STRUCTURE VULNERABILITY AND RISK ANALYSIS OF 3-LEGGED OFFSHORE STRUCTURE

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Abstract

Peninsular Malaysia is most affected by the distant Sumatra subduction zone earthquake. Meanwhile, Eastern Malaysia was subjected to major Philippine and Indonesian earthquake. Most of the offshore platform is at Terengganu, Sabah, and Sarawak. More than 65% of the offshore platform structure exceed the range of design between 20-30 years. This research aims to determine the vulnerability and risk analysis for the existing 3-legged offshore platform under earthquake load, study the behaviors of an offshore platform under major or minor earthquake loading, and study the dynamic characteristic of an offshore platform. SAP 2000 is use to analyses and modelling the 3-legged offshore platform. In SAP 2000, the response spectrum, time history, and free vibration will be performed. The mixed load of the platform consists of dead load, imposed load, environment loads, and earthquake load. The position of the offshore platform has referred to American Petroleum Institute (API) standard. The major earthquake under off-shore platform is El-Centro and the minor is Aceh compared to time history. Based on this study, Malaysia can withstand this low seismic activity, overall joint acceleration, velocity and displacement.

1 Introduction

Earthquake is a natural disaster, the world's most destructive and intimidating. Nobody is harmed by an earthquake, but as a result of the movement of the tectonic plate, it can destroy infrastructure and victims particularly strongly and severely [1]. The physical damage caused by the earthquake is building damage either caused by the environmental condition or poor quality of the building material [2]. Hence the earthquake effects that cause buildings to collapse that also affect engineers and architects. While Malaysia was considered a low seismic region, peninsular Malaysia is most affected by the distant Sumatra subduction zone earthquake, while Eastern Malaysia was subjected to major Philippine and Indonesian earthquakes [3,4]. Be-sides that, an offshore platform is a massive structure that is floating or fixed on the ocean, it used to drill wells in the ocean bed, which to extract oil and natural gas [5,6]. There are few types of offshore platforms: Fixed platform, Compliant tower, Sea star platform, Floating production system, Tension leg platform, Sub- Sea system, and SPAR platform. Fixed offshore platforms are the best choice due to a massive amount of the extraction of oil and gas platforms in Malaysia.

In Malaysia, there have most of the offshore platform structures is operate 24 hours per day. Most of the offshore platform is at Terengganu, Sabah, and Sarawak. This offshore platform is classified into two types of offshore platforms: shallow-water offshore and deep-water offshore platforms [7,8]. Additionally, there are two categories for offshore structure platforms, which are drilling offshore platforms and offshore storage platforms. Specifically, more than 65% offshore platform structure are exceeding the range of design life, which range from 20-30 years [9]. The offshore platforms might be vulnerable to the earthquake effect, but it has to verify with the research data and to use the prototype offshore structure to support the research.

2. Literature Review

An offshore platform is a structure that is built on the seabed and is used for a variety of purposes around the world, including oil and gas exploration and production [10-12]. The design engineer must analyse whether the offshore structure can operate for more than 25 years while susceptible to sea waves. Waves and wind load are two important aspects to consider while designing an offshore building. The fixed off-shore structure is a one-of-a-kind design since it can be built out in the middle of the ocean, and its primary function is to process oil and gas production.