



Failure of weak-storey during earthquakes

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ABSTRACT

The base floors of the existing buildings are generally arranged as garages or offices. No walls are built in at these floors due to its prescribed usage and comfort problems. But upper floors do have walls separating rooms from each other for the residential usage. In these arrangements, the upper floors of most buildings are more rigid than their base floors. As a result, the seismic behaviors of the base and the upper floors are significantly different from each other. This phenomenon is called as the weak-storey irregularity. Weak stories are subjected to larger lateral loads during earthquakes and under lateral loads their lateral deformations are greater than those of other floors so the design of structural members of weak stories is critical and it should be different from the upper floors.

In this paper; the seismic behavior of weak-storey is studied. Calculations are carried out for the building models which are consisting of various stories, storey heights and spans. Some weak-storey models are structural systems of existing buildings which are damaged during earthquakes. The results are compared with the current earthquake code. The ratio of buildings which have weak-storey irregularity is determined for both Ankara and Eskisehir regions. It is observed that negative effects of this irregularity can be reduced by some precautions during the construction stage. Also some recommendations are presented for the existing buildings with weak-storey irregularity.

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1. Introduction

Weak-storey is simply formed by the neighbor floors which have redundant columns, concrete walls and brick-wall areas. The most common observed earthquake damage types encountered in Turkey is caused by the weak-storey irregularities. Several types of architectural and structural plans lead to the formation of so called “weak” stories which are more vulnerable to ground excitations than others due to the fact that they are less stiff, less resistant, or both. In Turkey, the base floors are generally used for shopping stores, for car parking or for other commercial purposes. These buildings can be encountered especially in on both sides of the main city streets. The sides facing the main street are with glass partitioning walls for presentation purposes. Constructing a constant continuous column and concrete wall sections is the Turkish code requirement; the weak-storey occurs by the brick walls. Despite the developing technology in earthquake engineering, buildings which have weak-storey irregularities are still constructing. In recent years, most common construction practice in most of the Turkish cities aimed to create parking spaces in the base storey of multi-storey RC buildings by ignoring the masonry infill walls (Fig. 1).

This makes the base weak-storey much softer and weaker than the adjacent stories, in which masonry infill walls are provided. Most of these buildings were constructed without engineering supervision and lack of proper seismic design and ductile detailing. Several such buildings suffered severe damage or collapsed due to ground excitation Fig. 2. Analysis and

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