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# STATIC AND FREQUENCY ANALYSIS OF THE BEARING-TYPE TRANSFERRING

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**ABSTRACT:** The paper presents modal and frequency analysis of the bearing-type transferring with the help of the mathematic modeling of a finite element method with utilization of Pro-Engineer and Cosmos M.

**KEY WORDS:** modal analysis, frequency analysis, finite elements method

## 1. INTRODUCTION

The main production program in Matador Machinery, Inc. includes facilities for the rubber industry which compose 75% of the production at the moment. It also involves production line for the manufacture of the truck tyres, light-weight tyres and tyres. The line is adjusted to standard production of the ALL STEEL radial truck tyres 17,5“, 19,5“, 20“, 24“, 24,5“ in semiautomatic mode. The production line NR3 daily generates up to 300 pieces of tyres with two operators. It contains bearing-type transferring, attached to the frame from above (Fig. 1). Transferring was designed in Pro/Engineer program and then exported like “*.igs” to the program COSMOS M for the creation of the finite-element model. The static and dynamic calculation was made for the loading with reference to the weight functioning in individual centers. The weight of individual entities is: entity cast with the cylinders – 137 kg, upper convection – 33 kg, lower convection – 10 kg, grips – 64 kg, cylinders – 30 kg and maximal velocity of the cart motion $v_{max}$ =1 m/s.

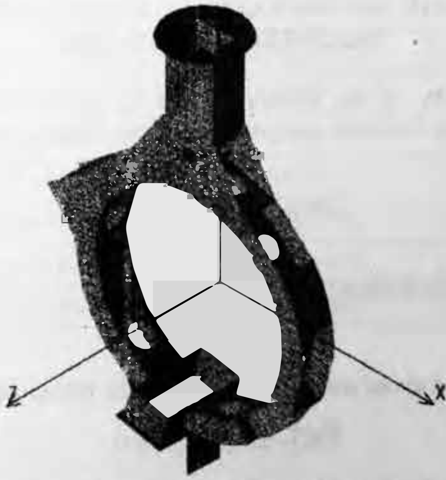



**Fig. 1: Bearing-type transferring**

## 2. CALCULATION OF THE TRANSFERRING CONSTRUCTION LOADING BY THE STATIC LOADING

Transferring`s mathematical model was created with fournodal thin shell elements. Stability equations are solved [1]:

$$[\mathbf{K}]\{\mathbf{u}\}=\{\mathbf{R}\} \qquad (1)$$

Static analysis of the transferring construction includes solution of the stability equations (1). The transferring computing model is presented on Fig. 2 and tenseness distribution is displayed on Fig. 3 in [MPa].

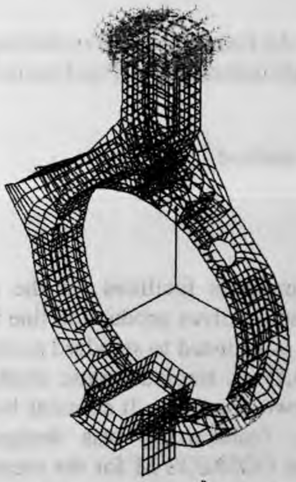


**Fig. 2:** The transferring computing model


**Fig. 3:** The tenseness distribution [MPa]

## 3. THE CALCULATION OF THE NATURAL FREQUENCIES AND NATURAL TRANSFERRING SHAPES

Natural vibration is ability of the system excited by the external impact effect to perform harmonic vibrations when the external excitation is gone. This problem is solved in differential equation:

$$[\mathbf{M}]\ddot{x}(t)+[\mathbf{K}]x(t)=0, \qquad (2)$$

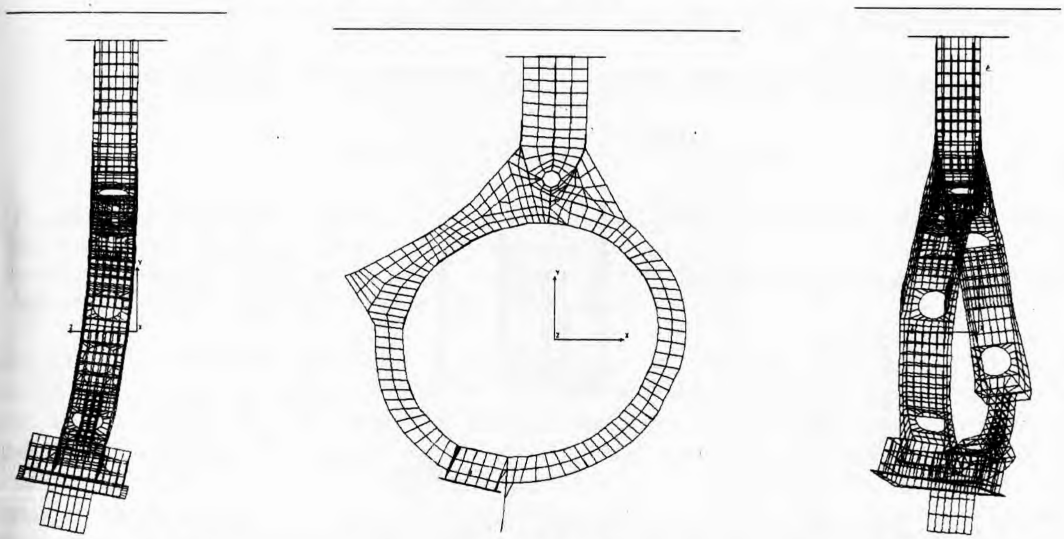
where $x(t)$ is the solution.
The solution of the (2) should be in form:

$$x(t)=y\sin(\Omega t). \qquad (3)$$

If we substitute it and eliminate trivial solution we come to the relationship:

$$\left([\mathbf{K}]-\Omega^2[\mathbf{M}]\right)\{y\}=0. \qquad (4)$$

This relationship is generalized problem of the natural values, solution of which is achieved by the semi-automatic-space iterative method. This method is based on the idea of the inverse iteration conversion with several vectors at the same time. Fig. 4 describes the first three natural shapes of vibrations and Tab. 1 describes first 10 frequencies of natural transferring.



F_Mode = 1
0.877774 Hz

F_Mode = 2
1.3057 Hz

F_Mode = 3
2.14418 Hz

**Fig. 4:** First three natural shapes of vibrations

**Tab. 1:** 10 frequencies of natural transferring

| FREQUENCY NUMBER | FREQUENCY (RAD/SEC) | FREQUENCY (CYCLES/SEC) | PERIOD (SECONDS) |
|---|---|---|---|
| 1 | 0.5515218E+01 | 0.8777742E+00 | 0.1139245E+01 |
| 2 | 0.8203944E+01 | 0.1305698E+01 | 0.7658738E+00 |
| 3 | 0.1347227E+02 | 0.2144178E+01 | 0.4663792E+00 |
| 4 | 0.1706904E+02 | 0.2716622E+01 | 0.3681042E+00 |
| 5 | 0.2629905E+02 | 0.4185623E+01 | 0.2389130E+00 |
| 6 | 0.2662395E+02 | 0.4237333E+01 | 0.2359975E+00 |
| 7 | 0.3796545E+02 | 0.6042389E+01 | 0.1654975E+00 |
| 8 | 0.3886765E+02 | 0.6185978E+01 | 0.1616559E+00 |
| 9 | 0.4973891E+02 | 0.7916193E+01 | 0.1263233E+00 |
| 10 | 0.5275567E+02 | 0.8396325E+01 | 0.1190997E+00 |

The frequency characteristic for nodal point No. 350 can be found on Fig. 5.

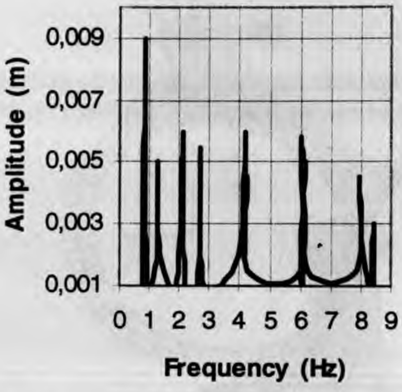



**Fig. 5:** Amplitude-frequency characteristic for the nodal point No. 350

## 4. CONCLUSIONS

Loading distribution on the transferring by the identical loading is much more salutary for gripping from above. Transferring is made of aluminum alloy and it is suitable that it works with sufficient high safety margin. The frequency analyses results showing that the first three vibrating shapes can affect transferring work session.

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