New Jersey Solutions to Complex Paving Challenges

- **Presented by:**
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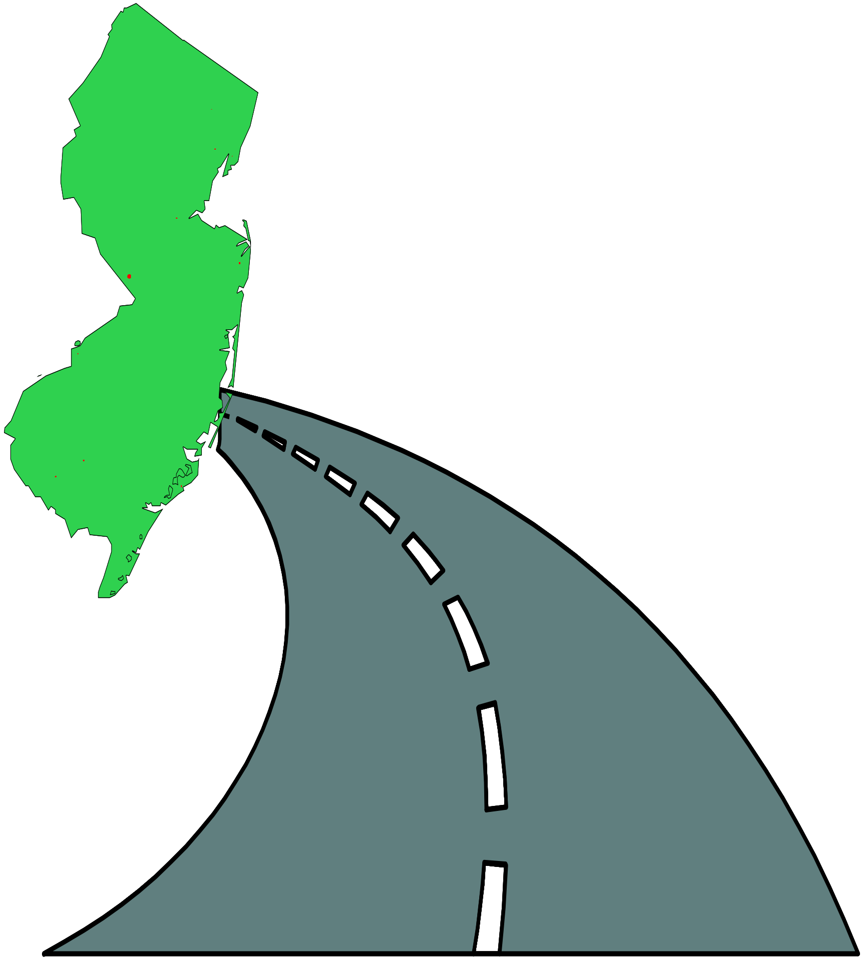
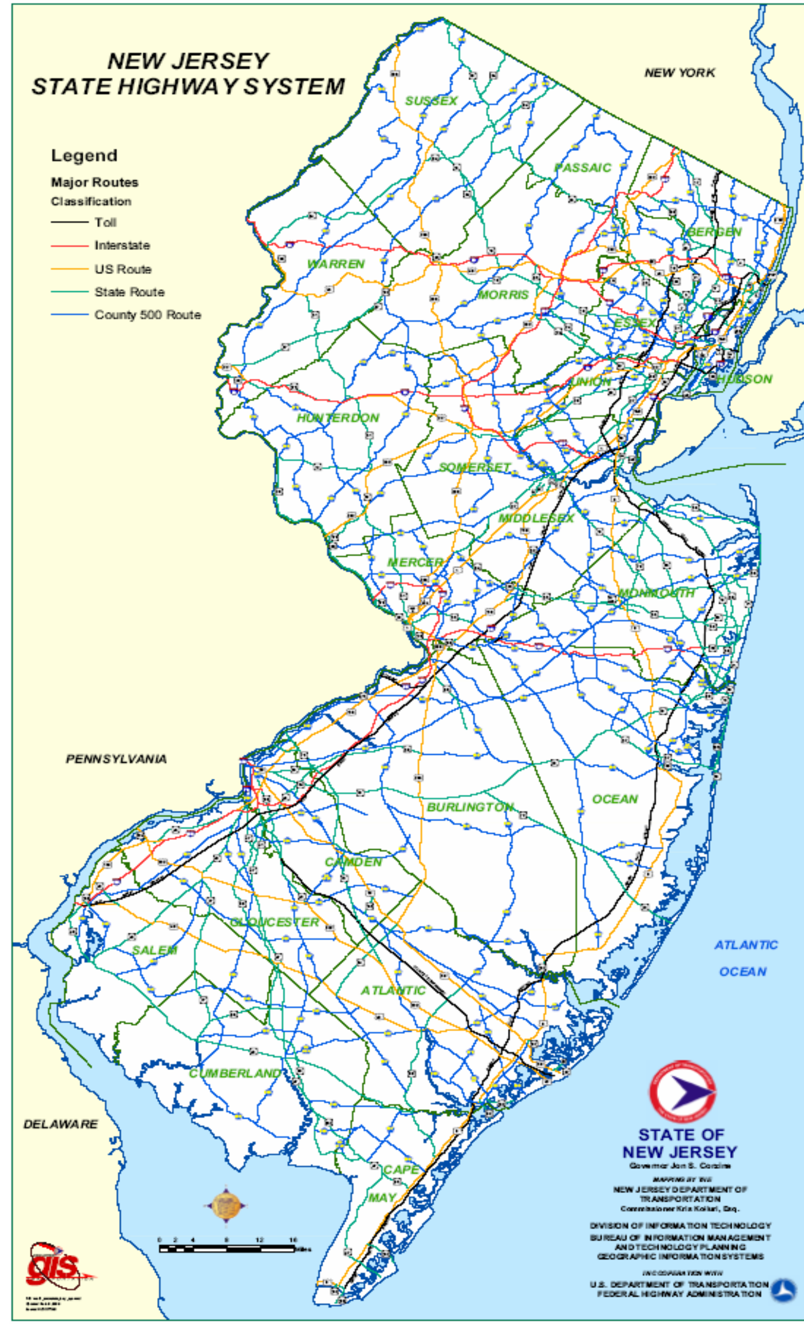
- Pavement Design and Pavement Management
- Design Services Division
- NJ Dept of Transportation



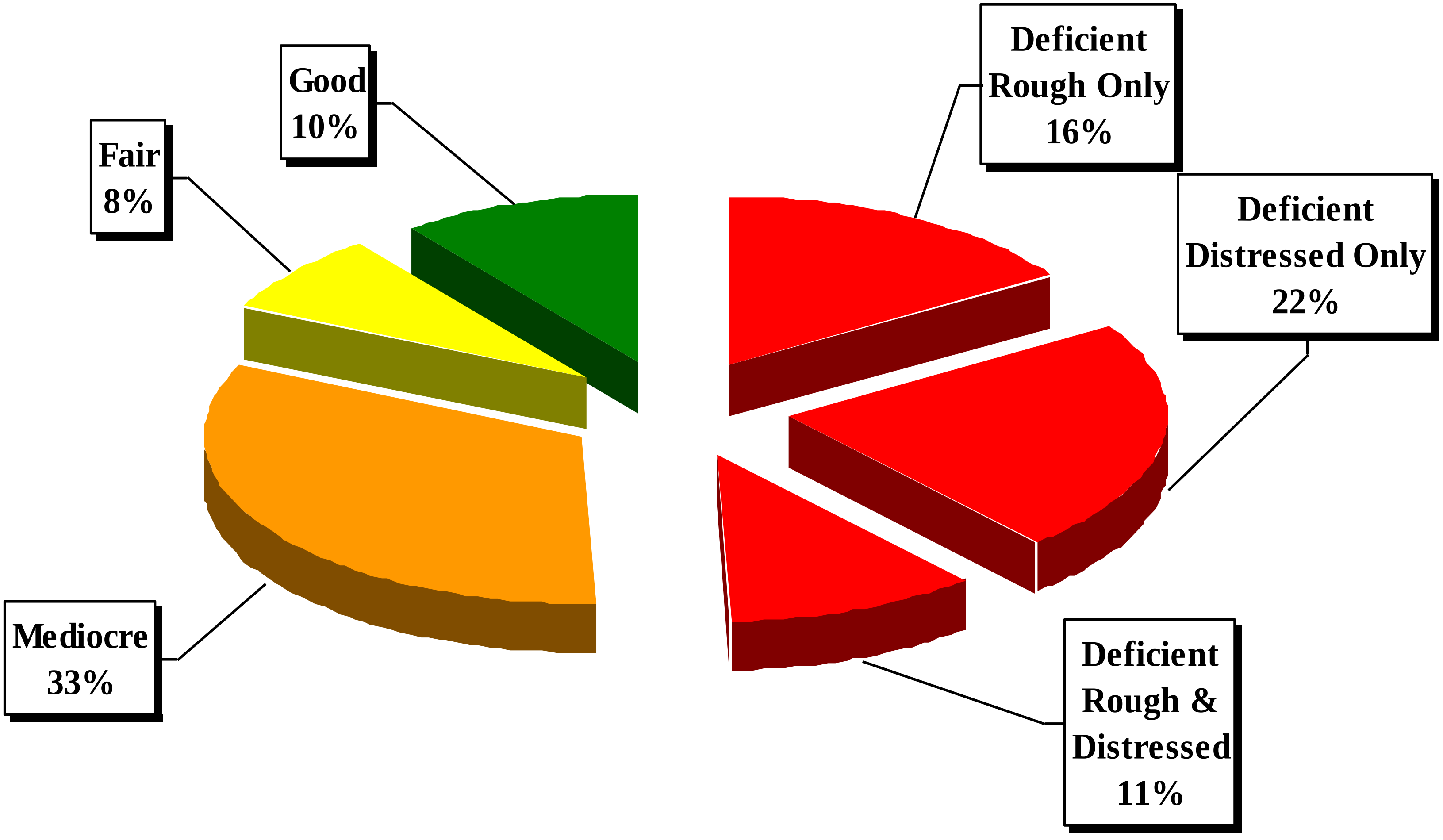
- **Presented to:**
- AMAP Annual Meeting
- Boston, February 2007

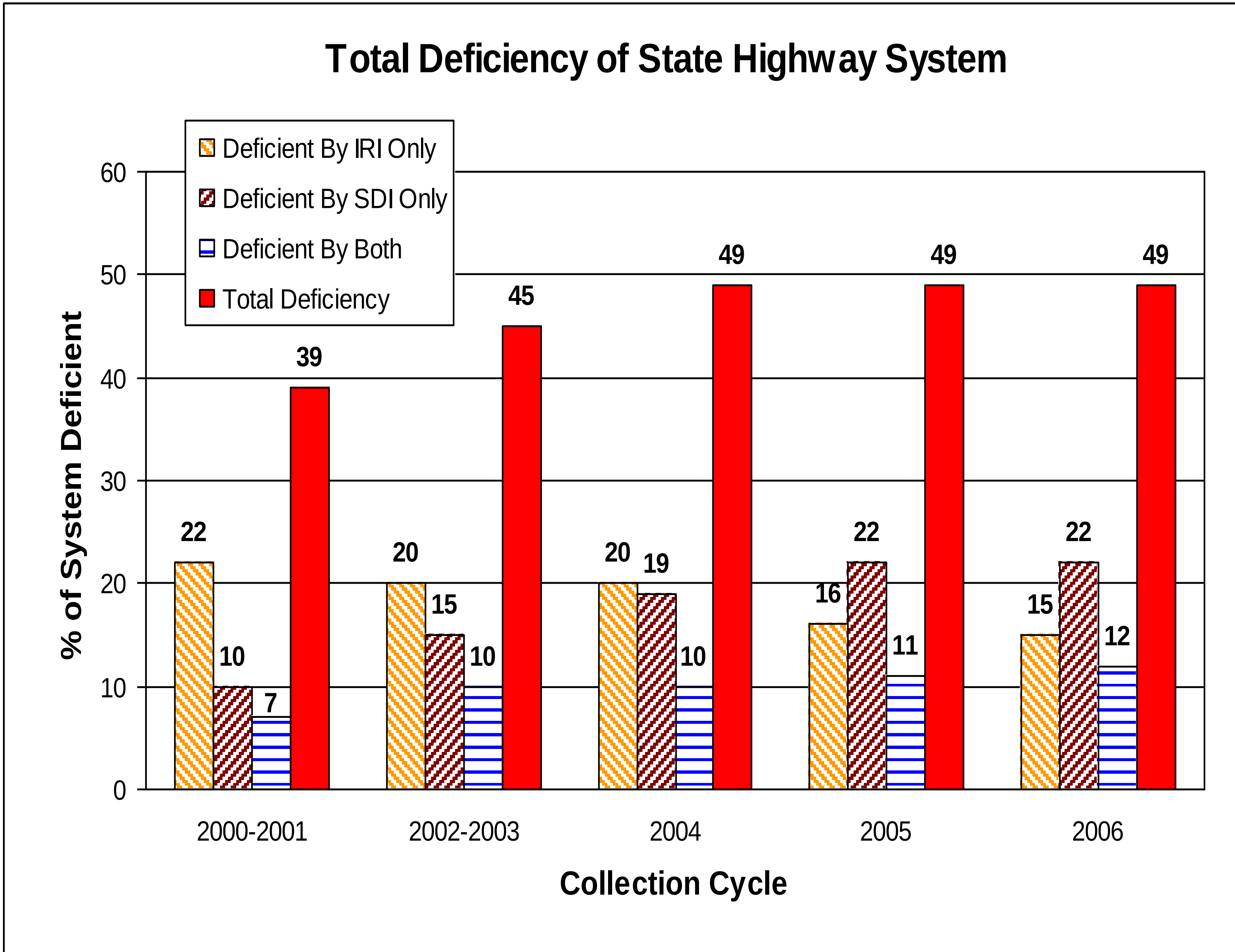

80
70
60
50
40
30
20
10
0
% With Deficient Smoothr
1996 1997 1998 1999 2001 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Fiscal Year
Reduce Funding by 33%
Continue Current Funding
Increase Funding by $100M/Yr
Reduce Half Deficient Backlog Using $290M/Yr
History
DEPARTMENT OF TRANSPORTATION
THE STATE OF NEW JERSEY

- Approximately 36,000 centerline miles of roadways in New Jersey
- NJDOT maintains approximately 2,344 centerline miles, 6% of total
- Two-thirds of all traffic, including a high percentage of heavy trucks, is carried on state-owned roads

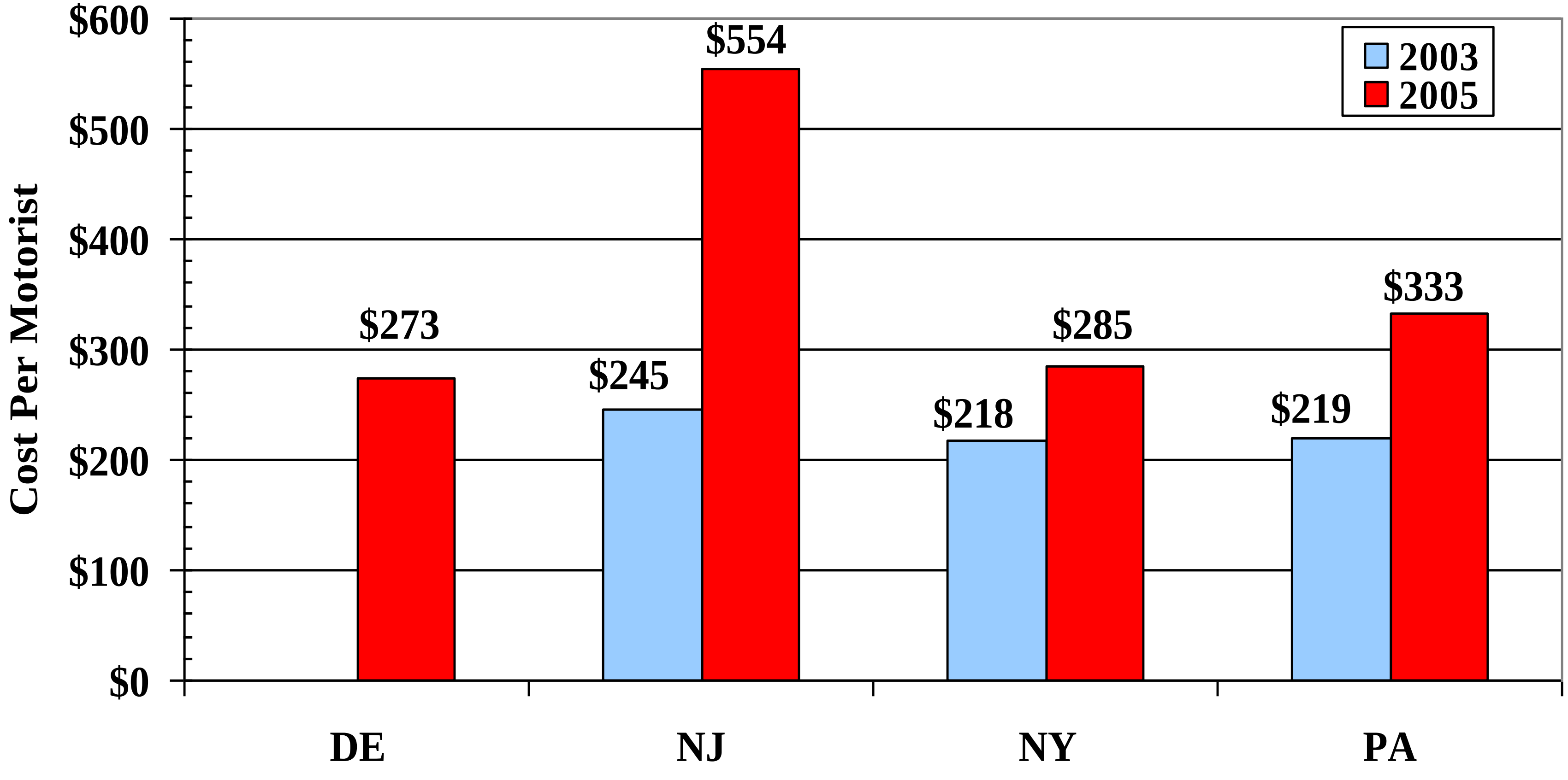


Current Functional Adequacy of NJ State Highway System
(Based on Roughness and Distress)



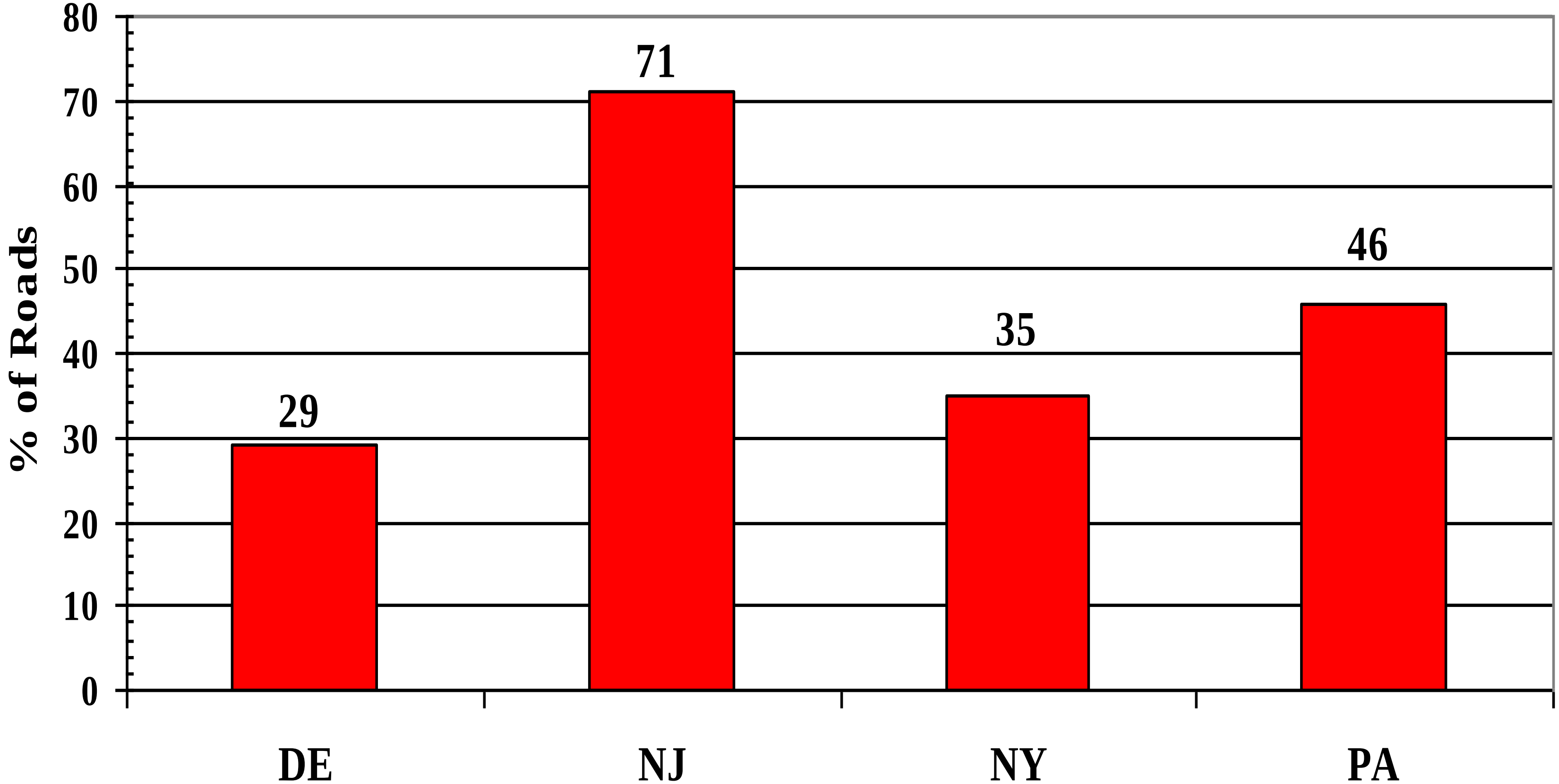

Total Deficiency of State Highway System
Deficient By IRI Only
Deficient By SDI Only
Deficient By Both
Total Deficiency
% of System Deficient
60
50
40
30
20
10
0
22
10
7
39
20
15
10
45
20
19
10
49
16
22
11
49
15
22
12
49
2000-2001
2002-2003
2004
2005
2006
Collection Cycle

ASCE's Costs Per Motorist in Extra Vehicle Repairs and Operating Costs Due to Poor Road Conditions

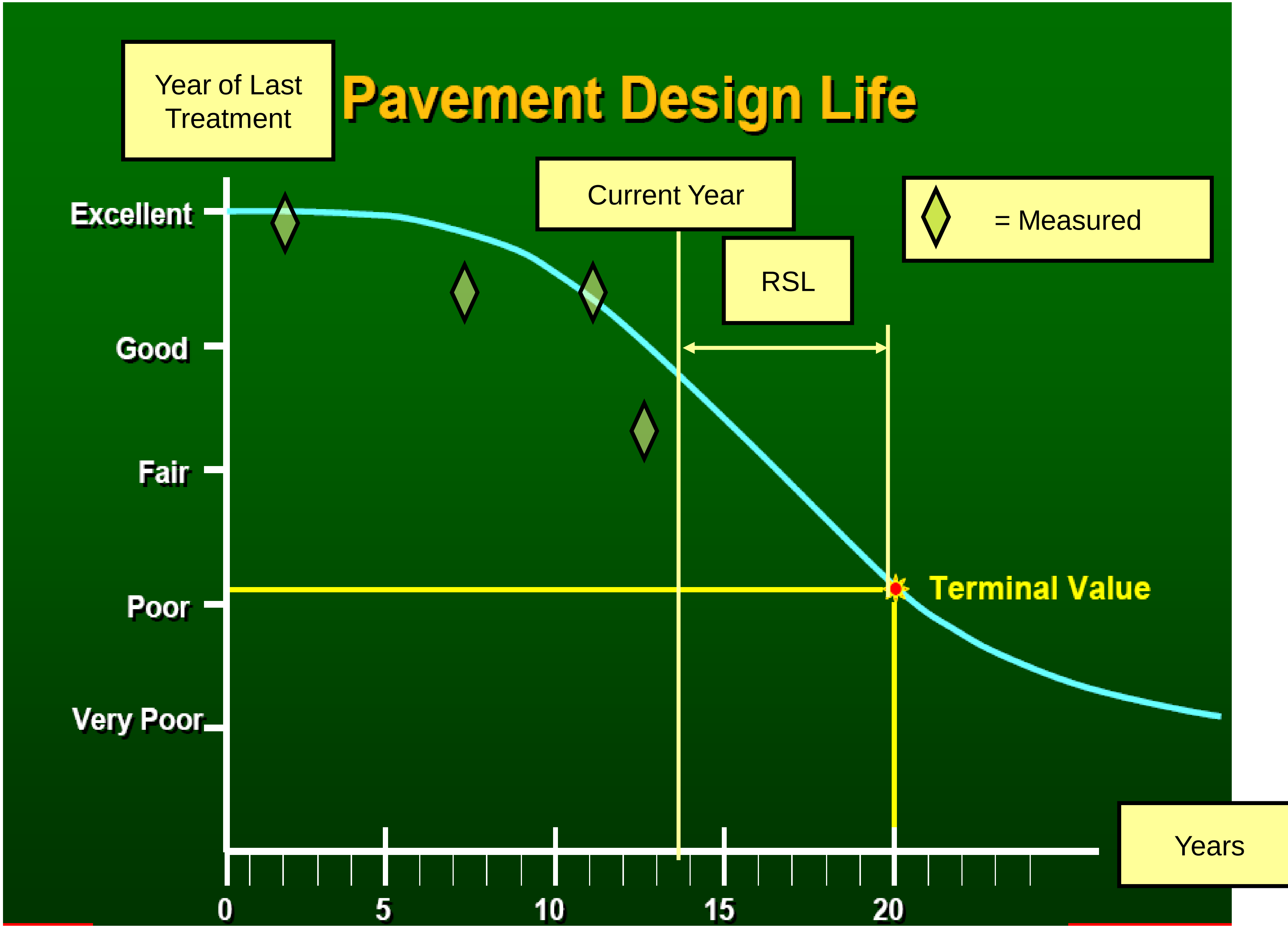


Source: ASCE, 2005 Report Card for America's Infrastructre

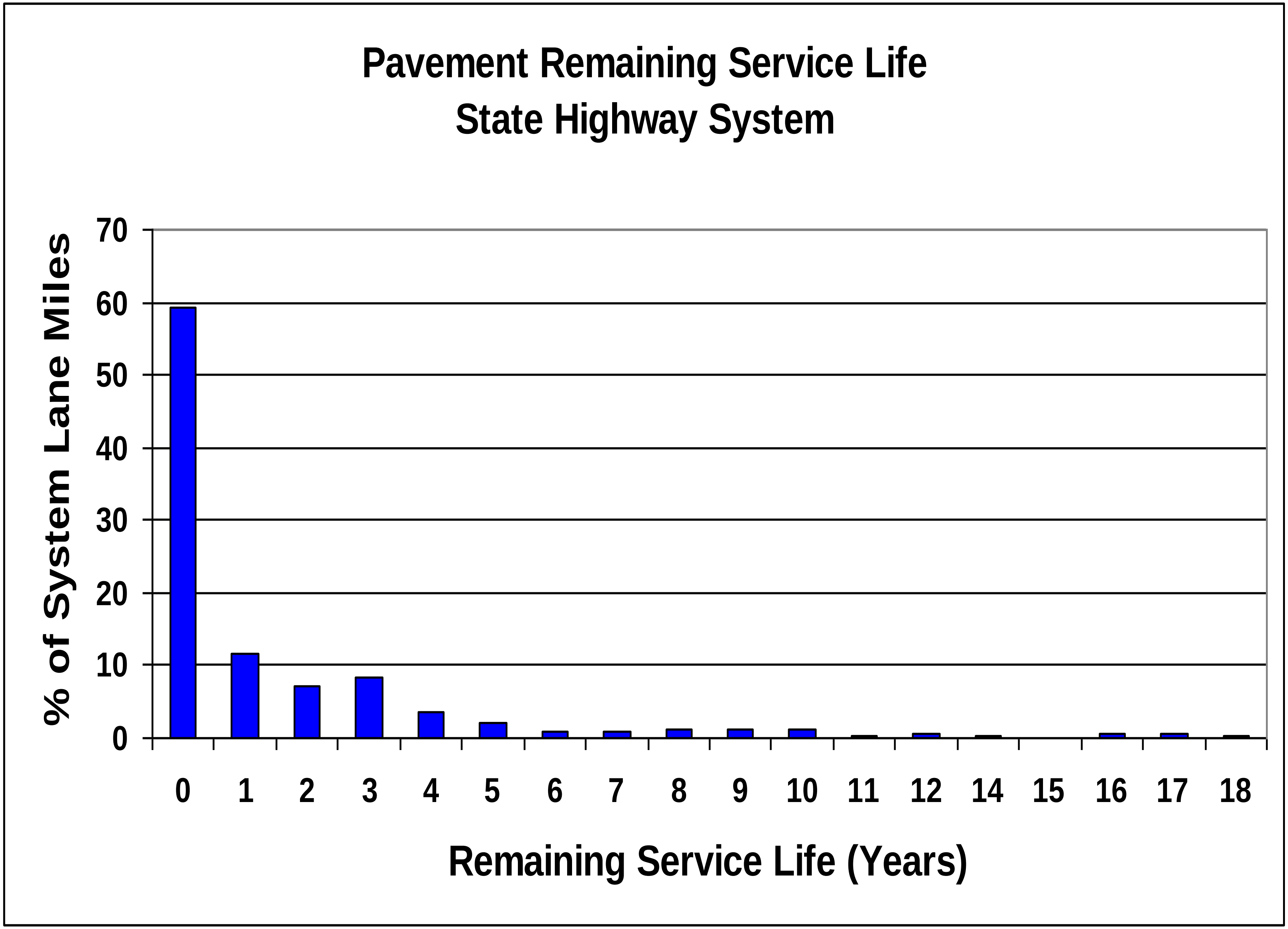
ASCE's % of Major Roads in Poor or Mediocre Condition



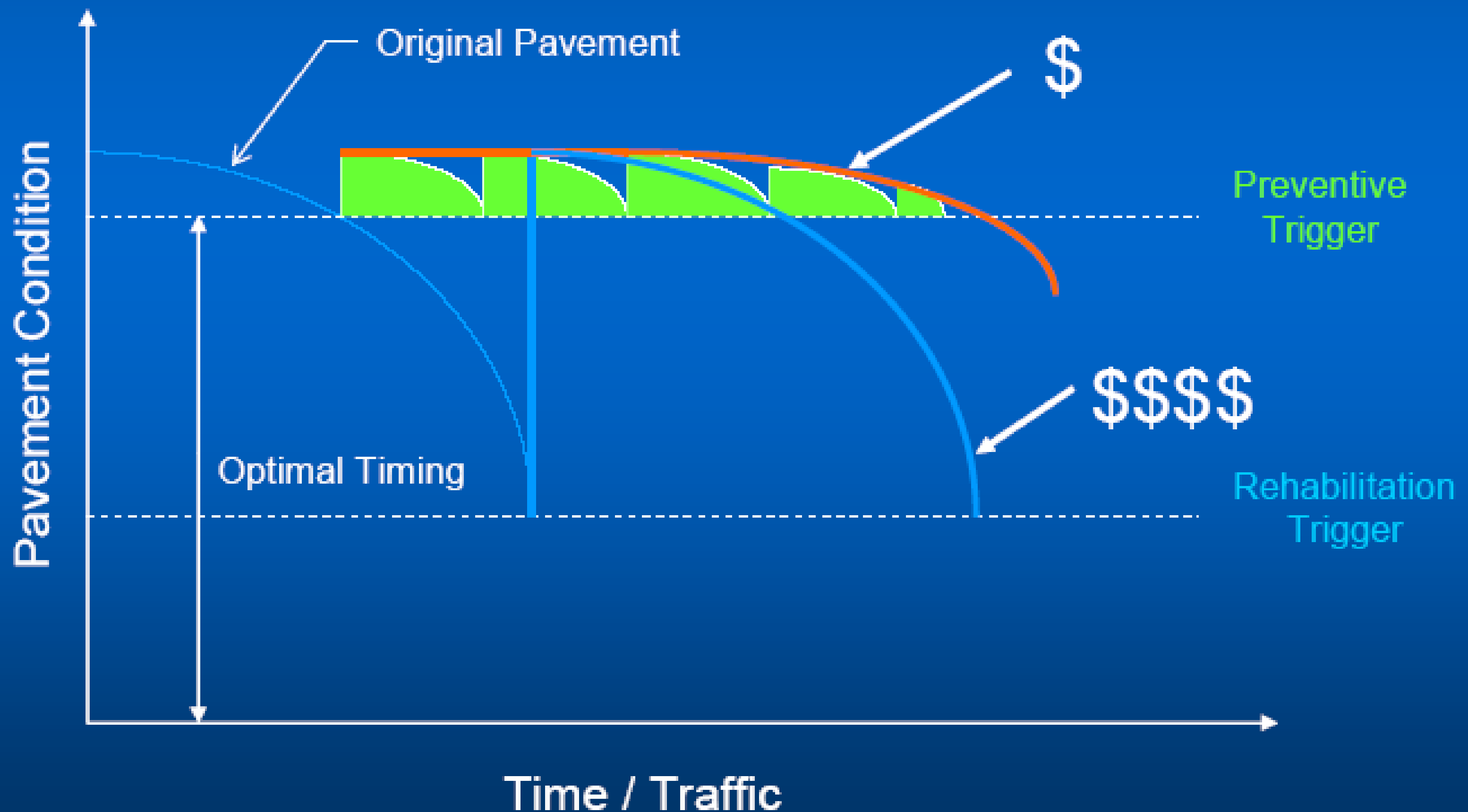
Source: ASCE, 2005 Report Card for America's Infrastructre



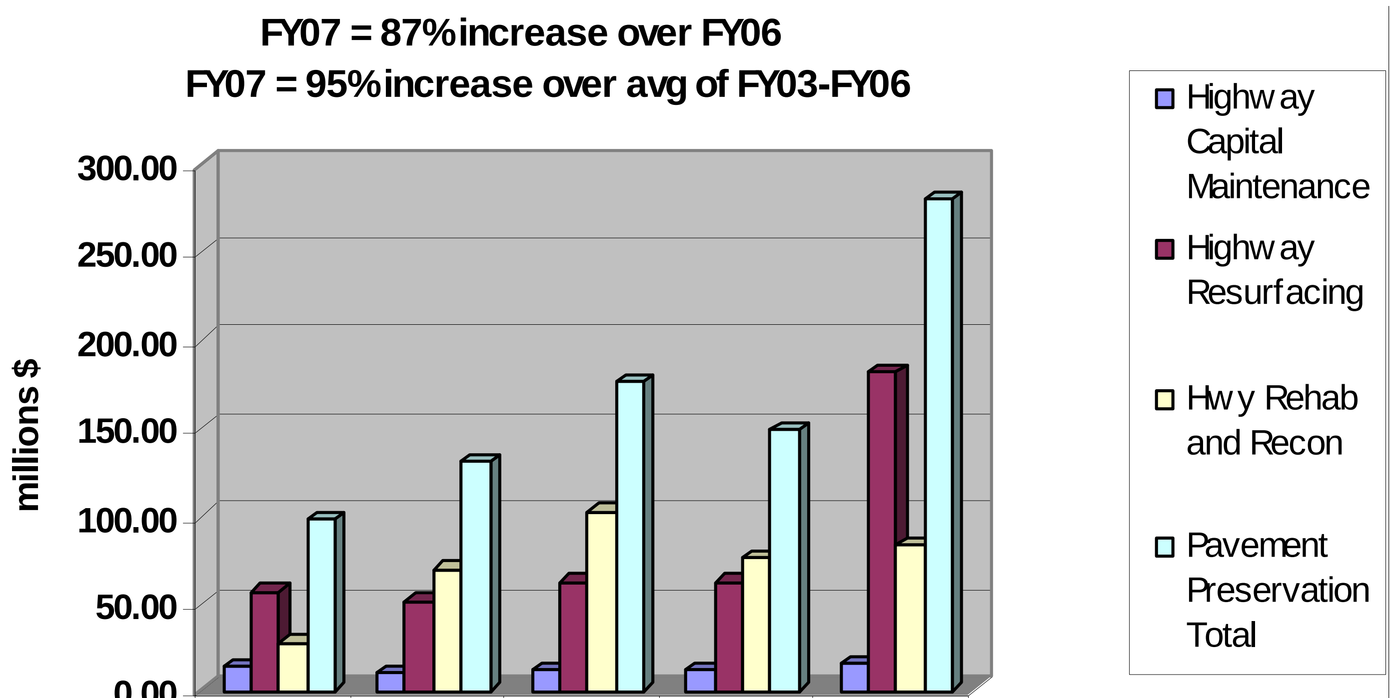
Year of Last Treatment
Pavement Design Life
Current Year
= Measured
RSL
Excellent
Good
Fair
Poor
Very Poor
Terminal Value
Years
0
5
10
15
20


Pavement Remaining Service Life
State Highway System
% of System Lane Miles
70
60
50
40
30
20
10
0
0
1
2
3
4
5
6
7
8
9
10
11
12
14
15
16
17
18
Remaining Service Life (Years)

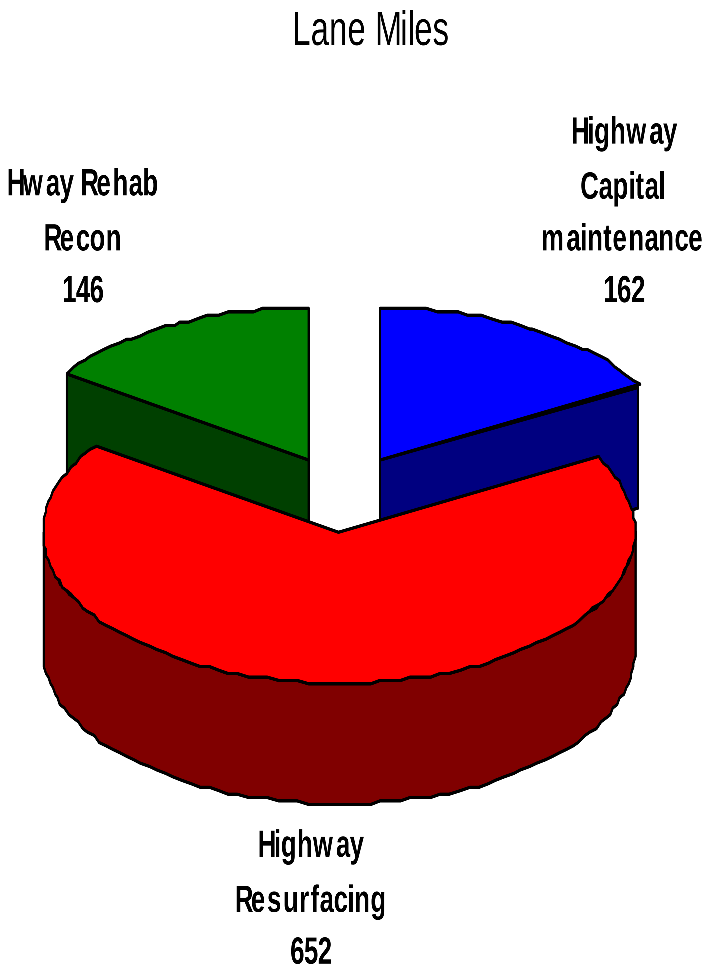
Concept of Pavement Preservation (P^2)



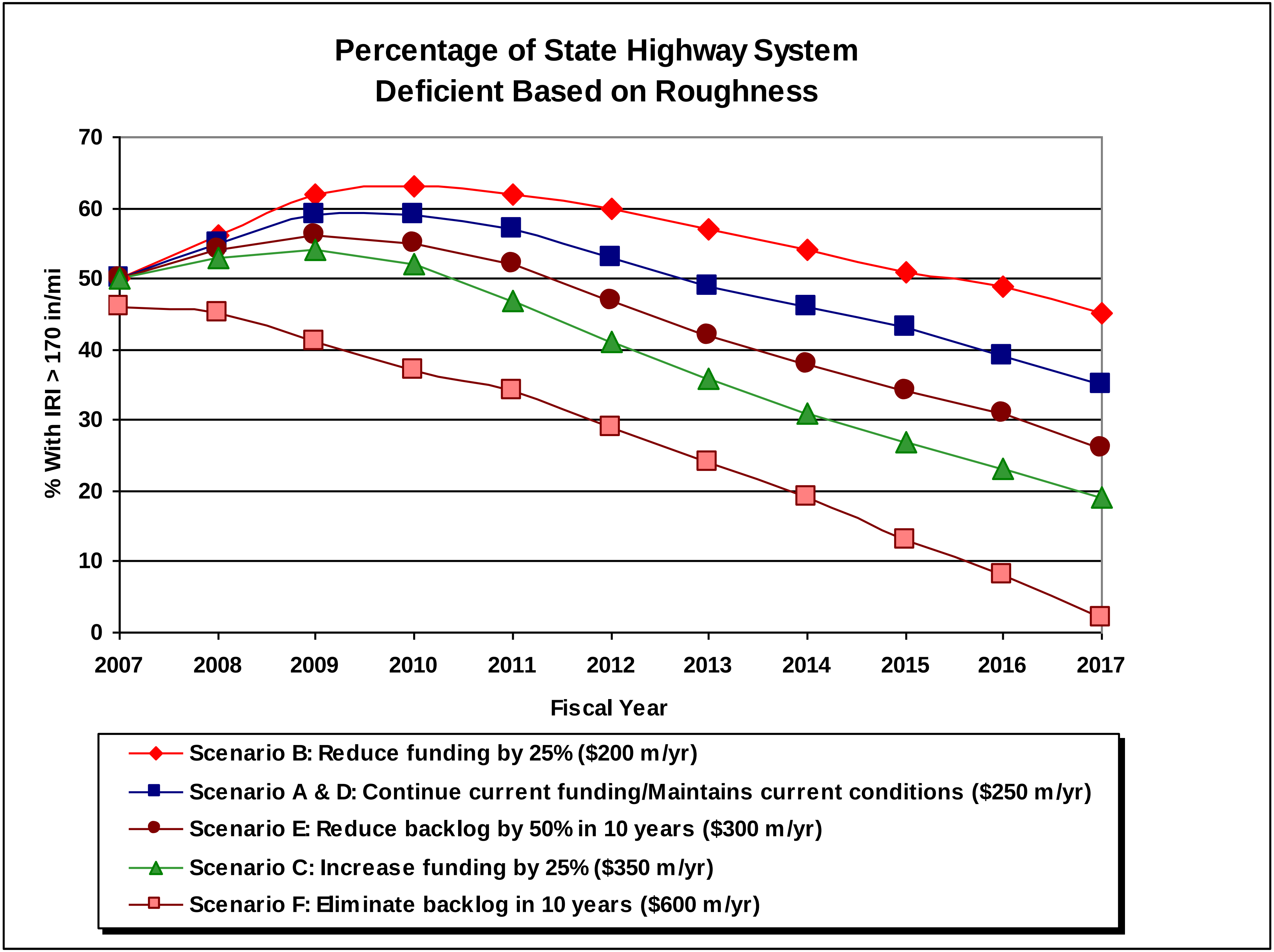
Pavement Preservation Budgets



	FY03	FY04	FY05	FY06	FY07
Highway Capital Maintenance	13.47	10.00	11.30	11.30	15.00
Highway Resurfacing	56.00	51.00	62.00	62.00	180.70
Hwy Rehab and Recon	27.45	69.00	101.70	75.14	83.20
Pavement Preservation Total	96.92	130.00	175.00	148.44	278.90

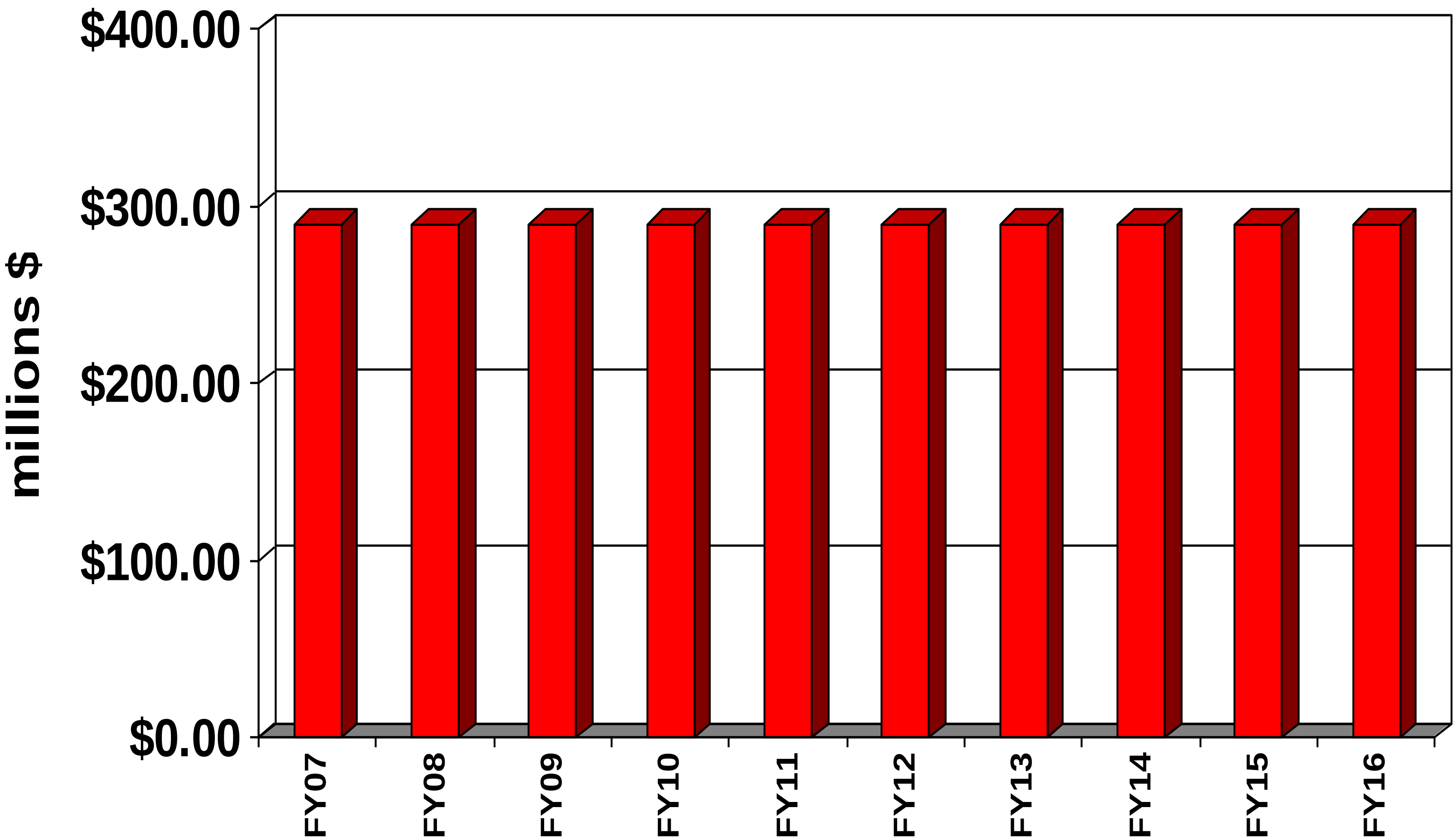


- <u>**Category**</u> <u>**Lane Miles**</u>
- Hwy Capt'l Maint 162
- Hwy Resurfacing 652
- Hwy Rehab Recon <u>146</u>
- **TOTAL = 960**



Percentage of State Highway System
Deficient Based on Roughness
% With IRI > 170 in/mi
0
10
20
30
40
50
60
70
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Fiscal Year
Scenario B: Reduce funding by 25% ($200 m/yr)
Scenario A & D: Continue current funding/Maintains current conditions ($250 m/yr)
Scenario E: Reduce backlog by 50% in 10 years ($300 m/yr)
Scenario C: Increase funding by 25% ($350 m/yr)
Scenario F: Eliminate backlog in 10 years ($600 m/yr)

CIS for Pavement Preservation



- Increasing need to repair and maintain rapidly deteriorating infrastructure leads to:
  - More work zones
  - More public dissatisfaction with work zone traffic congestion, delay and safety

- Facing the challenge of balancing essential roadway repairs and maintenance with mobility and safety concerns
  - Non-traditional construction method to balance essential roadway repairs and maintenance with mobility and safety → Full Road Closure

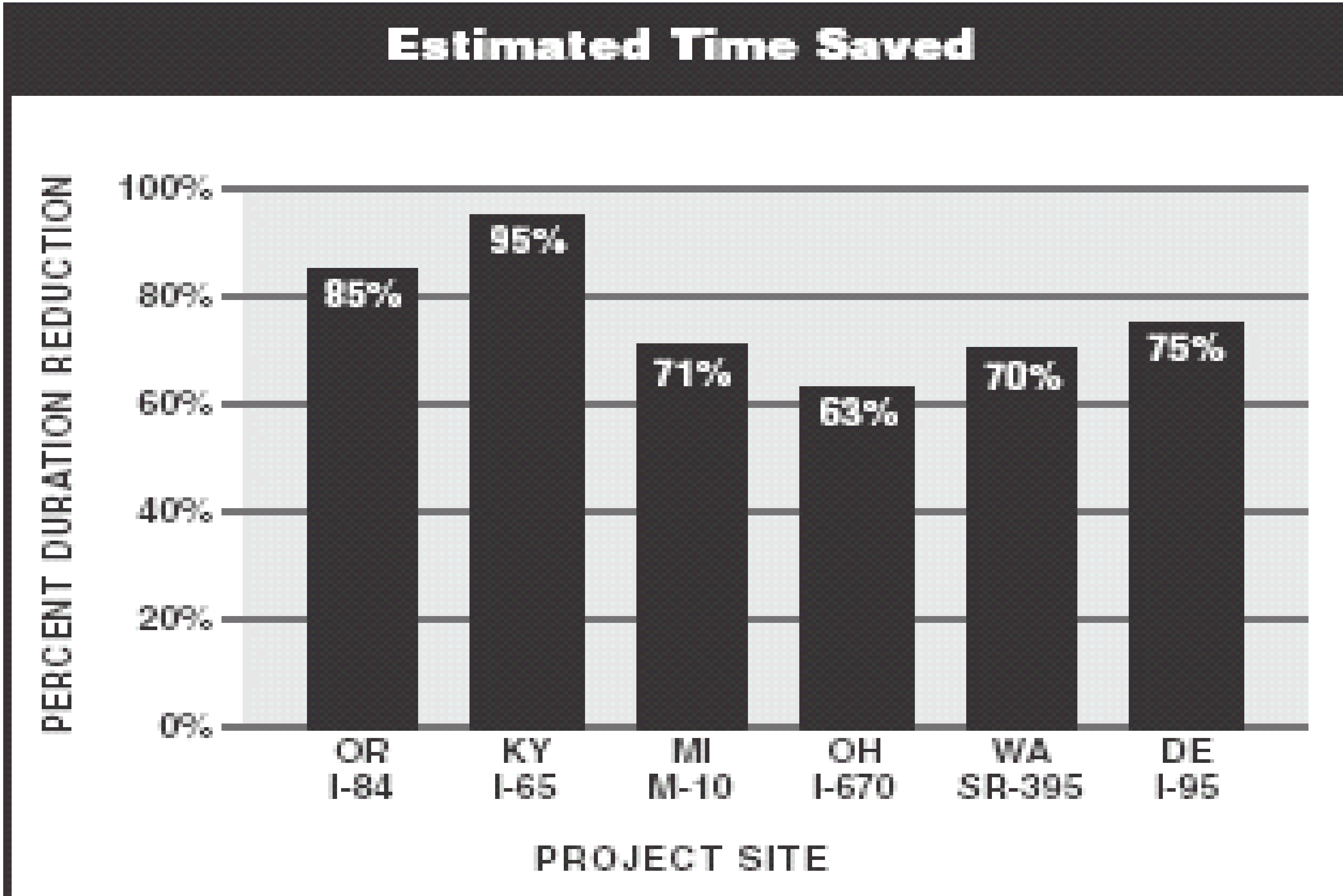
Considerations with Full Road Closure

- Not amendable to all construction situations
  - The availability of adequate alternate routes
- A solid management plan
  - Done on an accelerated schedule
    - Scheduled on a 24-hr. work basis, potential for impacts to local residents are concerned.
    - Ensure all the needs to be met throughout project duration
  - Balance the increased load on the network
    - Increased traffic densities on alternate routes must be assessed, planned for, and managed.

Benefits of Full Closure

- **Reduced project duration**
- **Increased worker productivity**
- **Improved safety**
- **Improved product quality**
- **Positive public sentiment**
- **Increased workspace and flexibility**
- **Reduced Impact on construction travelers**
- **Cost savings**

Full Road Closure Time Savings



Partnership between the NJDOT and Rutgers University:

Pavement Resource Program

Fatigue Studies

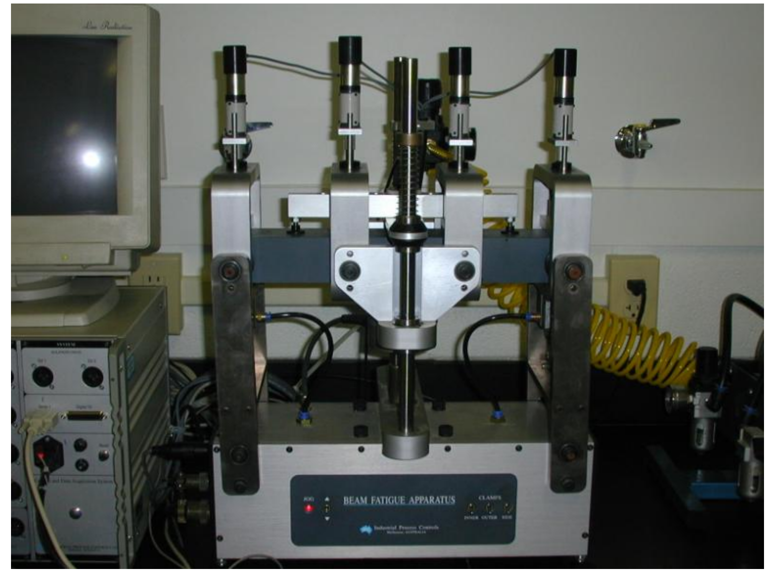
NJ’s 12H76 HMA

Reflective Cracking Studies

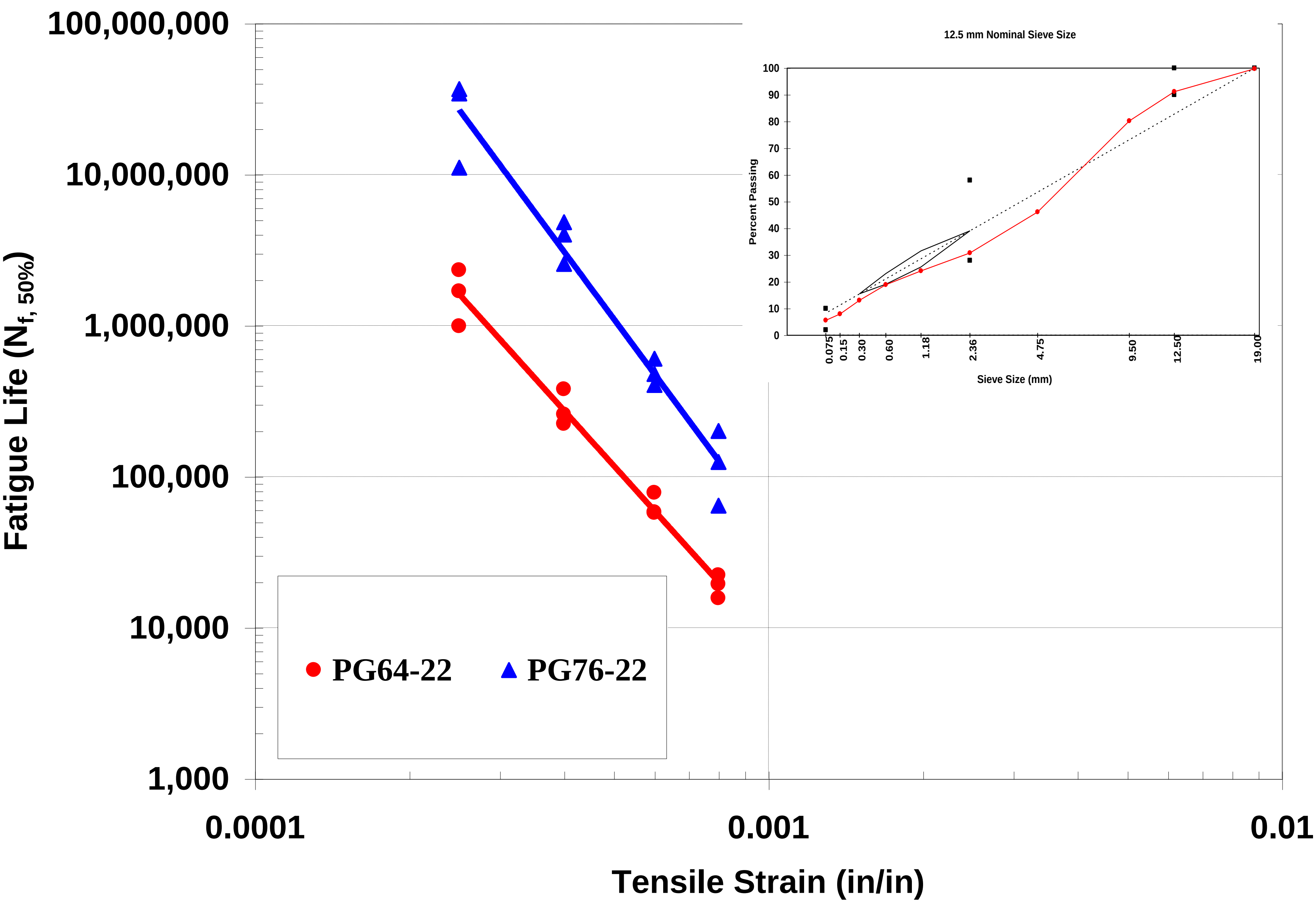
(Research Sections and Rich Bottom Layers)

Flexural Beam Fatigue Device

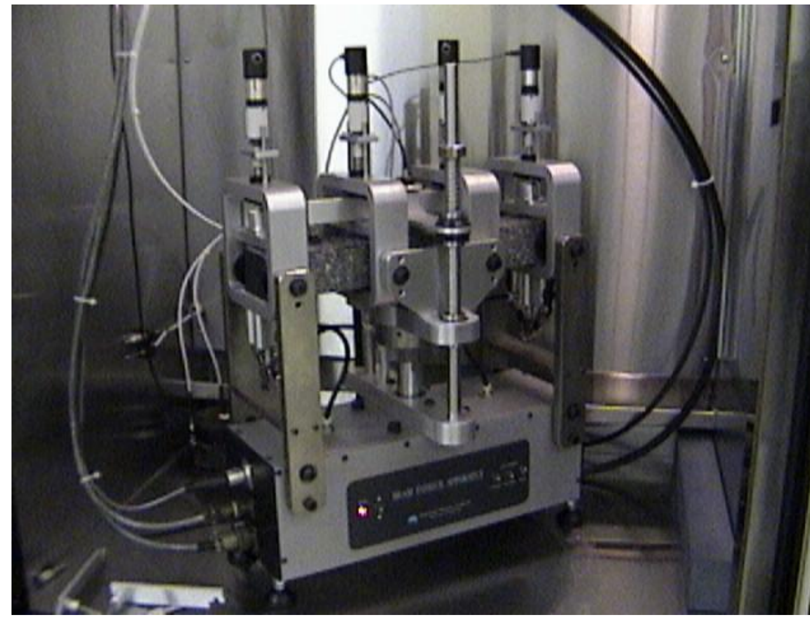
- Evaluate the fatigue properties of HMA compacted beam samples
- Test under variety of stress and strain conditions, as well as temperature



Superpave, 12.5mm (H), 5.1% AC



Determination of Beam Fatigue Deflections (Rt 34N)



Applied Tensile Microstrain

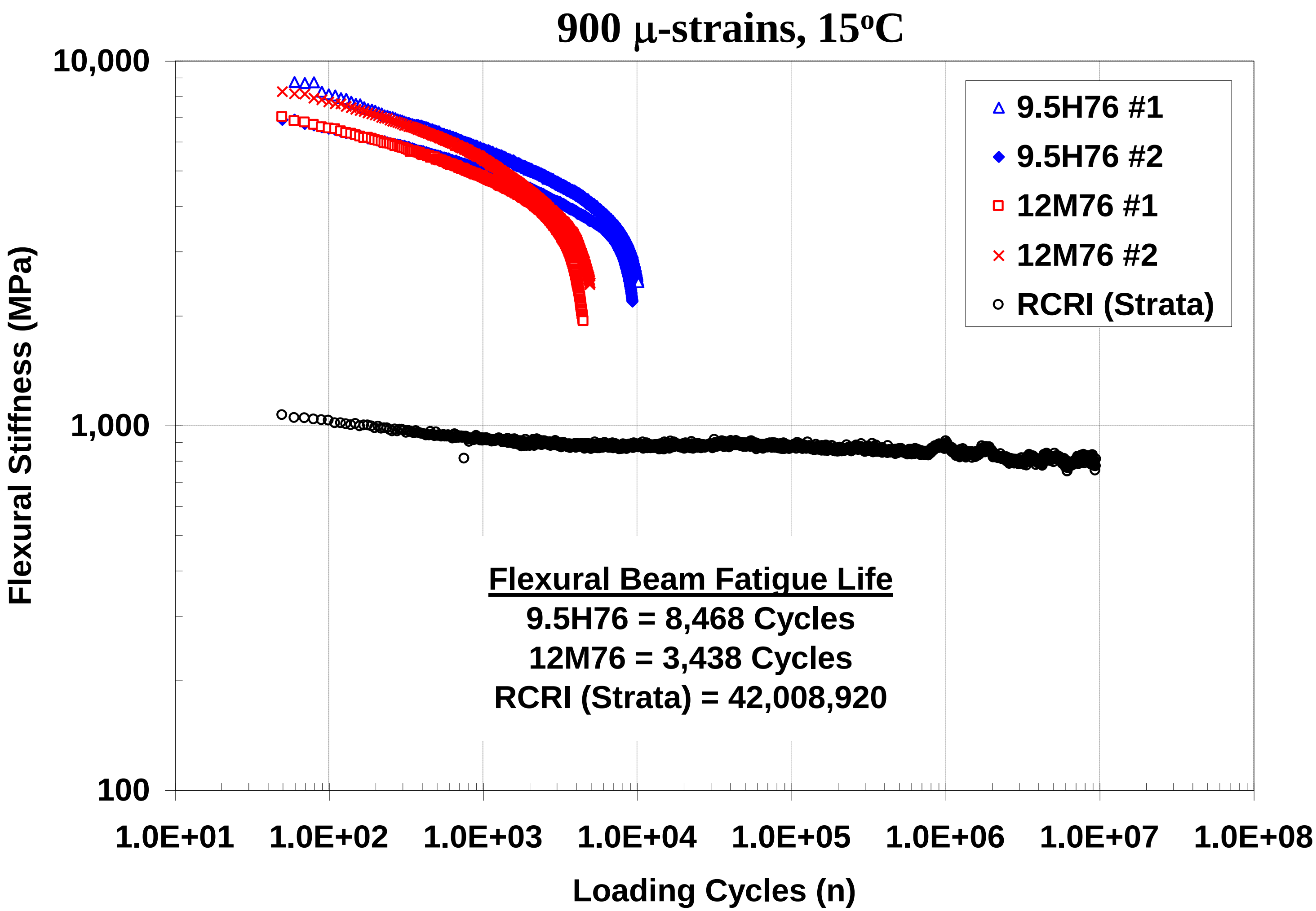
$$\varepsilon_t = \frac{12\,\delta\,h \;\; \mathrm{x}\; 1E6}{(3Go^2 - 4Gi^2)}$$

δ = peak deflection at the center of beam (mm)
h = average beam height (mm)
G_o= Outer gauge length (typically 355.5 mm)
G_i = Inner gauge length (typically 118.5mm)
(ε_t needs to be specified prior to starting test in μ-strains)

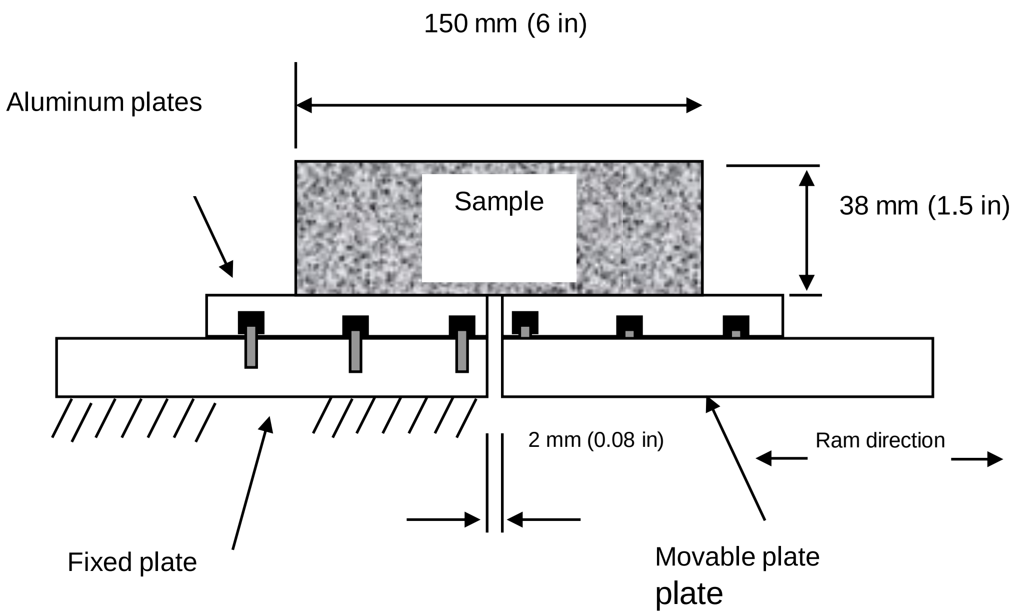
For typical sample – every 0.1 mm of beam deflection ≈ 200 μ-strain
(1 mil = 0.0254 mm)

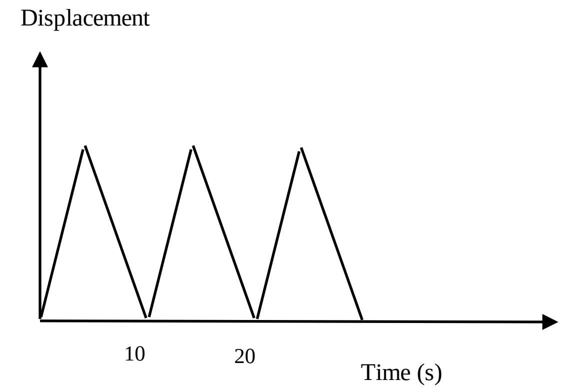
Ex: Rt 34N Largest δ_{max} = 17.3 mils = 817 μ-strains

Flexural Beam Fatigue – Modeled Joint Deflections of Rt 34N



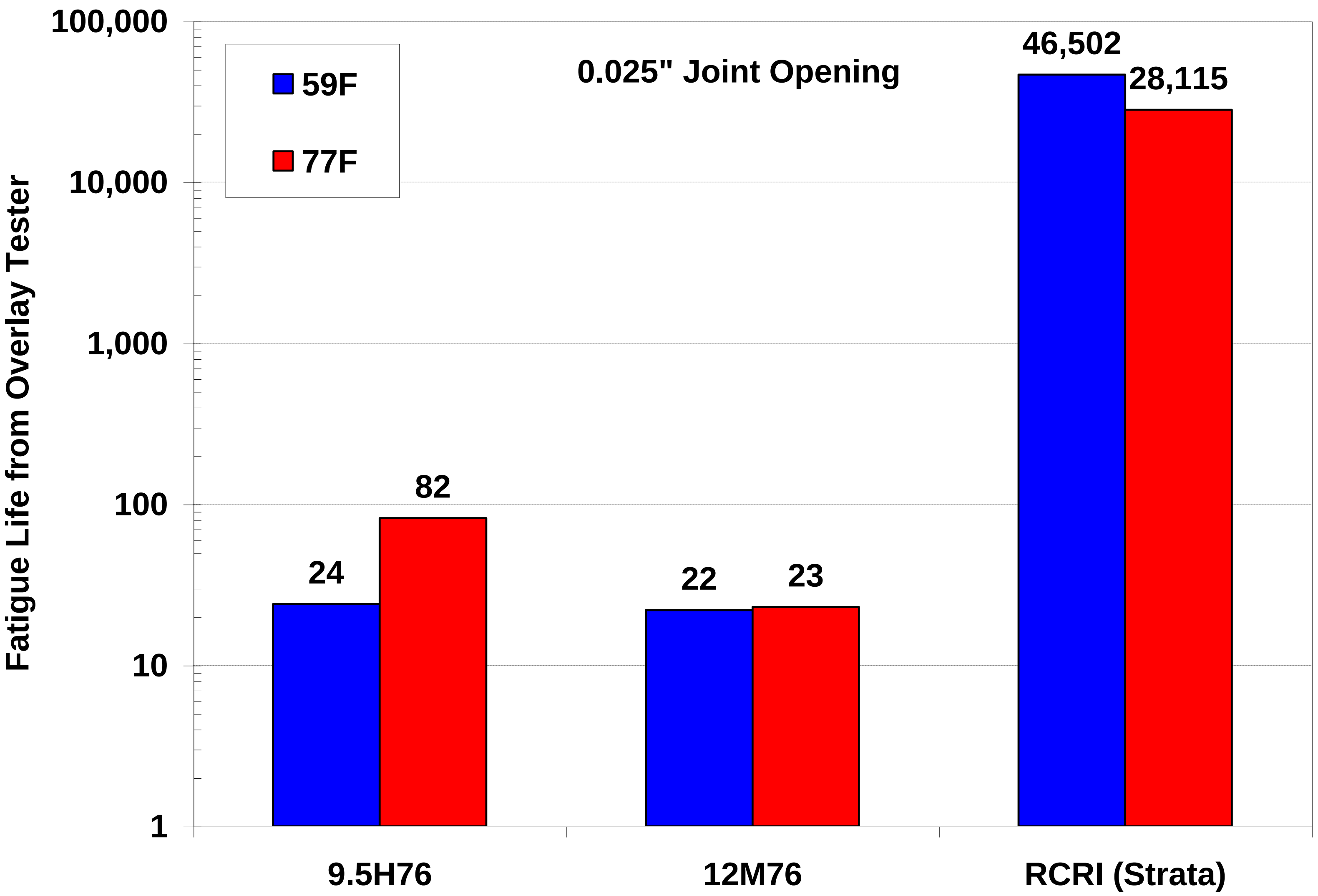
Overlay Tester



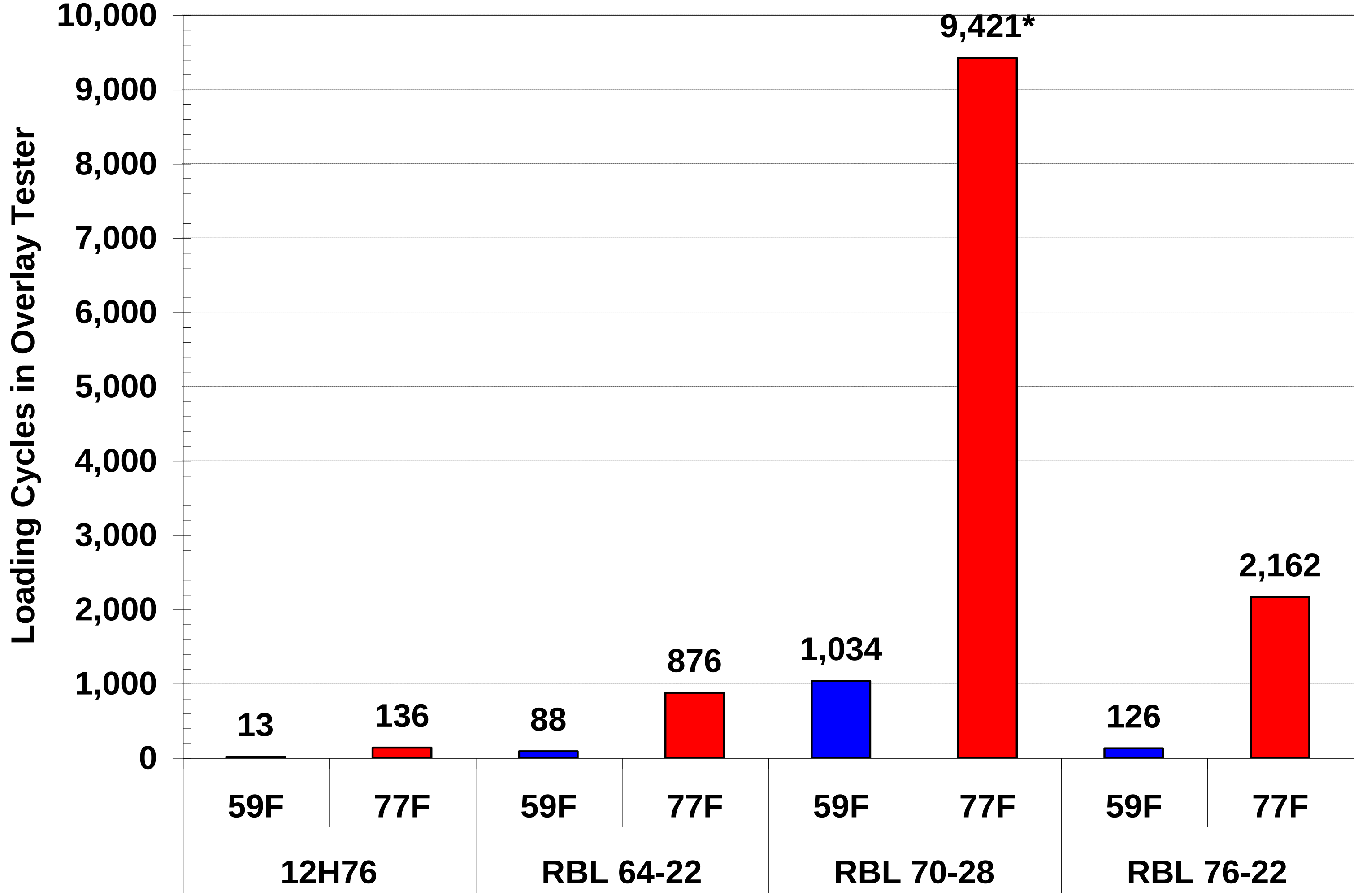


- Sample size: 6'' long by 3'' wide by 1.5'' high
- Loading: Continuously triangular displacement 5 sec loading and 5 sec unloading
- Standard Test Conditions (TxDOT)
  - Opening displacement: 0.025 in.
  - Room temperature: 77 F
- Definition of failure
  - Discontinuity in Load vs Displacement curve
  - Visible crack on surface

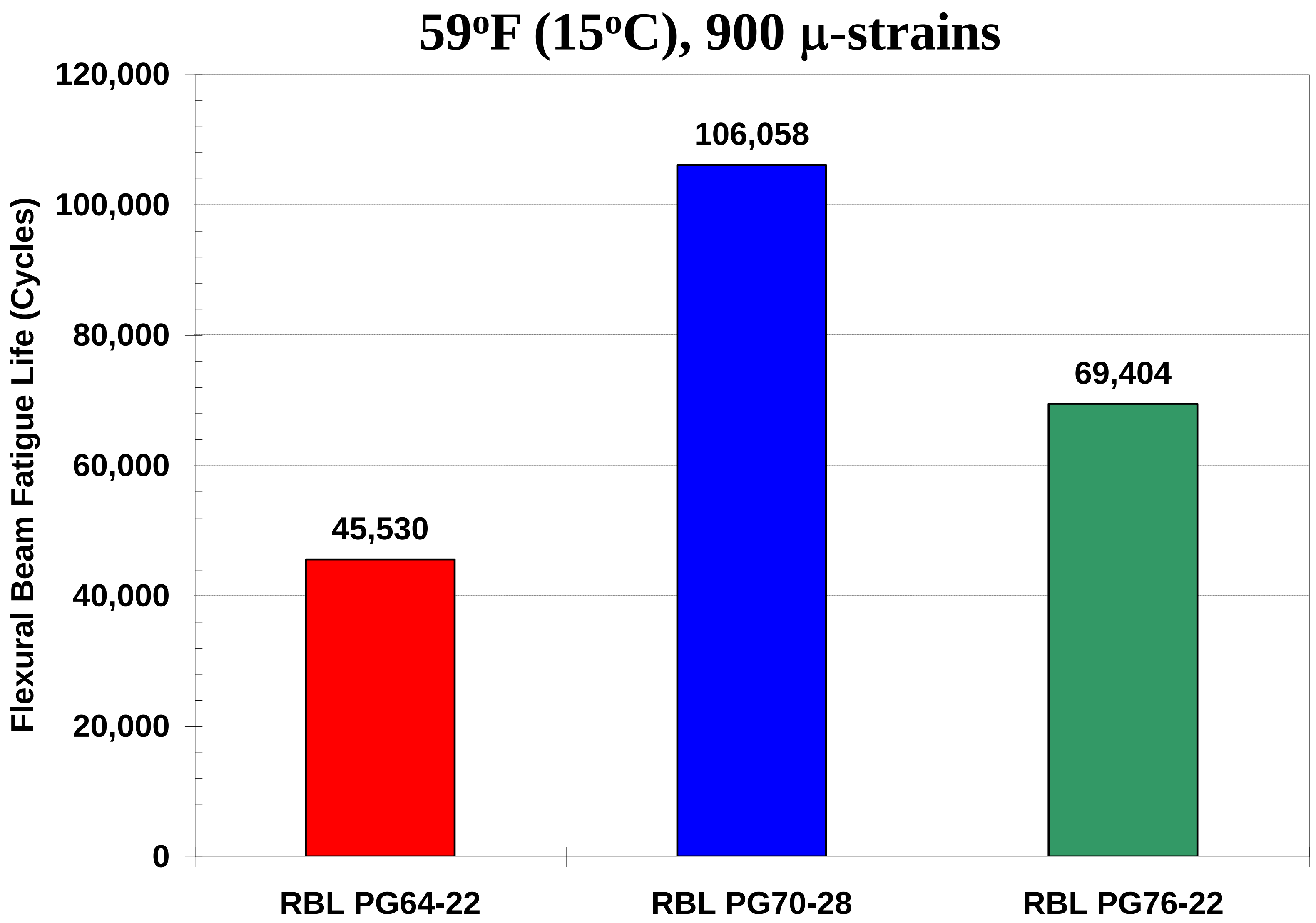
Overlay Tester (Modeled Rt 34N Horizontal Joint Movement)



Rich Bottom Layers (Anti-Reflective Cracking) – Overlay Tester



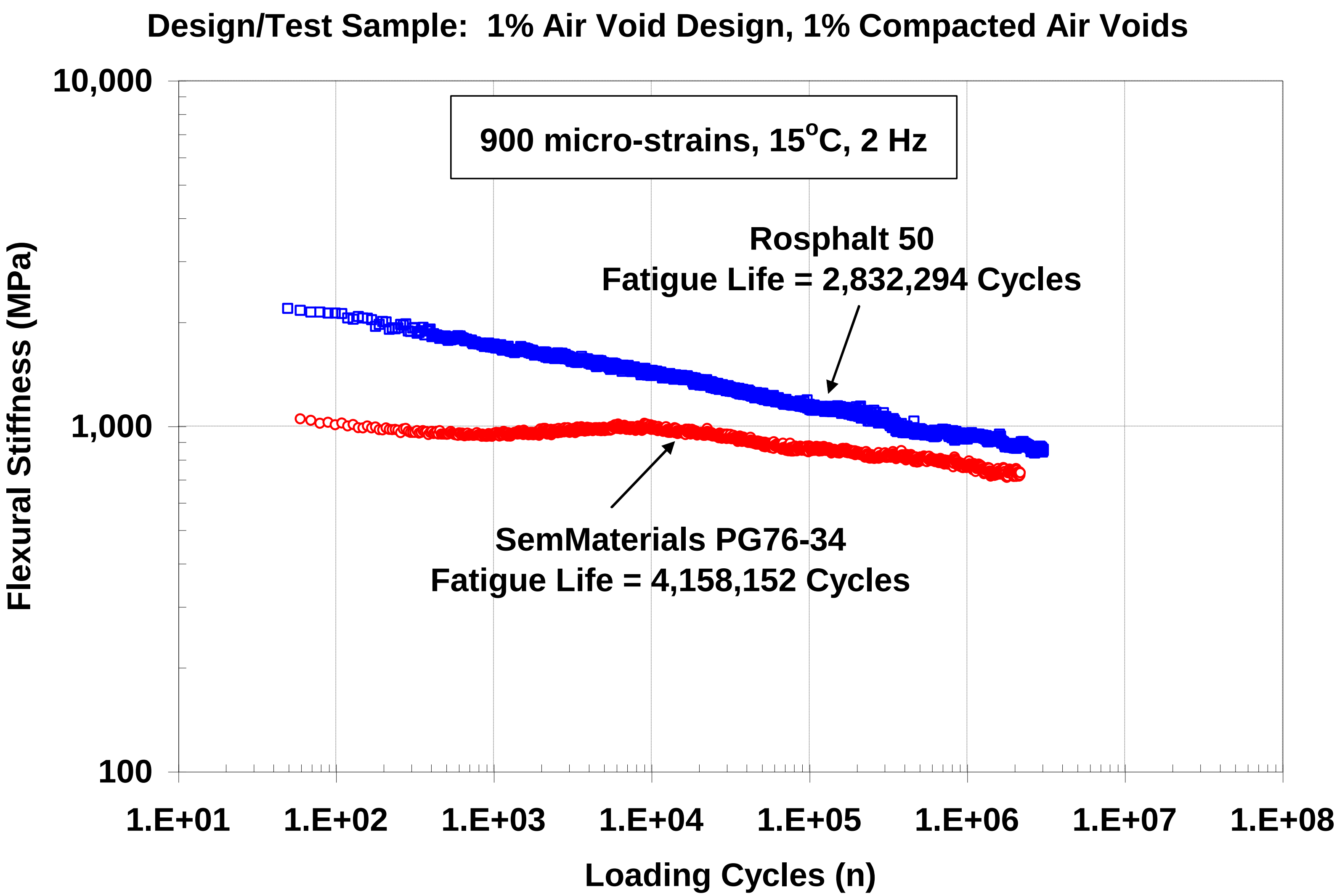
Flexural Beam Fatigue – RBL Mixes



Water Proof, Wearing Courses (WP-WC) for Bridge Decks

Fatigue and Rut Resistant Mixes (GWB Designs)

WP-WC (Fatigue Testing)



WP-WC (APA Testing)