FOREWORD

Devastating earthquakes such as those occurring in 1999 in Cordoba (Colombia), Kocaeli and Duzce (Turkey), or Chi-Chi (Taiwan), are increasing world-wide the awareness that realistic damage scenarios represent a crucial asset in the event of a destructive earthquake. This is true both for assessing the effort required by the post-event emergency, and for planning priorities in allocation of resources devoted to strengthening existing buildings and infrastructures.

In this light, the launching as early as 1996 of the so-called Catania project – probably the first comprehensive research effort in Europe to create damage scenarios for a mid-sized city - appears as a decision of considerable foresight on the side of both the funding agency (Italy's Department of Civil Protection, guided by Undersecretary of State Franco Barberi), and of the organisation actually performing the work (GNDT, the Italian Group for the Defence against Earthquakes). Securing since the beginning the close co-operation by the Catania municipal administration, through the competent "*Assessorato alla protezione civile*", has also proved decisive for the execution of the project, and will obviously remain essential for implementing its results, well beyond the GNDT undertaking.

As a matter of fact, the three-year effort of the Catania Project, as originally conceived, has come to a conclusion with the end of 1999. This volume, with its four parts subdivided into thirteen sections, is meant to provide more than a cursory overview of the ground covered. We have not intended, however, to give herein an exhaustive picture of the methods used in the different sectors of the project, but rather to concentrate on the results, especially those susceptible of short-term implementation. Methodological aspects are better covered in articles in Conference proceedings and journals; as an example, a whole special issue of the *Journal of Seismology* has been recently devoted to selected topics of our research.

Furthermore, presented here is but a part of the material, because the Project was since its inception conceived for a Geographical Information System (GIS) environment. Thus, all the results produced in map form, or referred to a specific map location, are now available in different GIS layers that can be accessed through the GNDT Web site http://emidius.itim.mi.cnr.it/GNDT/home.html (Progetto Esecutivo 1998, under 6B.1). Particularly significant in this respect are the predicted ground motion and building damage maps, and, as regards buildings of architectural interest, the damage assessments for all the old churches of Catania.

The development of earthquake damage scenarios actually makes an unusually broad demand in terms of disciplinary requirements: seismology and engineering seismology, geotechnical and earthquake engineering, and risk evaluation are all essential ingredients of the effort. Such multi-disciplinarity is faithfully reflected both in the list of the participating Research Units (RU) and in the table of contents.

Part I of this volume outlines the seismotectonic framework of Eastern Sicily as a basis, together with the seismic history of the area, for making the difficult choice of the scenario earthquakes. It should be stressed that from the point of view of seismic history and risk exposure, Catania is probably representative of the situations of other important cities in seismically hazardous regions of the Mediterranean and the Middle-East.

The determination of scenario earthquake ground motions, including the geotechnical zonation aspects necessary to quantify site effects and indirect deformative effects (such as soil liquefaction) in the Catania municipal area, are covered in Part II. A substantial effort has actually been devoted in the first phase of the project to create a GIS-compatible database of all available geotechnical and water-well borings, and to construct from here a geotechnical zonation map in a format appropriate for an earthquake scenario. Thanks to this approach, it will be possible to periodically update and improve the zonation as new boring data and better descriptions of local geologic details become available. Recording of weak earthquake motions by dense local seismometer arrays and installation of an accelerometer network, which was not possible during this project, is certainly a desirable step to be undertaken in the near future, to put the ground motion characterisation on a firmer observational basis.

Part III deals with the inventory of exposure, covering ordinary buildings, old churches (prominent part of the great Baroque architectural heritage of Catania), and bridges and viaducts. The major asset here has been the seismically oriented census carried out under the so-called “Progetto Lavori Socialmente Utili” (LSU) on the entire Catania building stock (some 30.000 units), and now nearing completion. This has, among other things allowed to better assess the reliability of the 1991 ISTAT census of dwellings, which represents virtually the only raw data available in any Italian city as a basis for a seismic scenario.

Finally, Part IV (and the appendix) illustrate the vulnerability and damage assessments for the different classes of structures considered, including statistics for the upper damage classes in masonry buildings and predicted overall damage maps for the scenario earthquakes. Two points are here worth stressing: on one hand the emphasis laid on the simultaneous use of different approaches, both traditional (e. g. the statistical vulnerability score) and new ones (such as the displacement limit state approach), to produce damage assessments for large populations of structures, so that comparisons and mutual calibrations are feasible. Such comparisons are apt to give practical guidance to future operators in earthquake scenario studies for other cities. The second point is represented by the in-depth experimental and numerical studies carried out especially on a few masonry structures, chosen as typical for the Catania building stock, which also provide some control on a few critical assumptions made in the vulnerability models. These points are believed to be strong assets of the project, and they are not commonly found in similar studies of other countries in which a standard software is used (e. g. HAZUS in the U. S.).

From the viewpoint of implementation, the critical steps through which a scenario study can be transformed into an effective tool in risk prevention strategies may, according to the most recent views on the subject, be stated as follows:

1. It should allow to assemble a GIS-based inventory, more or less exhaustive, of the elements at exposure which constitute a city, including the physical environment (soils, topography), the built environment (dwellings, offices, strategic and industrial buildings, etc.), socio-economic factors, etc.

2. It should bring out the different «*weak spots*» of a city, i. e. those which are likely to contribute substantially to damage, due to an abnormally high vulnerability.

3. It should lead to forming permanent specialist teams in the city, with a good knowledge of each of the previous elements and of their specific response after a natural event (like an earthquake) or a man-made one.

4. It should lead to establishing a local decision-making body, well integrated within the regional and national decision making systems.

5. It should lead to implementing a risk management plan that includes different actions, both as regards retrofitting of some construction types, and the organisation and preparation of appropriate services, and the interfacing with the local population.

6. It should finally lead to taking well-defined initiatives including a detailed programme of the tasks to be carried out, the responsible organisations involved, the duration required and an evaluation of costs.

Now, the different damage estimations for the most severe scenario in Catania, i.e. a repetition of the 1693 earthquake, consistently (even taking into account the wide uncertainty margins) point to the occurrence of severe destruction, involving both older and post-war construction. By the yardstick of the six steps just stated, this indication puts a difficult burden on top of the local administration. The scenario study in itself essentially covers most of items 1 and 2, and part of item 3; the development of the project has stimulated the Catania administration to take a few concrete steps in the direction indicated in items 2 to 6. These include, for instance, establishing a municipal seismic safety office, and the agreement from local banks for lower loan rates to property owners intending to retrofit their buildings. However, the way to go is still long, and much of it is now in the hands of local, regional and national decision makers. There is also little question, in our mind, that the extent to which the Catania project will receive a practical follow-up in the near future will represent a critical test on the willingness of local communities to undertake effective risk mitigation measures in the most exposed regions of Italy.

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