Master's Thesis Engineering Technology

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The design and assembly of a compact setup for testing helical springs and bolted joints

Pieter Goiris

Master of Electromechanical Engineering Technology

Problem statement and aim

At the University of Girona, the students of the bachelor of mechanical engineering perform tests on a compression spring and a bolt connection within the context of the course on machine elements. The goal of this master's thesis was to design and build a compact and interactive device to load these components. The device allows to apply a compressive force from zero to 1000N onto the spring and a tensile force from zero to 5000N on the bolt connection, which is either preloaded or not. The device is manually driven. Furthermore, the applied force is measurable with an accuracy of at least 5% and the compression of the spring with an accuracy of at least 0.5 mm. The maximum dimensions are 800mm x 350mm x 350mm. Finally, the device is considerably more ergonomic in use than the old device.

Method

Understanding the problem

To gain a clear insight into the subject matter it was necessary to study the course material regarding bolt connections and springs that the bachelor students also process during their studies. Furthermore, the tests for which the new device will serve, have been done repeatedly so that it became clear how the lab sessions practically take place.

Split into subproblems

The problem was split up into subproblems such as setup, transmission, frame, movement, etc. This ensures a more surveyable elaboration of the design. For all subproblems, a list of possible solutions was elaborated. These subsolutions were combined into a morphological overview which gives a clear view on all the options for the final solution. After this, the best solution for every subproblem was chosen by the means of a SWOT-analysis.

Design subsolutions

Then, the chosen subsolutions were designed in detail, taking into account strength calculations and connections with other subsolutions.

Combine subsolutions into total 3D design

Image 1: morphological overview

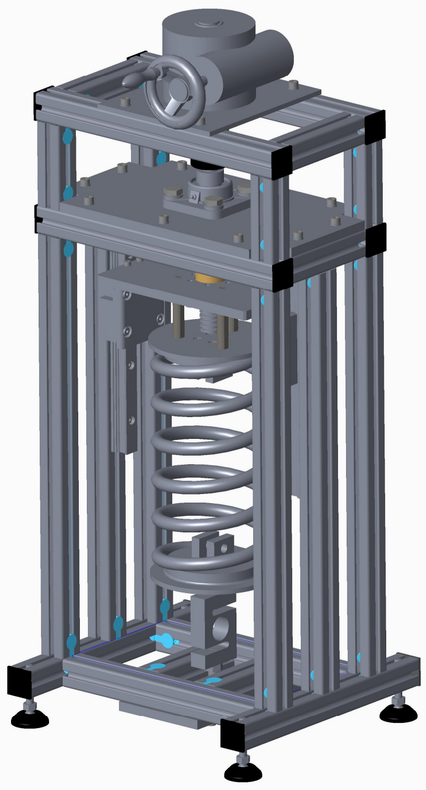

Image 2: 3D Design in PTC Creo

Realization

The 3D design was put into technical drawings. Finally, the manufactured parts and the bought parts were assembled to build the device according to the assembly drawing. A user manual was provided for the lab sessions, explaining the practical use of the device.

Tests

After the assembly of the device, a series of test with both the spring and the bolt connection should have been carried out to assess the accuracy and ergonomics of the new setup.

Conclusion

The designed device meets all requirements, it takes up a lot less space in the mechanical laboratory and it is more ergonomic due to the ergonomic height of the manual input movement and the absence of heavy weights. All 2D worksheet drawings are provided, a price calculation has been made and a short user manual is provided. The price calculation shows that the majority of the cost goes to the working hours needed to manufacture the parts.

However, due to unexpected delays in the production of the parts, more specifically because of unusual workloads at one of the suppliers, it was not possible to assemble and test the device before the presentation of the master's thesis. All parts were ordered and would arrive soon after the presentation date. After the presentation, the device nevertheless will be assembled and tested, so that a thorough comparison with the old device is possible. This comparison exists of a series of tests which give us a clear, statistically correct view on the measurement uncertainties.

Supervisors: Dr. Norbert Blanco Villaverde (Universitat de Girona)
Prof. dr. ir. Albert Van Bael (KU Leuven)

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