NTNU

TEP4105: Fluidmekanikk

Øving 11:
Høst 2014

Oppgave 1: Shallow water waves

Assume that a monochromatic wave with small amplitude ($ka \ll 1$) is propagating in shallow water ($kd \ll 1$), here k is the wave number, a is the wave amplitude and d is still water depth. Under these conditions, the following approximations are valid

$$u = u(x,t) \qquad \text{og} \qquad w \approx 0 \tag{1}$$

a

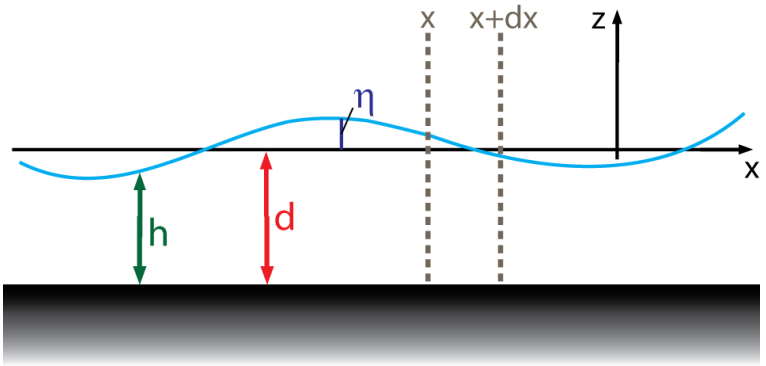
Show, using the linearized version of the Euler equations, that

$$p = p_0 + \gamma(\eta - z) \qquad \text{og} \qquad \frac{\partial u}{\partial t} = -g\frac{\partial \eta}{\partial x} \tag{2}$$

b

Show, by considering mass conservation between two vertical planes at position x and $x+dx$, that the continuity equation in this case can be written as

$$\frac{\partial h}{\partial t} + \frac{\partial (hu)}{\partial x} = 0 \qquad \text{med} \qquad h(x,t) \equiv d + \eta(x,t). \tag{3}$$



c

Using the equations above, derive the wave equation for η. Find the phase velocity of the wave. Compare the results to the general dispersion relation for waves with small amplitude. Is our wave dispersive?

Oppgave 2: Ocean waves

An ocean waves with period $T = 12$s travels on water with depth $d = 50$m. Find the wavelength L.