

The Green's Function for Periodic Structures in Diffraction Theory with an Application to Parallel Plate Media, I

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1. Introduction. In 1946, J. F. CARLSON & A. E. HEINS [1] studied the effect of a plane electromagnetic wave incident upon an infinite set of equally spaced, parallel plates of constant angle of stagger. At that time, the problem was formulated in terms of a finite number of plates, and then the limit was taken to produce the infinite structure. While, for the case of a finite number of plates, the edges act as scatterers, in the infinite case, the edges act as a grating. Hence, in this latter case, we may expect the usual specularly reflected wave, as well as the higher order diffracted plane waves (if they are present). Accordingly, we should start directly with the infinite structure and take into account the periodicity in the structure from the outset. If it were possible to find an appropriate Green's function, this could be accomplished. Such a Green's function may be constructed, and it is wave-guide-like in character, that is, it is defined in an infinite duct of finite width. The boundary conditions on the walls of this duct-like region are dictated by those in the original periodic structure. The radiation condition in a duct may be given without trouble, and we find that the formulation of the problem is much more direct and poses fewer mathematical difficulties.

The possibility of employing the "wave-guide" or rather "parallel plate" region from the start is due to two major features. First, we recognize that we have a periodic structure, that is, the set of equally spaced parallel plates. In the second place, because of the plane wave excitation, there is a phase change in the field due to this uniform spacing between the plates, the angle of stagger of the plates and the angle of incidence of the plane wave. With this clue, we observe that we are in a position to construct a Green's function with the appropriate type of periodicity and hence form an integral equation for the

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