DIN EN 1993-1-5:2019-10 (E)

Eurocode 3 - Design of steel struc tures - Part 1-5: Plated structural elements

Contents

Page

Foreword ... 4
National annex for EN 1993-1-5 ... 4
[A1] European foreword to Amendment A1 [A1] ... 5
[A2] European foreword to Amendment A2 [A2] ... 6
1 Introduction ... 7
1.1 Scope ... 7
1.2 Normative references ... 7
1.3 Terms and definitions ... 7
1.4 Symbols ... 8
2 Basis of design and modelling ... 9
2.1 General ... 9
2.2 Effective width models for global analysis ... 9
2.3 Plate buckling effects on uniform members ... 10
2.4 Reduced stress method ... 10
2.5 Non uniform members ... 11
2.6 Members with corrugated webs ... 11
3 Shear lag in member design ... 11
3.1 General ... 11
3.2 Effective^{s} width for elastic shear lag ... 11
3.2.1 [AC] Effective^{s} [AC] width ... 11
3.2.2 Stress distribution due to shear lag ... 13
3.2.3 In-plane load effects ... 14
3.3 Shear lag at the ultimate limit state ... 15
4 Plate buckling effects due to direct stresses at the ultimate limit state ... 16
4.1 General ... 16
4.2 Resistance to direct stresses ... 16
4.3 Effective cross section ... 16
4.4 Plate elements without longitudinal stiffeners ... 18
4.5 Stiffened plate elements with longitudinal stiffeners ... 22
4.5.1 General ... 22
4.5.2 Plate type behaviour ... 24
4.5.3 Column type buckling behaviour ... 24
4.5.4 Interaction between plate and column buckling ... 26
4.6 Verification ... 26
5 Resistance to shear ... 27
5.1 Basis ... 27
5.2 Design resistance ... 27
5.3 Contribution from the web ... 28
5.4 Contribution from flanges ... 31
5.5 Verification ... 32
6 Resistance to transverse forces ... 32
6.1 Basis ... 32
6.2 Design resistance ... 33
6.3 Length of stiff bearing ... 33

6.4 Reduction factor χ_F for effective length for resistance 34
6.5 Effective loaded length 34
6.6 Verification 35
7 Interaction 35
7.1 Interaction between shear force, bending moment and axial force 35
7.2 Interaction between transverse force, bending moment and axial force 36
8 Flange induced buckling 36
9 Stiffeners and detailing 37
9.1 General 37
9.2 Direct stresses 38
9.2.1 Minimum requirements for transverse stiffeners 38
9.2.2 Minimum requirements for longitudinal stiffeners 40
9.2.3 Welded plates 40
9.2.4 Cut outs in stiffeners 41
9.3 Shear 42
9.3.1 Rigid end post 42
9.3.2 Stiffeners acting as non-rigid end post 43
9.3.3 Intermediate transverse stiffeners 43
9.3.4 Longitudinal stiffeners 44
9.3.5 Welds 44
9.4 Transverse loads 44
10 Reduced stress method 44
Annex A (informative) Calculation of critical stresses for stiffened plates 48
A.1 Equivalent orthotropic plate 48
A.2 Critical plate buckling stress for plates with one or two stiffeners in the compression zone 51
A.2.1 General procedure 51
A.2.2 Simplified model using a column restrained by the plate 52
A.3 Shear buckling coefficients 53
Annex B (informative) Non-uniform members 55
B.1 General 55
B.2 Interaction of plate buckling and lateral torsional buckling 56
Annex C (informative) Finite Element Methods of analysis (FEM) 57
C.1 General 57
C.2 Use 57
C.3 Modelling 58
C.4 Choice of software and documentation 58
C.5 Use of imperfections 58
C.6 Material properties 61
C.7 Loads 62
C.8 Limit state criteria 62
C.9 Partial factors 63
Annex D (informative) Plate girders with corrugated webs 64
D.1 General 64
D.2 Ultimate limit state 64
D.2.1 Moment of resistance 64
D.2.2 Shear resistance 66
D.2.3 Requirements for end stiffeners 67
Annex E (normative) Alternative methods for determining effective cross sections 68
E.1 Effective areas for stress levels below the yield strength 68
E.2 Effective areas for stiffness 68