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An Efficient Meshless Approach for Modeling of Thin Plates Deformation Response

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A new Meshless Local Petrov-Galerkin (MLPG) method based on the mixed formulation proposed in [1] is applied to analysis of thin plates. In contrast to the available MLPG formulations for modeling of shell-like structures such as [2, 3], here both the strains and displacements are approximated independently. Discretization is performed by nodes located on the upper and lower surfaces. The strain and displacement fields are approximated by using the Moving Least Square (MLS) approach in the in-plane directions and by means of polynomial functions in the transversal direction. On applying local symmetric weak form of equilibrium equations over local sub-domains, the discretized governing equations are derived in terms of the nodal strain and displacement components. The nodal unknown strains are then replaced by the nodal displacement values employing the standard strain-displacement relations. These kinematics equations are enforced by means of the collocation method. Consequently, a closed system of equations is obtained on the global level with only nodal displacements as unknown variables. A novel procedure for elimination of thickness locking effect is also derived. This formulation is more efficient then the fully displacement approach. The shear locking is completely alleviated in a thin plate limit by employing the MLS basis of low order. In this way, a relatively small support domain is required, which significantly decreases computational costs. Accuracy and numerical efficiency of the proposed approach are demonstrated by numerical examples.

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