ARE FOREST OPERATIONS ON STEEP TERRAIN (AVERAGE OF 70% SLOPE INCLINATION) WITH WHEEL MOUNTED FORWARDERS WITHOUT SLIPPAGE POSSIBLE?

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Abstract: *A team of engineers and students from the technical University in Goettingen, Foresters, Physicists and an enineer of the Kaessbohrer AG with a winch mounted snow grooming vehicle PistenBully 300 W Polar made a pilotstudy in the forests of the Harz mountains to find out, if the long hidden theory of Dietmar Sohns works. The theory says, that the common forest harvesting machines should go to the trees and the transportation should be done by forwarders like in low lands. It should be possible to compensate the weight disposition on the forest machines with a spill – winch on rack length of 300 – 500 m up to an average slope inclination of 70 %. The pilotstudy showed that it is possible with the PistenBully winch. The sensor controlled winch ranged up to 40 KN, doubled by pulley to 80 kN, worked perfect. The whole study was prepared by a simulation programme of the Technical University. The maximum load of a full packed Forwarder with 25 t went without any slippage over a section of 85 % slope inclination. Several modifications have to be done to make the system perfect for the future.*

1. Introduction

The full mechanised harvesting systems with harvester and forwarder work very careful in conifer stands depending ground and the rest of the stands. Also the productivity and costs of the system helped to make a standard in low lands out of it. In the last years engineers started to prepare harvesters with special chassis, to climb in stands on steep terrain where forest workers did the cutting before. The transportation of these logs is done mostly by cable crane systems or downhill by forwarders mounted with “drunken” and / or psychologic extreme trained operators. In the last case, mostly the ground conditions get damaged. The costs of these harvesting operations gave you the only chance to cut heavy timber. Thinnings are too expensive. A long hidden theory of Dietmar Sohns wanted to adapt the common full mechanised harvesting – transportation system to all stands on steep terrain. It was necessary to ask physicists and to look in other disciplines beside forestry. And so we found a snow grooming vehicle with a winch, the PistenBully 300 W Polar of the Kaessbohrer Company. The spill – winch compensates the weight disposition of the machine on extreme terrain situations to have a uniform compression of the snow on the ski piste or you are able to move a certain amount of snow uphill. The technical base of the district - forest station in Lauterberg accompanied with this group of experts and a pilotstudy was arranged.

On the way of prepareing the study, a simulation programme was developed to know the exact dates for compensation of the weight dispositions. This depends on the slope inclination, the load and the practical traktion of the forwarder itself under the particular actual conditions. The aim is, to give the forwarder only so much help for traction as necessary. This is the only way to maintain the security restrictions. The simulation showed, that you need up to 80 kN traction – help at slopes up to 90 % and with a total weight of 25 t (forwarder with load). The sensorcontrolled unit of the winch of the PistenBully 300 W is able to hold the preselected compensation exactly whatever it happens, - forwarder stands still or goes up- or downhill. We had to double the 40 kN spill-winch of the PistenBully by pulley to 80 kN for our extreme situations. The PistenBully had a rope length of 1000 m.

Figure 1: Pistenbully connected with forwarder for traction help on steep terrain

2. Pilotstudy

In the Harz mountains we prepared with three students 15 racks from 20 up to 85 % slope inclination. A full forwarder - load of timber was weighed. A harvester worked in the second thinning along the racks so far he could do it without any help. The ground conditions are quite simple, a deep grounded skeletal brown soil out of greywacke, in the racks you found a carpet of branches where the harvester worked. The forwarder loaded the fixlength timber downhill and uphill the short timber. Everything was attended by a timestudy and a ground controll by sampleplots.

The PistenBully was connected by a deflection roller with the rope of the winch at the rear tow-bar of the forwarder Timberjack 1010 B. With the front shield of the PistenBully a satisfactory and secure stand of the machine was given (Figure 1 and 2). The weather was sunny and bright with some thunderstorms in the afternoon.

Figure 2: Rear tow – bar of the forwarder and traction rope

3. Results

The whole study was very successful and all our expectations were topped. The full loaded 25 ton heavy forwarder went uphill without slippage at a section of 85 % slope inclination (see Figure 3). The driving speed was the same as in low lands, but the loading procedure was disordered by the not tiltable crane. The forwarder operator had good nerves and is not chicken – hearted in his also not tiltable cabin. The mounting and demounting of the traction rope was uncomplicated. The operator in the forwarder and in the PistenBully communicated by radiotelephones and changed frequently the compensation by the simulation programme.

Figure 3: Full loaded forwarder (25 t) passing a section of 85% slope inclination without slippage

The average productivity of the forwarder was 6.1 m^3 per hour, the skidding distance had an average of 200 m. This is a little less than in standard situations in low lands. But we know the reasons for: disorders with the crane, time for mounting and demounting the traction rope, less experience of the operators in these situations and others.

The PistenBully costs inclusive operator and social costs are with 63 €/h pretty high, but you don't need all the equipment of this machine. There is also a way out with a radio control system of the winch to save personnel costs.

We didn't find any dramatic ground damages. In case of very bad sight situations of the forwarder operator especially uphill, we had some root and bark damages. The nearly totally missing slippage saved the ground also in combination with the carpet of branches (Figure 4). The situation is compareable with operations like this in low lands. The detailed results of the pilot study are published on a later date. The question in the title will be answered with a simple "yes, of course!"

Figure 4: Forwarder climbes a slope easily and without damages

4. Conclusions

In the low mountain range the full mechanised systems have 100 % more area to work in with this traction controlled winch, - a real step forward!

In the mountain region you don't need any more the simple diagonal skidding roads at the slopes.

The skidding distances get shortened because of a nearly right angle between the racks and truckroad.

You can make thinnings at all areas with an average slope inclination of 70 % accessable, - especially above the last or beneath the lowest truckroad in a valley with dead end to a river or swamp for example.

Because of haveing nearly no slippage, the ground will be save like in low lands. You can operate with carpets of branches in the racks to optimise the situations.

But you have to find a way to adapt the traction controll system of the PistenBully to a forest machine. The most flexible way would be, to put the winch on an old skidder (around 100 hp). The winch should have then a traction force of 80 kN. - so you need no pulley. Further you will have only one rope with a length of 500 m. Beside traction help for the full mechanised system you can use the machine as a common skidder. In areas (for example the alps) where you have lots of PistenBully machines you can use it in summer in the forests for traction help of harvesters and forwarders as well.

A second technical addition must be done at the harvesters and forwarders in such a system. You should have tilt able cranes and cabins for an ergonomic and effective worksituation of the operators. For security it would be necessary to have a simple mechanism at the front shield to press a spike quickly in the ground in case of a broken rope for example. A camerasystem for driving backwards / uphill would help to reduce damages on the stands.

Another, but not a simple way would be, to adapt the sensor controlled winch in a harvester or forwarder. The advantage would be, that you have a traction-rope without movement and more security. But nobody knows the price of such equipment when it is added.

The simulation programme will be a great help to prepare the worksituations and studies in the future.

We are sure, that the compensation of the weight disposition with the sensor-unit of the PistenBully is the key for further successful technical developments.

5. References

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