

عنوان مقاله:

Nonlocal Effect on Buckling of Triangular Nano-composite Plates

محل انتشار:

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خلاصه مقاله:

In the present study, small scale effect on critical buckling loads of triangular nano-composite plates under uniform in-plane compression is studied. Since at nano-scale the structure of the plate is discrete and the long-range cohesive forces become important, the size dependent nonlocal elasticity theory is employed to develop an equivalent continuum plate model for this nanostructure incorporating the change in its mechanical behavior. Two parameter Winkler-Pasternak elastic medium is used to precisely model the elastic behavior of the matrix surrounding the nano-plate. The governing stability equations are then derived using the classical plate theory and the principle of virtual work for a perfect uniform triangular nano-plate composite system. The well-known numerical Galerkin method is then used as the basis for the solution in conjunction with the areal coordinates system. The solution procedure views the entire nano-composite plate as a single super element which can be of general shape. Effects of nonlocal parameter, length, aspect ratio, mode number, anisotropy, edge supports and elastic medium on buckling loads are investigated. All of these parameters are seen to have significant effect on the stability characteristics of nano-composite plate. It is shown that the results depend obviously on the non-locality of buckled nano-composite plate, especially at very small dimensions, small aspect ratios, higher mode numbers, higher anisotropy and stiffer edge supports. Also it is seen that the medium parameters, especially the Winkler parameter, have significant influence on the small scale effect and can decrease or increase it. Also, it is seen that the classical continuum mechanics overestimates the results which can lead to deficient design and analysis of these widely used nanostructures. The results from current study can be used in design, analysis and optimization of different nano-devices such as nano-electro-mechanical systems (NEMS) utilizing nano-composite plates as load-bearing components. Although it is seen that nano-fillers, here the nano-plates, increase the stiffness of the whole nano-composite, by increasing the bending rigidities, on the other hand it is shown in this study that the small scale effect or the nonlocal effect decreases the critical loads of the nano-composite system. Thus, the nonlocal effect plays a key role in the design of these nanostructures and must be attended and comprehensively studied to avoid the failure of the nanostructure. Further, the solution employed here is general and can be applied to nano-composite plates with ... arbit

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