



Superpave Implementation

C-SHRP's Perspective

International Symposium on Binder Rheology
and Pavement Performance

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Presented by

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Topics of Discussion

- Brief Overview of C-SHRP
 - ◆ Involvement in Superpave research and implementation efforts
- Superpave versus the Canadian winter
- Superpave implementation across Canada



Introduction to C-SHRP

- Initiated in 1987 to extract benefits of US-SHRP with emphasis on Canadian highway problems
- 4 original technical areas
- Active research component in first phase (1987-1994)
 - ◆ Sponsored research in all four technical areas
- LTPP research and technology transfer are continuing focus



C-SHRP and Superpave

- Promoted evaluation of Superpave system in Canada
 - ◆ Applied research for Canadian situation
 - ◆ Test roads construction
 - ◆ Low temperature algorithm
 - ◆ Initial equipment purchase
 - ◆ Peer exchanges
 - ◆ CUPGA



Superpave vs. the Canadian winter

- June 2000 Tech Brief published
- Overview of C-SHRP Test Roads
 - ◆ Lamont, Hearst and Sherbrooke
- Objectives of TAC/Anderson Study
- Instrumentation
- Test Road Performance
- Evaluation of Superpave Models
- Main Conclusions



Overview of C-SHRP Test Roads

- Construction and instrumentation of 3 test roads in 1991/1992
- Primary Test Site - Lamont, Alberta
 - ◆ Secondary Highway 637:02
 - ◆ 7 test sections
 - ◆ 100mm AC over 280mm granular
 - ◆ 1992 traffic
 - ★ 260 vehicles/day
 - ★ 9 ESAL/day



Overview of C-SHRP Test Roads

- Satellite Test Site - Hearst, Ontario
 - ◆ Highway 631
 - ◆ 4 test sections
 - ◆ 50mm AC over 900mm granular
 - ◆ 1992 traffic
 - ★ 300 vehicles/day
 - ★ 25% trucks
- Satellite Test Site - Sherbrooke, Quebec
 - ◆ Autoroute 10
 - ◆ 4 test sections
 - ◆ 120mm AC over 830mm granular
 - ◆ 5-year ESAL count 2-3 million

Test Road	Section	CGSB Grade	SHRP PG Grade
Lamont	1	80-100B	58-22
Lamont	4	80-100C	
Sherbrooke	B	80-100B	
Lamont	5	80-100A	64-28
Sherbrooke	C		
Sherbrooke	D	150-200B	52-28
Lamont	2		
Hearst	BB	150-200A	
Hearst	A		
Hearst	B		
Lamont	6		
Sherbrooke	A	150-200A	
Lamont	7	200-300A	
Lamont	3	300-400A	46-34
Hearst	AA	200-300B	



Objectives of Current Study

- Initiated July 1995
- Further assess the low temperature aspects of Superpave
 - ◆ Assess, validate or suggest possible modifications to the Superpave system
 - ★ Incorporate Canadian specs
 - ◆ Validate existing fracture temperature prediction models or produce improved models
- Brief only covers Superpave related work
 - ◆ Full TAC Report available
 - ★ “Low Temperature Pavement Performance: An Evaluation Using C-SHRP Test Road Data”



Instrumentation of Test Sites

- Air and Pavement Temperature
 - ◆ Thermocouples throughout pavement depth and subgrade
- Low Temperature Cracking
 - ◆ Crack detection circuit
 - ★ 300m strip of aluminum foil tape
 - ★ 8 individual circuits installed at 50mm below pavement surface
- Data collection system
 - ◆ Recorded temps and when foil was broken (onset of cracking)



Test Road Performance

- Surface Distress
 - ◆ Distress surveys each year for 6 winters (5 for Sherbrooke)
 - ◆ Detailed crack counts and min. pavement temperatures reported in technical brief #19 (Table 1)
 - ◆ Average cracks/km (all sites)
 - ★ PG xx-22: 109 cracks/km
 - ★ PG xx-28: 41 cracks/km
 - ★ PG xx-34: 6 cracks/km
 - ◆ Fairly large variance within each PG Grade



Test Road Performance

■ Coefficients of Contraction

- ◆ From 0C to -25C, linear decrease in length (i.e. constant coefficient)
- ◆ From -25C to -45C, decrease in length with decrease in temp.
 - ★ Coefficient is temperature dependent
 - ★ About 40% smaller at -40C

■ Tensile Testing

- ◆ Direct tensile testing at -10, -20 and -30C much slower than SHRP protocol
- ◆ Creep testing also completed at 1000s loading
- ◆ Significant differences observed between stiffness values for similar asphalt grades



Evaluation of Superpave Models

- In 1994, AASHTO MP1 was used on recovered binders to grade each binder (Stiffness and m-value)
 - ◆ Original spec. used minimum air temp, not pavement surface temp.
 - ◆ Roque attempted to shift the original values to represent actual pavement temps.
 - ★ Shift method was unsuccessful
- In 1995, Robertson completed an alternative BBR analysis
 - ◆ Completed on PAV specimens
 - ◆ Results indicated that limiting stiffness of 300MPa was not restrictive enough – recommended 200MPa



Evaluation of Superpave Models – cont.

- Current study used BANDS-PC to determine asphalt stiffness for Lamont binders to compare with BBR results.
- Reasonable agreement, but BBR results were consistently smaller than nomograph values
 - ◆ Finding in contrary with previous studies that said nomograph values smaller
 - ★ Original stiffness value based on nomograph values then increased
- Therefore, current study proposed limiting stiffness value of 100MPa



Main Conclusions

- Cracking predictions based on BBR tests on recovered binders did not agree with observed performance.
- Based on study results, limiting stiffness of 100MPa appears appropriate for Canadian conditions to prevent thermal cracking.
- Superpave system gave reasonably good indication of cracking, however, considerable overlap of initial fracture temperatures was observed.
- Thermal coefficients of contraction were temperature dependent for extreme low temperatures

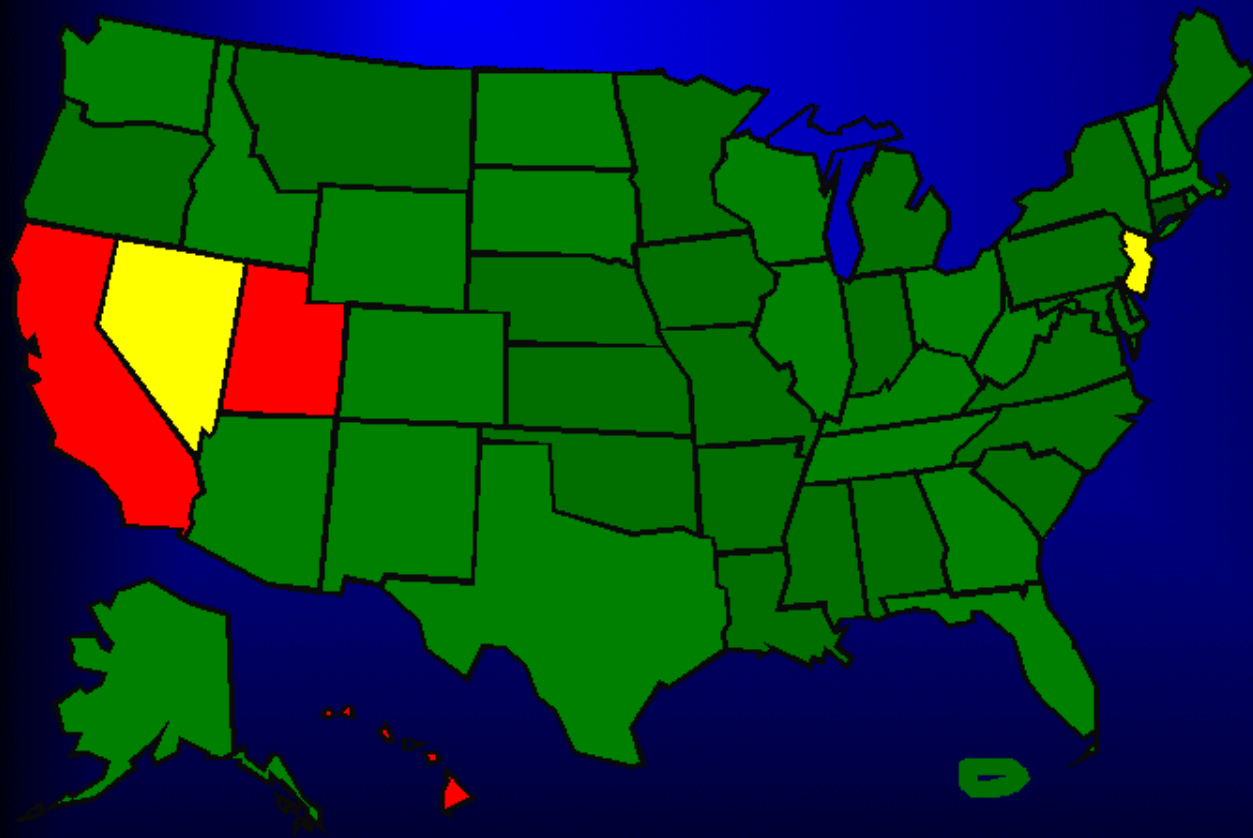


Superpave Implementation

- Actively pursued in United States
 - ◆ State agencies
 - ◆ FHWA
 - ◆ AASHTO
 - ◆ Lead States Team
- 1998 Implementation Survey III
 - ◆ 45% by tonnage, 40% of projects at SHA in 1999
 - ◆ In 2001, projection of 134 M tonnes (83% of HMA tonnage)



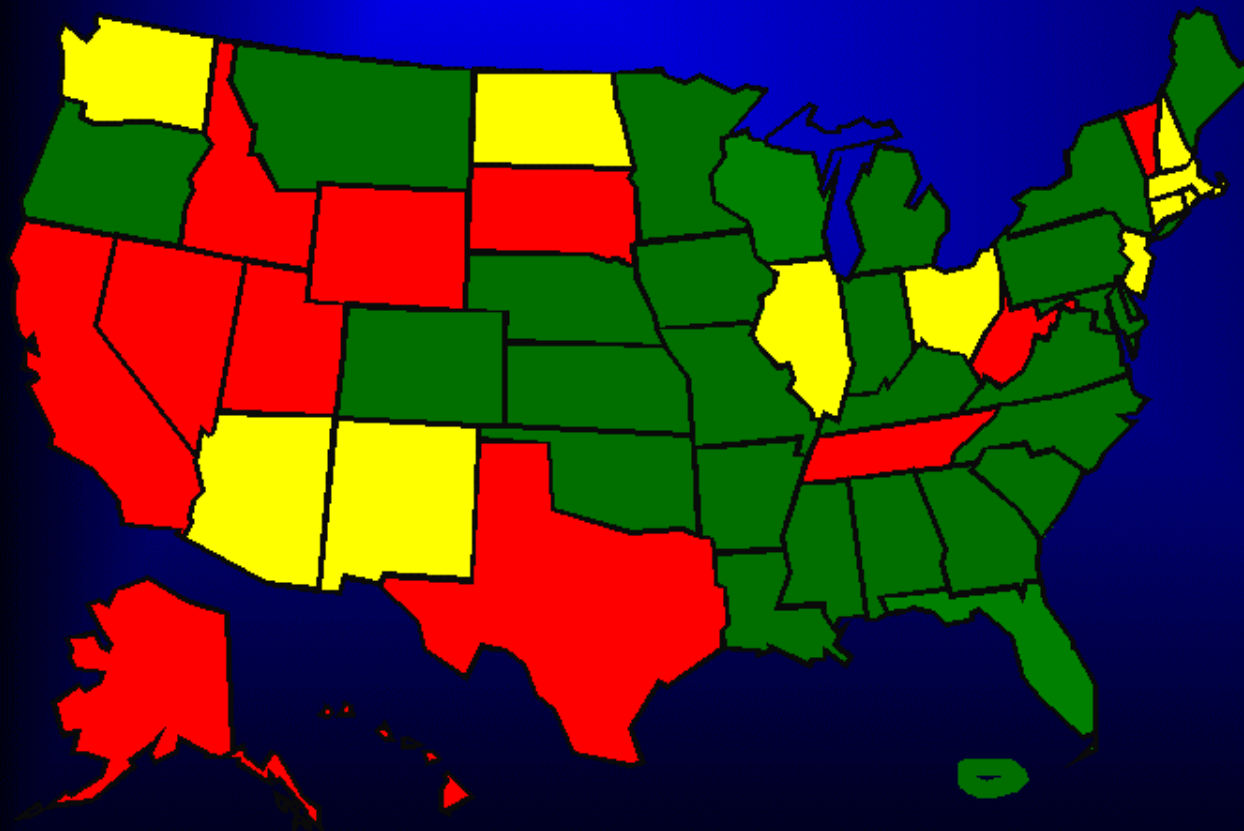
Superpave Binder Implementation



- By 2000 
- After 2000 
- Undetermined 



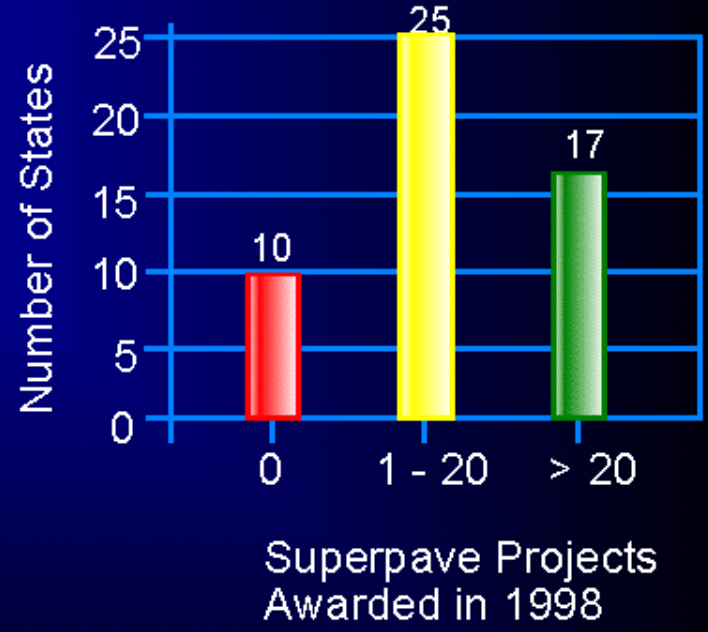
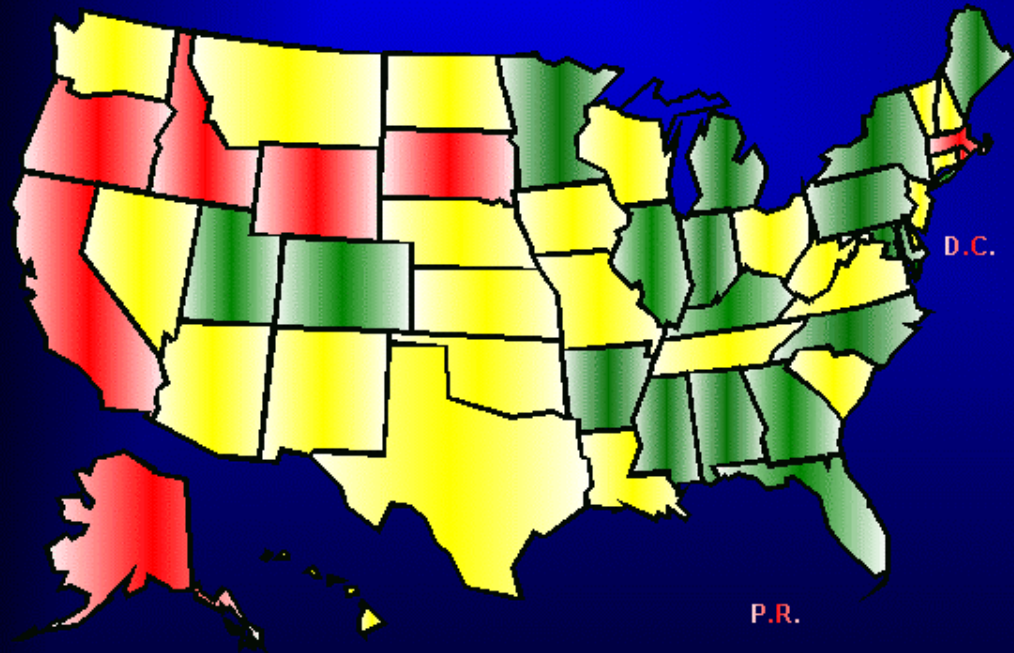
Superpave Mixture Implementation



- By 2000 
- After 2000 
- Undetermined 

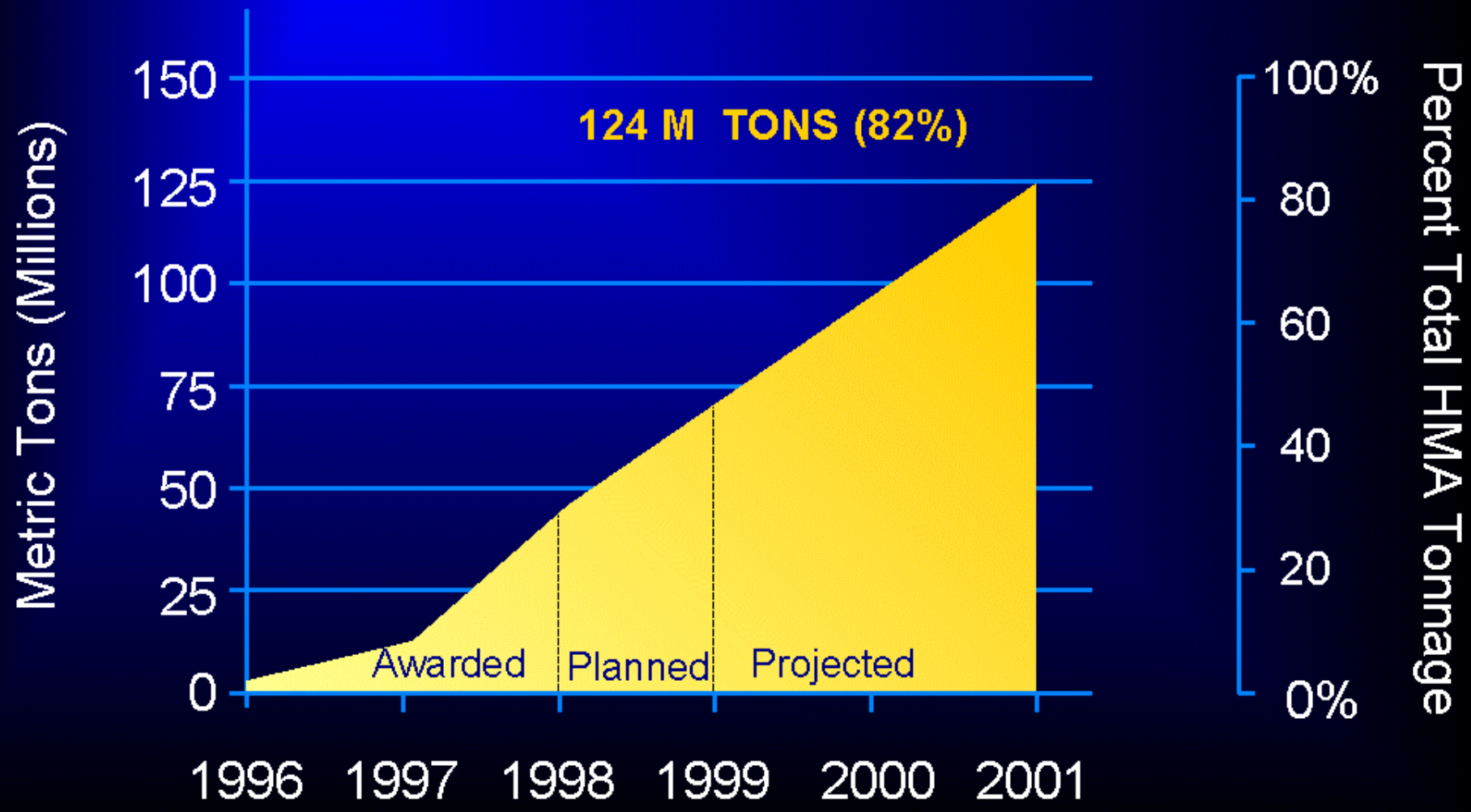


Superpave Project Distribution



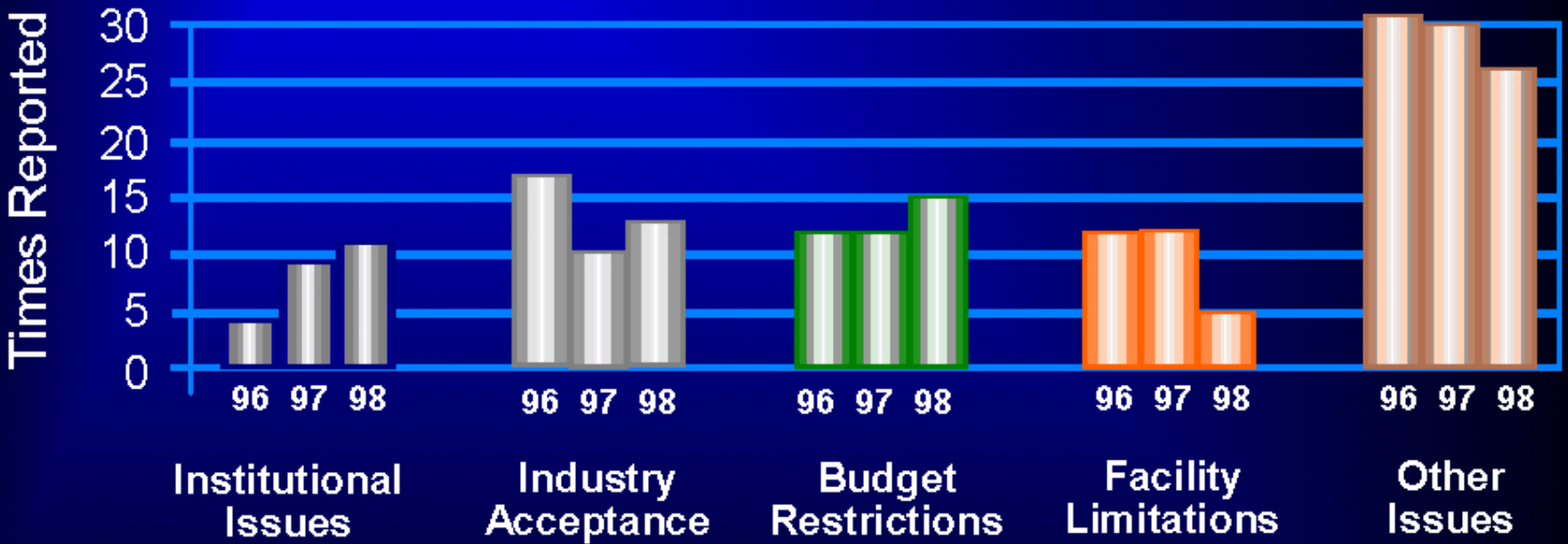


Projected Superpave Tonnage





Implementation Challenges





Implementation in Canada

- Not C-SHRP's mandate to promote implementation
 - ◆ Promote awareness, evaluation
 - ◆ No national lead on implementation
- Survey of C-SHRP sponsors to monitor implementation
 - ◆ 1992, 1995, 1998
- Steady growth apparent



1998 Survey

- C-SHRP with Vince Aurilio (Golder Associates)
- Objectives
 - ◆ To assess status of Superpave implementation In Canada
 - ◆ To identify key issues for agencies implementing Superpave
 - ◆ To share the information with all agencies and other industry stakeholders



1998 Survey Overview

- 12 provinces and territories surveyed
 - ◆ All except one responded
 - ◆ Little work done in territories due to limited infrastructure
- 26 questions
 - ◆ Testing capability, equipment availability, trial construction, implementation plans and schedule



In Brief ...

- Overall positive outlook
- Many benefits foreseen
- Some problems encountered or anticipated
- Implementation underway or planned in most regions of Canada
- Some awaiting results of further research



Testing Capability

- Most agencies own some Superpave testing equipment
- About half own binder equipment
- About half own gyratory
- About half own both
- Testing available across country through producer and consultant facilities



Trial Projects

- Every agency has conducted some trials with Superpave
 - ◆ Often only a component of system, not full Superpave design
 - ◆ Some focus on mix design, others on binder specification
- Four SPS 9 sites constructed
 - ◆ Alberta, Saskatchewan, Ontario, Quebec

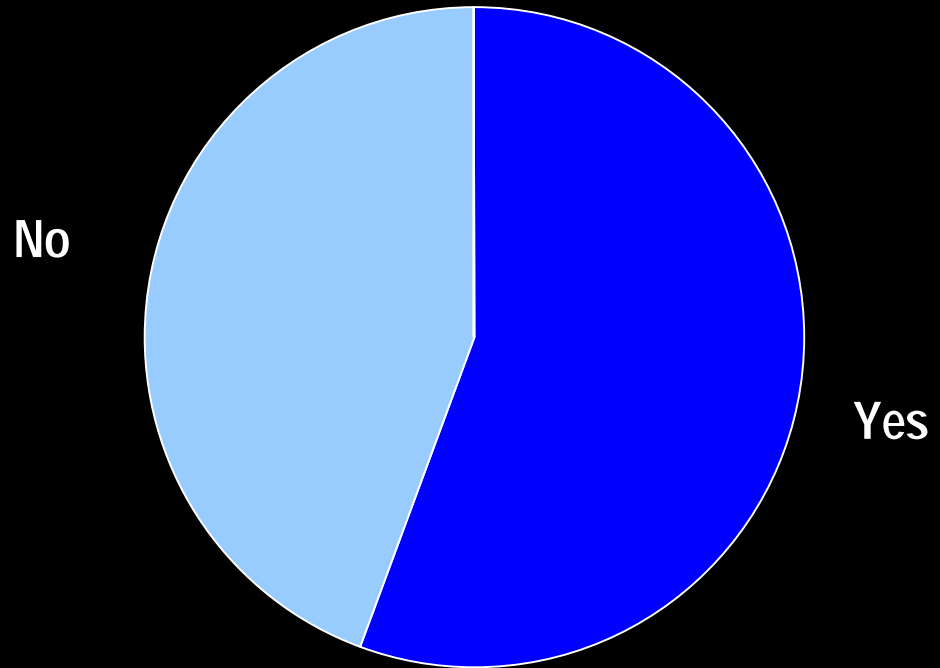


Observations

- Some problems noted with construction
 - ◆ Compaction more difficult
 - ◆ Adhesion to rollers
- Other concerns
 - ◆ Extremely porous mixes
 - ◆ Recycling ratio limited
 - ◆ Mix did not meet stripping criteria
 - ◆ Some aggregate sources do not meet criteria



Future Projects?





Implementation Issues

- 70% + of the agencies have implemented or have target implementation dates for binder spec; 40% for mix spec
 - ◆ Some expect to modify specs
- Benefits include
 - ◆ Longer pavement life
 - ◆ Reduced thermal cracking
 - ◆ Performance prediction
 - ◆ Long term cost savings
- Concerns
 - ◆ Higher costs for equipment, testing, materials
 - ◆ RAP limits
 - ◆ Supply and storage of multiple grades



Next C-SHRP Survey

- Next survey in progress
 - ◆ More comprehensive tracking study
 - ◆ More detailed information on each project in progress
 - ◆ Distributed to agencies; one response received
 - ★ Also interested in other responses
 - ◆ Results to be available on line
 - ◆ www.cshrp.org



Looking to the Future

- Superpave implementation taken seriously by all Canadian agencies
- Ongoing research and implementation initiatives being monitored closely
- US program assessed benefits of Superpave implementation
 - ◆ Millions to billions of dollars to be saved
- C-SHRP assessment of benefits looked more closely at low temperature analysis
 - ◆ Additional savings attributed to selection of correct binder



Questions?