UNIVERSITY OF CALIFORNIA BERKELEY
Department of Civil Engineering
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Structural Engineering,
Mechanics and Materials
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HW 9: Due 4/16/04

Consider the case of the shallow water equations where the depth of the water is a function of position, $H(x_1, x_2)$. If we assume that the wave heights are small and the velocities low, then we can work with the linearized shallow water equations. In this setting, the governing equations can be written as:

$$\frac{\partial \eta}{\partial t} + (H\overline{v}_i)_{,i} = 0 \tag{1}$$

$$\frac{\partial H\overline{v}_i}{\partial t} + gH\eta_{,i} = 0\,, \tag{2}$$

where $\eta(x_1, x_2, t) = h(x_1, x_2, t) - H(x_1, x_2)$ is the wave height, $g = 9.81\,\mathrm{m/s^2}$, and

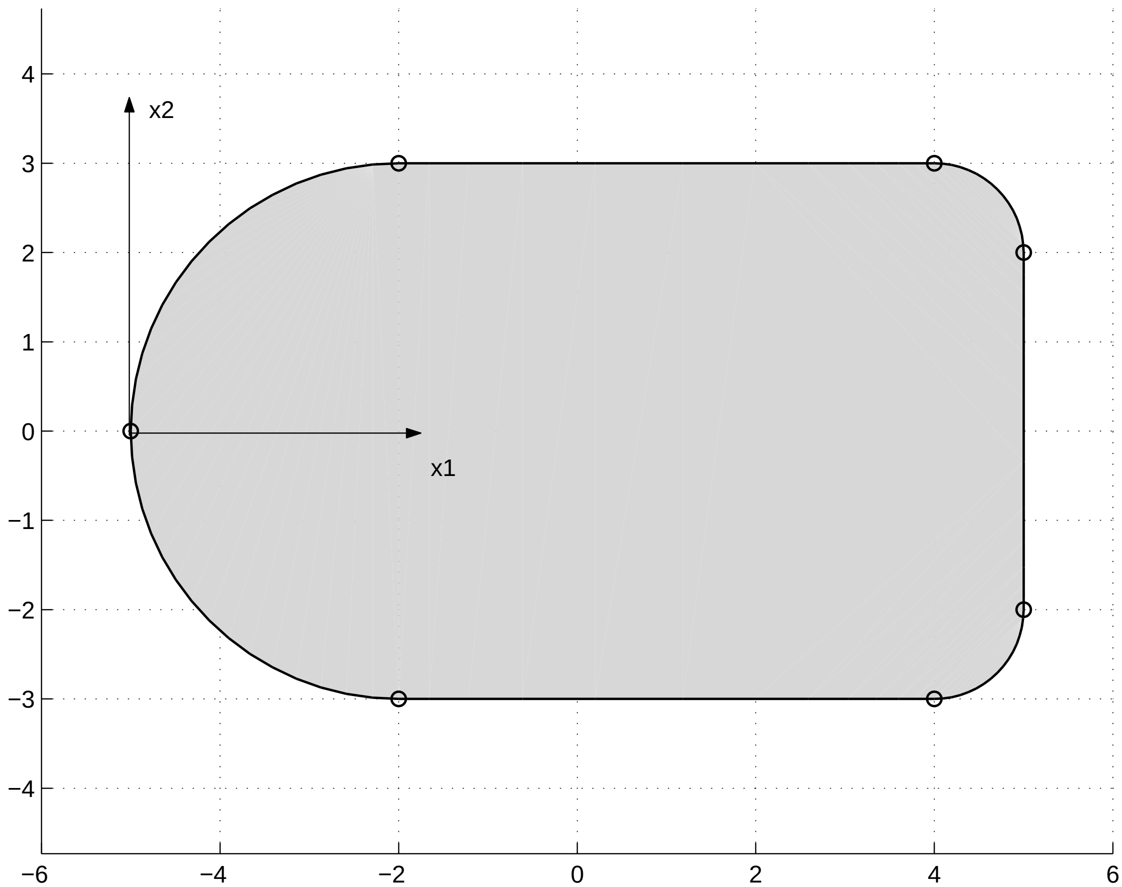
$$\overline{v}_i = \frac{1}{h}\int_{-H}^{\eta} v_i \, \mathrm{d}x_3\,. \tag{3}$$

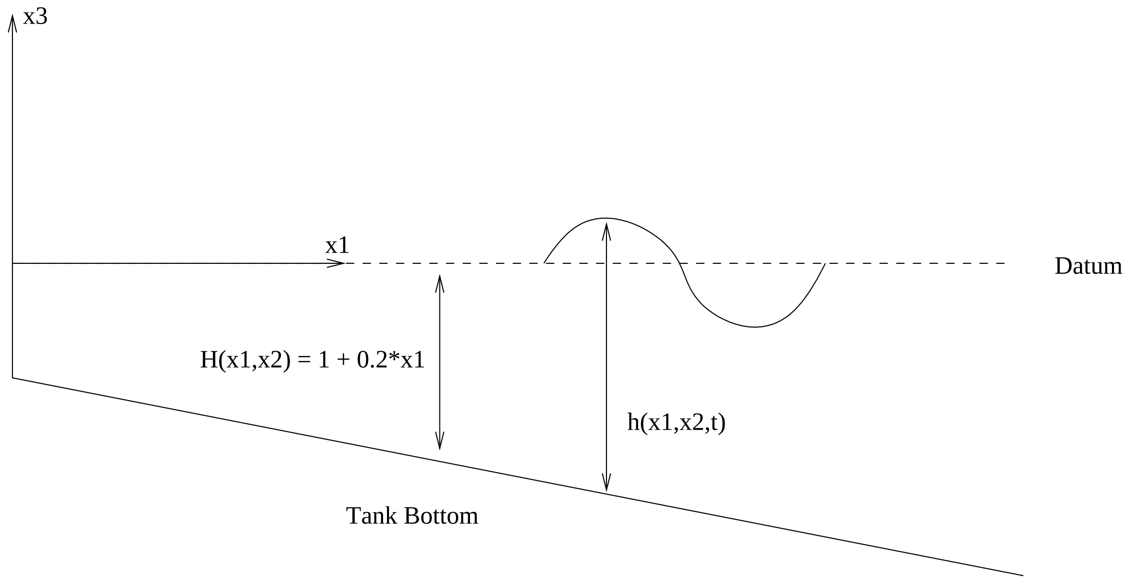
Assume a closed tank as shown in the figures with bottom depth $H(x_1, x_2) = 1.0 + 0.2x_1$ and initial wave disturbance $\eta(x_1, x_2, 0) = -0.1\exp[-(x_1 - 3)^2 - x_2^2]$.

1. Using the general PDE form simulate the motion of this system. Provide a basic description with text and figures of the motion that ensues.

2. Design a "wave break" in the tank to prevent the waves from dipping more than 2 cm or rising more than 2 cm at the left end. Hint: consider inserting baffles at various locations; both sub-surface and protruding are viable possiblities.

Milestone: For lab on wednesday you should have a running computation of the equations.


x2
x1
4
3
2
1
0
−1
−2
−3
−4
−6
−4
−2
0
2
4
6


x3
x1
Datum
H(x1,x2) = 1 + 0.2*x1
h(x1,x2,t)
Tank Bottom