

Leaving no impression Technological developments for reduced soil damage by forest machines

Rolf Björheden Skogforsk – the Forestry Research Institute of Sweden rolf.bjorheden@skogforsk.se

Technology cannot economically solve 'the soil issue'



... but combined with prudent planning, improved decision support and tactical skill, technology may contribute to an acceptable solution



Over the last 5 years Skogforsk has been involved in three concept machine projects for reduced soil impact:



A pendulum arm forwarder



Two rubber tracked forwarders

6-wheeled forwarder with pendulum arms

Xt28







Rexroth Bosch Group

Ш SVEASKOG

Automatic levelling through pendulum arm action

Individual wheel hub motors

6-wheeled forwarder with pendulum arms X228





Excellent capability for rough terrain



... reduced dynamic forces on soil and frame

6-wheeled forwarder with pendulum arms **X728**





Excellent capability for rough terrain

Rutting test (cf 8w forwarder of same class)



6-wheeled forwarder with pendulum arms Xt28





Standardized vibration test Reduced vibrations = higher speed

Comfort value results according to ISO 2631.^a

| Experimental data Velocity [m/s] Time [s] | | | XYZRMS (comfort value) | | | |
|---|------|--------|------------------------|------|------|------|
| Xt28 | 0.49 | 101.88 | 0.27 | 0.32 | 0.30 | 0.51 |
| Conventional | 0,50 | 101,16 | 0.31 | 0.37 | 0.37 | 0.61 |
| Difference | -1% | 1% | -11% | -13% | -21% | -15% |

^a Cabin floor comfort vibration levels on the Xt28 and a conventional machine, negative values indicates an improvement.

6-wheeled forwarder with pendulum arms Xt28





Superiour capability for

- rough terrain
- slope



A rough estimate: In Sweden, Xt28-type, pendulum arm machines may be the "Preferred technology" on 20 % of the area









BAE SYSTEMS HÄGGLUNDS









Built on Hägglunds BvS10 Not possible to drive with load

Rutting: Decreased by 70% cf c

Decreased by 70 % cf conventional forwarders with soft soil tracks

Vibration levels: Decreased by 30-50 %





Excellent traction:

Better climbing than conventional forwarders with drive tracks





Decreased fuel consumption in soft soil 10-20 % lower consumption on soft soil 55 % lower in deep snow

Heavy duty rubber track forwarder























Adams simulations

Configuration based on analyses of simulation results





February 2017 Ready for functional testing



March 2017 Technical tests... ... validation of functionality developments of methods & technical modifications



Standard vibration test track = Ground Roughness Class 2





OnTrack also tested on Ground Roughness Class 3

September 2017 Standard rutting tests







Summer 2017 Validation of functionality developments of methods



- Benchmarked against current 'best technologies' ٠
- Some 20 000 m³ solid forwarded, comfortable and stable .
- 17,5 m³ sub per PMH
- Lower fuel consumption/m³ than conventional forwarders
- Derailing issues ٠
- Durability of tracks and articulated steering hinge? •







Operating niche for tested vehicles



It is very important that the niche is not to narrow Initially all engaged institutes checked the feasibility of the technology and identified "must-go" demands for the machine



