

Surface Waves of Finite Energy

J. KAMPÉ DE FÉRIET & J. KOTIK¹

The University, Lille and Harvard University, Cambridge, Massachusetts

Communicated by H. GÖRTLER

1. During the last twenty years, a good deal of work has been done with the linearized gravity wave theory. In the most popular situation, one considers an infinite or semi-infinite ocean, of two or three dimensions, containing some sort of an obstacle, and proves the existence and uniqueness of motions which are regular except perhaps at the obstacle, and which behave like simple harmonic waves at infinity. The obstacles considered have been such things as beaches, submerged cylinders, vertical and horizontal plane barriers, docks, lumpy seabeds and the like. Besides proving the existence and uniqueness of the solution, one computes physical quantities like reflection coefficients in terms of the characteristic parameters of the wave and the geometry of the obstacle.

We will take up a different problem which seems to have attracted little attention, *the initial-value problem: if at time $t = 0$ the free surface has a prescribed form and if no forces except gravity act, what is the subsequent motion?*

The answer was given (in the case of infinite depth) by Cauchy [2] and Poisson [3] in case the initial elevation is the Dirac δ -function. The solution is in the form of a definite integral from which valuable information is obtained by using the method of stationary phase [1]. Thinking of the initial elevation as the limit of a sequence of step-functions, one could try to solve the general initial value problem by using a weighted superposition of these classical solutions; this was done by J. Kotik in [4]. On the other hand, one can think of the initial elevation as a superposition of sines and cosines, or Fourier Integral, in which case the solution is obtained by associating with each Fourier component of the initial elevation the appropriate simply harmonic wave and adding up. The formal expressions obtained in both cases are iterated integrals, and they differ

¹ Work done at Harvard University under Project N5ori-07634 with the Office of Naval Research.