

CHAPTER 4

MATERIALS AND GEOMETRY

Article 14. General principles

Both the determination of the structural response and the assessment of the effect of actions must be carried out using design values for the characteristics of the materials and for the geometric data of the structure.

Article 15. Materials

15.1 Characteristic values

For the purposes of this Code, the characteristic values of the strength of materials (compressive strength of concrete and compressive and tensile strength of steels) shall be the quartile corresponding to a probability of 0.05.

With regard to the tensile strength of concrete, two characteristic values shall be used, an upper and a lower, with the first being the quintile associated with a probability of 0.95 and the second quintile associated with a probability of 0.05. These characteristic values must be adopted in alternation depending on their influence on the problem in question.

For the consideration of some of the properties used in the calculation, the average or nominal values shall be used as the characteristic values.

For the purposes of defining the characteristic values of the fatigue properties of materials, the specific criteria laid down in Article 48 shall be followed.

15.2 Design values

The design values of the properties of the materials shall be obtained from the characteristic values divided by a partial safety factor.

15.3 Partial safety factors for materials

The partial safety factor values for the materials for the study of the Ultimate Limit States shall be those indicated in Table 15.3.

Table 15.3 Partial safety factors for the materials for the Ultimate Limit States

Design situation	Concrete γ_c	Steel for passive and active reinforcements γ_s
Persistent or temporary	1.5	1.15
Accidental	1.3	1.0

The factors laid down in Table 15.3 do not apply to the checking of the Fatigue Ultimate Limit State, which shall be checked in accordance with the criteria laid down in Article 48, nor to the fire checking when Annex 6 applies.

Partial safety factor values equal to one unit shall be adopted for the study of the Ultimate Limit States.

The partial safety factors for the materials for the Ultimate Limit States in Table 15.3 may be amended in accordance with the indications laid down in 15.3.1 and 15.3.2.

The partial safety factors for the materials for the Ultimate Limit States laid down in Table 15.3 correspond to the maximum geometric deviations laid down in Point 5.1 and in 5.3.d) of Annex 11 and to a statistical inspection of the concrete laid down in 86.5.4. In accordance with the Owners, these factors may be amended when the conditions laid down in this Annex arise.

15.3.1 Modification of the partial safety factor for steel

The partial safety factor for steel may be reduced to 1.10 when at least two of the following conditions are met:

- a) that the construction of the structure is closely controlled pursuant to the provisions of Chapter XVII and that the attachment tolerances of the reinforcement comply with those explicitly laid down in the design, which must be at least as demanding as those indicated in paragraph 6 of Annex No 11 to this Code.
- b) that the passive or active reinforcements, depending on the case, bear an officially recognized quality mark with a guarantee level compliant with Section 8 of Annex 19 to this Code, or which form part of a precast element bearing an officially recognized quality mark with a guarantee level compliant with the aforementioned Section.
- c) that the steel for the passive reinforcements bears an officially recognized quality mark

15.3.2 Modification of the partial safety factor for concrete

The partial safety factor for concrete may be reduced to 1.40 in general and to 1.35 for precast elements, when the following conditions are met simultaneously:

- a) that the construction of the structure is closely controlled pursuant to the provisions of Chapter XVII and that deviations in the geometry of the cross-section in relation to the nominal cross-sections of the design comply with those explicitly laid down in the design, which must be at least as demanding as those indicated in Section 6 of Annex No 11 to this Code, and
- b) that the concrete bears an officially recognized quality mark with a guarantee level compliant with Section 8 of Annex 19 to this Code, or which form part of a precast element bearing an officially recognized quality mark with a guarantee level compliant with the aforementioned Section.

Article 16. Geometry

16.1 Characteristic and design values

The nominal values laid down in the design drawings shall be adopted as characteristic and design values.

$$a_k = a_d = a_{nom}$$

In some cases, when imprecision relating to geometry have a significant effect on the reliability of the structure, the following shall be taken as design value for the geometric values:

$$a_d = a_{nom} + \Delta a$$

where Aa takes into account the possible unfavourable deviations to the nominal values, and is defined in accordance with the permitted tolerances.

16.2 Imperfections

In cases in which the effect of geometric imperfections is significant, these shall be taken into account in the assessment of the effect of actions on the structure.