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Investigation of buckled brace system of an existing industrial building

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ABSTRACT

In this study, the buckled brace system of a steel mill structure that has survived the Kocaeli (Marmara) Earthquake of 1999 was investigated. Three-dimensional computer model of the existing industrial building was generated using the commercially available finite element analysis software SAP2000. Evaluation of the structure for earthquake loading was performed according to the current national standard by using 3D computer model. For the buckled brace system, buckling analyses were carried out to evaluate buckling force. The obtained buckling force was compared with the corresponding earthquake load of this brace. Finally, it was seen that the buckling force was greater than earthquake force and the buckling has not occurred due to earthquake actions.

1. Introduction

In order to carry lateral forces due to wind and earthquakes, concentrically braced frames are widely used as efficient lateral-load resisting systems in steel construction. The bracing members are considered to buckle in compression and yield in tension under reverse cyclic loads. Experimental and analytical studies have been conducted by researchers on the investigation of the cyclic behaviour of bracing members [1,2].

Local or global failures of various steel structures were investigated by several researchers. In a study performed by Brencich [3], the collapse of an industrial steel shed under a 10 cm layer of fresh snow was investigated and it was seen that this collapse was a resultant of a chain of errors; in the design phase, during its assemblage and in the final inspection and control phase. In another study, results of engineering investigations on the reasons of total collapse of Katowice Fair Building structure were presented by Biegus and Rykaluk [4].

For the lateral forces in the industrial building considered in the current study, concentrically braced frames were used. After the catastrophic August 17, 1999 Kocaeli (Marmara) Earthquake, a part of the brace members were reported to have local failures. Therefore, the scope of this study is to investigate whether these brace members had buckled due to earthquake loads according to current national codes or not. Static nonlinear analysis was carried out to evaluate the response modification factors of frames in x–x and y–y directions of the mill structure. To evaluate buckling force of the buckled brace system, buckling analyses was performed.

2. Description of the steel mill structure

This study was performed for the steel structure shown in Fig. 1, having the scrap melting, casting, stripping and soaking pits halls at a steel mill at Bursa, one of the biggest industrial towns in Turkey. The schematic layout of the mill structure is

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