Subject	Limited period of fire resistance for fire models
Clause N°/ Subclause N° / Annex	2.4 (4) in EN 1991-1-2 2.1.3 (1) in all material Eurocodes

Reason for change

Develop proposals to reduce the number of NDPs and/or enable better consensus on values adopted by Countries to be achieved.

Original content

In EN 1991-1-2

2.4Temperature Analysis

(4) Depending on the design fire chosen in section 3, the following procedures should be used:

- with a nominal fire curve, the temperature analysis of the structural members is made for a specified period of time, without any cooling phase;

NOTE1 The specified period of time may be given in the national regulations or obtained from annex F following the specifications of the national annex.

- with a physically-based fire model, the temperature analysis of the structural members is made for the full duration of the fire, including the cooling phase.

NOTE 2 Limited periods of fire resistance may be set in the national annex.

In all material Eurocodes

2.1.3 Parametric fire exposure

(1) The load-bearing function is ensured if collapse is prevented during the complete duration of the fire, including the decay phase or during a required period of time.

Change

In EN 1991-1-2

(4) Depending on the design fire chosen in section 3, the following procedures should be used:

– with a nominal fire curve, the temperature analysis of the structural members is made for a specified period of time, without any cooling phase;

NOTE 1 The specified period of time may be given in the national regulations. If allowed by the national regulations, the specified period of time can be obtained from annex F following the specifications of the national annex.

– with a physically based fire model, the temperature analysis of the structural members is made for the full duration of the fire, including the cooling phase.

NOTE 2 The national annex may refer to national regulations in which limited periods of fire resistance are specified

In all material Eurocodes

(1) The load-bearing function is ensured if collapse is prevented during the complete duration of the fire, including the decay phase or during a required period of time according to 2.4 (4) of EN 1991-1-2

Background information

Information

Section 3 is “Thermal actions for temperature analysis”

Annex F (informative) is “Equivalent time of fire exposure”

For Note 1:

5 countries from the NDP database made no comment: CZE, FRA, LTU, PRT and SVK

10 countries from the database made a comment, out of which:

- 3 countries impose utilization of Annex F (using the term “should” or “shall”) without any reference to their national regulations:

  CYP: “The specific period of time should be obtained from Annex F.”

  NOR: “Determination of equivalent time of standard fire exposure as given by Annex F shall be used.”

  SVN: “The instructions and values in the table in Annex F shall be taken into account.”

- 2 countries accept Annex F (using the term “may be”) with reference to their national regulations:

  BGR: “The specified period of time may be obtained from annex F. The categorization of buildings and fire sectors depending of fire resistance may be performed according NA.4.”

  HUN: “The specified period of time may be

  - taken according to the Order by the Ministry of Interior No. 2/2002. (I.23.) Annex 5, Sec. I/3 "Requirements for fire protection of building structures" (see reference to NCCI), Table 1, 2 and 3;

  - or calculated according to Annex F allowing for modification factors given in the Order by the Ministry of Interior No. 2/2002. (I.23.) Annex 5, Sec. I/7 "Determination of the calculated fire load and the applicable requirements for fire protection " (see reference to NCCI), Clause 4.3, 4.4 and 4.5.”

- 2 countries don’t accept Annex F, one of them referring to national regulations

  DNK: “Annex F is not applicable.”

  FIN: “Instead of annex F national regulations are used.”

- The comment from 3 countries does not allow the PT to know whether Annex F is accepted or not, because the comment refers to some documents that the PT does not have. Also, for GBR, the PT does not know whether Annex F is considered as a fire model or not by GBR.

  IRL: “Periods of fire resistance may be set according to those specified in the Irish Building Regulations Technical Guidance Document B (TGD B) or derived from the alternative calculation procedures included within this National Annex.”

  ROU: “In order to determine fire resistance technical data specified in the N.A.2.4.1.1 and NA.2.4.1.2 table is used.”

  GBR: “BS EN 1991-1-2 recommends that temperature analysis is performed using a nominal temperature-time curve or a fire model.

  When performing temperature analysis in terms of the nominal temperature-time curve, the period of time within which to make the temperature analysis is specified:

a) for England and Wales in Approved Document B to the Building Regulations 2000 [1];

b) for Scotland in the Scottish Building Standards Technical Handbooks [2] and [3];"

Discussion by PT.

Clause 2.4(4) is indeed the place where it can be mentioned how the equivalent time of exposure determined according to Annex F has to be used.

Nevertheless, it is a privilege of each Member State to fix the safety level, possibly through the fire duration specified in the regulation. This privilege cannot be withdrawn by the Eurocode. As a consequence, the first part of the sentence, "The specified period of time may be given in the national regulations", must be maintained.

It is also the privilege of each Member State to allow, or not, application of Annex F. It is proposed to modify the end of the sentence in order to state more clearly that authorization to use Annex F is subjected to approval by national regulation. The new sentence thus becomes: "If allowed by national regulations, the specified period of time can be obtained from annex F following the specifications of the national annex".

<u>For Note 2:</u>

8 countries from the NDP database made no comment: BGR, CYP, CZE, HUN, LTU, POL, PRT and SVK.

8 countries from the database made a comment, out of which:

- 2 countries specify a full duration of the fire:

  DNK: With a fire model, a temperature analysis should be made for the full duration of the fire.

  GBR: When performing temperature analysis using fire models, no limited periods of fire resistance are specified. Fire models used should be soundly based, robust and suitable for the given fire design scenario.

- 2 countries accept limited duration of fire resistance

  IRL: Periods of fire resistance may be set according to those specified in the Irish Building Regulations Technical Guidance Document B (TGD B) or derived from the alternative calculation procedures included within this National Annex.

  NOR: Limitation period for fire resistance can alternatively be determined from clause 3

- The comment of 4 countries is not clear for the PT:

  FIN: "National regulations are applied. The design is based on design fire scenarios".

  This is not clear because we don't know what the national regulations specify.

  FRA.: "La limitation de la durée de résistance au feu ne peut être envisagée que dans le cadre de la réglementation en vigueur.

  NOTE La réglementation en vigueur à la date de parution de cette Annexe Nationale est l'arrêté du 22 mars 2004 traitant de la résistance au feu des produits, éléments de construction et d'ouvrages. "

  This is not clear because we don't know what the « réglementation en vigueur … arrêté du 22 mars 2004 » specifies.

ROU: “When structural members analysis is based on data presented in tables NA.2.4.1.1 and NA 2.4.1.2 or other simplified rules, referring to the nominal temperature-time curve, the temperature analysis is made only for the heating phase (without any cooling phase). “

This is not clear because the comment refers to nominal temperature-time curve whereas note 2 is, in our view, related to fire models

SVN: “The instructions and values in the table in Annex F shall be taken into account.”

This is not clear because this comment is related to note 1 and not to note 2:

Discussion by PT.

It has to be noted that each “material” Eurocode mentions the possibility to use the full duration of the fire or a specified period of time. This is the case in:

- section 2.1.3(1)P of EN 1992-1-2
- section 2.3.1 of EN 1993-1-2
- section 2.1.3 of EN 1994-1-2
- section 2.1.3 of EN 1995-1-2:
- section 2.1.3 of EN 1996-1-2
- section 2.1.3 of EN 1999-1-2

It has to be noted that this allowance to use a required period of time is not an NDP in these Eurocodes (it is even a principle in EN 1992-1-2). It would thus not be consistent to refrain the possibility to use a limited period of time in EN 1991-1-2 if it is explicitly allowed in the “material” Eurocodes.

Also, because the safety level is a privilege of each Member State, each Member State is thus allowed to fix limited periods of fire resistance time.

This note can thus not be deleted.

It is nevertheless proposed to modify the sentence in such a way that it refers to the national regulations that can be mentioned in the national annex.

Ease of use justification

The rephrasing of Note 2 makes it more clear, which goes in the direction of ease of use.

The fact to refer, in clause 2.3.1 of each material Eurocode, to clause 2.2 (4) of EN 1991-1-2 also goes in the direction of ease of use.

Subject	Use of natural fire models
Clause N°/ Subclause N° / Annex	3.1 (10) in EN 1991-1-2

Reason for change

Id.

Original content

(10) Gas temperatures Θg may be adopted as nominal temperature-time curves according to 3.2, or adopted according to the fire models given in 3.3.

NOTE The use of the nominal temperature-time curves according to 3.2 or, as an alternative, the use of the natural fire models according to 3.3 may be specified in the national annex.

Change

No change

Background information

According to our specifications: “As far as the chapter 3 of the fire parts of Eurocode is concerned, only the inconsistency aspects between different Eurocodes raised in NDPs need to be dealt with.”

As this clause is specific to EN 1991-1-2, there is no possibility of inconsistency between different Eurocodes and the PT need not deal with it.

Ease of use justification

N/A

Subject	Low or high strength concrete classes
Clause N°/ Subclause N° / Annex	1.1 (16) in EN 1994-1-2 6.1 (5) in EN 1992-1-2

Reason for change

Id.

Original content

In EN 1994-1-2

(16) This part of EN 1994 does not cover the design of composite structures with concrete strength classes lower than C20/25 and LC20/22 and higher than C50/60 and LC50/55.

NOTE : Information on Concrete Strength Classes higher than C50/60 is given in section 6 of EN 1992-1-2. The use of these concrete strength classes may be specified in the National Annex.

In EN 1992-1-2

(5) A reduction in strength, fc,θ/ fck, at elevated temperature should be made.

Note: The values fc,θ/ fck for use in a Country may be found in its National Annex. Three classes are given in Table 6.1N. However the values given for each rely on a limited amount of test results. The selection and limit of use of these classes to certain strength classes or type of concrete for use in a Country may be found in its National Annex. The recommended class for concrete C 55/67 and C 60/75 is Class 1, for concrete C 70/85 and C80/95 is Class 2 and for concrete C90/105 is Class 3. See also note to 6.4.2.1 (3) and 6.4.2.2 (2).

Change

No change

Background information

Although stated in different clauses, there is a common desire, in Eurocode 2 as in Eurocode 4, to submit utilisation of high strength concrete to authorisation in the national annex.

There is thus no inconsistency between these two Eurocodes.

Ease of use justification

Subject	Maximum temperature in the cooling phase
Clause N°/ Subclause N° / Annex	2.1.3 (2) in EN 1992-1-2, EN 1994-1-2, 1995-1-2 and 1996-1-2

Reason for change

Id.

Original content

In EN 1992-1-2

(2) For the verification of the separating function the following applies, assuming that the normal temperature is 20°C:

- the average temperature rise of the unexposed side of the construction should be limited to 140 K and the maximum temperature rise of the unexposed side should not exceed 180 K during the heating phase until the maximum gas temperature in the fire compartment is reached;

- the average temperature rise of the unexposed side of the construction should be limited to Δθ1 and the maximum temperature rise of the unexposed side should not exceed Δθ2 during the decay phase.

Note: The values of Δθ1 and Δθ2 for use in a Country may be found in its National Annex. The recommended values are Δθ1 = 200 K and Δθ2 = 240 K.

The same clause, with slight editorial variations, is present in EN 1994-1-2, EN 1995-1-2 and EN 1996-1-2

Change

(2) For the verification of the separating function the following applies, assuming that the normal temperature is 20°C:

- the average temperature rise of the unexposed side of the construction should be limited to 140 K and the maximum temperature rise of the unexposed side should not exceed 180 K during the heating phase until the maximum temperature in the fire compartment is reached;
- the average temperature rise of the unexposed side of the construction should be limited to 200 K and the maximum temperature rise of the unexposed side should not exceed 240 K during the cooling phase.

Background information

<u>Discussion by PT.</u>

From all countries who made a comment in the NDP database:

- 16 countries accepted the Recommended value (RV) of 200 and 240 K for EN 1992-1-2, 17 countries for EN 1994-1-2 and 15 countries for EN 1995-1-2.
- 2 countries made a comment and recommended values that are more severe than the RV.

  DNK: “140, 180”

  SWE: “180, 220”

- 1 country made a comment that is less severe than the RV.

  FIN: “No values are given for the average temperature rise and for the maximum temperature rise during the cooling phase of fire. The requirements for separation function EI is only based on a standard fire and on temperature limits set by it.”

The vast majority of Member States have accepted the recommended value and only 3 of them differ, 2 in one direction and 1 in the other direction.

Work performed by the PT

Numerical analyses have been performed on concrete separating elements using the material properties of EN 1992-1-2, see annexe 1 to this background document.

The thickness of four slabs has been calculated to fit exactly the insulating function I after 30, 60, 90 and 120 minutes of standard fire (respectively 52, 80, 101 and 117 mm). The temperature rise on the unexposed side of these slabs is thus 140 K after the respective period of standard fire.

The same elements have then been subjected to the parametric fire of Annex A of EN 1991-1-2, with a heating phase of same duration and same intensity as the standard fire previously used but now followed by a cooling phase. During the cooling phase of the fire, the temperature on the unexposed side of the elements keeps on rising for some time to decrease at a later stage.

The results show that the slabs designed to meet the insulation criteria of 140 K under the standard fire do not meet the insulating criteria of 200 K during the cooling phase of the parametric fire. The maximum temperature rise was respectively 273°C, 247°C, 235°C and 232°C.

In order to meet the insulating criteria of 200 K during the cooling phase, the thickness of the slabs should be increased respectively 52 to 75 mm, from 80 to 100 mm, from 101 to 120 mm and from 117 to 138 mm.

This shows that the recommended value of 200 K in the cooling phase is already more severe than the agreed value of 140 K used for the heating phase.

It thus does not seem necessary, from these examples on concrete elements, to propose values that are more severe than the RV.

On the other hand, giving no limit at all for the temperatures on the unexposed side during the decay phase, as proposed by FIN, would allow, for example, for a solid timber slab to completely burn through after the time of maximum temperature in the fire while being still declared appropriate when designed according to a parametric fire, which seems to be somehow extreme.

The PT therefore believes that that is a good possibility here to delete this NDP activated in only 3 member states, in different directions.

Ease of use justification

N/A

Subject	Emissivity of masonry
Clause N°/ Subclause N° / Annex	2.2 (2) in EN 1996-1-2

Reason for change

Id.

Original content

(2) The emissivity of a masonry surface should be taken as ε_m.

NOTE: The value to be ascribed to ε_m in a Country may be found in its National Annex. The value will depend on the material of the masonry.

Change

No change

Background information

Because masonry can be made of very different products and materials, some of them produced only locally, it is not unreasonable to allow each country to define a list of products or materials with their emissivity. It is indeed much more difficult for masonry to define generic properties than for other materials such as steel, concrete, timber or aluminium.

Ease of use justification

N/A

Subject	Partial safety factor for mechanical properties
Clause N°/ Subclause N° / Annex	2.3 (1) and/or 2.3 (2) in all “material” Eurocodes

Reason for change

Id.

Original content

In EN 1992-1-2:

(1)P Design values of mechanical (strength and deformation) material properties Xd,fi are defined as follows:

$X_{d,fi} = k_\theta X_k / \gamma_{M,fi}$ (2.1)

where:

X_k is the characteristic value of a strength or deformation property (generally f_k or E_k) for normal temperature design to EN 1992-1-1;

k_θ is the reduction factor for a strength or deformation property ($X_{k,\theta}$ / X_k), dependent on the material temperature, see 3.2.;

$\gamma_{M,fi}$ is the partial safety factor for the relevant material property, for the fire situation.

Note 1: The value of $\gamma_{M,fi}$ for use in a Country may be found in its National Annex. The recommended value is:

…

For mechanical properties of concrete and reinforcing and prestressing steel: $\gamma_{M,fi}$ = 1,0

Note 2: If the recommended values are modified, the tabulated data may require modification.

The same clause, with slight editorial variations, is present in the other material Eurocodes

Change

(1) P Design values of mechanical (strength and stiffness) material properties for the fire situation $X_{d,fi}$ are defined as follows:

$$X_{d,fi} = k_\theta X_k / \gamma_{M,fi} \qquad (4.1)$$

where:

X_k is the characteristic value of a strength or stiffness property (generally f_k or E_k) for normal temperature design according to EN 199X-1-1;

k_θ is the temperature-dependent reduction factor ($X_{k,\theta}$ / X_k) for a strength or stiffness property, see Section 5.3;

$Y_{M,fi}$ is the partial factor for the relevant mechanical material property for the fire situation, as defined according to 4.5 (2).

(2) The value of $\gamma_{M,fi}$ is 1,0.

Background information

A) The text in the parenthesis of the first sentence "*strength and deformation*" has been replaced by "*strength and stiffness*" because, first, deformation is not a material property, it is a result of the material behaviour. Also, because in the definition of X_k it is explicitly written "*generally* f_k *or* E_k", it is clear that the code writers had the stiffness in mind.

B) The partial safety factor is not an NDP anymore. This is because, all member states have accepted the recommended value of 1,0. This is thus a good opportunity to eliminate this NDP, as stated as an exception in Clause 4.1 of N 1250. Furthermore, it eliminates the need for note 2, the one indicating that tabulated data may require modification if the recommended value is modified. Modification of the tabulated data would certainly be a major step backward in terms of harmonization and ease of use, if allowed. It is not indicated, indeed, how the tabulated data should be modified and it can be feared that each Member State that would modify the tabulated data would come with his own tables, with differences between the tables.

C) The same clause with exactly the same wording should be used in all material Eurocodes, to ensure consistency.

Ease of use justification

Each elimination of an NDP makes the code easier to use.

Subject	Partial safety factor for thermal properties
Clause N°/ Subclause N° / Annex	2.3 (1) and/or 2.3 (2) in all “material” Eurocodes

Reason for change

Id.

Original content

In EN 1992-1-2

(2)P Design values of thermal material properties $X_{d,fi}$ are defined as follows:

- if an increase of the property is favourable for safety:

$X_{d,fi} = X_{k,\theta} / \gamma_{M,fi}$ (2.2a)

- if an increase of the property is unfavourable for safety:

$X_{d,fi} = \gamma_{M,fi} X_{k,\theta}$ (2.2b)

where:

$X_{k,\theta}$ is the value of a material property in fire design, generally dependent on the material temperature, see section 3;

$\gamma_{M,fi}$ is the partial safety factor for the relevant material property, for the fire situation.

Note 1: The value of $\gamma_{M,fi}$ for use in a Country may be found in its National Annex. The recommended value is:

For thermal properties of concrete and reinforcing and prestressing steel: $\gamma_{M,fi} = 1,0$

…

Note 2: If the recommended values are modified, the tabulated data may require modification.

The same clause, with slight editorial variations, is present in the other material Eurocodes.

Change

(3) P Design values of thermal material properties for the fire situation are defined as their characteristic value, for xxx as well as for thermally insulating products.

xxx gives the list of structural materials covered by each Eurocode (steel, concrete, timber, aluminium…)

Background information

Reasons to remove the partial factor are:

A) In the present Eurocodes, it may not be clear to all users that, when it comes to the rate of temperature increase, specific heat and density are favourable for safety and should thus be divided by the partial factor whereas thermal conductivity is unfavourable for safety and should thus be multiplied by the partial factor.

B) It may appear that some properties which are favourable for the rate of temperature increase are unfavourable for other phenomena such as spalling in concrete members or the indirect effects of actions resulting from thermal gradients for example. A sensitivity analysis should then be undertaken about each thermal property to decide whether the partial factor multiplies or divides this property

C) Even more complicated, some thermal properties may be unfavourable during the heating phase and favourable during the cooling phase of a fire.

D) It does not make sense to apply a partial factor to all thermal properties in general. Indeed, with the present situation, and considering only conduction in dry materials:

a. Some models like the simple model for uniform temperature distribution in unprotected steel members, see Eq. (4.25) in EN 1993-1-2 are driven by $1/C_a\ \rho_a$, which means that the characteristic value of this term would be multiplied by $(\gamma_{M,fi})^2$.

b. Eq. (4.27) for the temperature distribution in protected steel members is driven by $\lambda_p/C_a\ \rho_a$ which means that the characteristic value would here be multiplied by $(\gamma_{M,fi})^3$.

c. In numerical models, propagation of the heat wave in a solid is driven by $\lambda_m/C_m\ \rho_m$ which means that the characteristic value would be multiplied by $(\gamma_{M,fi})^3$ (with the advanced model being safer than the simple calculation model in unprotected steel members).

Considering the 3rd power of the partial factor was certainly not the intention of the code writers of the present Eurocodes.

It has to be noted that different fractiles may be used for the characteristic value of different thermal material properties.

The only viable alternative to the decision taken by the PT would be to divide only the specific heat, among all thermal properties, by the partial factor but this is not the way that has been chosen because, all Member States having accepted the recommended value of 1,0 for the partial factor, there is here a very good opportunity to eliminate this NDP, see Clause 4.1 in the document “N 1250 POLICY GUIDELINES AND PROCEDURES”.

Ease of use justification

We believe that there is here a major step toward ease of use. The text has been shorten significantly and the comprehension improved.

Subject	National annex to EN 1990
Clause N°/ Subclause N° / Annex	2.4.2 (3) in the “material” Eurocodes

Reason for change

Id.

Original content

In EN 1992-1-2

Note 1: Regarding equation (2.5), examples of the variation of the reduction factor η_{fi} versus the load ratio $Q_{k,1}/G_k$ for Expression (2.4) and different values of the combination factor $\psi_{1,1}$ are shown in Figure 2.1 with the following assumptions: γ_{GA} = 1,0, γ_G = 1,35 and γ_Q = 1,5. Expressions (2.5a) and (2.5b) give slightly higher values. Recommended values of partial factors are given in the relevant National Annexes of EN 1990.

The same clause, with slight editorial variations, is present in the other material Eurocodes

Change

No change

Background information

There is no NDP here, only a reference to a National Annex of another Eurocode. This can remain, as an information.

Ease of use justification

As this clause has been moved from the “material” Eurocodes to EN 1991-1-2, there is no inconsistency caused by slightly different wording anymore.

Subject	Class N or Class X in reinforcing bars
Clause N°/ Subclause N° / Annex	3.2.3(5)

Reason for change

Id.

Original content

Note: The choice of Class N (Table 3.2a) or X (Table 3.2b) to be used in a Country may be found in its National Annex. Class N is generally recommended. Class X is recommended only when there is experimental evidence for these values.

Change

No change

Background information

According to our specifications: “As far as the chapter 3 of the fire parts of Eurocode is concerned, only the inconsistency aspects between different Eurocodes raised in NDPs need to be dealt with.”

As this clause is specific to EN 1992-1-2, there is no possibility of inconsistency between different Eurocodes and the PT need not deal with it.

Ease of use justification

N/A

Subject	Class A or Class B in prestressing steel
Clause N°/ Subclause N° / Annex	3.2.4(2) in EN 1992-1-2

Reason for change

Id.

Original content

Note: The choice of Class A or Class B for use in a Country may be found in its National Annex.

Change

No change

Background information

According to our specifications: “As far as the chapter 3 of the fire parts of Eurocode is concerned, only the inconsistency aspects between different Eurocodes raised in NDPs need to be dealt with.”

As this clause is specific to EN 1992-1-2, there is no possibility of inconsistency between different Eurocodes and the PT need not deal with it.

Ease of use justification

N/A

Subject	Upper limit or lower limit for the thermal conductivity of concrete
Clause N°/ Subclause N° / Annex	3.3.3(1)

This is the topic of Task 4 of HGF PT. See the background document to this task.

Subject	Quasi-permanent or frequent value of the factor for the variable action Q1
Clause N°/ Subclause N° / Annex	4.3.1 (2)

This is the topic of Task 11 of HGF PT. See the background document to this task.

Subject	Thermal elongation, specific heat and thermal conductivity of masonry
Clause N°/ Subclause N° / Annex	3.3.3.1 (1), 3.3.3.2 (1) and 3.3.3.3 (1) of EN 1996-1-2

Reason for change

Id.

Original content

3.3.3.1 Thermal elongation

(1) The thermal elongation of masonry should be determined from tests or from a database.

NOTE: The variation of the thermal elongation with temperature for some materials is given in Annex D; values may be found in the National Annex.

3.3.3.2 Specific heat capacity

(1) The specific heat capacity of masonry, c_a, should be determined from tests or from a database.

NOTE 1: The variation of the specific heat capacity with temperature for some materials is given in Annex D

NOTE 2: The value of c_a to be used in a Country may be found in its National Annex.

3.3.3.3 Thermal conductivity

(1) The thermal conductivity, λ_a, should be determined from tests or from a database.

NOTE 1: The variation of the thermal conductivity with temperature for some materials is given in Annex D

NOTE 2: The value of λ_a to be used in a Country may be found in its National Annex.

Change

No change

Background information

Because masonry can be made of very different products and materials, some of them produced only locally, it is not unreasonable to allow each country to define a list of products or materials with their thermal properties. It is indeed much more difficult for masonry to define generic properties than for other materials such as steel, concrete, wood or aluminium.

Ease of use justification

N/A