PhD Research Proposal: PERFORMANCE MODELS FOR FOAMED BITUMEN PAVEMENTS

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I. Background

Focus of Current research in Foamed Bitumen (FB) pavements
Responses in foamed bitumen pavements

Repeated Load Triaxial (RLT) Test is suitable to measure this type of responses

I. Background

Permanent Deformation Test
I. Background

**Permanent Deformation Test. Multistage**

II. Objectives & Methodology

**Main Objectives:**
- Study the factors that affect the permanent deformation of FB mixes
- Study the factors that affect the resilient modulus of FB mixes
- Develop resilient and permanent deformation models
- Program and implement these models into a 3D Finite Element software
- Calibrate the models with measurements from the field
- Obtain general calibrated models for NZ conditions
II. Objectives & Methodology

Methodology:
- Research work based on laboratory, modelling, and real pavement data
- Application of statistics theory for optimal design of experiments
- Use representative materials from NZ (aggregates, bitumen, etc)
- Laboratory work based on Dynamic Triaxial Tests
- Modelling work based on 3D Finite Element Method
- Real pavement analysis based on data from CAPTIF and projects in NZ

III. Laboratory Work

Part 1: Mix Design

- Foam Properties
- Aggregate Size/ PI / OMC
- Cement
- Mixing with Bitumen (1% to 5%)
- Compaction
- Indirect Tensile Strength

- Bitumen Content (%)
- Dry Saturated
III. Laboratory Work

Part 2: Measuring permanent deformation and elastic properties

- **RLT test**

<table>
<thead>
<tr>
<th>FB Mixes</th>
<th>Granular</th>
<th>Binder</th>
<th>Cement</th>
<th>Specimen</th>
<th>Moisture</th>
<th>Density</th>
<th>Stress Conditions</th>
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<tr>
<td>A</td>
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### Results:
- How factors affect PD rate
- How factors affect Mr

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Part 3: Measuring long-term properties

- **RLT test**

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Cycles & e_v & 500,000 & Cycles \\
& & P &
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### Results:
- Verification of PD rates
- Study material flow

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IV. Modeling

Three dimensional finite element models

Results:
- Programming of Models
- Response prediction

V. Real Pavement Data

Testing CAPTIF sections
VI. Other topics/Research Status

Other Topics:
- Freeze/thaw cycles
- Environmental impact (Energy Consumption)
- Implementation of developed models in a simple software for practitioners

Current state of the research:
- Winstone Aggregates-Hunua from Auckland region for CAPTIF project
- 3D-FEM modelling of pavement materials
- Previous laboratory testing in University of Canterbury laboratories

PERFORMANCE OF PAVEMENTS USING FOAMED BITUMEN STABILISATION

Thanks...

Alvaro Gonzalez
Department of Civil Engineering
University of Canterbury, New Zealand
Part 4: Studying performance for low-temperature construction

- RLT test

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<th>Foam/Mixing</th>
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Results:
- Feasibility of winter work
- Effects on foam additives

V. Other topics/Research Status

Sample 1 (Material 1)

![Graph showing permanent deformation x (10^-6) vs cycles]

- Stage C
- Prediction
V. Other topics/Research Status

Sample 2 (Material 1)

Sample 3 (Material 2)
IV. Modeling

Part 2: Prediction of Resilient/Permanent Deformations

- Prediction of permanent deformation
- Prediction of resilient deformation

V. Real Pavement Data

Testing CAPTIF sections