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Evaluation of Progressive Collapse Performance in Double layer Diamatic Domes

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Abstract

Double-layer spatial domes are one of the most common spatial structures, the stability and progressive collapse of which are of great importance in design, construction and maintenance of such special structures. In this paper considering three loading cases and two types of support conditions, the collapse behaviour of double layer Diamatic dome has been investigated utilizing non-linear static analysis and alternate path method usage. In order to modelling compressive member behaviour, effective buckling modes have been obtained by eigenvalue buckling analysis for all of the members. Behaviour of compressive members has been obtained via definition of initial imperfection and non-linear static analysis. Riks arc-length method has been utilized for non-linear static analysis. The numerical results have indicated that reducing the number of the supports and focusing of load in a local area of the dome extremely impact on its vulnerability to failure, as in similar loading condition, decreasing the number of the supports reduces the capacity of damage resistance in spatial domes up to 50 percent. Investigating some models has shown that removing the critical members of the top layer has little effect on load-bearing capacity of the dome and it causes a slight failure in the structure. In this condition, structural redundancy can be considered equal to static indeterminacy. Load bearing capacity of the structure decreased up to 39 percent when compressive members of the web and bottom layers were removed. In this condition, the structure failure is considered moderate.

Keywords: Progressive Collapse; Alternate Path Method; Nonlinear Static Analysis; Double Layer Spatial Dome.

1. Introduction

One of the oldest impressive structural systems, domes which are formed from single or multi-layer bar elements, have geometrical curvature in longitudinal direction and ordinate. This structures are utilized to cover the large span like exhibitions, worships, stadiums and large halls. These specific structures create an unobstructed inner space and are so economical in material usage [1]. Being lighter compared to more conventional structural forms, high degree of redundancy, suitable and adequate stiff and consistent performance in load bearing made spatial domes particular and strategic structures that present very ideal utility in essential situations like destructive earthquakes or when it is needed to find a vast and safe shelter in urgent conditions. Research on progressive collapse began in 1968 after Ronan Point apartment destruction but incident of world trade towers in 2001 actuated researchers to evaluate of important buildings performance to abnormal loads and progressive collapse. These magnificent structures have always attracted engineers and designers because of their low weight, appropriate stiffness, ideal seismic performance, amazing beauty, covering

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