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	52-34
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

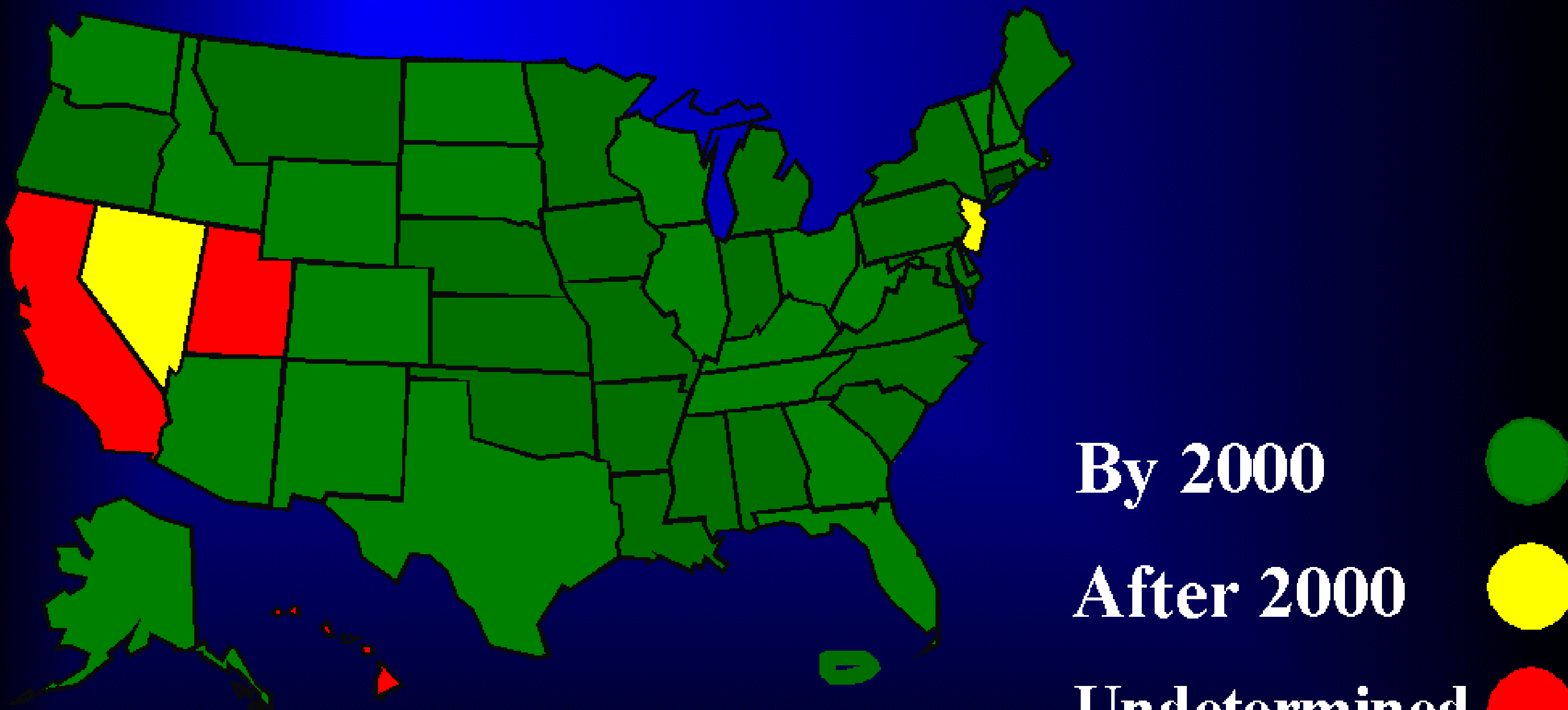
Main Conclusions

- 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

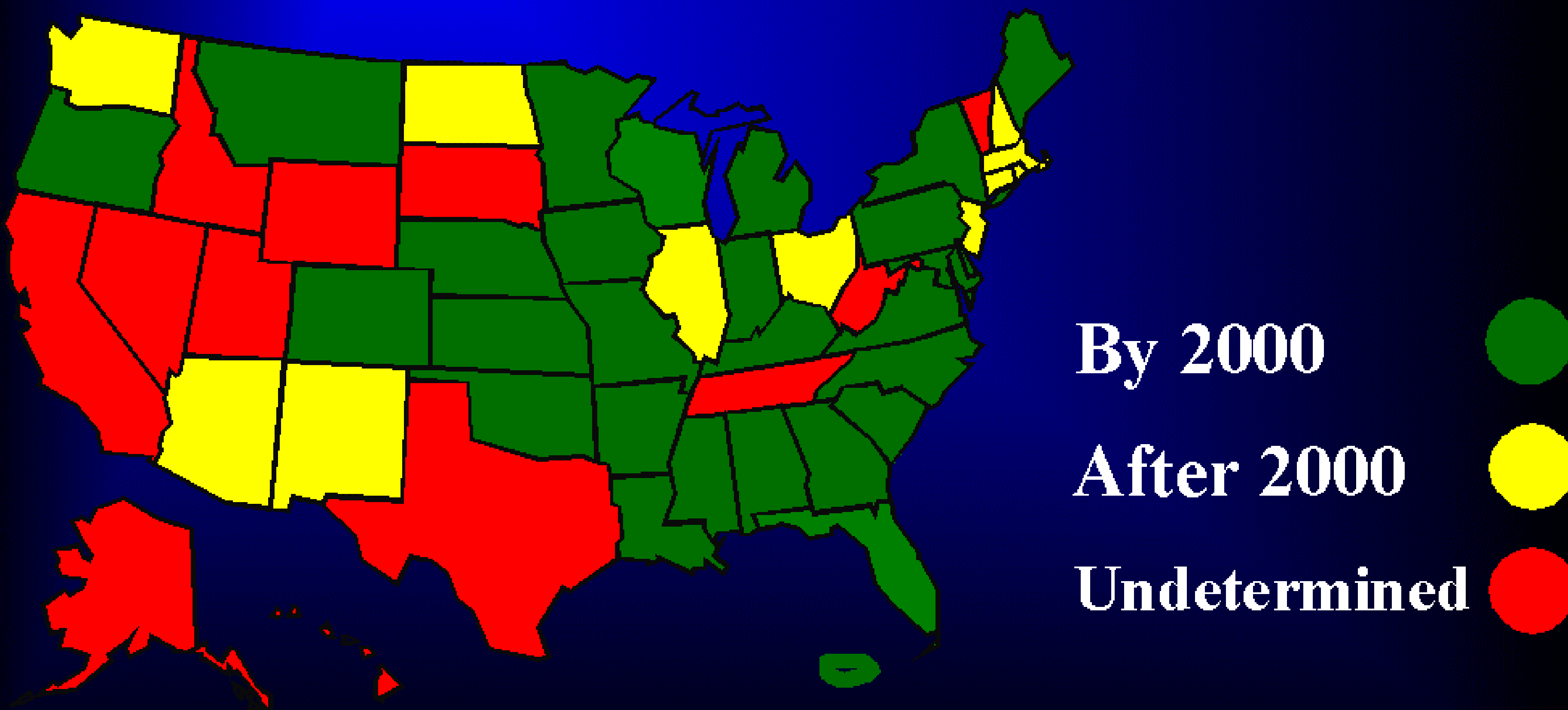
- Actively pursued in United States
  - State agencies
  - FHWA
  - AASHTO
  - Lead States Team
- 1998 Implementation Survey III
  - 45% by tonnage, 40% of projects at SHA in 1999
  - In 2001, projection of 134 M tonnes (83% of HMA tonnage)

Superpave Binder Implementation



FLORIDA - INDIANA - MARYLAND - NEW YORK - TEXAS - UTAH
AASHTO
Implementation Assistance
FHWA
SUPERPAVE LEAD STATES

Superpave Mixture Implementation



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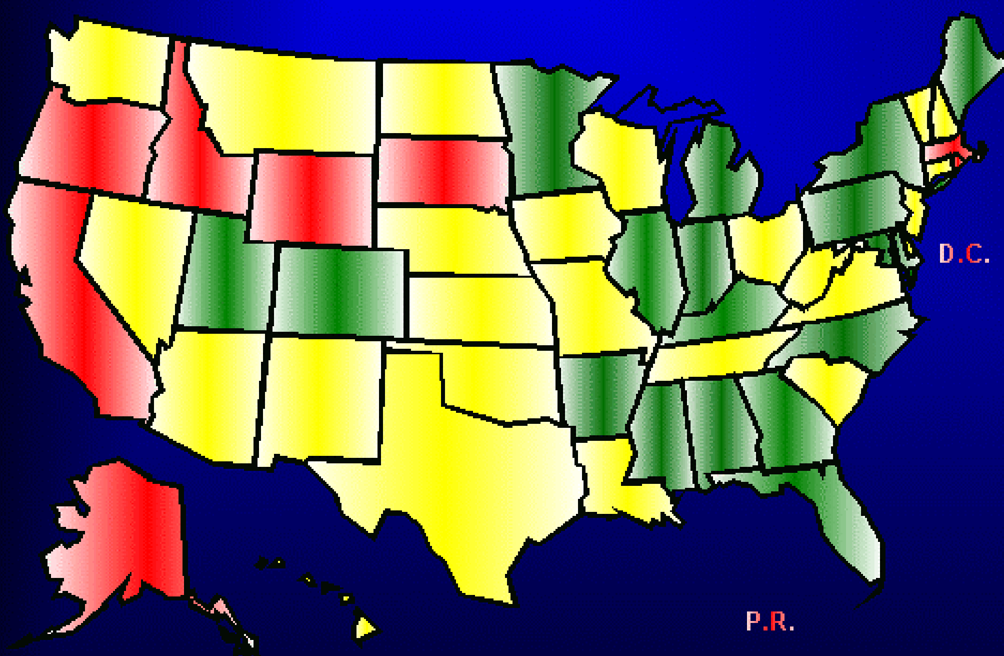
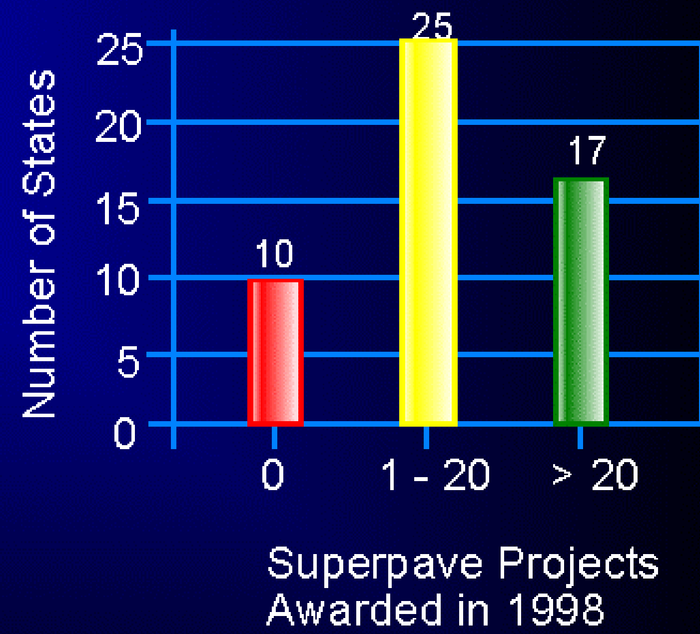
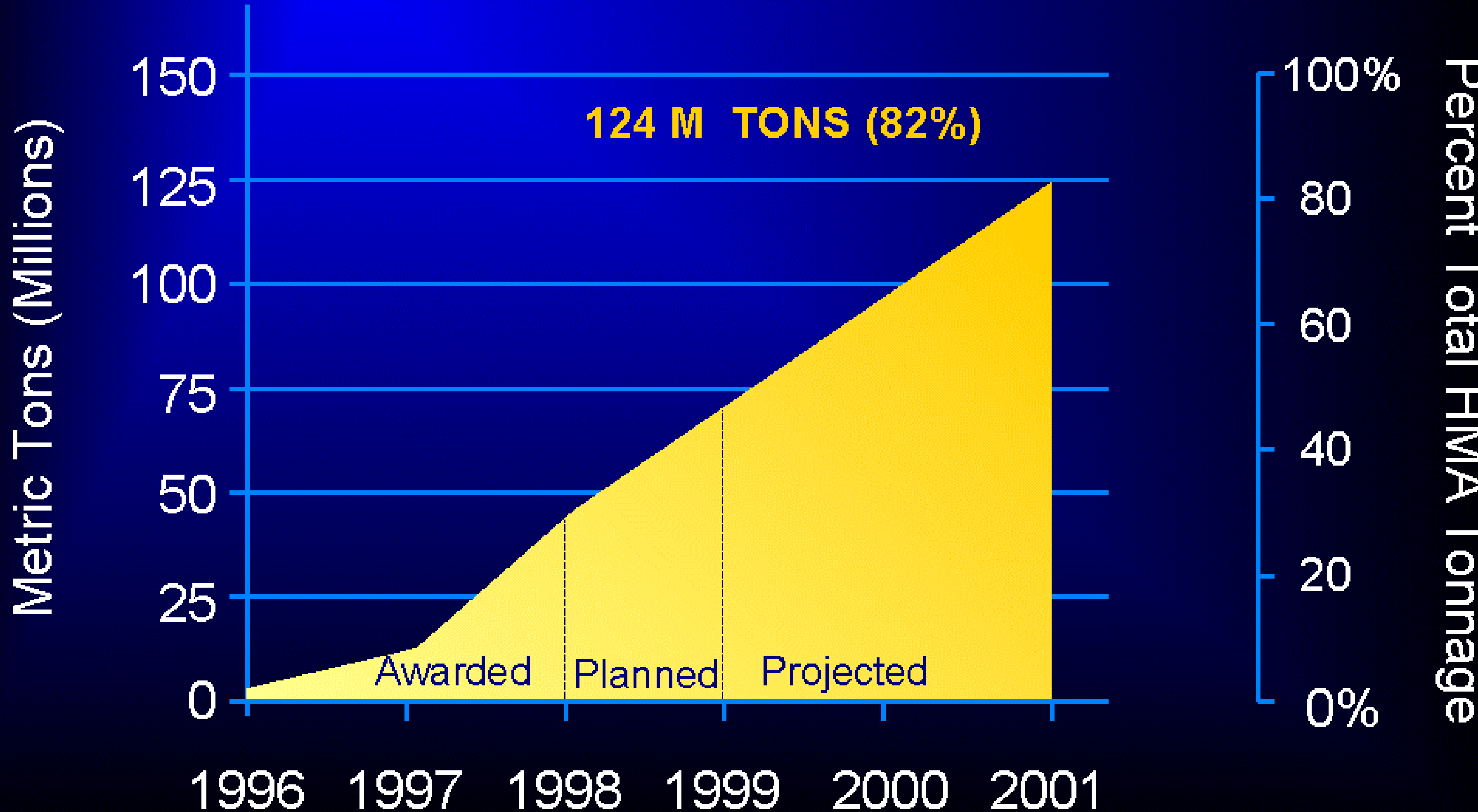
Superpave Project Distribution

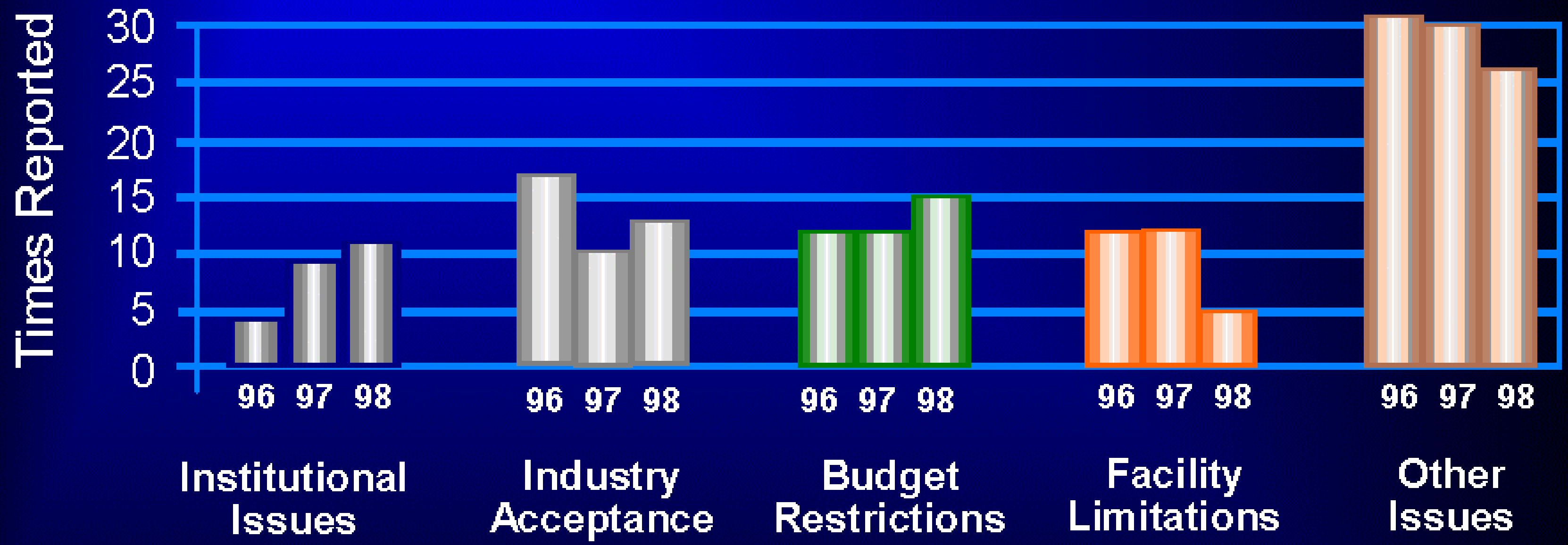




Projected Superpave Tonnage



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

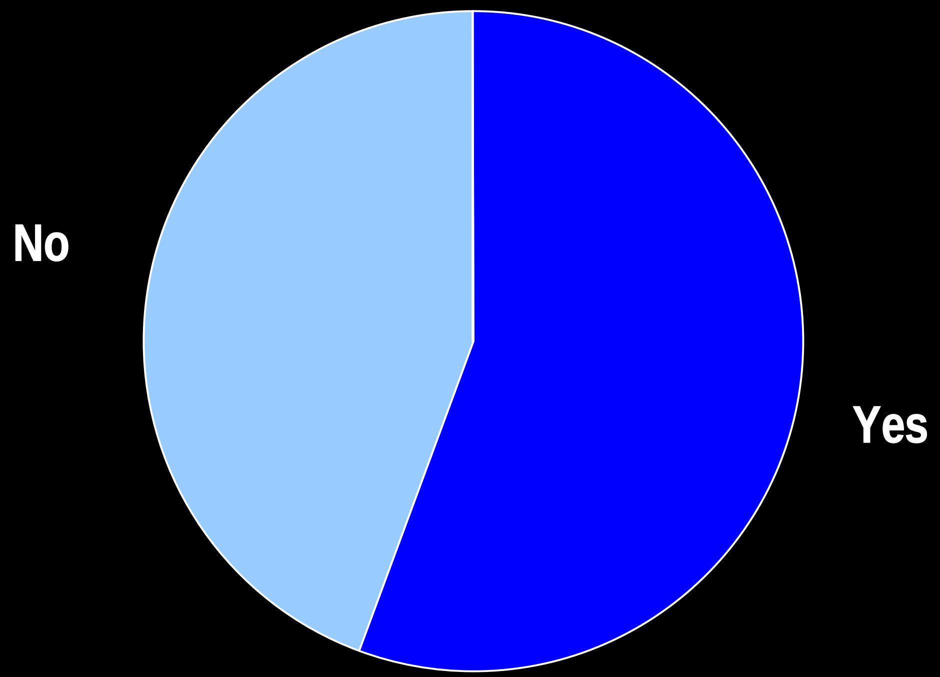
Trial Projects

- 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?