Asymmetric meshing technique (AMT) is a perturbation method to introduce disturbances (i.e., imperfections) in a finite-element model without changing geometry, boundary conditions, or loading conditions. For cylindrical shells under axial compression, asymmetric meshing in the form of a square patch of three different surface areas and a band in axial and/or circumferential directions with different areas is discussed in the first half of the article. The element size in the patch or band is lowered to a varying degree as compared to the rest of the shell in order to produce the asymmetry. The reduction in the buckling load was observed from 15% to 20%, which depends mainly on the total area of asymmetric meshing, and less on the amplitude of asymmetry, i.e., reduction in element size. While loading the shell, an isolated dimple formed near the bifurcation point that increased in size to reach a stable state in the postbuckling region corresponding to the postbuckling plateau load. The load-displacement behavior using asymmetric meshing is similar to the experimental results and the numerical results obtained by introducing initial geometric imperfections. Asymmetric meshing in the form of varying element size in both axial direction and circumferential direction of the shell is discussed in the second half of the article. Asymmetric meshing showed reduction in the buckling load up to 7% with small amplitude of asymmetry that further increases with increase in amplitude of asymmetry in meshing. Asymmetric meshing has relatively less influence on predicted buckling load but significant effect on load displacement behavior in the postbuckling range; overall buckling behavior depends on the directionality of asymmetric meshing employed in the model.