Pavement Distress Investigation

at Toronto Pearson International Airport

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Date: Sept 9, 2019

Location: 2019 SWIFT - Vancouver

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Overview

- Background Information
- Operation Planning
- Field Data Collection and Validation Method
- Repair Alternatives
- Lessons Learned

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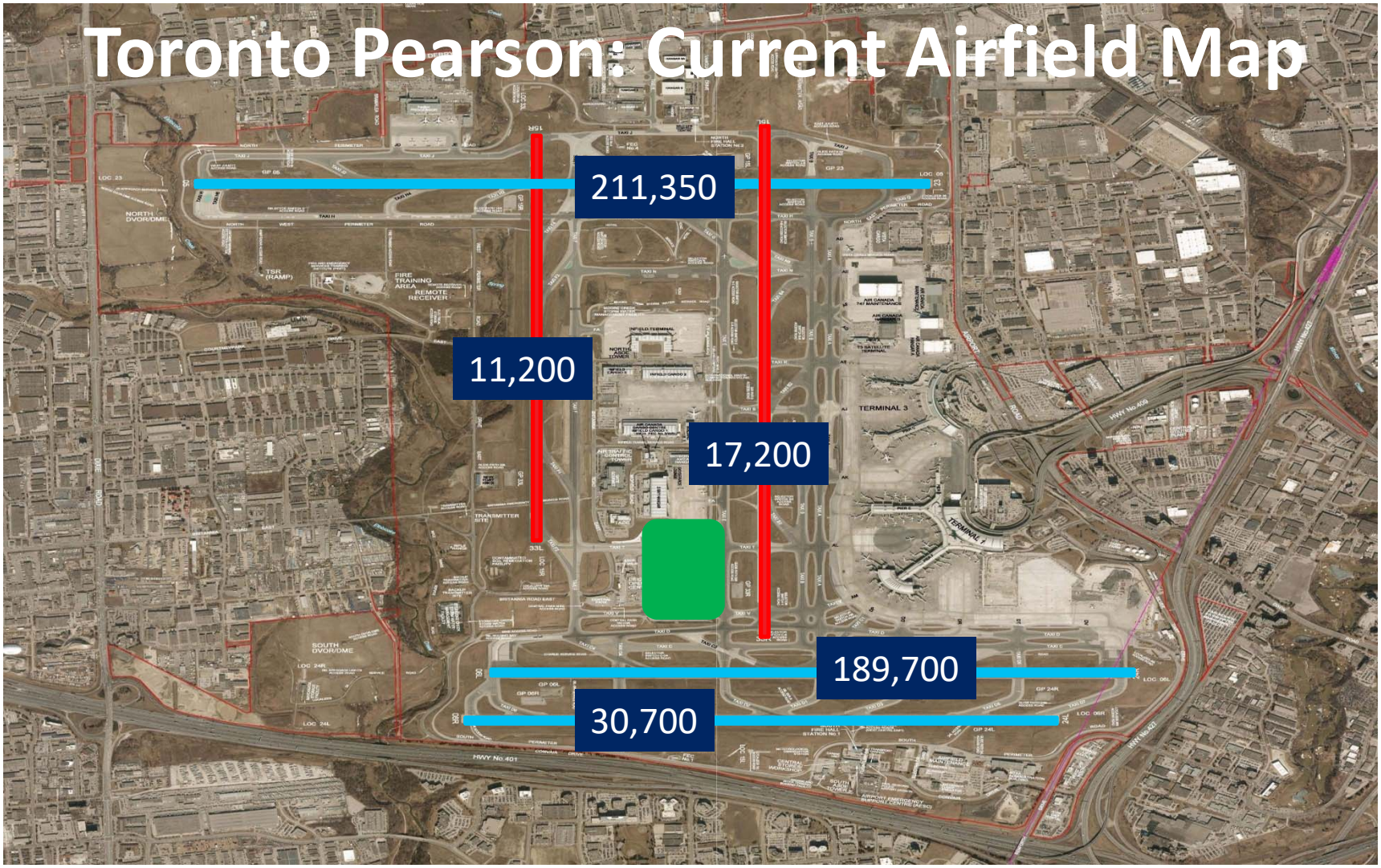
Toronto Pearson: Current Airfield Map



Toronto Pearson – Canada's Largest Airport

- 2018 Passenger Volume: 49.5 Million PAX.
- Ranking in North America: 2nd busiest airport
  (in terms of international passengers, 31.7 Million PAX.)
- Total airside paved areas: approx. 5.8 million m^2
  (concrete and asphalt)
- # aircraft movements: approx. 472,000
  annually
- Cargo processed: over 700,000 tonnes
- Direct Jobs created: 49,000
- Jobs facilitated by Pearson: 332,000
- GDP contribution to Ontario $42 Billion

Aircraft Movement

A quick comparison of annual Aircraft Movement in 2018 with other Canadian Airports

• Ottawa	78,000
• Halifax Stanfield	79,000
• Calgary	201,000
• Montreal Trudeau	240,000
• Vancouver	296,000
• Toronto Pearson	472,000

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Background Information

- This presentation will focus on work completed on a concrete taxiway.

- The purpose of this work was to visually inspect 100% of a concrete taxiway, to map the observed distresses, and then to develop repair recommendations based on the visual inspection results.

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Background Information con't

- Repair techniques for each distress type were developed for long term performance based on full closure assumption (Long Term solution) and

- Repair solutions that could be completed in a nightly closure (Short Term solution) were also considered.

Pavement Distress Investigation

Background Information con't

- In addition to recording the pavement defects and recommending repairs for the various types of distresses and their severity, the potential causes of the pavement distresses in the concrete panels were identified.

Pavement Distress Investigation

Background Information con't

- Maintaining the integrity and safety of the airport daily operation is a must for all travelers and stakeholders, therefore, a fast short-term repair solution to extend pavement life up to 2-3 years is preferable until a long-term solution is able to implement.
- Consultation with the Airlines, NavCanada, and internal stakeholders to develop a construction closure schedule is a must which will minimize operational disruptions for any short-term repair work.

Pavement Distress Investigation

Background Information con't

- Thorough discussion, consultation and risk mitigation with all stakeholders well in advance (3 years or more) including NavCanada, Airlines and local residents is a must for future long-term repair solution development at the busiest airport in Canada.

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Operational Planning

- At an initial planning stage, any closure options, restrictions and risks should be considered and discussed thoroughly with all stakeholders, designer and contractor prior to developing and finalizing any Operational Plan and Closure Schedule.

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Operational Planning con't

- Construction starts early to avoid summer rush, higher weather risk
- Phasing of works to minimize operational impact
- Temporary restrictions on air traffic such as
  - General/Business aviation flight restriction
- Shortened Runway Operation during construction
- Aircraft Arrival Rate assumption

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Field Data Collection

- The detailed pavement distress survey was completed based on the ASTM D 5340. Types of distresses observed:

Corner break	Concrete Delamination
Longitudinal, transverse & diagonal cracking	Joint spalling
Joint seal damage	Corner spalling
Scaling, map cracking & Mortar flaking	Wood, Plastic & Metal

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Field Data Collection - Corner break

1. Cement stabilized base strength exceeded the specified 6.5 MPa @ 28 days resulting in significant residual curling and subsequent corner cracking.
2. Localized loss of support under concrete slab.

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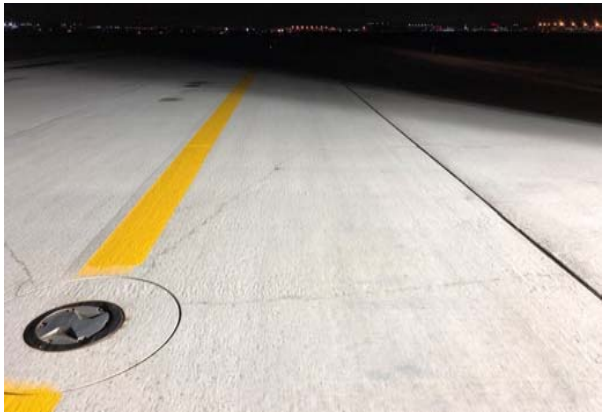
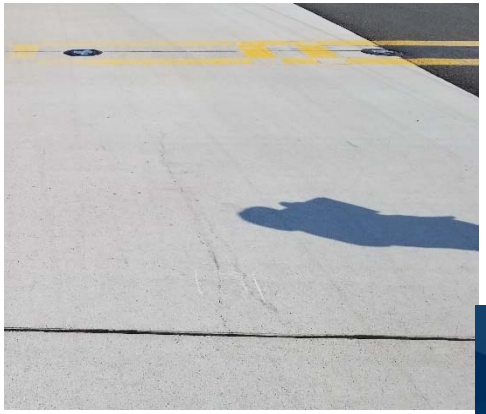
Field Data Collection - Longitudinal, Transverse & Diagonal Cracking

1. Varied levels of support under the concrete pavement causing differential deflections.
2. Loss of support under the concrete pavement.
3. Possible late or improper sawing of control joints (for low severity)





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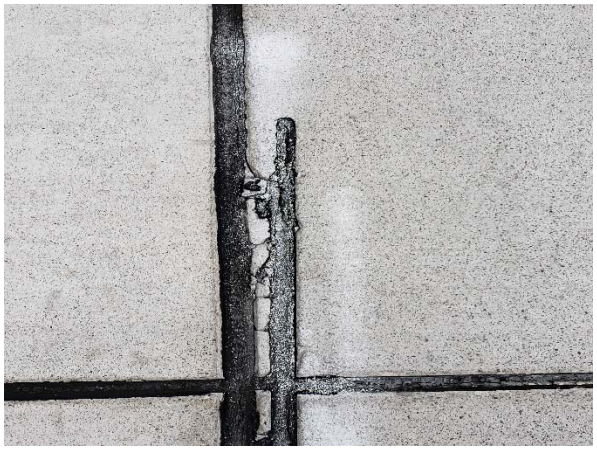
Field Data Collection - Joint seal damage

1. Improper installation of joint sealant)



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Field Data Collection - Scaling, Map Cracking & Mortar flaking

1. High water-cementitious ratio or surface concrete and / or poor curing practices
2. Excessive and early drying out of the surface of concrete due to hot temperatures and/ or windy conditions and late application of curing compound

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Field Data Collection - Joint spalling

1. Joint sides are weaker due to loss of moisture during the curing period (curing compound may not have been reapplied after saw cutting).

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Field Data Collection - Corner spalling

1. Excessive curling and / or warping due to high moisture differential and / or high-water content.
2. Weaker concrete at corner side joints due to improper curing that spalls off over time.

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Field Data Collection - Wood, Plastic & Metal

1. Poor housekeeping failing to remove garbage from pour area.
2. Possible displacement of dowel basket which surfaced during construction

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Field Data Collection - Concrete Delamination

1. Improper protection of concrete during inclement weather or possibly due to weight of protective tarps and anchor systems.
2. Premature sealing of the concrete surface.
3. Leaving excess concrete along the longitudinal joint of a previously poured lane.



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Repair Alternatives – Short Term

Neither full nor partial slab partial-depth replacement of concrete panels will easily be completed in an eight-hour closure period, therefore, quick repair techniques (short term) were recommended.

- Use very rapid setting chemical repair mortar, as the repair material for the partial-depth repairs, and
- Utilizing hot mix asphalt patching.

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Repair Alternatives – Long Term

- Depending on the severity of the defects, the recommended repairs (long term) vary including:
  - Full-depth repairs of slabs
  - Partial depth repairs,
  - Under-slab Grouting,
  - Removal of FOD and reseal joint,
  - Diamond grinding,
  - Coring of material imbedded in the concrete, and
  - Just monitoring the distresses.

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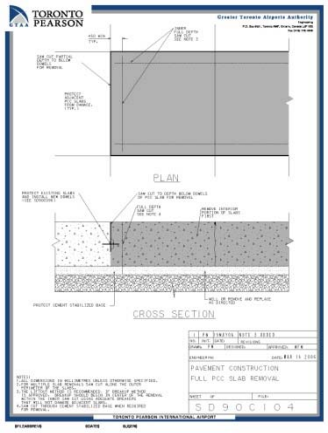
Repair Alternatives - Full-Depth Repairs of Slabs

1. The concrete panels and underlying cement stabilized base (CSB) and granular subbase should be completely removed (GTAA Drawing SD90C104)
2. The underlying subgrade should then be carefully assessed (using the Dynamic Cone Penetrometer)
3. Then the top of subgrade should be graded and proofrolled to a consistently dense state free of excessive deflections.



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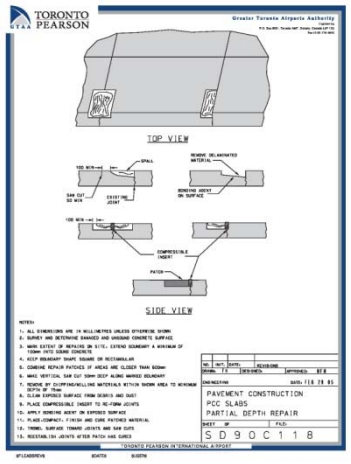
Repair Alternatives - Partial-Depth Repairs of Slabs

1. In general slabs with spalling less than one third of the depth of the concrete slab can be effectively repaired by using partial-depth repairs. (GTAA Drawing SD90C118)
2. The small areas of spalled / deteriorated concrete can be removed and replaced by patching materials. (National Concrete Pavement Technology)



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Repair Alternatives - Underslab Grouting

1. Grouting (if required) should be undertaken to fill voids and restore full contact with the underlying granular base or CSB.
2. The underslab grouting should be properly completed by a qualified and experienced contractor in accordance with the ACPA Concrete Pavement Repair Manual, ACPA Concrete Pavement Field Reference Preservation and Repair Manual, FAA 150/5380-6C and GTAA standard procedures.
3. Once the PCC slab grouting work has been completed, the existing crack (if required) should be sawn (not routed) with a crack chases diamond bladed saw and filled with an approved hot-poured joint sealant.

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Lessons Learned

- ✓ Experienced Contractor with good airfield construction experience is a must.
- ✓ Proper and sufficient protection of concrete slabs during curing period is a must.
- ✓ Proper water-cementitious ratio at surface of concrete.
- ✓ Proper housekeeping to remove garbage from pour area.
- ✓ In addition to material testing during construction, workmanship assurance is also important to ensure long lasting performance.

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Thank You

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