Coastal Engineering, 15 (1991) 305–308
Elsevier Science Publishers B.V., Amsterdam

Discussion

Waves in a harbour with partially reflecting structures, by M. Isaacson and S. Qu[1]

COMMENTS

L. Hamm
SOGREAH – Consulting Engineers, B.P. 172, Grenoble Cedex F380422, France

(Received September 27, 1990; accepted after revision November 6, 1990)

INTRODUCTION

In this article, the authors describe a numerical method based on the approach indicated by Berkhoff (1976) for solving the problem of computing wave disturbance in a harbour of constant depth, taking into account the effects of diffraction and partial reflection on the harbour quays and jetties.

The aim of this discussion is to inform readers that the present numerical method was proposed as far back as 1961 by Biesel and Ranson and that since then it has been validated and improved at regular intervals, as described below.

DEVELOPMENT OF THE METHOD – BACKGROUND

Original statement of the method

The method described by the authors was originally set out at the 1961 I.A.H.R. Congress in Dubrovnik by Francis Biesel, whose pioneering work in the field of wave modelling is well known to all those interested in the history of this subject. The paper delivered by Biesel and Ranson (1961) deals with the case of a basin of constant depth similar to that described by the present authors. This method was then described at the I.C.C.E. in Lisbon by Barailler and Gaillard (1964) and Montaz (1964).

In the second paper, validation of the method is described along with a detailed comparison between the systematic results obtained with physical models and with the numerical model. The effect of a real thick jetty with a

[1]Coastal Eng., 14(3): 193–214.

0378-3839/91/$03.50

semi-circular roundhead having vertical or truncated cone-shaped sides is also described.

Later developments

The method has been used in many harbour studies, and this has resulted in constant improvements being made, to make allowance for:
- refraction effects due to variable beds,
- the effects of multidirectional random incident waves, and
- the effects of breaking waves, in computing longshore currents behind a breakwater.

Inclusion of variable beds

Barailler and Gaillard (1964) laid the basis for this extension of the method. In the original method, which involved a constant depth, wave disturbance was computed as being the sum of actions from elementary sources distributed along the boundaries of the harbour basin. Disturbance then radiated outwards in straight lines from these sources. In the case of variable depths, disturbance radiates along wave radii computed by the classic method described by Munk and Arthur (1952) for pure linear refraction.

The numerical method, which is much more complex than in the preceding case, is described in detail by Barailler and Gaillard (1967). This article also presents a validation of the method by comparison with the results obtained on two physical models. It should be noted that the method has recently been rediscussed by Gaillard (1988) in this journal, in relation to further extension into the breaker zone.

In 1967, the complexity of the method, taking into account the precise effects of bed variations, meant that computation times were in practice very long. A simplified method for taking into account the effects of refraction was therefore developed. This is described in detail by Gaillard (1984) and involves representing the bed schematically by means of successive horizontal layers. The computational field is subdivided into several basins of constant depth and the refraction laws are applied at the boundaries between basins when the depths differ.

This method, which is far more economical and time-saving, is the one used in most harbour studies conducted at SOGREAH.

Multidirectional random waves

Gaillard (1984) described the extension of the method to the case of multidirectional waves. This development makes it possible to take more accurate account of the effects of real waves on disturbance in harbours. This paper also deals with practical applications, and in particular with the case of total wave reflection in a channel.

Extension to breaker zone

When it comes to modelling the formation of a tombolo behind an offshore breakwater, detailed information is needed concerning the wave and associated current conditions around the structure. Gaillard (1988) reviewed the complete variable bed model, introducing energy losses due to wave breaking and the computation of radiation stresses, for which the classic Longuet-Higgins and Stewart formulae cannot be applied. The relevant formulae, taking into account diffraction and reflection effects, are given by Gaillard (1982). The method was tested on the physical model described by Gourlay (1974), including a semi-circular beach with a 10% slope, protected by a breakwater.

CONCLUSIONS

This brief description of the developments made over the past 30 years by SOGREAH engineers shows that the method set out by the authors is indeed highly useful in modelling wave propagation where harbour and coastal structures are involved.

We recommend that the authors examine the above-mentioned references in detail. This will certainly enable them to save a considerable amount of time in proceeding with the later developments that they will have to make to their own software in order to render it applicable to real complex cases.

REFERENCES

Barailler, L. and Gaillard, P., 1964. Exemples de réalisations de modèles mathématiques à SOGREAH pour les études de propagation de houle. Proc. 9th ICCE, pp. 41–45.

Barailler, L. and Gaillard, P., 1967. Evolution récentes de modèles mathématiques d'agitation due à la houle. Calcul de la diffraction en profondeur non-uniforme. La Houille Blanche, 8: 861–869.

Berkhoff, J.C.W., 1976. Mathematical models for simple harmonic water wave diffraction and refraction. Delft Hydraul. Lab., Rep. 168.

Biesel, F. and Ranson, N., 1961. Calculs de diffraction de la houle. Proc. IAHR Conf., pp. 688–699.

Gaillard, P., 1982. Kinematic and dynamic properties of diffracted waves in constant water depth. Engineering Applications of Computational Hydraulics, Vol. 1, Pitman Advanced Publ. Progr., London, pp. 131–183.

Gaillard, P., 1984. Combined refraction–diffraction calculations with directional wave spectra. Proc. 19th ICCE, pp. 1040–1056.

Gaillard, P., 1988. Numerical modelling of wave-induced currents in the presence of coastal structures. Coastal Eng., 12(1): 63–81.

Gourlay, M.A., 1974. Wave set-up and wave generated currents in the lee of a breakwater headland. Proc. 14th ICCE, pp: 1976–1985.

Montaz, J.-P., 1964. Etude expérimentale systématique en vue de l'utilisation des modèles mathématiques pour l'étude de la diffraction pure de la poule. La Hoville Blanche, 7: 785–791.

Munk, W.H. and Arthur, R.S., 1952. Wave intensity along a refracted ray. Proc. Symp. Gravity Waves. U.S. Dep. Commerce, Natl. Bur. Standards, Circ. 521: 95–108.