



# **REHABILITATION OF RUNWAY 11/29 AT CFB BAGOTVILLE**

Presented by: Marla Hughesman  
CAPTG Sunday Workshop  
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# CFB BAGOTVILLE



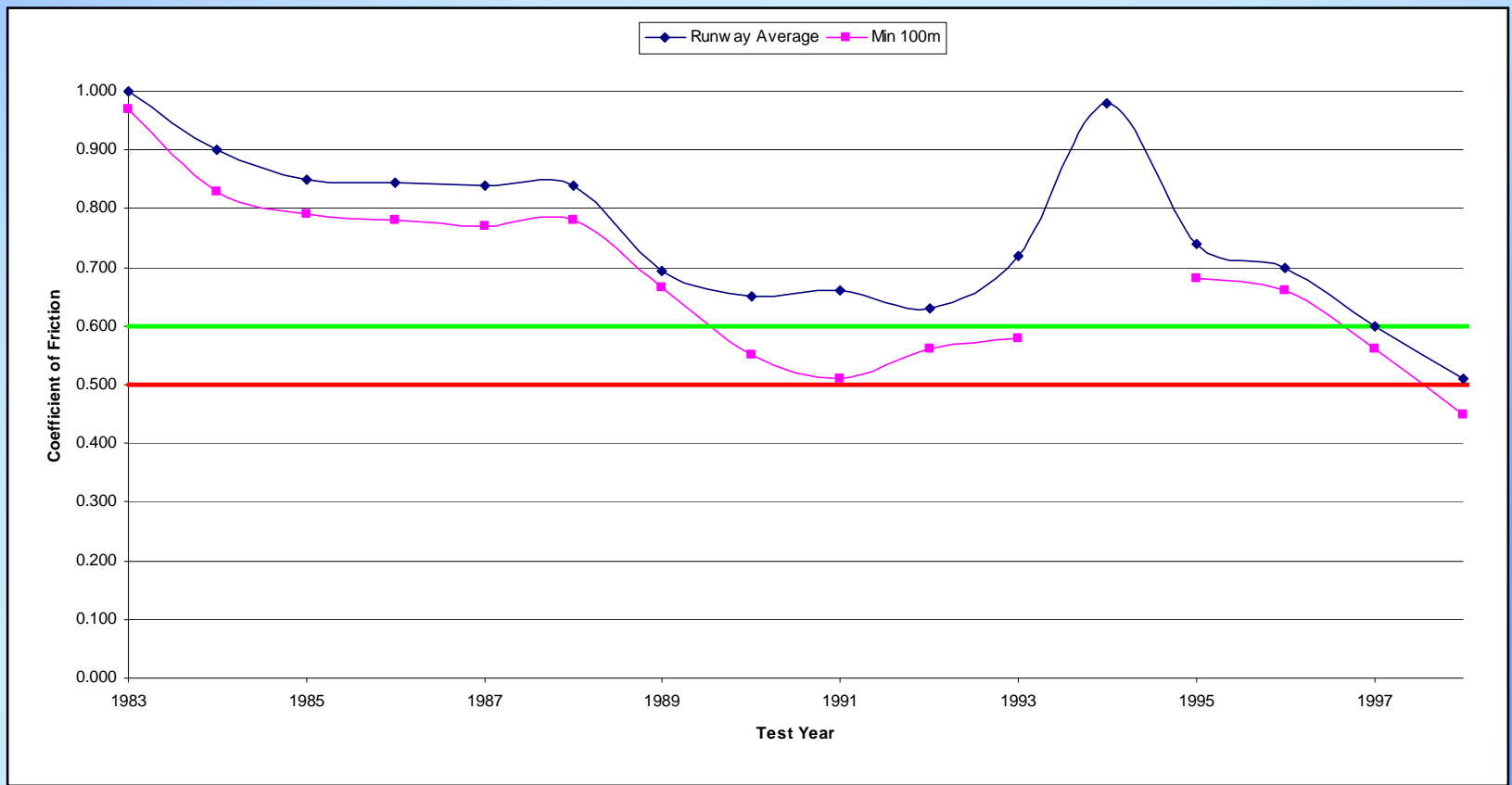
- Located approximately 400 km NE of Montreal
- One of the Canadian Forces Jet Fighter Bases
- Situated in the Canadian snow belt

# **RUNWAY 11/29**

- Main runway that runs East / West
- 3,048m (10,000 ft) long
- 45m (150 ft) wide
- The only completely concrete runway in the Canadian Forces
- Constructed in 1974
- Primary aggregate used was Limestone
- PCC Pavement = 305mm thick

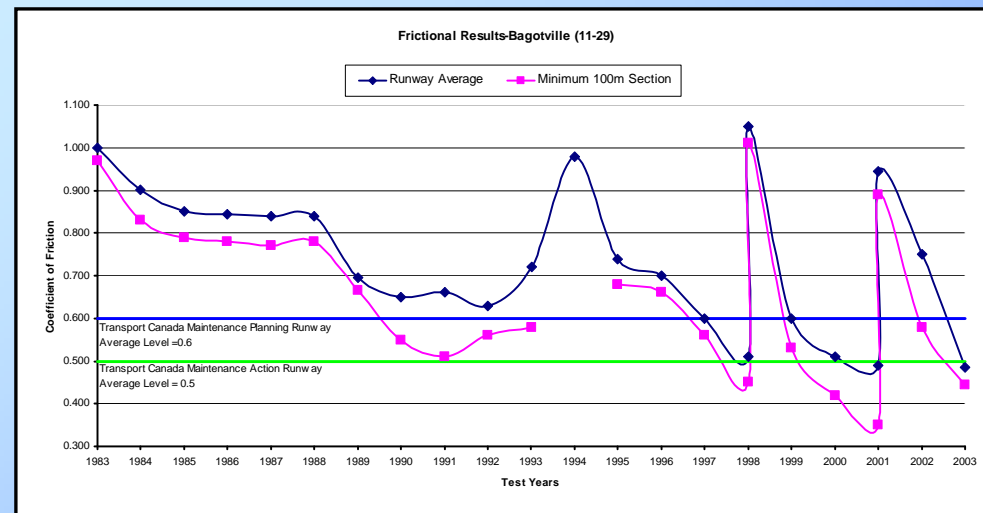
# THE FRICTION ISSUE

- Annually 1 Cdn Air Div tests the runways at all of the Air Force Bases to ensure that all meet the minimum 0.6 coefficient of friction required by Transport Canada.



# RETEXTURING 11/29

- 1994 was the first retexturing project on the runway.
- Following that the runway was redone:
  - 1998
  - 2001
  - 2004
  - 2005
- Losing friction levels in 6 months. Issuing NOTAMs for winter ops.



# REASONS FOR FRICTION LOSS

- Forensics investigation revealed that the Limestone aggregate used to construct the runway was extremely soft
- ATC & Heavy equipment was requiring daily brushing of the runway surface with steel brooms whose cartridges were allowed excessive wear
- Continual retexturing operations caused reduction of the cement matrix exposing more soft aggregate

# DIAMOND GRINDING

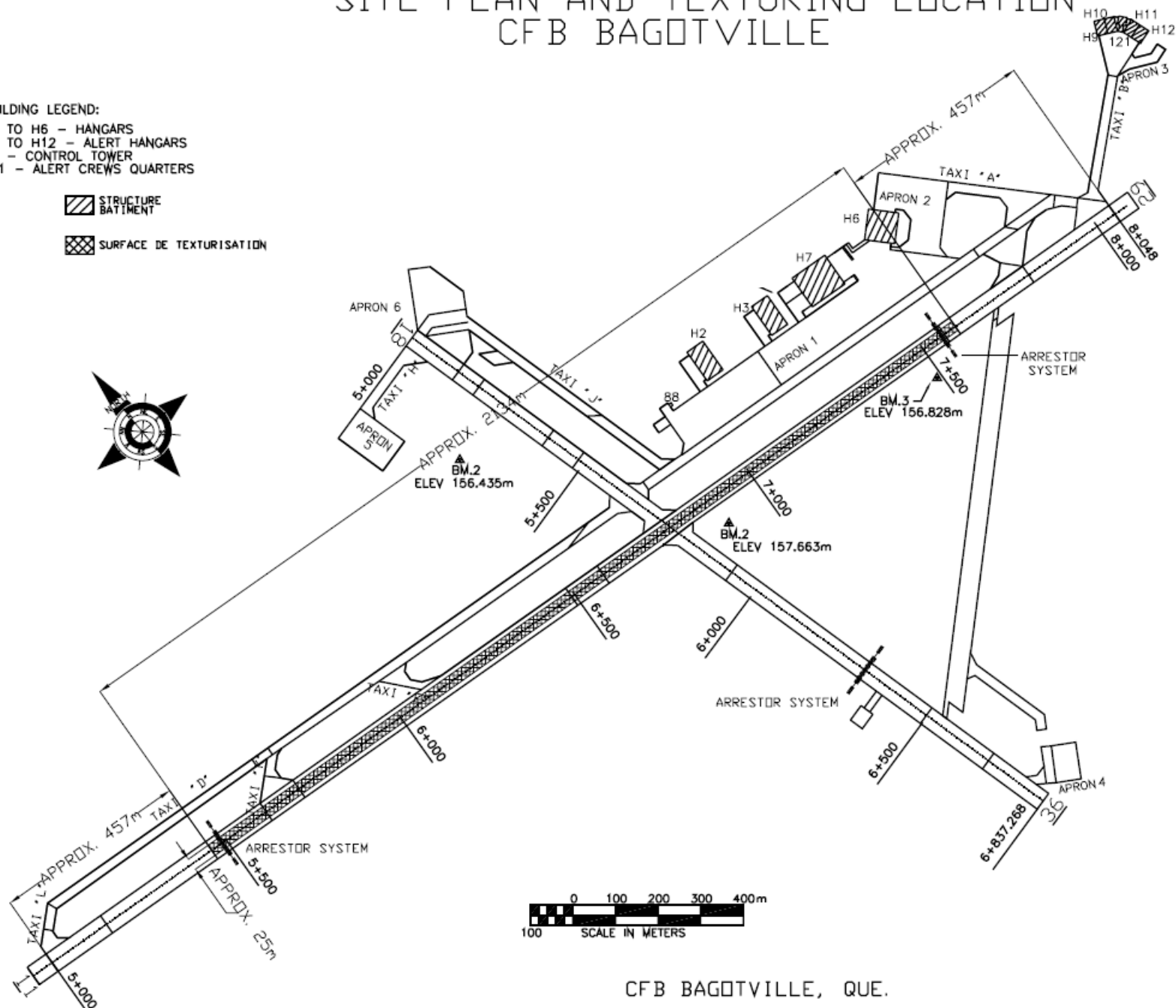
- Realized we needed a more permanent solution
- Also needed a band-aid to carry us through until a rehabilitation project could be funded
- Fall 2005 decided to do a diamond grinding trial, 3 patches on the centre line, to see how it would withstand Winter OPS
- Saw only a 25 – 30 % decrease in friction
- Decided to proceed with a full scale project in Summer 2006



# SITE PLAN AND TEXTURING LOCATION CFB BAGOTVILLE

## BUILDING LEGEND:

H2 TO H6 - HANGARS  
H9 TO H12 - ALERT HANGARS  
88 - CONTROL TOWER  
121 - ALERT CREWS QUARTERS



CFB BAGOTVILLE, QUE.



# OPTIONS ANALYSIS

- Considered 5 different rehabilitation methods:
  1. Rubbilize and overlay with 100mm of HMA
  2. Complete Reconstruction
    - a) Asphalt
    - b) Concrete
  3. Combination rubbilize/overlay and partial reconstruction of intersection
  4. Combination rubbilize/overlay and total reconstruction of intersection
  5. Concrete Unbonded Overlay

# CONSTRAINTS

- 11/29 is equipped with an arrestor gear system at each end
- Intersection with Runway 18/36
- Pre-approved budget amount
- Short construction season
- Unknown silt pockets throughout the site

# EVALUATION CRITERIA

- 6 Criteria were used in the evaluation:
  - Estimated cost
  - Construction - Pros & Cons
  - Operations – Pros & Cons
  - Design – Pros & Cons
  - Environmental – Pros & Cons
  - Risk Factors

# RUBBILIZE AND OVERLAY

PROS	CONS
<b>Construction</b>	
Minimal rain delays	Install drainage first
Use Existing structure – no excavation	Will not fix K deficiency at intersection
New construction technique	New construction technique
<b>Operations</b>	
No excavation so should get to HMA placement sooner	Re-install arrestor gear
Should finish Phase 1 prior to start of intersection	New technique – slow start-up, unknown noise,
	Require 3 week shut down of intersection

# RUBBILIZE AND OVERLAY

PROS	CONS
<b>Design</b>	
Simpler design grades	Keep displaced crown
	Redesign once post rubbilization survey complete
	Intersection would be flat and have elevation issues
<b>Environmental</b>	
Re-uses existing PCC, minimize disposal	Could cause excessive noise pollution
Minimal additional material requirements	

# **RUBBILIZE AND OVERLAY**

- Estimated Cost : \$9.5M
- Risk Factors – Could have unknown silt pockets that aren't dealt with
  - Trouble procuring specialized equipment

# RECONSTRUCTION - PCC

PROS	CONS
<b>Construction</b>	
Known construction technique	Take longer as have to excavate material
Does not require drainage installation prior to construction	More susceptible to rain delays
<b>Operations</b>	
Elevation of arrestor gear is not a concern	Take longer to complete
Less of a noise concern	Requires curing time
	Require joints to be cut



# RECONSTRUCTION - PCC

PROS	CONS
<b>Design</b>	
Allow the Intersection to be corrected	Requires elevations at each slab corner
Could up the crown in the centre	
<b>Environmental</b>	
	Requires the use of all new materials
	Does not reuse the existing concrete structure

# RECONSTRUCTION - PCC

- Estimated Cost : \$24.6M
- Risk Factors – Would deal with the unknown silt pockets
  - Could find additional adverse soil conditions

# RECONSTRUCTION – HMA

PROS	CONS
<b>Construction</b>	
Known construction technique	Take longer as have to excavate material
Does not require drainage installation prior to construction	More susceptible to rain delays
<b>Operations</b>	
Elevation of arrestor gear is not a concern	Take longer to complete
Less of a noise concern	Requires curing time
	Require joints to be cut

# RECONSTRUCTION - HMA

PROS	CONS
<b>Design</b>	
Allow the Intersection to be corrected	
Could up the crown in the centre	
Runway profiles and cross sections can be automated	
<b>Environmental</b>	
	Requires the use of all new materials
	Does not reuse the existing concrete structure

# RECONSTRUCTION - HMA

- Estimated Cost : \$14.5M
- Risk Factors – Would deal with the unknown silt pockets
  - Could find additional adverse soil conditions

# RUBBILIZE & PARTIAL RECONSTRUCTION

PROS	CONS
Construction	
Less concerns for rain delays	Delay in construction start due to drainage installation
Uses existing structure	May be difficult to partially remove rubbilized material
Minimal excavation time	Requires extra aggregate grading
	Requires extra surveying post rubbilization
Operations	
No excavation get to HMA placement sooner	New technique – could delay start-up
Allow Phase 1 complete before Intersection	Re-install arrestor gear
	Reduce PCN of the intersection from 49/R/B to 35/R/B

# RUBBILIZE & PARTIAL RECONSTRUCTION

PROS	CONS
<b>Design</b>	
Allow the Intersection to be corrected	Require additional details for partial removal of rubbilized material
Allow for better sloped intersection	Would keep displaced crown
	Redesign once post rubbilization survey complete
<b>Environmental</b>	
Re-uses some of the existing PCC, minimize disposal	Could cause excessive noise pollution
Lower additional material requirements	Will require disposal of some existing material
	Requires some new material for construction



# **RUBBILIZE & PARTIAL RECONSTRUCTION**

- Estimated Cost : \$9.1M
- Risk Factors – Would not deal with the unknown silt pockets
  - Could be difficult to grade rubbilized material requiring additional time in the intersection

# RUBBILIZE & COMPLETE RECONSTRUCTION

PROS	CONS
Construction	
Less concerns for rain delays	Delay in construction start due to drainage installation
Uses existing structure	If weather is inclement may cause extra delays at the intersection
Minimal excavation time	New technique
	Requires extra surveying post rubbilization
Operations	
No excavation get to HMA placement sooner	New technique – could delay start-up
Allow Phase 1 complete before Intersection	Re-install arrestor gear
	Could increase time in the intersection if weather is inclement

# RUBBILIZE & COMPLETE RECONSTRUCTION

PROS	CONS
<b>Design</b>	
Allow the Intersection to be corrected	May find that rubbilization isn't feasible due to small areas
Allow for better sloped intersection	Would keep displaced crown
	Redesign once post rubbilization survey complete
<b>Environmental</b>	
Re-uses some of the existing PCC, minimize disposal	Could cause excessive noise pollution
Lower additional material requirements	Will require disposal of some existing material
	Requires some new material for construction

# **RUBBILIZE & COMPLETE RECONSTRUCTION**

- Estimated Cost : \$9.5M
- Risk Factors – Could have unknown silt pockets that aren't dealt with

# UNBONDED PCC OVERLAY

PROS	CONS
<b>Construction</b>	
Less concerns for rain delays	Would not correct the K issue at the intersection
Uses existing structure	Requires a layer of HMA prior to installation of PCC
No excavation time	New technique
Does not require drainage installation prior to construction	Requires sawing and sealing of joints over existing joints
<b>Operations</b>	
No excavation get to placement sooner	New technique – could delay start-up
	Re-install arrestor gear
	May take longer to complete
	PCC needs time to cure and joints sawn

# UNBONDED PCC OVERLAY

PROS	CONS
<b>Design</b>	
	Would not correct the intersection
	Would keep displaced crown
	Requires elevations on each joint
<b>Environmental</b>	
Re-uses all of the existing PCC, minimize disposal	

# UNBONDED PCC OVERLAY

- Estimated Cost : \$20.6M
- Risk Factors – Could have unknown silt pockets that aren't dealt with



# DECISION MAKING

- Tight schedule
  - Project approval March 2008
  - Complete prior to Winter 2008
- Budget approved prior to final design (\$18M)
- Potential difficulties obtaining work permits for companies outside Québec
- Only one company that has rubblization equipment – would it be available?
- All documents required translation

# DECISION MAKING

- Decided because there were too many unknowns and because of tight deadlines that we would proceed with reconstruction in asphalt
- Project Timeline
  - Prequalification for Tender April 2008 to May 2008
  - Tender period 2 weeks
  - Awarded 12 June 2008
  - Project start 25 June 2008

# CONSTRUCTION BEGINS!











# CONSTRUCTION ISSUES

- Cracking of the new concrete slabs in the button area
- Installation of inset lights
- Sloughing of material under Arrestor Gear Pads
- Asphalt prices
- Drainage of the intersection

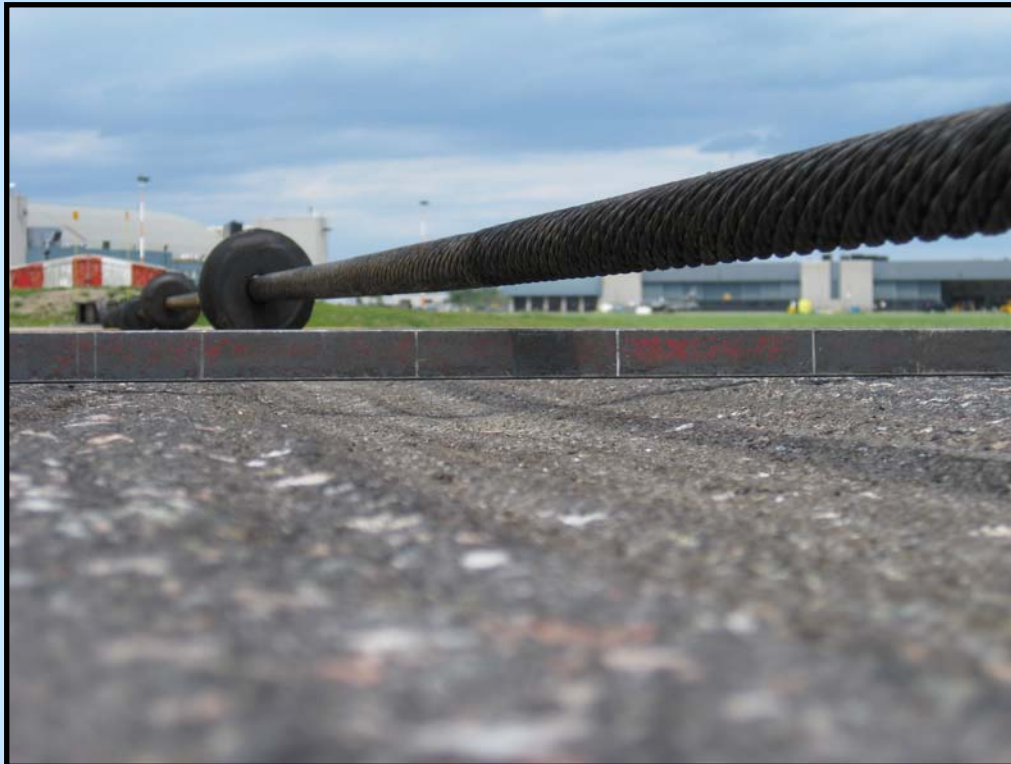
# CONSTRUCTION COMPLETED ??

- Runway was opened to traffic on 07 Nov 2008
- Final cost: \$18.6M (Approved funding was \$23M including contingencies)
- A month after opening received complaints from the ground crews about surface drainage in the intersection
- March 2009 contractor submitted claim for \$332K for asphalt extras
- April 2009 during the spring melt it was discovered that a pipe had been crushed during construction



# ARRESTOR GEAR

- August 2009 – 8 mths after construction
  - Advised that pavement under arrestor gear is wearing

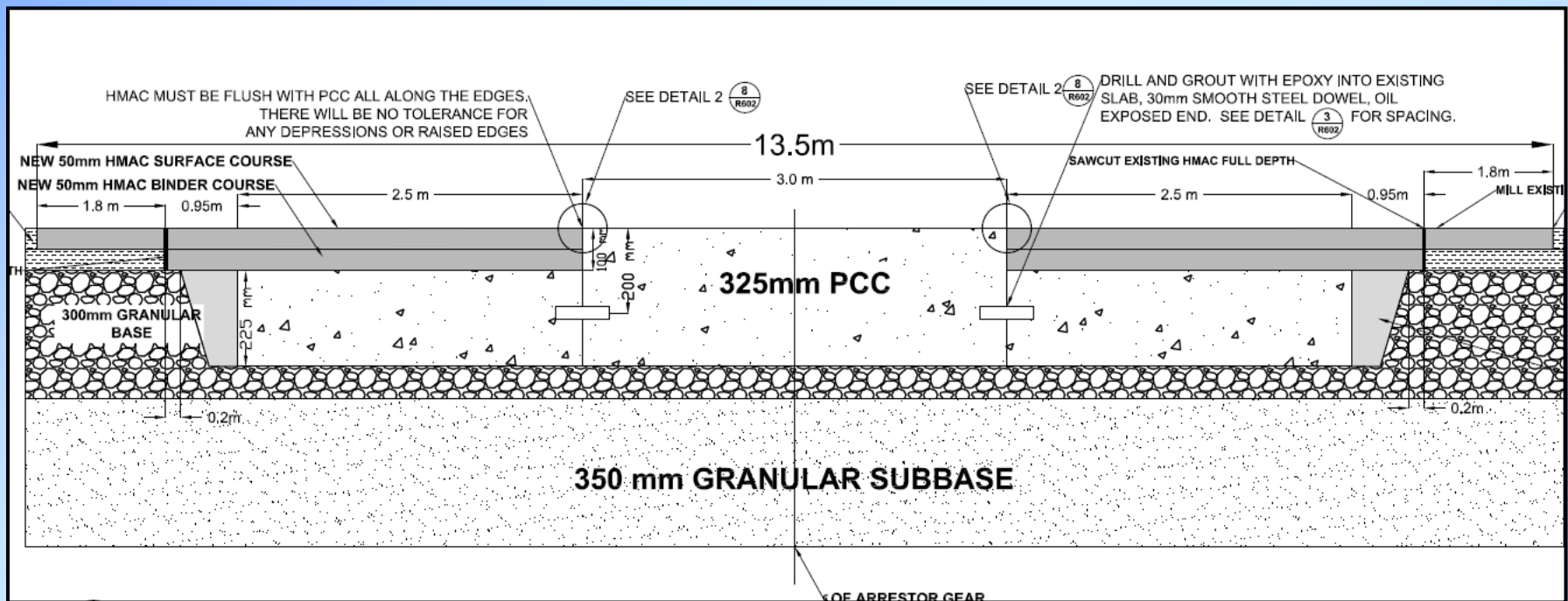


# ARRESTOR GEAR

- Advised the base to mill and repair the area with asphalt
- Issue is that the arrestor gear is employed 24 hrs
- Repair was completed
- Further repairs were required in Oct '09 and May '10 due to excessive wearing

# THE PROJECT CONTINUES...

- Decided during the winter to complete a design of a concrete strip that would lie under the arrestor gear.
- Strip is 3.0m wide and 325mm thick
- Done at both ends of the runway
- Requires transition slab between concrete and asphalt to minimize rutting potential
- Runway will be closed for 3 weeks to accommodate construction



# THE REPAIR





# PROJECT COMPLETION PART II

- Runway reopened August 26<sup>th</sup>, 2010
- Arrestor gear was not employed until September 9<sup>th</sup> (28 day cure)
- Some elevation issues that conflict with arrestor gear operations
- Question is.....how long will the concrete last????

# CONCLUSIONS

- Don't finalize your project budget before final design
- Runway projects require lots of logistical planning – a year of planning and design time doesn't cut it
- Try to merge projects to reduce closures (runway will be closed again next year for arrestor gear replacement)