RUNWAY 06L24R RECONSTRUCTION AND LESSONS LEARNED

Toronto Pearson International Airport

AVIA NG
AIRPORT CONSULTANTS

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Toronto Pearson

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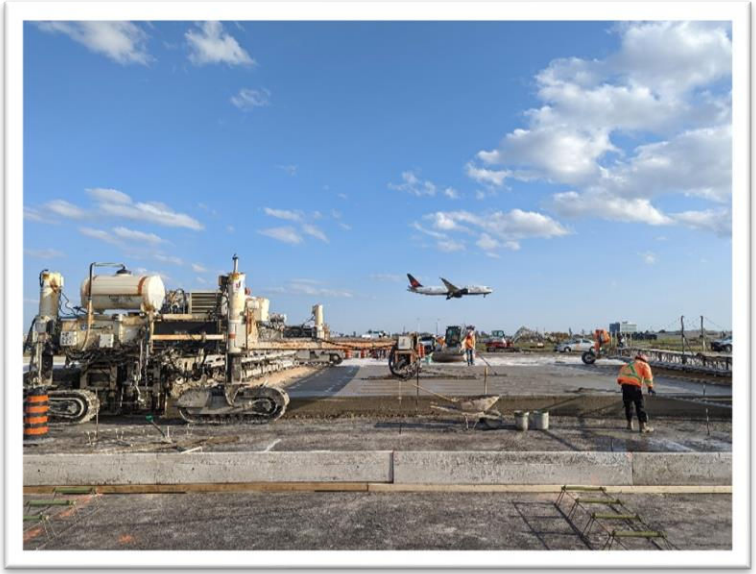
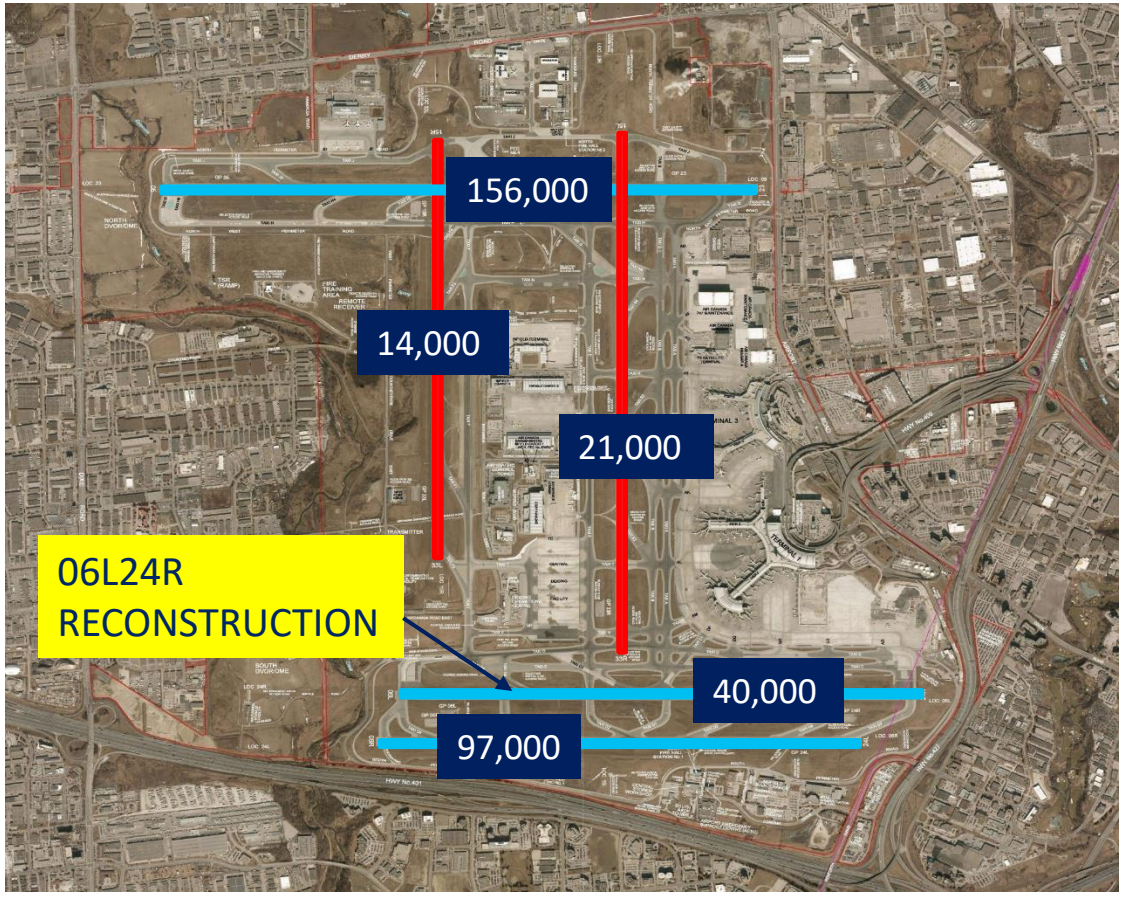


OUTLINE

- BACKGROUND INFORMATION
- OPERATION PLANNING
- RISK MITIGATION
- FIELD INVESTIGATION
- DESIGN ALTERNATIVES
- CONSTRUCTION/IMPLEMENTATION
- AIRCRAFT RIDE QUALITY ANALYSIS
- CONCLUSIONS
- LESSONS LEARNED
- REMARKS AND QUESTIONS

Toronto Pearson – Canada's Largest Airport



2022
Traffic
Movement

Toronto Pearson – Canada's Largest Airport

Toronto Pearson

- 2022 Passenger Volume ---------- 35.6 Million PAX.
- Ranking in North America* ---------- 2nd busiest airport
- Total airside paved areas ---------- approx. 5.8 million m^2
- # of aircraft movements **---------- approx. 336,800
- Cargo processed ***---------- 388,700 metric tonnes
- Direct Jobs created ----------50,000
- GDP contribution to Ontario ----------$42 Billion CAD

** In terms of international passengers, 29.6 Million PAX prior to COVID.*

*** 2022 Data*

**** 2020 Data*

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BACKGROUND INFORMATION

- Constructed in the 1960s to accommodate the critical aircraft B747-400, has reached the end of the pavement life, and reconstruction would meet the current and future new large aircraft (NLA) requirements.
- Joint reflection cracking including associated secondary spalling and faulting causing major FOD and safety concerns.
- Presence of voids/soft spots and lack of load transfer devices between concrete panels.

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OPERATION PLANNING

- Runway 06L24R was identified in the 5-year Airside Restoration Program since 2018.
- A planning group with GTAA's different internal stakeholders, Nav Canada, Airlines was formed.
- Usage of data including Runway Occupancy Time (ROT), Noise, Peak Hour Demands & Historical Weather to forecast the traffic movements was considered.

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OPERATION PLANNING cont'd

- Construction starts early to avoid summer rush but will have a higher weather risk.
- Temporary restrictions on air traffic to support runway movements (72-77-72) during 06L24R reconstruction from April 4, 2022 to November 18, 2022.
- General/Business Aviation restriction applied during reconstruction

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OPERATION PLANNING cont'd

Original Phasing, after 18 months discussion with all stakeholders

April 4 to June 24, 2022

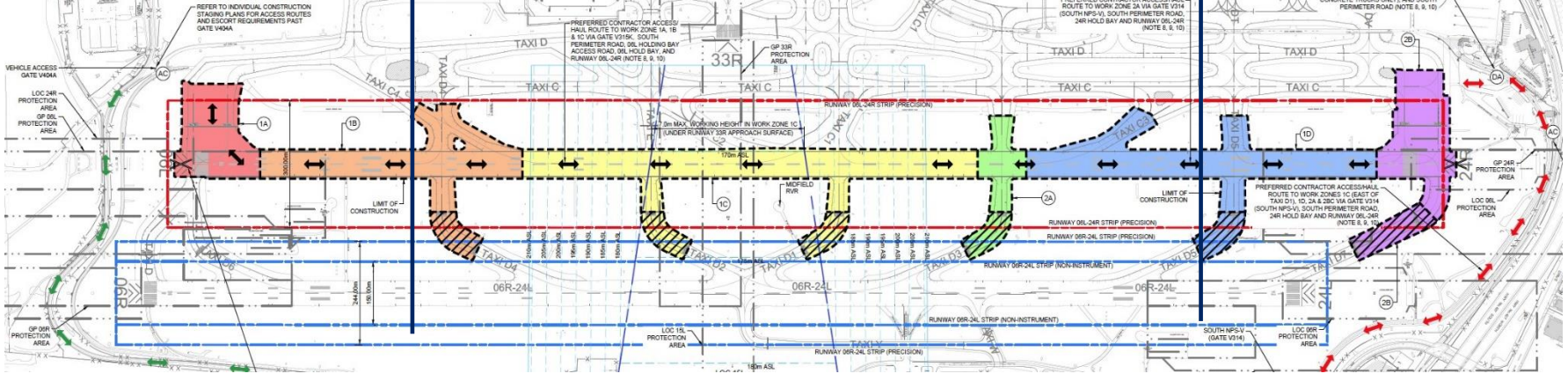
- 72/ hr. CAP Rate
- 42/ hr. MAX bound (Arr or Dep)
- 20 movements per quarter hr.

June 25 to Sept 14, 2022

- 77/ hr. CAP Rate
- 45/ hr. MAX bound (Arr or Dep)
- 22 movements per quarter hr.

Sept 15 to Nov 18, 2022

- 72/ hr. CAP Rate
- 42/ hr. MAX bound (Arr or Dep)
- 20 movements per quarter hr.



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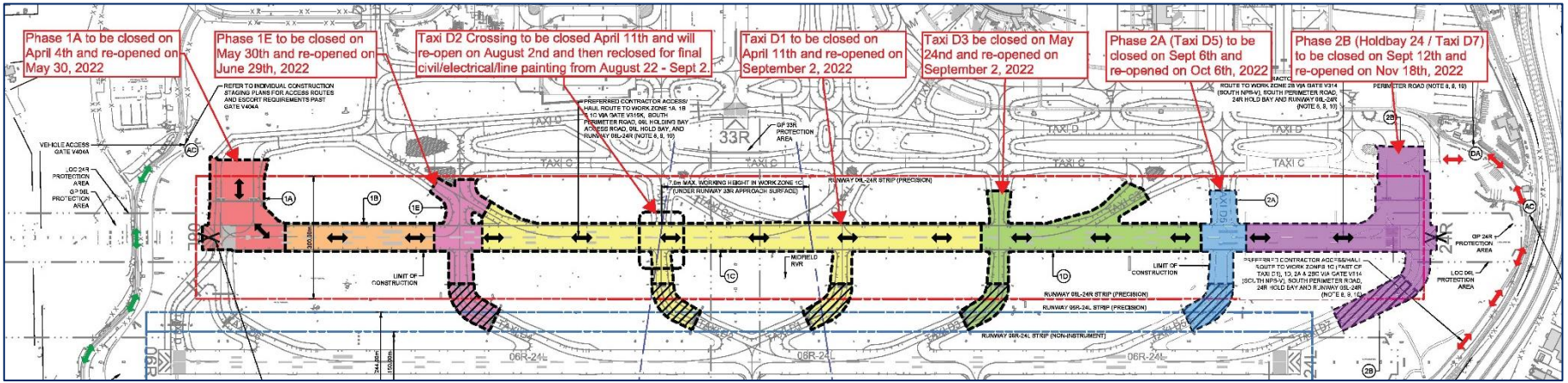
OPERATION PLANNING cont'd

- Updated Phasing, 1 Week Prior to Construction
- Broken down into 7 distinct phases with several sub-phases
- Key change was introduction of Phase 1E (Taxi D4)



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RISK MITIGATION

The following were the challenges that were considered as part of this construction practice:

- COVID
- Poor Weather
- Construction Delay
- Availability of Materials
- Reliability of Equipment
- Labour dispute with unionized construction workers

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RISK MITIGATION cont'd

The construction team mitigated some of the risks by:

- Followed proper COVID protocol (well developed).
- Reviewed, determined and included weather days based on the historical weather data between April to November into the project schedule.
- Serviced asphalt plant in advance (during winter months) to ensure smooth production in early spring.
- Supplied asphalt from two asphalt plants with a combined capacity of 7,000 tonnes per day versus only one plant for a standard paving job.
- Paved in echelon with 6 pavers to improve productivity and smoothness, to minimize cold paving joints and to reduce future maintenance costs.

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RISK MITIGATION cont'd

The construction team mitigated some of the risks by:

- Portable concrete batch plant was setup on airport property to minimize any potential delivery delay. Secured cement powder at onset of job.
- Hauled premium aggregate to asphalt plant in early spring, stockpiled for use to avoid supply shortage during construction.
- Pre-ordered all long lead items in advance to avoid delay during construction.
- Serviced all critical equipment in advance and provided standby equipment for all critical tasks such as telebelts for concreting, breakers for concrete removal, pavers and rollers for asphalt paving.

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RISK MITIGATION cont'd

The construction team mitigated some of the risks by:

- Work schedule and progress were reviewed on an ongoing basis to ensure the project would be completed on time. Extra crews or resources would be deployed if needed.
- Worked 24/7 whenever/wherever possible.
- Monitored weather forecast on an hourly basis, maintained good communication with all subcontractors and workers, and scheduled weather sensitive tasks such as concrete paving, asphalt paving only under favourable conditions to ensure the quality of the project was not compromised and to minimize any lost days due to weather.

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FIELD INVESTIGATION

- Visual Condition Inspection
- Non-destructive High-Capacity Falling Weight Deflectometer (HWD)
- Ground-Penetrating Radar (GPR) survey to determine the extent of voids.
- CCTV data review

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FIELD INVESTIGATION cont'd

Visual Condition Inspection

Pumping at the concrete joint underneath the pavement surface indicating poor joint load transfer

High Severity Multiple Transverse Reflective Crack with FOD concerns

Medium Severity Transverse Reflective Crack with FOD concerns

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FIELD INVESTIGATION cont'd

Visual Condition Inspection cont'd

Localized Severe Crack in Composite Pavement

Patched Longitudinal Crack in Concrete Slab and Adjacent Shattered Concrete Slab

Severe Asphalt Shoving north of HB24R

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FIELD INVESTIGATION cont'd

HWD Testing

LTE CONDITION	NUMBER OF TRANSVERSE JOINTS/CORNERS	PERCENTAGE (%)
Acceptable	1,358	86
Fair	107	7
Poor	105	6
Not Estimated	9	1
TOTAL	**1,579**	**100**

The lack of load transfer devices (Dowel Bars) in the transverse joints at the time of construction (1960s), poor to negligible aggregate interlock expected in 60-year-old concrete slabs, and pumping noticed at the transverse joints from the visual inspection, the general "Acceptable" joint load transfer (LTE >70%) observed might be attributed to thermally "Locked Joints" at the time of testing and recent thin asphalt overlaid at the keel section

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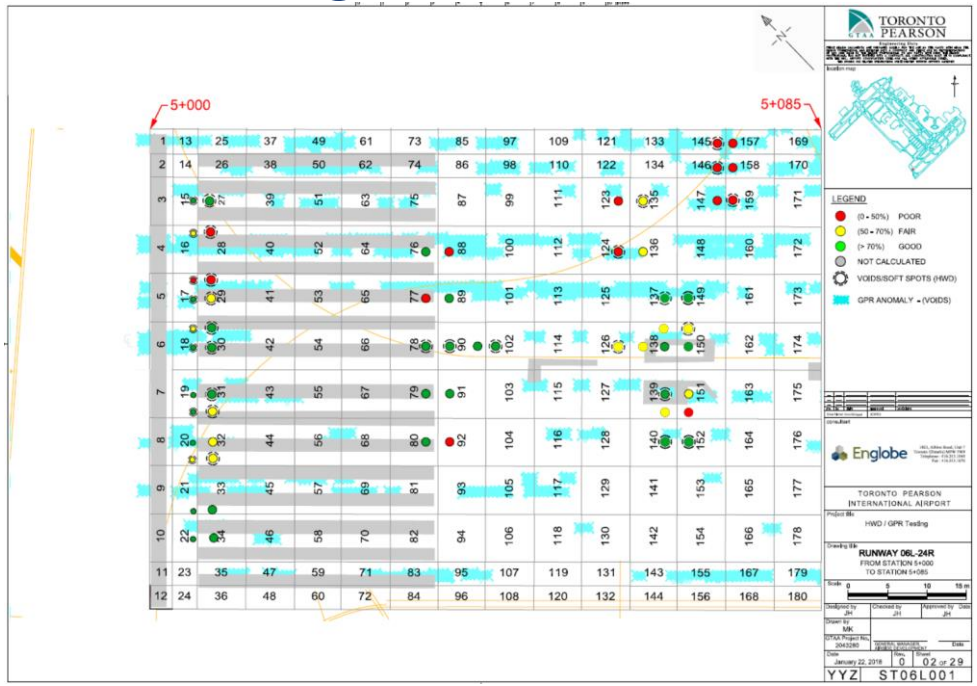
FIELD INVESTIGATION cont'd

GPR Testing



The GPR survey and analysis indicated many anomalous zones that were interpreted as possible voids or settlements below the concrete layers. The drawing on the left showed the typical GPR findings on 06L24R.

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FIELD INVESTIGATION cont'd

CCTV Data Review

Table 2A – Service Grade

Grade	Manhole	Pipe
		Section not inspected
0	Manhole not inspected	Section with undefined grade
1	Manhole with no potential for blockage observed	Section with no potential for blockage observed
2	Manhole with minimum blockage risk in short term but potential for further deteriorating situation	Section with minimal blockage risk in short term but potential for further deteriorating situation
3	Manhole with blockage unlikely in near future but possibility that the situation may further deteriorate	Section with blockage unlikely in near future but possibility that the situation may further deteriorate
4	Manhole with blockage likely in foreseeable future	Section with blockage likely in foreseeable future
5	Manhole with blockage or blockage imminent	Section with blockage or blockage imminent

Table 2B – Physical Grade

Grade	Manhole	Pipe
		Section not inspected
0	Manhole not inspected	Section with undefined grade
1	Manhole in very good condition	Section in acceptable structural condition
2	Manhole in good condition	Section with minimal collapse risk in short term but potential for further deterioration
3	Manhole in fair condition	Section with collapse unlikely in near future but further deterioration likely
4	Manhole in poor condition	Section with collapse likely in foreseeable future
5	Manhole in very poor condition	Section collapsed or with collapse imminent

Approx. 75% of subdrains had blockage or possibility of blockage in the foreseeable future.

Approx 35% of subdrains were in fair to poor condition.

During reconstruction of the RWY, localized repairs of subdrains and catchbasins were completed

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DESIGN ALTERNATIVES

Based on the forecasted aircraft movement data, Transport Canada Pavement Design Manual and FAARFIELD analysis, three rehabilitation options were proposed.

- **Option 1** – Reconstruct Rows 1 & 2 on both sides of the RWY centreline, including a new HMA overlay (approx. 30-yr life span)
- **Option 2** – Reconstruct Row 1 on both sides of the runway centreline, carry out DBR on Row 2 on both side of RWY centreline and place new HMA overlay (approx. 15 to 20-yr)
- **Option 3** – Carry out DBR on Rows 1 & 2 on both side of RWY centreline and place new HMA overlay (approx. 8 to 10-yr)

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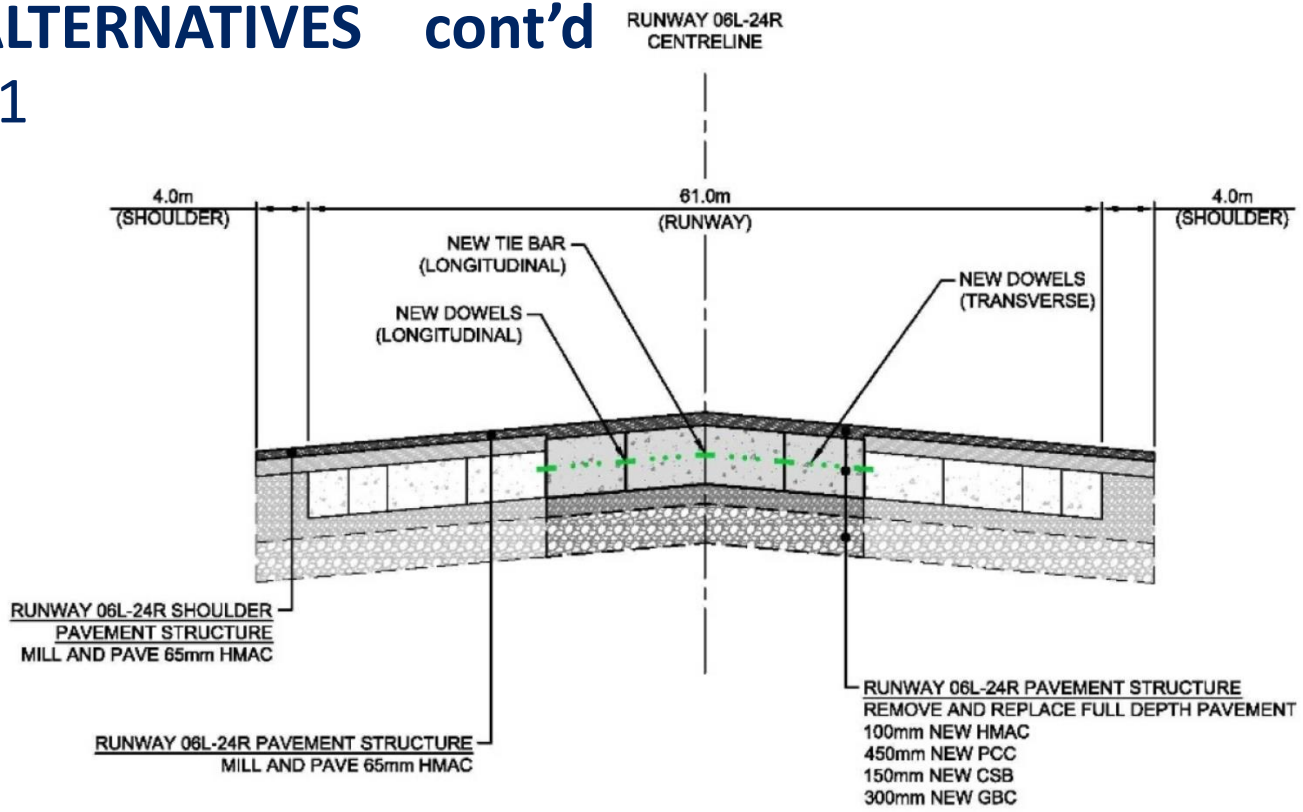
DESIGN ALTERNATIVES cont'd

- Option 1



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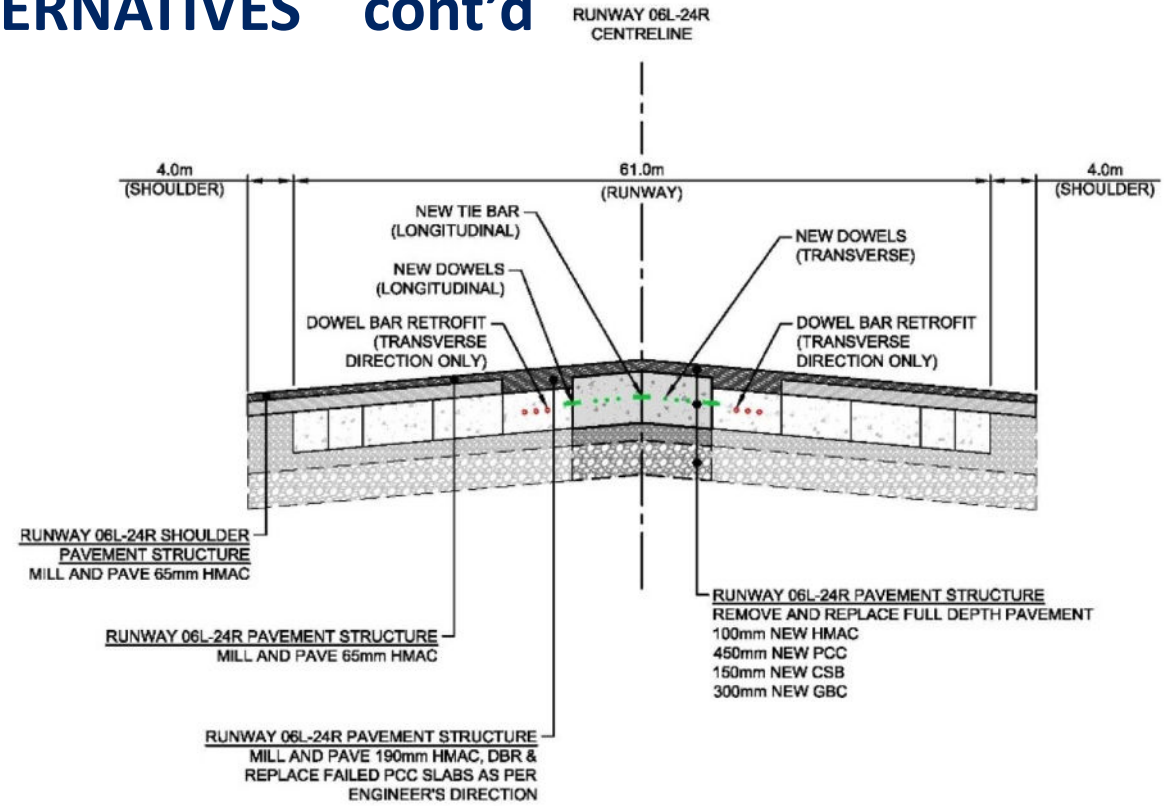
DESIGN ALTERNATIVES cont'd

- Option 2



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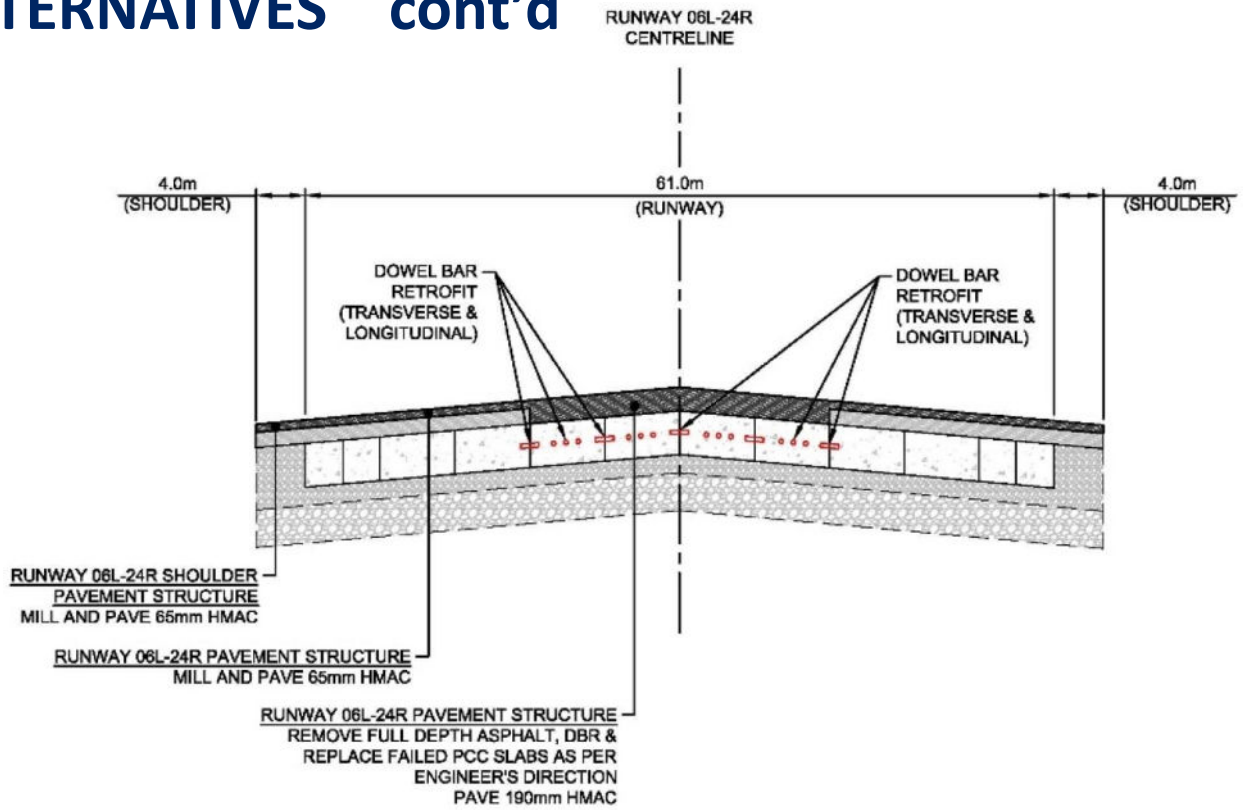
DESIGN ALTERNATIVES cont'd

- Option 3



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DESIGN ALTERNATIVES cont'd

- **Option 1** was the recommended alternative based on the pavement life expectancy, life cycle cost analysis, and operation impacts.

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CONSTRUCTION/IMPLEMENTATION

- Many unforeseen site conditions were encountered – drainage issues, soft spots, contaminated subsoil, etc.
- Contract Administration required daily coordination with all stakeholders to quickly resolve any issues on site to maintain schedule.
- All shop drawings and submittals were reviewed immediately.
- Quality Assurance results were turned over quickly.
- CCN’s, Site Instructions, CO’s, PPC’s, etc., were all expedited.

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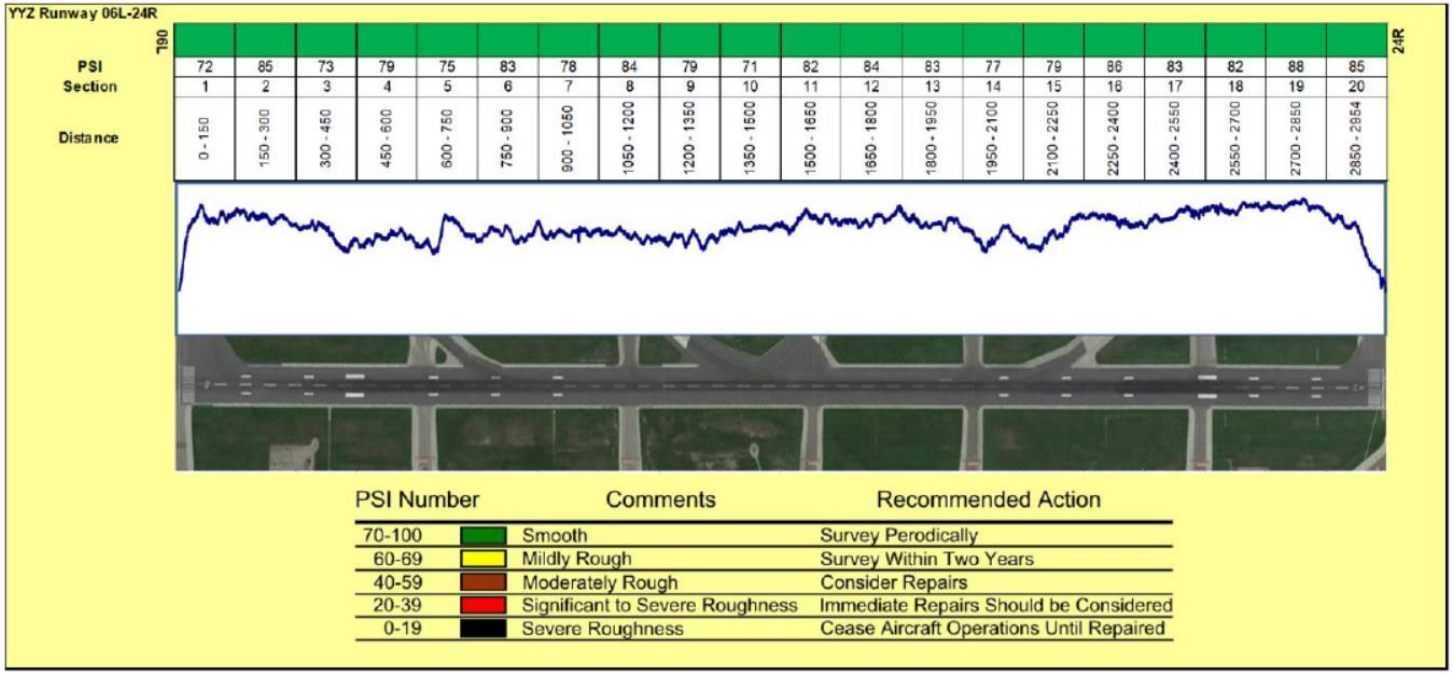
AIRCRAFT RIDE QUALITY ANALYSIS – AFTER PAVING

All sections were found to be smooth and acceptable.



PSI Number	Comments	Recommended Action
70-100	Smooth	Survey Perodically
60-69	Mildly Rough	Survey Within Two Years
40-59	Moderately Rough	Consider Repairs
20-39	Significant to Severe Roughness	Immediate Repairs Should be Considered
0-19	Severe Roughness	Cease Aircraft Operations Until Repaired

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REOPENING CELEBRATION & RIBBON CUTTING

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LESSONS LEARNED

- **Unforeseen site conditions** – maintain good as-built and record documents, carry out detailed site/geotechnical investigation prior to construction.
- **Experienced Contractor** – good airfield construction experience is a must including a robust quality control plan and good workmanship.
- **Experienced Design Team** – the ability to adjust on the fly and make quick decisions is imperative to the success of the project.
- **Airline endorsement** – airline sign-offs to maintain agreed upon plans and to prevent last minute changes

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CONCLUSIONS

Project Facts: Construction started on April 4, 2023 and was completed on Nov 18, 2022 as per schedule despite the delays caused by unforeseen site conditions, labour dispute, and material availability.

Concrete Removal/Installation	86,500 m2
Dowel/Tie Bars Installation	70,800 unit
Asphalt Milling	385,000 m2
HMAC surface course	64,200 t
HMAC lower course	18,800 t
Lighting	1,400 units

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LESSONS LEARNED cont'd

- **High impact capital projects** – system impact review to include all large-scale projects that have impacts to capacity.
- **High profile events** – TIFF, World Cup, etc. to be considered.
- **Social campaigns** – advance community engagement, advance notification to international carriers, elected official's support on election year.

REMARKS & QUESTIONS

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