

Chapter 10

Modeling of Offshore Aquaculture Floating Structure for Macro Algae Oceanic Cultivation

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ABSTRACT

Seaweed farming has become one of the economically important natural resources. The existing cultivation system for seaweed is not suitable for deployment in deep and open water areas. Moreover, the current cultivation system is not environmentally sustainable and is economically unstable. This chapter describes the design of the offshore floating structures scientifically based on improvement of the Long Line System for commercialized scale seaweed farming. Some key factors in the design, prototype, and testing of floating offshore structures considered in the development of ocean farming technology systems are discussed.

INTRODUCTION

Recent time shows trend where the concept of VLFS is becoming increasingly popular all around the world, especially in land-scarce island countries and in countries with long coastlines for a number of reasons. VLFSs has been constructed and/or can be built to create floating airports,

bridges, breakwaters, piers and docks, storage facilities (for instance for oil), wind and solar power plants, for military purposes, to create industrial space, emergency bases, entertainment facilities, recreation parks, sewerage treatment and waste disposal plants, nuclear power plants, mobile offshore structures and even for habitation. In fact, the last could become reality sooner than one may expect: already different concepts have been proposed for building floating cities or

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huge living complexes. As a result, this sector has received a lot of research interests in recent years.

Design of very large floating structure for seaweed cultivation project is a socio-economic being carried out as collaboration between UMT, Technip and Bureau Veritas towards developing offshore aquaculture marine technology platform that will provide supplementary income to fishermen in rural areas by selling seaweed as a cash crop and enhanced effective use of ocean resources. Beside the benefits of developing local capabilities and hands-on learning, this study is partly funded using funds for sustainable development.

The project involves design of the mooring system used to anchor and provide station keeping for the seaweed plantation platform to the sea-floor in order to prevent tangling of the seaweed and excessive movement of the platform. The project involve technology transfer from offshore industry to design floating platforms for offshore aquaculture, carry out model tests at UTM Lab towing tank facility with appropriate equipment and instrument to determine the hydrodynamic coefficients of different components, especially the seaweed, for use in design of the mooring system. The determined coefficients are used to design the configuration and appropriately size components of the mooring system.

The system design employed industry guidelines such as API RP 2SK, BV and DNV specification on how the data is to be used to design the station keeping (mooring) system including anchor piles and mooring components like shackles, chains, wires, ropes, etc. that make up the system, to assure the system is strong enough to withstand the expected loads and maintain required factors of safety.

Design for ship and offshore performance depends on geometric shape/form factor, load on the system and environmental load on the system factor data, some of which are available from historical and experimental data. However, in case of seaweed, the seaweed interacts directly with the environment, compare to other marine structure

where the structure has close interaction the environment, also available data on the hydrodynamic loading is lacking. Neither are there any known computational tools which can readily simulate the loads on such flexible, buoyant structures. So, the best way to quickly obtain such data is through the use of model tests. For this purpose, samples of seaweed cultures is subjected to static and dynamic tests for the purpose of determining the equivalent added mass and damping coefficients. The test result are then applied in typical software tools to design a mooring system for seaweed which has a good chance of surviving the expected metocean conditions for which it has been designed.

POTENTIAL OF SEAWEED

Seaweed farming has become an economically important natural resource. It has wide application potentials similar to other commodities such as palm oil and cocoa. Its application found uses product such as cosmetic, medicine, gelatine, food, and biomass energy source. There is currently a worldwide requirement to produce large amounts. However there is currently no proper system to deliver this demand (Kaur, 2009).

This chapter discusses a solution to overcome the problem of deep water and open water environment by proposing a design of offshore floating structure for seaweed farming. This study introduces an appropriate optimised design of the 'Long-Line Cultivation Method' for seaweed cultivation that meets current demand. The new design of floating structure for seaweed ocean farming will improve seaweed culture efficiency and its adoptability and continuity of its operation.

CONCEPT OF VLFS

The Mobile Offshore Base (MOB) and Mega-Float, are typical Very Large Floating Structure

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