



**The European Approach to Long
Lasting Asphalt Pavements:
A state-of-the-art review by ELLPAG**

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**ORITE International Conference on Perpetual Pavements,
Columbus, Ohio - September 2006**

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european

long-life

pavement

group



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is a **FEHRL** Working Group



(**F**orum of **E**uropean **N**ational
Highway **R**esearch **L**aboratories)

with support from **CEDR**

(**C**onference of **E**uropean **D**irectors of
Roads)



ELLPAG

Core Membership 11 countries



Four main aims of ELLPAG

With respect to long-life pavements:

- to determine best designs
- to determine economic benefits
- to understand deterioration mechanisms
- to encourage their use

With a particular emphasis on the needs of the structural support layers



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Main aims of the Group - 1

- To determine the best methods and optimum strategy for designing, constructing, assessing and maintaining pavements without structural deterioration i.e. 'long-life' pavements





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Main aims of the Group - 2

- To better understand the economic benefits of correctly constructed and maintained 'long-life' pavements

i.e. sustainable pavements?



Main aims of the Group - 3

- To better understand the deterioration mechanisms of pavements and thus how to classify pavements, in particular those known as 'long-life' pavements



Main aims of the Group - 4

- To encourage the use of 'long-life' pavement design and maintenance wherever appropriate



Objective - Short Term

- **A State-of-the-art Review of current European knowledge on the design and maintenance of fully flexible pavements, with emphasis on the structural layers**



Objective - Medium Term

- To produce similar State-of-the-art Reviews for the other common pavement types.

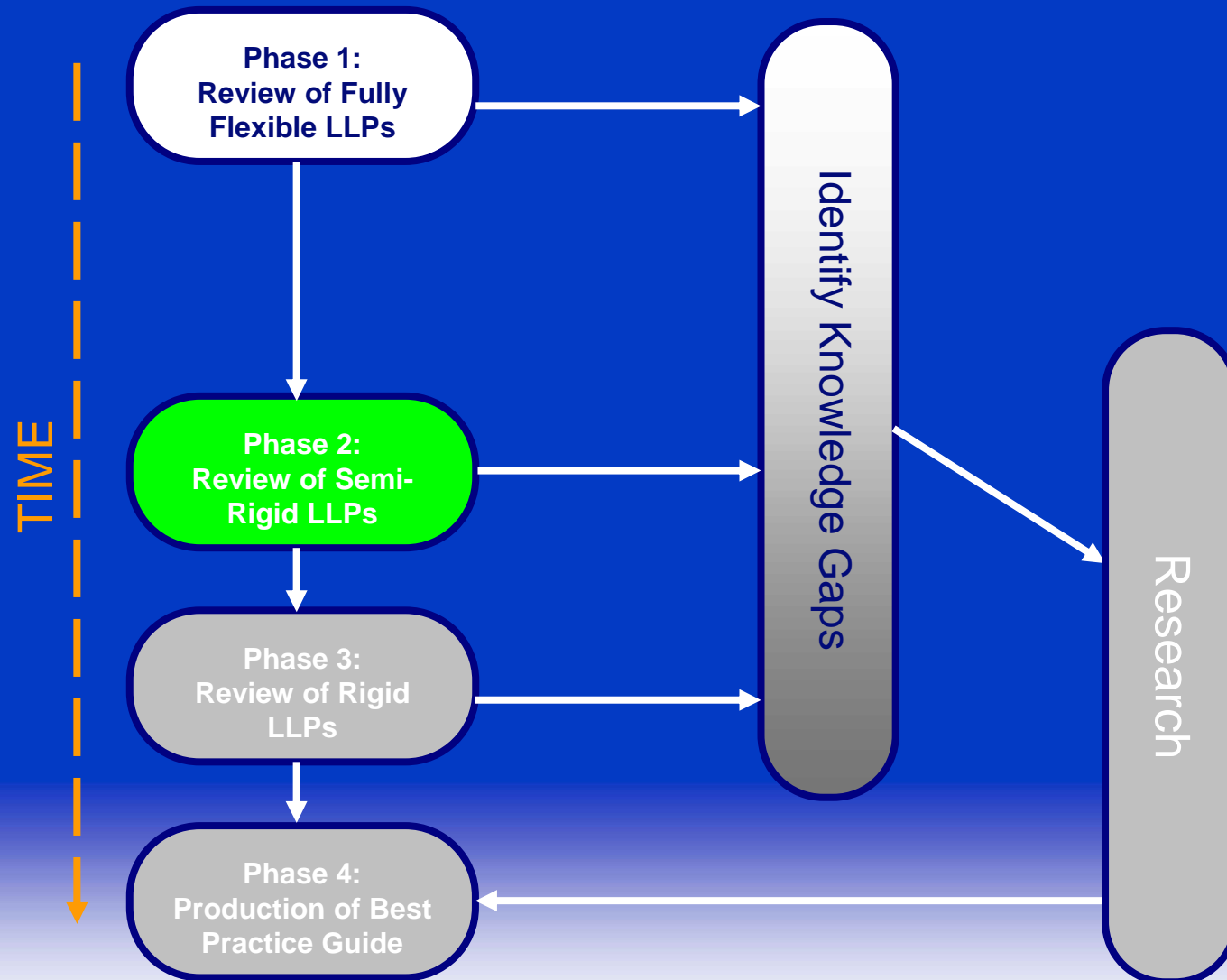


Objective - Long Term

- **A user-friendly Best Practice Guidance note on long life pavement design and maintenance for all the common types of pavement construction used in Europe.**











Plan for the flow of the work of ELLPAG



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Tasks carried out in Phase 1

-  • Technical Management
-  • Definition of Long-Life Pavements
-  • New Pavements
-  • Assessment and Upgrading
-  • Maintenance
-  • Economics
-  • Knowledge Gaps
-  • Production of the Final Report

CONTENTS

Definition

Design and construction

Assessment

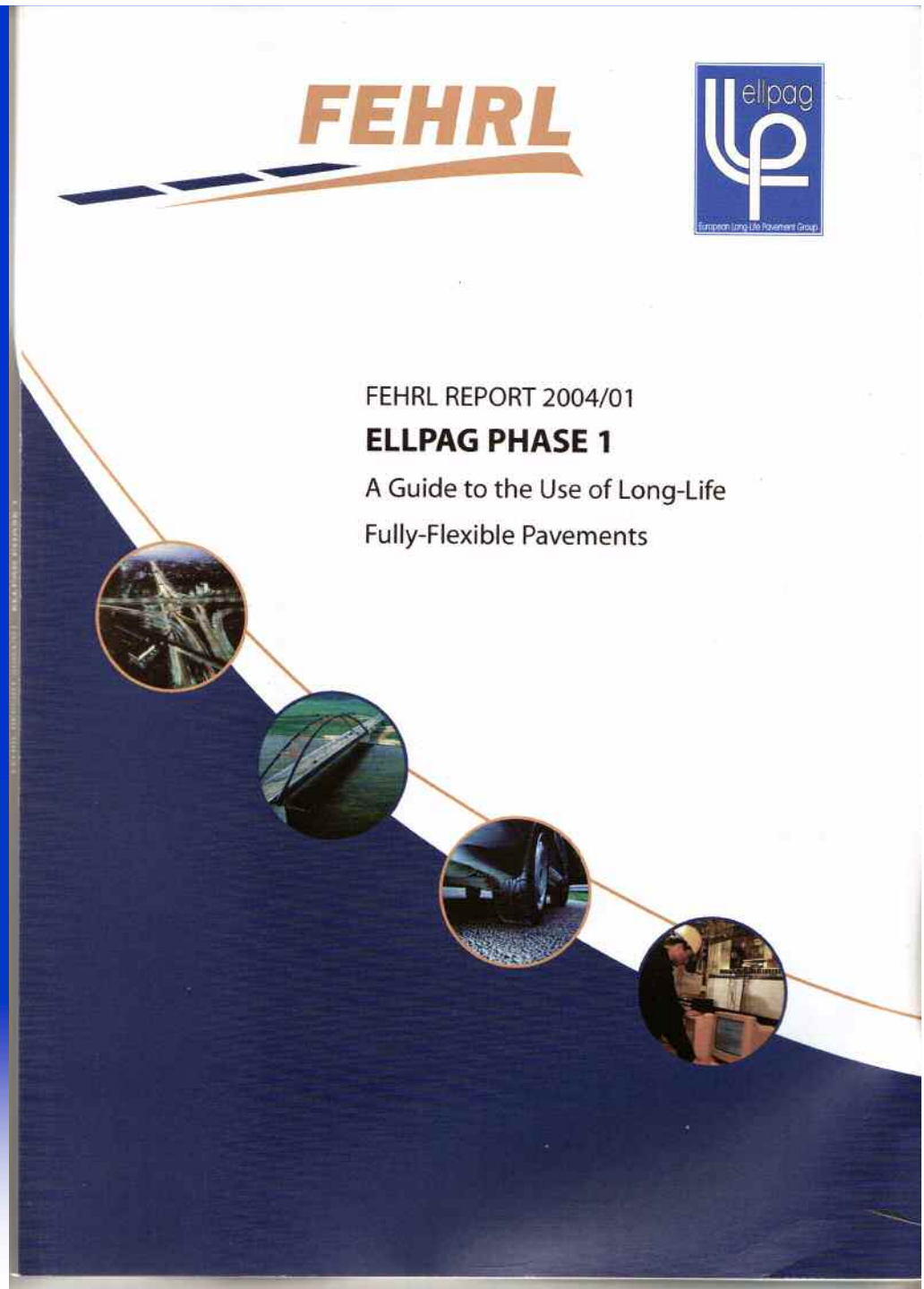
Maintenance

Economic analysis

Research needs

Recommendations

WWW.fehrl.org



Definition

- *A Long-life Pavement is a type of pavement where no significant deterioration will develop in the foundations or the road base layers provided that correct surface maintenance is carried out.*

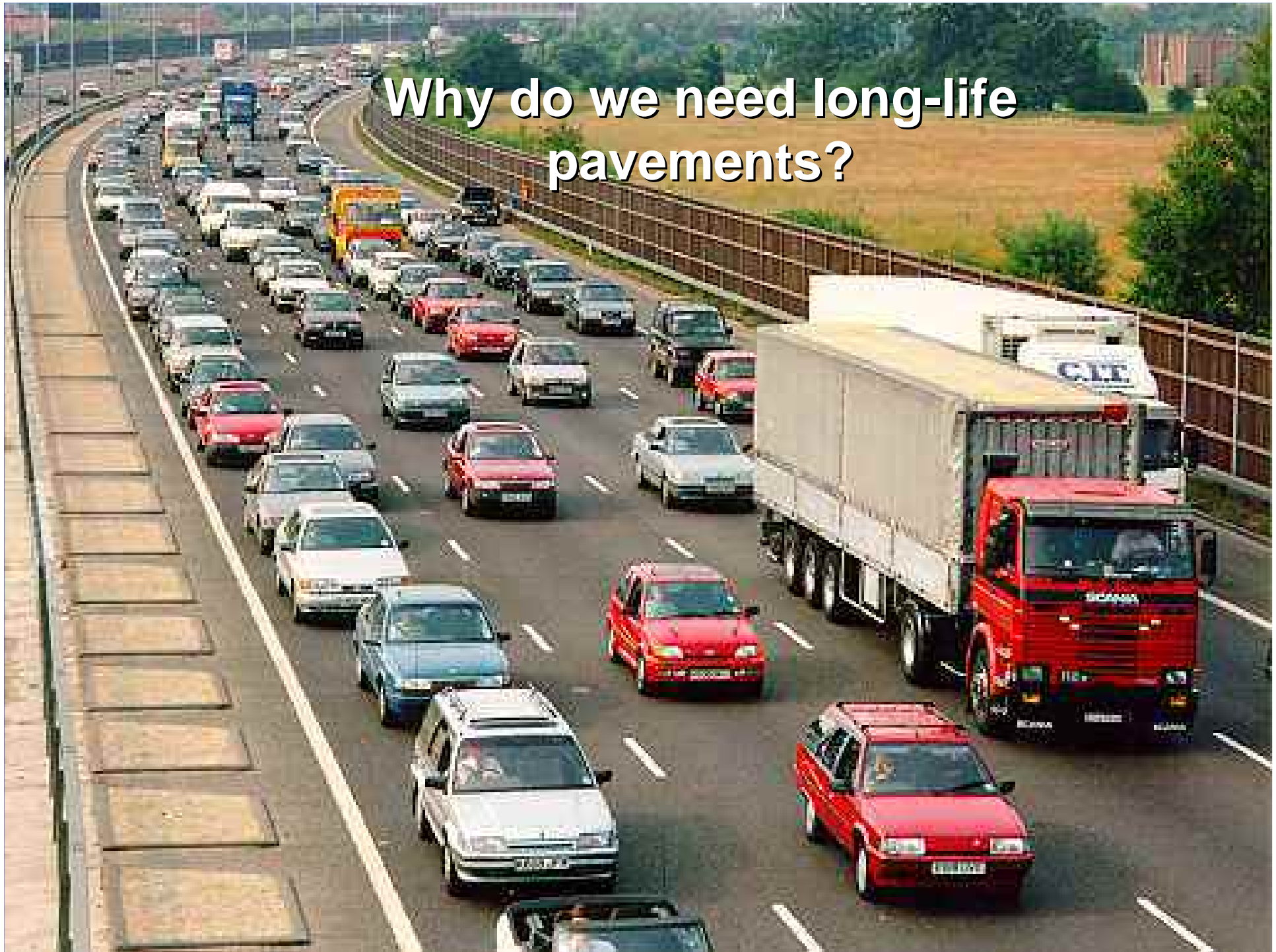


What does this mean?

- **There is much evidence for**
 - **Top down cracking only**
 - **Deformation only in surfacing**
- **If the pavement is sufficiently strong and well built**

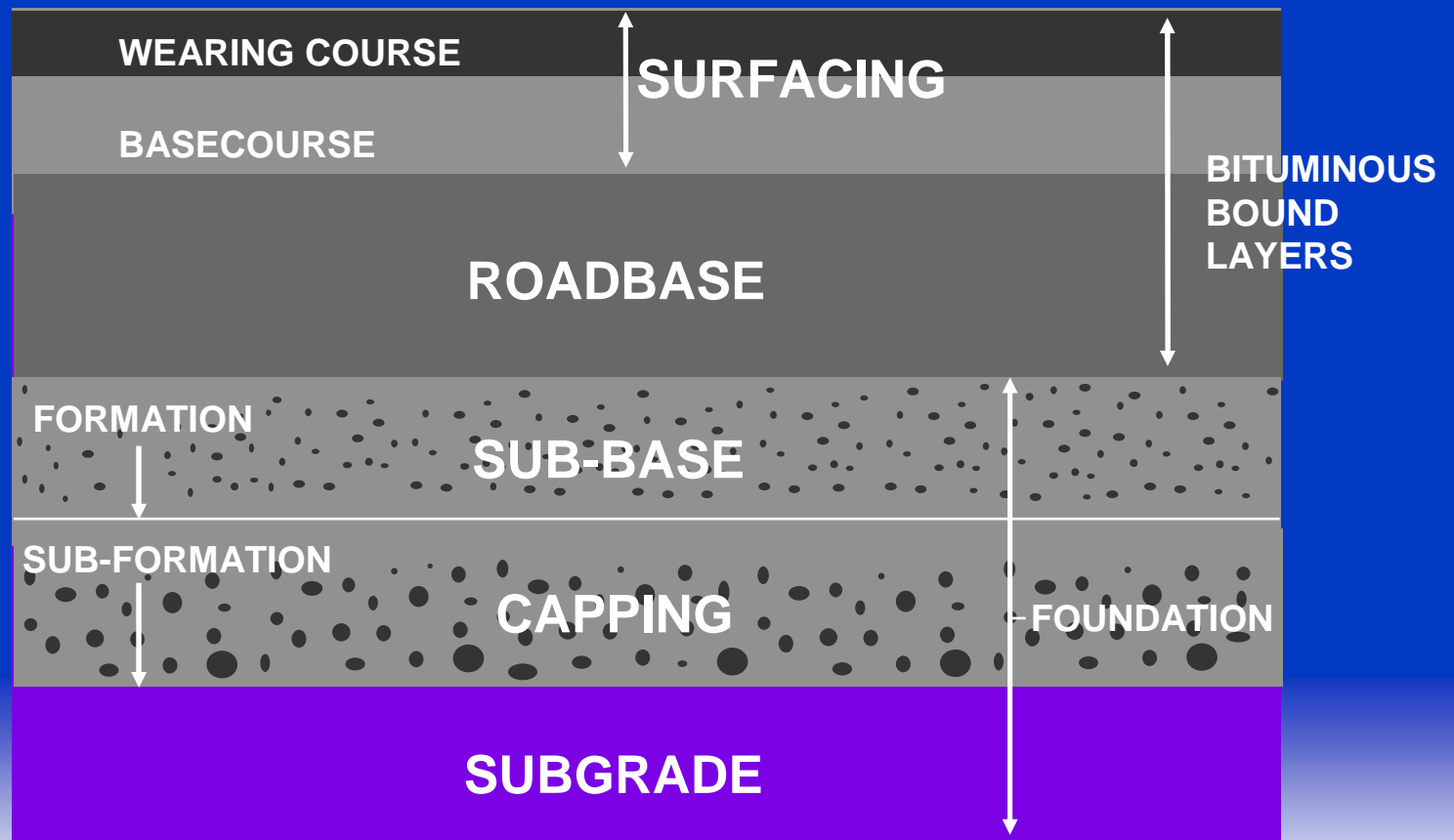


Why do we need long-life pavements?

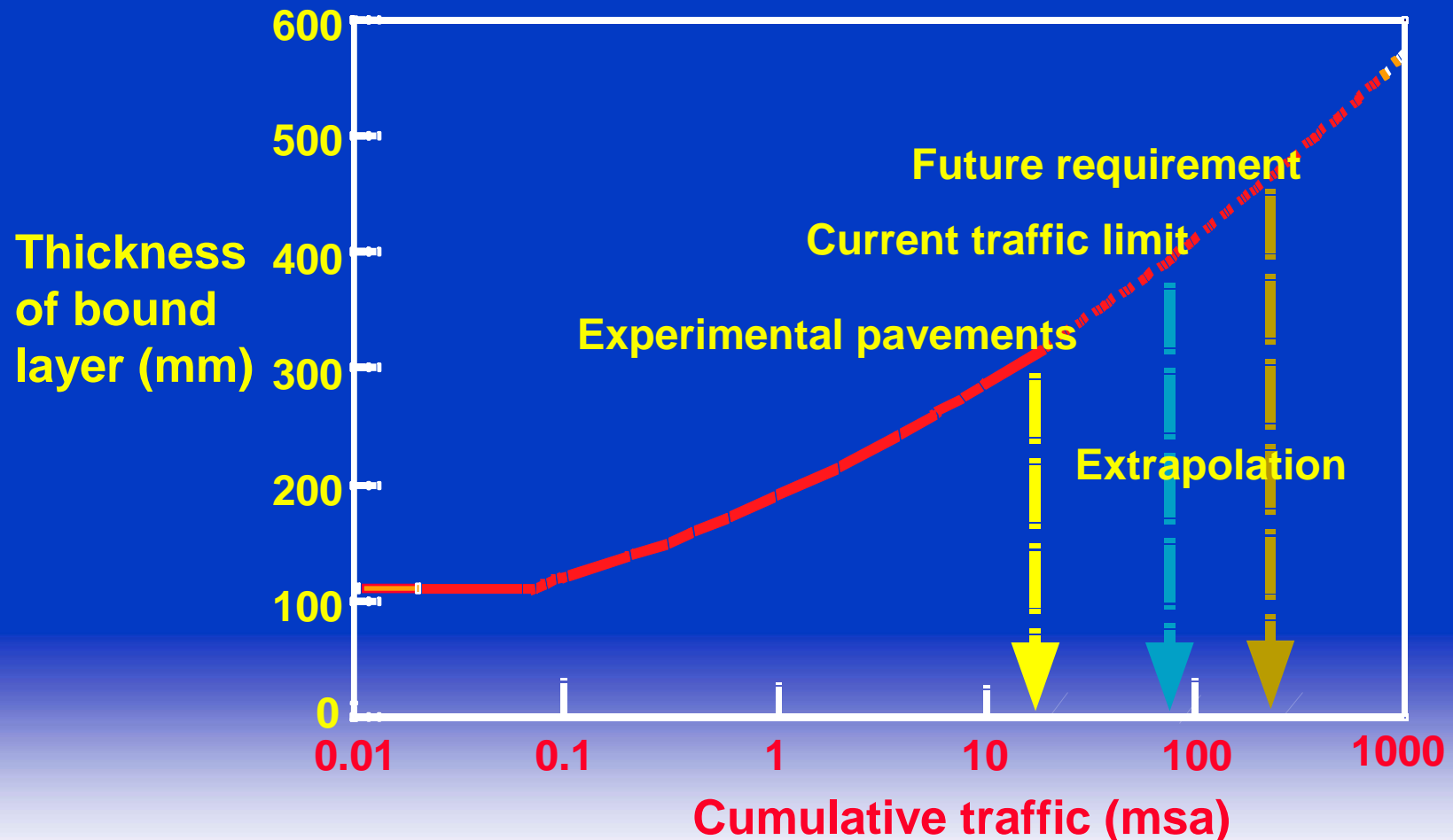




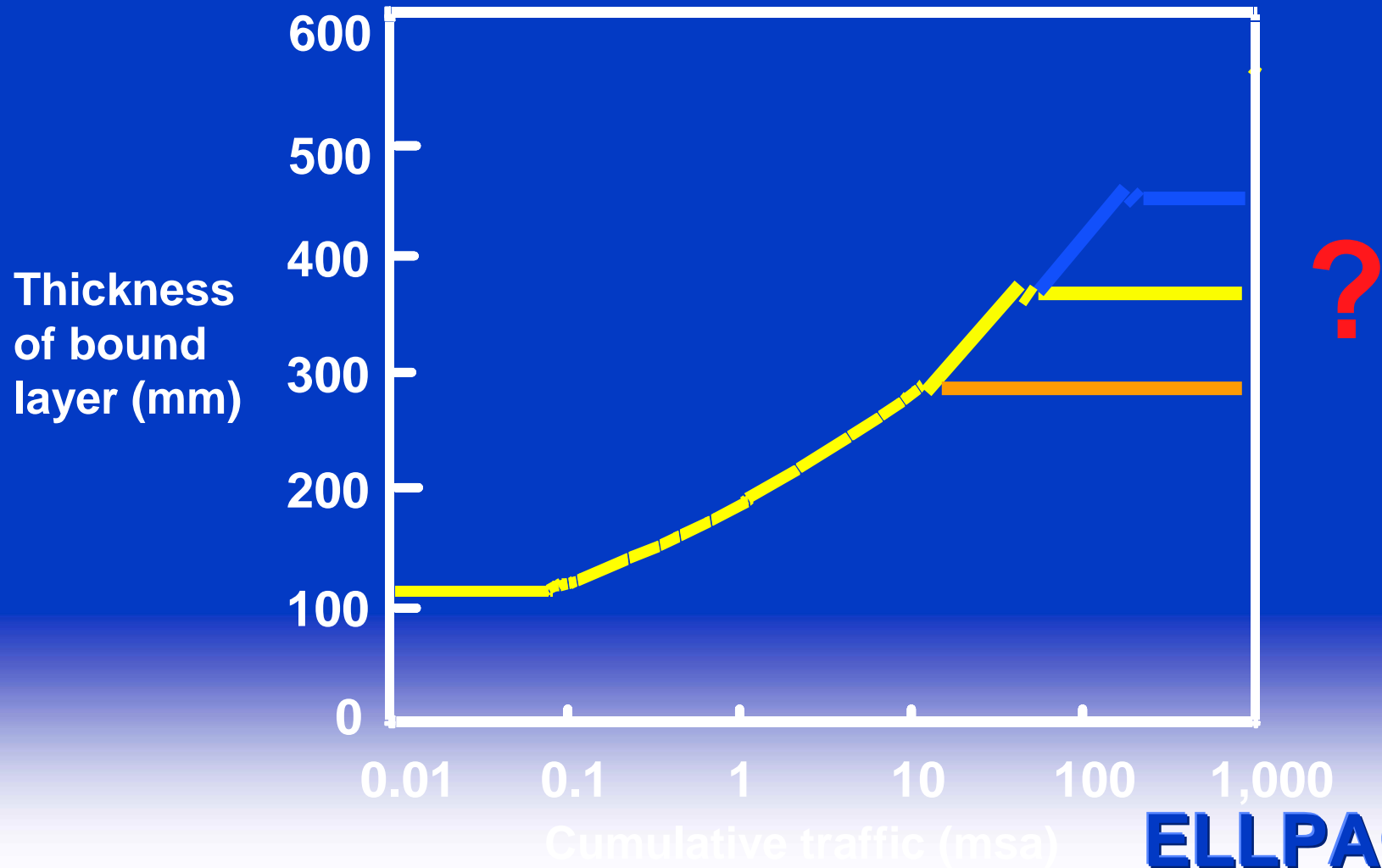
FLEXIBLE PAVEMENT CONSTRUCTION



DESIGN CHART (INCREASING THICKNESS)



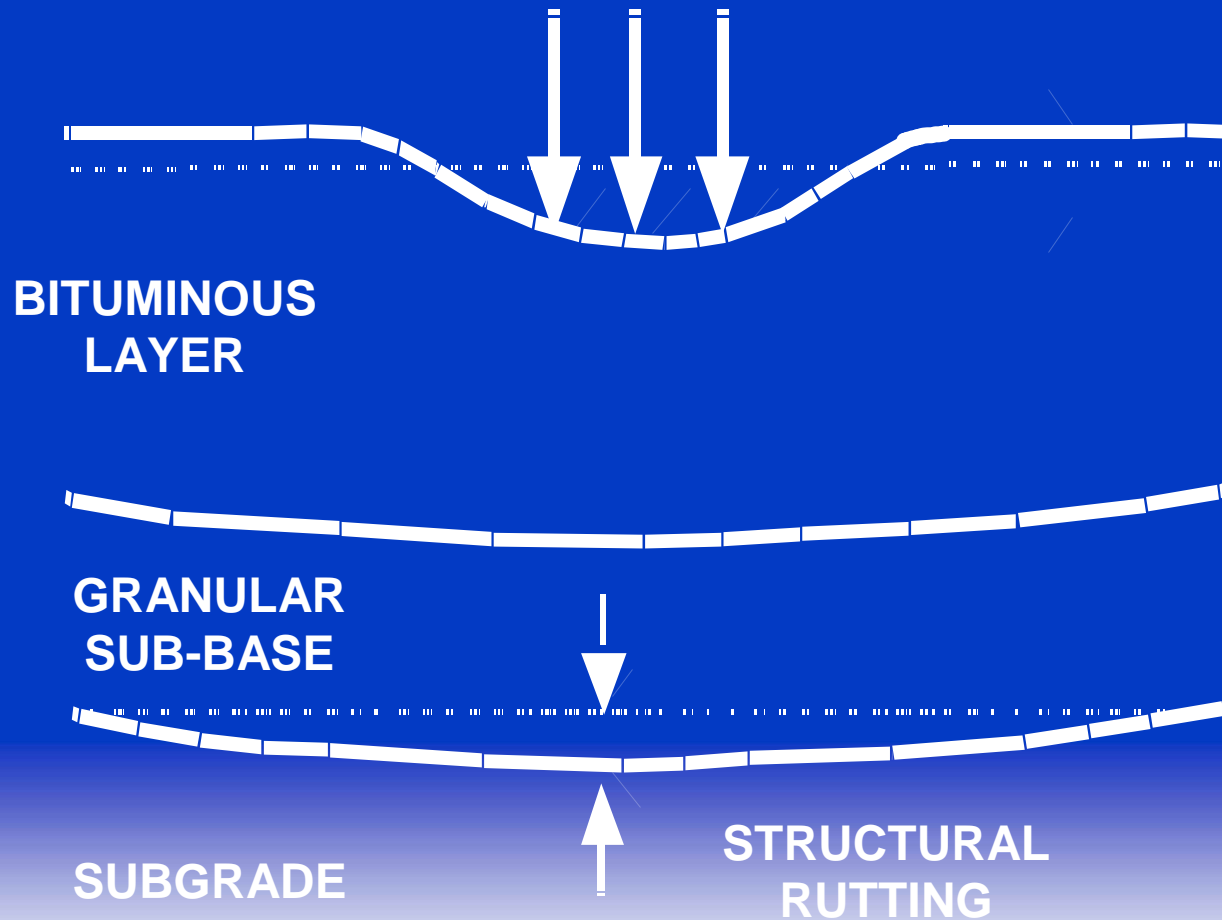
DESIGN CHART (CUT-OFF)



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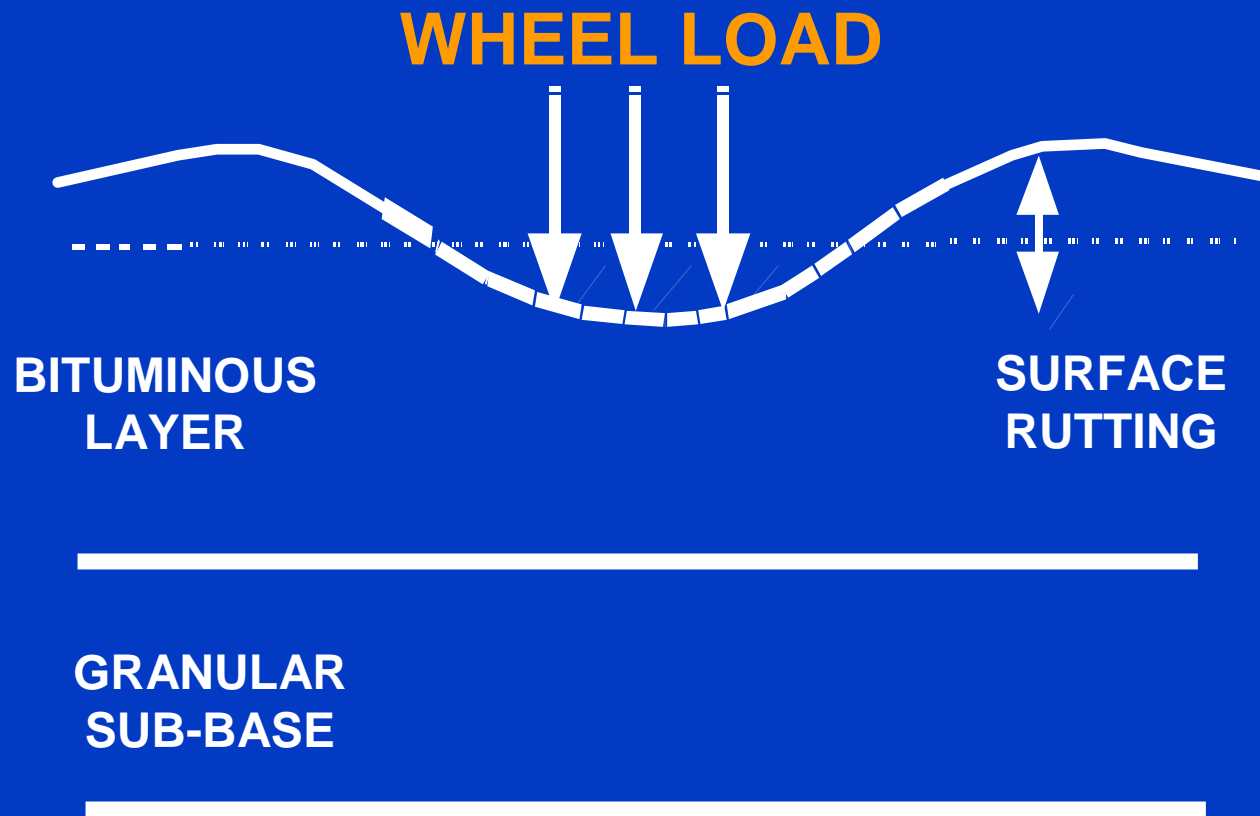
STRUCTURAL RUTTING

WHEEL LOAD



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SURFACE RUTTING

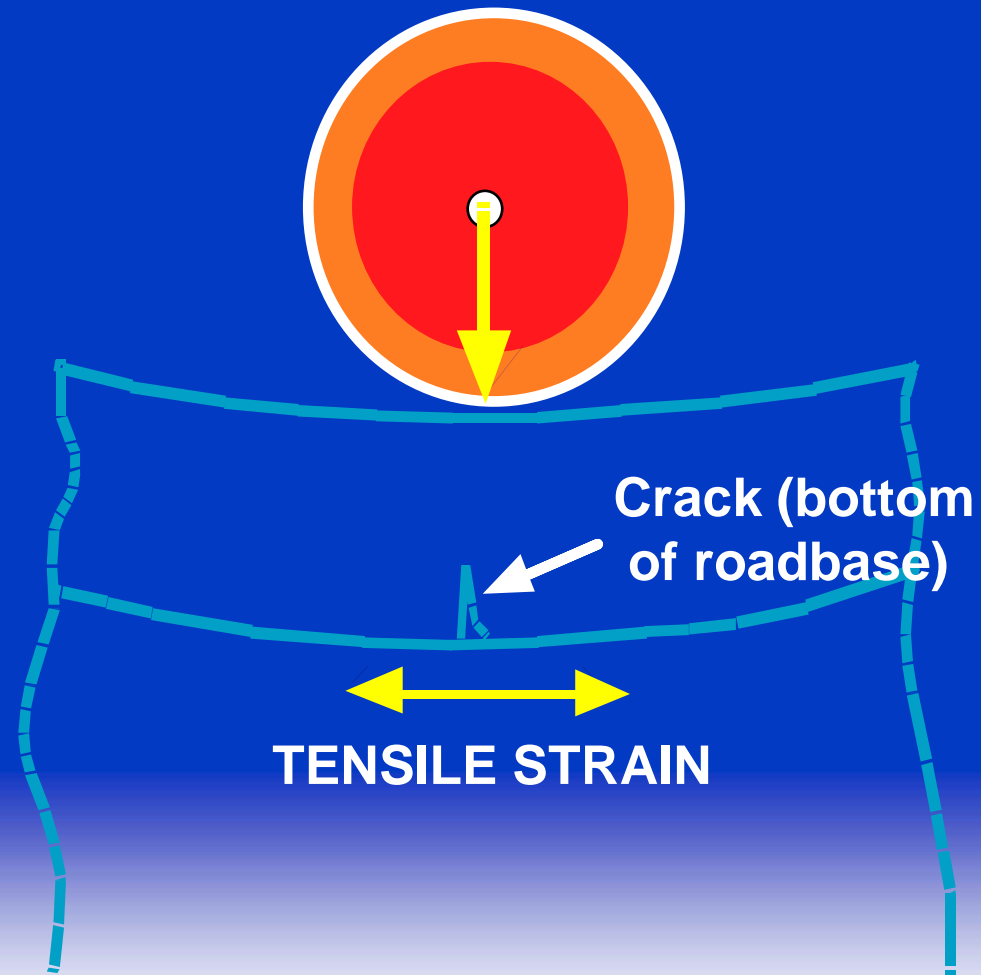


SUBGRADE

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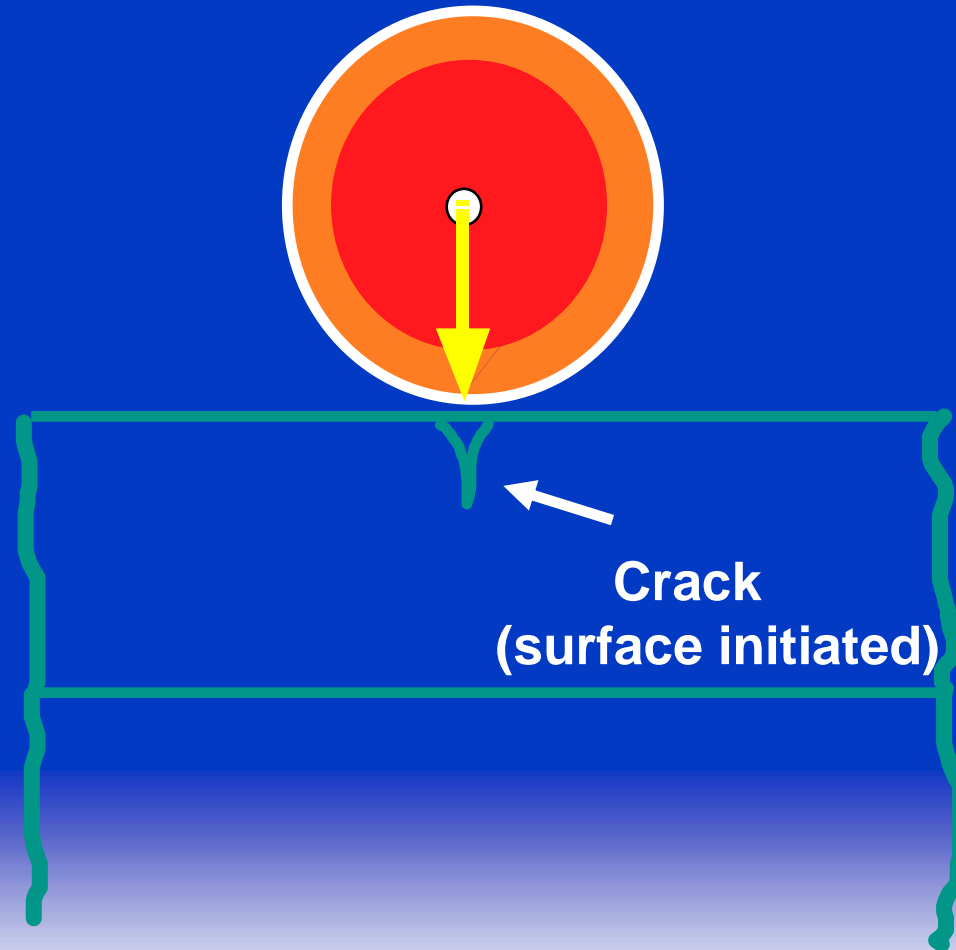
FATIGUE CRACKING

WHEEL LOAD



SURFACE CRACKING

WHEEL LOAD



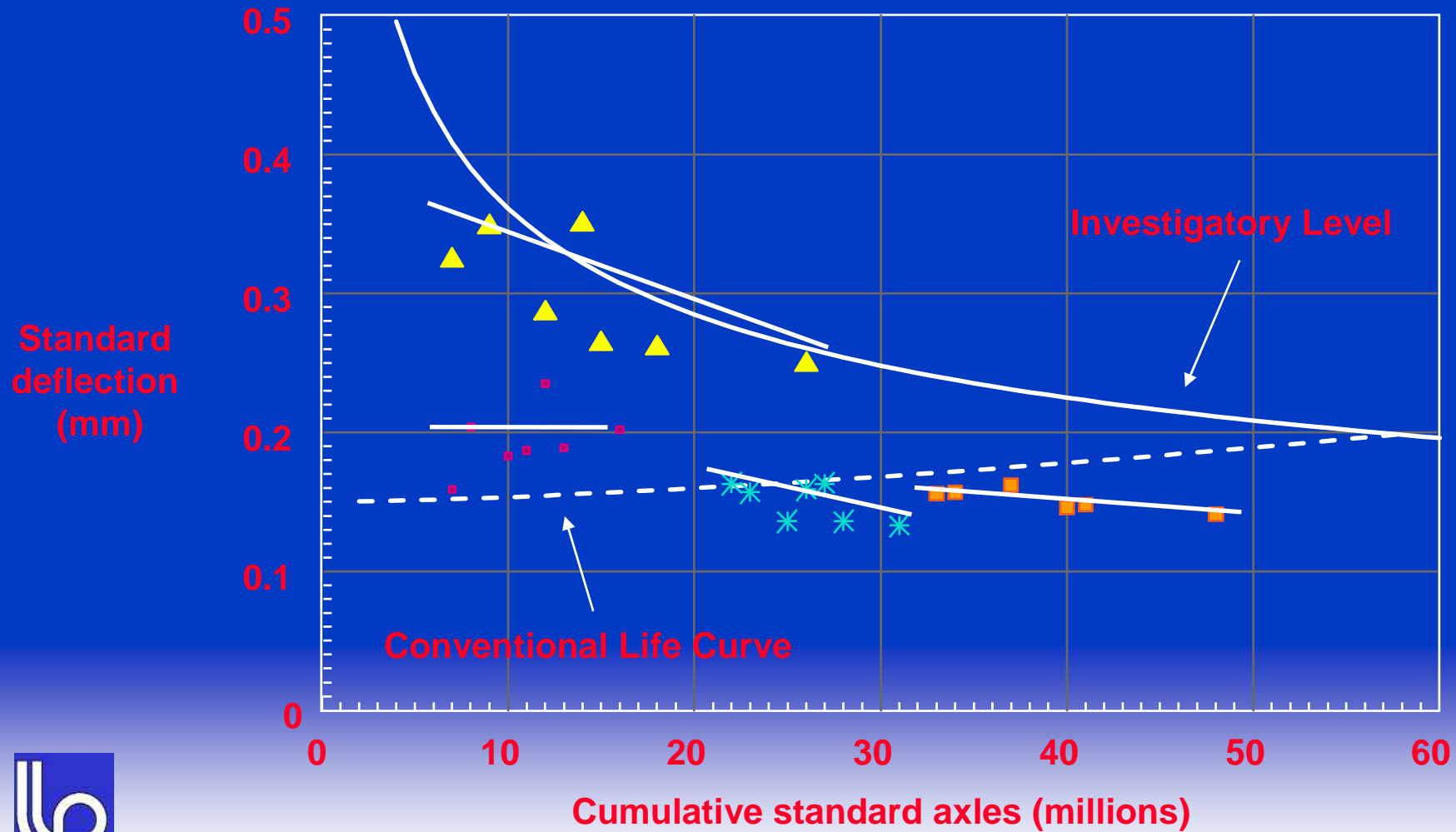
CORE THROUGH CRACK



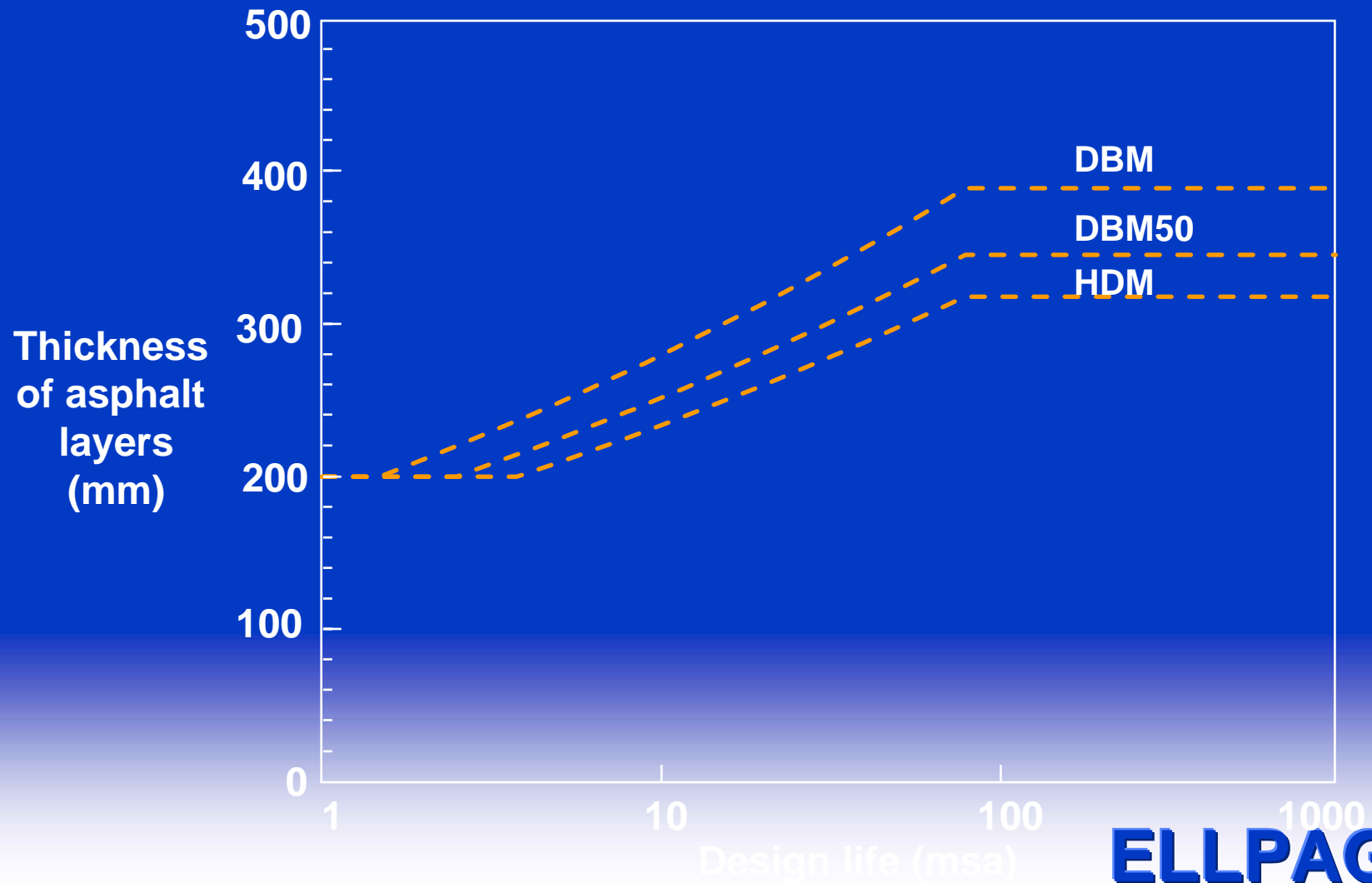
NON-STRUCTURAL RUTTING



DEFLECTION HISTORIES OF IN-SERVICE MOTORWAYS (DEFLECTOGRAPH)

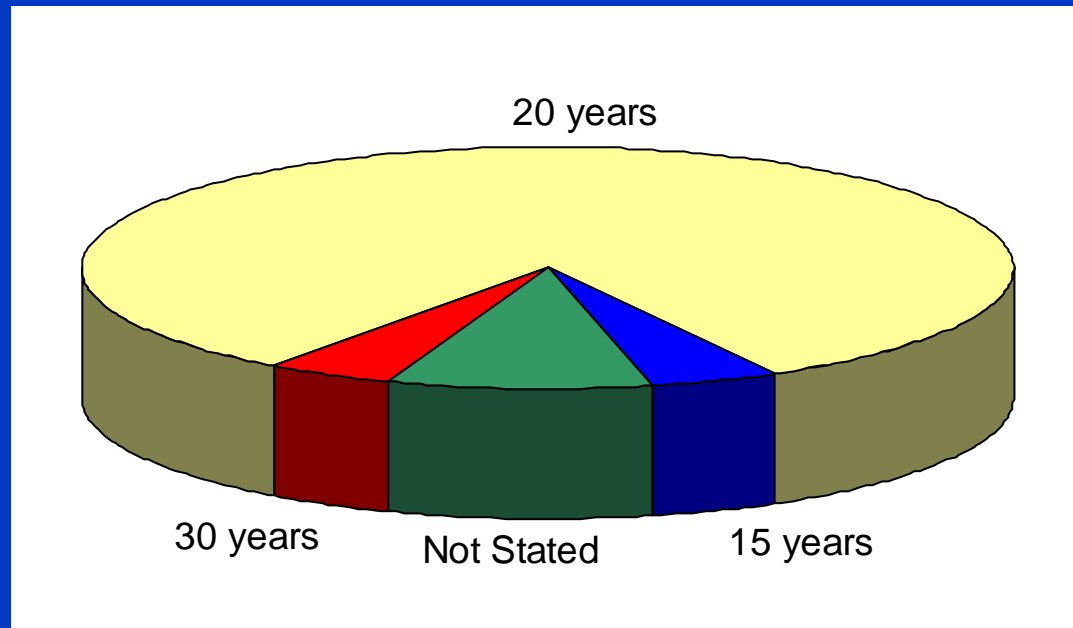


DESIGN CURVES FOR ASPHALT PAVEMENTS



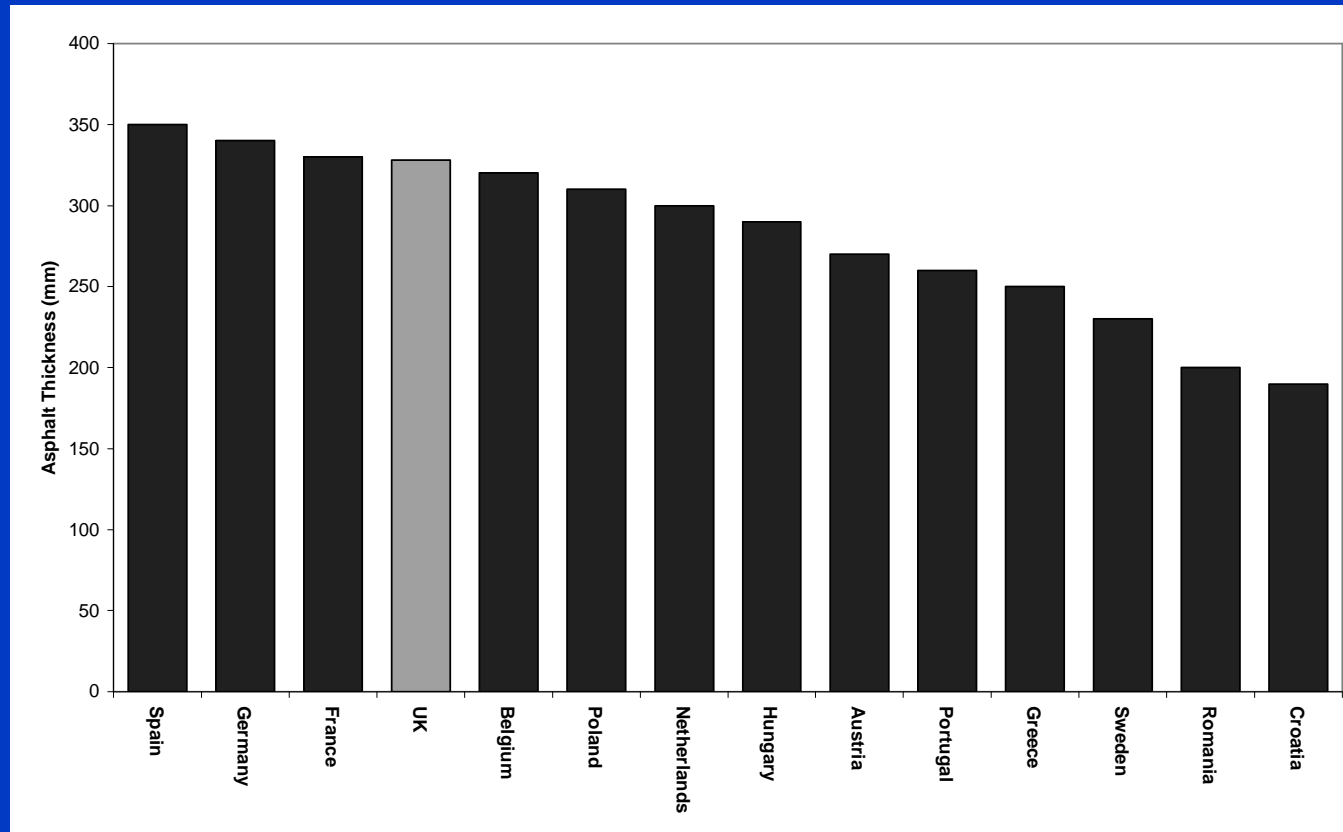
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Review of European Designs



Stated Nominal Design Periods

Review of European Designs

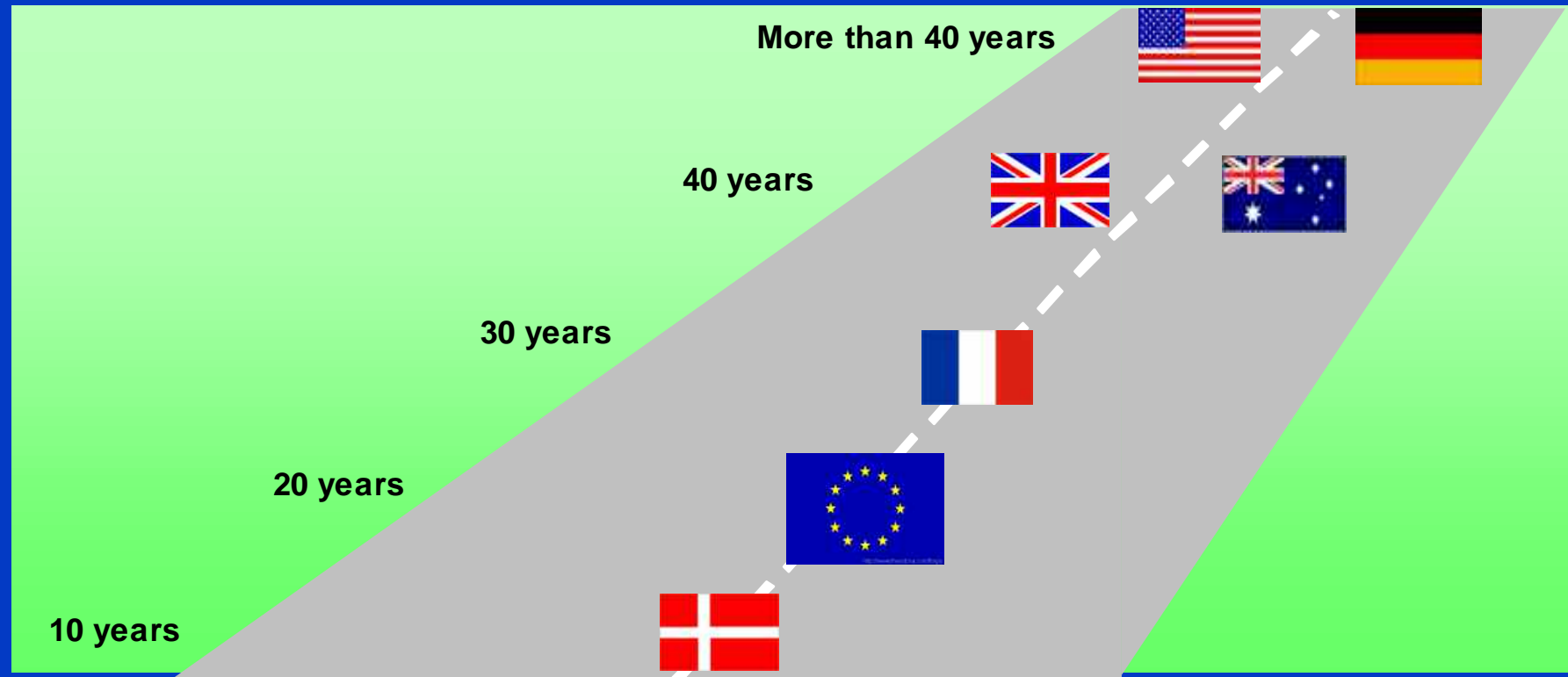


Asphalt design thicknesses for 100msa_{80} design traffic



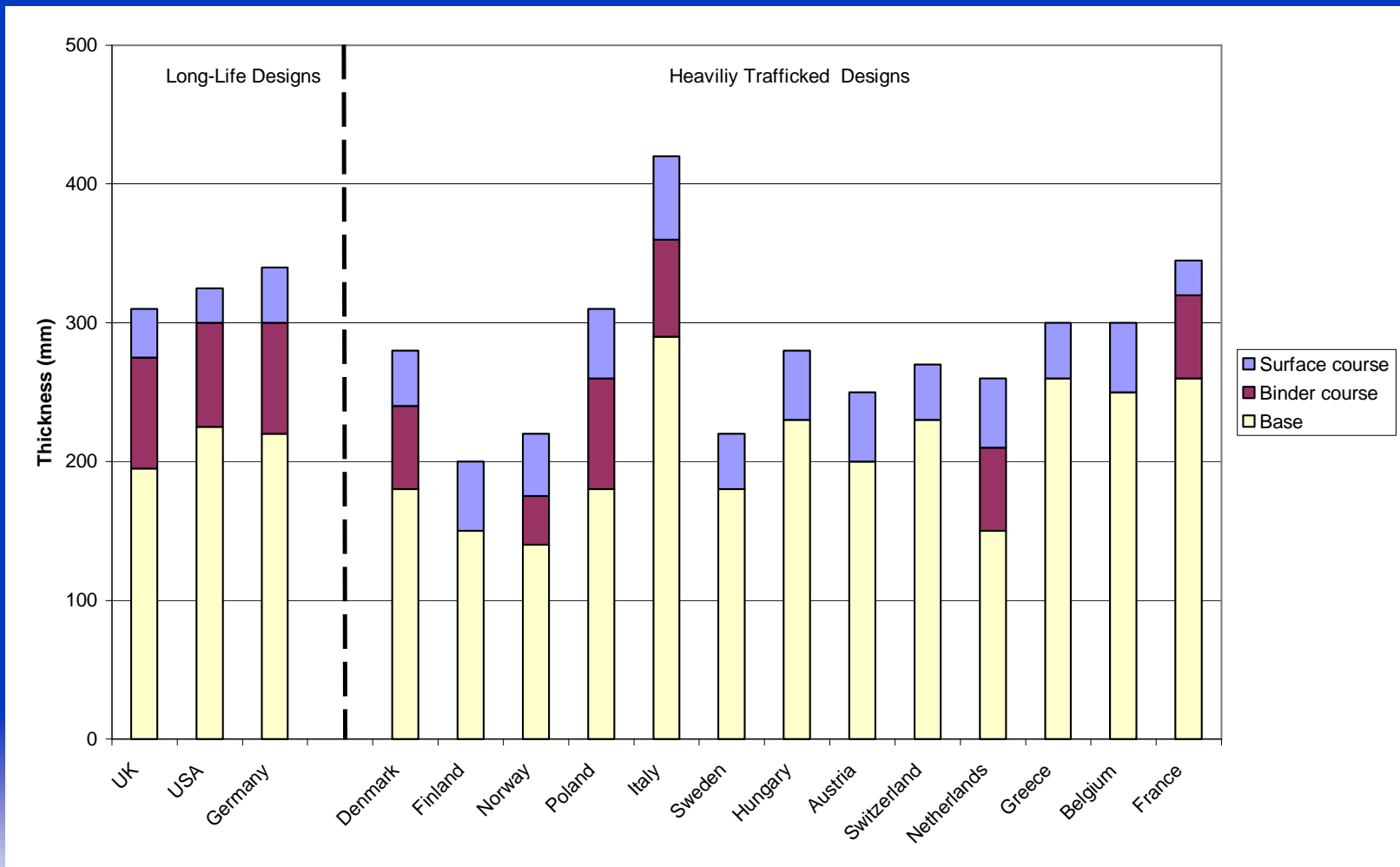
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Review of European Designs



Design periods in use

Example Pavement Designs



Economic benefits

- **Comparison of**
 - **Traditional pavement design**
- Vs**
- **Long-life designs**

Should not generalise for every design need to consider:



For every design need to consider:

- **Initial cost**
- **Deterioration cost**
- **Effects of road works**
 - **User delay costs**
 - **Accident costs**
- **Environmental costs**
- **Agency costs**
 - **Treatment costs**
 - **Traffic mangement costs**



Several Cost Benefit Analysis models available for the economic assessment of LLP's

- E.g.
 - Current UK model
 - OECD project model PASI (Project Analysis System International)
 - Model being developed within FORMAT project

None yet takes full account of all the necessary parameters however:



Sample network economic analysis

Considering a core network of 10,000 km over a 10 year period

- For new pavements, use of IIP designs could save
 - €50M in construction costs
 - €70M in maintenance costs
- For maintenance of existing network, use of IIP approach could save
 - €110M in maintenance works costs
 - €100M+ in road user costs
- + sustainability benefits



But

- **What proportion of existing pavements already LLPs?**
- **Are LLPS universally applicable?**
- **Do we fully understand the deterioration mechanisms of LLP's?**



No!

- Therefore we need to investigate further through cooperative European research, for example to discover:
 - How asphalt material properties relate to long-life behaviour
 - What is the optimum maintenance strategy for long-life pavements
 - How we can fully assess the economic benefits of LLP's

The benefits of such a programme would be
ENORMOUS



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Are they economic solutions?

Considering the management of a heavily trafficked core network of 10,000 km over a 10 year period the use of long-life designs can give **a total saving of well over**

€300M



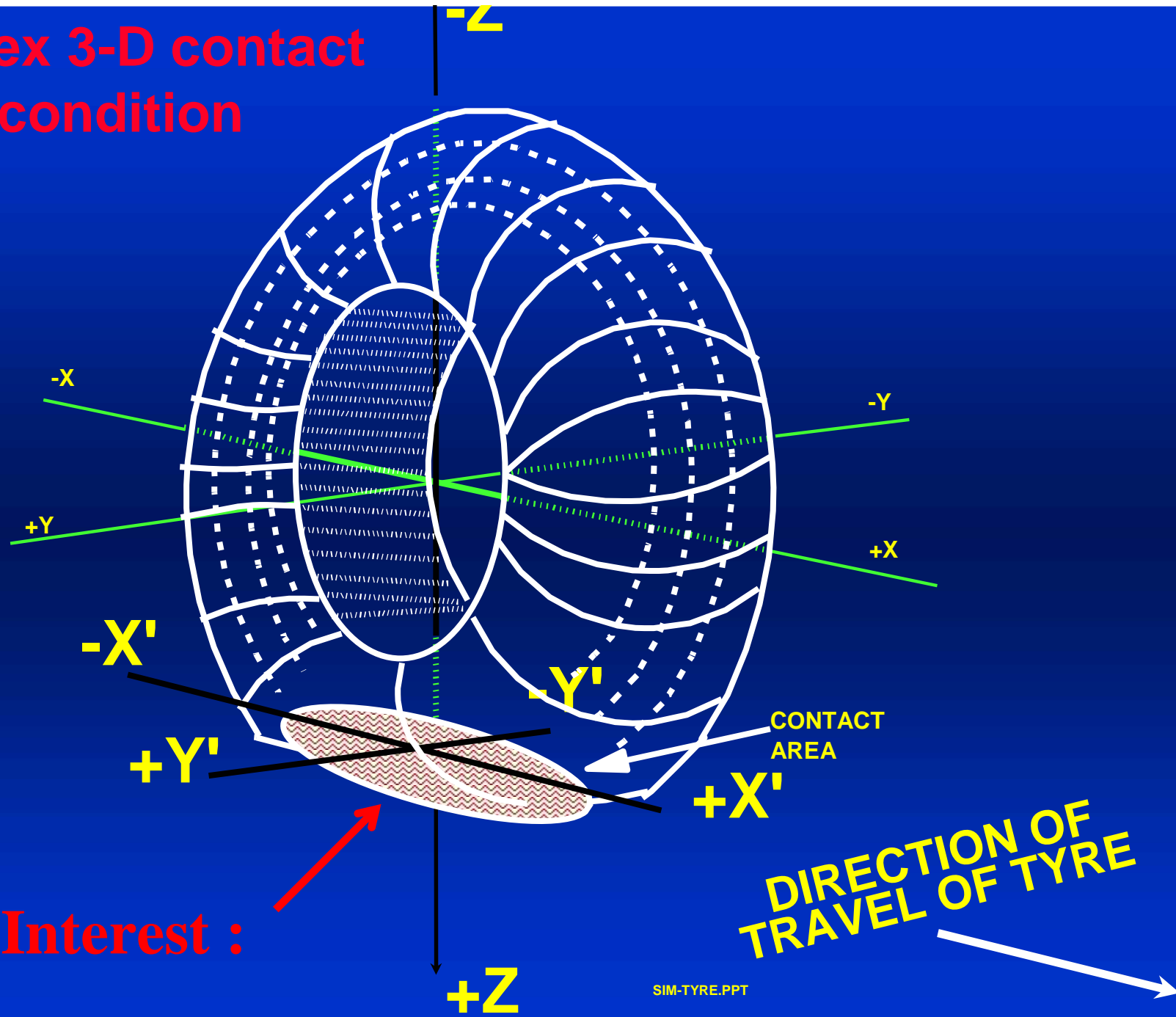
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Two questions?

- **Why are more countries not using long-life designs?**
- **Why is there not more research into long-life designs?**



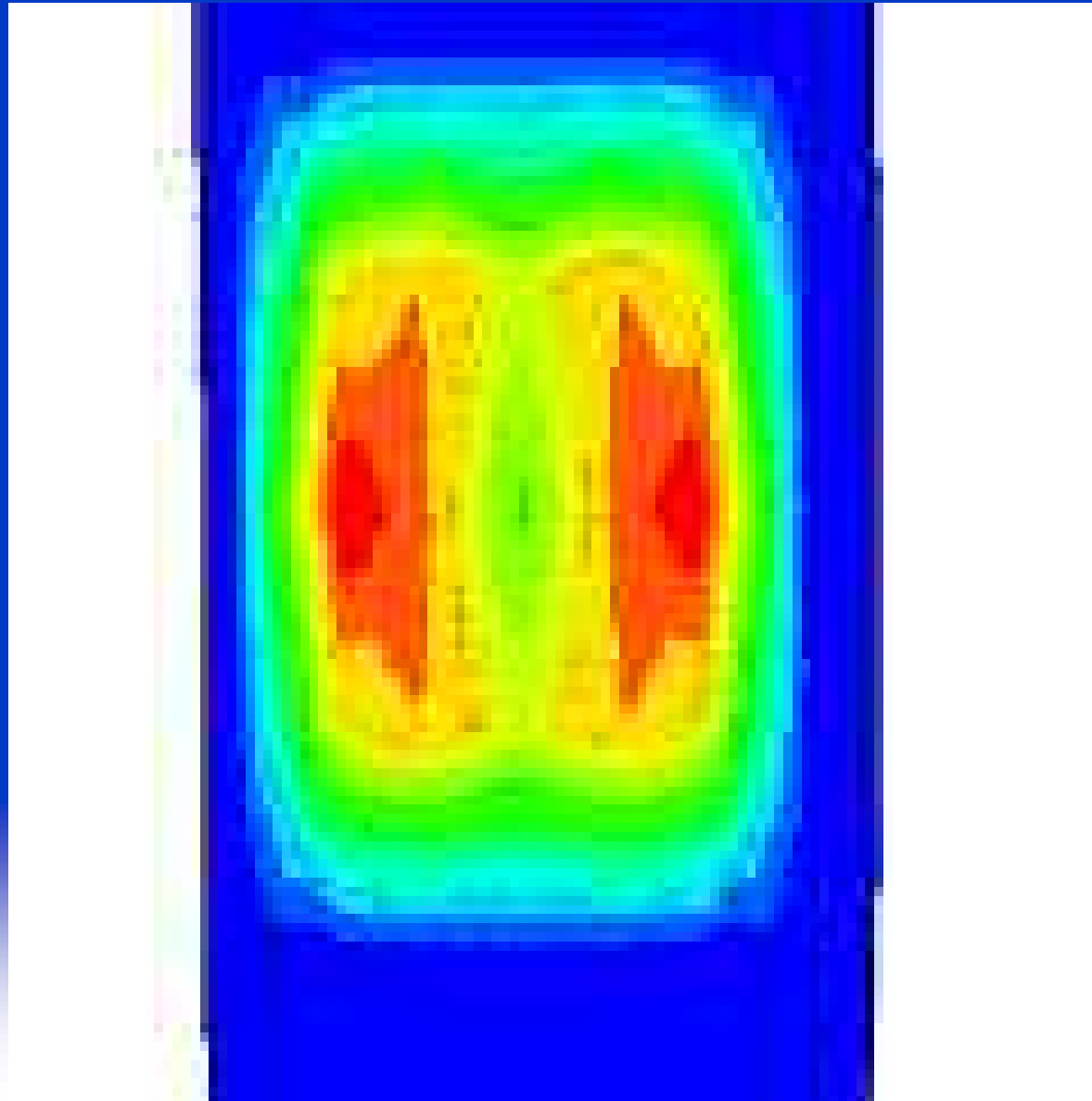
Complex 3-D contact stress condition



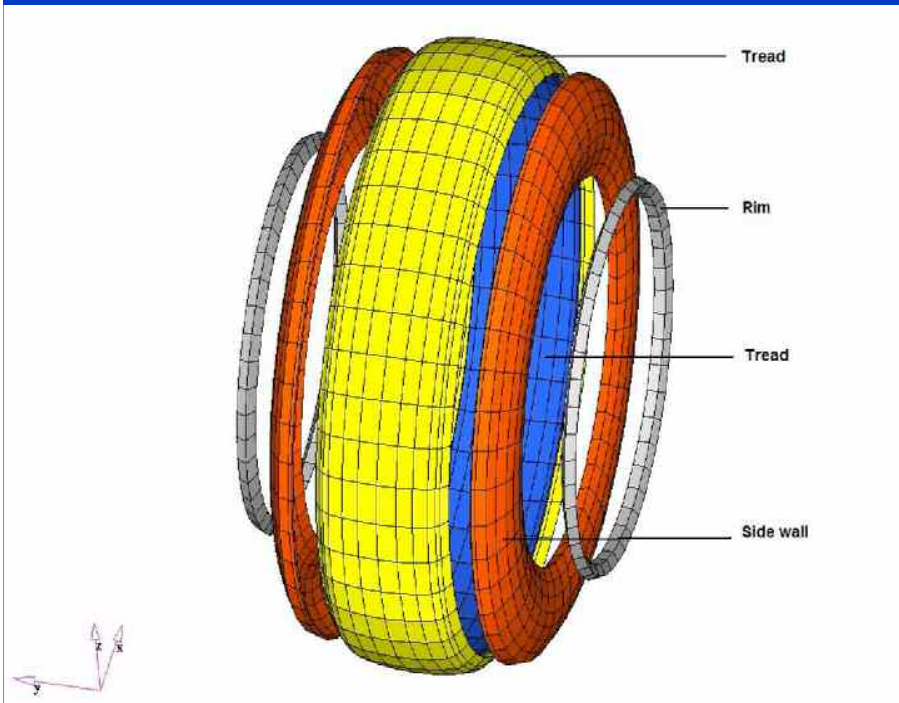
Area of Interest :

DIRECTION OF TRAVEL OF TYRE

Footprint of a tire when in contact with the pavement surface



Model the tyre/pavement system



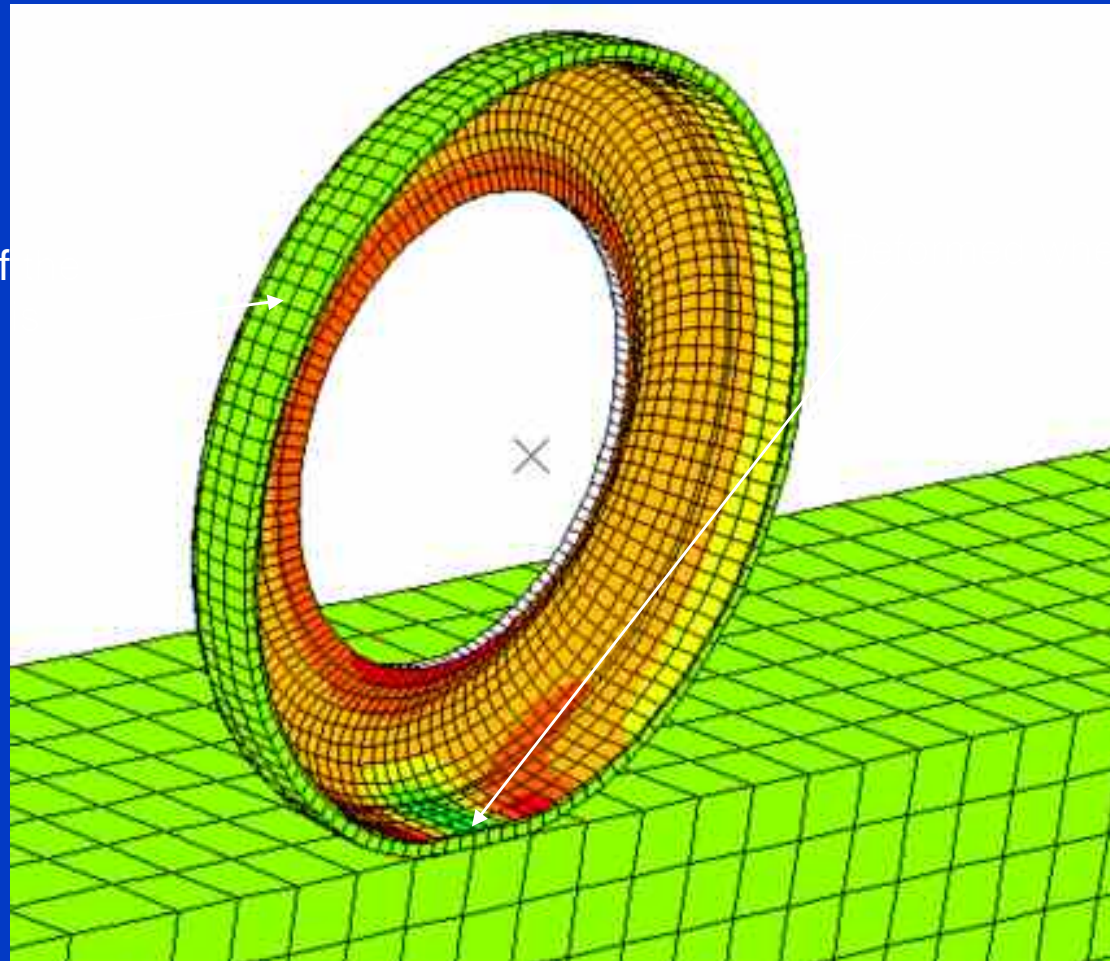
- Four stages of loading:
 - Inflate the wheel to the required pressure
 - Lower the wheel to the pavement surface
 - Apply the wheel load
 - Apply the wheel velocity



Modelling of the wheel

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Half of
wheel
used

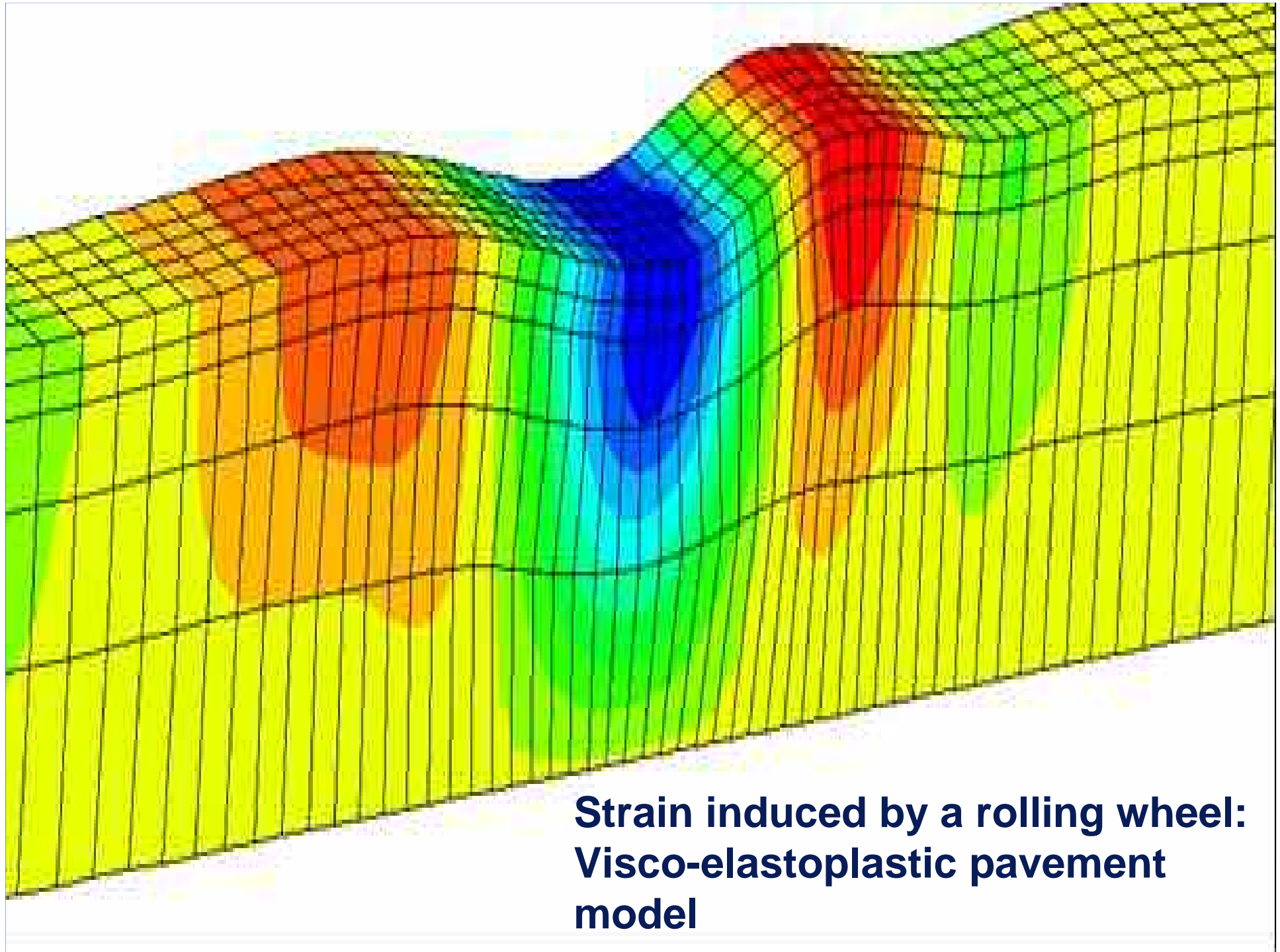


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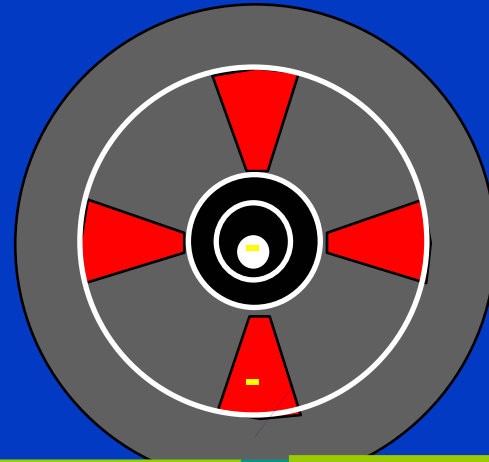


Half wheel model

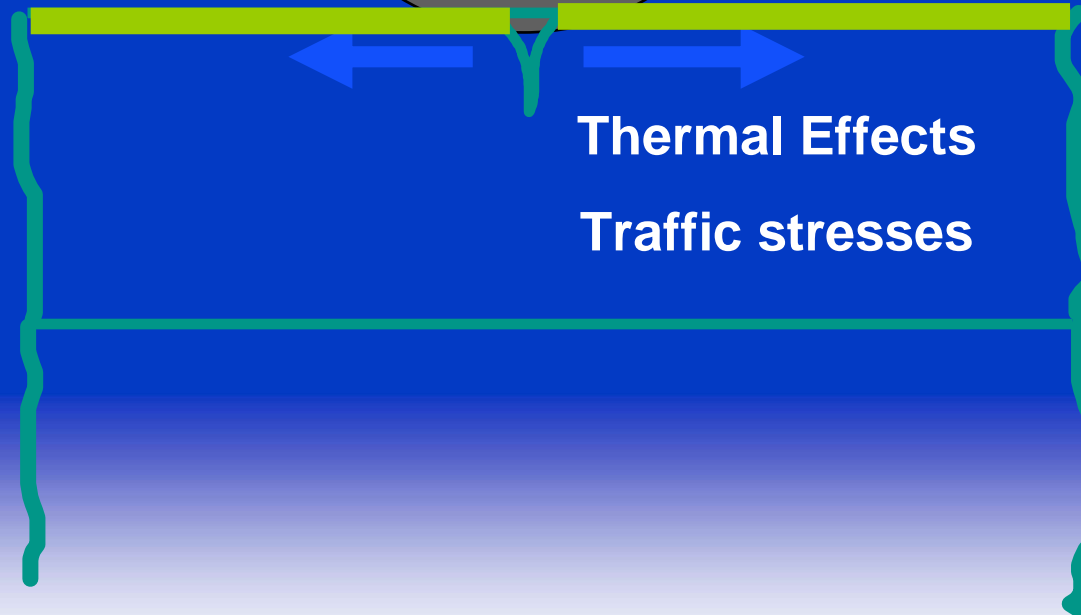
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SURFACE CRACKING

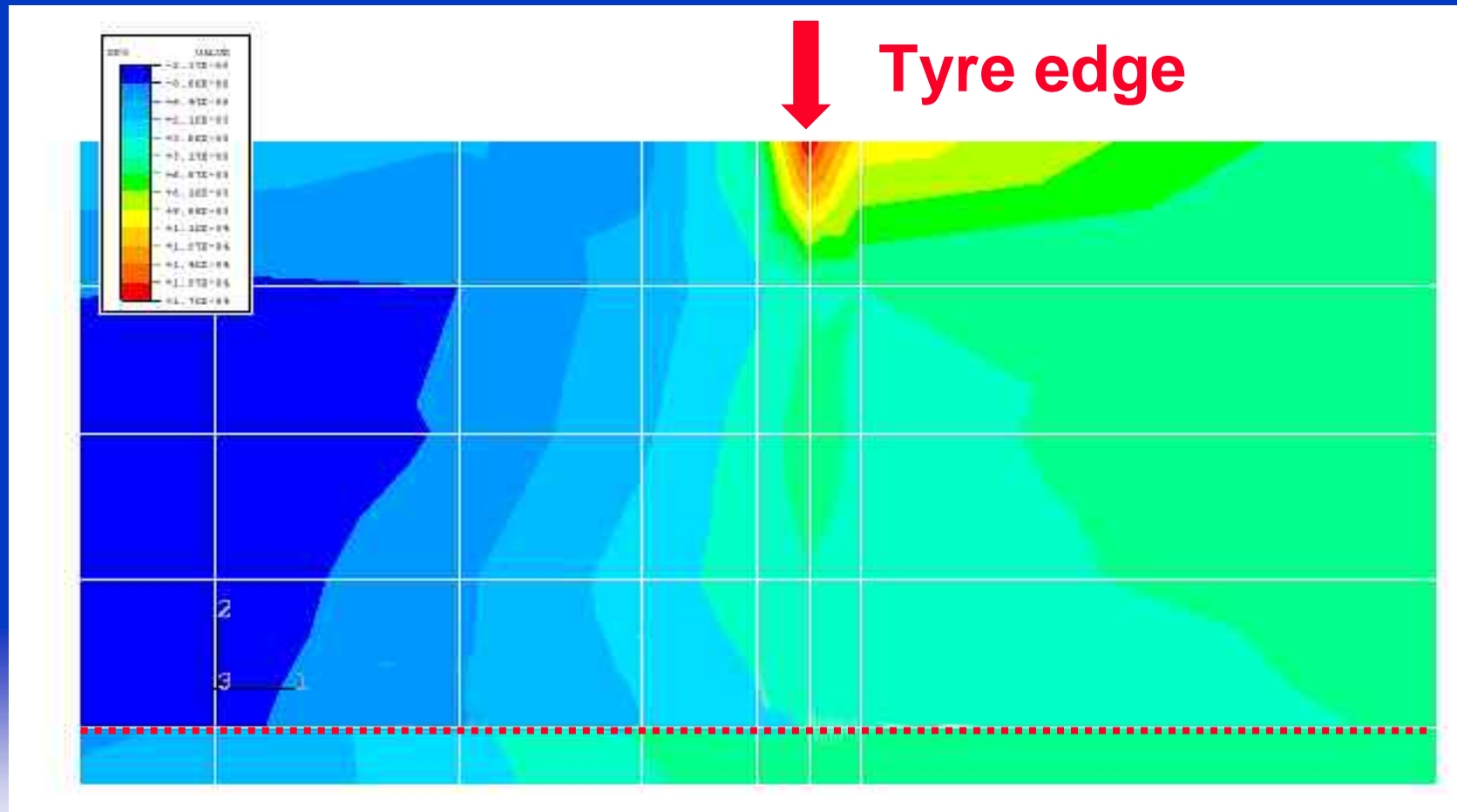


Excessive ageing at surface

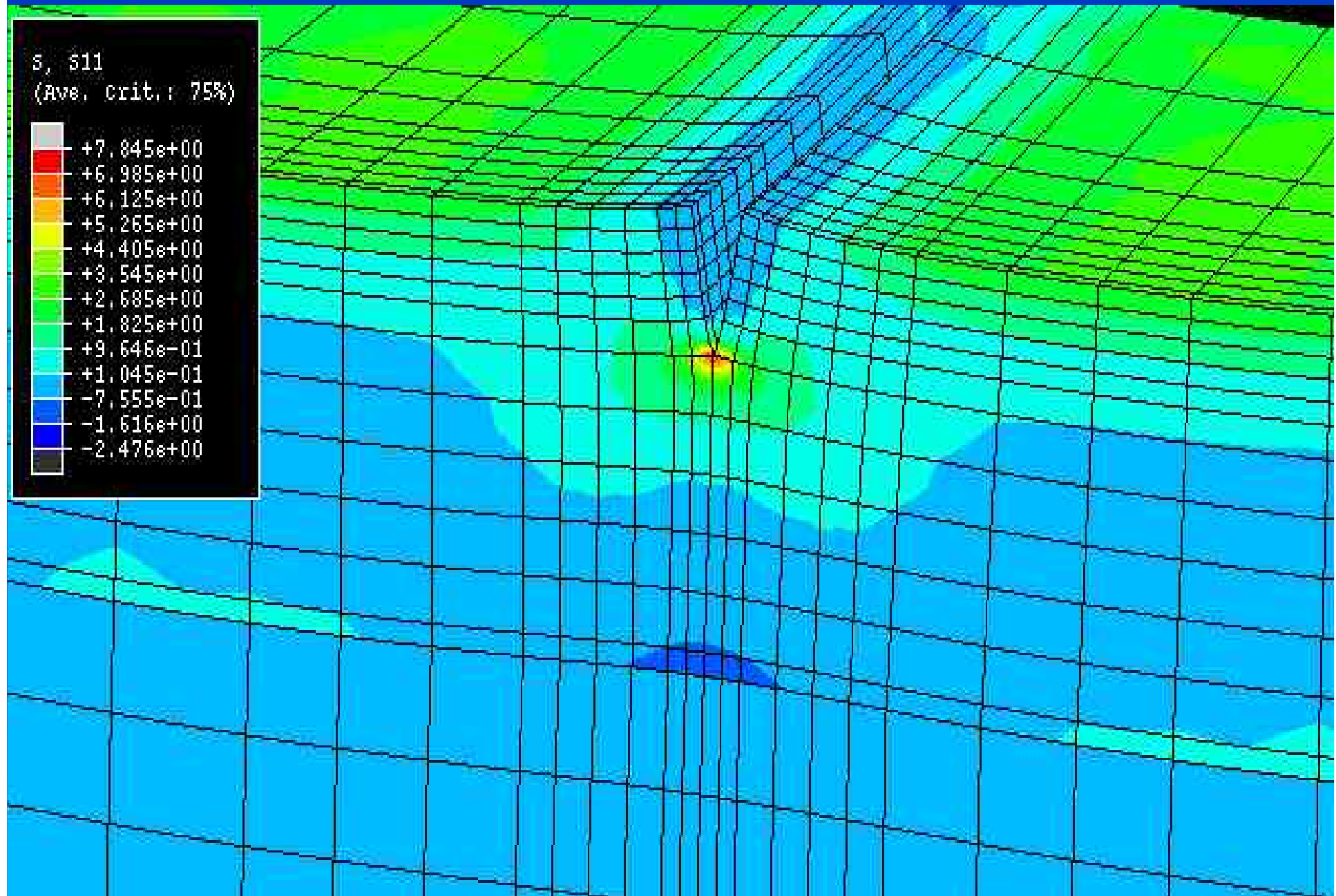


Load Associated Surface Cracking

Horizontal Tensile Strain (Zoom View)

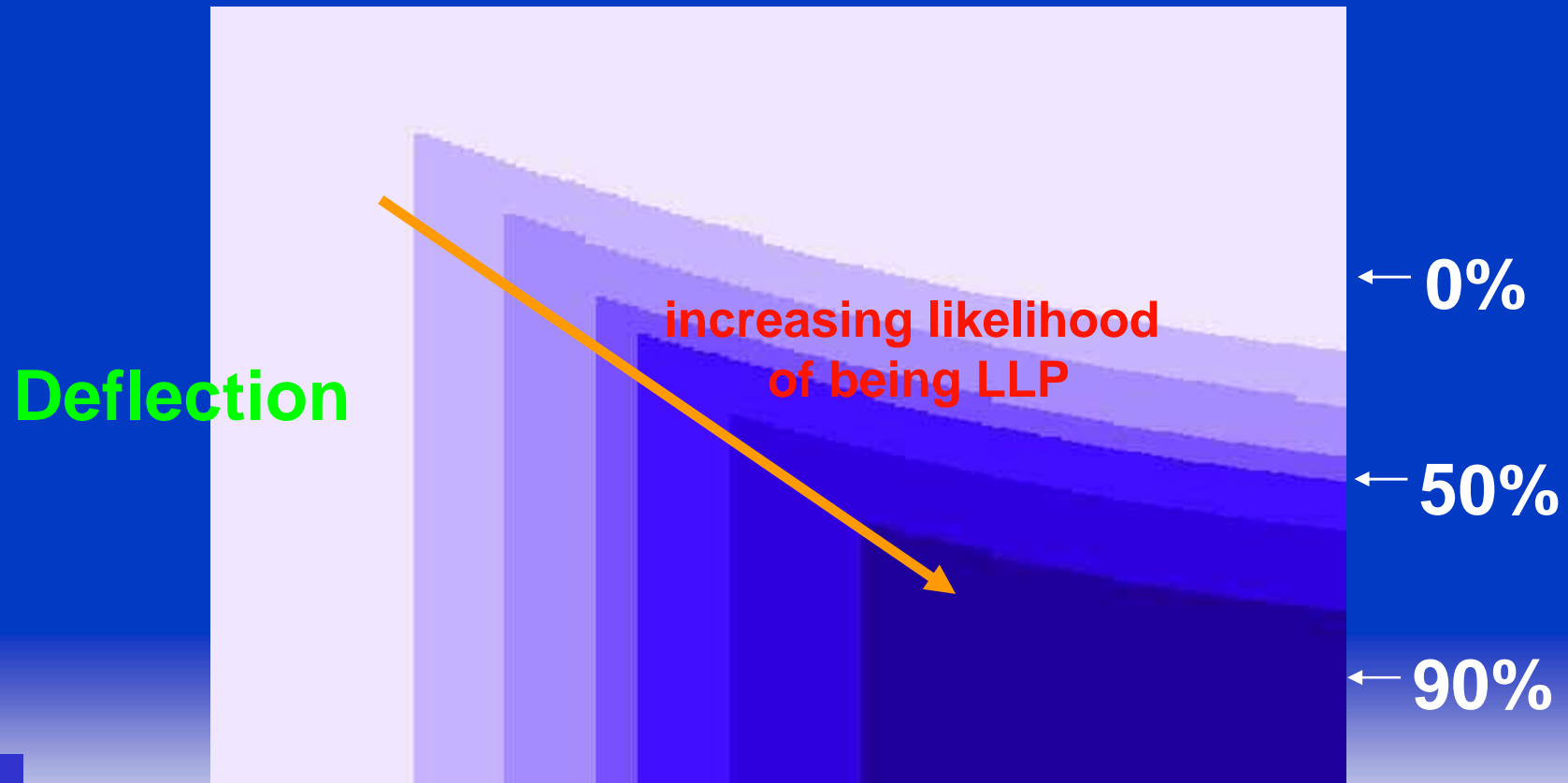


Stress distribution, cracked pavement



LIKELIHOOD OF PAVEMENTS BEING LONG LIFE

Likelihood of Pavement being Long-life



Bituminous Thickness

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A photograph of a cobblestone path leading through a grassy field towards a stone wall and trees under a blue sky. The path is made of dark, irregular stones and runs from the foreground towards the background. On the right side, there is a low stone wall. In the background, there are several trees, including a prominent one with a rounded canopy. The sky is a clear, bright blue.

**Thank you
for listening !**

Larry Mulvehill