

Impact of the 2016 Central Italy earthquakes (Amatrice, August 24, Mw 6.0 and Norcia, October 30, Mw 6.5) on natural and built environments

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Abstract

On August 24, 2016 an Mw 6.0 earthquake occurred in Central Italy resulting in 299 fatalities. On October 30, 2016 an Mw 6.5 earthquake struck the same area with fortunately no fatalities due to previous building evacuation. Based on our field reconnaissance immediately after each earthquake, extensive earthquake environmental effects (EEE) and building damage were observed in the fault-bounded intermontane basins of the affected area. The primary EEE included surface faulting during the first event and fault reactivation during the second on the western slopes of the Mt Vettore-Mt. Bove range. The secondary EEE during both events comprised ground cracks and slope movements comprising landslides and rockfalls generated mainly in the hanging wall of the causative fault.

Non-structural damage to RC buildings comprised cracking and detachment of infill walls from the surrounding RC frame and of large pieces of plaster from walls. Structural damage to RC buildings varied from light damage in RC elements to total collapse. More specifically, light cracks in columns, soft story failure, symmetrical buckling of reinforcement, compression damage and crushing at midheight of columns, bursting of over-stressed columns and partial or total collapse of the buildings along the vertical axis within their plan indicate the prevalence of the vertical component of the earthquake ground motion during both events. Damage to RC buildings is due to (a) poor quality of concrete and inadequate reinforcement, (b) absence of earthquake resistant features even in recent constructions, (c) inappropriate foundation close to the edge of flat hills leading to differential settlements and (d) the destructive effect of the vertical component of the earthquake ground motion. Damage to URM buildings varied from cracks and detachment of large plaster pieces from walls to mainly and mostly destruction of the building. Moreover, damage to masonry walls, piers, floors and roofs was also observed. Damage to URM buildings is due to (a) poor workmanship with randomly placed materials of inadequate quality bound by low-strength mortars and without any antiseismic precautions, (b) the effect of the vertical component of ground motion to buildings as well as (c) inadequate interventions and modifications after previous earthquake damage.

Key words: 2016 Amatrice earthquake; 2016 Norcia earthquakes; Central Italy; earthquake environmental effects; building damage