Road Safety & Pavement Materials Research – Past, Present and Future at The University of Auckland - Part 1 of 2
Presentation to REAAA AGM Forum – Auckland
28 May 2013
Presentation Overview

- Overview of UoA and Faculty of Engineering
- University of Auckland Transportation Research Capabilities
- Transportation Engineering Team
- Newmarket Laboratories
- Some recent research examples
  - Road Safety
  - Aggregates and Materials
- Discussion / Questions / Possibilities ??
The University of Auckland

- 42,000 students and 5,000 general and academic staff
- 7 Faculties
### University Strategic Goals

#### Table 1. Student population, revenue and economic impact

<table>
<thead>
<tr>
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<th>2004 Actual</th>
<th>2011 Actual</th>
<th>2020 Target</th>
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<tbody>
<tr>
<td>Percent postgraduate students</td>
<td>17%</td>
<td>20%</td>
<td>25%</td>
</tr>
<tr>
<td>External research revenue</td>
<td>$131m</td>
<td>$243m</td>
<td>$433m</td>
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<tr>
<td>Total revenue</td>
<td>$578m</td>
<td>$933m</td>
<td>$1,347m</td>
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<tr>
<td>Annual economic impact (NZIER multiplier)</td>
<td>$3.8b</td>
<td>$6.1b</td>
<td>$8.8b</td>
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Faculty of Engineering (2010)
5 Departments
3,200+ students per year
2,900 undergraduate
300 taught post graduate
560 post graduate research students
CEE – approx 1/3rd of Faculty ~115 PhDs
The CEE Dept

- 640 undergraduate students (yr 2, 3 and 4)
- 40 academic staff
- 16 support staff
- 115 PhD students (the largest Dept cohort in the University)
- Over $2.4M in research funding per year
# Research Centres

- Centre for Disaster Management
- Centre for Infrastructure Research
- Earthquake Engineering Research Centre
- Sustainability Research Centre
- Transportation Research Centre

Centres are a grouping of staff with common research interests
Transportation Engineering Programme

- 7 Academic Staff (5.2 FTE)
- 14 Masters courses
- >130 Transportation Postgraduate Students on taught Masters programs
- ~20 Masters Thesis / Res projects
- ~18 PhD’s
Figure 2 – Freight tonne-kilometres by mode 2006/07

- **Air**: 0.4%
- **Coastal shipping**: 14.9%
- **Rail**: 14.6%
- **Road**: 70.1%

*Not including Cook Strait traffic

Source: National Freight Demands Study 2008
Graduate Programme

- MEngSt (heavily supported by Industry > 100 students on the programme)
- Courses cover wide Transportation spectrum
  - Traffic Operations and Management
  - Planning and Design of Transport Facilities
  - Transport Planning
  - Transportation and Networks Analysis
  - Highway Safety and Operations
  - Infrastructure Asset Management
  - Road Management Systems
  - Advanced Pavement Engineering
  - Crash Reduction and Prevention
  - Highway Geometric Design
  - Transport Systems Economics
  - Planning and Managing Transport
  - Public Transport: Planning and Operation
  - Sustainable Transport: Planning and Design
  - Studies in Transportation 1 and 2
- ME by Thesis and PhD
The TRC at the UoA is to be the leading interdisciplinary centre for Transportation research in New Zealand (NZ), aimed at improving and impacting transportation practice in NZ and possibly internationally; the TRC will identify, develop, analyze and help to implement innovative solutions and new technology to persistent traffic and transportation problems.
TRC Aims 2010 - 2013

(1) Be the centre of knowledge and excellence that the transport industry turns to for answers;
(2) Become a trusted research provider for the government and private sector;
(3) Be an entity that students and researchers would like to be part of;
(4) Gain adequate laboratory space and equipment to offer researchers appropriate facilities to undertake practical research and experiments;
(5) Develop unique software knowledge and capability.
Research Partners within the University

Faculty of Engineering
- Depts of Civil and Environmental Engineering, Mechanical and Mechatronics, Chemical and Materials, Electrical and Software Engineering and Engineering Science PLUS Biomedical Engineering

Faculty of Business and Economics
- Prof Basil Sharp (Economics)
- Assoc Prof Paul Rouse (Accounting & Finance)

Faculty of Science
- Emeritus Prof Philippa Black (Geology)
- Prof Joel Baker (Geology)
- Prof Pip Forer (Geography)

Faculty of Creative Arts and Industries
- Prof Jenny Dixon (Planning)
- Prof Harvey Perkins (Planning and Director, Transforming Cities: Innovations for Sustainable Futures)

Faculty of Medical & Health Sciences
- Prof Alistair Woodward, (Population Health)
- Prof Rod Jackson (Population Health)
- Prof Shanthi Amerautannga (Population Health)
- Dr Kim Dirks (Environment and Population Health)
Research Partners / Funders external to the University

- Downer
- Fulton Hogan Ltd
- Green Vision Recycling
- RIMs
- NZ Transport Agency
- Ministry of Business, Innovation & Employment
- National Infrastructure Unit
- Ministry of Transport
- Auckland Council
- GHD
- Winstone Aggregates
- Roading New Zealand
- Ministry
- IDA
- NZCID
- Ministry
- Hutt River Recycling
CEE Laboratories

- Fluids
- Structures
- Geotechnical
- Transport
- Environmental

The research laboratories will be relocated to the new Newmarket campus and upgraded to state-of-the-art facilities.
University of Auckland Campuses
Newmarket UoA Campus

5.2 ha, UoA growing at 6000m² gfa per annum
Newmarket CEE Laboratories
Some Examples of Recent and Ongoing Road Safety and Materials Research Projects in the Dept of Civil & Environmental Engineering, The University of Auckland
The Cost of Congestion - Congestion and Traffic Capacity

- Congestion and traffic capacity are integrally linked and must be considered together.
- Congestion is subjective to most users.
- Congestion needs to be ‘defined’ and methodology agreed to enable consistent measurement of effectiveness (eg KPMs).
- KPMs / KPIs can be developed to allow performance to be measured over time.
- EEM Value of Time.
Fundamental Diagram of Traffic Flow – Terminology

- $q$: flow maximum
- $v$: speed
- $k$: density critical
- $k_j$: jam density
- $k_{mv}$: critical density
- $v_f$: free flow speed
- $q_m$: Maximum flow
- uncongested state
- congested state
Levels of Service Concepts

Free-Flow Speed, FFS = 120 km/h
110 km/h
100 km/h
90 km/h

Density = 1 pc/km/h
11 pc/km/h
16 pc/km/h
22 pc/km/h
26 pc/km/h

Flow Rate, \( v_p \) (pc/h/ln)

Average Passenger-Car Speed, \( S \) (km/h)
Travel Demand Management (Stages 1 and 2)

OBJECTIVE

The research will examine shifts in choice of transport modes in selected benchmark cities, and how shifts in travel behaviour were achieved.

This analysis will be used to test the assumption that additional investment into public transport, combined with TDM strategies, will lead to levels of service improvements set by the Auckland Plan. Figure 2 illustrates the projected levels of service for planned investment, which can be maximised with effective use of TDM strategies.

![Graph showing level of service projections](image)

Using information gathered from benchmark cities, forecasts will determine the projected level of service, based on planned investment and TDM strategies.

The research will aim to maximise the level of service by selecting the optimal TDM strategy to accompany planned investment, carefully considering the unique characteristics of the Auckland region and current travel behaviours.

CONTINUED RESEARCH

Stage Two research is considering appropriate TDM mechanisms identified in the initial phase:

- Residential and employment densities at transit hubs
- Design characteristics and amenities of urban space
- Diversity of land use across the region, projected fuel prices
- Effects of weather on mode choices.

Evaluating impacts of the TDM mechanisms on both personal and societal costs and benefits to Auckland:

- Effects on accessibility to key destinations
- Cost of mitigation
- Public health effects
- Environmental factors
- Local and regional economic impact, particularly for freight
Laboratory based Accelerated Polishing of Chipseal Aggregates and Skid Resistance

The University of Auckland New Zealand 28 May 2013

Electric motor, gear box and belt drive

Drive shaft

3 rotating pneumatic castor polishing wheels

Water Delivery pipes

Load weights

Safety cage

Lifting frame

Test sample

A prepared Lab Sample

The Accelerated Polishing Machine

The Dynamic Friction Tester

The Dynamic Friction Tester

Moutohora Greywacke Aggregate DFT(μ) Stage 1 and 2 Polishing

0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85

Time (mins)

Results

S2 - Moutohora PSV 63 Polished Sample

S3 - Moutohora PSV 63 Unpolished Sample

Unpolished Sample

Polished Sample

Stage 1: Polishing to ESR

Stage 2: Polishing with Additives

S2 - S3
Variation in Skid Resistance and the Geological Properties of Aggregates

Holcim Basalt Aggregate DFT(µ) Stage 1 and 2 Polishing

Time (mins)

New Zealand DF Tester (b) May 2013

Holcim Basalt Aggregate

S4 - Holcim PSV 52 Polished Sample
S5 - Holcim PS 52 Unpolished Sample

Unpolished Sample
Polished Sample
Stage 1: Polishing to ESR
Stage 2: Polishing with Additives

After Polishing with Leighton Buzzard Sand
After Polishing with Emery Powder