

ANALYSIS OF SHALLOW ELASTIC SHELLS USING A METHOD OF MOMENTS

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Abstract

The object of this investigation was to obtain approximate analytical solutions of the shallow shell equations and solutions are taken of polynomials which satisfy the boundary conditions but retain several undetermined coefficients. Elementary polynomials satisfying these conditions have frequently appeared in papers dealing with approximate solutions but here the formulation is put on a systematic basis and a family of possible polynomials is obtained. These polynomials are combined to form an approximate solution of the shell equations by imposing the condition that the first moments of the shell equations be satisfied.

In developing this technique, solutions to several second and fourth order problems have been obtained and are presented here. The method of moments is then applied to doubly-curved shells of constant curvature and rectangular platform and with combinations of simply supported and fixed edges. The convergence of moment solutions is investigated and comparisons are made either with exact Levy-type solutions where possible or with finite-difference solutions obtained by other authors. Several comparisons are also made with solutions obtained using membrane theory. The method of Galerkin is also used in some problems and recomputed loads are used throughout as an independent check on the accuracy of the approximate solutions.

A report is also made of experimental investigation of the behaviour of a reinforced concrete shell in the form of a hyperbolic paraboloid with straight edges. It was hoped to test the shell with all sides fixed and to compare the deflections with those predicted by an approximate solution but it was found that the supporting frame was not sufficiently well braced to maintain the corners of the shell rigidly fixed. The observed deflections were very

much greater than would have been expected with all sides fixed and it is suggested that the structural action in this case was more akin to that of a plate than a shell.