where
\[ m = k \sin \theta \]
is a constant following Snell's law. Then
\[ k^2 - m^2 = k^2 (1 - \sin^2 \theta) = k^2 \cos^2 \theta = l^2 \]
(2.10)

Equation 2.7 now becomes
\[ \ddot{\phi}_{zz} + l^2 \dot{\phi} = \alpha' \delta_x \phi_z + \alpha' \delta \phi_{zz} - m^2 \alpha' \delta \dot{\phi} \]
(2.11)

Allowing \( \delta(x) \to 0 \) for a physically flat bottom, the solution would be given by
\[ \phi = A e^{iz} + B e^{-iz} \]
(2.12)

\( A \) and \( B \) will be allowed to have complex values to allow for relative phase shifts for the most general solution.

Now, developing the boundary conditions at the ends of the domain for the case of a device causing reflection but still allowing some transmission at the shoreward limit yields
\[ \phi(x \to -\infty) = e^{ilx} + Re^{-ilx} \]
(2.13)

where the incident amplitude is taken to be 1 and \( R \) is the amplitude of the reflected wave.

The reflection coefficient is then given by \( |R| \). Likewise, with \( T \) being the transmitted amplitude, the boundary condition is
\[ \phi(x \to \infty) = Te^{ilx} \]
(2.14)

Strictly, conservation of energy requires
\[ |R|^2 + |T|^2 = 1 \]
(2.15)

if no energy attenuation occurs in the domain and the mean depth doesn't change.

For an arbitrary but finite bottom undulation in \( x \), assuming \( \alpha' \delta \sim (D/h) \) is small, or \( |\alpha' \delta| \ll 1 \), where \( D \) is the amplitude of the undulation, let
\[ \epsilon(\alpha' \delta)^* = (\alpha' \delta) \]
(2.16)