

**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 :

**ΜΕΛΕΤΗ ΕΦΑΡΜΟΓΗΣ ΑΝΤΙΣΤΗΡΙΞΗΣ**

**ΠΑΡΑΡΤΗΜΑ - ΤΕΥΧΟΣ II 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 2019
ΣΥΜΒΟΥΛΟΣ ΑΚΟΥΣΤΙΚΗΣ ΜΕΛΕΤΗΣ: Ι. ΜΑΡΙΝΟΣ	ΓΕΩΤΕΧΝΙΚΗ ΜΕΛΕΤΗ: Ν. ΔΕΡΕΚΑΣ		

ΣΦΡΑΓΙΔΕΣ ΥΠΟΓΡΑΦΕΣ

**ΔΕΡΕΚΑΣ ΣΠ. ΝΙΚΟΛΑΟΣ**  
ΓΕΩΛΟΓΟΣ  
Γ. ΠΑΠΑΝΔΡΕΟΥ 18 - ΙΩΑΝΝΙΝΑ  
ΑΦΜ: 070650751 - ΔΟΥ: Β' ΙΩΑΝΝΙΝΩΝ  
ΤΗΛ: 2651075650 / email: info@geosfarmogi.gr

Κεφ.	Υποκ.	Παρ.	ΠΕΡΙΕΧΟΜΕΝΑ
<b>8.</b>			<b>ΠΑΡΑΡΤΗΜΑ – ΤΕΥΧΟΣ ΙΙ Α</b>
	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 6,10m
			ii) Αντιστηριζόμενο ύψος 7,80 m
			iii) Αντιστηριζόμενο ύψος 9,70m
			iv) Αντιστηριζόμενο ύψος 3,60m
		8.5.2	Σεισμικές Συνθήκες
			i) Αντιστηριζόμενο ύψος 6,10m
			ii) Αντιστηριζόμενο ύψος 7,80m
			iii) Αντιστηριζόμενο ύψος 9,70m
			iv) Αντιστηριζόμενο ύψος 3,60m

ΕΡΓΟ : ΚΤΙΡΙΟ ΤΟΥ ΤΜΗΜΑΤΟΣ ΜΟΥΣΙΚΩΝ ΣΠΟΥΔΩΝ ΣΤΟ ΟΙΚΟΠΕΔΟ Ε.Α.Σ.Κ.

ΜΕΛΕΤΗ: ΜΕΛΕΤΗ ΑΝΤΙΣΤΗΡΙΞΗΣ - ΤΕΥΧΟΣ II Α: ΠΑΡΑΡΤΗΜΑ

## ΠΑΡΑΡΤΗΜΑ

### *8.1 Οριζοντιογραφία θέσεων γεωτεχνικής έρευνας*

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ΟΡΙΖΟΝΤΙΟΓΡΑΦΙΑ ΘΕΞΕΩΝ 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



ΕΡΓΟ : ΚΤΙΡΙΟ ΤΟΥ ΤΜΗΜΑΤΟΣ ΜΟΥΣΙΚΩΝ ΣΠΟΥΔΩΝ ΣΤΟ ΟΙΚΟΠΕΔΟ Ε.Α.Σ.Κ.

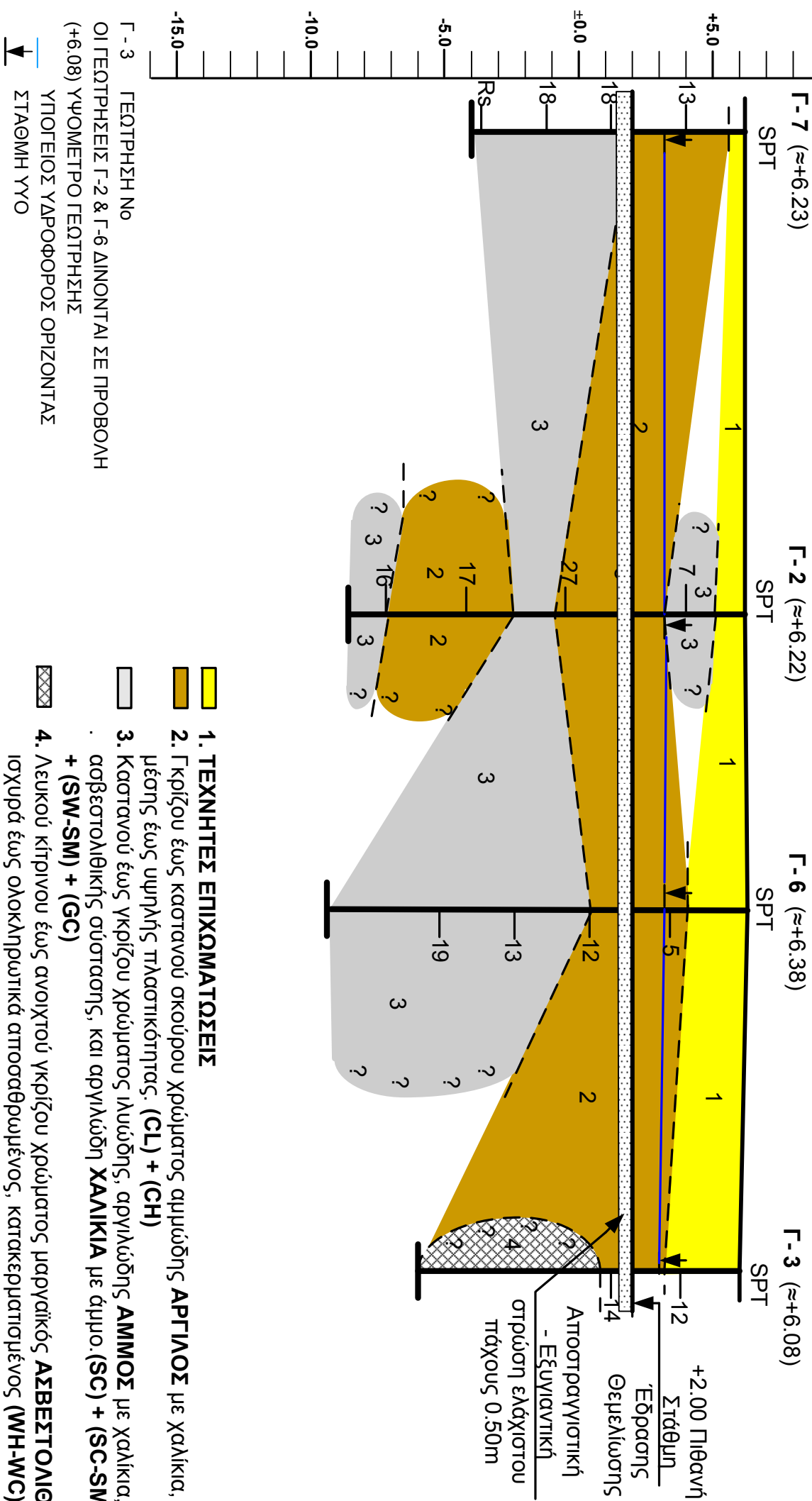
ΜΕΛΕΤΗ: ΜΕΛΕΤΗ ΑΝΤΙΣΤΗΡΙΞΗΣ - ΤΕΥΧΟΣ II Α: ΠΑΡΑΡΤΗΜΑ

## ΠΑΡΑΡΤΗΜΑ

### 8.2 Γενικευμένη τομή σχεδιασμού εδάφους

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ΚΤΙΡΙΟ Α



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

ΚΑΙΜΑΚΑ ΟΡ 1 : 200, ΚΑΤ 1 : 200

ΕΡΓΟ : ΚΤΙΡΙΟ ΤΟΥ ΤΜΗΜΑΤΟΣ ΜΟΥΣΙΚΩΝ ΣΠΟΥΔΩΝ ΣΤΟ ΟΙΚΟΠΕΔΟ Ε.Α.Σ.Κ.

ΜΕΛΕΤΗ: ΜΕΛΕΤΗ ΑΝΤΙΣΤΗΡΙΞΗΣ - ΤΕΥΧΟΣ ΙΙ Α: ΠΑΡΑΡΤΗΜΑ

## ΠΑΡΑΡΤΗΜΑ

### 8.3 Μητρώα γεωτρήσεων

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ΜΗΤΡΩΟ ΓΕΩΤΡΗΣΗΣ

ΕΡΓΟ: Ε-540/07 ΙΟΝΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ		ΘΕΣΗ : 9Η ΠΑΡΟΔΟΣ Ι.ΘΕΟΤΟΚΗ - Ο.Τ 379		ΦΥΛΛΟ: 1/1	
1. ΑΡΙΘΜΟΣ ΓΕΩΤΡΗΣΗΣ: Γ - 1		Χ=959.24 / Υ=1188.87		7. ΕΝΑΡΞΗ ΓΕΩΤΡΗΣΗΣ:	
2. ΟΛΙΚΟ ΒΑΘΟΣ ΓΕΩΤΡΗΣΗΣ (m): 15.00		17 / 07 / 07		8. ΛΗΞΗ ΓΕΩΤΡΗΣΗΣ:	
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 Μουζακίτη Σπυριδούλα	
6. ΣΩΛΗΝΩΣΗ: 104/114 έως 8.00 m		12. ΣΤΑΘΜΗ ΥΠΟΓΕΙΩΝ ΥΔΑΤΩΝ (m): 3.00			

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



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 Μουζακίτη Σπυριδούλα
6. ΣΩΛΗΝΩΣΗ: 104/114 έως 14.00 m		12. ΣΤΑΘΜΗ ΥΠΟΓΕΙΩΝ ΥΔΑΤΩΝ (m): 3.00		

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

ΜΗΤΡΩΟ ΓΕΩΤΡΗΣΗΣ

ΕΡΓΟ: Ε-540/07 ΙΟΝΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ		ΘΕΣΗ : 9Η ΠΑΡΟΔΟΣ Ι.ΘΕΟΤΟΚΗ - Ο.Τ 379	ΦΥΛΛΟ: 1/1
1. ΑΡΙΘΜΟΣ ΓΕΩΤΡΗΣΗΣ: Γ - 3	Χ=967.36 / Υ=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 Μουζακίτη Σπυριδούλα
6. ΣΩΛΗΝΩΣΗ: 104/114 έως 7.70 m		12. ΣΤΑΘΜΗ ΥΠΟΓΕΙΩΝ ΥΔΑΤΩΝ (m): 3.00	

ΒΑΘΟΣ m	ΠΕΡΙΓΡΑΦΗ ΥΛΙΚΩΝ	ΠΑΧΟΣ ΣΤΡΩΣΗΣ	ΕΙΔΟΣ ΔΕΙΓΜΑΤΟΣ	ΠΡΟΣΟΡΙΣΤΗ ΣΩΛΗΝΩΣΗ	N <sub>SPT</sub>	TCR %	RQD %	ΕΙΔΟΣ ΔΕΙΓΜΑΤΟΣ ΗΜΙΑΣ	ΠΑΡΑΤΗΡΗΣΕΙΣ Βάθος	ΒΑΘΟΣ m
0,00	ΤΕΧΝΗΤΕΣ ΕΠΙΧΩΜΑΤΩΣΕΙΣ	2.85 m	T-101(W)	104/114	4 7 5 12			Φ  Φ SPT	0.00 - 1.20	0,00
1,00									1.20 - 2.40	1,00
2,00									2.40 - 2.85	2,00
3,00	Καστανού χρώματος ισχνή αμμώδης ΑΡΓΙΛΟΣ με χαλίκια και ίχνη οργανικών, σπιφρή.	2.40 m			5 6 8 14			Φ SPT	2.85 - 4.80	3,00
4,00									4.80 - 5.25	4,00
5,00	(CL)	1.05 m						Φ	5.25 - 5.80	5,00
6,00	Λευκοκίτρινου χρώματος αργιλώδη ασβεστολιθικά ΧΑΛΙΚΙΑ με άμμο.								5.80 - 7.00	6,00
7,00	(GW)	5.70 m						Δ	7.00 - 7.70	7,00
8,00	(ΑΣΒΕΣΤΟΛΙΘΟΣ ο οποίος έχει μετατραπεί σε υπολειμματικό έδαφος) (Rs)								7.70 - 8.50	8,00
9,00	Ανοιχτού γκριζου έως λευκού χρώματος μαργακός ΑΣΒΕΣΤΟΛΙΘΟΣ, με ποικίλο βαθμό αποσάθρωσης, κατακερματισμένος.								8.50 - 9.20	9,00
10,00	(6.30 - 7.00) (WH)								9.20 - 10.20	10,00
11,00	(7.00 - 8.50) (WC)								10.20 - 11.30	11,00
12,00	(8.50 - 9.20) (WH)								11.30 - 12.00	12,00
13,00	9.20 - 9.80) (WC)	T6s-101(D)								13,00
14,00	(9.80 - 12.00) (WH-WM)									14,00
15,00										15,00
16,00										16,00

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 Μουζακίτη Σπυριδούλα
6. ΣΩΛΗΝΩΣΗ: 104/114 έως 14.70 m		12. ΣΤΑΘΜΗ ΥΠΟΓΕΙΩΝ ΥΔΑΤΩΝ (m): 3.30		

ΒΑΘΟΣ m	ΠΕΡΙΓΡΑΦΗ ΥΛΙΚΩΝ	ΠΑΛΟΣ ΣΤΡΟΣΗΣ	ΕΙΔΟΣ ΔΕΙΓΜΑΤΟΣ	ΕΠΙΠΛΗ ΠΡΟΣΟΡΙΣΤΗ ΣΩΛΗΝΩΣΗ	N <sub>SPT</sub>	TCR %	RQD %	ΕΙΔΟΣ ΔΕΙΓΜΑΤΟΣ ΗΜΩΣ	ΠΑΡΑΤΗΡΗΣΕΙΣ Βάθος	ΒΑΘΟΣ m
0,00	ΤΕΧΝΗΤΕΣ ΕΠΙΧΩΜΑΤΩΣΕΙΣ	2.75 m			19 7 12 5			Φ SPT	0.00 - 1.20  1.20 - 2.30 2.30 - 2.75	0,00
1,00										1,00
2,00										2,00
3,00	Σκούρου καστανού χρώματος ισχνή αμμώδης ΑΡΓΙΛΟΣ, μέση σφιγρή. Κατά θέσεις περιέχει λίγα λ-χ χαλίκια.	3.25 m			1 2 4 2			Φ SPT	2.75 - 4.30 4.30 - 4.75	3,00
4,00										4,00
5,00										5,00
6,00	(CL)			T-101(W)				Φ SPT	4.75 - 5.80  5.80 - 7.00 7.00 - 7.45	6,00
7,00										7,00
8,00										8,00
9,00	Καστανού χρώματος αργιλώδης ΑΜΜΟΣ με χαλίκια, πυκνής απόθεσης.	9.00 m			10 16 35 19			Φ SPT	7.45 - 9.70 9.70 - 10.15	9,00
10,00										10,00
11,00										11,00
12,00	Ως ανωτέρω.				13 20 45 25			Φ SPT	10.15 - 12.30 12.30 - 12.75	12,00
13,00										13,00
14,00										14,00
15,00	(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

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 Μουζακίτη Σπυριδούλα
6. ΣΩΛΗΝΩΣΗ: 104/114 έως 12.00 m			12. ΣΤΑΘΜΗ ΥΠΟΓΕΙΩΝ ΥΔΑΤΩΝ (m): 3.20		

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

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:	
2. ΟΛΙΚΟ ΒΑΘΟΣ ΓΕΩΤΡΗΣΗΣ (m): 15.50		23 / 07 / 07		8. ΛΗΞΗ ΓΕΩΤΡΗΣΗΣ:
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 Μουζακίτη Σπυριδούλα
6. ΣΩΛΗΝΩΣΗ: 104/114 έως 14.50 m		12. ΣΤΑΘΜΗ ΥΠΟΓΕΙΩΝ ΥΔΑΤΩΝ (m): 3.00		

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

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 Μουζακίτη Σπυριδούλα
6. ΣΩΛΗΝΩΣΗ: 104/114 έως 6.00 m		12. ΣΤΑΘΜΗ ΥΠΟΓΕΙΩΝ ΥΔΑΤΩΝ (m): 3.00		

ΒΑΘΟΣ m	ΠΕΡΙΓΡΑΦΗ ΥΛΙΚΩΝ	ΠΑΛΟΣ ΣΤΡΩΣΗΣ	ΕΙΔΟΣ ΔΕΙΓΜΑΤΟΣ ΗΠΗ	ΠΡΟΣΟΡΙΝΗ ΣΩΛΗΝΩΣΗ	N <sub>SPT</sub>	TCR %	RQD %	ΕΙΔΟΣ ΔΕΙΓΜΑΤΟΣ ΗΥΙΑΣ	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	5 6 13 7			Φ SPT	1.20 - 2.20 2.20 - 2.65	2,00
3,00	(CH)									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			6 8 18 10			SPT	5.00 - 5.45	6,00
7,00	(SM - SC)							Φ	5.45 - 6.50	7,00
8,00								Φ	6.50 - 7.50	8,00
9,00	Καστανού έως τοπικά γκρίζου χρώματος αργιλώδη ΧΑΛΙΚΙΑ με άμμο, μέσης πυκνότητας έως πολύ πυκνής απόθεσης	2.18 m			6 8 18 10			Φ	7.50 - 7.95	9,00
10,00	(GC)							Φ	7.95 - 9.00	10,00
					50/13cm Rs Rs			Φ SPT	9.00 - 10.00 10.00 - 10.13	10,00
	ΤΕΛΟΣ ΔΙΑΤΡΗΣΗΣ ΣΤΑ 10.13 m									
11,00										11,00
12,00										12,00
13,00										13,00
14,00										14,00
15,00										15,00
16,00										16,00

## ΠΑΡΑΡΤΗΜΑ

### 8.4 Συγκεντρωτικός πίνακας εργαστηριακών δοκιμών

**ΕΡΓΟΔΟΤΗΣ :**  
**ΕΡΓΟ :**  
**ΑΡΙΘΜΟΣ ΕΡΓΟΥ :**

**ΙΟΝΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ - Δ/ΝΣΗ ΤΕΧΝΙΚΩΝ ΕΡΓΩΝ**  
**ΕΚΠΟΝΗΣΗ ΓΕΩΤΕΧΝΙΚΗΣ ΜΕΛΕΤΗΣ ΤΩΝ ΝΕΩΝ ΚΤΙΡΙΑΚΩΝ ΕΓΚΛΗΣΩΝ**  
**ΤΟΥ ΙΟΝΙΟΥ ΠΑΝΕΠΙΣΤΗΜΙΟΥ ΣΤΟ ΟΙΚΟΠΕΔΟ Ε.Α.Σ.Κ. ΣΤΗΝ ΚΕΡΚΥΡΑ**  
**Ε- 540/07**

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

ΓΕΩΤΡΗΣΗ Νο	ΕΝΟΤΗΤΑ	ΒΑΘΟΣ ΔΕΙΓΜΑΤΟΣ	ΧΑΡΑΚΤΗΡΙΣΜΟΣ USCS		ΕΙΔΙΚΟ ΒΑΡΟΣ Gs						ΚΟΚΚΟΜΕΤΡΙΑ%						ΦΥΣΙΚΗ ΥΓΡΑΣΙΑ ΔΕΙΓΜΑΤΟΣ, w %			ΟΡΙΑ ΑΤΤΕΡΒΕΡΓ			ΦΑΙΝΟΜΕΝΑ ΒΑΡΗ		ΑΝΤΟΧΗ ΣΕ ΑΝΕΜΠΟΔΙΣΤΗ ΘΛΙΨΗ q <sub>u</sub> kPa		ΔΟΚΙΜΗ ΣΤΕΡΕΟΠΟΙΗΣΗΣ																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														



**ΕΡΓΟΔΟΤΗΣ :**  
**ΕΡΓΟ :**  
**ΙΟΝΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ - Δ/ΝΣΗ ΤΕΧΝΙΚΩΝ ΕΡΓΩΝ**  
**ΕΚΠΟΝΗΣΗ ΓΕΩΤΕΧΝΙΚΗΣ ΜΕΛΕΤΗΣ ΤΩΝ ΝΕΩΝ ΚΤΙΡΙΑΚΩΝ ΕΓΚΛΗΣΩΝ**  
**ΤΟΥ ΙΟΝΙΟΥ ΠΑΝΕΠΙΣΤΗΜΙΟΥ ΣΤΟ ΟΙΚΟΠΕΔΟ Ε.Α.Σ.Κ. ΣΤΗΝ ΚΕΡΚΥΡΑ**

**ΑΡΙΘΜΟΣ ΕΡΓΟΥ :**  
**E - 540/07**

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

ΓΕΩΤΡΗΣΗ Νο		ΕΝΟΤΗΤΑ	ΒΑΘΟΣ ΔΕΙΓΜΑΤΟΣ	ΧΑΡΑΚΤΗΡΙΣΜΟΣ USCS		ΕΙΔΙΚΟ ΒΑΡΟΣ Gs						ΦΥΣΙΚΗ ΥΓΡΑΣΙΑ ΔΕΙΓΜΑΤΟΣ, w %			ΟΡΙΑ ΑΤΤΕΡΒΕΡΓ			ΦΑΙΝΟΜΕΝΑ ΒΑΡΗ		ΑΝΤΟΧΗ ΣΕ ΑΝΕΜΠΟΔΙΣΤΗ ΘΛΙΨΗ q <sub>u</sub> kPa		ΔΟΚΙΜΗ ΣΤΕΡΕΟΠΟΙΗΣΗΣ		
					ΚΟΚΚΟΜΕΤΡΙΑ%						LL %	PL %	PI %	ΥΓΡΟ γ <sub>wet</sub> kN/m <sup>3</sup>	ΞΗΡΟ γ <sub>dry</sub> kN/m <sup>3</sup>				C <sub>c</sub>	C <sub>s</sub>	ΛΟΓΟΣ ΚΕΝΩΝ e <sub>0</sub>			
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											
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.

**ΕΡΓΟΔΟΤΗΣ :**

**ΙΟΝΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ - ΔΝΣΗ ΤΕΧΝΙΚΩΝ ΕΡΓΩΝ**

**ΕΡΓΟ :**

**ΕΚΠΟΝΗΣΗ ΓΕΩΤΕΧΝΙΚΗΣ ΜΕΛΕΤΗΣ ΤΩΝ ΝΕΩΝ ΚΤΙΡΙΑΚΩΝ ΕΓΚΕΣΕΩΝ  
ΤΟΥ ΙΟΝΙΟΥ ΠΑΝΕΠΙΣΤΗΜΙΟΥ ΣΤΟ ΟΙΚΟΠΕΔΟ Ε.Δ.Σ.Κ. ΣΤΗΝ ΚΕΡΚΥΡΑ**

**ΑΡΙΘΜΟΣ ΕΡΓΟΥ :**

**E- 540/07**

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

ΓΕΩΤΡΗΣΗ Νο	
ΕΝΟΤΗΤΑ	
ΒΑΘΟΣ ΔΕΙΓΜΑΤΟΣ	
ΧΑΡΑΚΤΗΡΙΣΜΟΣ USCS	
ΕΙΔΙΚΟ ΒΑΡΟΣ Gs	
ΧΑΛΙΚΙΑ	ΚΟΚΚΟΜΕΤΡΙΑ%
ΑΜΜΟΣ	
ΛΕΠΤ/ΚΑ	
ΙΛΥΣ	
ΑΡΓΙΛΙΟΣ	
D <sub>50</sub> (mm)	
ΦΥΣΙΚΗ ΥΓΡΑΣΙΑ ΔΕΙΓΜΑΤΟΣ, w %	
LL %	ΟΡΙΑ ΑΤΤΕΡΒΕΡΓ
PL %	
PI %	
ΥΓΡΟ γ <sub>wet</sub> kN/m <sup>3</sup>	ΦΑΙΝΟΜΕΝΑ ΒΑΡΗ
ΞΗΡΟ γ <sub>dry</sub> kN/m <sup>3</sup>	
ΑΝΤΟΧΗ ΣΕ ΑΝΕΜΠΟΔΙΣΤΗ ΘΛΙΨΗ q <sub>u</sub> kPa	
Cc	ΔΟΚΙΜΗ ΣΤΕΡΕΟΠΟΙΗΣΗΣ
Cs	
ΛΟΓΟΣ ΚΕΝΩΝ e <sub>0</sub>	

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
	M.O.	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															
	M.O.		66,2	30,9	3,0					7,4										

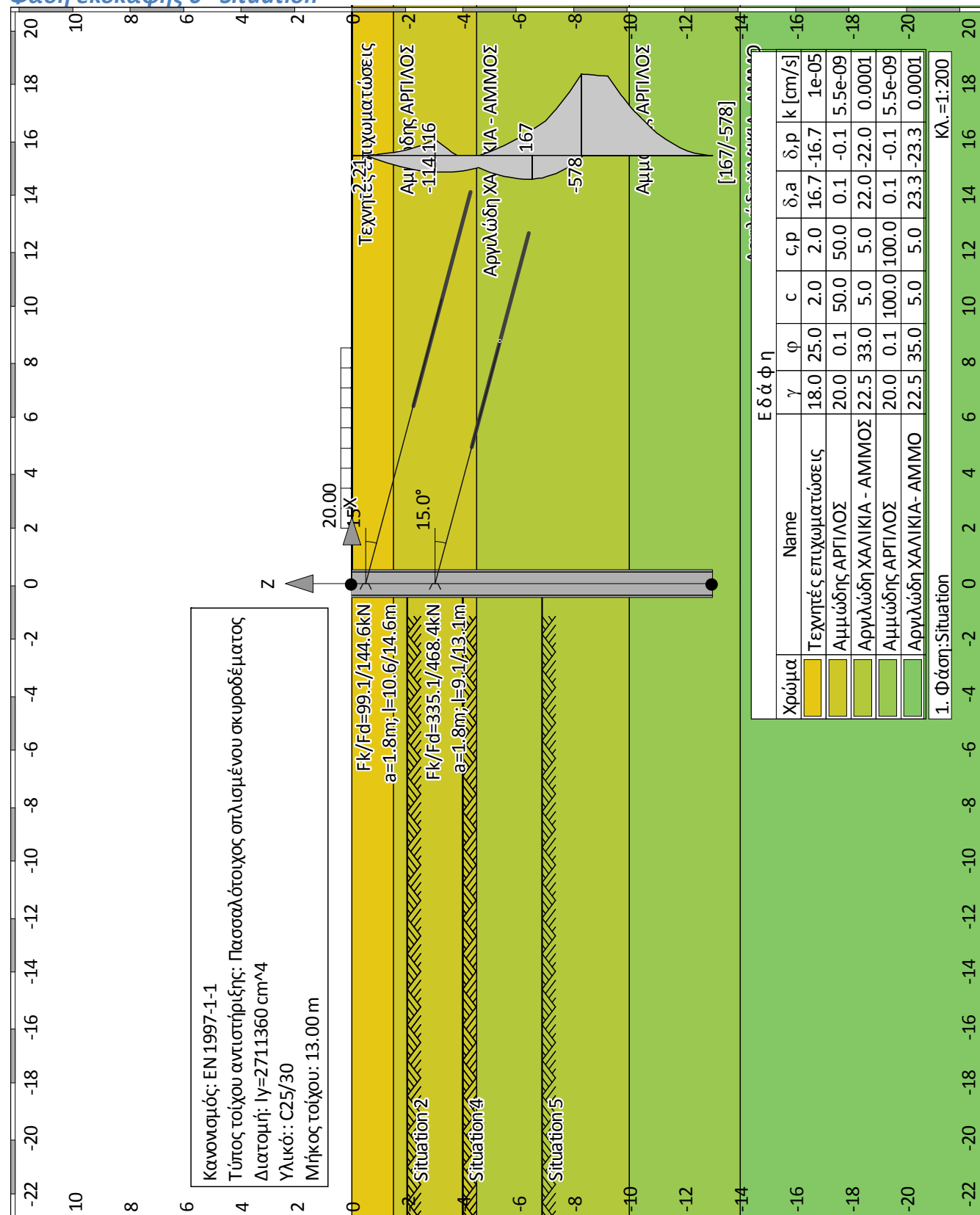
## ΠΑΡΑΡΤΗΜΑ

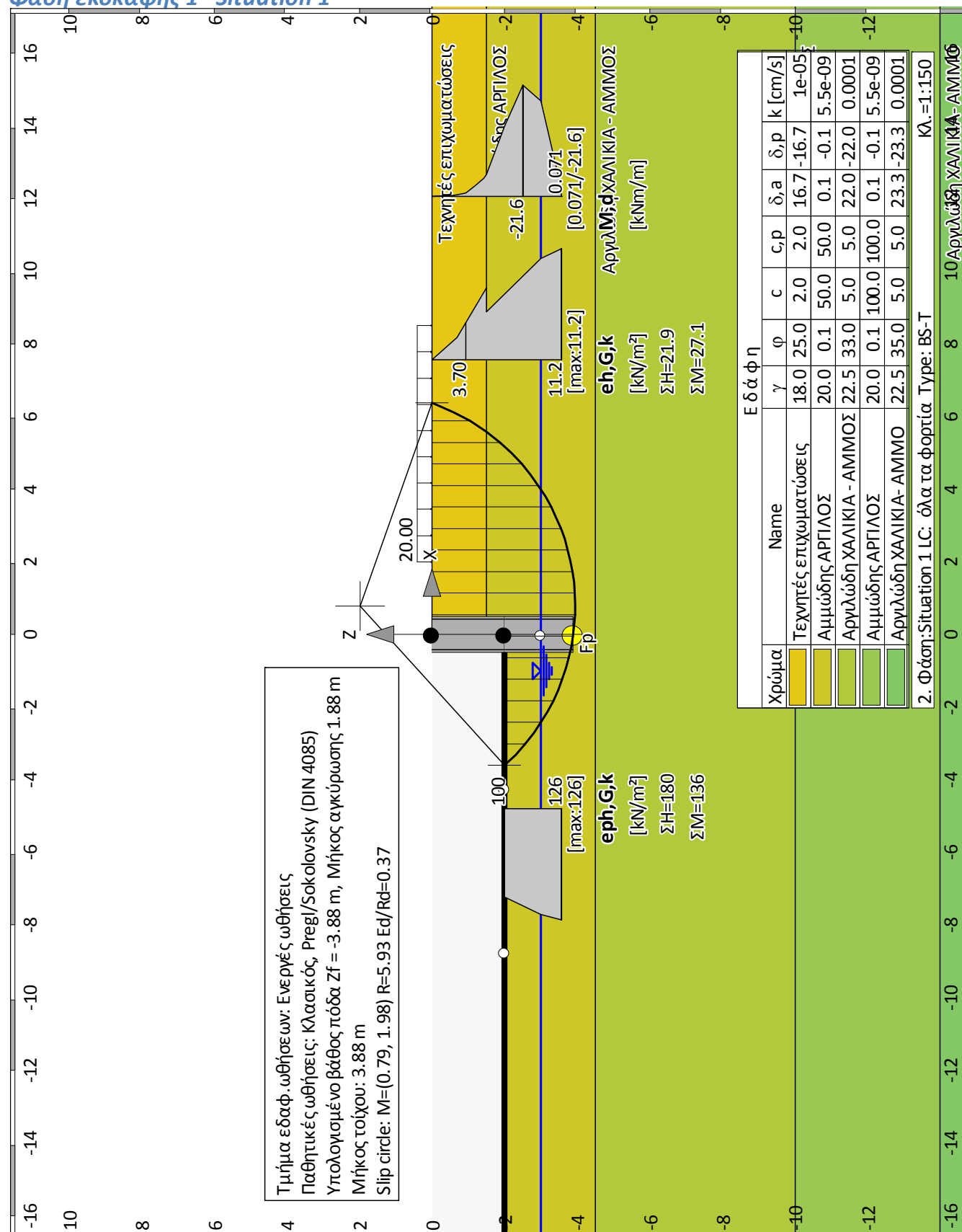
### 8.5 Αποτελέσματα ανάλυσης

#### 8.5.1 Στατικές Συνθήκες

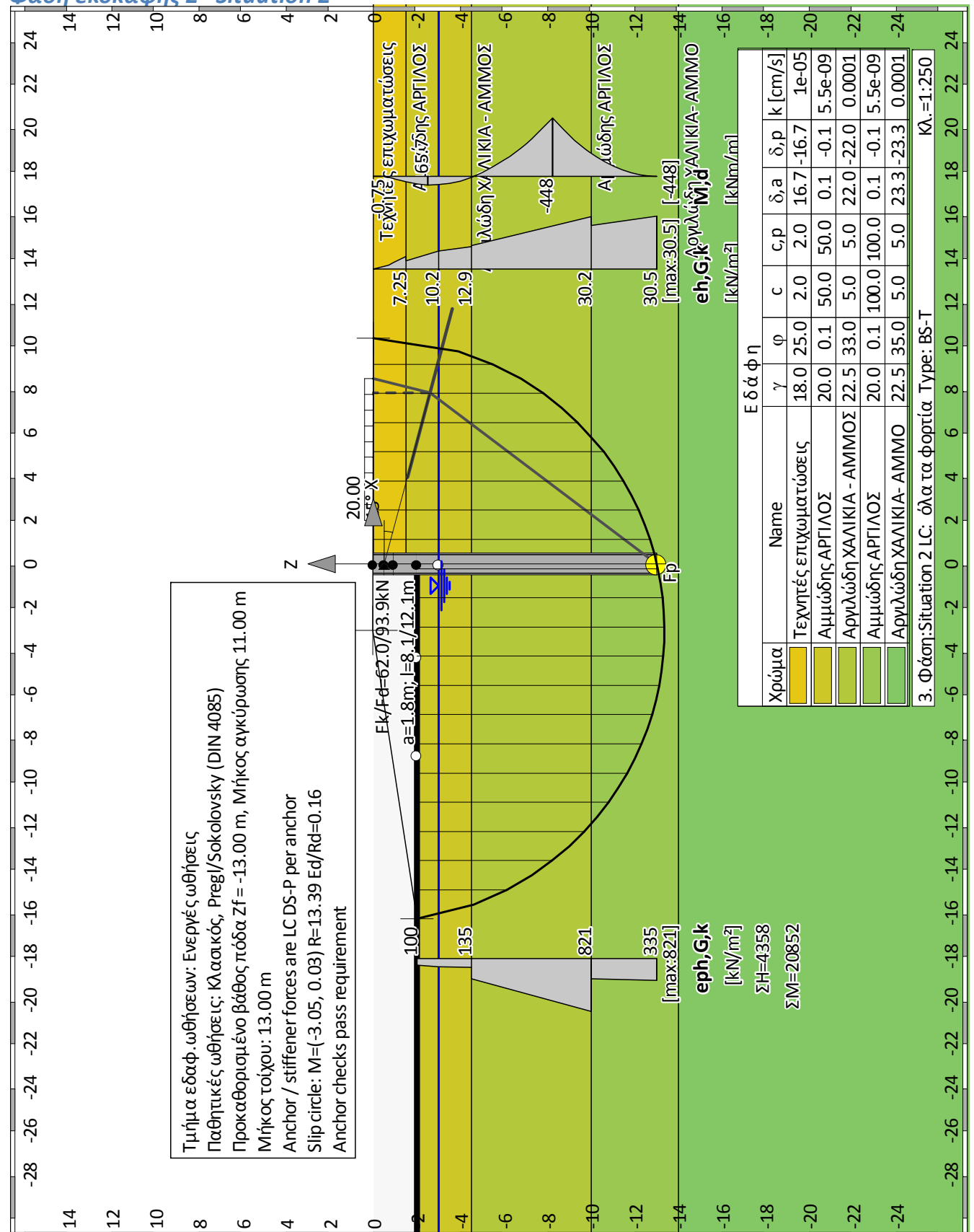
##### i) Αντιστηριζόμενο ύψος 6,10m

### Φάση εκσκαφής 0 "Situation"

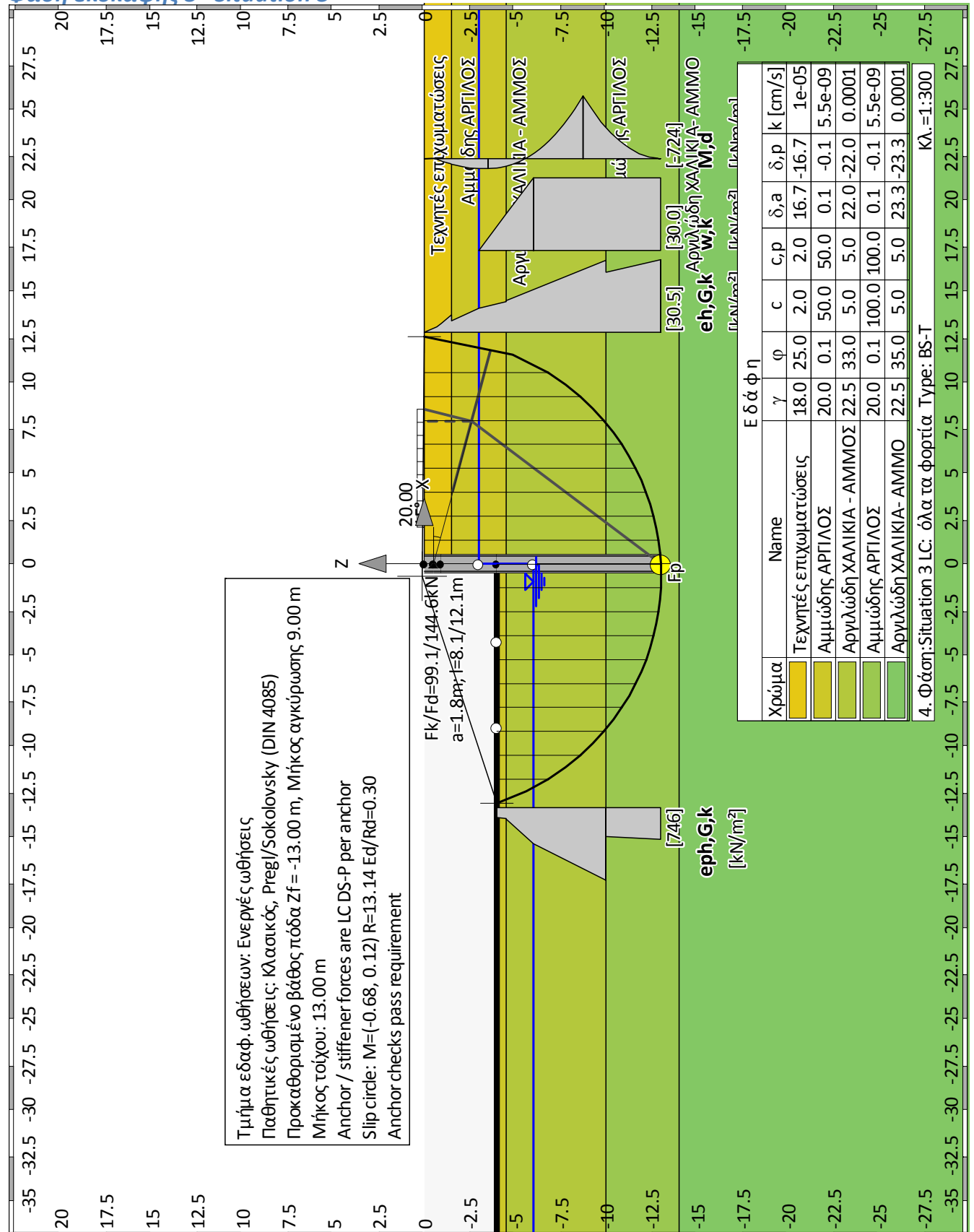




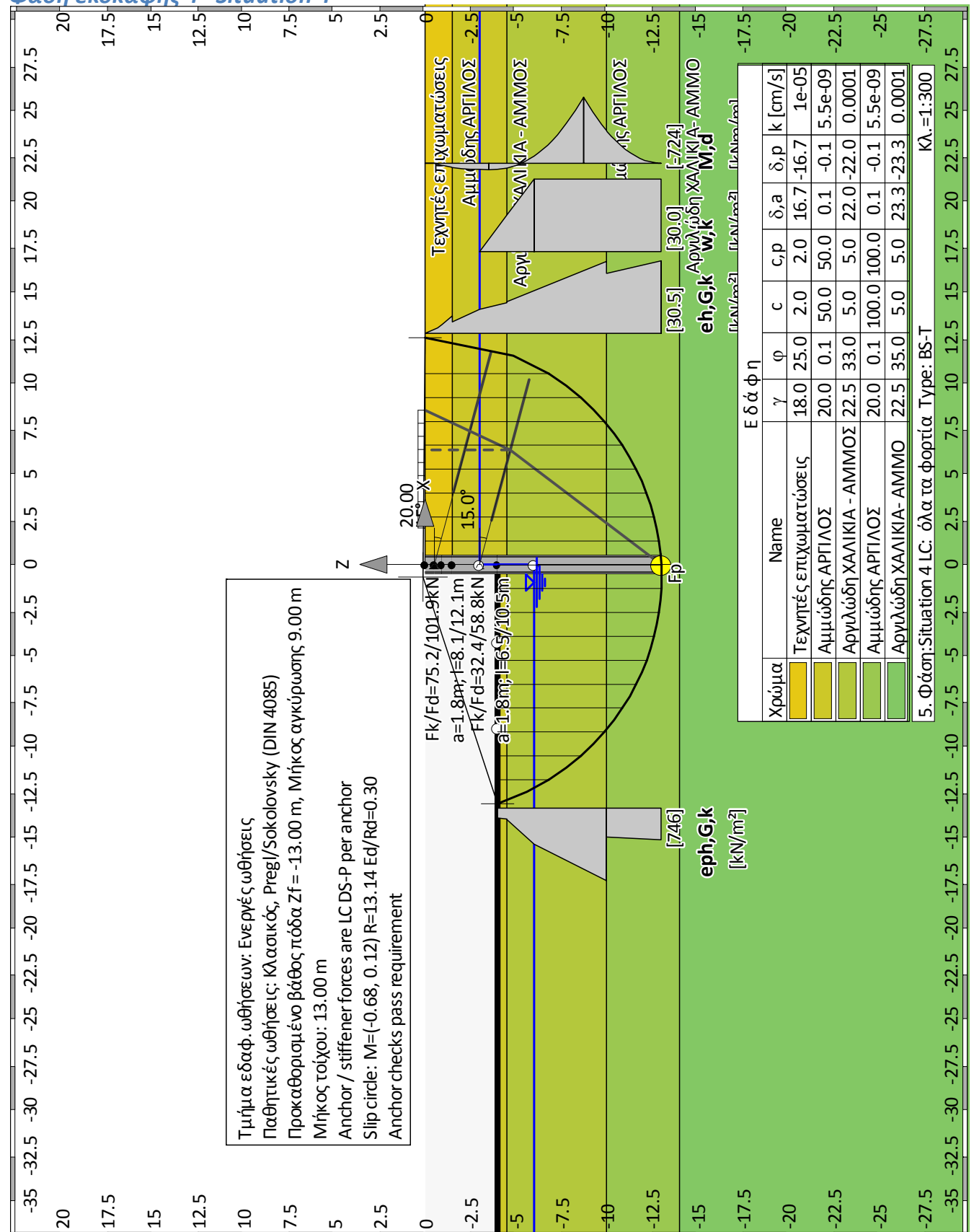
## Φάση εκσκαφής 2 "Situation 2"



## Φάση εκκαφής 3 "Situation 3"

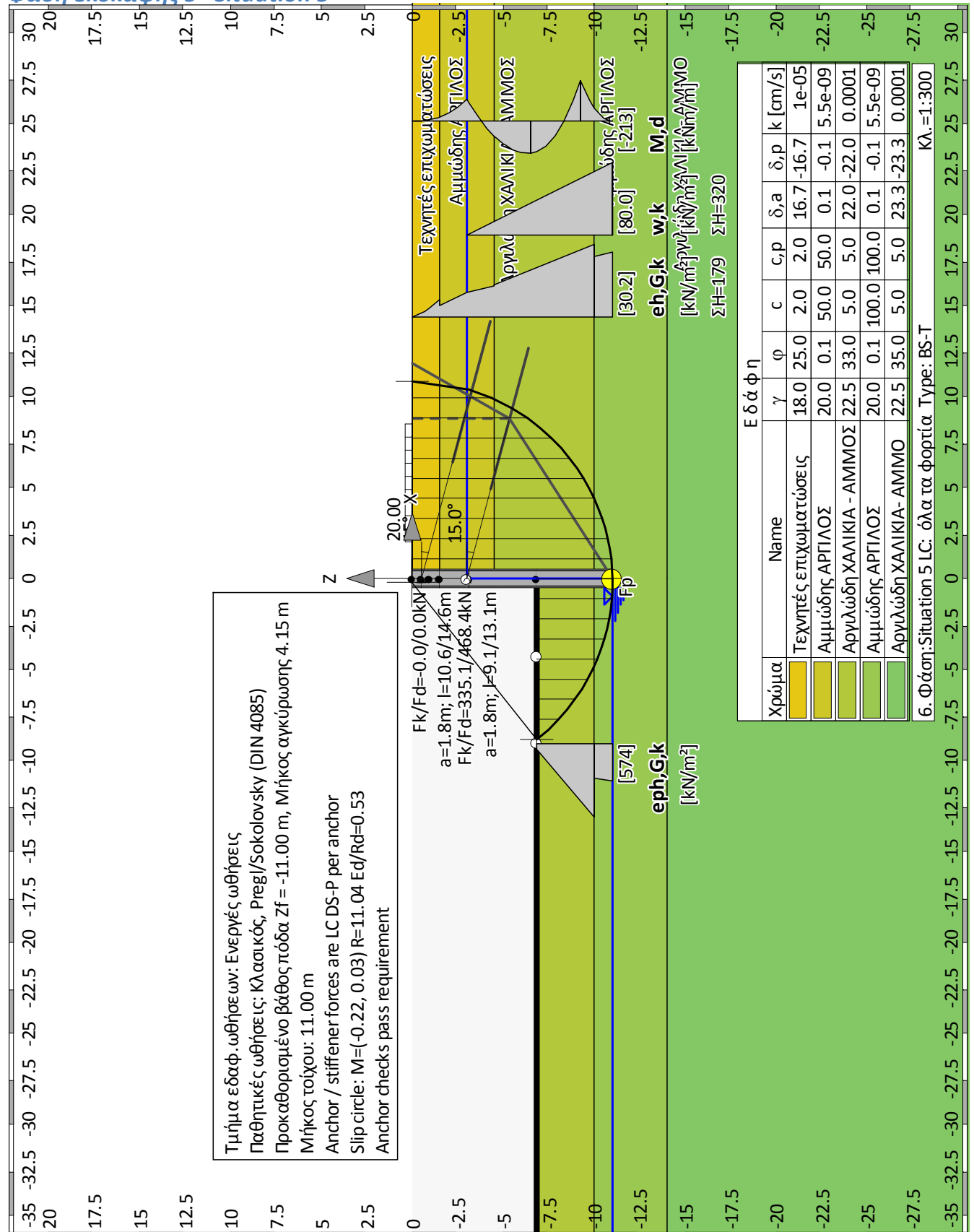


### Φάση εκσκαφής 4 "Situation 4"





## Φάση εκσκαφής 5 "Situation 5"



**Κανονισμός για 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
BS-T	1	1	1	1.300	0	1.250	1.400	1.400
BS-T/A	1	1	1	1.300	0	1.250	1.250	1.400
BS-E	1	1	1	1	0	1.250	1.400	1.400

**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
BS-T	1.350	1.350	1.350	1	1.500	0	1	1
BS-T/A	1.350	1.350	1.350	1	1.500	0	1	1
BS-E	1	1	1	1	1	0	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
BS-T	1.350	1.350	1.350	1	1.500	0	1	1
BS-T/A	1.350	1.350	1.350	1	1.500	0	1	1
BS-E	1	1	1	1	1	0	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
BS-T	1.350	1.350	1.350	1	1.500	0	1	1
BS-T/A	1.350	1.350	1.350	1	1.500	0	1	1
BS-E	1	1	1	1	1	0	1	1

**Κύκλος ολίσθησης: [GEO] A2 M2 R3**

γ-	G,dst g	G,stb Re	Q,dst a,t	Q,stb a,p	W Gt	phi N	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): Να, η=0.80

γ,Re,red (EAB EB22-6): Να, E0h &gt; 0%: η = 0.60 / 0.80

**System values****Τοίχος**

Τύπος τοίχου αντιστήριξης: Πασσαλότοιχος οπλισμένου σκυροδέματος

Διατομή: Iy=2711360 cm<sup>4</sup>

Υλικό: C25/30

Ίδιο βάρος: 25.000 [kN/m<sup>3</sup>]**Σημεία τοίχου**

z	d	E	Iy	E*Iy	A
[m]	[m]	[MN/m <sup>2</sup> ]	[cm <sup>4</sup> /m]	[MNm <sup>2</sup> ]	[cm <sup>2</sup> /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	Αμμόδης 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,θh	[-]	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	Αμμόδης	ΑΡΓΙΛΟΣ	Αργιλώδη	ΧΑΛΙΚΙΑ-	ΑΜΜΟΣ
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,θh	[-]	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 Αμμόδης 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 Αμμόδης ΑΡΓΙΛΟΣ:

z= -10.00

Author: FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München		Job No.:
Program: WALLS-Retain. Version 2017.046		
Structure: info@fides-dvp.de	www.fides-dvp.de	Tel:++49/89/143829-0 ASB Nr.:
		Date: 08.10.2018

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

Επιφ. φορτία:

Φορτία

xA	zA	xE	zE	PxA	PzA	PxE	PzE	Typ	LC-description
[m]	[m]	[m]	[m]	[	kN/m²		]		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 redistrib. to: Excavation level  
The earth pressure below the excavation acts without redistrib.  
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

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**Stress analysis****Earth pressure, horizontal**

Pressures characteristic, no redistribution, continuous wall

0.00-0.69

2.23

-1.50

7.25

5.76

-2.00

-100.3

15.2

-3.00

-120.4

10.2

-3.57

-126.1

11.2

15.2

z

eph,G+PG,k

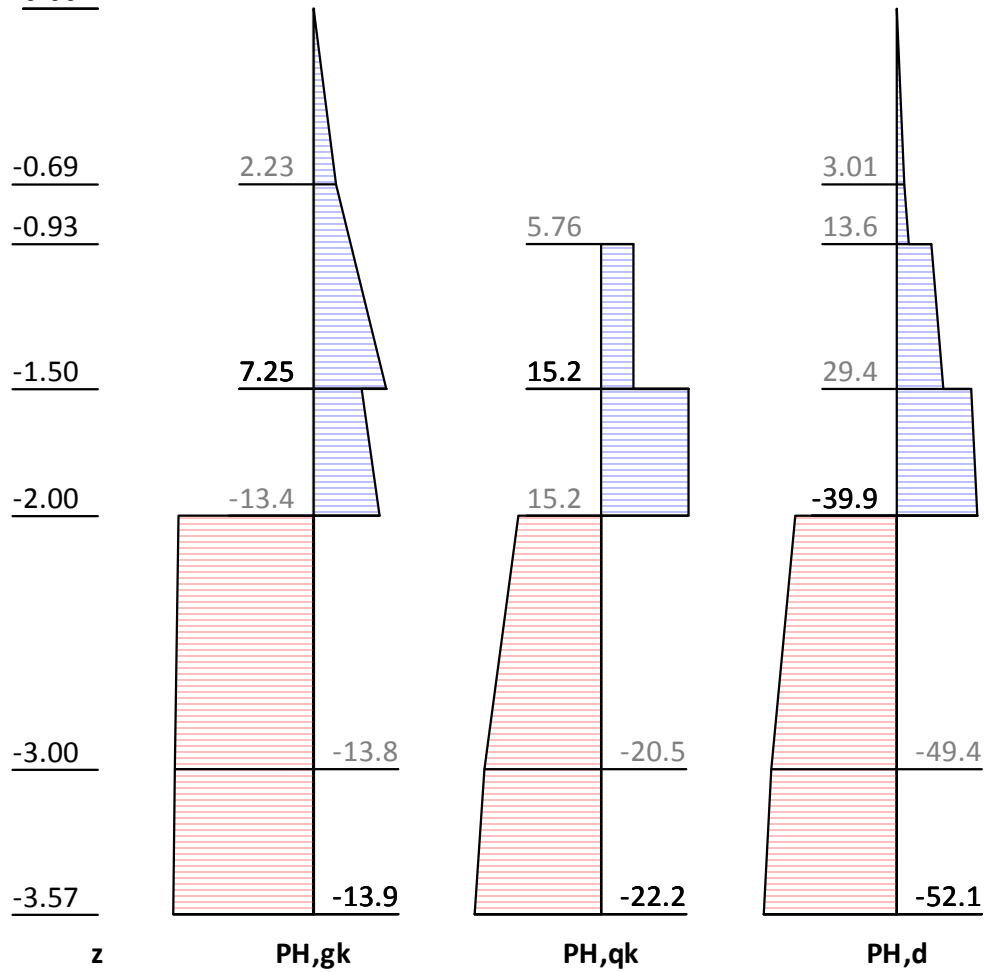
eah,G,k

eah,PQ,k

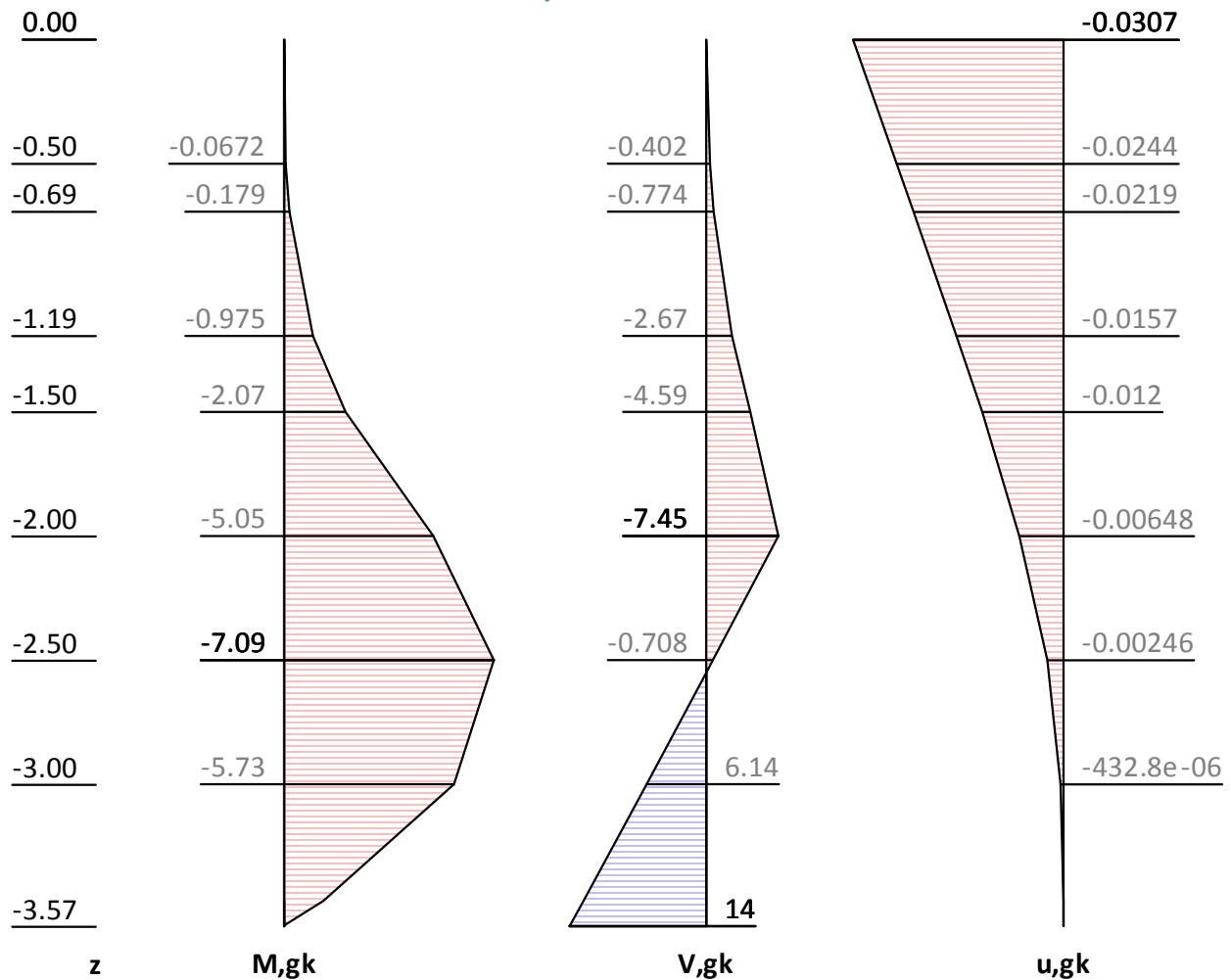
z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.93		3.72	0.00	5.00
-0.93		3.72	5.76	13.64
-1.50		7.25	5.76	18.43
-1.50		4.82	15.23	29.36
-2.00	-0.00	6.61	15.23	31.77
-2.00	-100.29	6.61	15.23	31.77
-3.57	-126.10	11.20	15.23	37.96

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

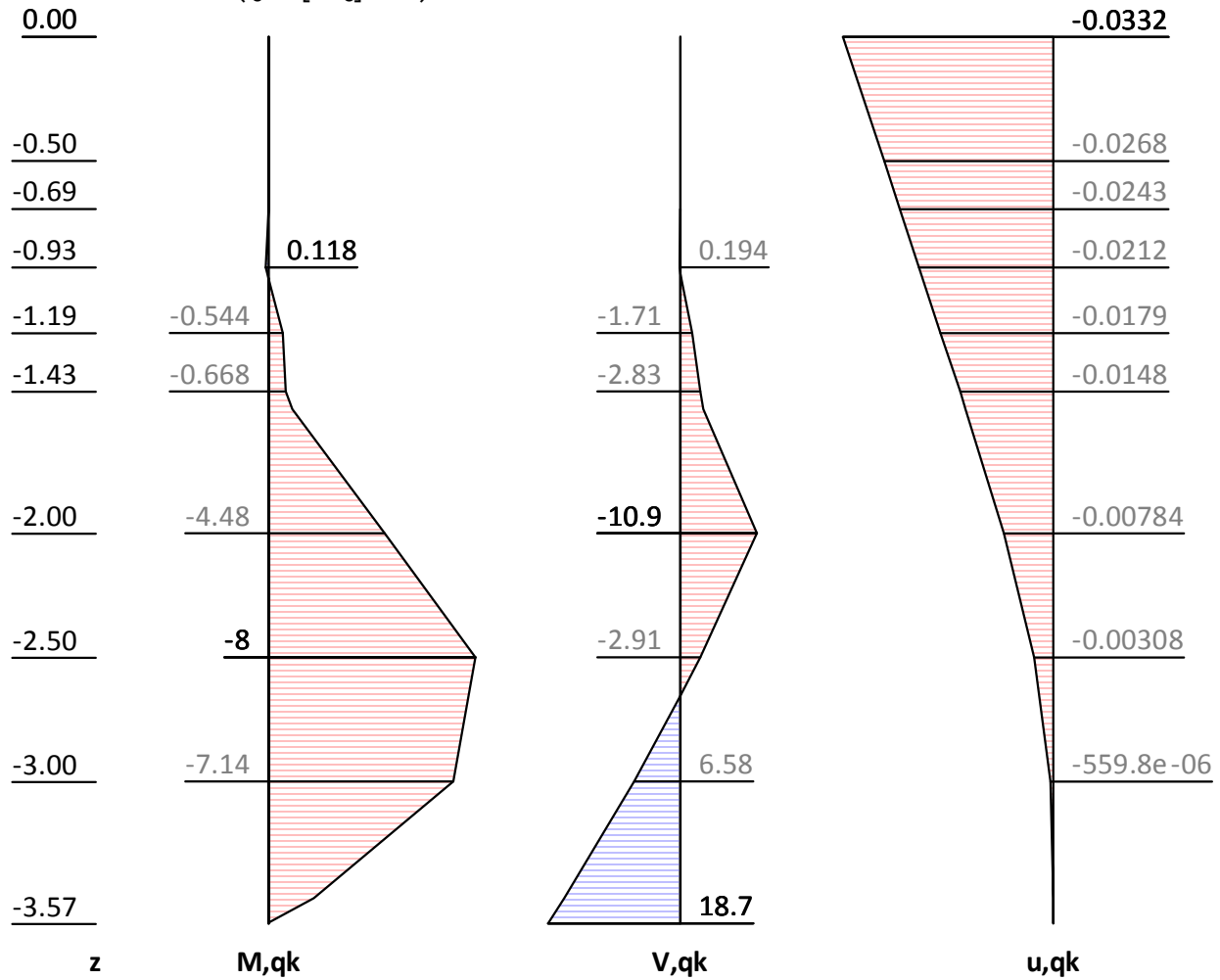
**H-pressure on static system**Level of mobilization:  $E_{p,gk}$  19.9,  $E_{p,qk}$  29.6,  $E_{p,d}$  100.0 [%]0.00

z [m]	PH,gk [kN/m <sup>2</sup> ]	PH,qk [kN/m <sup>2</sup> ]	PH,d [kN/m <sup>2</sup> ]
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

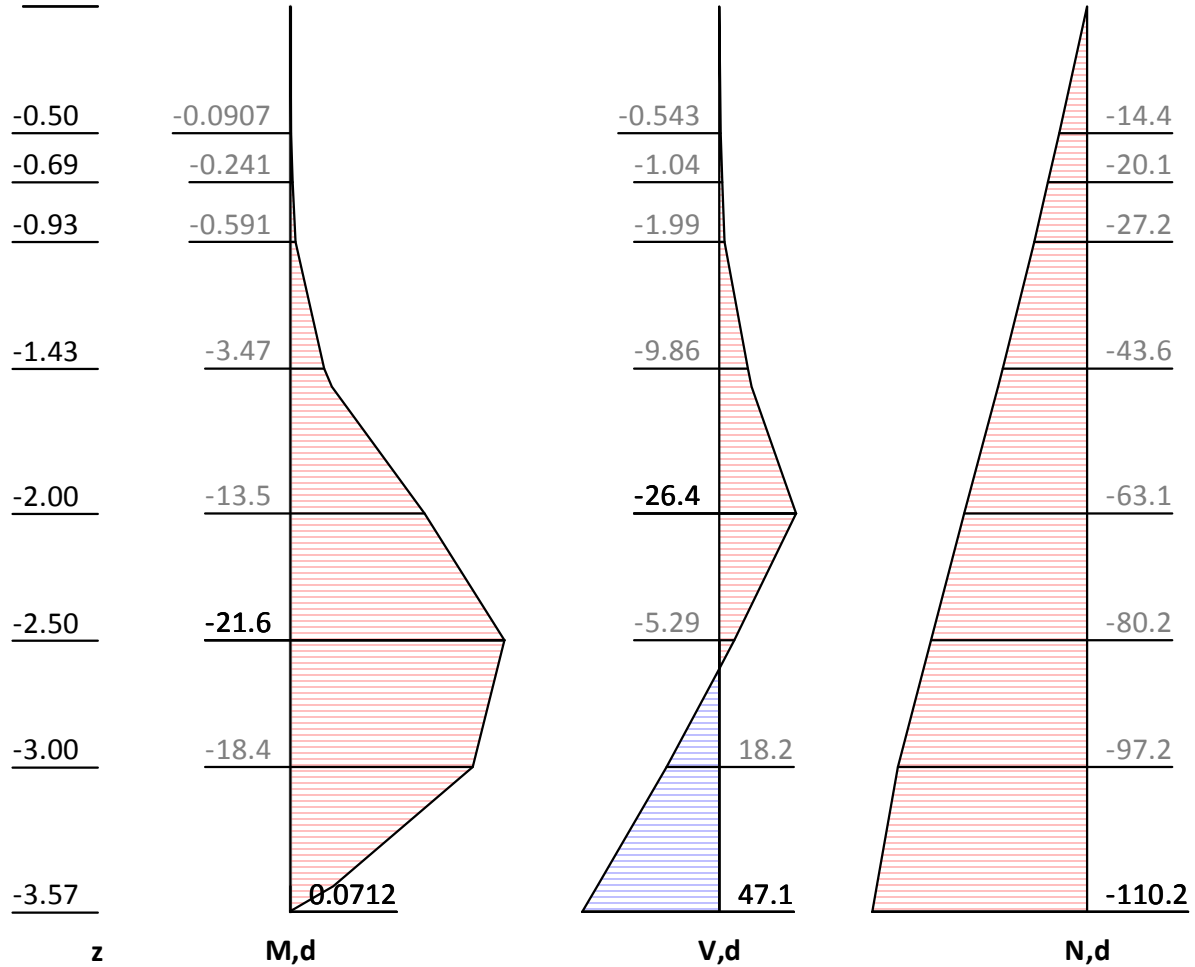


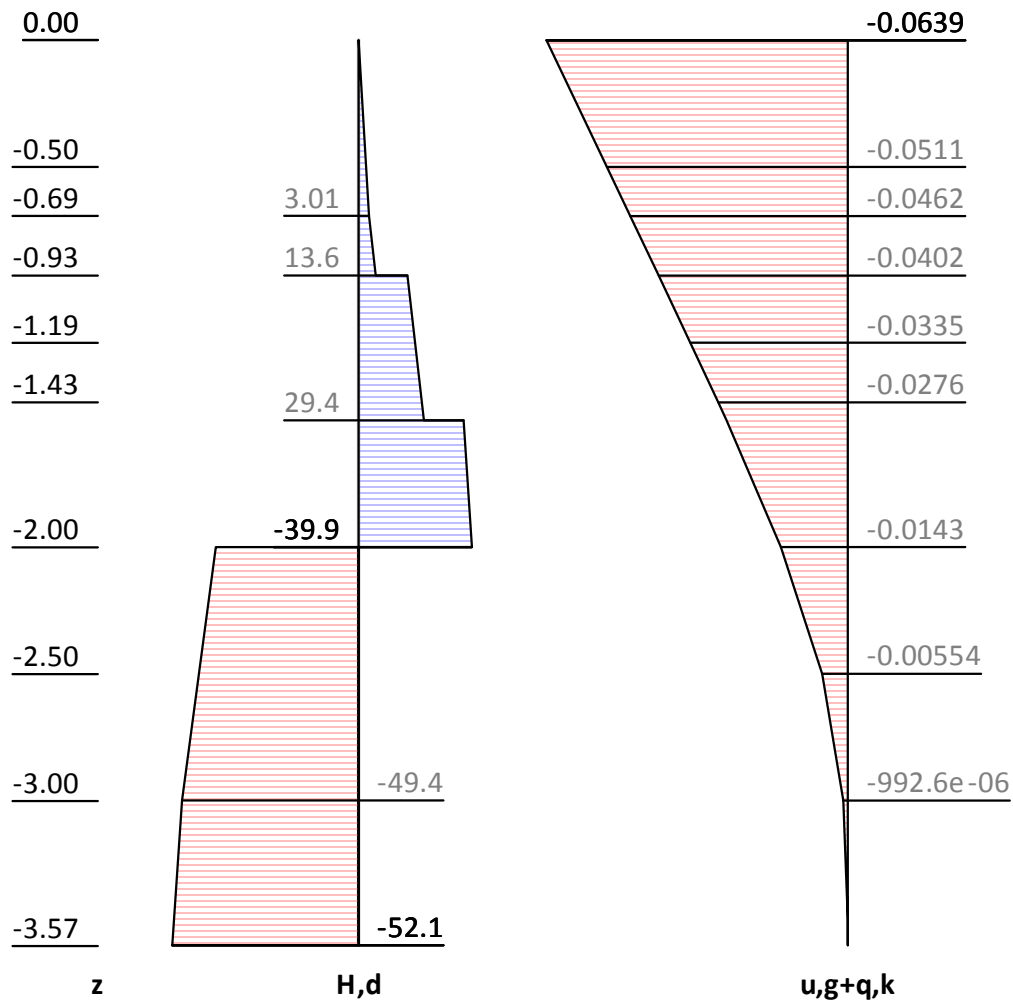
**Internal forces: Variable, characteristically**Method EB 82-4 ( $Q = [G+Q] - G$ ).

z [m]	H, q, k [kN/m <sup>2</sup> ]	M, q, k [kN/m <sup>2</sup> ]	V, q, k [kN/m <sup>2</sup> ]	N, q, k [kN/m <sup>2</sup> ]	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

0.00

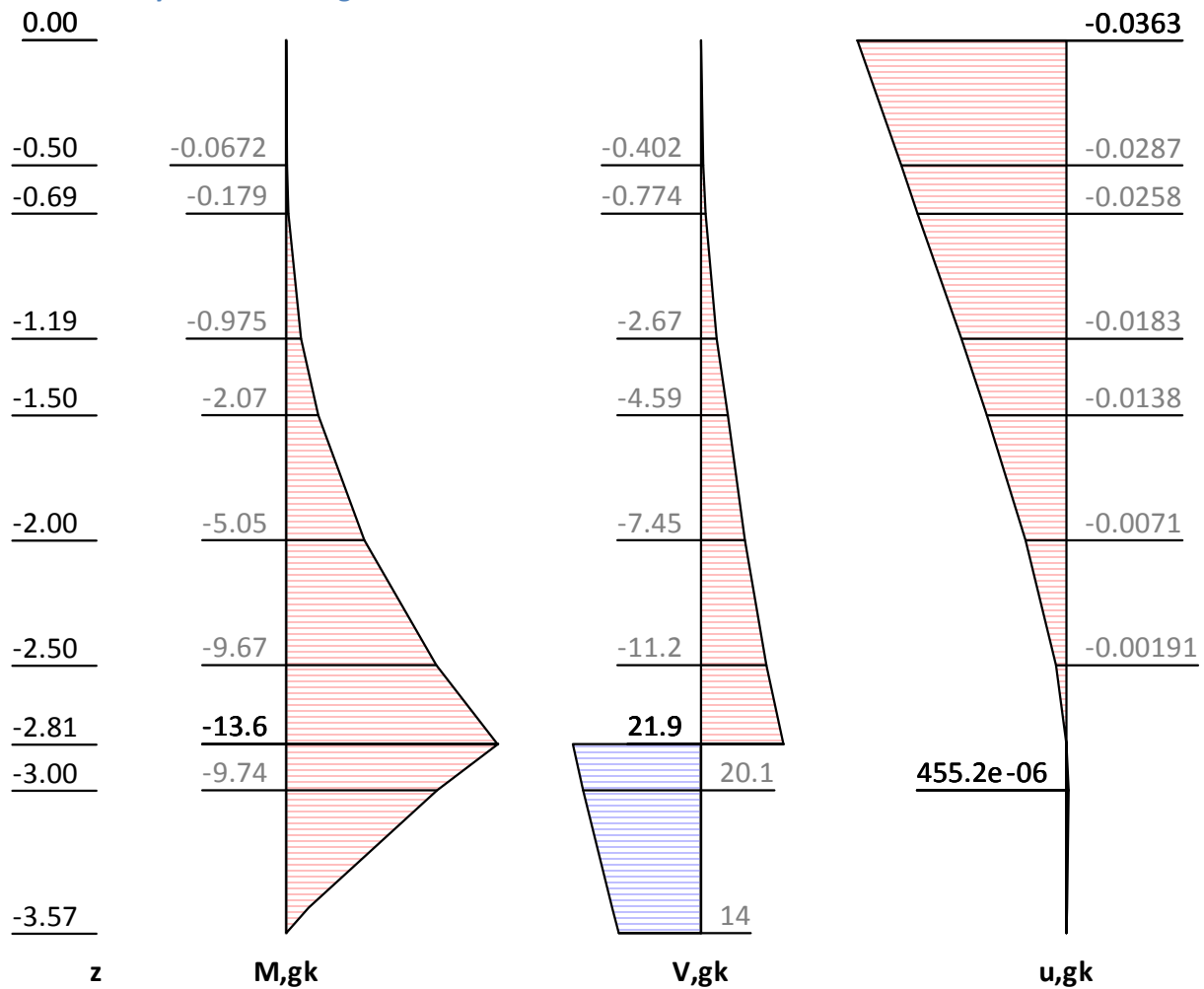




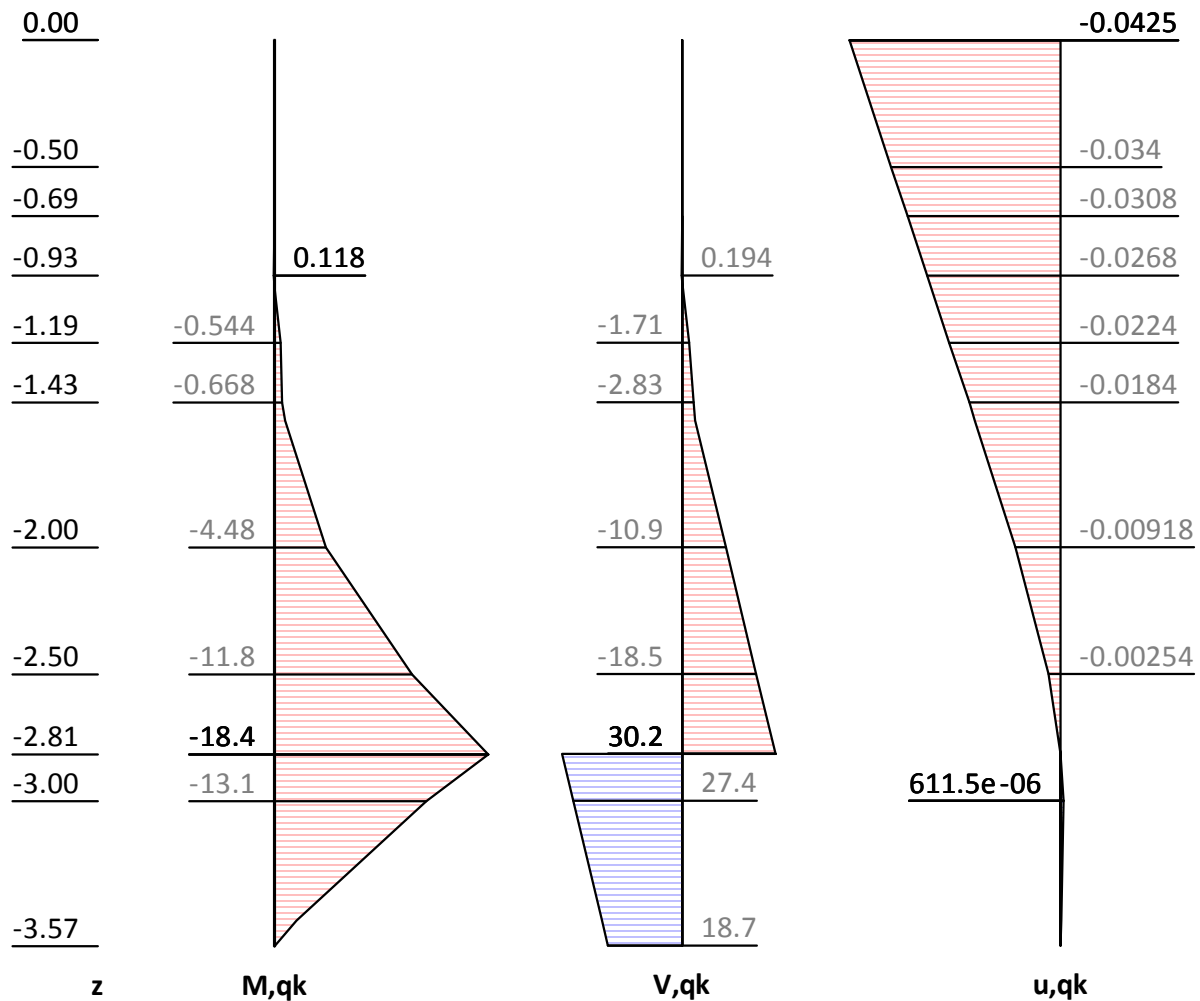
z [m]	H,d [kN/m <sup>2</sup> ]	M,d [kN/m <sup>2</sup> ]	V,d [kN/m <sup>2</sup> ]	N,d [kN/m <sup>2</sup> ]	u,g+q,k [mm]
0.00	0.00	0.00	0.00	0.00	-0.06
-0.93	5.00	-0.59	-1.99	-27.21	-0.04
-0.93	13.64	-0.59	-1.99	-27.21	-0.04
-1.50	18.43	-4.20	-11.13	-45.99	-0.03
-1.50	29.36	-4.20	-11.13	-45.99	-0.03
-2.00	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/m <sup>2</sup> ]	V,q,k [kN/m <sup>2</sup> ]	N,q,k [kN/m <sup>2</sup> ]	u,q,k [kN/m <sup>2</sup> ]
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]

Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>	Job No.:
Program: <b>WALLS-Retain. Version 2017.046</b>	
Structure: info@fides-dvp.de    www.fides-dvp.de    Tel:++49/89/143829-0    ASB Nr.:	Date: 08.10.2018

### Check of C-force (foot support)

$$z(C) = -3.57 \text{ [kN/m]}$$

$$G,k = \sum(\gamma \cdot h) = 62.69 \text{ [kN/m]}$$

$$P,k = \sum(Pz,k(x= 0.1)) = 0.00 \text{ [kN/m]}$$

$$kpgh,C(\phi_i= 0.1; \delta,C= 0.0^\circ) = 1.002 \text{ [-]}$$

$$kpch,C = 2.003 \text{ [-]}$$

$$eph,C,gk = (G,k+P,k) \cdot kpgh,C+2 \cdot c \cdot \sqrt{kpch,C} = 204.34 \text{ [kN/m}^2\text{]}$$

$$= (62.69+0.00) \cdot 1.002+2 \cdot 50.0 \cdot 1.415$$

$$Ed = Ch,d = 46.99 \text{ [kN/m}^2\text{]}$$

$$\delta,t,EAU = Ed/(2 \cdot eph,C,d) = 0.16 \text{ [m]}$$

$$\delta,t,EAB = 0.20 \cdot t = 0.31 \text{ [m]}$$

$$\delta,t = \delta,t,EAB = 0.31 \text{ [m]}$$

$$Rd = 2 \cdot \delta,t \cdot eph,C,gk/\gamma,Re$$

$$= 2 \cdot 0.31 \cdot 204.34/1.4$$

$$= 91.59 \text{ [kN/m}^2\text{]}$$

$Ed/Rd = 0.513 \text{ [-]}. \text{ Passes requirement}$

### Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.

z: -2.81 m

$Rd = Eph,k/\gamma,Re = 180.43 / 1.400 = 128.88 \text{ [kN/m]}$

$Ed(Bh,d)/Rd = 128.78 / 128.88 = 0.999 \text{ [-]}. \text{ Passes requirement}$

### 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( $\delta,p=-0.07^\circ$ )		-0.04
Ch,g	14.03	
Cv,g = Ch*tan( $\delta,C=0.0^\circ$ )		0.01
$\Sigma$	-0.00	75.74
		(downwards)

#### Simple check, EAB R 9-3a

$Vk \geq Bvk: 75.78 \geq 0.04 \text{ Passes requirement}$

### 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( $\delta,p=-0.07^\circ$ )		-0.04
Bh,q,k z=-2.81	-53.49	
Bv,q,k = Bh,k * tan( $\delta,p=-0.07^\circ$ )		-0.06
Ch,g	14.03	
Cv,g = Ch*tan( $\delta,C=0.0^\circ$ )		0.01
Ch,q	18.69	
Cv,q = Ch*tan( $\delta,C=0.0^\circ$ )		0.01
$\Sigma$	0.00	84.60
		(downwards)

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FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München

Program:

WALLS-Retain.

Structure:

info@fides-dvp.de    www.fides-dvp.de    Tel:++49/89/143829-0    ASB Nr.:

Job No.:

Date: 08.10.2018

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 occur).

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	dxM	Weight	Load	Water-	u*b	φ	c	θ
	[m]	b	[m]	[kN/m]	z-κατ.	φορτ.	[kN/m]	[°]	[kN/m²]	[°]
		[m]			[kN/m]					
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

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Author: FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München			Job No.:
Program: WALLS-Retain. Version 2017.046			
Structure:	info@fides-dvp.de	www.fides-dvp.de	Tel:++49/89/143829-0 ASB Nr.:
			Date: 08.10.2018
<div>Δράση Ed = (143.8*5.93 )</div> <div>Αντίσταση Rd = (390.7*5.93 +0.0)</div> <div>SLIP-CIRCLE <math>\mu = Ed/Rd = 0.37 &lt; 1.0</math>: Έλεγχος εκπληρώθηκε.</div> <div></div>			
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**Φάση εκσκαφής 2 "[2] Situation 2"**

LC: όλα τα φορτία Type: BS-T

**Εδαφικό σύστημα με 5 Στρώσεις**

Name	Τεχνητές επιχωματώσεις	Αμμόδης	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	Αμμόδης	ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟΣ
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 Αμμόδης 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 Αμμόδης ΑΡΓΙΛΟΣ:

z= -10.00

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

**Επιφ. φορτία:**

**Φορτία**

xA	zA	xE	zE	PxA	PzA	PxE	PzE	Typ	LC-description
[m]	[m]	[m]	[m]	[	kN/m²		]		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	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.

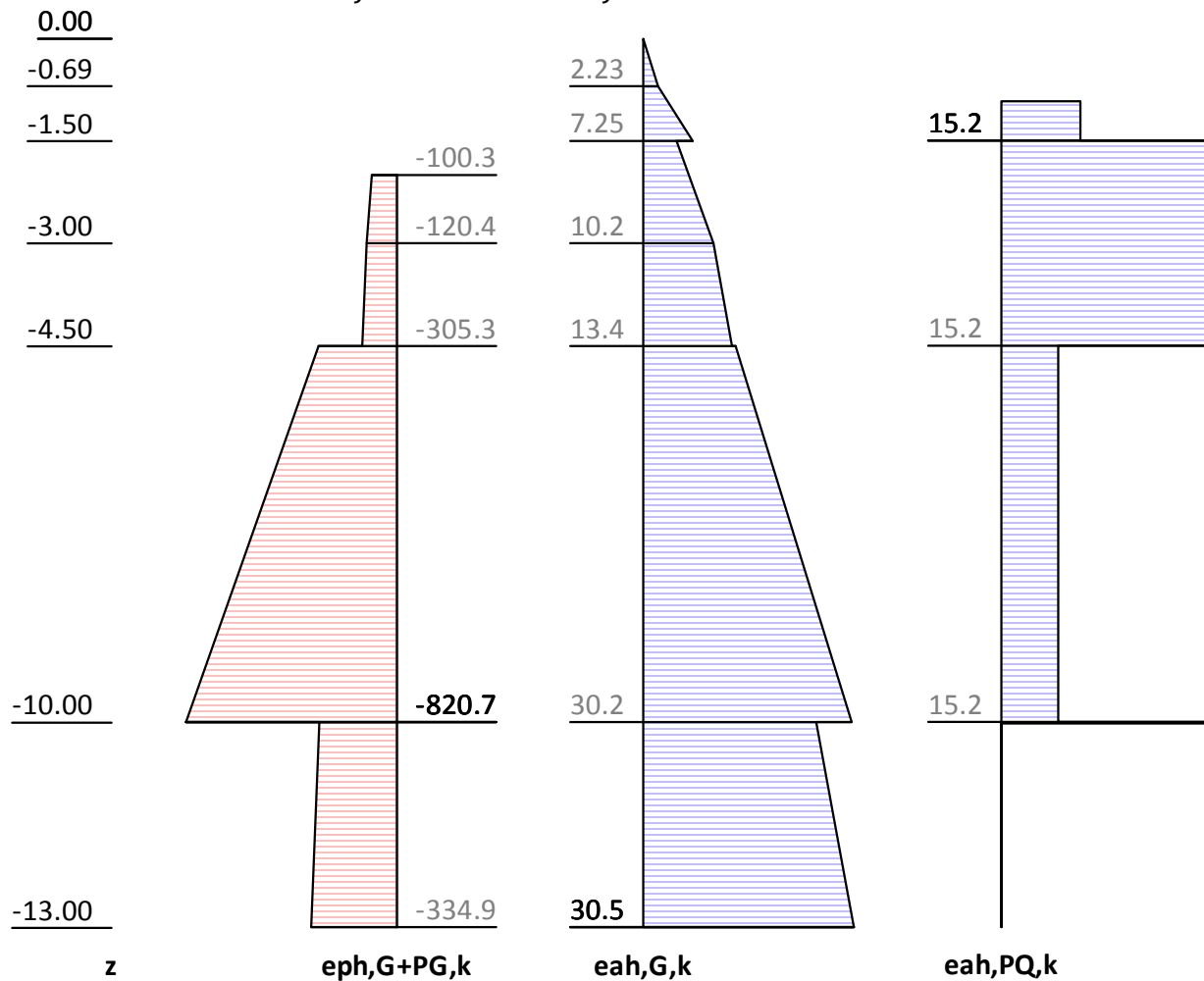
**Earth pressure coefficients kh**

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

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**Μήκος τοίχου**Foot depth for statics:  $z_f = -13.000$ **Stress analysis****Earth pressure, horizontal**

Pressures characteristic, no redistribution, continuous wall



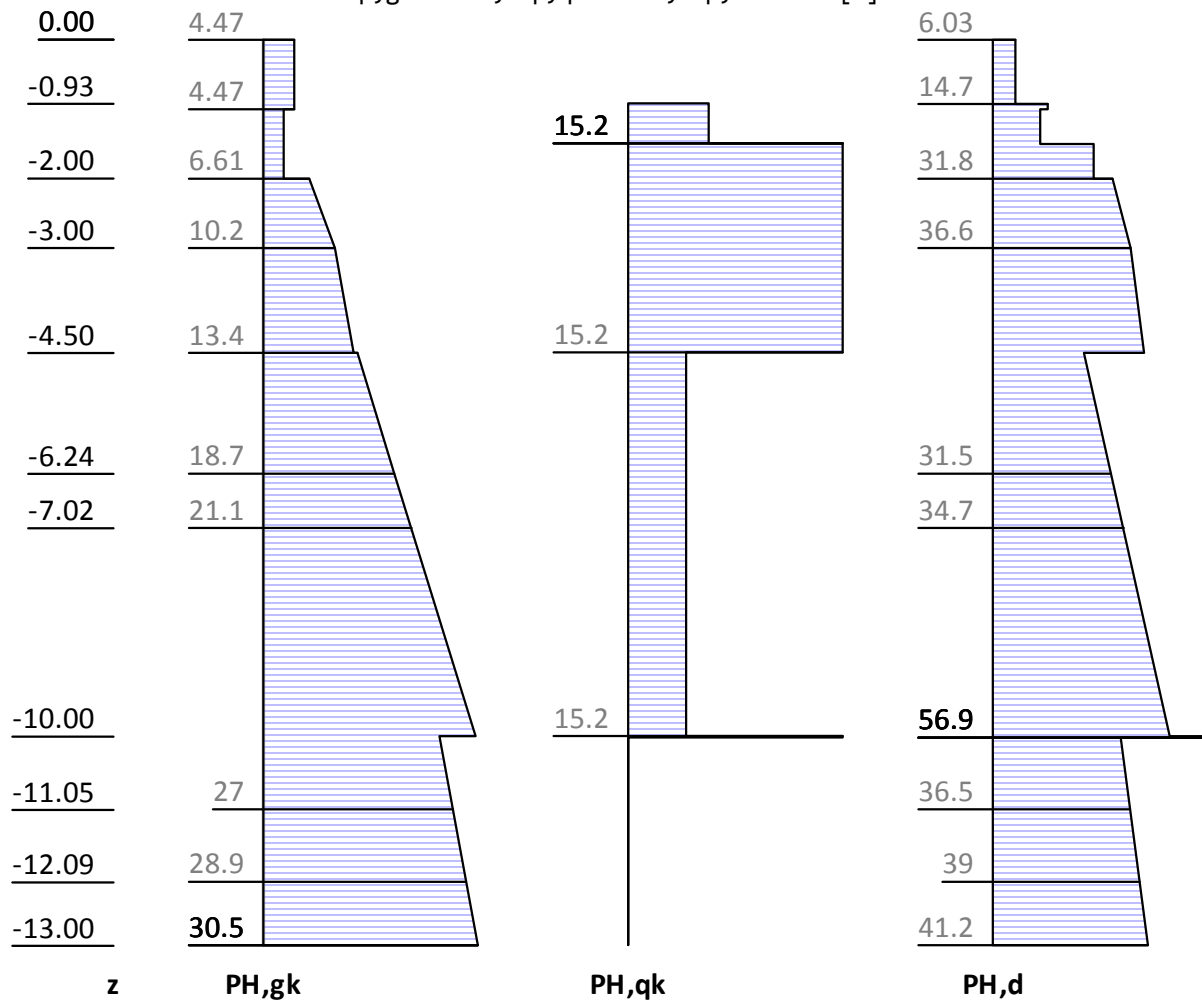
z [m]	eph,G,k [kN/m <sup>2</sup> ]	eah,G,k [kN/m <sup>2</sup> ]	eah,PQ,k [kN/m <sup>2</sup> ]	eah,d [kN/m <sup>2</sup> ]
0.00		0.00		0.00
-0.93		3.72	0.00	5.00
-0.93		3.72	5.76	13.64
-1.50		7.25	5.76	18.43
-1.50		4.82	15.23	29.36
-2.00	-0.00	6.61	15.23	31.77
-2.00	-100.29	6.61	15.23	31.77
-4.50	-135.45	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 [%]

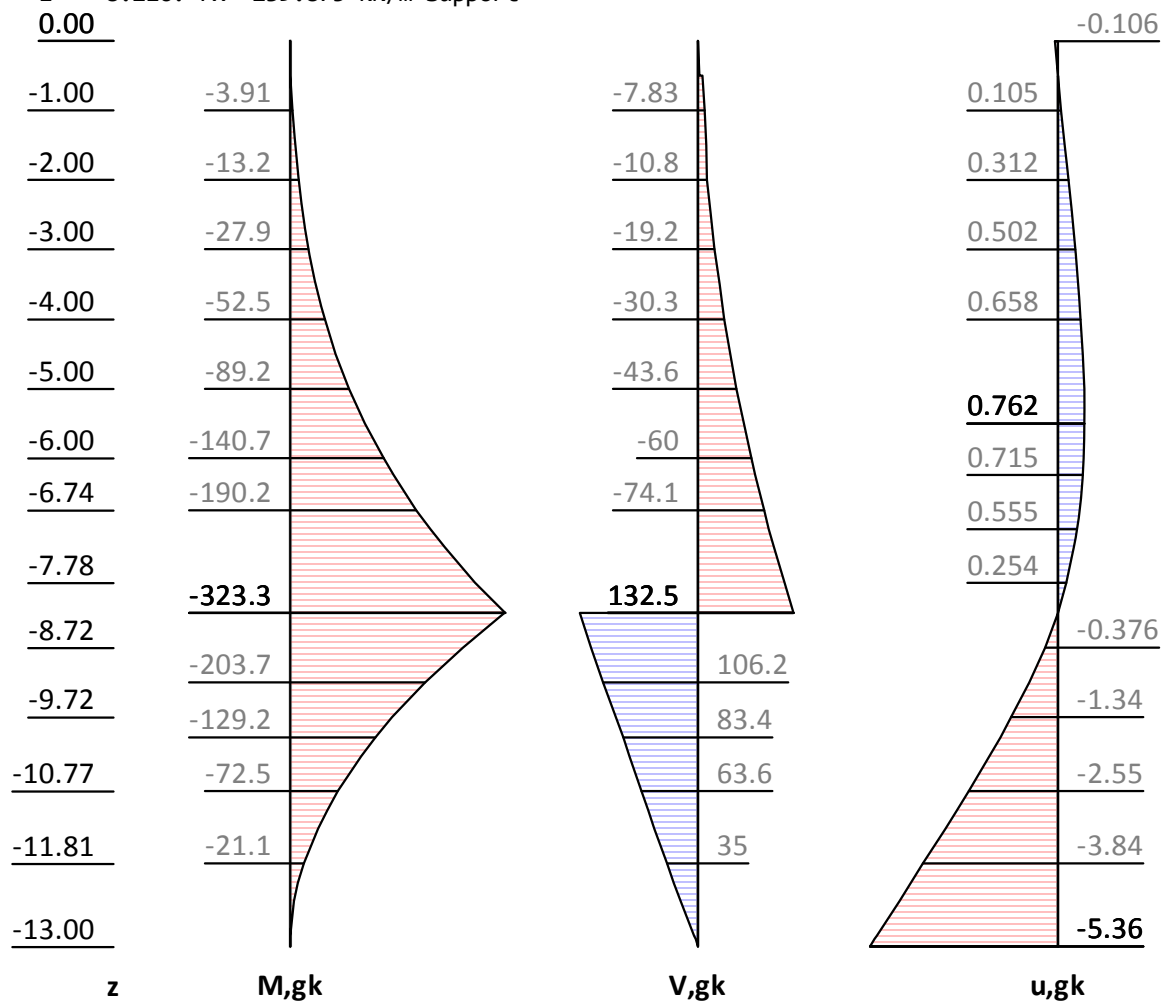


z [m]	PH,gk [kN/m²]	PH,qk [kN/m²]	PH,d [kN/m²]
0.00	4.47		6.03
-0.93	4.47	0.00	6.03
-0.93	4.47	5.76	14.68
-1.00	4.47	5.76	14.68
-1.00	2.98	5.76	12.67
-1.50	2.98	5.76	12.67
-1.50	2.98	15.23	26.88
-2.00	2.98	15.23	26.88
-2.00	6.61	15.23	31.77
-4.50	12.86	15.23	40.21
-4.50	13.38	4.15	24.29
-10.00	30.24	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

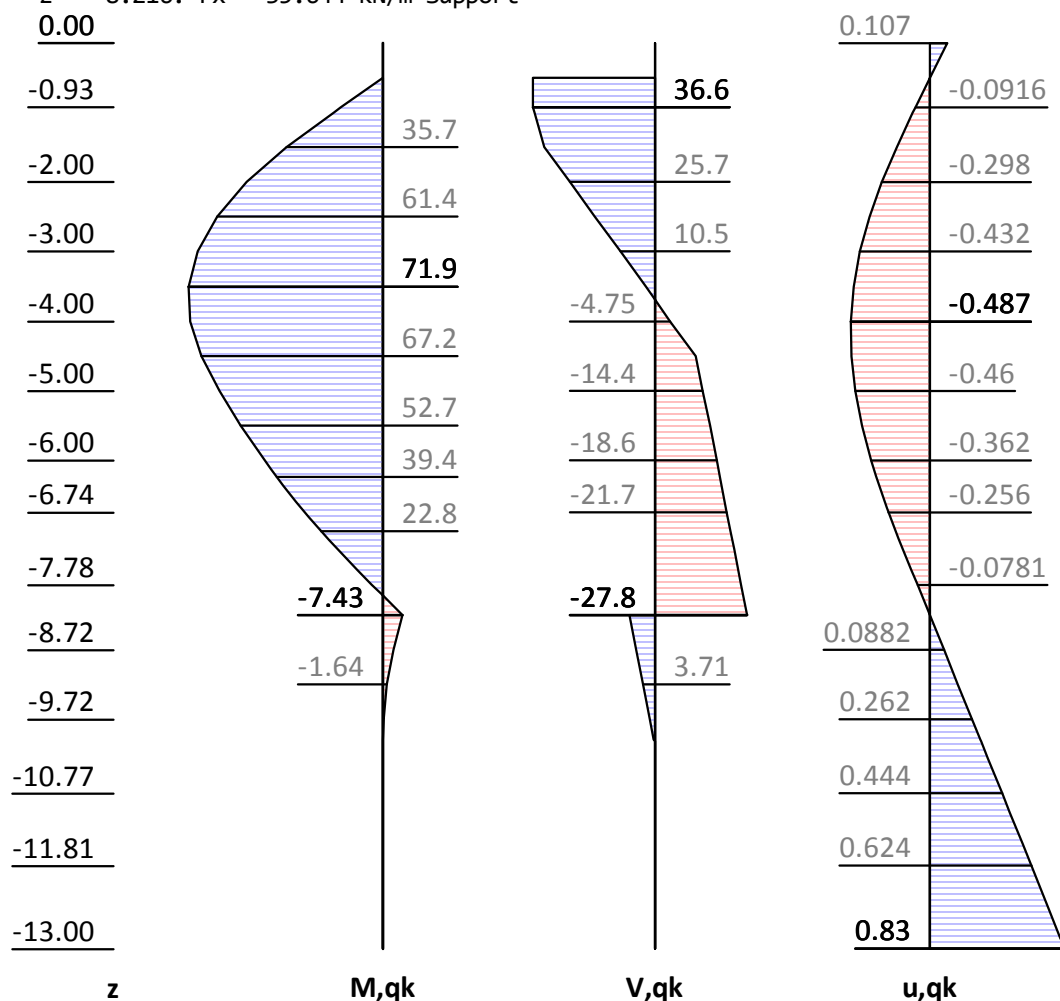
z= -8.216. Fx=-239.875 kN/m Support

**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]
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.  $F_x = -36.623$  kN/m Supportz= -8.216.  $F_x = -35.644$  kN/m Support

0.00



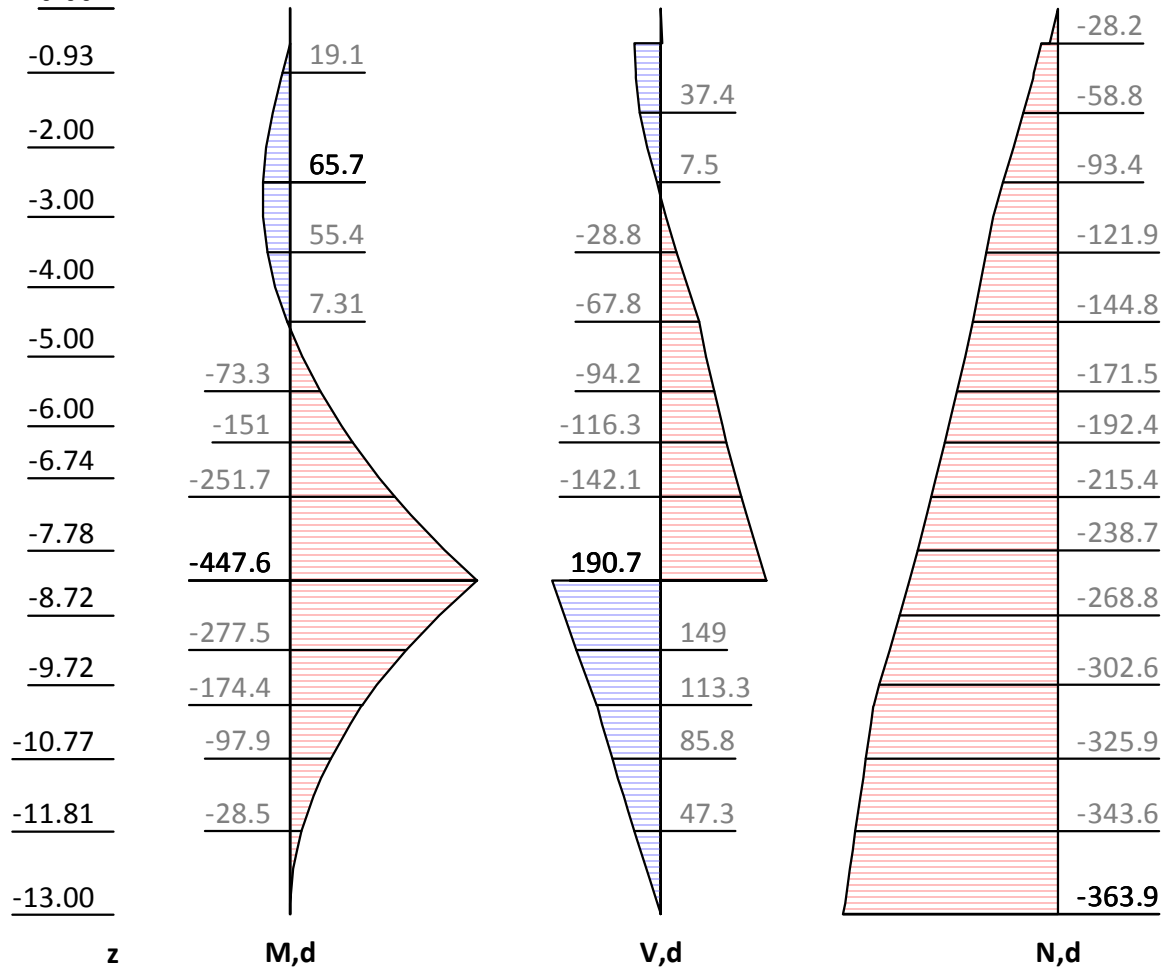
z [m]	H, q, k [kN/m²]	M, q, k [kN/m²]	V, q, k [kN/m²]	N, q, k [kN/m²]	u, q, k [mm]
0.00		0.00	-0.00		0.11
-0.50		-0.00	-0.00		0.00
-0.50		-0.00	36.62	-9.81	-0.00
-0.93	0.00	15.82	36.62	-9.81	-0.09
-0.93	5.76	15.82	36.62	-9.81	-0.09
-1.50	5.76	35.69	33.34	-10.65	-0.21
-1.50	15.23	35.69	33.34	-10.65	-0.21
-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

**0.00**

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**0.00**

**6.03**

**z**

**H,d**

**0.00147**

**u,g+q,k**

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

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z	H,d	M,d	V,d	N,d	u,g+q,k
[m]	[kN/m2]	[kN/m2]	[kN/m2]	[kN/m2]	[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 of earth support**

Check: Mobilizable earth resistance is sufficient for earth support force.  
 z: -8.22 m  
 $R_d = E_{ph,k}/\gamma_{Re} = 4358.35 / 1.400 = 3113.11 \text{ [kN/m]}$   
 $E_d(U_{h,d})/R_d = 377.30 / 3113.11 = 0.121 \text{ [-]}. \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-8.22	-239.88	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * 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.

V<sub>k</sub> >= B<sub>vk</sub>: 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
B <sub>h,g,k</sub> z=-8.22	-239.88	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * tan(δ,p=-22.00°)		-96.92
B <sub>h,q,k</sub> z=-8.22	-35.64	
B <sub>v,q,k</sub> = B <sub>h,k</sub> * 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.

V<sub>k</sub> >= B<sub>vk</sub>: 266.40 >= 111.32 Passes requirement

**Anchor verification**

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**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	θ1	θ2	lA	W,k	Q,k	Ea1,k	Ea2,k	Ra_cal,d	Sum(A,d)	Ed/Rd
[m]	[°]	[°]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]
-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°

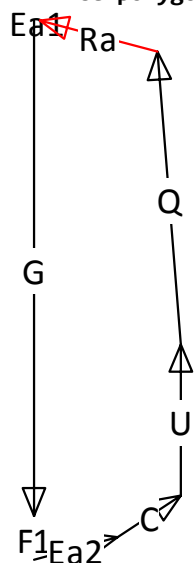
**Loads / forces (char.)**

		Fx	Fz	F	
		[kN/m]	[kN/m]	[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	

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**Force polygon**

Acting anchor forces  $E_d: \sum(A, d) = 52.2 \text{ kN/m}$   
 Possible anchor forces  $R_d: R_{a\_cal, d} = 345.6/1.400 = 246.9 \text{ kN/m}$   
 Verif. of lower failure plane  $E_d/R_d = 0.21 < 1.0$ : Έλεγχος εκπληρώθηκε.

**Check of steel tension**

$l_{tot}$  ...[m]: Total length of anchor incl. excess length at head  
 $A_s$  ....[mm<sup>2</sup>]: X-section area of steel member  
 $R_{i, d}$  ...[kN]: Ultimate strength of tension member ( $\gamma, M=1.15$ )  
 $A, d$  ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	$l_{tot}$	$A_s$	$R_{i, d}$	$A, d$
-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**

$l_{V, k}$  .....: Length of grout body  
 $D_{m, V, k}$  ....: Diameter of grout body  
 $\tau_{Gr, k}$  ....: Average applied skin friction along the grout body (from soil parameters)  
 $R_{a, k}$  ....: Charact. pullout resistance of the anchor  
 $\gamma_A$  .....: Partial safety factor of anchor pullout  
 $R_{a, d}$  .....:  $R_{a, k} / \gamma_A$   
 $A, d$  .....: Dimensioning force of the anchor from wall analysis

z	$l_{V, k}$	$D_{m, V, k}$	$\tau_{Gr, k}$	$R_{a, k}$	$\gamma_A$	$R_{a, d}$	$A, d$	$A, d / R_{a, d}$
[m]	[m]	[mm]	[kN/m <sup>2</sup> ]	[kN]	[-]	[kN]	[kN]	[-]
-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  $R \cdot \sin(\phi)$ .  
 The automatic slip circle optimization only considers circles that intersect the surface with an area of at least 0.25 m<sup>2</sup>.  
 The slip circle calculation only accepts circles including the wall.  
 The slip circle calculation only allows circular failure planes (no vertical tangents will occur).

Author:
FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München

Job No.:

Program:
WALLS-Retain.
Version 2017.046

Structure:
info@fides-dvp.de
www.fides-dvp.de
Tel:++49/89/143829-0
ASB Nr.:

Date: 08.10.2018

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	dxM	Weight	Load	Water-	u*b	φ	c	θ
	[m]	b	[m]	[kN/m]	z-κατ.	φορτ.	[kN/m]	[°]	[kN/m²]	[°]
					[kN/m]					
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.

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Author: FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München			Job No.:
Program: WALLS-Retain. Version 2017.046			
Structure:	info@fides-dvp.de	www.fides-dvp.de	Tel:++49/89/143829-0 ASB Nr.:
			Date: 08.10.2018
<div>Δράση Ed = (339.9*13.39)</div> <div>Αντίσταση Rd = (2119.0*13.39 +0.0)</div> <div>SLIP-CIRCLE <math>\mu = Ed/Rd = 0.16 &lt; 1.0</math>: Έλεγχος εκπληρώθηκε.</div> <div></div>			
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Program:	WALLS-Retain. Version 2017.046			
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### Φάση εκσκαφής 3 "[3] Situation 3"

LC: όλα τα φορτία Type: BS-T

#### Εδαφικό σύστημα με 5 Στρώσεις

Name	Τεχνητές επιχωματώσεις	Αμμόδης 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	Αμμόδης	ΑΡΓΙΛΟΣ	Αργιλώδη	ΧΑΛΙΚΙΑ-	ΑΜΜΟΣ
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 Αμμόδης 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 Αμμόδης ΑΡΓΙΛΟΣ:

z= -10.00

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Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>	Job No.:
Program: <b>WALLS-Retain. Version 2017.046</b>	
Structure: info@fides-dvp.de    www.fides-dvp.de    Tel:++49/89/143829-0    ASB Nr.:	Date: 08.10.2018

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

**Επιφ. φορτία:**  
**Φορτία**

xA	zA	xE	zE	PxA	PzA	PxE	PzE	Typ	LC-description
[m]	[m]	[m]	[m]	[	kN/m²		]		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

**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**  

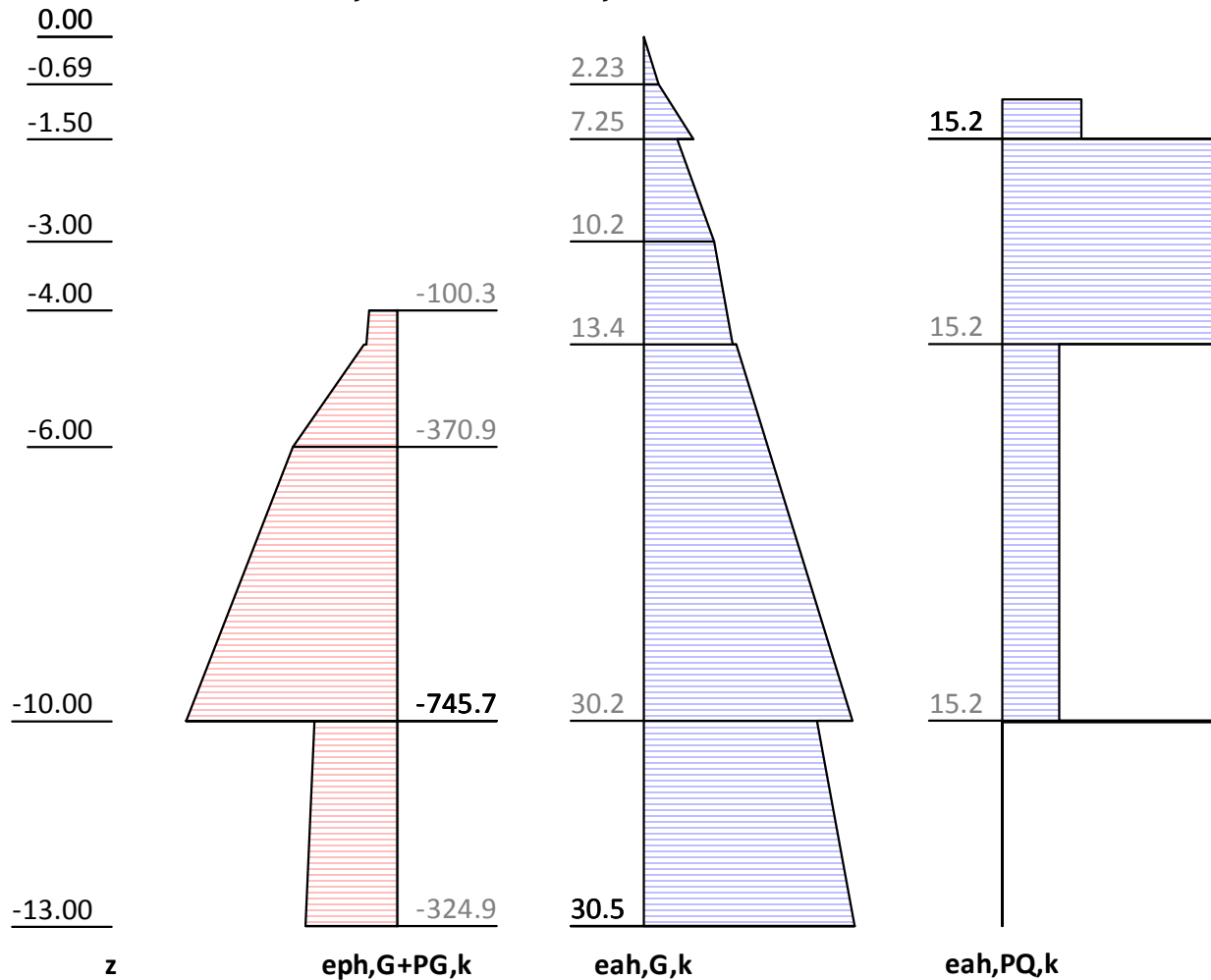
φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	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	--	--	"

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**Μήκος τοίχου**Foot depth for statics:  $z_f = -13.000$ **Stress analysis****Earth pressure, horizontal**

Pressures characteristic, no redistribution, continuous wall



$z$ [m]	$eph, G, k$ [kN/m <sup>2</sup> ]	$eah, G, k$ [kN/m <sup>2</sup> ]	$eah, PQ, k$ [kN/m <sup>2</sup> ]	$eah, d$ [kN/m <sup>2</sup> ]
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

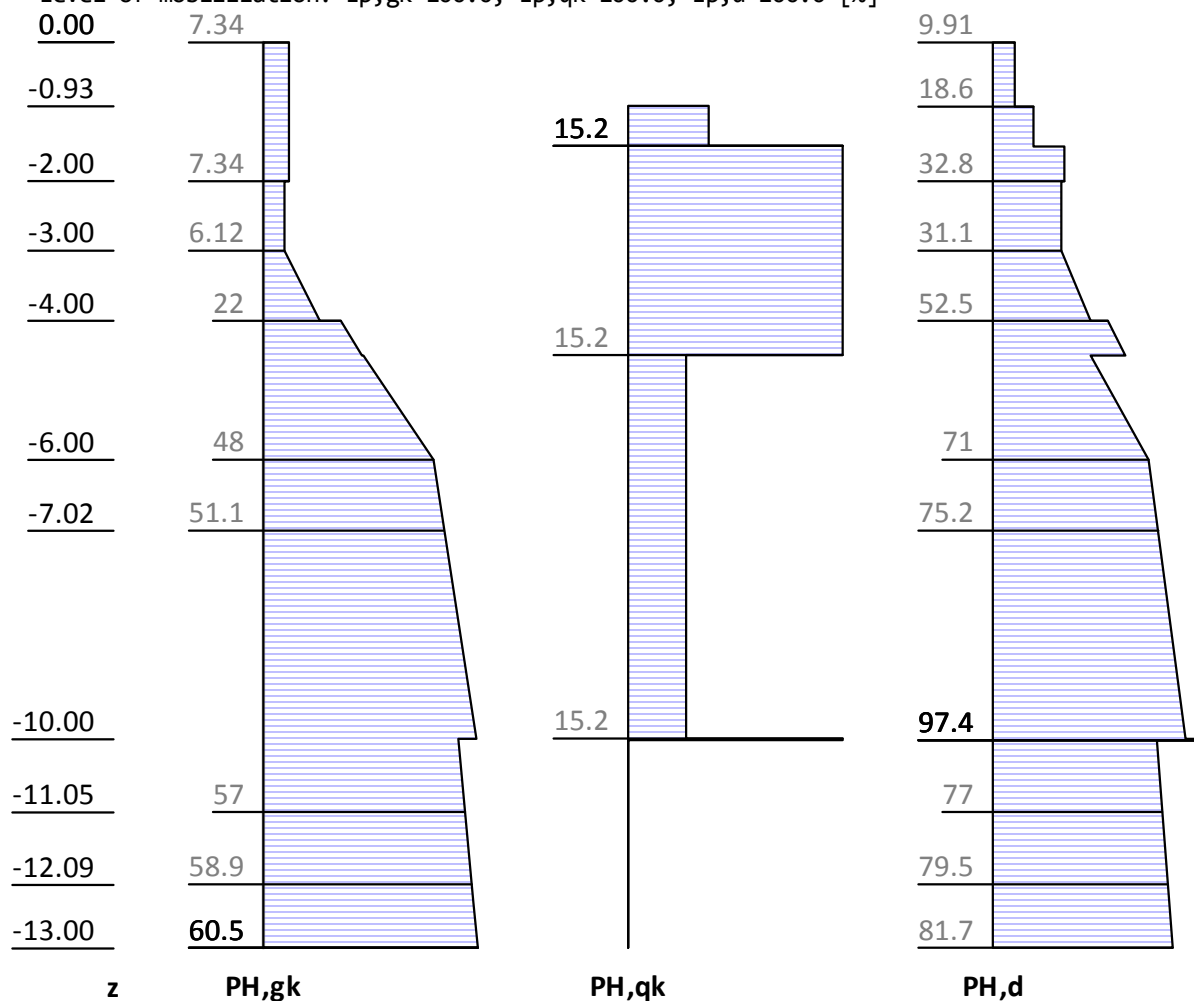


## Πίεση νερού

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 [%]

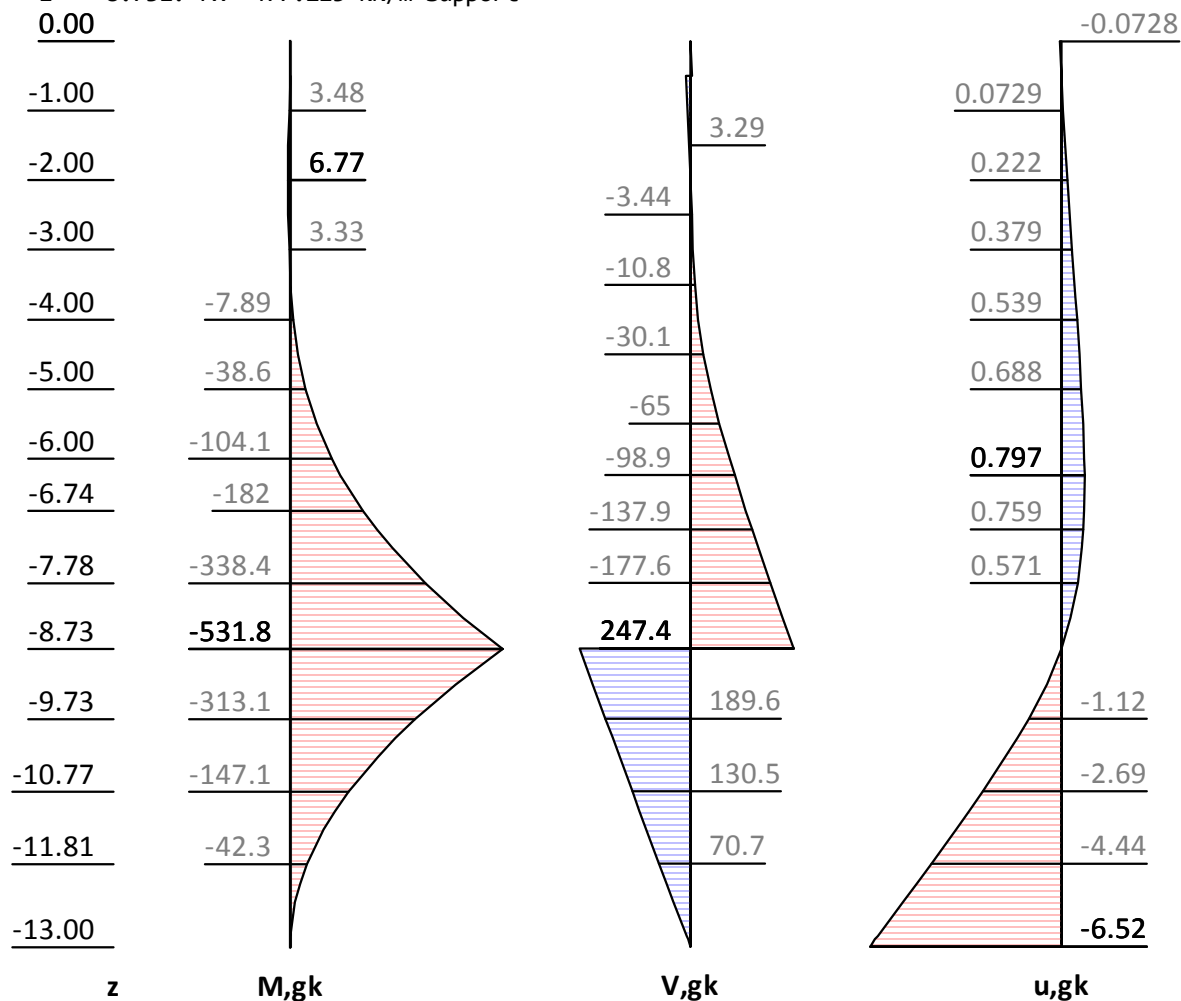


z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	7.34		9.91
-0.93	7.34	0.00	9.91
-0.93	7.34	5.76	18.56
-1.50	7.34	5.76	18.56
-1.50	7.34	15.23	32.76
-2.00	7.34	15.23	32.76
-2.00	6.12	15.23	31.11
-4.00	16.12	15.23	44.61
-4.00	21.97	15.23	52.50
-4.50	27.86	15.23	60.46
-4.50	28.38	4.15	44.54
-10.00	60.24	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

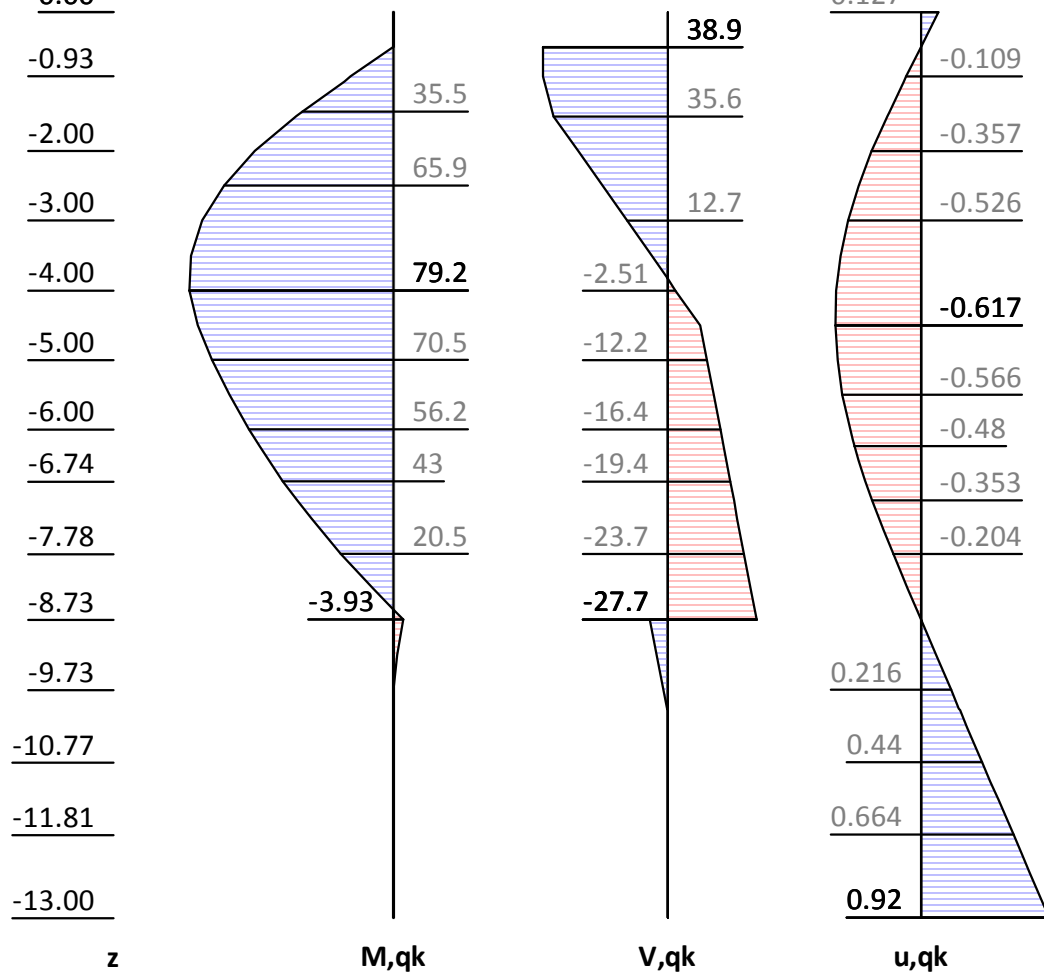
z= -8.731. Fx=-477.215 kN/m Support

**0.00**

z [m]	H, g, k [kN/m <sup>2</sup> ]	M, g, k [kN/m <sup>2</sup> ]	V, g, k [kN/m <sup>2</sup> ]	N, g, k [kN/m <sup>2</sup> ]	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.  $F_x = -38.854$  kN/m Supportz= -8.731.  $F_x = -33.414$  kN/m Support

0.00



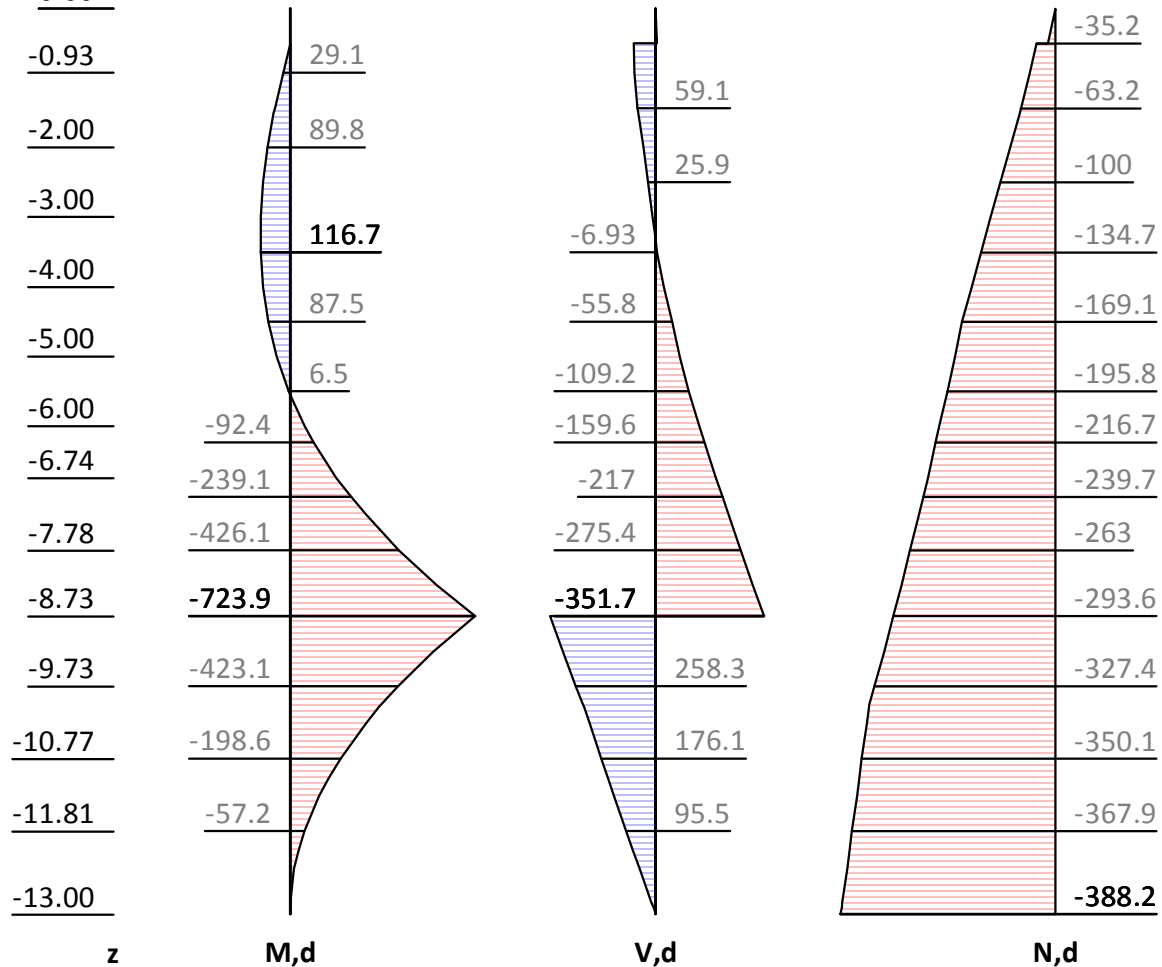
z [m]	H, q, k [kN/m²]	M, q, k [kN/m²]	V, q, k [kN/m²]	N, q, k [kN/m²]	u, q, k [mm]
0.00		0.00	0.00	0.00	0.13
-0.50		0.00	0.00	-0.00	0.00
-0.50		0.00	0.00	-0.00	-0.00
-0.50		0.00	38.85	-10.41	-0.00
-0.93	0.00	16.82	38.85	-10.41	-0.11
-0.93	5.76	16.82	38.85	-10.41	-0.11
-1.50	5.76	37.92	35.57	-11.25	-0.25
-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

**0.00**

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<div> <div> <div>0.00</div> <div>9.91</div> <div>0.0545</div> </div> <div> <div>-0.93</div> <div>18.6</div> <div>-0.0463</div> </div> <div> <div>-2.00</div> <div>32.8</div> <div></div> </div> <div> <div>-3.00</div> <div>31.1</div> <div>-0.12</div> </div> <div> <div>-4.00</div> <div>52.5</div> <div></div> </div> <div> <div>-5.00</div> <div></div> <div>0.181</div> </div> <div> <div>-6.00</div> <div>71</div> <div>0.317</div> </div> <div> <div>-6.74</div> <div>75.2</div> <div>0.411</div> </div> <div> <div>-7.78</div> <div></div> <div>0.23</div> </div> <div> <div>-8.73</div> <div></div> <div>-0.393</div> </div> <div> <div>-9.73</div> <div>97.4</div> <div>-1.23</div> </div> <div> <div>-10.77</div> <div>77</div> <div>-2.25</div> </div> <div> <div>-11.81</div> <div>79.5</div> <div>-3.78</div> </div> <div> <div>-13.00</div> <div>81.7</div> <div>-5.6</div> </div> </div> <div> <div>z</div> <div>H,d</div> <div>u,g+q,k</div> </div> <table> <tr> <th>z [m]</th><th>H,d [kN/m2]</th><th>M,d [kN/m2]</th><th>V,d [kN/m2]</th><th>N,d [kN/m2]</th><th>u,g+q,k [mm]</th></tr> <tr><td>0.00</td><td>9.91</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.05</td></tr> <tr><td>-0.00</td><td>9.91</td><td>-0.00</td><td>0.00</td><td>-0.00</td><td>0.05</td></tr> <tr><td>-0.50</td><td>9.91</td><td>-1.24</td><td>-4.96</td><td>-14.43</td><td>-0.00</td></tr> <tr><td>-0.50</td><td>9.91</td><td>-1.24</td><td>72.64</td><td>-35.22</td><td>-0.00</td></tr> <tr><td>-0.52</td><td>9.91</td><td>0.00</td><td>72.46</td><td>-35.73</td><td>-0.00</td></tr> <tr><td>-0.93</td><td>9.91</td><td>29.08</td><td>68.37</td><td>-47.64</td><td>-0.05</td></tr> <tr><td>-0.93</td><td>18.56</td><td>29.08</td><td>68.37</td><td>-47.64</td><td>-0.05</td></tr> <tr><td>-1.50</td><td>18.56</td><td>65.04</td><td>57.80</td><td>-65.35</td><td>-0.10</td></tr> <tr><td>-1.50</td><td>32.76</td><td>65.04</td><td>57.80</td><td>-65.35</td><td>-0.10</td></tr> <tr><td>-2.00</td><td>32.76</td><td>89.84</td><td>41.41</td><td>-82.71</td><td>-0.13</td></tr> <tr><td>-2.00</td><td>31.11</td><td>89.84</td><td>41.41</td><td>-82.71</td><td>-0.13</td></tr> <tr><td>-2.50</td><td>31.11</td><td>106.66</td><td>25.86</td><td>-100.03</td><td>-0.15</td></tr> <tr><td>-3.30</td><td>35.14</td><td>116.29</td><td>-0.00</td><td>-127.70</td><td>-0.13</td></tr> <tr><td>-3.50</td><td>37.86</td><td>116.68</td><td>-6.93</td><td>-134.66</td><td>-0.12</td></tr> <tr><td>-4.00</td><td>44.61</td><td>108.20</td><td>-27.55</td><td>-151.98</td><td>-0.07</td></tr> <tr><td>-4.00</td><td>52.50</td><td>108.20</td><td>-27.55</td><td>-151.98</td><td>-0.07</td></tr> <tr><td>-4.50</td><td>60.46</td><td>87.53</td><td>-55.79</td><td>-169.09</td><td>-0.00</td></tr> <tr><td>-4.50</td><td>44.54</td><td>87.53</td><td>-55.79</td><td>-169.09</td><td>-0.00</td></tr> <tr><td>-4.50</td><td>44.59</td><td>87.32</td><td>-55.95</td><td>-169.17</td><td>-0.00</td></tr> <tr><td>-5.55</td><td>63.09</td><td>-0.00</td><td>-112.61</td><td>-197.28</td><td>0.19</td></tr> <tr><td>-7.28</td><td>76.29</td><td>-298.11</td><td>-236.70</td><td>-247.56</td><td>0.41</td></tr> <tr><td>-8.73</td><td>82.29</td><td>-723.87</td><td>-351.73</td><td>-293.64</td><td>0.00</td></tr> <tr><td>-8.73</td><td>82.29</td><td>-723.87</td><td>342.63</td><td>-293.64</td><td>0.00</td></tr> <tr><td>-10.00</td><td>87.55</td><td>-356.66</td><td>234.84</td><td>-336.84</td><td>-1.23</td></tr> <tr><td>-10.00</td><td>97.28</td><td>-356.66</td><td>234.84</td><td>-336.84</td><td>-1.23</td></tr> <tr><td>-10.03</td><td>97.36</td><td>-349.66</td><td>231.92</td><td>-337.53</td><td>-1.26</td></tr> <tr><td>-10.03</td><td>74.51</td><td>-349.66</td><td>231.92</td><td>-337.53</td><td>-1.26</td></tr> </table>						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
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z	H,d	M,d	V,d	N,d	u,g,q,k
[m]	[kN/m2]	[kN/m2]	[kN/m2]	[kN/m2]	[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

$R_d = E_{ph,k}/\gamma_{Re} = 3582.08 / 1.400 = 2558.63 \text{ [kN/m]}$

$E_d(U_h,d)/R_d = 694.36 / 2558.63 = 0.271 \text{ [-]}. \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-8.73	-477.21	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * 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.

$V_k \geq B_{vk}: 255.41 \geq 192.81 \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-8.73	-477.21	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * tan(δ,p=-22.00°)		-192.81
B <sub>h,q,k</sub> z=-8.73	-33.41	
B <sub>v,q,k</sub> = B <sub>h,k</sub> * 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.

$V_k \geq B_{vk}: 284.33 \geq 206.31 \text{ Passes requirement}$

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## 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	θ1	θ2	lA	W,k	Q,k	Ea1,k	Ea2,k	Ra_cal,d	Sum(A,d)	Ed/Rd
[m]	[°]	[°]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]
-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:

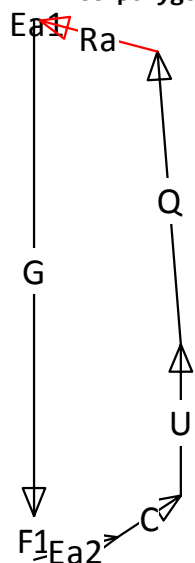
##### Γεωμετρία:

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	Fz	F	
		[kN/m]	[kN/m]	[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	

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**Force polygon**

Acting anchor forces  $E_d: \sum(A, d) = 80.3 \text{ kN/m}$   
 Possible anchor forces  $R_d: R_{a\_cal, d} = 345.6/1.400 = 246.9 \text{ kN/m}$

Verif. of lower failure plane  $E_d/R_d = 0.33 < 1.0$ : Έλεγχος εκπληρώθηκε.

**Check of steel tension**

$l_{tot}$  ...[m]: Total length of anchor incl. excess length at head

$A_s$  ....[mm<sup>2</sup>]: X-section area of steel member

$R_{i, d}$  ...[kN]: Ultimate strength of tension member ( $\gamma, M=1.15$ )

$A, d$  ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	$l_{tot}$	$A_s$	$R_{i, d}$	$A, d$
-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**

$l_{V, k}$  .....: Length of grout body

$D_{m, V, k}$  ....: Diameter of grout body

$\tau_{Gr, k}$  ....: Average applied skin friction along the grout body (from soil parameters)

$R_{a, k}$  ....: Charact. pullout resistance of the anchor

$\gamma_A$  .....: Partial safety factor of anchor pullout

$R_{a, d}$  .....:  $R_{a, k} / \gamma_A$

$A, d$  .....: Dimensioning force of the anchor from wall analysis

z	$l_{V, k}$	$D_{m, V, k}$	$\tau_{Gr, k}$	$R_{a, k}$	$\gamma_A$	$R_{a, d}$	$A, d$	$A, d / R_{a, d}$
[m]	[m]	[mm]	[kN/m <sup>2</sup> ]	[kN]	[-]	[kN]	[kN]	[-]
-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  $R \cdot \sin(\phi)$ .

The automatic slip circle optimization only considers circles that intersect the surface with an area of at least 0.25 m<sup>2</sup>.

The slip circle calculation only accepts circles including the wall.

The slipcircle calculation only allows circular failure planes (no vertical tangents will occur).



Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>							Job No.:	
Program: <b>WALLS-Retain. Version 2017.046</b>								
Structure: info@fides-dvp.de    www.fides-dvp.de    Tel:++49/89/143829-0    ASB Nr.:							Date: 08.10.2018	

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.**

Part: Block:      Please specify project informations. Record:		Archive No.:   <div style="text-align: right;">Page: 46</div>
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## Φάση εκσκαφής 4 "[4] Situation 4"

LC: όλα τα φορτία Type: BS-T

### Εδαφικό σύστημα με 5 Στρώσεις

Name	Τεχνητές επιχωματώσεις Αμμόδης 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,θh	[-]	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	Αμμόδης	ΑΡΓΙΛΟΣ	Αργιλώδη	ΧΑΛΙΚΙΑ-	ΑΜΜΟΣ
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,θh	[-]	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 Αμμόδης 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 Αμμόδης ΑΡΓΙΛΟΣ:

z= -10.00

Part:	Please specify project informations.	Page: 47	Archive No.:
Block:			
Record:			

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

## Επιφ. φορτία:

### Φορτία

xA	zA	xE	zE	PxA	PzA	PxE	PzE	Typ	LC-description
[m]	[m]	[m]	[m]	[	kN/m <sup>2</sup>		]		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:  $\varphi_{\min} = 40.000$ .  
Negative earth pressure fractions are set to zero.

### Redistribution of earth pressure

Shape of redistribution: Triangle (perpend. to wall).  
The earth pressure is getting redistrib. to: Excavation level  
The earth pressure below the excavation acts without redistrib.  
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

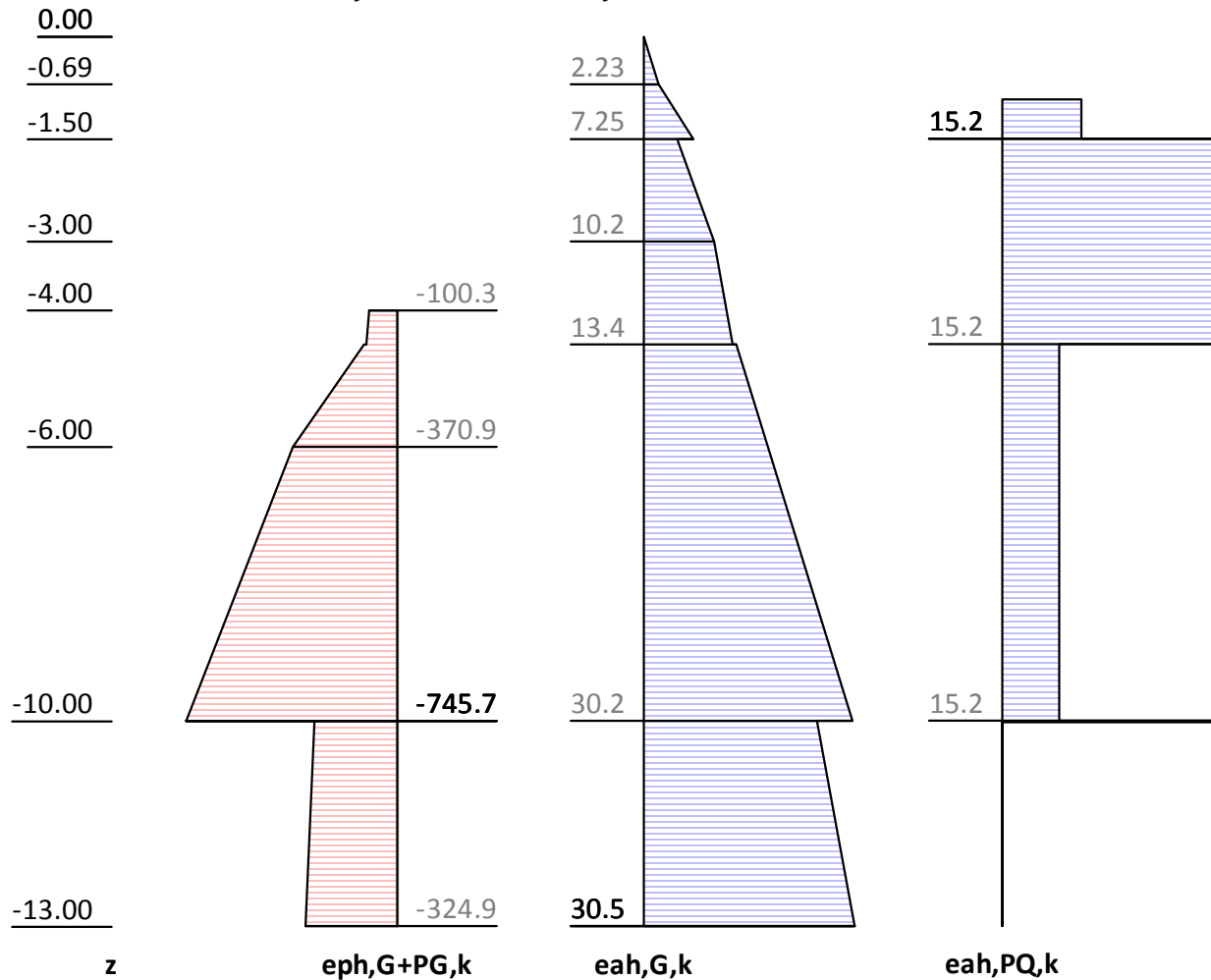
Anchor checks (lower failure plane): Ναι  
Anchor forces with safety level of DS-P: Ναι  
Verification of grout body pull out forces: Ναι  
 $\delta_a$ , Anchoring wall : used from soil layer.  
 $\delta_p$ , Anchoring wall : used from soil layer.

### Earth pressure coefficients kh

$\varphi$	$\alpha$	$\beta$	$\delta$	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:  $z_f = -13.000$ **Stress analysis****Earth pressure, horizontal**

Pressures characteristic, no redistribution, continuous wall



z [m]	eph, G, k [kN/m <sup>2</sup> ]	eah, G, k [kN/m <sup>2</sup> ]	eah, PQ, k [kN/m <sup>2</sup> ]	eah, d [kN/m <sup>2</sup> ]
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

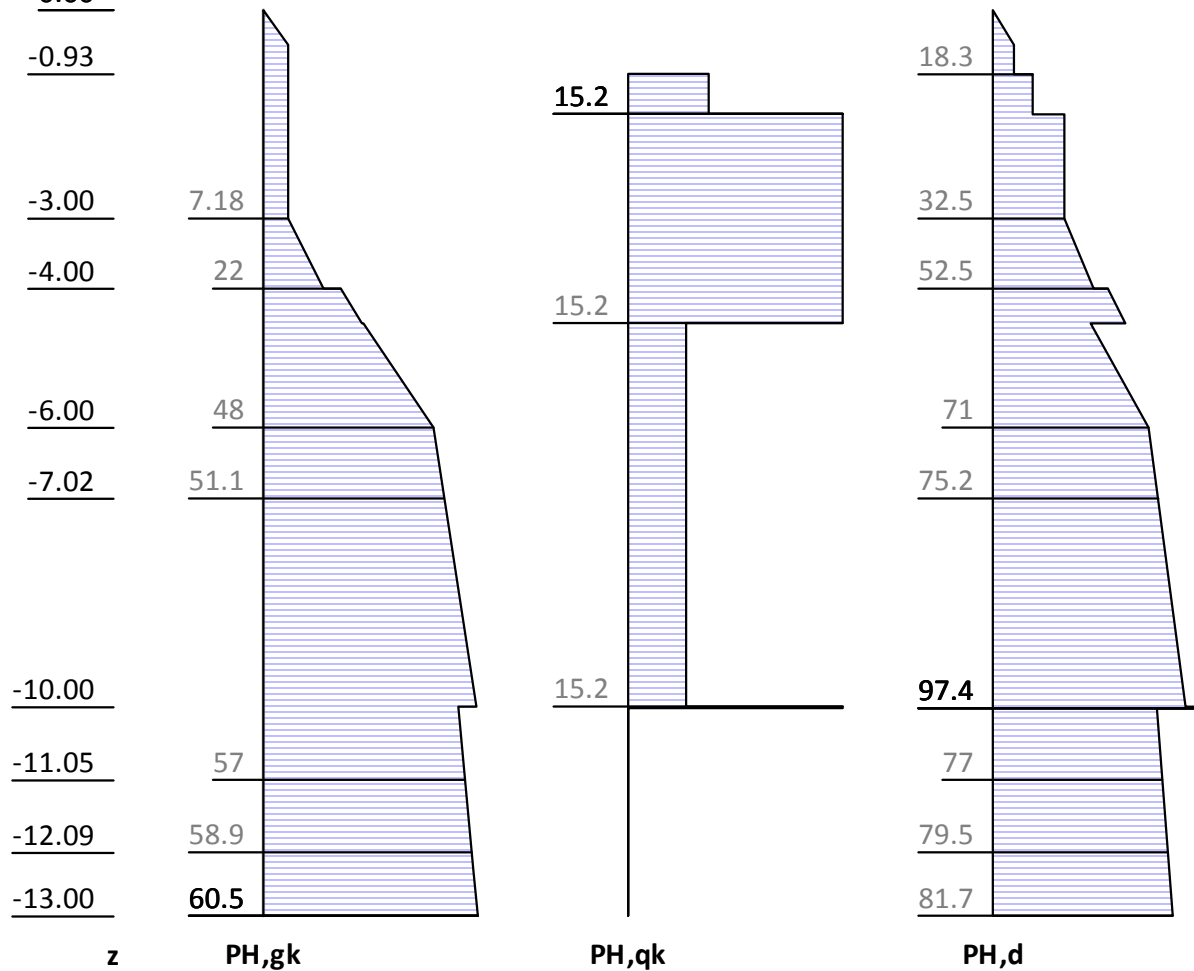
## Πίεση νερού

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 [%]

0.00



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

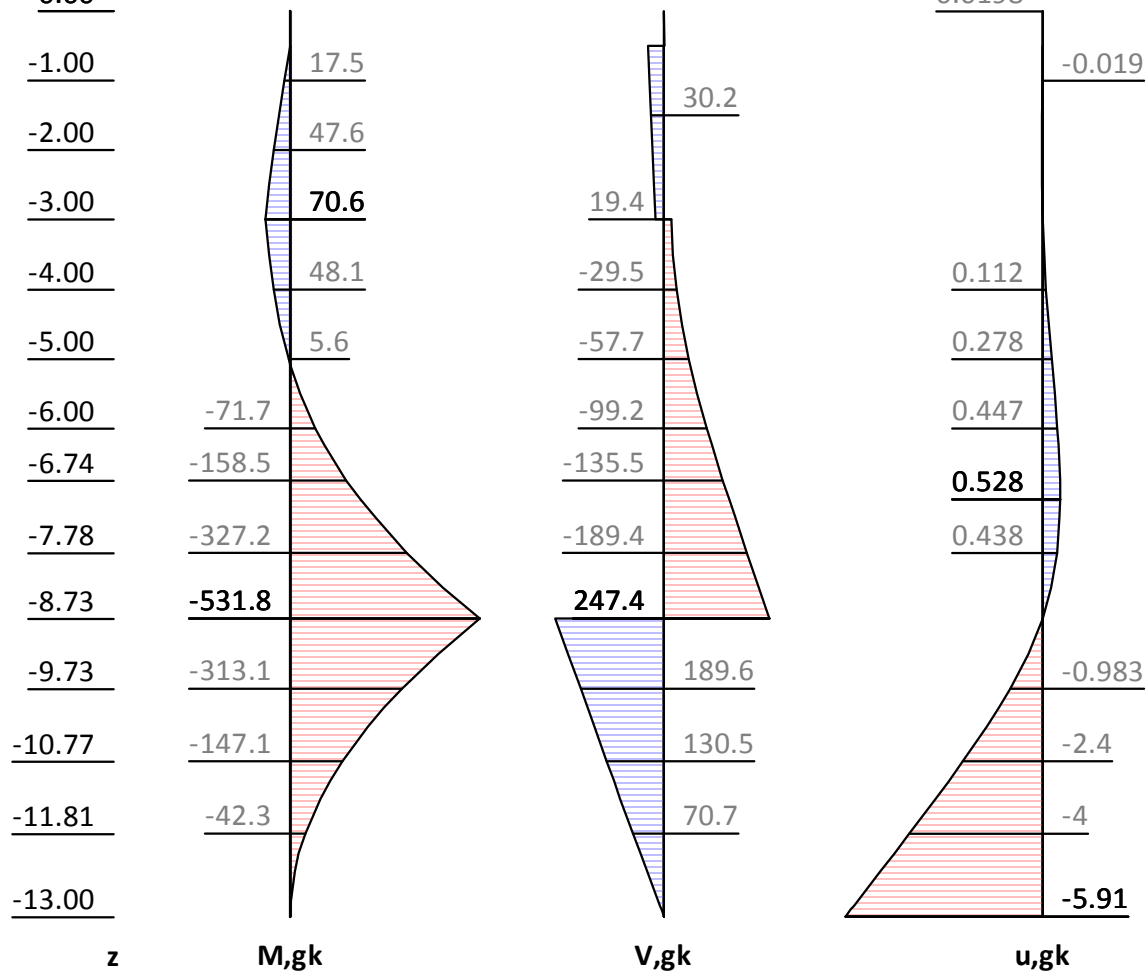
**V-pressure on static system****Internal forces: Permanent, characteristically**

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

0.00



z [m]	H, g, k [kN/m <sup>2</sup> ]	M, g, k [kN/m <sup>2</sup> ]	V, g, k [kN/m <sup>2</sup> ]	N, g, k [kN/m <sup>2</sup> ]	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

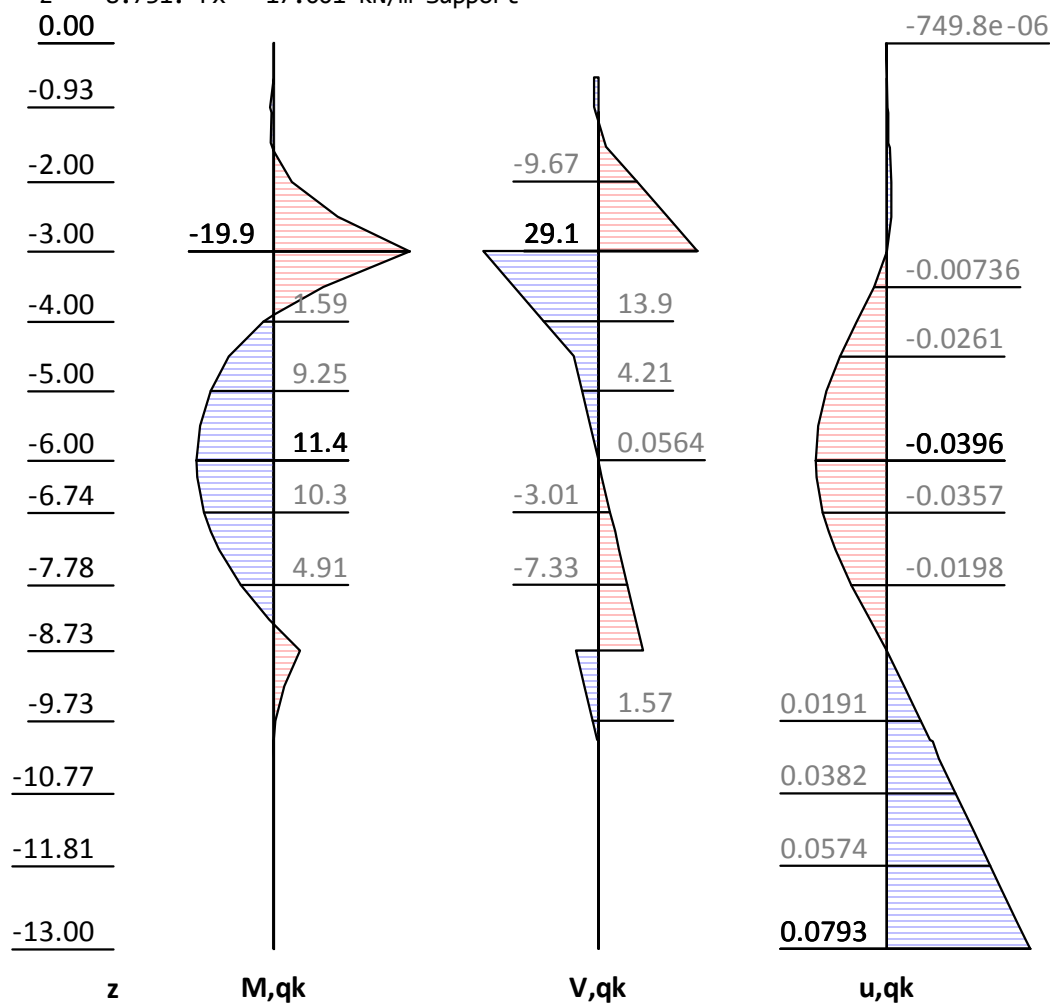
**Internal forces: Variable, characteristically**Method EB 82-4 ( $Q = [G+Q] - G$ ).

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

0.00



z [m]	H, q, k [kN/m <sup>2</sup> ]	M, q, k [kN/m <sup>2</sup> ]	V, q, k [kN/m <sup>2</sup> ]	N, q, k [kN/m <sup>2</sup> ]	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

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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

0.00

-0.93

21.2

-2.00

-3.00

-4.00

71.3

-5.00

51

-6.00

-21.4

-6.74

-113.9

-7.78

-253.9

-8.73

-434.3

-9.73

-723.9

-10.77

-423.1

-11.81

-198.6

-13.00

-57.2

M,d

-0.93

38.9

-2.00

-3.00

-4.00

-18.9

-5.00

-71.6

-6.00

-133.8

-6.74

-187.5

-7.78

-266.7

-8.73

-343.1

-9.73

258.3

-10.77

176.1

-11.81

95.5

V,d

-29

-56.9

-119.6

-154.3

-184.6

-212.1

-233.6

-265.4

-296

-329.8

-352.5

-370.2

-390.5

N,d

z

M,d

V,d

N,d

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<div> <div> <div>0.00</div> <div>-0.93</div> <div>-2.00</div> <div>-3.00</div> <div>-4.00</div> <div>-5.00</div> <div>-6.00</div> <div>-6.74</div> <div>-7.78</div> <div>-8.73</div> <div>-9.73</div> <div>-10.77</div> <div>-11.81</div> <div>-13.00</div> </div> <div> <div>18.3</div> <div>32.5</div> <div>52.5</div> <div>71</div> <div>75.2</div> <div>97.4</div> <div>77</div> <div>79.5</div> <div>81.7</div> </div> <div> <div>0.0191</div> <div>-0.0158</div> <div>0.0949</div> <div>0.245</div> <div>0.408</div> <div>0.495</div> <div>0.418</div> <div>-0.964</div> <div>-2.36</div> <div>-3.94</div> <div>-5.83</div> </div> </div> <div> <div>z</div> <div>H,d</div> <div>u,g+q,k</div> </div> <table> <tr> <th>z [m]</th><th>H,d [kN/m2]</th><th>M<sub>y</sub>,d [kN/m2]</th><th>V<sub>y</sub>,d [kN/m2]</th><th>N<sub>y</sub>,d [kN/m2]</th><th>u,g+q,k [mm]</th></tr> <tr><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.02</td></tr> <tr><td>-0.00</td><td>0.00</td><td>-0.00</td><td>0.00</td><td>-0.00</td><td>0.02</td></tr> <tr><td>-0.50</td><td>9.69</td><td>-0.40</td><td>-2.42</td><td>-14.30</td><td>0.00</td></tr> <tr><td>-0.51</td><td>9.69</td><td>0.00</td><td>52.19</td><td>-29.19</td><td>-0.00</td></tr> <tr><td>-0.93</td><td>9.69</td><td>21.17</td><td>48.10</td><td>-41.36</td><td>-0.02</td></tr> <tr><td>-0.93</td><td>18.33</td><td>21.17</td><td>48.10</td><td>-41.36</td><td>-0.02</td></tr> <tr><td>-1.50</td><td>18.33</td><td>45.61</td><td>37.65</td><td>-59.07</td><td>-0.03</td></tr> <tr><td>-1.50</td><td>32.54</td><td>45.61</td><td>37.65</td><td>-59.07</td><td>-0.03</td></tr> <tr><td>-2.00</td><td>32.54</td><td>60.35</td><td>21.38</td><td>-76.43</td><td>-0.03</td></tr> <tr><td>-2.50</td><td>32.54</td><td>66.97</td><td>5.11</td><td>-93.78</td><td>-0.02</td></tr> <tr><td>-2.66</td><td>32.54</td><td>66.50</td><td>0.00</td><td>-99.23</td><td>-0.02</td></tr> <tr><td>-3.00</td><td>32.54</td><td>65.47</td><td>-11.16</td><td>-111.13</td><td>-0.00</td></tr> <tr><td>-3.00</td><td>32.54</td><td>65.47</td><td>20.38</td><td>-119.59</td><td>-0.00</td></tr> <tr><td>-3.50</td><td>39.29</td><td>71.32</td><td>2.42</td><td>-136.94</td><td>0.04</td></tr> <tr><td>-3.56</td><td>40.06</td><td>70.86</td><td>0.00</td><td>-138.91</td><td>0.05</td></tr> <tr><td>-4.00</td><td>46.04</td><td>67.33</td><td>-18.91</td><td>-154.29</td><td>0.09</td></tr> <tr><td>-4.00</td><td>52.50</td><td>67.33</td><td>-18.91</td><td>-154.29</td><td>0.09</td></tr> <tr><td>-4.50</td><td>60.46</td><td>50.98</td><td>-47.15</td><td>-171.40</td><td>0.16</td></tr> <tr><td>-4.50</td><td>44.54</td><td>50.98</td><td>-47.15</td><td>-171.40</td><td>0.16</td></tr> <tr><td>-5.25</td><td>57.77</td><td>-0.00</td><td>-86.09</td><td>-191.36</td><td>0.29</td></tr> <tr><td>-7.02</td><td>75.22</td><td>-253.91</td><td>-208.37</td><td>-241.99</td><td>0.50</td></tr> <tr><td>-8.73</td><td>82.29</td><td>-723.87</td><td>-343.09</td><td>-295.95</td><td>0.00</td></tr> <tr><td>-8.73</td><td>82.29</td><td>-723.87</td><td>342.63</td><td>-295.95</td><td>0.00</td></tr> <tr><td>-8.73</td><td>82.29</td><td>-723.87</td><td>342.63</td><td>-295.95</td><td>-0.00</td></tr> <tr><td>-10.00</td><td>87.55</td><td>-356.66</td><td>234.84</td><td>-339.16</td><td>-1.30</td></tr> <tr><td>-10.00</td><td>97.28</td><td>-356.66</td><td>234.84</td><td>-339.16</td><td>-1.30</td></tr> <tr><td>-10.03</td><td>97.36</td><td>-349.66</td><td>231.92</td><td>-339.84</td><td>-1.33</td></tr> </table>						z [m]	H,d [kN/m2]	M <sub>y</sub> ,d [kN/m2]	V <sub>y</sub> ,d [kN/m2]	N <sub>y</sub> ,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 <sub>y</sub> ,d [kN/m2]	V <sub>y</sub> ,d [kN/m2]	N <sub>y</sub> ,d [kN/m2]	u,g+q,k [mm]																																																																																																																																																																								
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Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>	Job No.:
Program: <b>WALLS-Retain. Version 2017.046</b>	
Structure: info@fides-dvp.de    www.fides-dvp.de    Tel:++49/89/143829-0    ASB Nr.:	Date: 08.10.2018

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 of earth support**

Check: Mobilizable earth resistance is sufficient for earth support force.  
 z: -8.73 m  
 $R_d = E_{ph,k}/\gamma_{Re} = 3582.08 / 1.400 = 2558.63 \text{ [kN/m]}$   
 $E_d(U_{h,d})/R_d = 685.72 / 2558.63 = 0.268 \text{ [-]}. \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-8.73	-489.05	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * 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.

$V_k \geq B_{vk}: 252.24 \geq 197.59 \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-8.73	-489.05	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * tan(δ,p=-22.00°)		-197.59
B <sub>h,q,k</sub> z=-8.73	-17.00	
B <sub>v,q,k</sub> = B <sub>h,k</sub> * tan(δ,p=-22.00°)		-6.87
-----		
Σ	-0.00	81.09
		(downwards)

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Average anchor inclination  $\alpha, A = 15.00^\circ \geq 15^\circ$ .  
 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  $\geq$  Bvk: 285.55  $\geq$  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	$\vartheta 1$	$\vartheta 2$	lA	W,k	Q,k	Ea1,k	Ea2,k	Ra_cal,d	Sum(A,d)	Ed/Rd
[m]	[°]	[°]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]
-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	$\vartheta 1 = 52.92^\circ$
Inclination upper failure plane	$\vartheta 2 = 64.79^\circ$
Inclination separation plane	$\vartheta 12 = 90.00^\circ$

**Loads / forces (char.)**

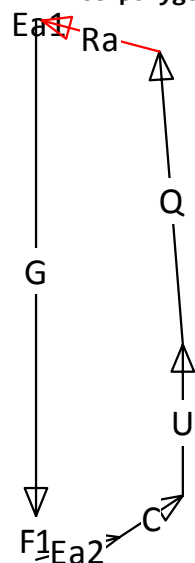
		Fx	Fz	F	
		[kN/m]	[kN/m]	[kN/m]	
Weight of main failure body	G,k:	0.0	-1152.2	1152.2	
Area loads on/in main failure body	F1,k:	0.0	-85.9	85.9	
Cohesion of lower failure plane	C,k:	246.8	326.6	409.4	
Pore water pressure on main body	U,k:	0.0	367.2	367.2	
Earth pres. on separation plane	Ea1,k:	-19.8	-0.0	19.8	$\delta = 0.0^\circ$
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	

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Force polygon



Acting anchor forces       $E_d: \text{Sum}(A,d)$       =      82.0 kN/m

Possible anchor forces  $R_d: R_{a,cal,d} = 315.8/1.400 = 225.6 \text{ kN/m}$

Verif. of lower failure plane  $E_d/R_d = 0.36 < 1.0$ : Έλεγχος εκπληρώθηκε.

### Check of steel tension

l,tot ...[m]: Total length of anchor incl. excess length at head

As ....[mm<sup>2</sup>]: X-section area of steel member

$R_{t,d} \dots [kN]$ : Ultimate strength of tension member ( $\gamma_t M=1.15$ )

A<sub>d</sub> .....[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

$\tau_{Gr,k}$  ...: Average applied skin friction along the grout body (from soil parameters)

Ra,k .....: Charact. pullout resistance of the anchor

$\gamma_A$  .....: Partial safety factor of anchor pullout

$$Ra_{d \dots} = Ra_k / \gamma A$$

A,d .....: Dimensioning force of the anchor from wall analysis

z	lVk	DmVk	$\tau_{Gr,k}$	Ra,k	$\gamma_A$	Ra,d	A,d	A,d/Ra,d
[m]	[m]	[mm]	[kN/m <sup>2</sup> ]	[kN]	[-]	[kN]	[kN]	[-]
-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  $R \cdot \sin(\phi)$ .

The automatic slip circle optimization only considers circles that intersect the surface with an area of at least 0.25 m<sup>2</sup>.

The slip circle calculation only accepts circles including the wall.

The slipcircle calculation only allows circular failure planes

(no vertical tangents will occur).

Author:

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Program:

WALLS-Retain.

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Job No.:

Date: 08.10.2018

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	dxM	Weight	Load	Water-	u*b	φ	c	θ
	[m]	[m]	[m]	[kN/m]	z-κατ. [kN/m]	φορτ. [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.

Part:

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Record:

Archive No.:

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**Φάση εκσκαφής 5 "[5] Situation 5"**

LC: όλα τα φορτία Type: BS-T

**Εδαφικό σύστημα με 5 Στρώσεις**

Name	Τεχνητές επιχωματώσεις	Αμμόδης	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,θh	[-]	0.5773817	0.9982547	0.455361
K,prgh	[-]	3.908103	1.004519	7.495617
K,prch	[-]	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	Αμμόδης	ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟΣ
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,θh	[-]	0.9982547	0.4264236
K,prgh	[-]	1.004519	9.146943
K,prch	[-]	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 Αμμόδης 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 Αμμόδης ΑΡΓΙΛΟΣ:

z= -10.00

Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>	Job No.:
Program: <b>WALLS-Retain. Version 2017.046</b>	
Structure: info@fides-dvp.de    www.fides-dvp.de    Tel:++49/89/143829-0    ASB Nr.:	Date: 08.10.2018

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

**Επιφ. φορτία:**  
**Φορτία**

xA	zA	xE	zE	PxA	PzA	PxE	PzE	Typ	LC-description
[m]	[m]	[m]	[m]	[	kN/m²		]		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: 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 redistb.  
 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**  

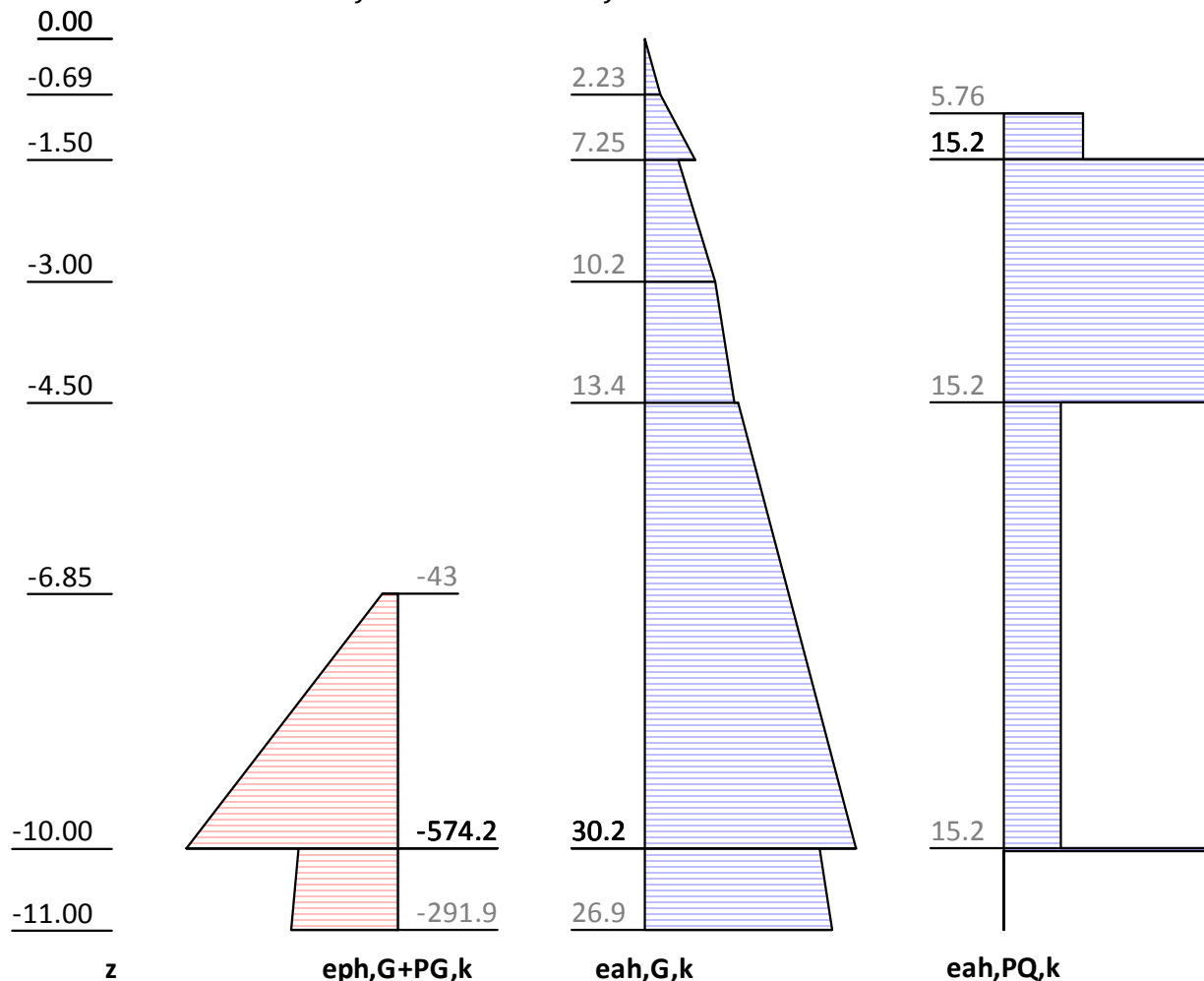
φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	Αμμώδης ΑΡΓΙΛΟΣ
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	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	--	--	"

Part:  Block: Please specify project informations.  Record:	Archive No.:
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**Μήκος τοίχου**Foot depth for statics:  $z_f = -11.000$ **Stress analysis****Earth pressure, horizontal**

Pressures characteristic, no redistribution, continuous wall



$z$ [m]	$eph, G, k$ [kN/m <sup>2</sup> ]	$eah, G, k$ [kN/m <sup>2</sup> ]	$eah, PQ, k$ [kN/m <sup>2</sup> ]	$eah, d$ [kN/m <sup>2</sup> ]
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]  
 $Eah, G, k: 179.10$ ,  $Eah, PG, k: 0.00$ ,  $Eah, PQ, k: 72.27$ ,  $Eah, d: 350.19$

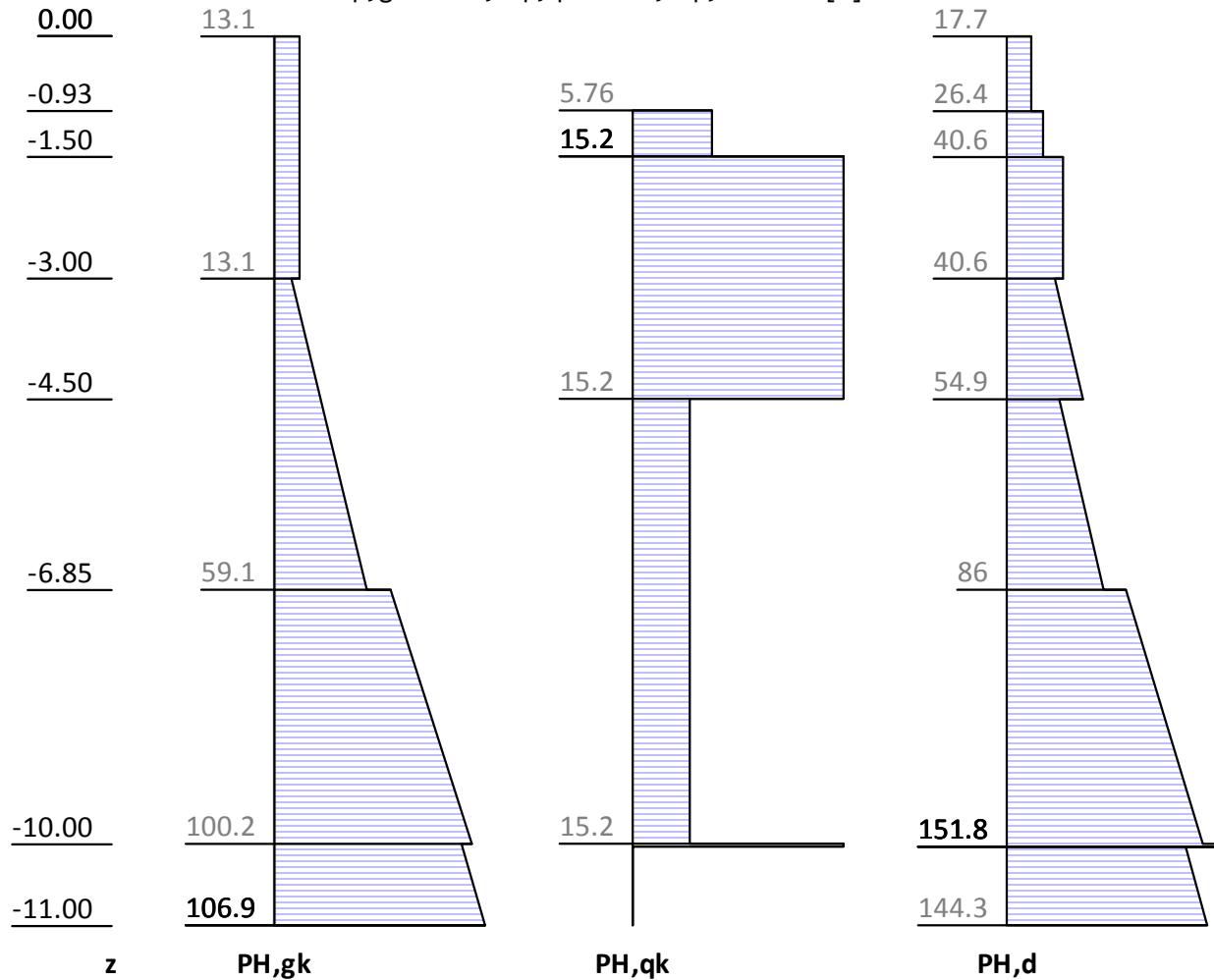


## Πίεση νερού

z [m]	W <sub>a,k</sub> [kN/m <sup>2</sup> ]	W <sub>k</sub> [kN/m <sup>2</sup> ]
-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 [%]



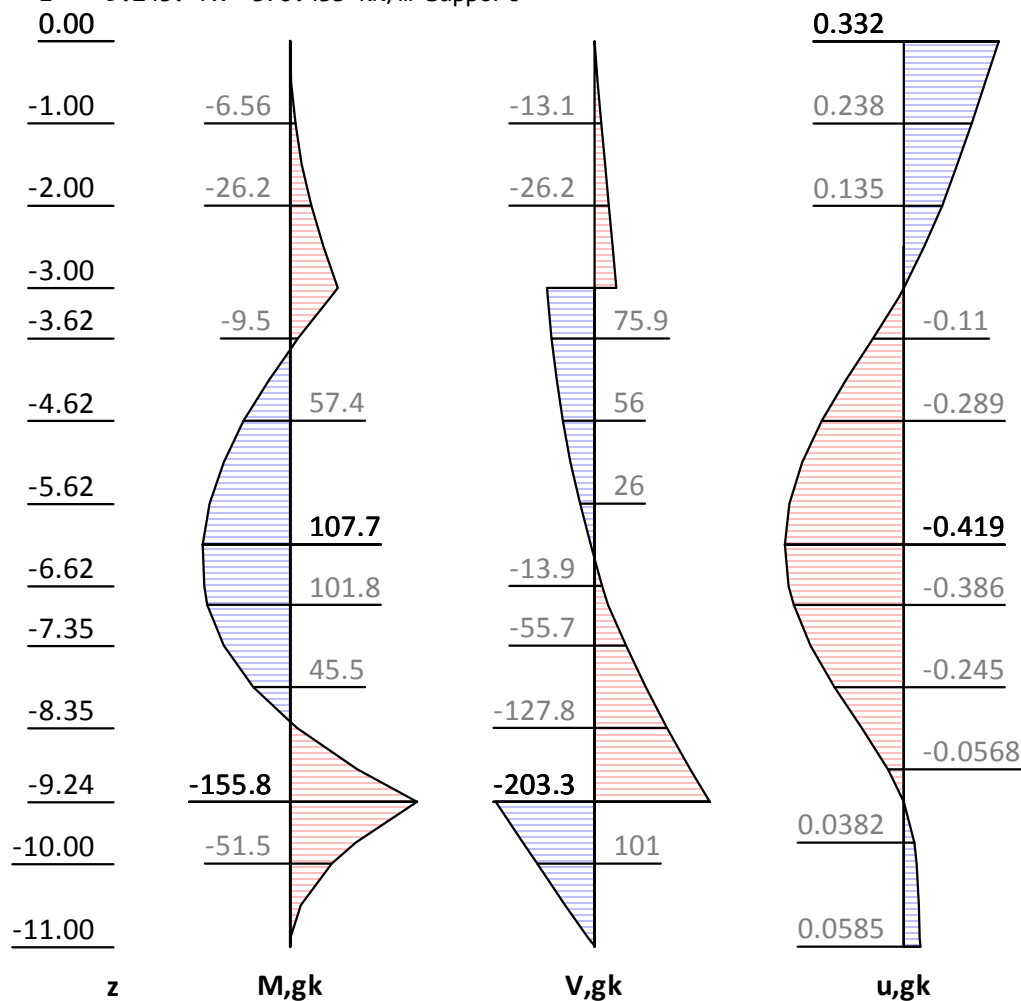
z [m]	PH,gk [kN/m <sup>2</sup> ]	PH,qk [kN/m <sup>2</sup> ]	PH,d [kN/m <sup>2</sup> ]
0.00	13.12		17.71
-0.93	13.12	0.00	17.71
-0.93	13.12	5.76	26.35
-1.50	13.12	5.76	26.35
-1.50	13.12	15.23	40.56
-3.00	13.12	15.23	40.56
-3.00	8.75	15.23	34.66
-4.50	23.75	15.23	54.91
-4.50	23.75	4.15	38.29
-6.85	47.25	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

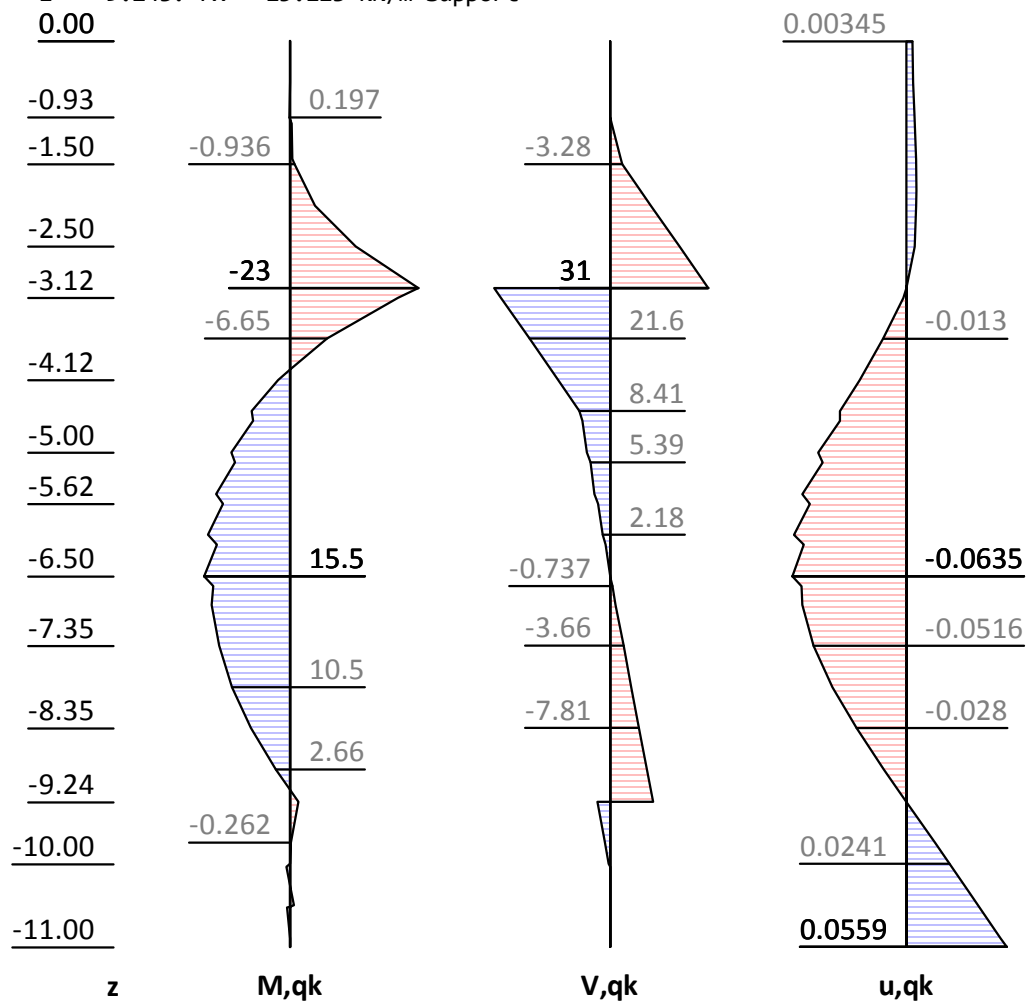
**Internal forces: Variable, characteristically**Method EB 82-4 ( $Q = [G+Q] - G$ ).

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

0.00



z [m]	H, q, k [kN/m <sup>2</sup> ]	M, q, k [kN/m <sup>2</sup> ]	V, q, k [kN/m <sup>2</sup> ]	N, q, k [kN/m <sup>2</sup> ]	u, q, k [mm]
0.00	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/m <sup>2</sup> ]	M, q, k [kN/m <sup>2</sup> ]	V, q, k [kN/m <sup>2</sup> ]	N, q, k [kN/m <sup>2</sup> ]	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

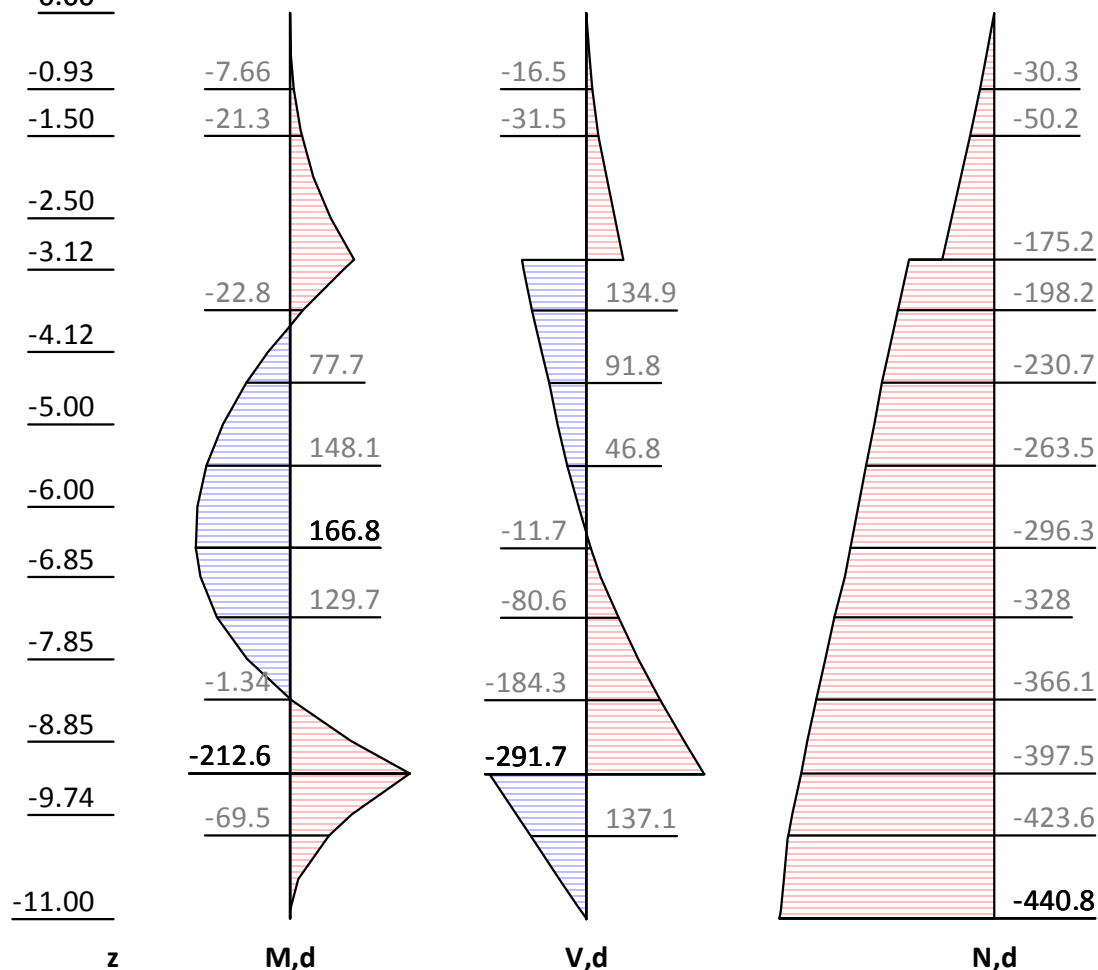
## Internal forces: Design

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

0.00



Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>					Job No.:																																																																																																																																																																								
Program: <b>WALLS-Retain. Version 2017.046</b>																																																																																																																																																																													
Structure:	info@fides-dvp.de	www.fides-dvp.de	Tel:++49/89/143829-0	ASB Nr.:	Date: 08.10.2018																																																																																																																																																																								
<div> <div> <div>0.00</div> <div>17.7</div> <div>0.336</div> </div> <div> <div>-0.93</div> <div>26.4</div> <div>0.249</div> </div> <div> <div>-1.50</div> <div>40.6</div> <div>0.194</div> </div> <div> <div>-2.50</div> <div>40.6</div> <div>0.0782</div> </div> <div> <div>-3.12</div> <div>40.6</div> <div>-0.0219</div> </div> <div> <div>-4.12</div> <div>54.9</div> <div>-0.23</div> </div> <div> <div>-5.00</div> <div></div> <div>-0.39</div> </div> <div> <div>-5.62</div> <div></div> <div>-0.477</div> </div> <div> <div>-6.50</div> <div>86</div> <div>-0.462</div> </div> <div> <div>-7.35</div> <div></div> <div>-0.379</div> </div> <div> <div>-8.35</div> <div></div> <div>-0.177</div> </div> <div> <div>-9.24</div> <div></div> <div></div> </div> <div> <div>-10.00</div> <div>151.8</div> <div>0.0715</div> </div> <div> <div>-11.00</div> <div>144.3</div> <div>0.114</div> </div> </div> <div> <div>z</div> <div>H,d</div> <div>u,g+q,k</div> </div> <table> <tr> <th>z</th><th>H,d</th><th>M<sub>d</sub></th><th>V<sub>d</sub></th><th>N<sub>d</sub></th><th>u,g+q,k</th></tr> <tr> <th>[m]</th><th>[kN/m2]</th><th>[kN/m2]</th><th>[kN/m2]</th><th>[kN/m2]</th><th>[mm]</th></tr> <tr><td>0.00</td><td>17.71</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.34</td></tr> <tr><td>-0.00</td><td>17.71</td><td>-0.00</td><td>0.00</td><td>-0.00</td><td>0.34</td></tr> <tr><td>-0.93</td><td>17.71</td><td>-7.66</td><td>-16.47</td><td>-30.32</td><td>0.25</td></tr> <tr><td>-0.93</td><td>26.35</td><td>-7.66</td><td>-16.47</td><td>-30.32</td><td>0.25</td></tr> <tr><td>-1.50</td><td>26.35</td><td>-21.32</td><td>-31.49</td><td>-50.16</td><td>0.19</td></tr> <tr><td>-1.50</td><td>40.56</td><td>-21.32</td><td>-31.49</td><td>-50.16</td><td>0.19</td></tr> <tr><td>-3.00</td><td>40.56</td><td>-114.18</td><td>-92.32</td><td>-107.85</td><td>0.00</td></tr> <tr><td>-3.00</td><td>40.56</td><td>-114.18</td><td>-92.32</td><td>-107.85</td><td>-0.00</td></tr> <tr><td>-3.00</td><td>34.66</td><td>-114.18</td><td>159.01</td><td>-175.19</td><td>-0.00</td></tr> <tr><td>-3.80</td><td>45.52</td><td>-0.00</td><td>126.36</td><td>-204.99</td><td>-0.16</td></tr> <tr><td>-4.50</td><td>54.91</td><td>77.75</td><td>91.83</td><td>-230.75</td><td>-0.31</td></tr> <tr><td>-4.50</td><td>38.29</td><td>77.75</td><td>91.83</td><td>-230.75</td><td>-0.31</td></tr> <tr><td>-6.00</td><td>58.54</td><td>164.76</td><td>19.20</td><td>-279.92</td><td>-0.48</td></tr> <tr><td>-6.31</td><td>62.72</td><td>166.05</td><td>0.00</td><td>-290.09</td><td>-0.47</td></tr> <tr><td>-6.50</td><td>65.29</td><td>166.83</td><td>-11.74</td><td>-296.31</td><td>-0.47</td></tr> <tr><td>-6.85</td><td>70.01</td><td>158.64</td><td>-35.41</td><td>-307.78</td><td>-0.44</td></tr> <tr><td>-6.85</td><td>85.99</td><td>158.64</td><td>-35.41</td><td>-307.78</td><td>-0.44</td></tr> <tr><td>-8.34</td><td>112.29</td><td>-0.00</td><td>-183.35</td><td>-365.77</td><td>-0.18</td></tr> <tr><td>-9.24</td><td>128.14</td><td>-212.58</td><td>-291.68</td><td>-397.52</td><td>0.00</td></tr> <tr><td>-9.24</td><td>128.14</td><td>-212.58</td><td>239.17</td><td>-397.52</td><td>0.00</td></tr> <tr><td>-10.00</td><td>141.55</td><td>-69.53</td><td>137.08</td><td>-423.61</td><td>0.07</td></tr> <tr><td>-10.00</td><td>151.28</td><td>-69.53</td><td>137.08</td><td>-423.61</td><td>0.07</td></tr> <tr><td>-10.03</td><td>151.76</td><td>-65.49</td><td>132.53</td><td>-424.30</td><td>0.07</td></tr> <tr><td>-10.03</td><td>128.91</td><td>-65.49</td><td>132.53</td><td>-424.30</td><td>0.07</td></tr> <tr><td>-11.00</td><td>144.35</td><td>-0.00</td><td>0.00</td><td>-440.84</td><td>0.11</td></tr> <tr><td>-11.00</td><td>144.35</td><td>-0.00</td><td>-0.00</td><td>-440.84</td><td>0.11</td></tr> </table>						z	H,d	M <sub>d</sub>	V <sub>d</sub>	N <sub>d</sub>	u,g+q,k	[m]	[kN/m2]	[kN/m2]	[kN/m2]	[kN/m2]	[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
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**Anchor forces with safety level of DS-P**

z[m]	A,d[kN]	F <sub>x,d</sub> [kN/m]
-0.50	0.0	-0.0
-3.00	468.4	-251.3

**Checks of earth statics****Check of earth support**

Check: Mobilizable earth resistance is sufficient for earth support force.

z: -9.24 m

$R_d = E_{ph,k}/\gamma_{Re} = 1253.99 / 1.400 = 895.71 \text{ [kN/m]}$

$E_d(U_h,d)/R_d = 530.85 / 895.71 = 0.593 \text{ [-]}. \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-9.24	-376.43	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * tan( $\delta,p=-22.00^\circ$ )		-152.09
$\Sigma$	-0.00	128.09 (downwards)

Average anchor inclination  $\alpha,A = 15.00^\circ \geq 15^\circ$ .

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.

$V_k \geq B_{vk}: 280.18 \geq 152.09 \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-9.24	-376.43	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * tan( $\delta,p=-22.00^\circ$ )		-152.09
B <sub>h,q,k</sub> z=-9.24	-15.11	
B <sub>v,q,k</sub> = B <sub>h,k</sub> * tan( $\delta,p=-22.00^\circ$ )		-6.11
$\Sigma$	-0.00	155.81 (downwards)

Average anchor inclination  $\alpha,A = 15.00^\circ \geq 15^\circ$ .

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.

$V_k \geq B_{vk}: 314.00 \geq 158.20 \text{ Passes requirement}$

**Anchor verification**

Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>					Job No.:	
Program: <b>WALLS-Retain.</b>					Version <b>2017.046</b>	
Structure: info@fides-dvp.de    www.fides-dvp.de    Tel:++49/89/143829-0    ASB Nr.:					Date: 08.10.2018	

**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

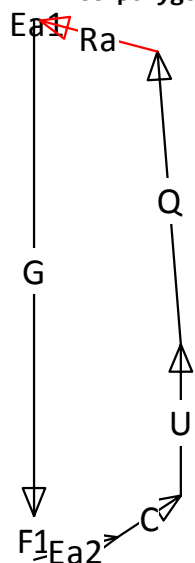
**Decisive failure body:**  
**Γεωμετρία:**  
 Foot point of lower failure plane                    x/z =    0.01/-11.00 m  
 Intersection lower/upper slid. plane                x/z =    8.78/ -5.35 m  
 Intersection upper slid. plane/surface               x/z =    11.81/    0.00 m  
 Intersection separation 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	

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**Force polygon**

Acting anchor forces  $E_d: \sum(A,d) = 260.1 \text{ kN/m}$

Possible anchor forces  $R_d: R_{a\_cal,d} = 365.1/1.400 = 260.8 \text{ kN/m}$

Verif. of lower failure plane  $E_d/R_d = 1.00 < 1.0$ : Έλεγχος εκπληρώθηκε.

**Check of steel tension**

$l_{tot}$  ...[m]: Total length of anchor incl. excess length at head

$A_s$  ....[mm<sup>2</sup>]: X-section area of steel member

$R_{i,d}$  ...[kN]: Ultimate strength of tension member ( $\gamma, M=1.15$ )

$A_{,d}$  ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	$l_{tot}$	$A_s$	$R_{i,d}$	$A_{,d}$
-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**

$l_{vk}$  .....: Length of grout body

$D_{mV,k}$  .....: Diameter of grout body

$\tau_{Gr,k}$  ....: Average applied skin friction along the grout body (from soil parameters)

$R_{a,k}$  ....: Charact. pullout resistance of the anchor

$\gamma_A$  .....: Partial safety factor of anchor pullout

$R_{a,d}$  .....: =  $R_{a,k} / \gamma_A$

$A_{,d}$  .....: Dimensioning force of the anchor from wall analysis

z	$l_{vk}$	$D_{mV,k}$	$\tau_{Gr,k}$	$R_{a,k}$	$\gamma_A$	$R_{a,d}$	$A_{,d}$	$A_{,d}/R_{a,d}$
[m]	[m]	[mm]	[kN/m <sup>2</sup> ]	[kN]	[-]	[kN]	[kN]	[-]
-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  $R \cdot \sin(\phi)$ .

The automatic slip circle optimization only considers circles that intersect the surface with an area of at least 0.25 m<sup>2</sup>.

The slip circle calculation only accepts circles including the wall.

The slipcircle calculation only allows circular failure planes (no vertical tangents will occur).



Author:
FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München

Job No.:

Program:
WALLS-Retain.
Version 2017.046

Structure:
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Tel:++49/89/143829-0
ASB Nr.:

Date: 08.10.2018

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	dxM	Weight	Load	Water-	u*b	φ	c	θ
	[m]	b	[m]	[kN/m]	z-κατ.	φορτ.	[kN/m]	[°]	[kN/m²]	[°]
		[m]			[kN/m]	[kN/m]				
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.

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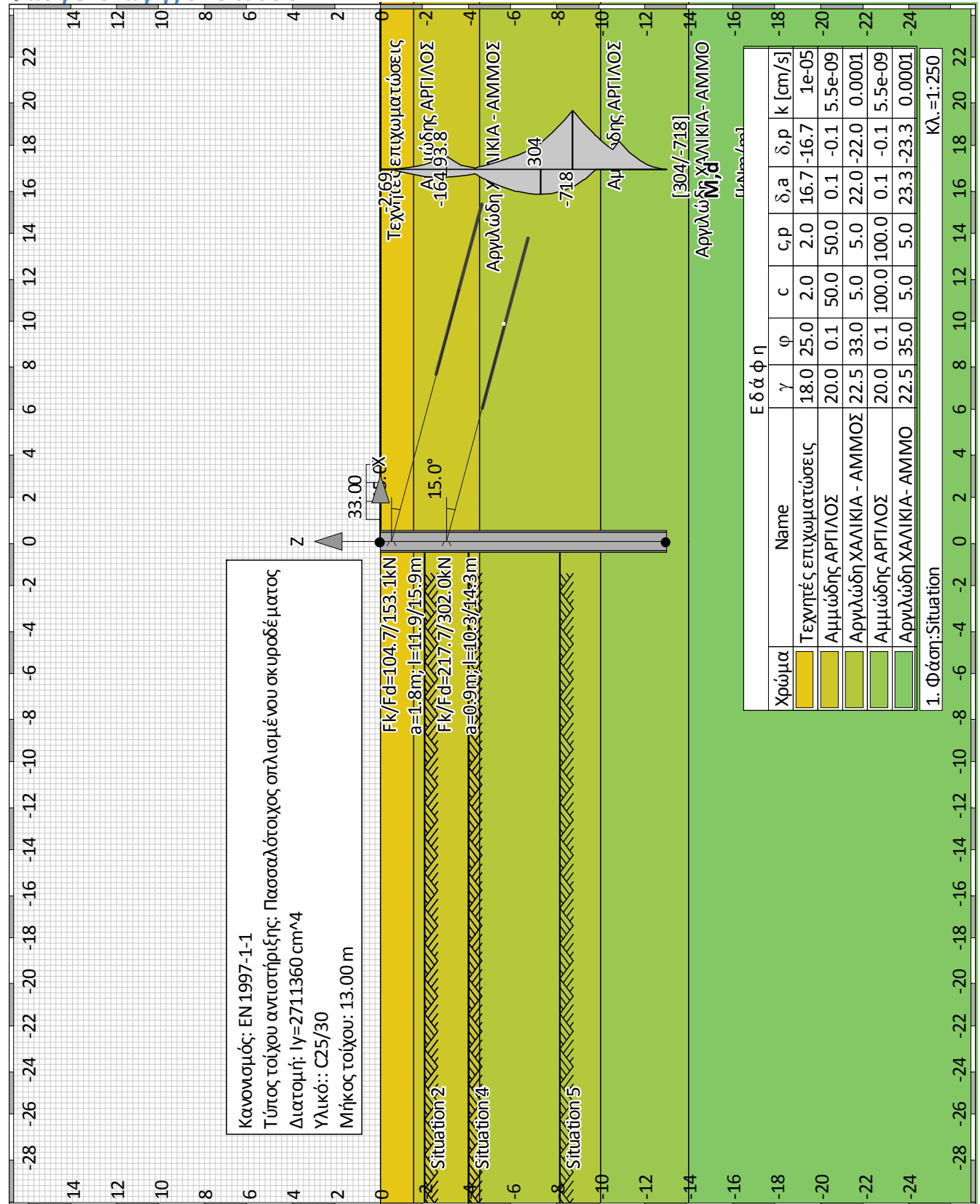
Archive No.:

## ΠΑΡΑΡΤΗΜΑ

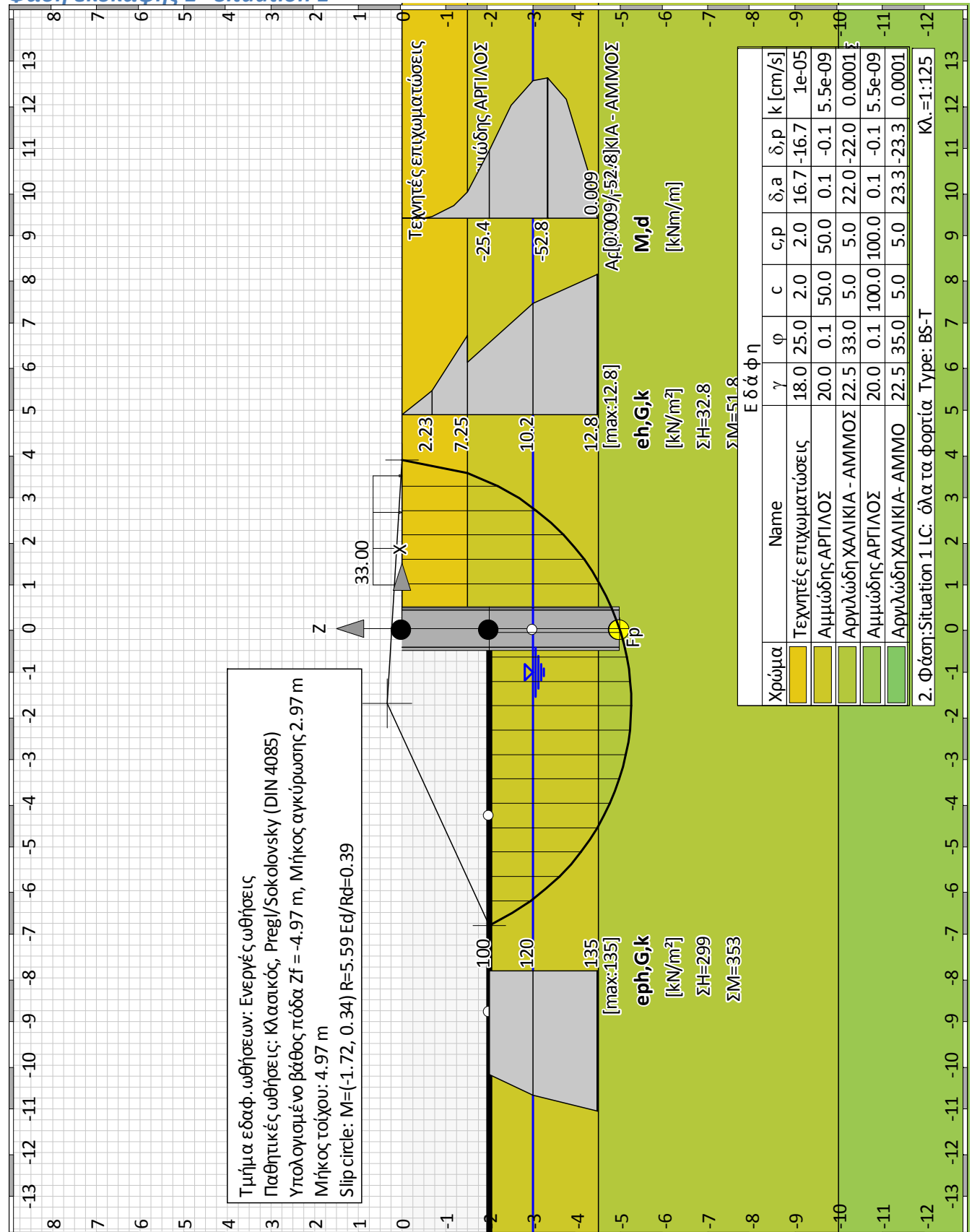
### 8.5 Αποτελέσματα ανάλυσης

#### 8.5.1 Στατικές Συνθήκες

- i) Αντιστηριζόμενο ύψος 7,80m

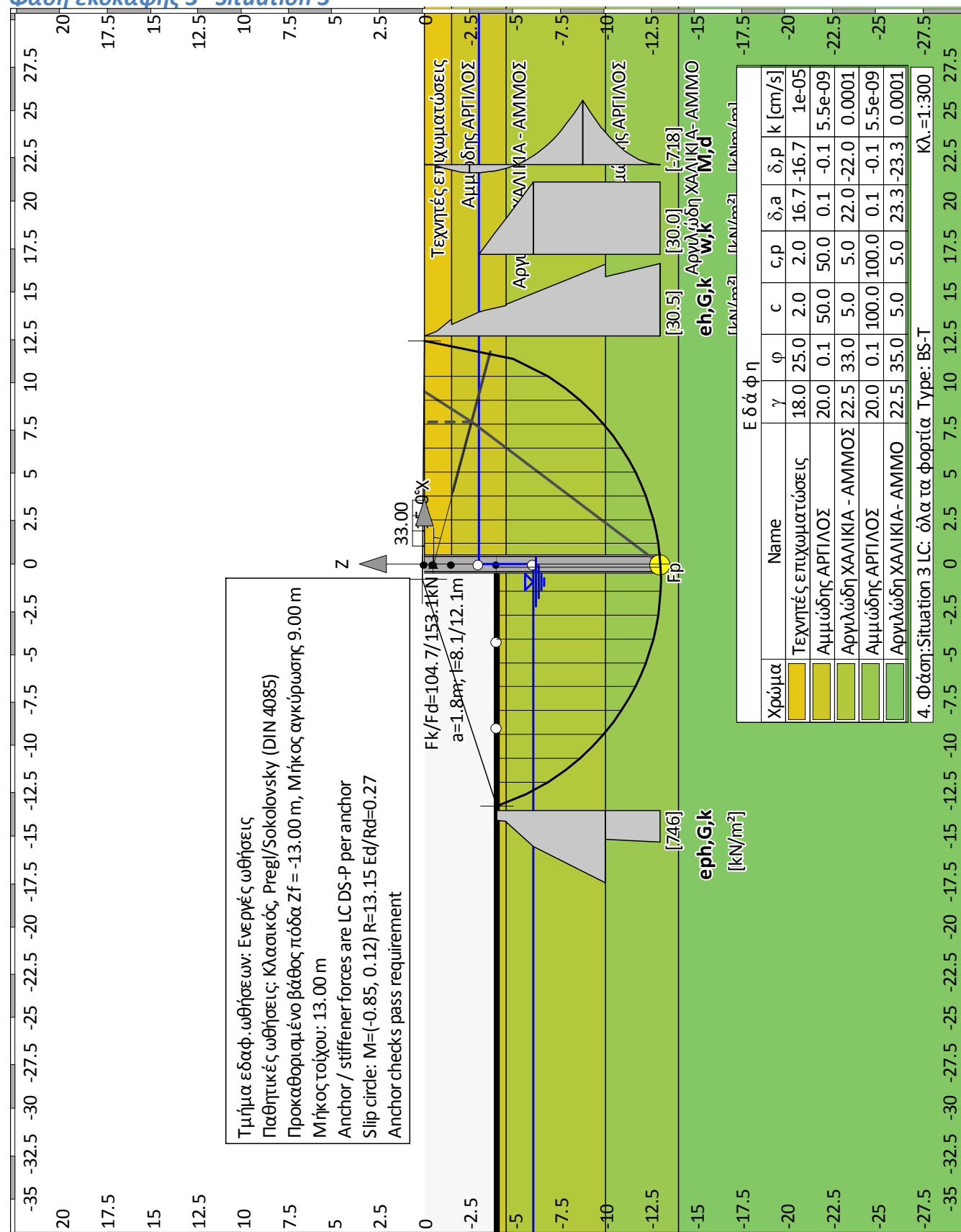
**Summary of all stages****Φάση εκσκαφής 0 "Situation"**

## Φάση εκσκαφής 1 "Situation 1"



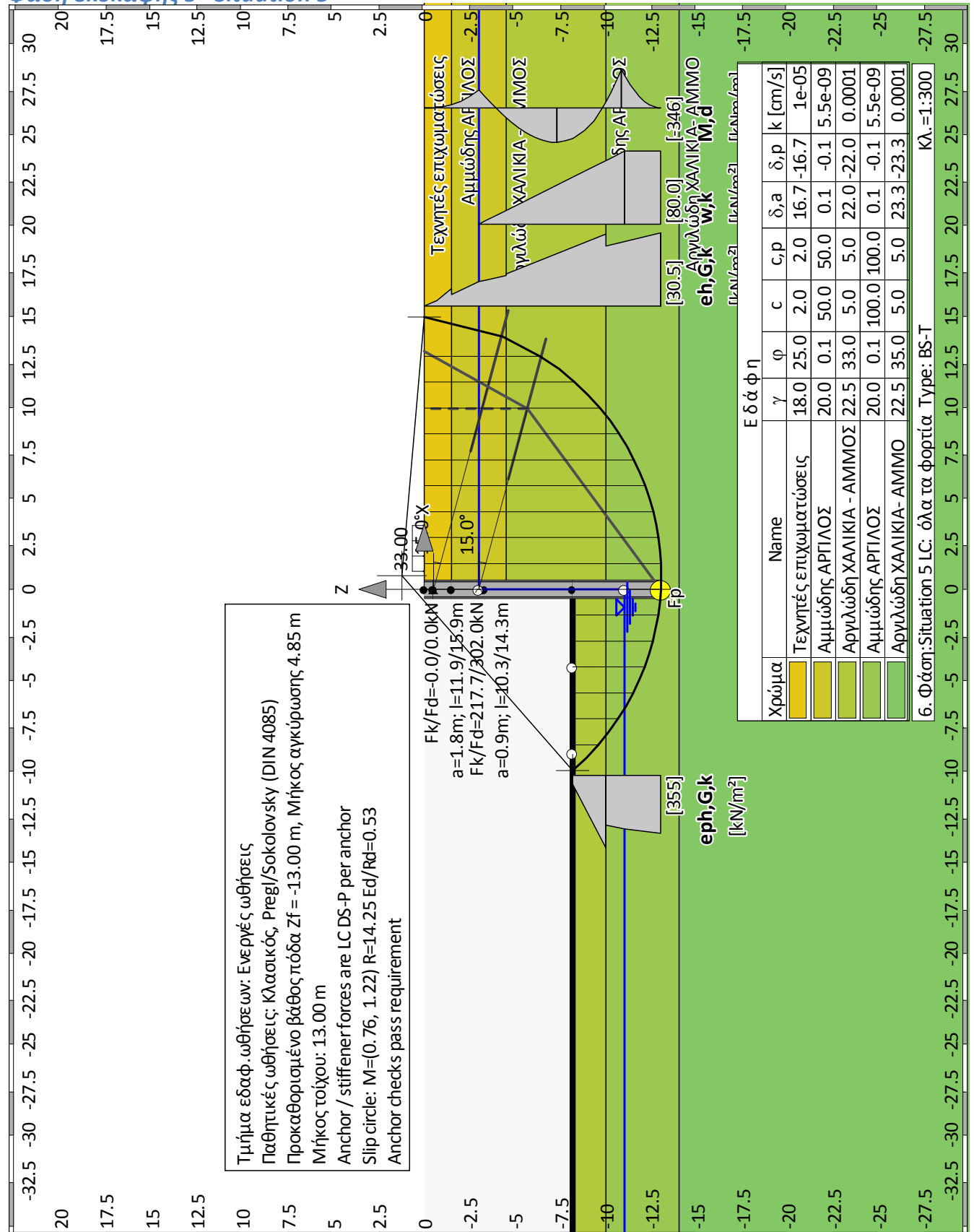


### Φάση εκσκαφής 3 "Situation 3"





## Φάση εκσκαφής 5 "Situation 5"





Author:	FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München				Job No.:
Program:	WALLS-Retain.		Version 2017.046		
Structure:	info@fides-dvp.de	www.fides-dvp.de	Tel:++49/89/143829-0	ASB Nr.:	Date: 08.10.2018

## Κανονισμός για 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
BS-T	1	1	1	1.300	0	1.250	1.400	1.400
BS-T/A	1	1	1	1.300	0	1.250	1.250	1.400
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					

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**Κύκλος ολίσθησης: [GEO] A2 M2 R3**

γ-	G,dst g	G,stb Re	Q,dst a,t	Q,stb a,p	W Gt	phi N	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

$\gamma_{Re,red}$  (EAB EB14-3):  $N_{a1}$ ,  $\eta=0.80$

$\gamma_{Re,red}$  (EAB EB22-6):  $N_{a1}$ ,  $E_{0h} > 0\%$ :  $\eta = 0.60 / 0.80$

**System values****Τοίχος**

Τύπος τοίχου αντιστήριξης: Πασσαλότοιχος οπλισμένου σκυροδέματος

Διατομή:  $I_y=2711360 \text{ cm}^4$

Υλικό: C25/30

Ίδιο βάρος:  $25.000 \text{ [kN/m}^3\text{]}$

**Σημεία τοίχου**

z	d	E	I <sub>y</sub>	E*I <sub>y</sub>	A
[m]	[m]	[MN/m <sup>2</sup> ]	[cm <sup>4</sup> /m]	[MNm <sup>2</sup> ]	[cm <sup>2</sup> /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	Αμμόδης 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,θh	[-]	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	Αμμόδης	ΑΡΓΙΛΟΣ	Αργιλώδη	ΧΑΛΙΚΙΑ-	ΑΜΜΟΣ
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,θh	[-]	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 Αμμόδης 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 Αμμόδης ΑΡΓΙΛΟΣ:

z= -10.00

Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>	Job No.:
Program: <b>WALLS-Retain. Version 2017.046</b>	
Structure: info@fides-dvp.de    www.fides-dvp.de    Tel:++49/89/143829-0    ASB Nr.:	Date: 08.10.2018

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

**Επιφ. φορτία:**  
**Φορτία**

xA	zA	xE	zE	PxA	PzA	PxE	PzE	Typ	LC-description
[m]	[m]	[m]	[m]	[	kN/m²		]		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 redistrib. to: Excavation level  
 The earth pressure below the excavation acts without redistrib.  
 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	--	--	"

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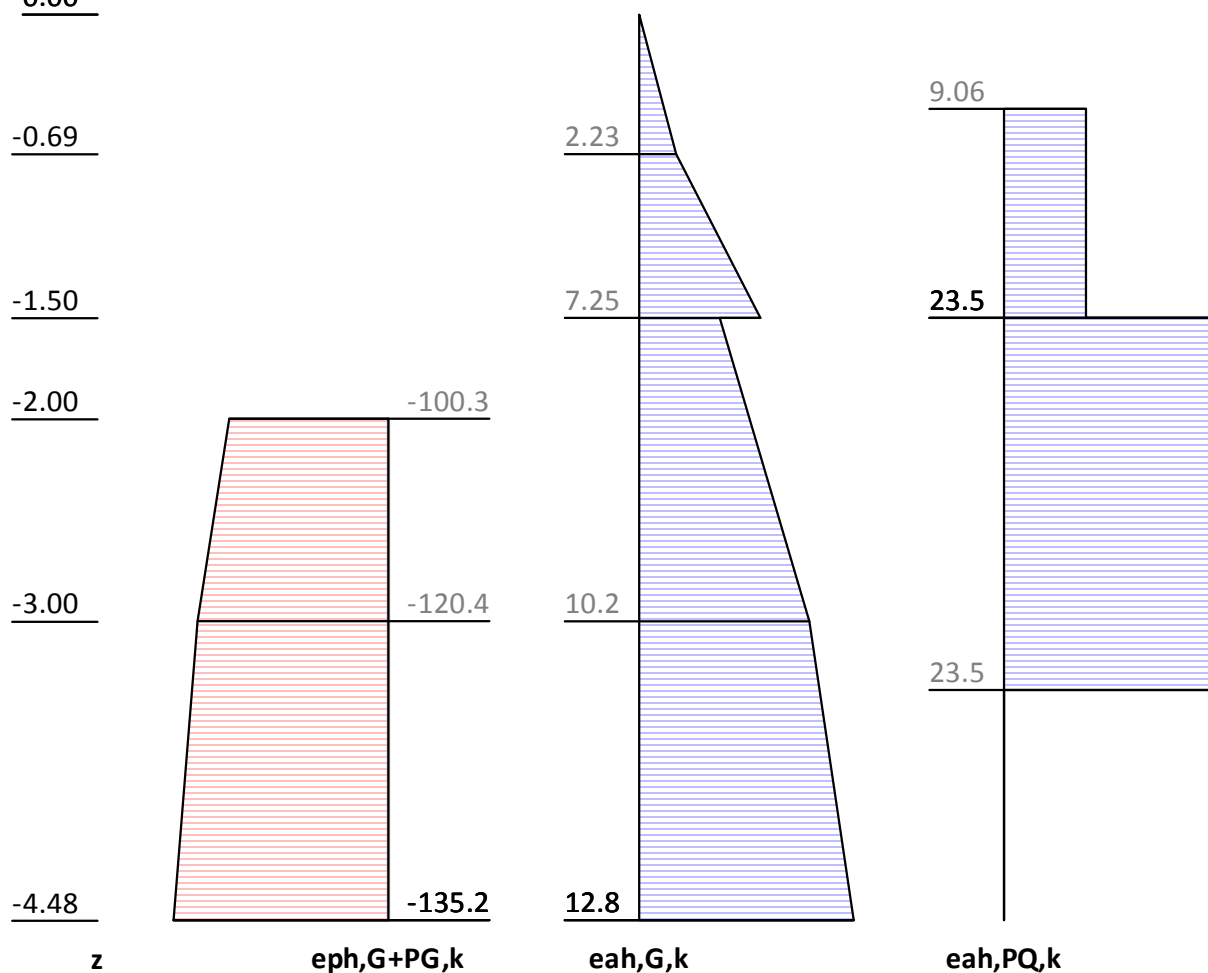
**Μήκος τοίχου**

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: z <sub>f</sub> = -4.476					

**Stress analysis****Earth pressure, horizontal**

Pressures characteristic, no redistribution, continuous wall

0.00



z [m]	eph, G, k [kN/m <sup>2</sup> ]	eah, G, k [kN/m <sup>2</sup> ]	eah, PQ, k [kN/m <sup>2</sup> ]	eah, d [kN/m <sup>2</sup> ]
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

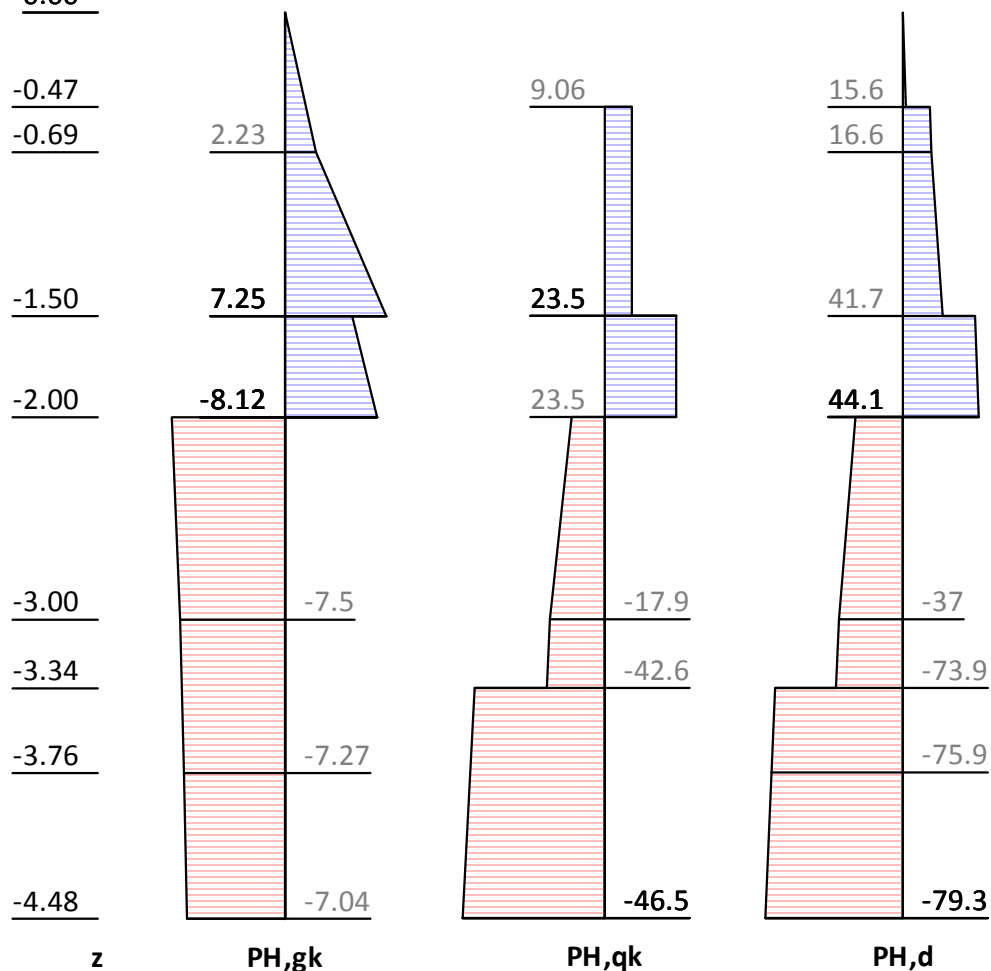
z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
-2.00	-100.29	6.61	23.48	44.14
-3.34	-123.79	10.79	23.48	49.78
-3.34	-123.79	10.79	0.00	14.56
-4.48	-135.21	12.82	0.00	17.30

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 [%]

0.00

z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	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**0.00-0.0611-0.50-0.0672-0.402-0.0504-1.19-0.975-2.67-0.0358-1.50-2.07-4.59-0.0294-2.00-5.05-7.45-0.0197-2.50-7.77-3.47-0.0114-3.00-8.540.36-0.00531-3.50-7.434.07-0.0017-3.76-6.125.97-704.5e-06-4.26-2.239.57-21.3e-06-4.4811.1**z****M,gk****V,gk****u,gk**

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 ( $Q = [G+Q] - G$ ).0.00-0.47-0.69-1.19-1.50-2.00-2.50-3.00-3.34-3.76-4.26-4.48

z

M,qk

-0.227

-2.37

-4.8

-12.4

-21.4

-26.8

-28.2

-24.3

-9.79

0.00755

-2.03

-6.55

-9.33

-21.1

-14.7

-6.59

-0.29

17.9

40.3

50.3

V,qk

-0.202-0.171-0.156-0.122-0.102-0.0706-0.0428-0.0211-0.0104-0.00302-95.3e-06

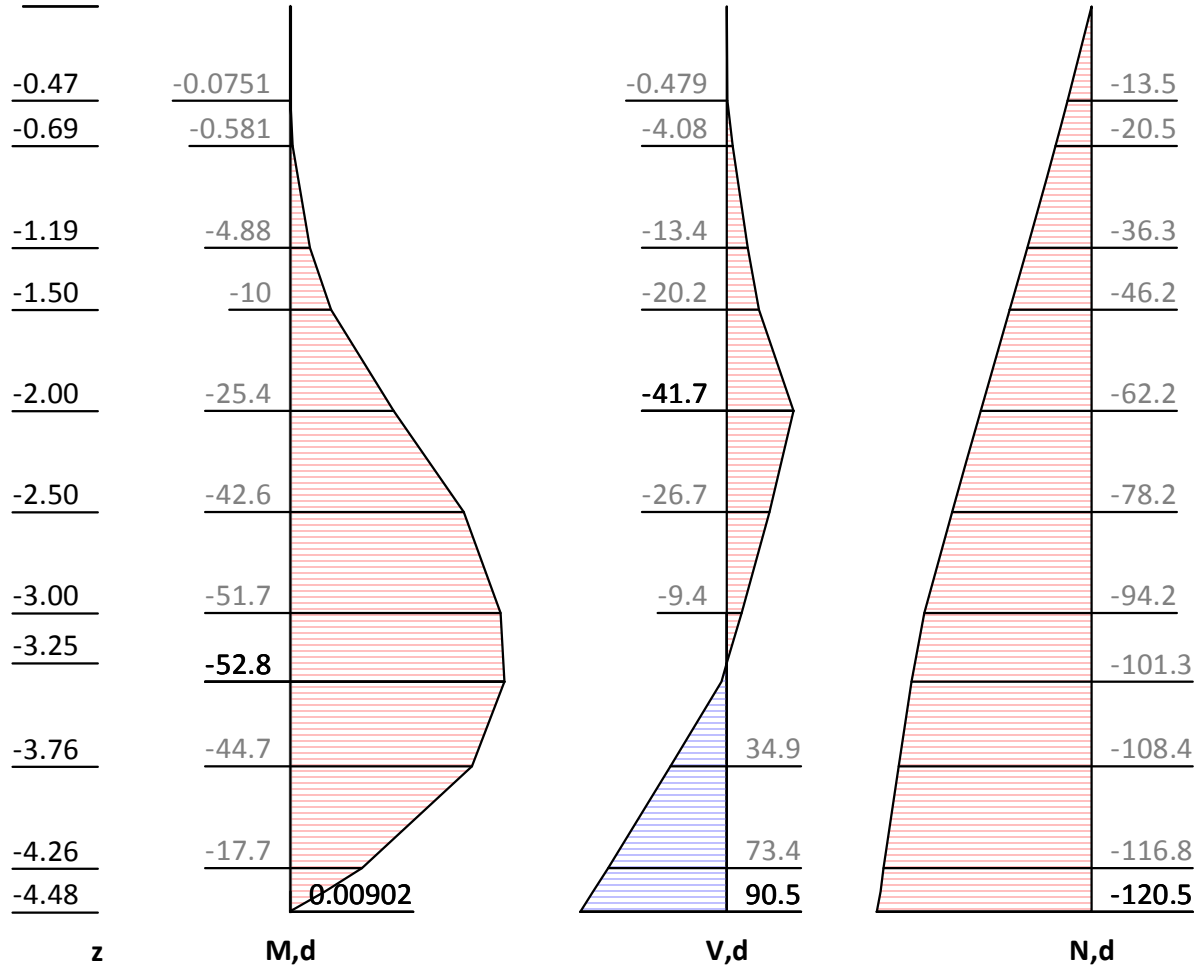
u,qk

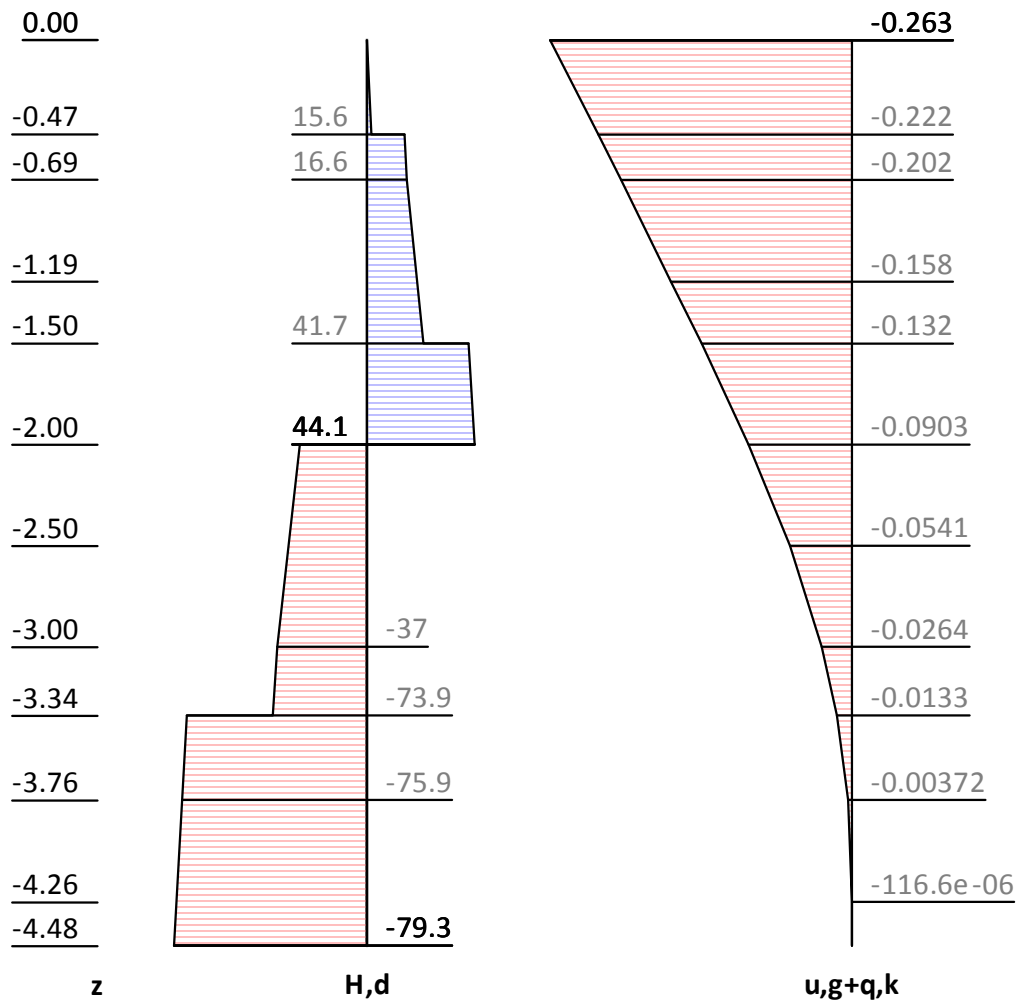
z [m]	H, q, k [kN/m2]	M, q, k [kN/m2]	V, q, k [kN/m2]	N, q, k [kN/m2]	u, q, k [mm]
0.00		0.00	0.00	0.00	-0.20
-0.47	0.00	0.01	0.02	0.01	-0.17
-0.47	9.06	0.01	0.02	0.01	-0.17
-0.48	9.06	-0.00	-0.05	0.00	-0.17
-1.50	9.06	-4.80	-9.33	-0.99	-0.10
-1.50	23.48	-4.80	-9.33	-0.99	-0.10
-2.00	23.48	-12.40	-21.07	-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

0.00

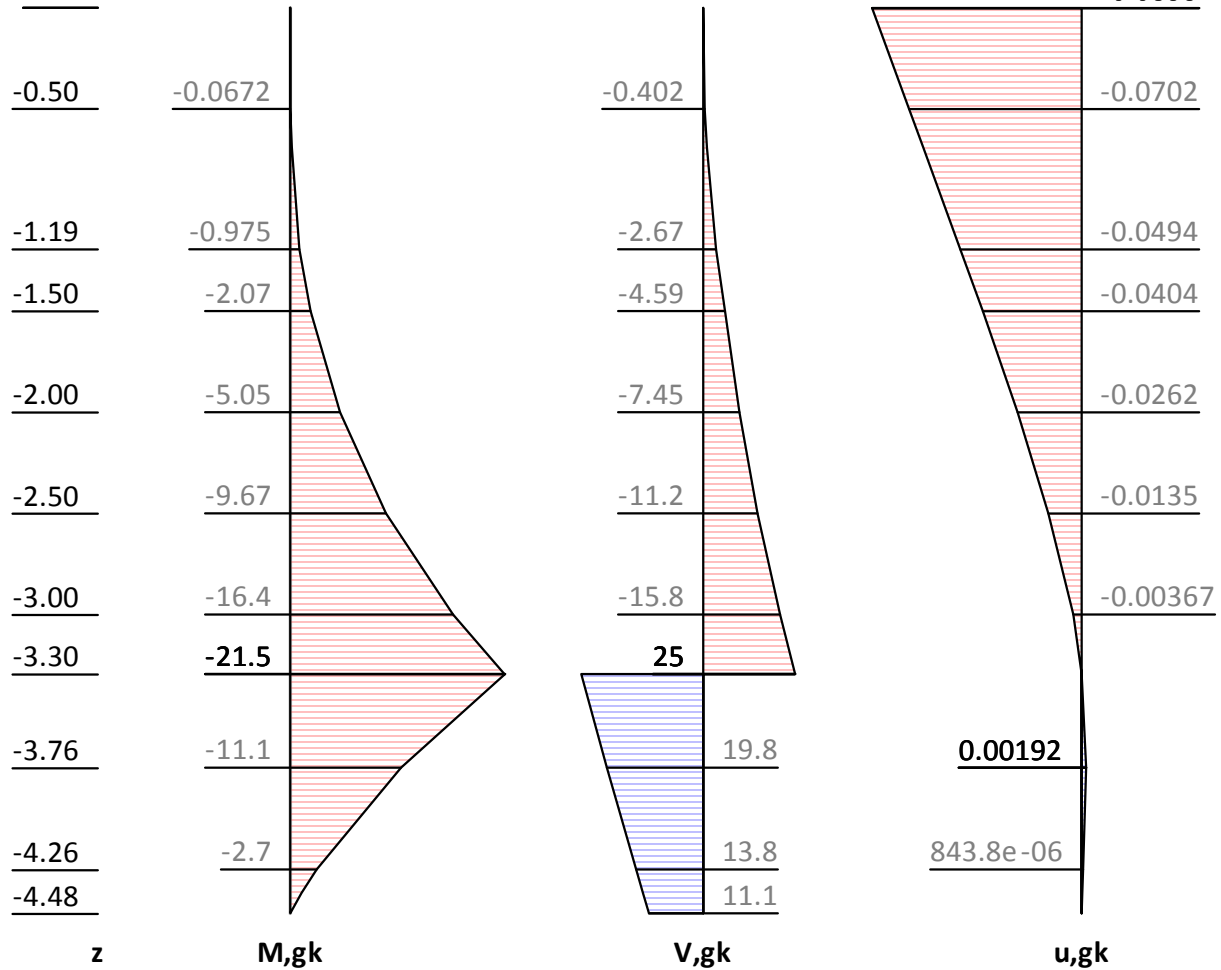




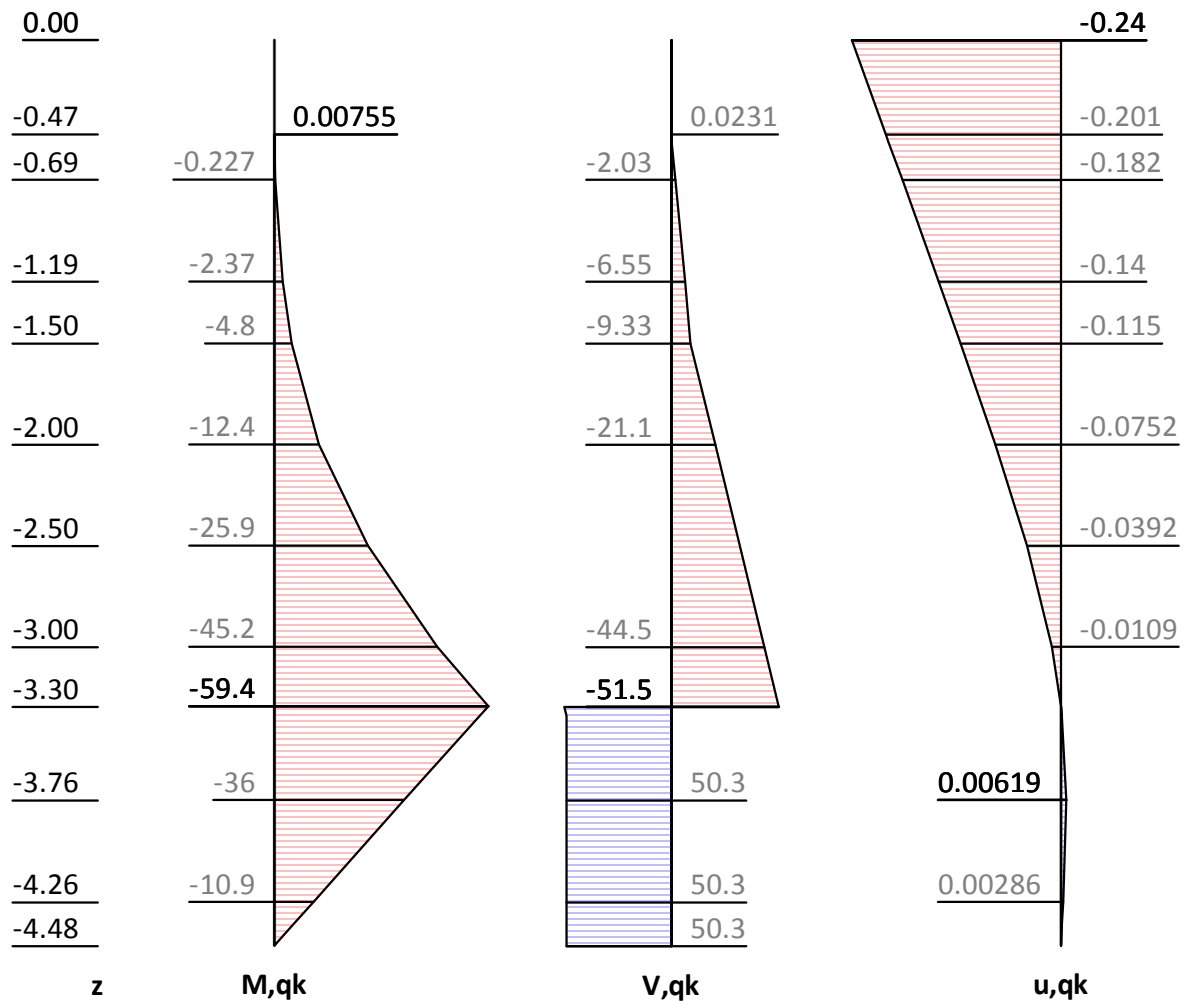
z [m]	H,d [kN/m <sup>2</sup> ]	M,d [kN/m <sup>2</sup> ]	V,d [kN/m <sup>2</sup> ]	N,d [kN/m <sup>2</sup> ]	u,g+q,k [mm]
0.00	0.00	0.00	-0.00	0.00	-0.26
-0.47	2.04	-0.08	-0.48	-13.54	-0.22
-0.47	15.62	-0.08	-0.48	-13.54	-0.22
-1.50	23.37	-10.00	-20.19	-46.20	-0.13
-1.50	41.73	-10.00	-20.19	-46.20	-0.13
-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

0.00

z [m]	M, g, k [kN/m <sup>2</sup> ]	V, g, k [kN/m <sup>2</sup> ]	N, g, k [kN/m <sup>2</sup> ]	u, g, k [kN/m <sup>2</sup> ]
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/m <sup>2</sup> ]	V,q,k [kN/m <sup>2</sup> ]	N,q,k [kN/m <sup>2</sup> ]	u,q,k [kN/m <sup>2</sup> ]
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]

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Structure: info@fides-dvp.de    www.fides-dvp.de    Tel:++49/89/143829-0    ASB Nr.:	Date: 08.10.2018

### Check of C-force (foot support)

$$z(C) = -4.48 \text{ [kN/m]}$$

$$G,k = \sum(\gamma \cdot h) = 71.76 \text{ [kN/m]}$$

$$P,k = \sum(Pz,k(x= 0.1)) = 0.00 \text{ [kN/m]}$$

$$kpgh,C(\phi_i= 0.1; \delta,C= 0.0^\circ) = 1.002 \text{ [-]}$$

$$kpch,C = 2.003 \text{ [-]}$$

$$eph,C,gk = (G,k+P,k) \cdot kpgh,C+2 \cdot c \cdot \sqrt{kpch,C} = 213.44 \text{ [kN/m}^2\text{]}$$

$$= (71.76+0.00) \cdot 1.002+2 \cdot 50.0 \cdot 1.415$$

$$Ed = Ch,d = 90.45 \text{ [kN/m}^2\text{]}$$

$$\delta,t,EAU = Ed/(2 \cdot eph,C,d) = 0.30 \text{ [m]}$$

$$\delta,t,EAB = 0.20 \cdot t = 0.50 \text{ [m]}$$

$$\delta,t = \delta,t,EAB = 0.50 \text{ [m]}$$

$$Rd = 2 \cdot \delta,t \cdot eph,C,gk/\gamma,Re$$

$$= 2 \cdot 0.50 \cdot 213.44/1.4$$

$$= 151.00 \text{ [kN/m}^2\text{]}$$

$Ed/Rd = 0.599 \text{ [-]}. \text{ Passes requirement}$

### Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.

z: -3.30 m

$Rd = Eph,k/\gamma,Re = 298.99 / 1.400 = 213.57 \text{ [kN/m]}$

$Ed(Bh,d)/Rd = 213.56 / 213.57 = 1.000 \text{ [-]}. \text{ Passes requirement}$

### Sum of H and V forces, (G)

Forces up to depth z:-4.48

Pos.	H	V
<hr style="border-top: 1px dashed black;"/>		
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( $\delta,p=-0.07^\circ$ )		-0.05
Ch,g	11.10	
Cv,g = Ch*tan( $\delta,C=0.0^\circ$ )		0.01
<hr style="border-top: 1px dashed black;"/>		
$\Sigma$	0.00	89.46
		(downwards)

#### Simple check, EAB R 9-3a

$V_k \geq Bvk: 89.51 \geq 0.05 \text{ Passes requirement}$

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

Forces up to depth z:-4.48

Pos.	H	V
<hr style="border-top: 1px dashed black;"/>		
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( $\delta,p=-0.07^\circ$ )		-0.05
Bh,q,k z=-3.30	-102.85	
Bv,q,k = Bh,k * tan( $\delta,p=-0.07^\circ$ )		-0.12
Ch,g	11.10	
Cv,g = Ch*tan( $\delta,C=0.0^\circ$ )		0.01
Ch,q	50.32	
Cv,q = Ch*tan( $\delta,C=0.0^\circ$ )		0.03
<hr style="border-top: 1px dashed black;"/>		
$\Sigma$	-0.00	94.93
		(downwards)

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**Simple check, EAB R 9-3a**  
 $V_k \geq B_v k: 95.10 \geq 0.17$  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  $R \cdot \sin(\phi)$ .  
 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 occur).

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 [m]	Width b [m]	dxM [m]	Weight [kN/m]	Load z-κατ. [kN/m]	Water- φορτ. [kN/m]	u*b [kN/m]	$\varphi$ [°]	c [kN/m²]	$\theta$ [°]
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 [kN/m]	$G \cdot \sin(\theta)$ [kN/m]	$(G - u \cdot b) \cdot \tan(\varphi) + c \cdot b$ [kN/m]	$\mu \cdot \sin(\theta) \cdot \tan(\varphi) + \cos(\theta)$ [-]	T [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

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**Version 2017.046**

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www.fides-dvp.de

Tel:++49/89/143829-0

ASB Nr.:

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No	Weight	$G \cdot \sin(\theta)$	$(G-u \cdot b) \cdot \tan(\varphi) + c \cdot b$	$\mu \cdot \sin(\theta) \cdot \tan(\varphi) + \cos(\theta)$	T
	[kN/m]	[kN/m]	[kN/m]	[-]	[kN/m]
19	26.20	24.75	10.62	0.466572	22.77
		-----			-----
		163.60			414.63

Δράση  $E_d = (163.6 \cdot 5.59)$

Αντίσταση  $R_d = (414.6 \cdot 5.59 + 0.0)$

**SLIP-CIRCLE  $\mu = E_d/R_d = 0.39 < 1.0$ : Έλεγχος εκπληρώθηκε.**

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**Φάση εκσκαφής 2 "[2] Situation 2"**

LC: όλα τα φορτία Type: BS-T

**Εδαφικό σύστημα με 5 Στρώσεις**

Name	Τεχνητές επιχωματώσεις	Αμμόδης 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,θh	[-]	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	Αμμόδης	ΑΡΓΙΛΟΣ	Αργιλώδη	ΧΑΛΙΚΙΑ-	ΑΜΜΟΣ
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,θh	[-]	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 Αμμόδης 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 Αμμόδης ΑΡΓΙΛΟΣ:

z= -10.00



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

**Επιφ. φορτία:**

**Φορτία**

xA	zA	xE	zE	PxA	PzA	PxE	PzE	Typ	LC-description
[m]	[m]	[m]	[m]	[	kN/m²		]		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:  $\varphi_{min} = 40.000$ .  
 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.

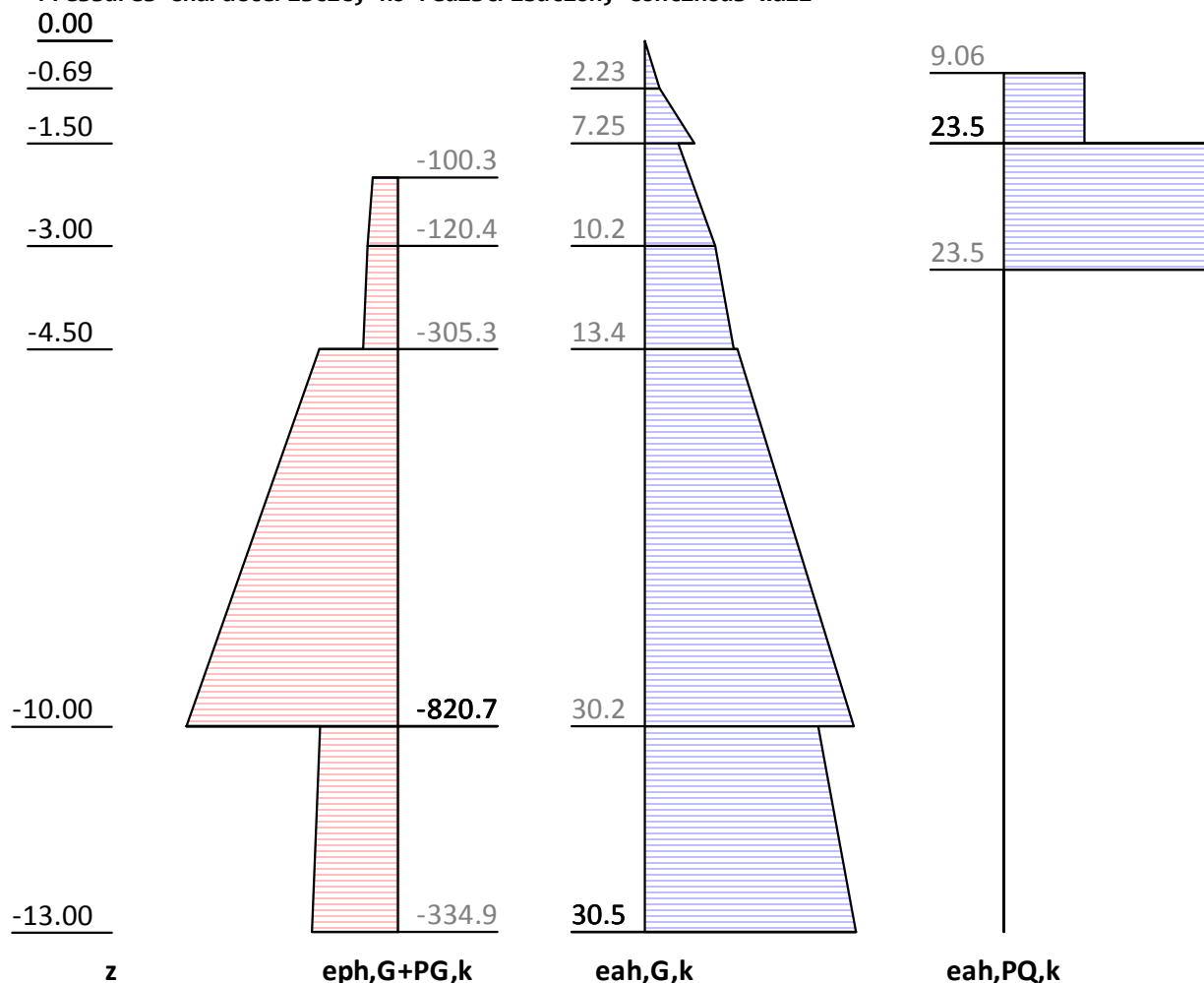
**Earth pressure coefficients kh**

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	--	--	"

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**Μήκος τοίχου**Foot depth for statics:  $z_f = -13.000$ **Stress analysis****Earth pressure, horizontal**

Pressures characteristic, no redistribution, continuous wall



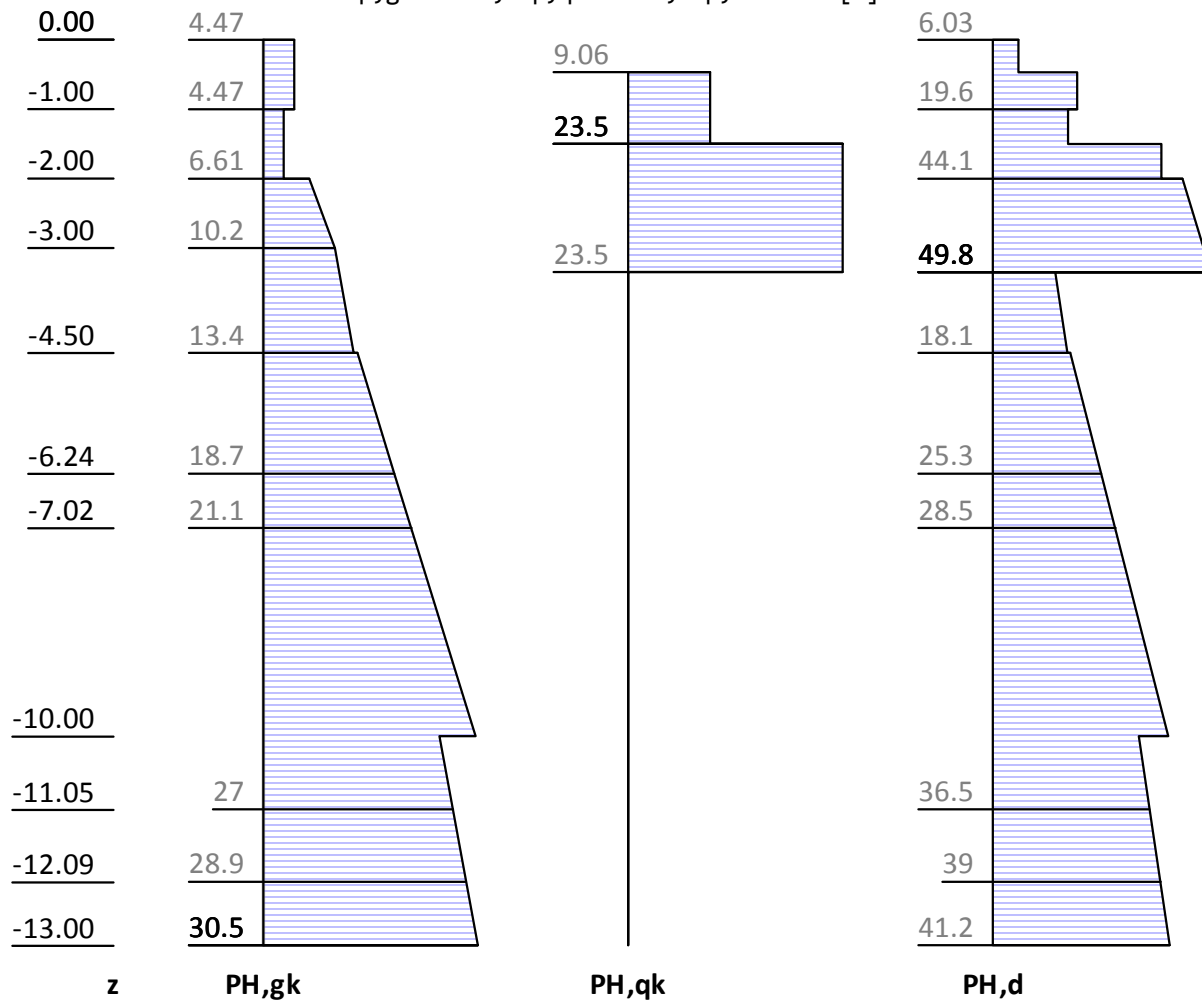
$z$ [m]	$eph, G, k$ [kN/m²]	$eah, G, k$ [kN/m²]	$eah, PQ, k$ [kN/m²]	$eah, d$ [kN/m²]
0.00		0.00		0.00
-0.47		1.52	0.00	2.04
-0.47		1.52	9.06	15.62
-1.50		7.25	9.06	23.37
-1.50		4.82	23.48	41.73
-2.00	-0.00	6.61	23.48	44.14
-2.00	-100.29	6.61	23.48	44.14
-3.34	-123.80	10.79	23.48	49.78
-3.34	-123.80	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 [%]

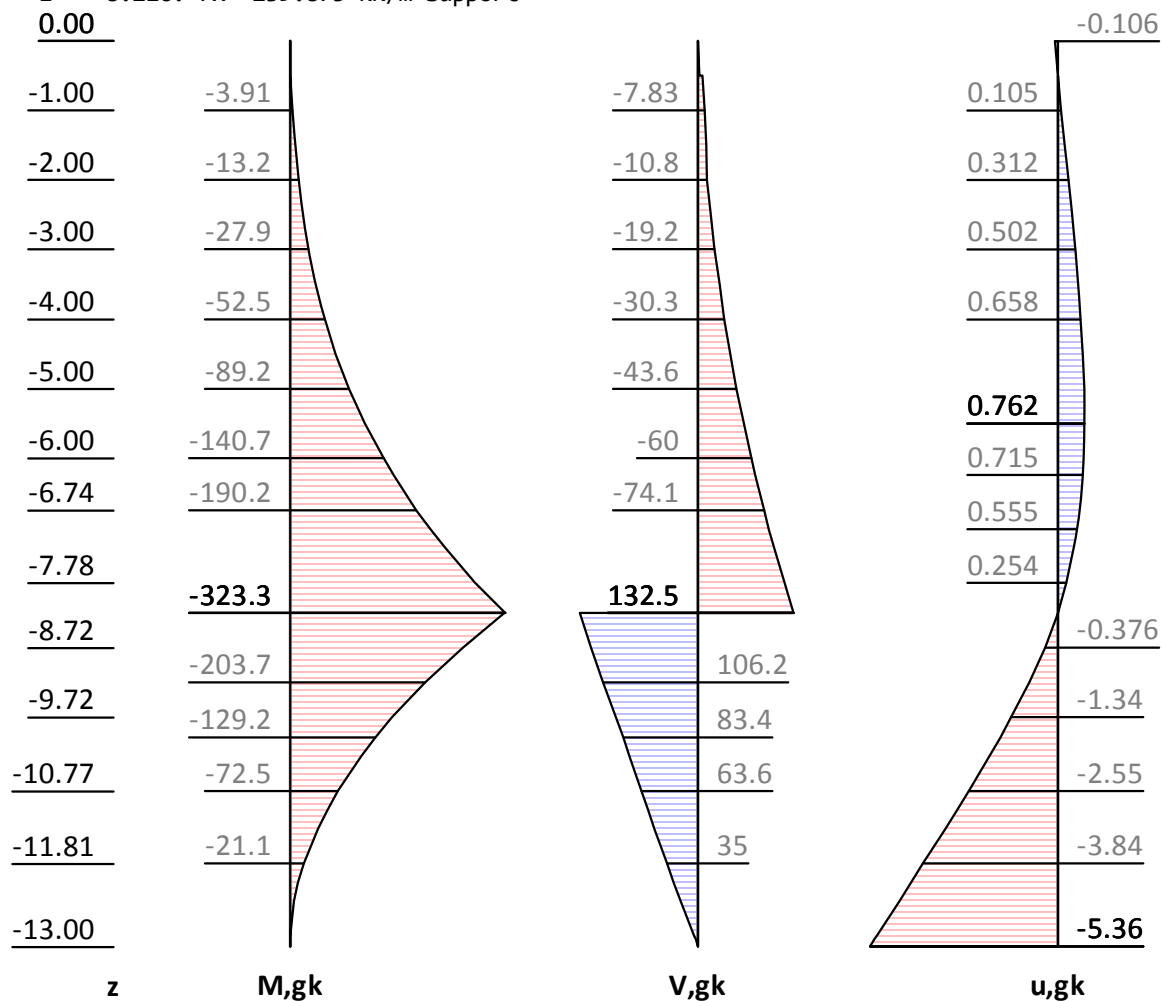


z [m]	PH,gk [kN/m²]	PH,qk [kN/m²]	PH,d [kN/m²]
0.00	4.47		6.03
-0.47	4.47	0.00	6.03
-0.47	4.47	9.06	19.62
-1.00	4.47	9.06	19.62
-1.00	2.98	9.06	17.61
-1.50	2.98	9.06	17.61
-1.50	2.98	23.48	39.25
-2.00	2.98	23.48	39.25
-2.00	6.61	23.48	44.14
-3.34	10.79	23.48	49.78
-3.34	10.79	0.00	14.56
-4.50	12.86	0.00	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

**0.00**

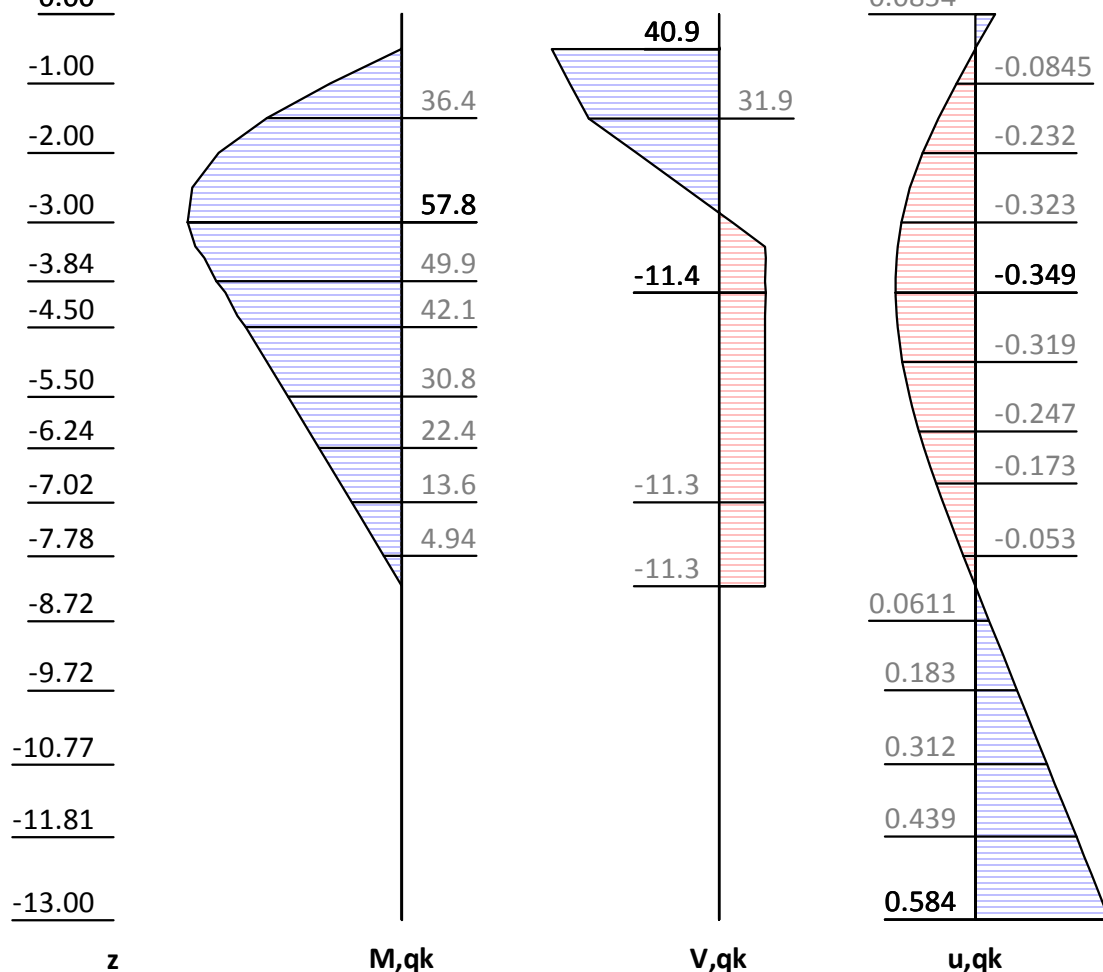
z [m]	H, g, k [kN/m <sup>2</sup> ]	M, g, k [kN/m <sup>2</sup> ]	V, g, k [kN/m <sup>2</sup> ]	N, g, k [kN/m <sup>2</sup> ]	u, g, k [mm]
0.00	4.47	0.00	0.00	0.00	-0.11
-0.00	4.47	-0.00	0.00	-0.00	-0.11
-0.50	4.47	-0.56	-2.23	-10.91	0.00
-0.50	4.47	-0.56	-5.59	-10.01	0.00
-1.00	4.47	-3.91	-7.83	-20.93	0.11
-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

0.00



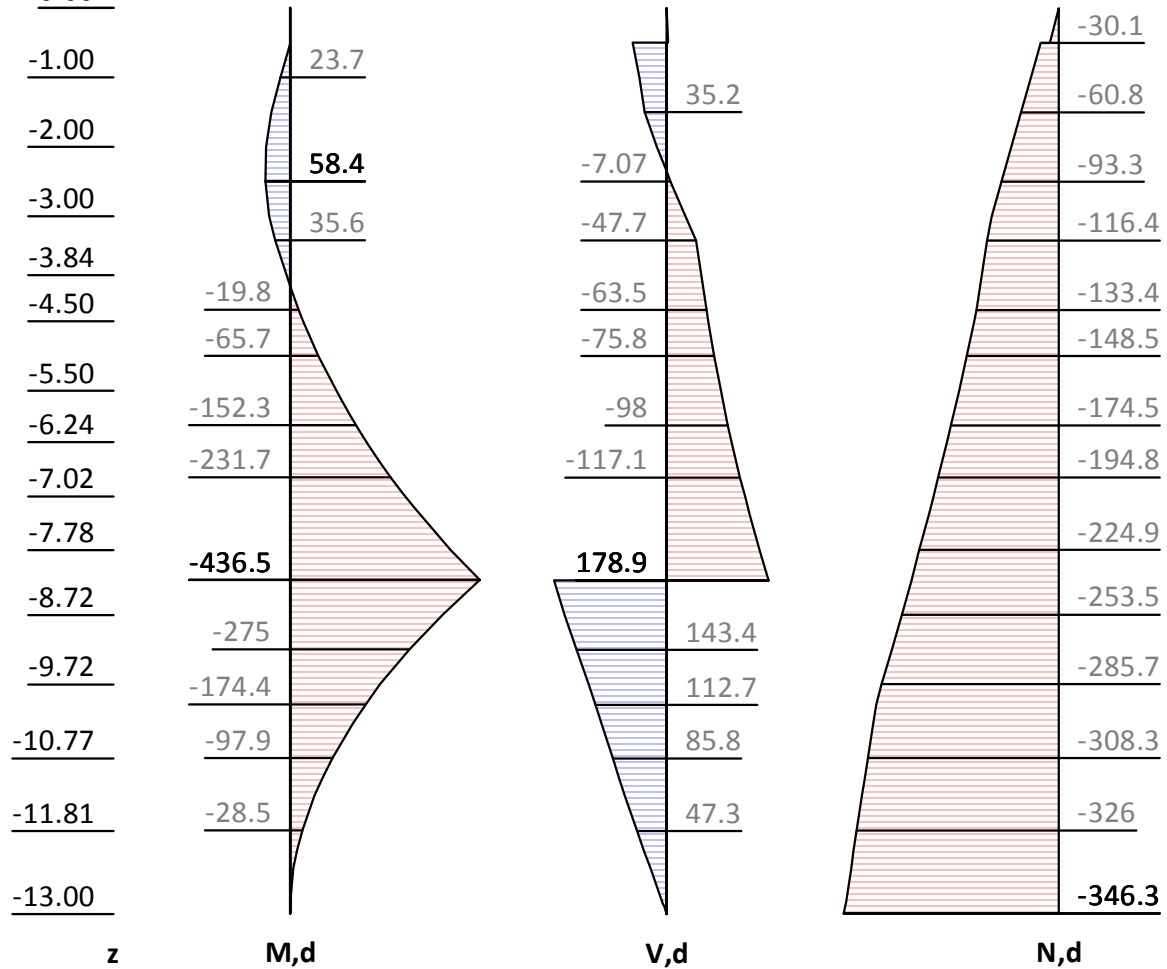
z [m]	H, q, k [kN/m²]	M, q, k [kN/m²]	V, q, k [kN/m²]	N, q, k [kN/m²]	u, q, k [mm]
0.00		0.00	-0.00	0.00	0.09
-0.47	0.00	0.03	-0.00	0.00	0.01
-0.47	9.06	0.03	0.00	0.00	0.01
-0.47	9.06	0.03	0.00	-0.00	0.01
-0.50	9.06	-0.00	-0.24	-0.03	0.00
-0.50	9.06	-0.00	40.92	-11.07	-0.00
-1.50	9.06	36.39	31.87	-12.02	-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/m <sup>2</sup> ]	M, q, k [kN/m <sup>2</sup> ]	V, q, k [kN/m <sup>2</sup> ]	N, q, k [kN/m <sup>2</sup> ]	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

**0.00**

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0.00

6.03

-1.00

19.6

-2.00

44.1

-3.00

49.8

-3.84

18.1

-4.50

25.3

-5.50

28.5

-6.24

36.5

-7.02

39

-7.78

41.2

-8.72

-9.72

-10.77

-11.81

-13.00

6.03

19.6

44.1

49.8

18.1

25.3

28.5

36.5

39

41.2

z

H,d

-0.0203

0.021

0.0799

0.178

0.287

0.375

0.493

0.455

0.201

-0.315

-1.16

-2.24

-3.4

-4.77

u,g+q,k

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**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 of earth support**

Check: Mobilizable earth resistance is sufficient for earth support force.

z: -8.22 m

$R_d = E_{ph,k}/\gamma_{Re} = 4358.35 / 1.400 = 3113.11 \text{ [kN/m]}$

$E_d(U_h,d)/R_d = 340.84 / 3113.11 = 0.109 \text{ [-]}. \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-8.22	-239.88	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * 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.

$V_k \geq B_{vk}: 238.08 \geq 96.92 \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-8.22	-239.88	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * tan(δ,p=-22.00°)		-96.92
B <sub>h,q,k</sub> z=-8.22	-11.34	
B <sub>v,q,k</sub> = B <sub>h,k</sub> * 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.

$V_k \geq B_{vk}: 254.67 \geq 101.50 \text{ Passes requirement}$

**Anchor verification**



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Structure: info@fides-dvp.de    www.fides-dvp.de    Tel:++49/89/143829-0    ASB Nr.:					Date: 08.10.2018	

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

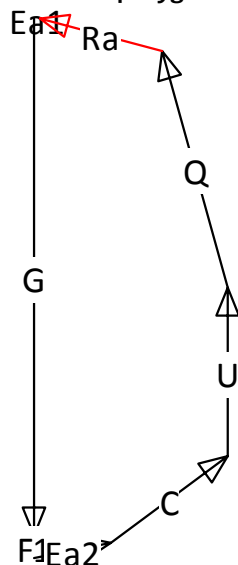
**Decisive failure body:**  
**Γεωμετρία:**  
 Foot point of lower failure plane                    x/z =    0.01/-13.00 m  
 Intersection lower/upper slid. plane                x/z =    7.84/ -2.60 m  
 Intersection upper slid. plane/surface                x/z =    9.50/    0.00 m  
 Intersection separation 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	Fz	F	
		[kN/m]	[kN/m]	[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	

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**Force polygon**

Acting anchor forces  $E_d: \sum(A,d) = 59.3 \text{ kN/m}$   
 Possible anchor forces  $R_d: R_{a\_cal,d} = 347.5/1.400 = 248.2 \text{ kN/m}$   
 Verif. of lower failure plane  $E_d/R_d = 0.24 < 1.0$ : Έλεγχος εκπληρώθηκε.

**Check of steel tension**

$l_{tot}$  ...[m]: Total length of anchor incl. excess length at head  
 $A_s$  ....[mm<sup>2</sup>]: X-section area of steel member  
 $R_{i,d}$  ...[kN]: Ultimate strength of tension member ( $\gamma, M=1.15$ )  
 $A_{,d}$  ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	$l_{tot}$	$A_s$	$R_{i,d}$	$A_{,d}$
-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**

$l_{vk}$  .....: Length of grout body  
 $D_{m,vk}$  ....: Diameter of grout body  
 $\tau_{Gr,k}$  ....: Average applied skin friction along the grout body (from soil parameters)  
 $R_{a,k}$  ....: Charact. pullout resistance of the anchor  
 $\gamma_A$  .....: Partial safety factor of anchor pullout  
 $R_{a,d}$  .....:  $R_{a,k} / \gamma_A$   
 $A_{,d}$  .....: Dimensioning force of the anchor from wall analysis

z	$l_{vk}$	$D_{m,vk}$	$\tau_{Gr,k}$	$R_{a,k}$	$\gamma_A$	$R_{a,d}$	$A_{,d}$	$A_{,d}/R_{a,d}$
[m]	[m]	[mm]	[kN/m <sup>2</sup> ]	[kN]	[-]	[kN]	[kN]	[-]
-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  $R \cdot \sin(\phi)$ .  
 The automatic slip circle optimization only considers circles that intersect the surface with an area of at least 0.25 m<sup>2</sup>.  
 The slip circle calculation only accepts circles including the wall.  
 The slipcircle calculation only allows circular failure planes (no vertical tangents will occur).

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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 [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	-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 [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	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.

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**Φάση εκσκαφής 3 "[3] Situation 3"**

LC: όλα τα φορτία Type: BS-T

**Εδαφικό σύστημα με 5 Στρώσεις**

Name	Τεχνητές επιχωματώσεις	Αμμόδης	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,θh	[-]	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	Αμμόδης	ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟΣ
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,θh	[-]	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 Αμμόδης 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 Αμμόδης ΑΡΓΙΛΟΣ:

z= -10.00

Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>		Job No.:
Program: <b>WALLS-Retain. Version 2017.046</b>		
Structure: info@fides-dvp.de	www.fides-dvp.de	Tel:++49/89/143829-0 ASB Nr.:
		Date: 08.10.2018

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

**Επιφ. φορτία:**

**Φορτία**

xA	zA	xE	zE	PxA	PzA	PxE	PzE	Typ	LC-description
[m]	[m]	[m]	[m]	[	kN/m²		]		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:  $\varphi_{min} = 40.000$ .  
 Negative earth pressure fractions are set to zero.

**Redistribution of earth pressure**

Shape of redistribution: Trapezoid.  
 The earth pressure is getting redistrib. to: Excavation level  
 The earth pressure below the excavation acts without redistrib.  
 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.

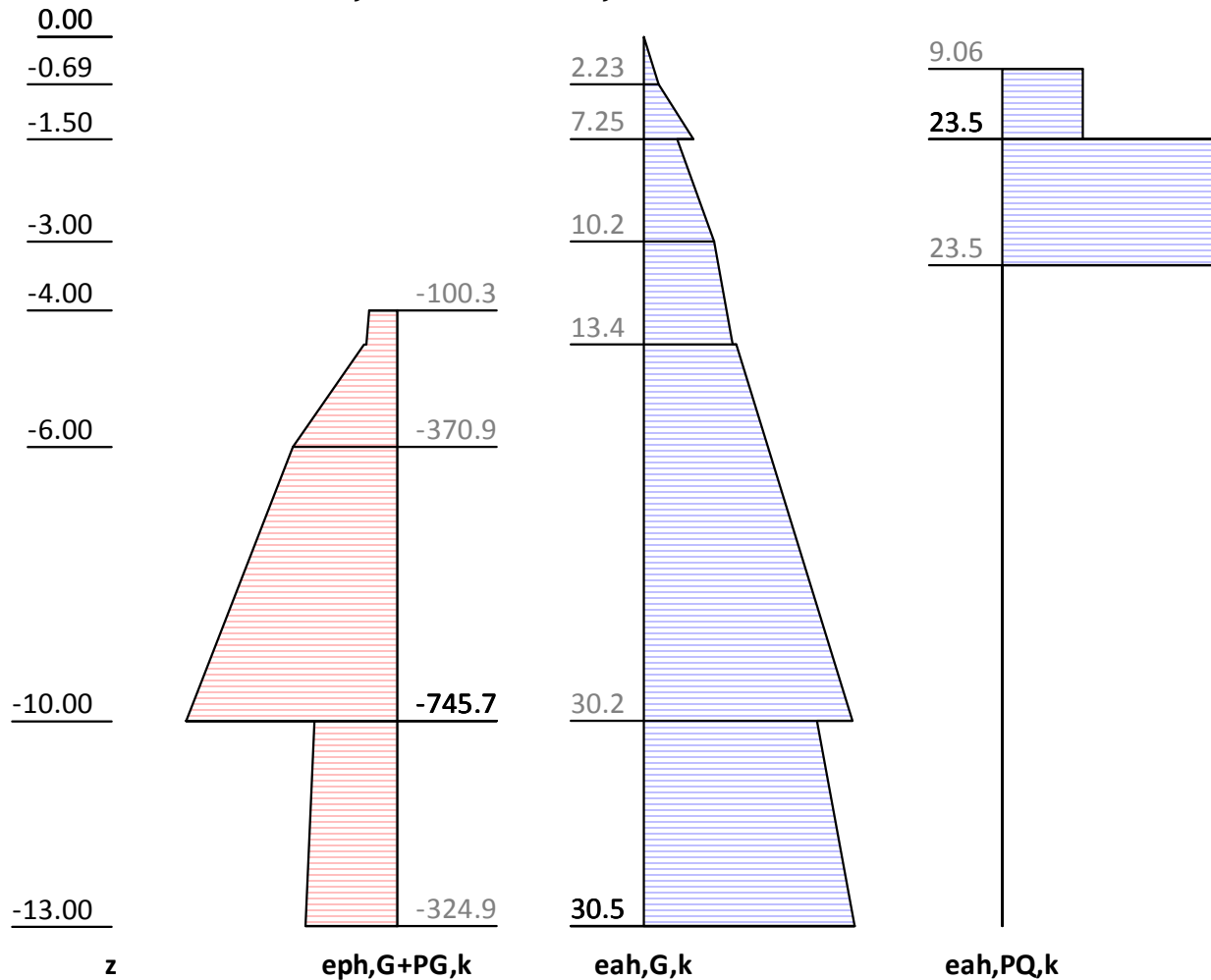
**Earth pressure coefficients kh**

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	--	--	"

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**Μήκος τοίχου**Foot depth for statics:  $z_f = -13.000$ **Stress analysis****Earth pressure, horizontal**

Pressures characteristic, no redistribution, continuous wall



$z$ [m]	$e_{ph}, G, k$ [kN/m <sup>2</sup> ]	$e_{ah}, G, k$ [kN/m <sup>2</sup> ]	$e_{ah}, PQ, k$ [kN/m <sup>2</sup> ]	$e_{ah}, d$ [kN/m <sup>2</sup> ]
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

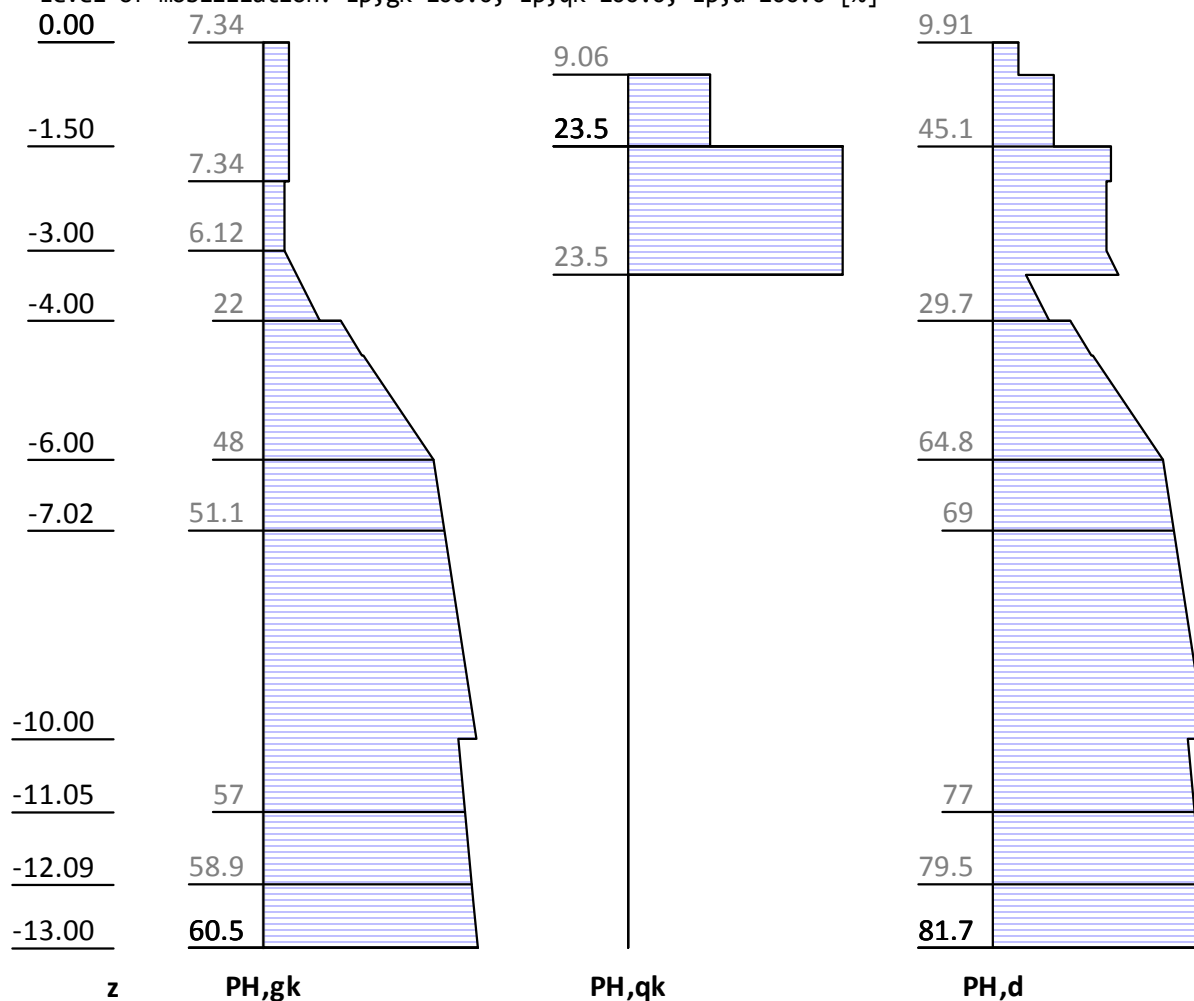
 $E_{ph}, G, k: -3582.08, E_{ph}, PG, k: 0.00$  [kN/m] $E_{ah}, G, k: 236.52, E_{ah}, PG, k: 0.00, E_{ah}, PQ, k: 52.53, E_{ah}, d: 398.10$

## 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 [%]



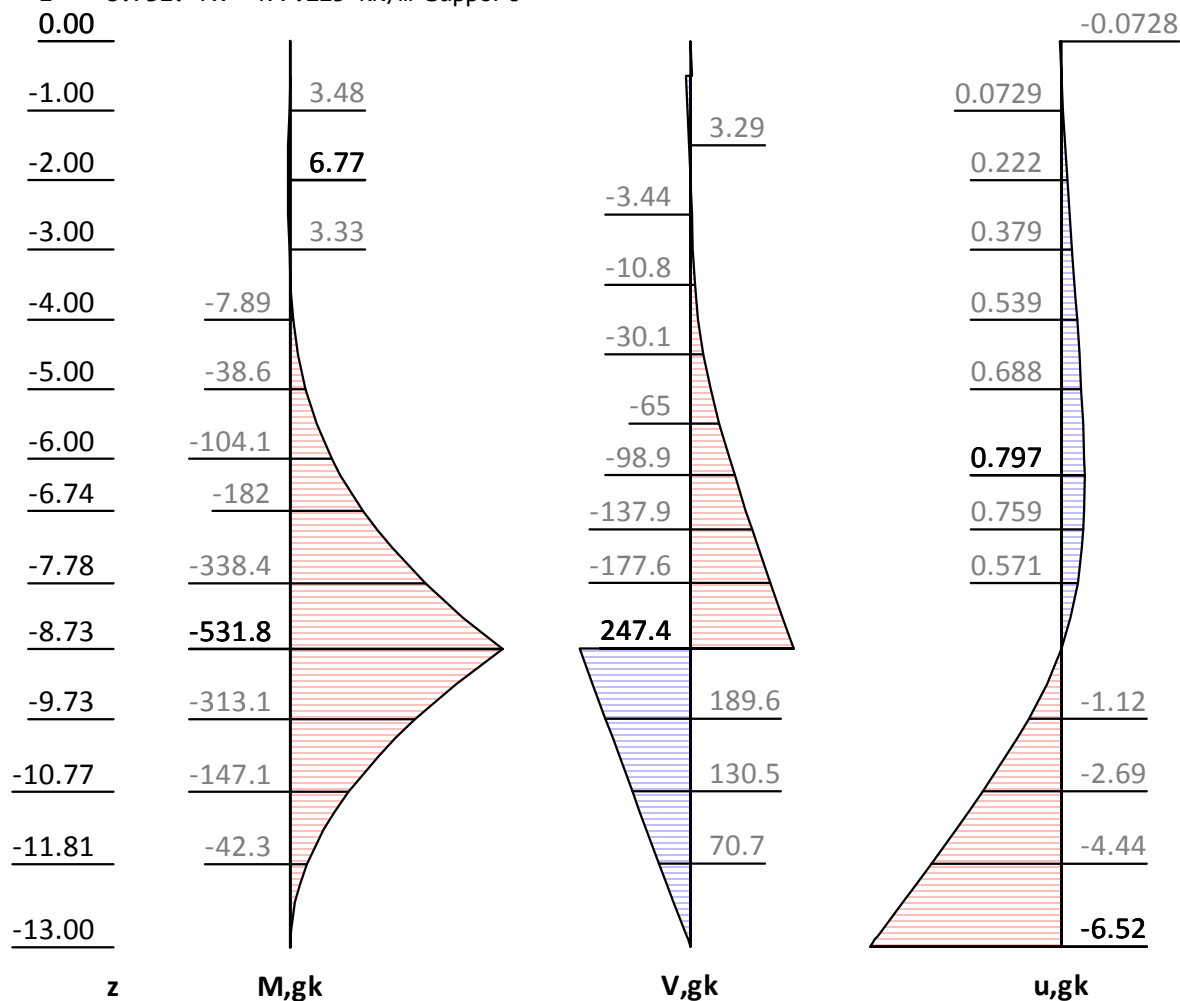
z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	7.34		9.91
-0.47	7.34	0.00	9.91
-0.47	7.34	9.06	23.50
-1.50	7.34	9.06	23.50
-1.50	7.34	23.48	45.13
-2.00	7.34	23.48	45.13
-2.00	6.12	23.48	43.48
-3.34	9.52	23.48	48.07
-3.34	9.52	0.00	12.85
-4.00	16.12	0.00	21.76
-4.00	21.97	0.00	29.65
-4.50	27.86	0.00	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

0.00



z [m]	H, g, k [kN/m <sup>2</sup> ]	M, g, k [kN/m <sup>2</sup> ]	V, g, k [kN/m <sup>2</sup> ]	N, g, k [kN/m <sup>2</sup> ]	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

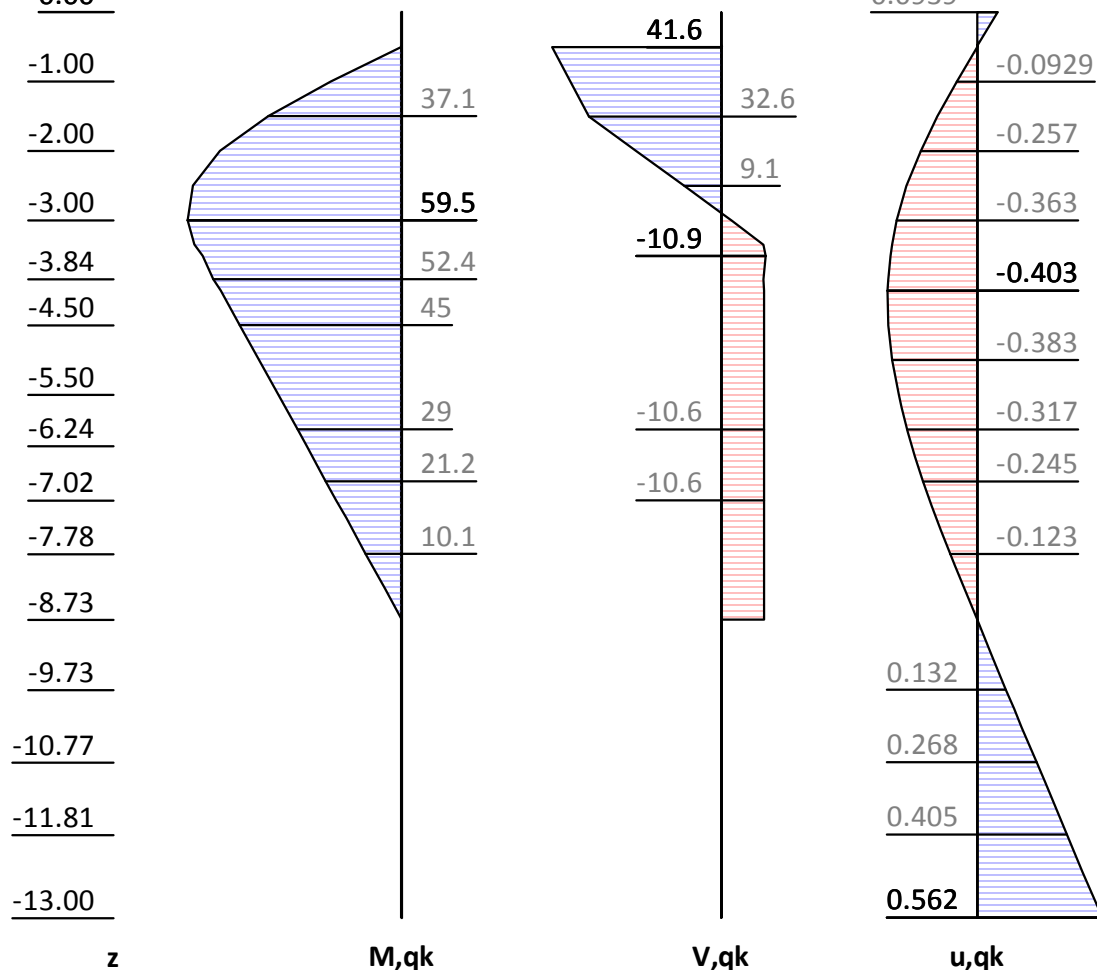


**Internal forces: Variable, characteristically**Method EB 82-4 ( $Q = [G+Q] - G$ ).

z= -0.500. Fx= -41.904 kN/m Support

z= -8.731. Fx= -10.628 kN/m Support

0.00



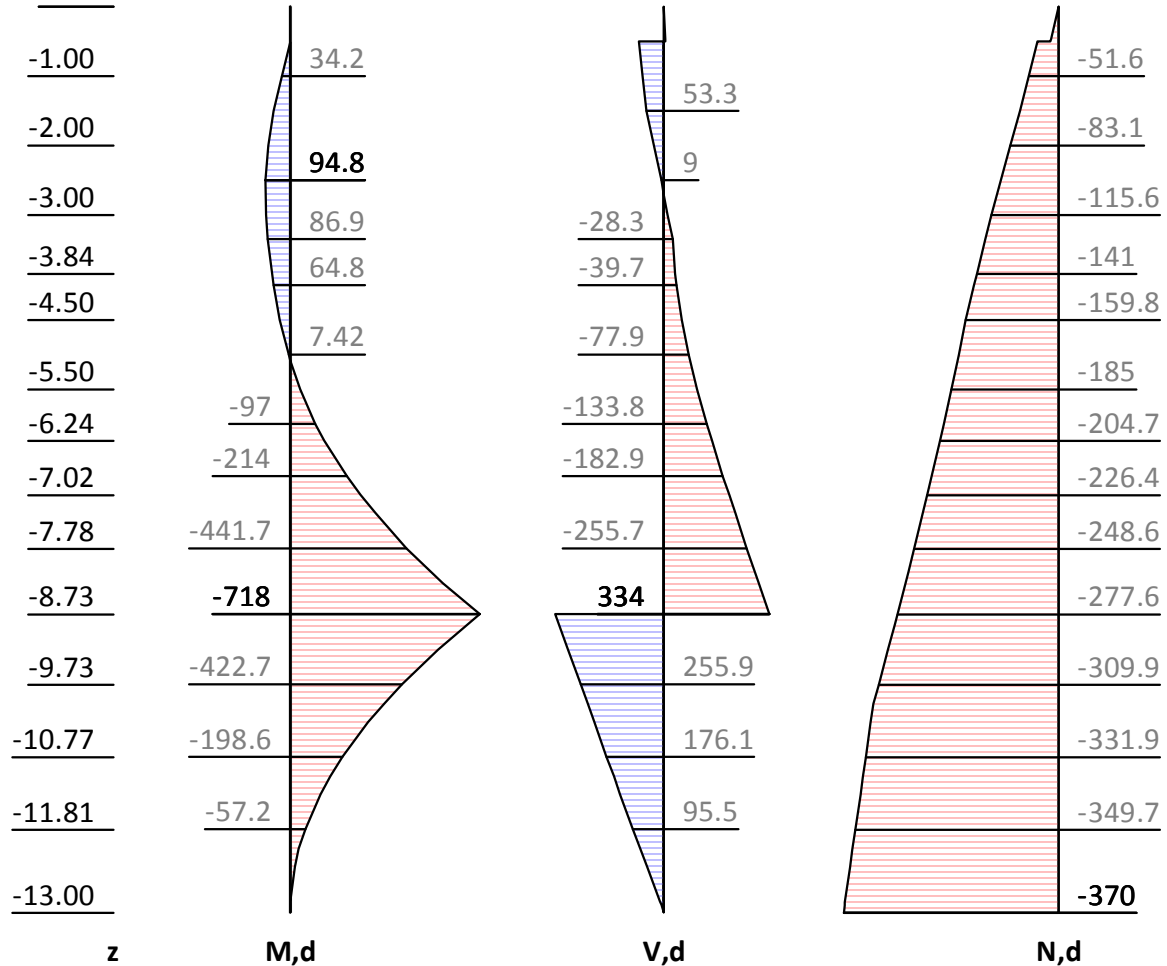
z [m]	H, q, k [kN/m <sup>2</sup> ]	M, q, k [kN/m <sup>2</sup> ]	V, q, k [kN/m <sup>2</sup> ]	N, q, k [kN/m <sup>2</sup> ]	u, q, k [mm]
0.00		0.00	0.00	0.00	0.09
-0.47	0.00	0.05	0.00	0.00	0.01
-0.47	9.06	0.05	0.00	-0.00	0.01
-0.50	9.06	0.00	-0.25	-0.03	0.00
-0.50	9.06	0.00	41.63	-11.26	-0.00
-1.50	9.06	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

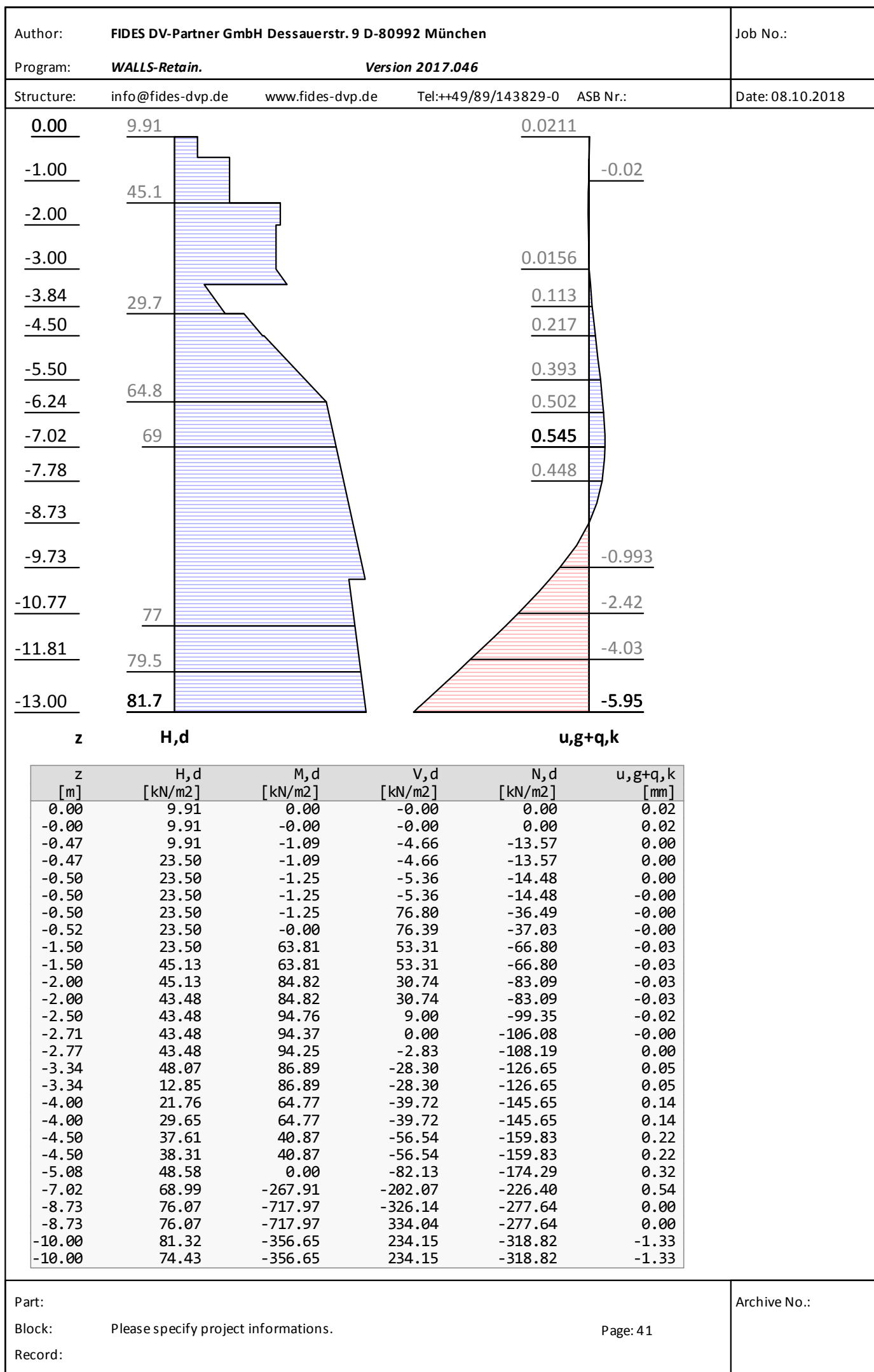
z [m]	H, q, k [kN/m <sup>2</sup> ]	M, q, k [kN/m <sup>2</sup> ]	V, q, k [kN/m <sup>2</sup> ]	N, q, k [kN/m <sup>2</sup> ]	u, q, k [mm]
-13.00	0.00	0.00	-0.00	-16.78	0.56

**Internal forces: Design**

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

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

0.00



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z	H,d	M,d	V,d	N,d	u,g,q,k
[m]	[kN/m2]	[kN/m2]	[kN/m2]	[kN/m2]	[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 of earth support**

Check: Mobilizable earth resistance is sufficient for earth support force.  
 z: -8.73 m  
 $R_d = E_{ph,k}/\gamma_{Re} = 3582.08 / 1.400 = 2558.63 \text{ [kN/m]}$   
 $E_d(U_{h,d})/R_d = 660.18 / 2558.63 = 0.258 \text{ [-]}. \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-8.73	-477.21	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * 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.

V<sub>k</sub> >= B<sub>vk</sub>: 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
B <sub>h,g,k</sub> z=-8.73	-477.21	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * tan(δ,p=-22.00°)		-192.81
B <sub>h,q,k</sub> z=-8.73	-10.63	
B <sub>v,q,k</sub> = B <sub>h,k</sub> * 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.

V<sub>k</sub> >= B<sub>vk</sub>: 272.19 >= 197.10 Passes requirement

**Anchor verification**

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Program: <b>WALLS-Retain.</b>					Version <b>2017.046</b>	
Structure: info@fides-dvp.de    www.fides-dvp.de    Tel:++49/89/143829-0    ASB Nr.:					Date: 08.10.2018	

**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	θ1	θ2	lA	W,k	Q,k	Ea1,k	Ea2,k	Ra_cal,d	Sum(A,d)	Ed/Rd
[m]	[°]	[°]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]
-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°

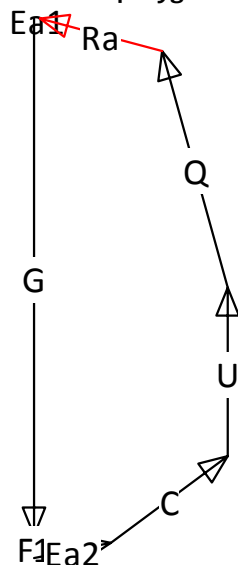
**Loads / forces (char.)**

		Fx	Fz	F	
		[kN/m]	[kN/m]	[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	

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**Force polygon**

Acting anchor forces  $E_d: \sum(A,d) = 85.1 \text{ kN/m}$   
 Possible anchor forces  $R_d: R_{a\_cal,d} = 347.5/1.400 = 248.2 \text{ kN/m}$   
 Verif. of lower failure plane  $E_d/R_d = 0.34 < 1.0$ : Έλεγχος εκπληρώθηκε.

**Check of steel tension**

$l_{tot}$  ...[m]: Total length of anchor incl. excess length at head  
 $A_s$  ....[mm<sup>2</sup>]: X-section area of steel member  
 $R_{i,d}$  ...[kN]: Ultimate strength of tension member ( $\gamma, M=1.15$ )  
 $A_{,d}$  ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	$l_{tot}$	$A_s$	$R_{i,d}$	$A_{,d}$
-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**

$l_{vk}$  .....: Length of grout body  
 $D_{m,vk}$  ....: Diameter of grout body  
 $\tau_{Gr,k}$  ....: Average applied skin friction along the grout body (from soil parameters)  
 $R_{a,k}$  ....: Charact. pullout resistance of the anchor  
 $\gamma_A$  .....: Partial safety factor of anchor pullout  
 $R_{a,d}$  .....: =  $R_{a,k} / \gamma_A$   
 $A_{,d}$  .....: Dimensioning force of the anchor from wall analysis

z	$l_{vk}$	$D_{m,vk}$	$\tau_{Gr,k}$	$R_{a,k}$	$\gamma_A$	$R_{a,d}$	$A_{,d}$	$A_{,d}/R_{a,d}$
[m]	[m]	[mm]	[kN/m <sup>2</sup> ]	[kN]	[-]	[kN]	[kN]	[-]
-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  $R \cdot \sin(\phi)$ .  
 The automatic slip circle optimization only considers circles that intersect the surface with an area of at least 0.25 m<sup>2</sup>.  
 The slip circle calculation only accepts circles including the wall.  
 The slipcircle calculation only allows circular failure planes (no vertical tangents will occur).

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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	dxM	Weight	Load	Water-	u*b	φ	c	θ
	[m]	b	[m]	[kN/m]	z-κατ.	φορτ.	[kN/m]	[°]	[kN/m²]	[°]
					[kN/m]					
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.**

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## Φάση εκσκαφής 4 "[4] Situation 4"

LC: όλα τα φορτία Type: BS-T

### Εδαφικό σύστημα με 5 Στρώσεις

Name	Τεχνητές επιχωματώσεις	Αμμόδης 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,θh	[-]	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	Αμμόδης	ΑΡΓΙΛΟΣ	Αργιλώδη	ΧΑΛΙΚΙΑ-	ΑΜΜΟΣ
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,θh	[-]	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 Αμμόδης 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 Αμμόδης ΑΡΓΙΛΟΣ:

z= -10.00

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

**Επιφ. φορτία:**

**Φορτία**

xA	zA	xE	zE	PxA	PzA	PxE	PzE	Typ	LC-description
[m]	[m]	[m]	[m]	[	kN/m²		]		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 redistrib. to: Excavation level  
 The earth pressure below the excavation acts without redistrib.  
 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**

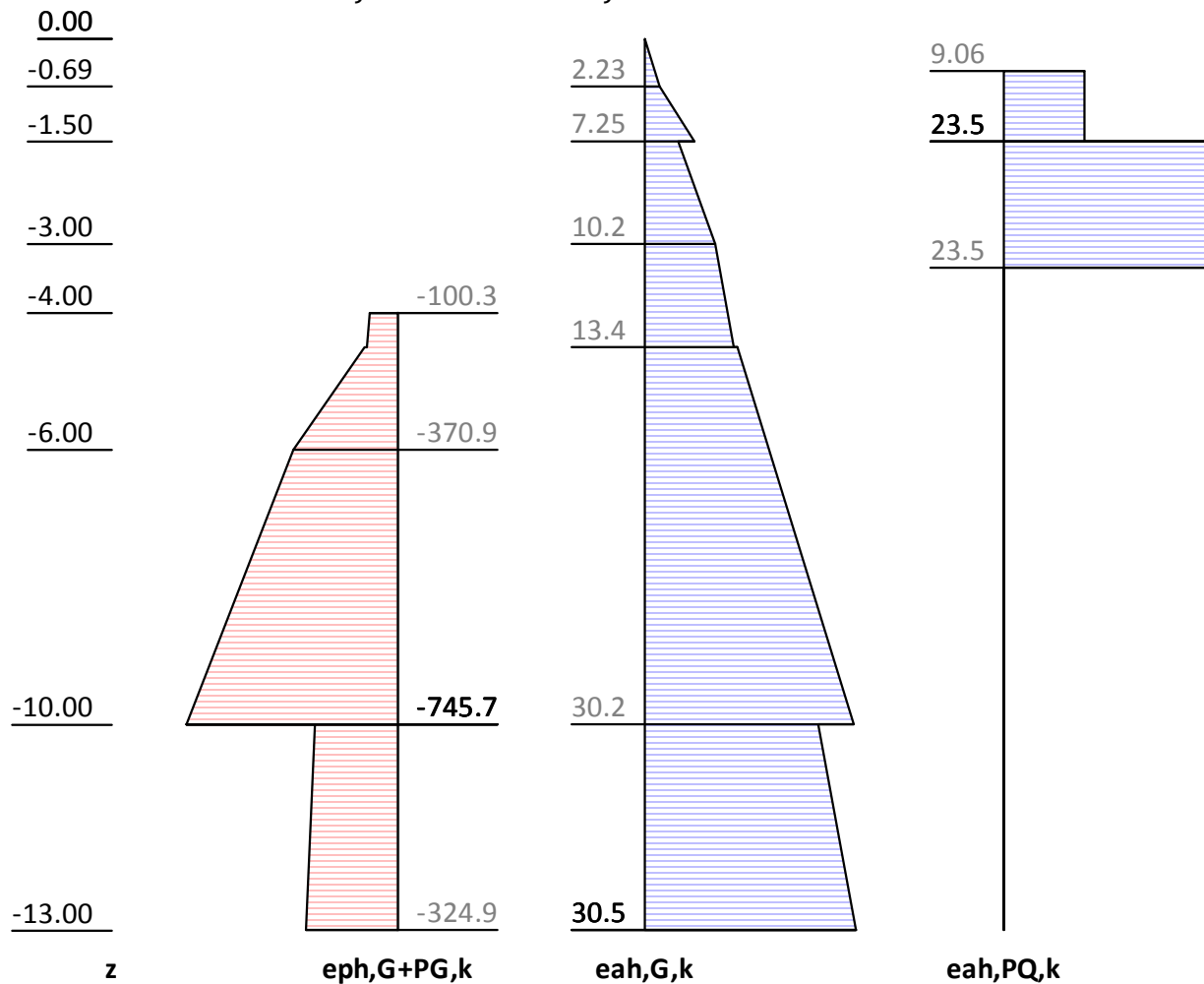
φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006	Αμμώδης ΑΡΓΙΛΟΣ
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	"
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	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	--	--	"

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**Μήκος τοίχου**Foot depth for statics:  $z_f = -13.000$ **Stress analysis****Earth pressure, horizontal**

Pressures characteristic, no redistribution, continuous 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

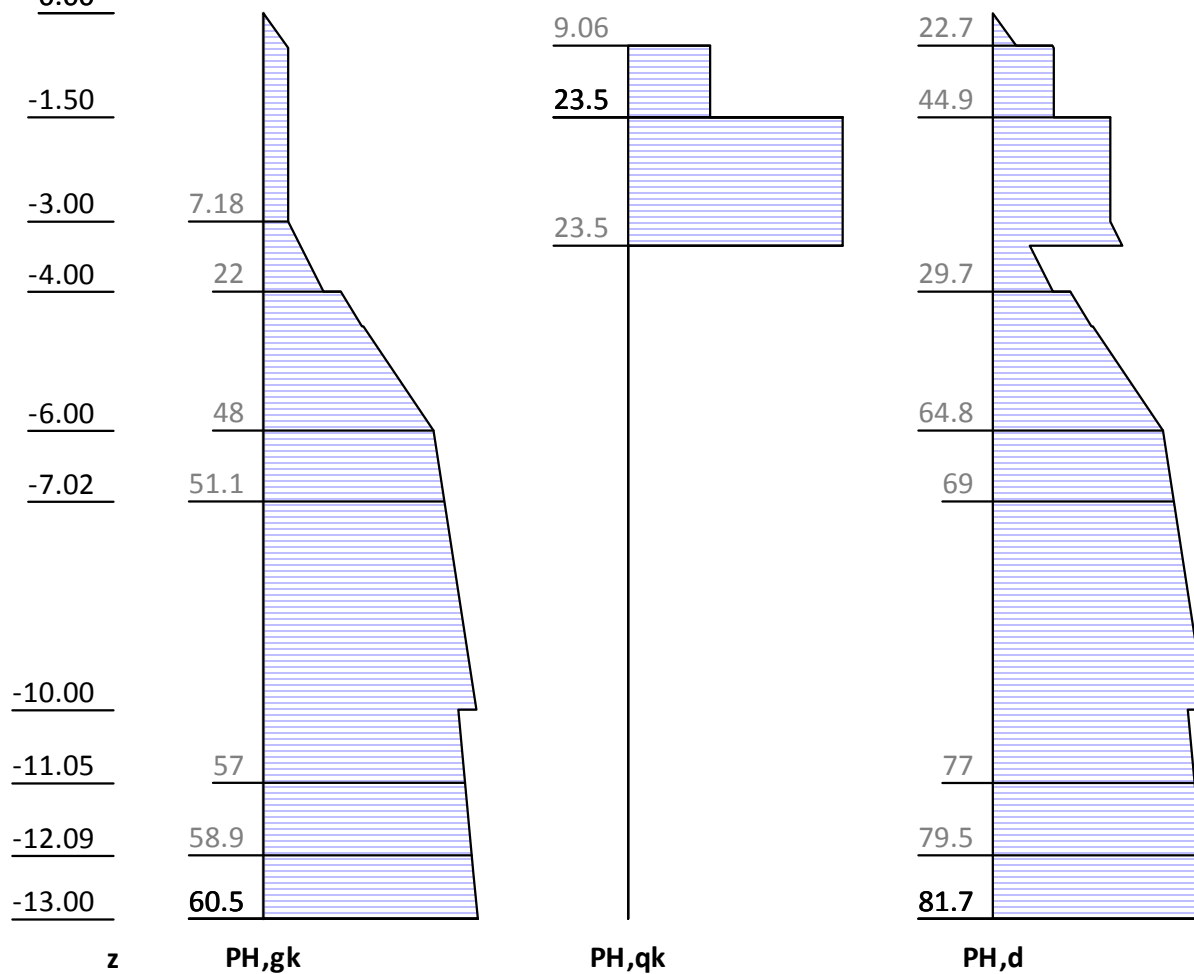
## Πίεση νερού

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 [%]

0.00



z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	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

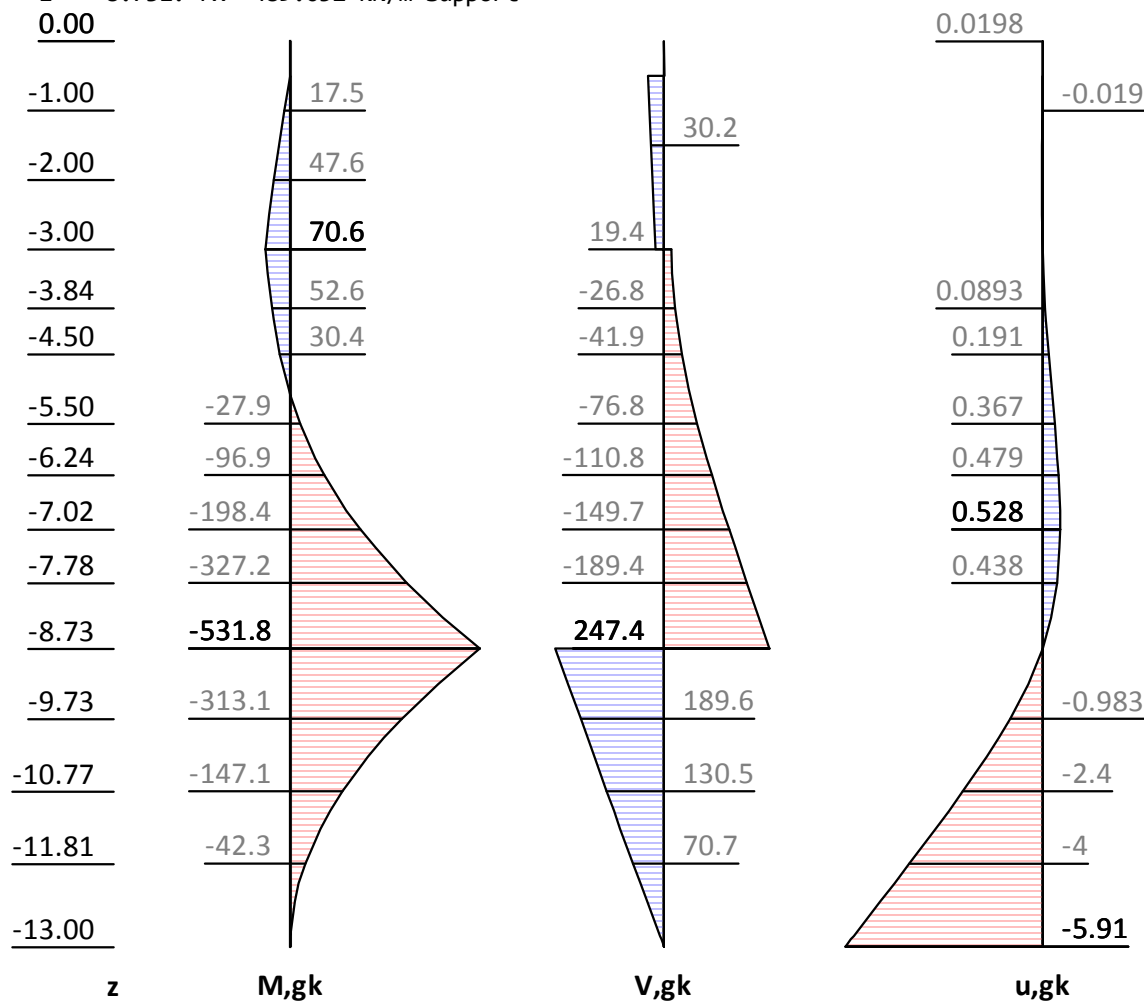
**V-pressure on static system****Internal forces: Permanent, characteristically**

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

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]
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

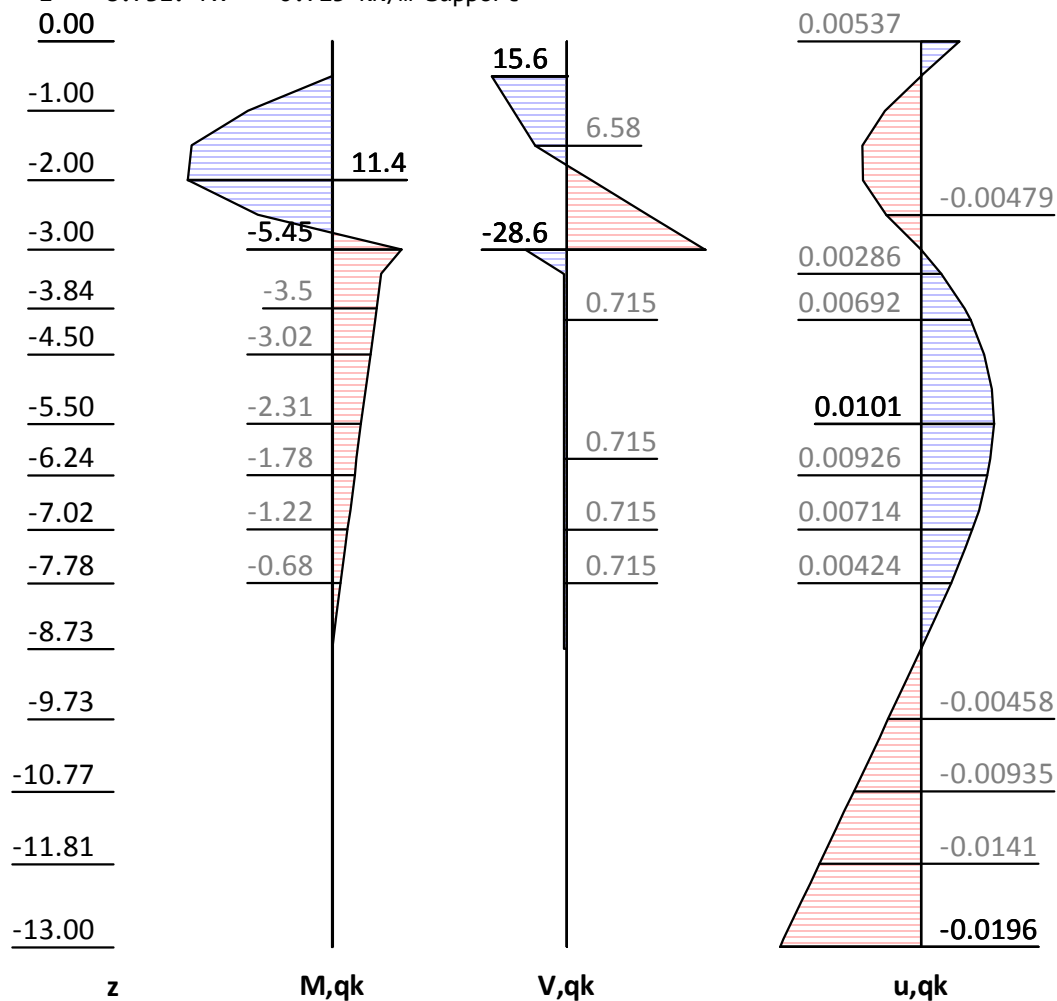
**Internal forces: Variable, characteristically**Method EB 82-4 ( $Q = [G+Q] - G$ ).

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

0.00



z [m]	H, q, k [kN/m <sup>2</sup> ]	M, q, k [kN/m <sup>2</sup> ]	V, q, k [kN/m <sup>2</sup> ]	N, q, k [kN/m <sup>2</sup> ]	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

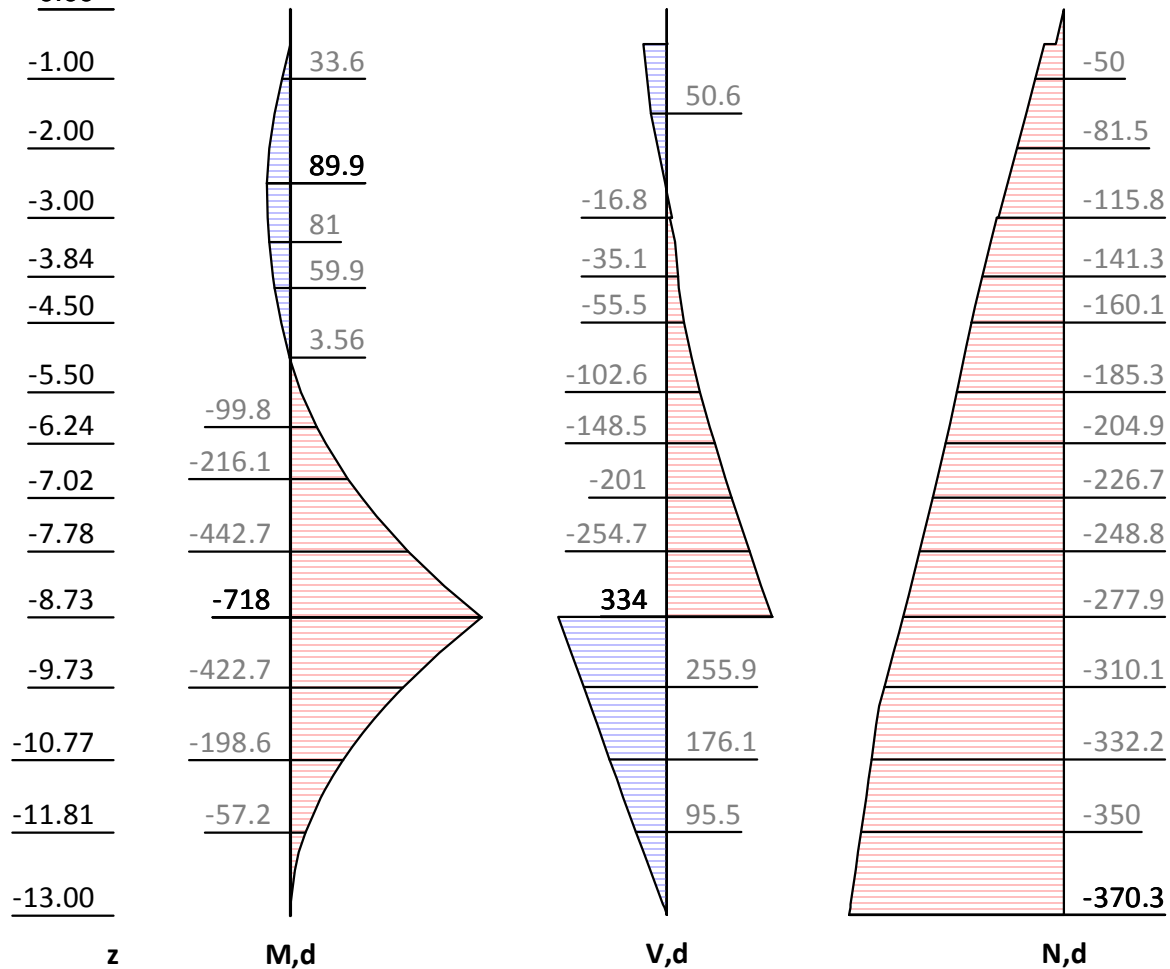
z [m]	H, q, k [kN/m <sup>2</sup> ]	M, q, k [kN/m <sup>2</sup> ]	V, q, k [kN/m <sup>2</sup> ]	N, q, k [kN/m <sup>2</sup> ]	u, q, k [mm]
-8.73	0.00	0.00	0.71	-19.82	0.00
-8.73	0.00	0.00	-0.00	-19.82	0.00
-11.81	0.00	0.00	-0.00	-19.82	-0.01
-12.35	0.00	0.00	-0.00	-19.82	-0.02
-12.90	0.00	0.00	-0.00	-19.82	-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

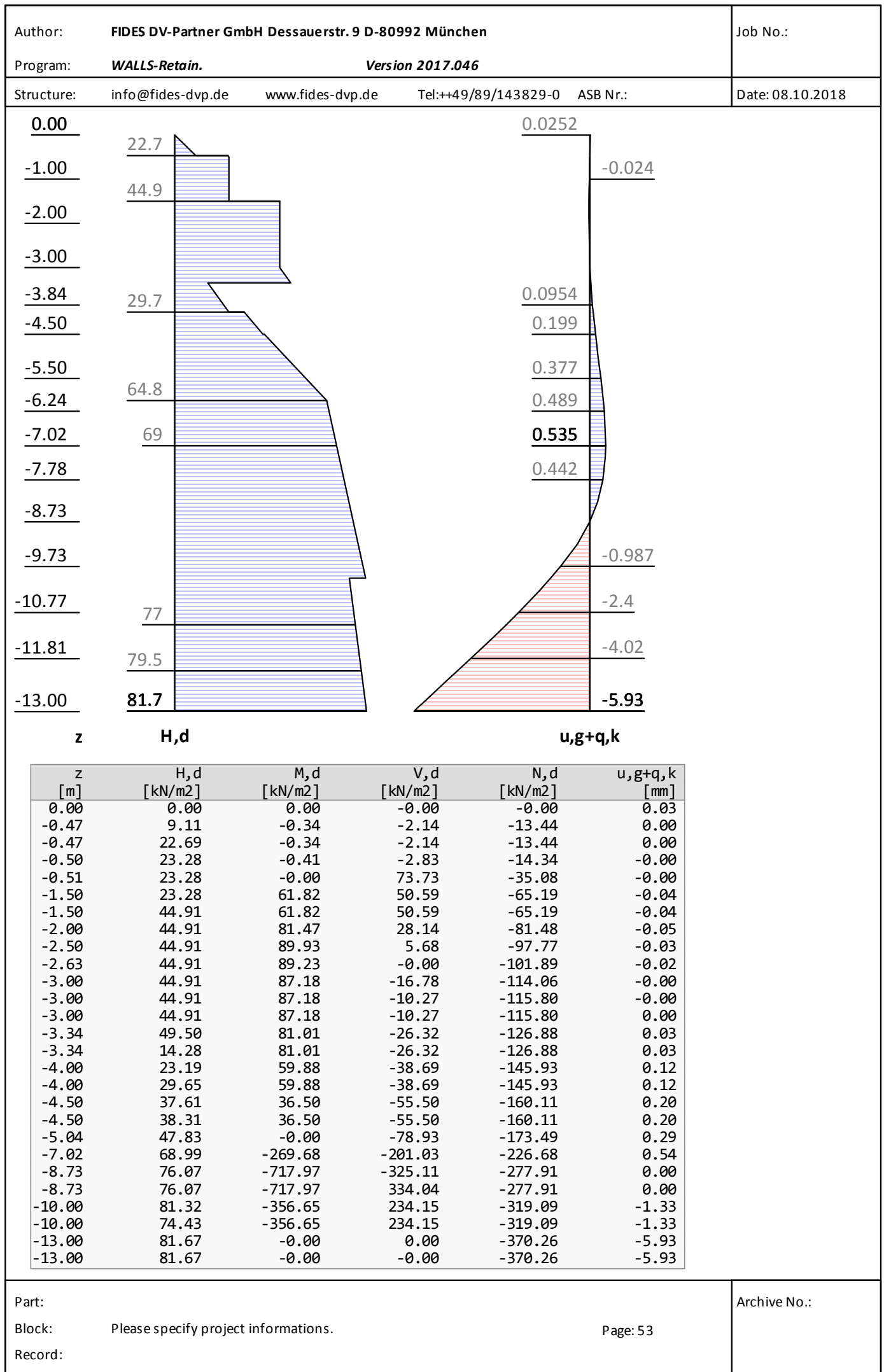
**Internal forces: Design**

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

**0.00**



**Anchor forces with safety level of DS-P**

z[m]	A,d[kN]	F <sub>x,d</sub> [kN/m]
-0.50	142.9	-76.7
-3.00	6.1	-6.5

**Checks of earth statics****Check of earth support**

Check: Mobilizable earth resistance is sufficient for earth support force.

z: -8.73 m

$R_d = E_{ph,k}/\gamma_{Re} = 3582.08 / 1.400 = 2558.63 \text{ [kN/m]}$

$E_d(U_{h,d})/R_d = 659.15 / 2558.63 = 0.258 \text{ [-]}. \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-8.73	-489.05	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * tan( $\delta,p=-22.00^\circ$ )		-197.59
$\Sigma$	-0.00	54.65 (downwards)

Average anchor inclination  $\alpha,A = 15.00^\circ \geq 15^\circ$ .

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.

$V_k \geq B_{vk}: 252.24 \geq 197.59 \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-8.73	-489.05	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * tan( $\delta,p=-22.00^\circ$ )		-197.59
B <sub>h,q,k</sub> z=-8.73	0.71	
B <sub>v,q,k</sub> = B <sub>h,k</sub> * tan( $\delta,p=-22.00^\circ$ )		0.29
$\Sigma$	-0.00	74.76 (downwards)

Average anchor inclination  $\alpha,A = 15.00^\circ \geq 15^\circ$ .

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.

$V_k \geq B_{vk}: 272.06 \geq 197.30 \text{ Passes requirement}$

**Anchor verification**



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Program: <b>WALLS-Retain.</b>				Version <b>2017.046</b>	
Structure: info@fides-dvp.de    www.fides-dvp.de    Tel:++49/89/143829-0    ASB Nr.:				Date: 08.10.2018	

### 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°

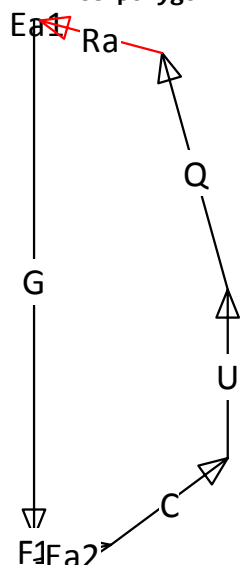
**Loads / forces (char.)**

		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	

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**Force polygon**

Acting anchor forces  $E_d: \sum(A,d) = 81.0 \text{ kN/m}$   
 Possible anchor forces  $R_d: R_{a\_cal,d} = 300.0/1.400 = 214.3 \text{ kN/m}$   
 Verif. of lower failure plane  $E_d/R_d = 0.38 < 1.0$ : Έλεγχος εκπληρώθηκε.

**Check of steel tension**

$l_{tot}$  ...[m]: Total length of anchor incl. excess length at head

$A_s$  ....[mm<sup>2</sup>]: X-section area of steel member

$R_{i,d}$  ...[kN]: Ultimate strength of tension member ( $\gamma, M=1.15$ )

$A_{d,d}$  ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	$l_{tot}$	$A_s$	$R_{i,d}$	$A_{d,d}$
-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**

$l_{vk}$  .....: Length of grout body

$D_{m,vk}$  .....: Diameter of grout body

$\tau_{Gr,k}$  ....: Average applied skin friction along the grout body (from soil parameters)

$R_{a,k}$  ....: Charact. pullout resistance of the anchor

$\gamma_A$  .....: Partial safety factor of anchor pullout

$R_{a,d}$  .....: =  $R_{a,k} / \gamma_A$

$A_{d,d}$  .....: Dimensioning force of the anchor from wall analysis

z	$l_{vk}$	$D_{m,vk}$	$\tau_{Gr,k}$	$R_{a,k}$	$\gamma_A$	$R_{a,d}$	$A_{d,d}$	$A_{d,d}/R_{a,d}$
[m]	[m]	[mm]	[kN/m <sup>2</sup> ]	[kN]	[-]	[kN]	[kN]	[-]
-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  $R \cdot \sin(\phi)$ .

The automatic slip circle optimization only considers circles that intersect the surface with an area of at least 0.25 m<sup>2</sup>.

The slip circle calculation only accepts circles including the wall.

The slipcircle calculation only allows circular failure planes (no vertical tangents will occur).

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Program:

WALLS-Retain.

Structure:

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Job No.:

Date: 08.10.2018

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	dxM	Weight	Load	Water-	u*b	φ	c	θ
	[m]	[m]	[m]	[kN/m]	z-κατ. [kN/m]	φορτ. [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.

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**Φάση εκσκαφής 5 "[5] Situation 5"**

LC: όλα τα φορτία Type: BS-T

**Εδαφικό σύστημα με 5 Στρώσεις**

Name	Τεχνητές επιχωματώσεις	Αμμόδης 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,θh	[-]	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	Αμμόδης	ΑΡΓΙΛΟΣ	Αργιλώδη	ΧΑΛΙΚΙΑ-	ΑΜΜΟΣ
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,θh	[-]	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 Αμμόδης 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 Αμμόδης ΑΡΓΙΛΟΣ:

z= -10.00

Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>	Job No.:
Program: <b>WALLS-Retain. Version 2017.046</b>	
Structure: info@fides-dvp.de    www.fides-dvp.de    Tel:++49/89/143829-0    ASB Nr.:	Date: 08.10.2018

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

**Επιφ. φορτία:**

**Φορτία**

xA	zA	xE	zE	PxA	PzA	PxE	PzE	Typ	LC-description
[m]	[m]	[m]	[m]	[	kN/m²		]		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: 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 redistrib. to: Excavation level  
 The earth pressure below the excavation acts without redistrib.  
 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**

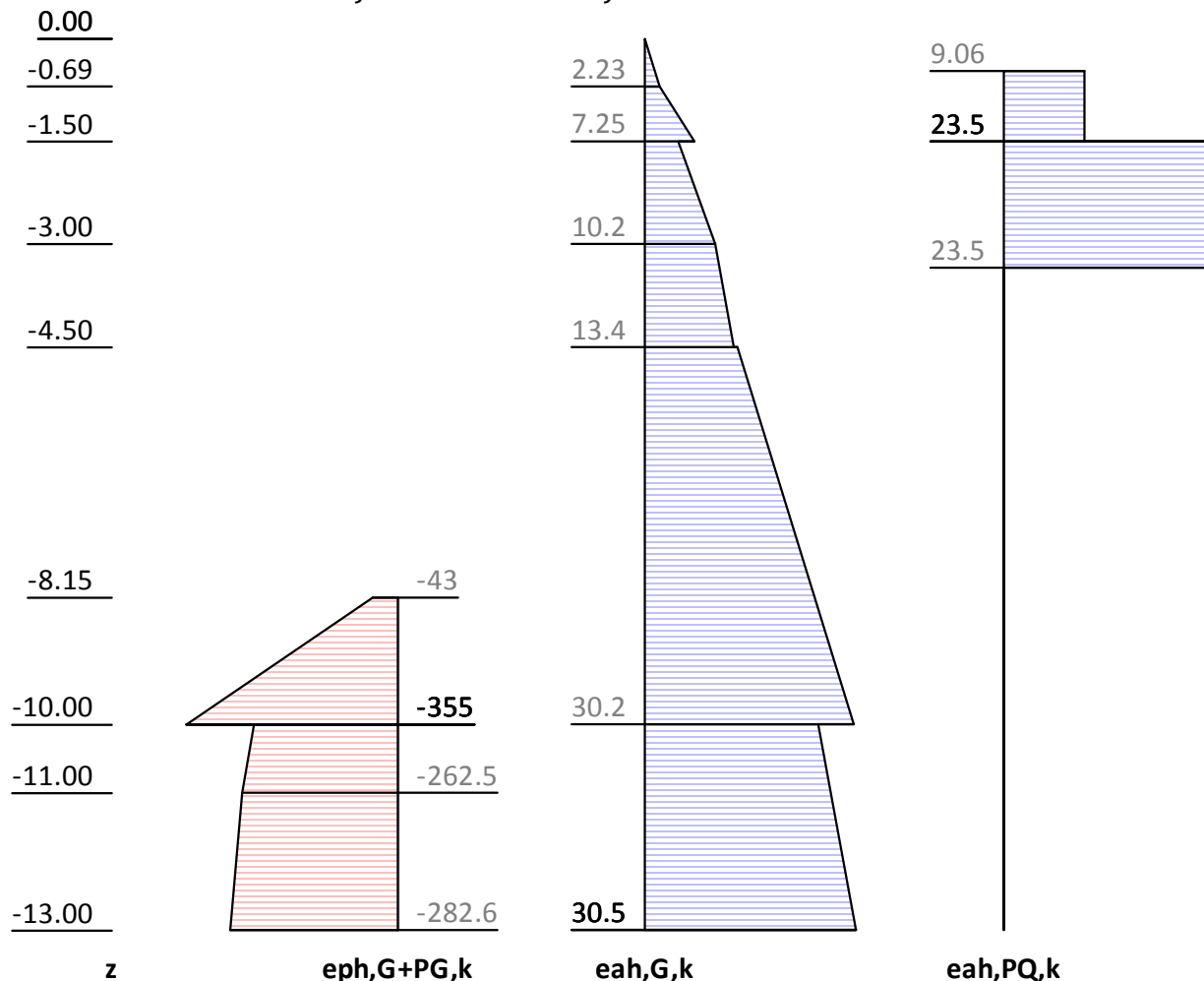
φ	α	β	δ	k0gh	kagh	kach	kpgh	kpch	
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	Αμμώδης ΑΡΓΙΛΟΣ
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ
33.0	0.0	0.0	22.0	--	0.245	0.855	--	--	"
0.1	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	--	--	"

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**Μήκος τοίχου**Foot depth for statics:  $z_f = -13.000$ **Stress analysis****Earth pressure, horizontal**

Pressures characteristic, no redistribution, continuous wall



$z$ [m]	$eph,G,k$ [kN/m <sup>2</sup> ]	$eah,G,k$ [kN/m <sup>2</sup> ]	$eah,PQ,k$ [kN/m <sup>2</sup> ]	$eah,d$ [kN/m <sup>2</sup> ]
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]

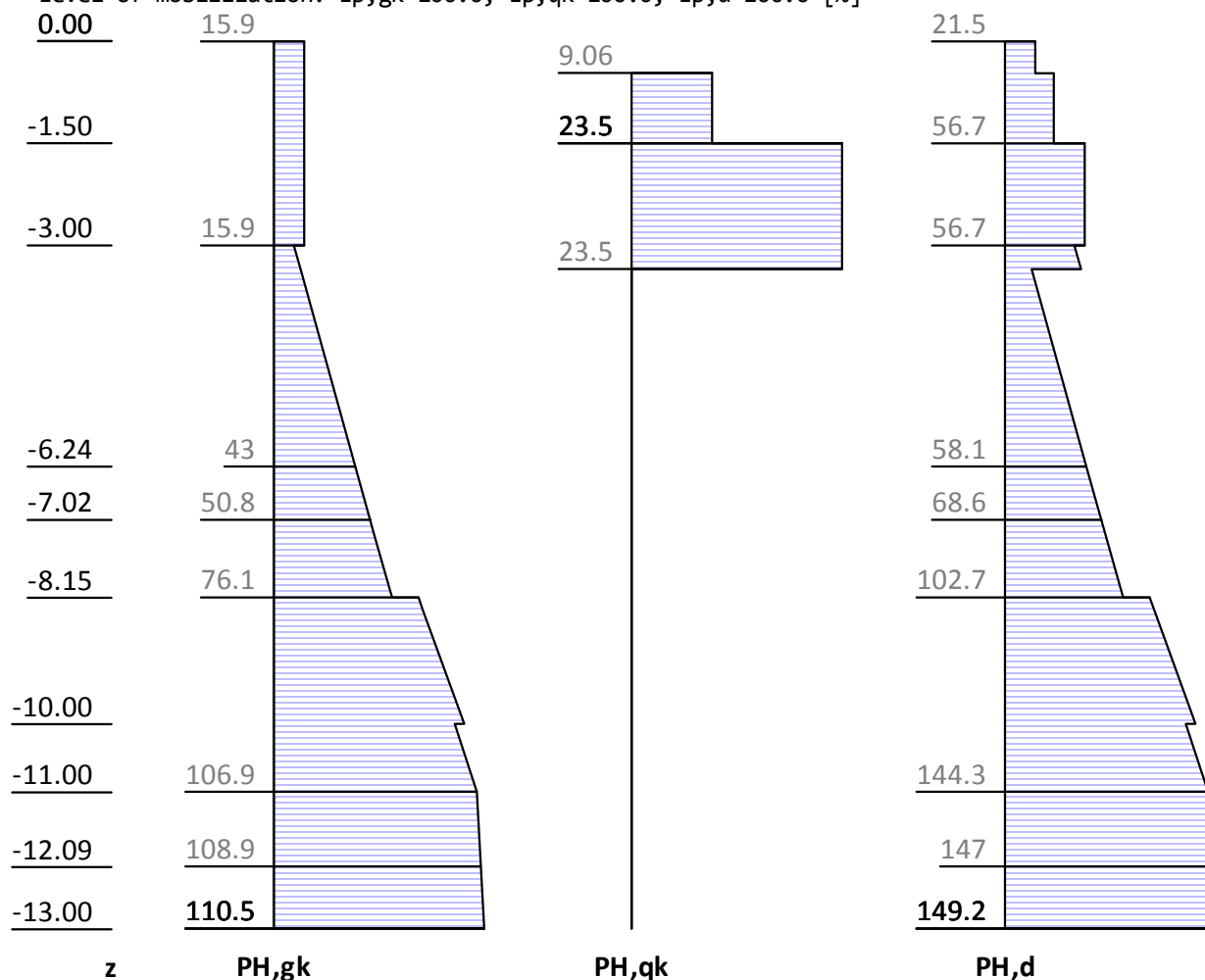
Eah,G,k: 236.52, Eah,PG,k: 0.00, Eah,PQ,k: 52.53, Eah,d: 398.10

## Πίεση νερού

z [m]	Wp,k [kN/m <sup>2</sup> ]	Wa,k [kN/m <sup>2</sup> ]	W,k [kN/m <sup>2</sup> ]
-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/m <sup>2</sup> ]	PH,qk [kN/m <sup>2</sup> ]	PH,d [kN/m <sup>2</sup> ]
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

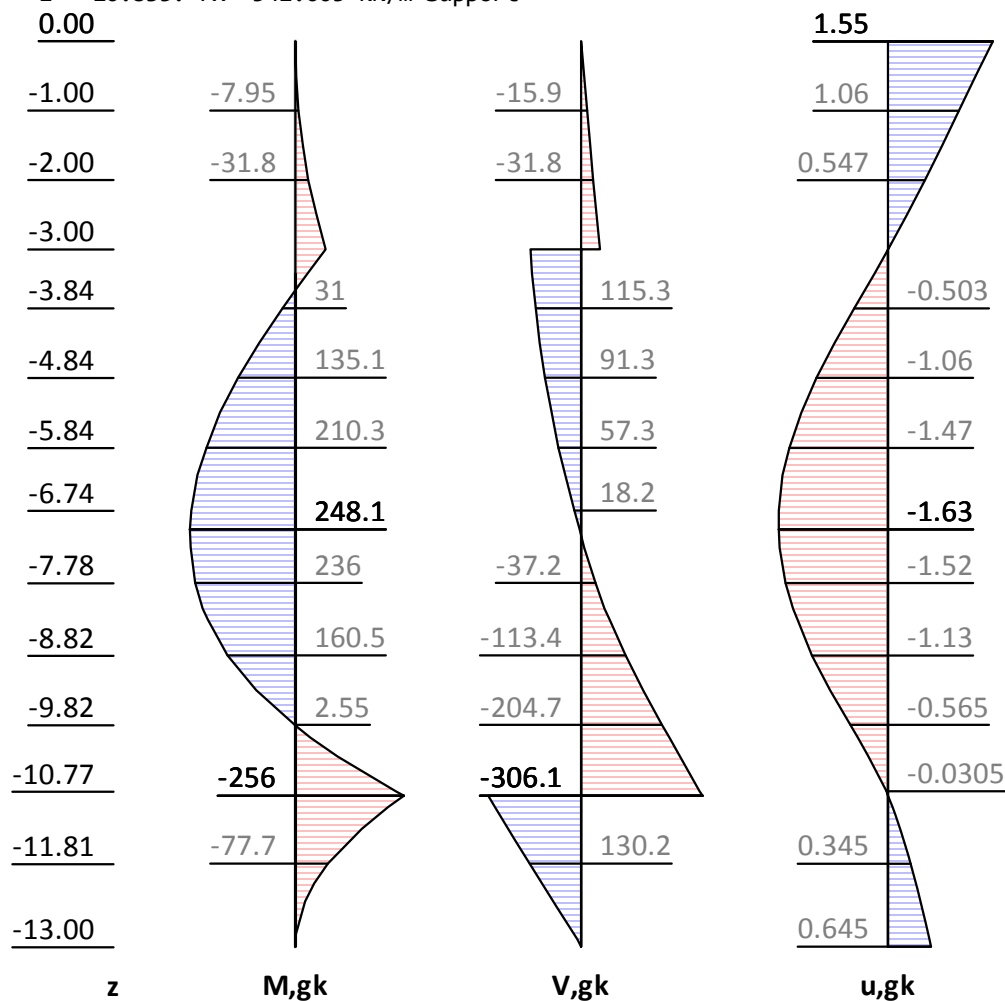
**V-pressure on static system****Internal forces: Permanent, characteristically**

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

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]
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



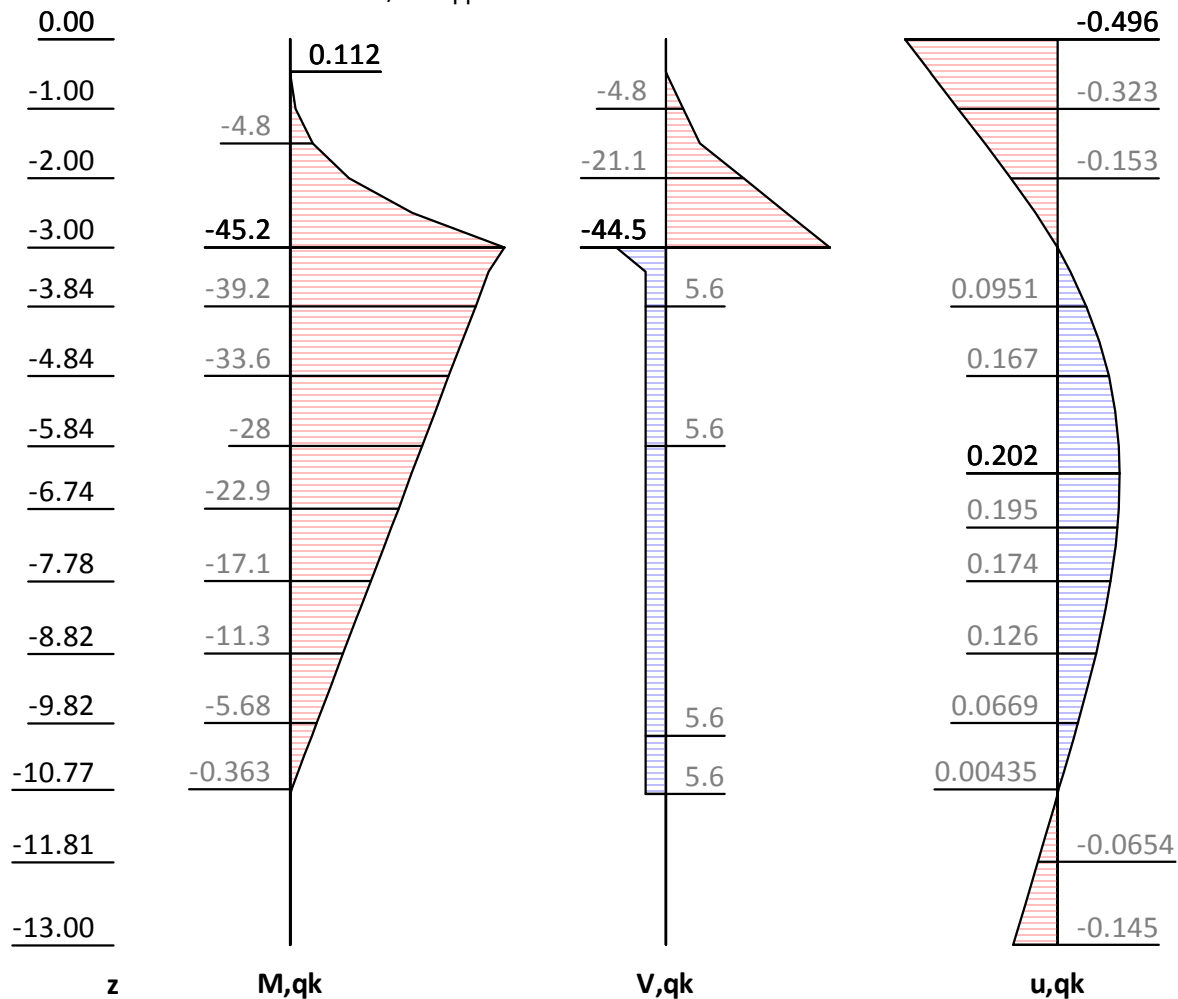
**Internal forces: Variable, characteristically**Method EB 82-4 ( $Q = [G+Q] - G$ ).

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

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]
0.00		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

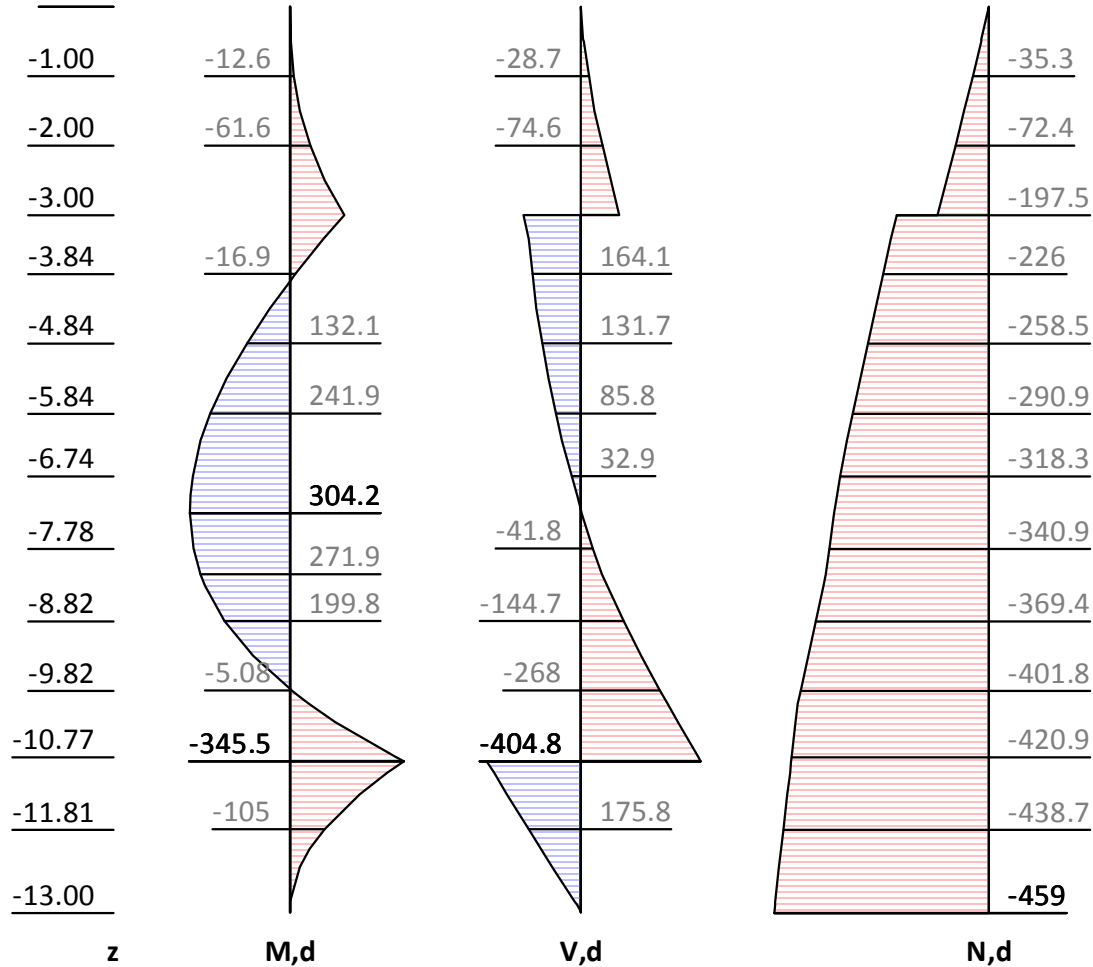
z [m]	H, q, k [kN/m <sup>2</sup> ]	M, q, k [kN/m <sup>2</sup> ]	V, q, k [kN/m <sup>2</sup> ]	N, q, k [kN/m <sup>2</sup> ]	u, q, k [mm]
-12.35	0.00	-0.00	0.00	-21.13	-0.10
-12.71	0.00	-0.00	0.00	-21.13	-0.13
-12.90	0.00	0.00	0.00	-21.13	-0.14
-12.94	0.00	-0.00	-0.00	-21.13	-0.14
-13.00	0.00	-0.00	-0.00	-21.13	-0.15

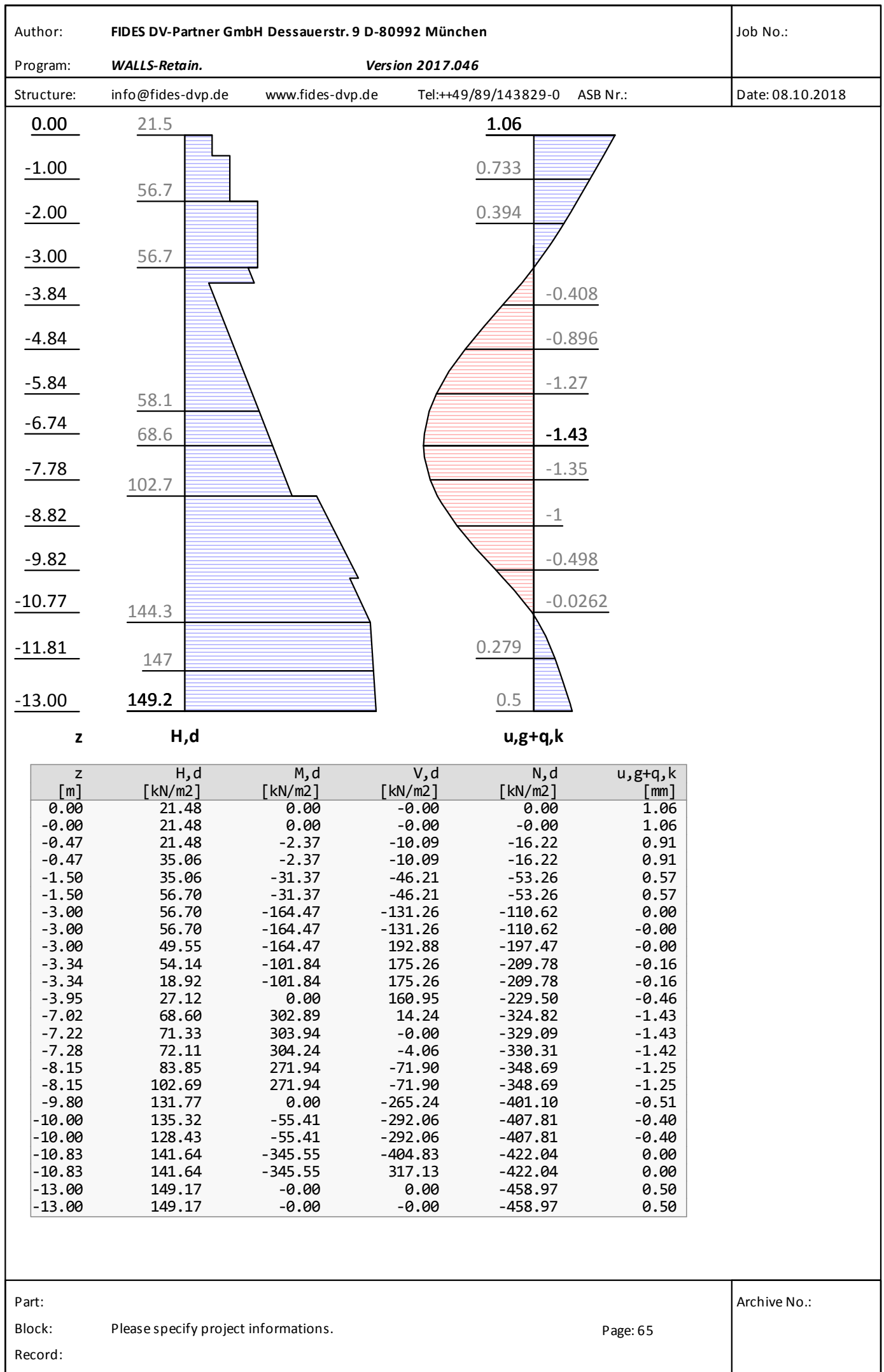
**Internal forces: Design**

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

**0.00**



**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 of 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**

Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>					Job No.:	
Program: <b>WALLS-Retain. Version 2017.046</b>						
Structure: info@fides-dvp.de    www.fides-dvp.de    Tel:++49/89/143829-0    ASB Nr.:					Date: 08.10.2018	

### 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	θ1	θ2	lA	W,k	Q,k	Ea1,k	Ea2,k	Ra_cal,d	Sum(A,d)	Ed/Rd
[m]	[°]	[°]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]
-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°

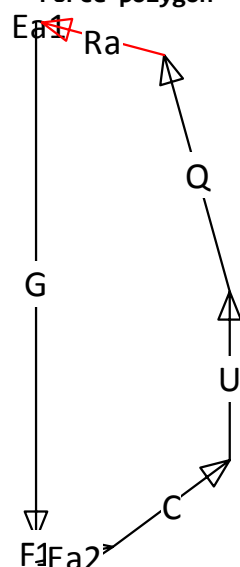
**Loads / forces (char.)**

		Fx	Fz	F	
		[kN/m]	[kN/m]	[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	

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**Force polygon**

Acting anchor forces  $E_d: \sum(A,d) = 335.6 \text{ kN/m}$   
 Possible anchor forces  $R_d: R_{a\_cal,d} = 470.1/1.400 = 335.8 \text{ kN/m}$   
 Verif. of lower failure plane  $E_d/R_d = 1.00 < 1.0$ : Έλεγχος εκπληρώθηκε.

**Check of steel tension**

$l_{tot}$  ...[m]: Total length of anchor incl. excess length at head  
 $A_s$  ....[mm<sup>2</sup>]: X-section area of steel member  
 $R_{i,d}$  ...[kN]: Ultimate strength of tension member ( $\gamma, M=1.15$ )  
 $A_{d,d}$  ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	$l_{tot}$	$A_s$	$R_{i,d}$	$A_{d,d}$
-0.50	Strand;3x0.60";1570/1770	15.87	420	573.4	0.0
-3.00	Strand;3x0.60";1570/1770	14.27	420	573.4	302.0

Check of steel tension: Passes requirement

**Check of anchor's soil friction**

$l_{vk}$  .....: Length of grout body  
 $D_{m,vk}$  .....: Diameter of grout body  
 $\tau_{Gr,k}$  ....: Average applied skin friction along the grout body (from soil parameters)  
 $R_{a,k}$  ....: Charact. pullout resistance of the anchor  
 $\gamma_A$  .....: Partial safety factor of anchor pullout  
 $R_{a,d}$  .....: =  $R_{a,k} / \gamma_A$   
 $A_{d,d}$  .....: Dimensioning force of the anchor from wall analysis

z	$l_{vk}$	$D_{m,vk}$	$\tau_{Gr,k}$	$R_{a,k}$	$\gamma_A$	$R_{a,d}$	$A_{d,d}$	$A_{d,d}/R_{a,d}$
[m]	[m]	[mm]	[kN/m <sup>2</sup> ]	[kN]	[-]	[kN]	[kN]	[-]
-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  $R \cdot \sin(\phi)$ .  
 The automatic slip circle optimization only considers circles that intersect the surface with an area of at least 0.25 m<sup>2</sup>.  
 The slip circle calculation only accepts circles including the wall.  
 The slipcircle calculation only allows circular failure planes (no vertical tangents will occur).

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	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/m <sup>2</sup> ]	[°]
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	$G \cdot \sin(\theta)$	$(G \cdot u^*b)^* \tan(\varphi) + c^*b$	$\mu^* \sin(\theta)^* \tan(\varphi) + \cos(\theta)$	T
	[kN/m]	[kN/m]	[kN/m]	[-]	[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  $E_d = (1015.8 \cdot 14.25 - 132.8)$

Αντίσταση  $R_d = (1877.9 \cdot 14.25 + 77.3)$

SLIP-CIRCLE  $\mu = Ed/Rd = 0.53 < 1.0$ : Έλεγχος εκπληρώθηκε.

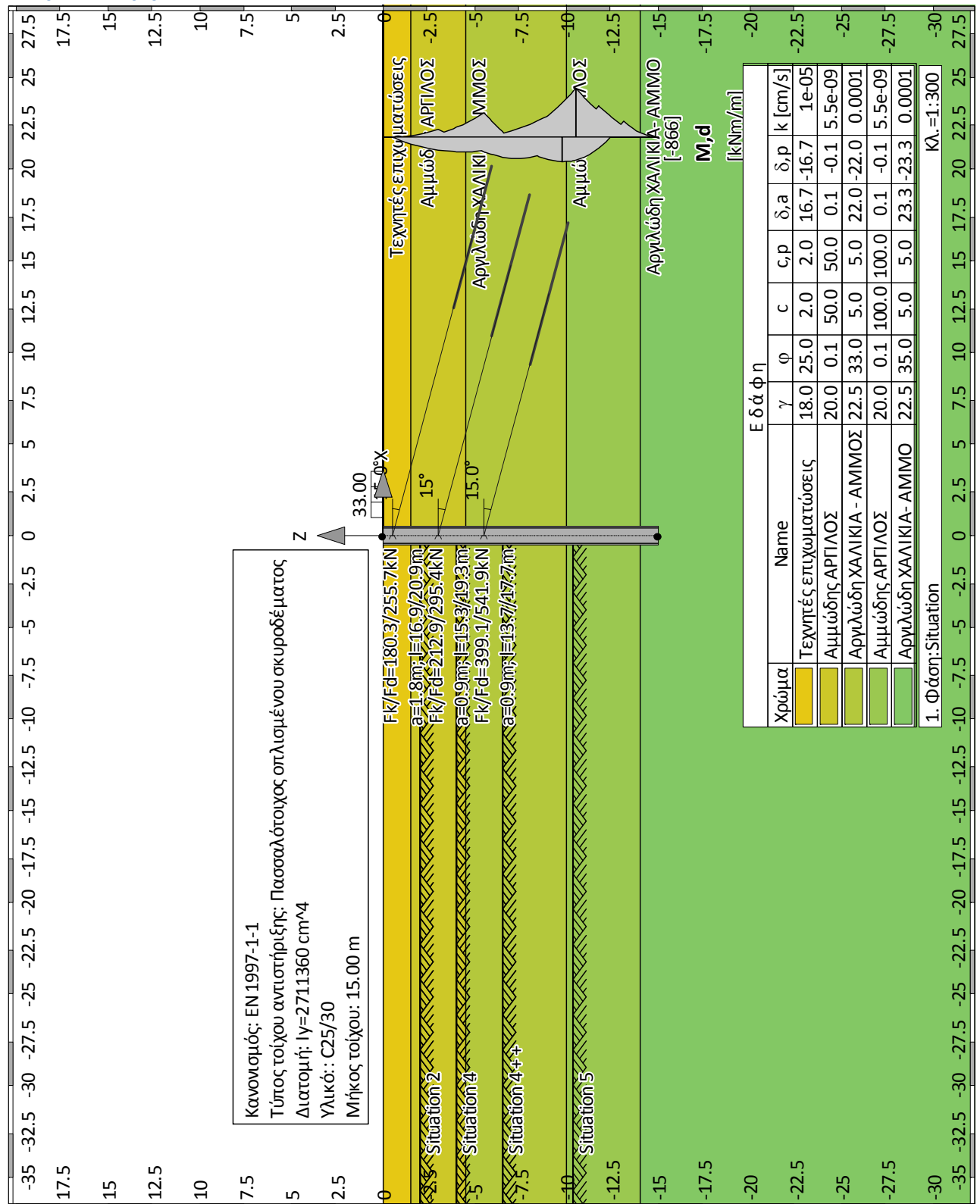
## ΠΑΡΑΡΤΗΜΑ

### 8.5 Αποτελέσματα ανάλυσης

#### 8.5.1 Στατικές Συνθήκες

- i) Αντιστηριζόμενο ύψος 9,70m



**Summary of all stages****Φάση εκσκαφής 0 "Situation"**

**Τμήμα εδαφ. ωθήσεων:** Ενεργές ωθήσεις  
**Παθητικές ωθήσεις:** Κλασικός, Pregl/Sokolovsky (DIN 4085)  
Υπολογισμένο βάθος πόδα Zf = -4.97 m, Μήκος ακύρωσης 2.97 m  
Μήκος τοίχου: 4.97 m  
Slip circle: M=(-1.72, 0.34) R=5.59 Ed/Rd=0.39

Χρώμα	Name	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
	Αμμόβηλος ΑΡΓΙΛΟΣ	20.0	0.1	50.0	50.0	0.1	-0.1	5.5e-09
	Αργιλώδη χαλίκια - ΑΜΜΟΣ	22.5	33.0	5.0	5.0	22.0	-22.0	0.0001
	Αμμόβηλος ΑΡΓΙΛΟΣ	20.0	0.1	100.0	100.0	0.1	-0.1	5.5e-09
	Αργιλώδη χαλίκια - ΑΜΜΟ	22.5	35.0	5.0	5.0	23.3	-23.3	0.0001

2. Φάση: Situation 1 LC: όλα τα φορτία Type: BS-T

Τμήμα εδαφ. ωθήσεων: Ενεργές ωθήσεις  
 Παθητικές ωθήσεις: Κλασικός, Pregel/Sokolovsky (DIN 4085)  
 Προκαθορισμένο βάθος πόδα  $Z_f = -15.00$  m, Μήκος αγκύρωσης 13.00 m  
 Μήκος τοίχου: 15.00 m  
 Anchor / stiffener forces are LC DS-P per anchor  
 Slip circle:  $M = (-3.91, 2.97)$  R=18.40 Ed/Rd=0.11  
 Anchor checks pass requirement

$F_k/F_d = 101.7/149.3$  kN  
 $a = 1.8$  m,  $l = 9.4/13.4$  m

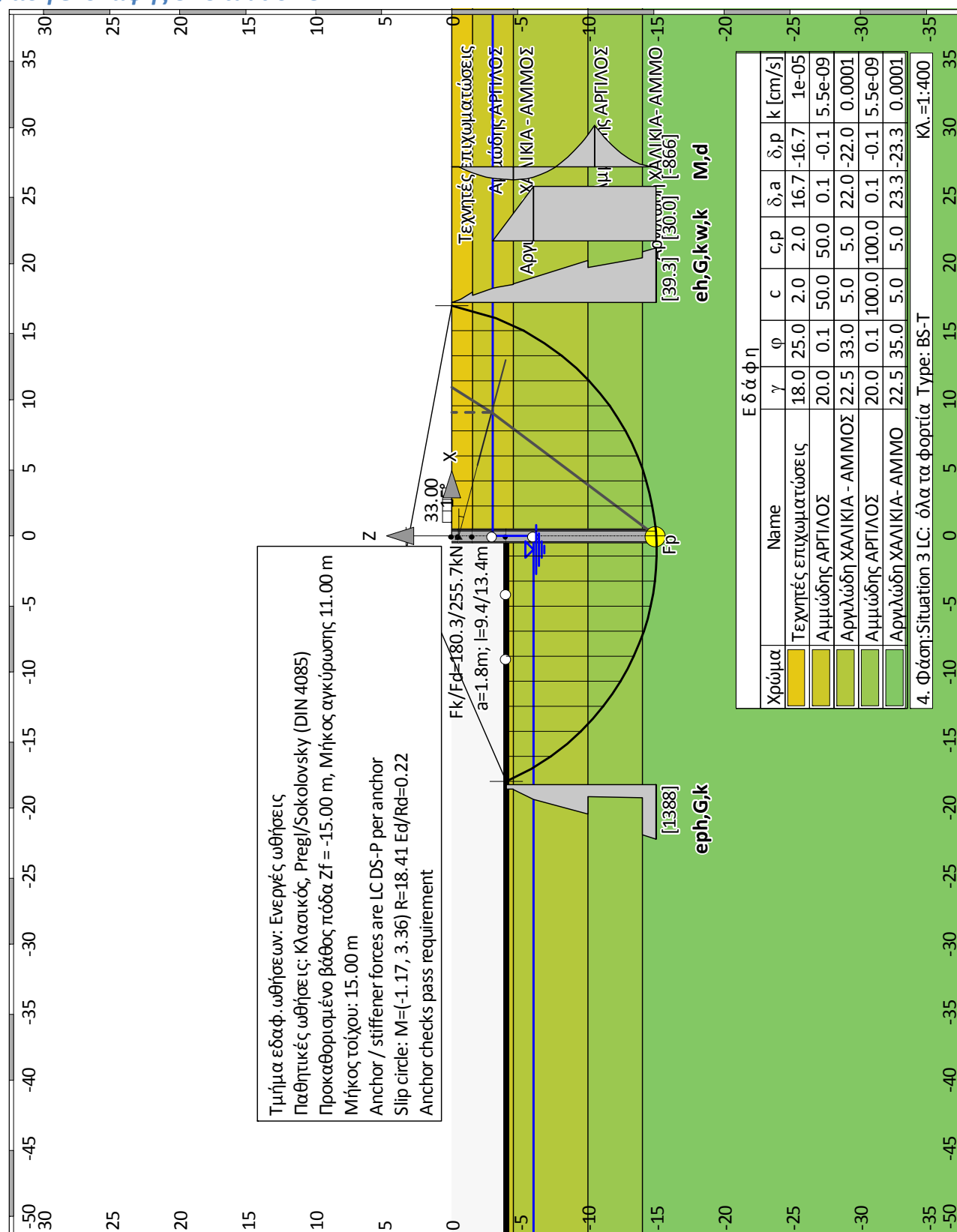
$[1480]$   
 $e_{ph}, G, k$   
 $[kN/m^2]$   
 $\Sigma H = 6121$   
 $\Sigma M = 30779$

Ε δ α φ η

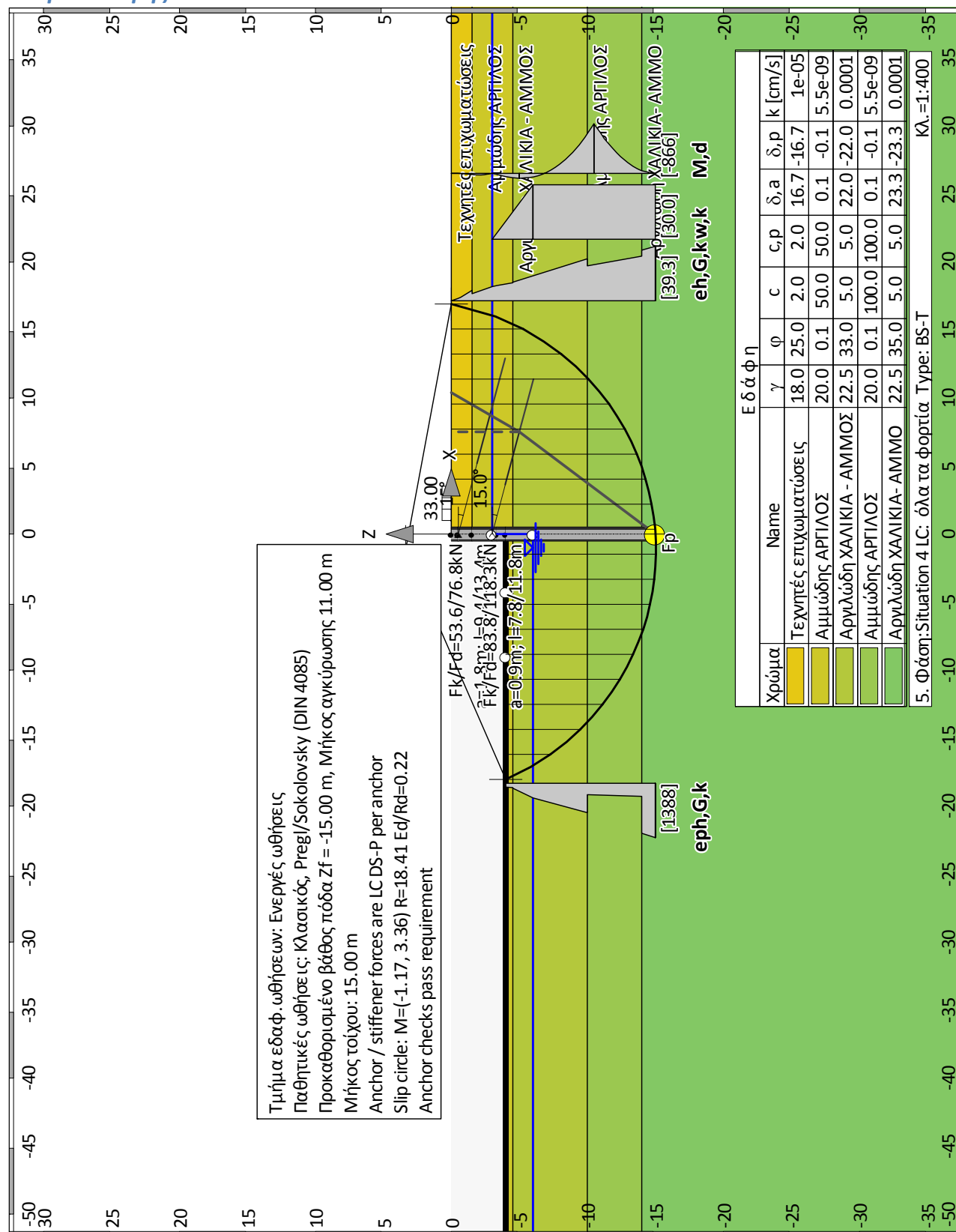
Χρώμα	Name	$\gamma$	$\varphi$	$c$	$c, p$	$\delta, a$	$\delta, p$	$k$	$k [cm/s]$
	Τεχνητές επιχωματώσεις	18.0	25.0	2.0	2.0	16.7	-16.7	1e-05	
	Αμιμώδης ΑΡΓΙΛΟΣ	20.0	0.1	50.0	50.0	0.1	-0.1	5.5e-09	
	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ	22.5	33.0	5.0	5.0	22.0	-22.0	0.0001	
	Αμιμώδης ΑΡΓΙΛΟΣ	20.0	0.1	100.0	100.0	0.1	-0.1	5.5e-09	
	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ	22.5	35.0	5.0	5.0	23.3	-23.3	0.0001	

3. Φάση: Situation 2 LC: όλα τα φορτία Type: BS-T  $\kappa_L = 1:250$

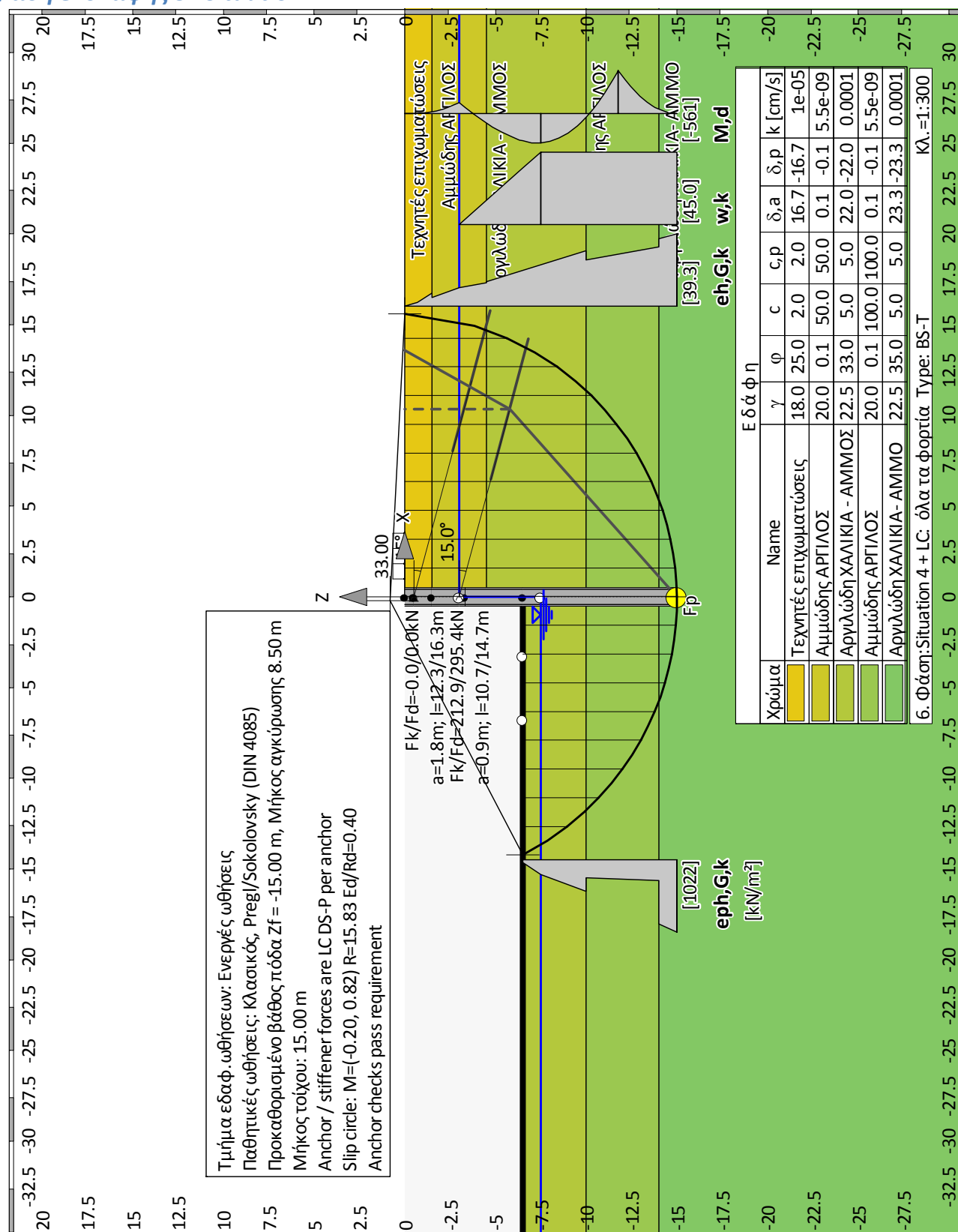
### Φάση εκσκαφής 3 "Situation 3"



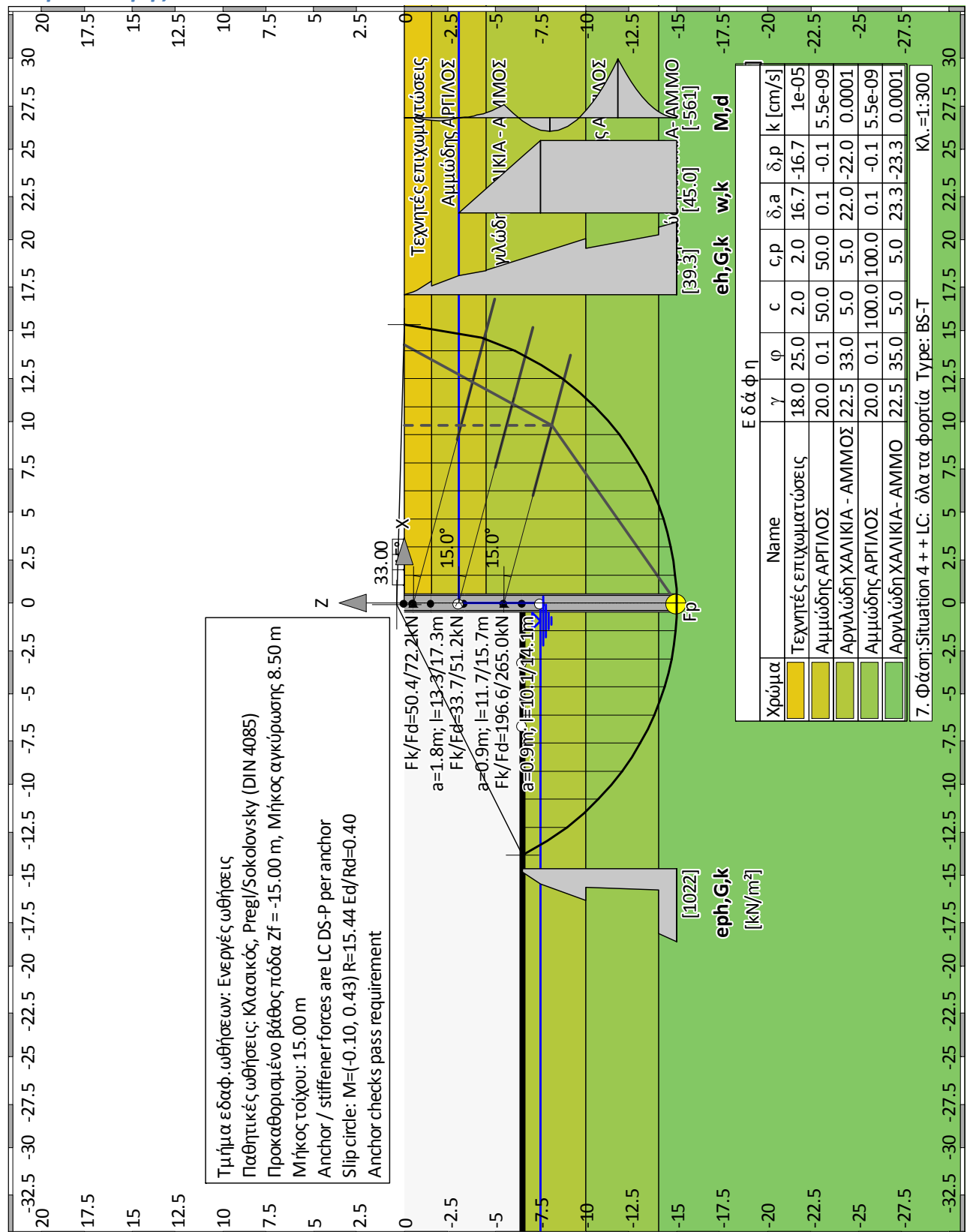
## Φάση εκσκαφής 4 "Situation 4"



### Φάση εκσκαφής 5 "Situation 4 +"

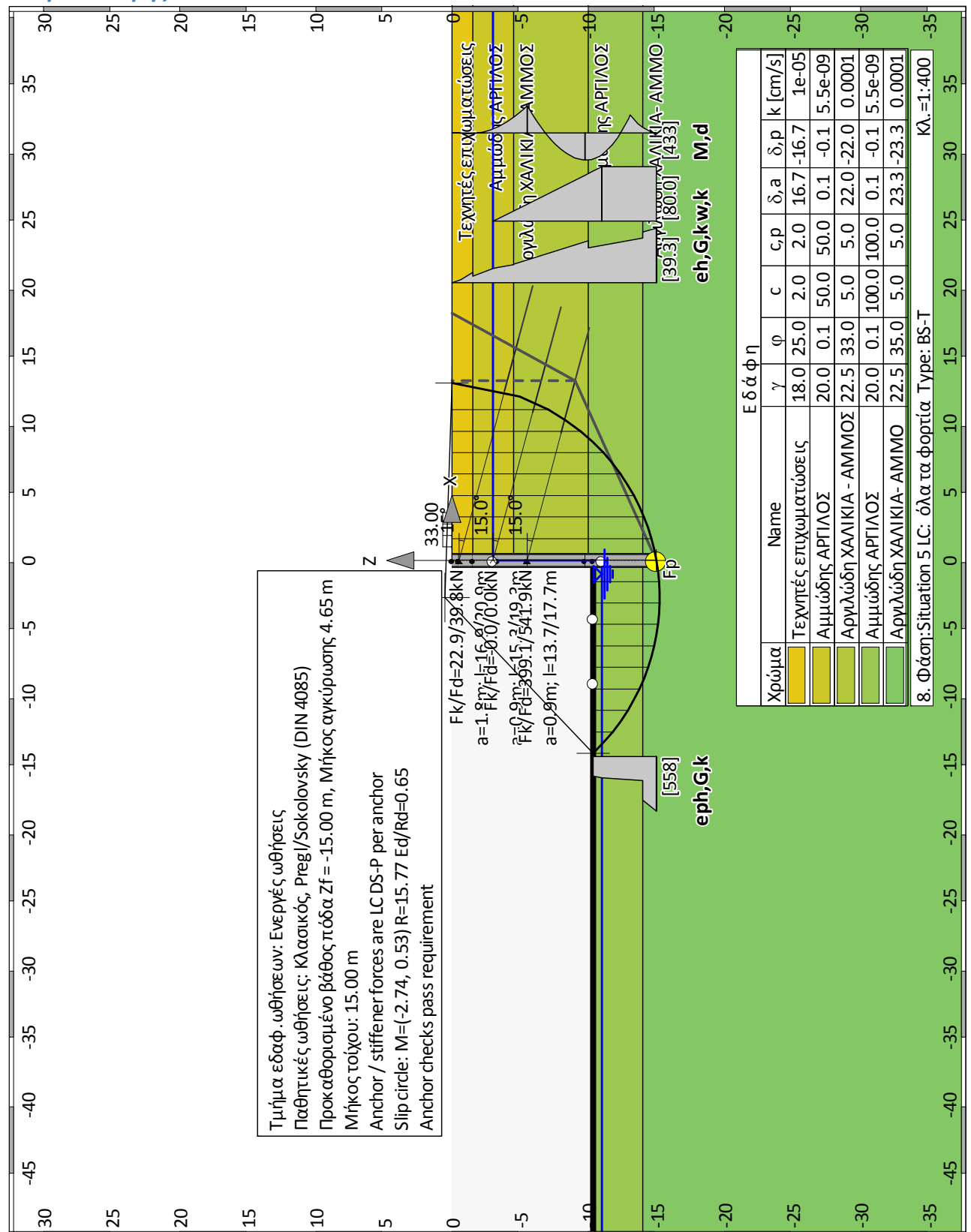


## Φάση εκσκαφής 6 "Situation 4 + +"





## Φάση εκσκαφής 7 "Situation 5"





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Program: <b>WALLS-Retain. Version 2017.046</b>									
Structure: info@fides-dvp.de    www.fides-dvp.de    Tel:++49/89/143829-0    ASB Nr.:								Date: 08.10.2018	

### Κανονισμός για 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					

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

**Κύκλος ολίσθησης: [GEO] A2 M2 R3**

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

**Hydraulic heave: [HYD] A1 M1 R1**

$\gamma$ -	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**

$\gamma$ -	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**

$\gamma$ -	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

$\gamma_{Re,red}$  (EAB EB14-3):  $N_{ai}$ ,  $\eta=0.80$   
 $\gamma_{Re,red}$  (EAB EB22-6):  $N_{ai}$ ,  $E0h > 0\%$ :  $\eta = 0.60 / 0.80$

**System values**

**Τοίχος**

Τύπος τοίχου αντιστήριξης: Πασσαλότοιχος οπλισμένου σκυροδέματος  
 Διατομή:  $I_y=2711360 \text{ cm}^4$   
 Υλικό:: C25/30  
 Ίδιο βάρος:  $25.000 \text{ [kN/m}^3\text{]}$

**Σημεία τοίχου**

z [m]	d [m]	E [MN/m <sup>2</sup> ]	$I_y$ [cm <sup>4</sup> /m]	$E \cdot I_y$ [MNm <sup>2</sup> ]	A [cm <sup>2</sup> /m]
0.00	100.0	31500.0	2711360	854.1	8400
-15.00	100.0	31500.0	2711360	854.1	8400

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### Φάση εκκαφής 1 "[1] Situation 1"

LC: όλα τα φορτία Type: BS-T

#### Εδαφικό σύστημα με 5 Στρώσεις

Name	Τεχνητές επιχωματώσεις	Αμμόδης	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,θh	[-]	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	Αμμόδης	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,θh	[-]	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 Αμμόδης ΑΡΓΙΛΟΣ:

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

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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	zA	xE	zE	PxA	PzA	PxE	PzE	Typ	LC-description
[m]	[m]	[m]	[m]	[	kN/m²		]		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:  $\varphi_{min} = 40.000$ .  
 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**

$\varphi$	$\alpha$	$\beta$	$\delta$	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	--	--	"

Part:		Archive No.:
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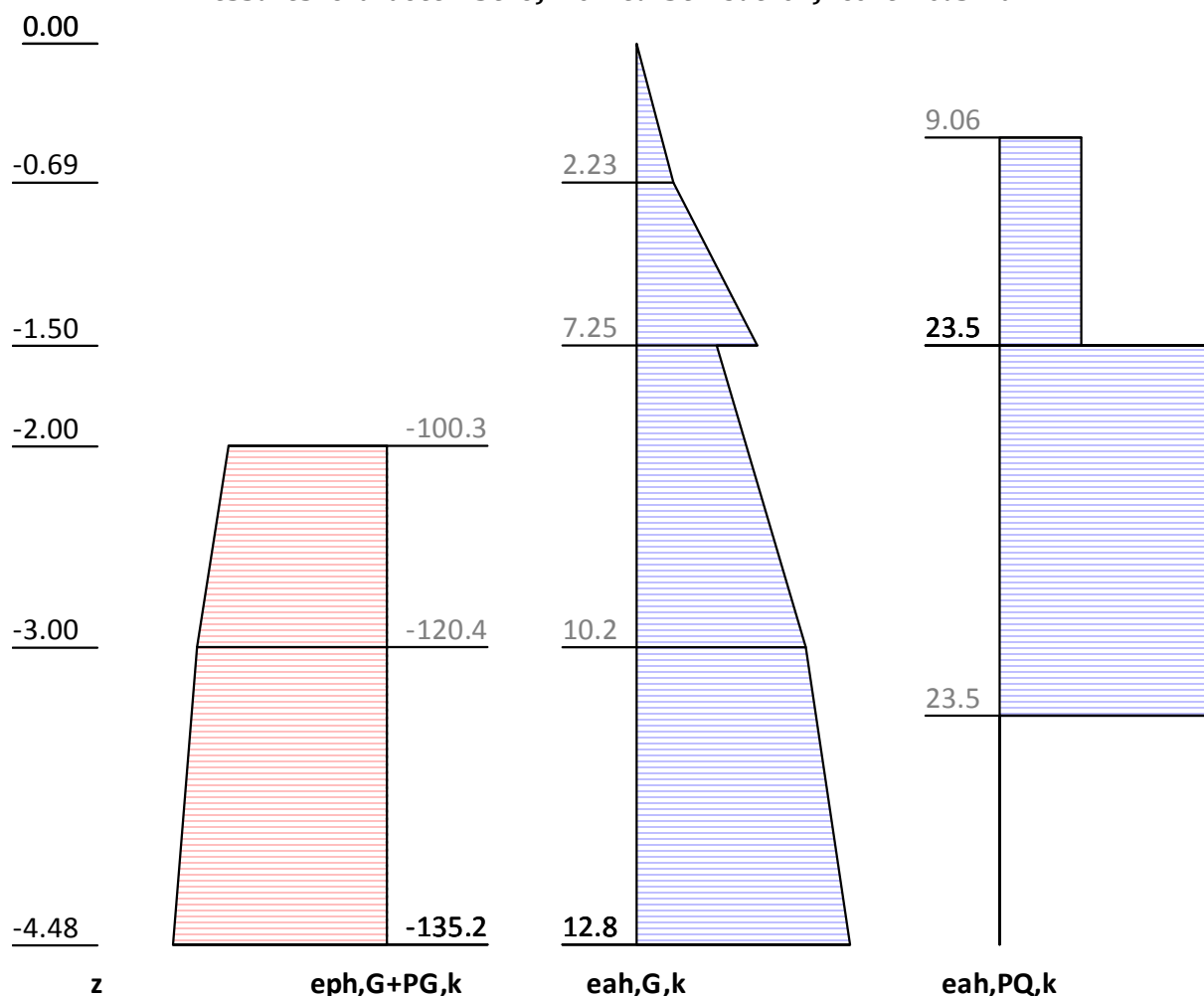
**Μήκος τοίχου**

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, continuous wall



z [m]	eph, G, k [kN/m <sup>2</sup> ]	eah, G, k [kN/m <sup>2</sup> ]	eah, PQ, k [kN/m <sup>2</sup> ]	eah, d [kN/m <sup>2</sup> ]
0.00		0.00		0.00

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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 <b>H-pressure on static system</b> Level of mobilization: Ep,gk 14.7, Ep,qk 34.4, Ep,d 100.0 [%]				
0.00				
-0.47				
-0.69	2.23		9.06	15.6
-1.50	7.25		23.5	41.7
-2.00	-8.12		23.5	44.1
-3.00	-7.5		-17.9	-37
-3.34			-42.6	-73.9
-3.76	-7.27			-75.9
-4.48	-7.04		-46.5	-79.3
z	PH,gk	PH,qk	PH,d	
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	

Author: FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München				Job No.:	
Program: WALLS-Retain. Version 2017.046					
Structure: info@fides-dvp.de		www.fides-dvp.de		Tel:++49/89/143829-0 ASB Nr.:	
				Date: 08.10.2018	

z	PH, gk	PH, qk	PH, d
[m]	[kN/m2]	[kN/m2]	[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

0.00

-0.50

-1.19

-1.50

-2.00

-2.50

-3.00

-3.50

-3.76

-4.26

-4.48

-0.0672

-0.975

-2.07

-5.05

-7.77

-8.54

-7.43

-6.12

-2.23

-0.402

-2.67

-4.59

-7.45

-3.47

0.36

4.07

5.97

9.57

11.1

-0.0611

-0.0504

-0.0358

-0.0294

-0.0197

-0.0114

-0.00531

-0.0017

-704.5e-06

-21.3e-06

z

M,gk

V,gk

u,gk

z	H, g, k	M, g, k	V, g, k	N, g, k	u, g, k
[m]	[kN/m2]	[kN/m2]	[kN/m2]	[kN/m2]	[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

Part:

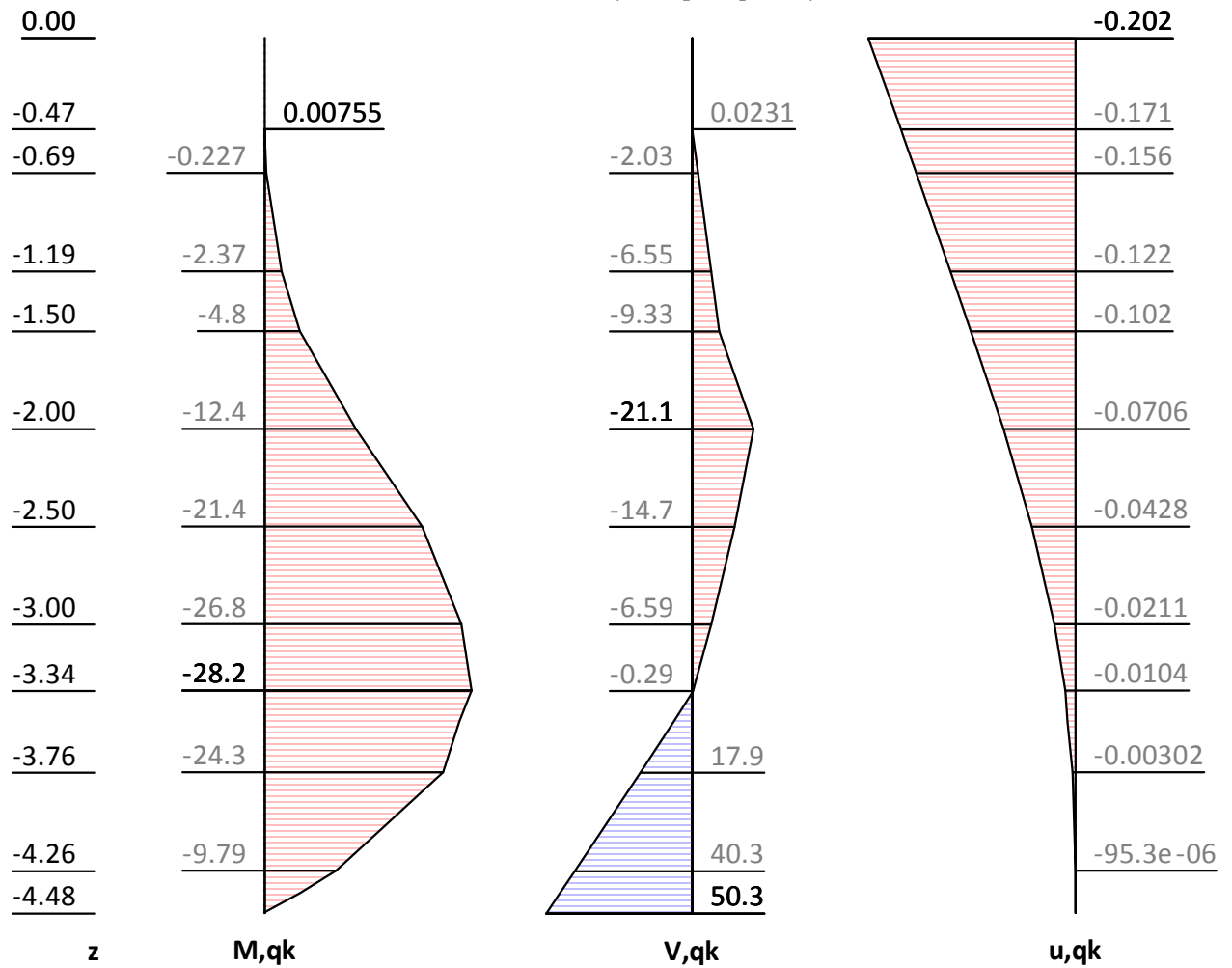
Block: Please specify project informations.

Record:

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Archive No.:

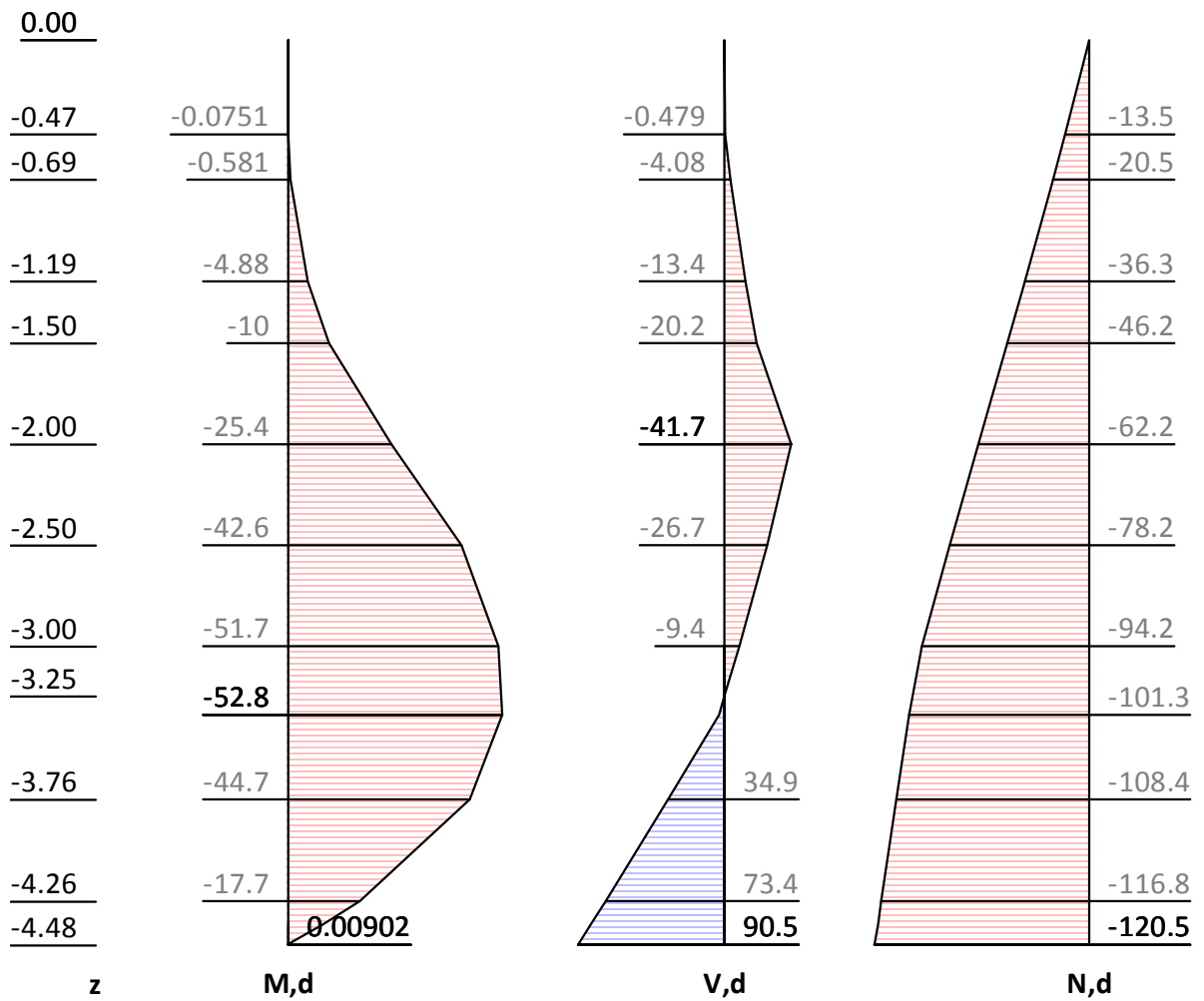
## Internal forces: Variable, characteristically

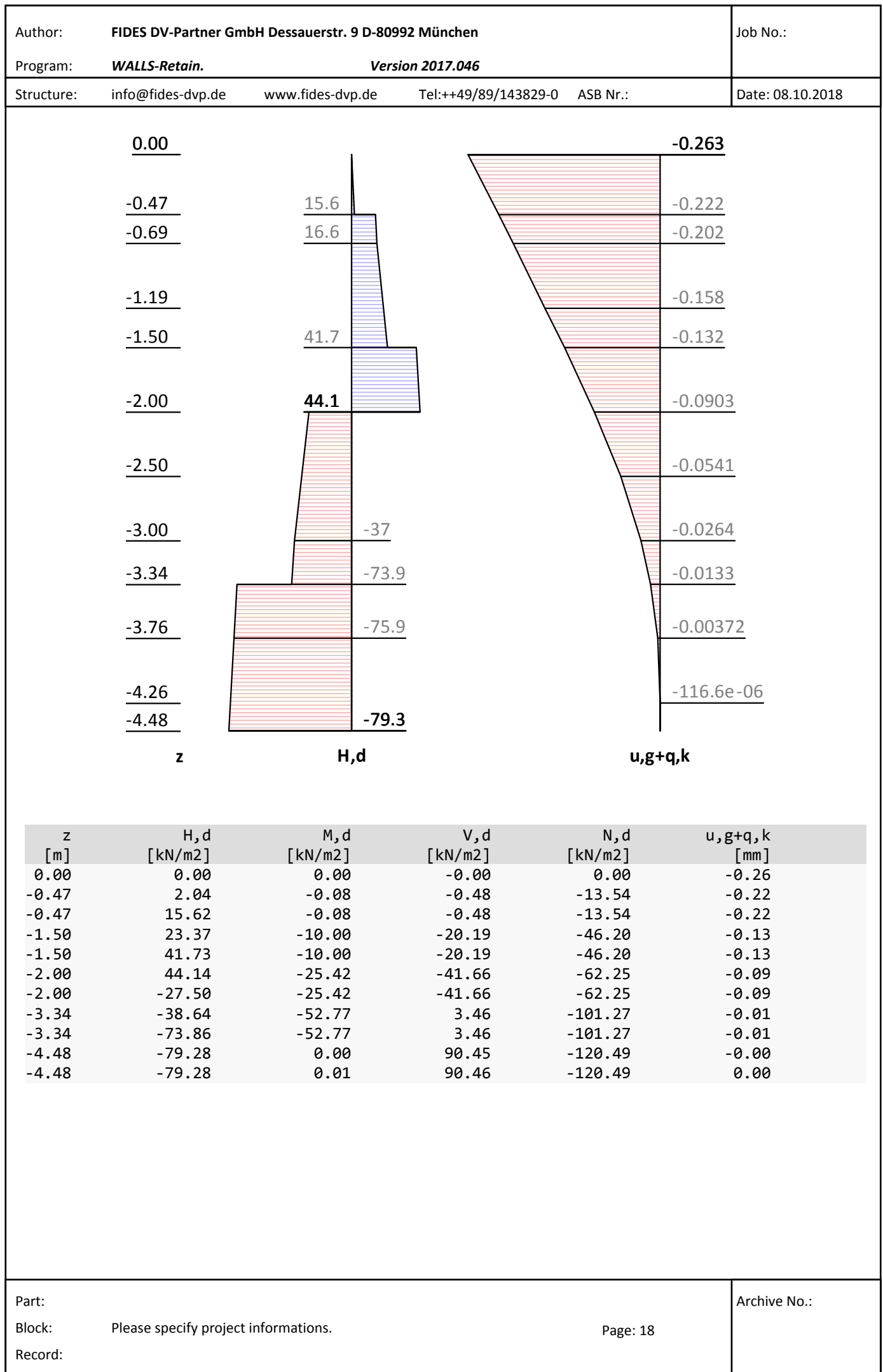
Method EB 82-4 ( $Q = [G+Q] - G$ ).

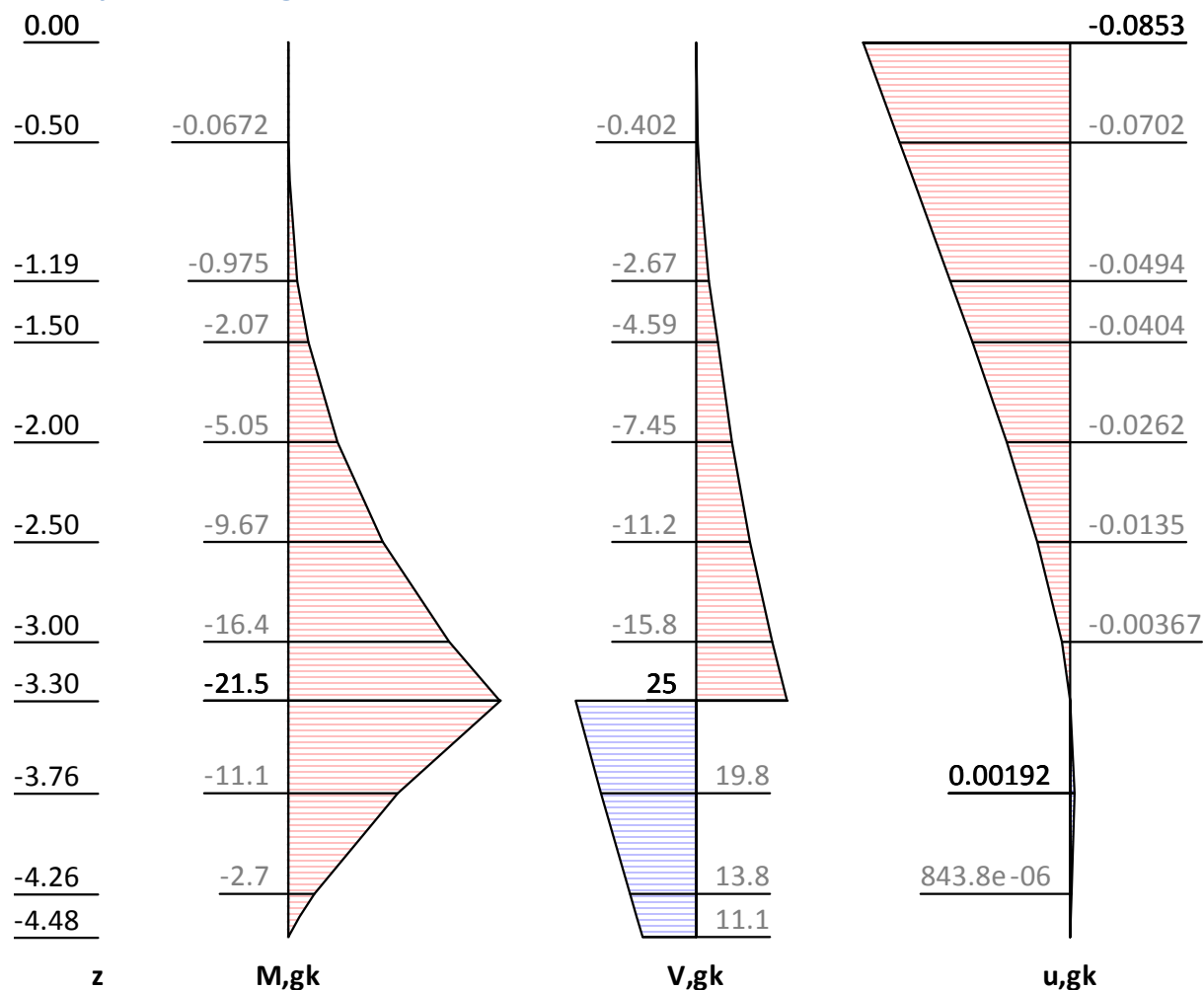
$z$ [m]	$H, q, k$ [kN/m²]	$M, q, k$ [kN/m²]	$V, q, k$ [kN/m²]	$N, q, k$ [kN/m²]	$u, q, k$ [mm]
0.00		0.00	0.00	0.00	-0.20
-0.47	0.00	0.01	0.02	0.01	-0.17
-0.47	9.06	0.01	0.02	0.01	-0.17
-0.48	9.06	-0.00	-0.05	0.00	-0.17
-1.50	9.06	-4.80	-9.33	-0.99	-0.10
-1.50	23.48	-4.80	-9.33	-0.99	-0.10
-2.00	23.48	-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



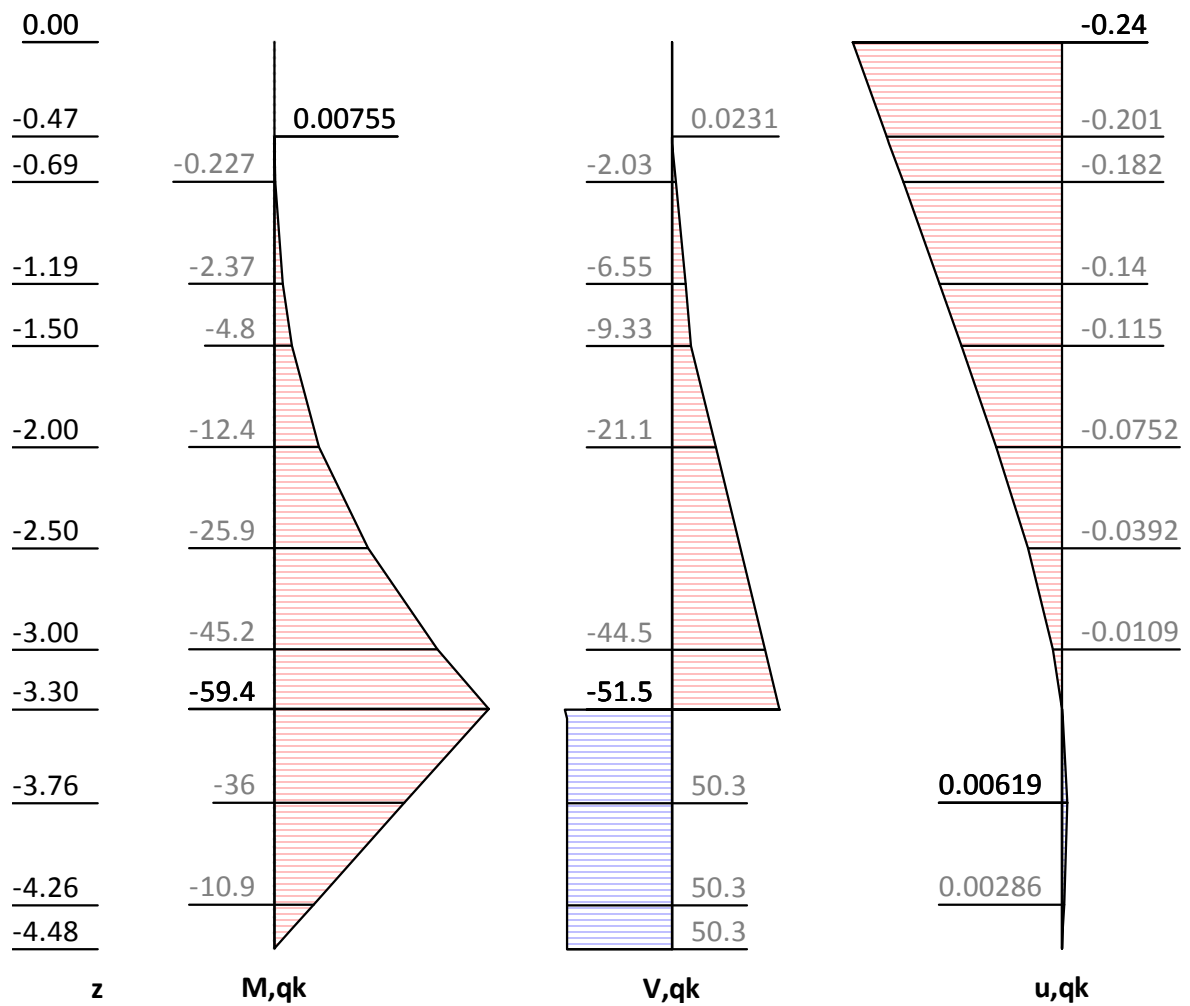
# Internal forces: Design





**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]

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			Date: 08.10.2018

**Check of C-force (foot support)**

$z(C) = -4.48 \text{ [kN/m]}$   
 $G, k = \sum(\gamma \cdot h) = 71.76 \text{ [kN/m]}$   
 $P, k = \sum(Pz, k(x= 0.1)) = 0.00 \text{ [kN/m]}$   
 $kpgh, C(\phi = 0.1; \delta, C = 0.0^\circ) = 1.002 \text{ [-]}$   
 $kpch, C = 2.003 \text{ [-]}$   
 $eph, C, gk = (G, k + P, k) \cdot kpgh, C + 2 \cdot c \cdot \sqrt{kpch, C} = 213.44 \text{ [kN/m}^2\text{]}$   
 $= (71.76 + 0.00) \cdot 1.002 + 2 \cdot 50.0 \cdot 1.415$   
 $Ed = Ch, d = 90.45 \text{ [kN/m}^2\text{]}$   
 $\delta, t, EAU = Ed / (2 \cdot eph, C, d) = 0.30 \text{ [m]}$   
 $\delta, t, EAB = 0.20 \cdot t = 0.50 \text{ [m]}$   
 $\delta, t = \delta, t, EAB = 0.50 \text{ [m]}$   
 $Rd = 2 \cdot \delta, t \cdot eph, C, gk / \gamma, Re$   
 $= 2 \cdot 0.50 \cdot 213.44 / 1.4 = 151.00 \text{ [kN/m}^2\text{]}$

$Ed/Rd = 0.599 \text{ [-]}. \text{ Passes requirement}$

**Check or earth support**

Check: Mobilizable earth resistance is sufficient for earth support force.

$z: -3.30 \text{ m}$   
 $Rd = Eph, k / \gamma, Re = 298.99 / 1.400 = 213.57 \text{ [kN/m]}$   

$Ed(Bh, d) / Rd = 213.56 / 213.57 = 1.000 \text{ [-]}. \text{ Passes requirement}$

**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( $\delta, p = -0.07^\circ$ )		-0.05
Ch, g	11.10	
Cv, g = Ch * tan( $\delta, C = 0.0^\circ$ )		0.01
-----		
$\Sigma$	0.00	89.46
		(downwards)

**Simple check, EAB R 9-3a**

$Vk \geq Bvk: 89.51 \geq 0.05 \text{ Passes requirement}$

**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( $\delta, p = -0.07^\circ$ )		-0.05
Bh, q, k z=-3.30	-102.85	
Bv, q, k = Bh, k * tan( $\delta, p = -0.07^\circ$ )		-0.12
Ch, g	11.10	
Cv, g = Ch * tan( $\delta, C = 0.0^\circ$ )		0.01
Ch, q	50.32	
Cv, q = Ch * tan( $\delta, C = 0.0^\circ$ )		0.03

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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 occur).

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

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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       $E_d = (163.6 * 5.59)$   
 Αντίσταση  $R_d = (414.6 * 5.59 + 0.0)$   

SLIP-CIRCLE  $\mu = E_d / R_d = 0.39 < 1.0$ : Έλεγχος εκπληρώθηκε.

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### Φάση εκκαφής 2 "[2] Situation 2"

LC: όλα τα φορτία Type: BS-T

#### Εδαφικό σύστημα με 5 Στρώσεις

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

Name	Αμμόδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20
γ,R	[kN/m3]	20
γ'	[kN/m3]	10
γ,p	[kN/m3]	20
γ,R,passive	[kN/m3]	20
γ,pw	[kN/m3]	10
φ	[°]	0.1
c	[kN/m2]	100
c,u	[kN/m2]	100
c παθητικό	[kN/m2]	100
δ,a	[°]	0.06666667
δ,p	[°]	-0.06666667
δ,c	[°]	0.03333333
k,agh	[-]	0.9955057
K,ach	[-]	1.994195
K,θh	[-]	0.9982547
K,pgh	[-]	1.004519
K,pch	[-]	2.00583
τ,gr	[kN/m2]	110
Ψ,A,max	[°]	90
k	[cm/s]	5.5e-09

Πορεία πρανούς:

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

Πορεία ανώτερου 2. στρώματος Αμμόδης ΑΡΓΙΛΟΣ:

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

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

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

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

**Επιφ. φορτία:**

**Φορτία**

xA	zA	xE	zE	PxA	PzA	PxE	PzE	Typ	LC-description
[m]	[m]	[m]	[m]	[	kN/m²		]		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:  $\varphi_{min} = 40.000$ .  
Negative earth pressure fractions are set to zero.

**Redistribution of earth pressure**

Shape of redistribution: Trapezoid.  
The earth pressure is getting redistrib. to: Excavation level  
The earth pressure below the excavation acts without redistrib.  
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): Ναί  
Anchor forces with safety level of DS-P: Ναί  
Verification of grout body pull out forces: Ναί  
δ,a,Anchoring wall : used from soil layer.  
δ,p,Anchoring wall : used from soil layer.

**Earth pressure coefficients kh**

$\varphi$	$\alpha$	$\beta$	$\delta$	k0gh	kagh	kach	kpgh	kpch
0.1	0.0	0.0	-0.1	--	--	--	1.005	-2.006

Τεχνητές επιχωματώσεις

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Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>					Job No.:				
Program: <b>WALLS-Retain. Version 2017.046</b>									
Structure: info@fides-dvp.de		www.fides-dvp.de		Tel:++49/89/143829-0		ASB Nr.:		Date: 08.10.2018	

$\varphi$	$\alpha$	$\beta$	$\delta$	$k_{0gh}$	$k_{agh}$	$k_{ach}$	$k_{pgh}$	$k_{pch}$	
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

0.00

-1.50

-3.00

-4.50

-10.00

-14.00

-15.00

**z**

**eph,G+PG,k**

**eah,G,k**

**eah,PQ,k**

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

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				Date: 08.10.2018

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

0.00	4.47		9.06	6.03
-1.00	4.47		23.5	19.6
-2.00	6.61			44.1
-3.00	10.2		23.5	
-4.50	13.4			18.1
-9.75				
-10.95	26.8			36.2
-12.15	29			39.1
-13.35	36.5			49.3
-15.00	39.3			53.1

z

PH,gk

PH,qk

PH,d

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

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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

0.00			-0.0767
-1.00	3.39	5.29	0.0768
-2.00	9.69	0.0516	0.234
-3.00	4.97	-9.91	0.401
-4.00	-10.8	-21.9	0.577
-5.00	-39.9	-36.8	0.75
-6.00	-85.5	-54.8	0.894
-7.00	-150.6	-75.8	0.966
-8.00	-238.1	-99.9	0.9
-9.00			0.609
-9.75	-414.4	153.6	0.174
-10.50	-276.5	128.1	-0.507
-11.25	-182.8	106	-1.41
-12.15	-76.4	70.8	-2.7
-12.95	-27.4	44.3	-3.96
-13.80			-5.37
-15.00			-7.39

z

M,gk

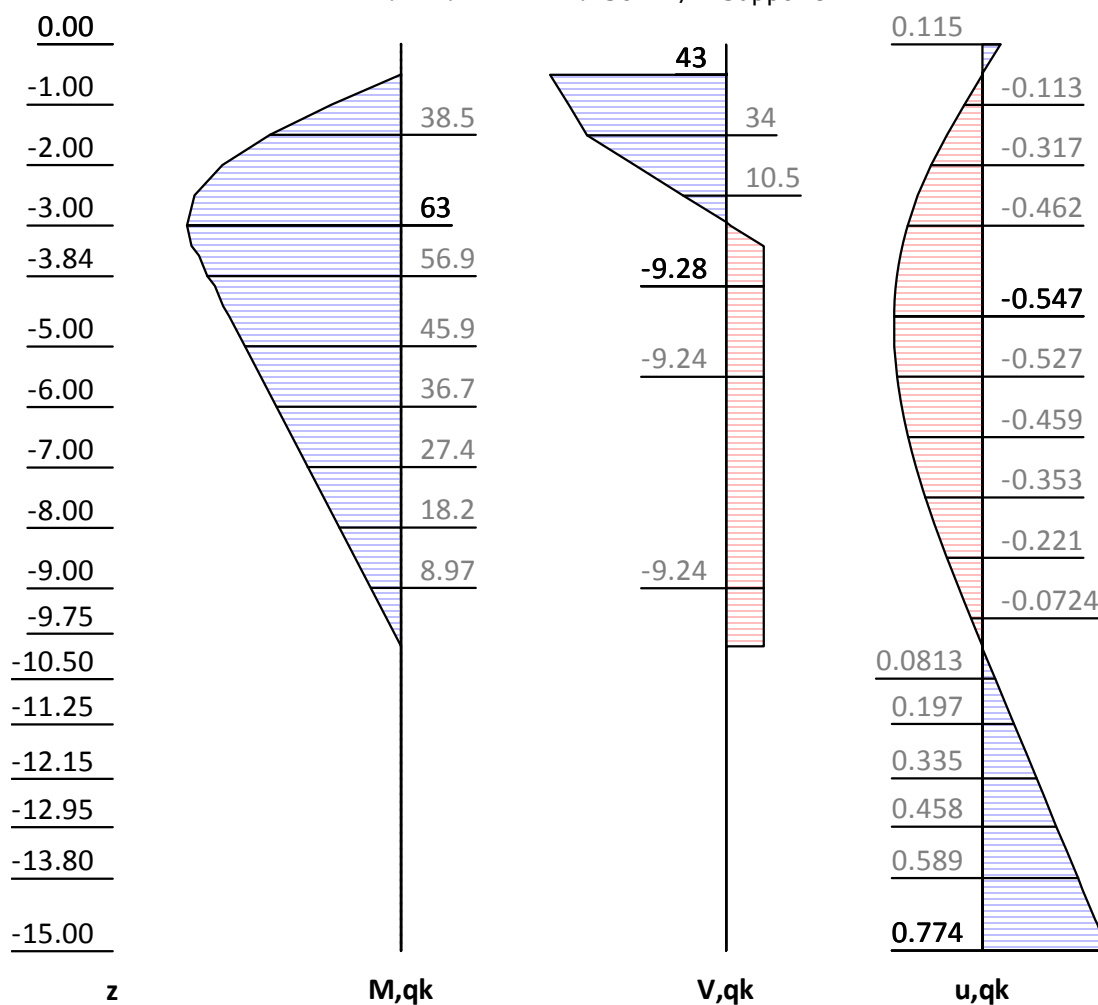
V,gk

u,gk

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z	H, g, k	M, g, k	V, g, k	N, g, k	u, g, k
[m]	[kN/m2]	[kN/m2]	[kN/m2]	[kN/m2]	[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

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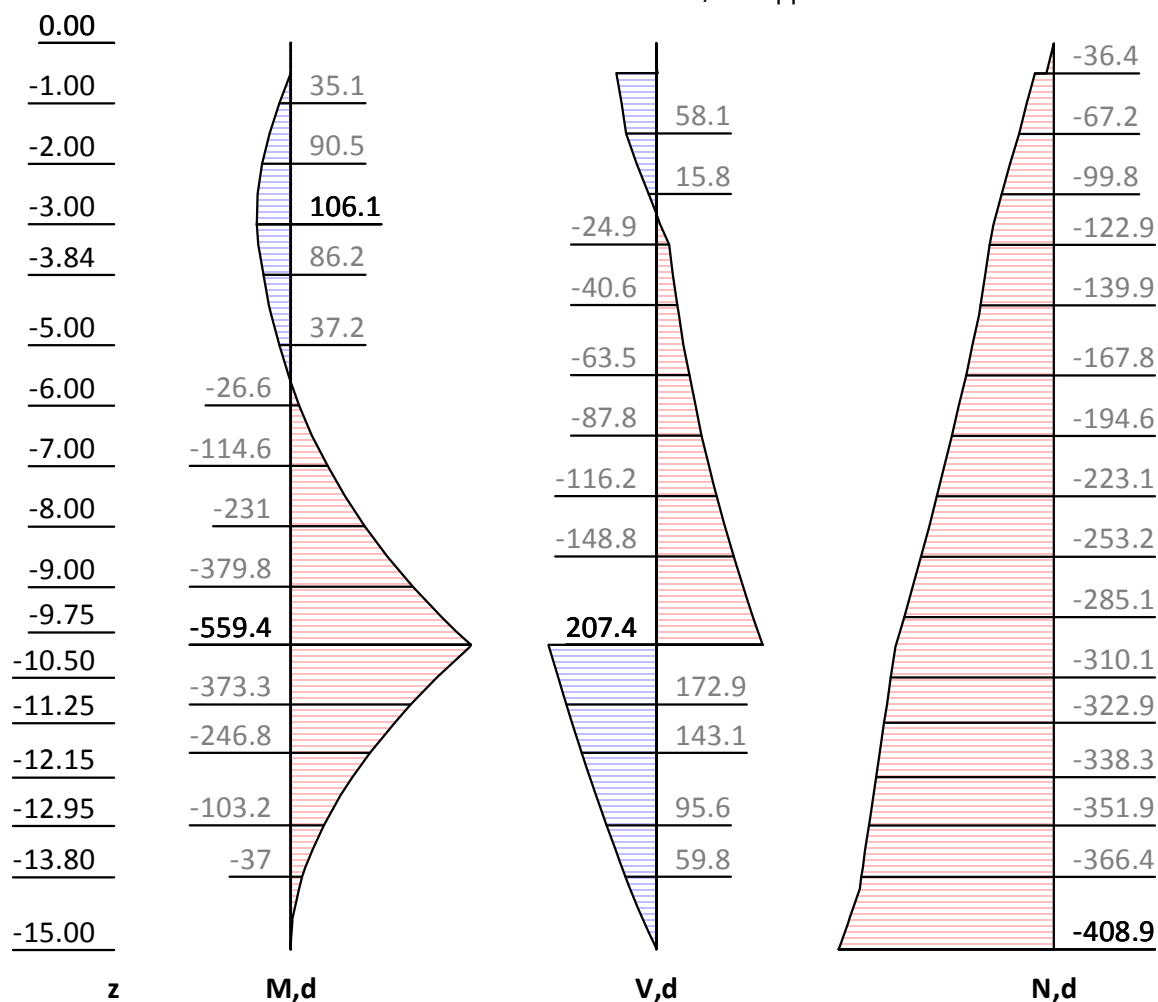
## Internal forces: Variable, characteristically

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

z [m]	H, q, k [kN/m <sup>2</sup> ]	M, q, k [kN/m <sup>2</sup> ]	V, q, k [kN/m <sup>2</sup> ]	N, q, k [kN/m <sup>2</sup> ]	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

## Internal forces: Design

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



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**0.00**

**-1.00**

**-2.00**

**-3.00**

**-3.84**

**-5.00**

**-6.00**

**-7.00**

**-8.00**

**-9.00**

**-9.75**

**-10.50**

**-11.25**

**-12.15**

**-12.95**

**-13.80**

**-15.00**

**z**

**6.03**

**19.6**

**44.1**

**18.1**

**36.2**

**39.1**

**49.3**

**53.1**

**H,d**

**0.0378**

**-0.0367**

**-0.0611**

**0.0206**

**0.207**

**0.396**

**0.556**

**0.611**

**0.461**

**0.14**

**-0.426**

**-1.21**

**-2.36**

**-3.5**

**-4.78**

**-6.61**

**u,g+q,k**

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

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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 on earth support**

Check: Mobilizable earth resistance is sufficient for earth support force.

z: -9.97 m

$R_d = E_{ph,k}/\gamma_{Re} = 6120.87 / 1.400 = 4372.05 \text{ [kN/m]}$

$E_d(U_{h,d})/R_d = 411.50 / 4372.05 = 0.094 \text{ [-]}. \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-9.97	-294.56	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * tan(δ,p=-22.00°)		-119.01
-----		
Σ	-0.00	164.82
		(downwards)

Average anchor inclination α<sub>A</sub> = 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.

$V_k \geq B_{vk}: 283.83 \geq 119.01 \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-9.97	-294.56	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * tan(δ,p=-22.00°)		-119.01
B <sub>h,q,k</sub> z=-9.97	-9.24	
B <sub>v,q,k</sub> = B <sub>h,k</sub> * tan(δ,p=-22.00°)		-3.73

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Pos.	H	V	
-----			
Σ	-0.00	178.25	
	(downwards)		

Average anchor inclination  $\alpha_A = 15.00^\circ \geq 15^\circ$ .

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  $\geq$  Bvk: 300.99  $\geq$  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	$\vartheta_1$	$\vartheta_2$	lA	W,k	Q,k	Ea1,k	Ea2,k	Ra_cal,d	Sum(A,d)	Ed/Rd
[m]	[°]	[°]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]
-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       $\vartheta_1 = 53.12^\circ$   
Inclination upper failure plane       $\vartheta_2 = 57.50^\circ$   
Inclination separation plane       $\vartheta_{12} = 90.00^\circ$

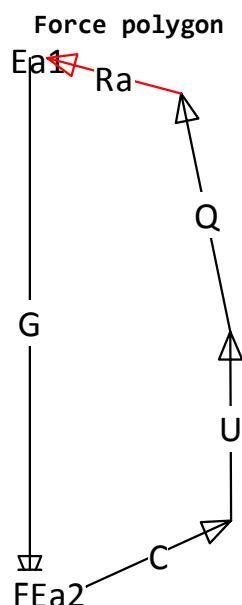
**Loads / forces (char.)**

		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	$\delta = 0.0^\circ$
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	

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



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 ....[mm<sup>2</sup>]: X-section area of steel member

Ri,d ...[kN]: Ultimate strength of tension member ( $\gamma, M=1.15$ )

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

$\tau_{Gr,k}$  ...: Average applied skin friction along the grout body (from soil parameters)

Ra,k .....: Charact. pullout resistance of the anchor

$\gamma_A$  .....: Partial safety factor of anchor pullout

Ra,d .....: = Ra,k /  $\gamma_A$

A,d .....: Dimensioning force of the anchor from wall analysis

z	lvk	DmVk	$\tau_{Gr,k}$	Ra,k	$\gamma_A$	Ra,d	A,d	A,d/Ra,d
[m]	[m]	[mm]	[kN/m <sup>2</sup> ]	[kN]	[-]	[kN]	[kN]	[-]
-0.50	8.00	318	110	879.1	1.100	799.2	> 149.3	0.2

Check of anchor's soil friction: Passes requirement

Author: FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München							Job No.:			
Program: WALLS-Retain. Version 2017.046										
Structure: info@fides-dvp.de www.fides-dvp.de Tel:++49/89/143829-0 ASB Nr.:							Date: 08.10.2018			
<b>Υπολογ. κύκλου ολίσθησης</b> 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 occur).  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					
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Δράση  $E_d = (338.5 \cdot 18.40)$   
 Αντίσταση  $R_d = (3047.7 \cdot 18.40 + 0.0)$   
SLIP-CIRCLE  $\mu = E_d/R_d = 0.11 < 1.0$ : Έλεγχος εκπληρώθηκε.

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### Φάση εκκαφής 3 "[3] Situation 3"

LC: όλα τα φορτία Type: BS-T

#### Εδαφικό σύστημα με 5 Στρώσεις

Name	Τεχνητές επιχωματώσεις	Αμμόδης	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,θh	[-]	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	Αμμόδης	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,θh	[-]	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 Αμμόδης ΑΡΓΙΛΟΣ:

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

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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

0.00

-1.50

-3.00

-4.00

-6.00

-10.00

-14.00

-15.00

z

-100.3

-370.9

-1273.9

-1388.3

eph,G+PG,k

7.25

10.2

13.4

30.2

36.5

39.3

eah,G,k

9.06

23.5

23.5

eah,PQ,k

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

Part:		Archive No.:	
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					Date: 08.10.2018

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	PH,gk	PH,qk	PH,d
0.00	7.34	9.06	9.91
-1.50	7.34	23.5	45.1
-3.00	6.12	23.5	
-4.00	22		38.3
-6.00	48		64.8
-9.75			
-10.95	56.8		76.7
-12.15	59		79.6
-13.35	66.5		89.8
-15.00	69.3		93.6

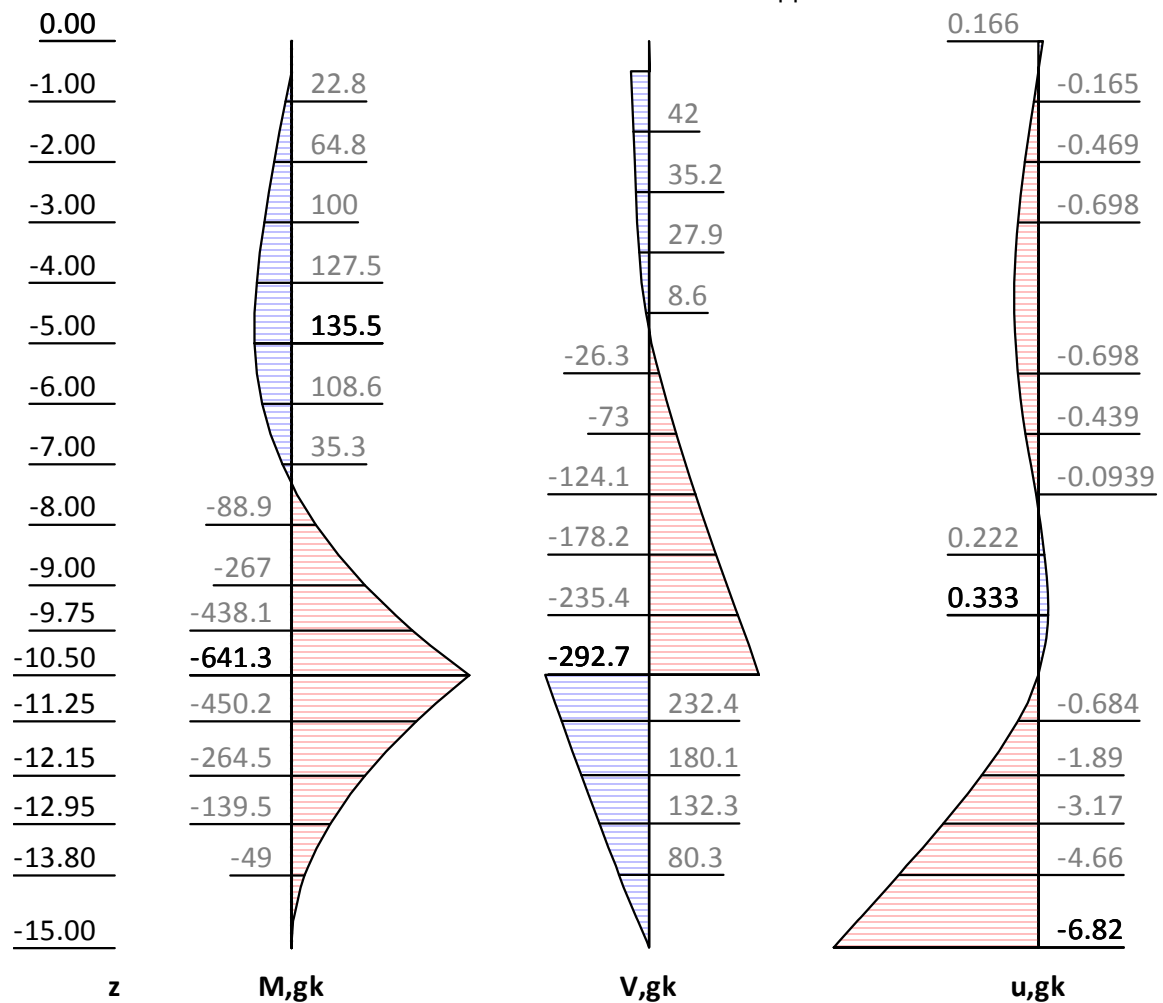
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<table border="1"> <thead> <tr> <th>z [m]</th> <th>PH, gk [kN/m2]</th> <th>PH, qk [kN/m2]</th> <th>PH, d [kN/m2]</th> </tr> </thead> <tbody> <tr><td>0.00</td><td>7.34</td><td></td><td>9.91</td></tr> <tr><td>-0.47</td><td>7.34</td><td>0.00</td><td>9.91</td></tr> <tr><td>-0.47</td><td>7.34</td><td>9.06</td><td>23.50</td></tr> <tr><td>-1.50</td><td>7.34</td><td>9.06</td><td>23.50</td></tr> <tr><td>-1.50</td><td>7.34</td><td>23.48</td><td>45.13</td></tr> <tr><td>-2.00</td><td>7.34</td><td>23.48</td><td>45.13</td></tr> <tr><td>-2.00</td><td>6.12</td><td>23.48</td><td>43.48</td></tr> <tr><td>-3.34</td><td>9.52</td><td>23.48</td><td>48.07</td></tr> <tr><td>-3.34</td><td>9.52</td><td>0.00</td><td>12.85</td></tr> <tr><td>-4.00</td><td>16.12</td><td>0.00</td><td>21.76</td></tr> <tr><td>-4.00</td><td>21.97</td><td>0.00</td><td>29.65</td></tr> <tr><td>-4.50</td><td>27.86</td><td>0.00</td><td>37.61</td></tr> <tr><td>-4.50</td><td>28.38</td><td>0.00</td><td>38.31</td></tr> <tr><td>-10.00</td><td>60.24</td><td>0.00</td><td>81.32</td></tr> <tr><td>-10.00</td><td>55.14</td><td>0.00</td><td>74.43</td></tr> <tr><td>-14.00</td><td>62.28</td><td>0.00</td><td>84.08</td></tr> <tr><td>-14.00</td><td>66.50</td><td>0.00</td><td>89.78</td></tr> <tr><td>-15.00</td><td>69.31</td><td>0.00</td><td>93.56</td></tr> </tbody> </table>				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
z [m]	PH, gk [kN/m2]	PH, qk [kN/m2]	PH, d [kN/m2]																																																																												
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Part: Block: Please specify project informations. Record:			Archive No.:																																																																												

**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/m <sup>2</sup> ]	M, g, k [kN/m <sup>2</sup> ]	V, g, k [kN/m <sup>2</sup> ]	N, g, k [kN/m <sup>2</sup> ]	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

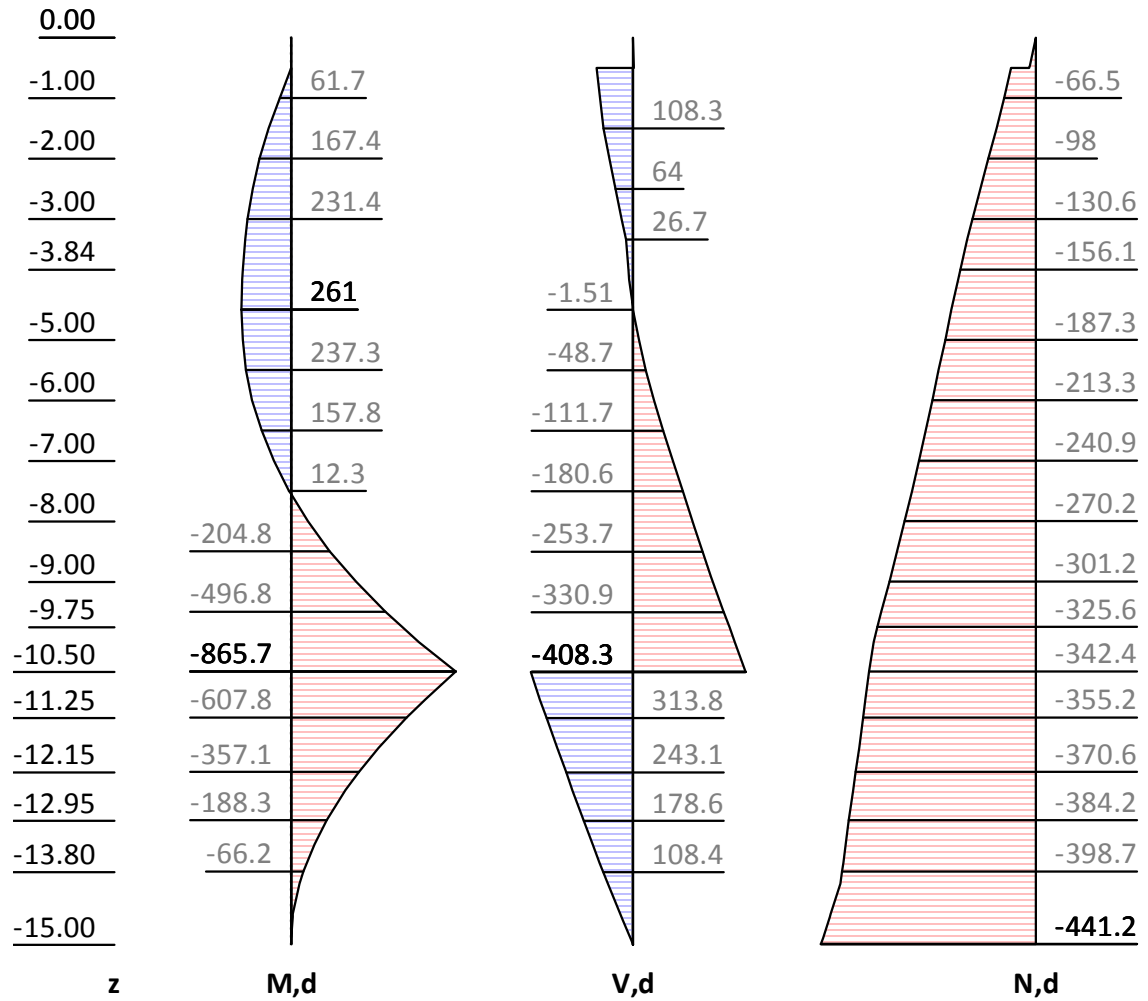
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z [m]	H, g, k [kN/m2]	M, g, k [kN/m2]	V, g, k [kN/m2]	N, g, k [kN/m2]	u, g, k [mm]
-10.00	55.14	-502.53	-265.09	-228.13	0.24
-10.50	56.03	-641.26	-292.74	-234.41	0.00
-10.50	56.03	-641.26	275.09	-234.41	0.00
-10.50	56.03	-641.26	275.09	-234.41	-0.00
-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					
0.00					0.123
-1.00			43.5		-0.122
-2.00			34.5		-0.343
-3.00			11		-0.505
-3.84			-9.02		-0.587
-5.00			-8.75		-0.614
-6.00					-0.579
-7.00			-8.75		-0.498
-8.00					-0.381
-9.00			-8.75		-0.239
-9.75			-8.75		-0.121
-10.50			-8.75		
-11.25					0.123
-12.15					0.27
-12.95					0.4
-13.80					0.539
-15.00					0.735
z	M,qk	V,qk	u,qk		
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
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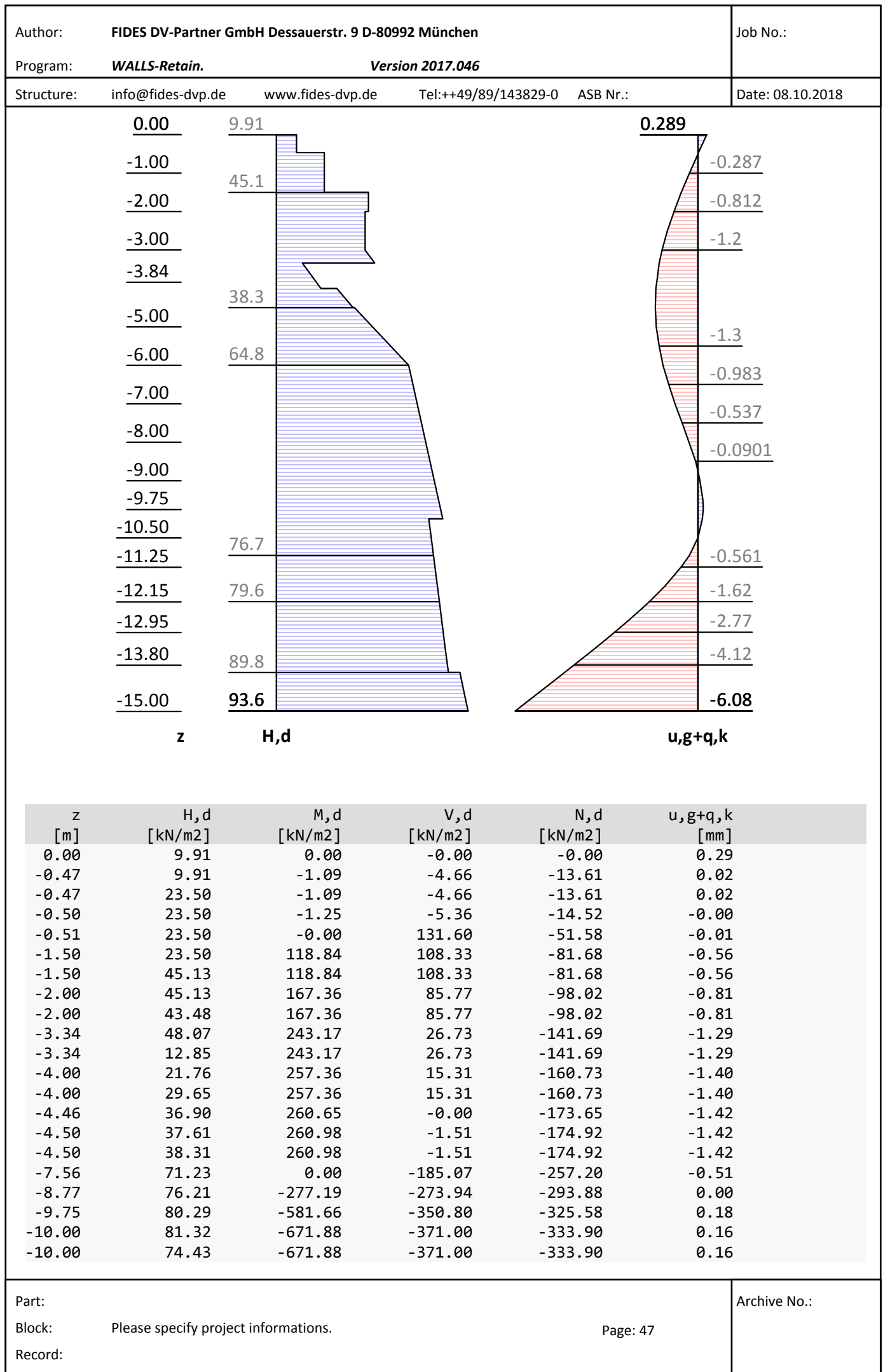
[illegible]

**Internal forces: Design**

z= -0.500. Fx=-137.195 kN/m Support

z= -10.497. Fx=-779.697 kN/m Support





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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

$R_d = E_{ph,k}/\gamma_{Re} = 5243.09 / 1.400 = 3745.06 \text{ [kN/m]}$

$Ed(U_{h,d})/R_d = 779.70 / 3745.06 = 0.208 \text{ [-]}. \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-10.50	-567.83	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * 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.

V<sub>k</sub> >= B<sub>vk</sub>: 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
B <sub>h,g,k</sub> z=-10.50	-567.83	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * tan(δ,p=-0.07°)		-0.66
B <sub>h,q,k</sub> z=-10.50	-8.75	
B <sub>v,q,k</sub> = B <sub>h,k</sub> * tan(δ,p=-0.07°)		-0.01
Σ	0.00	324.23
		(downwards)

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Average anchor inclination  $\alpha, A = 15.00^\circ \geq 15^\circ$ .

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.

$V_k \geq B_{vk}: 324.90 \geq 0.67$  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:**  
 $l_A$  .....: 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.  
 $E_{a1, k}$  .....: Earth pressure onto vertical separation plane.  
 $E_{a2, k}$  .....: Earth pressure between wall and main failure body.  
 $R_{a\_cal, d}$  ....: Dimensioning force of the resistance from the equilibrium of forces.  
                    $R_{a\_cal, d}$  corresponds to the max. possible anchor force of the force polygon.  
 $\text{Sum}(A, d)$  ....: Acting anchor forces along the grout body fractions within the failure body.  $\text{Sum}(A, d)$  is gained from the anchor pull forces of the wall analysis.

$z$	$\vartheta_1$	$\vartheta_2$	$l_A$	$W, k$	$Q, k$	$E_{a1, k}$	$E_{a2, k}$	$R_{a\_cal, d}$	$\text{Sum}(A, d)$	$E_d/R_d$
[m]	[°]	[°]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]
-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                     $\vartheta_1 = 53.12^\circ$   
 Inclination upper failure plane                     $\vartheta_2 = 57.50^\circ$   
 Inclination separation plane                         $\vartheta_{12} = 90.00^\circ$

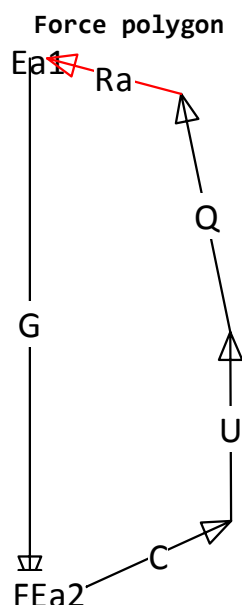
**Loads / forces (char.)**

		$F_x$	$F_z$	$F$	
		[kN/m]	[kN/m]	[kN/m]	
Weight of main failure body	$G, k:$	0.0	-1677.2	1677.2	
Area loads on/in main failure body	$F_1, k:$	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	$E_{a1, k}:$	-4.4	-0.0	4.4	$\delta = 0.0^\circ$
Earth pr. between wall<->main body	$E_{a2, k}:$	358.3	71.9	365.5	
Force in lower failure plane	$Q, k:$	-354.9	534.3	641.5	
Sum = possible anchor forces:	$R_{a\_cal, k}:$	381.8	-102.3	395.3	

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Acting anchor forces  $E_d: \text{Sum}(A,d) = 142.0 \text{ kN/m}$

Possible anchor forces  $R_d: R_{a\_cal,d} = 395.3/1.400 = 282.4 \text{ kN/m}$

Verif. of lower failure plane  $E_d/R_d = 0.50 < 1.0$ : Έλεγχος εκπληρώθηκε.

#### Check of steel tension

$l_{tot}$  ...[m]: Total length of anchor incl. excess length at head

$A_s$  ....[mm<sup>2</sup>]: X-section area of steel member

$R_{i,d}$  ...[kN]: Ultimate strength of tension member ( $\gamma, M=1.15$ )

$A,d$  ....[kN]: Dimensioning force of the anchor from wall analysis

$z$ [m] Anchor type

$z$ [m]	Anchor type	$l_{tot}$	$A_s$	$R_{i,d}$	$A,d$
-0.50	Strand;3x0.60";1570/1770	13.38	420	573.4	255.7

13.38 420 573.4 > 255.7 Passes requirement

Check of steel tension: Passes requirement

#### Check of anchor's soil friction

$l_{vk}$  .....: Length of grout body

$d_{m,vk}$  ....: Diameter of grout body

$\tau_{gr,k}$  ...: Average applied skin friction along the grout body (from soil parameters)

$R_{a,k}$  ....: Charact. pullout resistance of the anchor

$\gamma_A$  .....: Partial safety factor of anchor pullout

$R_{a,d}$  .....: =  $R_{a,k} / \gamma_A$

$A,d$  .....: Dimensioning force of the anchor from wall analysis

$z$	$l_{vk}$	$d_{m,vk}$	$\tau_{gr,k}$	$R_{a,k}$	$\gamma_A$	$R_{a,d}$	$A,d$	$A,d/R_{a,d}$
[m]	[m]	[mm]	[kN/m <sup>2</sup> ]	[kN]	[-]	[kN]	[kN]	[-]
-0.50	8.00	318	110	879.1	1.100	799.2	255.7	0.3

Check of anchor's soil friction: Passes requirement

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<b>Υπολογ. κύκλου ολίσθησης</b> 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 occur).										
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					
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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       $E_d = (646.2 \cdot 18.41)$

Αντίσταση    $R_d = (2945.4 \cdot 18.41 + 0.0)$

SLIP-CIRCLE

$\mu = E_d / R_d = 0.22$

$< 1.0$ : Έλεγχος εκπληρώθηκε.

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### Φάση εκκαφής 4 "[4] Situation 4"

LC: όλα τα φορτία Type: BS-T

#### Εδαφικό σύστημα με 5 Στρώσεις

Name	Τεχνητές επιχωματώσεις	Αμμόδης	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,θh	[-]	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	Αμμόδης	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,θh	[-]	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 Αμμόδης ΑΡΓΙΛΟΣ:

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

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

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

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

Επιφ. φορτία:

Φορτία

xA	zA	xE	zE	PxA	PzA	PxE	PzE	Typ	LC-description
[m]	[m]	[m]	[m]	[	kN/m²		]		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 redistrib. to: Excavation level

The earth pressure below the excavation acts without redistrib.

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): Ναί

Anchor forces with safety level of DS-P: Ναί

Verification of grout body pull out forces: Ναί

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

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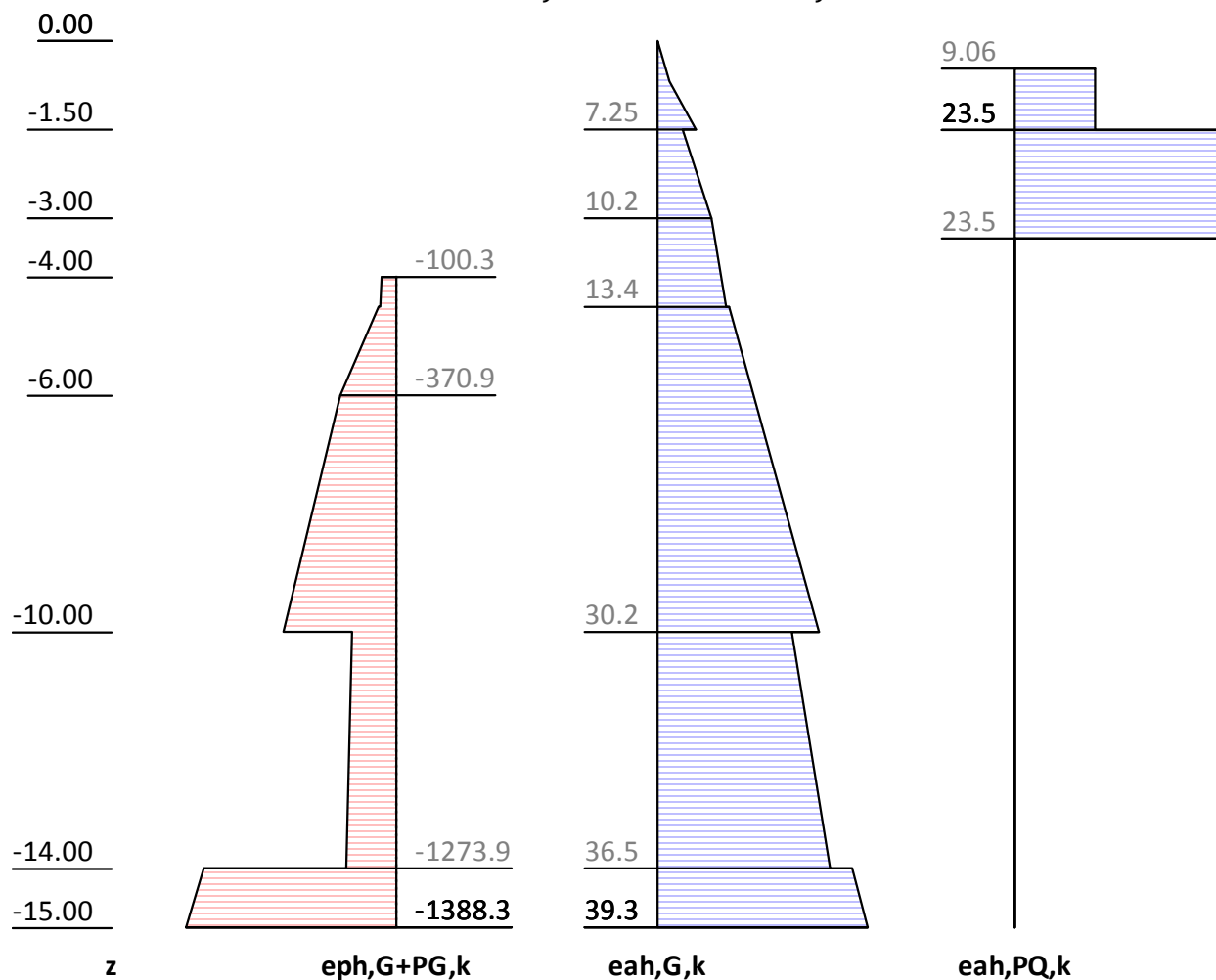
### Μήκος τοίχου

Foot depth for statics:  $z_f = -15.000$

## Stress analysis

### Earth pressure, horizontal

Pressures characteristic, no redistribution, continuous wall



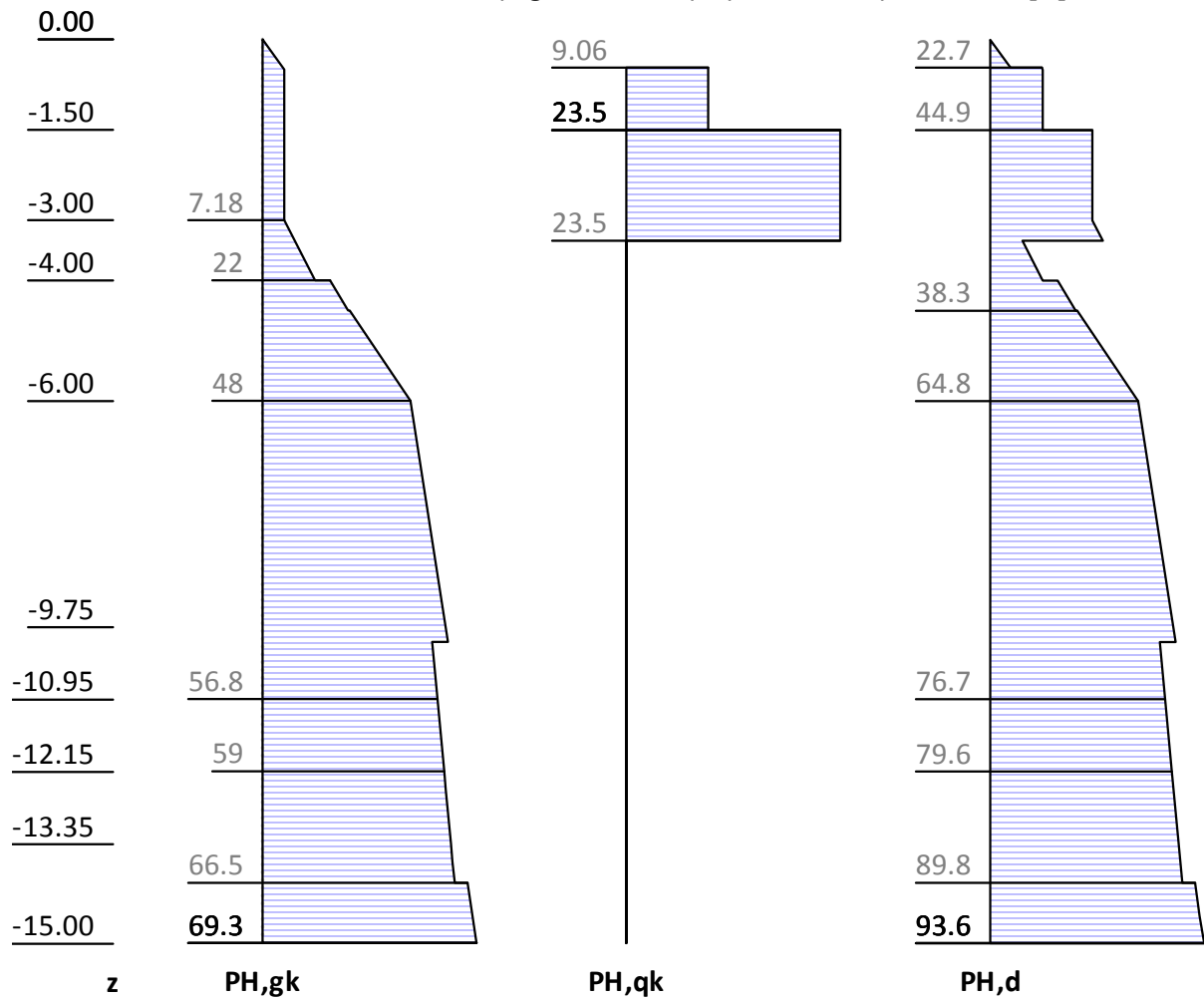
z [m]	eph,G,k [kN/m2]	eah,G,k [kN/m2]	eah,PQ,k [kN/m2]	eah,d [kN/m2]
0.00		0.00		0.00
-0.47		1.52	0.00	2.04
-0.47		1.52	9.06	15.62





**H-pressure on static system**

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



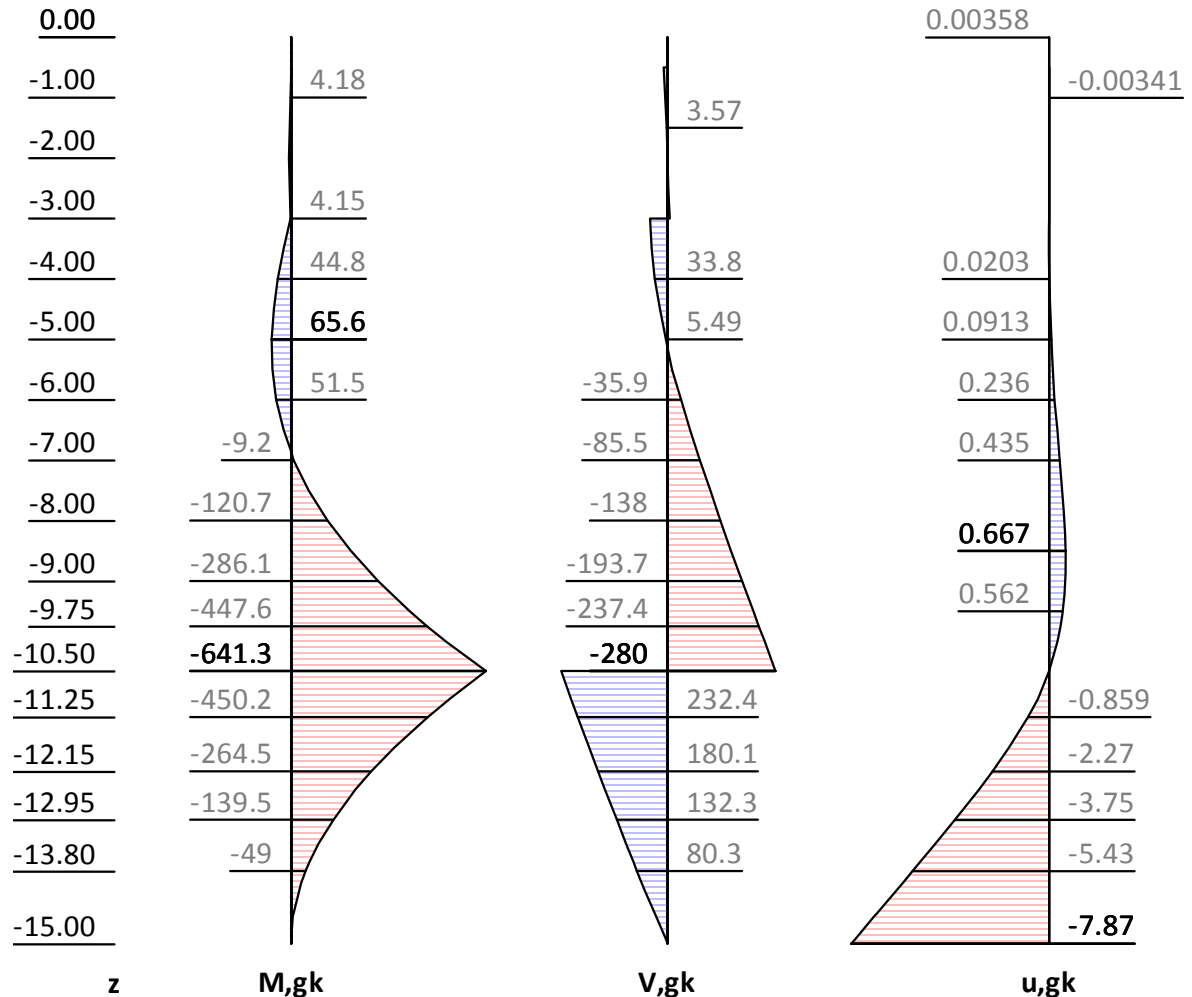
z [m]	PH,gk [kN/m²]	PH,qk [kN/m²]	PH,d [kN/m²]
0.00	0.00	0.00	0.00
-0.47	6.75	0.00	9.11
-0.47	6.75	9.06	22.69
-1.50	7.18	9.06	23.28
-1.50	7.18	23.48	44.91
-3.34	10.58	23.48	49.50
-3.34	10.58	0.00	14.28
-4.00	17.18	0.00	23.19
-4.00	21.97	0.00	29.65
-4.50	27.86	0.00	37.61
-4.50	28.38	0.00	38.31
-10.00	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/m <sup>2</sup> ]	M, g, k [kN/m <sup>2</sup> ]	V, g, k [kN/m <sup>2</sup> ]	N, g, k [kN/m <sup>2</sup> ]	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

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Program: WALLS-Retain. Version 2017.046					
Structure:	info@fides-dvp.de	www.fides-dvp.de	Tel:++49/89/143829-0	ASB Nr.:	Date: 08.10.2018
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
<b>Internal forces: Variable, characteristically</b> 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					
0.00					0.00554
-1.00					
-2.00		11.9	6.86		-0.00509
-3.00	-4.73		-28.4		0.00261
-3.84					0.0107
-5.00	-2.47		0.45		0.0142
-6.00	-2.02				0.0135
-7.00	-1.57				0.011
-8.00	-1.12				0.0071
-9.00	-0.674		0.45		0.00365
-9.75	-0.336				
-10.50		0.45			-0.00371
-11.25					-0.00816
-12.15					-0.0121
-12.95					-0.0163
-13.80					-0.0222
-15.00					
z	M,qk	V,qk	u,qk		
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
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Program: WALLS-Retain. Version 2017.046					
Structure: info@fides-dvp.de www.fides-dvp.de Tel:++49/89/143829-0 ASB Nr.:					Date: 08.10.2018
z	H, q, k	M, q, k	V, q, k	N, q, k	u, q, k
[m]	[kN/m2]	[kN/m2]	[kN/m2]	[kN/m2]	[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

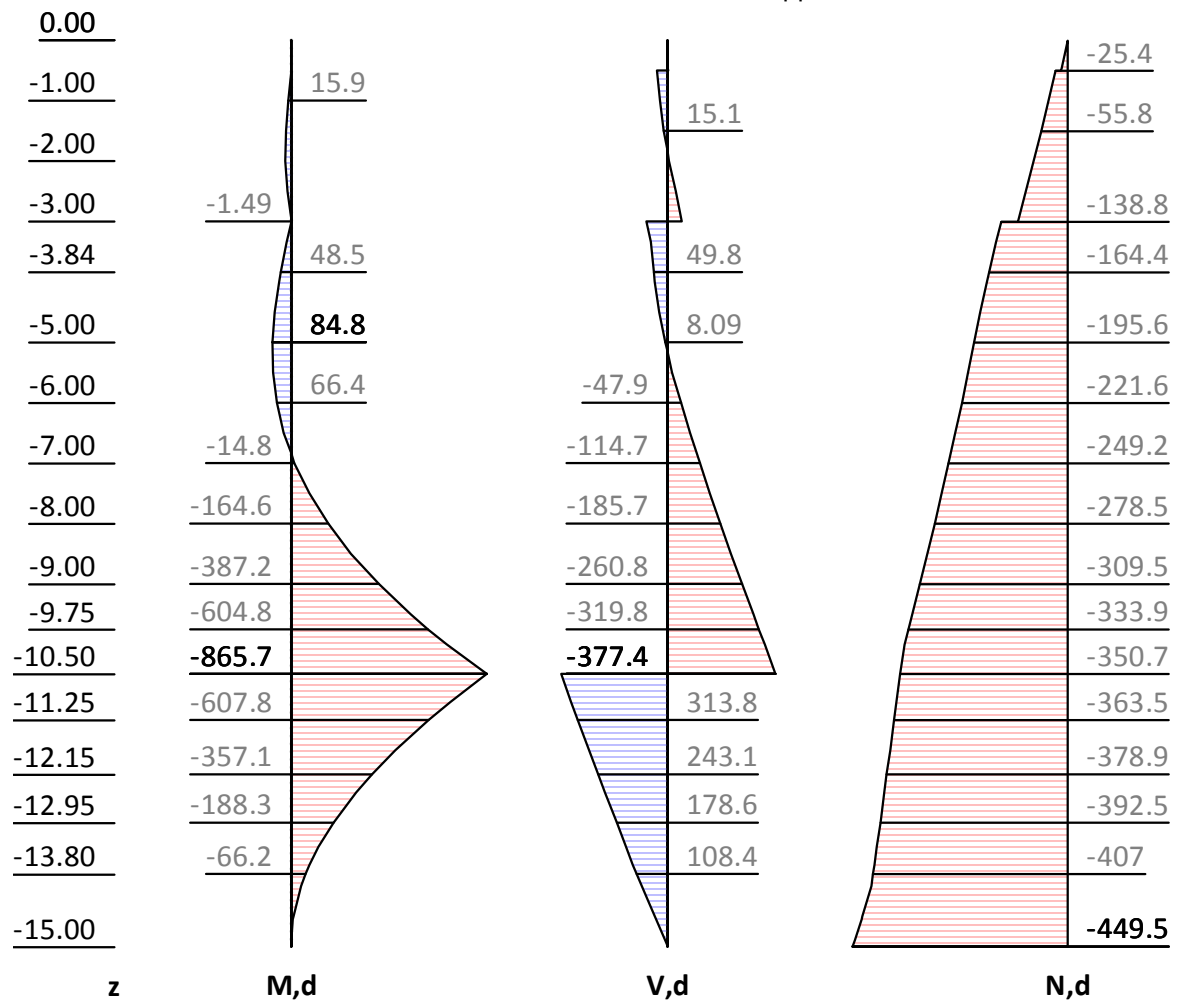
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## Internal forces: Design

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



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Structure:	info@fides-dvp.de	www.fides-dvp.de	Tel:++49/89/143829-0	ASB Nr.:	Date: 08.10.2018
<div> <div> <div>0.00</div> <div>-1.00</div> <div>-2.00</div> <div>-3.00</div> <div>-3.84</div> <div>-5.00</div> <div>-6.00</div> <div>-7.00</div> <div>-8.00</div> <div>-9.00</div> <div>-9.75</div> <div>-10.50</div> <div>-11.25</div> <div>-12.15</div> <div>-12.95</div> <div>-13.80</div> <div>-15.00</div> </div> <div> <div>22.7</div> <div>44.9</div> <div></div> <div></div> <div>38.3</div> <div>64.8</div> <div></div> <div></div> <div></div> <div></div> <div></div> <div>76.7</div> <div>79.6</div> <div></div> <div>89.8</div> <div>93.6</div> </div> <div> <div>0.00913</div> <div></div> <div>-0.00859</div> <div></div> <div>0.0217</div> <div>0.104</div> <div>0.25</div> <div>0.449</div> <div>0.676</div> <div>0.567</div> <div></div> <div>-0.863</div> <div>-2.28</div> <div>-3.76</div> <div>-5.44</div> <div>-7.89</div> </div> </div> <div> <div>z</div> <div>H,d</div> <div>u,g+q,k</div> </div>					
z	H,d	M,d	V,d	N,d	u,g+q,k
[m]	[kN/m2]	[kN/m2]	[kN/m2]	[kN/m2]	[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
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					Date: 08.10.2018

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

$R_d = E_{ph,k}/\gamma_{Re} = 5243.09 / 1.400 = 3745.06 \text{ [kN/m]}$

$E_d(U_{h,d})/R_d = 748.73 / 3745.06 = 0.200 \text{ [-]}. \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-10.50	-555.12	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * 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.

V<sub>k</sub> >= B<sub>vk</sub>: 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

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Program: <b>WALLS-Retain.</b> <span style="float: right;"><b>Version 2017.046</b></span>					
Structure: info@fides-dvp.de		www.fides-dvp.de		Tel:++49/89/143829-0 ASB Nr.:	
				Date: 08.10.2018	

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( $\delta$ ,p=-0.07°)		-0.65
Bh,q,k z=-10.50	0.45	
Bv,q,k = Bh,k * tan( $\delta$ ,p=-0.07°)		0.00
-----		
$\Sigma$	-0.00	330.13
	(downwards)	

Average anchor inclination  $\alpha, A = 15.00^\circ \geq 15^\circ$ .

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  $\geq$  Bvk: 330.77  $\geq$  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	$\vartheta 1$	$\vartheta 2$	lA	W,k	Q,k	Ea1,k	Ea2,k	Ra_cal,d	Sum(A,d)	Ed/Rd
[m]	[°]	[°]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]
-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                       $\vartheta 1 = 53.05^\circ$   
 Inclination upper failure plane                        $\vartheta 2 = 60.04^\circ$   
 Inclination separation plane                            $\vartheta 12 = 90.00^\circ$

**Loads / forces (char.)**

	Fx	Fz	F
	[kN/m]	[kN/m]	[kN/m]
Weight of main failure body                    G,k:	0.0	-1561.6	1561.6

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					Date: 08.10.2018

		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	$\delta = 0.0^\circ$
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 ....[mm<sup>2</sup>]: X-section area of steel member

Ri,d ...[kN]: Ultimate strength of tension member ( $\gamma, M=1.15$ )

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

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**Check of anchor's soil friction**

lV<sub>k</sub> .....: Length of grout body  
 D<sub>mV<sub>k</sub></sub> .....: Diameter of grout body  
 τ<sub>Gr,k</sub> ....: Average applied skin friction along the grout body (from soil parameters)  
 R<sub>a,k</sub> .....: Charact. pullout resistance of the anchor  
 γ<sub>A</sub> .....: Partial safety factor of anchor pullout  
 R<sub>a,d</sub> .....: = R<sub>a,k</sub> / γ<sub>A</sub>  
 A<sub>d</sub> .....: Dimensioning force of the anchor from wall analysis

z	lV <sub>k</sub>	D <sub>mV<sub>k</sub></sub>	τ <sub>Gr,k</sub>	R <sub>a,k</sub>	γ <sub>A</sub>	R <sub>a,d</sub>	A <sub>d</sub>	A <sub>d</sub> /R <sub>a,d</sub>
[m]	[m]	[mm]	[kN/m <sup>2</sup> ]	[kN]	[-]	[kN]	[kN]	[-]
-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 m<sup>2</sup>.  
 The slip circle calculation only accepts circles including the wall.  
 The slipcircle calculation only allows circular failure planes (no vertical tangents will occur).

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	dx <sub>M</sub>	Weight	Load	Water-	u*b	φ	c	θ
	[m]	b	[m]	[kN/m]	z-κατ.	φορτ.	[kN/m]	[°]	[kN/m <sup>2</sup> ]	[°]
		[m]			[kN/m]	[kN/m]				
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
----	--------	----------	----------------	-----------	---

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			+ 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

Αντίσταση  $R_d = (2945.4 \cdot 18.41 + 0.0)$

SLIP-CIRCLE  $\mu = E_d/R_d = 0.22 < 1.0$ : Έλεγχος εκπληρώθηκε.

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### Φάση εκκαφής 5 "[5] Situation 4 +"

LC: όλα τα φορτία Type: BS-T

#### Εδαφικό σύστημα με 5 Στρώσεις

Name	Τεχνητές επιχωματώσεις	Αμμόδης	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,θh	[-]	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	Αμμόδης	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,θh	[-]	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 Αμμόδης ΑΡΓΙΛΟΣ:

x [m]	0.00	0.00
z [m]	-6.50	-1.50

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Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:  
x [m] 0.00 0.00  
z [m] -6.50 -4.50

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

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

**Επιφ. φορτία:**  
**Φορτία**

xA	zA	xE	zE	PxA	PzA	PxE	PzE	Typ	LC-description
[m]	[m]	[m]	[m]	[	kN/m <sup>2</sup>		]		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 redistrib. to: Excavation level  
The earth pressure below the excavation acts without redistrib.  
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): Ναί  
Anchor forces with safety level of DS-P: Ναί  
Verification of grout body pull out forces: Ναί  
δ,a,Anchoring wall : used from soil layer.  
δ,p,Anchoring wall : used from soil layer.

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## Earth pressure coefficients kh

$\varphi$	$\alpha$	$\beta$	$\delta$	$k_{0gh}$	$k_{agh}$	$k_{ach}$	$k_{pgh}$	$k_{pch}$	
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	--	--	"

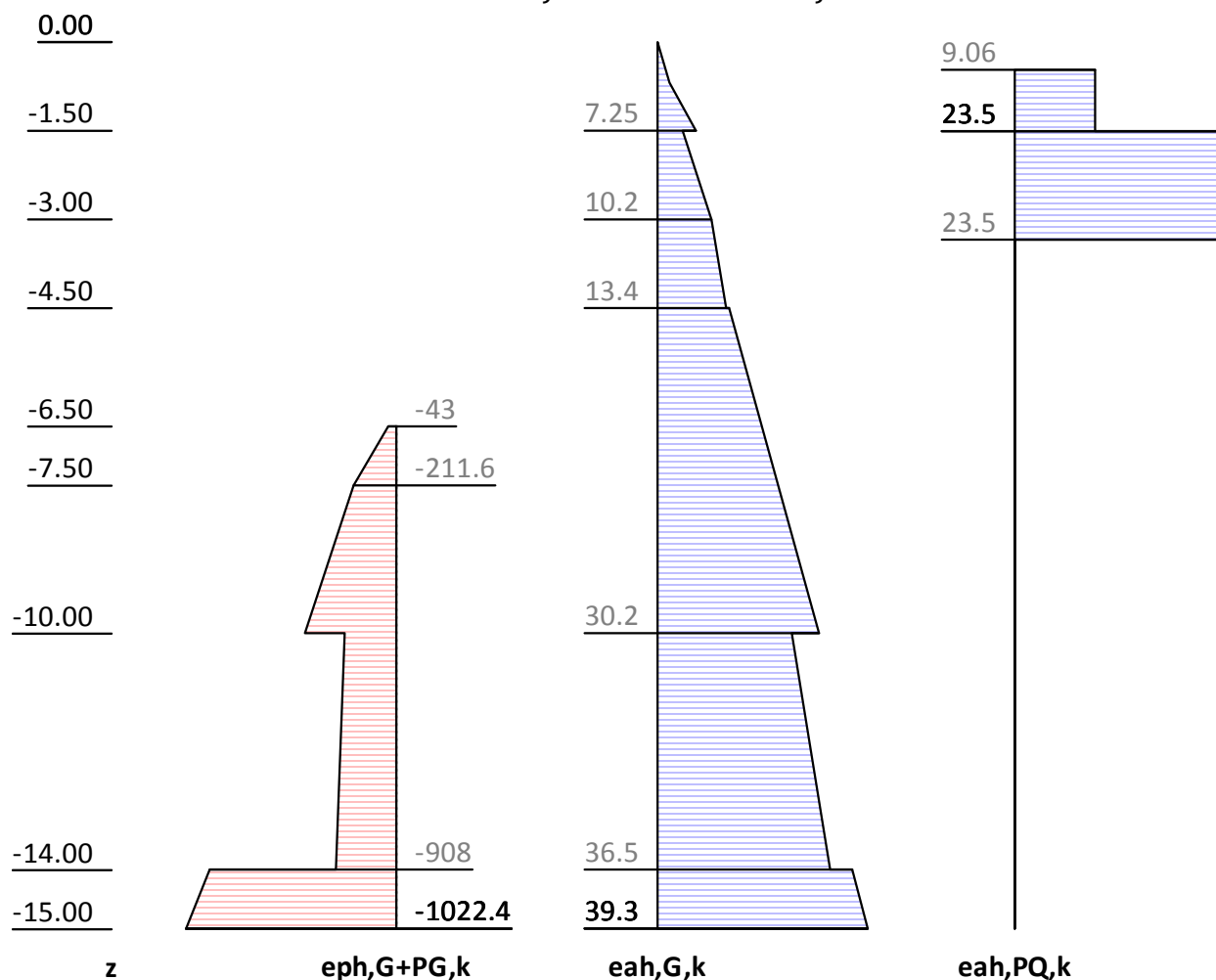
## Μήκος τοίχου

Foot depth for statics:  $z_f = -15.000$ 

## Stress analysis

## Earth pressure, horizontal

Pressures characteristic, no redistribution, continuous wall

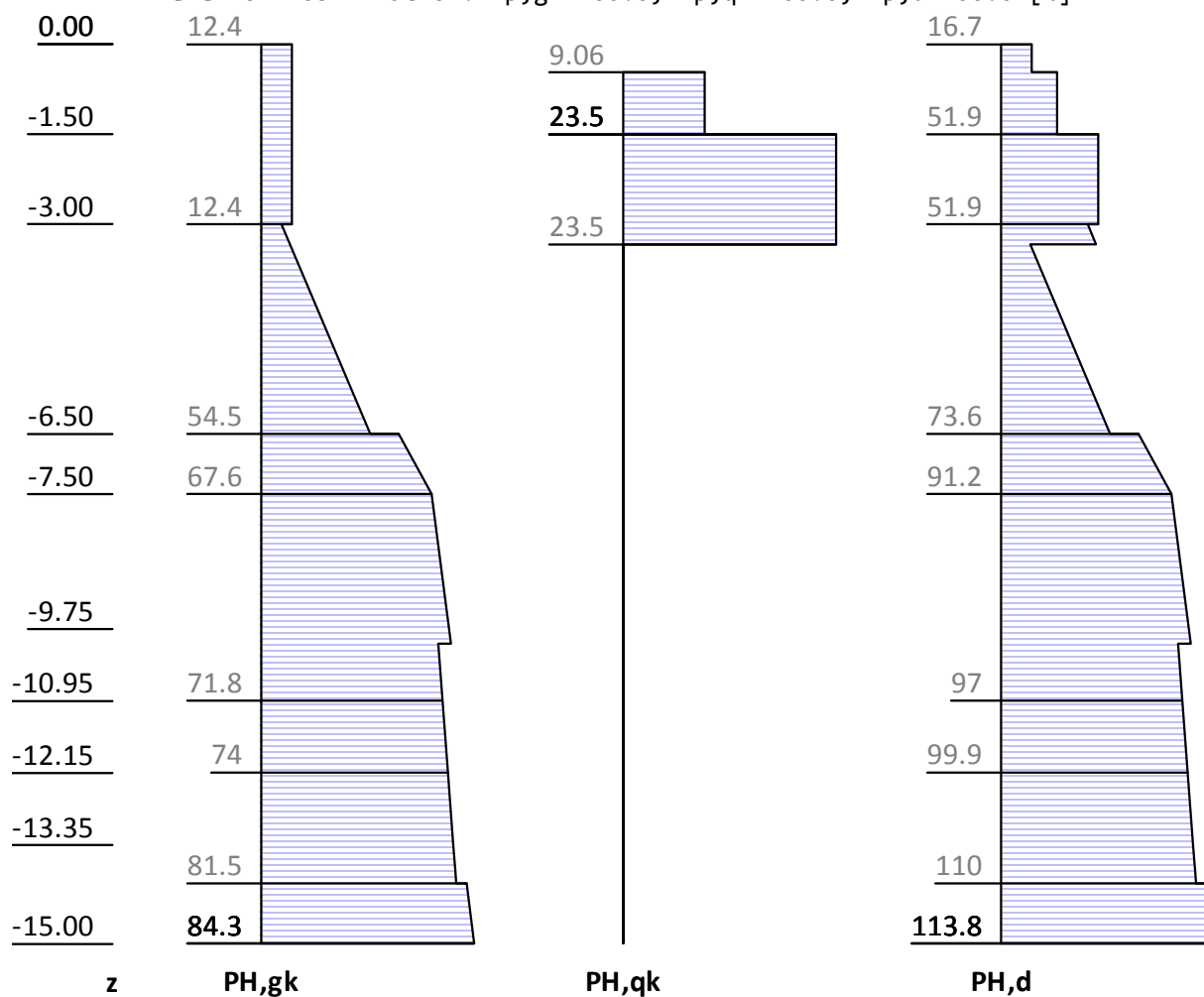


$z$ [m]	$e_{ph,G,k}$ [kN/m <sup>2</sup> ]	$e_{ah,G,k}$ [kN/m <sup>2</sup> ]	$e_{ah,PQ,k}$ [kN/m <sup>2</sup> ]	$e_{ah,d}$ [kN/m <sup>2</sup> ]
0.00		0.00		0.00
-0.47		1.52	0.00	2.04
-0.47		1.52	9.06	15.62



**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

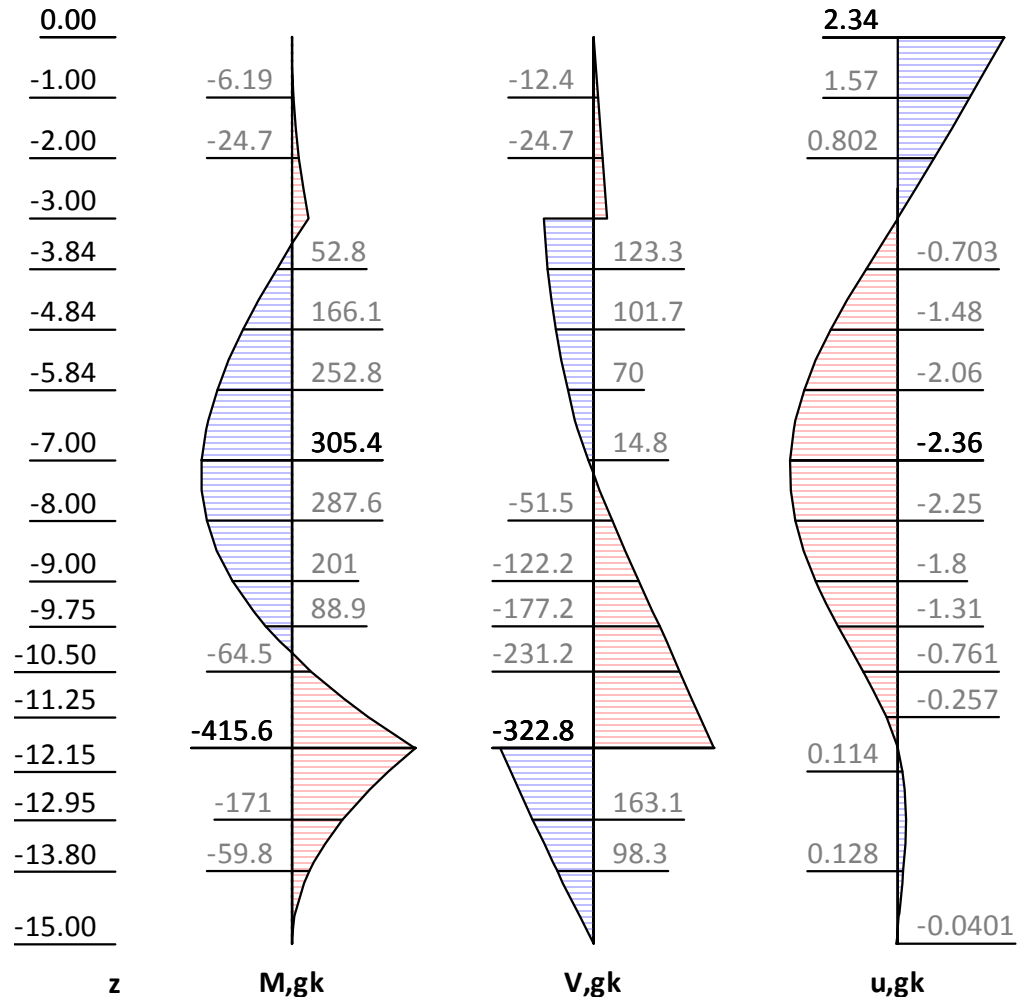


**V-pressure on static system****Internal forces: Permanent, characteristically**

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

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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

0.00

-1.00

-2.00

-3.00

-3.84

-4.84

-5.84

-7.00

-8.00

-9.00

-9.75

-10.50

-11.25

-12.15

-12.95

-13.80

-15.00

z

M,qk

0.0872

-4.8

-45.2

-39.7

-34.7

-29.7

-21.4

-13.8

-10.1

-6.35

-2.6

V,qk

-4.8

-21.1

-44.5

5

5

5

5

5

5

u,qk

-0.544

-0.355

-0.169

0.108

0.195

0.253

0.244

0.211

0.159

0.0932

0.0388

-0.0286

-0.0886

-0.152

-0.242

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

Part:

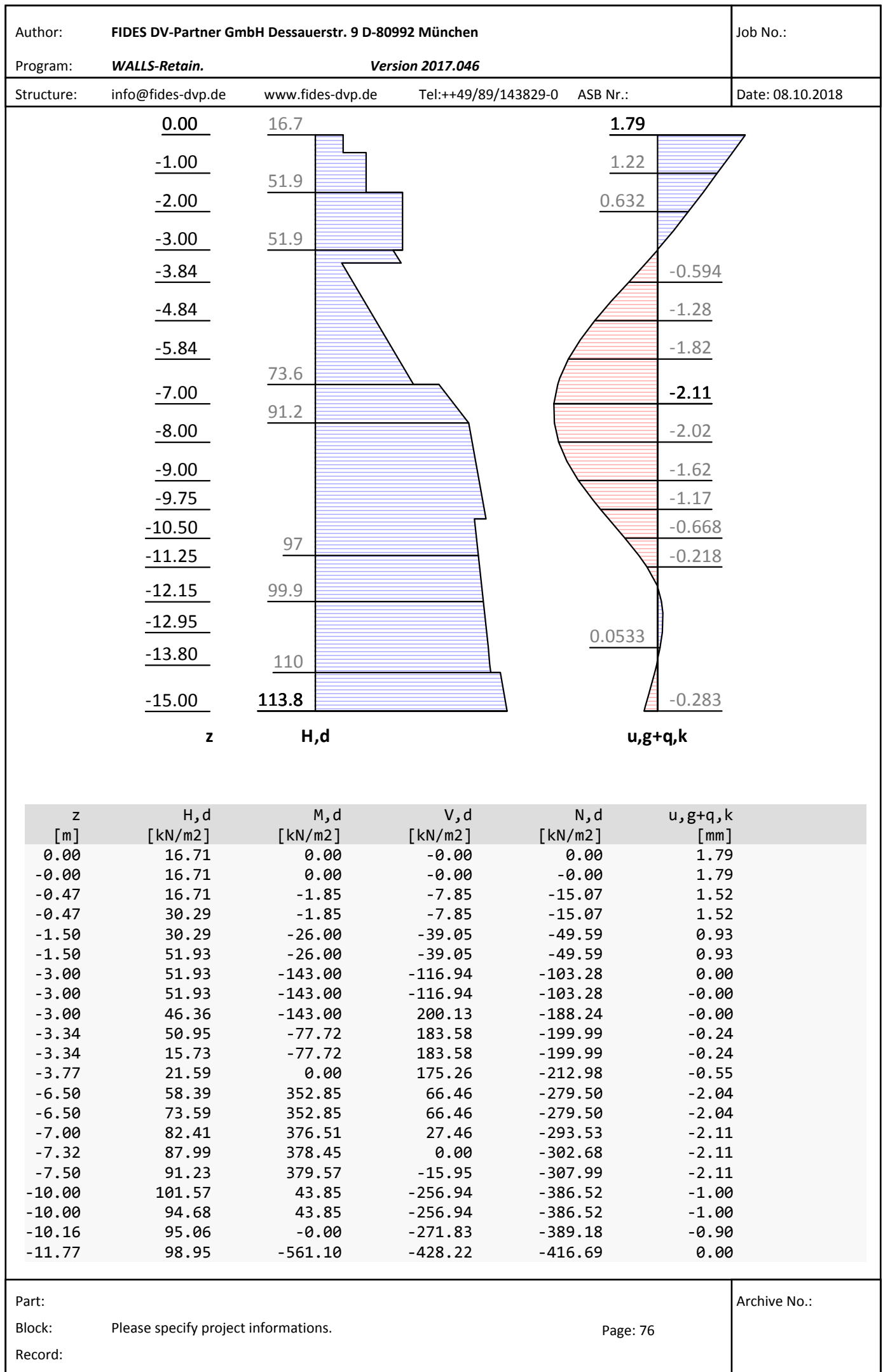
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Structure:	info@fides-dvp.de	www.fides-dvp.de	Tel:++49/89/143829-0	ASB Nr.:	Date: 08.10.2018
z [m]	H, q, k [kN/m2]	M, q, k [kN/m2]	V, q, k [kN/m2]	N, q, k [kN/m2]	u, q, k [mm]
-3.34	0.00	-42.15	5.00	-20.97	0.05
-6.50	0.00	-26.35	5.00	-20.97	0.25
-7.50	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					
0.00					
-1.00	-10.3		-23.9		-32.8
-2.00	-52		-65		-67.5
-3.00					-188.2
-3.84	11.8		174		-214.9
-4.84	172.2		144.8		-242.2
-5.84	296.8		102		-265.8
-7.00	379.6		27.5		-293.5
-8.00	317.3		-62.1		-322.9
-9.00	159.6		-157.4		-353.9
-9.75			-231.7		-378.2
-10.50	-96.5		-304.6		-395
-11.25	-561.1		-428.2		-407.8
-12.15					-423.2
-12.95	-230.8		220.1		-436.8
-13.80	-80.7		132.7		-451.3
-15.00					-493.8
z	M,d	V,d	N,d		
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Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>					Job No.:
Program: <b>WALLS-Retain. Version 2017.046</b>					
Structure: info@fides-dvp.de    www.fides-dvp.de    Tel:++49/89/143829-0    ASB Nr.:					Date: 08.10.2018

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

$R_d = E_{ph,k}/\gamma_{Re} = 3013.12 / 1.400 = 2152.23 \text{ [kN/m]}$

$Ed(U_h,d)/R_d = 766.89 / 2152.23 = 0.356 \text{ [-]}. \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-11.77	-573.62	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * tan(δ,p=-0.07°)		-0.67
-----		
Σ	-0.00	344.60
		(downwards)

Average anchor inclination α<sub>A</sub> = 15.00° >= 15°.

$\text{Verification of vertical forces due to EAB R 9 not required (R 9-5).}$

**Check EAB R 9-1**

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

$V_k \geq B_{vk}: 345.27 \geq 0.67 \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-11.77	-573.62	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * tan(δ,p=-0.07°)		-0.67
B <sub>h,q,k</sub> z=-11.77	5.00	
B <sub>v,q,k</sub> = B <sub>h,k</sub> * tan(δ,p=-0.07°)		0.01

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Program: <b>WALLS-Retain. Version 2017.046</b>					
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Pos.	H	V	
-----			
Σ	-0.00	365.58	(downwards)

Average anchor inclination  $\alpha, A = 15.00^\circ \geq 15^\circ$ .

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.

V<sub>k</sub> ≥ B<sub>vk</sub>: 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:**

l<sub>A</sub> .....: Length of anchor from head to center of grout body.  
 W<sub>k</sub> .....: Res. force from dead weight, loads, cohesion, ...  
 Q<sub>k</sub> .....: 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	θ1	θ2	l <sub>A</sub>	W <sub>k</sub>	Q <sub>k</sub>	Ea1,k	Ea2,k	Ra_cal,d	Sum(A,d)	Ed/Rd
[m]	[°]	[°]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]
-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.)**

		F <sub>x</sub>	F <sub>z</sub>	F	
		[kN/m]	[kN/m]	[kN/m]	
Weight of main failure body	G <sub>k</sub> :	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 <sub>k</sub> :	478.0	426.1	640.4	
Pore water pressure on main body	U <sub>k</sub> :	-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 <sub>k</sub> :	-364.1	938.4	1006.6	

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Program: <b>WALLS-Retain. Version 2017.046</b>					
Structure: info@fides-dvp.de		www.fides-dvp.de		Tel:++49/89/143829-0 ASB Nr.:	
				Date: 08.10.2018	

	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 ....[mm<sup>2</sup>]: X-section are of steel member  
 Ri,d ...[kN]: Ultimate strength of tension member (γ<sub>M</sub>=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  
 DmV<sub>k</sub> .....: Diameter of grout body  
 τ<sub>Gr,k</sub> ...: Average applied skin friction along the grout body (from soil parameters)  
 Ra,k .....: Charact. pullout resistance of the anchor  
 γ<sub>A</sub> .....: Partial safety factor of anchor pullout  
 Ra,d .....: = Ra,k / γ<sub>A</sub>  
 A,d .....: Dimensioning force of the anchor from wall analysis

z	lvk	DmV <sub>k</sub>	τ <sub>Gr,k</sub>	Ra,k	γ <sub>A</sub>	Ra,d	A,d	A,d/Ra,d
[m]	[m]	[mm]	[kN/m <sup>2</sup> ]	[kN]	[-]	[kN]	[kN]	[-]
-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

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Author: FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München							Job No.:			
Program: WALLS-Retain. Version 2017.046										
Structure: info@fides-dvp.de www.fides-dvp.de Tel:++49/89/143829-0 ASB Nr.:							Date: 08.10.2018			
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 occur).										
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	dxM	Weight	Load	Water-	u*b	φ	c	θ
	[m]	b	[m]	[kN/m]	z-κατ. [kN/m]	φορτ. [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)	μ*sin(θ)*	T					
	[kN/m]	[kN/m]	+ c*b [kN/m]	tan(φ)+cos(θ) [-]	[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					
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Συνεισφ. αγκυρίων: Αθρ. ροπών ανατροπής : -53.2 kN\*m/m  
" " resisting : 47.4 kN\*m/m

Αντίσταση  $R_d = (2395.1 \cdot 15.83 + 47.4)$

SLIP-CIRCLE  $\mu = E_d/R_d = 0.40 < 1.0$ : Έλεγχος εκπληρώθηκε.

Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>		Job No.:
Program: <b>WALLS-Retain.</b> <b>Version 2017.046</b>		
Structure: info@fides-dvp.de	www.fides-dvp.de	Tel:++49/89/143829-0 ASB Nr.: Date: 08.10.2018

### Φάση εκκαφής 6 "[6] Situation 4 + +"

LC: όλα τα φορτία Type: BS-T

### Εδαφικό σύστημα με 5 Στρώσεις

Name	Τεχνητές επιχωματώσεις	Αμμόδης	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,θh	[-]	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	Αμμόδης	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,θh	[-]	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 Αμμόδης ΑΡΓΙΛΟΣ:

x [m]	0.00	0.00
z [m]	-6.50	-1.50

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Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:

x [m]	0.00	0.00
z [m]	-6.50	-4.50

Πορεία ανώτερου 4. στρώματος Αμμόδης 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 [	PzA kN/m²	PxE ]	PzE ]	Typ	LC-description Name
1.00	0.00	3.50	0.00	0.00	33.00	0.00	33.00	a	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:  $\phi_{\min} = 40.000$ .

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 redistrib.

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):  $N_{a1}$   
 Anchor forces with safety level of DS-P:  $N_{a1}$   
 Verification of grout body pull out forces:  $N_{a1}$   
 $\delta_{a,A}$ , Anchoring wall : used from soil layer.  
 $\delta_{p,A}$ , Anchoring wall : used from soil layer.

## Earth pressure coefficients kh

$\varphi$	$\alpha$	$\beta$	$\delta$	$k_{0gh}$	$k_{agh}$	$k_{ach}$	$k_{pgh}$	$k_{pch}$	
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	--	--	"

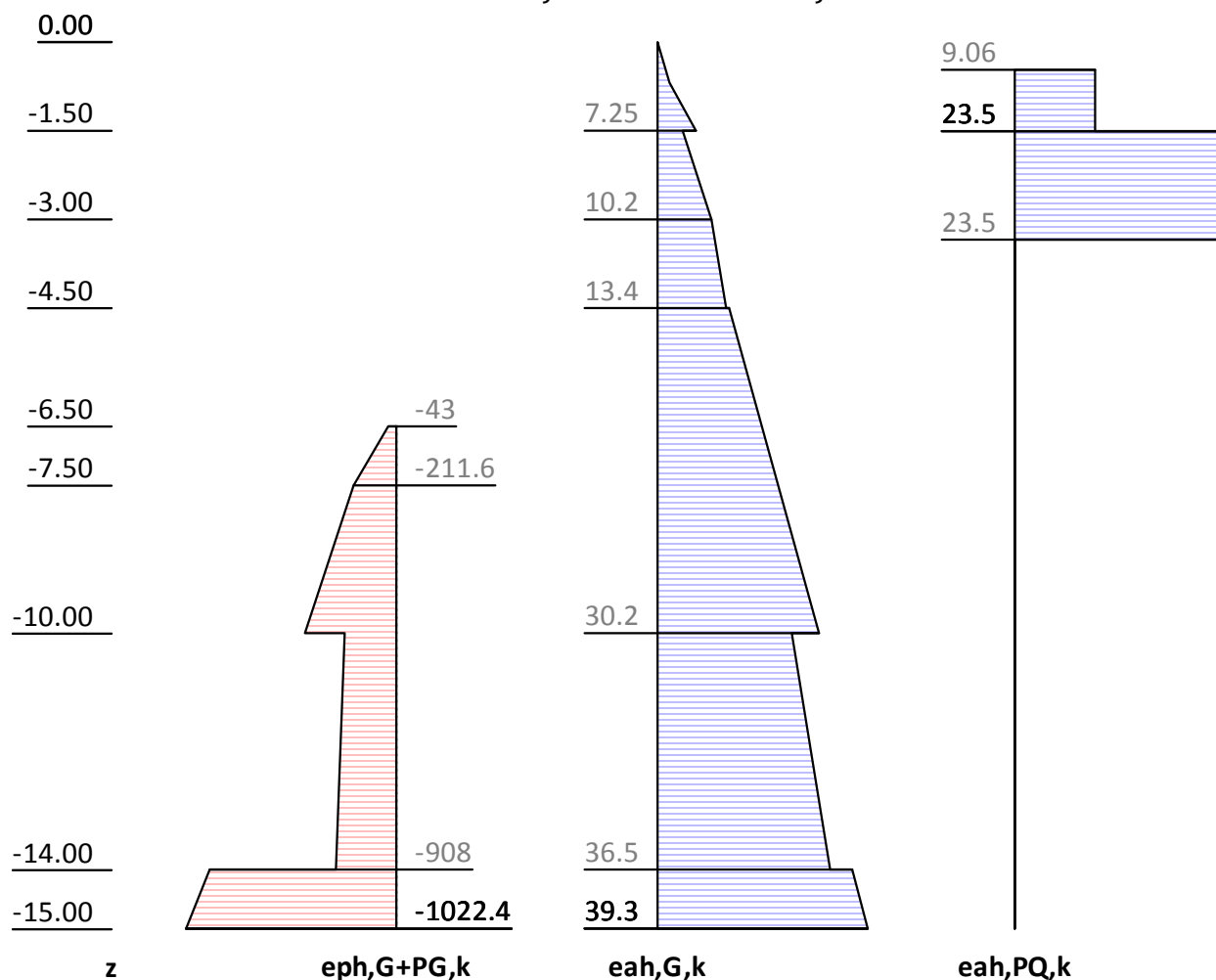
## Μήκος τοίχου

Foot depth for statics:  $z_f = -15.000$ 

## Stress analysis

## Earth pressure, horizontal

Pressures characteristic, no redistribution, continuous wall



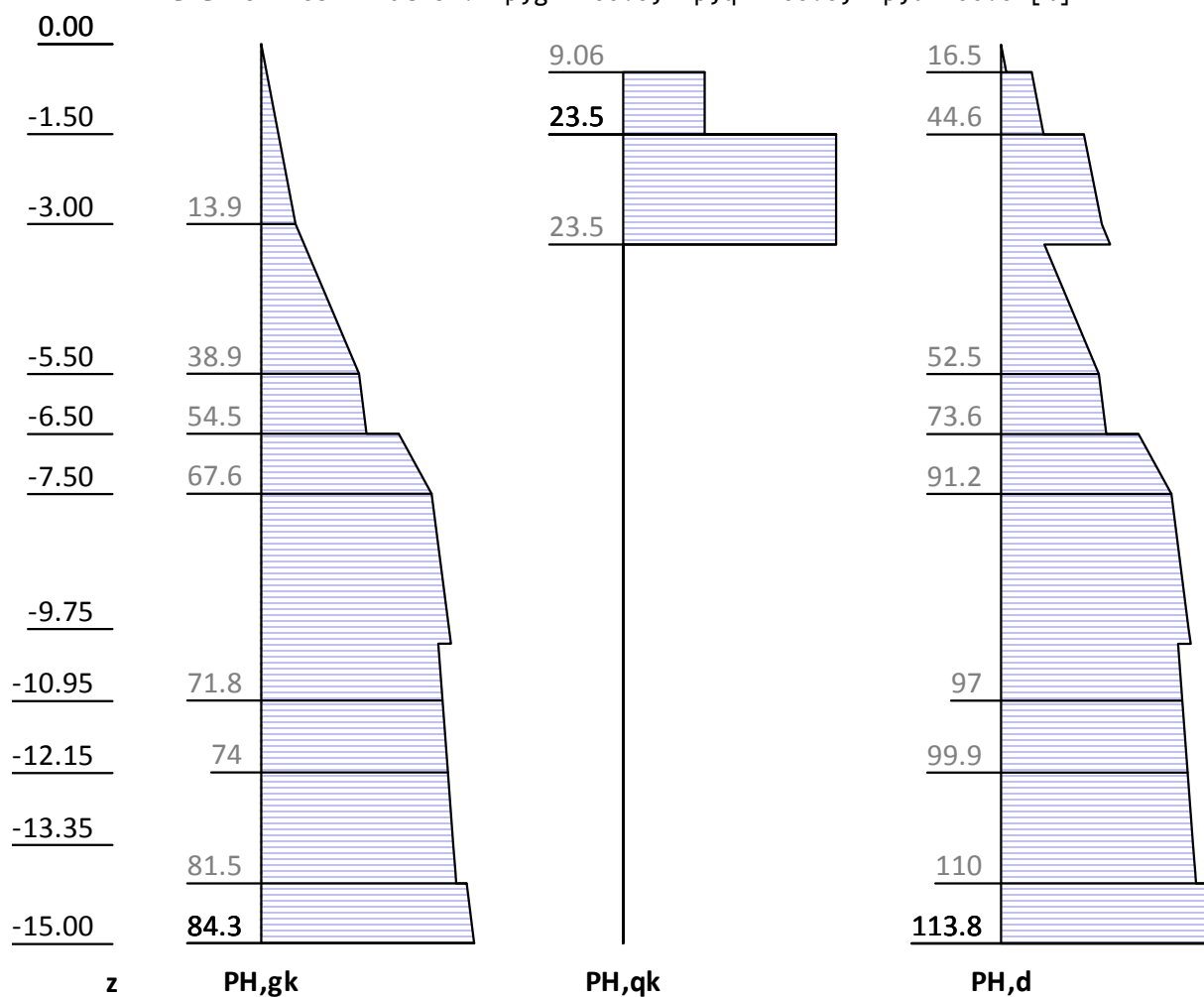
$z$ [m]	$eph,G,k$ [kN/m <sup>2</sup> ]	$eah,G,k$ [kN/m <sup>2</sup> ]	$eah,PQ,k$ [kN/m <sup>2</sup> ]	$eah,d$ [kN/m <sup>2</sup> ]
0.00		0.00		0.00
-0.47		1.52	0.00	2.04
-0.47		1.52	9.06	15.62

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

z [m]	Wp, k [kN/m <sup>2</sup> ]	Wa, k [kN/m <sup>2</sup> ]	W, k [kN/m <sup>2</sup> ]
-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	0.00
-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

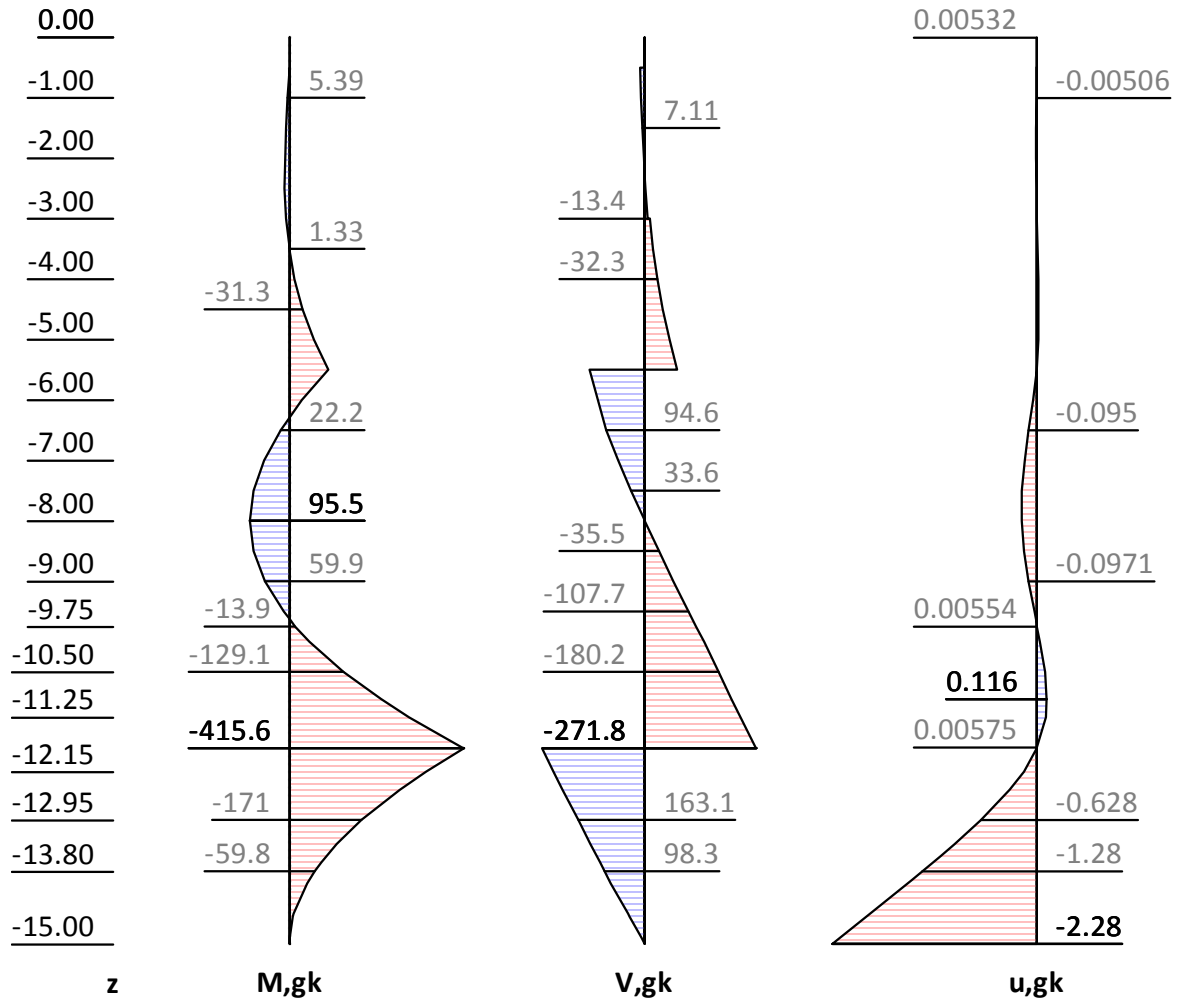
**V-pressure on static system****Internal forces: Permanent, characteristically**

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

**Internal forces: Variable, characteristically**

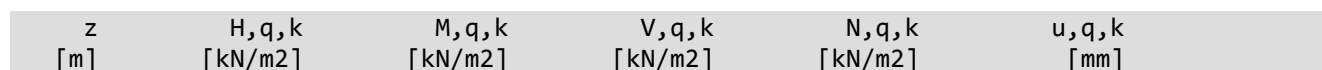
Method EB 82-4 ( $Q = [G+Q] - G$ ).

$z = -0.500$ .  $F_x = -14.744$  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





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Program: WALLS-Retain. Version 2017.046					
Structure: info@fides-dvp.de www.fides-dvp.de Tel:++49/89/143829-0 ASB Nr.:					Date: 08.10.2018
z	H, q, k	M, q, k	V, q, k	N, q, k	u, q, k
[m]	[kN/m2]	[kN/m2]	[kN/m2]	[kN/m2]	[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

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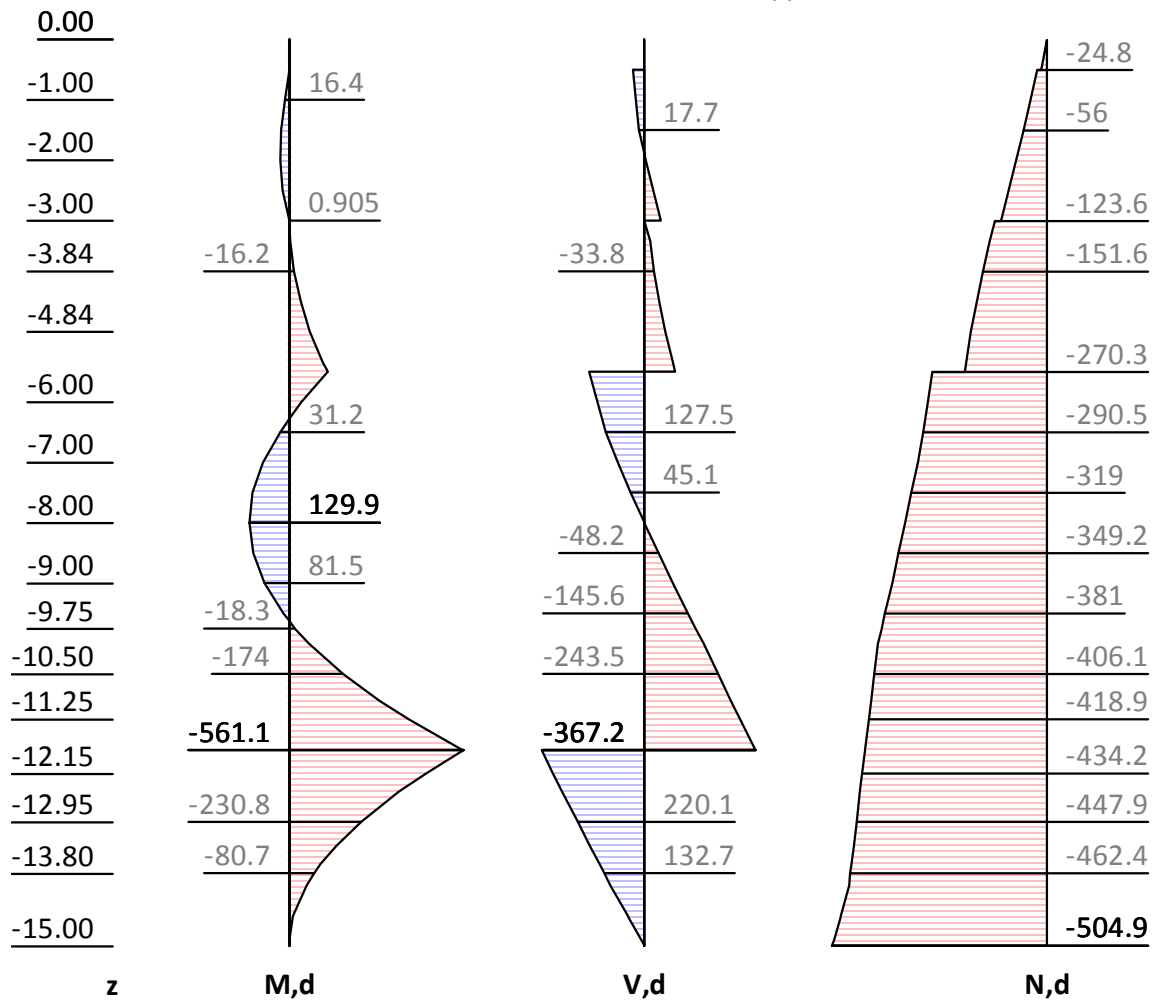
## Internal forces: Design

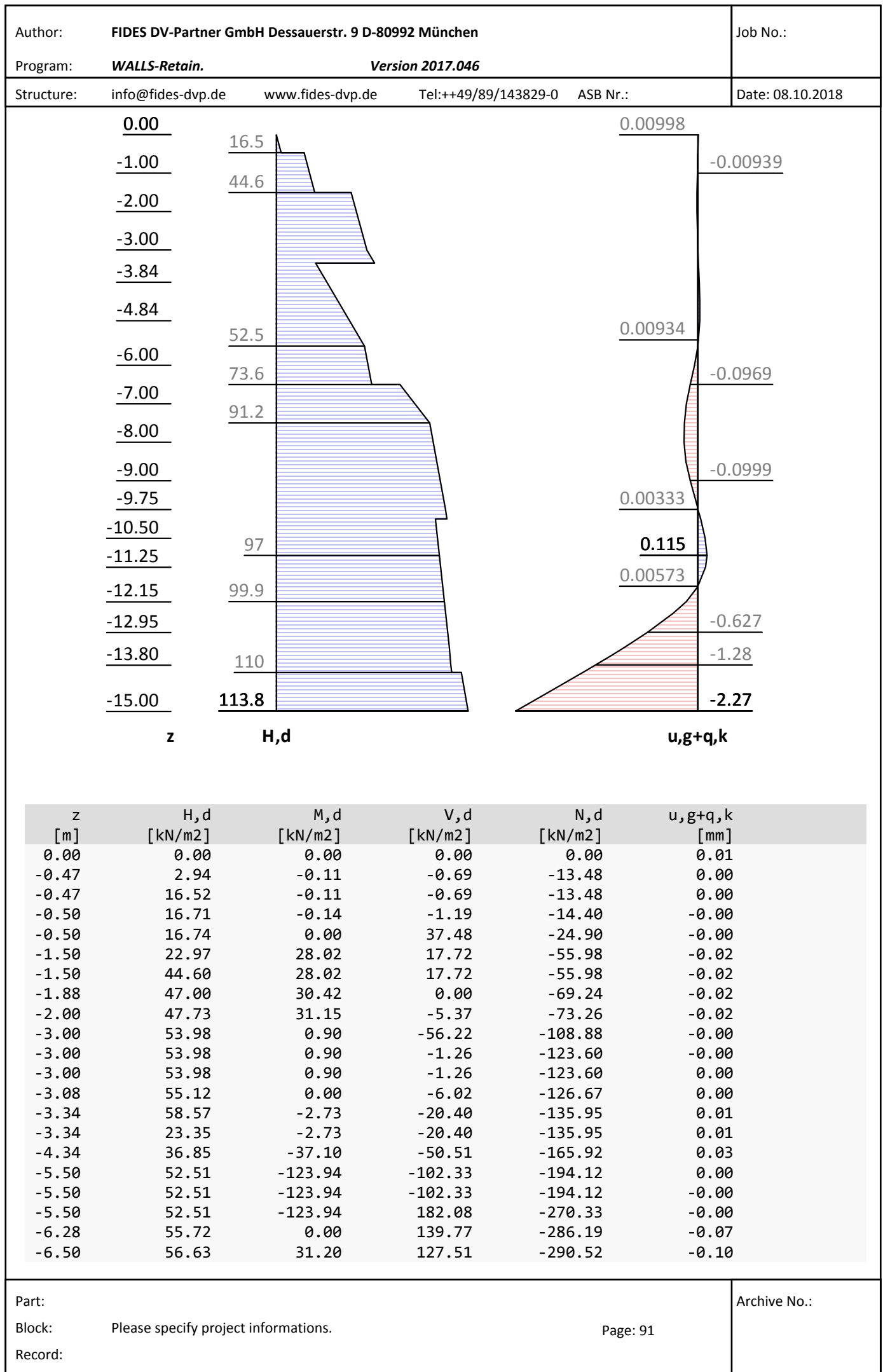
z= -0.500. Fx= -38.746 kN/m Support

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





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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 of earth support**

Check: Mobilizable earth resistance is sufficient for earth support force.

z: -11.77 m

$R_d = E_{ph,k}/\gamma, R_e = 3013.12 / 1.400 = 2152.23 \text{ [kN/m]}$

$E_d(U_h,d)/R_d = 705.84 / 2152.23 = 0.328 \text{ [-]}. \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-11.77	-522.67	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * tan(δ,p=-0.07°)		-0.61
-----		
Σ	-0.00	358.56
		(downwards)

Average anchor inclination α<sub>A</sub> = 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.

$V_k \geq B_{vk}: 359.17 \geq 0.61 \text{ Passes requirement}$

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

Forces up to depth z:-15.00

Pos.	H	V
------	---	---

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Program: <b>WALLS-Retain. Version 2017.046</b>						
Structure: info@fides-dvp.de		www.fides-dvp.de		Tel:++49/89/143829-0 ASB Nr.:		Date: 08.10.2018

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( $\delta$ ,p=-0.07°)		-0.61	
Bh,q,k z=-11.77	-0.16		
Bv,q,k = Bh,k * tan( $\delta$ ,p=-0.07°)		-0.00	
-----			
$\Sigma$	0.00	378.15	
		(downwards)	

Average anchor inclination  $\alpha$ ,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.

V<sub>k</sub> >= B<sub>vk</sub>: 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	$\theta 1$	$\theta 2$	lA	W,k	Q,k	Ea1,k	Ea2,k	Ra_cal,d	Sum(A,d)	Ed/Rd
[m]	[°]	[°]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]
-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

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Structure: info@fides-dvp.de		www.fides-dvp.de		Tel:++49/89/143829-0 ASB Nr.:	
					Date: 08.10.2018

**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 ....[mm<sup>2</sup>]: 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		

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Record:			

Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>					Job No.:				
Program: <b>WALLS-Retain.</b>					Version <b>2017.046</b>				
Structure: info@fides-dvp.de		www.fides-dvp.de		Tel:++49/89/143829-0		ASB Nr.:		Date: 08.10.2018	

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**

lV<sub>k</sub> .....: Length of grout body

D<sub>mV<sub>k</sub></sub> .....: Diameter of grout body

τ<sub>Gr,k</sub> ....: Average applied skin friction along the grout body (from soil parameters)

R<sub>a,k</sub> .....: Charact. pullout resistance of the anchor

γ<sub>A</sub> .....: Partial safety factor of anchor pullout

R<sub>a,d</sub> .....: = R<sub>a,k</sub> / γ<sub>A</sub>

A<sub>d</sub> .....: Dimensioning force of the anchor from wall analysis

z	lV <sub>k</sub>	D <sub>mV<sub>k</sub></sub>	τ <sub>Gr,k</sub>	R <sub>a,k</sub>	γ <sub>A</sub>	R <sub>a,d</sub>	A <sub>d</sub>	A <sub>d</sub> /R <sub>a,d</sub>
[m]	[m]	[mm]	[kN/m <sup>2</sup> ]	[kN]	[-]	[kN]	[kN]	[-]
-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 occur).

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	Width	dxM	Weight	Load	Water-	u*b	φ	c	θ
	[m]	b	[m]	[kN/m]	z-κατ.	φορτ.	[kN/m]	[°]	[kN/m <sup>2</sup> ]	[°]
	[m]	[m]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[°]	[kN/m <sup>2</sup> ]	[°]
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

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

Συνεισφ. κατακόρυφων φορτίων:

Συνεισφ. αγκυρίων: Αθρ. ροπών ανατροπής : -250.7 kN\*m/m  
 " " resisting : 129.3 kN\*m/m

Δράση  $E_d = (948.8 \cdot 15.44 - 250.7)$   
Αντίσταση  $R_d = (2351.3 \cdot 15.44 + 129.3)$

SLIP-CIRCLE  $\mu = E_d/R_d = 0.40 < 1.0$ : Έλεγχος εκπληρώθηκε.



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### Φάση εκκαφής 7 "[7] Situation 5"

LC: όλα τα φορτία Type: BS-T

**Εδαφικό σύστημα με 5 Στρώσεις**

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

Name	Αμμόδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20
γ,R	[kN/m3]	20
γ'	[kN/m3]	10
γ,p	[kN/m3]	20
γ,R,passive	[kN/m3]	20
γ,pw	[kN/m3]	10
φ	[°]	0.1
c	[kN/m2]	100
c,u	[kN/m2]	100
c παθητικό	[kN/m2]	100
δ,a	[°]	0.06666667
δ,p	[°]	-0.06666667
δ,c	[°]	0.03333333
k,agh	[-]	0.9955057
K,ach	[-]	1.994195
K,θh	[-]	0.9982547
K,pgh	[-]	1.004519
K,pch	[-]	2.00583
τ,gr	[kN/m2]	110
Ψ,A,max	[°]	90
k	[cm/s]	5.5e-09

Πορεία πρανούς:

x [m]	0.00	0.00
z [m]	-10.35	0.00

Πορεία ανώτερου 2. στρώματος Αμμόδης ΑΡΓΙΛΟΣ:

x [m]	0.00	0.00
z [m]	-10.35	-1.50

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Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:

x [m] 0.00 0.00

z [m] -10.35 -4.50

Πορεία ανώτερου 4. στρώματος Αμώδης 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	zA	xE	zE	PxA	PzA	PxE	PzE	Typ	LC-description
[m]	[m]	[m]	[m]	[	kN/m <sup>2</sup>		]		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:  $\varphi_{min} = 40.000$ .

Negative earth pressure fractions are set to zero.

**Redistribution of earth pressure**

Shape of redistribution: Triangle (perpend. to wall).

The earth pressure is getting redistrib. to: Excavation level

The earth pressure below the excavation acts without redistrib.

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

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**Αγκύρια**

Anchor checks (lower failure plane): Ναί

Anchor forces with safety level of DS-P: Ναί

Verification of grout body pull out forces: Ναί

δ,a,Anchoring wall : used from soil layer.

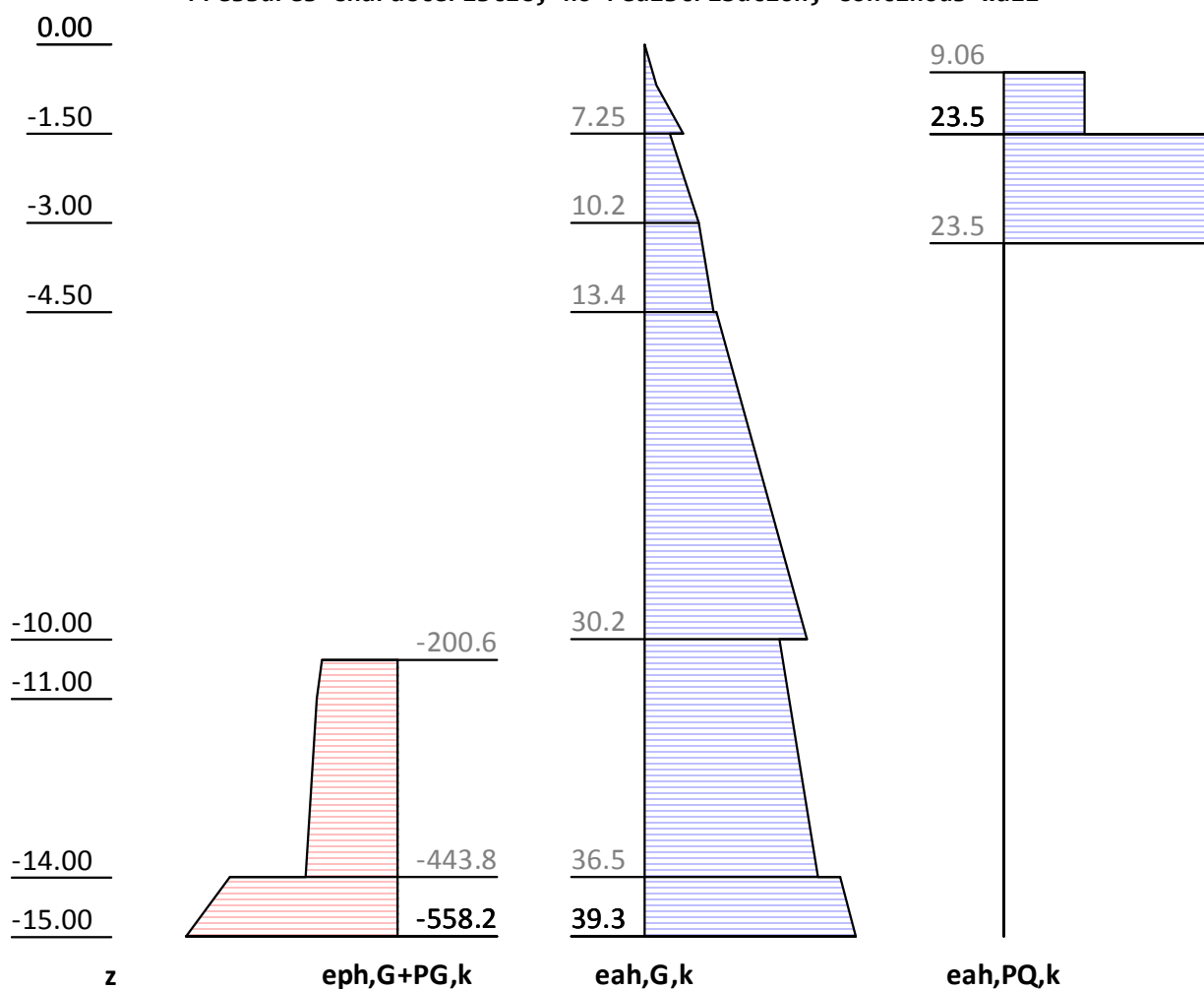
δ,p,Anchoring wall : used from soil layer.

**Earth pressure coefficients kh**

$\varphi$	$\alpha$	$\beta$	$\delta$	$k_{0gh}$	$k_{agh}$	$k_{ach}$	$k_{pgh}$	$k_{pch}$	
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	--	--	Αμμόδης 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	Αμμόδης 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:  $z_f = -15.000$ **Stress analysis****Earth pressure, horizontal**

Pressures characteristic, no redistribution, continuous wall

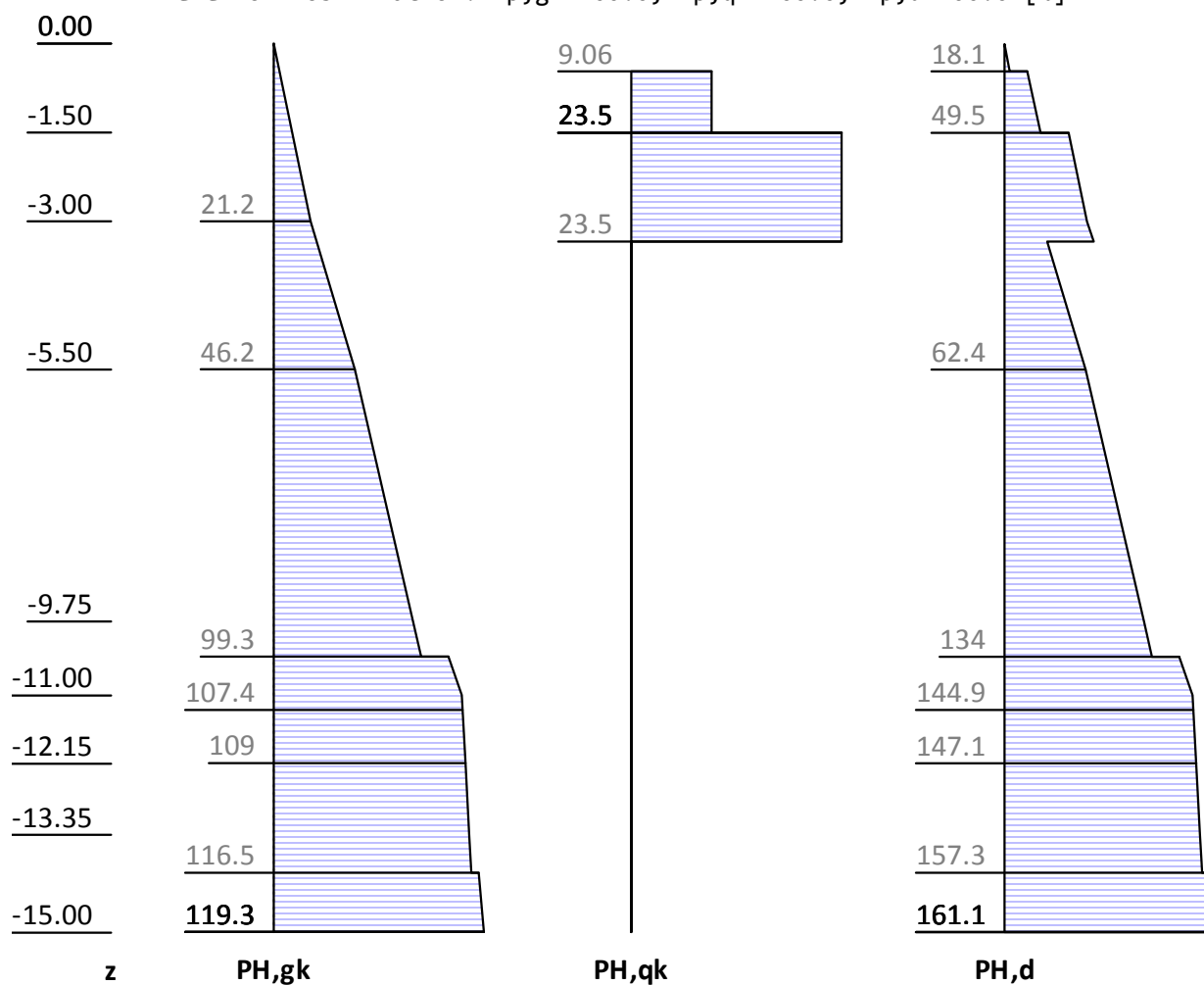


Eph,G,k:-1321.76, Eph,PG,k: 0.00 [kN/m]  
Eah,G,k: 305.81, Eah,PG,k: 0.00, Eah,PQ,k: 52.53, Eah,d: 491.64

z [m]	Wp, k [kN/m <sup>2</sup> ]	Wa, k [kN/m <sup>2</sup> ]	W, k [kN/m <sup>2</sup> ]
-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 [%]



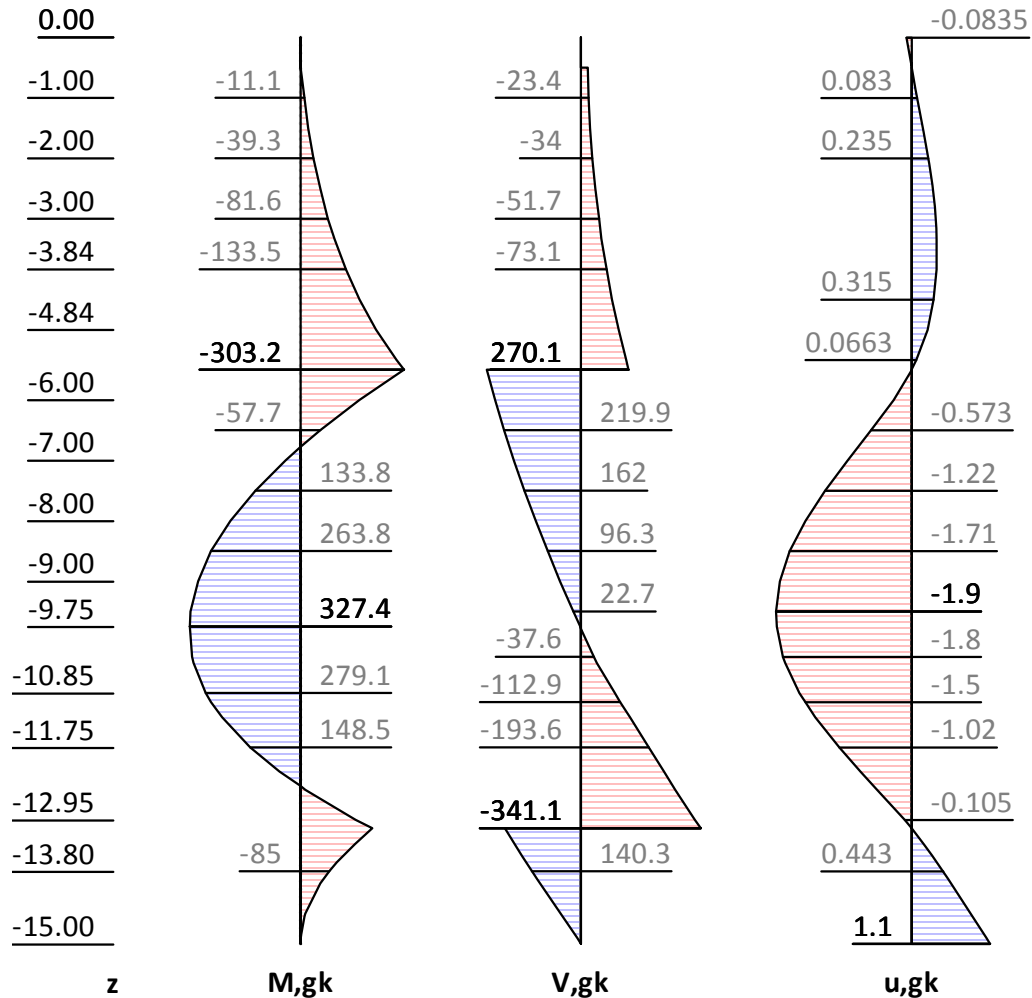
**V-pressure on static system****Internal forces: Permanent, characteristically**

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

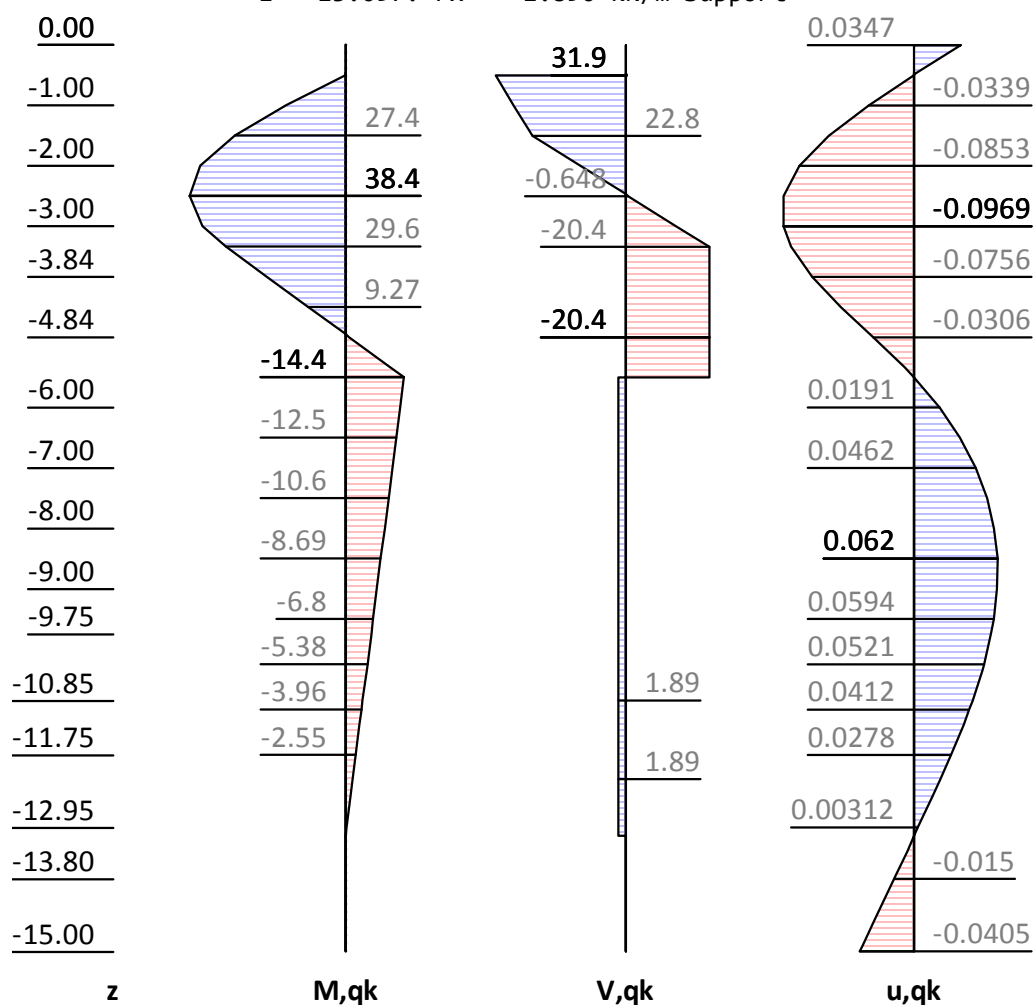
Method EB 82-4 ( $Q = [G+Q] - G$ ).

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

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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
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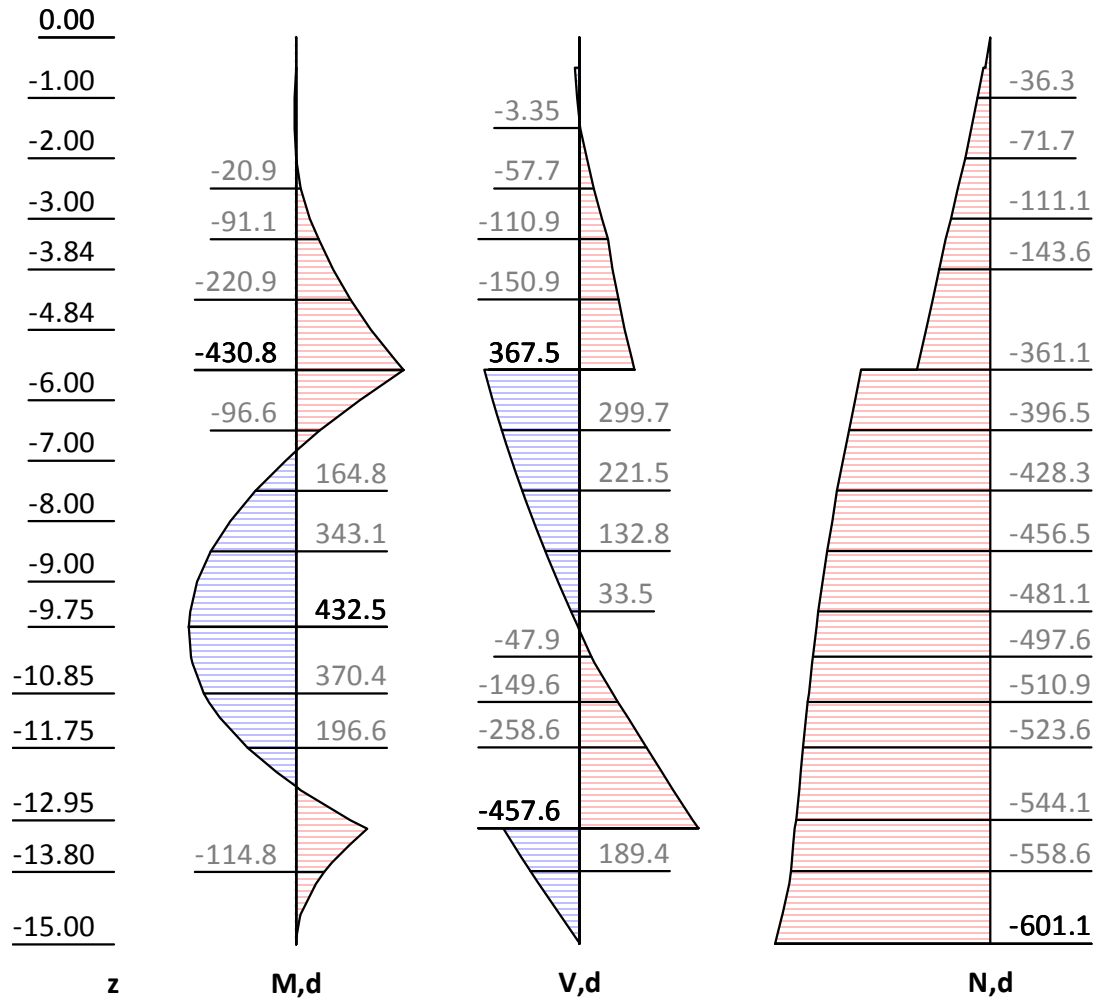
## Internal forces: Design

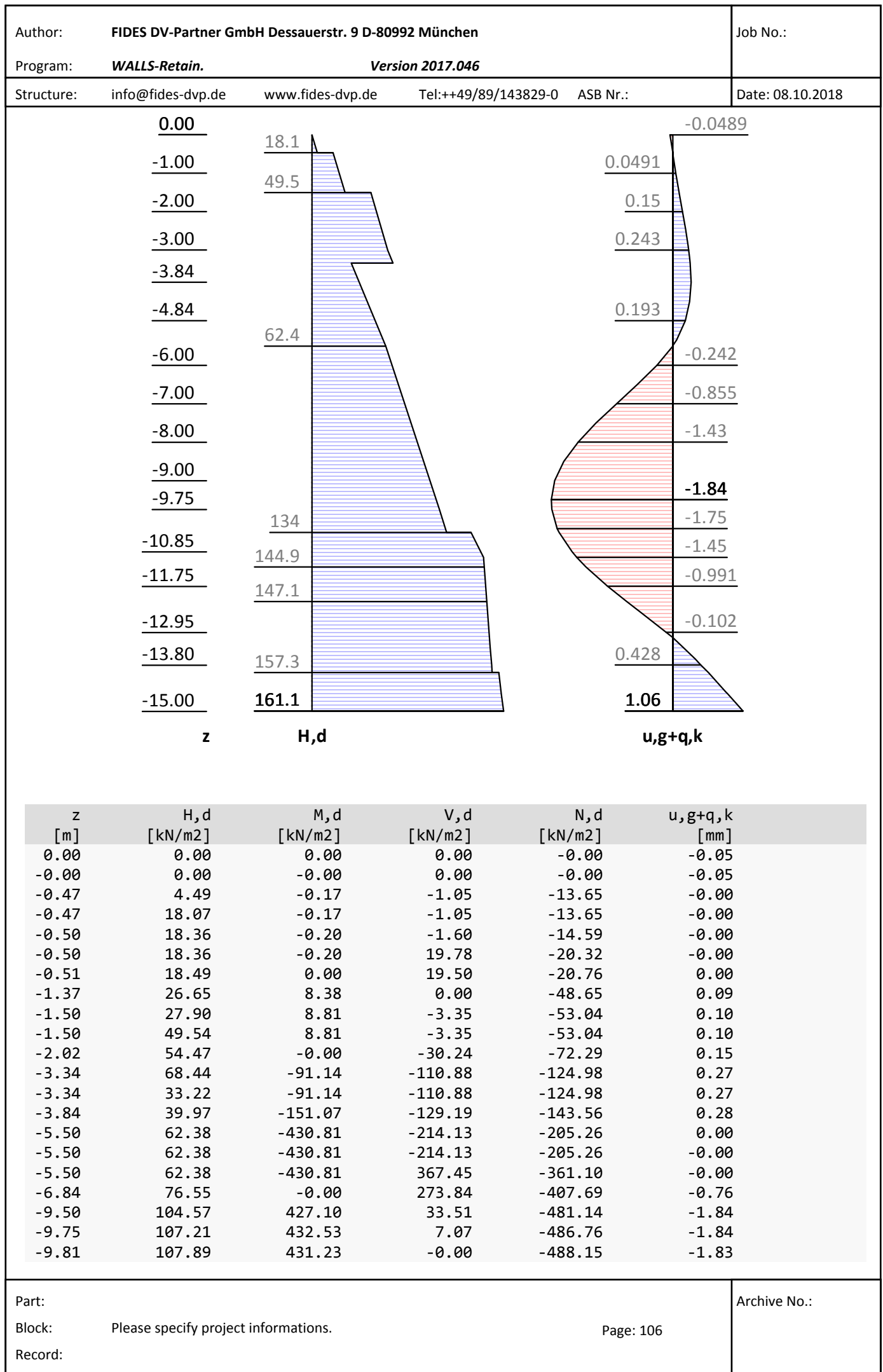
z= -0.500. Fx= -21.383 kN/m Support

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





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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

$R_d = E_{ph,k}/\gamma_{Re} = 1321.76 / 1.400 = 944.11 \text{ [kN/m]}$

$Ed(U_h,d)/R_d = 752.68 / 944.11 = 0.797 [-]$ . 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( $\delta,p=-0.07^\circ$ )		-0.65
-----		
$\Sigma$	0.00	416.99
		(downwards)

Average anchor inclination  $\alpha_A = 15.00^\circ \geq 15^\circ$ .

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.

$V_k \geq B_{vk}: 417.64 \geq 0.65$  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

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				Date: 08.10.2018	

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( $\delta$ ,p=-0.07°)		-0.65	
Bh,q,k z=-13.10	1.89		
Bv,q,k = Bh,k * tan( $\delta$ ,p=-0.07°)		0.00	
-----			
$\Sigma$	-0.00	437.13	
		(downwards)	

Average anchor inclination  $\alpha$ ,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	$\vartheta 1$	$\vartheta 2$	lA	W,k	Q,k	Ea1,k	Ea2,k	Ra_cal,d	Sum(A,d)	Ed/Rd
[m]	[°]	[°]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]
-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                $\vartheta 1$  = 24.31°  
 Inclination upper failure plane                $\vartheta 2$  = 61.31°  
 Inclination separation plane                    $\vartheta 12$  = 90.00°

**Loads / forces (char.)**

	FX	Fz	F
	[kN/m]	[kN/m]	[kN/m]
Weight of main failure body                   G,k:	0.0	-3314.2	3314.2

Part:		Archive No.:
Block:	Please specify project informations.	
Record:		

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Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>					Job No.:
Program: <b>WALLS-Retain. Version 2017.046</b>					
Structure: info@fides-dvp.de    www.fides-dvp.de    Tel:++49/89/143829-0    ASB Nr.:					Date: 08.10.2018

	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
<div style="border: 1px solid black; padding: 2px;">           Verif. of lower failure plane    Ed/Rd = 1.00    &lt; 1.0: Έλεγχος εκπληρώθηκε.         </div>		

**Check of steel tension**

l,tot ...[m]: Total length of anchor incl. excess length at head

As ....[mm<sup>2</sup>]: X-section area 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

Part: Block: Please specify project informations. Record:		Page: 109	Archive No.:
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<b>Check of anchor's soil friction</b> lV <sub>k</sub> .....: Length of grout body D <sub>mV<sub>k</sub></sub> .....: Diameter of grout body τ <sub>Gr,k</sub> ....: Average applied skin friction along the grout body (from soil parameters) R <sub>a,k</sub> .....: Charact. pullout resistance of the anchor γ <sub>A</sub> .....: Partial safety factor of anchor pullout R <sub>a,d</sub> .....: = R <sub>a,k</sub> / γ <sub>A</sub> A <sub>d</sub> .....: Dimensioning force of the anchor from wall analysis																																																																																																																																																																																																																																				
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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	24.38	-16.44	112.70	0.737802	152.75																																																																																																																																																																																																																															
2	64.29	-36.92	112.74	0.818090	137.80																																																																																																																																																																																																																															
Part: Block: Please specify project informations. Record:							Archive No.:  Page: 110																																																																																																																																																																																																																													

Συνεισφ. αγκυρίων: Αθρ. ροπών ανατροπής : -1973.2 kN\*m/m  
 " " resisting : 975.1 kN\*m/m

Αντίσταση  $R_d = (1878.9 \cdot 15.77 + 975.1)$

SLIP-CIRCLE  $\mu = E_d/R_d = 0.65 < 1.0$ : Έλεγχος εκπληρώθηκε.

## ΠΑΡΑΡΤΗΜΑ

### 8.5 Αποτελέσματα ανάλυσης

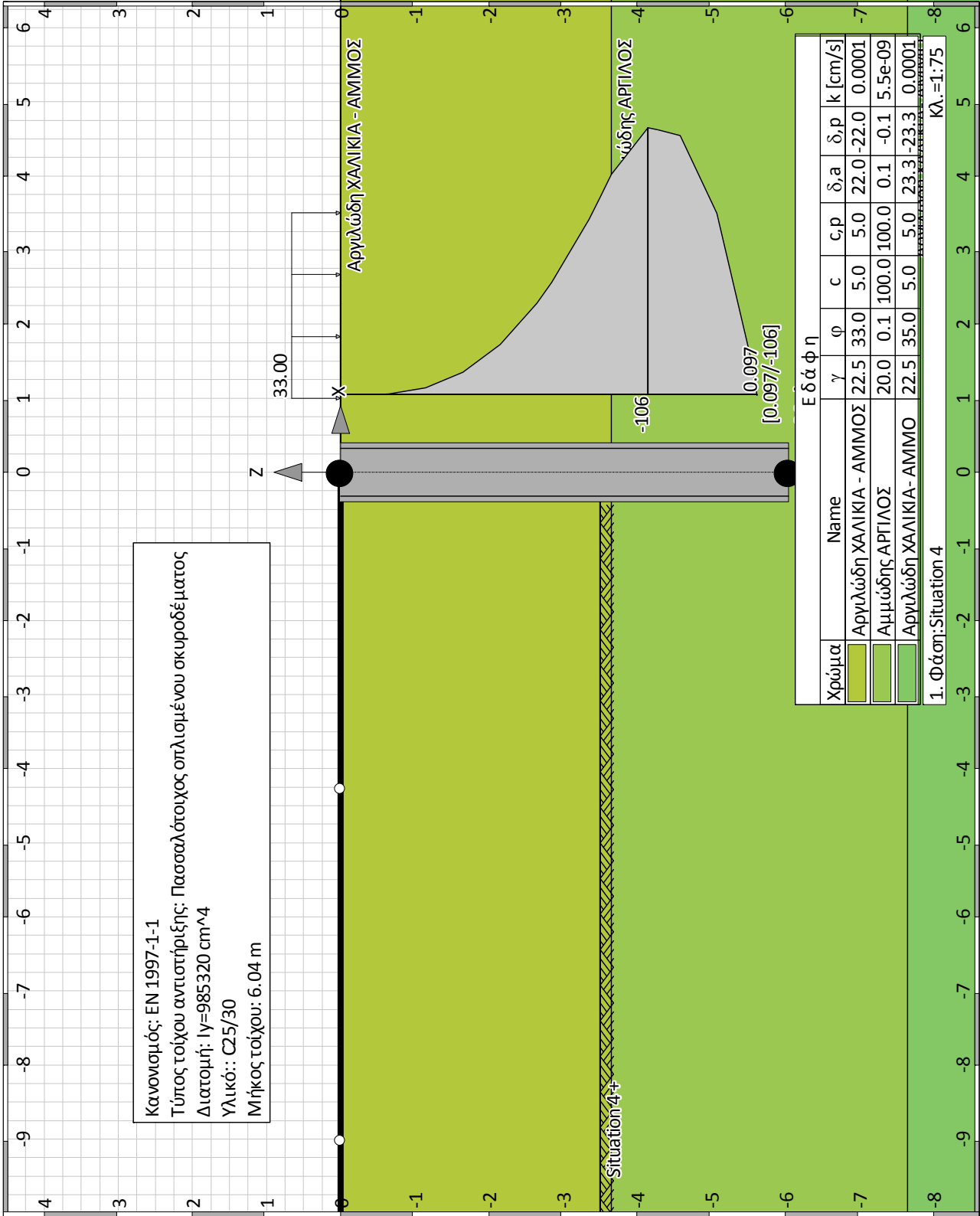
#### 8.5.1 Στατικές Συνθήκες

- i) Αντιστηριζόμενο ύψος 3,60m

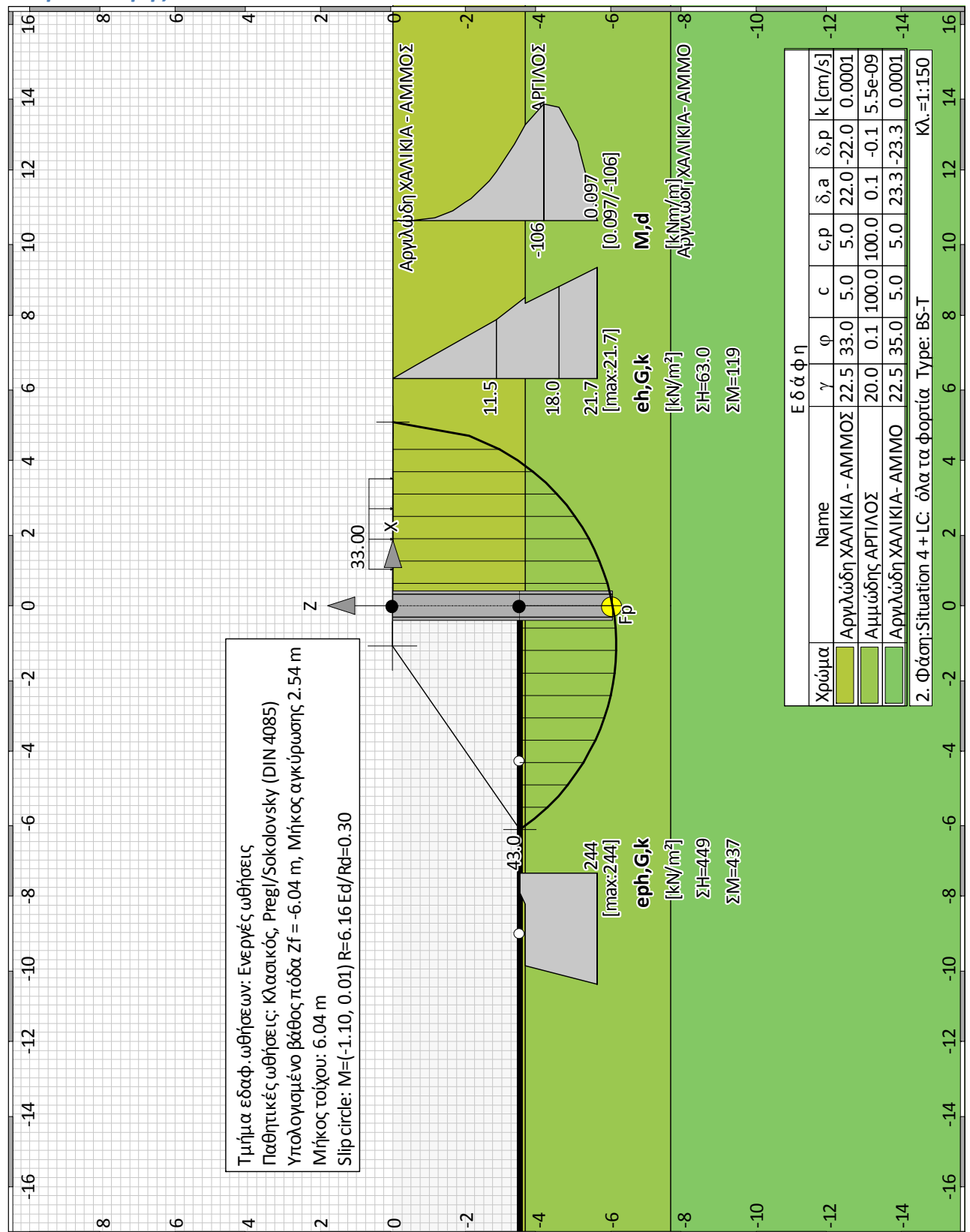


Summary of all stages

Φάση εκσκαφής 0 "Situation 4"



## Φάση εκσκαφής 1 "Situation 4 +"



Author: FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München								Job No.:	
Program: WALLS-Retain. Version 2017.046									
Structure: info@fides-dvp.de www.fides-dvp.de Tel:++49/89/143829-0 ASB Nr.:								Date: 08.10.2018	
<b>Κανονισμός για Ανάλυση και Διαστασιολόγηση</b>									
Διαστασ. ωπλισμ.σκυροδ.: EN 1992-1-1									
Γεωτεχν.Κανονισμός : EN 1997 (rev.12)_user									
National Annex: EN 1997-1									
<b>Safety factors:</b>									
<b>Earth pressure onto wall: [GEO] A1 M1 R2</b>									
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
<b>ΚΕ-μηχανισμός: [GEO] A2 M2 R3</b>									
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				
<b>Θραύση εδάφους: [GEO] A1 M1 R2</b>									
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						
<b>Ολίσθηση: [GEO] A1 M1 R2</b>									
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						
<b>Θραύση εδάφους: [GEO] A1 M1 R2</b>									
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						

Part:								Archive No.:	
Block: Please specify project informations.								Page: 3	
Record:									

Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>								Job No.:	
Program: <b>WALLS-Retain.</b>								Version <b>2017.046</b>	
Structure:		info@fides-dvp.de		www.fides-dvp.de		Tel:++49/89/143829-0		ASB Nr.:	
								Date: 08.10.2018	

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

**Κύκλος ολίσθησης: [GEO] A2 M2 R3**

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

**Hydraulic heave: [HYD] A1 M1 R1**

$\gamma$ -	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**

$\gamma$ -	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**

$\gamma$ -	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

$\gamma_{Re,red}$  (EAB EB14-3):  $N_{ai}$ ,  $\eta=0.80$   
 $\gamma_{Re,red}$  (EAB EB22-6):  $N_{ai}$ ,  $E_{0h} > 0\%$ :  $\eta = 0.60 / 0.80$

**System values**

**Τοίχος**

Τύπος τοίχου αντιστήριξης: Πασσαλότοιχος οπλισμένου σκυροδέματος  
 Διατομή:  $I_y=985320 \text{ cm}^4$   
 Υλικό:: C25/30  
 Ίδιο βάρος:  $25.000 \text{ [kN/m}^3\text{]}$

**Σημεία τοίχου**

z [m]	d [m]	E [MN/m <sup>2</sup> ]	$I_y$ [cm <sup>4</sup> /m]	$E \cdot I_y$ [MNm <sup>2</sup> ]	A [cm <sup>2</sup> /m]
0.00	80.0	31500.0	985320	310.4	6940
-6.04	80.0	31500.0	985320	310.4	6940

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Block: Please specify project informations.		Page: 4	
Record:			

Author: FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München				Job No.:	
Program: WALLS-Retain.		Version 2017.046			
Structure: info@fides-dvp.de		www.fides-dvp.de		Tel:++49/89/143829-0 ASB Nr.:	
				Date: 08.10.2018	

### Φάση εκσκαφής 1 "[1] Situation 4 +"

LC: όλα τα φορτία Type: BS-T

#### Εδαφικό σύστημα με 3 Στρώσεις

Name	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ	Αμμόδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟΣ
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,θh	[-] 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 Αμμόδης ΑΡΓΙΛΟΣ:

z= -3.65

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟΣ:

z= -7.65

#### Επιφ. φορτία:

##### Φορτία

xA	zA	xE	zE	PxA	PzA	PxE	PzE	Typ	LC-description
[m]	[m]	[m]	[m]	[	kN/m²		]		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.

Part:		Archive No.:
Block:	Please specify project informations.	
Record:		

Page: 5

Author: FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München					Job No.:																																																																							
Program: WALLS-Retain. Version 2017.046																																																																												
Structure: info@fides-dvp.de www.fides-dvp.de Tel:++49/89/143829-0 ASB Nr.:					Date: 08.10.2018																																																																							
<div>Redistribution of earth pressure</div> <div>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.</div> <div>Παθητικές ωθήσεις</div> <div>Method of calculation: Κλασικός, Pregl/Sokolovsky (DIN 4085).</div> <div>Options for water pressure</div> <div>Στήριξη πόδα</div> <div>Πακτωμένη στήριξη κατά Blum</div> <div>Earth pressure coefficients kh</div> <table><thead><tr><th>φ</th><th>α</th><th>β</th><th>δ</th><th>k0gh</th><th>kagh</th><th>kach</th><th>kpgh</th><th>kpch</th><th></th></tr></thead><tbody><tr><td>33.0</td><td>0.0</td><td>0.0</td><td>-22.0</td><td>--</td><td>--</td><td>--</td><td>7.496</td><td>-8.600</td><td>Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ</td></tr><tr><td>33.0</td><td>0.0</td><td>0.0</td><td>22.0</td><td>--</td><td>0.245</td><td>0.855</td><td>--</td><td>--</td><td>"</td></tr><tr><td>0.1</td><td>0.0</td><td>0.0</td><td>-0.1</td><td>--</td><td>--</td><td>--</td><td>1.005</td><td>-2.006</td><td>Αμμώδης ΑΡΓΙΛΟΣ</td></tr><tr><td>0.1</td><td>0.0</td><td>0.0</td><td>0.1</td><td>--</td><td>0.996</td><td>1.994</td><td>--</td><td>--</td><td>"</td></tr><tr><td>35.0</td><td>0.0</td><td>0.0</td><td>-23.3</td><td>--</td><td>--</td><td>--</td><td>9.147</td><td>-10.104</td><td>Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ</td></tr><tr><td>35.0</td><td>0.0</td><td>0.0</td><td>23.3</td><td>--</td><td>0.224</td><td>0.813</td><td>--</td><td>--</td><td>"</td></tr></tbody></table> <div>Μήκος τοίχου</div> <div>N: 1 Z: -4.550 M,Στήριξη πόδα,d: 104.27. Wall too short? Ναι</div> <div>N: 2 Z: -7.550 M,Στήριξη πόδα,d: -616.15. Wall too short? Όχι</div> <div>N: 3 Z: -5.540 M,Στήριξη πόδα,d: 12.92. Wall too short? Ναι</div> <div>N: 4 Z: -6.887 M,Στήριξη πόδα,d: -339.52. Wall too short? Όχι</div> <div>N: 5 Z: -5.984 M,Στήριξη πόδα,d: -73.39. Wall too short? Όχι</div> <div>N: 6 Z: -5.687 M,Στήριξη πόδα,d: -12.38. Wall too short? Όχι</div> <div>N: 7 Z: -5.588 M,Στήριξη πόδα,d: 4.92. Wall too short? Ναι</div> <div>N: 8 Z: -5.654 M,Στήριξη πόδα,d: -6.52. Wall too short? Όχι</div> <div>N: 9 Z: -5.610 M,Στήριξη πόδα,d: 1.21. Wall too short? Ναι</div> <div>N: 10 Z: -5.640 M,Στήριξη πόδα,d: -3.93. Wall too short? Όχι</div> <div>N: 11 Z: -5.620 M,Στήριξη πόδα,d: -0.47. Wall too short? Όχι</div> <div>N: 12 Z: -5.613 M,Στήριξη πόδα,d: 0.66. Wall too short? Ναι</div> <div>N: 13 Z: -5.618 M,Στήριξη πόδα,d: -0.10. Wall too short? Όχι</div> <div>Foot depth for statics: zf = -5.618</div>							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	--	--	"
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	--	--	"																																																																			
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35.0	0.0	0.0	23.3	--	0.224	0.813	--	--	"																																																																			
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Block: Please specify project informations.					Page: 6																																																																							
Record:																																																																												

**Stress analysis****Earth pressure, horizontal**

Pressures characteristic, no redistribution, continuous wall

0.00-2.85-3.50-5.62

z

eph,G+PG,k

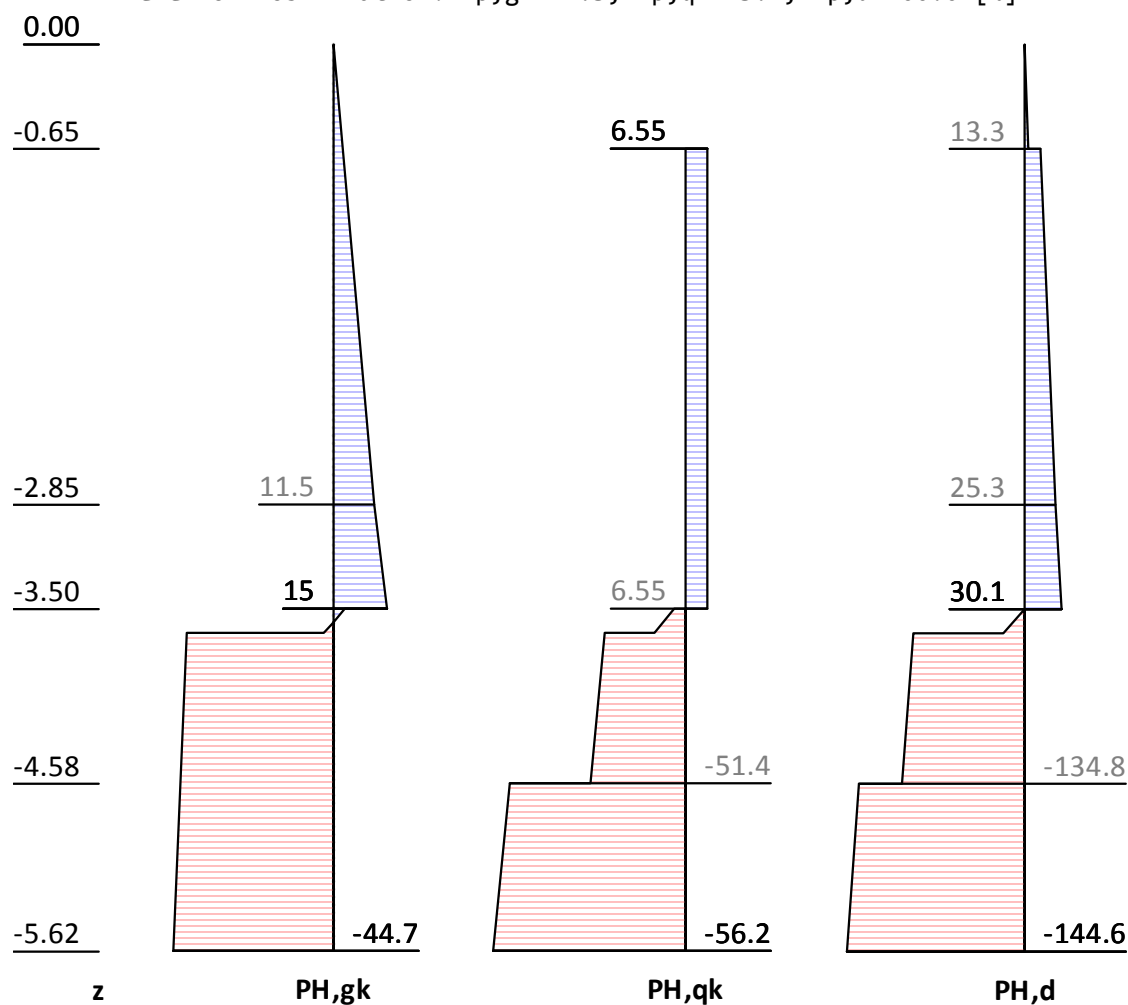
eah,G,k

eah,PQ,k

z [m]	eph,G,k [kN/m <sup>2</sup> ]	eah,G,k [kN/m <sup>2</sup> ]	eah,PQ,k [kN/m <sup>2</sup> ]	eah,d [kN/m <sup>2</sup> ]
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

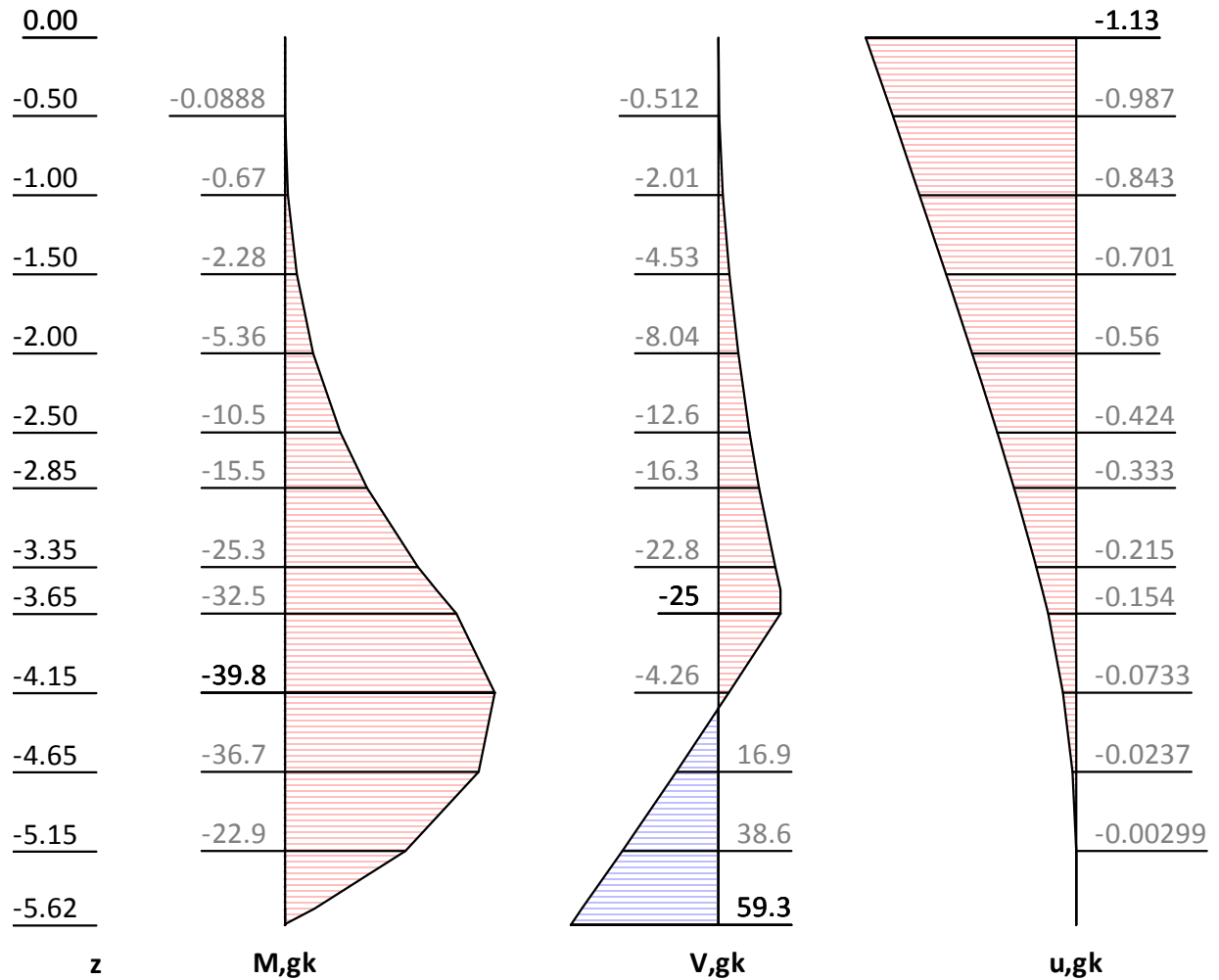
Eph,G,k: -448.60, Eph,PG,k: 0.00 [kN/m]

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:  $E_{p,gk}$  27.3,  $E_{p,qk}$  23.1,  $E_{p,d}$  100.0 [%]

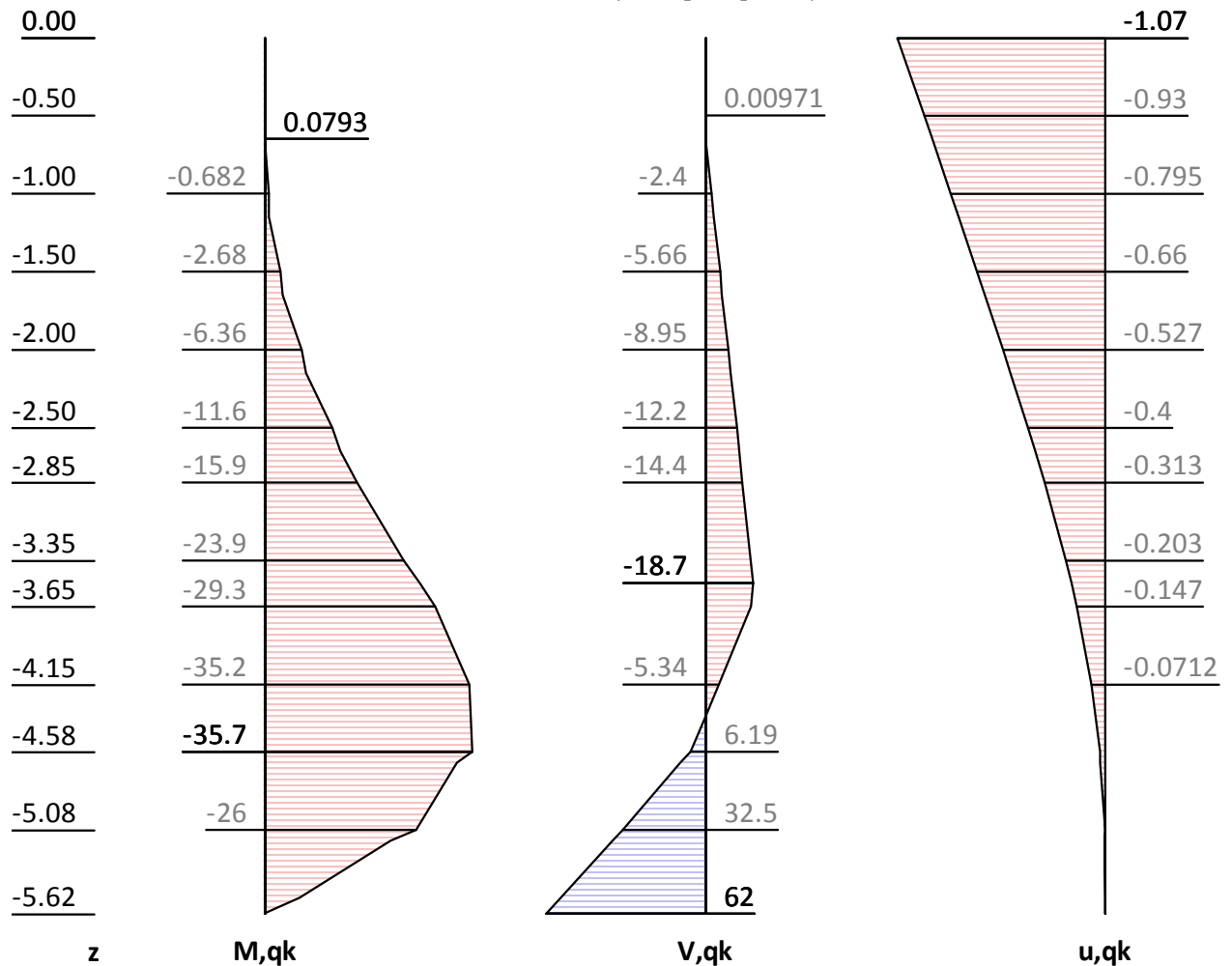
z [m]	PH,gk [kN/m2]	PH,qk [kN/m2]	PH,d [kN/m2]
0.00	0.00	0.00	0.00
-0.65	2.61	0.00	3.53
-0.65	2.61	6.55	13.34
-3.50	15.04	6.55	30.12
-3.50	3.31	-3.37	-0.60
-3.58	0.00	-6.56	-9.86
-3.65	-2.75	-9.21	-17.55
-3.65	-40.93	-23.58	-90.67
-4.58	-42.70	-27.89	-99.54
-4.58	-42.70	-51.37	-134.76
-5.62	-44.68	-56.18	-144.64



**V-pressure on static system****Internal forces: Permanent, characteristically**

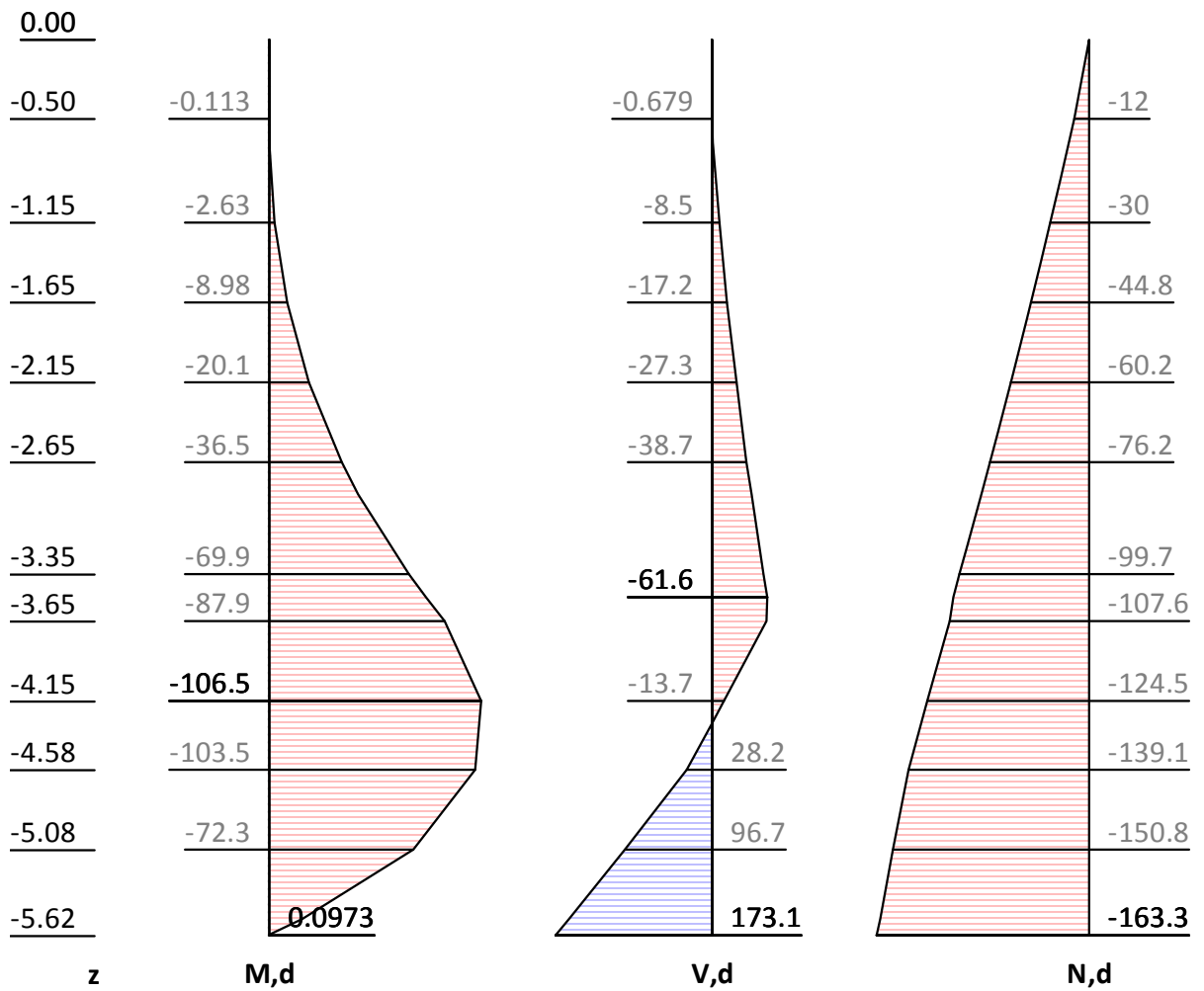
$z$ [m]	$H, g, k$ [kN/m²]	$M, g, k$ [kN/m²]	$V, g, k$ [kN/m²]	$N, g, k$ [kN/m²]	$u, g, k$ [mm]
0.00	0.00	0.00	0.00	0.00	-1.13
-3.50	15.04	-28.78	-24.93	-71.35	-0.18
-3.50	3.31	-28.78	-24.93	-71.35	-0.18
-3.58	0.00	-30.83	-24.95	-72.78	-0.17
-3.65	-2.75	-32.54	-24.97	-73.97	-0.15
-3.65	-40.93	-32.54	-24.97	-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

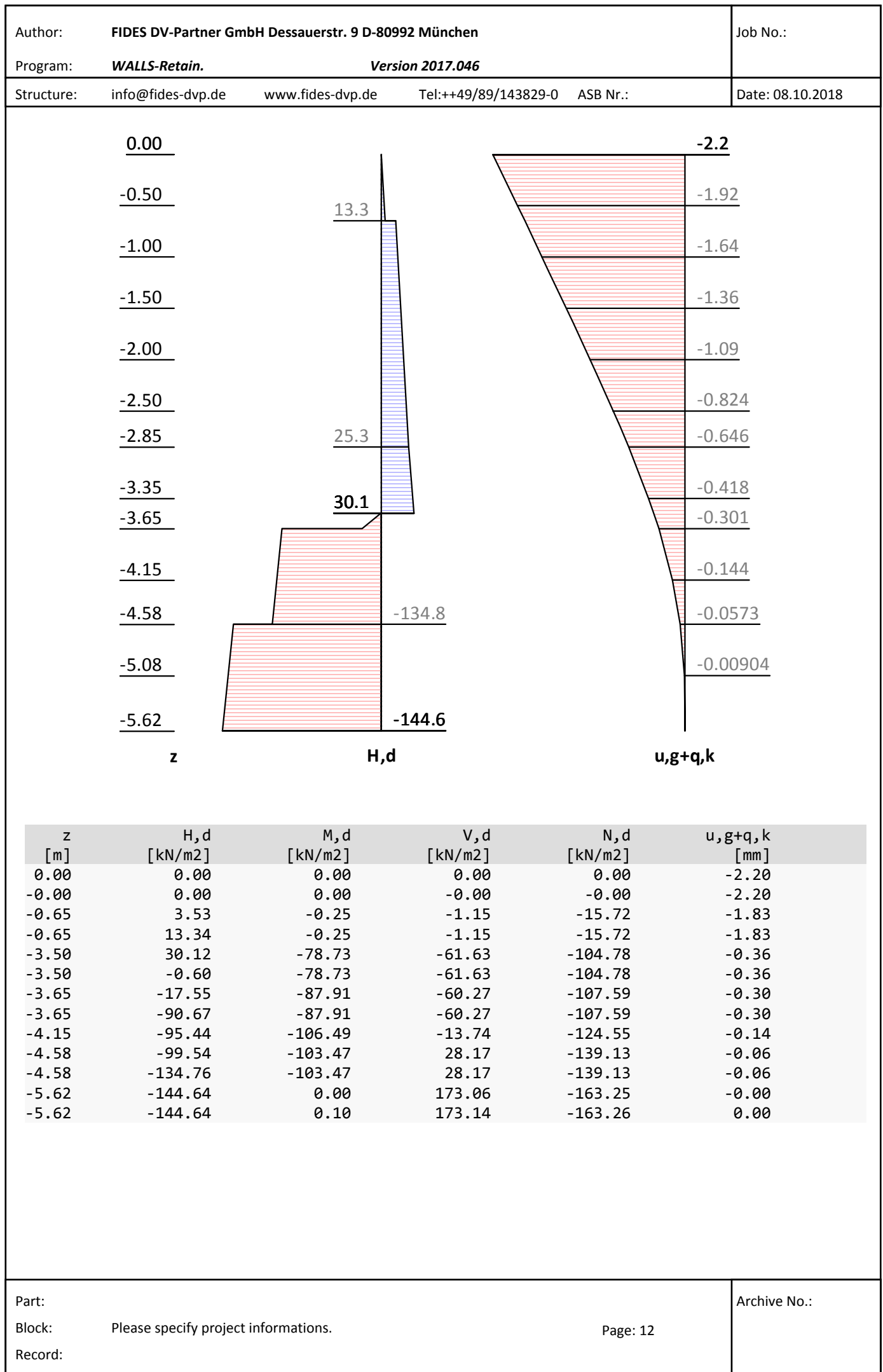
## Internal forces: Variable, characteristically

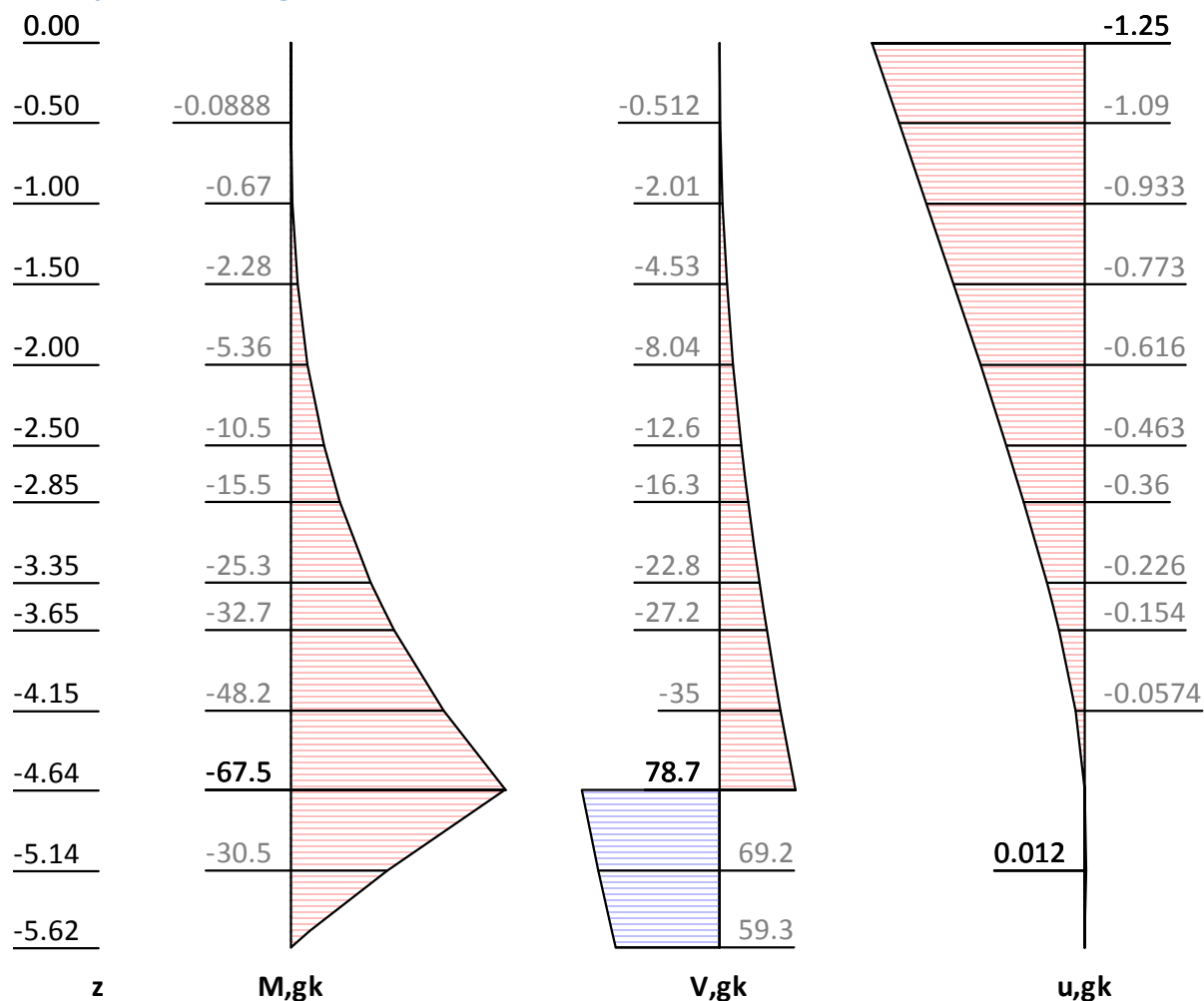
Method EB 82-4 ( $Q = [G+Q] - G$ ).

z [m]	H, q, k [kN/m <sup>2</sup> ]	M, q, k [kN/m <sup>2</sup> ]	V, q, k [kN/m <sup>2</sup> ]	N, q, k [kN/m <sup>2</sup> ]	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

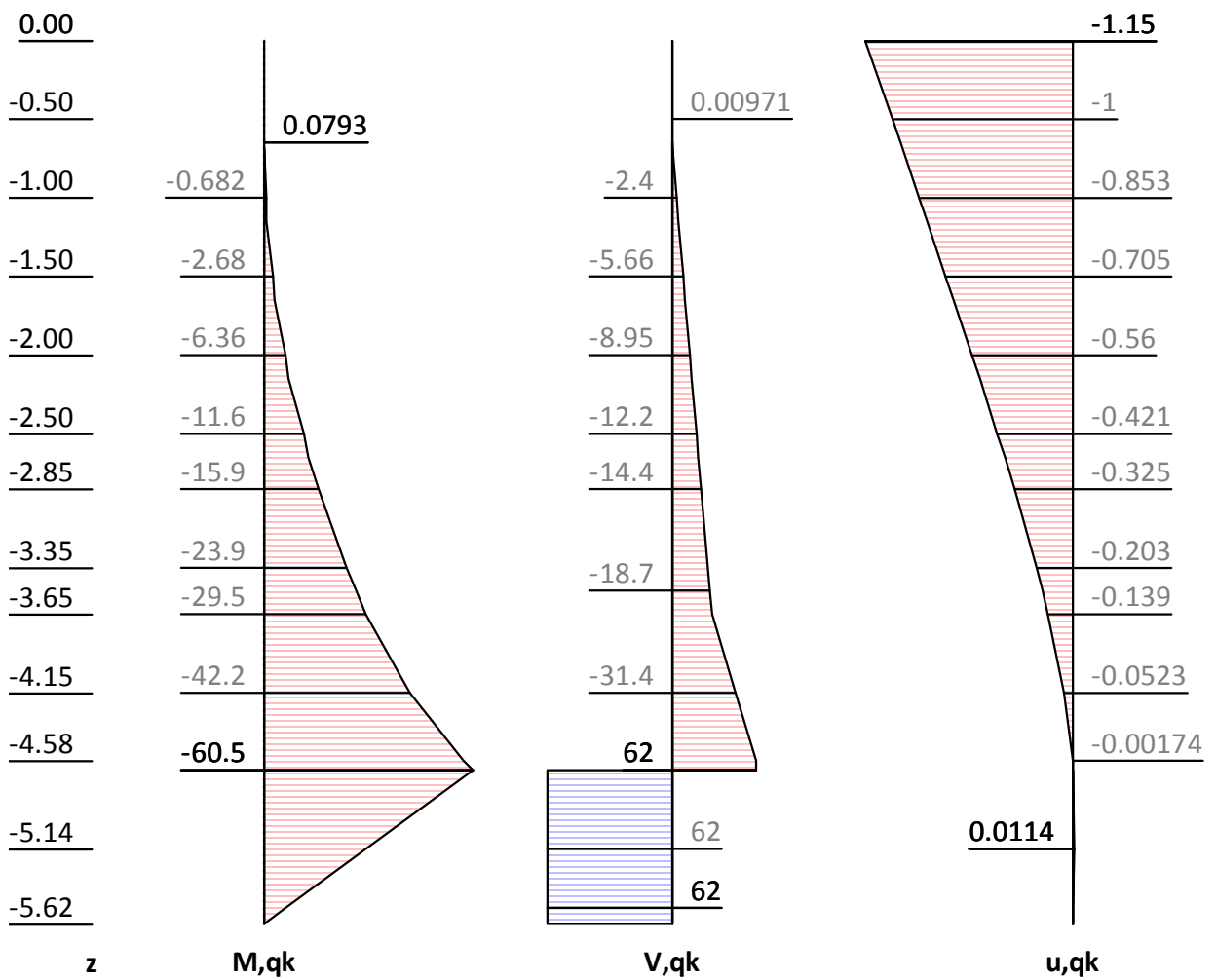
# Internal forces: Design





**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/m <sup>2</sup> ]	V, q, k [kN/m <sup>2</sup> ]	N, q, k [kN/m <sup>2</sup> ]	u, q, k [kN/m <sup>2</sup> ]
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]

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### Check of C-force (foot support)

$$z(C) = -5.62 \text{ [kN/m]}$$

$$G, k = \sum(\gamma \cdot h) = 121.48 \text{ [kN/m]}$$

$$P, k = \sum(Pz, k(x= 0.1)) = 0.00 \text{ [kN/m]}$$

$$kpgh, C(\phi = 0.1; \delta, C = 0.0^\circ) = 1.002 \text{ [-]}$$

$$kpch, C = 2.003 \text{ [-]}$$

$$eph, C, gk = (G, k + P, k) \cdot kpgh, C + 2 \cdot c \cdot \sqrt{kpch, C} = 404.79 \text{ [kN/m}^2\text{]}$$

$$= (121.48 + 0.00) \cdot 1.002 + 2 \cdot 100.0 \cdot 1.415$$

$$Ed = Ch, d = 173.04 \text{ [kN/m}^2\text{]}$$

$$\delta, t, EAU = Ed / (2 \cdot eph, C, d) = 0.30 \text{ [m]}$$

$$\delta, t, EAB = 0.20 \cdot t = 0.42 \text{ [m]}$$

$$\delta, t = \delta, t, EAB = 0.42 \text{ [m]}$$

$$Rd = 2 \cdot \delta, t \cdot eph, C, gk / \gamma, Re$$

$$= 2 \cdot 0.42 \cdot 404.79 / 1.4$$

$$= 244.92 \text{ [kN/m}^2\text{]}$$

$Ed/Rd = 0.707 \text{ [-]}. \text{ Passes requirement}$

### Check or earth support

Check: Mobilizable earth resistance is sufficient for earth support force.

$z: -4.64 \text{ m}$

$Rd = Eph, k / \gamma, Re = 448.60 / 1.400 = 320.43 \text{ [kN/m]}$

$Ed(Bh, d) / Rd = 320.33 / 320.43 = 1.000 \text{ [-]}. \text{ Passes requirement}$

### 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
$Bh, g, k \text{ } z=-4.64$	-122.29	
$Bv, g, k = Bh, k \cdot \tan(\delta, p = -0.07^\circ)$		-0.14
$Ch, g$	59.27	
$Cv, g = Ch \cdot \tan(\delta, C = 0.0^\circ)$		0.03
-----		
$\Sigma$	0.00	116.31
		(downwards)

### Simple check, EAB R 9-3a

$Vk \geq Bvk: 116.45 \geq 0.14 \text{ Passes requirement}$

### 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
$Bh, g, k \text{ } z=-4.64$	-122.29	
$Bv, g, k = Bh, k \cdot \tan(\delta, p = -0.07^\circ)$		-0.14
$Bh, q, k \text{ } z=-4.64$	-103.50	
$Bv, q, k = Bh, k \cdot \tan(\delta, p = -0.07^\circ)$		-0.12
$Ch, g$	59.27	
$Cv, g = Ch \cdot \tan(\delta, C = 0.0^\circ)$		0.03
$Ch, q$	62.02	
$Cv, q = Ch \cdot \tan(\delta, C = 0.0^\circ)$		0.04

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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 occur).

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. [kN/m]	Water- φορτ. [kN/m]	u*b	φ	c	θ
	[m]	[m]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[°]	[kN/m <sup>2</sup> ]	[°]
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

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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       $E_d = (269.5 * 6.16)$   
 Αντίσταση    $R_d = (892.4 * 6.16 + 0.0)$   

SLIP-CIRCLE  $\mu = E_d / R_d = 0.30 < 1.0$ : Έλεγχος εκπληρώθηκε.

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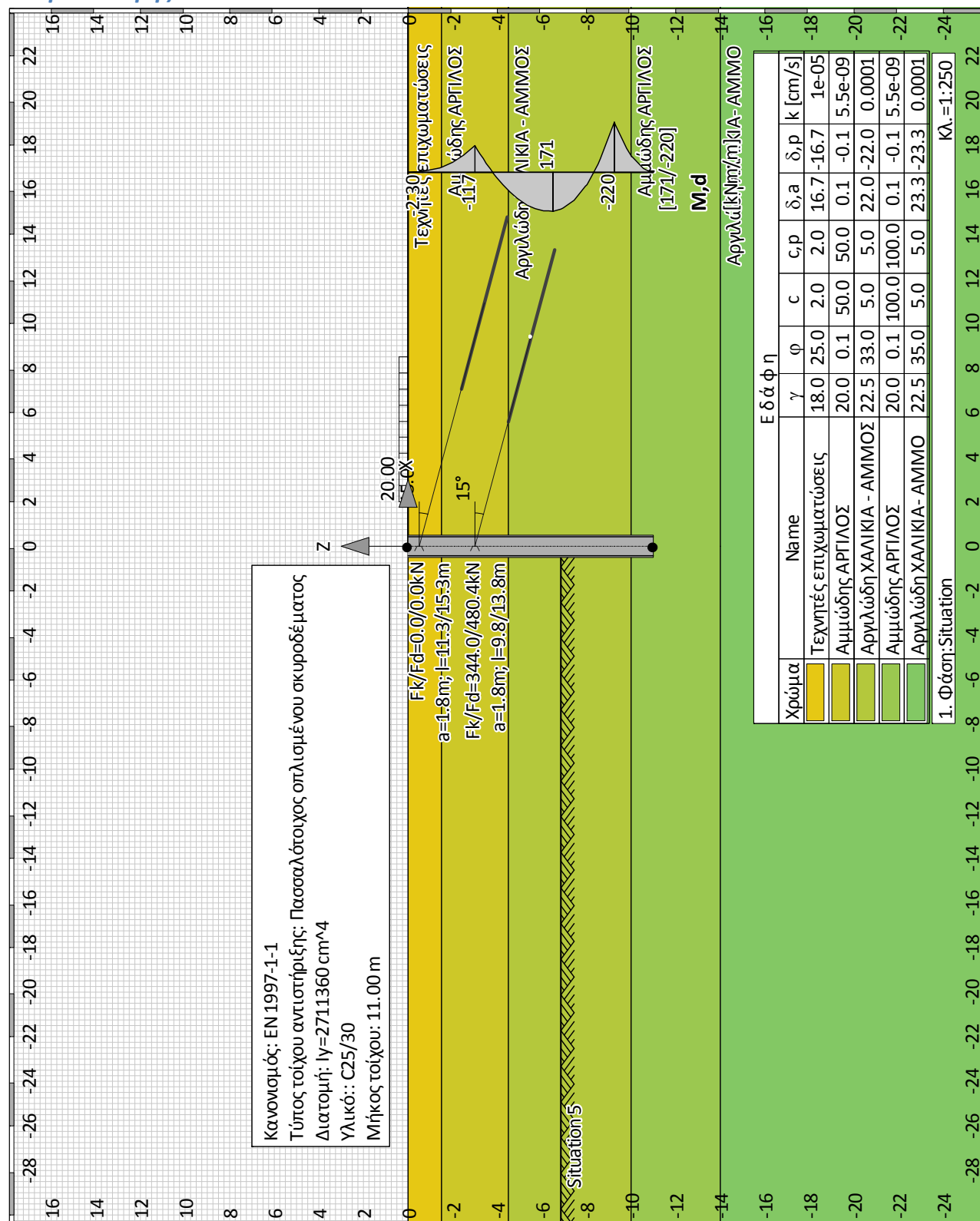
## ΠΑΡΑΡΤΗΜΑ

### 8.5 Αποτελέσματα ανάλυσης

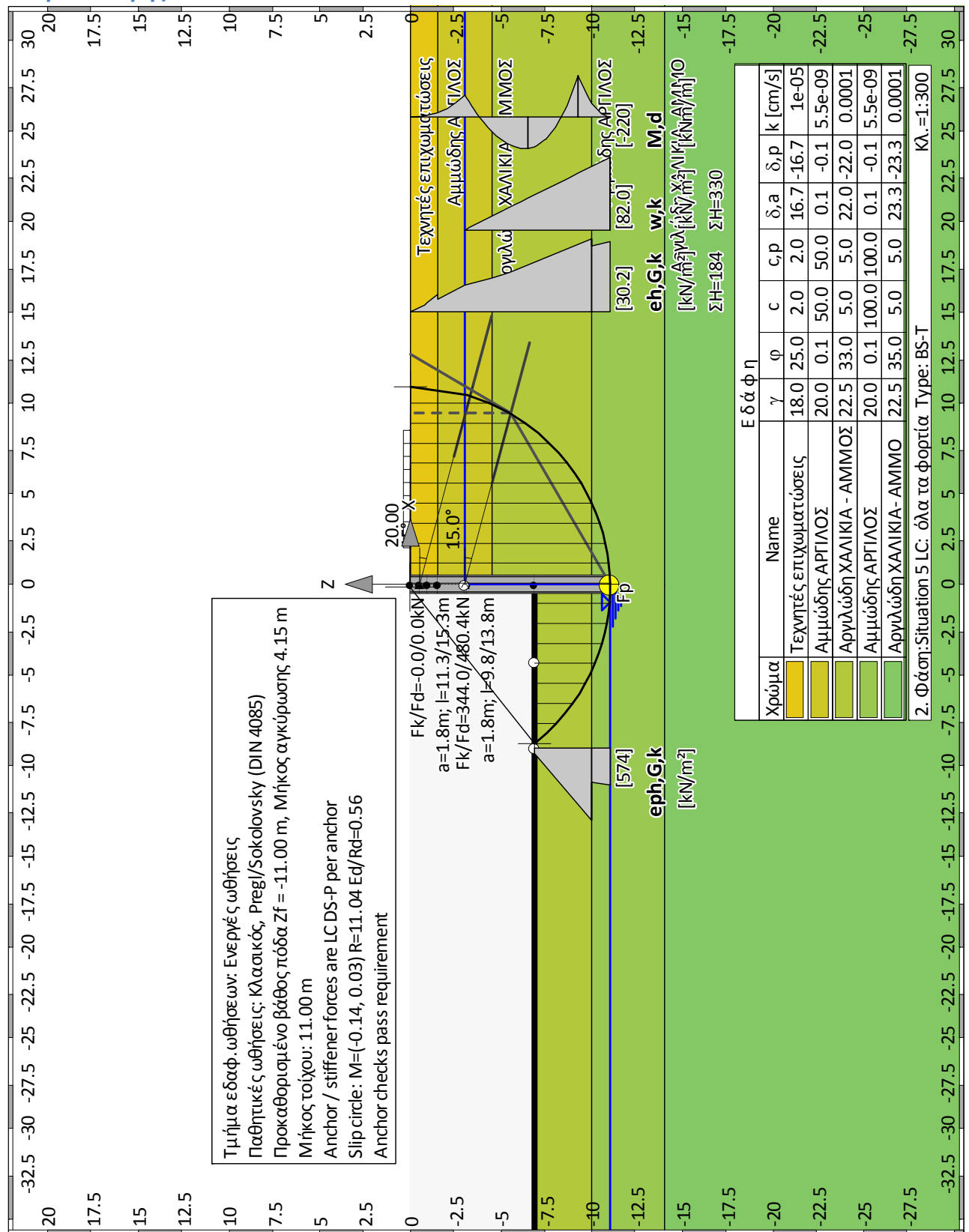
#### 8.5.2 Σεισμικές Συνθήκες

- i) Αντιστηριζόμενο ύψος 6,10m

## Φάση εκσκαφής 0 "Situation"



## Φάση εκσκαφής 1 "Situation 5"



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<b>Κανονισμός για Ανάλυση και Διαστασιολόγηση</b> Διαστασ. ωπλισμ.σκυροδ.: EN 1992-1-1 Γεωτεχν.Κανονισμός : EN 1997 (rev.12)_user National Annex: EN 1997-1									
<b>Safety factors:</b>									
<b>Earth pressure onto wall: [GEO] A1 M1 R2</b>									
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
<b>ΚΕ-μηχανισμός: [GEO] A2 M2 R3</b>									
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				
<b>Θραύση εδάφους: [GEO] A1 M1 R2</b>									
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						
<b>Ολίσθηση: [GEO] A1 M1 R2</b>									
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						
<b>Θραύση εδάφους: [GEO] A1 M1 R2</b>									
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						

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

**Κύκλος ολίσθησης: [GEO] A2 M2 R3**

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

**Hydraulic heave: [HYD] A1 M1 R1**

$\gamma$ -	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**

$\gamma$ -	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**

$\gamma$ -	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	

$\gamma_{Re,red}$  (EAB EB14-3):  $N_{ai}$ ,  $\eta=0.80$   
 $\gamma_{Re,red}$  (EAB EB22-6):  $N_{ai}$ ,  $E0h > 0\%$ :  $\eta = 0.60 / 0.80$

**System values**

**Τοίχος**

Τύπος τοίχου αντιστήριξης: Πασσαλότοιχος οπλισμένου σκυροδέματος  
 Διατομή:  $I_y=2711360 \text{ cm}^4$   
 Υλικό:: C25/30  
 Ίδιο βάρος:  $25.000 \text{ [kN/m}^3\text{]}$

**Σημεία τοίχου**

z [m]	d [m]	E [MN/m <sup>2</sup> ]	Iy [cm <sup>4</sup> /m]	E*Iy [MNm <sup>2</sup> ]	A [cm <sup>2</sup> /m]
0.00	100.0	31500.0	2711360	854.1	8400
-11.00	100.0	31500.0	2711360	854.1	8400

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### Φάση εκκαφής 1 "[1] Situation 5"

LC: όλα τα φορτία Type: BS-T

#### Εδαφικό σύστημα με 5 Στρώσεις

Name	Τεχνητές επιχωματώσεις	Αμμόδης	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,θh	[-]	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	Αμμόδης	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,θh	[-]	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 Αμμόδης ΑΡΓΙΛΟΣ:

x [m]	0.00	0.00
z [m]	-6.85	-1.50

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Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:

x [m]	0.00	0.00
z [m]	-6.85	-4.50

Πορεία ανώτερου 4. στρώματος Αμμόδης ΑΡΓΙΛΟΣ:

z= -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:

z= -14.00

**Επιφ. φορτία:**

**Φορτία**

xA	zA	xE	zE	PxA	PzA	PxE	PzE	Typ	LC-description
[m]	[m]	[m]	[m]	[	kN/m <sup>2</sup>		]		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:  $\varphi_{min} = 40.000$ .  
 Negative earth pressure fractions are set to zero.

**Redistribution of earth pressure**

Shape of redistribution: Trapezoid.  
 The earth pressure is getting redistrib. to: Excavation level  
 The earth pressure below the excavation acts without redistrib.  
 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**

$kh_{eq} = \alpha \cdot S \cdot r = 0.028$  (r=1.0)

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**Αγκύρια**

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

**Earth pressure coefficients kh**

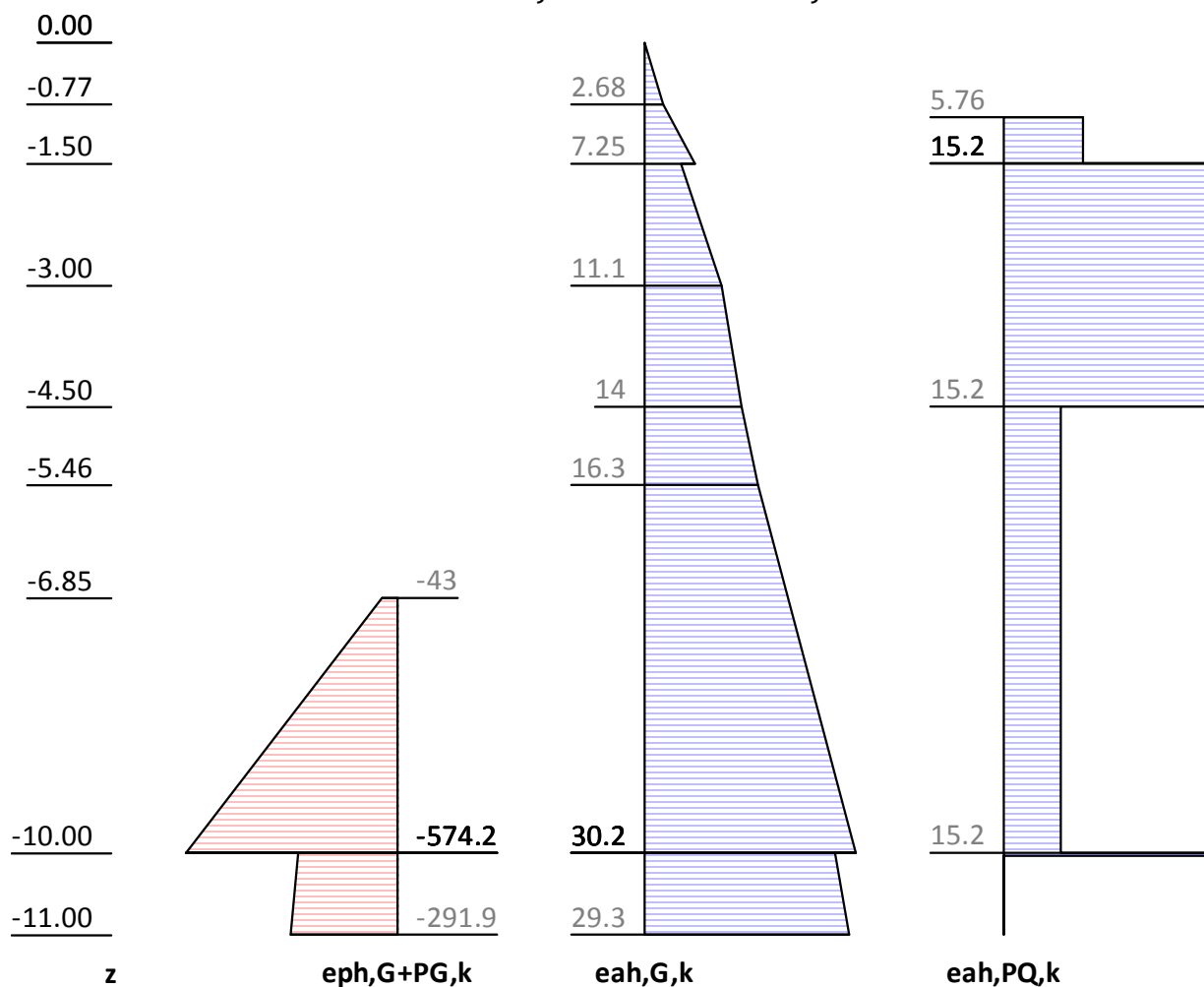
$\varphi$	$\alpha$	$\beta$	$\delta$	$k_{0gh}$	$k_{agh}$	$k_{ach}$	$k_{pgh}$	$k_{pch}$	
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	Αμμόδης ΑΡΓΙΛΟΣ
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - 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	Αμμόδης 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:  $z_f = -11.000$

**Stress analysis****Earth pressure, horizontal**

Pressures characteristic, no redistribution, continuous wall

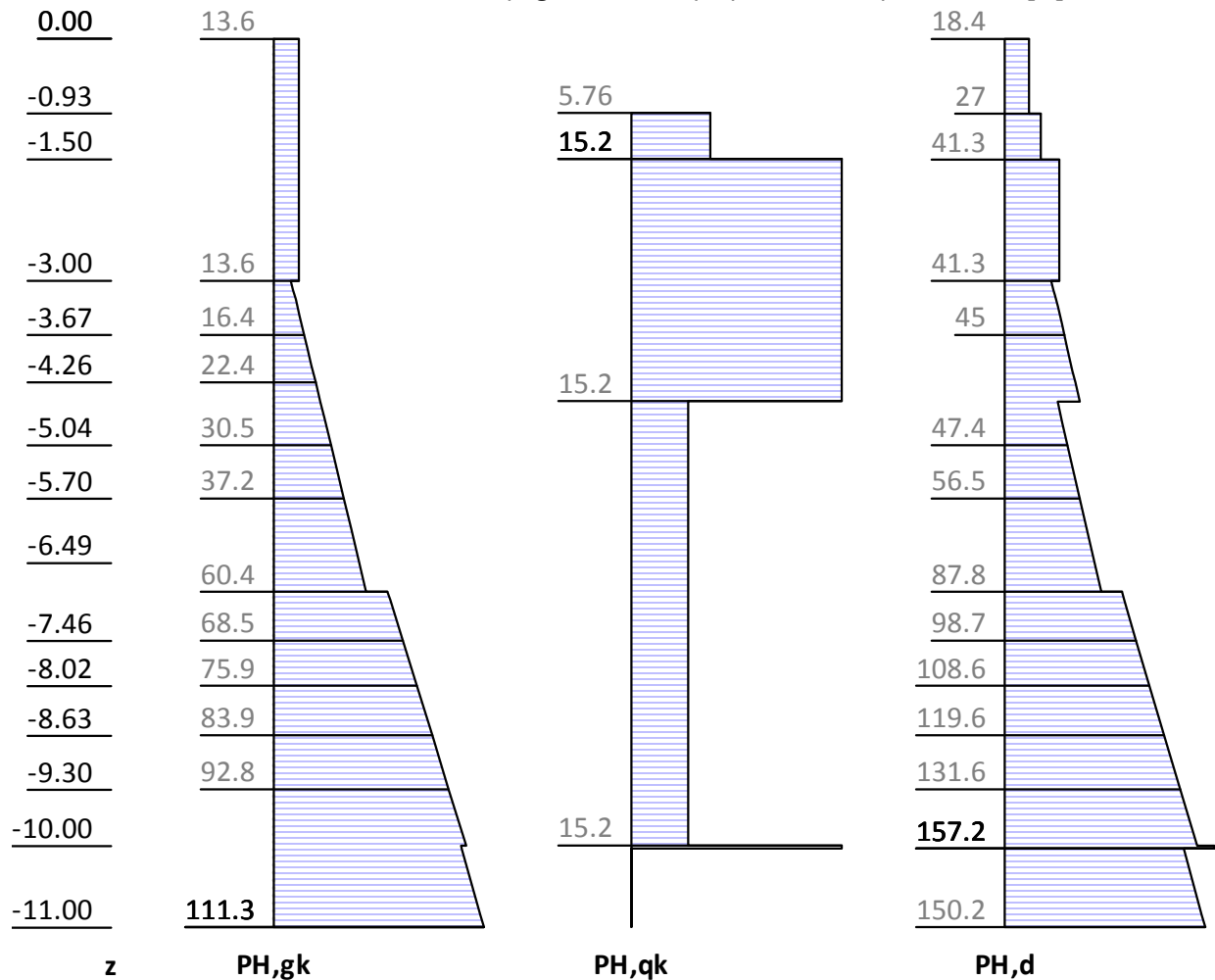


Eph,G,k:-1253.99, Eph,PG,k: 0.00 [kN/m]  
Eah,G,k: 184.27, Eah,PG,k: 0.00, Eah,PQ,k: 72.27, Eah,d: 357.17

z [m]	W <sub>a,st,k</sub> [kN/m <sup>2</sup> ]	W <sub>a,EQ,k</sub> [kN/m <sup>2</sup> ]	W <sub>tot,k</sub> [kN/m <sup>2</sup> ]
-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 [%]



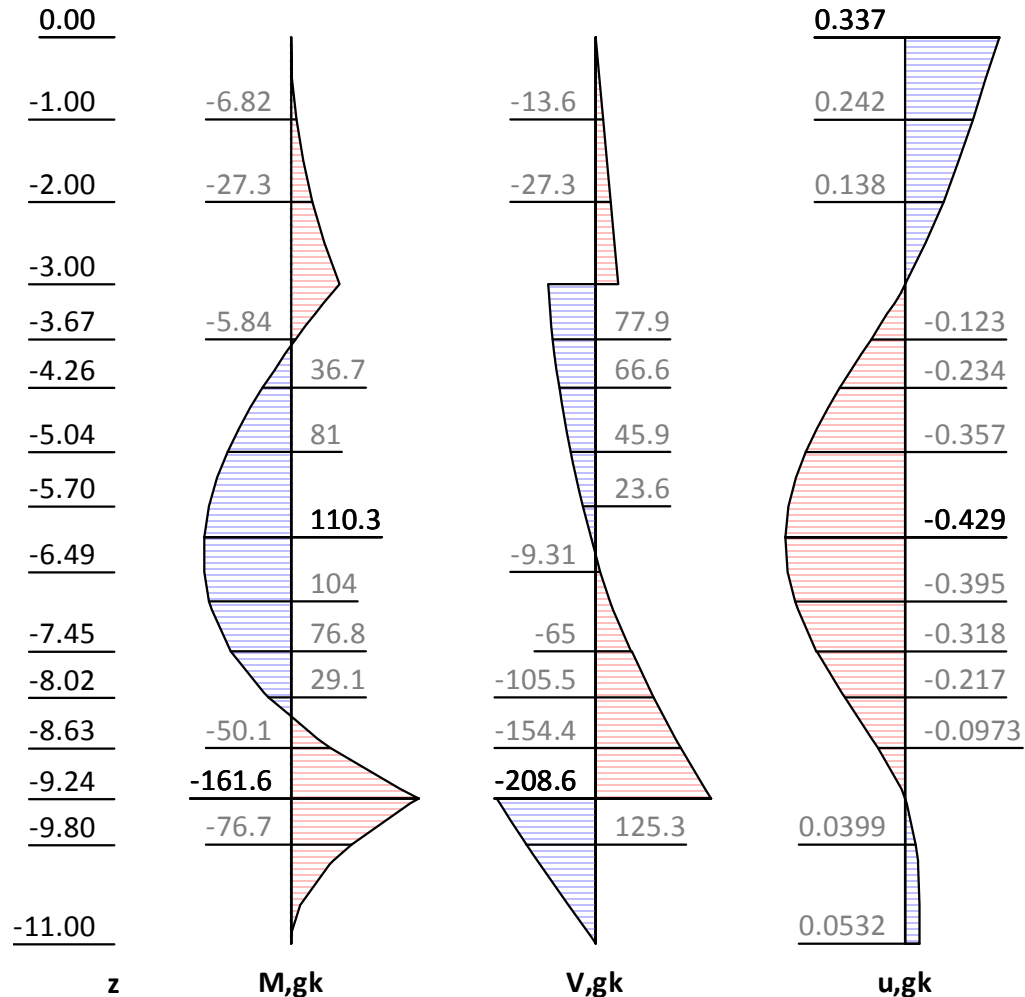
z [m]	PH,gk [kN/m²]	PH,qk [kN/m²]	PH,d [kN/m²]
0.00	13.63		18.40
-0.93	13.63	0.00	18.40
-0.93	13.63	5.76	27.05
-1.50	13.63	5.76	27.05
-1.50	13.63	15.23	41.25
-3.00	13.63	15.23	41.25
-3.00	9.09	15.23	35.13
-4.50	24.98	15.23	56.52
-4.50	24.98	4.15	39.90
-6.85	48.95	4.15	72.31
-6.85	60.44	4.15	87.82
-10.00	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



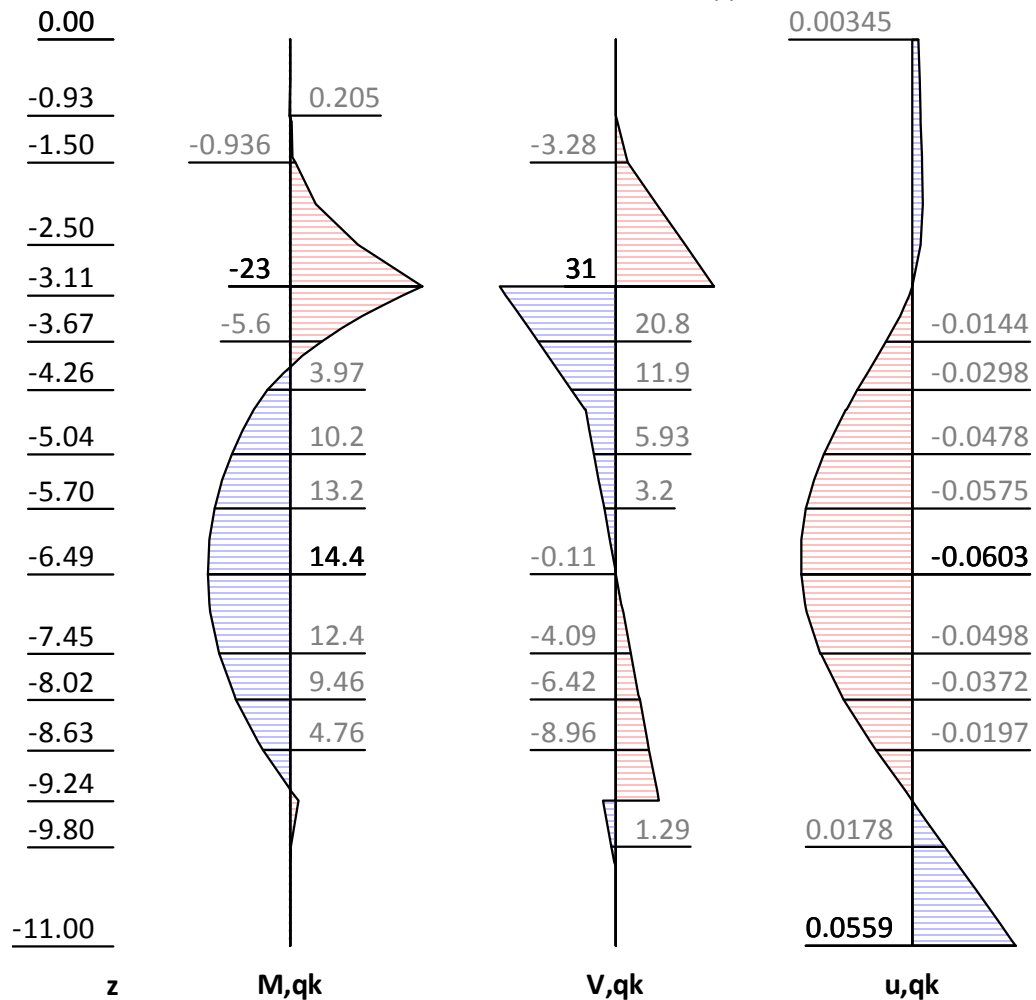
z [m]	H, g, k [kN/m <sup>2</sup> ]	M, g, k [kN/m <sup>2</sup> ]	V, g, k [kN/m <sup>2</sup> ]	N, g, k [kN/m <sup>2</sup> ]	u, g, k [mm]
0.00	13.63	-0.00	0.00	0.00	0.34
-0.00	13.63	-0.00	0.00	-0.00	0.34
-3.00	13.63	-61.35	-40.90	-72.53	-0.00
-3.00	9.09	-61.35	86.56	-106.68	-0.00
-3.75	17.17	-0.00	76.63	-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/m <sup>2</sup> ]	M, q, k [kN/m <sup>2</sup> ]	V, q, k [kN/m <sup>2</sup> ]	N, q, k [kN/m <sup>2</sup> ]	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

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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
<b>Internal forces: Design</b>  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					
0.00					
-0.93	-7.96		-17.1		-30.4
-1.50	-22.1		-32.5		-50.2
-2.50					
-3.11					-177
-3.67	-16.3		136.4		-201.9
-4.26		55.5	107.6		-223.6
-5.04		124.6	70.9		-250.3
-5.70		160.4	36.7		-271.9
-6.49		170.5	-12.7		-298.1
-7.45		122.3	-93.9		-332.1
-8.02		53.5	-152.1		-349.7
-8.63	-60.5		-221.9		-369.4
-9.24	-220.4		-298.8		-389.9
-9.80	-103.8		171.1		-409
-11.00					-433.3
z	M,d	V,d	N,d		
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**0.00**

**18.4**

**27**

**41.3**

**41.3**

**45**

**47.4**

**56.5**

**87.8**

**98.7**

**108.6**

**119.6**

**131.6**

**157.2**

**150.2**

**z**

**H,d**

**0.341**

**0.254**

**0.198**

**0.0798**

**-0.0205**

**-0.137**

**-0.264**

**-0.404**

**-0.489**

**-0.453**

**-0.368**

**-0.255**

**-0.117**

**0.0577**

**0.109**

**u,g+q,k**

z	H,d	M,d	V,d	N,d	u,g+q,k
[m]	[kN/m2]	[kN/m2]	[kN/m2]	[kN/m2]	[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

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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

$R_d = E_{ph,k}/\gamma_{Re} = 1253.99 / 1.400 = 895.71 \text{ [kN/m]}$

$E_d(U_{h,d})/R_d = 545.47 / 895.71 = 0.609 \text{ [-]}. \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-9.24	-387.26	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * 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.

V<sub>k</sub> >= B<sub>vk</sub>: 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
B <sub>h,g,k</sub> z=-9.24	-387.26	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * tan(δ,p=-22.00°)		-156.46
B <sub>h,q,k</sub> z=-9.24	-15.11	
B <sub>v,q,k</sub> = B <sub>h,k</sub> * tan(δ,p=-22.00°)		-6.11
Σ	0.00	152.86

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Pos.	H	V	
(downwards)			

Average anchor inclination  $\alpha, A = 15.00^\circ \geq 15^\circ$ .

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  $\geq$  Bvk: 315.43  $\geq$  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	$\vartheta 1$	$\vartheta 2$	lA	W,k	Q,k	Ea1,k	Ea2,k	Ra_cal,d	Sum(A,d)	Ed/Rd
[m]	[°]	[°]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]
-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	$\vartheta 1 = 30.09^\circ$
Inclination upper failure plane	$\vartheta 2 = 59.60^\circ$
Inclination separation plane	$\vartheta 12 = 90.00^\circ$

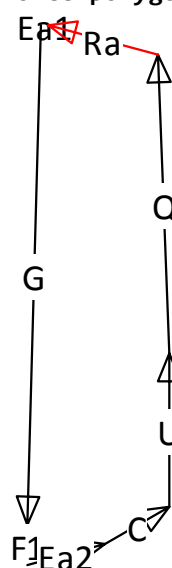
**Loads / forces (char.)**

		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	$\delta = 0.0^\circ$
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

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## Force polygon



Acting anchor forces  $E_d: \text{Sum}(A,d) = 266.7 \text{ kN/m}$   
 Possible anchor forces  $R_d: R_{a\_cal,d} = 374.1/1.400 = 267.2 \text{ kN/m}$   
 Verif. of lower failure plane  $E_d/R_d = 1.00 < 1.0$ : Έλεγχος εκπληρώθηκε.

## Check of steel tension

$l_{tot}$  ...[m]: Total length of anchor incl. excess length at head

$A_s$  ....[mm<sup>2</sup>]: X-section area of steel member

$R_{i,d}$  ...[kN]: Ultimate strength of tension member ( $\gamma_M=1.15$ )

$A_{d,d}$  ....[kN]: Dimensioning force of the anchor from wall analysis

z[m]	Anchor type	$l_{tot}$	$A_s$	$R_{i,d}$	$A_{d,d}$
-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

$l_{vk}$  .....: Length of grout body

$D_{m,vk}$  .....: Diameter of grout body

$\tau_{Gr,k}$  ...: Average applied skin friction along the grout body (from soil parameters)

$R_{a,k}$  .....: Charact. pullout resistance of the anchor

$\gamma_A$  .....: Partial safety factor of anchor pullout

$R_{a,d}$  .....:  $R_{a,k} / \gamma_A$

$A_{d,d}$  .....: Dimensioning force of the anchor from wall analysis

z	$l_{vk}$	$D_{m,vk}$	$\tau_{Gr,k}$	$R_{a,k}$	$\gamma_A$	$R_{a,d}$	$A_{d,d}$	$A_{d,d}/R_{a,d}$
[m]	[m]	[mm]	[kN/m <sup>2</sup> ]	[kN]	[-]	[kN]	[kN]	[-]
-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

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Structure: info@fides-dvp.de    www.fides-dvp.de    Tel:++49/89/143829-0    ASB Nr.:						Date: 08.10.2018	

**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 occur).

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	dxM	Weight	Load	Water-	u*b	φ	c	θ
	[m]	b	[m]	[kN/m]	z-κατ.	φορτ.	[kN/m]	[°]	[kN/m²]	[°]
					[kN/m]					
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)	μ*sin(θ)*	T
	[kN/m]	[kN/m]	+ c*b	tan(φ)+cos(θ)	[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

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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]
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	Επιφ.Φορ.*dzM	Πίεση νερού*dzM	οριζ.Σεισμός.*dzM
	[kN/m] [m]	[kN/m] [m]	[kN/m] [m]	[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.**

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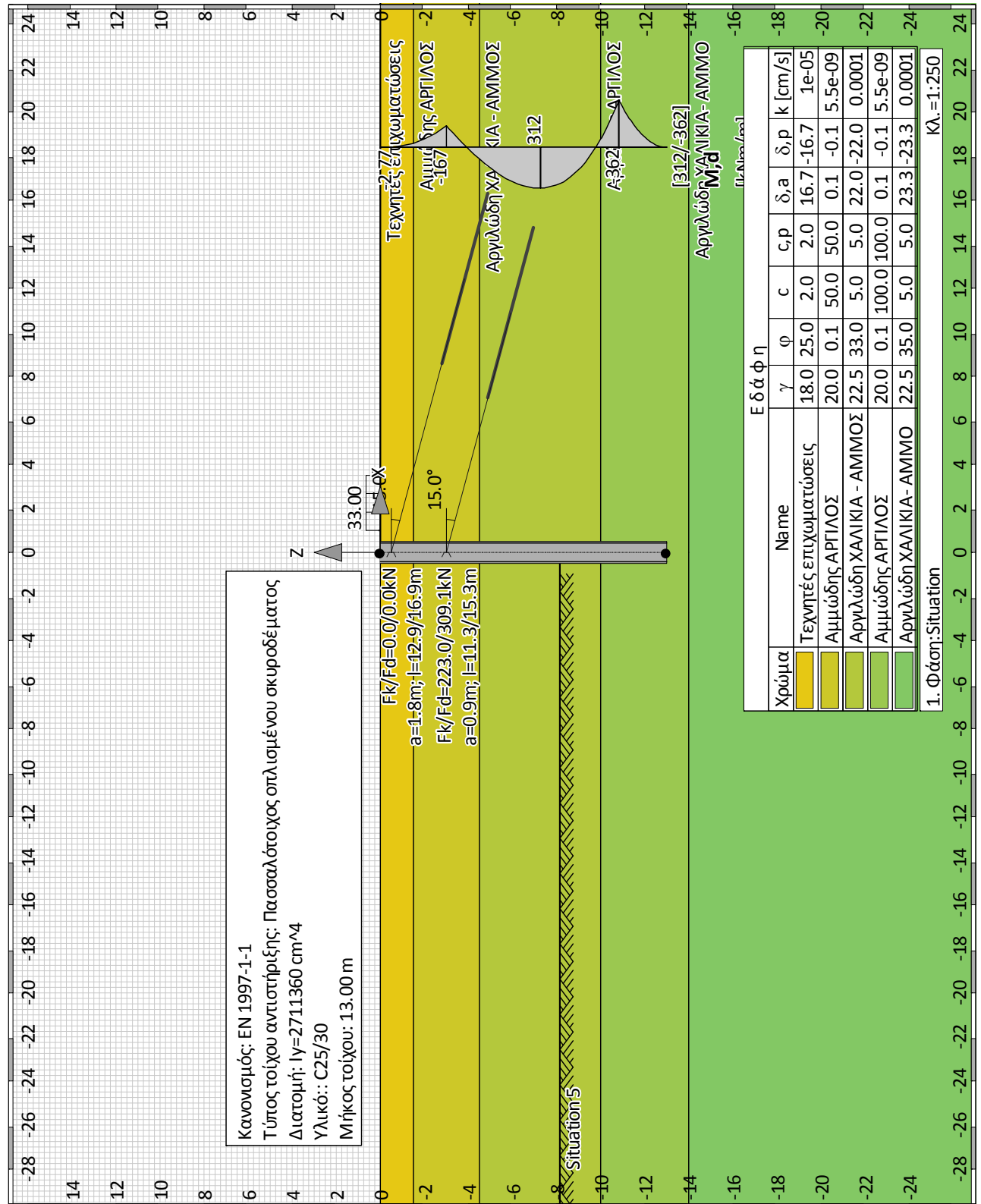
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## ΠΑΡΑΡΤΗΜΑ

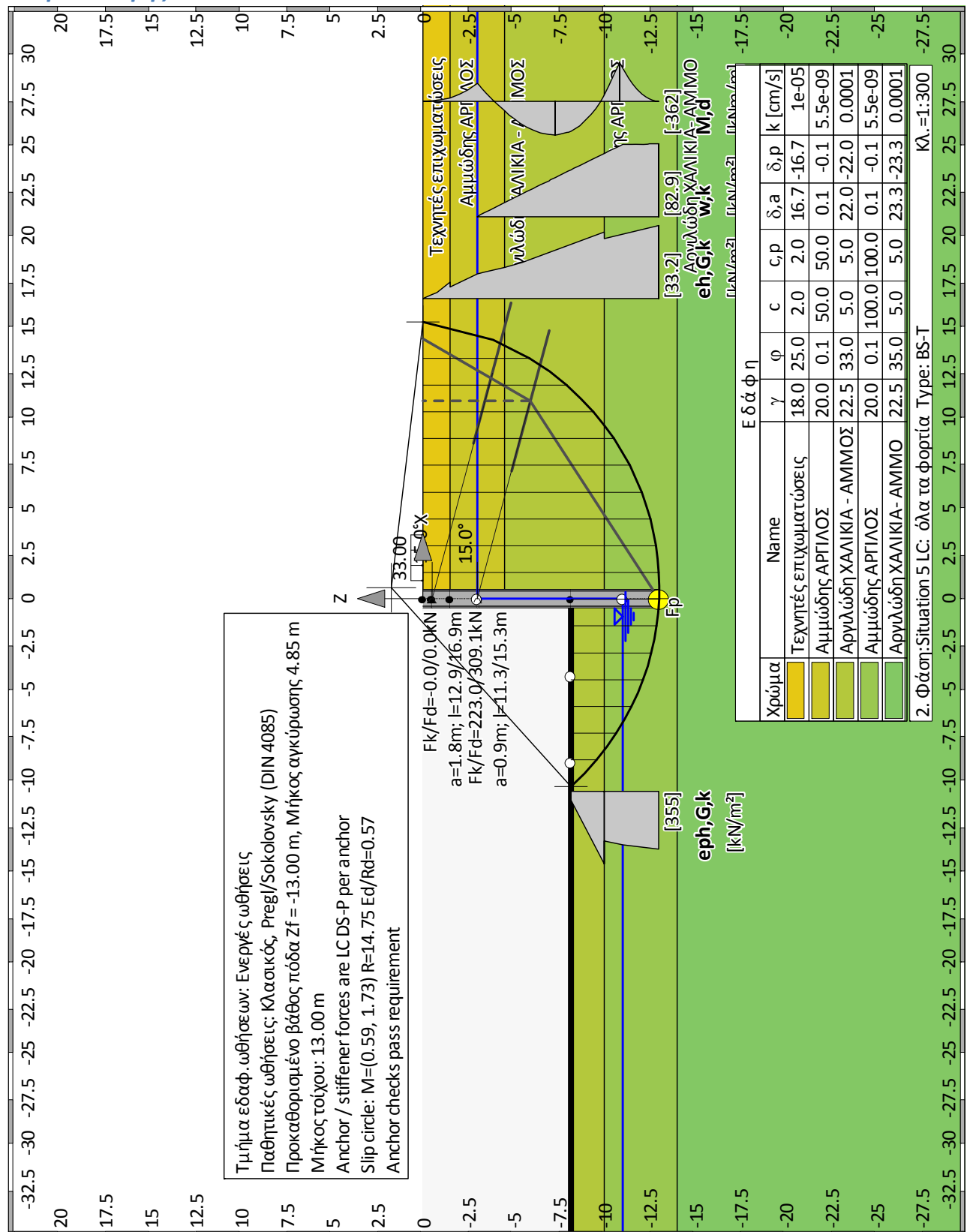
### 8.5 Αποτελέσματα ανάλυσης

#### 8.5.2 Σεισμικές Συνθήκες

- i) Αντιστηριζόμενο ύψος 7,80m

**Summary of all stages****Φάση εκσκαφής 0 "Situation"**

## Φάση εκσκαφής 1 "Situation 5"



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Program: WALLS-Retain. Version 2017.046									
Structure: info@fides-dvp.de www.fides-dvp.de Tel:++49/89/143829-0 ASB Nr.:								Date: 08.10.2018	
<b>Κανονισμός για Ανάλυση και Διαστασιολόγηση</b>									
Διαστασ. ωπλισμ.σκυροδ.: EN 1992-1-1									
Γεωτεχν.Κανονισμός : EN 1997 (rev.12)_user									
National Annex: EN 1997-1									
<b>Safety factors:</b>									
<b>Earth pressure onto wall: [GEO] A1 M1 R2</b>									
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
<b>ΚΕ-μηχανισμός: [GEO] A2 M2 R3</b>									
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				
<b>Θραύση εδάφους: [GEO] A1 M1 R2</b>									
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						
<b>Ολίσθηση: [GEO] A1 M1 R2</b>									
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						
<b>Θραύση εδάφους: [GEO] A1 M1 R2</b>									
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						

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Structure:		info@fides-dvp.de		www.fides-dvp.de		Tel:++49/89/143829-0		ASB Nr.:	
								Date: 08.10.2018	

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

**Κύκλος ολίσθησης: [GEO] A2 M2 R3**

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

**Hydraulic heave: [HYD] A1 M1 R1**

$\gamma$ -	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**

$\gamma$ -	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**

$\gamma$ -	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

$\gamma_{Re,red}$  (EAB EB14-3):  $N_{a1}$ ,  $\eta=0.80$   
 $\gamma_{Re,red}$  (EAB EB22-6):  $N_{a1}$ ,  $E0h > 0\%$ :  $\eta = 0.60 / 0.80$

**System values**

**Τοίχος**

Τύπος τοίχου αντιστήριξης: Πασσαλότοιχος οπλισμένου σκυροδέματος  
 Διατομή:  $I_y=2711360 \text{ cm}^4$   
 Υλικό:: C25/30  
 Ίδιο βάρος:  $25.000 \text{ [kN/m}^3\text{]}$

**Σημεία τοίχου**

z [m]	d [m]	E [MN/m <sup>2</sup> ]	$I_y$ [cm <sup>4</sup> /m]	$E \cdot I_y$ [MNm <sup>2</sup> ]	A [cm <sup>2</sup> /m]
0.00	100.0	31500.0	2711360	854.1	8400
-13.00	100.0	31500.0	2711360	854.1	8400

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Author: FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München		Job No.:
Program: WALLS-Retain. Version 2017.046		
Structure: info@fides-dvp.de	www.fides-dvp.de	Tel:++49/89/143829-0 ASB Nr.: Date: 08.10.2018

### Φάση εκκαφής 1 "[1] Situation 5"

LC: όλα τα φορτία Type: BS-T

#### Εδαφικό σύστημα με 5 Στρώσεις

Name	Τεχνητές επιχωματώσεις	Αμμόδης	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,θh	[-]	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	Αμμόδης	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,θh	[-]	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 Αμμόδης ΑΡΓΙΛΟΣ:

x [m]	0.00	0.00
z [m]	-8.15	-1.50

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Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:

x [m]      0.00      0.00

z [m]      -8.15      -4.50

Πορεία ανώτερου 4. στρώματος Αμμόδης ΑΡΓΙΛΟΣ:

z= -10.00

Πορεία ανώτερου 5. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:

z= -14.00

**Επιφ. φορτία:**

**Φορτία**

xA	zA	xE	zE	PxA	PzA	PxE	PzE	Typ	LC-description
[m]	[m]	[m]	[m]	[	kN/m <sup>2</sup>		]		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:  $\varphi_{min} = 40.000$ .

Negative earth pressure fractions are set to zero.

**Redistribution of earth pressure**

Shape of redistribution: Trapezoid.

The earth pressure is getting redistrib. to: Excavation level

The earth pressure below the excavation acts without redistrib.

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**

$kh_{eq} = \alpha \cdot S \cdot r = 0.028$  (r=1.0)

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**Αγκύρια**

Anchor checks (lower failure plane): Ναί  
 Anchor forces with safety level of DS-P: Ναί  
 Verification of grout body pull out forces: Ναί  
 $\delta_a$ , Anchoring wall : used from soil layer.  
 $\delta_p$ , Anchoring wall : used from soil layer.

**Earth pressure coefficients kh**

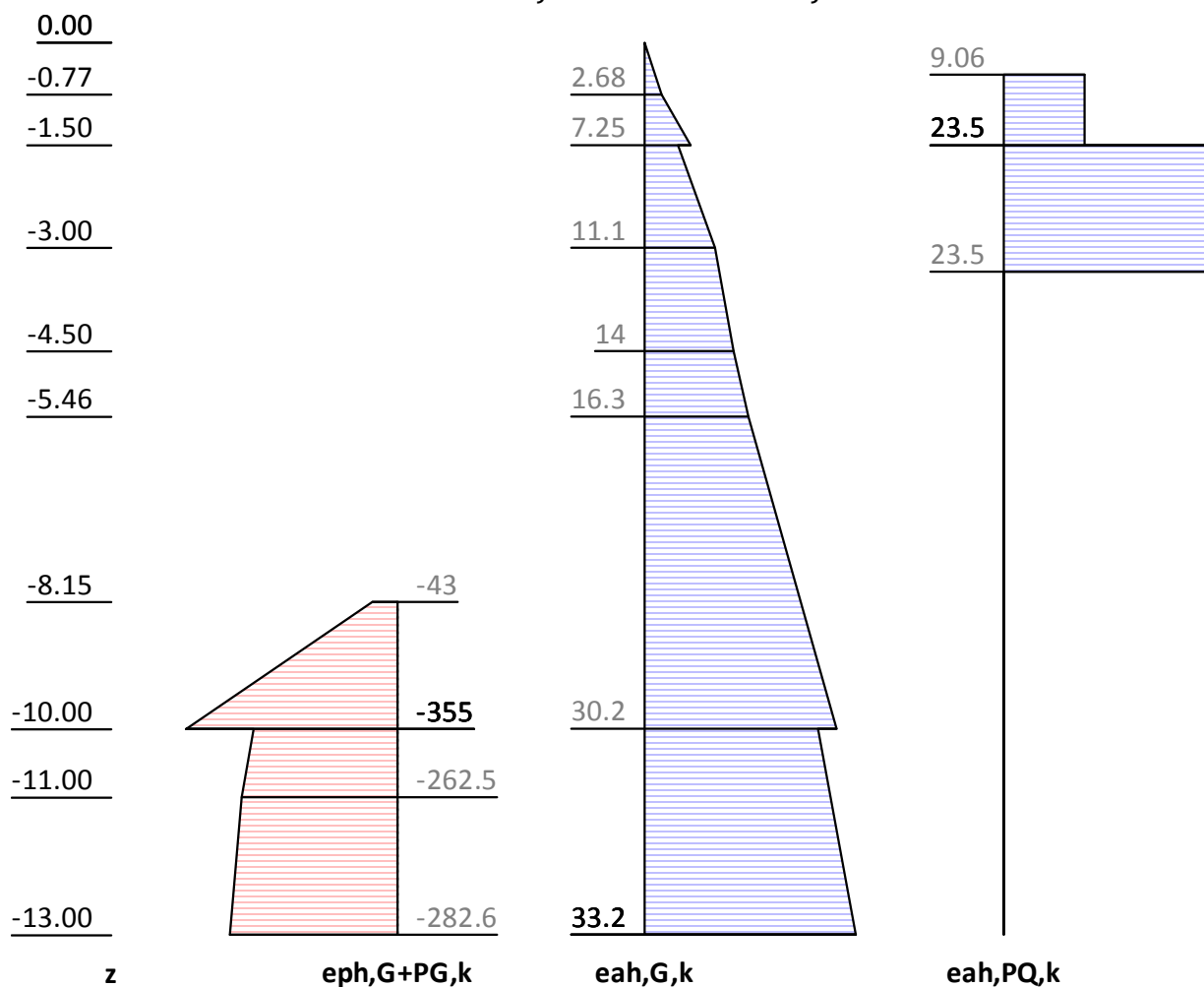
$\varphi$	$\alpha$	$\beta$	$\delta$	$k_{0gh}$	$k_{agh}$	$k_{ach}$	$k_{pgh}$	$k_{pch}$	
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Τεχνητές επιχωματώσεις
25.0	0.0	0.0	16.7	--	0.346	1.043	--	--	"
0.1	0.0	0.0	0.1	--	0.996	1.994	--	--	Αμμώδης ΑΡΓΙΛΟΣ
33.0	0.0	0.0	-22.0	--	--	--	7.496	-8.600	Αργιλώδη ΧΑΛΙΚΙΑ - 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:  $z_f = -13.000$

**Stress analysis****Earth pressure, horizontal**

Pressures characteristic, no redistribution, continuous wall



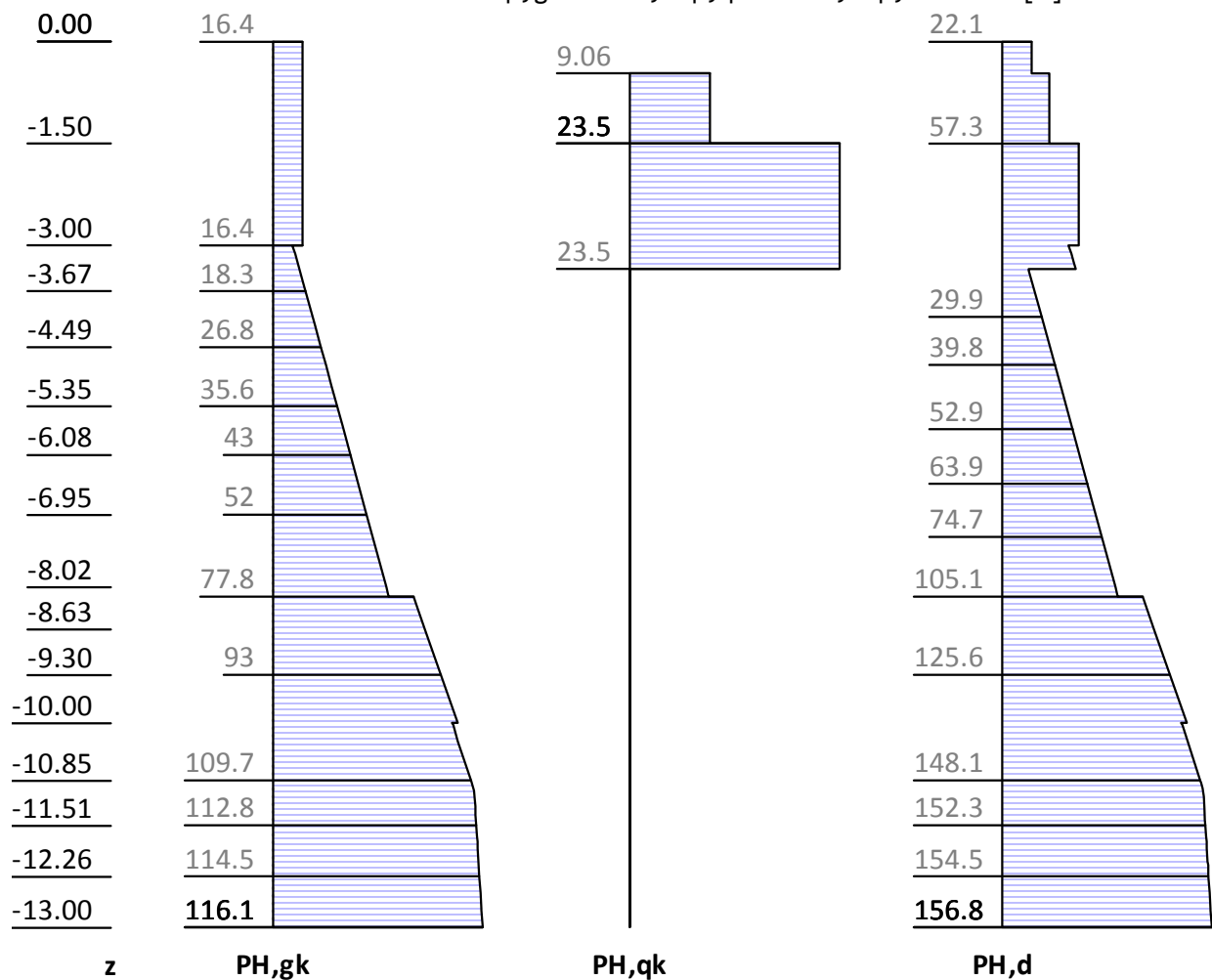
Eph,G,k:-1165.65, Eph,PG,k: 0.00 [kN/m]  
Eah,G,k: 246.74, Eah,PG,k: 0.00, Eah,PQ,k: 52.53, Eah,d: 411.90

## Πίεση νερού

z	Wp, st, k	Wa, st, k	Wp, EQ, k	Wa, EQ, k	W, tot, k
[m]	[kN/m2]	[kN/m2]	[kN/m2]	[kN/m2]	[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 [%]



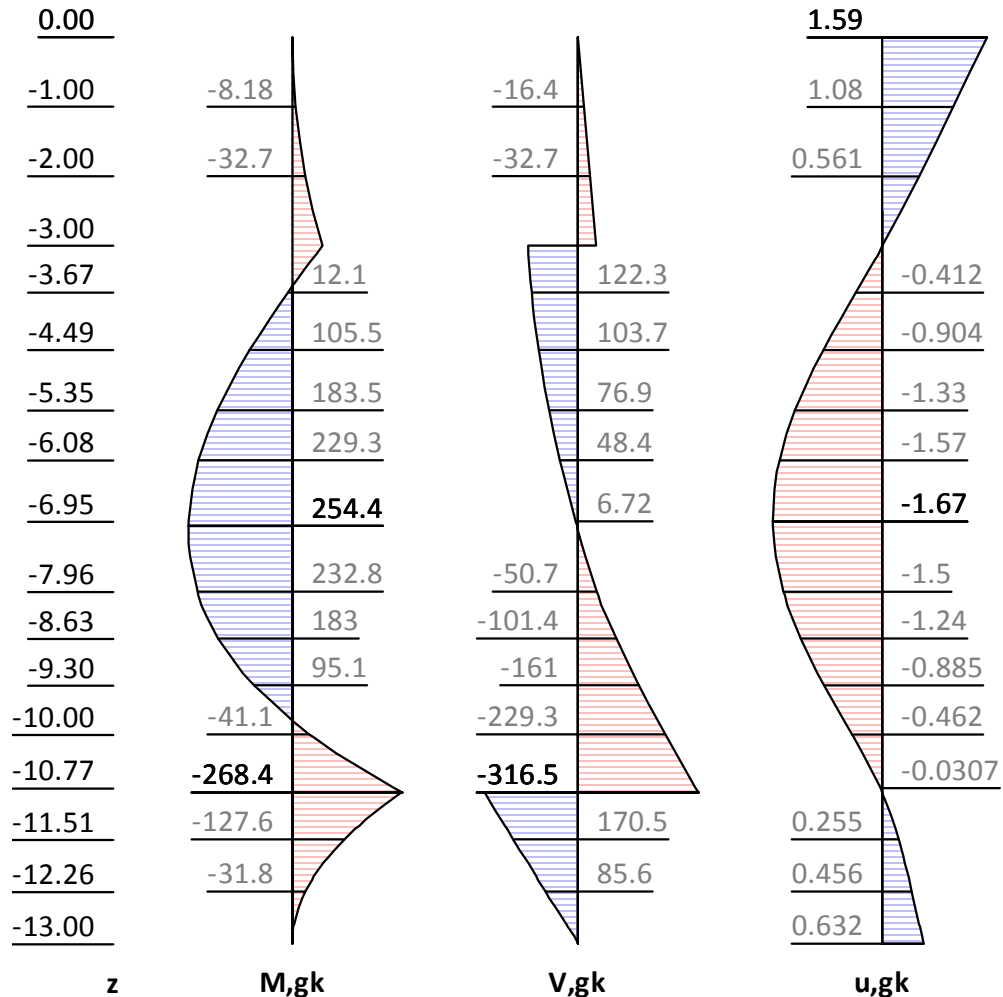
z [m]	PH,gk [kN/m²]	PH,qk [kN/m²]	PH,d [kN/m²]
0.00	16.36		22.08
-0.47	16.36	0.00	22.08
-0.47	16.36	9.06	35.67
-1.50	16.36	9.06	35.67
-1.50	16.36	23.48	57.30
-3.00	16.36	23.48	57.30
-3.00	10.91	23.48	49.95
-3.34	14.80	23.48	55.15
-3.34	14.80	0.00	19.93
-8.15	64.17	0.00	86.63
-8.15	77.83	0.00	105.06
-10.00	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/m <sup>2</sup> ]	M, g, k [kN/m <sup>2</sup> ]	V, g, k [kN/m <sup>2</sup> ]	N, g, k [kN/m <sup>2</sup> ]	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

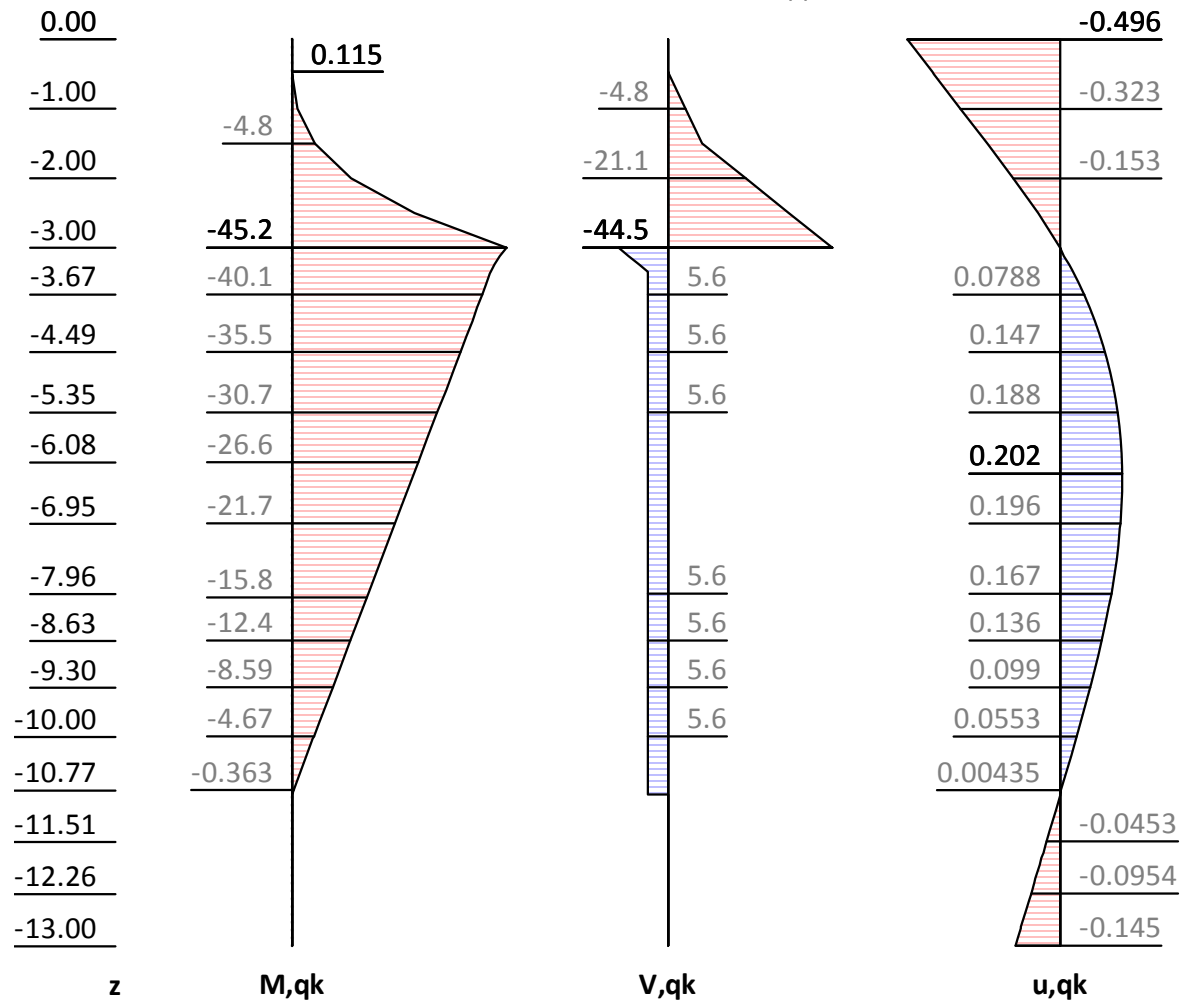
## Internal forces: Variable, characteristically

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/m <sup>2</sup> ]	M, q, k [kN/m <sup>2</sup> ]	V, q, k [kN/m <sup>2</sup> ]	N, q, k [kN/m <sup>2</sup> ]	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



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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					
0.00					
-1.00	-12.9		-29.3		-35.3
-2.00	-62.8		-75.8		-72.4
-3.00					-199.6
-3.67	-43.8		173.4		-222.7
-4.49		89.1	148.4		-249.4
-5.35		201.7	112.2		-277.3
-6.08		269.6	73.7		-300.8
-6.95		312.3	17.5		-329.3
-7.96		290.1	-60.1		-351
-8.63		228.5	-128.5		-369.7
-9.30		115.4	-208.9		-391.1
-10.00	-62.5		-301.2		-414.1
-10.77	-362.3		-418.9		-427.2
-11.51	-172.3		230.2		-439.9
-12.26	-43		115.5		-452.6
-13.00					-465.3
z	M,d	V,d	N,d		
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0.00

22.1

-1.00

57.3

-2.00

-3.00

-3.67

29.9

-4.49

39.8

-5.35

52.9

-6.08

63.9

-6.95

74.7

-7.96

105.1

-8.63

-9.30

125.6

-10.00

-10.77

148.1

-11.51

152.3

-12.26

154.5

-13.00

156.8

z

H,d

1.1

0.76

0.408

-0.333

-0.757

-1.14

-1.37

-1.47

-1.34

-1.11

-0.786

-0.407

-0.0263

0.209

0.361

0.487

u,g+q,k

z	H,d	M,d	V,d	N,d	u,g+q,k
[m]	[kN/m2]	[kN/m2]	[kN/m2]	[kN/m2]	[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

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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

$R_d = E_{ph,k}/\gamma, Re = 1165.65 / 1.400 = 832.61 \text{ [kN/m]}$

$Ed(U_h,d)/R_d = 751.02 / 832.61 = 0.902 \text{ [-]}. \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-10.83	-562.53	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * tan(δ,p=-0.07°)		-0.65
-----		
Σ	-0.00	320.62
		(downwards)

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

$\text{Verification of vertical forces due to EAB R 9 not required (R 9-5).}$

**Check EAB R 9-1**

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

$V_k \geq B_{vk}: 321.28 \geq 0.65 \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-10.83	-562.53	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * tan(δ,p=-0.07°)		-0.65
B <sub>h,q,k</sub> z=-10.83	5.60	
B <sub>v,q,k</sub> = B <sub>h,k</sub> * tan(δ,p=-0.07°)		0.01
-----		

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				Date: 08.10.2018	

Pos.	H	V	
Σ	0.00	341.76	(downwards)

Average anchor inclination  $\alpha, A = 15.00^\circ \geq 15^\circ$ .

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  $\geq$  Bvk: 342.41  $\geq$  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	$\vartheta 1$	$\vartheta 2$	lA	W,k	Q,k	Ea1,k	Ea2,k	Ra_cal,d	Sum(A,d)	Ed/Rd
[m]	[°]	[°]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]
-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	$\vartheta 1 = 33.09^\circ$
Inclination upper failure plane	$\vartheta 2 = 59.81^\circ$
Inclination separation plane	$\vartheta 12 = 90.00^\circ$

**Loads / forces (char.)**

		Fx	Fz	F	
		[kN/m]	[kN/m]	[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	$\delta = 0.0^\circ$
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	

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					Date: 08.10.2018

	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 ....[mm<sup>2</sup>]: X-section area 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	lvk	DmVk	τGr,k	Ra,k	γA	Ra,d	A,d	A,d/Ra,d
[m]	[m]	[mm]	[kN/m <sup>2</sup> ]	[kN]	[-]	[kN]	[kN]	[-]
-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

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<p>Υπολογ. κύκλου ολίσθησης</p> <p>LC: όλα τα φορτία Type: BS-T (combination: [GEO] A2 M2 R3, BS-T)</p> <p>Συντελ.Σεισμού: Οριζόντιος: 0.028 Κατακόρυφος : 0.014</p> <p>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 occur).</p> <p>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)</p> <p>Γεωμετρία λωρίδων:</p> <table><tr><th>No</th><th>x</th><th>Width</th><th>dxM</th><th>Weight</th><th>Load</th><th>Water-</th><th>u*b</th><th>φ</th><th>c</th><th>θ</th></tr><tr><th></th><th>[m]</th><th>b</th><th>[m]</th><th>[kN/m]</th><th>z-κατ.</th><th>φορτ.</th><th>[kN/m]</th><th>[°]</th><th>[kN/m²]</th><th>[°]</th></tr><tr><th></th><th></th><th></th><th></th><th></th><th>[kN/m]</th><th>[kN/m]</th><th></th><th></th><th></th><th></th></tr><tr><td>1</td><td>-9.62</td><td>1.47</td><td>-10.22</td><td>25.6</td><td>0.0</td><td>0.0</td><td>-0.0</td><td>27.45</td><td>3.57</td><td>-31.27*</td></tr><tr><td>2</td><td>-8.15</td><td>1.47</td><td>-8.74</td><td>66.8</td><td>0.0</td><td>0.0</td><td>-0.0</td><td>0.08</td><td>71.43</td><td>-36.35</td></tr><tr><td>3</td><td>-6.67</td><td>1.47</td><td>-7.27</td><td>95.4</td><td>0.0</td><td>0.0</td><td>-3.7</td><td>0.08</td><td>71.43</td><td>-29.52</td></tr><tr><td>4</td><td>-5.20</td><td>1.47</td><td>-5.79</td><td>117.2</td><td>0.0</td><td>0.0</td><td>-12.2</td><td>0.08</td><td>71.43</td><td>-23.12</td></tr><tr><td>5</td><td>-3.72</td><td>1.47</td><td>-4.32</td><td>133.3</td><td>0.0</td><td>0.0</td><td>-20.3</td><td>0.08</td><td>71.43</td><td>-17.02</td></tr><tr><td>6</td><td>-2.25</td><td>1.47</td><td>-2.84</td><td>144.4</td><td>0.0</td><td>0.0</td><td>-25.8</td><td>0.08</td><td>71.43</td><td>-11.11</td></tr><tr><td>7</td><td>-0.77</td><td>1.47</td><td>-1.37</td><td>150.7</td><td>0.0</td><td>0.0</td><td>-29.0</td><td>0.08</td><td>71.43</td><td>-5.32</td></tr><tr><td>8</td><td>0.70</td><td>1.47</td><td>0.11</td><td>399.2</td><td>19.1</td><td>0.0</td><td>-89.8</td><td>0.08</td><td>71.43</td><td>0.42</td></tr><tr><td>9</td><td>2.18</td><td>1.47</td><td>1.58</td><td>403.0</td><td>64.2</td><td>0.0</td><td>-148.3</td><td>0.08</td><td>71.43</td><td>6.16</td></tr><tr><td>10</td><td>3.65</td><td>1.47</td><td>3.06</td><td>396.0</td><td>25.5</td><td>0.0</td><td>-144.8</td><td>0.08</td><td>71.43</td><td>11.97</td></tr><tr><td>11</td><td>5.13</td><td>1.47</td><td>4.53</td><td>384.2</td><td>0.0</td><td>0.0</td><td>-138.9</td><td>0.08</td><td>71.43</td><td>17.90</td></tr><tr><td>12</td><td>6.60</td><td>1.47</td><td>6.01</td><td>367.3</td><td>0.0</td><td>0.0</td><td>-130.4</td><td>0.08</td><td>71.43</td><td>24.04</td></tr><tr><td>13</td><td>8.07</td><td>1.47</td><td>7.48</td><td>344.6</td><td>0.0</td><td>0.0</td><td>-118.9</td><td>0.08</td><td>71.43</td><td>30.49</td></tr><tr><td>14</td><td>9.55</td><td>1.47</td><td>8.96</td><td>314.8</td><td>0.0</td><td>0.0</td><td>-104.0</td><td>27.45</td><td>3.57</td><td>37.40</td></tr><tr><td>15</td><td>11.02</td><td>1.47</td><td>10.43</td><td>271.4</td><td>0.0</td><td>0.0</td><td>-84.4</td><td>27.45</td><td>3.57</td><td>45.02</td></tr><tr><td>16</td><td>12.50</td><td>1.47</td><td>11.91</td><td>213.4</td><td>0.0</td><td>0.0</td><td>-58.1</td><td>27.45</td><td>3.57</td><td>53.83</td></tr><tr><td>17</td><td>14.24</td><td>2.00</td><td>13.64</td><td>151.1</td><td>0.0</td><td>0.0</td><td>-29.1</td><td>0.08</td><td>35.71</td><td>67.70</td></tr></table> <p>*** Σημείωση: Στις λωρίδες σημειωμένες με '*' περιορίστηκε το theta στο 45°-Phi/2.</p> <p>Συνεισφ. κατακόρυφων φορτίων:</p> <table><tr><th>No</th><th>Weight</th><th>G*sin(θ)</th><th>(G-u*b)*tan(φ) + c*b</th><th>μ*sin(θ)* tan(φ)+cos(θ)</th><th>T</th></tr><tr><th></th><th>[kN/m]</th><th>[kN/m]</th><th>[kN/m]</th><th>[-]</th><th>[kN/m]</th></tr><tr><td>1</td><td>25.60</td><td>-17.74</td><td>18.57</td><td>0.701640</td><td>26.46</td></tr><tr><td>2</td><td>66.81</td><td>-39.60</td><td>105.43</td><td>0.804968</td><td>130.98</td></tr><tr><td>3</td><td>95.38</td><td>-46.99</td><td>105.47</td><td>0.869820</td><td>121.25</td></tr><tr><td>4</td><td>117.20</td><td>-46.02</td><td>105.49</td><td>0.919364</td><td>114.74</td></tr><tr><td>5</td><td>133.31</td><td>-39.02</td><td>105.50</td><td>0.955978</td><td>110.36</td></tr><tr><td>6</td><td>144.36</td><td>-27.82</td><td>105.51</td><td>0.981109</td><td>107.54</td></tr><tr><td>7</td><td>150.73</td><td>-13.97</td><td>105.51</td><td>0.995622</td><td>105.97</td></tr><tr><td>8</td><td>418.30</td><td>3.06</td><td>105.80</td><td>0.999979</td><td>105.80</td></tr><tr><td>9</td><td>467.14</td><td>50.13</td><td>105.78</td><td>0.994310</td><td>106.39</td></tr><tr><td>10</td><td>421.49</td><td>87.38</td><td>105.73</td><td>0.978438</td><td>108.06</td></tr><tr><td>11</td><td>384.19</td><td>118.07</td><td>105.68</td><td>0.951850</td><td>111.03</td></tr></table>												No	x	Width	dxM	Weight	Load	Water-	u*b	φ	c	θ		[m]	b	[m]	[kN/m]	z-κατ.	φορτ.	[kN/m]	[°]	[kN/m²]	[°]						[kN/m]	[kN/m]					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	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
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5	-3.72	1.47	-4.32	133.3	0.0	0.0	-20.3	0.08	71.43	-17.02																																																																																																																																																																																																																																																																																																											
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Program: <b>WALLS-Retain. Version 2017.046</b>					
Structure: info@fides-dvp.de    www.fides-dvp.de    Tel:++49/89/143829-0    ASB Nr.:					Date: 08.10.2018

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     $E_d = (1047.2*14.75+899.9-284.0)$

Αντίσταση     $R_d = (1909.0*14.75+149.3)$

$SLIP-CIRCLE \mu = E_d/R_d = 0.57 < 1.0$ : Έλεγχος εκπληρώθηκε.


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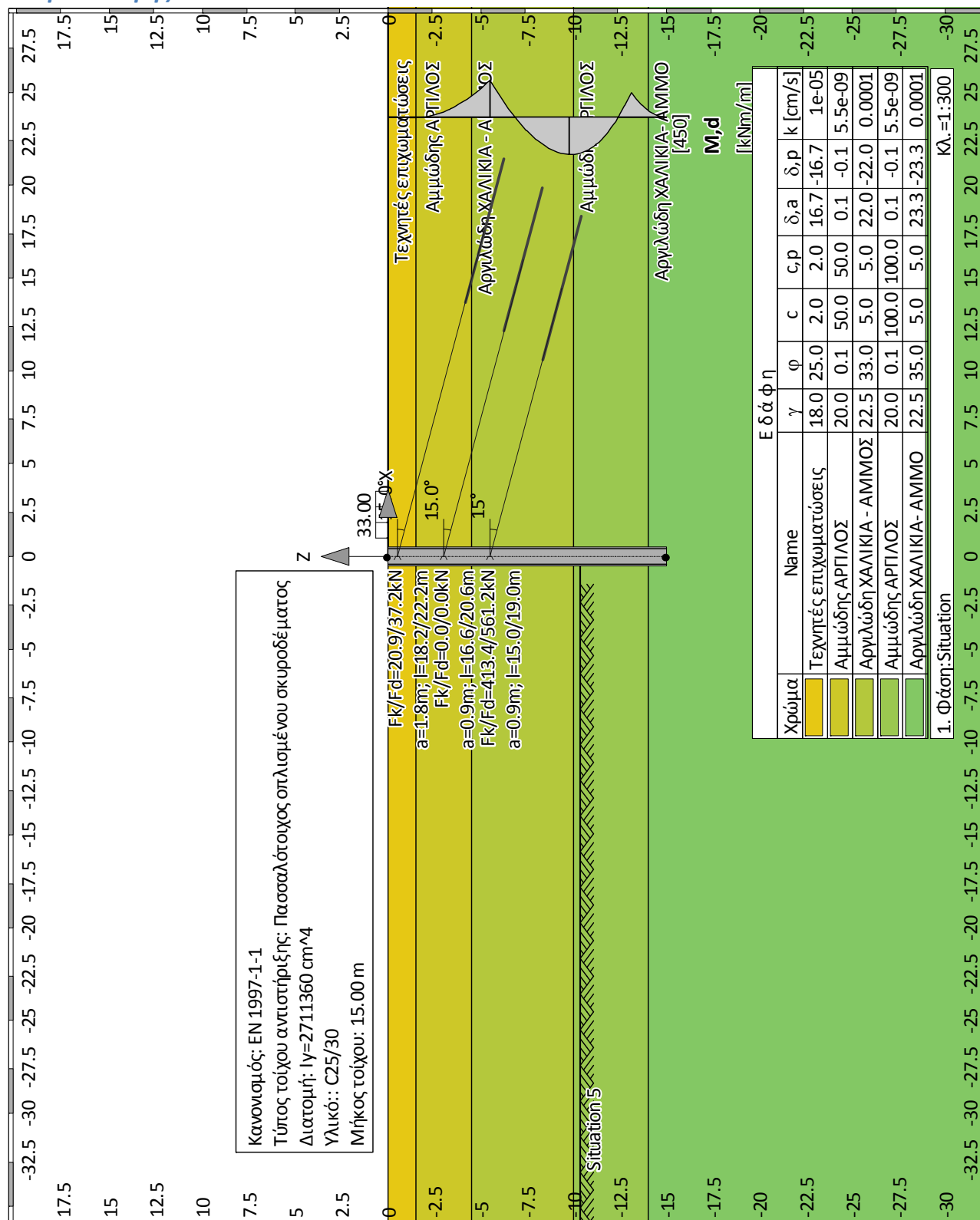
## ΠΑΡΑΡΤΗΜΑ

### 8.5 Αποτελέσματα ανάλυσης

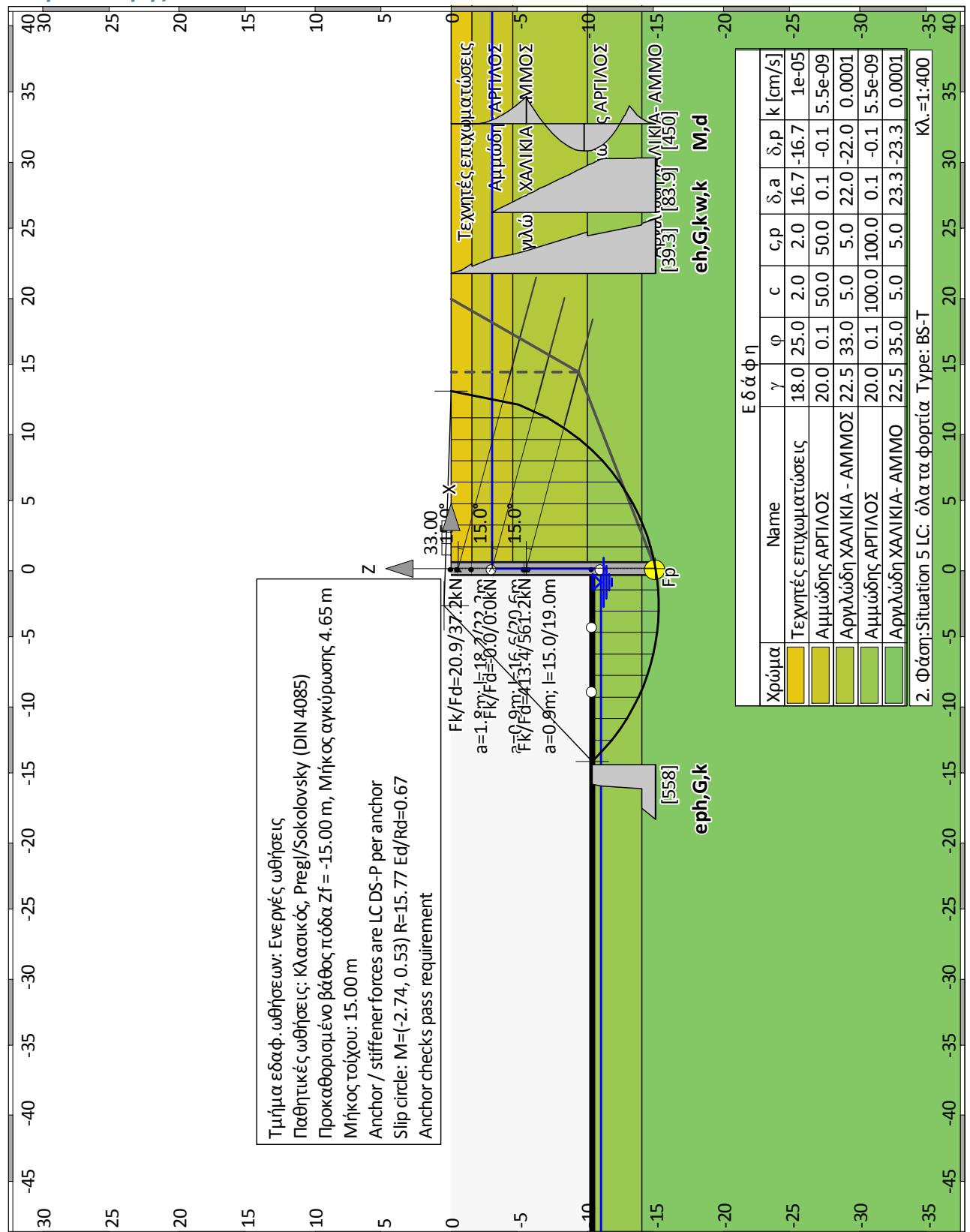
#### 8.5.2 Σεισμικές Συνθήκες

ι) Αντιστηριζόμενο ύψος 9,70m



**Summary of all stages****Φάση εκσκαφής 0 "Situation"**

## Φάση εκσκαφής 1 "Situation 5"



Author: FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München								Job No.:	
Program: WALLS-Retain. Version 2017.046									
Structure: info@fides-dvp.de www.fides-dvp.de Tel:++49/89/143829-0 ASB Nr.:								Date: 08.10.2018	
<b>Κανονισμός για Ανάλυση και Διαστασιολόγηση</b> Διαστασ. ωπλισμ.σκυροδ.: EN 1992-1-1 Γεωτεχν.Κανονισμός : EN 1997 (rev.12)_user National Annex: EN 1997-1									
<b>Safety factors:</b>									
<b>Earth pressure onto wall: [GEO] A1 M1 R2</b>									
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
<b>ΚΕ-μηχανισμός: [GEO] A2 M2 R3</b>									
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				
<b>Θραύση εδάφους: [GEO] A1 M1 R2</b>									
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						
<b>Ολίσθηση: [GEO] A1 M1 R2</b>									
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						
<b>Θραύση εδάφους: [GEO] A1 M1 R2</b>									
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						

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Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>								Job No.:	
Program: <b>WALLS-Retain. Version 2017.046</b>									
Structure: info@fides-dvp.de		www.fides-dvp.de		Tel:++49/89/143829-0		ASB Nr.:		Date: 08.10.2018	

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

**Κύκλος ολίσθησης: [GEO] A2 M2 R3**

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

**Hydraulic heave: [HYD] A1 M1 R1**

$\gamma$ -	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**

$\gamma$ -	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**

$\gamma$ -	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

$\gamma_{Re,red}$  (EAB EB14-3):  $N_{a1}$ ,  $\eta=0.80$   
 $\gamma_{Re,red}$  (EAB EB22-6):  $N_{a1}$ ,  $E0h > 0\%$ :  $\eta = 0.60 / 0.80$

**System values**

**Τοίχος**

Τύπος τοίχου αντιστήριξης: Πασσαλότοιχος οπλισμένου σκυροδέματος  
 Διατομή:  $I_y=2711360 \text{ cm}^4$   
 Υλικό:: C25/30  
 Ίδιο βάρος:  $25.000 \text{ [kN/m}^3\text{]}$

**Σημεία τοίχου**

z [m]	d [m]	E [MN/m <sup>2</sup> ]	Iy [cm <sup>4</sup> /m]	E*Iy [MNm <sup>2</sup> ]	A [cm <sup>2</sup> /m]
0.00	100.0	31500.0	2711360	854.1	8400
-15.00	100.0	31500.0	2711360	854.1	8400

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Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>		Job No.:
Program: <b>WALLS-Retain. Version 2017.046</b>		
Structure: info@fides-dvp.de	www.fides-dvp.de	Tel:++49/89/143829-0 ASB Nr.: Date: 08.10.2018

### Φάση εκκαφής 1 "[1] Situation 5"

LC: όλα τα φορτία Type: BS-T

#### Εδαφικό σύστημα με 5 Στρώσεις

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

Name	Αμμόδης ΑΡΓΙΛΟΣ	Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ
γ	[kN/m3]	20
γ,R	[kN/m3]	20
γ'	[kN/m3]	10
γ,p	[kN/m3]	20
γ,R,passive	[kN/m3]	20
γ,pw	[kN/m3]	10
φ	[°]	0.1
c	[kN/m2]	100
c,u	[kN/m2]	100
c παθητικό	[kN/m2]	100
δ,a	[°]	0.06666667
δ,p	[°]	-0.06666667
δ,c	[°]	0.03333333
k,agh	[-]	0.9955057
K,ach	[-]	1.994195
K,θh	[-]	0.9982547
K,pgh	[-]	1.004519
K,pch	[-]	2.00583
τ,gr	[kN/m2]	110
Ψ,A,max	[°]	90
k	[cm/s]	5.5e-09

Πορεία πρανούς:

x [m]	0.00	0.00
z [m]	-10.35	0.00

Πορεία ανώτερου 2. στρώματος Αμμόδης ΑΡΓΙΛΟΣ:

x [m]	0.00	0.00
z [m]	-10.35	-1.50

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Program: <b>WALLS-Retain.</b>				Version <b>2017.046</b>	
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Date: 08.10.2018					

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ:

x [m]	0.00	0.00
z [m]	-10.35	-4.50

Πορεία ανώτερου 4. στρώματος Αμώδης 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	zA	xE	zE	PxA	PzA	PxE	PzE	Typ	LC-description
[m]	[m]	[m]	[m]	[	kN/m <sup>2</sup>		]		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 redistrib. to: Excavation level  
 The earth pressure below the excavation acts without redistrib.  
 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)

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### Αγκύρια

Anchor checks (lower failure plane): Ναί  
Anchor forces with safety level of DS-P: Ναί  
Verification of grout body pull out forces: Ναί  
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	--	--	"

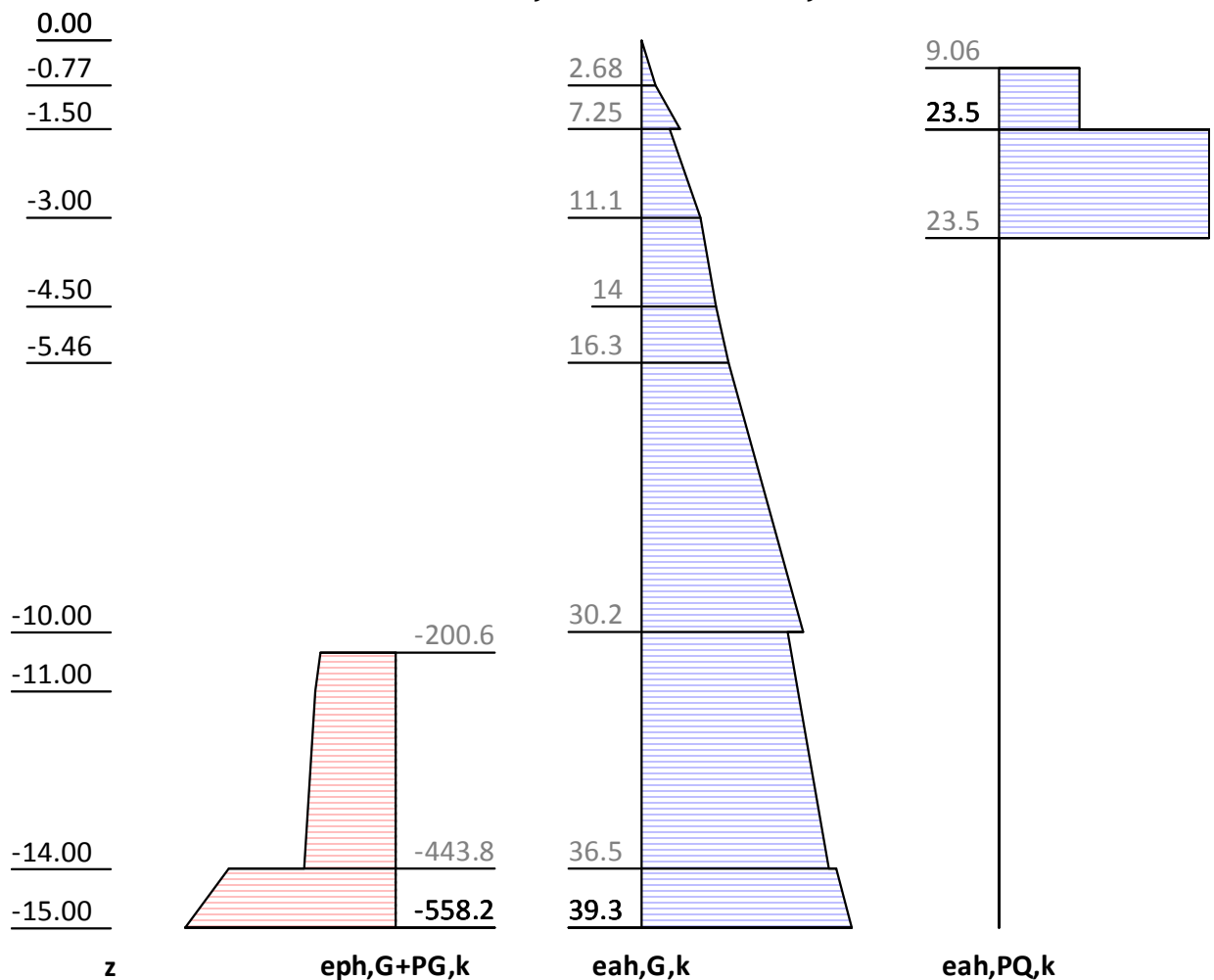
### Μήκος τοίχου

Foot depth for statics: zf = -15.000

### Stress analysis

#### Earth pressure, horizontal

Pressures characteristic, no redistribution, continous wall



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

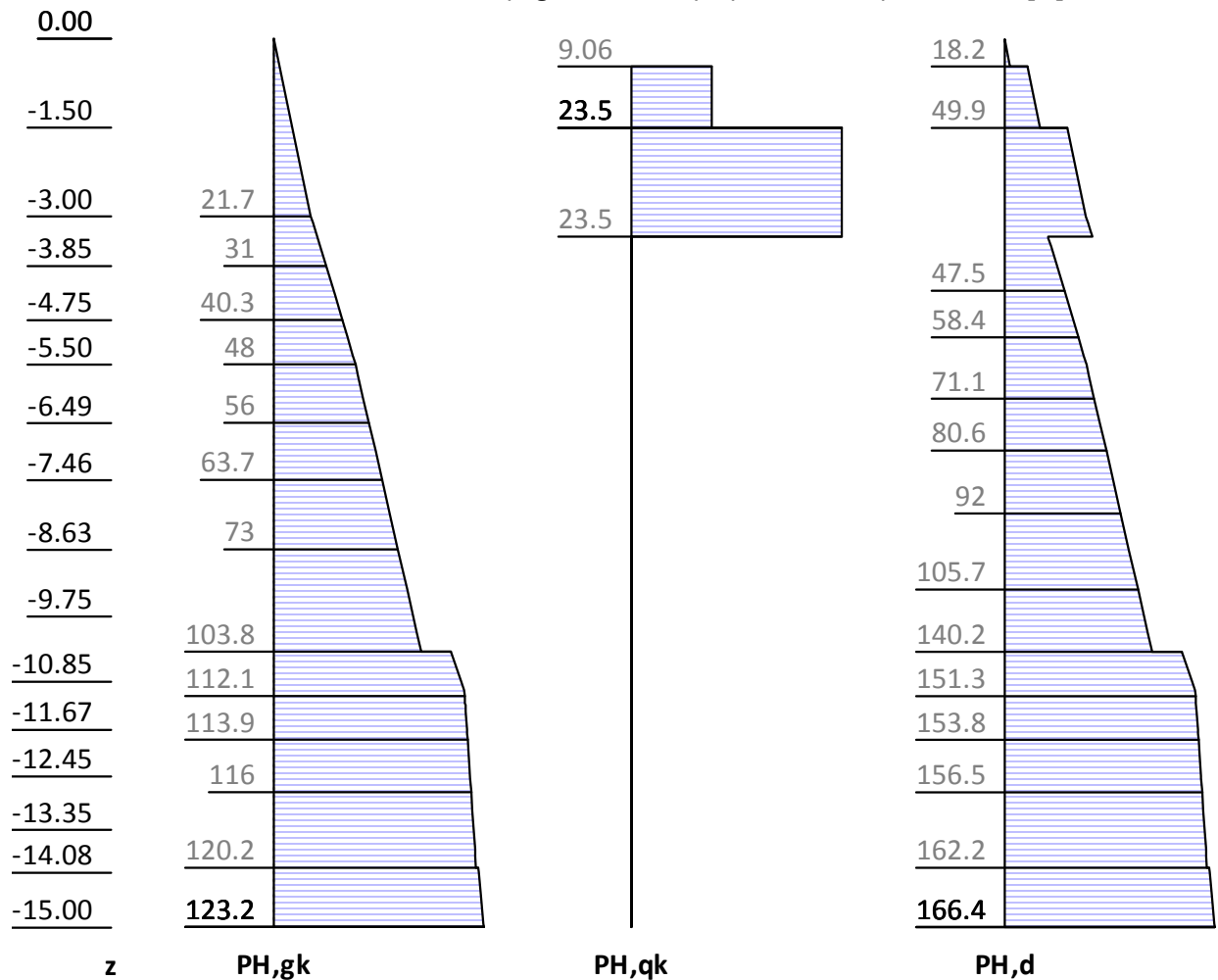
## Πίεση νερού

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	0.00
-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

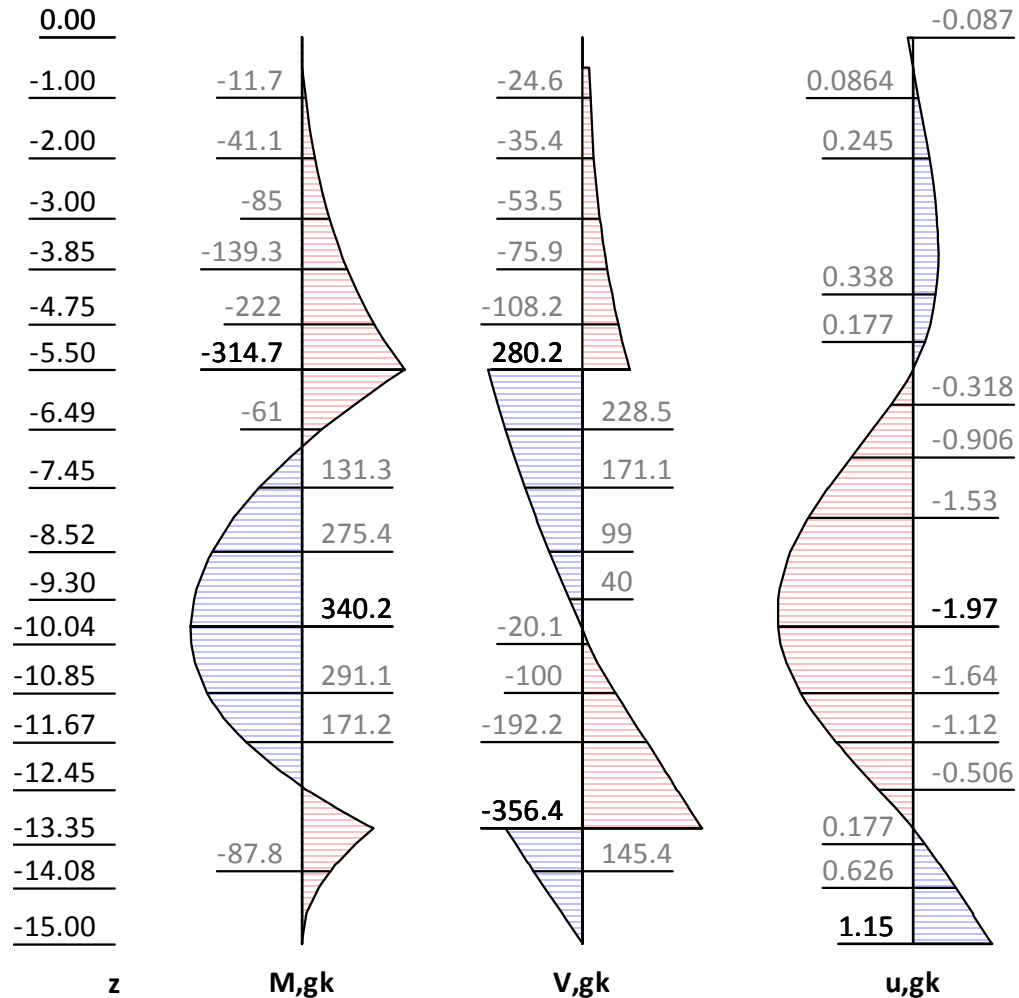
**V-pressure on static system****Internal forces: Permanent, characteristically**

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

Author: FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München					Job No.:
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Structure:	info@fides-dvp.de	www.fides-dvp.de	Tel:++49/89/143829-0	ASB Nr.:	Date: 08.10.2018
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
<b>Internal forces: Variable, characteristically</b> 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					
0.00					0.0347
-1.00					-0.0339
-2.00					-0.0853
-3.00					-0.0969
-3.85					-0.0753
-4.75					-0.0348
-5.50					
-6.49					0.0344
-7.45					0.0538
-8.52					0.0622
-9.30					0.0574
-10.04					0.0436
-10.85					0.0293
-11.67					0.0137
-12.45					-0.00539
-13.35					-0.0209
-14.08					-0.0405
-15.00					
z	M,qk	V,qk	u,qk		
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
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z	H, q, k	M, q, k	V, q, k	N, q, k	u, q, k
[m]	[kN/m2]	[kN/m2]	[kN/m2]	[kN/m2]	[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

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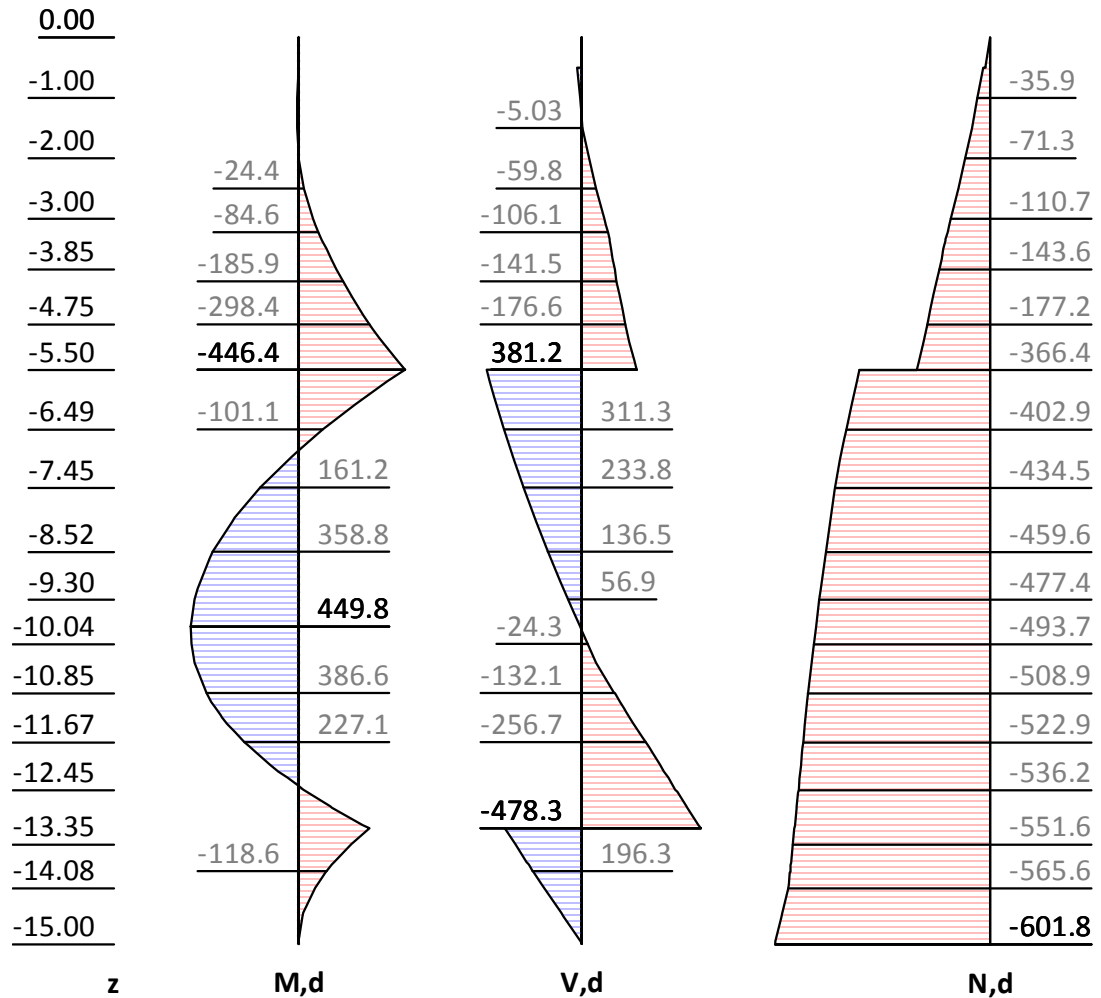
## Internal forces: Design

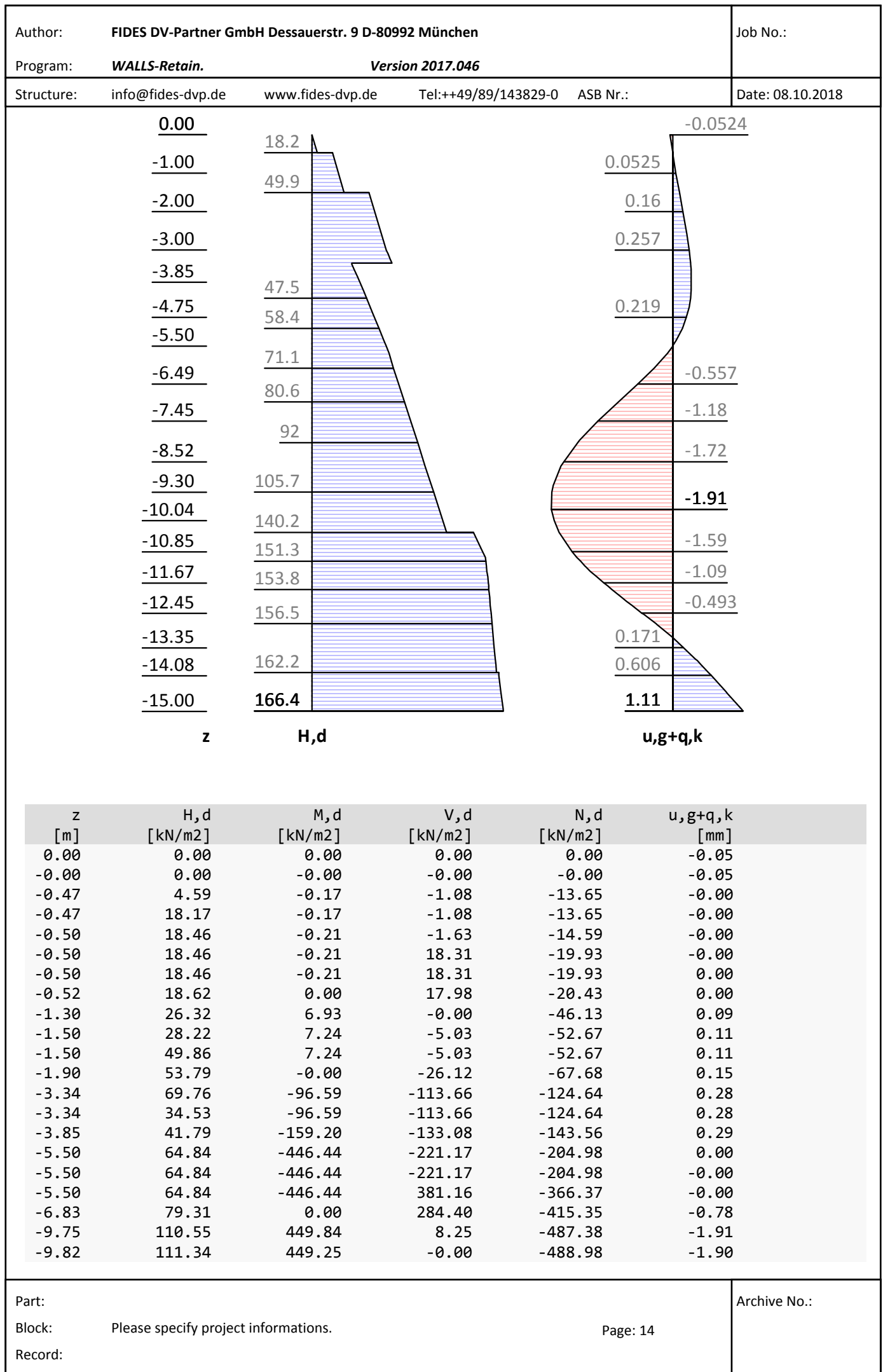
z= -0.500. Fx= -19.940 kN/m Support

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





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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

$R_d = E_{ph,k}/\gamma, R_e = 1321.76 / 1.400 = 944.11 \text{ [kN/m]}$

$E_d(U_h,d)/R_d = 786.16 / 944.11 = 0.833 \text{ [-]}. \text{ Passes requirement}$

**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
B <sub>h,g,k</sub> z=-13.10	-584.44	
B <sub>v,g,k</sub> = B <sub>h,k</sub> * 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.

$V_k \geq B_{vk}: 421.63 \geq 0.68 \text{ Passes requirement}$

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

Forces up to depth z:-15.00

Pos.	H	V
-----		

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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( $\delta$ ,p=-0.07°)		-0.68	
Bh,q,k z=-13.10	1.89		
Bv,q,k = Bh,k * tan( $\delta$ ,p=-0.07°)		0.00	
-----			
$\Sigma$	-0.00	441.09	
		(downwards)	

Average anchor inclination  $\alpha$ ,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.

V<sub>k</sub> >= B<sub>vk</sub>: 441.76 >= 0.68 Passes requirement

### Anchor verification

#### Anchor - Stability of lower failure plane

Περίπτωση 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:**

l<sub>A</sub> .....: Length of anchor from head to center of grout body.

W<sub>k</sub> .....: Res. force from dead weight, loads, cohesion, ...

Q<sub>k</sub> .....: Force in lower failure plane.

Ea<sub>1,k</sub>.....: Earth pressure onto vertical separation plane.

Ea<sub>2,k</sub>.....: Earth pressure between wall and main failure body.

Ra<sub>cal,d</sub> ....: Dimensioning force of the resistance from the equilibrium of forces.  
                   Ra<sub>cal,d</sub> 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	$\vartheta_1$	$\vartheta_2$	l <sub>A</sub>	W <sub>k</sub>	Q <sub>k</sub>	Ea <sub>1,k</sub>	Ea <sub>2,k</sub>	Ra <sub>cal,d</sub>	Sum(A,d)	Ed/Rd
[m]	[°]	[°]	[m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]
-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	$\vartheta_1$ = 21.27°
Inclination upper failure plane	$\vartheta_2$ = 60.26°
Inclination separation plane	$\vartheta_{12}$ = 90.00°

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**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	$\delta = 0.0^\circ$
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 ....[mm<sup>2</sup>]: X-section area of steel member

Ri,d ...[kN]: Ultimate strength of tension member ( $\gamma, M=1.15$ )

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

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<b>Check of anchor's soil friction</b> 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																																																																																																																																																																																																																																					
<table><tr><th>z</th><th>lVk</th><th>DmVk</th><th>τGr,k</th><th>Ra,k</th><th>γA</th><th>Ra,d</th><th></th><th>A,d</th><th>A,d/Ra,d</th></tr><tr><th>[m]</th><th>[m]</th><th>[mm]</th><th>[kN/m²]</th><th>[kN]</th><th>[-]</th><th>[kN]</th><th></th><th>[kN]</th><th>[-]</th></tr><tr><td>-0.50</td><td>8.00</td><td>318</td><td>110</td><td>879.1</td><td>1.100</td><td>799.2</td><td>&gt;</td><td>37.2</td><td>0.0</td></tr><tr><td>-3.00</td><td>8.00</td><td>318</td><td>110</td><td>879.1</td><td>1.100</td><td>799.2</td><td>&gt;</td><td>0.0</td><td>0.0</td></tr><tr><td>-5.50</td><td>8.00</td><td>318</td><td>110</td><td>879.1</td><td>1.100</td><td>799.2</td><td>&gt;</td><td>561.2</td><td>0.7</td></tr></table>										z	lVk	DmVk	τGr,k	Ra,k	γA	Ra,d		A,d	A,d/Ra,d	[m]	[m]	[mm]	[kN/m²]	[kN]	[-]	[kN]		[kN]	[-]	-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																																																																																																																																																																										
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<b>Υπολογ. κύκλου ολίσθησης</b> 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 occur).																																																																																																																																																																																																																																					
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:																																																																																																																																																																																																																																					
<table><tr><th>No</th><th>x</th><th>Width</th><th>dxM</th><th>Weight</th><th>Load</th><th>Water-</th><th>u*b</th><th>φ</th><th>c</th><th>θ</th></tr><tr><th></th><th>[m]</th><th>[m]</th><th>[m]</th><th>[kN/m]</th><th>z-κατ.</th><th>φορτ.</th><th>[kN/m]</th><th>[°]</th><th>[kN/m²]</th><th>[°]</th></tr><tr><th></th><th></th><th></th><th></th><th></th><th>[kN/m]</th><th>[kN/m]</th><th></th><th></th><th></th><th></th></tr><tr><td>1</td><td>-13.37</td><td>1.58</td><td>-10.64</td><td>24.7</td><td>0.0</td><td>0.0</td><td>-6.4</td><td>0.08</td><td>71.43</td><td>-42.40</td></tr><tr><td>2</td><td>-11.80</td><td>1.58</td><td>-9.06</td><td>65.2</td><td>0.0</td><td>0.0</td><td>-21.6</td><td>0.08</td><td>71.43</td><td>-35.05</td></tr><tr><td>3</td><td>-10.22</td><td>1.58</td><td>-7.48</td><td>96.3</td><td>0.0</td><td>0.0</td><td>-37.3</td><td>0.08</td><td>71.43</td><td>-28.32</td></tr><tr><td>4</td><td>-8.64</td><td>1.58</td><td>-5.91</td><td>120.4</td><td>0.0</td><td>0.0</td><td>-49.2</td><td>29.26</td><td>3.57</td><td>-21.98</td></tr><tr><td>5</td><td>-7.06</td><td>1.58</td><td>-4.33</td><td>139.9</td><td>0.0</td><td>0.0</td><td>-57.9</td><td>29.26</td><td>3.57</td><td>-15.92</td></tr><tr><td>6</td><td>-5.49</td><td>1.58</td><td>-2.75</td><td>153.0</td><td>0.0</td><td>0.0</td><td>-63.8</td><td>29.26</td><td>3.57</td><td>-10.04</td></tr><tr><td>7</td><td>-3.91</td><td>1.58</td><td>-1.17</td><td>160.1</td><td>0.0</td><td>0.0</td><td>-66.9</td><td>29.26</td><td>3.57</td><td>-4.26</td></tr><tr><td>8</td><td>-2.33</td><td>1.58</td><td>0.40</td><td>161.5</td><td>0.0</td><td>0.0</td><td>-67.6</td><td>29.26</td><td>3.57</td><td>1.47</td></tr><tr><td>9</td><td>-0.75</td><td>1.58</td><td>1.98</td><td>165.0</td><td>0.0</td><td>0.0</td><td>-129.6</td><td>29.26</td><td>3.57</td><td>7.22</td></tr><tr><td>10</td><td>0.82</td><td>1.58</td><td>3.56</td><td>495.4</td><td>0.0</td><td>0.0</td><td>-189.1</td><td>29.26</td><td>3.57</td><td>13.04</td></tr><tr><td>11</td><td>2.40</td><td>1.58</td><td>5.14</td><td>479.1</td><td>0.0</td><td>0.0</td><td>-181.8</td><td>29.26</td><td>3.57</td><td>19.01</td></tr><tr><td>12</td><td>3.98</td><td>1.58</td><td>6.71</td><td>457.0</td><td>13.5</td><td>0.0</td><td>-171.5</td><td>0.08</td><td>71.43</td><td>25.19</td></tr><tr><td>13</td><td>5.56</td><td>1.58</td><td>8.29</td><td>429.7</td><td>0.0</td><td>0.0</td><td>-157.7</td><td>0.08</td><td>71.43</td><td>31.71</td></tr><tr><td>14</td><td>7.13</td><td>1.58</td><td>9.87</td><td>394.1</td><td>0.0</td><td>0.0</td><td>-139.8</td><td>0.08</td><td>71.43</td><td>38.73</td></tr><tr><td>15</td><td>8.71</td><td>1.58</td><td>11.45</td><td>347.6</td><td>0.0</td><td>0.0</td><td>-116.2</td><td>0.08</td><td>71.43</td><td>46.52</td></tr><tr><td>16</td><td>10.29</td><td>1.58</td><td>13.02</td><td>278.6</td><td>0.0</td><td>0.0</td><td>-84.2</td><td>27.45</td><td>3.57</td><td>55.65</td></tr><tr><td>17</td><td>12.05</td><td>1.95</td><td>14.79</td><td>192.8</td><td>0.0</td><td>0.0</td><td>-40.5</td><td>27.45</td><td>3.57</td><td>69.64</td></tr></table>										No	x	Width	dxM	Weight	Load	Water-	u*b	φ	c	θ		[m]	[m]	[m]	[kN/m]	z-κατ.	φορτ.	[kN/m]	[°]	[kN/m²]	[°]						[kN/m]	[kN/m]					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
No	x	Width	dxM	Weight	Load	Water-	u*b	φ	c	θ																																																																																																																																																																																																																											
	[m]	[m]	[m]	[kN/m]	z-κατ.	φορτ.	[kN/m]	[°]	[kN/m²]	[°]																																																																																																																																																																																																																											
					[kN/m]	[kN/m]																																																																																																																																																																																																																															
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																																																																																																																																																																																																																											
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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:																																																																																																																																																																																																																																					
<table><tr><th>No</th><th>Weight</th><th>G*sin(θ)</th><th>(G-u*b)*tan(φ)</th><th>μ*sin(θ)*</th><th>T</th></tr></table>										No	Weight	G*sin(θ)	(G-u*b)*tan(φ)	μ*sin(θ)*	T																																																																																																																																																																																																																						
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Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>					Job No.:
Program: <b>WALLS-Retain. Version 2017.046</b>					
Structure: info@fides-dvp.de    www.fides-dvp.de    Tel:++49/89/143829-0    ASB Nr.:					Date: 08.10.2018

	[kN/m]	[kN/m]	+ c*b [kN/m]	tan(φ)+cos(θ) [-]	[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 [kN/m]	Επιφ.Φορ.*dzM [m]	Πίεση νερού*dzM [kN/m]	οριζ.Σεισμός.*dzM [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  $E_d = (1406.5*15.77+963.5-2351.6)$

Αντίσταση  $R_d = (1886.6*15.77+1149.1)$

SLIP-CIRCLE  $\mu = E_d/R_d = 0.67 < 1.0$ : Έλεγχος εκπληρώθηκε.


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## ΠΑΡΑΡΤΗΜΑ

### 8.5 Αποτελέσματα ανάλυσης

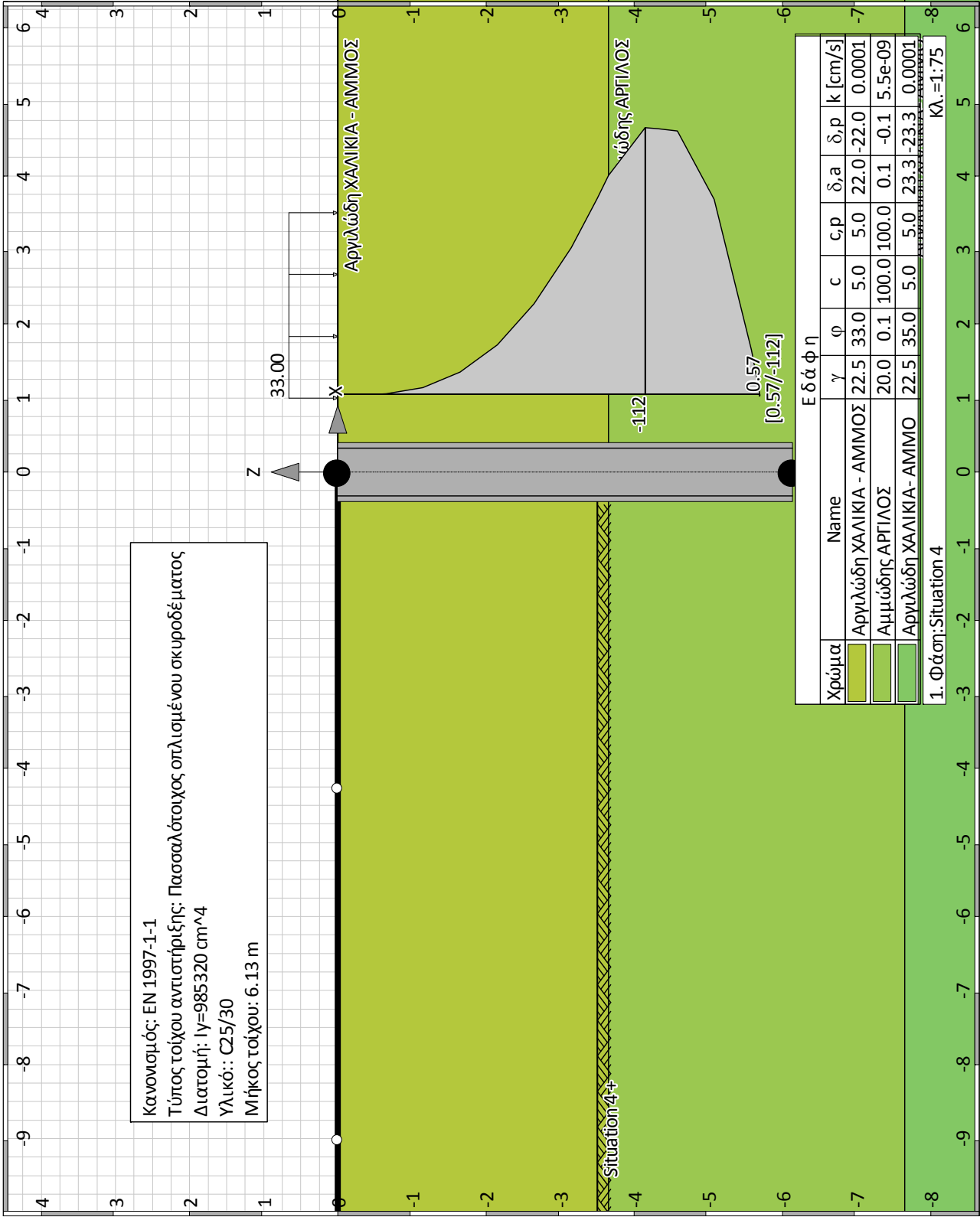
#### 8.5.2 Σεισμικές Συνθήκες

- i) Αντιστηριζόμενο ύψος 3,60m

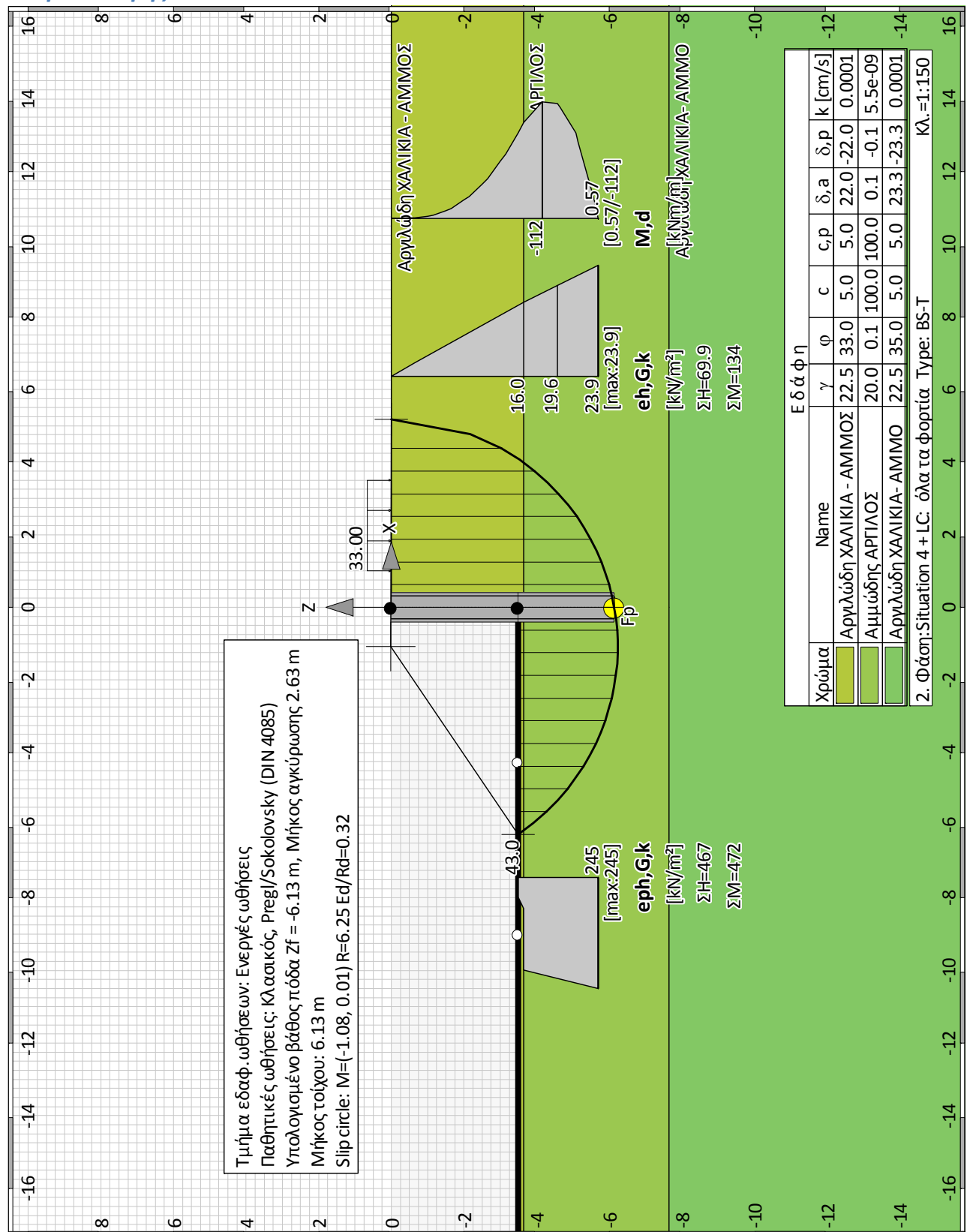
Version 2017.046

Summary of all stages

Φάση εκσκαφής 0 "Situation 4"



## Φάση εκσκαφής 1 "Situation 4 +"



Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>								Job No.:	
Program: <b>WALLS-Retain.</b>						Version <b>2017.046</b>			
Structure: <b>info@fides-dvp.de</b>		<b>www.fides-dvp.de</b>		ASB Nr.:		Date: 18.10.2018			

### Κανονισμός για 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					

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Record:									

Author: <b>FIDES DV-Partner GmbH Dessauerstr. 9 D-80992 München</b>								Job No.:	
Program: <b>WALLS-Retain.</b>								Version <b>2017.046</b>	
Structure: info@fides-dvp.de		www.fides-dvp.de		ASB Nr.:		Date: 18.10.2018			

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

**Κύκλος ολίσθησης: [GEO] A2 M2 R3**

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

**Hydraulic heave: [HYD] A1 M1 R1**

$\gamma$ -	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**

$\gamma$ -	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**

$\gamma$ -	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	

$\gamma_{Re,red}$  (EAB EB14-3): Ναί,  $\eta=0.80$   
 $\gamma_{Re,red}$  (EAB EB22-6): Ναί,  $E0h > 0\%$ :  $\eta = 0.60 / 0.80$

**System values**

**Τοίχος**

Τύπος τοίχου αντιστήριξης: Πασσαλότοιχος οπλισμένου σκυροδέματος  
 Διατομή:  $I_y=985320 \text{ cm}^4$   
 Υλικό:: C25/30  
 Ίδιο βάρος: 25.000 [kN/m3]

**Σημεία τοίχου**

z [m]	d [m]	E [MN/m2]	$I_y$ [cm4/m]	$E \cdot I_y$ [MNm2]	A [cm2/m]
0.00	80.0	31500.0	985320	310.4	6940
-6.13	80.0	31500.0	985320	310.4	6940

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### Φάση εκκαφής 1 "[1] Situation 4 +"

LC: όλα τα φορτία Type: BS-T

#### Εδαφικό σύστημα με 3 Στρώσεις

Name	Αργιλώδη ΧΑΛΙΚΙΑ - ΑΜΜΟΣ	Αμμόδης 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,θh	[-] 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 Αμμόδης ΑΡΓΙΛΟΣ:

z= -3.65

Πορεία ανώτερου 3. στρώματος Αργιλώδη ΧΑΛΙΚΙΑ- ΑΜΜΟ:

z= -7.65

#### Επιφ. φορτία:

##### Φορτία

xA	zA	xE	zE	PxA	PzA	PxE	PzE	Typ	LC-description
[m]	[m]	[m]	[m]	[	kN/m²		]		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.

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### 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

$k_{h,eq} = \alpha \cdot S \cdot r = 0.028$  (r=1.0)

### Earth pressure coefficients $k_h$

$\varphi$	$\alpha$	$\beta$	$\delta$	$k_{0gh}$	$k_{agh}$	$k_{ach}$	$k_{pgh}$	$k_{pch}$	
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	--	--	"

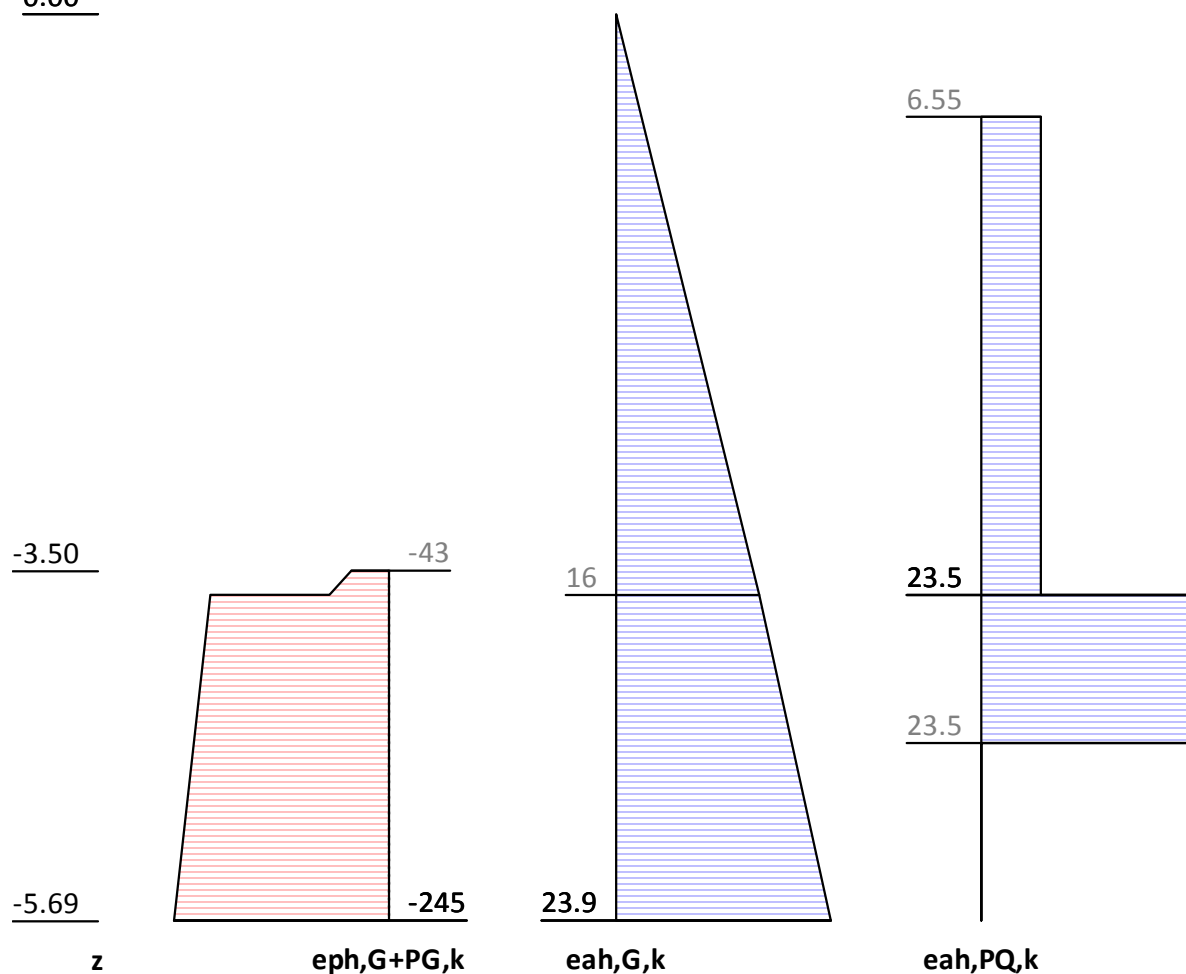
### Μήκος τοίχου

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:  $z_f = -5.694$

**Stress analysis****Earth pressure, horizontal**

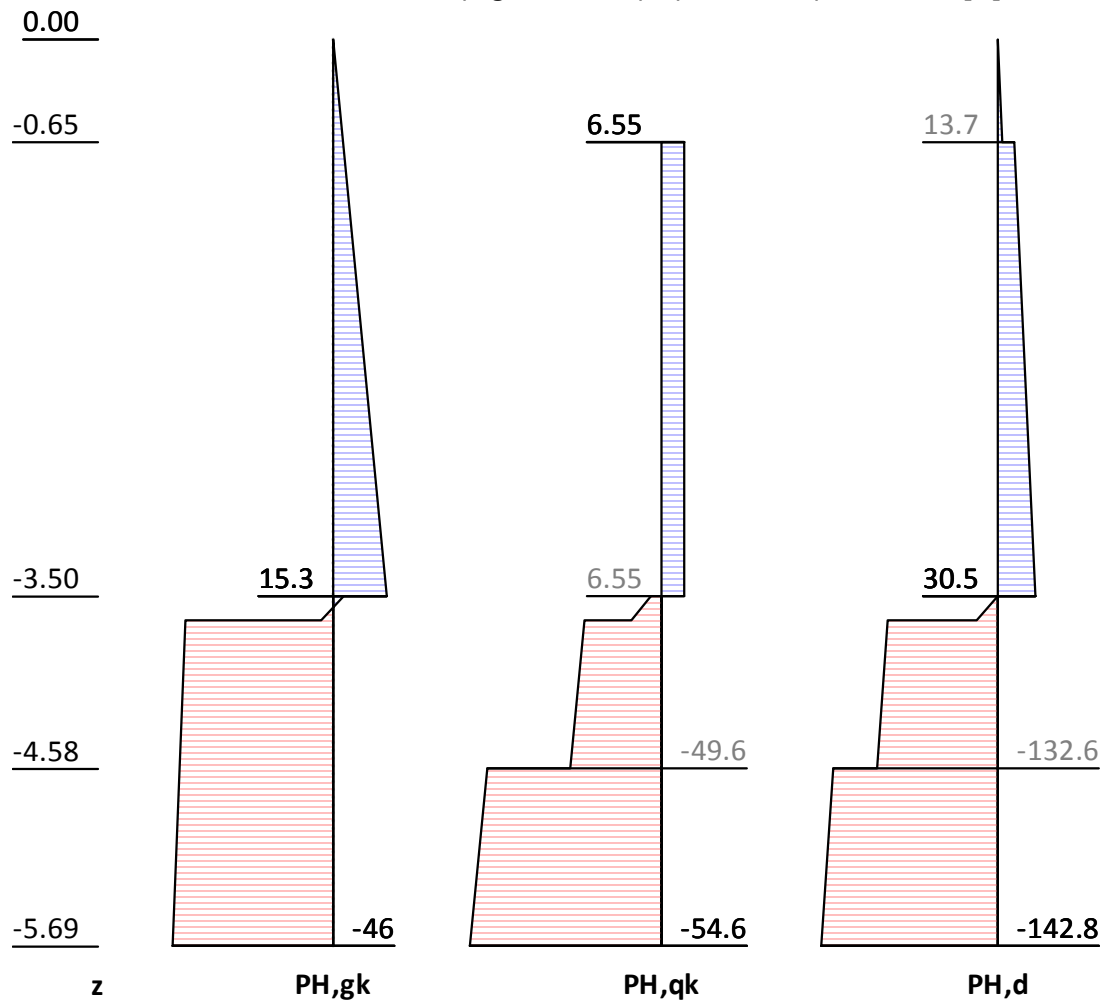
Pressures characteristic, no redistribution, continuous wall

0.00

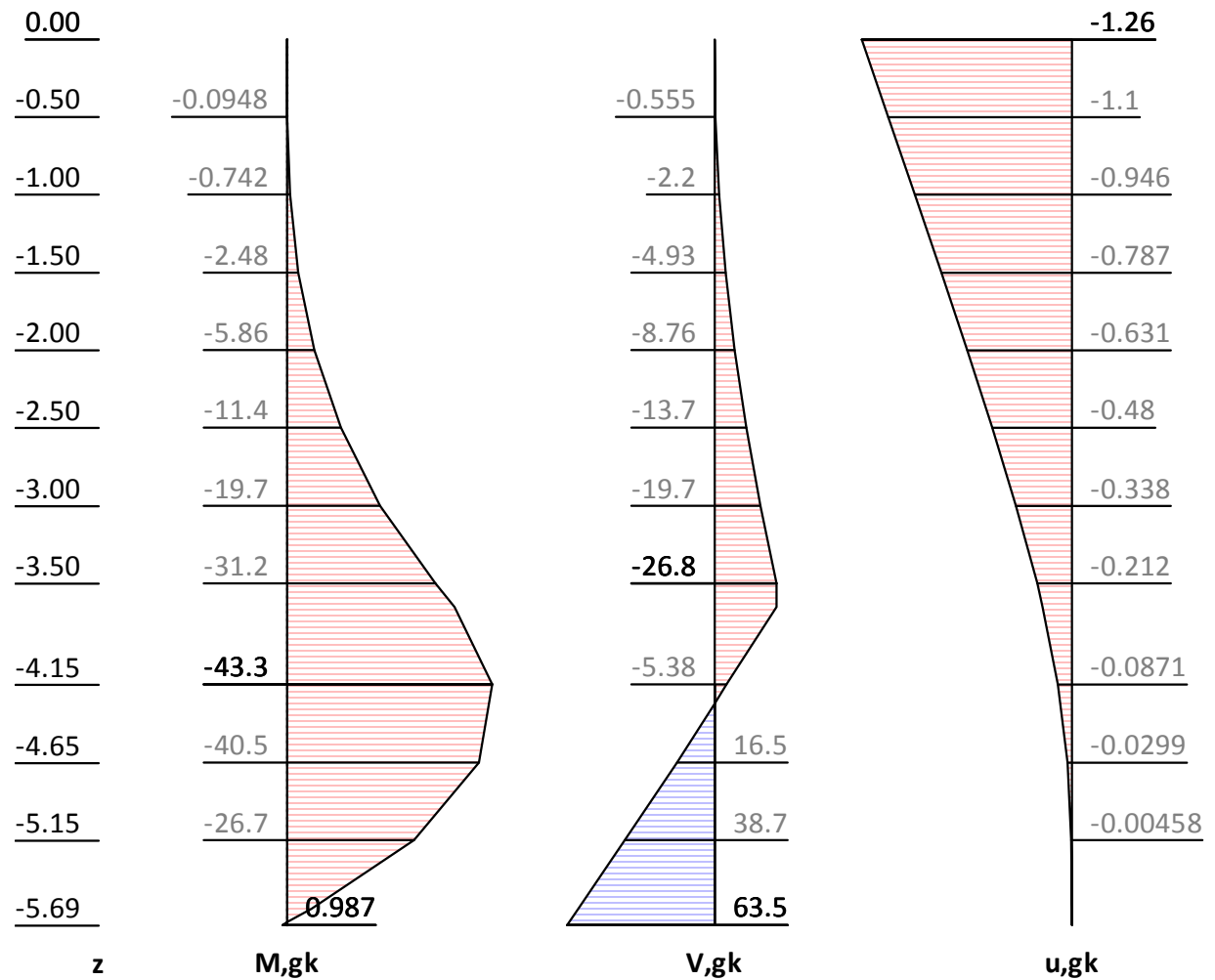
$z$ [m]	$eph,G,k$ [kN/m <sup>2</sup> ]	$eah,G,k$ [kN/m <sup>2</sup> ]	$eah,PQ,k$ [kN/m <sup>2</sup> ]	$eah,d$ [kN/m <sup>2</sup> ]
0.00		0.00		0.00
-0.65		2.84	0.00	3.84
-0.65		2.84	6.55	13.65
-3.50	-0.00	15.30	6.55	30.48
-3.50	-43.00	15.30	6.55	30.48
-3.65	-68.30	15.96	6.55	31.36
-3.65	-203.97	15.96	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:  $E_{p,gk}$  28.5,  $E_{p,qk}$  22.3,  $E_{p,d}$  100.0 [%]

z [m]	PH,gk [kN/m <sup>2</sup> ]	PH,qk [kN/m <sup>2</sup> ]	PH,d [kN/m <sup>2</sup> ]
0.00	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/m <sup>2</sup> ]	$M$ , g, k [kN/m <sup>2</sup> ]	$V$ , g, k [kN/m <sup>2</sup> ]	$N$ , g, k [kN/m <sup>2</sup> ]	$u$ , 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

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Internal forces: Variable, characteristically

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

0.00

-0.50

-1.00

-1.50

-2.00

-2.50

-3.00

-3.50

-4.15

-4.58

-5.08

-5.69

z

-0.687

-2.69

-6.35

-11.6

-18.6

-26.6

-35.4

-36.5

-27.9

1.18

M,qk

0.00765

-2.4

-5.67

-8.94

-12.2

-15.5

-18.7

-6.23

4.57

29.9

62.6

V,qk

-1.11

-0.966

-0.826

-0.687

-0.551

-0.42

-0.298

-0.187

-0.0787

u,qk

z	H, q, k	M, q, k	V, q, k	N, q, k	u, q, k
[m]	[kN/m2]	[kN/m2]	[kN/m2]	[kN/m2]	[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

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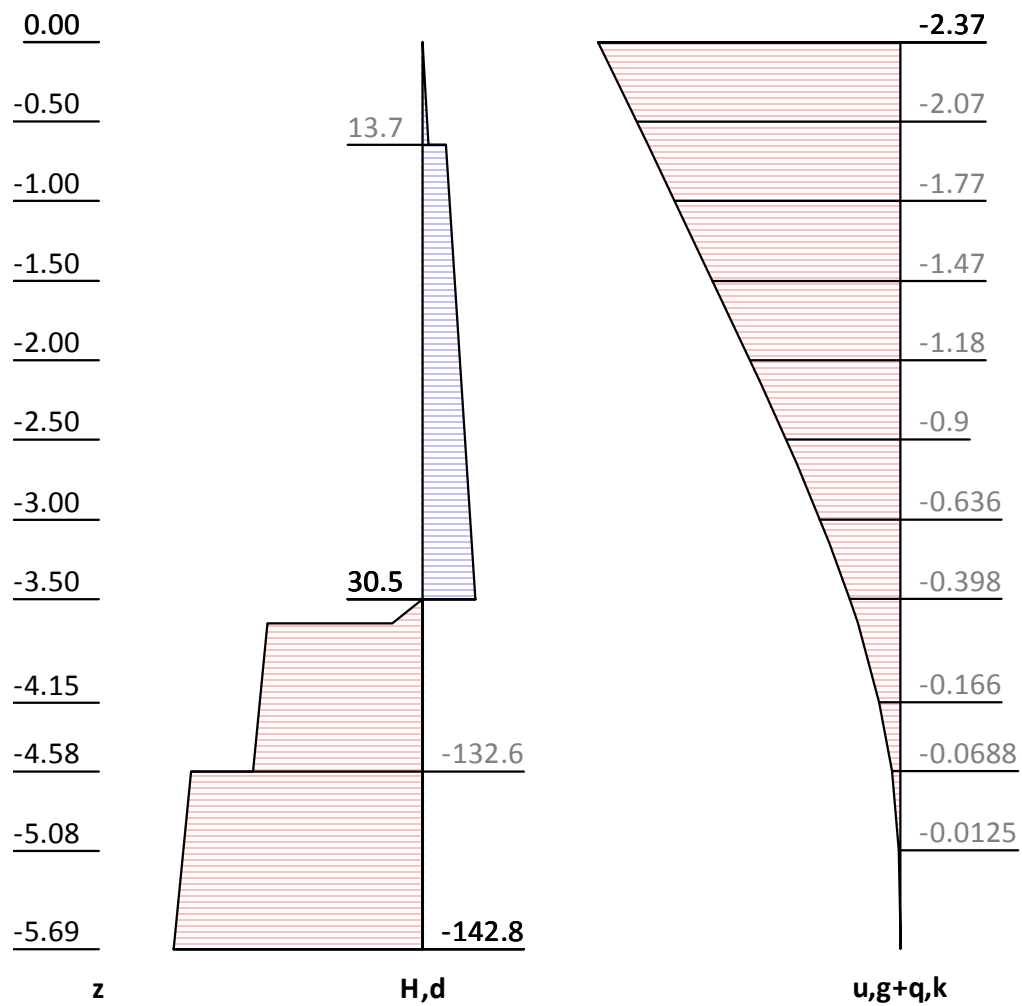
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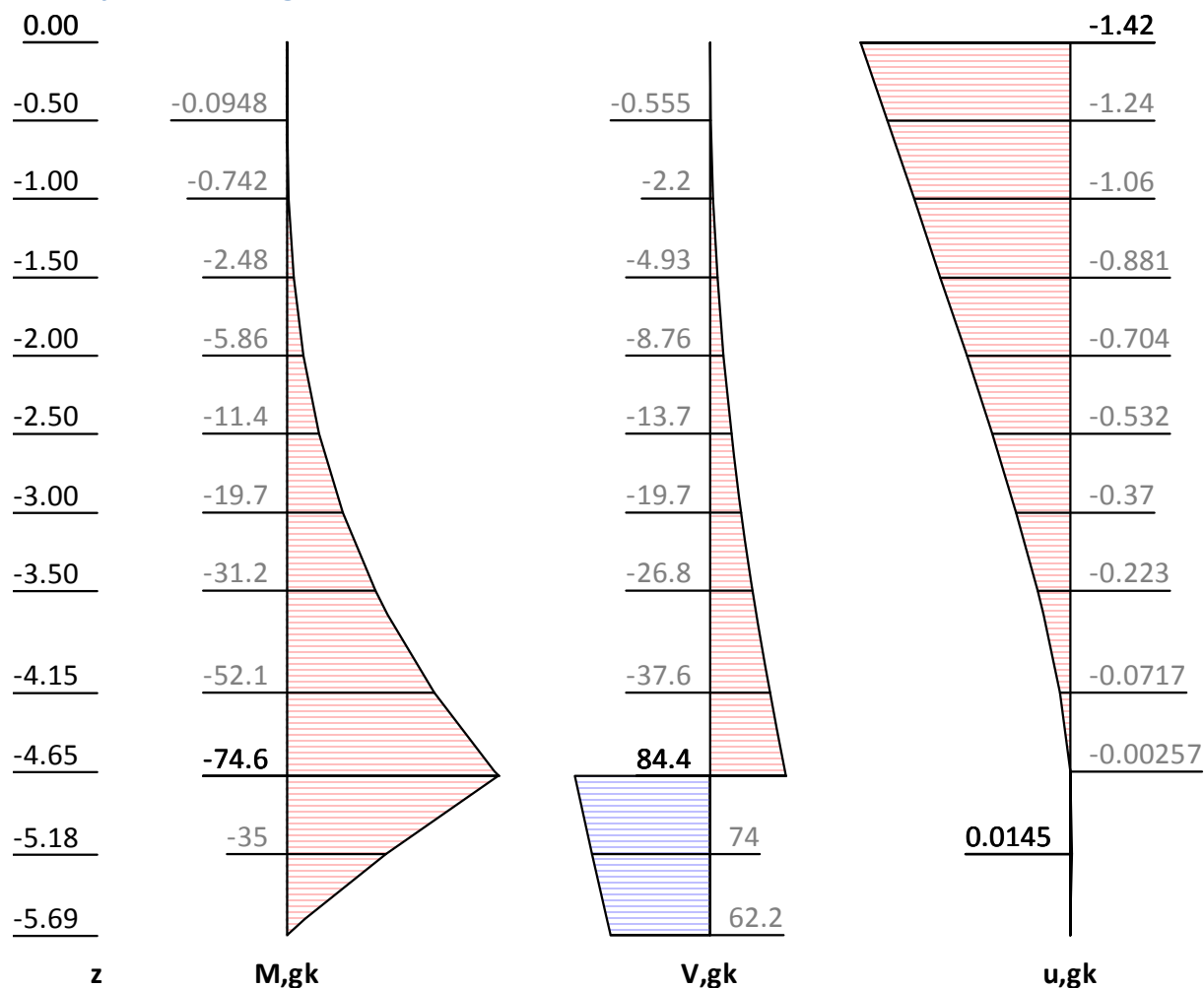
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**N,d**

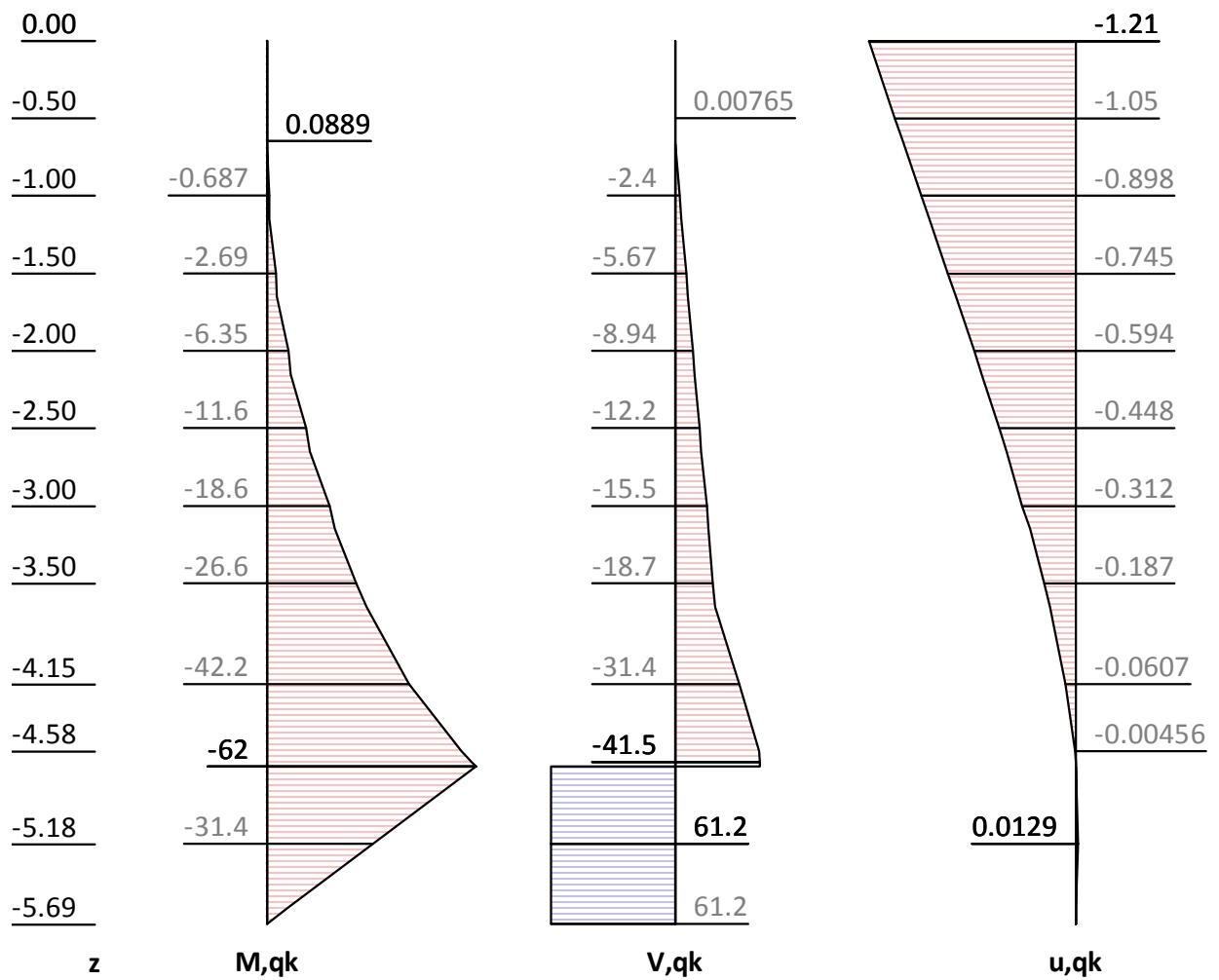


z [m]	H,d [kN/m <sup>2</sup> ]	M,d [kN/m <sup>2</sup> ]	V,d [kN/m <sup>2</sup> ]	N,d [kN/m <sup>2</sup> ]	u,g+q,k [mm]
0.00	0.00	0.00	0.00	0.00	-2.37
-0.00	0.00	0.00	-0.00	-0.00	-2.37
-0.65	3.84	-0.27	-1.25	-15.73	-1.98
-0.65	13.65	-0.27	-1.25	-15.73	-1.98
-3.50	30.48	-82.05	-64.13	-105.03	-0.40
-3.50	-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]

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### Check of C-force (foot support)

z(C)	= -5.69 [kN/m]
G,k = sum( $\gamma \cdot h$ )	= 123.00 [kN/m]
P,k = sum( $P_{z,k}(x=0.1)$ )	= 0.00 [kN/m]
kpgh,C( $\phi=0.1$ ; $\delta,C=0.0^\circ$ )	= 1.002 [-]
kpch,C	= 2.003 [-]
eph,C,gk = (G,k+P,k)*kpgh,C+2*c*sqrt(kpch,C)	= 406.31 [kN/m <sup>2</sup> ]
	= (123.00+0.00)*1.002+2*100.0*1.415
Ed = Ch,d	= 175.79 [kN/m <sup>2</sup> ]
$\delta,t,EAB = Ed/(2 \cdot eph,C,d)$	= 0.30 [m]
$\delta,t,EAB = 0.20 \cdot t$	= 0.44 [m]
$\delta,t = \delta,t,EAB$	= 0.44 [m]
Rd = $2 \cdot \delta,t \cdot eph,C,gk / \gamma,Re$	
	= $2 \cdot 0.44 \cdot 406.31 / 1.4$
	= 254.68 [kN/m <sup>2</sup> ]

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/ $\gamma,Re$  = 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( $\delta,p=-0.07^\circ$ )		-0.15
Ch,g	62.19	
Cv,g = Ch*tan( $\delta,C=0.0^\circ$ )		0.04
$\Sigma$	-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( $\delta,p=-0.07^\circ$ )		-0.15
Bh,q,k z=-4.68	-102.70	
Bv,q,k = Bh,k * tan( $\delta,p=-0.07^\circ$ )		-0.12
Ch,g	62.19	
Cv,g = Ch*tan( $\delta,C=0.0^\circ$ )		0.04
Ch,q	61.22	
Cv,q = Ch*tan( $\delta,C=0.0^\circ$ )		0.04

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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 occur).										
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					
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No	Weight	$G \cdot \sin(\theta)$	$(G - u \cdot b) \cdot \tan(\varphi) + c \cdot b$	$\mu \cdot \sin(\theta) \cdot \tan(\varphi) + \cos(\theta)$	T
	[kN/m]	[kN/m]	[kN/m]	[-]	[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
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		276.56			907.93

Συνεισφ. οριζόντιων φορτίων:

Αρ	Γραμ.Φορ*dzM	Επιφ.Φορ.*dzM	Πίεση νερού*dzM	οριζ.Σεισμός.*dzM
	[kN/m]	[m]	[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  $E_d = (276.6 \cdot 6.25 + 70.2)$

Αντίσταση  $R_d = (907.9 \cdot 6.25 + 0.0)$

$SLIP-CIRCLE \mu = E_d / R_d = 0.32 < 1.0$ : Έλεγχος εκπληρώθηκε.

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