Taller de Técnicas de Medición en Hidrología e Hidráulica

Módulo: Hidráulica de ambientes costeros

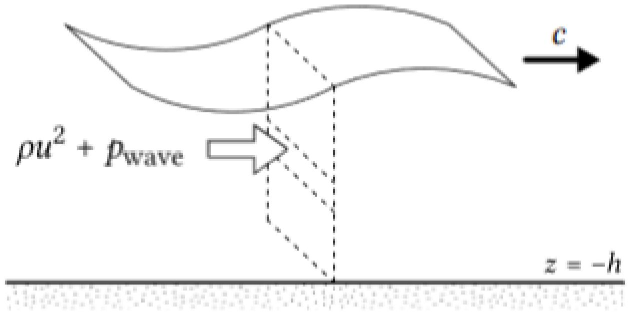
Clase 4: Repaso sobre hidrodinámica de la zona de rompiente y presentación del sistema de monitoreo de playas en base a imágenes.

UNIVERSIDAD DE LA REPÚBLICA URUGUAY

imfia

FACULTAD DE INGENIERIA

Flujo de momentum integrado en la vertical y promediado en la ola



$$S_{xx} = \underbrace{\overline{\int_{-h_0}^{\eta} (\rho u_x)\, u_x \, dz}}_{\text{part due to advection by horizontal particle velocity}} + \underbrace{\overline{\int_{-h_0}^{\eta} p_{\mathrm{wave}} \, dz}}_{\text{pressure part}}$$

$$S_{xy} = \overline{\int_{-h_0}^{\eta} (\rho u_x)\, u_y \, dz}$$

$$S_{yy} = \underbrace{\overline{\int_{-h_0}^{\eta} (\rho u_y)\, u_y \, dz}}_{\text{part due to advecion by horizontal particle velocity}} + \underbrace{\overline{\int_{-h_0}^{\eta} p_{\mathrm{wave}} \, dz}}_{\text{pressure part}}$$

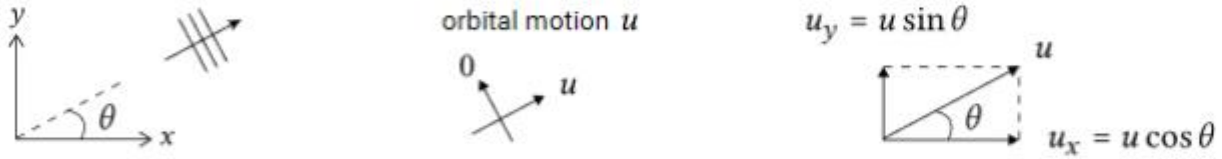


Figure 5.28: Coordinate system and velocity vector.

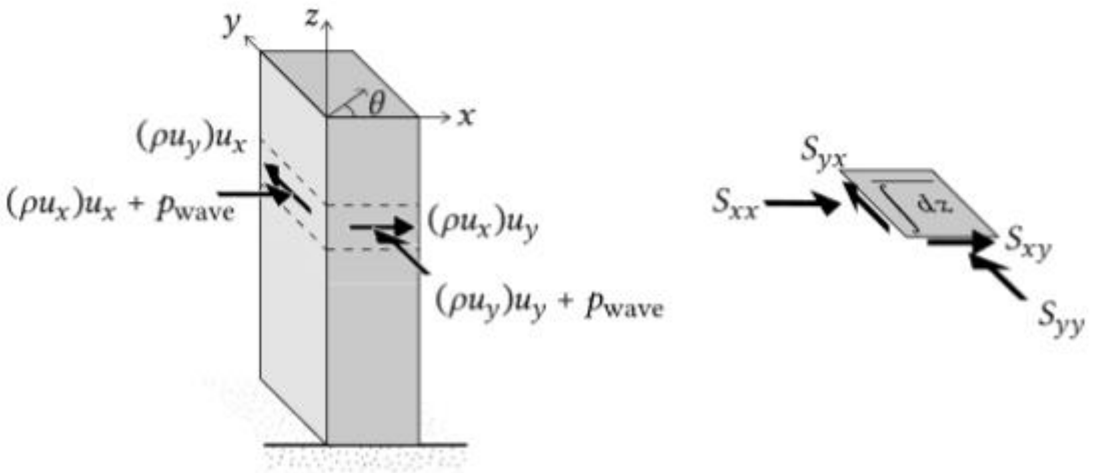


Figure 5.29: Schematic of the momentum transport and radiation stress components at a certain point in x, y-space for obliquely incident waves. The radiation stresses are obtained by integration of the momentum transport over the water column and averaging in time.

Cálculo a partir de teoría lineal

$$S_{xx} = \underbrace{\left(n - \frac{1}{2}\right)E}_{A} + \underbrace{n\cos^2\theta E}_{B}$$

$$S_{xy} = \underbrace{n\sin\theta\cos\theta E}_{B}$$

$$S_{yy} = \underbrace{\left(n - \frac{1}{2}\right)E}_{A} + \underbrace{n\sin^2\theta E}_{B}$$

$$S_{yx} = \underbrace{n\cos\theta\sin\theta E}_{B}$$

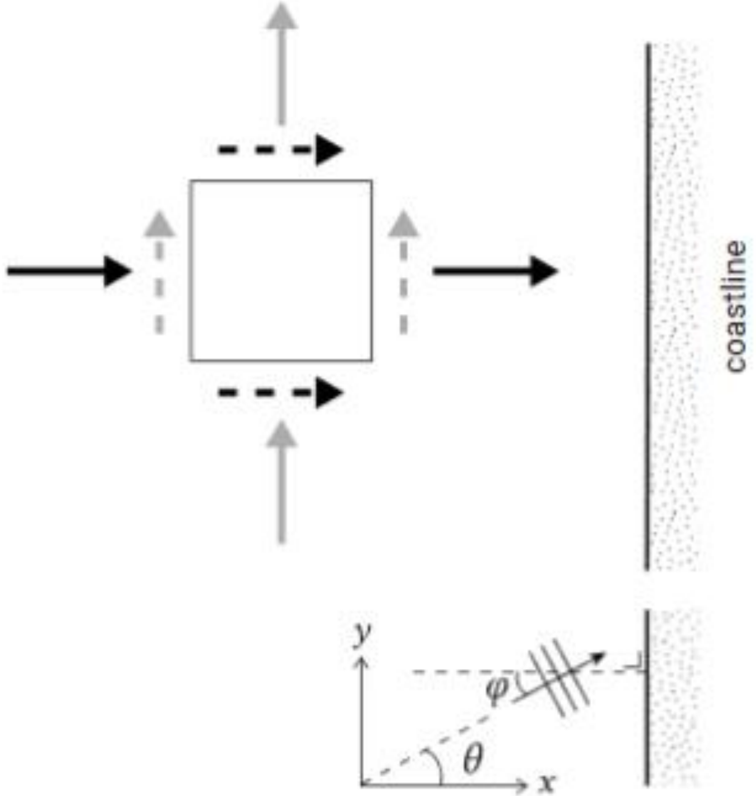
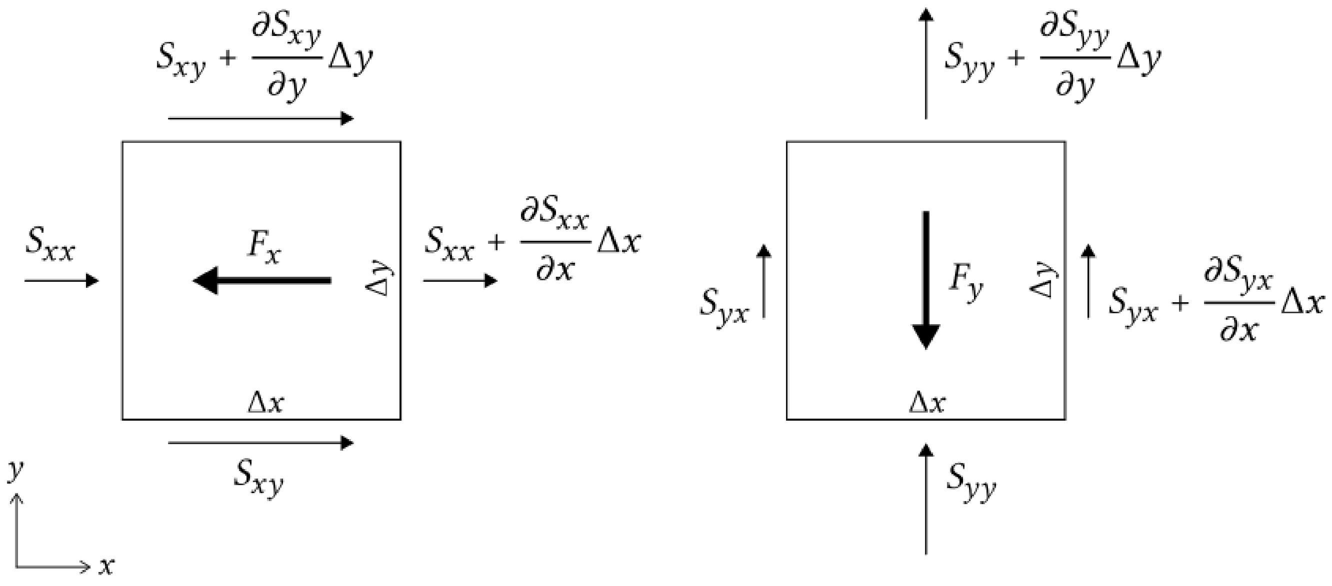


Figure 5.30: Radiation stress components according to linear wave theory. Situation sketch for alongshore uniform coast with depth contours parallel to y-axis. 'A' indicates the pressure part, 'B' indicates the part due to advection by the horizontal particle velocity.

Forzamiento inducido por el oleaje



$\frac{\partial S_{xx}}{\partial x} \longrightarrow$ *Set up y Set down*

$\frac{\partial S_{xy}}{\partial x} \longrightarrow$ *Corriente litoral*

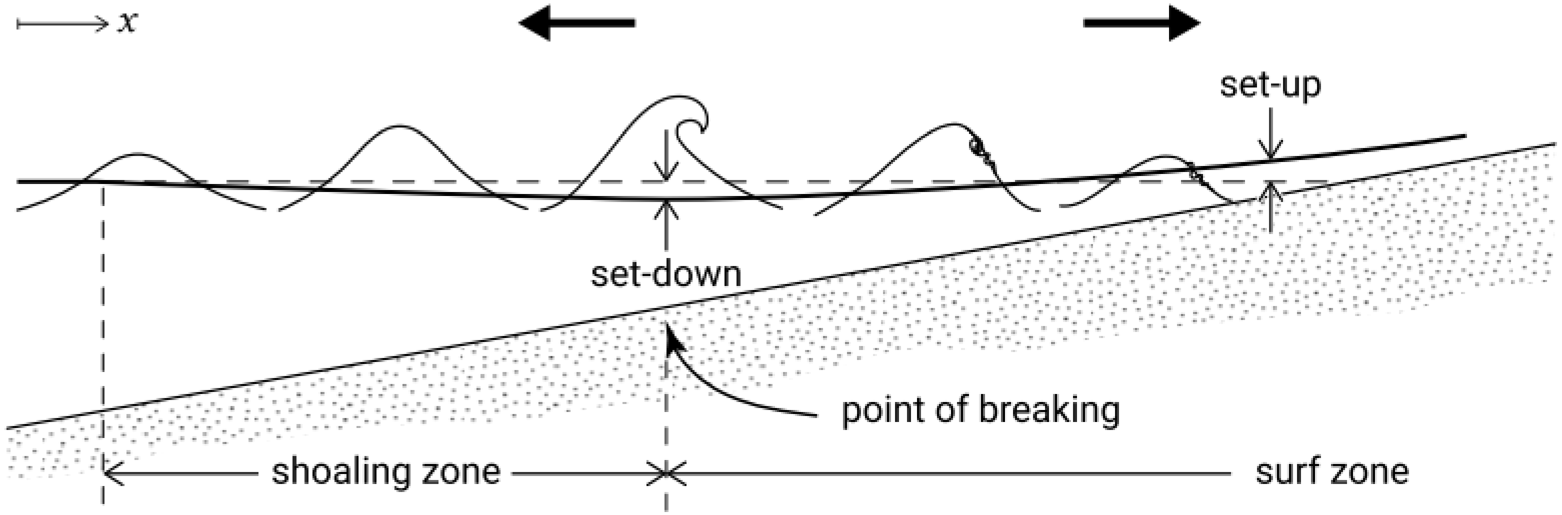
Balance mecánico *cross-shore*

Debido al asomeramiento

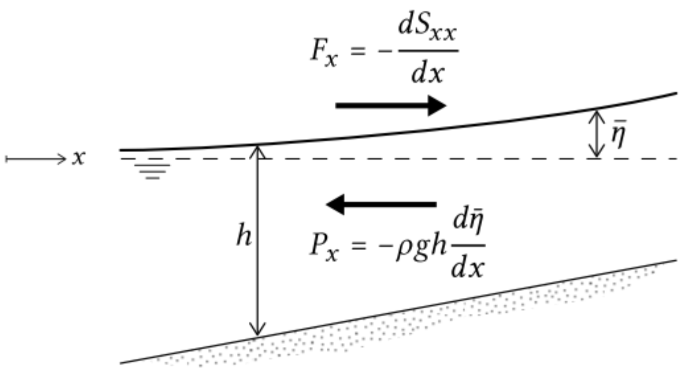
$$F_x = -\frac{dS_{xx}}{dx}$$

Debido a la rotura

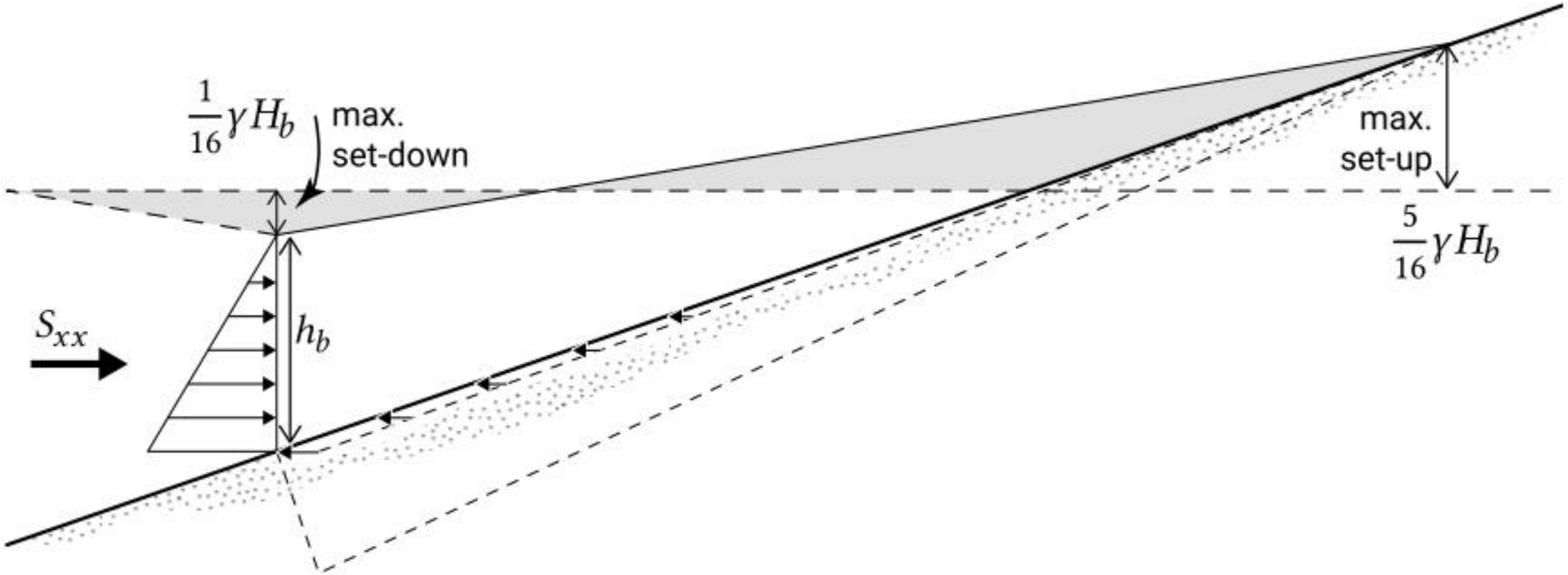
$$F_x = -\frac{dS_{xx}}{dx}$$



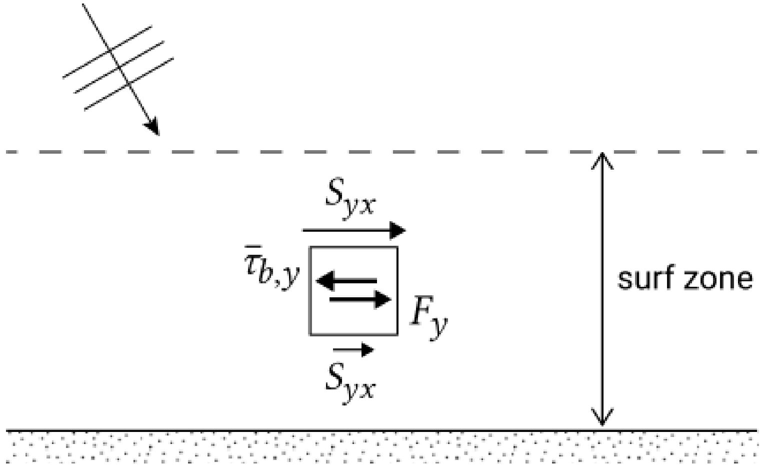
Balance mecánico *cross-shore*



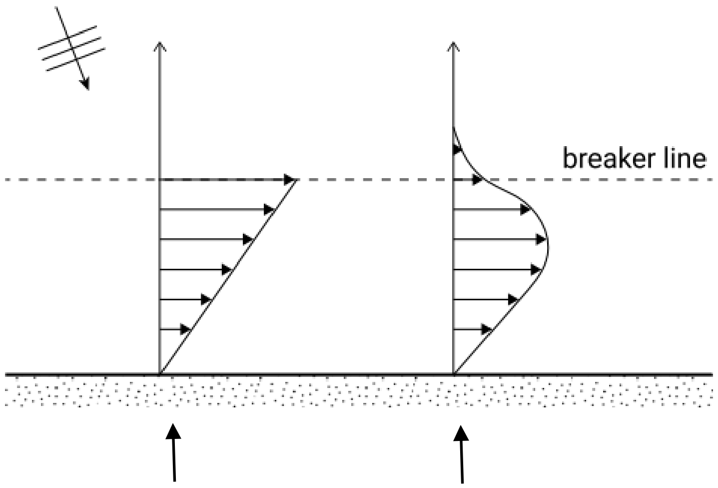
$$-\frac{dS_{xx}}{dx} = \rho g h \frac{d\bar{\eta}}{dx} = \rho g \left(h_0 + \bar{\eta}\right) \frac{d\bar{\eta}}{dx}$$



Balance mecánico *along-shore*



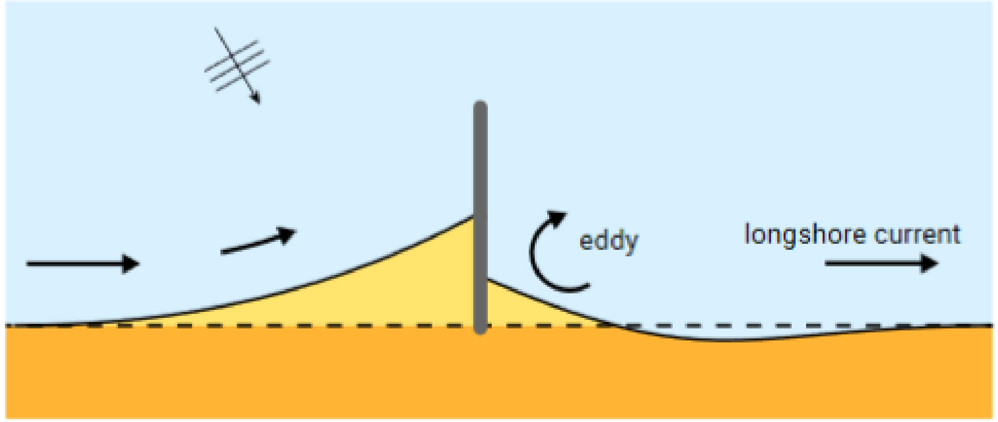
$$F_y = -\frac{dS_{yx}}{dx} = \overline{\tau}_{b,y}$$

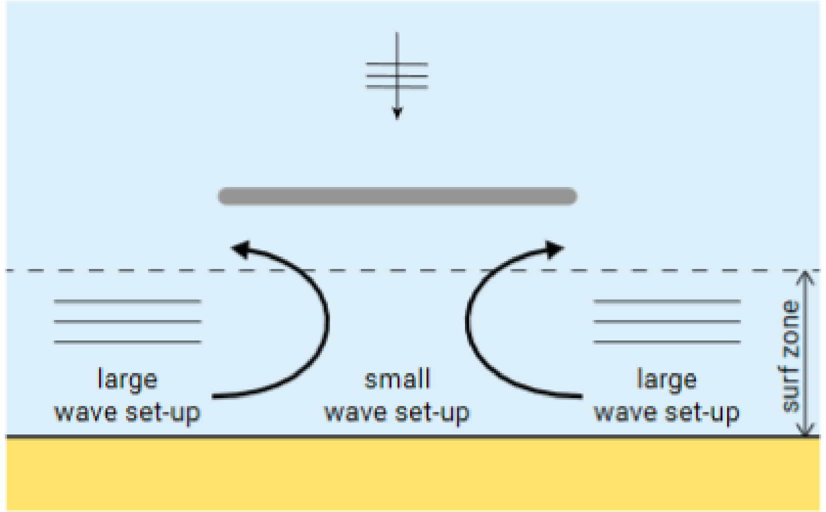


Resultado modelo analítico

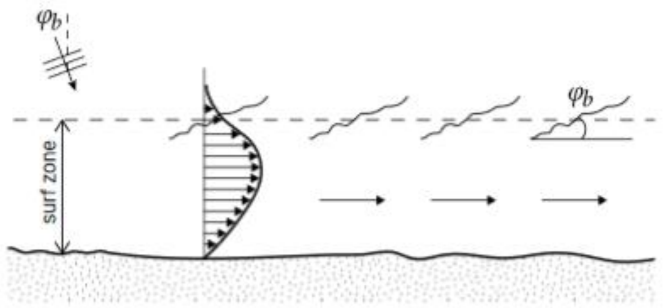
Influencia de vórtices horizontales

Patrones inducidos por zona de sombra detrás de estructuras

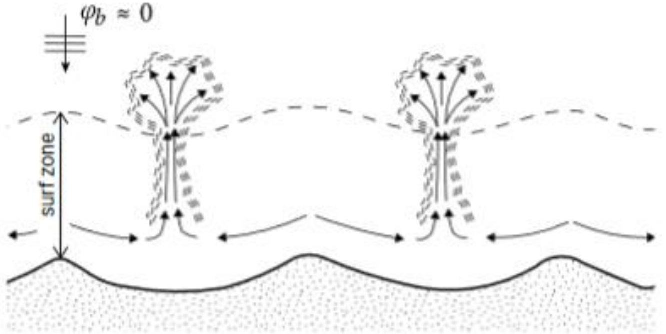




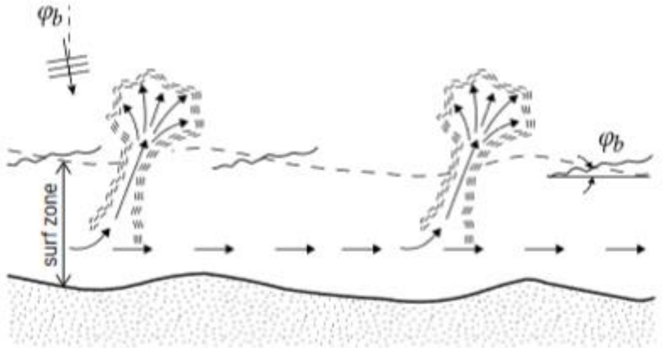
Corrientes de retorno



(a) typical longshore current distribution in the case of obliquely incident waves



(b) rip current pattern for undulating coastline in the case of approximately normal incidence



(c) combination of previous two cases for slightly oblique waves

Circulación entorno a bajos

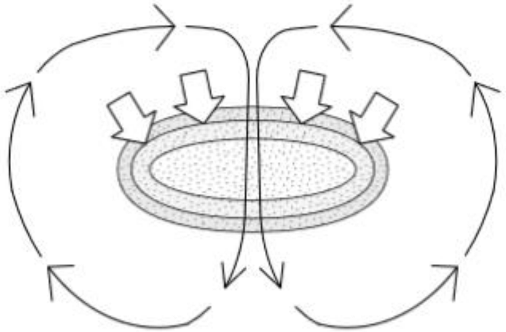


Figure 5.48: Wave-induced forces (white wider arrows) and currents (dark thinner arrows) around a shoal.

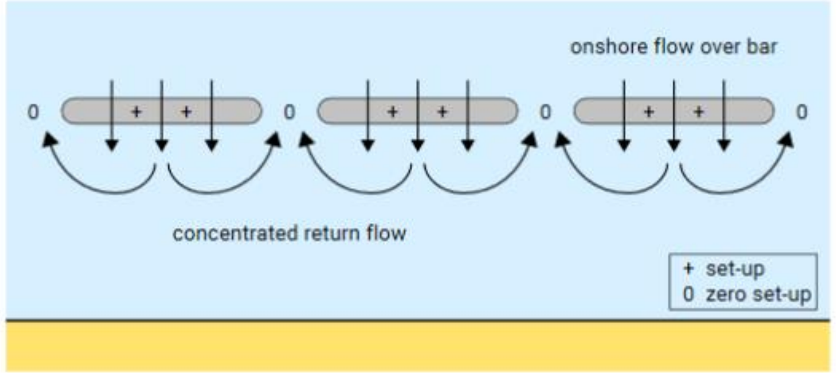
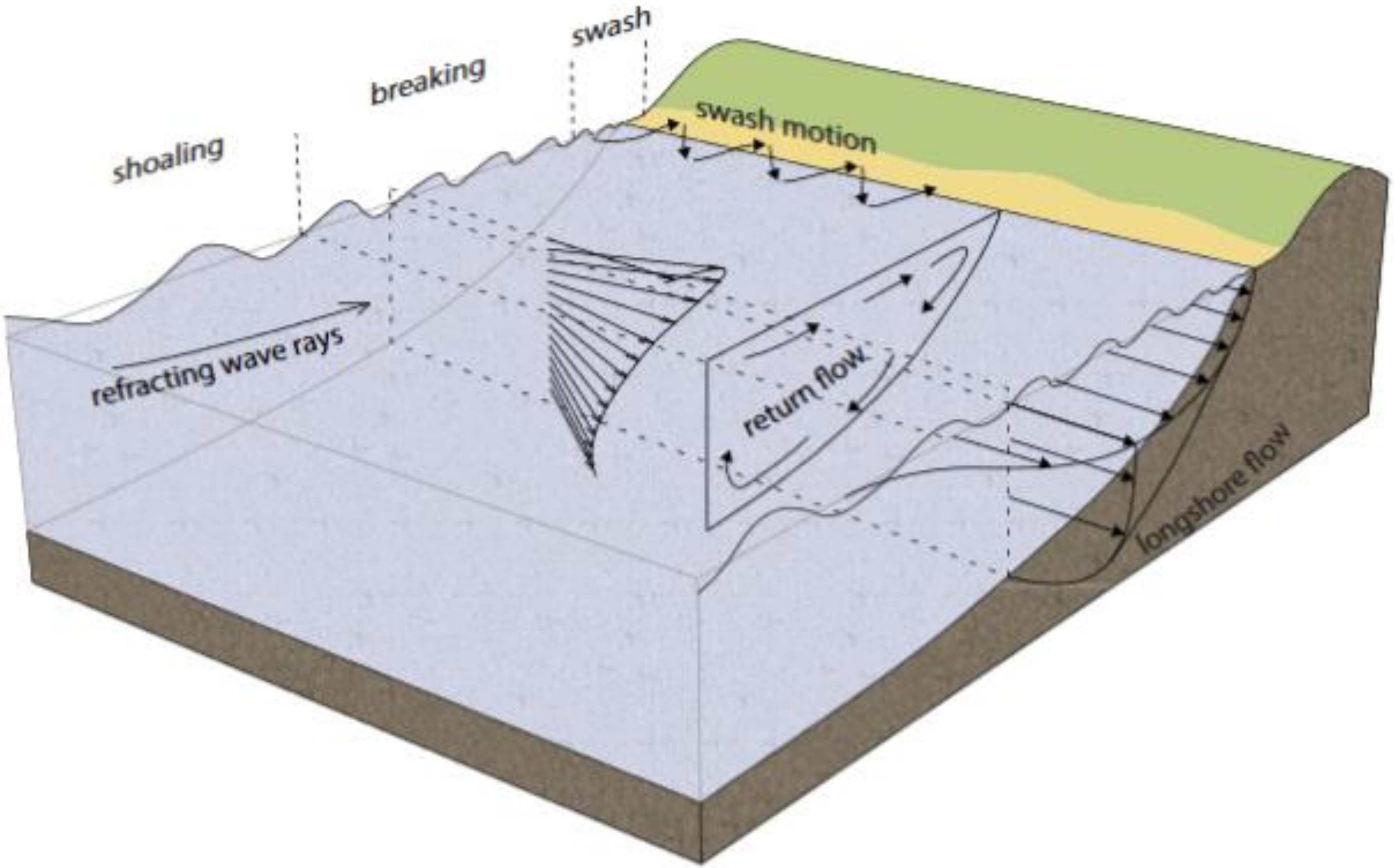
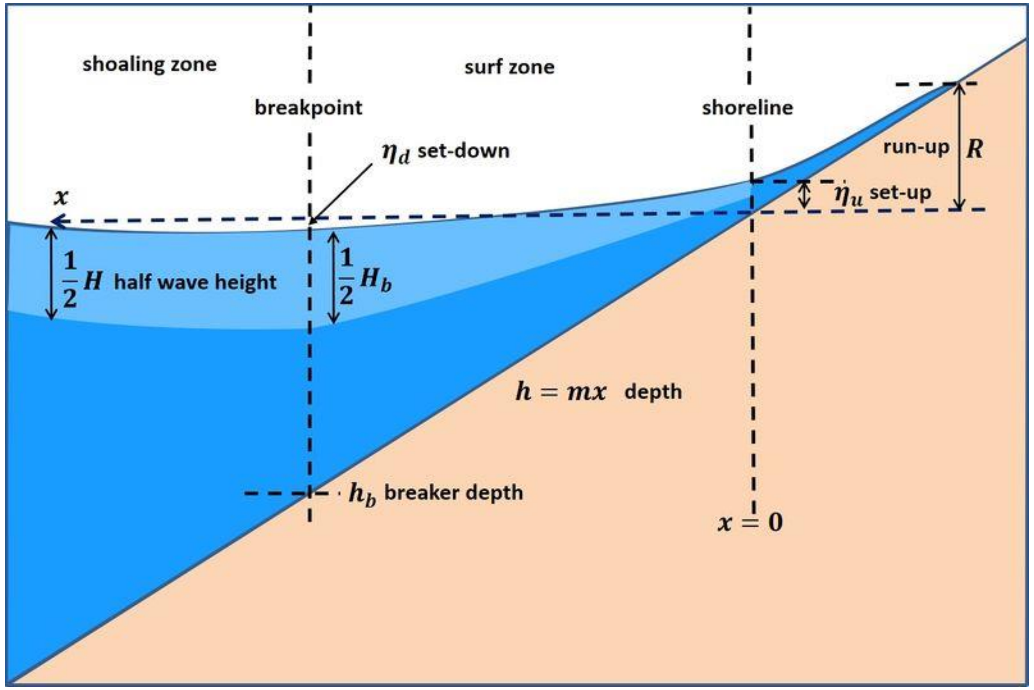


Figure 5.49: Rip currents in the case of submerged breakwaters (or an interrupted bar system).

Repaso


swash
breaking
shoaling
swash motion
refracting wave rays
return flow
longshore flow



Tomado de Coastalwiki

Stockdon et al. (2006):
Formulación empírica para estimar Run-up en playas naturales

$\xi_0 < 0.3$ $\quad R_2 = 0.043(H_0 L_0)^{1/2}.$

$0.3 \leq \xi_0 \leq 1.25$ $\quad R_2 = 1.1\left(0.35\beta_f(H_0 L_0)^{1/2} + \frac{[H_0 L_0(0.563\beta_f^2 + 0.004)]^{1/2}}{2}\right)$

$(\xi_0 > 1.25)$ $\quad R_2 = 0.73\beta_f(H_0 L_0)^{1/2}.$

Siendo:

$\xi = \frac{\beta}{(H/L_0)^{1/2}}.$ (Iribarren) $\quad$ R_2 es el run-up excedido el 2% del tiempo (Oleaje irregular) $\quad$ $H_0 = H_{s,0}$

β es la pendiente del frente de playa