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THE STUDIES OF THERMOELASTIC CONTACT FOR DETERMINATION THE FIELDS OF TEMPERATURES AND THERMAL TENSIONS IN BEARINGS INNERS (STATIONAR REGIM)

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Abstract: *Classical elastic contact stress theory concerns bodies whose temperature is uniform. Variation in temperature within the bodies may, of itself, give rise to thermal stresses but may also change the contact conditions through thermal distortion of their surface profile.*
The skill of machines tools is based in very large measure on the reliability of the bearings. The numerical methods permit to solve the thermal tensions problems. In the study is presented the temperature distributions in a conducting half-space, the result of the utilized of the finite element method for study the temperatures and the thermal tensions in inners bearings. The system is compound by inner acting by concentrated. Source of temperature is applied on the inner.
Keywords: *bearings, thermal, tensions, inner, temperature*

1.INTRODUCTION

Classical elastic contact stress theory concerns bodies whose temperature is uniform. Variation in temperature within the bodies may, of itself, give rise, to thermal stress but may also change the contact conditions through thermal distortion of their surface profile.

2.INSTATANEOUS LINE SOURCE

The treatment of two-dimensional problems is facilitated by the use of a line source in which units of heat pear unit length are instantaneously liberated on the surface of a half-space along y-axis. The temperature distribution is cylindrical about the y-axis.and at a distance R is given by relation (1).

$$\theta - \theta_0 = \left(\frac{H}{2\pi kt}\right) exp(-R^2/4kt) \quad (1)$$

3. TEMPERATURE AND THERMAL STRESS

The thermal field characterize the thermal distribution in all the points of the considerate zone of material, in a moment.
For determination the temperature in the bearings inners we used the Fourier differential equations, who described the transmission of heat in a homogeneous and izotropic bodies. The diffusion equation of heat in a homogeneous and izotropic bodies the Fourier differential equation

$$\frac{d\theta}{dt} = \frac{\lambda}{c\rho} = \nabla^2\theta + \frac{1}{c\rho}Q_s \quad (2)$$

where :
∇^2 - Laplace operator
c –thermal conductivity of material
ρ – density of material

λ – transmissibility coefficient
θ - temperature
Q_s – heat source
By change the difference equation with finite difference we obtain

$$[K_c^T]_{i+1} = \{Q_s\} = [K_{ci}^T]\{\theta_i\} + \{q\}_i \qquad (3)$$

where:
$\{Q\}_{i+1}$ - temperature at the i+1 moment
$\{Q\}$ - heat source
$[K_c]$ - conductivity matrix
$\{q\}$ - locale source heat
The recurrent process presented by equation (2) (finite difference it take by finite element , in the assembly process, of all structure, testing by a global system in a moment and resolve at the instantaneous equilibrium, make by equation

$$[K_c]\{\theta\} = \{Q_s\} \qquad (4)$$

The two-dimensional equation is

$$\frac{\partial}{\partial x}\left(K_{Tx}\frac{\partial T}{\partial x}\right) + \frac{\partial}{\partial y}\left(K_{Ty}\frac{\partial T}{\partial y}\right) + h(T - T_\infty) = 0 \qquad (5)$$

where :
T_∞ - the temperature in the environment
K_{Tx}, K_{Ty} – thermal conductivity
and $K_{Tx}, K_{Ty} = \frac{\lambda}{c\rho}$

By integration we obtain :

$$Q\int_{x_1}^{x}\int_{y_1}^{y}\left[\frac{\partial}{\partial x}\left(K_{Tx}\frac{\partial T}{\partial x}\right) + \frac{\partial}{\partial y}\left(K_{Ty}\frac{\partial T}{\partial y}\right)\right]^{-1} dxdy = T_1 - T \qquad (6)$$

and with the substitution

(7)

we obtain

$$Q_i = -K_{T_i}(T_{i+1} - T_i \qquad (8)$$

and with matrix notation obtain :

$$[K_T]\{T\} = \{Q\} \qquad (9)$$

we can calculated the nodal temperatures and then the thermal stresses and the thermal deformations
We obtain in static two-dimensional terms (by finite element) of the structure the results (fig.1) and (fig.2).

Initial conditions:

$T_{ext} = 49°C$ $D_g = 70$ mm
$T_{int} = 300°C$ $d_g = 52$ mm
$h = 4$ mm

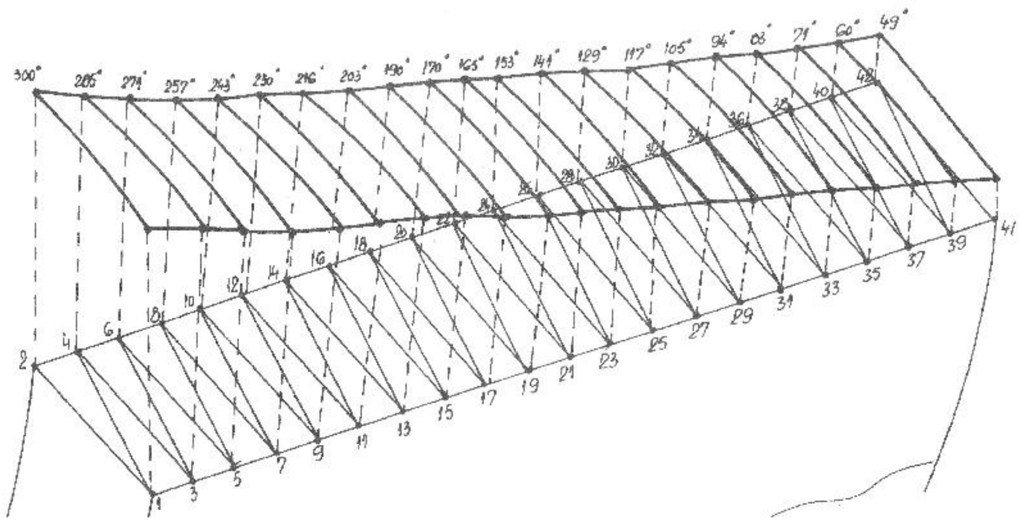

Figure1: The temperatures in exterior inner F.A.G. GS 811

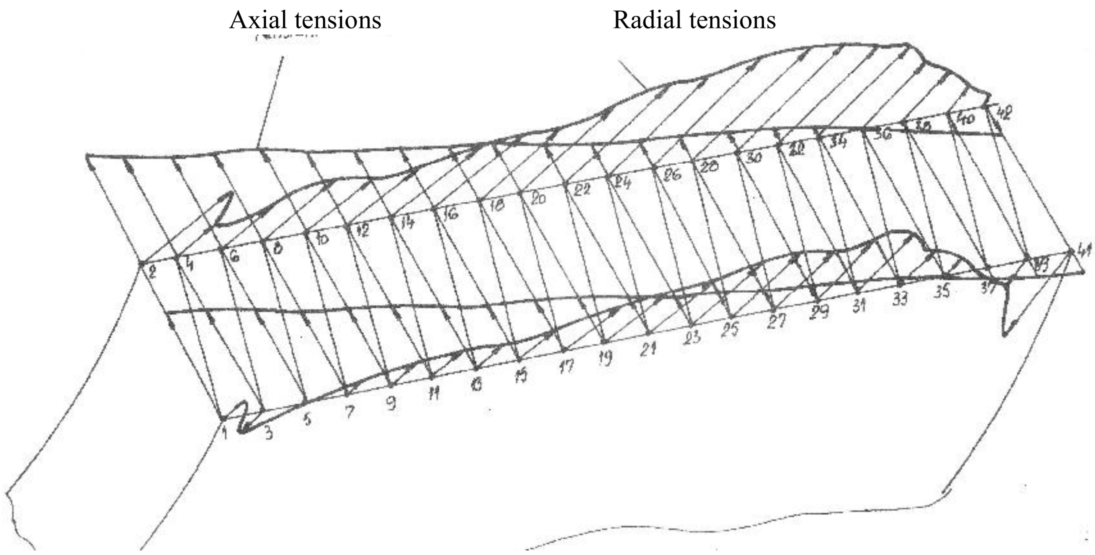

Figure 2: Thermic stress (radial – axial) in exterior inner F.A.G.GS 811

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