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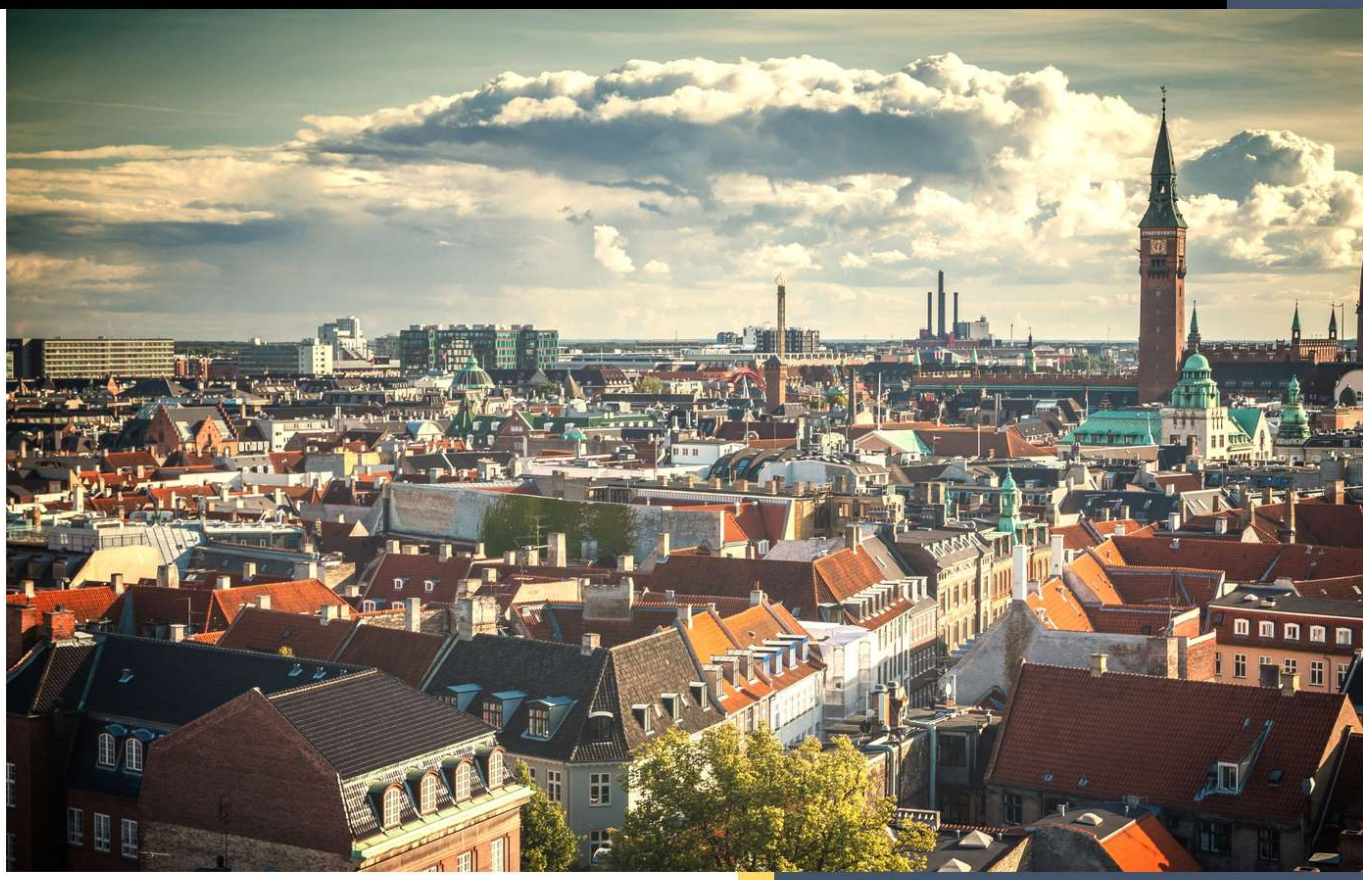
GLOBAL AND REGIONAL ASPECTS OF SUSTAINABLE DEVELOPMENT



COPENHAGEN, DENMARK

4-5.05.2021

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This issue of Scientific Collection «InterConf» contains the International Scientific and Practical Conference. The conference provides an interdisciplinary forum for researchers, practitioners and scholars to present and discuss the most recent innovations and developments in modern science. The aim of conference is to enable academics, researchers, practitioners and college students to publish their research findings, ideas, developments, and innovations.

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SUBSTANTIATION OF IMPROVEMENTS FOR THE BEARING STRUCTURE OF AN OPEN CAR WHEN UNLOADING WITH GRAB BUCKET

A higher efficiency of international transportation can be maintained by mutual cooperation of transport operators. Nowadays the most popular are rail and maritime transportation.

The research into the working conditions of transport means during international rail/sea transportation had demonstrated that the most vulnerable element is the bearing structure of a rail car. The damage is caused by the loads which exceed the allowable values. Besides, it should be noted that the bearing structure of a car is not suited to all operation modes, e.g. the unloading with a grab, transportation by a train ferry, etc. [1 – 3]

This leads to damage of the bearing structure of a rail car, which requires off-schedule repairs, additional maintenance expenditures, etc. Therefore, there is an urgent need to develop the technique for customization of the bearing structure of a rail car for effective operation.

The open cars in sea ports are unloaded with grabs. It should be mentioned that this unloading method may cause serious damage to structural elements of the body because the geometry of the body is not fitted to interaction with the grab. The most frequent damage to the bearing structure of a body during unloading with a grab are cracks, deformations, ruptures of the top cord and weld joints, etc. And the top cord of the frame suffers the most.

The research deals with introduction of viscous elements in the bearing structure of an open car in order to decrease the loads during unloading with a grab in the sea port terminals. An elastomer was suggested as the viscous material and the damper in the conditions of impact interaction between the grab and the top cord.

The authors suggested the application of elastomer with a viscous resistance coefficient of 0.3 kN·s/m and natural oscillation frequency of 10 Hz, because these dynamic characteristics are the most optimal values in terms of safety under the conditions of dynamic loading on the open car body; it means that the operation stability can be provided if the oscillation frequency of the bearing structure elements exceed 8 Hz.

It should be noted that at present there are a great amount of heat-resistant polymer materials which can be welded, if needed, during repairs of the open car body.

The strength of the improved bearing structure of an open car was calculated. The top cord of an open car with elastomer was modeled as a body with the geometry identical to the inner section of the top cord and the characteristics identical to that of the elastomer.

The research was made in the SolidWorks Simulation software with the finite element method. A 12-757 open car was taken as the prototype. Isoparametric tetrahedrons were taken as the finite elements. It was taken that the grab mass was 1800 kg, and the lowering speed to the top cord was 0.36 m/s [4].

The calculation demonstrated that the maximum equivalent stresses in the bearing structure did not exceed the allowable values and amounted to about 320 MPa, the maximum displacements were about 20 mm, and the deformations were $5.1 \cdot 10^{-3}$. Thus, the strength of the bearing structure of an open car body with

consideration of improvements was provided [5, 6]. The maximum equivalent stresses in the bearing structure were reduced three times in comparison to those in the typical structure.

The results of the research can be used by those who are concerned about higher operational efficiency of cars.

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