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English version

# Eurocode 1 - Actions on structures Part 1-6: General actions - Actions during execution

Eurocode 1 - Actions sur les structures - Partie 1-6 : Actions générales - Actions en cours d'exécution

Eurocode 1 - Einwirkungen auf Tragwerke Teil 1-6: Allgemeine Einwirkungen - Einwirkungen während der Bauausführung

This draft European Standard is submitted to CEN members for formal vote. It has been drawn up by the Technical Committee CEN/TC 250.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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**Contents** **Page**

# Foreword

This European document (EN 1991-1-6), has been prepared by Technical Committee CEN/TC250 “Structural Eurocodes”, the Secretariat of which is held by BSI.

CEN/TC250 is responsible for all Structural Eurocodes.

This document will supersede ENV 1991-2-6 : 1996.

Annexes A1 and A2 are normative and Annex B is informative. This Standard includes a Bibliography.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom[2].

**Background of the Eurocode programme**

In 1975, the Commission of the European Community decided on an action programme in the field of construction, based on article 95 of the Treaty. The objective of the programme was the elimination of technical obstacles to trade and the harmonisation of technical specifications.

Within this action programme, the Commission took the initiative to establish a set of harmonised technical rules for the design of construction works which, in a first stage, would serve as an alternative to the national rules in force in the Member States and, ultimately, would replace them.

For fifteen years, the Commission, with the help of a Steering Committee with Representatives of Member States, conducted the development of the Eurocodes programme, which led to the first generation of European codes in the 1980s.

In 1989, the Commission and the Member States of the EU and EFTA decided, on the basis of an agreement[3] between the Commission and CEN, to transfer the preparation and the publication of the Eurocodes to CEN through a series of Mandates, in order to provide them with a future status of European Standard (EN). This links de facto the Eurocodes with the provisions of all the Council’s Directives and/or Commission’s Decisions dealing with European standards (e.g. the Council Directive 89/106/EEC on construction products – CPD - and Council Directives 93/37/EEC, 92/50/EEC and 89/440/EEC on public works and services and equivalent EFTA Directives initiated in pursuit of setting up the internal market).

The Structural Eurocode programme comprises the following standards generally consisting of a number of Parts:

| | | |
|---|---|---|
| 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 steel and concrete structures |
| EN 1995 | Eurocode 5: | Design of timber structures |
| EN 1996 | Eurocode 6: | Design of masonry structures |

[2] To be augmented as appropriate
[3] Agreement between the Commission of the European Communities and the European Committee for Standardisation (CEN) concerning the work on EUROCODES for the design of building and civil engineering works (BC/CEN/03/89).

| | | |
|---|---|---|
| EN 1997 | Eurocode 7: | Geotechnical design |
| EN 1998 | Eurocode 8: | Design of structures for earthquake resistance |
| EN 1999 | Eurocode 9: | Design of aluminium structures |

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

**Status and field of application of Eurocodes**

The Member States of the EU and EFTA recognise that 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 of Council Directive 89/106/EEC, particularly Essential Requirement N°1 – Mechanical resistance and stability – and Essential Requirement N°2 – Safety in case of fire ;

– as a basis for specifying contracts for construction works and related engineering services ;

– as a framework for drawing up harmonised technical specifications for construction products (ENs and ETAs)

The Eurocodes, as far as they concern the construction works themselves, have a direct relationship with the Interpretative Documents[4] referred to in Article 12 of the CPD, although they are of a different nature from harmonised product standards[5]. Therefore, technical aspects arising from the Eurocodes work need to be adequately considered by CEN Technical Committees and/or EOTA Working Groups working on product standards with a view to achieving a full compatibility of these technical specifications with the Eurocodes.

The Eurocode standards provide common structural design rules for everyday use for the design of whole structures and component products of both a traditional and an innovative nature. Unusual forms of construction or design conditions are not specifically covered and additional expert consideration will be required by the designer in such cases.

**National Standards implementing Eurocodes**

The National Standards implementing Eurocodes will comprise the full text of the Eurocode (including any annexes), as published by CEN, which may be preceded by a National title page and National foreword, and may be followed by a National annex.

The National Annex may only contain information on those parameters which are left open in the Eurocode for national choice, known as Nationally Determined Parameters, to be used for the design of buildings and civil engineering works to be constructed in the country concerned, i.e. :

–values and/or classes where alternatives are given in the Eurocode,

–values to be used where a symbol only is given in the Eurocode,

–country specific data (geographical, climatic, etc), *e.g.* snow map,

–the procedure to be used where alternative procedures are given in the Eurocode.

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[4] According to Art. 3.3 of the CPD, the essential requirements (ERs) shall be given concrete form in interpretative documents for the creation of the necessary links between the essential requirements and the mandates for hENs and ETAGs/ETAs.

[5] According to Art. 12 of the CPD the interpretative documents shall :
a)give concrete form to the essential requirements by harmonising the terminology and the technical bases and indicating classes or levels for each requirement where necessary ;
b)indicate methods of correlating these classes or levels of requirement with the technical specifications, e.g. methods of calculation and of proof, technical rules for project design, etc. ;
c)serve as a reference for the establishment of harmonised standards and guidelines for European technical approvals.
The Eurocodes, *de facto*, play a similar role in the field of the ER 1 and a part of ER 2.

It may also contain:

–decisions on the application of informative annexes,

–references to non-contradictory complementary information to assist the user to apply the Eurocode.

**Links between Eurocodes and harmonised technical specifications (ENs and ETAs) for products**

There is a need for consistency between the harmonised technical specifications for construction products and the technical rules for works[6]. Furthermore, all the information accompanying the CE Marking of the construction products which refer to Eurocodes shall clearly mention which Nationally Determined Parameters have been taken into account.

**Additional information specific to EN 1991-1-6**

EN 1991-1-6 describes Principles and Application rules for the assessment of actions to be considered during execution of buildings and civil engineering works, including the following aspects :

— actions on structural and non-structural members during handling;
— geotechnical actions ;
— actions due to prestressing effects ;
— predeformations ;
— temperature, shrinkage, hydration effects ;
— wind actions ;
— snow loads ;
— actions caused by water ;
— actions due to atmospheric icing ;
— construction loads ;
— accidental actions
— seismic actions;

EN 1991-1-6 is intended for use by:

— clients (*e.g.* for the formulation of their specific requirements),
— designers and constructors,
— relevant authorities.

EN 1991-1-6 is intended to be used with EN 1990, the other Parts of EN 1991 and EN 1992 to EN 1999 for the design of structures.

**National annex**

This Part of EN1991 gives alternative procedures, values and recommendations for classes with notes indicating where national choices may have to be made. Therefore the National Standard implementing EN 1991-1-6 should have a National Annex containing all Nationally Determined Parameters to be used for the design of buildings and civil engineering works to be constructed in the relevant country.

National choice is allowed in EN 1991-1-6 through clauses:

| Clause | Item |
|---|---|
| 1.1(3) | Design rules for auxiliary construction works |
| 2 (4) | Positioning of construction loads classified as free |
| 3.1(1)P | Design situation corresponding to storm conditions |
| 3.1(5) NOTE 1<br>NOTE 2 | Return periods for the assessment of the characteristic values of variable actions during execution<br>Minimum wind speed during execution |
| 3.1(7) | Rules for the combination of snow loads and wind actions with construction loads |
| 3.1(8) NOTE 1 | Rules concerning imperfections in the geometry of the structure |

[6] see Art.3.3 and Art.12 of the CPD, as well as clauses 4.2, 4.3.1, 4.3.2 and 5.2 of ID 1.

| | |
|---|---|
| 3.3(2) | Criteria associated with serviceability limit states during execution |
| 3.3(6) | Serviceability requirements for auxiliary construction works |
| 4.9(6) NOTE 2 | Loads and water levels for floating ice |
| 4.10(1)P | Definition of actions due to atmospheric icing |
| 4.11.1(1)<br>Table 4.1 | Recommended characteristic values of construction loads $Q_{ca}$, $Q_{cb}$ and $Q_{cc}$ |
| 4.11.2(2) | Construction loads for personnel and equipment during casting |
| 4.12(1)P<br>NOTE 2 | Dynamic effects due to accidental actions |
| 4.12(2) | Dynamic effects due to falls of equipment |
| 4.12 (3) | Design values of human impact loads |
| 4.13(2) | Seismic actions |
| Annex A1<br>A1.1(1) | Representative values of the variable actions due to construction loads |
| Annex A1<br>A1.3(2) | Characteristic values of equivalent horizontal forces |
| Annex A2<br>A2.3(1) | Design values of vertical deflections for the incremental launching of bridges. |
| Annex A2<br>A2.4(2) | Reduction of the characteristic value of snow loads |
| Annex A2<br>A2.4(3) | Reduced values of characteristic snow loads for the verification of static equilibrium |

# Section 1 General

## 1.1 Scope

(1) EN 1991-1-6 provides principles and general rules for the determination of actions which should be taken into account during execution of buildings and civil engineering works.

NOTE 1 : This Part of EN 1991 may be used as guidance for the determination of actions to be taken into account for different types of construction works, including structural alterations such as refurbishment and/or partial or full demolition. Further guidance is given in Annexes A1 and A2.

NOTE 2 : Rules concerning the safety of people in and around the construction site are out of the scope of this European standard. Such rules may be defined for the individual project.

(2) The following subjects are dealt with in Part 1.6 of EN 1991.

Section 1 : General

Section 2 : Classification of actions

Section 3: Design situations and limit states

Section 4 : Representation of actions

Annex A1 : Supplementary rules for buildings (normative)

Annex A2 : Supplementary rules for bridges (normative)

Annex B : Actions on structures during alteration, reconstruction or demolition (informative)

(3) EN 1991-1-6 also gives rules for the determination of actions which may be used for the design of auxiliary construction works as defined in 1.5, needed for the execution of buildings and civil engineering works.

NOTE Design rules for auxiliary construction works may be defined in the National Annex or for the individual project. Guidance may be found in the relevant European standards. For example, design rules for formworks and falseworks are given in EN 12812.

## 1.2 Normative references

This European standard incorporates by dated or undated reference provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to, or revisions of, any of these publications apply to this European standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publications referred to applies (including amendments).

NOTE The Eurocodes were published as European Prestandards. The following European Standards which are published or in preparation are cited in normative clauses or in NOTES to normative clauses.

| | | |
|---|---|---|
| EN 1990 | Eurocode : Basis of structural design | |
| EN 1991-1-1 | Eurocode 1: Actions on structures | Part 1-1: Densities, self-weight, imposed loads for buildings |
| EN 1991-1-2 | Eurocode 1: Actions on structures | Part 1-2: Fire actions |
| EN 1991-1-3 | Eurocode 1: Actions on structures | Part 1-3: General actions: Snow loads |
| EN 1991-1-4 | Eurocode 1: Actions on structures | Part 1-4: General actions: Wind actions |

| | | |
|---|---|---|
| EN 1991-1-5 | Eurocode 1: Actions on structures | Part 1-5: General actions: Thermal actions |
| EN 1991-1-7 | Eurocode 1: Actions on structures | Part 1-7: Accidental actions |
| EN 1991-2 | Eurocode 1: Actions on structures | Part 2: Traffic loads on bridges |
| EN 1991-3 | Eurocode 1: Actions on structures | Part 3: Actions induced by cranes and machinery |
| EN 1991-4 | Eurocode 1: Actions on structures | Part 4: Silos and tanks |
| EN 1992 | Eurocode 2: Design of concrete structures | |
| EN 1993 | Eurocode 3: Design of steel structures | |
| EN 1994 | Eurocode 4: Design of composite steel and concrete 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 | |

## 1.3 Assumptions

(1)P The general assumptions given in EN 1990, 1.3 apply.

## 1.4 Distinction between principles and application rules

(1)P The rules in EN 1990, 1.4 apply.

## 1.5 Terms and definitions

### 1.5.1 General

(1) The terms and definitions given in EN 1990, 1.5 apply.

### 1.5.2 Additional terms and definitions specific to this Standard

**1.5.2.1**
**auxiliary construction works**
any works associated with the construction processes that are not required after use when the related execution activities are completed and they can be removed (*e.g.* falsework, scaffolding, propping systems, cofferdam, bracing, launching nose)

NOTE Completed structures for temporary use (*e.g.* a bridge for temporarily diverted traffic) are not regarded as auxiliary construction works.

**1.5.2.2**
**construction load**
load that can be present due to execution activities, but is not present when the execution activities are completed.

## 1.6 Symbols

For the purpose of this European standard, the following symbols apply (see also EN 1990).

Latin upper case letters

$A_{deb}$ area of obstruction (accumulation of debris)

$F_{deb}$ horizontal forces exerted by accumulation of debris

$F_{cb.k}$ characteristic values of concentrated construction loads $Q_{cb}$

$F_{hn}$ nominal horizontal forces

$F_{wa}$ horizontal forces due to currents on immersed obstacles

$Q_c$ construction loads (general symbol)

$Q_{ca}$ construction loads due to working personnel, staff and visitors, possibly with handtools or other small site equipment

$Q_{cb}$ construction loads due to storage of moveable items (e.g. building and construction materials, precast elements, and equipment)

$Q_{cc}$ construction loads due to non permanent equipment in position for use during execution, either static (e.g. formwork panels, scaffolding, falsework, machinery, containers) or during movement (e.g. travelling forms, launching girders and nose, counterweights)

$Q_{cd}$ construction loads due to moveable heavy machinery and equipment, usually wheeled or tracked (e.g. cranes, lifts, vehicles, lifttrucks, power installations, jacks, heavy control devices)

$Q_{ce}$ construction loads from accumulation of waste materials (e.g. surplus construction materials, excavated soil or demolition materials)

$Q_{cf}$ Construction loads from parts of a structure in temporary states (under execution) before the final design actions take effect

$Q_W$ wind actions

$Q_{wa}$ actions caused by water

Latin lower case letters

$b$ width of an immersed object

$c_{pe}$ external wind pressure coefficients for free-standing walls

$h$ water depth

$k$ shape factor for an immersed object

$p$ flowing water pressure, which may be current water

$q_{ca,k}$ characteristic values of the uniformly distributed loads of construction loads $Q_{ca}$

$q_{cb,k}$ characteristic values of the uniformly distributed loads of construction loads $Q_{cb}$

$q_{cc,k}$ characteristic values of the uniformly distributed loads representing construction loads $Q_{cc}$

$v_w$ mean speed of water

Greek lower case letters

$\rho_{wa}$ density of water

# Section 2 Classification of actions

## 2.1 General

(1)P Actions during execution shall be classified in accordance with EN 1990, 4.1.1, and may include construction loads and those that are not construction loads.

NOTE Tables 2.1 and 2.2 illustrate possible classifications.

**Table 2.1 Classification of actions (other than construction loads) during execution stages.**

| Related clause in this standard | Action | Classification | | | | Remarks | Source |
|---|---|---|---|---|---|---|---|
| | | **Variation in time** | **Classification / Origin** | **Spatial Variation** | **Nature (Static/Dynamic)** | | |
| 4.2 | Self weight | Permanent | Direct | Fixed with tolerance / Free | Static | Free during transportation / storage. Dynamic if dropped. | EN 1991-1-1 |
| 4.3 | Soil movement | Permanent | Indirect | Free | Static | | EN 1997 |
| 4.3 | Earth pressure | Permanent / variable | Direct | Free | Static | | EN 1997 |
| 4.4 | Prestressing | Permanent / variable | Direct | Fixed | Static | Variable for local design (anchorage). | EN 1990, EN 1992 to EN 1999 |
| 4.5 | Predeformations | Permanent / variable | Indirect | Free | Static | | EN 1990 |
| 4.6 | Temperature | Variable | Indirect | Free | Static | | EN 1991-1.5 |
| 4.6 | Shrinkage/Hydration effects | Permanent / variable | Indirect | Free | Static | | EN 1992, EN 1993, EN1994 |
| 4.7 | Wind actions | Variable / accidental | Direct | Fixed/free | Static / dynamic | See National Annex | EN 1991-1-4 |
| 4.8 | Snow loads | Variable/accidental | Direct | Fixed/free | Static / dynamic | See National Annex | EN 1991-1-3 |
| 4.9 | Actions due to water | Permanent / variable/accidental | Direct | Fixed/free | Static / dynamic | Permanent / Variable according to project specifications. Dynamic for water currents if relevant | EN 1990 |
| 4.10 | Atmospheric Ice loads | Variable | Direct | Free | Static / dynamic | See National Annex | ISO 12494 |
| 4.12 | Accidental | Accidental | Direct/indirect | Free | Static/dynamic | See National Annex | EN 1990, EN 1991-1-7 |
| 4.13 | Seismic | Variable / accidental | Direct | Free | Dynamic | See National Annex | EN 1990 (4.1), EN1998 |

## 2.2 Construction loads

(1) Construction loads (see also 4.11) should be classified as variable actions ($Q_c$).

NOTE 1 Table 2.2 gives the classification of construction loads

NOTE 2 Table 4.1 gives the full description and classification of construction loads

**Table 2.2 Classification of construction loads.**

| Related clause in this standard | Action (Short description) | Classification | | | | Remarks | Source |
|---|---|---|---|---|---|---|---|
| | | Variation in time | Classification / Origin | Spatial Variation | Nature (Static/Dynamic) | | |
| 4.11 | Personnel and handtools | Variable | Direct | Free | Static | | |
| 4.11 | Storage movable items | Variable | Direct | Free | Static / dynamic | Dynamic in case of dropped loads | EN 1991-1-1 |
| 4.11 | Non-permanent equipment | Variable | Direct | Fixed / Free | Static / dynamic | | EN 1991-3 |
| 4.11 | Movable heavy machinery and equipment | Variable | Direct | Free | Static / dynamic | | EN 1991-2, EN 1991-3 |
| 4.11 | Accumulation of waste materials | Variable | Direct | Free | Static / dynamic | Can impose loads on e.g. vertical surfaces also | EN 1991-1-1 |
| 4.11 | Loads from parts of structure in temporary states | Variable | Direct | Free | Static | Dynamic effects are excluded | EN 1991-1-1 |

NOTE 3 Construction loads, which are caused by cranes, equipment, auxiliary construction works/structures may be classified as fixed or free actions depending on the possible position(s) for use.

(3) Where construction loads are classified as fixed, then tolerances for possible deviations from the theoretical position should be defined.

NOTE The deviations may be defined for the individual project.

(4) Where construction loads are classified as free, then the limits of the area where they may be moved or positioned should be determined.

NOTE 1 The limits may be defined in the National Annex and for the individual project.

NOTE 2 In accordance with EN 1990, 1.3(2), control measures may have to be adopted to verify the conformity of the position and moving of construction loads with the design assumptions.

# Section 3 Design situations and limit states

## 3.1 General – identification of design situations

(1)P Transient, accidental and seismic design situations shall be identified and taken into account as appropriate for designs for execution.

NOTE For wind actions during storm conditions (*e.g.* cyclone, hurricane) the National Annex may select the design situation to be used. The recommended design situation is the accidental design situation.

(2) Design situations should be selected as appropriate for the structure as a whole, the structural members, the partially completed structure, and also for auxiliary construction works and equipment.

(3)P The selected design situations shall take into account the conditions that apply from stage to stage during execution in accordance with EN 1990, 3.2(3)P.

(4)P The selected design situations shall be in accordance with the execution processes anticipated in the design. Design situations shall take account of any (proposed) revisions to the execution processes.

(5) Any selected transient design situation should be associated with a nominal duration equal to or greater than the anticipated duration of the stage of execution under consideration. The design situations should take into account the likelihood for any corresponding return periods of variable actions (*e.g.* climatic actions).

NOTE 1 The return periods for the assessment of characteristic values of variable actions during execution may be defined in the National Annex or for the individual project. Recommended return periods of climatic actions are given in Table 3.1, depending on the nominal duration of the relevant design situation.

**Table 3.1 Recommended return periods for the assessment of the characteristic values of climatic actions**

| Duration | Return period (years) |
|---|---|
| ≤ 3 days | 2 [a] |
| ≤ 3 months (but > 3 days) | 5 [b] |
| ≤ 1 year (but > 3 months) | 10 |
| > 1 year | 50 |

[a] A nominal duration of three days, to be chosen for short execution phases, corresponds to the extent in time of reliable meteorological predictions for the location of the site. This choice may be kept for a slightly longer execution phase if appropriate organisational measures are taken. The concept of mean return period is generally not appropriate for short term duration.

[b] For a nominal duration of up to three months actions may be determined taking into account appropriate seasonal and shorter term meteorological climatic variations. For example, the flood magnitude of a river depends on the period of the year under consideration.

NOTE 2 A minimum wind velocity during execution may be defined in the National Annex or for the individual project. The recommended basic value for durations of up to 3 months is 20 m/s in accordance with EN 1991-1-4.

NOTE 3 Relationships between characteristic values and return period for climatic actions are given in the appropriate Parts of EN 1991.

(6) Where an execution stage design prescribes limiting climatic conditions, or weather window, the characteristic climatic actions should be determined taking into account :

– duration of the execution stage,

– the reliability of meteorological predictions,

– time to organise protection measures.

(7) The rules for the combination of snow loads and wind actions with construction loads $Q_c$ (see 4.11.1) should be defined.

NOTE : These rules may be defined in the National Annex or for the individual project.

(8) Imperfections in the geometry of the structure and of structural members should be defined for the selected design situations during execution.

NOTE 1 These imperfections may be defined in the National Annex or for the individual project. See also Annex A2 and EN 1990, 3.5 (3) and (7).

NOTE 2 For concrete structures, see also European Standards established by CEN/TC/229 ”Precast Concrete Products”. See EN 13670.

(9) Actions due to wind excitation (including aerodynamic effects due to passing vehicles, including trains) that are susceptible to produce fatigue effects on structural members should be taken into account.

NOTE See EN 1991-1-4 and EN 1991-2.

(10) Where the structure or parts of it are subjected to accelerations that may give rise to dynamic or inertia effects, these effects should be taken into account.

NOTE Significant accelerations may be excluded where possible movements are strictly controlled by appropriate devices.

(11) Actions caused by water, including for example uplift due to groundwater, should be determined in conjunction with water levels corresponding to specified or identified design situations, where appropriate.

NOTE These actions may commonly be determined in the same manner as specified in (5) above.

(12) Where relevant, design situations should be defined taking account of scour effects in flowing water.

NOTE For long construction phases, scour levels may have to be taken into account for the design of execution stages for permanent or auxiliary construction works immersed in flowing water, which may include currents. These levels may be defined for the individual project.

(13) Actions due to creep and shrinkage in concrete construction works should be determined on the basis of the expected dates and duration associated with the design situations, where relevant.

### 3.2 Ultimate limit states

(1)P Ultimate limit states shall be verified for all selected transient, accidental and seismic design situations as appropriate during execution in accordance with EN 1990.

NOTE 1 The combinations of actions for accidental design situations can either include the accidental action explicitly or refer to a situation after an accidental event. See EN 1990, Section 6.

NOTE 2 Generally, accidental design situations refer to exceptional conditions applicable to the structure or its exposure, such as impact, local failure and subsequent progressive collapse, fall of structural or non-structural parts, and, in the case of buildings, abnormal concentrations of building equipment and/or building materials, water accumulation on steel roofs, fire, etc.

NOTE 3 See also EN 1991-1-7.

(2) The verifications of the structure should take into account the appropriate geometry and resistance of the partially completed structure corresponding to the selected design situations.

### 3.3 Serviceability limit states

(1)P The serviceability limit states for the selected design situations during execution shall be verified, as appropriate, in accordance with EN 1990.

(2) The criteria associated with the serviceability limit states during execution should take into account the requirements for the completed structure.

NOTE The criteria associated with the serviceability limit states may be defined in the National Annex or for the individual project. See EN 1992 to EN 1999.

(3)P Operations during execution which can cause excessive cracking and/or early deflections and which may adversely affect the durability, fitness for use and/or aesthetic appearance in the final stage shall be avoided.

(4) Load effects due to shrinkage and temperature should be taken into account in the design and should be minimised by appropriate detailing.

(5) The combinations of actions should be established in accordance with EN 1990, 6.5.3 (2). In general, the relevant combinations of actions for transient design situations during execution are:

– the characteristic combination

– the quasi-permanent combination

NOTE Where frequent values of particular actions need to be considered, these values may be defined for the individual project.

(6) Serviceability requirements for auxiliary construction works should be defined in order to avoid any unintentional deformations and displacements which affect the appearance or effective use of the structure or cause damage to finishes or non-structural members.

NOTE These requirements may be defined in the National Annex or for the individual project.

# Section 4 Representation of actions

## 4.1 General

(1)P Characteristic and other representative values of actions shall be determined in accordance with EN 1990, EN 1991, EN 1997 and EN 1998.

NOTE 1 The representative values of actions during execution may be different from those used in the design of the completed structure. Common actions during execution, specific construction loads and methods for establishing their values are given in this Section.

NOTE 2 See also Section 2 for classification of actions and Section 3 for nominal duration of transient design situations.

NOTE 3 The action effects may be minimised or eliminated by appropriate detailing, providing auxiliary construction works or by protecting/safety devices.

(2) Representative values of construction loads ($Q_c$) should be determined taking into account their variations in time.

(3) Interaction effects between structures and parts of structures should be taken into account during execution. Such structures should include structures that form part of the auxiliary construction works.

(4)P When parts of a structure are braced or supported by other parts of a structure (*e.g.* by propping floor beams for concreting) the actions on these parts resulting from bracing or supporting shall be taken into account.

NOTE 1 Depending on the construction procedures, the supporting parts of the structure may be subjected to loads greater than the imposed loads for which they are designed for the persistant design situation. Additionally, the supporting slabs may not have developed their full strength capacities.

NOTE 2 See also 4.11 Construction loads.

(5) Horizontal actions from friction effects should be determined and based on the use of appropriate values of friction coefficients.

NOTE Lower and upper bounds of friction coefficients may have to be taken into account. Friction coefficients may be defined for the individual project.

## 4.2 Actions on structural and non-structural members during handling

(1) The self-weight of structural and non-structural members during handling should be determined in accordance with EN 1991-1-1.

(2) Dynamic or inertia effects of self-weight of structural and non-structural members should be taken into account.

(3) Actions on attachments for hoisting elements and materials should be determined according to EN 1991-3.

(4) Actions on structural and non-structural members due to support positions and conditions during hoisting, transporting or storage should take into account, where appropriate, the actual support conditions and dynamic or inertia effects due to vertical and horizontal accelerations.

NOTE See EN 1991-3 for the determination of vertical and horizontal accelerations due to transport and hoisting.

## 4.3 Geotechnical actions

(1)P The characteristic values of geotechnical parameters, soil and earth pressures, and limiting values for movements of foundations shall be determined according to EN 1997.

(2) The soil movements of the foundations of the structure and of auxiliary construction works, for example temporary supports during execution, should be assessed from the results of geotechnical investigations. Such investigations should be carried out to give information on both absolute and relative values of movements, their time dependency and possible scatter.

NOTE Movements of auxiliary construction works may cause displacements and additional stresses.

(3) The characteristic values of soil movements estimated on the basis of geotechnical investigations using statistical methods should be used as nominal values for imposed deformations of the structure.

NOTE It may be possible to adjust the calculated imposed deformations by considering the full soil-structure interaction.

## 4.4 Actions due to prestressing

(1) Actions due to prestressing should be taken into account, including the effects of interactions between the structure and auxiliary construction works (*e.g.* falsework) where relevant.

NOTE Prestressing forces during execution may be determined according to the requirements of EN 1992 to EN 1999 and possible specific requirements defined for the individual project.

(2) Loads on the structure from stressing jacks during the prestressing activities should be classified as variable actions for the design of the anchor region.

(3) Prestressing forces during the execution stage should be taken into account as permanent actions.

NOTE See also Section 3.

## 4.5 Predeformations

(1)P The treatment of the effects of predeformations shall be in conformity with the relevant design Eurocode (from EN 1992 to EN 1999).

NOTE Predeformations can result from, for example, displacements of supports (such as loosening of ropes or cables, including hangers, and displacements of bearings).

(2) Action effects from execution processes should be taken into account, especially where predeformations are applied to a particular structure in order to generate action effects for improving its final behaviour, particularly for structural safety and serviceability requirements.

(3) The action effects from predeformations should be checked against design criteria by measuring forces and deformations during execution.

## 4.6 Temperature, shrinkage, hydration effects

(1)P The effects of temperature, shrinkage and hydration shall be taken into account in each construction phase, as appropriate.

NOTE 1 For buildings, the actions due to temperature and shrinkage are not generally significant if appropriate detailing has been provided for the persistent design situation.

NOTE 2 Restraints from the effects of friction of bearings may have to be taken into account (see also 4.1 (5)).

(2) Climatic thermal actions should be determined according to EN 1991-1-5.

(3) Thermal actions due to hydration should be determined according to EN 1992, EN 1994 and EN 1995.

NOTE 1 Temperature can rise significantly in a massive concrete structure after casting, with consequent thermal effects.

NOTE 2 The extreme values of the minimum and maximum temperatures to be taken into account in the design may change due to seasonal variations.

(4) Shrinkage effects of structural building materials should be determined according to the relevant Eurocodes EN 1992 to EN 1999.

(5) In the case of bridges, for the determination of restraints to temperature effects of friction at bearings, that permit free movements, they should be taken into account on the basis of appropriate representative values.

NOTE See EN 1337 and EN 1990, Annex E1.

(6) Where relevant, second order effects should be taken into account and the effects of deformations from temperature and shrinkage should be combined with initial imperfections.

### 4.7 Wind actions

(1) The need for a wind dynamic response design procedure should be determined for the design for the execution stages, taking into account the degree of completeness and stability of the structure.

NOTE Criteria and procedures may be defined for the individual project.

(2) Where a dynamic response procedure is not needed, the characteristic values of static wind forces $F_W$ should be determined according to EN 1991-1-4 for the appropriate return period.

NOTE See 3.1 for recommended return periods.

(3) For lifting and moving operations or other construction phases that are of short duration, the maximum acceptable wind speed for the operations should be specified.

NOTE The maximum wind speed may be defined for the individual project. See also 3.1(6).

(4) The effects of wind induced vibrations such as vortex induced cross wind vibrations, galloping, flutter and rain-wind should be taken into account, including the potential for fatigue for slender elements.

(5) Wind actions on parts of the structure that are intended to be internal parts of the structure after its completion, such as walls, should be taken into account for execution processes.

NOTE In such cases, the external pressure coefficients $c_{pe}$ for free-standing walls may have to be applied.

(6) When determining wind forces, the areas of equipment, falsework and other auxiliary construction works that are loaded should be taken into account.

### 4.8 Snow loads

(1)P Snow loads shall be determined according to EN 1991-1-3 for the conditions of site and the required return period.

NOTE 1 For bridges see also Annex A2.

NOTE 2 See 3.1 for recommended return periods.

### 4.9 Actions caused by water

(1) In general, actions due to water, including ground water, ($Q_{wa}$) should be represented as static pressures and/or hydrodynamic effects, whichever gives the most unfavourable effects.

NOTE In general, phenomena covered by hydrodynamic effects are:

- the hydrodynamic force due to currents on immersed obstacles;
- forces due to wave actions;
- water effects caused by an earthquake (tsunamis).

(2) Actions caused by water may be taken into account in combinations as permanent or variable actions.

NOTE The classification of actions caused by water as permanent or variable may be defined for the individual project, taking account of the specific environmental conditions.

(3) Actions caused by water, including dynamic effects where relevant, exerted by currents on immersed structures should be applied perpendicularly to the contact surfaces. They should be determined for speed, water depth and shape of the structure taking into account the designed construction stages.

(4) The magnitude of the total horizontal force $F_{wa}$ (N) exerted by currents on the vertical surface should be determined by the expression 4.1. See also Figure 4.1.

$$F_{wa} = 1/2\, k\, \rho_{wa}\, h\, b\, v_{wa}^2 \qquad (4.1)$$

where:

$v_{wa}$ is the mean speed of the water averaged over the depth, in m/s;
$\rho_{wa}$ is the density of water, in kg/m$^3$;
$h$ is the water depth, but not including local scour depth, in m;
$b$ is the width of the object, in m;
$k$ is the shape factor, where

$k$ = 1,44 for an object of square or rectangular horizontal cross-section, and
$k$ = 0,70 for an object of circular horizontal cross-section.

NOTE $F_{wa}$ may be used to check the stability of bridge piers and cofferdams, etc. A more refined formulation may be used for $F_{wa}$ for a individual project.

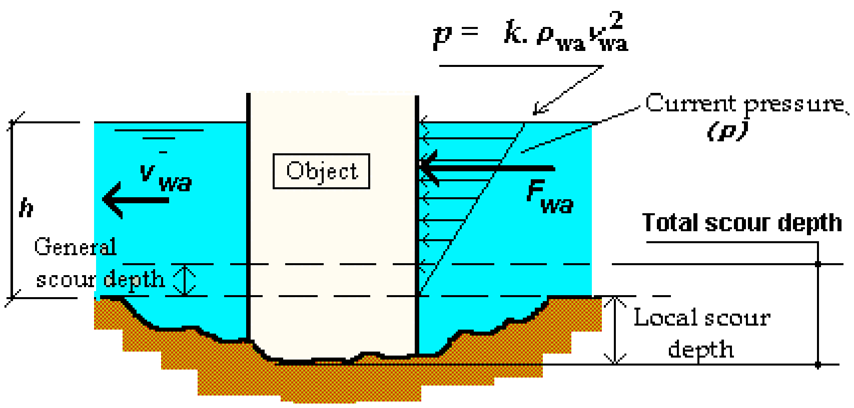



**Figure 4.1: Pressure and force due to currents**

(5) Where relevant, the possible accumulation of debris should be represented by a force $F_{deb}$ (N) and calculated for a rectangular object (*e.g.* cofferdam), for example, from:

$$F_{deb} = k_{deb}\, A_{deb}\, v_{wa}^2 \qquad (4.2)$$

where:
$k_{deb}$ is a debris density parameter, in kg/m$^3$
$v_{wa}$ is the mean speed of water flow, in m/s
$A_{deb}$ is the area of obstruction presented by the trapped debris and falsework, in m$^2$

NOTE 1 Expression (4.2) may be adjusted for the individual project, taking account of its specific environmental conditions.

NOTE 2 The recommended value of $k_{deb}$ is 666 kg/m$^3$.

(6) Actions due to ice, including floating ice, should be taken into account where relevant.

NOTE 1 The actions may be considered as a distributed load and acting in the direction of current flow equal to the highest or lower water levels, whichever gives the most unfavourable effects.

NOTE 2 The loads and water levels may be defined in the National Annex or for the individual project.

(7) Actions from rainwater should be taken into account for the conditions where there may be collection of water such as ponding effects from, for example, inadequate drainage, imperfections of surfaces, deflections and/or failure of de-watering devices.

### 4.10 Actions due to atmospheric icing

(1)P Actions due to atmospheric icing shall be taken into account where relevant.

NOTE The representative values of these actions may be defined in the National Annex or for the individual project. Guidance may be found in EN 1993-3 and in ISO 12494.

### 4.11 Construction loads

#### 4.11.1 General

(1) Construction loads ($Q_c$) (actions to be included for consideration are defined in Table 4.1) may be represented in the appropriate design situations (see EN 1990), either, as one single variable action, or where appropriate different types of construction loads may be grouped and applied as a single variable action. Single and/or a grouping of construction loads should be considered to act simultaneously with non construction loads as appropriate.

**Table 4.1 Representation of construction loads ($Q_c$)**

| Construction Loads ($Q_c$) | | | | |
|---|---|---|---|---|
| Actions | | | Representation | Remarks |
| Type | Symbol | Description | | |
| Personnel, and handtools | $Q_{ca}$ | Working personnel, staff and visitors, possibly with handtools or other small site equipment | Modelled as a uniformly distributed load $q_{ca}$ and applied as to obtain the most unfavourable effects. | The characteristic value $q_{ca,k}$ of the uniformly distributed load may be defined in the National Annex or for the individual project. The recommended value is 1,0 kN/m$^2$. See also 4.11.2. |
| Storage of movable items | $Q_{cb}$ | Storage of moveable items, e.g.:<br>- building and construction materials, precast elements, and<br>- equipment | Modelled as free actions and be represented as appropriate by:<br>– a uniformly distributed load $q_{cb}$;<br>– a concentrated load $F_{cb}$. | 1. The characteristic values of the uniformly distributed load and the concentrated load may be defined in the National Annex or for the individual project.<br>2. For bridges, the following values are recommended minimum values:<br>– $q_{cb,k}$ = 0,2 kN/m$^2$;<br>– $F_{cb,k}$ = 100 kN<br>where $F_{cb,k}$ may be applied over a nominal area for detailed design. For densities of construction materials, see EN1991-1-1. |
| Non permanent equipment | $Q_{cc}$ | Non permanent equipment in position for use during execution, either:<br>- static (e.g. formwork panels, scaffolding, falsework, machinery, containers) or<br>- during movement (e.g. travelling forms, launching girders and nose, counterweights) | Modelled as free actions and be represented as appropriate by:<br>– a uniformly distributed load $q_{cc}$; | 1. These loads may be defined for the individual project using information given by the supplier. Unless more accurate information are available, they may be modelled by a uniformly distributed load with a recommended minimum characteristic value of $q_{cc,k}$ = 0,5 kN/m$^2$.<br>2. A range of CEN design codes are available, for example, see EN 12811 and for formwork and falsework design see EN 12812. |
| Moveable heavy machinery and equipment | $Q_{cd}$ | Moveable heavy machinery and equipment, usually wheeled or tracked, (e.g. cranes, lifts, vehicles, lifttrucks, power installations, jacks, heavy lifting devices) | Assessed and unless specified should be modelled on information given in the relevant parts of EN 1991. | 1. Information for the determination of actions due to vehicles when not defined in the project specification, may be found in EN 1991-2, for example.<br>2. Information for the determination of actions due to cranes is given in EN 1991-3. |
| Accumulation of waste materials | $Q_{ce}$ | Accumulation of waste materials (e.g surplus construction materials, excavated soil, or demolition materials) | Taken into account by considering possible effects on horizontal, inclined and vertical elements (such as walls), depending on the build-up, and thus mass effects of the accumulation of material. | |
| Loads from parts of a structure in temporary states | $Q_{cf}$ | Loads from parts of a structure in temporary states (under execution) before the final design actions take effect , such as loads from lifting operations | Taken into account and modelled according to the planned execution sequences, including consequences of those sequences, for example, loads and reverse load effects due to particular processes of construction, such as assemblage | See also 4.11.2 for additional loads due to concrete being fresh |

NOTE 1 See EN 1990 and EN 1991 for advice on the simultaneity of non construction and construction loads.

NOTE 2 Groupings of loads to be taken into account are dependent on the individual project.

NOTE 3 See also Table 2.2.

(2)P Characteristic values of construction loads, including vertical and horizontal components where relevant, shall be determined according to the technical requirements for the execution of the works and the requirements of EN 1990.

NOTE 1 Recommended values of $\psi$ factors for construction loads are given in Annex A1 of this Standard for buildings, and in Annex A2 to EN 1990 for bridges.

NOTE 2 Additional loads may need to be taken into account. These loads may be defined for the individual project.

(3)P Horizontal actions resulting from the effects of construction loads shall be determined and taken into account in the structural design of a partly completed structure as well as the completed structure.

(4)P When construction loads cause dynamic effects, these effects shall be taken into account.

NOTE See also 3.1 (10) and EN 1990, Annexes A1 and A2.

### 4.11.2 Construction loads during the casting of concrete

(1) Actions to be taken into account simultaneously during the casting of concrete may include working personnel with small site equipment ($Q_{ca}$), formwork and loadbearing members ($Q_{cc}$) and the weight of fresh concrete (which is one example of $Q_{cf}$), as appropriate.

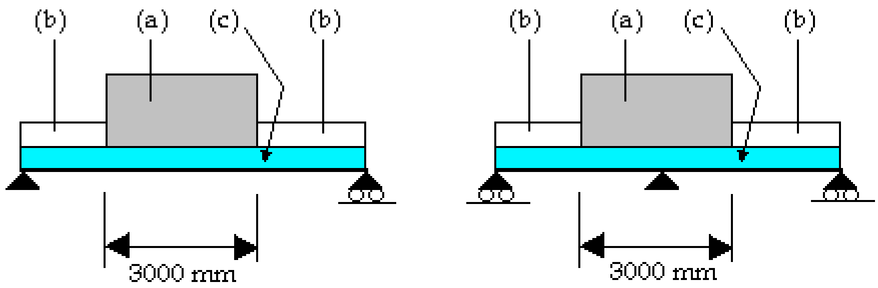
NOTE 1 For the density of fresh concrete see EN 1991-1-1 Table A.1.

NOTE 2 $Q_{ca}$, $Q_{cc}$ and $Q_{cf}$ may be given in the National Annex

NOTE 3 Recommended values for fresh concrete ($Q_{cf}$) may be taken from Table 4.2 and EN 1991-1-1, Table A.1. Other values may have to be defined, for example, when using self-levelling concrete or precast products.

Table 4.2 : Recommended characteristic values of actions due to construction loads during casting of concrete

| Action | Loaded area | Load in kN/m$^2$ |
|---|---|---|
| (a) | Inside the working area 3 m x 3 m<br>(or the span length if less) | 10 % of the self-weight of the concrete but not less than 0,75 and not more than 1,5<br>Includes $Q_{ca}$ and $Q_{cf}$ |
| (b) | Outside the working area | 0,75 covering $Q_{ca}$ |
| (c) | Actual area | Self-weight of the formwork, load-bearing element ($Q_{cc}$) and the weight of the fresh concrete for the design thickness ($Q_{cf}$) |




NOTE 4 Loads according to (a), (b) and (c), as given in Table 4.1, are intended to be positioned to cause the maximum effects (see Figure 4.2), which may be symmetrical or not.

(2) Horizontal actions of fresh concrete should be taken into account.

NOTE See also A1.3(2).

### 4.12 Accidental actions

(1)P Accidental actions such as impact from construction vehicles, cranes, building equipment or materials in transit (e.g. skip of fresh concrete), and/or local failure of final or temporary supports, including dynamic effects, that may result in collapse of load-bearing structural members, shall be taken into account, where relevant.

NOTE 1 Abnormal concentrations of building equipment and/or building materials on load-bearing structural members are not regarded as accidental actions.

NOTE 2 Dynamic effects may be defined in the National Annex or for the individual project. The recommended value of the dynamic amplification factor is 2. In specific cases a dynamic analysis is needed.

NOTE 3 Actions from cranes may be defined for the individual project. See also EN 1991-3.

(2) The action due to falls of equipment onto or from a structure, including the dynamic effects, should be defined and taken into account where relevant.

NOTE The dynamic effects due to such falls of equipment may be given in the National Annex or for the individual project.

(3) Where relevant, a human impact load should be taken into account as an accidental action, represented by a quasi-static vertical force.

NOTE The design value of the human impact force may be defined in the National Annex or for the individual project. Examples of values are :

a) 2,5 kN applied over an area 200 mm x 200 mm, to account for stumbling effects
b) 6,0 kN applied over an area 300 mm x 300 mm, to account for falling effects

(4) The effects of the actions described in paragraphs (1), (2) and (3) above should be assessed to determine the potential for inducing movement in the structure, and also the extent and effect of any such movement should be determined, with the potential for progressive collapse assessed.

NOTE: See also EN1991-1-7.

(5) Accidental actions used for design situations should be taken into account for any changes. To ensure that the appropriate design criteria is applied at all times, measures should be taken as work proceeds.

(6) Fire actions should be taken into account, where appropriate.

### 4.13 Seismic actions

(1) Seismic actions should be determined according to EN 1998, taking into account the reference period of the considered transient situation.

(2) The design values of ground acceleration and the importance factor $\gamma_I$ should be defined.

NOTE The design values of ground acceleration and the importance factor $\gamma_I$ may be defined in the National Annex or for the individual project.

# Annex A1
(normative)
# Supplementary rules for buildings

## A1.1 Ultimate limit states

(1) For transient, accidental and seismic design situations the ultimate limit state verifications should be based on combinations of actions applied with the partial factors for actions $\gamma_F$ and the appropriate $\psi$ factors.

NOTE 1 For values of $\gamma_F$ and $\psi$ factors see EN 1990, Annex A1.

NOTE 2 Representative values of the variable action due to construction loads may be set by the National Annex, within a recommended range of $\psi_0 = 0{,}6$ to 1,0. The recommended value of $\psi_0$ is 1,0.

The minimum recommended value of $\psi_2$ is 0,2 and it is further recommended that values below 0,2 are not selected.

NOTE 3 $\psi_1$ does not apply to construction loads during execution.

## A1.2 Serviceability limit states

(1) For the verification of serviceability limit states, the combinations of actions to be taken into account should be the characteristic and the quasi-permanent combinations as defined in EN 1990.

NOTE For recommended values of $\psi$–factors see A1.1, Notes 1 and 2.

## A1.3 Horizontal actions

(1)P Further to 4.11.1 (3), horizontal actions resulting from, for example, wind forces and the effects of sway imperfections and sway deformations shall be taken into account.

NOTE: See also 4.7 and EN 1990, 3.5(7).

(2) Nominal horizontal forces ($F_{hn}$) may be applied only when such a method can be justified as appropriate and reasonable for a particular case. In such cases, the determined nominal horizontal forces should be applied at locations to be give the worst effects, and may not always correspond to those of the vertical loads.

NOTE The characteristic values of these equivalent horizontal forces may be defined in the National Annex or for the individual project. The recommended value is 3 % of the vertical loads from the most unfavourable combination of actions.

# Annex A2
(normative)
# Supplementary rules for bridges

## A2.1 Ultimate limit states

(1) For transient, accidental and seismic design situations the ultimate limit state verifications should be performed.

NOTE For values of $\gamma_F$ and $\psi$ factors see EN 1990, Annex A2.

## A2.2 Serviceability limit states

(1) For serviceability limit states the partial factors for actions $\gamma_F$ should be taken as 1,0 unless otherwise specified in EN 1991 to EN 1999. The $\psi$-factors should be taken as specified in EN 1990, Annex A2.

## A2.3 Design values of deflections

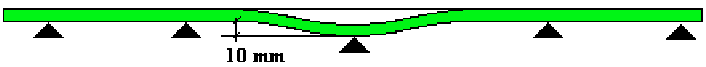
(1) For the incremental launching of bridges the design values for vertical deflections (see Figure A2.1) should be defined.

NOTE 1 The design values of vertical deflection may be defined in the National Annex or for the individual project. The recommended values are:

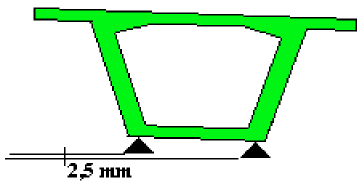
– ± 10 mm longitudinally for one bearing, the other bearings being assumed to be at the theoretical level (Figure A2.1a);

– ± 2,5 mm in the transverse direction for one bearing, the other bearings being assumed to be at the theoretical level (Figure A2.1b).

NOTE 2 The deflections in the longitudinal and transverse directions are considered mutually exclusive.




**a) Longitudinal deflection**




**b) Differential deflection in the transverse direction**

**Figure A2.1 : Deflections of bearings during execution for bridges built by the incremental launching method**

## A2.4 Snow loads

(1) Snow loads on bridges during execution should be based on values specified in EN 1991-1-3 taking account of the required return period (see Section 3).

(2) When daily removal of snow (also on weekends and holidays) is required for the project and safety measures for removal are provided, the characteristic snow load should be reduced compared to the value specified in EN 1991-1-3 for the final stage.

NOTE The reduction may be defined in the National Annex or for the individual project. The recommended characteristic value is 30 % of the characteristic value for permanent design situations.

(3) For the verification of the static equilibrium (EQU), and when justified by climatic conditions and duration of the construction, the characteristic snow load should be assumed to be uniformly distributed in the areas giving unfavourable action effects and should be equal to 75 % of the characteristic value for permanent design situations resulting from EN 1991-1-3.

NOTE The conditions of application of this rule and the reduced value may be defined in the National Annex.

### A2.5 Construction loads

(1) For the incremental launching of bridges horizontal forces due to friction effects should be determined, and applied between the bridge structure, the bearings and the piers, with dynamic action effects taken into account where appropriate.

(2) The design value of the horizontal friction forces should be evaluated, should be not less than *x* % of vertical loads, and should be determined to give the least favourable effects.

NOTE The value of *x* % may be specified in the National Annex. The recommended value is 10 %.

(3) The horizontal friction forces at every pier should be determined with the appropriate friction coefficients, $\mu_{min}$ and $\mu_{max}$ .

NOTE 1 The friction coefficients, $\mu_{min}$ and $\mu_{max}$, may be defined in the National Annex or for the individual project.

NOTE 2 Unless more accurate values are available from tests for movements on very low friction surfaces (e.g. PTFE - Polytetrafluoroethylene) the recommended values are :

$\mu_{min} = 0$

$\mu_{max} = 0,04$

# Annex B
(informative)
# Actions on structures during alteration, reconstruction or demolition

(1) Characteristic and other representative values of actions should be determined in accordance with EN 1990.

(2) The actual performance of structures affected by deterioration should be taken into account in the verification of the stages for reconstruction or demolition. The investigation of structural conditions to enable the identification of the load-bearing capacity of the structure and prevent unpredictable behaviour during reconstruction or demolition should be undertaken.

(3) Guidance for the most common actions and methods for their assessment is provided in Section 4. However, some construction loads during reconstruction or demolition may be different in characteristics and represention from those shown in Tables 2.2 and 4.1, and their effects on all relevant structures under relevant transient design situations should be verified.

(4) Combinations of actions for various design situations should be as given in EN 1990 and its Annexes A1 and A2.

(5) Unless more specific information is known the values of $\psi$ factors recommended for buildings in Annex A1 and EN 1990 Annex A1 and for bridges in EN 1990 Annex A2, may be considered in the design for transient design situations.

(6) All imposed loads, including traffic loads, should be considered if the part of structure remains in use during its reconstruction or partial demolition. These loads may vary at different transient stages. Traffic loads should include, for example, impact and horizontal forces from vehicles, wind actions on vehicles, aerodynamic effects from passing vehicles and trains where relevant.

(7) Reduction of traffic loads from their final design values should not be made unless the use of the structural part is monitored and regularly supervised.

(8) The reliability for the remaining structure or parts of the structure under reconstruction, partial or full demolition should be consistent with that considered in the Eurocodes for completed structures or parts of structures.

(9) The actions due to the works should not adversely affect neighbouring structures by, for example, removing or imposing loads that may cause instability.

(10) Construction loads specific for reconstruction or demolition should be determined taking into account, for example, methods and arrangements of storing materials, the techniques used during reconstruction or demolition, the execution system and the particular stages of work. Construction loads during reconstruction or demolition may also include the effects of storage from disassembled materials or dismantled elements, including horizontal actions.

(11) Dynamic effects should be considered where it is anticipated that activities during reconstruction or demolition will cause such effects.

# Bibliography

| | |
|---|---|
| EN 1337 | Structural bearings |
| EN 12811 | Temporary works equipment |
| EN 12812 | Falsework. Performance requirements and general design |
| EN 13670 | Execution of concrete structure |
| ISO 12494 | Atmospheric Icing of Structures |