On the necessity of the inf-sup condition for a mixed finite element formulation

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We study a non standard mixed formulation of the Poisson problem, sometimes known as dual mixed formulation. For reasons related to the equilibration of the flux, we use finite elements that are conforming in H(div) for the approximation of the gradients, even if the formulation would allow for discontinuous finite elements. The scheme is not uniformly inf-sup stable, but we can show existence and uniqueness of the solution, as well as optimal error estimates for the gradient variable when suitable regularity assumptions are made. Several additional remarks complete the paper, shedding some light on the sources of instability for mixed formulations.

References:

[1] https://arxiv.org/abs/2206.06968

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