

Jornada

Presentación del borrador del ANEJO NACIONAL Español del EUROCÓDIGO 7 de Segunda Generación

Madrid, 19 y 20 de noviembre 2025



EUROCODES

EN 1997

Geotechnical
design

ENTIDADES ORGANIZADORAS

UNE

Normalización
Española



GOBIERNO
DE ESPAÑA

MINISTERIO
DE TRANSPORTES
Y MOVILIDAD SOSTENIBLE

VICEPRESIDENCIA
TERCERA DEL GOBIERNO

MINISTERIO
PARA LA TRANSICIÓN ECOLÓGICA
Y EL RETO DEMOGRÁFICO

CEDEX

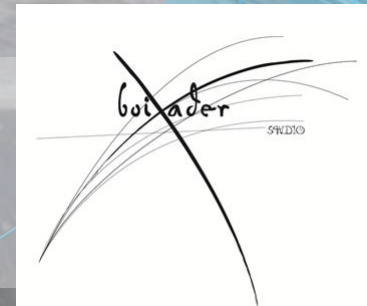
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Presentación del borrador del ANEJO NACIONAL Español del EUROCÓDIGO 7 de Segunda Generación

Parte 1 - Procedimiento para los cálculos numéricos (8.2)

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1. Objeto de la presentación

Eurocode 7 — Geotechnical design — Part 1: General rules

4.2 Principles of limit state design

4.2.1 General

(1) The principles of limit state design given in EN 1990:2023, Clause 5 shall apply to geotechnical structures.

(2) In addition to (1), limit states for geotechnical structures shall be verified by one or more of the following methods:

- calculation using the partial factor method (4.4) or other reliability-based methods;
- prescriptive rules (4.5);
- testing (4.6); or
- Observational Method (4.7).

7.1 Calculation models.....

7.1.1 General

7.1.2 Empirical models

7.1.3 Analytical models

7.1.4 Numerical models.....

7.1.4 Numerical models

(1) Numerical models may be used for the verification of limit states including the assessment of failure modes and ground movements.

8.2 Procedure for numerical models

(1) For geotechnical structures, verification of ultimate limit states by numerical models should be verified using both of the following factoring approaches:



2. Estadística de NDPs

Eurocode 7 — Geotechnical design — Part 1: General rules

Introduction

0.5 National annex for EN 1997-1

National choice is allowed in this document where explicitly stated within notes. National choice includes the selection of values for Nationally Determined Parameters (NDPs).

National choice is allowed in EN 1997-1 through notes to the following clauses:

4.1.2.2(1)	4.1.2.3(3)	4.1.3(1)	4.1.4(2)
4.1.5(1)	4.1.8(3)	4.2.3.2(2)	4.2.4(3)
4.3.2.3(2)	4.4.1.3(1) – 3 choices	4.4.1.3(9) – 2 choices	4.4.1.5(1) – 2 choices
4.5(1)	4.5(4)	5.4(2)	5.5(2)
5.5(3)	7.1.1(7)	7.2(2)	8.1.4.2(3)
8.2(1) – 2 choices	10.2(3)	12.1(4)	A.4(3)
A.4(8) – 2 choices	A.4(11)	C.3(3)	C.3(4)

National choice is allowed in EN 1997-1 on the application of the following informative annexes:

Annex A	Annex B	Annex C
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3. NDP - 8.2 (1) — Procedimiento para modelos numéricos



8.2 Procedure for numerical models

(1) For geotechnical structures, verification of ultimate limit states by numerical models should be verified using both of the following factoring approaches:

- Input factoring, using:
 - factors on actions γ_F from Verification Case 3 and;
 - factors on material properties γ_M from Set M2;
- Output factoring, using:
 - factors on effects-of-actions γ_E from Verification Case 4 and;
 - factors on material properties γ_M from Set M1.

NOTE 1 For input factoring, partial factors are not applied to resistance nor to effects of actions.

NOTE 2 For output factoring, partial factors are not applied to resistance nor to actions.

NOTE 3 The resistance of structural members is verified according to the other Eurocodes and EN 1997-3.

NOTE 4 Values of γ_F and γ_E are given in EN 1990:2023, Annex A.

NOTE 5 Values of γ_M are given in 4.4.1.3.

NOTE 6 The National Annex can specify cases where ultimate limit states can be verified by input or output factoring alone.

NOTE 7 The procedure for verification of ultimate limit states with numerical models is given in Table 8.1 (NDP) unless the National Annex gives a different procedure.

3. NDP - 8.2 (1) — Procedimiento para modelos numéricos

Table 8.1 (NDP) — Procedure for verification of ultimate limit states with numerical models

8.2 Procedure for numerical models

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 - factors on material properties γ_M from Set M2;
- Output factoring, using:
 - factors on effects-of-actions γ_E from Verification Case 4 and;
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NOTE 1 For input factoring, partial factors are not applied to resistance nor to effects of actions.

NOTE 2 For output factoring, partial factors are not applied to resistance nor to actions.

NOTE 3 The resistance of structural members is verified according to the other Eurocodes and EN 1997-3.

NOTE 4 Values of γ_F and γ_E are given in EN 1990:2023, Annex A.

NOTE 5 Values of γ_M are given in 4.4.1.3.

NOTE 6 The National Annex can specify cases where ultimate limit states can be verified by input or output factoring alone.

NOTE 7 The procedure for verification of ultimate limit states with numerical models is given in Table 8.1 (NDP) unless the National Annex gives a different procedure.

Table 8.1 (NDP) — Procedure for verification of ultimate limit states with numerical models

		Factoring approach - See 8.2(1)		
		Output VC4 + M1	Input VC3 + M2 (Recommended)	Input VC3 + M2 (Alternative)
		See 8.2 (1), (9), (10)	See 8.2 (1) and (6)	See 8.2 (1) and (7)
Construction Stage 1 (CS1)	Step 1 ^c Representative Step		Step 1 ^c Representative Step	Step 1 ^c --
	Input	Piezometric level or groundwater pressure	Representative values	
		Ground properties	Representative Values	
		Structural element properties	Representative Values	
		External actions	Representative Values	
	Output	Movements	a	
		Structural forces	a	
	Step 2 ULS Verification Step		Step 2 ULS Verification Step	Step 2 ULS Verification Step
	Input	Piezometric level or groundwater pressure	Design level ^b	Design level ^b
		Ground properties	Design values by M1 combination	Design values by M2 combination
		Structural element properties	Representative values	Representative values
		External actions	Design values by VC4 combination	Design values by VC3 combination
Output		Verification of ground failure	See 8.2(9) and (10)	ULS verified if equilibrium is attained in the ground with no failure of the structure
		Verification of structural failure	Design values (E_d) obtained by applying γ_E to calculation results See 8.2(9) and (10)	Design values (E_d) obtained directly from calculation results
CS2	Continue in the same way through any subsequent stage (CS2, CS3, etc.)			

^a These output values can be used for SLS verifications.

^b "The design piezometric level" can be obtained by applying a deviation to the representative piezometric level as stated in 6.5.1 (1), second bullet.

^c The start of Step 1 of any given Construction Stage continues from the end of Step 1 of the preceding Construction Stage.

^d Usually in this step, a strength reduction procedure is performed and the ULS verification is checked, as set in 8.2 (6). If a strength reduction procedure cannot be performed, or if different material factors cannot be applied to different geotechnical units, then Step 2 also continues from Step 1 of the preceding Construction Stage using design material properties determined with partial factors from Set M2.

3. NDP - 8.2 (1) — Procedimiento para modelos numéricos

Table 8.1 (NDP) — Procedure for verification of ultimate limit states with numerical models

Table 8.1 (NDP) — Procedure for verification of ultimate limit states with numerical models

			Factoring approach - See 8.2(1)			
			Output VC4 + M1	Input VC3 + M2 (Recommended)	Input VC3 + M2 (Alternative)	
			See 8.2 (1), (9), (10)	See 8.2 (1) and (6)	See 8.2 (1) and (7)	
Construction Stage 1 (CS1)			Step 1 ^c Representative Step	Step 1 ^c Representative Step	Step 1 ^c --	
	Input	Piezometric level or groundwater pressure	Representative values			Not applicable Go directly to Step 2
		Ground properties	Representative Values			
		Structural element properties	Representative Values			
		External actions	Representative Values			
	Output	Movements	a			
		Structural forces	a			
			Step 2 ULS Verification Step	Step 2 ULS Verification Step	Step 2 ULS Verification Step	
	Input	Piezometric level or groundwater pressure	Design level ^b	Design level ^b	Design level ^b	
		Ground properties	Design values by M1 combination	Partial factors M2 ^d	Design values by M2 combination	
		Structural element properties	Representative values	Representative values	Representative values	
		External actions	Design values by VC4 combination	Design values by VC3 combination	Design values by VC3 combination	
	Output	Verification of ground failure	See 8.2(9) and (10)	ULS verified if equilibrium is attained in the ground with no failure of the structure	ULS verified if equilibrium is attained in the ground with no failure of the structure	
		Verification of structural failure	Design values (E_d) obtained by applying γ_E to calculation results See 8.2(9) and (10)	Design values (E_d) obtained directly from calculation results See 8.2(8)	Design values (E_d) obtained directly from calculation results	
CS2	Continue in the same way through any subsequent stage (CS2, CS3, etc.)					

^a These output values can be used for SLS verifications.

^b "The design piezometric level" can be obtained by applying a deviation to the representative piezometric level as stated in 6.5.1 (1), second bullet.

^c The start of Step 1 of any given Construction Stage continues from the end of Step 1 of the preceding Construction Stage.

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3. NDP - 8.2 (1) – Procedimiento para modelos numéricos



NOTE 7 The procedure for verification of ultimate limit states with numerical models is given in Table 8.1 (NDP) unless the National Annex gives a different procedure.

8.2.(1). Nota 7: La Tabla 8.1 queda sustituida por las Tablas AN 8.1(a), AN 8.1(b) y AN 8.1(c).

Tabla 8.1

Table 8.1 (NDP) — Procedure for verification of ultimate limit states with numerical models

	Factoring approach - See 8.2(1)		
	Output VC4 + M1	Input VC3 + M2 (Recommended)	Input VC3 + M2 (Alternative)
	See 8.2 (1), (9), (10)	See 8.2 (1) and (6)	See 8.2 (1) and (7)
	Representative values	Representative values	Representative values
Input	Piezometric level or groundwater pressure Ground properties Structural element properties External actions	Representative values Representative values Representative values Representative values	Not applicable Go directly to Step 2
Output	Movements		

	Step 2 ULS Verification Step	Step 2 ¹⁰ ULS Verification Step	Step 2 ULS Verification Step	Step 2 ¹⁰ ULS Verification Step
	Design level ^a	Design level ^b	Design level ^b	Design level ^b
Input	Piezometric level or groundwater pressure Ground properties Structural element properties External actions	Design values by M1 combination Partial factors M2 ^d Representative values Design values by VC4 combination	Design values by M2 combination Representative values Design values by VC3 combination	Design values by M2 combination Representative values Design values by VC3 combination
Output	Verification of ground failure Design values (F _d) obtained by applying γ _f to calculation results See 8.2(9) and (10)	ULS verified if equilibrium is attained in the ground with no failure of the structure Design values (F _d) obtained directly from calculation results See 8.2(9)	ULS verified if equilibrium is attained in the ground with no failure of the structure Design values (F _d) obtained directly from calculation results See 8.2(9)	ULS verified if equilibrium is attained in the ground with no failure of the structure Design values (F _d) obtained directly from calculation results See 8.2(9)

Continue in the same way through any subsequent stage (CS2, CS3, etc.)

Notes:

- ^a The design piezometric level can be used for ULS verifications.
- ^b The design piezometric level can be obtained by applying a derivation to the representative piezometric level as stated in 6.5.1 (1), second bullet.
- ^c The start of Step 1 of any given Construction Stage continues from the end of Step 1 of the preceding Construction Stage.
- ^d Usually in this step, a strength reduction procedure is performed and the ULS verification is checked, as set in 8.2 (6). If a strength reduction procedure cannot be performed, or if different material factors cannot be applied to different geometrical units, then Step 2 also continues from Step 1 of the preceding Construction Stage using design material properties determined with partial factors from See M2.

Tabla AN 8.1(a)

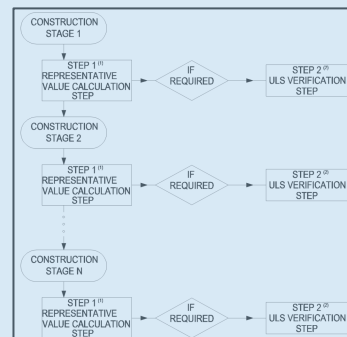


Tabla AN 8.1(b)

⁽¹⁾REPRESENTATIVE VALUE CALCULATION STEP

DATA	
Piezometric level	Representative values
Ground properties	Representative values
Structural properties	Representative values
External actions	Representative values

↓

ELASTOPLASTIC CALCULATION

RESULTS	
Movements	Can be used for SLS verifications
Structural forces	Can be used for SLS verifications

Tabla AN 8.1(c)

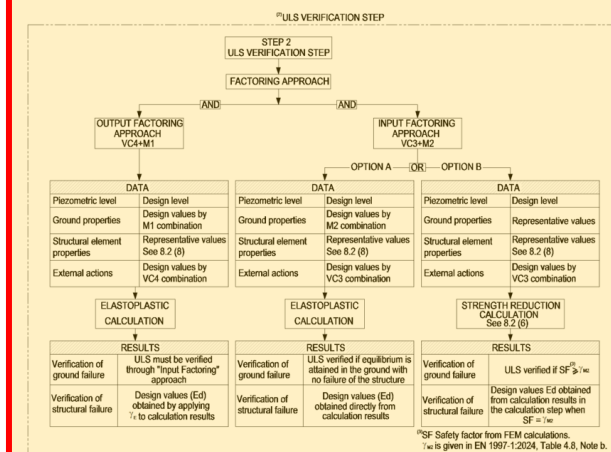


Diagrama de flujos

3. NDP - 8.2 (1) – Procedimiento para modelos numéricos

Tabla AN 8.1(a)

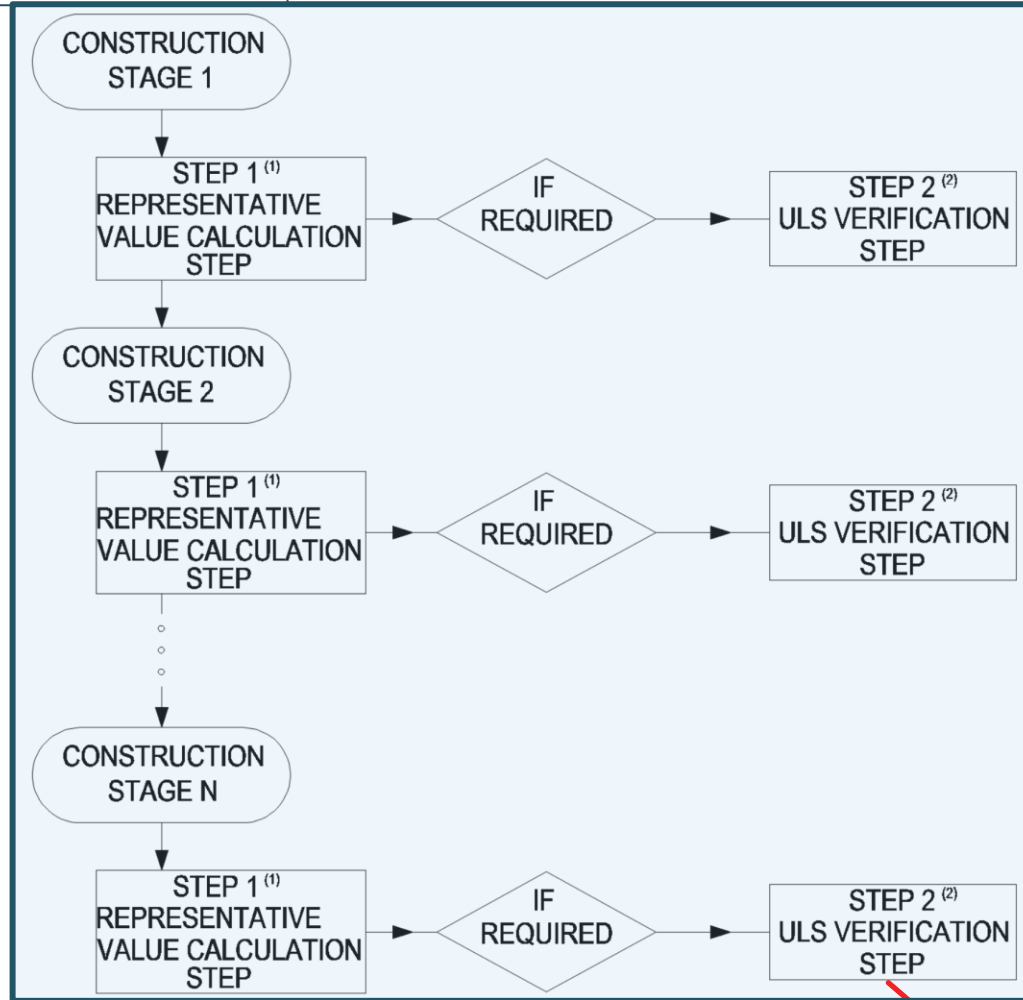
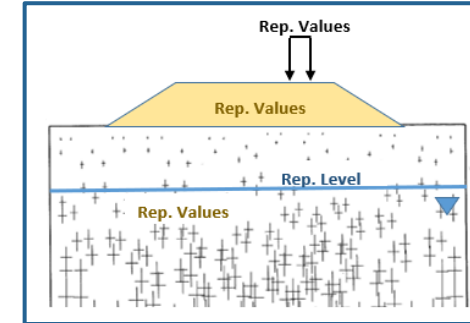


Tabla AN 8.1(b)

Tabla AN 8.1(c)



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3. NDP - 8.2 (1) – Procedimiento para modelos numéricos

Tabla AN 8.1(a)

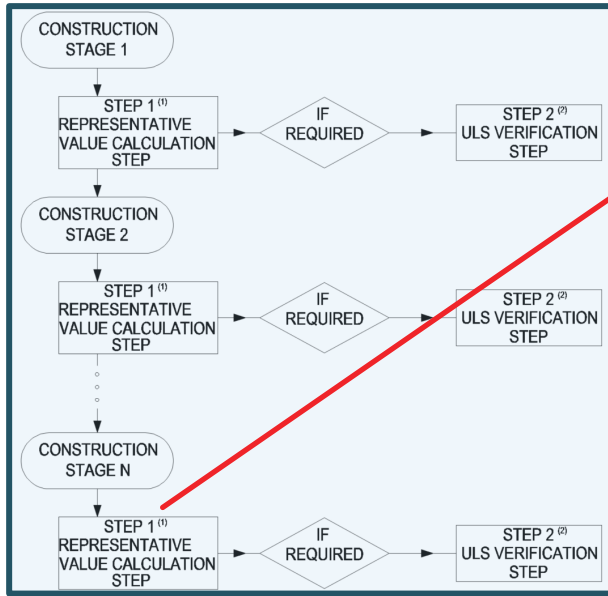
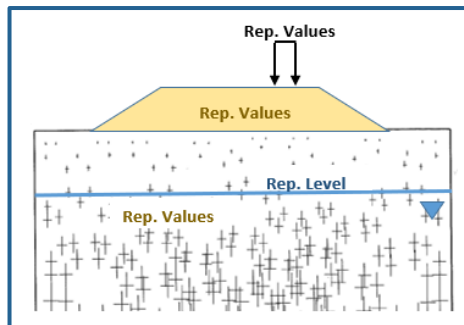
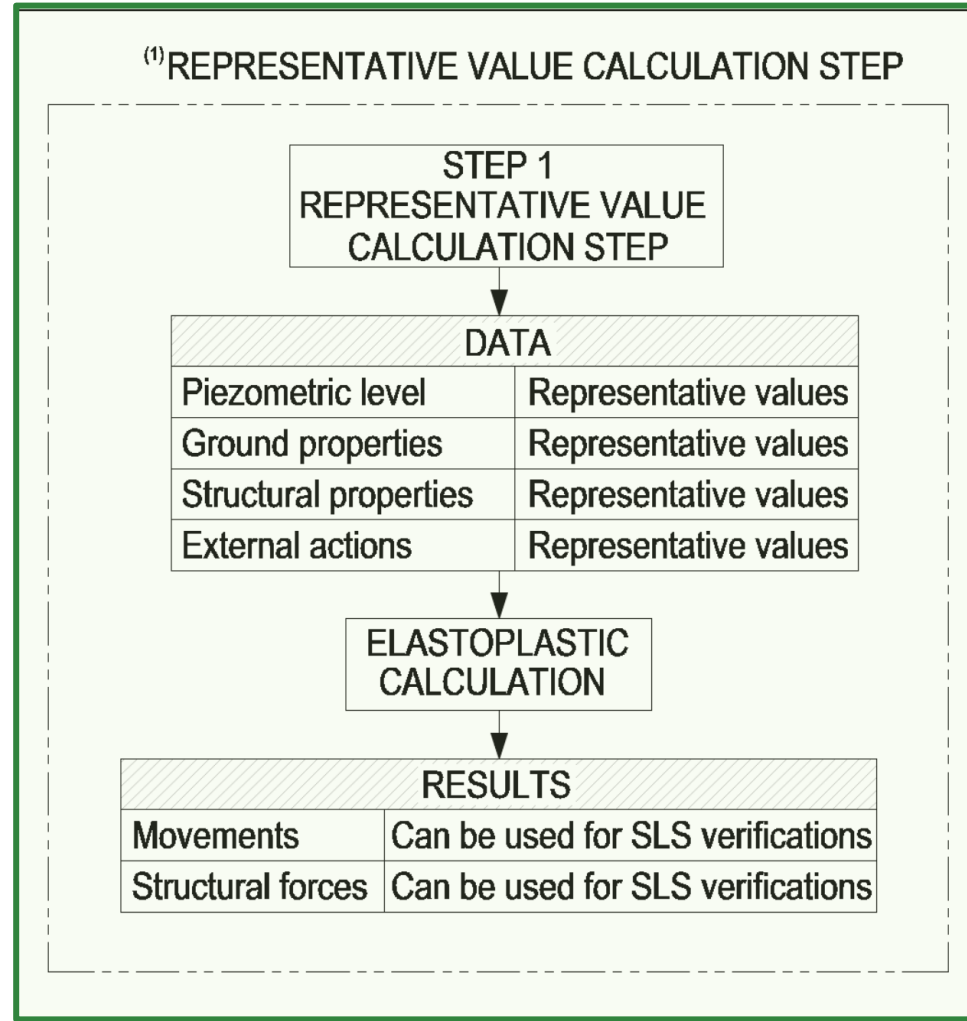


Tabla AN 8.1(b)



3. NDP - 8.2 (1) – Procedimiento para modelos numéricos

Tabla AN 8.1(a)

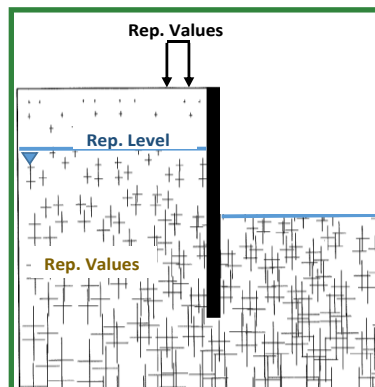
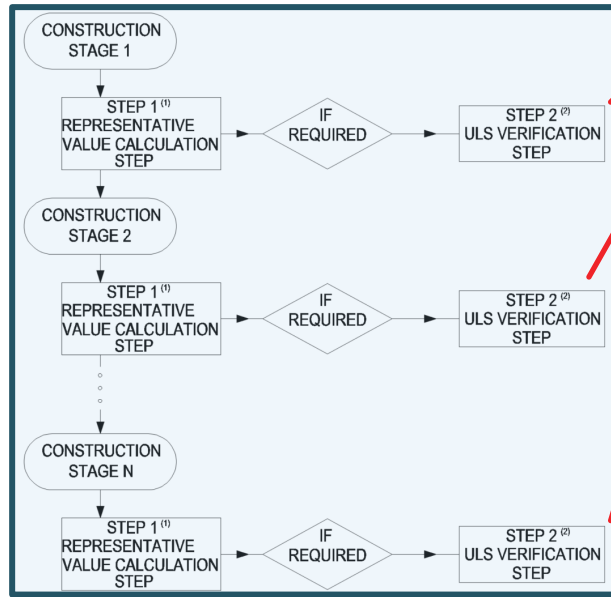
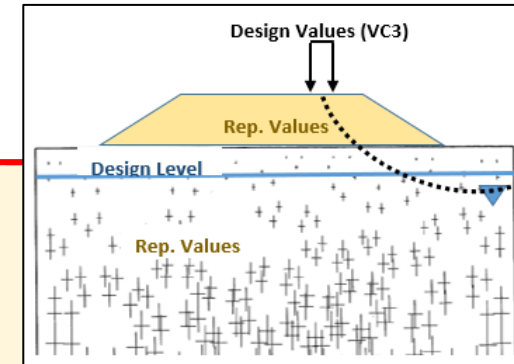
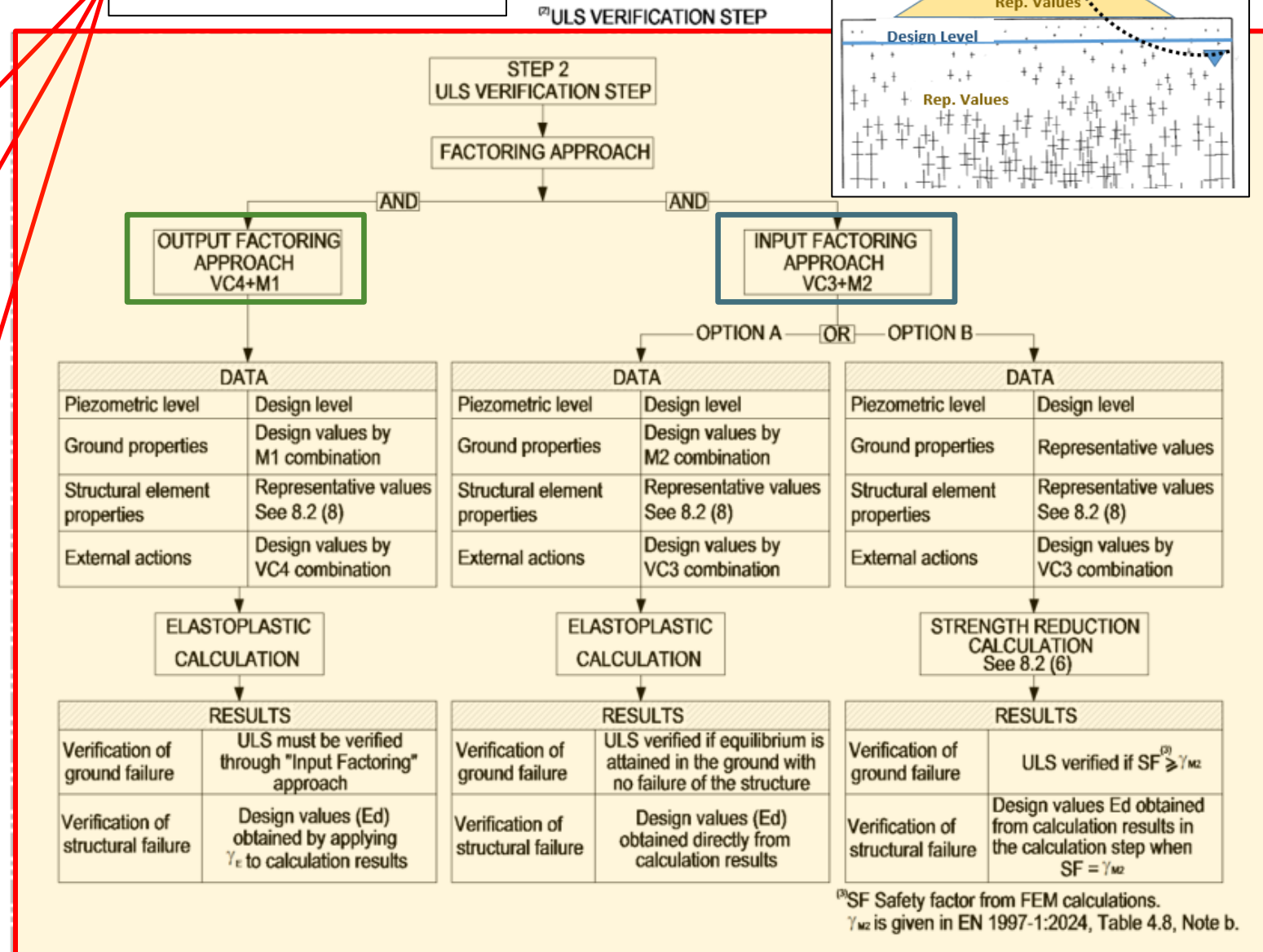


Tabla AN 8.1(c)



3. NDP - 8.2 (1) – Procedimiento para modelos numéricos



Tabla AN 8.1(c)

INPUT FACTORING
APPROACH
VC3+M2

OPTION A OR OPTION B

DATA		DATA	
Piezometric level	Design level	Piezometric level	Design level
Ground properties	Design values by M2 combination	Ground properties	Representative values
Structural element properties	Representative values See 8.2 (8)	Structural element properties	Representative values See 8.2 (8)
External actions	Design values by VC3 combination	External actions	Design values by VC3 combination

RESULTS		RESULTS	
Verification of ground failure	ULS verified if equilibrium is attained in the ground with no failure of the structure	Verification of ground failure	ULS verified if $SF \geq \gamma_{M2}$
Verification of structural failure	Design values (E_d) obtained directly from calculation results	Verification of structural failure	Design values E_d obtained from calculation results in the calculation step when $SF = \gamma_{M2}$

^(D) SF Safety factor from FEM calculations.
 γ_{M2} is given in EN 1997-1:2024, Table 4.8, Note b.

Tabla AN 4.8 – Factores parciales para propiedades del terreno en situaciones de proyecto permanentes y transitorias

Propiedad del terreno	Símbolo	M1 ^a	M2 ^a
Suelos y rellenos			
Resistencia al corte en tensiones efectivas ^b (τ_f)	$\gamma_{\tau f}$	1,00	1,40 k_M
Coefficiente de fricción de pico ($\tan \varphi'_p$) ^c	$\gamma_{\tan \varphi_p}$	1,00	1,40 k_M
Cohesión efectiva de pico (c'_p)	$\gamma_{c,p}$	1,00	1,40 k_M
Coefficiente de fricción de estado crítico ($\tan \varphi'_{cs}$) ^c	$\gamma_{\tan \varphi_{cs}}$	1,00	1,25 k_M
Coefficiente de fricción residual ($\tan \varphi'_r$) ^c	$\gamma_{\tan \varphi_r}$	1,00	1,25 k_M
Cohesión efectiva residual (c'_r)	$\gamma_{c,r}$	1,00	1,40 k_M
Resistencia al corte en tensiones totales (c_u)	γ_{cu}	1,00	1,40 k_M
Resistencia a compresión simple (q_u)	γ_{qu}	1,00	1,40 k_M
Roca intacta y masas rocosas^f			
Resistencia a corte (τ_f)	$\gamma_{\tau f}$	1,00	1,40 k_M
Resistencia a compresión simple ^d (q_u)	γ_{qu}	1,00	1,40 k_M
Discontinuidades en roca^e			
Resistencia a corte (τ_{dis})	$\gamma_{\tau dis}$	1,00	1,40 k_M
Coefficiente de fricción en la discontinuidad ($\tan \varphi_{dis}$) ^c	$\gamma_{\tan \varphi_{dis}}$	1,00	1,40 k_M
Cohesión aparente en la discontinuidad (c_{dis})	$\gamma_{c,dis}$	1,00	1,40 k_M
Coefficiente de fricción residual ($\tan \varphi'_{dis,r}$) ^{c,f}	$\gamma_{\tan \varphi_{dis,r}}$	1,00	1,25 k_M
Contactos terreno-estructura			
Coefficiente de fricción en el contacto terreno-estructura ($\tan \delta$)	$\gamma_{\tan \delta}$	1,00	1,40 k_M

^a M1 y M2 son conjuntos alternativos de coeficientes materiales, EN 1997.3:2024 especifica cuales usar para cada estructura geotécnica.

^b Es el valor parcial que se debe usar en las verificaciones de ELUs con modelos numéricos

3. NDP - 8.2 (1) — Procedimiento para modelos numéricos

NOTE 6 The National Annex can specify cases where ultimate limit states can be verified by input or output factoring alone.

8.2 Procedure for numerical models

(1) For geotechnical structures, verification of ultimate limit states by numerical models should be verified using both of the following factoring approaches:

- Input factoring, using:
 - factors on actions γ_F from Verification Case 3 and;
 - factors on material properties γ_M from Set M2;
- Output factoring, using:
 - factors on effects-of-actions γ_E from Verification Case 4 and;
 - factors on material properties γ_M from Set M1.



3. NDP - 8.2 (1) – Procedimiento para modelos numéricos

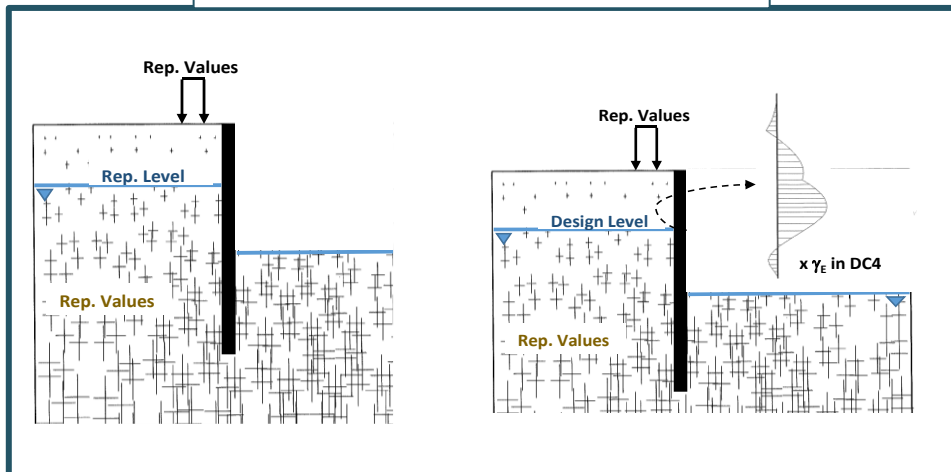


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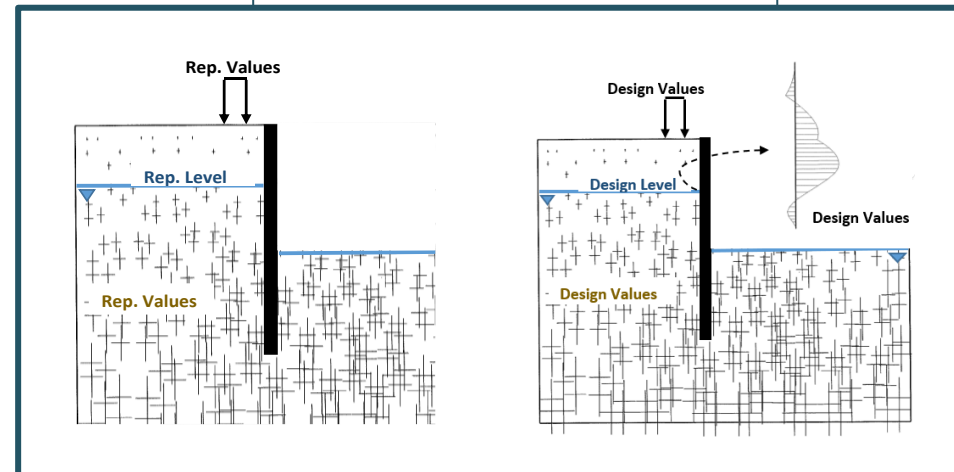


8.2.(1) Nota 6: Este Anejo Nacional no especifica casos en los que se pueda verificar los estados límite último únicamente mediante o el método “input factoring (traducción)” o el método “output factoring (traducción)”.

“Output Factoring”



“Input Factoring”



4. Resumen

- Revisar Tablas AN-8.1 (a), (b) y (c) con ejemplos para comprobar su validez
- Determinar si hay casos en los que se desee que se verifiquen únicamente por uno de los métodos (“Output Factoring” o “Input Factoring”)



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Parte 1 - Procedimiento para los cálculos numéricos (8.2)

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