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FINITE ELEMENTS METHOD IN ANALYSIS OF SUBASSEMBLES AND ASSEMBLES OF THE FREIGHT CAR

Abstract: The main purpose of this article is to present an analysis of the laboratory stand designed to study the wall of wagons as well as analysis of the wall of the wagon itself. The stand was firstly used for testing models made of standard materials, and subsequently will be used for modifications of existing models involving, for example, the composite materials introduction in the analysed construction.

1. Introduction

Railway transport is one of the main factors of economic development in each country. Currently, two transport types are of particular importance: rail and road transport. The first one, due to the long time loading and unloading, is the most cost-effective on large distances in a transport of bulk cargoes. It loses its importance in the carriage of cargo, mainly locally and regionally on short distances because of the competitive road transport. This is mainly due to the relation of costs.

Energy consumption for dislocation of load unit in the road transport is 3-5 times bigger than in rail transport. The road transport allows direct carriage of goods from the sender to the recipient without the need for transhipment what introduce savings in time and cost. For the obvious advantages of rail transport belong mainly the short duration of transport, there is no traffic jams here and it is greener than road transport.

2. Object under examination

Designed laboratory stand will allow to the analysis of the Eaos 408W wagons shown in Figure 1. This is a top wagon with open container and universal application. It is primarily used to carry bulk cargo such as: coal, stone or wood. The loading is done manually or mechanically, by using a stationary load, while the unloading manually by the four pairs of doors, or mechanically on the so-called tippler [2, 3, 4].

Fig.1. Eaos 408W wagon [6]

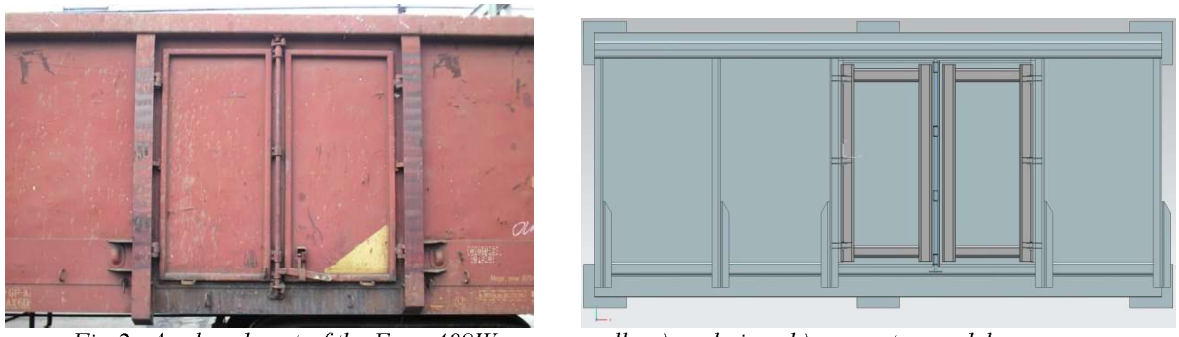

Fig.2. Analyzed part of the Eaos 408W wagon wall, a) real view, b) computer model

In general wagons walls are made of St3S steel. This is due to availability, price, strength of such material. The laboratory stand, together with the wall of the wagon model was designed according to the following design principles:

- The position was made in 1:4 scale,
- The position was made of steel sign St3S,
- Position allows you to ask hydraulic cylinder preset load,
- The simplified construction elements, that are crucial for analysis.

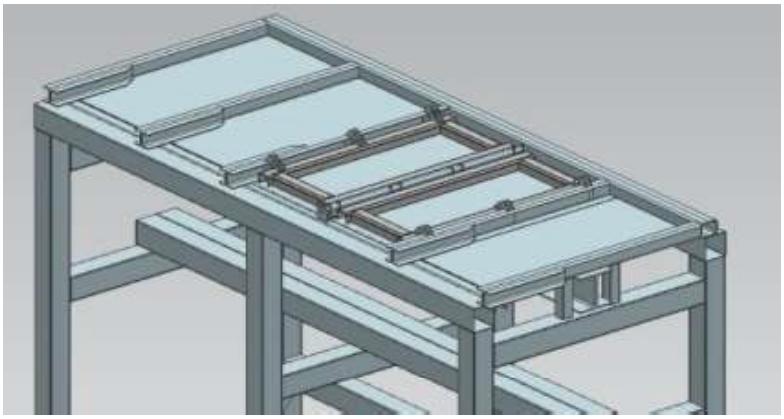

Fig.3. Computer model of the stand

To identify the state of stress in the wagon door it was assumed, that in order to carried out correct analysis, on the laboratory stand both, the door wagon and a part of construction elements should be mounted. It was shown in Figure 2.

3. FEM method in analysis of the computer model

In order to obtained value of displacement and stress of the object FEM strength analysis was conducted in Unigraphics software. Finite elements method (FEM) is the most common method for resolving the phenomena of complex mathematical character. The most important stage, in the analysis of this method, is so called discretization, so the imposition on the tested object elements with simple geometric shape depending on the analyzed surface. Finding of solution is closely linked with the computational power of computers and the numbers of finite elements, so from the complexity of the model. In many engineering cases, the discretization of the investigated technical object on elements is a simple matter, especially when we are dealing with simple constructions such as plates or grids. In complex cases, this division requires the designers knowledge and experience.

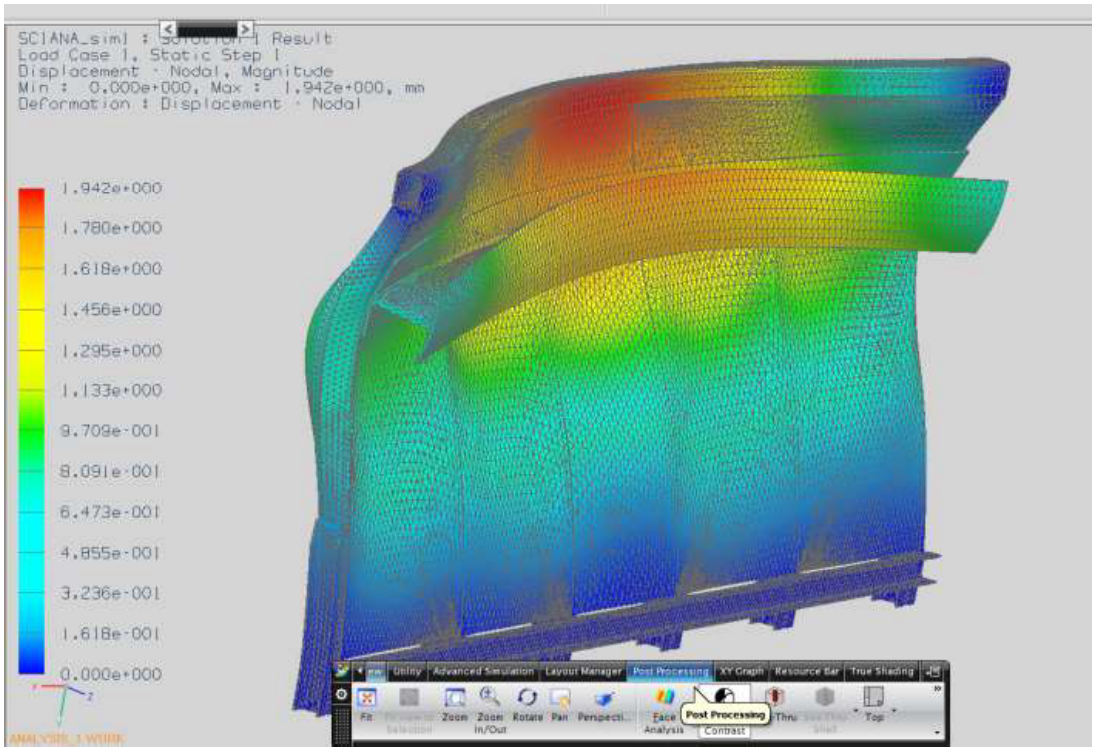

Fig.4a. FEM analysis of laboratory stand view 1

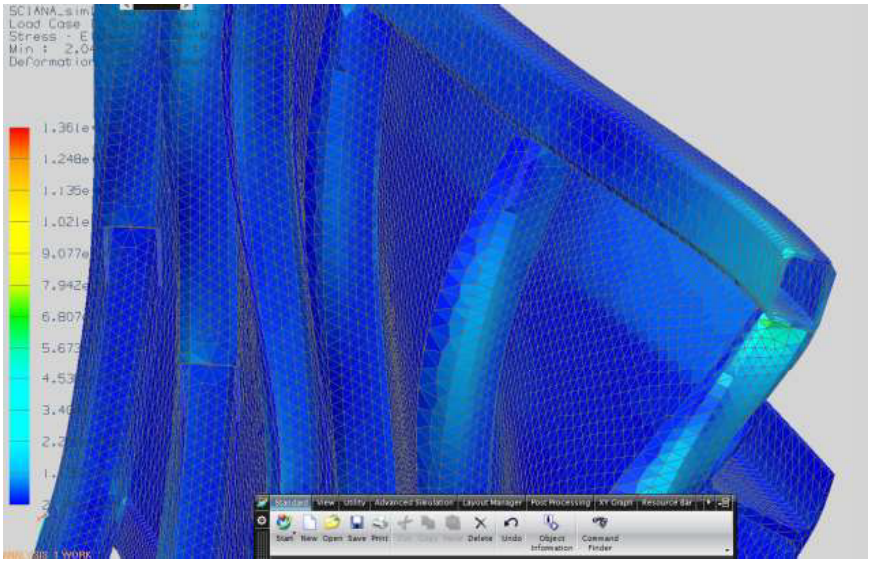

Fig.4b. FEM analysis of laboratory stand, view 2

In figure 4a and 4b were shown the object under examination. For the in which the applied exciting force equal to 25kN caused the maximum displacement, whose value does not exceed 1.8 mm. Comparing the stress values obtained after an analysis it was found that the limit values of steal are not exceeded by assuming loading.

This confirms the correctness of the geometrical parameters selection of metal profiles used to build a stand. In figure 5 was shown the wagon's wall, the largest displacements are marked in red color and are equal 1.9 mm.

4. Summary

In the presented paper, the modelling and analysis of the wagon's wall with the door and FEM analysis of laboratory used for those researches were described.

The stand and the test object was designed with the standard steel profiles in the 1:4 scale. The analysis was performed by finite elements method in Unigraphics program. It was found that size and shape of the profiles of both, the position and the whole wall of the wagon is valid under the assumption that the force value is 25kN and it is directed from the centre of the wagon.

The stand was designed for analysis of standard components. As a part of the future researches it is proposed application of composites or a composite-sheet metal combination in the wagons door.

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