

2nd Annual EUROPEAN FRICTION WORKSHOP

Field skid resistance and macrotexture performance: from early life to long-term relationship



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Field skid resistance and macrotexture performance: from early life to long-term relationship

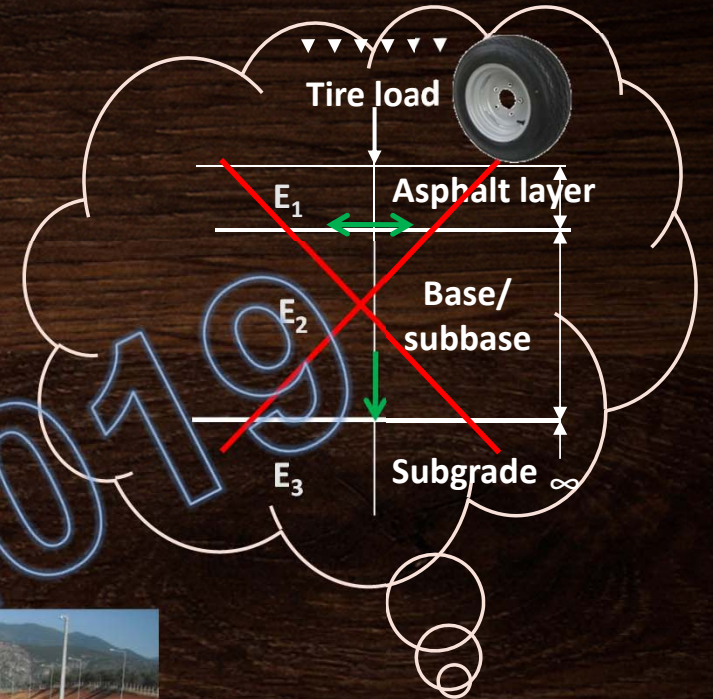
Outline

- *Background*
- *Objective*
- *Methodology*
- *Results*
- *Concluding Remarks*

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Background



?

Pavements serve society's needs

That's all folks guys...



Maria POMONI

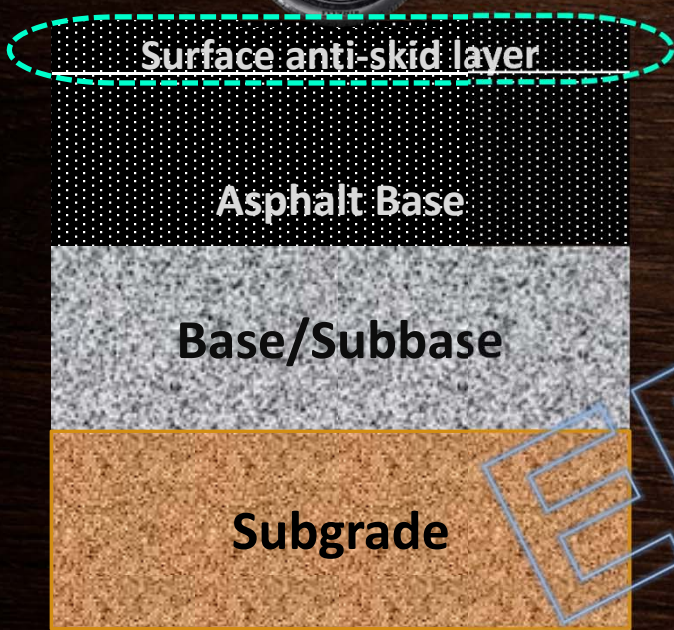
Background



Background



In contact with the tire tread of the moving vehicles



Functional condition

Characteristics of the upper/antiskidding layer

Structural condition

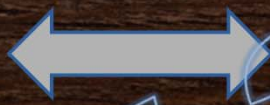
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Background

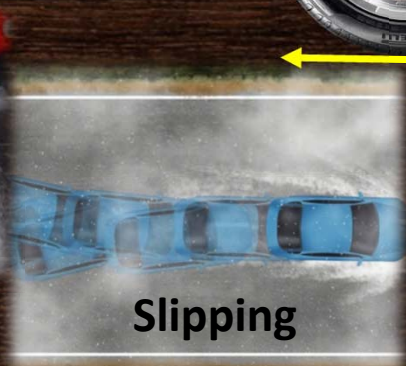
Macrotexture and Microtexture contribute to skid resistance properties of the surface layer



+ Microtexture



Main contributors to eliminate conditions connected to accidents



Objective

- To present and assess the long-term field evolution of skid resistance based on the effect of seasonal variation
- To illustrate the traffic effect on skid resistance and macrotexture long-term performance based on field data
- To assess the relationship between skid resistance and macrotexture evolution

Methodology

Site characteristics

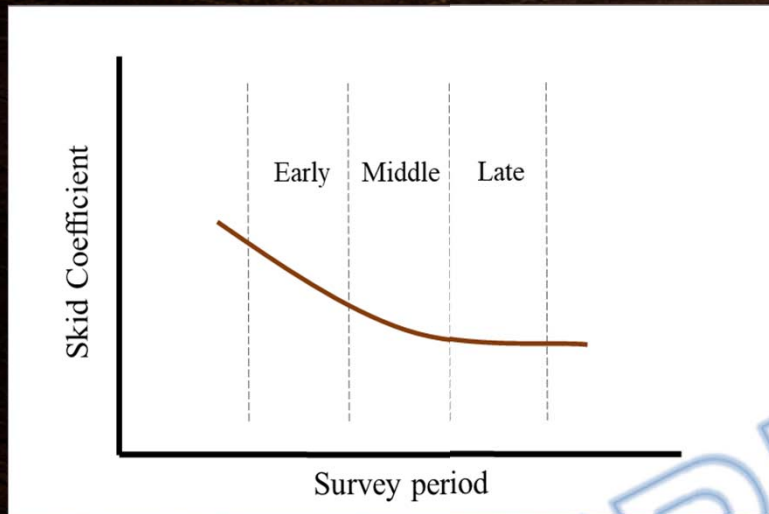
- ✓ In service - urban highway 14 years old, 11 consecutive years of monitoring
Surface layer: HMA, O-5 mix designation, ASTM D3515
- ✓ Differences in sections on traffic volume and geometric characteristics

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Methodology

Data collection



Skid resistance data

- **Early dry period:** Approximately one week after rainfalls
- **Middle dry period:** Approximately two to three months after period 1
- **Late dry period:** Approximately four to six months after period 1



GripTester

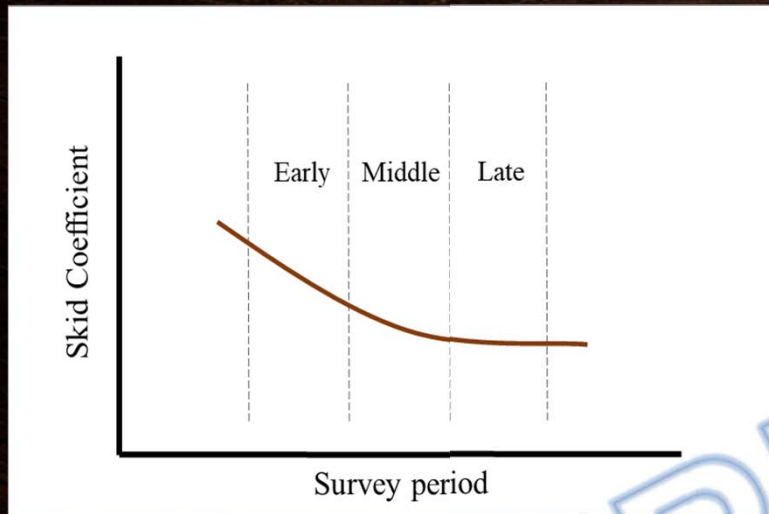
Grip Number: **GN**

Annual mean: Mean of three periods

✓ *To characterize the annual performance*

Methodology

Data collection



Macrotexture data



Laser Profiler

ASTM E1845

Mean Profile Depth: **MPD** (mm)



Annual mean: Mean of three periods

✓ *To characterize the annual performance*

Traffic: AADT

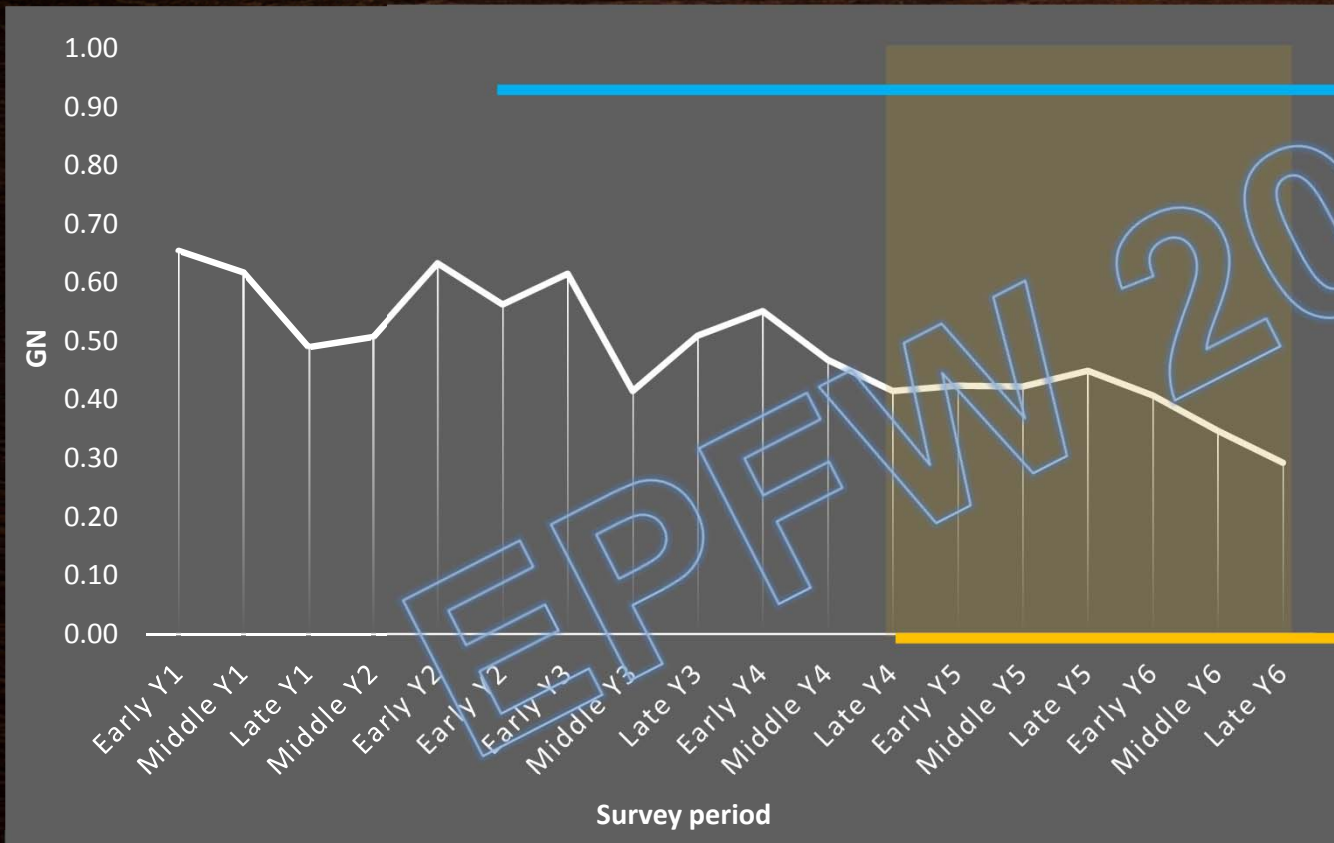


Cumulative traffic for each year of the total monitoring period



Results

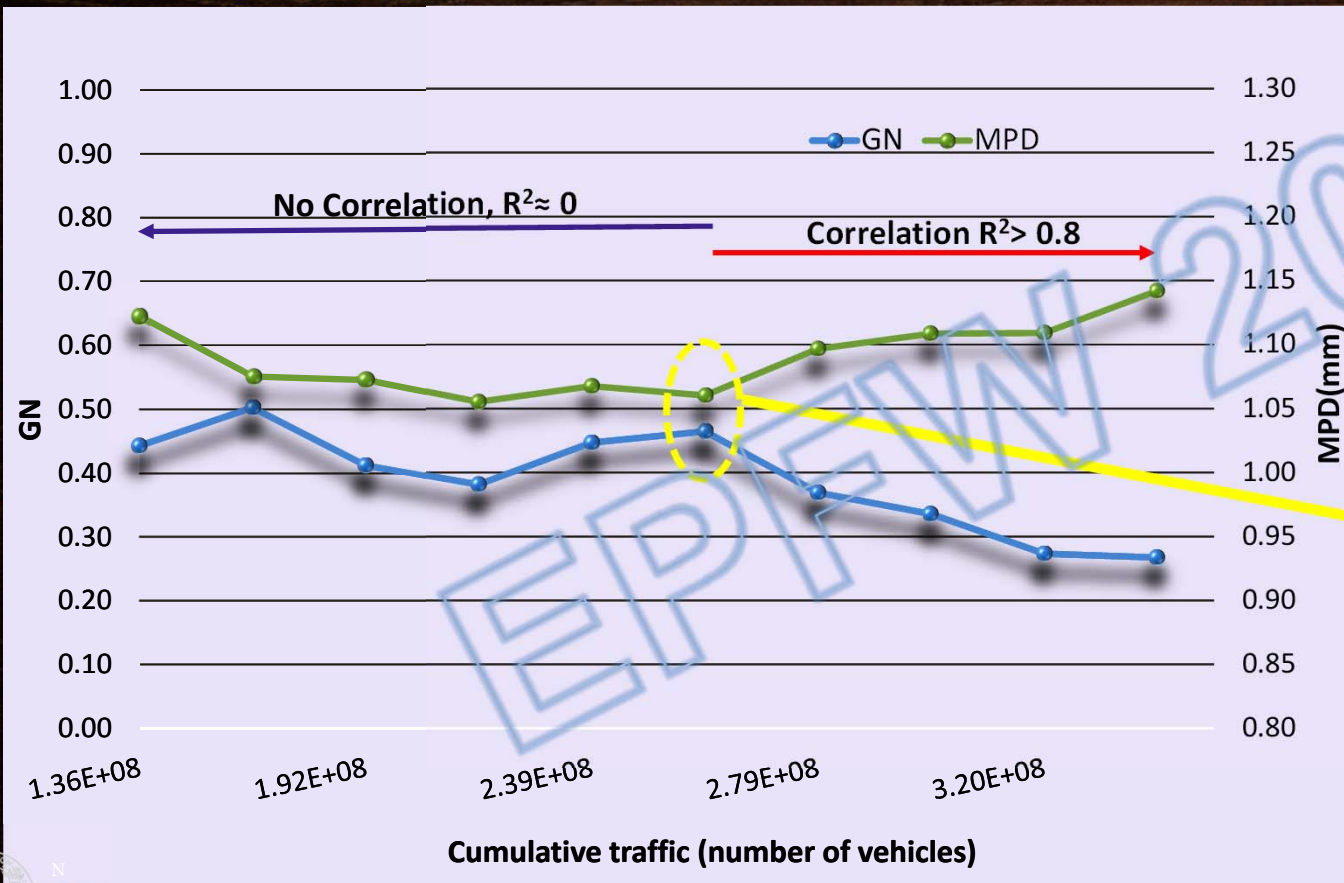
Seasonal Variation effect



- An indicative relationship between early and late GN measurements was balanced to be $GN_{late} = 65\% GN_{early}$
- Seasonal variation effect is gradually being less pronounced as skid resistance level reaches a low value

Results

Year to year deterioration



✓ Traffic volume effect

Start point: Evidence of Inverse trend between MPD-GN



Results

Before extensive polishing

Skid resistance ✓

Finest aggregates

Microtexture

Coarse aggregates

Macrottexture

After extensive polishing

Skid resistance ✗

Finest aggregates

Microtexture

Coarse aggregates

Macrottexture

Critical for the remainder of service life



Macrottexture before polishing (H_{before})

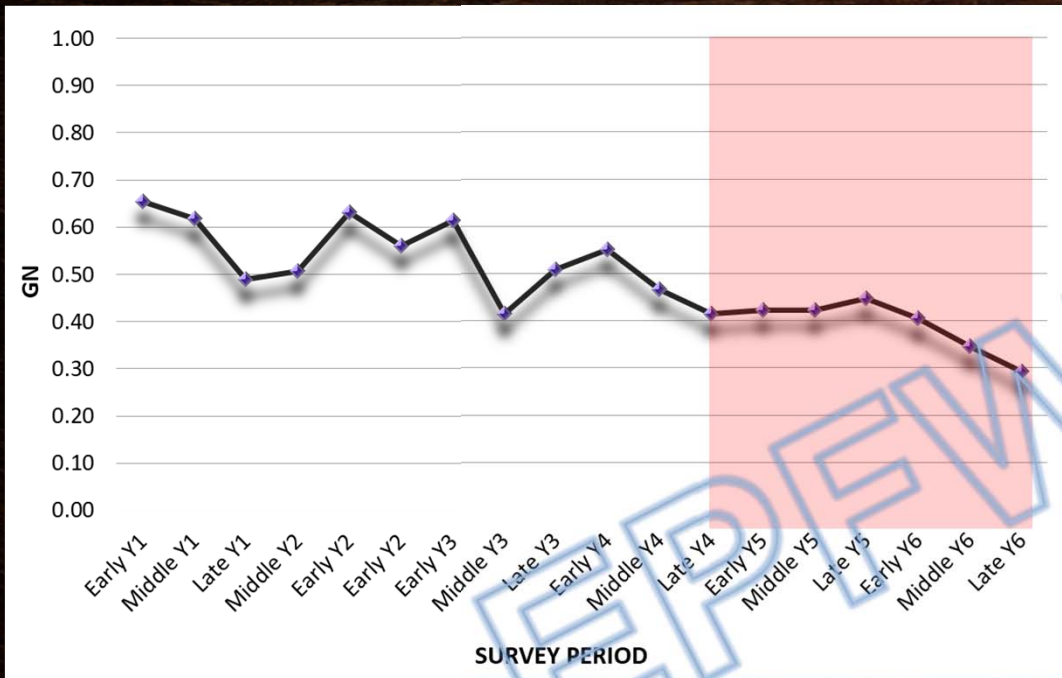


Macrottexture after polishing (H_{after})

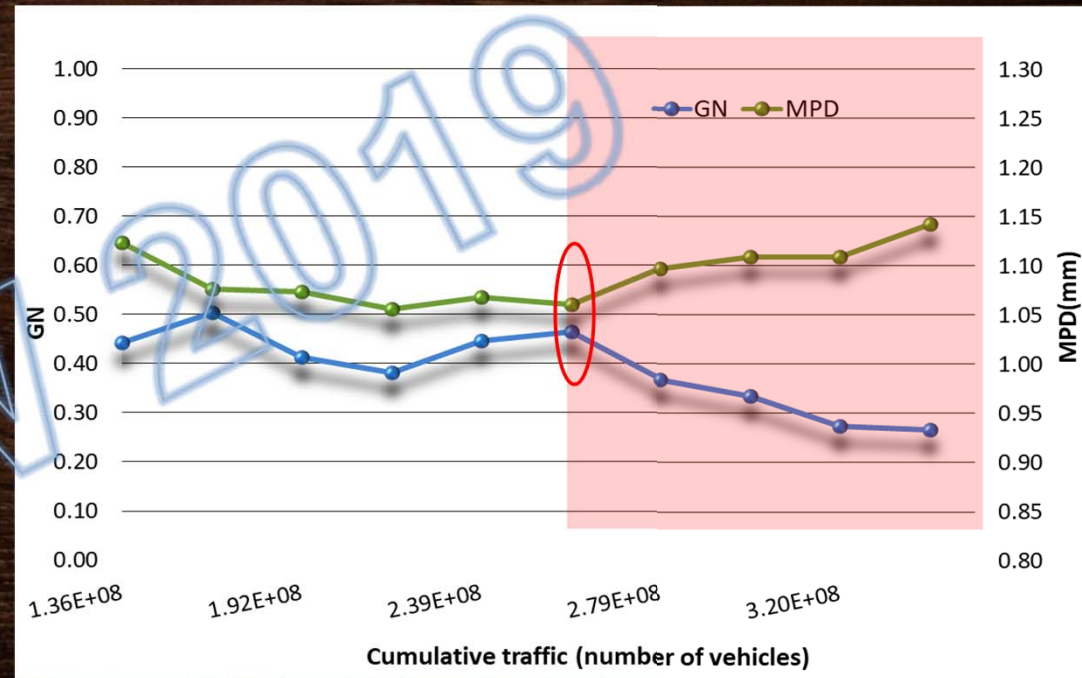
* H : height of aggregates above surface

Results

Seasonal Variation effect



Year to year deterioration



- ✓ Indications that the inverse trend between macrotexture and skid resistance is related to the decreasing influence of seasonal variation

Results

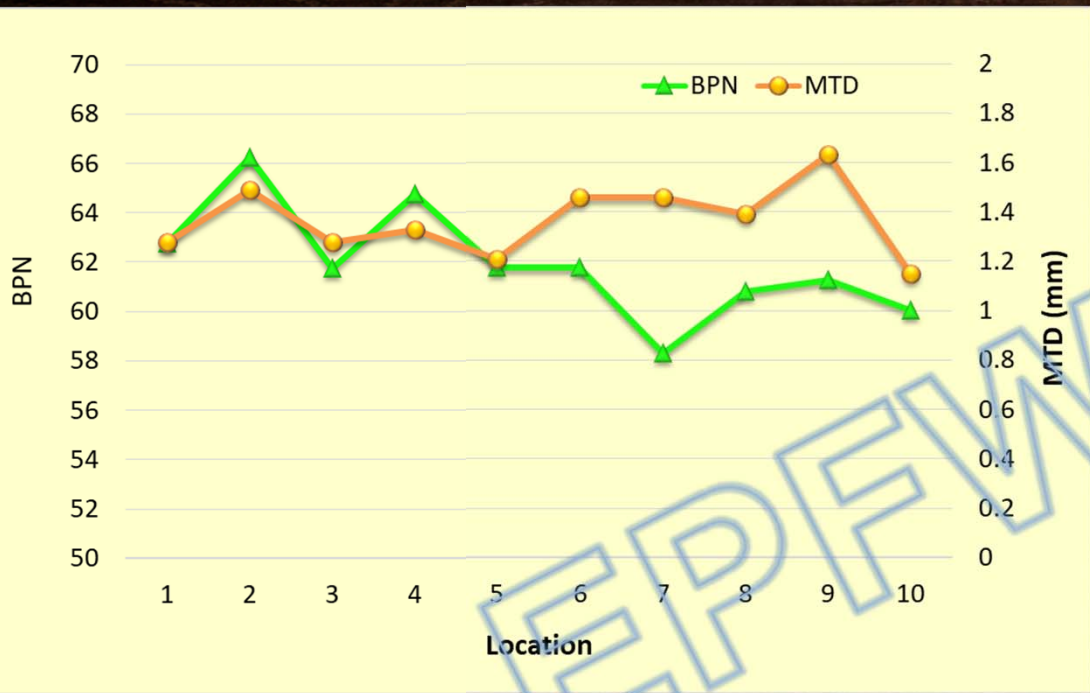
Extra sections investigated

- ✓ **Same asphalt** mixture properties
- ✓ **Later constructed**
- ✓ **Different weather conditions**, heavy rain during winter months and increased precipitation occurrence during summer months
- ✓ **Low traffic volume** (both light and heavy vehicles)

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Results

Extra sections investigated



BPN: British Pendulum Number
Testing device: British Pendulum

MTD: Mean Texture Depth (mm)
Testing method: Sand Patch

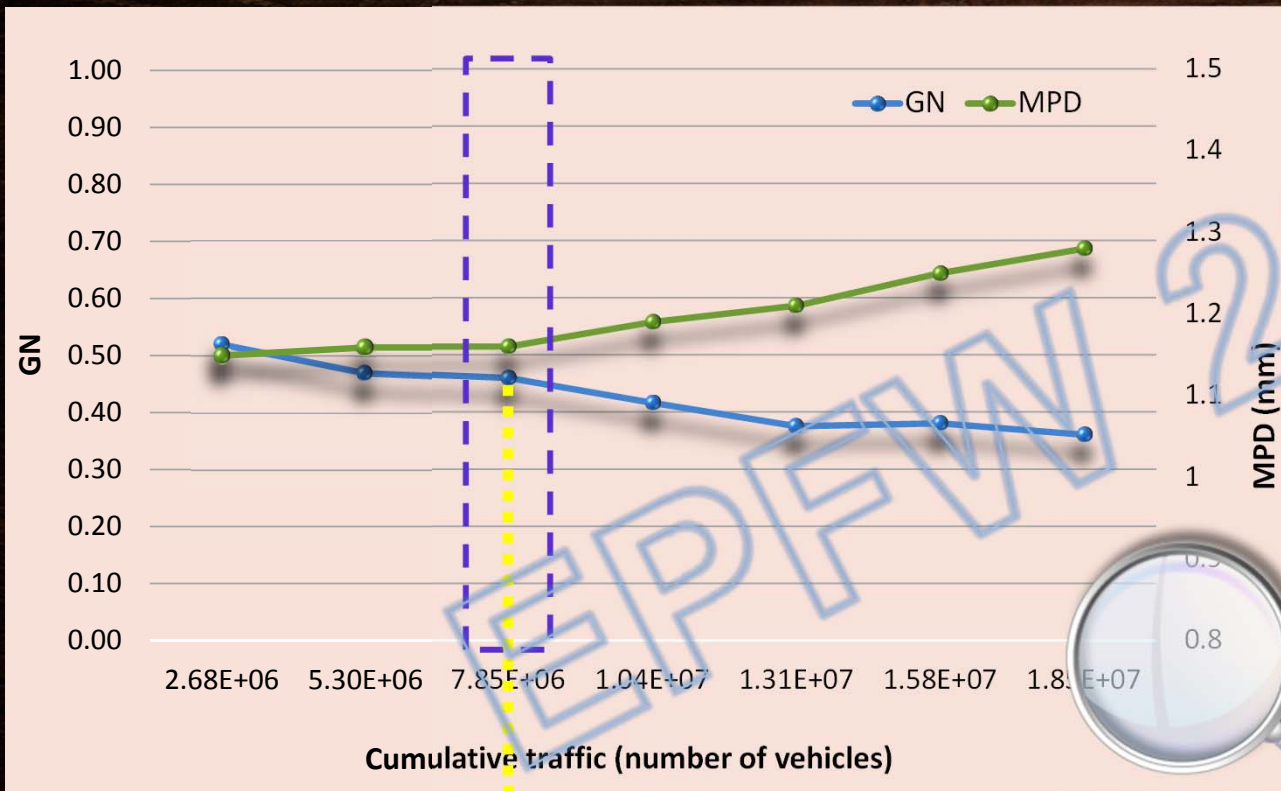
✓ Newly constructed pavement

✓ No traffic effect

✓ Indication of relationship between BPN and MTD measurements

Results

Extra sections investigated



Early evidence of clear inverse trend between MPD-GN



Results

Extra sections investigated

Loose debris are cleansed away due to **heavy rainfalls**, acting against **fine dust formation**

Low traffic volume cannot efficiently roughen the aggregates, just **polishing**

Increasing macrotexture



Decreasing skid resistance (+ microtexture)

Research question

- ✓ Seasonal variation effect
- ✓ Traffic volume
- ✓ Initial levels
- ✓



Macrotexture
Mainly used as an
input

**Computational
Simulation**

**Lab-based
Prediction
Models**

**Field data /
imaging
techniques**

Eliminate friction
measurements
(many measuring systems)



Estimate or Predict:
Skid resistance

Can we finally link these
characteristics?



Conclusions

It seems hard to find a safe relationship between field macrotexture and skid resistance

Albeit their proportional opposite trend, there is no equation to be used for estimating skid resistance through macrotexture measurements

Skid resistance and macrotexture should be considered together under pavement performance assessment but measured (monitored) separately

Conclusions

It is important to:

- ✓ **Collect data and face the challenges** of field conditions
 - Skid resistance and macrotexture measurements should be together with weather data (a few days before measurements)
- ✓ **Data analysis and performance assessment** should be strictly in relation to seasonal conditions of the area
- ✓ All the above to be considered under the **limitations of the utilized measuring device /method**

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Conclusions

Key aspects

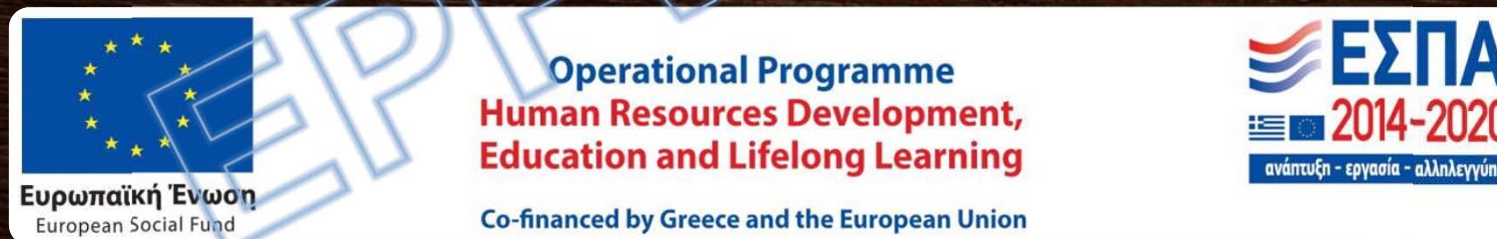
Continuous pavement monitoring

Assess field pavement performance considering the area of investigation



Acknowledgement

This research is co-financed by Greece and the European Union (European Social Fund- ESF) through the Operational Programme «Human Resources Development, Education and Lifelong Learning» in the context of the project “Strengthening Human Resources Research Potential via Doctorate Research” (MIS-5000432), implemented by the State Scholarships Foundation (IKY).





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Thank you!



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