

A Unique Multi-Functions Large-Scale Physical Model Testing Facility for Study of the Impact of Debris Flow on Flexible Barriers and Geo-Hazards in Hong Kong

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Collaborative Research Fund
(Equipment Grant)

Amount Awarded
HK\$8,208,882

Project Duration
3 years

Project Status
In progress

Introduction and main objective

Geo-hazards, such as debris flows, rock falls, landslides, have caused loss of human life and damage to infrastructures and buildings not only in Hong Kong (Plate 1), Mainland China (Plate 2), but also in many parts of the World. How to mitigate and prevent geo-hazards is a long-standing and challenging issue. The primary objective of this project is to custom design and make a large-scale multiple function physical model testing facility with comprehensive instrumentation for studying geo-hazards, especially the impact of debris flows on a resisting flexible barrier (Plate 3).



Plate 1. Landslides in Sau Mau Ping in 1972



Plate 2. A large debris flow on 8 August 2010 in Zhouqu, Gansu Province of China caused 1471 casualties and 294 missing persons



Plate 3. (a) Flexible barriers filled by debris at a site in Switzerland (left) and (b) a flexible barrier installed at a site in Hong Kong

Research activities in the project

Work done:

- (i) All instruments have been purchased and examined in Soil Mechanics Laboratory of PolyU including two high-speed video recorders, two high-speed data-loggers, one high-speed FBG optical fiber sensor data-logger (interrogator).
- (ii) All required conventional transducers were obtained and calibrated in Soil Mechanics Laboratory, including tension-link transducers and accelerometers.

- (iii) Special FBG optical fiber sensors have been designed, made, and calibrated in the Soil Mechanics Laboratory, including small FBG tension-link transducers, strain transducers, FBG pressure transducers.
- (iv) A software package for Discrete Element Model (DEM) modelling of the impact of debris flow on a flexible barrier has been obtained and used for preliminary simulation.
- (v) This custom-made multi-functions large-scale physical model testing facility with instrumentation and accessories has been installed at the site (Plate 4).



Plate 4: (a) An overall view of the facility (left) with a debris storage tank on the top, a flume, and a flexible barrier and (b) the front view of the flexible barrier with sensors and the flume (right)

Work to be done next:

- (i) To place two high-speed video recorders and connect all data-loggers to all transducers installed;
- (ii) To conduct a few test runs of the facility to make sure all functions of the facility are working well as designed;
- (iii) To conduct tests on the impact of rock fall, gravels and a local soil as debris on a flexible barrier; and
- (iv) To analyze all test data and assess the performance of the facility, and to write a completion report.

Collaboration with other universities

Collaboration has been made with CityU, CUHK, HKU, HKUST, GEO of CEDD of HKSARG, and HKIE-Geotechnical Division.

Achievement of project objectives

All the objectives have been largely achieved.

Research findings and outputs

This CRF grant is for a custom-made "Equipment". The research and publications are not the main activity and output of this CRF (Equipment) project.