Research of Machinery Equipment Metal Structure Course Experimental Teaching Based on CDIO

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ABSTRACT

"Machinery Equipment Metal Structure" is one of the core professional courses in engineering machinery. Based on colleges and universities' comprehensive training requirements for students' theoretical and practical aspects, and the current situation of the course teaching, we designed the destructive experiment of truss and box girder based on CDIO engineering education ideology. In terms of experimental content and teaching model, abilities of students are explored deeply, which deepen students' understanding of metal structure curriculum theory, and enhanced the students' practical ability, and improved students' awareness of innovation. What's more, it adapts to the needs of construction machinery enterprises and cultivates the higher qualified professional workers.

KEYWORDS

Machinery Equipment Metal Structure, truss girder, box girder, destructive experiment, CDIO

Machinery Equipment Metal Structure is a core professional course in the direction of lifting transportation machinery, engineering machinery, logistics machinery. Course is mainly about the application of steel structure of hoisting machinery, material selection and calculation method of steel load, strength, stiffness and stability, research methods, and design methods to the steel structure of typical hoisting machinery to train students for the practical problem, applying the learned knowledge to analyse and solve problems of engineering practice and innovation ability. Therefore, in the teaching process, we must pay attention to this part of the experiment teaching. Due to the experimental conditions, the traditional experimental teaching is mainly about demonstration teaching, students can not actively participate in the learning in the past, can't effectively enhance the students' learning motivation, and can't increase the ability of students to engineering practice.

The authors introduce the CDIO model for Machinery Equipment Metal Structure's experiment teaching course, relying on Yanshan University Mechanical College of the existing laboratory equipment and experimental conditions, design truss girder and box-girder destructive teaching experiment, the experiment has changed the traditional teaching mode, allow students to learn in the way of practice ,initiative and organic link between different courses, to improve the ability of students' engineering applications and cultivate innovative consciousness and sense of team. It plays an active role in deepening students' understanding of the metal structure of curriculum theory and practice, cultivating the engineering talent.

THE PRESENT SITUATION OF MACHINERY EQUIPMENT METAL STRUCTURE EXPERIMENT TEACHING

The existing teaching experiment of metal structure is generally divided into two kinds: the first one is the traditional simple experiment, which mainly refers to the experiment course of architectural steel structure, mostly for the component or planar structure experiment, such as beam bending experiment, column axial and plane truss experiment and so on. Restricted by laboratory equipment, experimental cost, mostly for demonstration and non-destructive experiment, students just watch the instructor operations and record the experiment data [1]. Students in the role of visitors rather than the role of the participants are involved in learning, have not a deep understanding of the experiment content and principle, engineering practice capacity can't get exercise. Domestic metal structure experiment of most colleges and universities adopt such way; the second is a new experiment on the actual use of machinery equipment steel structure, such as crane, crawler crane, transport machinery metal structure, such as Southwest Jiaotong university metal experiment is based on the actual use of a crane. Due to the different experimental conditions of each school, this model is also not suitable for popularization. Therefore, it is imperative to set up a Machinery Equipment Metal Structure course, which is in line with the industry development needs, improve students' practical ability, and satisfy the requirement of teaching and scientific research.

CDIO ENGINEERING EDUCATION CONCEPT

The CDIO engineering education concept, since 2000, by the MIT and the Swedish Chalmers Industrial University, Linkoping University, the Royal Institute of technology in Knut and Alice Wallenberg Foundation jointly explore engineering education outcomes. Product life cycle as CDIO (Conceive, Design, Implement, Operate) carrier, allows students to learn engineering in the way of initiative and practice, organic link between curriculums, to train engineering talents who meet the needs of society engineering application capabilities[2,3]. CDIO engineering education concept cultivate the students' engineering ability with the whole process as a carrier, including personal knowledge of engineering science and technology, the students' lifelong learning ability, team communication ability and products, processes and system build capacity under the environment of society and enterprise[4].

MACHINERY EQUIPMENT METAL STRUCTURE TEACHING EXPERIMENT DESIGN BASED ON CDIO

The main content of the Machinery Equipment Metal Structure destructive experiment are based on practical engineering machinery as the prototype , guide students to design truss beam and box beam scale model, 2m trapezoid truss beam and box beam of 700mm, and destructive experiments. Based on CDIO engineering education concept, design the whole experimental process according to the product life cycle (conception, design, implementation, operation) from development to operation, as shown in the figure 1 below:

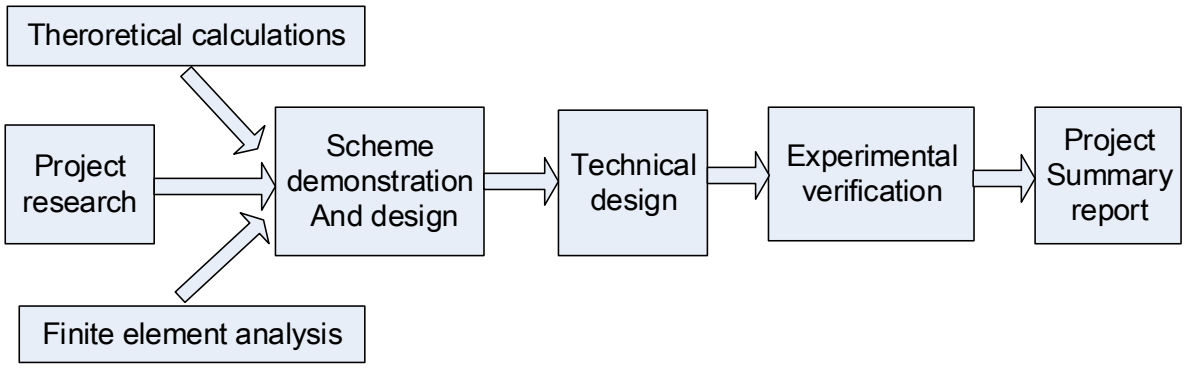

Figure 1 Curriculum organization mode

1. Scheme of the experiment

After the students selected topics, guidance teachers guide students to refer to the current crane structure design code,the construction and acceptance specifications, truss standard atlas, and lead the students to visit the laboratory existing double girder gantry crane, the site to watch various structure types of the truss and box girder crane,to explain the truss and box girder crane design idea as well as advantages and disadvantages, and the proportion between its various components are the key of mapping. Visiting and learning on the scene,let the students for a intuitive understanding of theoretical knowledge, understand and master theoretical knowledge.The students conceive during a visit to learn, complete the model contour design of truss girder and box girder.

2. The design of the experimental scheme

Same subject students in group of five or six, under the organization of the team leader to carry out discussion with the group,members,and give full play the enthusiasm and creativity of team,advantages and disadvantages compared to discuss the design of each student, drawing a little later presented the design scheme.To design three-dimensional modeling of the group scheme, and analyze its load using ANSYS software, put forward improvement opinions on the scheme and the optimal design scheme, complete the design analyze report.

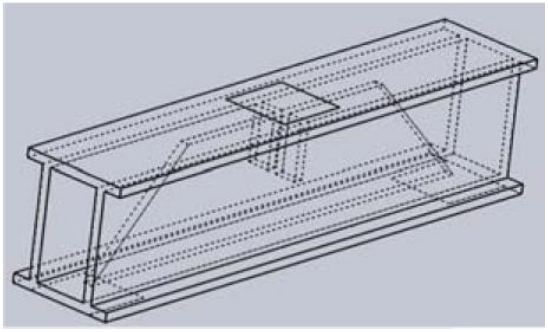

Figure 2. Three-dimensional model

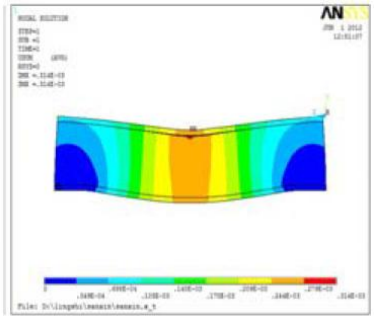

Figure 3. Compressive strength analysis

3. The experimental scheme implementation

After analyzing and modifying, put forward the optimum scheme, under the guidance of instructors, team members cooperate to complete truss beam and box beam welding production. After the test specimens produced, students complete their own truss girder and box beam structure destructive experiments measuring strain point selection, polish, strain gauge selection, patch, and experimental load loading, experimental data acquisition and experimental data processing, etc.

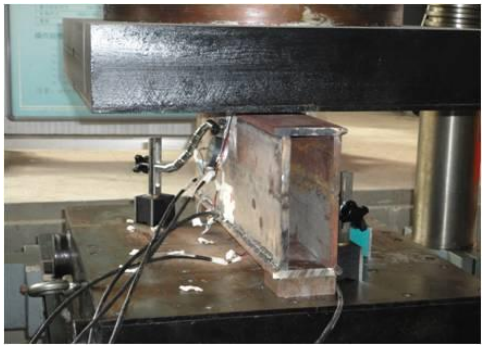

Figure 4. Field test

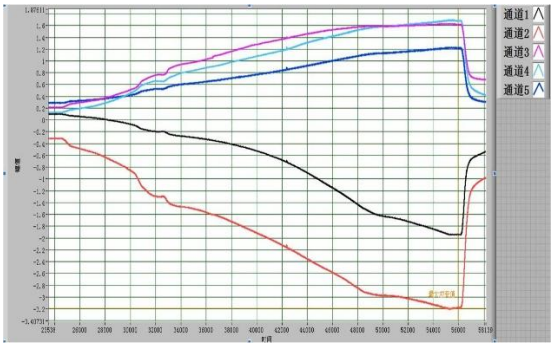

Figure 5. Load graph

Processing experimental data do not represent the end of the experiment, the team members combine data calculation with ANSYS software to analyze experimental data, improve, put forward improvement proposals and fully accomplish theory to guide practice, practice verify theory, finally return to guide the practice.Finally, write experimental report and experience. The whole experiment is the design process of the product, students not only master the theoretical knoeledge, but also improve the application ability of engineering practice, cultivate the team cooperation ability.

4. Scheme operation

The whole experiment teaching take the students as the main body, the laboyatory take open management mode. Students dispose of spare time freely, complete the design, construction and experimental work. The guiding teacher track management, provide guidance and corresponding experimental equipment. According to the concept of CDIO engineering education, educators transform into guider, it takes the initiative to learn, analyse and solve problems for students. Finally, students master the knowledge and cultivate skills in the experiment.

CONCLUSION

Machinery Equipment Metal Structure course experiment design based on CDIO take product development process as the main line, fully combines the CDIO (conception, design, implementation, operation) engineering education guidance, provide an experimental platform for students to promote and enhance the experimental ability. This reforms the traditional teaching mode and integrate teaching, experiment with practice training, strengthen the professional basic knowledge and the shills training, cultivate students' ability of theory combined with the actual.In the process of the whole experiment, students not only master relevant theoretical knowledge, and improve the students' ability to use knowledge, to solve the problem. It realized the higher education goals of mastering knowledge, exercising capacity and improving the quality .

REFERENCES

[1] Q. D. Qin& R. H, & H. Geng, (2013). Research and development of aero electronic experiment course based on the CDIO education concept. China Electric Power Education, 22, 164-165.
[2] L. Y. Peng, & A. J. Chen, (2010). Research and practice of non-destructive experiment teaching of simply supported steel truss. Modern Science, 265.
[3] Y. Zhou, & M, Zhou, & G. Z. Jiang, (2013). Experiment teaching reform for industrial engineering majors based on CDIO. Laboratory Science,16(2), 72-75.
[4] M. L. Zhang, (2009). Discussion of mechanical engineering education reform based on CDIO engineering education concept.Research on Education of Shanghai University of Engineering Science, 26-28.

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