WORKSHOPS ARE OFFERED IN CONJUNCTION WITH THE EVENT

ROCK ENGINEERING IN DIFFICULT CONDITIONS

"3rd Canada-US Rock Mechanics Symposium" & "20th Canadian Rock Mechanics Symposium"

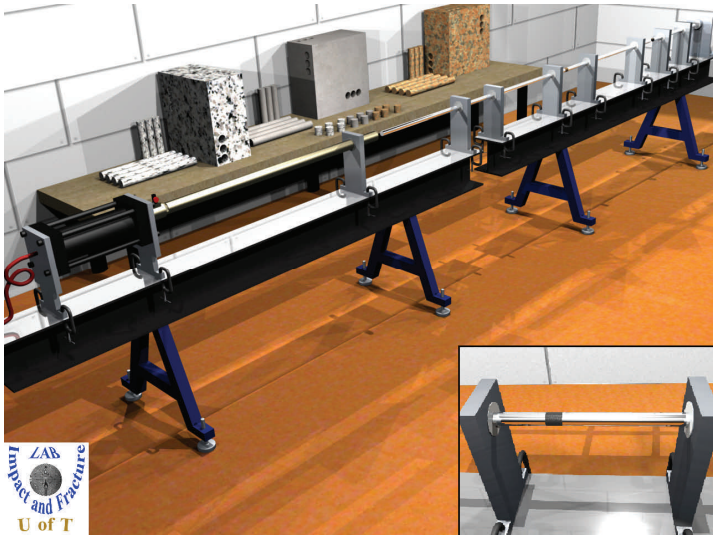
A Joint Meeting of the Canadian Rock Mechanics Association & the American Rock Mechanics Association
in Conjunction with the 2009 CIM Annual Conference and Exhibition

May 9, 2009
Toronto ON, Canada

WORKSHOP FEE: $300
MINIMUM 5 PARTICIPANTS

Dynamic Test of Rocks Using Split Hopkinson Bar Facility

Professor Kaiwen Xia, *Department of Civil Engineering, University of Toronto* and
Dr. Bo Song, *Sandia National Laboratories, Livermore, California*



OBJECTIVES

Rocks are prone to dynamic failures in mining and other geotechnical engineering applications. The objective of the short course is to show the applications of split Hopkinson pressure bar (SHPB) technique to the measurement of rock dynamic properties. One dimensional stress wave propagation theory with application to SHPB will be discussed, together with recent advancements of SHPB experimental techniques for testing brittle materials. Experimental method to quantify rock dynamic compressive, tensile, and fracture properties will be covered. The lecture will be augmented by laboratory experiments using the SHPB system at the Impact and Fracture Laboratory of the University of Toronto. Laboratory experiments on selected rocks will be conducted and the dynamic tests will be captured with a high speed camera (Photron Fastcam SA1) at speed up to 250 thousand frames per second.

COURSE CONTENT

Part 1: Basics of the split Hopkinson pressure bar (SHPB) (1/4 day)

Background and history of the SHPB technique; One-dimensional stress wave theory for the SHPB technique; Introduction of the SHPB apparatus; Fundamental principles of the SHPB technique; Assumptions and facts in the SHPB technique; Problems and solutions in dynamic characterization of different materials (metals, polymers, foams, and biological tissues) using the SHPB technique.

Part 2: Recent advances of the SHPB technique pertinent to dynamic characterization of rocks and rock-like brittle materials (1/4 day)

Challenges in dynamic characterization of brittle materials with the SHPB technique; Modifications of the SHPB technique for characterizing brittle materials:
Small-strain measurement
Dynamic stress equilibrium
Constant strain-rate deformation
Pulse shaping techniques in the SHPB technique for characterizing brittle materials; other issues in dynamic characterization of rocks and rock-like brittle materials.

Part 3: New methods of measuring rock dynamic tensile strength and rock dynamic fracture properties (1/4 day)

Dynamic Brazilian disc method in SHPB for tensile strength measurement: method validation and data reduction; Dynamic semi-circular bend technique for flexural tensile strength measurements: method validation and data reduction; Dynamic fracture measurement using a notched semi-circular bend technique: method validation, fracture initiation toughness and fracture energy.

Part 4: Laboratory tension and fracture experiments of rocks using SHPB with high speed photography (1/4 day)

Using the 25 mm SHPB system in the laboratory, two kinds of rocks (granite and sandstone) will be used for the experiments. Dynamic compression of the selected granite and sandstone;

ONE-DAY SHORT COURSE

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Dynamic Brazilian disc test of the selected granite; Dynamic fracture test of the selected sandstone.

WHO SHOULD ATTEND:

Civil and mining engineers who are involved in design of underground structures prone to dynamic failures are encouraged to take this short-course. In addition, mining engineers who are involved in rock blasting, rock crushing, and rock drilling will benefit from this course.

TIME SCHEDULE

8:30—10:15	Lectures
10:15—10:30	Coffee/tea break
10:30—12:15	Lectures
12:15—13:15	Lunch
13:15—15:00	Lectures
15:00—15:15	Coffee/tea break
15:15—17:00	Laboratory tests

NARRATIVE BIOGRAPHY of Dr. Song:

Dr. Bo Song is currently a Technical Staff at Sandia National Laboratories, California, USA. He obtained his Ph.D. in solid mechanics from the University of Science and Technology of China in 2000. He then worked as a Postdoctoral Research Associate and later a Research Assistant Professor in the Department of Aerospace and Mechanical Engineering at The University of Arizona. In 2005, he joined the School of Aeronautics and Astronautics at Purdue University as a Senior Research Scientist. Dr. Song then moved to Sandia National Laboratories, California as a Technical Staff in 2008. Dr. Song has been working on dynamic response of materials by using the Split Hopkinson pressure bar (SHPB) technique for more than 15 years. He is well recognized for his expertise in material testing using SHPB. Over years, he has developed numerous new experimental techniques in SHPB and has been applying SHPB to a variety materials, including ceramics, metals, rocks, sands, and biological tissues. Dr. Song is holding several full memberships in scientific communities. He is currently the Secretary of Dynamic Response of Materials Technical Division in the Society for Experimental Mechanics. Dr. Song has published nearly 100 technical papers and abstracts in books, peer-reviewed journals, and conference proceedings. He is also a technical reviewer for several international journals in the fields of mechanics and materials.

NARRATIVE BIOGRAPHY of Prof. Xia:

Prof. Kaiwen Xia is currently working an assistant professor in the engineering geoscience group of the Department of Civil Engineering and Lassonde Institute at the University of Toronto. He obtained both his B.S. and M.S. degrees in applied mechanics from the University of Science and Technology of China. In 2005, he finished his Ph.D. degree from California Institute of Technology (Caltech) majored in mechanical engineering and with a minor in geophysics. He joined the University of Toronto in February 2006 as a faculty member. Prof. Xia started working on dynamic response of materials when he was an undergraduate. He was then trained to carry out dynamic fracture experiments at Caltech, where he pioneered the application of cutting-edge dynamic fracture experimental techniques to earthquake physics studies. Since he joined the University of Toronto, Prof. Xia has been working on dynamic tests of rocks using split Hopkinson pressure bar (SHPB) system. He developed new techniques to measure rock dynamic tension and rock dynamic fracture properties using SHPB. Prof. Xia's academic contributions were recognized by the William F. Ballhaus Prize for outstanding doctoral dissertation in Aeronautics at Caltech in 2005 and the Harting Paper Award from Society for Experimental Mechanics in 2007. He served as a topical organizer in Geophysics and Tectonic of the 12th International Conference on Fracture and a member in the organizing committee of the Rock Engineering 2009 conference. Prof. Xia is a member in the ISRM commission on rock dynamics, whose purpose is to propose standard dynamic rock testing methods to the rock mechanics community. Prof. Xia has published about 60 technical papers and abstracts in books, peer-reviewed journals, and conference proceedings.

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