

Post-earthquake rehabilitation of healthcare buildings: the case study of the Mirandola Hospital

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ABSTRACT

Research significance

Recent earthquakes in Italy and other countries have shown the fragility of hospital complexes which resulted in many cases unusable due to structural and non-structural damage. This forced to evacuate hospitals in critical condition thus causing serious social impact especially for inpatients with reduced capability to move. Moreover, most of the injured people could not find adequate care due to hospitals unusability in the most affected areas. Depending on the extent of damage, unusable hospitals were either reopened after some weeks/months or demolished. As an example, demolition has been required in the case of the Amatrice hospital stricken by the 2016 earthquake occurred in Central Italy due to the severe suffered structural damage. In order to allow for a prompt resumption of the social activities of the local communities, the usability evaluation carried out in the immediate aftermath of a seismic event is a crucial step to decide about the short-term countermeasures and to obtain a gross estimate of the economic losses. After the first weeks, it is often necessary a more detailed assessment which allows for a more accurate evaluation of damage and, more importantly, about the reparability of the structure along with the study of feasible intervention strategies. This latter activity cannot be performed on the base of the expert judgment, as in the case of the usability evaluation, needing detailed analyses based on an increased knowledge of the structure.

The case study

Keeping in mind the objectives of detailed post-earthquake assessment and reparability evaluations a case study related to a building of the Santa Maria Bianca hospital of Mirandola has been analysed. This latter suffered light structural damage and moderate non-structural damage in the aftermath of the Emilia 2012 earthquake. After a brief description of damage distribution, structural analyses based on a finite element model are carried out and reported. The seismic capacity is compared to the code seismic demand making possible to discuss on the convenience to upgrade the building in the occasion of the repair works. As a result, in the second part of the paper, it is proposed an estimation of the upgrading costs which is one of the key aspects of the decision-making process in the aftermath of an earthquake. The intervention is based on strengthening techniques carried out acting only from outside, in order to reduce the social and economic costs due to abandoning the hospital, in comparison with strengthening interventions carried out inside the building. Strengthening techniques acting from outside the structure is a more and more emerging trend due to the need for rapidly restoring buildings which host important activities like, for example, schools and hospitals whose downtime has heavy social costs.