UDC 534.1:539.3

YU. S. VOROBIEV, N. YU. OVCHAROVA

HIGH-SPEED STRAINING SANDWICH ELEMENTS UNDER CONTACT IMPACTS

The work purpose is to analyze high-speed straining the sandwich elements at the elastoplastic stage under contact impacts. The element consisting of two thin layers from the titanium alloy and the inner ceramic layer is examined. The impactor is modeled as an elastoplastic body. The local impact results in variable straining by the time and spatial coordinates in a limited region Thus, each layer of the element is examined in the 3D statement. The simulation uses a dynamic version of the straining theory of plasticity, which takes into account the dependences of the stress intensities on the strain intensities and their rates. In so doing the dynamic properties of different materials for each layer are considered. The problem is a geometrically and physically nonlinear. The special features of the dynamic stress-strain state of all layers of the element are revealed using the finite element method. The results are used to improve the dynamic strength of the protective elements.

Keywords: high-speed straining, elastic-plastic deformations, contact impacts, three-dimensional models, sandwich elements, numerical analysis.

1. *Mossakovsky V. I.* Contacts of Elements for Shell Structures *(in Russian) / V. I. Mossakovsky, V. S. Hudramovich, Ye. M. Makeev.* – Kiev : Naukova Dumka, 1988. – 288 p.

2. *Galin L. A.* Contact Problems of Elasticity and Viscous Elasticity *(in Russian) / L. A. Galin.* – Moscow : Nauka, 1980. – 304 p.

3. *Stepanov G. V.* Elastoplastic Deformations of Materials under Pulse Loading *(in Russian) / G. V. Stepanov.* – Kiev : Naukova Dumka, 1979. – 266 p.

4. *Kukudzhanov V. N.* Numerical simulation of dynamic processes of straining and failure *(in Russian) / V. N. Kukudzhanov //* Uspekhi Mekhaniki. – 1985. – Vol. 8, No 4. – P. 2 – 55.

5. *Goldsmith V.* Impact– Moscow: Gossstroyizdat, 1965. – 447 p.

6. *Vorobiev Yu. S.* High-Speed Straining Structural Elements *(in Russian) / Yu. S. Vorobyev, A. V. Kolodyazhnyi, V. I. Sevryukov, Ye. G. Yanyutin.* – Kiev : Naukova Dumka, 1989. – 148 p.

7. *Meyers. M. A.* Dynamic Behavior of Materials */ M. A. Meyers.* – Wiley, New York, 1994.

8. *Vorobiev Yu. S.* Dynamics of structural elements under impacts *(in Russian) / Yu. S. Vorobyev, N. Yu. Ovcharova //* Vibratsii v Tekhnike i Tekhnologiakh. – 2014. – No 2(74). – P. 5 – 11.

9. *Vorobyev Yu. S.* Effects of dynamic properties on high-speed straining structural elements *(in Russian) / Yu. S. Vorobiev, N. Yu. Ovcharova //* Visnyk Zaporizkogo Natsionalnogo Universitety. Matematicheskoe Modelyuvannya i Prykladna Mekhanika. – 2015. – No 1. – P. 12 – 22.

10. *Vorobiov Iu. S.* FEM Analysis of Cylindrical Structural Elements under Local Shock Loading */ Iu. S. Vorobiov, L. Kruszka , N. Y. Ovcharova //* Applied Mechanics and Materials Trans. Tech. Publications, Switzerland. – 2014. – Vol. 566. – . 499 – 504.

11. Impact Wave Phenomena in Condensed Media *(in Russian) / G. I. Kanel, S. V. Razorenov, A. V. Utkin, V. Ye. Fortov.* – Moscow : Yanus K. – 1996. – 488 p.