

Posting

Suggested topics for Master's theses at the Chair of Steel and Hybrid Structures

31. März 2020

Suggested topics for Master's theses

- **»Numerical investigations of plates stiffened by longitudinally hollow sections under bending stresses and combined bending and compressive stresses«**
Numerical methods continue to become increasingly important. This also applies to verifications against plate buckling. For this stability mode, investigations using numerical methods should be carried out considering geometric as well as structural imperfections, evaluated and comparisons to the existing design models are to be made. In addition to high-quality GMNIA calculations with ANSYS, comparative practical solutions using elastic buckling analyses and verification procedures according to EC 3 are to be carried out. *(Contact: Mämpel)*
- **»Investigations on the reduction of the shear field stiffness of trapezoidal sheetings with non-rotating fastening«**
(Contact: Mämpel, Arnold)
- **»Further investigations for the calculation of stabilisation loads of steel constructions«**
(Contact: Mämpel)
- **»Further investigations on the influence of structural details on the stability behaviour of truss girders«**
(Contact: Mämpel)
- **»Static-Constructive Investigations of Skywalk Bauhaus.Walk«**
As part of an interdisciplinary master thesis, which was conducted by the Faculty of Architecture and Urban Studies in cooperation with the Chair of Steel and Hybrid Structures, a mobile Skywalk was developed and a feasibility study on various aspects is being prepared. This project offers many opportunities to statically and creatively expand interesting concepts. Moreover, various details are constructively to design and to be carried out the analysis of it. The different tasks should be primarily prepared in Student research projects. *(Contact: Mämpel)*

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- **»Use of modified adhesives in the construction field«**
 For the investigation of new fields of application of modified adhesives, a test program with different load scenarios is carried out. In particular, the use in the area of components at risk of stability is investigated. The execution, documentation and evaluation of these tests are to be processed within the scope of student work. This requires an understanding of the failure mechanism of adhesives. In addition, the tests are to be verified by numerical comparative calculations. The program ANSYS is suitable for this purpose. *(Contact: Wittor)*
- **»Investigations into the buckling-plate-like behaviour with a bounded axis of rotation between the edge of the plate and the openings«**
 Based on previous investigations on the stability behaviour of slim plates with openings, further considerations are to be carried out on the stability of narrow plate sections with larger openings. The application of standard controlled stability checks under consideration of the bar theory is in particular in the focus. *(Contact: Mämpel)*
- **»Geometric Imperfections for Plate-Buckling Verification«**
 Numerical methods continue to become increasingly important. This also applies to verifications against plate buckling. For this stability mode, investigations using numerical methods should be carried out considering equivalent geometric imperfections and be compared with existing design models. In this context unstiffened and stiffened buckling panels are to be included in the investigations. *(Contact: Mämpel)*
- **»Plate-Buckling Verification in Steel Bridge Construction«**
 For the investigation of plate buckling two main methods are distinguished. Until now, the conventional method in Germany is the method of reduced stresses. In the European context, this is not the standard procedure and a method taking into account effective cross-sections is focused.
 With regard to capacity and fatigue behaviour, which is of particular importance in the bridge design, comparative studies are to be carried out with the mentioned verification methods. In addition, numerical computations are to be performed which permit further evaluations and investigations regarding the design models. *(Contact: Mämpel)*
- **»Regarding the Connection Behaviour in Structural Beam Analysis Software«**
 For the calculation of internal forces and moments of steel and composite structures using beam theory, the behaviour of semi rigid joints has to be considered in terms of rotational spring stiffness. In practical application, this is connected to an iterative process, since the design of the connection can only be performed after having knowledge about the stressing of the joints.

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Within the framework of this thesis, spring models should be simplified to describe connection stiffness with only few possible influencing parameters. The aim is to integrate the connection description obtained thereby as an adaptive element in structural beam analysis software and to automate the iterative process of the calculation. (*Contact: Mämpel, Arnold, Ibanez*)

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- **»Use of multi-scale analysis methods for describing the material behaviour«**

Multi-scale analysis methods are used to describe microscopically induced material behaviour. The method is used in materials science to describe materials whose structure at higher resolution levels (meso, micro or nano level) has a non-homogeneous but partially periodic structure. This applies to all crystalline materials and thus also to steels.

Different tasks are possible on this topic as student research projects, bachelor and master theses. Possible areas of research are:

- numerical description of the steel material as multi-phase grain structure (microscopic or mesoscopic level);
- Investigations on the influence of the pronounced linearity (due to rolling) on effective material properties (modulus of elasticity, yield strength, tensile strength) of steels;
- Application of multi-scale analysis for the simulation of material behaviour under alternating stress;

Depending on the formulated focus, the task requires literature research, evaluation of experimental investigations (microscopic images), imaging of geometries and/or numerical investigations. The focus of the work can be formulated according to the student's interest. (*Contact: Wudtke*)

- **»Simulation of the bearing behaviour of welded joints«**

As a result of extreme thermal stresses, a change in the material condition occurs in the direct vicinity of the weld seam. In this heat-affected zone, a sequence of different structural states exists in a small space (several millimetres wide). The different stiffness and material properties of these microstructures in combination with the internal stresses caused by welding are the reason for the higher susceptibility to failure of the heat-affected zone compared to the thermally unaffected base material. For the numerical investigation of the load-bearing capacity of welded joints an adequate description of the heat-affected zone is aimed for. Different tasks are possible on this topic as student research projects, bachelor and master theses. Fundamental questions are:

- Numerical description of the heat-affected zone based on the model of functionally graded materials;
- Investigation of correlation relationships between the constitutive characteristics of steels (e.g. grain size, phase fraction) and their material properties;

- Identification of functional relationships between constitutive features of the heat-affected zone and their properties; *(Contact: Wudtke)*

- **»Experimental characterization of material properties on miniature samples«**

In the case of experimental investigations, which serve to determine the mechanical-technological material characteristics, the test body dimensions have a significant influence on the test result. For this reason, the valid standards for individual test procedures specify the dimensions of the test specimens. Failure to comply with these standards will result in a lack of comparability of the experimental results between the test specimens.

Within the scope of this work, an overview of already established experimental methods on small specimens (miniature specimens) for the characterization of material properties of steels is to be worked out. In addition to the aspects of the scale effect, the aspects of the measurement uncertainty are also to be included and considered. The knowledge gained will be validated by experimental investigations. *(Contact: Wudtke)*

- **»Further Investigations of Lateral Torsional Buckling of Girders with out of the Plane Elastic Intermediate supports of the Compression Flange«**

New scientific work indicates that systems with stability problems supported by elastic intermediate springs of the compression flange, the limit load results not of the first eigenmode. For limit load determination, higher eigenmodes has to be considered. As a part of student work, various publications have to be examined and further comparison calculations should be performed. *(Contact: Mämpel)*

- **»Evaluation of the Stability Behaviour of Cold Formed Σ -Purlins using Higher and High Strength Steel«**

The application of high strength steel becomes an increasing use in constructional steel work. This is also for cold-formed thin wall structural components for example Σ -purlin. Meanwhile, steel grades of S420 and S550 are propagated. Regarding to very slender components and distinct stability problem (plate buckling, distortional buckling, lateral torsional buckling), the efficient use of material is questioned. As a part of a special project, the cross section in the market with higher strength and high strength steel grades are to be examined. The economic efficiency is to be compared with standard steel strengths. *(Contact: Mämpel)*

- **»Implementation of Total Equivalent Imperfection Method for Girder under Bending and Compressive Stresses«**

Recent research work concern evermore about a global stability verification of a combined loading for bending and normal stresses of steel beams using the application of computational

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method in accordance with 2nd order theory. Based on the general verification method of the EC3 a generalized equivalent imperfection method is developed according to Papp. In the context of Master's thesis, the approach of this method should be profoundly explained and implemented in a suitable structural analyses program for beam elements. The application and functional capability are to be examined and evaluated with regard to various comparison calculations. (*Contact: Mämpel*)

- » **Topics of wood and wood-composite structures** «
(*Contact: Kästner*)
- » **Software Developments in Themes of Steel, Composite and Hybrid Construction** «
Program developments for different problems premising an easy allocation by spreadsheet-based VBA-programming.
For example: Development of a program for the calculation of connection resistance and stiffness.
(*Contact: Mämpel, Arnold, Ibanez*)

Further tasks are possible upon request.

Gladly we will supervise your own suitable topics, in agreement with the chair.

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