

Keystone C: Earth Dam Monitoring (2020)

Semester objective: Investigate earth dam breaching and possible dam improvements by connecting experiment and modeling, hydraulic and geotechnical engineering.

Description: The keystone C course group will focus on the mechanics and monitoring of earth dams. It will allow interested students to apply and enrich the knowledge about soil behavior and water flow that they learn in the courses Soil mechanics, Fluid mechanics, and Soil mechanics laboratory. For this purpose, we will combine an elective experimental monitoring project with a special material to be covered in the other three courses.

For the first full-scale trial of this course group, in the Spring 2020 semester, we plan to combine the following teaching and learning activities, illustrated in Fig. 1. As part of the project, students will plan and implement measurement methods that will be applied first to small-scale laboratory tests at NTU, then to a large-scale dam failure experiment coordinated by NCHU. As part of their courses on soil and fluid mechanics, they will also learn basic concepts and methods needed to model the effect of water flow on soil slopes and earth dams. For the large-scale experiment, they will work together with NCHU students as part of a large scale, collaborative team effort that will require both technical and project management skills.

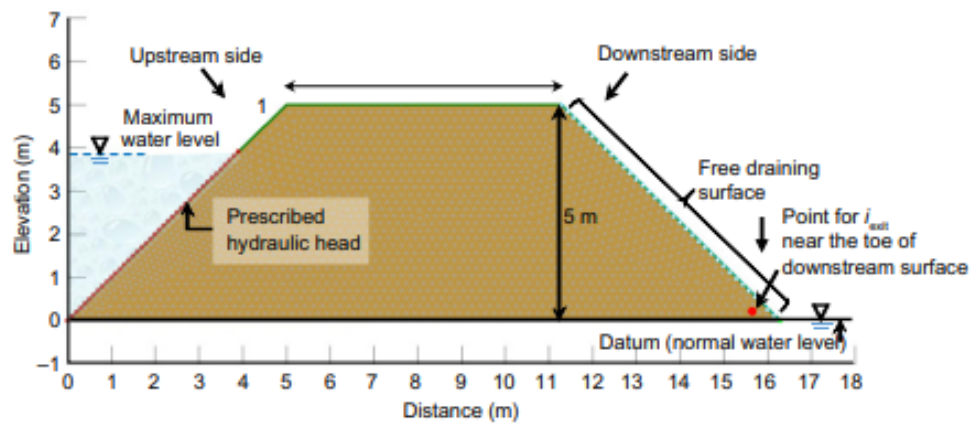
After observing the failure mechanism of an earth dam in the full-scale test, the students will be asked to propose remedial measures (e.g., toe filter, soil reinforcement, soil compaction, etc.), using the knowledge that they learned from soil mechanics and fluid mechanics courses. The students will further evaluate their ideas through a reduced-scale test or numerical analysis (seepage and slope stability analyses). The effectiveness and performance of the applied remedial measures on enhancing the mechanical and hydraulic stabilities of the earth dam then can be verified.



Figure 1. Activities and facilities planned for the keystone C course group: participation in the planning and monitoring of large scale earth dam failure tests organized by NCHU.



(a)



(b)

Figure 2. Evaluation and verification of the proposed remedial measures:
(a) reduced-scale test in laboratory; (b) numerical analysis

Schedule

Module	Week	Date	Class activity	Assignment due
1 Exploration experiments	1	3/6	Classroom: Semester intro Hydrotech lab: Flume operation, discharge and slope estimation	/
	2	3/13	Hydrotech lab: Experiments with loose and compacted dams/ compaction density evaluation	/
	3*	3/20	Classroom: Group reports, presentation by NCHU of large scale experiment plans and distribution into measurement teams	Observations report and measurement strategy ideas (teams of 4)
2 Modeling and measurement planning	4	3/27	Classroom: Mathematical modeling of triangular dam seepage and breaching	/
	5	4/3	No class (Make up holiday)	/
	6*	4/10	Classroom: Review of measurement plans for each team	Measurement plans for each team (coordinated with NCHU) (teams of 2)
LARGE SCALE FIELD EXPERIMENT	Sat- Sun	4/11- 12	On site: Build up, compaction and instrumentation of large dam (participation optional)	/
	7	4/17	On site: Practice and instrumentation set-up for the large scale test (participation mandatory)	/
	Sat	4/18	On-site: Large scale dam breach test (participation mandatory)	/
3 Small-scale laboratory experiments	8	4/24	Classroom: digital imaging tutorial	/
	9	5/1	Hydrotech lab: Instrumented small- scale experiments	/
	10*	5/8	Classroom: review of lab results and data processing	Lab test results for each team
4 Numerical modeling	11	5/15	Classroom: numerical methods tutorial	/
	12	5/22	Classroom: numerical methods clinic	/
	13*	5/29	Classroom: Review of numerical modeling results	Numerical modeling results for each team
Final report	14	6/5	Final report rehearsal for NTU teams	Draft oral report and slides
	15**	6/12	Final report by NTU and NCHU teams	Final report and slides

Grade

Grading items	Percentage
Four intermediate reports and reviews (marked * in schedule)	4 x 15 %
Final report (marked ** in schedule)	25 %
Semester participation	15 %