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EXAMINATION OF CRANE BOOMS ABOUT THEIR PROPENSITY FOR VIBRATION IN MECHANICAL MACHINING[8]

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Abstract: *It is known that in the case of mechanical processing by cutting on the efficiency of the process, the stability of the technological system is of great influence. Therefore, processing an unstable workpiece with a rotating tool (milling or scraping) is often accompanied by vibrations. They become a cause for a deterioration in the quality of the treated surface and a decrease in the life of the cutting tool. The positioning of a part in the attachment is binding with the requirement to ensure the accuracy of its processing. To reduce the vibration of the system to vibrations in such cases, an increasing part stability is applied by additional positioning and fixing. These are measures that are often applied intuitively, without analysis, justification and supposed effect. The publication examines the possibility to choose and apply solutions based on a preliminary modal analysis of the construction of the processed parts. Admittedly, such an approach makes sense and should be expected to be effective in processing parts of one type. These are common cases, even for large nomenclature enterprises. Typical examples of unstable construction are the thin-walled box-shaped parts. These are details that perform the role of hull base part in assembled product and require mechanical processing by cutting. Among them are the so-called columns which are part of the crane's arrows.*

Keywords*: Metal cutting, vibrations.*

INTRODUCTION

A major component in the construction of car carriers is the so-called column or "arrow". It is a thin-walled box-shaped body with a long length. For assembling to the other parts of the cradle, attachment machined surfaces are provided in the column construction. Among them, there are cylindrical openings, some of them accurate to IT7. Machining of these surfaces is generally hindered by frequent emerging vibrations resulting in deterioration in the quality of the machined surfaces and intensive wear of the cutting edges of the tools, the machine joints and deterioration in it`s accuracy (Dimitrov D et al 2007-2017). It is known that this is due to the low stability of the entire technological system and to a large extent to the column (the machined part) that is part of it. The proposed vibration solutions by cutting tools and metal cutting machine manufacturers do not have a sufficiently significant effect on such cases. Therefore one of the possible ways is to seek solutions related to the basic element of the technological system, the column. The first step in this direction is the present study. It is aimed at exploring the possibilities for pre-determination of the inclination of the column to become a source of vibration through a theoretical analysis using the finite element method

EXPLANATION

Some typical type representatives of the crane "arrows" that are in question are shown in Figure 1 in 3D. The following general features can be considered in their construction:

- First of all, they are thin-walled box-shaped bodies with a long length and relatively low stability.
- Secondly marked with A, B, C and D are the joining surfaces - cylindrical holes.
- Plates and other elements may be added to the main body.

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In order to determine the possible connection between the structural features of the "arrows" and their tendency to vibrate, it is necessary to examine models of them both idealized and those

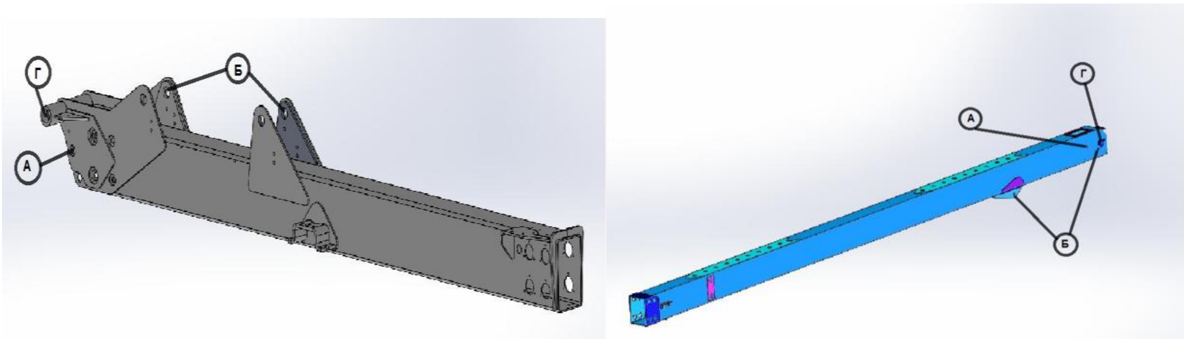

Fig.1. General appearance of the arrows from the lifter

that are closer to the actual constructions. To facilitate and speed up the task, it is advisable to use dedicated dynamic analysis software

Such applications are available in most current versions for 3D modeling and design. In this case, ABAQUS is used to simulate and study the dynamics of different constructs.

The main steps in the implementation of this study are the following:

1. Creating a simplified model of the construction of the column of the crane (Fig.2). In this case, this is a thin-walled rectangular beam with dimensions of 600x300x200mm. The disturbing force is at the tangential center of the beam.

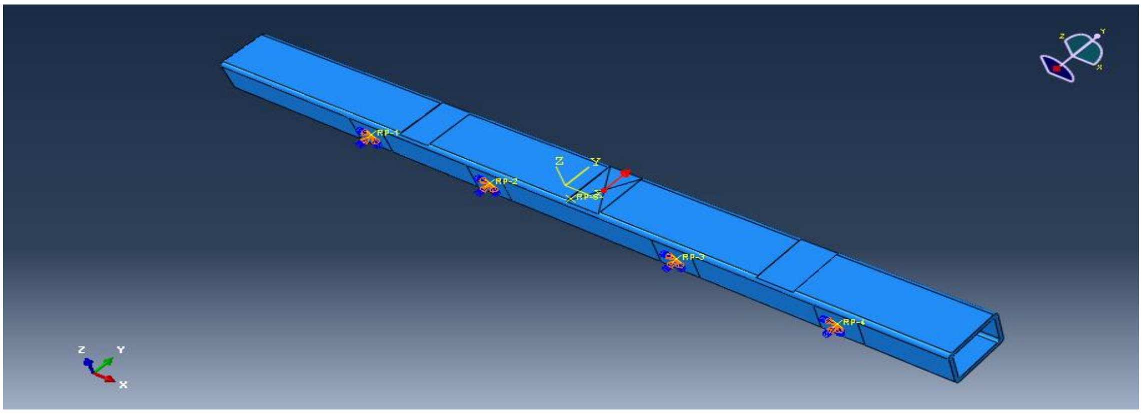

Fig. 2. Simplified model of the construction

2. Examination using the finite element method of the own frequencies and the model's own shapes (Fig.3) (Bozdouganova 1993-2008, Stoyanov2007-2017, Velchev 2003)

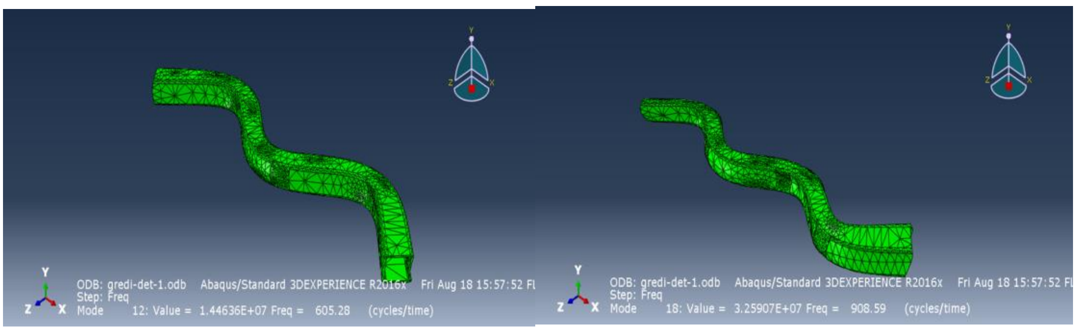

Fig. 3. The sixth and twelfth own form of the model

3. Development of different variations that take into account the establishment of such structures in their machining and the application point of the disturbing force. (Fig.4)

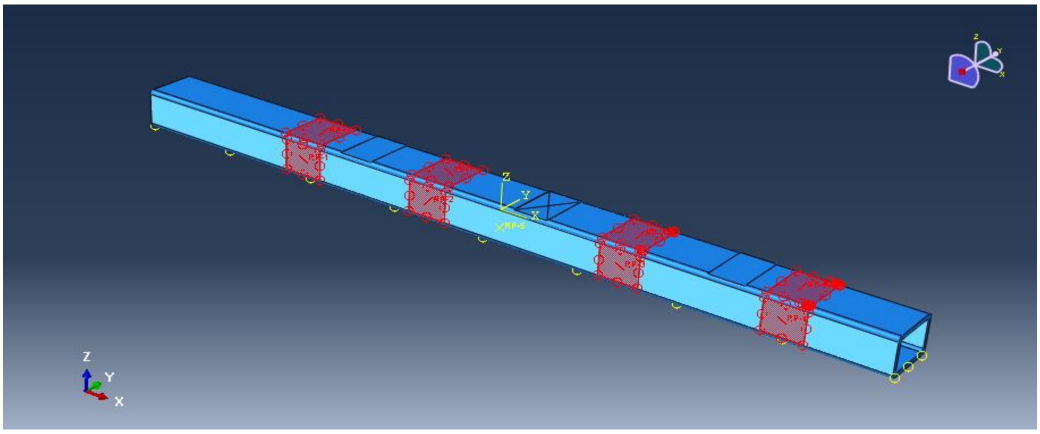

Fig.4 Variation with shown impact of the cutting forces in milling operation

4. Development of different variations corresponding to actual constructions and actual operation conditions. Studying their own frequencies and forms (Fig.5).

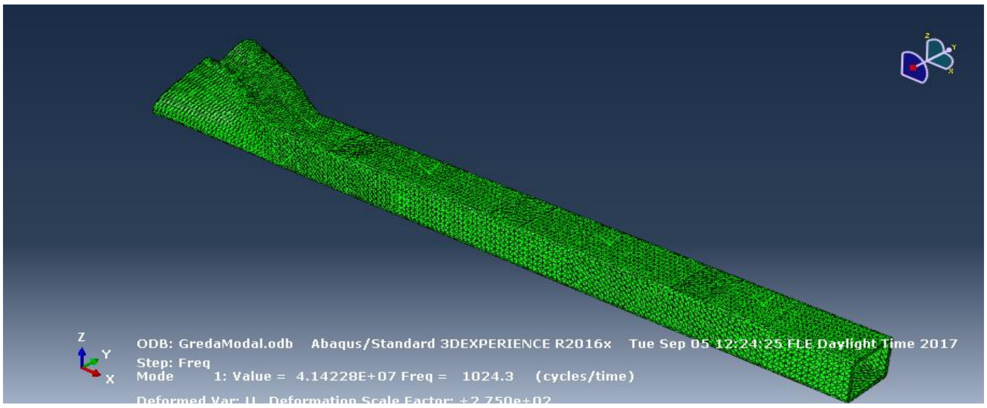

Fig. 5. First form for the variation in Figure 4.

CONCLUSIONS

With the help of suitable software, it is relatively easy to carry out a study and to illustrate the outcome of simpler models of the crane "arrow" type constructions as well as those that are closer to the real ones regarding their own shapes and vibration frequencies depending on the disposition and the external operation variations.

The results obtained from the preliminary theoretical experiments show that it is possible by modular analysis with the help of specialized software to determine the own shapes and respectively the zones with the greatest deviation of the crane boom model

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VERTICAL MC HAAS http://www.haascnc.com/DOCLIB/brochures/PDF/VMC.pdf?0629

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