Boundary value problems in diffration theory and lifting surface theory

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§ 1. Introduction

The present paper deals with a number of boundary value problems in diffraction theory and wing lifting surface theory with special reference to circular disks and apertures and to slits.

The problems of the diffraction of an incident wave (scalar or electromagnetic) by a circular disk, circular aperture, strip or slit have received considerable attention during the last decades. For a survey of the various methods of solution the reader is referred to the review articles of Bouwkamp [8] and of Hönl, Maue and Westpfahl [19]. In this paper we are especially interested in low-frequency expansions for the field quantities, valid when ka or kb is small, where k is the wave number, a is the radius of the disk or aperture, $2b$ is the width of the strip or slit. These expansions will be obtained from Fredholm integral equations of the second kind, the kernels of these integral equations being small when ka or kb is small.

The reduction of the scalar diffraction problem for a circular disk or circular aperture to Fredholm integral equations has been performed by several authors. We mention Magnus [34], Jones [23], Bazer and Brown [2], Bazer and Hochstadt [3], Heins and MacCamy [17], Noble [41], Collins [9e, f] and Williams [51].

Bazer and Brown [2], Bazer and Hochstadt [3], Collins [9e, f] start from certain integral representations for the transmitted or scattered wave. These integral representations which contain an unknown function, are designed to satisfy all conditions of the problem but one. The latter condition leads to a Fredholm integral equation of the second kind for the unknown function. A related integral equation with the same kernel was derived before by Jones [23], using a very complicated method. The above-mentioned integral representations may be considered as generalizations of similar representations exploited to solve some problems in potential theory, compare Love [31], Green and Zerna [14], Collins [9]. In an appendix to [3b] Bazer and Hochstadt show their integral representations to be related to a representation for