Universität Stuttgart

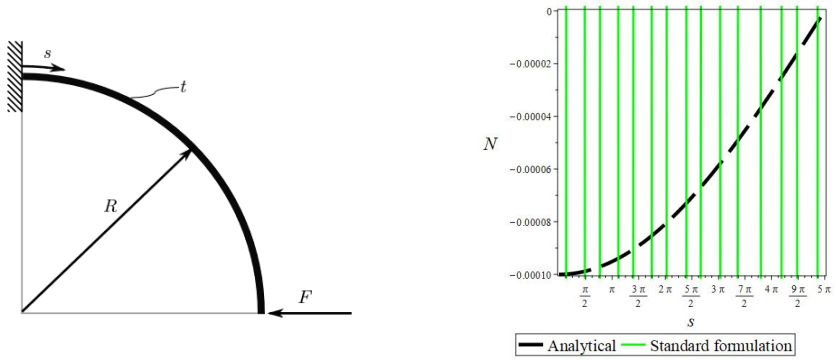
Baustatik und Baudynamik

Master Thesis

An investigation of intrinsically locking-free beam formulations for arbitrary discretization schemes

Shear-deformable beam and plate formulations are popular owing to the low continuity requirements between elements. However, the locking phenomenon hinders the approximation quality when choosing a relatively coarse mesh. For these formulations, the origin of locking is not in the method of discretization, but in the underlying differential equations being solved. With this motivation, a set of intrinsically locking-free formulations was developed that show locking-free characteristics irrespective of the discretization scheme.

In this thesis, Hierarchic Formulations (HF) and the Mixed-Displacement (MD) method ought to be investigated for different discretization schemes in terms of their locking-free behavior. Several problems with different boundary conditions and different loading conditions should be studied in the framework of shear-deformable beam theory. Lastly, a systematic comparative investigation of the quality of the results is required.



Oscillating member forces for a curved beam with $R/t = 100$

The specific tasks are

- Familiarization with intrinsically locking-free formulations (HF and MD)
- Familiarization with different discretization schemes, namely standard finite element method, isogeometric analysis, collocation, and mesh-free methods.
- Study HF and MD-based straight beam elements for arbitrary discretization schemes with different boundary conditions and different loading scenarios.
- Investigate the MD method for a curved beam element for arbitrary discretization schemes.
- Summary and evaluation of the results

Recommended fields of interest

Discretization methods, element technologies, locking.

Literature

Oesterle, B., Bieber, S., Sachse, R., Ramm, E., Bischoff, M., 2018. “Intrinsically locking-free formulations for isogeometric beam, plate and shell analysis”. Proc. Appl. Math. Mech. 18.