Pavement Smoothness
Overview

Mark Swanlund, P.E.
Federal Highway Administration (HIPT)
400 Seventh St. SW, Room 3118
Washington, DC 20590
Presentation Overview

• National Pavement Condition Goal
• Profiler Demonstration
• Guide Specification
• Profile Index Relationship Report
• Best Practices Guides
• Profile Viewer Software
• Related Activities
Pavement Smoothness Goal

95% of the travel on the NHS will be on roads with IRI of 170”/mile or less
Profiler Demonstration
Profiler Demonstration

- Conducted in 1999
- Ten States participated
- Lightweight profilers showcased
- Project criteria
  - compare at least three light weight profilers
  - conduct at least five replicate tests
Overall Conclusions

• Repeatability
  – Generally devices achieved good repeatability
  – One device in each demonstration did not demonstrate repeatability
  – Longer test lengths: better results
Overall Conclusions

- Reproducibility
  - Not demonstrated
Overall Conclusions

- **Owner Agency Tests**
  - lightweight profilers adequate if not comparing results

- **QC/QA Specifications**
  - Lightweight profilers not adequate without further work
    - test method
    - validation
    - equipment certification
    - operator certification/training
Need for Guide Specification

• Repeatability
  – can be improved
• Reproducibility
  – Not demonstrated in Profiler demo
  – Critical for implementation
Guide Spec Components

• Smoothness Specification
• Test Method
• Equipment Specification
• Equipment Certification/Calibration
• Operator Certification
Smoothness Specification

- Inertial profilers
  - lightweight
  - high speed
- Index IRI
- Full Pay 60-65”/mile, min30, max95
  - over 95 correct to 60
- Localized roughness
- Continuous function I/D
Test Method

• Verification (daily)
  – Height sensor
  – Bounce test
  – Establish Control Section
    • DMI check
    • IRI on control section

• Log of Verification
Test Method

- Operation speed critical
- Lead-in to test section
- Number of traces
- One sensor devices (MRI & HRI)
- Resolution of disputes
- File format
Equipment Specification

- Low speed (5-20 mph)
- High speed (20-70 mph)
- Automated triggering recommended
- Measuring IRI from 5-300 in /mile
- DMI accuracy of 0.1%
- Height sensor resolution 0.001 in.
- Reporting interval of 2 in.
Equipment Certification

• Tests
  – height sensor
  – DMI
  – Bounce test
• 10 runs on reference section
  – profile precision
  – profile accuracy
  – IRI precision
  – IRI accuracy
Equipment Certification

• Reference Profile
  – 4.75 in sample interval
  – established using rod and level, Dipstick, etc
  – 528 feet plus lead-in

• Certification for specific device
Operator Certification

• Training required
  – specific equipment (manufacturer)
  – profiling practices (NHI course)

• Written and practical test
  – smoothness specification
  – profiler calibration/verification
  – profile data collection
  – profile evaluation
Status

- Published as a Provisional Standard June 2003
- Refinements underway
Smoothness Index Relationships Report

• Assists States transition to IRI or PI_{0.0} specifications
• Utilized 40,000 LTPP Profiles
• Computed IRI, Simulated PI
• Converted existing specifications
Best Practice Guides

• HMA Smoothness Best Practice Guide
• PCC Smoothness Best Practice Guide
  – Measuring and specifying smoothness
  – Constructing smooth pavements

– Currently Available
Profile Viewer Software (ProVal)

- Profile Viewer 1.0
  - Software to View and Analyze Profile Data
  - Features
    - IRI
    - PI
    - Power Spectral Density (PSD)
    - Cross-Correlation
    - Standard file format
  - Future development.....
Related Activities

• Profiler Pooled Fund Project
  – 15 states and FHWA participating
  – Detailed presentation June 24, 1:45 pm
  – Contact: Bob Orthmeyer
Related Activities

• Smoothness Criteria for Concrete Pavement
  – FHWA research contract
  – Determine objectionable profile characteristics
  – How smooth is smooth enough?
  – Localized roughness

– Contact: Mark Swanlund
Questions?

Mark Swanlund
Federal Highway Administration
phone: 202-366-1323
email: mark.swanlund@fhwa.dot.gov