



Forensic evaluation of building damage using subsidence simulations

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ABSTRACT

We described the results obtained in the third phase of a broader project whose aim is to perform a detailed forensic evaluation of damages occurring over time to buildings in an industrial estate located on the outskirts of the town of La Unión (Murcia, Spain). The damages respond to subsidence that commenced in 1998, most probably as a result of cave-ins in mine workings.

The first phase of the research project involved mapping cracks in affected buildings and classifying them according to their most representative features. A set of points in the affected zone was also levelled at regular time intervals in order to monitor changes in the subsidence bowl.

The second phase involved the quantification—using biaxial extensometers and inclinometers—of the most significant parameters for the cracks detected in the buildings inventoried in the previous phase. A comparative analysis was also made of the data obtained in different stages of the study.

This final phase of the study is a detailed description of a subsidence simulated on the basis of a hypothetical cave-in of abandoned underground mine workings that aims to predict subsidence progression over time more accurately. The strain values obtained in the simulation were used to estimate potential damage to buildings in the affected zone according to damage severity classification criteria.

The simulation of soil subsidence developments over time in response to mine cave-ins is corroborated by data collected and analysed in the first two phases of the study and so confirms the conclusions of the earlier phases of the study.

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1. Introduction and description of the failures

Since the middle of the 19th century, subsidence has been a matter of concern to the mining sector, given the considerable damage caused to a terrain. Subsidence refers to vertical and horizontal movements—often the result of extraction activities performed in the subsoil—that affect the topographic surface. Such land movements and the resulting strains cause—sometimes very considerable—damage.

Intensive mining activity took place in the municipality of La Unión, located near the cities of Cartagena and Murcia in southeastern Spain (Fig. 1), from around the second half of the 19th century to around the middle of the 20th century. The population of La Unión grew from around 10,000 inhabitants to 35,000 inhabitants between 1870 and 1905 in response to the demand for labour in the large number of mines in the area. Galena and sphalerite were the main minerals mined, mainly extracted from mantos and seamed structures typically mined using an underground room-and-pillar system [1].

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