CHAPTER 138

WAVES GENERATED BY LARGE SHIPS AND SMALL BOATS

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The peak wave energy in a system of waves resulting from the passage of a ship is of importance in such problems as bank erosion, the motion of moored vessels, forces on fixed and floating docks, etc With respect to the bank erosion problem, the question often asked is whether the single passage of a large ship during a day, for example, is more damaging than numerous passages of small pleasure craft during the day With this in mind this study was conducted to determine the relative importance of the peak energy resulting from the passage of a Mariner class cargo ship and a pleasure cruiser The characteristics of these vessels are as follows

TABLE 1 MODEL CHARACTERISTICS

	Scale	Overall length (inches)	Beam (inches)	Draft (inches)	Total Displacement (lbs)
Mariner class cargo ship	1 96	70 75	9 25	3	37 32
Cruiser	1 16	48 75	-	2	24 91

The characteristics of the waves generated by these vessels moving at various speeds in deep and shallow water were determined from towing tests in a model basin (Ref 1)

The energy density or total energy per unit surface area is equivalent to the mean-square-height of the waves The value of this term in a finite wave train varies with distance outward from the sailing line From the point of view of the design of the banks of navigable channels and forces on docks or moored vessels, the peak wave energy associated with the maximum wave height in a wave train is of importance For example, Figure 1 shows the peak energy density, H_m^2, at various distances from the sailing line resulting from the cruiser model moving through shallow water (prototype depth = 5 5ft) at various speeds (Froude Numbers) It is obvious from Figure 1 how important the ship speed is in generating high waves,

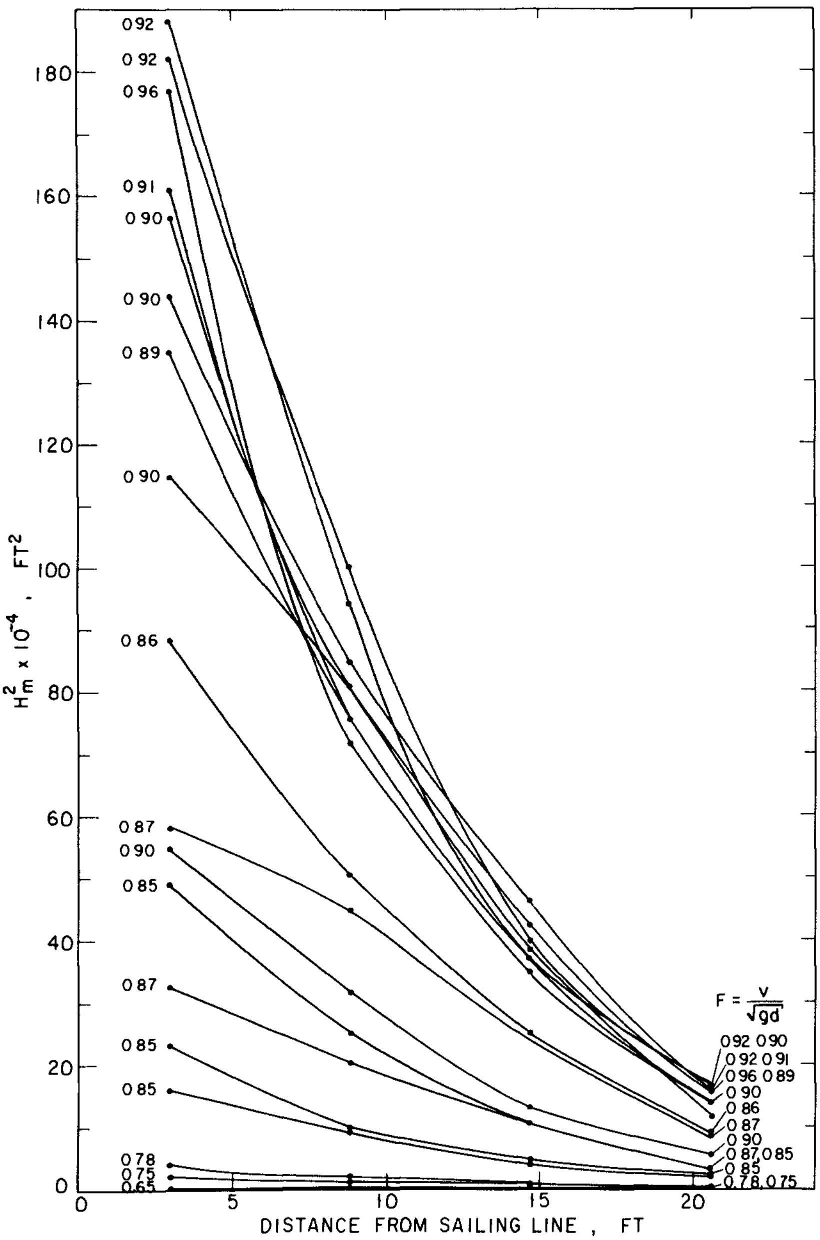

FIG 1 H_m^2 AS A FUNCTION OF DISTANCE FROM SAILING LINE WITH FROUDE NUMBER AS A PARAMETER FOR CRUISER MODEL IN SHALLOW WATER

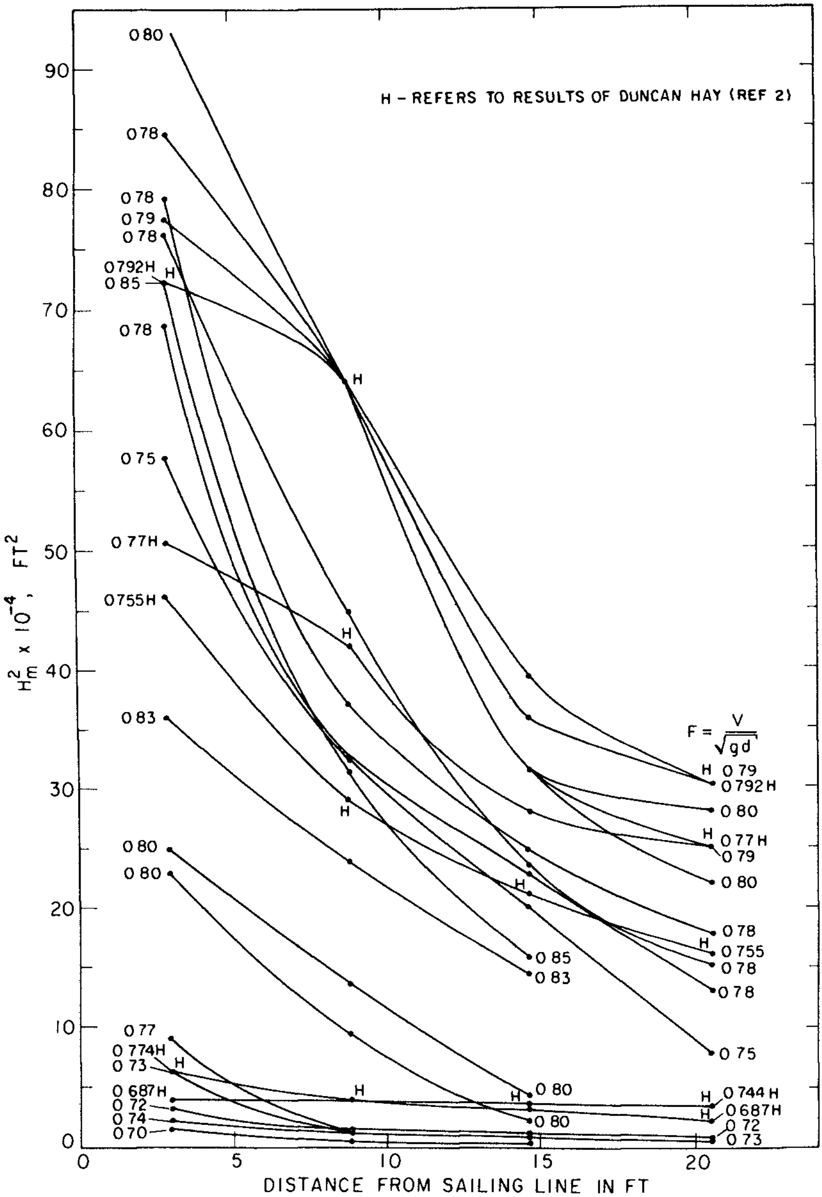

FIG 2 H_m^2 AS A FUNCTION OF DISTANCE FROM SAILING LINE WITH FROUDE NUMBER AS A PARAMETER FOR MARINER MODEL IN SHALLOW WATER

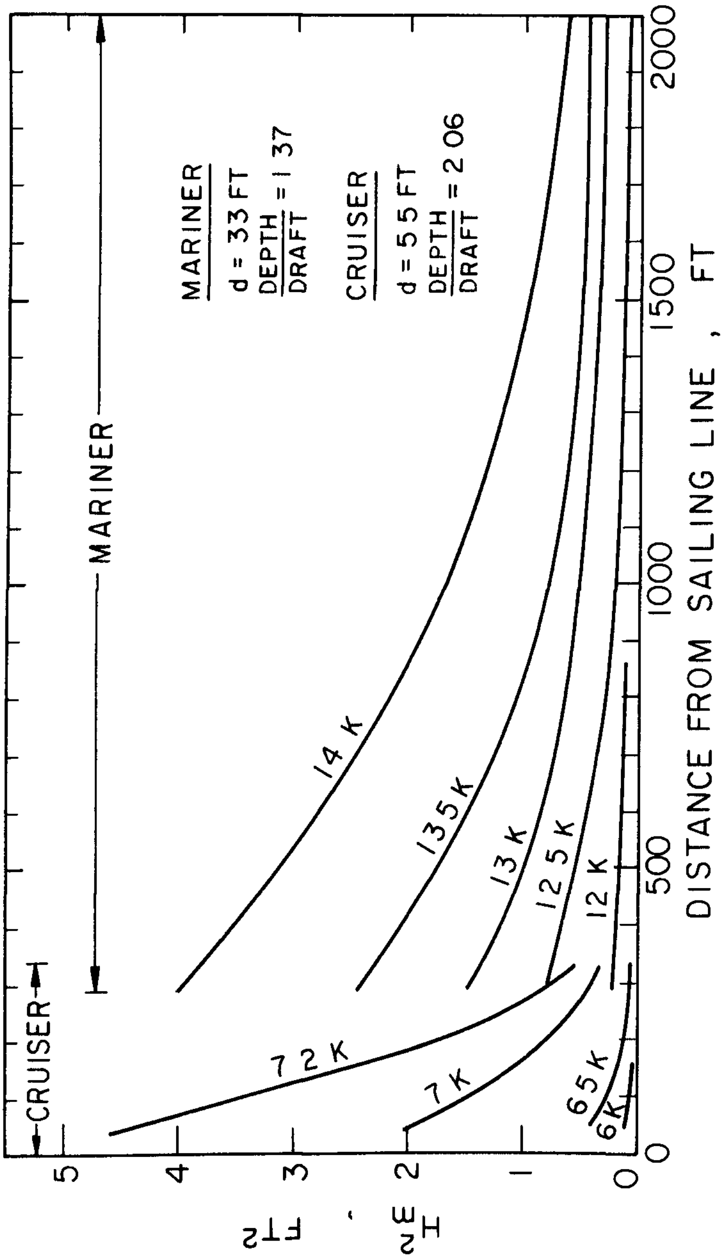

FIG 3 PROTOTYPE VALUES OF H_m^2 AS A FUNCTION OF DISTANCE FROM THE SAILING LINE WITH SHIP SPEED IN KNOTS AS A PARAMETER FOR A CARGO SHIP AND A CRUISER OPERATING IN SHALLOW WATER

particularly near the sailing line Figure 1 also shows that the peak energy density is reduced by about 90 percent at a distance of five ship lengths from the sailing line for high ship speeds

A plot similar to Figure 1, shown in Figure 2, is for the cargo ship model also moving in shallow water (prototype depth = 33 ft) It is obvious from Figures 1 and 2 that the wave-making resistance of the cruiser is much greater than the cargo ship, especially at high speeds and near the sailing line A cross-plot of data from the tests on the two models in prototype values is shown in Figure 3 where H_m^2, a measure of peak energy density, is given as a function of distance from the sailing line for various ship speeds in knots In both instances the models operated under shallow-water conditions, that is, a low value of the ratio of water depth to ship draft Comparisons of peak energy density for the two vessels can be made from Figure 3 For example, the cruiser travelling at 7 knots creates the same peak energy density at 150 ft from the sailing line as does the cargo ship travelling at 13 knots at 500 ft from the sailing line Another comparison is that at 300 ft from the sailing line the cruiser travelling at 7 knots creates the same peak density as the cargo ship does when travelling slightly more than 12 knots It therefore appears from these comparisons that for vessels of the sizes used in this study that small boats can induce more serious wave conditions than can a large ship

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