3rd International Conference
APT'08
MADRID. SPAIN
OCTOBER 1-3, 2008
Accelerated Pavement Testing

Feedback on the 3rd International Conference on Accelerated Pavement Testing 1-3 Oct 2008

RPF

11-12 Nov 2008

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Hosted by CEDEX

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Summary

- 75 presentations in 2,5 days
  - 7 from the Gautrans HVS Development Programme
- Tuesday: Pre-conference Workshops
  - 4 workshops:
    - APT for Airport Pavements
    - Introduction to APT
    - Evaluation of APT benefits
    - Measuring and modeling of APT

Summary

- Wednesday:
  - Conference Opening, Keynote Session, 6 Technical Sessions, Visit to the CEDEX APT Test Track
- Thursday:
  - Plenary Session, 7 Technical Sessions, Open Forum, Visit to Super Track
- Friday:
  - Plenary Session, 3 Technical Sessions, Synthesis, Closing

Conference Opening: 5 speakers

- Angel Aparicio: General Director Cedex
  Robert Skinner, TRB Execitive Director
  Bouzid Choubane, Chairmain TRB AFD40
  Claude van Rooten: President FEHRL Europe
  Francisco Criado, General Roads director, Spain
- Long standing link between APT and the history of pavement design
- Robert Skinner (TRB Executive Director) highlighted the close relationship between TRB and APT and the importance of international collaboration in transportation research
- Differences between APT and LTPP; long-term effects; need for improved modeling; show the tax-payers the benefits of what we do
- Claude Van Rooten (FEHRL): international collaboration; focus on efficient, safe, sustainable transport systems

Keynote Session

- Director General: Roads-Spain:
  - Need to develop accurate performance predictions;
  - evaluations of marginal materials, and
  - performance of rehabilitated pavements.
- Academia (UCD): address STRATEGIC ISSUES and IMPLEMENT the results. Do pre-project benefit/cost analysis to define goals; need to communicate with public; "*address tomorrow´s problems not today´s*"

TS1: Long-life Pavements

- Perpetual pavements CAN be tested with APT
  - Do not overstress, use realistic loads
- APT enables testing at various wheel speeds
  - Significantly different response
- APT is an efficient tool for testing emerging technologies
  - Warm-asphalt mixtures
  - Precast concrete slabs
- Opportunities for Public/Private Partnerships (PPPs)

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Testing of Perpetual Pavement with Warm Asphalt Concrete Surface Mixes in the Ohio - Shad Sargand

- 3 different products + control section:
  - Sasolbit
  - Evotherm
  - Aspha Min
- Typical Pavement structure:

32 mm	Warm Mix AC Surface Layer (Evotherm)
76 mm	Type II AC Levelling Layer
197 mm	Intermediate AC Layer
102 mm	Fatigue Resistant AC Layer
407 mm	**of which 85 is Warm AC**

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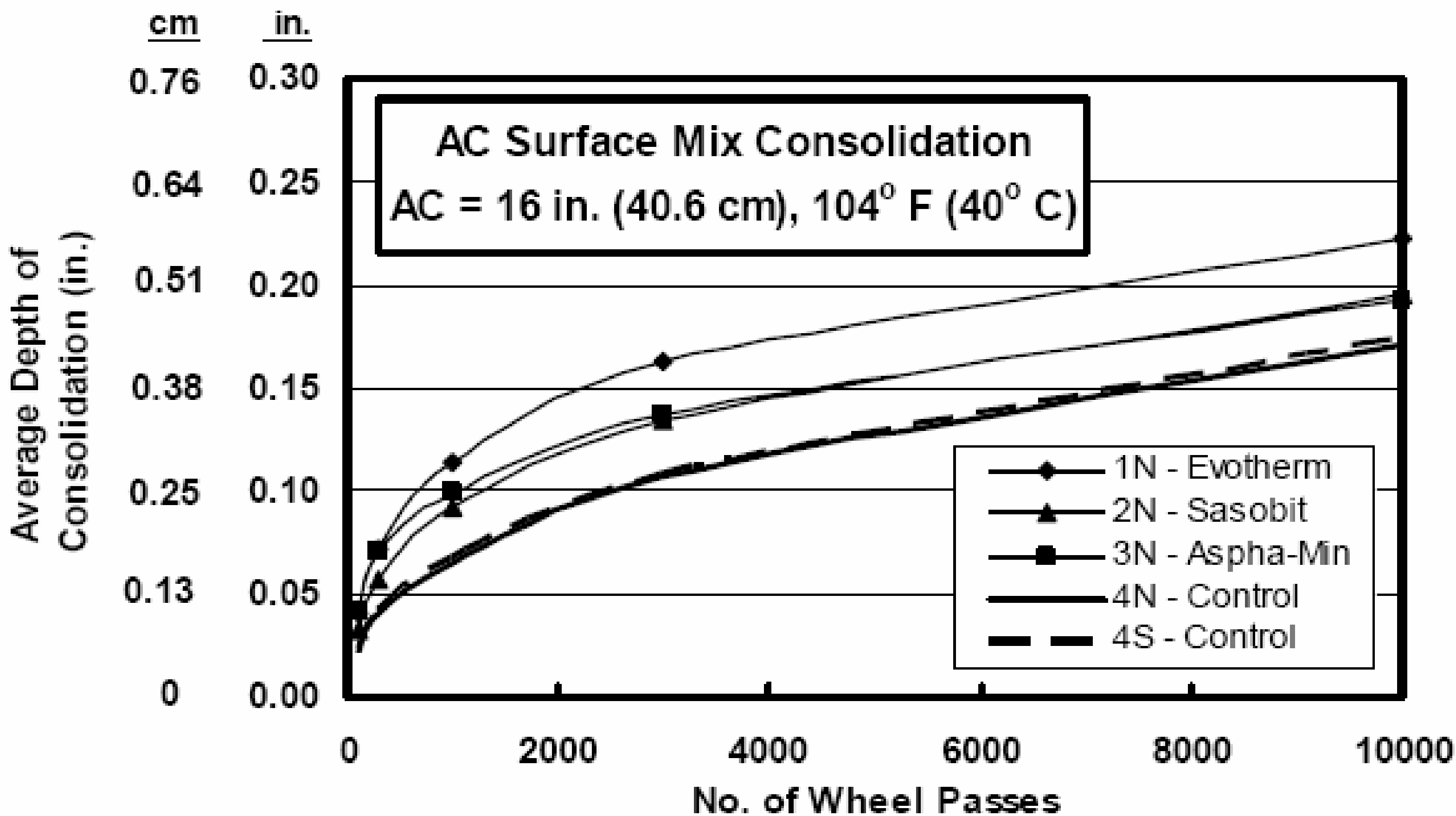
AC Surface Mix Consolidation
AC = 16 in. (40.6 cm), 104° F (40° C)
cm
in.
0.76
0.64
0.51
0.38
0.25
0.13
0
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Average Depth of Consolidation (in.)
0
2000
4000
6000
8000
10000
No. of Wheel Passes
1N - Evotherm
2N - Sasobit
3N - Aspha-Min
4N - Control
4S - Control

Conclusions

- Early consolidation of warm AC mixes under rolling tires was more than the conventional mix, after which the rate of consolidation was slightly less for the warm AC mixes than that for the conventional mix.
- Of the three warm AC mixes, Evotherm showed more consolidation than Aspha-Min and Sasobit, which were about the same.

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TS4: Modeling

- Current modeling approaches:
  - Empirical (e.g. current AASHTO)
  - Mechanistic-Empirical (e.g. future AASHTO MEPDG)
  - Incremental-recursive modeling (e.g. CalME)
- Incremental-recursive modeling by updating material properties with time
  - Monitor not only performance but response
- Use of probabilistic analysis
  - Confidence intervals on response (please no R^2)

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Calibration of Mechanistic-Empirical Models for Cracking and Rutting of New Pavements Using Heavy Vehicle Simulator Tests - Per Ullidtz

- Per developed a Mechanistic-Empirical Software package *CalME*
- *CalME* is an Incremental-Recursive Mechanistic- Empirical model (IRME)
- Material properties are updated in terms of damage for each time increment, using the "time hardening" approach, and used (recursively) as input to the next time increment. This approach predicts the pavement conditions at any point in time during the pavement life.
- The IRME can also be used to simulate APT tests or responses from test tracks.

Conclusions

- Good prediction of the resilient deflections of the pavements, at all load levels and for the whole duration of the tests.
- Permanent deformation of the individual layers in the pavement structures was predicted reasonably well and so was the overall permanent deformation at the pavement surface, including predictions for asphalt-rubber overlays.
- Before the models can be applied to the design of new pavements and rehabilitation overlays a number of issues need to be addressed such as the influence of aging, seasonal variations, wheel speeds and rest periods, and variability of materials, structure, loads and climate.

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TS6: Overlays

- APT is ideal for assessing overlay strategies in conjunction with laboratory testing
  - Used to better understand cracking mechanisms and cracking behavior
- Modified binders show significant performance benefits
- Tack coat designs are better understood
  - Use of appropriately selected tack coats reinforced

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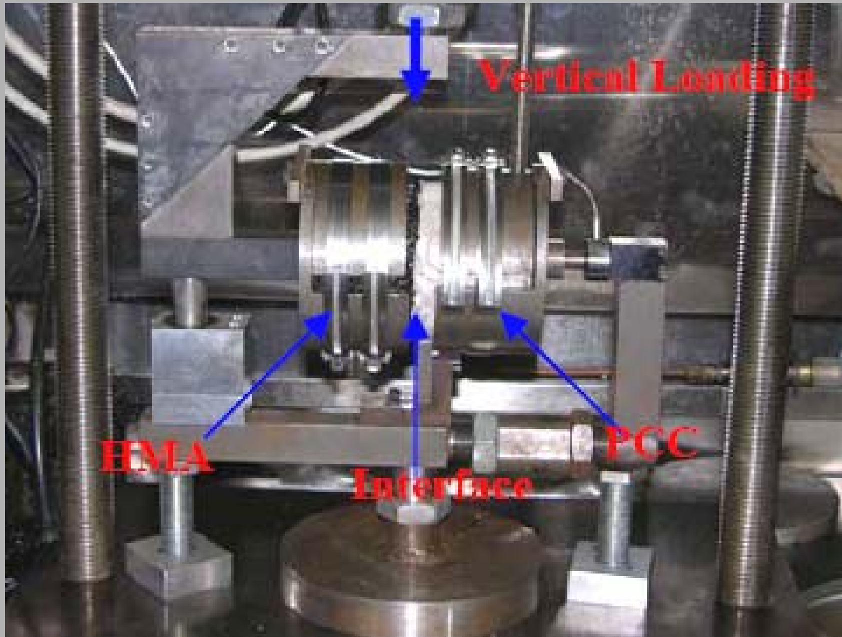
Modified binder experiment (D Jones)

- Six different overlays, including dense graded asphalt concrete (DGAC) and rubberized asphalt concrete (RAG-G) and three different terminal blend (wet-blend) Modified Binder sections were evaluated under the HVS
- *Will gap-graded modified binder (MB-G) mixes provide performance equal to gap-graded rubberized asphalt concrete (RAC-G) or DGAC mixes in half-thickness applications ?*
- MB binders are asphalt binders modified with polymers and recycled tire rubber and blended at the refinery (terminal blend)
- The results indicate that gap-graded mixes with MB-G 7 and 15 % recycled rubber will provide superior performance in terms of reflection cracking compared to the same half thickness (45mm) of RAC-G (Rubberized Asphalt Concrete Gap-graded) and full thickness (90mm) of DGAC, when used in thin overlays on cracked asphalt pavements.
- With regard to rutting performance, conventional dense-graded asphalt concrete was clearly superior to all other mixes, followed by the RAC-G, and then the modified binder mixes. Most of the rutting in the HVS test sections occurred in the DGAC layer below the overlays, and not in the overlay itself.

Use of Tack Coats (Imad L. Al-Qadi Illinois)

- Interface bonding between hot-mix asphalt (HMA) overlays and PCC pavements is one of the most significant factors affecting overlay service life. The quality of tack coat and its application rate have long been postulated as primary factors in overlay performance.
- Objectives of this study:
  - to conduct laboratory testing to optimize the tack coat application rate and
  - to validate the laboratory results using APT.
- Laboratory direct shear tests were performed on specimens prepared with field extracted PCC cores and laboratory compacted HMA. The laboratory investigation was validated by conducting APT



Use of Tack Coats (Imad L. Al-Qadi Illinois)

- The study concluded that SS-1hP (Emulsion) provided better interface shear strength than RC-70 (Cut-back bitumen). Additionally, the optimum residual tack coat application rate was determined to be 0.18 L/m^2 based on the field validated laboratory testing

Technical visit: Cedex test track

TS7: Economic Analysis

- Cost-benefit analyses extremely important for justifying research with APT
- Need to be realistic and defendable
- Structured, transparent approach needs to be followed
  - Analyses should be done <u>before</u> & after research
- Conservative estimates show benefit/cost ratios of 2 to 10
- Very important component of APT research "marketing"

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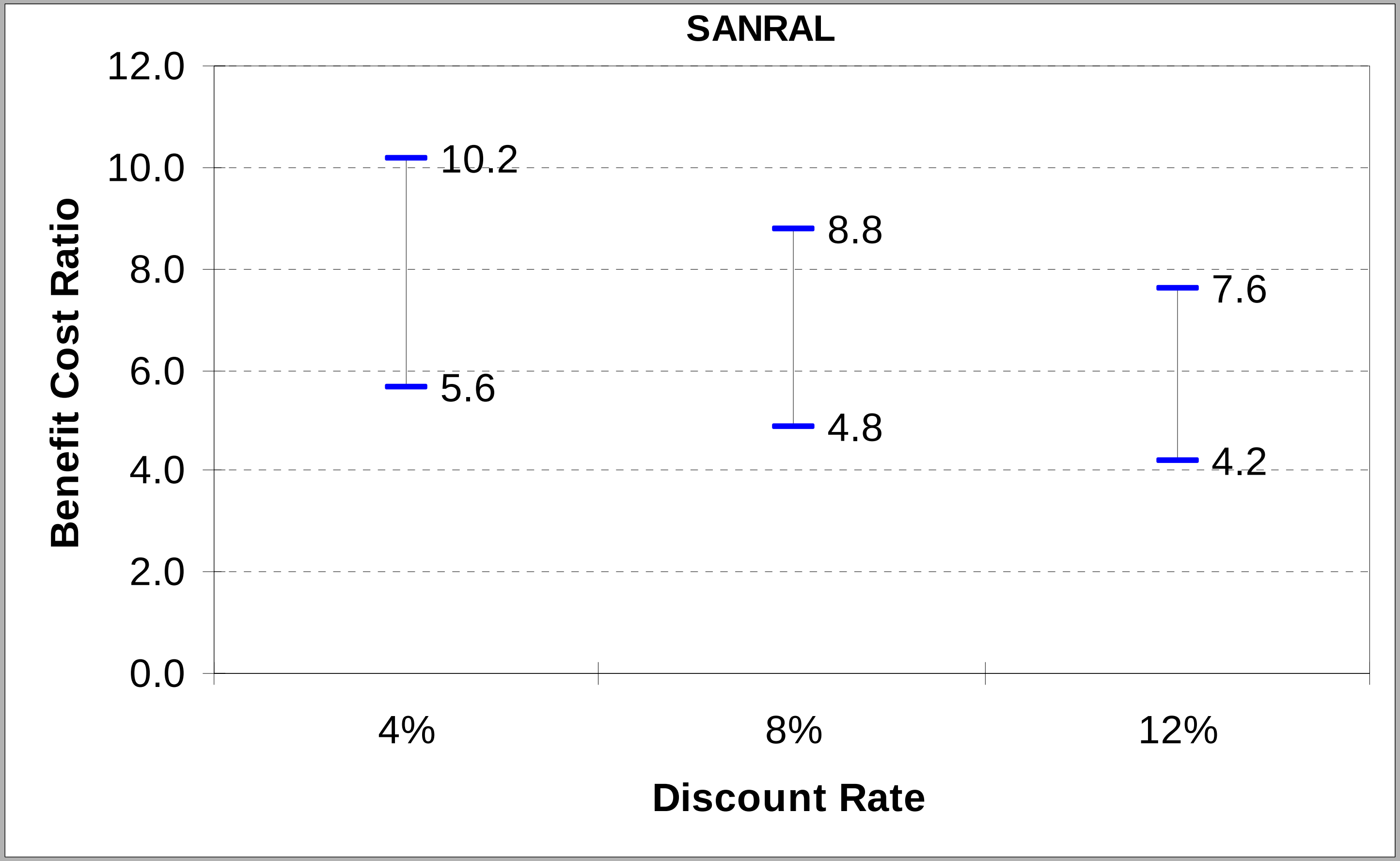
Cost Benefit Analysis (L du plessis)

- Paper by F Jooste, L Sampson, E Sadzik



C/B of the California HVS programme

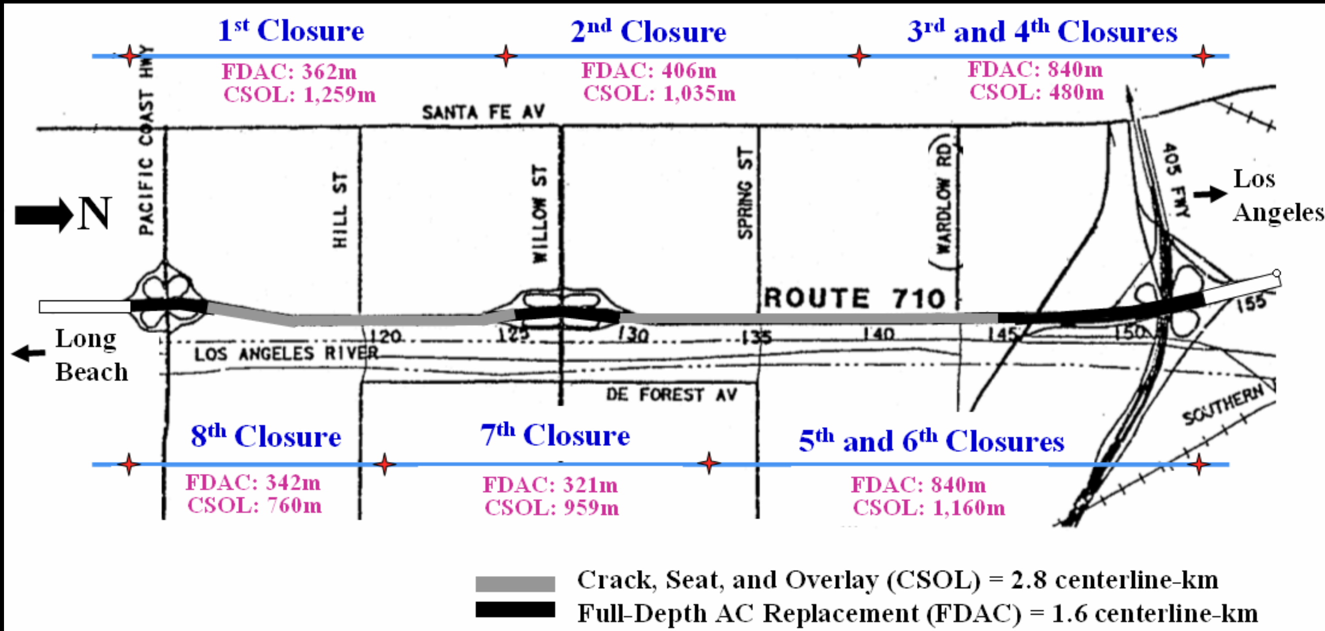
Gautrans Cost / Benefit methodology tested on a pilot project of the Californian HVS programme

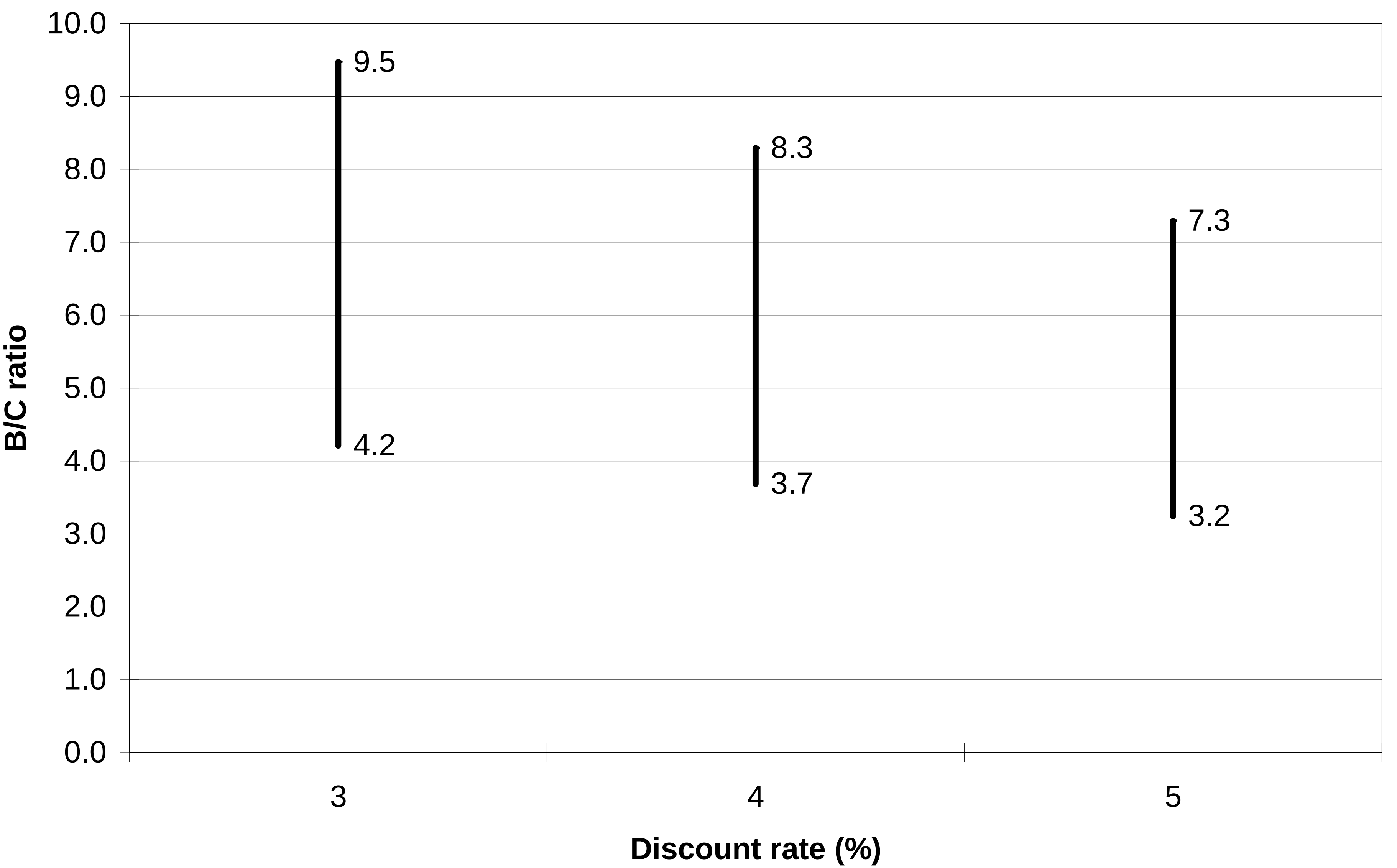
Case study: The I710 Project

- I710 close to Long Beach is one of the busiest highways in California (ADT = 164 000, 13% trucks)
- Badly deteriorated sections of a total of 26.4 lane-km had to be rehabilitated
- Ideal opportunity to showcase the Long-Life Pavement Rehabilitation Strategy (LLPRS) program of Caltrans which begun in 1998.
- HVS evaluation of a flexible pavement design rehabilitation alternative for a 200 million ESALs & design life of 30years

Case study: The I710 Project

- At that time concerns were raised about using the Caltrans design methods for asphalt concrete (AC) pavements on a major freight and commuter corridor for such a long design life and heavy traffic level.
- These circumstances provided an opportunity to implement findings and technologies proven through HVS testing:
  - A "composite pavement" consisting of a rut-resistant, modified binder mix surface layer was built on top of a fatigue-resistant, "rich-bottom", asphalt concrete layer. Benefits were associated with better quality materials that should extend pavement service life and reduce life cycle costs.




B/C ratio
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
9.5
4.2
8.3
3.7
7.3
3.2
3
4
5
Discount rate (%)

APT-evaluation of high stiffness base layers with high percentages of reclaimed asphalt Nicolas Bueche, Switserland

- (High Modulus Asphalt – HMA) with high percentages of recycled materials.
- Three different mixes were designed, optimized and compared, namely with 0%, 25% and 40% reclaimed asphalt.
- Based on the performance characteristics of the mixtures determined in the lab study and APT, no negative effect from the use of a high percentage of reclaimed asphalt has been observed in this study.
- However, it is important to keep in mind that such a conclusion cannot be extended to all the HMA mixes with 25 % or 40 % RAP. Parameters, such as the grading curve, the recycling material and the binder type play a key role in the final properties.

Open Forum

- Realistic prediction accuracy
  - Point estimates are useless, rather make use of Probabilistic concepts
- APT without modeling is “useless”
- Need to convince the sponsors to invest on some “basic research”
- When requesting funding:
  - link APT plans to national interests (environment, accidents)
  - Convert technical results to dollars
  - Be able to explain results in 30 seconds

Technical visit to Supertrack

- SUPERTRACK is an indoors facility for accelerated testing of high-speed railway tracks.

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Supertrack

The installation includes a 21 m long x 5m wide x 4m deep track box, with independent dynamic actuators that can reproduce the effect of bogies on the rails, simulating their approach to, passing and moving away from the testing section considered.

TS14: Environmental Effects

- Moisture is a key variable that should be controlled in APT and measured in LTPP
- Temperature is a key variable that can be successfully controlled during APT
  - At surface and with depth
- Both need to be model to capture seasonal effects
- Large amounts of data are collected
  - Need for user friendly accessible databases

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IMPROVED MODEL TO PREDICT FLEXIBLE PAVEMENT TEMPERATURE PROFILE
Raul Velasquez

- The performance of asphalt pavements is greatly influenced by environmental conditions. One of the most important environmental factors that significantly affect the mechanical properties of asphalt mixtures is temperature. Thus, accurate prediction of the temperature distribution within the pavement structure is important
- This paper proposes regression models to predict flexible pavement temperature profile by means of the least square method and measured values for air temperature, humidity, wind speed and calculated solar radiation at different pavement cells located at MnROAD accelerated pavement facility.
- A total of 13869 average meas urements of pavement temperature at different depths collected over the past 11years were used to develop regression models.

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Independent variables

Table 3. Correlation matrix for maximum pavement temperature .

	MaxPavTemp	MaxAirTemp	Hum	Depth	Solar	Wind
MaxPavTemp	1					
MaxAirTemp	**0.9397**	1				
Hum	-0.2487	-0.1541	1			
Depth	-0.2061	-0.1062	-0.0063	1		
Solar	**0.8606**	**0.7797**	-0.2258	-0.0975	1	
Wind	-0.3090	-0.2581	-0.0925	0.0316	-0.1715	1

Table 4. Correlation matrix for minimum pavement temperature .

	MinPavTemp	MinAirTemp	Depth	Solar	Wind	Hum
MinPavTemp	1					
MinAirTemp	**0.9634**	1				
Depth	-0.0281	-0.1062	1			
Solar	**0.8098**	**0.7647**	-0.0975	1		
Wind	-0.2594	-0.2231	0.0315	-0.1707	1	
Hum	-0.0604	-0.0034	-0.0061	-0.2264	-0.0927	1

USING APT AND LABORATORY TESTING TO EVALUATE THE PERFORMANCE OF HIGH MODULUS ASPHALT CONCRETE FOR BASE COURSES IN BRAZIL - Luciana Rohde

The basic idea of HMAC is to design a mix with hard grade bitumen at high binder content, around 6 percent (ratio by weight of the bitumen to the aggregate).

- PEN = at 25°C between 10 and 25 (1/10mm) and
- R&B softening point should vary among 60 and 85°C.

The hard grade bitumen provides higher modulus to the mix, allowing reducing the stresses transmitted to the granular layers and subgrade, without increasing pavement thickness.

Evaluation

- APT testing of 2 trial sections to verify the construction features and to monitor the traffic effect in the pavement.
  - 200,000 load cycles were applied with axle loads of 100 kN and 120kN
  - Deflections, rut depths were measured and cracks were mapped.
- Laboratory study
  - Marshall design to determine asphalt binder content
  - Tensile strength
  - Resilient modulus & fatigue (controlled stress mode),
  - Modified Lottman (Stripping)
  - Permanent deformation (LCPC simulator)
- The results show that HMAC presents excellent resilient behaviour in addition to high tensile strength, that make this kind of asphalt mixture most suitable for pavements submitted to very heavy traffic.

Conclusion

….Considering the mechanical characteristics (resilient modulus and indirect tensile strength), the thermal susceptibility, the fatigue life, the rutting resistance and the resistance to the moisture damage evaluated in laboratory, *it was verified that the performance of the high modulus asphalt mixture studied in the research here reported was superior to that of a reference mixture produced with conventional binder (pen grade 50/70).*