International Journal of Offshore and Polar Engineering
Vol. 4, No. 3, September 1994 (ISSN 1053-5381)

Prediction of Wave Effects on the MOLIKPAQ Platform

Michael Isaacson*
Department of Civil Engineering, University of British Columbia
Vancouver, British Columbia, Canada

Ken Gaida
Gulf Canada Resources Ltd., Calgary, Alberta, Canada

ABSTRACT

Computations of wave loads and runup for the MOLIKPAQ platform have been carried out on the basis of linear diffraction theory for four configurations corresponding to several water depths, both with and without a berm present. Maximum loads and runup are obtained for a series of regular wave conditions, and for six sea states corresponding to specified wave spectra. Parametric results are provided, and a procedure which utilizes these to provide estimates of maximum loads and runup for any other specified depths and wave conditions is indicated. In developing the wave loading results, comparisons have been carried out with results based on alternative methods applicable to a vertical axisymmetric structure, and to a vertical cylinder of arbitrary section. Such results have been found to be consistent with those obtained by the three-dimensional diffraction method. Other effects which are considered include those due to wave breaking, wave nonlinearities, currents, and wave direction. For many of the sea states considered, the maximum loads and runup are limited by wave breaking, so that particular attention is given to the inclusion of associated limits in the calculation procedure. Overall, since the structure was designed to withstand relatively high ice loads, the assessment has indicated that the structure is well-suited for deployment at sites exposed to relatively severe wave conditions.

INTRODUCTION

The MOLIKPAQ platform was deployed by Gulf Canada in the Beaufort Sea in 1984. It is a year-round drilling platform for use in the 15- to 50-m water depth range of the Beaufort Shelf. The engineering and construction required to deploy the MOLIKPAQ have been described by Jefferies et al. (1985), and Jefferies and Wright (1988). The platform itself corresponds to a steel caisson with an octagonal platform and a simply supported deck housing the drilling rig, accommodation modules, etc. Historically, it has served as a drilling platform intended to be used at any one location for only about a year, and can be deballasted and refloated for relocation to a new site. The caisson can be deployed in water depths up to 20 m without a berm. It has been utilized in water depths of 32 m in the Canadian Beaufort Sea by setting it on a prepared sand berm.

The core of the caisson is filled with sand to provide sufficient mass to resist lateral loads. The system was designed to take account of vertical loads, which include the live load and the systems' dead weight, and horizontal loads comprising of ice, earthquake and wave forces. The MOLIKPAQ's dead load when ballasted is approximately 320 MN, while the sand-fill in the core has a submerged weight of about 1,000 MN. The vertical live load is limited to about 170 MN. An extreme horizontal (environmental) load of about 600 MN was used in the design. Platform sites are ice-covered for most of the year, so that the dominant environmental load considered is due to ice, rather than earthquakes or waves. However, in view of potential applications of the platform at other locations as a drilling, production and oil storage facility, an assessment of wave effects on the platform has been carried out, and is described in the present paper.

PROBLEM DEFINITION

Description of Structure

Fig. 1 shows views of the MOLIKPAQ as assumed for the purposes of the wave loading assessment. (The structure is shown to an elevation of 29 m above its base.) Figs. 1(a) and 1(b) show plan and elevation views of the structure; Fig. 1(c) shows a detail of the elevation indicating relevant dimensions of the structure profile; and Fig. 1(d) shows a general elevation of the structure when founded on a berm. The MOLIKPAQ has an octagonal platform. At its base the structure is contained within a square of side length 111 m, with four long sides 67 m long and four short sides 31.1 m long. Four configurations have been analyzed, all corresponding to the same structure. These are:

Configuration I:	10-m draft, no berm
Configuration II:	15-m draft, no berm
Configuration III:	20-m draft, no berm
Configuration IV:	15-m draft, with a 1/7 slope berm and 30-m total water depth

The corresponding water levels relative to the structure are indicated in Fig. 1(c), and configuration IV is indicated in Fig. 1(d).

Environmental Conditions

In order to examine wave effects on the platform in a general sense, a series of wave conditions has been considered, including a series of regular wave conditions and six random sea states as follows:

(i) JONSWAP spectrum with $H_s = 10$ m, $T_p = 13$ s
(ii) JONSWAP spectrum with $H_s = 7$ m, $T_p = 10$ s

*ISOPE Member.
Received March 25, 1993: revised manuscript received by the editors January 31, 1994. The original version (prior to the final revised manuscript) was presented at the Third International Offshore and Polar Engineering Conference (ISOPE-93), Singapore, June 6-11, 1993.
KEY WORDS: Hydrodynamics, ocean engineering, offshore structures, wave forces, wave runup, waves.