

Accounting for the layered elastic strata in the Planar 3D model

*N. S. Markov*¹

¹*Peter the Great St. Petersburg Polytechnic University, Saint Petersburg, Russia*

Accounting for the layered structure of the rock is of special significance for modeling hydraulic fractures. In most cases, only the heterogeneity of stresses is used. However, there are cases in which this may not be enough to obtain an accurate solution. The work aims to develop an effective method to account both heterogeneities of elastic moduli and stresses and imply it into the Planar3D model.

The efficiency of the solution is provided by considering layers as a chain-like system [1, 2]. It is possible due to the fact that each layer has boundaries that are common with only its two neighbours. This serves to find Green function applying Fourier transform and sweep method for three very similar problems for layers without hydraulic fracture. Finally, the problem reduces to the singular integral equation formulated only on the boundary of the fracture.

The proposed method was successfully developed and tested. The results of using Planar3D model with the developed method demonstrate the potential of the coupled model. The time of calculation of the coupled model is not significantly higher, but the results are different in some cases compared with the original Planar3D model. It is shown that the opening of the final fracture may be different for the coupled and original model. It may cause a bigger difference when accounting proppant flow in the fracture. Comparison with results obtained by using the full three-dimensional model demonstrates a good agreement, but the developed method takes much less time.

This work was supported by Ministry of Science and Higher Education of the Russian Federation within the framework of the Federal Program "Research and development in priority areas for the development of the scientific and technological complex of Russia for 2014 – 2020" (activity 1.2), grant No. 14.575.21.0146 of September 26, 2017, unique identifier: RFMEFI57517X0146. The industrial partner of the grant is LLC "Gazprom-neft Science & Technology Centre".

References

- [1] A.M. Linkov, A.A. Linkova, A.A. Savitski *An Effective Method for Multi-Layered Media with Cracks and Cavities*. International Journal of Damage Mechanics, 3 (1994).
- [2] A.M. Linkov, N.A. Filippov *Difference Equations Approach to the Analysis of Layered Systems*. 1991.