Modal density and modal distribution of bending wave vibration fields in ribbed plates

Plates reinforced by ribs or joists are common elements in lightweight building structures, as well as in other engineering structures such as vehicles, ships, and aircraft. These structures, however, are often not well suited for simple structural acoustic prediction models such as statistical energy analysis. One reason is that the modal density is not uniformly distributed due to the spatial periodicity introduced by the ribs. This phenomenon is investigated in the present paper, using a modal model of a ribbed plate. The modal model uses the Fourier sine modes, and the coupling between the plate and ribs is incorporated using Hamilton's principle. This model is then used to investigate the modal density of the considered spatially periodic structure, and a grouping of the modes in different dominating directions is proposed. Suggestions are also given regarding how to proceed towards a simplified prediction model for ribbed plates.