

EVALUATION OF PAVEMENT SMOOTHNESS FOR LTPP SPS WIM SITES

NATMEC 2000



U.S. Department of Transportation
Federal Highway Administration



Long-Term Pavement Performance
Serving Your Need for Durable Pavements

Background

- ◆ Accuracy of traffic data from WIM scales affected by dynamic motions
- ◆ Dynamic load \neq static weight
- ◆ Dynamic motion is a function of:
 - + Short wavelength roughness - axle motions
 - + Long wavelength roughness - vehicle body bounce

Smoothness Specifications

Address following applications:

- ◆ Evaluation of existing WIM locations
- ◆ Acceptance of new WIM locations
- ◆ Annual check of active WIM locations

Evaluation of Existing WIM Locations

- ◆ Short wavelength:
 - + Longitudinal (required)
 - Profiler (can use straightedge)
 - + Transverse (optional)
 - Straightedge
- ◆ Long Wavelength (required)
 - + Profiler (can use Dipstick)

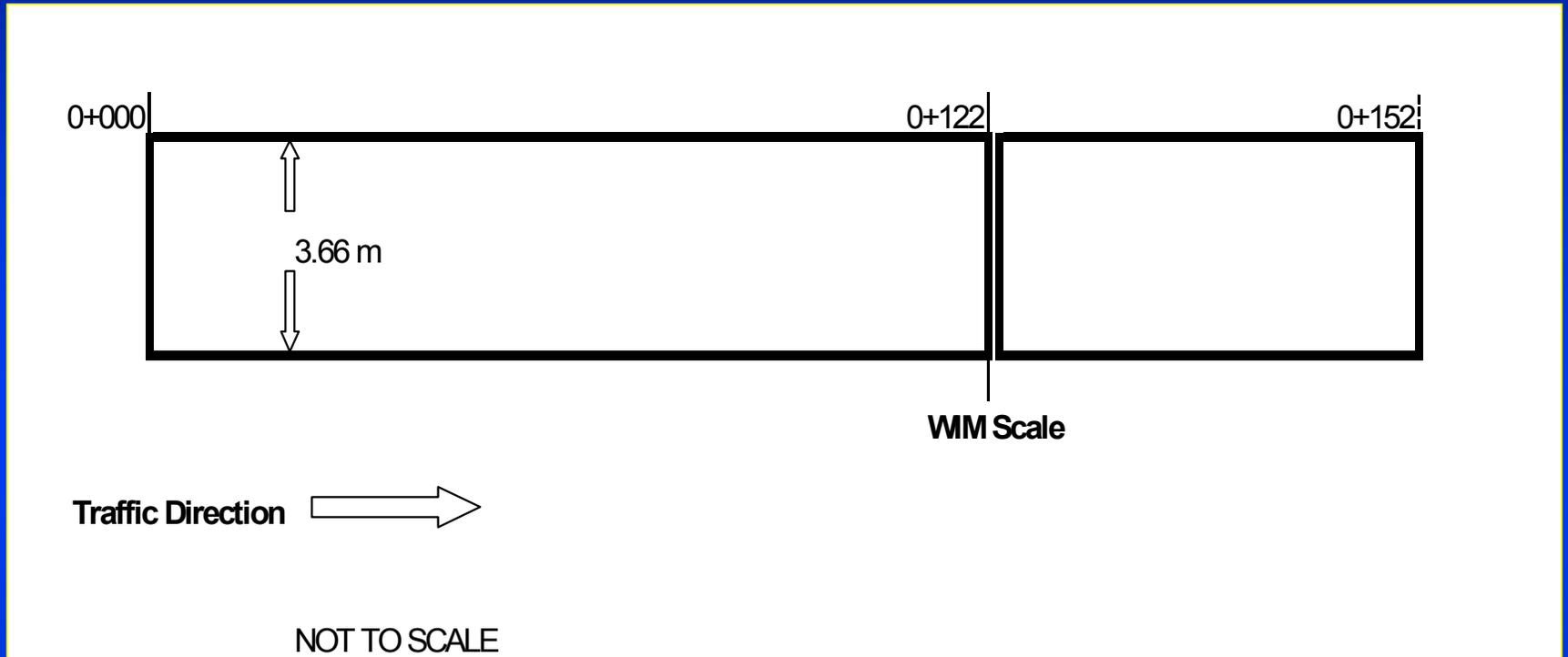
Annual Check of Active WIM Locations

- ◆ Short wavelength:
 - + Longitudinal (required)
 - Profiler
 - + Transverse (not required)
- ◆ Long Wavelength (required)
 - + Profiler (can use Dipstick)

Acceptance of New WIM Locations

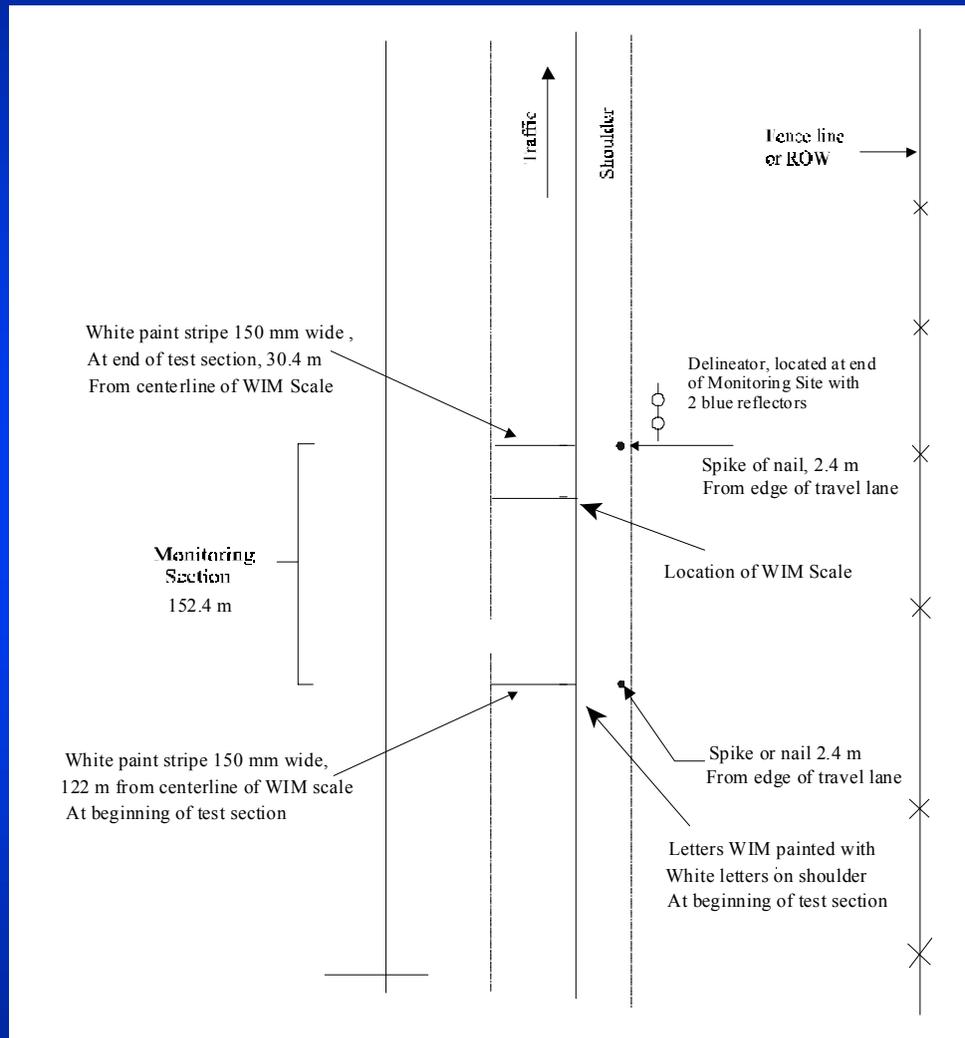
- ◆ Short wavelength:
 - + Longitudinal (required)
 - Straightedge
 - + Transverse (required)
 - Straightedge
- ◆ Long Wavelength (required)
 - + Profiler or Dipstick

WIM Section

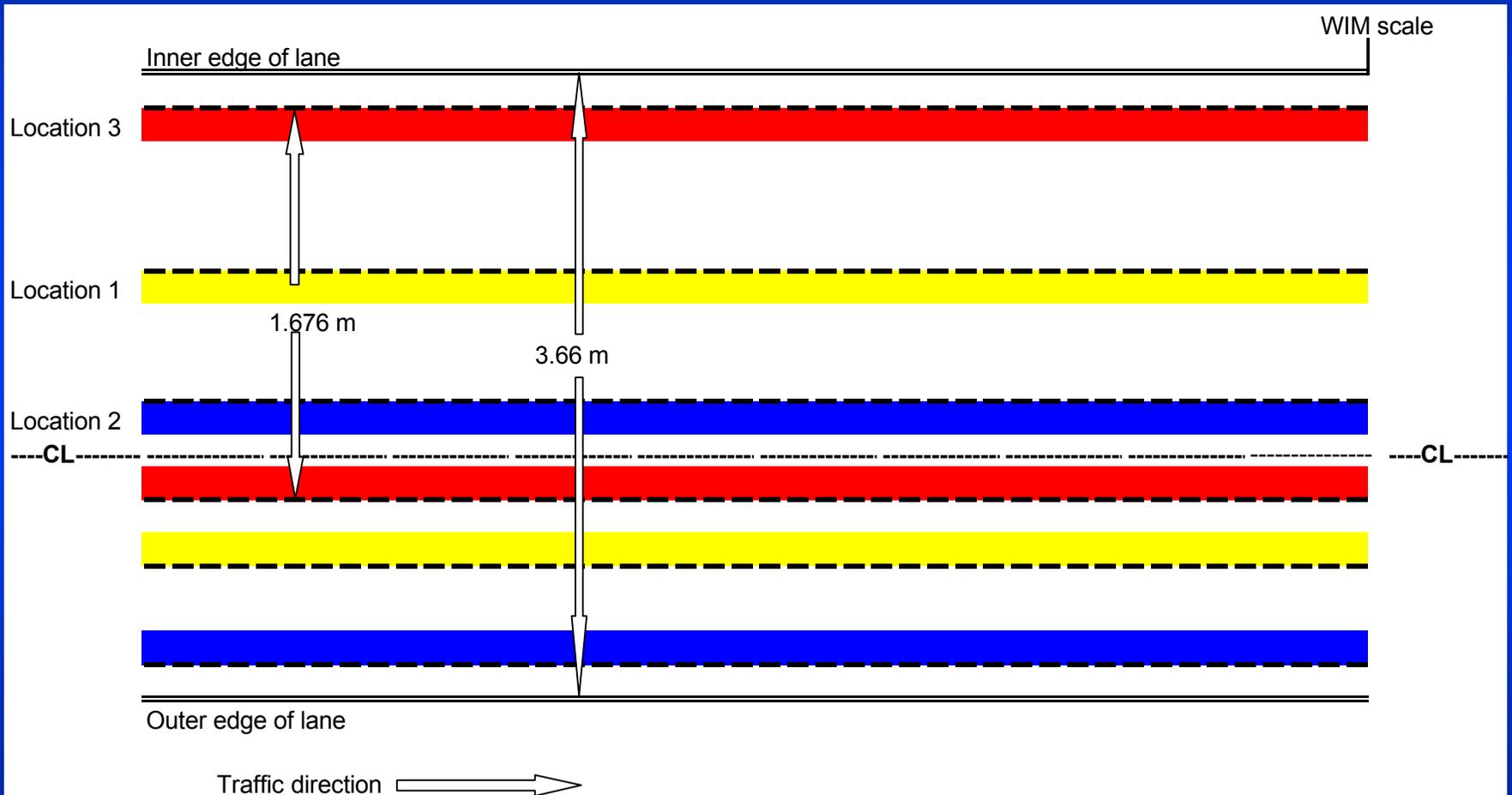


**Pavement surface types: (1) PCC, (2) AC
or (3) AC/ PCC (WIM)/AC**

WIM Section Markings



Short Wavelength - Profiler

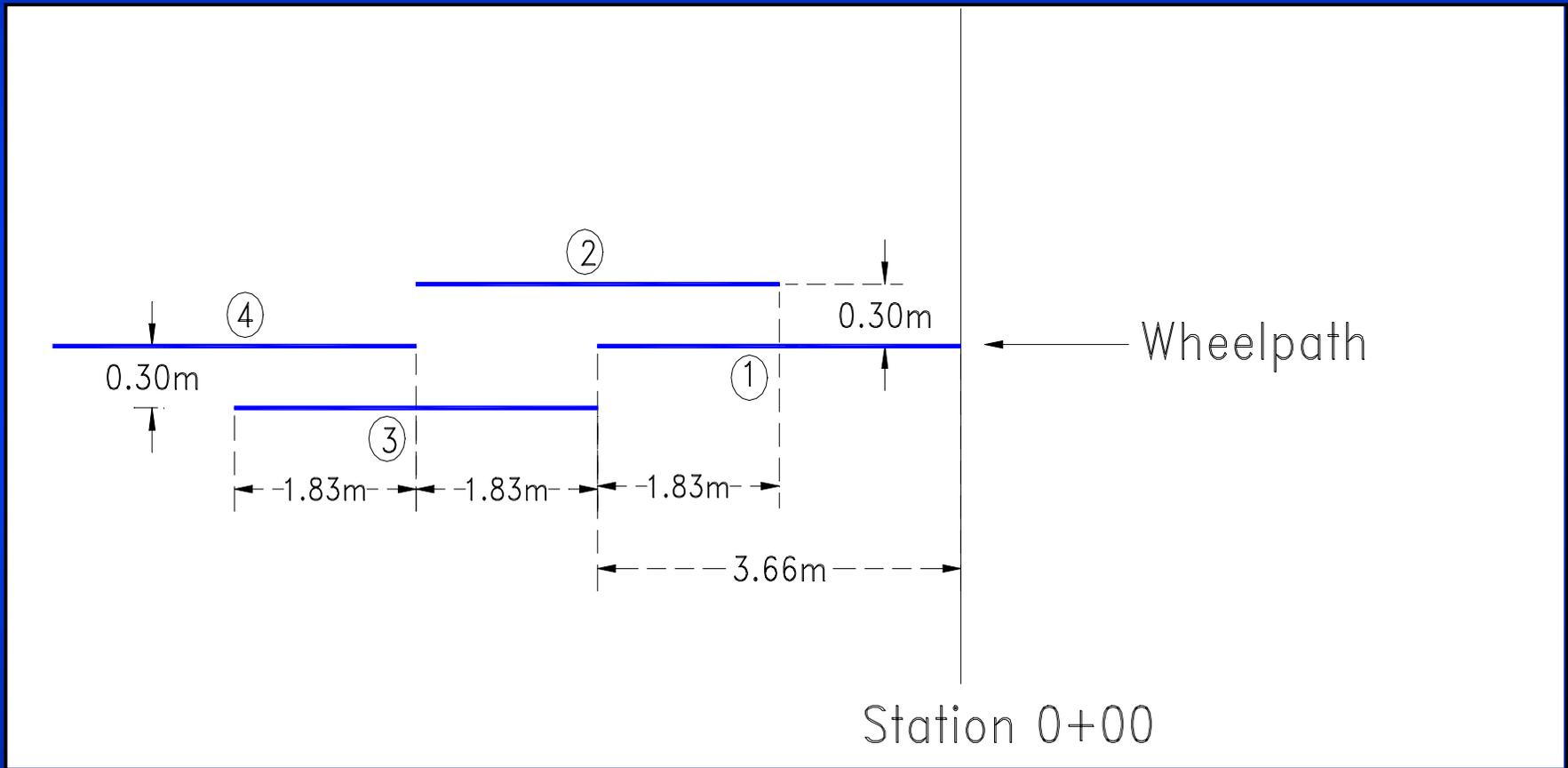


Short Wavelength - Profiler

- ◆ **Smoothness criteria**

If simulated 3 mm plate passes below limits of simulated straightedge at any longitudinal test location ***on all three passes for any given lateral location***, then WIM section is considered to have failed specification.

Short Wavelength - Straightedge

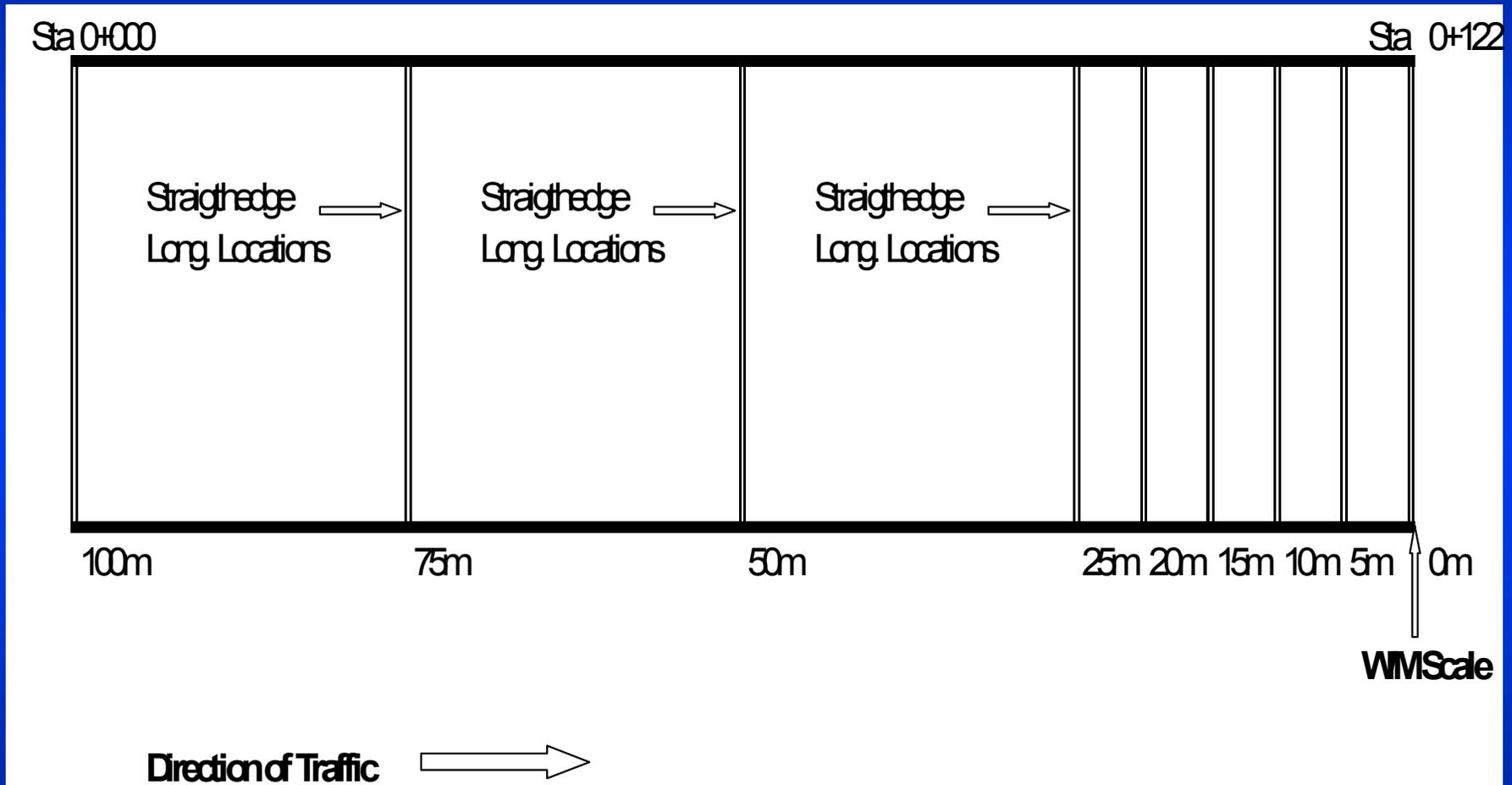


Short Wavelength - Straightedge

◆ Smoothness criteria

If 3 mm plate with $D = 150$ mm passes below limits of straightedge at any test location, then WIM section is considered to have failed specification.

Transverse Profile- Straightedge



Transverse Profile- Straightedge

◆ Smoothness criteria

If 3 mm plate with $D = 150$ mm passes below limits of straightedge at any transverse test location within 25m of the sensor, then WIM section is considered to have failed specification.

Long Wavelength - Profiler Data Collection Requirements

- ◆ Use data from short wavelength - profiler
 - + Class I profiler
 - + 2 sensors, 3 lateral locations
 - + Only 1 error-free run per lateral location required

Development of Long Wavelength Index

- ◆ Task 1: Setup Fleet of Typical Vehicles
- ◆ Task 2: Get Set of Profiles
- ◆ Task 3: Run Fleet Over Roads
- ◆ Task 4: Create Relevant Profile Analysis
- ◆ Task 5: Develop and Test Computer Software for On-Site Profile Assessment

1. Setup Typical Vehicle Fleet

- ◆ Use information from NCHRP Project 1-25
 - + Update vehicle suspension properties
 - + Change matrix to emphasize 3S2 vehicles
- ◆ Large number of runs will be needed to do statistical part of study and to test proposed algorithms for identifying passing or failing WIM sites

Vehicle Configurations

- ◆ Vehicle fleet will include broad range of suspension and tire combinations and vehicle layouts
- ◆ Each suspension combination implies list of vehicles that vary in wheel-base and tire combination
- ◆ Will vary overall weight, load distribution, and tire inflation level within given vehicle layout

2. *Get Set of Profiles*

- ◆ Set of profiles should cover broad range of pavement construction, type, climate and roughness conditions
- ◆ Confined to roads with speed limits between 40 and 70 mph, with emphasis on WIM calibration sites
- ◆ Real and synthesized profiles needed

3. Run Fleet Over Roads

- ◆ Must add batch run capability to TruckSim
- ◆ Simulate modest matrix of trucks over small set of artificial roads to define way to summarize dynamic wheel load output
- ◆ Run large batch run over all profiles to get predicted dynamic loads and summary statistics

4. *Create Relevant Profile Analysis*

- ◆ Index should determine if dynamic loads are within given percentage of static loads within set confidence interval
- ◆ Index should classify a site as: (1) acceptable, (2) acceptable with corrections or (3) not acceptable for WIM measurements

Long Wavelength Criteria

<i>Item</i>	<i>95% Confidence Level</i>
<i>Loaded single axle</i>	$\pm 20\%$
<i>Loaded tandem axle</i>	$\pm 15\%$
<i>GVW</i>	$\pm 10\%$

5. *Develop/Test Computer Software*

- ◆ Develop subroutine for computing analysis that results from study
 - + Input - profile, sample interval and profile points
 - + Output - index

Failure Resolution

- ◆ Failure does not eliminate site if equipment meets functional accuracy requirements
- ◆ Tailor resolution of pavement smoothness problem(s) to each WIM location; i.e., no canned solutions
- ◆ Solution(s) to be developed by expert team working with highway agency

Comments or More Information

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