Solid Earth Discussions

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Comment on se-2021-36

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Referee comment on "Numerical solutions of the flexure equation" by David Hindle and Olivier Besson, Solid Earth Discuss., https://doi.org/10.5194/se-2021-36-RC3, 2021

I have read the assessments posted by Stefan Schmalholz and Lorenzo Colli and agree that the points they raise need to be addressed. There is no point me repeating them in detail.

However, the points '2) Mechanical Validity' made by Stefan Schmalholz are exactly my main concern. The authors assume the thin elastic plate flexure equation correctly characterizes flexure of thin uniform plates but do not discuss whether the underlying theory in deriving the equation remains valid when extending the use of the equation to plates with lateral variations in flexural rigidity (D). As pointed out by Stefan there are several simplifying assumptions made in deriving the equation for uniform thickness plates.

The authors of this paper need to add an assessment of when these conditions and assumptions remain valid when D varies laterally. It appears both the whole-station and half-station methods give reasonably accurate answers when D varies 'slowly' along the plate in relation to the plate thickness (h). If so, is there any advantage to the half-station method in such cases?

More interesting is the question of whether the derivation of the thin plate equation is valid when D varies 'rapidly', for example in the form of a step function (which is also relevant to the end loaded truncated plate problem). The half-station method may be able to solve the equation accurately but is the equation itself correct? It seems that these questions need to be answered near the beginning of the paper to reassure readers.

The authors also discuss the McQeen and Beaumont 1989 paper on Tilted Block Basins and comment that the crustal/lithospheric blocks are rigid and just tilt with no flexure. I have already contacted David Hindle and given him a copy of a related 1986 MSc study by Paul Lloyd which addresses essentially the same tilted block basin problem with elastic flexure and in several different configurations.   This thesis should be referenced and could be used for comparisons with models solved with the half-station method if the lateral forcing can be converted to equivalent vertical forces or torques.

Overall, the Hindle and Besson paper is interesting from an academic point of view and will be strengthened if the 'mechanical validity' question is answered in some detail. When reviewing the model used by Paul Lloyd it occurred to me that for awkward geometries why would anyone try to use a thin-plate model? If problems like the tilted bock basin one could be solved using a 2D or 3D elastic finite element approach 35 years ago, doing the same thing today must be relatively easy?

My recommendation is that the paper be published after modifications that adequately address the points raised by the reviewers.