Steel Construction 3/2014

Design and Research

The international journal for steel construction in research and practice

Advertising Deadline:
August 05th 2014

Publishing Date:
September 1st 2014

Additional Circulation:

eurosteel 2014
September 10 – 12, 2014, Napoli, Italy

10th Japanese German Bridge Symposium
September 16 - 19, 2014, Munich, Germany.

Deutscher Stahlbautag 20140
October 29 – 30, 2014, Hannover, Germany

Membership journal of the ECCS

European Convention for Constructional Steelwork

Products & Projects

Company news about products and projects in constructional steelwork

Deadline for press releases: **17th July 2014**

Editorial Content

Cold-formed steel columns under l-d-g interaction - Experimental investigation

Jian Jiang, Guo-Qiang Li, Asif Usmani:

Influence of fire scenarios on progressive collapse mechanisms of steel framed structures

OpenSees is an open-source object-oriented software framework developed at UC Berkeley. The OpenSees framework has been recently extended to deal with structural behaviour under fire conditions. This paper presents the results of a numerical study, using OpenSees, of the progressive collapse of steel frames exposed to fire. After validating the capability of OpenSees against available analytical and experimental results of fire tests on steel members, a parametric study is carried out to find the progressive collapse mechanism of steel frames exposed to fire and corresponding influencing factors. The factors include load levels, lateral restraint, beam strength and fire scenarios. The catenary action of beams is considered by using a temperature-dependent corotational beam/column element. The results show that different progressive collapse mechanisms can happen due to the sequence of the buckling of columns. High load levels lead to the downward collapse of the whole structure compared with the lateral collapse for low load levels. The existing of lateral restraint causes the premature buckling of bottom columns which triggers the whole frame collapse. As the beam section increases, the collapse mechanism of steel frames changes from beam failure mode to column failure mode. The fire scenarios have significant effect on the collapse mode of steel frames. The work presented in this paper is a preliminary study of the progressive collapse of steel frames. Further work is underway to combine the influence of the effect of concrete floors. A simple design method is then expected to be proposed to investigate the robustness of steel structures against progressive collapse due to fire.

Masanori Fujita, Junpei Sakai, Hirotaka Oda, Mamoru Iwata:

Building system for a composite steel-timber structure

In order to address global environmental issues, there is an urgent need for the building structure field to use as much timber as possible to contribute to reforestation, as well as to research and develop a building system that does not diminish the structure's functionality and safety. The building structure field is required to actively use this wood as timber, but the timber is too weak to use for large buildings. Research and development of an appropriate building system that can utilize such timber is necessary.
This study examines the possibility of developing a building system for a composite steel–timber structure utilizing the authors' wealth of expertise in steel structure construction. Different types of composite steel–timber structure building systems are categorized, and their features are described. Furthermore, the individual types are evaluated for the performance requirements needed to develop a building system.

Ernst & Sohn A Wiley Company

Wilhelm Ernst & Sohn – Verlag für Architektur und technische Wissenschaften GmbH & Co. KG,
Rotherstraße 21, D- 10245 Berlin, Germany,
Anzeigen norbert.schippel@wiley.com, Tel. 030 47031 252

Martin Prachar, Michal Jandera, František Wald, Bin Zhao:

Fire resistance of slender section beams - Subjected to lateral-torsional buckling

The paper shows experimental and numerical research in slender cross-section beams in case of fire. The topic is very important as only little investigation was made and only few experimental data have been collected until now. In the framework of the RFCS project FIDESC4 - Fire Design of Steel Members with Welded or Hot-rolled Class 4 Cross-sections, several simple supported beams were tested at elevated temperature at the Czech Technical University in Prague.

Current Eurocode 3 contains a number of simple rules for design of slender Class 4 cross-sections which, based on recent numerical simulations, proved themselves to be over-conservative. Through refining these rules, material savings could be achieved which would lead to higher competitiveness of the steel structures. This also in the scope of the current research, however not published in the paper limited to lateral-torsional buckling behaviour only. Determination of the bending resistance for members subjected to lateral torsional buckling of Class 1 to 3 cross sections at elevated temperature is based on the same principles as the design at room temperature according to EC3 part 1-1 [1]. However it differs in using one imperfection factor only for all types of cross-sections. Informative Annex E of the standard (EC3 part 1-2 [2]) recommends using the design formulas for slender (Class 4) sections as well. But there is a restriction of critical temperature value and different reduction of yield strength is used (0.2% proof strength for Class 4 instead of 2.0% proof strength for stockier Class 1 to 3 sections). For the non-uniform members (variable section height), a limited design procedure is given in EC3 part 1-1 [1]. This is applicable for room temperature only. Possibility of using these rules for fire design is not confirmed yet.

Xi Zhang, Kim Rasmussen:

Tests of cold-formed steel portal frames with slender sections

Cold-formed steel sections are widely used in many applications such as structural frames, scaffolding systems, purlins, and storage racks. In particular, cold-formed steel portal frames can be an alternative to conventional hot-rolled steel portal frames for industrial, rural and residential low rise buildings. The advantages of using cold-formed steels include a higher strength to weight ratio, and reduced material, erection and transportation costs.

Over the past two decades a number of researchers [1-3] have undertaken tests on cold-formed steel portal frames. The tests mainly focused on the behaviour of joints, and employed relatively stocky sections. Hence, they provided little insight into the effects of cross-sectional instability on the overall stability of the frame.

In this paper, three portal frame tests are described, the main purpose of which was to study the effect of cross-sectional instability on the two-dimensional sway failure of cold-formed steel. The tests demonstrated significant local and distortional buckling before reaching the ultimate load. Finite element models were calibrated against the tests. The calibrated models therefore can be used for a parametric study to investigate the significance of the additional second-order effects caused by local/distortional bucking. The paper details the tests and the numerical simulations.

Yvonne Ciupack, Hartmut Pasternak, Manuel Schiel, Erdeniz Ince:

Adhesive bonded joints in steel structures

While classic joining techniques in steel construction have undergone advancements, fundamental problems still remain. The utilisation of structural bonding can remedy the situation, but despite having many advantages, has not been able to establish itself in civil engineering and specifically steel construction. The reason for this are doubts by engineers, architects and contractors regarding the verifiability, durability and load bearing capacity of bonded steel constructions. In order to facilitate the use of the innovative joining technique in construction, it is necessary to process bonded joints close to standardization.

Dan Dubina, Aurel Stratan, Cristian Vulcu, Adrian Ciutina:

High strength steel in seismic resistant building frames

Seismic resistant building frames designed as dissipative structures, must allow for plastic deformations to develop in specific members, whose behaviour is expected to be predicted and controlled by proper calculation and detailing. Members designed to remain elastic during earthquake, such as columns, are characterized by high strength demands. Dual-steel structural systems, optimized according to a Performance Based Design (PBD) philosophy, in which High Strength Steel (HSS) is used in predominantly “elastic” members, while Mild Carbon Steel (MCS) is used in dissipative members, can be very reliable and cost efficient. Because present seismic design codes do not cover this specific configuration, an extensive European research project [1], HSS-SERF - High Strength Steel in Seismic Resistant Building Frames, was carried out with the aim to investigate and evaluate the seismic performance of dual-steel building frames. On this purpose, and based on a large numerical and experimental program, the following objectives have been focused into the project:

Ernst & Sohn
A Wiley Company

Wilhelm Ernst & Sohn – Verlag für Architektur und technische Wissenschaften GmbH & Co. KG,
Rotherstraße 21, D- 10245 Berlin, Germany,
Anzeigen norbert.schippel@wiley.com, Tel. 030 47031 252

Sandra Jordão, Marco Pinho, Luís Costa Neves, João Pedro Martins, Aldina Santiago:

Behaviour of laminated glass beams reinforced with pre-stressed cables

Structural glass corresponds to an innovative material with extraordinary aesthetical and architectonic potential that has undergone significant technological advances in recent years, yielding it stronger and safer. For this reason, the use of structural glass has increased considerably in the last decade and is now an unavoidable presence in most of recent reference buildings. The structural capacity of glass elements is brought in from reinforcing techniques of different types. One of the possibilities corresponds to pre stressed cables reinforcement. This technique is very effective in terms of resistance and deformability and corresponds to a light reinforcing element rendering the so called spider web effect. In the framework of the research project "S-Glass: Structural performance and design rules of glass beams externally reinforced" (Cruz et al. [1]) study the behavior of laminated glass beams reinforced by too twin external steel rods. The work presented in the current paper is within the framework of S-Glass project aiming at characterizing the behavior of reinforced laminated glass beams in the non-crack regimen. For this purpose experimental and numerical analysis were prepared. The numerical model was used for a cable layout optimization analysis. Furthermore an analytical solution is put forward, which tackles the beam-cable load transfer indetermination. Final conclusions are established on the bases of a comparison established between experimental, numerical and analytical results.

Ewa Maria Kido, Zbigniew Cywiński:

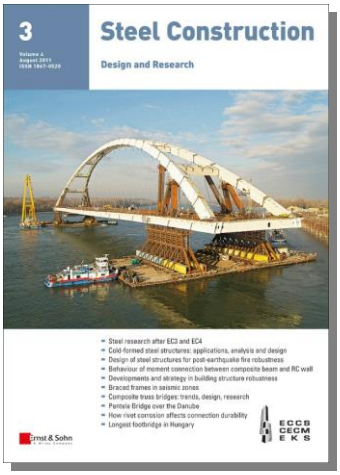
The new steel-glass architecture of railway stations in Japan

Due to the accelerating needs of communication, during the recent two decades many modern railway stations, made of steel and glass, have been built or upgraded, all over the world. That trend, influenced by local architectural tradition, is clearly visible also in Japan. This paper, focusing on that problem, is certain continuation of authors' former publication.

General Information

Membership journal of the ECCS

European Convention for Constructional Steelwork



Steel Construction

Design and Research

The international journal for steel construction in research and practice

Volume 6, 2013 - 4 issues per year
Editor: Ernst & Sohn, Berlin; Chief Editor: Dr.-Ing. Karl-Eugen Kurrer

Steel Construction - Design and Research
publishes peer-reviewed papers covering the entire field of steel construction research.

Steel Construction - Design and Research
unites in one journal the holistic-oriented steel construction, which interlinks competently - in the interest of resource-saving construction - with other types of construction like concrete-, glas-, cable- and membrane construction to the system-integrated steel construction.

Expert essays in **Steel Construction - Design and Research** are primary publications.

This journal is therefore aimed not only at academics, but in particular at consulting structural engineers, and also other engineers active in the relevant industries and authorities

In addition, **Steel Construction - Design and Research** informs about product innovations from the building and construction industry.

An internationally renowned editorial board assures a most interesting selection of topics and guarantees a high standard of the contributions.

Together with the expert journal Stahlbau (Steel Structures), being published in German at the publishing house Ernst & Sohn since 1928, Steel Construction - Design and Research, mirrors the world-wide development and the standard of knowledge in steel construction. Expert essays in both journals are primary publications. Steel Construction - Design and Research and Stahlbau (Steel Structures) are uniquely uniting the steel-construction community from research and practice on national and international levels in two complementary expert journals.

Ernst & Sohn
A Wiley Company

Wilhelm Ernst & Sohn – Verlag für Architektur und technische Wissenschaften GmbH & Co. KG,
Rotherstraße 21, D- 10245 Berlin, Germany,
Anzeigen norbert.schippel@wiley.com, Tel. 030 47031 252