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Topology optimizations of soft elastic plates for seismic response control of building structures

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Abstract

This study aims to develop a device which does never yield subject to large deformation under severe earthquakes. It is expected that seismic performances of building structures are improved by an elastic restoring force of the devices if the devices are used as bracing members. This paper presents a topology optimization approach to generate such device numerically from a plate. A formulation is set up, in which a yielding deformation is maximized for a plane stress finite element meshed plate under a tensile load. Inverse Fourier transform and a real-coded genetic algorithm (GA) are used as a topology optimization technique. The technique can not only suppress checkerboard patterns but can also control the complexity of topology by representing the topological pattern with the inverse Fourier function and restraining the minimum wave length of the inverse Fourier function. It is observed from numerical results that the proposed technique realizes very large elastic deformation.