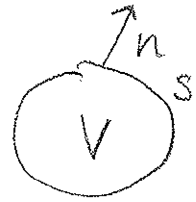
Noel Bartlow
4/21/2011

Some notes about problem setup:

$y=0$ is defined at undisturbed water surface,
Sea floor at $y=-h$

"continuity" equtron comes from conserving mass in an infinitesimal volume:



$$\underbrace{\frac{\partial}{\partial t}\int_V \rho \, dV}_{\text{change in mass with time}} = -\underbrace{\int_S \rho v \cdot \hat{n} \, dA}_{\text{mass flow out of surface}}$$

Use of divergence theorem and taking $V = dx\,dy\,dz \to 0$ yields $\frac{\partial \rho}{\partial t} = -\vec{\nabla} \cdot (\rho \vec{v})$ the continuity equation.

The momentum equation similarly comes from conserving momentum in an infinitesimal volume.
Here the total derivative is used, $\frac{D\vec{v}}{Dt} = \frac{\partial \vec{v}}{\partial t} + \vec{v} \cdot \vec{\nabla} v$

The second term is the "advected" velocity, that is velocity which is transported into the control volume, while the first term represents changes of velocity within the control volume.

The solution on page 6 is general (not shallow or deep water limits)

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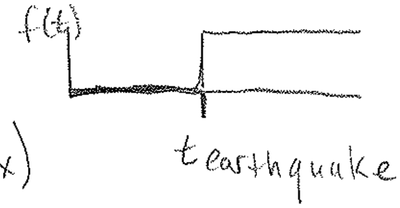
Notes on tsunami source setup:

V, ϕ same as before.

$F(x,t)$ is the sea floor, assumed to be seperable,

$F(x,t) = f(x) f(t)$. For an instantaneous earthquake,

$f(t)$ is a heavy side function:



this makes $V_z(z=-h) = \delta(t - t_{eq}) f(x)$

These notes make use of Laplace transforms (time, $t \to s$)

and Fourier transforms (space, $x \to k$)

s has units of $[t]^{-1}$, k is wave number with units $[x]^{-1}$

$$\hat{\bar{F}} = \bar{F}(s)\hat{f}(k) \rightarrow \text{the Laplace and Fourier transform of } F(x,t)$$

The final solution includes $\hat{F}(k) = f(t)\hat{F}(k)$

because $f(x)$ is specified by the actual earthquake sea floor changes. Thus the solution on page 14 is general to any tsunami generated by rapid vertical sea floor displacement.

Note the surface displacement is modulated by a $\frac{1}{\cosh(kh)}$ filter $\rightarrow$ it is a smoothed version of the sea floor displacement. This solution is only valid for constant water height $\rightarrow$ open ocean, not near shore