# SESSION 9 – CONSIDERATIONS FOR ROBUST PAVEMENT INTEGRATION OF IN-ROAD WPT

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NEW ZEALAND

# Wirelessly Powered Transport Infrastructure; MBIE

## PROJECT TEAM

## Multi-disciplinary Research Team:

- **University of Auckland:** Power Electronics and Inductive Power Research, Centre for Advanced Composites Materials, Transportation, Engineering Science, Business School
- **GNS Science**, Wellington
- **Victoria University of Wellington**, Robinson Research Institute

# Wirelessly Powered Transport Infrastructure; MBIE

## MECHANICAL TEAM, CENTRE FOR ADVANCED COMPOSITE MATERIALS

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### Academic Staff

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**A. Prof. Piaras Kelly**

**Dr. Tom Allen**

**Dr. Maedeh Amirpour**

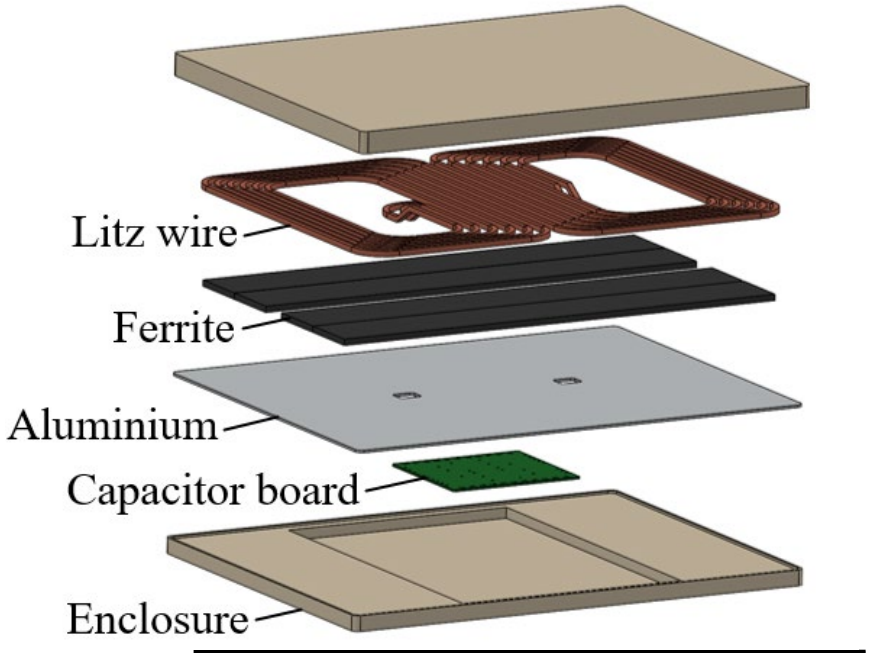
### Postdoctoral Fellow

**Dr. Willsen Wijaya**

### PhD Students

**Mr. Kai-Yeung Li**

**Mr. Christof Piefke**




- Polymer encased pad assemblies for asphalt pavements
- Materials characterization and selection
- Thermal and structural responses
  - Intermittent thermal loading
  - High frequency traffic loadings
  - Larger distances from utilities
- Multi-physics FEA modelling

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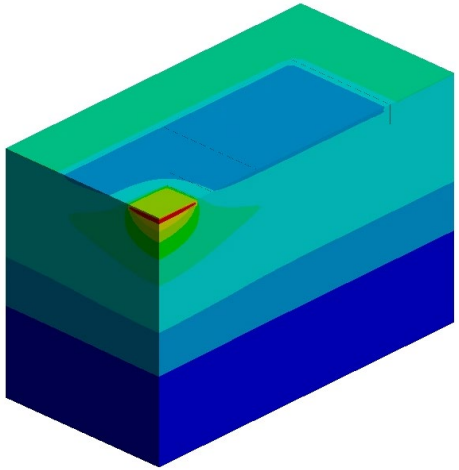
# Design for Impact of Complex Environments

## MATCHING MODEL COMPLEXITY TO DESIGN TASKS

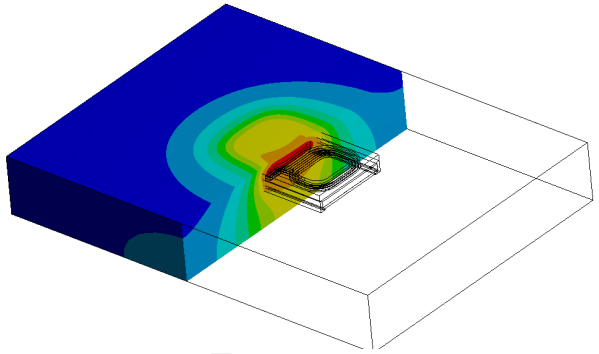
WPT **involves multiple physics**, and numerical tools such as ANSYS provide capability to couple several. However, a design problem should be addressed with a model of **sufficient complexity**.

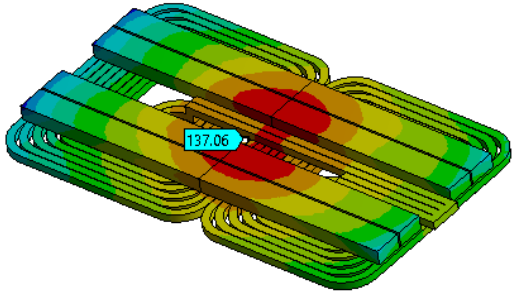
**Simple/Fast** ⟶ **Complex/Slow**



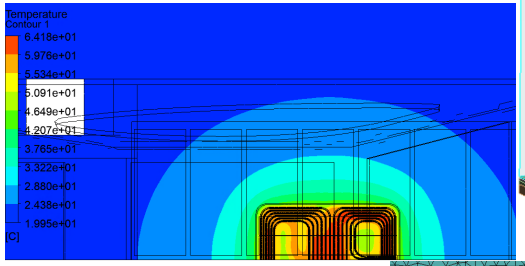
Transient Thermal

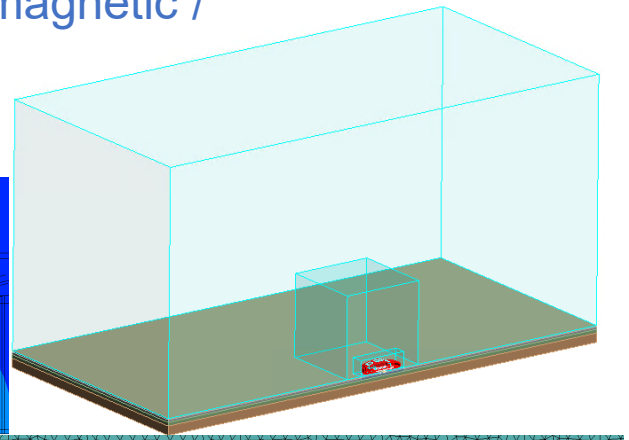
Coupled Electromagnetic / Thermal

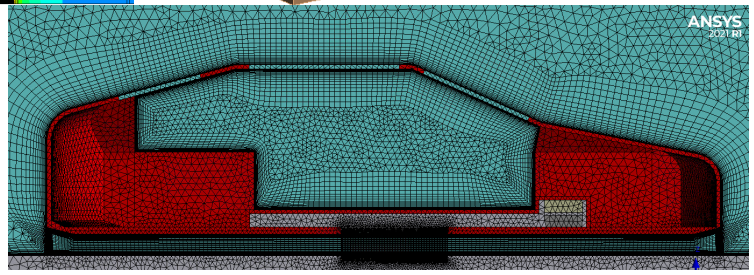





Coupled Electromagnetic / Thermal / Flow



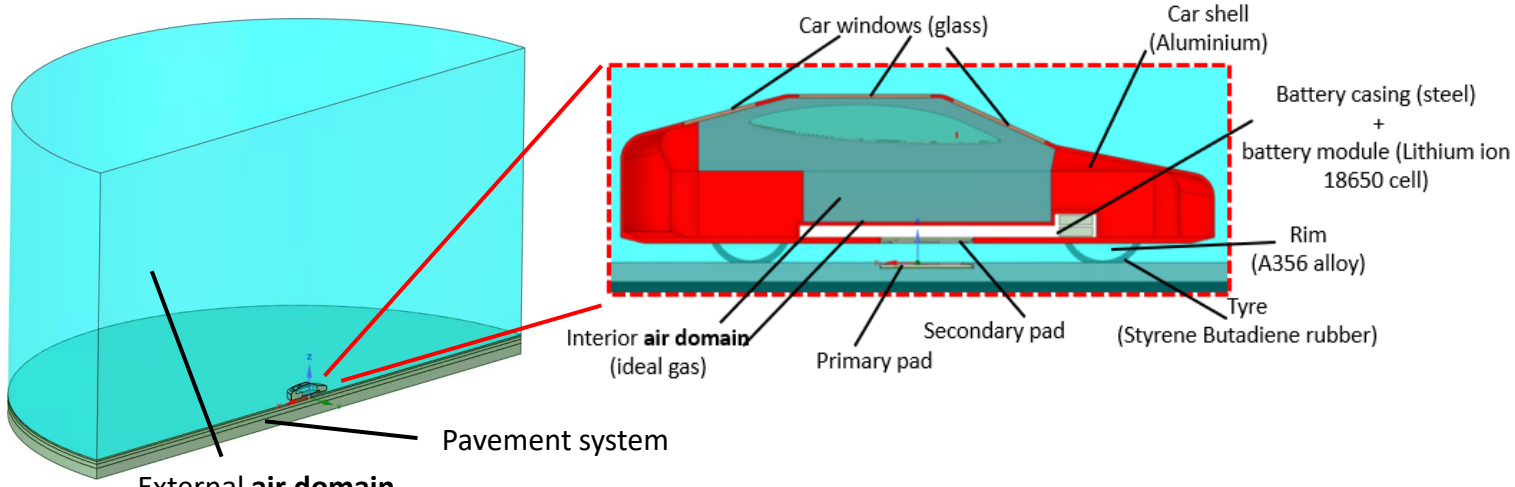



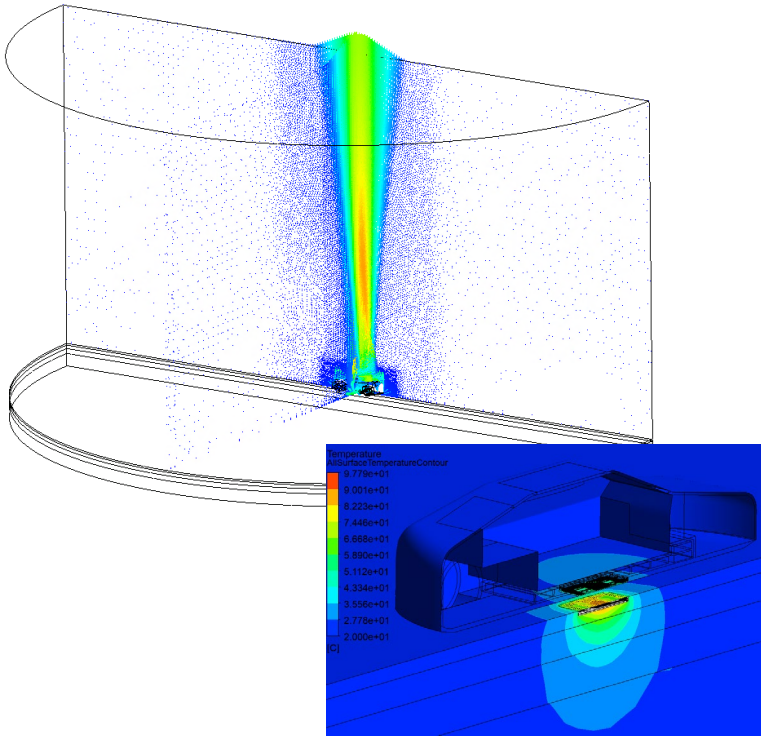



Coupled Thermal / Structural Behaviour

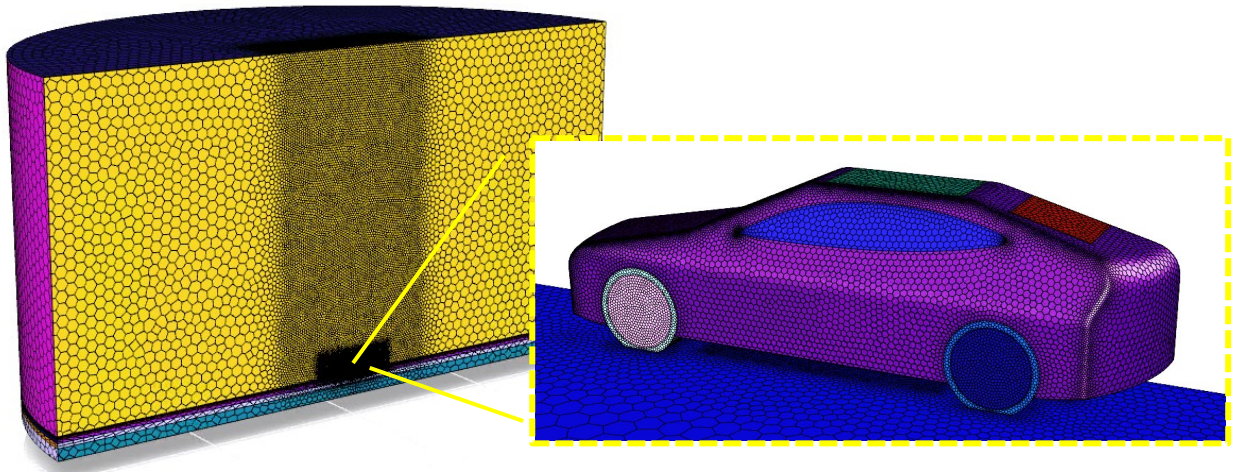
# Electromagnetic / Thermal Modelling

## EXAMPLE; MODELLING IMPACT OF VEHICLE ON TEMPERATURE FIELDS



Numerical discretisation



Complete poly-hex core mesh assembly prior to ANSYS System Coupling decomposition

Solve in ANSYS System Coupling

# Structural Modelling and Validation

## EXAMPLE; ¼ SCALE PAD DESIGN AND TESTING APPROACH

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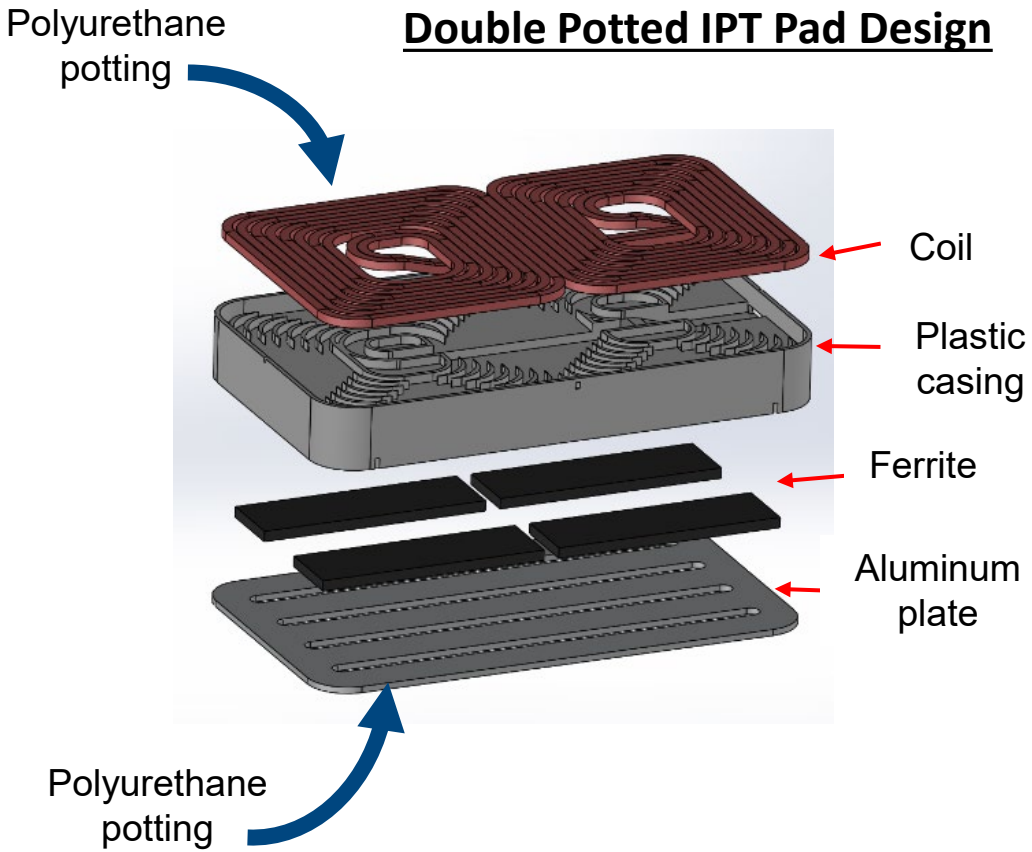
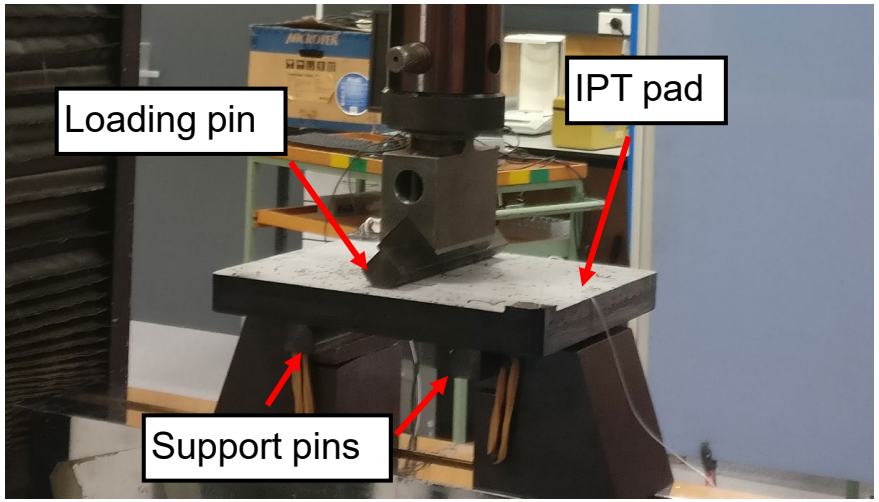
### Double Potted IPT Pad Design



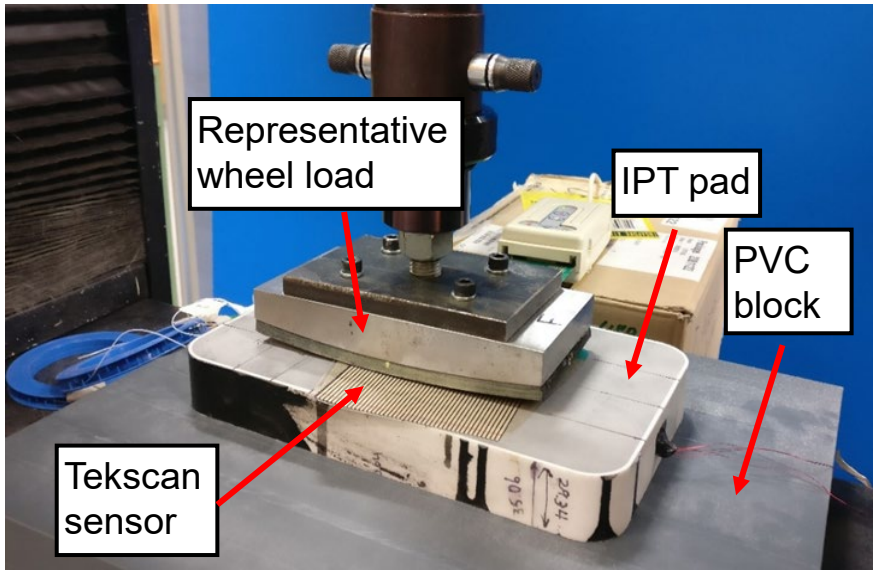

- Proposed ‘double sided’ pad design increased the quality and consistency of manufactured pads
- More linear and predictable mechanical response to traffic wheel loading

### 3-point Bending

Ferrite cores instrumented with strain gauges and FBG sensors




### Compression – simulated wheel loading

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# Structural Modelling and Validation

## EXAMPLE; VALIDATING PREDICTED DEFORMATION OF FERRITE

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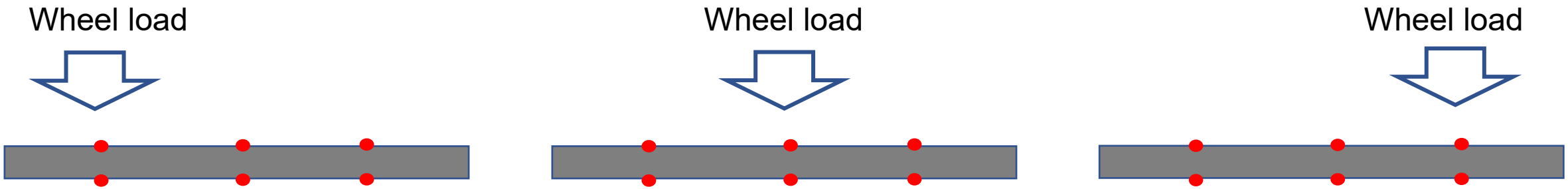
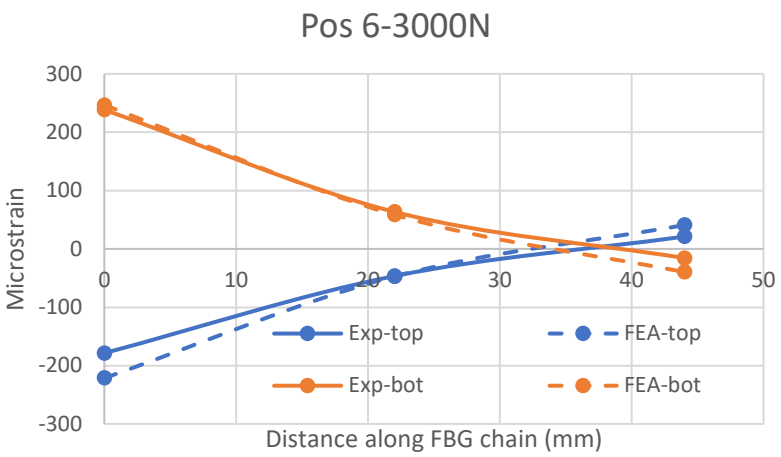
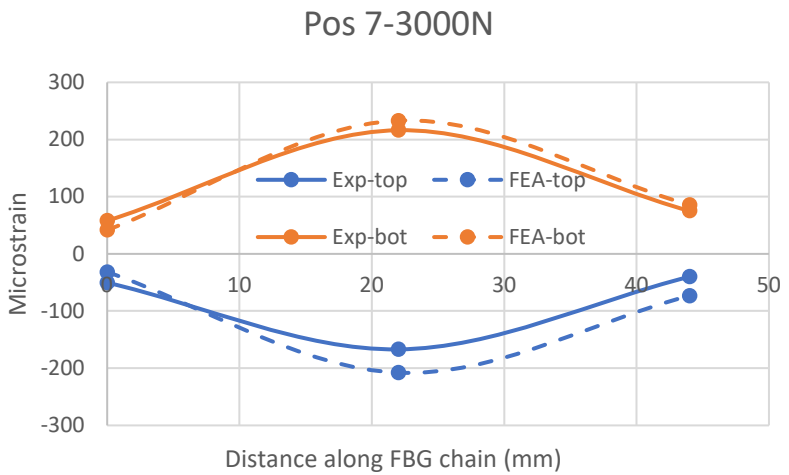
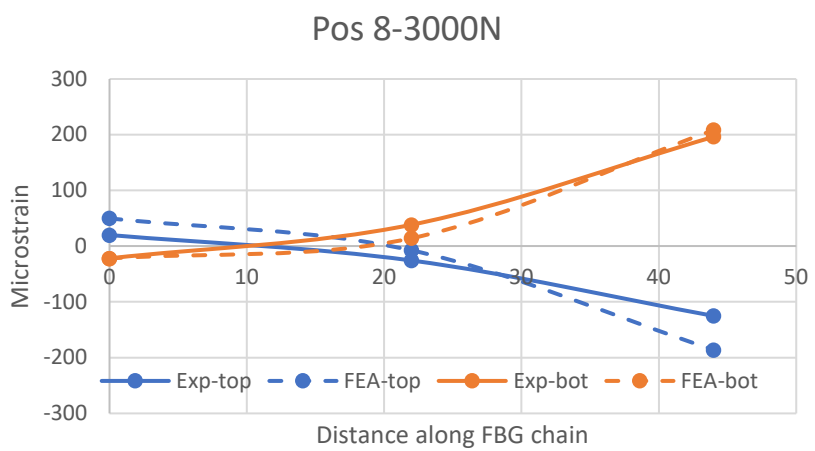
Considering deformations of ferrite, as a wheel load progresses across a ¼ scale pad:

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# Concluding Remarks

- **Multi-physics models**, enabled by careful **material characterisation**, are aiding development of pavement integrated WPT systems.
- Upcoming Pilot Projects will demonstrate that pavement integrated WPT can be realised, the continuing challenge being **design of cost effective solutions**.
- This will be achieved through a **highly multi-disciplinary effort**.