

**Modelling of material handling operations using controlled traffic**

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The development of a discrete-event model for the prediction of travelled distances of a machine operating in material handling operations using the concept of CTF is presented. The model is based on the mathematical formulation of the discrete events regarding the motion of the machine when performing the fieldwork pattern. To evaluate the model two slurry application experiments were designed. The experiments involved registering the position and monitoring the application status of the slurry applicator. Validation showed that the model could adequately predict the motion pattern of machinery operating in CTF. Prediction errors of total distance travelled, were 0.24% and 1.41% for the 2 experimental setups. The current model structure captures the interrelationships between the mutual influencing parameters of motion sequence and configurations of the CTF layout. This model has the potential to be used for autonomous vehicles.

**Durability of timber structures in agricultural and livestock buildings**

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A sample of 133 agricultural and livestock buildings was selected, including barns for housing different livestock species and other agricultural buildings such as storage buildings or hay barns. Timber durability was assessed based on the structural condition of the buildings, and the influence of the other variables on the condition of the structure was analysed. Data analysis revealed that the structural condition of the buildings studied was not affected by age or species. The factors with the strongest influence on the structural condition of the buildings were wood treatment, ventilation and the proper design of joints between timber members. Therefore, the durability of timber structures in the buildings studied was dependent on the construction practice, including the previous treatment of wood and the proper maintenance of the structure (ventilation, cleaning).

**Modelling of pneumatic tractor tyre interaction with multi-layered soil**

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A non-linear finite element (FE) model of the interaction of a tractor tyre with soil surface was developed as a procedure for analysing the contact pressure distribution for varying wheel loads and tyre inflation pressures. The tyre model considered the geometry and orientations of the tyre cords in each ply, the near-incompressible property of the tread rubber block, and the high and non-linear deformation of the carcass under the tread. The soil model was simulated with a linear model and considered a realistic soil cross-sectional area of influence with layers separation, including three soil surface layers and a hardpan layer. The three surface layers were within normal tillage depth (soil surface to 250 mm depth), with 250–300 mm hardpan substratum. Results from the simulation were compared with the measured data to verify the validity of the model for soft soil conditions. The comparison showed reasonably good agreement between the computed and measured general pattern of the pressure distribution at the tyre–soil interface under different loads and inflation pressures.