Outline

- A bit of history
- Marshall method
- Superpave method
- Airfield Asphalt Pavement Technology Program (AAPTP)
- DBA study for GTAA

A Bit of History

- Use of the AK specifications
- Based on Marshall method
- Shift to the use of Provincial specifications
  - Ease of material supply in different provinces
- Problem is that not all provinces use same standards leading to differing performance

The Marshall Method

- History
  - Developed by Bruce Marshall in late 1930's for Mississippi Highway Department
  - Further modified in 1943 for WWII
  - Adopted as typical design method in 1949
  - Worked well as a design method into the 1980's
- Problems
  - Wheel loading began to increase
  - Traffic on roads began to increase
  - Highways started to fail prematurely

Superpave

- Developed in response to pressures on the US highway system
- Strategic Highway Research Program (SHRP), authorized by Congress in 1987
- A highly focused, $150 million, 5-year effort designed to improve the performance of highway materials and highway maintenance practices with 2 subsequent extensions
- Adopted by all states within a few years (funded)

Superpave Mix Design System

- Use Performance Graded AC:
  - Selection of PGAC based on weather and traffic conditions at site
- Use Superpave Mix Design:
  - Perform Gyratory compaction based on traffic loading at site
- Superpave is still a work in progress
  - No accepted and validated performance test
  - Asphalt Mixture Performance Tester (AMPT)

PG Grading System for Asphalt Cement

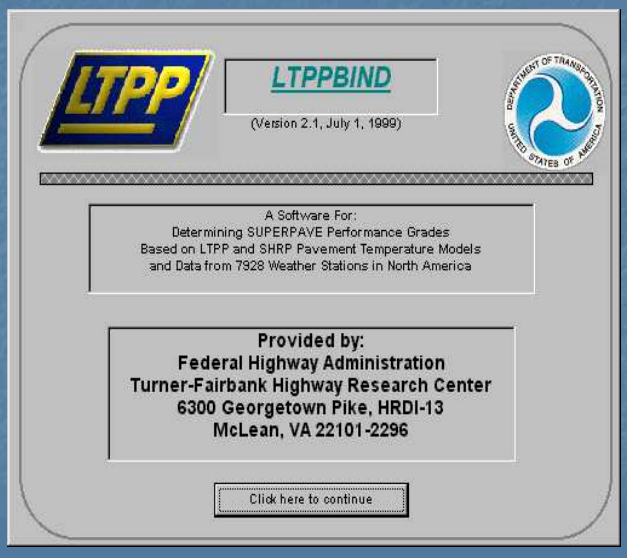
PG 58 – 28

Performance Grade

High Temperature
Average 7-day maximum pavement design temp

Low Temperature
Minimum pavement design temp

LTPPBIND Software

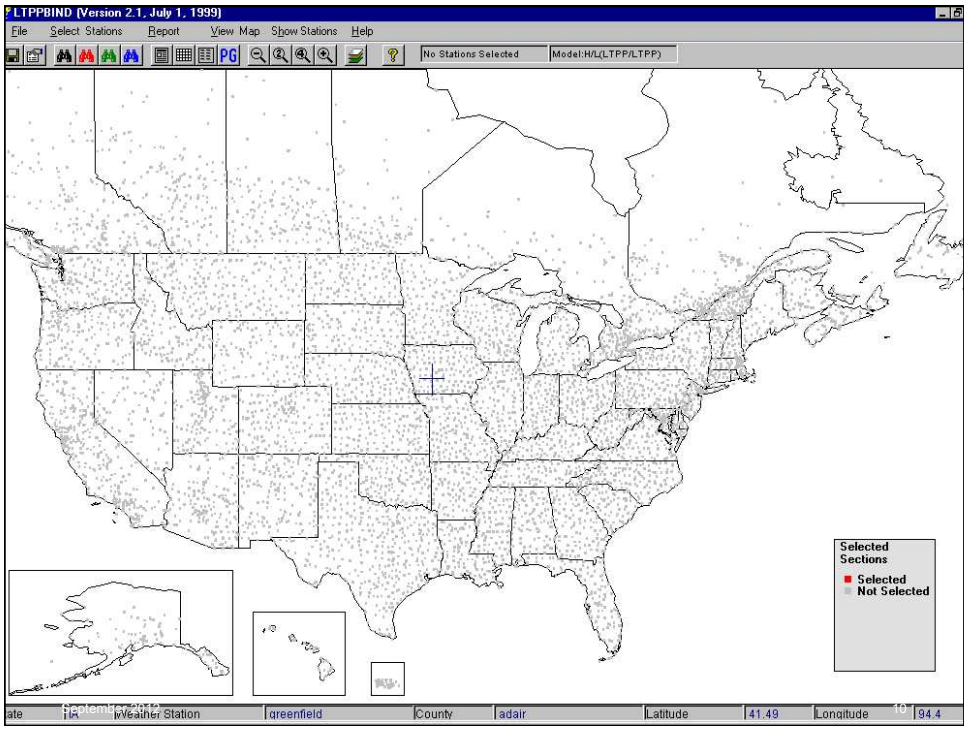


http://www.fhwa.dot.gov/pavement/ltpp/bind/dwnload.cfm

LTPPBIND Software

- Determines Superpave PG Grades for any area
- Uses pavement temperature models
- Algorithms convert air to pavement temperature
  - Canadian contribution to SHRP through C–SHRP
- Based on over 8000 weather stations
- Uses reliability model (risk) to give 2 temperatures
  - Average 7 day high temperature
  - Lowest Temperature

September 2012 9



Superpave Mix Design

- Selected design ESAL's will govern:
  - Coarse & Fine Aggregate Quality
    - Consensus properties – aggregate angularity (course and fine)
    - Higher traffic requires higher quality
    - Closer to surface requires higher quality
  - Gyratory compaction
    - $N_{initial}$ < 89 % (>11 % Voids)
    - N_{design} = 96 % (= 4 % Voids)
    - N_{max} < 98 % (> 2 % Voids)

Superpave vs. Marshall

Superpave vs. Marshall

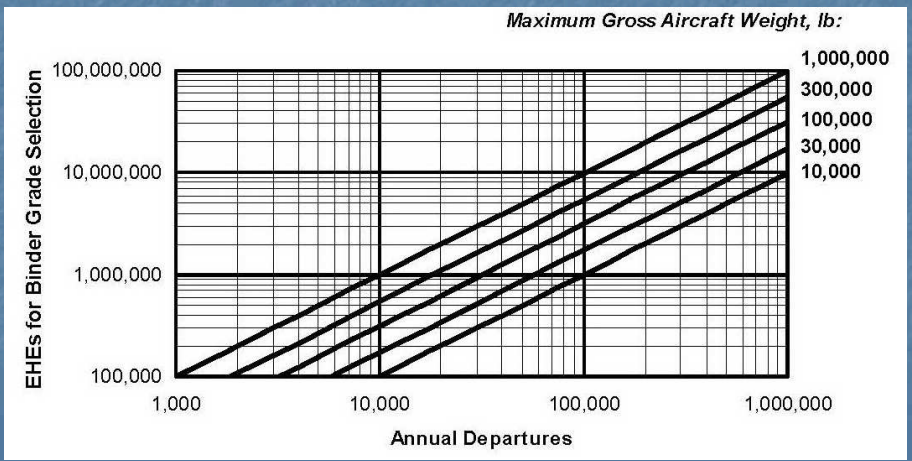
Airfield Asphalt Pavement Technology Program (AAPTP)

- FAA sponsored Research program carried out at Auburn University (same location as NCAT)
- Several research reports on using Superpave highway specifications for airport work
- Program was suspended in 2010 but reports still online
- Still delivering webinars
- Website – **www.aaptp.us**

PG Binder Grade Selection for Airfield Pavements (04-02)

- Determine EHE (Equivalent Highway ESALs)
- Method of evaluating loading on airfield as compared to pavements
  - Tire pressure
  - Wander (Pass-to-Coverage Ratio)
- Use of polymers – recommended in some cases due to stacking issues

Equivalent Highway ESALs (EHE)



Recommendations

Aircraft Stacking	Typical Speed (mph)		Design Traffic EHEs	Grade Adjustment (°C)	
	Runway Centers	Taxiways/ Runway Ends		Non-Modified Binders	Polymer Modified Binders*
None	≥ 45	15 to < 45	< 300,000	0	
Little or none	≥ 45	15 to < 45	300,000 to < 3 million	+7	Not Required +4
			3 million to < 10 million	+7	Suggested +4
			≥ 10 million	–	Required +4
Occasional	–	5 to < 15	< 10 million	+14	Suggested +11
			≥ 10 million	–	Required +11
Frequent	–	< 5	Any	–	Required +17

Implementation of Superpave Mix Design for Airfield Pavements (04-03)

- Three volume report with research comparing standard P-401 mixes to determine compatibility with Superpave
- 90% of North American runways are asphalt
- Looked at gradation and increased fines to reduce permeability
- Concerns about higher tire pressures but generally found that SGC produced higher densities

Recommendations

Table 40: Recommended Volumetric Properties For Selecting Optimum Asphalt Binder									
Tire Pressure (psi)	N_{design} Gyrations	Required Relative Density, (% G_{mm})		Voids in the Mineral Aggregate (VMA) (% Max) Maximum Aggregate Size				VFA Range (%)	Dust to Binder Ratio
		$N_{initial}$	N_{design}	1 ½"	1"	¾"	½"		
<100	50	≤90.5	96.0	12.0	13.0	14.0	15.0	70-80	0.6-1.2
100 to 200	65							65-78	
>200	80	≤89.0						65-75	

DBA Study for GTAA

- Concerns
  - Rutting and shoving in holding areas
  - Loss of friction
- Looked at typical GTAA mix specifications
- Looked at P-401 gradation mixes
  - FAA Brief 59A (May 2006)
- Looked at Marshall vs Superpave Gyratory for compaction
- Looked at some new asphalt binder technologies

Mixes studied

- Asphalt Cement Binder
  - PGAC 70-28 PMA + with Sasobit – MSCR testing at 58°C
- Reference GTAA Mixes – Marshall compaction
  - Surface (12.5 mm)
  - HDBC Binder (~16.0 mm)
- Superpave mixes
  - SP 12.5
  - SP 12.5 with 15% RAP + with Sasobit
  - SP 19.0 with Sasobit

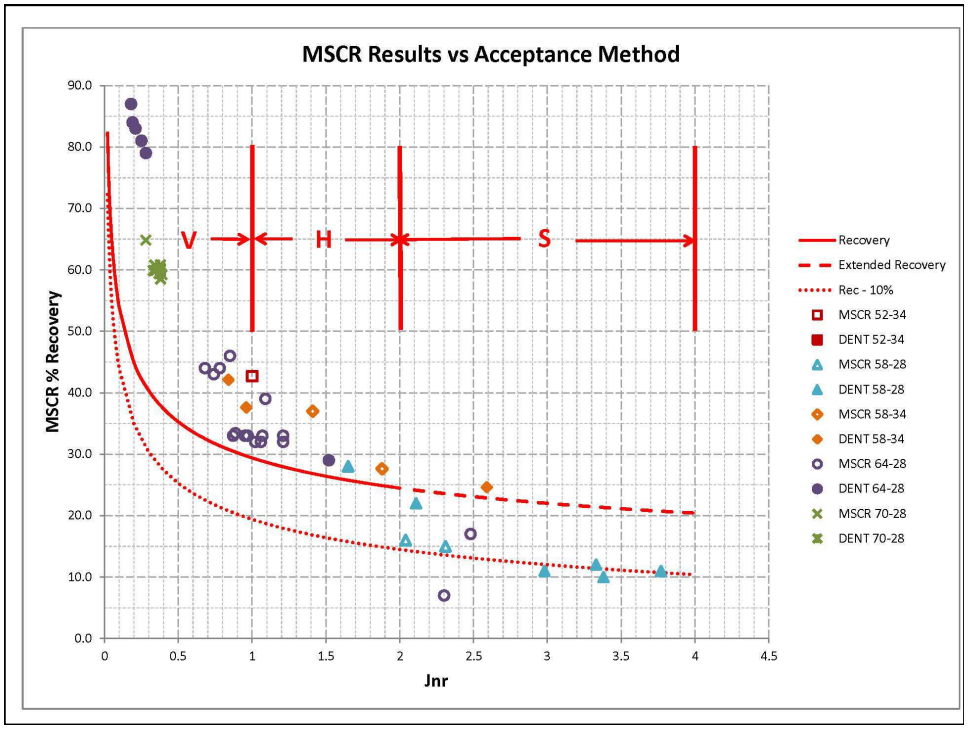
Multiple Stress Creep Recovery (MSCR)

- Change in asphalt cement testing for grade bumping

M320	58 -28	64 -28	70 -28	
MSCR	58S -28	58H -28	58V -28	58E -28

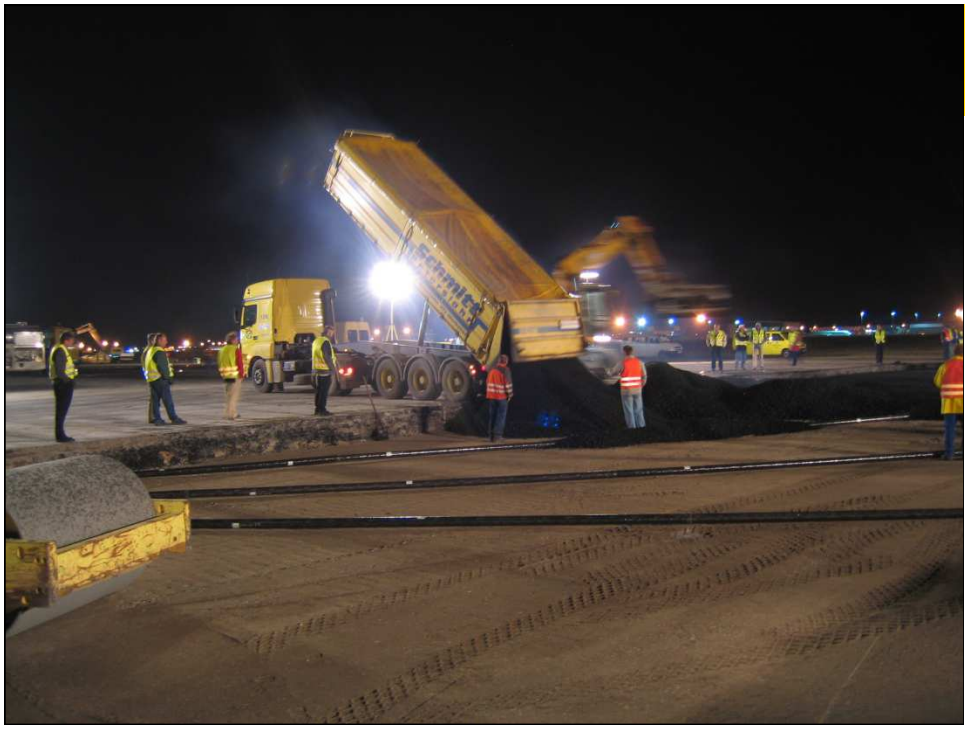
- Test done in standard DSR
- Run with script – take an additional ~15 min
- Run at two stress levels – 1.0 and 3.2 kPa

Test	Continuous Grade	MSCR Grade
PG 70 -28	73.4 -32.4	58E -28
with 1.5% Sasobit	76.7 -28.4	58E -28



Warm Asphalt – What is it?

- Used to reduce environmental impact but has added construction benefits – compaction aid
- Heating of aggregate greatly reduced so CO_2 reduced, NO_x and SO_x are cut in half and cost reduced
- Many processes
  - Chemical packages to change surface interaction, Organic additives, Foaming (mechanical or admixture), Thiopave
- All run at lower temperature of placement
  - Typically 25°C lower than HMA for same conditions
- Used for airport and highway work in Europe
- Many trials in US and Canada



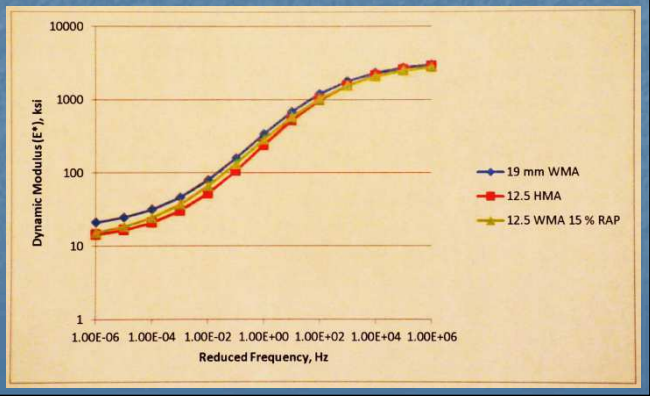
Testing Program

- Aggregate testing
  - Polished Stone Value (PSV)
- Mix Performance Testing
  - AMPT Dynamic Modulus – stiffness
  - AMPT Flow Number – rutting
  - Compactability and Coating – WMA mix design
  - Asphalt Pavement Analyser (APA) – rutting

September 2012 27

Results

- AMPT testing
  - RAP stiffer than no RAP
  - 19 mm WMA stiffer than 12.5 mm



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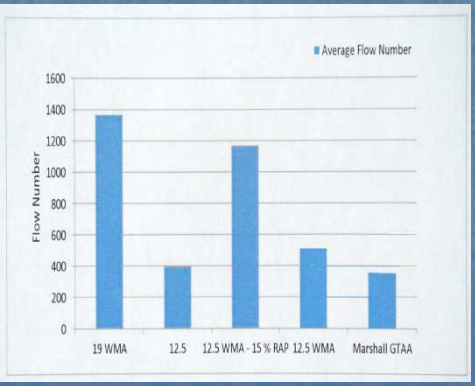
- Flow number is better (less likely to rut) for the WMA mixes and the surface mix with RAP
- Typical GTAA mix has a flow number than is acceptable



DBA Recommendations

- Asphalt cement grade is acceptable
- Superpave mixes meeting FAA P-401 specifications should preform better typical GTAA mixes
- The material and experience with Superpave is available in the GTAA area
- Trial projects should be undertaken to look at field performance


Thank you – Questions?
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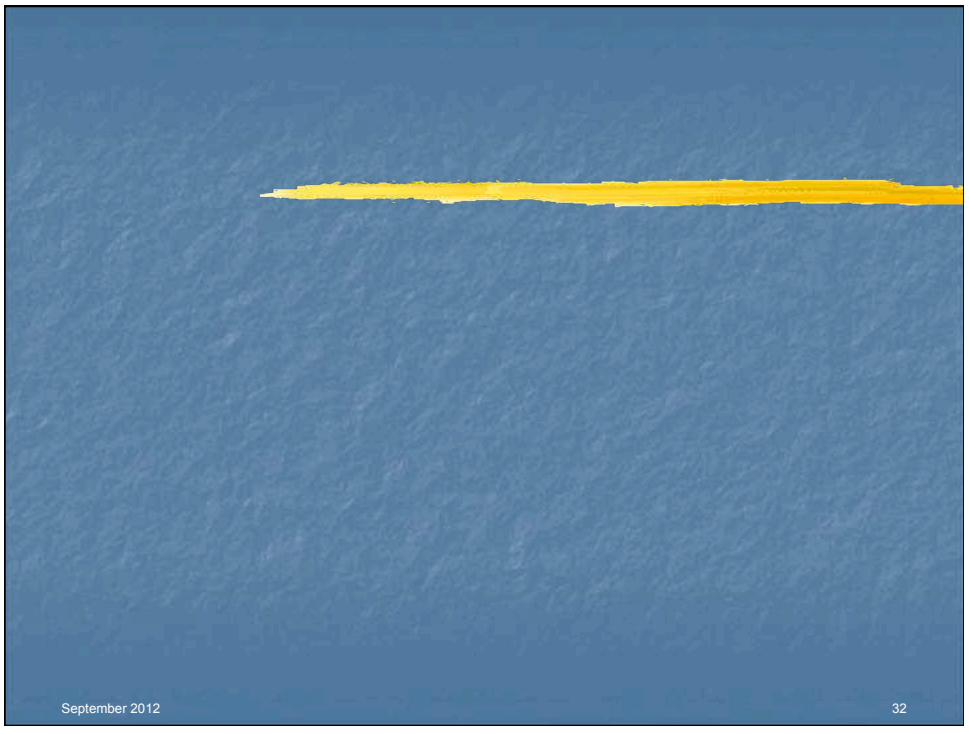
31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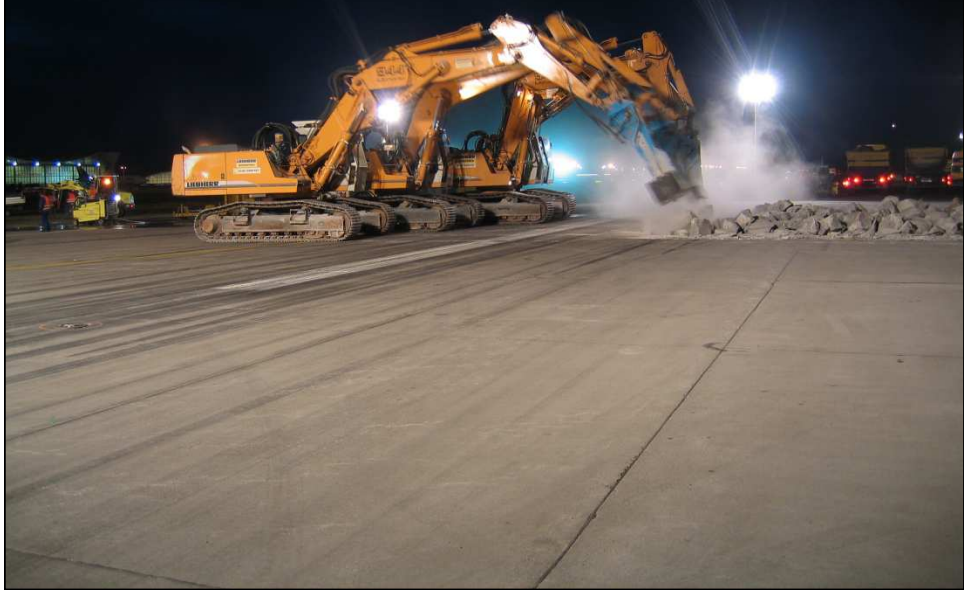
32

Frankfurt Airport - July 2004



Project Details

- Started in April 2003
- 4000-meter-long runway 61 m wide
- 300 incremental construction steps
- All night work to avoid interruptions in service
- Each night they replace 15 m length by full runway width
- Completed over 300 nights
- 60 cm asphalt layer on compacted gravel base and sand subgrade fill
- Low temperature asphalt with Sasobit (wax) in the beginning
- Later Shell bitumen with a different wax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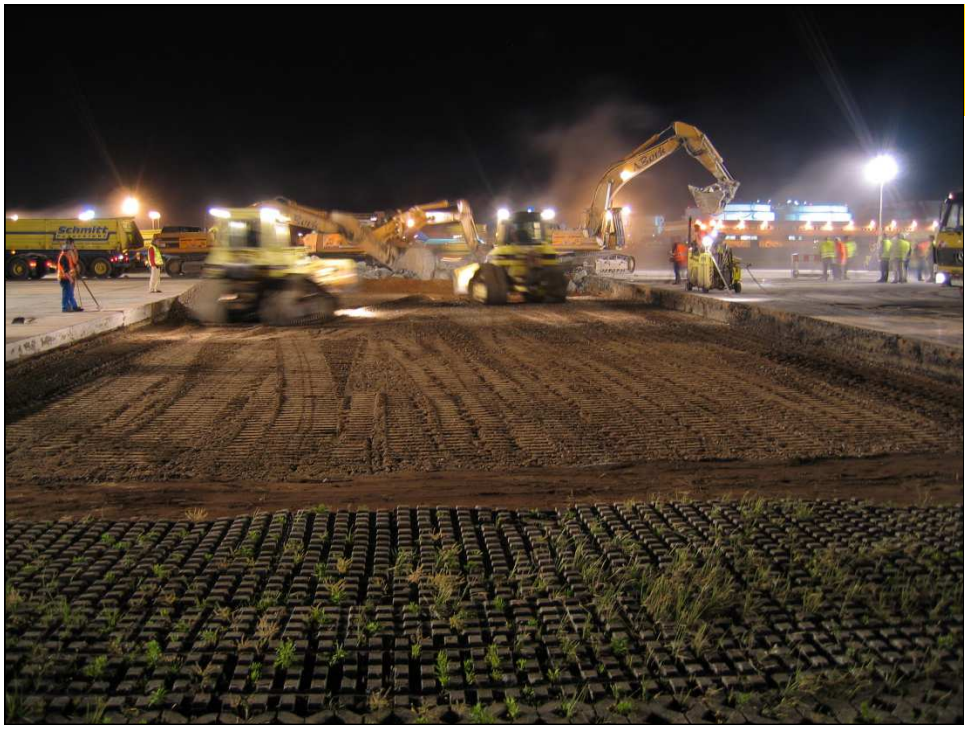
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Project Details

- 300 people involved in the project every day of production
- 60 of them were on the site during the night – about 35 are working on the site and about 25 are truck drivers
- 425,000 tonnes of asphalt in the contract
- Placed ~150 tonnes of WMA a night
- Because of conduits (runway lighting) and access issues, no paver used for the first lift of 24 cm (conduit diameter – 22 cm)

September 2012 40

Project Details

- Contract requirement – temperature of the pavement surface was not to be higher than 85°C at 06:30 – contractor chose warm mix
- When 150 to 200 m on centre-line were constructed, halted WMA placement for the night and milled surface to a depth of 4 cm
- Repaved full width with SMA surface for smoothness and friction (European Spec – 0/11 [gradation] with PmB 45 [SBS modified binder])
- Total project ~€38 million (~$62 million Can – 2004)
- Each night ~€ 120,000 (~$200,000 Can – 2004)