Dynamic Response of Braced Domes under Earthquake Load

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Abstract

This study deals with the dynamic response of steel domes as a type of steel space frames. The actual response varies according to type of bracing and plane angle between ribs and vertical distance between rings. Three values of plane angle were considered (15, 22.5 and 30) degree, and spacing between rings are (1.5 and 3) m, and four types of bracing are one way successive and non-successive and two way successive and non-successive. The minimum design loads according to ASCE7-05 are 1 kN/m_2 for dead load and 1 kN/m_2 for live load in addition to self-weight of the dome. There is small opening at the top of the dome to be the execution is easy.

In this study, the finite element method through **SAP2000** v14 program is used to perform the dynamic response of braced dome. The type of analysis is the forced vibration analysis which is performed in time domain where the load inputs are ground accelerations and the output are displacements. The free vibration analysis of any structure is very important to predict the natural frequencies and mode shapes of the structure. The force vibration analysis was used to find out the maximum displacements of the domes under the effect of earthquake load.

The results show that the change of frequency for the dome with one way bracing successively or two way bracing successively is very small so it is favorable to use one way bracing successively to decrease the weight of dome, and the change of frequency is so small for two way bracing as non-successively. The results showed that the increase of spacing between the rings form 1.5m to 3m lead to change of frequency approximately similar for the cases of plane angle that it is used in this study. The study shows that the increase of plane angle from 15 degree to 22.5 degree cause decrease in frequency approximately 14.55% and if increase to 30 degree, the decrease in frequency will be approximately 29.14%. V

The results of the effecting of a spacing between rings showed that the dome with plane angle equal to 22.5 degrees have a difference in max displacement very small if the spacing between rings is increased from 1.5m to 3m. and the dome with spacing between rings S=3m and plane angle equal to 15 or 30 degree have increasing of max displacement approximately quarter value of displacement for the dome with spacing between rings equal to 1.5m. The result showed that the dome with one way bracing successively have max displacement less than the

dome without bracing approximately 65.26% ; while the dome with two way bracing successively has a max displacement less than the dome without bracing approximately 73.95%. The dome with one way bracing non-successively has a max displacement less than the dome without bracing approximately 86.36%. In addition the dome with two way bracing non-successively has a max displacement less than the dome without bracing approximately 96.81%.