

# Performance of School Buildings in Turkey during the 1999 Düzce and the 2003 Bingöl Earthquakes

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Several school buildings were surveyed in the disaster areas of the Marmara (17 August 1999, Mw=7.4), Düzce (12 November 1999, Mw=7.2) and Bingöl (1 May 2003, Mw=6.4) earthquakes in Turkey. Among them, 21 reinforced concrete buildings were found to have an identical floor plan. Lateral load resisting structural system consisted of reinforced concrete frames (moment-resisting frame) in 16 of the buildings and structural concrete walls integrated with the moment-resisting frame (dual system) in the remaining five buildings. The number of stories above ground in these buildings ranged from 2 to 4. These school buildings provide a nearly ideal test of the effect of a single important structural characteristic on the performance of buildings with structural designs that are uniform in all other respects. Our observation is that the presence of structural walls improves the behavior of reinforced concrete systems drastically.

## INTRODUCTION

Teams of researchers from various U.S. institutions and organizations led by Purdue University and in collaboration with researchers from the Middle East Technical University (Turkey) made three surveys of damage to concrete structures in the cities of Düzce, Kaynaşlı and Bolu following the 1999 Marmara (Mw=7.4) and Düzce (Mw=7.2) earthquakes and in Bingöl and its vicinity after the 2003 earthquake (Mw=6.4) in Turkey (Fig. 1). The 1999 earthquakes devastated northwestern Turkey. The 2003 event caused damage in the eastern province of Bingöl (Özcebe et al. 2003). Full reports of these surveys, including

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