




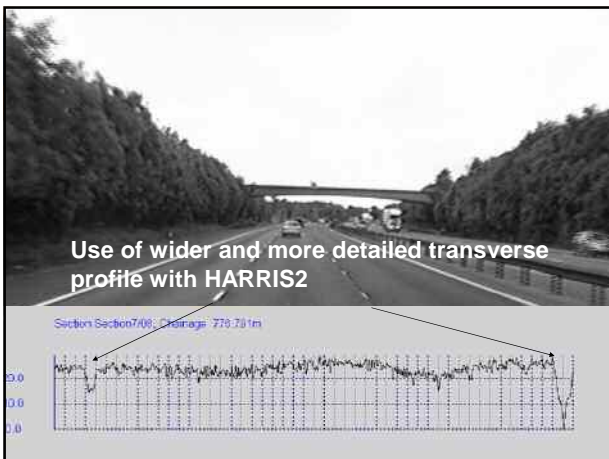




- ## Prime clients for following projects
- English Highways Agency
  - Department for Transport, England

- ## History of road profile measurements at TRL ( longitudinal)
- Multi wheel profilometer
  - Rolling Straight Edge
  - Bump integrator
  - High-speed Road Monitor (HRM) 
  - High-speed Survey Vehicle (HSV)
  - Highways Agency Road Research Information System (HARRIS1) 

- ## History of measurement of transverse profile at TRL
- High-speed Road Monitor (HRM)
  - High-speed Survey Vehicle (HSV)
  - Rutmeter
  - Highways Agency Road Research Information System (HARRIS1)
  - HARRIS2 



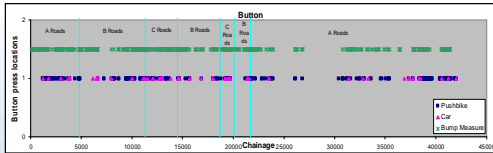
- ## Methods of interpreting profiles
- Longitudinal profile**
    - Variance (3m, 10m, 30m)
    - Power Spectrum Density
    - Wavelets
    - Bump measure
  - Transverse profile**
    - Rut depth
    - Transverse variance

## Identifying Bumps

- Existing measurements do not identify these – we need a new measure
- The **Central Difference Method** calculates a "derivative" for each point along the road (profile measurements (Pi), taken at distances (xi) along the road):

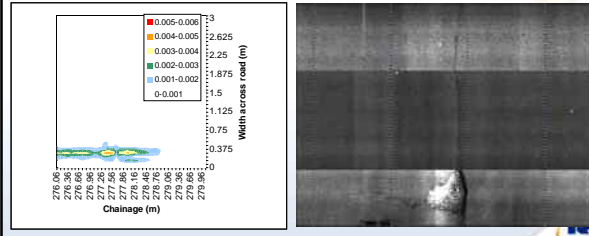
$$F'(x_i) = \frac{P_{i+1} - P_{i-1}}{x_{i+1} - x_{i-1}}$$

- The maximum of these values is calculated over 1m lengths.
- This identifies a high proportion of bumps (user button presses)

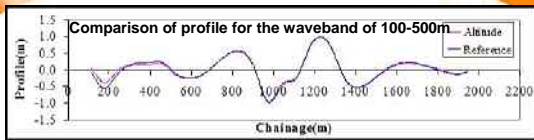


## Developing further measures - bumps

- Highlighting bumps with profile processing algorithms
- Characterising bumps by combining image processing and profile processing methodologies

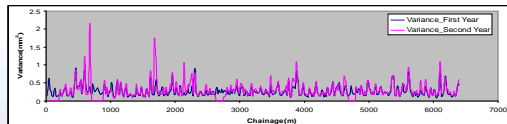
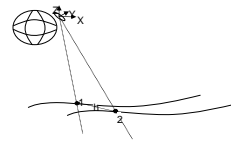


## Developing further measures – measuring absolute profile



## Developing further measures – changes in profile

- Development of algorithms to assess the change in shape, and hence identify structural deterioration
- Combining locational data (OSGR) with distance and profile data to align and compare



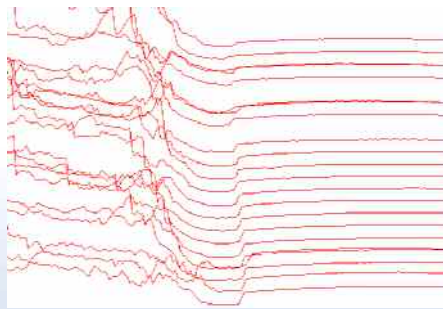
## Edge Deterioration - Enhanced Methods

- Location of the Road Edge
  - Using image processing
  - Using profile analysis
  - Combine to improve edge location



## Integrating 3D profiles and images (1)

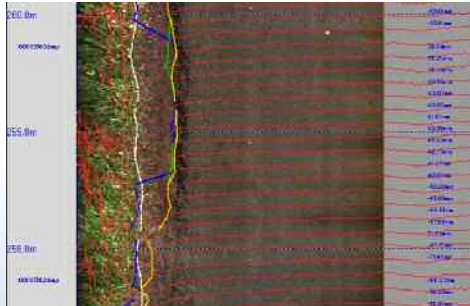
- Measurement of overriding
  - Fusion of image 'edge location' and profile 'step edge' information



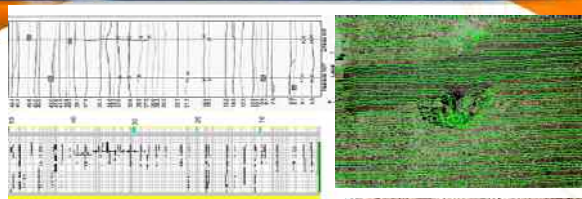
## Integrating 3D profiles and images (2)

### Measurement of overriding

- Fusion of image 'edge location' and profile 'step edge' information



## Enhanced data for scheme level inspection



- Developing "assisted" methods
  - Automatic joint detection
  - Automatic assessment of severity of profile defects
  - Loss of surface on overlaid concrete or High Friction Surfacing



## Extensive experience of measuring in-service roads

- **TRACS contracts 1 and 2**
  - Coverage of Core Strategic Network in England
    - 2000 10,000 lane km
    - 2007 40,000 lane km
- **SCANNER contract**
  - Coverage of Local Authority Network in UK
    - 2002 20,000 lane km
    - 2007 100,000 lane km
- **On behalf of HA and DfT, TRL provides comprehensive quality assurance services to all these surveys**

## Applicability to proposed R06 NDT projects (1)

- TRL have developed a wide ranging profile measurement capability – both longitudinal and transverse
- TRL have developed wide ranging methods of interpretation – both longitudinal and transverse
- TRL have developed techniques for combining profiles and images to provide even more robust results

All highly relevant to:

- (1) Automated methods of profiling bridges and other projects

## How to measure Rolling Wheel Deflection? (1)



## How to measure Rolling Wheel Deflection? (2)



English Highways Agency  
Traffic Speed Deflectometer



TRL and DRI working together to develop the potential of the Traffic Speed Deflectometer



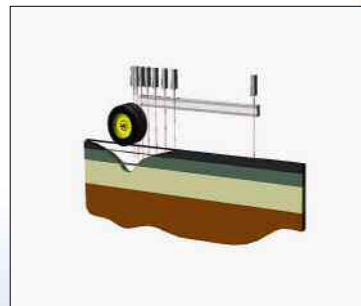
How does the TSD work?



It doesn't actually measure deflection!  
It actually measures deflection velocity



Principle of TSD measurement



Principle of TSD measurement

Deflection velocity [m/s]



Deflection [ $\mu\text{m}$ ]



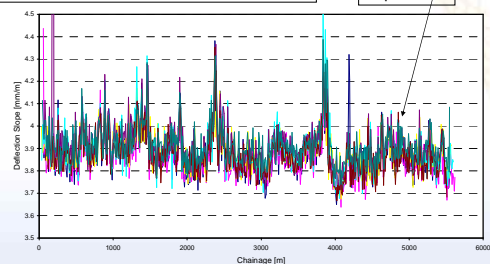
Deflection velocity / Driving velocity  
 $\alpha = \text{Deflection slope } [\mu\text{m/m}]$

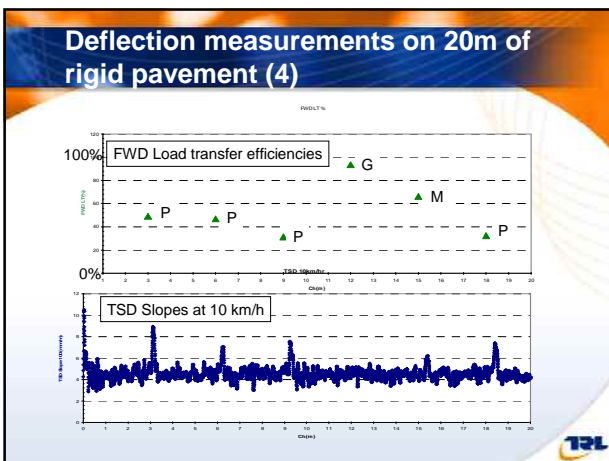
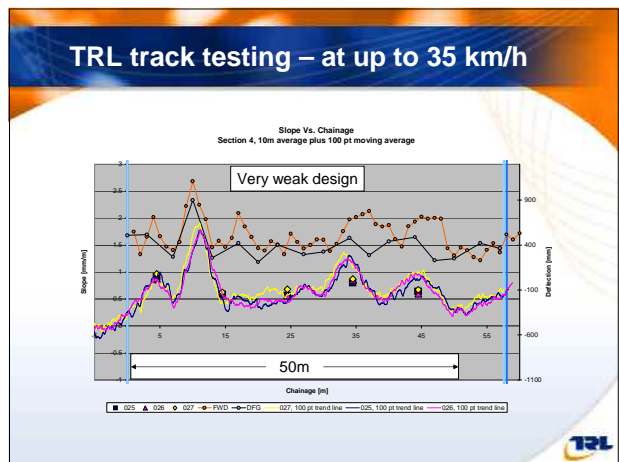
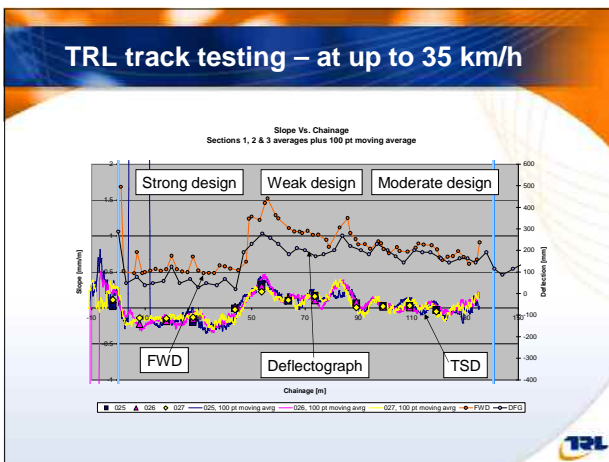
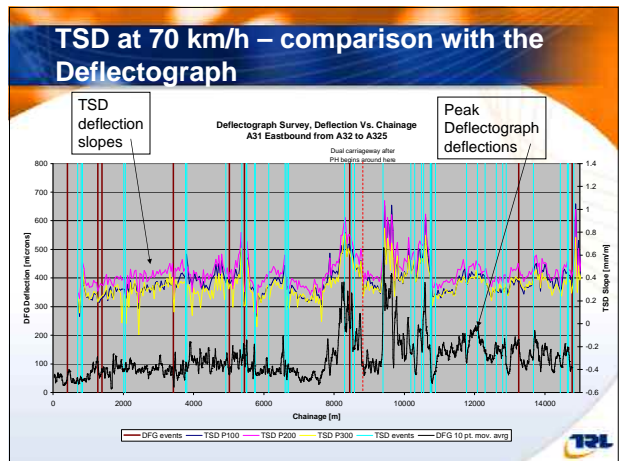
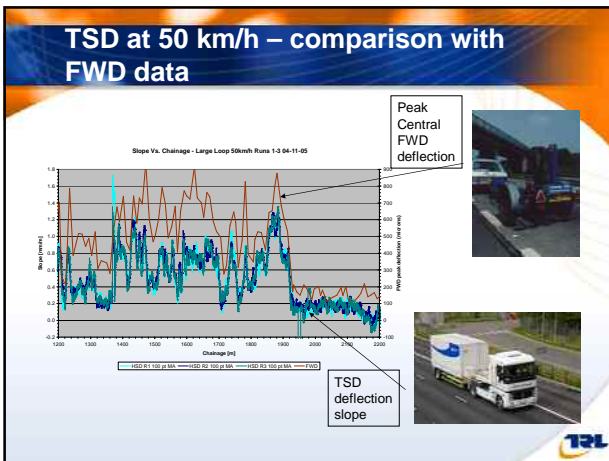


Repeatability of TSD at 70 km/h

Seven runs carried out over one month period

TSD deflection slopes





### Applicability to proposed R06 NDT projects - 2

The development of the TSD technology is highly relevant to:

(4) High speed continuous deflection device for pavements

TRL

## Summary

TRL has research experience in a number of areas relevant to the R06 project in particular

- Measurement and interpretation of road profile
- Measurement and interpretation of pavement deflection response



**Thank you  
for listening!**

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