

Any good vibrations with bogie tracks?

Abstract

A four-wheeled forestry machine is quite jumpy to ride on in uneven terrain. To overcome that problem Nordic forestry are often with 8wheels and often the wheels are placed in a bogie construction, which means all wheels are powered. To improve traction bogie tracks has been used both to get better grip but also to minimize soil damage. These tracks are often made of steel and could mean a rather bumpy travelling. The question is it really so?

Four paths were used three times, going upwards and downhill, with the variables wheels, bogie tracks, ± 15 ton load, tested on an eight-wheeled 20tons forwarder both on driver seat and cabin floor. The vibrations decreased and most with load. Thus bogie tracks from Olofsfors improve traction, decrease fuel consumption on soft ground and decrease vibrations

Keywords: forestry machine, bogie tracks, soft ground, fuel consumption, timber, steel tracks, rehn's dissertation

Volume 2 Issue 1 - 2018

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Received: December 19, 2017 | **Published:** January 17, 2018

Introduction

Forestry machines are often travelling on unprepared terrain, which means often rather bumpy ride. 4-wheeled machines became 6-wheeled and later on 8 wheeled machines to alleviate the worst obstacles. Nordic forestry people discovered if these wheels were arranged in bogie construction the machine (usually a forwarder that could carry timber) both could better negotiate obstacles and with all wheels driven one could get better climbing ability. Still machines could get stuck uphill in a snowy terrain. One way to improve traction was to put steel tracks on the wheels and there we are today. One of the bigger producers of bogie tracks in the world is Olofsfors in Northern Sweden. These tracks are of special steel to last when driving on stones and sand. Steel tracks on stony terrain must mean a bumpy ride for the operator many people are thinking. That is why we decided to test that opinion and Rehn's dissertation (2004, R.M.S. values that allowed driving 2.5-3.1h/day according to the ISO 2631-1 standard) showed that compared to snowmobiles and snow groomers, forwarder drivers belonged to those with most musculoskeletal disorders due to whole-body vibration exposure. In his study the forestry machines had no bogie tracks.

Aim

The aim was to compare vibrations in the cabin floor and the chair in a forwarder with wheels on the same forwarder with bogie tracks on the same wheels when it was empty and \pm loaded with 15tonnes of timber.

Material and method

A 20tons 8-wheeled Valmet 890.2 was used as test vehicle with 180kW engine and hydrostatic all-wheel drive (powerful enough to drive 30km/h in uneven terrain). The wheeled version had Nokian King tyres with 5,5bars inflation pressure which is the recommended pressure for this type of machine. The load space was LoadFlex with in-folded stakes, which means up-right stakes and a rather high load and possibly higher vibrations. 4 sets of EcoMax tracks were put on the machine for the tracked version, which added 4.8tonnes weight to the machine but increased vehicle stability due to lowered centre of

gravity. To load the machine 15tonnes of timber was prepared the day before using the built in scales in the banks (± 10 kg) (Figure 1).



Figure 1 The test vehicle, Valmet 890.2 with load but no bogie tracks.

The test area was a newly cut slope sloping 8 degrees gently sloping in one direction towards north. It was a gravelly till slope with Myrtillus and Vaccinium vegetation but small stones were mainly in the ground and thus not an obstacle for the vehicle. Moisture content was 30% (dry measured), but since it was a gravelly soil this amount of water in the soil had minor effect on rutting (No ruts afterwards). The machine was driving on a new passage for each trial that was about 70m long (from start to stop, measured with a ruler). Each trial was driven 3times (up-down-up) and each passage was clocked. Only one problem occurred and without tracks but with load some slippage occurred but once rolling the machine came up. Measurements were done according to International standard ISO 2631-1 on both driver seat and at the floor in the cabin of the forwarder near where the chair attachment. This sensor on the floor was loaded with a bag of 1kg. Vibrations at each point were measured in X, Y and Z simultaneously with two Larson Davis Human Vibration Monitor HMV100 with belonging measurement plate Dytran5131A. Measurement equipment was controlled with a calibrator (Brüel & Kjær 4294) before and after measurements (Figure 2).



Figure 2 EcoTracks bogie band from Olofsfors.

Results

In summary: Tracks reduce vibrations significantly in the chair and cabin floor in front of the seat. Load reduced significantly and speeds influenced the vibrations in the chair. Compared with older studies of ordinary forwarder¹ the reductions are remarkable and more than 50% and with bogie tracks the reduction was 95%, especially in the Y-direction. Analysed in SAS with generalised modelling it was found that the P-value for tracks was $p=0.5$ on the cabin floor. For the whole model $F=0.112$ especially with load (Table 1) (Table 2) (Figure 3). Thus the machine became more stable and less vibrating supplied with bogey tracks.

Table 1 Summary of exposure measurements made in the forwarder

Case	Track no	rpm	Length (m)	Time (minutes)			Load (ton)	Speed (m/min)			Chair. X-direction (m/s ²)		Floor			SumXYZ (m/s ²)	
				Up	Down	Up		Up	Down	Up	Up	Down	Up				
Wheel, 0-load	7	1550	67.2	2.47	1.569	2.06	22.0	24.1	34.5	32	0.35	0.36	0.38	0.23	0.24	0.29	0.53
Wheel, +load	4	1550	74.3	3.21	2.304	2.17	35.0	22.6	33.8	31.6	0.3	0.34	0.38	0.21	0.23	0.27	0.44
E-max, 0-load	5	1220	72.3	2.27	2.32	2.28	24.9	32.5	28.9	28.9	0.36	0.31	0.36	0.23	0.23	0.24	0.49
E-max, +load	2	1220	78.6	3.03	3.12	2.54	39.9	26.1	24.6	27.1	0.27	0.25	0.22	0.15	0.17	0.14	0.32

Table 2 Average values of measured exposure levels in three directions as well as the sum of them and 0 loads means no timber on the forwarder

Case	Meas. place	X-direction (m/s ²)	Y- direction (m/s ²)	Z- direction (m/s ²)	Sum (m/s ²)
Wheel, 0 load	Chair	0.36	0.31	0.33	0.58
	Floor	0.26	0.27	0.3	0.48
Wheel, + load	Chair	0.34	0.24	0.28	0.51
	Floor	0.24	0.21	0.19	0.37
Tracks, 0 load	Chair	0.34	0.26	0.33	0.54
	Floor	0.23	0.24	0.29	0.44
Tracks, + load	Chair	0.25	0.17	0.19	0.35
	Floor	0.15	0.17	0.18	0.29

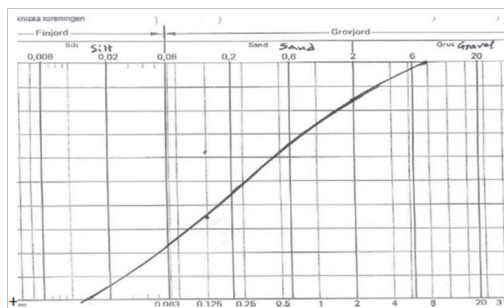


Figure 3 Sieving diagram for the test area.

Conclusion

With Olofsfors tracks like Eco Tracks, Eco Max etc. it is possible

to get better support on weak terrain,² less rolling resistance,³ and thereby less fuel consumption and now proven less vibrations in the cabin of the machine. On top of that recognised good service. Do we need more facts for buying Olofsfors bogie tracks?

Acknowledgments

None.

Conflict of interest

Authors declare that there is no conflict of interest.

References

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