SAMPLES OF SINGULAR DETAILED TEXTURE AND SKID RESISTANCE ANALYSIS

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Introduction

- **Singular studies / works**
  - Require specific techniques
- **Type of measurement**
  - Network level
    - High speed equipment used when possible
  - Project level
    - Specific equipment

Equipment characteristics

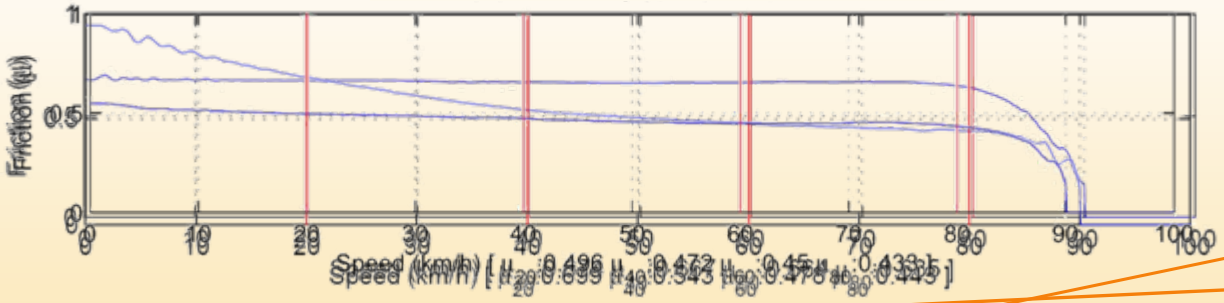
- **Texture**
  - Laser profiler mounted on vehicle
    - Either on profiling or skid resistance equipment
  - Static equipment to measure local characteristics
    - Sand patch
    - Circular Texture Meter (CTMeter)
- **Skid resistance**
  - High speed skid measurement units
    - SCRIM, Griptester, …
  - Static equipment to measure local characteristics
    - British pendulum
    - Dynamic Friction Tester (DFTester)

Specific singular works

- **M-30 Road (Madrid)**
  - Analysis of low skid road sections by static devices
    - Influence of speed
    - Influence of texture
- **Tram bus lane**
  - Compare the skid resistance of different pavement surfaces in order to build a guided tram bus lane

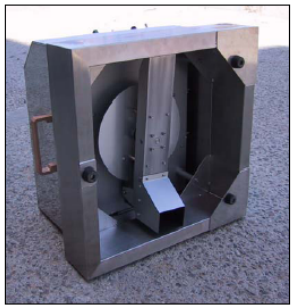
The characteristics of the equipment used (I)

- **DFTester**
  - ASTM E1911 Standard
  - Friction coefficient at speeds on the range: 100 km/h to 0 km/h
    - Allows to check differences on the skid resistance of different pavement surfaces at different speeds
  - Test procedure
    - Spinning wheel (platform) up to 100 km/h speed
    - Drop of the platform with the rubber sliders
    - Measurement of the skid resistance continuously until the stop of the spinning wheel
  - Samples:



The characteristics of the equipment used (II)

- **CTMeter**
  - ASTM E2157 Standard
  - Texture (MPD/RMS) at different directions
  - Laser profiler spins
  - Circular track



- **Common**
  - Small footprint
    - Usable on tight locations
  - Slow procedure
    - Unusable at network level

M-30 Road (Madrid)

- **Standard road testing with high speed device - Grip tester**
  - Results by means of:
    - Grip number
    - Converted to SCRIM coefficient
- **Detail testing to evaluate some poor skid resistance sections**
  - Skid resistance
    - DFTester
    - British pendulum
  - Texture
    - CTMeter (ASTM E21567)
    - Sand patch (ASTM E965)

Standard road testing results

- The results provided four kinds of pavement sections

	Grip Number	SCRIM Coefficient
Test section 1 (Good skid resistance)	0.66	0.56
Test section 2 (Good skid resistance)	0.69	0.59
Test section 3 (Poor skid resistance)	0.52	0.44
Test section 4 (Poor skid resistance)	0.55	0.47

Specific testing - Skid resistance & Texture

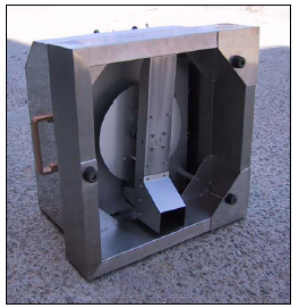
- **Skid resistance**
  - Average results

	British Pendulum	DFTester (20 km/h) μ_{20}	DFTester (40 km/h) μ_{40}	DFTester (60 km/h) μ_{60}	DFTester (80 km/h) μ_{80}
Test section 1 (Good skid resistance)	0.63	0.65	0.57	0.52	0.50
Test section 2 (Good skid resistance)	0.61	0.64	0.52	0.45	0.44
Test section 3 (Poor skid resistance)	0.57	0.54	0.46	0.42	0.41
Test section 4 (Poor skid resistance)	0.57	0.52	0.46	0.43	0.43

- **The results for skid resistance confirmed what was seen on grip tester (standard) results**
  - Sect. 1 and 2 ok
  - Sect. 3 and 4 low

- **Check that section 2 has quite large variations of skid resistance at different speeds**
  - It was not seen by high speed device (grip tester)
  - It was not seen by low speed device (pendulum)

Texture results



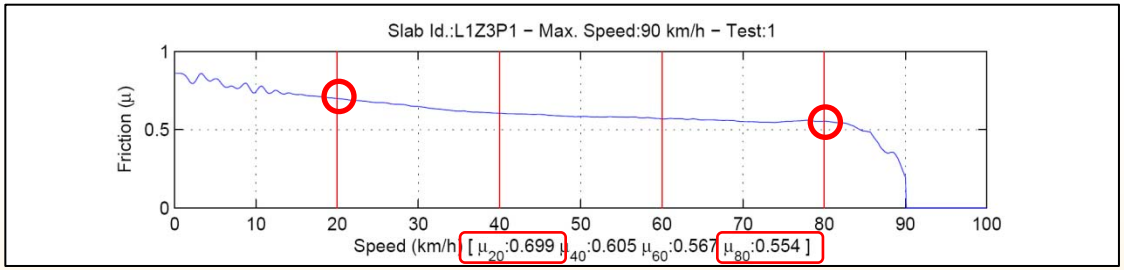
- **Texture**
  - Measured with
    - CTMeter
    - Sand patch

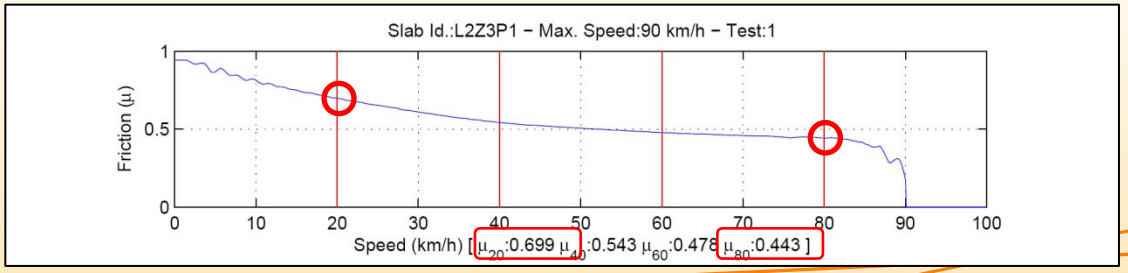
- **From the analysis of the textures**
  - Seems like section 2 has lower texture values than sections 1, 3 and 4

	MTD (ASTM E965)	MPD (ASTM2157)	RMS (ASTM2157)
Test section 1 (Good skid resistance)	1.44	1.48	1.16
Test section 2 (Good skid resistance)	1.23	1.15	0.97
Test section 3 (Poor skid resistance)	1.36	1.38	1.12
Test section 4 (Poor skid resistance)	1.29	1.40	1.16

Skid resistance and speed

- **Variations of skid resistance because of speed variation can once again provide erroneous information**
  - From high speed results section 1 and 2 seem to be similar but verifying their characteristics at different speeds showed that the pavement sections were working differently
  - Same skid coefficient at 20 km/h… and quite different at 80 km/h





Tram bus lane

- **Objective**
  - Help in the decision on how should be built the slabs that conform a guided tram bus lane
  - Evaluation of skid and texture characteristics of the pavement

- **Tasks**
  - Measure the slabs that are currently working on a similar setup on Essen (Germany)
  - Measure the different test slabs that are being manufactured
  - Compare the results of the measurements to decide how should the final slabs manufactured

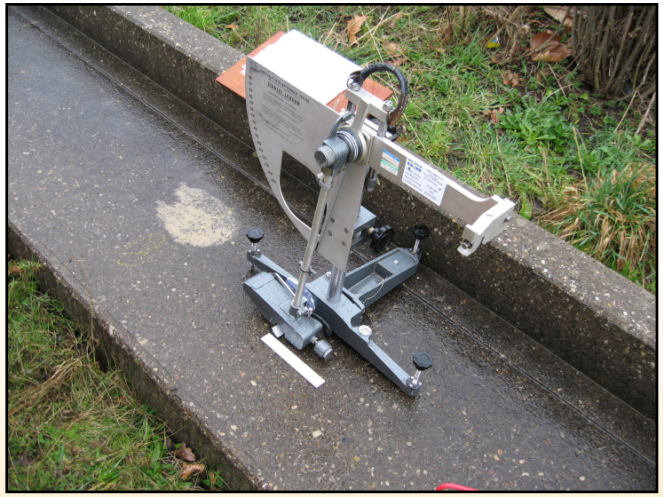
Cross section of the reference tram bus “rails”

- **Singular structure**
  - Road made as a “rail track”

Cross section of the tram-bus “rails”

Why use singular equipment (I)

- **Tight location (Reference site)**
  - Impossible to drive trough the guided tram bus lane with a “conventional” equipment as SCRIM and/or Griptester



Why use singular equipment (II)

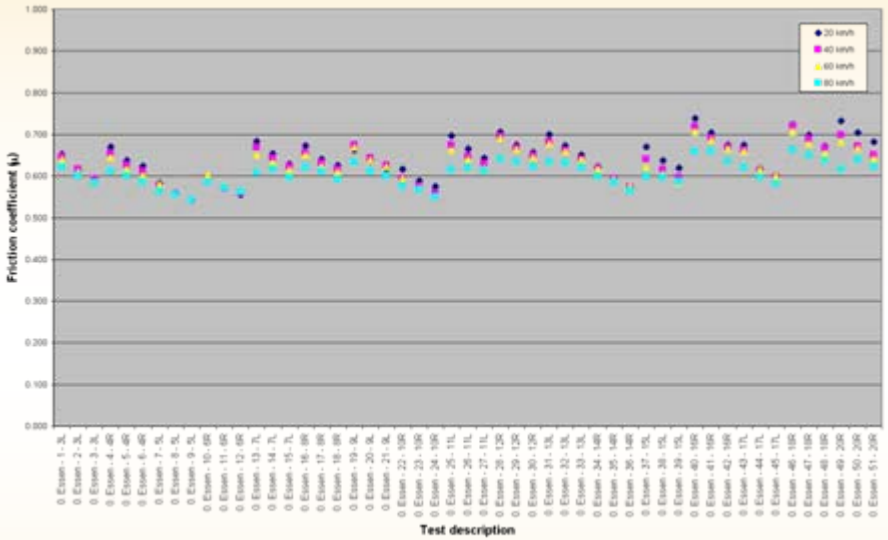
- **Laboratory (Test slabs)**
  - Impossible to measure the skid resistance of the test slabs with a “conventional” equipment as SCRIM and/or Griptester
  - Need of an static device

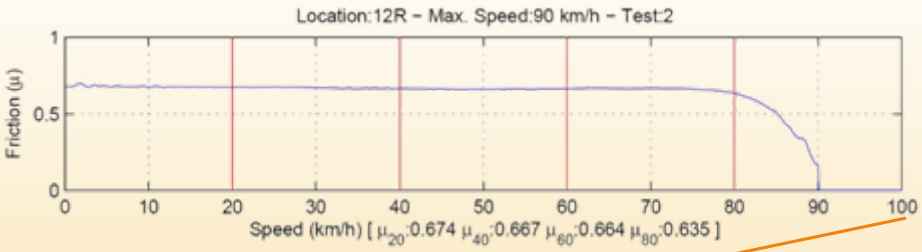
Testing procedure on the reference tram bus rails

- **Test a collection of points to verify the skid resistance properties of the reference track**
  - Test points: Over 50 tests

Results on the reference tram bus rails

- **Results homogeneous at different speed levels**
  - 20 to 80 km/h
- **Average skid coefficient results at the different speeds within the range:**
  - 0.60 to 0.64





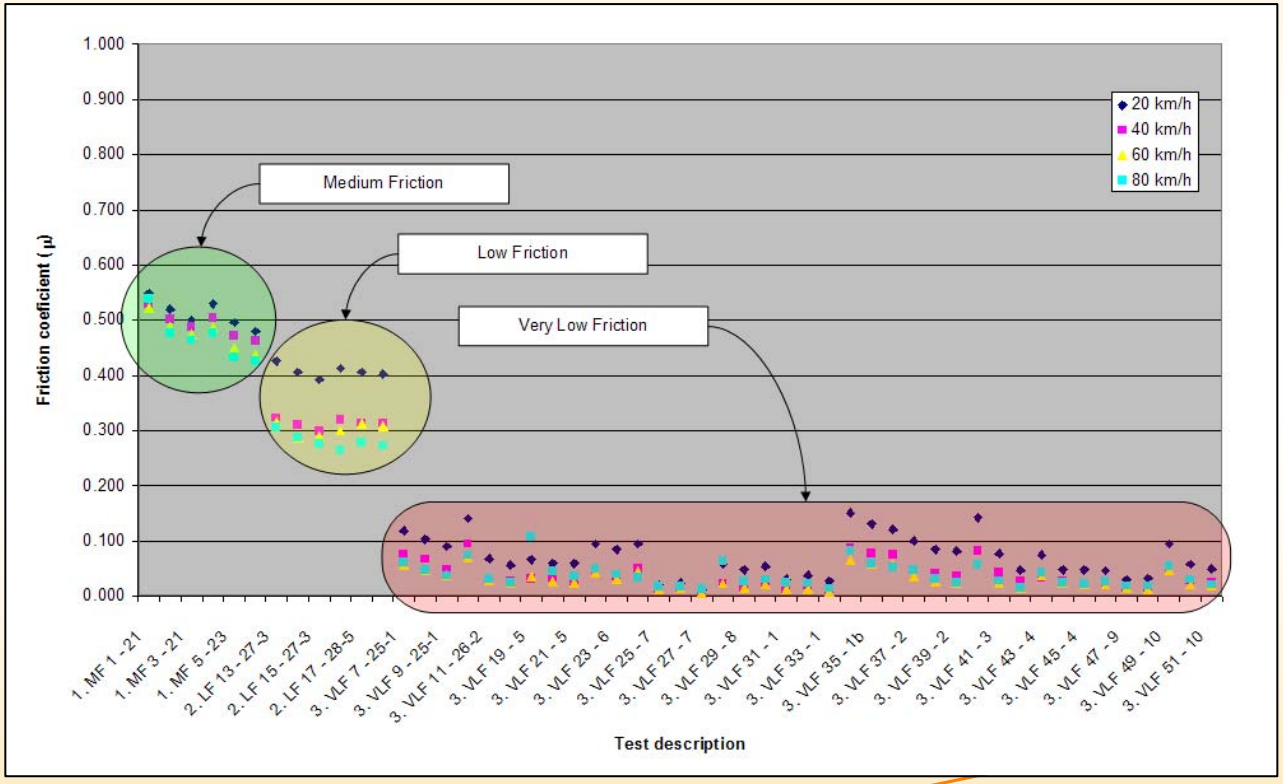
Procedure for testing the slabs

- **Track construction procedure**
  - The track manufactured on a factory
  - Then installed on the final location
- **Before building the new track**
  - Decide characteristics of the manufacturing procedure
  - Objective: Guarantee the skid resistance needs of the track
- **Manufactured test slabs characteristics:**
  - Regular slabs
  - Slabs treated with acid
  - Slabs modified with setting retardant

Those characteristics may have effect to the skid resistance of the resulting pavement

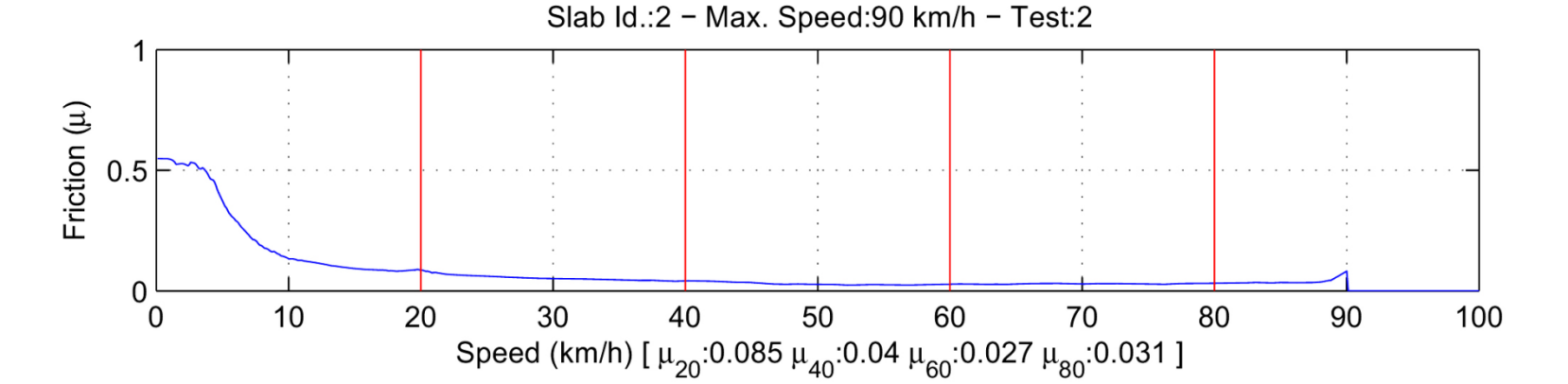
Results for test slabs

- Three groups of slabs based on their skid resistance
  - Medium
  - Low
  - Very low



Details of the results

- Very low friction values for sample



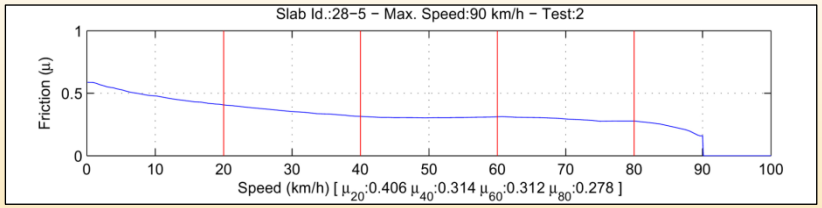
- Difference speed-friction 80-20 = 0.058
- Results (from 0 to 10 km/h) ok
- Problem if skid resistance verified ONLY at low speeds

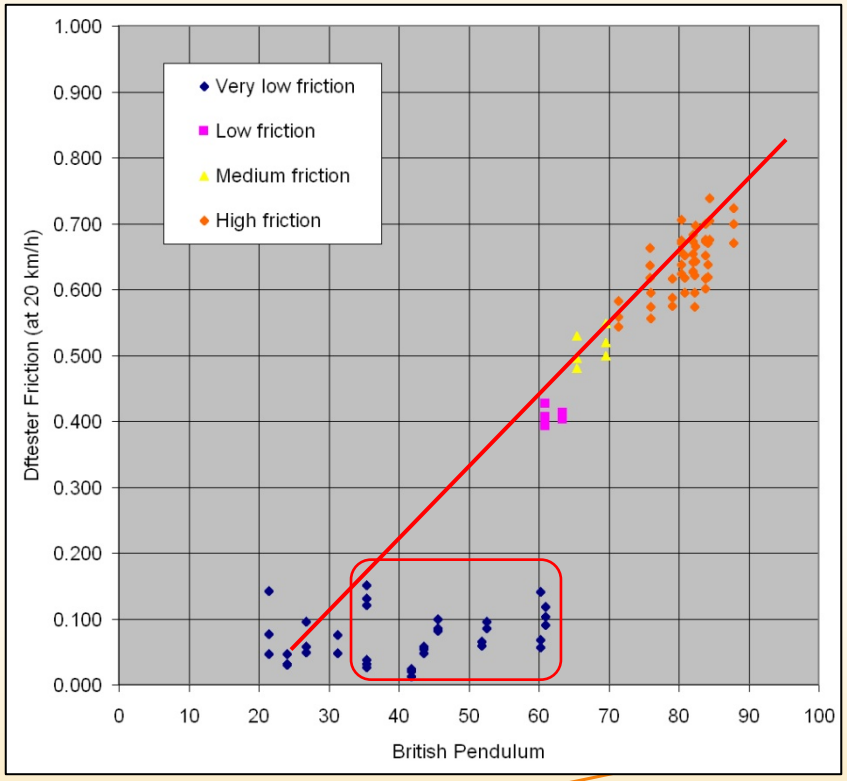
Skid resistance (British Pendulum)

- Problem of low speed results
- British pendulum values between 20 and 60
- DFTester provides values between 0.0 and 0.20 (Results at 20km/h)

- This issue is not significant if there are not variations of skid resistance in the pavement material because of the speed variations

  - DFTester results slope can be important



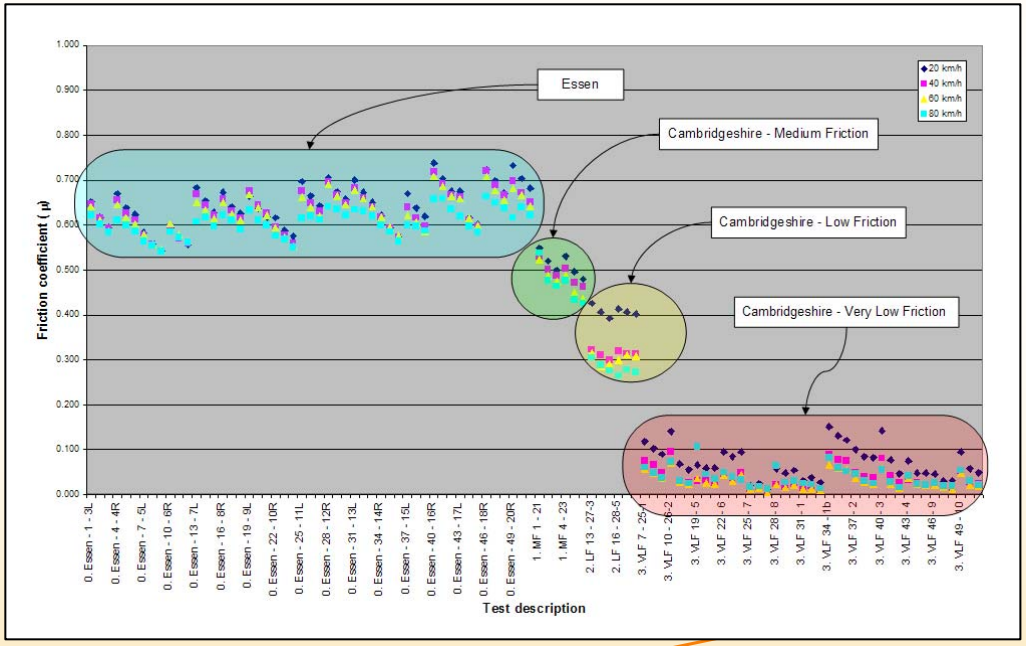


Compared results

- **Reference tram bus rail track compared to test slab results**

- **Reference slabs**
  - Good skid resistance

- **Test slabs**
  - Slabs modified with setting retardant provide good skid resistance
  - Other test slab may compromise the skid resistance of the resulting track/pavement



Overall conclusions

- **This kind of studies is not useful at network level**
  - Low performance
- **Static devices**
  - Like the pendulum can provide “confusing” results on some cases
- **High speed devices provide valuable information**
  - But that information can not always be applicable at speeds different to those at which the test has been done
- **Special projects may need special studies**

Thank you!

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