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DS/EN 1997-1:2024 DK NA:202x

**National Annex to: Eurocode 7 – Geotechnical design –
Part 1: General rules**

**Nationalt Anneks til: Eurocode 7 – Geoteknik –
Del 1: Generelle regler**

Foreword

Published [måned og år].

This National Annex (NA) to DS/EN 1997-1:2024 forms part of the national annexes to the second generation of Eurocodes.

This NA supersedes DS/EN 1997-1 DK NA:2021 when this NA is implemented in the Building Regulation (Bygningsreglementet 2018 – BR18) as an appendix.

During the transition period stated in the Building Regulation, both the first generation and the second generation of the Eurocodes and NAs may be applied.

This NA cannot be used in conjunction with the first generation of Eurocodes.

This NA lays down the conditions for the Danish implementation of EN 1997-1:2024 for construction works in conformity with the Danish Building Regulations; Bygningsreglement 2018 (BR 18). Other parties may bring this National Annex into force by reference.

The Eurocodes establish the principle that certain parameters are left open for national determination. These parameters are referred to as *Nationally Determined Parameters* (NDP) and specifies the nationally applicable values, classes or methods. Furthermore, the NA may provide *Non-Contradictory, Complementary Information* (NCCI), i.e. additional guidance and alternative methods or values that support the application of the Eurocode without altering or contradicting its provisions.

Further, this National Annex includes NOTES. Notes have the status of guidance and provides additional information intended to assist the understanding or use of text of the national annex.

In conformity with the Danish Building regulations, the verbal forms used in this Eurocode and NA are to be understood as follows:

- “shall” expresses a requirement to be followed
- “should” expresses a recommendation. Alternative approaches could be used if technically justified
- “may” expresses permission within the limits of the Danish Building Regulations
- “can” expresses a possibility or capability
- “is/are” expresses a statement of certainty or a fact.

This NA includes:

- Foreword;
- An overview of clauses with possible Nationally Determined Parameters (NDPs) and of Non-Contradictory Complementary Information (NCCI);
- National choice of Nationally Determined Parameters (NDP), and Non-Contradictory Complementary Information (NCCI)

Valid versions of the NAs, as well as previous versions and addenda can be found at www.bygningsreglementet.dk.

Overview of possible Nationally Determined Parameters (NDPs) and Non-Contradictory Complementary Information (NCCI)

The list below identifies the clauses where Nationally Determined Parameters (NDPs) are possible, and whether a national choice has been made, and if an informative annex is applicable or not applicable. Furthermore, clauses providing complementary information (NCCI) are identified in the list below.

Clause	Subject	Nationally Determined Parameter	Non-Contradictory Complementary Information
4.1.2.2(1) NOTE 1	Geotechnical Complexity Class, Table 4.1	National Choice	
4.1.2.3(3) NOTE 1	Geotechnical Complexity Class, Table 4.2	Unchanged	
4.1.3(1) NOTE 1	Consequences of failure, Table 4.3	National Choice	Complementary information
4.1.4(2)	Robustness	National Choice	
4.1.5(1)	Design service life	National Choice	
4.1.8(3)	Quality management	Awaiting	
4.2.3.2(2)	Validation of the Geotechnical Design Model	Unchanged	
4.2.4(3)	Validation of information from the Ground Investigation Report	Unchanged	
4.3.2.3(2)	Nominal value of ground properties	Unchanged	
4.4.1.1(1)	Verification of ultimate limit states		Complementary information
4.4.1.3(1) NOTE 1	Design values of ground properties Table 4.8	National Choice Awaiting	
4.4.1.3(1) NOTE 3	Design values of ground properties γ_M for accidental design situation	National Choice	
4.4.1.3(1) NOTE 4	Design values of ground properties k_M for different consequence classes	National Choice	
4.4.1.3(9)	Design values of ground properties	Unchanged	
4.4.1.5(1)	Design values of resistance	National Choice	

Clause	Subject	Nationally Determined Parameter	Non-Contradictory Complementary Information
NOTE 1	γ_R for accidental design situation		
4.4.1.5(1) NOTE 2	Design values of resistance k_R for different consequence classes	National Choice	
4.5(1)	Verification by prescriptive rules	Unchanged	
4.5(4)	Verification by prescriptive rules	Unchanged	
5.4(2)	Grout	Unchanged	
5.5(2)	Plain and reinforced concrete	Unchanged	
5.5(3)	Plain and reinforced concrete	Unchanged	
6.4(1)	Representative values of groundwater pressures		Complementary information
6.4(2)	Representative values of groundwater pressures		Complementary information
6.4(6)	Representative values of groundwater pressures		Complementary information
6.4(7)	Representative values of groundwater pressures		Complementary information
7.1.1(7) NOTE 1	Calculation models, Table 7.1	National Choice	
8.1.3.2(2)	Uplift, (8.1) and Figure 8.1E		Complementary information
8.1.4.2(3) NOTE 2	Hydraulic heave	National Choice	Complementary information
8.2(1) NOTE 6	Procedure for numerical models	Unchanged	
8.2(1) NOTE 7	Procedure for numerical models, Table 8.1	National Choice	
8.2(5)	Procedure for numerical models, Mobilisation of ground strength		Complementary information
10.2(3)	Supervision	National Choice	

Clause	Subject	Nationally Determined Parameter	Non-Contradictory Complementary Information
11.1.3(5)	Test evaluation		Complementary information
12.1(4)	Reporting	Unchanged	
Annex A	Characteristic value determination procedure	Informative with changes in annex A NA	
Annex A NA	Characteristic value determination procedure	Informative	
A.4(3)	Description of the determination procedure	Unchanged	
A.4(8)	Description of the determination procedure	Unchanged	
A.4(11)	Description of the determination procedure	Unchanged	
Annex B	Contents of reports	Informative with changes in annex B NA	
Annex B NA	Contents of reports	Informative	
Annex C	Guideline on selection of Geotechnical Complexity Class	Not Applicable	
Annex C NA	Guideline on selection of Geotechnical Complexity Class	Normative	
C.3(3)	Specific features to consider	National Choice	
C.3(4)	Specific features to consider	National Choice	
Annex E NA	Robustness of geotechnical structures	Awaiting Informative	

NOTE

Unchanged: Recommendations in the Eurocode to be followed.

National choice: A National Determined Parameter is chosen and defined.

Complementary information: (Non-contradictory) complementary information on how to use the Eurocode.

Normative: The Annex shall be used.

Informative: The Annex may be used.

Not applicable: The Annex cannot be used.

No further information: The Eurocode allows further information. No further information is given.

Nationally Determined Parameters (NDPs) and Non-Contradictory Complementary Information (NCCI)

4.1.2.2 (1) Geotechnical Complexity Class

(NDP)

Table 4.1 NA — Selection of Geotechnical Complexity Class

Geotechnical Complexity Class	Complexity	General features
GCC 3	High	Any of the following apply: – considerable uncertainty regarding ground conditions – highly variable or difficult ground conditions – significant sensitivity to groundwater and surface water conditions – significant complexity of the ground structure interaction – high risk of damaging neighbouring structures
GCC 2	Normal	GCC2 applies if GCC 1 and GCC3 are not applicable
GCC 1	Low	All the following conditions apply: – negligible uncertainty regarding the ground conditions – uniform ground conditions – low sensitivity to groundwater and surface water conditions, – low complexity of the ground structure interaction – low risk of damaging neighbouring structures
NOTE The terms ‘considerable’, ‘significant’, ‘highly’, etc. are relative to any comparable experience that exists for the particular geotechnical structure, design situation, and ground conditions.		

NOTE Specific features to consider when selecting the GCC are given in Annex C NA

4.1.2.3(3) Geotechnical Complexity Class

(NDP)

Table 4.2 NA – Relationship between Geotechnical Category (GC), Consequence Class (CC) and Geotechnical Complexity Class (GCC)

Consequence Class (CC) ^{a, b}	Geotechnical Complexity Class (GCC)			Consequence factor k_F , k_M or k_R
	Low GCC1	Medium GCC2	High GCC3	
High (CC3) Buildings	GC2	GC3	GC3	1,1
High (CC3b) Bridges	GC2	GC3	GC3	1,1
High (CC3a) Bridges	GC2	GC2	GC3	1,0
Normal (CC2) Bridges	GC2	GC2	GC3	1,0
Normal (CC2b) Buildings	GC2	GC2	GC3	1,0
Normal (CC2a) Buildings	GC2	GC2	GC3	1,0
Low (CC1)	GC1	GC2	GC2	0,9
^a For examples of bridges in different consequence classes, see DS/EN 1990-1 DK NA – Bridge part, Table A.2.1 NA. ^b For classification of buildings in different consequence classes, see DS/EN 1990-1 DK NA – building part, Table A.1.1 NA.				

4.1.3(1) Consequences of failure

(NDP)

Table 4.3 NA — Examples of geotechnical structures in different Consequence Classes

Consequence class ^c	Description of consequence	Examples
CC4	Highest	– Geotechnical structures whose integrity is of vital importance for civil protection ^a ;

Consequence class ^c	Description of consequence	Examples
CC3 ^d	Higher	– Retaining walls and foundations supporting structures, classified as CC3 – Motorway embankments and excavation slopes and retaining structures along motorways, and other roads of great importance for maintaining infrastructure. – Railway embankments and track bearing retaining structures – Dikes and dams protecting areas with high population density and activity, as well as critical infrastructure – Geotechnical structures with a primary navigational function ^b;
CC2 ^e	Normal	All geotechnical structures not classified as CC0, CC1, CC3, or CC4 – Minor road embankments not vital for society – Retaining structures along roads, where failure is not of great importance for maintaining the infrastructure. – Noise barriers where the height exceeds the distance to the nearest edge of the roadway or 5 m above ground level.
CC1	Lower	– Retaining walls and foundations supporting structures classified as CC1; – Excavation slopes and fillings, in areas where a failure will have low impact on society;
CC0	Lowest	Not applicable for geotechnical structures

Consequence class ^c	Description of consequence	Examples
a	Examples of geotechnical structures whose integrity is of vital importance for civil protection are road/railway embankments with a fundamental role in the event of natural disasters, earth dams connected to aqueducts and energy plants, earth dams and tailing dams with extreme consequences upon failure, foundation of nuclear structures, and major harbour structures.	
b	Examples of geotechnical structures with primary navigational function are marking or protecting entrances of ports.	
c	Geotechnical structures shall not be assigned with a lower Consequence Class (CC) than the structure it may support	
d	Subdivision of bridges in CC3a and CC3b according to DS/EN 1990 DK NA – Bridge part, Table A.2.1 NA.	
e	Subdivision of buildings in CC2a and CC2b according to DS/EN 1990 DK NA – Table A.1.1 NA.	

(NCCI)

If a geotechnical structure forms an integral part of a permanent structure, either wholly or partially, the geotechnical structure in this condition shall be assigned to the same consequence class as the permanent structure.

For geotechnical structures (e.g. retaining structures, slopes, cuttings and embankments) where buildings or civil engineering structures are located within the zone of influence, the applicable consequence class shall be selected as the highest consequence class of the affected neighbouring structures. The zone of influence shall be defined in accordance with DS/EN 1997-1, Clauses 3.1.6.1 and 4.1.2.1.

As a preliminary estimate, the zone of influence for a retaining structure can be assumed to cover the area from the support structure to a horizontal distance twice the level change (the free wall height), both in front of and behind the retaining structure. However, the extent of the area shall always be assessed based on the specific conditions, including topography, loads, ground and groundwater, which may result in an area larger or smaller than the preliminary estimate.

Where the consequences of failure of a geotechnical structure cannot be classified based on neighbouring structures as described above, the consequence class shall be established through a project-specific assessment of the potential consequences for people.

In such cases, the consequence class shall be selected based on the maximum simultaneous occupancy of people within the zone of influence (area affected by the failure), in accordance with Table 4.a NA:

Table 4.a NA– Indicative limit values for maximum simultaneous occupancy of people in the area affected by the failure of a retaining structure

Consequence Class	Maximum simultaneous occupancy of people
CC1	5

Consequence Class	Maximum simultaneous occupancy of people
CC2	50
CC3	300

4.1.4(2) Robustness

(NDP)

Annex E NA describes measures to enhance robustness of geotechnical structures.

4.1.5(1) Design service life

(NDP)

Table 4.4 NA — Design service life categories of geotechnical structures

Category of geotechnical structures	Design service life T_{lf} years
Geotechnical structures that support other structures	At least that of the supported structure ^a
Geotechnical structures ^b supporting (or incorporated into) road or railway infrastructure	See DS/EN 1990 DK NA, Table A.2.2 NA (Bridge Part)
Embankment dams for water defence	100
Geotechnical structures not covered by another category	50
Replaceable parts of geotechnical structure	25
Temporary geotechnical structures	≤ 10
Temporary grouted anchors ^c	2
^a See EN 1990:2023, Annex A ^b For example, slopes, cuttings, embankments, retaining structures, reinforced fill or soil nailed structures, or ground improvement ^c Durability requirements related to DS/EN 1993-5	

4.1.8(3) Quality management

(NDP)

Table 4.5 NA is awaiting the content in EC0 NA, Table B.1 NA, Table B.2 NA and Table B.3 NA

4.4.1.1(1) Verification of ultimate limit states, General

(NCCI)

Table 4.b NA – List of which approach must be used for specific geotechnical structures and analysis

Geotechnical structure	Reference in EN 1997-3	Re-sistance	Ap-proach	Action	Ground ^a
Slopes, cuttings and embankments	Table 4.2	GEO	MFA	VC3	M2
Spread foundations	Table 5.2	GEO+STR	MFA	VC1	M2
Piled foundations-axial resistance	Table 6.9 – 6.12	GEO	RFA	VC1	
		STR	MFA	VC1	
Piled foundations – transverse resistance	Table 6.9 – 6.12	GEO+STR	MFA	VC4	M1
		GEO+STR	MFA	VC1	M2
Retaining structures	Table 7.2	GEO+STR	MFA	VC4	M1
		GEO+STR	MFA	VC3	M2
		GEO+STR	MFA	VC1	M2
Anchors	Clause 8	GEO	RFA	All	
		STR	MFA	All	
Reinforced fill structures – internal failure	Table 9.4	GEO	MFA	VC3	M2
-Soil nailed structures – ground interface	Clause 10	GEO	RFA	All	
Soil nail and any connections		STR	MFA	All	
Rock bolts and rock surface support	Clause 11	GEO	RFA	All	
		STR	MFA	All	
Ground improvement	Table 12.4	GEO			

Geotechnical structure	Reference in EN 1997-3	Re-sistance	Ap-proach	Action	Ground ^a
Other geotechnical analysis	Reference in EN 1997-1	Re-sistance	Ap-proach	Action	Ground ^a
Procedure for numerical models:	Table 8.1				
(a) Output Factoring Approach		GEO+STR	MFA	VC4	M1
(b) Input Factoring Approach		GEO+STR	MFA	VC3	M2
(c) Input Factoring Approach		GEO+STR	MFA	VC1	M2
Uplift	8.1.3.2	GEO + STR		VC2(b)	
Structure		STR	MFA	All	
Tension elements		GEO	RFA	All	
		STR	MFA	All	
Ground layer, total stresses		GEO		VC2(b)	N/A ^b
^a M1 and M2 factors appear from DS/EN 1997-1, Table 4.8 NA.					
^b N/A = Not Applicable.					

4.4.1.3 (1) Design values of ground properties

(NDP, NOTE 1)

Table 4.8 NA — Partial factors on ground properties for persistent and transient design situations

Ground property	Symbol	M1 ^a	M2 ^a
Soil and fill			
Peak friction angle (φ'_p) ^b	$\gamma_{\tan\varphi,p}$	1,0	1,2 k_M
Peak cohesion (c'_p)	$\gamma_{c,p}$	1,0	1,2 k_M
Critical state friction angle (φ'_{cs}) ^b	$\gamma_{\tan\varphi,cs}$	1,0	1,1 k_M
Residual friction angle (φ'_r) ^b	$\gamma_{\tan\varphi,r}$	1,0	1,1 k_M
Residual cohesion (c'_r)	$\gamma_{c,r}$	1,0	1,1 k_M
Shear strength in total stress analysis (c_u)	γ_{cu}	1,0	1,8 k_M
Unconfined compressive strength (q_u)	γ_{qu}	1,0	1,8 k_M
Interface			
Ground/structure interface friction (δ) ^b	$\gamma_{\tan\delta}$	1,0	1,2 k_M
^a M1 and M2 are alternative sets of material factors. EN 1997-3 specifies which set to use for specific geotechnical structures. ^b Partial factor is applied to $\tan\varphi$.			

(NCCI)

Peak values are generally adopted for design cases governed by first-time failure, whereas critical state friction angle (also referred to as constant volume friction angle) may be relevant, for example when considering design situations in sand or gravel where strain compatibility is considered. Residual values of strength parameters may be relevant when designing measures to stabilize reactivated slope failures, particularly in high plasticity clays.

(NDP, NOTE 3)

$\gamma_M = 1,0$ for all ground properties in the accidental design situation.

(NDP, NOTE 4)

Values of k_M appear from Table 4.2 NA.

4.4.1.5(1) Design values of resistance

(NDP, NOTE 1)

$\gamma_R = 1,0$ for all resistances in the accidental design situation.

(NDP, NOTE 2)

Values of k_R appear from Table 4.2 NA.

6.4(1) Representative values of groundwater pressures

(NCCI)

To determine the representative groundwater pressure using one of the described statistical methods, sufficiently long time series of measurement data (piezometric levels) of adequate quality must be available.

The best data quality is typically achieved when groundwater levels are measured in wells screened in coarse soils within the primary aquifer, or by measuring the free water surface, for example in harbours. Furthermore, continuous logging of water levels generally provides significantly better data quality than manual measurements.

By sufficiently long time series, measurement series of a minimum duration of one year are meant. A one-year measurement series will, for example, reflect seasonal variations and other natural fluctuations related to the local geology (stratigraphy, permeability, flow conditions, etc.), but many other potential variable contributions may not necessarily be captured, including:

- Cloudbursts / heavy rainfall / large precipitation events
- Flooding from sea water
- Stopping of water abstraction
- Re-infiltration (or groundwater lowering) on adjacent properties
- Barrier effects (groundwater buildup behind impermeable structures, e.g., sheet piles)
- Infiltration of rainwater from SUDS (Sustainable Drainage Systems)
- Effects of removal or growth of vegetation
- Failing drainage systems
- Burst water mains

Determining the representative value of groundwater pressure using the described statistical methods alone is therefore associated with significant uncertainty and is not recommended.

Therefore, it is most often necessary to determine the representative groundwater pressure as the nominal value based on a cautious estimate, as recommended in 6.4 (2), (6) and (7).

NOTE 1 is corrected to the following:

The upper (or "superior") characteristic value $G_{wk,sup}$ should be selected as the 95% fractile and the lower (or "inferior") characteristic value $G_{wk,inf}$ as the 5% fractile of the statistical distribution of G_w .

6.4 (2)(6)(7) Representative values of groundwater pressures

(NCCI)

Groundwater pressure in low-permeability fine soils cannot be considered fully characterized based on water level measurements in standpipes. A cautious estimate (= nominal value) of the representative groundwater level in fine soils should normally be assumed at the level of the existing ground surface level, due to the risk of secondary aquifers, unless a reliable overflow arrangement or drainage system is installed or if adequate surface run-off conditions are present.

If the nominal value of groundwater pressure is to be determined at a lower level, e.g. based on water level measurements in coarse soil in the primary aquifer, all potential variable contributions must be assessed and included (see bullet list under NCCI to 6.4(1)). In such cases, additional consideration must be given to other possible adverse groundwater pressures resulting from near-surface secondary aquifers or artesian aquifers.

Structures affected by Uplift

For geotechnical structures where the self-weight of structural members and water are the predominant forces, it is advisable to achieve well-defined design assumptions through constructive means (e.g., overflow arrangements). For example, structures will generally not be adequately protected against erosion and uplift solely by applying a partial factor to the representative groundwater pressure. Instead, the structure must be protected through constructive measures.

Overflow arrangements may consist of a combination of overflow via the top edge or openings in walls and/or overflow through goosenecks integrated into the floor structure. Adequate capacity must be ensured, both in terms of volume and distribution across the structure, through the provision of drainage and discharge elements. Overflow water acts as a stabilizing element and must not be pumped away until the groundwater pressure has stabilized at an acceptable level.

7.1.1(7) Calculation models

(NDP)

Table 7.1 NA — Measures to validate calculation models

Geotechnical Category	Level of validation	Measures
GC3	High	All the measures given below for GC2 and, in addition: – calibrate the calculation model for all relevant design situations against another suitable calculation model or site observations.

GC2	Normal	All the measures given below: – confirm that the assumptions underlying the calculation model are relevant for all relevant design situations; – document the assumptions made in the calculation model; – document by literature reference that the calculation model has been used for comparable design situations; and – confirm that any calculation model used falls within the limits of application stated in EN 1997-3.
GC1	Low	All the measures given below: – confirm that comparable experience exists showing that the calculation model is suitable for the local conditions; – confirm that any calculation model used falls within the limits of application stated in EN 1997-3.

8.1.3.2(2) Loss of vertical equilibrium due to uplift

(NCCI)

The favourable permanent action $G_{rep,fav}$ from weight of submerged ground shall be calculated from the effective density γ' .

8.1.4.2(3) Hydraulic heave

(NDP)

$$\gamma_{HYD} = \gamma_{pv} = 0,8$$

(NCCI)

u_d is the design groundwater pressure in the presence of flow. The partial factor γ_G from DS/EN 1990 DK NA, Table A.1.8 NA, VC2 (b) shall be applied.

$p'_{v,rep}$ is the representative value of any effective overburden pressure at the top of the ground layer in which the upward seepage takes place.

γ_{rep} is replaced with $\gamma_{s,rep}$ and the explanation is clarified to:

$\gamma_{s,rep}$ is the saturated representative weight density of the ground.

In Figure 8.2 $\sigma'_{v,rep}$ should be replaced with $p'_{v,rep}$ to be consistent with formula (8.3).

8.2(1) Procedure for numerical models

(NDP)

Table 8.1 NA - Procedure for verification of ultimate limit states with numerical models

			Factoring approach - See 8.2(1), combination (a), (b) and (c)		
			Output VC4 + M1	Input VC3 + M2	Input VC1 + M2
			(a)	(b)	(c) ^e
			See 8.2 (1), (9), (10)	See 8.2 (1) and (6)	See 8.2 (1) and (6)
Construction Stage 1 (CS1)			Step 1 ^c Representative Step	Step 1 ^c Representative Step	Step 1c Representative Step
	Input	Groundwater 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	Groundwater level or groundwater pressure	Design level ^b	Design level ^b	Design level ^b
		Ground properties	Design values by M1 combination	Partial factors M2 ^d	Partial factors M2 ^d
		Structural element properties	Representative values	Representative values	Representative values
		External actions	Design values by VC4 combination	Design values by VC3 combination	Design values by VC1 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 See 8.2(8)

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 groundwater level shall be determined as stated in 6.5.1 (1), first or second bullet point
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, the analysis performs a soil strength reduction and the ULS verification is checked, as set in 8.2 (6), If the analysis cannot perform strength reduction or apply different material factors 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.
e	In combination (c) VC1+M2 the consequence factor on the material properties is omitted

8.2(5) Procedure for numerical models

(NCCI)

Numerical analyses shall account for the effect of dilatancy on mobilised ground strength. If an associated flow rule is adopted in the model, the material parameters must be modified to maintain conservatism in the predicted response. This can be achieved through a Davis reduction of the friction angle. In some cases, this leads to solutions that are overly conservative, suggesting that non-associated flow rules or other reduction approaches may be more suitable.

10.2(3) Supervision

(NDP)

The Working Environment Act is valid.

11.1.3(5) Test evaluation

(NCCI)

The effect of an increase in stress levels after completion of tests of piles, anchors etc. should be disregarded unless adequately documented. Conversely, the effect of any decrease in stress level following testing (for example due to excavation or rise in groundwater table) should be subject to further evaluation.

12.1(4) Reporting

(NDP)

In the NOTE below (in) Table 12.1 there is a typo: the referenced annex should be B.4.4 and not C.4.4

Annex A NA: Characteristic value determination procedure

This informative Annex A NA provides following changes to the informative annex A for Characteristic value determination procedure.

A.2 Scope and field of application (Adding clause)

(2) However, the procedure described in A.4 can also be used to determine the characteristic resistance of piles.

A.3 Background (replacement of formula)

$$V_x = \sqrt{V_{x,inh}^2 + V_{x,stat}^2 + V_{x,meas}^2 + V_{x,trans}^2} \quad (\text{A.11 NA})$$

where

V_x *is the coefficient of variation of the observed property value;*

$V_{x,inh}$ is the coefficient of variation of the property due to inherent ground variability;

$V_{x,stat}$ Is the coefficient of variation of the statistical uncertainty;

$V_{x,meas}$ is the coefficient of variation of the measurement error;

$V_{x,trans}$ is the coefficient of variation of the transformation error.

A.4 Description of the determination procedure (replacement of clause)

(4 NA) The procedure in this Annex shall be used to evaluate the different terms in the following formula when the ground property is considered to follow a normal distribution [repeated from Formula (4.5)], see also formula (A.5) when the ground property is considered to follow a log-normal distribution:

Annex B: NA Contents of report

This informative Annex B NA provides following changes to the informative annex B for Contents of report.

B.4.1 (1) General content (Correcting the first part of clause (1))

(1 NA) The Geotechnical Design Report should include, but is not limited to, the following information, where relevant:

Annex C NA: Selection of Geotechnical Complexity Class

C.1 Use of this Annex

(1) This Normative Annex provides complementary guidance to Clause 4 for selection of appropriate Geotechnical Complexity Class.

C.2 Scope and field of application

(1) This Annex covers guidelines on selection of appropriate Geotechnical Complexity Class.

C.3 Specific features to consider

(1) The Geotechnical Complexity Class should be selected based on an evaluation of the degree of severity for the design situation of these general features:

- uncertainty of the ground conditions;
- variability and difficulty of the ground conditions;
- sensitivity of the geotechnical structure to groundwater and surface water conditions;
- complexity of the ground-structure interaction;
- environmental impact.

(2) The evaluation of the severity should be based on engineering judgement, with a scale from significant, considerable, high at one end to negligible, uniform, low at the other end of the scale.

NOTE Specific features to include in the evaluation of the severity of the general features is given in Table C.1 NA.

(3) If the evaluation in (1) results in a high severity for any of the general features, the GCC should be selected as GCC 3.

NOTE Guideline on specific features to be fulfilled for GCC3 is given in Table C.4 NA.

(4) If the evaluation in (1) results in a low severity for all the general features, the GCC should be selected as GCC 1.

NOTE Guideline on specific features to be fulfilled for GCC1 is given in Table C.2 NA.

(5) If the evaluation in (1) results in selection of neither GCC3 nor GCC1, the GCC should be selected as GCC2.

NOTE Guideline on specific features to be fulfilled for GCC2 is given in Table C.3 NA.

Table C.1 NA — Examples of specific features to account for in selection of the Geotechnical Complexity Class (GCC)

General features	Specific feature
Uncertainty in ground condition	– evaluation of uncertainty from the available results from ground investigations; – evaluation of completeness of available results and relevance of ground investigation method with respect to best possible knowledge of the ground conditions; – ground conditions are with high certainty expected to be as interpreted from the ground investigations.
Variability or difficulty of ground condition	– ground with weak layers or zones; – unfavourable discontinuity patterns; – potential pre-existing failure surfaces; – occurrence of ground conditions where geotechnical structure design or execution need detailed assessment. E.g. fine soil sensitive to disturbance, aggressive soil, highly compressible soil, organic soil, creep soil, swelling soil.
Sensitivity to ground-water and surface water conditions	– existence of hydraulic gradient and seepage forces; – exposure to erosion, scour or piping; – potential for water flow; – high groundwater level; – variability in water level; – excavation below groundwater level.
Complexity of the ground-structure interaction	Ground: – ongoing ground movements (settlement and/or slope movement); – potential unstable ground; – progressive failure of natural or improved ground; Loading conditions: – structure subjected to dynamic, cyclic or seismic actions; – highly concentrated loading on part of the geotechnical structure; Structure: – potentially sensitive adjacent structure or complex interaction with adjacent structures; – sensitivity of the structure to movements and differential movements; – complexity of the structure itself including geometry, variation in plane and depth; – lack of documented comparable experience for the considered geotechnical structure and execution of it in similar conditions.
Environmental impact	– Influence on neighbouring ground and structures.

Table C.2 NA – Examples of specific features to select Geotechnical Complexity Class 1, GCC1

General features	Specific feature GCC1
Uncertainty in ground condition	– documented comparable experience of the ground conditions; – no known information that indicates uncertainty in the ground conditions.
Variability or difficulty of ground condition	– available results from Ground investigations validate simple and uniform ground conditions; – no known weak layers or unfavourable discontinuities; – ground considered as suitable for the specific application without further improvement; – spread foundations, fills and floors supported directly on the soil should only be assigned to GCC 1 when the foundation bed consists of late glacial or older deposits of either coarse soils or fine soils with $c_{uk} > 75$ kPa and $I_p < 15$ %, which are not included in the tables C.3 NA and C.4 NA for GCC2 and GCC3 respectively.
Sensitivity to ground water and surface water conditions	– no excavation below the groundwater level (groundwater level $\geq 0,5$ m below the excavation level); – no exposure to erosion, scour or piping or any other water induced transport of soil particles; – minimal potential of water flow through the structure; – low influence from groundwater and/or surface water.

General features	Specific feature GCC1
Complexity of the ground-structure interaction	Ground: – no records of significant ground movements (settlement and/or slope movement); – horizontal or slightly inclined ground surface; Loading conditions: – no dynamic, cyclic or seismic actions; – no concentrated loading; – light buildings, where the design foundation action for spread foundation shall not exceed: - 250 kN for pad foundations, or - 100 kN per m strip foundation. Structure: – gravity walls and retaining walls for excavations, where the retained height does not exceed 2 m (incl. any slope behind); – excavations or cuttings with inclinations not exceeding 1 vertical to 1,5 horizontal and a maximum difference in level of 3 m; – surcharge fills with a maximum height of 3 m; – 0,30 m and 0,40 m thick in situ cast concrete basement walls subjected to earth pressure; wall sections up to 10 m² and 15 m², when the walls are supported only by transverse walls and basement floor, respectively, and 15 m² and 20 m², respectively, when the basement wall is also restrained on top by e.g. a deck. It is assumed that the walls do not contain openings for windows or doors; – building or geotechnical structure insensitive to movements and differential movements; – floor slabs and pavements with layout and dimensions according to common practice without detailed design analyses; – thickness of compacted sand fills below floors not exceeding 0,6 m; – pipes and drains which can be laid in accordance with standard procedures as specified in the relevant standards. NOTE: piled foundations are classified as GCC2 or GCC3
Environmental impact	– low risk of damaging neighbouring ground and structures, including houses, sewage and supply pipes, public traffic areas etc.; – absence of sensitive neighbouring structures within the zone of influence.

Table C.3 NA – Examples of specific features to select Geotechnical Complexity Class 2, GCC2

General features	Specific feature GCC2
Uncertainty in ground condition	It shall be ensured that the ground investigation covers all significant soil layers, including in particular: – deposits with high settlement potential, e.g. gyttja, peat, postglacial clay, pumped sand fill, topsoil and uncontrolled fill; – clays with high swelling potential; – deposits susceptible to sliding failure.
Variability or difficulty of ground condition	Below mentioned soil types: – late-glacial Allerød-deposits; – inter-glacial marine and bog deposits; – clays characterised by $I_P > 15\%$.
Sensitivity to ground water and surface water conditions	– groundwater level (non-lowered) ≤ 3 m above the excavation level; – groundwater level can be lowered using normal measures (excl. reinfiltration).
Complexity of the ground-structure interaction	Loading conditions: – Spread foundations, where the design foundation action/pressure shall not exceed: - 5000 kN for pad foundations, or - 1000 kN per m strip foundation, or - 1000 kN/m² (of the effective area). Structure: – retaining structures anchored in one level with struts or ground anchors; – retaining walls, basement walls and unanchored concrete bases subjected to water pressure.
Environmental impact	Where a project can damage neighbouring structures, sewage and supply lines, public traffic areas, or similar, e.g. by excavation, pile driving or ground water lowering, the GCC should at least be selected as GCC2, adapted to the nature, size and foundation of these structures.

Table C.4 NA – Examples of specific features to select Geotechnical Complexity Class 3, GCC3

General features	Specific feature GCC3
Uncertainty in ground condition	GCC3 shall be selected, if there is considerable uncertainty in ground conditions.
Variability or difficulty of ground condition	Soil types mentioned below: – Palaeogene high plasticity (plastic) clays; – high plasticity clays with slicken sided fissures; – chalk or limestone with cavities or "sinkholes" (disintegrated/dissolved by percolation of surface water). NOTE – It is not uncommon that high plasticity Miocene clays contain slicken sided fissures. As an exception, quaternary clays may also contain slicken sided fissures.
Sensitivity to ground water and surface water conditions	– deposits where the permeability increases with depth – high ground water level (non-lowered) > 3 m above the excavation level; – artesian water pressure (groundwater level above ground surface); – groundwater lowering with reinfiltration; – where permanent damage to structures or bearing ground layers can occur without warning due to the absence or failure of ground water lowering or drainage systems.
Complexity of the ground-structure interaction	Ground: – steeply inclined ground surface – unstable slopes – areas with significant landslide hazards Loading conditions: – structure subjected to dynamic, cyclic or seismic actions Structure: – high sensitivity of the structure to movements and differential movements; – excavations and retaining structures adjacent to deflection- and settlement prone buildings and structures; – retaining structures anchored in more than one level with struts or ground anchors; – retaining structures anchored with soil nails or micropiles; – retaining walls as support structure facilitated by soil stabilisation; – head of tie located below the ground water table; – all types of base anchorages (resisting water pressure, soil heave etc.). – spread foundations on controlled clay fill, possibly lime stabilised

General features	Specific feature GCC3
Environmental impact	GCC3 shall be selected, if there is high risk of damaging neighbouring structures or houses.

Annex E NA: Guidance to enhance robustness of geotechnical structures

Awaiting