

Falling Weight Deflectometers



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Outline

- What is a Falling Weight Deflectometer?
 - Components
 - Instrumentation Details
 - Instrumentation Specifications
 - Applications
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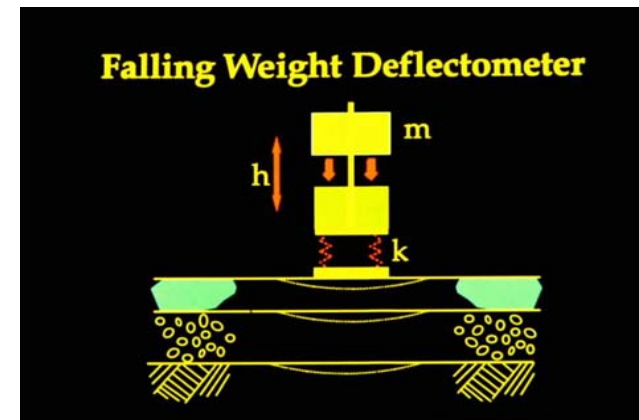
What is the FWD?

- ❑ Non-destructive test equipment for pavements
- ❑ Imparts a dynamic load to a pavement structure
- ❑ Simulates a moving wheel load
- ❑ Measures deflection of the pavement surface



What is the FWD used for?

- Structural capacity/remaining life estimates
- Finding in-situ layer moduli
- Load transfer efficiency of joints in concrete pavements
- Pavement management



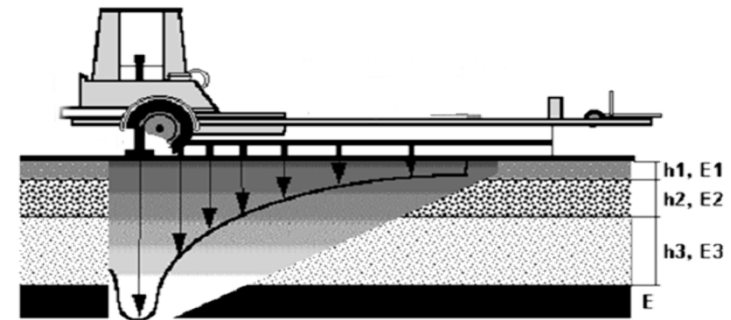
FWD Components

- Load Cell
- LVDT, Geophones, Accelerometers
 - Displacement measurement
- Infrared temperature gages
 - Pavement Temperature
 - Air Temperature
 - Surface Temperature
- Electronic Distance Measurement
- Control/Data Acquisition Unit

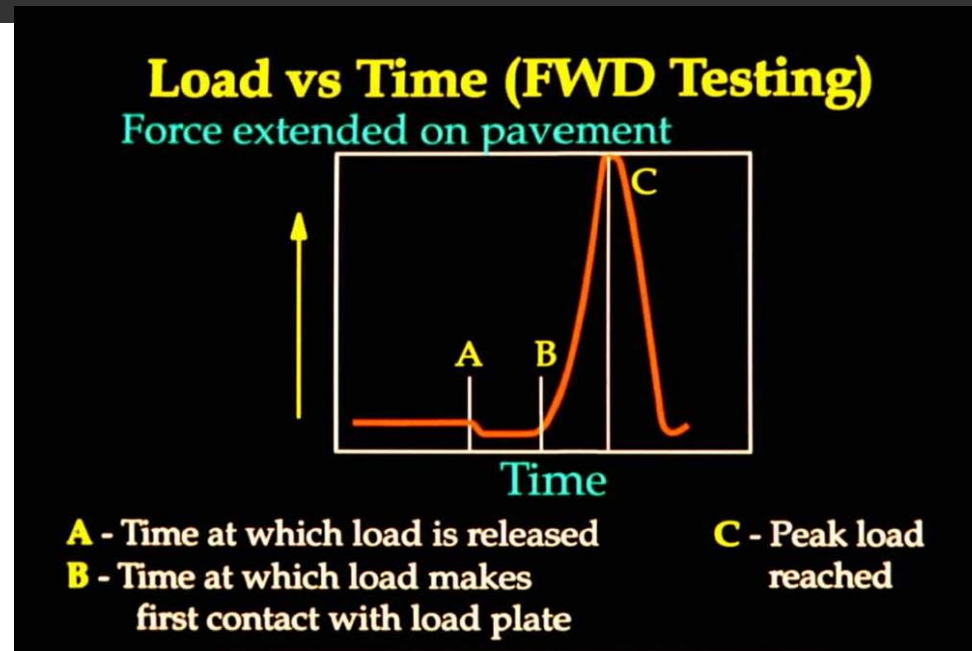


FWD Components

- All instrumentation used simultaneously
- Deflection profile is key output
- Temperature and load data used with deflections to back-calculate pavement structure characteristics

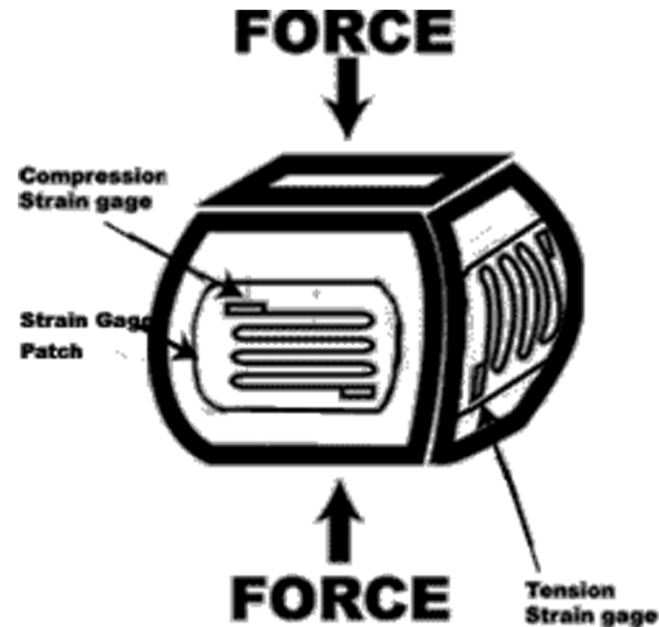


Load Cell Details



- ❑ Load cell used to measure the impulse loading
- ❑ Heavy-duty load cell required to support loading up to 60 kips in magnitude
- ❑ Load created from dropping weights from specified height

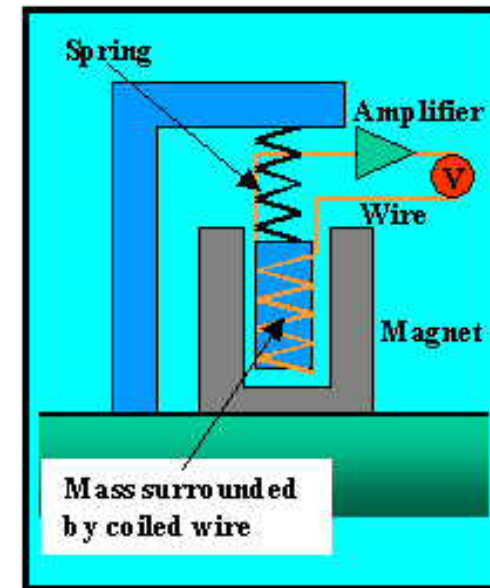
Load Cell Details



- Load cell measures applied force with strain gages inside assembly
- Measured strains on a stainless steel block allows calculation of applied force

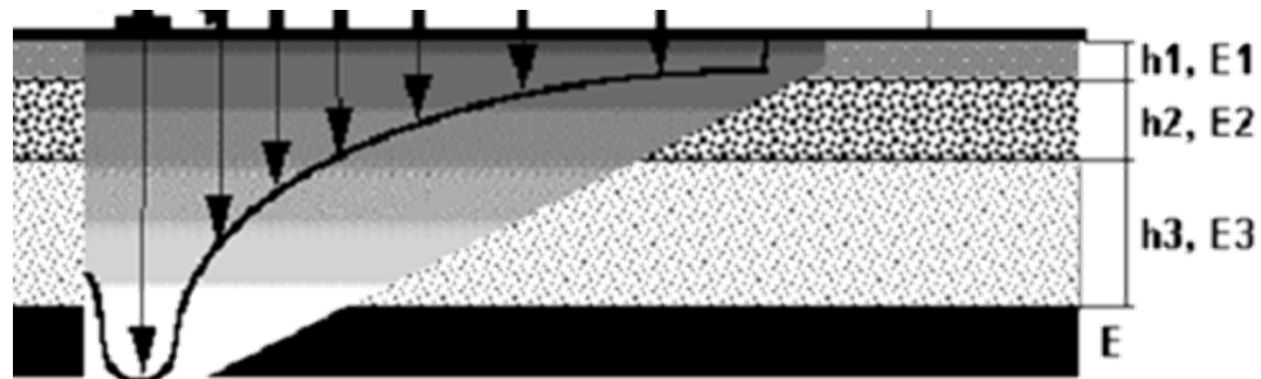
Deflection Gage Details

- Geophones, LVDT's, or Accelerometers measure deflections
- Geophones and LVDT's are most commonly used
- Deflections measured at known distances from load plate



Deflection Gage Details

- Deflection basin is desired output
- Deflections are on magnitude of 0-100 mils (mil=1/1000 in.)
 - High sensitivity is required for measurement



Temperature and Distance Gages

□ Temperature

- Air, Surface, and Pavement temperatures recorded
- Temperature used to normalize data
- Curves based on pavement type
 - Properties of asphalt are very temperature dependant

□ Distance Measuring Device

- Electronic Distance measuring device is attached to the axle of the trailer
 - Records test locations with deflection and load data
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Instrumentation Specifications

□ Load Cells

□ Range: 0 - 60,000 lb.

□ Accuracy: 2%

□ Displacement

□ Range: 0 to 100 mils (0 to 2500 μm)

□ Accuracy: ± 0.04 mils (1 μm)

□ Temperature

□ Range: 0 to 750° F

□ Accuracy: $\pm 0.5^\circ$ F

FWD Applications

- Pavement analysis and design
 - Airports
 - Highways
 - City Streets
 - Parking lots
 - Pavement Management Systems
 - Pavement rehab./overlay design
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Advantages of FWD Testing

- Test large area very quickly
 - Run 1 test per minute
 - Grid pattern to get general picture
 - Data compiled and viewed in real-time
 - Entire test can be run from a laptop inside vehicle
 - Non-destructive test
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Summary

- The FWD is composed of several types of instrumentation that work together.
 - Load cells, deflection gages, temperature gages working in unison to provide engineering insight
 - Provides fast, non-destructive evaluation of pavements
 - Provides information on condition of underlying pavement layers
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