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TIME HISTORY ANALYSIS OFF SHORE STRUCTURES WITH DIFFERENT BRACINGS

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ABSTRACT:- In this paper time history analysis is performed for off shore steel structures for El-centro data for 31sec.the effect of slope (different angle 0 degree,20 degree and 30 degree) is studied for various loading condition and the effect bracings (single bracings,knee bracings, cross bracings) for different loading are also studied. For FEA analysis SAP 2000 is used which observed very effective for analysis.

Keywords-Off shore structure, SAP 2000, El-Centro, Bracings

I. INTRODUCTION

The total number of offshore platform in various bays, gulf and oceans of the world is increasing year by year, most of which are of fixed jacket-type platforms located in 30 m to 200 m depth for oil and gas exploration purposes. Fixed offshore platforms are subjected to different environmental loads during their lifetime. These loads are imposed on platforms through natural phenomena such as wind, current, wave, earthquake, snow and earth movement. Among various types of environmental loading, wave forces loading is dominated loads. The results of these investigations highlight the importance of accurately simulating nonlinear effects in fixed offshore structures from the point of view of safe design and operation of such systems.

It is necessary to design an offshore structure such that it can respond to moderate environmental loads without damage and is capable of resisting severe environmental loads without seriously endangering the occupants. The standard design of the structure is carried out using the allowable stress method. However, it is important to clarify the effects on nonlinear responses for an offshore structure under the severe wave conditions. Offshore structures may be analyzed using static or dynamic analysis methods. Static analysis methods are sufficient for structures, which are rigid enough to neglect the dynamic forces associated with the motion under the time-dependent environmental loadings. On the other hand, structures which are flexible due to their particular form and which are to be used in deep sea must be checked for dynamic loads.

II.REVIEW OF LITERATURE

In 2012 B. Asgarian & H. R. Shokrgozar from K. N. Toosi University of Technology, Tehran, Iran studied the Seismic Performance Evaluation of Steel Jacket Platform with Float over Deck Systems. The results show that platforms with FOD system could not satisfy API-RP-2A design requirements in direction that braces are removed for float-over deck installation operation. So, the new bracing system was proposed for weak directions to improve the seismic performance of this type of platforms.

III. PROBLEM STATEMENT

The studied platform is a fixed Jacket-Type platform currently installed in the Suez gulf, Red sea, 1988 shown in Figure 3, The offshore structure is a four legs jacket platform, consists of a steel tubular-space frame. There are diagonal brace members in both vertical and horizontal planes in the units to enhance the structural stiffness. The Platform was originally designed as a 4-pile platform installed in 110 feet (110' =33.5 m) water depth.

• The Top side structure consists of Helideck 50'x50' at ELevation, EL. (+54') & Production deck
50'x50' at EL. (+26'); Top of jacket at EL (+12.5').

• The Jacket consists of 4 legs with 33 inch Outer Diameter (33'' O.D.) & 1 inch Wall Thickness
(1''W.T.) between EL. (+10') and EL. (-23') and (33'' O.D. x 0.5'' W.T.) between EL. (-23') and
EL. (-110').

• In the splash zone area that is assumed to extend from EL. (-6') to EL. (+6') LAT. (Lowest
Astronomical Tide).

• The jacket legs are horizontally braced with tubular members (8.625'' O.D. x 0.322'' W.T.) at
elevations (+10'); (10.75'' O.D. x 0.365'' W.T.) at elevations (-23'); (12.75'' O.D. x 0.375'' W.T.) at elevations (-62') and (14'' O.D. X 0.375'' W.T.) at elevations (-110').

• In the vertical direction, the jacket is X-braced with tubular members (12.75'' O.D. x 0.844'' W.T.) from EL. (+10') to EL. (-23') and (12.75'' O.D. x 0.375'' W.T.) from EL. (-23') to EL. (-110'). The platform is supported by 4 piles (30'' O.D. x 1.25'' W.T.).)

3.1 Description of loading:

Density of various materials considered for design,
Concrete – 25kN/m3
Insulation – 1kN/m3
Structural steel – 78.5kN/m3
Live load – 5kN/m3
Wind load:
The following wind parameters are followed in accessing the wind loads on the structure
Basic wind speed – 55m/s
Terrain category -2
Class of structure – c
Risk coefficient k1 – 1
Topography factor k3– 1
K2 factor taken from Draft Code CED 38(7892):2013 (third revision of IS 4998(part 1):1992)
Earthquake force data:
Earthquake load for the chimney has been calculated as per IS 1893(par 4) : 2005

Zone factor – 0.16
Seismic zone – III
Importance factor (I) – 1.5
Reduction factor (R) – 3

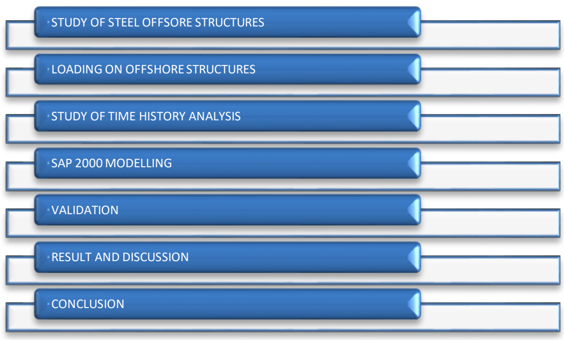
IV. DATA COLLECTED

Idealization of above problem statement is modeled in finite element analysis tool SAP 2000.Following models are prepared for comparative analysis of offshore steel structures

Table no: 1 different models of off shore

MODEL NO. 1	OFFSHORE PLATFOREM WITH SINGLE BRACING 0 DEGREE
MODEL NO. 2	OFFSHORE PLATFOREM WITH DOUBLE BRACING 0 DEGREE
MODEL NO. 3	OFFSHORE PLATFOREM WITH KNEE BRACING 0 DEGREE
MODEL NO. 4	OFFSHORE PLATFOREM WITH SINGLE BRACING 20 DEGREE
MODEL NO. 5	OFFSHORE PLATFOREM WITH DOUBLE BRACING 20 DEGREE
MODEL NO. 6	OFFSHORE PLATFOREM WITH KNEE BRACING 20 DEGREE
MODEL NO. 7	OFFSHORE PLATFOREM WITH SINGLE BRACING 30 DEGREE
MODEL NO. 8	OFFSHORE PLATFOREM WITH DOUBLE BRACING 30 DEGREE
MODEL NO. 9	OFFSHORE PLATFOREM WITH KNEE BRACING 30 DEGREE

V. METHODOLOGY



Flow chart No. 1 Methodology Steps

VI. GROUND MOTIONS AND LINEAR TIME HISTORY ANALYSIS:

Dynamic analysis using the time history analysis calculates the building responses at discrete time steps using discretized record of synthetic time history as base motion. If three or more time history analyses are performed, only the maximum responses of the parameter of interest are selected.

6.1 Response Spectrum Method:

Response spectrum analysis is a procedure for computing the statistical maximum response of a structure to a base excitation. Each of the vibration modes that are considered may be assumed to respond independently as a single-degree-of-freedom system. Spectra which determine the base acceleration applied to each mode according to its period (the number of seconds required for a cycle of vibration).

VII. SAP MODEL SOFTWARE

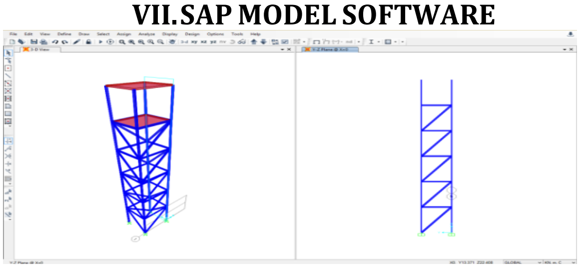


Fig. 1: Single Bracing 0 Degree

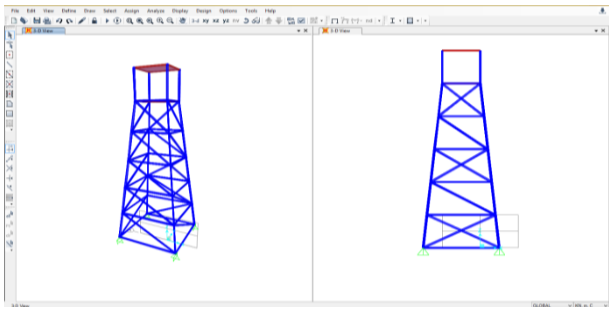


Fig. 2: Single Bracing 20 Degree

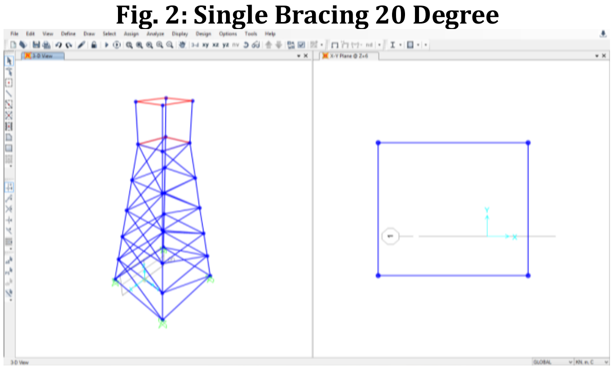
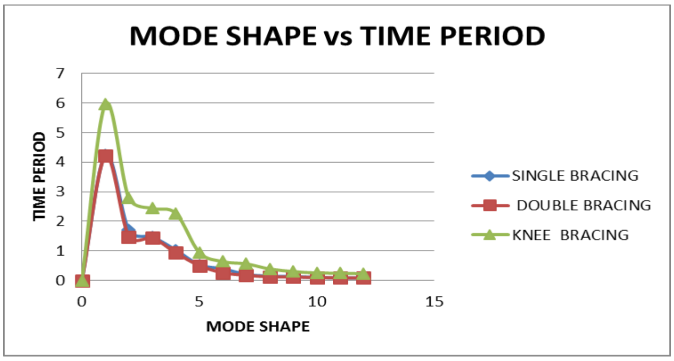


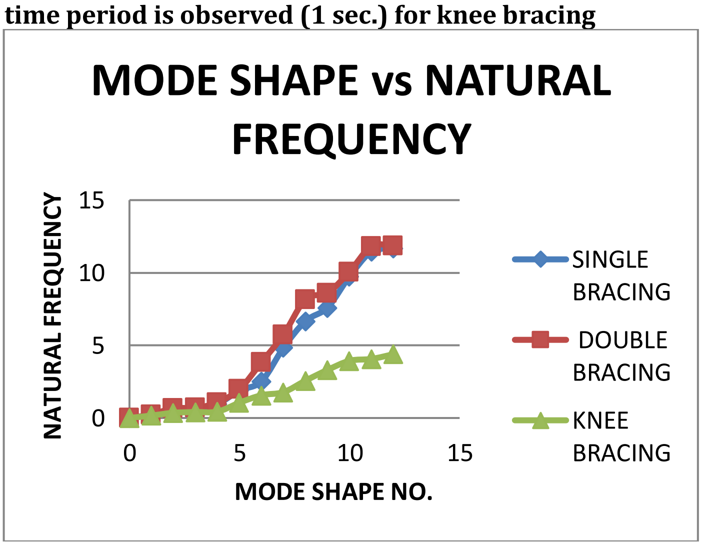
Fig.3: Single Bracing 20 Degree

VIII. RESULT AND DISCUSSION



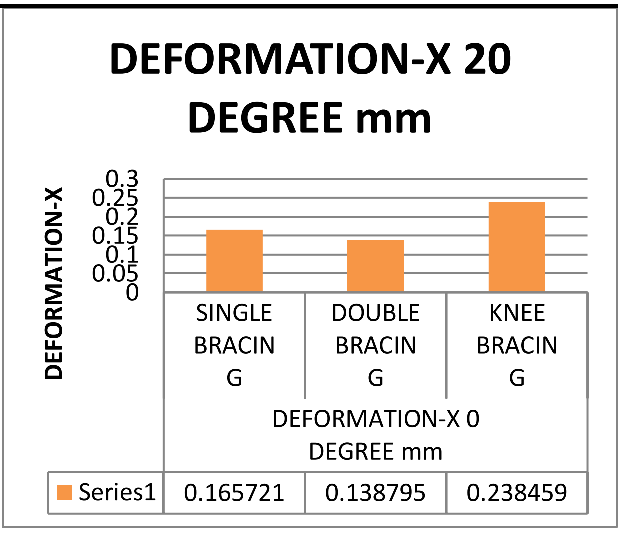
Graph 1:Mode Shear vs Time Period

In this graph 5.1Mode Shear vs Time Periodhighest time period is observed (1 sec.) for knee bracing

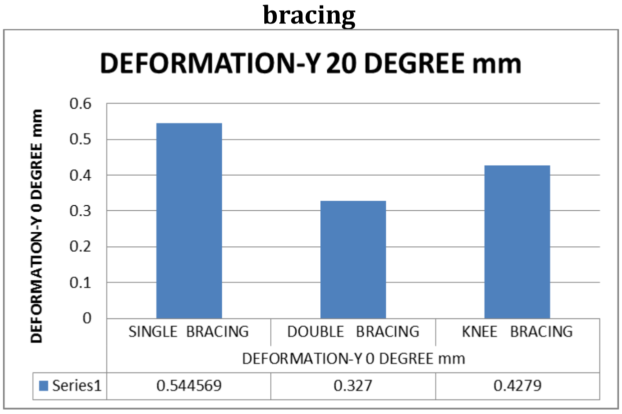


Graph 2: Mode Shear vs Natural Frequency

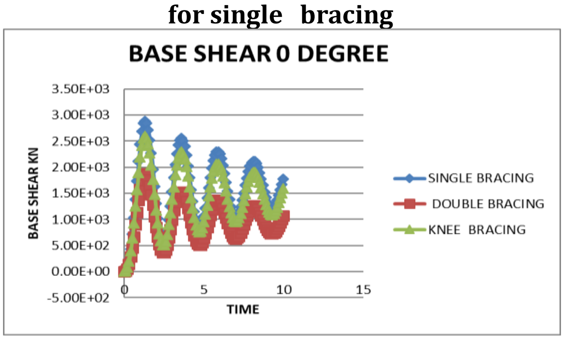
In this graph 2Mode Shear vs Natural Frequency highest natural frequency(14 Hz) is observed for double bracing



Graph 3: Deformation-x20 Degree
In this Graph 3: Deformation-x20 Degree highest deformation is observed 0.24mm for single bracing



Graph 4:Deformation-y20 Degree
In this graph 0.6 mm highest deformation is observed for single bracing



Graph 5:Base shear kN for o degree
In thisgraph 5 Base shear 295 kN for o degree highest base shear is observed for single bracing

IX. CONCLUSION

In this paper various types of bracings are studied subjected to dynamic load and it is observed that deformation in y direction is 25% less in double bracingand 15 % less in knee bracing.But deformation in X direction is observed more in knee bracings.in addition to this natural frequency is observed more in knee bracings. For base shear it is observed that base shear is 15% more in single bracings than cross bracings and knee bracings

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