XVIII International Conference on "MATERIAL HANDLING, CONSTRUCTIONS AND LOGISTICS"

DYNAMIC BEHAVIOR OF THE ELEMENTS OF GEAR-BOX

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Abstract: *Dynamic behavior of the elements of gear-box was defined based on the dynamic calculation realized by finite element method. Frequencies and appropriate deformation fields (oscillations) were obtained by using program package KOMIPS. All structures of the considered construction of the gear-box were involved in calculation: cover, input- shaft, middle-shaft and output-shaft. Modeling was done by using plate (shell) and volume finite elements.*

Key words: *gear-box, frequency, dynamic behavior, finite element*

1. INTRODUCTION

In this paper dynamic behavior of the elements of the gear-box in Drive unit B-1800 – Kostolac is presented. The power of electromotor is P=630 kW with angular velocity of n=980 o/min.

Considered gear-box is consisted of: cover, input-shaft, middle-shaft and output-shaft.

Cover of the gear-box is in dimensions 2550×1660×1060 mm. Lover part of the cover is shown on Figure 1.

Figure 1. Cover of the gear-box

Input-shaft of the gear-box is 960 mm length, changeable cross-section. Diameters of the shaft on its ends are ∅150 mm and ∅120 mm.

Middle-shaft of the gear-box is 1100 mm length. Diameters of the shaft on its ends are ∅300 mm and ∅290 mm.

On Figure 2 middle-shaft is presented.

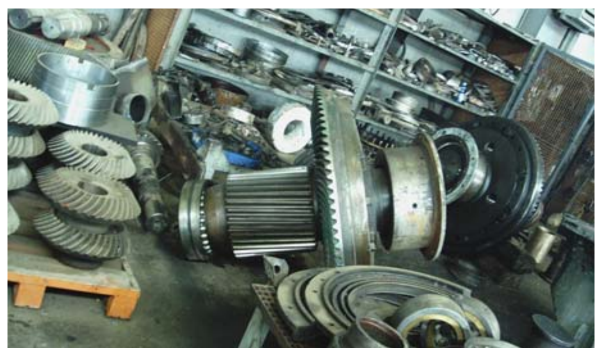


Figure 2. Middle-shaft

Output-shaft has length of 1050 mm and changeable cross-sections. Diameters of this shaft on its ends are ∅300 mm and ∅390 mm.

Output-shaft of the considered gear-box is presented on Figure 3.

Figure 3. Output-shaft of gear-box

2. DYNAMIC CALCULATION OF THE ELEMENTS OF GEAR-BOX

Calculation presented in the paper is done by using program-system Komputation Modeling and Calculation of Structures [1], [4] (KOMIPS, autor T. Maneski).

2.1 Modeling and calculation of the cover

Modeling of the cover of gear-box is done using by 1886 nodes. Finite element mesh is formed with 937 plate finite elements and 335 volume finite elements.

The part of the cover modeled by plate (shell) finite elements is shown on Figure 4.

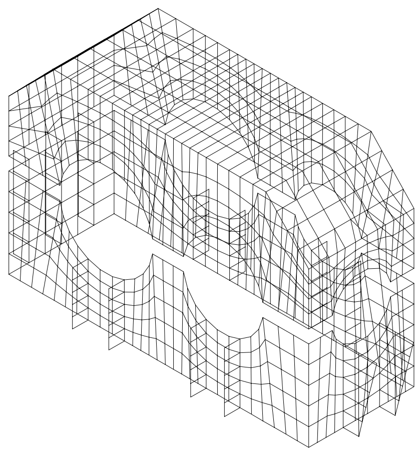


Figure 4. Plate finite elements (mesh)

Mesh consisted of volume finite elements is presented on Figure 5.

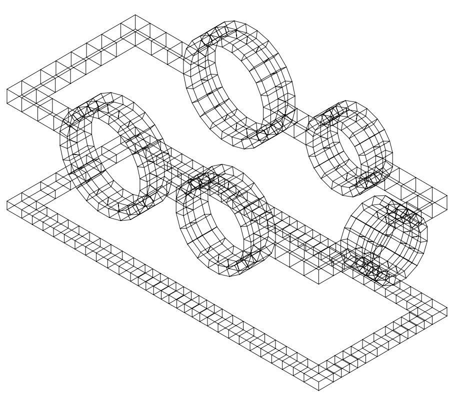


Figure 5. Volume finite elements (mesh)

The whole model is presented on Figure 6 in axonometry and only by the contour.

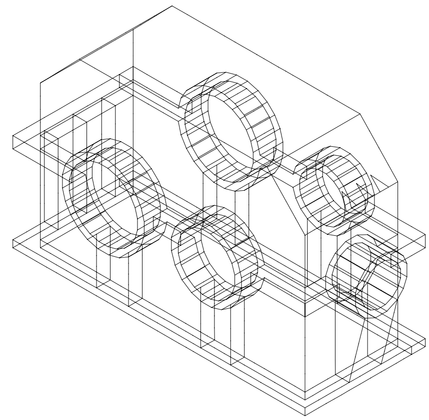
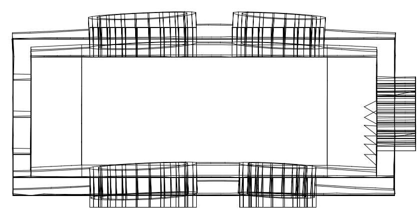


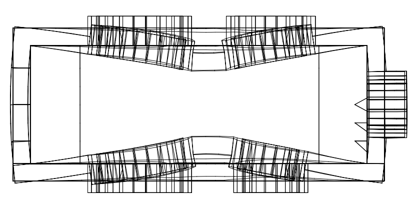
Figure 6. Contour of the cover

Numerical results

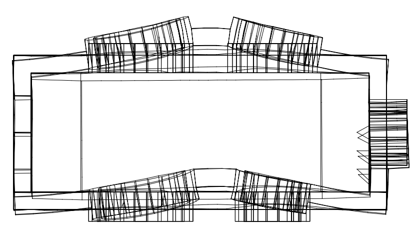
For the considered structure first three modes of oscillations are obtained. Appropriate deformations are presented on Figures 7a and 7b over two projections.



First mode

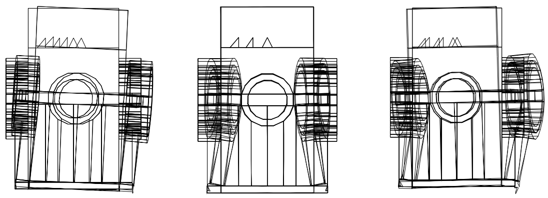


Second mode



Third mode

Figure 7a. Three modes of oscillations (horizontal projection)



First Second Third

Figure 7b. Three modes of oscillations (vertical projection)

The values of the appropriate frequences [Hz] are noticed in Table 1.

Table 1. Main frequences

	First	Second	Third
Frequency	15.8 Hz	23.6 Hz	29.4 Hz

2.2 Modeling and calculation of the input-shaft

Modeling of the input-shaft of gear-box is done using by 766 nodes. Finite element mesh is formed with 576 volume finite elements.

Appropriate model is presented on Figure 8 by the contour.

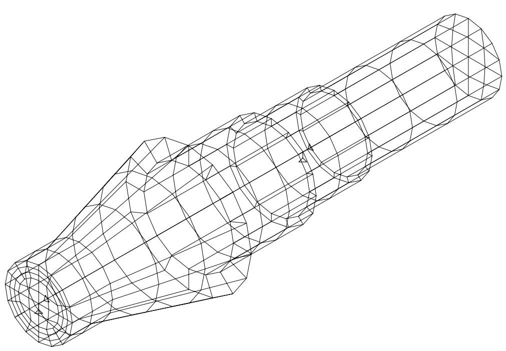


Figure 8. Model of the input-shaft

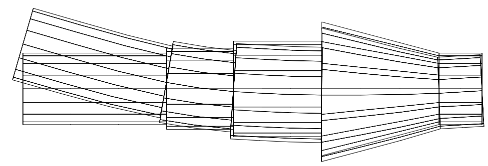
Numerical results

Dynamic calculation for this part of gear-box is done for two cases: withot the influence of the coupling and with the coupling mass of 500 kg.

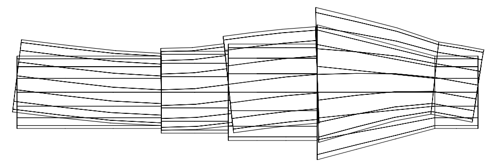
Results are noticed in teble 2.

Table 2. Main frequences of input-shaft

Coupling mass	First frequncy	Second frequency
0 kg	165 Hz	303.6 Hz
500 kg	3.5 Hz	25.1 Hz



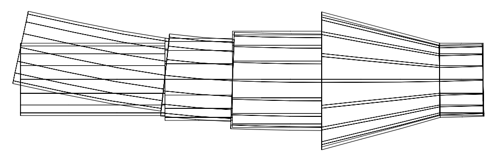
First mode



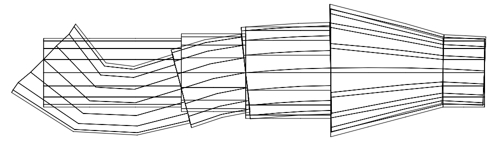
Second mode

Figure 9. Two modes of oscilations (mass 0 kg)

Appropriate deformations are presented on Figure 9 (without the influence of the coupling mass) and Figure 10 (coupling mass is 500 kg).



First mode



Second mode

Figure 10. Two modes of oscilations (mass 500 kg)

As it is shown, coupling is very important for dynamic behavior of these shaft.

2.3 Modeling and calculation of the middle-shaft

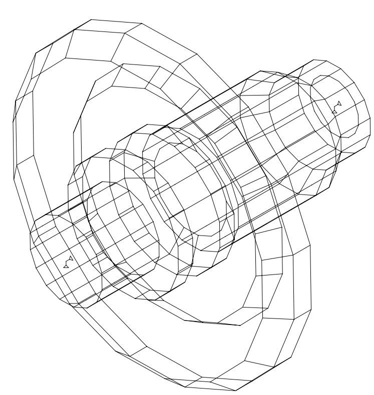
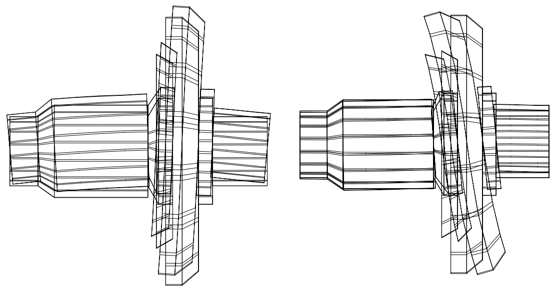


Figure 11. Model of the middle-shaft (contour)

Obtained results are presented on Figure 12 (oscilations) and in Table 3 (main frequences).



First mode Second mode

Figure 12. Two modes of oscillations

Table 3. Main frequences of middle-shaft

	First	Second
Frequency	89 Hz	139 Hz

2.4 Modeling and calculation of the output-shaft

Model for calculation is shown on Figure 13 and obtained results on Figure 14 and Table 4.

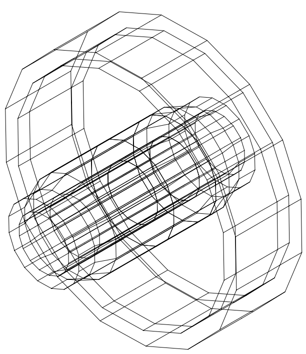
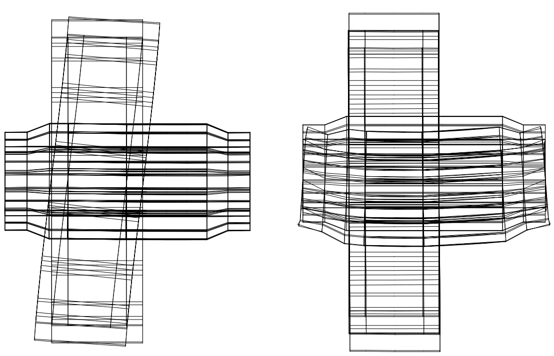


Figure 13. Model of the out-shaft (contour)



First mode Second mode

Figure 14. Two modes of oscilations

Table 4. Main frequences of the output-shaft

	First	Second
Frequency	61.2 Hz	110.8 Hz

3. CONCLUSION

Presented calculation is shown that the main frequencies of all shafts are high enough. But the influence of the other parts of the construction, as well as the coupleing, is very important. Dynamic behavior of the cover has to be better.

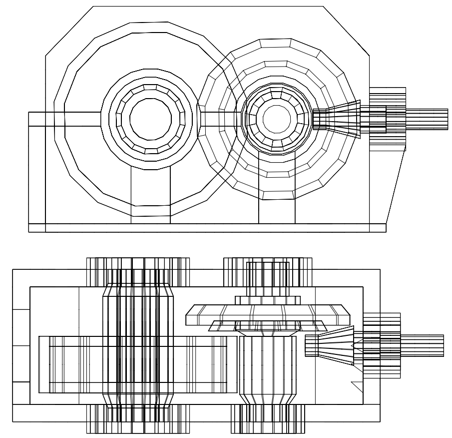


Figure 15. Model of the gear-box

In next calculation, the construction of gear-box presentid on Figure 15 has to be coupled with electromotor [5] (Figure 16) and performance shaft, and placed on the momentum bar with the appropriate support.

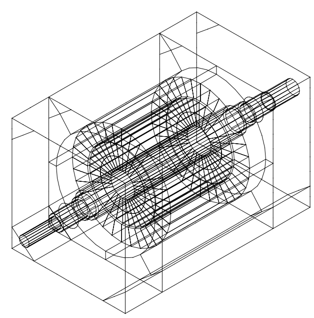


Figure 16. Model of electromotor

REFERENCES

[1] Maneski T., Program package KOMIPS, Bgd. (1998)

[2] Maneski T., Milošević-Mitić V., Ostrić D., "*Postavke čvrstoće konstrukcija*", Monog., Bgd. (2002)

[3] Maneski T., "Rešeni problemi čvrstoće konstrukcija", Belgrade (2002)

[4] T. Maneski, "*Komputation Modeling and Calculation of Structures*", Monog., Belgrade (1997)

[5] Andjelic N., Maneski T., Milošević Mitić V., "The Influence of the Coupling on the Dynamic Behavior of Electromotor", VII MAREN, Belgrade (2006)