

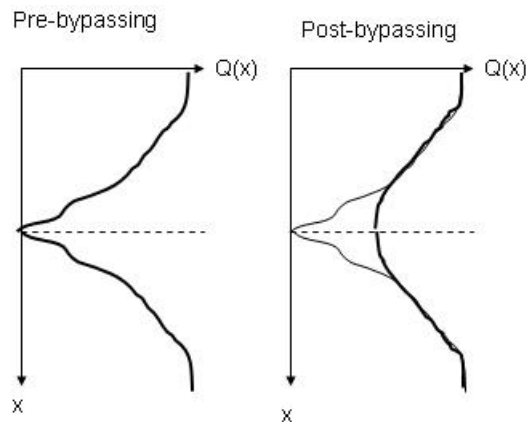


1. DD 8.11

8.11. A shore-perpendicular structure is placed in a location where the unaffected longshore transport is Q_0 (See Figure 8.43). Diffraction effects may be ignored.

- (a) For the case where bypassing has not yet occurred, as shown in Figure 8.43 (a-1), qualitatively sketch in the figure the longshore sediment transport rate updrift and downdrift of the structure.**
- (b) For the case where bypassing has commenced, as shown in Figure 8.43 (b-1), qualitatively sketch in the figure the longshore sediment transport rate updrift and downdrift of the structure.**

Before bypassing, the longshore sediment transport rate should be the same for only large distances updrift and downdrift of the jetty. Once bypassing has commenced, the longshore sediment transport rate updrift and downdrift of the structure will look the same except in the direct vicinity of the structure where it is not longer zero but some small finite value. In an ideal sense it would equal the transport far away from the structure, but residual currents may transport some of that material in the cross-shore direction. That is why I left a small “dip” in the plot.



Sketch of the longshore sediment transport near a jetty for pre- and post-bypassing.

2. DD 9.1

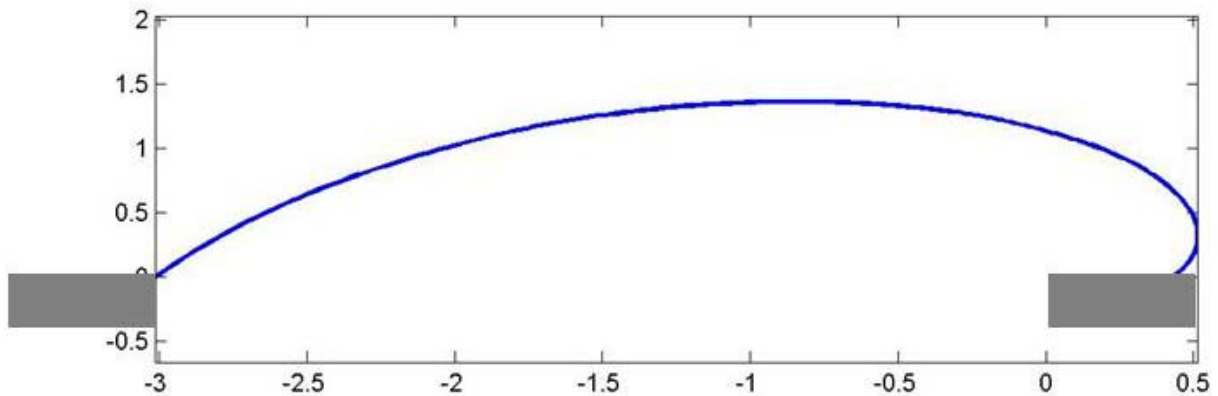
Suppose you visit a beach where beach cusps are present and the runup (or swash) occurs alternatively in adjacent embayments. What does this imply with regard to the formation of the cusps? Alternatively, the swash occurs simultaneously in adjacent embayments. What mechanism(s) does this imply?

If the runup occurs alternatively in adjacent embayments, then the likely mechanisms may be subharmonic standing edge waves that alternately fill embayments. If on the other hand, the embayments fill simultaneously, then one would suspect that either a self organization or swash processes are the formative and maintenance mechanism for the observed cusps.

3. DD 9.2

Two rocky headlands situated 3km apart, are located on a shoreline that runs in a north-south direction and faces due west. Between the headlands is a sandy beach. The predominant wave direction is from north-northwest. What is the likely indentation of the sandy shoreline? Sketch the shoreline.

The predominant wave direction is roughly 45 degrees. Using Figure 9.5, a 45 degree wave angle suggests an indentation ratio of roughly 0.45. Given the distance between the headland as 3km, this would suggest an indentation of 1.35 km.



4. DD 9.4

Consider the two possibilities (edge waves and swash processes) as causative mechanisms for beach cusps. Fill out the table below, indicating the effect (increase, decrease or none) that an increase in each variable would have on beach cusp spacing. In addition, provide a brief explanation for each choice.

| | Wave Period | Beach Slope, β | Wave Height | Grain size | Swash Length | Cusp Relief |
|-----------------|-------------|----------------------|---------------|------------|---------------|---------------|
| EDGE WAVE | increase | increase | no dependence | increase | No dependence | No dependence |
| SWASH PROCESSES | increase | decrease | increase | decrease | increase | increase |

Answers are based on the fact that for subharmonic edge waves, the cusp spacing is given by

$$L_e = \frac{(gT_w)^2}{2\pi} \sin[(2n+1)\beta]$$

and for swash processes the cusp spacing is given as

$$\lambda = 4\sqrt{\varepsilon} \xi_{y,\max}$$

where ε is the cusp relief

For edge waves, if the wave period increases the cusps spacing will increase due to squared proportionality. If beach slope increases, cusp spacing increases due to direct dependence. There is no dependence in the equation for spacing on wave height. If the grain size increases, the beach slope should increase thereby increasing the cusp spacing. There is no dependence on swash length or cusp relief for cusp spacing in the equation for edge wave generation.

For swash processes, if the wave period increases, the swash excursion should increase (beach acts as low pass filter), increasing cusp spacing. If slope increases, swash duration decreases, excursion decreases and so will the cusp spacing. If wave height increases, it is likely that the excursion will also increase causing increase in spacing (although when wave heights get very large, cusps tend to be destroyed). As grain size increases, beach slope increases, swash duration and excursion decrease so cusp spacing decreases. As swash length increases cusp spacing increases due to direct relationship. As cusp relief increases, so does cusp spacing due to direct dependence.

5. DD 10.3

10.3. A laboratory study is to be carried out to determine the equilibrium beach profile. The median grain size in the prototype is 0.4 mm with wave conditions of 1 m height and a 4 s period. Develop scale relationships for the following cases based on dean number similitude:

(a) If the sand used in the model has a grain size of 0.2 mm.

Dean number similitude requires that

$$\left(\frac{H}{wT}\right)_p = \left(\frac{H}{wT}\right)_m, \text{ where subscripts p and m denote prototype and model respectively.}$$

On the assumption that water is used in both cases, the fall velocities obtained from Figure 2.7 are roughly 0.025 m/s and 0.06 m/s for the 0.2 and 0.4 mm particles respectively.

Thus for Dean number similitude

$$\frac{H_m}{T_m} = \left(\frac{H}{wT}\right)_p w_m = \frac{1 * 0.025}{0.06 * 4} = 0.1; \text{ the wave height to period ratio has to be 1:10 rather than the 1:4 for the prototype.}$$

(b) A length scale of 1/25 is dictated by the space limitations of the laboratory. What sand size should be used?

From similitude for a 1/25 scale model

$$w_m = \frac{T_p w_p}{H_p} \frac{H_m}{T_m} = w_p \frac{H_m T_p}{H_p T_m} = 0.06 \frac{1}{25} \sqrt{25} = 0.012 \text{ m/s}, \text{ where the square root of 25 is based on the fact that the wave length is proportional to the wave period squared.}$$

Using Figure 2.7, a fall velocity of 0.012 m/s is roughly equivalent to a sand diameter of about 0.1 mm.

6. DD 10.8

10.8 Sand is being added at a constant rate as a point source to the shoreline. The wave height is constant. Observations indicate that the shoreline advanced 100m seaward after 1 year. How many years will be required for the shoreline to advance 250 m.

There are two unknowns in the problem: The rate at which sand is being added and longshore diffusivity. Start by determining an equation for y as a function of time.

$$y(0,t) = \int_0^t \frac{M}{\sqrt{4\pi Gt}} dt$$

or

$$y(0,t) = \frac{M}{\sqrt{G}} \frac{1}{\sqrt{\pi}} t^{1/2}$$

For 100m advancement after 1 year, the ratio $\frac{M}{\sqrt{G}} = 100\sqrt{\pi}$.

Thus, $y(0,t) = 100t^{1/2}$. Solving for the time it takes for the shoreline to advance to 250 m yields $t = 6.25$ years.

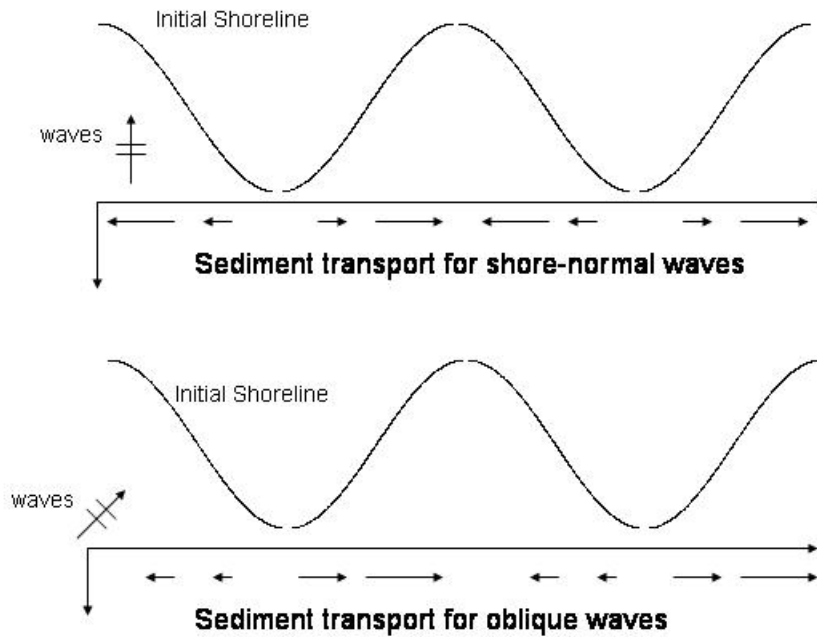
7. DD 10.10

10.7. For the initial shoreline position of $y(x,0) = B \cos \lambda x$, the shoreline position is slowly returned to a straight line according to the Pelnard-Considere solution given by Eq. 10.34.

(a) Sketch the shoreline position and alongshore sediment transport for normal wave incidence at time $t=0$.

(b) Sketch the sediment transport for oblique incidence.

The cases look similar except that for the oblique wave case, the transport magnitudes are reduced for shoreline orientations more normal to wave direction and enhanced for shoreline orientations more oblique to wave direction. In both cases, the vector length is proportional to the sediment transport magnitude.



Initial shoreline and sediment transport magnitudes as a function of wave direction.

(c) Qualitatively explain why shoreline oscillations damp out faster for shorter wavelength shoreline perturbations. There are two reasons.

First, shorter wavelength perturbations have less sediment volume associated with them than longer wavelength perturbations so there is less material that needs to be transported to damp out the signal. Second, shorter wavelength perturbations have steeper planform gradients. Since the alongshore transport is governed by the wave angle of attack, the steeper planform gradients cause larger sediment transport gradients which leads to a more rapid damping of the perturbation.

8. Suppose we want to perform a nourishment project that is 4 km long and we require the new beach to be 35 m wider. Given that $h^*=7\text{m}$, $B=1.75\text{ m}$, $d_N=0.18\text{ mm}$ and the fill material is $d_F=0.22\text{ mm}$. Determine the volume per meter required, assuming for simplicity, an overfill factor of 1.

Since the fill material is larger than the native, we expect an intersecting profile with the volume given by

$$V = B\Delta y_o + \frac{3}{5} A_N \frac{\Delta y_o^{5/3}}{\left[1 - \left(\frac{A_N}{A_F}\right)^{3/2}\right]^{2/3}}$$

Thus we use table 7.2 to determine the scale factors as 0.0936 and 0.106 for native and fill respectively. Problem is essentially plug and chug from this stage. I get $V=129.8\text{ m}^3/\text{m}$.

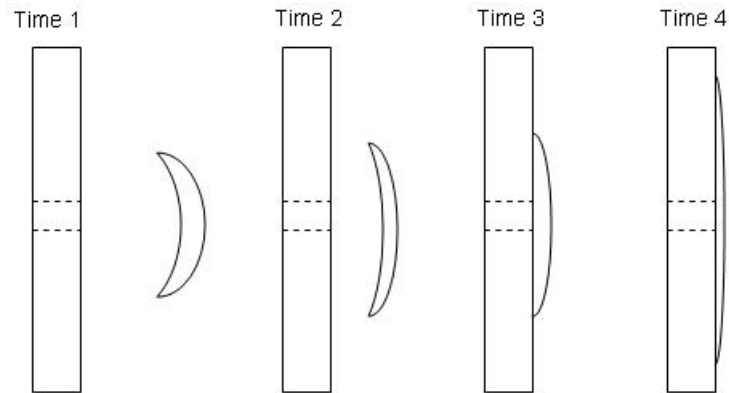
9. DD13.3. If a new tidal inlet is excavated, it is known that the ebb tidal shoals will grow and eventually achieve an equilibrium.

(a) Describe the processes that result in an equilibrium volume being reached for the shoals; that is, why do they grow and what limits their growth? For simplicity, assume that the waves approach the shore normally.

Shoals grow as a competition between two processes. The ebb tides flushes sediment out of the inlet towards the sea. After leaving the inlet, the ebb tidal flow decreases and sediments are deposited. The waves, however, break on and cause currents on the shoals which would decrease their size. Hence their growth is limited by the competing processes. Large waves and small ebb tidal flow results in small shoals and vice versa.

(b) Suppose that an inlet with mature ebb tidal shoals is closed. Again, consider normal wave incidence. Discuss the fate of the shoal material. Sketch several stages of the shoreline planform.

If the inlet is closed, the fate of the shoal is to disperse. In a strict sense, with no competing mechanism, there is too much sediment on the profile. The shoal will move landward and then disperse along the shoreline.



Time history of shoal movement after inlet (dashed lines) is closed.

(c) If the ebb tidal shoals appear as shown in Figure 13.24 for natural conditions and two jetties are installed, what will happen to the portions of the shoals labeled "AB" and "CD"?

In this case, the mechanism that was in equilibrium with the waves maintaining the shoal (the ebb tidal flow) is now removed. The waves will drive the widowed shoal segments back onto shore. It is likely that new ebb tidal shoals will develop further seaward depending on the amount of sediment available to be delivered now that the longshore drift has been interrupted.