CHAPTER I

INTRODUCTION

Background

Explicit solutions of plates of irregular shapes, if possible at all, are very complicated. Therefore, numerical methods such as finite difference or finite element are usually employed. The boundary integral method which has been developed recently provides also an alternative approach to the field of mechanics and potential problems. The first application of boundary integral technique to plate bending problems appears to be due to Jaswon and Maiti (1) who formulated the problems in terms of singular integral equations and solved them numerically around the boundary for uniformly loaded rectangular plates either clamped or simply supported edges by digital computer programs. Proceeding along this line, Maiti and Chakrabarty (2) devoted their attention to handle discontinuous boundaries when the simply supported polygonal plates subjected to uniformly distributed loads were under consideration. Altiero and Sikarskie (3) presented the formulation only for clamped plates of arbitrary plan forms by embedding the real plate in a fictitious plate for which the displacement function was known and also discussed about singularities involving higher derivatives of the deflection which caused numerical difficulties in the integral equations. To revise the previous work, Wu and Altiero (4) extended the formulation to include plates of arbitrary boundary conditions and applied to two rectangular plates with mixed boundary conditions (i.e. clamped, simply supported and free edges). Numerical difficulties arised in the earlier work were avoided by defining an integration contour which differed from the boundary of the real plate. In the same time, Stern (5) published a direct approach to obtain the general formulation in terms of a pair of singular integral equations concerning displacement, normal slope, bending moment and supplemented shear on the boundary.

Applying Betti's reciprocal theorem based on energy consideration, Tottenham (6) formulated the problem without involving complicated mathematical formulation. He also concluded that the higher order singularities which are involved in the formulation may be treated simply by the consideration of force equilibrium.

Among the above-mentioned papers in problems of thin elastic plate, the analysis of plates with interior supports seems to receive relatively little attention. The recent paper presented by Bezine (7) introduced the boundary integral method to solve plates with various boundary conditions and having interior point supports. The approach is that the usual boundary equations have to be supplemented by an additional condition for each point supports.

Scope of Study

The object of this present study is to extend Bezine's work by applying the direct method of boundary integral equations to the bending problem of rectilinear thin isotropic elastic plates with interior supports inside the plate domain. The axial and rotational stiffness of the interior support are included in this study which may facilitate the analysis and design of such structural elements as flat plates and plates on elastic foundation of arbitrary plan forms. Computer program written in FORTRAN 77 language is also developed for practical uses of this study.

Numerical results carried out on several examples are presented and compared with the solution of other investigators and with the results of finite element method. The efficiency of the method is also discussed.