

Fatigue life predictions for a European pavement test section subjected to individual and platoon truck configurations

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ENSEMBLE



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Objectives:

Benefits of platooning trucks, both partially or fully self-driven:

- Reducing congestion for a better traffic flow.
- Improving the braking/acceleration abilities of the vehicles.
- Reducing fuel consumption.
- Reducing operating costs of the vehicles
- Enhancing road safety.

Platooning trucks generates new traffic multi-load configurations with the following characteristics:

- Reduced deviation of the lateral position of the vehicles forming the platoon and therefore loads channelization.
- Reduced inter-truck distances between the trucks in the platoon, which may hinder the self-healing capacity of asphalt concrete materials.
- Multi-loads → fatigue in pavements.



Need to evaluate the risk of increased pavement damage due to platooning trucks

2018: the European Union develops a research project called ENSEMBLE.

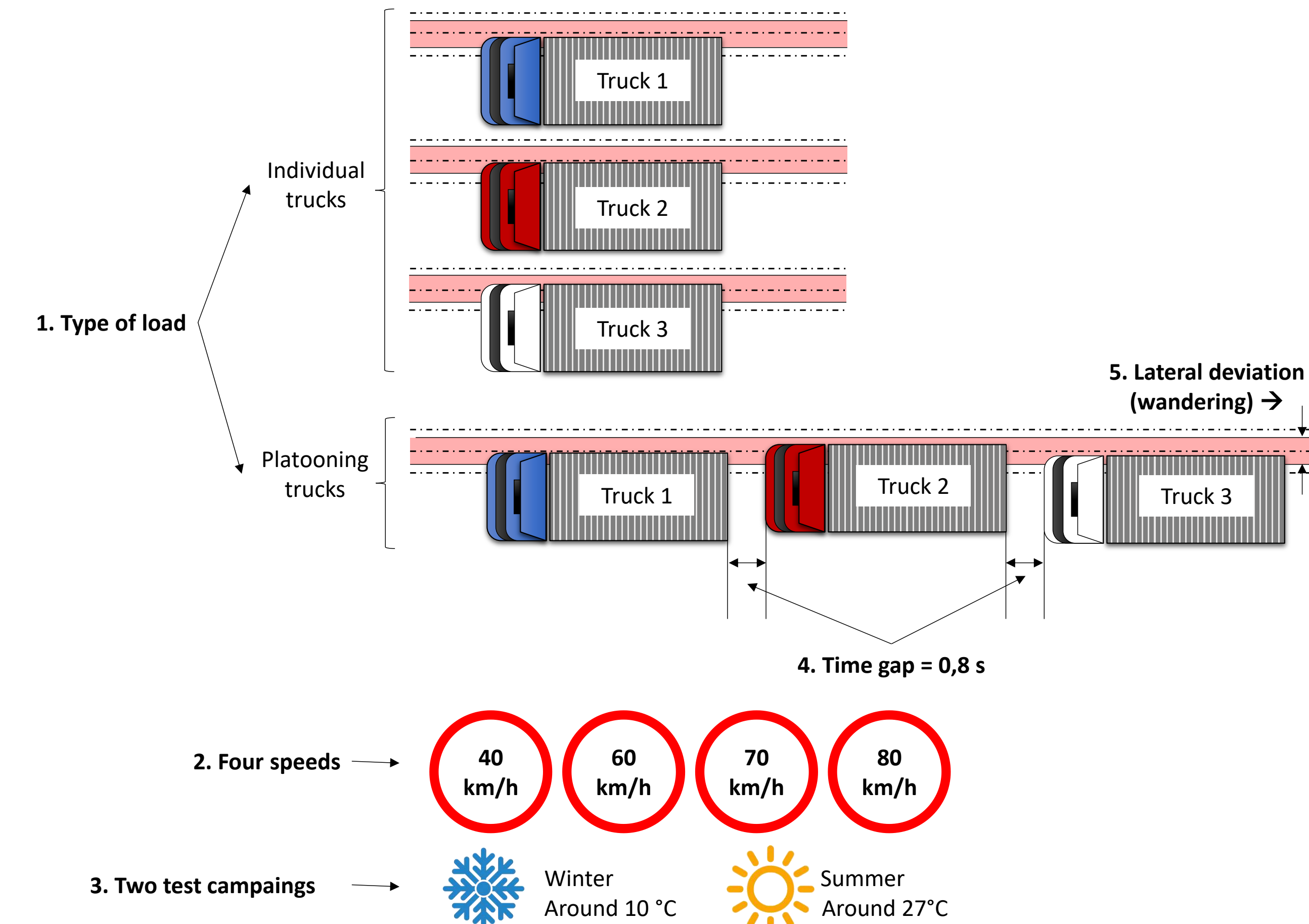
ENSEMBLE's objectives are to pave the way for adopting multi-brand truck platooning in Europe to improve fuel economy, traffic safety, and throughput.

The ENSEMBLE project is led by TNO and joined by:

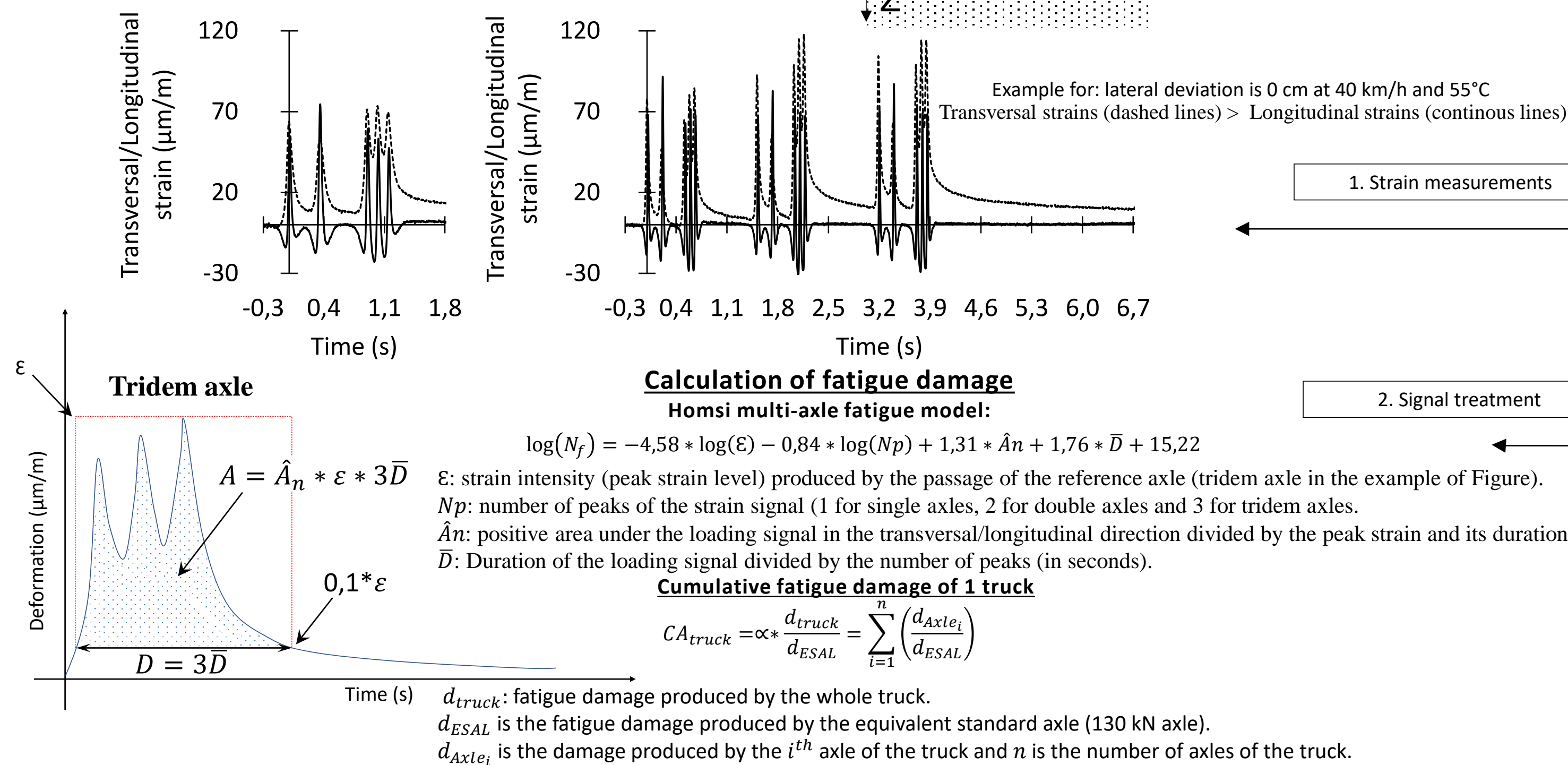
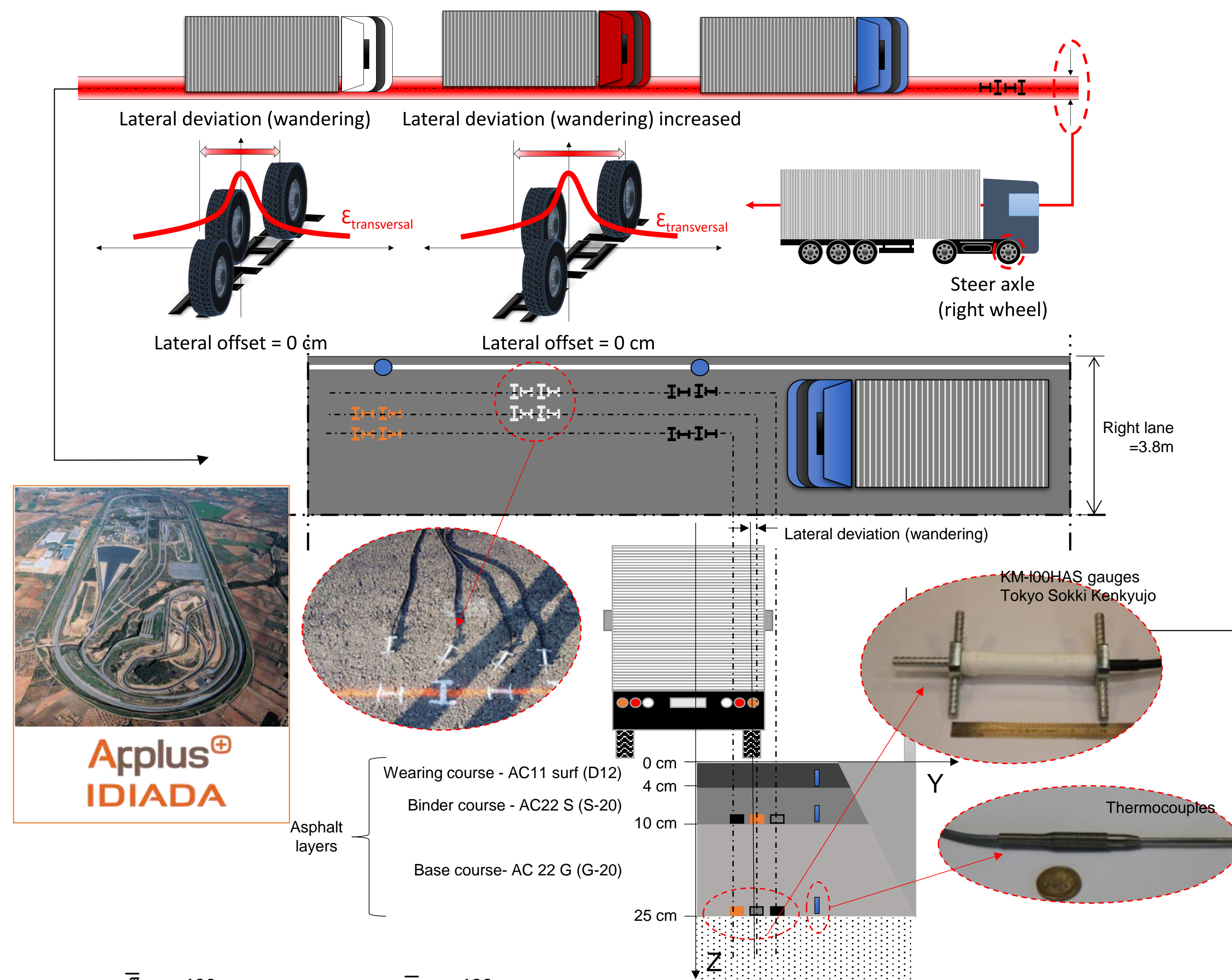
- Six European truck manufacturers: DAF, DAIMLER, IVECO, MAN, SCANIA and VOLVO Group.
- CLEPA, representing the suppliers of automotive equipment and components and will support research, innovation and deployment as drivers for industrial growth
- Suppliers supporting OEMs: NXP, ZF, WABCO, Bosch, Continental, Brembo.
- ERTICO – ITS Europe – the crucial link to the European Truck Platooning Community.
- Knowledge partners: Applus IDIADA, UNIV GUSTAV EIFFEL, KTH and VU Brussel.



Test conditions:



Pavement response measurements under platoon loading:

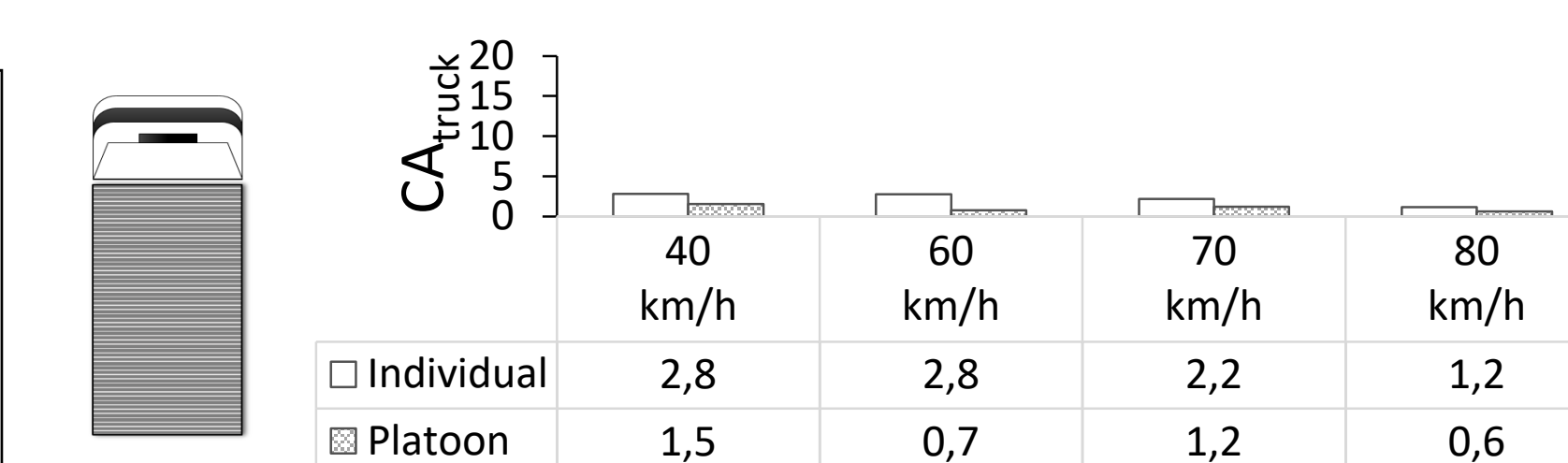
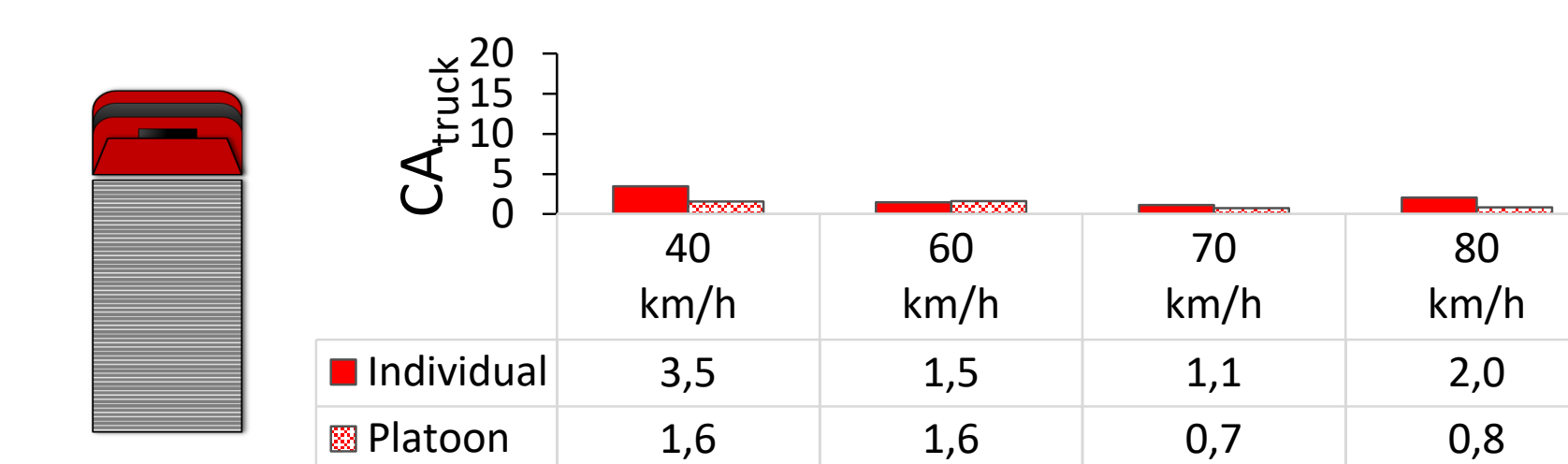
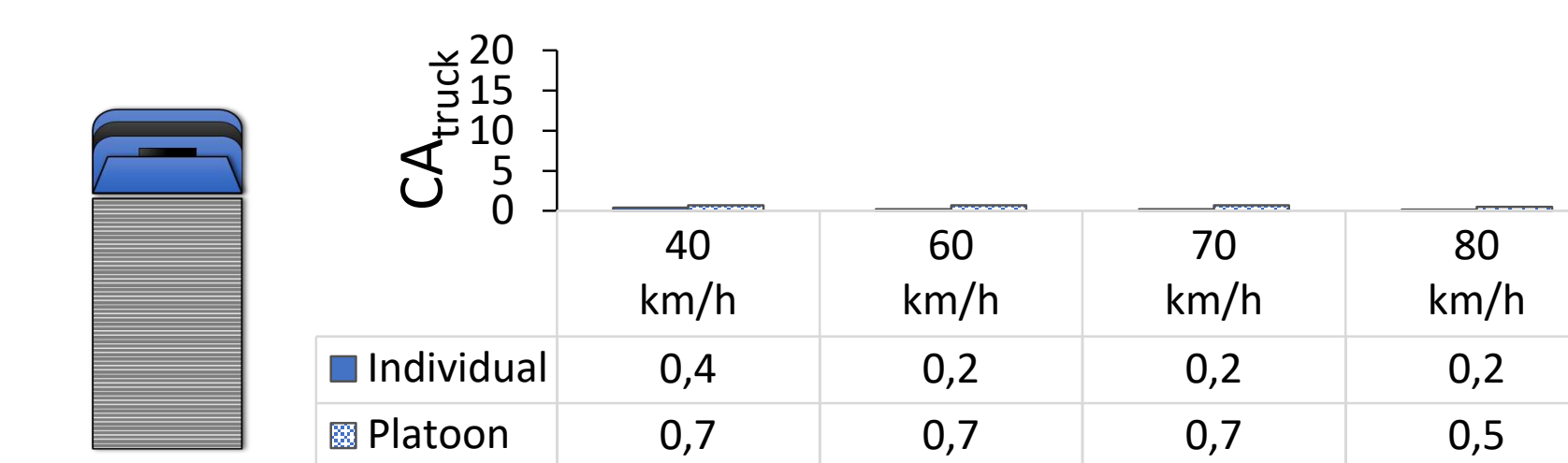


Fatigue damage results:

For Damage = 20%:



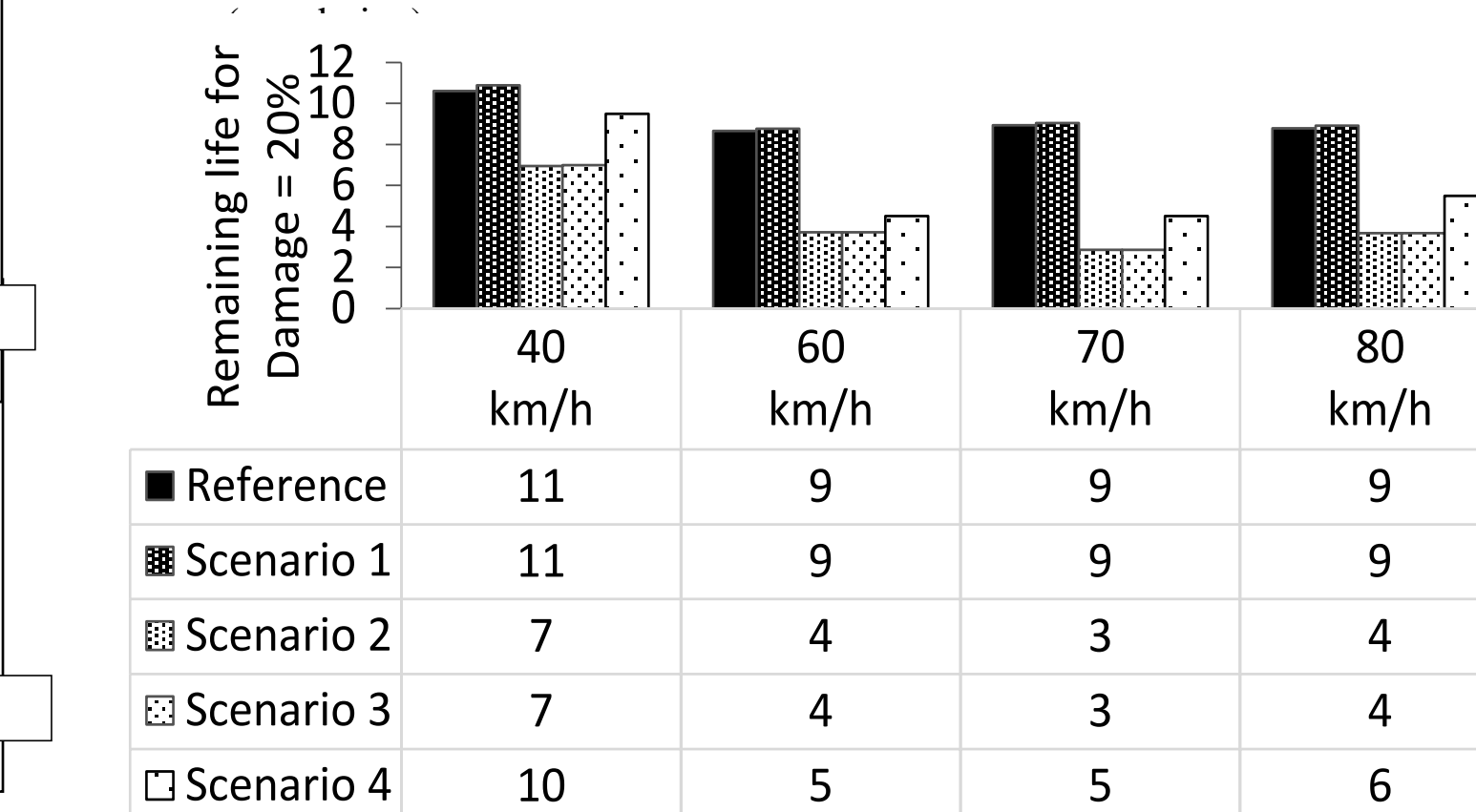
- Platooning trucks do not increase the fatigue damage in comparison to individual trucks.



Impact on pavement service:

Considering reaching 20% of fatigue damage for four traffic scenarios:

- Scenario 1: platooning trucks in winter and individual trucks in summer → No effect
- Scenario 2: platooning trucks in summer and individual trucks in winter → Significant increase in damage
- Scenario 3: platooning trucks in both winter and summer → Significant increase in damage
- Scenario 4: platooning trucks in winter and summer but increasing lateral deviation to 40 cm → Damage can be significantly reduced by increasing lateral deviation



Conclusions:

For the conditions analyzed (pavement structure, platoon truck configurations):

- Transversal strains > longitudinal strains.
- Strain accumulation effects, especially at high temperature.
- Effect of platooning trucks (multi-axle loading) is mainly important at high temperatures.
- Further research studies:

- ✓ Improved fatigue model to represent platooning effects (reduced rest periods and traffic channelization).
- ✓ The data obtained can be used to develop models for the impact of platoons and perform parametric studies related to: (1) traffic distribution along the year and along the time of the day, (2) percentage of platoon penetration in the daily and annual traffic, (3) level of loading of the trucks, number of trucks in platoon configuration, (4) lateral wandering, (5) inter-truck distances and (6) representative existing pavement structures.