World Academy of Science, Engineering and Technology
International Journal of Transport and Vehicle Engineering
Vol:12, No:02, 2018

Railway Composite Flooring Design: Numerical Simulation and Experimental Studies

Authors : O. Lopez, F. Pedro, A. Tadeu, J. Antonio, A. Coelho

Abstract : The future of the railway industry lies in the innovation of lighter, more efficient and more sustainable trains. Weight optimizations in railway vehicles allow reducing power consumption and CO_2 emissions, increasing the efficiency of the engines and the maximum speed reached. Additionally, they reduce wear of wheels and rails, increase the space available for passengers, etc. Among the various systems that integrate railway interiors, the flooring system is one which has greater impact both on passenger safety and comfort, as well as on the weight of the interior systems. Due to the high weight saving potential, relative high mechanical resistance, good acoustic and thermal performance, ease of modular design, cost-effectiveness and long life, the use of new sustainable composite materials and panels provide the latest innovations for competitive solutions in the development of flooring systems. However, one of the main drawbacks of the flooring systems is their relatively poor resistance to point loads. Point loads in railway interiors can be caused by passengers or by components fixed to the flooring system, such as seats and restraint systems, handrails, etc. In this way, they can originate higher fatigue solicitations under service loads or zones with high stress concentrations under exceptional loads (higher longitudinal, transverse and vertical accelerations), thus reducing its useful life. Therefore, to verify all the mechanical and functional requirements of the flooring systems, many physical prototypes would be created during the design phase, with all of the high costs associated with it. Nowadays, the use of virtual prototyping methods by computer-aided design (CAD) and computer-aided engineering (CAE) softwares allow validating a product before committing to making physical test prototypes. The scope of this work was to current computer tools and integrate the processes of innovation, development, and manufacturing to reduce the time from design to finished product and optimise the development of the product for higher levels of performance and reliability. In this case, the mechanical response of several sandwich panels with different cores, polystyrene foams, and composite corks, were assessed, to optimise the weight and the mechanical performance of a flooring solution for railways. Sandwich panels with aluminum face sheets were tested to characterise its mechanical performance and determine the polystyrene foam and cork properties when used as inner cores. Then, a railway flooring solution was fully modelled (including the elastomer pads to provide the required vibration isolation from the car body) and perform structural simulations using FEM analysis to comply all the technical product specifications for the supply of a flooring system. Zones with high stress concentrations are studied and tested. The influence of vibration modes on the comfort level and stability is discussed. The information obtained with the computer tools was then completed with several mechanical tests performed on some solutions, and on specific components. The results of the numerical simulations and experimental campaign carried out are presented in this paper. This research work was performed as part of the POCI-01-0247-FEDER-003474 (coMMUTe) Project funded by Portugal 2020 through COMPETE 2020.

Keywords : cork agglomerate core, mechanical performance, numerical simulation, railway flooring system

Conference Title : ICRMTSDIT 2018 : International Conference on Railway Mass Transit Systems, Design and Interiors Technology

Conference Location : Paris, France

Conference Dates : February 19-20, 2018