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Comparative Study of Structural Geometric to the Ultimate Strength on Fixed Jacket Platform

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Abstract. The brace configuration plays an important role to the ultimate strength of fixed jacket platform. The braces against the combined load in vertical and horizontal direction. In the present study, the ultimate strength of the fixed jacket platform is analysed considering the shape of the structural geometric. Four types of brace configuration namely, K, N, X and Y are taken to be assessed. Dimensions of the structure are constant including properties and materials. The boundary conditions are assumed to be fixed at the bottom part. The Non-Linear Finite Element Analysis (NLFEA) is adopted to calculate the ultimate strength of the structure and those results of brace configuration are compared with one another and discussed in the present study.

1 Introduction

Jacket platform is one of the common offshore platforms which are used at shallow and middle water. Generally, the structure has three to eight of leg because it has a good stability against the axial and lateral loads. The structure consists of three components; those are deck, jacket and pile. Deck is structural component located above water line, while jacket and pile are submerged into the water. The supported structure called jacket which functioned for exploration and other activities.

The ultimate strength has been assessed by many researches. The configuration effect of the symmetrical and unsymmetrical shape tubular member in buckling strength on fixed offshore platform has been discussed by [1]. Two kinds of offshore structures were taken to be considered in the analysis. The axial and lateral loads were imposed to jacket legs and other structural components. The material and dimensions were assumed to be constant and homogeneous. The boundary conditions were idealized to be fixed at bottom level. To assess buckling strength, the Finite Element Method (FEM) was used. Buckling and fatigue strength were assessed for jacket structures under symmetrical and unsymmetrical configuration shape. The Finite Element Method (FEM) was adopted to calculate those structures. The result obtained

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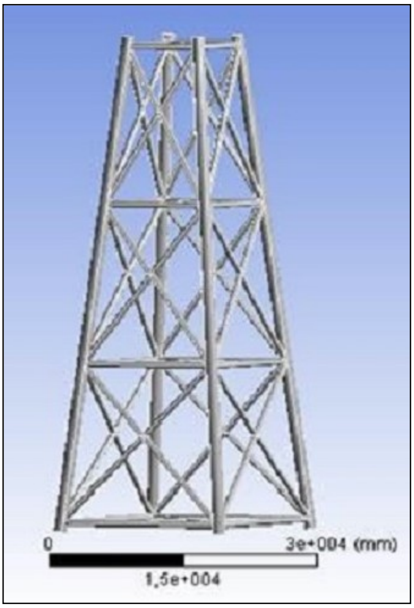
by Finite Element Analysis was compared with the analytical solution. In addition, the Response Amplitude Operator (RAO) was applied to obtain fatigue life [2]. A closed-form prediction of buckling stress in local mode, including interaction of connected elements, and distortional mode, including consideration of the elastic and geometric stiffness at the web/flange juncture was conducted [3]. A mathematical model for slip buckling and its analytical solution has been founded for the analysis of layered and geometrically perfect composite columns with inter-layer slip between the layers was proposed [4]. Also, buckling of non-uniform column was analysed using Finite Element Analysis [5]. A research and development project for structural bamboo species were investigated [6].

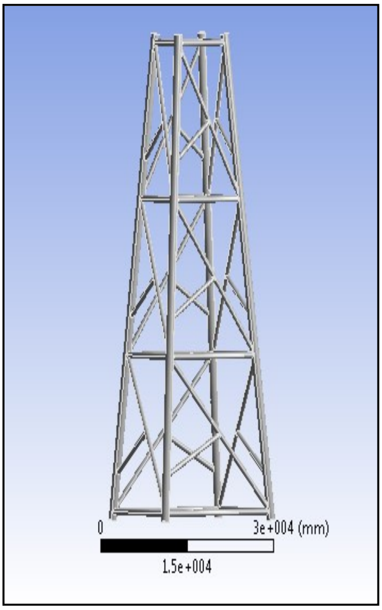
In the present study, the ultimate strength is analysed using Finite Element Method considering the configuration shape on the jacket platform. Four types of braces namely K, N, X and Y. Dimensions of the structure are constant including properties and materials. The boundary conditions are assumed to be fixed at seabed. The results of brace configuration are compared with one another.

2 Finite Element Modelling

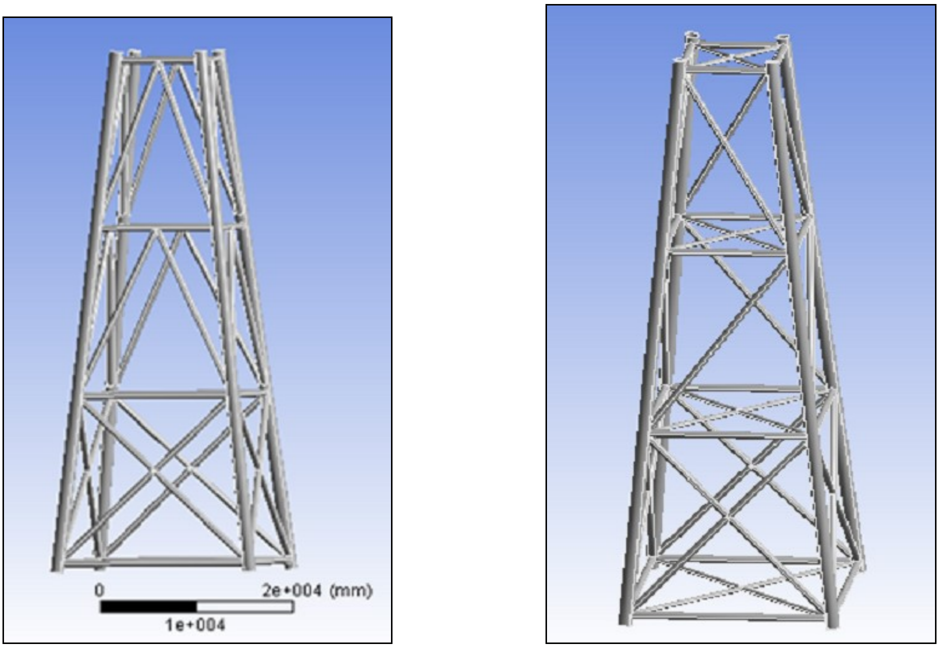
The finite element modelling of those structures considering the shape difference of the brace configurations X, Y, K and N are described in Fig. 1. The material and section properties are set to be constant. Depth and dimension of those structures are also constant. The braces configurations of those structures are illustrated in Figure 1. It should be noted that the boundary conditions at the end support on the seabed are fixed.



(a) Brace X



(b) Brace Y

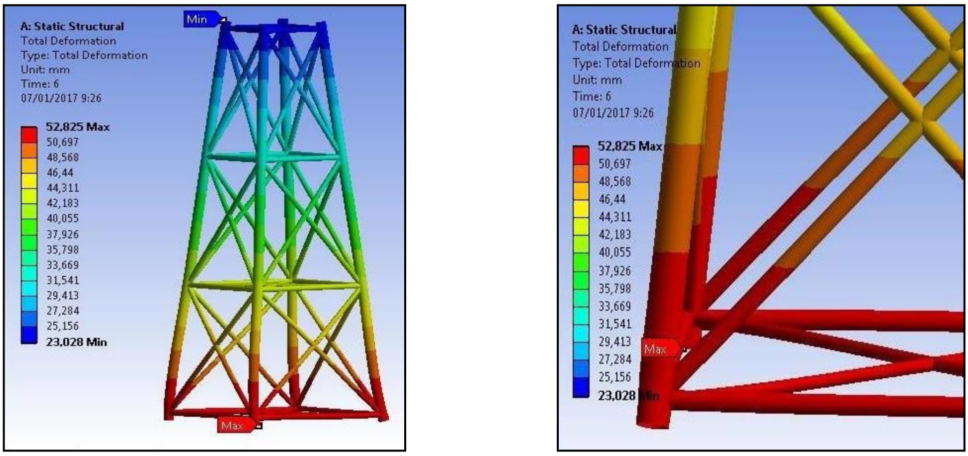


(c) Brace K (d) Brace N

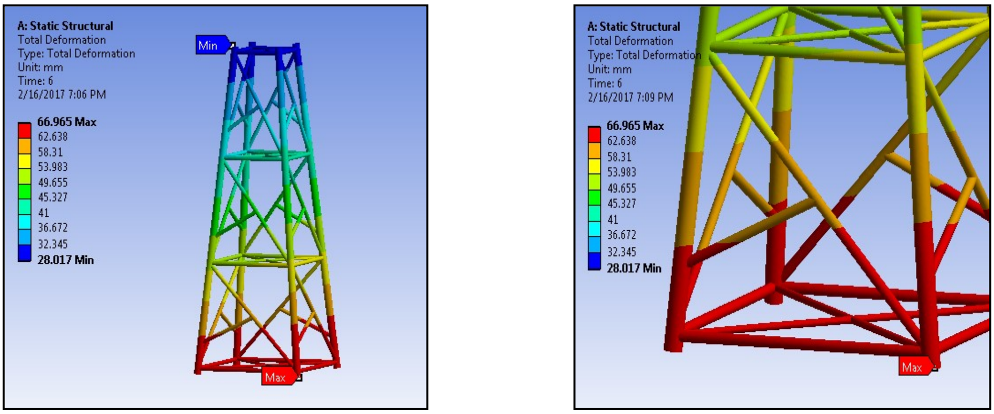
Fig. 1. Braces Configurations of Fixed Offshore Platform

3 Results and Discussions

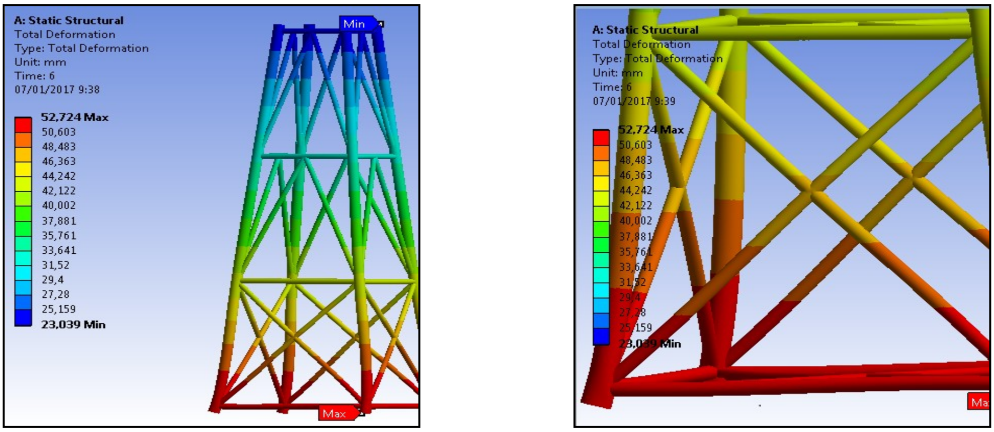
The deformation of those structures are shown in Fig. 2. It is generally observed that the maximum deformations are located near the lower part.



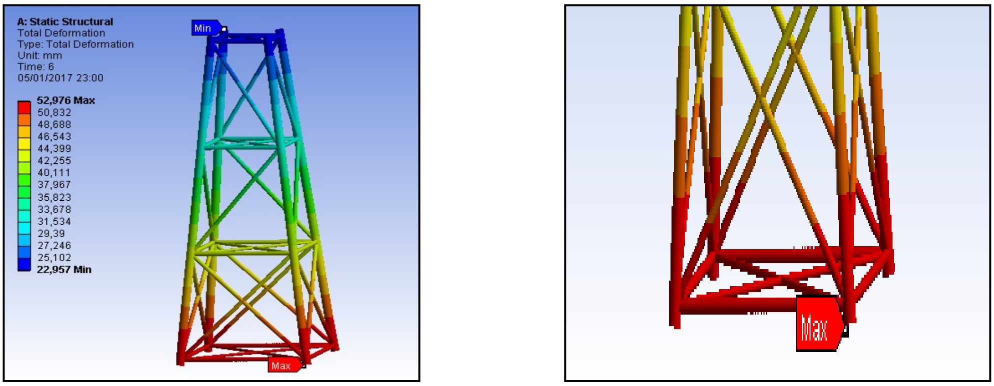
(a) Brace X



(b) Brace Y



(c) Brace K



(d) Brace N

Fig. 2. Deformations of the Structure

The maximum deformations concentrate at local part as illustrated in Fig. 2. It should be noted that the end support of the jacket legs are assumed to be fixed. The stress-strain curve relationship obtained by Finite Element Analysis for four type of fixed offshore platform are shown in Fig.3. The axial force is applied to those structure and it is distributed to all jacket legs. The stress-strain relationship of each structure with brace configuration X, Y, K and N are identical in elastic region. For plastic, the stress-strain relationship for brace-Y is significantly increased compare to brace K, N and X. The stress-strain curve of brace-Y may be caused by the configuration of the structural braces above of the Brace-X component at the lower part. It is known that the Brace-X at lower part of those structures are identical. However, the above configurations of those structures are totally different with one another. The stress-strain curve of brace-X of the structure is smaller, than followed by Brace-N, Brace-K and Brace-Y. This may due to the brace-X is more rigid for the structural component when the structure againts the vertical loading even the horizontal loading is applied to the structure. According to the result shows that the brace-Y gives larger stress compares to the others which is better for design purpose.

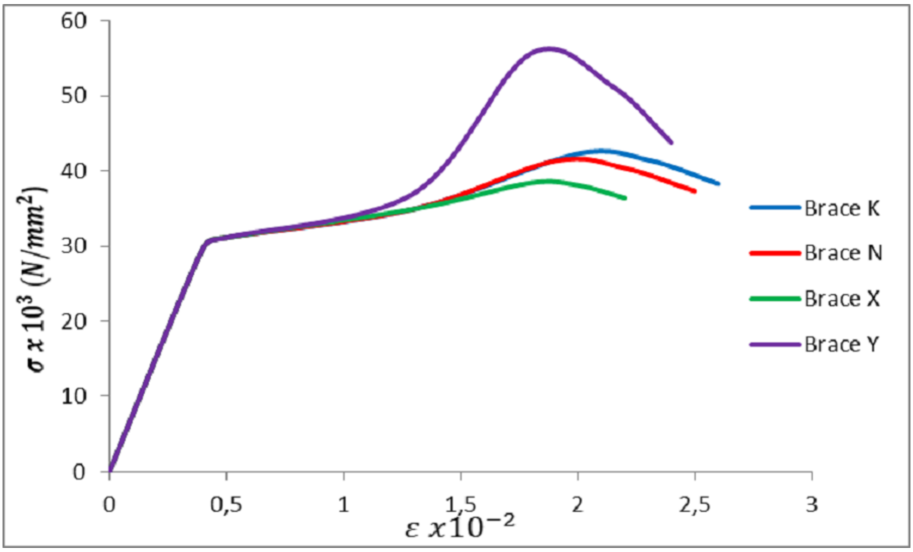


Fig. 3. Stress-strain Curve Relationship

4 Conclusions

The ultimate strength of brace-Y is significant difference compare to X, K and N braces. This phenomenon indicated by the stress-strain relationship of those structures. The characteristics of those structure both deformations and stress-strain relationship are caused by the configuration shape of the braces located at the middle and upper part.

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