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CONTRIBUTIONS TO THE IMPROVEMENT OF COOLING BEDS MECHANISM OF PROFILED ROLLING MILS

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ABSTRACT

The cooling beds of rolling mils have a very important role in obtains of a finite product of high quality; thing so which is pointed out better at small profiles rolling mils. These cooling beds assure a conducted cooling of laminates profiles at the same time wish straightening them during the crossing of the cooling-bed reliability, a diminution of exploitation costs.

The cooling beds of small profiles rolling mils of SC ISPAT-SIDERURGICA SA Hunedoara is most complex, being formed, beside the classics receive-exhaust reeling-path by a few mechanism like: separation mechanism, the mechanism of taking-over and transversal removal, grouping-removing mechanism.

It's being studied the braking mechanism at the entrance on the cooling-beds. The kinematics and cinetostatic study of this mechanism conducts to dates and conclusions, which can be used forward at the study of component parts of the mechanism using an analysing program with established finite element.

Based of results obtained from the kinematics and cinetostatic analyses of the mechanism and the results of feign-modelling is suggested a new solution for the construction of component nod of this mechanism. It must be underlined the fact that, because of the very big length of cooling bed and reduplication of component parts, this thing has a favourable influence concerning the working and the exploitation of the braking mechanism, wish positive influence in global working of the cooling bed rolling mills.

The study can be extended for all the component mechanism of this cooling bed.

KEY WORKS:
cooling beds, small profiles rolling mils, braking mechanism, kinematics and cinetostatic analyses.

1. INTRODUCTION

The cooling bed from small profiles rolling mils of is one of the most complicate constructive-functional cooling beds, first of all owing to a lot of mechanisms which compose that bed and to functions correlations necessity to each phase mechanism of technological process.

Owing this cooling bed, small profiles rolled longs and cooling bed is long. So, the mechanisms of bed components are made by a base multiply, on a 120m length.

The studied sub ensemble, presented in figure 1, take part from the 1 wire brake mechanism. The entire bushes are made of bronze, CuSn6Zn4Pb4, but with different geometrical size.

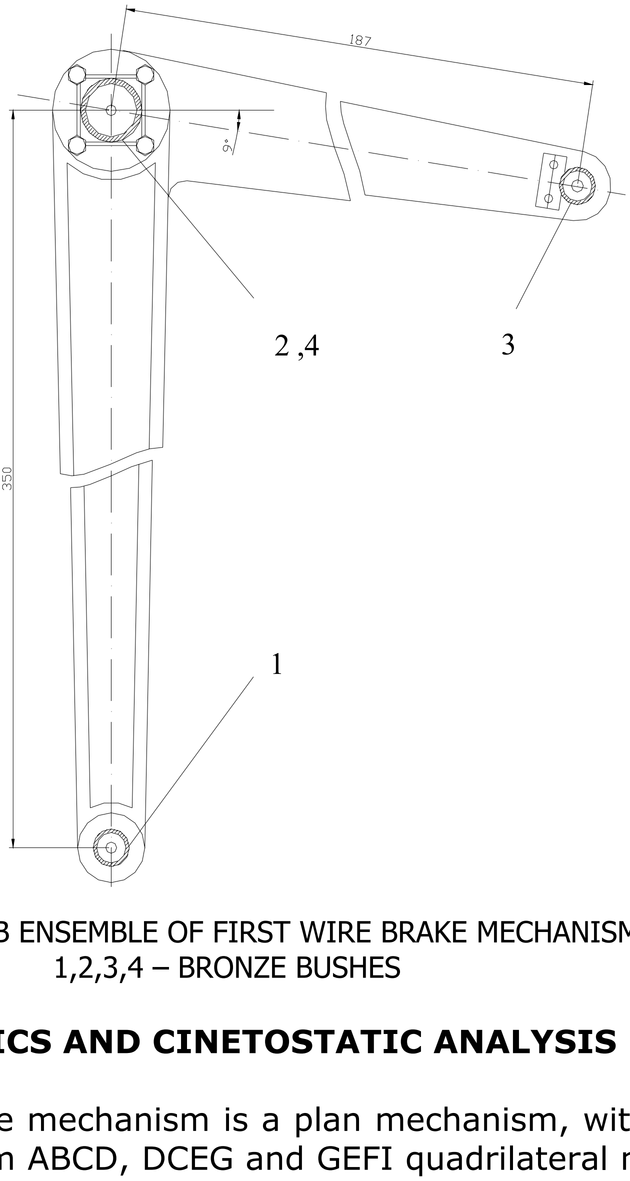

FIGURE 1. SUB ENSEMBLE OF FIRST WIRE BRAKE MECHANISM
1,2,3,4 – BRONZE BUSHES

2. THE KINEMATICS AND CINETOSTATIC ANALYSIS

The first wire brake mechanism is a plan mechanism, with one motor element. It's made from ABCD, DCEG and GEFI quadrilateral mechanisms. By EG and FI lever are rigidity GH and IJK levers (angles are EGH and FIK 81°). It is represented in repose position. For kinematics analysis, is necessary a structural decomposition of first wire brake mechanism which is presented in figure 2.

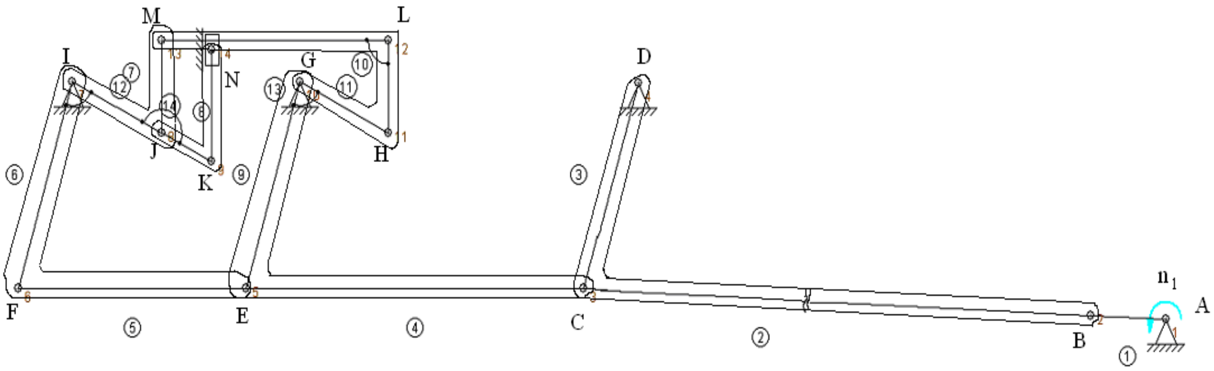

FIGURE 2. STRUCTURAL DECOMPOSITION MECHANISM

The cinematic scheme of brake mechanism is presented in figure 3. Also, the angle between extreme positions is 47° and couple trajectory adequate by one complete rotation of crank is presented in figure 3.

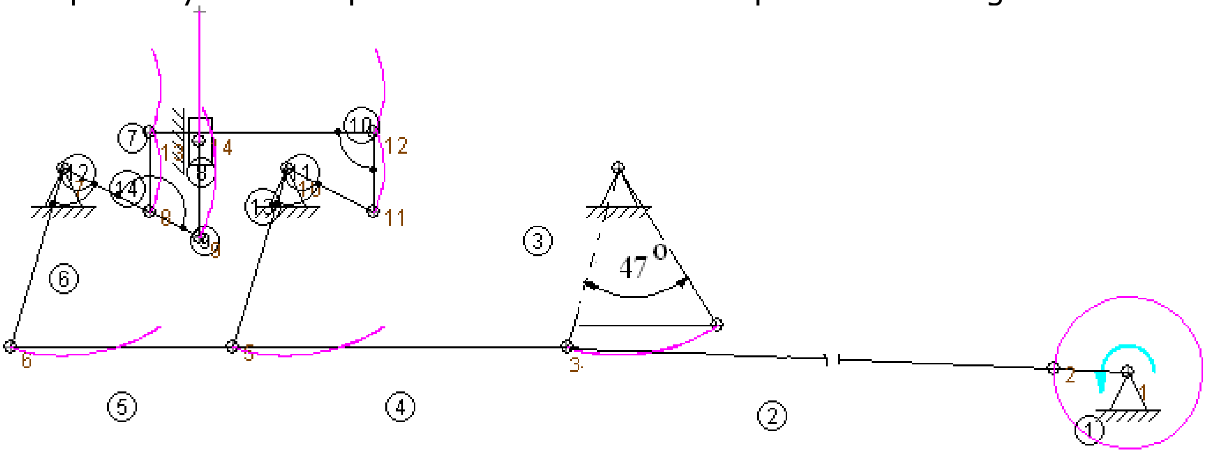

FIGURE 3. CINEMATIC SCHEME AND COUPLE TRAJECTORY ADEQUATE BY ONE COMPLETE ROTATION OF CRANK

For the studied case we consider that the motor element has a rule movement law with constant speed and zero acceleration, the angular speed is ω_1=6,28 rad/s. After cinematic analysis, for cinematic studied couple we'll obtain the next graph (diagram) for removes, speeds and accelerations in function of time, and is presented in 4,5 and 6 figure.

For the cinetostatic analysis the previous made mechanism is attached at the constitutive elements load in the middle of element load, reported at the first couple of element. Will establish the numerical values for the motor moment and the useful and resisting force, like in the figure 7. The study is made in condition of gravity accelerations.

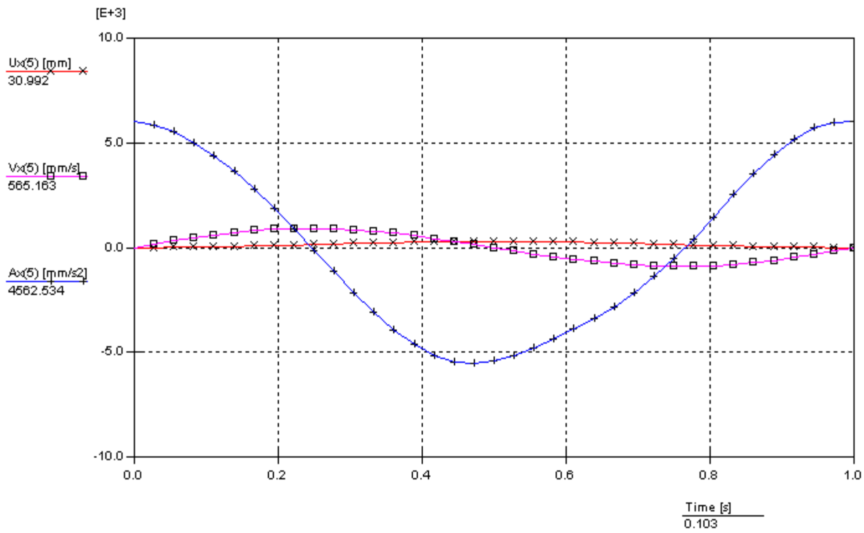

FIGURE 4. THE TIME DEPENDENT VARIATION OF SPACE, SPEED AND ACCELERATION FOR NODE 5, ON THE AXE OX

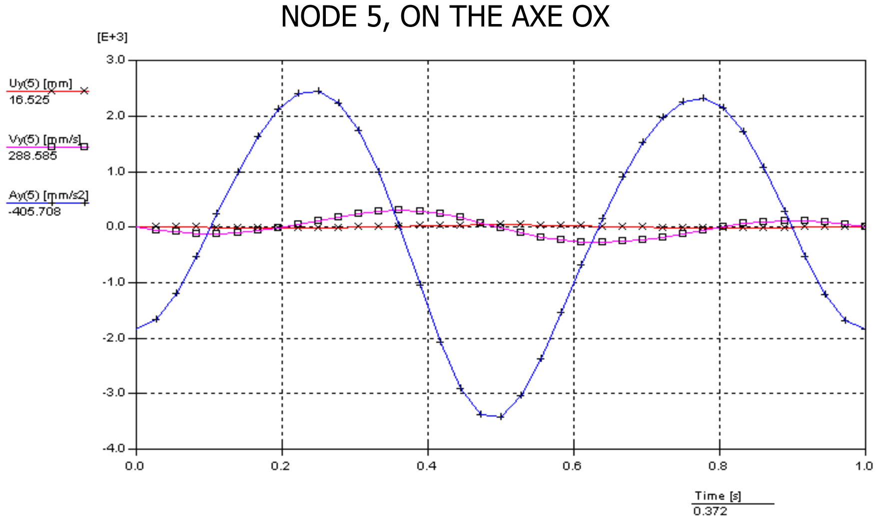

FIGURE 5. THE TIME DEPENDENT VARIATION OF SPACE, SPEED AND ACCELERATION FOR NODE 5, ON THE AXE OY

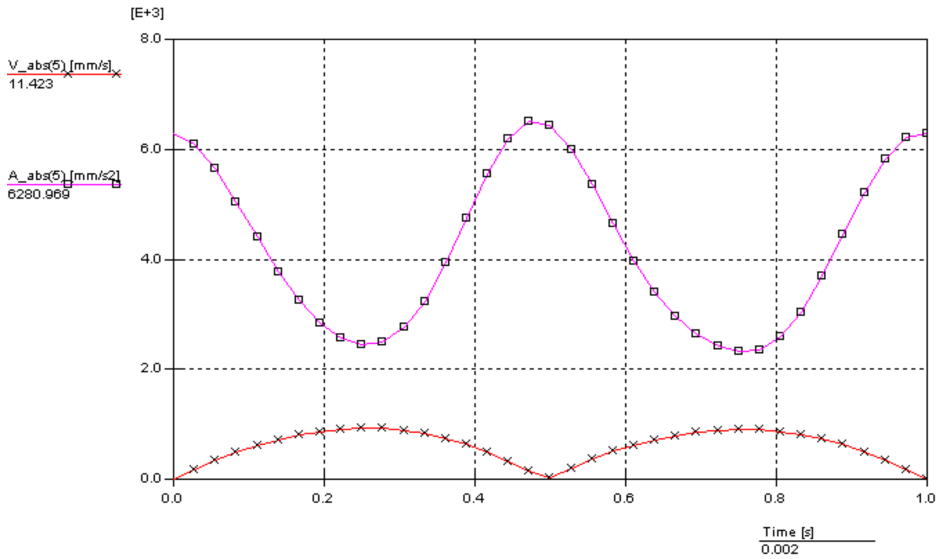

FIGURE 6. THE TIME DEPENDENT VARIATION OF SPACE, SPEED AND ACCELERATION FOR NODE 5, ABSOLUTE VALUE

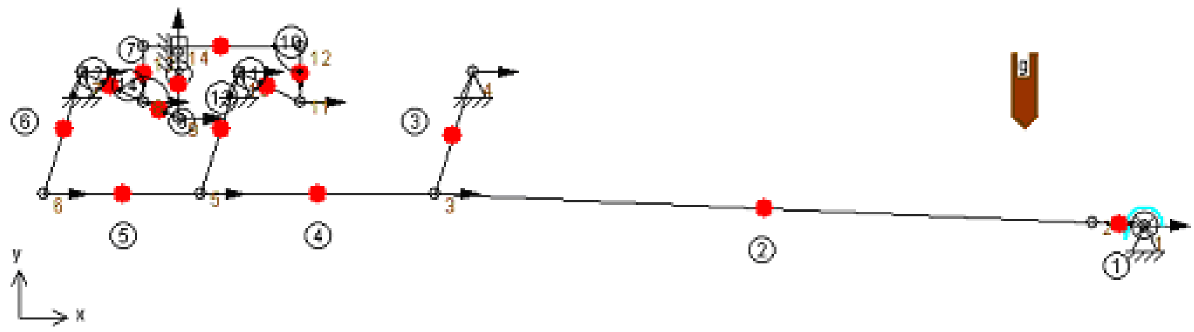

FIGURE 7. CINETOSTATIC ANALYSIS FOR FIRST BRAKE MECHANISM

After the cinetostatic analysis, in node 5 the force presents the next variation for one cinematic cycle, the variation presented in figure 8. We must say the nodes force was approximated by successive evaluations.

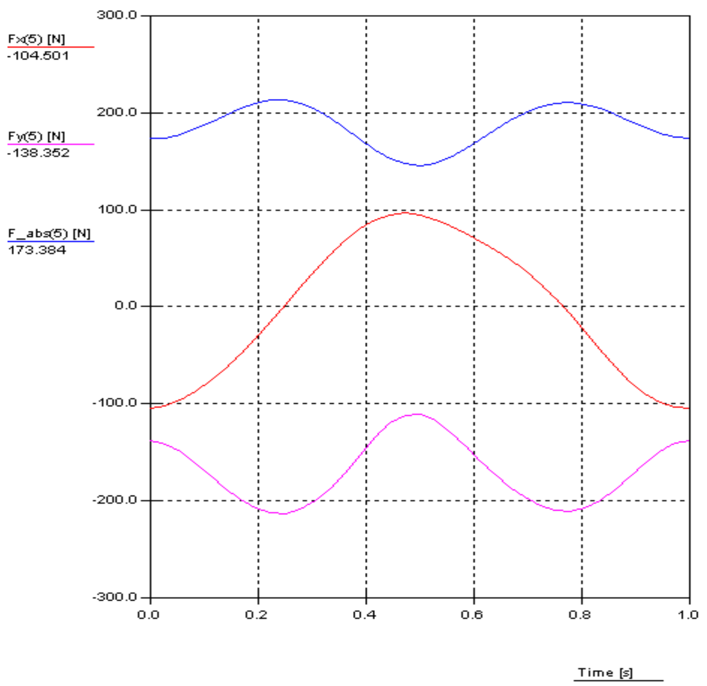

FIGURE 8. FORCE VARIATION IN NODE 5

With the maxim absolute force will be analyze, using analysis software with a finite element the jack behave from studied articulation.

3. THE ANALYSIS WITH FINITE ELEMENT

The comportment of static involve requirement can be evidence if the material is used in respective condition of work. The study will be making for the studied material on a lot of achieve cases of loading.

These cases of loading are on the half of bushes interior surface and the loading of all bush interior surface, respective the loading on a line with a distribute force which actuate on all bush interior surface, uniform, and the outside surface is considered fix. The maximum force is used on calculus; coming of age with a safe factor is 280 N.

The maximum specific pressure for an half of bush interior surface is:

$$p_{m_j} = \frac{F_{max}}{S_i/2} = \frac{280 \cdot 10^{-6}}{3{,}14 \cdot \frac{28{,}2}{2} \cdot 59 \cdot 10^{-6}} = 0{,}1076\,MPa,$$

The maximum specific pressure for all bush surfaces is:

$$p_{m_i} = \frac{F_{max}}{S_i} = \frac{280 \cdot 10^{-6}}{3{,}14 \cdot 28{,}2 \cdot 59 \cdot 10^{-6}} = 0{,}0538\,MPa,$$

where: F_{max} – maximum force from couple
S_i – is the jack interior surface

By simulation is prove the involve checking at static loading of a polymeric composite, which can replace the bronze in the bush construction from the fifth bush of brake mechanism. Mechanical characteristics are presented in table 1.

TABLE 1. MECHANICAL CHARACTERISTICS OF POLYMERIC COMPOSITE

POLYMERIC COMPOSITE		
CHARACTERISTIC	VALUE	MEASURE UNIT
DENSITY	1,20E-06	kg/mm^3
ELASTICITY MODULUS	2,40E+03	MPa
POISSON CONSTANT	0,15	-
LINEAR EXPANSION CONSTANT	1,10E-04	$1/^oC$
SPECIFIC HEAT	711	$J/kg\cdot^oC$
THERMAL CONDUCTIVITY	0,00031	$W/mm\cdot^oC$

The polymeric composite is a polymers composite assortment on polyamide 6 base, thermo stabile and graphite additives. It has superior mechanics properties, self-lubrificating properties and low friction coefficient.

The model of bush finite element is presented next. Sow in figure 9 is presented the mesh division of model, and in table 5 are presented the characteristics of finite element model.

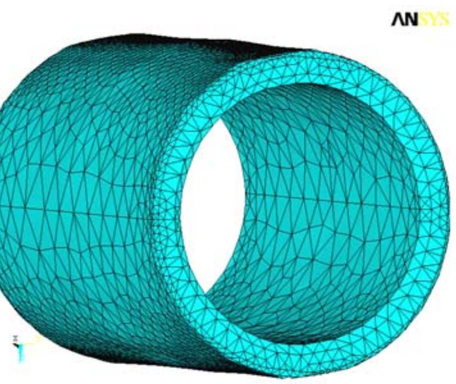

FIGURE 9. MESH DIVISION OF MODEL

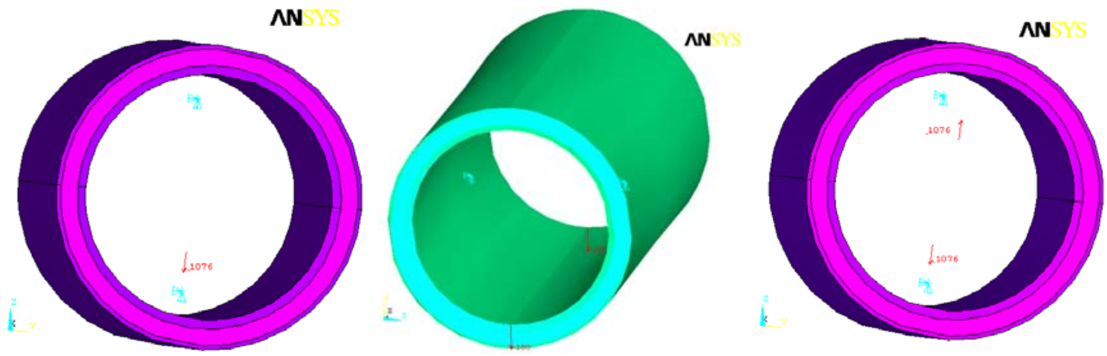

FIGURE 10. LOADING CASE

The presence of thermo-stabile and graphite additives makes possible utilization under high temperature, which in real conditions utilization mustn't cross after 80-100°C. Also is resisting in corrosive medium.

In figures 11,12 and 13 is presented comparative the equivalent stress from bush for the first, second and third loading cases, and in figures 14,15 and 16 is presented comparative the displaced shape from bush for the first, second and third loading cases.

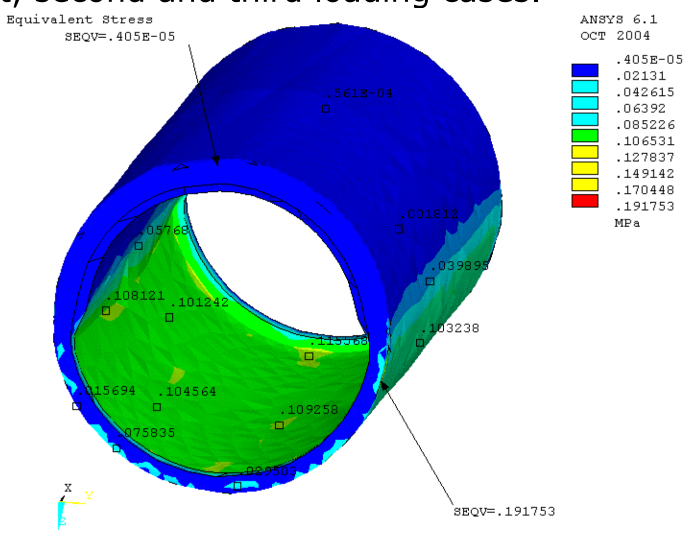

FIGURE 11. EQUIVALENT STRESS FOR FIRST LOADING CASE

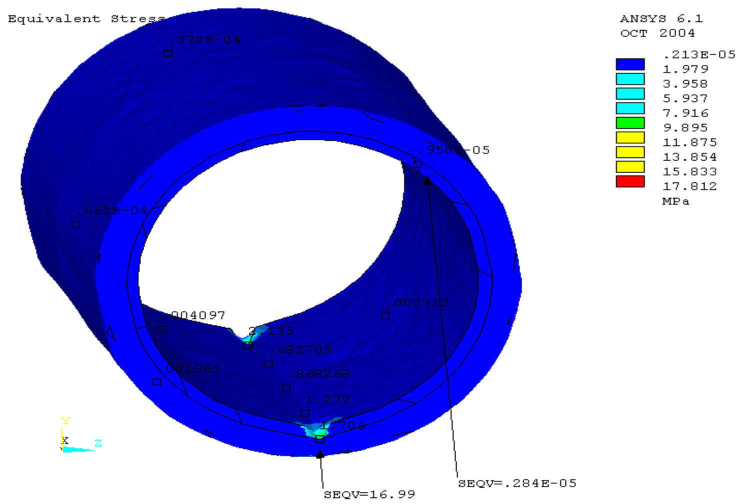

FIGURE 12. EQUIVALENT STRESS FOR SECOND LOADING CASE

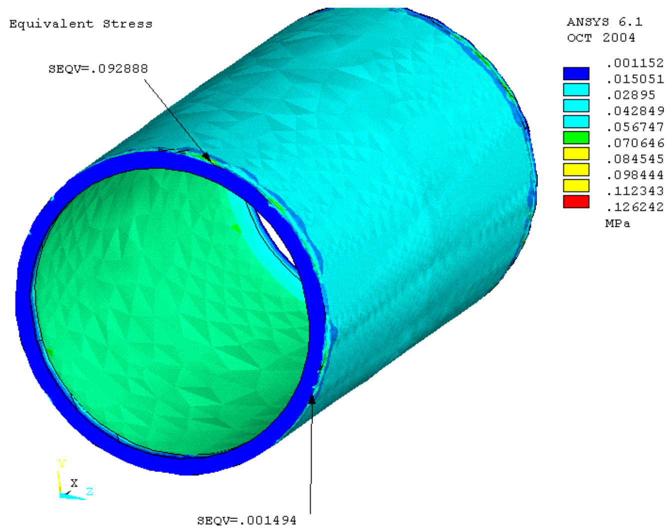

FIGURE 13. EQUIVALENT STRESS FOR THIRD LOADING CASE

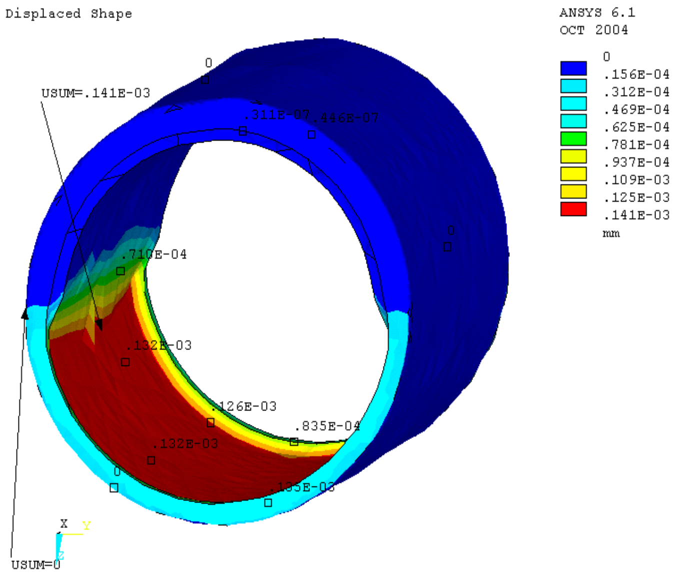

FIGURE 14 DISPLACED SHAPE FOR FIRST LOADING CASE

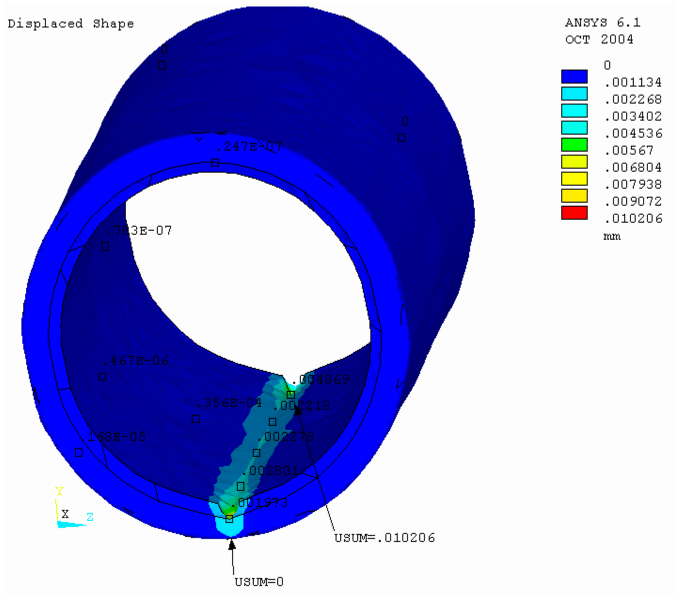

FIGURE 15. DISPLACED SHAPE FOR SECOND LOADING CASE

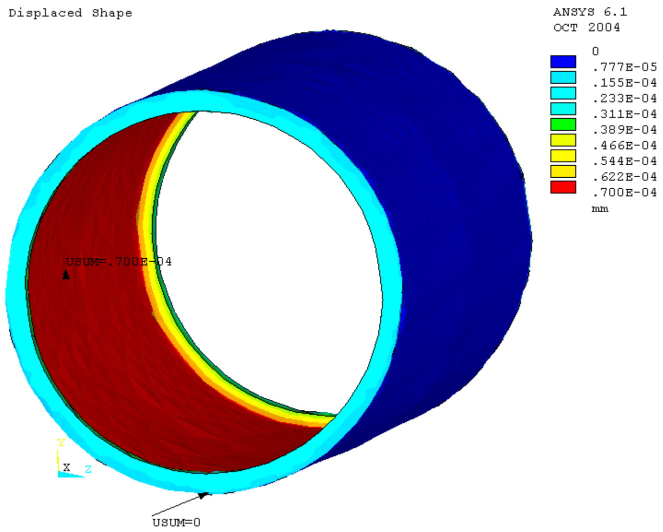

FIGURE 16. DISPLACED SHAPE FOR THIRD LOADING CASE

4. CONCLUSIONS

The studied bush is considered representative for the all bush component of these mechanisms. If the bed cooling mechanisms are made from a big number of nodes, I consider that the material replace from bush with cheap one, will subtract the maintenance cost of cooling bed equipment. In all loading variants, the maximum values of tension from material are under the accepted values, a flow limit is min. 70Mpa.

In table 2 and table 3 is presented a synthesis a direct stress value and displaced shape value for all studied cases (loading are applied as entire interior surface, one half interior surface and line).

TABLE 2. DIRECT STRESS VALUE

DIRECT STRESS [MPa]				
CASE	VALUE	X	Y	Z
½ surface	Min.	-0.10808	-0.24756	-0.19706
	Max.	2.40773E-02	2.36031E-02	2.68427E-02
line	Min.	-4.9058	-18.427	-8.6566
	Max.	0.80752	2.9322	3.7819
surface	Min.	-4.48733E-02	-0.11130	-9.07908E-02
	Max.	5.95998E-03	1.45268E-02	1.29378E-02

TABLE 3. DISPLACED SHAPE VALUE

DISPLACED SHAPE [mm]					
CASE	VALUE	X	Y	Z	VECTORIAL SUM
1/2 surface	Max.	-7.45089E-07	-2.51384E-06	2.57532E-06	2.62512E-06
line	Max.	7.13866E-04	-1.02004E-02	1.40984E-03	1.02056E-02
surface	Max.	-1.07561E-05	-6.75514E-05	-7.03294E-05	7.03504E-05

Finally we can affirm that in the end of this study the conclusion from static requirement and the low using temperature, the polymeric composite is used in the bearing construction.

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