

THE EUROCODE SYSTEM

The Eurocodes are a set of European Standards (EN) for the design of **buildings and other civil engineering works** and **construction products**.

Why the Eurocodes were developed?

The objective of the European Commission is for “the Eurocodes to establish a set of common technical rules for the design of buildings and civil engineering works *which will ultimately replace the differing rules in the various Member States*”.

Their legal basis lies in **Recommendation (2003/887/EC)** “on the implementation and use of Eurocodes for construction works and structural construction products”, issued by the European Commission on the 11th December 2003. This recommendation follows the publication of **Council Directive 89/106/EEC** on the approximation of laws, regulations and administrative provisions of the Member States relating to construction products, “The Construction Products Directive”, and the introduction of the concept of Essential Requirements of construction products.

The **Eurocodes** cover the basis of design, actions on structures, (including loadings and fire), the principal construction materials (concrete, steel, timber, masonry and aluminium), all major fields of structural engineering (including geo-technics, earthquake resistance), and a wide range of types of structures and products, (buildings, bridges, towers and masts, silos, etc).

THE CONSTRUCTION PRODUCTS DIRECTIVE

The Construction Products Directive (Council Directive 89/106/EEC) is one of over twenty New Approach Directives whose aim is **to breakdown artificial barriers to trade** throughout the European Union and is intended for products placed on the market.

According to the Construction Products Directive, construction products suitable for construction works need to satisfy the following six essential requirements as appropriate:

- **mechanical resistance and stability**
- **safety in case of a fire**
- **hygiene, health and the environment**
- **safety in use**
- **protection against noise**
- **energy economy and heat retention**

The first and parts of the second and fourth Essential Requirements are applicable to the Eurocodes.

The Construction Products Directive is currently based on four elements:

1. A *harmonized system of technical specifications*, which are **harmonized European Standards** (hENs) and **European Technical Approvals** (ETAs).
2. The *European Organisation for Technical Approvals* (**EOTA**), which coordinates all activities relating to ETAs and ETA Guidelines. There are two possibilities for the basis of ETAs:
 - European Technical Approval Guidelines (ETAGs) relate to a number of separate manufacturers in several countries of the EU;
 - Common Understanding of Assessment Procedures (CUAPs) relate to a single manufacturer.
3. An *agreed system of **attestation of conformity*** for each product family, which may involve a third party to assess conformity. The choice of the system of attestation depends upon the consequences of failure of the product and the product characteristics.
4. **CE Marking of construction products**, based on the provisions of the technical specifications for a product. CE Marking follows the successful approval of a product and symbolizes the conformity of the product with the applicable Community requirements imposed on the manufacturer, and is mandatory for products covered by a Directive. A product bearing the CE Marking **may freely circulate within the European Economic Area**.

CE MARKING

CE marking is mandatory for products covered by a Directive and allows them to freely circulate within the European Economic Area.

CE marking follows the successful approval of a product and symbolizes the conformity of the product with the Directive.

The use of Eurocodes raises a presumption of conformity with the Essential Requirement 1, and parts of Essential Requirements 2 and 4 of the CPD.



CE conformity marking consisting of the CE symbol given in directive 93/68/EEC

Identification of the notified body

Name or identifying mark and registered address of the producer
Last two digits of the year in which the marking was affixed

Number of the FPC certificate


Number and title of European standard concerned

Generic name and intended use

Information on product mandated characteristics including detailing (to be adapted to the specific product by the producer)

For products made for a specific use, the technical documentation shall indicate the place of destination

Table ZA.4.1

 0123-CPD-0001
AnyCo Ltd, PO Bx 21, B-1050 02
0123-CPD-0456 EN XXX Precast concrete bridge element BEAM (for bridges)
Concrete : Compressive strength f_{ck} = xx N/mm ² Reinforcing steel : Ultimate tensile strength f_{tk} = yy N/mm ² Tensile yield strength f_{yk} = zzz N/mm ² Prestressing steel : Ultimate tensile strength f_{pk} = uuu N/mm ² Tensile 0.1% proof-stress $f_{p0.1k}$ = www N/mm ² Mechanical ultimate strength (design values): Bending moment capacity (of the middle section) mmm kNm Shear capacity (of the end sections) vv kN Load capacity (total loading condition) ppp kN/m Material safety factors applied in strength calculation: For concrete γ_c = z.zz For steel γ_s = x.xx Resistance to fire R nn min Reaction to fire class A.1 Durability against corrosion: Exposure class L Durability against freeze-thaw: Exposure class XF2 Note: For detailing, other NDPs and complementary indications see the technical (design) documentation Technical documentation: Position number xxxxxx

Malta has promulgated a Product Safety Act (No.V of 2001) on the basis of which Legal Notice 270 (November 2001) refers to **Construction Products Regulations**

The **Construction Product Regulations** are applicable to **all** imported products as well as to those manufactured for the local market.

If any construction product does not comply with the requirement that they “enable works in which they are employed, provided they are properly designed and built, to satisfy the essential requirements” then it **cannot** be manufactured, placed on the market or put into service.

LN 270 of 2001 reproduces Annex III from the CPD Directive that establishes the methods by which conformity of a product is controlled.

Two basic methods:

Control by the manufacturer: initial type testing, factory production control, testing of samples.

Control by an independent approved body: surveillance of factory production control, audit testing

The required method of control depends on the criticality of the product, and is generally indicated in the harmonised standard for the product.

EXAMPLE

Harmonised Standards for Precast Concrete Products were published in 1995, L129 14/07/95, (revised L029 03/02/99).

CEN/TC 229 has determined that precast concrete products generally require a type **2+** attestation method. This is found in the CPD Annex III – 2ii. It means that the regime of control required is:

For the manufacturer: first an initial-type testing of all declared characteristics of the product, (based on EN13747 or 13369), then a factory production control regime, (plus, possibly, testing of samples)

For the independent approved body: a certification of the factory production control regime, based on an initial inspection of the factory, and of the factory production control regime, and then a continuous surveillance of the factory production control regime related to strength parameters, concrete and steel strength and detailing (say an annual visit)

<p>DESIGN STANDARDS:</p>	<p>The Eurocodes</p>
<p>CONSTRUCTION PRODUCT STANDARDS: steel, concrete, structural bearings, barriers, parapets, etc.</p>	<p>EUROPEAN TECHNICAL APPROVALS: expansion joints, pre-stressing tendons, etc.</p>
<p>EXECUTION STANDARDS:</p>	<p>Execution of concrete, steel structures, etc.</p>
<p>TEST STANDARDS:</p>	<p>Testing of concrete, masonry units, fire tests, etc.</p>

EUROPEAN STANDARDS FAMILY

EUROCODES serve as reference documents for the following purposes:

- as a means to prove compliance of building and civil engineering works with the Essential Requirements (ER) of Council Directive 89/106/EEC on the approximation of laws, regulations and administrative provisions of the Member States relating to construction products, particularly ER 1 “Mechanical resistance and stability” and ER 2 “Safety in case of fire”;
- as a basis for specifying public contracts for construction works and related engineering services;
- as a framework for drawing up harmonized technical specifications for construction products.

The Eurocodes are the most technically advanced suite of structural design codes in the world. They provide design methods whose development has been fully transparent and promote innovation in structural design. The Eurocodes present significant opportunities for the export of construction products and engineering services both in the European and the world markets.

Conflicting National Standards must be withdrawn by 2010.

EN 1990	Eurocode: Basis of structural design
EN 1991	Eurocode 1: Actions on structures
EN 1992	Eurocode 2: Design of concrete structures
EN 1993	Eurocode 3: Design of steel structures
EN 1994	Eurocode 4: Design of composite concrete and steel structures
EN 1995	Eurocode 5: Design of timber structures
EN 1996	Eurocode 6: Design of masonry structures
EN 1997	Eurocode 7: Geotechnical design
EN 1998	Eurocode 8: Design of structures for earthquake resistance
EN 1999	Eurocode 9: Design of aluminium structures

The EN Eurocodes

NATIONALLY DETERMINED PARAMETERS

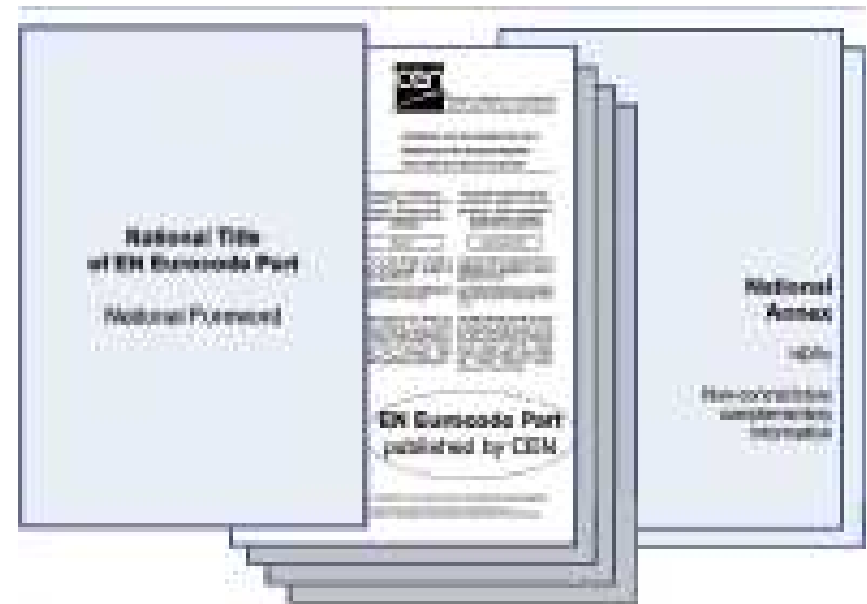
The Eurocodes “recognise the responsibility of regulatory authorities in each Member State and have safeguarded their right to determine values related to safety matters at national level where these continue to vary from State to State”.

National choice is provided by the Eurocodes with sets of recommended values which can be replaced by **Nationally Determined Parameters** (NDPs). The NDPs account for possible differences in geographical or climatic conditions, or in ways of life, as well as different levels of protection that may prevail at national, regional or local level.

NATIONAL IMPLEMENTATION

Publication of the Eurocodes was completed in 2007. They can be used in parallel with National Standards until mid-2010, the latest date for withdrawing conflicting National Standards, and for adopting exclusively Eurocodes.

The National Standard transposing the Eurocode Part will be composed of the **Eurocode text followed by the National Annex**. The National Annex may contain information on the NDPs to be used in the country concerned, decisions on the application of informative annexes and reference to non-contradictory complementary information.



BASIS OF DESIGN

EN 1990 establishes, for all the structural Eurocodes, the **Principles and Requirements for safety, serviceability and durability of structures**.

EN 1990 also provides the basis for the structural design and verification of buildings and civil engineering works and gives guidelines for related aspects of structural reliability.

The Eurocodes provide **common structural design rules** for everyday use for the design of *structures and products* of both a traditional and an innovative nature.

The verification procedure is based on the limit state concept used in conjunction with partial safety factors. The Eurocodes allow for design based on probabilistic methods, as well as for design assisted by testing, and provide guidance for the use of these methods.

The Eurocodes are written in a style encouraging innovation and form a common basis for R&D in civil engineering.

ASSUMPTIONS

A construction work or product designed according to the principles and rules of EN 1990 is deemed to meet the Fundamental Requirements, provided the assumptions of EN 1990 to EN 1999 are satisfied.

The general assumptions of EN 1990 are:

- the choice of the structural system and the design of the structure is made by appropriately qualified and experienced personnel;
- execution is carried out by personnel having the appropriate skill and experience;
- adequate supervision and quality control is provided during execution of the work, i.e. in design offices, factories, plants, and on site;
- the construction materials and products are used as specified in EN 1990 or in EN 1991 to EN 1999 or in the relevant execution standards, or reference material or product specifications;
- the structure will be adequately maintained;
- the structure will be used in accordance with the design assumptions.

Fundamental Requirements

The structure and structural members should be designed, executed and maintained in such a way that they meet the following principal fundamental requirements:

- **Safety** requirement – the structure will sustain all actions and influences likely to occur during execution and use, during its intended life, with appropriate degrees of reliability and in an economic way,.
- **Serviceability** requirement – the structure will remain fit for the use for which it is required, during its intended life, with appropriate degrees of reliability and in an economic way.
- **Robustness** requirement – the structure will not be damaged by events such as explosion, impact or consequences of human errors, to an extent disproportionate to the original cause.
- **Fire requirement** – the structural resistance shall be adequate for the required period of time. The general objective is to limit risks with respect to the individual and society, neighbouring property, the environment, or directly exposed property.

Reliability management

EN 1990 is the first operational code to recognize the possibility of *reliability differentiation* and provides guidance for obtaining different levels of reliability. Reliability differentiation comprises the measures intended for the socio-economic optimisation of the resources to be used to build construction works, taking into account all the expected consequences of failures and the cost of the construction works.

The choice of the levels of reliability for a particular structure takes account of the relevant factors, including:

- the possible cause and/or mode of attaining a limit state;
- the possible consequences of failure in terms of risk to life, injury and potential economical losses;
- public perception of failure, and social and environmental conditions in a particular location;
- the expense and procedures necessary to reduce the risk of failure.

DESIGN WORKING LIFE	EXAMPLES
10 years	TEMPORARY STRUCTURES
10 to 25 years	REPLACEABLE STRUCTURAL PARTS
15 to 30 years	AGRICULTURAL AND SIMILAR STRUCTURES
50 years	BUILDING STRUCTURES AND OTHER COMMON STRUCTURES
100 years	MONUMENTAL STRUCTURES, BRIDGES, OTHER STRUCTURES

The design working life is the period for which a structure or part of it is to be used for its intended purpose with anticipated maintenance but without major repair being necessary.

The notion of design working life is useful for the:

- selection of design actions (e.g. wind, earthquake);
- consideration of material property deterioration (e.g. fatigue, creep);
- evaluation of the life-cycle cost;
- development of maintenance strategies.

BENEFITS AND OPPORTUNITIES ARISING FROM THE IMPLEMENTATION OF THE EUROCODES

The Eurocodes are a major and necessary tool for the successful implementation of the **Internal Market for construction products and services**. The benefits and opportunities arising from the implementation and use of the Eurocodes are to:

- lead to **more uniform levels of safety** in construction in Europe;
- provide **common design criteria** and methods to fulfill the specified requirements for mechanical resistance, stability and resistance to fire, including aspects of durability and economy;
- provide a **common understanding** between owners, operators and users, designers, contractors and manufacturers;
- provide a common and transparent basis for **fair competition** in the construction market;
- facilitate the **exchange of construction services**;
- facilitate the **marketing and use of structural components and kits**;
- facilitate the **marketing and use of materials and constituent products**;
- allow the preparation of **common design aids and software**;
- increase the **competitiveness of the European civil engineering firms, contractors, designers and product manufacturers** in their world-wide activities;
- provide a **common basis for research and development**.

BENEFITS FOR CITIZENS/CONSUMERS

- Wider choice of goods and services, better quality and lower prices.
- More competition in public procurement means better value and higher quality services for the taxpayer.

BENEFITS FOR BUSINESS

- Firms, particularly SMEs, have access to 27 countries and 500 million consumers in Europe.
- Companies are able to bid for contracts to supply goods and services to public authorities in other Member States.
- CE marking reduces border bureaucracy and the cost of multiple testing and certification.
- By aligning the regulatory systems (e.g. public procurement, conformity assessment), trade between the EU and neighbouring countries becomes easier.