

Nonlin. Processes Geophys. Discuss., referee comment RC2
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Comment on npg-2020-45

Anonymous Referee #2

Referee comment on "Analytical Solution for the Influence of Irregular Shape Loads Near the Borehole Strain Observation" by Wei Yan and Zirui Li, Nonlin. Processes Geophys. Discuss., <https://doi.org/10.5194/npg-2020-45-RC2>, 2021

The authors are addressing a long standing problem that relies on inclusion of Bousinesq's 1885 solution for a vertical point load on a halfspace. If I understood the mathematics correctly, they hoped to simply superpose adjacent and scaled point forces over irregular areas in order to determine the strains and stresses induced in the half-space below by simply adding the contribution of each point force (to attempt to simulate a load on the surface). Regrettfully, I do not think that this manuscript warrants publication at the current time for a number of reasons. First, the authors seem to not know about the very extensive literature on this problem that has existed for decades. While I had dabbled with use of this equation for purposes of material property determination I was not up to date, but even a cursory Google search brought up two recent papers (BOUSSINESQ DISPLACEMENT POTENTIAL FUNCTIONS METHOD FOR FINDING VERTICAL STRESSES AND DISPLACEMENT FIELDS DUE TO DISTRIBUTED LOAD ON ELASTIC HALF SPACE, January 2017, Electronic Journal of Geotechnical Engineering 22(15):5687-5709; and DOI:10.1061/(ASCE)SC.1943-5576.0000567) that addressed these issues. These refer back to texts such as (Kachanov M.L, Shafiro B. and Tsukrov I. Handbook of Elasticity Solutions. Springer Science and Business Media Kluwer Academic Publishers Dordrecht The Netherlands, 2003.) that go into detail in some of the complexities required to solve such problems. As such, I am concerned that what appears to be a simplified superposition may be insufficient to appropriately solve this problem. I am further concerned that simply applying a force proportional at a given point that is proportional to the topography (or equivalently the amount of mass) over the point of the loading mass may not appropriately account for the distribution of the load. I do not have the time to check on this, but I would urge the authors to at least check their solution against these earlier results.

Finally, it seems to me that often strains are measured in deeper boreholes, but the effects shown are at very shallow depths. I expect one needs to consider a St. Venant approach in which there would be a near and far field approach to analysis of the problem. This would need to be described. It would be good to perhaps show how you would intend to actually apply these results to show how they might influence a deeper strain observation so that the reader would understand better the utility. It seems to me

that it needs to be emphasised that this only really would be important when the load on the surface is changed.

One other area the authors should investigate is whether there are already more realistic poroelastic solutions that might be relevant to your problem. Certainly this has been solved for tidal corrections and even atmospheric loading, so I would argue that more work is required to better understand this problem