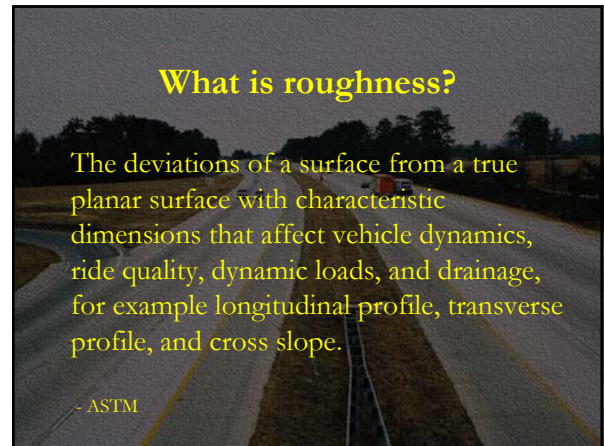
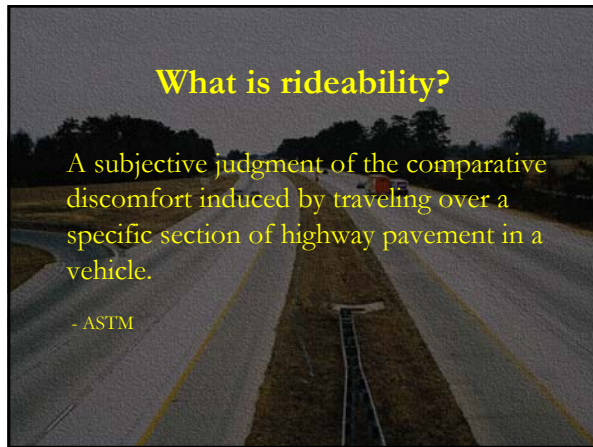


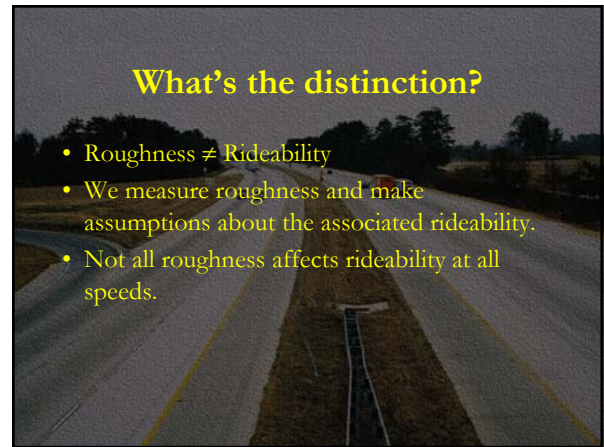
Smoothness
Rideability Measurement in South Carolina
Merrill Zwanka
SCDOT Office of Materials and Research



What is roughness?
The deviations of a surface from a true planar surface with characteristic dimensions that affect vehicle dynamics, ride quality, dynamic loads, and drainage, for example longitudinal profile, transverse profile, and cross slope.
- ASTM

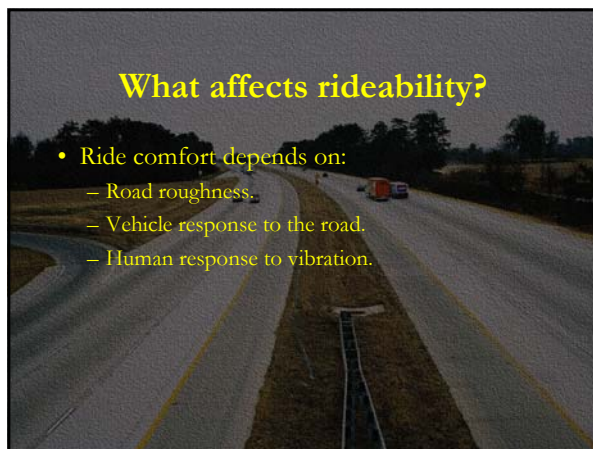


What is rideability?
A subjective judgment of the comparative discomfort induced by traveling over a specific section of highway pavement in a vehicle.
- ASTM



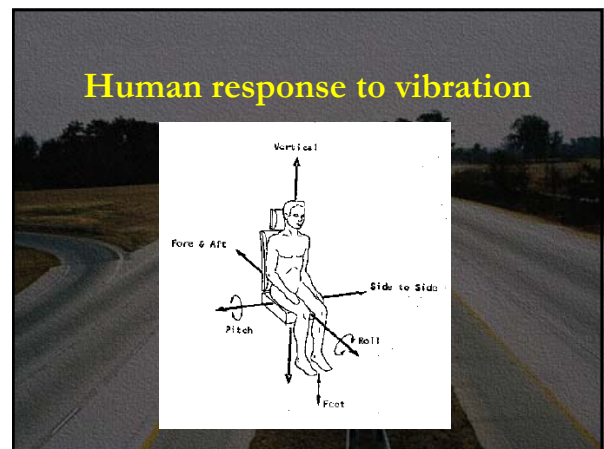
What's the distinction?

- Roughness \neq Rideability
- We measure roughness and make assumptions about the associated rideability.
- Not all roughness affects rideability at all speeds.

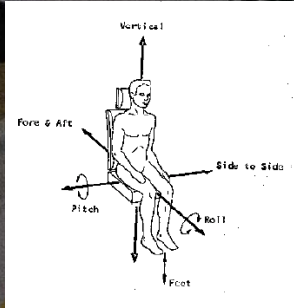


What affects rideability?

- Ride comfort depends on:
 - Road roughness.
 - Vehicle response to the road.
 - Human response to vibration.

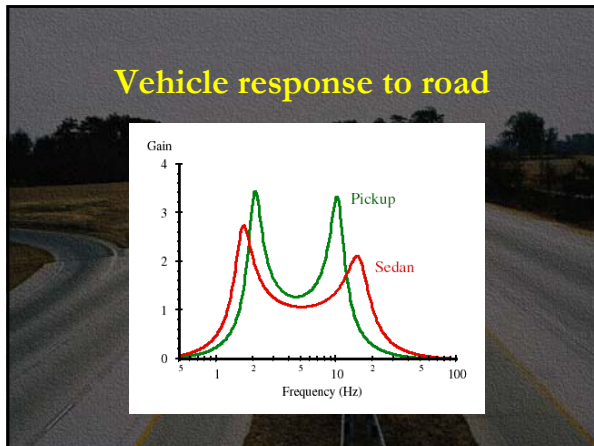


Human response to vibration

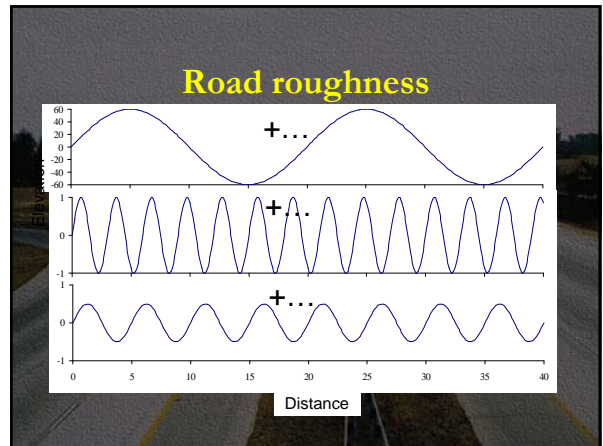


The diagram shows a human figure sitting on a chair with various axes of vibration indicated: Vertical (up and down), Fore & Aft (forward and backward), Side to Side (left and right), Pitch (tilting forward and backward), Roll (tilting left and right), and Foot (up and down).

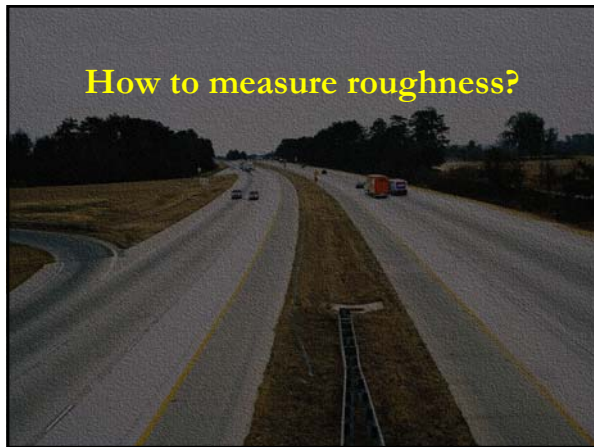
Vehicle response to road



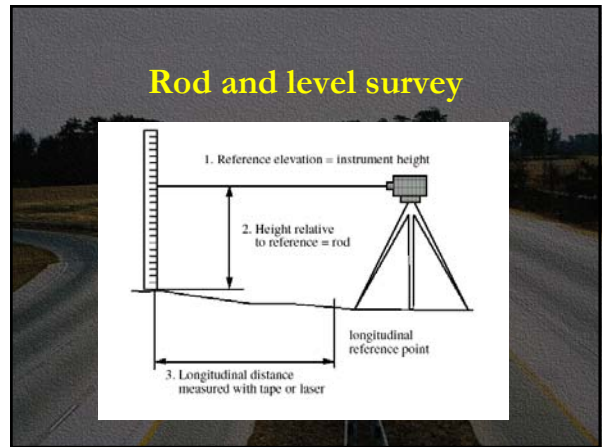
Road roughness



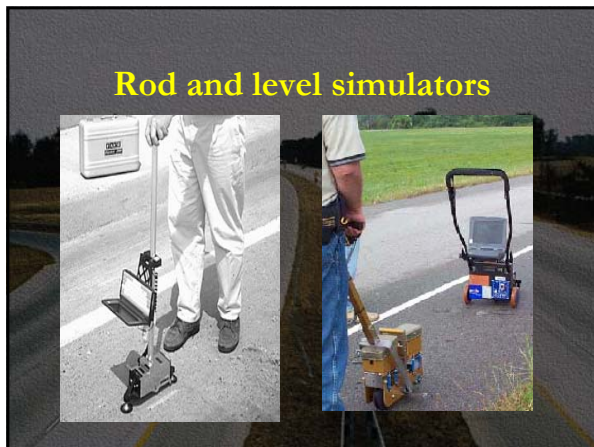
How to measure roughness?



Rod and level survey



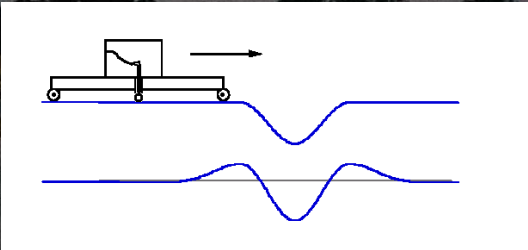
Rod and level simulators



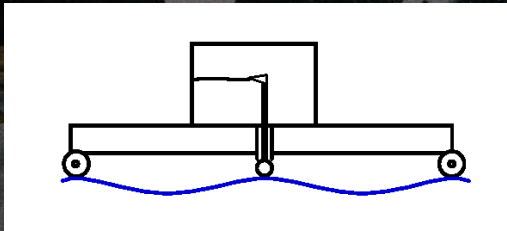
Rolling straightedges



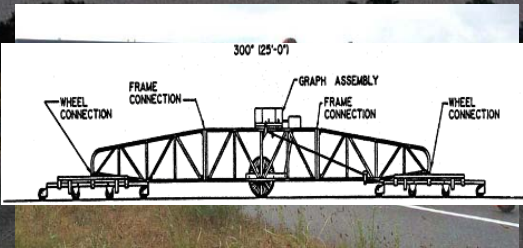
Rolling straightedges



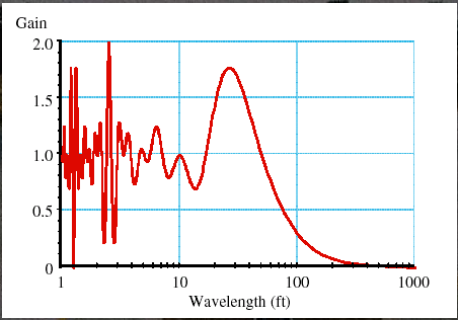
Rolling straightedges



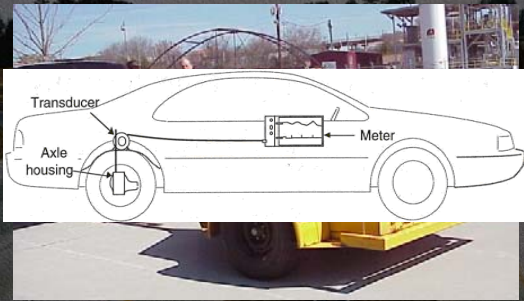
Profilographs



Profilographs



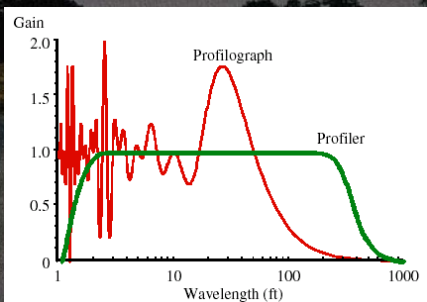
Response-type device



High speed inertial profilers

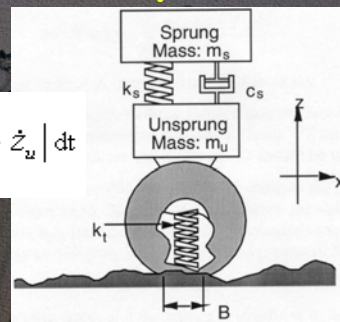


High speed inertial profilers

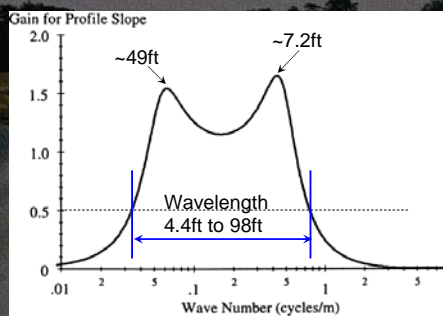


Profile → Rideability = IRI

$$IRI = \frac{1}{L} \int_0^{L/V} |\dot{z}_s - \dot{z}_u| dt$$



Profile → Rideability = IRI



SCDOT Rideability Specification

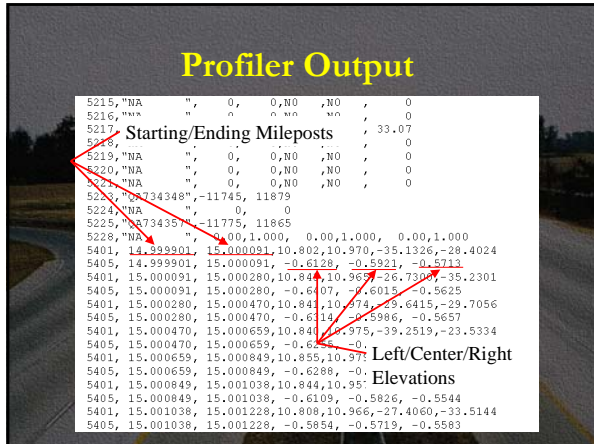
- From 1980's to 2007 –
 - Mays Ride Meter
 - Full payment for new pavement up to MRN of 40 on one mile lots.
 - Bonus payment for MRN of 34 or less.
 - Pay reduction for MRN of 41 or greater.
 - Rideability for overlays based on the improvement from pre-overlay rideability.

SCDOT Rideability Specification

- Beginning in August 2007 letting –
 - Inertial Profiler
 - Full payment for new pavement up to IRI of 65 on 0.1 mile lots.
 - Bonus payment for IRI of 55 or less.
 - Pay reduction for IRI of 66 or greater.
 - Rideability for overlays based on the improvement from pre-overlay rideability.

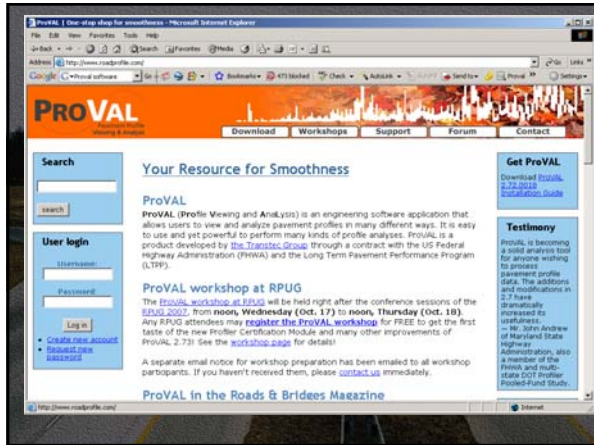
Profiler Output

- Measurement are taken at 3 inch intervals.
- Filters out wavelengths longer than 200 feet.
- May also include differential GPS information.
- Can operate between 25 and 70 mph.



ProVAL Software

- Stands for Profile Viewing and Analysis.
- Developed by The Transtec Group for FHWA.
- Available for internet downloading at no cost from www.roadprofile.com.
- Provides a graphical way to view and analyze profiler output.

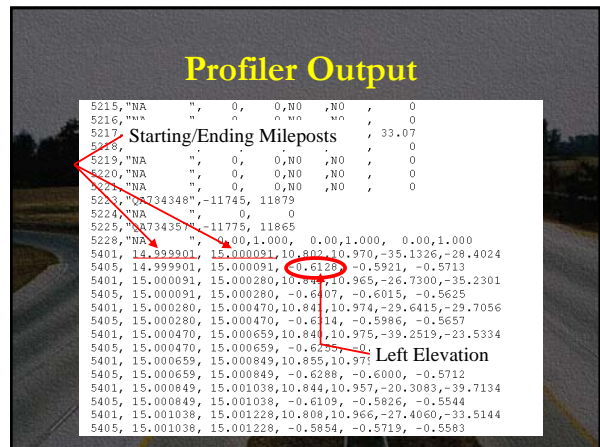


ProVAL Software

- Allows contractor and field personnel to look at actual profile and form better corrective action plan.
- Takes away the "black box" perception of rideability measurement.

ProVal Software

- Held a seminar for both contractor and DOT personnel on May 30, 2007 on how to use ProVal.
- Based on phone calls and questions, the software is being used.



2007 SEAUPG CONFERENCE – SAN ANTONIO, TEXAS

