31	10.52	210.9	0.0	0.0	-61.6	27.45	3.57	53.16
19	11.48	1.97	12.16	187.7	0.0	0.0	-37.4	27.45	3.57	67.69

*** Σημείωση: Στις λωρίδες σημειωμένες με '*'
περιορίστηκε το theta στο 45°-Phi/2.

Συνεισφ. κατακόρυφων φορτίων:

No	Weight	G*sin(θ)	(G-u*b)*tan(φ) + c*b	μ*sin(θ)* tan(φ)+cos(θ)	T
	[kN/m]	[kN/m]	[kN/m]	[-]	[kN/m]
1	46.30	-41.66	25.97	0.773880	33.56
2	110.01	-87.97	50.25	0.773880	64.93
3	154.33	-107.99	62.83	0.773880	81.18
4	186.36	-111.76	94.07	0.799981	117.59
5	209.16	-104.51	94.08	0.865995	108.64
6	226.59	-90.57	94.09	0.916483	102.67
7	239.51	-71.78	94.10	0.953911	98.65
8	248.43	-49.61	94.11	0.979775	96.05
9	253.67	-25.29	94.11	0.994977	94.59
10	255.39	0.08	94.11	1.000000	94.11
11	353.60	35.47	94.22	0.994998	94.70
12	365.52	73.22	94.22	0.979817	96.16
13	374.82	112.56	94.24	0.953968	98.78
14	361.88	144.86	94.23	0.916548	102.81
15	344.42	172.32	94.22	0.866056	108.79
16	321.59	193.05	94.20	0.800019	117.75
17	271.68	190.26	103.36	0.822867	125.61
18	210.90	168.78	82.26	0.724183	113.58
19	187.66	173.61	85.10	0.523667	162.50
		573.08			1912.65

Δράση Ed = (573.1*13.14)
Αντίσταση Rd = (1912.7*13.14 +0.0)

SLIP-CIRCLE μ = Ed/Rd = 0.30 < 1.0: Έλεγχος εκπληρώθηκε.

Φάση εκσκαφής 4 "[4] Situation 4"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 5 Στρώσεις

Name		Τεχνητές επιχωματώσεις	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
γ	[kN/m3]	18	20	22.5
γ,R	[kN/m3]	18	20	22.5
γ'	[kN/m3]	8	10	12.5
γ,p	[kN/m3]	18	20	22.5
γ,R,passive	[kN/m3]	18	20	22.5
γ,pw	[kN/m3]	8	10	12.5
φ	[°]	25	0.1	33
c	[kN/m2]	2	50	5
c,u	[kN/m2]	10	50	5
c παθητικό	[kN/m2]	2	50	5
δ,a	[°]	16.66667	0.06666667	22
δ,p	[°]	-16.66667	-0.06666667	-22
δ,c	[°]	8.333333	0.03333333	11
k,agh	[-]	0.3456501	0.9955057	0.2452023
K,ach	[-]	1.043051	1.994195	0.8549058
K,0h	[-]	0.5773817	0.9982547	0.455361
K,pgh	[-]	3.908103	1.004519	7.495617
K,pch	[-]	5.180327	2.00583	8.599509
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	10e-06	5.5e-09	100e-06

Name		Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20	22.5
γ,R	[kN/m3]	20	22.5
γ'	[kN/m3]	10	12.5
γ,p	[kN/m3]	20	22.5
γ,R,passive	[kN/m3]	20	22.5
γ,pw	[kN/m3]	10	12.5
φ	[°]	0.1	35
c	[kN/m2]	100	5
c,u	[kN/m2]	100	5
c παθητικό	[kN/m2]	100	5
δ,a	[°]	0.06666667	23.33333
δ,p	[°]	-0.06666667	-23.33333
δ,c	[°]	0.03333333	11.66667
k,agh	[-]	0.9955057	0.2244207
K,ach	[-]	1.994195	0.8126539
K,0h	[-]	0.9982547	0.4264236
K,pgh	[-]	1.004519	9.146943
K,pch	[-]	2.00583	10.104
τ,gr	[kN/m2]	110	110
Ψ,A,max	[°]	90	90
k	[cm/s]	5.5e-09	100e-06

Πορεία πρανούς:
x [m] 0.00 0.00
z [m] -4.00 0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
x [m] 0.00 0.00
z [m] -4.00 -1.50

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:
z= -4.50

Πορεία ανώτερου 4. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
z= -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -14.00

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
2.00	0.00	8.50	0.00	0.00	20.00	0.00	20.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Στάθμη νερού:

x [m]	0.00	0.00
z [m]	-6.00	-3.00

Αγκύρια

z[m]	min.l[m]	Alpha[°]	C-H[kN/m]	P0[kN]	u0[m]
-0.50	0.00	15.00	αόρισ.	0.00	0.0000
-3.00	0.00	15.00	αόρισ.	0.00	0.0000

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Ενεργές ωθήσεις.
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: Triangle (perpend. to wall).
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
Levels of redistribution Z1: -0.500, Z2: -3.000 [m].
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Κλασικός, Pregl/Sokolovsky (DIN 4085).

Options for water pressure

Στήριξη πόδα

Πόδας οριζοντίως μετακινούμενος

Αγκύρια

Anchor checks (lower failure plane): Ναι
Anchor forces with safety level of DS-P: Ναι
Verification of grout body pull out forces: Ναι
δ,a,Anchoring wall : used from soil layer.
δ,p,Anchoring wall : used from soil layer.

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

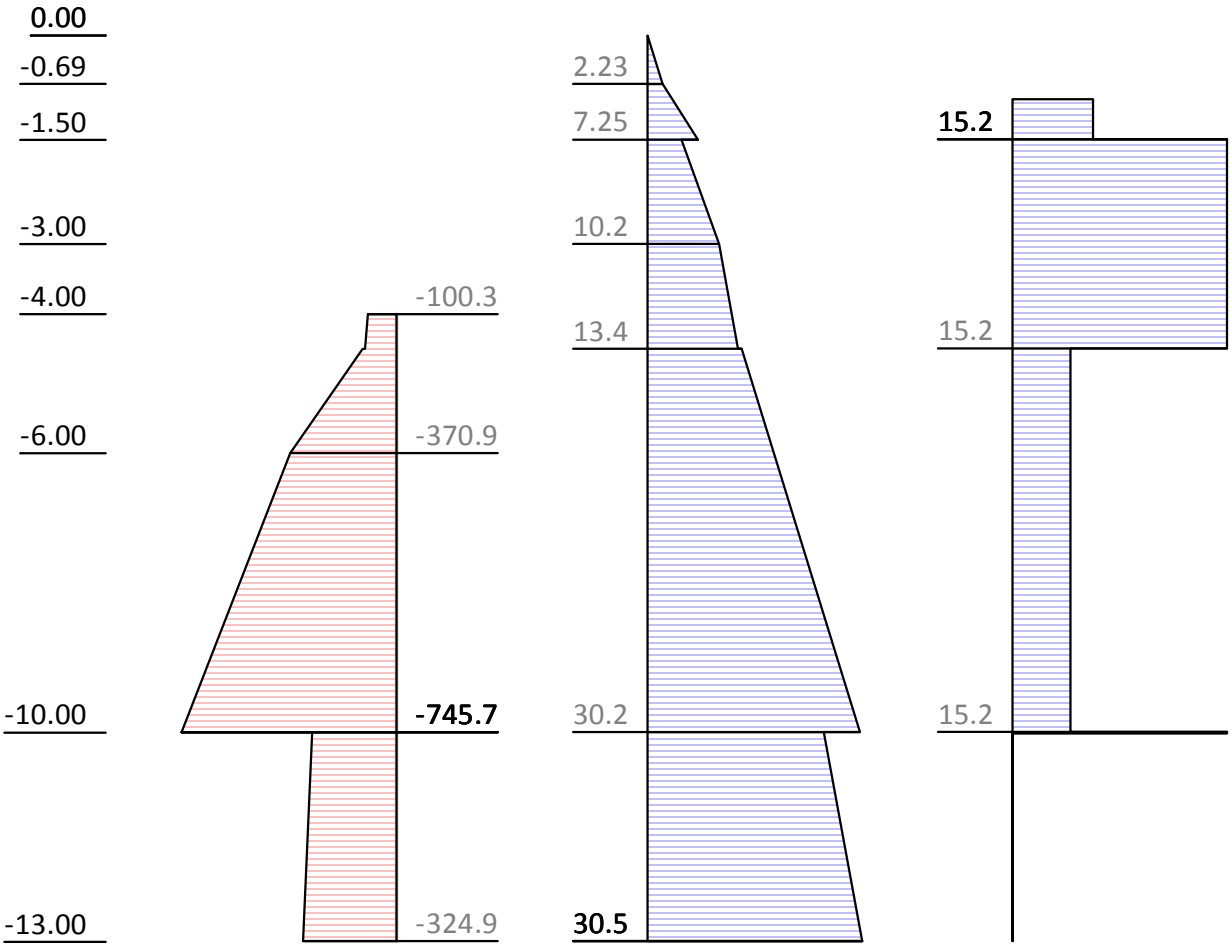
Μήκος τοίχου

Foot depth for statics: zf = -13.000

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall



z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.93		3.72	0.00	5.00
-0.93		3.72	5.76	13.64
-1.50		7.25	5.76	18.43
-1.50		4.82	15.23	29.36
-4.00	-0.00	11.97	15.23	39.00
-4.00	-100.29	11.97	15.23	39.00
-4.50	-110.34	12.86	15.23	40.21
-4.50	-117.95	13.38	4.15	24.29
-10.00	-745.71	30.24	4.15	47.05
-10.00	-294.76	25.14	15.23	56.78
-10.03	-295.06	25.19	15.23	56.86
-10.03	-295.06	25.19	0.00	34.01
-13.00	-324.89	30.49	0.00	41.17

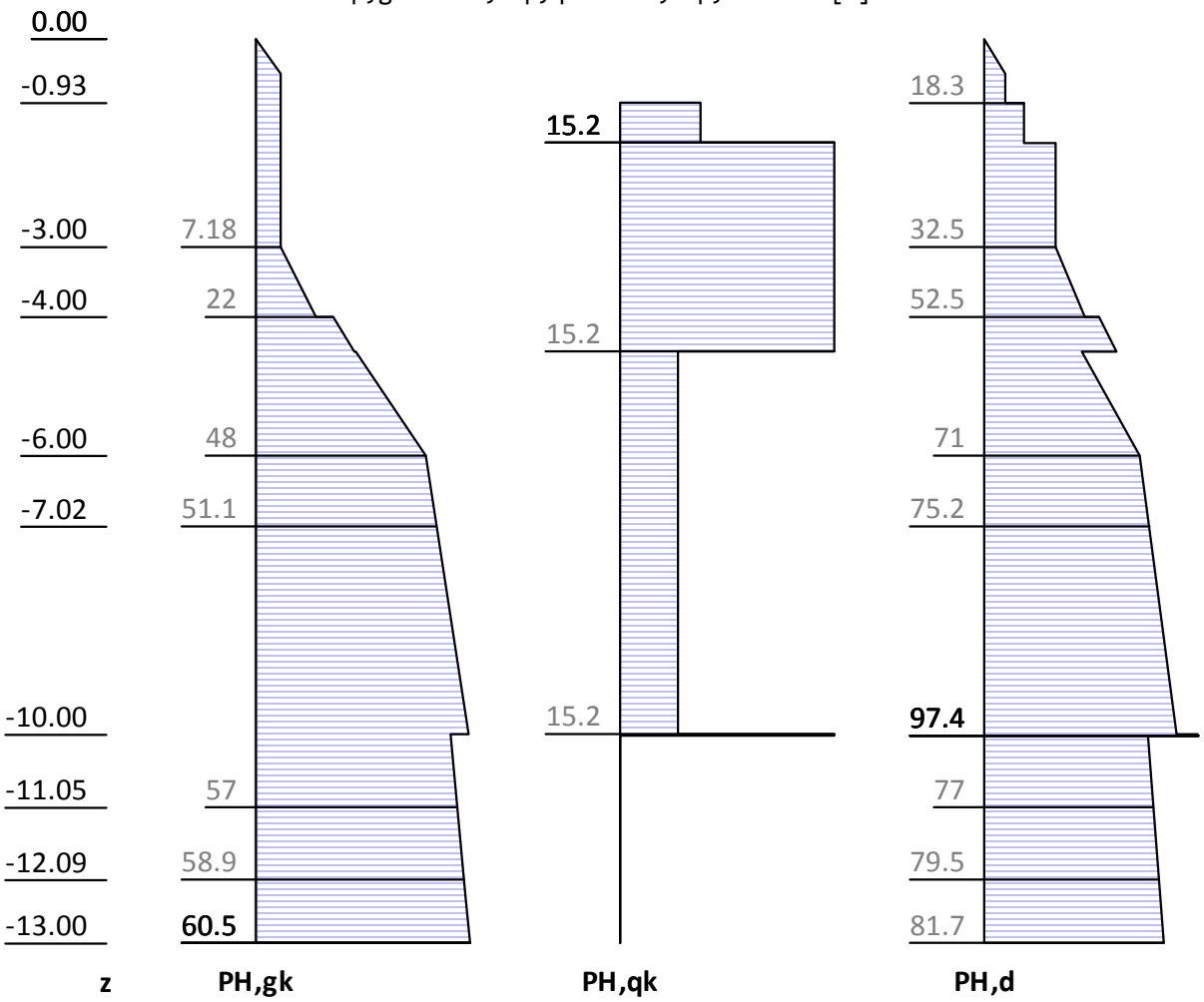
Eph,G,k:-3582.08, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 236.52, Eah,PG,k: 0.00, Eah,PQ,k: 72.27, Eah,d: 427.70

Πίεση νερού

z [m]	Wp,k [kN/m2]	Wa,k [kN/m2]	W,k [kN/m2]
-3.00		0.00	0.00
-6.00	0.00	30.00	30.00
-6.24	-2.40	32.40	30.00
-13.00	-70.00	100.00	30.00

H-pressure on static system

Level of mobilization: Ep,gk 100.0, Ep,qk 100.0, Ep,d 100.0 [%]

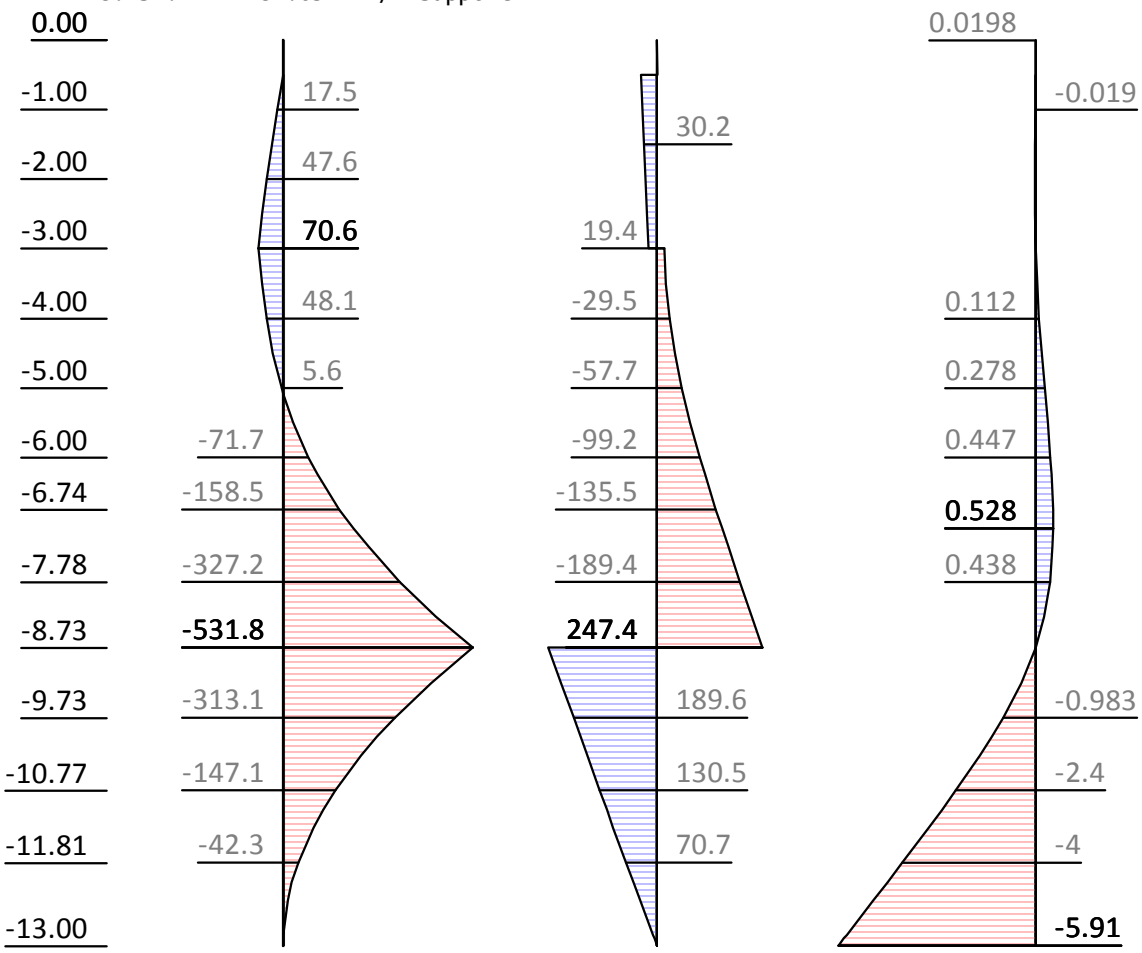


z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	0.00		0.00
-0.93	7.18	0.00	9.69
-0.93	7.18	5.76	18.33
-1.50	7.18	5.76	18.33
-1.50	7.18	15.23	32.54
-4.00	17.18	15.23	46.04
-4.00	21.97	15.23	52.50
-4.50	27.86	15.23	60.46
-4.50	28.38	4.15	44.54
-10.00	60.24	4.15	87.55
-10.00	55.14	15.23	97.28
-10.03	55.19	15.23	97.36
-10.03	55.19	0.00	74.51
-13.00	60.49	0.00	81.67

V-pressure on static system

Internal forces: Permanent, characteristically

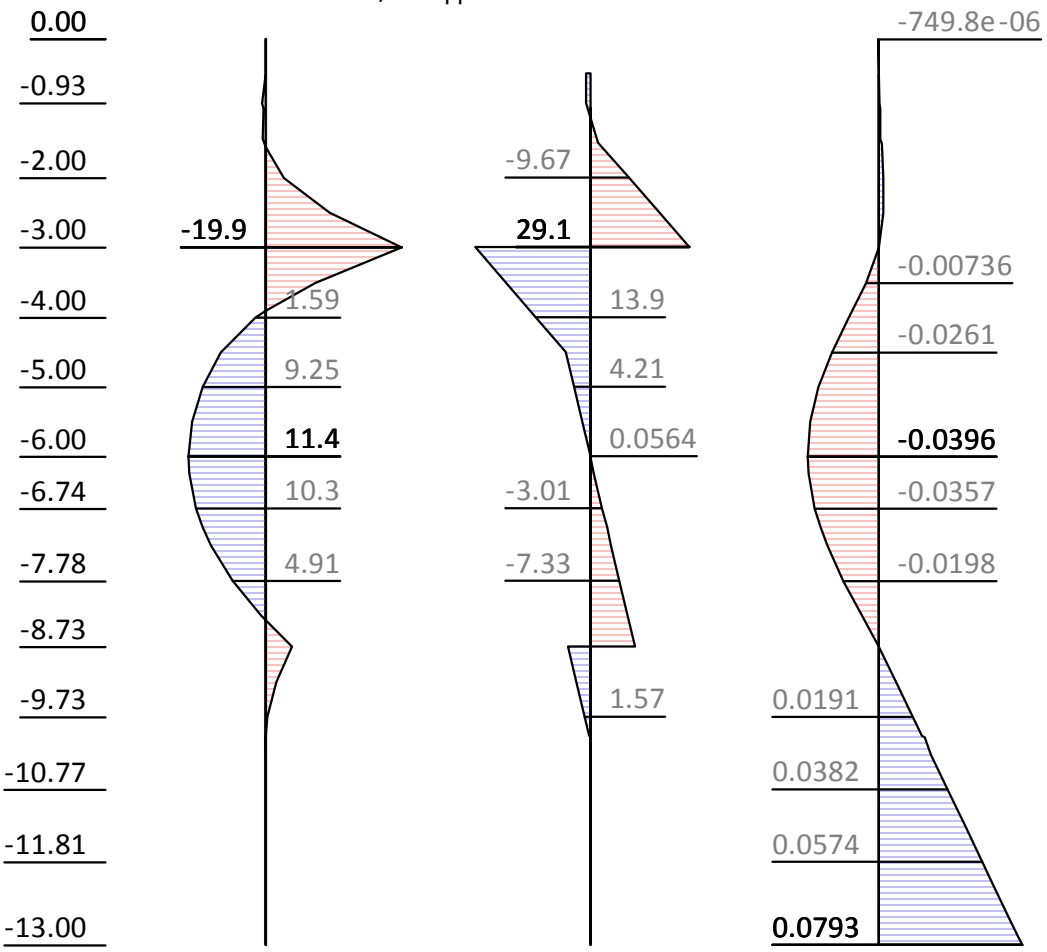
z= -0.500. Fx= -39.142 kN/m Support
z= -3.000. Fx= 36.675 kN/m Support
z= -8.731. Fx=-489.052 kN/m Support



z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	0.00	0.00	0.00	0.00	0.02
-0.50	7.18	-0.30	-1.79	-10.59	0.00
-0.51	7.18	-0.00	37.29	-21.26	-0.00
-2.00	7.18	47.65	26.58	-53.14	-0.04
-3.00	7.18	70.64	19.40	-74.52	-0.00
-3.00	7.18	70.64	19.40	-74.52	0.00
-3.00	7.18	70.64	-17.27	-64.69	0.00
-4.00	17.18	48.11	-29.45	-86.07	0.11
-4.00	21.97	48.11	-29.45	-86.07	0.11
-4.50	27.86	30.39	-41.91	-96.57	0.19
-4.50	28.38	30.39	-41.91	-96.57	0.19
-5.08	36.00	0.00	-60.93	-107.31	0.29
-7.02	51.10	-198.40	-149.71	-145.88	0.53
-8.73	56.35	-531.83	-241.61	-183.84	0.00
-8.73	56.35	-531.83	247.44	-183.84	0.00
-8.73	56.35	-531.83	247.44	-183.84	-0.00
-10.00	60.24	-264.19	173.45	-214.34	-1.32
-10.00	55.14	-264.19	173.45	-214.34	-1.32
-13.00	60.49	-0.00	0.00	-252.24	-5.91
-13.00	60.49	0.00	-0.00	-252.24	-5.91

Internal forces: Variable, characteristically

Method EB 82-4 (Q = [G+Q] - G).
z= -0.500. Fx= -1.230 kN/m Support
z= -3.000. Fx= -54.036 kN/m Support
z= -8.731. Fx= -17.001 kN/m Support

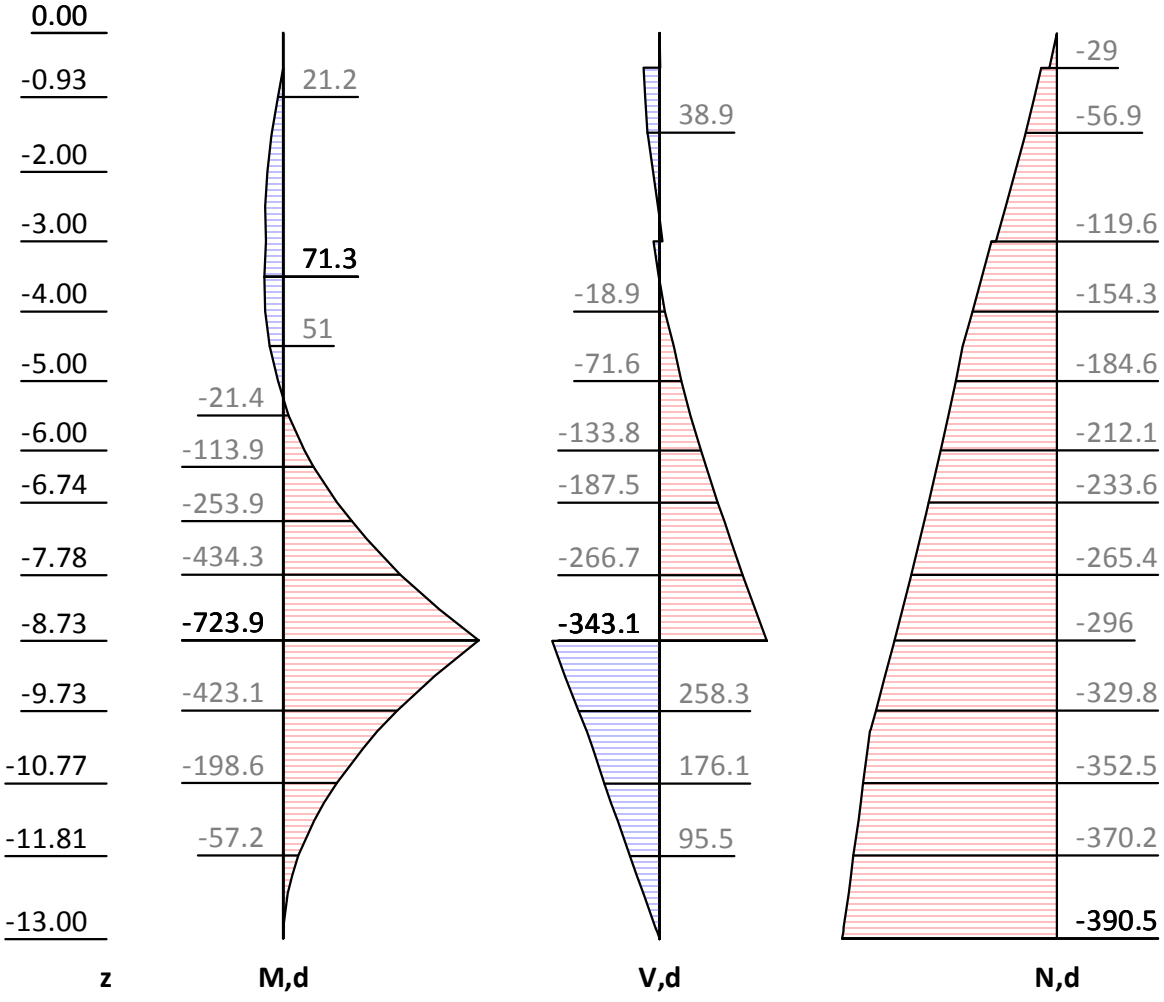


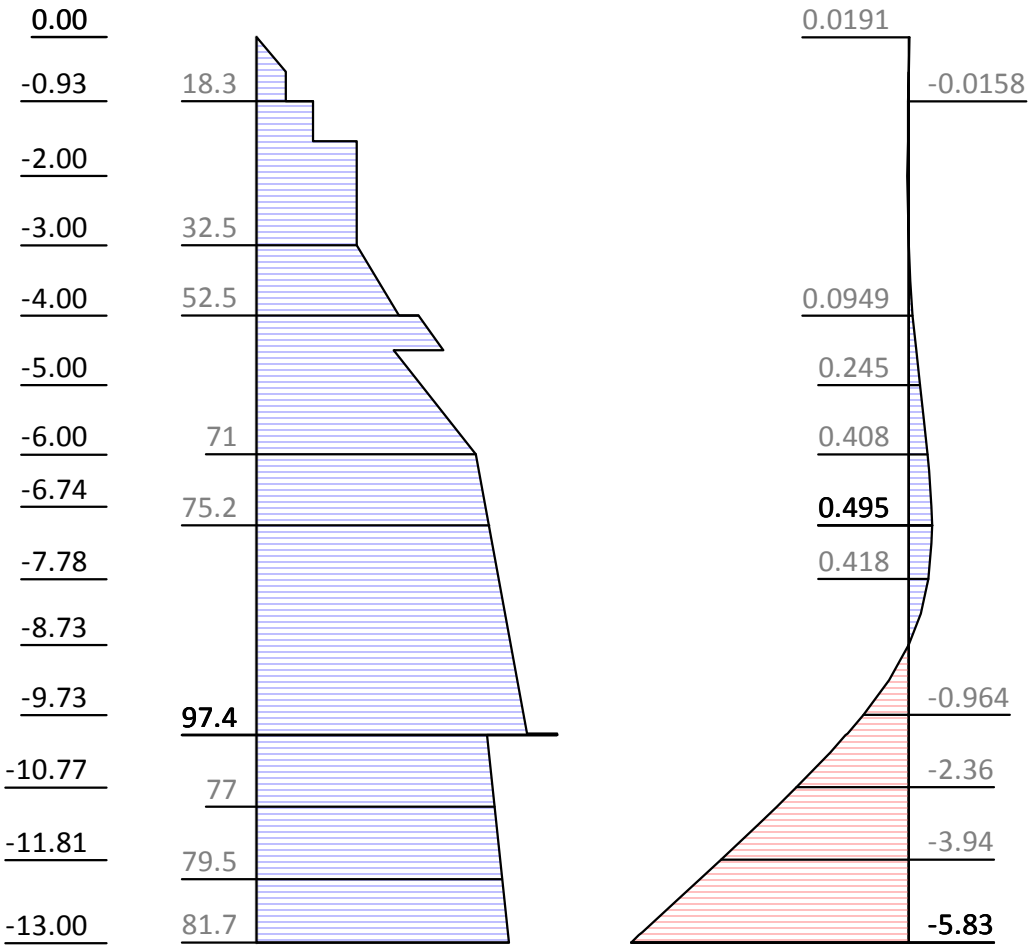
z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00		-0.00	-0.00
-0.50		0.00	0.00	-0.00	-0.00
-0.50		0.00	1.23	-0.33	-0.00
-0.50		0.00	1.23	-0.33	0.00
-0.93	0.00	0.64	1.23	-0.33	0.00
-0.93	5.76	0.64	1.23	-0.33	0.00
-1.00	5.76	0.41	0.83	-0.43	0.00
-1.14	5.76	0.45	0.00	-0.64	0.00
-1.43	5.76	0.53	-1.65	-1.07	0.00
-1.50	5.76	0.29	-2.05	-1.17	0.00
-1.50	15.23	0.29	-2.05	-1.17	0.00
-1.55	15.23	-0.00	-2.82	-1.37	0.00
-2.50	15.23	-9.39	-17.29	-5.07	0.00
-3.00	15.23	-19.92	-24.90	-7.02	-0.00
-3.00	15.23	-19.92	29.13	-21.50	-0.00
-3.91	15.23	0.00	15.27	-25.05	-0.02
-4.50	15.23	6.64	6.28	-27.35	-0.03
-4.50	4.15	6.64	6.28	-27.35	-0.03
-6.00	4.15	11.39	0.06	-28.95	-0.04
-6.01	4.15	11.38	0.00	-28.96	-0.04
-8.35	4.15	0.00	-9.70	-31.45	-0.01

z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
-8.73	4.15	-3.93	-11.28	-31.85	0.00
-8.73	4.15	-3.93	5.72	-31.85	0.00
-10.00	4.15	-0.01	0.46	-33.20	0.02
-10.00	15.23	-0.01	0.46	-33.20	0.02
-10.00	15.23	0.00	0.44	-33.20	0.02
-10.03	15.23	0.20	0.01	-33.32	0.03
-10.03	0.00	0.20	0.01	-33.32	0.03
-10.27	0.00	0.00	0.00	-33.32	0.03
-10.27	0.00	0.00	-0.00	-33.32	0.03
-12.35	0.00	0.00	-0.00	-33.32	0.07
-12.85	0.00	0.00	-0.00	-33.32	0.08
-12.88	0.00	0.00	-0.00	-33.32	0.08
-12.90	0.00	-0.00	-0.00	-33.32	0.08
-12.95	0.00	0.00	-0.00	-33.32	0.08
-13.00	0.00	-0.00	-0.00	-33.32	0.08

Internal forces: Design

z= -0.500. Fx= -54.688 kN/m Support
z= -3.000. Fx= -31.543 kN/m Support
z= -8.731. Fx=-685.722 kN/m Support





z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	0.00	0.00	0.00	0.00	0.02
-0.00	0.00	-0.00	0.00	-0.00	0.02
-0.50	9.69	-0.40	-2.42	-14.30	0.00
-0.51	9.69	0.00	52.19	-29.19	-0.00
-0.93	9.69	21.17	48.10	-41.36	-0.02
-0.93	18.33	21.17	48.10	-41.36	-0.02
-1.50	18.33	45.61	37.65	-59.07	-0.03
-1.50	32.54	45.61	37.65	-59.07	-0.03
-2.00	32.54	60.35	21.38	-76.43	-0.03
-2.50	32.54	66.97	5.11	-93.78	-0.02
-2.66	32.54	66.50	0.00	-99.23	-0.02
-3.00	32.54	65.47	-11.16	-111.13	-0.00
-3.00	32.54	65.47	20.38	-119.59	-0.00
-3.50	39.29	71.32	2.42	-136.94	0.04
-3.56	40.06	70.86	0.00	-138.91	0.05
-4.00	46.04	67.33	-18.91	-154.29	0.09
-4.00	52.50	67.33	-18.91	-154.29	0.09
-4.50	60.46	50.98	-47.15	-171.40	0.16
-4.50	44.54	50.98	-47.15	-171.40	0.16
-5.25	57.77	-0.00	-86.09	-191.36	0.29
-7.02	75.22	-253.91	-208.37	-241.99	0.50
-8.73	82.29	-723.87	-343.09	-295.95	0.00
-8.73	82.29	-723.87	342.63	-295.95	0.00
-8.73	82.29	-723.87	342.63	-295.95	-0.00
-10.00	87.55	-356.66	234.84	-339.16	-1.30
-10.00	97.28	-356.66	234.84	-339.16	-1.30
-10.03	97.36	-349.66	231.92	-339.84	-1.33

z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
-10.03	74.51	-349.66	231.92	-339.84	-1.33
-13.00	81.67	-0.00	0.00	-390.49	-5.83
-13.00	81.67	0.00	-0.00	-390.49	-5.83

Anchor forces with safety level of DS-P

z[m]	A,d[kN]	Fx,d[kN/m]
-0.50	101.9	-54.7
-3.00	58.8	-31.5

Checks of earth statics

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -8.73 m
Rd = Eph,k/γ,Re = 3582.08 / 1.400 = 2558.63 [kN/m]

Ed(Uh,d)/Rd = 685.72 / 2558.63 = 0.268 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-13.00

Pos.	H	V
H/V pressure G+P+W,k	491.52	49.97
Wall weight		201.61
H/V pressure passive		0.00
Support z: -0.50	-39.14	10.49
Support z: -3.00	36.67	-9.83
Bh,g,k z=-8.73	-489.05	
Bv,g,k = Bh,k * tan(δ,p=-22.00°)		-197.59
Σ	-0.00	54.65 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.

Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1
Vertical component of earth resistance is less than the downwards pointing vertical forces.

Vk >= Bvk: 252.24 >= 197.59 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-13.00

Pos.	H	V
H/V pressure G+P+W,k	563.79	68.48
Wall weight		201.61
H/V pressure passive		0.00
Support z: -0.50	-40.37	10.82
Support z: -3.00	-17.36	4.65
Bh,g,k z=-8.73	-489.05	
Bv,g,k = Bh,k * tan(δ,p=-22.00°)		-197.59
Bh,q,k z=-8.73	-17.00	
Bv,q,k = Bh,k * tan(δ,p=-22.00°)		-6.87
Σ	-0.00	81.09 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.

Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1
Vertical component of earth resistance is less than
the downwards pointing vertical forces.

Vk >= Bvk: 285.55 >= 204.46 Passes requirement

Anchor verification

Anchor - Stability of lower failure plane

Περίπτ.Φόρτισης: όλα τα φορτία BS-P
Αυτόμ. υπολογ. μήκους αγκυρίων:
All anchors are extended (if necessary)
Favourable variable loads in main failure body are not being considered.
Bottom of lower failure plane: z=-13.00 m

Iteration of failure mechanisms:
lA .....: Length of anchor from head to center of grout body.
W,k .....: Res. force from dead weight, loads, cohesion, ...
Q,k .....: Force in lower failure plane.
Ea1,k.....: Earth pressure onto vertical separation plane.
Ea2,k.....: Earth pressure between wall and main failure body.
Ra_cal,d ...: Dimesioning force of the resistance from the equilibrium of forces. Ra_cal,d corresponds to the max. possible anchor force of the force polygon.
Sum(A,d) ...: Acting anchor forces along the grout body fractions within the failure body. Sum(A,d) is gained from the anchor pull forces of the wall analysis.

z [m]	ϑ1 [°]	ϑ2 [°]	lA [m]	W,k [kN/m]	Q,k [kN/m]	Ea1,k [kN/m]	Ea2,k [kN/m]	Ra_cal,d [kN/m]	Sum(A,d) [kN/m]	Ed/Rd [-]
-0.50	53.0	75.8	8.12	657.7	503.9	11.2	316.3	246.9	89.1	0.36
-3.00	52.9	64.8	6.52	597.7	456.7	19.8	316.3	225.6	82.0	0.36

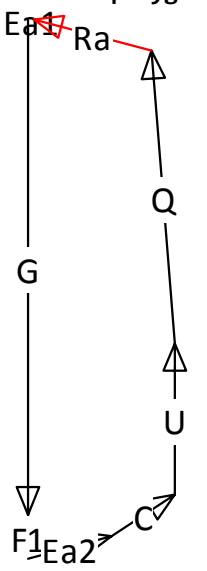
Decisive failure body:
Γεωμετρία:

Foot point of lower failure plane	x/z =	0.01/-13.00 m
Intersection lower/upper slid. plane	x/z =	6.29/ -4.69 m
Intersection upper slid. plane/surface	x/z =	8.50/ 0.00 m
Intersection separation plane/surface	x/z =	6.29/ 0.00 m
Inclination lower failure plane	ϑ1	= 52.92°
Inclination upper failure plane	ϑ2	= 64.79°
Inclination separation plane	ϑ12	= 90.00°

Loads / forces (char.)

		Fx [kN/m]	Fz [kN/m]	F [kN/m]	
Weight of main failure body	G,k:	0.0	-1152.2	1152.2	
Area loads on/in main failure body	F1,k:	0.0	-85.9	85.9	
Cohesion of lower failure plane	C,k:	246.8	326.6	409.4	
Pore water pressure on main body	U,k:	0.0	367.2	367.2	
Earth pres. on separation plane	Ea1,k:	-19.8	-0.0	19.8	δ= 0.0°
Earth pr. between wall<->main body	Ea2,k:	308.8	68.5	316.3	
Force in lower failure plane	Q,k:	-230.7	394.2	456.7	
Sum = possible anchor forces:	Ra_cal,k:	305.1	-81.7	315.8	

Force polygon



Acting anchor forces Ed: Sum(A,d) = 82.0 kN/m
Possible anchor forces Rd: Ra_cal,d = 315.8/1.400 = 225.6 kN/m

Verif. of lower failure plane Ed/Rd = 0.36 < 1.0: Έλεγχος εκπληρώθηκε.

Check of steel tension

l,tot ...[m]: Total length of anchor incl. excess length at head
As ....[mm2]: X-section are of steel member
Ri,d ...[kN]: Ultimate strength of tension member (γ,M=1.15)
A,d ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	l,tot	As	Ri,d		A,d	
-0.50	Strand;3x0.60";1570/1770	12.12	420	573.4	>	101.9	Passes requirement
-3.00	Strand;3x0.60";1570/1770	10.52	420	573.4	>	58.8	Passes requirement

Check of steel tension: Passes requirement

Check of anchor's soil friction

lVk .....: Length of grout body
DmVk ....: Diameter of grout body
τGr,k ...: Average applied skin friction along the grout body (from soil parameters)
Ra,k ....: Charact. pullout resistance of the anchor
γA ......: Partial safety factor of anchor pullout
Ra,d ....: = Ra,k / γA
A,d .....: Dimensioning force of the anchor from wall analysis

z [m]	lVk [m]	DmVk [mm]	τGr,k [kN/m²]	Ra,k [kN]	γA [-]	Ra,d [kN]		A,d [kN]	A,d/Ra,d [-]
-0.50	8.00	318	110	879.1	1.100	799.2	>	101.9	0.1
-3.00	8.00	318	110	879.1	1.100	799.2	>	58.8	0.1

Check of anchor's soil friction: Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)
Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (-0.68, 0.12), Ακτίνα = 13.14
Αρχ.σημ.= (-13.16, -4.00), Τελ.σημ. = (12.47, 0.00)

Γεωμετρία λωρίδων:

No	x [m]	Width b [m]	dxM [m]	Weight [kN/m]	Load z-κατ. [kN/m]	Water-φορτ. [kN/m]	u*b [kN/m]	φ [°]	c [kN/m²]	θ [°]
1	-12.50	1.31	-11.83	46.3	0.0	0.0	-5.3	27.45	3.57	-31.27*
2	-11.19	1.31	-10.51	110.0	0.0	0.0	-22.3	27.45	3.57	-31.27*
3	-9.87	1.31	-9.20	154.3	0.0	0.0	-42.4	27.45	3.57	-31.27*
4	-8.56	1.31	-7.88	186.4	0.0	0.0	-57.4	0.08	71.43	-36.85
5	-7.25	1.31	-6.57	209.2	0.0	0.0	-68.9	0.08	71.43	-29.98
6	-5.93	1.31	-5.25	226.6	0.0	0.0	-77.7	0.08	71.43	-23.56
7	-4.62	1.31	-3.94	239.5	0.0	0.0	-84.2	0.08	71.43	-17.44
8	-3.30	1.31	-2.62	248.4	0.0	0.0	-88.7	0.08	71.43	-11.52
9	-1.99	1.31	-1.31	253.7	0.0	0.0	-91.3	0.08	71.43	-5.72
10	-0.67	1.31	0.00	255.4	0.0	0.0	-92.2	0.08	71.43	0.02
11	0.64	1.31	1.32	353.6	0.0	0.0	-111.0	0.08	71.43	5.76
12	1.96	1.31	2.63	349.6	15.9	0.0	-128.1	0.08	71.43	11.56
13	3.27	1.31	3.95	340.6	34.2	0.0	-123.6	0.08	71.43	17.48
14	4.58	1.31	5.26	327.7	34.2	0.0	-117.1	0.08	71.43	23.60
15	5.90	1.31	6.58	310.2	34.2	0.0	-108.3	0.08	71.43	30.02
16	7.21	1.31	7.89	287.4	34.2	0.0	-96.8	0.08	71.43	36.89
17	8.53	1.31	9.20	255.3	16.4	0.0	-81.8	27.45	3.57	44.45
18	9.84	1.31	10.52	210.9	0.0	0.0	-61.6	27.45	3.57	53.16
19	11.48	1.97	12.16	187.7	0.0	0.0	-37.4	27.45	3.57	67.69

*** Σημείωση: Στις λωρίδες σημειωμένες με '*'
περιορίστηκε το theta στο 45°-Phi/2.

Συνεισφ. κατακόρυφων φορτίων:

No	Weight [kN/m]	G*sin(θ) [kN/m]	(G-u*b)*tan(φ) + c*b [kN/m]	μ*sin(θ)* tan(φ)+cos(θ) [-]	T [kN/m]
1	46.30	-41.66	25.97	0.773880	33.56
2	110.01	-87.97	50.25	0.773880	64.93
3	154.33	-107.99	62.83	0.773880	81.18
4	186.36	-111.76	94.07	0.799981	117.59
5	209.16	-104.51	94.08	0.865995	108.64
6	226.59	-90.57	94.09	0.916483	102.67
7	239.51	-71.78	94.10	0.953911	98.65
8	248.43	-49.61	94.11	0.979775	96.05
9	253.67	-25.29	94.11	0.994977	94.59
10	255.39	0.08	94.11	1.000000	94.11
11	353.60	35.47	94.22	0.994998	94.70
12	365.52	73.22	94.22	0.979817	96.16
13	374.82	112.56	94.24	0.953968	98.78
14	361.88	144.86	94.23	0.916548	102.81
15	344.42	172.32	94.22	0.866056	108.79
16	321.59	193.05	94.20	0.800019	117.75
17	271.68	190.26	103.36	0.822867	125.61
18	210.90	168.78	82.26	0.724183	113.58
19	187.66	173.61	85.10	0.523667	162.50
		573.08			1912.65

Δράση Ed = (573.1*13.14)
Αντίσταση Rd = (1912.7*13.14 +0.0)

SLIP-CIRCLE μ = Ed/Rd = 0.30 < 1.0: Έλεγχος εκπληρώθηκε.

Φάση εκσκαφής 5 "[5] Situation 5"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 5 Στρώσεις

Name		Τεχνητές επιχωματώσεις	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
γ	[kN/m3]	18	20	22.5
γ,R	[kN/m3]	18	20	22.5
γ'	[kN/m3]	8	10	12.5
γ,p	[kN/m3]	18	20	22.5
γ,R,passive	[kN/m3]	18	20	22.5
γ,pw	[kN/m3]	8	10	12.5
φ	[°]	25	0.1	33
c	[kN/m2]	2	50	5
c,u	[kN/m2]	10	50	5
c παθητικό	[kN/m2]	2	50	5
δ,a	[°]	16.66667	0.06666667	22
δ,p	[°]	-16.66667	-0.06666667	-22
δ,c	[°]	8.333333	0.03333333	11
k,agh	[-]	0.3456501	0.9955057	0.2452023
K,ach	[-]	1.043051	1.994195	0.8549058
K,0h	[-]	0.5773817	0.9982547	0.455361
K,pgh	[-]	3.908103	1.004519	7.495617
K,pch	[-]	5.180327	2.00583	8.599509
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	10e-06	5.5e-09	100e-06

Name		Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20	22.5
γ,R	[kN/m3]	20	22.5
γ'	[kN/m3]	10	12.5
γ,p	[kN/m3]	20	22.5
γ,R,passive	[kN/m3]	20	22.5
γ,pw	[kN/m3]	10	12.5
φ	[°]	0.1	35
c	[kN/m2]	100	5
c,u	[kN/m2]	100	5
c παθητικό	[kN/m2]	100	5
δ,a	[°]	0.06666667	23.33333
δ,p	[°]	-0.06666667	-23.33333
δ,c	[°]	0.03333333	11.66667
k,agh	[-]	0.9955057	0.2244207
K,ach	[-]	1.994195	0.8126539
K,0h	[-]	0.9982547	0.4264236
K,pgh	[-]	1.004519	9.146943
K,pch	[-]	2.00583	10.104
τ,gr	[kN/m2]	110	110
Ψ,A,max	[°]	90	90
k	[cm/s]	5.5e-09	100e-06

Πορεία πρανούς:
x [m] 0.00 0.00
z [m] -6.85 0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
x [m] 0.00 0.00
z [m] -6.85 -1.50

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:
x [m] 0.00 0.00
z [m] -6.85 -4.50

Πορεία ανώτερου 4. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
z= -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -14.00

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
2.00	0.00	8.50	0.00	0.00	20.00	0.00	20.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Στάθμη νερού:

x [m] 0.00 0.00
z [m] -11.00 -3.00

Αγκύρια

z[m]	min.l[m]	Alpha[°]	C-H[kN/m]	P0[kN]	u0[m]
-0.50	0.00	15.00	0.00	0.00	0.0000
-3.00	0.00	15.00	αόριστ.	0.00	0.0000

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Ενεργές ωθήσεις.
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: Trapezoid.
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
Levels of redistribution Z1: 0.000, Z2: -3.000 [m].
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Κλασικός, Pregl/Sokolovsky (DIN 4085).

Options for water pressure

Στήριξη πόδα

Πόδας οριζοντίως μετακινούμενος

Αγκύρια

Anchor checks (lower failure plane): Ναι
Anchor forces with safety level of DS-P: Ναι
Verification of grout body pull out forces: Ναι
δ,a,Anchoring wall : used from soil layer.
δ,p,Anchoring wall : used from soil layer.

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	Αμμώδης ΑΡΓΙΛΟΣ
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

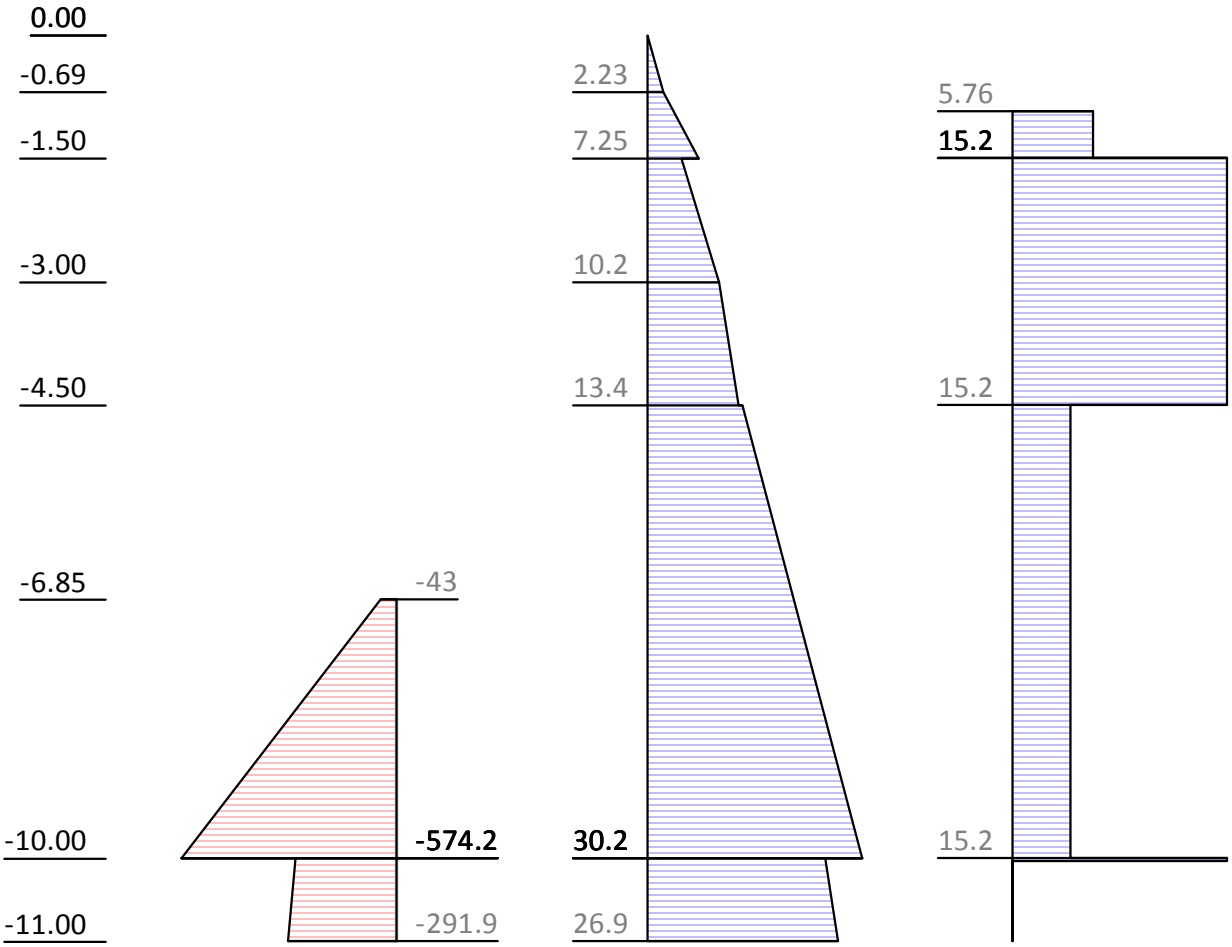
Μήκος τοίχου

Foot depth for statics: zf = -11.000

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall



z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.93		3.72	0.00	5.00
-0.93		3.72	5.76	13.64
-1.50		7.25	5.76	18.43
-1.50		4.82	15.23	29.36
-4.50		12.86	15.23	40.21
-4.50		13.38	4.15	24.29
-6.85	-0.00	20.58	4.15	34.01
-6.85	-43.00	20.58	4.15	34.01
-10.00	-574.25	30.24	4.15	47.05
-10.00	-271.78	25.14	15.23	56.78
-10.03	-272.38	25.19	15.23	56.86
-10.03	-272.38	25.19	0.00	34.01
-11.00	-291.87	26.92	0.00	36.35

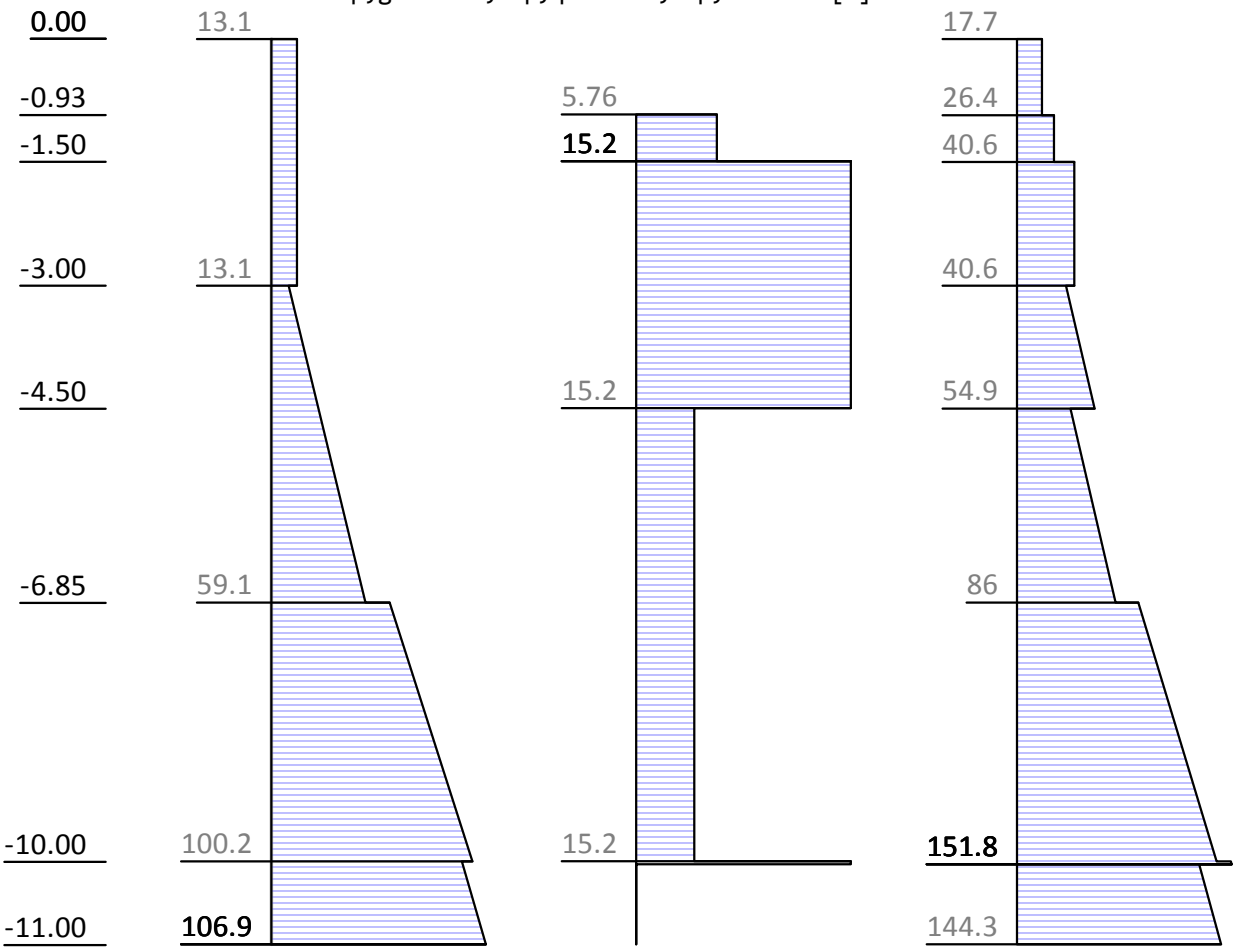
Eph,G,k:-1253.99, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 179.10, Eah,PG,k: 0.00, Eah,PQ,k: 72.27, Eah,d: 350.19

Πίεση νερού

z [m]	Wa,k [kN/m2]	W,k [kN/m2]
-3.00	0.00	0.00
-11.00	80.00	80.00

H-pressure on static system

Level of mobilization: Ep,gk 100.0, Ep,qk 100.0, Ep,d 100.0 [%]

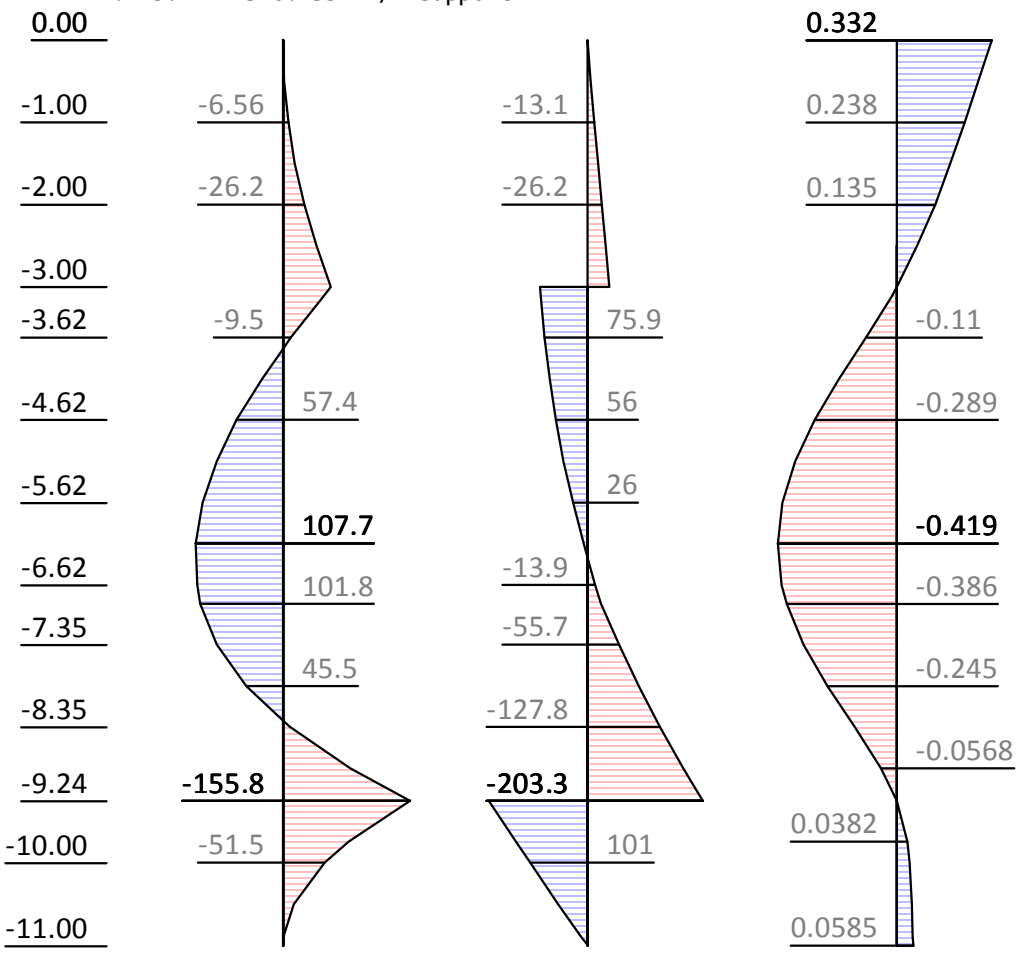


z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	13.12		17.71
-0.93	13.12	0.00	17.71
-0.93	13.12	5.76	26.35
-1.50	13.12	5.76	26.35
-1.50	13.12	15.23	40.56
-3.00	13.12	15.23	40.56
-3.00	8.75	15.23	34.66
-4.50	23.75	15.23	54.91
-4.50	23.75	4.15	38.29
-6.85	47.25	4.15	70.01
-6.85	59.08	4.15	85.99
-10.00	100.24	4.15	141.55
-10.00	95.14	15.23	151.28
-10.03	95.49	15.23	151.76
-10.03	95.49	0.00	128.91
-11.00	106.92	0.00	144.35

V-pressure on static system

Internal forces: Permanent, characteristically

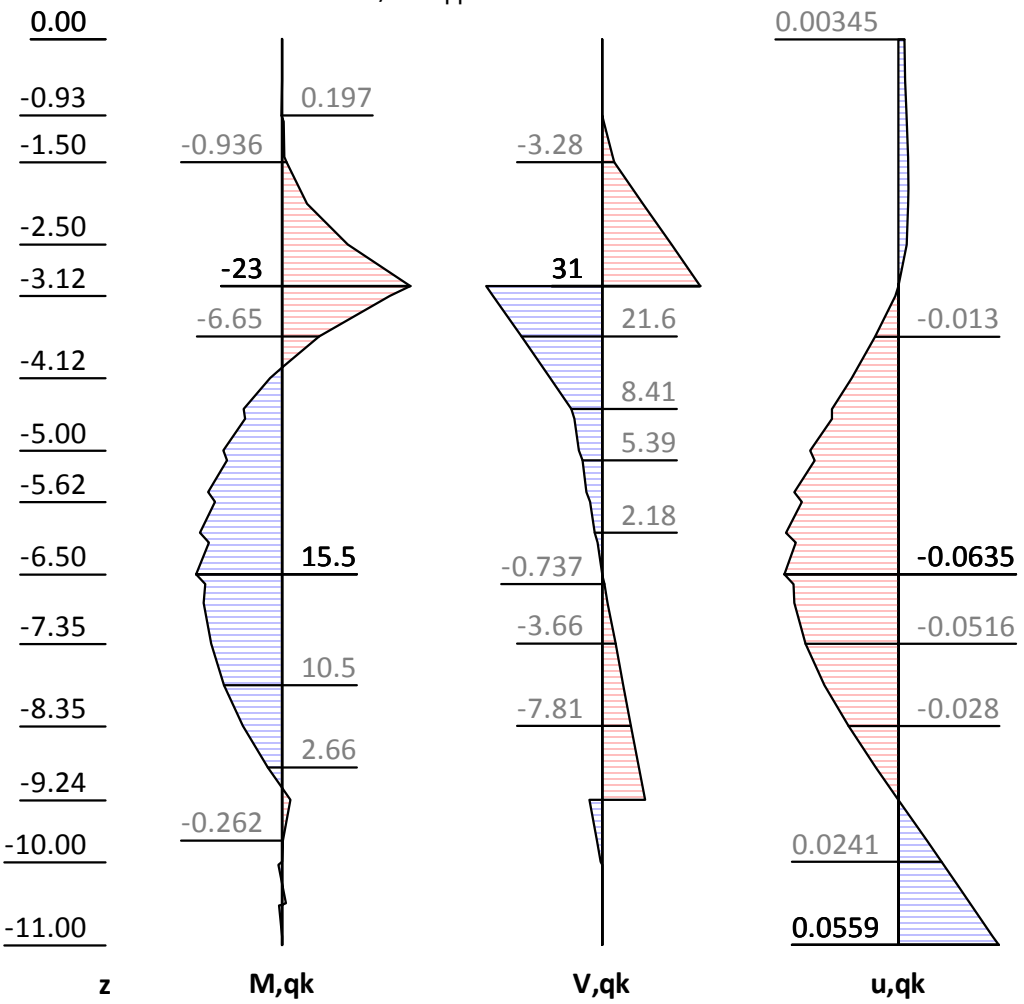
z= -0.500. Fx= -0.000 kN/m Support
z= -3.000. Fx=-122.669 kN/m Support
z= -9.243. Fx=-376.433 kN/m Support



z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	13.12	0.00	-0.00	0.00	0.33
-0.00	13.12	0.00	-0.00	-0.00	0.33
-3.00	13.12	-59.02	-39.35	-72.45	-0.00
-3.00	8.75	-59.02	83.32	-105.32	-0.00
-3.75	16.27	-0.00	73.63	-122.70	-0.13
-6.12	39.95	107.68	7.34	-177.39	-0.42
-6.29	41.68	107.13	0.00	-181.38	-0.41
-6.85	47.25	101.81	-24.47	-194.26	-0.39
-6.85	59.08	101.81	-24.47	-194.26	-0.39
-8.27	77.62	0.00	-121.68	-233.52	-0.16
-9.24	90.31	-155.76	-203.27	-257.91	0.00
-9.24	90.31	-155.76	173.17	-257.91	0.00
-10.00	100.24	-51.50	101.03	-276.34	0.05
-10.00	95.14	-51.50	101.03	-276.34	0.05
-11.00	106.92	-0.00	-0.00	-288.97	0.06
-11.00	106.92	0.00	-0.00	-288.97	0.06

Internal forces: Variable, characteristically

Method EB 82-4 (Q = [G+Q] - G).
z= -0.500. Fx= 0.000 kN/m Support
z= -3.000. Fx= -57.154 kN/m Support
z= -9.243. Fx= -15.113 kN/m Support

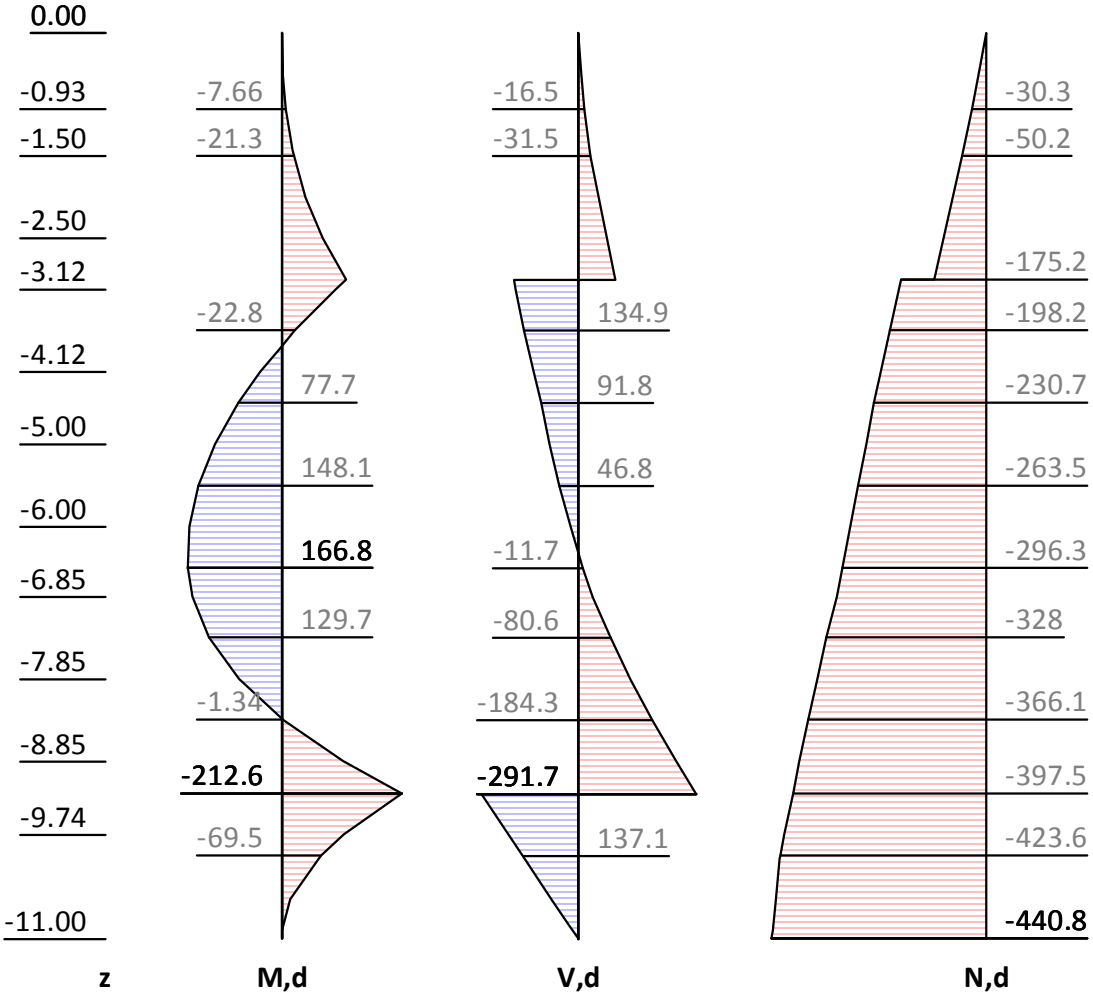


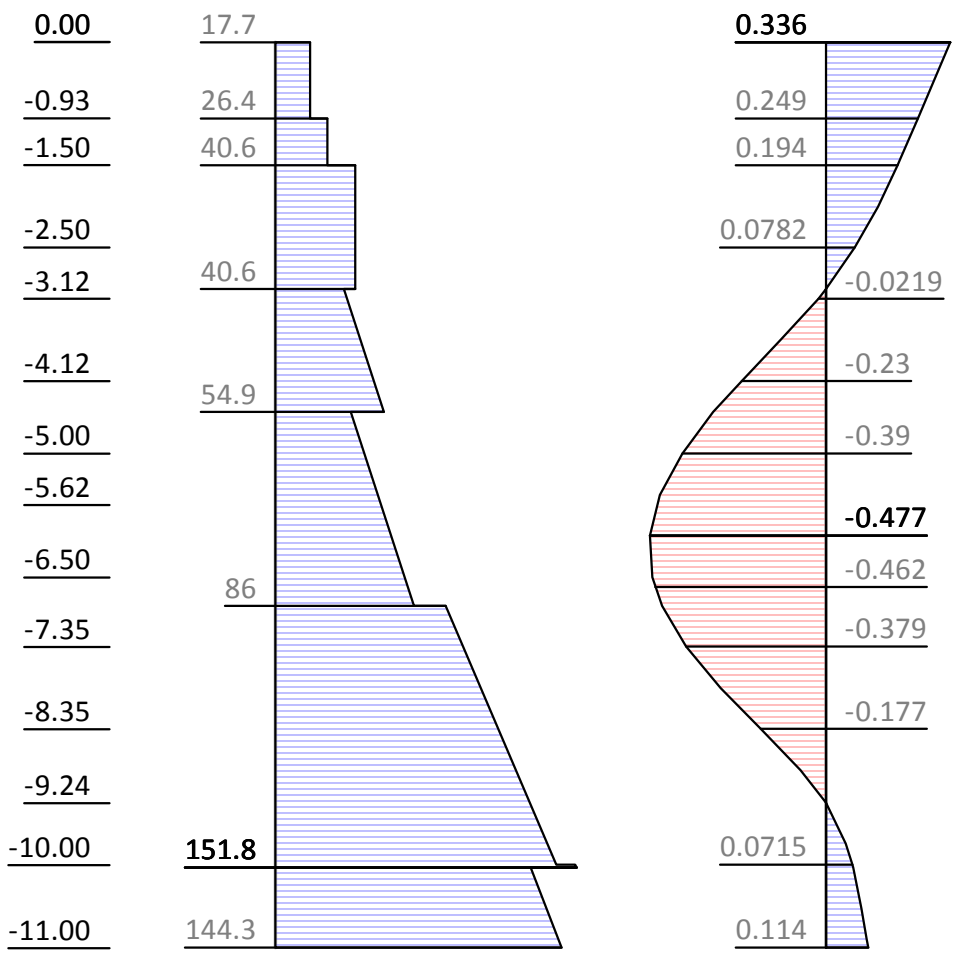
z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00	0.00	0.00	0.00
-0.93	0.00	0.20	0.00	-0.00	0.00
-0.93	5.76	0.20	0.00	-0.00	0.00
-0.96	5.76	0.00	-0.16	-0.04	0.00
-1.43	5.76	-0.52	-2.88	-0.74	0.01
-1.50	5.76	-0.94	-3.28	-0.84	0.01
-1.50	15.23	-0.94	-3.28	-0.84	0.01
-2.00	15.23	-4.50	-10.90	-2.79	0.01
-3.00	15.23	-23.00	-26.13	-6.69	0.00
-3.00	15.23	-23.00	-26.13	-6.69	-0.00
-3.00	15.23	-23.00	31.02	-22.01	-0.00
-3.99	15.23	0.00	15.91	-25.88	-0.02
-4.50	15.23	6.95	8.41	-27.86	-0.04
-4.50	4.15	6.95	8.41	-27.86	-0.04
-5.00	4.15	10.63	6.34	-28.39	-0.05
-5.50	4.15	13.31	4.27	-28.92	-0.06
-6.00	4.15	14.86	2.18	-29.45	-0.06
-6.50	4.15	15.52	0.12	-29.98	-0.06
-6.52	4.15	15.28	-0.00	-30.00	-0.06
-6.85	4.15	14.13	-1.58	-30.36	-0.06
-9.10	4.15	-0.00	-10.92	-32.75	-0.00

z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
-9.24	4.15	-1.54	-11.51	-32.90	0.00
-9.24	4.15	-1.54	3.60	-32.90	0.00
-10.00	4.15	-0.01	0.46	-33.70	0.02
-10.00	15.23	-0.01	0.46	-33.70	0.02
-10.00	15.23	-0.00	0.45	-33.71	0.02
-10.03	15.23	0.69	0.08	-33.82	0.03
-10.03	0.00	0.69	0.08	-33.82	0.03
-10.26	0.00	-0.00	0.00	-33.82	0.03
-10.26	0.00	-0.01	-0.00	-33.82	0.03
-10.50	0.00	-0.71	-0.08	-33.82	0.04
-10.52	0.00	-0.00	-0.00	-33.82	0.04
-10.52	0.00	0.01	0.00	-33.82	0.04
-10.90	0.00	0.00	0.00	-33.82	0.05
-10.96	0.00	-0.00	-0.00	-33.82	0.05
-11.00	0.00	-0.00	-0.00	-33.82	0.06

Internal forces: Design

z= -0.500. Fx= -0.000 kN/m Support
z= -3.000. Fx=-251.335 kN/m Support
z= -9.243. Fx=-530.855 kN/m Support





z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	17.71	0.00	0.00	0.00	0.34
-0.00	17.71	-0.00	0.00	-0.00	0.34
-0.93	17.71	-7.66	-16.47	-30.32	0.25
-0.93	26.35	-7.66	-16.47	-30.32	0.25
-1.50	26.35	-21.32	-31.49	-50.16	0.19
-1.50	40.56	-21.32	-31.49	-50.16	0.19
-3.00	40.56	-114.18	-92.32	-107.85	0.00
-3.00	40.56	-114.18	-92.32	-107.85	-0.00
-3.00	34.66	-114.18	159.01	-175.19	-0.00
-3.80	45.52	-0.00	126.36	-204.99	-0.16
-4.50	54.91	77.75	91.83	-230.75	-0.31
-4.50	38.29	77.75	91.83	-230.75	-0.31
-6.00	58.54	164.76	19.20	-279.92	-0.48
-6.31	62.72	166.05	0.00	-290.09	-0.47
-6.50	65.29	166.83	-11.74	-296.31	-0.47
-6.85	70.01	158.64	-35.41	-307.78	-0.44
-6.85	85.99	158.64	-35.41	-307.78	-0.44
-8.34	112.29	-0.00	-183.35	-365.77	-0.18
-9.24	128.14	-212.58	-291.68	-397.52	0.00
-9.24	128.14	-212.58	239.17	-397.52	0.00
-10.00	141.55	-69.53	137.08	-423.61	0.07
-10.00	151.28	-69.53	137.08	-423.61	0.07
-10.03	151.76	-65.49	132.53	-424.30	0.07
-10.03	128.91	-65.49	132.53	-424.30	0.07
-11.00	144.35	-0.00	0.00	-440.84	0.11
-11.00	144.35	-0.00	-0.00	-440.84	0.11

Anchor forces with safety level of DS-P

z[m]	A,d[kN]	Fx,d[kN/m]
-0.50	0.0	-0.0
-3.00	468.4	-251.3

Checks of earth statics

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -9.24 m
Rd = Eph,k/γ,Re = 1253.99 / 1.400 = 895.71 [kN/m]
Ed(Uh,d)/Rd = 530.85 / 895.71 = 0.593 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-11.00

Pos.	H	V
H/V pressure G+P+W,k	499.10	49.90
Wall weight		197.41
H/V pressure passive		0.00
Support z: -0.50		0.00
Support z: -3.00	-122.67	32.87
Bh,g,k z=-9.24	-376.43	
Bv,g,k = Bh,k * tan(δ,p=-22.00°)		-152.09
Σ	-0.00	128.09 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.
Verification of vertical forces due to EAB R 9 not required (R 9-5).
Check EAB R 9-1
Vertical component of earth resistance is less than the downwards pointing vertical forces.
Vk >= Bvk: 280.18 >= 152.09 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-11.00

Pos.	H	V
H/V pressure G+P+W,k	571.37	68.41
Wall weight		197.41
H/V pressure passive		0.00
Support z: -0.50		0.00
Support z: -3.00	-179.82	48.18
Bh,g,k z=-9.24	-376.43	
Bv,g,k = Bh,k * tan(δ,p=-22.00°)		-152.09
Bh,q,k z=-9.24	-15.11	
Bv,q,k = Bh,k * tan(δ,p=-22.00°)		-6.11
Σ	-0.00	155.81 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.
Verification of vertical forces due to EAB R 9 not required (R 9-5).
Check EAB R 9-1
Vertical component of earth resistance is less than the downwards pointing vertical forces.
Vk >= Bvk: 314.00 >= 158.20 Passes requirement

Anchor verification

Anchor - Stability of lower failure plane

Περίπτ.Φόρτισης: όλα τα φορτία BS-P
Αυτόμ. υπολογ. μήκους αγκυρίων:
All anchors are extended (if necessary)
Favourable variable loads in main failure body are not being considered.
Bottom of lower failure plane: z=-11.00 m

Iteration of failure mechanisms:
lA .....: Length of anchor from head to center of grout body.
W,k .....: Res. force from dead weight, loads, cohesion, ...
Q,k .....: Force in lower failure plane.
Ea1,k.....: Earth pressure onto vertical separation plane.
Ea2,k.....: Earth pressure between wall and main failure body.
Ra_cal,d ...: Dimesioning force of the resistance from the equilibrium of forces. Ra_cal,d corresponds to the max. possible anchor force of the force polygon.
Sum(A,d) ...: Acting anchor forces along the grout body fractions within the failure body. Sum(A,d) is gained from the anchor pull forces of the wall analysis.

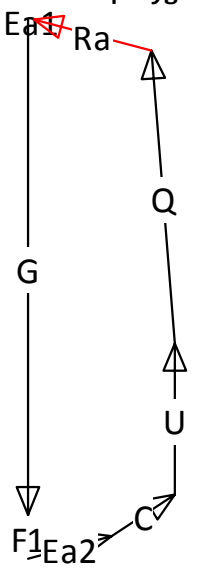
z [m]	ϑ1 [°]	ϑ2 [°]	lA [m]	W,k [kN/m]	Q,k [kN/m]	Ea1,k [kN/m]	Ea2,k [kN/m]	Ra_cal,d [kN/m]	Sum(A,d) [kN/m]	Ed/Rd [-]
-0.50	39.2	57.5	10.03	969.2	823.5	4.4	260.5	204.9	204.4	1.00
-3.00	32.8	60.5	9.09	1057.2	879.7	19.1	260.5	260.8	260.1	1.00

Decisive failure body:
Γεωμετρία:
Foot point of lower failure plane x/z = 0.01/-11.00 m
Intersection lower/upper slid. plane x/z = 8.78/ -5.35 m
Intersection upper slid. plane/surface x/z = 11.81/ 0.00 m
Intersection separation plane/surface x/z = 8.78/ 0.00 m
Inclination lower failure plane ϑ1 = 32.76°
Inclination upper failure plane ϑ2 = 60.49°
Inclination separation plane ϑ12 = 90.00°

Loads / forces (char.)

		Fx [kN/m]	Fz [kN/m]	F [kN/m]	
Weight of main failure body	G,k:	0.0	-1487.1	1487.1	
Area loads on/in main failure body	F1,k:	0.0	-130.0	130.0	
Cohesion of lower failure plane	C,k:	191.5	123.2	227.7	
Pore water pressure on main body	U,k:	-0.0	454.2	454.2	
Earth pres. on separation plane	Ea1,k:	-19.1	-0.0	19.1	δ= 0.0°
Earth pr. between wall<->main body	Ea2,k:	251.4	68.4	260.5	
Force in lower failure plane	Q,k:	-71.0	876.8	879.7	
Sum = possible anchor forces:	Ra_cal,k:	352.7	-94.5	365.1	

Force polygon



Acting anchor forces Ed: Sum(A,d) = 260.1 kN/m
Possible anchor forces Rd: Ra_cal,d = 365.1/1.400 = 260.8 kN/m
Verif. of lower failure plane Ed/Rd = 1.00 < 1.0: Έλεγχος εκπληρώθηκε.

Check of steel tension

l,tot ...[m]: Total length of anchor incl. excess length at head
As ....[mm2]: X-section are of steel member
Ri,d ...[kN]: Ultimate strength of tension member (γ,M=1.15)
A,d ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	l,tot	As	Ri,d		A,d	
-0.50	Strand;3x0.60";1570/1770	14.62	420	573.4	>	0.0	Passes requirement
-3.00	Strand;3x0.60";1570/1770	13.09	420	573.4	>	468.4	Passes requirement

Check of steel tension: Passes requirement

Check of anchor's soil friction

lVk .....: Length of grout body
DmVk ....: Diameter of grout body
τGr,k ...: Average applied skin friction along the grout body (from soil parameters)
Ra,k ....: Charact. pullout resistance of the anchor
γA ......: Partial safety factor of anchor pullout
Ra,d ....: = Ra,k / γA
A,d .....: Dimensioning force of the anchor from wall analysis

z [m]	lVk [m]	DmVk [mm]	τGr,k [kN/m²]	Ra,k [kN]	γA [-]	Ra,d [kN]		A,d [kN]	A,d/Ra,d [-]
-0.50	8.00	318	110	879.1	1.100	799.2	>	0.0	0.0
-3.00	8.00	318	110	879.1	1.100	799.2	>	468.4	0.6

Check of anchor's soil friction: Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)
Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (-0.22, 0.03), Ακτίνα = 11.04
Αρχ.σημ.= (-8.85, -6.85), Τελ.σημ. = (10.82, 0.00)

Γεωμετρία λωρίδων:

No	x	Width b	dxM	Weight	Load z-κατ.	Water-φορτ.	u*b	φ	c	θ
	[m]	[m]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[°]	[kN/m²]	[°]
1	-8.30	1.10	-8.08	15.9	0.0	0.0	-0.0	27.45	3.57	-31.27*
2	-7.19	1.10	-6.98	41.6	0.0	0.0	-0.0	27.45	3.57	-31.27*
3	-6.09	1.10	-5.88	61.3	0.0	0.0	-0.0	27.45	3.57	-31.27*
4	-4.99	1.10	-4.77	76.4	0.0	0.0	-0.0	27.45	3.57	-25.61
5	-3.88	1.10	-3.67	86.7	0.0	0.0	-0.0	0.08	71.43	-19.41
6	-2.78	1.10	-2.56	93.9	0.0	0.0	-0.0	0.08	71.43	-13.43
7	-1.67	1.10	-1.46	98.4	0.0	0.0	-0.0	0.08	71.43	-7.60
8	-0.57	1.10	-0.36	100.5	0.0	0.0	-0.1	0.08	71.43	-1.85
9	0.53	1.10	0.75	251.8	0.0	0.0	-43.9	0.08	71.43	3.88
10	1.64	1.10	1.85	251.5	4.9	0.0	-86.6	0.08	71.43	9.66
11	2.74	1.10	2.96	246.1	28.7	0.0	-83.8	0.08	71.43	15.53
12	3.84	1.10	4.06	237.9	28.7	0.0	-79.7	0.08	71.43	21.58
13	4.95	1.10	5.16	225.9	28.7	0.0	-74.1	27.45	3.57	27.89
14	6.05	1.10	6.27	209.3	28.7	0.0	-66.6	27.45	3.57	34.59
15	7.16	1.10	7.37	187.7	28.7	0.0	-56.9	27.45	3.57	41.89
16	8.26	1.10	8.47	159.3	20.6	0.0	-44.1	27.45	3.57	50.15
17	9.36	1.10	9.58	119.9	0.0	0.0	-25.9	27.45	3.57	60.20
18	10.37	0.91	10.58	53.7	0.0	0.0	-6.2	0.08	35.71	73.51

*** Σημείωση: Στις λωρίδες σημειωμένες με '*'
περιορίστηκε το theta στο 45°-Phi/2.

Συνεισφ. κατακόρυφων φορτίων:

No	Weight	G*sin(θ)	(G-u*b)*tan(φ) + c*b	μ*sin(θ)* tan(φ)+cos(θ)	T
	[kN/m]	[kN/m]	[kN/m]	[-]	[kN/m]
1	15.92	-11.66	12.21	0.711695	17.16
2	41.62	-26.31	25.57	0.711695	35.92
3	61.31	-32.63	35.80	0.711695	50.30
4	76.44	-33.04	43.65	0.782676	55.77
5	86.74	-28.82	78.97	0.942943	83.75
6	93.92	-21.81	78.98	0.972483	81.21
7	98.44	-13.02	78.99	0.991118	79.69
8	100.45	-3.24	78.99	0.999456	79.03
9	251.75	17.05	79.14	0.997753	79.32
10	256.44	43.02	79.09	0.985955	80.21
11	274.79	73.57	79.11	0.963688	82.10
12	266.61	98.04	79.11	0.930200	85.05
13	254.64	119.11	97.75	1.012714	96.53
14	238.01	135.13	92.98	0.979603	94.92
15	216.40	144.50	86.79	0.928336	93.49
16	179.88	138.10	74.49	0.852249	87.41
17	119.87	104.02	52.79	0.736051	71.72
18	53.69	51.48	32.49	0.284555	114.19
		753.48			1367.76

Συνεισφ. αγκυρίων: Αθρ. ροπών ανατροπής : -228.6 kN*m/m
" " resisting : 160.0 kN*m/m

Δράση Ed = (753.5*11.04-228.6)
Αντίσταση Rd = (1367.8*11.04+160.0)

SLIP-CIRCLE μ = Ed/Rd = 0.53 < 1.0: Έλεγχος εκπληρώθηκε.

ΠΑΡΑΡΤΗΜΑ

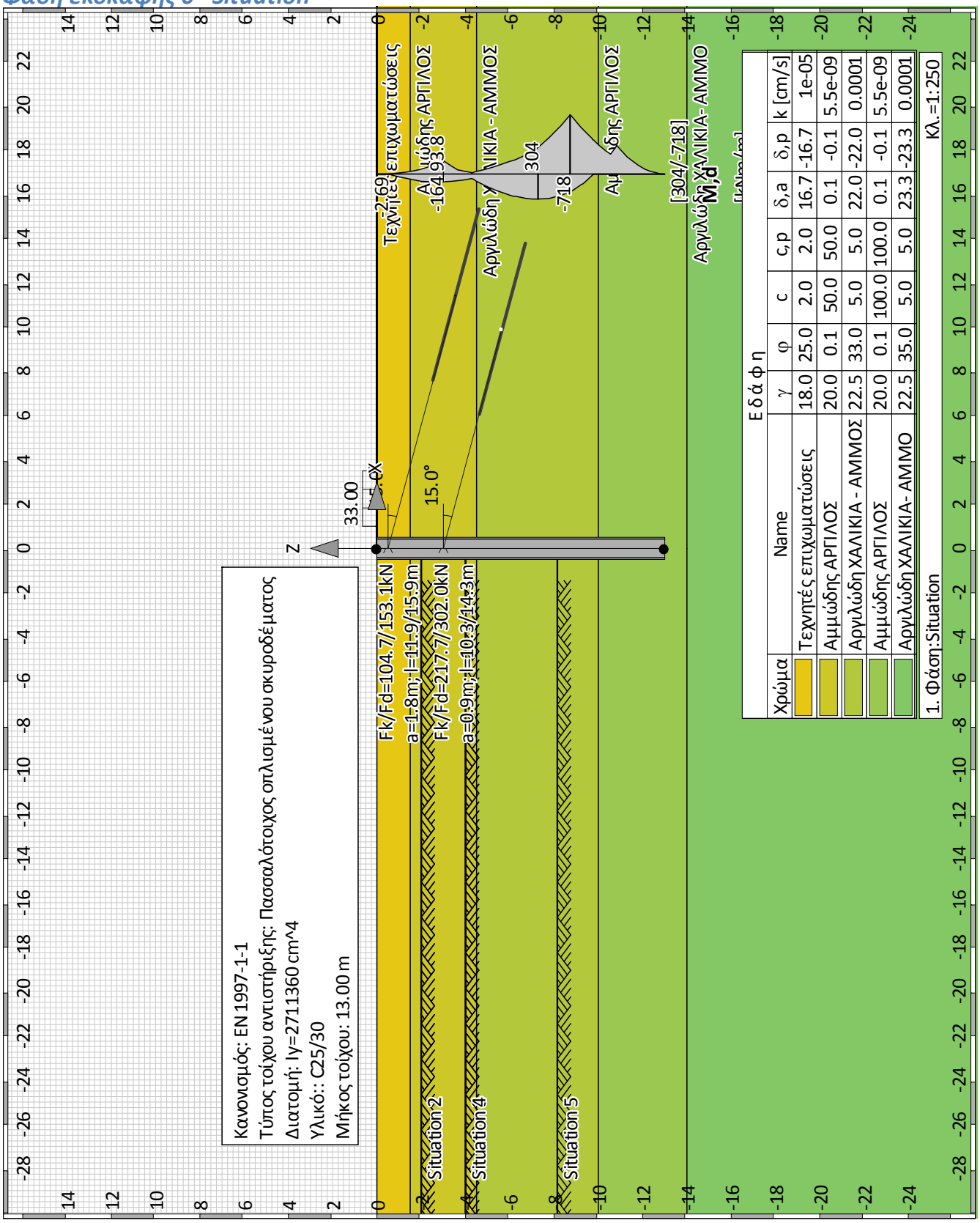
8.5 *Αποτελέσματα ανάλυσης*

8.5.1 *Στατικές Συνθήκες*

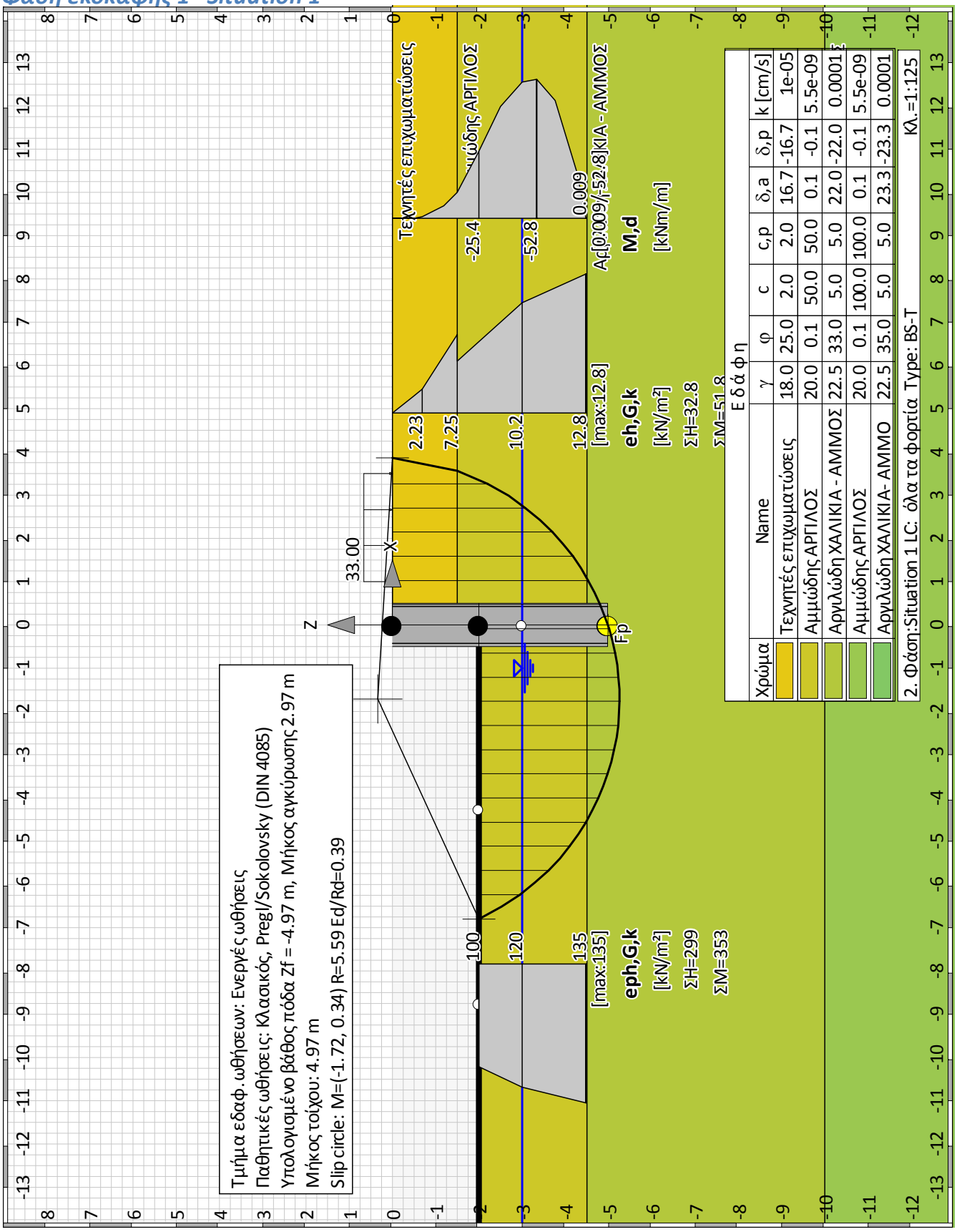
ii) Αντιστηριζόμενο ύψος 7,65m

Summary of all stages

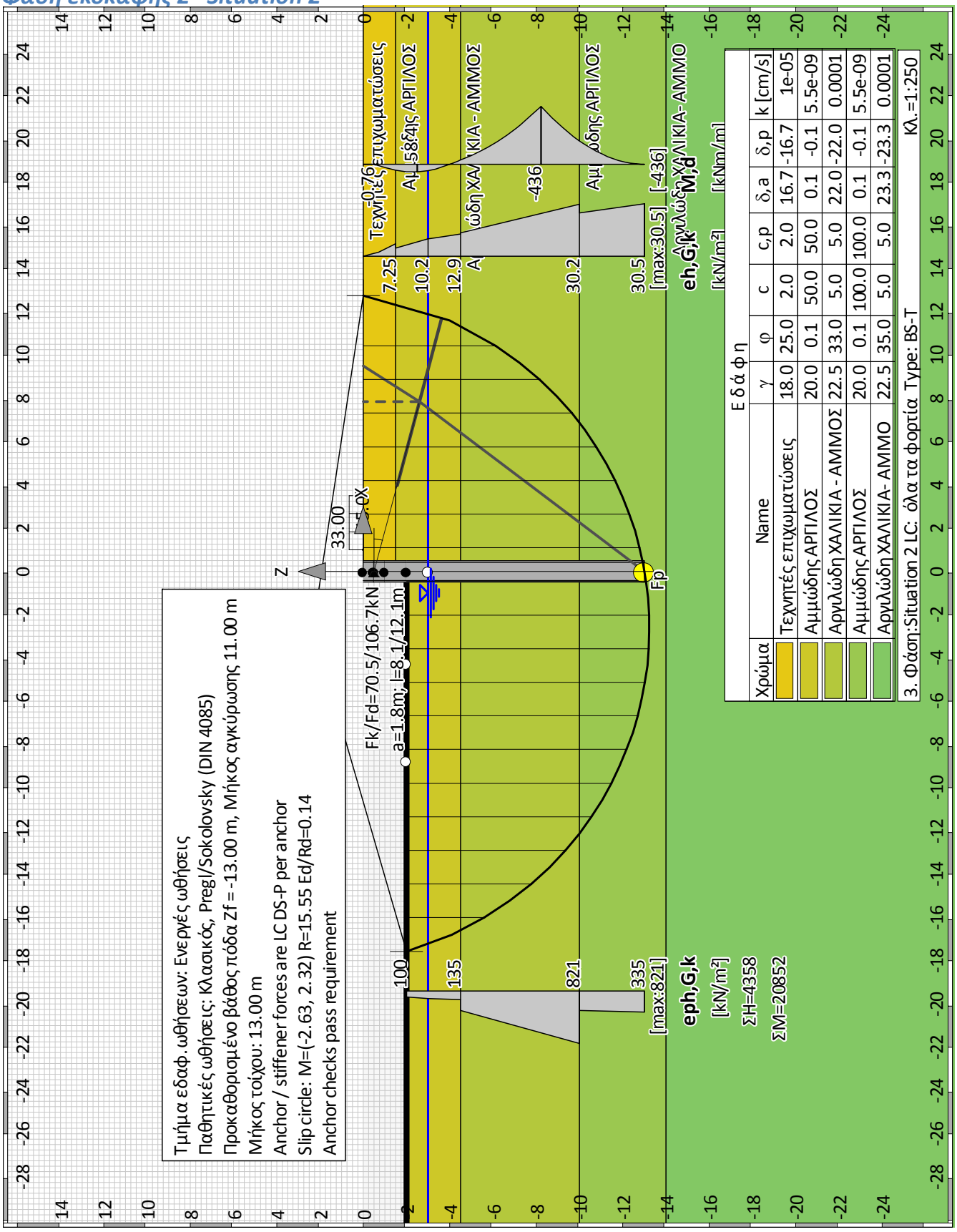
Φάση εκσκαφής 0 "Situation"



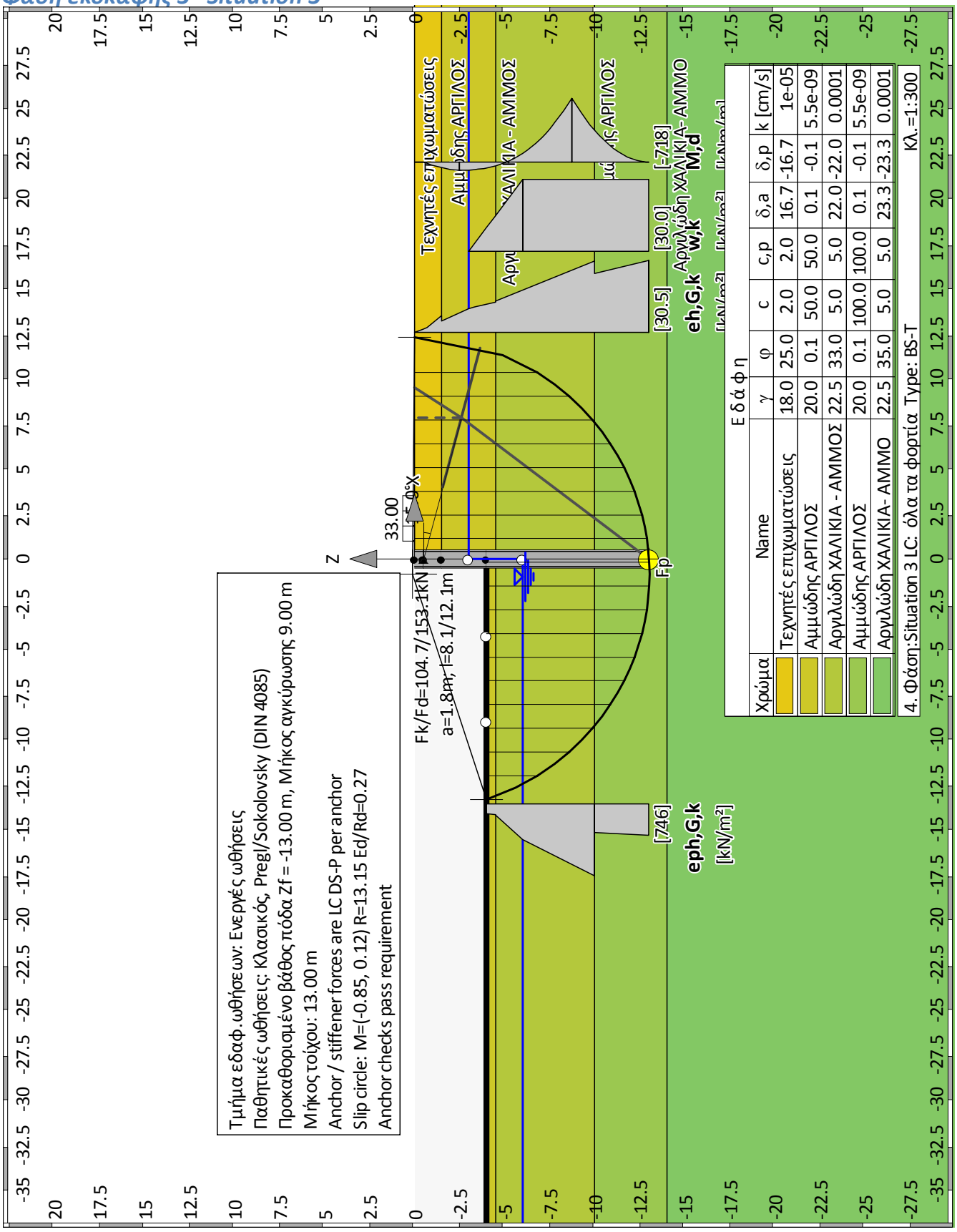
Φάση εκσκαφής 1 "Situation 1"



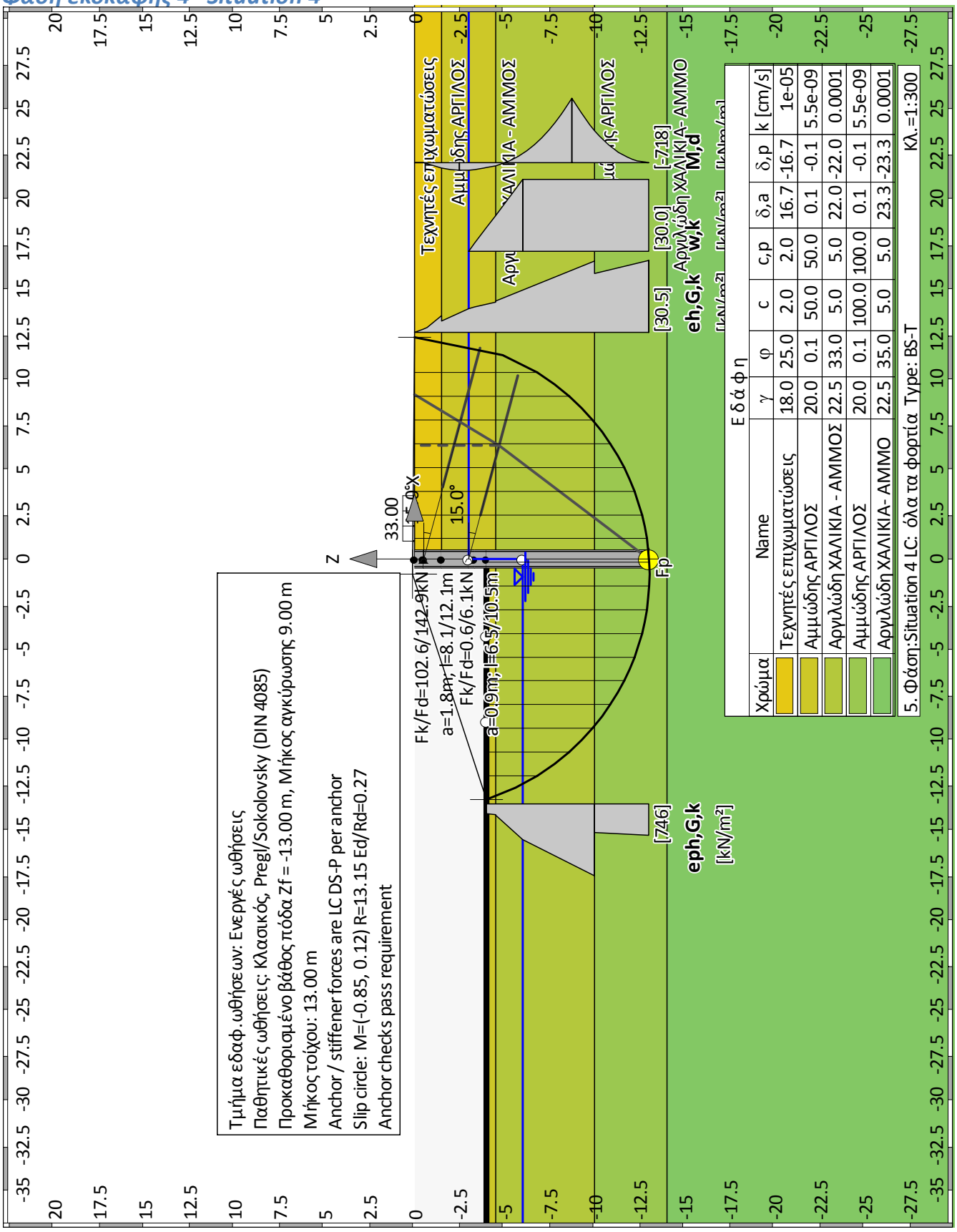
Φάση εκσκαφής 2 "Situation 2"



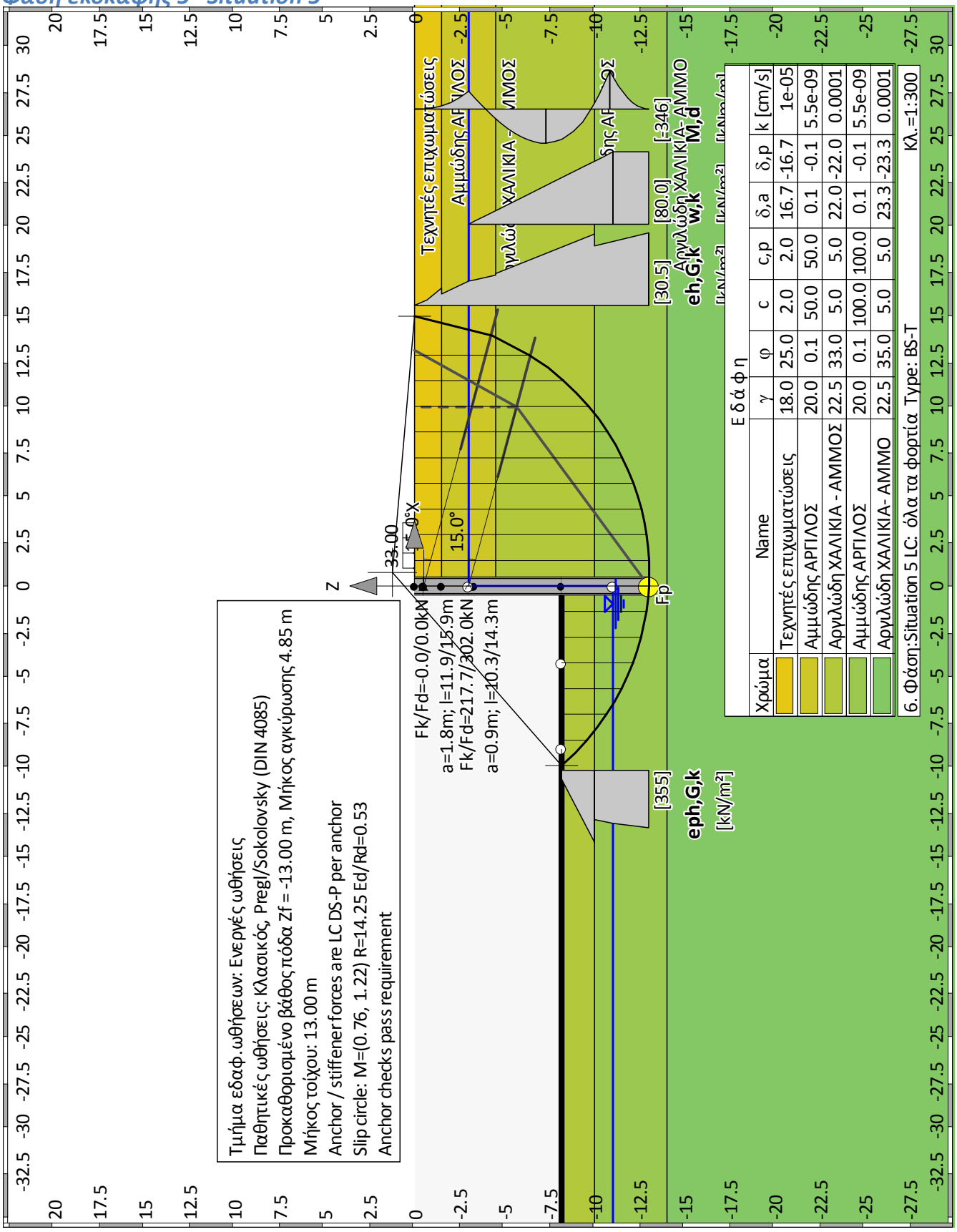
Φάση εκσκαφής 3 "Situation 3"



Φάση εκσκαφής 4 "Situation 4"



Φάση εκσκαφής 5 "Situation 5"



Κανονισμόςγια Ανάλυση και Διαστασιολόγηση

Διαστασ. ωπλισμ.σκυροδ.: EN 1992-1-1
Γεωτεχν.Κανονισμός : EN 1997 (rev.12)_user
National Annex: EN 1997-1

Safety factors:

Earth pressure onto wall: [GEO] A1 M1 R2

γ-	G,dst	E0G	G,stb	Q,dst	Q,stb	phi	coe	cu	g
BS-P	1.350	1.350	1	1.500	0	1	1	1	1
BS-T	1.350	1.350	1	1.500	0	1	1	1	1
BS-T/A	1.350	1.350	1	1.500	0	1	1	1	1
BS-E	1	1	1	1	0	1	1	1	1

ΚΕ-μηχανισμός: [GEO] A2 M2 R3

γ-	G,dst g	G,stb a,t	W a,p	Q,dst Gt	Q,stb N	phi	coe	cu
BS-P	1	1	1	1.300	0	1.250	1.400	1.400
	1	1	1	1	1			
BS-T	1	1	1	1.300	0	1.250	1.400	1.400
	1	1	1	1	1			
BS-T/A	1	1	1	1.300	0	1.250	1.250	1.400
	1	1	1	1	1			
BS-E	1	1	1	1	0	1.250	1.400	1.400
	1	1	1	1	1			

Θραύση εδάφους: [GEO] A1 M1 R2

γ-	G,dst cu	E0G g	W Re	G,stb	Q,dst	Q,stb	phi	coe
BS-P	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.400					
BS-T	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.400					
BS-T/A	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.400					
BS-E	1	1	1	1	1	0	1	1
	1	1	1					

Ολίσθηση: [GEO] A1 M1 R2

γ-	G,dst cu	E0G g	W Rh	G,stb	Q,dst	Q,stb	phi	coe
BS-P	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.100					
BS-T	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.100					
BS-T/A	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.100					
BS-E	1	1	1	1	1	0	1	1
	1	1	1					

Θραύση εδάφους: [GEO] A1 M1 R2

γ-	G,dst cu	E0G g	W Rv	G,stb	Q,dst	Q,stb	phi	coe
BS-P	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.400					
BS-T	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.400					
BS-T/A	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.400					
BS-E	1	1	1	1	1	0	1	1
	1	1	1					

Κύκλος ολίσθησης: [GEO] A2 M2 R3

	γ-g	G,dst Re	G,stb a,t	Q,dst a,p	Q,stb Gt	W N	phi	coe	cu
BS-P	1	1	1.300	0	1	1.250	1.400	1.400
	1	1	1	1	1	1			
BS-T	1	1	1.300	0	1	1.250	1.400	1.400
	1	1	1	1	1	1			
BS-T/A	1	1	1.300	0	1	1.250	1.250	1.400
	1	1	1	1	1	1			
BS-E	1	1	1	0	1	1.250	1.400	1.400
	1	1	1	1	1	1			

Hydraulic heave: [HYD] A1 M1 R1

	γ-	G,dst	G,stb	Q,dst	H
BS-P	1.350	0.900	1.500	1.800
BS-T	1.350	0.900	1.500	1.600
BS-T/A	1.350	0.900	1.500	1.500
BS-E	1	1	1	1

Failure of structural elements: [STR] A1 M1 R1

	γ-	M	Gtf	cd	N
BS-P	1.150	1.400	1.400	1.150
BS-T	1.150	1.300	1.300	1.150
BS-T/A	1.150	1.250	1.250	1.150
BS-E	1	1	1	1

Stability: [EQU] A1 M1 R1

	γ-	G,dst	G,stb	Q,dst	Q,stb	phi	coe	cu	g
BS-P	1	0.900	1.500	0	1.250	1.250	1.400	1
BS-T	1	0.900	1.500	0	1.250	1.250	1.400	1
BS-T/A	1	0.900	1.500	0	1.250	1.250	1.400	1
BS-E	1	1	1	0	1.250	1.400	1.400	1

γ,Re,red (EAB EB14-3): Ναι, η=0.80
γ,Re,red (EAB EB22-6): Ναι, E0h > 0%: η = 0.60 / 0.80

System values

Τοίχος

Τύπος τοίχου αντιστήριξης: Πασσαλότοιχος οπλισμένου σκυροδέματος
Διατομή: Iy=2711360 cm^4
Υλικό:: C25/30
Ίδιο βάρος: 25.000 [kN/m3]

Σημεία τοίχου

z [m]	d [m]	E [MN/m2]	Iy [cm4/m]	E*Iy [MNm2]	A [cm2/m]
0.00	100.0	31500.0	2711360	854.1	8400
-13.00	100.0	31500.0	2711360	854.1	8400

Φάση εκσκαφής 1 "[1] Situation 1"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 5 Στρώσεις

Name		Τεχνητές επιχωματώσεις	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
γ	[kN/m3]	18	20	22.5
γ,R	[kN/m3]	18	20	22.5
γ'	[kN/m3]	8	10	12.5
γ,p	[kN/m3]	18	20	22.5
γ,R,passive	[kN/m3]	18	20	22.5
γ,pw	[kN/m3]	8	10	12.5
φ	[°]	25	0.1	33
c	[kN/m2]	2	50	5
c,u	[kN/m2]	10	50	5
c παθητικό	[kN/m2]	2	50	5
δ,a	[°]	16.66667	0.06666667	22
δ,p	[°]	-16.66667	-0.06666667	-22
δ,c	[°]	8.333333	0.03333333	11
k,agh	[-]	0.3456501	0.9955057	0.2452023
K,ach	[-]	1.043051	1.994195	0.8549058
K,0h	[-]	0.5773817	0.9982547	0.455361
K,pgh	[-]	3.908103	1.004519	7.495617
K,pch	[-]	5.180327	2.00583	8.599509
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	10e-06	5.5e-09	100e-06

Name		Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20	22.5
γ,R	[kN/m3]	20	22.5
γ'	[kN/m3]	10	12.5
γ,p	[kN/m3]	20	22.5
γ,R,passive	[kN/m3]	20	22.5
γ,pw	[kN/m3]	10	12.5
φ	[°]	0.1	35
c	[kN/m2]	100	5
c,u	[kN/m2]	100	5
c παθητικό	[kN/m2]	100	5
δ,a	[°]	0.06666667	23.33333
δ,p	[°]	-0.06666667	-23.33333
δ,c	[°]	0.03333333	11.66667
k,agh	[-]	0.9955057	0.2244207
K,ach	[-]	1.994195	0.8126539
K,0h	[-]	0.9982547	0.4264236
K,pgh	[-]	1.004519	9.146943
K,pch	[-]	2.00583	10.104
τ,gr	[kN/m2]	110	110
Ψ,A,max	[°]	90	90
k	[cm/s]	5.5e-09	100e-06

Πορεία πρανούς:
x [m] 0.00 0.00
z [m] -2.00 0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
x [m] 0.00 0.00
z [m] -2.00 -1.50

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:
z= -4.50

Πορεία ανώτερου 4. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
z= -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -14.00

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
1.00	0.00	3.50	0.00	0.00	33.00	0.00	33.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Στάθμη νερού:

x [m] 0.00
z [m] -3.00

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Ενεργές ωθήσεις.
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: No redistribution of earth pressure.
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Κλασικός, Pregl/Sokolovsky (DIN 4085).

Options for water pressure

Στήριξη πόδα

Πακτωμένη στήριξη κατά Blum

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

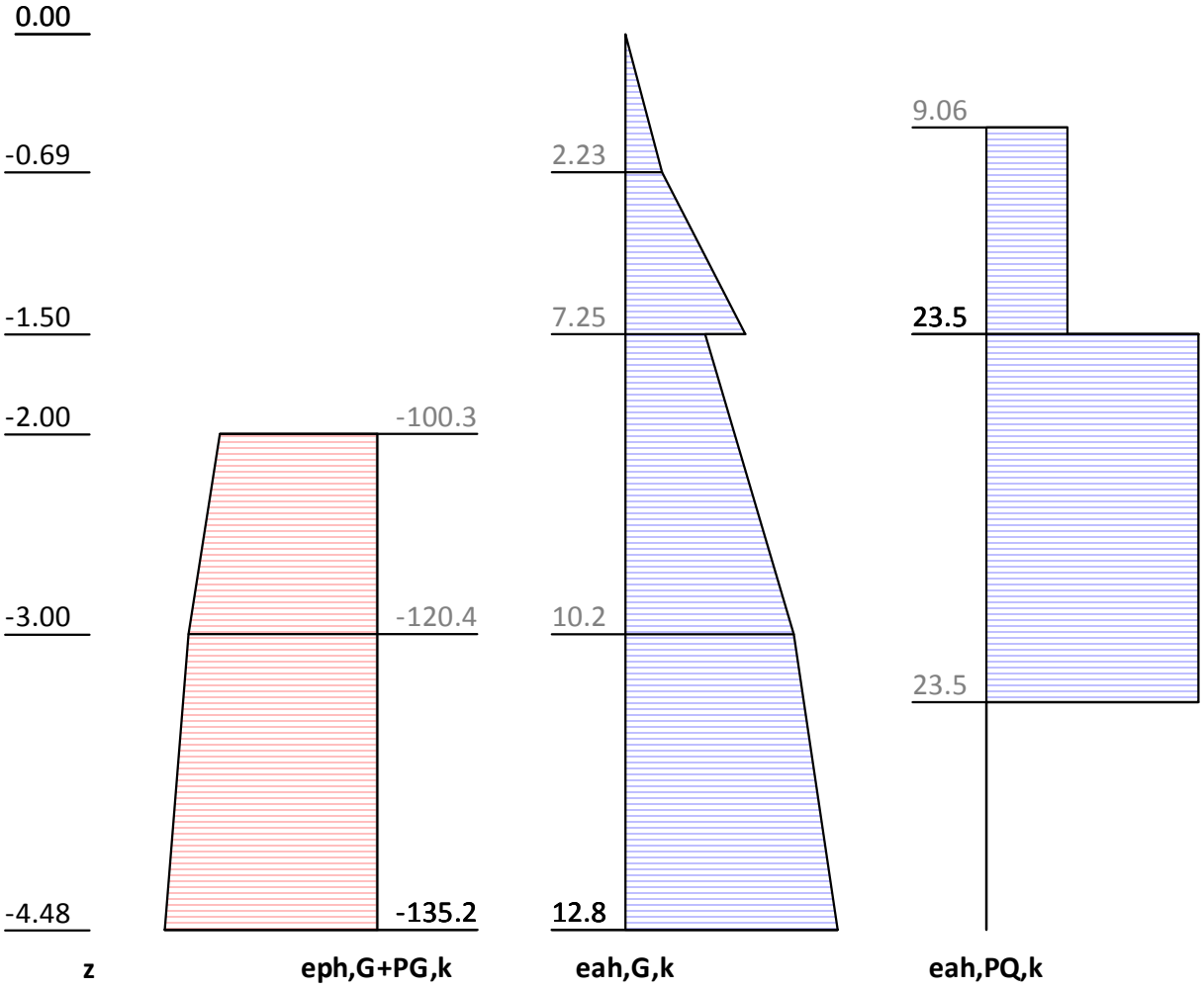
Μήκος τοίχου

```
N:   1 Z:   -3.000 M,Στήριξη πόδα,d:    51.74. Wall too short? Ναι
N:   2 Z:   -6.000 M,Στήριξη πόδα,d:  -401.07. Wall too short? Όχι
N:   3 Z:   -3.990 M,Στήριξη πόδα,d:    34.70. Wall too short? Ναι
N:   4 Z:   -5.337 M,Στήριξη πόδα,d:  -155.60. Wall too short? Όχι
N:   5 Z:   -4.434 M,Στήριξη πόδα,d:     3.70. Wall too short? Ναι
N:   6 Z:   -5.039 M,Στήριξη πόδα,d:   -82.64. Wall too short? Όχι
N:   7 Z:   -4.634 M,Στήριξη πόδα,d:   -16.37. Wall too short? Όχι
N:   8 Z:   -4.500 M,Στήριξη πόδα,d:   -13.22. Wall too short? Όχι
N:   9 Z:   -4.456 M,Στήριξη πόδα,d:     1.79. Wall too short? Ναι
N:  10 Z:   -4.486 M,Στήριξη πόδα,d:    -0.87. Wall too short? Όχι
N:  11 Z:   -4.466 M,Στήριξη πόδα,d:     0.92. Wall too short? Ναι
N:  12 Z:   -4.479 M,Στήριξη πόδα,d:    -0.27. Wall too short? Όχι
N:  13 Z:   -4.470 M,Στήριξη πόδα,d:     0.53. Wall too short? Ναι
N:  14 Z:   -4.476 M,Στήριξη πόδα,d:    -0.01. Wall too short? Όχι
Foot depth for statics: zf = -4.476
```

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall



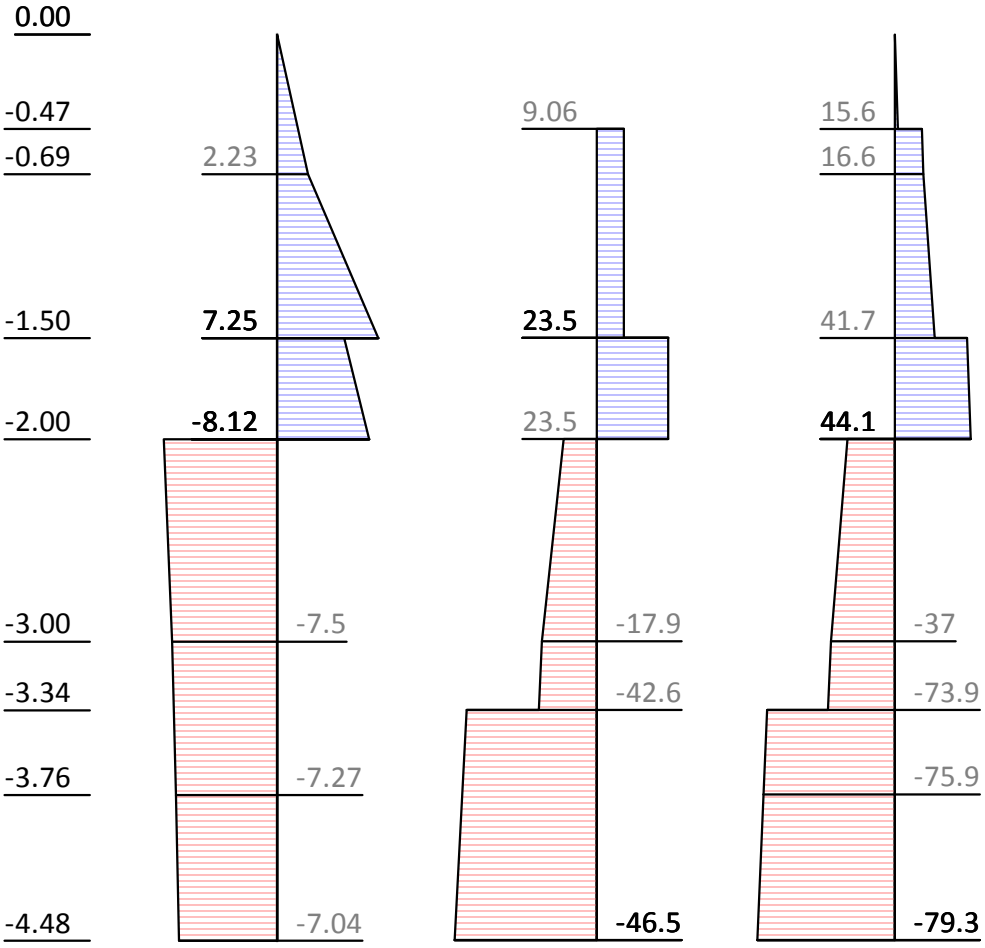
z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.47		1.52	0.00	2.04
-0.47		1.52	9.06	15.62
-1.50		7.25	9.06	23.37
-1.50		4.82	23.48	41.73
-2.00	-0.00	6.61	23.48	44.14

z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
-2.00	-100.29	6.61	23.48	44.14
-3.34	-123.79	10.79	23.48	49.78
-3.34	-123.79	10.79	0.00	14.56
-4.48	-135.21	12.82	0.00	17.30

Eph,G,k: -298.99, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 32.82, Eah,PG,k: 0.00, Eah,PQ,k: 52.53, Eah,d: 123.10

H-pressure on static system

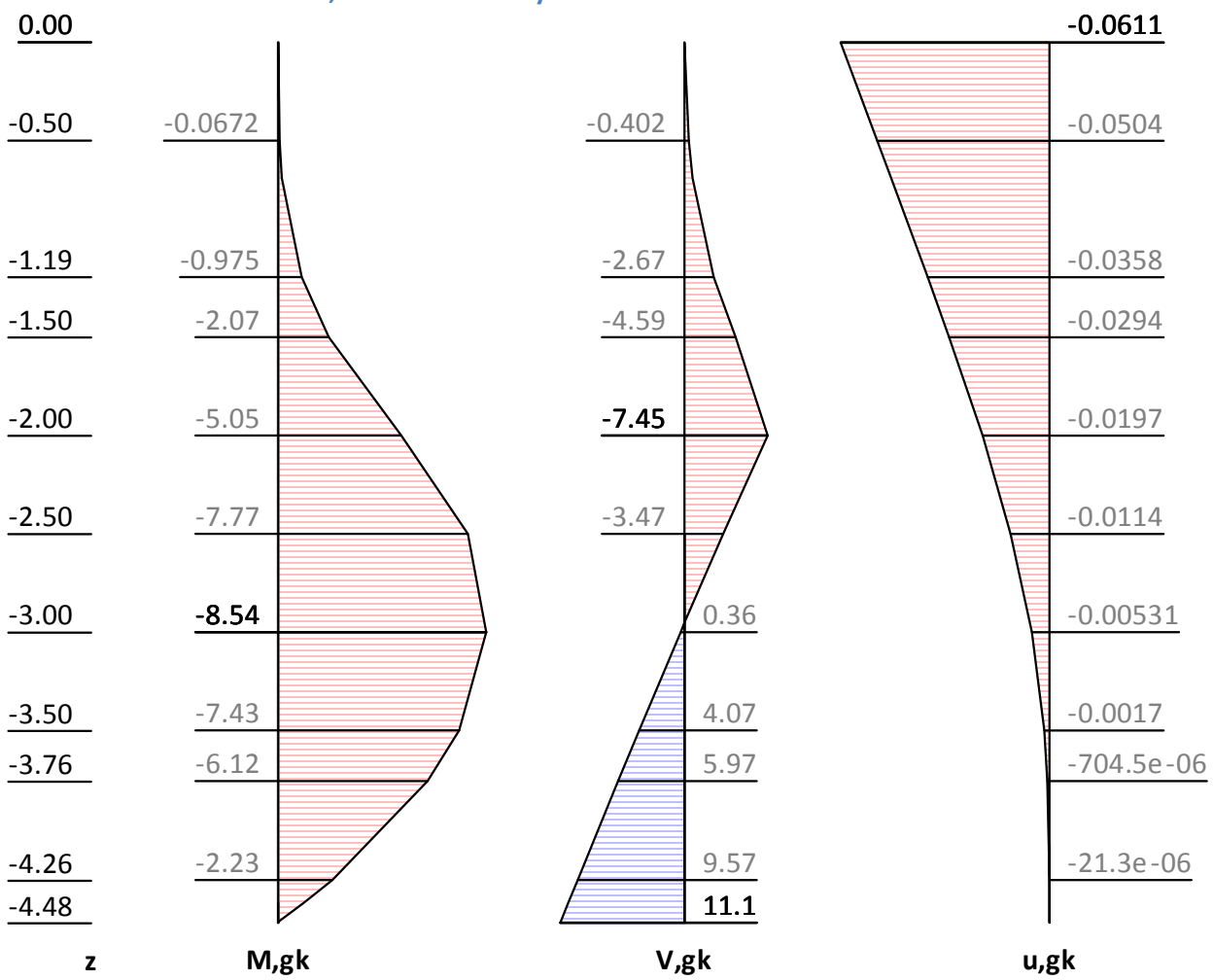
Level of mobilization: Ep,gk 14.7, Ep,qk 34.4, Ep,d 100.0 [%]



z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	0.00		0.00
-0.47	1.52	0.00	2.04
-0.47	1.52	9.06	15.62
-1.50	7.25	9.06	23.37
-1.50	4.82	23.48	41.73
-2.00	6.61	23.48	44.14
-2.00	-8.12	-11.02	-27.50
-3.34	-7.40	-19.10	-38.64
-3.34	-7.40	-42.58	-73.86
-4.48	-7.04	-46.51	-79.28

V-pressure on static system

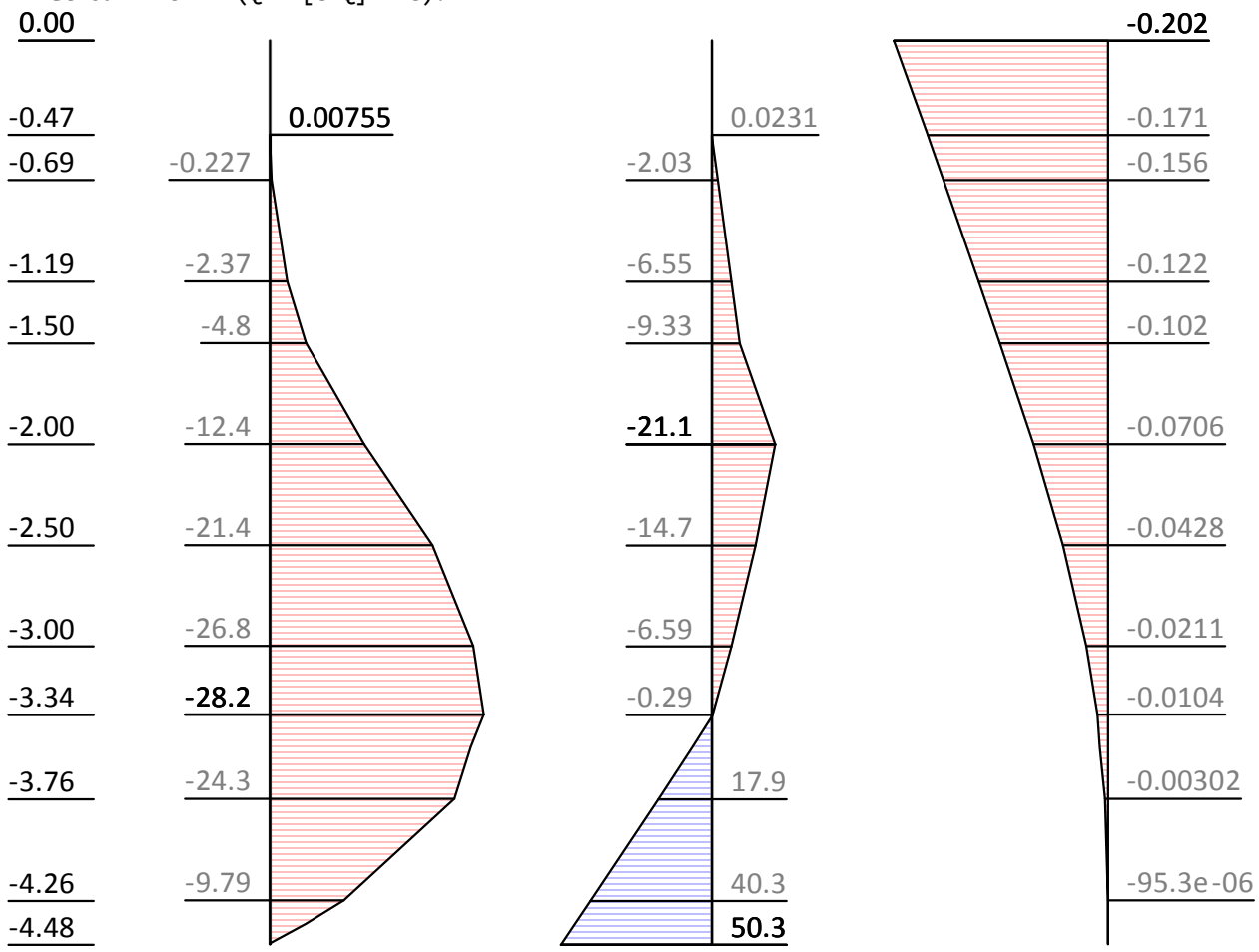
Internal forces: Permanent, characteristically



z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	0.00	0.00	0.00	0.00	-0.06
-1.50	7.25	-2.07	-4.59	-33.13	-0.03
-1.50	4.82	-2.07	-4.59	-33.13	-0.03
-2.00	6.61	-5.05	-7.45	-43.63	-0.02
-2.00	-8.12	-5.05	-7.45	-43.63	-0.02
-2.95	-7.53	-8.47	0.00	-63.64	-0.01
-3.00	-7.50	-8.54	0.36	-64.62	-0.01
-4.48	-7.04	-0.00	11.10	-83.21	-0.00
-4.48	-7.04	0.00	11.10	-83.21	0.00

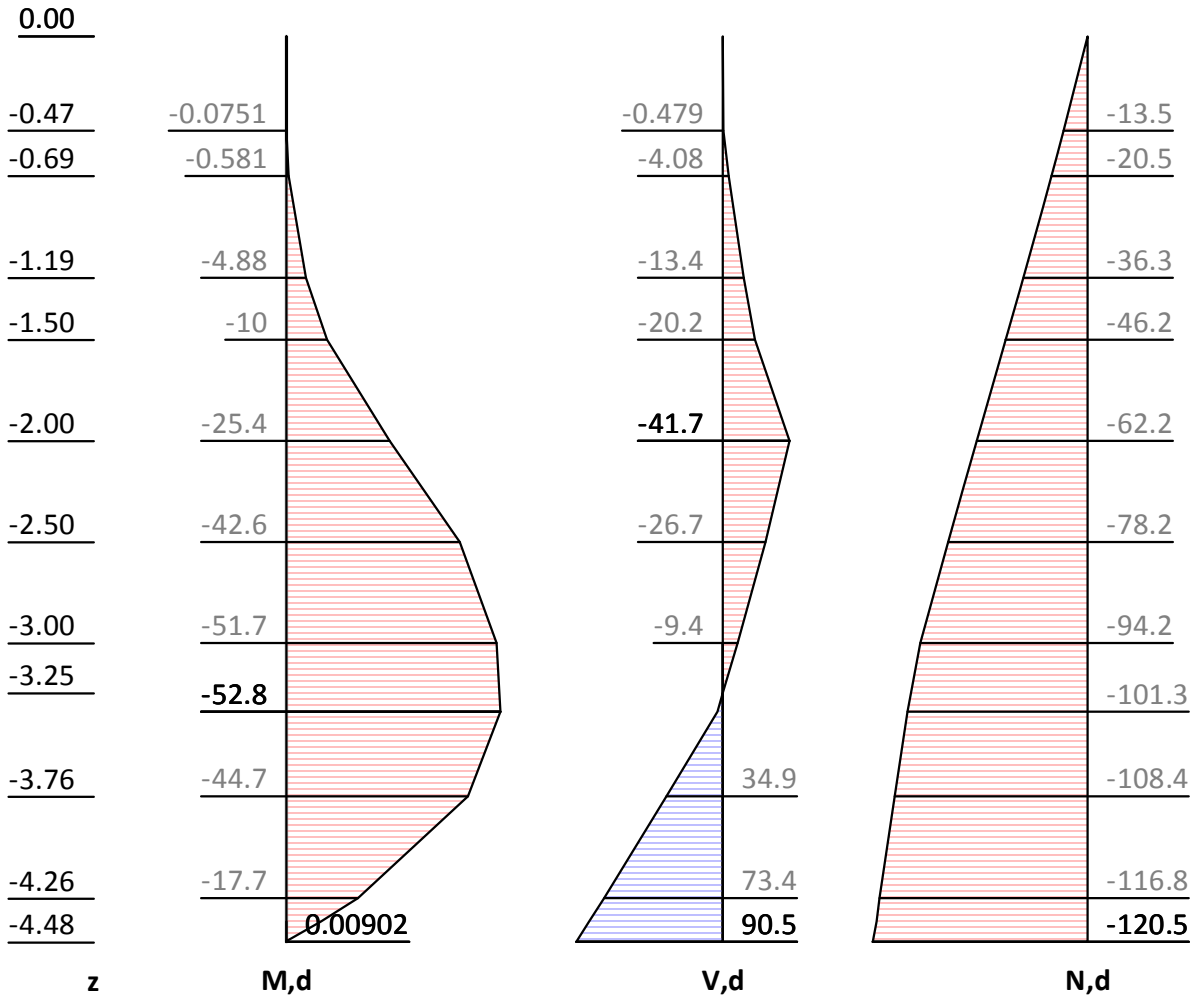
Internal forces: Variable, characteristically

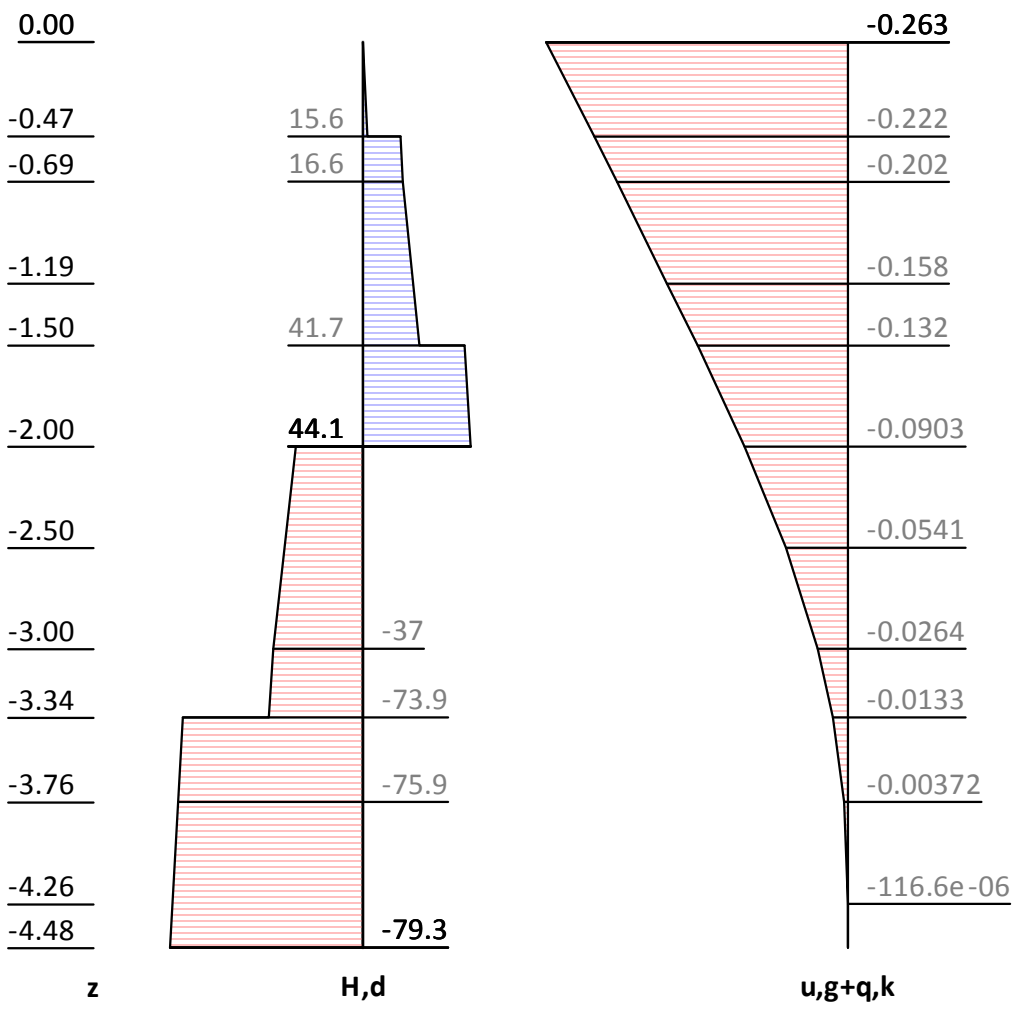
Method EB 82-4 (Q = [G+Q] - G).



z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00	0.00	0.00	-0.20
-0.47	0.00	0.01	0.02	0.01	-0.17
-0.47	9.06	0.01	0.02	0.01	-0.17
-0.48	9.06	-0.00	-0.05	0.00	-0.17
-1.50	9.06	-4.80	-9.33	-0.99	-0.10
-1.50	23.48	-4.80	-9.33	-0.99	-0.10
-2.00	23.48	-12.40	-21.07	-2.23	-0.07
-2.00	-11.02	-12.40	-21.07	-2.23	-0.07
-3.34	-19.10	-28.20	-0.29	-5.50	-0.01
-3.34	-42.58	-28.20	-0.29	-5.50	-0.01
-3.35	-42.61	-28.12	-0.00	-5.50	-0.01
-4.48	-46.51	0.00	50.32	-5.44	-0.00
-4.48	-46.51	0.00	50.32	-5.44	0.00

Internal forces: Design

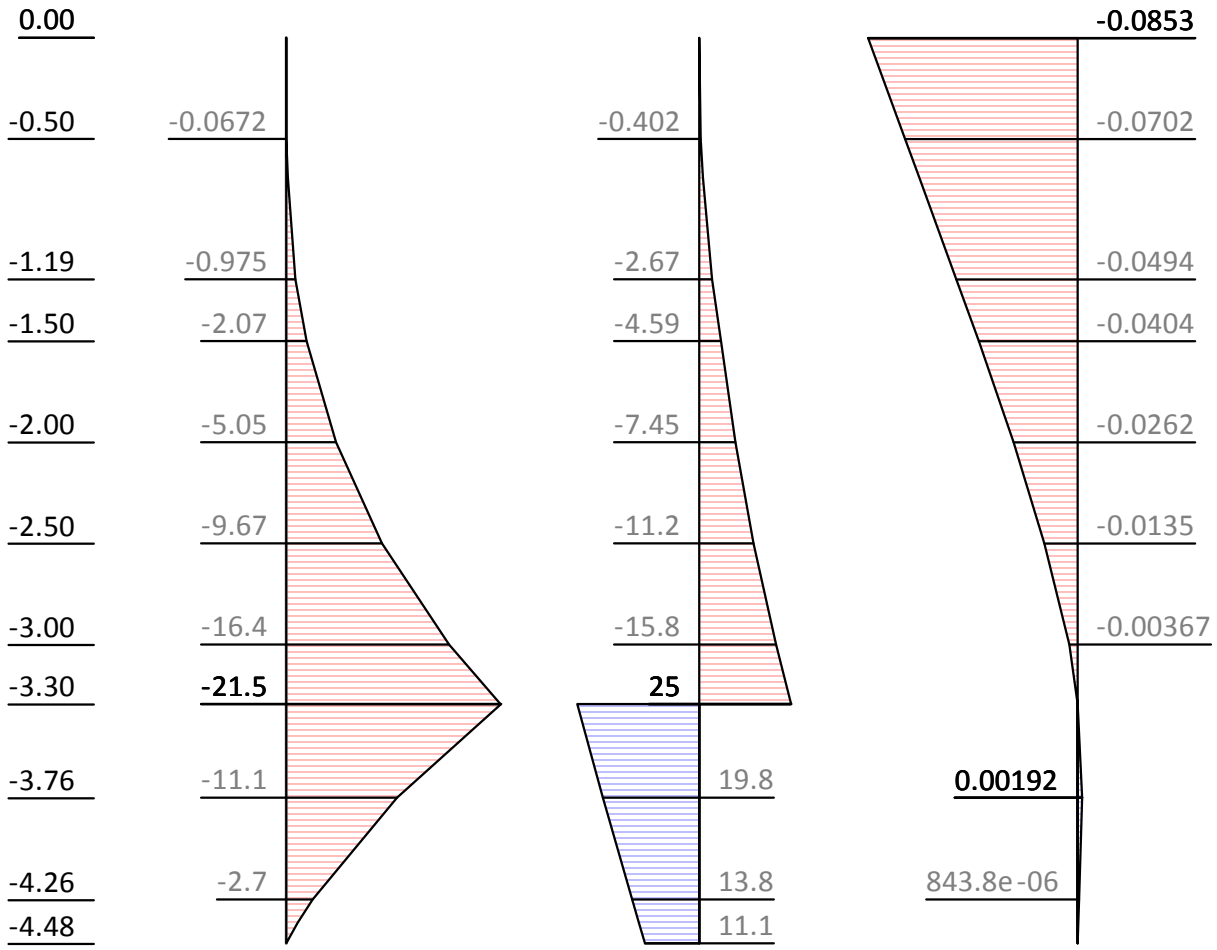




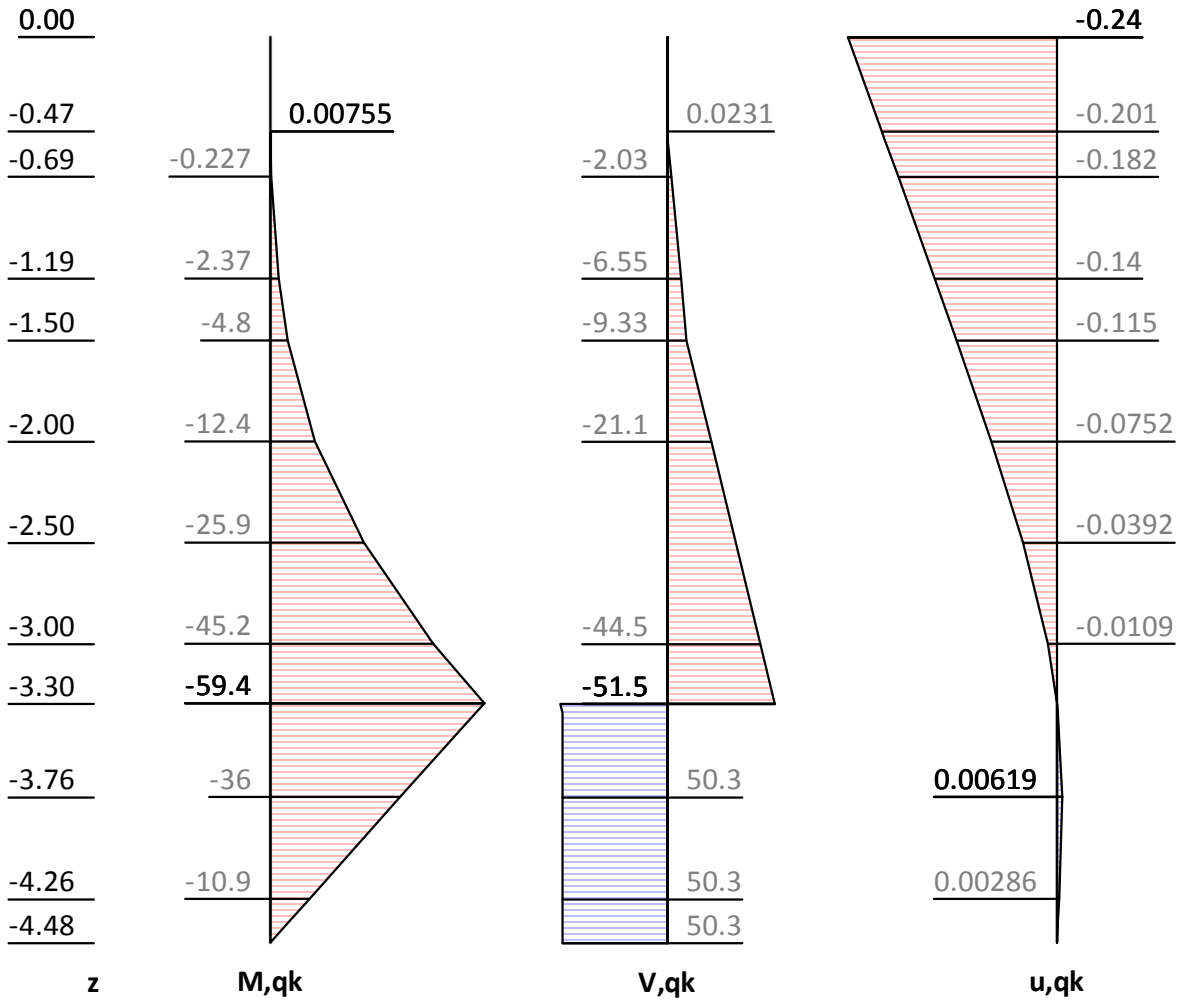
z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	0.00	0.00	-0.00	0.00	-0.26
-0.47	2.04	-0.08	-0.48	-13.54	-0.22
-0.47	15.62	-0.08	-0.48	-13.54	-0.22
-1.50	23.37	-10.00	-20.19	-46.20	-0.13
-1.50	41.73	-10.00	-20.19	-46.20	-0.13
-2.00	44.14	-25.42	-41.66	-62.25	-0.09
-2.00	-27.50	-25.42	-41.66	-62.25	-0.09
-3.34	-38.64	-52.77	3.46	-101.27	-0.01
-3.34	-73.86	-52.77	3.46	-101.27	-0.01
-4.48	-79.28	0.00	90.45	-120.49	-0.00
-4.48	-79.28	0.01	90.46	-120.49	0.00

Checks of earth statics

Substitute system according to Blum



z [m]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [kN/m2]
0.00	0.00	0.00	0.00	-0.09
-3.30	-21.54	-18.93	-68.37	0.00
-3.30	-21.54	24.98	-68.37	0.00
-3.76	-11.12	19.82	-74.23	0.00
-4.48	0.00	11.10	-83.26	0.00



z [m]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [kN/m2]
0.00	0.00	0.00	0.00	-0.24
-0.47	0.01	0.02	0.01	-0.20
-0.48	-0.00	-0.05	-0.00	-0.20
-3.30	-59.42	-51.50	-5.45	0.00
-3.30	-59.42	51.35	-5.45	0.00
-3.76	-36.04	50.32	-5.56	0.01
-4.48	0.00	50.32	-5.56	0.00

Bh,gk = -43.91; Ch,gk = 11.10 [kN/m]
Bh,qk = -102.85; Ch,qk = 50.32 [kN/m]
Bh,d = -213.56; Ch,d = 90.45 [kN/m]

Check of C-force (foot support)

```
z(C)                                          =   -4.48 [kN/m]
G,k = sum(γ*h)                                =   71.76 [kN/m]
P,k = sum(Pz,k(x=  0.1))                      =    0.00 [kN/m]
kpgh,C(phi=  0.1; δ,C=  0.0°)                 =   1.002 [-]
kpch,C                                        =   2.003 [-]
eph,C,gk =(G,k+P,k)*kpgh,C+2*c*sqrt(kpch,C)=  213.44 [kN/m2]
         = (71.76+0.00)*1.002+2*50.0*1.415
Ed = Ch,d                                     =   90.45 [kN/m2]
δ,t,EAU          = Ed/(2*eph,C,d)             =    0.30 [m]
δ,t,EAB          =  0.20 * t                  =    0.50 [m]
δ,t = δ,t,EAB                                 =    0.50 [m]
Rd = 2*δ,t*eph,C,gk/γ,Re
   = 2*0.50*213.44/1.4
                                              =  151.00 [kN/m2]
```

Ed/Rd = 0.599 [-]. Passes requirement

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -3.30 m
Rd = Eph,k/γ,Re = 298.99 / 1.400 = 213.57 [kN/m]

Ed(Bh,d)/Rd = 213.56 / 213.57 = 1.000 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-4.48

Pos.	H	V
H/V pressure G+P+W,k	32.82	1.66
Wall weight		87.84
H/V pressure passive		0.00
Bh,g,k z=-3.30	-43.91	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.05
Ch,g	11.10	
Cv,g = Ch*tan(δ,C=0.0°)		0.01
Σ	0.00	89.46 (downwards)

Simple check, EAB R 9-3a

Vk >= Bvk: 89.51 >= 0.05 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-4.48

Pos.	H	V
H/V pressure G+P+W,k	85.35	7.22
Wall weight		87.84
H/V pressure passive		0.00
Bh,g,k z=-3.30	-43.91	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.05
Bh,q,k z=-3.30	-102.85	
Bv,q,k = Bh,k * tan(δ,p=-0.07°)		-0.12
Ch,g	11.10	
Cv,g = Ch*tan(δ,C=0.0°)		0.01
Ch,q	50.32	
Cv,q = Ch*tan(δ,C=0.0°)		0.03
Σ	-0.00	94.93 (downwards)

Simple check, EAB R 9-3a

Vk >= Bvk: 95.10 >= 0.17 Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)
Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (-1.72, 0.34), Ακτίνα = 5.59
Αρχ.σημ.= (-6.79, -2.00), Τελ.σημ. = (3.86, 0.00)

Γεωμετρία λωρίδων:

No	x	Width b	dxM	Weight	Load z-κατ.	Water-φορτ.	u*b	φ	c	θ
	[m]	[m]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[°]	[kN/m²]	[°]
1	-6.51	0.56	-4.80	5.9	0.0	0.0	-0.0	0.08	35.71	-44.96*
2	-5.96	0.56	-4.24	14.6	0.0	0.0	-1.7	0.08	35.71	-44.96*
3	-5.40	0.56	-3.68	20.9	0.0	0.0	-4.8	0.08	35.71	-41.18
4	-4.84	0.56	-3.12	25.7	0.0	0.0	-7.2	0.08	35.71	-33.95
5	-4.28	0.56	-2.56	29.6	0.0	0.0	-9.1	27.45	3.57	-27.29
6	-3.72	0.56	-2.00	32.7	0.0	0.0	-10.5	27.45	3.57	-21.01
7	-3.16	0.56	-1.44	35.0	0.0	0.0	-11.5	27.45	3.57	-14.98
8	-2.60	0.56	-0.89	36.5	0.0	0.0	-12.1	27.45	3.57	-9.12
9	-2.04	0.56	-0.33	37.3	0.0	0.0	-12.5	27.45	3.57	-3.35
10	-1.49	0.56	0.23	37.3	0.0	0.0	-12.5	27.45	3.57	2.38
11	-0.93	0.56	0.79	36.7	0.0	0.0	-12.2	27.45	3.57	8.14
12	-0.37	0.56	1.35	35.3	0.0	0.0	-11.6	27.45	3.57	13.98
13	0.19	0.56	1.91	50.5	0.0	0.0	-10.7	27.45	3.57	19.97
14	0.75	0.56	2.47	50.8	1.2	0.0	-9.3	27.45	3.57	26.20
15	1.31	0.56	3.03	47.1	24.0	0.0	-7.5	0.08	35.71	32.79
16	1.87	0.56	3.58	42.5	24.0	0.0	-5.2	0.08	35.71	39.91
17	2.42	0.56	4.14	36.5	24.0	0.0	-2.2	0.08	35.71	47.86
18	2.98	0.56	4.70	28.3	24.0	0.0	-0.2	0.08	35.71	57.30
19	3.56	0.60	5.28	16.0	10.2	0.0	-0.0	20.46	1.43	70.88

*** Σημείωση: Στις λωρίδες σημειωμένες με '*'
περιορίστηκε το theta στο 45°-Phi/2.

Συνεισφ. κατακόρυφων φορτίων:

No	Weight	G*sin(θ)	(G-u*b)*tan(φ) + c*b	μ*sin(θ)* tan(φ)+cos(θ)	T
	[kN/m]	[kN/m]	[kN/m]	[-]	[kN/m]
1	5.93	-5.09	19.96	0.707211	28.23
2	14.60	-11.07	19.97	0.707211	28.24
3	20.90	-13.76	19.98	0.752238	26.56
4	25.70	-14.35	19.98	0.829212	24.10
5	29.58	-13.56	12.66	0.794707	15.93
6	32.72	-11.73	13.56	0.860042	15.77
7	35.01	-9.05	14.22	0.913023	15.57
8	36.51	-5.79	14.65	0.954871	15.34
9	37.27	-2.18	14.87	0.986300	15.08
10	37.33	1.55	14.89	1.007651	14.77
11	36.69	5.19	14.70	1.018951	14.43
12	35.31	8.53	14.31	1.019913	14.03
13	50.54	17.26	22.71	1.009894	22.49
14	52.06	22.98	24.20	0.987773	24.50
15	71.04	38.47	20.04	0.840984	23.83
16	66.44	42.63	20.04	0.767457	26.11
17	60.44	44.82	20.04	0.671336	29.85
18	52.28	43.99	20.03	0.540685	37.04

No	Weight [kN/m]	G*sin(θ) [kN/m]	(G-u*b)*tan(φ) + c*b [kN/m]	μ*sin(θ)* tan(φ)+cos(θ) [-]	T [kN/m]
19	26.20	24.75	10.62	0.466572	22.77
		163.60			414.63

Δράση Ed = (163.6*5.59)
Αντίσταση Rd = (414.6*5.59 +0.0)

SLIP-CIRCLE μ = Ed/Rd = 0.39 < 1.0: Έλεγχος εκπληρώθηκε.

Φάση εκσκαφής 2 "[2] Situation 2"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 5 Στρώσεις

Name		Τεχνητές επιχωματώσεις	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
γ	[kN/m3]	18	20	22.5
γ,R	[kN/m3]	18	20	22.5
γ'	[kN/m3]	8	10	12.5
γ,p	[kN/m3]	18	20	22.5
γ,R,passive	[kN/m3]	18	20	22.5
γ,pw	[kN/m3]	8	10	12.5
φ	[°]	25	0.1	33
c	[kN/m2]	2	50	5
c,u	[kN/m2]	10	50	5
c παθητικό	[kN/m2]	2	50	5
δ,a	[°]	16.66667	0.06666667	22
δ,p	[°]	-16.66667	-0.06666667	-22
δ,c	[°]	8.333333	0.03333333	11
k,agh	[-]	0.3456501	0.9955057	0.2452023
K,ach	[-]	1.043051	1.994195	0.8549058
K,0h	[-]	0.5773817	0.9982547	0.455361
K,pgh	[-]	3.908103	1.004519	7.495617
K,pch	[-]	5.180327	2.00583	8.599509
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	10e-06	5.5e-09	100e-06

Name		Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20	22.5
γ,R	[kN/m3]	20	22.5
γ'	[kN/m3]	10	12.5
γ,p	[kN/m3]	20	22.5
γ,R,passive	[kN/m3]	20	22.5
γ,pw	[kN/m3]	10	12.5
φ	[°]	0.1	35
c	[kN/m2]	100	5
c,u	[kN/m2]	100	5
c παθητικό	[kN/m2]	100	5
δ,a	[°]	0.06666667	23.33333
δ,p	[°]	-0.06666667	-23.33333
δ,c	[°]	0.03333333	11.66667
k,agh	[-]	0.9955057	0.2244207
K,ach	[-]	1.994195	0.8126539
K,0h	[-]	0.9982547	0.4264236
K,pgh	[-]	1.004519	9.146943
K,pch	[-]	2.00583	10.104
τ,gr	[kN/m2]	110	110
Ψ,A,max	[°]	90	90
k	[cm/s]	5.5e-09	100e-06

Πορεία πρανούς:
x [m] 0.00 0.00
z [m] -2.00 0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
x [m] 0.00 0.00
z [m] -2.00 -1.50

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:
z= -4.50

Πορεία ανώτερου 4. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
z= -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -14.00

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
1.00	0.00	3.50	0.00	0.00	33.00	0.00	33.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Στάθμη νερού:

x [m] 0.00
z [m] -3.00

Αγκύρια

z[m]	min.l[m]	Alpha[°]	C-H[kN/m]	P0[kN]	u0[m]
-0.50	0.00	15.00	αόριστ.	0.00	0.0000

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Ενεργές ωθήσεις.
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: Trapezoid.
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
Levels of redistribution Z1: 0.000, Z2: -1.000 [m].
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Κλασικός, Pregl/Sokolovsky (DIN 4085).

Options for water pressure

Στήριξη πόδα

Πόδας οριζοντίως μετακινούμενος

Αγκύρια

Anchor checks (lower failure plane): Ναι
Anchor forces with safety level of DS-P: Ναι
Verification of grout body pull out forces: Ναι
δ,a,Anchoring wall : used from soil layer.
δ,p,Anchoring wall : used from soil layer.

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

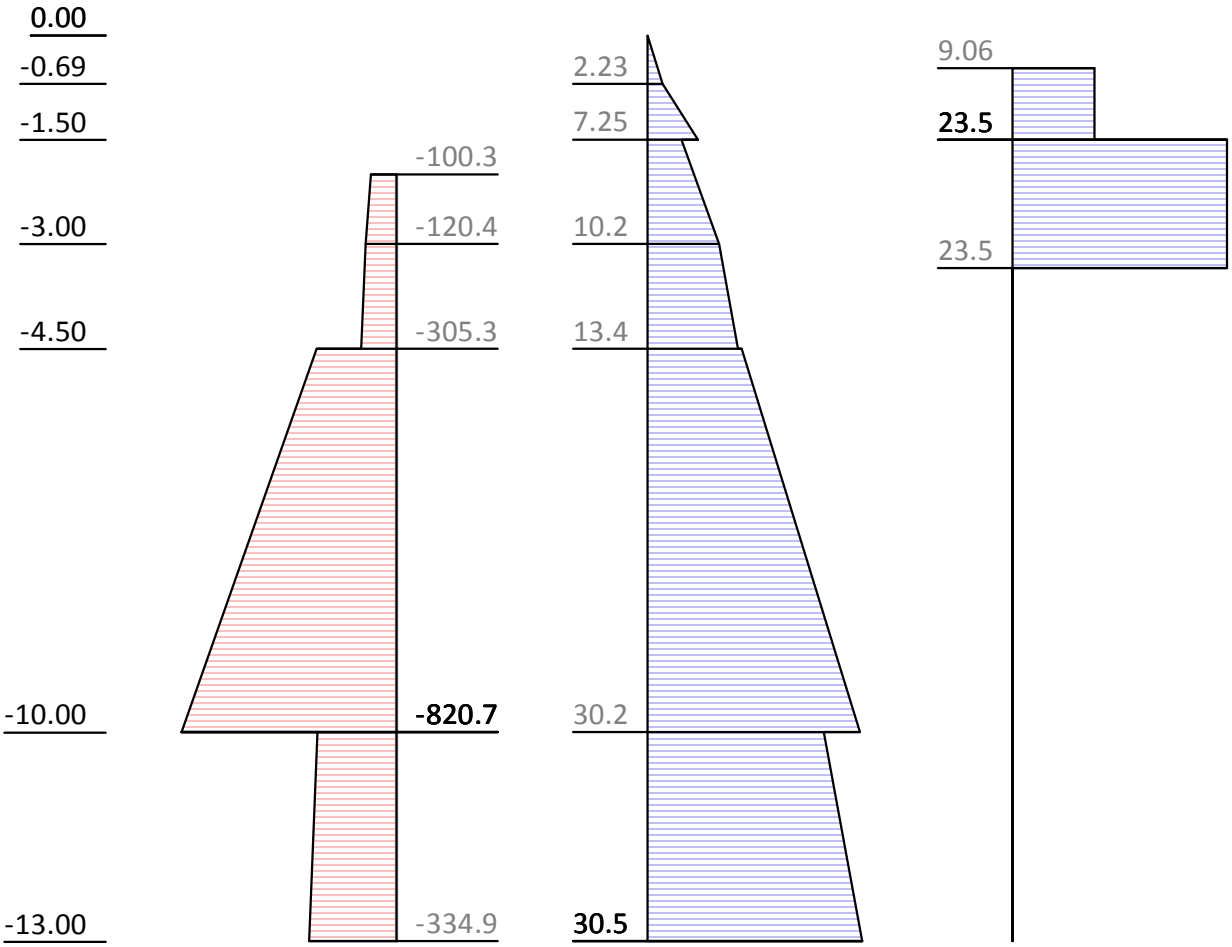
Μήκος τοίχου

Foot depth for statics: zf = -13.000

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall

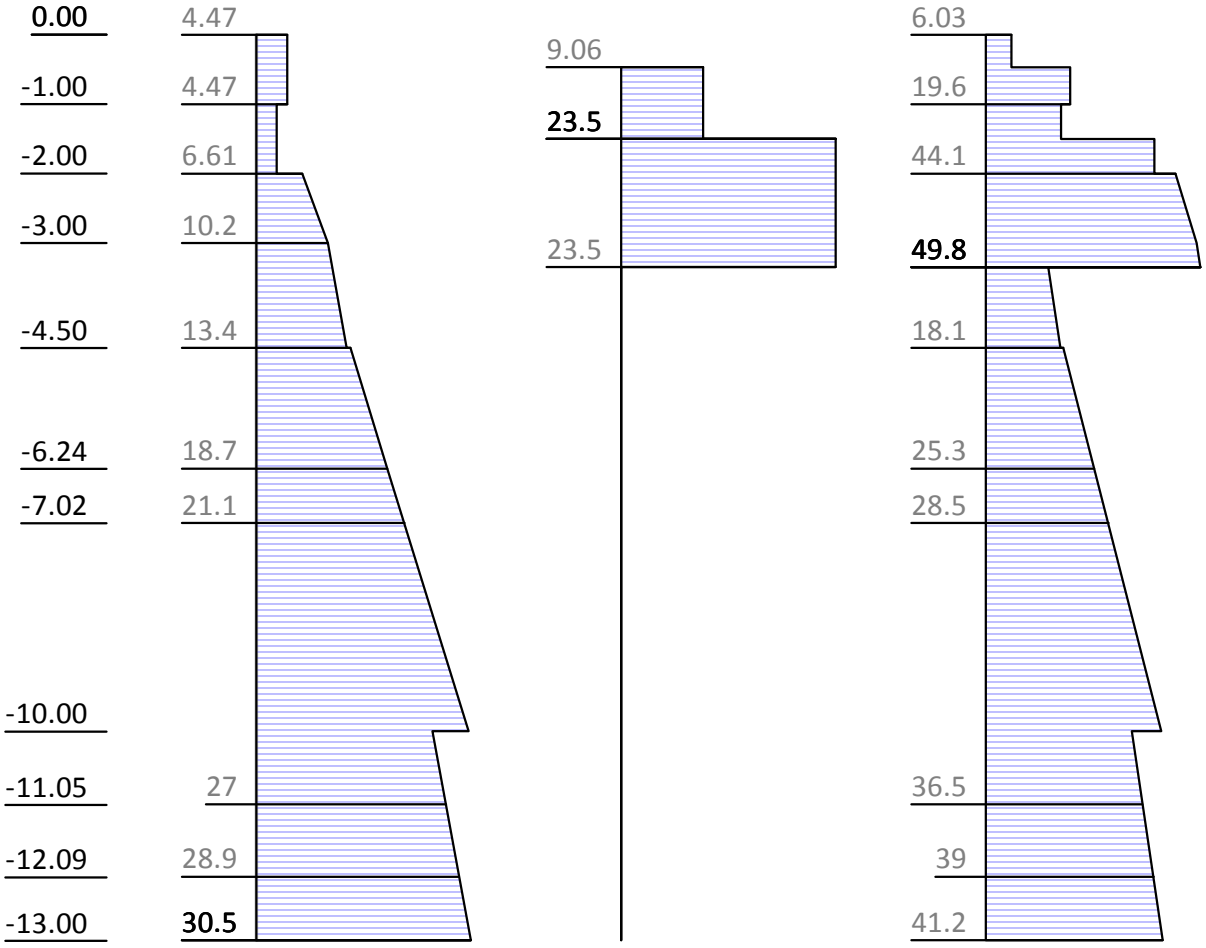


z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.47		1.52	0.00	2.04
-0.47		1.52	9.06	15.62
-1.50		7.25	9.06	23.37
-1.50		4.82	23.48	41.73
-2.00	-0.00	6.61	23.48	44.14
-2.00	-100.29	6.61	23.48	44.14
-3.34	-123.80	10.79	23.48	49.78
-3.34	-123.80	10.79	0.00	14.56
-4.50	-135.45	12.86	0.00	17.36
-4.50	-305.34	13.38	0.00	18.06
-10.00	-820.67	30.24	0.00	40.82
-10.00	-304.80	25.14	0.00	33.93
-13.00	-334.94	30.49	0.00	41.17

Eph,G,k:-4358.35, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 236.52, Eah,PG,k: 0.00, Eah,PQ,k: 52.53, Eah,d: 398.10

H-pressure on static system

Level of mobilization: Ep,gk 100.0, Ep,qk 100.0, Ep,d 100.0 [%]

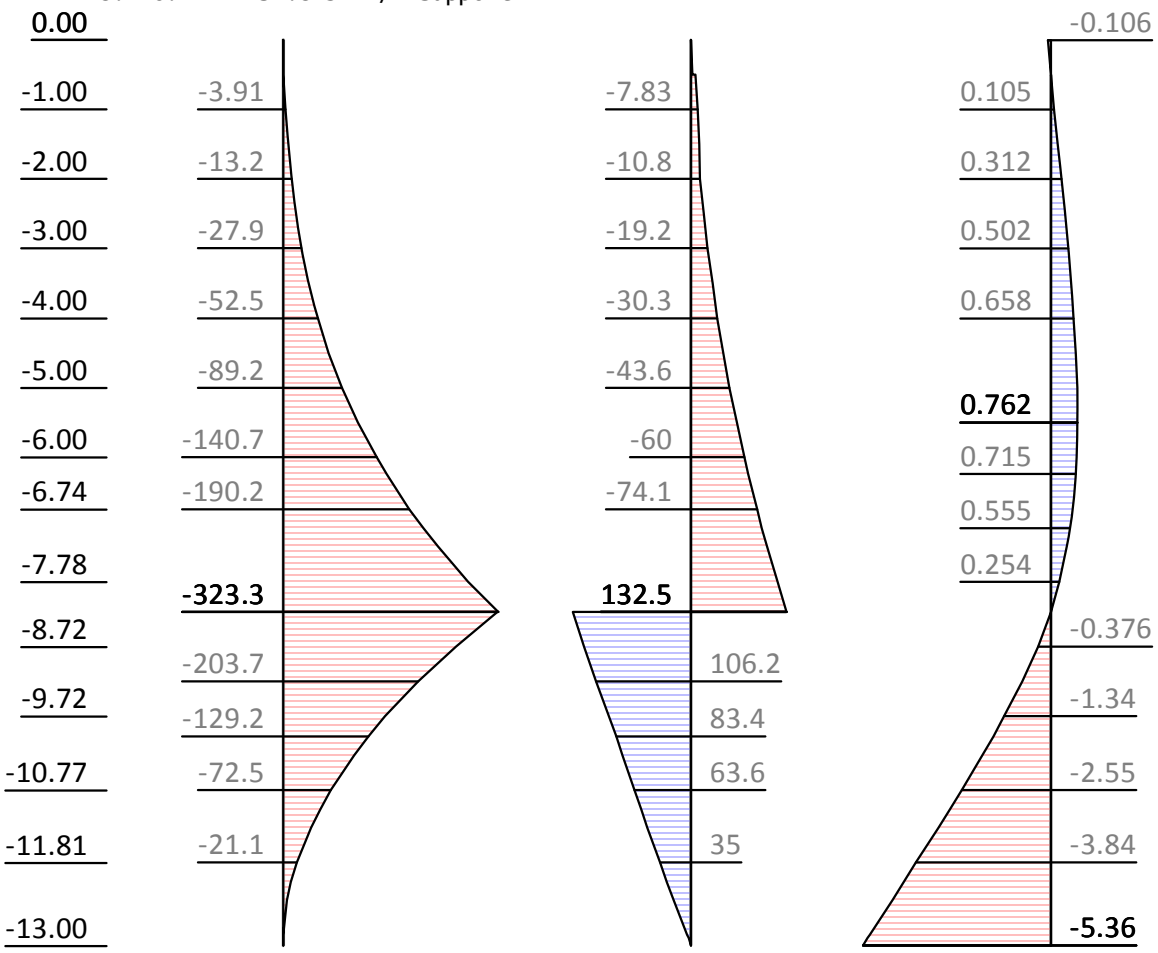


z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	4.47		6.03
-0.47	4.47	0.00	6.03
-0.47	4.47	9.06	19.62
-1.00	4.47	9.06	19.62
-1.00	2.98	9.06	17.61
-1.50	2.98	9.06	17.61
-1.50	2.98	23.48	39.25
-2.00	2.98	23.48	39.25
-2.00	6.61	23.48	44.14
-3.34	10.79	23.48	49.78
-3.34	10.79	0.00	14.56
-4.50	12.86	0.00	17.36
-4.50	13.38	0.00	18.06
-10.00	30.24	0.00	40.82
-10.00	25.14	0.00	33.93
-13.00	30.49	0.00	41.17

V-pressure on static system

Internal forces: Permanent, characteristically

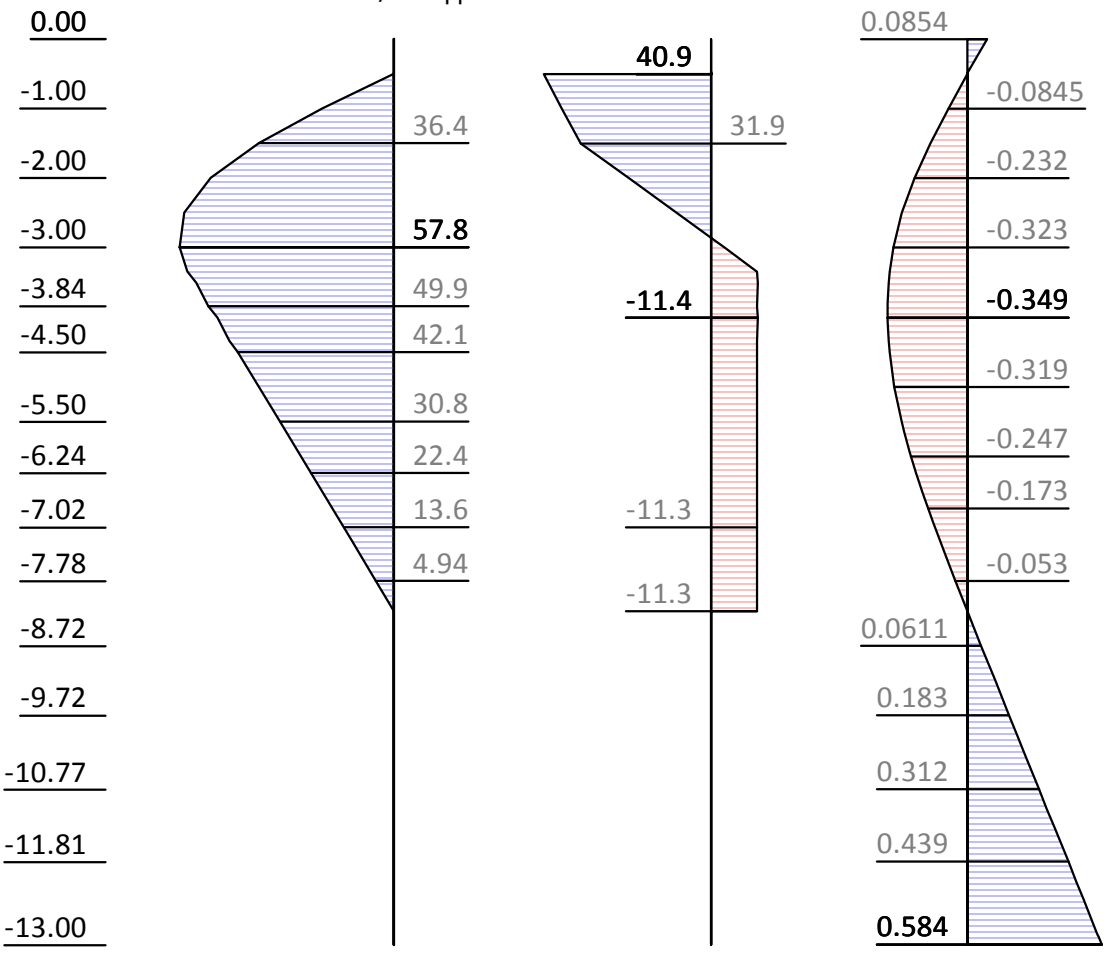
z= -0.500. Fx= 3.356 kN/m Support
z= -8.216. Fx=-239.875 kN/m Support



z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	4.47	0.00	0.00	0.00	-0.11
-0.00	4.47	-0.00	0.00	-0.00	-0.11
-0.50	4.47	-0.56	-2.23	-10.91	0.00
-0.50	4.47	-0.56	-5.59	-10.01	0.00
-1.00	4.47	-3.91	-7.83	-20.93	0.11
-1.00	2.98	-3.91	-7.83	-20.93	0.11
-2.00	2.98	-13.23	-10.81	-42.48	0.31
-2.00	6.61	-13.23	-10.81	-42.48	0.31
-4.50	12.86	-69.20	-36.48	-82.41	0.72
-4.50	13.38	-69.20	-36.48	-82.41	0.72
-5.50	16.45	-112.89	-51.40	-101.04	0.76
-8.22	24.78	-323.32	-107.35	-157.87	0.00
-8.22	24.78	-323.32	132.52	-157.87	0.00
-10.00	30.24	-129.19	83.45	-200.18	-1.65
-10.00	25.14	-129.19	83.45	-200.18	-1.65
-13.00	30.49	-0.00	0.00	-238.08	-5.36

Internal forces: Variable, characteristically

Method EB 82-4 (Q = [G+Q] - G).
z= -0.500. Fx= -41.195 kN/m Support
z= -8.216. Fx= -11.337 kN/m Support

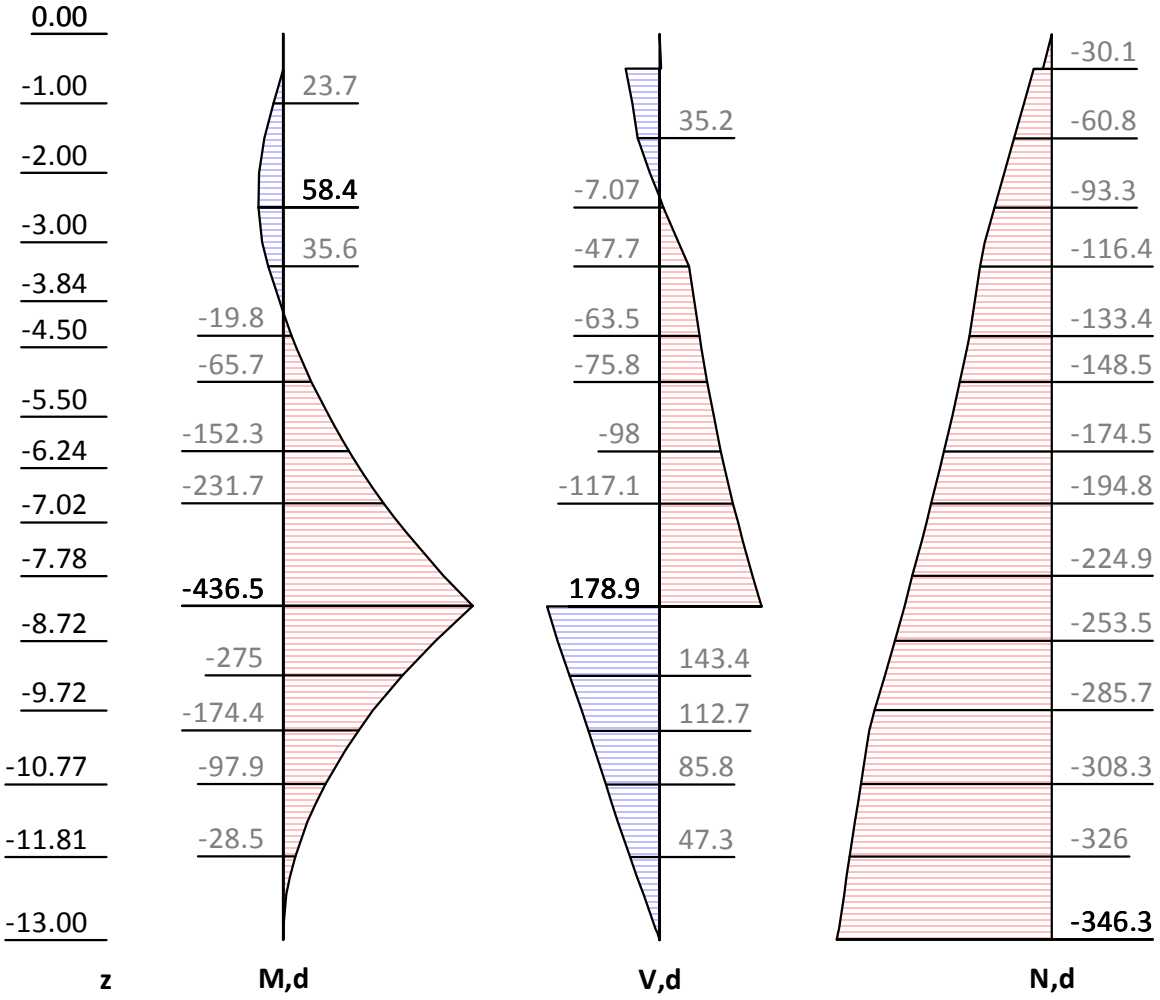


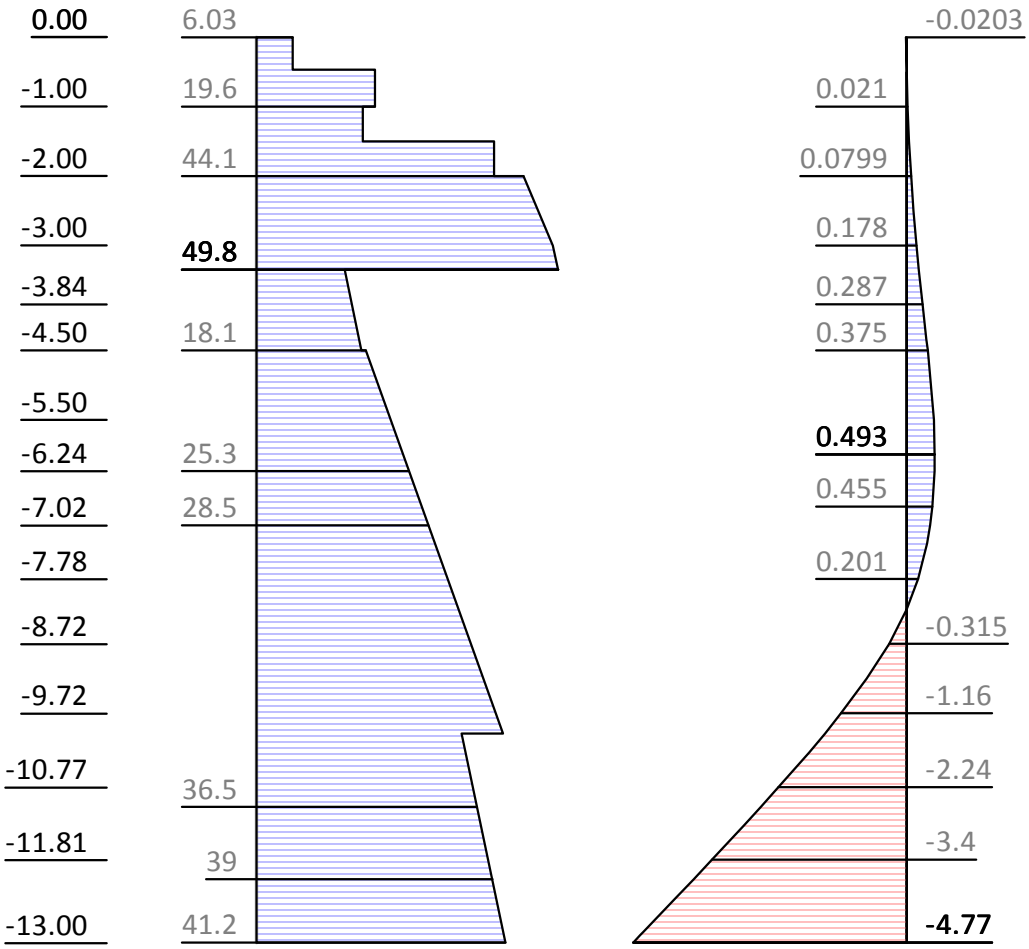
z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00	-0.00	0.00	0.09
-0.47	0.00	0.03	-0.00	0.00	0.01
-0.47	9.06	0.03	0.00	0.00	0.01
-0.47	9.06	0.03	0.00	-0.00	0.01
-0.50	9.06	-0.00	-0.24	-0.03	0.00
-0.50	9.06	-0.00	40.92	-11.07	-0.00
-1.50	9.06	36.39	31.87	-12.02	-0.16
-1.50	23.48	36.39	31.87	-12.02	-0.16
-2.86	23.48	57.42	0.00	-15.40	-0.31
-3.00	23.48	57.78	-3.35	-15.75	-0.32
-3.34	23.48	55.57	-11.29	-16.59	-0.34
-3.34	0.00	55.57	-11.29	-16.59	-0.34
-3.50	0.00	53.17	-11.39	-16.59	-0.34
-4.00	0.00	47.47	-11.39	-16.59	-0.35
-6.00	0.00	25.12	-11.34	-16.59	-0.25
-8.22	0.00	0.00	-11.34	-16.59	0.00
-8.22	0.00	0.00	-0.00	-16.59	0.00
-10.00	0.00	0.00	-0.00	-16.59	0.22
-11.05	0.00	0.00	-0.00	-16.59	0.35
-12.18	0.00	0.00	-0.00	-16.59	0.48
-12.85	0.00	-0.00	-0.00	-16.59	0.57
-12.90	0.00	-0.00	-0.00	-16.59	0.57

z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
-12.99	0.00	0.00	0.00	-16.59	0.58
-13.00	0.00	0.00	0.00	-16.59	0.58

Internal forces: Design

z= -0.500. Fx= -57.261 kN/m Support
z= -8.216. Fx=-340.838 kN/m Support





z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	6.03	0.00	0.00	0.00	-0.02
-0.47	6.03	-0.67	-2.84	-13.85	-0.00
-0.47	19.62	-0.67	-2.84	-13.85	-0.00
-0.50	19.62	-0.76	-3.42	-14.78	-0.00
-0.50	19.62	-0.76	53.84	-30.12	-0.00
-0.50	19.62	-0.76	53.84	-30.12	0.00
-0.52	19.62	0.00	53.53	-30.60	0.00
-1.00	19.62	23.71	44.03	-45.57	0.02
-1.00	17.61	23.71	44.03	-45.57	0.02
-1.50	17.61	43.52	35.22	-60.84	0.05
-1.50	39.25	43.52	35.22	-60.84	0.05
-2.00	39.25	56.22	15.60	-77.25	0.08
-2.00	44.14	56.22	15.60	-77.25	0.08
-2.34	45.80	57.72	-0.00	-88.29	0.11
-2.50	46.55	58.41	-7.07	-93.29	0.12
-3.34	49.78	35.58	-47.74	-116.40	0.22
-3.34	14.56	35.58	-47.74	-116.40	0.22
-4.01	16.17	0.00	-58.03	-127.73	0.31
-4.50	17.36	-30.22	-66.25	-136.15	0.37
-4.50	18.06	-30.22	-66.25	-136.15	0.37
-6.00	24.27	-152.27	-98.01	-174.49	0.49
-8.22	33.46	-436.48	-161.93	-238.01	0.00
-8.22	33.46	-436.48	178.90	-238.01	0.00
-10.00	40.82	-174.40	112.65	-295.13	-1.43
-10.00	33.93	-174.40	112.65	-295.13	-1.43
-13.00	41.17	-0.00	0.00	-346.30	-4.77
-13.00	41.17	0.00	0.00	-346.30	-4.77

Anchor forces with safety level of DS-P

z[m]	A,d[kN]	Fx,d[kN/m]
-0.50	106.7	-57.3

Checks of earth statics

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -8.22 m
Rd = Eph,k/γ,Re = 4358.35 / 1.400 = 3113.11 [kN/m]
Ed(Uh,d)/Rd = 340.84 / 3113.11 = 0.109 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-13.00

Pos.	H	V
H/V pressure G+P+W,k	236.52	49.97
Wall weight		189.01
H/V pressure passive		0.00
Support z: -0.50	3.36	-0.90
Bh,g,k z=-8.22	-239.88	
Bv,g,k = Bh,k * tan(δ,p=-22.00°)		-96.92
Σ	-0.00	141.16 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.
Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1
Vertical component of earth resistance is less than the downwards pointing vertical forces.
Vk >= Bvk: 238.08 >= 96.92 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-13.00

Pos.	H	V
H/V pressure G+P+W,k	289.05	55.52
Wall weight		189.01
H/V pressure passive		0.00
Support z: -0.50	-37.84	10.14
Bh,g,k z=-8.22	-239.88	
Bv,g,k = Bh,k * tan(δ,p=-22.00°)		-96.92
Bh,q,k z=-8.22	-11.34	
Bv,q,k = Bh,k * tan(δ,p=-22.00°)		-4.58
Σ	0.00	153.17 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.
Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1
Vertical component of earth resistance is less than the downwards pointing vertical forces.
Vk >= Bvk: 254.67 >= 101.50 Passes requirement

Anchor verification

Anchor - Stability of lower failure plane

Περίπτ.Φόρτισης: όλα τα φορτία BS-P
Αυτόμ. υπολογ. μήκους αγκυρίων:
All anchors are extended (if necessary)
Favourable variable loads in main failure body are not being considered.
Bottom of lower failure plane: z=-13.00 m

Iteration of failure mechanisms:
lA .....: Length of anchor from head to center of grout body.
W,k .....: Res. force from dead weight, loads, cohesion, ...
Q,k .....: Force in lower failure plane.
Ea1,k.....: Earth pressure onto vertical separation plane.
Ea2,k.....: Earth pressure between wall and main failure body.
Ra_cal,d ...: Dimesioning force of the resistance from the equilibrium of forces. Ra_cal,d corresponds to the max. possible anchor force of the force polygon.
Sum(A,d) ...: Acting anchor forces along the grout body fractions within the failure body. Sum(A,d) is gained from the anchor pull forces of the wall analysis.

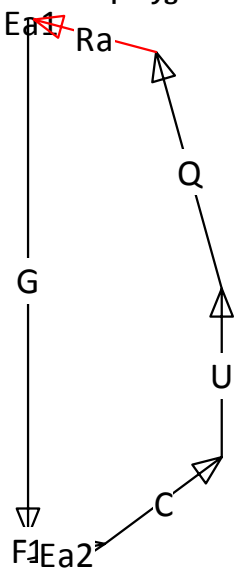
z [m]	ϑ1 [°]	ϑ2 [°]	lA [m]	W,k [kN/m]	Q,k [kN/m]	Ea1,k [kN/m]	Ea2,k [kN/m]	Ra_cal,d [kN/m]	Sum(A,d) [kN/m]	Ed/Rd [-]
-0.50	53.0	57.5	8.12	627.9	477.6	4.4	294.3	248.2	59.3	0.24

Decisive failure body:
Γεωμετρία:
Foot point of lower failure plane x/z = 0.01/-13.00 m
Intersection lower/upper slid. plane x/z = 7.84/ -2.60 m
Intersection upper slid. plane/surface x/z = 9.50/ 0.00 m
Intersection separation plane/surface x/z = 7.84/ 0.00 m
Inclination lower failure plane ϑ1 = 53.02°
Inclination upper failure plane ϑ2 = 57.50°
Inclination separation plane ϑ12 = 90.00°

Loads / forces (char.)

		Fx [kN/m]	Fz [kN/m]	F [kN/m]	
Weight of main failure body	G,k:	0.0	-1257.6	1257.6	
Area loads on/in main failure body	F1,k:	0.0	-82.5	82.5	
Cohesion of lower failure plane	C,k:	318.1	422.5	528.8	
Pore water pressure on main body	U,k:	0.1	376.4	376.4	
Earth pres. on separation plane	Ea1,k:	-4.4	-0.0	4.4	δ= 0.0°
Earth pr. between wall<->main body	Ea2,k:	289.1	55.5	294.3	
Force in lower failure plane	Q,k:	-267.2	395.8	477.6	
Sum = possible anchor forces:	Ra_cal,k:	335.6	-89.9	347.5	

Force polygon



Acting anchor forces Ed: Sum(A,d) = 59.3 kN/m
Possible anchor forces Rd: Ra_cal,d = 347.5/1.400 = 248.2 kN/m

Verif. of lower failure plane Ed/Rd = 0.24 < 1.0: Έλεγχος εκπληρώθηκε.

Check of steel tension

l,tot ...[m]: Total length of anchor incl. excess length at head
As ....[mm2]: X-section are of steel member
Ri,d ...[kN]: Ultimate strength of tension member (γ,M=1.15)
A,d ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	l,tot	As	Ri,d		A,d	
-0.50	Strand;3x0.60";1570/1770	12.12	420	573.4	>	106.7	Passes requirement

Check of steel tension: Passes requirement

Check of anchor's soil friction

lVk .....: Length of grout body
DmVk ....: Diameter of grout body
τGr,k ...: Average applied skin friction along the grout body (from soil parameters)
Ra,k ....: Charact. pullout resistance of the anchor
γA .....: Partial safety factor of anchor pullout
Ra,d ....: = Ra,k / γA
A,d .....: Dimensioning force of the anchor from wall analysis

z [m]	lVk [m]	DmVk [mm]	τGr,k [kN/m²]	Ra,k [kN]	γA [-]	Ra,d [kN]		A,d [kN]	A,d/Ra,d [-]
-0.50	8.00	318	110	879.1	1.100	799.2	>	106.7	0.1

Check of anchor's soil friction: Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)
Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (-2.63, 2.32), Ακτίνα = 15.55
Αρχ.σημ.= (-17.57, -2.00), Τελ.σημ. = (12.75, 0.00)

Γεωμετρία λωρίδων:

No	x	Width b	dxM	Weight	Load z-κατ.	Water-φορτ.	u*b	φ	c	θ
	[m]	[m]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[°]	[kN/m²]	[°]
1	-16.79	1.56	-14.16	65.5	0.0	0.0	-20.2	0.08	35.71	-44.96*
2	-15.23	1.56	-12.61	157.8	0.0	0.0	-57.4	27.45	3.57	-31.27*
3	-13.68	1.56	-11.05	222.0	0.0	0.0	-86.6	27.45	3.57	-31.27*
4	-12.12	1.56	-9.50	270.1	0.0	0.0	-108.2	27.45	3.57	-31.27*
5	-10.57	1.56	-7.94	302.9	0.0	0.0	-124.8	0.08	71.43	-30.71
6	-9.01	1.56	-6.39	328.1	0.0	0.0	-137.4	0.08	71.43	-24.25
7	-7.46	1.56	-4.83	346.8	0.0	0.0	-146.8	0.08	71.43	-18.10
8	-5.90	1.56	-3.28	359.9	0.0	0.0	-153.4	0.08	71.43	-12.16
9	-4.35	1.56	-1.72	367.8	0.0	0.0	-157.3	0.08	71.43	-6.35
10	-2.79	1.56	-0.17	370.7	0.0	0.0	-158.8	0.08	71.43	-0.61
11	-1.24	1.56	1.39	368.8	0.0	0.0	-157.9	0.08	71.43	5.12
12	0.32	1.56	2.94	402.6	4.1	0.0	-154.4	0.08	71.43	10.91
13	1.87	1.56	4.50	407.6	66.7	0.0	-148.5	0.08	71.43	16.82
14	3.43	1.56	6.05	390.1	36.4	0.0	-139.7	0.08	71.43	22.91
15	4.98	1.56	7.61	366.4	0.0	0.0	-127.8	0.08	71.43	29.30
16	6.54	1.56	9.17	335.4	0.0	0.0	-112.1	0.08	71.43	36.11
17	8.09	1.56	10.72	290.9	0.0	0.0	-91.7	27.45	3.57	43.58
18	9.65	1.56	12.28	230.8	0.0	0.0	-64.5	27.45	3.57	52.12
19	11.59	2.32	14.22	178.5	0.0	0.0	-36.5	0.08	35.71	66.07

*** Σημείωση: Στις λωρίδες σημειωμένες με '*'
περιορίστηκε το theta στο 45°-Phi/2.

Συνεισφ. κατακόρυφων φορτίων:

No	Weight	G*sin(θ)	(G-u*b)*tan(φ) + c*b	μ*sin(θ)* tan(φ)+cos(θ)	T
	[kN/m]	[kN/m]	[kN/m]	[-]	[kN/m]
1	65.52	-59.66	55.60	0.707466	78.60
2	157.78	-127.91	57.73	0.818084	70.57
3	222.01	-157.78	75.92	0.818084	92.80
4	270.09	-164.94	89.66	0.818084	109.60
5	302.94	-154.71	111.33	0.859679	129.50
6	328.10	-134.74	111.35	0.911705	122.13
7	346.84	-107.75	111.36	0.950458	117.17
8	359.92	-75.82	111.37	0.977517	113.93
9	367.80	-40.71	111.38	0.993836	112.07
10	370.74	-3.96	111.38	0.999941	111.39
11	368.84	32.95	111.38	0.996019	111.82
12	406.74	77.01	111.44	0.981950	113.48
13	474.34	137.24	111.54	0.957285	116.52
14	426.54	166.06	111.48	0.921173	121.02
15	366.45	179.31	111.42	0.872193	127.74
16	335.39	197.65	111.39	0.808006	137.86
17	290.94	200.55	109.06	0.773070	141.08
18	230.82	182.19	91.99	0.669646	137.36
19	178.48	163.14	83.23	0.405715	205.15
		308.14			2269.80

Δράση Ed = (308.1*15.55)
Αντίσταση Rd = (2269.8*15.55 +0.0)

SLIP-CIRCLE μ = Ed/Rd = 0.14 < 1.0: Έλεγχος εκπληρώθηκε.

Φάση εκσκαφής 3 "[3] Situation 3"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 5 Στρώσεις

Name		Τεχνητές επιχωματώσεις	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
γ	[kN/m3]	18	20	22.5
γ,R	[kN/m3]	18	20	22.5
γ'	[kN/m3]	8	10	12.5
γ,p	[kN/m3]	18	20	22.5
γ,R,passive	[kN/m3]	18	20	22.5
γ,pw	[kN/m3]	8	10	12.5
φ	[°]	25	0.1	33
c	[kN/m2]	2	50	5
c,u	[kN/m2]	10	50	5
c παθητικό	[kN/m2]	2	50	5
δ,a	[°]	16.66667	0.06666667	22
δ,p	[°]	-16.66667	-0.06666667	-22
δ,c	[°]	8.333333	0.03333333	11
k,agh	[-]	0.3456501	0.9955057	0.2452023
K,ach	[-]	1.043051	1.994195	0.8549058
K,0h	[-]	0.5773817	0.9982547	0.455361
K,pgh	[-]	3.908103	1.004519	7.495617
K,pch	[-]	5.180327	2.00583	8.599509
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	10e-06	5.5e-09	100e-06

Name		Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20	22.5
γ,R	[kN/m3]	20	22.5
γ'	[kN/m3]	10	12.5
γ,p	[kN/m3]	20	22.5
γ,R,passive	[kN/m3]	20	22.5
γ,pw	[kN/m3]	10	12.5
φ	[°]	0.1	35
c	[kN/m2]	100	5
c,u	[kN/m2]	100	5
c παθητικό	[kN/m2]	100	5
δ,a	[°]	0.06666667	23.33333
δ,p	[°]	-0.06666667	-23.33333
δ,c	[°]	0.03333333	11.66667
k,agh	[-]	0.9955057	0.2244207
K,ach	[-]	1.994195	0.8126539
K,0h	[-]	0.9982547	0.4264236
K,pgh	[-]	1.004519	9.146943
K,pch	[-]	2.00583	10.104
τ,gr	[kN/m2]	110	110
Ψ,A,max	[°]	90	90
k	[cm/s]	5.5e-09	100e-06

Πορεία πρανούς:
x [m] 0.00 0.00
z [m] -4.00 0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
x [m] 0.00 0.00
z [m] -4.00 -1.50

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:
z= -4.50

Πορεία ανώτερου 4. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
z= -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -14.00

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
1.00	0.00	3.50	0.00	0.00	33.00	0.00	33.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Στάθμη νερού:

x [m]	0.00	0.00
z [m]	-6.00	-3.00

Αγκύρια

z[m]	min.l[m]	Alpha[°]	C-H[kN/m]	P0[kN]	u0[m]
-0.50	0.00	15.00	αόριστ.	0.00	0.0000

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Ενεργές ωθήσεις.
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: Trapezoid.
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
Levels of redistribution Z1: 0.000, Z2: -2.000 [m].
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Κλασικός, Pregl/Sokolovsky (DIN 4085).

Options for water pressure

Στήριξη πόδα

Πόδας οριζοντίως μετακινούμενος

Αγκύρια

Anchor checks (lower failure plane): Ναι
Anchor forces with safety level of DS-P: Ναι
Verification of grout body pull out forces: Ναι
δ,a,Anchoring wall : used from soil layer.
δ,p,Anchoring wall : used from soil layer.

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

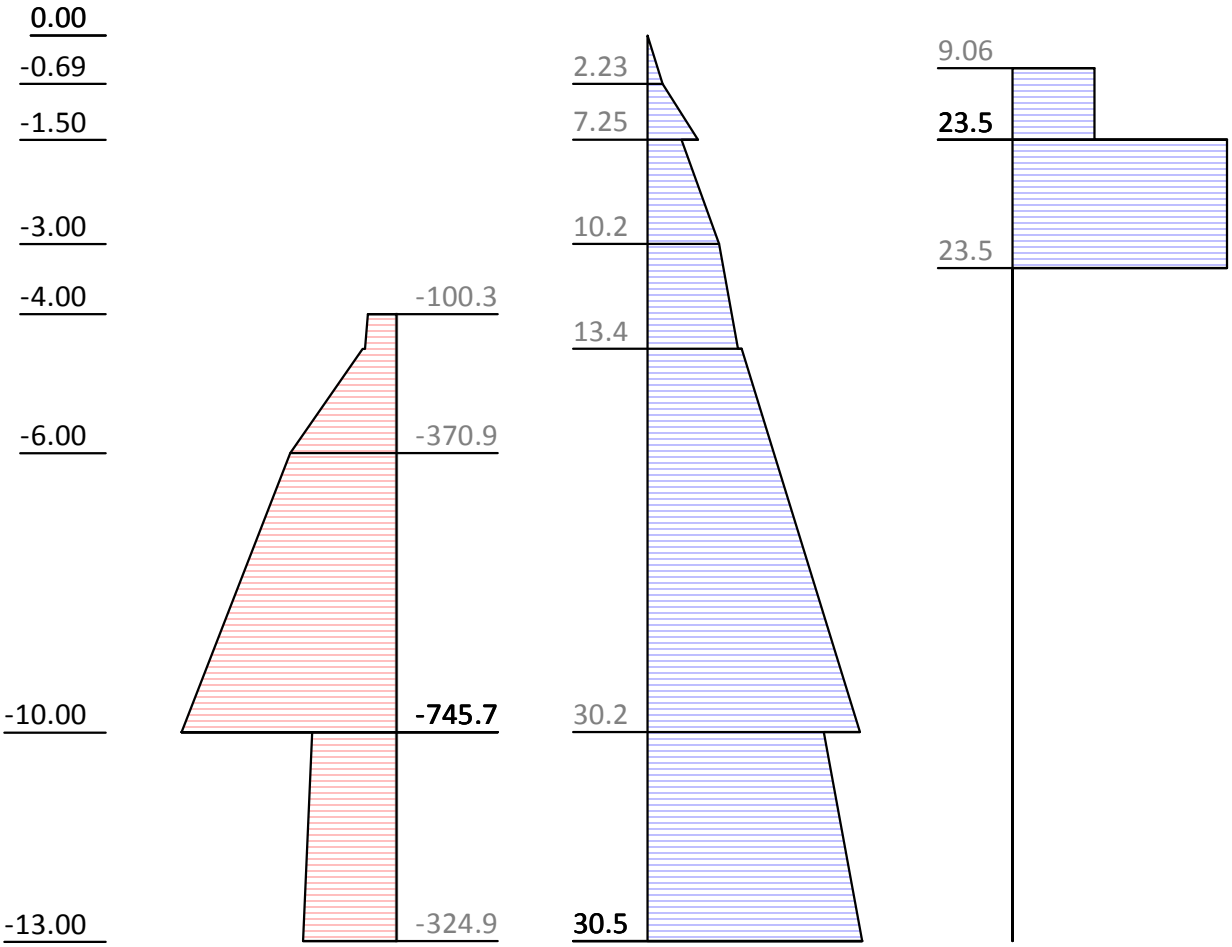
Μήκος τοίχου

Foot depth for statics: zf = -13.000

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall



z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.47		1.52	0.00	2.04
-0.47		1.52	9.06	15.62
-1.50		7.25	9.06	23.37
-1.50		4.82	23.48	41.73
-3.34		10.79	23.48	49.78
-3.34		10.79	0.00	14.56
-4.00	-0.00	11.97	0.00	16.15
-4.00	-100.29	11.97	0.00	16.15
-4.50	-110.34	12.86	0.00	17.36
-4.50	-117.95	13.38	0.00	18.06
-10.00	-745.71	30.24	0.00	40.82
-10.00	-294.76	25.14	0.00	33.93
-13.00	-324.89	30.49	0.00	41.17

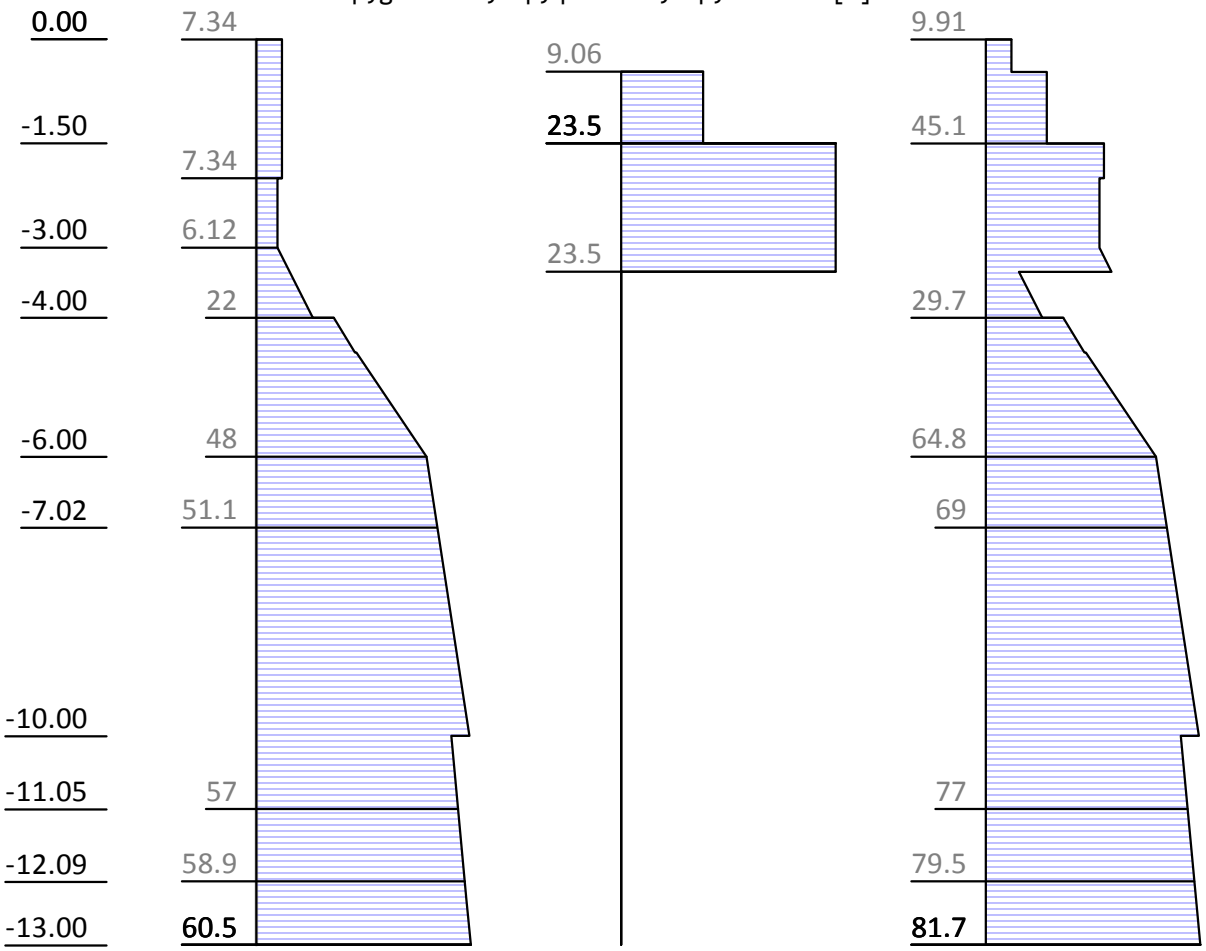
Eph,G,k:-3582.08, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 236.52, Eah,PG,k: 0.00, Eah,PQ,k: 52.53, Eah,d: 398.10

Πίεση νερού

z [m]	Wp,k [kN/m2]	Wa,k [kN/m2]	W,k [kN/m2]
-3.00		0.00	0.00
-6.00	0.00	30.00	30.00
-6.24	-2.40	32.40	30.00
-13.00	-70.00	100.00	30.00

H-pressure on static system

Level of mobilization: Ep,gk 100.0, Ep,qk 100.0, Ep,d 100.0 [%]

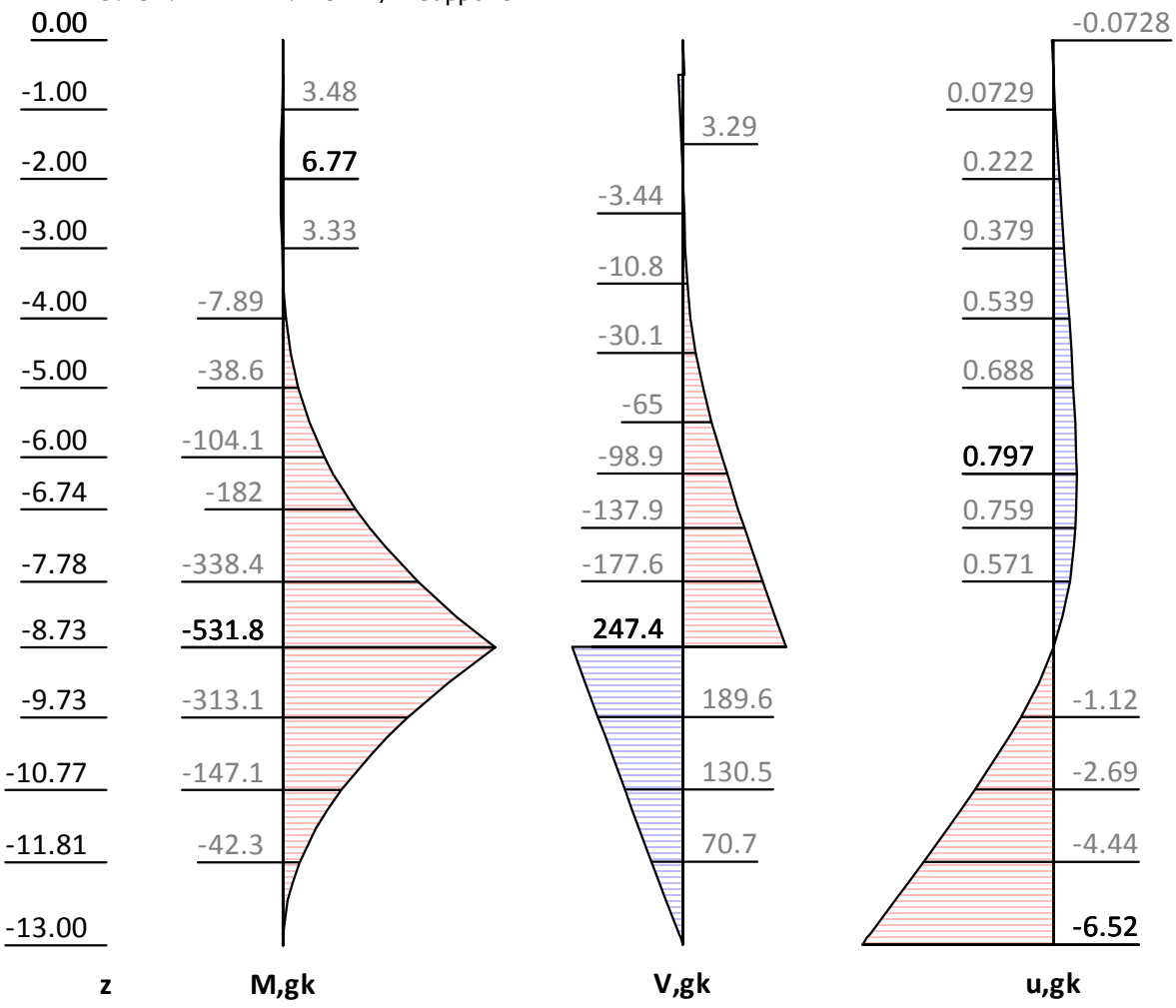


z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	7.34		9.91
-0.47	7.34	0.00	9.91
-0.47	7.34	9.06	23.50
-1.50	7.34	9.06	23.50
-1.50	7.34	23.48	45.13
-2.00	7.34	23.48	45.13
-2.00	6.12	23.48	43.48
-3.34	9.52	23.48	48.07
-3.34	9.52	0.00	12.85
-4.00	16.12	0.00	21.76
-4.00	21.97	0.00	29.65
-4.50	27.86	0.00	37.61
-4.50	28.38	0.00	38.31
-10.00	60.24	0.00	81.32
-10.00	55.14	0.00	74.43
-13.00	60.49	0.00	81.67

V-pressure on static system

Internal forces: Permanent, characteristically

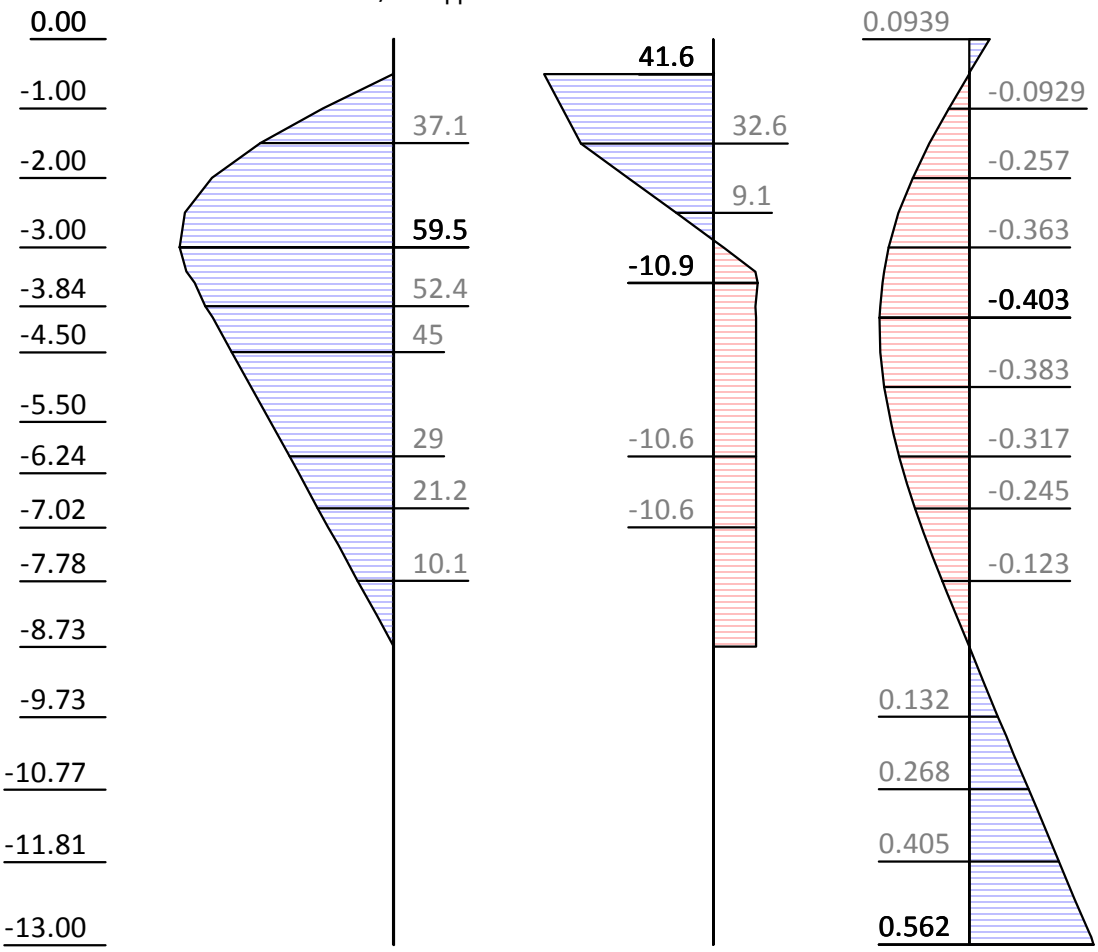
z= -0.500. Fx= -14.305 kN/m Support
z= -8.731. Fx=-477.215 kN/m Support



z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	7.34	0.00	-0.00	0.00	-0.07
-0.50	7.34	-0.92	-3.67	-10.69	-0.00
-0.50	7.34	-0.92	10.63	-14.52	-0.00
-0.60	7.34	0.00	9.87	-16.76	0.02
-1.95	7.34	6.70	0.00	-45.49	0.21
-2.00	7.34	6.77	-0.38	-46.60	0.22
-2.00	6.12	6.77	-0.38	-46.60	0.22
-3.39	10.06	-0.00	-9.90	-76.34	0.44
-4.00	16.12	-7.89	-17.61	-89.24	0.54
-4.00	21.97	-7.89	-17.61	-89.24	0.54
-4.50	27.86	-19.69	-30.07	-99.75	0.62
-4.50	28.38	-19.69	-30.07	-99.75	0.62
-6.24	48.71	-126.42	-98.94	-132.95	0.80
-8.73	56.35	-531.83	-229.78	-187.01	0.00
-8.73	56.35	-531.83	247.44	-187.01	0.00
-10.00	60.24	-264.19	173.45	-217.51	-1.50
-10.00	55.14	-264.19	173.45	-217.51	-1.50
-13.00	60.49	0.00	0.00	-255.41	-6.52

Internal forces: Variable, characteristically

Method EB 82-4 (Q = [G+Q] - G).
z= -0.500. Fx= -41.904 kN/m Support
z= -8.731. Fx= -10.628 kN/m Support

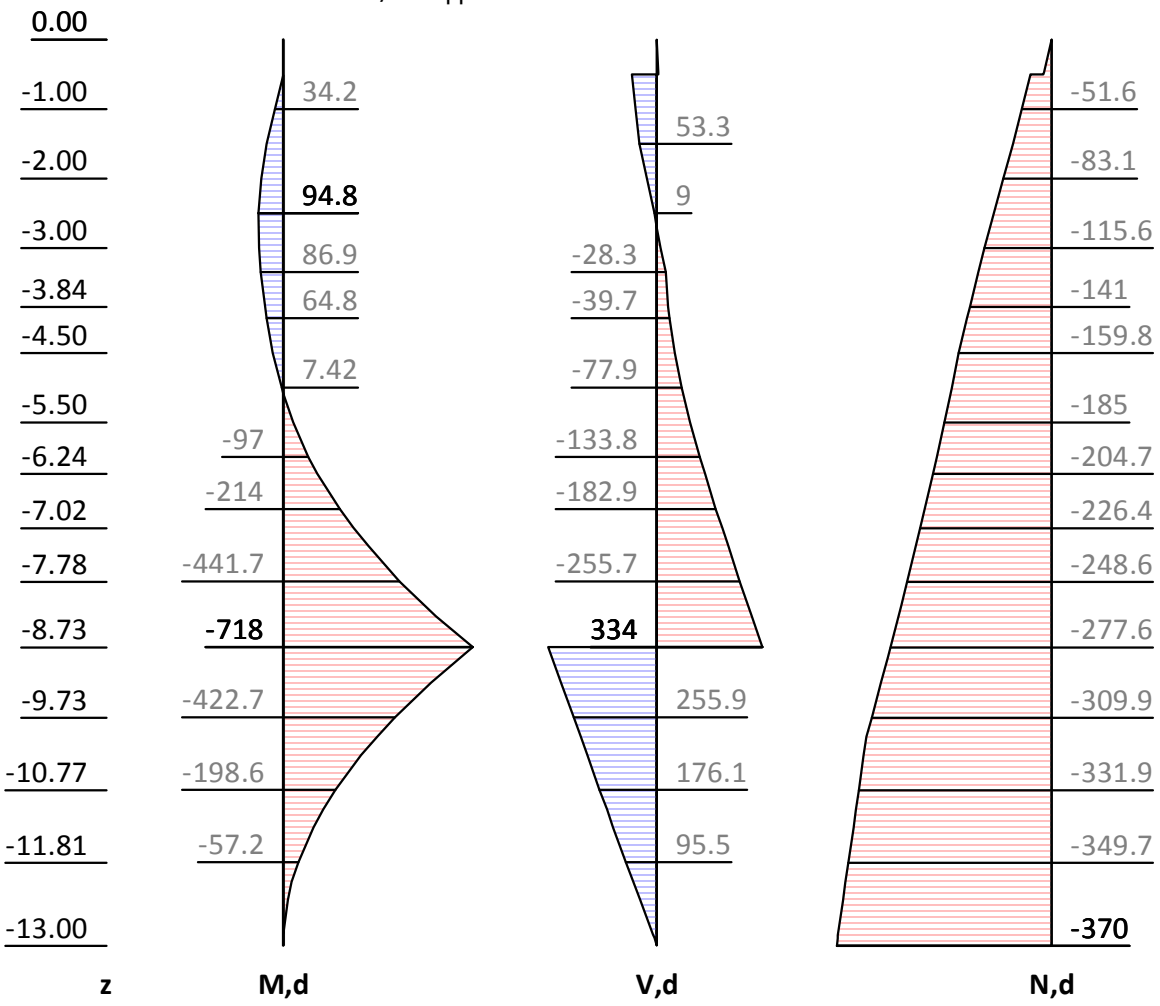


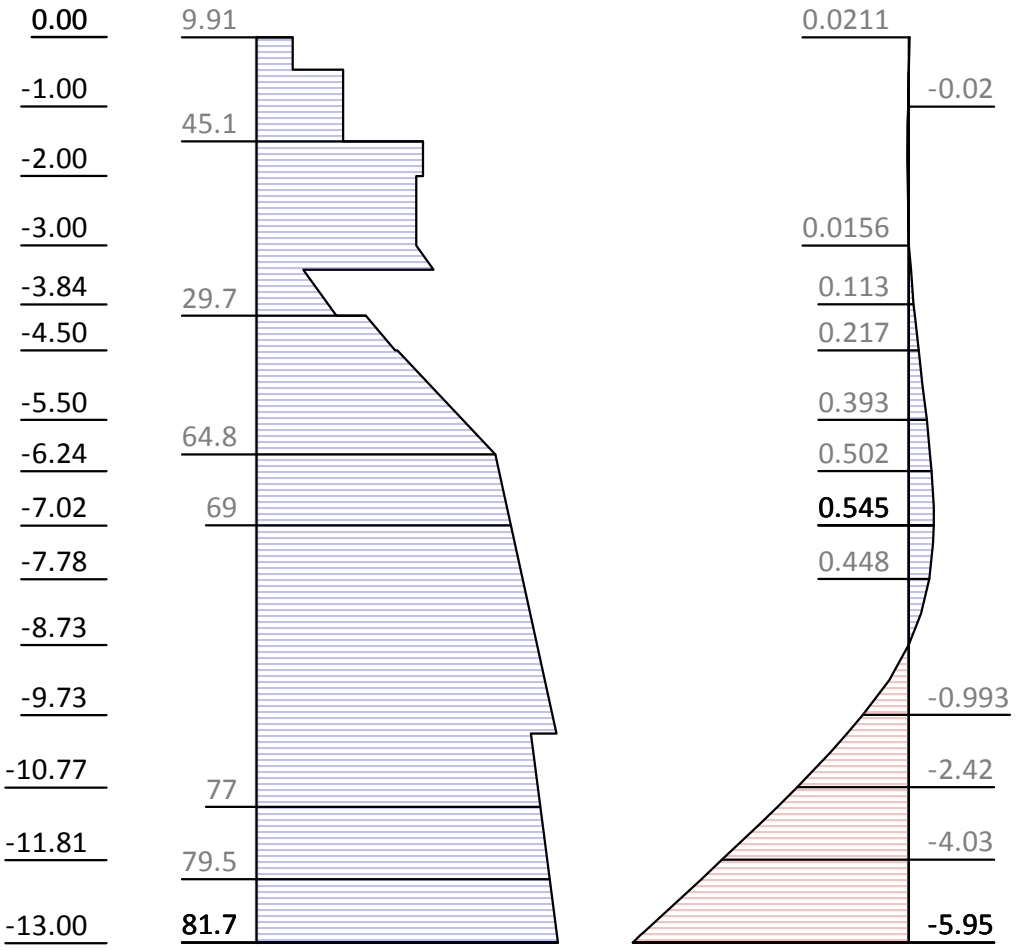
z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00	0.00	0.00	0.09
-0.47	0.00	0.05	0.00	0.00	0.01
-0.47	9.06	0.05	0.00	-0.00	0.01
-0.50	9.06	0.00	-0.25	-0.03	0.00
-0.50	9.06	0.00	41.63	-11.26	-0.00
-1.50	9.06	37.10	32.58	-12.21	-0.18
-1.50	23.48	37.10	32.58	-12.21	-0.18
-2.89	23.48	59.19	0.00	-15.66	-0.35
-3.00	23.48	59.55	-2.64	-15.94	-0.36
-3.34	23.48	57.54	-10.36	-16.78	-0.38
-3.34	0.00	57.54	-10.36	-16.78	-0.38
-3.50	0.00	55.27	-10.90	-16.78	-0.39
-3.84	0.00	52.36	-10.36	-16.78	-0.40
-4.00	0.00	50.28	-10.63	-16.78	-0.40
-6.24	0.00	26.47	-10.63	-16.78	-0.30
-8.28	0.00	4.79	-10.63	-16.78	-0.06
-8.73	0.00	0.00	-10.63	-16.78	-0.00
-8.73	0.00	-0.00	-10.63	-16.78	0.00
-8.73	0.00	-0.00	0.00	-16.78	0.00
-11.81	0.00	-0.00	0.00	-16.78	0.41
-12.87	0.00	0.00	0.00	-16.78	0.54
-12.90	0.00	0.00	0.00	-16.78	0.55

z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
-13.00	0.00	0.00	-0.00	-16.78	0.56

Internal forces: Design

z= -0.500. Fx= -82.168 kN/m Support
z= -8.731. Fx=-660.182 kN/m Support





z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	9.91	0.00	-0.00	0.00	0.02
-0.00	9.91	-0.00	-0.00	0.00	0.02
-0.47	9.91	-1.09	-4.66	-13.57	0.00
-0.47	23.50	-1.09	-4.66	-13.57	0.00
-0.50	23.50	-1.25	-5.36	-14.48	0.00
-0.50	23.50	-1.25	-5.36	-14.48	-0.00
-0.50	23.50	-1.25	76.80	-36.49	-0.00
-0.52	23.50	-0.00	76.39	-37.03	-0.00
-1.50	23.50	63.81	53.31	-66.80	-0.03
-1.50	45.13	63.81	53.31	-66.80	-0.03
-2.00	45.13	84.82	30.74	-83.09	-0.03
-2.00	43.48	84.82	30.74	-83.09	-0.03
-2.50	43.48	94.76	9.00	-99.35	-0.02
-2.71	43.48	94.37	0.00	-106.08	-0.00
-2.77	43.48	94.25	-2.83	-108.19	0.00
-3.34	48.07	86.89	-28.30	-126.65	0.05
-3.34	12.85	86.89	-28.30	-126.65	0.05
-4.00	21.76	64.77	-39.72	-145.65	0.14
-4.00	29.65	64.77	-39.72	-145.65	0.14
-4.50	37.61	40.87	-56.54	-159.83	0.22
-4.50	38.31	40.87	-56.54	-159.83	0.22
-5.08	48.58	0.00	-82.13	-174.29	0.32
-7.02	68.99	-267.91	-202.07	-226.40	0.54
-8.73	76.07	-717.97	-326.14	-277.64	0.00
-8.73	76.07	-717.97	334.04	-277.64	0.00
-10.00	81.32	-356.65	234.15	-318.82	-1.33
-10.00	74.43	-356.65	234.15	-318.82	-1.33

z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
-13.00	81.67	-0.00	0.00	-369.98	-5.95

Anchor forces with safety level of DS-P

z[m]	A,d[kN]	Fx,d[kN/m]
-0.50	153.1	-82.2

Checks of earth statics

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -8.73 m
Rd = Eph,k/γ,Re = 3582.08 / 1.400 = 2558.63 [kN/m]

Ed(Uh,d)/Rd = 660.18 / 2558.63 = 0.258 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-13.00

Pos.	H	V
H/V pressure G+P+W,k	491.52	49.97
Wall weight		201.61
H/V pressure passive		0.00
Support z: -0.50	-14.30	3.83
Bh,g,k z=-8.73	-477.21	
Bv,g,k = Bh,k * tan(δ,p=-22.00°)		-192.81
Σ	0.00	62.60 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.

Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1
Vertical component of earth resistance is less than the downwards pointing vertical forces.

Vk >= Bvk: 255.41 >= 192.81 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-13.00

Pos.	H	V
H/V pressure G+P+W,k	544.05	55.52
Wall weight		201.61
H/V pressure passive		0.00
Support z: -0.50	-56.21	15.06
Bh,g,k z=-8.73	-477.21	
Bv,g,k = Bh,k * tan(δ,p=-22.00°)		-192.81
Bh,q,k z=-8.73	-10.63	
Bv,q,k = Bh,k * tan(δ,p=-22.00°)		-4.29
Σ	0.00	75.09 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.

Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1
Vertical component of earth resistance is less than the downwards pointing vertical forces.

Vk >= Bvk: 272.19 >= 197.10 Passes requirement

Anchor verification

Anchor - Stability of lower failure plane

Περίπτ.Φόρτισης: όλα τα φορτία BS-P
Αυτόμ. υπολογ. μήκους αγκυρίων:
All anchors are extended (if necessary)
Favourable variable loads in main failure body are not being considered.
Bottom of lower failure plane: z=-13.00 m

Iteration of failure mechanisms:
lA .....: Length of anchor from head to center of grout body.
W,k .....: Res. force from dead weight, loads, cohesion, ...
Q,k .....: Force in lower failure plane.
Ea1,k.....: Earth pressure onto vertical separation plane.
Ea2,k.....: Earth pressure between wall and main failure body.
Ra_cal,d ...: Dimesioning force of the resistance from the equilibrium of forces. Ra_cal,d corresponds to the max. possible anchor force of the force polygon.
Sum(A,d) ...: Acting anchor forces along the grout body fractions within the failure body. Sum(A,d) is gained from the anchor pull forces of the wall analysis.

z [m]	ϑ1 [°]	ϑ2 [°]	lA [m]	W,k [kN/m]	Q,k [kN/m]	Ea1,k [kN/m]	Ea2,k [kN/m]	Ra_cal,d [kN/m]	Sum(A,d) [kN/m]	Ed/Rd [-]
-0.50	53.0	57.5	8.12	627.9	477.6	4.4	294.3	248.2	85.1	0.34

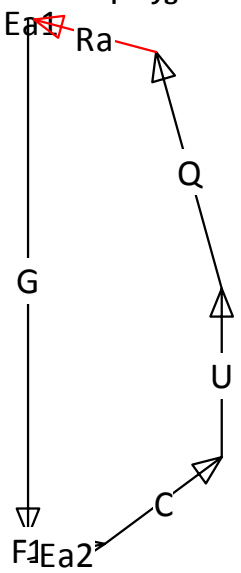
Decisive failure body:
Γεωμετρία:

Foot point of lower failure plane	x/z =	0.01/-13.00 m
Intersection lower/upper slid. plane	x/z =	7.84/ -2.60 m
Intersection upper slid. plane/surface	x/z =	9.50/ 0.00 m
Intersection separation plane/surface	x/z =	7.84/ 0.00 m
Inclination lower failure plane	ϑ1 =	53.02°
Inclination upper failure plane	ϑ2 =	57.50°
Inclination separation plane	ϑ12 =	90.00°

Loads / forces (char.)

		Fx [kN/m]	Fz [kN/m]	F [kN/m]	
Weight of main failure body	G,k:	0.0	-1257.6	1257.6	
Area loads on/in main failure body	F1,k:	0.0	-82.5	82.5	
Cohesion of lower failure plane	C,k:	318.1	422.5	528.8	
Pore water pressure on main body	U,k:	0.1	376.4	376.4	
Earth pres. on separation plane	Ea1,k:	-4.4	-0.0	4.4	δ= 0.0°
Earth pr. between wall<->main body	Ea2,k:	289.1	55.5	294.3	
Force in lower failure plane	Q,k:	-267.2	395.8	477.6	
Sum = possible anchor forces:	Ra_cal,k:	335.6	-89.9	347.5	

Force polygon



Acting anchor forces Ed: Sum(A,d) = 85.1 kN/m
Possible anchor forces Rd: Ra_cal,d = 347.5/1.400 = 248.2 kN/m
Verif. of lower failure plane Ed/Rd = 0.34 < 1.0: Έλεγχος εκπληρώθηκε.

Check of steel tension

l,tot ...[m]: Total length of anchor incl. excess length at head
As ....[mm2]: X-section are of steel member
Ri,d ...[kN]: Ultimate strength of tension member (γ,M=1.15)
A,d ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	l,tot	As	Ri,d		A,d	
-0.50	Strand;3x0.60";1570/1770	12.12	420	573.4	>	153.1	Passes requirement

Check of steel tension: Passes requirement

Check of anchor's soil friction

lVk .....: Length of grout body
DmVk ....: Diameter of grout body
τGr,k ...: Average applied skin friction along the grout body (from soil parameters)
Ra,k ....: Charact. pullout resistance of the anchor
γA .....: Partial safety factor of anchor pullout
Ra,d ....: = Ra,k / γA
A,d .....: Dimensioning force of the anchor from wall analysis

z [m]	lVk [m]	DmVk [mm]	τGr,k [kN/m²]	Ra,k [kN]	γA [-]	Ra,d [kN]		A,d [kN]	A,d/Ra,d [-]
-0.50	8.00	318	110	879.1	1.100	799.2	>	153.1	0.2

Check of anchor's soil friction: Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)
Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (-0.85, 0.12), Ακτίνα = 13.15
Αρχ.σημ.= (-13.34, -4.00), Τελ.σημ. = (12.31, 0.00)

Γεωμετρία λωρίδων:

No	x	Width b	dxM	Weight	Load z-κατ.	Water-φορτ.	u*b	φ	c	θ
	[m]	[m]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[°]	[kN/m²]	[°]
1	-12.68	1.32	-11.84	46.4	0.0	0.0	-5.4	27.45	3.57	-31.27*
2	-11.37	1.32	-10.52	110.2	0.0	0.0	-22.4	27.45	3.57	-31.27*
3	-10.05	1.32	-9.20	154.6	0.0	0.0	-42.5	27.45	3.57	-31.27*
4	-8.74	1.32	-7.89	186.7	0.0	0.0	-57.6	0.08	71.43	-36.85
5	-7.42	1.32	-6.57	209.5	0.0	0.0	-69.1	0.08	71.43	-29.98
6	-6.11	1.32	-5.26	227.0	0.0	0.0	-77.9	0.08	71.43	-23.56
7	-4.79	1.32	-3.94	239.9	0.0	0.0	-84.4	0.08	71.43	-17.44
8	-3.47	1.32	-2.63	248.9	0.0	0.0	-88.8	0.08	71.43	-11.52
9	-2.16	1.32	-1.31	254.1	0.0	0.0	-91.5	0.08	71.43	-5.73
10	-0.84	1.32	0.00	255.8	0.0	0.0	-92.4	0.08	71.43	0.01
11	0.47	1.32	1.32	341.0	5.5	0.0	-111.2	0.08	71.43	5.75
12	1.79	1.32	2.63	350.1	56.4	0.0	-128.3	0.08	71.43	11.55
13	3.10	1.32	3.95	341.2	45.3	0.0	-123.8	0.08	71.43	17.47
14	4.42	1.32	5.26	328.2	0.0	0.0	-117.3	0.08	71.43	23.59
15	5.73	1.32	6.58	310.7	0.0	0.0	-108.5	0.08	71.43	30.02
16	7.05	1.32	7.90	287.9	0.0	0.0	-97.0	0.08	71.43	36.89
17	8.36	1.32	9.21	255.7	0.0	0.0	-81.9	27.45	3.57	44.45
18	9.68	1.32	10.53	211.3	0.0	0.0	-61.7	27.45	3.57	53.15
19	11.32	1.97	12.17	188.1	0.0	0.0	-37.5	27.45	3.57	67.68

*** Σημείωση: Στις λωρίδες σημειωμένες με '*'
περιορίστηκε το theta στο 45°-Phi/2.

Συνεισφ. κατακόρυφων φορτίων:

No	Weight	G*sin(θ)	(G-u*b)*tan(φ) + c*b	μ*sin(θ)* tan(φ)+cos(θ)	T
	[kN/m]	[kN/m]	[kN/m]	[-]	[kN/m]
1	46.40	-41.75	26.01	0.781050	33.30
2	110.22	-88.15	50.33	0.781050	64.44
3	154.63	-108.20	62.93	0.781050	80.57
4	186.69	-111.97	94.14	0.799945	117.68
5	209.52	-104.71	94.15	0.865969	108.72
6	226.98	-90.74	94.16	0.916464	102.75
7	239.92	-71.92	94.17	0.953898	98.72
8	248.86	-49.71	94.18	0.979767	96.12
9	254.11	-25.35	94.18	0.994973	94.66
10	255.84	0.06	94.18	1.000000	94.18
11	346.59	34.74	94.28	0.995002	94.76
12	406.54	81.40	94.34	0.979825	96.29
13	386.43	116.02	94.32	0.953981	98.87
14	328.20	131.35	94.25	0.916566	102.83
15	310.71	155.43	94.24	0.866082	108.81
16	287.85	172.78	94.22	0.800055	117.77
17	255.74	179.07	94.99	0.813259	116.81
18	211.27	169.06	82.38	0.713221	115.50
19	188.11	174.02	85.28	0.510978	166.90
		521.43			1909.69

Δράση Ed = (521.4*13.15)
Αντίσταση Rd = (1909.7*13.15 +0.0)

SLIP-CIRCLE μ = Ed/Rd = 0.27 < 1.0: Έλεγχος εκπληρώθηκε.

Φάση εκσκαφής 4 "[4] Situation 4"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 5 Στρώσεις

Name		Τεχνητές επιχωματώσεις	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
γ	[kN/m3]	18	20	22.5
γ,R	[kN/m3]	18	20	22.5
γ'	[kN/m3]	8	10	12.5
γ,p	[kN/m3]	18	20	22.5
γ,R,passive	[kN/m3]	18	20	22.5
γ,pw	[kN/m3]	8	10	12.5
φ	[°]	25	0.1	33
c	[kN/m2]	2	50	5
c,u	[kN/m2]	10	50	5
c παθητικό	[kN/m2]	2	50	5
δ,a	[°]	16.66667	0.06666667	22
δ,p	[°]	-16.66667	-0.06666667	-22
δ,c	[°]	8.333333	0.03333333	11
k,agh	[-]	0.3456501	0.9955057	0.2452023
K,ach	[-]	1.043051	1.994195	0.8549058
K,0h	[-]	0.5773817	0.9982547	0.455361
K,pgh	[-]	3.908103	1.004519	7.495617
K,pch	[-]	5.180327	2.00583	8.599509
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	10e-06	5.5e-09	100e-06

Name		Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20	22.5
γ,R	[kN/m3]	20	22.5
γ'	[kN/m3]	10	12.5
γ,p	[kN/m3]	20	22.5
γ,R,passive	[kN/m3]	20	22.5
γ,pw	[kN/m3]	10	12.5
φ	[°]	0.1	35
c	[kN/m2]	100	5
c,u	[kN/m2]	100	5
c παθητικό	[kN/m2]	100	5
δ,a	[°]	0.06666667	23.33333
δ,p	[°]	-0.06666667	-23.33333
δ,c	[°]	0.03333333	11.66667
k,agh	[-]	0.9955057	0.2244207
K,ach	[-]	1.994195	0.8126539
K,0h	[-]	0.9982547	0.4264236
K,pgh	[-]	1.004519	9.146943
K,pch	[-]	2.00583	10.104
τ,gr	[kN/m2]	110	110
Ψ,A,max	[°]	90	90
k	[cm/s]	5.5e-09	100e-06

Πορεία πρανούς:
x [m] 0.00 0.00
z [m] -4.00 0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
x [m] 0.00 0.00
z [m] -4.00 -1.50

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:
z= -4.50

Πορεία ανώτερου 4. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
z= -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -14.00

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
1.00	0.00	3.50	0.00	0.00	33.00	0.00	33.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Στάθμη νερού:

x [m]	0.00	0.00
z [m]	-6.00	-3.00

Αγκύρια

z[m]	min.l[m]	Alpha[°]	C-H[kN/m]	P0[kN]	u0[m]
-0.50	0.00	15.00	αόρισ.	0.00	0.0000
-3.00	0.00	15.00	αόρισ.	0.00	0.0000

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Ενεργές ωθήσεις.
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: Triangle (perpend. to wall).
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
Levels of redistribution Z1: -0.500, Z2: -3.000 [m].
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Κλασικός, Pregl/Sokolovsky (DIN 4085).

Options for water pressure

Στήριξη πόδα

Πόδας οριζοντίως μετακινούμενος

Αγκύρια

Anchor checks (lower failure plane): Ναι
Anchor forces with safety level of DS-P: Ναι
Verification of grout body pull out forces: Ναι
δ,a,Anchoring wall : used from soil layer.
δ,p,Anchoring wall : used from soil layer.

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

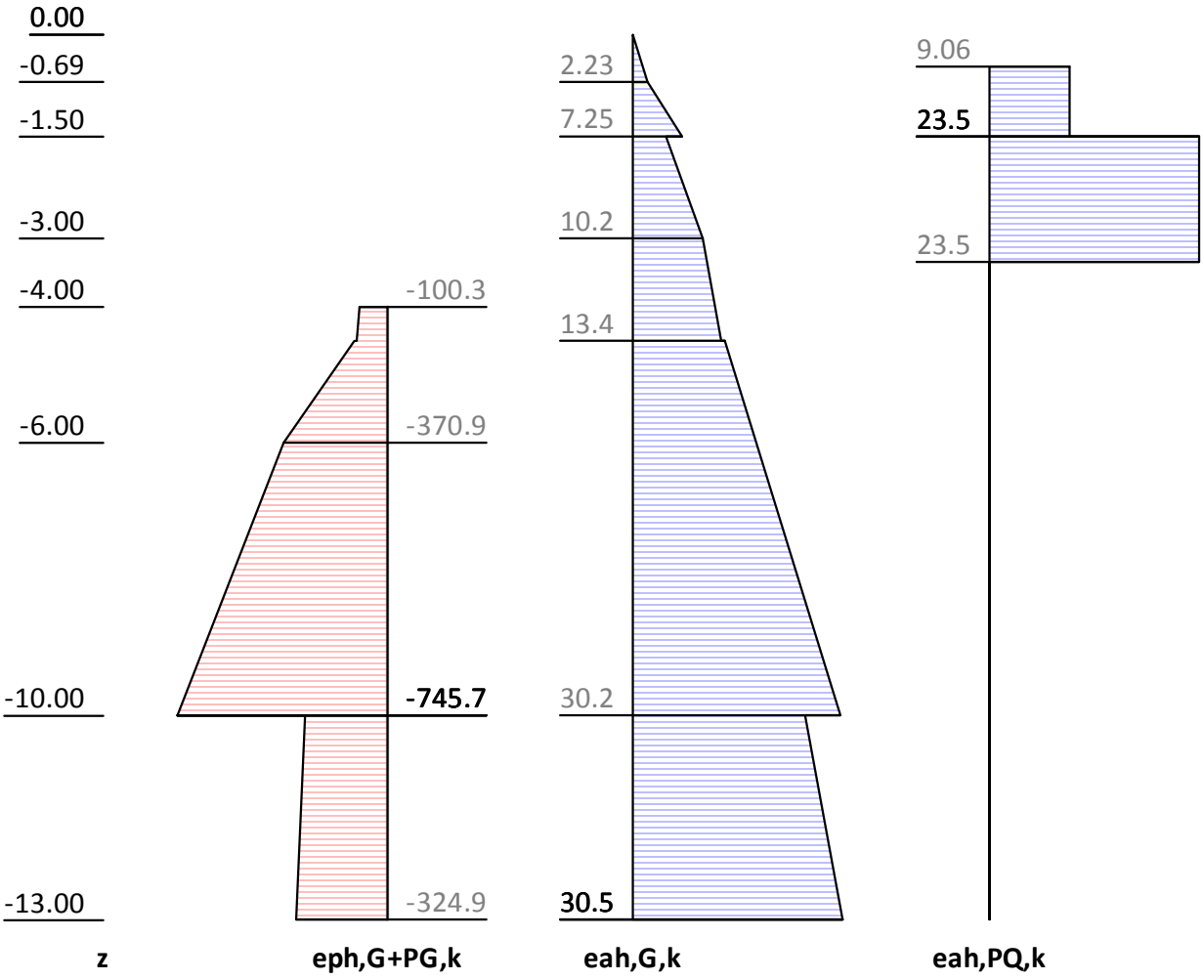
Μήκος τοίχου

Foot depth for statics: zf = -13.000

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall



z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.47		1.52	0.00	2.04
-0.47		1.52	9.06	15.62
-1.50		7.25	9.06	23.37
-1.50		4.82	23.48	41.73
-3.34		10.79	23.48	49.78
-3.34		10.79	0.00	14.56
-4.00	-0.00	11.97	0.00	16.15
-4.00	-100.29	11.97	0.00	16.15
-4.50	-110.34	12.86	0.00	17.36
-4.50	-117.95	13.38	0.00	18.06
-10.00	-745.71	30.24	0.00	40.82
-10.00	-294.76	25.14	0.00	33.93
-13.00	-324.89	30.49	0.00	41.17

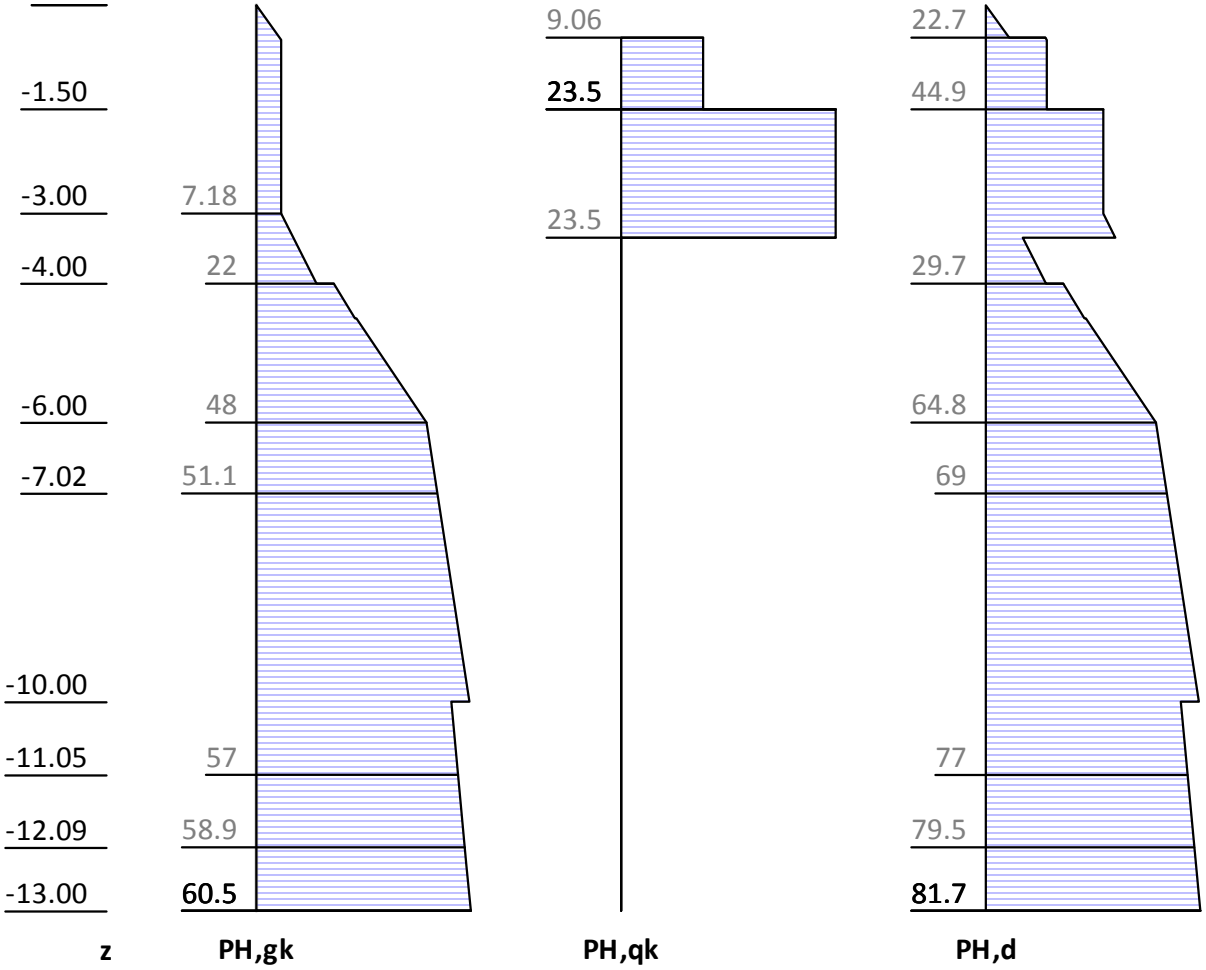
Eph,G,k:-3582.08, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 236.52, Eah,PG,k: 0.00, Eah,PQ,k: 52.53, Eah,d: 398.10

Πίεση νερού

z [m]	Wp,k [kN/m2]	Wa,k [kN/m2]	W,k [kN/m2]
-3.00		0.00	0.00
-6.00	0.00	30.00	30.00
-6.24	-2.40	32.40	30.00
-13.00	-70.00	100.00	30.00

H-pressure on static system

Level of mobilization: Ep,gk 100.0, Ep,qk 100.0, Ep,d 100.0 [%]

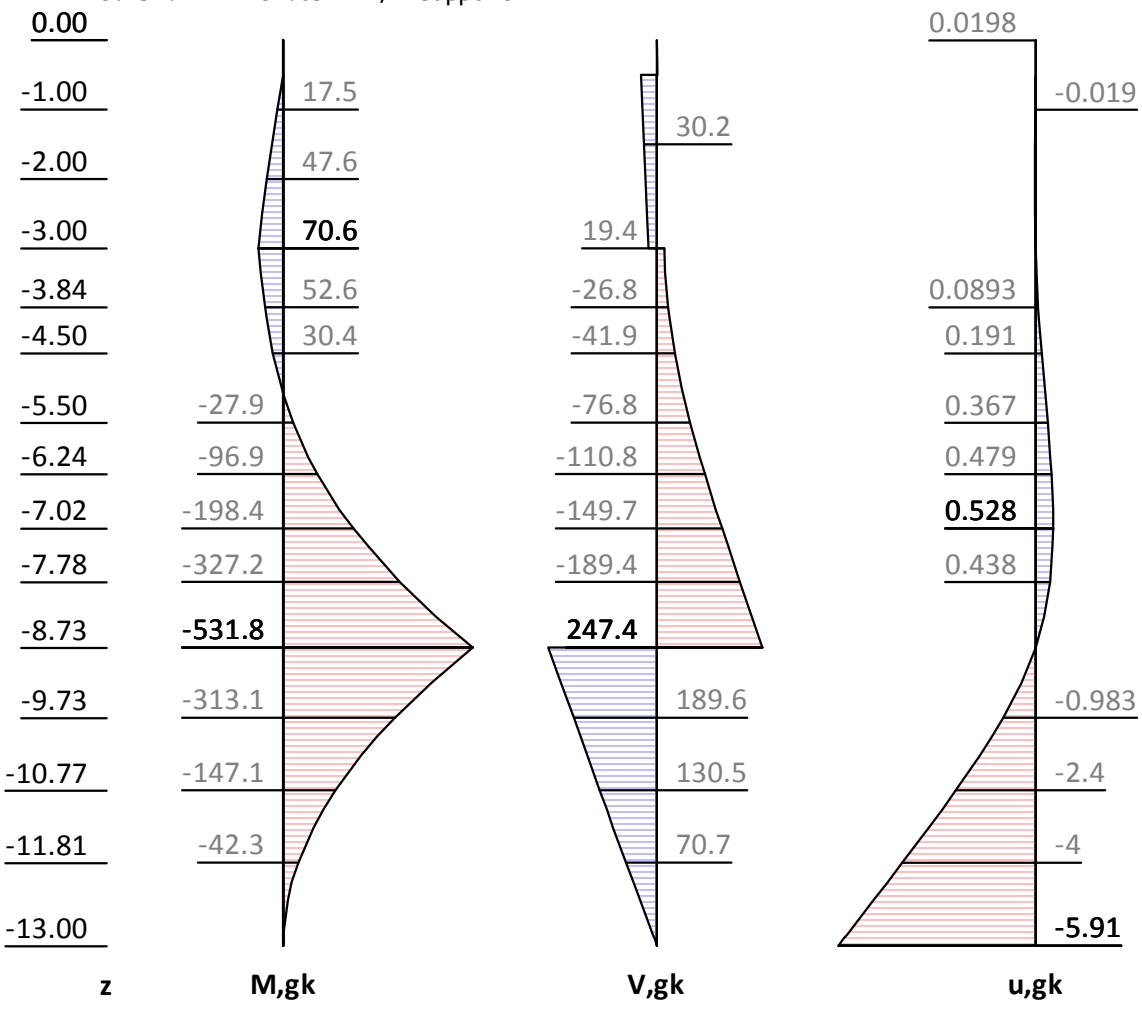


z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	0.00		0.00
-0.47	6.75	0.00	9.11
-0.47	6.75	9.06	22.69
-1.50	7.18	9.06	23.28
-1.50	7.18	23.48	44.91
-3.34	10.58	23.48	49.50
-3.34	10.58	0.00	14.28
-4.00	17.18	0.00	23.19
-4.00	21.97	0.00	29.65
-4.50	27.86	0.00	37.61
-4.50	28.38	0.00	38.31
-10.00	60.24	0.00	81.32
-10.00	55.14	0.00	74.43
-13.00	60.49	0.00	81.67

V-pressure on static system

Internal forces: Permanent, characteristically

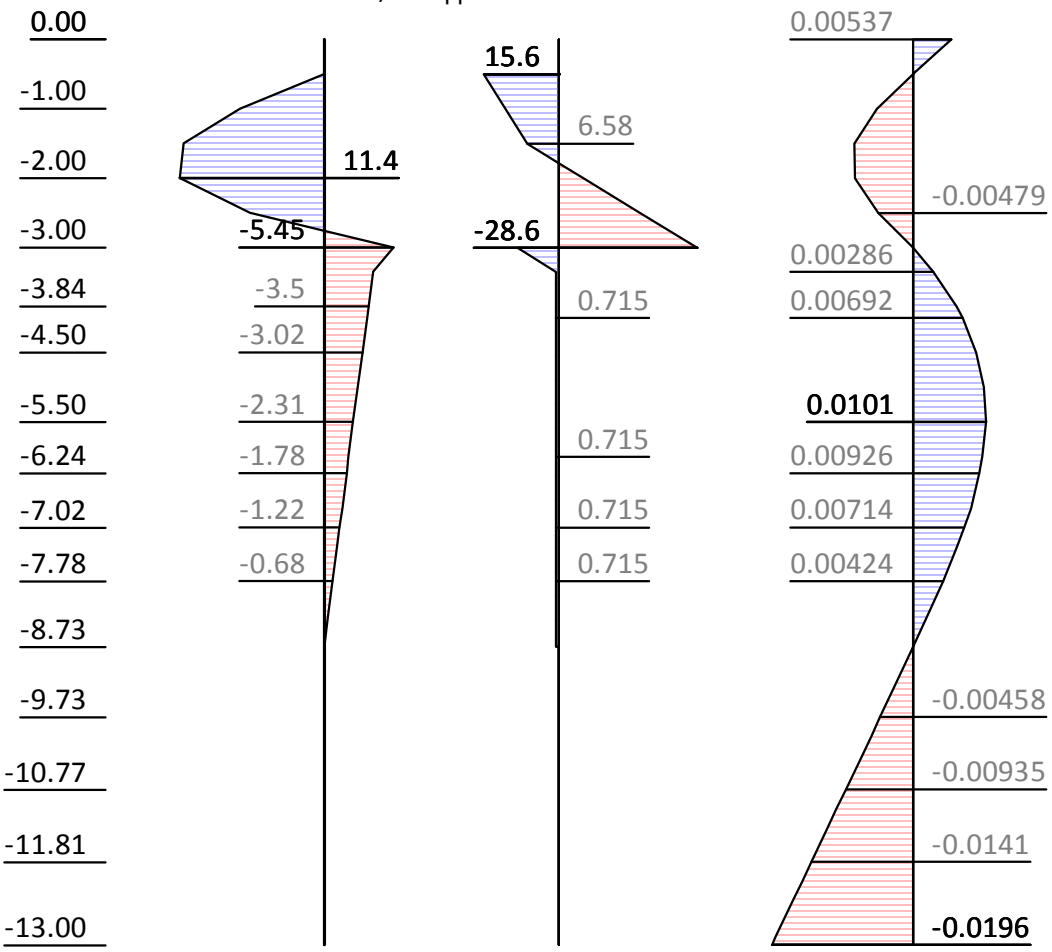
z= -0.500. Fx= -39.142 kN/m Support
z= -3.000. Fx= 36.675 kN/m Support
z= -8.731. Fx=-489.052 kN/m Support



z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	0.00	0.00	0.00	0.00	0.02
-0.50	7.18	-0.30	-1.79	-10.59	-0.00
-0.51	7.18	-0.00	37.29	-21.26	-0.00
-2.00	7.18	47.65	26.58	-53.14	-0.04
-3.00	7.18	70.64	19.40	-74.52	0.00
-3.00	7.18	70.64	-17.27	-64.69	0.00
-4.00	17.18	48.11	-29.45	-86.07	0.11
-4.00	21.97	48.11	-29.45	-86.07	0.11
-4.50	27.86	30.39	-41.91	-96.57	0.19
-4.50	28.38	30.39	-41.91	-96.57	0.19
-5.08	36.00	-0.00	-60.93	-107.31	0.29
-7.02	51.10	-198.40	-149.71	-145.88	0.53
-8.73	56.35	-531.83	-241.61	-183.84	0.00
-8.73	56.35	-531.83	247.44	-183.84	0.00
-10.00	60.24	-264.19	173.45	-214.34	-1.32
-10.00	55.14	-264.19	173.45	-214.34	-1.32
-13.00	60.49	-0.00	0.00	-252.24	-5.91
-13.00	60.49	0.00	-0.00	-252.24	-5.91

Internal forces: Variable, characteristically

Method EB 82-4 (Q = [G+Q] - G).
z= -0.500. Fx= -15.903 kN/m Support
z= -3.000. Fx= -37.344 kN/m Support
z= -8.731. Fx= 0.715 kN/m Support

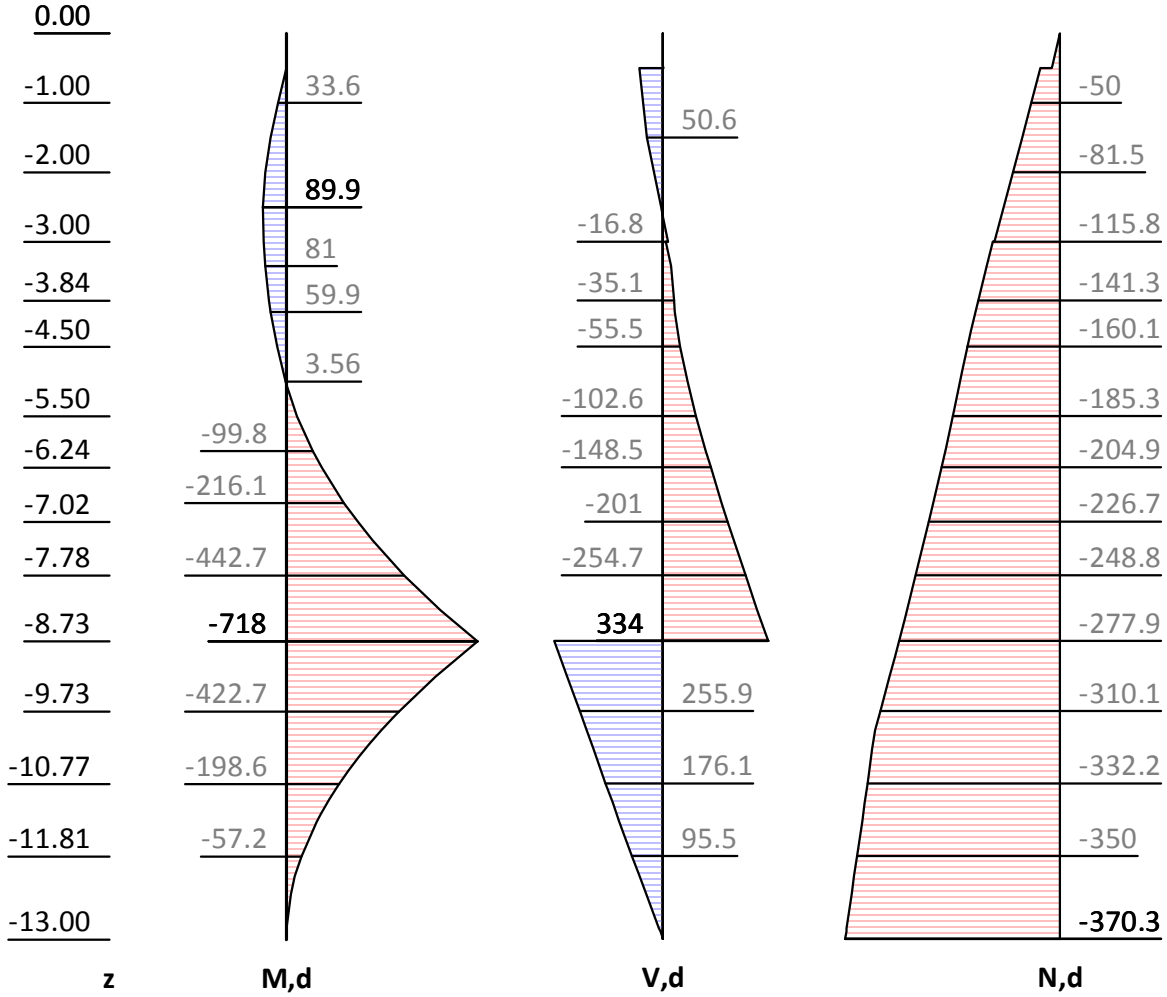


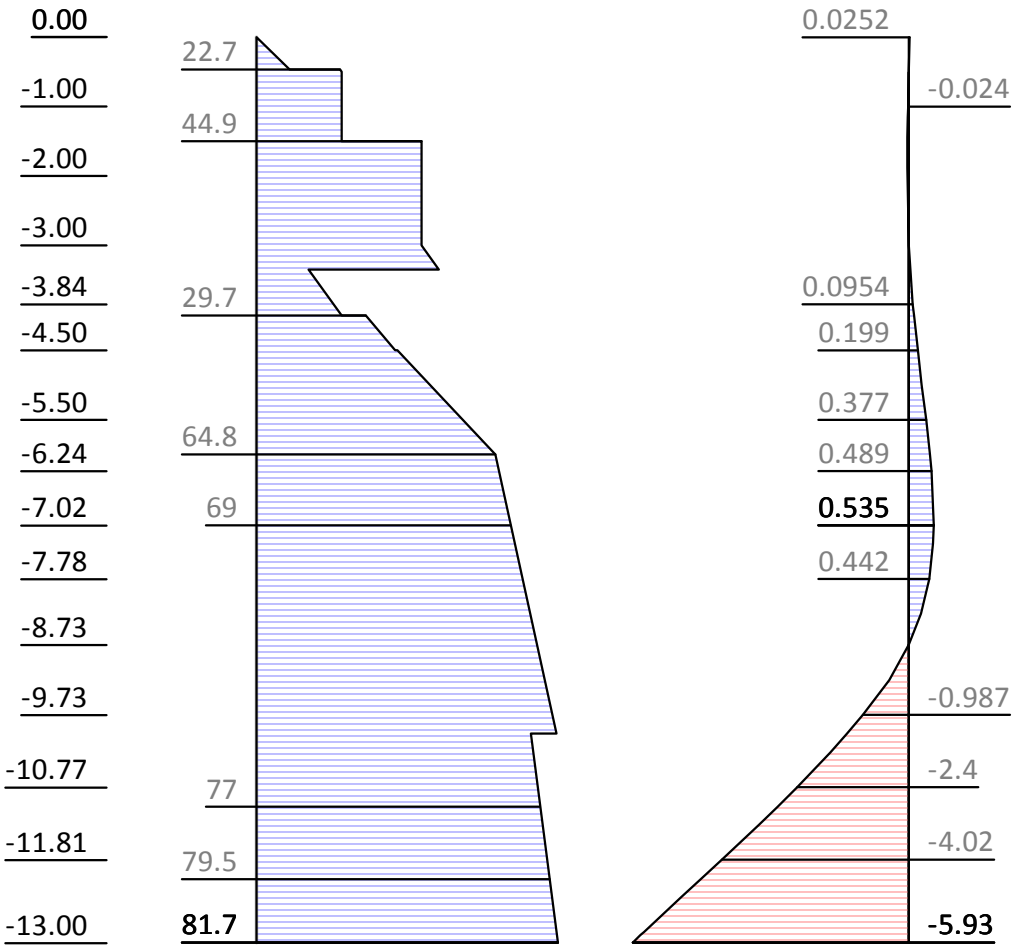
z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00	-0.00	-0.00	0.01
-0.00		0.00	0.00	0.00	0.01
-0.47	0.00	0.03	0.10	0.01	0.00
-0.47	9.06	0.03	0.10	0.01	0.00
-0.48	9.06	0.02	-0.00	-0.00	0.00
-0.50	9.06	-0.00	-0.23	-0.02	0.00
-0.50	9.06	0.00	15.63	-4.29	-0.00
-1.50	9.06	11.10	6.58	-5.25	-0.01
-1.50	23.48	11.10	6.58	-5.25	-0.01
-1.78	23.48	11.29	0.00	-5.94	-0.01
-2.00	23.48	11.43	-5.17	-6.49	-0.01
-2.76	23.48	0.00	-23.01	-8.38	-0.00
-3.00	23.48	-5.45	-28.65	-8.97	-0.00
-3.00	23.48	-5.45	8.70	-18.98	-0.00
-3.00	23.48	-5.45	8.70	-18.98	0.00
-3.34	23.48	-3.85	0.71	-19.82	0.00
-3.34	0.00	-3.85	0.71	-19.82	0.00
-4.00	0.00	-3.38	0.71	-19.82	0.01
-5.50	0.00	-2.31	0.71	-19.82	0.01
-6.00	0.00	-1.95	0.71	-19.82	0.01
-6.24	0.00	-1.78	0.71	-19.82	0.01

z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
-8.73	0.00	0.00	0.71	-19.82	0.00
-8.73	0.00	0.00	-0.00	-19.82	0.00
-11.81	0.00	0.00	-0.00	-19.82	-0.01
-12.35	0.00	0.00	-0.00	-19.82	-0.02
-12.90	0.00	0.00	-0.00	-19.82	-0.02
-12.90	0.00	-0.00	-0.00	-19.82	-0.02
-12.93	0.00	0.00	-0.00	-19.82	-0.02
-13.00	0.00	-0.00	-0.00	-19.82	-0.02

Internal forces: Design

z= -0.500. Fx= -76.697 kN/m Support
z= -3.000. Fx= -6.504 kN/m Support
z= -8.731. Fx=-659.148 kN/m Support





z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	0.00	0.00	-0.00	-0.00	0.03
-0.47	9.11	-0.34	-2.14	-13.44	0.00
-0.47	22.69	-0.34	-2.14	-13.44	0.00
-0.50	23.28	-0.41	-2.83	-14.34	-0.00
-0.51	23.28	-0.00	73.73	-35.08	-0.00
-1.50	23.28	61.82	50.59	-65.19	-0.04
-1.50	44.91	61.82	50.59	-65.19	-0.04
-2.00	44.91	81.47	28.14	-81.48	-0.05
-2.50	44.91	89.93	5.68	-97.77	-0.03
-2.63	44.91	89.23	-0.00	-101.89	-0.02
-3.00	44.91	87.18	-16.78	-114.06	-0.00
-3.00	44.91	87.18	-10.27	-115.80	-0.00
-3.00	44.91	87.18	-10.27	-115.80	0.00
-3.34	49.50	81.01	-26.32	-126.88	0.03
-3.34	14.28	81.01	-26.32	-126.88	0.03
-4.00	23.19	59.88	-38.69	-145.93	0.12
-4.00	29.65	59.88	-38.69	-145.93	0.12
-4.50	37.61	36.50	-55.50	-160.11	0.20
-4.50	38.31	36.50	-55.50	-160.11	0.20
-5.04	47.83	-0.00	-78.93	-173.49	0.29
-7.02	68.99	-269.68	-201.03	-226.68	0.54
-8.73	76.07	-717.97	-325.11	-277.91	0.00
-8.73	76.07	-717.97	334.04	-277.91	0.00
-10.00	81.32	-356.65	234.15	-319.09	-1.33
-10.00	74.43	-356.65	234.15	-319.09	-1.33
-13.00	81.67	-0.00	0.00	-370.26	-5.93
-13.00	81.67	-0.00	-0.00	-370.26	-5.93

Anchor forces with safety level of DS-P

z[m]	A,d[kN]	Fx,d[kN/m]
-0.50	142.9	-76.7
-3.00	6.1	-6.5

Checks of earth statics

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -8.73 m
Rd = Eph,k/γ,Re = 3582.08 / 1.400 = 2558.63 [kN/m]

Ed(Uh,d)/Rd = 659.15 / 2558.63 = 0.258 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-13.00

Pos.	H	V
H/V pressure G+P+W,k	491.52	49.97
Wall weight		201.61
H/V pressure passive		0.00
Support z: -0.50	-39.14	10.49
Support z: -3.00	36.67	-9.83
Bh,g,k z=-8.73	-489.05	
Bv,g,k = Bh,k * tan(δ,p=-22.00°)		-197.59
Σ	-0.00	54.65 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.

Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1
Vertical component of earth resistance is less than
the downwards pointing vertical forces.

Vk >= Bvk: 252.24 >= 197.59 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-13.00

Pos.	H	V
H/V pressure G+P+W,k	544.05	55.52
Wall weight		201.61
H/V pressure passive		0.00
Support z: -0.50	-55.05	14.75
Support z: -3.00	-0.67	0.18
Bh,g,k z=-8.73	-489.05	
Bv,g,k = Bh,k * tan(δ,p=-22.00°)		-197.59
Bh,q,k z=-8.73	0.71	
Bv,q,k = Bh,k * tan(δ,p=-22.00°)		0.29
Σ	-0.00	74.76 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.

Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1
Vertical component of earth resistance is less than
the downwards pointing vertical forces.

Vk >= Bvk: 272.06 >= 197.30 Passes requirement

Anchor verification

Anchor - Stability of lower failure plane

Περίπτ.Φόρτισης: όλα τα φορτία BS-P
Αυτόμ. υπολογ. μήκους αγκυρίων:
All anchors are extended (if necessary)
Favourable variable loads in main failure body are not being considered.
Bottom of lower failure plane: z=-13.00 m

Iteration of failure mechanisms:
lA .....: Length of anchor from head to center of grout body.
W,k .....: Res. force from dead weight, loads, cohesion, ...
Q,k .....: Force in lower failure plane.
Ea1,k.....: Earth pressure onto vertical separation plane.
Ea2,k.....: Earth pressure between wall and main failure body.
Ra_cal,d ...: Dimesioning force of the resistance from the equilibrium of forces. Ra_cal,d corresponds to the max. possible anchor force of the force polygon.
Sum(A,d) ...: Acting anchor forces along the grout body fractions within the failure body. Sum(A,d) is gained from the anchor pull forces of the wall analysis.

z [m]	ϑ1 [°]	ϑ2 [°]	lA [m]	W,k [kN/m]	Q,k [kN/m]	Ea1,k [kN/m]	Ea2,k [kN/m]	Ra_cal,d [kN/m]	Sum(A,d) [kN/m]	Ed/Rd [-]
-0.50	53.0	57.5	8.12	627.9	477.6	4.4	294.3	248.2	86.1	0.35
-3.00	52.9	59.0	6.52	594.7	472.6	7.4	294.3	214.3	81.0	0.38

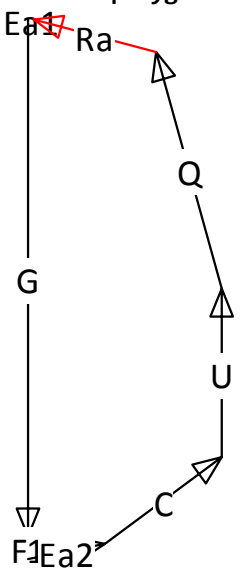
Decisive failure body:
Γεωμετρία:

Foot point of lower failure plane	x/z =	0.01/-13.00 m
Intersection lower/upper slid. plane	x/z =	6.29/ -4.69 m
Intersection upper slid. plane/surface	x/z =	9.11/ 0.00 m
Intersection separation plane/surface	x/z =	6.29/ 0.00 m
Inclination lower failure plane	ϑ1 =	52.92°
Inclination upper failure plane	ϑ2 =	59.03°
Inclination separation plane	ϑ12 =	90.00°

Loads / forces (char.)

		Fx [kN/m]	Fz [kN/m]	F [kN/m]	
Weight of main failure body	G,k:	0.0	-1152.2	1152.2	
Area loads on/in main failure body	F1,k:	0.0	-82.5	82.5	
Cohesion of lower failure plane	C,k:	246.8	326.6	409.4	
Pore water pressure on main body	U,k:	0.0	367.2	367.2	
Earth pres. on separation plane	Ea1,k:	-7.4	-0.0	7.4	δ= 0.0°
Earth pr. between wall<->main body	Ea2,k:	289.1	55.5	294.3	
Force in lower failure plane	Q,k:	-238.7	407.8	472.6	
Sum = possible anchor forces:	Ra_cal,k:	289.8	-77.7	300.0	

Force polygon



Acting anchor forces Ed: Sum(A,d) = 81.0 kN/m
Possible anchor forces Rd: Ra_cal,d = 300.0/1.400 = 214.3 kN/m
Verif. of lower failure plane Ed/Rd = 0.38 < 1.0: Έλεγχος εκπληρώθηκε.

Check of steel tension

l,tot ...[m]: Total length of anchor incl. excess length at head
As ....[mm2]: X-section are of steel member
Ri,d ...[kN]: Ultimate strength of tension member (γ,M=1.15)
A,d ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	l,tot	As	Ri,d		A,d	
-0.50	Strand;3x0.60";1570/1770	12.12	420	573.4	>	142.9	Passes requirement
-3.00	Strand;3x0.60";1570/1770	10.52	420	573.4	>	6.1	Passes requirement

Check of steel tension: Passes requirement

Check of anchor's soil friction

lVk .....: Length of grout body
DmVk ....: Diameter of grout body
τGr,k ...: Average applied skin friction along the grout body (from soil parameters)
Ra,k ....: Charact. pullout resistance of the anchor
γA .....: Partial safety factor of anchor pullout
Ra,d ....: = Ra,k / γA
A,d .....: Dimensioning force of the anchor from wall analysis

z [m]	lVk [m]	DmVk [mm]	τGr,k [kN/m²]	Ra,k [kN]	γA [-]	Ra,d [kN]		A,d [kN]	A,d/Ra,d [-]
-0.50	8.00	318	110	879.1	1.100	799.2	>	142.9	0.2
-3.00	8.00	318	110	879.1	1.100	799.2	>	6.1	0.0

Check of anchor's soil friction: Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)
Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (-0.85, 0.12), Ακτίνα = 13.15
Αρχ.σημ.= (-13.34, -4.00), Τελ.σημ. = (12.31, 0.00)

Γεωμετρία λωρίδων:

No	x [m]	Width b [m]	dxM [m]	Weight [kN/m]	Load z-κατ. [kN/m]	Water-φορτ. [kN/m]	u*b [kN/m]	φ [°]	c [kN/m²]	θ [°]
1	-12.68	1.32	-11.84	46.4	0.0	0.0	-5.4	27.45	3.57	-31.27*
2	-11.37	1.32	-10.52	110.2	0.0	0.0	-22.4	27.45	3.57	-31.27*
3	-10.05	1.32	-9.20	154.6	0.0	0.0	-42.5	27.45	3.57	-31.27*
4	-8.74	1.32	-7.89	186.7	0.0	0.0	-57.6	0.08	71.43	-36.85
5	-7.42	1.32	-6.57	209.5	0.0	0.0	-69.1	0.08	71.43	-29.98
6	-6.11	1.32	-5.26	227.0	0.0	0.0	-77.9	0.08	71.43	-23.56
7	-4.79	1.32	-3.94	239.9	0.0	0.0	-84.4	0.08	71.43	-17.44
8	-3.47	1.32	-2.63	248.9	0.0	0.0	-88.8	0.08	71.43	-11.52
9	-2.16	1.32	-1.31	254.1	0.0	0.0	-91.5	0.08	71.43	-5.73
10	-0.84	1.32	0.00	255.8	0.0	0.0	-92.4	0.08	71.43	0.01
11	0.47	1.32	1.32	341.0	5.5	0.0	-111.2	0.08	71.43	5.75
12	1.79	1.32	2.63	350.1	56.4	0.0	-128.3	0.08	71.43	11.55
13	3.10	1.32	3.95	341.2	45.3	0.0	-123.8	0.08	71.43	17.47
14	4.42	1.32	5.26	328.2	0.0	0.0	-117.3	0.08	71.43	23.59
15	5.73	1.32	6.58	310.7	0.0	0.0	-108.5	0.08	71.43	30.02
16	7.05	1.32	7.90	287.9	0.0	0.0	-97.0	0.08	71.43	36.89
17	8.36	1.32	9.21	255.7	0.0	0.0	-81.9	27.45	3.57	44.45
18	9.68	1.32	10.53	211.3	0.0	0.0	-61.7	27.45	3.57	53.15
19	11.32	1.97	12.17	188.1	0.0	0.0	-37.5	27.45	3.57	67.68

*** Σημείωση: Στις λωρίδες σημειωμένες με '*'
περιορίστηκε το theta στο 45°-Phi/2.

Συνεισφ. κατακόρυφων φορτίων:

No	Weight [kN/m]	G*sin(θ) [kN/m]	(G-u*b)*tan(φ) + c*b [kN/m]	μ*sin(θ)* tan(φ)+cos(θ) [-]	T [kN/m]
1	46.40	-41.75	26.01	0.781050	33.30
2	110.22	-88.15	50.33	0.781050	64.44
3	154.63	-108.20	62.93	0.781050	80.57
4	186.69	-111.97	94.14	0.799945	117.68
5	209.52	-104.71	94.15	0.865969	108.72
6	226.98	-90.74	94.16	0.916464	102.75
7	239.92	-71.92	94.17	0.953898	98.72
8	248.86	-49.71	94.18	0.979767	96.12
9	254.11	-25.35	94.18	0.994973	94.66
10	255.84	0.06	94.18	1.000000	94.18
11	346.59	34.74	94.28	0.995002	94.76
12	406.54	81.40	94.34	0.979825	96.29
13	386.43	116.02	94.32	0.953981	98.87
14	328.20	131.35	94.25	0.916566	102.83
15	310.71	155.43	94.24	0.866082	108.81
16	287.85	172.78	94.22	0.800055	117.77
17	255.74	179.07	94.99	0.813259	116.81
18	211.27	169.06	82.38	0.713221	115.50
19	188.11	174.02	85.28	0.510978	166.90
		521.43			1909.69

Δράση Ed = (521.4*13.15)
Αντίσταση Rd = (1909.7*13.15 +0.0)

SLIP-CIRCLE μ = Ed/Rd = 0.27 < 1.0: Έλεγχος εκπληρώθηκε.

Φάση εκσκαφής 5 "[5] Situation 5"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 5 Στρώσεις

Name		Τεχνητές επιχωματώσεις	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
γ	[kN/m3]	18	20	22.5
γ,R	[kN/m3]	18	20	22.5
γ'	[kN/m3]	8	10	12.5
γ,p	[kN/m3]	18	20	22.5
γ,R,passive	[kN/m3]	18	20	22.5
γ,pw	[kN/m3]	8	10	12.5
φ	[°]	25	0.1	33
c	[kN/m2]	2	50	5
c,u	[kN/m2]	10	50	5
c παθητικό	[kN/m2]	2	50	5
δ,a	[°]	16.66667	0.06666667	22
δ,p	[°]	-16.66667	-0.06666667	-22
δ,c	[°]	8.333333	0.03333333	11
k,agh	[-]	0.3456501	0.9955057	0.2452023
K,ach	[-]	1.043051	1.994195	0.8549058
K,0h	[-]	0.5773817	0.9982547	0.455361
K,pgh	[-]	3.908103	1.004519	7.495617
K,pch	[-]	5.180327	2.00583	8.599509
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	10e-06	5.5e-09	100e-06

Name		Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20	22.5
γ,R	[kN/m3]	20	22.5
γ'	[kN/m3]	10	12.5
γ,p	[kN/m3]	20	22.5
γ,R,passive	[kN/m3]	20	22.5
γ,pw	[kN/m3]	10	12.5
φ	[°]	0.1	35
c	[kN/m2]	100	5
c,u	[kN/m2]	100	5
c παθητικό	[kN/m2]	100	5
δ,a	[°]	0.06666667	23.33333
δ,p	[°]	-0.06666667	-23.33333
δ,c	[°]	0.03333333	11.66667
k,agh	[-]	0.9955057	0.2244207
K,ach	[-]	1.994195	0.8126539
K,0h	[-]	0.9982547	0.4264236
K,pgh	[-]	1.004519	9.146943
K,pch	[-]	2.00583	10.104
τ,gr	[kN/m2]	110	110
Ψ,A,max	[°]	90	90
k	[cm/s]	5.5e-09	100e-06

Πορεία πρανούς:
x [m] 0.00 0.00
z [m] -8.15 0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
x [m] 0.00 0.00
z [m] -8.15 -1.50

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:
x [m] 0.00 0.00
z [m] -8.15 -4.50

Πορεία ανώτερου 4. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
z= -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -14.00

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
1.00	0.00	3.50	0.00	0.00	33.00	0.00	33.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Στάθμη νερού:

x [m] 0.00 0.00
z [m] -11.00 -3.00

Αγκύρια

z[m]	min.l[m]	Alpha[°]	C-H[kN/m]	P0[kN]	u0[m]
-0.50	0.00	15.00	0.00	0.00	0.0000
-3.00	0.00	15.00	αόριστ.	0.00	0.0000

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Ενεργές ωθήσεις.
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: Trapezoid.
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
Levels of redistribution Z1: 0.000, Z2: -3.000 [m].
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Κλασικός, Pregl/Sokolovsky (DIN 4085).

Options for water pressure

Στήριξη πόδα

Πόδας οριζοντίως μετακινούμενος

Αγκύρια

Anchor checks (lower failure plane): Ναι
Anchor forces with safety level of DS-P: Ναι
Verification of grout body pull out forces: Ναι
δ,a,Anchoring wall : used from soil layer.
δ,p,Anchoring wall : used from soil layer.

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	Αμμώδης ΑΡΓΙΛΟΣ
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

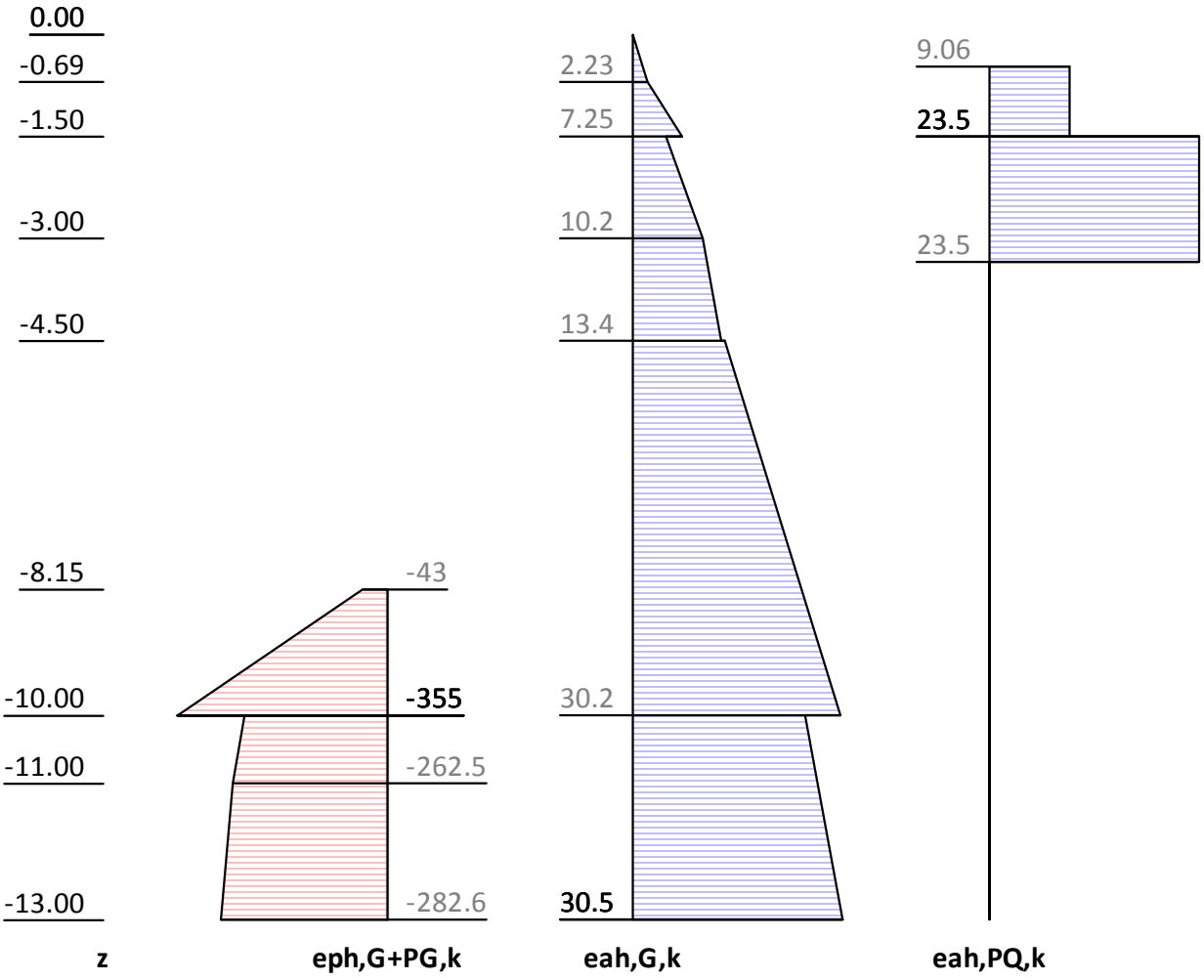
Μήκος τοίχου

Foot depth for statics: zf = -13.000

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall



z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.47		1.52	0.00	2.04
-0.47		1.52	9.06	15.62
-1.50		7.25	9.06	23.37
-1.50		4.82	23.48	41.73
-3.34		10.79	23.48	49.78
-3.34		10.79	0.00	14.56
-4.50		12.86	0.00	17.36
-4.50		13.38	0.00	18.06
-8.15	-0.00	24.57	0.00	33.17
-8.15	-43.00	24.57	0.00	33.17
-10.00	-355.00	30.24	0.00	40.82
-10.00	-242.40	25.14	0.00	33.93
-13.00	-282.58	30.49	0.00	41.17

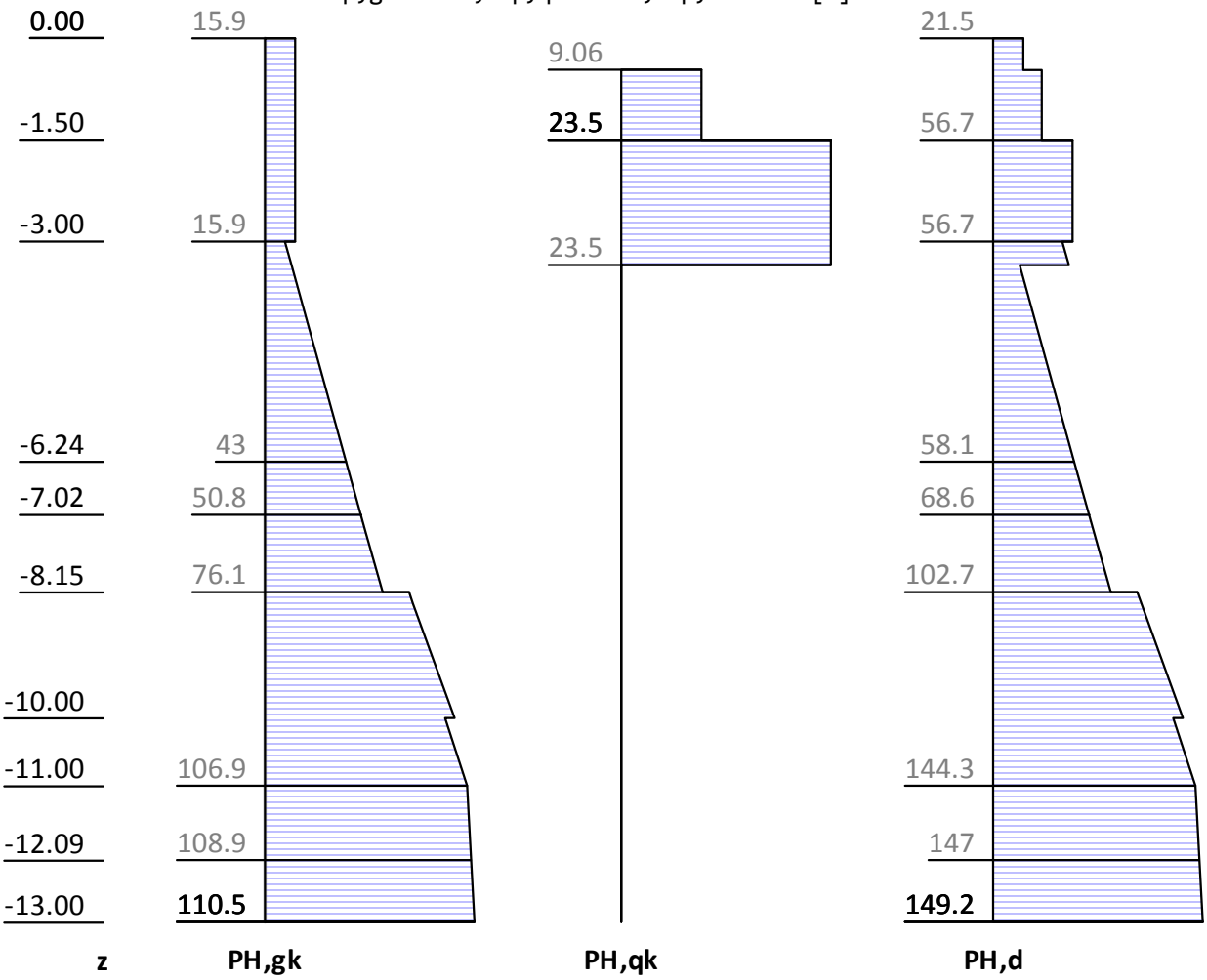
Eph,G,k:-1165.65, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 236.52, Eah,PG,k: 0.00, Eah,PQ,k: 52.53, Eah,d: 398.10

Πίεση νερού

z [m]	Wp,k [kN/m2]	Wa,k [kN/m2]	W,k [kN/m2]
-3.00		0.00	0.00
-11.00	0.00	80.00	80.00
-13.00	-20.00	100.00	80.00

H-pressure on static system

Level of mobilization: Ep,gk 100.0, Ep,qk 100.0, Ep,d 100.0 [%]

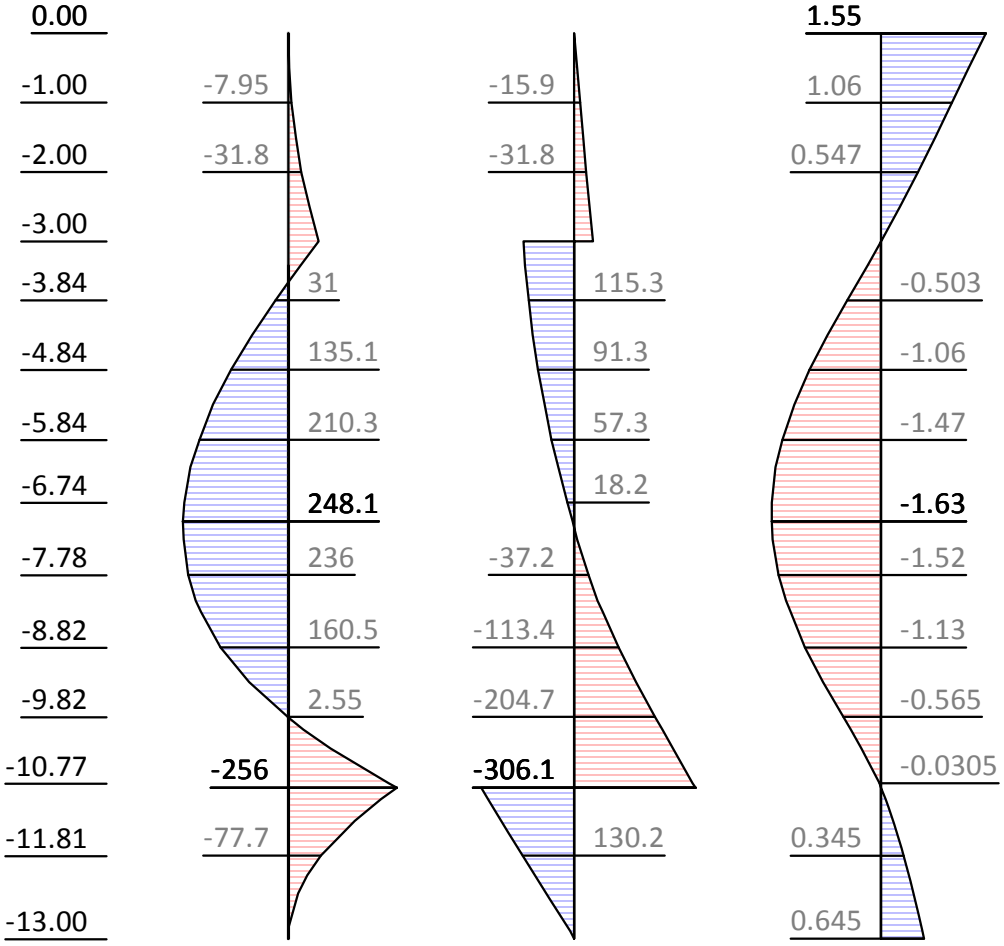


z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	15.91		21.48
-0.47	15.91	0.00	21.48
-0.47	15.91	9.06	35.06
-1.50	15.91	9.06	35.06
-1.50	15.91	23.48	56.70
-3.00	15.91	23.48	56.70
-3.00	10.61	23.48	49.55
-3.34	14.01	23.48	54.14
-3.34	14.01	0.00	18.92
-8.15	62.11	0.00	83.85
-8.15	76.07	0.00	102.69
-10.00	100.24	0.00	135.32
-10.00	95.14	0.00	128.43
-13.00	110.49	0.00	149.17

V-pressure on static system

Internal forces: Permanent, characteristically

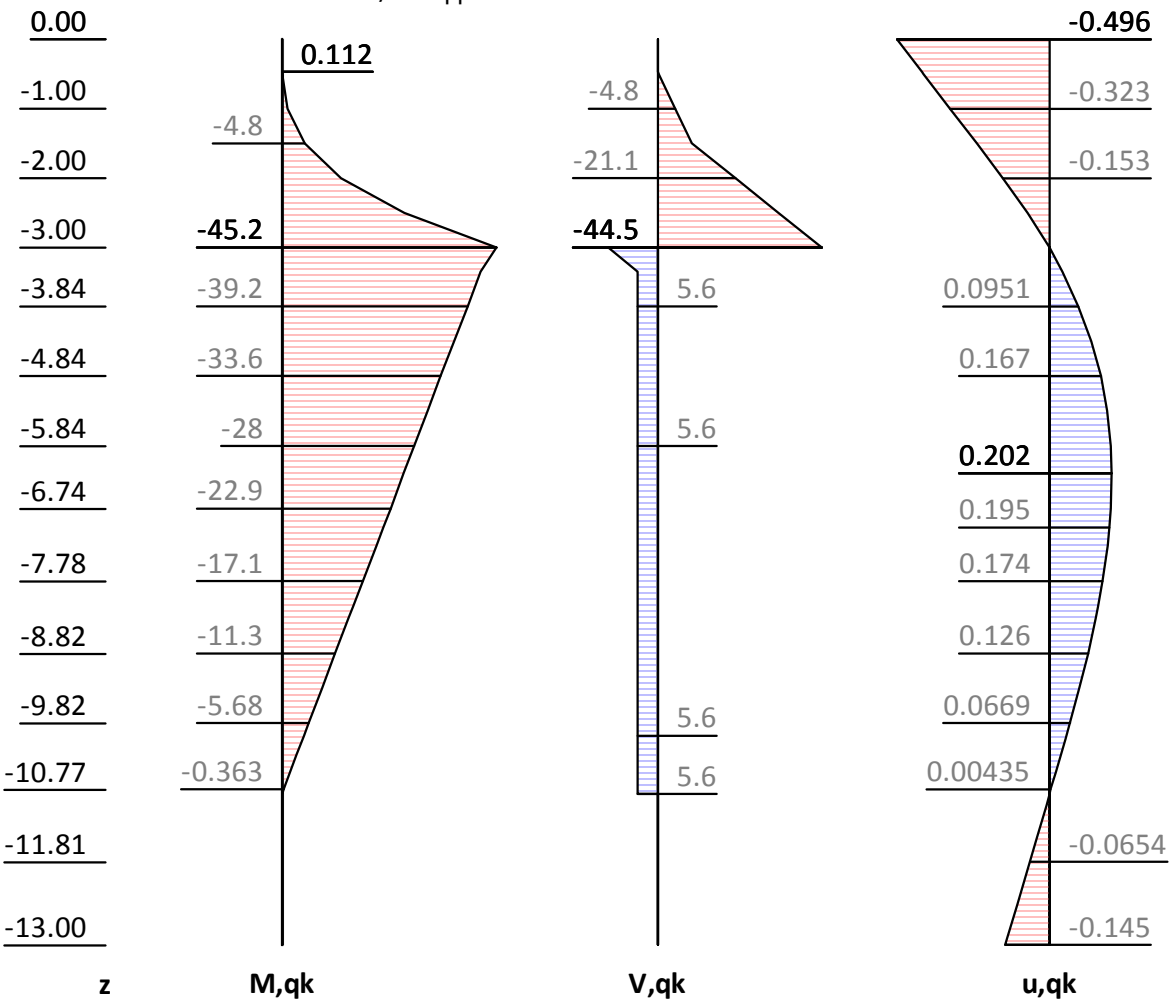
z= -0.500. Fx= -0.000 kN/m Support
z= -3.000. Fx=-175.514 kN/m Support
z= -10.835. Fx=-541.005 kN/m Support



z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	15.91	-0.00	-0.00	0.00	1.55
-3.00	15.91	-71.59	-47.73	-76.70	-0.00
-3.00	10.61	-71.59	127.79	-123.73	-0.00
-3.58	16.42	0.00	119.61	-137.70	-0.35
-7.02	50.81	248.09	4.33	-217.13	-1.63
-7.10	51.64	247.89	0.00	-218.42	-1.62
-8.15	62.11	218.13	-59.48	-234.81	-1.41
-8.15	76.07	218.13	-59.48	-234.81	-1.41
-9.83	98.04	-0.00	-205.92	-274.45	-0.56
-10.00	100.24	-35.85	-222.56	-278.60	-0.46
-10.00	95.14	-35.85	-222.56	-278.60	-0.46
-10.83	104.92	-255.96	-306.09	-289.14	0.00
-10.83	104.92	-255.96	234.91	-289.14	0.00
-13.00	110.49	-0.00	0.00	-316.50	0.65

Internal forces: Variable, characteristically

Method EB 82-4 (Q = [G+Q] - G).
z= -0.500. Fx= 0.000 kN/m Support
z= -3.000. Fx= -58.130 kN/m Support
z= -10.835. Fx= 5.597 kN/m Support

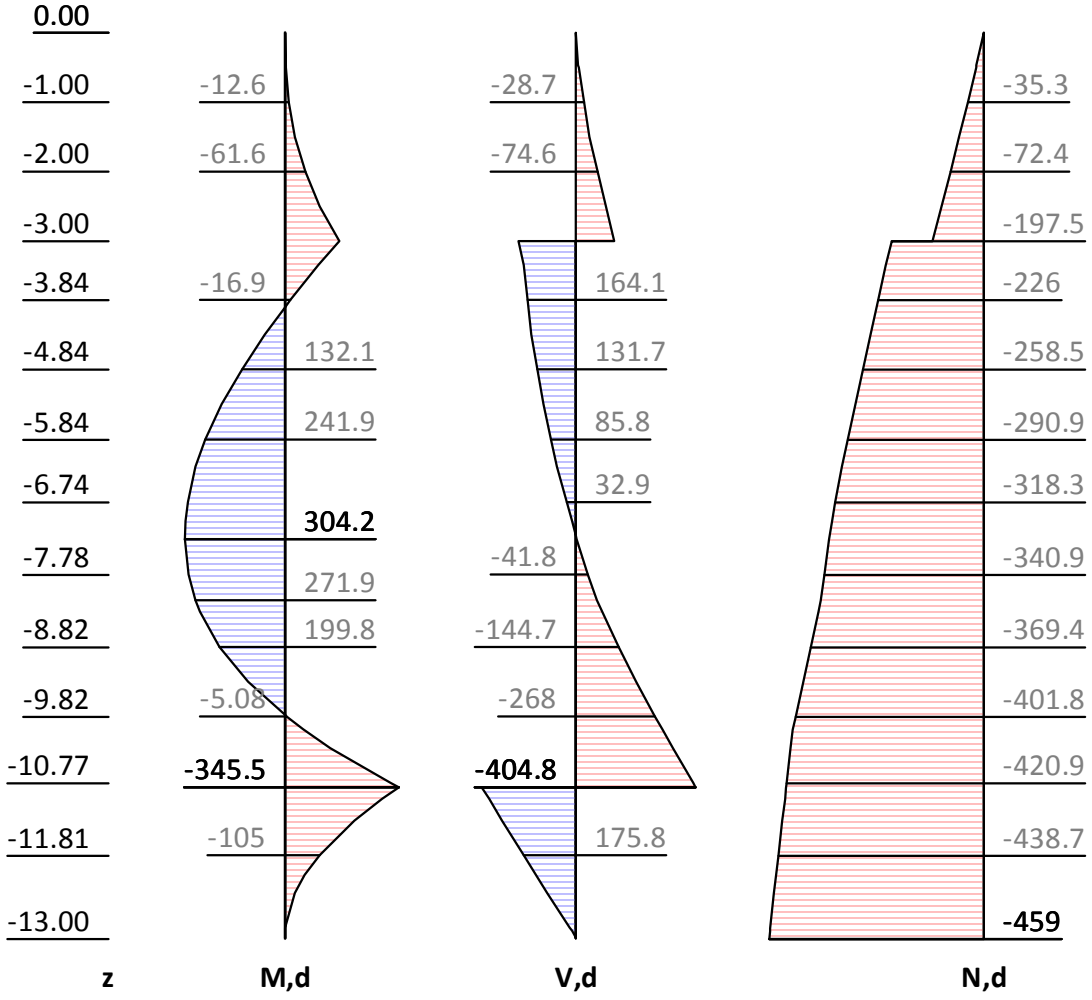


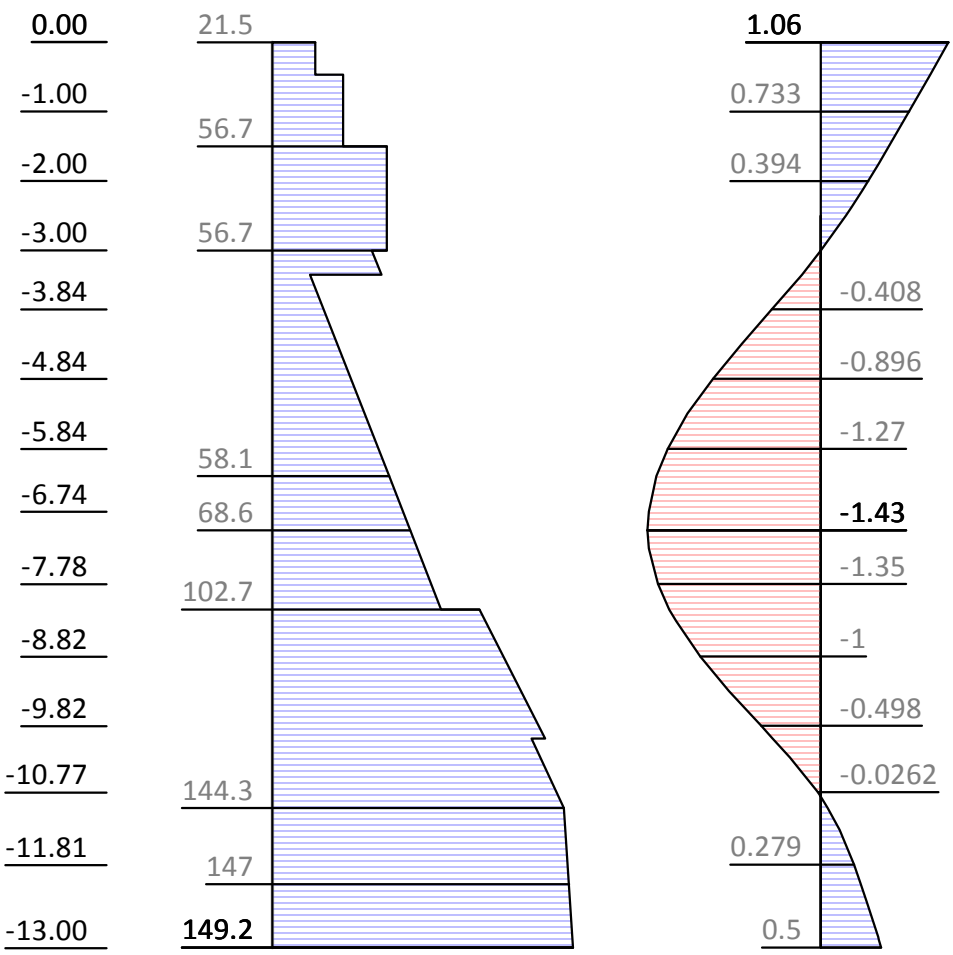
z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00	-0.00	-0.00	-0.50
-0.47	0.00	0.11	-0.00	-0.00	-0.41
-0.47	9.06	0.11	-0.00	0.00	-0.41
-0.50	9.06	-0.00	-0.26	-0.03	-0.41
-1.50	9.06	-4.80	-9.33	-0.99	-0.24
-1.50	23.48	-4.80	-9.33	-0.99	-0.24
-3.00	23.48	-45.21	-44.55	-4.71	-0.00
-3.00	23.48	-45.21	13.58	-20.29	-0.00
-3.34	23.48	-41.95	5.60	-21.13	0.04
-3.34	0.00	-41.95	5.60	-21.13	0.04
-5.84	0.00	-27.96	5.60	-21.13	0.20
-6.24	0.00	-25.72	5.60	-21.13	0.20
-7.02	0.00	-21.35	5.60	-21.13	0.20
-7.28	0.00	-19.90	5.60	-21.13	0.19
-8.15	0.00	-15.03	5.60	-21.13	0.16
-8.32	0.00	-14.08	5.60	-21.13	0.15
-9.82	0.00	-5.68	5.60	-21.13	0.07
-10.83	0.00	-0.00	5.60	-21.13	0.00
-10.83	0.00	-0.00	0.00	-21.13	0.00
-11.31	0.00	-0.00	0.00	-21.13	-0.03
-11.81	0.00	-0.00	0.00	-21.13	-0.07

z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
-12.35	0.00	-0.00	0.00	-21.13	-0.10
-12.71	0.00	-0.00	0.00	-21.13	-0.13
-12.90	0.00	0.00	0.00	-21.13	-0.14
-12.94	0.00	-0.00	-0.00	-21.13	-0.14
-13.00	0.00	-0.00	-0.00	-21.13	-0.15

Internal forces: Design

z= -0.500. Fx= -0.000 kN/m Support
z= -3.000. Fx=-324.139 kN/m Support
z= -10.835. Fx=-721.960 kN/m Support





z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	21.48	0.00	-0.00	0.00	1.06
-0.00	21.48	0.00	-0.00	-0.00	1.06
-0.47	21.48	-2.37	-10.09	-16.22	0.91
-0.47	35.06	-2.37	-10.09	-16.22	0.91
-1.50	35.06	-31.37	-46.21	-53.26	0.57
-1.50	56.70	-31.37	-46.21	-53.26	0.57
-3.00	56.70	-164.47	-131.26	-110.62	0.00
-3.00	56.70	-164.47	-131.26	-110.62	-0.00
-3.00	49.55	-164.47	192.88	-197.47	-0.00
-3.34	54.14	-101.84	175.26	-209.78	-0.16
-3.34	18.92	-101.84	175.26	-209.78	-0.16
-3.95	27.12	0.00	160.95	-229.50	-0.46
-7.02	68.60	302.89	14.24	-324.82	-1.43
-7.22	71.33	303.94	-0.00	-329.09	-1.43
-7.28	72.11	304.24	-4.06	-330.31	-1.42
-8.15	83.85	271.94	-71.90	-348.69	-1.25
-8.15	102.69	271.94	-71.90	-348.69	-1.25
-9.80	131.77	0.00	-265.24	-401.10	-0.51
-10.00	135.32	-55.41	-292.06	-407.81	-0.40
-10.00	128.43	-55.41	-292.06	-407.81	-0.40
-10.83	141.64	-345.55	-404.83	-422.04	0.00
-10.83	141.64	-345.55	317.13	-422.04	0.00
-13.00	149.17	-0.00	0.00	-458.97	0.50
-13.00	149.17	-0.00	-0.00	-458.97	0.50

Anchor forces with safety level of DS-P

z[m]	A,d[kN]	Fx,d[kN/m]
-0.50	0.0	-0.0
-3.00	302.0	-324.1

Checks of earth statics

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -10.83 m
Rd = Eph,k/γ,Re = 1165.65 / 1.400 = 832.61 [kN/m]

Ed(Uh,d)/Rd = 721.96 / 832.61 = 0.867 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-13.00

Pos.	H	V
H/V pressure G+P+W,k	716.52	49.97
Wall weight		222.61
H/V pressure passive		0.00
Support z: -0.50		0.00
Support z: -3.00	-175.51	47.03
Bh,g,k z=-10.83	-541.00	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.63
Σ	0.00	318.98 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.

Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1
Vertical component of earth resistance is less than the downwards pointing vertical forces.

Vk >= Bvk: 319.61 >= 0.63 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-13.00

Pos.	H	V
H/V pressure G+P+W,k	769.05	55.52
Wall weight		222.61
H/V pressure passive		0.00
Support z: -0.50		0.00
Support z: -3.00	-233.64	62.60
Bh,g,k z=-10.83	-541.00	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.63
Bh,q,k z=-10.83	5.60	
Bv,q,k = Bh,k * tan(δ,p=-0.07°)		0.01
Σ	-0.00	340.12 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.

Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1
Vertical component of earth resistance is less than the downwards pointing vertical forces.

Vk >= Bvk: 340.74 >= 0.62 Passes requirement

Anchor verification

Anchor - Stability of lower failure plane

Περίπτ.Φόρτισης: όλα τα φορτία BS-P
Αυτόμ. υπολογ. μήκους αγκυρίων:
All anchors are extended (if necessary)
Favourable variable loads in main failure body are not being considered.
Bottom of lower failure plane: z=-13.00 m

Iteration of failure mechanisms:
lA .....: Length of anchor from head to center of grout body.
W,k .....: Res. force from dead weight, loads, cohesion, ...
Q,k .....: Force in lower failure plane.
Ea1,k.....: Earth pressure onto vertical separation plane.
Ea2,k.....: Earth pressure between wall and main failure body.
Ra_cal,d ...: Dimesioning force of the resistance from the equilibrium of forces. Ra_cal,d corresponds to the max. possible anchor force of the force polygon.
Sum(A,d) ...: Acting anchor forces along the grout body fractions within the failure body. Sum(A,d) is gained from the anchor pull forces of the wall analysis.

z [m]	ϑ1 [°]	ϑ2 [°]	lA [m]	W,k [kN/m]	Q,k [kN/m]	Ea1,k [kN/m]	Ea2,k [kN/m]	Ra_cal,d [kN/m]	Sum(A,d) [kN/m]	Ed/Rd [-]
-0.50	42.7	57.5	10.87	1010.5	822.1	4.4	294.3	287.9	287.8	1.00
-3.00	36.5	60.7	10.27	1142.4	912.7	25.1	294.3	335.8	335.6	1.00

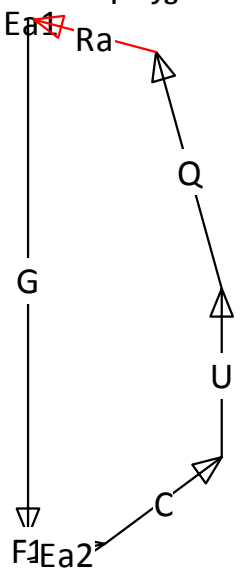
Decisive failure body:
Γεωμετρία:

Foot point of lower failure plane	x/z =	0.01/-13.00 m
Intersection lower/upper slid. plane	x/z =	9.92/ -5.66 m
Intersection upper slid. plane/surface	x/z =	13.09/ 0.00 m
Intersection separation plane/surface	x/z =	9.92/ 0.00 m
Inclination lower failure plane	ϑ1 =	36.55°
Inclination upper failure plane	ϑ2 =	60.71°
Inclination separation plane	ϑ12 =	90.00°

Loads / forces (char.)

		Fx [kN/m]	Fz [kN/m]	F [kN/m]	
Weight of main failure body	G,k:	0.0	-1922.8	1922.8	
Area loads on/in main failure body	F1,k:	0.0	-82.5	82.5	
Cohesion of lower failure plane	C,k:	434.0	321.7	540.2	
Pore water pressure on main body	U,k:	0.0	626.9	626.9	
Earth pres. on separation plane	Ea1,k:	-25.1	-0.0	25.1	δ= 0.0°
Earth pr. between wall<->main body	Ea2,k:	289.1	55.5	294.3	
Force in lower failure plane	Q,k:	-243.9	879.5	912.7	
Sum = possible anchor forces:	Ra_cal,k:	454.1	-121.7	470.1	

Force polygon



Acting anchor forces Ed: Sum(A,d) = 335.6 kN/m
Possible anchor forces Rd: Ra_cal,d = 470.1/1.400 = 335.8 kN/m
Verif. of lower failure plane Ed/Rd = 1.00 < 1.0: Έλεγχος εκπληρώθηκε.

Check of steel tension

l,tot ...[m]: Total length of anchor incl. excess length at head
As ....[mm2]: X-section are of steel member
Ri,d ...[kN]: Ultimate strength of tension member (γ,M=1.15)
A,d ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	l,tot	As	Ri,d		A,d	
-0.50	Strand;3x0.60";1570/1770	15.87	420	573.4	>	0.0	Passes requirement
-3.00	Strand;3x0.60";1570/1770	14.27	420	573.4	>	302.0	Passes requirement

Check of steel tension: Passes requirement

Check of anchor's soil friction

lVk .....: Length of grout body
DmVk ....: Diameter of grout body
τGr,k ...: Average applied skin friction along the grout body (from soil parameters)
Ra,k ....: Charact. pullout resistance of the anchor
γA .....: Partial safety factor of anchor pullout
Ra,d ....: = Ra,k / γA
A,d .....: Dimensioning force of the anchor from wall analysis

z [m]	lVk [m]	DmVk [mm]	τGr,k [kN/m²]	Ra,k [kN]	γA [-]	Ra,d [kN]		A,d [kN]	A,d/Ra,d [-]
-0.50	8.00	318	110	879.1	1.100	799.2	>	0.0	0.0
-3.00	8.00	318	110	879.1	1.100	799.2	>	302.0	0.4

Check of anchor's soil friction: Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)
Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (0.76, 1.22), Ακτίνα = 14.25
Αρχ.σημ.= (-9.97, -8.15), Τελ.σημ. = (14.96, 0.00)

Γεωμετρία λωρίδων:

No	x [m]	Width b [m]	dxM [m]	Weight [kN/m]	Load z-κατ. [kN/m]	Water-φορτ. [kN/m]	u*b [kN/m]	φ [°]	c [kN/m²]	θ [°]
1	-9.26	1.42	-10.02	24.3	0.0	0.0	-0.0	27.45	3.57	-31.27*
2	-7.84	1.42	-8.60	63.4	0.0	0.0	-0.0	0.08	71.43	-37.12
3	-6.41	1.42	-7.17	90.4	0.0	0.0	-3.4	0.08	71.43	-30.23
4	-4.99	1.42	-5.75	111.1	0.0	0.0	-11.3	0.08	71.43	-23.80
5	-3.56	1.42	-4.32	126.5	0.0	0.0	-19.1	0.08	71.43	-17.67
6	-2.14	1.42	-2.90	137.2	0.0	0.0	-24.4	0.08	71.43	-11.74
7	-0.71	1.42	-1.47	143.5	0.0	0.0	-84.6	0.08	71.43	-5.94
8	0.71	1.42	-0.05	386.6	18.2	0.0	-142.7	0.08	71.43	-0.20
9	2.14	1.42	1.38	384.7	61.1	0.0	-141.7	0.08	71.43	5.54
10	3.56	1.42	2.80	378.7	27.9	0.0	-138.7	0.08	71.43	11.33
11	4.99	1.42	4.22	368.4	0.0	0.0	-133.5	0.08	71.43	17.25
12	6.41	1.42	5.65	353.3	0.0	0.0	-125.9	0.08	71.43	23.36
13	7.84	1.42	7.07	333.0	0.0	0.0	-115.7	0.08	71.43	29.77
14	9.26	1.42	8.50	306.5	0.0	0.0	-102.3	0.08	71.43	36.62
15	10.69	1.42	9.92	268.4	0.0	0.0	-84.9	27.45	3.57	44.15
16	12.11	1.42	11.35	216.8	0.0	0.0	-61.5	27.45	3.57	52.80
17	13.89	2.13	13.13	178.0	0.0	0.0	-35.9	0.08	35.71	67.14

*** Σημείωση: Στις λωρίδες σημειωμένες με '*'
περιορίστηκε το theta στο 45°-Phi/2.

Συνεισφ. κατακόρυφων φορτίων:

No	Weight [kN/m]	G*sin(θ) [kN/m]	(G-u*b)*tan(φ) + c*b [kN/m]	μ*sin(θ)* tan(φ)+cos(θ) [-]	T [kN/m]
1	24.32	-17.11	17.72	0.710544	24.94
2	63.39	-38.26	101.86	0.796924	127.82
3	90.45	-45.54	101.89	0.863628	117.98
4	111.14	-44.85	101.91	0.914685	111.42
5	126.51	-38.39	101.92	0.952610	106.99
6	137.17	-27.91	101.93	0.978926	104.12
7	143.50	-14.85	101.85	0.994554	102.41
8	404.86	-1.41	102.14	0.999991	102.14
9	445.86	43.03	102.20	0.995404	102.67
10	406.61	79.90	102.14	0.980647	104.16
11	368.37	109.23	102.10	0.955249	106.88
12	353.35	140.11	102.09	0.918324	111.17
13	333.05	165.36	102.07	0.868399	117.54
14	306.48	182.82	102.06	0.803047	127.09
15	268.41	186.95	100.44	0.910957	110.25
16	216.83	172.71	85.80	0.825802	103.89
17	177.97	163.99	76.44	0.389235	196.38
		1015.79			1877.85

Συνεισφ. αγκυρίων: Αθρ. ροπών ανατροπής : -132.8 kN*m/m
" " resisting : 77.3 kN*m/m

Δράση Ed = (1015.8*14.25-132.8)
Αντίσταση Rd = (1877.9*14.25+77.3)

SLIP-CIRCLE μ = Ed/Rd = 0.53 < 1.0: Έλεγχος εκπληρώθηκε.

ΠΑΡΑΡΤΗΜΑ

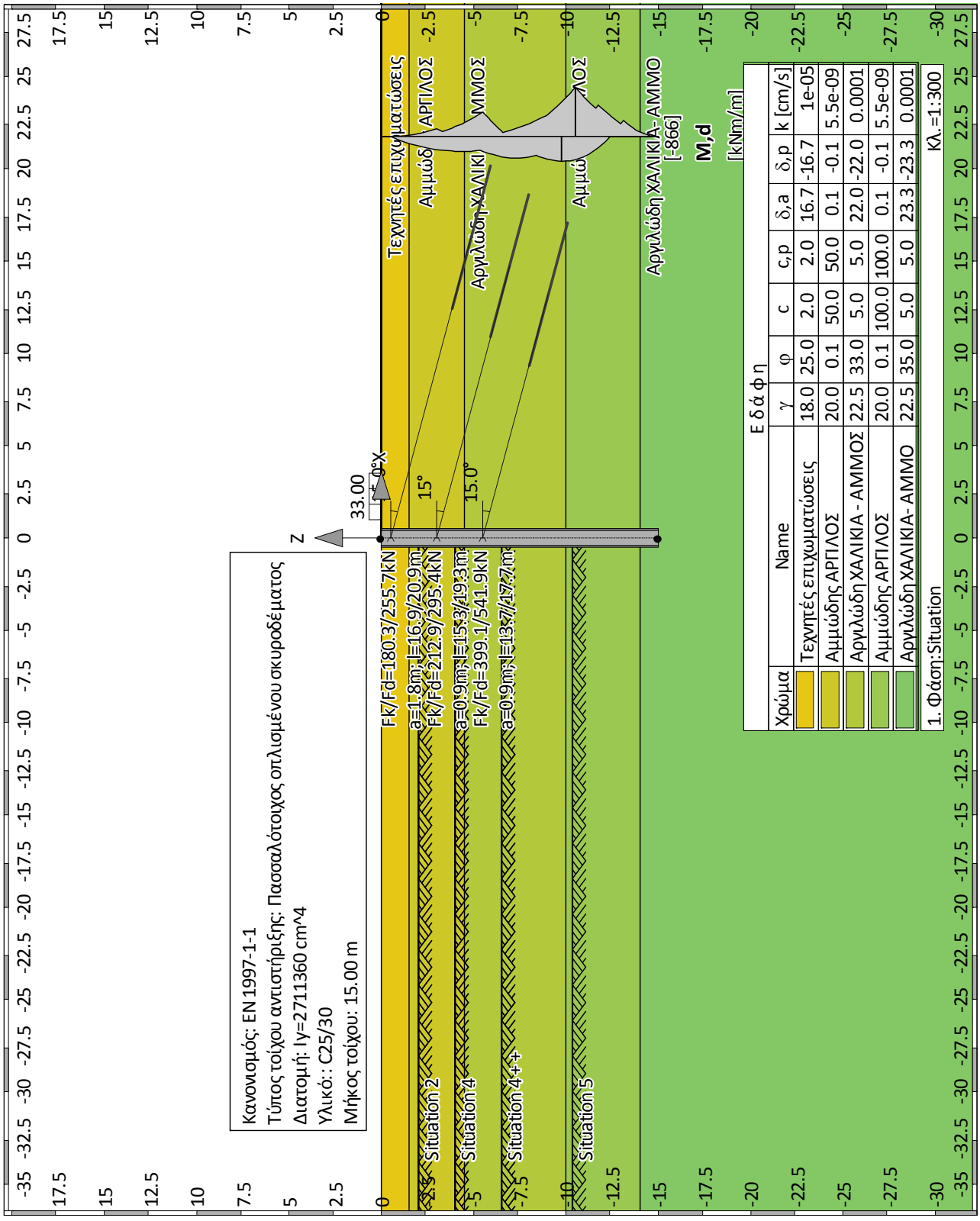
8.5 *Αποτελέσματα ανάλυσης*

8.5.1 *Στατικές Συνθήκες*

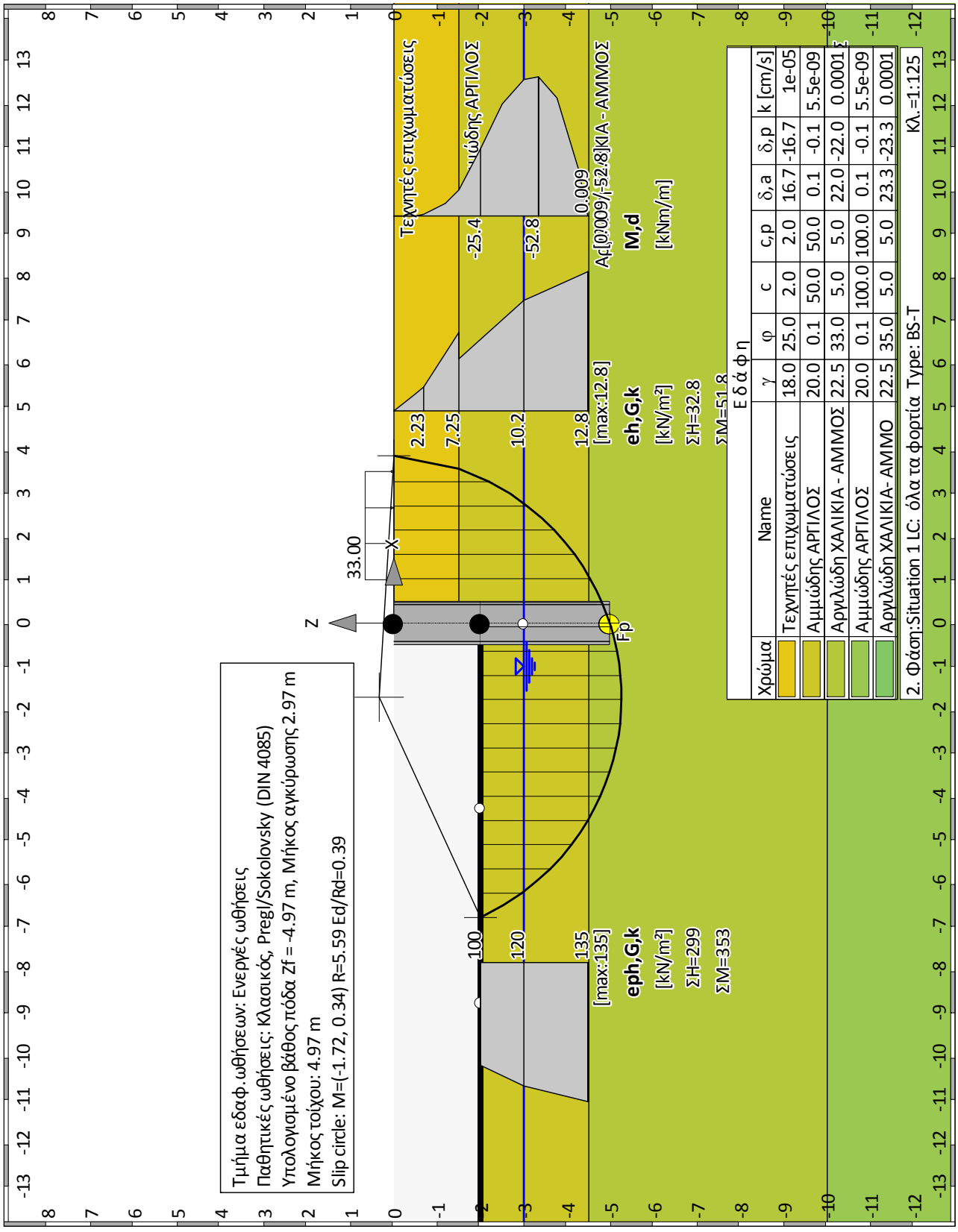
iii) Αντιστηριζόμενο ύψος 9,85m

Summary of all stages

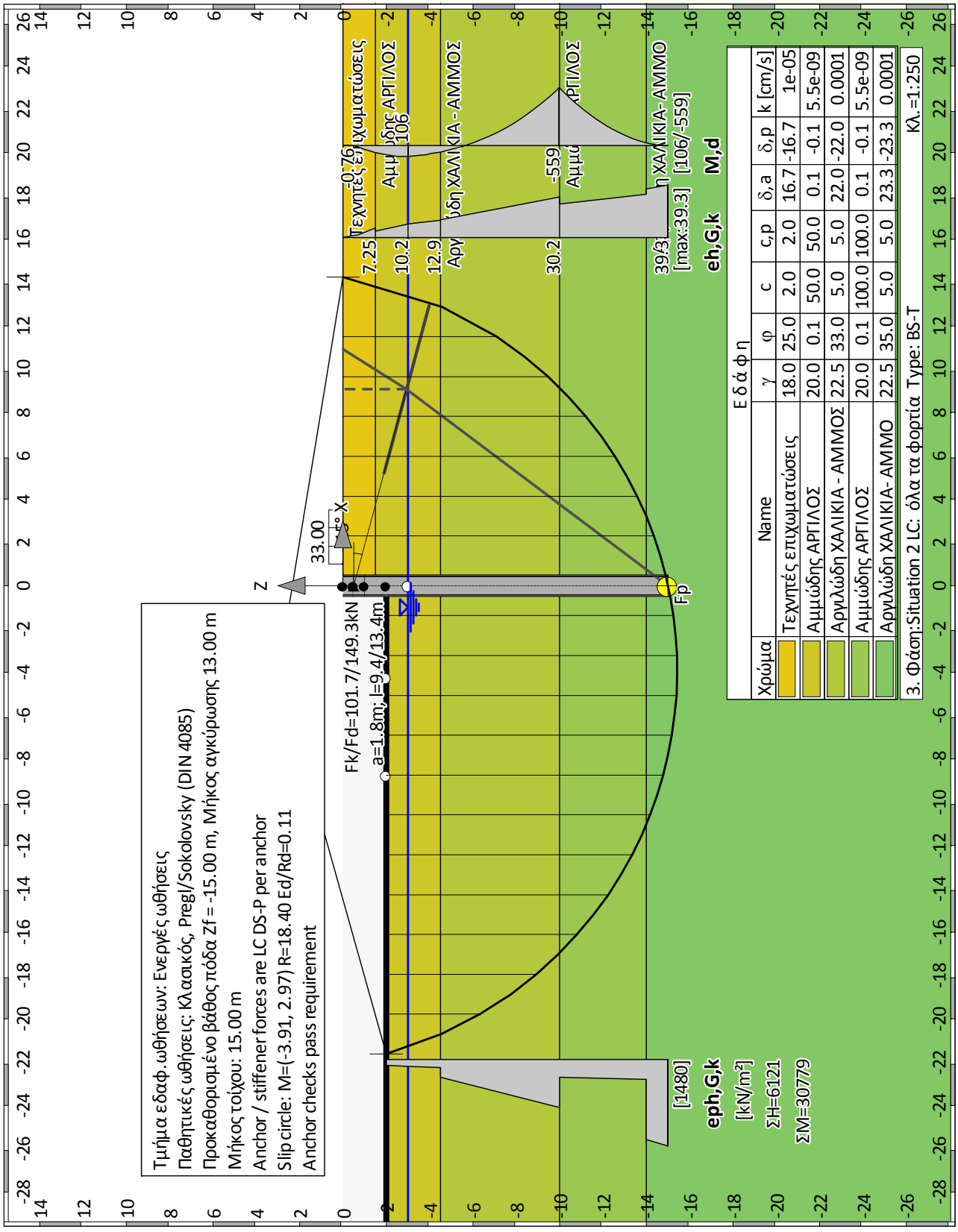
Φάση εκσκαφής 0 "Situation"



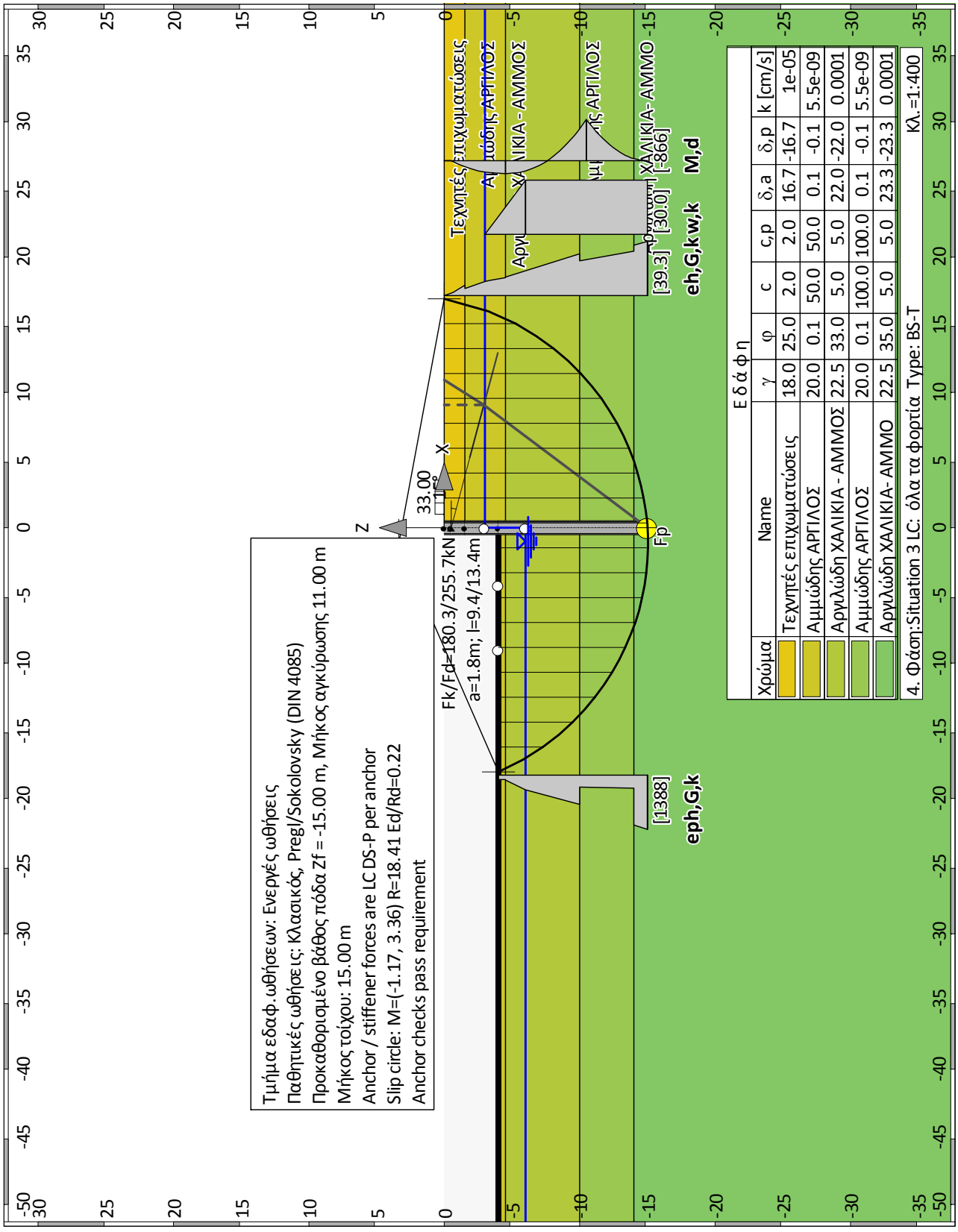
Φάση εκσκαφής 1 "Situation 1"



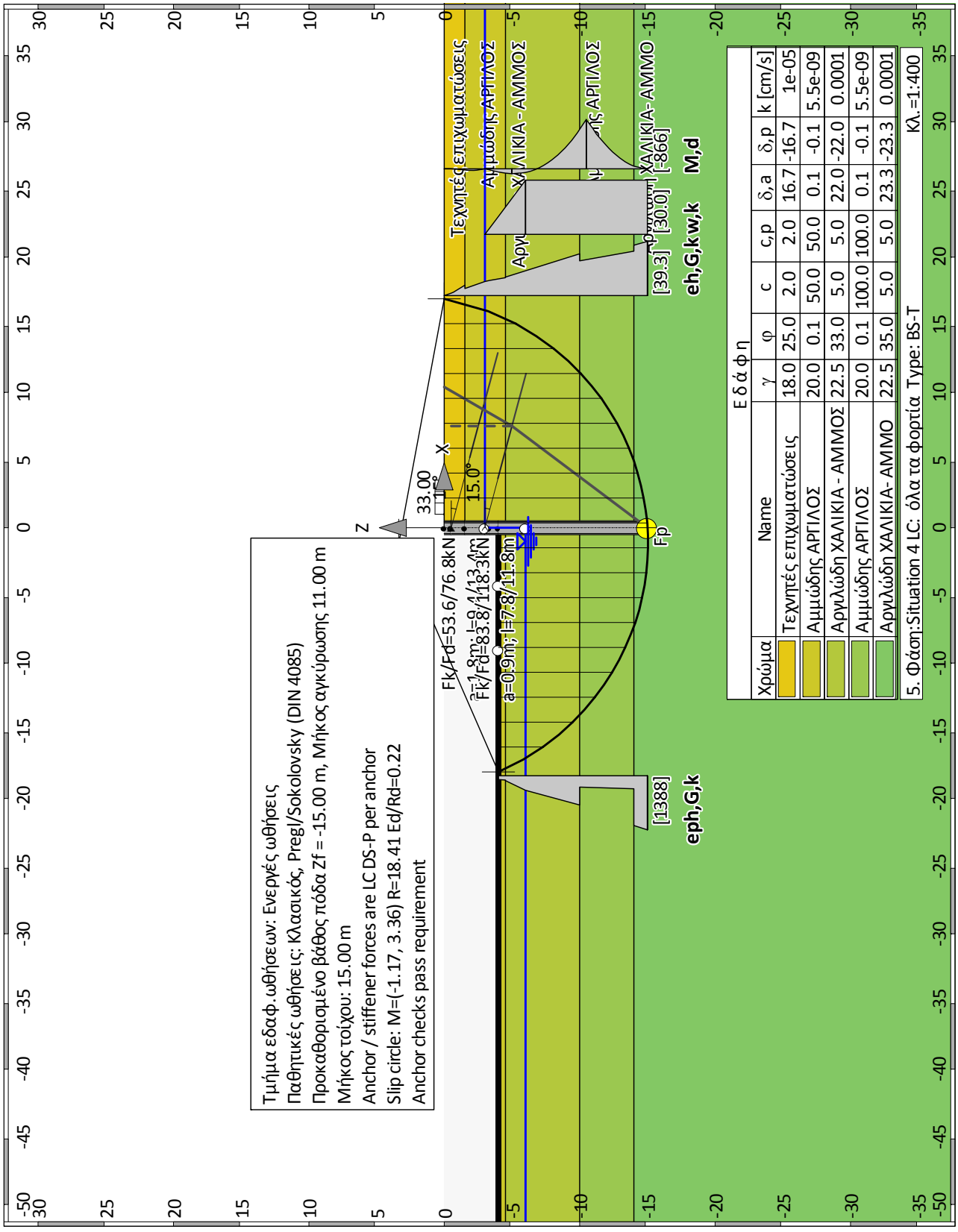
Φάση εκσκαφής 2 "Situation 2"



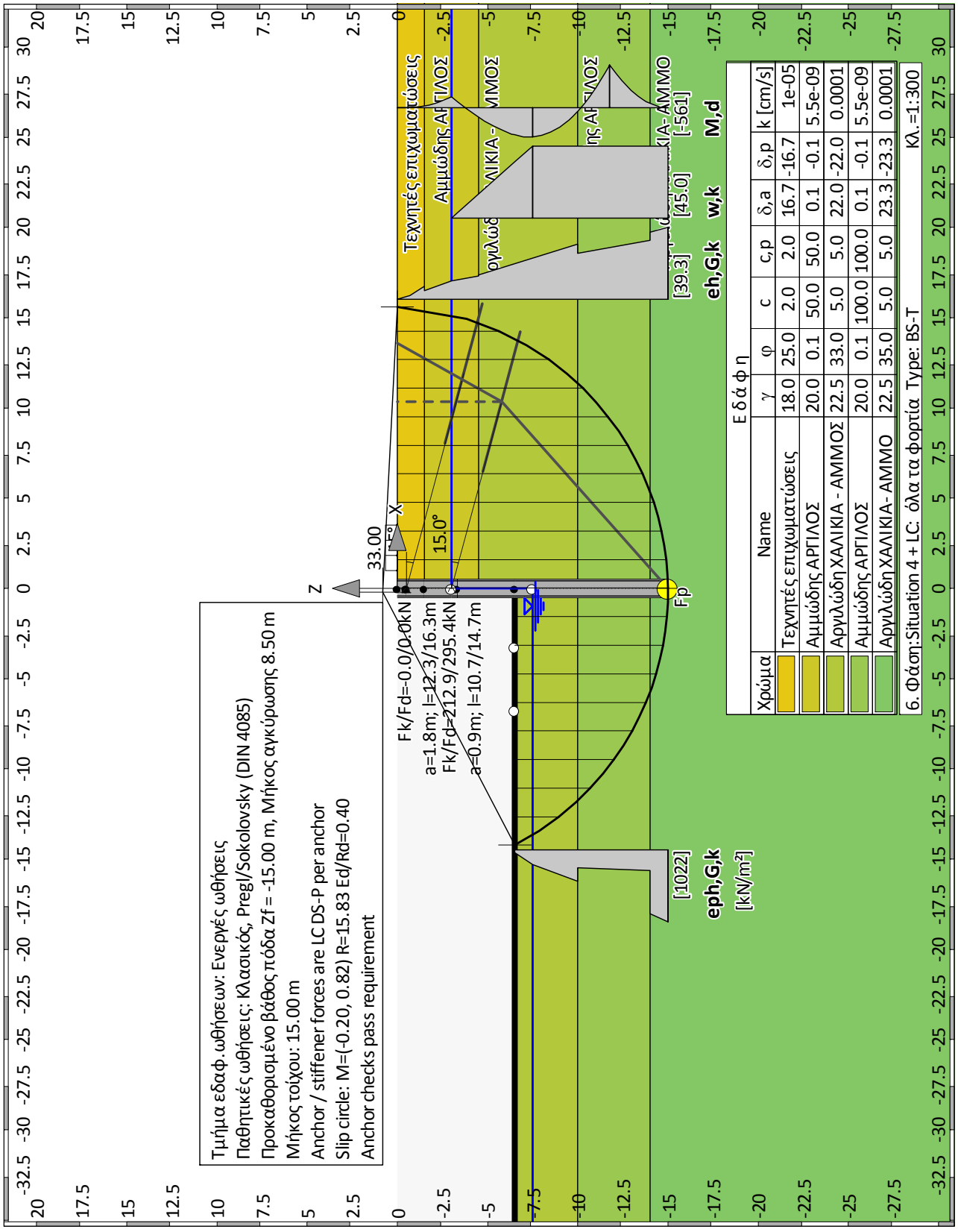
Φάση εκσκαφής 3 "Situation 3"



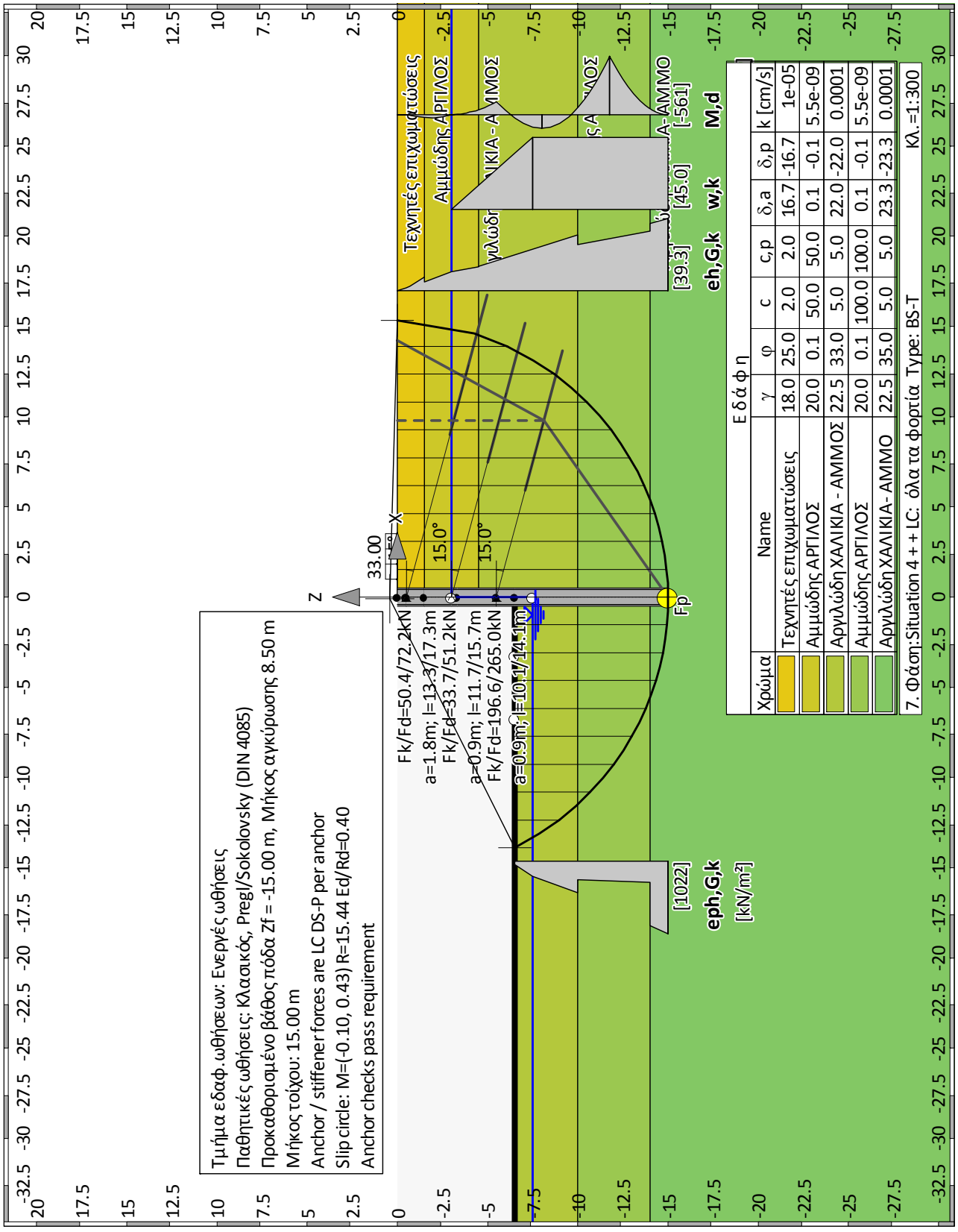
Φάση εκσκαφής 4 "Situation 4"



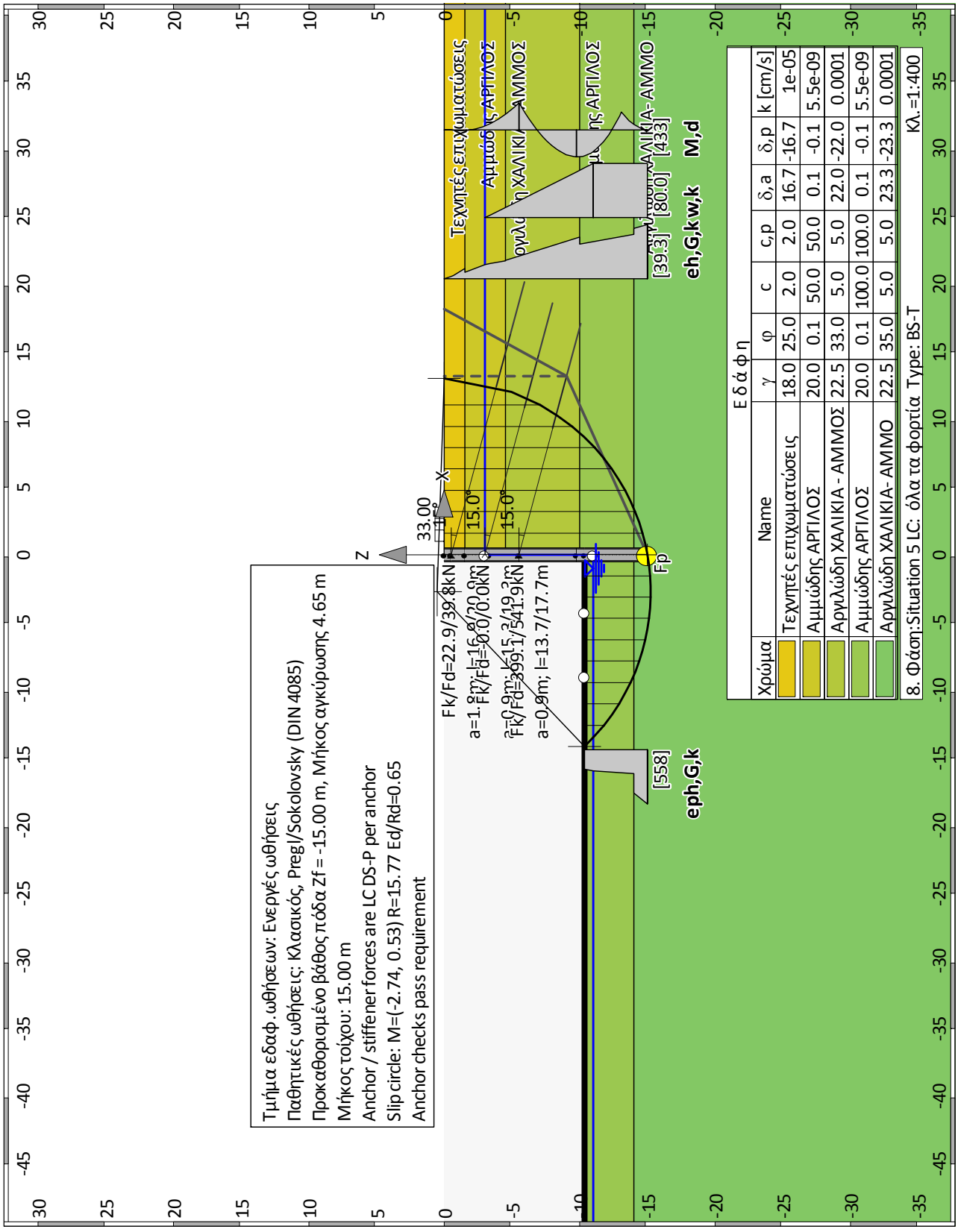
Φάση εκσκαφής 5 "Situation 4 +"



Φάση εκσκαφής 6 "Situation 4 + +"



Φάση εκσκαφής 7 "Situation 5"



Κανονισμόςγια Ανάλυση και Διαστασιολόγηση

Διαστασ. ωπλισμ.σκυροδ.: EN 1992-1-1
Γεωτεχν.Κανονισμός : EN 1997 (rev.12)_user
National Annex: EN 1997-1

Safety factors:

Earth pressure onto wall: [GEO] A1 M1 R2

	γ-	G,dst	E0G	G,stb	Q,dst	Q,stb	phi	coe	cu	g
BS-P		1.350	1.350	1	1.500	0	1	1	1	1
BS-T		1.350	1.350	1	1.500	0	1	1	1	1
BS-T/A		1.350	1.350	1	1.500	0	1	1	1	1
BS-E		1	1	1	1	0	1	1	1	1

ΚΕ-μηχανισμός: [GEO] A2 M2 R3

	γ-	G,dst	G,stb	W	Q,dst	Q,stb	phi	coe	cu
		g	a,t	a,p	Gt	N			
BS-P		1	1	1	1.300	0	1.250	1.400	1.400
		1	1	1	1	1			
BS-T		1	1	1	1.300	0	1.250	1.400	1.400
		1	1	1	1	1			
BS-T/A		1	1	1	1.300	0	1.250	1.250	1.400
		1	1	1	1	1			
BS-E		1	1	1	1	0	1.250	1.400	1.400
		1	1	1	1	1			

Θραύση εδάφους: [GEO] A1 M1 R2

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Re					
BS-P		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-T		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-T/A		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-E		1	1	1	1	1	0	1	1
		1	1	1					

Ολίσθηση: [GEO] A1 M1 R2

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Rh					
BS-P		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.100					
BS-T		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.100					
BS-T/A		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.100					
BS-E		1	1	1	1	1	0	1	1
		1	1	1					

Θραύση εδάφους: [GEO] A1 M1 R2

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Rv					
BS-P		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-T		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Rv					
BS-T/A		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-E		1	1	1	1	1	0	1	1
		1	1	1					

Κύκλος ολίσθησης: [GEO] A2 M2 R3

	γ-	G,dst	G,stb	Q,dst	Q,stb	W	phi	coe	cu
		g	Re	a,t	a,p	Gt	N		
BS-P		1	1	1.300	0	1	1.250	1.400	1.400
		1	1	1	1	1	1		
BS-T		1	1	1.300	0	1	1.250	1.400	1.400
		1	1	1	1	1	1		
BS-T/A		1	1	1.300	0	1	1.250	1.250	1.400
		1	1	1	1	1	1		
BS-E		1	1	1	0	1	1.250	1.400	1.400
		1	1	1	1	1	1		

Hydraulic heave: [HYD] A1 M1 R1

	γ-	G,dst	G,stb	Q,dst	H
BS-P		1.350	0.900	1.500	1.800
BS-T		1.350	0.900	1.500	1.600
BS-T/A		1.350	0.900	1.500	1.500
BS-E		1	1	1	1

Failure of structural elements: [STR] A1 M1 R1

	γ-	M	Gtf	cd	N
BS-P		1.150	1.400	1.400	1.150
BS-T		1.150	1.300	1.300	1.150
BS-T/A		1.150	1.250	1.250	1.150
BS-E		1	1	1	1

Stability: [EQU] A1 M1 R1

	γ-	G,dst	G,stb	Q,dst	Q,stb	phi	coe	cu	g
BS-P		1	0.900	1.500	0	1.250	1.250	1.400	1
BS-T		1	0.900	1.500	0	1.250	1.250	1.400	1
BS-T/A		1	0.900	1.500	0	1.250	1.250	1.400	1
BS-E		1	1	1	0	1.250	1.400	1.400	1

γ,Re,red (EAB EB14-3): Ναι, η=0.80
γ,Re,red (EAB EB22-6): Ναι, E0h > 0%: η = 0.60 / 0.80

System values

Τοίχος

Τύπος τοίχου αντιστήριξης: Πασσαλότοιχος οπλισμένου σκυροδέματος
Διατομή: Iy=2711360 cm^4
Υλικό:: C25/30
Ίδιο βάρος: 25.000 [kN/m3]

Σημεία τοίχου

z	d	E	Iy	E*Iy	A
[m]	[m]	[MN/m2]	[cm4/m]	[MNm2]	[cm2/m]
0.00	100.0	31500.0	2711360	854.1	8400
-15.00	100.0	31500.0	2711360	854.1	8400

Φάση εκσκαφής 1 "[1] Situation 1"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 5 Στρώσεις

Name		Τεχνητές επιχωματώσεις	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
γ	[kN/m3]	18	20	22.5
γ,R	[kN/m3]	18	20	22.5
γ'	[kN/m3]	8	10	12.5
γ,p	[kN/m3]	18	20	22.5
γ,R,passive	[kN/m3]	18	20	22.5
γ,pw	[kN/m3]	8	10	12.5
φ	[°]	25	0.1	33
c	[kN/m2]	2	50	5
c,u	[kN/m2]	10	50	5
c παθητικό	[kN/m2]	2	50	5
δ,a	[°]	16.66667	0.06666667	22
δ,p	[°]	-16.66667	-0.06666667	-22
δ,c	[°]	8.333333	0.03333333	11
k,agh	[-]	0.3456501	0.9955057	0.2452023
K,ach	[-]	1.043051	1.994195	0.8549058
K,0h	[-]	0.5773817	0.9982547	0.455361
K,pgh	[-]	3.908103	1.004519	7.495617
K,pch	[-]	5.180327	2.00583	8.599509
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	10e-06	5.5e-09	100e-06

Name		Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20	22.5
γ,R	[kN/m3]	20	22.5
γ'	[kN/m3]	10	12.5
γ,p	[kN/m3]	20	22.5
γ,R,passive	[kN/m3]	20	22.5
γ,pw	[kN/m3]	10	12.5
φ	[°]	0.1	35
c	[kN/m2]	100	5
c,u	[kN/m2]	100	5
c παθητικό	[kN/m2]	100	5
δ,a	[°]	0.06666667	23.33333
δ,p	[°]	-0.06666667	-23.33333
δ,c	[°]	0.03333333	11.66667
k,agh	[-]	0.9955057	0.2244207
K,ach	[-]	1.994195	0.8126539
K,0h	[-]	0.9982547	0.4264236
K,pgh	[-]	1.004519	9.146943
K,pch	[-]	2.00583	10.104
τ,gr	[kN/m2]	110	110
Ψ,A,max	[°]	90	90
k	[cm/s]	5.5e-09	100e-06

Πορεία πρανούς:

x [m]	0.00	0.00
z [m]	-2.00	0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:

x [m]	0.00	0.00
z [m]	-2.00	-1.50

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:
z= -4.50

Πορεία ανώτερου 4. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
z= -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -14.00

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
1.00	0.00	3.50	0.00	0.00	33.00	0.00	33.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Στάθμη νερού:

x [m] 0.00
z [m] -3.00

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Ενεργές ωθήσεις.
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: No redistribution of earth pressure.
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Κλασικός, Pregl/Sokolovsky (DIN 4085).

Options for water pressure

Στήριξη πόδα

Πακτωμένη στήριξη κατά Blum

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

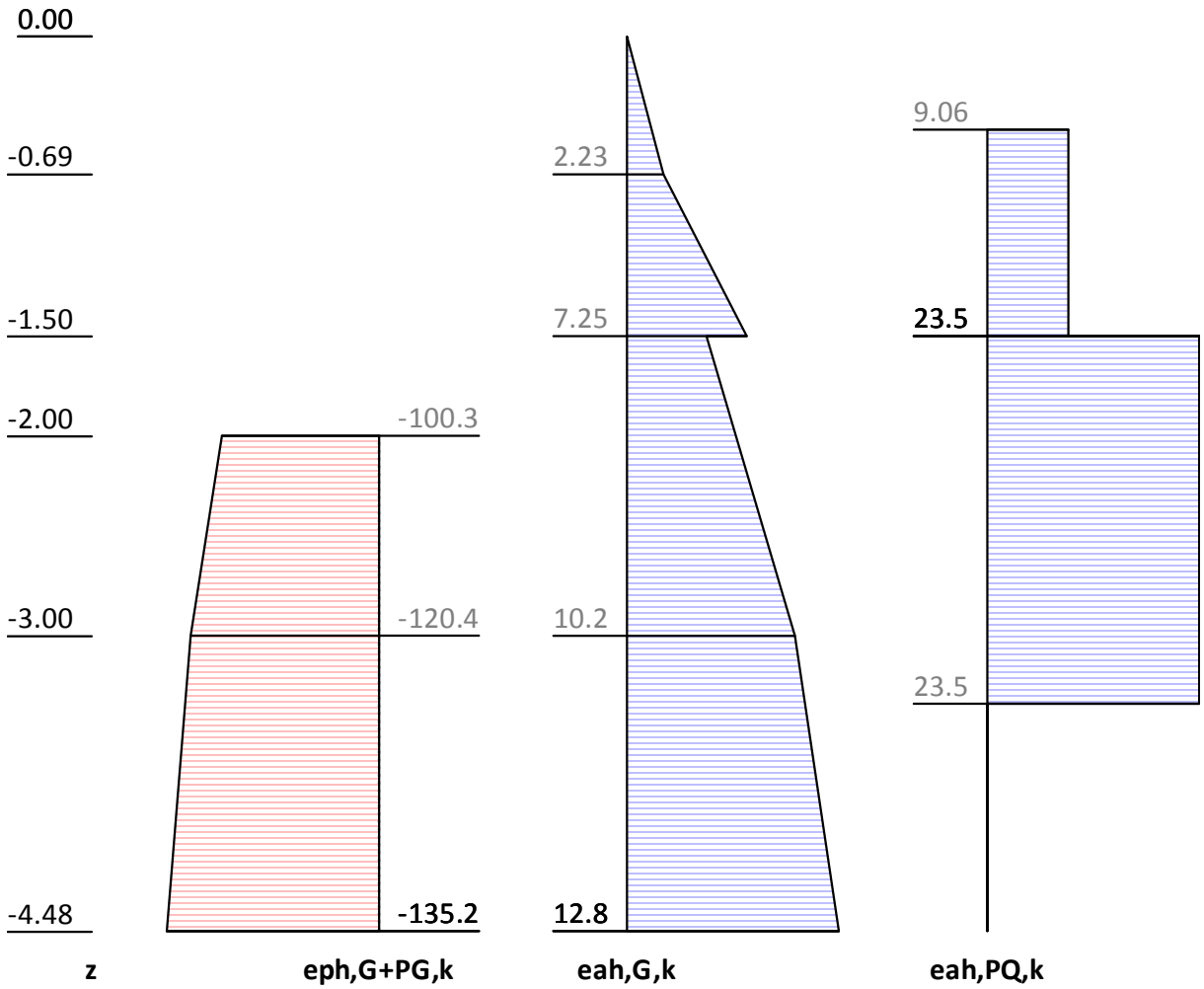
Μήκος τοίχου

```
N:    1 Z:    -3.000 M,Στήριξη πόδα,d:    51.74. Wall too short? Ναι
N:    2 Z:    -6.000 M,Στήριξη πόδα,d:  -401.07. Wall too short? Όχι
N:    3 Z:    -3.990 M,Στήριξη πόδα,d:    34.70. Wall too short? Ναι
N:    4 Z:    -5.337 M,Στήριξη πόδα,d:  -155.60. Wall too short? Όχι
N:    5 Z:    -4.434 M,Στήριξη πόδα,d:     3.70. Wall too short? Ναι
N:    6 Z:    -5.039 M,Στήριξη πόδα,d:   -82.64. Wall too short? Όχι
N:    7 Z:    -4.634 M,Στήριξη πόδα,d:   -16.37. Wall too short? Όχι
N:    8 Z:    -4.500 M,Στήριξη πόδα,d:   -13.22. Wall too short? Όχι
N:    9 Z:    -4.456 M,Στήριξη πόδα,d:     1.79. Wall too short? Ναι
N:   10 Z:    -4.486 M,Στήριξη πόδα,d:    -0.87. Wall too short? Όχι
N:   11 Z:    -4.466 M,Στήριξη πόδα,d:     0.92. Wall too short? Ναι
N:   12 Z:    -4.479 M,Στήριξη πόδα,d:    -0.27. Wall too short? Όχι
N:   13 Z:    -4.470 M,Στήριξη πόδα,d:     0.53. Wall too short? Ναι
N:   14 Z:    -4.476 M,Στήριξη πόδα,d:    -0.01. Wall too short? Όχι
Foot depth for statics: zf = -4.476
```

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall



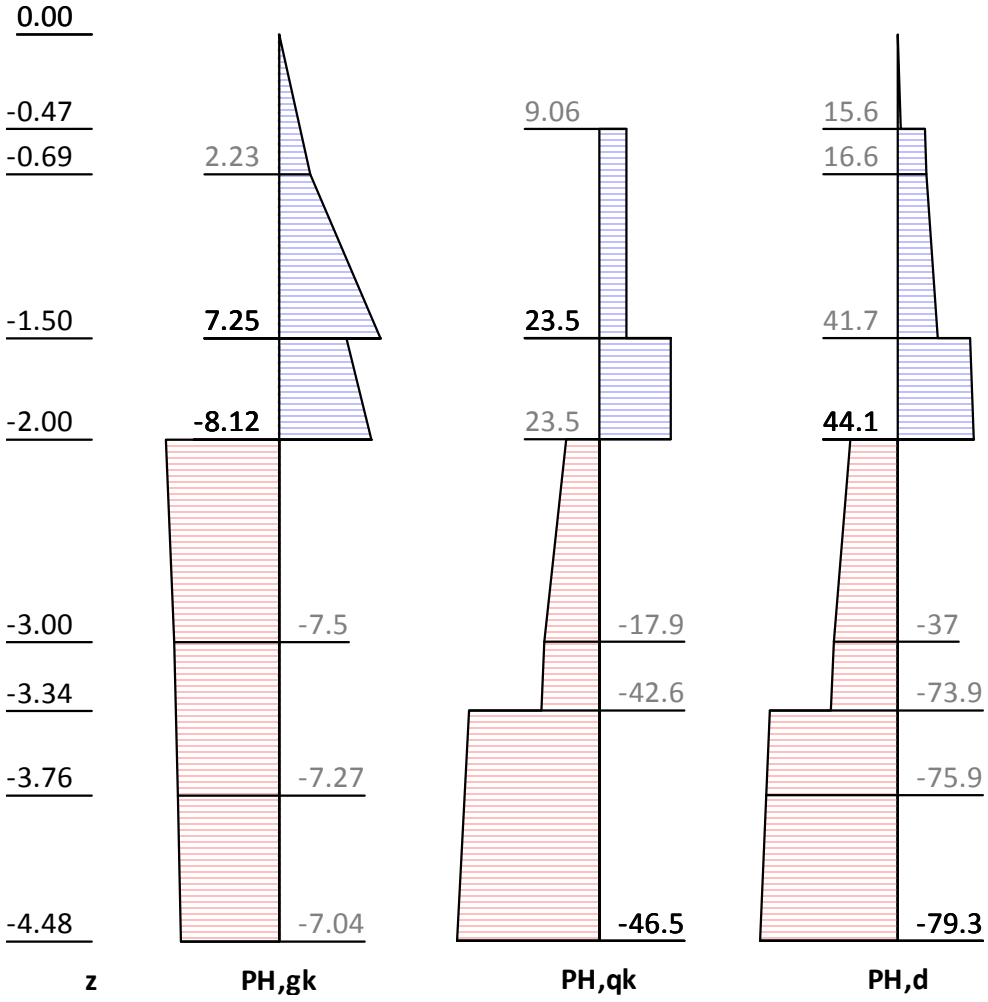
z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00

z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
-0.47		1.52	0.00	2.04
-0.47		1.52	9.06	15.62
-1.50		7.25	9.06	23.37
-1.50		4.82	23.48	41.73
-2.00	-0.00	6.61	23.48	44.14
-2.00	-100.29	6.61	23.48	44.14
-3.34	-123.79	10.79	23.48	49.78
-3.34	-123.79	10.79	0.00	14.56
-4.48	-135.21	12.82	0.00	17.30

Eph,G,k: -298.99, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 32.82, Eah,PG,k: 0.00, Eah,PQ,k: 52.53, Eah,d: 123.10

H-pressure on static system

Level of mobilization: Ep,gk 14.7, Ep,qk 34.4, Ep,d 100.0 [%]

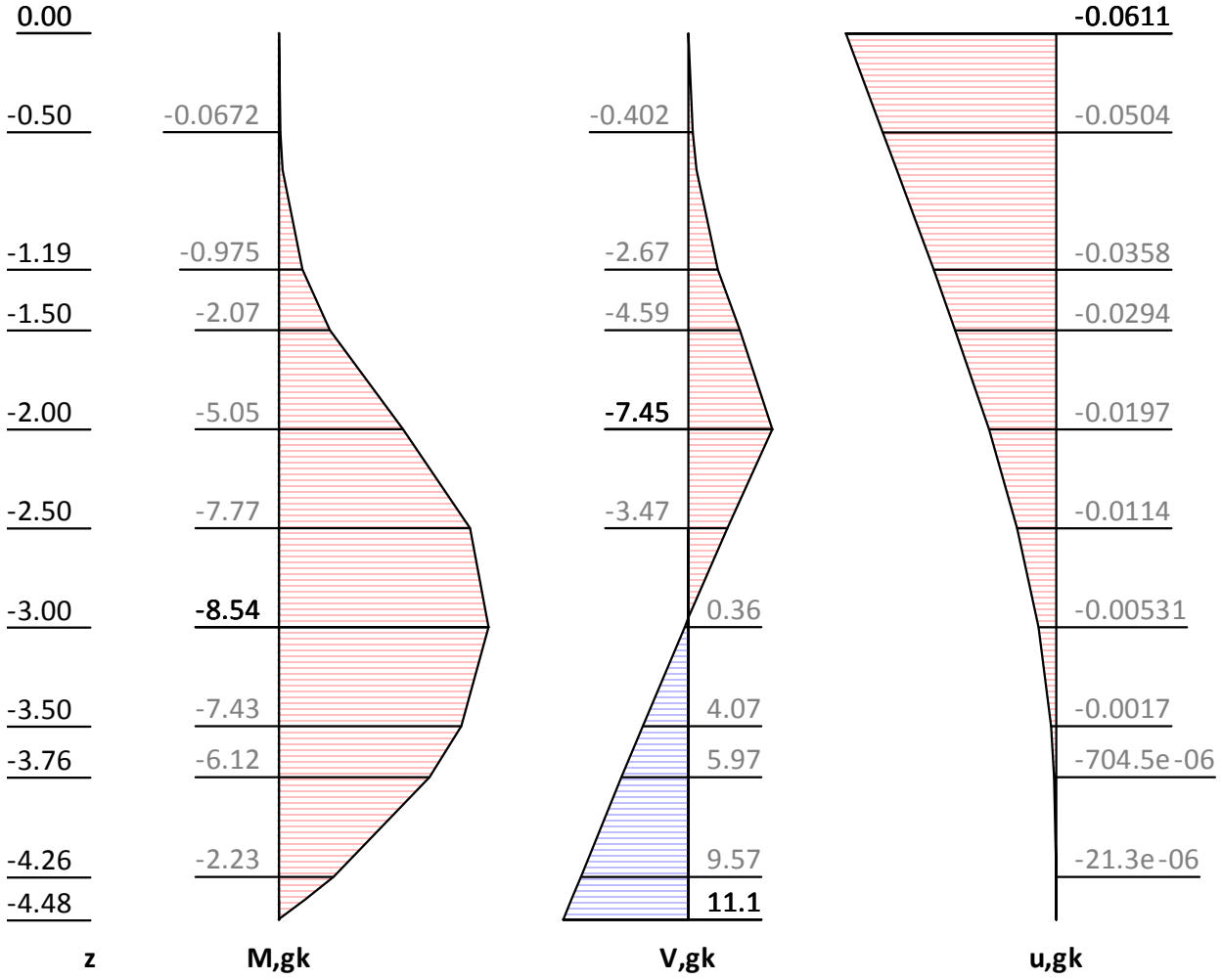


z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	0.00		0.00
-0.47	1.52	0.00	2.04
-0.47	1.52	9.06	15.62
-1.50	7.25	9.06	23.37
-1.50	4.82	23.48	41.73

z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
-2.00	6.61	23.48	44.14
-2.00	-8.12	-11.02	-27.50
-3.34	-7.40	-19.10	-38.64
-3.34	-7.40	-42.58	-73.86
-4.48	-7.04	-46.51	-79.28

V-pressure on static system

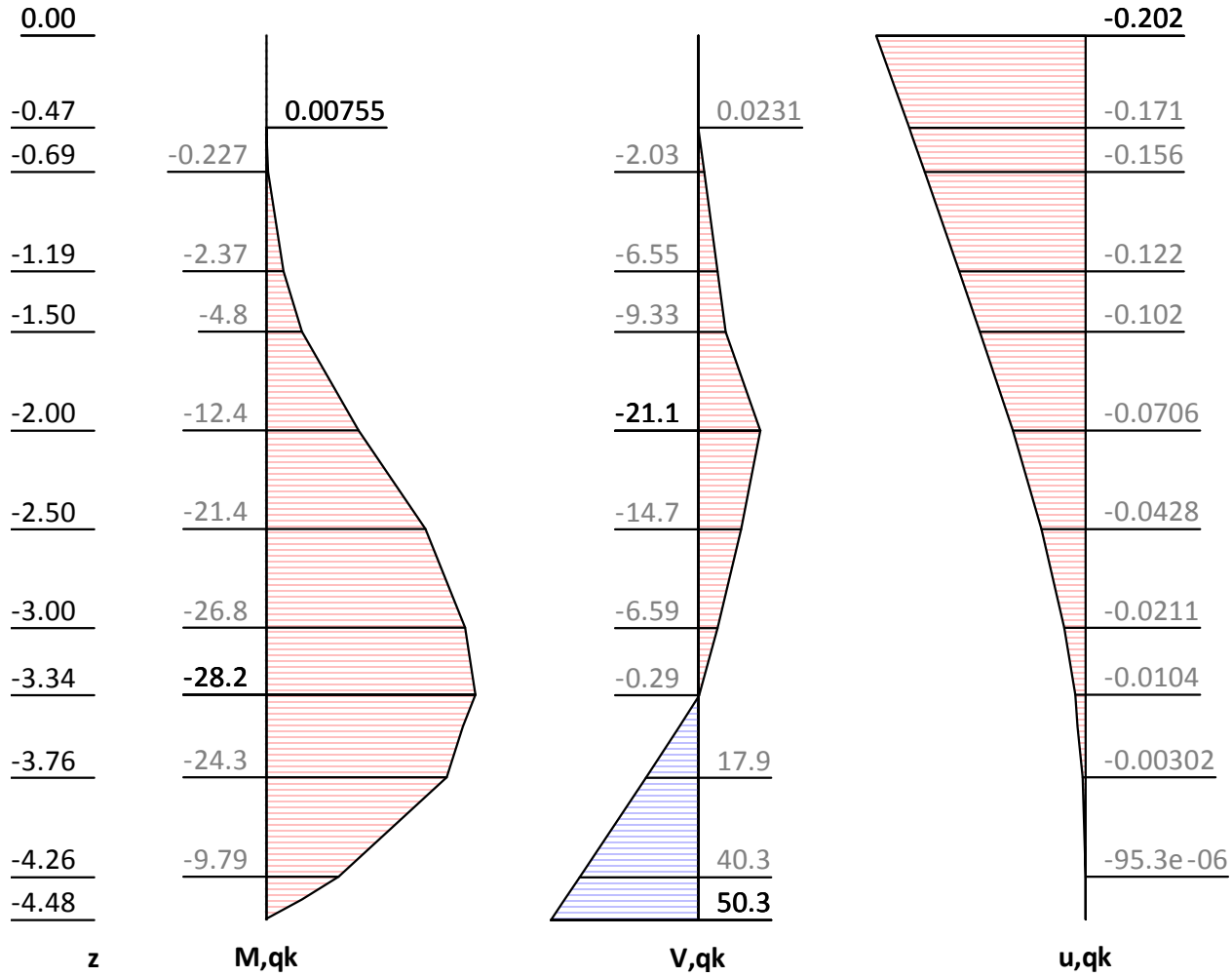
Internal forces: Permanent, characteristically



z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	0.00	0.00	0.00	0.00	-0.06
-1.50	7.25	-2.07	-4.59	-33.13	-0.03
-1.50	4.82	-2.07	-4.59	-33.13	-0.03
-2.00	6.61	-5.05	-7.45	-43.63	-0.02
-2.00	-8.12	-5.05	-7.45	-43.63	-0.02
-2.95	-7.53	-8.47	0.00	-63.64	-0.01
-3.00	-7.50	-8.54	0.36	-64.62	-0.01
-4.48	-7.04	-0.00	11.10	-83.21	-0.00
-4.48	-7.04	0.00	11.10	-83.21	0.00

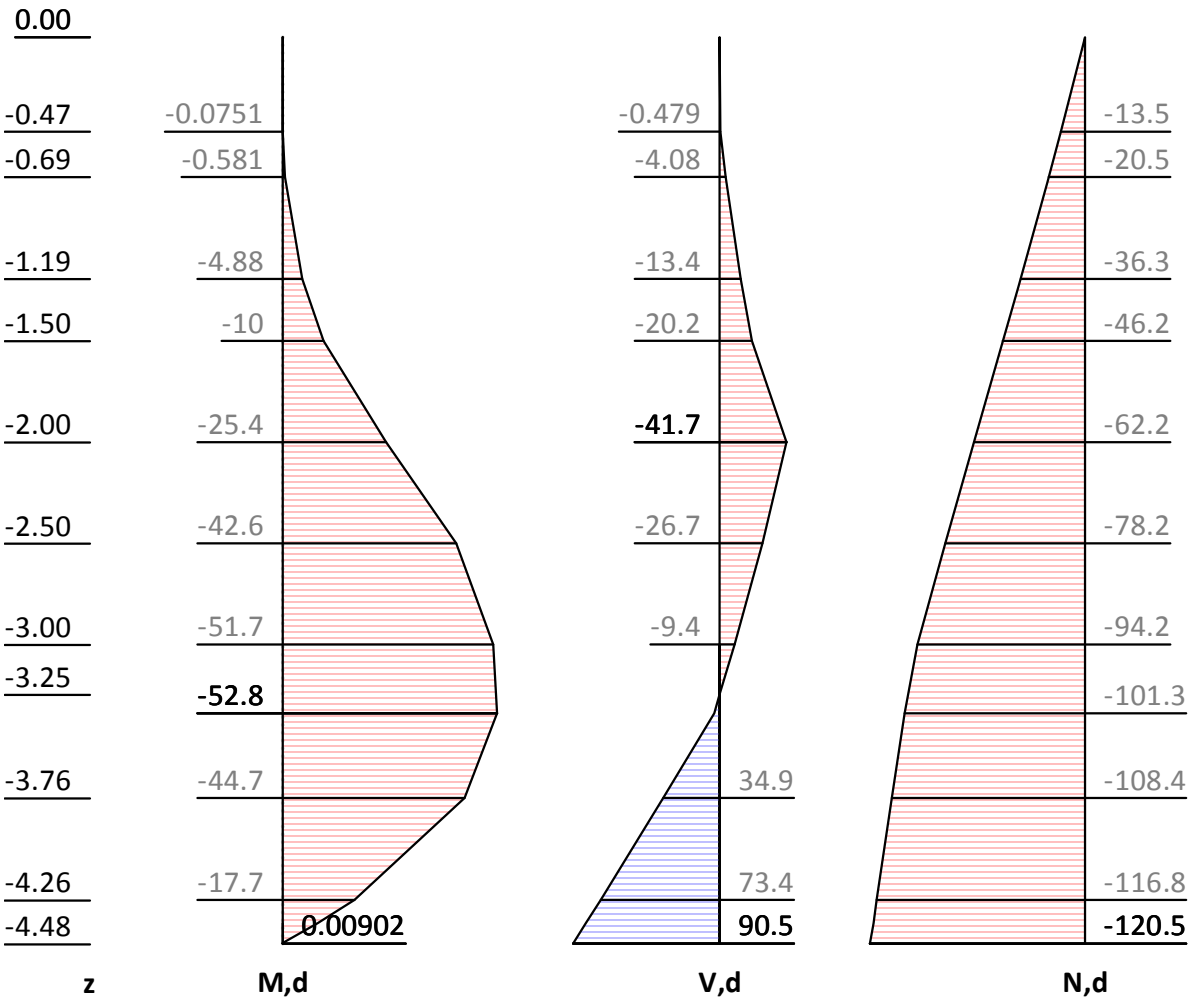
Internal forces: Variable, characteristically

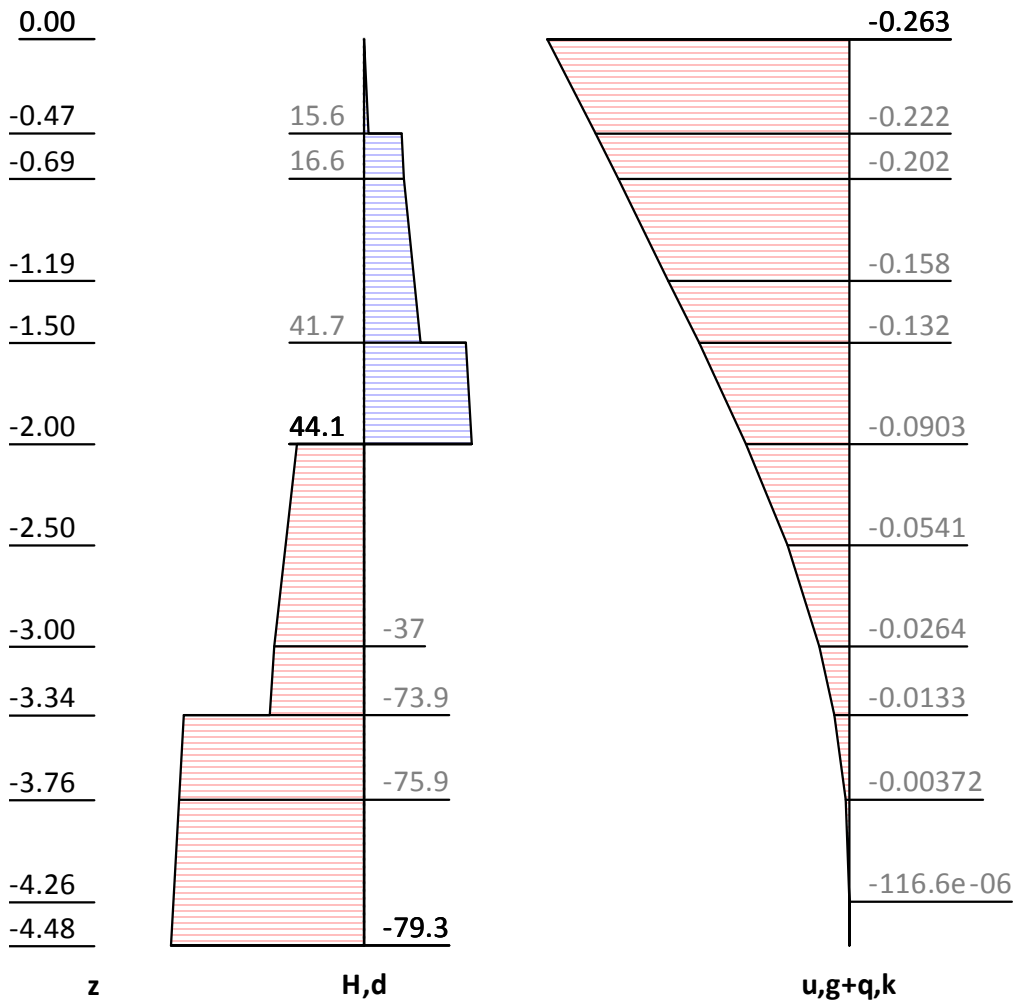
Method EB 82-4 (Q = [G+Q] - G).



z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00	0.00	0.00	-0.20
-0.47	0.00	0.01	0.02	0.01	-0.17
-0.47	9.06	0.01	0.02	0.01	-0.17
-0.48	9.06	-0.00	-0.05	0.00	-0.17
-1.50	9.06	-4.80	-9.33	-0.99	-0.10
-1.50	23.48	-4.80	-9.33	-0.99	-0.10
-2.00	23.48	-12.40	-21.07	-2.23	-0.07
-2.00	-11.02	-12.40	-21.07	-2.23	-0.07
-3.34	-19.10	-28.20	-0.29	-5.50	-0.01
-3.34	-42.58	-28.20	-0.29	-5.50	-0.01
-3.35	-42.61	-28.12	-0.00	-5.50	-0.01
-4.48	-46.51	0.00	50.32	-5.44	-0.00
-4.48	-46.51	0.00	50.32	-5.44	0.00

Internal forces: Design

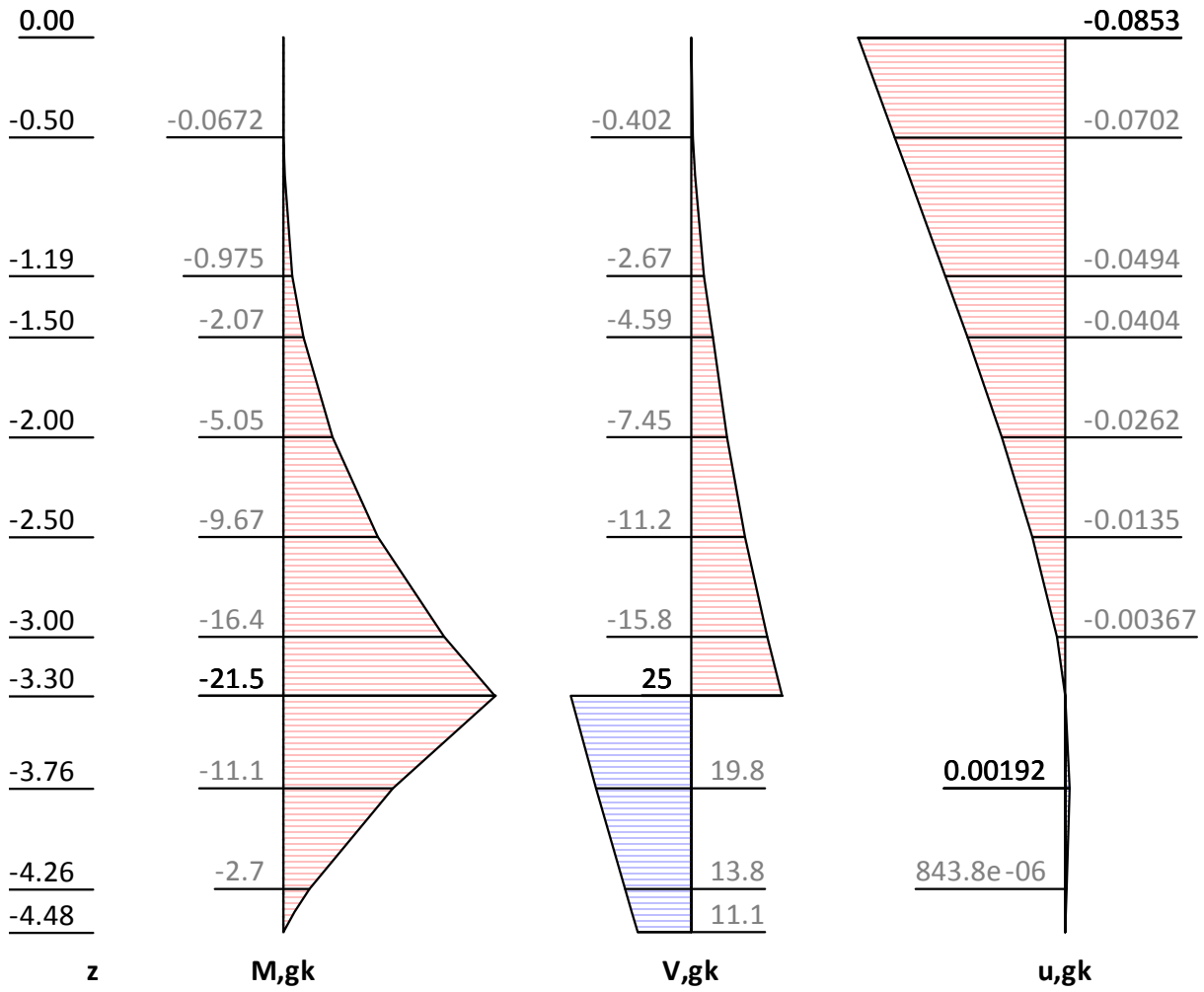




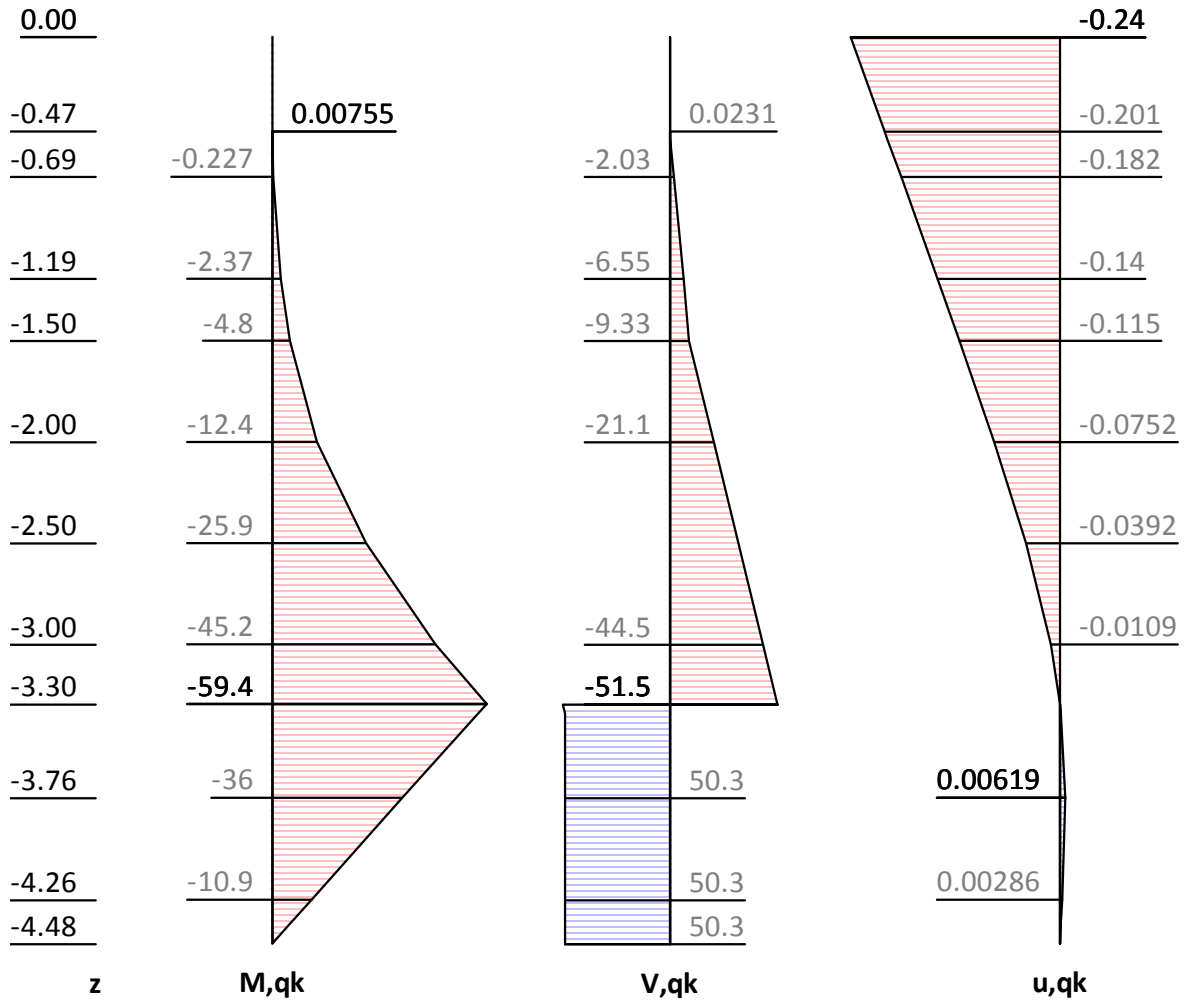
z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	0.00	0.00	-0.00	0.00	-0.26
-0.47	2.04	-0.08	-0.48	-13.54	-0.22
-0.47	15.62	-0.08	-0.48	-13.54	-0.22
-1.50	23.37	-10.00	-20.19	-46.20	-0.13
-1.50	41.73	-10.00	-20.19	-46.20	-0.13
-2.00	44.14	-25.42	-41.66	-62.25	-0.09
-2.00	-27.50	-25.42	-41.66	-62.25	-0.09
-3.34	-38.64	-52.77	3.46	-101.27	-0.01
-3.34	-73.86	-52.77	3.46	-101.27	-0.01
-4.48	-79.28	0.00	90.45	-120.49	-0.00
-4.48	-79.28	0.01	90.46	-120.49	0.00

Checks of earth statics

Substitute system according to Blum



z [m]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [kN/m2]
0.00	0.00	0.00	0.00	-0.09
-3.30	-21.54	-18.93	-68.37	0.00
-3.30	-21.54	24.98	-68.37	0.00
-3.76	-11.12	19.82	-74.23	0.00
-4.48	0.00	11.10	-83.26	0.00



z [m]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [kN/m2]
0.00	0.00	0.00	0.00	-0.24
-0.47	0.01	0.02	0.01	-0.20
-0.48	-0.00	-0.05	-0.00	-0.20
-3.30	-59.42	-51.50	-5.45	0.00
-3.30	-59.42	51.35	-5.45	0.00
-3.76	-36.04	50.32	-5.56	0.01
-4.48	0.00	50.32	-5.56	0.00

Bh,gk = -43.91; Ch,gk = 11.10 [kN/m]
Bh,qk = -102.85; Ch,qk = 50.32 [kN/m]
Bh,d = -213.56; Ch,d = 90.45 [kN/m]

Check of C-force (foot support)

```
z(C)                                          =   -4.48 [kN/m]
G,k = sum(γ*h)                                =   71.76 [kN/m]
P,k = sum(Pz,k(x=  0.1))                      =    0.00 [kN/m]
kpgh,C(phi=  0.1; δ,C=  0.0°)                 =   1.002 [-]
kpch,C                                        =   2.003 [-]
eph,C,gk =(G,k+P,k)*kpgh,C+2*c*sqrt(kpch,C)=  213.44 [kN/m2]
         = (71.76+0.00)*1.002+2*50.0*1.415
Ed = Ch,d                                     =   90.45 [kN/m2]
δ,t,EAU          = Ed/(2*eph,C,d)             =    0.30 [m]
δ,t,EAB          =  0.20 * t                  =    0.50 [m]
δ,t = δ,t,EAB                                 =    0.50 [m]
Rd = 2*δ,t*eph,C,gk/γ,Re
   = 2*0.50*213.44/1.4
                                              =  151.00 [kN/m2]
```

Ed/Rd = 0.599 [-]. Passes requirement

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -3.30 m
Rd = Eph,k/γ,Re = 298.99 / 1.400 = 213.57 [kN/m]

Ed(Bh,d)/Rd = 213.56 / 213.57 = 1.000 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-4.48

Pos.	H	V
H/V pressure G+P+W,k	32.82	1.66
Wall weight		87.84
H/V pressure passive		0.00
Bh,g,k z=-3.30	-43.91	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.05
Ch,g	11.10	
Cv,g = Ch*tan(δ,C=0.0°)		0.01
Σ	0.00	89.46
		(downwards)

Simple check, EAB R 9-3a

Vk >= Bvk: 89.51 >= 0.05 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-4.48

Pos.	H	V
H/V pressure G+P+W,k	85.35	7.22
Wall weight		87.84
H/V pressure passive		0.00
Bh,g,k z=-3.30	-43.91	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.05
Bh,q,k z=-3.30	-102.85	
Bv,q,k = Bh,k * tan(δ,p=-0.07°)		-0.12
Ch,g	11.10	
Cv,g = Ch*tan(δ,C=0.0°)		0.01
Ch,q	50.32	
Cv,q = Ch*tan(δ,C=0.0°)		0.03

Pos.	H	V
Σ	-0.00	94.93 (downwards)

Simple check, EAB R 9-3a

Vk >= Bvk: 95.10 >= 0.17 Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)
Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (-1.72, 0.34), Ακτίνα = 5.59
Αρχ.σημ.= (-6.79, -2.00), Τελ.σημ. = (3.86, 0.00)

Γεωμετρία λωρίδων:

No	x	Width b	dxM	Weight	Load z-κατ.	Water-φορτ.	u*b	φ	c	θ
	[m]	[m]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[°]	[kN/m²]	[°]
1	-6.51	0.56	-4.80	5.9	0.0	0.0	-0.0	0.08	35.71	-44.96*
2	-5.96	0.56	-4.24	14.6	0.0	0.0	-1.7	0.08	35.71	-44.96*
3	-5.40	0.56	-3.68	20.9	0.0	0.0	-4.8	0.08	35.71	-41.18
4	-4.84	0.56	-3.12	25.7	0.0	0.0	-7.2	0.08	35.71	-33.95
5	-4.28	0.56	-2.56	29.6	0.0	0.0	-9.1	27.45	3.57	-27.29
6	-3.72	0.56	-2.00	32.7	0.0	0.0	-10.5	27.45	3.57	-21.01
7	-3.16	0.56	-1.44	35.0	0.0	0.0	-11.5	27.45	3.57	-14.98
8	-2.60	0.56	-0.89	36.5	0.0	0.0	-12.1	27.45	3.57	-9.12
9	-2.04	0.56	-0.33	37.3	0.0	0.0	-12.5	27.45	3.57	-3.35
10	-1.49	0.56	0.23	37.3	0.0	0.0	-12.5	27.45	3.57	2.38
11	-0.93	0.56	0.79	36.7	0.0	0.0	-12.2	27.45	3.57	8.14
12	-0.37	0.56	1.35	35.3	0.0	0.0	-11.6	27.45	3.57	13.98
13	0.19	0.56	1.91	50.5	0.0	0.0	-10.7	27.45	3.57	19.97
14	0.75	0.56	2.47	50.8	1.2	0.0	-9.3	27.45	3.57	26.20
15	1.31	0.56	3.03	47.1	24.0	0.0	-7.5	0.08	35.71	32.79
16	1.87	0.56	3.58	42.5	24.0	0.0	-5.2	0.08	35.71	39.91
17	2.42	0.56	4.14	36.5	24.0	0.0	-2.2	0.08	35.71	47.86
18	2.98	0.56	4.70	28.3	24.0	0.0	-0.2	0.08	35.71	57.30
19	3.56	0.60	5.28	16.0	10.2	0.0	-0.0	20.46	1.43	70.88

*** Σημείωση: Στις λωρίδες σημειωμένες με '*'
περιορίστηκε το theta στο 45°-Phi/2.

Συνεισφ. κατακόρυφων φορτίων:

No	Weight	G*sin(θ)	(G-u*b)*tan(φ) + c*b	μ*sin(θ)* tan(φ)+cos(θ)	T
	[kN/m]	[kN/m]	[kN/m]	[-]	[kN/m]
1	5.93	-5.09	19.96	0.707211	28.23
2	14.60	-11.07	19.97	0.707211	28.24
3	20.90	-13.76	19.98	0.752238	26.56
4	25.70	-14.35	19.98	0.829212	24.10
5	29.58	-13.56	12.66	0.794707	15.93
6	32.72	-11.73	13.56	0.860042	15.77

No	Weight [kN/m]	G*sin(θ) [kN/m]	(G-u*b)*tan(φ) + c*b [kN/m]	μ*sin(θ)* tan(φ)+cos(θ) [-]	T [kN/m]
7	35.01	-9.05	14.22	0.913023	15.57
8	36.51	-5.79	14.65	0.954871	15.34
9	37.27	-2.18	14.87	0.986300	15.08
10	37.33	1.55	14.89	1.007651	14.77
11	36.69	5.19	14.70	1.018951	14.43
12	35.31	8.53	14.31	1.019913	14.03
13	50.54	17.26	22.71	1.009894	22.49
14	52.06	22.98	24.20	0.987773	24.50
15	71.04	38.47	20.04	0.840984	23.83
16	66.44	42.63	20.04	0.767457	26.11
17	60.44	44.82	20.04	0.671336	29.85
18	52.28	43.99	20.03	0.540685	37.04
19	26.20	24.75	10.62	0.466572	22.77
		163.60			414.63

Δράση Ed = (163.6*5.59)
Αντίσταση Rd = (414.6*5.59 +0.0)
SLIP-CIRCLE μ = Ed/Rd = 0.39 < 1.0: Έλεγχος εκπληρώθηκε.

Φάση εκσκαφής 2 "[2] Situation 2"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 5 Στρώσεις

Name		Τεχνητές επιχωματώσεις	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
γ	[kN/m3]	18	20	22.5
γ,R	[kN/m3]	18	20	22.5
γ'	[kN/m3]	8	10	12.5
γ,p	[kN/m3]	18	20	22.5
γ,R,passive	[kN/m3]	18	20	22.5
γ,pw	[kN/m3]	8	10	12.5
φ	[°]	25	0.1	33
c	[kN/m2]	2	50	5
c,u	[kN/m2]	10	50	5
c παθητικό	[kN/m2]	2	50	5
δ,a	[°]	16.66667	0.06666667	22
δ,p	[°]	-16.66667	-0.06666667	-22
δ,c	[°]	8.333333	0.03333333	11
k,agh	[-]	0.3456501	0.9955057	0.2452023
K,ach	[-]	1.043051	1.994195	0.8549058
K,0h	[-]	0.5773817	0.9982547	0.455361
K,pgh	[-]	3.908103	1.004519	7.495617
K,pch	[-]	5.180327	2.00583	8.599509
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	10e-06	5.5e-09	100e-06

Name		Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20	22.5
γ,R	[kN/m3]	20	22.5
γ'	[kN/m3]	10	12.5
γ,p	[kN/m3]	20	22.5
γ,R,passive	[kN/m3]	20	22.5
γ,pw	[kN/m3]	10	12.5
φ	[°]	0.1	35
c	[kN/m2]	100	5
c,u	[kN/m2]	100	5
c παθητικό	[kN/m2]	100	5
δ,a	[°]	0.06666667	23.33333
δ,p	[°]	-0.06666667	-23.33333
δ,c	[°]	0.03333333	11.66667
k,agh	[-]	0.9955057	0.2244207
K,ach	[-]	1.994195	0.8126539
K,0h	[-]	0.9982547	0.4264236
K,pgh	[-]	1.004519	9.146943
K,pch	[-]	2.00583	10.104
τ,gr	[kN/m2]	110	110
Ψ,A,max	[°]	90	90
k	[cm/s]	5.5e-09	100e-06

Πορεία πρανούς:

x [m]	0.00	0.00
z [m]	-2.00	0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:

x [m]	0.00	0.00
z [m]	-2.00	-1.50

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:
z= -4.50

Πορεία ανώτερου 4. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
z= -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -14.00

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
1.00	0.00	3.50	0.00	0.00	33.00	0.00	33.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Στάθμη νερού:

x [m] 0.00
z [m] -3.00

Αγκύρια

z[m]	min.l[m]	Alpha[°]	C-H[kN/m]	P0[kN]	u0[m]
-0.50	0.00	15.00	αόρισ.	0.00	0.0000

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Ενεργές ωθήσεις.
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: Trapezoid.
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
Levels of redistribution Z1: 0.000, Z2: -1.000 [m].
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Κλασικός, Pregl/Sokolovsky (DIN 4085).

Options for water pressure

Στήριξη πόδα

Πόδας οριζοντίως μετακινούμενος

Αγκύρια

Anchor checks (lower failure plane): Ναι
Anchor forces with safety level of DS-P: Ναι
Verification of grout body pull out forces: Ναι
δ,a,Anchoring wall : used from soil layer.
δ,p,Anchoring wall : used from soil layer.

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Τεχνητές επιχωματώσεις

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

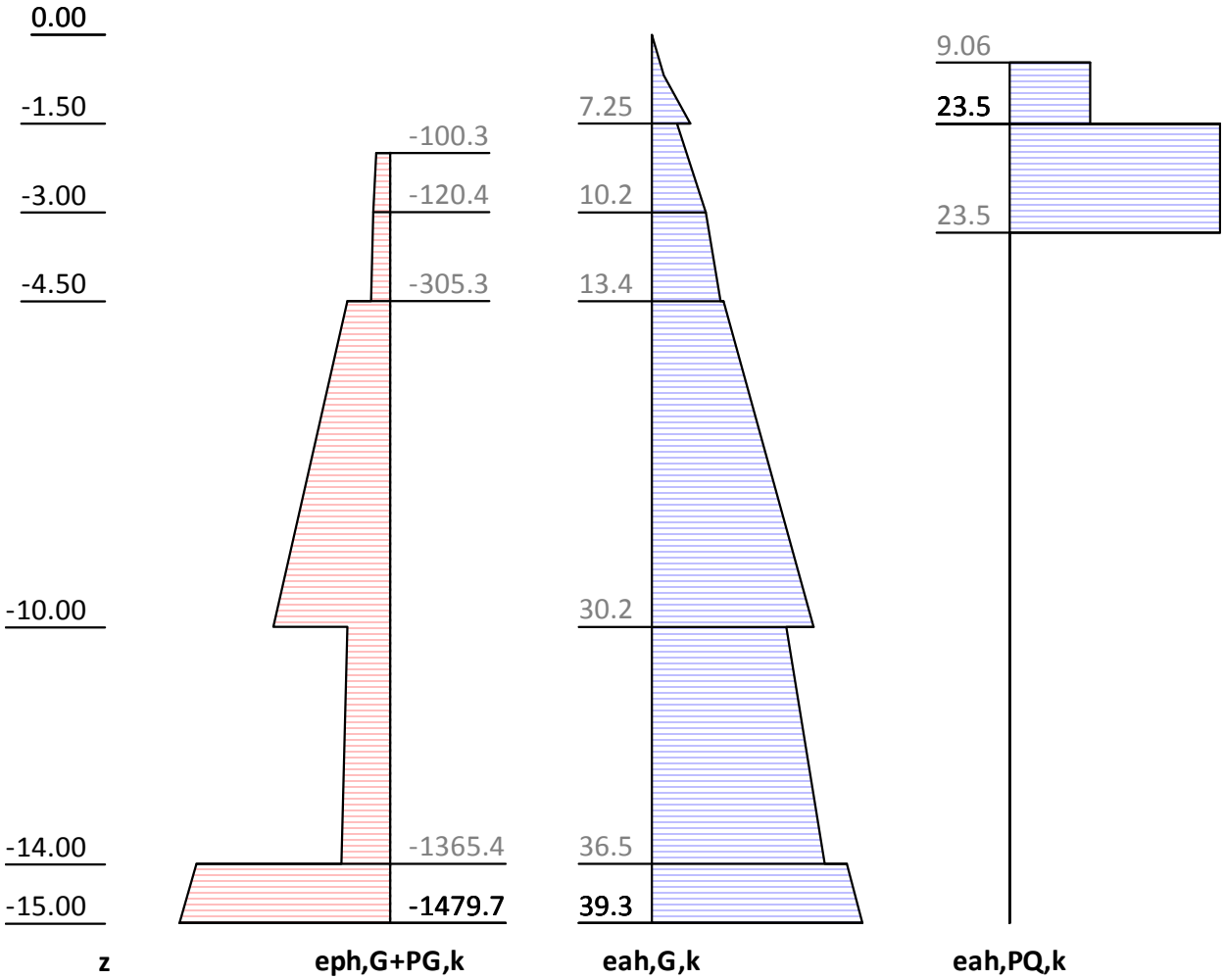
Μήκος τοίχου

Foot depth for statics: zf = -15.000

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall



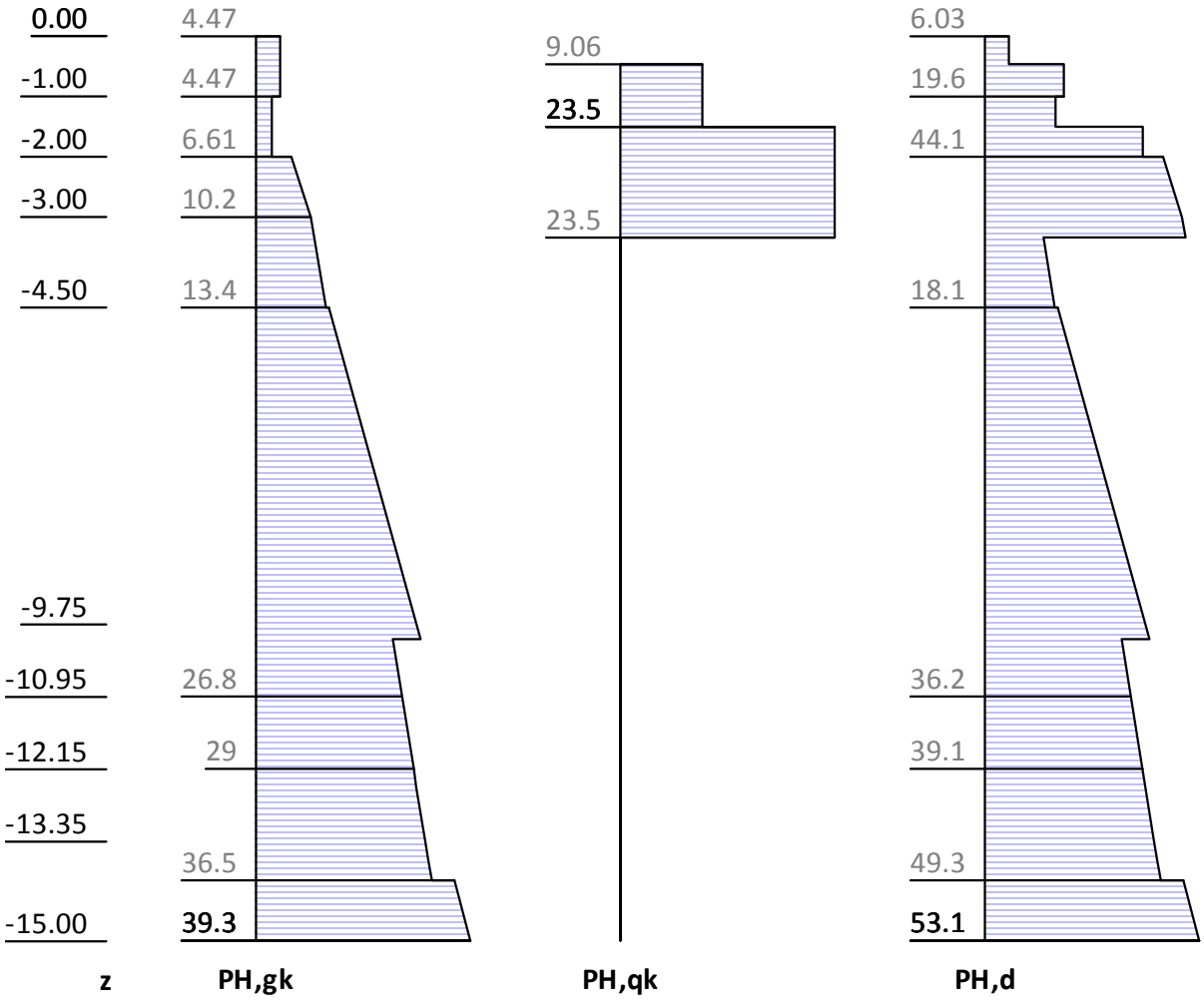
z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.47		1.52	0.00	2.04
-0.47		1.52	9.06	15.62
-1.50		7.25	9.06	23.37

z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
-1.50		4.82	23.48	41.73
-2.00	-0.00	6.61	23.48	44.14
-2.00	-100.29	6.61	23.48	44.14
-3.34	-123.80	10.79	23.48	49.78
-3.34	-123.80	10.79	0.00	14.56
-4.50	-135.45	12.86	0.00	17.36
-4.50	-305.34	13.38	0.00	18.06
-10.00	-820.67	30.24	0.00	40.82
-10.00	-304.80	25.14	0.00	33.93
-14.00	-344.98	32.28	0.00	43.58
-14.00	-1365.39	36.50	0.00	49.28
-15.00	-1479.73	39.31	0.00	53.06

Eph,G,k:-6120.87, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 305.81, Eah,PG,k: 0.00, Eah,PQ,k: 52.53, Eah,d: 491.64

H-pressure on static system

Level of mobilization: Ep,gk 100.0, Ep,qk 100.0, Ep,d 100.0 [%]



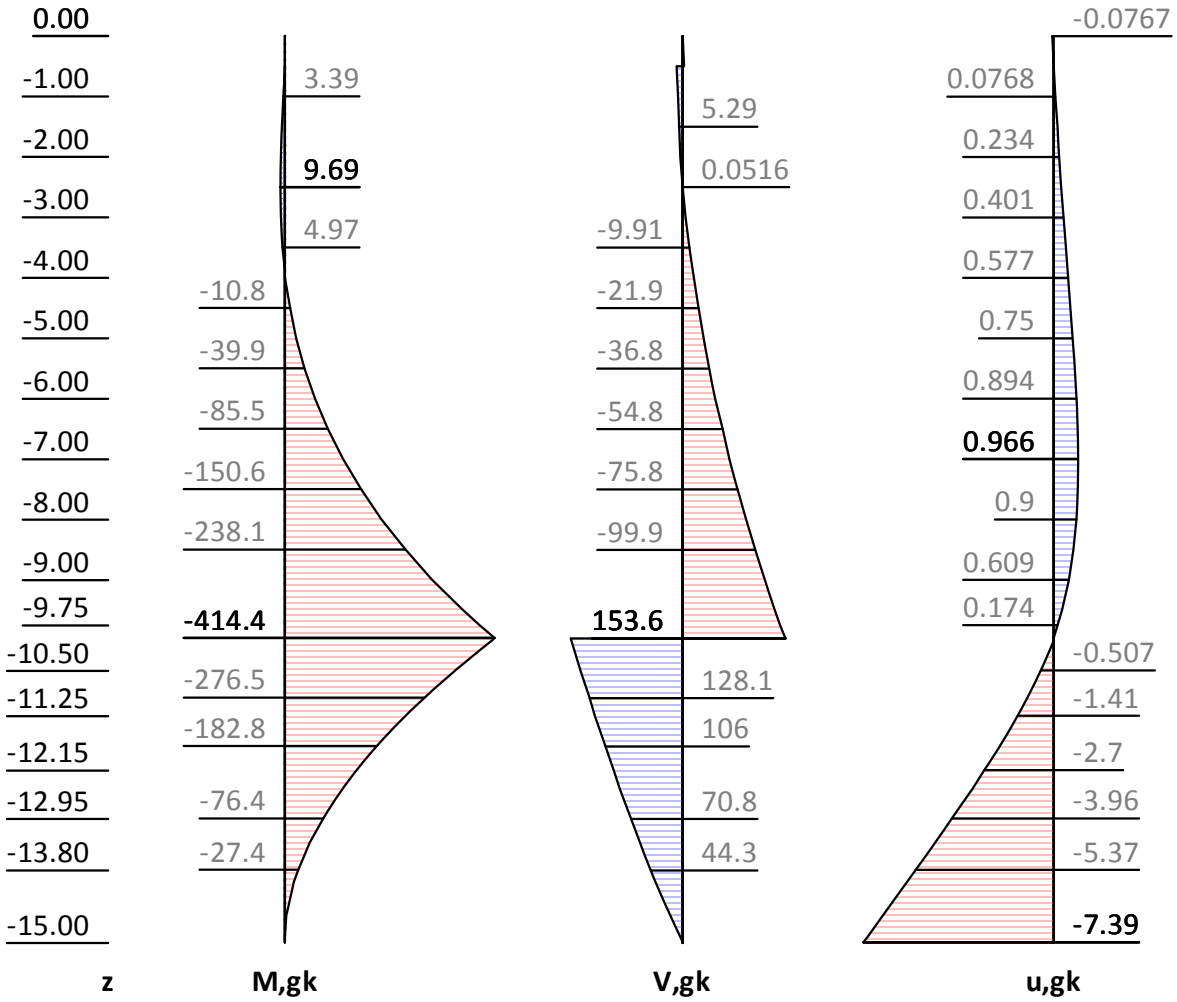
z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	4.47		6.03
-0.47	4.47	0.00	6.03

z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
-0.47	4.47	9.06	19.62
-1.00	4.47	9.06	19.62
-1.00	2.98	9.06	17.61
-1.50	2.98	9.06	17.61
-1.50	2.98	23.48	39.25
-2.00	2.98	23.48	39.25
-2.00	6.61	23.48	44.14
-3.34	10.79	23.48	49.78
-3.34	10.79	0.00	14.56
-4.50	12.86	0.00	17.36
-4.50	13.38	0.00	18.06
-10.00	30.24	0.00	40.82
-10.00	25.14	0.00	33.93
-14.00	32.28	0.00	43.58
-14.00	36.50	0.00	49.28
-15.00	39.31	0.00	53.06

V-pressure on static system

Internal forces: Permanent, characteristically

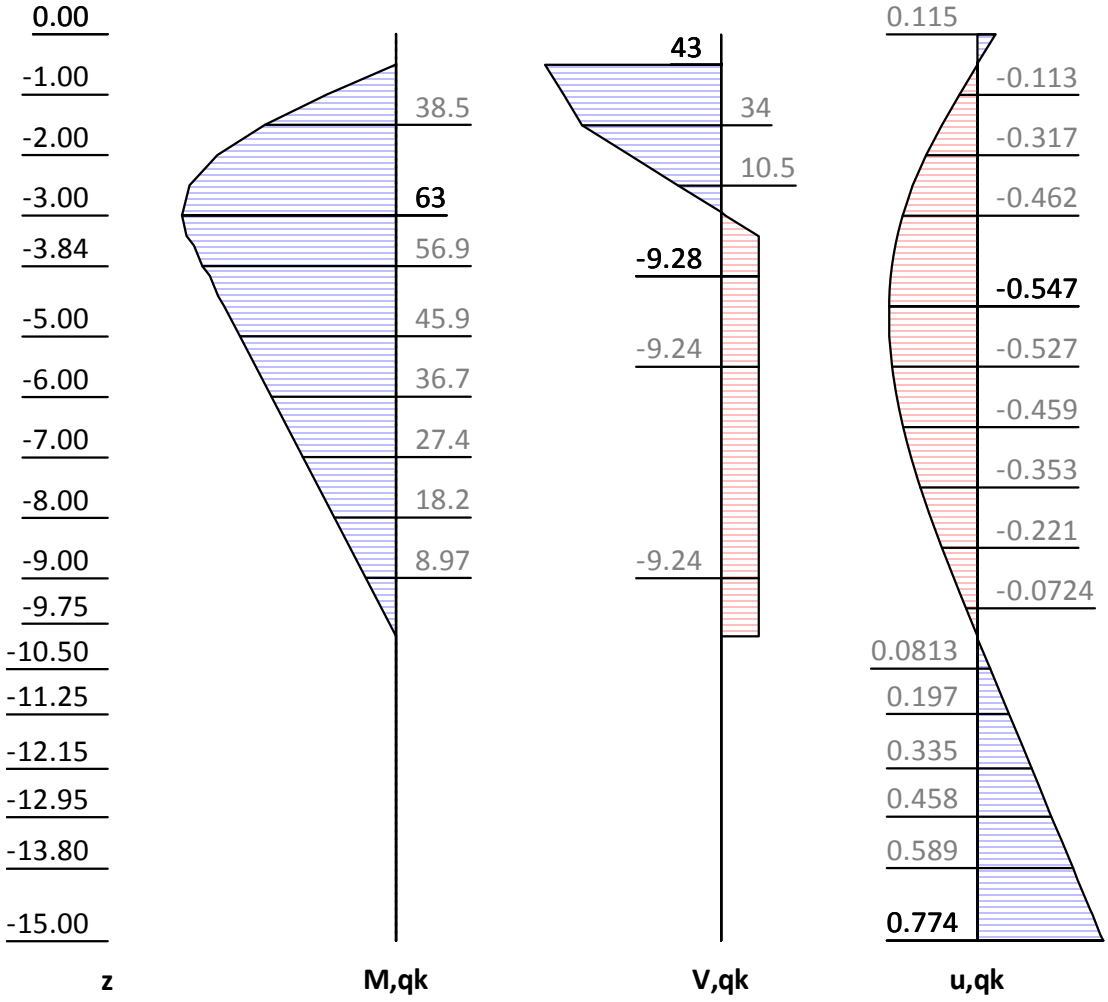
z= -0.500. Fx= -11.253 kN/m Support
z= -9.971. Fx=-294.557 kN/m Support



z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	4.47	0.00	0.00	0.00	-0.08
-0.00	4.47	-0.00	0.00	-0.00	-0.08
-0.50	4.47	-0.56	-2.23	-10.99	-0.00
-0.50	4.47	-0.56	9.02	-14.00	-0.00
-0.50	4.47	-0.56	9.02	-14.00	0.00
-0.57	4.47	0.00	8.70	-15.56	0.01
-1.00	4.47	3.39	6.78	-24.99	0.08
-1.00	2.98	3.39	6.78	-24.99	0.08
-2.00	2.98	8.68	3.80	-46.65	0.23
-2.00	6.61	8.68	3.80	-46.65	0.23
-2.50	8.39	9.69	0.05	-57.15	0.32
-2.51	8.41	9.67	0.00	-57.27	0.32
-3.89	11.77	-0.00	-14.40	-78.89	0.56
-4.50	12.86	-10.76	-21.87	-86.58	0.67
-4.50	13.38	-10.76	-21.87	-86.58	0.67
-7.00	21.04	-115.41	-64.93	-135.48	0.97
-9.97	30.15	-414.37	-140.96	-203.64	0.00
-9.97	30.15	-414.37	153.60	-203.64	0.00
-10.00	30.24	-409.99	152.74	-204.34	-0.02
-10.00	25.14	-409.99	152.74	-204.34	-0.02
-14.00	32.28	-19.19	37.90	-254.88	-5.70
-14.00	36.50	-19.19	37.90	-254.88	-5.70
-15.00	39.31	-0.00	0.00	-283.83	-7.39
-15.00	39.31	-0.00	-0.00	-283.83	-7.39

Internal forces: Variable, characteristically

Method EB 82-4 (Q = [G+Q] - G).
z= -0.500. Fx= -43.297 kN/m Support
z= -9.971. Fx= -9.236 kN/m Support

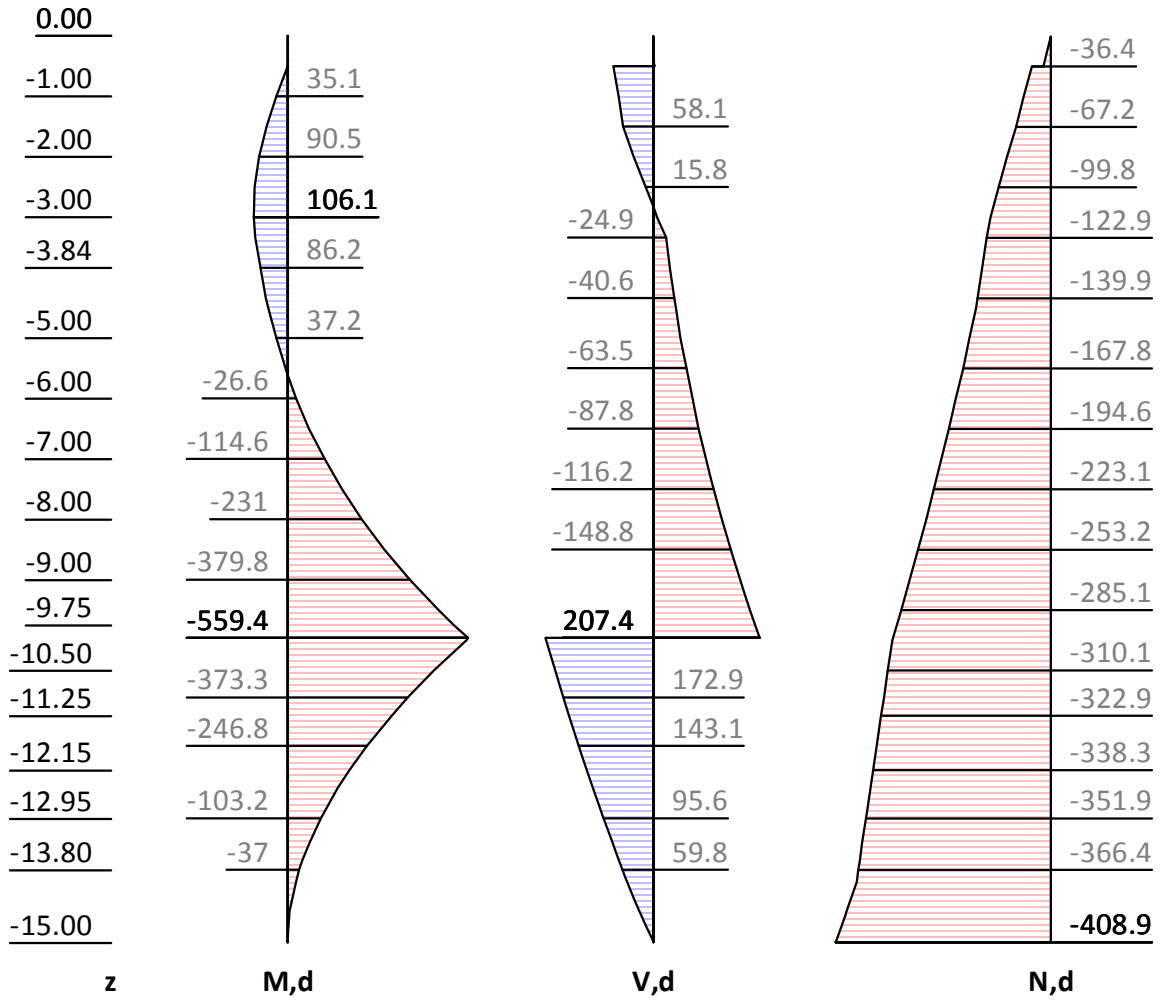


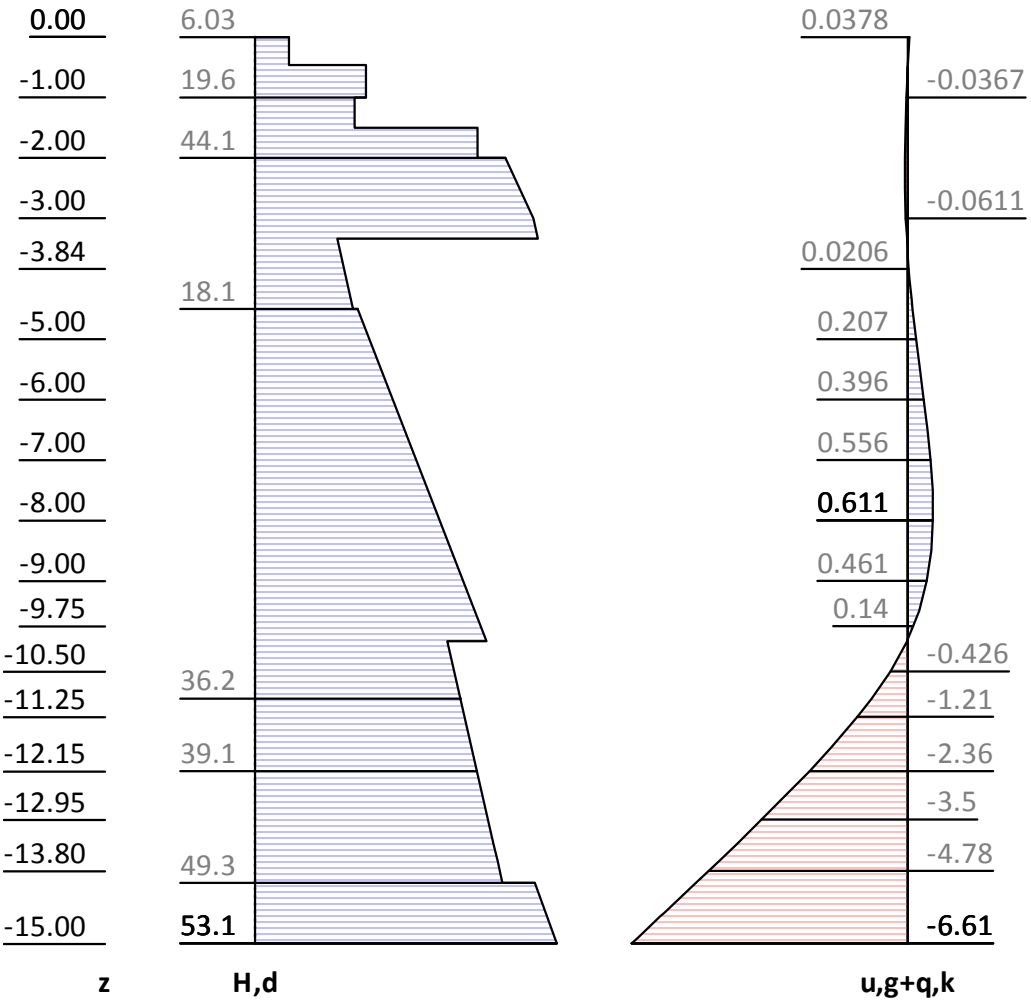
z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00	-0.00	0.00	0.11
-0.47	0.00	0.03	-0.00	0.00	0.01
-0.47	9.06	0.03	-0.00	0.00	0.01
-0.47	9.06	0.03	-0.00	-0.00	0.01
-0.50	9.06	0.00	-0.24	-0.03	0.00
-0.50	9.06	0.00	43.02	-11.63	-0.00
-1.50	9.06	38.49	33.97	-12.59	-0.22
-1.50	23.48	38.49	33.97	-12.59	-0.22
-2.95	23.48	62.78	0.00	-16.18	-0.46
-3.00	23.48	63.03	-1.25	-16.31	-0.46
-3.34	23.48	61.54	-9.19	-17.16	-0.50
-3.34	0.00	61.54	-9.19	-17.16	-0.50
-3.50	0.00	59.47	-9.28	-17.16	-0.51
-4.00	0.00	54.83	-9.28	-17.16	-0.53
-4.50	0.00	50.53	-9.24	-17.16	-0.55
-6.50	0.00	32.06	-9.24	-17.16	-0.46
-7.50	0.00	22.83	-9.24	-17.16	-0.35

z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
-8.00	0.00	18.21	-9.24	-17.16	-0.29
-9.75	0.00	2.05	-9.24	-17.16	-0.03
-9.97	0.00	0.00	-9.24	-17.16	0.00
-9.97	0.00	0.00	0.00	-17.16	0.00
-10.00	0.00	0.00	0.00	-17.16	0.00
-13.35	0.00	0.00	-0.00	-17.16	0.52
-13.65	0.00	0.00	-0.00	-17.16	0.57
-13.80	0.00	0.00	0.00	-17.16	0.59
-14.49	0.00	0.00	-0.00	-17.16	0.69
-14.90	0.00	-0.00	-0.00	-17.16	0.76
-14.95	0.00	-0.00	0.00	-17.16	0.77
-15.00	0.00	0.00	0.00	-17.16	0.77

Internal forces: Design

z= -0.500. Fx= -80.137 kN/m Support
z= -9.971. Fx=-411.505 kN/m Support





z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	6.03	0.00	0.00	0.00	0.04
-0.47	6.03	-0.67	-2.84	-13.95	0.00
-0.47	19.62	-0.67	-2.84	-13.95	0.00
-0.50	19.62	-0.76	-3.42	-14.88	0.00
-0.50	19.62	-0.76	-3.42	-14.88	-0.00
-0.50	19.62	-0.76	76.71	-36.35	-0.00
-0.51	19.62	-0.00	76.50	-36.68	-0.00
-1.00	19.62	35.14	66.90	-51.91	-0.04
-1.00	17.61	35.14	66.90	-51.91	-0.04
-1.50	17.61	66.39	58.10	-67.24	-0.07
-1.50	39.25	66.39	58.10	-67.24	-0.07
-2.00	39.25	90.54	38.47	-83.72	-0.08
-2.00	44.14	90.54	38.47	-83.72	-0.08
-2.83	48.15	105.47	-0.00	-110.38	-0.07
-3.00	48.96	106.14	-8.08	-115.81	-0.06
-3.34	49.78	100.55	-24.86	-122.86	-0.03
-3.34	14.56	100.55	-24.86	-122.86	-0.03
-3.65	15.32	91.57	-29.62	-128.21	-0.00
-4.50	17.36	61.28	-43.38	-142.62	0.12
-4.50	18.06	61.28	-43.38	-142.62	0.12
-5.62	22.68	0.00	-66.24	-170.84	0.32

z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
-8.00	32.55	-231.00	-131.98	-237.95	0.61
-9.97	40.70	-559.40	-204.14	-300.65	0.00
-9.97	40.70	-559.40	207.36	-300.65	0.00
-10.00	40.82	-553.49	206.20	-301.60	-0.02
-10.00	33.93	-553.49	206.20	-301.60	-0.02
-14.00	43.58	-25.90	51.17	-369.83	-5.08
-14.00	49.28	-25.90	51.17	-369.83	-5.08
-15.00	53.06	-0.00	0.00	-408.91	-6.61
-15.00	53.06	-0.00	-0.00	-408.91	-6.61

Anchor forces with safety level of DS-P

z[m]	A,d[kN]	Fx,d[kN/m]
-0.50	149.3	-80.1

Checks of earth statics

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -9.97 m
Rd = Eph,k/γ,Re = 6120.87 / 1.400 = 4372.05 [kN/m]
Ed(Uh,d)/Rd = 411.50 / 4372.05 = 0.094 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-15.00

Pos.	H	V
H/V pressure G+P+W,k	305.81	66.61
Wall weight		214.21
H/V pressure passive		0.00
Support z: -0.50	-11.25	3.02
Bh,g,k z=-9.97	-294.56	
Bv,g,k = Bh,k * tan(δ,p=-22.00°)		-119.01
Σ	-0.00	164.82 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.
Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1

Vertical component of earth resistance is less than
the downwards pointing vertical forces.
Vk >= Bvk: 283.83 >= 119.01 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-15.00

Pos.	H	V
H/V pressure G+P+W,k	358.34	72.16
Wall weight		214.21
H/V pressure passive		0.00
Support z: -0.50	-54.55	14.62
Bh,g,k z=-9.97	-294.56	
Bv,g,k = Bh,k * tan(δ,p=-22.00°)		-119.01
Bh,q,k z=-9.97	-9.24	
Bv,q,k = Bh,k * tan(δ,p=-22.00°)		-3.73

Pos.	H	V
Σ	-0.00	178.25 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.

Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1

Vertical component of earth resistance is less than the downwards pointing vertical forces.

Vk >= Bvk: 300.99 >= 122.74 Passes requirement

Anchor verification

Anchor - Stability of lower failure plane

Περίπτ.Φόρτισης: όλα τα φορτία BS-P
Αυτόμ. υπολογ. μήκους αγκυρίων:
All anchors are extended (if necessary)
Favourable variable loads in main failure body are not being considered.
Bottom of lower failure plane: z=-15.00 m

Iteration of failure mechanisms:

lA .....: Length of anchor from head to center of grout body.
W,k .....: Res. force from dead weight, loads, cohesion, ...
Q,k .....: Force in lower failure plane.
Ea1,k.....: Earth pressure onto vertical separation plane.
Ea2,k.....: Earth pressure between wall and main failure body.
Ra_cal,d ...: Dimesioning force of the resistance from the equilibrium of forces. Ra_cal,d corresponds to the max. possible anchor force of the force polygon.
Sum(A,d) ...: Acting anchor forces along the grout body fractions within the failure body. Sum(A,d) is gained from the anchor pull forces of the wall analysis.

z [m]	ϑ1 [°]	ϑ2 [°]	lA [m]	W,k [kN/m]	Q,k [kN/m]	Ea1,k [kN/m]	Ea2,k [kN/m]	Ra_cal,d [kN/m]	Sum(A,d) [kN/m]	Ed/Rd [-]
-0.50	53.1	57.5	9.38	805.4	641.5	4.4	365.5	282.4	83.0	0.29

Decisive failure body:

Γεωμετρία:

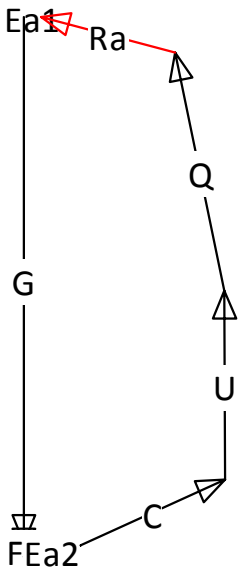
Foot point of lower failure plane	x/z = 0.01/-15.00 m
Intersection lower/upper slid. plane	x/z = 9.07/ -2.93 m
Intersection upper slid. plane/surface	x/z = 10.93/ 0.00 m
Intersection separation plane/surface	x/z = 9.07/ 0.00 m
Inclination lower failure plane	ϑ1 = 53.12°
Inclination upper failure plane	ϑ2 = 57.50°
Inclination separation plane	ϑ12 = 90.00°

Loads / forces (char.)

		Fx [kN/m]	Fz [kN/m]	F [kN/m]	
Weight of main failure body	G,k:	0.0	-1677.2	1677.2	
Area loads on/in main failure body	F1,k:	0.0	-82.5	82.5	
Cohesion of lower failure plane	C,k:	383.4	511.0	638.9	
Pore water pressure on main body	U,k:	-0.5	540.1	540.1	
Earth pres. on separation plane	Ea1,k:	-4.4	-0.0	4.4	δ= 0.0°
Earth pr. between wall<->main body	Ea2,k:	358.3	71.9	365.5	
Force in lower failure plane	Q,k:	-354.9	534.3	641.5	

		Fx [kN/m]	Fz [kN/m]	F [kN/m]
Sum = possible anchor forces:	Ra_cal,k:	381.8	-102.3	395.3

Force polygon



Acting anchor forces Ed: Sum(A,d) = 83.0 kN/m
Possible anchor forces Rd: Ra_cal,d = 395.3/1.400 = 282.4 kN/m
Verif. of lower failure plane Ed/Rd = 0.29 < 1.0: Έλεγχος εκπληρώθηκε.

Check of steel tension

l,tot ...[m]: Total length of anchor incl. excess length at head
As ....[mm2]: X-section are of steel member
Ri,d ...[kN]: Ultimate strength of tension member (γ,M=1.15)
A,d ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	l,tot	As	Ri,d		A,d	
-0.50	Strand;3x0.60";1570/1770	13.38	420	573.4	>	149.3	Passes requirement

Check of steel tension: Passes requirement

Check of anchor's soil friction

lVk .....: Length of grout body
DmVk ....: Diameter of grout body
τGr,k ...: Average applied skin friction along the grout body (from soil parameters)
Ra,k ....: Charact. pullout resistance of the anchor
γA ......: Partial safety factor of anchor pullout
Ra,d ....: = Ra,k / γA
A,d .....: Dimensioning force of the anchor from wall analysis

z [m]	lVk [m]	DmVk [mm]	τGr,k [kN/m²]	Ra,k [kN]	γA [-]	Ra,d [kN]		A,d [kN]	A,d/Ra,d [-]
-0.50	8.00	318	110	879.1	1.100	799.2	>	149.3	0.2

Check of anchor's soil friction: Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)
Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (-3.91, 2.97), Ακτίνα = 18.40
Αρχ.σημ.= (-21.62, -2.00), Τελ.σημ. = (14.25, 0.00)

Γεωμετρία λωρίδων:

No	x	Width b	dxM	Weight	Load z-κατ.	Water-φορτ.	u*b	φ	c	θ
	[m]	[m]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[°]	[kN/m²]	[°]
1	-20.70	1.84	-16.79	93.8	0.0	0.0	-30.6	27.45	3.57	-31.27*
2	-18.86	1.84	-14.95	226.5	0.0	0.0	-85.2	27.45	3.57	-31.27*
3	-17.02	1.84	-13.12	317.0	0.0	0.0	-126.3	27.45	3.57	-31.27*
4	-15.18	1.84	-11.28	377.4	0.0	0.0	-156.8	0.08	71.43	-37.80
5	-13.34	1.84	-9.44	423.7	0.0	0.0	-180.1	0.08	71.43	-30.85
6	-11.50	1.84	-7.60	459.1	0.0	0.0	-197.9	0.08	71.43	-24.38
7	-9.66	1.84	-5.76	487.8	0.0	0.0	-211.2	29.26	3.57	-18.23
8	-7.82	1.84	-3.92	508.6	0.0	0.0	-220.5	29.26	3.57	-12.29
9	-5.98	1.84	-2.08	521.2	0.0	0.0	-226.1	29.26	3.57	-6.48
10	-4.14	1.84	-0.24	526.0	0.0	0.0	-228.2	29.26	3.57	-0.74
11	-2.30	1.84	1.60	523.2	0.0	0.0	-227.0	29.26	3.57	5.00
12	-0.47	1.84	3.44	529.4	0.0	0.0	-222.3	29.26	3.57	10.79
13	1.37	1.84	5.28	562.0	0.0	0.0	-214.0	29.26	3.57	16.69
14	3.21	1.84	7.12	534.8	51.7	0.0	-201.8	0.08	71.43	22.78
15	5.05	1.84	8.96	501.8	0.0	0.0	-185.2	0.08	71.43	29.15
16	6.89	1.84	10.80	458.6	0.0	0.0	-163.4	0.08	71.43	35.96
17	8.73	1.84	12.64	402.4	0.0	0.0	-135.0	0.08	71.43	43.41
18	10.57	1.84	14.48	320.6	0.0	0.0	-97.1	27.45	3.57	51.92
19	12.87	2.76	16.78	244.5	0.0	0.0	-56.4	27.45	3.57	65.79

*** Σημείωση: Στις λωρίδες σημειωμένες με '*'
περιορίστηκε το theta στο 45°-Phi/2.

Συνεισφ. κατακόρυφων φορτίων:

No	Weight	G*sin(θ)	(G-u*b)*tan(φ) + c*b	μ*sin(θ)* tan(φ)+cos(θ)	T
	[kN/m]	[kN/m]	[kN/m]	[-]	[kN/m]
1	93.80	-85.62	39.38	0.824745	47.75
2	226.45	-184.07	79.97	0.824745	96.96
3	316.97	-225.95	105.60	0.824745	128.04
4	377.44	-231.31	131.72	0.790106	166.72
5	423.66	-217.27	131.76	0.858400	153.49
6	459.08	-189.53	131.78	0.910736	144.70
7	487.82	-152.61	161.52	0.930339	173.62
8	508.60	-108.25	167.96	0.963843	174.27
9	521.18	-58.81	171.87	0.986591	174.21
10	525.99	-6.76	173.36	0.999118	173.51
11	523.15	45.59	172.48	1.001617	172.20
12	529.42	99.08	178.63	0.993975	179.71
13	562.05	161.39	201.56	0.975750	206.57
14	586.46	227.05	131.95	0.922076	143.10

No	Weight [kN/m]	G*sin(θ) [kN/m]	(G-u*b)*tan(φ) + c*b [kN/m]	μ*sin(θ)* tan(φ)+cos(θ) [-]	T [kN/m]
15	501.78	244.44	131.86	0.873393	150.97
16	458.56	269.25	131.83	0.809568	162.84
17	402.40	276.51	131.79	0.726620	181.37
18	320.64	252.39	122.69	0.662179	185.28
19	244.49	222.98	107.55	0.462758	232.42
		338.48			3047.73

Δράση Ed = (338.5*18.40)
Αντίσταση Rd = (3047.7*18.40 +0.0)

SLIP-CIRCLE μ = Ed/Rd = 0.11 < 1.0: Έλεγχος εκπληρώθηκε.

Φάση εκσκαφής 3 "[3] Situation 3"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 5 Στρώσεις

Name		Τεχνητές επιχωματώσεις	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
γ	[kN/m3]	18	20	22.5
γ,R	[kN/m3]	18	20	22.5
γ'	[kN/m3]	8	10	12.5
γ,p	[kN/m3]	18	20	22.5
γ,R,passive	[kN/m3]	18	20	22.5
γ,pw	[kN/m3]	8	10	12.5
φ	[°]	25	0.1	33
c	[kN/m2]	2	50	5
c,u	[kN/m2]	10	50	5
c παθητικό	[kN/m2]	2	50	5
δ,a	[°]	16.66667	0.06666667	22
δ,p	[°]	-16.66667	-0.06666667	-22
δ,c	[°]	8.333333	0.03333333	11
k,agh	[-]	0.3456501	0.9955057	0.2452023
K,ach	[-]	1.043051	1.994195	0.8549058
K,0h	[-]	0.5773817	0.9982547	0.455361
K,pgh	[-]	3.908103	1.004519	7.495617
K,pch	[-]	5.180327	2.00583	8.599509
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	10e-06	5.5e-09	100e-06

Name		Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20	22.5
γ,R	[kN/m3]	20	22.5
γ'	[kN/m3]	10	12.5
γ,p	[kN/m3]	20	22.5
γ,R,passive	[kN/m3]	20	22.5
γ,pw	[kN/m3]	10	12.5
φ	[°]	0.1	35
c	[kN/m2]	100	5
c,u	[kN/m2]	100	5
c παθητικό	[kN/m2]	100	5
δ,a	[°]	0.06666667	23.33333
δ,p	[°]	-0.06666667	-23.33333
δ,c	[°]	0.03333333	11.66667
k,agh	[-]	0.9955057	0.2244207
K,ach	[-]	1.994195	0.8126539
K,0h	[-]	0.9982547	0.4264236
K,pgh	[-]	1.004519	9.146943
K,pch	[-]	2.00583	10.104
τ,gr	[kN/m2]	110	110
Ψ,A,max	[°]	90	90
k	[cm/s]	5.5e-09	100e-06

Πορεία πρανούς:

x [m]	0.00	0.00
z [m]	-4.00	0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:

x [m]	0.00	0.00
z [m]	-4.00	-1.50

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:
z= -4.50

Πορεία ανώτερου 4. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
z= -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -14.00

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
1.00	0.00	3.50	0.00	0.00	33.00	0.00	33.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Στάθμη νερού:

x [m]	0.00	0.00
z [m]	-6.00	-3.00

Αγκύρια

z[m]	min.l[m]	Alpha[°]	C-H[kN/m]	P0[kN]	u0[m]
-0.50	0.00	15.00	αόρισ.	0.00	0.0000

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Ενεργές ωθήσεις.
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: Trapezoid.
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
Levels of redistribution Z1: 0.000, Z2: -2.000 [m].
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Κλασικός, Pregl/Sokolovsky (DIN 4085).

Options for water pressure

Στήριξη πόδα

Πόδας οριζοντίως μετακινούμενος

Αγκύρια

Anchor checks (lower failure plane): Ναι
Anchor forces with safety level of DS-P: Ναι
Verification of grout body pull out forces: Ναι
δ,a,Anchoring wall : used from soil layer.
δ,p,Anchoring wall : used from soil layer.

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Τεχνητές επιχωματώσεις

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

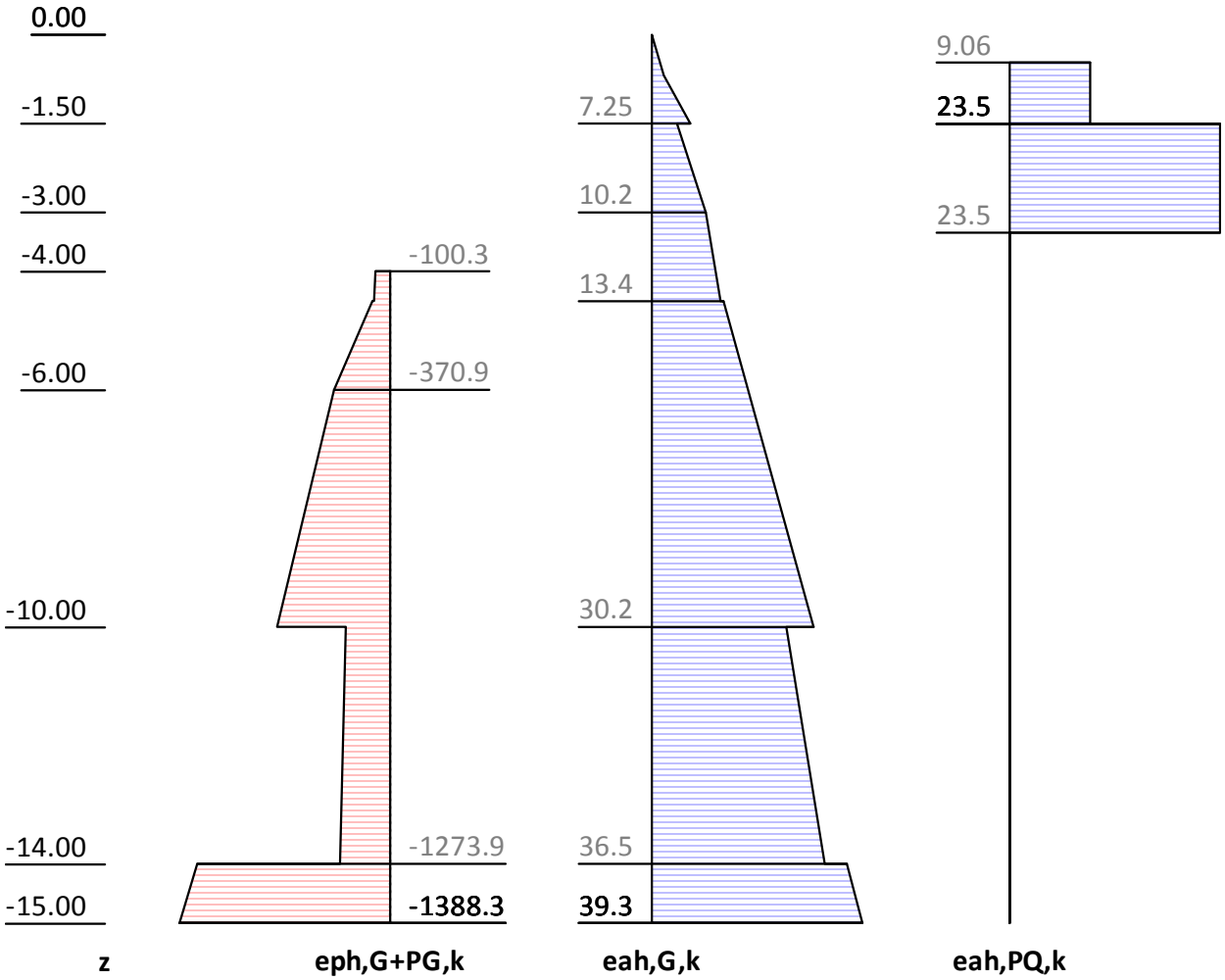
Μήκος τοίχου

Foot depth for statics: zf = -15.000

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall



z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.47		1.52	0.00	2.04
-0.47		1.52	9.06	15.62
-1.50		7.25	9.06	23.37

z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
-1.50		4.82	23.48	41.73
-3.34		10.79	23.48	49.78
-3.34		10.79	0.00	14.56
-4.00	-0.00	11.97	0.00	16.15
-4.00	-100.29	11.97	0.00	16.15
-4.50	-110.34	12.86	0.00	17.36
-4.50	-117.95	13.38	0.00	18.06
-10.00	-745.71	30.24	0.00	40.82
-10.00	-294.76	25.14	0.00	33.93
-14.00	-334.94	32.28	0.00	43.58
-14.00	-1273.92	36.50	0.00	49.28
-15.00	-1388.26	39.31	0.00	53.06

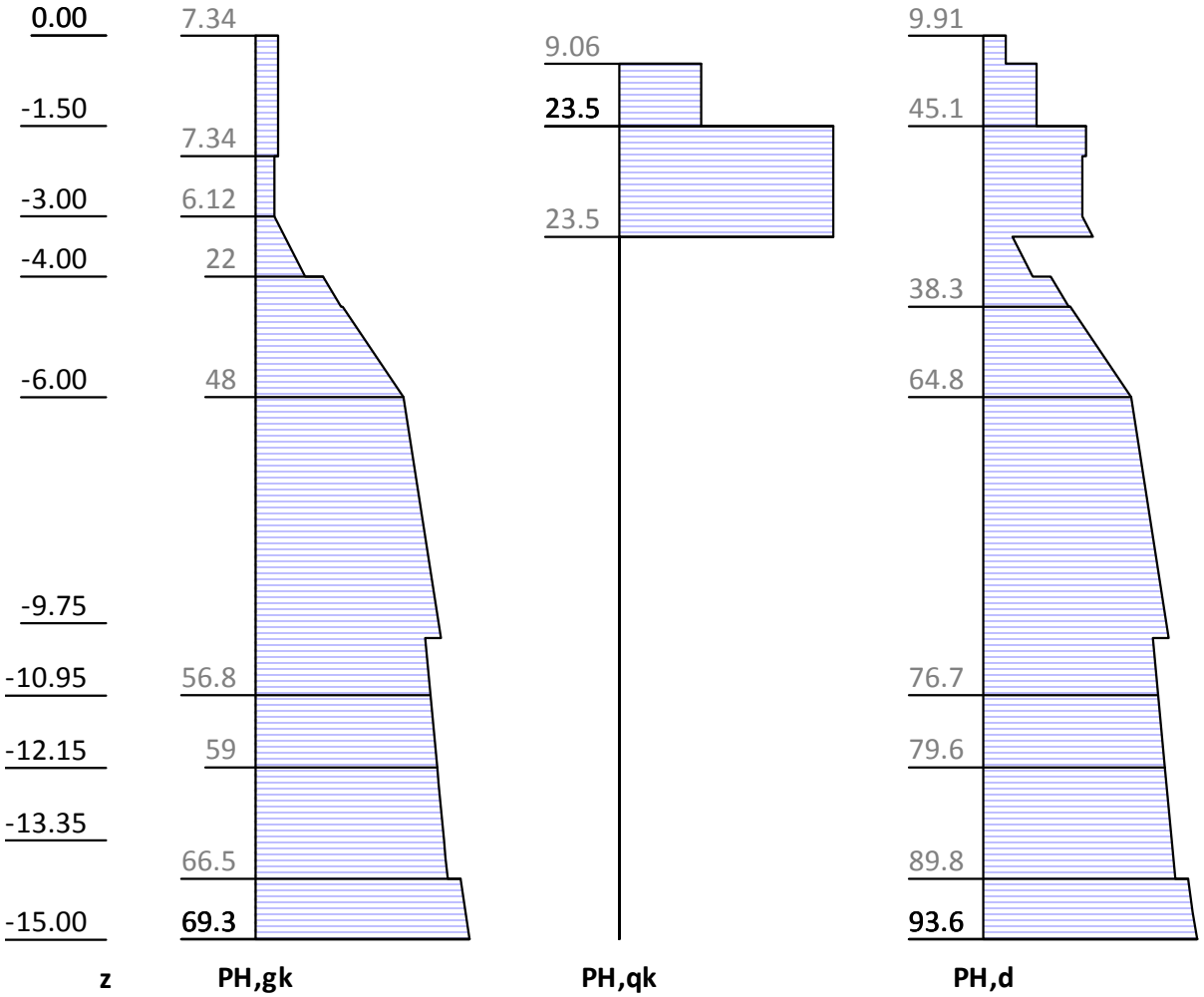
Eph,G,k:-5243.09, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 305.81, Eah,PG,k: 0.00, Eah,PQ,k: 52.53, Eah,d: 491.64

Πίεση νερού

z [m]	Wp,k [kN/m2]	Wa,k [kN/m2]	W,k [kN/m2]
-3.00		0.00	0.00
-6.00	0.00	30.00	30.00
-15.00	-90.00	120.00	30.00

H-pressure on static system

Level of mobilization: Ep,gk 100.0, Ep,qk 100.0, Ep,d 100.0 [%]

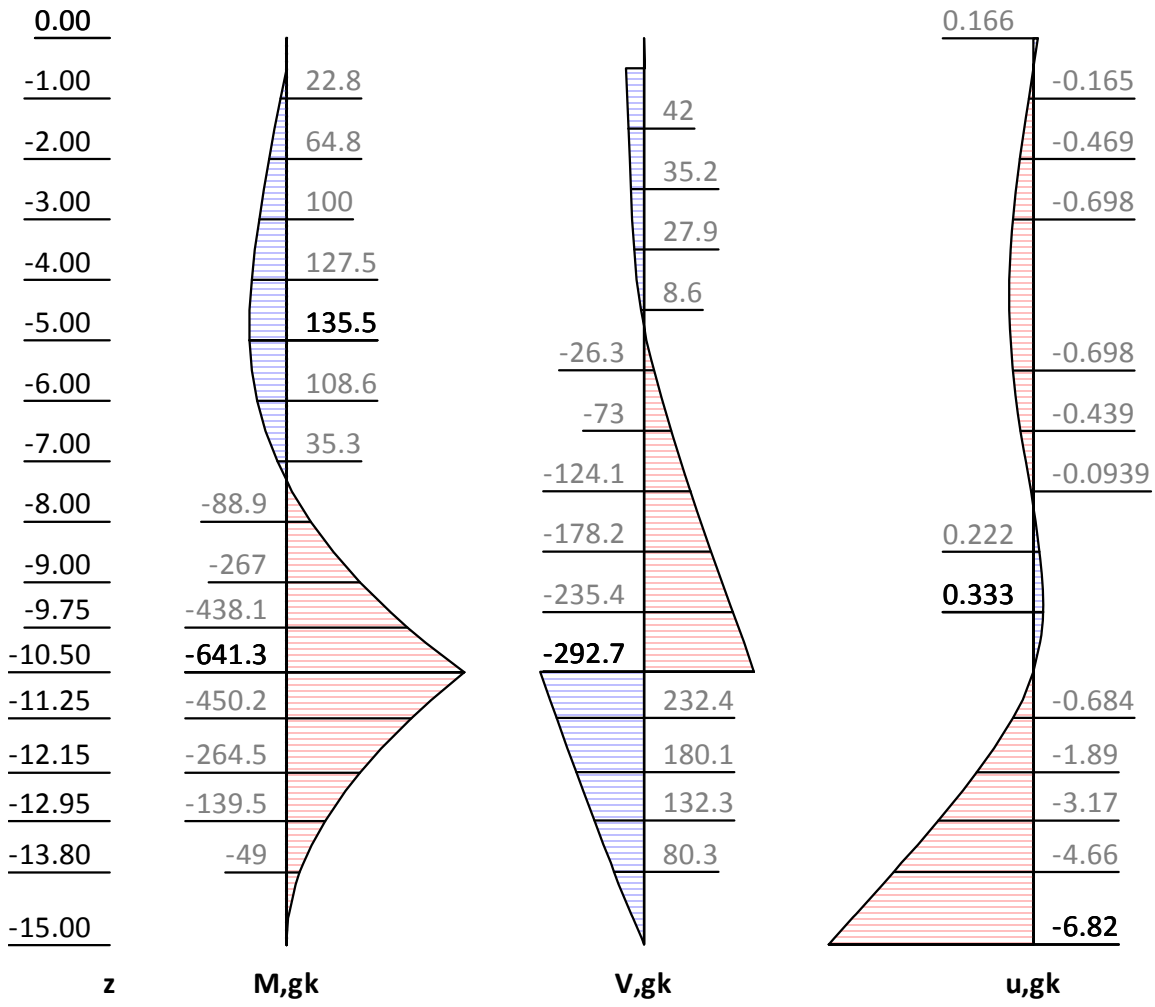


z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	7.34		9.91
-0.47	7.34	0.00	9.91
-0.47	7.34	9.06	23.50
-1.50	7.34	9.06	23.50
-1.50	7.34	23.48	45.13
-2.00	7.34	23.48	45.13
-2.00	6.12	23.48	43.48
-3.34	9.52	23.48	48.07
-3.34	9.52	0.00	12.85
-4.00	16.12	0.00	21.76
-4.00	21.97	0.00	29.65
-4.50	27.86	0.00	37.61
-4.50	28.38	0.00	38.31
-10.00	60.24	0.00	81.32
-10.00	55.14	0.00	74.43
-14.00	62.28	0.00	84.08
-14.00	66.50	0.00	89.78
-15.00	69.31	0.00	93.56

V-pressure on static system

Internal forces: Permanent, characteristically

z= -0.500. Fx= -52.979 kN/m Support
z= -10.497. Fx=-567.831 kN/m Support

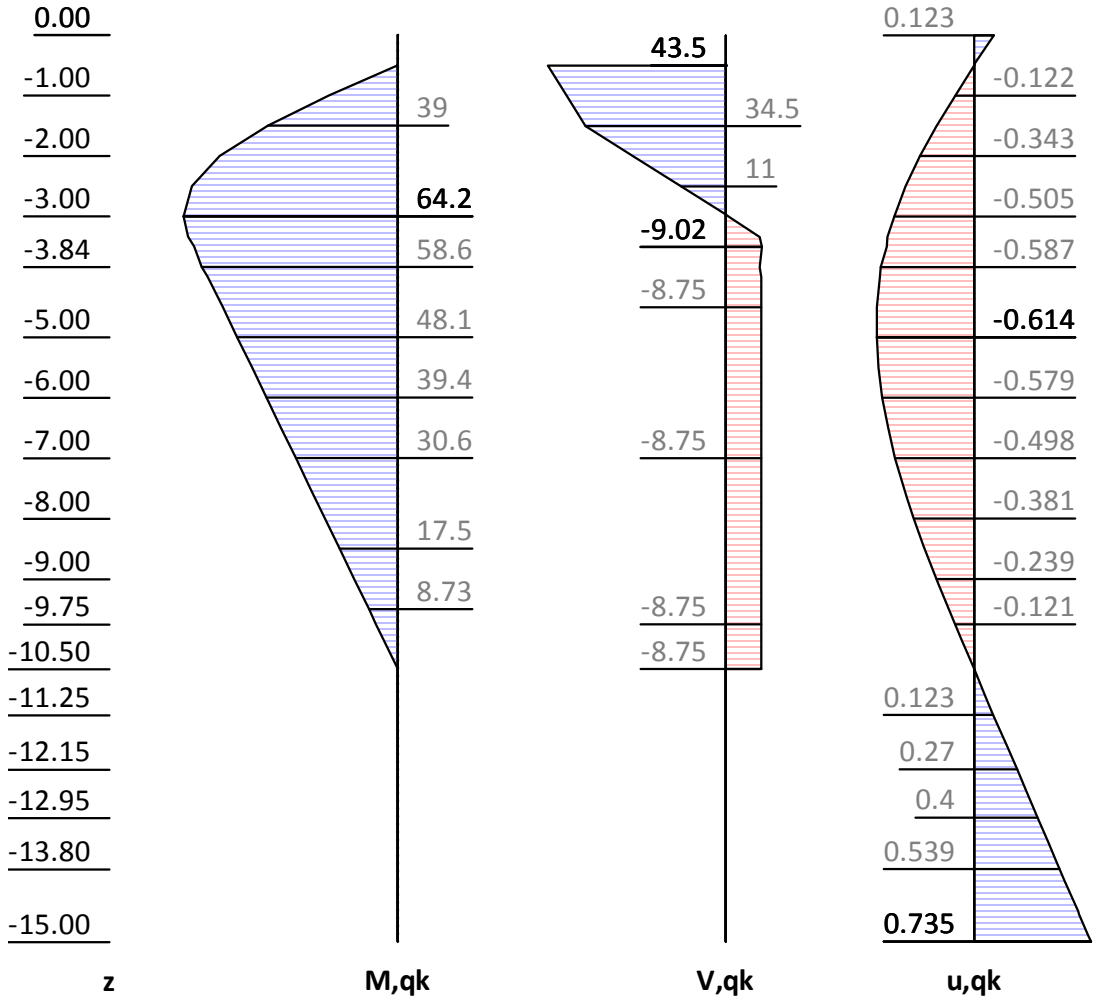


z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	7.34	-0.00	0.00	-0.00	0.17
-0.50	7.34	-0.92	-3.67	-10.73	0.00
-0.50	7.34	-0.92	-3.67	-10.73	-0.00
-0.50	7.34	-0.92	49.31	-24.92	-0.00
-0.52	7.34	0.00	49.17	-25.34	-0.01
-2.00	7.34	64.78	38.29	-57.10	-0.47
-2.00	6.12	64.78	38.29	-57.10	-0.47
-4.00	16.12	127.47	21.06	-99.85	-0.81
-4.00	21.97	127.47	21.06	-99.85	-0.81
-4.50	27.86	135.01	8.60	-110.36	-0.81
-4.50	28.38	135.01	8.60	-110.36	-0.81
-4.77	31.93	135.26	0.00	-115.34	-0.79
-5.00	34.91	135.47	-7.23	-119.52	-0.77
-7.32	52.02	-0.00	-114.69	-166.07	-0.16
-7.77	53.42	-57.82	-138.71	-175.99	0.00
-9.50	58.71	-377.68	-235.37	-215.88	0.33
-10.00	60.24	-502.53	-265.09	-228.13	0.24

z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
-10.00	55.14	-502.53	-265.09	-228.13	0.24
-10.50	56.03	-641.26	-292.74	-234.41	0.00
-10.50	56.03	-641.26	275.09	-234.41	0.00
-10.50	56.03	-641.26	275.09	-234.41	-0.00
-14.00	62.28	-34.19	67.90	-278.66	-5.02
-14.00	66.50	-34.19	67.90	-278.66	-5.02
-15.00	69.31	-0.00	0.00	-307.61	-6.82

Internal forces: Variable, characteristically

Method EB 82-4 (Q = [G+Q] - G).
z= -0.500. Fx= -43.783 kN/m Support
z= -10.497. Fx= -8.750 kN/m Support

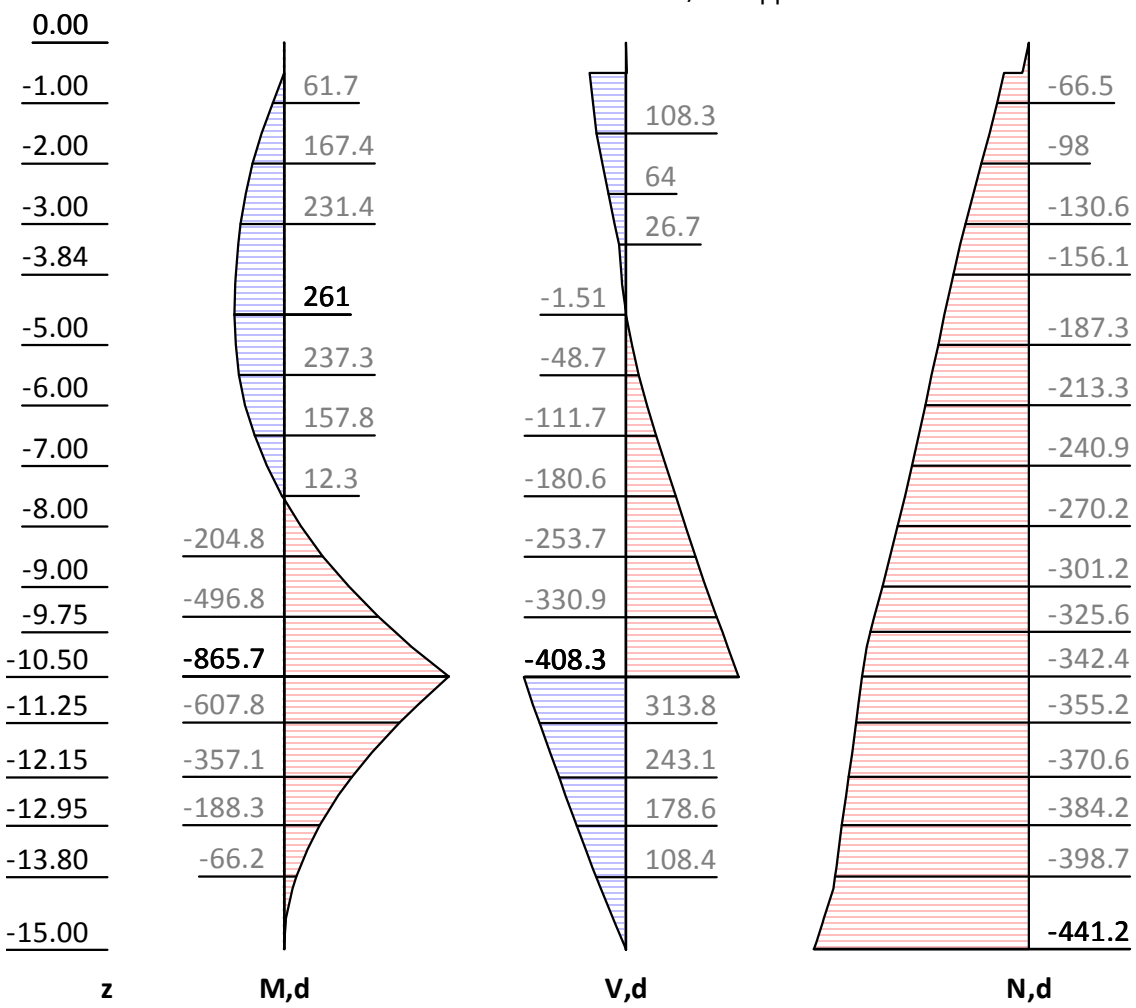


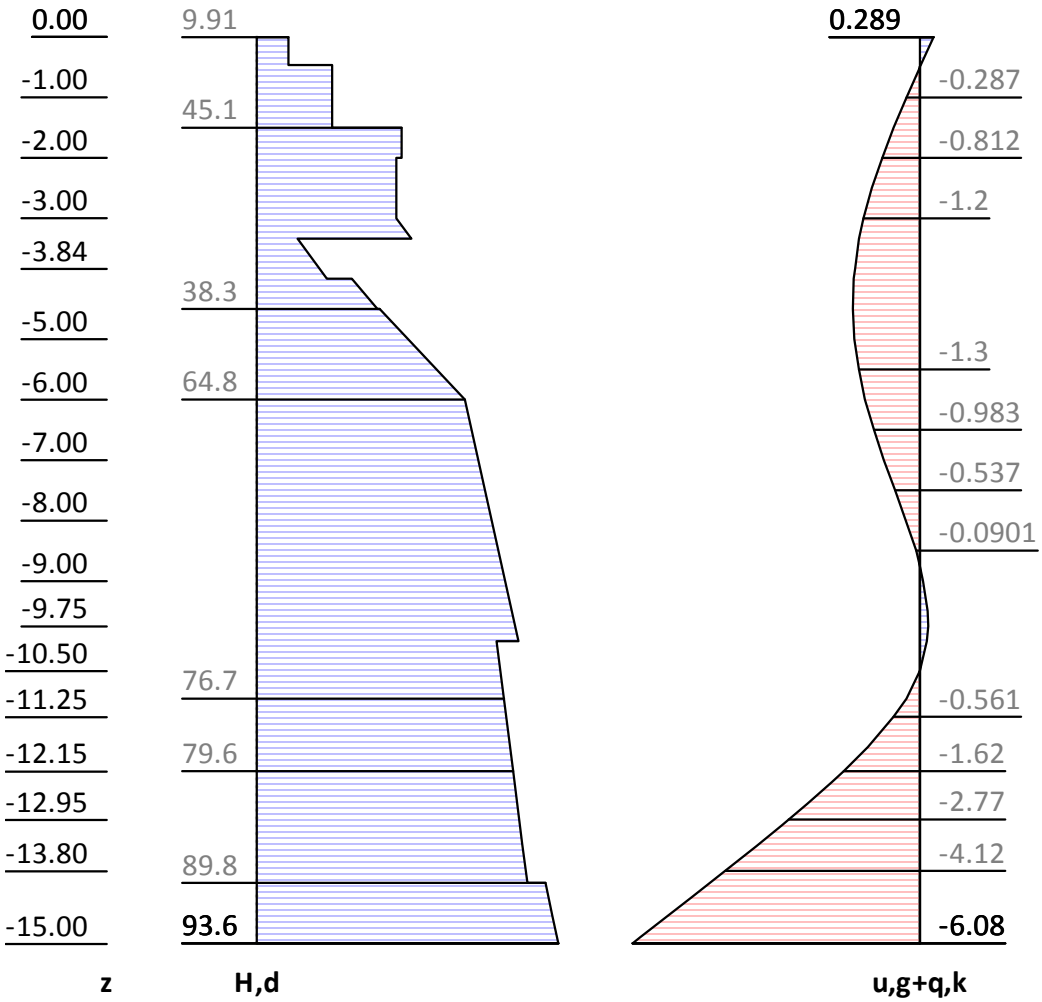
z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00	-0.00	0.00	0.12
-0.47	0.00	0.05	-0.00	0.00	0.01
-0.47	9.06	0.05	0.00	-0.00	0.01
-0.47	9.06	0.05	-0.00	-0.00	0.01
-0.50	9.06	0.00	-0.25	-0.03	0.00
-0.50	9.06	0.00	43.51	-11.76	-0.00
-1.50	9.06	38.98	34.45	-12.72	-0.24

z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
-1.50	23.48	38.98	34.45	-12.72	-0.24
-2.97	23.48	64.08	-0.00	-16.36	-0.50
-3.00	23.48	64.24	-0.77	-16.44	-0.50
-3.34	23.48	62.87	-8.48	-17.29	-0.55
-3.34	0.00	62.87	-8.48	-17.29	-0.55
-3.50	0.00	60.91	-9.02	-17.29	-0.55
-4.00	0.00	56.85	-8.75	-17.29	-0.59
-5.00	0.00	48.10	-8.75	-17.29	-0.61
-5.50	0.00	43.73	-8.75	-17.29	-0.60
-6.00	0.00	39.35	-8.75	-17.29	-0.58
-7.00	0.00	30.60	-8.75	-17.29	-0.50
-8.00	0.00	21.85	-8.75	-17.29	-0.38
-10.50	0.00	0.00	-8.75	-17.29	0.00
-10.50	0.00	0.00	-0.00	-17.29	0.00
-13.35	0.00	0.00	-0.00	-17.29	0.47
-13.65	0.00	0.00	-0.00	-17.29	0.51
-13.80	0.00	0.00	0.00	-17.29	0.54
-14.38	0.00	-0.00	-0.00	-17.29	0.63
-14.55	0.00	-0.00	-0.00	-17.29	0.66
-14.90	0.00	-0.00	-0.00	-17.29	0.72
-15.00	0.00	-0.00	-0.00	-17.29	0.74

Internal forces: Design

```
z=  -0.500. Fx=-137.195 kN/m Support
z= -10.497. Fx=-779.697 kN/m Support
```





z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	9.91	0.00	-0.00	-0.00	0.29
-0.47	9.91	-1.09	-4.66	-13.61	0.02
-0.47	23.50	-1.09	-4.66	-13.61	0.02
-0.50	23.50	-1.25	-5.36	-14.52	-0.00
-0.51	23.50	-0.00	131.60	-51.58	-0.01
-1.50	23.50	118.84	108.33	-81.68	-0.56
-1.50	45.13	118.84	108.33	-81.68	-0.56
-2.00	45.13	167.36	85.77	-98.02	-0.81
-2.00	43.48	167.36	85.77	-98.02	-0.81
-3.34	48.07	243.17	26.73	-141.69	-1.29
-3.34	12.85	243.17	26.73	-141.69	-1.29
-4.00	21.76	257.36	15.31	-160.73	-1.40
-4.00	29.65	257.36	15.31	-160.73	-1.40
-4.46	36.90	260.65	-0.00	-173.65	-1.42
-4.50	37.61	260.98	-1.51	-174.92	-1.42
-4.50	38.31	260.98	-1.51	-174.92	-1.42
-7.56	71.23	0.00	-185.07	-257.20	-0.51
-8.77	76.21	-277.19	-273.94	-293.88	0.00
-9.75	80.29	-581.66	-350.80	-325.58	0.18
-10.00	81.32	-671.88	-371.00	-333.90	0.16
-10.00	74.43	-671.88	-371.00	-333.90	0.16

z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
-10.50	75.64	-865.69	-408.33	-342.38	0.00
-10.50	75.64	-865.69	371.37	-342.38	0.00
-14.00	84.08	-46.15	91.67	-402.12	-4.44
-14.00	89.78	-46.15	91.67	-402.12	-4.44
-15.00	93.56	-0.00	-0.00	-441.21	-6.08

Anchor forces with safety level of DS-P

z[m]	A,d[kN]	Fx,d[kN/m]
-0.50	255.7	-137.2

Checks of earth statics

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -10.50 m
Rd = Eph,k/γ,Re = 5243.09 / 1.400 = 3745.06 [kN/m]
Ed(Uh,d)/Rd = 779.70 / 3745.06 = 0.208 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-15.00

Pos.	H	V
H/V pressure G+P+W,k	620.81	66.61
Wall weight		226.81
H/V pressure passive		0.00
Support z: -0.50	-52.98	14.20
Bh,g,k z=-10.50	-567.83	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.66
Σ	-0.00	306.95
		(downwards)

Average anchor inclination α,A = 15.00° >= 15°.
Verification of vertical forces due to EAB R 9 not required (R 9-5).
Check EAB R 9-1
Vertical component of earth resistance is less than
the downwards pointing vertical forces.
Vk >= Bvk: 307.61 >= 0.66 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-15.00

Pos.	H	V
H/V pressure G+P+W,k	673.34	72.16
Wall weight		226.81
H/V pressure passive		0.00
Support z: -0.50	-96.76	25.93
Bh,g,k z=-10.50	-567.83	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.66
Bh,q,k z=-10.50	-8.75	
Bv,q,k = Bh,k * tan(δ,p=-0.07°)		-0.01
Σ	0.00	324.23
		(downwards)

Average anchor inclination α,A = 15.00° >= 15°.
Verification of vertical forces due to EAB R 9 not required (R 9-5).
Check EAB R 9-1
Vertical component of earth resistance is less than
the downwards pointing vertical forces.
Vk >= Bvk: 324.90 >= 0.67 Passes requirement

Anchor verification

Anchor - Stability of lower failure plane

Περίπτ.Φόρτισης: όλα τα φορτία BS-P
Αυτόμ. υπολογ. μήκους αγκυρίων:
All anchors are extended (if necessary)
Favourable variable loads in main failure body are not being considered.
Bottom of lower failure plane: z=-15.00 m

Iteration of failure mechanisms:
lA .....: Length of anchor from head to center of grout body.
W,k .....: Res. force from dead weight, loads, cohesion, ...
Q,k .....: Force in lower failure plane.
Ea1,k.....: Earth pressure onto vertical separation plane.
Ea2,k.....: Earth pressure between wall and main failure body.
Ra_cal,d ...: Dimesioning force of the resistance from the equilibrium of forces. Ra_cal,d corresponds to the max. possible anchor force of the force polygon.
Sum(A,d) ...: Acting anchor forces along the grout body fractions within the failure body. Sum(A,d) is gained from the anchor pull forces of the wall analysis.

z [m]	ϑ1 [°]	ϑ2 [°]	lA [m]	W,k [kN/m]	Q,k [kN/m]	Ea1,k [kN/m]	Ea2,k [kN/m]	Ra_cal,d [kN/m]	Sum(A,d) [kN/m]	Ed/Rd [-]
-0.50	53.1	57.5	9.38	805.4	641.5	4.4	365.5	282.4	142.0	0.50

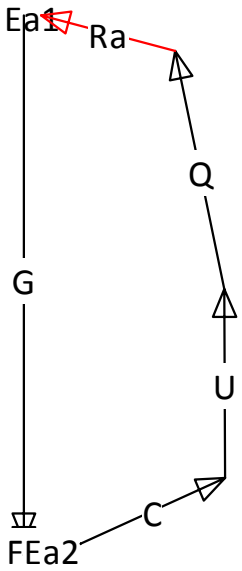
Decisive failure body:
Γεωμετρία:

Foot point of lower failure plane	x/z =	0.01/-15.00 m
Intersection lower/upper slid. plane	x/z =	9.07/ -2.93 m
Intersection upper slid. plane/surface	x/z =	10.93/ 0.00 m
Intersection separation plane/surface	x/z =	9.07/ 0.00 m
Inclination lower failure plane	ϑ1 =	53.12°
Inclination upper failure plane	ϑ2 =	57.50°
Inclination separation plane	ϑ12 =	90.00°

Loads / forces (char.)

		Fx [kN/m]	Fz [kN/m]	F [kN/m]	
Weight of main failure body	G,k:	0.0	-1677.2	1677.2	
Area loads on/in main failure body	F1,k:	0.0	-82.5	82.5	
Cohesion of lower failure plane	C,k:	383.4	511.0	638.9	
Pore water pressure on main body	U,k:	-0.5	540.1	540.1	
Earth pres. on separation plane	Ea1,k:	-4.4	-0.0	4.4	δ= 0.0°
Earth pr. between wall<->main body	Ea2,k:	358.3	71.9	365.5	
Force in lower failure plane	Q,k:	-354.9	534.3	641.5	
Sum = possible anchor forces:	Ra_cal,k:	381.8	-102.3	395.3	

Force polygon



Acting anchor forces Ed: Sum(A,d) = 142.0 kN/m
Possible anchor forces Rd: Ra_cal,d = 395.3/1.400 = 282.4 kN/m
Verif. of lower failure plane Ed/Rd = 0.50 < 1.0: Έλεγχος εκπληρώθηκε.

Check of steel tension

l,tot ...[m]: Total length of anchor incl. excess length at head
As ....[mm2]: X-section are of steel member
Ri,d ...[kN]: Ultimate strength of tension member (γ,M=1.15)
A,d ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	l,tot	As	Ri,d		A,d	
-0.50	Strand;3x0.60";1570/1770	13.38	420	573.4	>	255.7	Passes requirement

Check of steel tension: Passes requirement

Check of anchor's soil friction

lVk .....: Length of grout body
DmVk ....: Diameter of grout body
τGr,k ...: Average applied skin friction along the grout body (from soil parameters)
Ra,k ....: Charact. pullout resistance of the anchor
γA ......: Partial safety factor of anchor pullout
Ra,d ....: = Ra,k / γA
A,d .....: Dimensioning force of the anchor from wall analysis

z [m]	lVk [m]	DmVk [mm]	τGr,k [kN/m²]	Ra,k [kN]	γA [-]	Ra,d [kN]		A,d [kN]	A,d/Ra,d [-]
-0.50	8.00	318	110	879.1	1.100	799.2	>	255.7	0.3

Check of anchor's soil friction: Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)
Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (-1.17, 3.36), Ακτίνα = 18.41
Αρχ.σημ.= (-18.04, -4.00), Τελ.σημ. = (16.92, 0.00)

Γεωμετρία λωρίδων:

No	x	Width b	dxM	Weight	Load z-κατ.	Water-φορτ.	u*b	φ	c	θ
	[m]	[m]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[°]	[kN/m²]	[°]
1	-17.12	1.84	-15.95	73.3	0.0	0.0	-11.6	27.45	3.57	-31.27*
2	-15.28	1.84	-14.11	182.4	0.0	0.0	-43.7	27.45	3.57	-31.27*
3	-13.44	1.84	-12.27	259.5	0.0	0.0	-79.3	0.08	71.43	-41.80
4	-11.60	1.84	-10.43	312.7	0.0	0.0	-106.1	0.08	71.43	-34.51
5	-9.76	1.84	-8.59	353.7	0.0	0.0	-126.8	0.08	71.43	-27.81
6	-7.92	1.84	-6.75	384.8	0.0	0.0	-142.4	0.08	71.43	-21.51
7	-6.08	1.84	-4.91	409.2	0.0	0.0	-153.8	29.26	3.57	-15.46
8	-4.24	1.84	-3.07	426.2	0.0	0.0	-161.4	29.26	3.57	-9.59
9	-2.40	1.84	-1.23	435.1	0.0	0.0	-165.4	29.26	3.57	-3.82
10	-0.56	1.84	0.61	464.3	0.0	0.0	-193.5	29.26	3.57	1.91
11	1.28	1.84	2.46	571.7	0.0	0.0	-218.3	29.26	3.57	7.67
12	3.12	1.84	4.30	557.5	0.0	0.0	-211.9	29.26	3.57	13.50
13	4.96	1.84	6.14	535.0	0.0	0.0	-201.9	0.08	71.43	19.48
14	6.80	1.84	7.98	506.8	0.0	0.0	-187.7	0.08	71.43	25.68
15	8.65	1.84	9.82	469.3	0.0	0.0	-168.8	0.08	71.43	32.24
16	10.49	1.84	11.66	420.5	0.0	0.0	-144.2	0.08	71.43	39.30
17	12.33	1.84	13.50	352.9	0.0	0.0	-111.9	27.45	3.57	47.17
18	14.17	1.84	15.34	256.0	0.0	0.0	-67.6	27.45	3.57	56.45
19	16.01	1.84	17.18	113.9	0.0	0.0	-20.8	0.08	35.71	68.96

*** Σημείωση: Στις λωρίδες σημειωμένες με '*'
περιορίστηκε το theta στο 45°-Phi/2.

Συνεισφ. κατακόρυφων φορτίων:

No	Weight	G*sin(θ)	(G-u*b)*tan(φ) + c*b	μ*sin(θ)* tan(φ)+cos(θ)	T
	[kN/m]	[kN/m]	[kN/m]	[-]	[kN/m]
1	73.32	-63.54	38.61	0.795524	48.54
2	182.42	-139.84	78.66	0.795524	98.88
3	259.49	-172.98	131.73	0.745214	176.76
4	312.74	-177.20	131.76	0.823821	159.94
5	353.71	-165.04	131.79	0.884327	149.03
6	384.82	-141.07	131.81	0.930268	141.69
7	409.23	-109.10	149.66	0.931041	160.74
8	426.16	-71.00	154.91	0.965549	160.44
9	435.12	-28.98	157.69	0.989595	159.35
10	464.32	15.51	158.26	1.003547	157.70
11	571.73	76.27	204.56	1.007458	203.05
12	557.49	130.12	200.15	1.001067	199.93
13	534.96	178.36	131.94	0.942887	139.93
14	506.78	219.64	131.92	0.901333	146.36

No	Weight [kN/m]	G*sin(θ) [kN/m]	(G-u*b)*tan(φ) + c*b [kN/m]	μ*sin(θ)* tan(φ)+cos(θ) [-]	T [kN/m]
15	469.28	250.32	131.89	0.846025	155.90
16	420.47	266.33	131.86	0.774016	170.36
17	352.86	258.79	131.76	0.763395	172.59
18	255.95	213.31	104.42	0.647666	161.22
19	113.91	106.31	65.74	0.359372	182.93
		646.21			2945.35

Δράση Ed = (646.2*18.41)
Αντίσταση Rd = (2945.4*18.41 +0.0)
SLIP-CIRCLE μ = Ed/Rd = 0.22 < 1.0: Έλεγχος εκπληρώθηκε.

Φάση εκσκαφής 4 "[4] Situation 4"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 5 Στρώσεις

Name		Τεχνητές επιχωματώσεις	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
γ	[kN/m3]	18	20	22.5
γ,R	[kN/m3]	18	20	22.5
γ'	[kN/m3]	8	10	12.5
γ,p	[kN/m3]	18	20	22.5
γ,R,passive	[kN/m3]	18	20	22.5
γ,pw	[kN/m3]	8	10	12.5
φ	[°]	25	0.1	33
c	[kN/m2]	2	50	5
c,u	[kN/m2]	10	50	5
c παθητικό	[kN/m2]	2	50	5
δ,a	[°]	16.66667	0.06666667	22
δ,p	[°]	-16.66667	-0.06666667	-22
δ,c	[°]	8.333333	0.03333333	11
k,agh	[-]	0.3456501	0.9955057	0.2452023
K,ach	[-]	1.043051	1.994195	0.8549058
K,0h	[-]	0.5773817	0.9982547	0.455361
K,pgh	[-]	3.908103	1.004519	7.495617
K,pch	[-]	5.180327	2.00583	8.599509
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	10e-06	5.5e-09	100e-06

Name		Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20	22.5
γ,R	[kN/m3]	20	22.5
γ'	[kN/m3]	10	12.5
γ,p	[kN/m3]	20	22.5
γ,R,passive	[kN/m3]	20	22.5
γ,pw	[kN/m3]	10	12.5
φ	[°]	0.1	35
c	[kN/m2]	100	5
c,u	[kN/m2]	100	5
c παθητικό	[kN/m2]	100	5
δ,a	[°]	0.06666667	23.33333
δ,p	[°]	-0.06666667	-23.33333
δ,c	[°]	0.03333333	11.66667
k,agh	[-]	0.9955057	0.2244207
K,ach	[-]	1.994195	0.8126539
K,0h	[-]	0.9982547	0.4264236
K,pgh	[-]	1.004519	9.146943
K,pch	[-]	2.00583	10.104
τ,gr	[kN/m2]	110	110
Ψ,A,max	[°]	90	90
k	[cm/s]	5.5e-09	100e-06

Πορεία πρανούς:

x [m]	0.00	0.00
z [m]	-4.00	0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:

x [m]	0.00	0.00
z [m]	-4.00	-1.50

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:
z= -4.50

Πορεία ανώτερου 4. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
z= -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -14.00

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
1.00	0.00	3.50	0.00	0.00	33.00	0.00	33.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Στάθμη νερού:

x [m]	0.00	0.00
z [m]	-6.00	-3.00

Αγκύρια

z[m]	min.l[m]	Alpha[°]	C-H[kN/m]	P0[kN]	u0[m]
-0.50	0.00	15.00	αόρισ.	0.00	0.0000
-3.00	0.00	15.00	αόρισ.	0.00	0.0000

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Ενεργές ωθήσεις.
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: Triangle (perpend. to wall).
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
Levels of redistribution Z1: -0.500, Z2: -3.000 [m].
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Κλασικός, Pregl/Sokolovsky (DIN 4085).

Options for water pressure

Στήριξη πόδα

Πόδας οριζοντίως μετακινούμενος

Αγκύρια

Anchor checks (lower failure plane): Ναι
Anchor forces with safety level of DS-P: Ναι
Verification of grout body pull out forces: Ναι
δ,a,Anchoring wall : used from soil layer.
δ,p,Anchoring wall : used from soil layer.

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

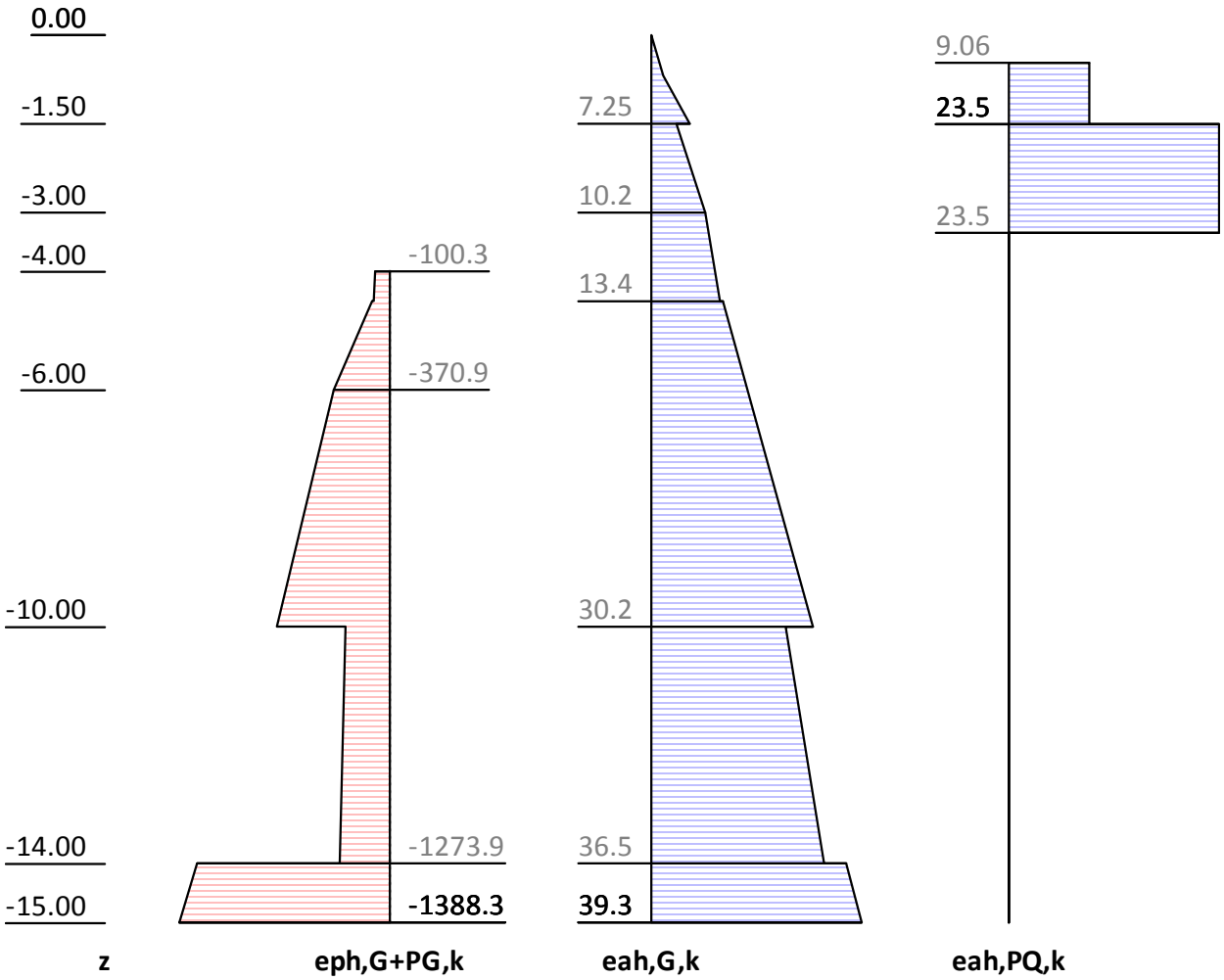
Μήκος τοίχου

Foot depth for statics: zf = -15.000

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall



z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.47		1.52	0.00	2.04
-0.47		1.52	9.06	15.62

z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
-1.50		7.25	9.06	23.37
-1.50		4.82	23.48	41.73
-3.34		10.79	23.48	49.78
-3.34		10.79	0.00	14.56
-4.00	-0.00	11.97	0.00	16.15
-4.00	-100.29	11.97	0.00	16.15
-4.50	-110.34	12.86	0.00	17.36
-4.50	-117.95	13.38	0.00	18.06
-10.00	-745.71	30.24	0.00	40.82
-10.00	-294.76	25.14	0.00	33.93
-14.00	-334.94	32.28	0.00	43.58
-14.00	-1273.92	36.50	0.00	49.28
-15.00	-1388.26	39.31	0.00	53.06

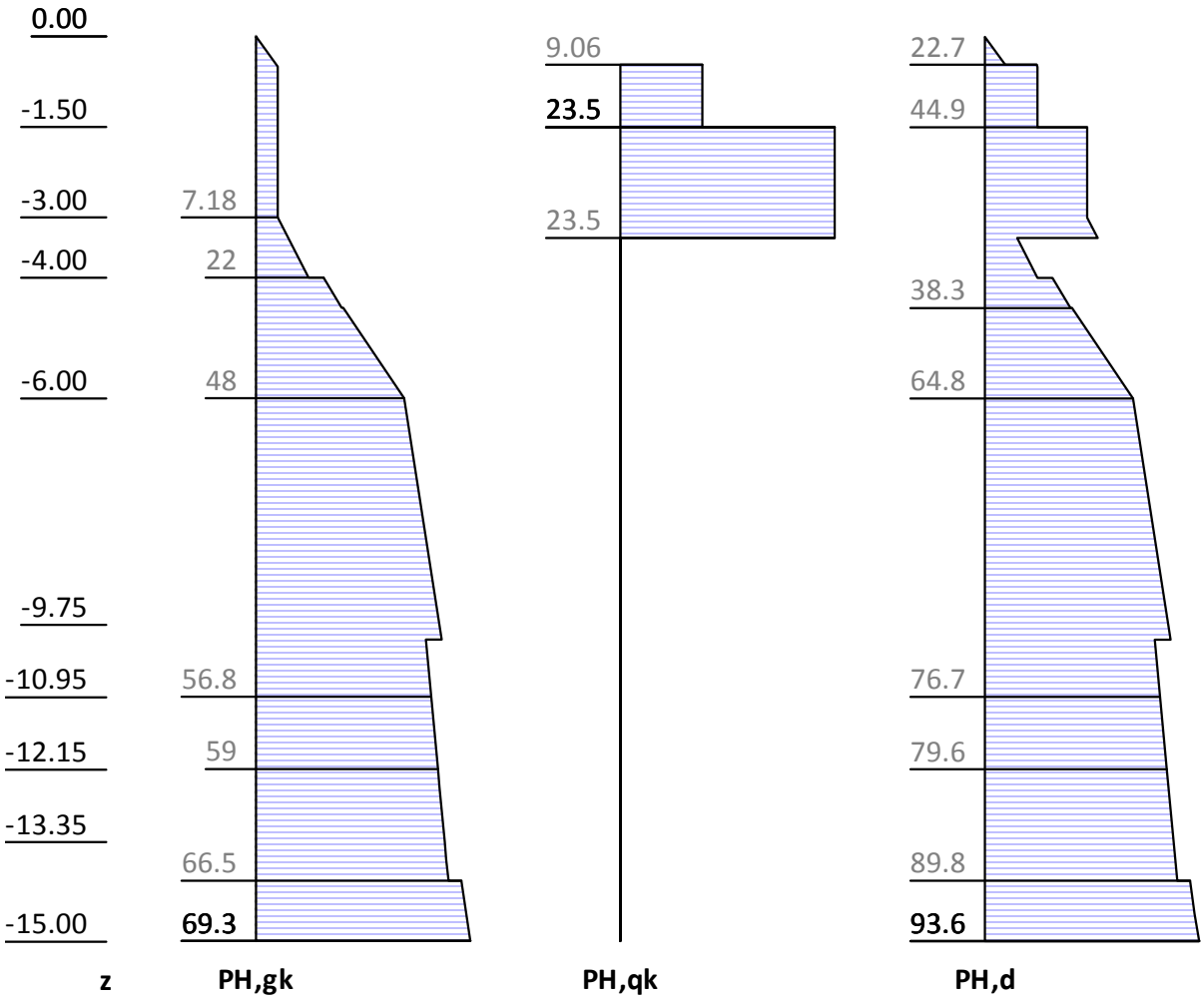
Eph,G,k:-5243.09, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 305.81, Eah,PG,k: 0.00, Eah,PQ,k: 52.53, Eah,d: 491.64

Πίεση νερού

z [m]	Wp,k [kN/m2]	Wa,k [kN/m2]	W,k [kN/m2]
-3.00		0.00	0.00
-6.00	0.00	30.00	30.00
-15.00	-90.00	120.00	30.00

H-pressure on static system

Level of mobilization: Ep,gk 100.0, Ep,qk 100.0, Ep,d 100.0 [%]

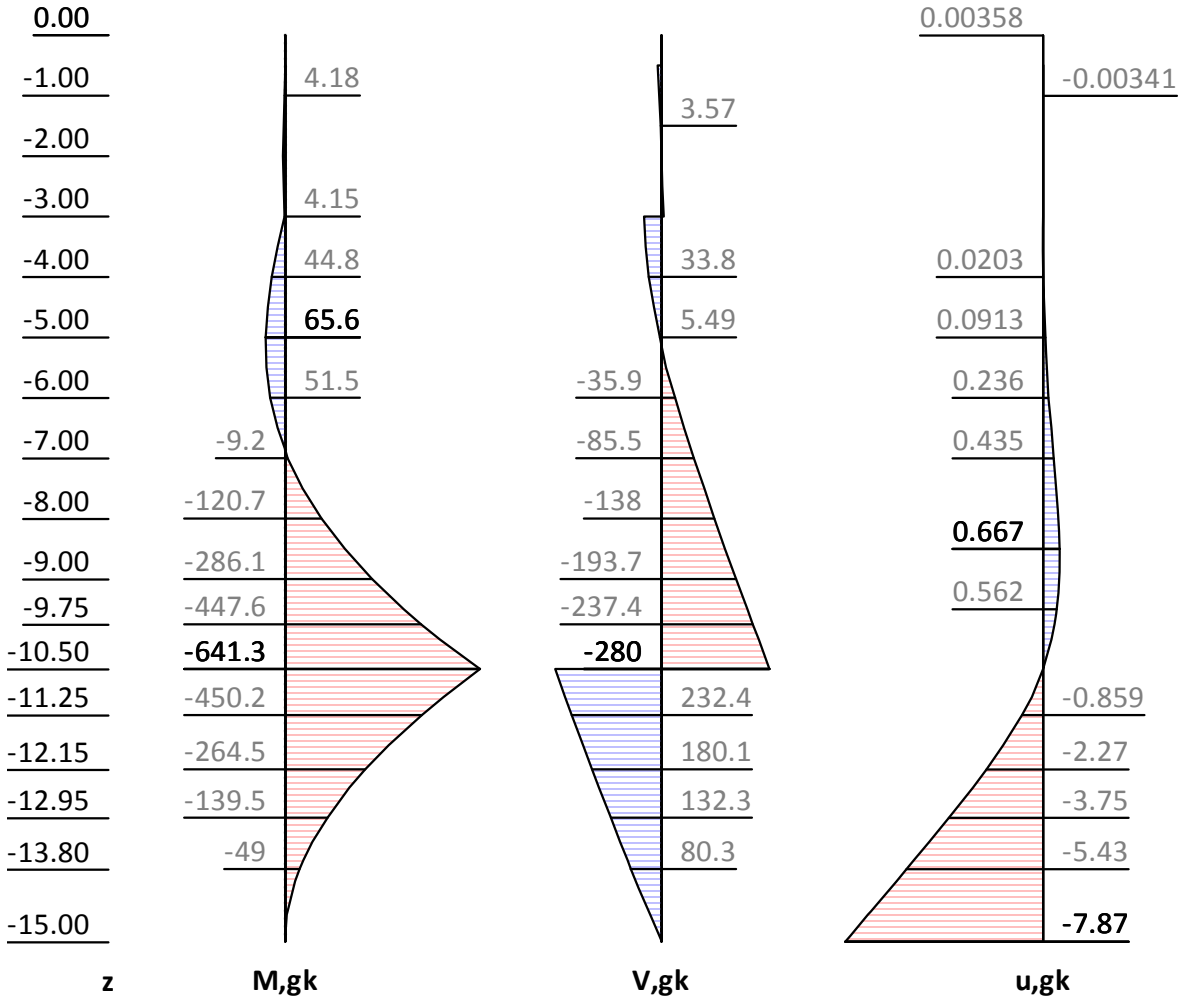


z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	0.00		0.00
-0.47	6.75	0.00	9.11
-0.47	6.75	9.06	22.69
-1.50	7.18	9.06	23.28
-1.50	7.18	23.48	44.91
-3.34	10.58	23.48	49.50
-3.34	10.58	0.00	14.28
-4.00	17.18	0.00	23.19
-4.00	21.97	0.00	29.65
-4.50	27.86	0.00	37.61
-4.50	28.38	0.00	38.31
-10.00	60.24	0.00	81.32
-10.00	55.14	0.00	74.43
-14.00	62.28	0.00	84.08
-14.00	66.50	0.00	89.78
-15.00	69.31	0.00	93.56

V-pressure on static system

Internal forces: Permanent, characteristically

```
z=  -0.500. Fx= -12.546 kN/m Support
z=  -3.000. Fx= -53.148 kN/m Support
z= -10.497. Fx=-555.115 kN/m Support
```

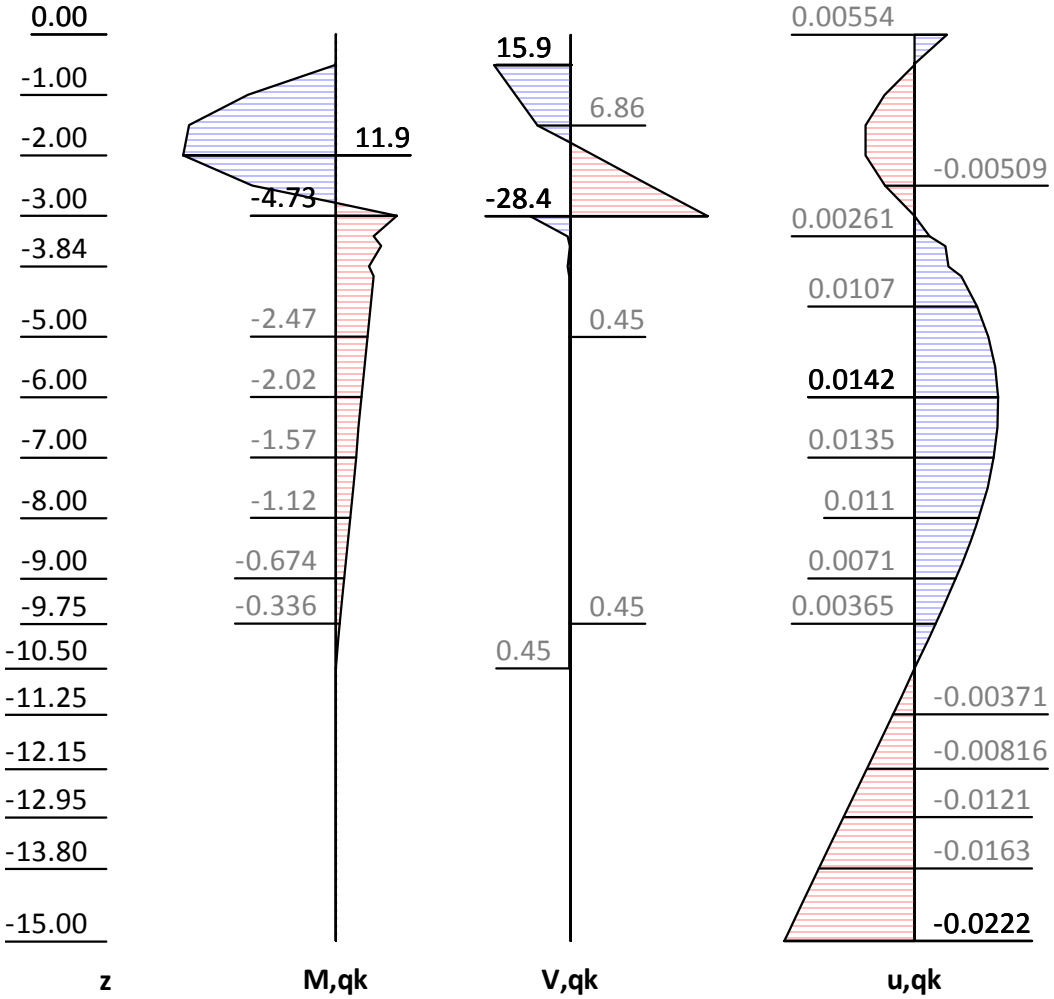


z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	0.00	0.00	0.00	0.00	0.00
-0.50	7.18	-0.30	-1.79	-10.61	0.00
-0.50	7.18	-0.30	-1.79	-10.61	-0.00
-0.50	7.18	-0.30	10.75	-13.97	-0.00
-0.53	7.18	0.00	10.51	-14.69	-0.00
-2.00	7.18	7.75	-0.00	-46.09	-0.01
-2.00	7.18	7.75	-0.02	-46.13	-0.01
-3.00	7.18	4.15	-7.19	-67.58	-0.00
-3.00	7.18	4.15	45.96	-81.82	-0.00
-4.00	17.18	44.85	33.78	-103.26	0.02
-4.00	21.97	44.85	33.78	-103.26	0.02
-4.50	27.86	58.75	21.32	-113.77	0.05
-4.50	28.38	58.75	21.32	-113.77	0.05
-5.00	34.91	65.56	5.49	-122.93	0.09
-5.14	36.79	65.02	-0.00	-125.65	0.11
-6.87	50.66	0.00	-79.12	-160.03	0.41

z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
-8.50	55.64	-196.55	-165.48	-195.70	0.67
-10.00	60.24	-508.85	-252.38	-231.53	0.36
-10.00	55.14	-508.85	-252.38	-231.53	0.36
-10.50	56.03	-641.26	-280.03	-237.82	0.00
-10.50	56.03	-641.26	275.09	-237.82	0.00
-14.00	62.28	-34.19	67.90	-282.07	-5.83
-14.00	66.50	-34.19	67.90	-282.07	-5.83
-15.00	69.31	-0.00	-0.00	-311.02	-7.87

Internal forces: Variable, characteristically

Method EB 82-4 (Q = [G+Q] - G).
z= -0.500. Fx= -16.193 kN/m Support
z= -3.000. Fx= -36.789 kN/m Support
z= -10.497. Fx= 0.450 kN/m Support

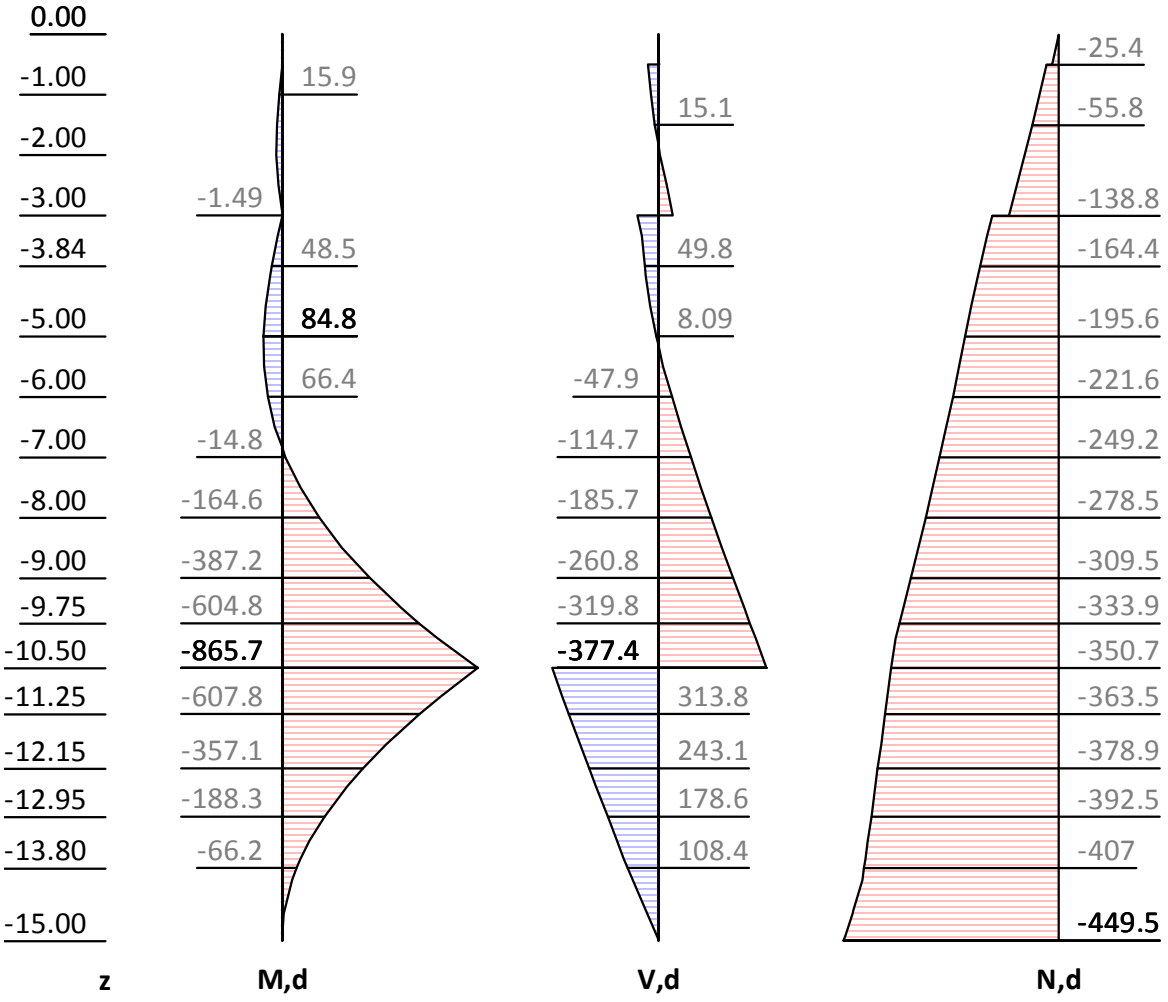


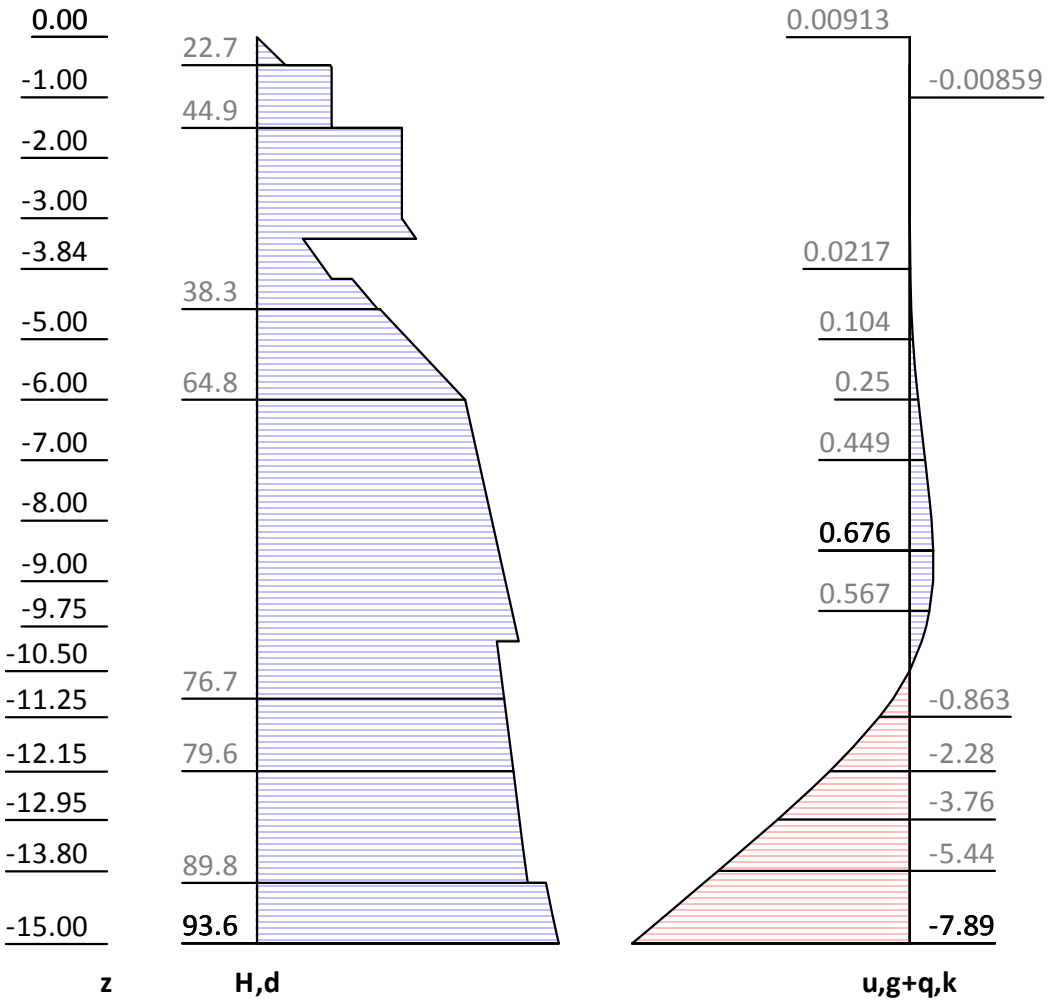
z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00	0.00	0.00	0.01
-0.47	0.00	0.03	0.10	0.01	0.00
-0.47	9.06	0.03	0.10	0.01	0.00
-0.48	9.06	0.02	0.00	-0.00	0.00
-0.50	9.06	0.00	-0.23	-0.02	0.00

z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
-0.50	9.06	0.00	15.92	-4.37	-0.00
-1.50	9.06	11.39	6.86	-5.33	-0.01
-1.50	23.48	11.39	6.86	-5.33	-0.01
-1.79	23.48	11.67	-0.00	-6.05	-0.01
-2.00	23.48	11.87	-4.88	-6.57	-0.01
-2.79	23.48	-0.00	-23.41	-8.53	-0.00
-3.00	23.48	-4.73	-28.36	-9.05	-0.00
-3.00	23.48	-4.73	8.43	-18.91	-0.00
-3.34	23.48	-2.95	0.72	-19.75	0.00
-3.34	0.00	-2.95	0.72	-19.75	0.00
-3.50	0.00	-3.50	0.18	-19.75	0.01
-3.84	0.00	-2.59	0.72	-19.75	0.01
-4.00	0.00	-2.92	0.45	-19.75	0.01
-6.00	0.00	-2.02	0.45	-19.75	0.01
-7.00	0.00	-1.57	0.45	-19.75	0.01
-8.00	0.00	-1.12	0.45	-19.75	0.01
-10.50	0.00	-0.00	0.45	-19.75	0.00
-10.50	0.00	0.00	0.45	-19.75	0.00
-10.50	0.00	0.00	-0.00	-19.75	0.00
-11.25	0.00	0.00	-0.00	-19.75	-0.00
-11.75	0.00	0.00	-0.00	-19.75	-0.01
-13.35	0.00	0.00	-0.00	-19.75	-0.01
-13.65	0.00	0.00	-0.00	-19.75	-0.02
-14.14	0.00	0.00	-0.00	-19.75	-0.02
-14.55	0.00	-0.00	-0.00	-19.75	-0.02
-14.90	0.00	-0.00	-0.00	-19.75	-0.02
-14.96	0.00	-0.00	0.00	-19.75	-0.02
-15.00	0.00	0.00	0.00	-19.75	-0.02

Internal forces: Design

```
z=  -0.500. Fx= -41.227 kN/m Support
z=  -3.000. Fx=-126.934 kN/m Support
z= -10.497. Fx=-748.731 kN/m Support
```





z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	0.00	0.00	0.00	0.00	0.01
-0.47	9.11	-0.34	-2.14	-13.46	0.00
-0.47	22.69	-0.34	-2.14	-13.46	0.00
-0.50	23.28	-0.41	-2.83	-14.37	-0.00
-0.50	23.28	-0.41	38.40	-25.41	-0.00
-0.51	23.28	-0.00	38.10	-25.80	-0.00
-1.50	23.28	26.35	15.12	-55.80	-0.01
-1.50	44.91	26.35	15.12	-55.80	-0.01
-1.84	44.91	27.64	0.00	-66.80	-0.01
-2.00	44.91	28.27	-7.33	-72.13	-0.01
-2.96	44.91	0.00	-50.61	-103.61	-0.00
-3.00	44.91	-1.49	-52.24	-104.81	-0.00
-3.00	44.91	-1.49	74.69	-138.82	-0.00
-3.00	44.91	-1.49	74.69	-138.82	0.00
-3.02	45.21	-0.00	73.63	-139.55	0.00
-3.34	49.50	21.22	58.64	-149.93	0.01
-3.34	14.28	21.22	58.64	-149.93	0.01
-4.00	23.19	56.16	46.27	-169.03	0.03
-4.00	29.65	56.16	46.27	-169.03	0.03
-4.50	37.61	75.26	29.46	-183.22	0.06
-4.50	38.31	75.26	29.46	-183.22	0.06

z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
-5.00	47.13	84.80	8.09	-195.58	0.10
-5.16	49.90	84.11	0.00	-199.59	0.12
-6.85	68.28	-0.00	-104.44	-244.97	0.42
-8.50	75.11	-266.69	-222.73	-293.83	0.68
-10.00	81.32	-687.29	-340.04	-342.20	0.36
-10.00	74.43	-687.29	-340.04	-342.20	0.36
-10.50	75.64	-865.69	-377.36	-350.68	0.00
-10.50	75.64	-865.69	371.37	-350.68	0.00
-10.50	75.64	-865.69	371.37	-350.68	-0.00
-14.00	84.08	-46.15	91.67	-410.42	-5.85
-14.00	89.78	-46.15	91.67	-410.42	-5.85
-15.00	93.56	-0.00	-0.00	-449.50	-7.89

Anchor forces with safety level of DS-P

z[m]	A,d[kN]	Fx,d[kN/m]
-0.50	76.8	-41.2
-3.00	118.3	-126.9

Checks of earth statics

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -10.50 m
Rd = Eph,k/γ,Re = 5243.09 / 1.400 = 3745.06 [kN/m]
Ed(Uh,d)/Rd = 748.73 / 3745.06 = 0.200 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-15.00

Pos.	H	V
H/V pressure G+P+W,k	620.81	66.61
Wall weight		226.81
H/V pressure passive		0.00
Support z: -0.50	-12.55	3.36
Support z: -3.00	-53.15	14.24
Bh,g,k z=-10.50	-555.12	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.65
Σ	-0.00	310.37 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.
Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1

Vertical component of earth resistance is less than
the downwards pointing vertical forces.
Vk >= Bvk: 311.02 >= 0.65 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-15.00

Pos.	H	V
H/V pressure G+P+W,k	673.34	72.16
Wall weight		226.81
H/V pressure passive		0.00

Pos.		H	V
Support z:	-0.50	-28.74	7.70
Support z:	-3.00	-89.94	24.10
Bh,g,k z=-10.50		-555.12	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)			-0.65
Bh,q,k z=-10.50		0.45	
Bv,q,k = Bh,k * tan(δ,p=-0.07°)			0.00
Σ		-0.00	330.13 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.
Verification of vertical forces due to EAB R 9 not required (R 9-5).
Check EAB R 9-1
Vertical component of earth resistance is less than
the downwards pointing vertical forces.
Vk >= Bvk: 330.77 >= 0.65 Passes requirement

Anchor verification

Anchor - Stability of lower failure plane

Περίπτ.Φόρτισης: όλα τα φορτία BS-P
Αυτόμ. υπολογ. μήκους αγκυρίων:
All anchors are extended (if necessary)
Favourable variable loads in main failure body are not being considered.
Bottom of lower failure plane: z=-15.00 m

Iteration of failure mechanisms:
lA .....: Length of anchor from head to center of grout body.
W,k .....: Res. force from dead weight, loads, cohesion, ...
Q,k .....: Force in lower failure plane.
Ea1,k.....: Earth pressure onto vertical separation plane.
Ea2,k.....: Earth pressure between wall and main failure body.
Ra_cal,d ...: Dimesioning force of the resistance from the equilibrium of forces. Ra_cal,d corresponds to the max. possible anchor force of the force polygon.
Sum(A,d) ...: Acting anchor forces along the grout body fractions within the failure body. Sum(A,d) is gained from the anchor pull forces of the wall analysis.

z [m]	ϑ1 [°]	ϑ2 [°]	lA [m]	W,k [kN/m]	Q,k [kN/m]	Ea1,k [kN/m]	Ea2,k [kN/m]	Ra_cal,d [kN/m]	Sum(A,d) [kN/m]	Ed/Rd [-]
-0.50	53.1	57.5	9.38	805.4	641.5	4.4	365.5	282.4	173.7	0.62
-3.00	53.0	60.0	7.79	759.9	613.0	13.0	365.5	257.4	170.9	0.66

Decisive failure body:
Γεωμετρία:

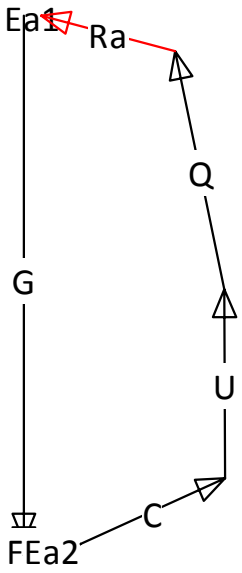
Foot point of lower failure plane	x/z =	0.01/-15.00 m
Intersection lower/upper slid. plane	x/z =	7.52/ -5.02 m
Intersection upper slid. plane/surface	x/z =	10.41/ 0.00 m
Intersection separation plane/surface	x/z =	7.52/ 0.00 m
Inclination lower failure plane	ϑ1 =	53.05°
Inclination upper failure plane	ϑ2 =	60.04°
Inclination separation plane	ϑ12 =	90.00°

Loads / forces (char.)

		Fx [kN/m]	Fz [kN/m]	F [kN/m]
Weight of main failure body	G,k:	0.0	-1561.6	1561.6

		Fx [kN/m]	Fz [kN/m]	F [kN/m]	
Area loads on/in main failure body	F1,k:	0.0	-82.5	82.5	
Cohesion of lower failure plane	C,k:	323.4	429.9	538.0	
Pore water pressure on main body	U,k:	-0.5	526.3	526.3	
Earth pres. on separation plane	Ea1,k:	-13.0	-0.0	13.0	δ= 0.0°
Earth pr. between wall<->main body	Ea2,k:	358.3	71.9	365.5	
Force in lower failure plane	Q,k:	-320.2	522.7	613.0	
Sum = possible anchor forces:	Ra_cal,k:	348.0	-93.3	360.3	

Force polygon



Acting anchor forces Ed: Sum(A,d) = 170.9 kN/m
Possible anchor forces Rd: Ra_cal,d = 360.3/1.400 = 257.4 kN/m
Verif. of lower failure plane Ed/Rd = 0.66 < 1.0: Έλεγχος εκπληρώθηκε.

Check of steel tension

l,tot ...[m]: Total length of anchor incl. excess length at head
As ....[mm2]: X-section are of steel member
Ri,d ...[kN]: Ultimate strength of tension member (γ,M=1.15)
A,d ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	l,tot	As	Ri,d		A,d	
-0.50	Strand;3x0.60";1570/1770	13.38	420	573.4	>	76.8	Passes requirement
-3.00	Strand;3x0.60";1570/1770	11.79	420	573.4	>	118.3	Passes requirement

Check of steel tension: Passes requirement

Check of anchor's soil friction

lVk .....: Length of grout body
DmVk ....: Diameter of grout body
τGr,k ...: Average applied skin friction along the grout body (from soil parameters)
Ra,k ....: Charact. pullout resistance of the anchor
γA ......: Partial safety factor of anchor pullout
Ra,d ....: = Ra,k / γA
A,d .....: Dimensioning force of the anchor from wall analysis

z [m]	lVk [m]	DmVk [mm]	τGr,k [kN/m²]	Ra,k [kN]	γA [-]	Ra,d [kN]		A,d [kN]	A,d/Ra,d [-]
-0.50	8.00	318	110	879.1	1.100	799.2	>	76.8	0.1
-3.00	8.00	318	110	879.1	1.100	799.2	>	118.3	0.1

Check of anchor's soil friction: Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)
Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (-1.17, 3.36), Ακτίνα = 18.41
Αρχ.σημ.= (-18.04, -4.00), Τελ.σημ. = (16.92, 0.00)

Γεωμετρία λωρίδων:

No	x [m]	Width b [m]	dxM [m]	Weight [kN/m]	Load z-κατ. [kN/m]	Water- φορτ. [kN/m]	u*b [kN/m]	φ [°]	c [kN/m²]	θ [°]
1	-17.12	1.84	-15.95	73.3	0.0	0.0	-11.6	27.45	3.57	-31.27*
2	-15.28	1.84	-14.11	182.4	0.0	0.0	-43.7	27.45	3.57	-31.27*
3	-13.44	1.84	-12.27	259.5	0.0	0.0	-79.3	0.08	71.43	-41.80
4	-11.60	1.84	-10.43	312.7	0.0	0.0	-106.1	0.08	71.43	-34.51
5	-9.76	1.84	-8.59	353.7	0.0	0.0	-126.8	0.08	71.43	-27.81
6	-7.92	1.84	-6.75	384.8	0.0	0.0	-142.4	0.08	71.43	-21.51
7	-6.08	1.84	-4.91	409.2	0.0	0.0	-153.8	29.26	3.57	-15.46
8	-4.24	1.84	-3.07	426.2	0.0	0.0	-161.4	29.26	3.57	-9.59
9	-2.40	1.84	-1.23	435.1	0.0	0.0	-165.4	29.26	3.57	-3.82
10	-0.56	1.84	0.61	464.3	0.0	0.0	-193.5	29.26	3.57	1.91
11	1.28	1.84	2.46	571.7	0.0	0.0	-218.3	29.26	3.57	7.67
12	3.12	1.84	4.30	557.5	0.0	0.0	-211.9	29.26	3.57	13.50
13	4.96	1.84	6.14	535.0	0.0	0.0	-201.9	0.08	71.43	19.48
14	6.80	1.84	7.98	506.8	0.0	0.0	-187.7	0.08	71.43	25.68
15	8.65	1.84	9.82	469.3	0.0	0.0	-168.8	0.08	71.43	32.24
16	10.49	1.84	11.66	420.5	0.0	0.0	-144.2	0.08	71.43	39.30
17	12.33	1.84	13.50	352.9	0.0	0.0	-111.9	27.45	3.57	47.17
18	14.17	1.84	15.34	256.0	0.0	0.0	-67.6	27.45	3.57	56.45
19	16.01	1.84	17.18	113.9	0.0	0.0	-20.8	0.08	35.71	68.96

*** Σημείωση: Στις λωρίδες σημειωμένες με '*'
περιορίστηκε το theta στο 45°-Phi/2.

Συνεισφ. κατακόρυφων φορτίων:

No	Weight	G*sin(θ)	(G-u*b)*tan(φ)	μ*sin(θ)*	T

			+ c*b	tan(φ)+cos(θ)	
	[kN/m]	[kN/m]	[kN/m]	[-]	[kN/m]
1	73.32	-63.54	38.61	0.795524	48.54
2	182.42	-139.84	78.66	0.795524	98.88
3	259.49	-172.98	131.73	0.745214	176.76
4	312.74	-177.20	131.76	0.823821	159.94
5	353.71	-165.04	131.79	0.884327	149.03
6	384.82	-141.07	131.81	0.930268	141.69
7	409.23	-109.10	149.66	0.931041	160.74
8	426.16	-71.00	154.91	0.965549	160.44
9	435.12	-28.98	157.69	0.989595	159.35
10	464.32	15.51	158.26	1.003547	157.70
11	571.73	76.27	204.56	1.007458	203.05
12	557.49	130.12	200.15	1.001067	199.93
13	534.96	178.36	131.94	0.942887	139.93
14	506.78	219.64	131.92	0.901333	146.36
15	469.28	250.32	131.89	0.846025	155.90
16	420.47	266.33	131.86	0.774016	170.36
17	352.86	258.79	131.76	0.763395	172.59
18	255.95	213.31	104.42	0.647666	161.22
19	113.91	106.31	65.74	0.359372	182.93
		646.21			2945.35

Δράση Ed = (646.2*18.41)
Αντίσταση Rd = (2945.4*18.41 +0.0)

SLIP-CIRCLE μ = Ed/Rd = 0.22 < 1.0: Έλεγχος εκπληρώθηκε.

Φάση εκσκαφής 5 "[5] Situation 4 +"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 5 Στρώσεις

Name		Τεχνητές επιχωματώσεις	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
γ	[kN/m3]	18	20	22.5
γ,R	[kN/m3]	18	20	22.5
γ'	[kN/m3]	8	10	12.5
γ,p	[kN/m3]	18	20	22.5
γ,R,passive	[kN/m3]	18	20	22.5
γ,pw	[kN/m3]	8	10	12.5
φ	[°]	25	0.1	33
c	[kN/m2]	2	50	5
c,u	[kN/m2]	10	50	5
c παθητικό	[kN/m2]	2	50	5
δ,a	[°]	16.66667	0.06666667	22
δ,p	[°]	-16.66667	-0.06666667	-22
δ,c	[°]	8.333333	0.03333333	11
k,agh	[-]	0.3456501	0.9955057	0.2452023
K,ach	[-]	1.043051	1.994195	0.8549058
K,0h	[-]	0.5773817	0.9982547	0.455361
K,pgh	[-]	3.908103	1.004519	7.495617
K,pch	[-]	5.180327	2.00583	8.599509
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	10e-06	5.5e-09	100e-06

Name		Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20	22.5
γ,R	[kN/m3]	20	22.5
γ'	[kN/m3]	10	12.5
γ,p	[kN/m3]	20	22.5
γ,R,passive	[kN/m3]	20	22.5
γ,pw	[kN/m3]	10	12.5
φ	[°]	0.1	35
c	[kN/m2]	100	5
c,u	[kN/m2]	100	5
c παθητικό	[kN/m2]	100	5
δ,a	[°]	0.06666667	23.33333
δ,p	[°]	-0.06666667	-23.33333
δ,c	[°]	0.03333333	11.66667
k,agh	[-]	0.9955057	0.2244207
K,ach	[-]	1.994195	0.8126539
K,0h	[-]	0.9982547	0.4264236
K,pgh	[-]	1.004519	9.146943
K,pch	[-]	2.00583	10.104
τ,gr	[kN/m2]	110	110
Ψ,A,max	[°]	90	90
k	[cm/s]	5.5e-09	100e-06

Πορεία πρανούς:

x [m]	0.00	0.00
z [m]	-6.50	0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:

x [m]	0.00	0.00
z [m]	-6.50	-1.50

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:
x [m] 0.00 0.00
z [m] -6.50 -4.50

Πορεία ανώτερου 4. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
z= -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -14.00

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
1.00	0.00	3.50	0.00	0.00	33.00	0.00	33.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Στάθμη νερού:

x [m] 0.00 0.00
z [m] -7.50 -3.00

Αγκύρια

z[m]	min.l[m]	Alpha[°]	C-H[kN/m]	P0[kN]	u0[m]
-0.50	0.00	15.00	0.00	0.00	0.0000
-3.00	0.00	15.00	αόρισ.	0.00	0.0000

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Ενεργές ωθήσεις.
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: Trapezoid.
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
Levels of redistribution Z1: 0.000, Z2: -3.000 [m].
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Κλασικός, Pregl/Sokolovsky (DIN 4085).

Options for water pressure

Στήριξη πόδα

Πόδας οριζοντίως μετακινούμενος

Αγκύρια

Anchor checks (lower failure plane): Ναι
Anchor forces with safety level of DS-P: Ναι
Verification of grout body pull out forces: Ναι
δ,a,Anchoring wall : used from soil layer.
δ,p,Anchoring wall : used from soil layer.

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	Αμμώδης ΑΡΓΙΛΟΣ
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

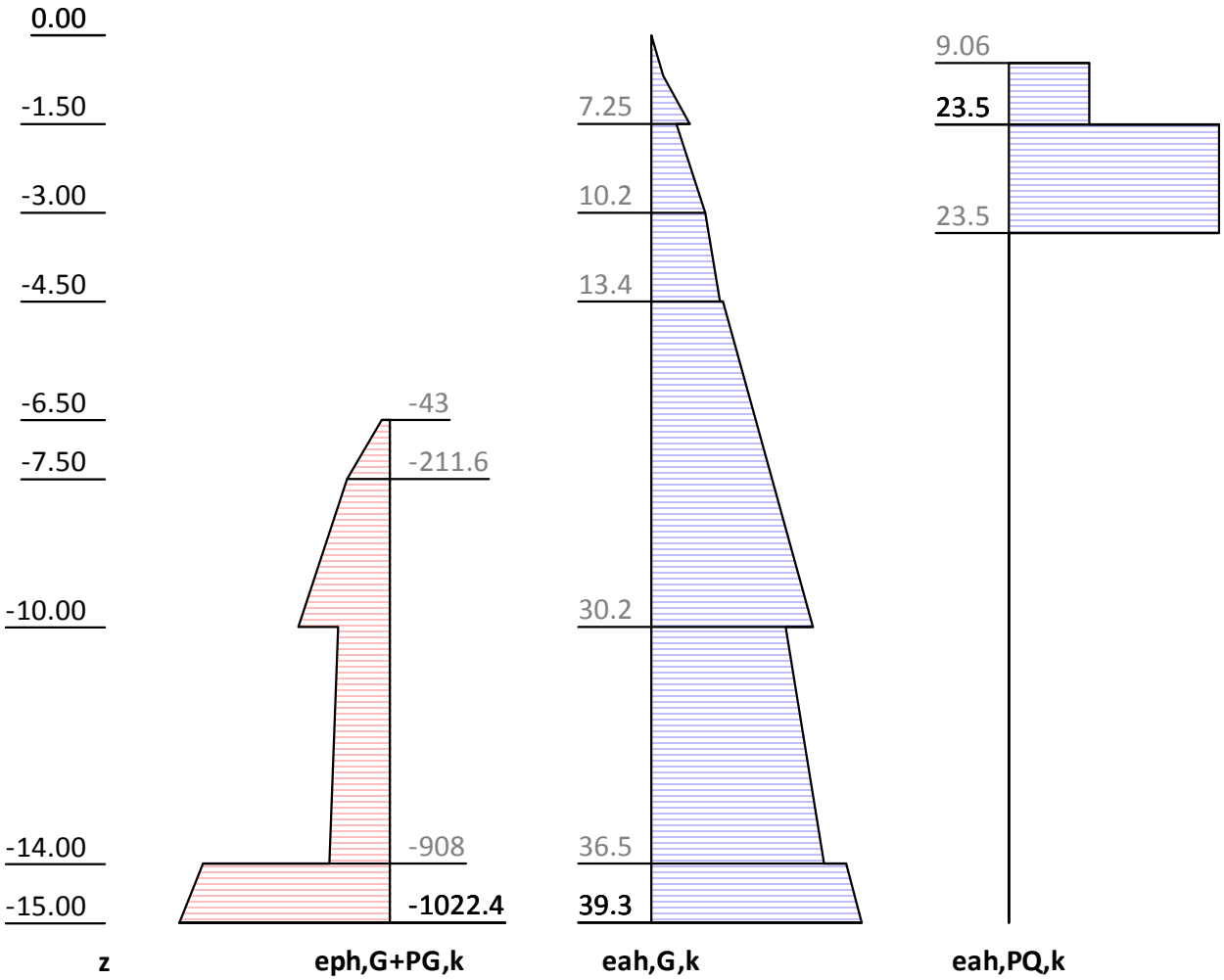
Μήκος τοίχου

Foot depth for statics: zf = -15.000

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall



z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.47		1.52	0.00	2.04
-0.47		1.52	9.06	15.62

z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
-1.50		7.25	9.06	23.37
-1.50		4.82	23.48	41.73
-3.34		10.79	23.48	49.78
-3.34		10.79	0.00	14.56
-4.50		12.86	0.00	17.36
-4.50		13.38	0.00	18.06
-6.50	-0.00	19.51	0.00	26.34
-6.50	-43.00	19.51	0.00	26.34
-10.00	-445.89	30.24	0.00	40.82
-10.00	-254.58	25.14	0.00	33.93
-14.00	-294.76	32.28	0.00	43.58
-14.00	-908.05	36.50	0.00	49.28
-15.00	-1022.38	39.31	0.00	53.06

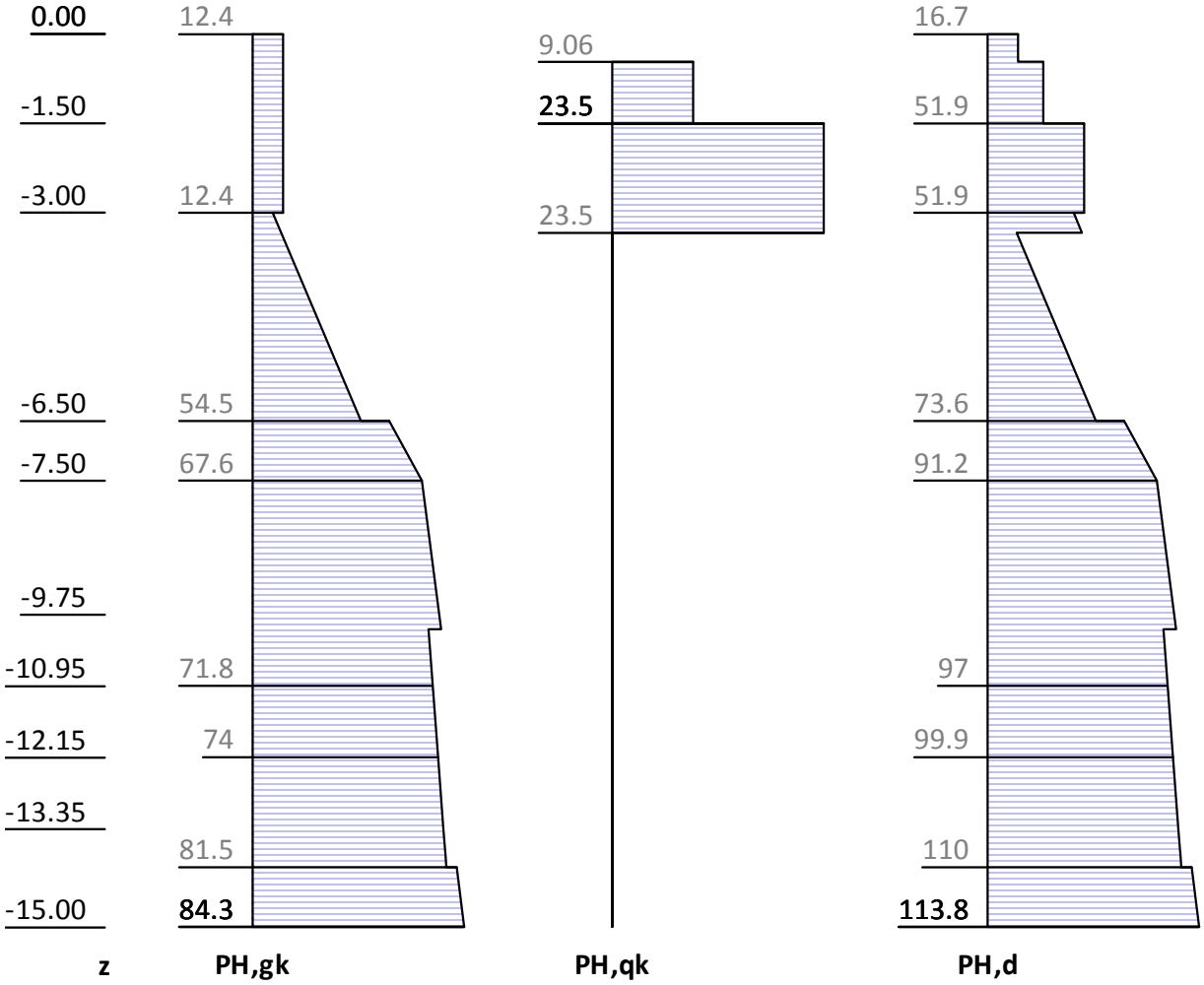
Eph,G,k:-3013.12, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 305.81, Eah,PG,k: 0.00, Eah,PQ,k: 52.53, Eah,d: 491.64

Πίεση νερού

z [m]	Wp,k [kN/m2]	Wa,k [kN/m2]	W,k [kN/m2]
-3.00		0.00	0.00
-7.50	0.00	45.00	45.00
-13.80	-63.00	108.00	45.00
-15.00	-75.00	120.00	45.00

H-pressure on static system

Level of mobilization: Ep,gk 100.0, Ep,qk 100.0, Ep,d 100.0 [%]

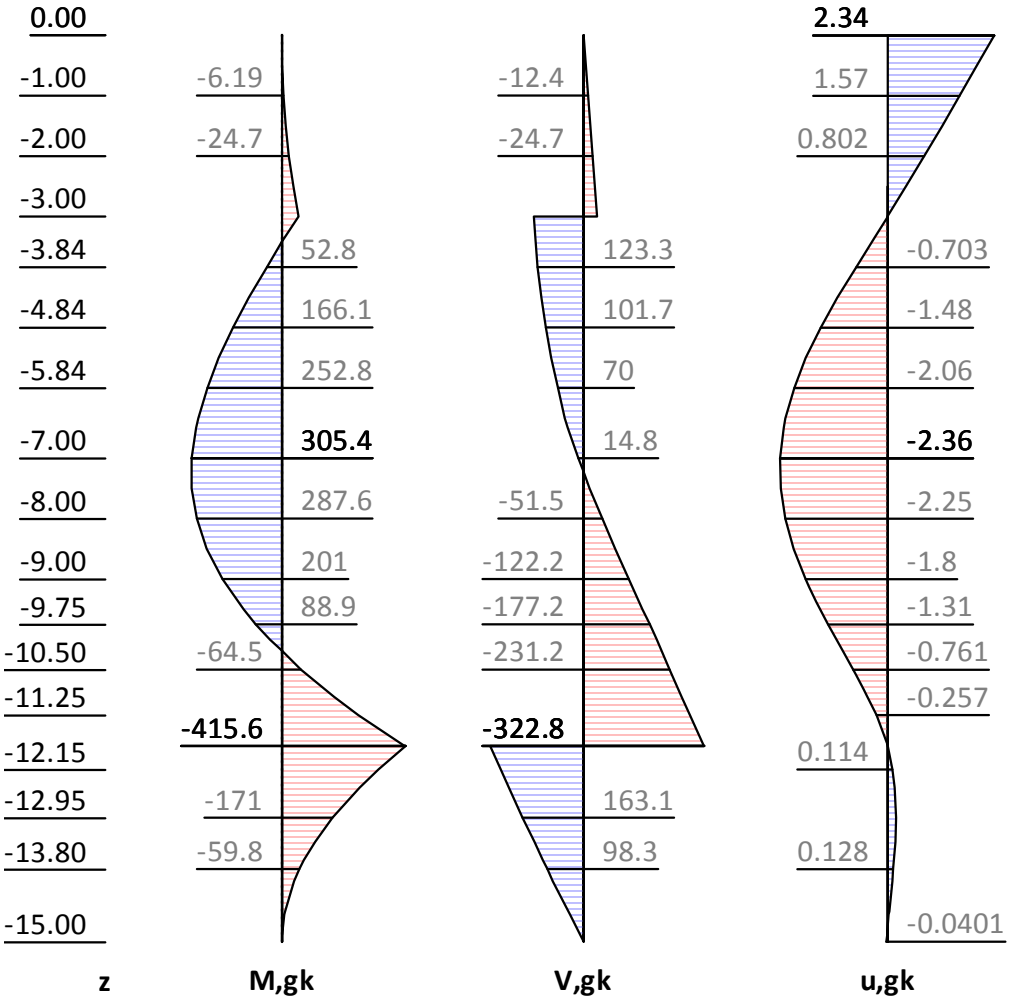


z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	12.37		16.71
-0.47	12.37	0.00	16.71
-0.47	12.37	9.06	30.29
-1.50	12.37	9.06	30.29
-1.50	12.37	23.48	51.93
-3.00	12.37	23.48	51.93
-3.00	8.25	23.48	46.36
-3.34	11.65	23.48	50.95
-3.34	11.65	0.00	15.73
-6.50	43.25	0.00	58.39
-6.50	54.51	0.00	73.59
-10.00	75.24	0.00	101.57
-10.00	70.14	0.00	94.68
-14.00	77.28	0.00	104.33
-14.00	81.50	0.00	110.03
-15.00	84.31	0.00	113.81

V-pressure on static system

Internal forces: Permanent, characteristically

```
z=  -0.500. Fx=  -0.000 kN/m Support
z=  -3.000. Fx=-170.938 kN/m Support
z= -11.769. Fx=-573.621 kN/m Support
```

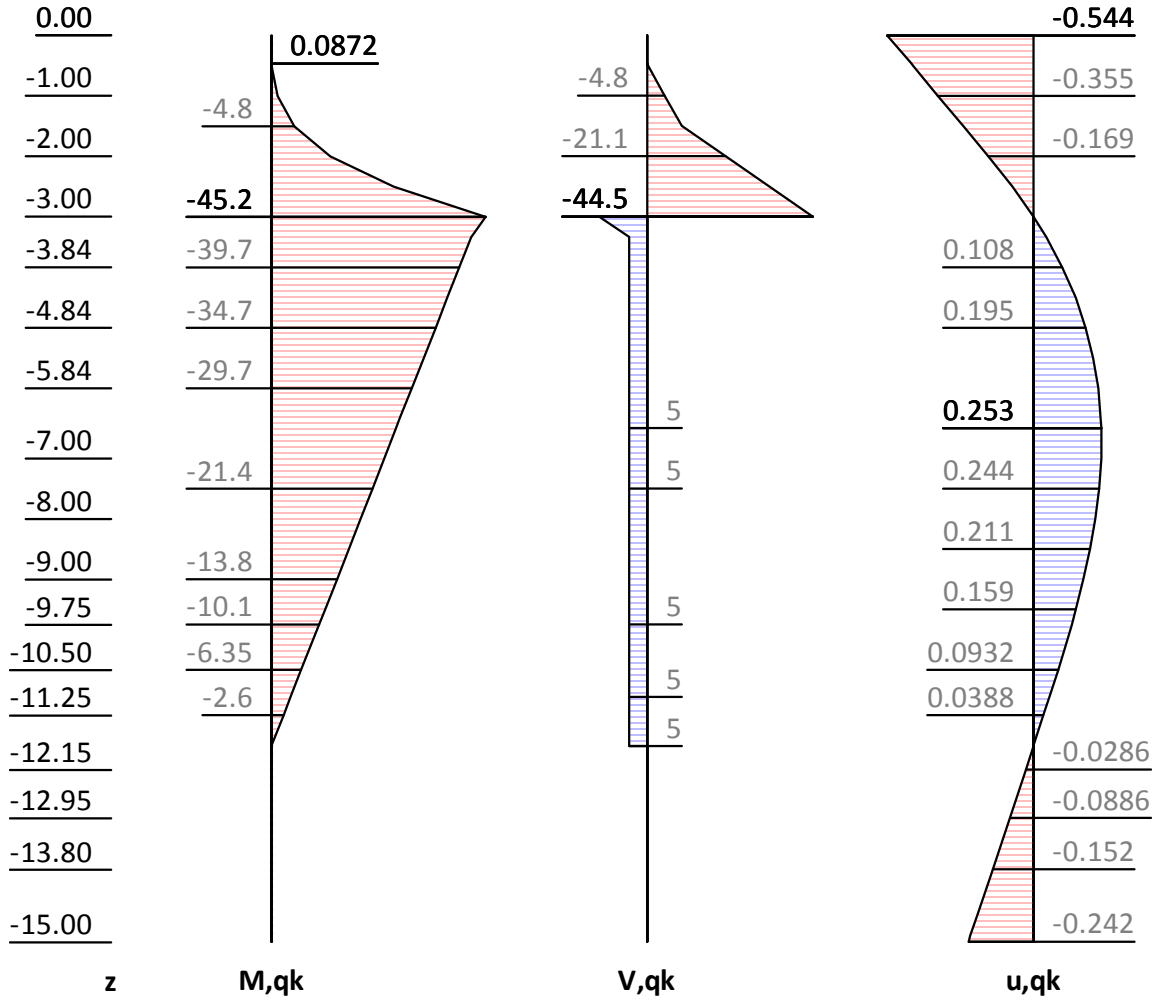


z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	12.37	-0.00	0.00	0.00	2.34
-0.00	12.37	-0.00	0.00	-0.00	2.34
-3.00	12.37	-55.69	-37.12	-71.27	-0.00
-3.00	8.25	-55.69	133.81	-117.07	-0.00
-3.42	12.50	-0.00	129.23	-126.71	-0.35
-6.50	43.25	290.65	43.67	-183.73	-2.29
-6.50	54.51	290.65	43.67	-183.73	-2.29
-7.00	61.04	305.40	14.79	-194.13	-2.36
-7.23	64.05	305.16	-0.00	-199.05	-2.36
-10.00	75.24	42.31	-195.88	-263.01	-1.13
-10.00	70.14	42.31	-195.88	-263.01	-1.13
-10.20	70.49	0.00	-209.87	-265.51	-0.98
-11.77	73.30	-415.63	-322.76	-285.36	0.00
-11.77	73.30	-415.63	250.86	-285.36	0.00
-12.95	75.41	-171.00	163.06	-300.28	0.19
-14.00	77.28	-41.69	82.90	-313.54	0.10

z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
-14.00	81.50	-41.69	82.90	-313.54	0.10
-14.73	83.54	-4.43	22.92	-334.47	0.00
-15.00	84.31	0.00	0.00	-342.49	-0.04

Internal forces: Variable, characteristically

Method EB 82-4 (Q = [G+Q] - G).
z= -0.500. Fx= 0.000 kN/m Support
z= -3.000. Fx= -57.533 kN/m Support
z= -11.769. Fx= 5.001 kN/m Support

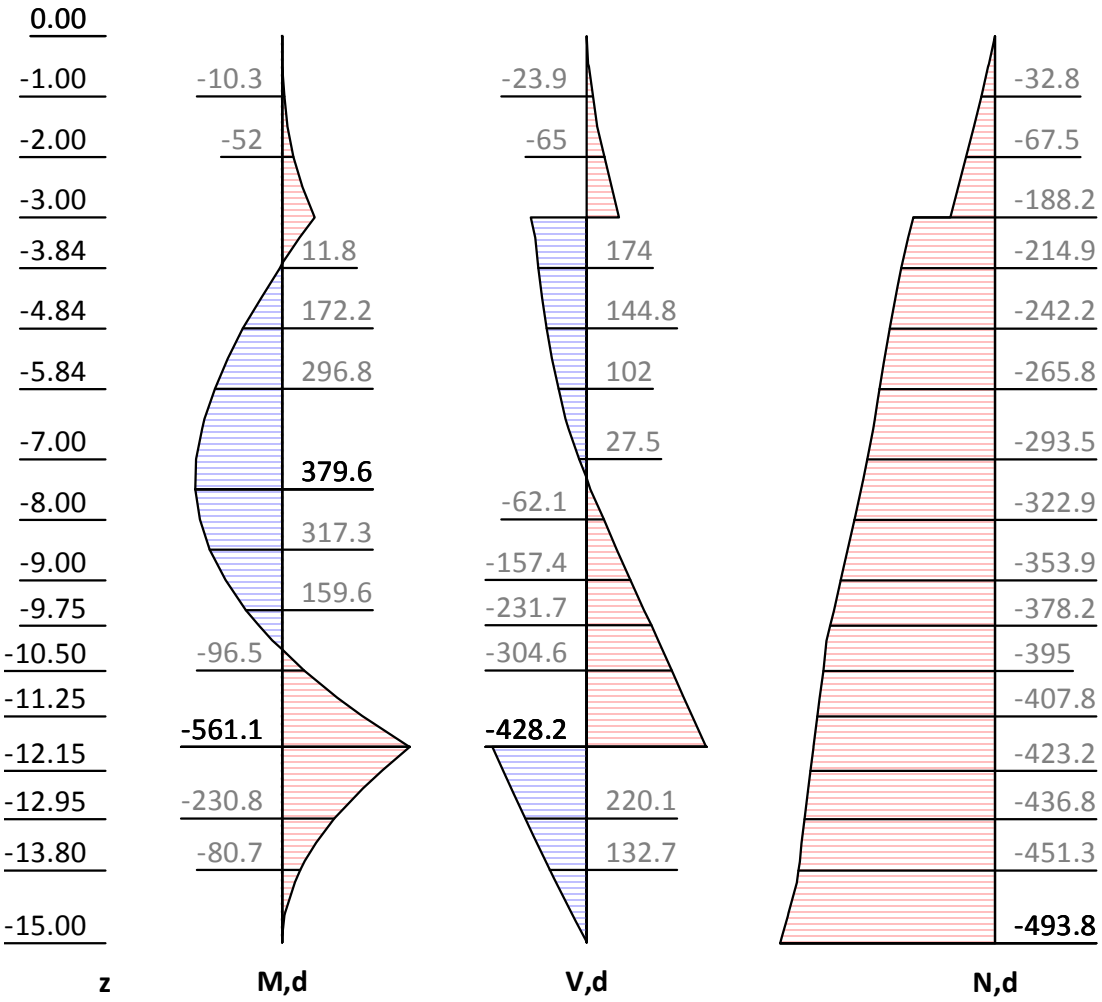


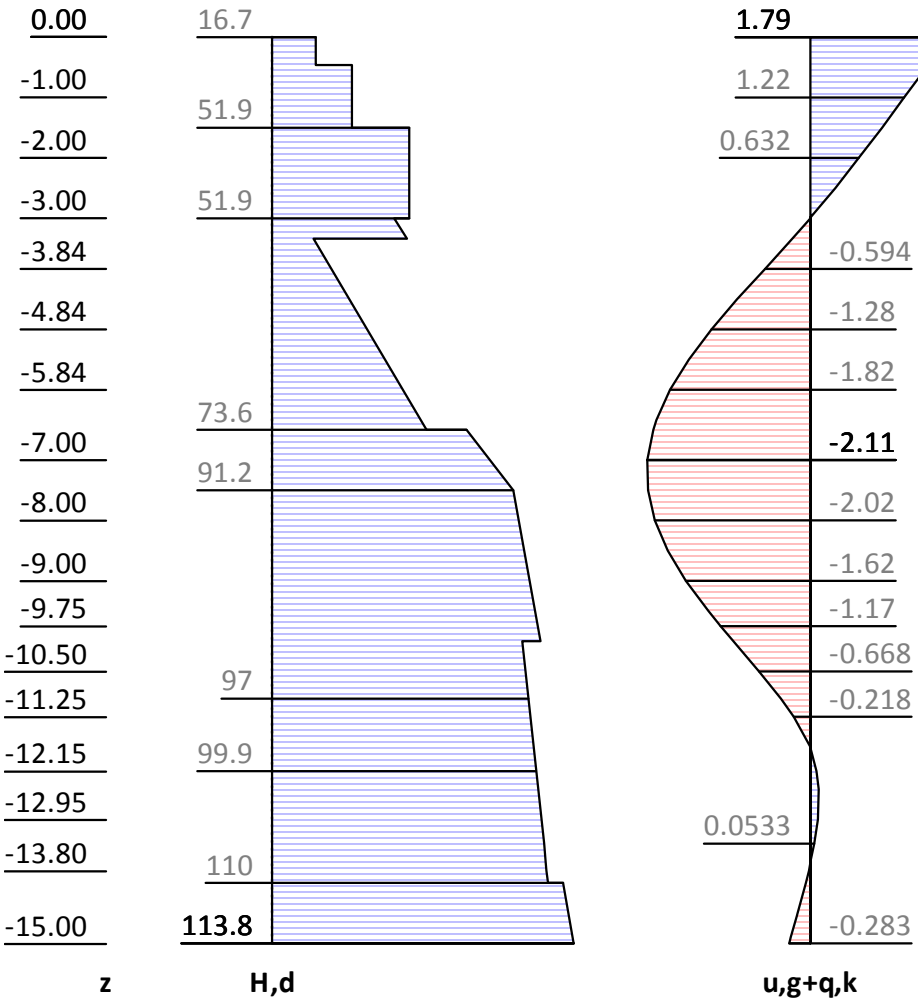
z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00	-0.00	-0.00	-0.54
-0.47	0.00	0.09	-0.00	-0.00	-0.45
-0.47	9.06	0.09	-0.00	0.00	-0.45
-0.50	9.06	0.00	-0.26	-0.03	-0.45
-1.50	9.06	-4.80	-9.33	-0.99	-0.26
-1.50	23.48	-4.80	-9.33	-0.99	-0.26
-3.00	23.48	-45.21	-44.55	-4.71	-0.00
-3.00	23.48	-45.21	12.98	-20.13	-0.00
-3.00	23.48	-45.21	12.98	-20.13	0.00
-3.34	23.48	-42.15	5.00	-20.97	0.05

z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
-3.34	0.00	-42.15	5.00	-20.97	0.05
-6.50	0.00	-26.35	5.00	-20.97	0.25
-7.50	0.00	-21.35	5.00	-20.97	0.24
-9.75	0.00	-10.10	5.00	-20.97	0.14
-11.77	0.00	-0.00	5.00	-20.97	0.00
-11.77	0.00	-0.00	0.00	-20.97	0.00
-12.95	0.00	-0.00	0.00	-20.97	-0.09
-13.80	0.00	-0.00	0.00	-20.97	-0.15
-14.82	0.00	-0.00	0.00	-20.97	-0.23
-14.90	0.00	0.00	0.00	-20.97	-0.23
-14.96	0.00	-0.00	-0.00	-20.97	-0.24
-15.00	0.00	-0.00	-0.00	-20.97	-0.24

Internal forces: Design

z= -0.500. Fx= -0.000 kN/m Support
z= -3.000. Fx=-317.067 kN/m Support
z= -11.769. Fx=-766.887 kN/m Support





z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	16.71	0.00	-0.00	0.00	1.79
-0.00	16.71	0.00	-0.00	-0.00	1.79
-0.47	16.71	-1.85	-7.85	-15.07	1.52
-0.47	30.29	-1.85	-7.85	-15.07	1.52
-1.50	30.29	-26.00	-39.05	-49.59	0.93
-1.50	51.93	-26.00	-39.05	-49.59	0.93
-3.00	51.93	-143.00	-116.94	-103.28	0.00
-3.00	51.93	-143.00	-116.94	-103.28	-0.00
-3.00	46.36	-143.00	200.13	-188.24	-0.00
-3.34	50.95	-77.72	183.58	-199.99	-0.24
-3.34	15.73	-77.72	183.58	-199.99	-0.24
-3.77	21.59	0.00	175.26	-212.98	-0.55
-6.50	58.39	352.85	66.46	-279.50	-2.04
-6.50	73.59	352.85	66.46	-279.50	-2.04
-7.00	82.41	376.51	27.46	-293.53	-2.11
-7.32	87.99	378.45	0.00	-302.68	-2.11
-7.50	91.23	379.57	-15.95	-307.99	-2.11
-10.00	101.57	43.85	-256.94	-386.52	-1.00
-10.00	94.68	43.85	-256.94	-386.52	-1.00
-10.16	95.06	-0.00	-271.83	-389.18	-0.90
-11.77	98.95	-561.10	-428.22	-416.69	0.00

z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
-11.77	98.95	-561.10	338.66	-416.69	0.00
-12.45	100.59	-353.58	270.73	-428.30	0.11
-13.67	103.53	-99.34	146.46	-449.07	-0.00
-14.00	104.33	-56.28	111.92	-454.74	-0.06
-14.00	110.03	-56.28	111.92	-454.74	-0.06
-15.00	113.81	-0.00	-0.00	-493.83	-0.28

Anchor forces with safety level of DS-P

z[m]	A,d[kN]	Fx,d[kN/m]
-0.50	0.0	-0.0
-3.00	295.4	-317.1

Checks of earth statics

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -11.77 m
Rd = Eph,k/γ,Re = 3013.12 / 1.400 = 2152.23 [kN/m]
Ed(Uh,d)/Rd = 766.89 / 2152.23 = 0.356 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-15.00

Pos.	H	V
H/V pressure G+P+W,k	744.56	66.35
Wall weight		233.11
H/V pressure passive		0.00
Support z: -0.50		0.00
Support z: -3.00	-170.94	45.80
Bh,g,k z=-11.77	-573.62	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.67
Σ	-0.00	344.60 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.
Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1

Vertical component of earth resistance is less than
the downwards pointing vertical forces.
Vk >= Bvk: 345.27 >= 0.67 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-15.00

Pos.	H	V
H/V pressure G+P+W,k	797.09	71.91
Wall weight		233.11
H/V pressure passive		0.00
Support z: -0.50		0.00
Support z: -3.00	-228.47	61.22
Bh,g,k z=-11.77	-573.62	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.67
Bh,q,k z=-11.77	5.00	
Bv,q,k = Bh,k * tan(δ,p=-0.07°)		0.01

Pos.	H	V
Σ	-0.00	365.58 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.

Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1

Vertical component of earth resistance is less than the downwards pointing vertical forces.

Vk >= Bvk: 366.24 >= 0.66 Passes requirement

Anchor verification

Anchor - Stability of lower failure plane

Περίπτ.Φόρτισης: όλα τα φορτία BS-P
Αυτόμ. υπολογ. μήκους αγκυρίων:
All anchors are extended (if necessary)
Favourable variable loads in main failure body are not being considered.
Bottom of lower failure plane: z=-15.00 m

Iteration of failure mechanisms:

lA .....: Length of anchor from head to center of grout body.
W,k .....: Res. force from dead weight, loads, cohesion, ...
Q,k .....: Force in lower failure plane.
Ea1,k.....: Earth pressure onto vertical separation plane.
Ea2,k.....: Earth pressure between wall and main failure body.
Ra_cal,d ...: Dimesioning force of the resistance from the equilibrium of forces. Ra_cal,d corresponds to the max. possible anchor force of the force polygon.
Sum(A,d) ...: Acting anchor forces along the grout body fractions within the failure body. Sum(A,d) is gained from the anchor pull forces of the wall analysis.

z [m]	ϑ1 [°]	ϑ2 [°]	lA [m]	W,k [kN/m]	Q,k [kN/m]	Ea1,k [kN/m]	Ea2,k [kN/m]	Ra_cal,d [kN/m]	Sum(A,d) [kN/m]	Ed/Rd [-]
-0.50	46.6	57.5	11.32	1100.3	914.2	4.4	365.5	300.9	299.6	1.00
-3.00	41.7	60.8	10.72	1226.2	1006.6	27.5	365.5	328.6	328.3	1.00

Decisive failure body:

Γεωμετρία:

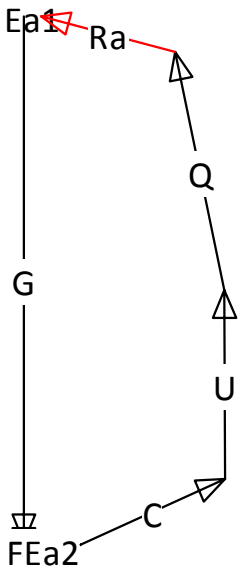
Foot point of lower failure plane	x/z = 0.01/-15.00 m
Intersection lower/upper slid. plane	x/z = 10.36/ -5.78 m
Intersection upper slid. plane/surface	x/z = 13.59/ 0.00 m
Intersection separation plane/surface	x/z = 10.36/ 0.00 m
Inclination lower failure plane	ϑ1 = 41.71°
Inclination upper failure plane	ϑ2 = 60.78°
Inclination separation plane	ϑ12 = 90.00°

Loads / forces (char.)

		Fx [kN/m]	Fz [kN/m]	F [kN/m]	
Weight of main failure body	G,k:	0.0	-2237.5	2237.5	
Area loads on/in main failure body	F1,k:	0.0	-82.5	82.5	
Cohesion of lower failure plane	C,k:	478.0	426.1	640.4	
Pore water pressure on main body	U,k:	-0.5	764.5	764.5	
Earth pres. on separation plane	Ea1,k:	-27.5	-0.0	27.5	δ= 0.0°
Earth pr. between wall<->main body	Ea2,k:	358.3	71.9	365.5	
Force in lower failure plane	Q,k:	-364.1	938.4	1006.6	

		Fx [kN/m]	Fz [kN/m]	F [kN/m]
Sum = possible anchor forces:	Ra_cal,k:	444.4	-119.1	460.0

Force polygon



Acting anchor forces Ed: Sum(A,d) = 328.3 kN/m
Possible anchor forces Rd: Ra_cal,d = 460.0/1.400 = 328.6 kN/m
Verif. of lower failure plane Ed/Rd = 1.00 < 1.0: Έλεγχος εκπληρώθηκε.

Check of steel tension

l,tot ...[m]: Total length of anchor incl. excess length at head
As ....[mm2]: X-section are of steel member
Ri,d ...[kN]: Ultimate strength of tension member (γ,M=1.15)
A,d ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	l,tot	As	Ri,d		A,d	
-0.50	Strand;3x0.60";1570/1770	16.32	420	573.4	>	0.0	Passes requirement
-3.00	Strand;3x0.60";1570/1770	14.72	420	573.4	>	295.4	Passes requirement

Check of steel tension: Passes requirement

Check of anchor's soil friction

lVk .....: Length of grout body
DmVk ....: Diameter of grout body
τGr,k ...: Average applied skin friction along the grout body (from soil parameters)
Ra,k ....: Charact. pullout resistance of the anchor
γA ......: Partial safety factor of anchor pullout
Ra,d ....: = Ra,k / γA
A,d .....: Dimensioning force of the anchor from wall analysis

z [m]	lVk [m]	DmVk [mm]	τGr,k [kN/m²]	Ra,k [kN]	γA [-]	Ra,d [kN]		A,d [kN]	A,d/Ra,d [-]
-0.50	8.00	318	110	879.1	1.100	799.2	>	0.0	0.0
-3.00	8.00	318	110	879.1	1.100	799.2	>	295.4	0.4

Check of anchor's soil friction: Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)
Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (-0.20, 0.82), Ακτίνα = 15.83
Αρχ.σημ.= (-14.23, -6.50), Τελ.σημ. = (15.61, 0.00)

Γεωμετρία λωρίδων:

No	x	Width b	dxM	Weight	Load z-κατ.	Water-φορτ.	u*b	φ	c	θ
	[m]	[m]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[°]	[kN/m²]	[°]
1	-13.44	1.58	-13.25	48.1	0.0	0.0	-11.5	27.45	3.57	-31.27*
2	-11.86	1.58	-11.66	120.6	0.0	0.0	-36.7	27.45	3.57	-31.27*
3	-10.27	1.58	-10.08	168.6	0.0	0.0	-60.9	0.08	71.43	-39.55
4	-8.69	1.58	-8.50	205.0	0.0	0.0	-79.2	0.08	71.43	-32.46
5	-7.11	1.58	-6.91	233.0	0.0	0.0	-93.3	0.08	71.43	-25.89
6	-5.53	1.58	-5.33	254.4	0.0	0.0	-103.9	29.26	3.57	-19.68
7	-3.94	1.58	-3.75	271.3	0.0	0.0	-111.4	29.26	3.57	-13.69
8	-2.36	1.58	-2.16	282.0	0.0	0.0	-116.2	29.26	3.57	-7.86
9	-0.78	1.58	-0.58	288.9	0.0	0.0	-154.0	29.26	3.57	-2.10
10	0.81	1.58	1.00	495.1	0.0	0.0	-189.3	29.26	3.57	3.63
11	2.39	1.58	2.58	488.7	0.0	0.0	-186.4	29.26	3.57	9.40
12	3.97	1.58	4.17	476.4	0.0	0.0	-180.9	29.26	3.57	15.27
13	5.56	1.58	5.75	458.0	0.0	0.0	-172.6	0.08	71.43	21.30
14	7.14	1.58	7.33	435.2	0.0	0.0	-161.2	0.08	71.43	27.60
15	8.72	1.58	8.92	405.2	0.0	0.0	-146.0	0.08	71.43	34.28
16	10.30	1.58	10.50	366.2	0.0	0.0	-126.3	0.08	71.43	41.55
17	11.89	1.58	12.08	312.5	0.0	0.0	-100.3	27.45	3.57	49.76
18	13.47	1.58	13.67	232.8	0.0	0.0	-63.5	27.45	3.57	59.69
19	14.94	1.35	15.13	99.4	0.0	0.0	-17.8	0.08	35.71	72.94

*** Σημείωση: Στις λωρίδες σημειωμένες με '*'
περιορίστηκε το theta στο 45°-Phi/2.

Συνεισφ. κατακόρυφων φορτίων:

No	Weight	G*sin(θ)	(G-u*b)*tan(φ) + c*b	μ*sin(θ)* tan(φ)+cos(θ)	T
	[kN/m]	[kN/m]	[kN/m]	[-]	[kN/m]
1	48.10	-40.25	24.67	0.746750	33.03
2	120.59	-88.84	49.21	0.746750	65.90
3	168.60	-107.35	113.22	0.770752	146.90
4	205.02	-110.03	113.25	0.843470	134.26
5	233.00	-101.75	113.27	0.899361	125.94
6	254.40	-85.66	89.96	0.866117	103.86
7	271.29	-64.22	95.20	0.918509	103.65
8	282.02	-38.55	98.53	0.959961	102.64
9	288.92	-10.60	81.21	0.991096	81.94
10	495.14	31.34	176.97	1.012186	174.83
11	488.70	79.80	174.97	1.023190	171.00

No	Weight [kN/m]	G*sin(θ) [kN/m]	(G-u*b)*tan(φ) + c*b [kN/m]	μ*sin(θ)* tan(φ)+cos(θ) [-]	T [kN/m]
12	476.38	125.43	171.14	1.023749	167.17
13	458.03	166.40	113.47	0.931877	121.76
14	435.24	201.64	113.45	0.886463	127.98
15	405.19	228.24	113.43	0.826571	137.23
16	366.15	242.87	113.41	0.748729	151.46
17	312.54	238.56	115.93	0.804774	144.06
18	232.84	201.01	93.64	0.684218	136.86
19	99.36	94.99	48.38	0.293972	164.56
		963.03			2395.06

Συνεισφ. αγκυρίων: Αθρ. ροπών ανατροπής : -53.2 kN*m/m
" " resisting : 47.4 kN*m/m

Δράση Ed = (963.0*15.83-53.2)
Αντίσταση Rd = (2395.1*15.83+47.4)

SLIP-CIRCLE μ = Ed/Rd = 0.40 < 1.0: Έλεγχος εκπληρώθηκε.

Φάση εκσκαφής 6 "[6] Situation 4 + +"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 5 Στρώσεις

Name		Τεχνητές επιχωματώσεις	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
γ	[kN/m3]	18	20	22.5
γ,R	[kN/m3]	18	20	22.5
γ'	[kN/m3]	8	10	12.5
γ,p	[kN/m3]	18	20	22.5
γ,R,passive	[kN/m3]	18	20	22.5
γ,pw	[kN/m3]	8	10	12.5
φ	[°]	25	0.1	33
c	[kN/m2]	2	50	5
c,u	[kN/m2]	10	50	5
c παθητικό	[kN/m2]	2	50	5
δ,a	[°]	16.66667	0.06666667	22
δ,p	[°]	-16.66667	-0.06666667	-22
δ,c	[°]	8.333333	0.03333333	11
k,agh	[-]	0.3456501	0.9955057	0.2452023
K,ach	[-]	1.043051	1.994195	0.8549058
K,0h	[-]	0.5773817	0.9982547	0.455361
K,pgh	[-]	3.908103	1.004519	7.495617
K,pch	[-]	5.180327	2.00583	8.599509
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	10e-06	5.5e-09	100e-06

Name		Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20	22.5
γ,R	[kN/m3]	20	22.5
γ'	[kN/m3]	10	12.5
γ,p	[kN/m3]	20	22.5
γ,R,passive	[kN/m3]	20	22.5
γ,pw	[kN/m3]	10	12.5
φ	[°]	0.1	35
c	[kN/m2]	100	5
c,u	[kN/m2]	100	5
c παθητικό	[kN/m2]	100	5
δ,a	[°]	0.06666667	23.33333
δ,p	[°]	-0.06666667	-23.33333
δ,c	[°]	0.03333333	11.66667
k,agh	[-]	0.9955057	0.2244207
K,ach	[-]	1.994195	0.8126539
K,0h	[-]	0.9982547	0.4264236
K,pgh	[-]	1.004519	9.146943
K,pch	[-]	2.00583	10.104
τ,gr	[kN/m2]	110	110
Ψ,A,max	[°]	90	90
k	[cm/s]	5.5e-09	100e-06

Πορεία πρανούς:

x [m]	0.00	0.00
z [m]	-6.50	0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:

x [m]	0.00	0.00
z [m]	-6.50	-1.50

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:
x [m] 0.00 0.00
z [m] -6.50 -4.50

Πορεία ανώτερου 4. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
z= -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -14.00

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
1.00	0.00	3.50	0.00	0.00	33.00	0.00	33.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Στάθμη νερού:

x [m] 0.00 0.00
z [m] -7.50 -3.00

Αγκύρια

z[m]	min.l[m]	Alpha[°]	C-H[kN/m]	P0[kN]	u0[m]
-0.50	0.00	15.00	αόρισ.	0.00	0.0000
-3.00	0.00	15.00	αόρισ.	0.00	0.0000
-5.50	0.00	15.00	αόρισ.	0.00	0.0000

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Ενεργές ωθήσεις.
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: Triangle (perpend. to wall).
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
Levels of redistribution Z1: -3.000, Z2: -5.500 [m].
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Κλασικός, Pregl/Sokolovsky (DIN 4085).

Options for water pressure

Στήριξη πόδα

Πόδας οριζοντίως μετακινούμενος

Αγκύρια

Anchor checks (lower failure plane): Ναι
Anchor forces with safety level of DS-P: Ναι
Verification of grout body pull out forces: Ναι
δ,a,Anchoring wall : used from soil layer.
δ,p,Anchoring wall : used from soil layer.

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	Αμμώδης ΑΡΓΙΛΟΣ
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

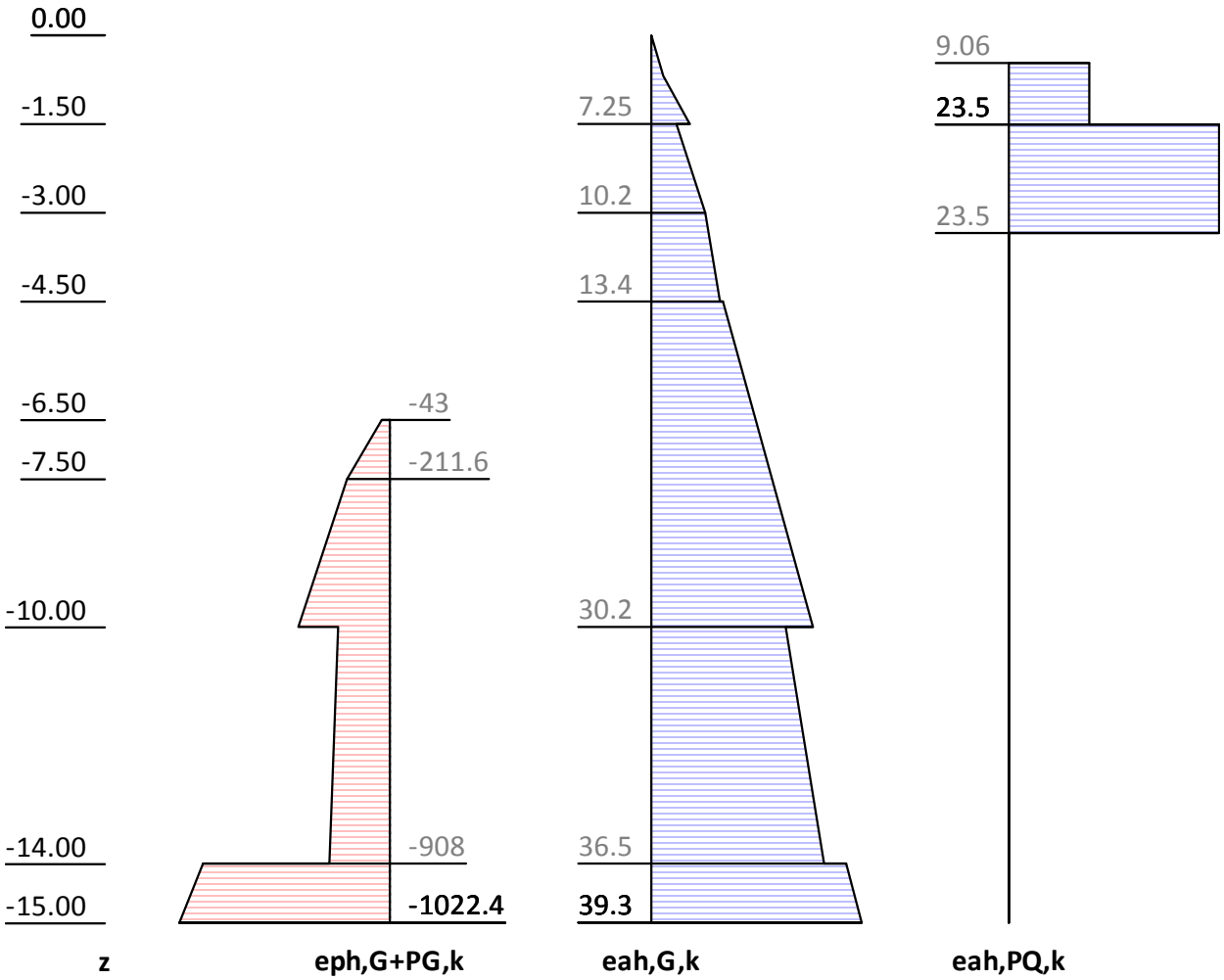
Μήκος τοίχου

Foot depth for statics: zf = -15.000

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall



z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.47		1.52	0.00	2.04
-0.47		1.52	9.06	15.62

z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
-1.50		7.25	9.06	23.37
-1.50		4.82	23.48	41.73
-3.34		10.79	23.48	49.78
-3.34		10.79	0.00	14.56
-4.50		12.86	0.00	17.36
-4.50		13.38	0.00	18.06
-6.50	-0.00	19.51	0.00	26.34
-6.50	-43.00	19.51	0.00	26.34
-10.00	-445.89	30.24	0.00	40.82
-10.00	-254.58	25.14	0.00	33.93
-14.00	-294.76	32.28	0.00	43.58
-14.00	-908.05	36.50	0.00	49.28
-15.00	-1022.38	39.31	0.00	53.06

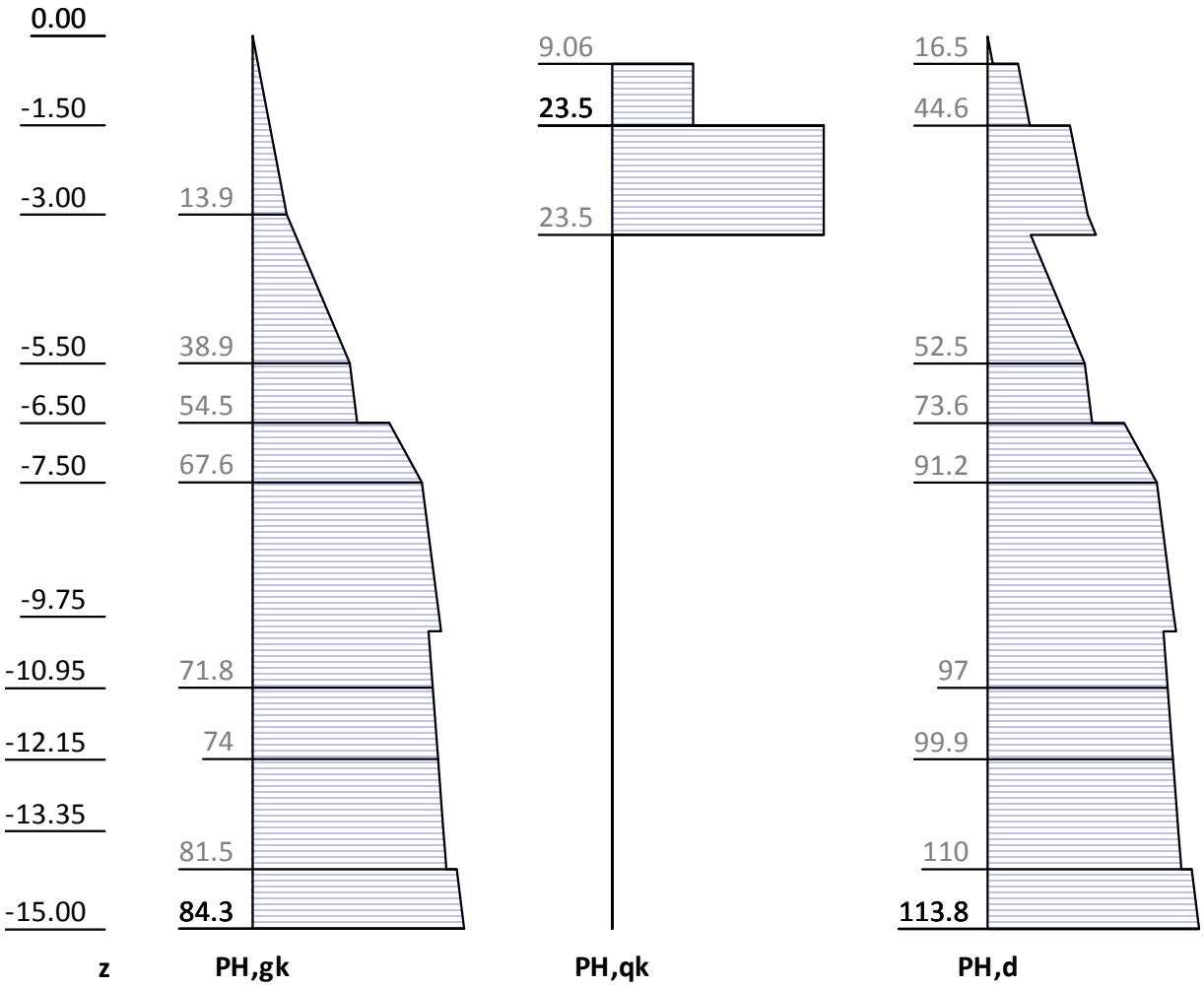
Eph,G,k:-3013.12, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 305.81, Eah,PG,k: 0.00, Eah,PQ,k: 52.53, Eah,d: 491.64

Πίεση νερού

z [m]	Wp,k [kN/m2]	Wa,k [kN/m2]	W,k [kN/m2]
-3.00		0.00	0.00
-7.50	0.00	45.00	45.00
-13.80	-63.00	108.00	45.00
-15.00	-75.00	120.00	45.00

H-pressure on static system

Level of mobilization: Ep,gk 100.0, Ep,qk 100.0, Ep,d 100.0 [%]

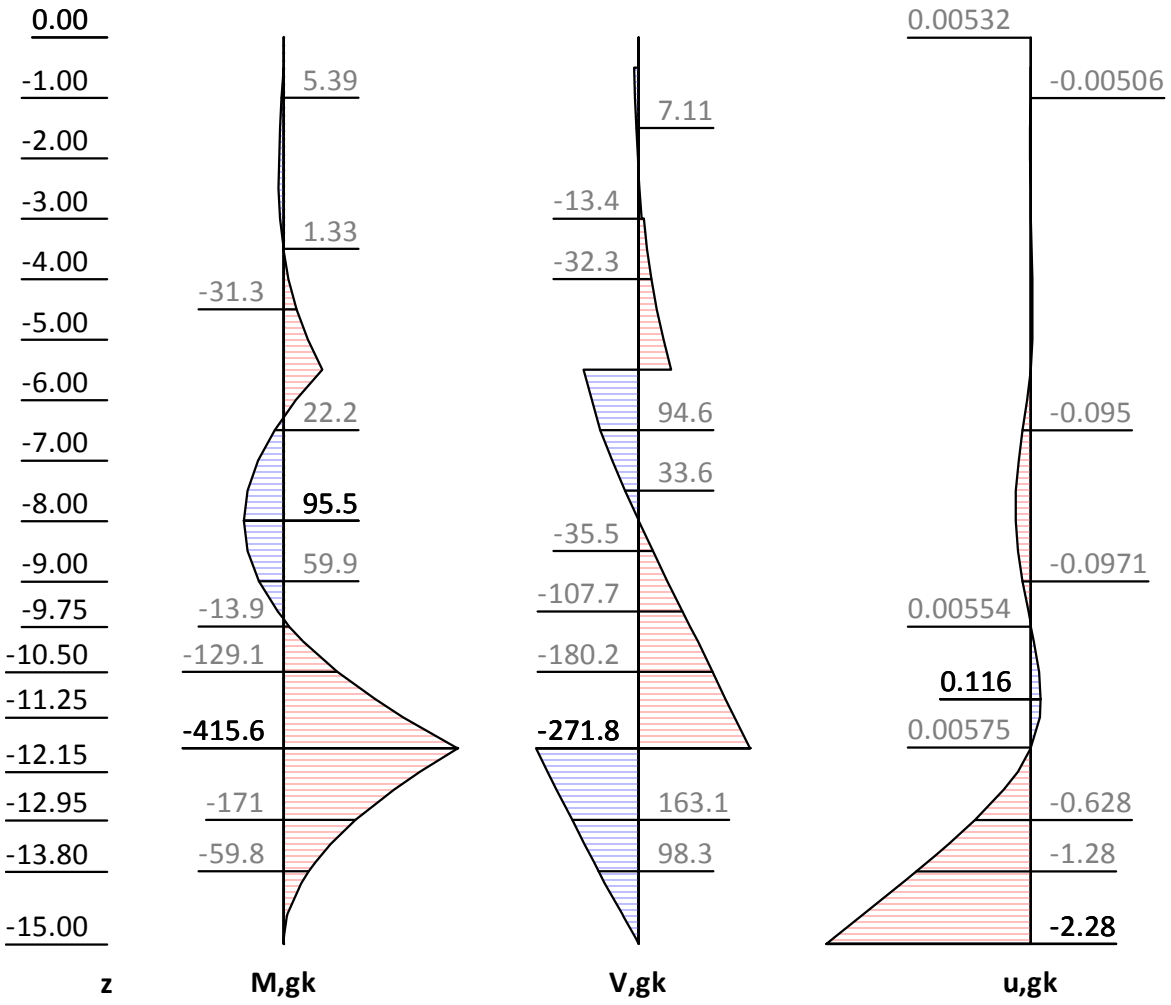


z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	0.00		0.00
-0.47	2.18	0.00	2.94
-0.47	2.18	9.06	16.52
-1.50	6.95	9.06	22.97
-1.50	6.95	23.48	44.60
-3.34	17.30	23.48	58.57
-3.34	17.30	0.00	23.35
-6.50	41.95	0.00	56.63
-6.50	54.51	0.00	73.59
-10.00	75.24	0.00	101.57
-10.00	70.14	0.00	94.68
-14.00	77.28	0.00	104.33
-14.00	81.50	0.00	110.03
-15.00	84.31	0.00	113.81

V-pressure on static system

Internal forces: Permanent, characteristically

```
z=  -0.500. Fx= -12.318 kN/m Support
z=  -3.000. Fx=   4.829 kN/m Support
z=  -5.500. Fx=-214.401 kN/m Support
z= -11.769. Fx=-522.670 kN/m Support
```

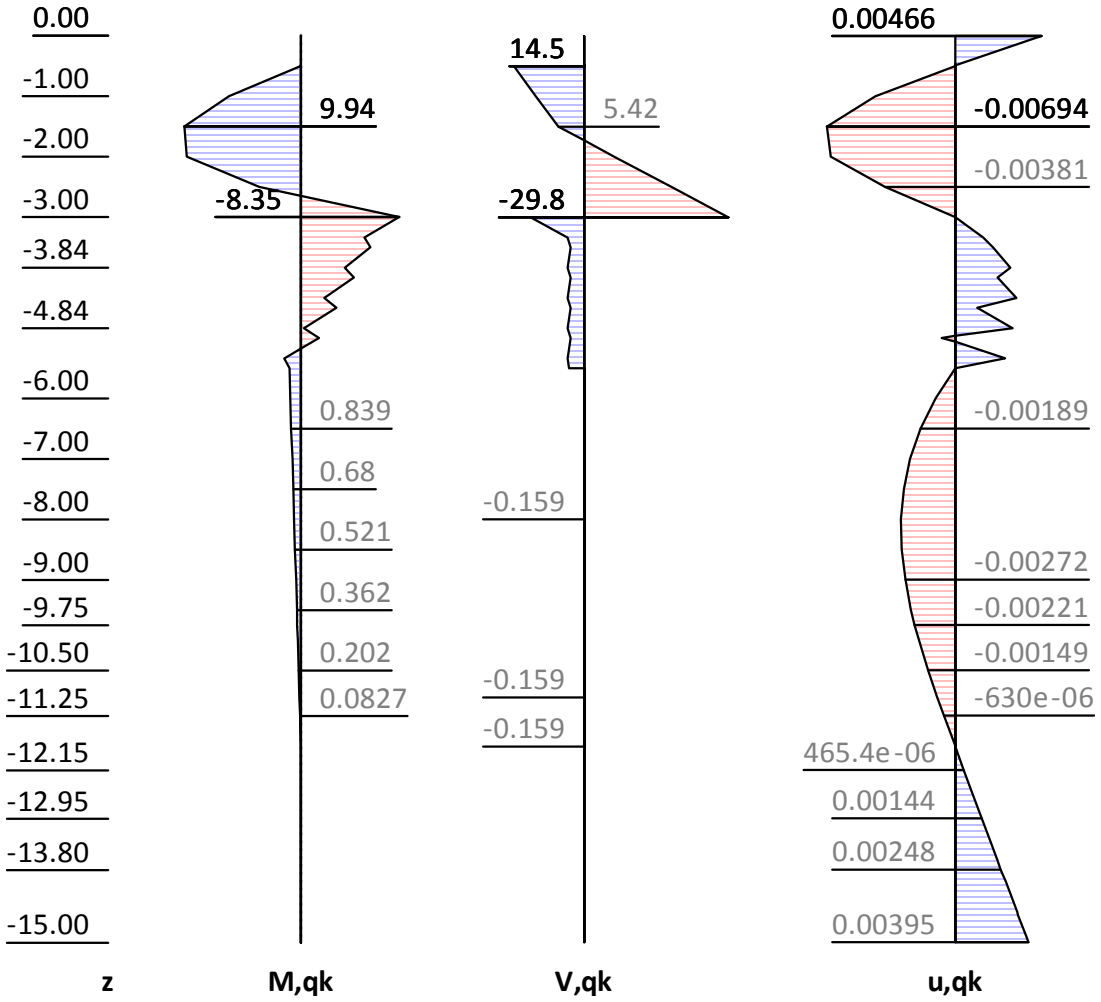


z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	0.00	0.00	0.00	0.00	0.01
-0.50	2.32	-0.10	-0.58	-10.63	0.00
-0.51	2.36	0.00	11.71	-14.12	-0.00
-2.00	9.27	12.30	3.05	-47.40	-0.01
-2.29	10.62	12.46	0.00	-54.24	-0.01
-2.50	11.58	12.57	-2.16	-59.08	-0.01
-3.00	13.90	9.95	-8.53	-71.02	0.00
-3.00	13.90	9.95	-13.36	-69.73	0.00
-3.55	19.39	-0.00	-22.62	-82.46	0.01
-4.50	28.90	-31.35	-45.45	-102.17	0.02
-5.50	38.90	-92.92	-79.35	-119.60	-0.00
-5.50	38.90	-92.92	135.05	-177.05	-0.00
-6.29	41.30	0.00	103.33	-188.93	-0.07
-6.50	41.95	22.18	94.63	-192.01	-0.10
-6.50	54.51	22.18	94.63	-192.01	-0.10

z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
-7.99	69.08	95.40	0.00	-223.94	-0.17
-8.00	69.11	95.54	-0.59	-224.13	-0.17
-9.63	74.11	0.00	-117.37	-262.21	-0.01
-9.71	74.35	-9.44	-123.36	-264.18	-0.00
-10.00	75.24	-47.83	-144.93	-271.28	0.04
-10.00	70.14	-47.83	-144.93	-271.28	0.04
-10.95	71.83	-217.42	-212.37	-283.28	0.12
-11.77	73.30	-415.63	-271.81	-293.63	0.00
-11.77	73.30	-415.63	250.86	-293.63	0.00
-14.00	77.28	-41.69	82.90	-321.82	-1.44
-14.00	81.50	-41.69	82.90	-321.82	-1.44
-15.00	84.31	0.00	0.00	-350.77	-2.28

Internal forces: Variable, characteristically

```
Method EB 82-4 (Q = [G+Q] - G).
z=  -0.500. Fx= -14.744 kN/m Support
z=  -3.000. Fx= -40.985 kN/m Support
z=  -5.500. Fx=   3.357 kN/m Support
z= -11.769. Fx=  -0.159 kN/m Support
```

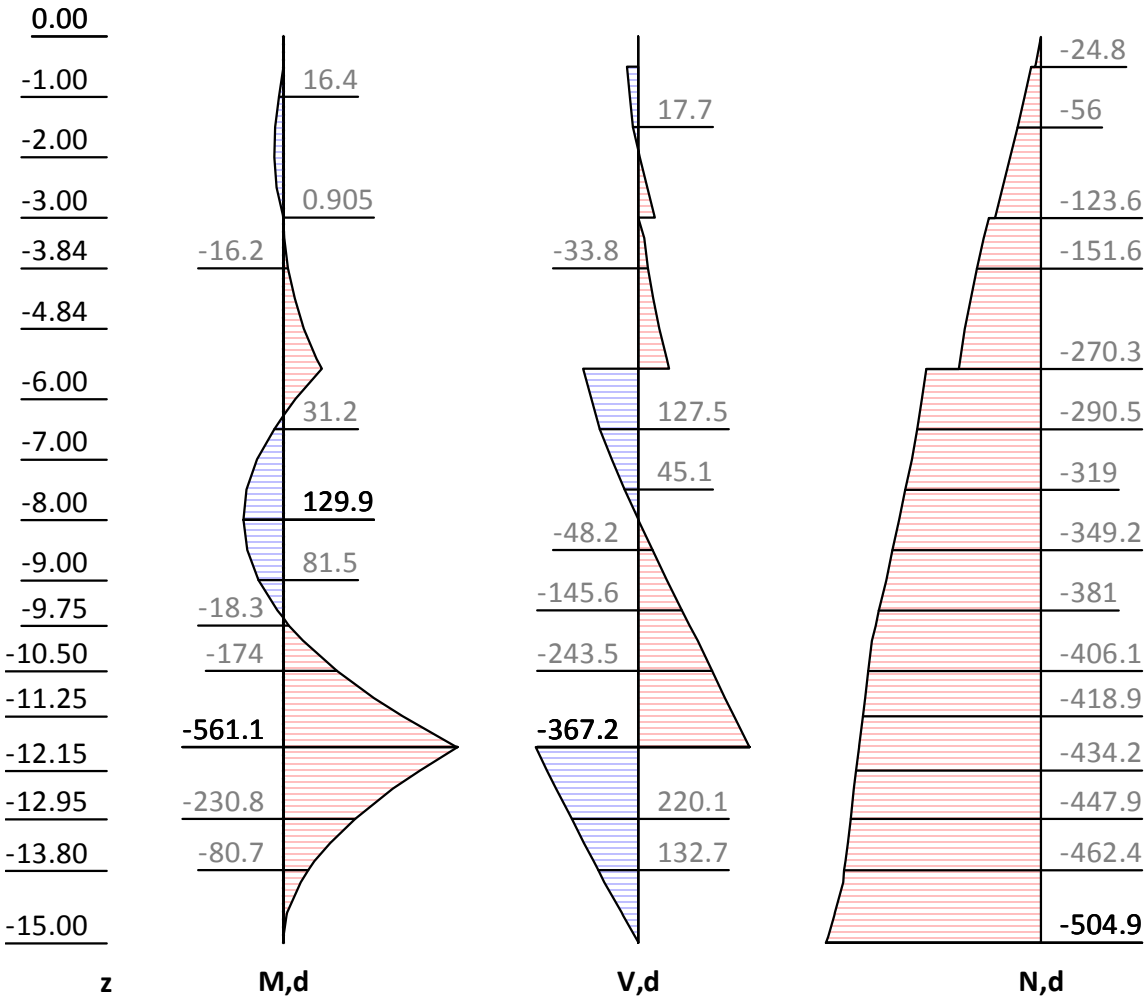


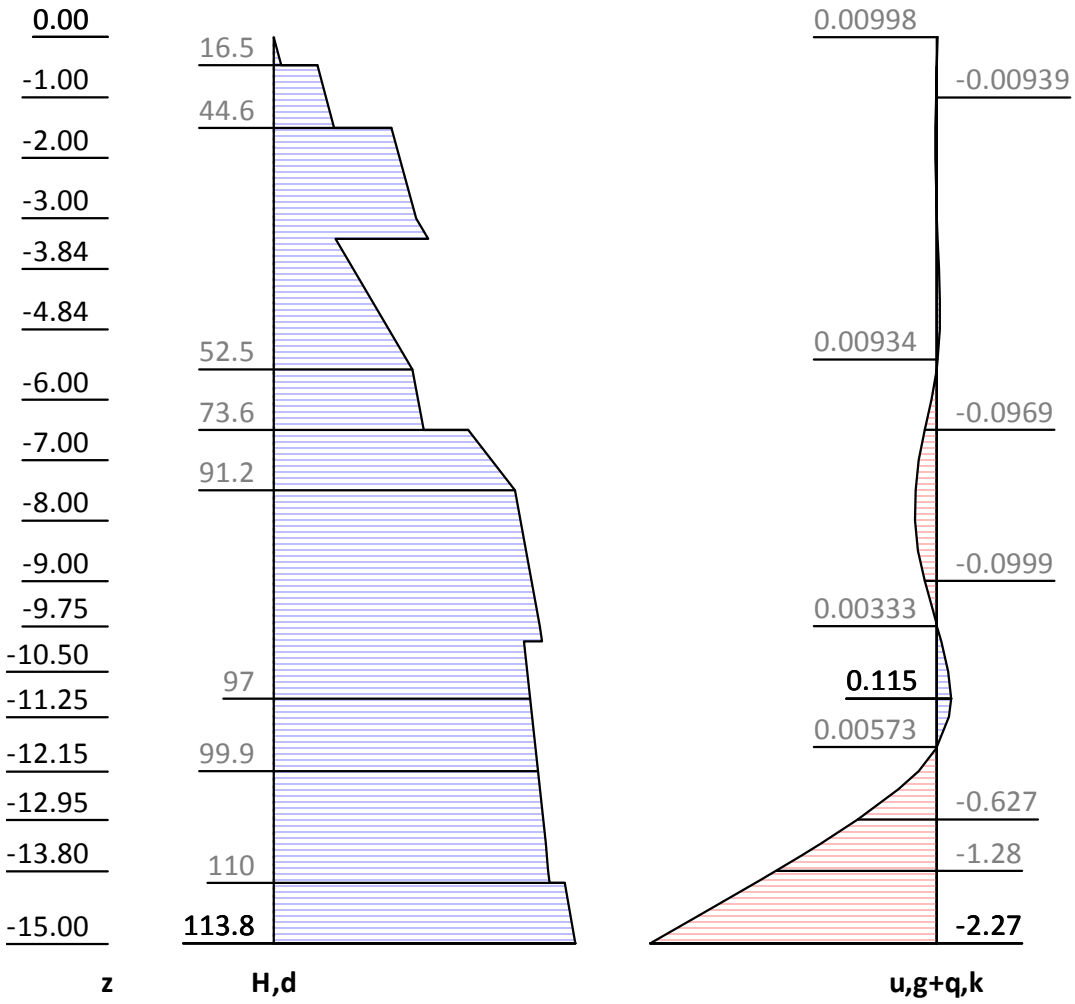
z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]

z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00	0.00	0.00	0.00
-0.47	0.00	0.01	0.03	0.01	0.00
-0.47	9.06	0.01	0.03	0.01	0.00
-0.48	9.06	0.01	-0.03	-0.00	0.00
-0.49	9.06	0.00	-0.19	-0.02	0.00
-0.50	9.06	0.00	14.47	-3.98	-0.00
-1.50	9.06	9.94	5.42	-4.94	-0.01
-1.50	23.48	9.94	5.42	-4.94	-0.01
-1.73	23.48	9.83	0.00	-5.51	-0.01
-2.65	23.48	0.00	-21.60	-7.80	-0.00
-3.00	23.48	-8.35	-29.80	-8.66	-0.00
-3.00	23.48	-8.35	11.18	-19.64	-0.00
-3.34	23.48	-5.45	3.47	-20.77	0.00
-3.34	0.00	-5.45	3.47	-20.77	0.00
-3.50	0.00	-5.94	2.92	-20.75	0.00
-3.84	0.00	-3.75	3.46	-21.27	0.00
-4.00	0.00	-4.49	2.91	-21.21	0.00
-4.34	0.00	-2.01	3.46	-21.65	0.00
-4.50	0.00	-3.03	2.92	-21.54	0.00
-4.84	0.00	-0.27	3.46	-21.89	0.00
-4.97	0.00	-1.31	3.02	-21.77	-0.00
-5.00	0.00	-1.57	2.92	-21.74	-0.00
-5.07	0.00	-0.91	3.03	-21.80	-0.00
-5.18	0.00	-0.00	3.20	-21.88	0.00
-5.34	0.00	1.43	3.45	-22.00	0.00
-5.50	0.00	1.00	3.20	-21.92	0.00
-5.50	0.00	1.00	-0.16	-21.02	0.00
-5.50	0.00	1.00	-0.16	-21.02	-0.00
-6.50	0.00	0.84	-0.16	-21.02	-0.00
-7.00	0.00	0.76	-0.16	-21.02	-0.00
-8.00	0.00	0.60	-0.16	-21.02	-0.00
-9.50	0.00	0.36	-0.16	-21.02	-0.00
-11.77	0.00	0.00	-0.16	-21.02	0.00
-11.77	0.00	0.00	-0.00	-21.02	0.00
-12.45	0.00	0.00	-0.00	-21.02	0.00
-13.35	0.00	0.00	-0.00	-21.02	0.00
-13.65	0.00	0.00	-0.00	-21.02	0.00
-13.80	0.00	0.00	-0.00	-21.02	0.00
-14.90	0.00	0.00	-0.00	-21.02	0.00
-14.94	0.00	0.00	-0.00	-21.02	0.00
-15.00	0.00	-0.00	-0.00	-21.02	0.00

Internal forces: Design

```
z=  -0.500. Fx= -38.746 kN/m Support
z=  -3.000. Fx= -54.959 kN/m Support
z=  -5.500. Fx=-284.406 kN/m Support
z= -11.769. Fx=-705.843 kN/m Support
```





z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	0.00	0.00	0.00	0.00	0.01
-0.47	2.94	-0.11	-0.69	-13.48	0.00
-0.47	16.52	-0.11	-0.69	-13.48	0.00
-0.50	16.71	-0.14	-1.19	-14.40	-0.00
-0.50	16.74	0.00	37.48	-24.90	-0.00
-1.50	22.97	28.02	17.72	-55.98	-0.02
-1.50	44.60	28.02	17.72	-55.98	-0.02
-1.88	47.00	30.42	0.00	-69.24	-0.02
-2.00	47.73	31.15	-5.37	-73.26	-0.02
-3.00	53.98	0.90	-56.22	-108.88	-0.00
-3.00	53.98	0.90	-1.26	-123.60	-0.00
-3.00	53.98	0.90	-1.26	-123.60	0.00
-3.08	55.12	0.00	-6.02	-126.67	0.00
-3.34	58.57	-2.73	-20.40	-135.95	0.01
-3.34	23.35	-2.73	-20.40	-135.95	0.01
-4.34	36.85	-37.10	-50.51	-165.92	0.03
-5.50	52.51	-123.94	-102.33	-194.12	0.00
-5.50	52.51	-123.94	-102.33	-194.12	-0.00
-5.50	52.51	-123.94	182.08	-270.33	-0.00
-6.28	55.72	0.00	139.77	-286.19	-0.07
-6.50	56.63	31.20	127.51	-290.52	-0.10

z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
-6.50	73.59	31.20	127.51	-290.52	-0.10
-7.99	93.25	129.64	-0.00	-333.55	-0.17
-8.00	93.30	129.88	-1.04	-333.89	-0.17
-9.63	100.06	0.00	-159.01	-385.40	-0.01
-9.73	100.44	-14.70	-168.33	-388.47	0.00
-10.00	101.57	-64.14	-195.90	-397.55	0.04
-10.00	94.68	-64.14	-195.90	-397.55	0.04
-10.95	96.97	-293.32	-286.94	-413.75	0.11
-11.77	98.95	-561.10	-367.18	-427.72	0.00
-11.77	98.95	-561.10	338.66	-427.72	-0.00
-14.00	104.33	-56.28	111.92	-465.77	-1.44
-14.00	110.03	-56.28	111.92	-465.77	-1.44
-15.00	113.81	-0.00	-0.00	-504.85	-2.27
-15.00	113.81	0.00	-0.00	-504.85	-2.27

Anchor forces with safety level of DS-P

z[m]	A,d[kN]	Fx,d[kN/m]
-0.50	72.2	-38.7
-3.00	51.2	-55.0
-5.50	265.0	-284.4

Checks of earth statics

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -11.77 m
Rd = Eph,k/γ,Re = 3013.12 / 1.400 = 2152.23 [kN/m]
Ed(Uh,d)/Rd = 705.84 / 2152.23 = 0.328 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-15.00

Pos.	H	V
H/V pressure G+P+W,k	744.56	66.61
Wall weight		233.11
H/V pressure passive		0.00
Support z: -0.50	-12.32	3.30
Support z: -3.00	4.83	-1.29
Support z: -5.50	-214.40	57.45
Bh,g,k z=-11.77	-522.67	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.61
Σ	-0.00	358.56 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.
Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1

Vertical component of earth resistance is less than
the downwards pointing vertical forces.
Vk >= Bvk: 359.17 >= 0.61 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-15.00

Pos.	H	V

Pos.	H	V
H/V pressure G+P+W,k	797.09	72.16
Wall weight		233.11
H/V pressure passive		0.00
Support z: -0.50	-27.06	7.25
Support z: -3.00	-36.16	9.69
Support z: -5.50	-211.04	56.55
Bh,g,k z=-11.77	-522.67	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.61
Bh,q,k z=-11.77	-0.16	
Bv,q,k = Bh,k * tan(δ,p=-0.07°)		-0.00
Σ	0.00	378.15 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.
Verification of vertical forces due to EAB R 9 not required (R 9-5).
Check EAB R 9-1
Vertical component of earth resistance is less than
the downwards pointing vertical forces.
Vk >= Bvk: 378.76 >= 0.61 Passes requirement

Anchor verification

Anchor - Stability of lower failure plane

Περίπτ.Φόρτισης: όλα τα φορτία BS-P
Αυτόμ. υπολογ. μήκους αγκυρίων:
All anchors are extended (if necessary)
Favourable variable loads in main failure body are not being considered.
Bottom of lower failure plane: z=-15.00 m

Iteration of failure mechanisms:
lA .....: Length of anchor from head to center of grout body.
W,k .....: Res. force from dead weight, loads, cohesion, ...
Q,k .....: Force in lower failure plane.
Ea1,k.....: Earth pressure onto vertical separation plane.
Ea2,k.....: Earth pressure between wall and main failure body.
Ra_cal,d ...: Dimesioning force of the resistance from the equilibrium of forces. Ra_cal,d corresponds to the max. possible anchor force of the force polygon.
Sum(A,d) ...: Acting anchor forces along the grout body fractions within the failure body. Sum(A,d) is gained from the anchor pull forces of the wall analysis.

z [m]	ϑ1 [°]	ϑ2 [°]	lA [m]	W,k [kN/m]	Q,k [kN/m]	Ea1,k [kN/m]	Ea2,k [kN/m]	Ra_cal,d [kN/m]	Sum(A,d) [kN/m]	Ed/Rd [-]
-0.50	44.6	57.5	11.98	1203.1	1001.1	4.4	365.5	318.1	316.6	1.00
-3.00	40.9	60.8	10.97	1267.4	1038.9	28.8	365.5	339.0	337.7	1.00
-5.50	35.2	61.3	10.12	1328.4	1041.5	85.6	365.5	379.5	379.2	1.00

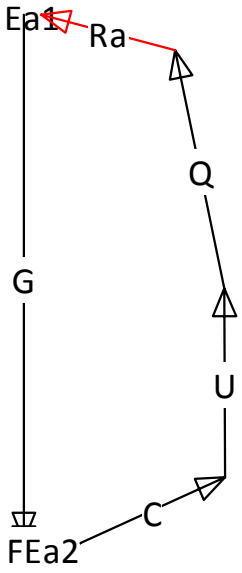
Decisive failure body:
Γεωμετρία:

Foot point of lower failure plane	x/z = 0.01/-15.00 m
Intersection lower/upper slid. plane	x/z = 9.78/ -8.12 m
Intersection upper slid. plane/surface	x/z = 14.23/ 0.00 m
Intersection separation plane/surface	x/z = 9.78/ 0.00 m
Inclination lower failure plane	ϑ1 = 35.15°
Inclination upper failure plane	ϑ2 = 61.25°
Inclination separation plane	ϑ12 = 90.00°

Loads / forces (char.)

		Fx [kN/m]	Fz [kN/m]	F [kN/m]	
Weight of main failure body	G,k:	0.0	-2359.4	2359.4	
Area loads on/in main failure body	F1,k:	0.0	-82.5	82.5	
Cohesion of lower failure plane	C,k:	588.5	414.4	719.8	
Pore water pressure on main body	U,k:	-0.4	836.3	836.3	
Earth pres. on separation plane	Ea1,k:	-85.6	-0.0	85.6	δ= 0.0°
Earth pr. between wall<->main body	Ea2,k:	358.3	71.9	365.5	
Force in lower failure plane	Q,k:	-347.6	981.7	1041.5	
Sum = possible anchor forces:	Ra_cal,k:	513.2	-137.5	531.3	

Force polygon



Acting anchor forces	Ed: Sum(A,d)	= 379.2 kN/m
Possible anchor forces	Rd: Ra_cal,d = 531.3/1.400	= 379.5 kN/m
Verif. of lower failure plane	Ed/Rd = 1.00	< 1.0: Έλεγχος εκπληρώθηκε.

Check of steel tension

l,tot ...[m]: Total length of anchor incl. excess length at head
As ....[mm2]: X-section are of steel member
Ri,d ...[kN]: Ultimate strength of tension member (γ,M=1.15)
A,d ....[kN]: Dimensioning force of the anchor from wall analysis

z[m] Anchor type	l,tot	As	Ri,d	A,d

z[m]	Anchor type	l,tot	As	Ri,d		A,d	
-0.50	Strand;3x0.60";1570/1770						
		17.32	420	573.4	>	72.2	Passes requirement
-3.00	Strand;3x0.60";1570/1770						
		15.72	420	573.4	>	51.2	Passes requirement
-5.50	Strand;4x0.60";1570/1770						
		14.12	560	764.5	>	265.0	Passes requirement

Check of steel tension: Passes requirement

Check of anchor's soil friction

lVk .....: Length of grout body
DmVk ....: Diameter of grout body
τGr,k ...: Average applied skin friction along the grout body (from soil parameters)
Ra,k ....: Charact. pullout resistance of the anchor
γA .....: Partial safety factor of anchor pullout
Ra,d ....: = Ra,k / γA
A,d .....: Dimensioning force of the anchor from wall analysis

z [m]	lVk [m]	DmVk [mm]	τGr,k [kN/m²]	Ra,k [kN]	γA [-]	Ra,d [kN]		A,d [kN]	A,d/Ra,d [-]
-0.50	8.00	318	110	879.1	1.100	799.2	>	72.2	0.1
-3.00	8.00	318	110	879.1	1.100	799.2	>	51.2	0.1
-5.50	8.00	318	110	879.1	1.100	799.2	>	265.0	0.3

Check of anchor's soil friction: Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)
Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (-0.10, 0.43), Ακτίνα = 15.44
Αρχ.σημ.= (-13.89, -6.50), Τελ.σημ. = (15.33, 0.00)

Γεωμετρία λωρίδων:

No	x [m]	Width b [m]	dxM [m]	Weight [kN/m]	Load z-κατ. [kN/m]	Water-φορτ. [kN/m]	u*b [kN/m]	φ [°]	c [kN/m²]	θ [°]
1	-13.12	1.54	-13.02	47.3	0.0	0.0	-11.3	27.45	3.57	-31.27*
2	-11.58	1.54	-11.48	117.9	0.0	0.0	-35.9	27.45	3.57	-31.27*
3	-10.03	1.54	-9.94	164.4	0.0	0.0	-59.3	0.08	71.43	-40.07
4	-8.49	1.54	-8.39	199.7	0.0	0.0	-77.1	0.08	71.43	-32.93
5	-6.95	1.54	-6.85	226.8	0.0	0.0	-90.8	0.08	71.43	-26.34
6	-5.40	1.54	-5.31	247.5	0.0	0.0	-101.1	29.26	3.57	-20.10
7	-3.86	1.54	-3.76	264.0	0.0	0.0	-108.4	29.26	3.57	-14.10
8	-2.32	1.54	-2.22	274.6	0.0	0.0	-113.2	29.26	3.57	-8.26
9	-0.77	1.54	-0.67	279.7	0.0	0.0	-150.2	29.26	3.57	-2.50
10	0.77	1.54	0.87	483.1	0.0	0.0	-184.7	29.26	3.57	3.23
11	2.32	1.54	2.41	477.4	0.0	0.0	-182.2	29.26	3.57	8.99
12	3.86	1.54	3.96	466.0	0.0	0.0	-177.1	29.26	3.57	14.85
13	5.40	1.54	5.50	448.8	0.0	0.0	-169.4	0.08	71.43	20.88
14	6.95	1.54	7.05	427.5	0.0	0.0	-158.7	0.08	71.43	27.15

No	x	Width b	dxM	Weight	Load z-κατ.	Water-φορτ.	u*b	φ	c	θ
	[m]	[m]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[°]	[kN/m²]	[°]
15	8.49	1.54	8.59	399.5	0.0	0.0	-144.6	0.08	71.43	33.80
16	10.04	1.54	10.13	363.0	0.0	0.0	-126.2	0.08	71.43	41.02
17	11.58	1.54	11.68	313.9	0.0	0.0	-101.9	27.45	3.57	49.14
18	13.12	1.54	13.22	240.1	0.0	0.0	-67.9	27.45	3.57	58.91
19	14.61	1.44	14.71	118.1	0.0	0.0	-22.3	0.08	35.71	72.36

*** Σημείωση: Στις λωρίδες σημειωμένες με '*'
περιορίστηκε το theta στο 45°-Phi/2.

Συνεισφ. κατακόρυφων φορτίων:

No	Weight	G*sin(θ)	(G-u*b)*tan(φ) + c*b	μ*sin(θ)* tan(φ)+cos(θ)	T
	[kN/m]	[kN/m]	[kN/m]	[-]	[kN/m]
1	47.26	-39.87	24.20	0.748089	32.34
2	117.88	-87.66	48.08	0.748089	64.27
3	164.41	-105.82	110.42	0.764959	144.35
4	199.68	-108.56	110.44	0.839007	131.64
5	226.80	-100.62	110.46	0.895952	123.29
6	247.52	-85.06	87.55	0.862999	101.45
7	264.01	-64.33	92.66	0.915908	101.17
8	274.61	-39.45	95.95	0.957817	100.18
9	279.69	-12.21	78.08	0.989380	78.91
10	483.11	27.22	172.65	1.010888	170.79
11	477.37	74.63	170.87	1.022322	167.14
12	466.04	119.47	167.36	1.023348	163.54
13	448.77	159.92	110.66	0.934552	118.41
14	427.53	195.10	110.65	0.890056	124.32
15	399.48	222.25	110.63	0.831260	133.09
16	363.02	238.26	110.60	0.754825	146.53
17	313.95	237.45	115.67	0.809502	142.89
18	240.07	205.58	94.95	0.692271	137.16
19	118.09	112.54	51.56	0.303561	169.85
		948.84			2351.30

Συνεισφ. αγκυρίων: Αθρ. ροπών ανατροπής : -250.7 kN*m/m
" " resisting : 129.3 kN*m/m

Δράση Ed = (948.8*15.44-250.7)
Αντίσταση Rd = (2351.3*15.44+129.3)
SLIP-CIRCLE μ = Ed/Rd = 0.40 < 1.0: Έλεγχος εκπληρώθηκε.

Φάση εκσκαφής 7 "[7] Situation 5"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 5 Στρώσεις

Name		Τεχνητές επιχωματώσεις	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
γ	[kN/m3]	18	20	22.5
γ,R	[kN/m3]	18	20	22.5
γ'	[kN/m3]	8	10	12.5
γ,p	[kN/m3]	18	20	22.5
γ,R,passive	[kN/m3]	18	20	22.5
γ,pw	[kN/m3]	8	10	12.5
φ	[°]	25	0.1	33
c	[kN/m2]	2	50	5
c,u	[kN/m2]	10	50	5
c παθητικό	[kN/m2]	2	50	5
δ,a	[°]	16.66667	0.06666667	22
δ,p	[°]	-16.66667	-0.06666667	-22
δ,c	[°]	8.333333	0.03333333	11
k,agh	[-]	0.3456501	0.9955057	0.2452023
K,ach	[-]	1.043051	1.994195	0.8549058
K,0h	[-]	0.5773817	0.9982547	0.455361
K,pgh	[-]	3.908103	1.004519	7.495617
K,pch	[-]	5.180327	2.00583	8.599509
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	10e-06	5.5e-09	100e-06

Name		Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20	22.5
γ,R	[kN/m3]	20	22.5
γ'	[kN/m3]	10	12.5
γ,p	[kN/m3]	20	22.5
γ,R,passive	[kN/m3]	20	22.5
γ,pw	[kN/m3]	10	12.5
φ	[°]	0.1	35
c	[kN/m2]	100	5
c,u	[kN/m2]	100	5
c παθητικό	[kN/m2]	100	5
δ,a	[°]	0.06666667	23.33333
δ,p	[°]	-0.06666667	-23.33333
δ,c	[°]	0.03333333	11.66667
k,agh	[-]	0.9955057	0.2244207
K,ach	[-]	1.994195	0.8126539
K,0h	[-]	0.9982547	0.4264236
K,pgh	[-]	1.004519	9.146943
K,pch	[-]	2.00583	10.104
τ,gr	[kN/m2]	110	110
Ψ,A,max	[°]	90	90
k	[cm/s]	5.5e-09	100e-06

Πορεία πρανούς:

x [m]	0.00	0.00
z [m]	-10.35	0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:

x [m]	0.00	0.00
z [m]	-10.35	-1.50

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:
x [m] 0.00 0.00
z [m] -10.35 -4.50

Πορεία ανώτερου 4. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
x [m] 0.00 0.00
z [m] -10.35 -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -14.00

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
1.00	0.00	3.50	0.00	0.00	33.00	0.00	33.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Στάθμη νερού:

x [m] 0.00 0.00
z [m] -11.00 -3.00

Αγκύρια

z[m]	min.l[m]	Alpha[°]	C-H[kN/m]	P0[kN]	u0[m]
-0.50	0.00	15.00	αόρισ.	0.00	0.0000
-3.00	0.00	15.00	0.00	0.00	0.0000
-5.50	0.00	15.00	αόρισ.	0.00	0.0000

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Ενεργές ωθήσεις.
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: Triangle (perpend. to wall).
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
Levels of redistribution Z1: -3.000, Z2: -5.500 [m].
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Κλασικός, Pregl/Sokolovsky (DIN 4085).

Options for water pressure

Στήριξη πόδα

Πόδας οριζοντίως μετακινούμενος

Αγκύρια

Anchor checks (lower failure plane): Ναι
Anchor forces with safety level of DS-P: Ναι
Verification of grout body pull out forces: Ναι
δ,a,Anchoring wall : used from soil layer.
δ,p,Anchoring wall : used from soil layer.

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	Αμμώδης ΑΡΓΙΛΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

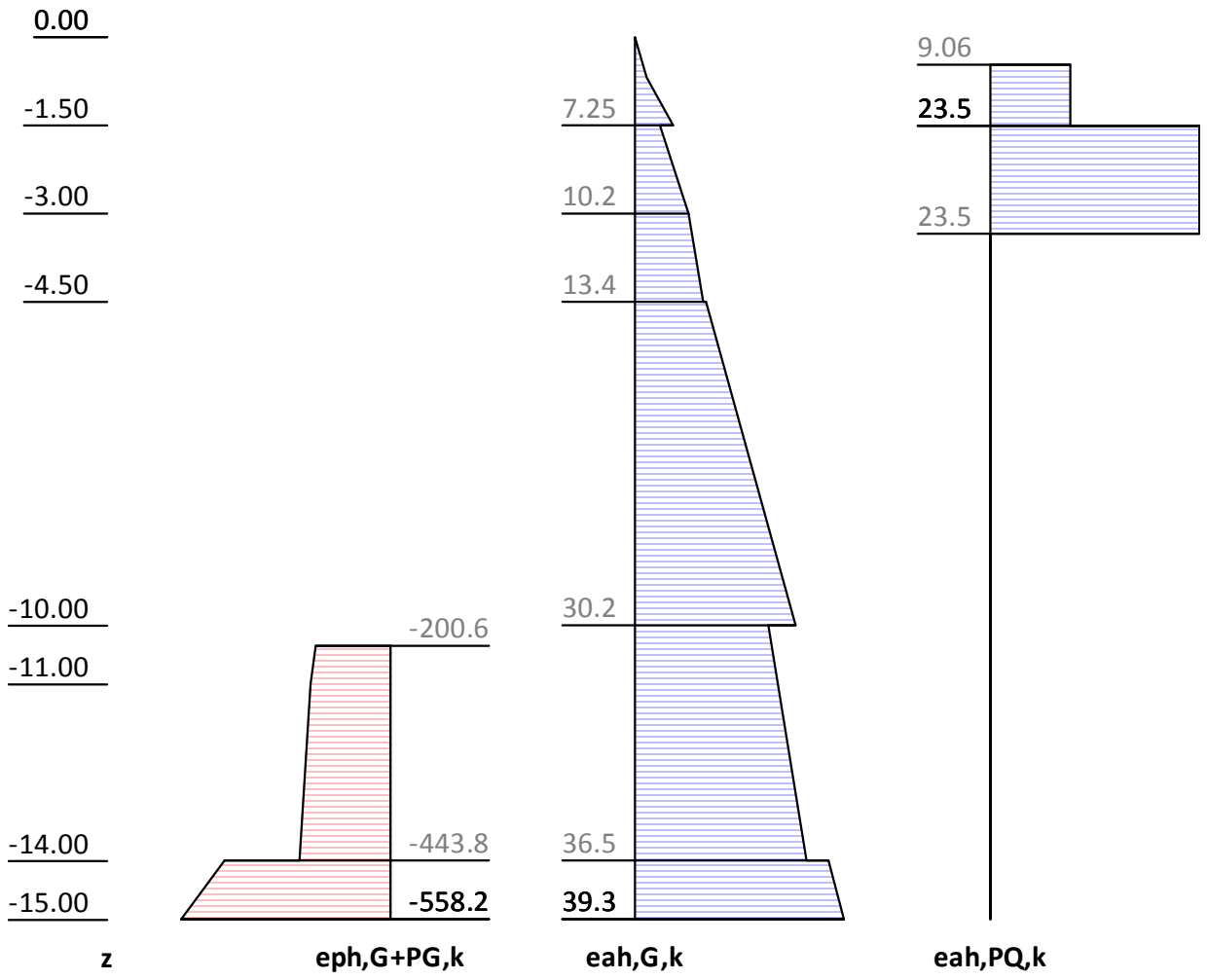
Μήκος τοίχου

Foot depth for statics: zf = -15.000

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall



z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.47		1.52	0.00	2.04
-0.47		1.52	9.06	15.62
-1.50		7.25	9.06	23.37
-1.50		4.82	23.48	41.73
-3.34		10.79	23.48	49.78
-3.34		10.79	0.00	14.56
-4.50		12.86	0.00	17.36
-4.50		13.38	0.00	18.06
-10.00		30.24	0.00	40.82
-10.00		25.14	0.00	33.93
-10.35	-0.00	25.76	0.00	34.78
-10.35	-200.58	25.76	0.00	34.78
-14.00	-243.78	32.28	0.00	43.58
-14.00	-443.84	36.50	0.00	49.28
-15.00	-558.18	39.31	0.00	53.06

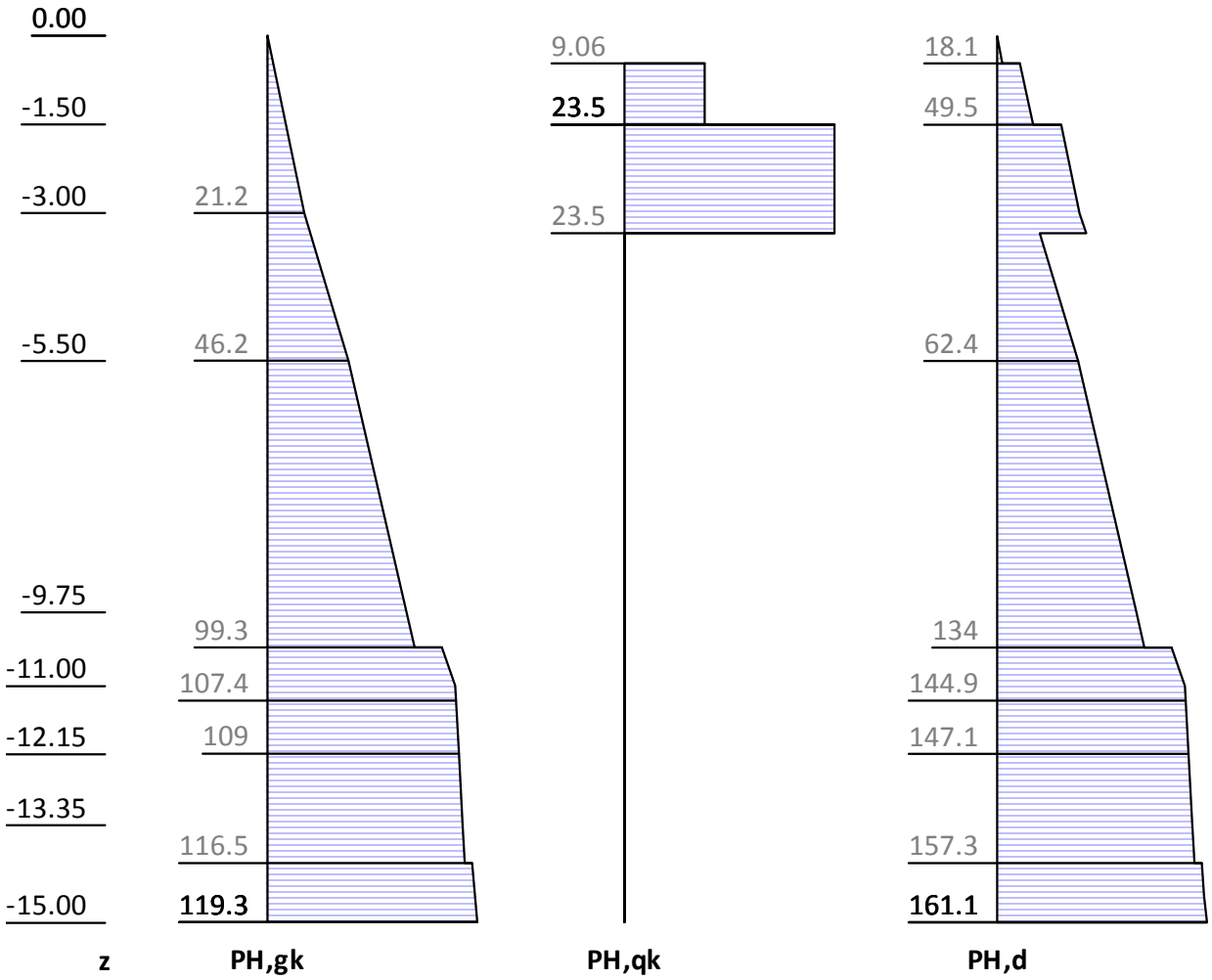
Eph,G,k:-1321.76, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 305.81, Eah,PG,k: 0.00, Eah,PQ,k: 52.53, Eah,d: 491.64

Πίεση νερού

z [m]	Wp,k [kN/m2]	Wa,k [kN/m2]	W,k [kN/m2]
-3.00		0.00	0.00
-11.00	0.00	80.00	80.00
-15.00	-40.00	120.00	80.00

H-pressure on static system

Level of mobilization: Ep,gk 100.0, Ep,qk 100.0, Ep,d 100.0 [%]

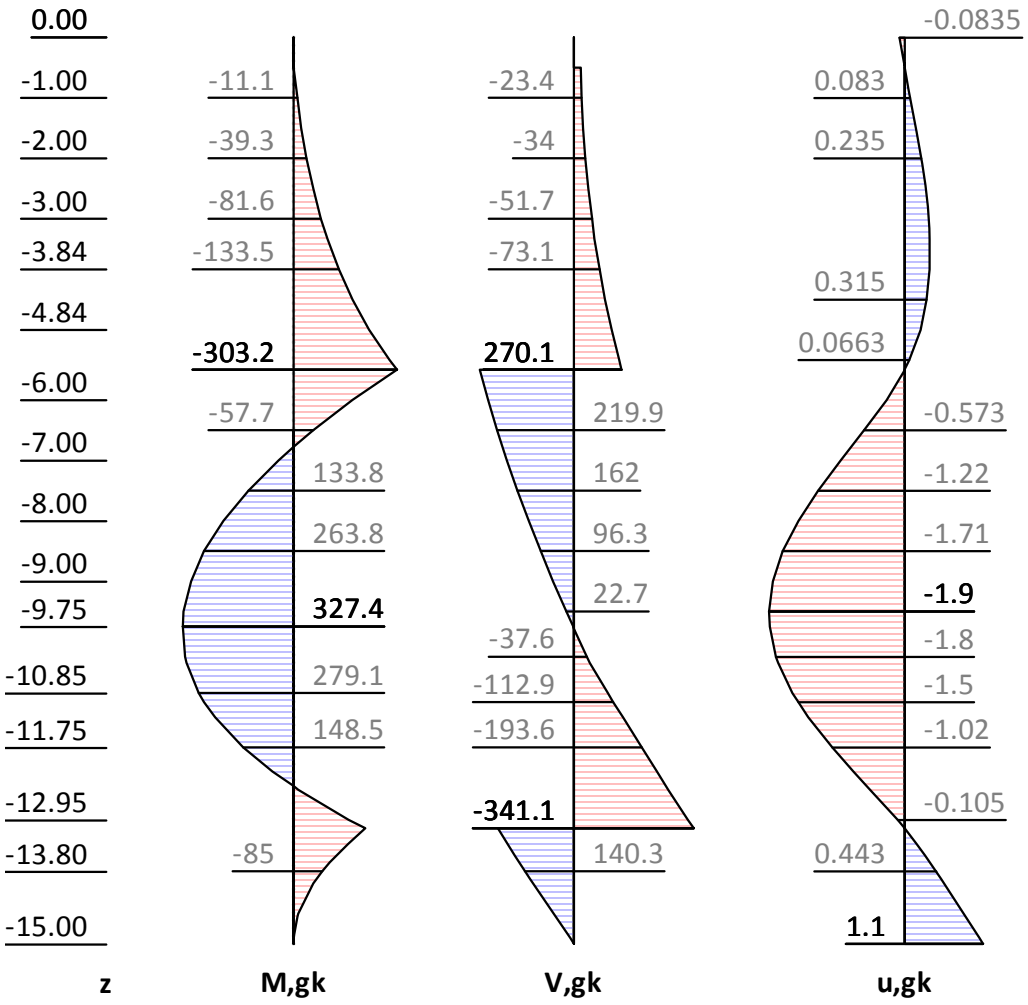


z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	0.00		0.00
-0.47	3.32	0.00	4.49
-0.47	3.32	9.06	18.07
-1.50	10.60	9.06	27.90
-1.50	10.60	23.48	49.54
-3.34	24.61	23.48	68.44
-3.34	24.61	0.00	33.22
-10.35	84.10	0.00	113.54
-10.35	99.26	0.00	134.00
-14.00	112.28	0.00	151.58
-14.00	116.50	0.00	157.28
-15.00	119.31	0.00	161.06

V-pressure on static system

Internal forces: Permanent, characteristically

```
z=  -0.500. Fx=  19.900 kN/m Support
z=  -3.000. Fx=  -0.000 kN/m Support
z=  -5.500. Fx=-406.072 kN/m Support
z= -13.097. Fx=-559.638 kN/m Support
```

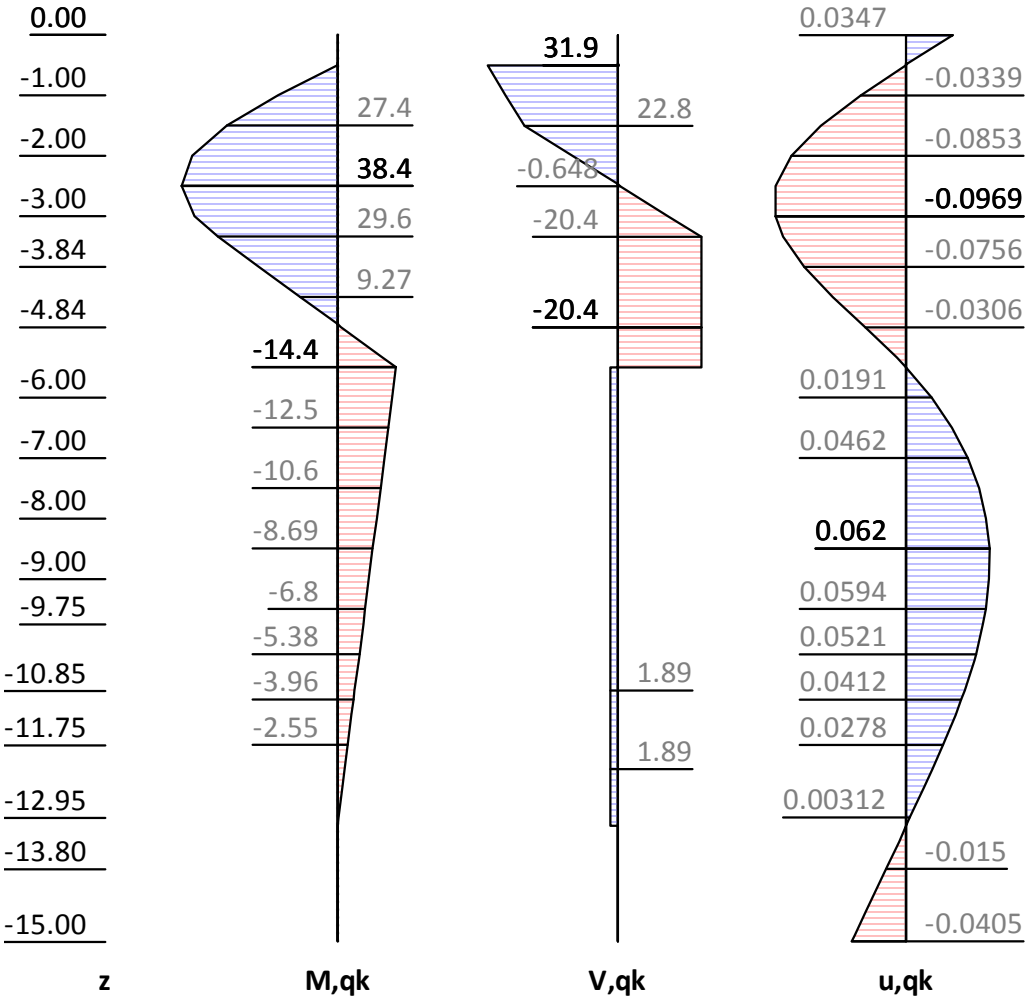


z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	0.00	0.00	-0.00	0.00	-0.08
-0.50	3.53	-0.15	-0.88	-10.77	0.00
-0.50	3.53	-0.15	-20.78	-5.44	0.00
-3.34	24.61	-100.44	-59.50	-76.83	0.36
-5.50	46.21	-303.16	-135.98	-136.30	0.00
-5.50	46.21	-303.16	-135.98	-136.30	-0.00
-5.50	46.21	-303.16	270.09	-245.10	-0.00
-6.78	56.21	-0.00	204.30	-278.07	-0.76
-9.50	77.46	323.92	22.72	-334.02	-1.90
-9.75	79.42	327.42	3.14	-338.18	-1.89
-9.79	79.72	326.76	0.00	-338.80	-1.89
-10.35	84.10	314.72	-45.92	-347.82	-1.77
-10.35	99.26	314.72	-45.92	-347.82	-1.77
-12.40	109.42	0.00	-263.94	-373.67	-0.53
-13.10	110.67	-211.24	-341.06	-382.53	0.00

z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
-13.10	110.67	-211.24	218.58	-382.53	0.00
-14.00	112.28	-59.19	117.90	-393.94	0.56
-14.00	116.50	-59.19	117.90	-393.94	0.56
-15.00	119.31	-0.00	0.00	-422.89	1.10

Internal forces: Variable, characteristically

Method EB 82-4 (Q = [G+Q] - G).
z= -0.500. Fx= -32.166 kN/m Support
z= -3.000. Fx= 0.000 kN/m Support
z= -5.500. Fx= -22.257 kN/m Support
z= -13.097. Fx= 1.890 kN/m Support

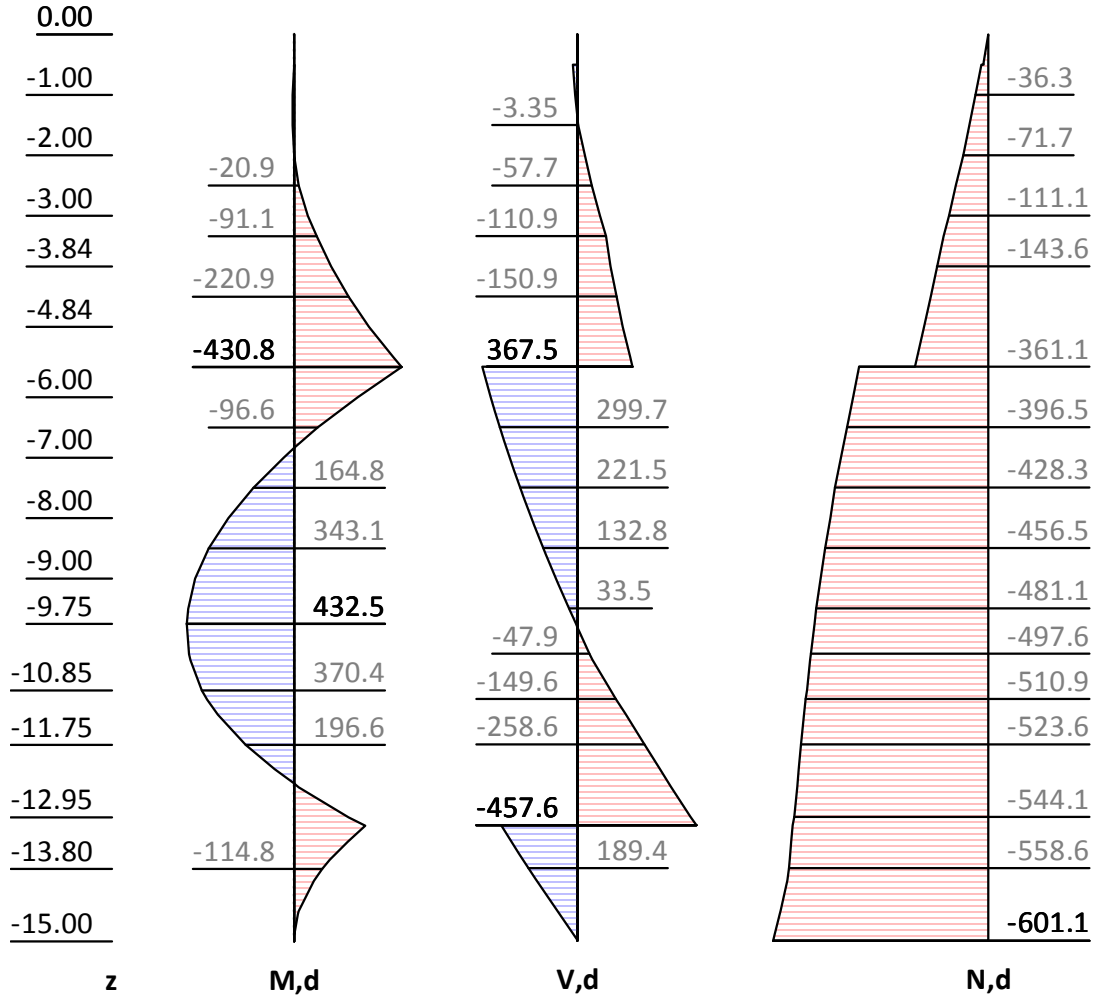


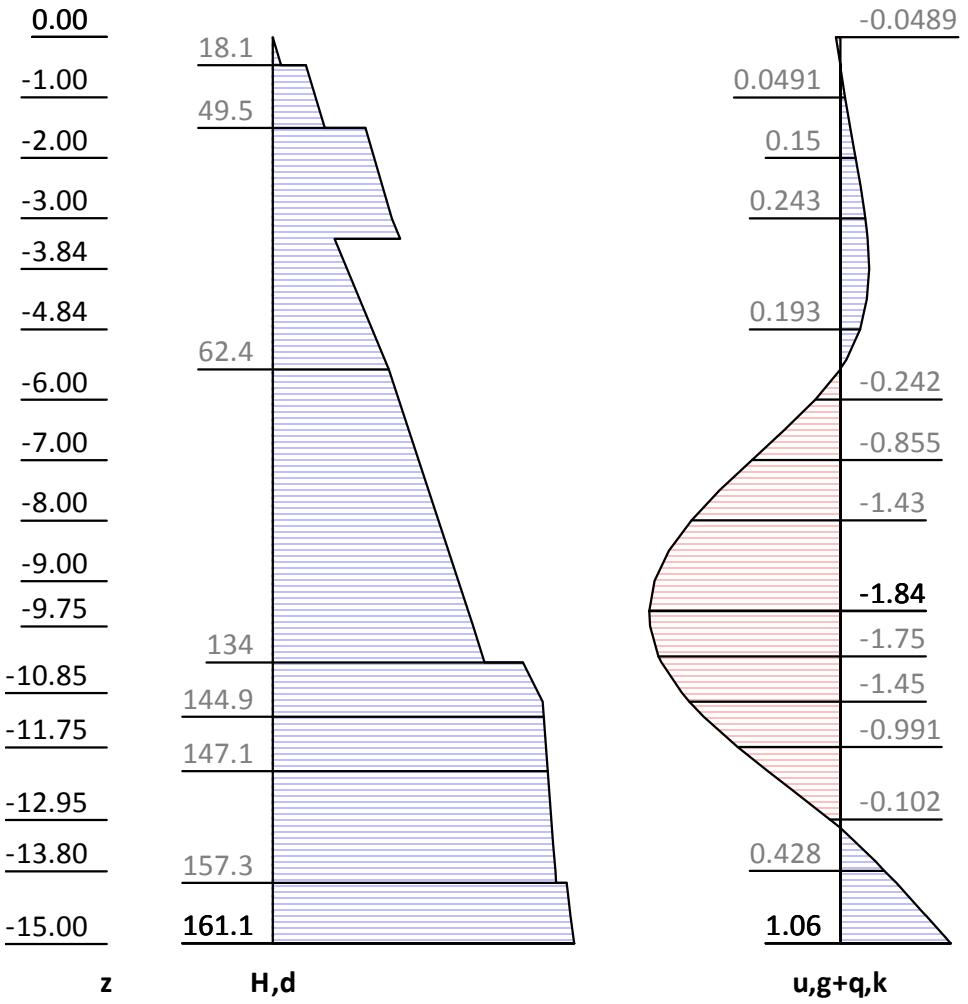
z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00	0.00	-0.00	0.03
-0.00		0.00	0.00	-0.00	0.03
-0.47	0.00	0.02	0.05	0.02	0.00
-0.47	9.06	0.02	0.05	0.02	0.00
-0.47	9.06	0.01	0.00	0.01	0.00
-0.48	9.06	0.01	-0.06	0.00	0.00
-0.49	9.06	-0.00	-0.21	-0.02	0.00
-0.50	9.06	-0.00	31.89	-8.65	-0.00

z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
-1.50	9.06	27.36	22.84	-9.61	-0.06
-1.50	23.48	27.36	22.84	-9.61	-0.06
-2.47	23.48	38.29	0.00	-12.02	-0.10
-2.50	23.48	38.43	-0.65	-12.09	-0.10
-3.00	23.48	35.20	-12.38	-13.33	-0.10
-3.34	23.48	29.63	-20.37	-14.18	-0.09
-3.34	0.00	29.63	-20.37	-14.18	-0.09
-4.80	0.00	-0.00	-20.37	-14.18	-0.03
-4.84	0.00	-0.92	-20.37	-14.18	-0.03
-5.50	0.00	-14.36	-20.37	-14.18	-0.00
-5.50	0.00	-14.36	1.89	-20.14	-0.00
-5.50	0.00	-14.36	1.89	-20.14	0.00
-7.50	0.00	-10.58	1.89	-20.14	0.05
-8.50	0.00	-8.69	1.89	-20.14	0.06
-9.00	0.00	-7.74	1.89	-20.14	0.06
-9.75	0.00	-6.33	1.89	-20.14	0.06
-11.00	0.00	-3.96	1.89	-20.14	0.04
-12.15	0.00	-1.79	1.89	-20.14	0.02
-13.10	0.00	0.00	1.89	-20.14	0.00
-13.10	0.00	0.00	-0.00	-20.14	0.00
-13.20	0.00	-0.00	-0.00	-20.14	-0.00
-13.65	0.00	-0.00	-0.00	-20.14	-0.01
-14.00	0.00	-0.00	0.00	-20.14	-0.02
-14.50	0.00	0.00	0.00	-20.14	-0.03
-14.55	0.00	0.00	0.00	-20.14	-0.03
-14.90	0.00	0.00	-0.00	-20.14	-0.04
-15.00	0.00	0.00	0.00	-20.14	-0.04

Internal forces: Design

```
z=  -0.500. Fx= -21.383 kN/m Support
z=  -3.000. Fx=  -0.000 kN/m Support
z=  -5.500. Fx=-581.582 kN/m Support
z= -13.097. Fx=-752.677 kN/m Support
```





z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	0.00	0.00	0.00	-0.00	-0.05
-0.00	0.00	-0.00	0.00	-0.00	-0.05
-0.47	4.49	-0.17	-1.05	-13.65	-0.00
-0.47	18.07	-0.17	-1.05	-13.65	-0.00
-0.50	18.36	-0.20	-1.60	-14.59	-0.00
-0.50	18.36	-0.20	19.78	-20.32	-0.00
-0.51	18.49	0.00	19.50	-20.76	0.00
-1.37	26.65	8.38	0.00	-48.65	0.09
-1.50	27.90	8.81	-3.35	-53.04	0.10
-1.50	49.54	8.81	-3.35	-53.04	0.10
-2.02	54.47	-0.00	-30.24	-72.29	0.15
-3.34	68.44	-91.14	-110.88	-124.98	0.27
-3.34	33.22	-91.14	-110.88	-124.98	0.27
-3.84	39.97	-151.07	-129.19	-143.56	0.28
-5.50	62.38	-430.81	-214.13	-205.26	0.00
-5.50	62.38	-430.81	-214.13	-205.26	-0.00
-5.50	62.38	-430.81	367.45	-361.10	-0.00
-6.84	76.55	-0.00	273.84	-407.69	-0.76
-9.50	104.57	427.10	33.51	-481.14	-1.84
-9.75	107.21	432.53	7.07	-486.76	-1.84
-9.81	107.89	431.23	-0.00	-488.15	-1.83

z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
-10.35	113.54	417.09	-59.16	-499.77	-1.72
-10.35	134.00	417.09	-59.16	-499.77	-1.72
-12.39	147.70	-0.00	-352.63	-534.56	-0.52
-13.10	149.41	-285.17	-457.60	-546.62	0.00
-13.10	149.41	-285.17	295.08	-546.62	0.00
-14.00	151.58	-79.90	159.17	-562.03	0.54
-14.00	157.28	-79.90	159.17	-562.03	0.54
-15.00	161.06	-0.00	-0.00	-601.11	1.06

Anchor forces with safety level of DS-P

z[m]	A,d[kN]	Fx,d[kN/m]
-0.50	39.8	-21.4
-3.00	0.0	-0.0
-5.50	541.9	-581.6

Checks of earth statics

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -13.10 m
Rd = Eph,k/γ,Re = 1321.76 / 1.400 = 944.11 [kN/m]
Ed(Uh,d)/Rd = 752.68 / 944.11 = 0.797 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-15.00

Pos.	H	V
H/V pressure G+P+W,k	945.81	66.35
Wall weight		247.81
H/V pressure passive		0.00
Support z: -0.50	19.90	-5.33
Support z: -3.00		0.00
Support z: -5.50	-406.07	108.81
Bh,g,k z=-13.10	-559.64	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.65
Σ	0.00	416.99 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.
Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1

Vertical component of earth resistance is less than
the downwards pointing vertical forces.
Vk >= Bvk: 417.64 >= 0.65 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-15.00

Pos.	H	V
H/V pressure G+P+W,k	998.34	71.91
Wall weight		247.81
H/V pressure passive		0.00
Support z: -0.50	-12.27	3.29
Support z: -3.00		0.00

Pos.		H	V
Support z:	-5.50	-428.33	114.77
Bh,g,k z=-13.10		-559.64	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)			-0.65
Bh,q,k z=-13.10		1.89	
Bv,q,k = Bh,k * tan(δ,p=-0.07°)			0.00
Σ		-0.00	437.13 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.
Verification of vertical forces due to EAB R 9 not required (R 9-5).
Check EAB R 9-1
Vertical component of earth resistance is less than
the downwards pointing vertical forces.
Vk >= Bvk: 437.78 >= 0.65 Passes requirement

Anchor verification

Anchor - Stability of lower failure plane

Περίπτ.Φόρτισης: όλα τα φορτία BS-P
Αυτόμ. υπολογ. μήκους αγκυρίων:
All anchors are extended (if necessary)
Favourable variable loads in main failure body are not being considered.
Bottom of lower failure plane: z=-15.00 m

Iteration of failure mechanisms:
lA .....: Length of anchor from head to center of grout body.
W,k .....: Res. force from dead weight, loads, cohesion, ...
Q,k .....: Force in lower failure plane.
Ea1,k.....: Earth pressure onto vertical separation plane.
Ea2,k.....: Earth pressure between wall and main failure body.
Ra_cal,d ...: Dimesioning force of the resistance from the equilibrium of forces. Ra_cal,d corresponds to the max. possible anchor force of the force polygon.
Sum(A,d) ...: Acting anchor forces along the grout body fractions within the failure body. Sum(A,d) is gained from the anchor pull forces of the wall analysis.

z [m]	ϑ1 [°]	ϑ2 [°]	lA [m]	W,k [kN/m]	Q,k [kN/m]	Ea1,k [kN/m]	Ea2,k [kN/m]	Ra_cal,d [kN/m]	Sum(A,d) [kN/m]	Ed/Rd [-]
-0.50	39.3	57.5	13.82	1499.3	1240.7	4.4	365.5	388.9	388.5	1.00
-3.00	34.0	61.0	13.18	1641.3	1324.4	41.2	365.5	451.1	449.8	1.00
-5.50	24.3	61.3	13.67	2012.5	1531.7	113.9	365.5	621.0	619.6	1.00

Decisive failure body:
Γεωμετρία:

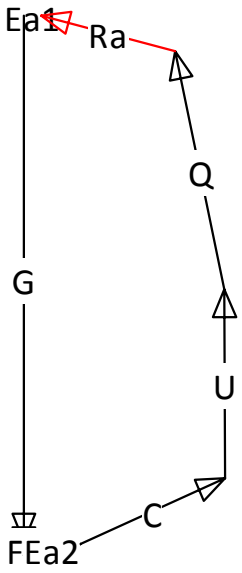
Foot point of lower failure plane	x/z =	0.01/-15.00 m
Intersection lower/upper slid. plane	x/z =	13.21/ -9.04 m
Intersection upper slid. plane/surface	x/z =	18.15/ 0.00 m
Intersection separation plane/surface	x/z =	13.21/ 0.00 m
Inclination lower failure plane	ϑ1 =	24.31°
Inclination upper failure plane	ϑ2 =	61.31°
Inclination separation plane	ϑ12 =	90.00°

Loads / forces (char.)

		Fx [kN/m]	Fz [kN/m]	F [kN/m]
Weight of main failure body	G,k:	0.0	-3314.2	3314.2

		Fx [kN/m]	Fz [kN/m]	F [kN/m]	
Area loads on/in main failure body	F1,k:	0.0	-82.5	82.5	
Cohesion of lower failure plane	C,k:	907.1	409.8	995.4	
Pore water pressure on main body	U,k:	-0.6	1190.2	1190.2	
Earth pres. on separation plane	Ea1,k:	-113.9	-0.0	113.9	δ= 0.0°
Earth pr. between wall<->main body	Ea2,k:	358.3	71.9	365.5	
Force in lower failure plane	Q,k:	-311.1	1499.8	1531.7	
Sum = possible anchor forces:	Ra_cal,k:	839.8	-225.0	869.5	

Force polygon



Acting anchor forces Ed: Sum(A,d) = 619.6 kN/m
Possible anchor forces Rd: Ra_cal,d = 869.5/1.400 = 621.0 kN/m
Verif. of lower failure plane Ed/Rd = 1.00 < 1.0: Έλεγχος εκπληρώθηκε.

Check of steel tension

l,tot ...[m]: Total length of anchor incl. excess length at head
As ....[mm2]: X-section are of steel member
Ri,d ...[kN]: Ultimate strength of tension member (γ,M=1.15)
A,d ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	l,tot	As	Ri,d		A,d	
-0.50	Strand;3x0.60";1570/1770	20.87	420	573.4	>	39.8	Passes requirement
-3.00	Strand;3x0.60";1570/1770	19.27	420	573.4	>	0.0	Passes requirement
-5.50	Strand;4x0.60";1570/1770	17.67	560	764.5	>	541.9	Passes requirement

Check of steel tension: Passes requirement

Check of anchor's soil friction

lVk .....: Length of grout body
DmVk ....: Diameter of grout body
τGr,k ...: Average applied skin friction along the grout body (from soil parameters)
Ra,k ....: Charact. pullout resistance of the anchor
γA ......: Partial safety factor of anchor pullout
Ra,d ....: = Ra,k / γA
A,d .....: Dimensioning force of the anchor from wall analysis

z [m]	lVk [m]	DmVk [mm]	τGr,k [kN/m²]	Ra,k [kN]	γA [-]	Ra,d [kN]		A,d [kN]	A,d/Ra,d [-]
-0.50	8.00	318	110	879.1	1.100	799.2	>	39.8	0.0
-3.00	8.00	318	110	879.1	1.100	799.2	>	0.0	0.0
-5.50	8.00	318	110	879.1	1.100	799.2	>	541.9	0.7

Check of anchor's soil friction: Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)
Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (-2.74, 0.53), Ακτίνα = 15.77
Αρχ.σημ.= (-14.16,-10.35), Τελ.σημ. = (13.03, 0.00)

Γεωμετρία λωρίδων:

No	x [m]	Width b [m]	dxM [m]	Weight [kN/m]	Load z-κατ. [kN/m]	Water-φορτ. [kN/m]	u*b [kN/m]	φ [°]	c [kN/m²]	θ [°]
1	-13.37	1.58	-10.64	24.4	0.0	0.0	-6.3	0.08	71.43	-42.40
2	-11.80	1.58	-9.06	64.3	0.0	0.0	-21.3	0.08	71.43	-35.05
3	-10.22	1.58	-7.48	95.0	0.0	0.0	-36.8	0.08	71.43	-28.32
4	-8.64	1.58	-5.91	118.8	0.0	0.0	-48.5	29.26	3.57	-21.98
5	-7.06	1.58	-4.33	138.0	0.0	0.0	-57.1	29.26	3.57	-15.92
6	-5.49	1.58	-2.75	150.9	0.0	0.0	-62.9	29.26	3.57	-10.04
7	-3.91	1.58	-1.17	157.9	0.0	0.0	-66.0	29.26	3.57	-4.26
8	-2.33	1.58	0.40	159.3	0.0	0.0	-66.6	29.26	3.57	1.47
9	-0.75	1.58	1.98	162.7	0.0	0.0	-127.8	29.26	3.57	7.22
10	0.82	1.58	3.56	488.5	0.0	0.0	-186.5	29.26	3.57	13.04
11	2.40	1.58	5.14	472.5	0.0	0.0	-179.3	29.26	3.57	19.01
12	3.98	1.58	6.71	450.7	13.3	0.0	-169.1	0.08	71.43	25.19
13	5.56	1.58	8.29	423.8	0.0	0.0	-155.6	0.08	71.43	31.71
14	7.13	1.58	9.87	388.6	0.0	0.0	-137.8	0.08	71.43	38.73
15	8.71	1.58	11.45	342.8	0.0	0.0	-114.6	0.08	71.43	46.52
16	10.29	1.58	13.02	274.7	0.0	0.0	-83.0	27.45	3.57	55.65
17	12.05	1.95	14.79	190.2	0.0	0.0	-40.0	27.45	3.57	69.64

Συνεισφ. κατακόρυφων φορτίων:

No	Weight [kN/m]	G*sin(θ) [kN/m]	(G-u*b)*tan(φ) + c*b [kN/m]	μ*sin(θ)* tan(φ)+cos(θ) [-]	T [kN/m]
1	24.38	-16.44	112.70	0.737802	152.75
2	64.29	-36.92	112.74	0.818090	137.80

No	Weight [kN/m]	G*sin(θ) [kN/m]	(G-u*b)*tan(φ) + c*b [kN/m]	μ*sin(θ)* tan(φ)+cos(θ) [-]	T [kN/m]
3	95.01	-45.07	112.76	0.879907	128.15
4	118.78	-44.46	44.98	0.790901	56.87
5	138.01	-37.86	50.94	0.861677	59.11
6	150.91	-26.31	54.94	0.921164	59.64
7	157.94	-11.74	57.12	0.970145	58.88
8	159.30	4.09	57.54	1.009017	57.03
9	162.68	20.44	25.15	1.037854	24.24
10	488.54	110.24	174.84	1.056421	165.51
11	472.46	153.86	169.86	1.064136	159.62
12	464.02	197.51	113.09	0.905273	124.92
13	423.75	222.75	113.05	0.851176	132.82
14	388.62	243.14	113.03	0.780670	144.78
15	342.81	248.76	112.99	0.688720	164.07
16	274.74	226.84	105.25	0.843168	124.83
17	190.17	178.30	85.01	0.664654	127.91
		1387.12			1878.92

Συνεισφ. αγκυρίων: Αθρ. ροπών ανατροπής : -1973.2 kN*m/m
" " resisting : 975.1 kN*m/m

Δράση Ed = (1387.1*15.77-1973.2)
Αντίσταση Rd = (1878.9*15.77+975.1)
SLIP-CIRCLE μ = Ed/Rd = 0.65 < 1.0: Έλεγχος εκπληρώθηκε.

ΠΑΡΑΡΤΗΜΑ

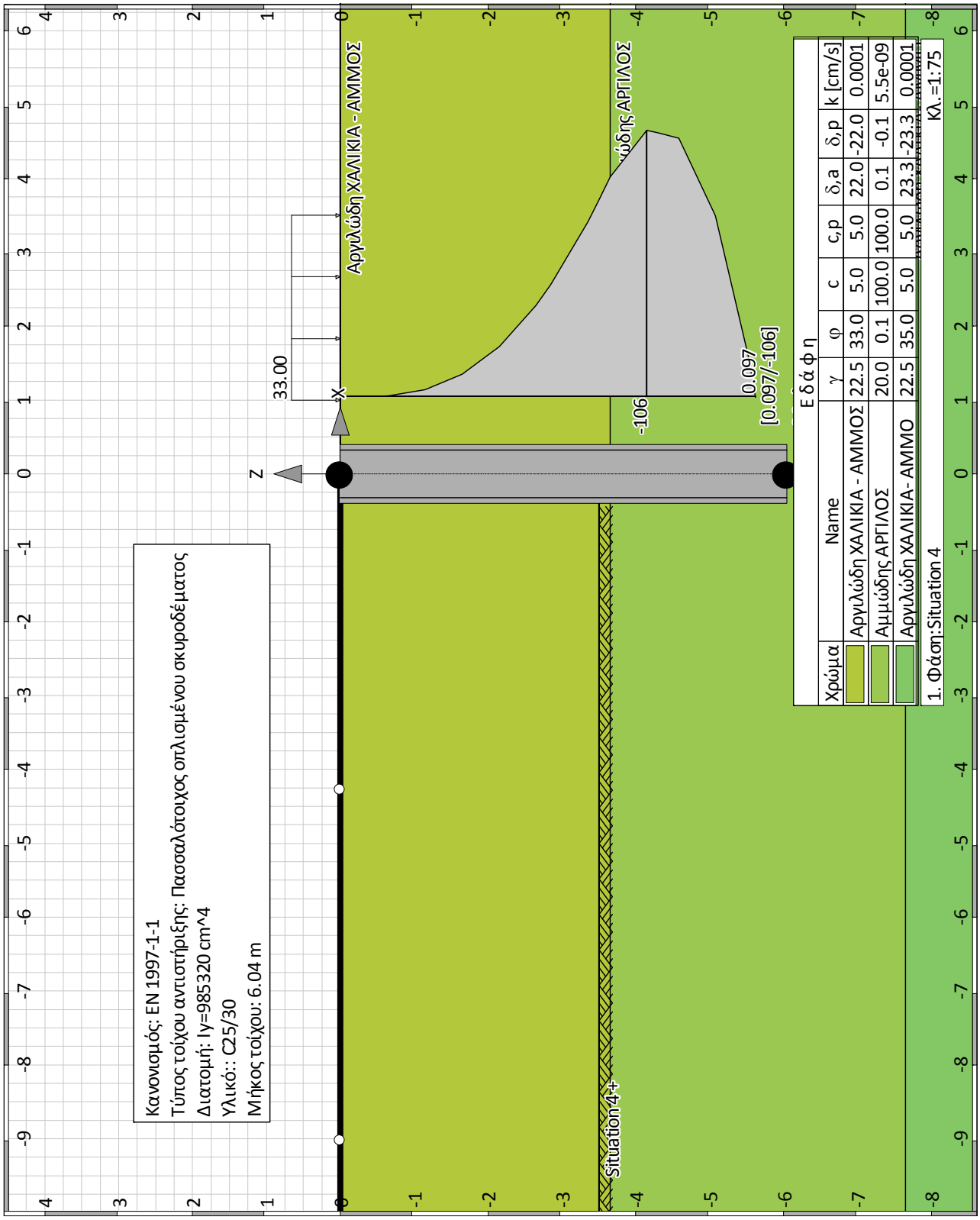
8.5 *Αποτελέσματα ανάλυσης*

8.5.1 *Στατικές Συνθήκες*

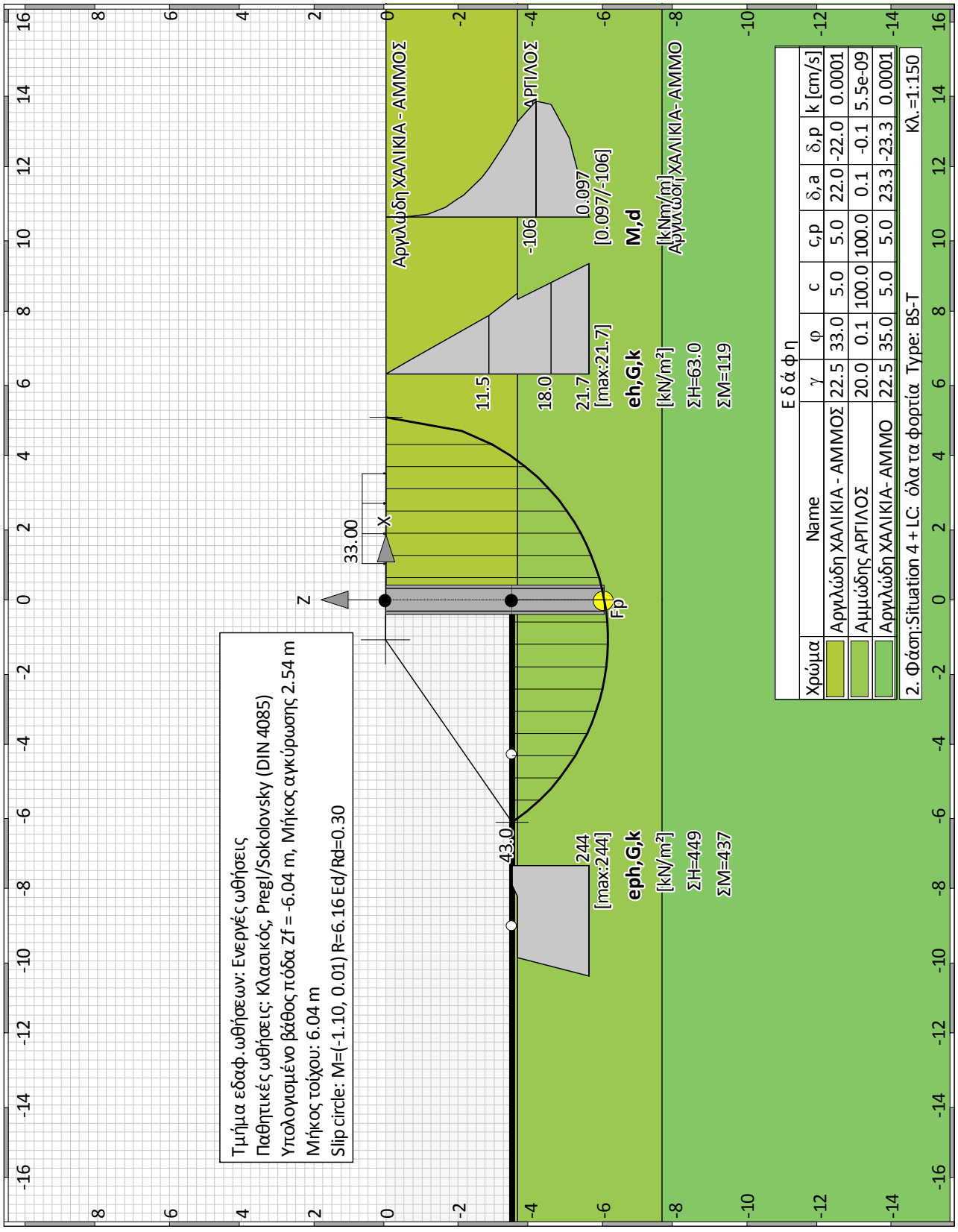
iv) Αντιστηριζόμενο ύψος 3,50m

Summary of all stages

Φάση εκσκαφής 0 "Situation 4"



Φάση εκσκαφής 1 "Situation 4 +"



Κανονισμόςγια Ανάλυση και Διαστασιολόγηση

Διαστασ. ωπλισμ.σκυροδ.: EN 1992-1-1
Γεωτεχν.Κανονισμός : EN 1997 (rev.12)_user
National Annex: EN 1997-1

Safety factors:

Earth pressure onto wall: [GEO] A1 M1 R2

	γ-	G,dst	E0G	G,stb	Q,dst	Q,stb	phi	coe	cu	g
BS-P		1.350	1.350	1	1.500	0	1	1	1	1
BS-T		1.350	1.350	1	1.500	0	1	1	1	1
BS-T/A		1.350	1.350	1	1.500	0	1	1	1	1
BS-E		1	1	1	1	0	1	1	1	1

ΚΕ-μηχανισμός: [GEO] A2 M2 R3

	γ-	G,dst	G,stb	W	Q,dst	Q,stb	phi	coe	cu
		g	a,t	a,p	Gt	N			
BS-P		1	1	1	1.300	0	1.250	1.400	1.400
		1	1	1	1	1			
BS-T		1	1	1	1.300	0	1.250	1.400	1.400
		1	1	1	1	1			
BS-T/A		1	1	1	1.300	0	1.250	1.250	1.400
		1	1	1	1	1			
BS-E		1	1	1	1	0	1.250	1.400	1.400
		1	1	1	1	1			

Θραύση εδάφους: [GEO] A1 M1 R2

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Re					
BS-P		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-T		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-T/A		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-E		1	1	1	1	1	0	1	1
		1	1	1					

Ολίσθηση: [GEO] A1 M1 R2

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Rh					
BS-P		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.100					
BS-T		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.100					
BS-T/A		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.100					
BS-E		1	1	1	1	1	0	1	1
		1	1	1					

Θραύση εδάφους: [GEO] A1 M1 R2

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Rv					
BS-P		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-T		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Rv					
BS-T/A		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-E		1	1	1	1	1	0	1	1
		1	1	1					

Κύκλος ολίσθησης: [GEO] A2 M2 R3

	γ-	G,dst	G,stb	Q,dst	Q,stb	W	phi	coe	cu
		g	Re	a,t	a,p	Gt	N		
BS-P		1	1	1.300	0	1	1.250	1.400	1.400
		1	1	1	1	1	1		
BS-T		1	1	1.300	0	1	1.250	1.400	1.400
		1	1	1	1	1	1		
BS-T/A		1	1	1.300	0	1	1.250	1.250	1.400
		1	1	1	1	1	1		
BS-E		1	1	1	0	1	1.250	1.400	1.400
		1	1	1	1	1	1		

Hydraulic heave: [HYD] A1 M1 R1

	γ-	G,dst	G,stb	Q,dst	H
BS-P		1.350	0.900	1.500	1.800
BS-T		1.350	0.900	1.500	1.600
BS-T/A		1.350	0.900	1.500	1.500
BS-E		1	1	1	1

Failure of structural elements: [STR] A1 M1 R1

	γ-	M	Gtf	cd	N
BS-P		1.150	1.400	1.400	1.150
BS-T		1.150	1.300	1.300	1.150
BS-T/A		1.150	1.250	1.250	1.150
BS-E		1	1	1	1

Stability: [EQU] A1 M1 R1

	γ-	G,dst	G,stb	Q,dst	Q,stb	phi	coe	cu	g
BS-P		1	0.900	1.500	0	1.250	1.250	1.400	1
BS-T		1	0.900	1.500	0	1.250	1.250	1.400	1
BS-T/A		1	0.900	1.500	0	1.250	1.250	1.400	1
BS-E		1	1	1	0	1.250	1.400	1.400	1

γ,Re,red (EAB EB14-3): Ναι, η=0.80
γ,Re,red (EAB EB22-6): Ναι, E0h > 0%: η = 0.60 / 0.80

System values

Τοίχος

Τύπος τοίχου αντιστήριξης: Πασσαλότοιχος οπλισμένου σκυροδέματος
Διατομή: Iy=985320 cm^4
Υλικό:: C25/30
Ίδιο βάρος: 25.000 [kN/m3]

Σημεία τοίχου

z	d	E	Iy	E*Iy	A
[m]	[m]	[MN/m2]	[cm4/m]	[MNm2]	[cm2/m]
0.00	80.0	31500.0	985320	310.4	6940
-6.04	80.0	31500.0	985320	310.4	6940

Φάση εκσκαφής 1 "[1] Situation 4 +"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 3 Στρώσεις

Name		Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	22.5	20	22.5
γ,R	[kN/m3]	22.5	20	22.5
γ'	[kN/m3]	12.5	10	12.5
γ,p	[kN/m3]	22.5	20	22.5
γ,R,passive	[kN/m3]	22.5	20	22.5
γ,pw	[kN/m3]	12.5	10	12.5
φ	[°]	33	0.1	35
c	[kN/m2]	5	100	5
c,u	[kN/m2]	5	100	5
c παθητικό	[kN/m2]	5	100	5
δ,a	[°]	22	0.06666667	23.33333
δ,p	[°]	-22	-0.06666667	-23.33333
δ,c	[°]	11	0.03333333	11.66667
k,agh	[-]	0.2452023	0.9955057	0.2244207
K,ach	[-]	0.8549058	1.994195	0.8126539
K,0h	[-]	0.455361	0.9982547	0.4264236
K,pgh	[-]	7.495617	1.004519	9.146943
K,pch	[-]	8.599509	2.00583	10.104
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	100e-06	5.5e-09	100e-06

Πορεία πρανούς:

x [m]	0.00	0.00
z [m]	-3.50	0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
z= -3.65

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -7.65

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
1.00	0.00	3.50	0.00	0.00	33.00	0.00	33.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Ενεργές ωθήσεις.
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: No redistribution of earth pressure.
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Κλασικός, Pregl/Sokolovsky (DIN 4085).

Options for water pressure

Στήριξη πόδα

Πακτωμένη στήριξη κατά Blum

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

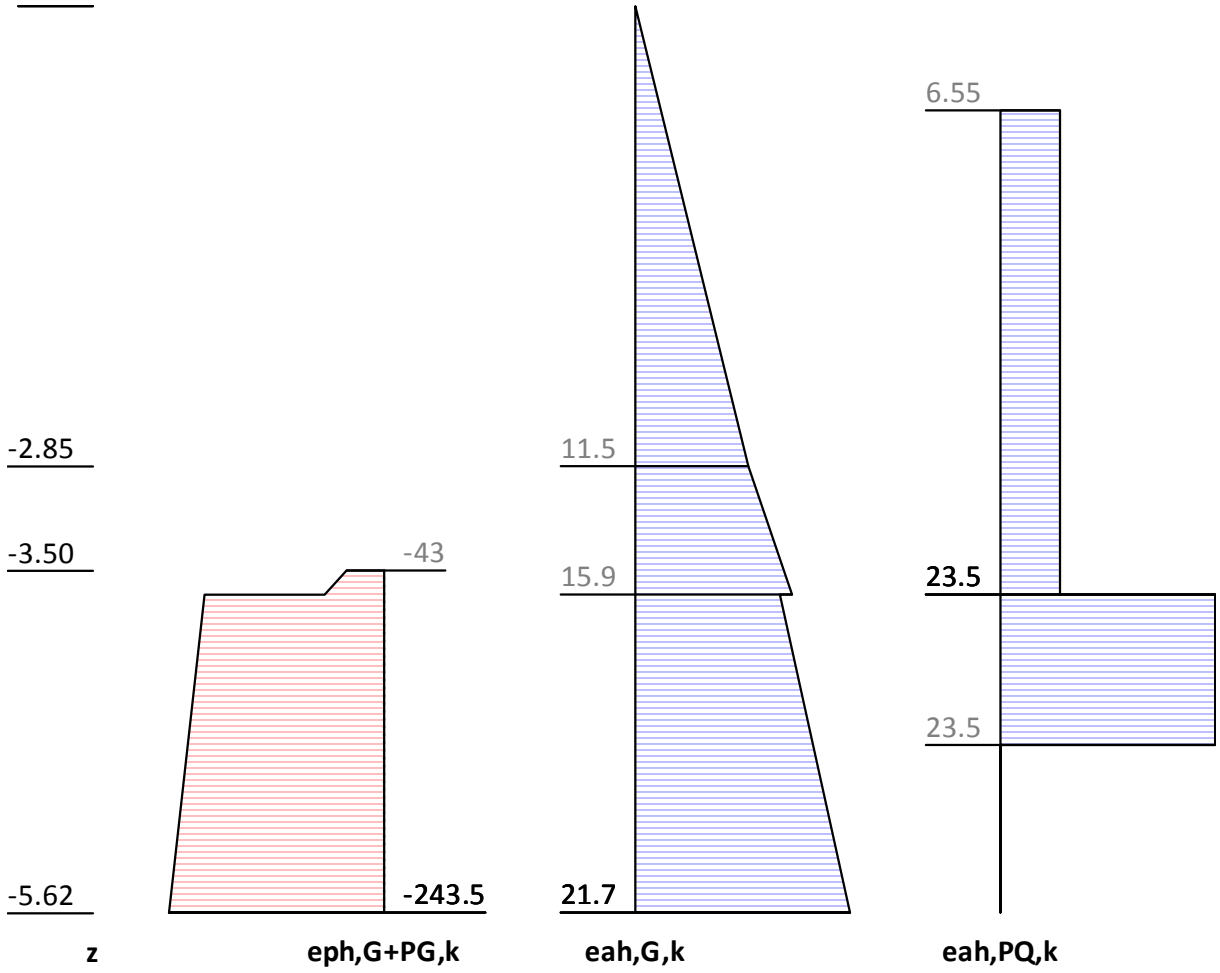
Μήκος τοίχου

```
N:   1 Z:   -4.550 M,Στήριξη πόδα,d:   104.27. Wall too short? Ναι
N:   2 Z:   -7.550 M,Στήριξη πόδα,d:  -616.15. Wall too short? Όχι
N:   3 Z:   -5.540 M,Στήριξη πόδα,d:    12.92. Wall too short? Ναι
N:   4 Z:   -6.887 M,Στήριξη πόδα,d:  -339.52. Wall too short? Όχι
N:   5 Z:   -5.984 M,Στήριξη πόδα,d:   -73.39. Wall too short? Όχι
N:   6 Z:   -5.687 M,Στήριξη πόδα,d:   -12.38. Wall too short? Όχι
N:   7 Z:   -5.588 M,Στήριξη πόδα,d:     4.92. Wall too short? Ναι
N:   8 Z:   -5.654 M,Στήριξη πόδα,d:    -6.52. Wall too short? Όχι
N:   9 Z:   -5.610 M,Στήριξη πόδα,d:     1.21. Wall too short? Ναι
N:  10 Z:   -5.640 M,Στήριξη πόδα,d:    -3.93. Wall too short? Όχι
N:  11 Z:   -5.620 M,Στήριξη πόδα,d:    -0.47. Wall too short? Όχι
N:  12 Z:   -5.613 M,Στήριξη πόδα,d:     0.66. Wall too short? Ναι
N:  13 Z:   -5.618 M,Στήριξη πόδα,d:    -0.10. Wall too short? Όχι
Foot depth for statics: zf = -5.618
```

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall

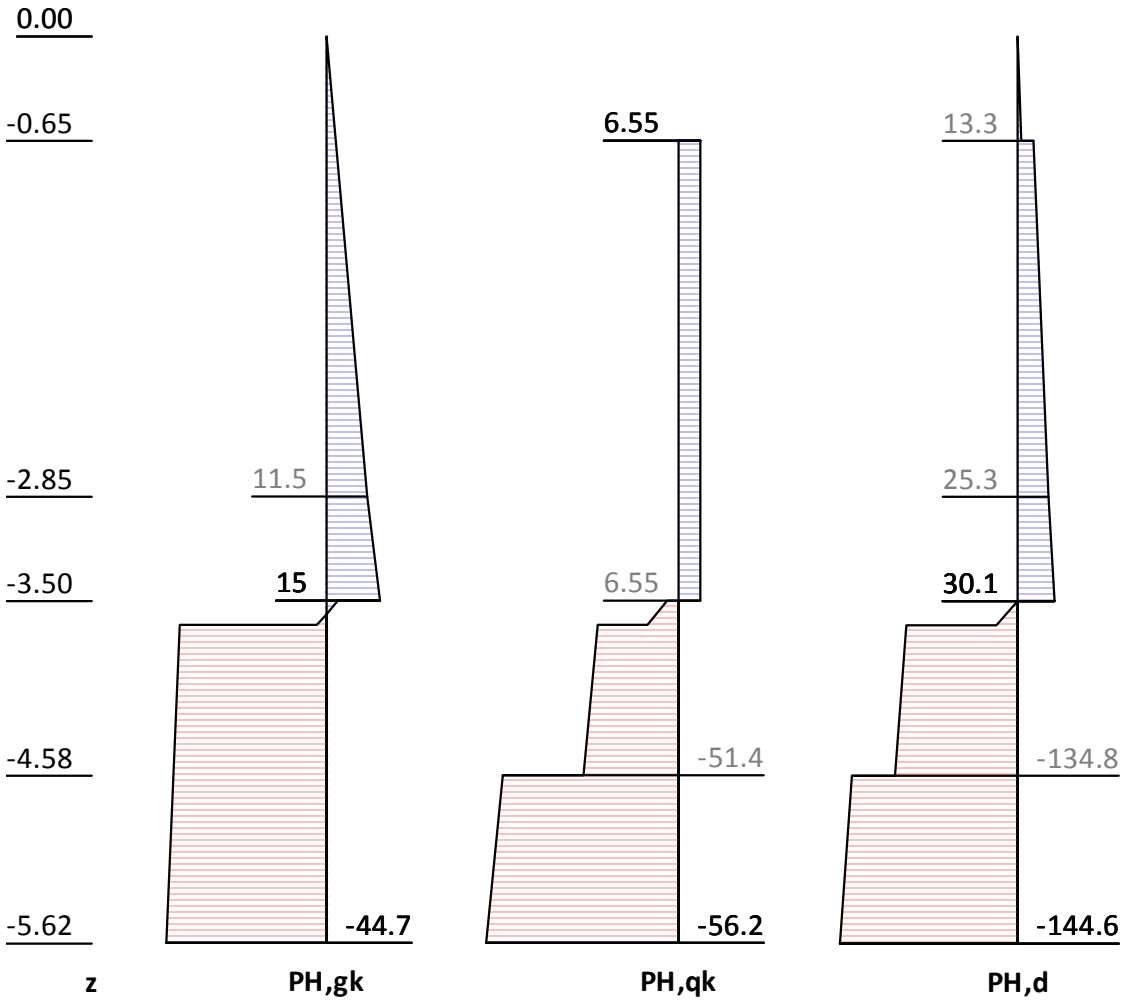


z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.65		2.61	0.00	3.53
-0.65		2.61	6.55	13.34
-3.50	-0.00	15.04	6.55	30.12
-3.50	-43.00	15.04	6.55	30.12
-3.65	-68.30	15.86	6.55	31.23
-3.65	-203.97	14.67	23.48	55.02
-4.58	-222.64	17.98	23.48	59.51
-4.58	-222.64	17.98	0.00	24.28
-5.62	-243.51	21.70	0.00	29.29

Eph,G,k: -448.60, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 63.02, Eah,PG,k: 0.00, Eah,PQ,k: 41.47, Eah,d: 147.29

H-pressure on static system

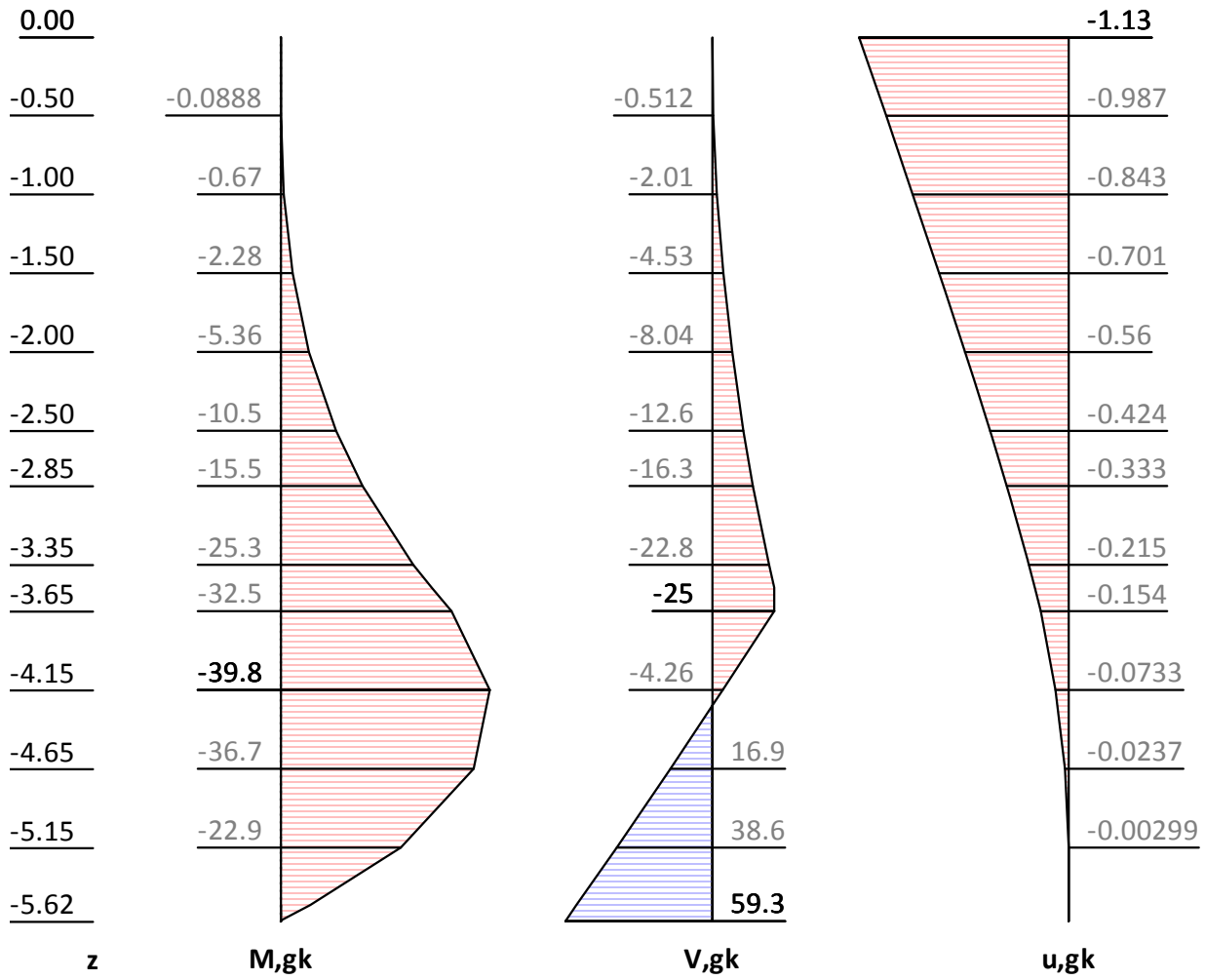
Level of mobilization: Ep,gk 27.3, Ep,qk 23.1, Ep,d 100.0 [%]



z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	0.00		0.00
-0.65	2.61	0.00	3.53
-0.65	2.61	6.55	13.34
-3.50	15.04	6.55	30.12
-3.50	3.31	-3.37	-0.60
-3.58	0.00	-6.56	-9.86
-3.65	-2.75	-9.21	-17.55
-3.65	-40.93	-23.58	-90.67
-4.58	-42.70	-27.89	-99.54
-4.58	-42.70	-51.37	-134.76
-5.62	-44.68	-56.18	-144.64

V-pressure on static system

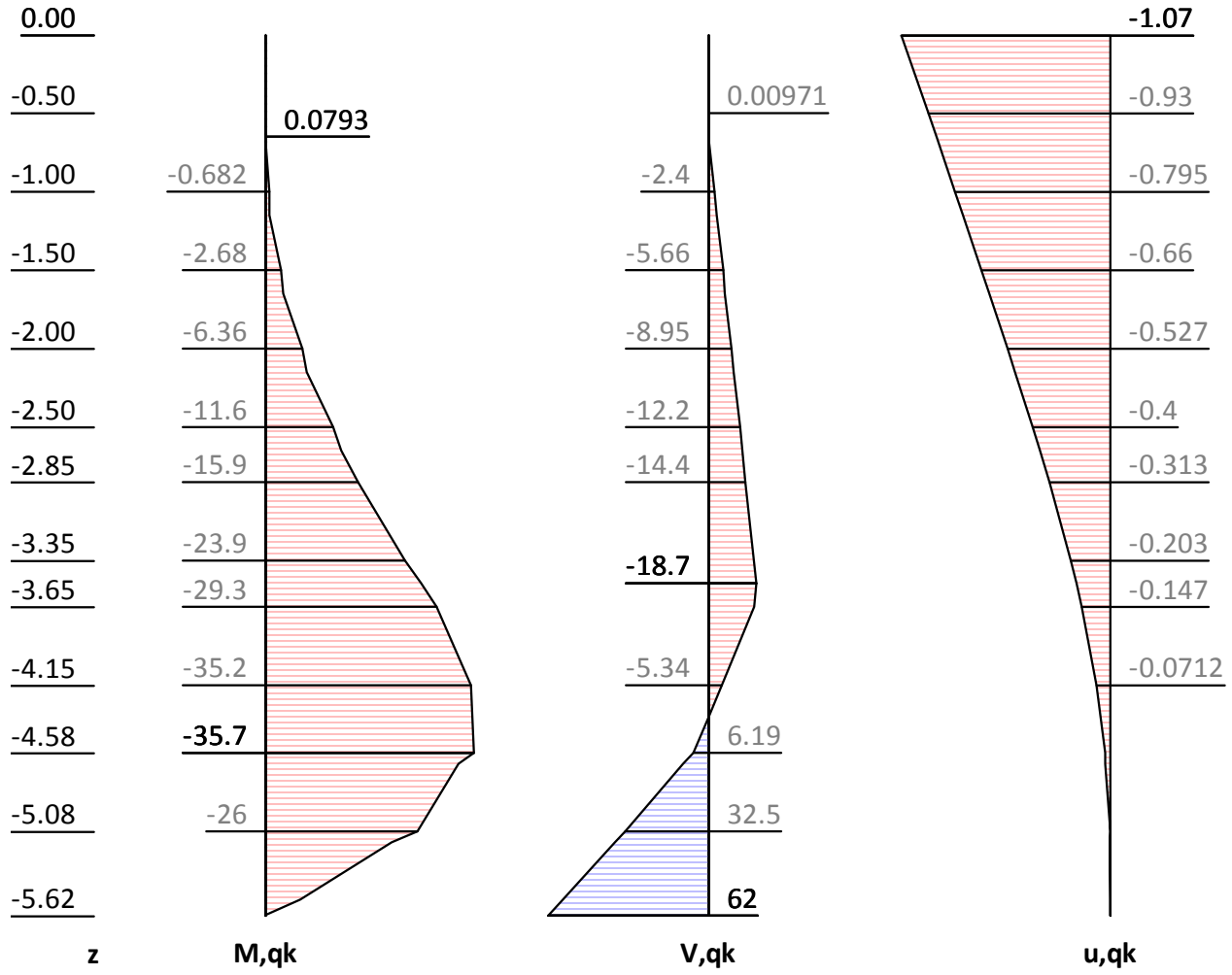
Internal forces: Permanent, characteristically



z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	0.00	0.00	0.00	0.00	-1.13
-3.50	15.04	-28.78	-24.93	-71.35	-0.18
-3.50	3.31	-28.78	-24.93	-71.35	-0.18
-3.58	0.00	-30.83	-24.95	-72.78	-0.17
-3.65	-2.75	-32.54	-24.97	-73.97	-0.15
-3.65	-40.93	-32.54	-24.97	-73.97	-0.15
-4.15	-41.89	-39.82	-4.26	-82.62	-0.07
-4.25	-42.08	-39.19	0.00	-84.36	-0.06
-5.62	-44.68	-0.00	59.27	-108.01	-0.00
-5.62	-44.68	0.00	59.27	-108.01	0.00

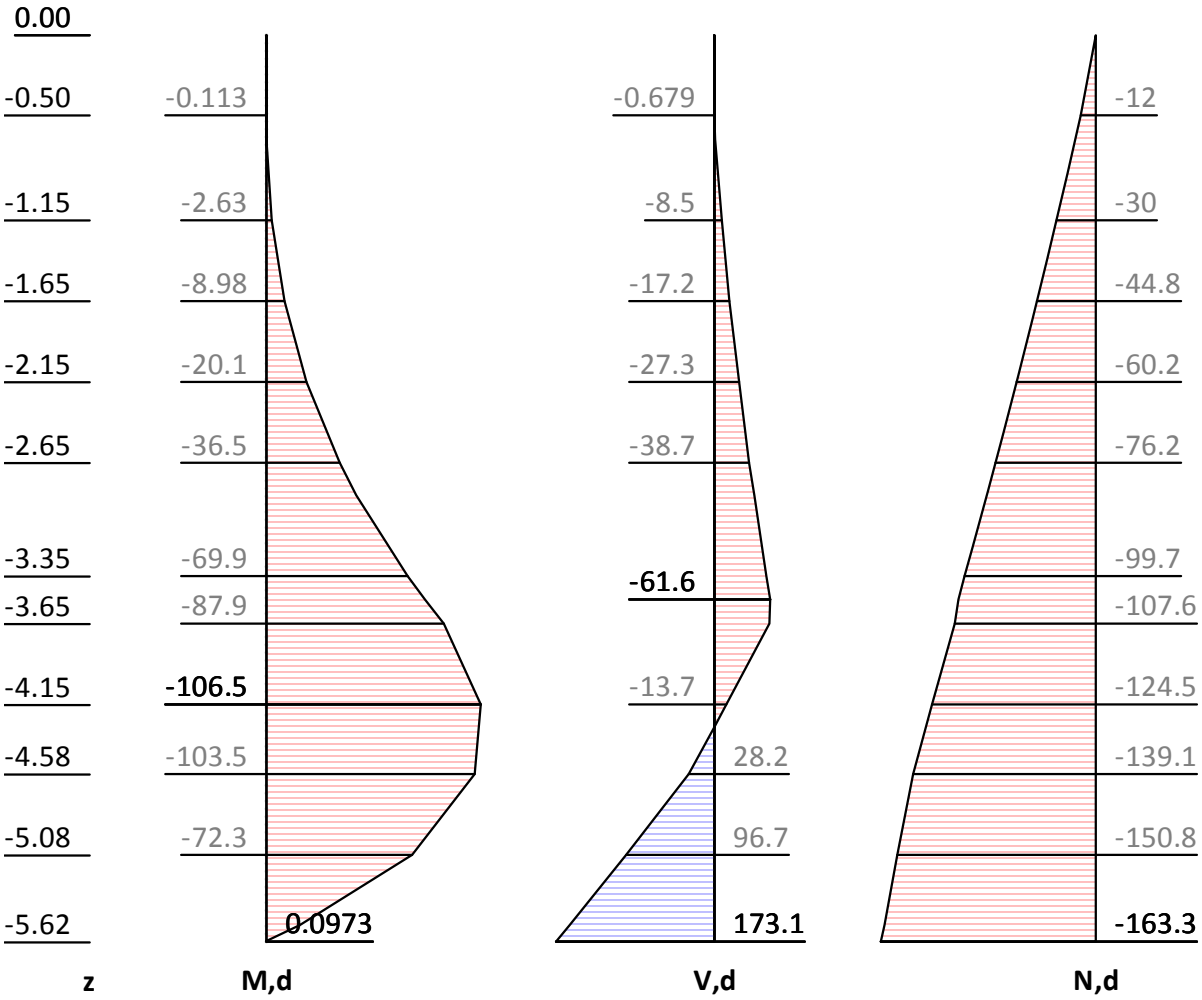
Internal forces: Variable, characteristically

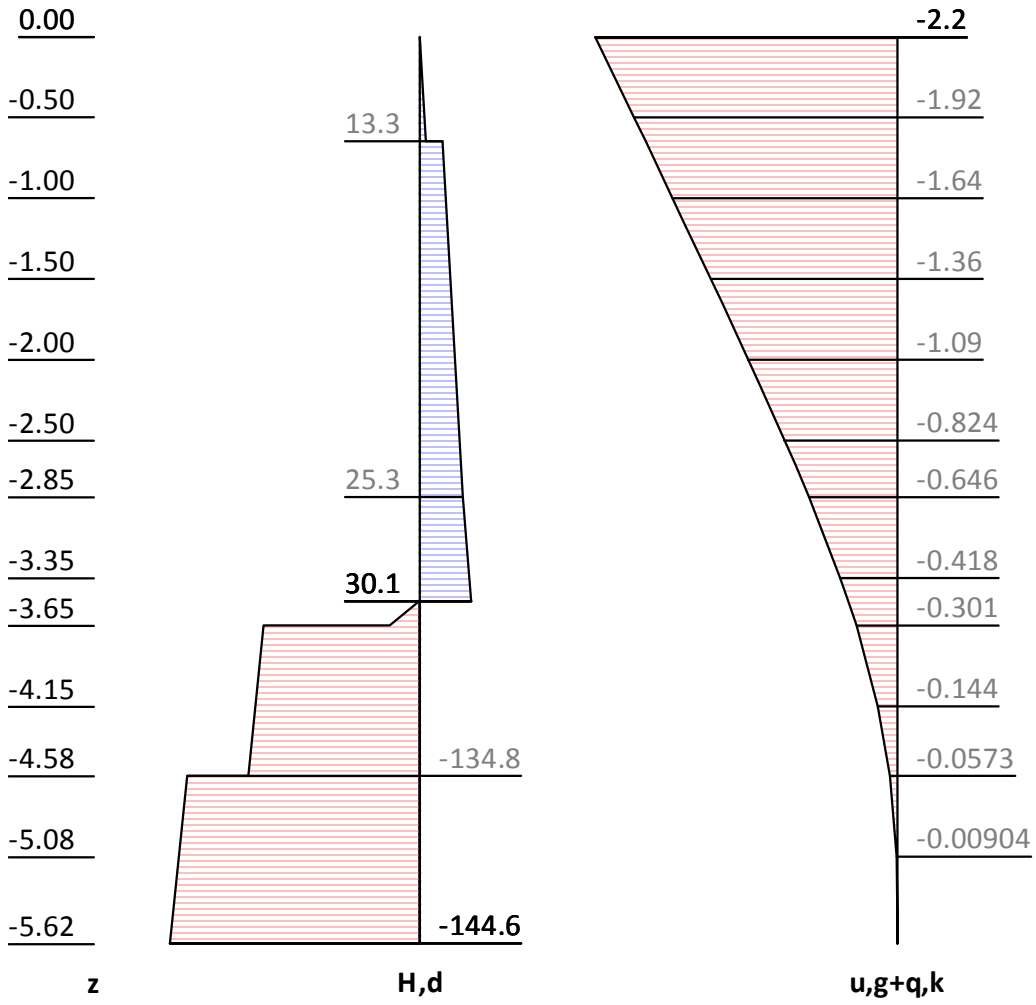
Method EB 82-4 (Q = [G+Q] - G).



z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00	-0.00	0.00	-1.07
-0.00		0.00	0.00	0.00	-1.07
-0.65	0.00	0.08	0.11	0.05	-0.89
-0.65	6.55	0.08	0.11	0.05	-0.89
-0.67	6.55	0.05	-0.00	0.01	-0.89
-0.67	6.55	0.03	-0.04	0.00	-0.88
-0.69	6.55	0.00	-0.15	-0.03	-0.88
-3.50	6.55	-26.58	-18.66	-5.64	-0.17
-3.50	-3.37	-26.58	-18.66	-5.64	-0.17
-3.65	-9.21	-29.32	-17.71	-5.15	-0.15
-3.65	-23.58	-29.32	-17.71	-5.15	-0.15
-4.35	-26.82	-35.39	-0.00	-10.08	-0.05
-4.58	-27.89	-35.65	6.19	-11.70	-0.03
-4.58	-51.37	-35.65	6.19	-11.70	-0.03
-4.65	-51.69	-33.02	9.92	-11.69	-0.03
-5.15	-54.01	-21.67	36.34	-11.66	-0.00
-5.62	-56.18	0.00	62.02	-11.63	-0.00
-5.62	-56.18	0.00	62.02	-11.63	0.00

Internal forces: Design

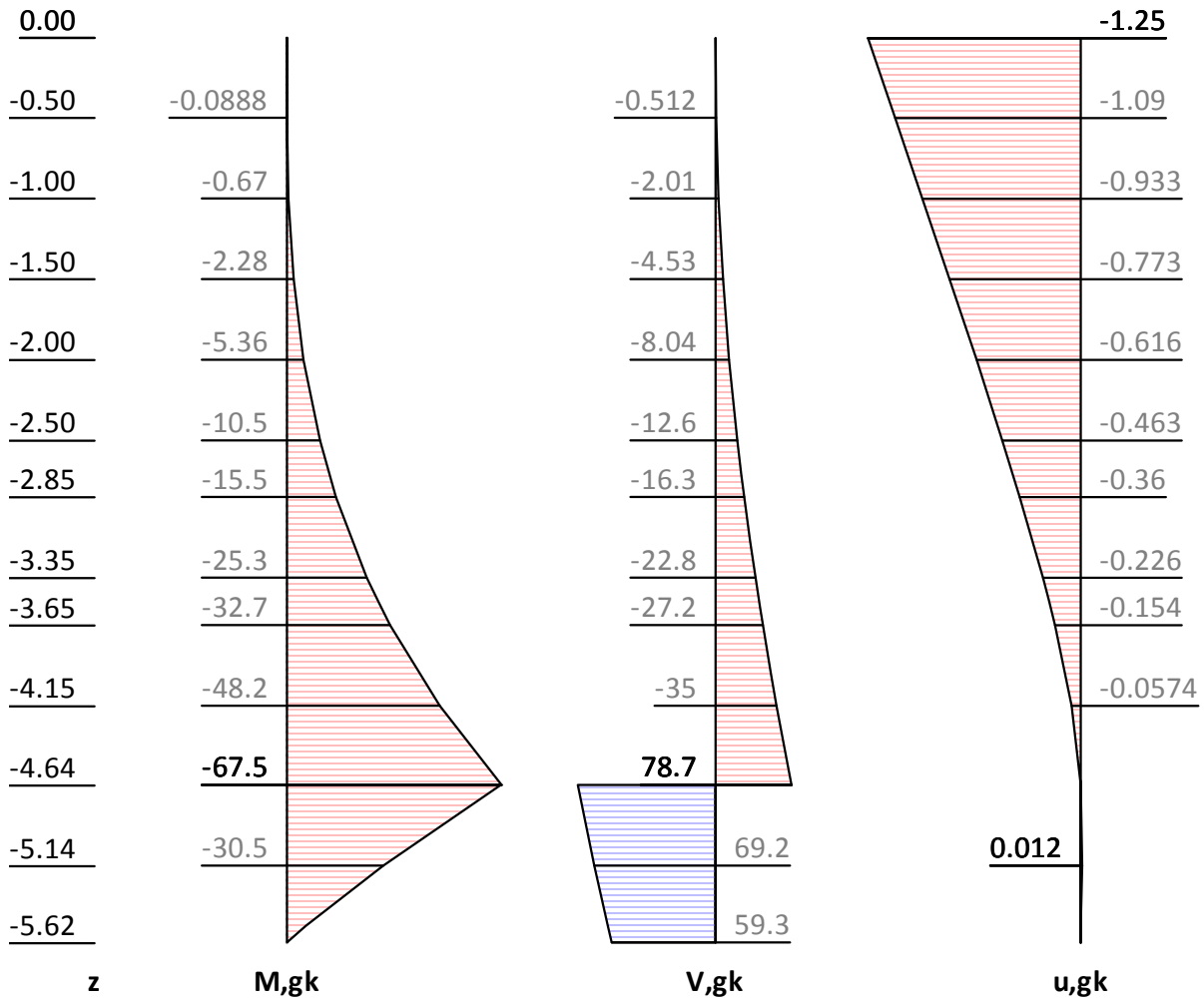




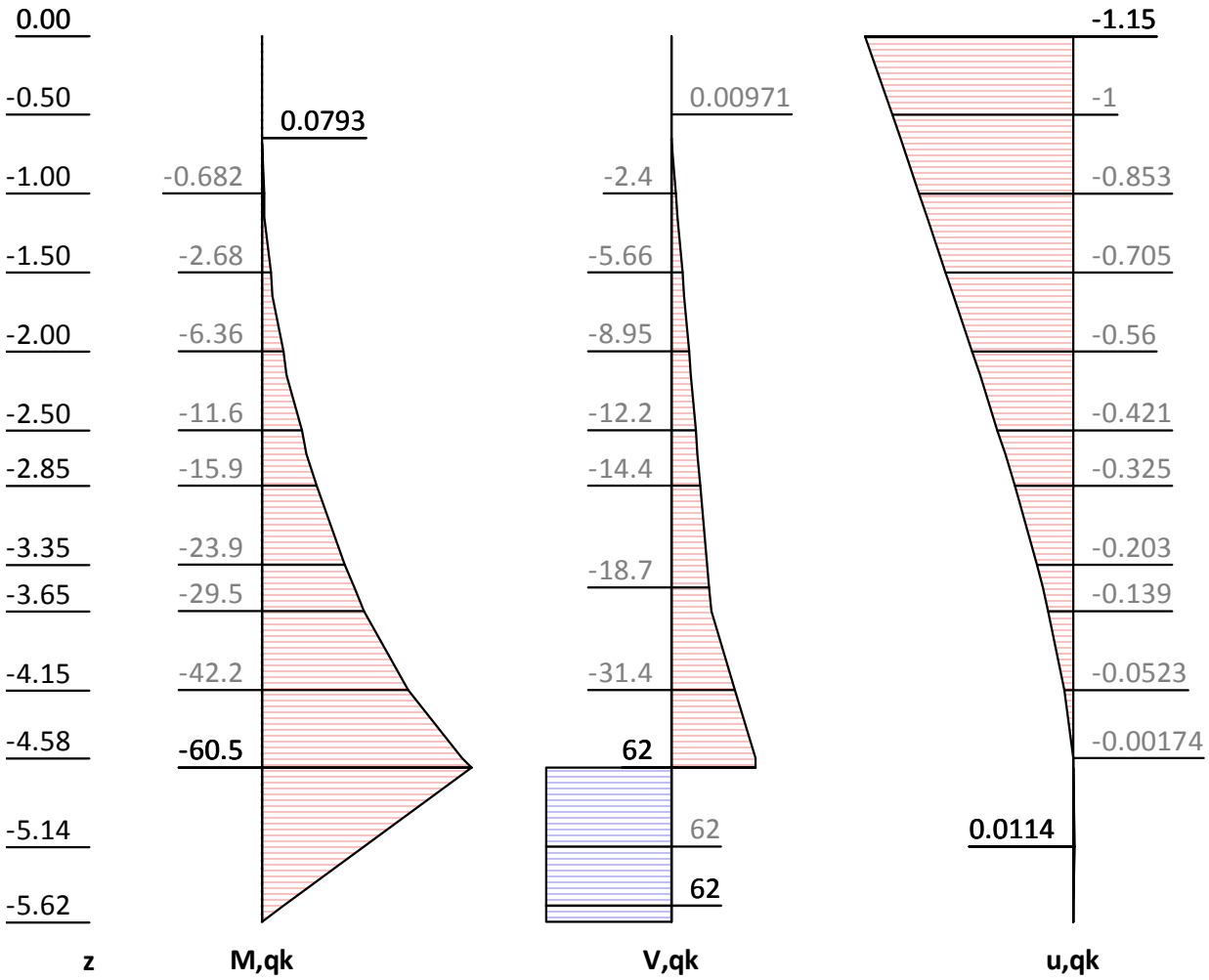
z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	0.00	0.00	0.00	0.00	-2.20
-0.00	0.00	0.00	-0.00	-0.00	-2.20
-0.65	3.53	-0.25	-1.15	-15.72	-1.83
-0.65	13.34	-0.25	-1.15	-15.72	-1.83
-3.50	30.12	-78.73	-61.63	-104.78	-0.36
-3.50	-0.60	-78.73	-61.63	-104.78	-0.36
-3.65	-17.55	-87.91	-60.27	-107.59	-0.30
-3.65	-90.67	-87.91	-60.27	-107.59	-0.30
-4.15	-95.44	-106.49	-13.74	-124.55	-0.14
-4.58	-99.54	-103.47	28.17	-139.13	-0.06
-4.58	-134.76	-103.47	28.17	-139.13	-0.06
-5.62	-144.64	0.00	173.06	-163.25	-0.00
-5.62	-144.64	0.10	173.14	-163.26	0.00

Checks of earth statics

Substitute system according to Blum



z [m]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [kN/m2]
0.00	0.00	0.00	0.00	-1.25
-4.64	-67.55	-43.56	-92.13	0.00
-4.64	-67.55	78.72	-92.13	0.00
-5.14	-30.54	69.17	-100.82	0.01
-5.62	0.00	59.27	-109.07	0.00



z [m]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [kN/m2]
0.00	0.00	0.00	0.00	-1.15
-0.65	0.08	0.11	0.05	-0.96
-0.67	0.05	-0.00	0.01	-0.95
-0.67	0.03	-0.04	0.00	-0.95
-0.69	-0.00	-0.15	-0.03	-0.95
-4.64	-60.47	-41.47	-12.53	0.00
-4.64	-60.47	62.02	-12.53	0.00
-5.14	-29.64	62.02	-12.53	0.01
-5.52	-6.20	62.02	-12.53	0.00
-5.62	0.00	62.02	-12.53	0.00

```
Bh,gk =  -122.29; Ch,gk =    59.27 [kN/m]
Bh,qk =  -103.50; Ch,qk =    62.02 [kN/m]
Bh,d  =  -320.33; Ch,d  =   173.04 [kN/m]
```

Check of C-force (foot support)

```
z(C)                                          =   -5.62 [kN/m]
G,k = sum(γ*h)                                =  121.48 [kN/m]
P,k = sum(Pz,k(x=  0.1))                      =    0.00 [kN/m]
kpgh,C(phi=  0.1; δ,C=  0.0°)                 =   1.002 [-]
kpch,C                                        =   2.003 [-]
eph,C,gk =(G,k+P,k)*kpgh,C+2*c*sqrt(kpch,C)=  404.79 [kN/m2]
         = (121.48+0.00)*1.002+2*100.0*1.415
Ed = Ch,d                                     =  173.04 [kN/m2]
δ,t,EAU          = Ed/(2*eph,C,d)             =    0.30 [m]
δ,t,EAB          =  0.20 * t                  =    0.42 [m]
δ,t = δ,t,EAB                                 =    0.42 [m]
Rd = 2*δ,t*eph,C,gk/γ,Re
   = 2*0.42*404.79/1.4
                                              =  244.92 [kN/m2]
```

Ed/Rd = 0.707 [-]. Passes requirement

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -4.64 m
Rd = Eph,k/γ,Re = 448.60 / 1.400 = 320.43 [kN/m]

Ed(Bh,d)/Rd = 320.33 / 320.43 = 1.000 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-5.62

Pos.	H	V
H/V pressure G+P+W,k	63.02	11.61
Wall weight		104.81
H/V pressure passive		0.00
Bh,g,k z=-4.64	-122.29	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.14
Ch,g	59.27	
Cv,g = Ch*tan(δ,C=0.0°)		0.03
Σ	0.00	116.31 (downwards)

Simple check, EAB R 9-3a

Vk >= Bvk: 116.45 >= 0.14 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-5.62

Pos.	H	V
H/V pressure G+P+W,k	104.49	24.14
Wall weight		104.81
H/V pressure passive		0.00
Bh,g,k z=-4.64	-122.29	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.14
Bh,q,k z=-4.64	-103.50	
Bv,q,k = Bh,k * tan(δ,p=-0.07°)		-0.12
Ch,g	59.27	
Cv,g = Ch*tan(δ,C=0.0°)		0.03
Ch,q	62.02	
Cv,q = Ch*tan(δ,C=0.0°)		0.04

Pos.	H	V
Σ	0.00	128.76 (downwards)

Simple check, EAB R 9-3a

Vk >= Bvk: 129.02 >= 0.26 Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)
Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (-1.10, 0.01), Ακτίνα = 6.16
Αρχ.σημ.= (-6.17, -3.50), Τελ.σημ. = (5.06, 0.00)

Γεωμετρία λωρίδων:

No	x	Width b	dxM	Weight	Load z-κατ.	Water-φορτ.	u*b	φ	c	θ
	[m]	[m]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[°]	[kN/m²]	[°]
1	-5.86	0.62	-4.76	5.3	0.0	0.0	0.0	0.08	71.43	-44.96*
2	-5.24	0.62	-4.14	13.2	0.0	0.0	0.0	0.08	71.43	-42.19
3	-4.63	0.62	-3.52	19.3	0.0	0.0	0.0	0.08	71.43	-34.86
4	-4.01	0.62	-2.91	23.9	0.0	0.0	0.0	0.08	71.43	-28.14
5	-3.39	0.62	-2.29	27.5	0.0	0.0	0.0	0.08	71.43	-21.82
6	-2.78	0.62	-1.67	30.1	0.0	0.0	0.0	0.08	71.43	-15.76
7	-2.16	0.62	-1.06	31.8	0.0	0.0	0.0	0.08	71.43	-9.88
8	-1.54	0.62	-0.44	32.7	0.0	0.0	0.0	0.08	71.43	-4.11
9	-0.93	0.62	0.17	32.9	0.0	0.0	0.0	0.08	71.43	1.62
10	-0.31	0.62	0.79	32.3	0.0	0.0	0.0	0.08	71.43	7.37
11	0.30	0.62	1.41	79.2	0.0	0.0	0.0	0.08	71.43	13.20
12	0.92	0.62	2.02	77.2	9.9	0.0	0.0	0.08	71.43	19.17
13	1.54	0.62	2.64	74.1	26.4	0.0	0.0	0.08	71.43	25.36
14	2.15	0.62	3.26	70.0	26.4	0.0	0.0	0.08	71.43	31.89
15	2.77	0.62	3.87	64.6	26.4	0.0	0.0	0.08	71.43	38.93
16	3.39	0.62	4.49	57.5	18.1	0.0	0.0	0.08	71.43	46.75
17	4.00	0.62	5.11	47.7	0.0	0.0	0.0	27.45	3.57	55.93
18	4.69	0.75	5.79	35.5	0.0	0.0	0.0	27.45	3.57	69.91

*** Σημείωση: Στις λωρίδες σημειωμένες με '*'
περιορίστηκε το theta στο 45°-Phi/2.

Συνεισφ. κατακόρυφων φορτίων:

No	Weight	G*sin(θ)	(G-u*b)*tan(φ) + c*b	μ*sin(θ)* tan(φ)+cos(θ)	T
	[kN/m]	[kN/m]	[kN/m]	[-]	[kN/m]
1	5.25	-4.05	44.04	0.707302	62.26
2	13.22	-8.88	44.05	0.740592	59.48
3	19.27	-11.02	44.06	0.820262	53.71
4	23.93	-11.29	44.07	0.881591	49.98
5	27.47	-10.21	44.07	0.928219	47.48
6	30.05	-8.16	44.07	0.962284	45.80
7	31.78	-5.46	44.08	0.985087	44.74

No	Weight [kN/m]	G*sin(θ) [kN/m]	(G-u*b)*tan(φ) + c*b [kN/m]	μ*sin(θ)* tan(φ)+cos(θ) [-]	T [kN/m]
8	32.72	-2.34	44.08	0.997400	44.19
9	32.88	0.93	44.08	0.999610	44.09
10	32.28	4.14	44.08	0.991782	44.44
11	79.19	18.08	44.14	0.973674	45.34
12	87.09	28.60	44.15	0.944692	46.74
13	100.58	43.08	44.17	0.903790	48.87
14	96.43	50.95	44.17	0.849245	52.01
15	91.02	57.20	44.16	0.778190	56.75
16	75.59	55.06	44.14	0.685505	64.39
17	47.71	39.52	26.99	0.690174	39.10
18	35.49	33.33	21.11	0.490794	43.02
		269.49			892.40

Δράση Ed = (269.5*6.16)
Αντίσταση Rd = (892.4*6.16 +0.0)
SLIP-CIRCLE μ = Ed/Rd = 0.30 < 1.0: Έλεγχος εκπληρώθηκε.

ΠΑΡΑΡΤΗΜΑ

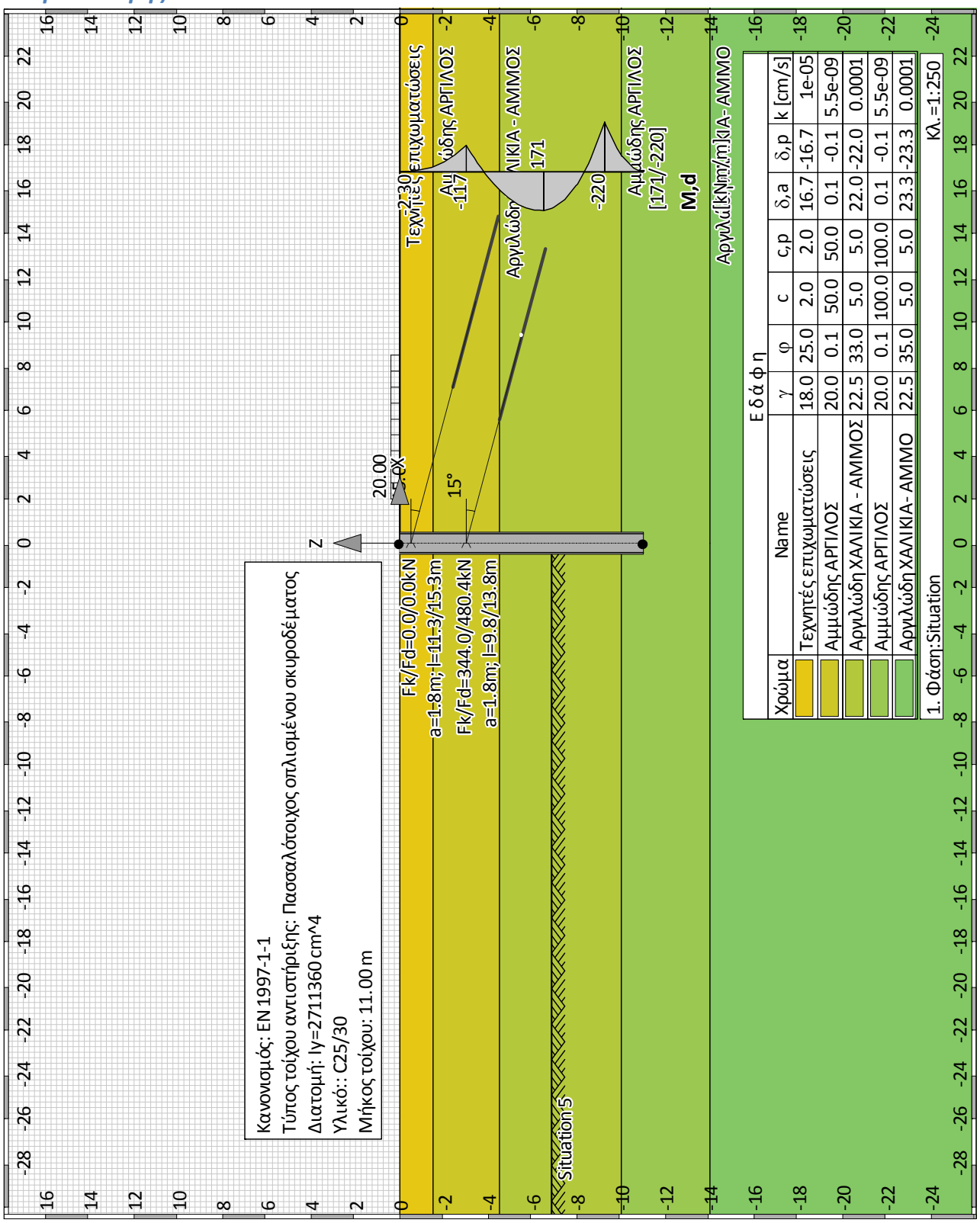
8.5 *Αποτελέσματα ανάλυσης*

8.5.2 *Σεισμικές Συνθήκες*

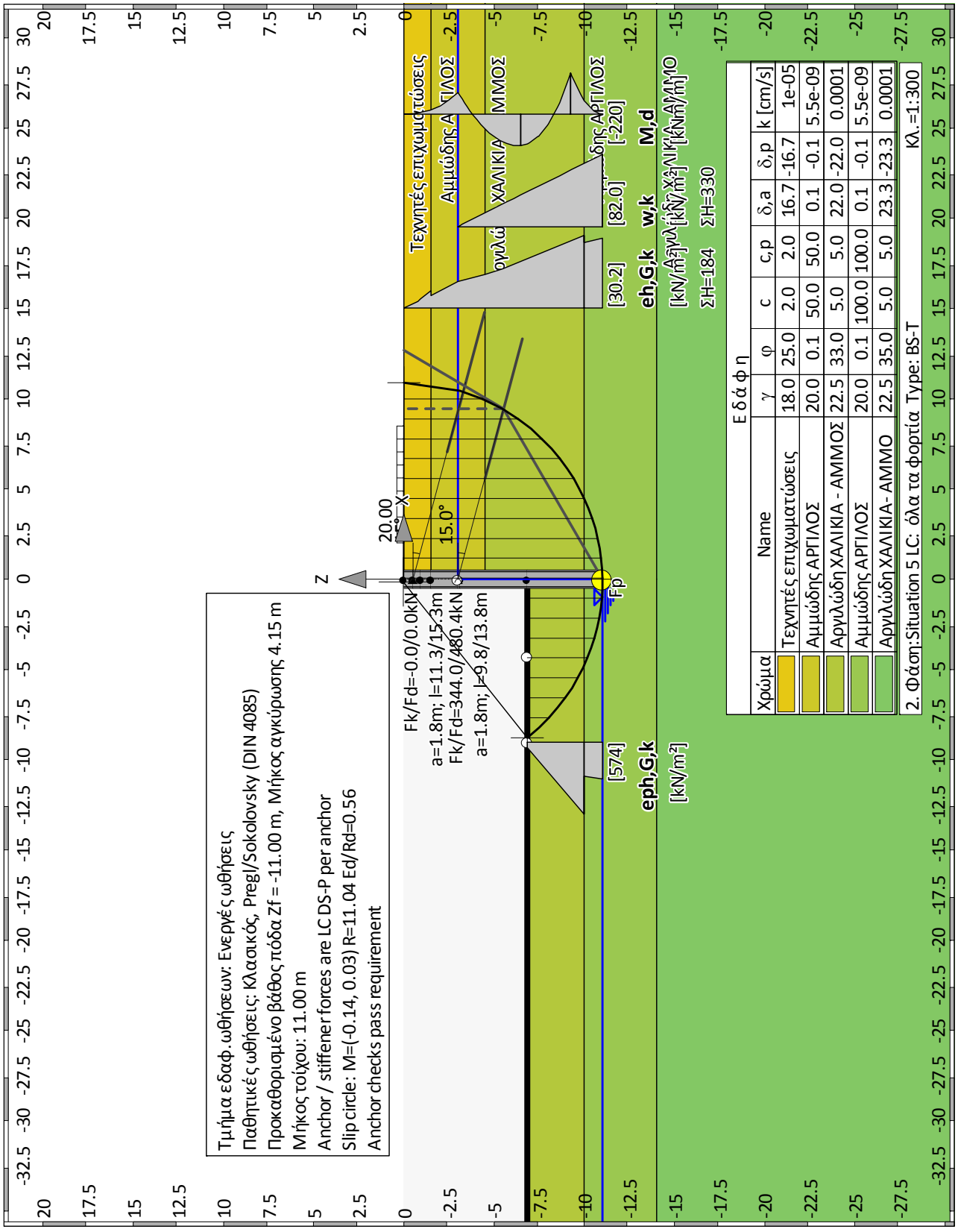
i) Αντιστηριζόμενο ύψος 6,35m

Summary of all stages

Φάση εκσκαφής 0 "Situation"



Φάση εκσκαφής 1 "Situation 5"



Κανονισμόςγια Ανάλυση και Διαστασιολόγηση

Διαστασ. ωπλισμ.σκυροδ.: EN 1992-1-1
Γεωτεχν.Κανονισμός : EN 1997 (rev.12)_user
National Annex: EN 1997-1

Safety factors:

Earth pressure onto wall: [GEO] A1 M1 R2

	γ-	G,dst	E0G	G,stb	Q,dst	Q,stb	phi	coe	cu	g
BS-P		1.350	1.350	1	1.500	0	1	1	1	1
BS-T		1.350	1.350	1	1.500	0	1	1	1	1
BS-T/A		1.350	1.350	1	1.500	0	1	1	1	1
BS-E		1	1	1	1	0	1	1	1	1

ΚΕ-μηχανισμός: [GEO] A2 M2 R3

	γ-	G,dst	G,stb	W	Q,dst	Q,stb	phi	coe	cu
		g	a,t	a,p	Gt	N			
BS-P		1	1	1	1.300	0	1.250	1.400	1.400
		1	1	1	1	1			
BS-T		1	1	1	1.300	0	1.250	1.400	1.400
		1	1	1	1	1			
BS-T/A		1	1	1	1.300	0	1.250	1.250	1.400
		1	1	1	1	1			
BS-E		1	1	1	1	0	1.250	1.400	1.400
		1	1	1	1	1			

Θραύση εδάφους: [GEO] A1 M1 R2

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Re					
BS-P		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-T		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-T/A		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-E		1	1	1	1	1	0	1	1
		1	1	1					

Ολίσθηση: [GEO] A1 M1 R2

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Rh					
BS-P		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.100					
BS-T		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.100					
BS-T/A		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.100					
BS-E		1	1	1	1	1	0	1	1
		1	1	1					

Θραύση εδάφους: [GEO] A1 M1 R2

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Rv					
BS-P		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-T		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Rv					
BS-T/A		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-E		1	1	1	1	1	0	1	1
		1	1	1					

Κύκλος ολίσθησης: [GEO] A2 M2 R3

	γ-	G,dst	G,stb	Q,dst	Q,stb	W	phi	coe	cu
		g	Re	a,t	a,p	Gt	N		
BS-P		1	1	1.300	0	1	1.250	1.400	1.400
		1	1	1	1	1	1		
BS-T		1	1	1.300	0	1	1.250	1.400	1.400
		1	1	1	1	1	1		
BS-T/A		1	1	1.300	0	1	1.250	1.250	1.400
		1	1	1	1	1	1		
BS-E		1	1	1	0	1	1.250	1.400	1.400
		1	1	1	1	1	1		

Hydraulic heave: [HYD] A1 M1 R1

	γ-	G,dst	G,stb	Q,dst	H
BS-P		1.350	0.900	1.500	1.800
BS-T		1.350	0.900	1.500	1.600
BS-T/A		1.350	0.900	1.500	1.500
BS-E		1	1	1	1

Failure of structural elements: [STR] A1 M1 R1

	γ-	M	Gtf	cd	N
BS-P		1.150	1.400	1.400	1.150
BS-T		1.150	1.300	1.300	1.150
BS-T/A		1.150	1.250	1.250	1.150
BS-E		1	1	1	1

Stability: [EQU] A1 M1 R1

	γ-	G,dst	G,stb	Q,dst	Q,stb	phi	coe	cu	g
BS-P		1	0.900	1.500	0	1.250	1.250	1.400	1
BS-T		1	0.900	1.500	0	1.250	1.250	1.400	1
BS-T/A		1	0.900	1.500	0	1.250	1.250	1.400	1
BS-E		1	1	1	0	1.250	1.400	1.400	1

γ,Re,red (EAB EB14-3): Ναι, η=0.80
γ,Re,red (EAB EB22-6): Ναι, E0h > 0%: η = 0.60 / 0.80

System values

Τοίχος

Τύπος τοίχου αντιστήριξης: Πασσαλότοιχος οπλισμένου σκυροδέματος
Διατομή: Iy=2711360 cm^4
Υλικό:: C25/30
Ίδιο βάρος: 25.000 [kN/m3]

Σημεία τοίχου

z	d	E	Iy	E*Iy	A
[m]	[m]	[MN/m2]	[cm4/m]	[MNm2]	[cm2/m]
0.00	100.0	31500.0	2711360	854.1	8400
-11.00	100.0	31500.0	2711360	854.1	8400

Φάση εκσκαφής 1 "[1] Situation 5"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 5 Στρώσεις

Name		Τεχνητές επιχωματώσεις	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
γ	[kN/m3]	18	20	22.5
γ,R	[kN/m3]	18	20	22.5
γ'	[kN/m3]	8	10	12.5
γ,p	[kN/m3]	18	20	22.5
γ,R,passive	[kN/m3]	18	20	22.5
γ,pw	[kN/m3]	8	10	12.5
φ	[°]	25	0.1	33
c	[kN/m2]	2	50	5
c,u	[kN/m2]	10	50	5
c παθητικό	[kN/m2]	2	50	5
δ,a	[°]	16.66667	0.06666667	22
δ,p	[°]	-16.66667	-0.06666667	-22
δ,c	[°]	8.333333	0.03333333	11
k,agh	[-]	0.3456501	0.9955057	0.2452023
K,ach	[-]	1.043051	1.994195	0.8549058
K,0h	[-]	0.5773817	0.9982547	0.455361
K,pgh	[-]	3.908103	1.004519	7.495617
K,pch	[-]	5.180327	2.00583	8.599509
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	10e-06	5.5e-09	100e-06

Name		Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20	22.5
γ,R	[kN/m3]	20	22.5
γ'	[kN/m3]	10	12.5
γ,p	[kN/m3]	20	22.5
γ,R,passive	[kN/m3]	20	22.5
γ,pw	[kN/m3]	10	12.5
φ	[°]	0.1	35
c	[kN/m2]	100	5
c,u	[kN/m2]	100	5
c παθητικό	[kN/m2]	100	5
δ,a	[°]	0.06666667	23.33333
δ,p	[°]	-0.06666667	-23.33333
δ,c	[°]	0.03333333	11.66667
k,agh	[-]	0.9955057	0.2244207
K,ach	[-]	1.994195	0.8126539
K,0h	[-]	0.9982547	0.4264236
K,pgh	[-]	1.004519	9.146943
K,pch	[-]	2.00583	10.104
τ,gr	[kN/m2]	110	110
Ψ,A,max	[°]	90	90
k	[cm/s]	5.5e-09	100e-06

Πορεία πρανούς:

x [m]	0.00	0.00
z [m]	-6.85	0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:

x [m]	0.00	0.00
z [m]	-6.85	-1.50

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:
x [m] 0.00 0.00
z [m] -6.85 -4.50

Πορεία ανώτερου 4. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
z= -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -14.00

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
2.00	0.00	8.50	0.00	0.00	20.00	0.00	20.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Στάθμη νερού:

x [m] 0.00 0.00
z [m] -11.00 -3.00

Αγκύρια

z[m]	min.l[m]	Alpha[°]	C-H[kN/m]	P0[kN]	u0[m]
-0.50	0.00	15.00	0.00	0.00	0.0000
-3.00	0.00	15.00	αόρισ.	0.00	0.0000

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Mononobe/Okabe (earth quake EC 8).
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: Trapezoid.
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
Levels of redistribution Z1: 0.000, Z2: -3.000 [m].
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Mononobe/Okabe (earth quake EC 8).

Options for water pressure

Στήριξη πόδα

Πόδας οριζοντίως μετακινούμενος

Earthquake

kh,eq = α*S*r = 0.028 (r=1.0)

Αγκύρια

Anchor checks (lower failure plane): Ναι
Anchor forces with safety level of DS-P: Ναι
Verification of grout body pull out forces: Ναι
δ,a,Anchoring wall : used from soil layer.
δ,p,Anchoring wall : used from soil layer.

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	Αμμώδης ΑΡΓΙΛΟΣ
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

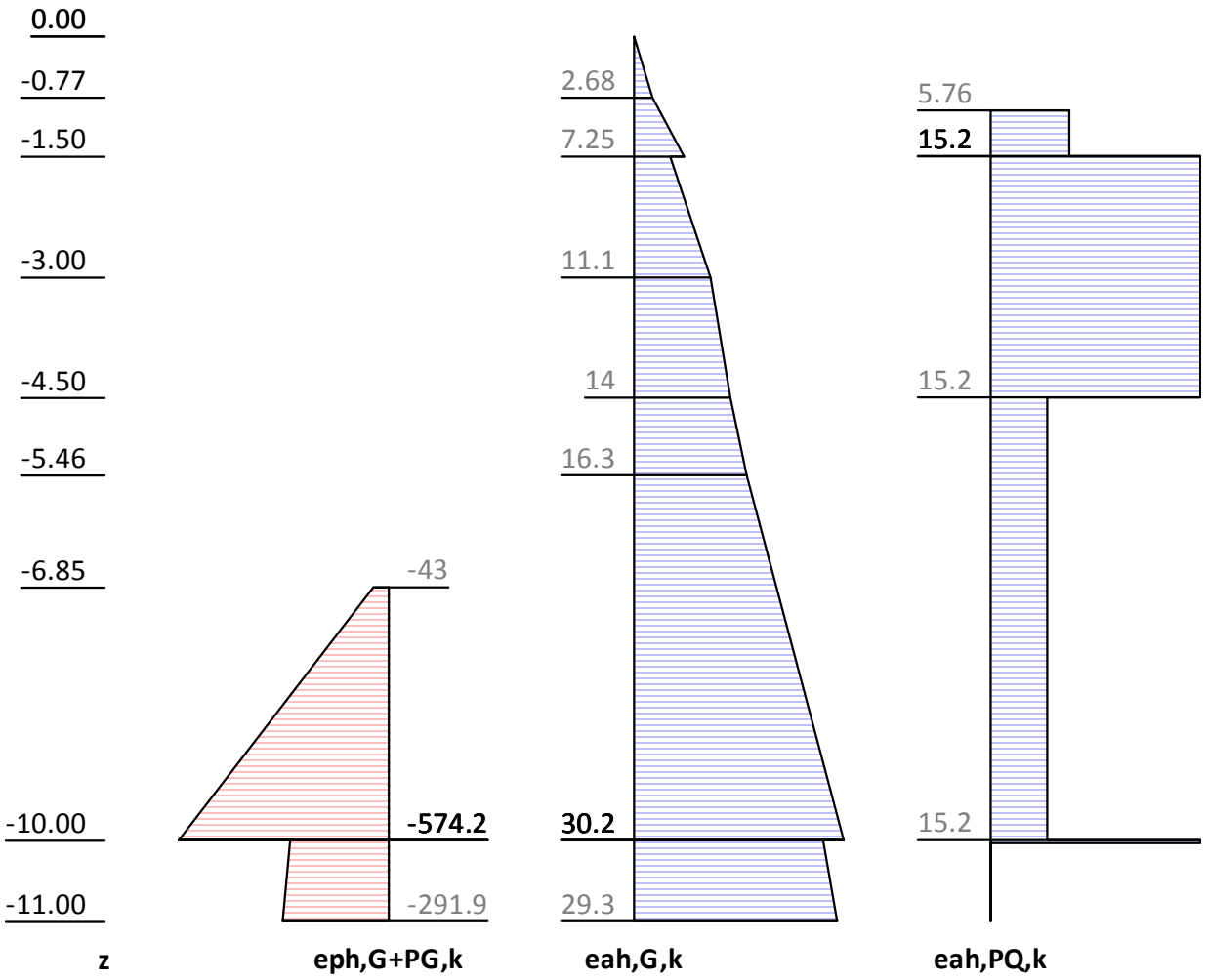
Μήκος τοίχου

Foot depth for statics: zf = -11.000

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall



z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.93		3.68	0.00	5.00
-0.93		3.68	5.76	13.64
-1.50		7.25	5.76	18.43
-1.50		5.25	15.23	29.93
-4.50		13.99	15.23	41.74
-4.50		13.99	4.15	25.11
-6.85	-0.00	20.58	4.15	34.01
-6.85	-43.00	20.58	4.15	34.01
-10.00	-574.25	30.24	4.15	47.05
-10.00	-271.78	27.35	15.23	59.77
-10.03	-272.38	27.41	15.23	59.85
-10.03	-272.38	27.41	0.00	37.00
-11.00	-291.87	29.29	0.00	39.54

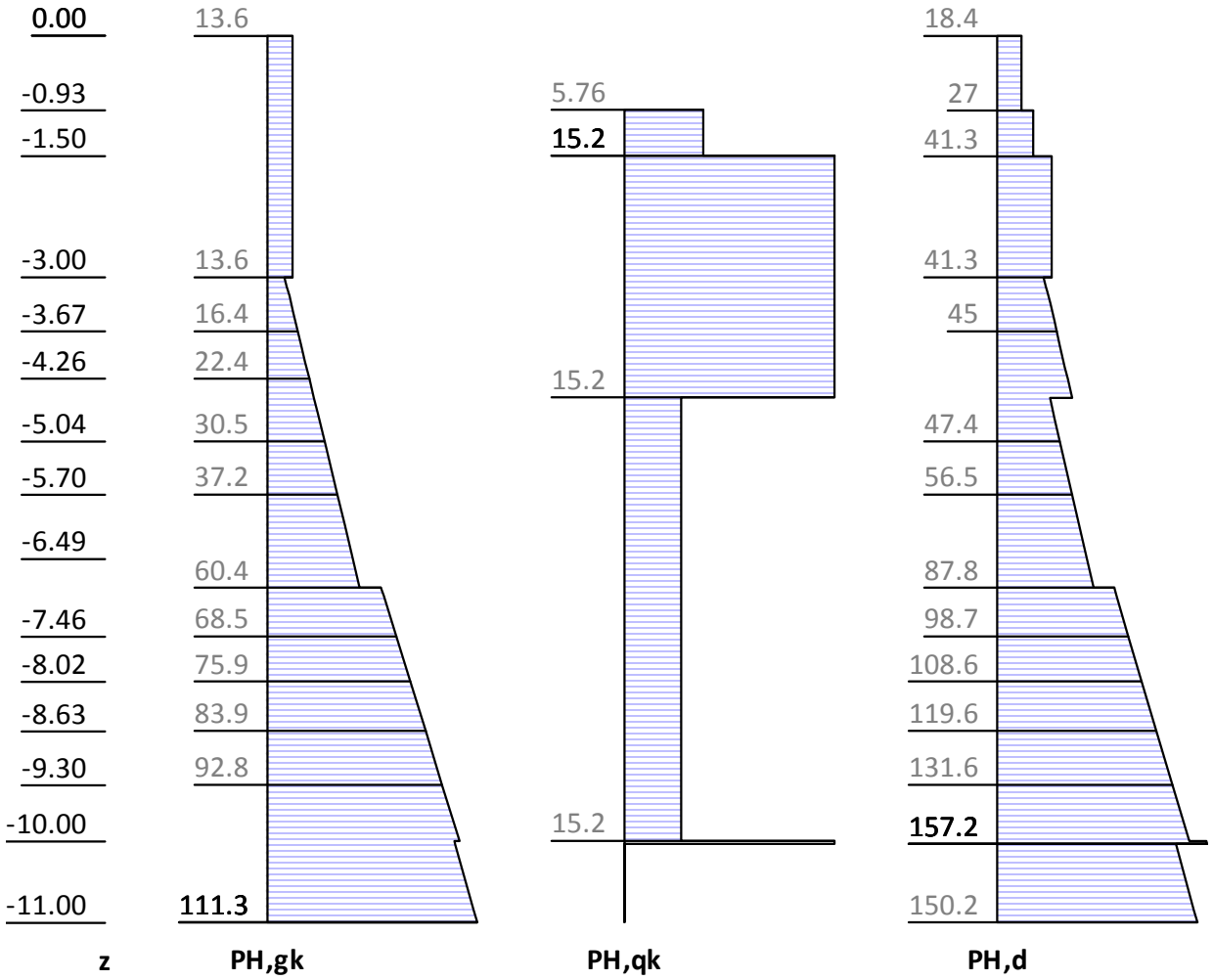
Eph,G,k:-1253.99, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 184.27, Eah,PG,k: 0.00, Eah,PQ,k: 72.27, Eah,d: 357.17

Πίεση νερού

z [m]	Wa,st,k [kN/m2]	Wa,EQ,k [kN/m2]	W,tot,k [kN/m2]
-3.00	0.00	0.00	0.00
-11.00	80.00	1.96	81.96

H-pressure on static system

Level of mobilization: Ep,gk 100.0, Ep,qk 100.0, Ep,d 100.0 [%]

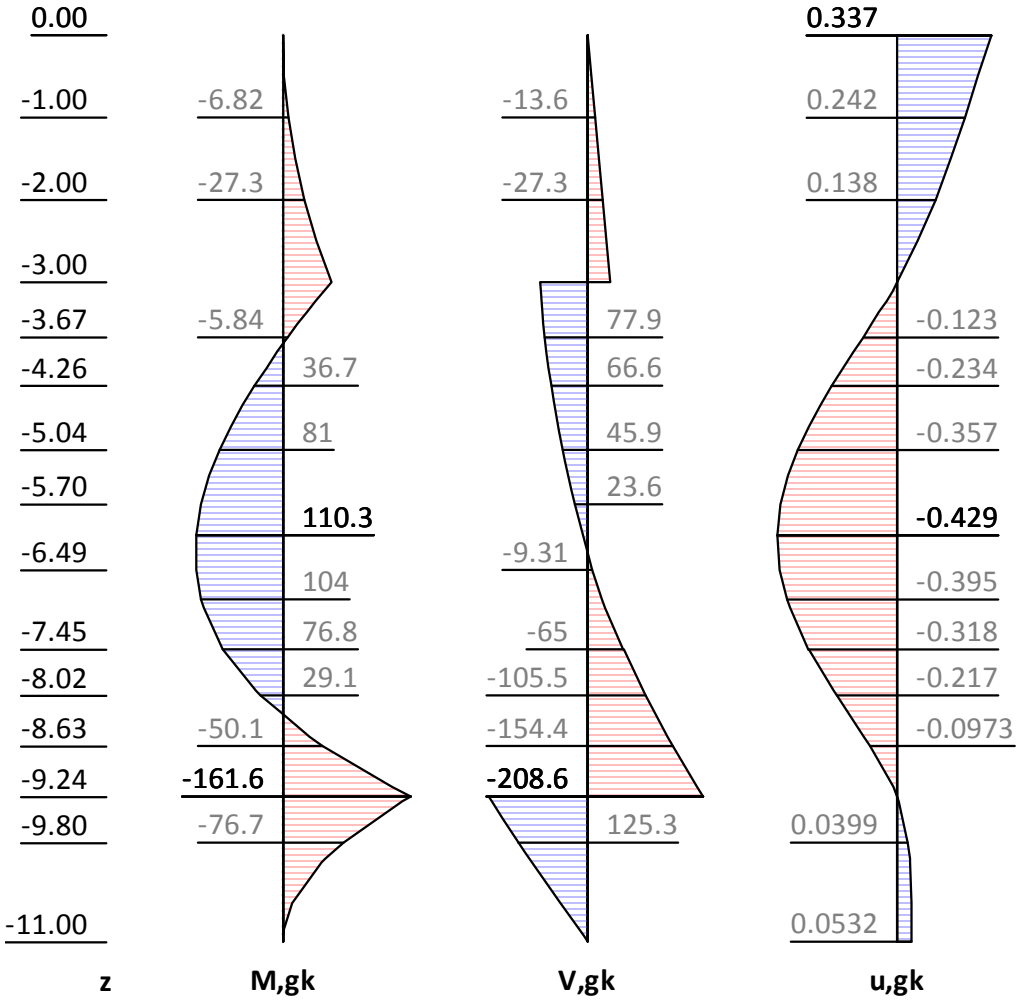


z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	13.63		18.40
-0.93	13.63	0.00	18.40
-0.93	13.63	5.76	27.05
-1.50	13.63	5.76	27.05
-1.50	13.63	15.23	41.25
-3.00	13.63	15.23	41.25
-3.00	9.09	15.23	35.13
-4.50	24.98	15.23	56.52
-4.50	24.98	4.15	39.90
-6.85	48.95	4.15	72.31
-6.85	60.44	4.15	87.82
-10.00	102.07	4.15	144.02
-10.00	99.18	15.23	156.75
-10.03	99.55	15.23	157.23
-10.03	99.55	0.00	134.38
-11.00	111.25	0.00	150.19

V-pressure on static system

Internal forces: Permanent, characteristically

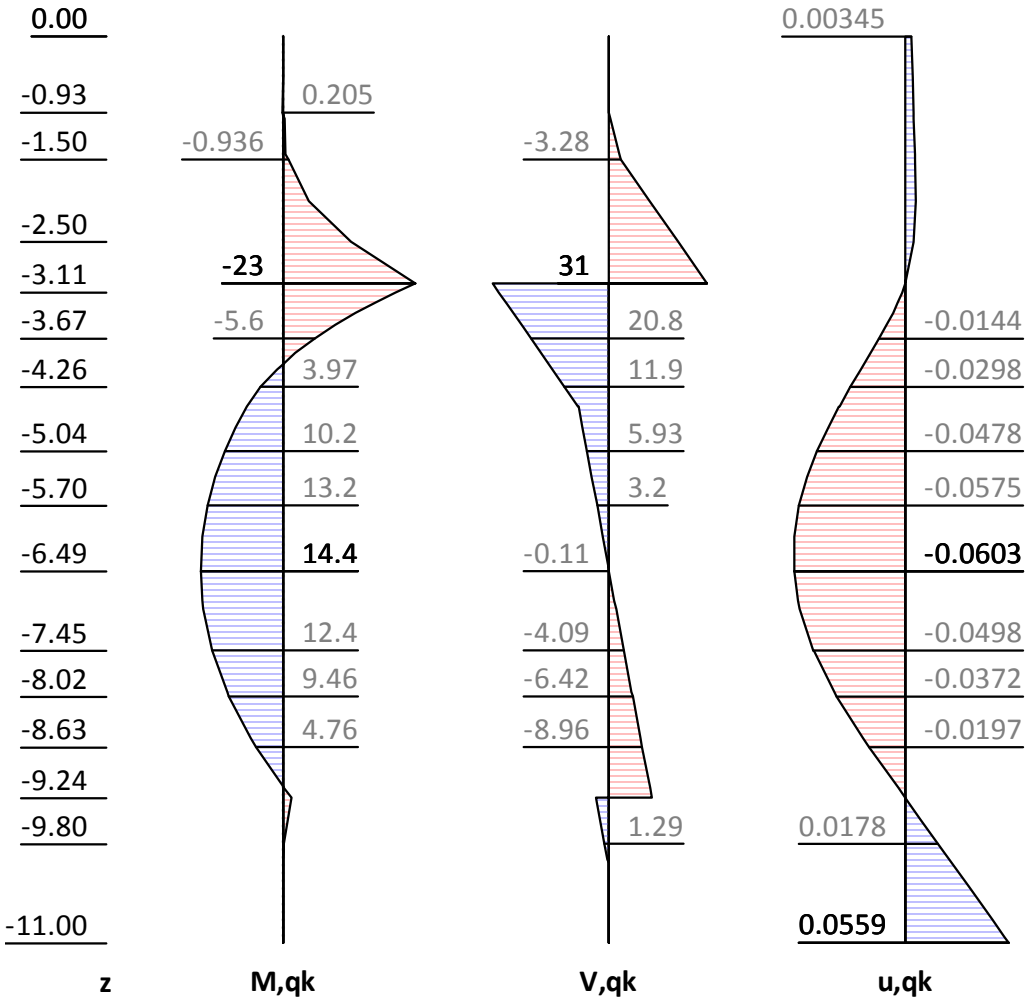
```
z=  -0.500. Fx=  -0.000 kN/m Support
z=  -3.000. Fx=-127.457 kN/m Support
z=  -9.243. Fx=-387.259 kN/m Support
```



z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	13.63	-0.00	0.00	0.00	0.34
-0.00	13.63	-0.00	0.00	-0.00	0.34
-3.00	13.63	-61.35	-40.90	-72.53	-0.00
-3.00	9.09	-61.35	86.56	-106.68	-0.00
-3.75	17.17	-0.00	76.63	-123.97	-0.14
-6.08	41.08	110.34	8.74	-177.82	-0.43
-6.28	43.14	110.31	0.00	-182.50	-0.42
-6.85	48.95	104.04	-26.05	-195.68	-0.39
-6.85	60.44	104.04	-26.05	-195.68	-0.39
-8.25	78.95	-0.00	-123.93	-229.19	-0.17
-9.24	92.04	-161.56	-208.55	-252.28	0.00
-9.24	92.04	-161.56	178.70	-252.28	0.00
-10.00	102.07	-53.61	105.22	-270.71	0.05
-10.00	99.18	-53.61	105.22	-270.71	0.05
-11.00	111.25	0.00	0.00	-283.35	0.05

Internal forces: Variable, characteristically

Method EB 82-4 (Q = [G+Q] - G).
z= -0.500. Fx= 0.000 kN/m Support
z= -3.000. Fx= -57.154 kN/m Support
z= -9.243. Fx= -15.113 kN/m Support

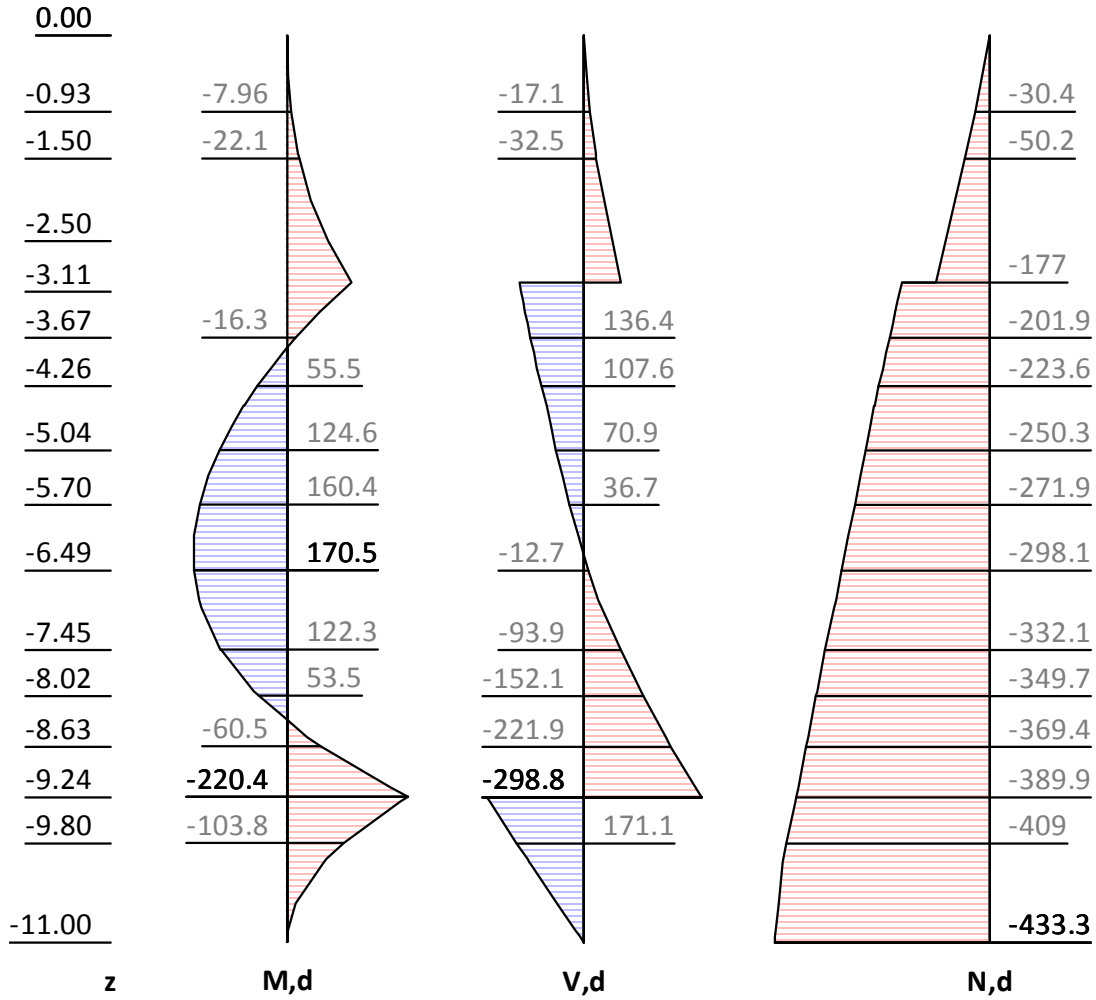


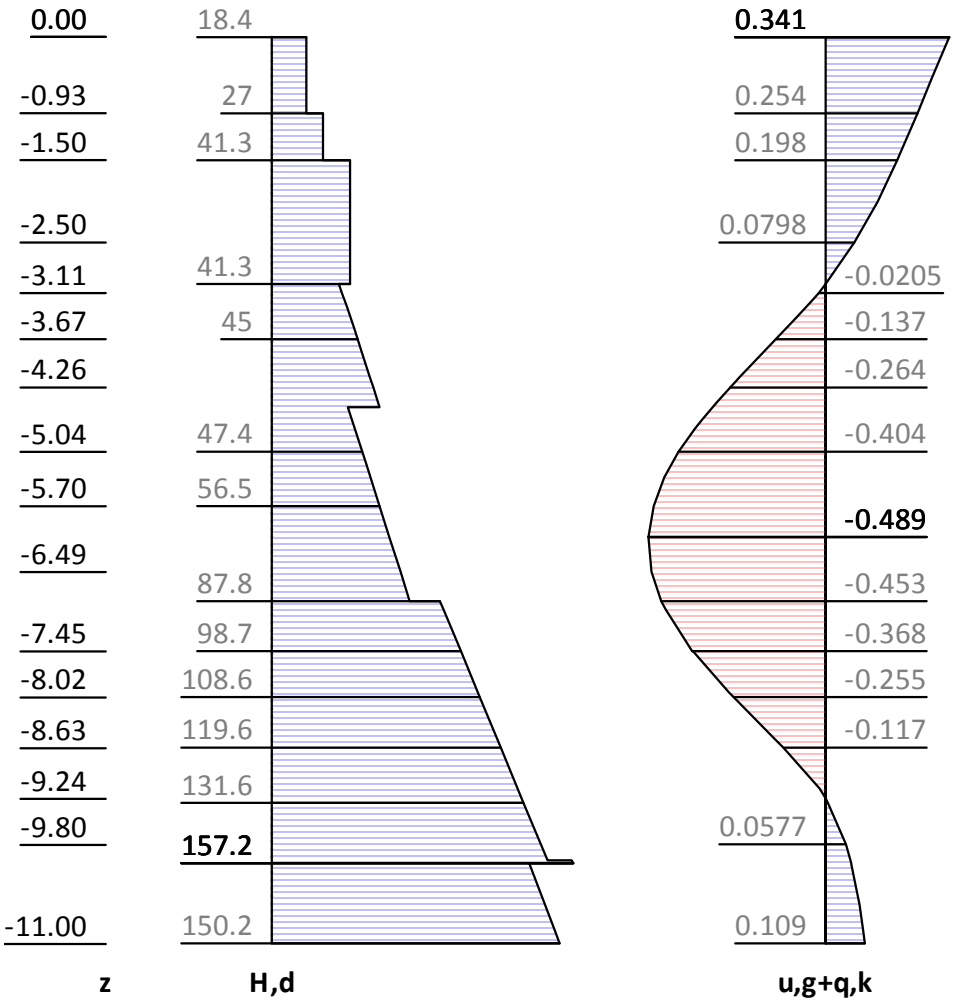
z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00	-0.00	0.00	0.00
-0.50		0.00	-0.00	-0.00	0.00
-0.93	0.00	0.21	-0.00	-0.00	0.00
-0.93	5.76	0.21	0.00	-0.00	0.00
-0.96	5.76	0.00	-0.16	-0.04	0.00
-1.43	5.76	-0.52	-2.88	-0.74	0.01
-1.50	5.76	-0.94	-3.28	-0.84	0.01
-1.50	15.23	-0.94	-3.28	-0.84	0.01
-2.00	15.23	-4.50	-10.90	-2.79	0.01
-3.00	15.23	-23.00	-26.13	-6.69	0.00
-3.00	15.23	-23.00	-26.13	-6.69	-0.00
-3.00	15.23	-23.00	31.02	-22.01	-0.00
-3.98	15.23	-0.00	16.11	-25.83	-0.02
-4.50	15.23	6.41	8.18	-27.86	-0.04
-4.50	4.15	6.41	8.18	-27.86	-0.04
-6.46	4.15	14.41	0.00	-29.95	-0.06

z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
-6.49	4.15	14.43	-0.11	-29.98	-0.06
-9.11	4.15	-0.00	-10.94	-32.75	-0.00
-9.24	4.15	-1.54	-11.51	-32.90	0.00
-9.24	4.15	-1.54	3.60	-32.90	0.00
-10.00	4.15	-0.01	0.46	-33.70	0.02
-10.00	15.23	-0.01	0.46	-33.70	0.02
-10.01	15.23	0.00	0.32	-33.74	0.02
-10.03	15.23	0.02	0.00	-33.82	0.03
-10.03	0.00	0.02	0.00	-33.82	0.03
-10.04	0.00	0.00	-0.00	-33.82	0.03
-10.54	0.00	0.00	-0.00	-33.82	0.04
-10.93	0.00	0.00	-0.00	-33.82	0.05
-11.00	0.00	0.00	0.00	-33.82	0.06

Internal forces: Design

z= -0.500. Fx= -0.000 kN/m Support
z= -3.000. Fx=-257.799 kN/m Support
z= -9.243. Fx=-545.469 kN/m Support





z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	18.40	0.00	0.00	0.00	0.34
-0.00	18.40	-0.00	-0.00	-0.00	0.34
-0.93	18.40	-7.96	-17.12	-30.35	0.25
-0.93	27.05	-7.96	-17.12	-30.35	0.25
-1.50	27.05	-22.11	-32.53	-50.22	0.20
-1.50	41.25	-22.11	-32.53	-50.22	0.20
-3.00	41.25	-117.32	-94.42	-107.95	0.00
-3.00	41.25	-117.32	-94.42	-107.95	-0.00
-3.00	35.13	-117.32	163.38	-177.03	-0.00
-3.80	46.69	0.00	130.73	-206.48	-0.16
-4.50	56.52	79.96	94.37	-232.62	-0.31
-4.50	39.90	79.96	94.37	-232.62	-0.31
-6.08	61.68	170.13	14.24	-284.36	-0.49
-6.30	64.72	170.34	-0.00	-291.59	-0.48
-6.49	67.43	170.52	-12.73	-298.06	-0.48
-6.85	72.31	161.65	-37.54	-309.71	-0.45
-6.85	87.82	161.65	-37.54	-309.71	-0.45
-8.32	113.96	0.00	-185.68	-359.24	-0.19
-9.24	130.48	-220.42	-298.82	-389.93	0.00
-9.24	130.48	-220.42	246.65	-389.93	0.00
-10.00	144.02	-72.39	142.73	-416.02	0.07

z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
-10.00	156.75	-72.39	142.73	-416.02	0.07
-10.03	157.23	-68.18	138.02	-416.71	0.07
-10.03	134.38	-68.18	138.02	-416.71	0.07
-11.00	150.19	0.00	0.00	-433.25	0.11

Anchor forces with safety level of DS-P

z[m]	A,d[kN]	Fx,d[kN/m]
-0.50	0.0	-0.0
-3.00	480.4	-257.8

Checks of earth statics

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -9.24 m
Rd = Eph,k/γ,Re = 1253.99 / 1.400 = 895.71 [kN/m]
Ed(Uh,d)/Rd = 545.47 / 895.71 = 0.609 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-11.00

Pos.	H	V
H/V pressure G+P+W,k	514.72	50.05
Wall weight		197.41
H/V pressure passive		0.00
Support z: -0.50		0.00
Support z: -3.00	-127.46	34.15
Bh,g,k z=-9.24	-387.26	
Bv,g,k = Bh,k * tan(δ,p=-22.00°)		-156.46
Σ	-0.00	125.15
		(downwards)

Average anchor inclination α,A = 15.00° >= 15°.
Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1

Vertical component of earth resistance is less than
the downwards pointing vertical forces.
Vk >= Bvk: 281.61 >= 156.46 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-11.00

Pos.	H	V
H/V pressure G+P+W,k	586.98	68.55
Wall weight		197.41
H/V pressure passive		0.00
Support z: -0.50		0.00
Support z: -3.00	-184.61	49.47
Bh,g,k z=-9.24	-387.26	
Bv,g,k = Bh,k * tan(δ,p=-22.00°)		-156.46
Bh,q,k z=-9.24	-15.11	
Bv,q,k = Bh,k * tan(δ,p=-22.00°)		-6.11
Σ	0.00	152.86

Pos.	H	V (downwards)

Average anchor inclination α,A = 15.00° >= 15°.
Verification of vertical forces due to EAB R 9 not required (R 9-5).
Check EAB R 9-1
Vertical component of earth resistance is less than
the downwards pointing vertical forces.
Vk >= Bvk: 315.43 >= 162.57 Passes requirement

Anchor verification

Anchor - Stability of lower failure plane

Περίπτ.Φόρτισης: όλα τα φορτία BS-P
Αυτόμ. υπολογ. μήκους αγκυρίων:
All anchors are extended (if necessary)
Favourable variable loads in main failure body are not being considered.
Bottom of lower failure plane: z=-11.00 m

Iteration of failure mechanisms:
lA .....: Length of anchor from head to center of grout body.
W,k .....: Res. force from dead weight, loads, cohesion, ...
Q,k .....: Force in lower failure plane.
Ea1,k.....: Earth pressure onto vertical separation plane.
Ea2,k.....: Earth pressure between wall and main failure body.
Ra_cal,d ...: Dimesioning force of the resistance from the equilibrium of forces. Ra_cal,d corresponds to the max. possible anchor force of the force polygon.
Sum(A,d) ...: Acting anchor forces along the grout body fractions within the failure body. Sum(A,d) is gained from the anchor pull forces of the wall analysis.

z [m]	ϑ1 [°]	ϑ2 [°]	lA [m]	W,k [kN/m]	Q,k [kN/m]	Ea1,k [kN/m]	Ea2,k [kN/m]	Ra_cal,d [kN/m]	Sum(A,d) [kN/m]	Ed/Rd [-]
-0.50	36.8	56.5	10.70	1063.1	921.3	4.9	265.5	199.8	198.9	1.00
-3.00	30.1	59.6	9.78	1158.7	982.1	24.6	265.5	267.2	266.7	1.00

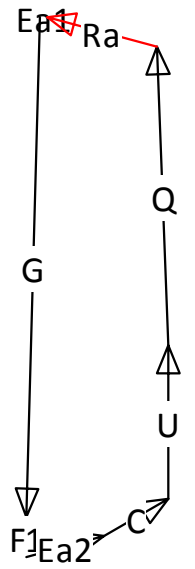
Decisive failure body:
Γεωμετρία:

Foot point of lower failure plane	x/z =	0.01/-11.00 m
Intersection lower/upper slid. plane	x/z =	9.45/ -5.53 m
Intersection upper slid. plane/surface	x/z =	12.69/ 0.00 m
Intersection separation plane/surface	x/z =	9.45/ 0.00 m
Inclination lower failure plane	ϑ1 =	30.09°
Inclination upper failure plane	ϑ2 =	59.60°
Inclination separation plane	ϑ12 =	90.00°

Loads / forces (char.)

		Fx [kN/m]	Fz [kN/m]	F [kN/m]	
Weight of main failure body	G,k:	-45.3	-1641.2	1641.8	
Area loads on/in main failure body	F1,k:	0.0	-131.8	131.8	
Cohesion of lower failure plane	C,k:	211.1	122.3	244.0	
Pore water pressure on main body	U,k:	0.0	503.9	503.9	
Earth pres. on separation plane	Ea1,k:	-24.6	-0.0	24.6	δ= 0.0°
Earth pr. between wall<->main body	Ea2,k:	256.5	68.6	265.5	
Force in lower failure plane	Q,k:	-36.4	981.4	982.1	
Sum = possible anchor forces:	Ra_cal,k:	361.3	-96.8	374.1	

Force polygon



Acting anchor forces Ed: Sum(A,d) = 266.7 kN/m
Possible anchor forces Rd: Ra_cal,d = 374.1/1.400 = 267.2 kN/m
Verif. of lower failure plane Ed/Rd = 1.00 < 1.0: Έλεγχος εκπληρώθηκε.

Check of steel tension

l,tot ...[m]: Total length of anchor incl. excess length at head
As ....[mm2]: X-section are of steel member
Ri,d ...[kN]: Ultimate strength of tension member (γ,M=1.15)
A,d ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	l,tot	As	Ri,d		A,d	
-0.50	Strand;3x0.60";1570/1770	15.31	420	573.4	>	0.0	Passes requirement
-3.00	Strand;3x0.60";1570/1770	13.78	420	573.4	>	480.4	Passes requirement

Check of steel tension: Passes requirement

Check of anchor's soil friction

lVk .....: Length of grout body
DmVk ....: Diameter of grout body
τGr,k ...: Average applied skin friction along the grout body (from soil parameters)
Ra,k ....: Charact. pullout resistance of the anchor
γA ......: Partial safety factor of anchor pullout
Ra,d ....: = Ra,k / γA
A,d .....: Dimensioning force of the anchor from wall analysis

z [m]	lVk [m]	DmVk [mm]	τGr,k [kN/m²]	Ra,k [kN]	γA [-]	Ra,d [kN]		A,d [kN]	A,d/Ra,d [-]
-0.50	8.00	318	110	879.1	1.100	799.2	>	0.0	0.0
-3.00	8.00	318	110	879.1	1.100	799.2	>	480.4	0.6

Check of anchor's soil friction: Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)

Συντελ.Σεισμού: Οριζόντιος: 0.028
Κατακόρυφος : 0.014

Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (-0.14, 0.03), Ακτίνα = 11.04
Αρχ.σημ.= (-8.78, -6.85), Τελ.σημ. = (10.89, 0.00)

Γεωμετρία λωρίδων:

No	x	Width b	dxM	Weight	Load z-κατ.	Water-φορτ.	u*b	φ	c	θ
	[m]	[m]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[°]	[kN/m²]	[°]
1	-8.23	1.10	-8.08	16.1	0.0	0.0	-0.0	27.45	3.57	-31.27*
2	-7.12	1.10	-6.98	42.2	0.0	0.0	-0.0	27.45	3.57	-31.27*
3	-6.02	1.10	-5.87	62.1	0.0	0.0	-0.0	27.45	3.57	-31.27*
4	-4.91	1.10	-4.77	77.5	0.0	0.0	-0.0	27.45	3.57	-25.61
5	-3.81	1.10	-3.67	87.9	0.0	0.0	-0.0	0.08	71.43	-19.40
6	-2.71	1.10	-2.56	95.2	0.0	0.0	-0.0	0.08	71.43	-13.43
7	-1.60	1.10	-1.46	99.8	0.0	0.0	-0.0	0.08	71.43	-7.60
8	-0.50	1.10	-0.36	109.4	0.0	0.0	-44.8	0.08	71.43	-1.85
9	0.60	1.10	0.75	257.9	0.0	0.0	-89.2	0.08	71.43	3.89
10	1.71	1.10	1.85	255.0	6.9	0.0	-87.7	0.08	71.43	9.66
11	2.81	1.10	2.96	249.5	29.1	0.0	-85.0	0.08	71.43	15.53
12	3.92	1.10	4.06	241.2	29.1	0.0	-80.8	0.08	71.43	21.58
13	5.02	1.10	5.16	229.0	29.1	0.0	-75.1	27.45	3.57	27.89
14	6.12	1.10	6.27	212.2	29.1	0.0	-67.5	27.45	3.57	34.60
15	7.23	1.10	7.37	190.3	29.1	0.0	-57.7	27.45	3.57	41.90
16	8.33	1.10	8.47	161.5	19.0	0.0	-44.7	27.45	3.57	50.16
17	9.44	1.10	9.58	121.5	0.0	0.0	-26.2	27.45	3.57	60.20
18	10.44	0.91	10.58	54.4	0.0	0.0	-6.2	0.08	35.71	73.52

*** Σημείωση: Στις λωρίδες σημειωμένες με '*'
περιορίστηκε το theta στο 45°-Phi/2.

Συνεισφ. κατακόρυφων φορτίων:

No	Weight	G*sin(θ)	(G-u*b)*tan(φ) + c*b	μ*sin(θ)* tan(φ)+cos(θ)	T
	[kN/m]	[kN/m]	[kN/m]	[-]	[kN/m]
1	16.14	-11.82	12.33	0.704289	17.50
2	42.19	-26.67	25.86	0.704289	36.72
3	62.15	-33.08	36.23	0.704289	51.44
4	77.48	-33.49	44.19	0.776549	56.91
5	87.92	-29.21	78.96	0.942949	83.74
6	95.20	-22.11	78.97	0.972486	81.21
7	99.78	-13.19	78.98	0.991120	79.69
8	109.35	-3.52	78.93	0.999456	78.97
9	257.93	17.49	79.08	0.997752	79.25
10	261.87	43.94	79.08	0.985952	80.21
11	278.58	74.60	79.11	0.963684	82.09

No	Weight [kN/m]	G*sin(θ) [kN/m]	(G-u*b)*tan(φ) + c*b [kN/m]	μ*sin(θ)* tan(φ)+cos(θ) [-]	T [kN/m]
12	270.28	99.41	79.10	0.930193	85.04
13	258.14	120.76	99.05	1.019375	97.16
14	241.28	137.00	94.21	0.987682	95.38
15	219.37	146.50	87.93	0.937831	93.76
16	180.46	138.56	74.48	0.863155	86.29
17	121.50	105.44	53.45	0.748355	71.43
18	54.38	52.14	32.47	0.284503	114.13
		762.75			1370.94

Συνεισφ. οριζόντιων φορτίων:

Αρ	Γραμ.Φορ*dzM [kN/m]	[m]	Επιφ.Φορ.*dzM [kN/m]	[m]	Πίεση νερού*dzM [kN/m]	[m]	οριζ.Σεισμός.*dzM [kN/m]	[m]
1	-		-		-		0.4 *	7.20
2	-		-		-		1.2 *	7.71
3	-		-		-		1.7 *	8.11
4	-		-		-		2.1 *	8.42
5	-		-		-		2.4 *	8.62
6	-		-		-		2.6 *	8.77
7	-		-		-		2.8 *	8.87
8	-		-		-		3.0 *	8.81
9	-		-		-		7.1 *	5.69
10	-		-		-		7.0 *	5.63
11	-		-		-		6.9 *	5.51
12	-		-		-		6.7 *	5.34
13	-		-		-		6.3 *	5.10
14	-		-		-		5.9 *	4.75
15	-		-		-		5.3 *	4.30
16	-		-		-		4.5 *	3.71
17	-		-		-		3.4 *	2.86
18	-		-		-		1.5 *	1.62

*** Προσοχή: Στήλη 'οριζ. σεισμ.' είναι επιρροή στο οριζόντιο
συντελ.σεισμού πάνω στο I.B.
Αθρ. Ροπών από 'Συνεισφορά οριζόντιων φορτίων:': 404.0 kN*m/m
Συνεισφ. αγκυρίων: Αθρ. ροπών ανατροπής : -279.2 kN*m/m
" " resisting : 190.7 kN*m/m

Δράση Ed = (762.7*11.04+404.0-279.2)
Αντίσταση Rd = (1370.9*11.04+190.7)
SLIP-CIRCLE μ = Ed/Rd = 0.56 < 1.0: Έλεγχος εκπληρώθηκε.

ΠΑΡΑΡΤΗΜΑ

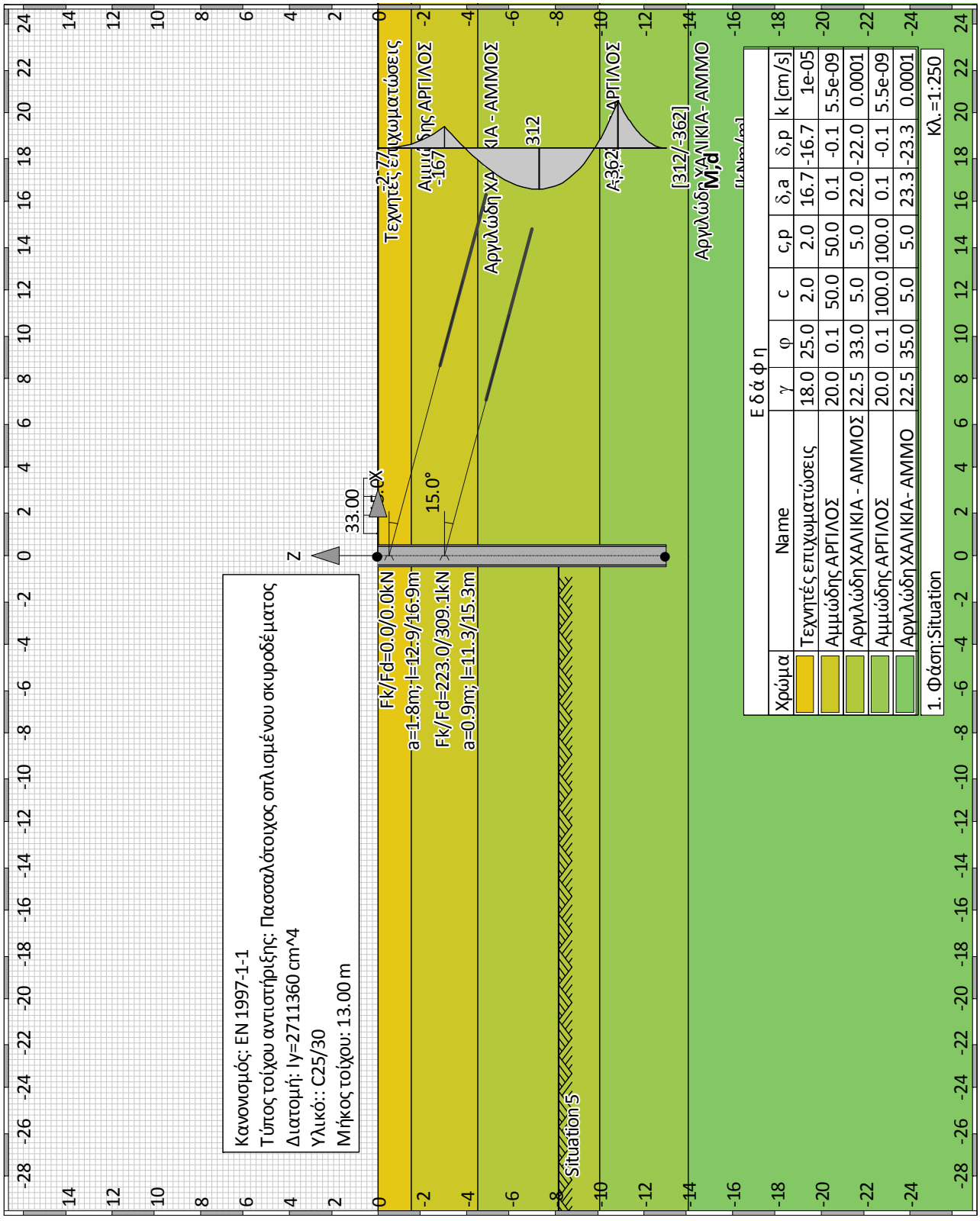
8.5 *Αποτελέσματα ανάλυσης*

8.5.2 *Σεισμικές Συνθήκες*

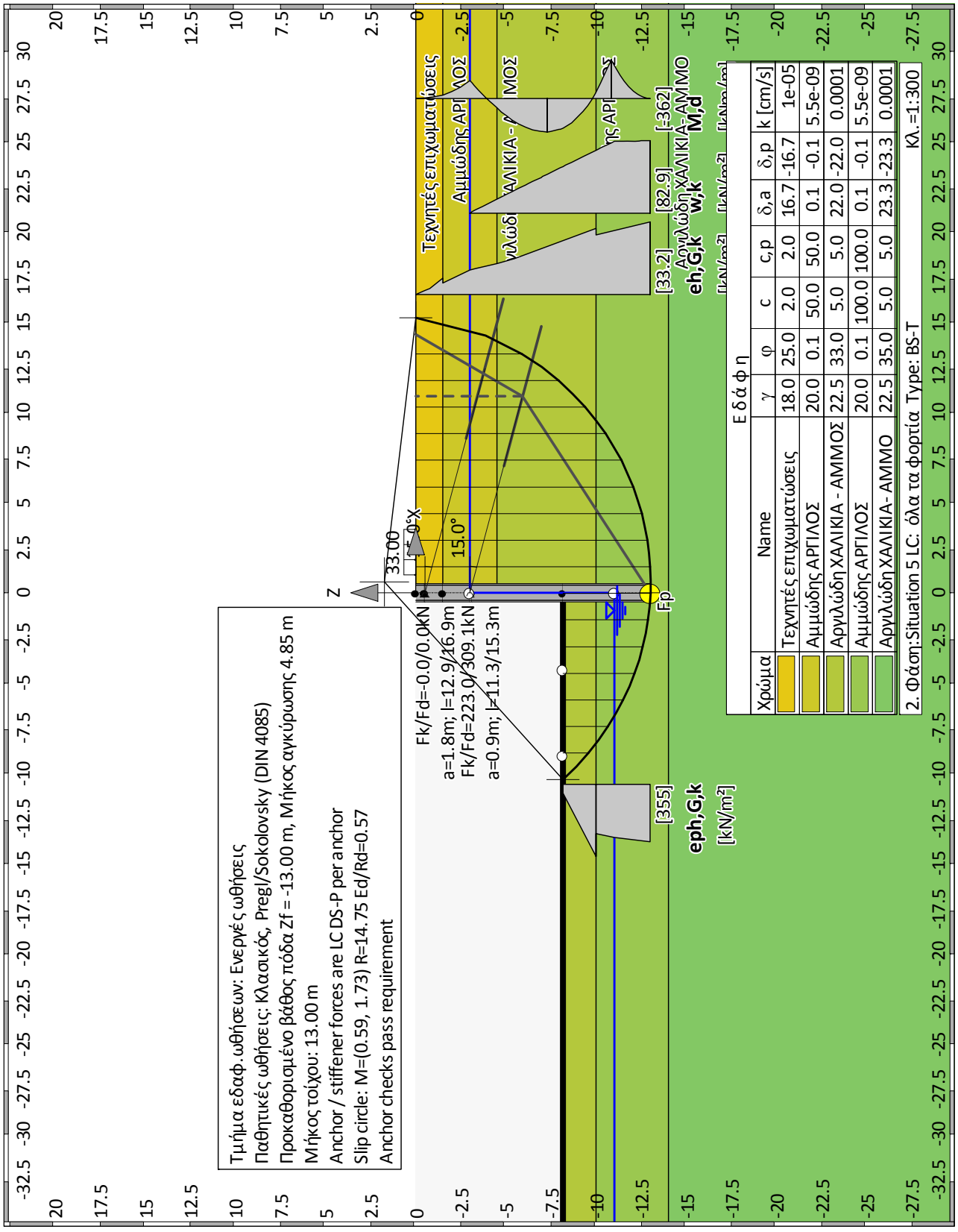
ii) Αντιστηριζόμενο ύψος 7,65m

Summary of all stages

Φάση εκσκαφής 0 "Situation"



Φάση εκσκαφής 1 "Situation 5"



Κανονισμόςγια Ανάλυση και Διαστασιολόγηση

Διαστασ. ωπλισμ.σκυροδ.: EN 1992-1-1
Γεωτεχν.Κανονισμός : EN 1997 (rev.12)_user
National Annex: EN 1997-1

Safety factors:

Earth pressure onto wall: [GEO] A1 M1 R2

	γ-	G,dst	E0G	G,stb	Q,dst	Q,stb	phi	coe	cu	g
BS-P		1.350	1.350	1	1.500	0	1	1	1	1
BS-T		1.350	1.350	1	1.500	0	1	1	1	1
BS-T/A		1.350	1.350	1	1.500	0	1	1	1	1
BS-E		1	1	1	1	0	1	1	1	1

ΚΕ-μηχανισμός: [GEO] A2 M2 R3

	γ-	G,dst	G,stb	W	Q,dst	Q,stb	phi	coe	cu
		g	a,t	a,p	Gt	N			
BS-P		1	1	1	1.300	0	1.250	1.400	1.400
		1	1	1	1	1			
BS-T		1	1	1	1.300	0	1.250	1.400	1.400
		1	1	1	1	1			
BS-T/A		1	1	1	1.300	0	1.250	1.250	1.400
		1	1	1	1	1			
BS-E		1	1	1	1	0	1.250	1.400	1.400
		1	1	1	1	1			

Θραύση εδάφους: [GEO] A1 M1 R2

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Re					
BS-P		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-T		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-T/A		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-E		1	1	1	1	1	0	1	1
		1	1	1					

Ολίσθηση: [GEO] A1 M1 R2

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Rh					
BS-P		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.100					
BS-T		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.100					
BS-T/A		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.100					
BS-E		1	1	1	1	1	0	1	1
		1	1	1					

Θραύση εδάφους: [GEO] A1 M1 R2

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Rv					
BS-P		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-T		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Rv					
BS-T/A		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-E		1	1	1	1	1	0	1	1
		1	1	1					

Κύκλος ολίσθησης: [GEO] A2 M2 R3

	γ-	G,dst	G,stb	Q,dst	Q,stb	W	phi	coe	cu
		g	Re	a,t	a,p	Gt	N		
BS-P		1	1	1.300	0	1	1.250	1.400	1.400
		1	1	1	1	1	1		
BS-T		1	1	1.300	0	1	1.250	1.400	1.400
		1	1	1	1	1	1		
BS-T/A		1	1	1.300	0	1	1.250	1.250	1.400
		1	1	1	1	1	1		
BS-E		1	1	1	0	1	1.250	1.400	1.400
		1	1	1	1	1	1		

Hydraulic heave: [HYD] A1 M1 R1

	γ-	G,dst	G,stb	Q,dst	H
BS-P		1.350	0.900	1.500	1.800
BS-T		1.350	0.900	1.500	1.600
BS-T/A		1.350	0.900	1.500	1.500
BS-E		1	1	1	1

Failure of structural elements: [STR] A1 M1 R1

	γ-	M	Gtf	cd	N
BS-P		1.150	1.400	1.400	1.150
BS-T		1.150	1.300	1.300	1.150
BS-T/A		1.150	1.250	1.250	1.150
BS-E		1	1	1	1

Stability: [EQU] A1 M1 R1

	γ-	G,dst	G,stb	Q,dst	Q,stb	phi	coe	cu	g
BS-P		1	0.900	1.500	0	1.250	1.250	1.400	1
BS-T		1	0.900	1.500	0	1.250	1.250	1.400	1
BS-T/A		1	0.900	1.500	0	1.250	1.250	1.400	1
BS-E		1	1	1	0	1.250	1.400	1.400	1

γ,Re,red (EAB EB14-3): Ναι, η=0.80
γ,Re,red (EAB EB22-6): Ναι, E0h > 0%: η = 0.60 / 0.80

System values

Τοίχος

Τύπος τοίχου αντιστήριξης: Πασσαλότοιχος οπλισμένου σκυροδέματος
Διατομή: Iy=2711360 cm^4
Υλικό:: C25/30
Ίδιο βάρος: 25.000 [kN/m3]

Σημεία τοίχου

z	d	E	Iy	E*Iy	A
[m]	[m]	[MN/m2]	[cm4/m]	[MNm2]	[cm2/m]
0.00	100.0	31500.0	2711360	854.1	8400
-13.00	100.0	31500.0	2711360	854.1	8400

Φάση εκσκαφής 1 "[1] Situation 5"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 5 Στρώσεις

Name		Τεχνητές επιχωματώσεις	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
γ	[kN/m3]	18	20	22.5
γ,R	[kN/m3]	18	20	22.5
γ'	[kN/m3]	8	10	12.5
γ,p	[kN/m3]	18	20	22.5
γ,R,passive	[kN/m3]	18	20	22.5
γ,pw	[kN/m3]	8	10	12.5
φ	[°]	25	0.1	33
c	[kN/m2]	2	50	5
c,u	[kN/m2]	10	50	5
c παθητικό	[kN/m2]	2	50	5
δ,a	[°]	16.66667	0.06666667	22
δ,p	[°]	-16.66667	-0.06666667	-22
δ,c	[°]	8.333333	0.03333333	11
k,agh	[-]	0.3456501	0.9955057	0.2452023
K,ach	[-]	1.043051	1.994195	0.8549058
K,0h	[-]	0.5773817	0.9982547	0.455361
K,pgh	[-]	3.908103	1.004519	7.495617
K,pch	[-]	5.180327	2.00583	8.599509
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	10e-06	5.5e-09	100e-06

Name		Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20	22.5
γ,R	[kN/m3]	20	22.5
γ'	[kN/m3]	10	12.5
γ,p	[kN/m3]	20	22.5
γ,R,passive	[kN/m3]	20	22.5
γ,pw	[kN/m3]	10	12.5
φ	[°]	0.1	35
c	[kN/m2]	100	5
c,u	[kN/m2]	100	5
c παθητικό	[kN/m2]	100	5
δ,a	[°]	0.06666667	23.33333
δ,p	[°]	-0.06666667	-23.33333
δ,c	[°]	0.03333333	11.66667
k,agh	[-]	0.9955057	0.2244207
K,ach	[-]	1.994195	0.8126539
K,0h	[-]	0.9982547	0.4264236
K,pgh	[-]	1.004519	9.146943
K,pch	[-]	2.00583	10.104
τ,gr	[kN/m2]	110	110
Ψ,A,max	[°]	90	90
k	[cm/s]	5.5e-09	100e-06

Πορεία πρανούς:

x [m]	0.00	0.00
z [m]	-8.15	0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:

x [m]	0.00	0.00
z [m]	-8.15	-1.50

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:
x [m] 0.00 0.00
z [m] -8.15 -4.50

Πορεία ανώτερου 4. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
z= -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -14.00

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
1.00	0.00	3.50	0.00	0.00	33.00	0.00	33.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Στάθμη νερού:

x [m] 0.00 0.00
z [m] -11.00 -3.00

Αγκύρια

z[m]	min.l[m]	Alpha[°]	C-H[kN/m]	P0[kN]	u0[m]
-0.50	0.00	15.00	0.00	0.00	0.0000
-3.00	0.00	15.00	αόρισ.	0.00	0.0000

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Mononobe/Okabe (earth quake EC 8).
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: Trapezoid.
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
Levels of redistribution Z1: 0.000, Z2: -3.000 [m].
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Mononobe/Okabe (earth quake EC 8).

Options for water pressure

Στήριξη πόδα

Πόδας οριζοντίως μετακινούμενος

Earthquake

kh,eq = α*S*r = 0.028 (r=1.0)

Αγκύρια

Anchor checks (lower failure plane): Ναι
Anchor forces with safety level of DS-P: Ναι
Verification of grout body pull out forces: Ναι
δ,a,Anchoring wall : used from soil layer.
δ,p,Anchoring wall : used from soil layer.

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	Αμμώδης ΑΡΓΙΛΟΣ
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

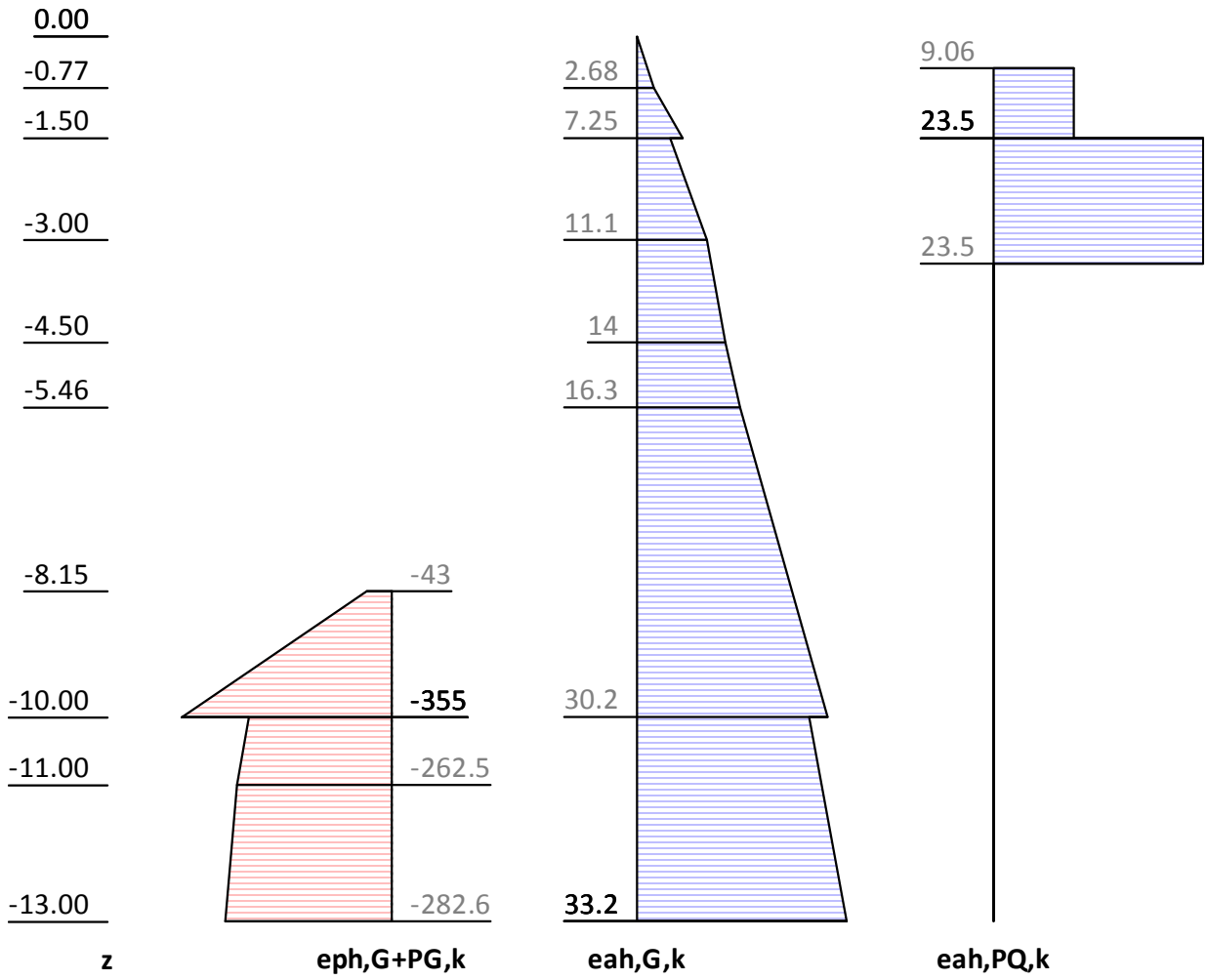
Μήκος τοίχου

Foot depth for statics: zf = -13.000

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall



z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.47		1.63	0.00	2.22
-0.47		1.63	9.06	15.80
-1.50		7.25	9.06	23.37
-1.50		5.25	23.48	42.30
-3.34		11.74	23.48	51.06
-3.34		11.74	0.00	15.84
-8.15	-0.00	24.57	0.00	33.16
-8.15	-43.00	24.57	0.00	33.16
-10.00	-355.00	30.24	0.00	40.82
-10.00	-242.40	27.35	0.00	36.92
-13.00	-282.58	33.18	0.00	44.79

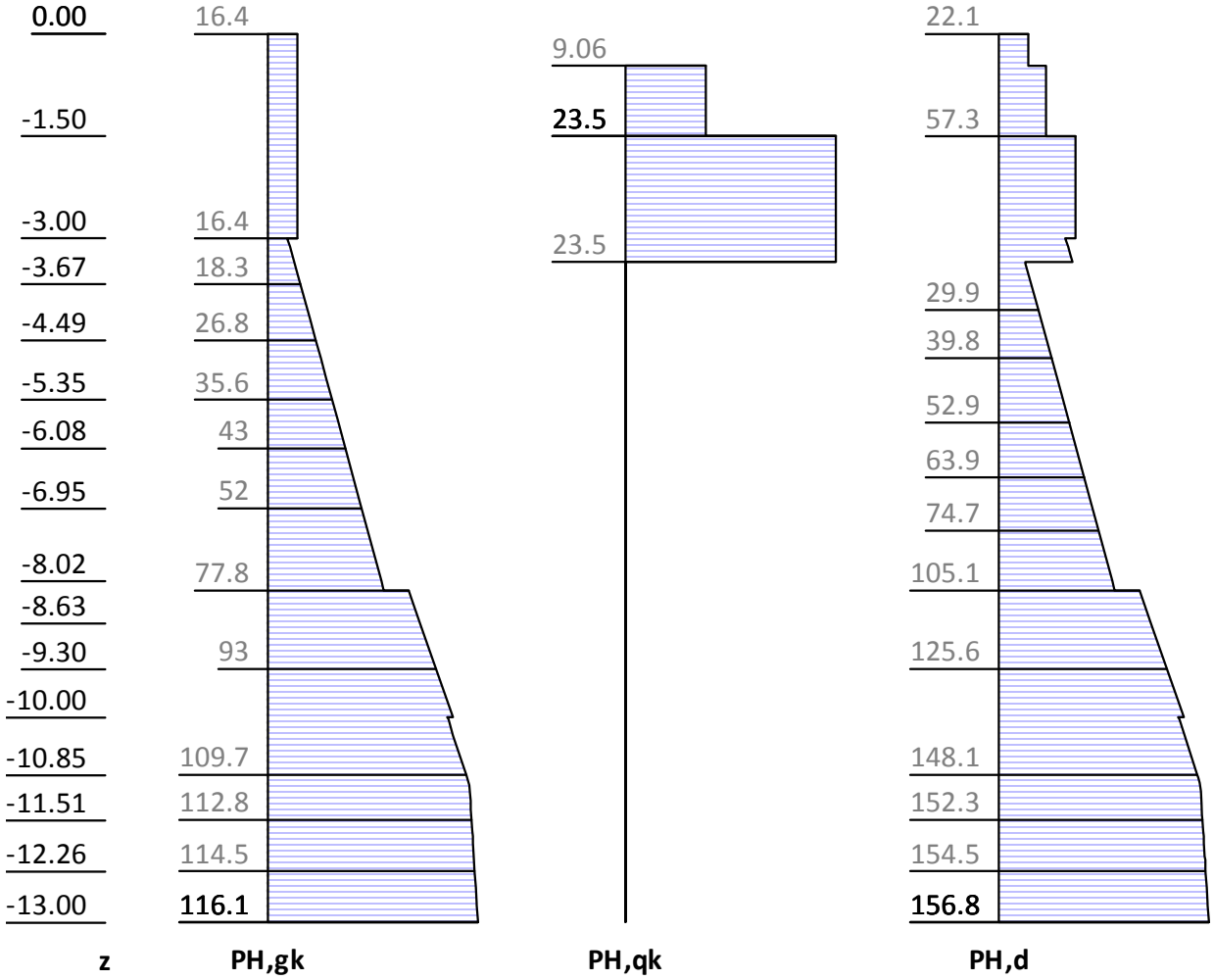
Eph,G,k:-1165.65, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 246.74, Eah,PG,k: 0.00, Eah,PQ,k: 52.53, Eah,d: 411.90

Πίεση νερού

z [m]	Wp,st,k [kN/m2]	Wa,st,k [kN/m2]	Wp,EQ,k [kN/m2]	Wa,EQ,k [kN/m2]	W,tot,k [kN/m2]
-3.00		0.00		0.00	0.00
-11.00	0.00	80.00	0.00	2.19	82.19
-13.00	-20.00	100.00	0.49	2.45	82.94

H-pressure on static system

Level of mobilization: Ep,gk 100.0, Ep,qk 100.0, Ep,d 100.0 [%]

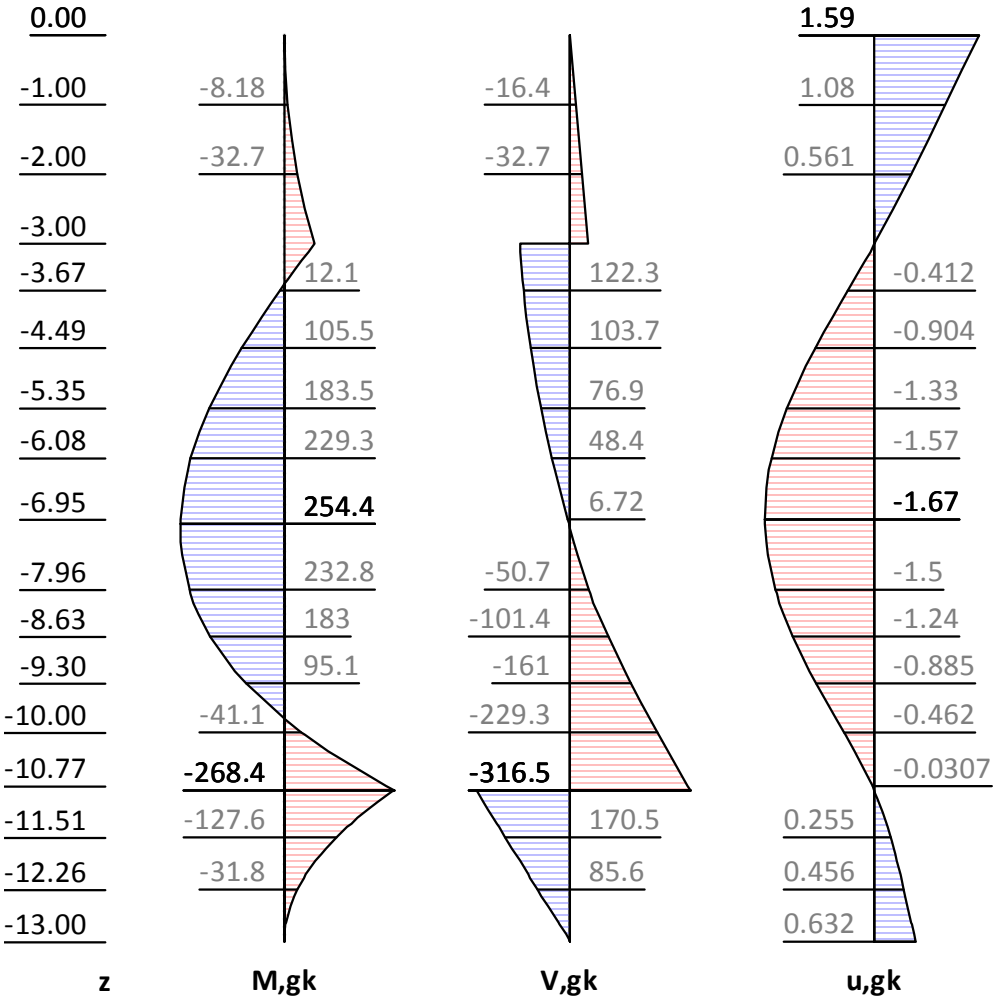


z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	16.36		22.08
-0.47	16.36	0.00	22.08
-0.47	16.36	9.06	35.67
-1.50	16.36	9.06	35.67
-1.50	16.36	23.48	57.30
-3.00	16.36	23.48	57.30
-3.00	10.91	23.48	49.95
-3.34	14.80	23.48	55.15
-3.34	14.80	0.00	19.93
-8.15	64.17	0.00	86.63
-8.15	77.83	0.00	105.06
-10.00	102.29	0.00	138.09
-10.00	99.40	0.00	134.19
-13.00	116.12	0.00	156.76

V-pressure on static system

Internal forces: Permanent, characteristically

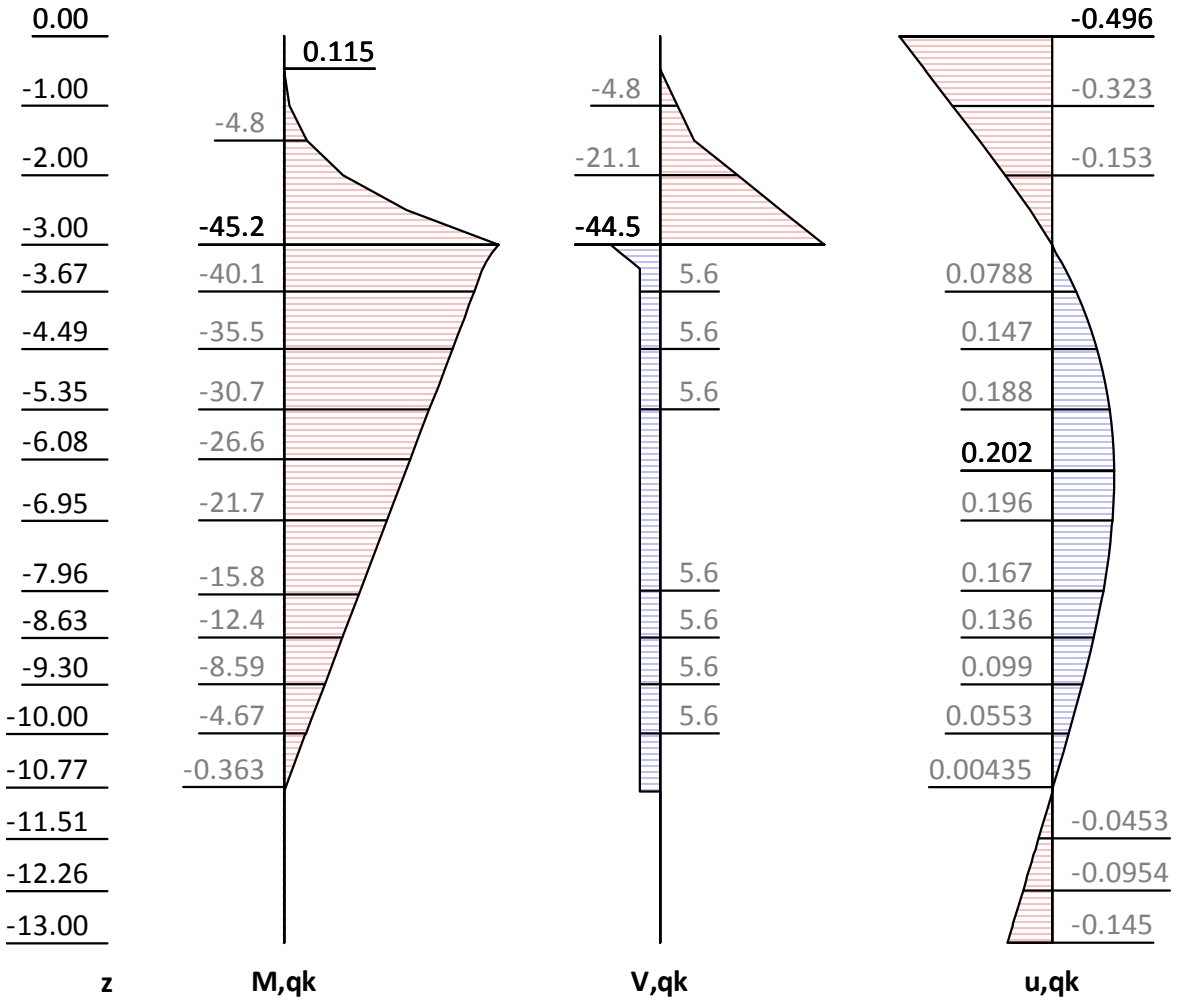
```
z=  -0.500. Fx=  -0.000 kN/m Support
z=  -3.000. Fx=-181.180 kN/m Support
z= -10.835. Fx=-562.533 kN/m Support
```



z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	16.36	-0.00	0.00	0.00	1.59
-0.00	16.36	-0.00	0.00	-0.00	1.59
-3.00	16.36	-73.60	-49.07	-76.77	-0.00
-3.00	10.91	-73.60	132.11	-125.32	-0.00
-3.57	17.23	-0.00	123.95	-139.13	-0.35
-6.95	52.00	254.05	6.72	-220.47	-1.67
-7.02	52.66	254.38	3.29	-221.77	-1.67
-7.08	53.28	254.16	0.00	-222.73	-1.66
-8.15	64.17	222.03	-62.72	-239.47	-1.44
-8.15	77.83	222.03	-62.72	-239.47	-1.44
-9.81	99.80	-0.00	-210.38	-278.63	-0.58
-10.00	102.29	-41.13	-229.33	-283.26	-0.46
-10.00	99.40	-41.13	-229.33	-283.26	-0.46
-10.83	109.48	-268.40	-316.52	-293.81	0.00
-10.83	109.48	-268.40	246.01	-293.81	0.00
-13.00	116.12	-0.00	-0.00	-321.17	0.63

Internal forces: Variable, characteristically

Method EB 82-4 (Q = [G+Q] - G).
z= -0.500. Fx= 0.000 kN/m Support
z= -3.000. Fx= -58.130 kN/m Support
z= -10.835. Fx= 5.597 kN/m Support

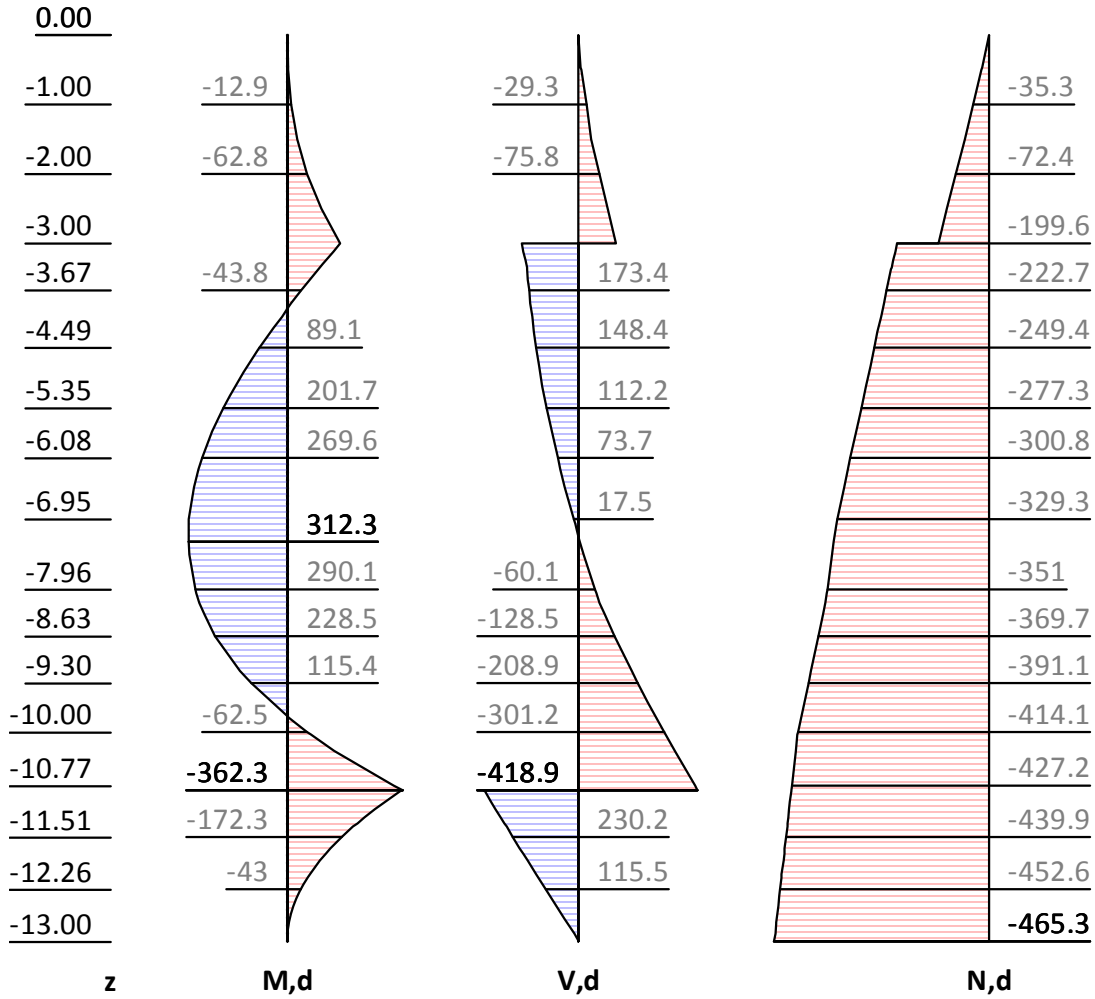


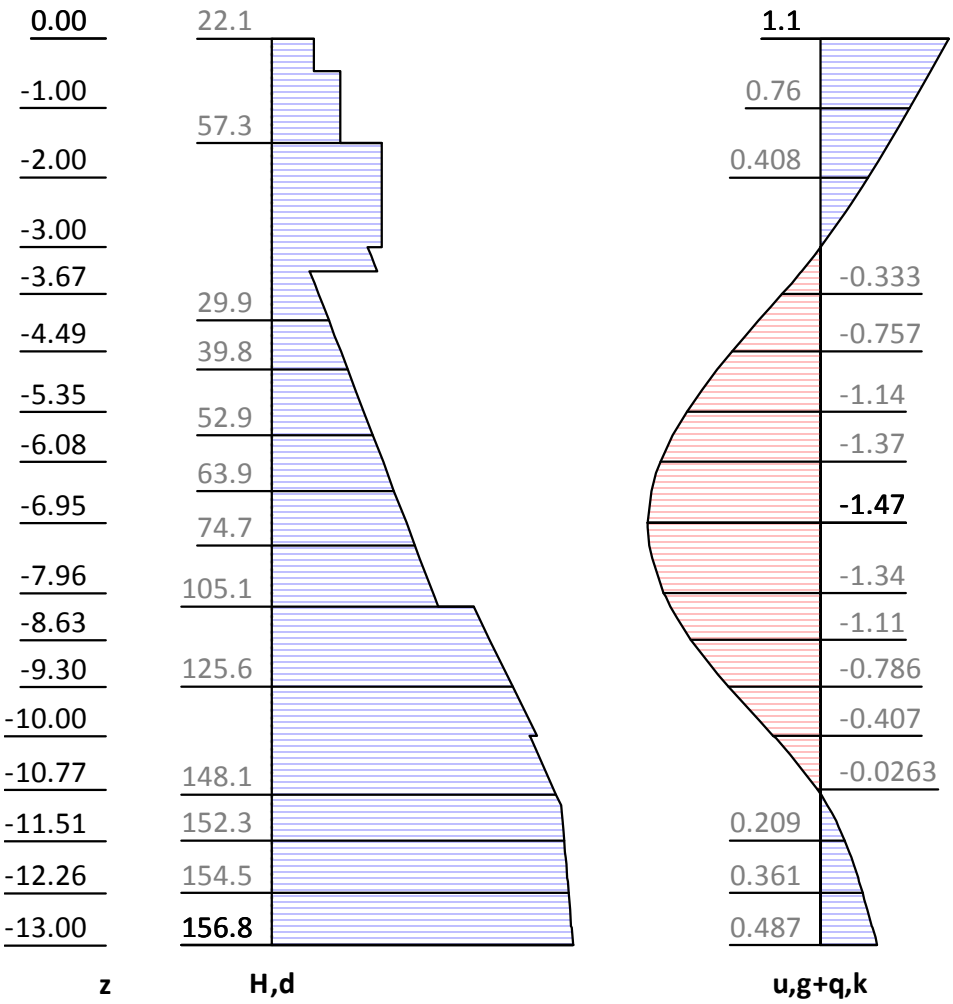
z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00	-0.00	0.00	-0.50
-0.47	0.00	0.12	-0.00	0.00	-0.41
-0.47	9.06	0.12	0.00	-0.00	-0.41
-0.50	9.06	0.00	-0.26	-0.03	-0.41
-1.50	9.06	-4.80	-9.33	-0.99	-0.24
-1.50	23.48	-4.80	-9.33	-0.99	-0.24
-3.00	23.48	-45.21	-44.55	-4.71	-0.00
-3.00	23.48	-45.21	13.58	-20.29	-0.00
-3.00	23.48	-45.21	13.58	-20.29	0.00
-3.34	23.48	-41.93	5.61	-21.13	0.04
-3.34	0.00	-41.93	5.61	-21.13	0.04
-4.26	0.00	-36.81	5.60	-21.13	0.13
-6.08	0.00	-26.63	5.60	-21.13	0.20
-6.24	0.00	-25.72	5.60	-21.13	0.20
-6.49	0.00	-24.29	5.60	-21.13	0.20

z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
-6.95	0.00	-21.72	5.60	-21.13	0.20
-7.28	0.00	-19.90	5.60	-21.13	0.19
-7.96	0.00	-16.11	5.60	-21.13	0.17
-10.04	0.00	-4.45	5.60	-21.13	0.05
-10.77	0.00	-0.36	5.60	-21.13	0.00
-10.83	0.00	-0.00	5.60	-21.13	0.00
-10.83	0.00	-0.00	0.00	-21.13	0.00
-10.83	0.00	-0.00	0.00	-21.13	-0.00
-10.85	0.00	-0.00	0.00	-21.13	-0.00
-11.00	0.00	-0.00	0.00	-21.13	-0.01
-11.36	0.00	-0.00	0.00	-21.13	-0.04
-11.85	0.00	-0.00	0.00	-21.13	-0.07
-12.09	0.00	-0.00	0.00	-21.13	-0.08
-12.68	0.00	-0.00	0.00	-21.13	-0.12
-12.73	0.00	0.00	0.00	-21.13	-0.13
-12.75	0.00	-0.00	0.00	-21.13	-0.13
-12.75	0.00	0.00	0.00	-21.13	-0.13
-12.92	0.00	0.00	0.00	-21.13	-0.14
-13.00	0.00	0.00	0.00	-21.13	-0.15

Internal forces: Design

z= -0.500. Fx= -0.000 kN/m Support
z= -3.000. Fx=-331.788 kN/m Support
z= -10.835. Fx=-751.024 kN/m Support





z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	22.08	0.00	-0.00	0.00	1.10
-0.00	22.08	-0.00	-0.00	-0.00	1.10
-0.47	22.08	-2.44	-10.38	-16.24	0.94
-0.47	35.67	-2.44	-10.38	-16.24	0.94
-1.50	35.67	-32.05	-47.11	-53.30	0.59
-1.50	57.30	-32.05	-47.11	-53.30	0.59
-3.00	57.30	-167.18	-133.07	-110.71	-0.00
-3.00	49.95	-167.18	198.72	-199.61	-0.00
-3.34	55.15	-102.61	180.83	-211.92	-0.16
-3.34	19.93	-102.61	180.83	-211.92	-0.16
-3.93	28.29	0.00	166.53	-231.09	-0.47
-6.95	70.19	310.39	17.47	-329.33	-1.47
-7.20	73.52	311.99	-0.00	-334.82	-1.46
-7.28	74.67	312.28	-6.11	-336.59	-1.46
-8.15	86.63	277.20	-76.27	-354.98	-1.28
-8.15	105.06	277.20	-76.27	-354.98	-1.28
-9.78	134.14	0.00	-271.21	-406.75	-0.53
-10.00	138.09	-62.54	-301.20	-414.10	-0.41

z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
-10.00	134.19	-62.54	-301.20	-414.10	-0.41
-10.83	147.80	-362.34	-418.91	-428.34	0.00
-10.83	147.80	-362.34	332.11	-428.34	0.00
-13.00	156.76	-0.00	-0.00	-465.28	0.49
-13.00	156.76	0.00	-0.00	-465.28	0.49

Anchor forces with safety level of DS-P

z[m]	A,d[kN]	Fx,d[kN/m]
-0.50	0.0	-0.0
-3.00	309.1	-331.8

Checks of earth statics

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -10.83 m
Rd = Eph,k/γ,Re = 1165.65 / 1.400 = 832.61 [kN/m]
Ed(Uh,d)/Rd = 751.02 / 832.61 = 0.902 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-13.00

Pos.	H	V
H/V pressure G+P+W,k	743.71	50.12
Wall weight		222.61
H/V pressure passive		-0.00
Support z: -0.50		0.00
Support z: -3.00	-181.18	48.55
Bh,g,k z=-10.83	-562.53	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.65
Σ	-0.00	320.62
		(downwards)

Average anchor inclination α,A = 15.00° >= 15°.
Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1

Vertical component of earth resistance is less than
the downwards pointing vertical forces.
Vk >= Bvk: 321.28 >= 0.65 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-13.00

Pos.	H	V
H/V pressure G+P+W,k	796.25	55.68
Wall weight		222.61
H/V pressure passive		0.00
Support z: -0.50		0.00
Support z: -3.00	-239.31	64.12
Bh,g,k z=-10.83	-562.53	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.65
Bh,q,k z=-10.83	5.60	
Bv,q,k = Bh,k * tan(δ,p=-0.07°)		0.01

Pos.	H	V
Σ	0.00	341.76 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.
Verification of vertical forces due to EAB R 9 not required (R 9-5).
Check EAB R 9-1
Vertical component of earth resistance is less than
the downwards pointing vertical forces.
Vk >= Bvk: 342.41 >= 0.65 Passes requirement

Anchor verification

Anchor - Stability of lower failure plane

Περίπτ.Φόρτισης: όλα τα φορτία BS-P
Αυτόμ. υπολογ. μήκους αγκυρίων:
All anchors are extended (if necessary)
Favourable variable loads in main failure body are not being considered.
Bottom of lower failure plane: z=-13.00 m

Iteration of failure mechanisms:
lA .....: Length of anchor from head to center of grout body.
W,k .....: Res. force from dead weight, loads, cohesion, ...
Q,k .....: Force in lower failure plane.
Ea1,k.....: Earth pressure onto vertical separation plane.
Ea2,k.....: Earth pressure between wall and main failure body.
Ra_cal,d ...: Dimesioning force of the resistance from the equilibrium of forces. Ra_cal,d corresponds to the max. possible anchor force of the force polygon.
Sum(A,d) ...: Acting anchor forces along the grout body fractions within the failure body. Sum(A,d) is gained from the anchor pull forces of the wall analysis.

z [m]	ϑ1 [°]	ϑ2 [°]	lA [m]	W,k [kN/m]	Q,k [kN/m]	Ea1,k [kN/m]	Ea2,k [kN/m]	Ra_cal,d [kN/m]	Sum(A,d) [kN/m]	Ed/Rd [-]
-0.50	39.7	56.5	11.80	1144.9	969.1	4.9	304.4	279.3	278.4	1.00
-3.00	33.1	59.8	11.27	1296.6	1067.4	33.1	304.4	344.9	343.4	1.00

Decisive failure body:
Γεωμετρία:

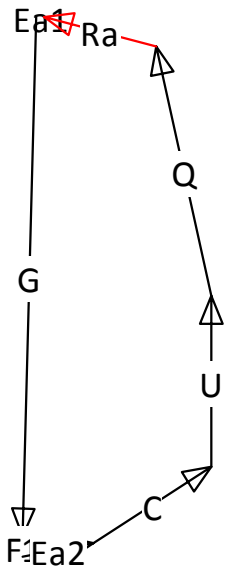
Foot point of lower failure plane	x/z =	0.01/-13.00 m
Intersection lower/upper slid. plane	x/z =	10.88/ -5.92 m
Intersection upper slid. plane/surface	x/z =	14.32/ 0.00 m
Intersection separation plane/surface	x/z =	10.88/ 0.00 m
Inclination lower failure plane	ϑ1 =	33.09°
Inclination upper failure plane	ϑ2 =	59.81°
Inclination separation plane	ϑ12 =	90.00°

Loads / forces (char.)

		Fx [kN/m]	Fz [kN/m]	F [kN/m]	
Weight of main failure body	G,k:	-60.0	-2171.3	2172.2	
Area loads on/in main failure body	F1,k:	0.0	-83.7	83.7	
Cohesion of lower failure plane	C,k:	491.7	320.4	586.9	
Pore water pressure on main body	U,k:	-0.1	711.9	711.9	
Earth pres. on separation plane	Ea1,k:	-33.1	-0.0	33.1	δ= 0.0°
Earth pr. between wall<->main body	Ea2,k:	299.3	55.7	304.4	
Force in lower failure plane	Q,k:	-231.5	1042.0	1067.4	

		Fx [kN/m]	Fz [kN/m]	F [kN/m]
Sum = possible anchor forces:	Ra_cal,k:	466.4	-125.0	482.9

Force polygon



Acting anchor forces Ed: Sum(A,d) = 343.4 kN/m
Possible anchor forces Rd: Ra_cal,d = 482.9/1.400 = 344.9 kN/m
Verif. of lower failure plane Ed/Rd = 1.00 < 1.0: Έλεγχος εκπληρώθηκε.

Check of steel tension

l,tot ...[m]: Total length of anchor incl. excess length at head
As ....[mm2]: X-section are of steel member
Ri,d ...[kN]: Ultimate strength of tension member (γ,M=1.15)
A,d ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	l,tot	As	Ri,d		A,d	
-0.50	Strand;3x0.60";1570/1770	16.87	420	573.4	>	0.0	Passes requirement
-3.00	Strand;3x0.60";1570/1770	15.27	420	573.4	>	309.1	Passes requirement

Check of steel tension: Passes requirement

Check of anchor's soil friction

lVk .....: Length of grout body
DmVk ....: Diameter of grout body
τGr,k ...: Average applied skin friction along the grout body (from soil parameters)
Ra,k ....: Charact. pullout resistance of the anchor
γA ......: Partial safety factor of anchor pullout
Ra,d ....: = Ra,k / γA
A,d .....: Dimensioning force of the anchor from wall analysis

z [m]	lVk [m]	DmVk [mm]	τGr,k [kN/m²]	Ra,k [kN]	γA [-]	Ra,d [kN]		A,d [kN]	A,d/Ra,d [-]
-0.50	8.00	318	110	879.1	1.100	799.2	>	0.0	0.0
-3.00	8.00	318	110	879.1	1.100	799.2	>	309.1	0.4

Check of anchor's soil friction: Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)

Συντελ.Σεισμού: Οριζόντιος: 0.028
Κατακόρυφος : 0.014

Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (0.59, 1.73), Ακτίνα = 14.75
Αρχ.σημ.= (-10.36, -8.15), Τελ.σημ. = (15.24, 0.00)

Γεωμετρία λωρίδων:

No	x	Width b	dxM	Weight	Load z-κατ.	Water-φορτ.	u*b	φ	c	θ
	[m]	[m]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[°]	[kN/m²]	[°]
1	-9.62	1.47	-10.22	25.6	0.0	0.0	-0.0	27.45	3.57	-31.27*
2	-8.15	1.47	-8.74	66.8	0.0	0.0	-0.0	0.08	71.43	-36.35
3	-6.67	1.47	-7.27	95.4	0.0	0.0	-3.7	0.08	71.43	-29.52
4	-5.20	1.47	-5.79	117.2	0.0	0.0	-12.2	0.08	71.43	-23.12
5	-3.72	1.47	-4.32	133.3	0.0	0.0	-20.3	0.08	71.43	-17.02
6	-2.25	1.47	-2.84	144.4	0.0	0.0	-25.8	0.08	71.43	-11.11
7	-0.77	1.47	-1.37	150.7	0.0	0.0	-29.0	0.08	71.43	-5.32
8	0.70	1.47	0.11	399.2	19.1	0.0	-89.8	0.08	71.43	0.42
9	2.18	1.47	1.58	403.0	64.2	0.0	-148.3	0.08	71.43	6.16
10	3.65	1.47	3.06	396.0	25.5	0.0	-144.8	0.08	71.43	11.97
11	5.13	1.47	4.53	384.2	0.0	0.0	-138.9	0.08	71.43	17.90
12	6.60	1.47	6.01	367.3	0.0	0.0	-130.4	0.08	71.43	24.04
13	8.07	1.47	7.48	344.6	0.0	0.0	-118.9	0.08	71.43	30.49
14	9.55	1.47	8.96	314.8	0.0	0.0	-104.0	27.45	3.57	37.40
15	11.02	1.47	10.43	271.4	0.0	0.0	-84.4	27.45	3.57	45.02
16	12.50	1.47	11.91	213.4	0.0	0.0	-58.1	27.45	3.57	53.83
17	14.24	2.00	13.64	151.1	0.0	0.0	-29.1	0.08	35.71	67.70

*** Σημείωση: Στις λωρίδες σημειωμένες με '*'
περιορίστηκε το theta στο 45°-Phi/2.

Συνεισφ. κατακόρυφων φορτίων:

No	Weight	G*sin(θ)	(G-u*b)*tan(φ) + c*b	μ*sin(θ)* tan(φ)+cos(θ)	T
	[kN/m]	[kN/m]	[kN/m]	[-]	[kN/m]
1	25.60	-17.74	18.57	0.701640	26.46
2	66.81	-39.60	105.43	0.804968	130.98
3	95.38	-46.99	105.47	0.869820	121.25
4	117.20	-46.02	105.49	0.919364	114.74
5	133.31	-39.02	105.50	0.955978	110.36
6	144.36	-27.82	105.51	0.981109	107.54
7	150.73	-13.97	105.51	0.995622	105.97
8	418.30	3.06	105.80	0.999979	105.80
9	467.14	50.13	105.78	0.994310	106.39
10	421.49	87.38	105.73	0.978438	108.06
11	384.19	118.07	105.68	0.951850	111.03

No	Weight [kN/m]	G*sin(θ) [kN/m]	(G-u*b)*tan(φ) + c*b [kN/m]	μ*sin(θ)* tan(φ)+cos(θ) [-]	T [kN/m]
12	367.29	149.60	105.67	0.913609	115.66
13	344.56	174.80	105.65	0.862160	122.55
14	314.84	191.21	114.81	0.973521	117.93
15	271.39	191.96	102.39	0.915441	111.85
16	213.45	172.32	85.97	0.828146	103.81
17	151.10	139.80	71.70	0.380153	188.61
		1047.19			1908.99

Συνεισφ. οριζόντιων φορτίων:

Αρ	Γραμ.Φορ*dzM [kN/m]	[m]	Επιφ.Φορ.*dzM [kN/m]	[m]	Πίεση νερού*dzM [kN/m]	[m]	οριζ.Σεισμός.*dzM [kN/m]	[m]
1	-		-		-		0.7 *	10.26
2	-		-		-		1.8 *	10.87
3	-		-		-		2.6 *	11.31
4	-		-		-		3.2 *	11.67
5	-		-		-		3.7 *	11.93
6	-		-		-		4.0 *	12.11
7	-		-		-		4.2 *	12.21
8	-		-		-		11.0 *	8.37
9	-		-		-		11.1 *	8.30
10	-		-		-		10.9 *	8.19
11	-		-		-		10.6 *	8.00
12	-		-		-		10.1 *	7.74
13	-		-		-		9.5 *	7.38
14	-		-		-		8.7 *	6.93
15	-		-		-		7.5 *	6.26
16	-		-		-		5.9 *	5.37
17	-		-		-		4.2 *	3.71

*** Προσοχή: Στήλη 'οριζ. σεισμ.' είναι επιρροή στο οριζόντιο
συντελ.σεισμού πάνω στο I.B.
Αθρ. Ροπών από 'Συνεισφορά οριζόντιων φορτίων:': 899.9 kN*m/m
Συνεισφ. αγκυρίων: Αθρ. ροπών ανατροπής : -284.0 kN*m/m
" " resisting : 149.3 kN*m/m

Δράση Ed = (1047.2*14.75+899.9-284.0)
Αντίσταση Rd = (1909.0*14.75+149.3)
SLIP-CIRCLE μ = Ed/Rd = 0.57 < 1.0: Έλεγχος εκπληρώθηκε.

ΠΑΡΑΡΤΗΜΑ

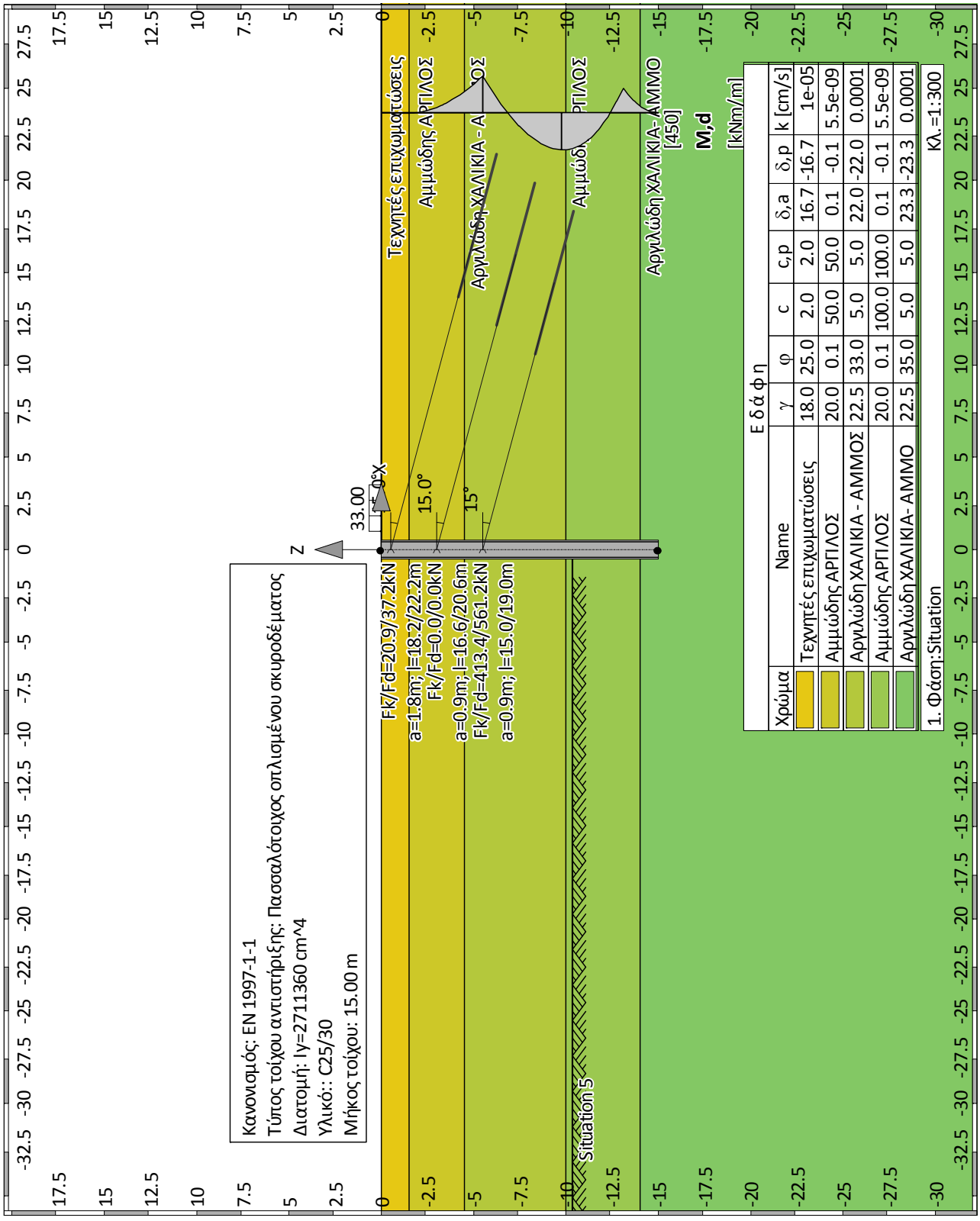
8.5 *Αποτελέσματα ανάλυσης*

8.5.2 *Σεισμικές Συνθήκες*

iii) Αντιστηριζόμενο ύψος 9,85m

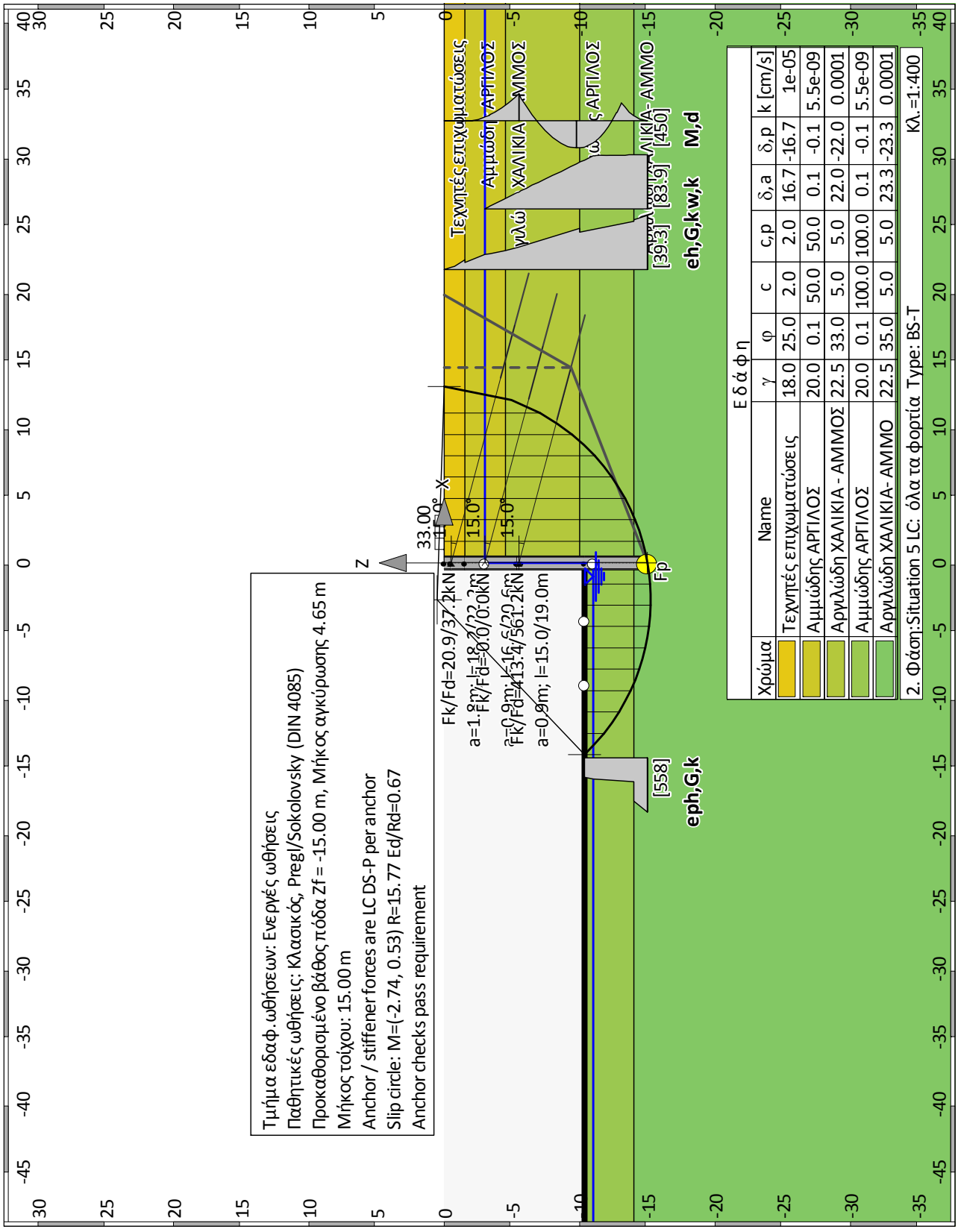
Summary of all stages

Φάση εκσκαφής 0 "Situation"



Χρώμα	Name	Εδάφη γ	φ	c	c,p	δ,a	δ,p	k [cm/s]
	Τεχνητές επιχωματώσεις	18.0	25.0	2.0	2.0	16.7	-16.7	1e-05
	Αμμώδης ΑΡΓΙΛΟΣ	20.0	0.1	50.0	50.0	0.1	-0.1	5.5e-09
	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ	22.5	33.0	5.0	5.0	22.0	-22.0	0.0001
	Αμμώδης ΑΡΓΙΛΟΣ	20.0	0.1	100.0	100.0	0.1	-0.1	5.5e-09
	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ	22.5	35.0	5.0	5.0	23.3	-23.3	0.0001

Φάση εκσκαφής 1 "Situation 5"



Κανονισμόςγια Ανάλυση και Διαστασιολόγηση

Διαστασ. ωπλισμ.σκυροδ.: EN 1992-1-1
Γεωτεχν.Κανονισμός : EN 1997 (rev.12)_user
National Annex: EN 1997-1

Safety factors:

Earth pressure onto wall: [GEO] A1 M1 R2

	γ-	G,dst	E0G	G,stb	Q,dst	Q,stb	phi	coe	cu	g
BS-P		1.350	1.350	1	1.500	0	1	1	1	1
BS-T		1.350	1.350	1	1.500	0	1	1	1	1
BS-T/A		1.350	1.350	1	1.500	0	1	1	1	1
BS-E		1	1	1	1	0	1	1	1	1

ΚΕ-μηχανισμός: [GEO] A2 M2 R3

	γ-	G,dst	G,stb	W	Q,dst	Q,stb	phi	coe	cu
		g	a,t	a,p	Gt	N			
BS-P		1	1	1	1.300	0	1.250	1.400	1.400
		1	1	1	1	1			
BS-T		1	1	1	1.300	0	1.250	1.400	1.400
		1	1	1	1	1			
BS-T/A		1	1	1	1.300	0	1.250	1.250	1.400
		1	1	1	1	1			
BS-E		1	1	1	1	0	1.250	1.400	1.400
		1	1	1	1	1			

Θραύση εδάφους: [GEO] A1 M1 R2

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Re					
BS-P		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-T		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-T/A		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-E		1	1	1	1	1	0	1	1
		1	1	1					

Ολίσθηση: [GEO] A1 M1 R2

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Rh					
BS-P		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.100					
BS-T		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.100					
BS-T/A		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.100					
BS-E		1	1	1	1	1	0	1	1
		1	1	1					

Θραύση εδάφους: [GEO] A1 M1 R2

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Rv					
BS-P		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-T		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Rv					
BS-T/A		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-E		1	1	1	1	1	0	1	1
		1	1	1					

Κύκλος ολίσθησης: [GEO] A2 M2 R3

	γ-	G,dst	G,stb	Q,dst	Q,stb	W	phi	coe	cu
		g	Re	a,t	a,p	Gt	N		
BS-P		1	1	1.300	0	1	1.250	1.400	1.400
		1	1	1	1	1	1		
BS-T		1	1	1.300	0	1	1.250	1.400	1.400
		1	1	1	1	1	1		
BS-T/A		1	1	1.300	0	1	1.250	1.250	1.400
		1	1	1	1	1	1		
BS-E		1	1	1	0	1	1.250	1.400	1.400
		1	1	1	1	1	1		

Hydraulic heave: [HYD] A1 M1 R1

	γ-	G,dst	G,stb	Q,dst	H
BS-P		1.350	0.900	1.500	1.800
BS-T		1.350	0.900	1.500	1.600
BS-T/A		1.350	0.900	1.500	1.500
BS-E		1	1	1	1

Failure of structural elements: [STR] A1 M1 R1

	γ-	M	Gtf	cd	N
BS-P		1.150	1.400	1.400	1.150
BS-T		1.150	1.300	1.300	1.150
BS-T/A		1.150	1.250	1.250	1.150
BS-E		1	1	1	1

Stability: [EQU] A1 M1 R1

	γ-	G,dst	G,stb	Q,dst	Q,stb	phi	coe	cu	g
BS-P		1	0.900	1.500	0	1.250	1.250	1.400	1
BS-T		1	0.900	1.500	0	1.250	1.250	1.400	1
BS-T/A		1	0.900	1.500	0	1.250	1.250	1.400	1
BS-E		1	1	1	0	1.250	1.400	1.400	1

γ,Re,red (EAB EB14-3): Ναι, η=0.80
γ,Re,red (EAB EB22-6): Ναι, E0h > 0%: η = 0.60 / 0.80

System values

Τοίχος

Τύπος τοίχου αντιστήριξης: Πασσαλότοιχος οπλισμένου σκυροδέματος
Διατομή: Iy=2711360 cm^4
Υλικό:: C25/30
Ίδιο βάρος: 25.000 [kN/m3]

Σημεία τοίχου

z	d	E	Iy	E*Iy	A
[m]	[m]	[MN/m2]	[cm4/m]	[MNm2]	[cm2/m]
0.00	100.0	31500.0	2711360	854.1	8400
-15.00	100.0	31500.0	2711360	854.1	8400

Φάση εκσκαφής 1 "[1] Situation 5"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 5 Στρώσεις

Name		Τεχνητές επιχωματώσεις	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
γ	[kN/m3]	18	20	22.5
γ,R	[kN/m3]	18	20	22.5
γ'	[kN/m3]	8	10	12.5
γ,p	[kN/m3]	18	20	22.5
γ,R,passive	[kN/m3]	18	20	22.5
γ,pw	[kN/m3]	8	10	12.5
φ	[°]	25	0.1	33
c	[kN/m2]	2	50	5
c,u	[kN/m2]	10	50	5
c παθητικό	[kN/m2]	2	50	5
δ,a	[°]	16.66667	0.06666667	22
δ,p	[°]	-16.66667	-0.06666667	-22
δ,c	[°]	8.333333	0.03333333	11
k,agh	[-]	0.3456501	0.9955057	0.2452023
K,ach	[-]	1.043051	1.994195	0.8549058
K,0h	[-]	0.5773817	0.9982547	0.455361
K,pgh	[-]	3.908103	1.004519	7.495617
K,pch	[-]	5.180327	2.00583	8.599509
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	10e-06	5.5e-09	100e-06

Name		Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20	22.5
γ,R	[kN/m3]	20	22.5
γ'	[kN/m3]	10	12.5
γ,p	[kN/m3]	20	22.5
γ,R,passive	[kN/m3]	20	22.5
γ,pw	[kN/m3]	10	12.5
φ	[°]	0.1	35
c	[kN/m2]	100	5
c,u	[kN/m2]	100	5
c παθητικό	[kN/m2]	100	5
δ,a	[°]	0.06666667	23.33333
δ,p	[°]	-0.06666667	-23.33333
δ,c	[°]	0.03333333	11.66667
k,agh	[-]	0.9955057	0.2244207
K,ach	[-]	1.994195	0.8126539
K,0h	[-]	0.9982547	0.4264236
K,pgh	[-]	1.004519	9.146943
K,pch	[-]	2.00583	10.104
τ,gr	[kN/m2]	110	110
Ψ,A,max	[°]	90	90
k	[cm/s]	5.5e-09	100e-06

Πορεία πρανούς:

x [m]	0.00	0.00
z [m]	-10.35	0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:

x [m]	0.00	0.00
z [m]	-10.35	-1.50

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:
x [m] 0.00 0.00
z [m] -10.35 -4.50

Πορεία ανώτερου 4. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
x [m] 0.00 0.00
z [m] -10.35 -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -14.00

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
1.00	0.00	3.50	0.00	0.00	33.00	0.00	33.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Στάθμη νερού:

x [m] 0.00 0.00
z [m] -11.00 -3.00

Αγκύρια

z[m]	min.l[m]	Alpha[°]	C-H[kN/m]	P0[kN]	u0[m]
-0.50	0.00	15.00	αόρισ.	0.00	0.0000
-3.00	0.00	15.00	0.00	0.00	0.0000
-5.50	0.00	15.00	αόρισ.	0.00	0.0000

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Mononobe/Okabe (earth quake EC 8).
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: Triangle (perpend. to wall).
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
Levels of redistribution Z1: -3.000, Z2: -5.500 [m].
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Mononobe/Okabe (earth quake EC 8).

Options for water pressure

Στήριξη πόδα

Πόδας οριζοντίως μετακινούμενος

Earthquake

kh,eq = α*S*r = 0.028 (r=1.0)

Αγκύρια

Anchor checks (lower failure plane): Ναι
Anchor forces with safety level of DS-P: Ναι
Verification of grout body pull out forces: Ναι
δ,a,Anchoring wall : used from soil layer.
δ,p,Anchoring wall : used from soil layer.

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	Αμμώδης ΑΡΓΙΛΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

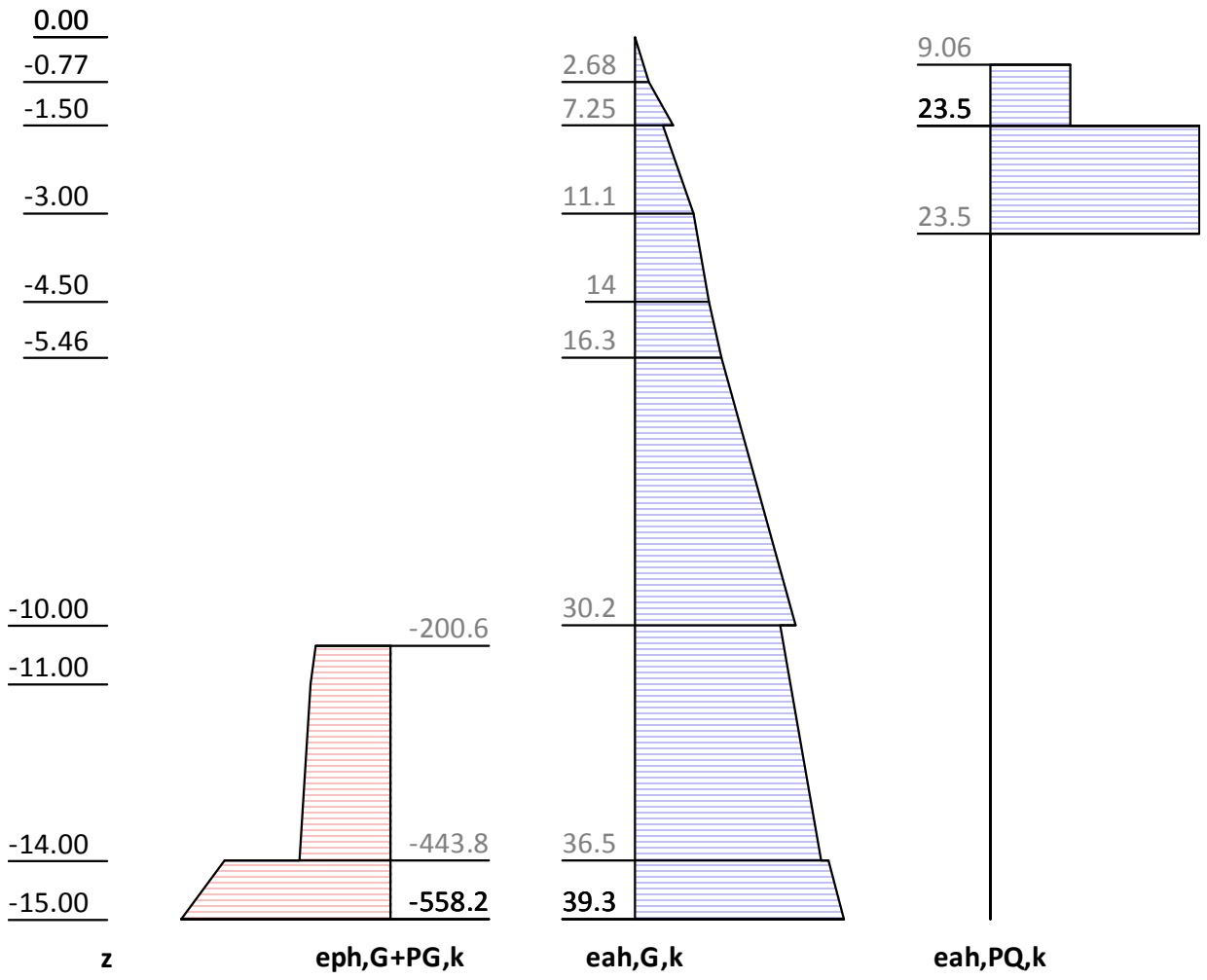
Μήκος τοίχου

Foot depth for statics: zf = -15.000

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall



z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.47		1.63	0.00	2.22
-0.47		1.63	9.06	15.80
-1.50		7.25	9.06	23.37
-1.50		5.25	23.48	42.30
-3.34		11.74	23.48	51.06
-3.34		11.74	0.00	15.84
-10.00		30.24	0.00	40.82
-10.00		27.35	0.00	36.92
-10.35	-0.00	28.03	0.00	37.84
-10.35	-200.58	28.03	0.00	37.84
-14.00	-243.78	35.12	0.00	47.41
-14.00	-443.84	36.50	0.00	49.28
-15.00	-558.18	39.31	0.00	53.06

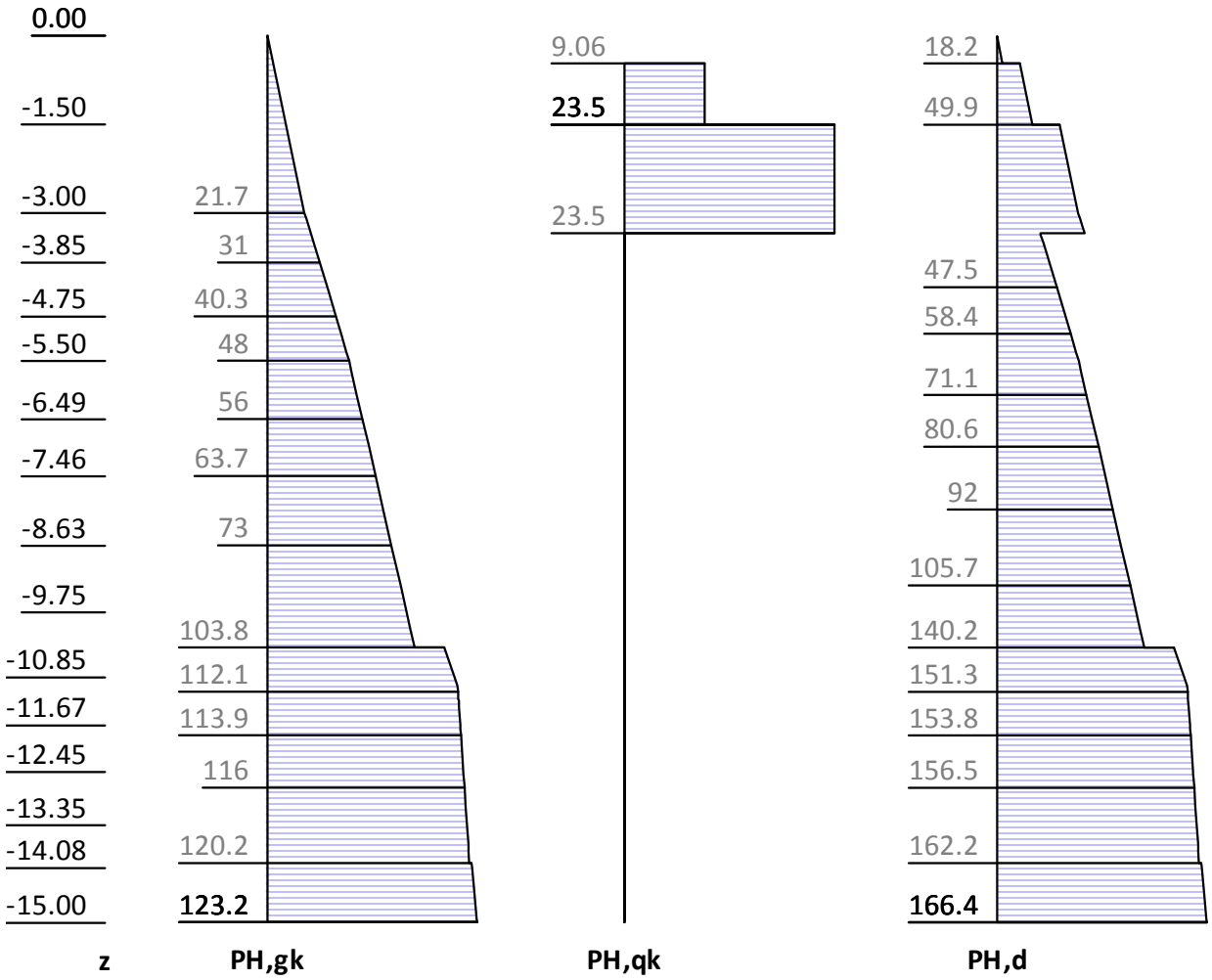
Eph,G,k:-1321.76, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 318.79, Eah,PG,k: 0.00, Eah,PQ,k: 52.53, Eah,d: 509.17

Πίεση νερού

z [m]	Wp,st,k [kN/m2]	Wa,st,k [kN/m2]	Wp,EQ,k [kN/m2]	Wa,EQ,k [kN/m2]	W,tot,k [kN/m2]
-3.00		0.00		0.00	0.00
-11.00	0.00	80.00	0.00	2.40	82.40
-15.00	-40.00	120.00	0.98	2.94	83.92

H-pressure on static system

Level of mobilization: Ep,gk 100.0, Ep,qk 100.0, Ep,d 100.0 [%]

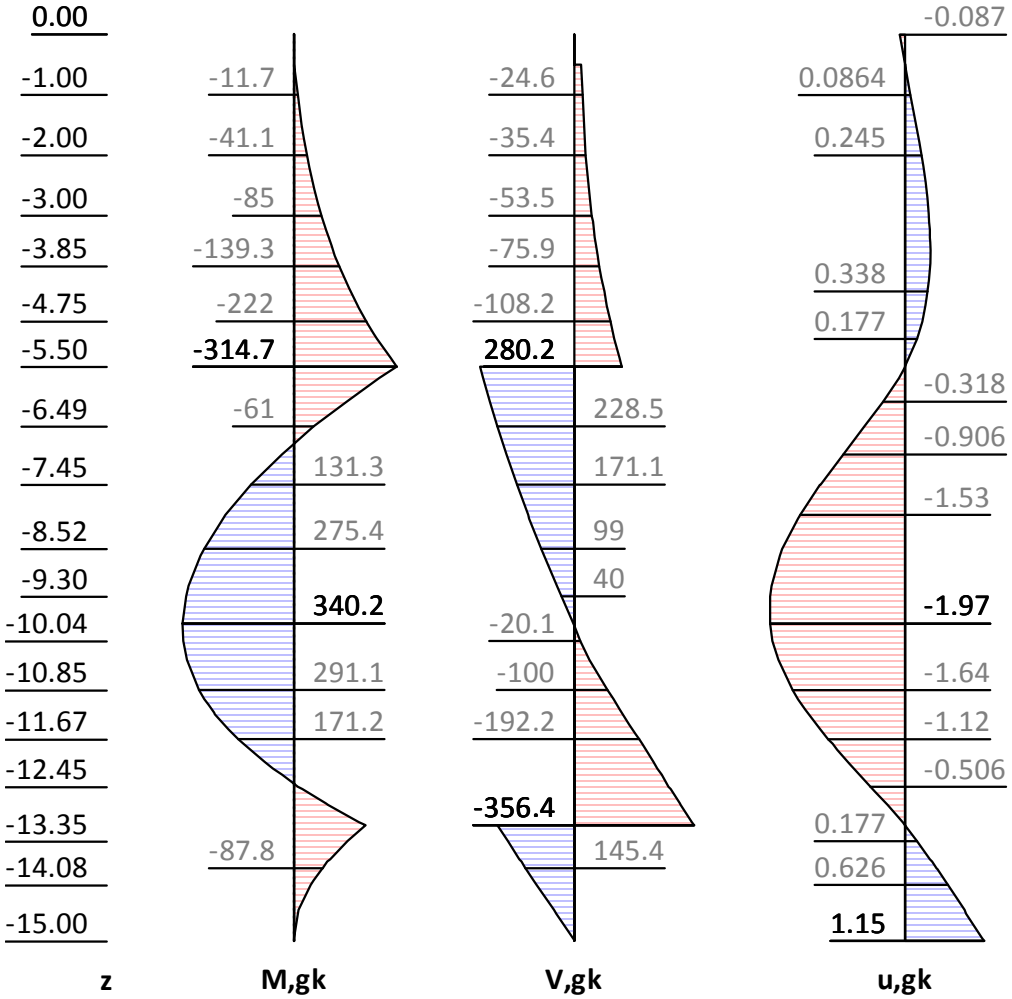


z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	0.00		0.00
-0.47	3.40	0.00	4.59
-0.47	3.40	9.06	18.17
-1.50	10.84	9.06	28.22
-1.50	10.84	23.48	49.86
-3.34	25.62	23.48	69.76
-3.34	25.62	0.00	34.53
-10.35	86.64	0.00	116.97
-10.35	103.83	0.00	140.17
-13.35	117.34	0.00	158.41
-14.00	118.78	0.00	160.36
-14.00	120.16	0.00	162.22
-15.00	123.23	0.00	166.36

V-pressure on static system

Internal forces: Permanent, characteristically

```
z=  -0.500. Fx=  20.969 kN/m Support
z=  -3.000. Fx=  -0.000 kN/m Support
z=  -5.500. Fx=-421.440 kN/m Support
z= -13.097. Fx=-584.438 kN/m Support
```

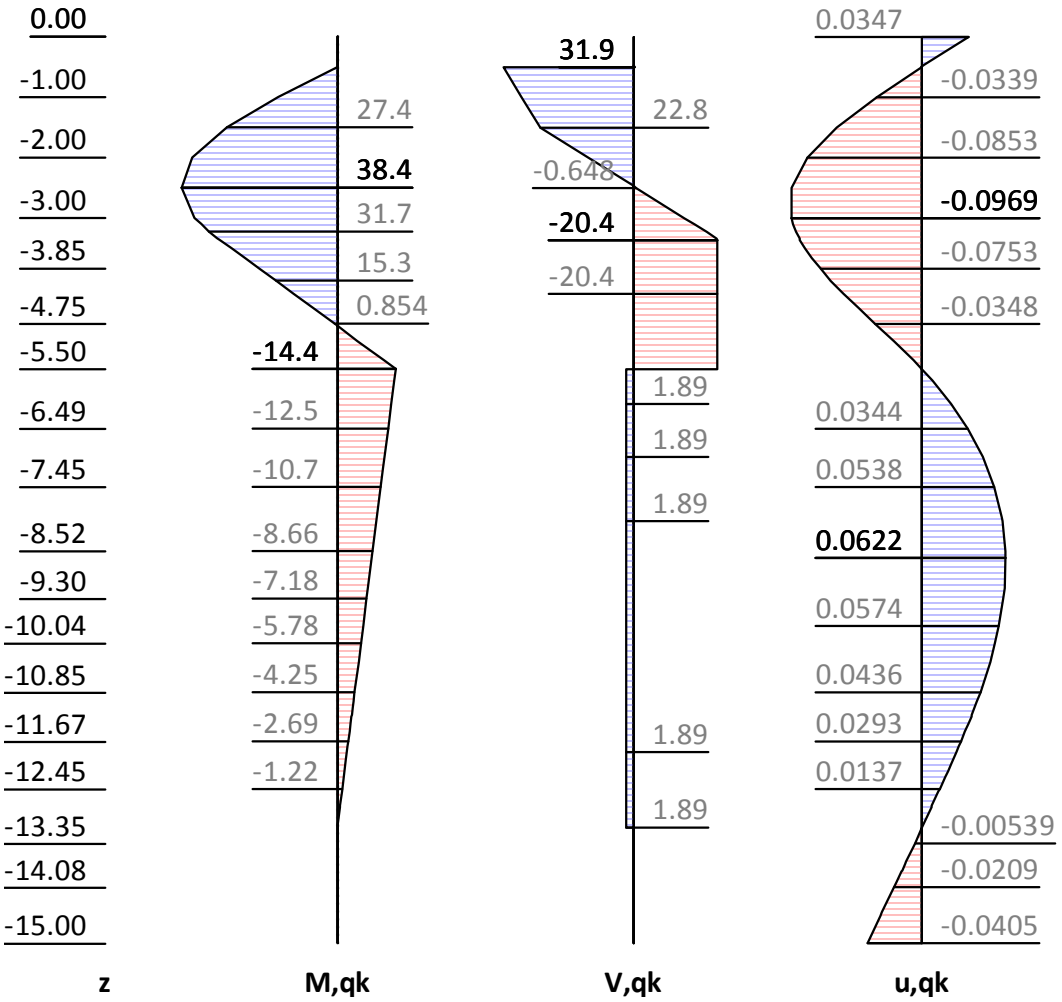


z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	0.00	0.00	-0.00	-0.00	-0.09
-0.00	0.00	-0.00	-0.00	-0.00	-0.09
-0.50	3.61	-0.15	-0.90	-10.77	0.00
-0.50	3.61	-0.15	-21.87	-5.15	0.00
-3.51	27.40	-115.36	-66.08	-81.27	0.37
-5.50	48.03	-314.75	-141.20	-136.09	0.00
-5.50	48.03	-314.75	-141.20	-136.09	-0.00
-5.50	48.03	-314.75	280.24	-249.01	-0.00
-6.77	58.26	-0.00	212.10	-283.66	-0.79
-9.75	81.89	340.24	4.01	-338.64	-1.97
-9.80	82.27	339.85	-0.00	-339.42	-1.96
-10.35	86.64	327.62	-46.55	-348.29	-1.85
-10.35	103.83	327.62	-46.55	-348.29	-1.85
-10.85	109.93	291.11	-99.98	-354.61	-1.64
-10.85	109.93	290.69	-100.45	-354.66	-1.63

z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
-12.40	115.20	0.00	-275.78	-374.22	-0.55
-13.10	116.78	-219.18	-356.37	-383.00	0.00
-13.10	116.78	-219.18	228.07	-383.00	0.00
-13.35	117.34	-165.20	198.44	-386.20	0.18
-13.35	117.34	-164.75	198.17	-386.23	0.18
-14.00	118.78	-61.10	121.70	-394.42	0.58
-14.00	120.16	-61.10	121.70	-394.42	0.58
-15.00	123.23	-0.00	-0.00	-423.37	1.15

Internal forces: Variable, characteristically

Method EB 82-4 (Q = [G+Q] - G).
z= -0.500. Fx= -32.166 kN/m Support
z= -3.000. Fx= 0.000 kN/m Support
z= -5.500. Fx= -22.257 kN/m Support
z= -13.097. Fx= 1.890 kN/m Support

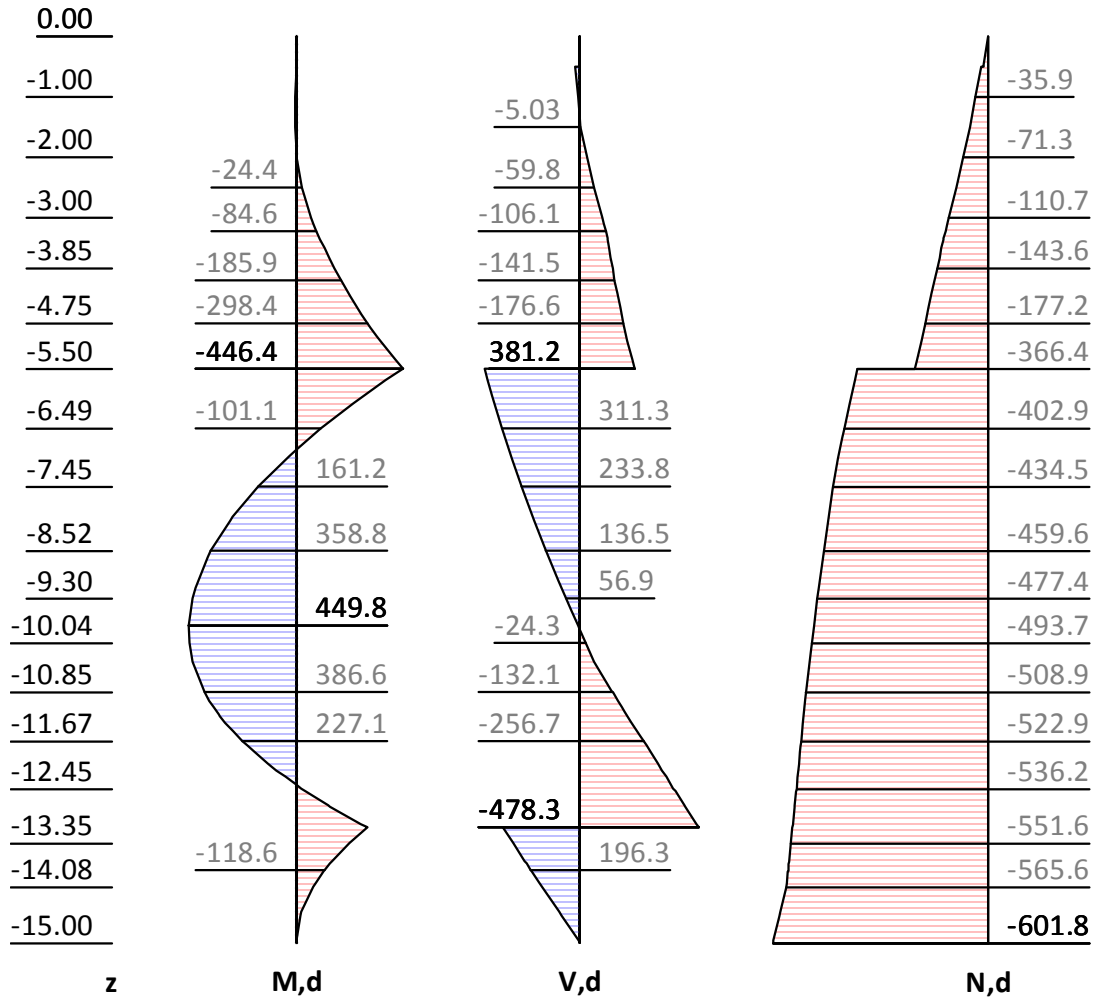


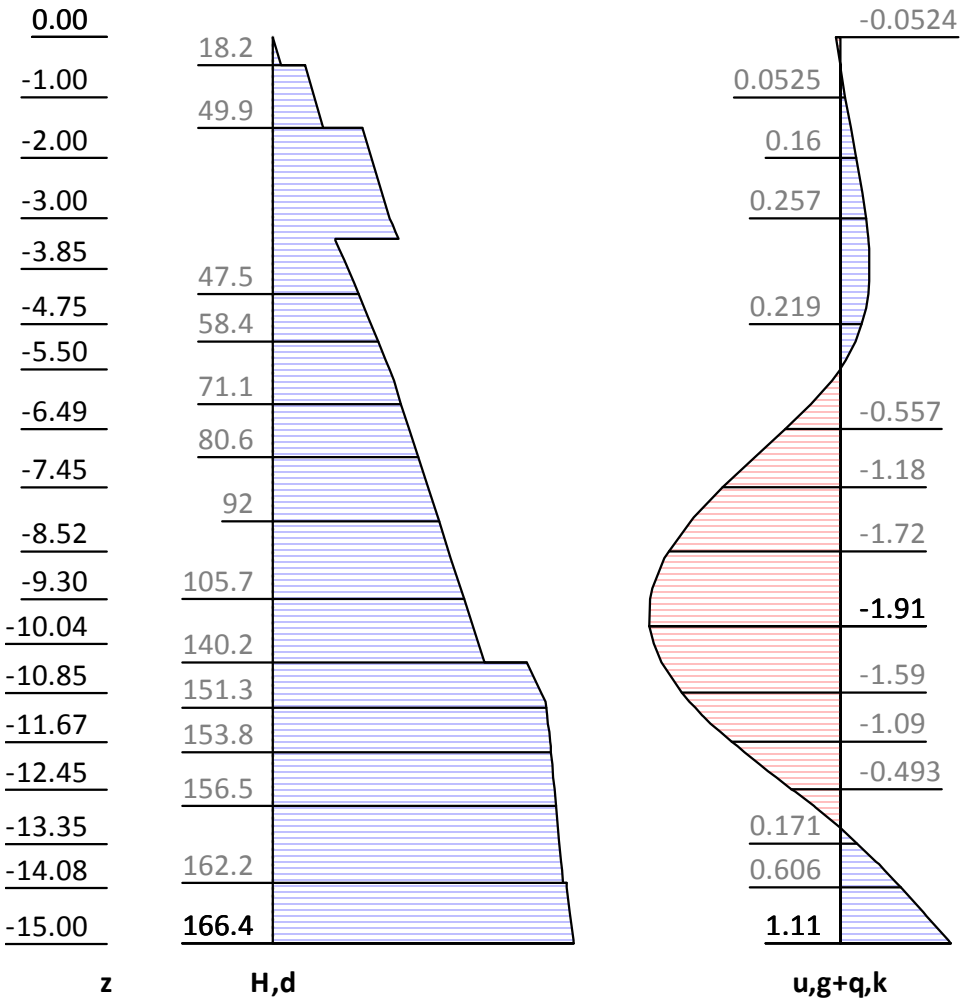
z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		-0.00	0.00	-0.00	0.03
-0.00		0.00	0.00	0.00	0.03
-0.47	0.00	0.02	0.05	0.02	0.00
-0.47	9.06	0.02	0.05	0.02	0.00

z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
-0.47	9.06	0.01	0.00	0.01	0.00
-0.48	9.06	0.01	-0.06	-0.00	0.00
-0.49	9.06	0.00	-0.21	-0.02	0.00
-0.50	9.06	0.00	31.89	-8.65	-0.00
-1.50	9.06	27.36	22.84	-9.61	-0.06
-1.50	23.48	27.36	22.84	-9.61	-0.06
-2.47	23.48	38.29	0.00	-12.02	-0.10
-2.50	23.48	38.43	-0.65	-12.09	-0.10
-3.00	23.48	35.20	-12.38	-13.33	-0.10
-3.34	23.48	29.67	-20.35	-14.18	-0.09
-3.34	0.00	29.67	-20.35	-14.18	-0.09
-3.36	0.00	29.14	-20.37	-14.18	-0.09
-3.51	0.00	26.16	-20.37	-14.18	-0.09
-4.79	0.00	0.00	-20.37	-14.18	-0.03
-5.04	0.00	-4.96	-20.37	-14.18	-0.02
-5.50	0.00	-14.36	-20.37	-14.18	-0.00
-5.50	0.00	-14.36	1.89	-20.14	-0.00
-8.63	0.00	-8.45	1.89	-20.14	0.06
-9.75	0.00	-6.33	1.89	-20.14	0.06
-10.04	0.00	-5.78	1.89	-20.14	0.05
-10.85	0.00	-4.25	1.89	-20.14	0.04
-10.85	0.00	-4.24	1.89	-20.14	0.04
-11.00	0.00	-3.96	1.89	-20.14	0.04
-11.11	0.00	-3.76	1.89	-20.14	0.04
-11.23	0.00	-3.53	1.89	-20.14	0.04
-11.67	0.00	-2.69	1.89	-20.14	0.03
-12.26	0.00	-1.59	1.89	-20.14	0.02
-12.45	0.00	-1.22	1.89	-20.14	0.01
-13.04	0.00	-0.11	1.89	-20.14	0.00
-13.10	0.00	-0.00	1.89	-20.14	0.00
-13.10	0.00	-0.00	0.00	-20.14	0.00
-13.35	0.00	-0.00	0.00	-20.14	-0.01
-13.70	0.00	-0.00	0.00	-20.14	-0.01
-13.82	0.00	-0.00	0.00	-20.14	-0.02
-14.08	0.00	-0.00	0.00	-20.14	-0.02
-14.42	0.00	0.00	0.00	-20.14	-0.03
-14.55	0.00	0.00	0.00	-20.14	-0.03
-14.95	0.00	0.00	-0.00	-20.14	-0.04
-15.00	0.00	0.00	0.00	-20.14	-0.04

Internal forces: Design

```
z=  -0.500. Fx= -19.940 kN/m Support
z=  -3.000. Fx=  -0.000 kN/m Support
z=  -5.500. Fx=-602.329 kN/m Support
z= -13.097. Fx=-786.157 kN/m Support
```





z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	0.00	0.00	0.00	0.00	-0.05
-0.00	0.00	-0.00	-0.00	-0.00	-0.05
-0.47	4.59	-0.17	-1.08	-13.65	-0.00
-0.47	18.17	-0.17	-1.08	-13.65	-0.00
-0.50	18.46	-0.21	-1.63	-14.59	-0.00
-0.50	18.46	-0.21	18.31	-19.93	-0.00
-0.50	18.46	-0.21	18.31	-19.93	0.00
-0.52	18.62	0.00	17.98	-20.43	0.00
-1.30	26.32	6.93	-0.00	-46.13	0.09
-1.50	28.22	7.24	-5.03	-52.67	0.11
-1.50	49.86	7.24	-5.03	-52.67	0.11
-1.90	53.79	-0.00	-26.12	-67.68	0.15
-3.34	69.76	-96.59	-113.66	-124.64	0.28
-3.34	34.53	-96.59	-113.66	-124.64	0.28
-3.85	41.79	-159.20	-133.08	-143.56	0.29
-5.50	64.84	-446.44	-221.17	-204.98	0.00
-5.50	64.84	-446.44	-221.17	-204.98	-0.00
-5.50	64.84	-446.44	381.16	-366.37	-0.00
-6.83	79.31	0.00	284.40	-415.35	-0.78
-9.75	110.55	449.84	8.25	-487.38	-1.91
-9.82	111.34	449.25	-0.00	-488.98	-1.90

z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
-10.35	116.97	434.50	-60.01	-500.40	-1.79
-10.35	140.17	434.50	-60.01	-500.40	-1.79
-10.85	148.41	386.63	-132.13	-508.93	-1.59
-10.85	148.41	386.07	-132.77	-509.00	-1.59
-12.40	155.50	0.00	-368.62	-535.31	-0.54
-13.10	157.65	-295.89	-478.27	-547.26	0.00
-13.10	157.65	-295.89	307.89	-547.26	0.00
-13.35	158.41	-223.02	267.89	-551.58	0.17
-13.35	158.41	-222.41	267.53	-551.62	0.17
-14.00	160.36	-82.49	164.29	-562.67	0.56
-14.00	162.22	-82.49	164.29	-562.67	0.56
-15.00	166.36	0.00	0.00	-601.75	1.11
-15.00	166.36	0.00	-0.00	-601.75	1.11

Anchor forces with safety level of DS-P

z[m]	A,d[kN]	Fx,d[kN/m]
-0.50	37.2	-19.9
-3.00	0.0	-0.0
-5.50	561.2	-602.3

Checks of earth statics

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -13.10 m
Rd = Eph,k/γ,Re = 1321.76 / 1.400 = 944.11 [kN/m]
Ed(Uh,d)/Rd = 786.16 / 944.11 = 0.833 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-15.00

Pos.	H	V
H/V pressure G+P+W,k	984.91	66.51
Wall weight		247.81
H/V pressure passive		0.00
Support z: -0.50	20.97	-5.62
Support z: -3.00		0.00
Support z: -5.50	-421.44	112.92
Bh,g,k z=-13.10	-584.44	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.68
Σ	-0.00	420.95 (downwards)

Average anchor inclination α,A = 15.00° >= 15°.
Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1

Vertical component of earth resistance is less than
the downwards pointing vertical forces.
Vk >= Bvk: 421.63 >= 0.68 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-15.00

Pos.	H	V

Pos.	H	V
H/V pressure G+P+W,k	1037.44	72.07
Wall weight		247.81
H/V pressure passive		0.00
Support z: -0.50	-11.20	3.00
Support z: -3.00		0.00
Support z: -5.50	-443.70	118.89
Bh,g,k z=-13.10	-584.44	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.68
Bh,q,k z=-13.10	1.89	
Bv,q,k = Bh,k * tan(δ,p=-0.07°)		0.00
Σ	-0.00	441.09
		(downwards)

Average anchor inclination α,A = 15.00° >= 15°.
Verification of vertical forces due to EAB R 9 not required (R 9-5).

Check EAB R 9-1
Vertical component of earth resistance is less than
the downwards pointing vertical forces.
Vk >= Bvk: 441.76 >= 0.68 Passes requirement

Anchor verification

Anchor - Stability of lower failure plane

Περίπτ.Φόρτισης: όλα τα φορτία BS-P
Αυτόμ. υπολογ. μήκους αγκυρίων:
All anchors are extended (if necessary)
Favourable variable loads in main failure body are not being considered.
Bottom of lower failure plane: z=-15.00 m

Iteration of failure mechanisms:
lA .....: Length of anchor from head to center of grout body.
W,k .....: Res. force from dead weight, loads, cohesion, ...
Q,k .....: Force in lower failure plane.
Ea1,k.....: Earth pressure onto vertical separation plane.
Ea2,k.....: Earth pressure between wall and main failure body.
Ra_cal,d ...: Dimesioning force of the resistance from the equilibrium of forces. Ra_cal,d corresponds to the max. possible anchor force of the force polygon.
Sum(A,d) ...: Acting anchor forces along the grout body fractions within the failure body. Sum(A,d) is gained from the anchor pull forces of the wall analysis.

z [m]	ϑ1 [°]	ϑ2 [°]	lA [m]	W,k [kN/m]	Q,k [kN/m]	Ea1,k [kN/m]	Ea2,k [kN/m]	Ra_cal,d [kN/m]	Sum(A,d) [kN/m]	Ed/Rd [-]
-0.50	37.5	56.5	14.51	1612.0	1380.3	4.9	378.3	363.9	362.9	1.00
-3.00	31.7	60.0	14.04	1788.9	1491.7	50.4	378.3	437.7	435.9	1.00
-5.50	21.3	60.3	14.97	2266.3	1782.7	135.4	378.3	642.4	640.1	1.00

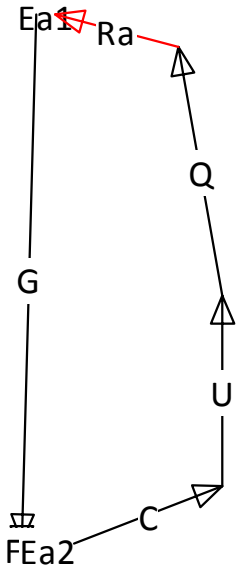
Decisive failure body:
Γεωμετρία:

Foot point of lower failure plane	x/z =	0.01/-15.00 m
Intersection lower/upper slid. plane	x/z =	14.46/ -9.37 m
Intersection upper slid. plane/surface	x/z =	19.81/ 0.00 m
Intersection separation plane/surface	x/z =	14.46/ 0.00 m
Inclination lower failure plane	ϑ1 =	21.27°
Inclination upper failure plane	ϑ2 =	60.26°
Inclination separation plane	ϑ12 =	90.00°

Loads / forces (char.)

		Fx [kN/m]	Fz [kN/m]	F [kN/m]	
Weight of main failure body	G,k:	-103.0	-3730.5	3731.9	
Area loads on/in main failure body	F1,k:	0.0	-83.7	83.7	
Cohesion of lower failure plane	C,k:	1048.2	408.1	1124.8	
Pore water pressure on main body	U,k:	-0.5	1346.0	1346.0	
Earth pres. on separation plane	Ea1,k:	-135.4	-0.0	135.4	δ= 0.0°
Earth pr. between wall<->main body	Ea2,k:	371.3	72.1	378.3	
Force in lower failure plane	Q,k:	-311.9	1755.2	1782.7	
Sum = possible anchor forces:	Ra_cal,k:	868.7	-232.8	899.3	

Force polygon



Acting anchor forces Ed: Sum(A,d) = 640.1 kN/m
Possible anchor forces Rd: Ra_cal,d = 899.3/1.400 = 642.4 kN/m
Verif. of lower failure plane Ed/Rd = 1.00 < 1.0: Έλεγχος εκπληρώθηκε.

Check of steel tension

l,tot ...[m]: Total length of anchor incl. excess length at head
As ....[mm2]: X-section are of steel member
Ri,d ...[kN]: Ultimate strength of tension member (γ,M=1.15)
A,d ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	l,tot	As	Ri,d		A,d	
-0.50	Strand;3x0.60";1570/1770	22.17	420	573.4	>	37.2	Passes requirement
-3.00	Strand;3x0.60";1570/1770	20.57	420	573.4	>	0.0	Passes requirement
-5.50	Strand;4x0.60";1570/1770	18.97	560	764.5	>	561.2	Passes requirement

Check of steel tension: Passes requirement

Check of anchor's soil friction

lVk .....: Length of grout body
DmVk ....: Diameter of grout body
τGr,k ...: Average applied skin friction along the grout body (from soil parameters)
Ra,k ....: Charact. pullout resistance of the anchor
γA ......: Partial safety factor of anchor pullout
Ra,d ....: = Ra,k / γA
A,d .....: Dimensioning force of the anchor from wall analysis

z [m]	lVk [m]	DmVk [mm]	τGr,k [kN/m²]	Ra,k [kN]	γA [-]	Ra,d [kN]		A,d [kN]	A,d/Ra,d [-]
-0.50	8.00	318	110	879.1	1.100	799.2	>	37.2	0.0
-3.00	8.00	318	110	879.1	1.100	799.2	>	0.0	0.0
-5.50	8.00	318	110	879.1	1.100	799.2	>	561.2	0.7

Check of anchor's soil friction: Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)

Συντελ.Σεισμού: Οριζόντιος: 0.028
Κατακόρυφος : 0.014

Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (-2.74, 0.53), Ακτίνα = 15.77
Αρχ.σημ.= (-14.16,-10.35), Τελ.σημ. = (13.03, 0.00)

Γεωμετρία λωρίδων:

No	x [m]	Width b [m]	dxM [m]	Weight [kN/m]	Load z-κατ. [kN/m]	Water-φορτ. [kN/m]	u*b [kN/m]	φ [°]	c [kN/m²]	θ [°]
1	-13.37	1.58	-10.64	24.7	0.0	0.0	-6.4	0.08	71.43	-42.40
2	-11.80	1.58	-9.06	65.2	0.0	0.0	-21.6	0.08	71.43	-35.05
3	-10.22	1.58	-7.48	96.3	0.0	0.0	-37.3	0.08	71.43	-28.32
4	-8.64	1.58	-5.91	120.4	0.0	0.0	-49.2	29.26	3.57	-21.98
5	-7.06	1.58	-4.33	139.9	0.0	0.0	-57.9	29.26	3.57	-15.92
6	-5.49	1.58	-2.75	153.0	0.0	0.0	-63.8	29.26	3.57	-10.04
7	-3.91	1.58	-1.17	160.1	0.0	0.0	-66.9	29.26	3.57	-4.26
8	-2.33	1.58	0.40	161.5	0.0	0.0	-67.6	29.26	3.57	1.47
9	-0.75	1.58	1.98	165.0	0.0	0.0	-129.6	29.26	3.57	7.22
10	0.82	1.58	3.56	495.4	0.0	0.0	-189.1	29.26	3.57	13.04
11	2.40	1.58	5.14	479.1	0.0	0.0	-181.8	29.26	3.57	19.01
12	3.98	1.58	6.71	457.0	13.5	0.0	-171.5	0.08	71.43	25.19
13	5.56	1.58	8.29	429.7	0.0	0.0	-157.7	0.08	71.43	31.71
14	7.13	1.58	9.87	394.1	0.0	0.0	-139.8	0.08	71.43	38.73
15	8.71	1.58	11.45	347.6	0.0	0.0	-116.2	0.08	71.43	46.52
16	10.29	1.58	13.02	278.6	0.0	0.0	-84.2	27.45	3.57	55.65
17	12.05	1.95	14.79	192.8	0.0	0.0	-40.5	27.45	3.57	69.64

Συνεισφ. κατακόρυφων φορτίων:

No	Weight	G*sin(θ)	(G-u*b)*tan(φ)	μ*sin(θ)*	T

			+ c*b	tan(φ)+cos(θ)	
	[kN/m]	[kN/m]	[kN/m]	[-]	[kN/m]
1	24.72	-16.67	112.70	0.737781	152.76
2	65.19	-37.44	112.74	0.818072	137.81
3	96.34	-45.70	112.76	0.879892	128.15
4	120.44	-45.09	45.53	0.786137	57.91
5	139.94	-38.39	51.57	0.858185	60.09
6	153.03	-26.68	55.63	0.918945	60.54
7	160.15	-11.91	57.84	0.969199	59.68
8	161.53	4.14	58.27	1.009344	57.73
9	164.96	20.73	25.43	1.039453	24.46
10	495.38	111.78	177.21	1.059293	167.29
11	479.08	156.01	172.16	1.068281	161.15
12	470.52	200.28	113.09	0.905286	124.93
13	429.68	225.86	113.06	0.851193	132.82
14	394.06	246.54	113.03	0.780689	144.78
15	347.61	252.24	113.00	0.688743	164.07
16	278.59	230.02	106.64	0.852914	125.03
17	192.84	180.79	86.11	0.675720	127.43
		1406.54			1886.64

Συνεισφ. οριζόντιων φορτίων:

Αρ	Γραμ.Φορ*dzM		Επιφ.Φορ.*dzM		Πίεση νερού*dzM		οριζ.Σεισμός.*dzM	
	[kN/m]	[m]	[kN/m]	[m]	[kN/m]	[m]	[kN/m]	[m]
1	-		-		-		0.7 *	11.26
2	-		-		-		1.8 *	11.89
3	-		-		-		2.7 *	12.38
4	-		-		-		3.3 *	12.76
5	-		-		-		3.9 *	13.06
6	-		-		-		4.2 *	13.25
7	-		-		-		4.4 *	13.36
8	-		-		-		4.5 *	13.38
9	-		-		-		4.6 *	13.20
10	-		-		-		13.7 *	8.05
11	-		-		-		13.2 *	7.81
12	-		-		-		12.6 *	7.48
13	-		-		-		11.9 *	7.08
14	-		-		-		10.9 *	6.55
15	-		-		-		9.6 *	5.88
16	-		-		-		7.7 *	4.90
17	-		-		-		5.3 *	3.09

*** Προσοχή: Στήλη 'οριζ. σεισμ.' είναι επιρροή στο οριζόντιο
συντελ.σεισμού πάνω στο I.B.

Αθρ. Ροπών από 'Συνεισφορά οριζόντιων φορτίων:': 963.5 kN*m/m
Συνεισφ. αγκυρίων: Αθρ. ροπών ανατροπής : -2351.6 kN*m/m
" " resisting : 1149.1 kN*m/m

Δράση Ed = (1406.5*15.77+963.5-2351.6)
Αντίσταση Rd = (1886.6*15.77+1149.1)

SLIP-CIRCLE μ = Ed/Rd = 0.67 < 1.0: Έλεγχος εκπληρώθηκε.

ΠΑΡΑΡΤΗΜΑ

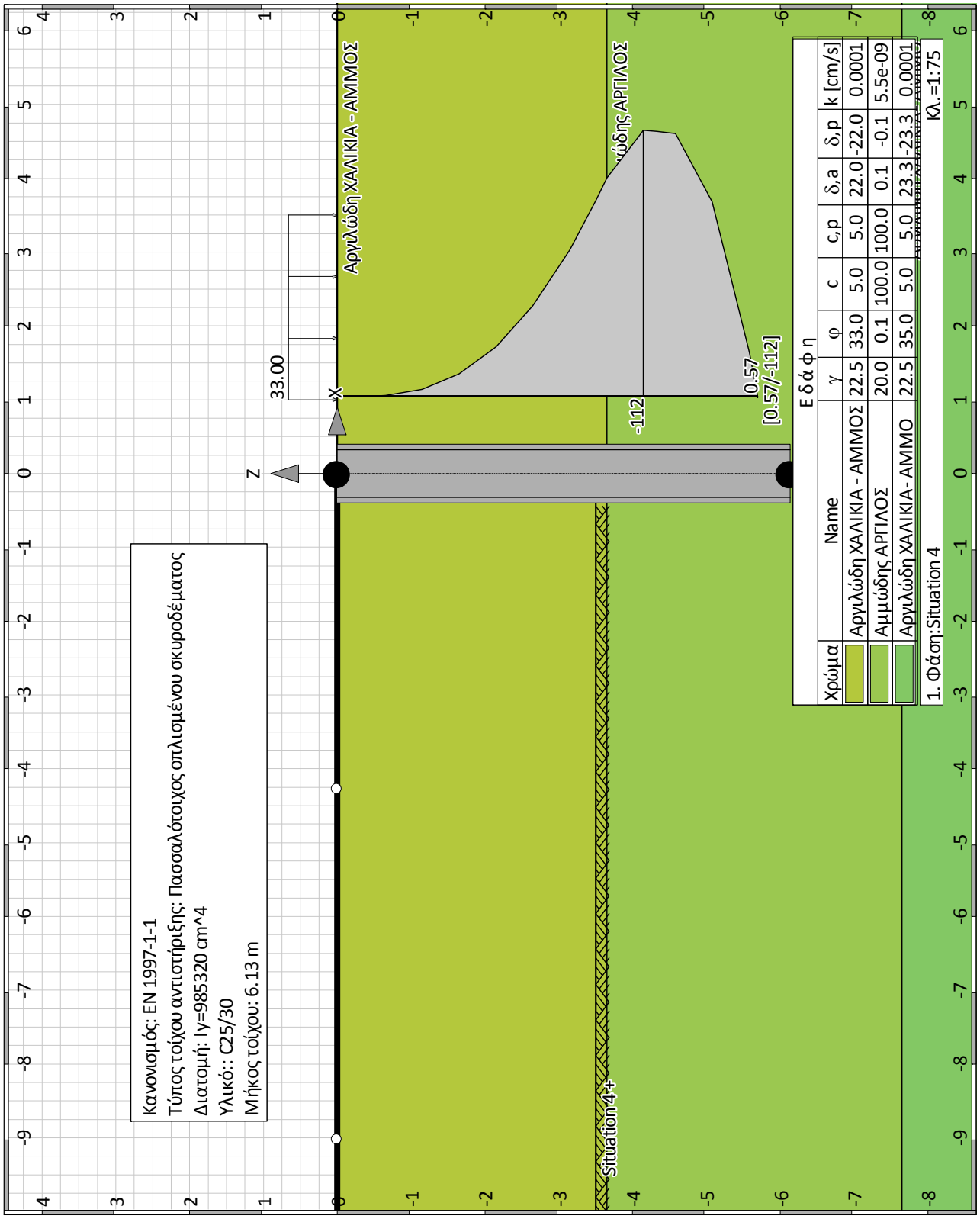
8.5 *Αποτελέσματα ανάλυσης*

8.5.2 *Σεισμικές Συνθήκες*

iv) Αντιστηριζόμενο ύψος 3,50m

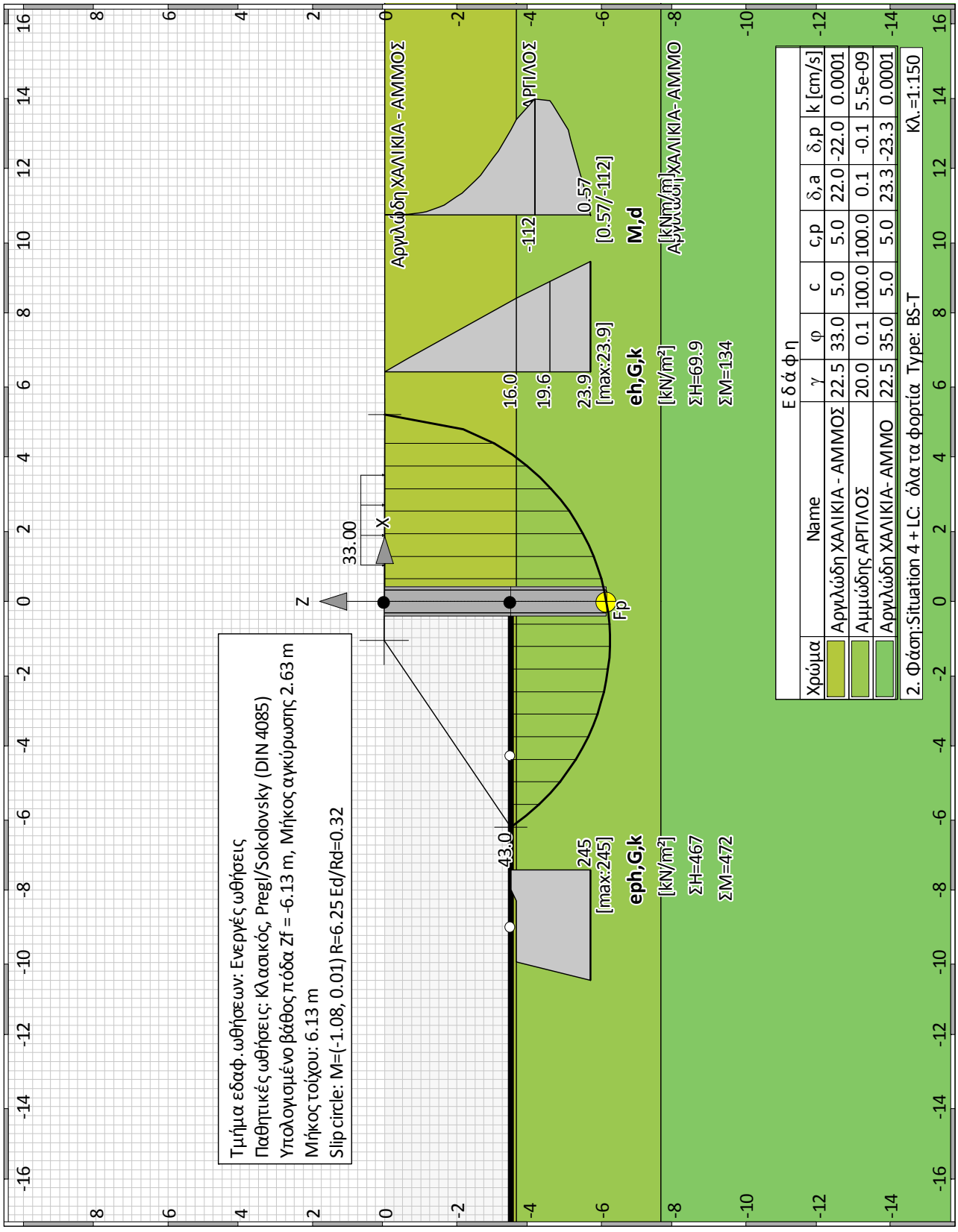
Summary of all stages

Φάση εκσκαφής 0 "Situation 4"



Χρώμα	Name	γ	φ	c	c,p	δ,a	δ,p	k [cm/s]
	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ	22.5	33.0	5.0	5.0	22.0	-22.0	0.0001
	Αμμώδης ΑΡΓΙΛΟΣ	20.0	0.1	100.0	100.0	0.1	-0.1	5.5e-09
	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ	22.5	35.0	5.0	5.0	23.3	-23.3	0.0001

Φάση εκσκαφής 1 "Situation 4 +"



Κανονισμόςγια Ανάλυση και Διαστασιολόγηση

Διαστασ. ωπλισμ.σκυροδ.: EN 1992-1-1
Γεωτεχν.Κανονισμός : EN 1997 (rev.12)_user
National Annex: EN 1997-1

Safety factors:

Earth pressure onto wall: [GEO] A1 M1 R2

	γ- G,dst	E0G	G,stb	Q,dst	Q,stb	phi	coe	cu	g
BS-P	1.350	1.350	1	1.500	0	1	1	1	1
BS-T	1.350	1.350	1	1.500	0	1	1	1	1
BS-T/A	1.350	1.350	1	1.500	0	1	1	1	1
BS-E	1	1	1	1	0	1	1	1	1

ΚΕ-μηχανισμός: [GEO] A2 M2 R3

	γ- G,dst g	G,stb a,t	W a,p	Q,dst Gt	Q,stb N	phi	coe	cu
BS-P	1	1	1	1.300	0	1.250	1.400	1.400
	1	1	1	1	1			
BS-T	1	1	1	1.300	0	1.250	1.400	1.400
	1	1	1	1	1			
BS-T/A	1	1	1	1.300	0	1.250	1.250	1.400
	1	1	1	1	1			
BS-E	1	1	1	1	0	1.250	1.400	1.400
	1	1	1	1	1			

Θραύση εδάφους: [GEO] A1 M1 R2

	γ- G,dst cu	E0G g	W Re	G,stb	Q,dst	Q,stb	phi	coe
BS-P	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.400					
BS-T	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.400					
BS-T/A	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.400					
BS-E	1	1	1	1	1	0	1	1
	1	1	1					

Ολίσθηση: [GEO] A1 M1 R2

	γ- G,dst cu	E0G g	W Rh	G,stb	Q,dst	Q,stb	phi	coe
BS-P	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.100					
BS-T	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.100					
BS-T/A	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.100					
BS-E	1	1	1	1	1	0	1	1
	1	1	1					

Θραύση εδάφους: [GEO] A1 M1 R2

	γ- G,dst cu	E0G g	W Rv	G,stb	Q,dst	Q,stb	phi	coe
BS-P	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.400					
BS-T	1.350	1.350	1.350	1	1.500	0	1	1
	1	1	1.400					

	γ-	G,dst	E0G	W	G,stb	Q,dst	Q,stb	phi	coe
		cu	g	Rv					
BS-T/A		1.350	1.350	1.350	1	1.500	0	1	1
		1	1	1.400					
BS-E		1	1	1	1	1	0	1	1
		1	1	1					

Κύκλος ολίσθησης: [GEO] A2 M2 R3

	γ-	G,dst	G,stb	Q,dst	Q,stb	W	phi	coe	cu
		g	Re	a,t	a,p	Gt	N		
BS-P		1	1	1.300	0	1	1.250	1.400	1.400
		1	1	1	1	1	1		
BS-T		1	1	1.300	0	1	1.250	1.400	1.400
		1	1	1	1	1	1		
BS-T/A		1	1	1.300	0	1	1.250	1.250	1.400
		1	1	1	1	1	1		
BS-E		1	1	1	0	1	1.250	1.400	1.400
		1	1	1	1	1	1		

Hydraulic heave: [HYD] A1 M1 R1

	γ-	G,dst	G,stb	Q,dst	H
BS-P		1.350	0.900	1.500	1.800
BS-T		1.350	0.900	1.500	1.600
BS-T/A		1.350	0.900	1.500	1.500
BS-E		1	1	1	1

Failure of structural elements: [STR] A1 M1 R1

	γ-	M	Gtf	cd	N
BS-P		1.150	1.400	1.400	1.150
BS-T		1.150	1.300	1.300	1.150
BS-T/A		1.150	1.250	1.250	1.150
BS-E		1	1	1	1

Stability: [EQU] A1 M1 R1

	γ-	G,dst	G,stb	Q,dst	Q,stb	phi	coe	cu	g
BS-P		1	0.900	1.500	0	1.250	1.250	1.400	1
BS-T		1	0.900	1.500	0	1.250	1.250	1.400	1
BS-T/A		1	0.900	1.500	0	1.250	1.250	1.400	1
BS-E		1	1	1	0	1.250	1.400	1.400	1

γ,Re,red (EAB EB14-3): Ναι, η=0.80
γ,Re,red (EAB EB22-6): Ναι, E0h > 0%: η = 0.60 / 0.80

System values

Τοίχος

Τύπος τοίχου αντιστήριξης: Πασσαλότοιχος οπλισμένου σκυροδέματος
Διατομή: Iy=985320 cm^4
Υλικό:: C25/30
Ίδιο βάρος: 25.000 [kN/m3]

Σημεία τοίχου

z	d	E	Iy	E*Iy	A
[m]	[m]	[MN/m2]	[cm4/m]	[MNm2]	[cm2/m]
0.00	80.0	31500.0	985320	310.4	6940
-6.13	80.0	31500.0	985320	310.4	6940

Φάση εκσκαφής 1 "[1] Situation 4 +"

LC: όλα τα φορτία Type: BS-T

Εδαφικό σύστημα με 3 Στρώσεις

Name		Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ	Αμμώδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	22.5	20	22.5
γ,R	[kN/m3]	22.5	20	22.5
γ'	[kN/m3]	12.5	10	12.5
γ,p	[kN/m3]	22.5	20	22.5
γ,R,passive	[kN/m3]	22.5	20	22.5
γ,pw	[kN/m3]	12.5	10	12.5
φ	[°]	33	0.1	35
c	[kN/m2]	5	100	5
c,u	[kN/m2]	5	100	5
c παθητικό	[kN/m2]	5	100	5
δ,a	[°]	22	0.06666667	23.33333
δ,p	[°]	-22	-0.06666667	-23.33333
δ,c	[°]	11	0.03333333	11.66667
k,agh	[-]	0.2452023	0.9955057	0.2244207
K,ach	[-]	0.8549058	1.994195	0.8126539
K,0h	[-]	0.455361	0.9982547	0.4264236
K,pgh	[-]	7.495617	1.004519	9.146943
K,pch	[-]	8.599509	2.00583	10.104
τ,gr	[kN/m2]	110	110	110
Ψ,A,max	[°]	90	90	90
k	[cm/s]	100e-06	5.5e-09	100e-06

Πορεία πρανούς:

x [m]	0.00	0.00
z [m]	-3.50	0.00

Πορεία ανώτερου 2. στρώματος Αμμώδης ΑΡΓΙΛΟΣ:
z= -3.65

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:
z= -7.65

Επιφ. φορτία:

Φορτία

xA [m]	zA [m]	xE [m]	zE [m]	PxA [kN/m²]	PzA [kN/m²]	PxE [kN/m²]	PzE [kN/m²]	Typ	LC-description Name
1.00	0.00	3.50	0.00	0.00	33.00	0.00	33.00	q	1

Κατανομή εδαφ.πιέσεων

Κατανομή εδαφ.πιέσεων	Name
Rectangular within a layer	

Παράμετροι υπολογισμού

Earth pressure options

Τμήμα εδαφ.ωθήσεων: Mononobe/Okabe (earth quake EC 8).
Angle of slip plane: DIN 4085.
Split block loads into 1 sections.
Consideration of minimum earth pressure: φ,min = 40.000.
Negative earth pressure fractions are set to zero.

Redistribution of earth pressure

Shape of redistribution: No redistribution of earth pressure.
The earth pressure is getting redistb. to: Excavation level
The earth pressure below the excavation acts without redistrb.
The earth pressure from variable loads will be included in redistribution.

Παθητικές ωθήσεις

Method of calculation: Mononobe/Okabe (earth quake EC 8).

Options for water pressure

Στήριξη πόδα

Πακτωμένη στήριξη κατά Blum

Earthquake

kh,eq = α*S*r = 0.028 (r=1.0)

Earth pressure coefficients kh

φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
35.0	0.0	0.0	-23.3	--	--	--	9.147	-10.104	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"

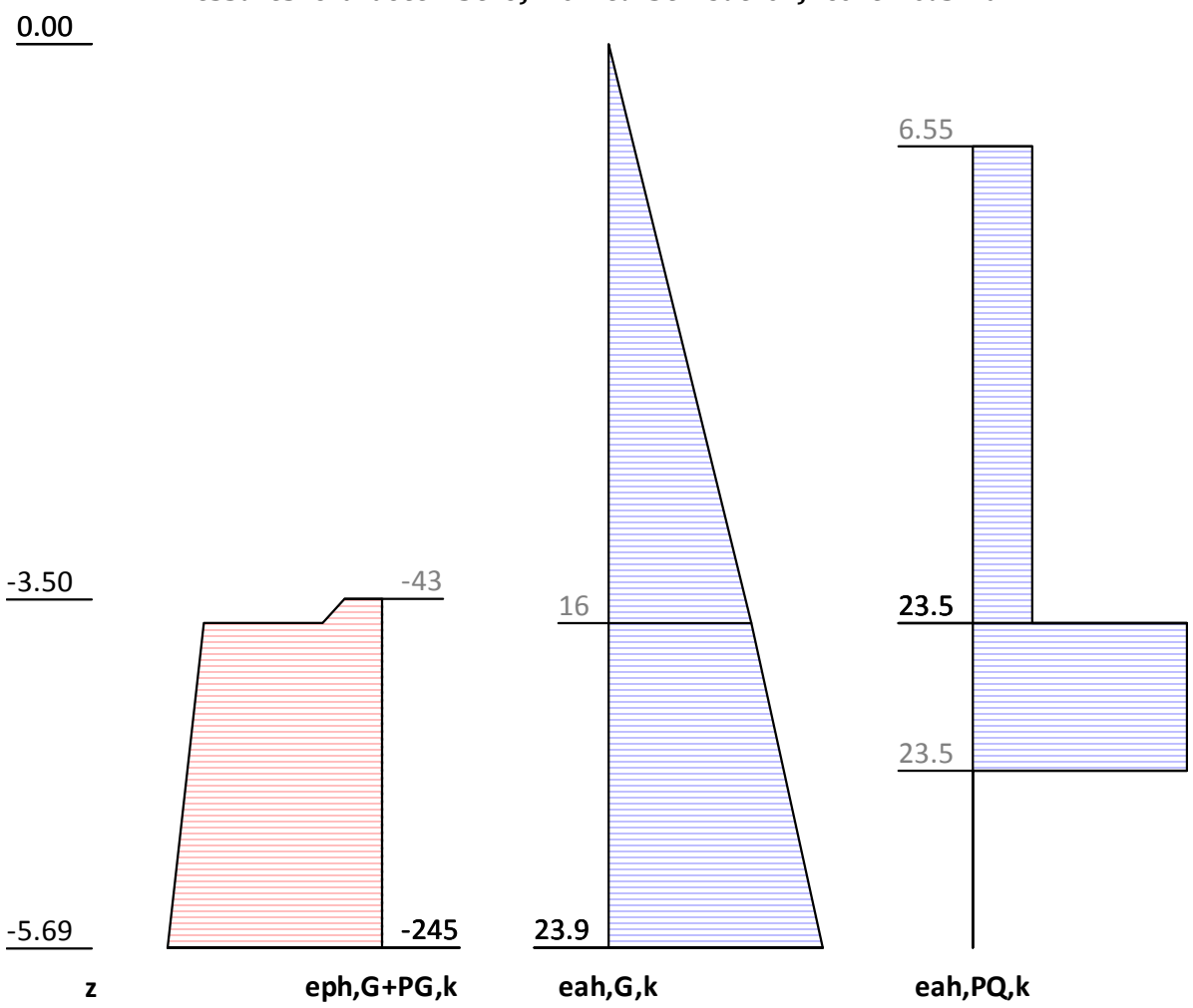
Μήκος τοίχου

```
N:   1 Z:   -4.550 M,Στήριξη πόδα,d:   111.01. Wall too short? Ναι
N:   2 Z:   -7.550 M,Στήριξη πόδα,d:  -585.12. Wall too short? Όχι
N:   3 Z:   -5.540 M,Στήριξη πόδα,d:    25.00. Wall too short? Ναι
N:   4 Z:   -6.887 M,Στήριξη πόδα,d:  -316.09. Wall too short? Όχι
N:   5 Z:   -5.984 M,Στήριξη πόδα,d:   -58.13. Wall too short? Όχι
N:   6 Z:   -5.687 M,Στήριξη πόδα,d:     0.69. Wall too short? Ναι
N:   7 Z:   -5.886 M,Στήριξη πόδα,d:   -37.30. Wall too short? Όχι
N:   8 Z:   -5.752 M,Στήριξη πόδα,d:   -11.21. Wall too short? Όχι
N:   9 Z:   -5.708 M,Στήριξη πόδα,d:    -3.17. Wall too short? Όχι
N:  10 Z:   -5.694 M,Στήριξη πόδα,d:    -0.57. Wall too short? Όχι
N:  11 Z:   -5.689 M,Στήριξη πόδα,d:     0.28. Wall too short? Ναι
Foot depth for statics: zf = -5.694
```

Stress analysis

Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall

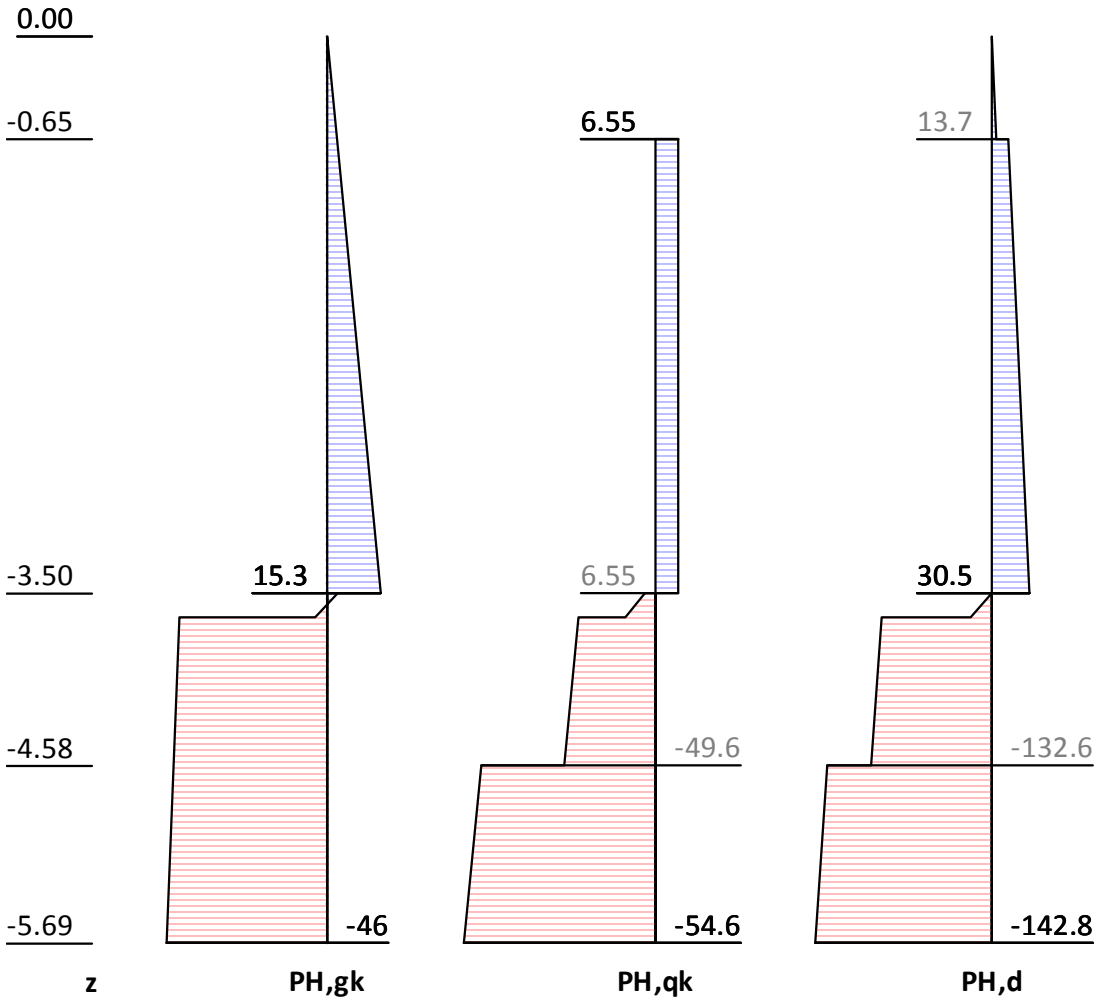


z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.65		2.84	0.00	3.84
-0.65		2.84	6.55	13.65
-3.50	-0.00	15.30	6.55	30.48
-3.50	-43.00	15.30	6.55	30.48
-3.65	-68.30	15.96	6.55	31.36
-3.65	-203.97	15.96	23.48	56.76
-4.58	-222.69	19.58	23.48	61.64
-4.58	-222.69	19.58	0.00	26.42
-5.69	-245.03	23.90	0.00	32.26

Eph,G,k: -467.19, Eph,PG,k: 0.00 [kN/m]
Eah,G,k: 69.85, Eah,PG,k: 0.00, Eah,PQ,k: 41.47, Eah,d: 156.51

H-pressure on static system

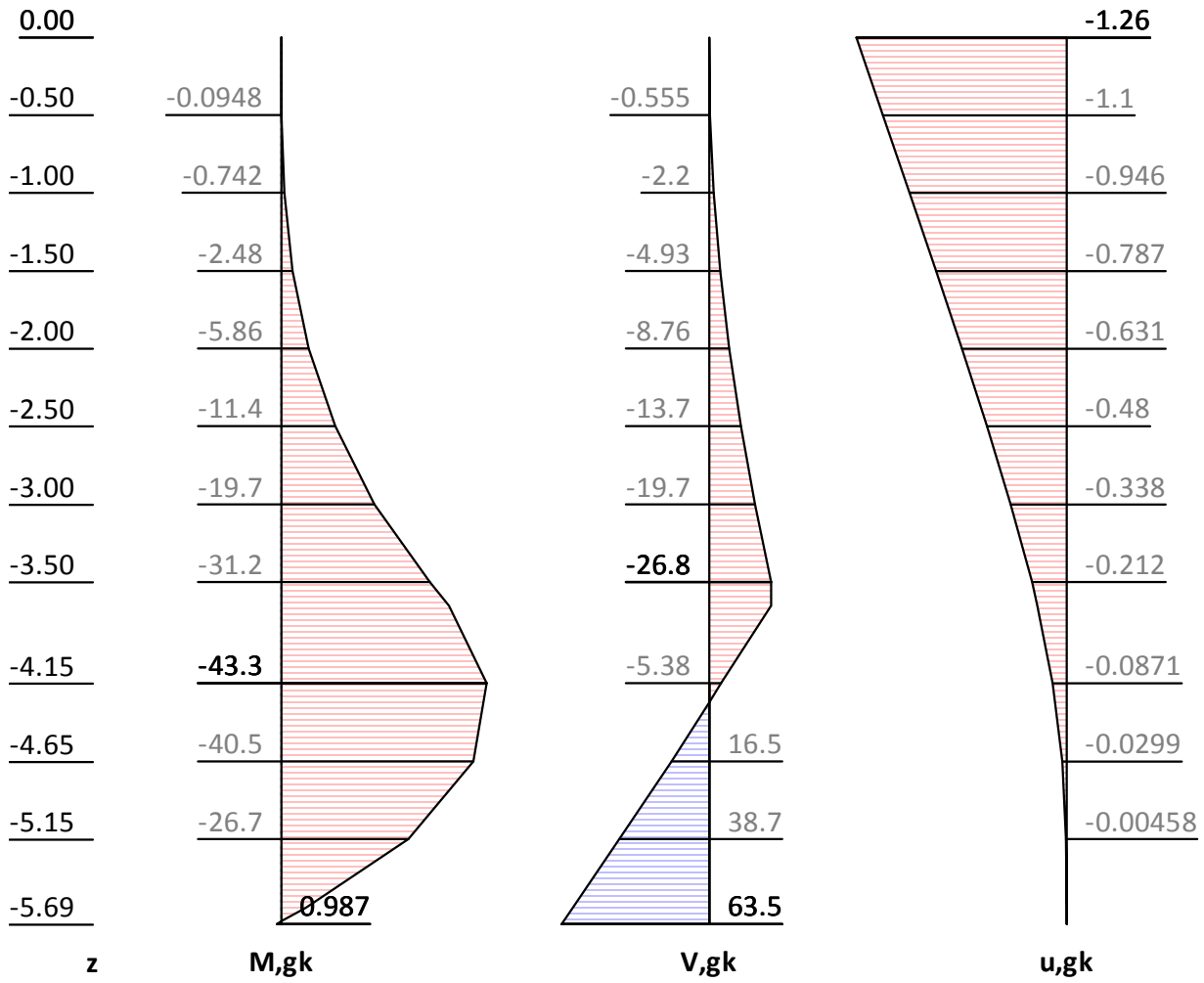
Level of mobilization: Ep,gk 28.5, Ep,qk 22.3, Ep,d 100.0 [%]



z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	0.00		0.00
-0.65	2.84	0.00	3.84
-0.65	2.84	6.55	13.65
-3.50	15.30	6.55	30.48
-3.50	3.03	-3.04	-0.24
-3.57	-0.00	-5.64	-8.16
-3.65	-3.54	-8.67	-17.42
-3.65	-42.26	-21.98	-88.93
-4.58	-43.99	-26.14	-97.40
-4.58	-43.99	-49.62	-132.62
-5.69	-46.04	-54.61	-142.76

V-pressure on static system

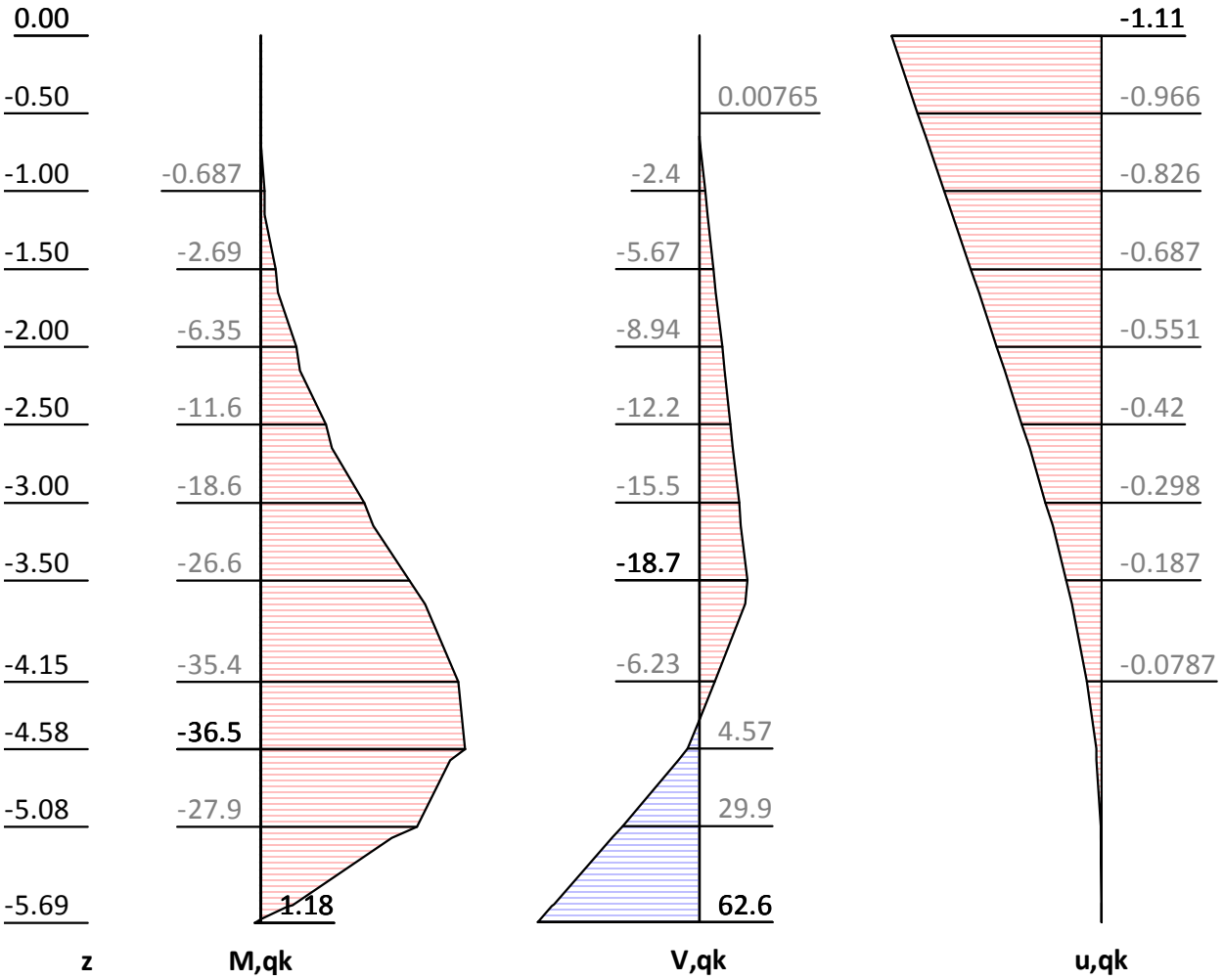
Internal forces: Permanent, characteristically



z [m]	H,g,k [kN/m2]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [mm]
0.00	0.00	0.00	0.00	0.00	-1.26
-3.50	15.30	-31.24	-26.78	-71.54	-0.21
-3.50	3.03	-31.24	-26.78	-71.54	-0.21
-3.57	-0.00	-33.10	-26.76	-72.73	-0.20
-3.65	-3.54	-35.27	-26.74	-74.13	-0.18
-3.65	-42.26	-35.27	-26.74	-74.13	-0.18
-4.15	-43.19	-43.29	-5.38	-82.78	-0.09
-4.27	-43.42	-42.61	0.00	-84.91	-0.07
-5.67	-46.01	-0.00	62.76	-109.20	-0.00
-5.69	-46.04	0.99	63.50	-109.48	0.00

Internal forces: Variable, characteristically

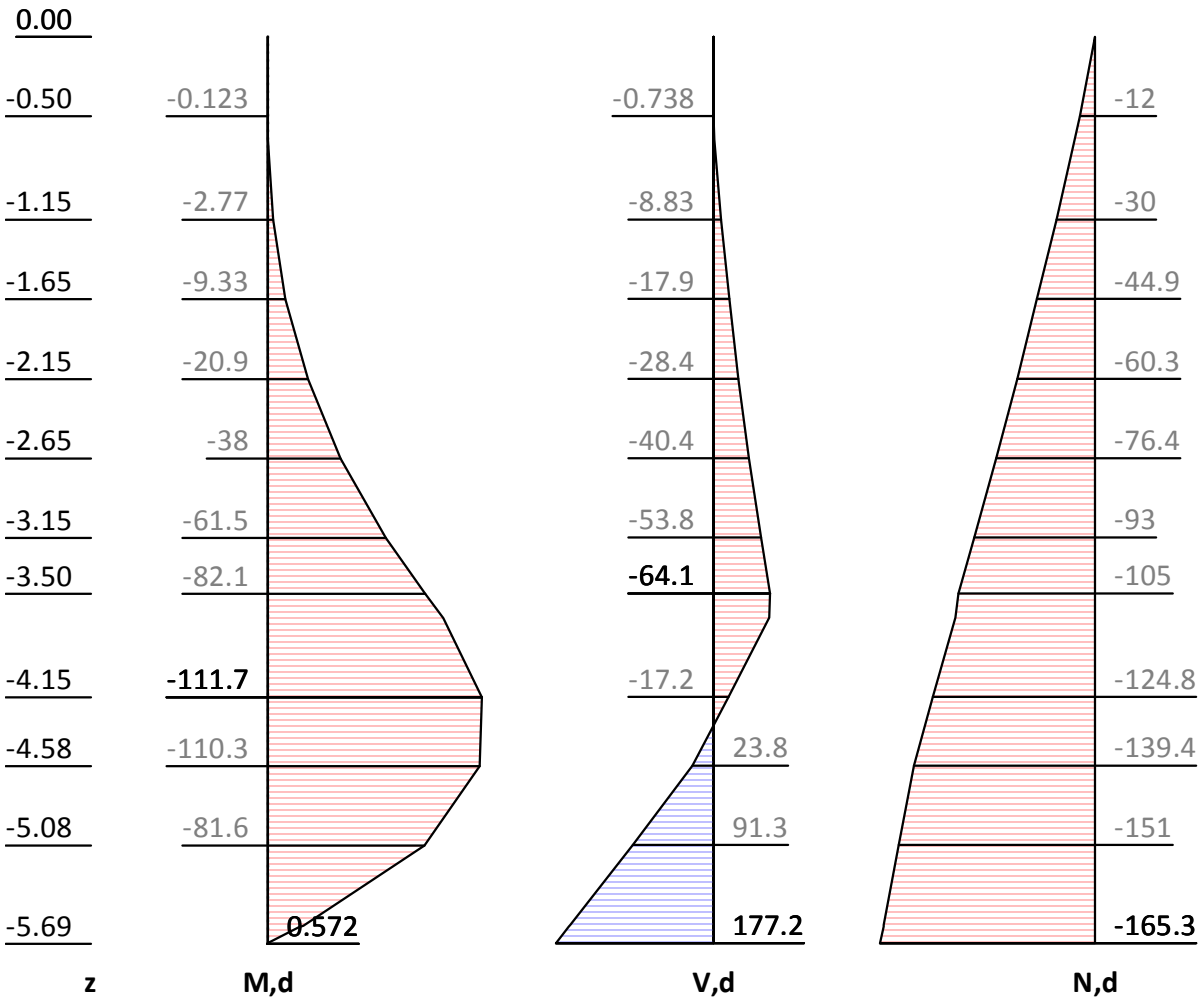
Method EB 82-4 (Q = [G+Q] - G).

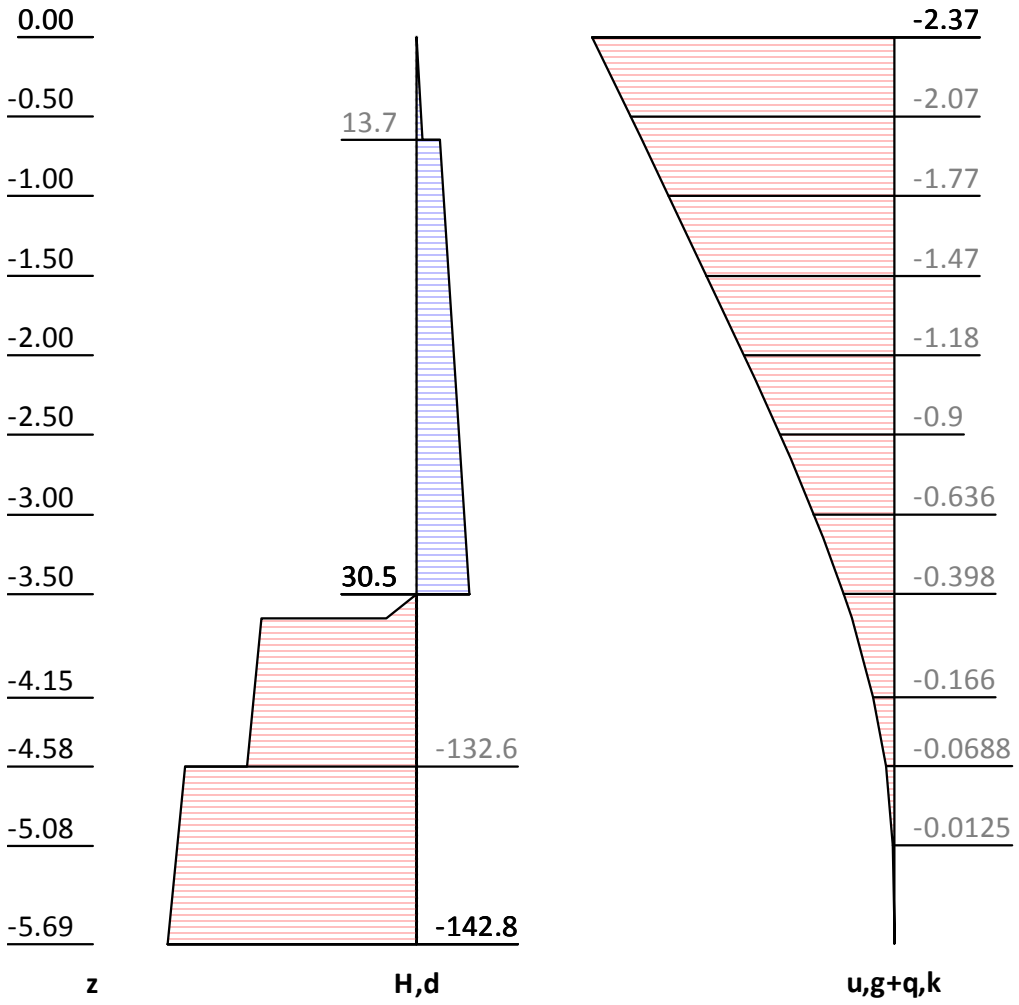


z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
0.00		0.00	0.00	0.00	-1.11
-0.65	0.00	0.09	0.12	0.05	-0.92
-0.65	6.55	0.09	0.12	0.05	-0.92
-0.67	6.55	0.05	-0.00	0.01	-0.92
-0.67	6.55	0.04	-0.04	0.00	-0.92
-0.69	6.55	-0.00	-0.16	-0.04	-0.91
-3.50	6.55	-26.58	-18.66	-5.64	-0.19
-3.50	-3.04	-26.58	-18.66	-5.64	-0.19
-3.65	-8.67	-29.33	-17.78	-5.18	-0.16
-3.65	-21.98	-29.33	-17.78	-5.18	-0.16
-4.40	-25.33	-36.00	-0.00	-10.45	-0.05
-4.58	-26.14	-36.45	4.57	-11.73	-0.03
-4.58	-49.62	-36.45	4.57	-11.73	-0.03
-4.65	-49.94	-33.93	8.18	-11.72	-0.03
-5.15	-52.18	-23.50	33.70	-11.69	-0.01
-5.57	-54.08	-5.99	56.10	-11.67	-0.00
-5.58	-54.11	-5.71	56.45	-11.67	0.00
-5.59	-54.15	-4.93	57.11	-11.67	-0.00
-5.67	-54.52	-0.00	61.58	-11.66	-0.00

z [m]	H,q,k [kN/m2]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [mm]
-5.69	-54.61	1.18	62.65	-11.66	0.00

Internal forces: Design

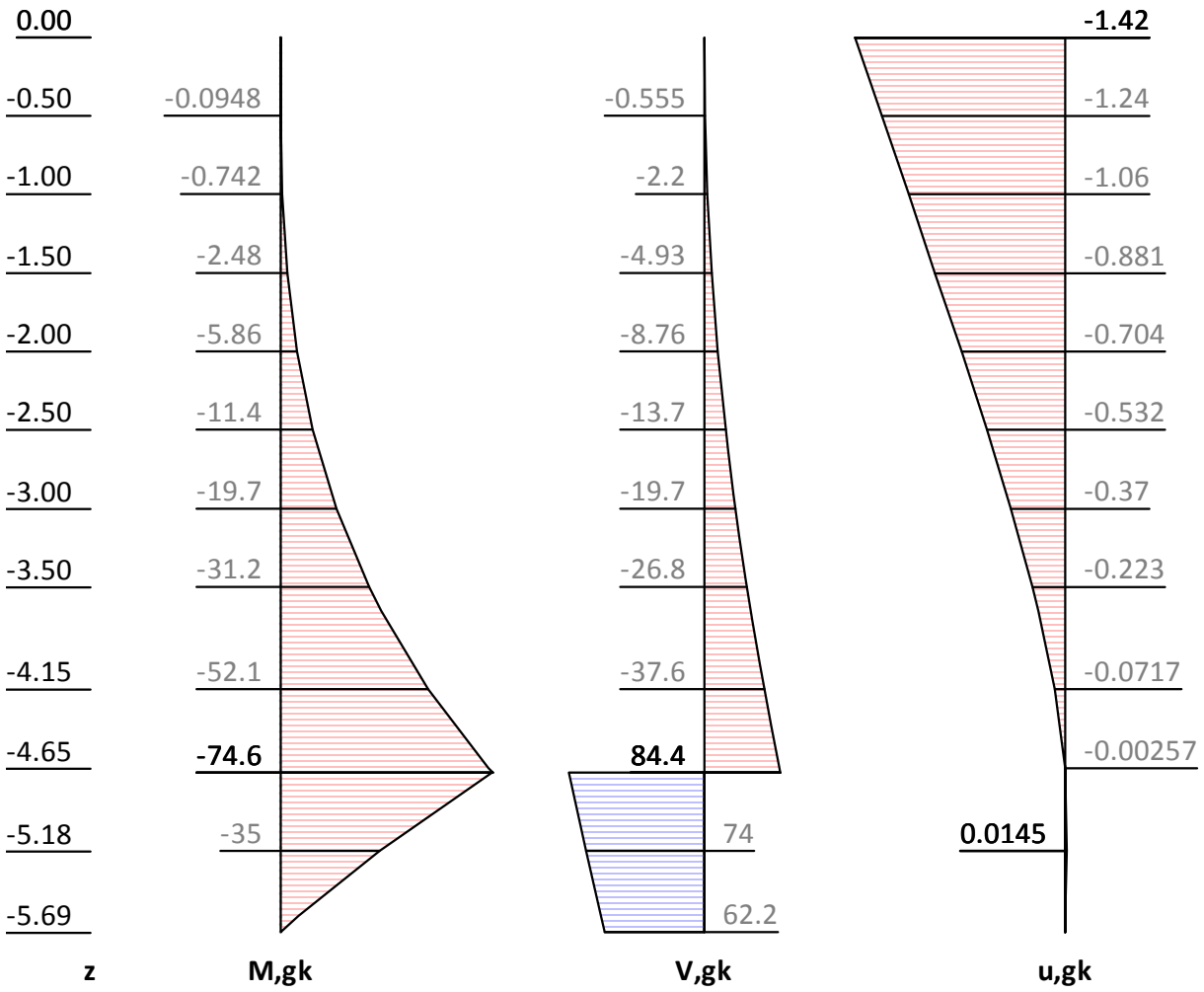




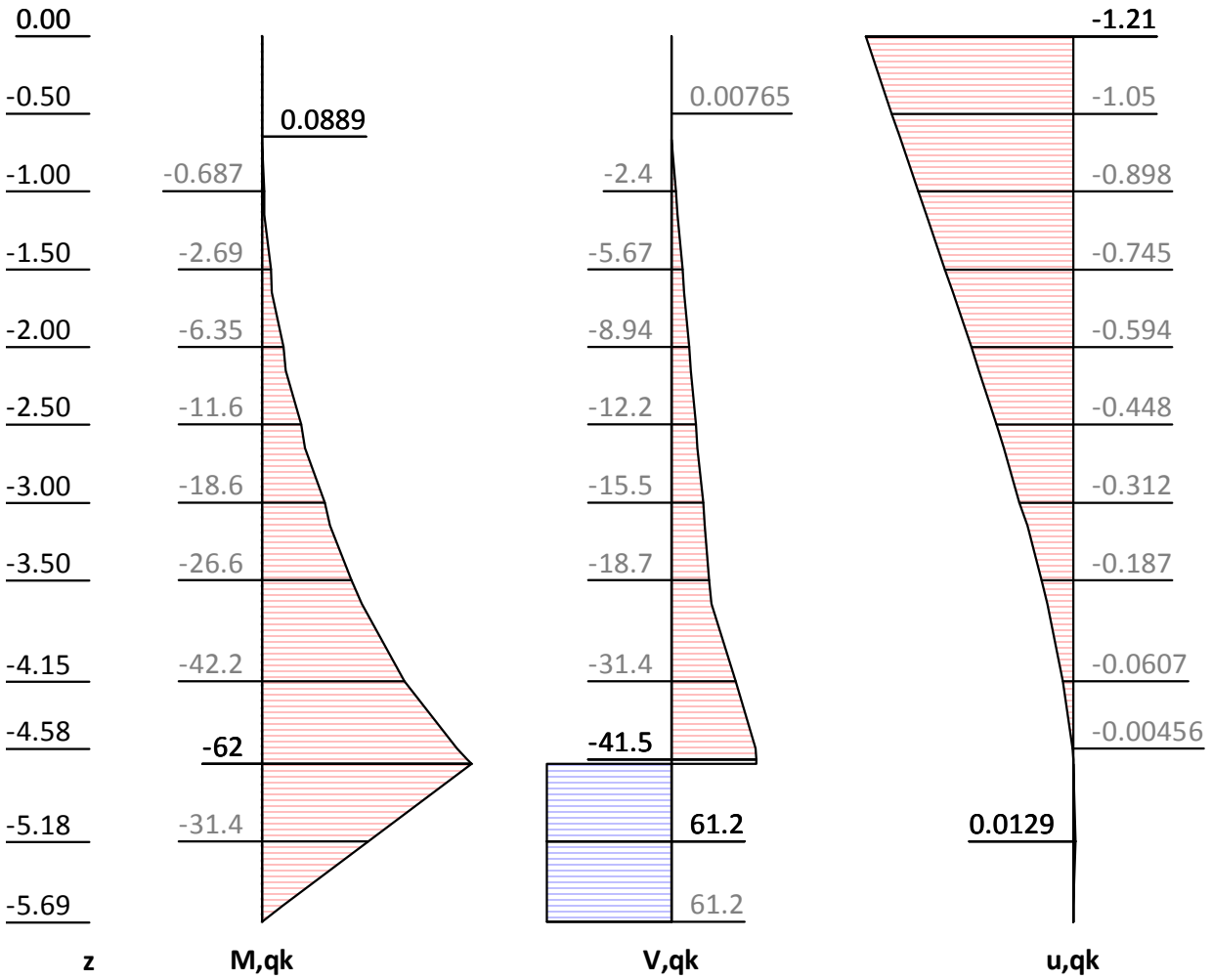
z [m]	H,d [kN/m2]	M,d [kN/m2]	V,d [kN/m2]	N,d [kN/m2]	u,g+q,k [mm]
0.00	0.00	0.00	0.00	0.00	-2.37
-0.00	0.00	0.00	-0.00	-0.00	-2.37
-0.65	3.84	-0.27	-1.25	-15.73	-1.98
-0.65	13.65	-0.27	-1.25	-15.73	-1.98
-3.50	30.48	-82.05	-64.13	-105.03	-0.40
-3.50	-0.24	-82.05	-64.13	-105.03	-0.40
-3.65	-17.42	-91.60	-62.81	-107.86	-0.34
-3.65	-88.93	-91.60	-62.81	-107.86	-0.34
-4.15	-93.48	-111.68	-17.20	-124.82	-0.17
-4.33	-95.12	-111.12	0.00	-130.92	-0.13
-4.58	-97.40	-110.34	23.83	-139.40	-0.07
-4.58	-132.62	-110.34	23.83	-139.40	-0.07
-5.69	-142.73	-0.00	176.72	-165.23	-0.00
-5.69	-142.76	0.57	177.20	-165.31	0.00

Checks of earth statics

Substitute system according to Blum



z [m]	M,g,k [kN/m2]	V,g,k [kN/m2]	N,g,k [kN/m2]	u,g,k [kN/m2]
0.00	0.00	0.00	0.00	-1.42
-4.68	-74.62	-47.63	-92.99	0.00
-4.68	-74.62	84.42	-92.99	0.00
-5.18	-34.99	73.95	-101.68	0.01
-5.69	0.00	62.19	-110.60	0.00



z [m]	M,q,k [kN/m2]	V,q,k [kN/m2]	N,q,k [kN/m2]	u,q,k [kN/m2]
0.00	-0.00	0.00	0.00	-1.21
-0.00	0.00	0.00	0.00	-1.21
-0.65	0.09	0.12	0.05	-1.01
-0.67	0.05	0.00	0.01	-1.00
-0.67	0.04	-0.04	0.00	-1.00
-0.69	0.00	-0.16	-0.04	-0.99
-4.65	-60.79	-41.48	-12.53	-0.00
-4.68	-62.04	-41.47	-12.53	0.00
-4.68	-62.04	61.22	-12.53	0.00
-5.18	-31.43	61.22	-12.53	0.01
-5.69	0.00	61.22	-12.53	0.00

Bh,gk = -132.05; Ch,gk = 62.19 [kN/m]
Bh,qk = -102.70; Ch,qk = 61.22 [kN/m]
Bh,d = -332.31; Ch,d = 175.79 [kN/m]

Check of C-force (foot support)

```
z(C)                                          =   -5.69 [kN/m]
G,k = sum(γ*h)                                =  123.00 [kN/m]
P,k = sum(Pz,k(x=  0.1))                      =    0.00 [kN/m]
kpgh,C(phi=  0.1; δ,C=  0.0°)                 =   1.002 [-]
kpch,C                                        =   2.003 [-]
eph,C,gk =(G,k+P,k)*kpgh,C+2*c*sqrt(kpch,C)=  406.31 [kN/m2]
         = (123.00+0.00)*1.002+2*100.0*1.415
Ed = Ch,d                                     =  175.79 [kN/m2]
δ,t,EAU          = Ed/(2*eph,C,d)             =    0.30 [m]
δ,t,EAB          =  0.20 * t                  =    0.44 [m]
δ,t = δ,t,EAB                                 =    0.44 [m]
Rd = 2*δ,t*eph,C,gk/γ,Re
   = 2*0.44*406.31/1.4
                                              =  254.68 [kN/m2]
```

Ed/Rd = 0.690 [-]. Passes requirement

Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.
z: -4.68 m
Rd = Eph,k/γ,Re = 467.19 / 1.400 = 333.71 [kN/m]

Ed(Bh,d)/Rd = 332.31 / 333.71 = 0.996 [-]. Passes requirement

Sum of H and V forces, (G)

Forces up to depth z:-5.69

Pos.	H	V
H/V pressure G+P+W,k	69.85	11.81
Wall weight		106.39
H/V pressure passive		-0.00
Bh,g,k z=-4.68	-132.05	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.15
Ch,g	62.19	
Cv,g = Ch*tan(δ,C=0.0°)		0.04
Σ	-0.00	118.09 (downwards)

Simple check, EAB R 9-3a

Vk >= Bvk: 118.24 >= 0.15 Passes requirement

Sum of H and V forces, (G+Q)

Forces up to depth z:-5.69

Pos.	H	V
H/V pressure G+P+W,k	111.33	24.34
Wall weight		106.39
H/V pressure passive		0.00
Bh,g,k z=-4.68	-132.05	
Bv,g,k = Bh,k * tan(δ,p=-0.07°)		-0.15
Bh,q,k z=-4.68	-102.70	
Bv,q,k = Bh,k * tan(δ,p=-0.07°)		-0.12
Ch,g	62.19	
Cv,g = Ch*tan(δ,C=0.0°)		0.04
Ch,q	61.22	
Cv,q = Ch*tan(δ,C=0.0°)		0.04

Pos.	H	V
Σ	0.00	130.54 (downwards)

Simple check, EAB R 9-3a

Vk >= Bvk: 130.81 >= 0.27 Passes requirement

Υπολογ. κύκλου ολίσθησης

LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)

Συντελ.Σεισμού: Οριζόντιος: 0.028
Κατακόρυφος : 0.014

Vertical variable loads only act if they are outside of R*sin(phi).
The automatic slip circle optimization only considers circles that intersect
the surface with an area of at least 0.25 m2.
The slip circle calculation only accepts circles including the wall.
The slipcircle calculation only allows circular failure planes
(no vertical tangents will occour).

Γεωμετ.κύκλου (μήκη και συντεταγμ. σε (m))
Κέντρο = (-1.08, 0.01), Ακτίνα = 6.25
Αρχ.σημ.= (-6.25, -3.50), Τελ.σημ. = (5.17, 0.00)

Γεωμετρία λωρίδων:

No	x	Width b	dxM	Weight	Load z-κατ.	Water-φορτ.	u*b	φ	c	θ
	[m]	[m]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[°]	[kN/m²]	[°]
1	-5.94	0.63	-4.86	5.6	0.0	0.0	0.0	0.08	71.43	-44.96*
2	-5.31	0.63	-4.23	14.0	0.0	0.0	0.0	0.08	71.43	-42.61
3	-4.69	0.63	-3.61	20.4	0.0	0.0	0.0	0.08	71.43	-35.24
4	-4.06	0.63	-2.98	25.3	0.0	0.0	0.0	0.08	71.43	-28.49
5	-3.44	0.63	-2.36	29.1	0.0	0.0	0.0	0.08	71.43	-22.15
6	-2.81	0.63	-1.73	31.8	0.0	0.0	0.0	0.08	71.43	-16.08
7	-2.19	0.63	-1.11	33.7	0.0	0.0	0.0	0.08	71.43	-10.20
8	-1.56	0.63	-0.48	34.7	0.0	0.0	0.0	0.08	71.43	-4.42
9	-0.94	0.63	0.14	34.9	0.0	0.0	0.0	0.08	71.43	1.32
10	-0.31	0.63	0.77	34.5	0.0	0.0	0.0	0.08	71.43	7.06
11	0.31	0.63	1.39	82.8	0.0	0.0	0.0	0.08	71.43	12.89
12	0.94	0.63	2.02	80.6	11.0	0.0	0.0	0.08	71.43	18.84
13	1.56	0.63	2.64	77.4	27.2	0.0	0.0	0.08	71.43	25.02
14	2.19	0.63	3.27	73.1	27.2	0.0	0.0	0.08	71.43	31.53
15	2.81	0.63	3.89	67.6	27.2	0.0	0.0	0.08	71.43	38.54
16	3.44	0.63	4.52	60.3	16.2	0.0	0.0	0.08	71.43	46.30
17	4.06	0.63	5.14	50.4	0.0	0.0	0.0	27.45	3.57	55.39
18	4.77	0.79	5.85	39.4	0.0	0.0	0.0	27.45	3.57	69.47

*** Σημείωση: Στις λωρίδες σημειωμένες με '*'
περιορίστηκε το theta στο 45°-Phi/2.

Συνεισφ. κατακόρυφων φορτίων:

No	Weight	G*sin(θ)	(G-u*b)*tan(φ) + c*b	μ*sin(θ)* tan(φ)+cos(θ)	T
	[kN/m]	[kN/m]	[kN/m]	[-]	[kN/m]
1	5.57	-4.33	44.65	0.707287	63.13
2	14.01	-9.48	44.67	0.735679	60.71
3	20.41	-11.77	44.67	0.816485	54.72

No	Weight [kN/m]	G*sin(θ) [kN/m]	(G-u*b)*tan(φ) + c*b [kN/m]	μ*sin(θ)* tan(φ)+cos(θ) [-]	T [kN/m]
4	25.33	-12.08	44.68	0.878689	50.85
5	29.08	-10.96	44.69	0.926044	48.26
6	31.83	-8.82	44.69	0.960746	46.52
7	33.67	-5.96	44.69	0.984132	45.41
8	34.69	-2.67	44.69	0.996997	44.83
9	34.90	0.80	44.70	0.999746	44.71
10	34.48	4.24	44.69	0.992462	45.03
11	82.84	18.47	44.76	0.974918	45.91
12	91.55	29.57	44.77	0.946544	47.30
13	104.59	44.24	44.79	0.906319	49.42
14	100.33	52.47	44.79	0.852567	52.53
15	94.77	59.04	44.78	0.782501	57.23
16	76.56	55.35	44.75	0.691173	64.75
17	50.43	41.51	28.43	0.703591	40.41
18	39.44	36.94	23.33	0.504914	46.20
		276.56			907.93

Συνεισφ. οριζόντιων φορτίων:

Αρ	Γραμ.Φορ*dzM [kN/m]	[m]	Επιφ.Φορ.*dzM [kN/m]	[m]	Πίεση νερού*dzM [kN/m]	[m]	οριζ.Σεισμός.*dzM [kN/m]	[m]
1	-		-		-		0.2 *	3.72
2	-		-		-		0.4 *	4.05
3	-		-		-		0.6 *	4.30
4	-		-		-		0.7 *	4.50
5	-		-		-		0.8 *	4.64
6	-		-		-		0.9 *	4.75
7	-		-		-		0.9 *	4.82
8	-		-		-		1.0 *	4.86
9	-		-		-		1.0 *	4.87
10	-		-		-		1.0 *	4.84
11	-		-		-		2.3 *	2.97
12	-		-		-		2.2 *	2.88
13	-		-		-		2.1 *	2.76
14	-		-		-		2.0 *	2.60
15	-		-		-		1.9 *	2.40
16	-		-		-		1.7 *	2.13
17	-		-		-		1.4 *	1.78
18	-		-		-		1.1 *	1.10

*** Προσοχή: Στήλη 'οριζ. σεισμ.' είναι επιρροή στο οριζόντιο
συντελ.σεισμού πάνω στο I.B.
Αθρ. Ροπών από 'Συνεισφορά οριζόντιων φορτίων:': 70.2 kN*m/m

Δράση Ed = (276.6*6.25 +70.2)
Αντίσταση Rd = (907.9*6.25 +0.0)

SLIP-CIRCLE μ = Ed/Rd = 0.32 < 1.0: Έλεγχος εκπληρώθηκε.
