



Introducing innovative force limiting device based on reduced length buckling restrained brace

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Abstract

Space structure is referred to a structural system that involves three dimensions. These structures provide the best solution for covering large, column free areas. The popularity of space structures is mainly derived from their appearance, ease of erection and economy of them. Buckling and post-buckling characteristics of space structures greatly influence their stability. Space structures have tendency to collapse in a brittle manner due to buckling of a number of critical compression members. Force limiting devices can be used to improve the post-buckling characteristics of compressive members. In the present study, an innovative force limiting device is introduced and their behavior in pressure is investigated by ABAQUS finite element software. This type of force limiting device is designed based on reduced length buckling restrained brace.

Keywords: Force limiting device, Space Structures, Reduced Length buckling restrained brace, Finite Element Analysis.

1. INTRODUCTION (with two 9 pt lines space from the keywords)

Space Structures provide the best solution for covering large open areas with no intermediate columns. These structures combine aesthetic criteria with light weight, easy fabrication and ease of erection. These structures suffer from progressive collapse due to compression failure of some members. When a compressive member buckles due to overloading, it will shed extra force on neighboring members. If neighboring members cannot tolerate the new amount of force, it triggers their failure and progressive collapse will occur. High degrees of statically redundancy causes space structures to be more sensitive for the effects of member lack of fit. Therefore, buckling and Post-buckling characteristics of compression members greatly influence on space structures stability. In order to make space structures more safe, truss compression members must be effectively prevent from buckling.

In the last years, several techniques have been developed to control the behavior of space trusses one of the most known of which is based on using force limiting devices. The principle behind using these devices is to introduce artificial ductility in truss compression members. Schmidt et al introduced the first type of force limiting device in 1979. Marsh et al utilized force limiting device in combination with Bamford joint and Mero joint [1]. Schmidt et al equipped double layer grids with force limiting devices [2]. Three models tested which were statically determined, statically non determined and full scale truss. Results indicate that, in statically determined truss using force limiting devices did not lead to load bearing capacity incensement. Using force limiting device in statically undetermined truss leads to increase in both ductility and load bearing capacity. Mukai et al investigated the effect of force limiting device on stability analysis of three double layer grids [3]. Results indicate that applying FLD to solely one member of space truss did not affect collapse behavior. In the other test they equipped all top layer members with force limiting device. It caused great influence on truss ductility. Teda et al studied the effect of force limiting device on imperfect space trusses [4]. Results indicate that using force limiting device in imperfect structures causes the truss to have constant load bearing capacity. Parke introduced an effective force limiting device and investigated its effect on double layer grids [5]. It's made of an inner tube and an outer tube and four strips. Under compression both tubes become under compressive stresses while the middle strips carry tensile stresses. Therefore the overall behavior of the member become ductile. Abedi and Parke introduced multi tubular force limiting