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Non-linear elastic in-plane buckling of crown-pinned arches with end rotational restraints

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Crown-pinned arches are commonly used in engineering practice. This paper investigates the elastic in-plane buckling of crown-pinned shallow arches with end rotational restraints. The stiffness of the end restraints varies with different boundary conditions. When the stiffness vanishes, the support becomes pin-ended. When the stiffness approaches infinite, the support is then fully fixed. The finite element model is established and is used to analyze the non-linear in-plane buckling behaviour of circular shallow arches under different loading cases including uniformly distributed radial load and central concentrated load and different boundary conditions. Comparison with the analytical solutions exhibits good agreement. It is shown that the stiffness of the end restraints have significant effects on the buckling behaviour of arches and that the crown-pinned arches can buckle in a limit point instability mode, but cannot buckle in a bifurcation mode.

Keywords: Crown-pinned arch, Finite element, In-plane buckling, Limit point, Rotational restraint