

C1. Wave friction factor

$$\begin{cases} f_w = 0.00251 \exp \left[5.21 \left(\frac{2T_w}{k_{sw}} \right)^{0.1} \bar{a} \right]^{-0.19} & \text{for } \frac{\bar{a}}{k_{sw}} > 1.587 \\ f_w = 0.3 & \text{for } \frac{\bar{a}}{k_{sw}} \leq 1.587 \end{cases} \quad (21)$$

$$\begin{cases} f_w = 0.00251 \exp \left[5.21 \left(\frac{\bar{a}}{k_{sw}} \right)^{-0.19} \right] & \text{for } \frac{\bar{a}}{k_{sw}} > 1.587 \\ f_w = 0.3 & \text{for } \frac{\bar{a}}{k_{sw}} \leq 1.587 \end{cases} \quad (A.4)$$

C2. Current friction factor

$$(\theta) = \frac{\frac{1}{2} \bar{a} |u_0|^2}{(s-1)gd_{50}} + \frac{\frac{1}{2} \bar{a} \bar{u}^2}{(s-1)gd_{50}} \quad (A.3)$$

$$f_b = 2 \left[\frac{0.4}{\ln(30\bar{a}/k_{50})} \right]^2 \quad (20)$$

$$\alpha = \frac{|u_0|}{|u_0| + \bar{u}} \quad (19)$$

$$f_{wi} = \alpha f_b + (1-\alpha) f_w \quad (18)$$

$$\tau_{wbe} = \mu \frac{f_{wi}}{2\epsilon} \alpha_w \bar{u}^3 \quad (22)$$

$$\theta_w = \theta_b \frac{|u_{rx}|}{|u_{tx}|} + \frac{\tau_{wbe}}{(s-1)gd_{50}} \quad (15)$$

$$|\theta| = \frac{\frac{1}{2} f_{wi} |u_0|^2}{(s-1)gd_{50}} \quad (17)$$

D. Ripple model

$$\mu = \begin{cases} 6 & \text{if } d_{50} \leq 0.15 \text{ mm} \\ 6 - \frac{5(d_{50}-0.15)}{(0.20-0.15)} & \text{if } 0.15 \text{ mm} < d_{50} < 0.20 \text{ mm} \\ 1 & \text{if } d_{50} \geq 0.20 \text{ mm} \end{cases} \quad (A.2)$$

$$k_{50} = \max \{ 3d_{50}, d_{50}[\mu + 6((\theta)-1)] \} + 0.4r^2/\lambda \quad (A.1)$$

$$k_{sw} = \max \{ d_{50}, d_{50}[\mu + 6((\theta)-1)] \} + 0.4r^2/\lambda \quad (A.5)$$

A. Intra-wave velocity time-series

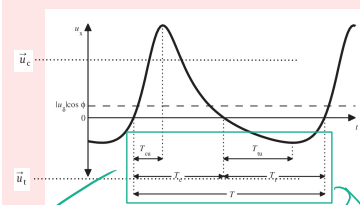


Fig. 1. Definition sketch of near-bed velocity time-series in wave direction. The parameters T_w and T_r are the positive (crest) and negative (trough) flow durations. Similarly, T_{cw} and T_{cr} are the durations of flow acceleration in positive and negative x-directions.

$$\bar{u} = \sqrt{\frac{2}{T} \int_0^T u_c^2(t) dt} \quad (8)$$

$$\bar{a} = \frac{\bar{u} T}{2\pi} \quad (9)$$

$$u_{cx} = \frac{1}{2} \sqrt{2} \bar{u}_c \quad (10)$$

$$u_{tx} = \frac{1}{2} \sqrt{2} \bar{u}_t \quad (11)$$

$$u_x(t) = u_w(t) + |u_0| \cos \varphi \quad (4)$$

$$u_y = |u_0| \sin \varphi \quad (5)$$

$$\vec{u}_{cx} = \{u_{cx}, u_{cy}\} = \{ |u_0| \cos \varphi, |u_0| \sin \varphi \} \quad (12)$$

$$\vec{u}_{tx} = \{u_{tx}, u_{ty}\} = \{ -|u_0| \cos \varphi, |u_0| \sin \varphi \} \quad (13)$$

I tried to find all of the connections on this map so I could do a better job as the GitHub admin & code compiler. This should make it easier to see how all of the parts fit in together and help coordinate this effort.

■ - missing variable or link.

F. Sheet flow thickness

$$\theta_1 = \frac{\frac{1}{2} f_{wi} \bar{u}^2}{(s-1)gd_{50}} \quad (C.2)$$

$$\delta_{50} = \begin{cases} 25\theta_1 & \text{if } d_{50} \leq 0.15 \text{ mm} \\ \left[25 - \frac{12(d_{50}-0.15)}{(0.20-0.15)} \right] \theta_1 & \text{if } 0.15 \text{ mm} < d_{50} < 0.20 \text{ mm} \\ 13\theta_1 & \text{if } d_{50} \geq 0.20 \text{ mm} \end{cases} \quad (C.1)$$

B. Entrained sand load

$$Q_s = \begin{cases} 0 & \text{if } |\theta| \leq \theta_{cr} \\ m|\theta| - \theta_{cr} & \text{if } |\theta| > \theta_{cr} \end{cases} \quad (2)$$

E. Phase lag

$$Q_c = \begin{cases} Q_c & \text{if } P_c \leq 1 \\ \frac{1}{P_c} Q_c & \text{if } P_c > 1 \end{cases} \quad (23)$$

$$Q_t = \begin{cases} 0 & \text{if } P_t \leq 1 \\ \left(1 - \frac{1}{P_t} \right) Q_c & \text{if } P_t > 1 \end{cases} \quad (24)$$

$$Q_w = \begin{cases} Q_c & \text{if } P_t \leq 1 \\ \frac{1}{P_t} Q_c & \text{if } P_t > 1 \end{cases} \quad (25)$$

$$Q_{tc} = \begin{cases} 0 & \text{if } P_t \leq 1 \\ \left(1 - \frac{1}{P_t} \right) Q_c & \text{if } P_t > 1 \end{cases} \quad (26)$$

$$P_c = \begin{cases} \alpha \left(\frac{1-\xi \bar{u}_c}{\epsilon_w} \right) \frac{\eta}{2(T_c - T_{cu}) W_{sc}} & \text{if } \eta > 0 \text{ (ripple regime)} \\ \alpha \left(\frac{1-\xi \bar{u}_c}{\epsilon_w} \right) \frac{\delta_{sc}}{2(T_c - T_{cu}) W_{sc}} & \text{if } \eta = 0 \text{ (sheet flow regime)} \end{cases} \quad (27)$$

$$P_t = \begin{cases} \alpha \left(\frac{1-\xi \bar{u}_t}{\epsilon_w} \right) \frac{\eta}{2(T_t - T_{tu}) W_{st}} & \text{if } \eta > 0 \text{ (ripple regime)} \\ \alpha \left(\frac{1-\xi \bar{u}_t}{\epsilon_w} \right) \frac{\delta_{st}}{2(T_t - T_{tu}) W_{st}} & \text{if } \eta = 0 \text{ (sheet flow regime)} \end{cases} \quad (28)$$

$$W_{sc} = W_s - W_{min}(T_c) \quad (29)$$

$$W_{st} = \max(W_s - W_{max}(T_t), 0) \quad (30)$$

G. Main function

$$\vec{\tau} = \frac{\bar{a}}{\sqrt{(s-1)gd_{50}}} \sqrt{\frac{Q_c}{P_c} \frac{Q_t}{P_t} \frac{Q_w}{P_w} \frac{Q_{tc}}{P_{tc}}} \quad (1)$$