E-learning tools for understanding and testing of a range of concrete properties

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Outline

- Introduction
- Subject ‘Construction Materials’ outline for full-time and part-time students in PolyU
- Teaching and learning challenges in university and in industry
- Implementation of the e-learning platform in the subject
- Five aspects of concrete properties
- Web-based e-learning platform
- Pre-lab quizzes and results
- Online video watching
- Conclusion

Introduction

- The e-learning platform aims to enhance the quality of student learning on concrete properties by filming some common and important concrete testing procedures, and distributing them in the web.
- Students and practitioners will be able to familiarize, visualize and conceptualize the underlying principles of the tests with the videos filmed.
- These videos serve to complement the study of tedious and apparently “boring” laboratory testing procedures and specifications.

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CSE 308
Construction Materials

Level 3 undergraduate subject (year 2)

Course Instructor

Prof. Chi-sun Poon
The Hong Kong Polytechnic University

Course Outline

Concrete *(10 weeks)*

Module I. Introduction and Basic Concepts

- Definition
- Advantages of concrete as a construction material
- Comparison between structural concrete and steel
- Types of structural concrete (Plain concrete, Reinforced cement concrete, Prestressed concrete)
- Constituent materials of concrete – a brief introduction (cement, aggregates, water and admixtures)
- Production of concrete – a brief review

Module II. Cement

- Chemical composition of cement
- Manufacture of Portland cement

Module II. Cement *(contd.)*

- Hydration of cement
- Types of Portland cement
- Tests to evaluate physical and mechanical properties of cement

Module III. Aggregates

- General classification of aggregates
- Physical and mechanical properties of aggregates
- Size and grading of aggregates
- Grading requirements
- Maximum aggregate size

Module IV. Properties of Fresh Concrete

- Workability of concrete
- Factors affecting workability
- Measurement of workability

Module IV. Properties of Fresh Concrete *(contd.)*

- Problems in fresh concrete (Segregation, Bleeding)
- Placing and compaction of concrete

Module V. Properties of Hardened Concrete

- Factors affecting the strength of concrete
  - Water-cement ratio
  - Aggregate-cement ratio
  - Strength and maximum size of aggregates
  - Compaction, mixing temperature and curing method
  - Effect of age
- Tensile strength of concrete
- Relation between tensile and compressive strength of concrete
- Bond strength of concrete

Module VI. Testing of Hardened Concrete

- Compressive strength tests
  - Destructive tests (Cube test, Cylinder test, Core test)
  - Non-destructive tests (Rebound hammer, Penetration resistance, Pull- out, Ultrasonic Pulse velocity)
- Tensile strength test
- Flexural test (modulus of rupture)
- Bond strength test

Module VII. Concrete Admixtures

- Benefits of admixtures
- Types of admixtures (Water-reducers, Accelerators, Retarders)
- Mineral admixtures (Silica fume, Fly ash, Blast furnace slag)
- Performance and properties of blended concretes

Module VIII. Concrete Mix Design

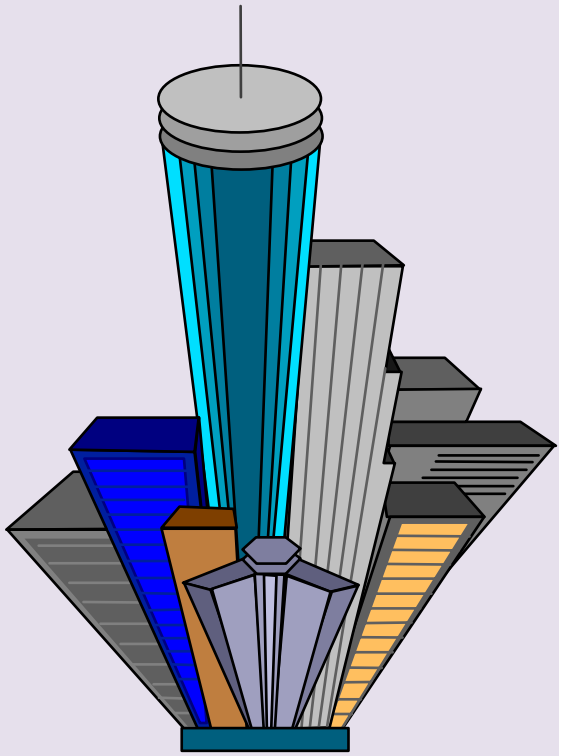
- Process of mix selection
- Factors affecting the mix proportions
  - Durability
  - Strength
  - Cost
- Mix design methods
  - Absolute volume approach
  - British method (DOE)
  - ASTM method

Module IX. Special Concretes

- High performance concrete
- Fiber reinforced concrete
- Roller compacted concrete
- Light weight concrete
- Polymer composites

Module X. Durability of Concrete

- Permeability of concrete
- Sulphate attack
- Attack by sea water
- Acid attack
- Alkali-aggregate reaction
- Corrosion of reinforcement



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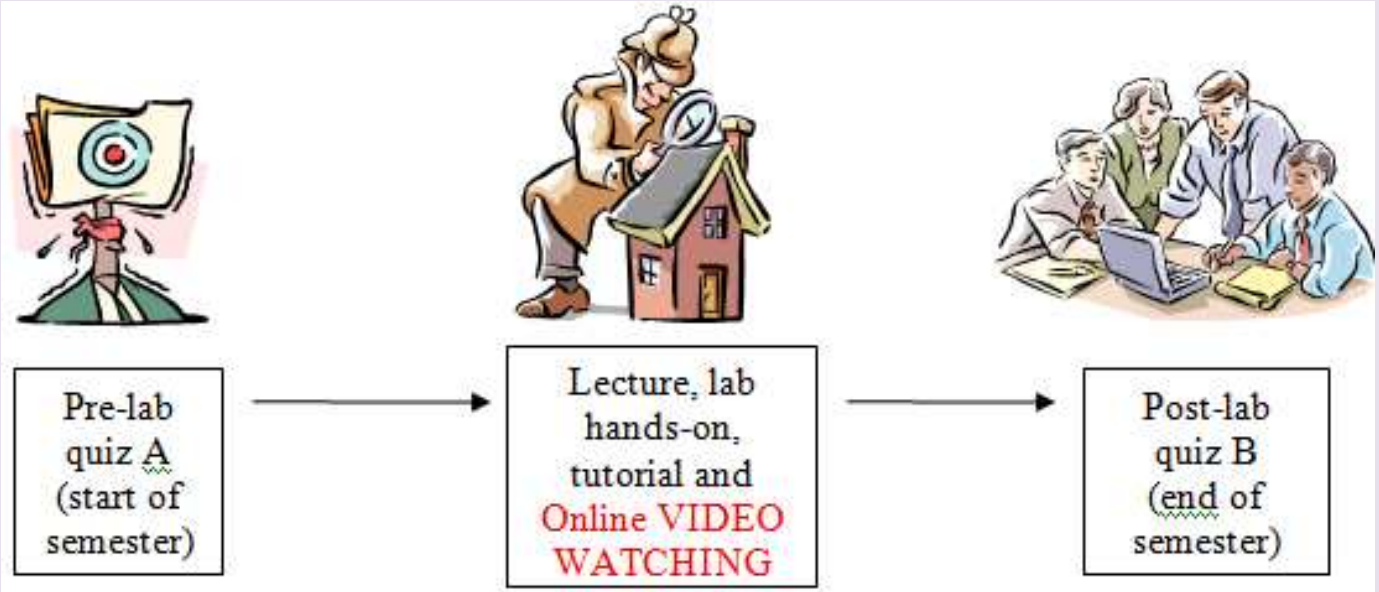
Teaching and learning challenges in university and in industry

Teaching challenge to lecturer:
Massive class size

Learning challenge to students:
Too many students in a lab session

Learning challenge to practicing engineers:
Exhaustion after work

Implementation of the e-learning platform in the subject

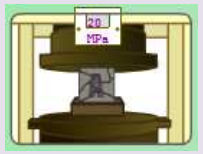


Five aspects of concrete properties

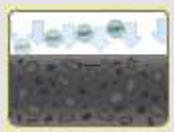
Conventional

1. Workabilitiy for normal concrete

2. Hardened properties of concrete



3. Durability of concrete

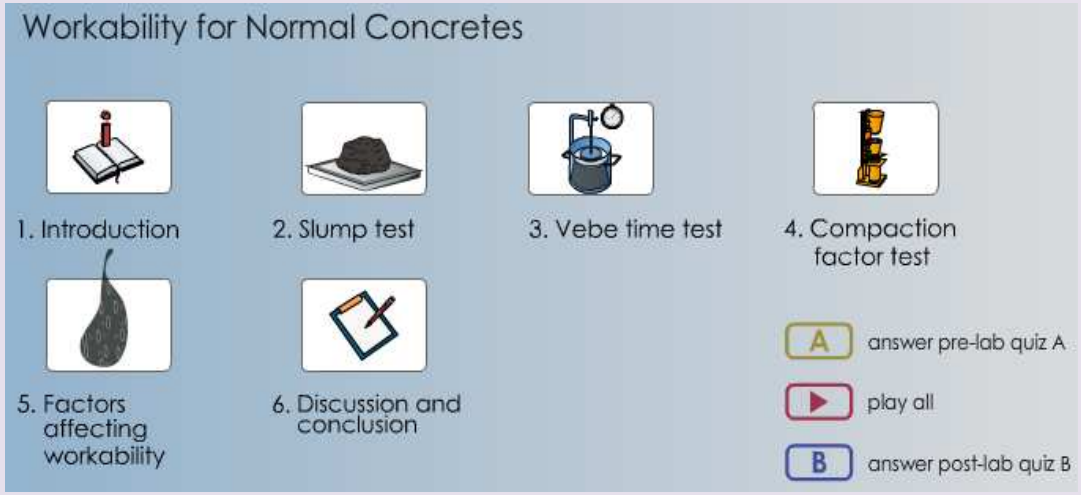


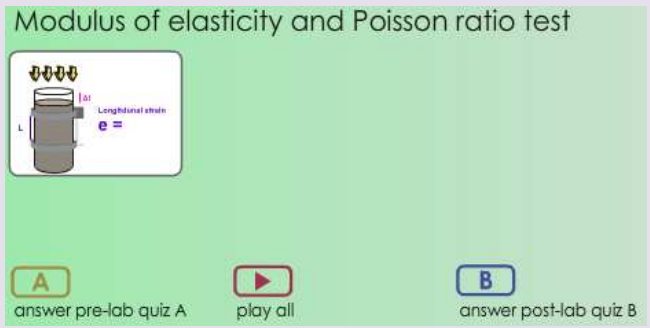
New

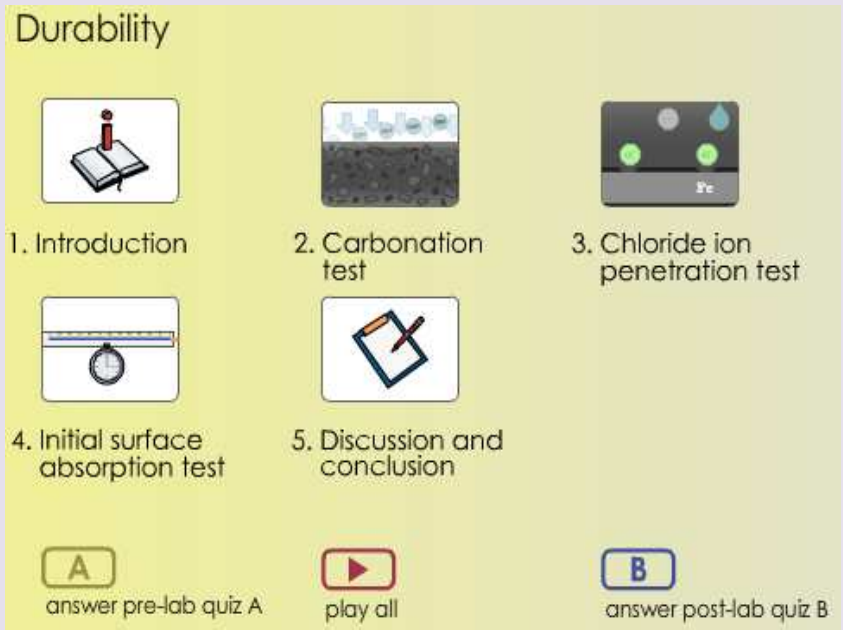
4. Workability for self-compacting concrete

5. Nondestructive evaluation of concrete

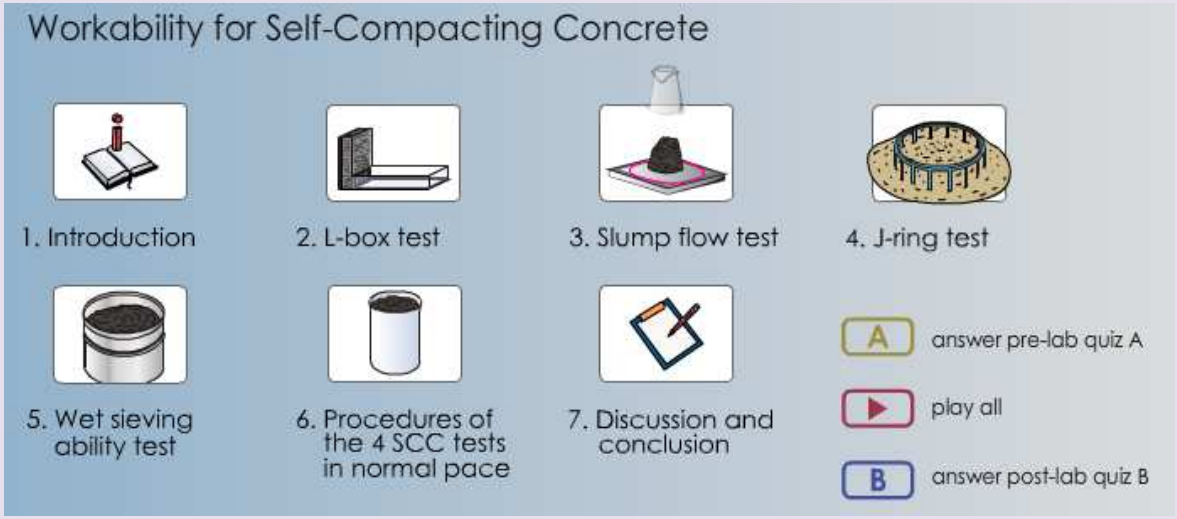
Conventional part of concrete properties (Workability, hardened properties and durability)

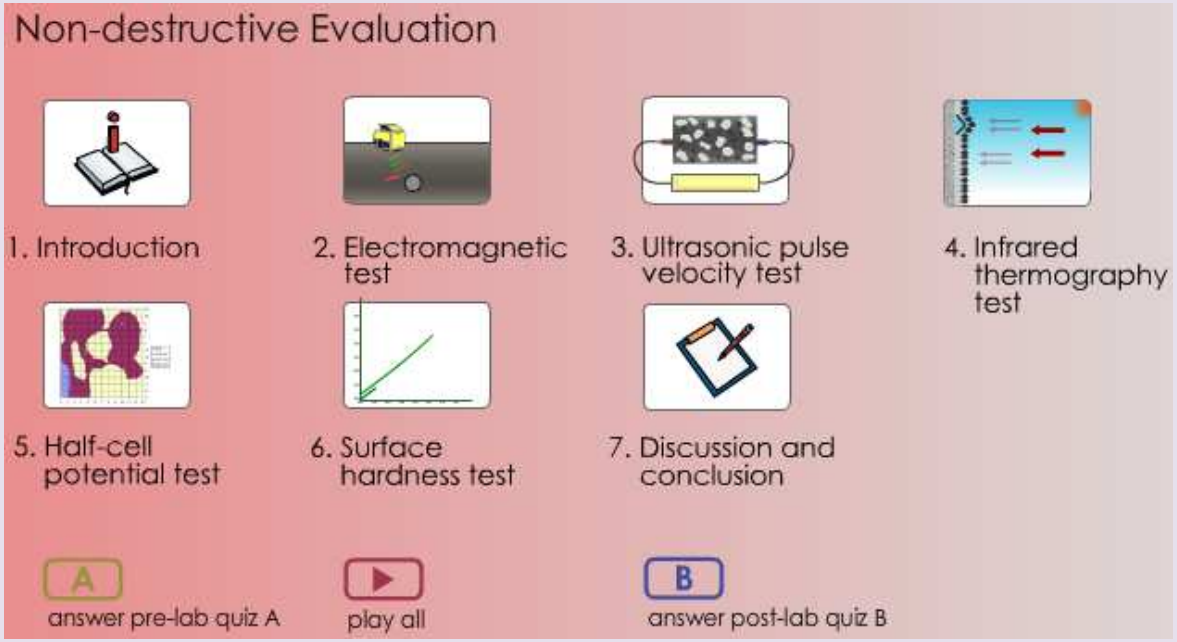






Newer part of concrete properties (SCC and NDE)





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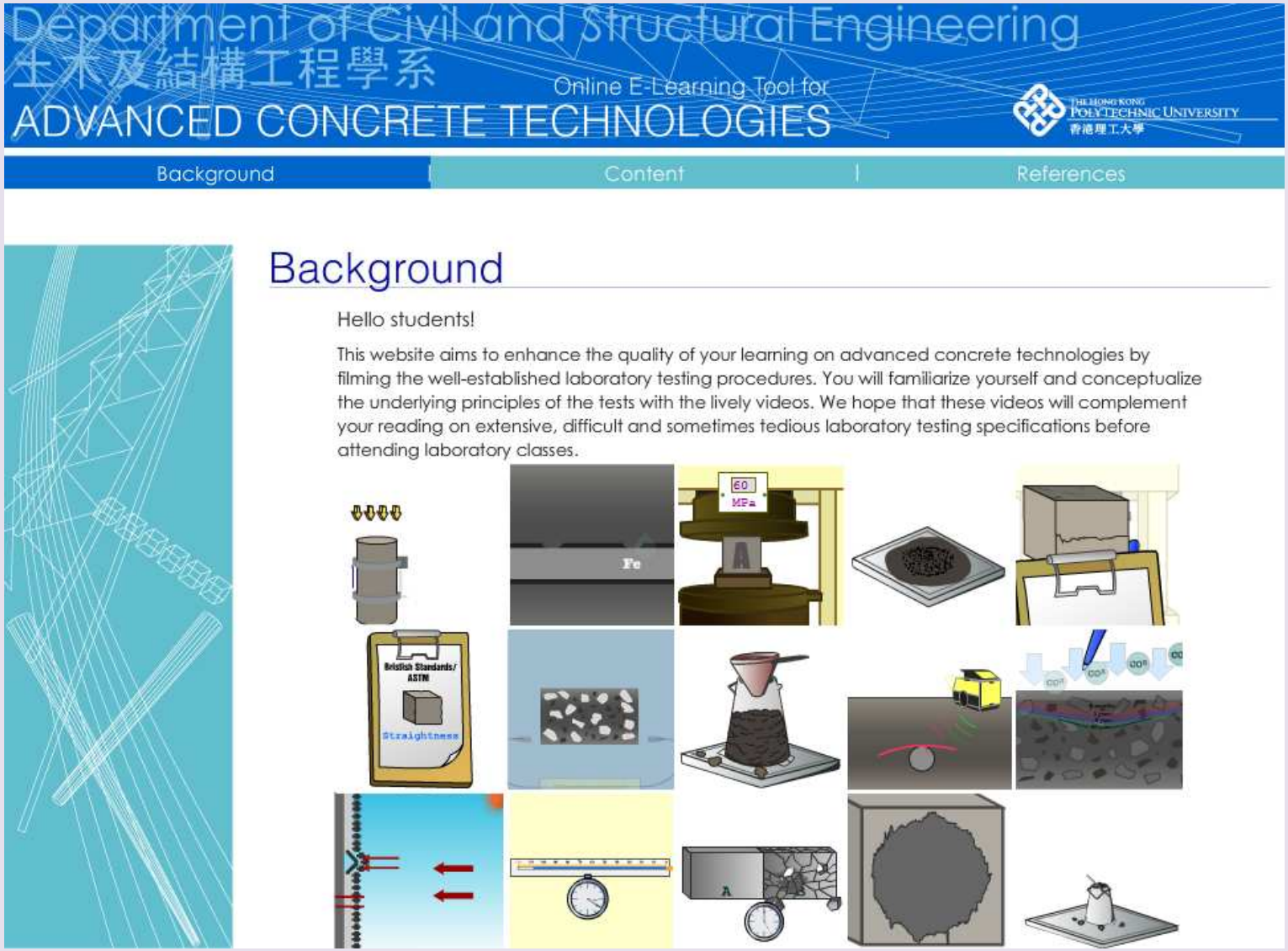
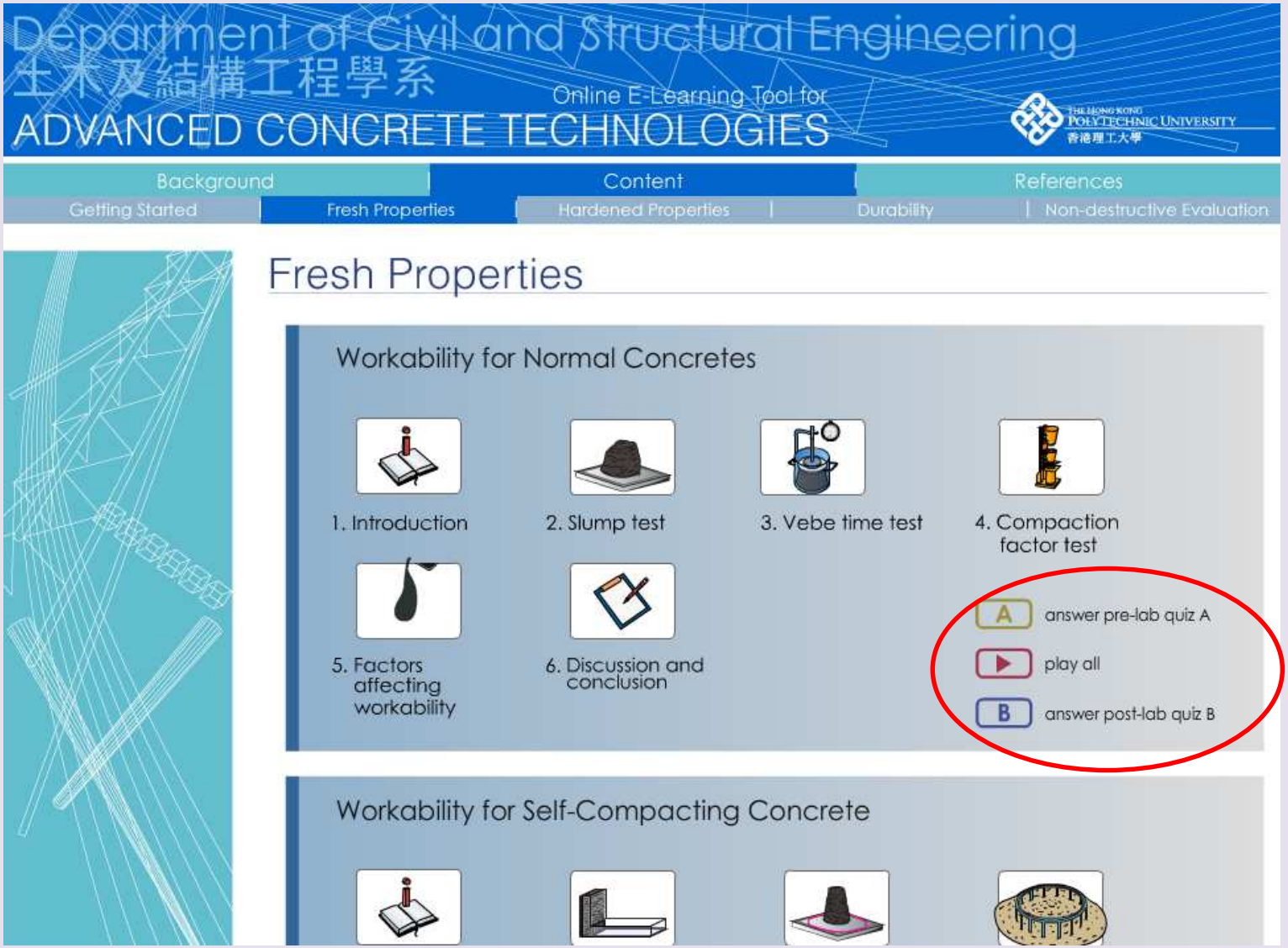
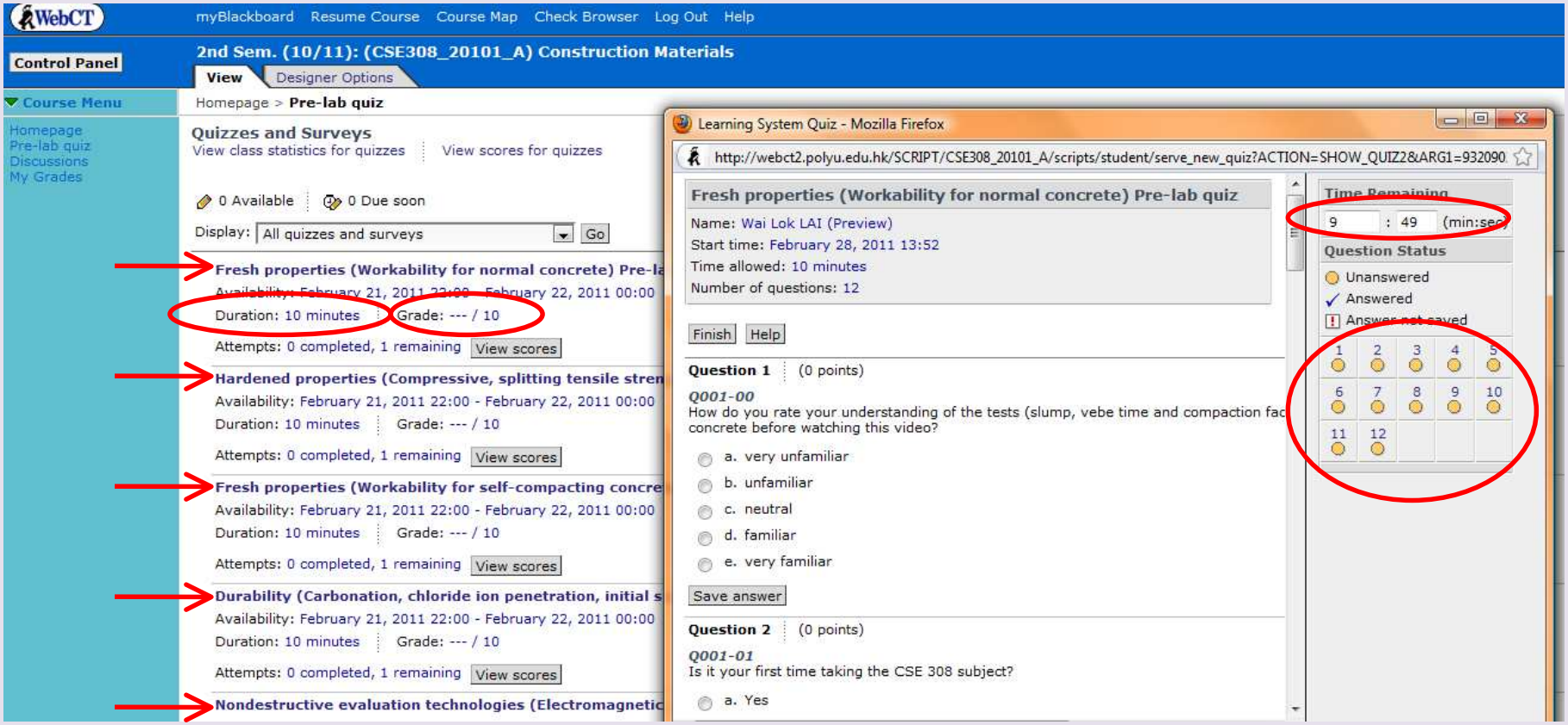
Web-based e-learning platform (background)



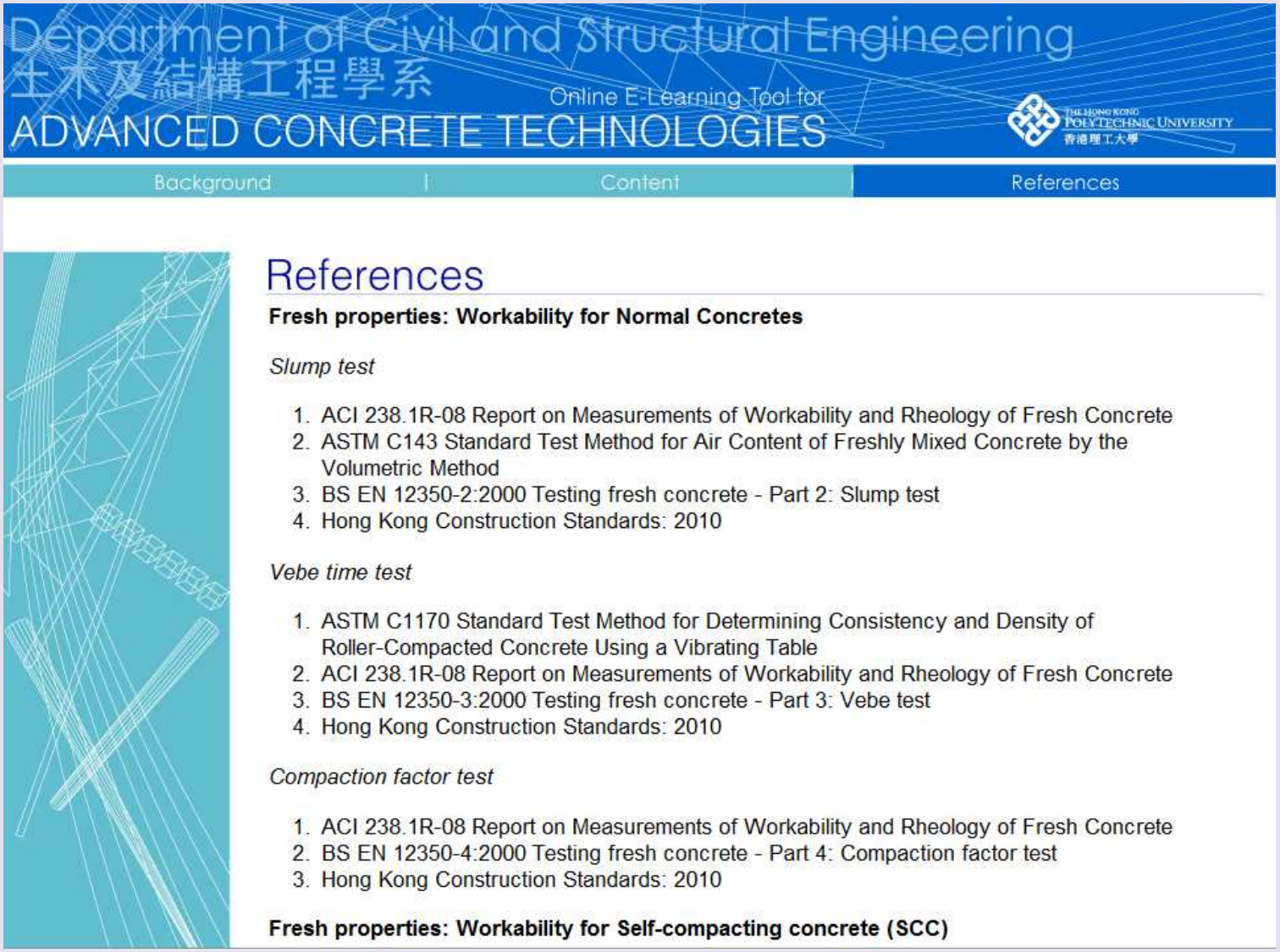
Web-based e-learning platform (Content videos)



Webct (on-line e-learning quiz platform)



Web-based e-learning platform (references)



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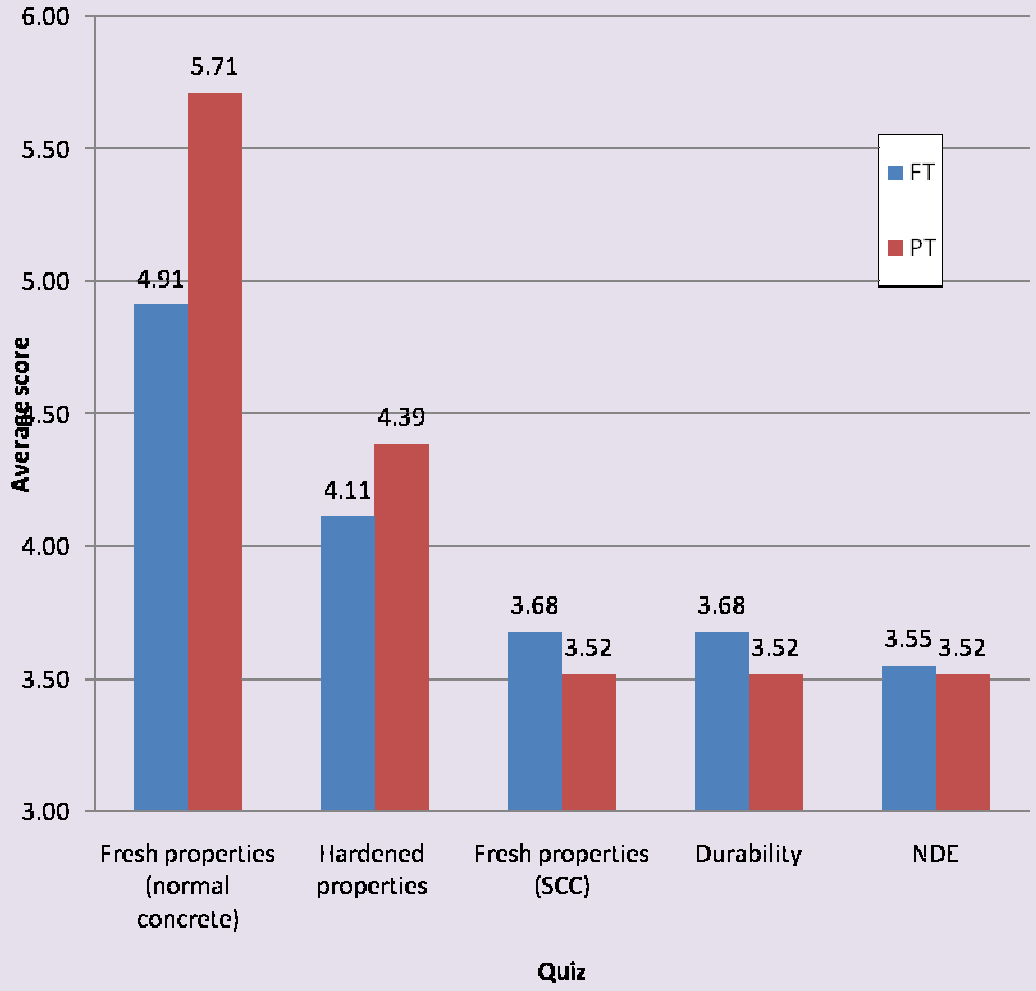
Pre-lab quizzes

- 87 full-time and 31 part-time students answered all the 5 quizzes

Results

1. Average score of inexperienced full-time and experienced part-time students
2. Score distributions

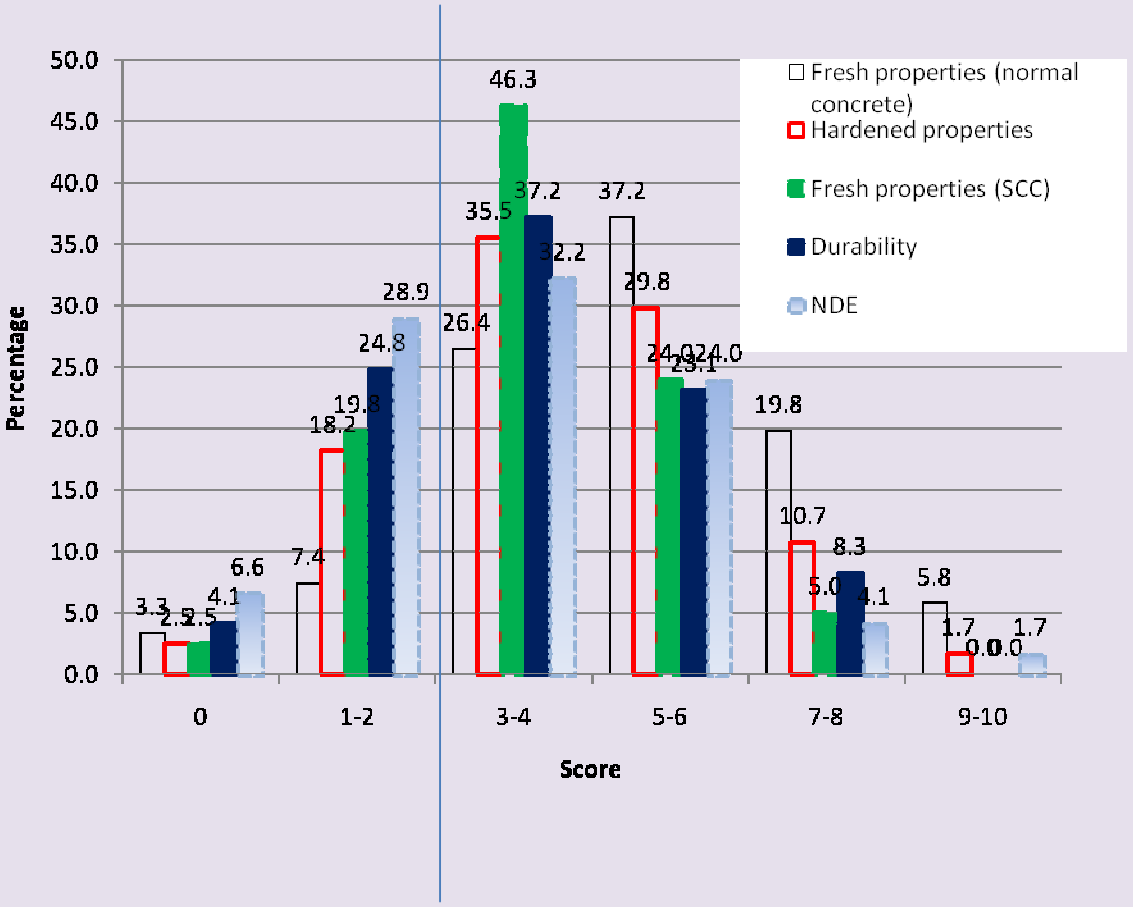
1. Average score of inexperienced full-time and experienced PT students



1. Conventional concrete properties of the first two quizzes should be much easier, and those of the last three new properties (SCC, durability and NDE) should be more difficult.

2. Par-time students performed much better than full-time students in the first two quizzes. However the differences are small for the latter three quizzes. It is because the contents of the latter three tests are not familiar to even students with some experience.

2. Score distributions



1. Scores are normally distributed.
2. Score less than 2 means that the result is worse than blind guess.

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Online e-learning video viewing

Structure of the videos

1. Introduction

- Why are these properties important?
- Why are these tests important?
- Connections of these properties with others (e.g. how fresh properties affect hardened properties)

2. Step of the tests

a…..
b…..
c…..

3. Factors affecting the subjects

a…..
b…..
c…..

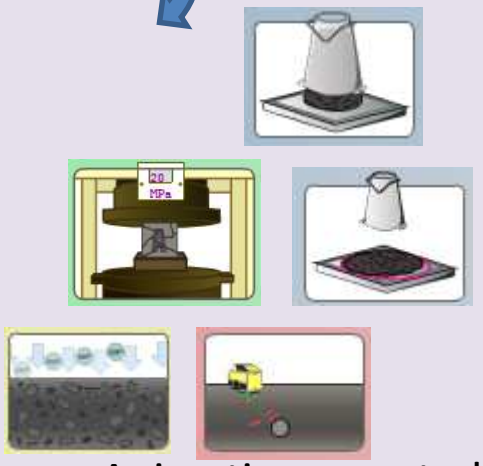
4. Discussions and Conclusions

- Summarize the tests and the properties
- Reference to international and local standards for further reading

Special features of the videos: collaborative efforts

Department of Civil and Structural Engineering, HK PolyU

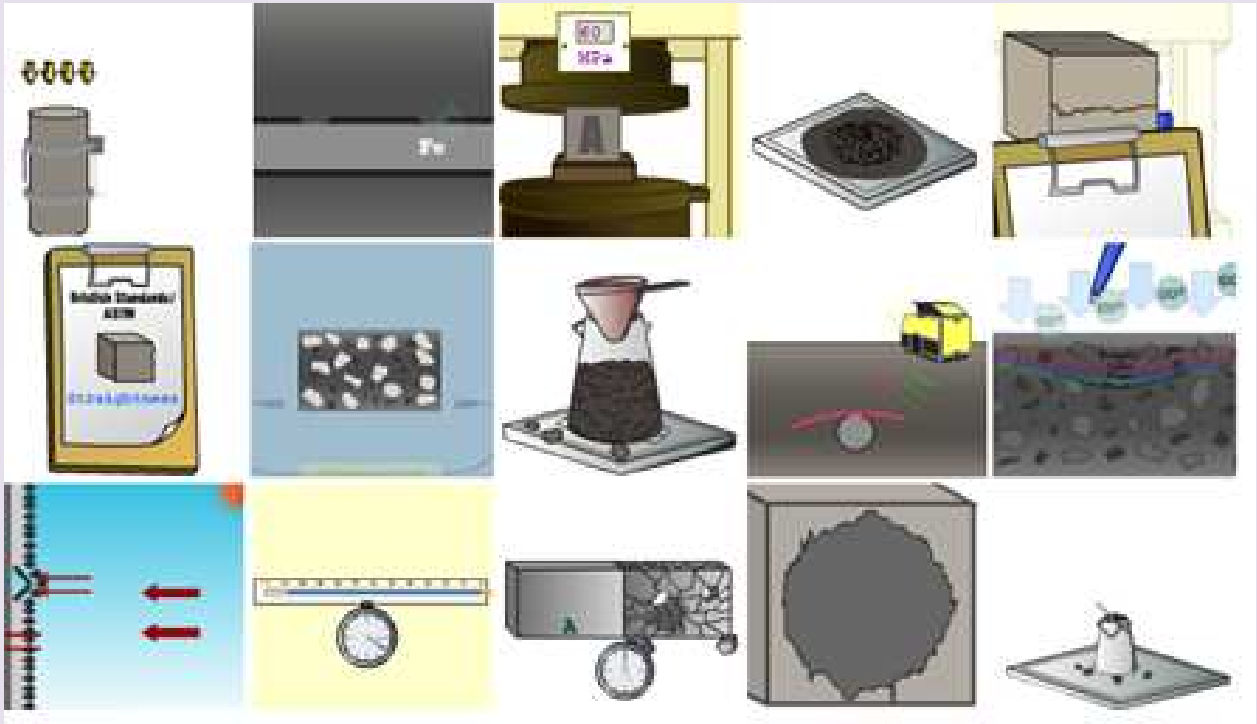
Professional video shooting and crew



Animations created by School of Design, HK PolyU

Professional advice by Education Development Centre, HK PolyU

Special features of the videos: Animations



Two short clips of videos on Self-compacting concrete and Nondestructive Evaluation

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- Effectiveness of the e-learning platform will be fully assessed by the end of 2011, after the post-lab quizzes and feedback from the students are evaluated.

- The e-learning videos will be available in PolyU library and distributed to other tertiary institutions and Government bodies and interested parties as appropriate.