

The Importance of Education on the Subject: Technology of Mechanical Joining

機械性接合工藝教育的重要性

First, some popular aphorisms and thoughts by wise people:

“He who loves practice without theory is like the sailor who boards ship without a rudder and compass and therefore never knows where he may cast.”

- Leonardo da Vinci

“... we must not only invest sufficient funds in science, but the education must also become a priority”.

- Zuzana Čaputová, President of the Slovak Republic

“It's not derogatory to be stupid, but stupid to stay it's a shame”

- N.N.

Introduction

In the works of many authors, the contrast between the importance of screw connections in the mechanical connection of parts and the attention paid to them by the professional society was repeatedly emphasized. And the reason? Fastener elements are produced on a mass scale, are easily available and, above all, cheap. I recently conducted a small experiment. In front of the entrance gate to an unnamed Fastener Fair, I threw a bolt (Fig. 1) on the ground and watched from afar to see what would happen.

Apart from some people kicking it, nothing happened at all. No one stopped to wonder what the screw was doing there, how it got there, and why it came loose. Everyone was hurrying about their business. No one realized that a screw as such can also serve as a valuable study material.



Fig. 1. Bolt

There Would be No Industrial Revolution Without the Threaded Fasteners “Mission”

The Watt engine (Fig. 2) was a defining development of the Industrial Revolution because of its rapid incorporation into many industries. James Watt could start the industrial revolution with his invention because, metaphorically speaking, he stood on the shoulders of the pioneers of the development of screw joints. And, there were not a few of them. Fig. 3 shows only the torso of them.

Let one of the most professional continue to talk about it.

Chief of Mechanical Engineering Department of Design Engineering and Joining Technology of University of Applied Sciences Zwickau, Germany, Prof. Dr.-Ing. Bohumil Brůžek said:

“In practice, bolts are the most widely used machine components. The use of bolted joints is very versatile. A failure of the bolted joint could cause serious consequences. Therefore, proper design, dimensioning and subsequent assembly of bolted joints is of great importance. In industrial practice, however, **the importance of bolted joints is very often underestimated and bolts are only used according to “feel”.**”

As mentioned above, bolted joints are used in many different ways. In order to facilitate their use, various shapes and geometries of bolts have been standardised. However, there is no standard for the dimensioning and assembly of a bolted joint. Therefore, at least a few guidelines have been developed in Germany within the framework of the VDI (Verein Deutscher Ingenieure e.V. - Association of German Engineers), which very quickly found acceptance throughout Europe. They help the designers to design the bolted joints “correctly” and to pay attention to the corresponding assembly parameters. This is also taught in the training courses at colleges and universities.

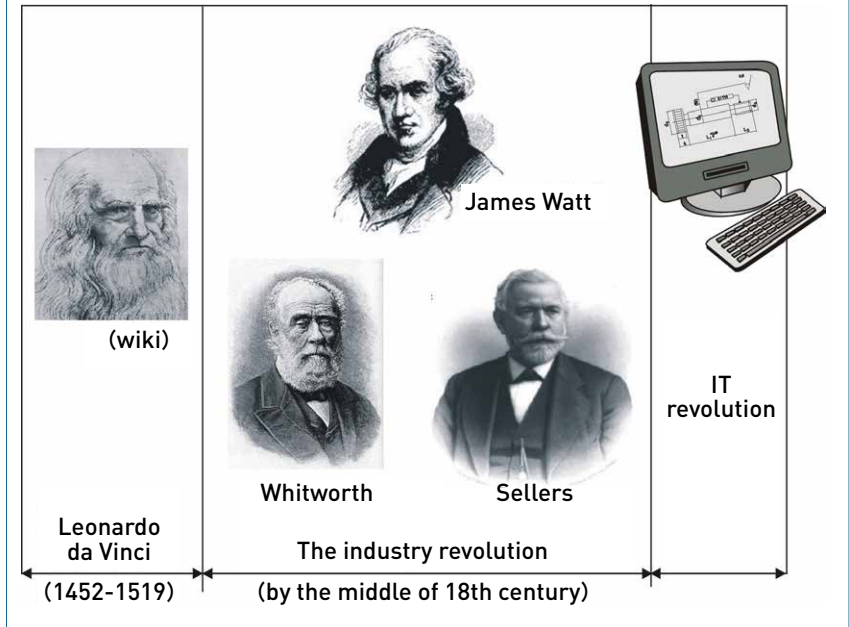
The “classical” education in the mechanical engineering study at the University of Applied Sciences in Zwickau (WHZ) naturally also includes imparting the specialist knowledge about bolted joints. First of all, the subject of Design Theory teaches how a bolted joint is represented on a drawing. Some design tips are also discussed. Furthermore, the dimensioning of bolted joints is explained in the subject Machine Elements. However, the theory is limited to the “basic bolted joints”, i.e. centrally tensioned and centrally bolted single bolt joints.





Fig. 2. Watt engine

Fig. 3. Screw joint pioneers



Students can also try out the acquired knowledge for themselves in the context of accompanying practical courses. The students can also work on the topic of bolted joints within the framework of student work. In doing so, they investigate, among other things, friction values in the connections or reduction of the pre-tensioning forces as a result of the setting behaviour.

The aim of education is that students can be considered as qualified specialists on the labour market and avoid the failure of bolted joints as far as possible through proper design in practice.

Because I also lectured there externally, I can confirm these words and add that the named department has a perfectly equipped laboratory, which is very important. Despite this, **a significant decrease in students' interest in studies can be observed. Many dangerous accidents would not have happened if...**

Let the crash of the MB 80 of the Alaska Airlines company be a memento due to excessive wear due to insufficient lubrication of the retractable (elevating) screw, where 88 people died. Even such similar cases as the accident of an indoor swimming pool (the author reports on this elsewhere), the release of car wheels while driving and countless other cases caused an enormous boom in science and research. Let us mention at least the development of the apparatus for testing the resistance of screw joints to vibrations and dynamic stress, which was constructed by Gerhard H. Junker and first published in 1969 under the name The New Criteria for Self-Loosening of Fasteners Under Vibration, after which it was also named the Junker test (Fig. 4).

This was an important step for a radical increase in security. It is part of the stable laboratory equipment of many important theoretical workplaces.

Conclusion

It is not known exactly why, **but students' interest in studying the given subject is decreasing and it probably does not only apply to Europe.** It is impossible to agree with the opinion that the given topic is theoretically exhausted and has reached a saturated state. ■

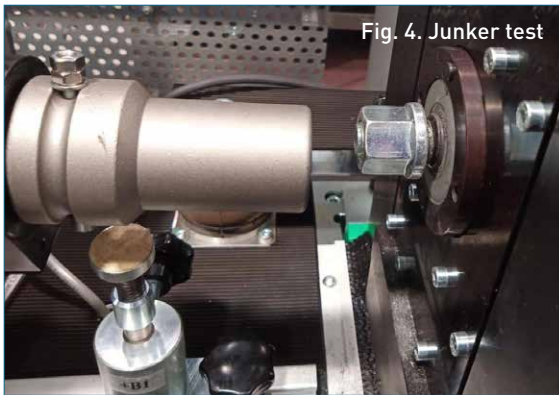


Fig. 4. Junker test

In the course of their studies, students can further deepen their knowledge of bolted joints in the subject "Connecting elements". The content here concentrates on the design of bolted connections according to VDI 2230. The calculation is also extended to eccentrically bolted and braced bolted connections. Also discussed are multi-bolt connections, which can occur more frequently in practice than single-bolt connections. However, it is not useful to calculate the bolted joints in a time-consuming and accurate way if they are then assembled incorrectly. For this reason, the assembly process is explained in detail and the consequences of assembly errors are explained.