



## Learning structural behaviour of trusses through laboratory models

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## Summary

This paper presents a methodology applied to teaching of subjects related to structural design and analysis, as well as strength of materials, during the second year of our University studies program. The aim of this methodology is to improve the students' understanding of the structural behaviour from the very early stages of their college education process.

Students take part in a workshop that fosters their involvement within all the stages of the process of the structure design, such as characterization of the material to be used, analysis of different theoretical models based on theoretical courses, structure numerical simulation using an ad-hoc mobile app, building the model, test their model in the laboratory and drawing up conclusions explaining the model collapse.

**Keywords:** structural design; structural models; structures lab; significant learning; structural model competition, spaghetti structures, spaghetti trusses; mechanical properties; skill-based learning.

## 1. Introduction

In order to enhance the students' motivation, an annual spaghetti truss competition is held just when the students have to test their models. In this competition our students are split into groups with 2-3 persons in each, and they have to design and build a structure under certain common bases. Awards consist in up to two points added to the final grades for teams developing winner models.

They must fulfill some milestones in their path. First, they have to figure out the mechanical properties of the material they are going to use. Then, they will design their truss and build the model with spaghetti. Eventually they test their model on a universal testing machine and, after discussing the results, extract their conclusions.

## 2. Mechanical properties of the material

Holding a competition within the learning process fosters establishing relationships among the knowledge acquired in both subjects: Building Materials and Structural Design. This is due to the students' interest in acquiring skills that allow them to fine-tune the performance of their model. These skills comprise a better understanding of both: the material mechanical behaviour of the material, and the inherent characteristics of truss systems.

In order to accomplish it, five different approaches have been used: Deepening the students' understanding of simple concepts related to strength of materials; designing a tests campaign all together, students and teachers; designing a suitable laboratory test to obtain the material mechanical properties; studying the obtained results achieved and discussing them in groups; being able to manage essential concepts and obtaining parameters applicable to structural models, as well as foreseeing the structure behaviour. Some of these concepts are sampling, precision, accuracy, standard deviation, mean and characteristic strengths, experimental error, etc.