Analysis and design of steel structures for buildings
according to Eurocode 0, 1 and 3

Steel Design 1

H.H. Snijder

H.M.G.M. Steenbergen

Structural basics

Colophon

text	prof.ir. H.H. Snijder (chapter 1 to 7)
	ir. H.M.G.M. Steenbergen (chapter 1 and 2)
editing	ir. C.H. van Eldik / Bouwen met Staal
graphic design	Karel Ley / Fig.84-Reclamestudio
published by	Bouwen met Staal
ISBN	978-90-72830-98-2

The publication of this textbook has been made possible by:

Bauforumstahl	www.bauforumstahl.de
Bouwen met Staal	www.bouwenmetstaal.nl
Infosteel	www.infosteel.be
Stahlbau Zentrum Schweiz	www.szs.ch
Tata Steel	www.tatasteelconstruction.com
World Steel Association	www.constructsteel.org

This textbook was originally published in 2011 (and updated in 2012) by Bouwen met Staal, in Dutch, as *Krachtswerking* by the same authors. The English translation has been prepared by prof.ir. H.H. Snijder and ir. F.M.W. van den Hove (both Eindhoven University of Technology) and checked by dr. G. Couchman (The Steel Construction Institute).

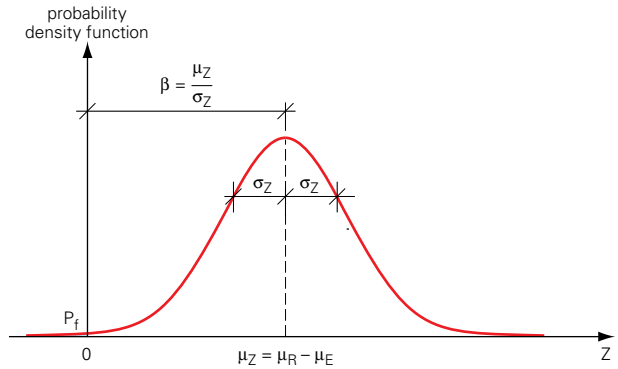
The text is based on the (English) EN version of the Eurocodes using default and/or recommended values. Where a country can make a national choice – or when non-contradictory complementary information may be used – this is indicated by the following symbol: NA. Separate annexes contain the national choices for Belgium, Germany, Luxembourg, The Netherlands and Switzerland. These annexes can be downloaded free of charge from the websites of the (national) organisations as well as any errata, corrections and additions to this textbook.

Illustrations

All unnamed photographs and all drawings come from the archive of Bouwen met Staal.

ANP/J.M. Margolles 1.8
Aveq Fotografie p. 4-1, p. 6-1
Corbis/Arcaid/Craig Auckland p. 2-1
C.H. van Eldik p. 1-1
Foto Jan Bouwhuis 1.1
Getty Images/AFP/Mandel Ngan 1.2
Sean Pavone Photo 6.1
H. Schuurmans 2.1
Shinkenchiku-sha cover
iStockfoto 1.7, p. 7-1
G. Terberg 1.6

Content



2.4 The reliability index β is a measure for the probability of failure.

and the consequences for the environment, see *Structural basics 1* (Structural safety), table 1.11. Depending on the consequences of its failure, a (part of a) structure is classified into a consequence class with corresponding reliability class, with a coupled reliability index β, see *Structural basics 1*, table 1.12. The reliability index (a number) can be regarded as a 'measure' of the level of safety that is required during the period of use of a structure. The reliability index depends on the reference period, which corresponds with the design working life.

In figure 2.4, the safety Z is expressed as the difference between the resistance R, and the effect of actions E:

$$Z = R - E \tag{2.8}$$

The reliability index β is the ratio between the average safety μ_Z and its standard deviation σ_Z. The probability of failure P_f is a measure of the area below the curve for which $Z < 0$ is valid; this is where failure occurs.

The required value for the reliability index is a minimum value which always needs to be satisfied. A greater value may be chosen for certain structures, perhaps to meet client requirements or additional legal requirements. Examples would be nuclear power plants, or for a crucial part of a structure. In such cases there will be a smaller probability of failure, so a larger value for the reliability index, see *Structural basics 1*, table 1.5. For most buildings, a probability of failure of $P_f \approx 10^{-4}$ is acceptable: this matches a reliability of $\beta = 3{,}8$.

2.2.3 Partial factors for actions

EN 1990, Annex A1 provides recommended values for the partial factors for actions for buildings.

a NA Six different limit states are distinguished, depending on the design situation (table 2.5).

Values for the partial factors for permanent loads G (γ_G), variable actions Q (γ_Q) and accidental actions A (γ_A) are also provided, see table 2.6. For the ultimate limit state STR/GEO (set B), the partial factors depend on the reliability class (RC1, RC2 or RC3) and are derived from the reliability index β.

In table 2.6, for the ultimate limit state STR/GEO (set B), either equation (6.10) of cl. 6.4.3.2(3)

b NA has to be used or the set of equations (6.10a) and (6.10b). The choice is made in the National Annexes of the different countries. To obtain the partial factor for permanent loads in equation

c NA (6.10b), the recommended ξ value of 0,85 was used. This value may be specified differently in the National Annexes of the different countries.