East African Scholars Journal of Engineering and Computer Sciences
Abbreviated Key Title: East African Scholars J Eng Comput Sci
ISSN 2617-4480 (Print) | ISSN 2663-0346 (Online) |
Published By East African Scholars Publisher, Kenya
Volume-2 | Issue-10 | Oct-2019 |

OPEN ACCESS

Research Article

Exploration and Practice of the Curriculum Reform of the Finite Element Method

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Abstract: The finite element method has become a useful numerical analysis tool in engineering analysis. In most engineering colleges, the "finite element method" has been widely regarded as an important degree course in graduate courses. As a tool-based course, the principle of teaching reform of the finite element method of engineering majors is to cooperate well with other professional courses to realize the professional training objectives. In view of the characteristics of the finite element method and its problems, this paper implements a set of teaching reforms from the aspects of teaching methods, practical methods, and textbook rectification, and puts forward constructive measures. After practice, it has achieved good teaching effects and realized the goal of modern engineering education reform.

Keywords: the finite element method; theory; practice; teaching reform.

1. INTRODUCTION

The basic idea of finite element arises from the need of Boeing aircraft structural analysis. Courant published a paper on the use of slice polynomials in the triangular region to deal with torsion problems in 1943, and the name "finite element" was officially proposed by Clough in 1960 (Jingquan, Lv. 2011).The finite element method is a numerical method that approximates the real physical system. After more than 60 years of development, the theory is quite perfect and its application is very extensive. The finite element method plays an important role in the national economy and science and technology because of its excellent characteristics in adaptability to complex structures, applicability to various physical problems, and high efficiency of computer implementation (YU, Y. T., & DU, P. A. 2008). The finite element method is a discretized numerical calculation method. It can calculate various complicated engineering problems by means of computers. It is a powerful tool to solve problems, such as structural analysis, fluid mechanics, electromagnetics, thermals, and elastic mechanics. Through the continuous efforts of mechanics and computational mathematics, the application of this method has penetrated into the research fields of civil engineering, water conservancy, machinery, aerospace, weapons, materials, and electromagnetics (Shuguang, R. *et al.*, 2016). Mechanical engineering graduate students need to master the theoretical methods of modern science and technology such as computer science, study the working principle, motion and dynamic performance of various mechanical systems, structures and their components, theoretical methods of simulation and optimization, vibration and noise , friction, wear and lubrication, transmission, innovative inventions and design and calculation methods. The finite element method has become one of the indispensable tools for mechanical engineering graduate students to carry out mechanical design and solve practical engineering problems. Therefore, the finite element method is generally included in the graduate degree program (Liu, Yi., & Yujun, X. 2012).

2. TEACHING CONTENT REFORM

2.1 Problems in Traditional Teaching

The reform of teaching methods is one of the important contents of China's current higher education reform.In the finite element traditional acceptance teaching mode, the content of the "teaching" and "learning" of the course is pre-set, and the content is mostly the accumulation of experience of the predecessors; most of the teachers only focus on the explanation of traditional theoretical knowledge, it is disadvantage to inspire the students' innovative

Quick Response Code

Journal homepage:
http://www.easpublisher.com/easjecs/

Article History
Received: 13.09.2019
Accepted: 26.09.2019
Published: 09.10.2019

DOI: 10.36349/easjecs.2019.v02i10.002

thinking.And this course has strong connection with engineering practice.The finite element method should focus on cultivating students' ability to solve practical engineering problems, not just limited to the instillation of theoretical knowledge (Pan, Z. 2000).The curriculum construction has not kept pace with the professional expansion of the course.

- The teaching mode is still characterized by the original mechanics major. The proportion of theoretical teaching is too large, and the practical teaching method is easily ignored. This is not in line with the training objectives of most engineering majors, and the fundamental knowledge and interest of students (Zhaoping, W. 2013).
- The curriculum lacks professional orientation and lacks content association and cooperation with other courses in the profession.
- From the past teaching situation, students generally reflect that the theory is difficult to understand, the curriculum is useless, and have less interesting in learning this course. At the same time, since the perspective of the birth and development of finite element, it has always been based on the solution of practical engineering problems. Therefore, simply carrying out theoretical teaching is easy to keep away from reality, which is not conducive to cultivate high-quality, creative products design analysis talentso for engineering applications (Wei, T. *et al.,* 2010; Xiaojian, W. 2011; & Xiaorong, W. *et al.,* 2011).

2.2 TEACHING REFORM METHODS

With the advancement of society and the rapid development of science and technology, the demand of finite element analysis application talents in many industries is increasing.Postgraduate education in colleges and universities should adapt to the needs of social development and meet the requirements of different positions for the training of various talents.There should be different education and training systems for the training of talents in different jobs.The theory and application of the finite element method have developed from the 40s and 50s of the last century to today. It should be said to be quite rigorous and perfect. It has strict logical reasoning and mathematical derivation.For the graduate students in engineering colleges, the focus of teaching should not be limited on the derivation of formulas, but in teaching students how to use these formulas and methods to solve engineering problems.Based on this, the key point of teaching should be to explain the physical meaning of the relevant principles and formulas, so that the students can make the principles and formulas to explain their application through appropriate examples.

(1) Reforming Course Content

According to the graduate talent training model, professional teaching plans and the actual situation of the students, a practical syllabus is produced, and making efforts to set the teaching content and the degree of conformity to the students' cognitive rules, to realize the systematic structure of the curriculum and to scientificize the teaching content. .When the content is arranged, the students are mainly involved in comprehending the principle of the method, diluting the mathematical proof, focusing on the professor of the method, and mainly cultivating the students' practical ability.In the teaching, the related knowledge of material mechanics and elastoplastic mechanics should be systematically reviewed. On this basis, the finite element method is systematically applied to elastoplastic mechanics, so that students can master the basic theory of finite element method (Guangjun, G. 2000).

(2) Strengthening The Practice Link

The whole teaching model design is based on the cycle of “practice-theory-re-practice-re-theory” and gradually deepens.The finite element course is a very practical course. The experimental content is an important part of the teaching content. In the finite element course teaching, it takes advantage of the school laboratory to provide the static strength test of the brake beam and the bogie for students and write a test report.Students can conduct static intensity analysis through commercial software for physical cases, and form static intensity calculation reports, which are compared with experimental data analysis.This process focuses on the student's ability to analyze and solve practical problems.

The finite element is a very important instrumental course in the engineering profession. It can form cooperation and mutual promotion with a large number of engineering professional courses, thus serving the professional training objectives.At this stage, under the guidance of professionally targeted principles, the revision of the teaching objectives and innovative teaching content is the focus of teaching reform. The teaching methods should focus on the practical teaching methods, enhance the application of the curriculum, and ensure students' interest in learning (Xingwang, B. *et al.,* 2011).

3. The Effectiveness of Teaching Reform

In short, the "finite element method" is a combination of theory and practice, which not only requires students to master systematic theoretical analysis skills, but also requires strong engineering practice.Therefore, using the diversified teaching methods to teach the finite element method, students can master the theory and method of the course, and have the ability to analyze and solve problems independently, so as to achieve the purpose of teaching and learning.We should focus on the combination of teaching and engineering practice on the content of the course.Teaching examples used in teaching should select representative examples from engineering practice; letting students participate in the numerical

calculation of actual engineering, and finally achieve the goal of combining the teaching of the course with engineering practice.The Finite Element Method course has achieved good results through reforming and practicing.The college has earnestly explored and continuously summed up experience, and gradually established a set of curriculum quality monitoring system suitable for school development. It has played an active role in promoting the reform of teaching model and strengthening students' theoretical ability, practical ability and innovative ability.

Acknowledgements

This work was supported by the fifth batch of Shanghai University Applied Undergraduate Pilot Specialty "Automobile Service Engineering" Construction and by Shanghai High-level the integration between secondary vocational education and applied undergraduate education pilot model construction project.

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