DTU Byg
Institut for Byggeri og Anlæg

INNOVATION DAY 2013

DTU

Distortional mechanics of thin-walled structures

Background and Motivation

Thin-walled members are often used in the civil, mechanical and aerospace industry due to the effective use of the materials.

Figure 1: Examples of thin-walled members.

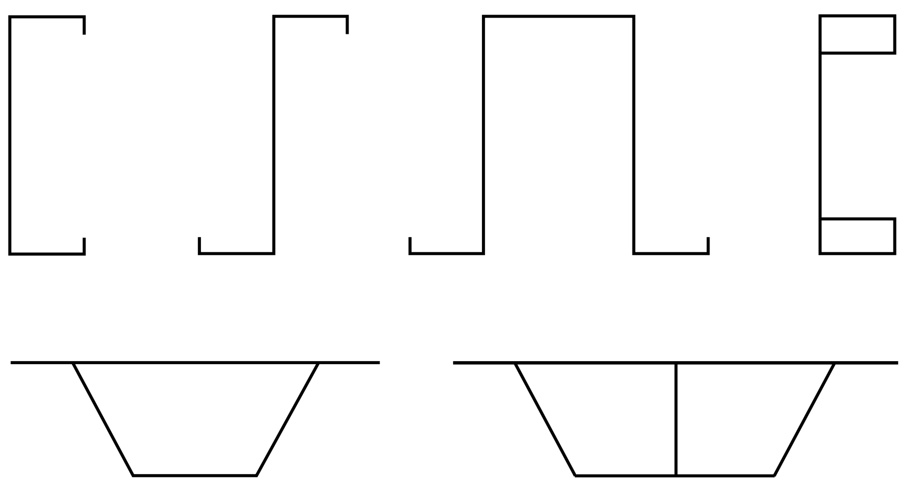

Figure 2: Examples of thin-walled member cross section.

Because of an increased use there has been increased focus on optimization and more detailed calculations. The present research deals with a novel theory concerning more detailed calculations in the context of distortion of the cross section.

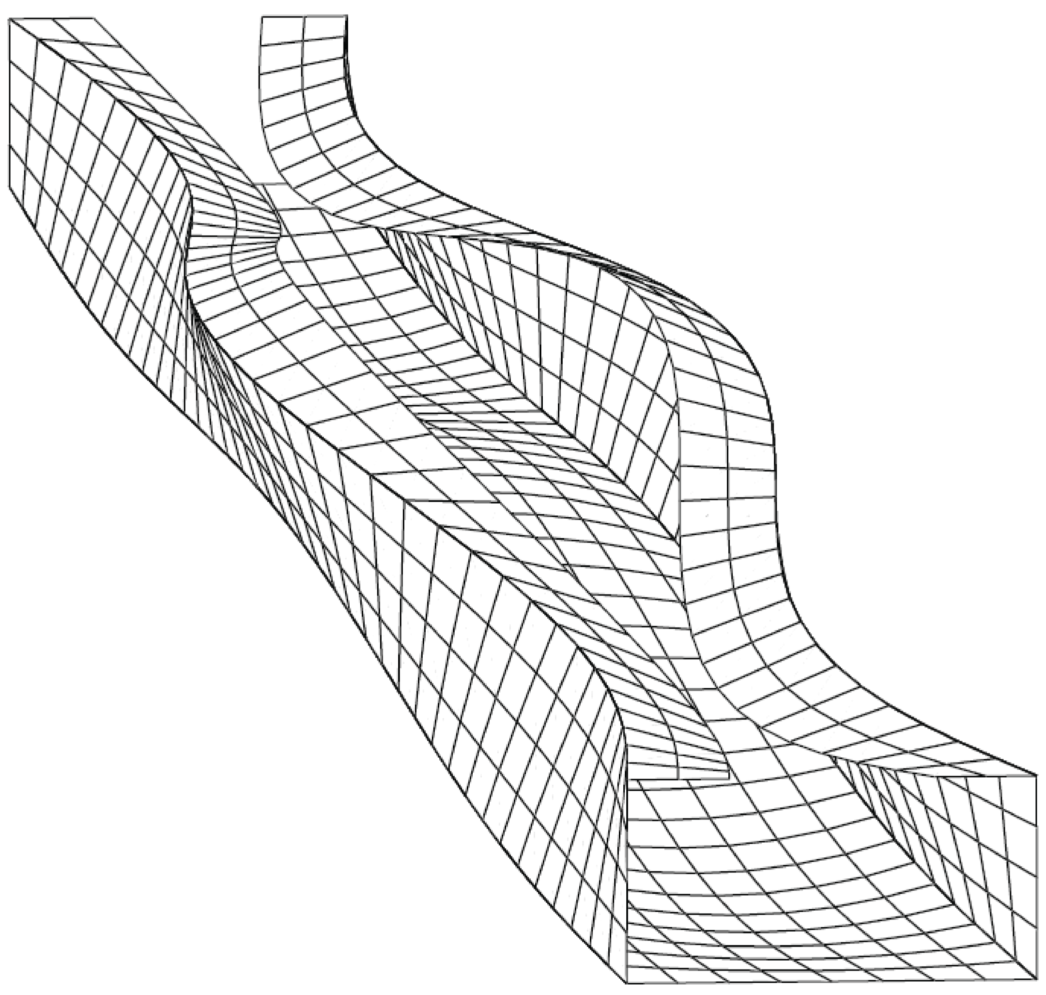

Figure 3: Distorted cross section.

Purpose and Methods

The new theory is a considerable theoretical improvement which can provide fast analysis of complex dynamic problems and stability related issues. Thus making it a good alternative to classical and time consuming finite element calculations.

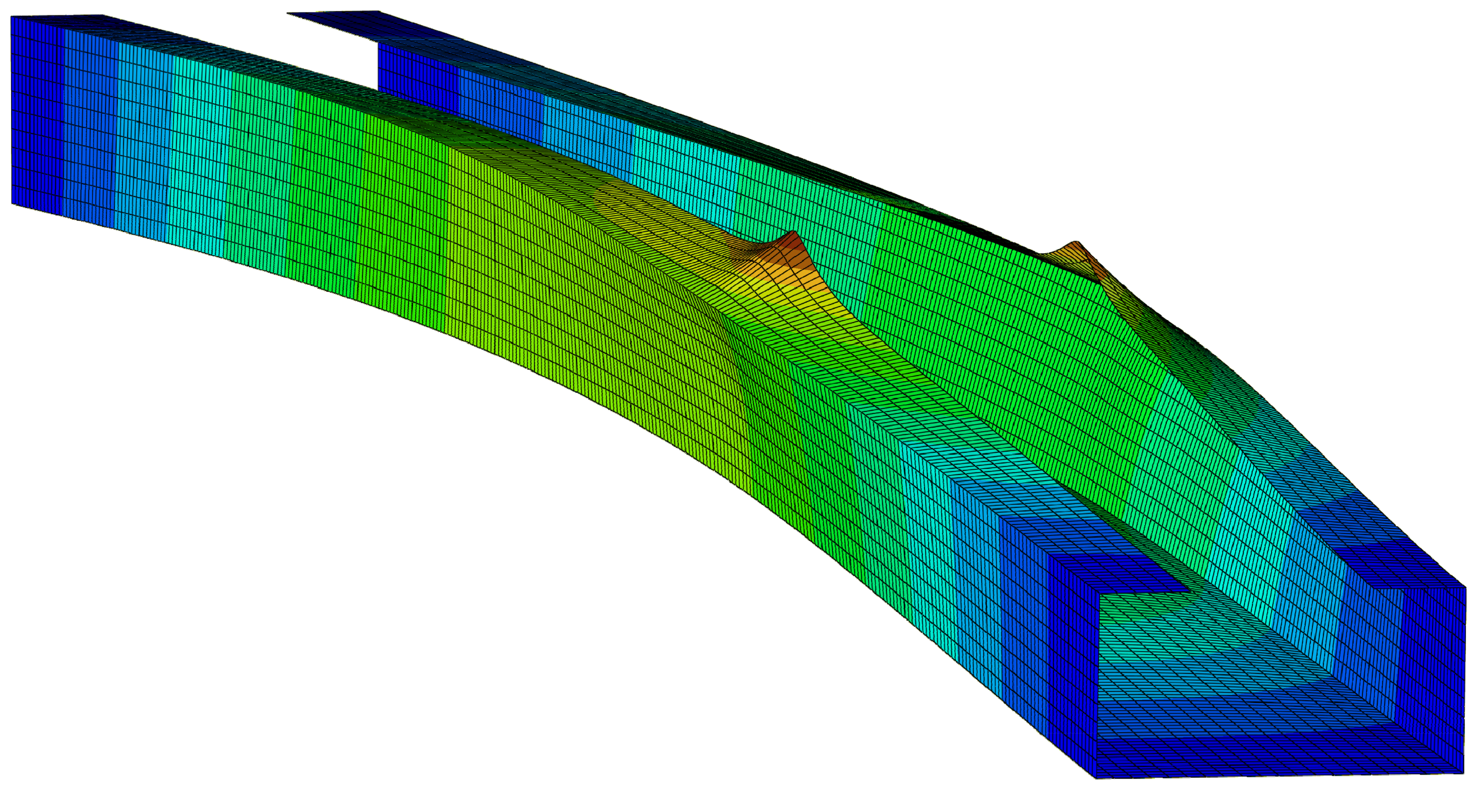

Figure 4: Shell Finite Element Model: Time consuming and CPU expensive model using 92106 degrees of freedom.

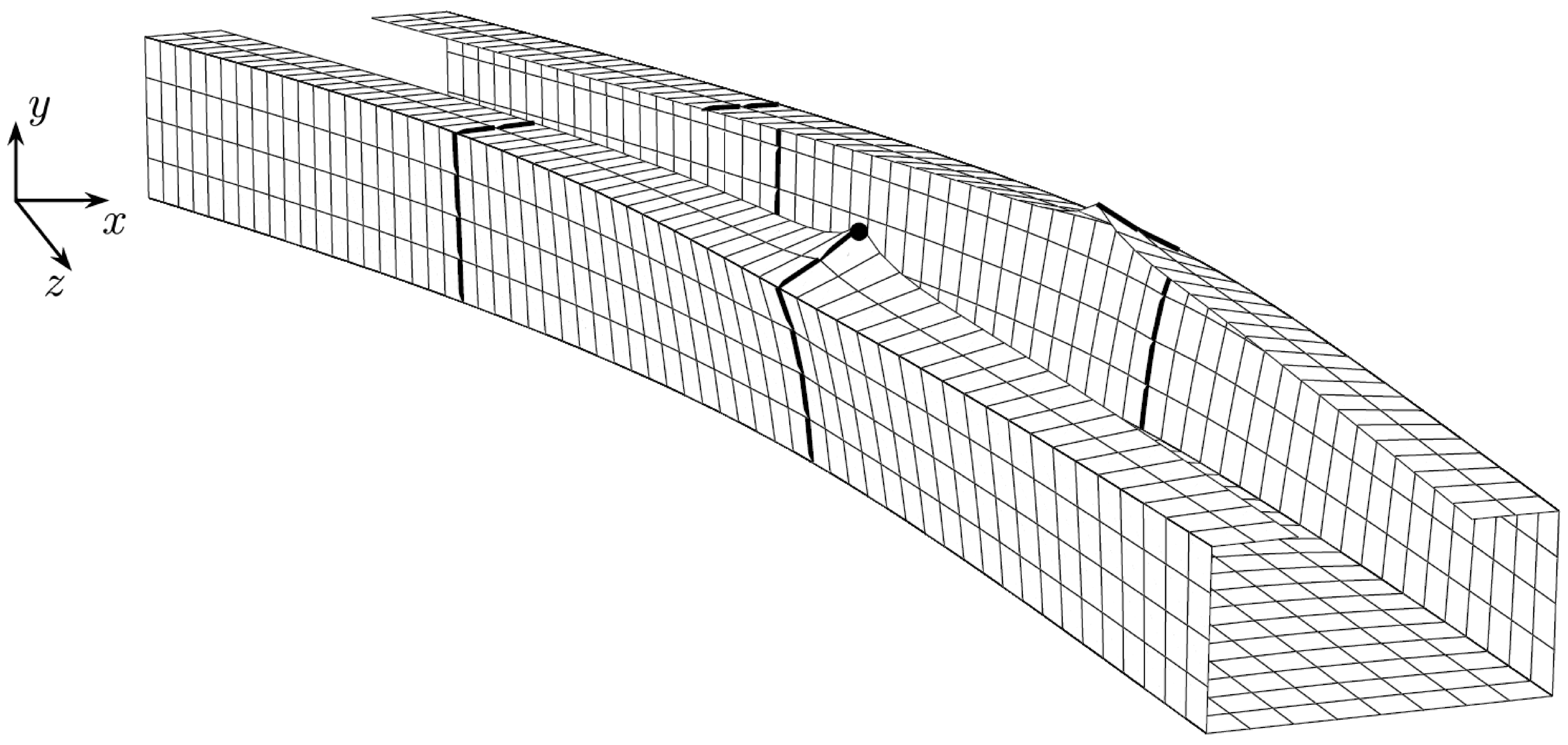

Figure 5: Generalized Beam Theory (GBT) model: A fast and economic alternative using only 264 degrees of freedom.

Due to this mode based approach the mechanics of the problems at hand are very well described and understood.

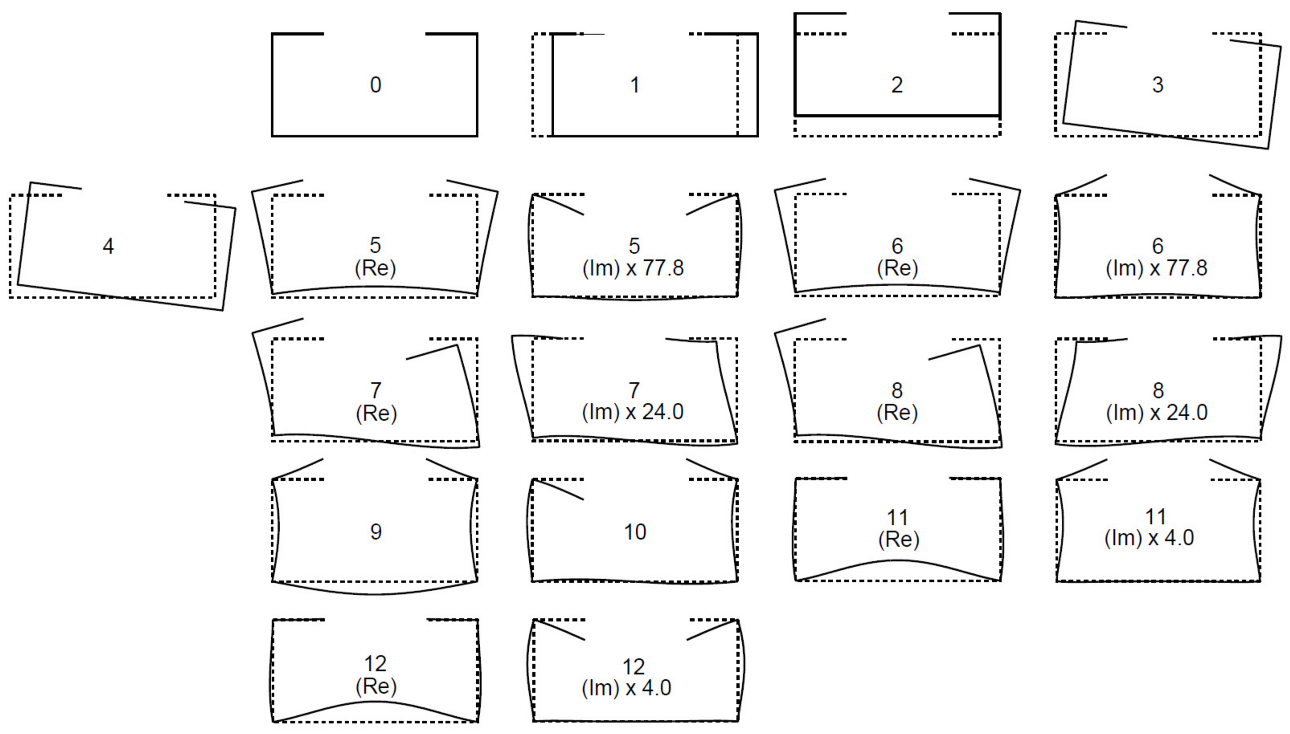

Figure 6: Lipped channel – 13 in-plane deformation mode shapes.

Results

	GBT [mm]	Abaqus [mm]	Difference [%]
u_x	-1.424	-1.415	0.6
u_y	4.697	4.772	1.6

Table 1: Nodal displacements of GBT and FE analysis.

	GBT [MPa]	Abaqus [MPa]	Difference [%]
σ_z	-31.2	-38.6	4.8
σ_s	492.3	481.9	2.1

Table 2: Stress distributions of GBT and FE analysis.

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