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THEORETICAL MODELS FOR RUT DEPTH EVALUATION AFTER A FORESTRY MACHINE'S WHEEL PASSOVER

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ABSTRACT

The paper presents a mathematical model designed to calculate the depth of the rut formed by a small-sized skidder on soft soils. The model bases on scientific research in the theory of off-the-road locomotion, completed with the authors' own theoretical developments. The model uses deformation modulus and bearing capacity as integral characteristics of strength and deformability of the soil. Moreover, because the deformation modulus of soft soils has a low value and is comparable to the normal stresses, the model uses a refined dependence for linking the soil deformation and the load parameters. Other physical and mechanical properties of the soil expressed in terms of its modulus, the expressions obtained as a result of the reference data approximation. The developed mathematical model uses refined formula to account the relationship of tire deflection of small-sized skidder and the soil deformation. The formula allows taking into account the fact that, ceteris paribus on soft soils deformation of the tire is smaller in value than the tire deformation on stronger soils. The model also takes into account the deviation of the direction of load resulting from the normal to the surface of soil and translational speed of the mover. This is achieved by introducing into the formulae for calculation of the bearing capacity correction factor on the direction of the load and the dynamic coefficient, calculated using the soil's rheological parameter in calculating the average pressure on the contact patch of soil with the mover. The model is implemented numerically in the software package Maple 2015. As a result of the calculated data approximation obtained a simplified model to estimate the depth formed on the soft soils under the influence of the small-sized skidder's mover.

Keywords: soft soil, forest soil, peatland soil, wheel interaction, small-sized skidder, rutting, deformation modulus

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