IMPROVING BUILDING AND POPULATION RESILIENCE TO SEISMIC RISK

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Recent earthquakes clearly showed the need of risk management tools for supporting, from one side, emergency operations and, on the other side allowing for an effective decision-making process concerning damage assessment, recovery and resilience enhancement of impacted constructions, and management of post-earthquake as well as reconstruction planning at urban scale.

To predict and to reduce through a suitable planning the potential loss in future events, loss assessment studies are needed and a number of them are being carried out by the specialist's community.

The three fundamental components of loss assessment are: hazard, fragility and inventory. The correct evaluation of each one of the abovementioned components increases the reliability of the assessment outcome. Fragility relationships are used to determine the exceeding probabilities of certain damage states that are in turn used to obtain social and economic impacts through damage factors and socio-economic impact models. In addition, hazard and inventory should be dependable and should include all the necessary information required for the assessment study.

The management of the seismic risk based on the consequences (Consequences-Based Risk Assessment and Management) is a powerful tool that aims at transforming vulnerable communities into resilient ones by addressing issues concerning the earthquake impact assessment, the loss mitigation, the community response and the post-disaster recovery.

The paper reports on the results so far obtained in the framework of a research project conducted by the authors at regional scale. The project is taking advantage of the knowledge obtained from the assessment and retrofit of constructions damaged by the 2009 L'Aquila earthquake, from the results of the vulnerability assessment of public buildings carried out in Italy, and from available data on consequences from recent earthquakes. The project consists of the following Work Packages (WP):

WP1: State-of-the-art and target constructions. Typical assets of constructions to be considered as research targets are identified. Classes of configurations to be considered are defined. The potentialities of software data-bases are checked and the need for enhancements to available open source procedure pointed-out.

WP2: Hazard assessment and performance levels. Hazard model to be considered are chosen among the national and regional ones. Performance levels to be accounted for in the consequence evaluation are defined. Hazard levels and quake characteristics are identified. Definition of earthquake databases, generation and selection criteria suitable for the application of the successive assessment methodologies and performance-based consequence evaluation methods are identified and implemented. The outcomes such as national and regional hazard models are implemented in the m-HARP software. A repository for this project will be developed to store and manage the outcomes.

WP3: Damage scenarios assessment. For the previously identified most typical assets, the damage scenarios related to earthquakes loads are outlined with objective criteria and with reference to the outcome of the experience in previous

events. Specific collapse mechanisms and adequate consequence limits are defined.

WP4: Fragility curves representative of the assets vulnerability. Types of structural and non-structural vulnerability indicators are identified and response evaluation through advanced nonlinear analysis is performed. Construction of fragility curves of various configuration classes will be done withthe curves as the outcomes implemented in the software and will be stored in the repository.

WP5: Consequence functions. Response-damage fragility curves for typical structural elements will be defined. Data bases on correlation between damage and consequence as well as fragility curves damage-consequence are obtained. The WP will also consider and analyze specific issues related to intervention, out-of-service conditions, social consequences as well as the loss of irreproducible goods like cultural heritage. The consequence functions will be implemented as analyses in the m-HARP software.

WP6: Assessment of the effectiveness through simulation of real situations. The improved tool results in a decision support system allowing for the consequence calculation within a performance-based framework. The effectiveness of the appropriate assessment procedure will be checked through simulation of real situations. Taking advantage of data-bases made available within the synergetic cooperation with Umbria Region and Yunnan Province the defined procedures and solutions can be applied to sample areas for simulating the consequences of past earthquakes and evaluating the consequence of future earthquakes on assets under different hypothetical protecting scenarios. The data and results of the damage assessments will be stored in a repository.

WP7: Training and knowledge dissemination seminars. Guidelines and/or handbooks for an appropriate spreading of the knowledge in the practical applications will be drawn up. A number of seminars/workshops will be held aimed at the spreading of the research results and training of specialized technicians to be prepared on the defined techniques.