

Analytical Solution for Multi-Segmented Toroidal Shells under Uniform Pressure

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Abstract : The requirements for various toroidal shell forms are increasing due to new applications, available storage space and the consideration of appearance. Because of the complexity of some of these structural forms, the finite element method is nowadays mainly used for their analysis, even for simple static studies. This paper presents an easy-to-use analytical algorithm for pressurized multi-segmented toroidal shells of revolution. The membrane solution, which acts as a particular solution of the bending-theory equations, is developed based on membrane theory of shells, and a general approach is formulated for quantifying discontinuity effects at the shell junctions using the well-known Geckeler's approximation. On superimposing these effects, and applying the ensuing solution to the problem of the pressurized toroid with four segments, closed-form stress results are obtained for the entire toroid. A numerical example is carried out using the developed method. The analytical results obtained show excellent agreement with those from the finite element method, indicating that the proposed method can be also used for complementing and verifying FEM results, and providing insights on other related problems.

Keywords : bending theory of shells, membrane hypothesis, pressurized toroid, segmented toroidal vessel, shell analysis

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