Please be aware that this PDF has been created from the original hardcopy document, which might not be in good condition and so the PDF might reflect this.

BSI

UDC 624.21.01

Steel, concrete and composite bridges

Part 1. General statement

Ponts en acier, ponts en beton, ponts mixtes
Partie 1. Généralités

Brücken aus Stahl, Beton und Verbundbau
Teil 1. Allgemeine Angaben

British Standards Institution

Gr 3

Contents

Foreword

General. BS 5400 is a document combining codes of practice to cover the design and construction of steel, concrete and composite bridges and specifications for the loads*, materials and workmanship. It is based on the principles of limit state design outlined in ISO 2394 'General principles for the verification of the safety of structures'. It comprises the following :

- Part 1 General statement
- Part 2 Specification for loads
- Part 3 Code of practice for design of steel bridges
- Part 4 Code of practice for design of concrete bridges
- Part 5 Code of practice for design of composite bridges
- Part 6 Specification for materials and workmanship, steel
- Part 7 Specification for materials and workmanship, concrete, reinforcement and prestressing tendons
- Part 8 Recommendations for materials and workmanship, concrete, reinforcement and prestressing tendons
- Part 9 Code of practice for bearings
- Part 10 Code of practice for fatigue

Some of the above Parts are manuals of good practice, whilst others express requirements in specific terms. For this reason BS 5400 should not by reference be incorporated as a whole into construction contracts. Certain Parts, i.e. Part 2, Part 6 and Part 7, may be suitable for individual incorporation by reference, provided that care is taken to ascertain that no provisions in such Parts conflict with other provisions in the text of the contract.

It is intended that the application and interpretation of BS 5400 in design is entrusted to appropriately qualified and experienced chartered engineers, and that construction is carried out under the direction of appropriately qualified supervisors.

As stated above, the basis of BS 5400 is limit state design. Accordingly, it differs in principle from its predecessor, BS 153 'Steel girder bridges'. Although the load factors adopted are judged appropriate in the light of current knowledge, detailed comparisons between the designs resulting from BS 5400 and those from its predecessor will be possible only from the results of the use of this standard in practice and from empirical calibration studies. The results from these studies will enable possible adjustments to be made at periodic intervals. Users of BS 5400 should recognize the need for engineering judgement arising especially from the difference in principle mentioned above.

Objective of BS 5400. The aim of BS 5400 is the achievement of acceptable levels of probability in order that the structure being designed will not become unfit for the use for which it is required, i.e. that it will not reach limit state during its design life. It specifies certain design requirements and a coherent set of partial safety factors for bridges in the UK†, which combine to provide what is considered to be an acceptably low probability of attaining the limit states given in clause 4.

*Throughout BS 5400 external forces applied to the structure and imposed deformations such as those due to changes in temperature will be referred to as 'loads' or 'loading'; the stress resultants in the structure arising from its response will be referred to as 'load effects.'

†For bridges to be designed to other load specifications, see clause 11.

British Standard

Steel, concrete and composite bridges

Part 1. General statement

1. Scope

Part 1 of BS 5400 is a statement of the general concepts embodied in other Parts of the standard. It describes the application of the limit state principles adopted and includes sections on analysis and foundation design, both of which are common to all forms of bridge construction.

2. References

The titles of the standards publications referred to in this Part of this British Standard are listed on the inside back cover.

3. Definitions

3.1 Loads. The loads to be considered in determining the load effects, S, on the structure are specified in Part 2 and are described throughout as nominal loads. For certain loads statistical distributions are available and for these a return period of 120 years has been adopted. Where such distributions are not available nominal values, based on judgement and experience, are given, and these are considered to approximate to a 120-year return period.

3.2 Strength of materials. Where statistical data are available on the strength of materials, characteristic values are given in the appropriate Parts of this standard. Where such data are not available, nominal values are given to be used as characteristic values in all the computations.

3.3 Design values

3.3.1 ***Design loads.*** The design loads, Q^*, are determined from the nominal loads, Q_k, according to the relation

$$Q^* = \gamma_{fL} . Q_k$$

where γ_{fL} is a factor given in Part 2 for each load.

$$\gamma_{fL} = \text{function} (\gamma_{f1} . \gamma_{f2})$$

where

γ_{f1} takes account of the possibility of unfavourable deviation of the loads from their nominal values,

γ_{f2} takes account of the reduced probability that various loadings acting together will all attain their nominal values simultaneously.

3.3.2 ***Design load effects.*** The design load effects, S^*, are obtained from the design loads by the relation

$$S^* = \gamma_{f3} \text{ (effects of } Q^*)$$
$$= \gamma_{f3} \text{ (effects of } \gamma_{fL} . Q_k)$$

where γ_{f3} is a factor that takes account of inaccurate assessment of the effects of loading, unforeseen stress distribution in the structure, and variations in dimensional accuracy achieved in construction.

Values of γ_{f3} are given in Parts 3, 4, and 5.

Where linear relationships can be assumed between loading and load effects, S^* can be determined from

$$S^* = \text{(effects of } \gamma_{f3} . \gamma_{fL} . Q_k)$$

This relation may also be appropriate in certain non-linear problems (see relevant sections of the standard).

3.3.3 ***Design resistance.*** The design resistance, R^*, may be defined as

$$R^* = \text{function} \frac{(f_k)}{(\gamma_m)}$$

or optionally

$$R^* = \frac{\text{function } (f_k)}{\gamma_m} \quad \text{when } \gamma_m \text{ can be explicitly treated,}$$

where

f_k is the characteristic (or nominal) strength of the material,

γ_m is a reduction factor specified in the relevant parts of this standard (which = function ($\gamma_{m1} . \gamma_{m2}$))

where

γ_{m1} is intended to cover the possible reductions in the strength of the materials in the structure as a whole as compared with the characteristic value deduced from the control test specimen,

γ_{m2} is intended to cover possible weaknesses of the structure arising from any cause other than the reduction in the strength of the materials allowed for in γ_{m1}, including manufacturing tolerances.

In the case of certain materials, where γ_m can be explicitly treated, expression of function (f_k) is given in relevant parts of the standard. In the case of other materials expressions for R^* are given.

4. Limit states

4.1 General. The two limit states adopted in BS 5400 are:

(a) the ultimate limit state, and

(b) the serviceability limit state.

4.2 Ultimate limit states. The ultimate limit states applicable to this standard are:

(a) loss of equilibrium of a part or the whole of the structure when considered as a rigid body;

(b) deterioration, due to fatigue, to a stage where failure occurs;

(c) a post elastic or post buckling state determined by the current extent of knowledge of the ultimate behaviour of bridge structures and which, in certain cases, relates only to the collapse strength of the section considered and not to the collapse strength of the whole structure.

4.3 Serviceability limit states. The serviceability limit states applicable to this standard are:

(a) that condition beyond which a loss of utility or cause for public concern may be expected and remedial action required;

(b) the vibration limits stated in Part 2 as applied to footbridges.