



SUSTAINABLE CIVIL INFRASTRUCTURE DEVELOPMENT: CASE STUDIES

(Second Edition)

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Sustainable Civil Infrastructure Development: Case Studies

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Chapter 25

Hydrodynamic Response of an Offshore Floating Wind-Solar-Aquaculture System

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Abstract

This study presents a new concept design combining a solar array with a floating steel fish-farming cage. This combined solar and aquaculture system is intended to utilize the ocean space and water resources more effectively and

more economically, while greatly shortening the payback period of investment in offshore power generation. The details of this solar and aquaculture design are described, showing that a square-shaped fishing cage serves as a floating foundation for the 7600 m² solar array. ANSYS Design Modeler and Aqwa are used to perform the hydrodynamic response analysis of free-floating condition of solar and aquaculture in the time domain and frequency domain and coupled analysis involving solar and aquaculture and the mooring lines in the frequency domain and time domain. The motion RAOs indicated that the proposed concept possesses effective hydrodynamic seakeeping performances. A potential site located in the Bay of Bengal is selected to deploy the solar and aquaculture system. Its feasibility is then examined in terms of the hydrodynamic motions and structural dynamic response driven by waves and current. Fully coupled time-domain simulations are carried out for 50-year survival conditions. The whole structure exhibits outstanding performance for its small motions in random seas. Technically, the solar and aquaculture system has strong competitiveness and wide prospects in the offshore industry for both power exploitation and marine aquaculture in intermediate and deep waters.

Keywords: Floating foundation; Offshore fish farming; Combined solar-aquaculture system; Hydrodynamic analysis and Responses

I. Introduction

This study is focused on the hydrodynamic analysis for a Wind Solar Aquaculture (WSA) offshore structure shown in Figure 25.1); which are being used in blue economy for support economy of a country.

The WSA structure operation are secured to use of mooring line. The moored system of a structure made the study of hydrodynamic response. For renewable energy like wind, solar the structure should be a special and cutting edge system and the structure should combine with net steel cage that is helpful for fish farming.

This floating platform support the economy like a foundation support a building, which also includes solar, wind energy systems and fish farming space. This platform is fixed under the sea ground surface and electricity will be produced by the vertical axis wind turbines (VAWTs) and by the solar panels. The power should help the structure to run aquaculture system. Fish farming cage in this cage make this structure economical structure. WSA structure is involved for blue economy, blue economy means the sustainable use of ocean resources for economic growth of a country that will help to improve

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Basu Bhowmick is an undergraduate student in department of civil engineering from Dr. B. C. Roy Engineering College, Durgapur, West Bengal (2020-2024 Batch).



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M K Loganathan has been awarded a PhD from Indian Institute of Technology, Delhi, India and undertook Post-Doctoral research from Chang Gung University, Taiwan. He has significant experience in senior positions, both in the industry and academics. He has remarkable research contributions, including sponsored research funding & industrial consultation, peer reviewed publications, supervising Master and Doctoral students, etc. His areas of research include reliability and maintenance of infrastructure, renewable energy, coastal environment, among others.



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