Research on increasing the lastingness of a rolling bridge

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Abstract: - The paper's purpose is to analysis the stresses and strains state in the strength structure of a rolling bridge, presenting a fast and evaluated computer aided solving method for complex static indeterminate structures. The analysis of the stresses and strains state of the strength structure of a rolling bridge for increasing its solidity in exploitation is made using the calculation software with finite elements COSMOS/M. The research performed allows the evaluation of the stresses state, pointing out the critical areas and measures which are imposed in order to increase the solidity and bearing capacity of the strength structure for the rolling bridge. The results we have obtained allowed us to make up a study about the dimension optimization of the strength structure in order to design the rolling bridge. Thus, the material use could be reduced without exceeding the limits of the most appropriate resistance.

Key-Words: stress, rolling bridge, analysis, model, strength, finite elements, shell type.

1 Introduction

Metallurgy industry develops certain technological processes whose features need the use of all equipments of the assemblies – these equipments belong to the hardware cattegory, [1]. The most appropriate equipments we use in this domain are the rolling bridges, because they provide some advantages, such as: they could adjust according to the features of the technology process, they could lift up and transport a large range of weights, they do not need too much space, and are used for a large range of activities. The sub-installation is the most important element of the strength structure when assembling the rolling bridges, because it should provide the lastigness, stiffness during transportation and assembling, easy maintenance during use, and its elements should adjust to the dynamic use of the equipment [1], [17]. Their design features very widely according to their major operational specifications, such as: type of motion of the rolling bridge structure, weight and type of the load, location of the rolling bridge, geometric features and environmental conditions. Since the rolling bridge design procedures are highly standardized with these components, most effort and time are spent on interpreting and implementing the available design standards, [1], [2]. The research of the strength structures stress for the elevating and conveying plants, represents a very important stage for the design of some installations according to the reliability imposed by the norms and standards in the field [9], [12], [15]. DIN – Taschenbuch and F.E.M Rules (Federation Europeene de la Manutention) offer design methods and empirical approaches and equations that are based on previous design experience and widely accepted design procedures. DIN- Taschenbuch are collection of standards related to rolling bridge design. This norms generally state standards values of design parameters. F.E.M rules are mainly an accepted collection of rules to guide rolling bridge designers. It includes criteria for deciding on the external loads to select crane components, [2], [3]. There are many published studies on structural and component stresses, safety under loading and dynamic behavior of cranes, [2], [3], [4],[9],[13],[16],[17]. Solid modeling of rolling bridge structures and finite element analysis to find the displacements and stress values has been investigated by Demirsoy, [7]. Solid modeling technique applied for rolling bridge structures and an analysis of these structures using the finite element method provided in [11]. Solid modeling of a rolling bridge, the loadings at different points on the bridge and their application of the finite element method have been studied in [2], [3], [6], [13], [16].

This paper approaches the issue of the static stresses-strains state analysis for the strength structure of an overhead rolling bridge using the finite elements method. The rolling bridge is installed inside a hall of the iron (and steel) works where we perform the steel continuous casting. The analysis of stresses and strains is performed using the finite elements calculation software COSMOS/M, [19], [20].

2 Application of finite element method to a rolling bridge

Among numerical techniques, the finite element method is widly used due to the availability of many user-friendly commercial softwares. This method can be applied to obtain solutions to a variety of problems in engineering. Steady, transient, linear or nonlinear problems in stress analysis, heat transfer, fluid flow and electromechanism problems. The finite element method can analyse any geometry, and solves both stresses and displacements, [2],[3]. This method approximates the solutions of the entire domain under study as an assemblage of discrete finite elements interconnected at nodal points on the element boundaries. The approximate solution is formulated over each element matrix and thereafter assembled to obtain the stiffness matrix and displacement and force vectors of the entire domain, [2],[3],[5], [17]. Modern methods we have used are based on calculation software implemented through automatic data processing devices and allow us to study the stress very accurately, especially because balance and continuous equations are performed very fast and accurate. The results are accurate, mainly if the structure modeling and connection environment are as much accurate as possible. [8],[14], [19].

In this study finite element modeling is carried out by means of the COSMOS commercial package. This program have a modular form in accordance the stages of the method: pre-processing, solutions (processing) and post-processing. This program has shell type elements with three or four nodes per element and six degrees per node in the finite elements library which secure a very good calculation accuracy. This type of finite elements allows us to perform a liniar or non-liniar analysis of the strength structure of the rolling bridge. In case we shape up and we use such type of finite elements, the elements are compatible if only we should use a complete cubic polynomina, [2], [3], [5], [8], [10],[14], [17]. A shell element may be defined, which allows in the plane or curved surface of the element and posseses both length. It width and may only be used in 3 D simulation, [2],[3],[14],[17].

3 The study and the research program

In order to carry out our study about increasing the lastingness of the strength structure of a rolling bridge during the production process, we should consider the way it works when we use big weights after a time the equipment had been used for the production process. Therefore, it is extremely important to know the values of both stresses and strain state of the strength structure. Thus, we should shape up the strenght structure with the help of a special software based on finite elements, [17]. The study and research software helps us get the data we need to shape up, to carry out the shaping up and the result analysis.

According to these requirements, the study has been made for:

- analysing the structure and the connection amongst the elements of the strength structure;
- specifying the loading and combinations during their use;
- shaping up using finite elements, in order to carry out the space calculation;
- carrying out the space calculation and connection amongst the elements of the strength structure, with the help of COSMOS software (finite elements-based);
- analysing the calculations and results.

4 Structure analysis of a rolling bridge

The rolling bridge we are analysing is able to lift up to 100 KN, and the items are lift up to 17,3 m. It is made up by the following main sub-installations: strength structure – 1, , trolley - 2, the translation mechanism - 3, the electric installation and additional elements – 4, fig.1.

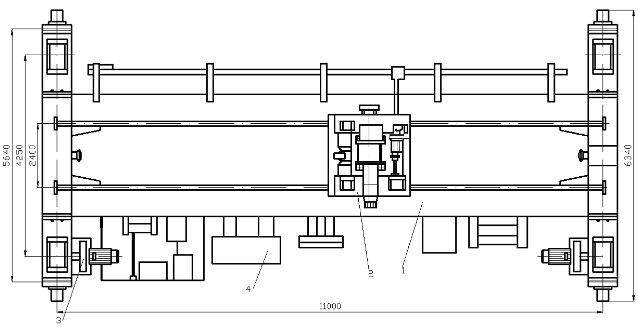

Fig.1 The strength structure of a rolling bridge

In the case of the particular rolling bridge we are analysing, the strength structure is made of locker-beams - both the two longitudinal beams and the two end beams. They made up a close-plan rectangular area. The longitudinal beams are very long and stressed, thus we make them according to a