



Driving Indiana's Economic Growth

## Pavement Evaluation Resources Supporting PMS Program

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## INDOT System Information

Route System	Lane Miles
All Routes	27,217
Interstates	4,261
Non – Interstates – NHS	5,154
Non – NHS	17, 802



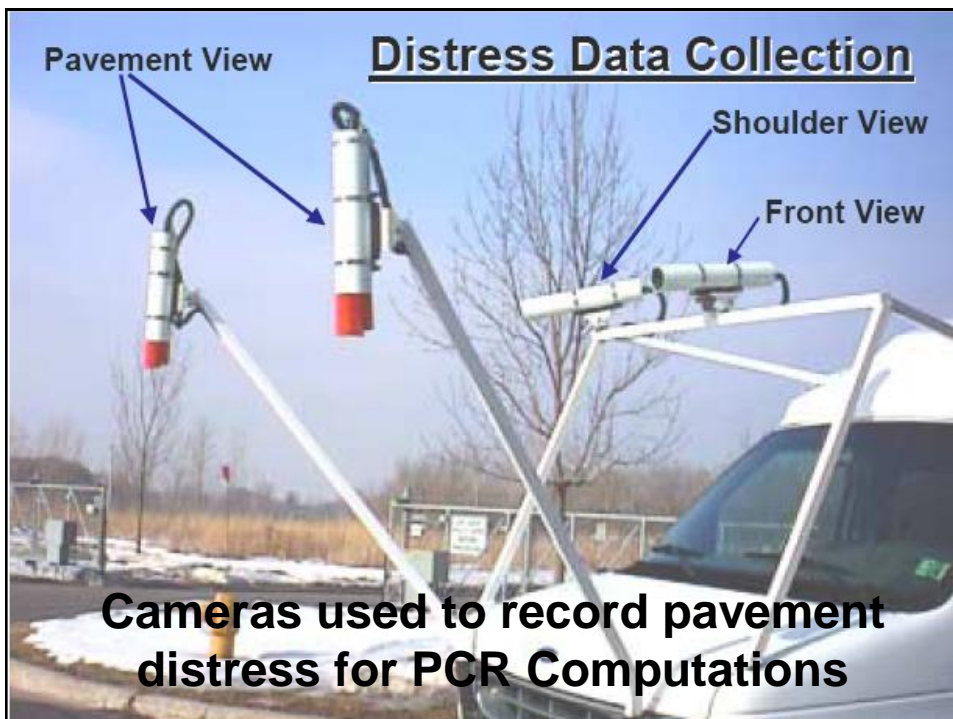
## Contracted Resources

### Video Inspection Vehicle



**Estimated Cost = \$ 100/Lane Mile**

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## Pavement Surface Skid Resistance

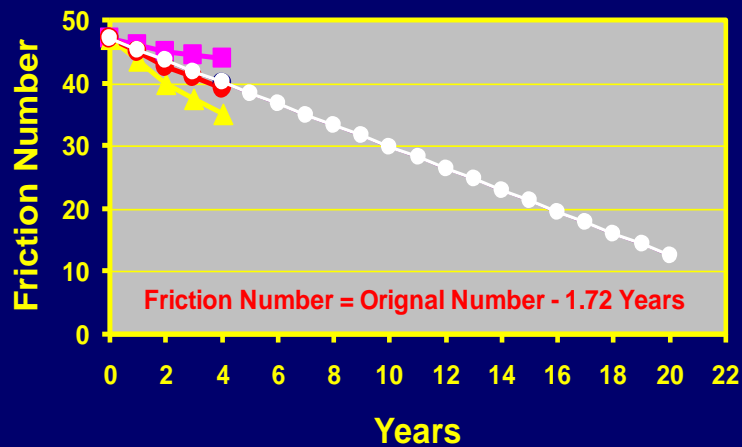
- 40 mph, Smooth Tire, Wet  
Pavement Surface

Condition	Friction Number
Excellent	>40
Very Good	35 – 40
Good	25 – 35
Fair	20 – 25
Poor	< 20

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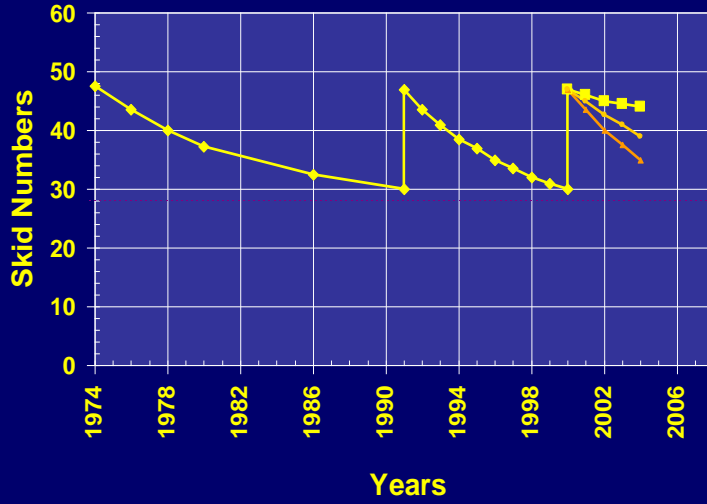
## Friction Performance



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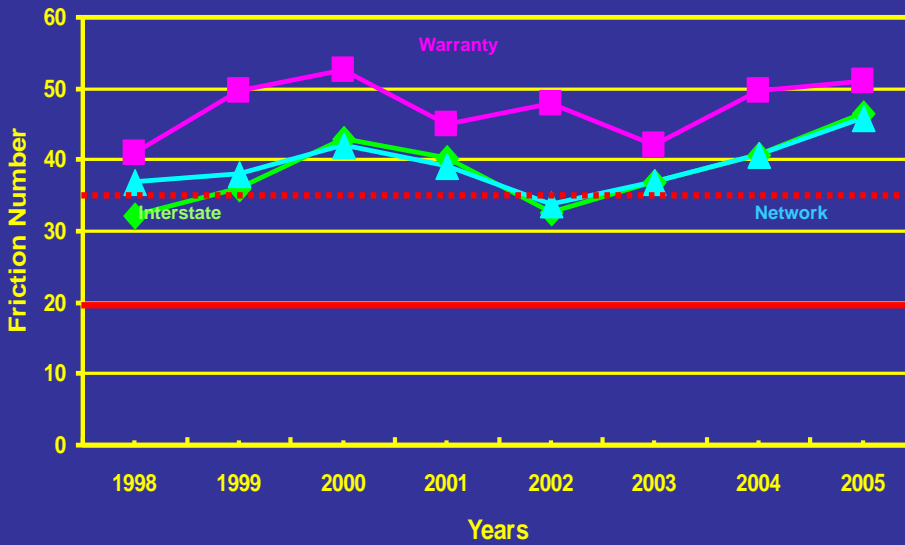


# Friction Performance



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Average Skid Resistance (Friction number)  
40 mph, Smooth Tire & Wet pavement





## Decisions Driven by Friction Data

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- Initially was used just to report the pavement surface condition
- Preservation at Locations of Low Friction Values – **Saved Lives and Properties**
- Planning for preservation needs
- Warranty Contract Compliance
- Special Tests (What Materials best suited to provide acceptable values)

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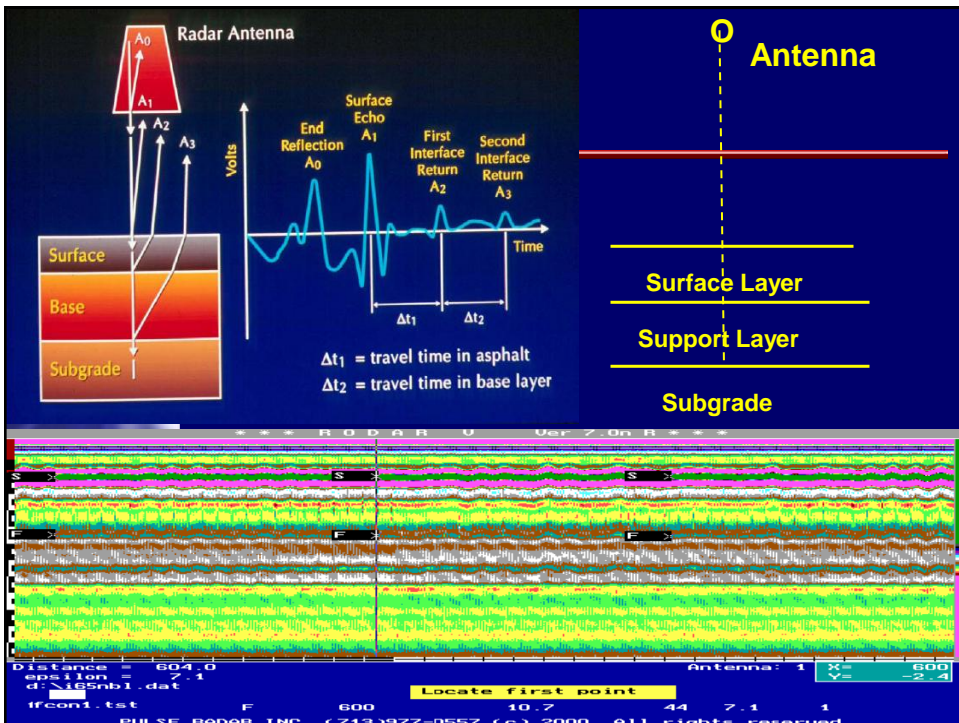
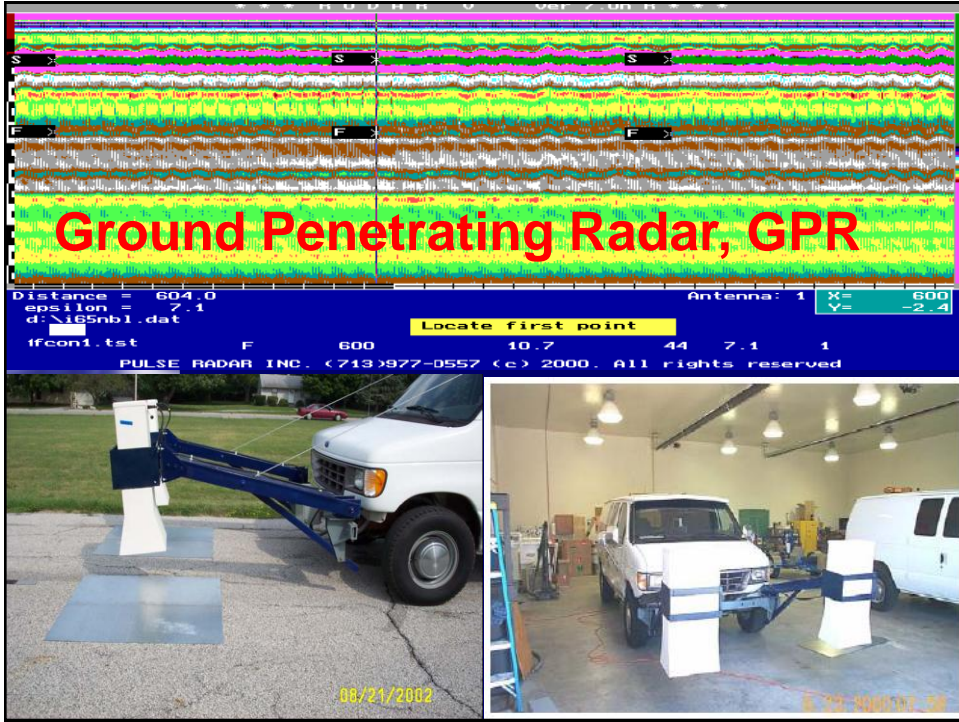


## Ground Penetrating Radar- GPR

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- Air Coupled Antenna
  - **Highway Speed**
- Ground Coupled Antenna
  - **Traffic Control**

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Material	Mean	Range
Portland Cement Concrete	9	6 - 12
Asphalt Concrete and Dry Sand	5	3 - 7
Rock	9	6 - 12
Dry Aggregate Base/ Subbase	7	5 - 9
Wet Aggregate Base/Subbase	15	10 - 20*
Subgrade	15	5 - 25*
Air	1	
Water	80	



## Ground Penetrating Radar- GPR

- Thickness Evaluation
- Moisture Entrapment Causing Stripping or Disintegration
- Water Infiltrations at Joints and cracks and Subsurface Drainage effectiveness
- Utility Location
- Bridge Deck Evaluation





## Ride Quality, IRI, and Texture Depth Measurements



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## Ride Quality, IRI, and Texture Depth Measurements

- IRI: Warranty Contracts - **Now**
- IRI: Smoothness Award - **Now**
- IRI: Network Data Quality Cross Check and Calibration - **Planned**
- IRI: Construction specifications **Planned – Research**
- Texture Depth: Preservation Needs **Planned – Research**
- Texture Depth: Evaluation of Materials used in preservation – **Planned – Research**

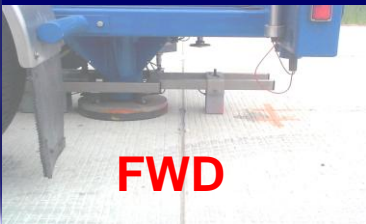
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**Falling Weight Deflectometer**

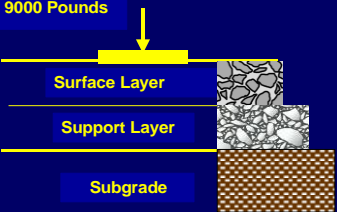


## Project Level Pavement Deflection

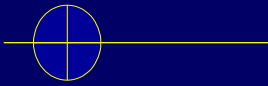


**FWD**

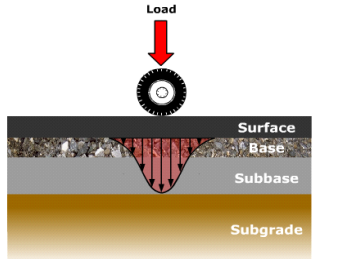
**P= 9000 Pounds**



D2	D1	D3	D4	D5	D6	D7	D8	D9
-12	0	8	12	18	24	36	48	60



**Network Level?**

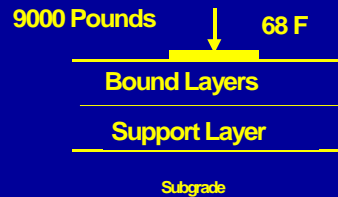




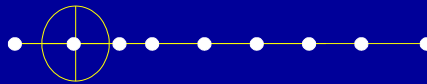
## Project Level Pavement Deflection

### FWD Standard Tests

AASHTO T – 256  
ASTM D 4694



D2    D1    D3 D4            D5    D6    D7            D8    D9  
-12    0       8 12                18    24    36                48    60



FWD

Deflection Basin is Dependent  
Upon Thickness & Material  
Properties

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## Pavement Deflection Falling Weight Deflectometer, FWD

- Pavement and/or Shoulder Structural Evaluation
- Remaining Life Calculations
- Overlay Design
- Joints and Cracks Evaluation
- Pavement Layers Moduli Backcalculation
- Undersealing Requirements
- Subgrade Evaluation

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## Project Level Pavement Deflection

### Pavement Deflection

Center Deflection in mils , 9000 Pounds (40 KN), 68 F (20 C)

	Interstates	Heavy Traffic	Medium Traffic	Light Traffic
Excellent	< 4	< 5	< 6	< 8
Very Good	4 – 6	5 – 7	6 – 8	8 – 10
Good	6 – 8	7 – 9	8 – 10	10 – 12
Fair	8 – 10	9 – 11	10 – 12	12 – 14
Poor	>10	>11	>12	>14
ESALs, Millions	> 30	10 – 30	3 – 10	< 3

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## Undersealing Concrete and Composite Pavements

Center Deflection	Outer Deflection	Extent	Underseal
Low	Low	The Majority of the Pavement Segment	No
High	High	Localized	Yes
Low	High	Localized	Yes
High	High	The Majority of the Pavement Segment	No

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