



Evaluation of Seismic Performance of Steel Lattice Transmission Towers

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Abstract

The electricity transmission systems are an important lifeline for modern societies. They are used for overhead power lines as supporting structures. Transmission towers are designed to meet electrical and structural requirements. They are designed according to the weight of conductors and environmental effects such as wind and ice loads. They also considered other extraordinary stresses such as cable breakage and ice-breaking effects. Because of a common perception that transmission line (TL) towers show low sensitivity to earthquakes, the effects of the earthquake in TL tower construction are not considered. For this reason, TL towers are investigated with regard to the seismic performance in this study. The principal objectives of this research are: i) to assess the sensitivity of typical TL towers to earthquake loads, ii) to retrofit an existing steel lattice tower using a new section Centre To Center (CTC). In this study, a finite element model of a representative 154 KV transmission tower in Turkey was performed using a set of 10 recorded earthquake ground movements. The four-legged square TL tower has been analyzed and designed for Turkey, Eskisehir seismic zone considering 42.95 m height using finite element (FE) software. Therefore, a new section Centre To Center (CTC) type has been designed and the failed sections have been replaced with a designed section using the SAP2000 section designer. The results show that the load of failure increased after retrofitting. The retrofitting method was effective and easily conducted in fields.

Keywords: Earthquake Damage; Non-linear Dynamic Analysis; Retrofitting; Seismic Evaluation; Transmission Tower.

1. Introduction

A transmission steel tower is a high-rise structure, known as an electricity tower. It used to carry overhead lines [1]. Electrical engineering advancement shows the need to support heavy conductors that led to the current existing towers. Transmission line towers are high rise-structures, the height of well-above the side dimensions. These are space frames made of steel profiles, which have a separate foundation for every leg. The customer sets the elevation of the transmission tower and the engineer designs the overall configuration, element, and connection details.

The power generated in power stations was transmitted via transmission power lines and transported by transmission power line towers. The transmitting power line towers cost 35 to 45% of the overall expenditure of the transmission network. So, the largest economy must be achieved in its design and installation [2]. Despite the advanced sensor technology and seismological academic efforts, earthquakes stay unpredictable.

In Turkey, where most of the total population lives in urban areas, for instance, Eskisehir city, which is in northwestern Turkey, is a quiet active zone. Eskisehir's city center lies in the 2nd and 3rd-degree earthquake zones.

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