# Field Evaluation of Portland Cement Concrete Pavement Surface Texture and Frictional Properties

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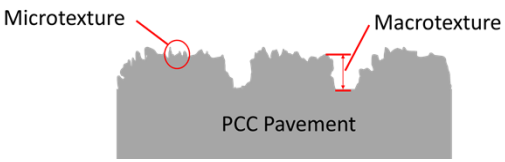
## INTRODUCTION

- Portland cement concrete (PCC) can be used as a construction material in pavement
- PCC has different material and structural properties than hot mix asphalt (HMA) that are desirable under various circumstances
- One difference between PCC and HMA is that PCC requires **surface texturing** as part of the initial construction process
- This can be done by several methods, including:
  - Burlap drag,
  - Broom drag, and
  - Tining
- Surface texture for a **new** pavement is generally considered in two components:
  - Microtexture ($\mu < 0.5$ mm)
  - Macrotexture (50 mm > $\mu$ > 0.5 mm)




- Many pavement properties are affected by surface texture, including:
  - Smoothness (macro)
  - Tire-pavement noise (macro)
  - Surface water drainage (macro)
  - Skid-resistance (micro and macro)
- The method of surface texturing can therefore greatly impact the performance of the pavement in these areas
- This study looks at the initial surface texture of three PCC pavements constructed in summer/fall of 2016 and compares with skid-resistance performance as measured by the British Pendulum Test (BPT)

Two surface textures with same design differing by construction practices

## BACKGROUND

- Three PCC pavement projects were evaluated:

**Harwood-Bayly Intersection (Ajax, Ontario)**

- Intersection of 4-lane Harwood Ave. and 6-lane Bayly St.
- 30,000 AADT (est.) with 5% trucks/buses
- Pilot PCC project to address severe HMA rutting and shoving
- New pavement: 200 mm JPCP placed over 100 mm Gran. A base
- Longitudinal burlap drag followed by transverse tines
- Manually raked tines, 3 mm wide @ 13 mm spacing

Harwood-Bayly Intersection before (left) and after (right)

**Jameston Ave. (Hamilton, Ontario)**

- Residential street
- Intermittent bus and truck traffic
- Pilot PCC project to address frequent resurfacing required for composite pavement streets throughout Hamilton rutting
- New pavement: 100 mm JPCP unbonded overlay over HMA or geotextile separation layer and ~200 mm existing concrete base
- Transverse broom drag finish

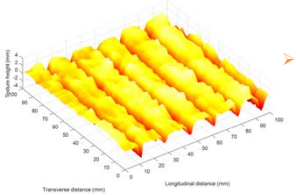
Jameston Ave. before (left) and after (right)

**Precast Panels, Highway 400 NB (south of Barrie, Ontario)**

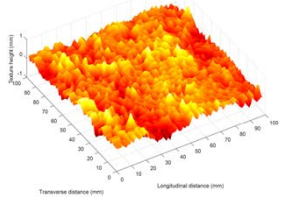
- High-volume highway
- 50,000 AADT (est.), 16% trucks, in NB direction
- Pilot PCC project to address frequent deep-seated rutting issues on 400-series highways
- New pavement: 200 mm reinforced precast panels over ~200mm existing HMA and granular base material
- Longitudinal broom drag and longitudinal tining
- Tining rig, 3 mm wide @ 19 mm spacing


## DATA COLLECTION

- At each project, several surface areas were located for testing
- Each area was approximately 100 mm x 100 mm
- In each case the pavement was tested prior to traffic loading, ensuring the surface texture was in "as-constructed" condition
- An LS-40 Line-Laser Scanner was used to build a numerically-based topographical profile of the concrete surface in the dry condition



- Laser-line scan topographical image of broom + tine finish (scale -4 to +4 mm)

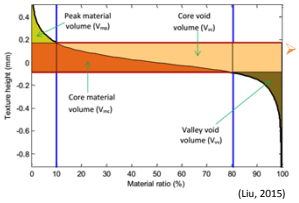


- Laser-line scan topographical image of broom finish (scale -1 to +1 mm)

- Following scanning, a British Pendulum Test was performed at each location in the wet condition, to produce BPNs which serve as frictional indicators
- British pendulums are used worldwide and represent a relatively easy method for measuring pavement surface friction

- BPNs often show high variability and can be influenced by conditions such as wind and operator

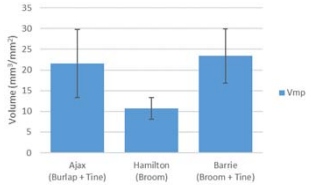
## ANALYSIS



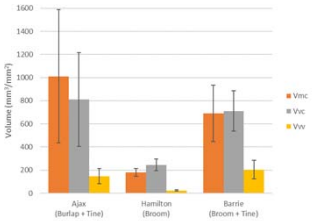

(Liu, 2015)

- Line-laser data was processed using volume based indicies (p=10%, q=80%)

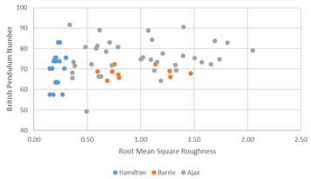
## RESULTS




- Broom + tine and burlap + tine had significantly higher peak material volumes than broom only




- Burlap + Tine had the highest average core material volume, though high variability
- Tining Rig in Broom + Tine appeared to slightly improve valley void volume
- Broom finish resulted in least texture area




- All BPN values were found to be quite high
- Consistent with new PCC pavement
- No correlation was found between BPN and surface profile measures (RMSR, Vmp, Vmc, etc.)

## CONCLUSIONS/FUTURE

- The construction method has significant effects on surface texture
- Manual vs machine texturing appears to increase the variability of the surface texture
- BPN apparently can not reliably be correlated with traditional 3D functional parameters
- The change of the surface textures over time will be measured with Line-laser scans and BPN
- These values will be studied in conjunction with traffic volumes and relevant environmental conditions
- The test areas were documented so exact areas will be re-visited

Liu, Q. (2015). Three-Dimensional Pavement Surface Texture Measurement and Statistical Analysis. (Thesis) Department of Civil Engineering, University of Manitoba. Winnipeg, MB

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