Los Eurocódigos Estructurales

Jornada informativa

EN1990: Eurocódigo 0 – Bases de Cálculo

EN1991: Eurocódigo 1 – Acciones

8 de Junio de 2022

José M. Simón-Talero

Consejero Delegado – TORROJA INGENIERIA SLP

Profesor Asociado- ETS Ingenieros de Caminos, C. y P. UPM

Presidente de UNE CTN140/SC1 & SC10

Contenido

1. EN1990. Bases de proyecto
   - Ámbito y alcance
   - Partes
   - Algunas notas sobre los coeficientes parciales
   - Algunas particularidades
2. EN1991. Acciones
   - Partes
   - Últimas discusiones
3. Calendario de implantación de los Eurocódigos 0 y 1. (tareas pendientes)

Contenido

1. EN1990. Bases de proyecto
   - Ámbito y alcance
   - Partes
   - Algunas notas sobre los coeficientes parciales
   - Algunas particularidades
2. EN1991. Acciones
   - Partes
   - Algunas particularidades
   - Últimas discusiones
3. Calendario de implantación de los Eurocódigos 0 y 1. (tareas pendientes)

Ámbito y Alcance del EN1990

- Objeto y alcance
  - Definir principios y requerimientos de proyecto relativos a la seguridad, funcionalidad, robustez y durabilidad de las estructuras
  - Definir las bases de cálculo para el proyecto "estructural y geotécnico"
  - Definir las bases de cálculo del método de los estados límite.

- Ámbito de aplicación
  - Nuevas estructuras
  - Estructuras existentes
    - Evaluación
    - Reparación, mejoras o modificaciones
    - Cambios de uso

Partes del EN1990

- “Paquete 1”
  - Clausulas generales 1 a 8. (Normativa)
  - Anejo A: Aplicaciones Generales y a edificaciones (Normativo)
  - Anejo B: Gestión técnica del proyecto y ejecución (Informativo)
  - Anejo C: Análisis de fiabilidad y calibración de la norma (Informativo)
  - Anejo D: Proyecto asistido por ensayos (Informativo)
  - Anejo E: Guía adicional para mejorar la robustez (Informativo)
  - Anejo F: Métodos para la determinación del rango de tensiones para análisis de fatiga (Informativo)
- “Paquete 2a”
  - Anejo A2: Aplicación a puentes (Normativo)
  - Anejo G: Bases de proyecto para apoyos (Informativo)
  - Anejo H: Vibraciones en pasarelas debidas al tráfico peatonal (Informativo)
- “Paquete 2b”
  - Anejo A3: Aplicación a torres, mástiles y chimeneas (Informativo)
  - Anejo A4: Aplicación a silos y tanques (Informativo)
  - Anejo A5: Aplicación a estructuras de soporte de grúas (Informativo)
  - Anejo A6: Aplicación a estructuras “marinas costeras” (Informativo)

Algunas notas sobre los coeficientes

- **Coeficientes de combinación de acciones**
  - **ELU**

$$\sum F_d = \sum_i \gamma_{G,i} G_{k,i} + \gamma_{Q,1} Q_{k,1} + \sum_{j>1} \gamma_{Q,j} \psi_{0,j} Q_{k,j} + \left(\gamma_P P_k\right)$$

  - **ELS (comb. Frecuente)**

$$\sum F_d = \sum_i G_{k,i} + \psi_{1,1} Q_{k,1} + \sum_{j>1} \psi_{2,j} Q_{k,j} + \left(P_k\right)$$

Table A.2.7 (NDP) — Combination factors for road bridges

Action[a]	Symbol		ψ_0	ψ_1	ψ_2
Traffic loads[f] (see prEN 1991-2:2021 Table 6.5 and Table 6.6)	gr1a (LM1+footway and cycle-track loads)[l, m]	TS	0,75	0,75	0
		UDL	0,40	0,40	0
		Footway+cycle-track loads[k]	0,40	0,40	0
	gr1b (Single axle)[d]		0	0,75	0
	gr2 (Horizontal forces)		0	0	0
	gr3 (Pedestrian loads)		0	0,4	0
	gr4 (LM4 – Crowd loading)		0	-	0
	gr5 (LM3 – Special vehicles)[c]		0	-	0
Wind forces[e, f, g]	F_{Wk} Persistent design situations		0,6	0,2	0
	Execution[b]		0,8	-	0
	F_W^*		1,0	-	-
Thermal actions[g]	T_k		0,6[i]	0,6	0,5
Snow loads	$Q_{Sn,k}$ Persistent design situations[h]		0	0	0
	Execution[b]		0,8	-	-
Water actions			i	i	i
Construction actions[b]	Q_c		1,0	-	1,0

Table A.1.7 (NDP) — Combination factors for buildings

Action	ψ_0	ψ_1	ψ_2
Imposed loads in buildings (see EN 1991-1-1):	0,7	0,5	0,3
Category A: domestic, residential areas	0,7	0,5	0,3
Category B: office areas	0,7	0,7	0,6
Category C: congregation areas	0,7	0,7	0,6
Category D: shopping areas	1,0	0,9	0,8
Category E: storage areas			
Category F: traffic area, vehicle weight ≤ 30 kN	0,7	0,7	0,6
Category G: traffic area, 30 kN < vehicle weight ≤ 160 kN	0,7	0,5	0,3
Category H: roofs accessible for normal maintenance and repair only (see EN 1991-1-1)	0,7	0	0
Construction loads (see EN 1991-1-6)	0,6 to <u>1,0</u>	--	0,2
Snow loads on buildings (see EN 1991-1-3)[a]	0,7	0,5	0,2
— Finland, Iceland, Norway, Sweden			
— Remainder of CEN Member States, for sites located at altitude H > 1000 m a.s.l.	0,7	0,5	0,2
— Remainder of CEN Member States, for sites located at altitude H ≤ 1000 m a.s.l.	0,5	0,2	0
Wind loads on buildings (see EN 1991-1-4)	0,6	0,2	0
Temperature (non-fire) in buildings (see EN 1991-1-5)	0,6	0,5	0
Icing (see EN 1991-1-9)	0,5	0,2	0
Standing water (see the other Eurocodes)	-	-	-
Waves and currents (see EN 1991-1-8)			
NOTE Where ranges are given, the recommended value is underlined.			
[a] For countries not mentioned, see the National Annex or relevant local guidance.			

Algunas notas sobre los coeficientes

- ## Coeficientes de mayoración de acciones (ELU)

Table A.2.10 (NDP) — Partial factors on actions and effects for fundamental (persistent and transient) design situations for bridges and associated geotechnical structures

Action or effect				Partial factors γ_F and γ_E for Design Cases 1 to 4				
Type	Group	Symbol	Resulting effect	Structural resistance	Combined structural resistance and static equilibrium / uplift		Geotechnical design	
Design case				DC1[a]	DC2(a)[a]	DC2(b)[a]	DC3[a]	DC4[a]
Formula				(8.4)	(8.4)		(8.4)	(8.5)
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[m]	γ_{Gw}		$1{,}2k_F$	$1{,}2k_F$	1,0	1,0	
	Settlement	$\gamma_{G,set}$		$1{,}2k_F$[h]	$1{,}2k_F$[h]	1,0	1,0	
	All[c]	$\gamma_{G,stb}$	stabilizing[d]	not used	1,25[b]	1,0	not used	
	Water[m]	$\gamma_{Gw,stb}$			1,0[b]	1,0		
	All[f]	$\gamma_{G,fav}$	favourable[e]	1,0	1,0	1,0	1,0	
	Settlement	$\gamma_{G,set}$		0	0	0	0	0
Prestress-ing (P_k)		γ_P[g]						
Variable action (Q_k)	Road / pedestrian traffic		unfavourable	$1{,}35k_F$	$1{,}35k_F$	$1{,}35k_F$	1,15	$\gamma_{Q,1}/\gamma_{G,1}$[f]
	Rail traffic (except as below)[i]			$1{,}45k_F$	$1{,}45k_F$	$1{,}45k_F$	1,25	
	SW/2, gr16, gr17[j]			$1{,}2k_F$	$1{,}2k_F$	$1{,}2k_F$	1,0	
	Other[k]	γ_Q		$1{,}5k_F$	$1{,}5k_F$	$1{,}5k_F$	1,3	
	Variable 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	effects are not factored				
		$\gamma_{E,fav}$	favourable					

a See A.2.7(4) to A.2.7(7) for verifications using Design Cases 1 to 4.

b The value of $\gamma_{G,stb}$ = 1,25 is based on 1,35 x ρ with ρ = 0,925. The value of $\gamma_{G,stb}$ = 1,0 8.3.3.1.

c Applied to all permanent actions except water pressures and settlement, including: se elements other than structural, ballast, soil, ground water and free water, removable loads,

d Applied to the stabilizing component of an action originating from a single source.

e Applied to actions whose entire effect is favourable and independent of the unfavourab

Table A.2.11 (NDP) — Consequence factors for bridges and associated geotechnical structures

Consequence class (CC)	Description of consequences	Consequence factor k_F
CC3b	Higher (upper risk group)	1.1
CC3a	Higher (lower risk group)	1.0
CC2	Normal	1.0
CC1	Lower	0.9

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

Action or effect				Partial factors γ_F and γ_E for Design Cases 1 to 4				
Type	Group	Symbol	Resulting effect	Structural resistance	Static equilibrium and uplift		Geotechnical design	
Design case				DC1[a]	DC2(a)[b]	DC2(b)[b]	DC3[c]	DC4[d]
Formula				(8.4)	(8.4)		(8.4)	(8.5)
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	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	
Pre-stressing (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	$\gamma_{Q,1}/\gamma_{G,1}$[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	effects are not factored				$1{,}35k_F$
		$\gamma_{E,fav}$	favourable					1,0

a Design Case 1 (DC1) is used both for structural and geotechnical design.

b Design Case 2 (DC2) is used for the combined verification of strength and static equilibrium, when the structure is sensitive to variations in permanent action arising from a single-source. Values of γ_F are taken from columns (a) or (b), whichever gives the less favourable outcome.

c Design Case 3 (DC3) is typically used for the design of slopes and embankments, spread foundations, and gravity retaining structures. See EN 1997 for details.

d Design Case 4 (DC4) is typically used for the design of transversally loade (in some countries) gravity retaining structures. See EN 1997 for details.

e The values of $\gamma_{G,stb}$ = 1,15 and 1,0 are based on $\gamma_{G,inf}$ = 1,35 ρ and 1,2 ρ wi

f Applied to all actions except water pressures.

g Applied to the stabilizing part of an action originating from a single sourc

h Applied to actions whose entire effect is favourable and independent of t

$\gamma_{Q,1}$ = corresponding value of γ_Q from DC1 and $\gamma_{G,1}$ = corresponding valu

k See other relevant Eurocodes for the definition of γ_P where γ_P is materi

l For water actions induced by waves and currents, see subclause A.6.

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

Consequence class (CC)	Description of consequences	Consequence factor k_F
CC3	Higher	1,1
CC2	Normal	1,0
CC1	Lower	0,9

Algunas particularidades del EN1990

- **Vida útil ("Service life")**
  - **Definición:**

La "vida útil de cálculo" (design service life) *es el tiempo en que una estructura o perte de ella puede ser utilizada para el fin o uso para el que fue construida siempre que se mantenga adecuadamente pero sin que sea necesaria ninguna reparación importante*.

Table A.1.2 (NDP) — Design service life categories for buildings

Category of buildings	Design service life, T_{life} years
Monumental building structures	100
Building structures not covered by another category	50
Agricultural, industrial, and similar structures Replaceable structural parts	25
Temporary structures[a, b]	≤ 10

[a] For structures or parts of structures that can be dismantled in order to be re-used, see 4.5(3).

[b] For specific temporary structural members, such as anchors, T_{life} ≤ 2 years can be considered.

Table A.1.1 (NDP) — Examples of buildings in different consequence classes

Consequence class	Description of consequence	Examples
CC3	Higher	Buildings where people assemble, e.g. grandstands, concert halls
CC2	Normal	Buildings where people normally enter, e.g. residential and office buildings
CC1	Lower	Buildings where people do not normally enter, e.g. agricultural buildings, storage buildings

Table A.2.2 (NDP) — Design service life categories for bridges

Category of structures	Design service life, T_{life} years
Bridges (including their foundations and tension components), other civil engineering structures supporting road or railway traffic[a]	100[b]
Bridges where the main structural members have reduced protection[a]	50[b]
Replaceable structural parts other than tension components	25
Temporary structures[c]	≤ 10

[a] See the material Eurocode parts for durability requirements to protect structural members to achieve the design service life.

[b] A lower value of design service life may be used where specified by the relevant authority, or where not specified, agreed for a specific project by the relevant parties. A lower value of design service life can be relevant, for example, for bridges in a low consequence class where the economic consequences of replacement after a shorter design service life are agreed to be acceptable by the relevant authority or relevant parties.

[c] See 4.5(3) for classification of temporary structures, which excludes structures that can be dismantled and reused.

Table A.2.1 (NDP) — Examples of bridges in different consequence classes

Consequence class	Description of consequence	Examples
CC3b	Higher (upper risk group)	Where an increased level of reliability is required, when specified by the relevant authority or, where not specified, agreed for a specific project by the relevant parties
CC3a	Higher (lower risk group)	Railway bridges on main railway lines, bridges over main railway lines, bridges over and under major roads
CC2	Normal	Bridges not in other consequence classes
CC1	Lower	Short span bridges on local roads with little traffic (provided they do not span over main railway lines or major roads)

Algunas particularidades del EN1990

- **Criterios de proyecto en ELS**
  - **Art 8.4.4. Criterio de comprobación:**

La comprobación de los requisitos del ELS de deformaciones se podrá realizar de una de estas dos formas:

- Como se indica en el Anejo A para los diferentes tipos de estructuras.
- Como especifique la autoridad competente o, cuando no se especifique, como se acuerde para cada proyecto en particular por las partes intervinientes.

8.4.4 Design criteria

(1) The deformations to be taken into account in relation to serviceability requirements should be either:

— as given in Annex A for different types of construction works; or

— as specified by the relevant authority or, where not specified, agreed for a specific project by the relevant parties.

NOTE 1 For other specific serviceability criteria such as crack width, stress or strain limitation, or slip resistance, see the other Eurocodes.

NOTE 2 Serviceability criteria for seismic design are given in EN 1998.

Algunas particularidades del EN1990

- **Comprobación de flechas**
  - **Edificios (Anejo A):**

Table A.1.10 (NDP) — Suggested maximum vertical deflections for non-industrial buildings

Serviceability criteria	Limiting damage to elements other than structural[a]	Comfort of users	Appearance
Combination of actions to be considered	Characteristic, Formula (8.29)	Frequent, Formula (8.30)	Quasi-permanent, Formula (8.31)
Not accessible roof	Roofing rigid roofing: $w_2+w_3 \le L/250$ resilient roofing: $w_2+w_3 \le L/125$ Ceiling plastered ceiling: $w_2+w_3 \le L/350$ false ceiling: $w_2+w_3 \le L/250$	$w_2+w_3 \le L/300$	$w_1+w_2-w_c \le L/250$
Floor, accessible roof	Internal partition walls not reinforced: — partitions of brittle material or non-flexible: $w_2+w_3 \le L/500$ — partitions of non-brittle materials: $w_{max} \le L/400$ reinforced walls: $w_2+w_3 \le L/380$ removable walls: $w_2+w_3 \le L/250$ Flooring: — tiles rigidly fixed: $w_2+w_3 \le L/500$ — small tiles[b] or deflection not fully transmitted: $w_2+w_3 \le L/350$ — resilient flooring: $w_2+w_3 \le L/250$ Ceiling plastered ceiling: $w_2+w_3 \le L/350$ false ceiling: $w_2+w_3 \le L/250$	$w_2+w_3 \le L/300$	$w_1+w_2-w_c \le L/250$
Structural frames	Windows: — no loose joints (no clearance between glass and frame): $w_2+w_3 \le L/1000$ — with loose joints: $w_2+w_3 \le L/350$		

[a] L = span (or, for cantilever, twice the length); w_1, w_2, w_3, w_{max} are defined in Figure A.1.1.

[b] Small tiles: sides less than 10 cm.

Table A.1.11 (NDP) — Suggested maximum permitted horizontal displacements for non-industrial buildings

Serviceability criteria[a]	No damage to elements other than structural	Comfort of users	Appearance
Combination of actions to be considered	Characteristic Formula (8.29)	Frequent Formula (8.30)	Quasi-permanent Formula (8.31)
Overall horizontal displacement u	Single-storey buildings: $u \le H/400$ Multi-storey buildings: $u \le H/500$	$u \le H/250$	
Horizontal displacement u_i over a storey height	Brittle partition walls: $u_i \le H_i/500$ and $u_i \le 6$mm No brittle partition walls: $u_i \le H_i/200$	$u_i \le H_i/250$	$u_i \le H_i/250$

[a] H = height of building; H_i = storey height; u_i and u are defined in Figure A.1.2.

Table A.1.13 (NDP) — Suggested maximum permitted differential settlement of foundations for different structural sensitivity classes

Structural sensitivity class	Description of sensitivity	Maximum differential settlement[a] $\Delta s_{CA,SLS}$
SSC5	Highest	10 mm
SSC4	Higher	15 mm
SSC3	Normal	30 mm
SSC2	Lower	60 mm
SSC1	Lowest	100 mm

[a] See EN 1997-1 for the definition of differential settlement of foundations.

Algunas particularidadesdel EN1990

- **Comprobación de flechas**
  - **Puentes de carretera (Anejo A2)**

Los requerimientos y criterios de comprobación de flechas y de vibraciones podrán ser definidos por la autoridad competente o, cuando no se especifique, acordados para cada proyecto en particular por las partes intervinientes.

NOTA 1: La comprobación del ELS de flechas y de vibraciones en puentes de carretera es relevante solo en casos excepcionales. La combinación de acciones frecuentes será la que se utilice para la comprobación de flechas.

A.2.8.2 Serviceability criteria for road bridges

(1) Requirements and criteria should be specified by the relevant authority or, where not specified, agreed for a specific project by the relevant parties for road bridges concerning deformations and vibrations, where relevant.

NOTE 1 The verification of serviceability limit states concerning deformation and vibration is relevant only in exceptional cases for road bridges. The frequent combination of actions can be used for the assessment of deformation.

Algunas particularidades del EN1990

- **Comprobación de flechas**
  - **Puentes de ferrocarril (Anejo A2)**

  En puentes de ferrocarril se limitaran las flechas (deformaciones) y las vibraciones conforme a lo que se incdica en A.2.8.4

  Se efectuarán las siguientes comprobaciones:

  - Relativas a la seguridad del tráfico ferroviario:
    - Aceleración vertical del tablero
    - Alabeo del tablero
    - Flecha vertical del tablero (giros relativos en extremos)
    - Flecha transversal del tablero
    - Movimiento longitudinal del tablero
  - Relativas al confort del pasajero
    - Aceleración vertical
    - Flecha vertical
    - Análisis de interacción dinámica vehículo/puente

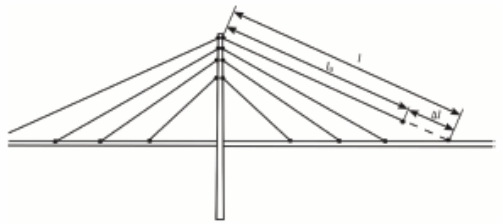
Algunas particularidades del EN1990

- **Vibraciones producidas por el tráfico de peatones en pasarelas**
  - Nuevo Anejo H
  - Acciones dinámicas definidas en prEN 1991-2, Anejo G
  - Definición de los criterios de comprobación

Table H.1— Comfort levels

Comfort level	Degree of comfort	$a_{lim,vertical}$ m/s²	$a_{lim,horizontal}$ m/s²
CL3	Maximum	≤ 0,5	≤ 0,1
CL2	Medium	≤ 1,0	≤ 0,3
CL1	Minimum	≤ 2,5	≤ 0,8
CL0	No limit set	-	-

- **Tratamiento de tirantes (puentes atirantados, mástiles,**
  - Definición de “pretensado” (art 3.1.2)



  - Definición de los valores del coeficiente de mayoración de acciones, ligado a las cargas externas ($\gamma_P = \gamma_g$)
  - Definición de situaciones de cálculo “especiales”:
    Sustitución de tirantes, rotura accidental de tirantes, …

Contenido

1. EN1990. Bases de proyecto
   - Ámbito y alcance
   - Partes
   - Algunas notas sobre los coeficientes parciales
   - Algunas particularidades
2. EN1991. Acciones
   - Partes
   - Algunas particularidades
   - Últimas discusiones
3. Calendario de implantación de los Eurocódigos 0 y 1. (tareas pendientes)

Partes del EN1991

- **EN1991-1**
  - **EN1991-1-1:** **Densidades, pesos propios, cargas en edificios** (40 pags)
  - **EN1991-1-2:** **Acciones en estructuras sometidas a fuego** (75 pags)
  - **EN1991-1-3:** **Acción de la nieve** (35 pags)
  - **EN1993-1-4:** **Acción del viento** (307 pags)
  - **EN1991-1-5:** **Acciones térmicas** (35 pags)
  - **EN1991-1-6:** **Acciones a considerar durante la construcción** (36 pags)
  - **EN1991-1-7:** **Acciones accidentales** (66 pags)
  - **EN1991-1-8:** **Acciones debidas a olas y corrientes** (224 pags)
  - **EN1991-1-9:** **Acciones debidas al "hielo atmsoférico"** (30 pags)
- **EN1991-2:** **Acciones en puentes** (153 pags)
- **EN1991-3:** **Acciones producidas por grúas y maquinarias** (56 pags)
- **EN1991-4:** **Acciones en silos y tanques** (152 pags)

(TOTAL EN1991 ….. 1209 pags)

Algunas particularidades del EN1991

- **En1991-1: Valor de la sobrecarga de uso en edificios (art 6.5)**

Table 6.1 (NDP) — Categories of use and values for q_k and Q_k

Category	Specific Use	Example	q_k [kN/m²]	Q_k [kN]	Typical dimension of the area loaded by Q_k expressed in (m × m)
A	Areas for domestic and residential activities	**A1** Rooms in residential buildings and houses, including corridors.	2,0	2,0	0,05 × 0,05
		A2 Bedrooms, wards, dormitories, private bathrooms and toilets in hospitals, hotels, hostels and other institutional residential occupancies.	2,0	2,0	0,05 × 0,05
B[a]	Public areas (not susceptible to crowding)	**B1** Office areas for general use including corridors other than archive / storage areas (see Category E)	3,0	3,0	0,05 × 0,05
		B2 Kitchens, communal bathrooms and toilets in hospitals, hotels, hostels and other institutional residential occupancies.	3,0	3,0	0,05 × 0,05
C[b,d]	Public areas where people may congregate (with the exception of areas defined under category A, B, and D)	**C1**: Areas with tables, etc. e.g. areas in schools, cafés, restaurants, dining halls, reading rooms, receptions.	3,0	4,0	0,05 × 0,05
		C2: Areas with fixed seats, e.g. areas in churches, theatres, cinemas, conference rooms, lecture halls, assembly halls, waiting rooms.	4,0	4,0	0,05 × 0,05
		C3: Areas without obstacles for moving people, e.g. areas in museums, exhibition rooms, etc. and corridors to areas not belonging to categories A1, B1 and C5.	5,0	4,0	0,05 × 0,05
		C4: Areas with possible physical activities, e.g. dance halls, gymnastic rooms, stages.	5,0	7,0	0,05 × 0,05
		C5: Areas susceptible to large crowds, e.g. in buildings for public events including corridors like concert halls, sports halls including stands, and railway platforms.	7,5	4,5	0,05 × 0,05
D	Shopping areas	**D1**: Areas in retail shops	4,0	4,0	0,05 × 0,05
		D2: Areas in department stores	5,0	7,0	0,05 × 0,05
E	Areas for archive, storage and industrial use[e]	**E1**: Areas susceptible to accumulation of goods, including access areas [f]	7,5	7,0	*
		E2: Industrial use [g,h,i]	*		
F	Garages and vehicle traffic areas (excluding ordinary roads and bridges)	Gross vehicle weight ≤ 30 kN: **F1** Traffic and parking areas for light vehicles (≤ 8 seats not including driver) e.g. garages; parking areas, parking halls	2,5	20	*
G		30 kN < Gross vehicle weight ≤ 160 kN: **G1** Traffic and parking areas for medium vehicles (on 2 axles) e.g. access routes, delivery zones, zones accessible to fire engines	5,0	90	0,2 × 0,2
		Gross vehicle weight > 160 kN: **G2** Traffic and parking areas for heavy vehicles [k]	*		
H[l]	Roofs not accessible except for normal maintenance and repair		0,4	1,0	0,05 × 0,05
I	Roofs accessible with occupancy according to categories A to G		See categories A to G		
K	Roofs accessible for special services, such as classes HC for helicopter landing areas		5,0	See Table 8.4	
S	Stairs and landings	**S1** Stairs and landings to areas belonging to category A1 and B1.	See categories A1 and B1		0,05 × 0,05
		S2 Stairs and landings for tribunes without fixed seats that are defined as escape ways.	7,5	3,0	0,05 × 0,05
		S3 Stairs and landings not belonging to category S1 or S2.	5,0	2,0	0,05 × 0,05
T	Terraces and balconies	**T1** Roof terraces, access balconies, balconies, loggias etc.	3,0	2,0	0,05 × 0,05

- **En1991-1: "Sobrecarga" de los tabiques (art 6.5)**

6.5.3.1 Partitions treated as imposed loads

(1) The self-weight of partitions may be taken into account by introducing a uniformly distributed load $q_{k,p}$, provided that the following conditions are verified:

- the relevant floor allows a sufficient distribution of a line load orthogonal to the intended orientation of the partition, and
- the self-weight of the partition is $Q_{k,p} \leq 3{,}0$ kN/m wall length.

NOTE Partitions are elements other than structural; as such, according to 5.2(2), they are expected to be classified as permanent actions, typically free for their spatial variation. The simplified approach provided in (1) only applies when the conditions defined above are verified. See (4) for heavier partitions.

(2) The uniformly distributed load $q_{k,p}$ defined in (1) should be added to the imposed loads of floors obtained from Table 6.1 (NDP).

(3) The value of this uniformly distributed load $q_{k,p}$ for partitions with a self-weight $Q_{k,p} \leq 3{,}0$ kN/m wall length should be based on the self-weight of the partitions.

NOTE In such a case, $q_{k,p}$ is derived from Formula (6.1) unless the National Annex gives different rules:

$$q_{k,p} = \max\{0{,}35\ \text{kN/m}^2;\ 0{,}4/\text{m}\ Q_{k,p}\} \qquad (6.1)$$

with:

$Q_{k,p}$ expressed in kN/m wall length

$q_{k,p}$ expressed in kN/m^2

- **En1991-1: Reducción de la sobrecarga de uso en edificios (art 6.5)**

6.5.3.2 Reduction factors

(1) The reduction factors α_A and α_n specified in this clause, which are applicable to the q_k values for imposed loads, may be used unless otherwise specified by the relevant authority or agreed for a specific project by the relevant parties.

NOTE 1 α_A is the reduction factor relevant to imposed loads on floors, beams and roofs; α_n is the reduction factor relevant to columns and walls depending on the number of storeys above such columns and walls.

NOTE 1 The value for the reduction factor α_A for categories A, B,C, D and category I (accessible roofs) is determined from Formula (6.2) unless the National Annex gives an alternative method and/or specific rules for the use of the reduction factor α_A, including its application for partitions and for specific categories C and D, where the reduction factor could be inappropriate to use.

$$\alpha_A = 0.5 + \frac{10}{A} \leq 1{,}0 \qquad (6.2)$$

with the restriction for categories C and D: $\alpha_A \geq 0{,}6$

where:

A is the tributary area expressed in m^2.

$$\alpha_n = 0.7 + \frac{0{,}6}{n} \leq 1{,}0 \qquad (6.3)$$

where α_n is calculated for each floor considering the number of floors n above the column or wall under consideration.

Últimas discusiones del EN1991

- **EN1991-2. Acciones en puentes**
  - **Anejo G (Informativo)**

    Acciones dinámicas producidas por el tráfico peatonal en pasarelas

  - **Art 6.9 & 8.10**

    Acciones del tráfico rodado en terraplenes de acceso a puentes (modelos 2D y 3D)
    dinámicas producidas por el tráfico peatonal en pasarelas

- **EN1991-3. Acciones producidas por grúas y maquinaria**
  - **EN1991-3**

    Polémica por la transpformaciñon de esa parte del Eurocódigo en una “Especificaciñon Técnica de CEN”

Contenido

1. EN1990. Bases de proyecto
   - Ámbito y alcance
   - Partes
   - Algunas notas sobre los coeficientes parciales
   - Algunas particularidades
2. EN1991. Acciones
   - Partes
   - Algunas particularidades
   - Últimas discusiones
3. Calendario de implantación de los Eurocódigos 0 y 1. (tareas pendientes)

Calendario de implantación del EN1990 y EN1991

- "CEN Enquiry" = versión "quasi definitiva"
- "Formal Vote" = traducciones al francés y alemán ya completadas
- EN1990. Eurocódigo 0

Parte		Nombre	CEN Enquiry start	Formal Vote	Recommended ANC start
prEN1990	Package 1	Bases de proyecto estructural y geotécnico (Gral, clausulas 1 a 8)	03-sep-20	20-abr-22	21-dic-21
		Annex A. Gral y edificios (Normativo)	03-sep-20	20-abr-22	21-dic-21
		Annex B. Technical management measures (Informativo)	03-sep-20	20-abr-22	21-dic-21
		Annex C. Fiabilidad y calibración (Informativo)	03-sep-20	20-abr-22	21-dic-21
		Annex D. Proyecto asistido con ensayos (Informativo)	03-sep-20	20-abr-22	21-dic-21
		Annex E. Robustez de edificios y puentes (Informativo)	03-sep-20	20-abr-22	21-dic-21
		Annex F. Rangos de fatiga (Informativo)	03-sep-20	20-abr-22	21-dic-21
prEN1990	Package 2a	Annex A2. Acciones en puentes	02-sep-21	25-ago-22	11-may-22
		Annex G. Apoyos (Normativo)	02-sep-21	25-ago-22	11-may-22
		Annex H. Vibraciones en pasarelas (Informativo)	02-sep-21	25-ago-22	11-may-22
prEN1990	Package 2b	Annex A3. Torres, mástiles y chimeneas	29-may-23	18-nov-24	19-jul-22
		Annex A4. Silos y tanques	29-may-23	18-nov-24	19-jul-22
		Annex A5. Estructuras de grúas	29-may-23	18-nov-24	19-jul-22
		Annex A6. "Coastal structures"	29-may-23	18-nov-24	19-jul-22
prEN1990-	2	Estructuras existentes			

Calendario de implantación del EN1990 y EN1991

- **EN1991. Eurocódigo 1**

Parte		Nombre	Vote CEN Enquiry	CEN Enquiry start	Formal Vote	Recommended ANC start
EN1991-	1-1	Densidades, pesos propios, cargas en edificios	10-may-22	nov-22	may-24	ene-24
EN1991-	1-2	Fuego	01-sep-21	jul-21	feb-23	oct-22
EN1991-	1-3	Nieve	10-may-22	ene-23	may-24	ene-24
EN1991-	1-4	Viento	12-may-22	jul-23	mar-25	mar-24
EN1991-	1-5	Acciones térmicas	12-may-22	ene-23	may-24	ene-24
EN1991-	1-6	Acciones durante la construcción	12-may-22	jul-23	nov-24	ene-24
EN1991-	1.7	Acciones accidentales	12-may-22	jul-23	nov-24	ene-24
EN1991-	1-8	Olas y corrientes	12-may-22	jul-23	mar-25	nov-23
EN1991-	1-9	Hielo atmosférico	12-may-22	ene-23	nov-24	
EN1991-	2	Acciones en puentes		jul-21	ene-23	sept-22
		Acciones en puentes	23-dec-21			
EN1991-	3	Grúas y maquinaria		jul-23	nov-24	ene-24
EN1991-	4	Silos y tanques	12-may-22	jul-23	ene-25	sept-23

Muchas gracias por su atención

Los Eurocódigos Estructurales

Jornada informativa

EN1990: Eurocódigo 0 – Bases de Cálculo

EN1991: Eurocódigo 1 – Acciones

8 de Junio de 2022

José M. Simón-Talero

Consejero Delegado – TORROJA INGENIERIA SLP

Profesor Asociado- ETS Ingenieros de Caminos, C. y P. UPM

Presidente de UNE CTN140/SC1 & SC10