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Comparative Analysis of Topology of Manhole Covers

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Abstract— This work proposes to investigate the weight-based topological comparison of the stress, strain energy density (SED), and displacement states of three different types of manhole covers. This research utilizes 3D computational modeling to compare the effect of the topology of the bottom face of manholes using the COMSOL-Multiphysics computer complex based on the finite element method (FEM). The general methodology of this work is based on the first failure theory - maximum principal stress theory (MPST) and Haigh's theories as a more applicable theory for evaluating the cast iron materials used in the manufacturing of the studied manhole tops, and evaluation of the deflection. Presented work took into consideration the fact that the bottom face of the manhole tops is complex and played dominated role in their stress and energy states. The qualitative and quantitative investigation of stress, SED, and deflection are presented and identified the more reliable type of the tops from point of view of consumption of material and optimum topology of the bottom surface of manhole top.

The most difference between specimens in material consumption is 142%, while the difference of maximum and minimum values of principal stresses and SED reach 392%, 769%, and 3807% respectively, and maximum deflection up to 659%. Results of the investigation confirm that the weight of manhole covers cannot be considered as the main affecting factors the bearing capacity and stiffness, in this regard, the optimal distribution of the material (topology) plays an important role.

Keywords—Manhole Cover, 3D, SED, COMSOL