Design of single span beams in SLS and ULS using semi-continuous beam-to-column joints. Part 1: Beams with constant bending stiffness and joints according to EN1993-1-8

Slotted cold-formed steel studs are used in load bearing external plasterboard walls. The cold-formed steel studs in these walls are supported by and joined to track profiles at the bottom and top level. In this paper the load bearing studs are tested in compression in order to observe the behaviour of the studs and the track joints. The experiments include a joint design with a special web stiffener used in practice. The studs are made of C-profiles and the tracks of U-profiles. Eight different test series are performed. The test series each have different column lengths, thicknesses, and are both with and without web stiffeners to see the influence of these on the joint behaviour and load bearing capacity of the slotted cold-formed steel studs.

Circular Hollow Section Through Plate Connections

Prior research on through plate connections to Circular Hollow Sections (CHS) is reviewed and a finite element (FE) study, validated against laboratory experiments, is presented. This FE analysis indicates that the behaviour of through plate-to-CHS connections closely matches the sum of branch plate-to-CHS connection behaviour in plate tension and compression, for a given geometric configuration. A connection design strength, shown to be valid for a wide range of connection geometries, which is the sum of existing design recommendations for branch plate-to-CHS connections loaded in axial tension and compression, is hence proposed for through plate-to-CHS T-connections. This thereby enables maximum advantage to be taken of the capacity of this type of “reinforced” tubular connection.

Lateral torsional buckling behaviour of I-section beam-columns with one-sided rotation and warping restraint

In many practical applications, columns are often fixed to a practically rigid concrete structure at the column base. This additional restraint should increase the real load-carrying capacity if the section is susceptible to lateral torsional buckling. However, this effect is rarely taken into account in design, as most current design rules do not provide sufficient guidance on how to account for this additional rigidity, and thus the column base-point fixity is often ignored. The background for the verification formulae against lateral torsional buckling (LTB) of I-section beams-columns in the Eurocode EN 1993-1-1 consists of comprehensive parametric numerical studies for members with “end fork” conditions only, i.e. for members with free rotational and warping deformations at both ends. However, these specific boundary conditions are not clearly mentioned in the code.

In the study presented in this paper, a comprehensive series of numerical FEM-analyses for the realistic lateral torsional buckling behaviour of beam-columns with one-sided rotation and warping restraints were carried out and compared with the results based on the LTB resistance of the Eurocode, calculated with increased idealised buckling loads (Ncr, Mcr) that account for the end restraints. The most important results of this study are presented in this paper and the comparison of the ultimate capacity is made for two different design methods for beam-columns in Eurocode 3: the interaction concept (EN1993-1-1: 6.3.3) and the general method (EN1993-1-1:6.3.4).

In addition, a simplified formula for the additional bimoment at the end restraint is given, to be used for design of the welded joint. Finally, an improved LTB design curve (buckling reduction factors LT) is presented, developed at the authors’ institution, which may be used for the studied cases.
Deformations of the steel shell of a vertical cylindrical tank caused by underpressure

Underpressure in a tank with a fixed roof may arise in the final stage of its construction as well as during its exploitation. After completion of the construction, when the tank is empty and all manholes and valves, through which air could get into the tank, are closed tightly, underpressure may arise in case of sudden change in weather – air pressure and temperature, which is particularly dangerous in spring or summer. In the process of tank exploitation underpressure may arise if breathing valves are obstructed, for example covered by snow during pumping out a product stored in the tank. Underpressure may cause extensive deformations of the shell or the roof of the tank. However, the shell undergoes deformation more frequently, since the roof has a stiff support structure. The article presents stages of deformations of the tank shell and their development from the occurrence of the first deformation to either removal of causes of underpressure or crack of the steel shell and thus automatic equalization of pressure inside the tank with atmospheric pressure.

Curtain wall façade system under lateral actions with regard to limit states

Akbar Pirmoz, Reza Attamejad, Parviz Ahadi, Vahid Farajkhah

Finite element analysis of extended stiffened end plate link-to-column connections

The applicability of extended stiffened end plate (ESEP) connections used as link-to-column connections in eccentrically braced frames (EBFs) with long (flexural yielding) links is examined in this paper. A finite element method (FEM) is used for this purpose, based on a validated parametric FE benchmark. Analyzing the numerical model of an ESEP connection, designed based on the recent seismic design rules for special moment frames, revealed that of link-to-column connections of EBFs sustain more severe conditions than moment connections of moment resisting systems. The implemented design approach is examined and the results are discussed. The results demonstrated that ESEP connections can be used as a successful alternative for link-to-column connections of EBFs and the system with this type of connection can achieve the required rotations for long or flexural links.

Engineering approaches for ETFE Foil Cladding systems - Design concepts for single layer systems and pneumatically stabilized multi-layer systems

Stefan Lehnert, Carl Maywald, Sebastian Gerhold

Reports

Czesław Machelski, Robert Toczkiewicz

Effects of connection flexibility in bridge girders under movable loads

The paper concerns problem of connection flexibility in steel-concrete bridge girders under live, movable loads. Static action of the load changing location on the structure is considered. The analytical model of the girder assuming a strain discontinuity in steel-concrete interface as a result of beam-plate partial interaction is used. Effects of flexible connection are characterised by the proposed index defined on the basis of internal forces in the girder. This index can be calculated during load tests on the basis of the neutral axis position in considered section of the girder. Conducted numerical analyses show that values of the index characterizing beam-plate interaction depend on the position of the load on the structure and the function describing connection stiffness.
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