NEW HEAVY TRUCKS AND PAVEMENTS - EXPERIENCES FROM FINLAND

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28.8.2015 High Capacity Transport årskonferens, Örebro
INTRODUCTION

• October 2013: maximum allowed total weight in Finland 76 tonnes. Earlier 60 tonnes.
• Some maximum allowed axle weights were increased as well; e.g. triple bogie on a truck 24 tonnes → 27 tonnes
• Triple bogie on a trailer still remains at 24 tonnes.
• Transition period of five years: 60 tonnes vehicles → 64 tonnes
• If the new maximum total weights are utilized, at least 65% of the trailer weight will have to be distributed on dual tyre axles to minimize pavement damage.
In addition to changes in maximum allowed weights, there are currently seven HCT trucks in traffic in Finland. Either heavier than 76 tonnes or longer than 25,25 metres or both. Each of these trucks has special permit for exceeding the maximum weight or length, and they are only allowed to operate on predefined routes. Also the drivers of these trucks are named and they have had training.
RESEARCH PROJECTS

- Risk analysis and follow up of Pajala - Svappavaara iron ore transportation route (150 km), Sweden
- Massat & Mitat (Weights & Dimensions) project for the Finnish Transport Agency
  - The goal of the project was to evaluate the effects of new heavier trucks on the condition of road structures. The project work group consisted of several research organizations and companies with expertise in pavement engineering.
- Effect of Axle and Tyre Configurations on Pavement Durability
  - A prestudy project ordered by the ROADEX Network Partners. The report sets out to provide a general information package on the effect of different truck options, axle configurations, tyre types and tyre pressure options on pavements, other road structures and subgrades.
- PEHKO 2015-2025
  - A pilot project for proactive pavement maintenance carried out in two maintenance areas in Finland
- State-of-the-Art study for Trafikverket
  - to evaluate the choice of the right tyre configuration including tyre pressure linked to the introduction of heavier vehicles on the road network
EXPERIENCES FROM RESEARCH PROJECTS: TYRE TYPE AND SINGLE TYRE WIDTH

- With super single tyres (385 and 425) the loading effect can be many times higher than with dual tyres
- The effect of steering axle is greater than predicted
- Wide based single tyres (495) are almost as good as dual tyres but unfortunately not used in Finnish trucks
- With thin pavement the effect of tyre width is relatively greater than with thick pavement
EXPERIENCES FROM RESEARCH PROJECTS: "WEAKEST LINK", EXAMPLE FROM NORWAY

Norway/Rv94_HP3/8800-9450
3x8t triple bogie, tyre pressure 800 kPa

- Calculated lifetime (heavy axles)
  - PAVEMENT: dual tyres 500 000
  - super single tyres 160 000
  - UNBOUND STRUCTURE: dual tyres 4 650 000
  - super single tyres 450 000
  - SUBGRADE: dual tyres 610 000
  - super single tyres 495 000

ROADSCANNERS
TOP DOWN CRACKING DUE TO SUPER SINGLE TYRE WEAR
EXPERIENCES FROM RESEARCH PROJECTS: TYRE PRESSURE

- Use of unnecessary high tyre pressures for fuel saving: even 1100 kPa pressures were measured on trucks in Finland.
- This practice is not illegal because most countries do not have limits for maximum tyre pressures. Should there be more control / sanctions?
- Recent years: research on the effects and benefits of reduced tyre pressures (CTI/TPCS).
- Now more attention should be similarly paid to overly high pressures because of their potential harmful effect on pavement lifetime.
EXPERIENCES FROM RESEARCH PROJECTS: SUBGRADE RELATED PROBLEMS

• Pajala road follow up: Increasing total weight and number of axles → higher stresses and deformations on the subgrade level
• Also results from PEHKO project show the same
• The worst deformations / damages appear on sections with weak subgrade (<10 MPa) and especially where subgrade turns from weak to stiffer
• Big trucks are ”pushing a wave” in front of them.
• This is a clear evidence that this common statement is not true: “Stresses to the road do not increase if the total weight is increased because the number of axles is also increasing.”
**PUMPING EFFECT AND RECOVERY TIMES**

- Increased number of axles $\rightarrow$ pore water pressure in the road structure and subgrade soil rises.
- Especially in the spring during the frost thaw and after freeze-thaw cycles.
- Because of the increased pore pressure the stiffness of the unbound structural materials is decreased.
- Under several consecutive heavy loading repetitions this leads to increased deformations and rutting speed.
The magnitude of stresses and strains in a road structure can also be affected by how smooth and even the road surface is.

Uneven bumps can cause impact loads to the pavement due to the suspension system of trucks.

Stresses and strains after a bump can be substantially higher than normally and cause a faster deterioration of the pavement.
FINLAND: FUTURE GOAL IS PROACTIVE MAINTENANCE

- PEHKO 2015 - 2025: pilot project for proactive pavement maintenance
- The idea is to react before there are visible damages on the road surface
- Potential savings up to 50 %
CONCLUSIONS AND RECOMMENDATIONS

• Dual tyres are much more road friendly than super single tyres
• Tyre pressure is also very important factor
• Thicker pavements / bound layers (at least 150 mm)
• New pavement on top of old poor condition pavement does not help - old pavement needs to be remixed completely or milled away
• Greater attention to drainage and winter maintenance (for instance removal of snow walls has to be done early enough)
• If money is not available for strengthening, load restrictions should be applied during the spring in weak paved road sections
• Convoy driving of heavy trucks should not be allowed to ensure enough recovery time for road structures
• Bridges: strengthening or load restrictions
THANK YOU!