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## STRIKER SHAPE OPTIMIZATION AS THE PROBLEM OF GAME THEORY

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### ABSTRACT

The questions of the shape optimization of an axisymmetric rigid striker and structure optimization of layered perforated plates are studied on the base of the Nash game approach (Stadler, 1984), (Banichuk, Ivanova, 2016 (a)) for layered plates made on the given set of materials. As a criterion of the multipurpose optimization problem it is chosen the ballistic limit velocity under additional constraints on the striker mass and the layered shield mass. The process of penetration of the rigid body into an elastic-plastic medium is modelled by the application of the two parts representation for the resistance force (Banichuk, Ivanova, 2016 (b)). It is proposed and realized the solution algorithm of the conflict game problem: the optimal shape striker against the optimal structure layered shield. It is considered the case when the striker mass is given and does not depend on its volume and also the case with the constraint on the striker mass (volume). With the application of an evolution numerical method (genetic algorithm) the optimal shapes of penetrating bodies and corresponding optimal shield structures are found and analyzed for all cases.

**Keywords:** optimization, game approach, high-speed penetration.

### INTRODUCTION

The study of processes of high-speed penetration of rigid strikers into deformed media and perforation of shield structures is actual and of theoretical and practical interest. Scientific investigations in this region are very wide and include many experimental, analytical and numerical components. Also the optimal structural design plays the important role in this aspect. Many studies were devoted to the problem of optimal shape determination of rigid bodies penetrating with high speed into deformed (elastic-plastic, concrete, brittle) media. Also problems of shield structure optimization were investigated by many authors.

Now we propose the game approach to solve the problem of high-speed perforation of the layered slab by the axisymmetric striker (optimal shape striker against optimal shield structure).

### RESULTS AND CONCLUSIONS

The questions of shape optimization of rigid strikers perforating the layered slab are studied in game statement. As a criterion of multipurpose optimization problem it was taken the ballistic limit velocity, which is a very important characteristic of striker-medium interaction. It was proposed and realized the iteration solution algorithm for the conflict game problem (optimal

shape striker against optimal layered structure) under additional constraints on the striker mass and slab mass and also for some geometrical limitations. For all considered cases the optimal shapes of penetrating bodies (rigid strikers) and optimal layered structures were found using the evolution numerical method (genetic algorithm).

All optimal strikers have the shape with blunted (a little) nose part. The analysis of numerical results for all considered cases permits to make a conclusion (in the frame of using model of high-speed interaction) that the optimal shape of striker is determined by its geometrical and inertial characteristics and do not depend on the mass of the slab, its thickness and layers ordering. In the Fig. 1 it is shown that the optimal shapes practically are the same for cases 1,2 and 3,4, although they corresponds to different optimal layered structures. Thus, it is sufficient to determine the optimal shape of the striker (minimizing the ballistic limit velocity) for some given layered structure and then use this solution for the shield optimization according to maximum of the ballistic limit velocity.

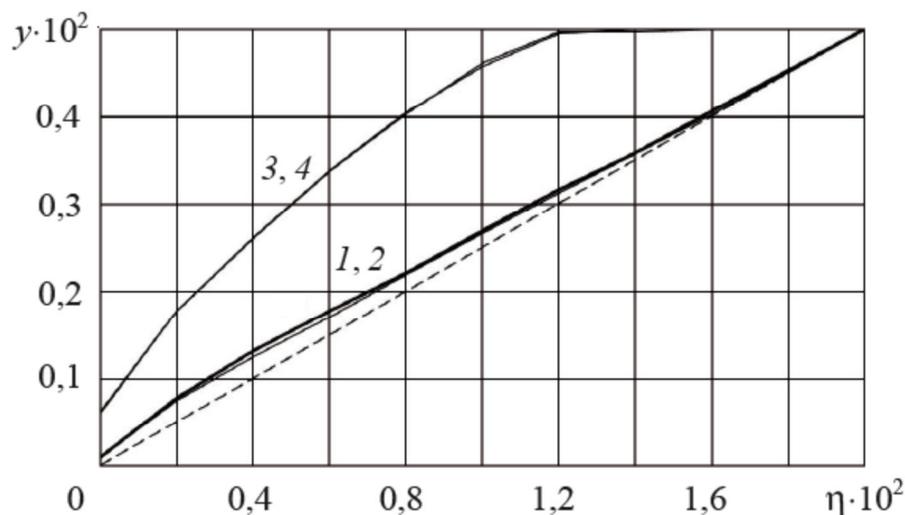


Fig. 1 - Optimal striker shapes  $y(\eta)$  [m].

## ACKNOWLEDGMENTS

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