DESIGN OF STABILIZATION METHODS FOR PLATE ELEMENTS ON THE BASIS OF MODAL DECOMPOSITION

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The present study deals with the design of stabilized finite element methods for Reissner/Mindlin-type plate problems. The motivation is to obtain stable elements and improve coarse mesh accuracy at the same time. The underlying formulation is based on plate finite elements with algebraic subgrid scale stabilization, as presented in [1]. It relies on certain relationships of stabilized methods to concepts that have been developed earlier in finite element technology, in particular the 'residual bending flexibility' or 'deflection matching' technique.

The framework presented in [1] allows the design of stabilization techniques on the basis of mechanical insight into the behavior of plate elements in dependence of material parameters and geometric properties. This allows an adjustment of the stabilization parameters that guarantee stability of the formulation and improve coarse mesh accuracy at the same time**.**

A particular choice of certain arbitrary, 'free parameters', still present in this formulation, can be accomplished with the help of typical benchmark tests. Of course such a procedure is somehow unsatisfactory and the question for more sound procedures or analytical methods arises.

Therefore, we discuss in the present study procedures for the computation of the free parameters on the basis of modal decomposition of the element stiffness matrix. After ensuring correct representation of rigid body modes and satisfaction of bending and twisting patch tests this leaves us with a number of deformation modes (three in the case of linear triangles and six in the case of four-node quadrilaterals) which can be 'scaled' with the help of the free stabilization parameters.

In the special case of Timoshenko beams this procedure directly leads to the exact stiffness matrix. For plates, however, an exact stiffness matrix does not exist in a strict sense, because of the singularities associated with concentrated nodal forces. The specification of the 'exact' (or at least 'best approximation of') deformation energy for a certain deformation mode is therefore a non-trivial question and the key ingredient of a sensible strategy for the determination of optimal stabilization parameters.

We discuss possible answers to this question and present numerical experiments to demonstrate the properties of the stabilized plate finite elements derived on the basis of these considerations.

References

[1] M. Bischoff and K.-U. Bletzinger, "Improving Stability and Accuracy of Plate Finite Elements via Algebraic Subgrid Scale Stabilization", submitted to *Computer Methods in Applied Mechanics and Engineering*.