SUMMARY & REVIEW
of
FIELD DATA WORKSHOP I

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FIELD DATA WORKSHOP II

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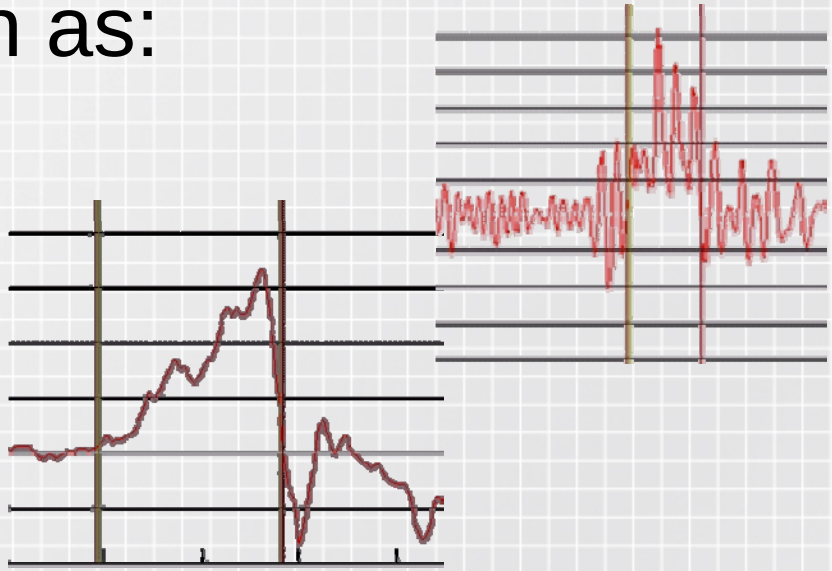
PURPOSE AND SCOPE, FDW I

- Proper acquisition of field data, to be used for the creation of laboratory simulation tests
- “Data Depot” baseline requirements
- Topics:
  - Project description and documentation
  - Instrument mounting
  - Control of variables
  - Instrument recording setup
  - Data and analysis (leading to FDW II)

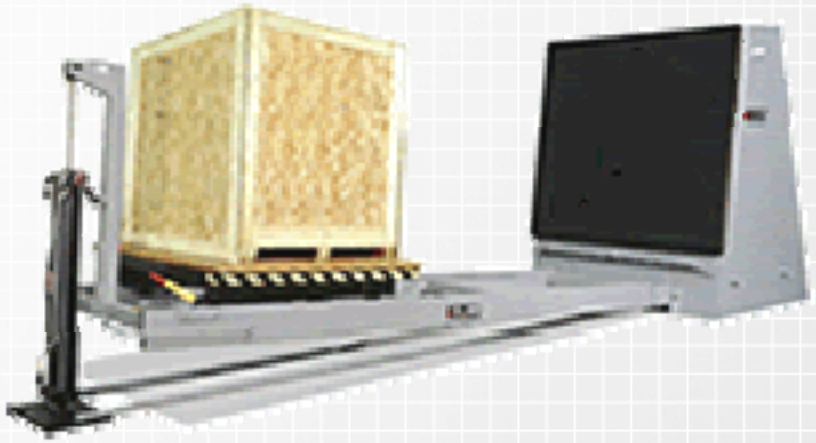
SHOCK/IMPACT APPLICATION

- Measure shocks/impacts associated with situations such as:
  - Railcar coupling
  - Truck docking
  - Pallet marshalling
  - Etc.

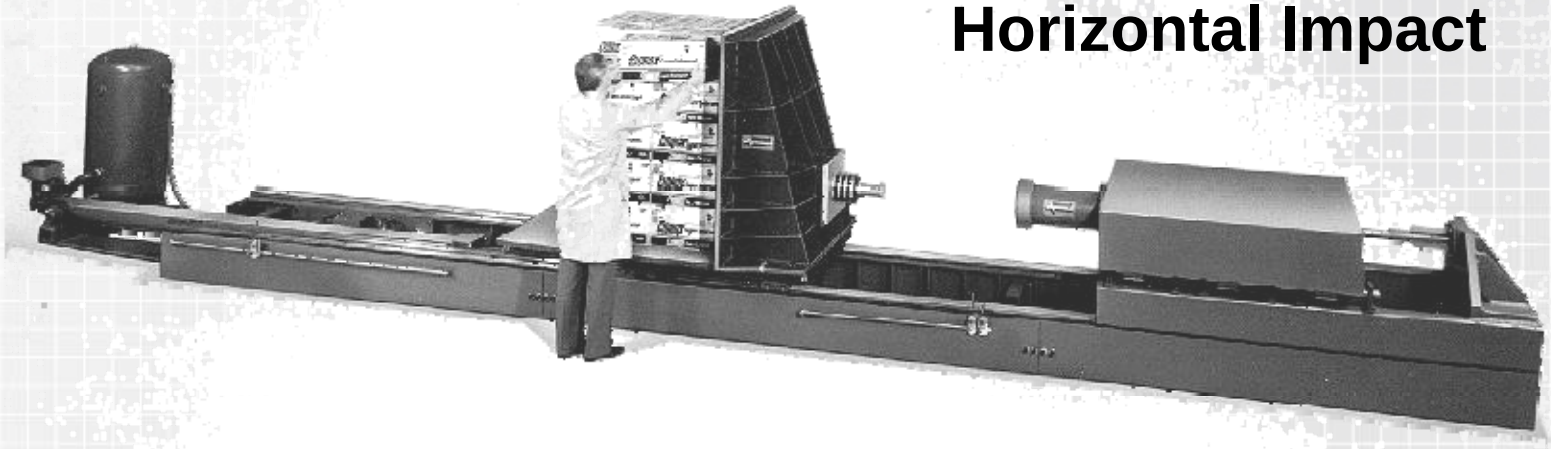


- Then simulate the damaging aspects of those shocks/impacts in the laboratory

LAB SIMULATIONS



Inclined-Impact



Horizontal Impact

MEASUREMENT PROJECT DESCRIPTION

- The data is most useful with complete supporting information:
  - The vehicle/equipment and details
    - Type and configuration
    - Suspension system, draft gear, structure, design
    - Load or lading
  - Related equipment/obstacles and conditions
  - Impact speeds
  - The instrument and details
    - Mounting means, location, and orientation
    - Recording setup

MEASUREMENT PROJECT DESCRIPTION

Photos, videos, drawings, etc.

can be extremely valuable

INSTRUMENT MOUNTING

- The recorder should be solidly mounted near the impact point
  - Any structure between the instrument mounting location and the location best representing dynamic inputs could adversely affect the data

INSTRUMENT MOUNTING

Railcar Coupling

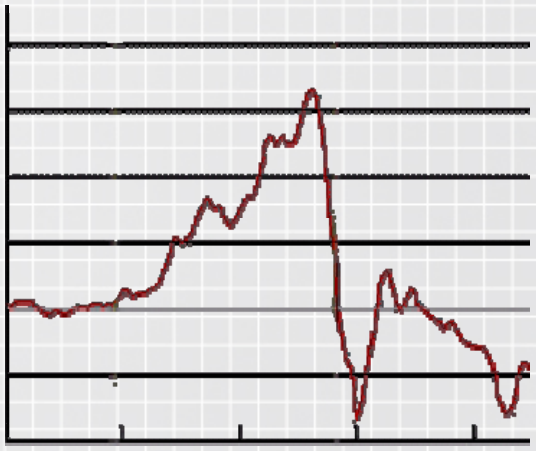
Pallet Marshalling

CONTROL OF VARIABLES

- In general, explore only one set of variables at a time
  - Same rail car, lading, recorder mounting
    - Explore different impact speeds
    - Change lading, same set of impact speeds
    - Change car type, same set of impact speeds
  - Same unit load, same lift truck
    - Explore different impact speeds
    - Same load, explore different impact types
    - Change load, same set of impact speeds
- Data to support extrapolation

INSTRUMENT RECORDING SETUP

- The measurement of shock pulses is relatively straightforward
  - Full-waveform recording
  - Capture sufficient time to contain the pulse
  - Sample fast enough relative to pulse duration and frequency content
  - Level triggering with pre-trigger recording
  - Frequency response to cover both long pulses and high frequencies



DROP APPLICATION

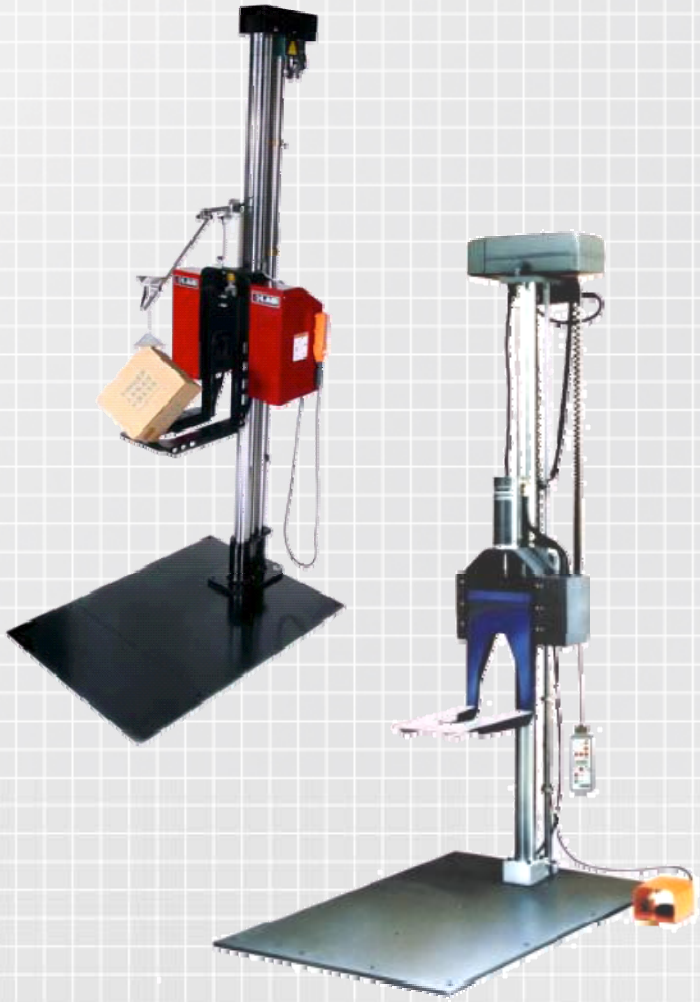
- Statistically characterize the handling drops and shocks
  - Typically, how many?
  - From what heights, or with what damage potential?
  - What impact orientations?
- Configure a lab free-fall drop test sequence that provides reasonable simulation

DROP APPLICATION

- Except for data analysis, a drop height measurement project is relatively straightforward
  - Prepare the instrumented test package
  - Ship it through the distribution environment
  - Record acceleration-vs.-time data
- Data analysis is the challenge
  - Drop height or damage potential is not measured directly, it is calculated or deduced from acceleration information

LAB SIMULATION

- Free-fall drop testing in the lab, onto a hard surface
- Desired data is in terms of “Equivalent Free-Fall Drop Height” (EFFDH) or equivalent damage potential

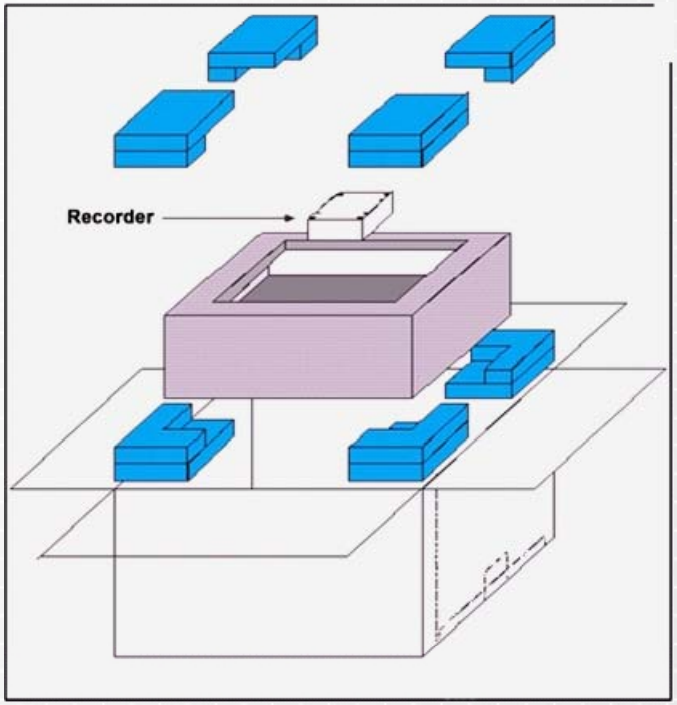


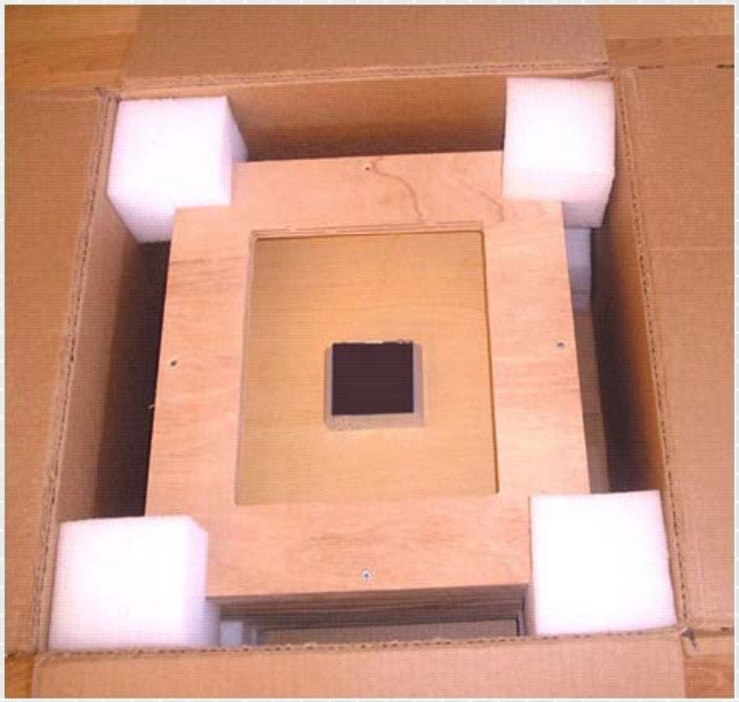
MEASUREMENT PROJECT DESCRIPTION

- The data is most useful with complete supporting information:
  - The instrumented package
    - Physical details – size, weight, construction, etc.
    - Recorder orientation
  - Distribution system – carriers, routes, vehicles, equipment, conditions, etc.
  - The instrument and details
    - Recorder mounting
    - Recording setup

INSTRUMENT MOUNTING

- Dummy package, not actual product





Solid recorder mounting, non-resonant structure, external cushions

INSTRUMENT MOUNTING

- Rigid outer container, interior cushioning

CONTROL OF VARIABLES

- In general, explore only one set of variables at a time
- Possible variables
  - Package
    - Configuration, size, weight
    - Markings, etc.
  - Distribution
    - Modes
    - Carriers
    - Routes
    - Service levels

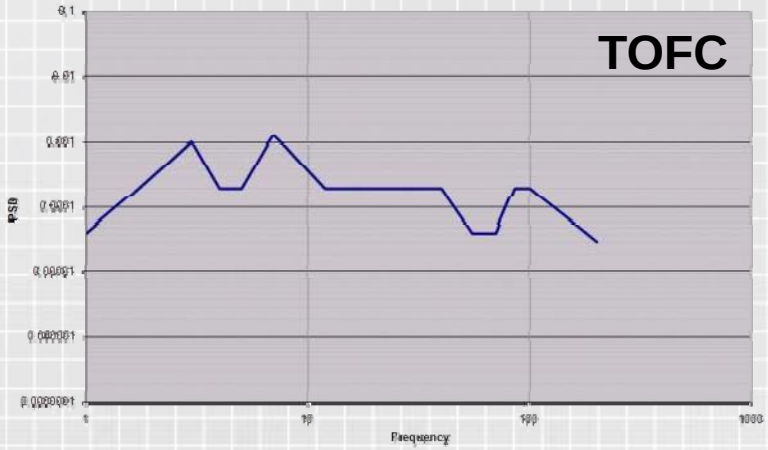
INSTRUMENT RECORDING SETUP

- Essentially a straightforward shock pulse measurement setup
  - Full-waveform recording
    - Must be able to record 100's or 1000's of pulses
  - Capture sufficient time to contain the data
  - Level triggering
    - With pre-trigger recording
    - Long pre-trigger record time – data before the pulse can be important
  - Exact setup depends upon characteristics of dummy package

VIBRATION APPLICATION

- Measure vehicle vibrations
- Analyze data into PSD (power spectral density) plots
- Conduct random vibration, PSD-based vertical vibration tests in the lab

LAB SIMULATION



MEASUREMENT PROJECT DESCRIPTION

- The data is most useful with complete supporting information:
  - The vehicle and details
    - Type and configuration
    - Suspension system (road and rail vehicles)
    - Lading
  - The road/rail/air conditions
  - The instrument and details
    - Mounting means, location, and orientation
    - Recording setup

MEASUREMENT PROJECT DESCRIPTION

- It can also be helpful to know:
  - Routes and speeds
  - GPS information related to vibration data
  - Details, details, details

Photos, videos, drawings, maps, etc. can be extremely valuable

INSTRUMENT MOUNTING

- Ideally, the recorder should be solidly mounted to the floor or floor structure of the vehicle
  - The objective is to have the table of the lab testing machine simulate the movement of the vehicle's floor
  - It is not possible to make adequate vehicle vibration measurements with a recorder mounted in a package placed up in the load

INSTRUMENT MOUNTING

CONTROL OF VARIABLES

- In general, explore only one set of variables at a time
- Possible variables
  - Vehicle and suspension type
  - Type and amount of lading
  - Recorder mounting location
  - Routes
  - Road categories and conditions
  - Speeds
  - Etc.

INSTRUMENT RECORDING SETUP

- The instruments do not record continuously, but time and/or level trigger to capture time events of a few seconds each
  - Full-waveform recording is required
  - Must be able to record thousands of events
  - Long enough event times to capture desired low frequencies
  - High enough sampling rate to measure desired high frequencies