

Computer Aided Teaching for Material Mechanics

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Keywords: Mechanics of Materials, Virtual Interactive Teaching, Computer-aided analysis.

Abstract. According to the characteristics and teaching status of Material Mechanics course, a computer aided teaching software including 12 typical examples based on ANSYS, MATLAB and JAVA was designed. The software has the characteristics of visualization, interactivity and comprehensiveness, which can be applied in theory and practice teaching. Teaching practice proves that it is helpful to inspire students' learning interest and improve learning effect.

1. Introduction

Material Mechanics is a core course of civil engineering, which plays an important role in the engineering training. The course teaches students basic concepts and methods of strength, stiffness and stability, meanwhile it trains modeling ability and practice ability for students. Compared with research-oriented university, our students are relatively weak in mathematical basis, and mainly engaged in front-line work after graduation. When they face the abstract concepts and complex mathematical deduction and calculation of Material Mechanics course, some students feel difficult to study, and then gradually lose their motivation and effort to learn, which results in their lack of mechanic concepts and principles. Hence, how to make students firmly grasp professional knowledge, basic skills and practical ability, and to be helpful for following study of specialized courses is a problem.

The 21st century is the information age, and computer technology is developing rapidly. Hence it provides new development for Material Mechanics course teaching. Many engineering colleges have carried out teaching reforming in China [1-2]. With the help of numerical analysis and animation techniques, computer-aided teaching could help students to understand the deformation and failure process of bars under different conditions, and inspire students' learning interest and improve learning effect.

2. Design of virtual interactive teaching software

2.1 Design ideas

The flow chart of the Aided Teaching software is shown in Fig.1. First, we select typical examples of each chapter, then, the reaction force, internal force, stress, strain and deformation of bars are correspondingly calculated by MATLAB based on the Material Mechanics analytic method, due to MATLAB has powerful numerical calculation and simple programming language. After that, ANSYS is used to numerical simulation after building model, meshing, setting constraints and loading, then export the animation of deformation and stress of the model during loading process. Java can develop a friendly graphical user interface. In this study, the modified interactive parameter interface (Fig.2) is produced by Java compiler [3]. The interactive system consists of 12 finite element examples: axial tension and compression, torsion of circular shaft, bending, stretching and bending combination, oblique and bending combination, bending and torsion combination and compressive bar stability. Each example contains three modules. Selecting an example, animation demonstration from ANSYS numerical analysis can directly show the whole loading and deformation process, at the same time the theoretical solution can be invoked by MATLAB program. In addition, the models can be calculated by calling the command flow of ANSYS.

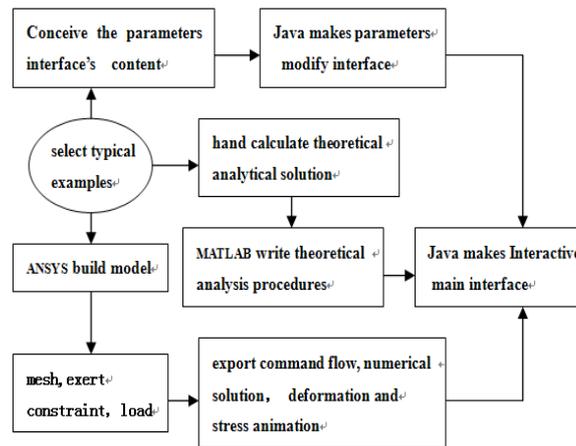


Fig. 1. The flow Chart



Fig. 2. The interactive system

2.2 Design features

Our computer-aided analysis software has characteristics of visualization and interaction. The powerful numerical analysis and graphical display can not only make students to easily understand and grasp the abstract concept, but also help students to improve their ability of imagination and thinking. Moreover, it can help students get rid of time and space constraints so as to practice repeatedly. Meanwhile, it can solve the impact of teaching time deficiency. As a result, it can inspire the interest and improve the thinking capability of students in learning, then improve the study effect of mechanical materials.

This paper takes the stress and deformation analysis of cantilever beam as an example to demonstrate the whole process.

A cantilever beam (length 2.5m, height 0.6m and width 0.3m) is loaded with a concentrated force of 1KN shown in Figure 3. Firstly, the corresponding numerical solution and stress animation (Fig.4) were obtained by ANSYS simulation. Then export the command file. After that, the user can modify the command file with the help of the parameter modification interface to determine that the ANSYS software is called to calculate the numerical solution of different models. At the same time, the MATLAB program is used to calculate the theoretical analytic solution for comparison.

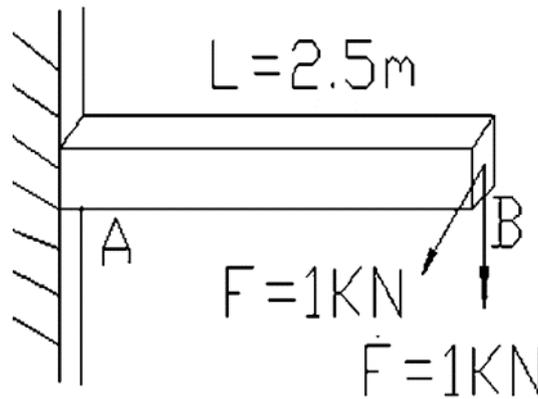
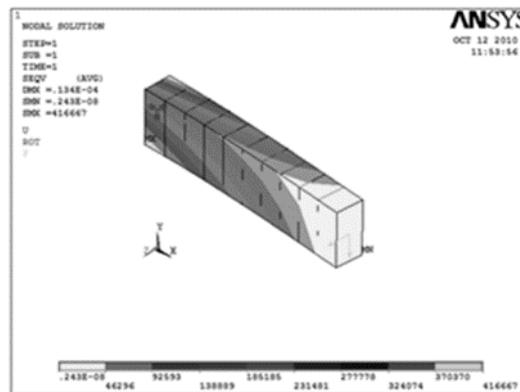


Fig. 3. Cantilever oblique bending model



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