13.811 Advanced Structural Dynamics and Acoustics

Second Half - Problem Set 1

Assigned: 5 Apr 2004   Due: 14 Apr 2004

Problem 1

Earl G. Williams Problem 2.3

Problem 2

Consider a 2-D water halfspace with sound speed c m/s and density ρ kg/m^3 and a lower halfspace that consists of a massless plate covering the entire $z = 0$ axis and resting on an elastic foundation. The elastic foundation has a static stiffness of K N/m^3, such that

$$P(x) = K \bullet w(x)$$

Where: P(x): Pressure along plate surface
              w(x): Vertical Displacement along plate surface
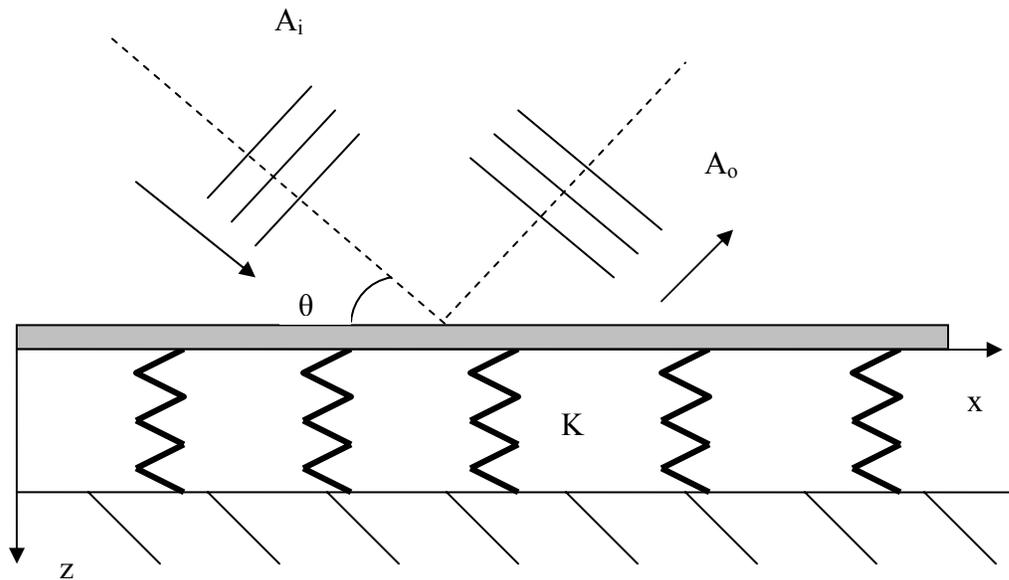
A plane harmonic acoustic wave of frequency ω at an angle θ is incident on the plate surface from the water halfspace as illustrated in the diagram above with pressure amplitude of A_i. The reflected wave has amplitude of A_o.

(a)   Derive an expression for A_o in terms of A_i, θ, ω, c, K and ρ.

(b)   Investigate asymptotic behavior of the expression derived in (a) as the following approaches limits:

    i.   Stiffness of the elastic foundation, K
    ii.   Frequency of wave, ω

    Discuss the physical meaning of any asymptote that arises.