FWD/HWD Void Detection Beneath Concrete Pavements or Overlaid Concrete Pavements

Prepared by:
Khaled Galal, Ph.D.
Pavement & Materials Research Team Leader
Stantec Consulting
Charlotte, NC

Presented by:
Leanne Whiteley-Lagace, M.A.Sc., P.Eng.
Pavement Engineer
Stantec Consulting
Hamilton, ON

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Presentation Outline

- Voids – what's the big deal?
- What causes them?
- How can we detect them?

Oops…

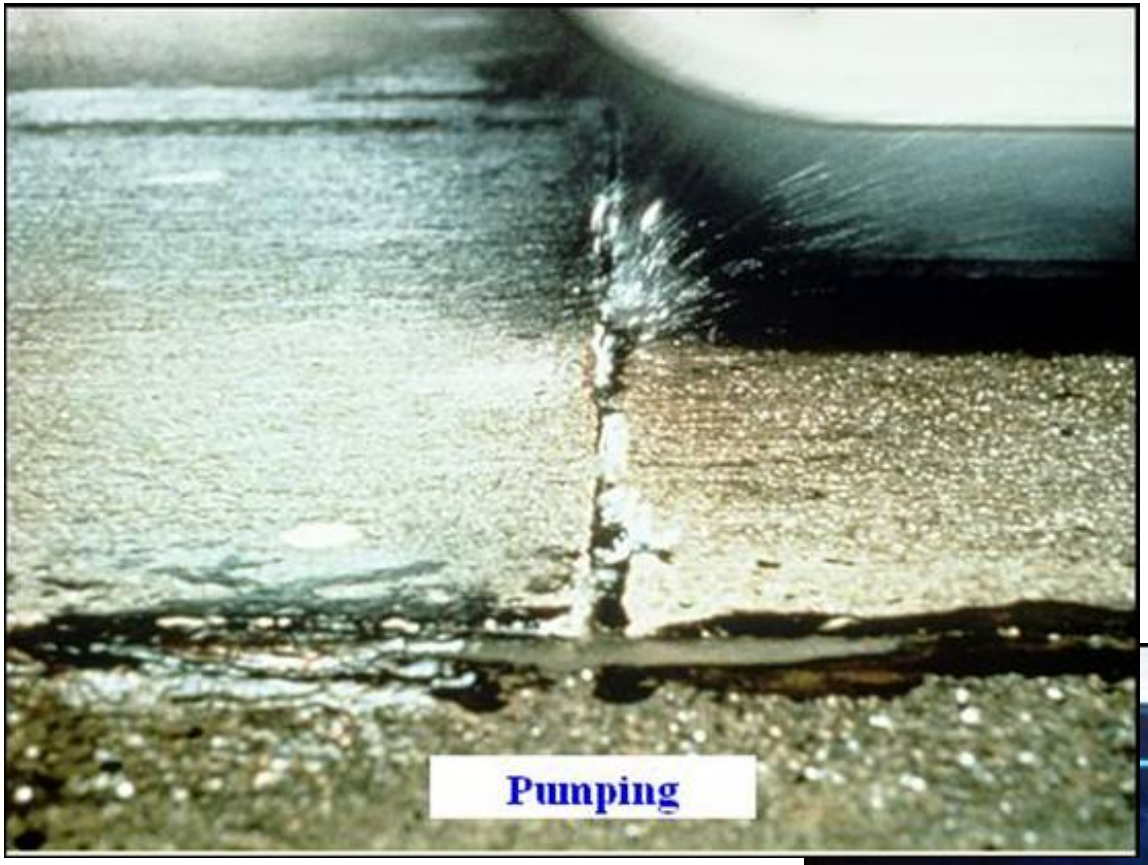
Development of Voids

- Pumping action of concrete pavement
- Subbase disintegration
- Lack of doweled pavement
- Poor subbase and/or subgrade compaction
- Poor construction

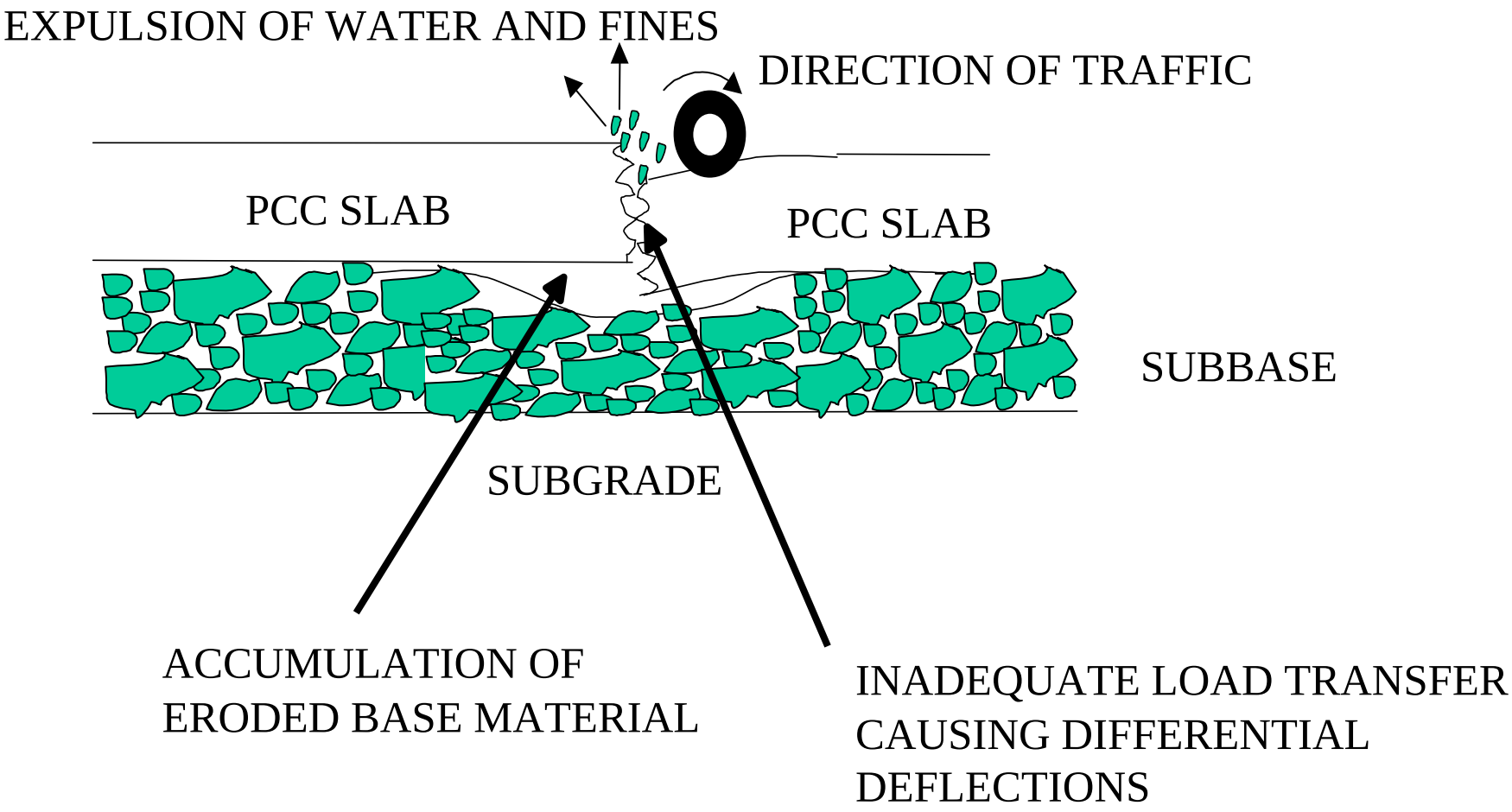
Development of Voids

- Excess subgrade and subbase (unbound materials) moisture
- High water table
- Aggregate segregation during construction
- Combination of one or more of the above

Pumping & loss of fines



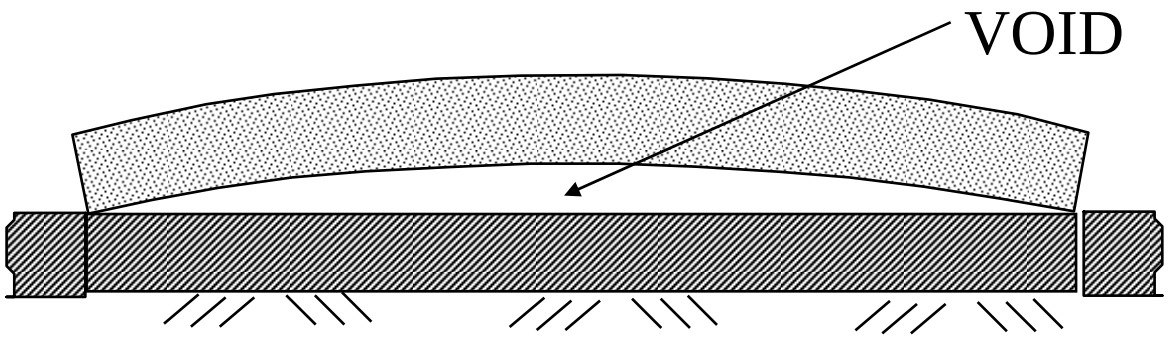
Faulting (Pumping Mechanism)



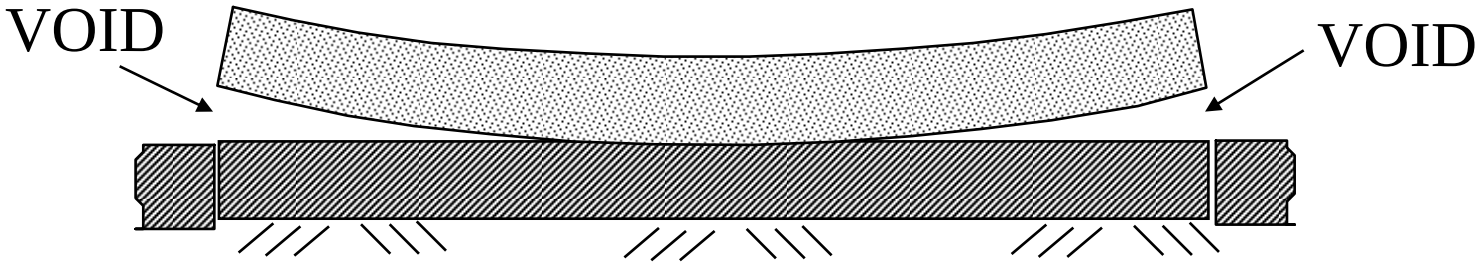
Void Detection/Underseal

- Underseal Analysis
  - Conduct FWD/HWD test at multiple load levels
  - At a minimum, test leave and approach PCC slabs within 60-100 cm (2-3 ft) of slab edge
  - Recommend randomly testing PCC slab centre
  - Test at the direction of traffic movement
  - Avoid testing at extreme temperature

Slab Curling – Temperature Difference



DAYTIME CURLING

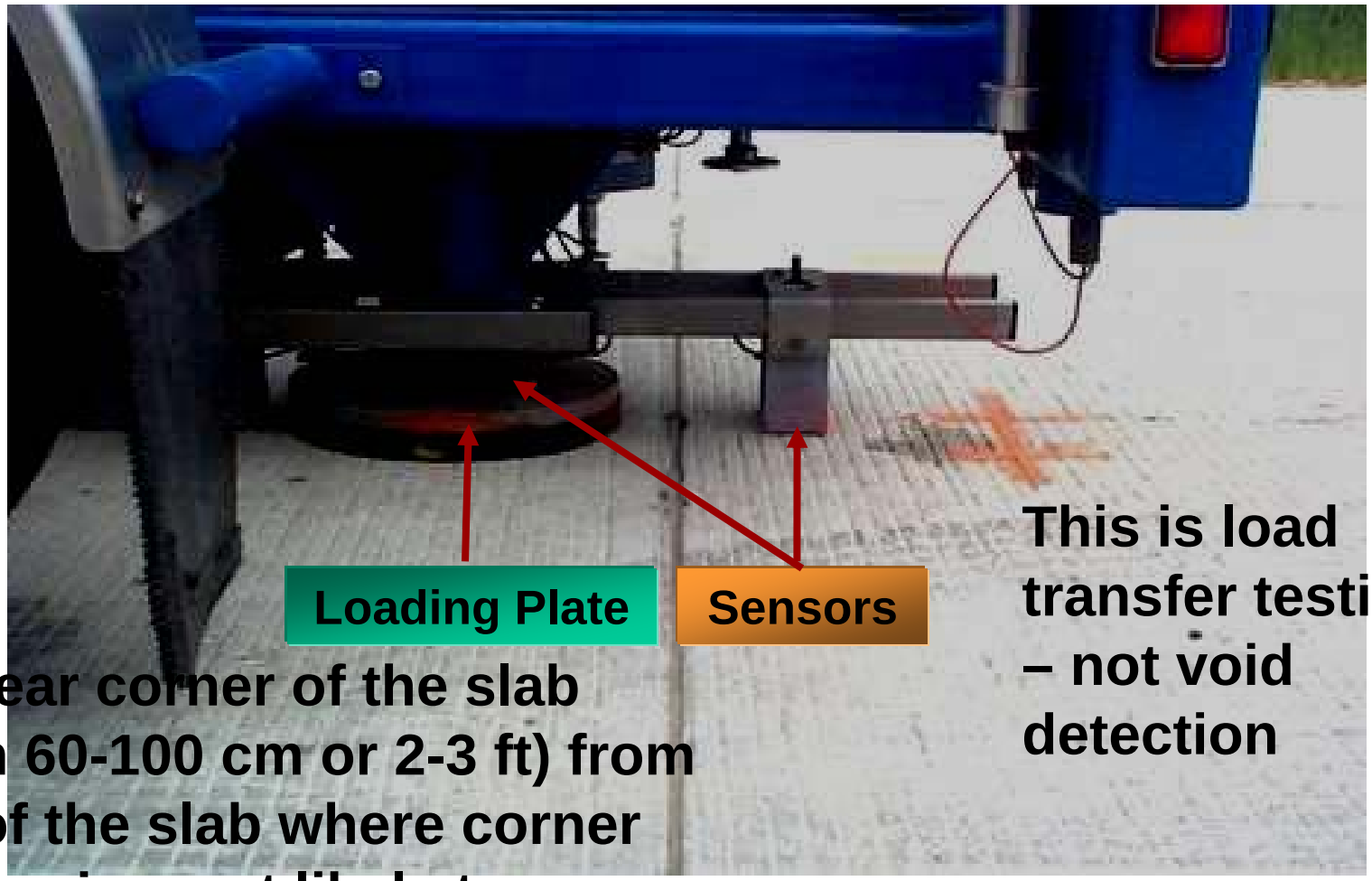


NIGHTTIME CURLING

Slab Curling

- At high surface temp = edge contact
- At low surface temp = centre contact
- **Avoid corner tests if slab does NOT have edge contact**
- Recommend FWD/HWD testing when curling/warping does not exist – usually when temperature differential is minimum between top and bottom of the slab

FWD/HWD Void detection is performed at corner of the Slab



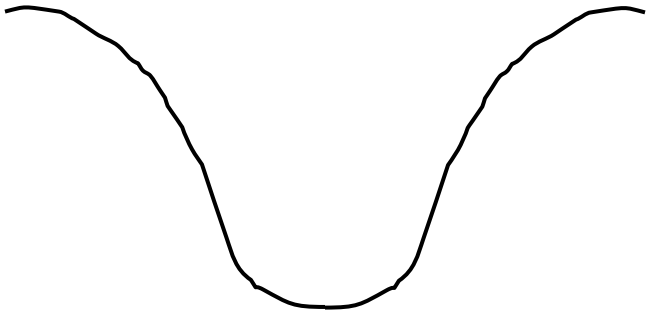
Test near corner of the slab (within 60-100 cm or 2-3 ft) from edge of the slab where corner cracking is most likely to occur

This is load transfer testing – not void detection

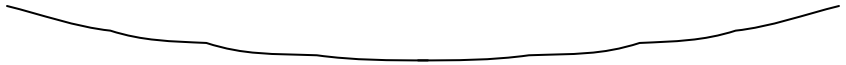
Testing Sensitivity

- FWD/HWD is very sensitive to the presence of voids beneath the corner of PCC or overlaid PCC slabs
- FWD/HWD sensitivity is reduced where dowels are used for load transfer across PCC slabs
- FWD/HWD testing must be conducted at multiple load levels to detect the voids beneath PCC or overlaid PCC Slabs

Deflection Basin Parameters



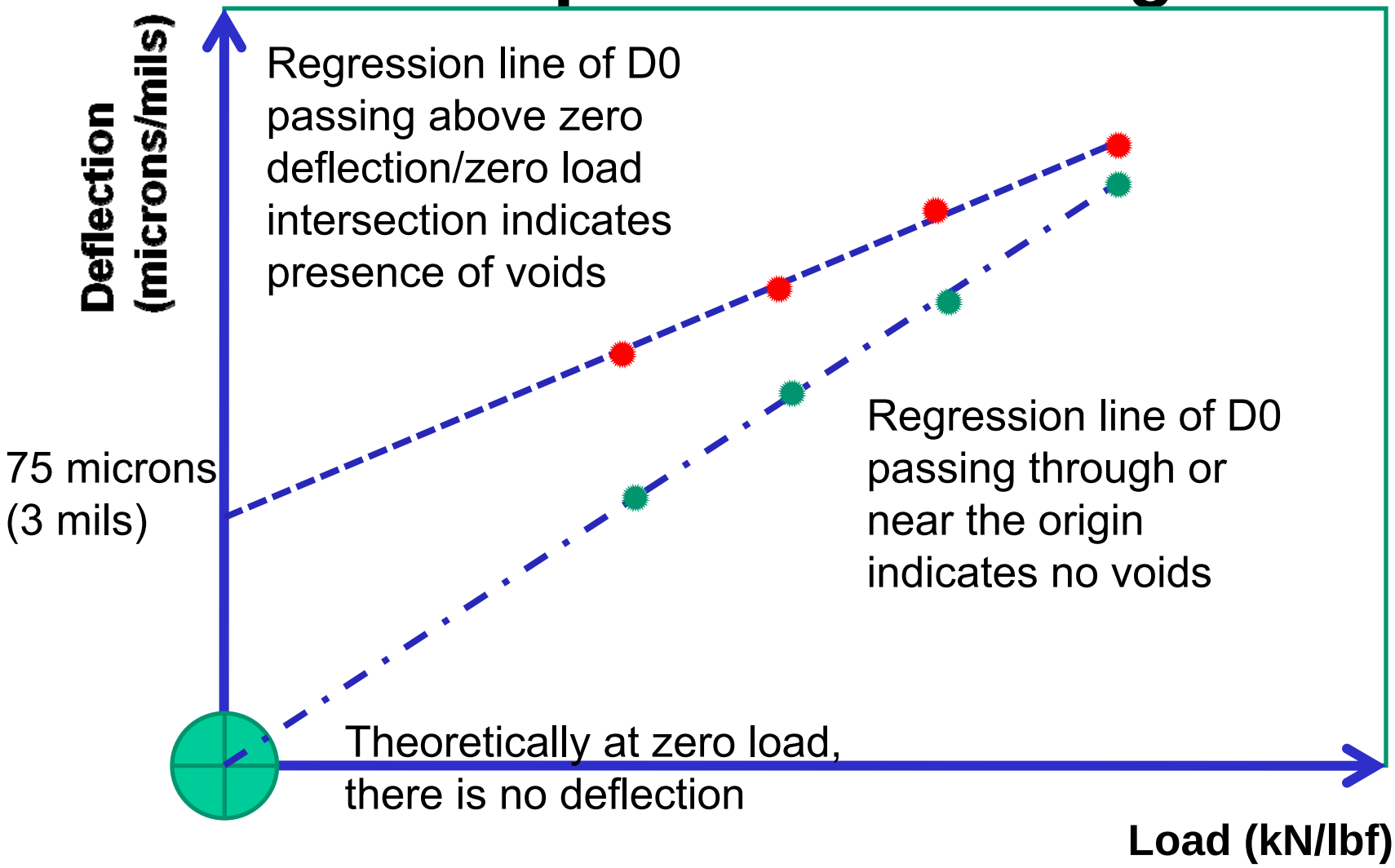
Weak Pavement/
High deflection
(Void-like
conditions)



Strong Pavement/
Low deflection
(No void-like
conditions)

- Deflection magnitude
- Slope
- Deflection difference
- Radius
- Area
- Deflection ratio

Void Detection Method 1: Multiple Load Testing

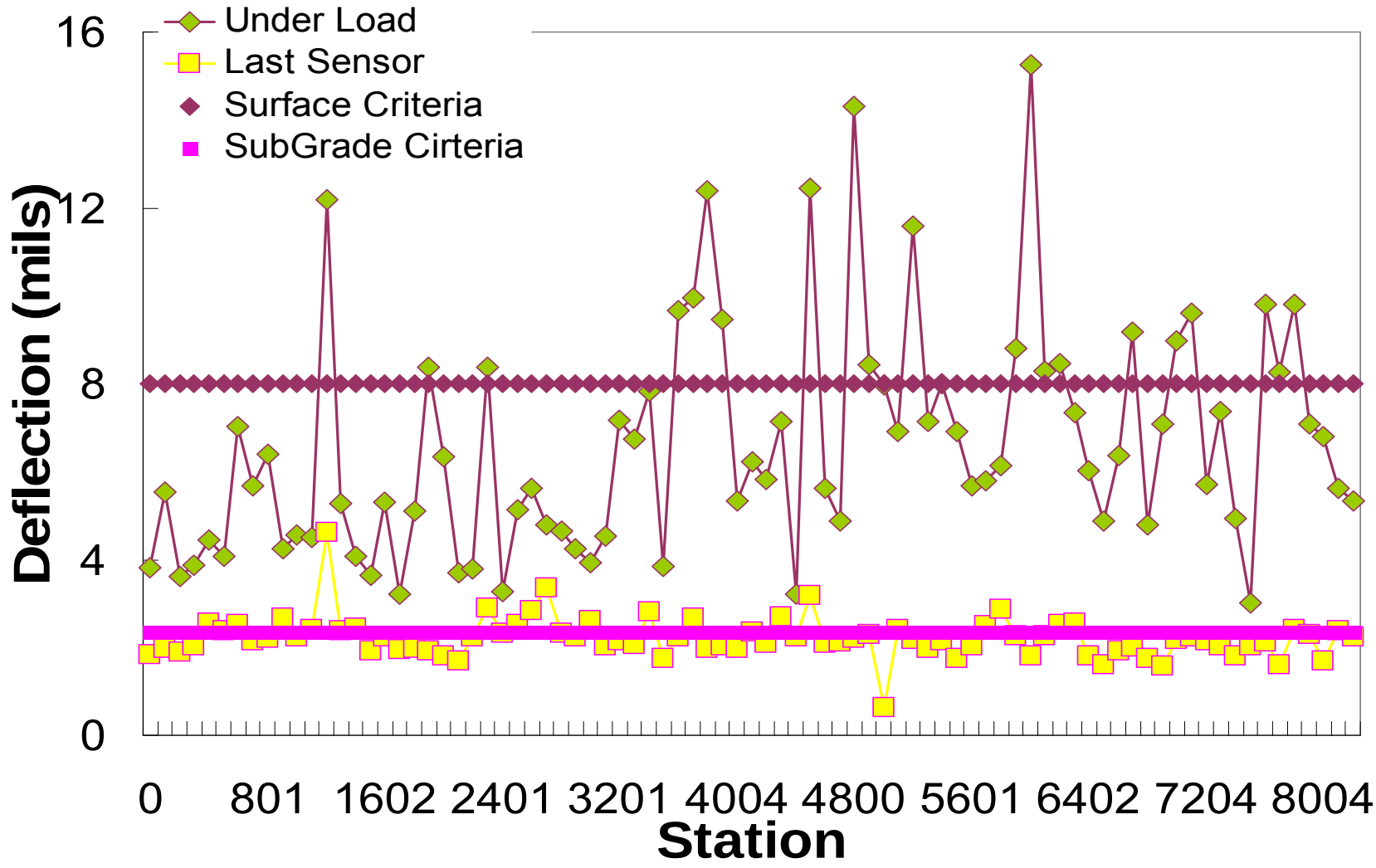


Void Detection Method 2: Centre Slab Load Test Comparison

Load Transfer	D0 (at center of the slab)	D0 (at slab corner)	D0 function of thickness & load	D0 Normalized to 40 kN (9,000 lbf) (for overlaid PCC must normalize to 20°C or 70°F)
Doweled	Example: 75 microns (3 mils)	2.5 – 3 times measured centre deflection (D0)	40 kN (9,000lbf)	≥ 187 - 225 microns (7.5 -9.0 mils)
Non-Doweled	Example: 75 microns (3 mils)	3.5 – 4 times measured centre deflection (D0)	40 kN (9,000lbf)	≥ 262 - 300 microns (10.5 – 12.0 mils)

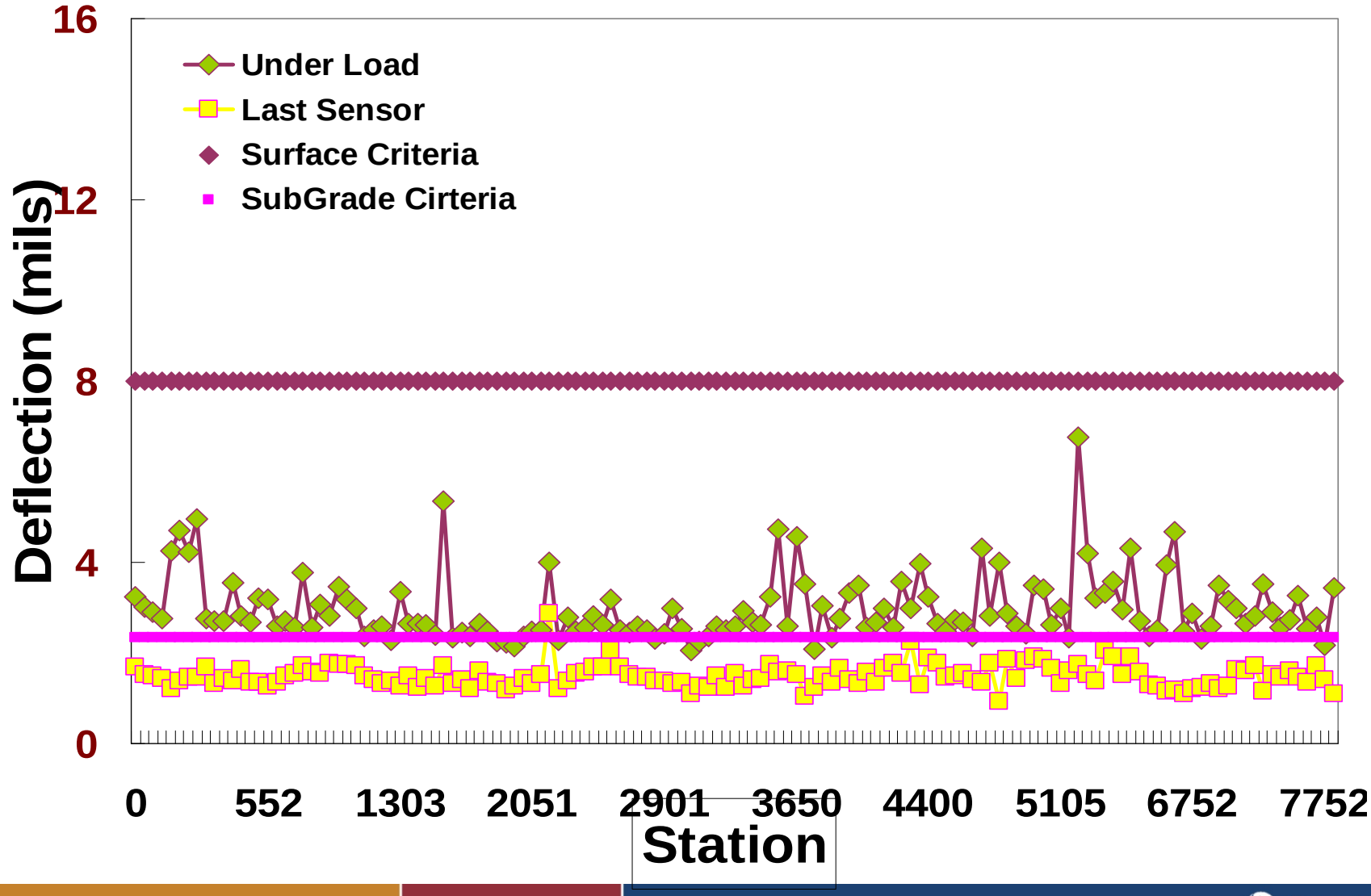
Before Underseal

Void Detection Method 3: Maximum Deflection Criteria



After Underseal

Void Detection Method 3: Maximum Deflection Criteria



Keep in mind...

- It is possible that one methodology may indicate the presence of voids, while another method may indicate no voids
  - Relatively small void (for now)
  - Presence of other distresses
- All three methodologies are used in conjunction with each other

Questions

Khaled A. Galal, Ph.D.
Pavement & Material
Research Team Leader

2127 Ayrsley Town
Boulevard Ste. 300
Charlotte NC 28273
Ph: (980) 297-7655
Fx: (704) 329-0905
Cell: (980) 225-3077
Khaled.Galal@stantec.com

Leanne Whiteley-Lagace, M.A.Sc., P.Eng.
Pavement Engineer

1400 Rymal Road East
Hamilton ON
Ph: (905) 381-3243
Fx: (905) 385-3534
Cell: (289) 339-1749
Leanne.WhiteleyLagace
@stantec.com