

## NETWORK PAVEMENT EVALUATION USING FWD AND GPR

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### Objectives:

1. Prepare for Full Implementation of AASHTO 2002 (Mechanistic Information)
2. Support Pavement Layers Thickness Inventory & Minimize the Need for Coring
3. Possible Integration with Pavement Management

### Thickness Information

- How deep the pavement surface can be milled before resurfacing



HMA

Rehabilitation  
Strategies



Composite

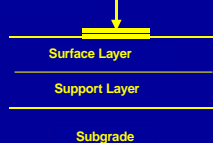


Coring to Verify  
Pavement  
Thickness

Needs to be  
Minimized



P= 9000 Pounds



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



FWD

Deflection Bowl is Dependent Upon  
Thickness & Material Properties

### • Pavement Stiffness

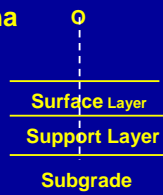
- Center Deflection in mils , 9000 Pounds (40 KN), 68 F (20 C)

	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

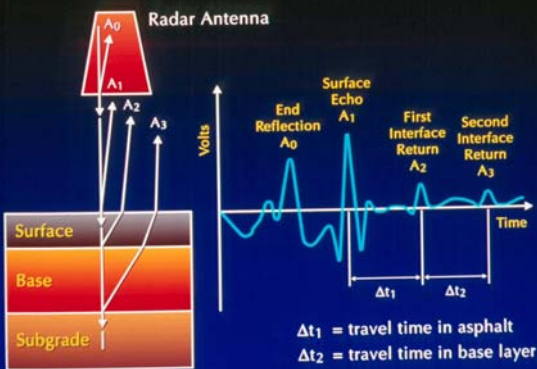
## GPR

- Ground Penetrating Radar (GPR) pavement related technology was developed during the SHRP program
- Short wave pulses of electromagnetic energy are transmitted into the pavement
- These pulses are reflected at each interface back to the radar antenna with the voltage amplitude and arrival time that is related to the thickness and material properties pavement layers

## Antenna



## GPR Principles



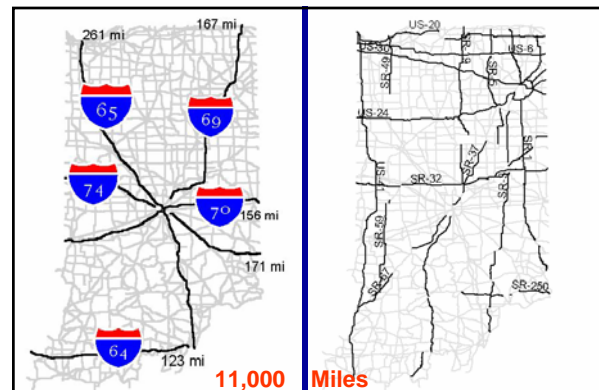
## Dielectric Constant

Material	Mean	Range
PCC	9	6 – 12
Rock	7	6 – 12
HMA	5	3 – 7
Dry Aggregate	7	5 – 9
Wet Aggregate	15	10 – 20
Subgrade	15	5 – 20
Water	80	
Air	1	

## Standard Tests

FWD: AASHTO T – 256  
 ASTM D 4694

GPR: ASTM D 4748



### FWD Data Collection

- Truck Lane, Both Bound Directions
- 5 Points/Mile
- 9000 Pounds Load, 68 F Temperature

### GPR Data Collection

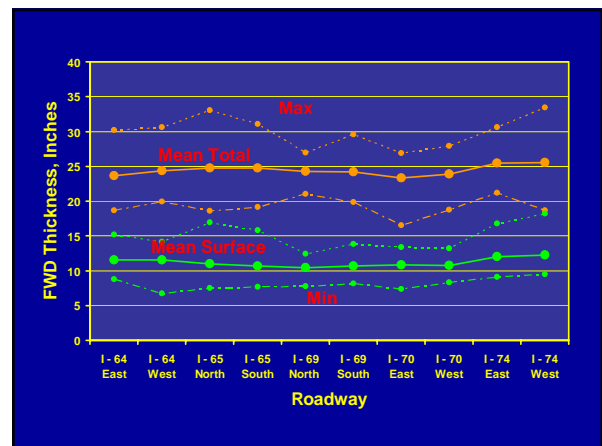
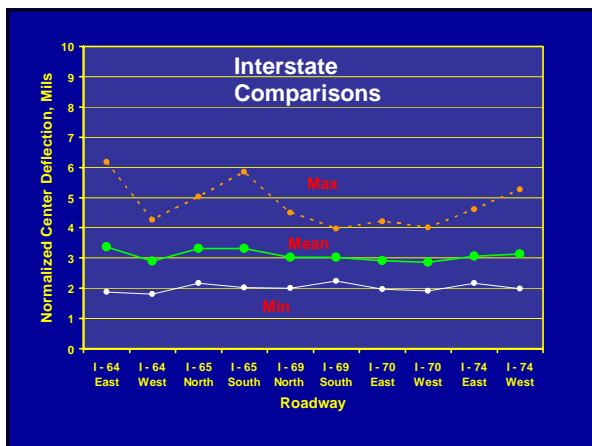
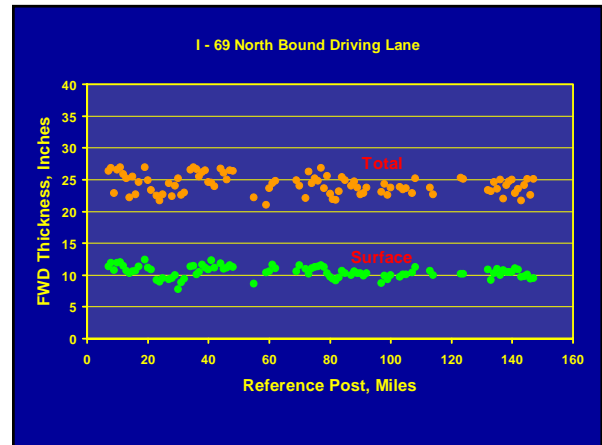
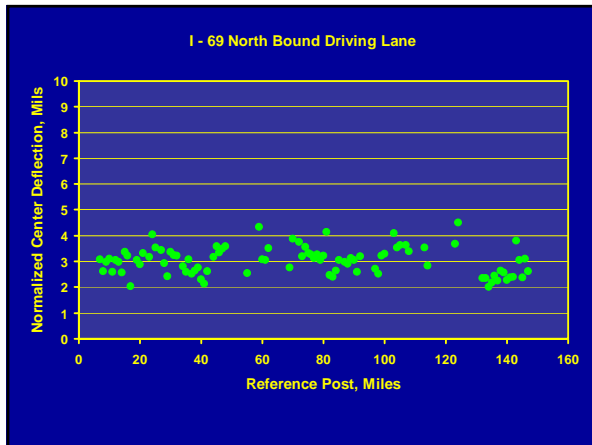
- Truck Lane, Both Bound Directions
- Thickness Picks, at least 5 Points/Mile

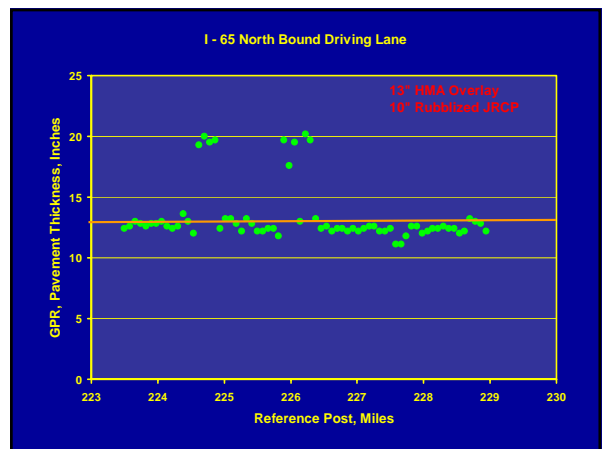
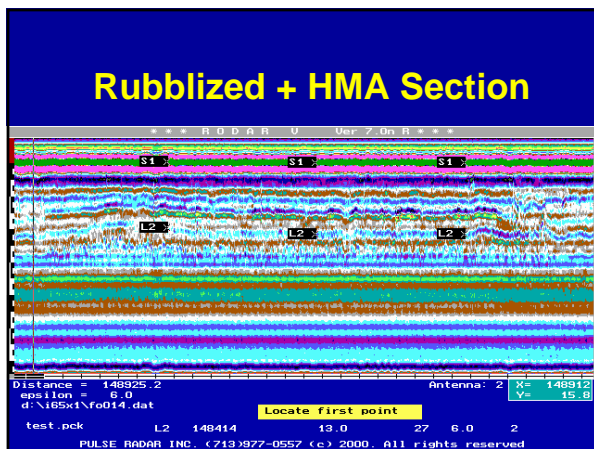
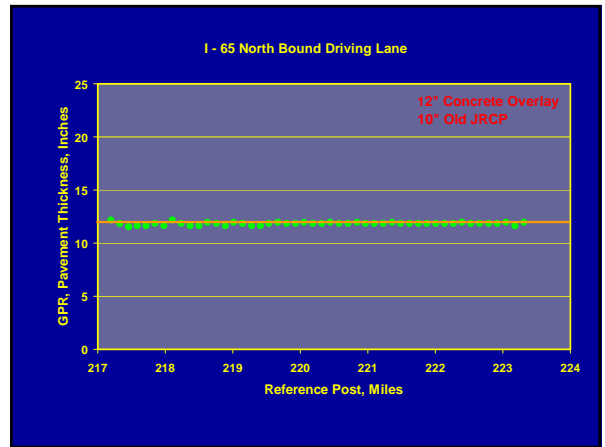
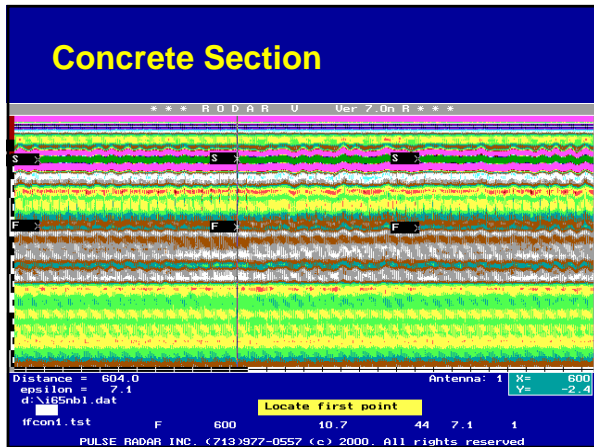
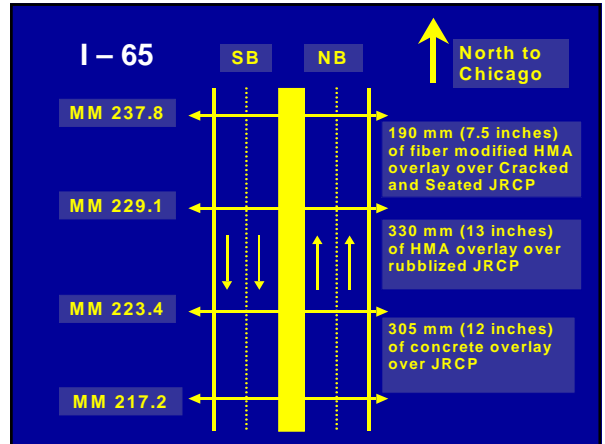
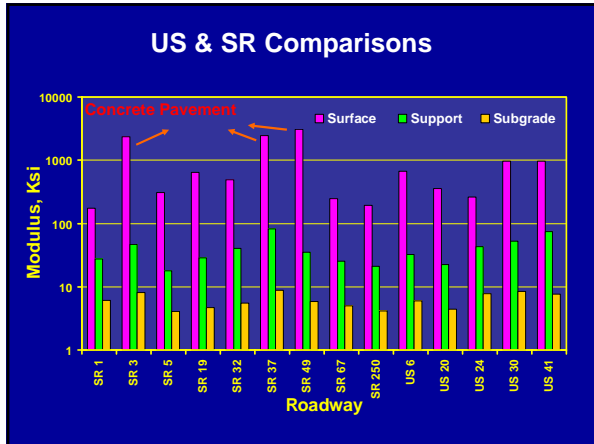
### Thickness Data

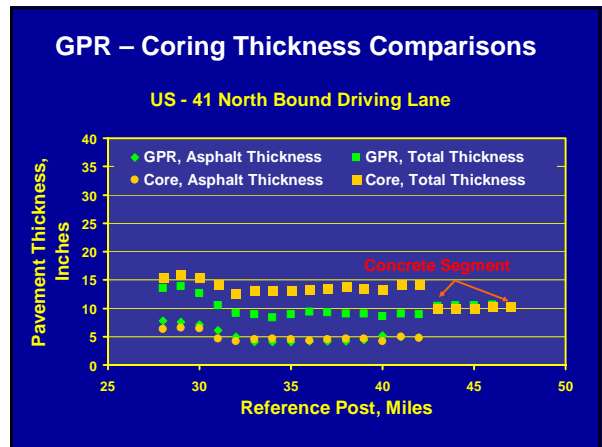
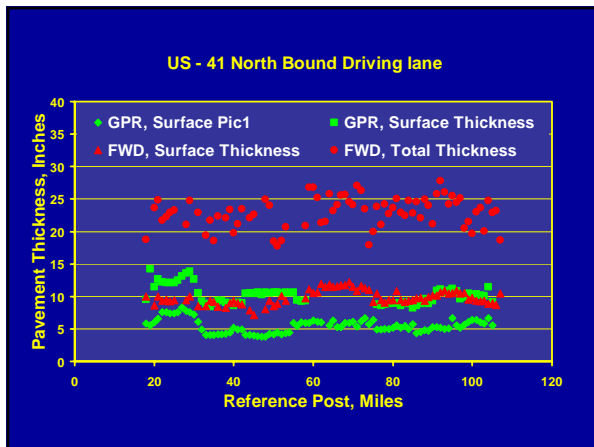
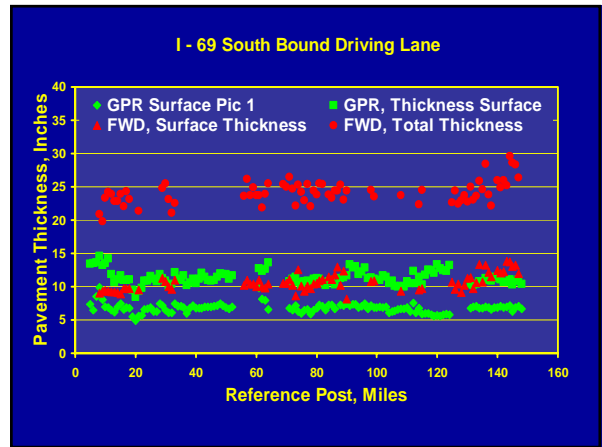
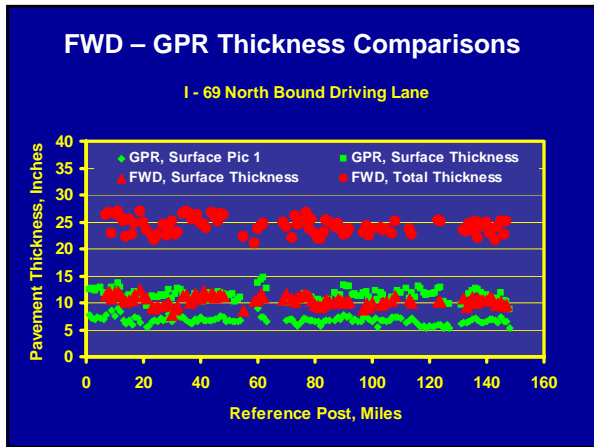
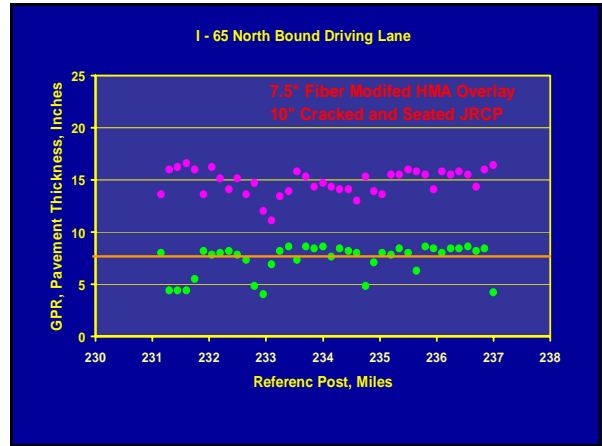
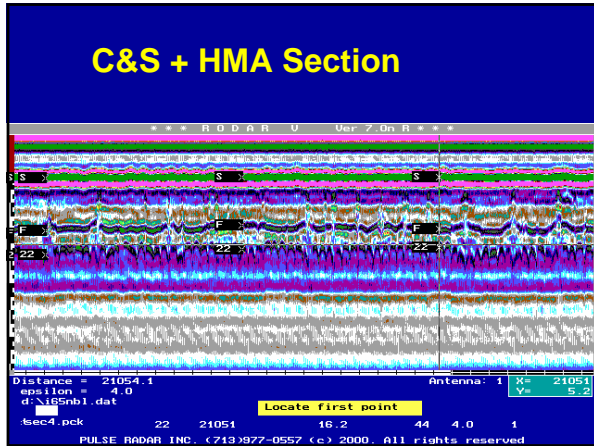
- GPR – FWD – Cores

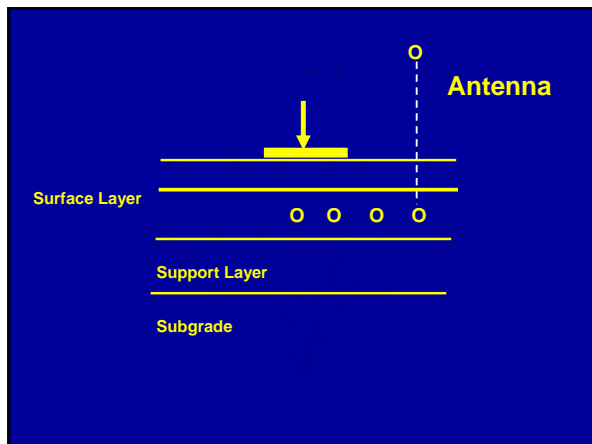
### FWD Response Variables

- Normalized Deflection
- Subgrade MR & CBR
- Surface Modulus and Layer Coefficient
- Support Modulus and Layer Coefficient
- Surface Thickness & Structural Number
- Support Thickness & Structural Number
- Total Thickness and total Structural Number
- Remaining Life, Years
- Overlay Thickness Required









## FINDINGS & CONCLUSIONS

A pavement thickness and structural capacity inventory of INDOT Interstate Highways was developed.

INDOT Interstate Highway pavements are currently in a very good structural condition.

## FINDINGS & CONCLUSIONS

GPR estimates concrete thickness of concrete pavements, HMA thickness of flexible pavement and HMA thickness of composite pavements almost perfectly.

GPR thickness estimation of pavement layers underneath these layers is not as accurate and needs adjustment through very limited coring.

GPR did not provide any estimate of unbound pavement layers or total pavement thickness.

## FINDINGS & CONCLUSIONS

FWD can be used to estimate combined surface thickness and total pavement thickness.

Estimate of combined surface thickness matched the GPR estimate in some situation or was slightly lower.

GPR is not expected to completely eliminate the need for coring. GPR can be used to establish the coring requirements to help interpret the GPR data fill the gaps in thickness estimation and verify thickness results.

## FINDINGS & CONCLUSIONS

Network level testing employing FWD and GPR is a worthwhile, technically sound program that can be integrated in pavement management strategies.

FWD data on 2200 lane miles of the INDOT network is recommended annually for network level pavement evaluation.

Only three FWD tests per mile in the driving lane of one direction are recommended. The information collected will allow the equivalent of 100% coverage of the whole network in 5 years.

U.S. Roads and State Routes may need more emphasis in network level testing than Interstate Highways.