Coastal Engineering Technical Note

BROKEN WAVE FORCES

PURPOSE: To provide revised guidance on broken wave forces.

GENERAL: A determination of broken wave forces on structures is necessary for structure design, and also for determining economic benefits of hurricane protection projects. The Shore Protection Manual (SPM 1984), Section 7.III.4.a, presents an older method of determining broken wave forces on a structure seaward of the still-water shoreline. A need was recognized to update the method to incorporate the present state of knowledge on broken wave decay. The method presented herein uses the information found in Camfield (1991) on broken wave decay. A definition sketch is shown in Figure 1. This corrects Figure 7-104 in the SPM.

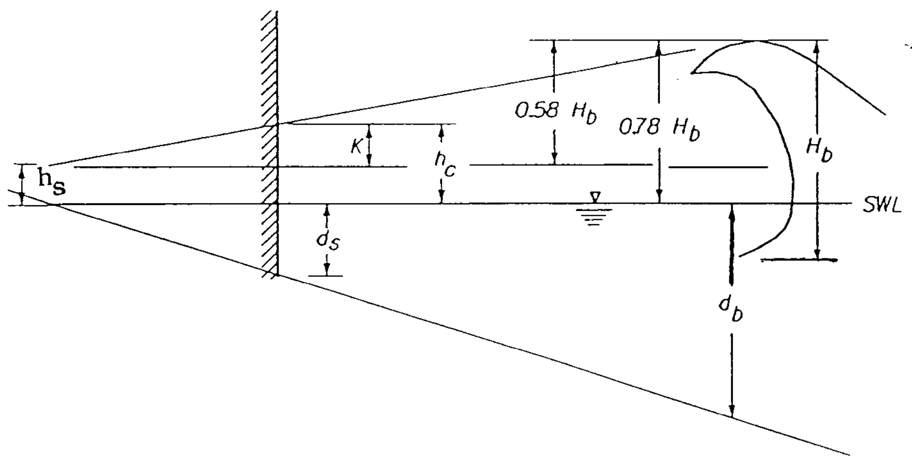

Figure 1. Broken wave decay.

DETERMINATION OF WAVE FORCE: Camfield (1990, 1991) shows that the broken wave height at the shoreline, h_s, can be approximated by

$$h_s = 0.2\ H_b$$

where H_b is the breaking wave height. The broken wave height in any given water depth can be found by assuming a linear decay of the broken wave and a linear decrease in water depth. This will be slightly conservative. From Figure 1, the broken wave crest above SWL at the wall, h_c, is given by

$$h_c = K + 0.2\ H_b$$

where K is a height to be determined. By similar triangles

$$\frac{d_s}{d_b} = \frac{K}{0.58H_b}$$

$$K = 0.58H_b\frac{d_s}{d_b}$$

$$h_c = \left(0.2 + 0.58\frac{d_s}{d_b}\right) H_b$$

where d_s is the water depth at the structure and d_b is the water depth where the wave breaks. This corrects Equation 7-95 in the SPM.

The wave force then is determined by the method shown in the SPM. The dynamic component of the wave force, R_m, is given as

$$R_m = p_m h_c = \frac{w d_b h_c}{2}$$

where w is the specific weight of water (approximately 64 lb/ft^3) and the overturning moment, M_m, caused by the dynamic force is

$$M_m = R_m\left(d_s + \frac{h_c}{2}\right)$$

The hydrostatic force component, R_s, is

$$R_s = \frac{w\ (d_s + h_c)^2}{2}$$

and the overturning moment from the hydrostatic force, R_s, will be

$$M_s = R_s \frac{(d_s + h_c)}{3} = \frac{w\ \ (d_s + h_c)^3}{6}$$

The total force on the wall, R_t, and the total overturning moment, M_t, are given by

$$R_t = R_m + R_s$$

and

$$M_t = M_m + M_s$$

ADDITIONAL INFORMATION: If further information is needed relative to the information contained herein, please contact Dr. Fred E. Camfield, CEWES-CW (commercial 601-634-2012, FTS 542-2012, or FAX 601-634-2055).

REFERENCES:

Camfield, F. E. 1990. "Wave Forces on a Wall Shoreward of the Still-Water Line," Coastal Engineering Technical Note III-29, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Camfield, F. E. 1991. "Wave Force on Wall," Journal of Waterway, Port, Coastal, and Ocean Engineering, American Society of Civil Engineers, Vol. 117, No. 1.

Shore Protection Manual. 1984. 4th Ed. 2 vols., U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center, U.S. Government Printing Office, Washington, DC.