STRESS-DEFORMED STATE AND GEOMETRICAL PARAMETERS WITH THE ELECTROMECHANICAL STRENGTHENING

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Abstract

Conducted analysis of choice of optimum geometry of discrete electromechanics treatment after the criterion of minimization of remaining tensions in a superficial layer by a computer design. Analysis of the stress - deformed state of the surface layer by coating the surface of a discrete - hardened zones electromechanical treatment of various geometrical parameters showed that the criterion of minimizing the residual stress is the most optimal cross-hardened profile, which occupies 54% of the entire bearing surface.

Key words: electromechanics treatment, discrete surface, stress - deformed state, wearproof elements

The tasks of researches. Electromechanics treatment forms on-the-spot a structure with the set distributing of properties of durability on the local volumes of surface. The fixed surface shows by itself a regular discrete structure which consists of elements of white layer.

Researches show on the study of mechanisms of formation of elements of white layer [1-2-3], that changing the structural and technological parameters of electromechanics treatment (EMT) it is on-the-spot possible to form discrete structures with the necessary location of the fixed fragments and set area of the fixed surface.

The phenomenes determines the features of mechanical conduct, which flow in superficial, layer and property of the superficially fixed standard. The analysis of researches shows [1-2-3] that it is necessary for effective work of fixed EMT of surface, that the mutual location of the fixed fragments and area of coverage of surface took into account the features of external of details environments.

Optimum from point of operating descriptions EMT of surface will be fixed with the formed specific structures and fragments of white layer.

The analysis of works shows in this direction [1-2-3-4], that the most conducted researches, electromechanics treatment, are directed on the study of mechanisms and phenomena which are in a superficial layer at EMT and properties of the fixed surface.

The aim of these researches is an analysis of influence of type of mutual location of elements of white layer and area of coverage of surface on the feature of behavior of the hardened body in the conditions of friction.

For an analysis the conducted design of behavior of heterogeneous material, the surface of that is reinforced by the elements of white layer with higher descriptions of durability as compared to material of matrix in the conditions of friction.

For a design the model of finish elements was used for an squared beam by sizes a 15 × 15 × 6 mm, each of parties of that is presented as 30 elements, that made 27 000 elements.

Base model. The condition of friction of material designed by addition to the fortified surface of the normal and tangent (Fig. 1) loading, by a size according to 1 and 0,1 MPa. Surface, opposed to the hardened surface, envisaged hardly. A calculation model is presented on Fig. 2.

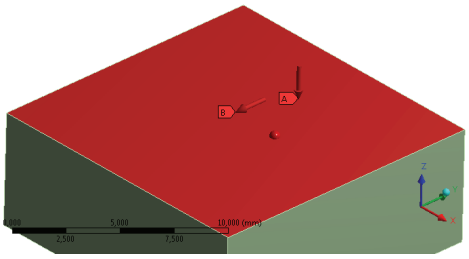

Fig. 1. Calculation model of body in the conditions of friction

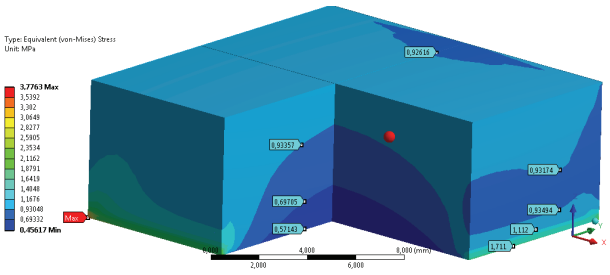

Fig. 2. Equivalent (for Mises) tensions unhardened body

For realization of comparative estimations the calculation analysis of the stress-deformed state of unhardened body is conducted at first. As a result of deformations the stress-deformed state presented on Fig. 2-4.

In connection with that the surface of body yields to influence of the tangent loading inplane XY, interest presents character of distribution of tangent tensions in this plane (Fig. 3) and equiscalar surfaces (Fig. 4).

The analysis of the stress-deformed state of homogeneous body under act of the normal and tangent loading on one of planes shows that distribution of tangent tensions inplane XY has symmetric character in relation to the plane of action of the tangent loading (fig. 4).

Thus squeezing and stretchings tensions have symmetric character and arrive at the absolute values of 0,02 MPa (Fig. 3). Thus maximal equivalent (in Mises) tensions arrive at the values of 3,8 MPa.

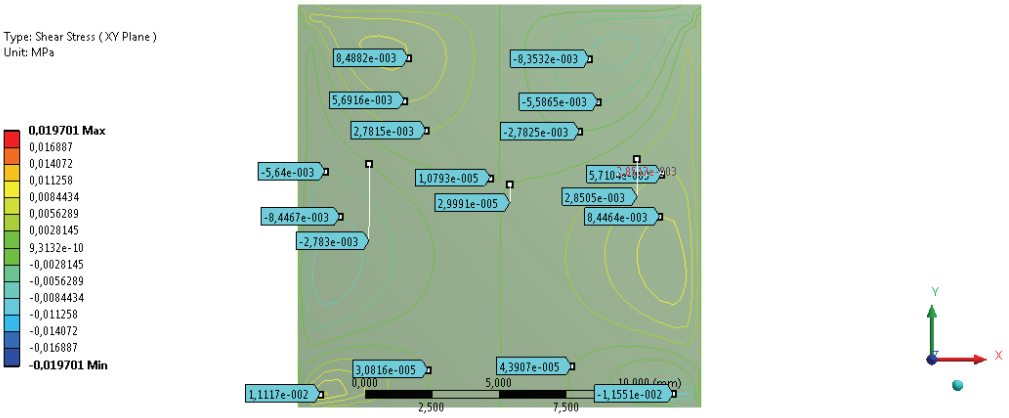

Fig.3. Isolines of distribution of tangent tensions inplane XY of unhardened body

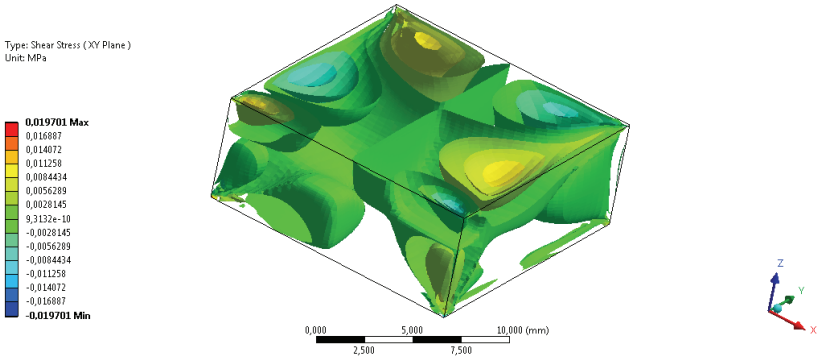

Fig.4. Equiscalar surfaces of distribution of tangent tensions inplane XY of unhardened body

Standards, after electromechanics treatment, from the point of view of mechanics of the deformed body, present by bodies with the heterogeneous surface reinforced by locally hardened zones (LHZ). Formation in the superficial layer of regular discrete structure causes the change of the stress-deformed state (TDS) bodies in the process of loading.

The thus stress-deformed state of body will depend, both from character of the added loading and from the geometrical parameters of mutual location by the locally fortified zones. In any event LHZ are the concentrators of tensions.

Design TDS EMT of the modified surfaces. The analysis of different geometrical charts of electromechanics treatment of surface shows in the conditions of the normal and tangent loading, that the mutual location of LHZ can change the stress-deformed state, both aside detensioning, and aside increase.

At electromechanics treatment of surface on a chart on a fig. 5 elements are located discretely with the set step and are the concentrators of tensions. Such location of zones of treatment is brought to that equivalent tensions of superficial layer arrive at the values of 740 MPa (Fig. 6) and 400 MPa in a subsuperficial layer.

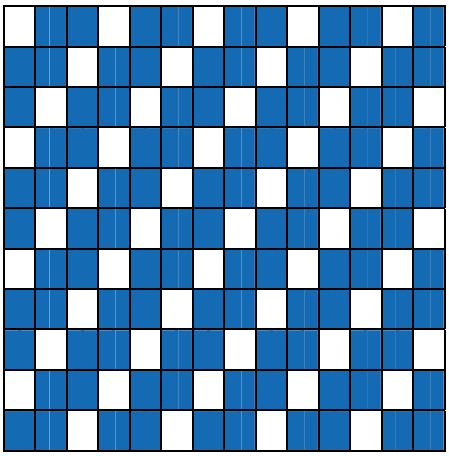

Fig.5. Location of the surface wearproof elements

If we consider that this maximum tangential stress is about 370 MPa, the relative position of a wearproof surface LHZ bring to the appearance and development of microcracks and destruction surface layer.

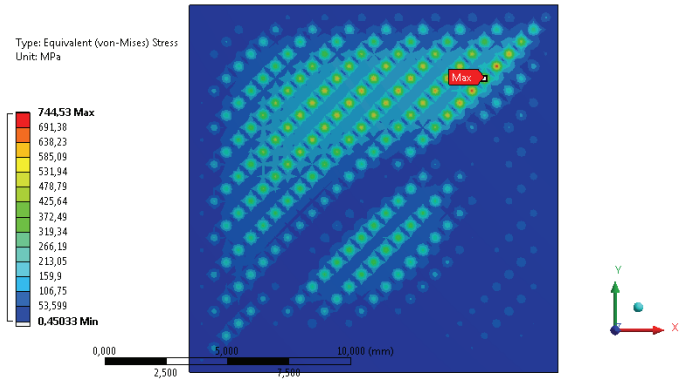

Fig. 6. Distribution of equivalent stresses (in Mises) on the body surface

Calculation analysis shows that the scheme relative position LHZ (Fig. 5) also leads to the appearance a significant difference between the tensile (220 MPa) and squeezing (370 MPa) stresses on the surface, which contributes to fatigue fracture layers.

Thus, when choosing of structural geometric parameters electromechanical process is worth proceed from the condition of minimizing the stress-deformed state of the surface layer based operating conditions details.

Analysis of various geometric and technological options for finishing the surface shows that the optimal scheme of conditions to minimize the stress state of the surface, which operates under the friction will diagram shown in Fig. 7. That is the best alternative location LHZ as cross sections processing.

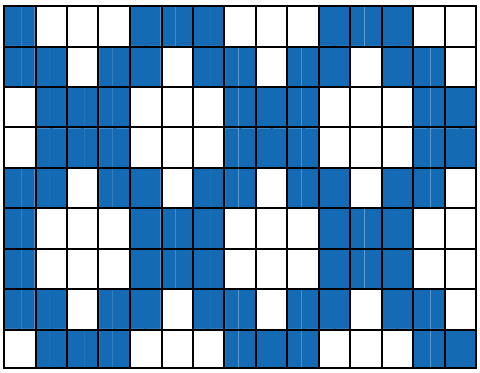

Fig.7. Scheme of location the surface wearproof elements

Analysis of the results shows that the optimal relative position LHZ area and surface coating be achieved minimum influence of the stress concentration by LHZ in the surface layer.

Comparative analysis of equivalent stresses (in Mises) homogeneous body and hardened by EMT optimal scheme shows that maximum tension have the same value 3,77 MPa. The maximum tangential tension hardened body and unstable is 2 MPa.

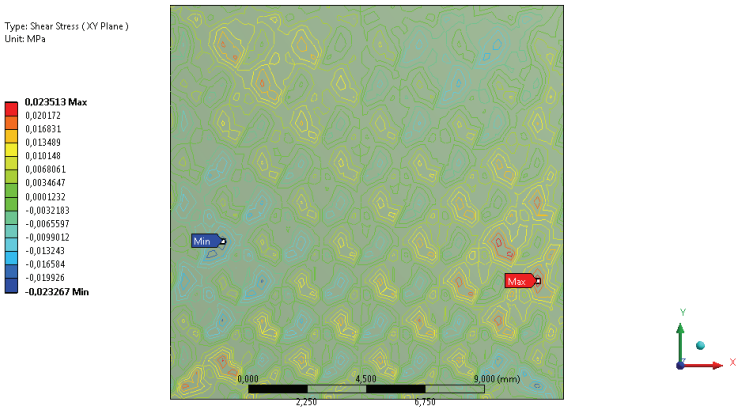

Fig. 8. Isolines distribution of shear stresses in the XY plane optimally hardened body

Analysis of the distribution tangential stresses (Fig. 8 - 9), shows that on the surface there are tensile and compressive tangent equal in absolute value. The maximum value of 0,02 MPa, which is almost equal to the maximum value of stresses unstable body 0,019 MPa.

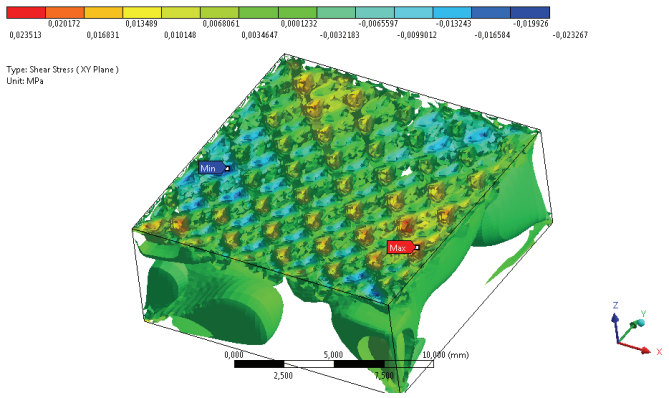

Fig. 9. Equiscalar surfaces distribution of tangential stresses in the XY plane optimally hardened body

Thus, by proper choice of scheme processing, the relative position of wearproof elements of white layer be achieved minimum of the stress concentration in the surface layer in the operation thus significantly increase the wear resistance of the surface.

Minimization of stress state of the surface by varying the location LZZ us to obtain the surface stress-deformed state (Fig. 8- 9) that promotes increase the fatigue strength of the surface layer.

It should be noted that the analysis of various geometric and technological options for finishing the surface showed that the chosen scheme (Fig. 7) optimal strengthening the surface area was 0,54. Increase or decrease the area coverage has led to an increase in all components of the stress-deformed state.

Analysis of the results showed that dominant factor in minimizing the stress-deformed state of the surface is the relative position of wear resistant LHZ.

Conclusion

Analysis of the stress - deformed state of the surface layer by coating the surface of a discrete - hardened zones electromechanical treatment of various geometrical parameters showed that the criterion of minimizing the residual stress is the most optimal cross-hardened profile, which occupies 54% of the entire bearing surface.

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