Re-evaluation of Wave Transmission Coefficient Formulae from Submerged Breakwater Physical Models

Harry Charles Friebel[1,2]
Lee E. Harris, Ph.D., P.E., MASCE[3]

[1] Graduate Research Assistant, Davidson Laboratory, Stevens Institute of Technology, Hoboken, New Jersey 07030, USA. Email: HarryFriebel@hotmail.com
[2] Research performed as Graduate Research Assistant, Department of Marine and Environmental Systems, Florida Institute of Technology, Melbourne, Florida 32901, USA.
[3] Associate Professor of Ocean Engineering and Oceanography, Department of Marine and Environmental Systems, Florida Institute of Technology, Melbourne, Florida 32901, USA. Email: Lharris@fit.edu

ABSTRACT

Increasing interest in utilizing submerged breakwaters and artificial reefs for shoreline stabilization requires accurate predictive models and relationships for wave attenuation. The object of this study was to develop a two-dimensional (2-D) model as an improvement to the existing wave transmission coefficient models. A total of five data sets were combined and analyzed: Seelig (1980), Daemrich and Kahle (1985), Van der Meer (1988), Daemen (1991), and Seabrook (1997).

This paper describes the development of an empirical model as an improvement to existing wave transmission models. This new model provides the required design criteria for use in determining wave attenuation for submerged breakwaters. The model developed in this study was determined to be the ‘best fit’ model from all five data sets used.

The results of this study confirm that the transmission coefficient is highly dependent upon the dimensionless ratio of the freeboard to the incident wave height. The significance of other dimensionless variables in the model in order of decreasing significance were the ratios of structure crest width to water depth, structure height to water depth, crest width to wavelength, and freeboard to crest width. These variables also represent the dominant physical processes associated with the wave transmission process and wave/structure interaction. The model developed in this study is recommended for use as an engineering aid for preliminary design of submerged breakwaters.

ADDITIONAL INDEX WORDS: Wave Transmission, Wave Attenuation, Transmission Coefficient, Transmission Model, Submerged Breakwater, Submerged Breakwater Model

Wave Transmission Variables

Previous studies of submerged breakwaters have indicated a variety of important variables associated with wave transmission over submerged breakwaters. The most important physical variables that correlate with K_t have been identified as:

- **A_t**: equivalent cross-sectional area of breakwater
- **B**: crest width of breakwater
- **d_s**: water depth at toe of structure
- **D_n50**: nominal material diameter
- **F**: freeboard = h - d_s
- **h**: height of structure from seabed
- **H_i**: incident wave height (H_{si} or H_{moi})
- **L**: wavelength at local depth

Table 1. Correlation of Top Five Variables versus K_t

Variable	CORRELATION
h/d_s	-0.75
F/H_{moi}	-0.68
F/B	-0.67
B/d_s	-0.63
B/L	-0.49

The 'best fit' model with a RSQ value of 0.9402 and a standard deviation of 0.0510 is listed below and plotted in Figure 1.

$$K_t = -0.4969\exp\left(\frac{F}{H_{moi}}\right) - 0.0292\left(\frac{B}{d_s}\right) - 0.4257\left(\frac{h}{d_s}\right) - 0.0696\log\left(\frac{B}{L}\right) + 0.1359\left(\frac{F}{B}\right) + 1.0905$$

The preceding model is valid for the following variable ranges:

$$-8.696 \le F/H_{moi} \le 0.000$$
$$0.286 \le B/d_s \le 8.750$$
$$0.440 \le h/d_s \le 1.000$$
$$0.024 \le B/L \le 1.890$$
$$-1.050 \le F/B \le 0.000$$

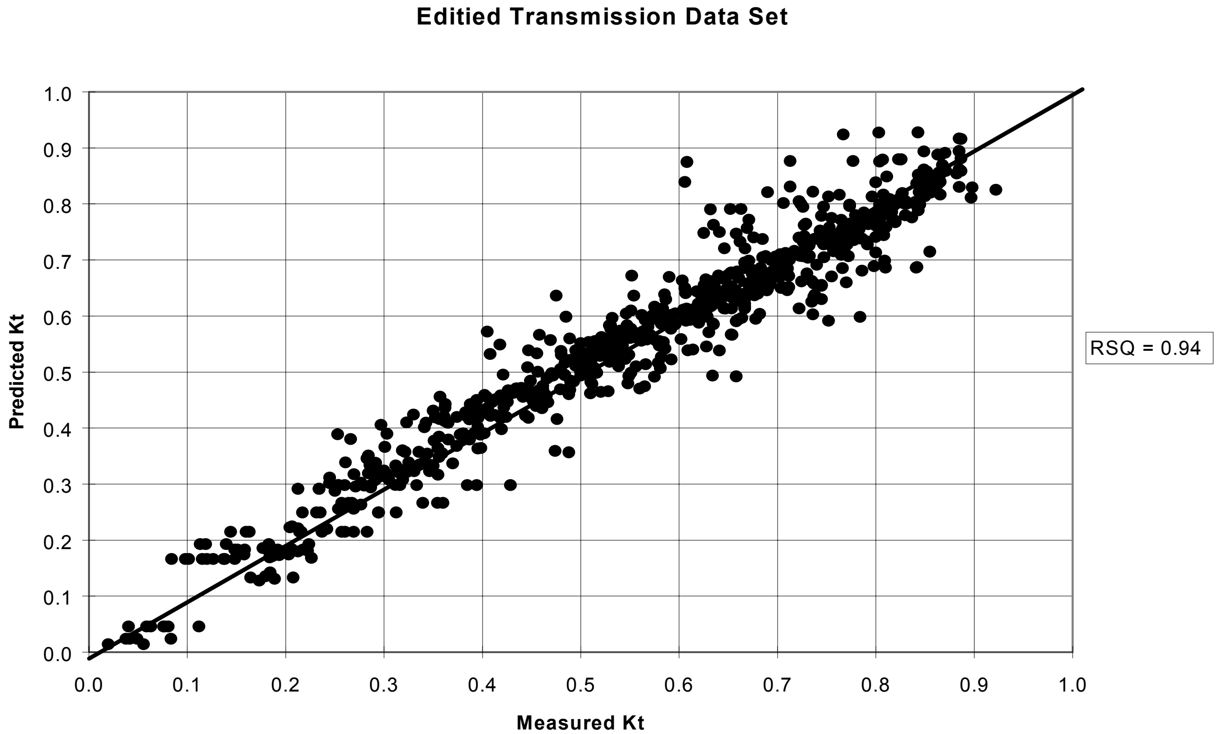

Figure 1. Edited Transmission Data Set

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