1. ASSESSMENT OF OBJECTIVES

The following three objectives were identified in the project proposal:

1. Develop a finite element program capable of modeling the dynamic response of offshore net pens for use as a design tool in the open ocean aquaculture industry.

2. The accuracy and validity of the finite element code developed in the first objective above was to be assessed by comparing the numerical results with experiments on test structures conducted at the University of New Hampshire.

3. Reliability analyses of existing net pen designs were to be performed using the finite element code developed in the first objective.

Of the three objectives listed above, the first two objectives were successfully met, while the third was not.

Objective #1

To address the first objective, a finite element program was developed for predicting the dynamic response of entire offshore net pen systems. The capabilities of the code are reported in Gosz et al. [1]. In addition, a Java based graphical user interface was developed to make the program easy to use. Modules were developed create fully three-dimensional rendered animations of the motion of the net pens including the surface wave motion. The code is presently being for research and educational purposed at the Illinois Institute of Technology. Ocean Spar Technologies [2] is also using the code for the development and design of mooring systems, trawl nets, net pen systems. They are also using the code to help market their products and to train customers in their proper use. The code has been used extensively to assess the performance of various classes of net pen systems commonly used by the open ocean aquaculture industry. Two of such net pen designs analyzed were the Ocean Spar cage and a gravity cage shown in figures 1 and 2 below.
Fig. 1. Finite element simulation of Ocean Spar cage.

Fig. 2. Finite element simulation of a Gravity cage.

**Objective #2**

To address the second objective scale model tests were carried out in the wave tank at the University of New Hampshire. Professors Rob Swift and Barbaros Celikkol of the University of New Hampshire coordinated this effort along with graduate students M. Palczynski and D. Michelin. In this experimental effort, a simple test structure with a single mooring system was constructed. The structure was then subjected to surface waves of varying heights and frequencies. The motion of the cage was recorded using optical techniques. A description of the experimental setup as well as the results are reported in Swift et al. [3]. A finite element model of the test structure was then created and numerical simulations were carried out both at the University of New Hampshire and the Illinois Institute of Technology. The comparisons between the numerical and experimental results are reported in [3] and [4]. Overall, very good agreement was obtained between the numerical and experimental results.
**Objective #3**

The third objective indicated in the project proposal is the only objective that was not met. During the course of the research, no reliability analyses were carried out. This task is still something we plan to do in the future.

2. NEW RESEARCH DIRECTIONS

During the course of the project, new research areas were identified and pursued. A list of these areas is provided below:

1. Analysis of flow-induced vibrations of cables and other flexible structures subjected to fluid flow.

2. Analysis and simulation of trawl nets for cost and shape optimization.

3. REFERENCES


4. PUBLICATIONS AND PRESENTATIONS TO DATE


243-250. ASME International Congress and Exposition, November 16-21, 1997, Dallas, Texas.


5. NAMES AND MAJORS OF STUDENTS SUPPORTED

Ken Kestler, University of New Hampshire, Mechanical Engineering
Mike Palczynski, University of New Hampshire, Mechanical Engineering
Michelin, Derek, University of New Hampshire, Mechanical Engineering
Ahsan Faiz, Illinois Institute of Technology, M.S., Mechanical Engineering

6. TITLES OF THESES COMPLETED OR IN PROGRESS