Enhanced Learning through Undertaking Scaled Construction Projects in Laboratory Environments

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Courses I Am Teaching

• CVEN4102 – Operations and Projects
• CVEN9723 – Design of Construction Operations
• Introduction of construction methods, engineering design and operations planning
• Covering three categories of engineering operations
  – Building construction
  – Heavy civil construction
  – Underground infrastructure construction
• Number of Enrolment in 2016
  – CVEN4102: 240
  – CVEN9723: 93
Challenges in Learning & Teaching

- Lack of field knowledge in engineering construction and management
- Difficulties of running construction site tours for large classes due to workplace safety concerns and limited space
- Hard to experiment best practice and design theories in construction projects
Scaled Construction Laboratory

• An innovative and interactive scaled construction platform used to mimic an earthmoving/mining construction site in the laboratory
• Active and engaged learning exercises have been developed based on the platform since 2015
Development of Construction Laboratory

• Engineering Models
  – 1:14.5 scale
  – Battery powered with fully functional hydraulic systems

• Fleet of Scaled Machinery
  – 1 CAT 345D Hydraulic Excavator
  – 4 CAT 740 Articulated Dump Trucks
  – 1 CAT 966G Series II Wheel Loader
Development of Construction Laboratory

• Loading Bay
• Loading Materials
• Operator Chair of the Excavator
Laboratory Layout

**EXCAVATION CYCLE**

1. Start Load
2. End Load
3. Start Dump
4. End Dump
5. Arrive Cut

**HAULING CYCLE**

Excavator fills one truck with approximate 6 - 8 bucket loads

End Load → Swing → Dump → Return

Weighbridge

Haul

Start Dump → End Dump

Return
Loading Design with Hydraulic Excavator

Student Design 1

Student Design 2
Loading Design with Hydraulic Excavator

Student Design 1
16 Sec

Student Design 2
37 Sec
Loading Design with Wheel Loader

Student Design 1

Student Design 2
Loading Design with Wheel Loader

Student Design 1

31 Sec

Student Design 2

33 Sec
Laboratory Competition on Earthmoving Project

• Time Estimation for A Given Task
  – 1 Excavator
  – 2 or 3 Dump Trucks
  – ? Truck loads

• Factors to Be Considered
  – Idle time or queuing
  – Human factors
  – Equipment breakdown
  – Etc.
Laboratory Competition on Earthmoving Project

Time-lapse Video of Earthmoving Project
Laboratory Competition on Earthmoving Project

• Results for 1 Lab Session with 11 Groups

• Results for CVEN4102 in S2 2016
  – 26% of 65 groups within ± 10% errors of actual time
Student Testimonials

• Over 600 students attended the laboratory since 2015

• Best lab(oratory) in my uni(versity) life!

• The lab(oratory) is very unique and practical!

• I hope Sydney University had this lab when I studied my undergraduate there!

• Student Voice - Adem Abdioglu
Future Development

- Student-Led Project: Earth Mover Challenge
Acknowledgement

- 2015 UNSW Learning and Teaching Innovation Grants

- School of Civil and Environmental Engineering
  - Prof. Stephen Foster, Head of School
  - Prof. David Carmichael, Leader of ECM Group
  - Dr. Steven Davis, Co-chair of TLC
  - Prof. Richard Stuetz, Co-chair of TLC
  - Dr. Mary O'Connell, External Relations Manager
Thank You! Any Questions?

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