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DEVELOPMENT OF DIDACTIC EQUIPMENT FOR IN-CLASS EXPERIMENTAL ANALYSIS OF BEAM BENDING

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ABSTRACT

This work presents the design and development of an educational equipment intended to provide for experimental stress analysis techniques out of the laboratory, that is, for in-class demonstration problems. The equipment was designed in order to present the theory of beam bending in different loading/supports configurations. It was designed for portability while allowing for ease of use by students both in handling of loads/supports and measurement methods. The design, construction, testing and validation against analytical and numerical methods are presented.

Keywords: educational equipment; experimental stress analysis; beam bending

INTRODUCTION

Some of the most common educational procedures for experimental mechanics and mechanics of materials are based on problem solving and well established. A common difficulty faced while teaching this discipline lies in the translation from abstraction to physical reality. This is overcome, as possible, with demonstration problems closely related to practical engineering problems. Other strategies are helpful and can be used with advantages: project based learning (Crone, 2002), computer assisted problem-solving (Philpot et al., 2003), use of experimental apparatus to demonstrate theory (Kadlowec et al., 2002). For that purpose an educational project was established at several disciplines related with Mechanics of Materials and currently teaching at the University of Minho. This project consists in the development of portable data acquisition equipment that uses telemetry for data transmission, coupled with portable in-class demonstration apparatus. This work presents the design and development of one such apparatus for the analysis of beam bending theory. Such equipment can also be used with stress analysis techniques, namely strain gauges.

RESULTS AND CONCLUSIONS

The developed equipment is presented Figure 1. The design consists of a base frame built using stiff aluminium extrusions wherein supports for beams of rectangular section were added. These supports are modular in the sense that can easily be modified for fixed (clamped) or simply supported cases. The length between supports can also be modified as well as load weights. Figure 2 presents preliminary results of validation, comparing experimental values of maximum deflection with results from numerical and analytical techniques, for a simply supported beam and load at mid-span. Detailed results and validation are pending for the final full paper version.

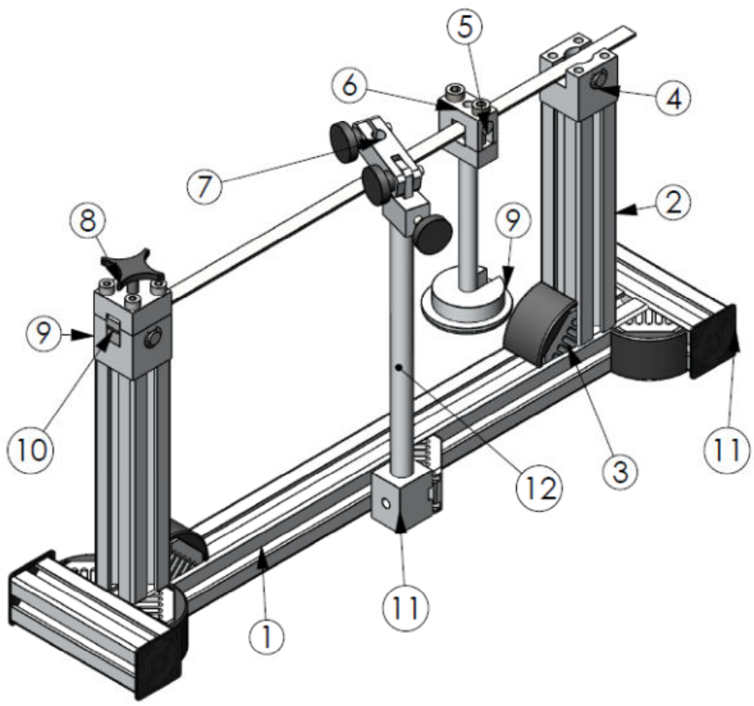

Fig. 1 - 3D view of didactic beam bending apparatus

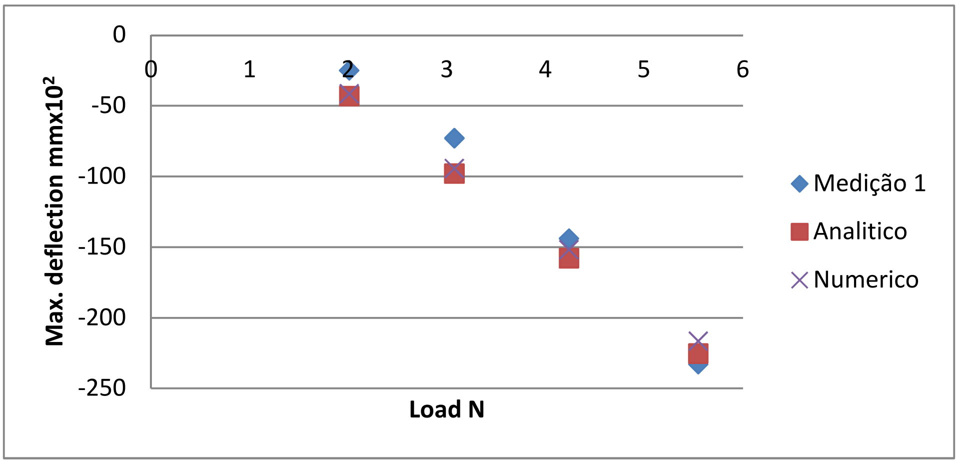

Fig. 2 - Validation results

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