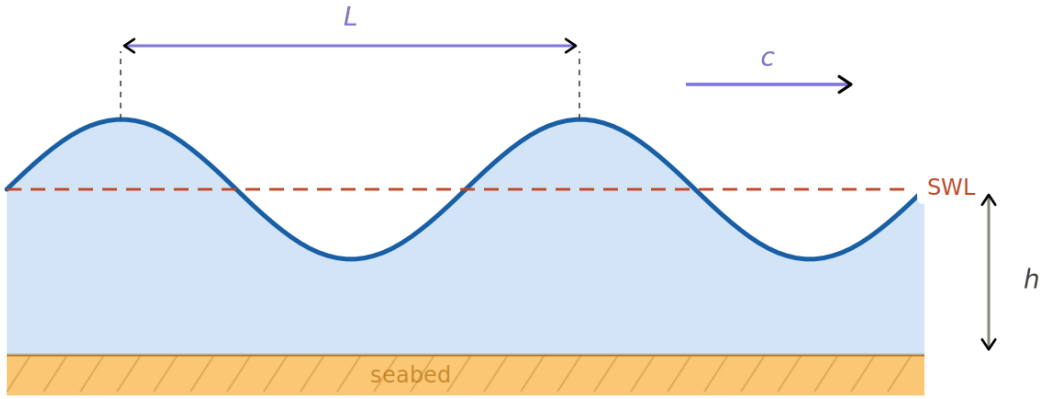
CIE 115 "Computers in Civil Engineering"

LAB 10

Background Information:



In coastal/ocean engineering, we often need to estimate the speed of a wave c (m/sec) as it moves over different ocean depths, based on its period T (s). In general, the speed of a wave can be calculated as $c = \frac{\omega}{k}$, where $\omega = \frac{2\pi}{T}$ (rad/sec) is the angular frequency and $k = \frac{2\pi}{L}$ (rad/m) is the wave number; L (m) is the wavelength, meaning the distance between successive wave crests as shown in the figure above. To obtain the wave number k, we need to rely on an iterative solution using the *dispersion relation*:

$$(1) \quad \frac{\omega^2 \times h}{g} = k \times h \, tanh(k \times h),$$

where h (m) is the ocean depth, g (9.81 m/sec^2) is the gravitational acceleration, and *tanh*( ) is the hyperbolic tangent function. Equation 1 can be re-arranged with respect to k as follows:

$$(2) \quad k = \frac{\omega^2 \times h}{g \times h \, tanh(k \times h)}.$$

Problem Statement:

Consider an ocean wave with a period of $T = 8$ sec that travels over a depth of $h = 15$ m. Develop an algorithm that computes the wave number k. Design the algorithm in such a way so that it "calls" a recursive function, which iteratively solves Equation 2 to find k – start with a $k = 0.0667$ and use a tolerance of 1E-8. Before it stops, your algorithm should calculate and output both the wave's speed c and the wavelength L.

Submission Process:

Create a flowchart for the algorithm above using the symbols we learned in class. Draw and label the flowchart neatly using a stencil and straightedge. Turn in your flowchart in paper format to the instructor or TA. Now, write MATLAB code following a similar logic as your flowchart. Make sure your MATLAB code includes appropriate comments, and it is working as expected without any errors.

*Note: For the flowchart, recall the following symbols…