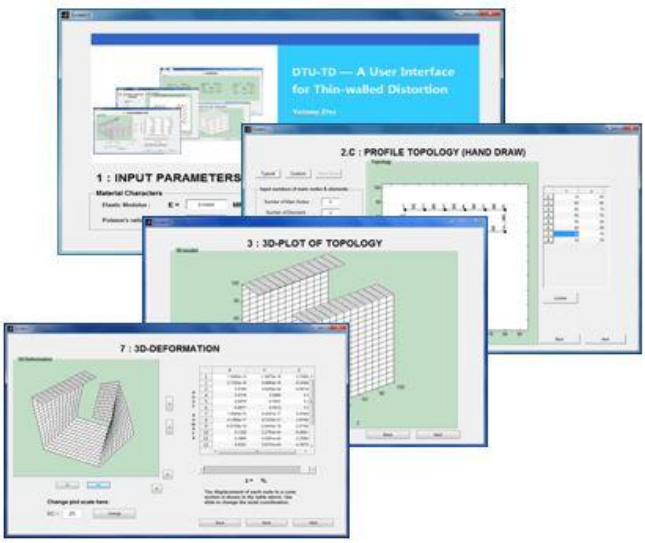
DTU-TD — A User Interface for Thin-walled Distortion



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Preface

This master thesis is written at DTU-BYG, Department of Civil Engineering in the Technical University of Denmark, as a part of completion of the Master's Degree in Civil Engineering. The project corresponds to 35 ECTS points and is made during the period 01.02.2013-23.08.2013.

A user interface for thin-walled distortion has been developed and introduced in this project. The supervisors are Professor Jeppe Jönsson and Associate Professor Michael Joachim Andreassen, both affiliated to DTU-BYG. The work is based on the work done in the articles Sander (2013) and Mygind (2013).

The MATLAB code of the user interface can be found in the CD-ROM together with the thesis. To run the user interface, MATLAB environment is required. The program can be opened by run the file "DTU_TD.m" in the main folder.

This thesis is submitted on 26th of August 2013.

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Writing this thesis has been a challenging experience in my study life, at same time full of interest. During the researching process my weakness in the theory of elastic mechanics has been complemented in a certain level, and my ability of programing enhanced a lot which will be very useful in the future works.

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Abstract

Since the use of thin-walled structural elements have been much increased during recent years because of the significant high strength and cost-saving, more accurate calculation method is required to deal with the complex structural behavior. In the last decades, Generalized Beam Theory (GBT) has been developed as an effective approach in thin-walled elements analysis. In this master thesis, a GBT-based user interface is introduced with: (i) a comprehensive explanation of the background GBT theory. (ii) a detailed user manual and (iii) the results of application tests.

DTU-TD, which was designed to apply GBT to calculate the deformation and inner stress of thin-wall beam elements, is mainly based on the method introduced in Sander (2013) and Mygind (2013). In order to enable other researchers to reuse the user interface conveniently to test their improved theory, DTU-TD was written using MATLAB Graphical User Interface Development Environment (MATLAB GUIDE). The user interface related to this thesis is the original version and named as DTU-TD 1.0α, which could calculate the deformations and stresses in cross-sections of loaded homogeneous thin-walled single elements. The users are allowed to set up material parameters, create custom cross-section profiles, identify different boundary conditions and load conditions, save and export results in DTU-TD 1.0α. A detailed user manual is given in this thesis.

Some tests were made to verify the correctness and practicability of DTU-TD. The results have been compared to hand calculations and results from ABAQUS. The tests improved that DTU-TD 1.0α could accomplish the calculation process for most situations and gave the users intuitive results. It was also found that the shear contribution to deformations cannot be calculated correctly. This problem is very obvious when dealing with short beams where shear deformations should have a large contribution. Though distortional contributions are successfully included in this user interface, further improvement of the background theory is required to obtain correct shear deformations and stresses.

Disregarding the defect in shear calculation, the work with DTU-TD somehow provides a new platform in the research area of GBT, which hopefully could make contributions to the dissemination of thin-walled structures.