Novel continuous limit analysis modeling with rigid or deformable polygon discretization

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Abstract. Continuous-modeling limit analysis is one of the promising tools for analyzing the failure of soil-like material. Standard formulation come up from the idea of finite element analysis. Usually, in this approach, the freedom of the degrees is assigned at the nodes. However, such a theory will limit the shape of the elements, which is only applicable to solving triangular mesh. In this paper, we propose a novel approach based on the idea of continuous modeling limit analysis. Here, all the variables are assigned at the centroid of the element, through which the approach can be easily extended to consider arbitrary polygon discretization. First, we derive the governing formulations for limit analysis with arbitrary polygon rigid elements. Then, assuming constant strain distribution, the formulation is expanded to apply deformable elements. Implementing the proposed theory, the classical strip footing problem is solved as a benchmark study. The collapses predicted by triangular, random voronoi, and centroid voronoi mesh are compared. The results given by deformable and rigid elements are also discussed. Finally, a series of parametric studies on the material property is also carried out.

Keywords: limit analysis, polygon mesh, Voronoi, continuous modelling.