4th ‘ Short-term prediction of Rock failure ’ competition

(Notice 1)

August 10-12, 2024, Taiyuan, Shanxi, China

The Short-term Prediction of Rock Failure Competition is an event held to promote the resolution of key scientific issues related to major natural and engineering disasters in rock mass systems such as earthquakes, landslides, rock bursts, and gas outbursts. The activity takes the form of conducting indoor large-scale rock sample failure tests. Each participating team uses its own physical detection methods, theoretical calculations, analysis, and simulation methods to predict key parameters such as failure time, released energy, and failure form of the same rock sample. The purpose of the competition is to promote the innovation of theories, methods, technologies, and monitoring instruments for complex geological disasters and nonlinear rock mechanics, and to enhance human ability to predict and forecast major natural disasters in rock mass systems. This undoubtedly has important significance and value for disaster prevention and mitigation.

The competition is proposed by Prof. Zhao Yangsheng of Taiyuan University of Technology, supervisor of the Chinese Society of Rock Mechanics and Engineering and academician of the Chinese Academy of Sciences. It has been successfully held in Taiyuan University of Technology in October 2021 (1st session), August 2022 (2nd session) and August 2023 (3rd session) respectively. A total of 34 teams from universities and research institutes across China participated in the three competitions.

The contents of the competition include (1) the time of rock failure, (2) the energy released by rock failure, and (3) the location and type of rock failure. The competition has the following characteristics: a) the answer is unique; b) the contents possess practical and scientific significance; c) the challenging nature of the competition process; d) Comparison of the advantages and disadvantages of different theories, methods, and instruments. The previous three competitions have shown that high-level research teams compete on the same platform, where they can compare different rock failure theories, methods, technologies, and monitoring instruments they have developed, and learn from each other. This is of great significance for predicting rock failure and even major natural disasters in rock mass systems

We sincerely invite rock mechanics research teams from all over the world to participate in this competition and learn from each other in the competition to promote the development of theory and technology for predicting rock mass disasters.

Relevant matters are hereby notified as follows:

1. Organizational unit

Organizer: Journal of Rock Mechanics and Engineering, the Taiyuan University of Technology, Shanxi Society of Rock Mechanics and Engineering

Undertaker: Key Laboratory of In-situ Property-improving Mining of Ministry of Education, the Taiyuan University of Technology

2. Organizing Committee

Director: Zhao Yangsheng

Deputy Director: Li Shucai, Liu Caicai, Pan Yishan

Members: Yang Qiang, Ji Hongguang, Wang Jiachen, Zhu Wancheng, Tan Yunliang, Wang Laigui, Li Xibing, Zhang Guang, Feng Zengchao, Wu Aiqing, Huang Lixing, Huang Hongwei, Feng Tao, Li Xiao, Tang Chun'an, Li Ning, Yang Ganshe, Liu Xinrong

3. Competition arrangement

3.1 Competition venue:

Key Laboratory of In-situ Property-improving Mining of Ministry of Education, Taiyuan University of Technology, Shanxi Province, China

3.2 Competition content:

The participating teams use self theories, methods, and testing instruments to monitor the process of uniaxial compression test of rock loaded at a constant displacement rate, predict the time of failure, the main fracture surface, and the elastic energy released during rock sample failure. The supporting documents of the prediction results shall be submitted within the specified time, including but not limited to the prediction principle, monitoring equipment, data processing method, calculation basis, calculation process, and calculation results, etc.

3.3 Experimental conditions of the competition:

Testing machine: XPS-1000 servo control multi-function testing machine in the key laboratory of the Property-improving Mining of Ministry of Education, Taiyuan University of Technology. The axial pressure is 10MN, and the axial displacement and load can be servo-controlled, experimental data can be recorded and stored in real-time. Rock samples can be loaded at a constant displacement rate, constant load rate, or according to a certain slope and pulse form. This competition adopts constant displacement rate loading.

Cuboid sample size: 200mm * 200mm * 400mm, sample lithology: granite and sandstone.

3.4 Experiment and competition procedures:

1) Place the test piece on the testing machine and apply 1000N preload.

2) The participating teams install sensors and testing instruments, the installed sensors and testing equipment should not interfere with the testing of other participating teams (**It is not allowed to install sensors that actively transmit electromagnetic or vibration signals**).

3) After the test instruments of all the participating teams are installed, the testing machine begins to load at the same displacement rate. All participating teams use self instruments to monitor a series of physical and mechanical information such as rock deformation and damage in real-time.

4) The testing machine is continuously loading, and the participating teams continuously monitor the physical and mechanical information that occurs during the compression process of the rock sample, predict the time of failure, the main fracture surface, and the released elastic energy, and submit the prediction results in time.

5) The testing machine continues to load until the sample fails, the participating team continuously monitors all physical and mechanical information until the end of the test.

6) The review committee gives the standard answer according to the accurate failure time, load-displacement curve, displacement-time curve recorded by the testing machine, and the sketch of the main fracture surface is given after the failure of the rock sample.

7) Each team needs to complete the failure prediction of one granite and one sandstone sample respectively, and submit the supporting documents within 2 hours after the test of the second sample.

8) The review committee scores based on the forecast results and supporting documents submitted by the participating teams.

3.5 Composition of participating teams:

Each unit (university, scientific research institute, State Key Laboratory) can set up a team independently, or form a team together with other units (The maximum number of units to jointly form a team is three), encouraging domestic and foreign units to form teams together. Each team is composed of three members. At least one member is a non-student, and the other two members are not limited to educational background and professional title. During the competition, only the contestants can operate, process, and analyze the data on-site and submit the prediction results.

3.6 Competition rules:

1) The sponsor, Taiyuan University of Technology, is responsible for preparing the basic test conditions of the test samples, test machine, and competition, and conducts the whole process of uniaxial compression of the rock samples. The displacement-load and displacement-time curve recorded by the testing machine in real-time during the competition will not be provided to the participating teams but will be announced after the competition.

2) The instruments, meters, and calculation software used by the participating teams to monitor, and predict the failure of rock samples are all provided by the participating teams. The organizers will not provide them.

3) During the test, 5-7 teams will simultaneously monitor the same sample in real-time. Considering that it is impossible to set too dense monitoring points for real rock mass failure prediction, this competition limits each team to set no more than 5 sensors (such as strain gauges, acoustic emission probes, etc.) on the sample surface, and the maximum linearity of the contact surface between a single sensor and the sample is less than 20mm. It is not allowed to drill holes in the test piece or inject fluid into the sample. The number and size of sensors or non-contact test probes installed outside the sample are not limited.

4) Each team should submit the prediction results before the rock fails. Otherwise, the score will be zero.

3.7 Review criteria:

1) Standard answer: the review committee gives a standard answer according to the load-displacement curve, displacement-time curve recorded by the testing machine in real-time, and the spatial coordinates of the main fracture surface determined after the failure of the sample.

2) Prediction of failure time: It refers to the time of sample failure, defined as the point of 1/2 of the peak strength on the stress-strain curve after the peak strength. The standard answer is determined by the review committee according to the load-displacement curve recorded by the testing machine in real time. The score is calculated based on the accuracy of time prediction and the weighting coefficient of advance prediction, with a full score of 50 points.

3) Prediction of the main fracture surface: the main fracture surface refers to the whole fracture surface that causes the sample to fail. The review committee will give the standard answer according to the sketch of the sample failure. The judges will score according to the similarity between the actual fracture surface and the drawing of the contestants. The score of each team is the average score of all judges, with a full score of 20 points.

4) Prediction of fracture energy: fracture energy refers to the elastic strain energy accumulated before the peak strength. The review committee determines the standard answer according to the load-displacement curve recorded by the testing machine in real time. The score is the ratio of predicted fracture energy to the standard answer multiplied by the total score, with a full score of 30 points.

5) Weighting value of supporting documents ξ: The supporting documents give the basis of the above three indicators. If the supporting documents for each indicator are correct and logical, the weighted value is 1 point. If there are no supporting documents or if the supporting documents cannot explain the prediction result, the weighting value is 0. The weighting value of supporting documents for each team is the average score of all judges.

6) Rank the first, second, and third places according to the scores of each participating team. In addition, an "Individual Award for Time Forecast" is set up, which will be awarded to the top three for predicting the time of sample failure.

4. Important time nodes

- June 30, 2024: deadline for registration of participating teams
- July 10, 2024: The organizing committee conducts a qualification review of the participating teams and notifies the teams that have obtained the qualification to participate
- August 9, 2024: participating teams prepare for the competition
- August 10-11, 2024: The competition will be held in the Key Laboratory of Property-improving Mining of Ministry of Education at Taiyuan University of Technology
- August 12, 2024: Publish relevant experimental data and curves, and hold academic seminars on short-term prediction of rock failure.

Please send the registration form and relevant documents to the designated email: alv-1001@163.com

5. Other matters

To protect the intellectual property rights of the participating teams, the people who have nothing to do with the competition are not allowed to enter the test site. Relevant academic documents will be collected after the meeting.

The organizer reserves the right to interpret this event.

6. Contact information

Lv Zhaoxing TEL: 13834540915, Email: alv-1001@163.com

Feng Zengchao TEL: 13191077109, Email: fengzhengchao@tyut.edu.cn

'Short-term Prediction of Rock Failure' Competition Organizing Committee

September 28, 2023

Registration Form					
Institution		Team Academic Leader			
Information of Participants					
Full Name	Department	Age	Academic Degree	Position	Major
Team Research Achievement					
Person to Contact		Tel		Email	