CHAPTER - VII

CONCLUSIONS

7.1. General Discussion

The study of Rayleigh wave scattering due to surface irregularities on the surface of the earth is desirable as these waves are mainly responsible for the damage during an earthquake. The damage is due to large seismic wave amplification associated with the local topography of the affected area. If the scattered field is determined, the energy scattered around the scatterer can be calculated and the effects can be worked out.

In this chapter, we summarize the results of the problems discussed in the previous chapters. Rayleigh wave scattering due to some familiar discontinuities or irregularities on the surface of the earth is the main study. Mountains and rocks on the ground or coastal regions form a wide class of surface irregularities on the surface of the earth. These are contemplated as rigid plane boundaries and Rayleigh wave scattering at the corners of the rigid plane boundaries is the main theme of the discussion considered in the thesis.

The first problem discussed in Chapter II, Rayleigh wave scattering due to plane barriers in the surface of deep ocean is considered. The problem has an application to scattering of seismic waves due to patches of
pack-ice or artificially created plane barriers in the surface of a deep ocean. In a deep ocean, there are \((n+1)\) plane vertical barriers in the surface equally spaced at a distance 'a' apart and each of the same depth \(H\). If \(a = 0\) or \(n = 0\), the problem reduces to one discussed by Mann and Deshwal (1985) in the case of a single plane rigid barrier in the surface of a deep ocean. The reflected waves in (2.88) depend upon the number of plane barriers and the distance between equally spaced parallel plane barriers. The transmitted waves in (2.87) do not depend upon the number of plane barriers.

The second problem discussed in Chapter III, represents the model of the oceanic crustal layer overlying the solid mantle of the earth. In this problem, we discuss the scattering effects of seismic waves due to the presence of pack-ice in shallow oceans. The ice is supposed to be uniformly distributed on half of the surface of the liquid layer. The thin, uniform and smooth distribution of pack-ice is such that it exerts a normal stress proportional to the normal stress proportional to the normal acceleration. The reflected waves in (3.70) cancel incident waves. The surface waves travelling along the impeding surface are obtained in (3.77). The scattered waves propagate with the velocities of the waves in the solid and decay as they move away from the tip of the impeding
The third problem discussed in the Chapter IV is Rayleigh wave scattering at a vertical discontinuity in the surface of a solid half-space. There is a vertical discontinuity in the surface of a solid half-space. The reflected waves in the region \( x < 0 \) are found in (4.90-4.91) and the transmitted waves in the region \( x \geq 0 \) are obtained in (4.116-4.117). For the region \( x \leq 0 \), P and SV-type scattered waves are derived in (4.112) and (4.113) respectively and for the region \( x \geq 0 \), the SV-type scattered waves are given by (4.133).

In Chapter V, we discuss the problem of scattering of Rayleigh waves due to the presence of floating ice in a shallow ocean. There is a thin, smooth and uniform distribution of ice along the region \(-a \leq x \leq 0, z = -H\), on the surface of the liquid layer. The scattered waves are of the form \( \sin \gamma(z+H)\exp(-k'_{2}x)/x^{3/2} \) and the amplitude of the reflected wave depends upon the length of the ice. This problem has its application to theoretical seismology and linear theory of water waves.

Lastly, the problem of Rayleigh wave scattering at the foot of a long mountain has been considered in Chapter VI. The mountain is taken with its base occupying the region \( 0 \leq x < \infty, z = 0 \) in the free surface of an elastic solid half space \( z \geq 0 \). Mountain is assumed to be rigid
such that there is no displacement across the mountain. The compressional and shear waves reflected back to the region $x < 0$ are obtained in (6.70) and (6.71) respectively. The transmitted waves in (6.108), (6.109) in the region $x \geq 0$ are exactly same as the incident waves. The scattered waves in (6.90) and (6.99) for far-field are cylindrical waves falling off exponentially.

7.2. Scattered Waves

The scattered waves are the contribution due to branch cuts. The potentials in the shallow ocean due to the branch cuts at $\varepsilon = \pm k$ are found to vanish. This implies that the scattered waves in the shallow ocean do not propagate with the speed of the compressional waves in the layer but with the speeds of the compressional and shear waves in the solid.

The scattered waves in (2.105), (3.99), (3.106), (4.112), (4.133), (5.116), (6.90) and (6.99) are of the form $\exp(-k_2 r)/r$, where $r$ is the distance from the tip of the scatterer. These are cylindrical waves diverging out exponentially as they move away from the scatterer. The waves possess this character when $x$ is large in comparison to $z$, i.e., at the distant points from the scatterer. The far-field of the scattered waves behaves as decaying cylindrical waves. Karp and Karal (1962) have obtained the same form of the potential, i.e., $\exp(-k_2 r)/r$ for the
diffracted field of electromagnetic waves by a right-angled wedge. Gregory (1966) has found the same form of the scattered field for Rayleigh waves propagating in an elastic half space and striking at an impeding surface. Deshwal (1971) too has shown that the scattered waves behave as decaying cylindrical waves at distant points. Recently, Mann and Deshwal (1986), have obtained that the scattered waves behave as cylindrical waves while studying Rayleigh wave scattering at the corner of an elastic quarter space. Close to the corner of the scatterer, the scattered field in (2.105), (4.112), (4.133), (6.90), (6.99) is of the form

\[ \cos \left( \sqrt{k^2 + k'^2} z \right) \exp(-k x) / x^{3/2} \]

or

\[ \sin \left( \sqrt{k^2 + k'^2} z \right) \exp(-k x) / x^{3/2} \]

It has a decaying factor in x and a periodic character in z. The wave is dominant close to the scatterer and falls rapidly if it moves in the direction of z. Thus the scattered waves are dominant close to the scatterer and die out as cylindrical waves at distant points.

7.3. Boundary Conditions

In this section, it is established that the solutions satisfy the boundary conditions. In first problem, in Chapter II, if we put \( a = 0 \) or \( n = 0 \) in (2.105), we get the equation (95) which is obtained by Mann and
Deshwal (1985).

In Chapter III, reflected waves (3.70) in the layer cancels the incident waves and satisfy the boundary condition $\phi_t = 0, z = -H, x > 0$. Similarly, it can be established that the solutions of the problems studied in the other chapters satisfy the boundary conditions of the problem.

Lastly, we remark that the Wiener-Hopf technique is a complicated and lengthy procedure. New methods and techniques are desirable to study these problems to curtail the mathematics involved.