

BRITISH STANDARD

**BS 5400 :
Part 10 : 1980**

*Incorporating
Amendment No. 1*

Steel, concrete and composite bridges —

Part 10: Code of practice for fatigue

ICS 93.040

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW



Summary of pages

The following table identifies the current issue of each page. Issue 1 indicates that a page has been introduced for the first time by amendment. Subsequent issue numbers indicate an updated page. Vertical sidelining on replacement pages indicates the most recent changes (amendment, addition, deletion).

Page	Issue	Page	Issue
Front cover	2	6	original
Inside front cover	blank	7 to 42	original
a	1	43	2
b	blank	44	original
c	blank	45 to 48	original
d	1	49	2
1	2	50	blank
2	2	51	2
3	2	52	blank
4	2	53	2
4a	1	54	blank
4b	blank	Inside back cover	original
5	2	Back cover	2

Contents

	Page		Page
Foreword	1	8.2.2 Procedure	12
Cooperating organizations	Back cover	8.2.3 Adjustment factors for σ_H , class S details only	12
Recommendations		8.3 Damage calculation, single vehicle method	12
1. Scope	2	8.3.1 General	12
1.1 General	2	8.3.2 Procedure	12
1.2 Loading	2	8.4 Damage calculation, vehicle spectrum method	14
1.3 Assessment procedures	2	8.4.1 General	14
1.4 Other sources of fatigue damage	2	8.4.2 Design spectrum	14
1.5 Limitations	2	8.4.3 Simplification of design spectrum	14
1.5.1 Steel decks	2	8.4.4 Calculation of damage	14
1.5.2 Reinforcement	2	9. Fatigue assessment of railway bridges	18
1.5.3 Shear connectors	2	9.1 Methods of assessment	18
2. References	2	9.1.1 General	18
3. Definitions and symbols	2	9.1.2 Simplified procedure	18
3.1 Definitions	2	9.2 Assessment without damage calculation	18
3.2 Symbols	3	9.2.1 General	18
4. General guidance	3	9.2.2 Procedure	18
4.1 Design life	3	9.2.3 Non-standard design life	18
4.2 Classification and workmanship	3	9.2.4 Multiple cycles	20
4.3 Stresses	4	9.3 Damage calculation	20
4.4 Methods of assessment	4	9.3.1 General	20
4.5 Factors influencing fatigue behaviour	3	9.3.2 Design spectrum for standard loading	20
5. Classification of details	4	9.3.3 Design spectrum for non-standard loading	20
5.1 Classification	4	9.3.4 Simplification of spectrum	20
5.1.1 General	4	9.3.5 Calculation of damage	20
5.1.2 Classification of details in table 17	4	10. Fatigue assessment of bridges carrying highway and railway loading	20
5.2 Unclassified details	4	11. The Palmgren-Miner rule	20
5.2.1 General	4	11.1 General	20
5.2.2 Post-welding treatments	4	11.2 Design σ_r-N relationship	22
5.3 Workmanship and inspection	4	11.3 Treatment of low stress cycles	22
5.3.1 General	4	11.4 Procedure	22
5.3.2 Detrimental effects	4	11.5 Miner's summation greater than unity	22
5.4 Steel decks	4	Appendices	
6. Stress calculations	4	A. Basis of σ_r-N relationship	23
6.1 General	4	B. Cycle counting by the reservoir method	25
6.1.1 Stress range for welded details	4	C. Derivation of standard highway bridge fatigue; loading and methods of use	25
6.1.2 Stress range for welds	4	D. Examples of fatigue assessment of highway bridges by simplified methods	30
6.1.3 Effective stress range for non-welded details	4	E. Derivation of standard railway load spectra	34
6.1.4 Calculation of stresses	4	F. Examples of stress histories and cycle counting procedure	38
6.1.5 Effects to be included	5	G. Testing of shear connectors	41
6.1.6 Effects to be ignored	5	H. Explanatory notes on detail classification	41
6.2 Stress in parent metal	5	Tables	
6.3 Stress in weld throats other than those attaching shear connectors	5	1. Annual flow of commercial vehicles ($n_c \times 10^6$)	8
6.4 Stresses in welds attaching shear connectors	6	2. Standard load spectra for RU loading	11
6.4.1 General	6	3. Standard load spectra for RL loading	12
6.4.2 Stud connectors	6	4. Values of k_3 for RU loading of railway bridges	19
6.4.3 Channel and bar connectors	6	5. Values of k_4 for railway bridges	19
6.5 Axial stress in bolts	6	6. Values of k_5 for railway bridges	19
7. Loadings for fatigue assessment	6	7. Values of k_6 for RL loading of railway bridges	19
7.1 Design loadings	6	8. Design σ_r-N relationships and constant amplitude non-propagating stress range values	22
7.2 Highway loading	6	9. Mean-line σ_r-N relationships	23
7.2.1 General	6	10. Probability factors	23
7.2.2 Standard loading	6	11. Typical commercial vehicle groups	27
7.2.3 Application of loading	6	12. Proportional damage from individual groups of typical commercial vehicles	28
7.2.4 Allowance for impact	8		
7.2.5 Centrifugal forces	8		
7.3 Railway loading	8		
7.3.1 General	8		
7.3.2 Application of loading	8		
7.3.3 Standard load spectra	10		
8. Fatigue assessment of highway bridges	12		
8.1 Methods of assessment	12		
8.1.1 General	12		
8.1.2 Simplified procedures	12		
8.2 Assessment without damage calculation	12		
8.2.1 General	12		