Dynamic Response of Linked, Moored, Floating Structures

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Abstract

The hydrodynamic behaviour of multiple floating and submerged bodies has been studied in previous work (Björkenstam & Lei 1991, Lei & Bergdahl, 1992). This three-dimensional complex problem is mainly solved in two steps. The first step consists in solving the hydrodynamic forces in the frequency domain by means of linearized diffraction theory, which considers the interaction between the bodies through the fluid. The boundary value problem involved to obtain the velocity potential on or around the bodies is solved numerically by a panel method. The second step deals with the motion response problem based on linear vibration theory. The presented dynamic model is modified to include the effect of elastic connections between the bodies, and the effect of a mooring system since the effects can drastically alter the behaviour of the floating bodies as well as the wave characteristics around the objects. In this preliminary investigation, quasi-static analysis is employed to estimate the equivalent stiffnesses of the mooring cables from their static force-displacement curves. The dynamics of and the drag force on the cables are thus neglected. Owing to the small relative movement between the bodies, the elastic connections are simply simulated as massless springs along the axes of the coordinate system. The full equation of motion is finally expressed as a harmonic oscillating system subjected to the hydrodynamic forces and the constraining forces from the external support.

An extension of the previously developed program, FB, for floating bodies (Lei, 1990) will be made in conjunction with a well-developed dynamic mooring analysis program, MODEX (Lindahl & Bergdahl, 1987). The modified source code will be applicable to a set of linked breakwaters floating in obliquely regular waves, as well as to wave power devices, consisting of a floating buoy connected to a submerged plate by some type of power take-off mechanism. The definition sketches of the problems are respectively given in Fig. 1 and Fig. 2. These two cases will be chosen as the illustrative examples to show the interaction with the neighbours, the elastic links and the mooring lines on the dynamic response.

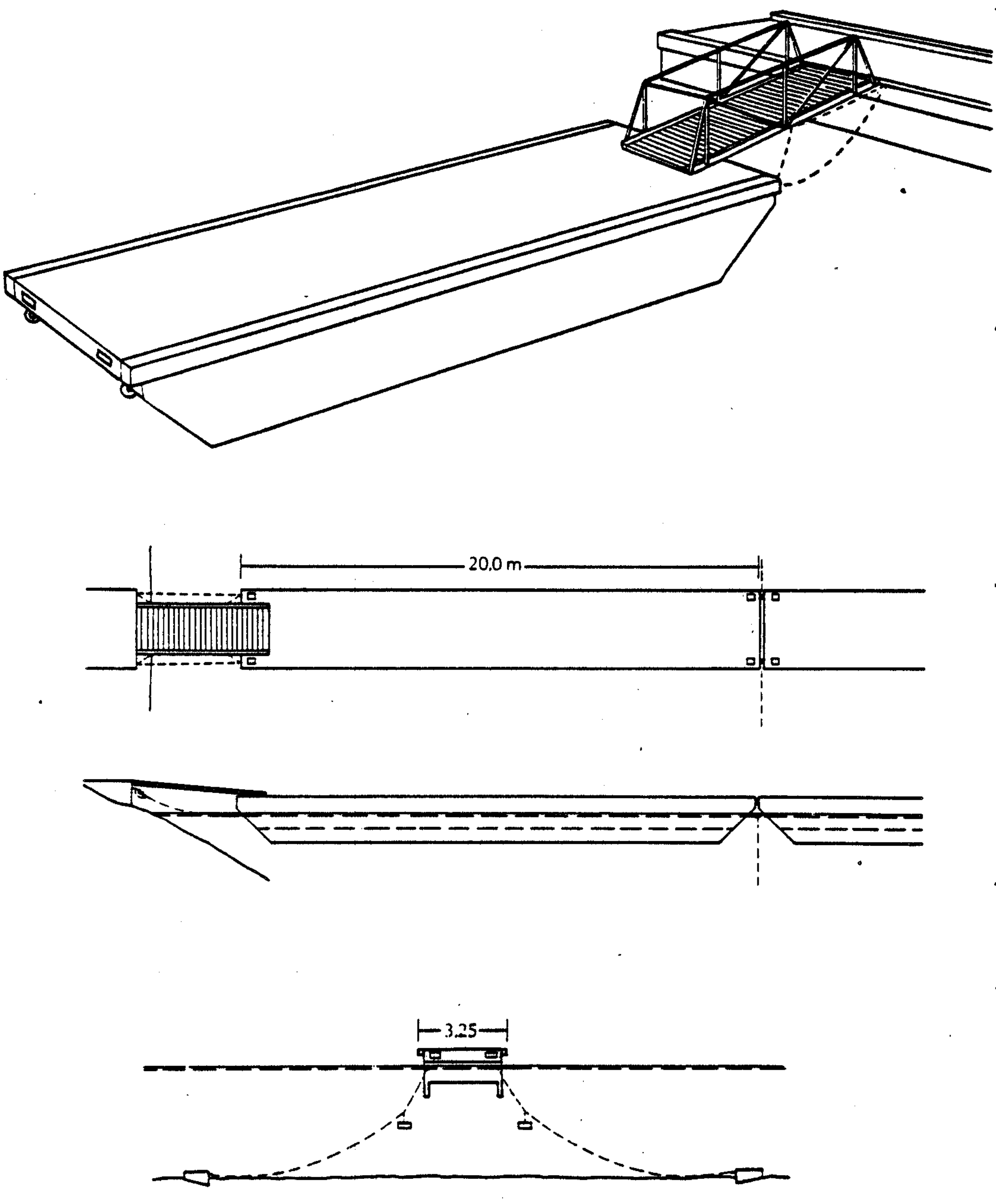

Fig. 1 Sketch of the linked floating breakwaters

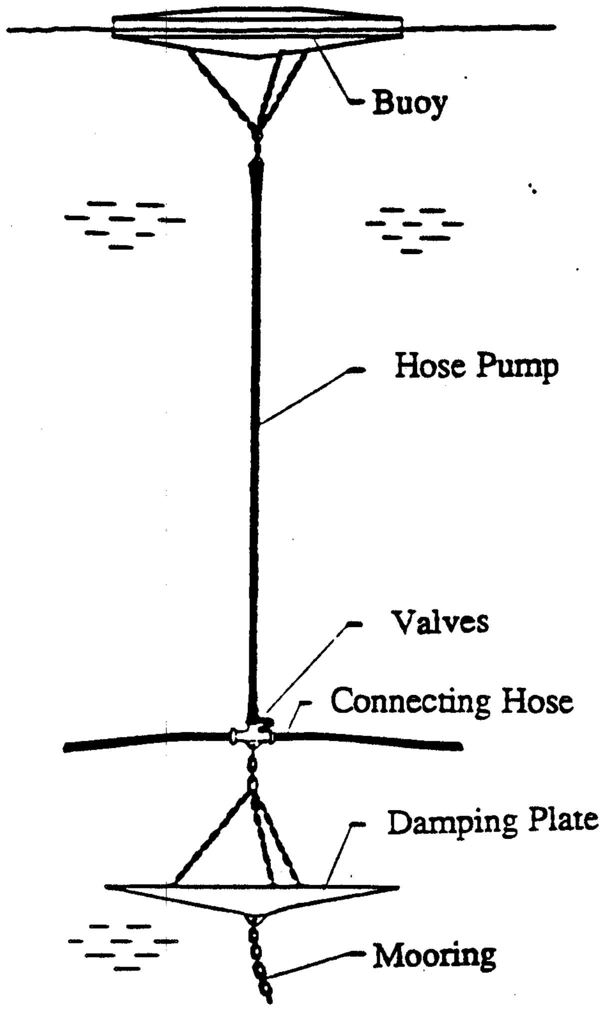

Fig . 2 Sketch of the wave power device

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