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# Steel, concrete and composite bridges

Part 4. Code of practice for design of concrete bridges

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Ponts en acier, ponts en béton, ponts mixtes  
Partie 4. Règles pour le calcul des ponts en béton

Brücken aus Stahl, Beton und Verbundbau  
Teil 4. Richtlinie für den Entwurf und die Bemessung von Stahlbetonbrücken

British Standards Institution



Gr8

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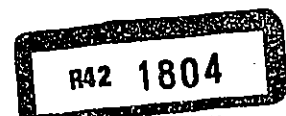
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**Foreword**

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 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

\*In course of preparation



British Standard

**Steel, concrete and composite bridges**

Part 4. Code of practice for design of concrete bridges

**1. Scope**

This Part of this British Standard deals with the design of concrete bridges. It contains much in common with CP 110 'The structural use of concrete'.

After stating the objectives and requirements of design, particular requirements are given for reinforced concrete, prestressed concrete and composite concrete construction.

Structural elements included are beams, slabs, columns and walls, bases, tension members and connections between precast concrete members.

**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 and symbols**

**3.1 Definitions.** For definitions see Part 1. For the sake of clarity the factors which together comprise the partial safety factor for loads are restated as follows.

**design loads** are the loads obtained by multiplying the characteristic loads by  $\gamma_f$ , the partial safety factor for loads.  $\gamma_f$  is a function of three individual factors,  $\gamma_{f1}$ ,  $\gamma_{f2}$  and  $\gamma_{f3}$ , which take account of the following.

- $\gamma_{f1}$  possible unusual increases in load beyond those considered in deriving the characteristic load;
- $\gamma_{f2}$  reduced probability that, with combinations of load, the individual loads would all be at their characteristic values;
- $\gamma_{f3}$  inaccurate assessment of effects of loading, unforeseen stress redistribution in structure, variation in dimensional accuracy achieved in construction and the importance of the limit state being considered.

The relevant values of the function  $\gamma_{fL}$  ( $=\gamma_{f1} \cdot \gamma_{f2}$ ) are given in Part 2.

The values of  $\gamma_{f3}$  are given in clause 5.

**3.2 Symbols.** The symbols in this Part of this standard are as follows.

$A_c$	Area of concrete
$A_{cl}$	Area of effective concrete flange
$A_o$	Area enclosed by the median wall line
$A_{ps}$	Area of prestressing tendons
$A'_s$	Area of compression reinforcement
$A'_{s1}$	Area of compression reinforcement in the more highly compressed face
$A_s$	Area of tension reinforcement
$A_{s2}$	Area of reinforcement in other face
$A_{sc}$	Area of longitudinal reinforcement (for columns)

$A_{sL}$	Cross-sectional area of longitudinal reinforcement provided for torsion
$A_{sv}$	Cross-sectional area of the two legs of a link
$A_t$	Area of transverse reinforcement
$a$	Deflection
$a'$	Distance from compression face to point at which the crack width is being calculated
$a_b$	Distance between bars
$a_{cent}$	Distance of the centroid of the concrete flange from the centroid of the composite section
$a_{cr}$	Distance from the point (crack) considered to the surface of nearest longitudinal bar
$a_s$	Distance of the centroid of the steel from the centroid of the net concrete section
$b$	Width of section
$b_c$	Breadth of compression face
$b_e$	Width of contact surface (between in situ and precast components)
$b_t$	Breadth of section at level of tension reinforcement
$b_w$	Breadth of web or rib of a member
$C$	Torsional constant
$c_{min}$	Minimum cover to tension steel
$D_c$	Density of concrete at time of test
$d$	Effective depth of tension reinforcement
$d'$	Depth to compression reinforcement
$d_c$	Depth of concrete in compression
$d_o$	Depth to additional reinforcement to resist horizontal loading
$d_t$	Effective depth in shear
$d_2$	Depth to reinforcement
$E_c$	Static secant modulus of elasticity of concrete
$E_{cf}$	Modulus of elasticity of flange concrete
$E_{cq}$	Dynamic tangent modulus of elasticity of concrete
$E_s$	Modulus of elasticity of steel
$e$	Base of Napierian logarithms
$e$	Eccentricity
$e_a$	Additional eccentricity due to deflections in walls
$e_x$	Resultant eccentricity of load at right angles to plane of wall
$e_{x1}$	Resultant eccentricity calculated at top of wall
$e_{x2}$	Resultant eccentricity calculated at bottom of wall
$F_{bst}$	Tensile bursting force
$F_{bt}$	Tensile force due to ultimate loads in a bar or group of bars
$F_h$	Maximum horizontal ultimate load
$F_v$	Maximum vertical ultimate load
$f_{bs}$	Bond stress
$f_{cav}$	Average compressive stress in the flexural compressive zone
$f_{ci}$	Concrete strength at (initial) transfer
$f_{cj}$	Stress in concrete at application of an increment of stress at time $j$