This original Equation 5.176 is converted to Equation 5.177 so as to express the parameter, *Rec* (m), in terms of nominal diameters, D_n (m), rather than sieve sizes *D* (m). The conversion is based on the ratio $D_n/D \cong 0.84$ as discussed in Section 3.4. The value based on 3000 waves is presented, followed by a correction, in Equation 5.178, for other storm durations, expressed as N = number of waves.

$$\frac{Rec}{D_{n50}} = -12.4 + 0.39\left(\frac{H_s}{\Delta D_{n50}}\right)^{2.5} + 8.95\left(\frac{D_{n85}}{D_{n15}}\right) - 1.27\left(\frac{D_{n85}}{D_{n15}}\right)^2 + 7.3R_P \quad (5.177)$$

The time correction factor, Equation 5.178, for duration (number of waves, *N*) is defined as a function of the relative number of waves (*N*/3000) and reads:

$$\frac{Rec_N}{Rec_{3000}} = 1 + 0.111\ln\left(\frac{N}{3000}\right) \quad (5.178)$$

Hall and Kao (1991) found good agreement between predictions based on these equations and data obtained from prototype berm breakwaters.

Reshaping method developed by Tørum *et al* (2003)

Tørum (1999), Tørum *et al* (2000) and Tørum *et al* (2003) followed to some extent the approach of Hall and Kao (1991). With reference to Figure 5.65 the recession, *Rec* (m), was analysed based on model tests. It was noticed that for a given berm breakwater all the reshaped profiles intersected with the original berm at an almost fixed point A, at a distance h_f (m) below SWL; see Figure 5.65.

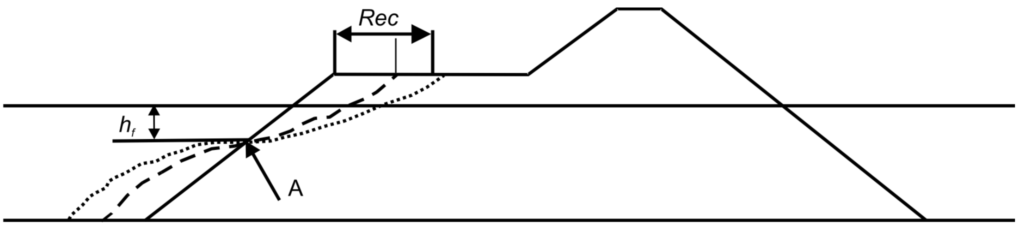

Figure 5.65 *Recession on a reshaping berm breakwater*

As an approximation, the *fixed depth*, h_f (m), can be obtained from Equation 5.179, which gives the relationship between that depth and the structural parameters (Tørum *et al*, 2003):

$$\frac{h_f}{D_{n50}} = 0.2\frac{h}{D_{n50}} + 0.5 \qquad \text{for the range: } 12.5 < h/D_{n50} < 25 \quad (5.179)$$

where h = water depth in front of the berm breakwater (m)

The relationship between the dimensionless recession, Rec/D_{n50} (-), and the period stability number *HoTo* (-), the gradation of the armourstone, f_g (-), and the water depth, h (m), has been derived by a group of researchers, among others Menze (2000) and Tørum *et al* (2003)). This relationship is given here as Equation 5.180 (see also Figure 5.66):

$$\frac{Rec}{D_{n50}} = 0.0000027(HoTo)^3 + 0.000009(HoTo)^2 + 0.11(HoTo) - f(f_g) - f\left(h/D_{n50}\right) \quad (5.180)$$

where *HoTo* is the wave period stability number, $= N_s \cdot T_m\sqrt{(g/D_{n50})}$ (-), $f(f_g)$ is gradation factor function given in Equation 5.181; $f_g = D_{n85}/D_{n15}$ (with $1.3 < f_g < 1.8$):

$$f(f_g) = -9.9f_g^2 + 23.9f_g - 10.5 \quad (5.181)$$

and $f(h/D_{n50})$ = depth factor function, given in Equation 5.182:

$$f\left(h/D_{n50}\right) = -0.16\left(\frac{h}{D_{n50}}\right) + 4.0 \qquad \text{for the range: } 12.5 < h/D_{n50} < 25 \quad (5.182)$$