

YEAR 2 – Professional skills for Civil Engineers II

Development of an electronic structural analysis and design tool

Introduction

This project is a part of a semester long module that aims to develop our students professional skills through project based learning. The module focusses on three independent areas, namely a) Development of electronic tools for engineers, b) Employability and c) Entrepreneurship. Within the scope of the first area, civil engineering students were asked to develop an analysis tool for simple structural design and analysis as if it was commercial software.

Activity Description

- Each group comprises 5-6 students. The students are given a structural form (a truss or frame) and are asked to create a general, foolproof software either in MS Excel or MATLAB, that can analyze the particular structural form for any dimensions and a selection of load locations and directions. A selection of different structural sections should also be available for design purposes.
- For the first work package, the software, given section dimensions and material grade, should calculate sectional properties for 3 or 4 different sectional forms (i.e I-, CHS, RHS etc).
- For the second work package, upon input of loading the software should provide stress resultants (BMD and SFD for frames and AFD for trusses). Also upon selection of sections of each member the software should provide elastic displacements and warning for member buckling, yielding and when span/deflection ratios according to Eurocodes are violated.
- It is essential that the software should be user-friendly and straightforward to the user. More importantly all calculation cells must be locked and validation checks must be performed prior to its submission.
- All groups were asked to create a video tutorial for their software as well as a printed user manual.
- Students were asked to research online and use manuals in order to program their own software.

Highlights and resources

- Such a project aims at reinforcing existing knowledge which is relatively recent (i.e. elastic beam and truss analysis). Creating a general (in terms of dimensions and loading) model and then programming it in a software for another person to use helps understanding, while the creation of the video tutorials enables students to explain in their own words and verbalize their understanding.
- Project briefs can be found at www.steliosyiatros.weebly.com/teaching.html
- Some of the project video tutorials can be found at the CIVENGatCUT channel on YouTube. Two examples follow:
 - <https://www.youtube.com/watch?v=0C2IlaZZX2M>
 - <https://www.youtube.com/watch?v=ONJQEzHTRbo>

Student feedback

- All students commented that the exercise forced them to think deeply and test their existing knowledge of structural analysis. Having to structure their thought process for analysis and explain it to others, provided them with the opportunity to revise

and work out and learn the fundamentals of analysis. Furthermore, they were also exposed to design requirements such as section properties, section classification, deflection and elastic limits, as well as buckling.

- Also for the first time in their studies, they were able to leverage their new knowledge into a “potentially commercial” product with value. At a later stage in the semester, they were asked to consider themselves a startup and find a market for this product.

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