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Impact of platooning on roads & bridges

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Outline

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- Impact assessment within ENSEMBLE,
- Background on traffic loads and road infrastructure,
- Pavements,
- Bridges,
- Tunnels,
- General conclusion.

Impact assessment within ENSEMBLE

WP4: different Impact analyses

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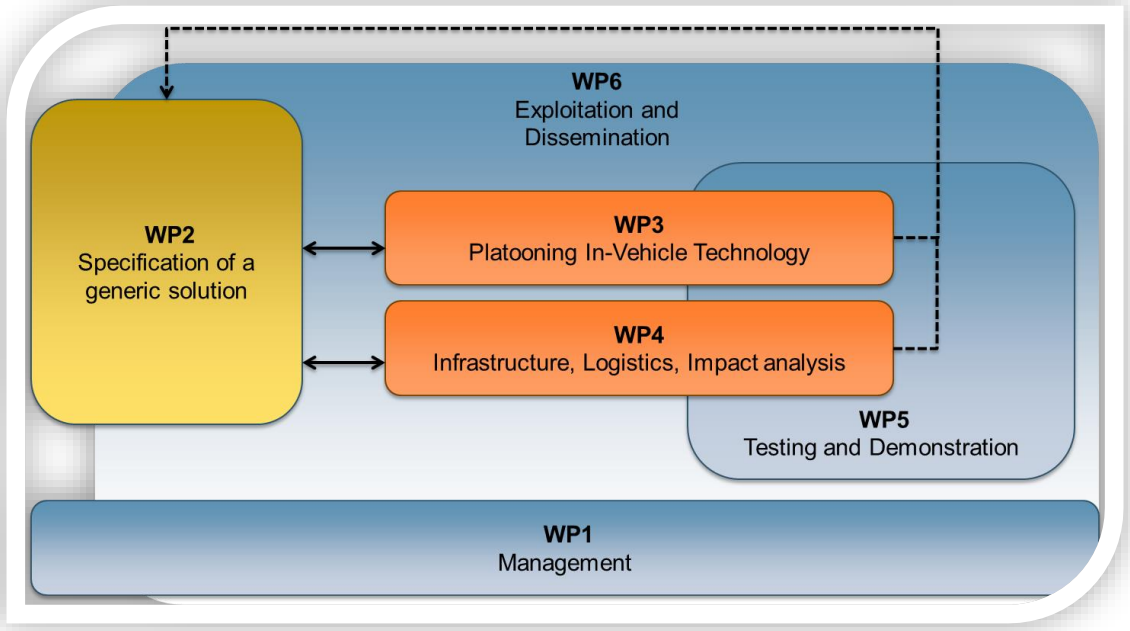
- Impact of platooning on roads and bridges
- Economic and environmental benefits of multi-brand platooning
- Impact on truck drivers and other road users
- Impact on traffic flow



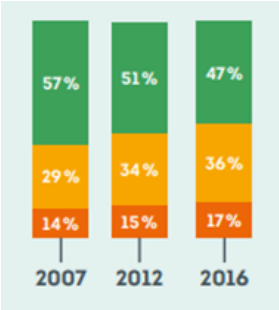
Multidimensional assessment of impact of platooning!

Background on traffic loads and road infrastructure

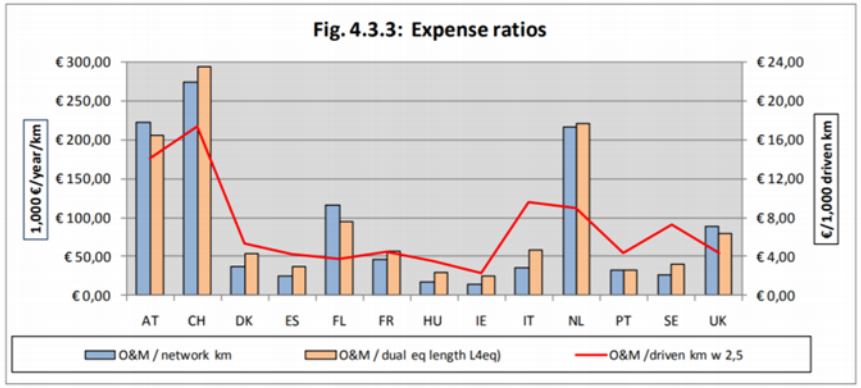
Situation in France

- **Pavement:**

Structural health (in % of total surface):



2040km of roads highly damaged in (metropolitan) France



- **Bridges:**

22 years: Average time between first damage signs and repair

30% of stock needs maintenance or important repair actions.

- **Without changes, in 2037:**

62% of pavement highly damaged,

6% of bridges out of service.

Reference: Réseau routier national non concédé : résultats d'audits, Ministère de la Transition écologique et solidaire, 2019.

Vital connections blocked for trucks

Country: Germany, Leverkusen
Construction Year: 1965
Use: 111.900 vehicles per day
Closed from 09-2016 till 2020

Country: Netherlands, Gorinchem
Construction Year: 1961
Use: 93.800 vehicles per day of which 18.000 trucks
Costs of transport losses: 33 mil. Euros
Closed to heavy traffic in Octobre 2016

Influencing demand

is necessary: (re)building costs time

as we first have to signal, prove by research, propose and demand budget, the allocation of budget takes time (politically), involve the public takes time, form a project, contract and start constructing.

In the Netherlands for the main infrastructure

10 yrs for pavements,

20 yrs for bridges, viaducts, ecoducts,

30 yrs for surge barriers / the delta.

Research questions

- In the context of
  - Aging infrastructure,
  - Limited budget for maintenance, repair, strengthening,
  - New vehicles or traffic management procedures,

  the questions are:

  - How to assess the impact of traffic loads on infrastructure?
  - How to reduce the impact of platoons on road infrastructure?
  - Which advantages to take into account (link with communication with infrastructure)?

Impact on pavement

Objectives

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- Characterise the structural responses of pavements structures subjected to individual and platoon truck configurations.

- Evaluate the change in the pavement fatigue life due to the multiloading with reduced rest periods effect associated to truck platoon configurations.

- Define truck platoon configurations pavement friendly.

Methodology

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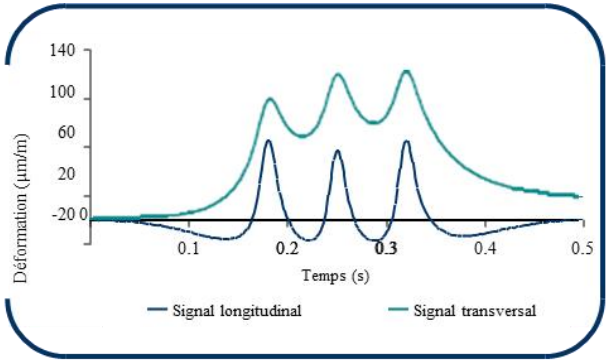
Characteristics of Heavy Vehicle & Loads, Cumulated traffic

Instrumentation on site

Several configurations of platoons (speed, distance between vehicles, etc.)

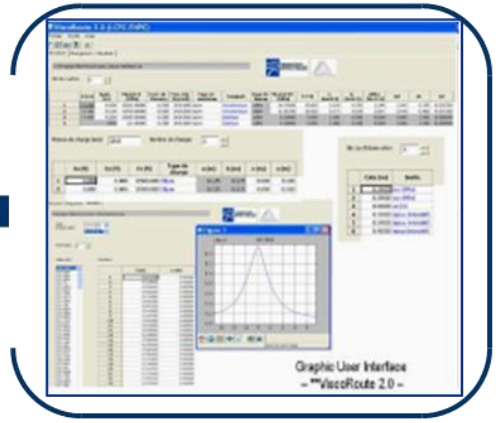


Considered Deformation (shape, intensity, etc.)

$\varepsilon_{max} = \ldots$
$Np = \ldots \quad \hat{A}n = \ldots$
$\overline{D} = \ldots$

Signal processing / Calculation of different parameters

Wandering + Miner law



For a HV, Pavement Design Tool Alizé ou ViscoRoute©

Life duration Prediction

Fatigue law (new model)

Experimental program in Lab.

Reproduce in Lab. different configurations of platoons

Conclusions on pavement impacts

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- There are parameters that can be managed in truck platoon configurations in order for the pavement fatigue life to **remain** the same :
  - Traffic distribution along the year and along the time of the day,
  - Percentage of platoon penetration in the daily and annual traffic,
  - Truck loads,
  - Number of trucks in platoon configuration,
  - Wandering,
  - Inter-truck distances.

- Optimized management could be reflected in terms of:
  - (1) longer fatigue cracking/permanent deformation life,
  - (2) lower pavement structure thicknesses obtained during pavement design,
  - (3) later rehabilitation/maintenance treatments.

Impact on bridges

Situations to consider

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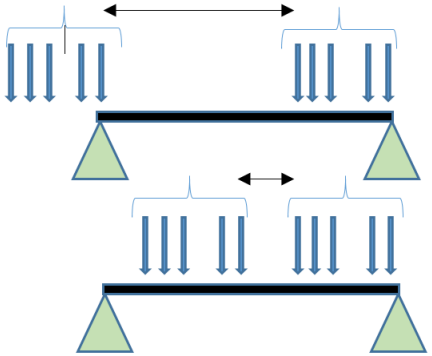
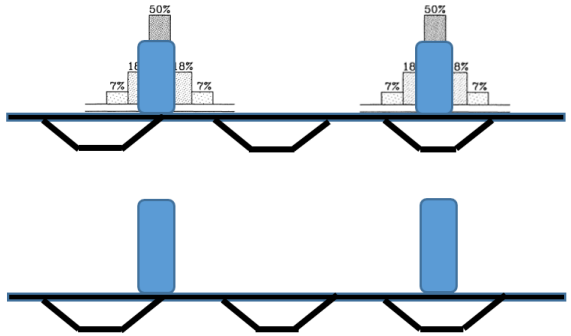
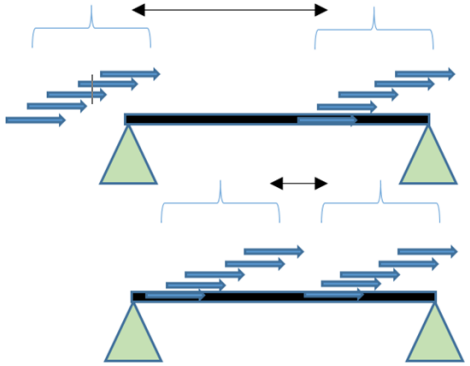
Longitudinal issue: more trucks on bridges + less wandering





Horizontal issue: more braking forces on a bridge



Methodology

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- Assessment of traffic on various types of bridges,
- Collection of types of structures (1, 2 and 3 span bridges, spans between 10m and 200m), many structural effects (bending moments, shear forces, tension in cable for L=200m),
- Collection of vehicles/traffics to be considered, and compared to platoons: isolated vehicles, current recorded traffics, modified traffic (introduction of platoons), ...

Results on the impact of platoons on bridges

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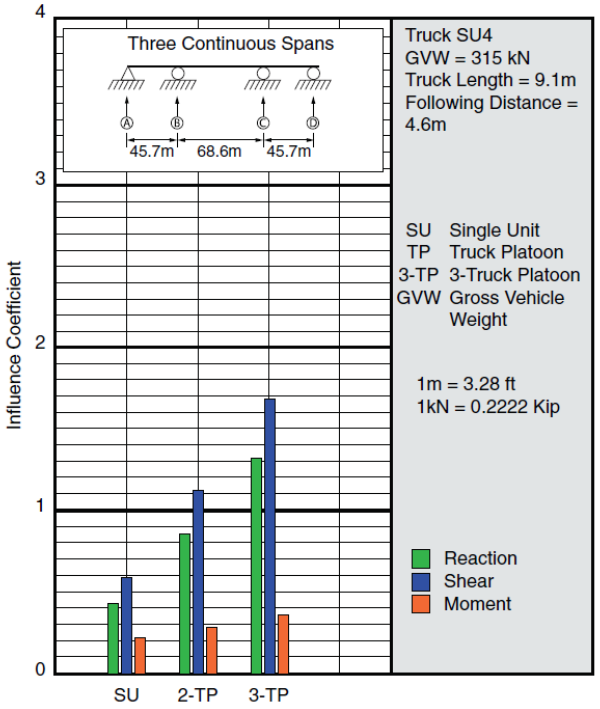
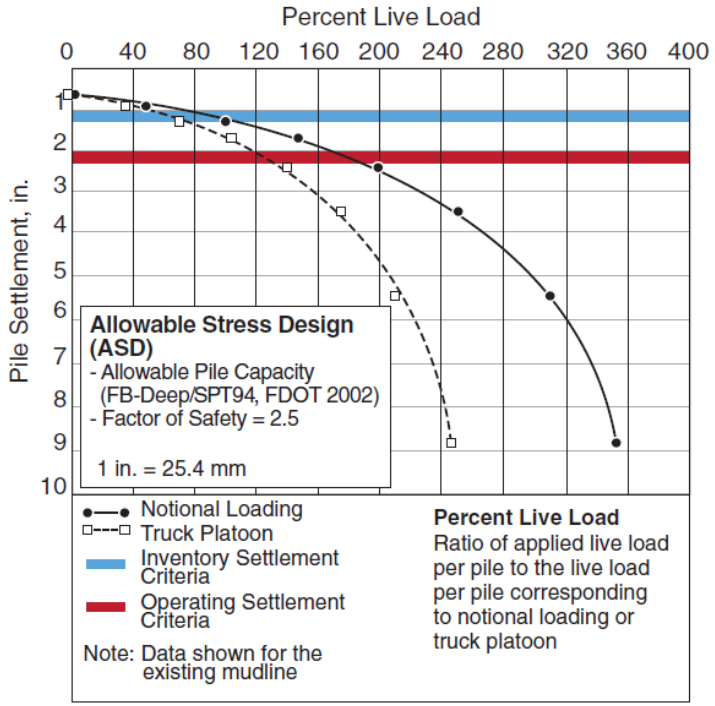
- Platoons induce higher stress in the structures,
- Still inferior to the design stress,
- Nevertheless service life is reduced in general, but countermeasures are proposed.





Sayed, S. M., Sunna, H. N., & Moore, P. R. (2020). Truck Platooning Impact on Bridge Preservation. *Journal of Performance of Constructed Facilities*, *34*(3).

Impact on tunnels

Methodology

- For the tunnel issue:
  Meetings with a private tunnel manager (Tunnel du Mont Blanc) and public tunnel manager (CETU: Centre d'Etudes Techniques des Tunnels),

- Preparation of a questionnaire: physical and digital caracteristics of the infrastructure, ITS possibilities, traffic management possibilities, foreseen added value…,

- Questionnaire sent to PIARC committee for tunnels.

Tunnels and platoons

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- Disparate situation:
  - Some tunnel managers are not in favor of platoons -> would request a dissolution of platoon before entering the tunnel,
  - Some tunnel managers are in favor of platooning -> reducing gaps between trucks.

- Not many quantitative results:
  - Positive impact: safety (better gap management),
  - Negative impact: higher potential fire loads,
  - Outcome could be slightly beneficial.

General conclusions, perspectives

Conclusions

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- Multi-brand platooning is affecting the road infrastructure,
- Parameters change the impact of platoons on road infrastructure:
  - Time gap between trucks,
  - Wandering,
  - Authorization for trucks during winter/summer or along the day,
  - % of trucks in platoon configuration,
  - Loads of the trucks.
- Awareness of infrastructure managers is needed.


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