

Development and Application of a Cross-scale Integrated Virtual Experimental System for Full Tailing Cemented Backfill

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Abstract: On the basis of uniaxial compression test and microscanning, digital image technology was used to process and integrate the experimental data of full tailing consolidated backfill, and a uniaxial compression simulation experiment system for two-dimensional full tailing consolidated backfill was established considering the microstructure. With the curing age and mechanical parameters of the whole tailing cemented backfill as inputs, the system was used to realize the virtual simulation of the test block preparation, uniaxial compressive test and microstructure scanning electron microscope analysis of the whole tailing cemented backfill at different ages. The application of the virtual experiment system enriches the experiment content, improves students' ability of experiment design, enhances students' interest in learning and shortens the experiment time, which is of great significance for improving students' practical ability and improving the efficiency of experiment course.

Keywords: University Education; Mine Filling Technology; In-class Experiments; Virtual Experiment

“Mine filling principle and technology” is an important core course for mining engineering majors. The theory and practice of this course are closely combined to supplement each other. Through practical courses, students can deepen their understanding of theoretical knowledge, train their practical operational ability, clarify the importance of material detection and evaluation, enhance their awareness of engineering quality, and cultivate a rigorous style of work. However, at present, most universities have a large number of students, limited laboratory resources, coupled with weak experimental faculty and teaching hardware facilities, which are far from meeting the requirements of experimental teaching. Under such a situation, the implementation of practical teaching links often appears empty and ineffective. Therefore, it is more and more important to improve the existing experimental teaching conditions and find a new experimental teaching mode that can supplement and replace the traditional experimental teaching mode. Virtual experimental auxiliary teaching system makes use of modern computer network and programming technology to make up for the problems existing in the current experimental teaching, which is more and more welcomed by universities all over the world. Therefore, “mine filling principle and technology”, as a practical course, can achieve twice the result with half the effort and has important practical significance.

1. Main problems existing in mine filling principle and technology experiment course

“Mine filling principle and technology” course in colleges and universities has an important status in the mining engineering and related, and its experimental teaching is the top priority of this course teaching, but at the moment, principle and technology of mine filling experiment there are all kinds of problems, such as the lesson hours less, less experimental

organization lacks reasonable arrangement, experimental content and knowledge update slow, traditional single teaching means, teaching methods, teaching system is weak and less full-time experiment teaching team personnel^[1-2]. Research shows that the practical experience of teaching value is provided by the laboratory is widely recognized by the educators of^[3], therefore, if these problems can't be settled in a timely manner, to the understanding of the students' knowledge and master, ability of theory with practice and actual engineering problem solving ability, will produce adverse effects, such as the production practice of ability in under the condition of limited resources, explore new experiment teaching method is imperative.

2. Teaching method of virtual experiment assisted experiment course

2.1 The design idea of comprehensive virtual experimental system for full tailing cemented backfill across scales

Virtual experiment system on the basis of the digital model by computer to complete the simulation, virtual experiment system in the design of sand cementation filling body, the choice of experimental projects involved as far as possible to cover the entire course the focus of the teaching contents, different schools can also be set based on the characteristics of the schools of the professional, the main content includes the following three aspects.

- (1) Preparation and maintenance of trial erection and filling slurry system.
- (2) Uniaxial compressive strength and tensile strength test.
- (3) Experiments on micro properties of filling materials.

Through the network management platform, students can log in according to their assigned accounts, make appointments or conduct experiments they are interested. If the teacher wants to use the software in class, he can log in through the teacher's account and start the demonstration and operation of the virtual experiment. In class, teachers and students can interact with each other, and students can finish many experimental projects by themselves in limited time. After class, students can also conduct experiments on the Internet for many times. While consolidating the classroom contents, they can also do some experiments on materials they are interested in, so as to update their knowledge, supplement and enrich the experimental content of this course.

2.2 Conduct experimental design in advance by using virtual experiments

Experimental design is very necessary for the course of mine filling principle and technology, but it is also difficult. Such as the determination of the standard consistency of cement water consumption, setting time and other indicators, in addition to the standard, normative method, the tester should also have certain practical experience. For example, when measuring the properties of concrete, the design and debugging of the mix ratio are relatively complex processes, which is a great challenge for inexperienced beginner students. In addition, it is very difficult to master these contents in a very limited class period. Therefore, in practice, it is often the teacher who designs the experiment in advance, and the students conduct the experiment according to the established process. However, the final scores of the students are evaluated and given in the form of experimental report. In this process, the students' ability is not really improved.

Virtual experiment design allows students to simulate the experiment with virtual experiment software before the experiment. First of all, students carry out experimental design according to the established objectives to be measured. Each parameter calculated is input in the virtual operation and virtual experimental software is run to check whether the calculation is correct. In this way, experimental errors caused by theoretical calculation errors can be avoided and correction can be made before the experiment begins. At the same time, students can also in the heart of the virtual experiment to simulate the situations may arise in the experiments, and the corresponding adjustment data input, each case whether the software will give the right information to help the students master the correctness and the rationality of the design of experiment, such not only exercise the students' ability to understand and master the theoretical knowledge, also make the students can flexible application of relevant theories in the actual experiment.

2.3 Develop efficient software, enrich experimental content, and enhance learning interest

The development of virtual experimental software should be based on the characteristics of this course, considering the convenience and simplicity of students' use, and ensuring the interestingness and effectiveness of the software.

2.4 Use virtual experiment to shorten the experiment time

In the strength experiment of backfill, the experiment takes a long time to complete, and the operation of the experiment is only a simple repetition. For example, the determination of backfill condensation time takes a long time from the production, curing and testing of specimens, and the following operation procedures are almost the same after the initial measurement. But in practice, due to the reason of class hours, often let students learn to operate the process, and did not really grasp the initial coagulation, the final coagulation evaluation criteria will end the experiment. The mechanical properties of concrete, such as, do again due to the maintenance time is long, the laboratory often use block some previously done on instruments demonstrate determination process, students can't really participate in, and after the use of virtual experiment, teachers to teach students using virtual experiments test the performance of some common materials, and emphasizes the problems in the process of the measured, matters needing attention, etc., the student has the certain basis after the application of theoretical knowledge and practical experiments to operation, on-site interpretation, deepen the impression, not only save time, and can have twice the result with half the effort.

3. Conclusion

There are many problems in mine filling principle and technology experiment course, such as less class hours, more content, slow updating of knowledge, single teaching method, etc. But the practice of this course is very strong. Through experimental training, students' professional theoretical knowledge can be applied and further strengthened. In practice, due to the influence of many factors, the experimental teaching effect often fails to reach the expected effect, and can't really improve and exercise students' practical ability. The development and utilization of virtual laboratory can conform to this trend, and the development of effective auxiliary experimental teaching software is an important means to improve and perfect experimental teaching.

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