GEIGER ENGINEERS

Geiger Gossen Hamilton Liao Engineers P.C.   New York/Bellingham

11 April 1996

Mr. Harry Jones
Bellingham Marine Industries, Inc.
'C' & Maple Streets
Bellingham, WA 98227

Subject: Bridgehaven Marina, Port Ludlow, WA   GGHL#96801-05
             Wave Study

Dear Mr. Jones:

Per your request, Geiger Engineers has performed a brief analysis of the wave climate at the above referenced marina. The procedures outlined in the 1984 <u>Shore Protection Manual</u> by the U.S. Army Corps of Engineers, were used in estimating the wave climate at the site. Our study did not include a frequency of return analysis for various wind speeds. Therefore, we selected wind speeds, from 50 to 80 mph, in order to determine a range of wave characteristics. The resulting wave climate is for the vicinity of the marina's entrance. Wave refraction along the fetches and diffraction around the shoreline/breakwater have not been considered. Furthermore, we have considered the east northeast fetch to extend from the marina site to the Hood Canal Floating Bridge. It is possible that long period, low amplitude waves pass the floating bridge and travel into the Hood Canal.

The marina entrance is exposed primarily to east northeast and northeast fetches, see Figure 1. The longer of the two is towards the east northeast and is approximately 3.5 (statute) miles long. A secondary exposure is from across the canal to the east southeast with a fetch of about 1.85 miles. Water depths along all of the fetches are considered deep with the exception of Case Shoal northeast of the marina. Below are summaries of the wave conditions generated by varying winds for two fetches:

- <u>East northeast Fetch:</u> (Fetch = 3.5 miles)

Wind	Adj. wind	Hs	Tp	Lo	t
50mph	56.5mph	3.2'	3.26sec	54'	58min
60mph	69.4mph	3.9'	3.49sec	62'	54min
70mph	82.6mph	4.6'	3.70sec	70'	51min
80mph	95.9mph	5.4'	3.88sec	77'	48min

- East southeast Fetch: (Fetch = 1.85 miles)

Wind	Adj. wind	Hs	Tp	Lo	t
50mph	57.0mph	2.3'	2.64sec	35.7'	38min
60mph	70.0mph	2.9'	2.83sec	41.0'	35min
70mph	83.4mph	3.4'	3.0sec	46.1'	33min
80mph	96.8mph	4.0'	3.15sec	50.9'	32min

- where;
  Wind = fastest-mile wind speed at elevation of 33',
  Adj. wind = wind stress factor,
  Hs = significant wave height,
  Tp = peak spectral period,
  Lo = deep water wave length and
  t = minimum required duration of wind.

Attached please find a glossary of commonly used coastal engineering terms for further definitions.

Based on the photographs of the site you supplied us, the existing rubblemound breakwater serves to protect the marina from waves out of the northeast. The peninsula to the southeast of the marina protects the docks from waves originating from that direction. The breakwater appears to have deteriorated to the point that given a high tide the effectiveness of the breakwater is greatly reduced due to its low freeboard and narrow width of its crest. In addition, the eastern end of the breakwater does not appear to extend far enough to the southeast to provide the docks protection from east northeast waves which diffract around the end of the breakwater. Based on the photographs, the marina entrance appears to be quite narrow at low tide elevations so any extension of the existing breakwater to reduce the predicted diffraction problem would probably require dredging to some degree to widen the entrance.

We trust that you find the above information to be useful. If you have any questions, please do not hesitate to contact us.
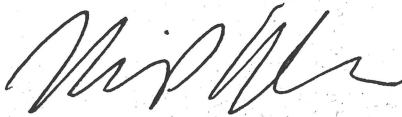
Yours very truly,
Geiger Gossen Hamilton Liao Engineers PC

William A. Haynes, P.E.

Kris P. Hamilton, P.E.

Attachments