



INTERNATIONAL ROAD FEDERATION
FEDERATION ROUTIERE INTERNATIONALE

PERFORMANCE OF ROADS AT HOT CLIMATE

Dr. Otakar Vacin

Associate Professor

Czech Technical University in Prague



Presentation overview

- **Sustainable design**
 - Introduction of new materials
- **Tests overview**
 - Asphalt (bitumen)
 - Asphalt mix
- **Results**
- **Conclusion**

Pavement Sustainability

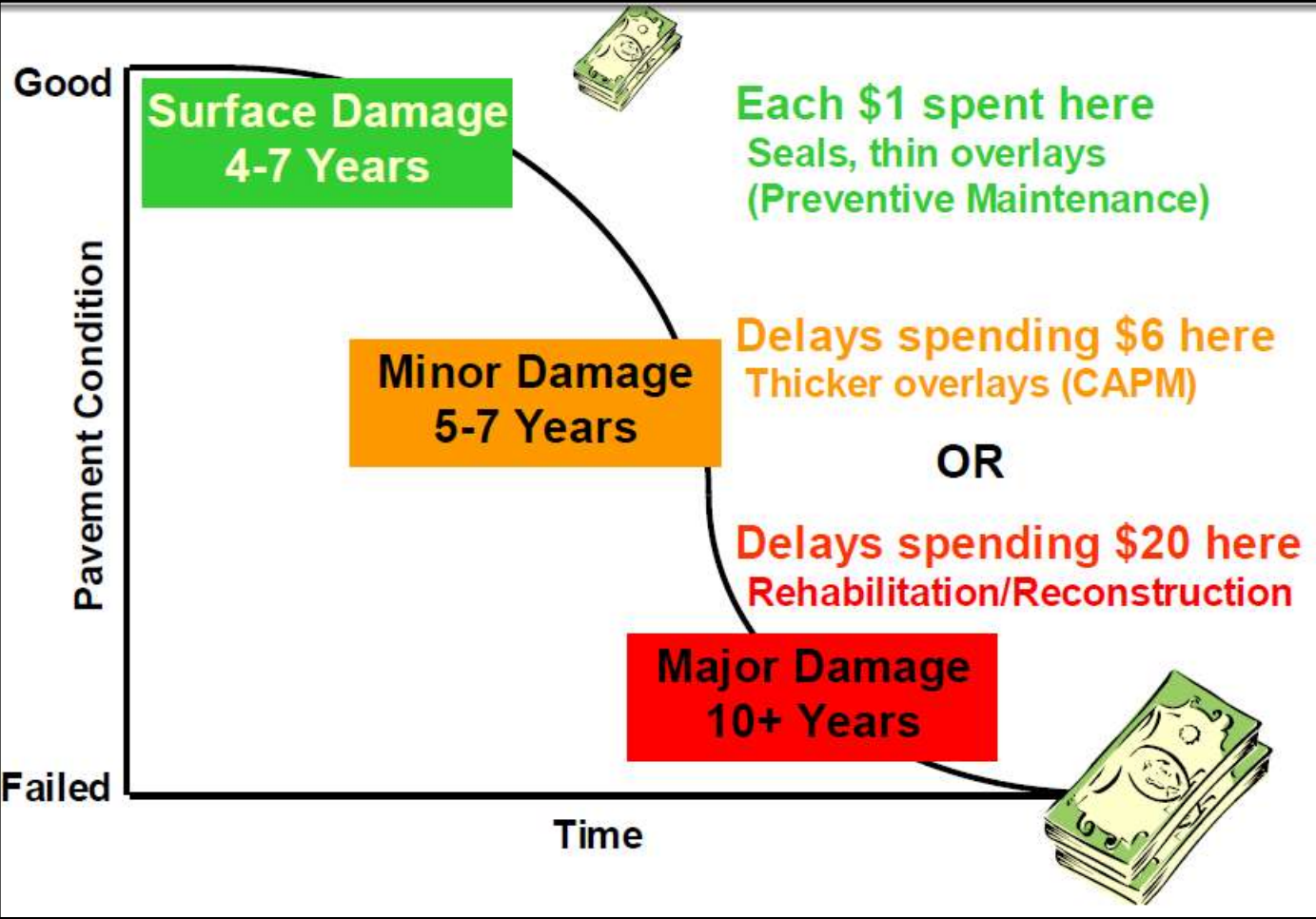


Figure -Pavement Preservation Concept used by Caltrans.

Road designs and concepts

- **Recent trends**

- Increase in heavy traffic annually
- Need to avoid closures and minimise reapers and maintenance



- **Sustainable pavement design**

Sustainable pavement design

- **Ensuring the long life of the structure is given by:**
 - Improvement of technological processes
 - Quality design methodology, prevent fatigue layers
 - Building stronger structural layers
- **Using new / high quality materials**

New Asphalts / modified bitumen

- **Reason**

- Roads were starting to fail in Europe due to high traffic

- **Solution**

- Introduction of polymer modified bitumen to extend the life time of the network

- **Procedures for paving**

- Are the same, one material been replaced by another

New Asphalts / modified bitumen

- **Principle**

- Reactive polymer is added in to hot asphalt and dissolved

- **Benefits**

- Rutting reductions
- Minimization of Local distresses reduction
- Increase of the safety and riding comfort

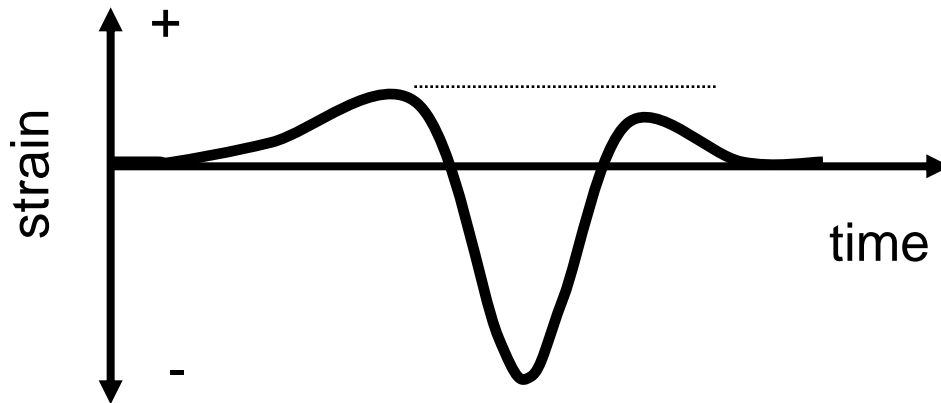
- **New tests procedures are essential**

New test procedures

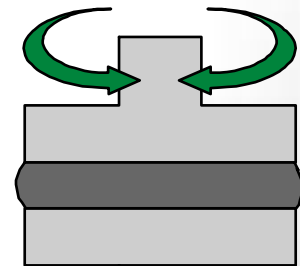
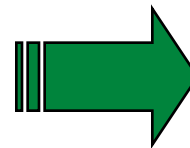
- **Why do we need characterize materials?**
 - Classic test procedures as penetration, softening point and all types of ductility are easy to use but doesn't reflect reality



Real time loading



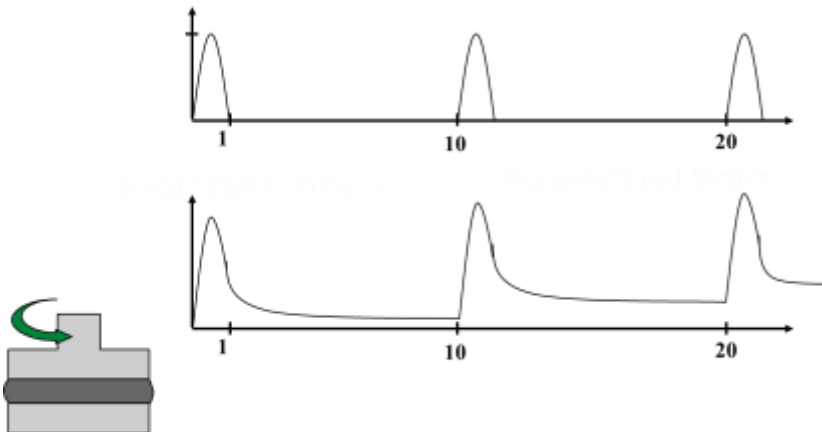
**Solution is in shear
measurement of
bitumen**



Tests for High Temperature

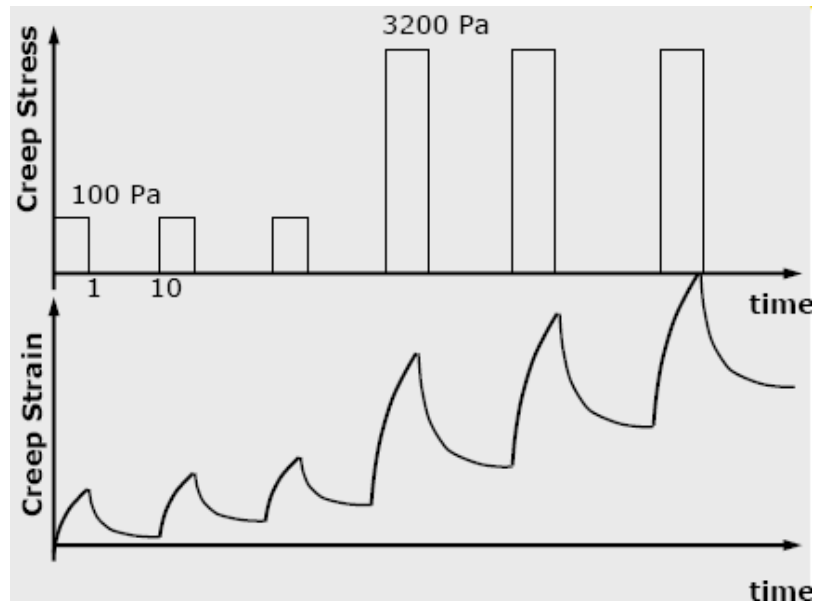
Evaluating alternate procedures

- Dynamic oscillation
 - G^* shear modulus (Pa) , phase angle (ϕ)
- Dynamic testing and modeling of creep
 - J_{nr} Non-Recoverable Compliance (Pa^{-1})

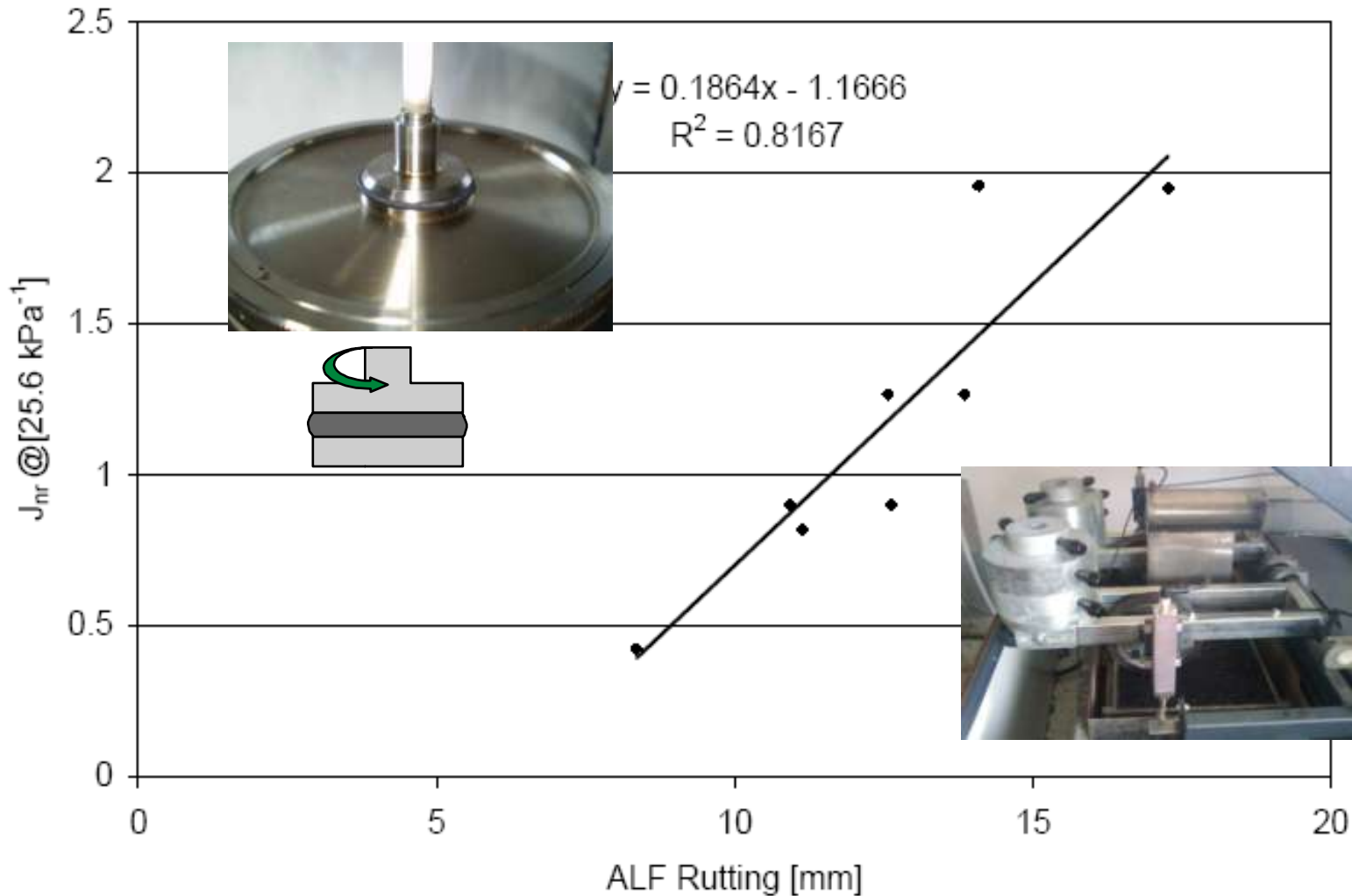


MSCR research objective

- Evaluation of the method
- Polymer selection and ranking
- Additives (PPA)



Correlation between mix and bitumen



Testing results

materials	Softening point	Critical temperature	MSCR
	(°C)	(°C)	3,2 (kPa-1)
Base asphalt	50,6	68	13,76
Base+PPA	59,3	78	13,59
Base + polymer 1	63,4	82	8,857
Base + polymer 2	65,5	80	9,145

Rutting failure

Principle:

European standard under EN 12697-22; The susceptibility of a bituminous material to deform is assessed by measuring the rut depth formed by repeated passes of a loaded wheel at high temperature.

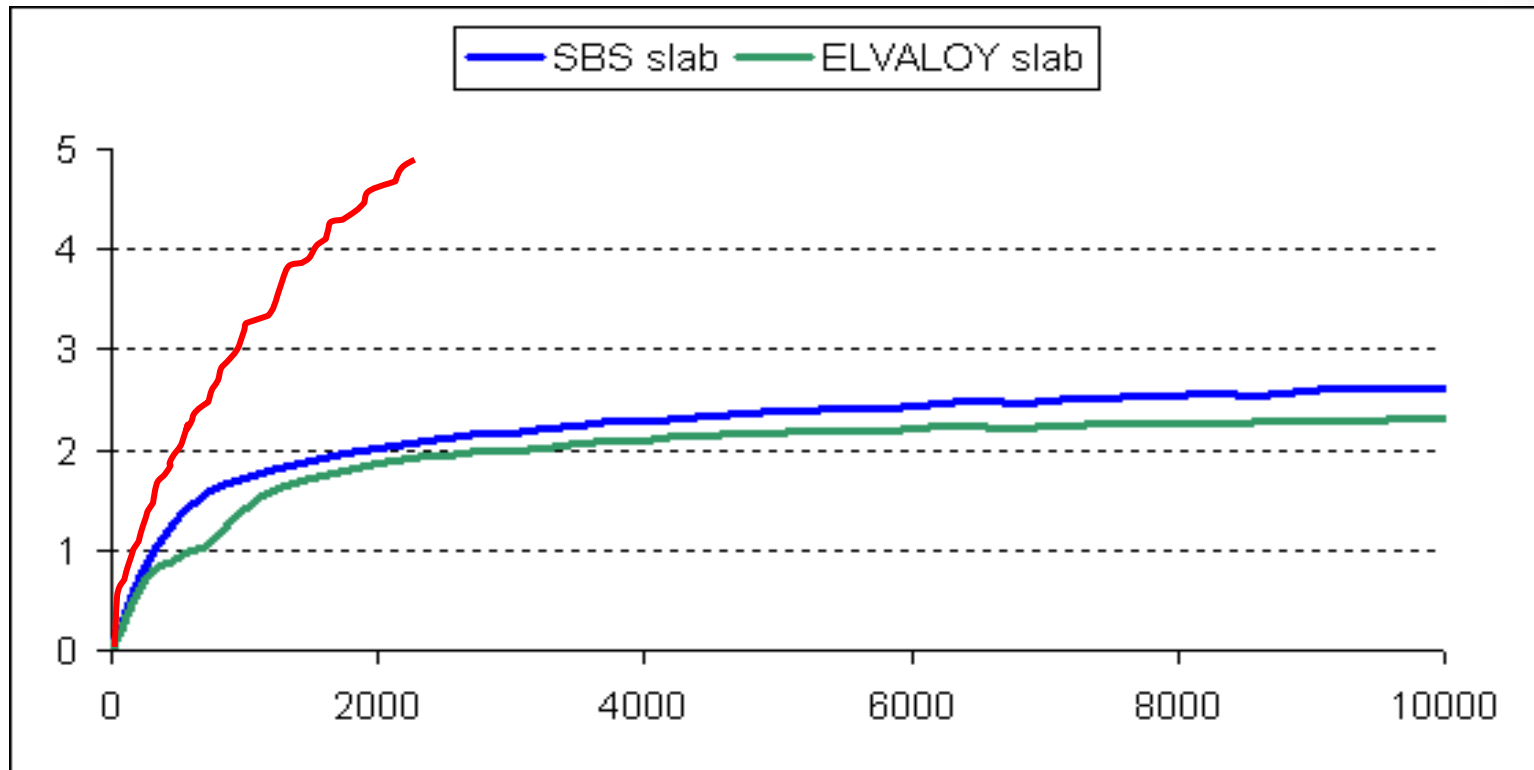
The procedure involves rubberized wheel which pass 10,000 cycles at temperature of 60°C on mix slabs prepared in the laboratory. Rut depth is recorded. Good indicator for hot climates.



Rutting failure

- Test study conducted by CTU university
 - Aggregates , binder, mix design from U.A.E.
 - Bitumen content 4%
 - Bitumen design:
 - **A60/70 + 4.5% SBS + 0.075% Sulfur**
 - **A60/70 + 2.0% Elvaloy[®] RET AM + 0.3% PPA**
- Comparison with base bitumen

Conclusions, wheel test



Polymers samples shows higher rutting resistance at high temperatures

Overall

- **Highway traffic will be increasing**
- **New polymers in asphalt roads are essential safe for infrastructure**
- **Sustainable, long term solution is getting more important than ever**

Thank you!

vacin@fd.cvut.cz

