UNIVERSITY OF EAST SARAJEVO
FACULTY OF MECHANICAL ENGINEERING

2nd INTERNATIONAL SCIENTIFIC CONFERENCE

COMETa2014

"Conference on Mechanical Engineering Technologies and Applications"

PROCEEDINGS

2nd - 5th December 2014
East Sarajevo - Jahorina, B&H, RS

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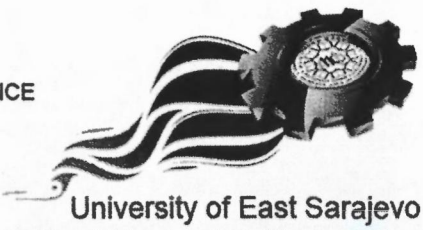

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Faculty of Mechanical Engineering
Conference on Mechanical Engineering Technologies and Applications

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PREFACE

Production in developed countries is based on the modernization and optimization of the production processes with the application of new technologies that are the result of scientific research. The application of new technology enables company's efficient production and competitiveness in the world market.

Faculty of Mechanical Engineering, University of East Sarajevo, organizes the Second International conference "COMETa2014 - Conference on Mechanical Engineering Technologies and Application", which has tasks: to increase economic competitiveness in the region and to give an contribution to creation of unique European Research Area.

Globally, we are witnessing a rapid development and a host of new technological solutions, which occur primarily in the multidisciplinary development (mechatronics) but also in development of completely new technologies, such as nanotechnology, biomaterials, bioengineering, new energy sources, intelligent machines and processes, micro-technique, etc. All of this puts researchers and engineers in the new challenges and creates opportunities for products and technologies that provide a precondition for economic recovery and creation of new jobs.

COMETa2014 conference program structure is consisted of the following thematic areas: Production technologies and advanced materials, Energy and environment, Applied mechanics and mechatronics, Development of products and mechanical systems, Quality and management and Organization and maintenance.

Participation in international conference COMETa2014 was achieved by: 229 authors from 11 countries, with a total of 102 papers, including 3 plenary lectures.

Inside of conference COMETa2014 has been planned organization of three working meeting and one round table discussion based on actual topics of conference. During the conference, it will be presented some of technical solutions produced in companies from our region.

The presence of a large number of participants from Bosnia and Herzegovina and abroad as well as the problems which are processed at the conference, coincide with the themes promoted by the European Union in its development programs.

On the basis of previous exposure, a gathering of scientists and researchers at the international conference COMETa should be understood not only as an exchange of knowledge and achievements of the narrower set of scientists and researchers, but also as a constant and serious attempt to focus social consciousness and social life on activities that ensures progress and prosperity of any society, and that is productive work, creating new knowledge and economic development.

On behalf of the Organizing Committee and Scientitific Committiee of the Conference COMETa2014, we want to express our gratefullness to all authors, reviewers, as well as insititutions, companies and individuals who contributed to realization of the Conference.

East Sarajevo, November 19th, 2014.

President of the Scientific Committee

Prof. dr Biljana Marković

President of the Organizing Committee

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ANALYSIS OF PRE-STRESSES CAUSED BY WIRE TENSION OF STONE CUTTING MACHINE

Dragan Čukanović[1], Milan Blagojević[2], Snežana Vulović[3], Miroslav Živković[4]

Abstract: In this paper finite element model of machine for stone cutting is created. In accordance with the real working environment appropriate boundary conditions are applied. Pre-stress static analysis is performed. Results of analysis and field of von Mises equivalent pre-stress are shown. Based on the results of analysis appropriate conclusions are presented.

Key words: Pre-stress, Static analysis, Stone cutting machine, FEM

1. INTRODUCTION

In the modern age of technology, sophisticated devices and structures, software for the calculation and simulation behavior are widely used. Based on different theoretical methods these programs are effectively used in different areas of industry. The main task is to create 2D or 3D models as well as to do static and dynamic linear and nonlinear analysis in order to predict the behavior of structures in a real working environment. Today, software based on finite element method (FEM) has become one of the most frequently used method for solving such problems.

Pre-stress static analysis provides an opportunity to simulate how a prestiffened or prestressed structure affects your model's deformations, stresses and strains. This type of analysis determines the strengthening or weakening of the part due to the applied loads. Results of a previously run pre-stress static analysis can be the starting point for some other type of analysis. Pre-stress static analysis can be run for the different problem and situations. For example, if the specified loads in the static analysis are close in magnitude to a corresponding buckling load. In this case, the prestiffening effects are negligible from a static analysis. Also, if applied loads affect the stiffness of the model. For example, if there is a model with an existing load that projects an existing force. Beside above mentioned, pre-stress static analysis can be run in order to get more specific information about the model.

In this paper the analysis goal is the pre-stresses analysis of the machine for stone cutting. The analysis is performed using finite elements model generated by software Femap. Calculations are performed by software NX Nastran [1].

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2. MODEL

Machine is modeled using software Femap with NX Nastran solver. According to the construction type, shell elements of the appropriate thickness, 3D elements (for modeling some part of rollers), beam element and rod elements (for modeling wires) are used for creating the finite element mesh. Structure is modeled in details with 151527 elements and 167273 nodes. Figure 1 shows the FE model of the machine with 40 wires.

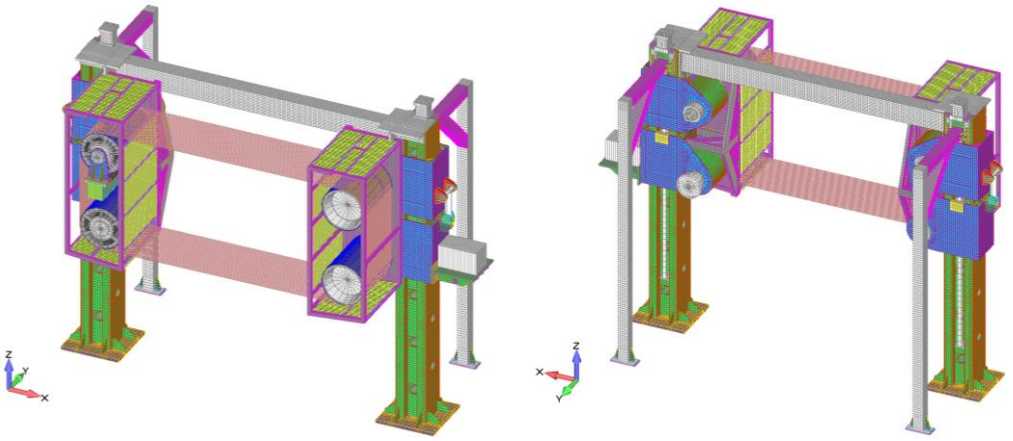


Figure 1. *Finite element model*

2.1 Material characteristics

Structural components are made of steel except small rollers, that are made of aluminum. Over the rollers there is a polyurethane strip with 90 Sh [2]. Table 1 shows physical characteristics of materials.

Table 1. *Material properties*

Materials	E [N/mm^2]	ρ [kg/mm^3]	v
Steel	$2.1 \cdot 10^5$	$7.8 \cdot 10^{-6}$	0.3
Aluminum	$70 \cdot 10^5$	$2.7 \cdot 10^{-6}$	0.34
Polyurethane	$0.025 \cdot 10^5$	$1.2 \cdot 10^{-6}$	0.49

2.2 Loads

The goal of this analysis is to determine the pre-stresses caused by wire tension before cutting. The tension force in the wire before cutting process is F_w=2500 N. Wire tension is simulated by thermo-mechanical analysis. On the nodes that belong to elements that represent wire, force of tension corresponding to the given temperature is applied. On the driving roller friction force is acting during the cutting. Friction force in the wire is F_f=M/R_ω=370N, where M=150Nm is the drive torque, and R_ω=0.406 m is diameter of drive roller. Friction forces are given as a concentrated force on the drive roller, see figure 2.

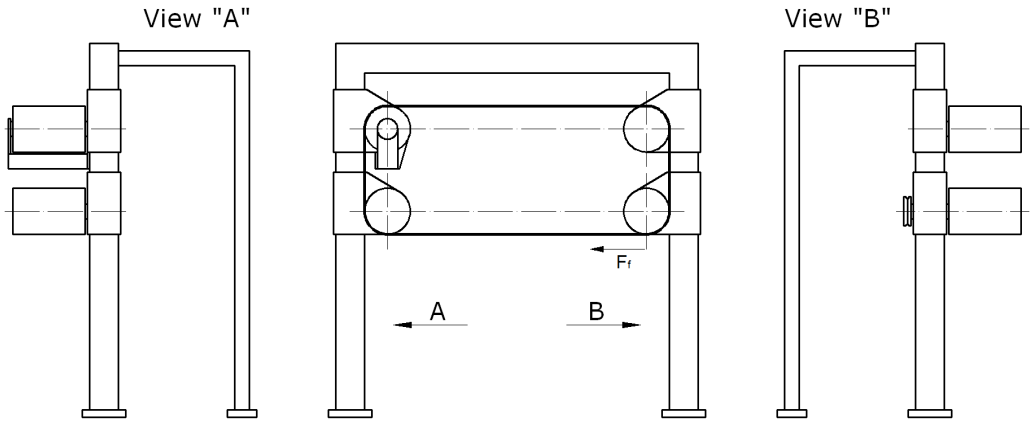
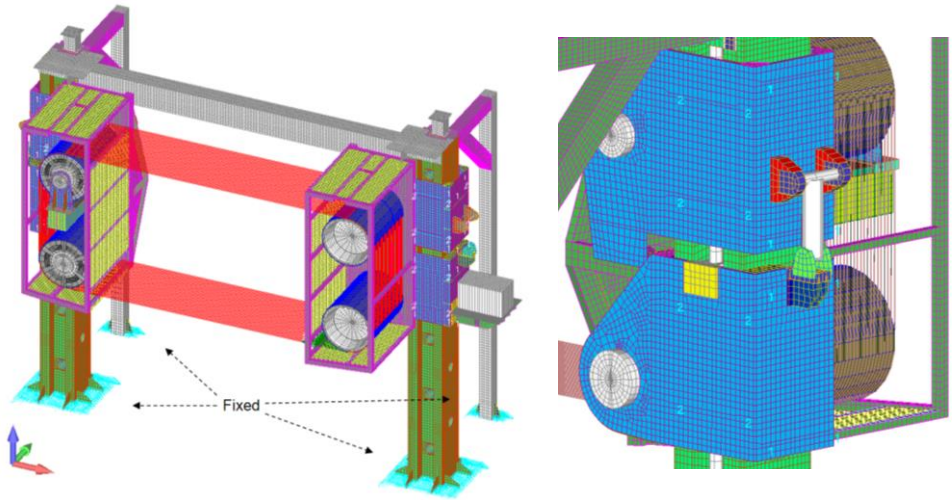


Figure 2. *Friction force*

2.3 Boundary conditions

Boundary conditions are given in accordance with the requirements of the real construction of machine. All nodes at the contact surface between machine and base are fixed, figure 3. Colors in figure 3. match the various thickness of shell elements. At the locations of small wheels, which provide vertical guidance of moving parts, constraint equations are given, see figure 3.



(a) *(b)*

Figure 3. *Boundary conditions*

3. RESULTS

Figure 4 shows field of von Mises equivalent pre-stress in structure before the cutting process. Maximal value of the equivalent stress is 85.8 MPa [3].

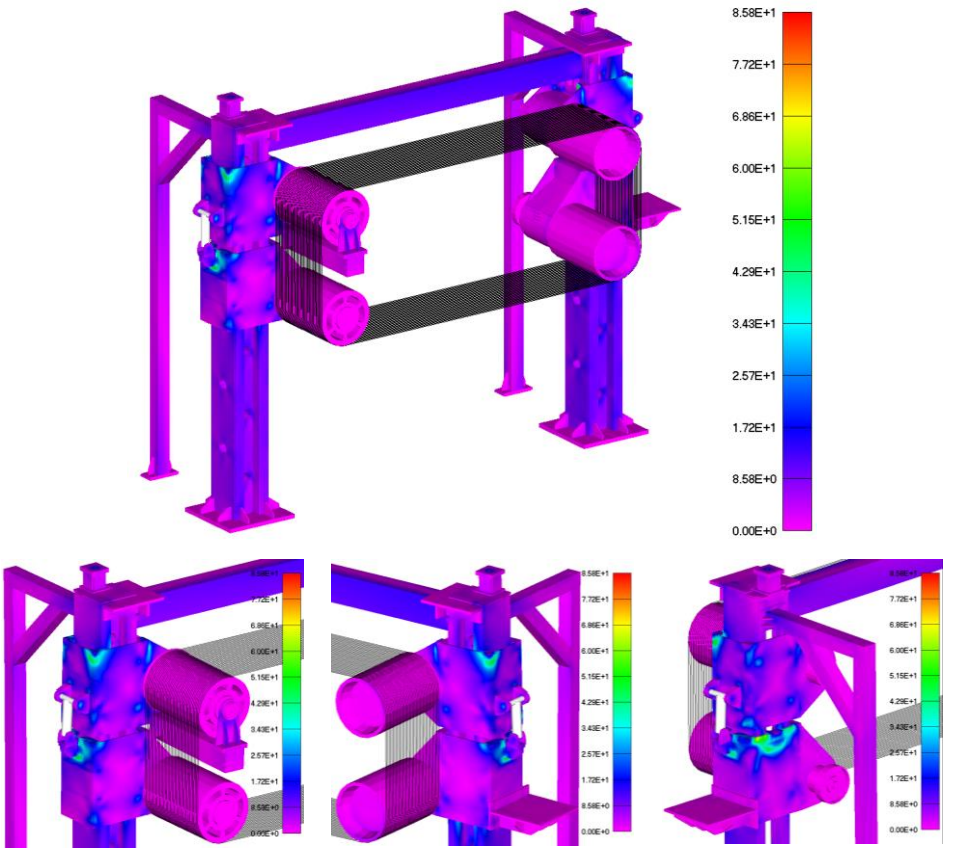


Figure 4. *Field of von Misses stress*

4. CONCLUSION

The finite element model of the machine for stone cutting is presented. Loads and constraints are modeled very realistically.

Stresses occurring in the structure due to the wire tension is relatively low. They are far below the yield stress for the material of which the machine is made.

In the future work, this model will be used for modal and dynamic analysis. Particularly it is interesting effect of prestressing on own frequencies of machine.

ACKNOWLEDGMENT

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