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## **Conceiving and mechanical designing of a walking harvester for temporary trails**

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**Abstract:** In these days it's common to harvest trees fully mechanized from skid roads, which are planned in a distance of 20 metres to each other. These trails should be permanently used. If they have an average width of four metres, they will take over about 20 percent of the area that is precedencely used technical by the harvesting machines. If the soil is ecologically valueable or tends towards compaction, it will be useful to raise the distance between the trails up to 40 metres.

Out of the reach of the harvester cranes, one has to harvest motormanually for example with a chainsaw. But if it could be possible to limit the impact on the soil so it has the chance to regenerate by itself, it will be permissible to operate this area by a special harvesting machine. This machine will be moving on authentic „temporary trails“, because the soil is precedencely used biological – not technical.

Also such kind of machine has to be light and requires a novel chassis, that makes it possible to touch the soil just in a punctiform way. The marginal impact and the huge interfaces for regeneration of the soil are a grand advantage to protect it against extensive consolidation.

This presentation wants to introduce such a machine, which could be used on „temporary trails“. Established chassis were analysed in regard to their compatibility of soil. So, chassis with wheel-based- or crawler-type-undercarriage shows linear and continuous impacted tracks. Because of their weight, there are huge vertical affecting forces and because of the acting slip, there are tangential affecting forces, so called shear forces. These forces act together and disturb or destroy the driven soil.

A stepping movement offers a punctiform, non-continuous consolidation. But the existing solutions got a too small step size, so that moving uphill shows, as well as wheel based machines, continuous tracks. Walking excavators are harmful, too, because the machine acts as a wheel-based one or the „walking“ boom slides the mass of the machine behind.

What is demanded?

- the impairment of soil should be minimised
- the deadweight of the machines should be reduced
- renouncement of relative motions (in terms of the soil)
- avoidance of continuous and/or extensive consolidations of soil.

The examinations show a novel kind of stepping movement that is non-bionical. It is patented now. So it is possible to put the feet of the machine only vertically on to and off to the soil. The mechanism enables the harvesting machine to reach a stepping distance of eight metres. With every step, only three touch-downs contact the soil. There is no need of brakes, steering, driving gear and so on anymore, so there is a reduction of weight possible. The walking or stepping mechanism is very simple conceived, also simple to control by the operator. It is possible to rotate the machine in an angle of  $360^\circ$  on the spot, without any added technical efforts. Also after every step, it is allowed to choose an absolut new direction of moving. With the stepping mechanism, it is possible, that a forestry crane with an outreach of 10 metres could act dynamically in up to large 480 squaremetres in workspace, without any relative motion in terms of the soil.

The feet of the walking machine builds a large platform in the forest, so it is possible to lift a big bulk with a light deadweight of the machine itself. A movement uphill, downhill (36% gradient) and aslant is possible without any problems.

The harvesting machine was conveyed and designed in a degree dissertation of the TU Dresden with the skills that was taught as a special kind of mechanical engineering. This kind, so called, „Industrial Design Engineering“ includes the integrated development of products in mechanical engineering and in design (as shaping or creating the exterior). The conceiving includes static calculations to the point of examine several mechanical parts of the machine in stress simulations; also many, for a former realisation absolutely necessary single solutions. Last but not least, the workplace of the operator was ergonomically designed.

The weight of the walking harvester is just about 7.5 tons. The absolutely „Worst Case“ (uphill with  $36^\circ$  gradient in an disadvantageous position, working with the maximal outreach of ten metres) offers an netto lifting power about 60 kNm. Just a light modification of this worst-case-position allows a lifting power up to 100 kNm! Comparable Harvesters got either a deadweight of 11 up to 16 tons or a maximal outreach of seven

metres. If the harvester gets an accumulating felling head and works on a temporary trail between two permanent trails, it will be useful, that the „temporary-trail-machine“ fells trees into the area of ordinary harvesters, working on the permanent trails. The ordinary ones could finish the process. The walking mechanism allows to move on rocky parts and to cross barriers with a dimension up to 4 m (for example watertrenches). A low-cost-transportation is possible with two plug-on-wheels and a special hitch on a simple semi-truck.