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Review and application of analytical models of forest soil bearing capacity

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Typical forest soil consists of large amount of tree roots that are buried in several thin layers. Many studies have shown that roots in forest soils significantly contribute to the bearing capacity of the soils. The behavior of soil reinforced with tree roots is highly complex and depends both on root and soil type, but also their combination. The mechanical properties of the roots and the soil are quite different from each other giving a heterogeneous soil structure. Currently, there is no general model available for the purpose of estimating the bearing capacity and the rut depth caused by forestry machine traffic on real forest soil. Studies on the behavior of roots located in soil are not abundant, partly because they are not visible and easily accessible for testing and the soil must not be affected by the test procedure.

Next generation forestry machines must be must gentler to soil and roots, especially in thinning operations, than present machines. This asks for better and more general multi-body dynamic simulation models of wheel-rooted soil interaction and effects due to combined pressure and shear that can be efficiently used for estimating the soil bearing capacity and vehicle mobility when designing those machines.

This paper reviews and compares analytical models of forest soil bearing capacity, such as discrete roots treated as wires with zero bending stiffness, discrete roots with shearing effects, and the root layer treated as an isotropic plate.