

# Comparison of Modulus Values Using Various Devices

Dar-Hao Chen, Ph.D., P.E.  
Texas Department of Transportation

# NDG

- ◆ Labor Intensive, too much paper work
- ◆ loss benefit without wearing badge
- ◆ 3% in density could be 50% in stiffness

# On Top of Base and Subgrade

- ◆ Pharr District (US83& 281, FM495, B83)
- ◆ Abilene District (I20, US280)
- ◆ Austin District (FM619)
- ◆ El Paso District (SH178)
- ◆ Fort Worth District (US281, US287, FM2026)
- ◆ Atlanta District (SH49, FM 1735)

- ◆ **SPA**, Seismic Pavement Analyzer
- ◆ **P-SPA**, Portable Seismic Pavement Analyzer
- ◆ **FWD**, Falling Weight Deflectometer
- ◆ **HSG**, Humboldt Stiffness Gauge
- ◆ **DCP**, Dynamic Cone Penetrometer
- ◆ **laboratory**
  - Ultrasonic,
  - Triaxial, and
  - Free-free resonant column tests



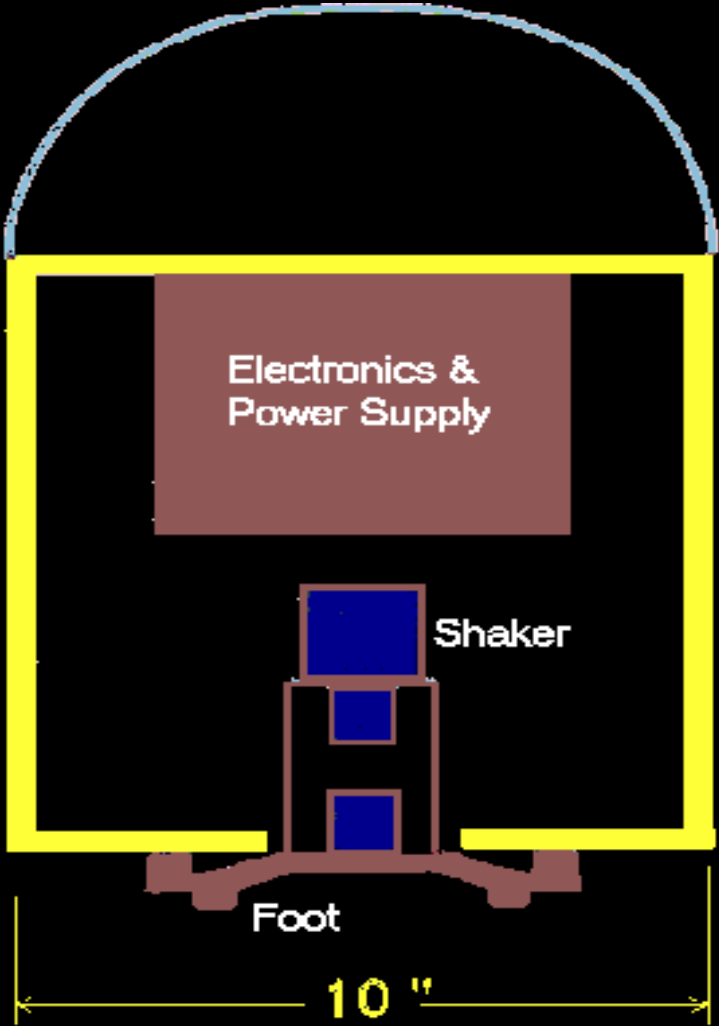
I-20, Top of Base



HSG

State Approved Pencil

100-200 hz



HSG



**US281, Jackshoro**





**Dry Ice**



**Vacuum**



US281, Jackshoro

Manual Seismic



**US281, Jackshoro**

**Humbolt  
Stiffness  
Gauge**

**Seismic  
Testing**





I-20, Top of Base



FWD

SASW

HSG



# US380, Top of Base, Failed DD



SASW

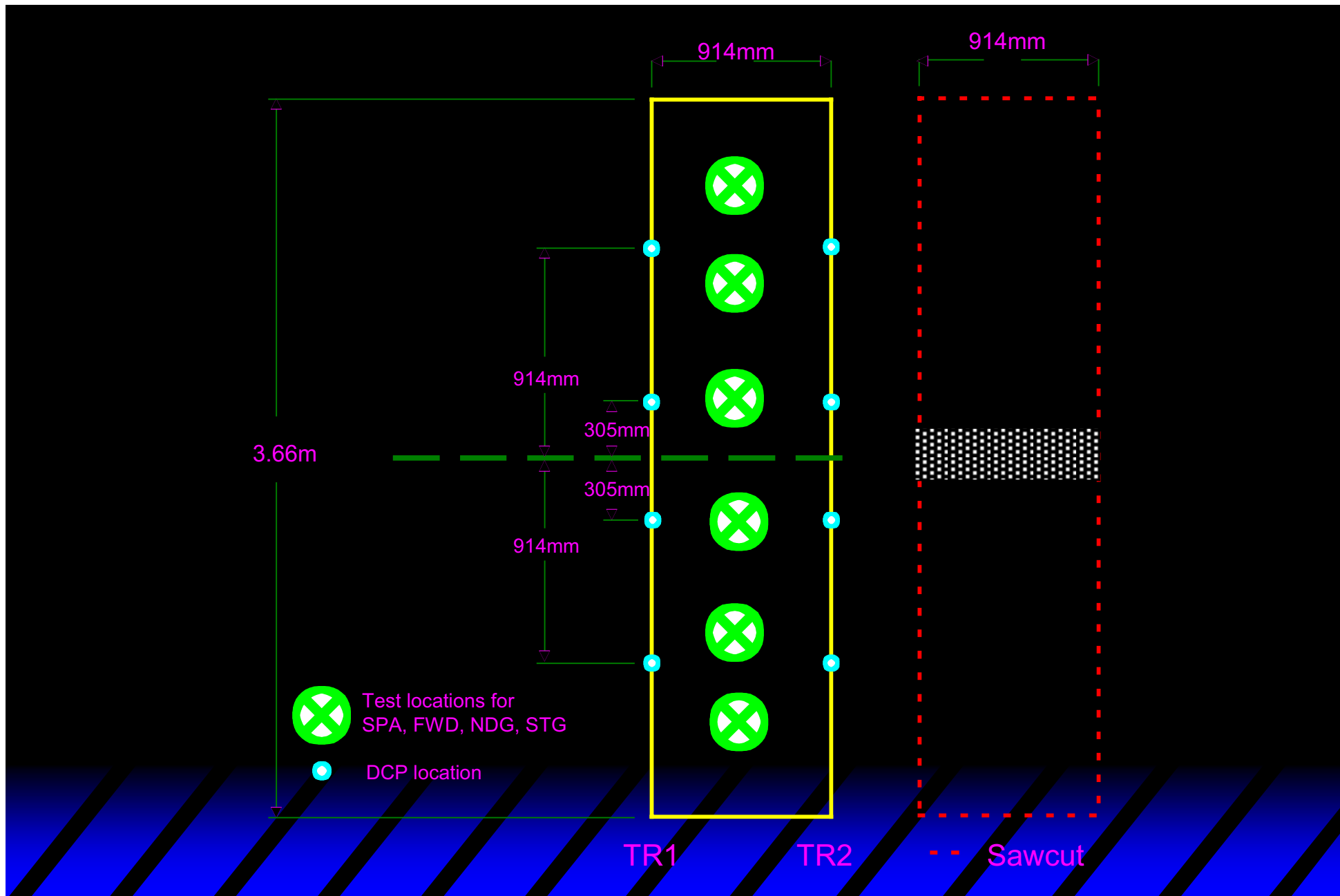
NDG























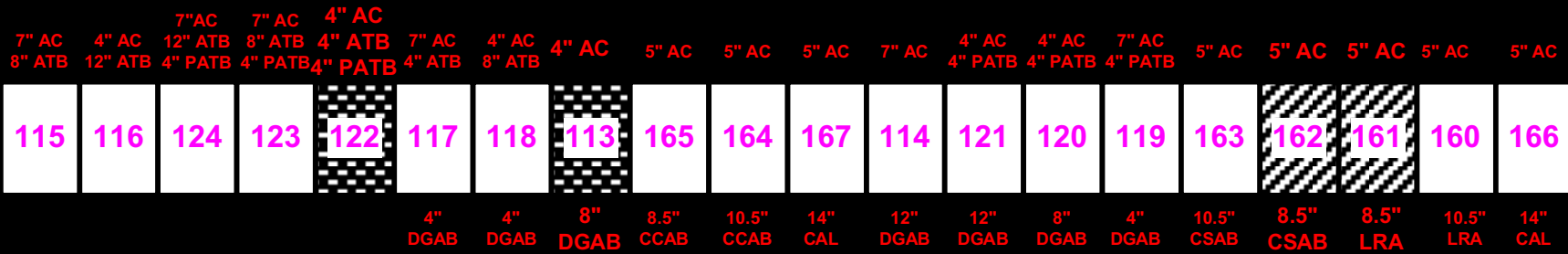








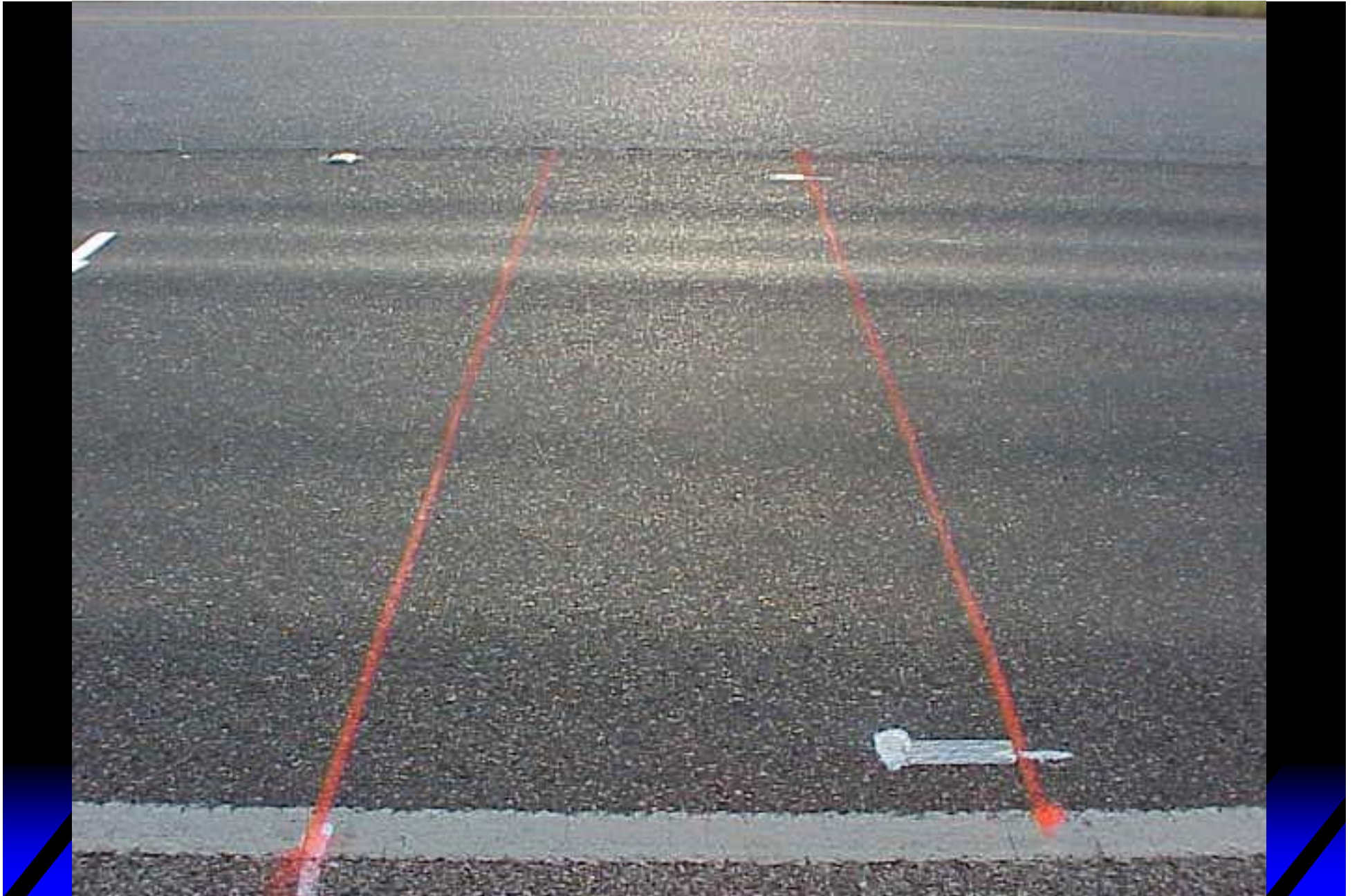
# Southbound US281 SPS-1 Sections



- Acronyms:**
- AC = Asphalt Concrete
  - ATB = Asphalt Treated Base
  - PATB = Permeable Asphalt Treated Base
  - DGAB = Dense Graded Aggregate Base
  - CCAB = Crushed Concrete Aggregate Base
  - CAL = Caliche
  - CSAB = Crushed Stone Aggregate Base
  - LRA = Lime Rock Asphalt















## Recycling Tire Chips (15% higher cost)



# Stiffness Testing in El Paso, TX



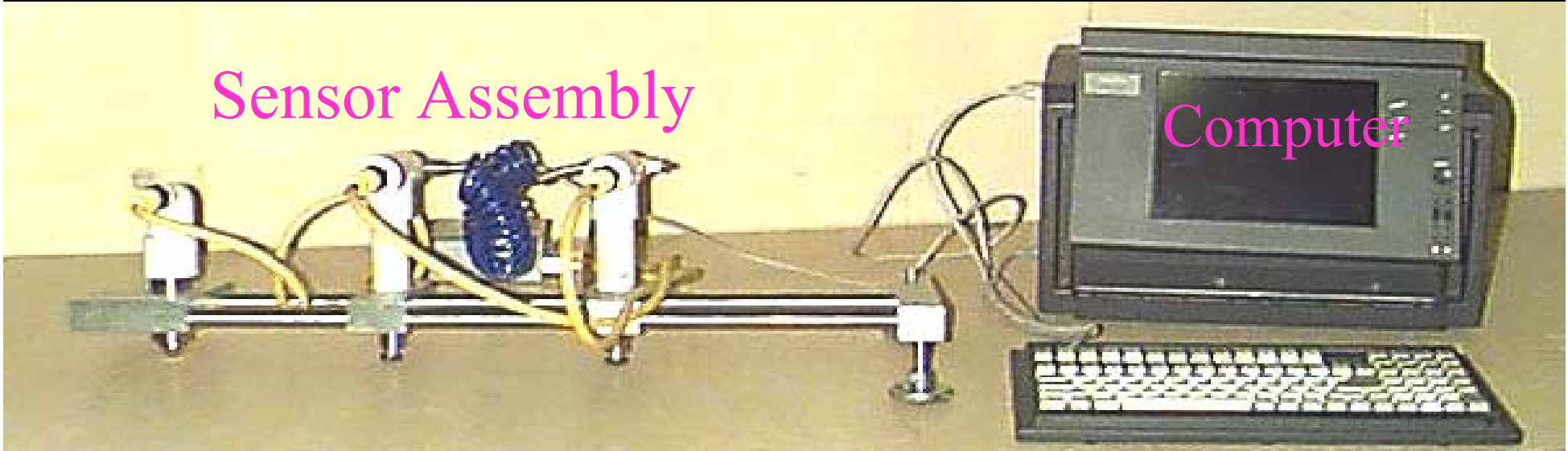
Rod Monitors Horizontal  
and Vertical Movement

Humboldt  
Stiffness  
Gauge

# *DSPA for Testing Base and Subgrade*

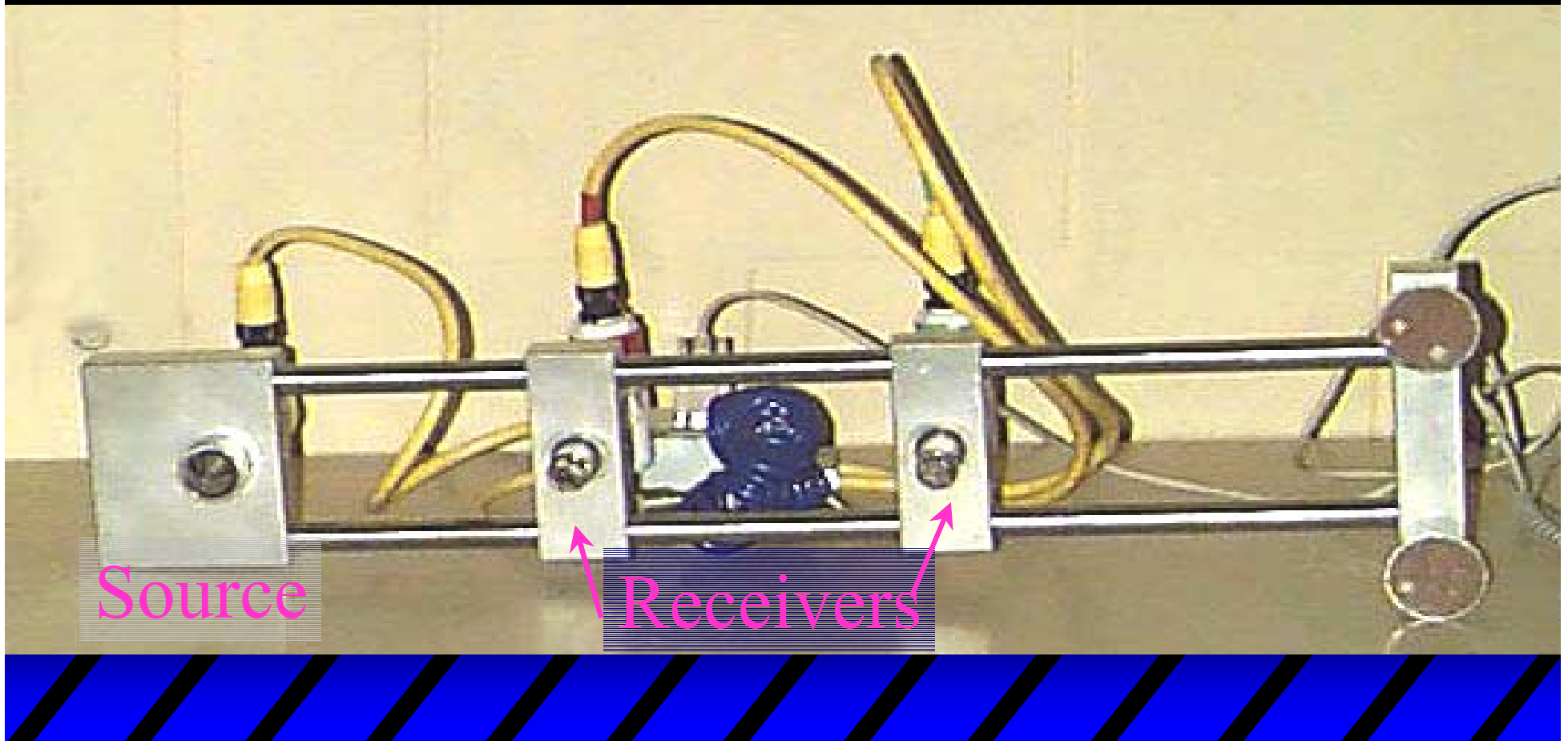
Sensor Assembly

Computer





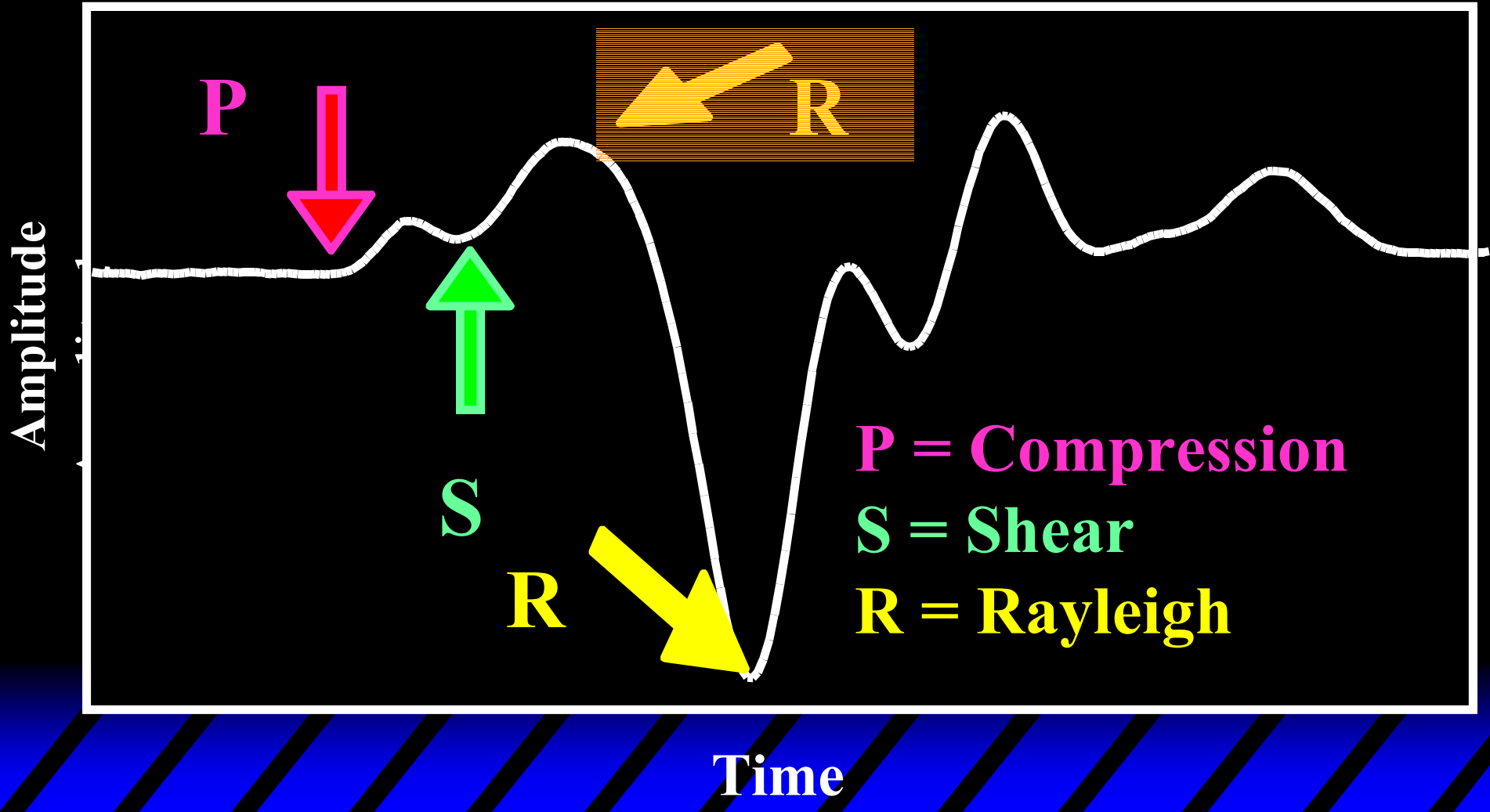
# *DSPA for Testing Base and Subgrade*



# *Seismic Devices*

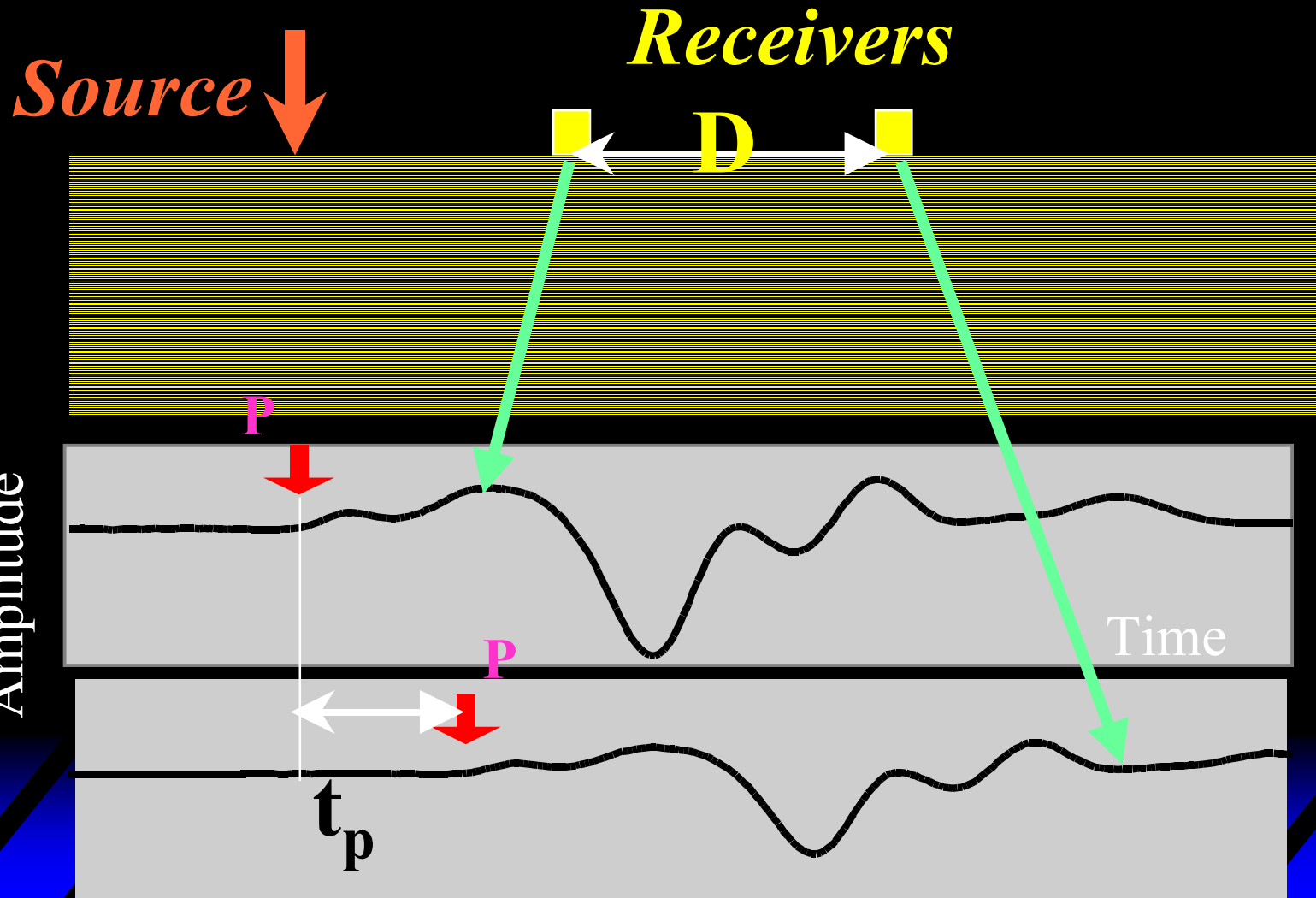


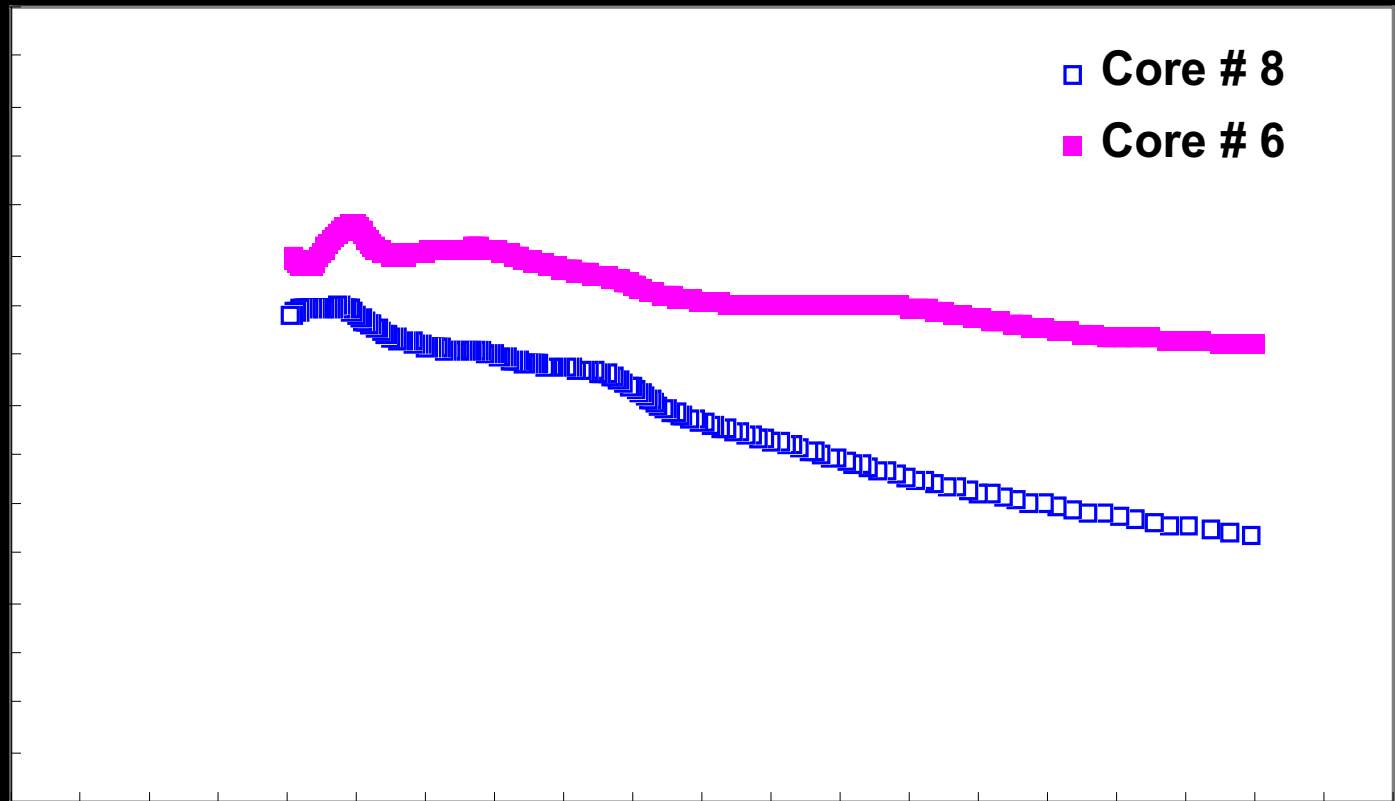
# Typical Signal





# Ultrasonic Body Waves (UBW)









# Recommendation for Subgrade

- ◆ Above 10MN/m--Good
- ◆ Above 20 MN/m-- Excellent

# Recommendation for Base

<b>Base Quality</b>	<b>HSG (MN/M)</b>	<b>HSG (ksi)</b>	<b>VS (M/sec)</b>	<b>FWD (ksi)</b>
<b>Weak</b>	<b>&lt;10</b>	<b>&lt;13</b>	<b>&lt;250</b>	<b>&lt;20</b>
<b>Good</b>	<b>18-24</b>	<b>22-30</b>	<b>300-350</b>	<b>45-65</b>
<b>Excellent</b>	<b>&gt;30</b>	<b>&gt;38</b>	<b>&gt;400</b>	<b>&gt;100</b>

?????

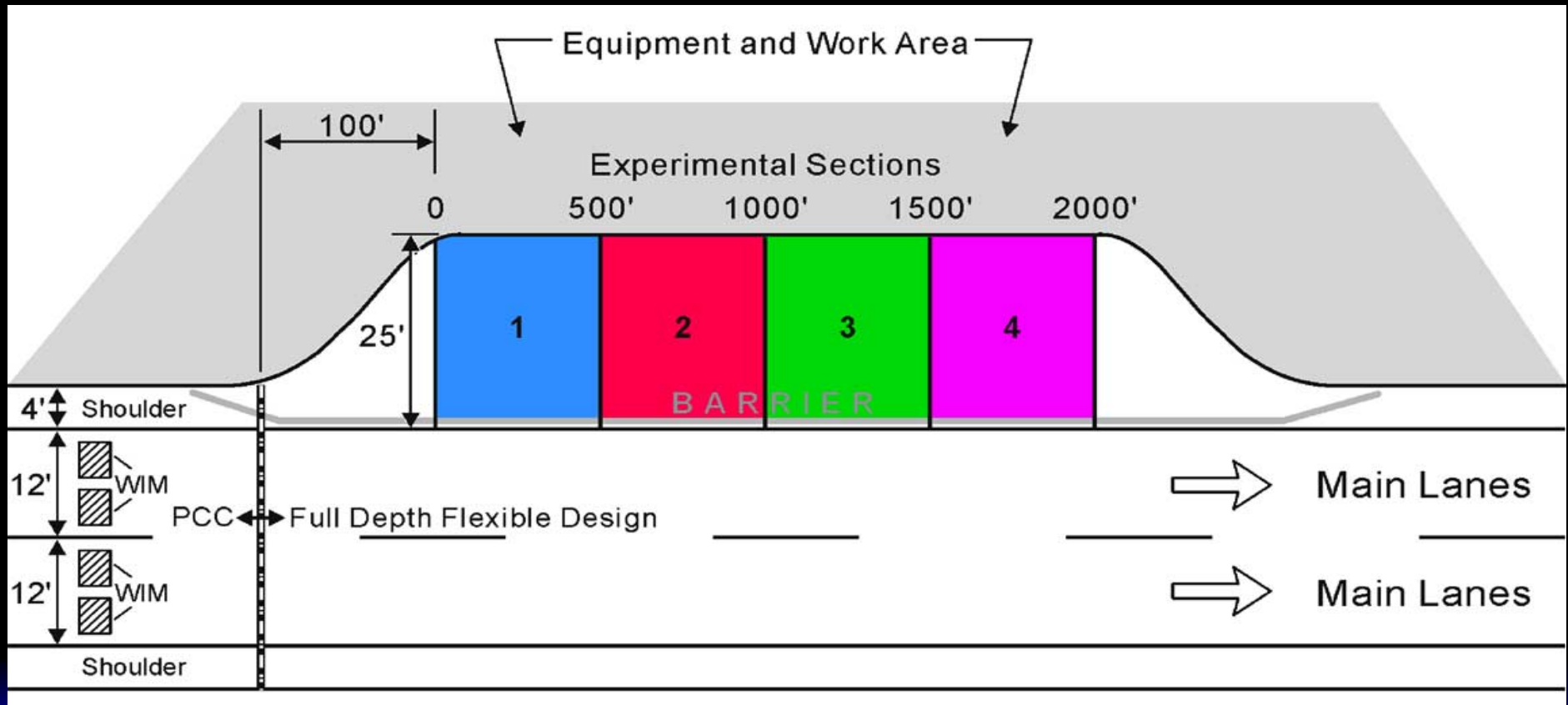
- ◆ Depth (composite stiffness)
- ◆ Calibration (when is out of the range)
- ◆ Stiffness range (old one is good for untreated base and subgrade with low stiffness)



# Future Projects

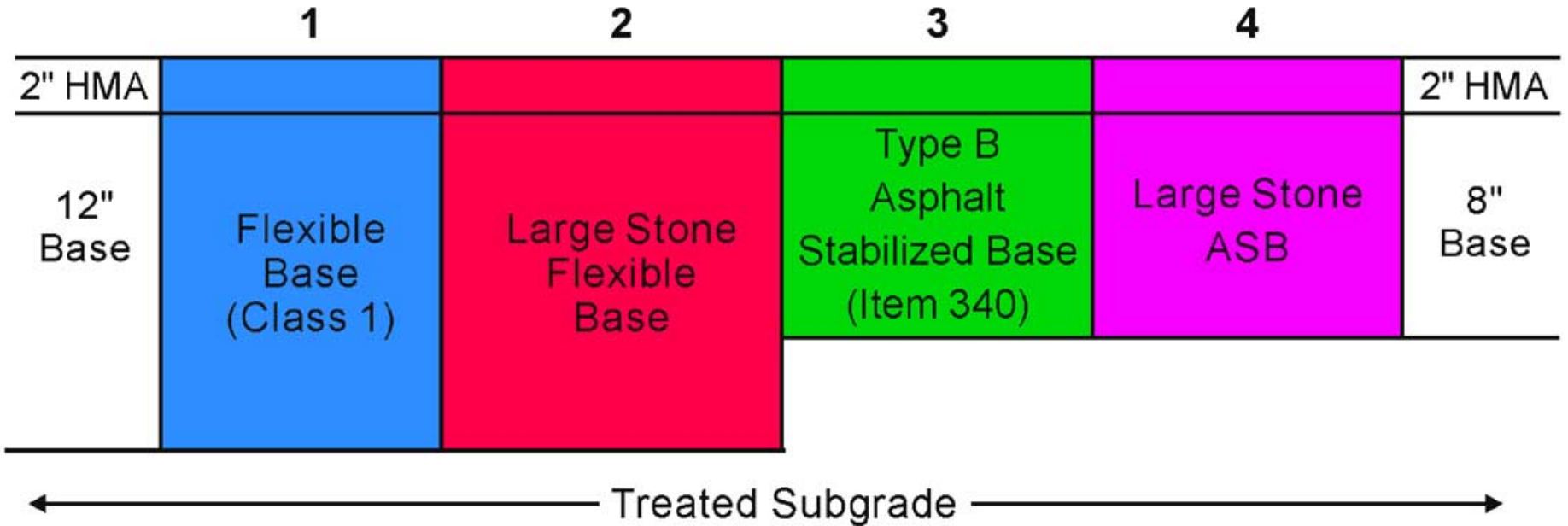
- ◆ SH114
- ◆ US59
- ◆ FM699, FM123, and FM 31

# Proposed MLS Experimental Sections on SH114, Fort Worth District



# Proposed MLS Experimental Sections on SH114, Fort Worth District

## Experimental Sections





# Schedule

- ◆ Plan from Area office to District Design 8/1/00
- ◆ Letting
- ◆ Construction