INSTITUTO DE LA INGENIERÍA DE ESPAÑA

Asociación Caminos

JORNADA

EUROCODIGOS 2G

Novedades en el Eurocódigo 7
Proyecto geotécnico

José Estaire Gepp

Jefe de Área // Laboratorio Geotecnia - CEDEX

Project Team EN 1997

jose.estaire@cedex.es

GOBIERNO DE ESPAÑA
MINISTERIO DE TRANSPORTES Y MOVILIDAD SOSTENIBLE
VICEPRESIDENCIA TERCERA DEL GOBIERNO
MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA Y EL RETO DEMOGRÁFICO
CEDEX CENTRO DE ESTUDIOS Y EXPERIMENTACIÓN DE OBRAS PÚBLICAS

Idea 1 – Estructura y su cimiento

- Una estructura se considera y se calcula como un continuo
- La cimentación es parte de la estructura
- La cimentación se calcula con los mismos criterios que la propia estructura
- Las bases de proyecto se dan en el EC-0

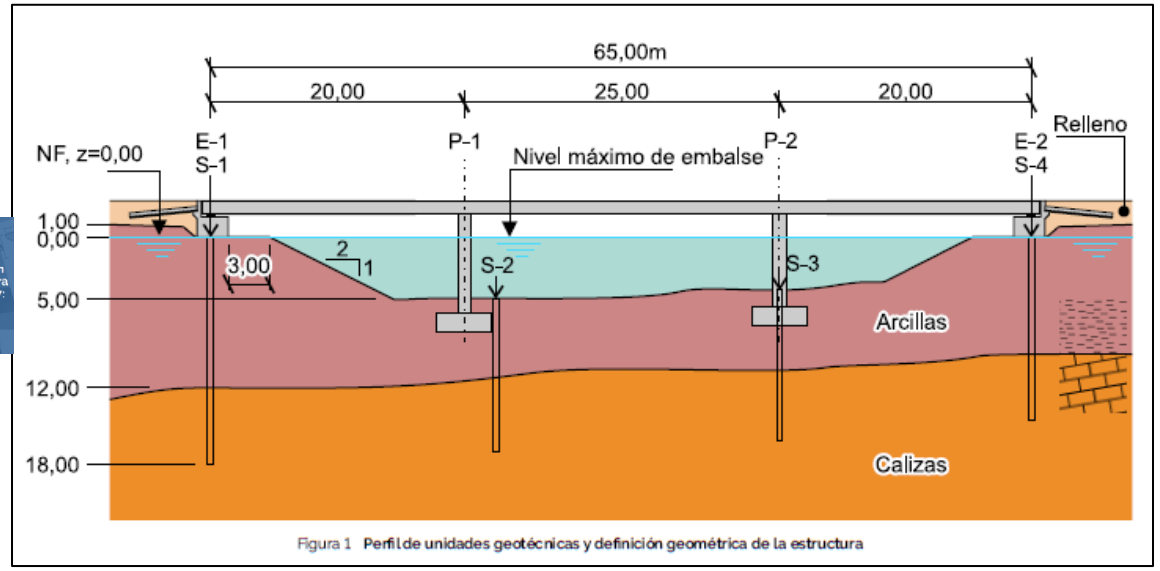
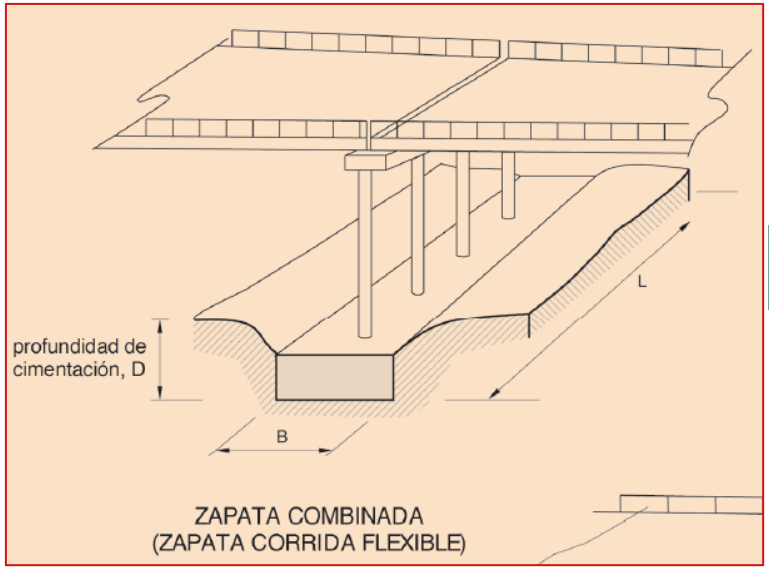
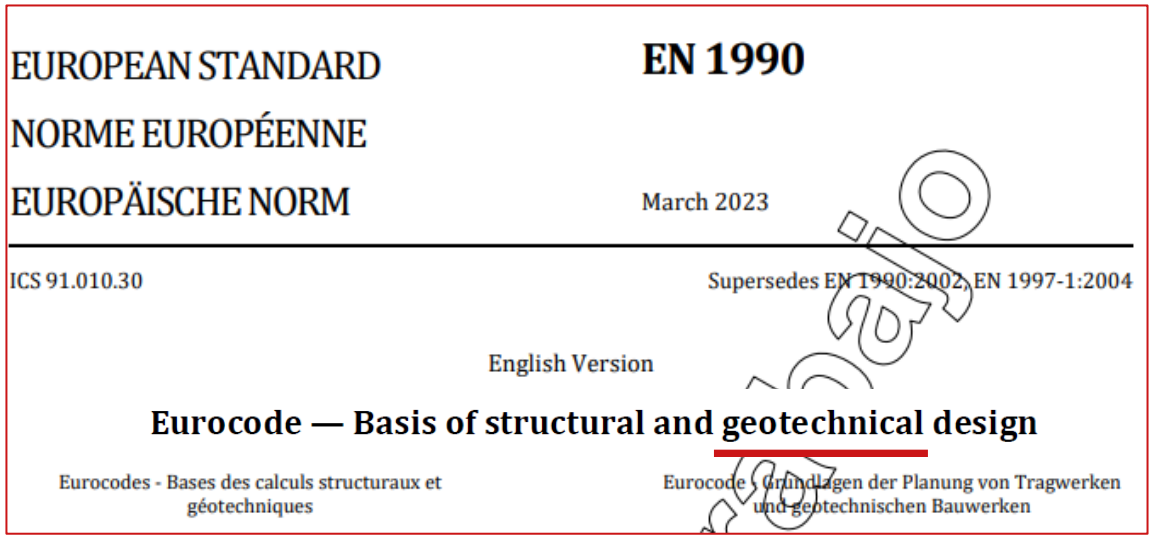


Figura 1 Perfil de unidades geotécnicas y definición geométrica de la estructura



Idea 1 – Estructura y su cimiento

- Una estructura se considera y se calcula como un continuo
- La cimentación es parte de la estructura
- La cimentación se calcula con los mismos criterios que la propia estructura
- Las bases de proyecto se dan en el EC-0



EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 1990

March 2023

ICS 91.010.30

Supersedes EN 1990:2002, EN 1997-1:2004

English Version

Eurocode — Basis of structural and geotechnical design

Eurocodes - Bases des calculs structuraux et géotechniques

Eurocode - Grundlagen der Planung von Tragwerken und geotechnischen Bauwerken

Idea 1 – Estructura y su cimiento

EUROPEAN STANDARD **EN 1990**
NORME EUROPÉENNE
EUROPÄISCHE NORM March 2023

ICS 91.010.30 Supersedes EN 1990:2002, EN 1997-1:2004

English Version

Eurocode - Basis of structural and geotechnical design

Eurocodes - Bases des calculs structuraux et géotechniques | Eurocode - Grundlagen der Planung von Tragwerken und geotechnischen Bauwerken

Table 4.1 (NDP) — Qualification of consequence classes

Consequence class	Indicative qualification of consequences	
	Loss of human life or personal injury[a]	Economic, social or environmental consequences[a]
CC4 – Highest	Extreme	Huge
CC3 – High	High	Very great
CC2 – Normal	Medium	Considerable
CC1 – Low	Low	Small
CC0 – Lowest	Very low	Insignificant

[a] The consequence class is chosen based on the more severe of these two columns.

Table A.1.9 (NDP) — Consequence factors for buildings and geotechnical structures

Consequence class (CC)[a]	Description of consequences	Consequence factor k_F
CC3	High	1,1
CC2	Normal	1,0
CC1	Low	0,9

[a] The provisions in Eurocodes cover design rules for structures classified as CC1 to CC3, see 4.3.

Table A.1.8 (NDP) — Partial factors on actions and effects for verification cases VC1 to VC4 for persistent and transient (fundamental) design situations

Action or effect				Partial factors γ_F and γ_E for verification cases				
Type	Group	Symbol	Resulting effect	Structural resistance[a]	Static equilibrium and uplift[b]		Geotechnical design	
Verification case				VC1[a]	VC2(a)[b]	VC2(b)[b]	VC3[c]	VC4[d]
Permanent action (G_k)	All[f]	γ_G	unfavourable /destabilizing	$1{,}35k_F$	$1{,}35k_F$	1,0	1,0	G_k is not factored
	Water[l]	γ_{Gw}		$1{,}2k_F$	$1{,}2k_F$	1,0	1,0	
	All[f]	$\gamma_{G,stb}$	stabilizing[g]	not used	1,15[e]	1,0	not used	
	Water[l]	$\gamma_{Gw,stb}$			1,0[e]	1,0		
	All	$\gamma_{G,fav}$	favourable[h]	1,0	1,0	1,0	1,0	
Prestressing (P_k)		γ_P[k]						
Variable action (Q_k)	All[f]	γ_Q	unfavourable	$1{,}5k_F$	$1{,}5k_F$	$1{,}5k_F$	1,3	$\gamma_{Q,red}$[j]
	Water[l]	γ_{Qw}		$1{,}35k_F$	$1{,}35k_F$	$1{,}35k_F$	1,15	1,0
	All	$\gamma_{Q,fav}$	favourable	0				
Effects of actions (E)		γ_E	unfavourable	γ_E is not applied				$1{,}35k_F$
		$\gamma_{E,fav}$	favourable					1,0

Idea 2 – Novedades en EC7-2G

Objetivos de la revisión del EC7-2G

Main objectives for 2nd Generation EC7

CEN/TC250: Standard suitable for all common design cases without demanding disproportinate levels of effort

Other objectives:

Ease of use

- Clear language, same structure in all Eurocodes,
- Avoid alternative rules
- No rules of little practical use, no "textbook"

Harmonisation

- More common design rules,
- Less Nationally Determined Parameters (NDP)

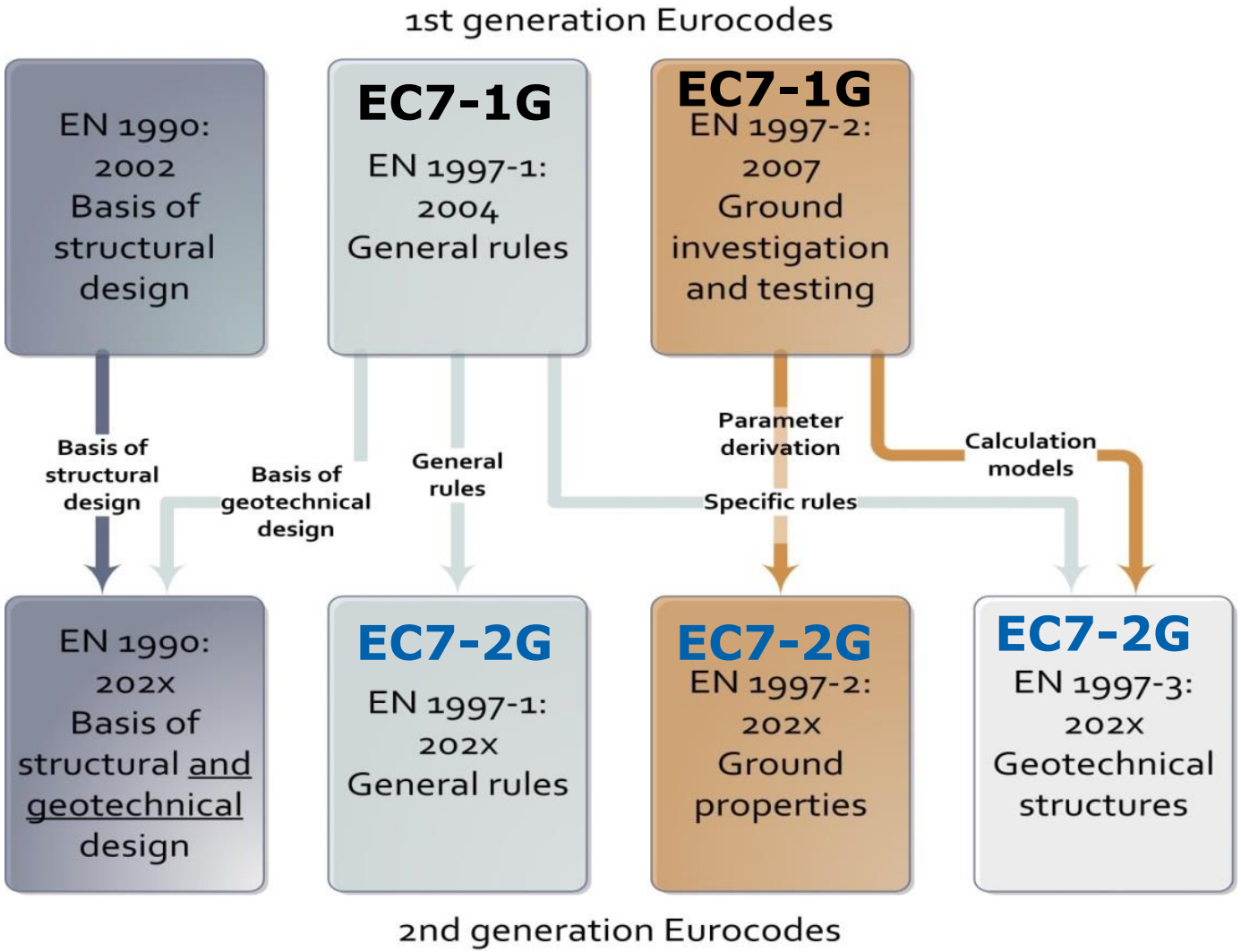
New developments

- Numerical models
- Probabilistic design
- New geotechnical structures
- Sustainability (thermo-active geostructures)

Introduction to Second Generation of Eurocode 7	Adriaan van Seters Chairman CEN/TC250/SC 7 "Eurocode 7"

Idea 2 – Novedades en EC7-2G

Reorganización



Idea 2 – Novedades en EC7-2G

JORNADA EUROCODIGOS 2G

Nuevos contenidos

EN 1997-1:2024 includes the following significant technical changes with respect to EN 1997-1:2004:

Eurocode 7 — Geotechnical design — Part 1: General rules

EN 1997-1:2024 includes the following significant technical changes with respect to EN 1997-1:2004:

- the scope of EN 1997-1 has been extended to include rock (the word "ground" is now used extensively to denote soil, rock, and fill);
- the Geotechnical Category has been redefined as a combination of the Consequence Class of the structure and the complexity of the ground (Geotechnical Complexity Class) (Clause 4 and Annex C);
- robustness, durability and sustainability have been introduced as new topics (Clause 4);
- the representative value of a ground property has been defined as either a nominal value (cautious estimate) or a characteristic value (based on statistical evaluation) (Clause 4 and Annex A);
- a new clause on the determination of groundwater levels and groundwater pressures has been added (Clause 6);
- a new procedure for verifying ultimate limit states using numerical models has been added (Clause 8);
- greater emphasis has been given to serviceability limit states, including ground movements and structural and hydraulic aspects (Clause 9);
- a new clause on the implementation of design (covering supervision, inspection, monitoring, and maintenance) has been added (Clause 10);
- a new clause on testing has been added, covering tests for determining ground properties, tests for measuring the resistance of geotechnical structures, product quality tests, and tests to determine geotechnical behaviour (Clause 11); and
- the clause on reporting has been revised to cover updated specification of the Ground Investigation and Geotechnical Design Reports and new requirements for Geotechnical Construction Records and geotechnical test reports (Clause 12 and Annex C).

Eurocode 7 — Geotechnical design — Part 2: Ground properties

EN 1997-2:2024 includes the following significant technical changes with respect to EN 1997-2:2007:

- the Scope of EN 1997-2 has been completely revised to assist the determination of ground parameters for design rather than provide a synopsis of ground investigation techniques;
- the concept of a Ground Model has been introduced to represent a site specific outline of the disposition and character of the ground and groundwater (Clause 4);
- the ground investigation process has been set out more clearly under the topics desk study (Annex C), site inspection (Annex C), preliminary and design investigations, and monitoring (Clause 5);
- rules for the minimum extent and spacing of ground investigation locations have been added (Clause 5 and Annex H);
- the description and classification of soil and rock (including discontinuities) have been described, mainly by reference to separate EN ISO standards (Clause 6);
- a new clause covering state, physical and chemical properties of the ground has been added (Clause 7);
- a new clause covering strength and stiffness parameters of the ground has been added, together with correlations linked to test data (Clauses 8 and 9 and Annexes E and F);
- a new clause covering cyclic, dynamic and seismic ground properties has been added together with correlations linked to test data (Clause 10 and Annex G);
- new clauses covering groundwater and geohydraulic properties and thermal properties have been added (Clauses 11 and 12); and
- the rules for reporting of ground investigations in the Ground Investigation Report have been revised (Annex A).

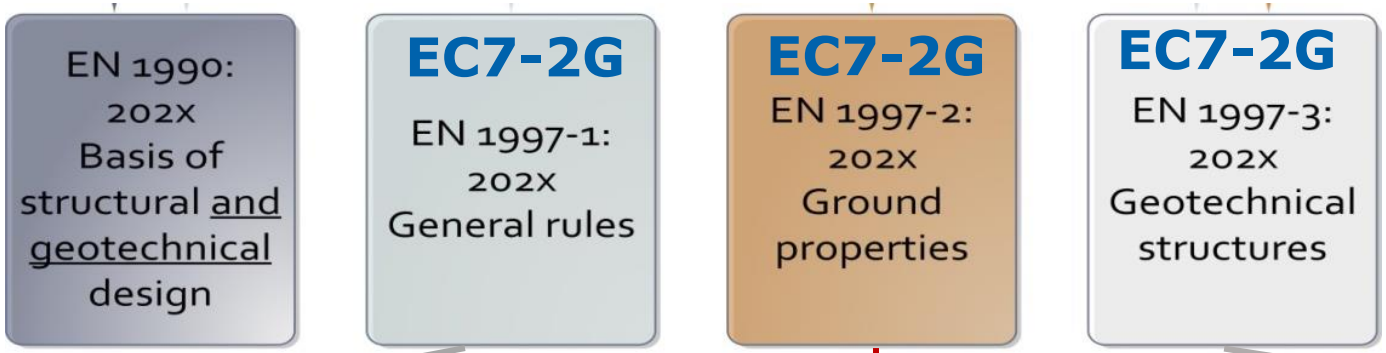
Eurocode 7 - Geotechnical design - Part 3: Geotechnical structures

In comparison with the previous edition of EN 1997-1, the following main changes have been made:

- the Scope of EN 1997-3 has been extended to include geotechnical structures on/in rock (the word "ground" is now used extensively to denote soil, rock, and fill);
- new geotechnical structures have been added: pile groups and piled rafts (in Clause 6), reinforced fill structures (in Clause 9), soil nailed structures (in Clause 10), rock bolts and rock surface support (in Clause 11); ground improvement (in Clause 12) and groundwater control measures (in Clause 13);
- existing clauses on slopes, cuttings and embankments (in Clause 4), spread foundations (in Clause 5), piled foundations (in Clause 6), retaining structures (in Clause 7) and anchors (Clause 8) have been extensively revised;
- the basis of design of geotechnical structures has been aligned with EN 1990:2023;
- verification of ultimate limit state has been presented using (a) partial factors or other probabilistic methods, (b) prescriptive rules, (c) testing and (d) the Observational Method;
- durability and sustainability issues, e.g. corrosion and maintenance strategies have been addressed and an Annex K on thermoactive geostructure design introduced;
- harmonization of partial factors in ultimate limit state verification for all CEN-member states has been achieved especially for slopes and piled foundations;
- the use of numerical methods has been incorporated into the verification of limit states;
- numerous state-of-the-art calculation models have been presented in informative annexes;

Idea 2 – Novedades en EC7-2G

Nuevos contenidos



- Sistema de fiabilidad
  - **Categoría Geotécnica**
- Agua del terreno
- Determ. Valores Representativos
- Procedim. Modelos numéricos
- **Implementación del proyecto durante la construcción**

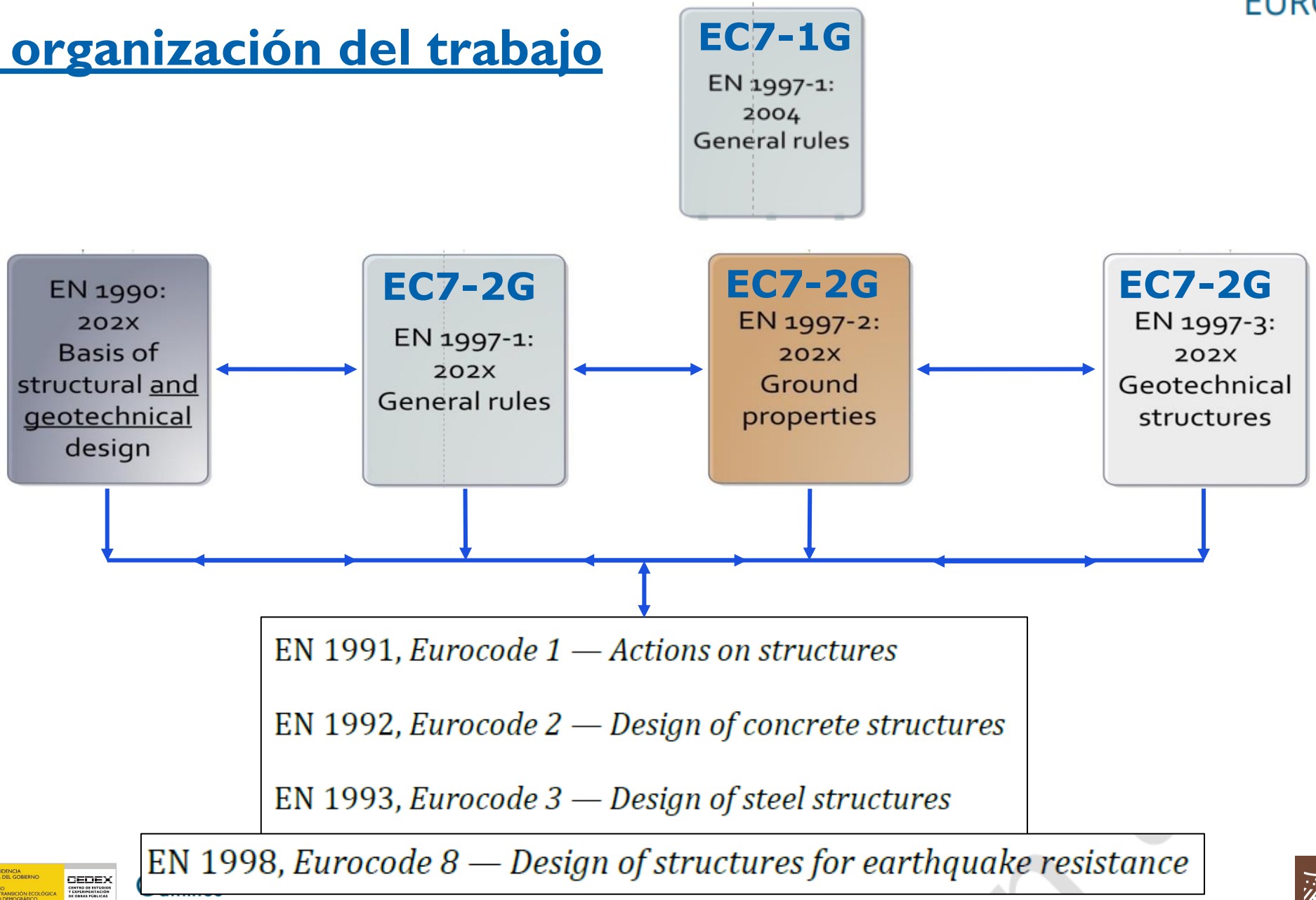
- Importancia de las propiedades del terreno
- Reconocimiento geotécnico
- Modelo del terreno
- Listado de propiedades y métodos de obtención

- Modelo de terreno para cálculo geotécnico
- Modelos de cálculo en Anejos
- Nuevas estructuras geotécnicas
  - Estruct. de relleno reforzado
  - Elementos de refuerzo
  - Técnicas de mejora del terreno
  - Control del agua del terreno

EC-7 de Segunda Generación: evolución revolucionaria

Idea 2 – Novedades en EC7-2G

Nueva organización del trabajo



Idea 2 – Novedades en EC7-2G

Nuevos contenidos

6 Piled foundations

6.6.2.5 Structural resistance

(1) The structural resistance of a single piles should be verified in accordance with:

— EN 1992-1-1 for reinforced and plain concrete, grout or mortar piles;

— EN 1993-1-1 and EN 1993-5 for steel piles and single bar grouted micropiles;

— EN 1994-1-1 for composite steel and concrete piles;

— EN 1995-1-1 for timber piles.

~~Tope estructural~~

8 Anchors

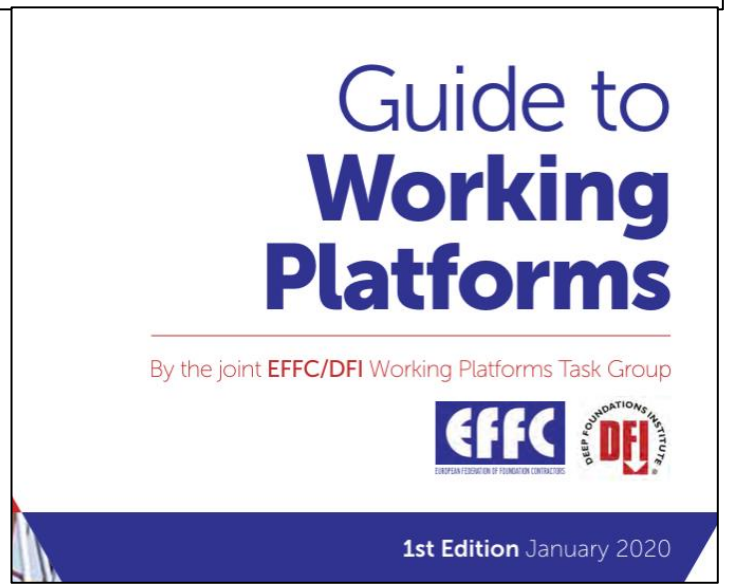
8.6.3 Structural resistance

(1) The design value of the ultimate limit state resistance of the structural elements of an anchor shall comply with EN 1993-5 and:

Working platforms

(4) The limit states of temporary working platforms (reinforced or not) may be verified according to other methods than given in (1) to (3).

NOTE Guidance for the design of temporary working platforms can be found in EFFC-DFI Guide for Working Platforms (2020) and Temporary Work forum TWf Guide (2019).



Idea 3 – Mirada al futuro

Subcomité CTN 140-SC7

Presidencia
Lab. Geotecnia - CEDEX

Administración	Sociedades Técnicas	Universidades	Consultores geotécnicos	Empresas proyectistas	Empresas constructoras geotécnicas	Empresas constructoras generales
D.G. Carreteras D. G. Agua ADIF Puertos del Estado CEDEX AENA Min. Vivienda	SEMSIG SEMR AETESS ICOG (Geólogos) CIMNE	U.Politécnica Madrid U. Politécnica Cataluña U. P. Cantabria U. Politécnica Valencia Univ. Compl. Madrid Univ. Extremadura Universidad de Sevilla Universidad de Vigo Universidad de Málaga	Acciona Ing. AECON B&A Ing. Esteyco Estudio Boixader Geot. Fectum Ineco Ingeap Intemac Saalg Geomech Sfriso y Asoc. Systra	Adhorna Arup Idom Eptisa Sener	AEEET AETESS Geobrugg Geocisa Huesker Keller Cimentaciones Macaferri Mixan Mix Rodio-Kronsa Terratest Tierra Armada VSL	Acciona Dragados FCC

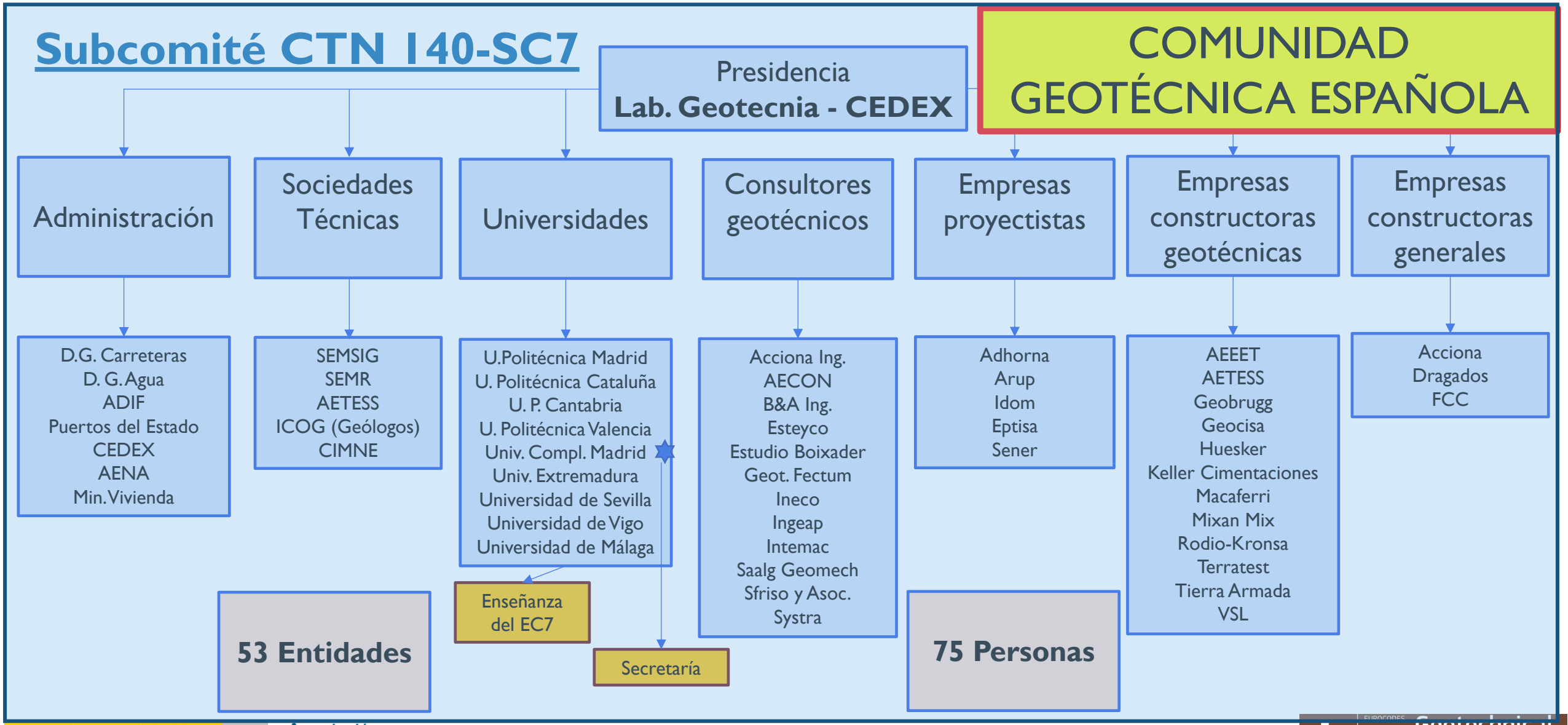
Enseñanza del EC7

Secretaría

53 Entidades

75 Personas

Idea 3 – Mirada al futuro



Idea 3 – Mirada al futuro

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 1990

March 2023

ICS 91.010.30 — Supersedes EN 1990:2002, EN 1997-1:2004

English Version

Eurocode - Basis of structural and geotechnical design

Date: 2023-11-09

EN 1997-1:2024

CEN/TC 250

Secretariat: BSI

Eurocode 7 — Geotechnical design — Part 1: General rules

CEN/TC 250

Date: 2023-10-30

EN 1997-2:2024

CEN/TC 250

Secretariat: BSI

Eurocode 7 — Geotechnical design — Part 2: Ground properties

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

FINAL DRAFT
FprEN 1997-3

October 2024

ICS 91.010.30; 93.020 — Will supersede EN 1997-1:2004

English Version

Eurocode 7 - Geotechnical design - Part 3: Geotechnical structures

- EN 1990: 202x Basis of structural and geotechnical design
- EN 1997-1: 202x General rules
- EN 1997-2: 202x Ground properties
- EN 1997-3: 202x Geotechnical structures

EUROCODES EN 1997 Geotechnical design

Idea 3 – Mirada al futuro

Guías JRC sobre EC7-2G

Assembling the ground model and the derived values

Guidelines for the application of the 2nd generation of Eurocode 7: Geotechnical design

Garin, H., Baldwin, M., Reiffsteck, P., van Der Made, K.-J., Wudtke, R., Lamas, L., Virely, D., Polo Lopez, C.S.

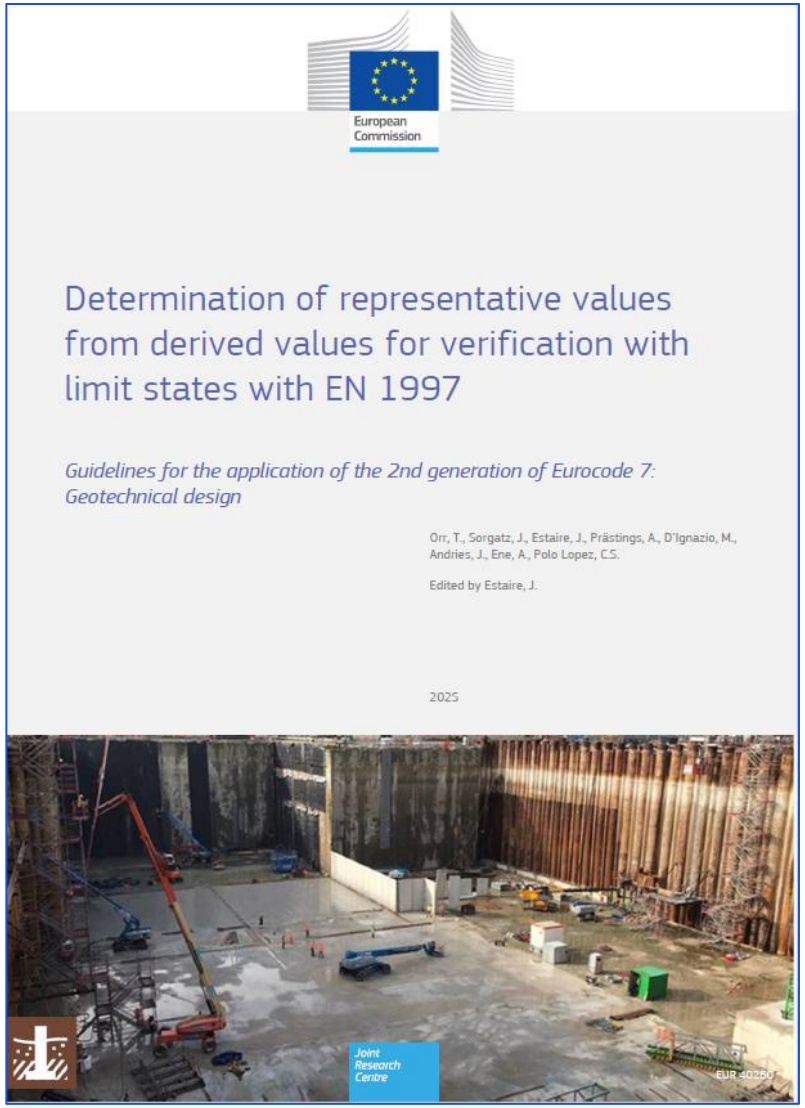
Edited by Garin, H.

Reliability-based verification of limit states for geotechnical structures

Guidelines for the application of the 2nd generation of Eurocode 7: Geotechnical design

van Den Eijnden, B., Knuuti, M., Lesny, K., Löfman, M., Mavritsakis, A., Roubos, A., Schweckendiek, T., Sciarretta, F., Ebener, A., Escher, K., Spross, J., Commend, S., Hehenkamp, M., Arnold, P., Wilhelm, S., Ene, A., Rimoldi, P., Pereira, R.

Edited by Schweckendiek, T.



Implementation of Design during Execution & Service Life

Guidelines for the application of the 2nd generation of Eurocode 7: Geotechnical design

Bogusz, W., Caplane, C., Hard, D., Idda, K., Ingram, P., Kanty, P., Kushwaha, A., Nayrand, N., Sand, O., Sciarretta, F., Tsitsas, G., Vogt, H.

Edited by Hard, D.

Evaluation of Eurocode EN 1997

Testing by next-generation engineers using case studies

Report prepared by SC TG B1

Design examples using 2nd Generation Eurocode 7

Prepared by SC7 TG B2

INSTITUTO DE LA INGENIERÍA DE ESPAÑA

Asociación Caminos

JORNADA

EUROCODIGOS 2G

Novedades en el Eurocódigo 7
Proyecto geotécnico

José Estaire Gepp

Jefe de Área // Laboratorio Geotecnia - CEDEX

Project Team EN 1997

jose.estaire@cedex.es

GOBIERNO DE ESPAÑA
MINISTERIO DE TRANSPORTES Y MOVILIDAD SOSTENIBLE
VICEPRESIDENCIA TERCERA DEL GOBIERNO
MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA Y EL RETO DEMOGRÁFICO
CEDEX CENTRO DE ESTUDIOS Y EXPERIMENTACIÓN DE OBRAS PÚBLICAS