

A world map in a lighter shade of blue is centered on a darker blue background, serving as a backdrop for the text.

# **FWD Operator Training**

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**What the FWD Operator Needs to  
Know to Collect Accurate Data and  
Help Achieve Successful Analysis**

# Why Should We Be Training?

- **The Analysis is Only as Good as the Data Collected!**
- **Training Should:**
  - **Reduce Error (Both Testing and Analysis)**
  - **Provide More Reliable Recommendations**
  - **Reduce Costs**

# Training

- **One Size Does Not Fit All...**
- **Training Will Be Different for Various Organizations**
- **However, Some Aspects Should be Consistent Throughout**

# FWD Data Collection

- **Highways (Long Stretches, Short Runs)**
- **City Streets**
- **Runways**
- **Taxiways**
- **Airport Aprons**
- **Loading Facilities (Ports, Docks, Freight Yards)**
- **Railroad Yards**

2:40pm

# Uses of FWD Data

- **Project or Network Level**
  - Backcalculation
  - Structural Capacity Analysis (Remaining Life)
  - Rehabilitation Design (Overlay Design)
  - Subgrade/Subbase/Base Characterization
  - Joint/Crack Load Transfer
  - Void Detection
  - Construction QC/QA
  - Others

# Basic FWD Knowledge

- **Desirable Operator Skills:**
  - **Knowledgeable Regarding Equipment Setup and Operation**
  - **Basic Understanding of Signal Processing for Troubleshooting**
  - **Automotive Upkeep and Diagnostics**
  - **Computer Skills**



# Basic FWD Knowledge

## • Operator Duties/Expectations:



- Operator Becomes the Eyes and Ears of the Office Staff, Therefore They Must Have Appropriate Tools
- Understand Project Goals and Objectives
- Understand Client (or Engineer) Expectations
- Clear Communication is Essential for Successful Data Analysis



# Basic FWD Knowledge

- **Routine Maintenance Issues:**
  - **Checking Sensors**
    - Temperature (Air and IR)
    - Distance (DMI) for Accuracy
    - Deflection
  - **Deflection Sensor Calibration**
    - Monthly Relative Calibrations
    - Annual Reference Calibrations
  - **Vehicle/Trailer Maintenance**



# Basic FWD Knowledge

## Equipment Issues (Routine):

### – Inspect FWD Including:

- Hydraulics and Charging System
- Load Cell Rubber Pad
- Sensor Positions
- Air, IR, DMI and Deflection Sensors

### – Inspect Vehicle Condition, Including:

- Tires
- Brakes
- Belts
- Etc...



# Basic Data Collection Knowledge

- **Pavement Distress Identification**
  - Operators Should be Trained to Identify All Types of Distress
  - Learn How to Adapt Data Collection Procedures to Distresses Present
- **Temperature Data Collection**
- **Understand Criteria for Bore/Core Locations**

4:02pm

# Basic Data Collection Knowledge

- **Various Situations Call For Different FWD Data Collection Efforts:**
  - **Pavement Type (AC, PCC, or Composite)**
  - **Intervals**
  - **Loads**
  - **Sensor Spacing**
  - **Stationing**
- **This Information Should be Supplied by the Engineer, But...**

# Basic Data Collection Knowledge

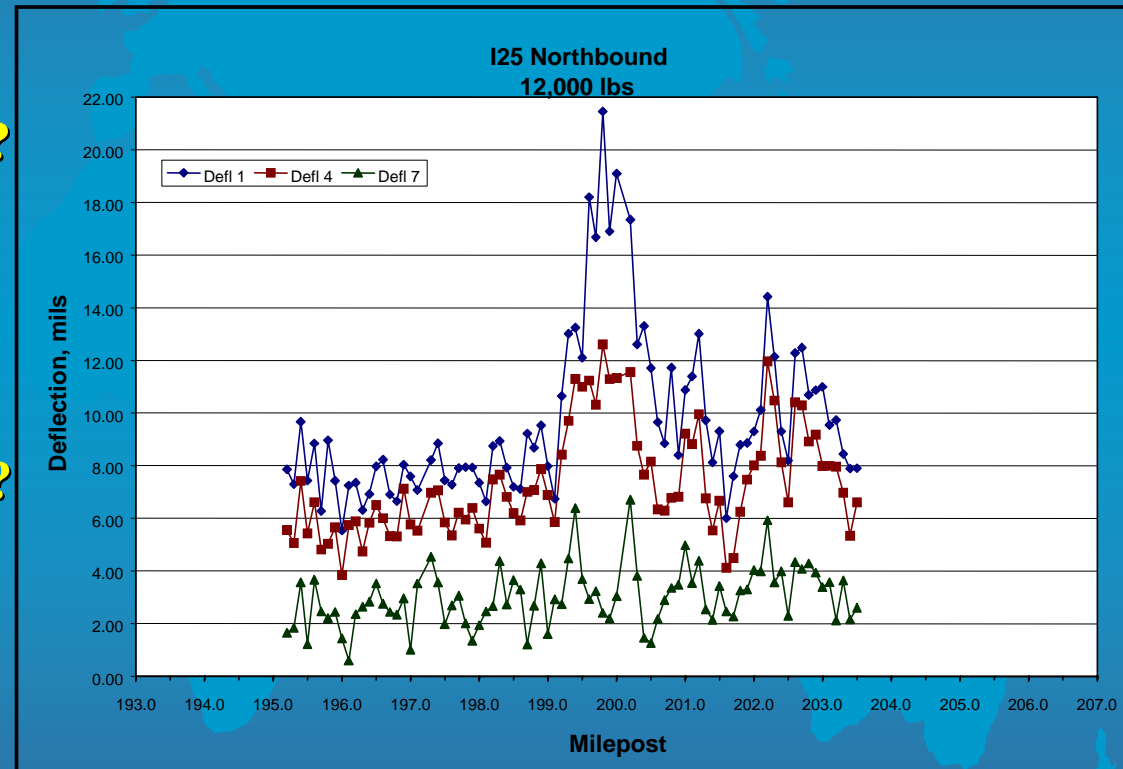
- **Denote Areas of Maintenance and Rehabilitation**
  - **Follow Sampling Plan (e.g. random spacing within wheelpath)**
  - **Understand How to Adjust Target Loads for Field Conditions**
  - **Understand How to Adjust Sampling to Account for Deviations in the Field**
- 

# Basic Data Collection Knowledge

- **Know Criteria Regarding Acceptable Conditions for Testing**
- **Understand When Not to Test**
  - **Affected by Traffic and Weather Conditions**
  - **Also Affected by Condition of FWD Equipment**

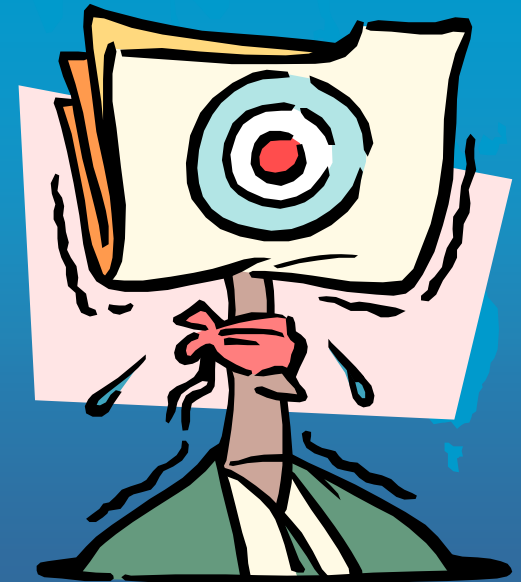
# Basic Data Collection Knowledge

- **Variability**
  - What Causes Variability?
  - What is Acceptable?
  - What Can the Operator do to Minimize Variance?
  - How Does it Affect the Analysis Effort?
  - Variability is Project Dependent!



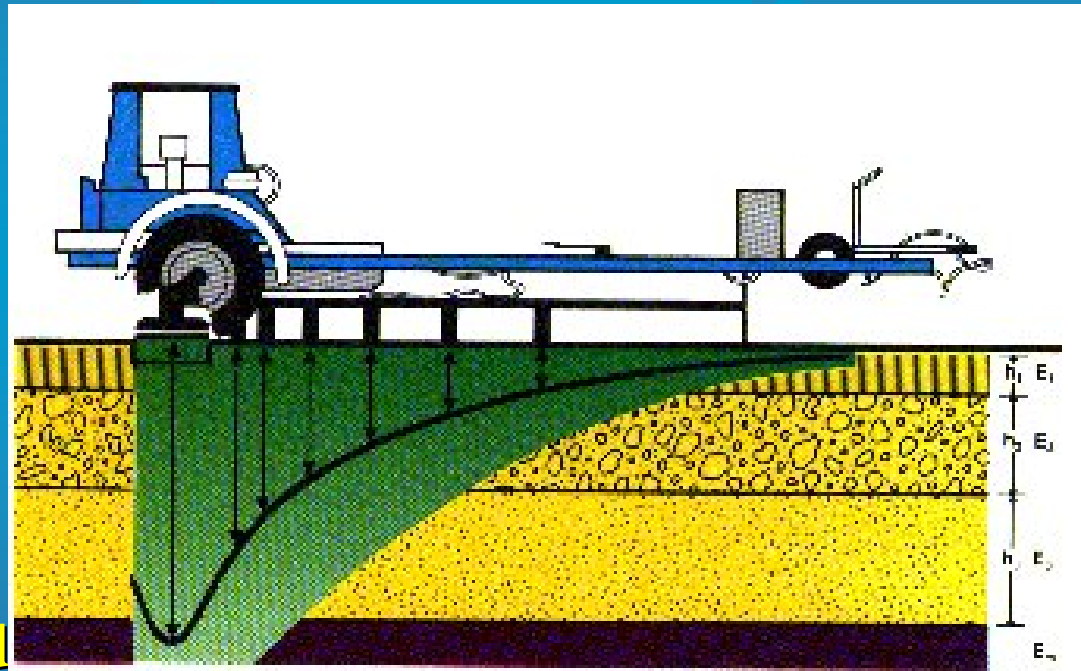
# Basic Data Collection Knowledge

- **Reducing or Minimizing Error (Data Collection):**
  - **Systematic**
    - Internal To Measuring Device
    - Bias or Offset
    - Compare to Independent Reference
    - Corrected By Adjustment Factor
  - **Random**
    - Repeatability and Least-Count
    - Detected in Repeated Measurements
    - No Trend – Random or Stochastic
    - Minimize By Multiple Measurement
    - Standard Deviation Used as Measure



# Basic Data Collection Knowledge

- Sources of FWD Data Error:
  - Load Cell
  - Deflection Sensors
  - Analog-To-Digital Conversion
  - Lack of Seating
  - Inappropriate Load



# Basic Data Collection Knowledge

- **Steps to Minimize Data Collection/Analysis Error:**
  - **Calibrate FWD**
    - Reference Annually
    - Relative Monthly
  - **Use Seating Drops**
  - **Use Multiple Drops**
  - **Obtain Reliable Supporting Data (for Data Analysis)**
    - Layer Thickness
    - Other

# Prior to Data Collection

- **Check Operation of the FWD**
- **Warm Up FWD Prior to Data Collection**
- **Adjust Drop Heights To Match Expected Loads**
- **Set Appropriate Seating Drops**

# Basic Analysis Knowledge

- **SCI/BCI Calculations**
  - **Surface Curvature Index (e.g. Sensor 1 - Sensor 2)**
  - **Base Curvature Index (e.g. Sensor 3 - Sensor 4)**
- **Backcalculation of Moduli**
  - **Linear**
  - **Non-Linear**
- **Joint/Crack Load Transfer Efficiency**

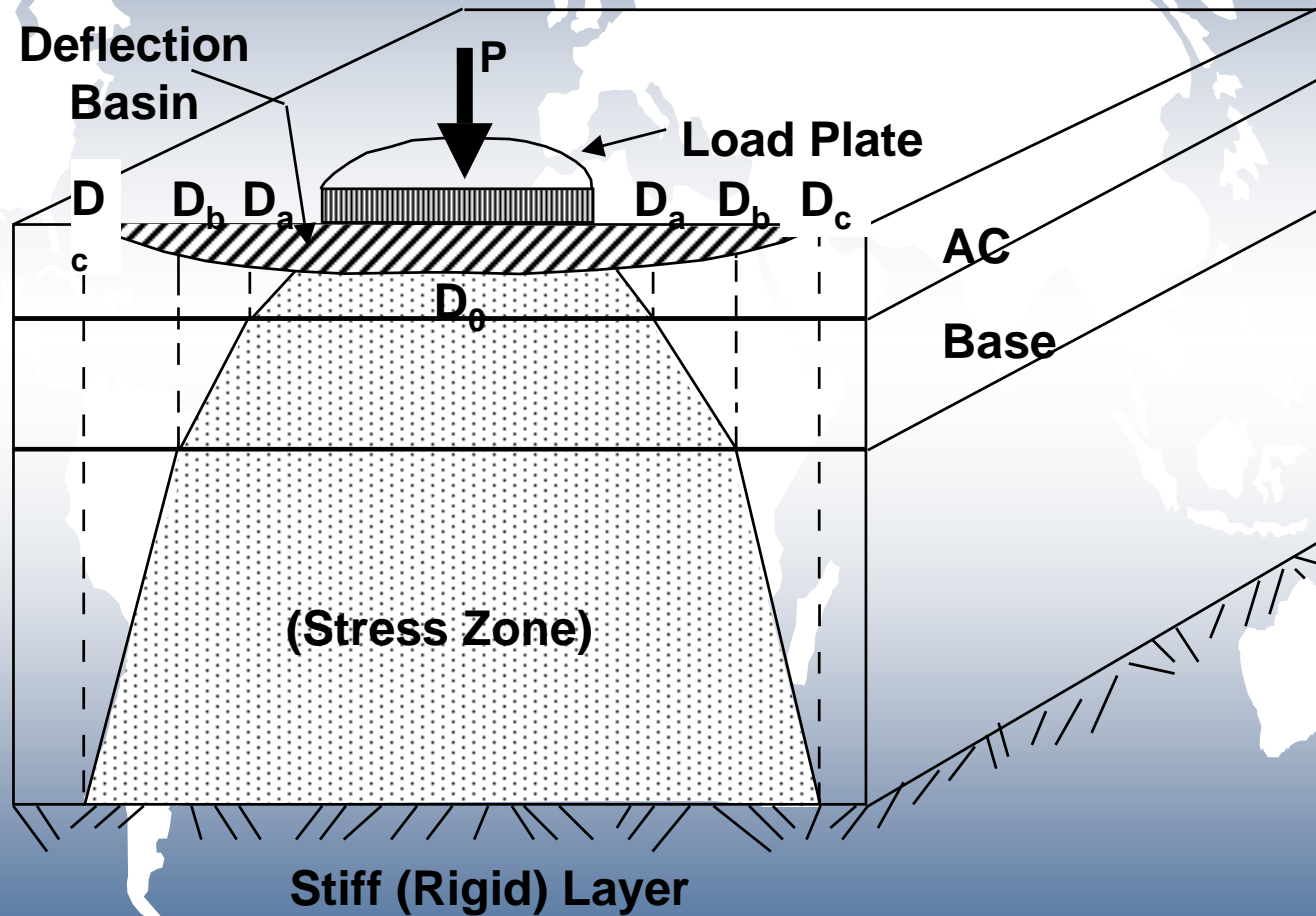
# Basic Analysis Knowledge

- **Operator Should be Aware of the Differences Between Analysis Techniques**
  - Data Collection Plan Depends on the Analyses to be Conducted...
- **Operator Should Experience Some Aspects of Analysis**
  - Backcalculation
  - Load Transfer Efficiency
  - Etc...



# Basic Analysis Knowledge

## Underlying Layers Affect Deflection Readings and Analyses



# What Can the Operator Do to Help Analysis?

- **Review Data - Don't Just Collect**
  - Look for Inconsistencies
  - Look for Non-Decreasing Deflections
  - Look at Loads
  - Change Load Package/Drop Height, if Required During Initial Setup



# Look at the Big Picture

- **Areas of Water Ponding**
- **Pumping of Joints and/or Cracks**
- **Culverts**
- **Utility Locations**
- **Drainage Ditches**
- **Shoulder Conditions**

# Document Conditions

- **Denote What is Normal and Abnormal**
- **Take Pictures!!**
- **Use Notes/Comments Capabilities of FWD Software**



**Thank You!**



**Fugro Consultants LP**

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FWD Users Group  
Helena, Montana