Impact of platooning on roads & bridges

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Outline

• Impact assessment within ENSEMBLE,
• Background on traffic loads and road infrastructure,
• Pavements,
• Bridges,
• Tunnels,
• General conclusion.
Impact assessment within ENSEMBLE
WP4: different Impact analyses

- 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):
  - 2012: 57%
  - 2016: 51%
  - 2020: 47%

- **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.

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 October 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

• 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 multiload with reduced rest periods effect associated to truck platoon configurations.

• Define truck platoon configurations pavement friendly.
Methodology

Characteristics of Heavy Vehicle & Loads, Cumulated traffic

Instrumentation on site

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

Considered Deformation (shape, intensity, etc.)

Life duration Prediction

Wandering + Miner law

\[ \varepsilon_{\text{max}} = \ldots \]
\[ N_p = \ldots \bar{\Delta} n = \ldots \]
\[ D = \ldots \]

Signal processing / Calculation of different parameters

Fatigue law (new model)

Experimental program in Lab.

For a HV, Pavement Design Tool Alizé ou ViscoRoute®

Reproduce in Lab. different configurations of platoons
Conclusions on pavement impacts

• 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

Longitudinal issue: more trucks on bridges + less wandering

Horizontal issue: more braking forces on a bridge
Methodology

• 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

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

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 characteristics of the infrastructure, ITS possibilities, traffic management possibilities, foreseen added value…,

- Questionnaire sent to PIARC committee for tunnels.
Tunnels and platoons

• 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

- 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.