AIMS AND OBJECTIVES

The main aim of this study is to develop a program using already developed equations to analyse and plot refraction diagrams for practical applications.

Refraction theory is formally valid only in areas of slowly varying depth and its accuracy in regions with abrupt bathymetry such as steep shoals and submarine canyons is unknown. Few field studies have being conducted to test the limits of refraction approximation over complex bathymetry. This study aims to develop a program that yields refraction pattern of a wave train in the wave field and calculates wave parameters along the wave train using the method proposed by Dean and Dalarymple (1984). This model takes an input, wave conditions along the offshore boundary of the model also known as deep water and generates wave condition as the wave propagates into shallower water.

The basic objectives of the program are listed below:

1. **Output:** The computer output must be in a suitable format such that the user can with ease determine the various parameters he requires.
2. **Data:** The requisite data for operating the program must be of a format such that the user can operate with maximum ease, and such that probability of erroneous data insertion is limited to a minimum.
3. **Accuracy:** The result achieved from a practical application must be sufficiently accurate to give a realistic representation of the natural condition.
4. **Internal Documentation of the program:** The program should be sufficiently internally documented to facilitate the determination of the program logic, such that a user can understand and locate the program

sequences, in case he might want to make additions or alterations to the program for his own applications. This can be achieved by inserting a comment in the program.

As a brief summary the ultimate goal of the project is to produce a well-documented computer program, which can satisfactorily be used in practical applications for determining wave refraction diagrams for arbitrary prevailing deep sea wave conditions, in an area where the bottom topography is uneven.

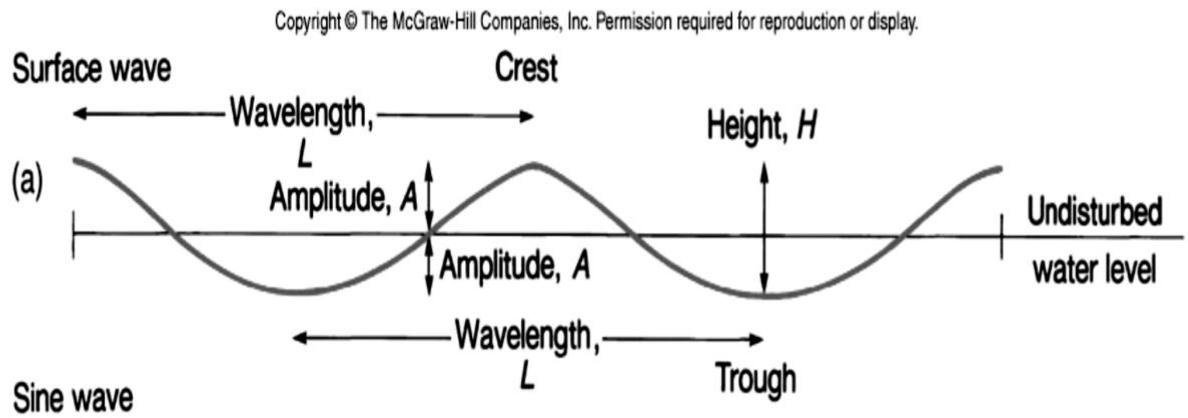


Figure 2.1. A Typical Wave Characteristics

Wave Parameters

• **Wavelength** = λ = Length between wave crests (or troughs)

• **Wave Number** = κ = 2π/λ (units of 1/length)

• **Wave Period** = T = Time it takes a wave crest to travel one wavelength (units of time)

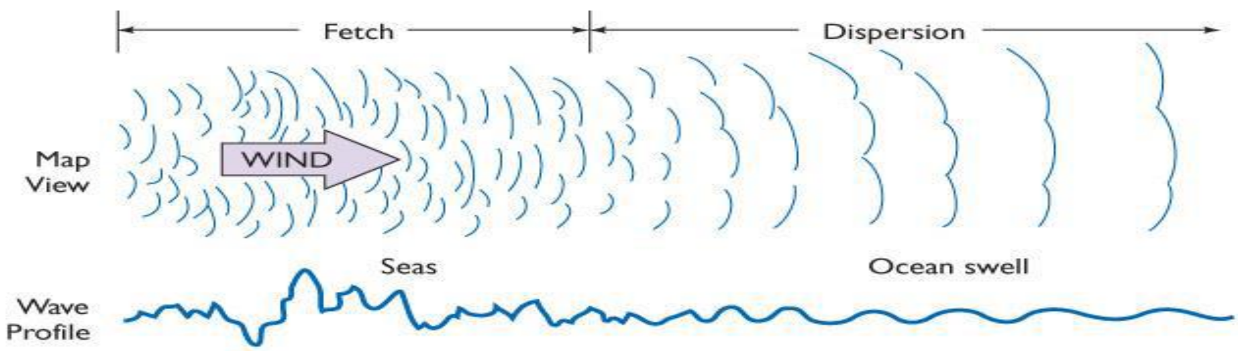
• **Angular Frequency** = ω = 2π/T (units of 1/time)

• **Wave Speed** = C = ω/κ Distance a wave crest travels per unit time (units of distance/time)

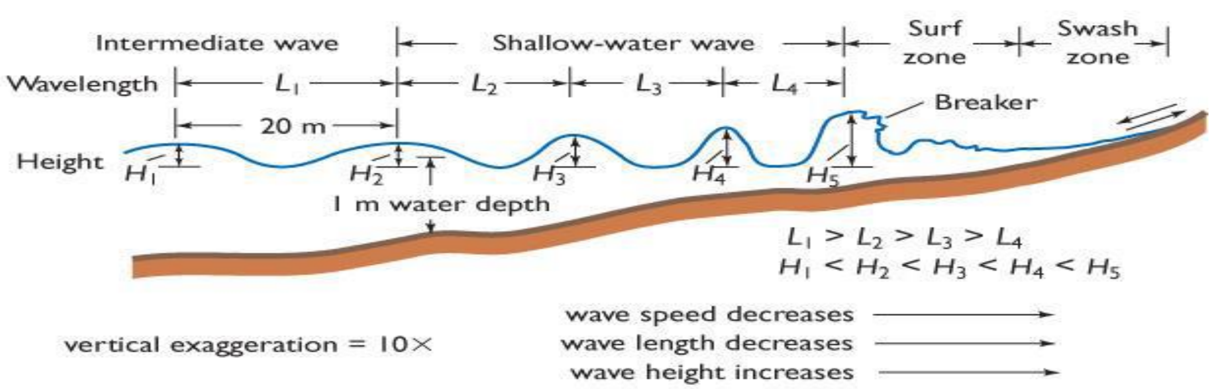
• **Wave Height** = 2a = Twice the wave amplitude

• **Wave Steepness** = Wave Height/Wavelength.

• **Amplitude** of a wave motion = A



(a) DEEP-WATER WAVE TRANSFORMATIONS



(b) SHALLOW-WATER WAVES IN PROFILE

REQUIRED EQUATIONS

For deep water

$$\boldsymbol{L_0 = \frac{g}{2\Pi} T^2}$$

L = wave length

g = gravity

T = period (time it takes for one wave crest to travel one wave length)

$$\mathbf{C_0 = \frac{L_0}{T}}$$

$\mathbf{C_0}$ = Wave celerity

Steepness = $\frac{H_0}{L_0}$

H_0 = Wave Height

$U_C = \frac{\pi H_0}{T}$

U_C = water particle speed

For shallow water

Celerity C = $\sqrt{gd}$

d = depth of water

Wave angle direction = $\alpha = sin^{-1}\left(\frac{C}{C_0}\ sin\ \alpha_0\right)$

α_0 = initial wave angle which take as 35, 60 and 90 degrees.

$$\sqrt{\frac{c_{g0}}{c_g}} = K_s \quad = Showling \quad Coefficient \qquad 2.32$$

$$\frac{Cos\ \alpha_0}{Cos\ \alpha} = K_r = refraction\ coefficient$$

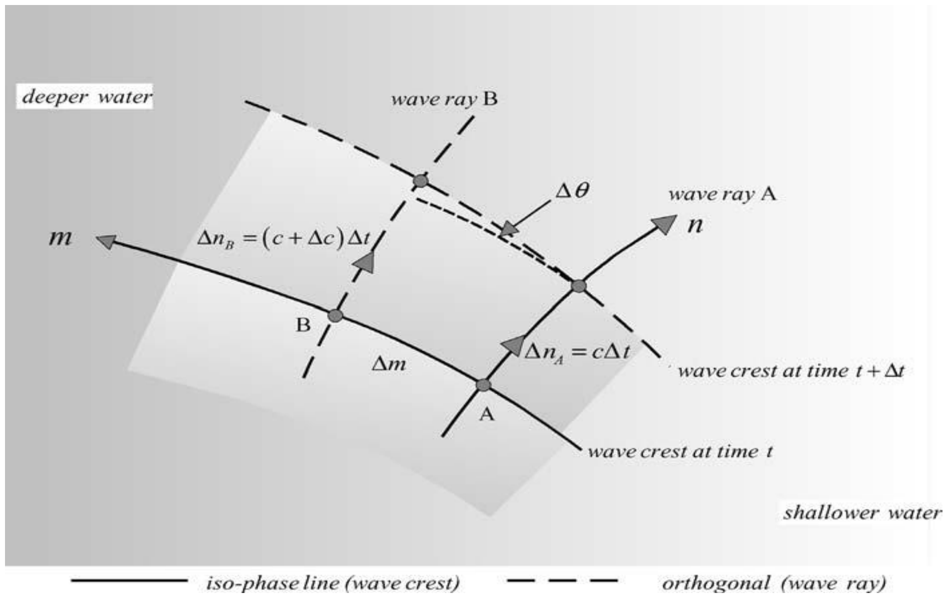


Figure 3.3 Schematic diagram showing adjacent rays. (The turning of a wave crest towards the region with lower phase speed (i.e., shallower water)).

$$\frac{d^2\beta}{ds^2} + p\,\frac{d\beta}{ds} + q\beta \tag{3.10}$$

Where

$$p(s) = -\frac{cos\theta}{C}\frac{\delta C}{\delta x} - \frac{sin\theta}{C}\frac{\delta C}{\delta \gamma} \tag{3.11}$$

And

$$q(s) = \frac{sin^2\theta}{C}\frac{\delta^2 C}{\delta x^2} - 2\,\frac{sin\theta cos\theta}{C}\frac{\delta^2 C}{\delta x \delta \gamma} + \frac{cos^2\theta}{C}\frac{\delta^2 C}{\delta y^2}$$

Wave Height

$$H = H_0\sqrt{\frac{c_{g0}}{c_g}}\,\frac{1}{\sqrt{\beta}}$$

Where

H_0 = wave height in deep water

K = wave number ($2\pi/L$)

L = wave length