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On the modal characteristics of damaging structures subjected to earthquakes

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Structural Health Monitoring, especially for structures located in seismic prone areas, has assumed a meaning of great importance in last years, for the possibility to make a more objective and more rapid estimation of the damage occurred on buildings after a seismic event. In the last years many researchers are working to set-up new methodologies for Non-destructive Damage Evaluation based on the variation of the dynamic behaviour of structures under seismic loads. The NDE methods for damage detection and evaluation can be classified into four levels, according to the specific criteria provided by the Rytter. Each level of identification is correlated with specific information related to monitored structure. In fact, by increasing the level it is possible to obtain more information about the state of the health of the structures, to know if damage occurred on the structures, to quantify and localize the damage and to evaluate its impact on the monitored structure. Several authors discussed on the possibility to use the mode shape curvature to localize damage on structural elements, for example, by applying the curvature-based method to frequency response function instead of mode shape, and demonstrated the potential of this approach by considering real data. Damage detection approach based on dynamic monitoring of structural properties over time has received a considerable attention in recent scientific literature. In earthquake engineering field, the recourse to experimental research is necessary to understand the mechanical behaviour of the various structural and non-structural components. In this paper a new methodology to detect and localize a possible damage occurred on a framed structure after an earthquake is presented and discussed. The main outcomes retrieved from many numerical non linear dynamic models of reinforced concrete framed structures characterized by 3, 5 and 8 floors with different geometric configurations and designed for gravity loads only are here presented. In addition, the main results of experimental shaking table tests carried out on a steel framed model are also showed to confirm the effectiveness of the proposed procedure.

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