SURF 2008

6th Symposium on Pavement Surface Characteristics

Portorož, Slovenija, 20-22 Oct 2008

Background and Purpose of Symposium

- Organised every 4 years by PIARC since 1988

- Main objectives:
  - To exchange technology, ideas and visions on road and airport pavement surface characteristics
  - to share and discuss experience about how to improve quality through effective management of road infrastructure assets with management systems capable of integrating all infrastructure components, based on performance indicators describing road functionality, in accordance with user expectations and managers' requests
  - To highlight importance of considering surface characteristics when building or repairing roads and highways

Themes of the Symposium

- Assessments of pavements (12)
  - Friction (4)
  - Noise (4)
  - Cracking (3)
- Data analysis tools (11)
- Performance criteria (3)
- Pavement management (8)
- Vehicle-road interaction (9)

54 Papers

World Bank's experience

DECIDING WHAT TO COLLECT:

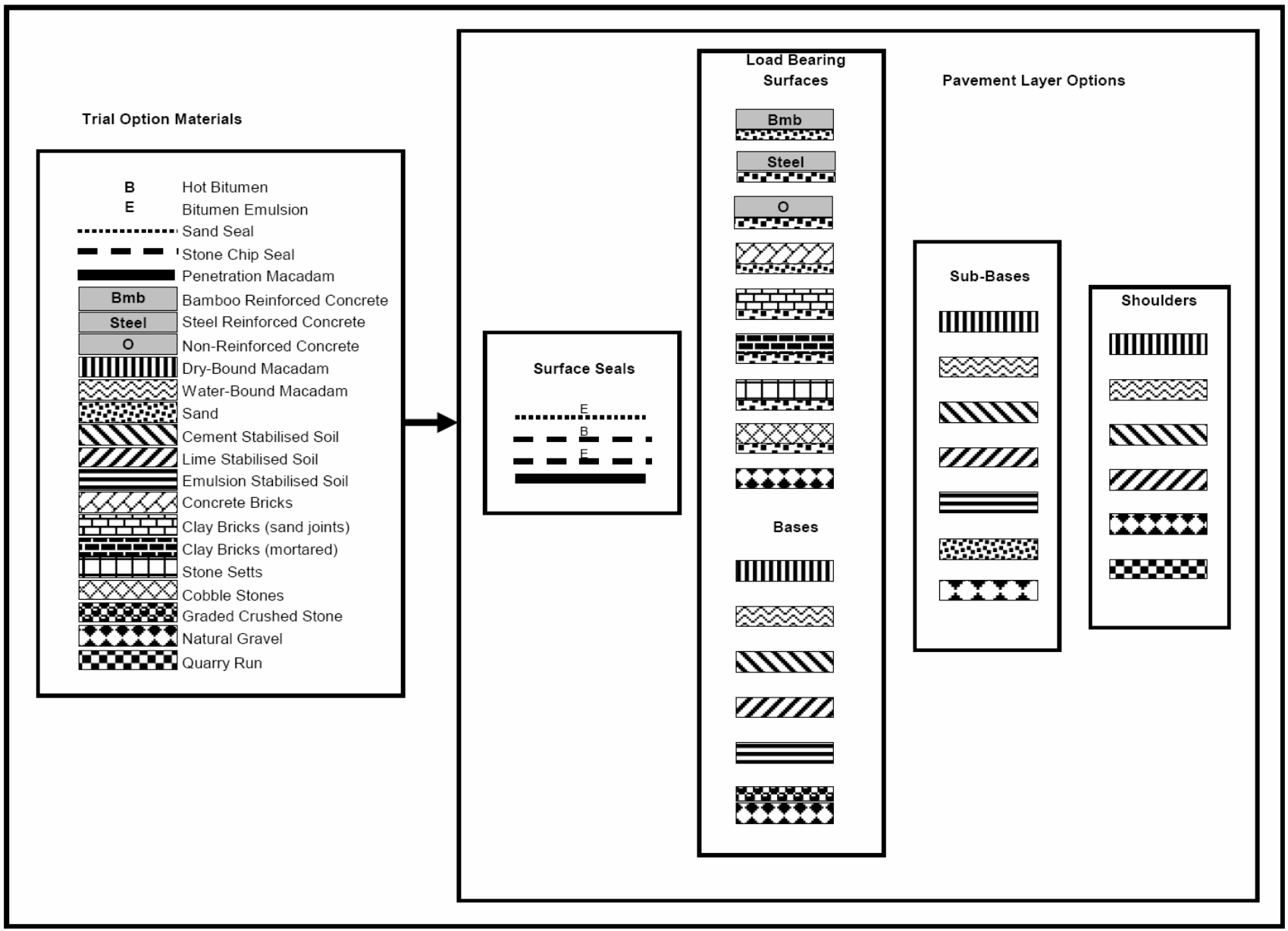
- Data collection is expensive. Each data item collected requires time, effort, and money to collect, store, retrieve, and use. The first rule of data collection is that data should never be collected because "it would be nice to have the data", or because "it might be useful someday." Many projects failed in the long-term because the sustainability—usually in terms of affordability—of the data collection program was not properly considered. The process that needs to be followed is to ask the following questions:
  - What decisions do we need to make to manage the network?
  - What data are needed to support these decisions?
  - Can we afford to collect these data initially?
  - Can we afford to keep the data current over a long time period?

- The guiding principles should always be:
  - Collect only the data you need;
  - Collect data to the lowest level of detail sufficient to make appropriate decisions; and,
  - Collect data only when they are required.

Where gravel should not be used (Petts et al)

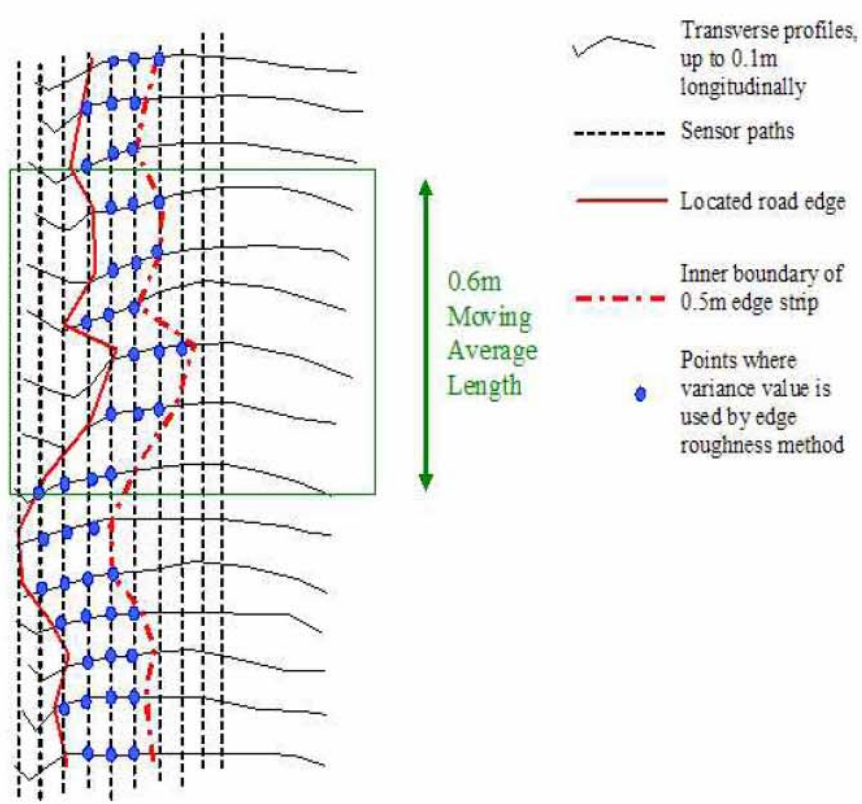
- **Gravel quality is poor** – Gravel should comply with grading and plasticity requirements, and not break down under traffic
- **Compaction & thickness cannot be assured**
- **Haul distances are long** (longer than 10km)
- **Rainfall is very high (**annual precipitation is greater than 2,000mm)
- **There are dry season dust problems**
- **Traffic levels are high (**more than 200 motor vehicles per day)
- **There are Longitudinal Gradients** (< 1m/year on longitudinal road gradients of more than 6% or 1-2m/year on gradients of more than 4%)
- **Adequate maintenance cannot be provided**
- **Subgrade is weak or soaked (flood risk)**
- **Gravel deposits are limited/environmentally sensitive**

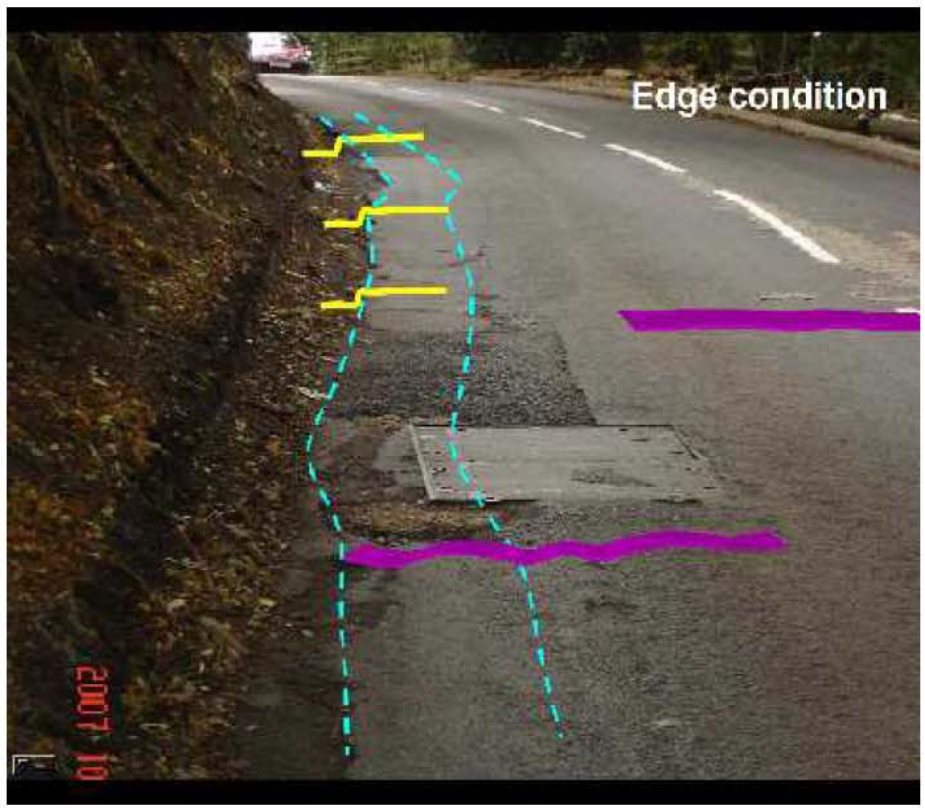
Alternatives to Gravel Roads (Petts et al)



Surveillance Techniques

- Assessment of surface ravelling, edge roughness & stepping
  - Viable alternative to visual surveys
  - Algorithms developed using data obtained from traffic-speed condition surveys (25 lasers across survey width of 3.3m)



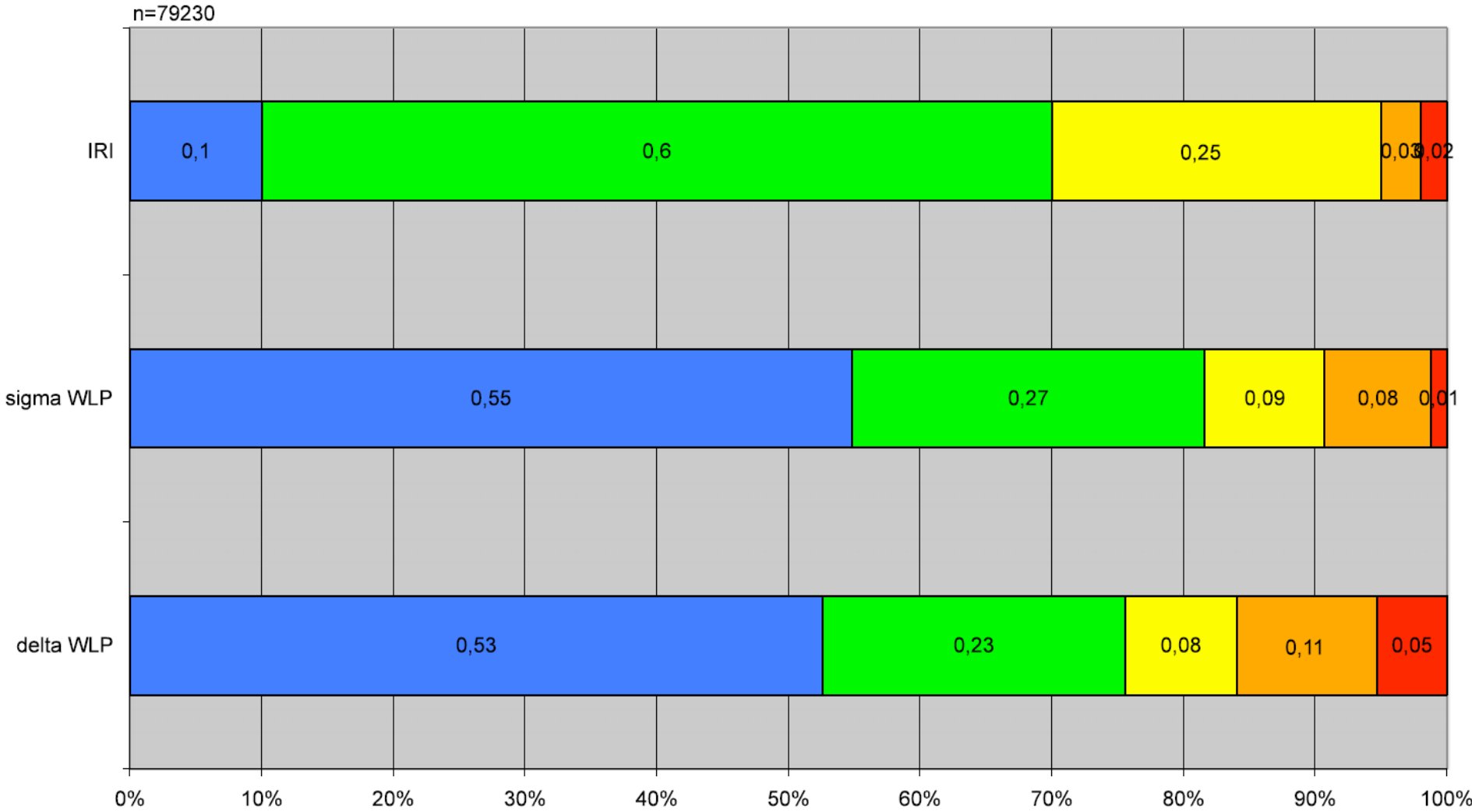


Surveillance Techniques

- Weighted longitudinal profile (WLP)
  - Contrary to IRI, WLP able to characterise 3 phenomena of longitudinal evenness: irregular, periodic & transient unevenness
    - σWLP: std deviation - irregular unevenness
    - ΔWLP: range of variation - transient occurrences
    - ΔWLP/σWLP: unevenness characteristic of road

      3 “wavy/periodic” → 6 “irregular” → >6 “transient” (bumps, potholes)
  - WLP method is applicable for both acceptance tests and road monitoring and assessment
  - WLP to be used in pavement management activities in countries such as Austria

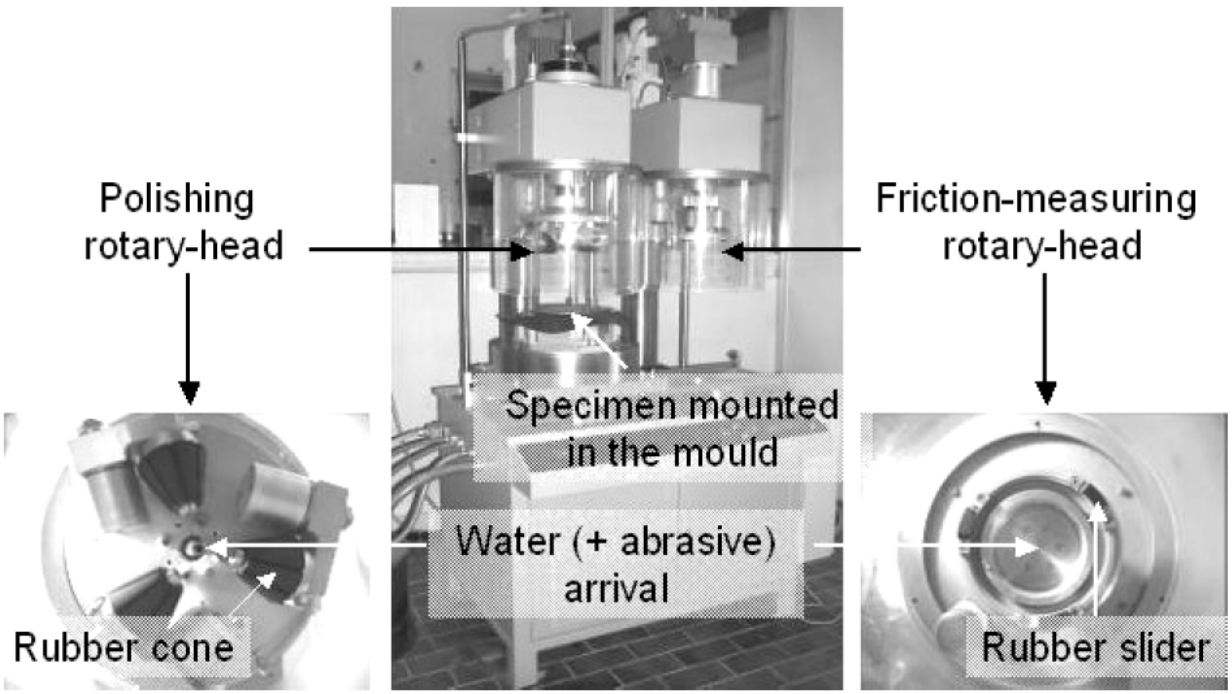
Austrian motorway and expressway network 2004/2005
Distribution of target value - acceptance limit - warning value - threshold value

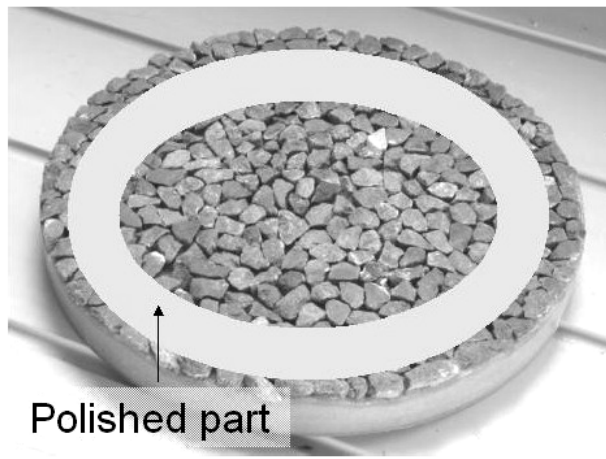


Skid Resistance

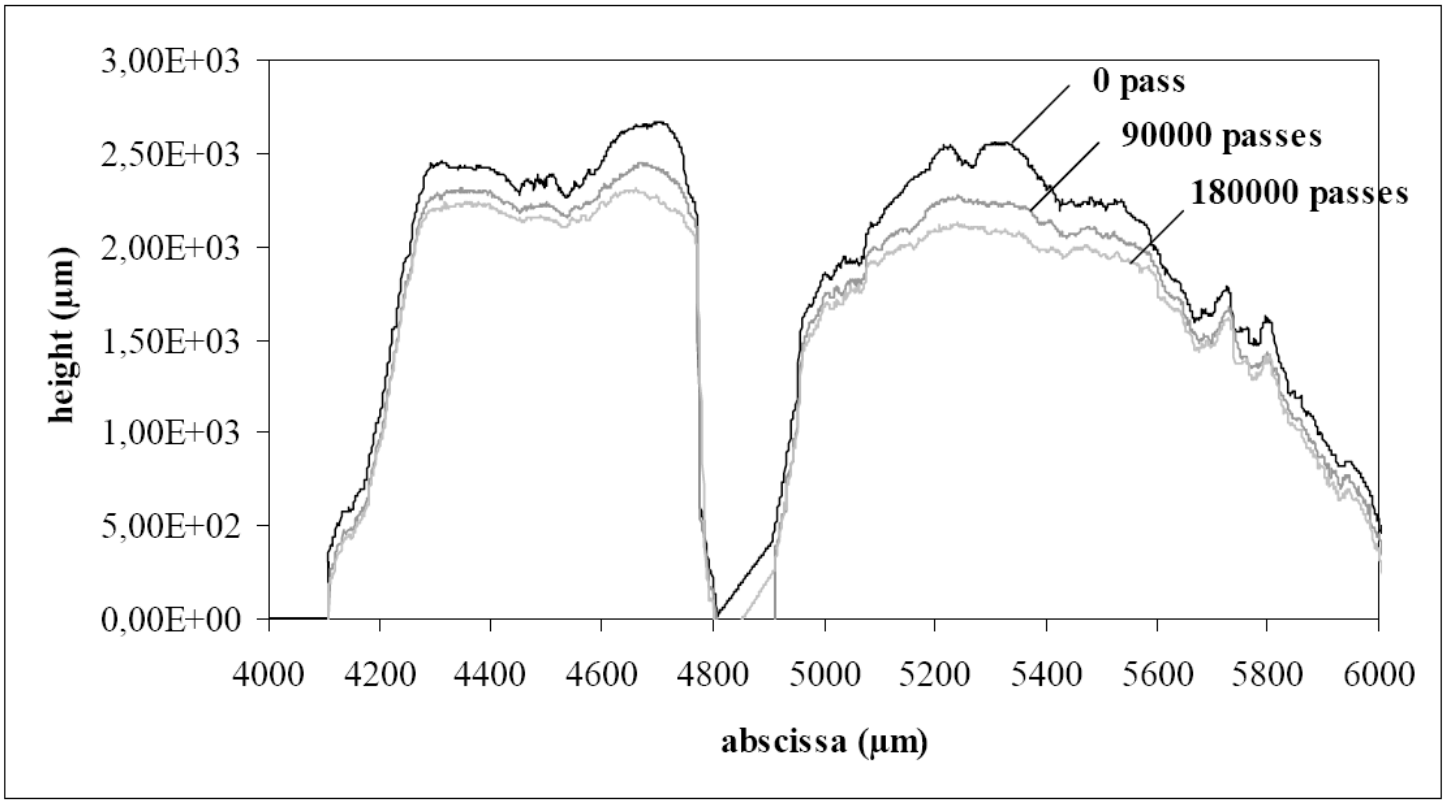
- Traditionally, long-term skid resistance addressed by PSV of coarse aggregate
- Solution not economical since all quarries cannot provide this aggregate quality
- More appropriate, performance-related test required that can simulate:
  - Mechanical wear (polishing)
  - Binder removal
  - Seasonal variations
  - Material ageing as a result of climatic actions
- Wehner/Schulze test recommended (developed in 1970s)

Wehner/Schulze test





Wehner/Schulze test



Wehner/Schulze test versus SCRIM

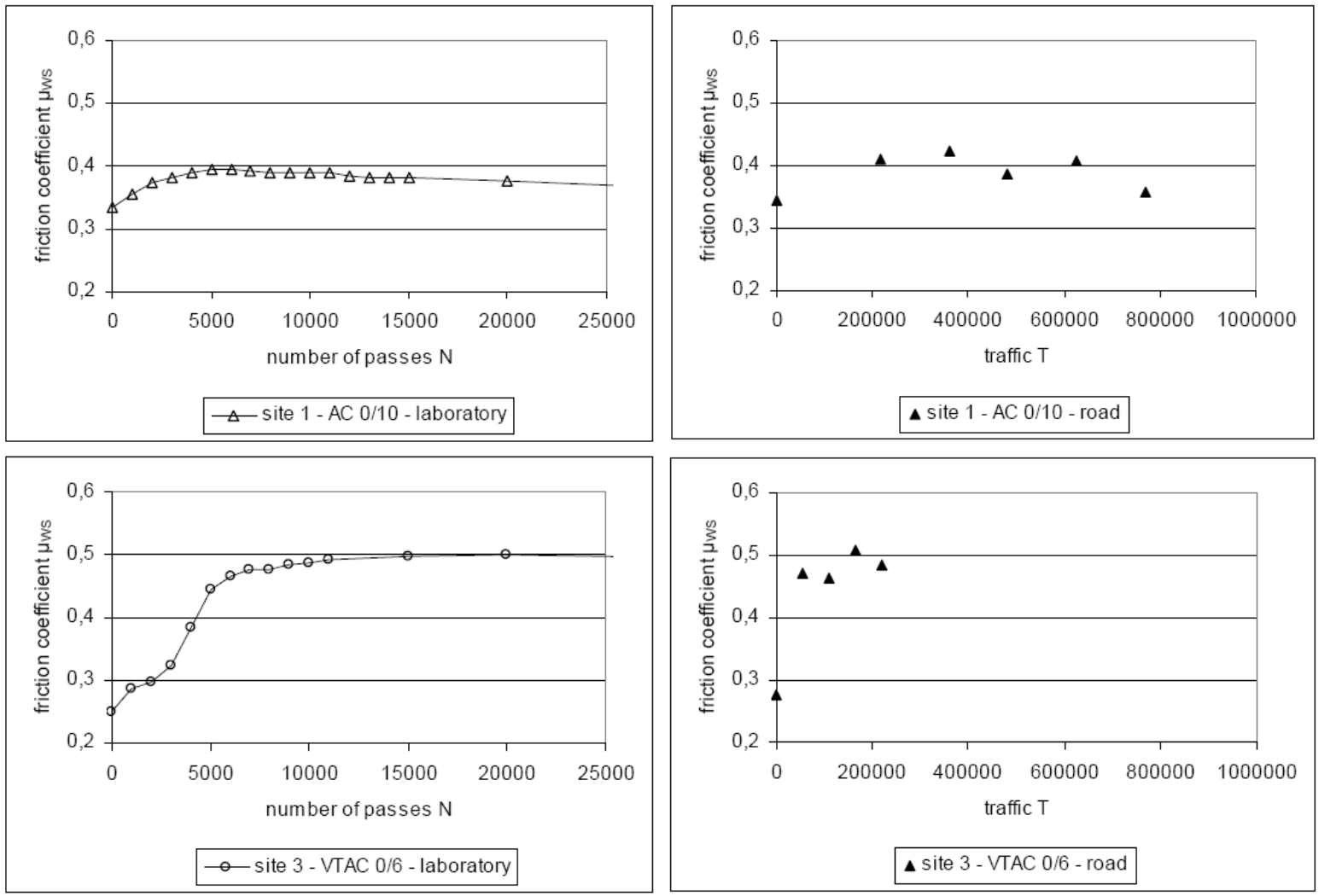
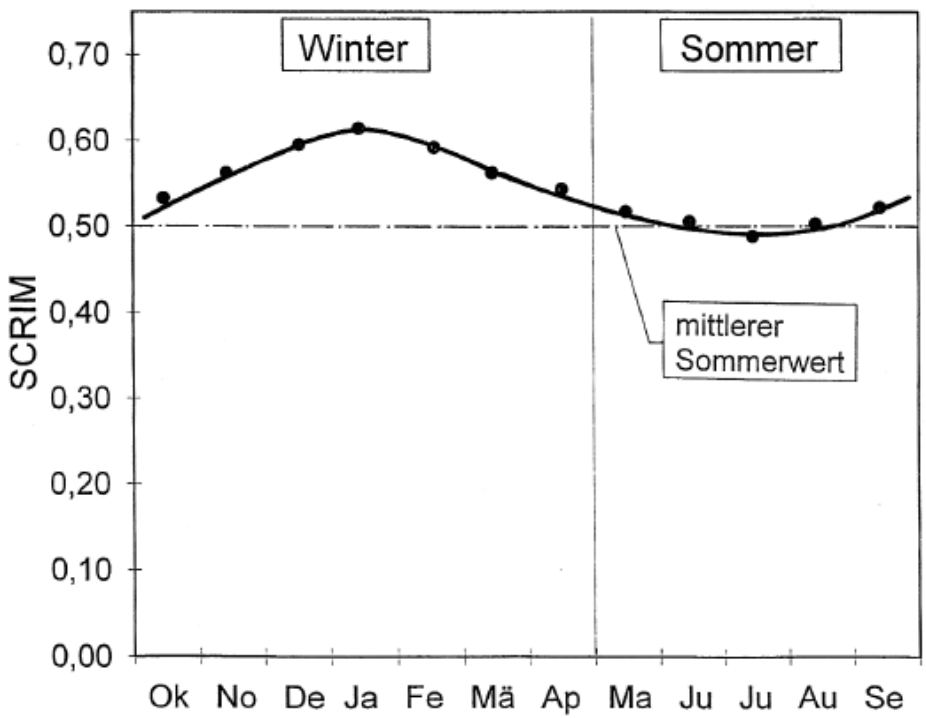


Figure 3 – Comparison simulated (left)/actual (right) friction evolutions – Case of new roads

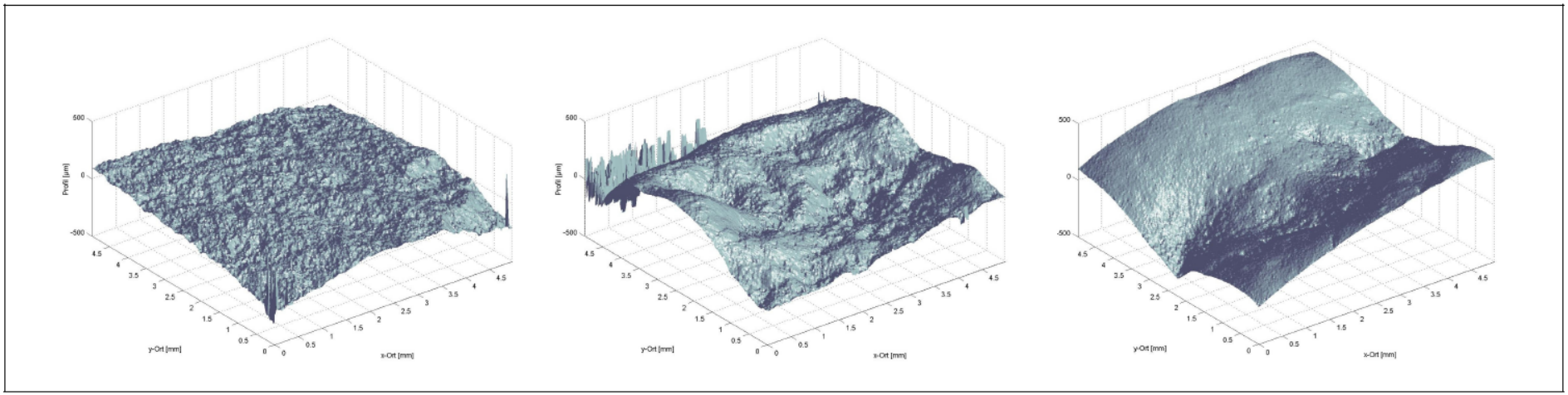
Managing skid resistance

- On most heavily trafficked roads, skid resistance decreases over time (**polishing** – traffic volume with fine dirt)
- On rural roads with less traffic, grip values sometimes increase (**roughening** – traffic volume with coarse dirt, weathering (frost, acids, etc)

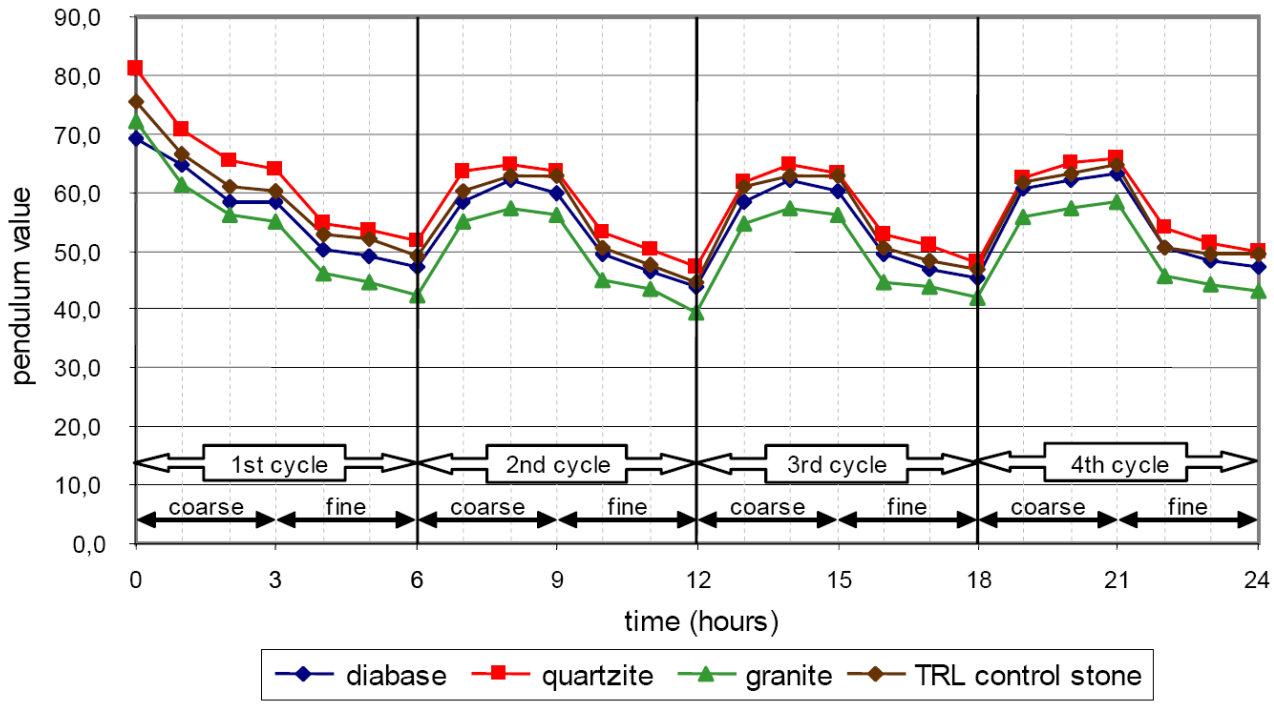


our future through science

Managing skid resistance



Before polishing *Coarse polishing agent* *Fine polishing agent*



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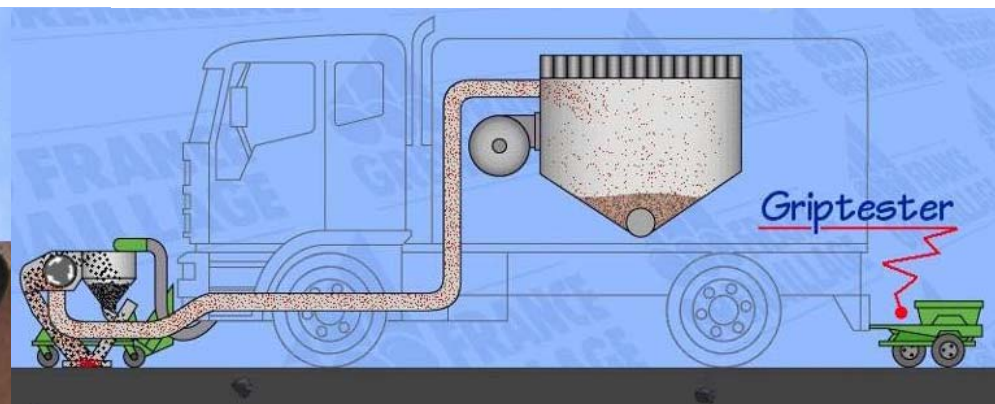
Managing skid resistance

- Addressing skid resistance problems:
  - Could possibly use “cheaper” materials on low-volume roads if known that they will be roughened
  - Spray coarse sand during wet weather
  - Blasting with steel micro-spheres with 1.3-2.0mm diameter at high speed (65-110 m/s)
    - Does not generate dust
    - Can be applied on rough surfaces with rutting
    - Cheaper than micro-grinding
    - Reported improvements
      - SCRIM: 50% (from 46 to 70)
      - Griptester at 1 km/h: 55% (from 62 to 96)
      - TRL Pendulum: 30% (from 33 to 43)



Managing skid resistance

- Addressing skid resistance problems:
  - Micro-grinding
    - Can increase friction coefficient by up to 30%
    - Has shown to decrease accident rates dramatically
    - Approach can also be used to improve IRI (by up to 50% reported)
    - But, not recommended for pavements with transverse deformation

Low Initial Dry Friction (Bituplaning)

- Documented as early as 1940s
- Particular problem on negative-textured road surfaces in early age (<4 months) where dry friction often less than wet friction

CSIR

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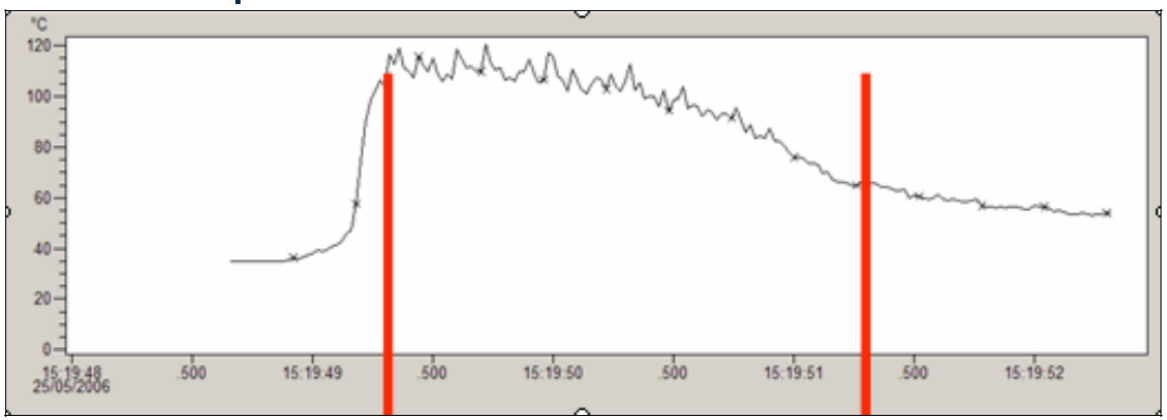
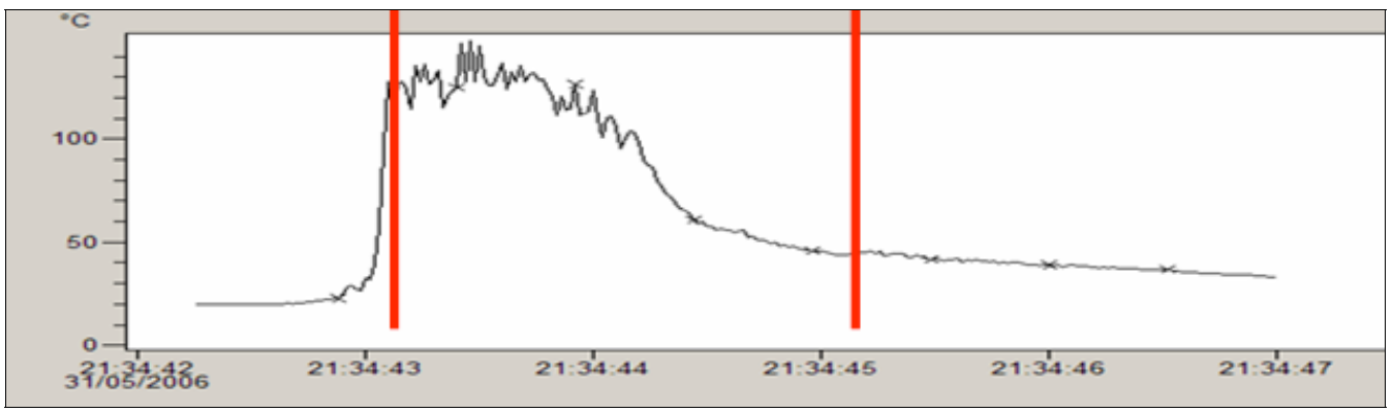
Low Initial Dry Friction (Bituplaning)

- Could be caused by “melting of road surface” as a result of heat transfer, or high levels of shear the binder/mastic is exposed to



Negative texture



Positive texture

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Low Initial Dry Friction (Bituplaning)

- Solutions
  - Removal of binder film unsuccessful & damages layer
  - Driver training – make them aware of risk of bituplaning
  - Chip spreader mounted at the rear of asphalt spreader
    - for SMA, roll in 2.4 kg/m^2 of 2/6 chippings at >110°C
    - for 2PA, 200 g/m^2 of crusher sand at >50°C

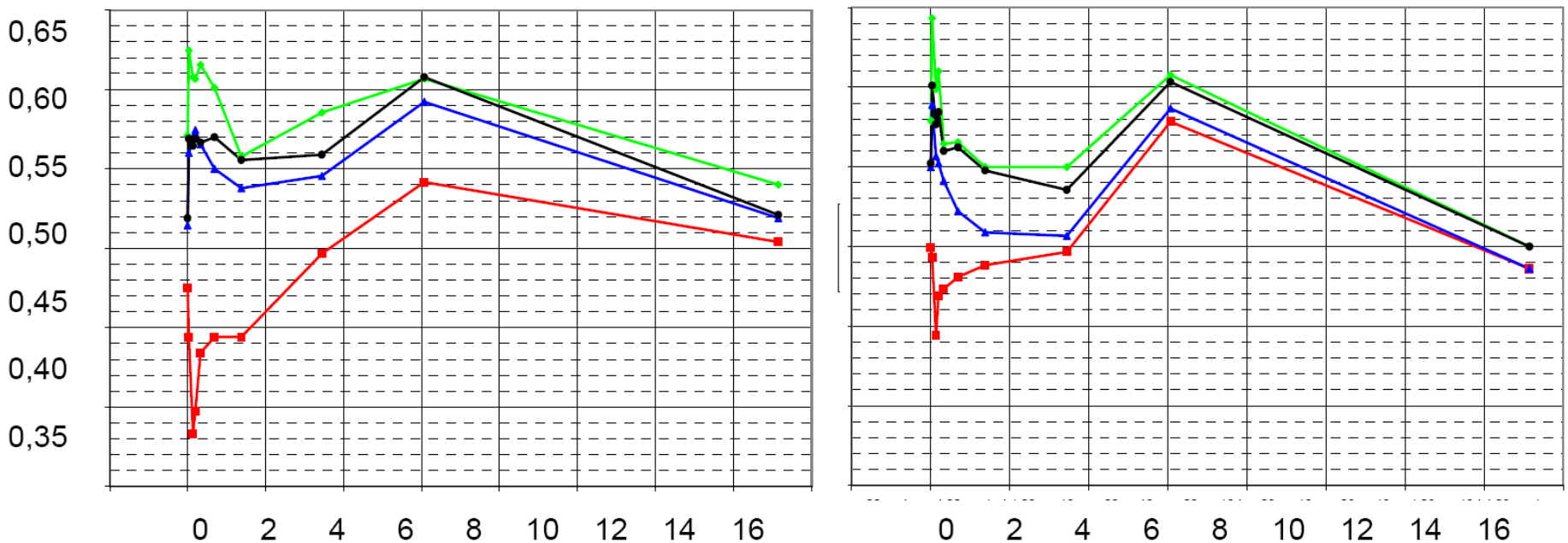
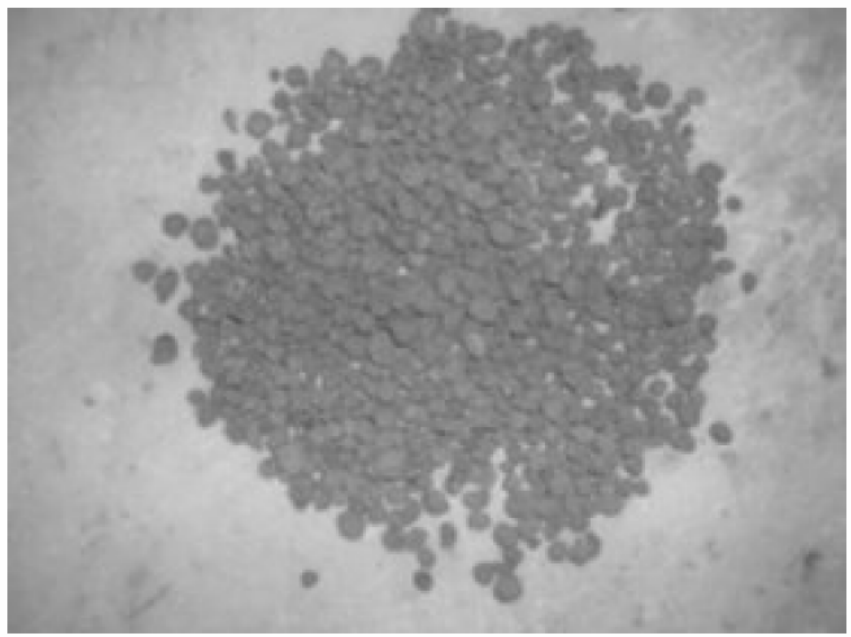


Figure 4 **N342, SMA 0/8, Wet SR vs months after opening [7];**
left: in between wheel paths, right: near side wheel path;
top to bottom: green: treated with crusher sand, black: 2/6, blue: 1/3, red: untreated

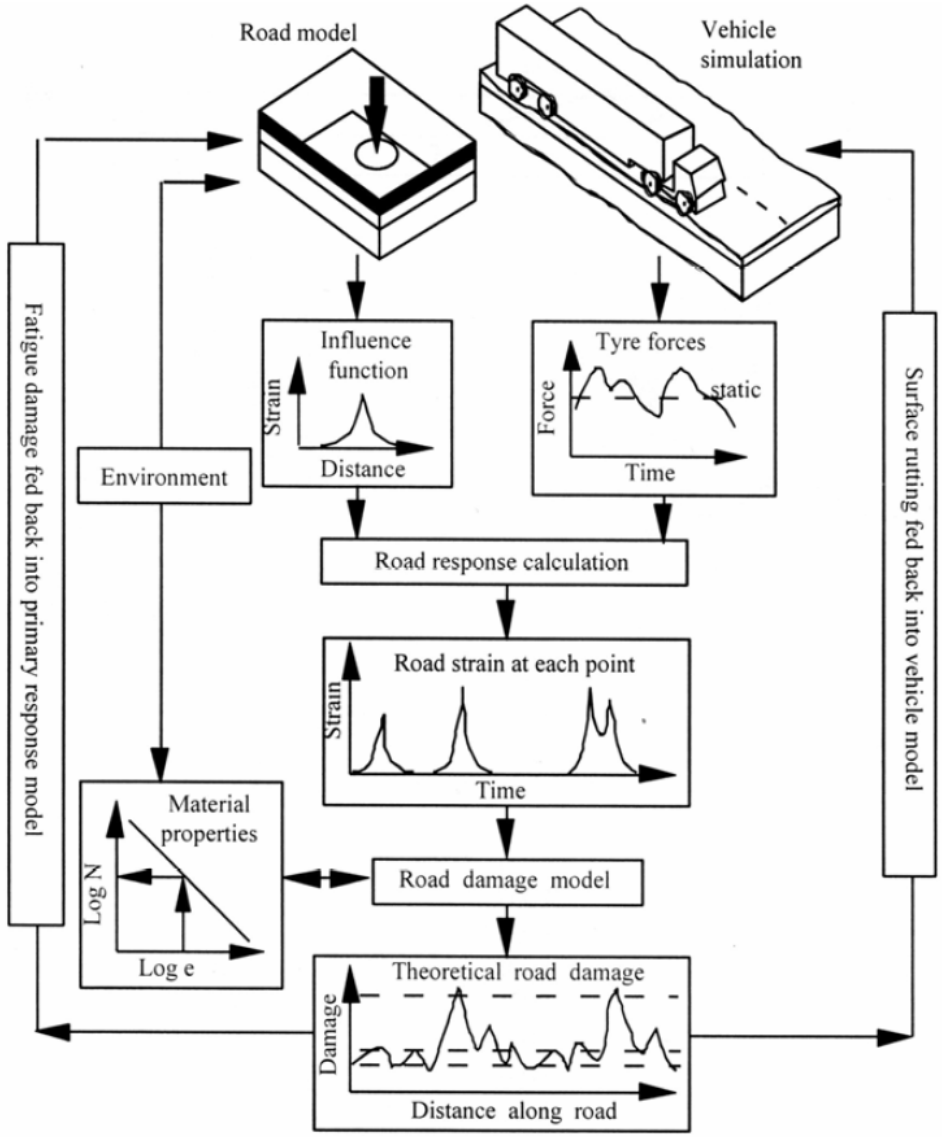
Alternative materials

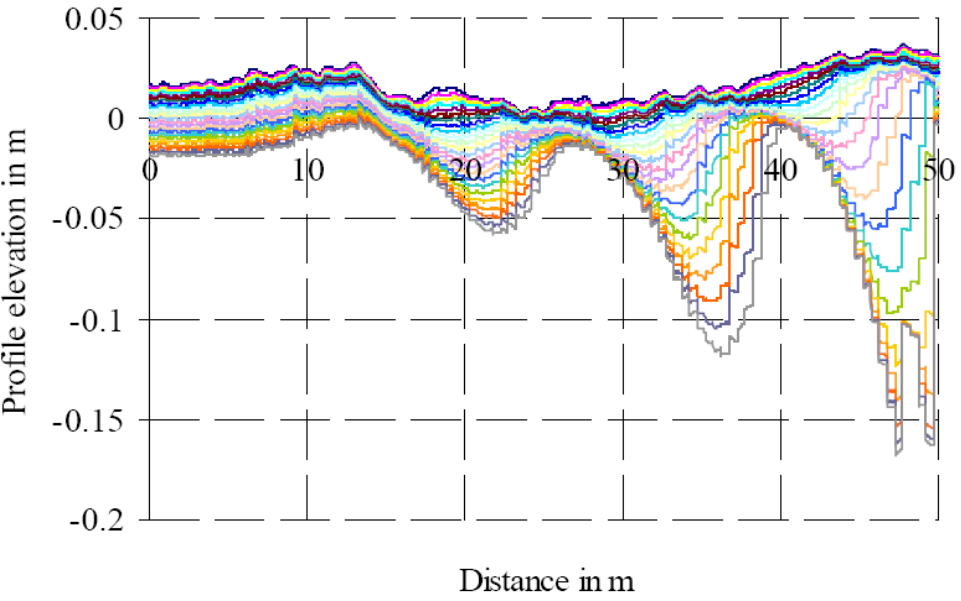
- Synthetic lightweight aggregate
  - Up to 15% replacement of aggregate with expanded clay
  - Produced by firing clay in rotary kiln at ±1200°C causing expansion
  - Rapid cooling freezes granule structure
  - Rounded granules with rough surface
  - Chemically inert, good affinity to bitumen, good moisture resistance
  - Maintains high microtexture, even after polishing
  - Good performance in terms of texture, friction and noise reduction



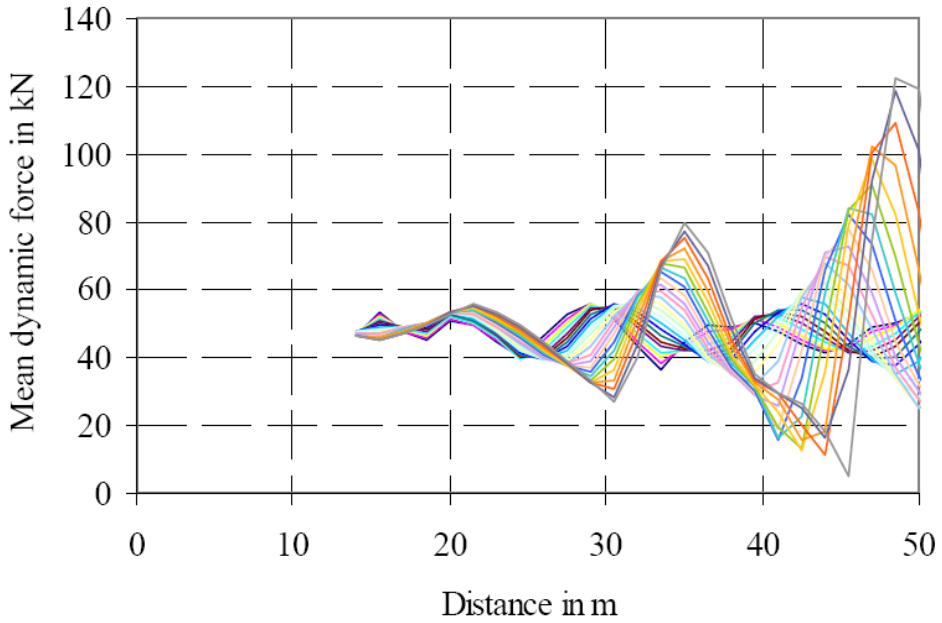
Prediction of deterioration by ME Methods

- Pattern of force applied on pavement is a function of vehicle dynamics, which in turn depends on longitudinal profile
- If the initial profile and truck population is known, profile changes in response of applied loading can be calculated

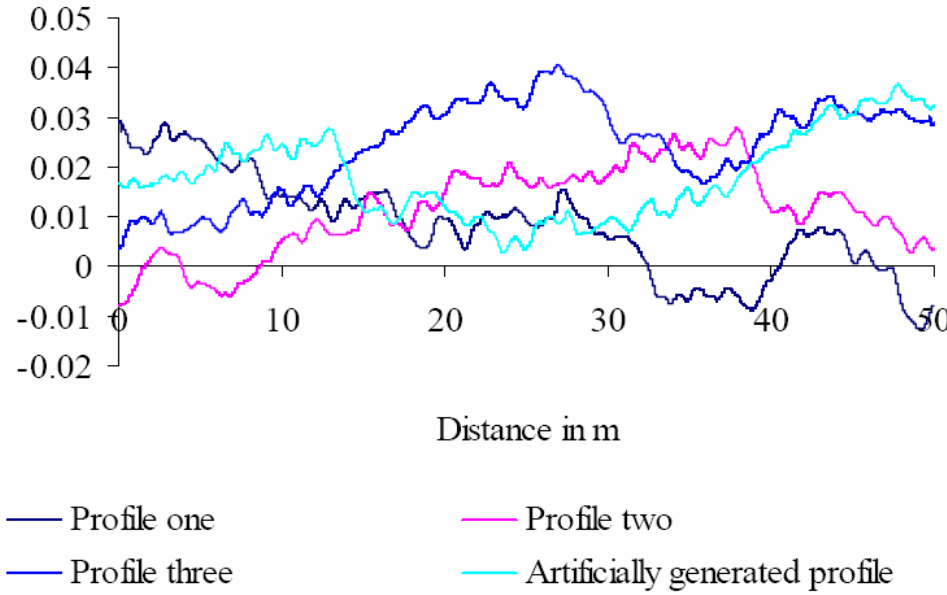




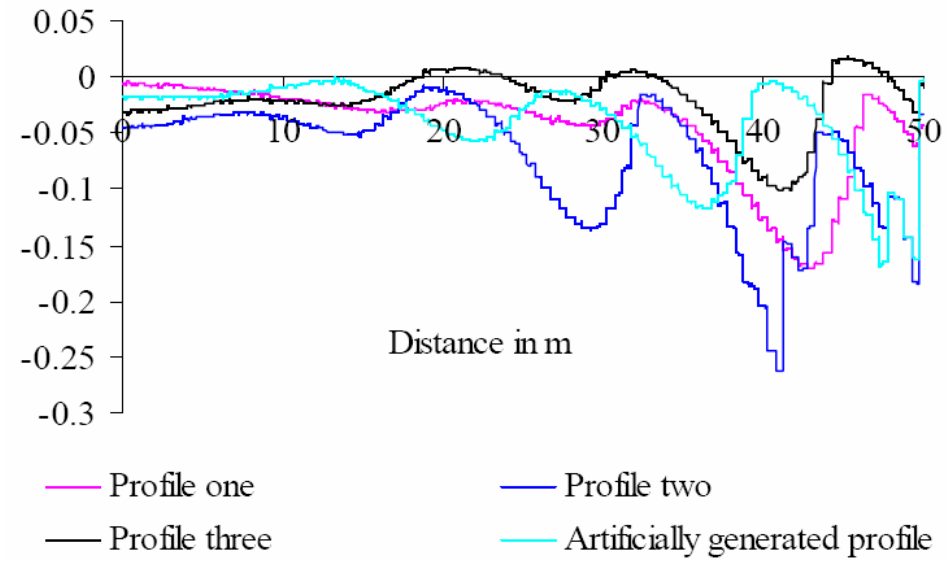
(a) Evolution of surface profile



(b) Evolution of mean pattern of applied force



(a) Initial road surface profiles



(b) Road surface profiles after 23 million axle load

TYROSAFE

- Funded by EU 7th Framework Programme (FP7)

- Addresses:
  - Lack of awareness of importance of skid resistance
  - Harmonisation of measuring systems
  - Address conflicts with other important road surface characteristics

Skid resistance (safety)
Rolling resistance (energy)
Noise emission (health)

Interdependencies ??

different …

- measuring policies
- measuring methods
- measured parameters