JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

AN ANALYSIS OF COASTAL STRUCTURE FOUNDATION FOR WIND TURBINE

VIPIN GAUR[1],VIKAS GARG[2]

*1,M.Tech Scholar (Department of Structural Engineering),GRIMT, Radaur (Kurushetra University), Kurushetra, Haryana, India

*2.Assistant professor (Department of Civil Engineering),GRIMT,RADAUR ,YAMUNANAGAR,HARYANA,INDIA

I.INTRODUCTION

Wind energy has proved to be one of the best options for electricity generation. Our future is to increases the production of clean and sustainable energy. In the near future these production has caused the search for alternative sources of energy to usual hydroelectric, fossil fuel or nuclear. This type of energy is presently the fastest growing energy technology in the world. Offshore generation utilizes the higher wind speeds offshore. A wind turbine referred to as a wind energy converter, is a device that converts the wind's kinetic energy into electrical energy. Wind turbines are manufactured in a wide range of vertical and horizontal axis. The smallest turbines are used for applications such as battery charging for auxiliary power for boats or caravans or to power traffic warning signs. Larger turbines can be used for making contributions to a domestic power supply while selling unused power back to the utility supplier via the electrical grid.

The First Offshore Wind Project of India (FOWPI) is part of the "Clean Energy Cooperation with India (CECI) ", which aims at enhancing India's capacity to deploy low carbon energy production and improve energy efficiency, contributing to the mitigation of global climate change. Project activities will support India's efforts to secure the energy supply security, within a well-established framework for strategic energy cooperation between the EU and India.

FOWPI is planned to achieve the first 200MW sized offshore wind farm near the coast of Gujarat, 25km off Jafarabad. Project will emphasis on bringing the vast experience of offshore wind rich European countries to India which aims to provide technical assistance for setting up the wind-farm and creation of a knowledge centre in the country. FOWPI will be led by COWI A/S (Denmark) with key support from . FOWPI will focus on finalization of design and technical specification of the wind farm including foundation, electrical network, turbines etc.

In this project the geotechnical engineering has a very important role to play in terms of providing the best technical, environmental and economic solution. The latter is maybe the key for the success of the project in terms of competitiveness. In the wind farm project the cost of the foundations has been estimated between 15% and 40% of the total installation cost.

Figure 1.1: Wind Turbine Offshore Structure

1.2 FOUNDATIONS

Marine foundations are used to transmit structural design loadings to the subsoil. The type of foundation element to be employed will depend on

(1) The nature of loading

(2) The stiffness and strength of the surface sediments

(3) The desires of the builder

The two major foundation types are those that employ a surface loading mechanism like shallow foundations and those that extend down through the surface sediments to a lower layer like deep foundations. An example of a foundation system for surface loading is the mat used on a gravity platform. The deep pile that is used on a jacket platform is an example of a deep foundation system.

Wind turbine tower is a typical high-rise structure building. The average wind tower height on earth is around 90m – 130m.The wind turbine foundation bears the load transmitted from the wind turbine tower and the turbine on the top, especially the huge overturning moments. For each type, foundation can be both in round shape or in octagon shape. The diameter ranges from 15m to 22m.For offshore wind turbine tower.

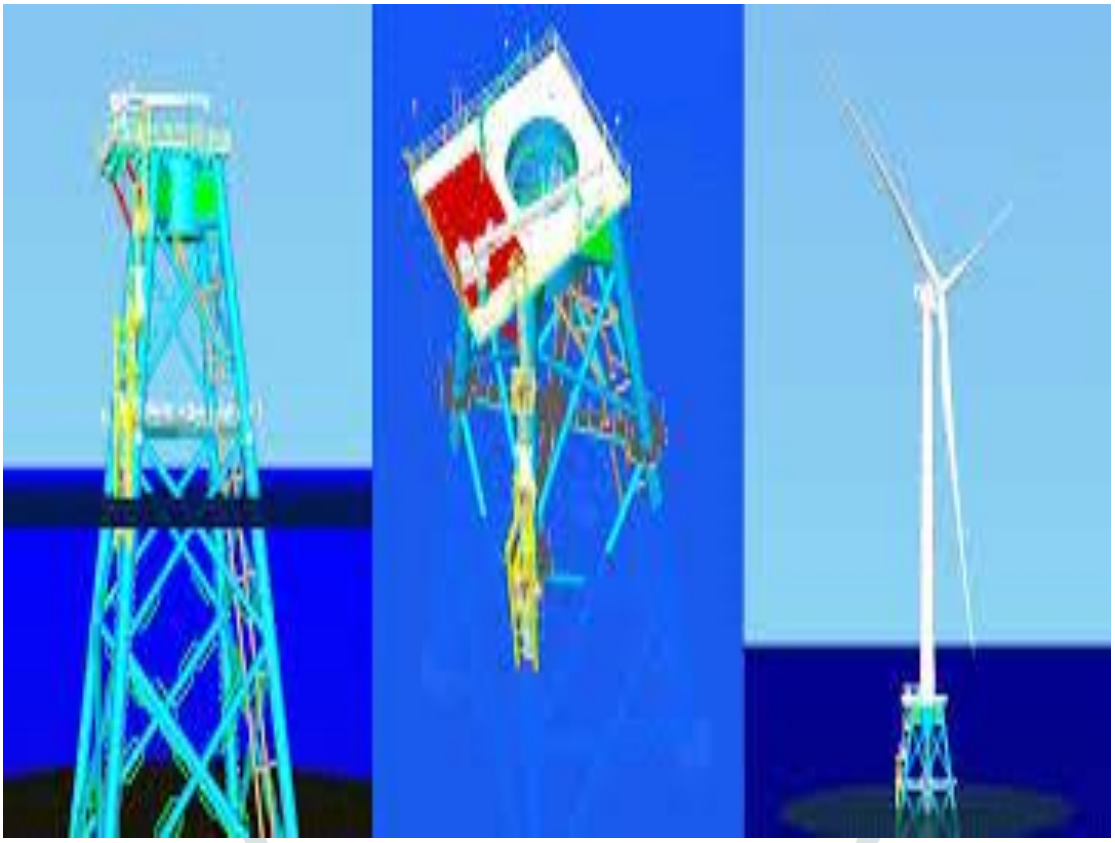

Fig 1.2 Foundation of Wind Turbine

1.3 OBJECTIVE OF THIS STUDY

- The main purpose of offshore wind turbine foundation design is to produce safe, functional structures that can withstand loads structure. The most important difference from other structures of offshore structure is difference in operating and manufacturing zone and structure is exposed to different loads at different stages.

2. LITERATURE REVIEW

In this report following the literature review, the rig and sand used will be detailed. Subsequently the results of the bearing capacity tests for model caissons of different length of skirt and different sand densities will be given and analyzed.

Subhamoy Bhattacharya (2019): Design of Foundations for Offshore Wind Turbines is a comprehensive reference which covers the design of foundations for offshore wind turbines. He gives an overview of a wind farm and a wind turbine structure and compares with Offshore Oil and Gas Structures and examines the different types of loads on the offshore wind turbine structure which also includes seismic loads. This study focuses on the modes of vibrations, design considerations and the necessary calculations required. It covers the geotechnical site investigation, cyclic behavior of soils, cyclic and dynamic soil structure interactions. He takes a case study of a wind turbine and demonstrates how to carry out step by step calculations, estimating the stiffness of different types of foundations, estimating loads on foundations for monopile, jacket and floating cases, estimating natural frequency of system.

M. Dolores, Joes santos (2014): studied the difference between supports system and foundation type of offshore structure. This study also introduce new issue in research for future like wave theory, wave load action, scour process etc. They explain essentials factors for foundation design like soil characteristics, component of foundation, effects of these loads on foundation and attain stability of foundation. They also studied the design life of offshore structure according to the wave theory.

3.EXPERIMENTAL PROGRAM

3.1 FOUNDATION COMPONENTS FOR OFFSHORE STRUCTURE

The jacket foundation is provided by open-ended tubular steel piles, with diameters up to 2m. The piles are driven approximately 40 - 80 m, and in some cases 120 m deep into the seabed. There are basically three types of pile/jacket arrangement.

Axial load resistance is required for bearing as well as for tension. The pile accumulates both skin friction as well as end bearing resistance.

Lateral load resistance of the pile is required for restraint of the horizontal forces. These forces lead to significant bending of the pile near to the seabed.

Number, arrangement, diameter and penetration of the piles depend on the environmental loads and the soil conditions at the location.

Several foundation components are available for wind energy offshore towers:

- Gravity-type
- Monopile
- Jacket-pile
- Tripod
- Suction caissons

FIG3.1: OFFSHORE STRUCTURE PILE DRIVEN METHOD

4.PROBLEM FORMULATION

4.1 STAAD REPORT BASED ON ANALYSIS

STAAD reports are based on modeling, member incidences which make the structure skeleton. To make the structure identical material, loads, supports are provided to structure. Reports are generated only when all the assumption and loading conditions are absolutely correct. In main menu bar RUN command will gives a report after post processing. This report is generated with zero error, hence our assumptions are correct and structure is safe for structural point of view.

By using STAAD pro v8i foundation is analyzed by 0 Error. Hence foundation is well suited to such type of site.

STAAD.Pro Report

To: From:

Copy to: Date: 23/09/2019 19:14:00 Ref: ca/ Document1

Job Information

	Engineer	Checked	Approved
Name:			
Date:	14-Sep-19		

Structure Type SPACE FRAME

Number of Nodes	617	Highest Node	619
Number of Elements	1320	Highest Beam	1399

Number of Basic Load Cases -2
Number of Combination Load Cases 4

Included in this printout are data for:
All The Whole Structure

Included in this printout are results for load cases:

Type	L/C	Name
Primary	1	LOAD CASE 1
Primary	2	LOAD CASE 2
Primary	3	LOAD CASE 3
Combination	4	GENERATED INDIAN CODE GENRAL_STRUCTURES
Combination	5	GENERATED INDIAN CODE GENRAL_STRUCTURES
Combination	6	GENERATED INDIAN CODE GENRAL_STRUCTURES
Combination	7	GENERATED INDIAN CODE GENRAL_STRUCTURES

4.2DEFLECTION OF BEAMS AND COLUMNS

Minor deflections are obtained in beams and columns. These deflections are proved balanced when wind forces and wave pressures acts over wind turbine. These deflection are negligible and structure prove safe for all type of deflection.

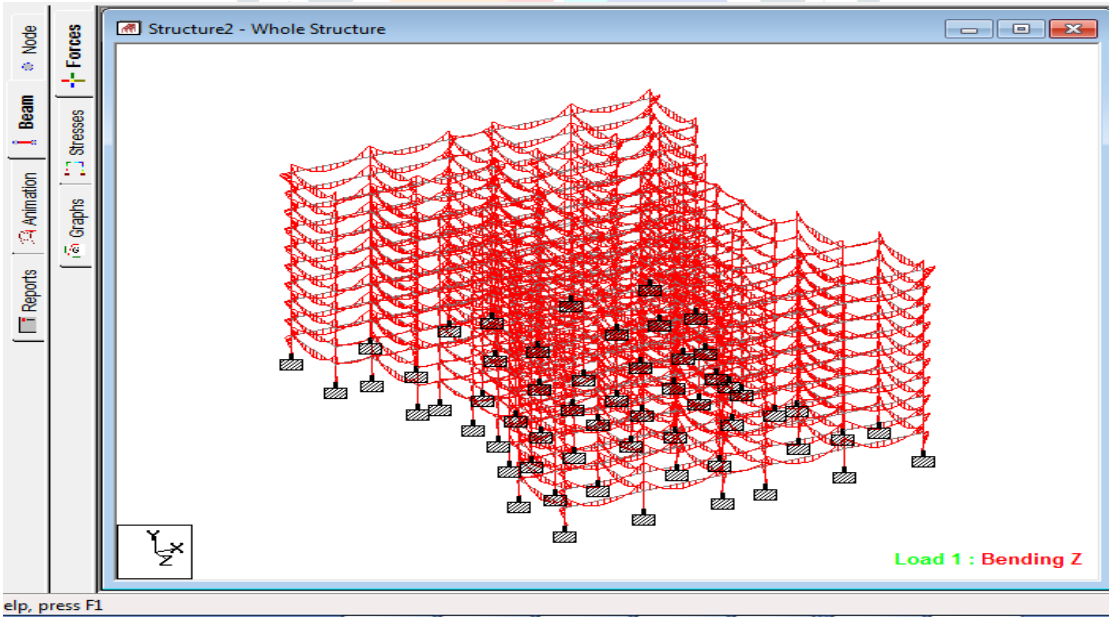

FIG 4.2: Deflection due to Shear force and Bending moments

5.CONCLUSION AND FUTURE SCOPE

In each platform ring type foundation is chosen mainly due to water depth considerably and due to the deck equipment necessary to perform its service.

Selection of offshore structures based on water depths:

a) The jack up ring - 90 m to 150 m
b) The fixed platforms - up to about 600 m
c) Semi-submersible platforms - up to 1000 m
d) The tension leg platforms - greater than 300 m to 1200 m.
e) The spar platform - more than 1800 m.

Forces on these structures due to the ocean and atmosphere include ocean waves and currents, wind, buoyancy and friction at the base. Various loading parameters are described here, which are key factors that must consider in the analysis and design of offshore structures. The present of marine growth has significant effects on the hydrodynamic loading of offshore structures and should be taken into consideration in the design and analysis of structures.
By using STAAD pro v8i foundation is analyzed by 0 Error. Hence foundation is well suited to such type of site.

6. REFERENCES

• Aggarwal, S. L., Malhotra, A. K., and Banerjee, R. (1979), Engineering properties of calcareous soils affecting the design of deep penetration piles for offshore structures, Proceedings 9th Annual Offshore Technology Conference, Houston, **3**, pp. 503–512.

• Anderson, K. H. (1976), Behavior of clay subjected to undrained cyclic loading, Conference on the Behavior of Offshore Structures, BOSS 76, Trondheim, Norwegian Geotechnical Institute.

• Anderson, K. H., Hansteen, O. L., Hoeg, K., and Prevost, J. H. (1978), Soil Deformations Due to Cyclic Loads on Offshore Structures, Norwegian Geotechnical Institute, No. 16.

• Andresen, A., Berre, T., Kieven, A., and Lunne, T. (1979), Procedures used to obtain soil parameters for foundation engineering in the North Sea, Marine Geotechnology, **3**, pp. 201–266.

• Angemeer, J., Carlson, E. D., and Klick, J. H. (1973) Techniques and results of offshore pile load testing in calcareous soils, Offshore Technology Conference, Houston, Paper 1894.