

**Selected design problems of thin-walled steel members and connections  
in building structures / Marek Tomasz Piekarczyk. – Cracow, 2018**

Spis treści

<b>Preface</b>	<b>9</b>
<b>Important symbols</b>	<b>11</b>
<b>1. The influence of different instability modes on the behaviour and design of thin-walled steel structures</b>	<b>13</b>
1.1. Definition of thin-walled members	13
1.2. Types of instabilities	14
1.2.1. Overall instability of a structure	14
1.2.2. Global buckling of a member	15
1.2.3. Local and distortional buckling of thin-walled members	17
1.3. Post-buckling strength in designing steel structures	20
1.3.1. Structural sensitivity to imperfections	20
1.3.2. Advanced analysis of the behaviour of structures under loading	24
1.4. General characteristics of steel structures revealing post-buckling reserve of strength	28
1.5. References	29
<b>2. Design of thin-walled steel girders</b>	<b>32</b>
2.1. Behaviour of thin-walled steel girders in bending	32
2.2. Finite element method for stability and strength analysis	35
2.2.1. Introduction	35
2.2.2. Examples of finite element analysis	38
2.3. Designing transversally stiffened steel girders according to EN 1993-1-5	42
2.3.1. Basis of design	42
2.3.2. Effective width method	43
2.3.2.1. General requirements and resistance to direct stresses	43
2.3.2.2. Effective cross section	43
2.3.2.3. Web buckling and cross-section resistance regarding shear	47
2.3.2.4. Interaction between shear force and bending moment in a web panel	50
2.4. References	51
<b>3. Resistance of steel girders in bending and compression</b>	<b>55</b>
3.1. Introduction	55
3.2. Numerical models and their calibration	56
3.3. Ultimate limit state calculations	58
3.3.1. Assumptions applied in draft of Eurocode 3 (1992)	58
3.3.2. Assumptions of Vlasov's theory	59
3.4. Influence of torsion on carrying capacity of girders	60

3.4.1. Realization of torsion	60
3.4.2. Results	61
3.4.3. Girders in torsion. Conclusions	64
3.5. Post-buckling behaviour of steel thin-walled columns	64
3.5.1. Influence of imperfections	64
3.5.2. Influence of stiffeners	65
3.5.3. Web slenderness	69
3.5.4. Interaction of local and global buckling	72
3.5.5. Columns. Conclusions	75
3.6. Behaviour of a steel thin-walled girder with a very slender web under cyclic load	76
3.6.1. Numerical model	76
3.6.2. Cyclic load	76
3.6.3. Comment on the results for cyclic loading	78
3.7. References	79
<b>4. Plate girders with corrugated webs. Usage and design</b>	<b>81</b>
4.1. General characteristic of plate girders with corrugated webs	81
4.2. Fabrication process of sin-girders	84
4.3. Corrugated girders as basic building structural elements	86
4.4. Carrying-capacity of plate girders with corrugated webs	92
4.4.1. Analytical approach in codification	92
4.4.1.1. General assumptions	92
4.4.1.2. Moment a resistance about major axis	93
4.4.1.3. Shear resistance in bending about major axis	95
4.4.1.4. Resistance to concentrated loads transferred onto the web	96
4.4.2. Interaction of bending and shear	97
4.4.3. Effect of the corrugated web opening on the girder behaviour and resistance	105
4.4.4. Analysis of the behaviour of sin-girders under patch loading	115
4.5. References	122
<b>5. Application of cold-formed products</b>	<b>124</b>
5.1. Types of cold formed products. Consequences of manufacturing	124
5.1.1. Typical products	124
5.1.2. Residual stresses as effect of cold-forming	129
5.1.3. Average yield strength	130
5.2. Materials and fasteners for thin-walled assemblages	131
5.2.1. Materials	131
5.2.2. Non-conventional fasteners	132
5.3. Fields of application of cold-formed steel members	133
5.3.1. Plane load-bearing members	133
5.3.2. Linear members	136
5.3.3. New possibilities of hall design with primary bearing elements made of cold-formed members	138
5.4. Characteristic behaviour of cold-formed members under loading	149
5.4.1. Comparison with conventional steel members	149
5.4.2. Numerical analysis of a zed purlin behaviour	149

5.4.3. Simplified analytical models for the assessment of the carrying-capacity of cold-formed members	152
5.5. Interaction between cold-formed zed-purlins and steel roof sheeting under loading	160
5.5.1. Introduction	160
5.5.2. Experimental investigations	161
5.5.3. Numerical models	167
5.5.4. Analytical calculations	173
5.5.5. Conclusion and final remarks	173
5.6. Application of cold-formed members in structures. Summary	174
5.6.1. Advantages	174
5.6.2. Good practice notes	175
5.7. References	175
<b>6. Adhesive bonding in connecting and strengthening steel thin-walled structures</b>	<b>179</b>
6.1. Introduction	179
6.2. Basic dilemmas of application of adhesive bonding in structural connections	184
6.2.1. Selection of an adhesive	185
6.2.2. Assessment of mechanical properties of adhesives	186
6.2.3. Technological and structural limitations	188
6.2.3.1. General designing rules	188
6.2.3.2. Influence of assembling technology	189
6.2.3. Influence of environmental conditions and types of loads	189
6.2.3.1. Effects of temperature on mechanical properties of glues	189
6.2.3.2. Example of the influence of elevated temperature on the behaviour of a lap adhesive joint	191
6.2.3.3. Influence of long-term and cyclic or dynamic loading	193
6.3. Design methods for adhesive connections	196
6.3.1. Analytical solutions	196
6.3.2. Numerical methods	200
6.3.3. Handbook and standard approaches	204
6.4. Examples of application of adhesive connections in thin-walled steel building structures	205
6.4.1. Façades on steel frameworks	205
6.4.2. Cold folded profiles and their strengthening	206
6.4.3. Plate girders and their strengthening	208
6.4.4. Cellular beam systems and steel-polymer-steel systems	211
6.5. Conclusions	212
6.6. References	213
<b>Summary</b>	<b>218</b>