WATER WAVES

Most water waves are generated by storms at sea. Many waves are present in a storm sea state: each has a different wavelength and period. Theory shows that the speed of propagation of a wave or its phase speed is a function of water depth. It travels faster in deeper water. Theory also shows that the speed of a wave is a function of its wavelength. Long wavelength waves travel faster than short wavelength waves. This explains why storm generated waves, which approach shore, are generally a single wavelength. Because waves travel at different speeds, they tend to separate or disperse. When waves approach shore, they are influenced by the seabed by a process known as refraction. This can focus or spread out wave energy onto a site. Close to shore water depth is not the same everywhere: so points on wave crests move at different speeds and crests become bent. This explains why crests which approach a shore line tend to line up with it: points in deep water travel faster than points in shallow water and overtake them.

Wave energy travels at a speed known as the group speed. This is generally not the same as the phase speed. However, for shallow water, both speeds are the same, and they depend only on the water depth. A large low pressure system moving over shallow water would generate an enormous wave if the system speed and the wave energy speed were the same. Basically wave energy gets trapped in the system frame when the system speed matches the wave energy speed. Tides are basically shallow water waves. Here the pull of the Moon mimics a low pressure system. Theory shows that if water depth was 22km everywhere on Earth the Moon pull would produce gigantic tides. They would probably drain the oceans and swamp the continents everyday. Fortunately the average water depth is only 3km.

Water waves can interact with structures and cause them to move or experience loads. For wave structure interaction, an important parameter is $5D/\lambda$ where D is the characteristic dimension of the structure and λ is the wavelength or distance between crests. Structures are considered large if $5D/\lambda$ is much greater than unity: they are considered small if $5D/\lambda$ is much less than unity. Small structures are transparent to waves. Large structures scatter waves.

WATER PARTICLE VELOCITIES

$$U = + H/2 \ 2\pi/T \ e^{kz} \ \mathrm{Sin}(kX)$$

$$W = - H/2 \ 2\pi/T \ e^{kz} \ \mathrm{Cos}(kX)$$

WATER PARTICLE ACCELERATIONS

$$dU/dt = - H/2 \ (2\pi/T)^2 \ e^{kz} \ \mathrm{Cos}(kX)$$

$$dW/dt = - H/2 \ (2\pi/T)^2 \ e^{kz} \ \mathrm{Sin}(kX)$$

WATER PARTICLE ORBITS

$$x_p = x_o + H/2 \ e^{kz} \ \mathrm{Cos}(kX)$$

$$Z_p = z_o + H/2 \ e^{kz} \ \mathrm{Sin}(kX)$$

WAVE RESSURE

$$\Delta P = \rho g \ \eta \ e^{kz}$$

WAVE PROFILE

$$\eta = H/2 \ \mathrm{Sin}(kX)$$

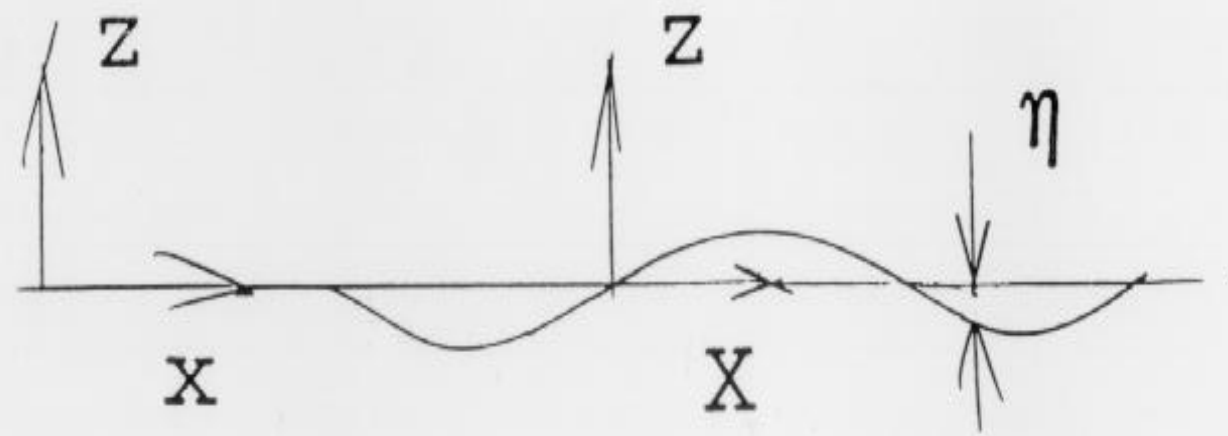
DISPERSION RELATIONSHIP

$$C_P = \sqrt{g/k} \qquad \omega = \sqrt{gk}$$

$$\omega = 2\pi/T \qquad k = 2\pi/\lambda$$

HYDRODYNAMIC RATIOS

$$5D/\lambda \qquad 5D/d$$



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