Seismic

Benefits in brief

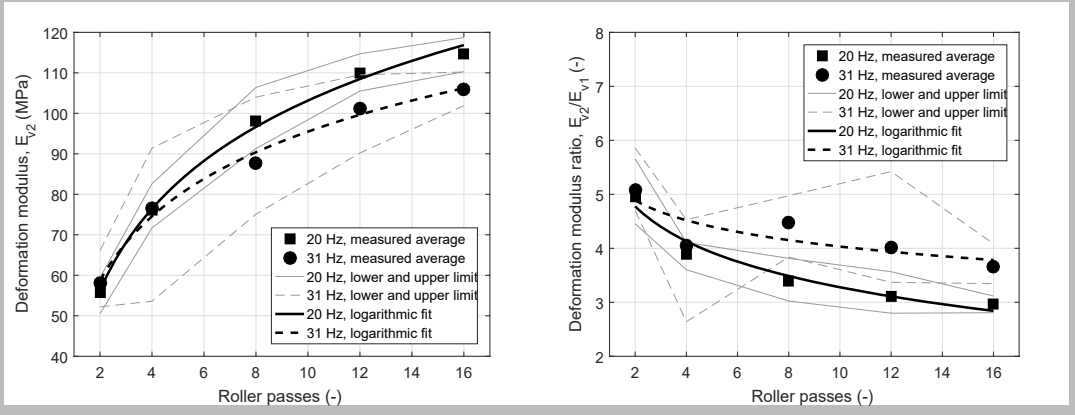
DYNAPAC
FAYAT GROUP

Well proven performance

The intelligent SEISMIC-system improves compaction performance significantly compared to conventional compaction carried out at fixed frequency. SEISMIC automatically detects the optimum compaction frequency (resonant frequency in the drum-soil system) and adjusts the machine settings accordingly every 0.2 seconds. The increase in performance has been proven in an extensive test program carried out by Dr. Carl Wersäll at KTH Royal Institute of Technology. Dr. Wersäll has compared compaction performance with the SEISMIC-system turned on and off respectively. Comparisons have been made both in a controlled laboratory environment, as well as in several field trials. All the results are published in a number of articles, reports and theses on this topic. The test program revealed several benefits with the SEISMIC system, and the highlights from the tests can be found below.

Increased stiffness with less passes

Results from Static Plate Load Tests are shown in the picture below. A higher value of Ev2 indicates that the soil stiffness is greater and thus that the compaction effort has been more effective. The results show that the same stiffness is achieved after 11 passes at 20 Hz, which was the optimum compaction frequency found by the SEISMIC-system in this case, compared to 16 passes at 31 Hz, implying a reduction in the required number of passes of approximately 30%! This saves a lot of time, money and fuel! In addition, the energy consumption during operation for a machine fitted with the SEISMIC system is less compared to a conventional machine, since the compaction frequency is significantly lower when the machine operates in SEISMIC-mode.

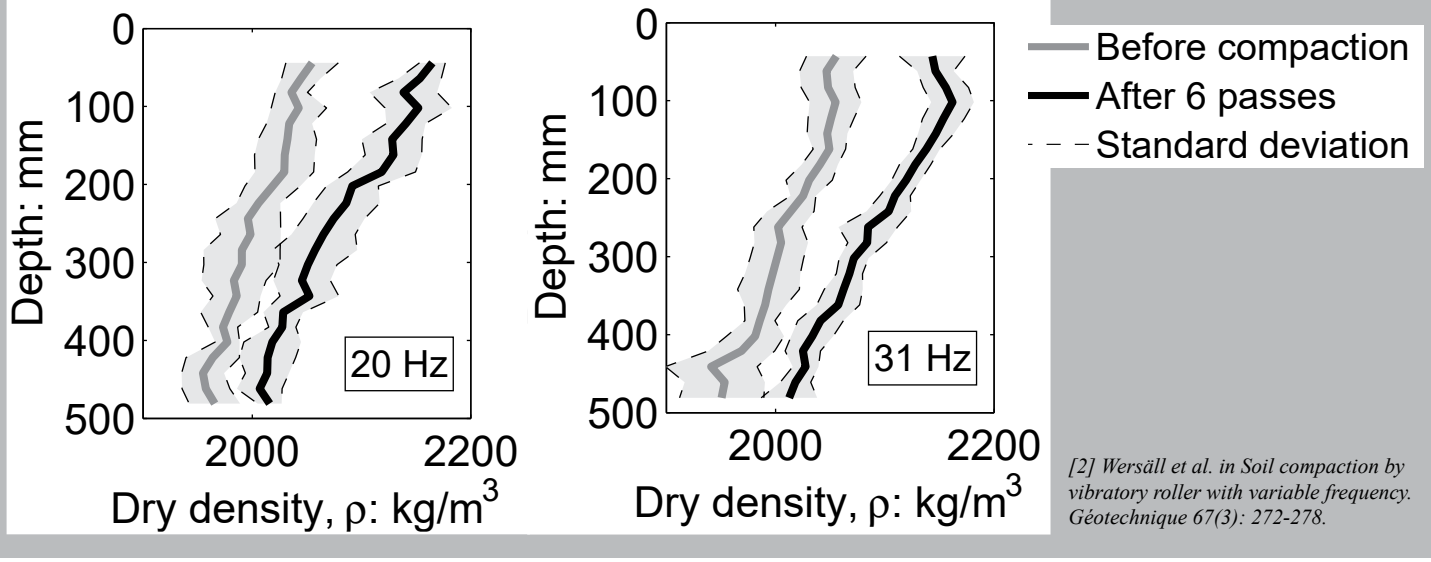


Also shown are the quotients Ev2/Ev1. A low quotient indicates that compaction is close to being finished. The picture clearly shows that the quotients are lower for operation in SEISMIC-mode compared to conventional compaction.

[1] Wersäll C, Nordfelt I, Larsson S. 2018. Resonant roller compaction of gravel in full-scale tests. Transp Geotech 14: 93-97.

No loosening of the top layer

Density measurements (performed with Nuclear Density Gauge) after six passes for optimum and fixed frequency are shown in the figure below. The gray lines indicate the initial density before compaction, and the black lines indicate the density after six vibratory passes.



[2] Wersäll et al. in Soil compaction by vibratory roller with variable frequency. Géotechnique 67(3): 272-278.

Note in the figure that for optimum frequency, in this case 20 Hz, the decrease in density in the top layer is not as pronounced as for the higher frequency. Loosening of the top layer is a common problem with vibratory compaction of granular materials, but it seems that when the compaction frequency is automatically tuned to an optimum value, the loosening effect is more or less eliminated. This is good news, because loosening of the top layer normally needs to be rectified with one or several static passes towards the end of the compaction work. The results above imply that these static passes may be omitted if the machine operates in SEISMIC-mode and this, in turn, will again save both time, fuel and money!

Compaction performance and centrifugal force

Another very important conclusion is that a reduced frequency implies a significant reduction in centrifugal force as this is proportional to the compaction frequency squared. Centrifugal force is often used as a measure of the compaction performance of the roller, but the results above clearly show, that an increased centrifugal force is not equal to an increase in compaction performance. What matters is that a correct compaction frequency is utilized for the unique conditions on every specific work site, and this is exactly what the SEISMIC-system does.

Conclusion

Taking all measurements into account, it is evident that compaction under the conditions presented above is more effective when using the SEISMIC-system compared to conventional compaction carried out at a fixed frequency.

Summary

To summarize the findings outlined we can conclude that:

- Vibratory compaction is most efficient if it is carried out with a compaction frequency close to the resonant frequency (SEISMIC system) of the drum-soil system.
- From tests on crushed gravel, the number of passes until a certain compaction target is reached can be reduced with up to 30 %, if compaction is carried out with the SEISMIC-system compared to conventional compaction at a higher fixed frequency.
- The surface loosening effect in granular materials that is a common problem for conventional compaction is more or less eliminated on granular soils, meaning that the static passes towards the end of the compaction process for ”finish compaction” might be omitted.
- The SEISMIC-system allows for fuel savings of up to 10 % compared to conventional compaction. Combined with Dynapac´s ECO-mode, that always comes with the SEISMIC-machines, fuel savings of up to 25 % can be expected.
- The drum amplitude is greatly enhanced when the machine is operated in SEISMIC-mode. This in turn yields much higher strain levels in the soil (compared to conventional compaction), which contribute to an improved compaction.
- Compaction in SEISMIC-mode utilizes lower frequencies compared to conventional compaction. This saves fuel and energy, but also clearly states that centrifugal force is not a good measure of the compaction performance.
- The lower operating frequency also means a significant decrease in machine wear and noise levels.

[1] Wersäll C, Nordfelt I, Larsson S. 2018. Resonant roller compaction of gravel in full-scale tests. Transp Geotech 14: 93-97.
[2] Wersäll et al. in Soil compaction by vibratory roller with variable frequency. Géotechnique 67(3): 272-278.

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