INTERPRETATIVE DOCUMENT

Essential Requirement No 1

"MECHANICAL RESISTANCE AND STABILITY"

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ANNEX

ESSENTIAL REQUIREMENT:MECHANICAL RESISTANCE AND STABILITY

1. GENERAL

1.1 Purpose and scope

(1) This Interpretative Document relates to Council Directive 89/106/EEC[3] of 21 December 1988 on the approximation of laws, regulations and administrative provisions of the Member States relating to construction products, hereinafter referred to as "the Directive".

(2) Article 3 of the Directive stipulates that the purpose of the Interpretative Documents is to give concrete form to the essential requirements for the creation of the necessary links between the essential requirements set out in Annex I to the Directive and the mandates for the preparation of harmonized standards and guidelines for European technical approvals or the recognition of other technical specifications within the meaning of Articles 4 and 5 of the Directive.

Where considered necessary, the provisions of this Interpretative Document will be further specified in each particular mandate. In drafting the mandates, account will be taken, if necessary, of the other essential requirements of the Directive, as well as of other relevant Directives concerning construction products.

(3) This Interpretative Document deals with the aspects of the works where "Mechanical resistance and stability" may be concerned. It identifies products or product families and characteristics relating to their satisfactory performance.

For each intended use of the product, the mandates will indicate in further detail which of those characteristics shall be dealt with in the harmonised specifications, using a step-by-step procedure with CEN/ CENELEC/ EOTA, which will allow the product characteristics to be modified or complemented, if necessary.

Annex I to the Directive gives the following definition of the essential requirement which is applicable when and where the works are subject to regulations containing such a requirement:

"The construction works must be designed and built in such a way that the loadings that are liable to act on it during its construction and use will not lead to any of the following:

a) collapse of the whole or part of the works;

b) major deformations to an inadmissible degree;

c) damage to other parts of the works or to fittings or installed equipment as a result of major deformation of the load-bearing construction;

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(3) OJEC L 40 of 11.2.1989

d) damage by an event to an extent disproportionate to the original cause."

(4) In accordance with the Council Resolution of 7 May 1985 (New Approach) and the preamble of the Directive, this interpretation of the essential requirement is intended not to reduce the existing and justified levels of protection for works in the Member States.

1.2 Levels or classes for essential requirements and for related product performances

1.2.1 Where differences specified in Article 3(2) of the Directive are identified and justified in conformity with Community law, classes for essential requirements and for related product performances may be necessary. The purpose of such classes is to achieve the free circulation and free use of construction products.

In this case such classes shall be determined either in the interpretative document or according to the procedure provided for in Article 20(2)(a) of the Directive. Where through this procedure a classification of product performance is identified as the means of expressing the range of requirement levels of the works, the Commission will within the mandate request CEN, CENELEC or EOTA to make the appropriate proposal.

The range of requirement levels covered by the classes depends on the existing and justified levels encountered in Member States.

In cases where a Member State determines in conformity to Article 6(3) of the Directive among the classes only one or some classes to be observed in its territory (or part of it), it shall do so only on the basis of the differences specified in Article 3(2) of the Directive.

1.2.2 Where justified differences specified in Article 3(2) of the Directive are not identified, classes (or levels) of product performances may also be used by the standardizers as a means of convenience for specifiers, manufacturers and purchasers. For certain products, classes (or levels) make it easier to use the standard to relate product performance to its intended use.

Such performance classes (or levels) for products may with reference to Article 4(1) of the Directive therefore be established by the standardizers who will keep the Commission and the Standing Committee informed of the ongoing work on this matter in the framework of the execution of mandates.

1.2.3 Each time classes are defined for works or for products, it is necessary to set up a class called "no performance determined" when and where at least one Member State has no legal requirement at all in that field.

1.3 Meaning of general terms used in the Interpretative Documents

1.3.1 **Construction works**

"Construction works" means everything that is constructed or results from construction operations and is fixed to the ground. This term covers both **buildings** and **civil engineering** works. In the Interpretative Documents "construction works" are also referred to as the "works". Construction works include for example: dwellings; industrial, commercial, office, health, educational, recreational and agricultural buildings; bridges; roads and highways; railways; pipe networks; stadiums; swimming pools; wharfs; platforms; docks; locks; channels; dams; towers; tanks; tunnels; etc.

1.3.2 **Construction products**

(1) This term refers to products which are produced for incorporation in a permanent manner in the works and placed as such on the market. The terms "construction products" or "products", where used in the Interpretative Documents, include materials, elements and components (single or in a kit) of prefabricated systems or installations which enable the works to meet the essential requirements.

(2) Incorporation of a product in a permanent manner in the works means:

- that its removal reduces the performance capabilities of the works; and
- that the dismantling or the replacement of the product are operations which involve construction activities.

1.3.3 **Normal maintenance**

(1) Maintenance is a set of preventive and other measures which are applied to the works in order to enable the works to fulfil all its functions during its working life. These measures include cleaning, servicing, repainting, repairing, replacing parts of the works where needed, etc.

(2) Normal maintenance generally includes inspections and occurs at a time when the costs of the intervention which has to be made are not disproportionate to the value of the part of the works concerned, consequential costs being taken into account.

1.3.4 **Intended use**

The intended use of a product refers to the role(s) that the product is intended to play in the fulfilment of the essential requirements.

1.3.5 **Economically reasonable working life**

(1) The working life is the period of time during which the performance of the works will be maintained at a level compatible with the fulfilment of the essential requirements.

(2) An economically reasonable working life presumes that all relevant aspects are taken into account, such as:

- costs of design, construction and use;
- costs arising from hindrance of use;
- risks and consequences of failure of the works during its working life and costs of insurance covering these risks;
- planned partial renewal;
- costs of inspections, maintenance, care and repair;
- costs of operation and administration;
- disposal;
- environmental aspects.

1.3.6 **Actions**

Actions which may affect the compliance of the works with the essential requirements are brought about by agents acting on the works or parts of the works. Such agents include mechanical, chemical, biological, thermal and electro-magnetic agents.

1.3.7 **Performance**

Performance is a quantitative expression (value, grade, class or level) of the behaviour of a works, part of the works or product, for an action to which it is subject or which it generates under the intended service conditions (for the works or parts of works) or intended use conditions (for products).

2. EXPLANATION OF THE ESSENTIAL REQUIREMENT "MECHANICAL RESISTANCE AND STABILITY"

2.1 Meanings of terms used in the text of the Essential Requirement "Mechanical Resistance and Stability"[(4)]:

2.1.1 **Load-bearing construction**

Organized assembly of connected parts designed to provide mechanical resistance and stability to the works. In this Interpretative Document, "load-bearing construction" is referred to as **"the structure"**.

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(4) For the meaning of these terms given in the following, account was taken of the International Standard ISO 8930 dated 1987-12-15

2.1.2 **Loadings that are liable to act on the works**

Actions and other influences which may cause stress, deformations or degradation in the works during their construction and use. In this Interpretative Document, "actions and other influences" are referred to as **"actions"**.

2.1.3 **Collapse**

Various forms of failure of the structure as described in section *3.4.1*.

2.1.4 **Inadmissible deformation**

Deformation or cracking of the works or part of the works which invalidates the assumptions made for the determination of the stability, the mechanical resistance or the serviceability of the works or parts of it, or causes significant reduction in the durability of the works.

2.1.5 **Damage by an event to an extent disproportionate to the original cause**

This means large damage of the works relative to the original cause (by events like explosions, impact, overload or consequence of human errors) which could have been avoided or limited without unacceptable difficulties or costs.

2.2 Other specific terms

Other specific terms are defined or explained where they occur in the text. See in particular chapter 3.

3. BASIS FOR VERIFICATION OF THE SATISFACTION OF THE ESSENTIAL REQUIREMENT "MECHANICAL RESISTANCE AND STABILITY"

3.1 General

(1) This chapter identifies basic principles prevailing in Member States for the verification of the satisfaction of the essential requirement "Mechanical resistance and stability". These principles are currently complied with when and where the works are subject to regulations containing this essential requirement. Chapter 4 provides guidance on how to meet this essential requirement by compliance with the technical specifications referred to in Article 4 of the Directive.

(2) The essential requirement, as far as applicable, is satisfied with acceptable probability during an economically reasonable working life of the works.

(3) The satisfaction of the essential requirement is assured by a number of interrelated measures concerned in particular with:

- the planning and design of the works, the execution of the works and necessary maintenance;
- the properties, performances and use of the construction products.

(4) It is up to the Member States, when and where they feel it necessary, to take measures concerning the supervision of planning, design and execution of the works, and concerning the qualifications of parties and persons involved. Where this supervision and this control of qualifications are directly connected with the characteristics of products, the relevant provisions shall be laid down in the context of the mandate for the preparation of the standards and guidelines for European technical approval related to the products concerned.

3.2 Actions

(1) *See section 2.1.2*

(2) When considering the satisfaction of the Essential Requirement, a distinction may be made between the following types of actions:

- Permanent actions: permanent actions due to gravity ; actions of soil and water pressure ; deformations imposed during construction, etc.
- Variable actions: imposed loads on floors, roofs or other parts of the works (excluding wind and snow); snow and ice loads; wind loads (static and dynamic); water and wave loads; thermal actions, frost; loads in silos and tanks; traffic loads on bridges and pavements; actions induced by cranes; dynamic actions from machinery; construction loads; etc.
- Accidental actions: impact; explosions; seismic actions; actions due to fire; etc.

3.3 Verification of the satisfaction of the essential requirement

(1) Verifications prevailing in Member States are based on the limit state concept described *in section 3.4*, using appropriate design models (supplemented, if necessary, by tests) involving all relevant variables. This implies that models are sufficiently precise to predict the behaviour of the structure and normally take into account the minimum standard of workmanship likely to be achieved, and the reliability of the information on which the design is based, and the assumptions made concerning maintenance.

(2) Testing is also used where calculation methods are not applicable or appropriate. In such cases testing complies with the basic principles given in this Chapter.

(3) Special measures are required for some actions, e.g. seismic actions or the effect of fire or impact.

(4) Potential damage of the works by an event to an extent disproportionate to the original cause may be limited or avoided by an appropriate choice of one or more of the following measures:

- avoiding, eliminating or reducing the hazards to which the structure may be exposed;
- selecting a structural form which has low sensitivity to the hazards considered;
- providing adequate ductility of the structure for energy absorption.

3.4 Methods for verifying mechanical resistance and stability of works

(1) Limit states are states beyond which the performance requirements are no longer satisfied. Limit states may relate to persistent situations during the working life of the works or to transient situations during the execution of the works (stage of construction and/or assembling or repair), or to unintended uses or accidents. In general, distinction is made between ultimate limit states and serviceability limit states.

(2) Ultimate limit states are those associated with the various forms of structural failure or states close to structural failure, which for practical purposes are also considered as ultimate limit states.

(3) Ultimate limit states which may require consideration include:

- loss of equilibrium of the structure or any part of it, considered as a rigid body;
- failure by excessive deformation or settlement, transformation into a mechanism, rupture, or loss of stability of the structure or any part of it, including supports and foundations.

(4) Serviceability limit states correspond to states beyond which specified criteria for the structure related to its use or function are no longer met.

(5) Serviceability limit states which may require consideration are for example:

- deformations or deflections which cause anxiety or hinder the effective use of the works or cause unacceptable damage to finishes or non-structural elements;

- vibrations which cause discomfort to people or damage to the works or its contents, or which limit its functional effectiveness;
- detrimental cracking.

4. TECHNICAL SPECIFICATIONS AND GUIDELINES FOR EUROPEAN TECHNICAL APPROVAL

4.1 General

(1) "Technical specifications" means those referred to in Article 4 of the Directive. "Guidelines for European Technical Approval" of a product or family of products means those referred to in Article 11 of the Directive.

(2) A general distinction is made between:

- **Category A**: These are standards, which concern the design and execution of buildings and civil engineering works and their parts, or particular aspects thereof, with a view to the fulfilment of the essential requirements as set out in Council Directive 89/106/EEC.

Category A standards should be taken into consideration within the scope of the Directive as far as the differences in laws, regulations and administrative provisions of Member States prevent the development of harmonised product standards.

- **Category B**: These are technical specifications and guidelines for European technical approval which exclusively concern construction products subject to an attestation of conformity and marking according to Articles 13, 14 and 15 of Council Directive 89/106/EEC. They concern requirements with regard to performance and/or other properties, including durability, of those characteristics that may influence the fulfilment of the essential requirements, testing and compliance criteria of a product. Category B standards that concern a family of products, or several families of products, are of a different character and are called horizontal (category Bh) standards.

(3) This distinction between Categories A and B is not intended to lay down different priorities for the work on the respective documents but to reflect the difference in the responsibilities of the authorities of Member States and in those of the bodies for European Standardisation and Technical Approval in implementing the Directive 89/106/EEC.

(4) In order to ensure the quality of these documents with a view to the fulfilment of the essential requirement, the provisions of this Interpretative Document will result in specific conditions which will be included in the mandates for the preparation of the respective European standards and guidelines for the European technical approval.

(5) The assumptions made in Category A standards on the one hand and those made in Category B specifications on the other shall be compatible with each other.

(6) Category B technical specifications and guidelines for European technical approval shall indicate the intended use(s) of the respective products.

4.2 Provisions concerning works or parts of them

4.2.1 **Basis for verification**

In order to satisfy the essential requirement on mechanical resistance and stability, works in Member States are currently verified on the basis of procedures:

a) complying with the provisions of Chapter 3 of this Interpretative Document including the relevant limit states to be considered;

b) making provisions with respect to the serviceability limit states; the owner of the works may lay down special or additional serviceability requirements depending on the function of the works.

4.2.2 **Actions**

(1) The ranges of values for actions and other influences which need to be considered for the design, execution and use of the works are currently given in the national regulations. These also provide the representative values of actions and influences and specify the types of actions and values or classes to be considered for particular types of works.

(2) As far as fatigue design is concerned, national regulations or category A standards referred to in *4.1 (2)* may consider rules for different working lives and rules for return periods.

4.2.3 **Partial safety factor format**

Design rules in technical specifications and in guidelines for European technical approval may be based on partial safety factor format using representative values for actions and the properties of materials. In such a case account is taken of the fact that levels of safety and serviceability depend on the quality assurance system. The desired levels of safety and serviceability may be established by using probabilistic reliability methods.

4.2.4 **Simplified rules**

Technical specifications and guidelines for European technical approval may include simplified design rules based on the limit state concept, such as:

Case 1 - Verification by calculations:

a) by simplifying the calculation for ultimate limit states and/or serviceability limit states, or

b) by considering only serviceability limit states, where the ultimate limit states need not be considered explicitly;

Case 2 - Verification without calculations:

a) by specifying particular detailing rules, or

b) for simple works, by specifying particular provisions based on substantial experience.

4.3 Provisions concerning products

4.3.1 **Products and related characteristics which may be relevant to the essential requirement**

(1) For the purpose of preparing mandates for Category B standards and guidelines for European technical approval, the list given in the appendix indicates products of families of products which may be placed on the market and which contribute to the ability of the works as a whole, or certain parts of the works, to satisfy the essential requirement. This list of products is not exhaustive.

(2) In this list, the characteristics relevant to the essential requirement, which need to be taken into account in the preparation of the mandates for European standards and guidelines for European technical approval, are shown against each product or family of products. They are also indicative of the characteristics to be considered in the mandates for those products that are not included in the list.

(3) For the characteristics listed in the appendix the following applies:

i) where mentioned, tolerances on sizes are to be considered in the specifications with reference to the overall design or execution need;

ii) where relevant (e.g. plastics), the range of temperature in which characteristics must be valid has to be expressed;

iii) even in cases where this is not specifically mentioned, a conventional age as well as rate of testing may be specified;

iv) durability (referred to the values of characteristics) is intended to mean the extent to which the values of the characteristics are maintained during the working life under the natural process of change of the characteristics, by excluding the effect of aggressive external actions.

v) the Interpretative Document applies to products where their performance affects the structural integrity of works (as a whole and in their separate parts).

4.3.2 **Performances of Products**

(1) As far as practicable the characteristics of products should be described in performance terms in the technical specifications and guidelines for European technical approval. Methods of calculation, measurement, and testing (where possible), together with compliance criteria, shall be given either in the relevant technical specifications or in references called up in such specifications.

(2) The expression of the product performances should be compatible with the basis for the verification of the essential requirement as currently in use in Member States and referred to in Chapter 3 and as provided in the European Category A standards referred to in *4.1(2)*, taking into account the actual implementation of these documents.

4.3.3 **Attestation of conformity of products**

(1) "Attestation of conformity" of products means that the provisions and procedures laid down in Articles 13, 14 and 15 of and Annex III to the Directive are followed. These provisions aim to ensure that, with acceptable probability, the performance of a product will be achieved as specified in the relevant technical specification.

(2) The mandates will include indications concerning the conformity attestation procedures within the framework of Annex III to the Directive and related provisions to be indicated in the technical specifications and guidelines for European technical approval.

5. WORKING LIFE, DURABILITY

5.1 Treatment of working life of construction works in relation to the essential requirement

(1) It is up to the Member States, when and where they feel it necessary, to take measures concerning the working life which can be considered reasonable for each type of works, or for some of them, or for parts of the works, in relation to the satisfaction of the essential requirements.

(2) Where provisions concerning the durability of works in relation to the essential requirement are connected with the characteristics of products, the mandates for the preparation of the European standards and guidelines for European technical approvals, related to these products, will also cover durability aspects.

5.2 Treatment of working life of construction products in relation to the essential requirement

(1) Category B specifications and guidelines for European technical approval should include indications concerning the working life of the products in relation to the intended uses and the methods for its assessment.

(2) The indications given on the working life of a product cannot be interpreted as a guarantee given by the producer, but are regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.