

**Zeitschrift:** IABSE reports = Rapports AIPC = IVBH Berichte  
**Band:** 70 (1993)

**Artikel:** Decision process for monuments  
**Autor:** Corsanego, Alfredo / D'Agostino, Salvatore / Gavarini, Carlo  
**DOI:** <https://doi.org/10.5169/seals-53339>

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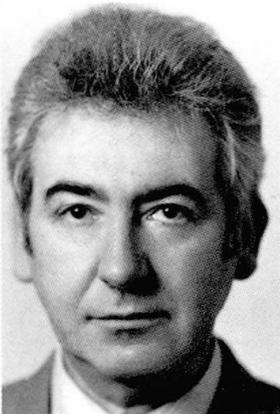
## Decision Process for Monuments

Procédure de décision pour les monuments

Entscheidungsprozess für denkmalgeschützte Gebäude

### Alfredo CORSANEGO

Prof. of Struct. Mechanics  
Univ. of Genoa  
Geno, Italy



### Salvatore D'AGOSTINO

Prof. of Struct. Mechanics  
Univ. of Naples  
Naples, Italy



### Carlo GAVARINI

Prof. of Struct. Mechanics  
Univ. La Sapienza  
Rome, Italy



### SUMMARY

The authors report on the main problems examined by the National Committee for the Seismic Protection of Monuments and Italian Cultural Heritage; such problems concern the seismic vulnerability of the whole cultural heritage and the guidelines to adopt for the measures directed both to the seismic protection and the preservation.

### RÉSUMÉ

Les auteurs exposent les problèmes principaux qui ont été récemment discutés dans le Comité National Italien pour la Protection Séismique des Monuments. Il s'agit de la vulnérabilité séismique de tout le patrimoine monumental et des critères à appliquer pour assurer aussi bien la protection séismique que la conservation.

### ZUSAMMENFASSUNG

Die Autoren berichten über die Hauptprobleme, welche kürzlich im nationalen Komitee zum Schutz der Baudenkmäler vor Erdbeben behandelt wurden. Diese Probleme betreffen die seismische Verwundbarkeit des gesamten italienischen Kulturguts und die Kriterien, nach welchen Eingriffe zum Schutz vor Erdbeben und zur Erhaltung der Bauwerke vorzunehmen sind.



## 1. INTRODUCTION

Italy is a country where neither earthquakes nor monuments are lacking. They are often present in the same area, with interferences, as amply documented by the History.

By now there is a general conviction that the Cultural Heritage our ancestors have handed down to us through Architecture, has to be conserved for our successors as integral as possible. It is equally evident that the seismic protection of constructions avoids the often irreparable damages that the earthquakes may cause. These two statements seem to mean an obvious syllogism, according to which the interventions directed towards the highest degree of seismic protection should also assure the greatest possibility of preservation. Yet we know it isn't so, since the interventions are often heavy, intrusive and irreversible and they may alter remarkably the signs of material culture present in the building.

These already complex problems are further complicated by the fact that by now we still know very little about the real vulnerability of ancient buildings and about the actual seismic hazard of sites where they are situated.

Two facts, quite different from each other but both equally relevant, must be mentioned. The first regards the ancient constructions whose reserves of resistance are progressively diminishing due to the decay, which in a state of complete neglect and general carelessness is made more accelerated. The second concerns the high risk present in some monuments which, either because of their capacity to give rise to interest or due to their present functions which often differ from the original ones, are subjected to great and uncontrolled concourses of persons.

The debate about the monumental heritage risen in Italy in recent years, is based upon these and other considerations. But in order that such debate would lead to really tangible consequences, it is necessary that the already existing knowledge will be enriched with a vast amount of researches and experiences on the field.

While describing such researches and experiences and developing some critical and methodological considerations, we shall here pay a particular attention to researches aimed at supplying information on a territorial scale, indispensable to define policies for the conservation of the cultural heritage.

The presentation will be divided in two parts, dealing with:

- a) the methodologies for the assessment of seismic vulnerability and risk of the architectural patrimony;
- c) the intervention strategies on the patrimony.

In Italy the National Committee for the Seismic Protection of Monumental Building and Italian Cultural Heritage (CNPPCRS) has the institutional task of promoting researches aimed at the systematic collection of data on architectonic, cultural heritage exposed to seismic risk and at the individuation of evaluations on its seismic vulnerability and on the intervention provisions.



This description of the present State of the Art and of the tendencies admitting of developments, even if it reflects personal opinions of the authors, intends to present some results and trends of the Committee.

## 2. SEISMIC VULNERABILITY AND RISK OF MONUMENTAL BUILDINGS

It is long since the necessity of collecting systematically all the possible information relevant to the Italian monuments has been felt, so much that there exist a Central Institute of the Ministry of Cultural and Environmental Heritage, ICCD (Central Institute for the Cataloguing and the Documentation) founded for this purpose; such an Institute has prepared and uses a series of forms regarding the knowledge relevant to the architectonic heritage as well as to the other kind of cultural property. Anyhow, what has been done till now is not yet a System, able to permit the management of the information with such a systematical way and efficiency that is required today and is possible using the modern computing instruments.

It is important to observe that the above-mentioned problem cannot be solved simply by proceeding to the computerization of the existing instruments, even if they are valid; what is necessary to do is quite more difficult in that one should put together conceptions, needs, different disciplinary languages, mostly in a large context of different institutions, organizations and conditions. That is why first of all it is necessary to conceive a national system, on the level of a conceptual form, in order to verify, through a discussion relevant to a concrete planning hypothesis, if what one is proposing corresponds to the different needs and expectations.

The mentioned National Committee has carried out a discussion regarding the general lines of such a problem [02,03,10,13,14] and moreover has predisposed a first instrument of work consisting in a form for the first level survey of the seismic vulnerability of monumental buildings [16,17]; such a form should be considered only as a part of a much larger series of operations, precisely the above-mentioned National System.

The fundamental elements to propose for the System can be the following:

- systematic collection of data by means of coordinated forms or equivalent surveying methodologies, possibly computerized and easy to load; among these forms and methodologies are included the existing ones;
- hierarchical ordering of such instruments and their coordinated use (forms of I level, of II level, of expert levels, possible monitoring, etc.);
- systematic loading of data on computer, in order to create a national data bank easy to use by the operators;
- setting up of a practice of programmed control, that follows the phase of surveying, for the continuous updating of the data;
- study and preparation of programs for the management of the data in order to supply for:
  - "friendly" systems of access and readout of the data;



- general intervention plans, indicating the priorities and estimations of the costs;
- punctual evaluations of hypothesis of intervention;
- ...
- systematic updating of data, once the interventions have been carried out, accounting for a general planned maintenance of the monumental patrimony as a whole.

On the ground of the above described definition the proposed system has been called SISTEMA NAZIONALE PER LA CATALOGAZIONE, IL RILEVAMENTO, LA SORVEGLIANZA E LA MANUTENZIONE PROGRAMMATA DEI MONUMENTI: CA.RI.S.MA. (National system for the cataloguing, the survey, the control and the planned maintenance of monumental buildings) [17].

The form of the first level for the monumental buildings, both churches and other kinds of buildings, applicable in seismic and non-seismic areas, conceived in the optics of the System CA.RI.S.MA, is directed to gather information which can be subdivided in 12 classes:

- data for the identification of the monument;
- synthetic description;
- present destination of use;
- position in the environmental context;
- soil and foundations;
- state of maintenance;
- crowding;
- structural seismic history;
- geometric and material description;
- presence of cracks;
- decay;
- interventions carried out.

The form is completed with some figures, usually 2. The first reports a general planimetry and the second reports plans and significant sections of the monument.

Later on, the gathered data can be loaded in a database by means of a suitable program, including the use of a scanner for the drawings and possible vectoring. A software for the loading of the data directly on site by means of a Laptop is a useful alternative; such a software, called CADING in the English version, has already been prepared.

The data management and elaboration present quite difficult and delicate problems. Among the most important exigencies of the possible users we can mention at least the following ones:

- consultation of the forms, one by one or according to topics, for generic information;
- simply to work out and to compare historical, typological, quantitative, numerical, functional data;
- assessments of vulnerability;
- risk evaluations;
- proposals of priorities of intervention;
- development of intervention strategies;
- studies of hypotheses for intervention plans;
- singling out of situations requiring close studies;

- singling out of situations requiring monitoring;
- studies regarding the coordinated use of monuments.

Most, if not all, of the above problems, can be solved developing methodologies and/or models and/or decision processes to be implemented as Expert Systems. A first System of this kind has been proposed to evaluate the seismic risk and supply the elements that serve to create some scales indicating the priorities of intervention [20,21]. The proposed method is based on the following elements:

- maximum importance given to the "structural seismic history";
- in the "most fortunate" cases the same history leads directly to the evaluation of the risk, graduated only in three levels: high, medium, low;
- in other cases the evaluation of the risk requires the previous assessment of the seismic vulnerability of the monument (also this latter on three levels);
- assessment of the above vulnerability by means of typological comparisons with other monuments included in the database;
- maximum attention to the decay and its development;
- distinct consideration of the risk regarding the people (RP) and of the risk regarding the conservation of the monument (RM);
- consideration of an external risk (RE), connected with the position of the monument in the environmental context;
- consideration of the "value" of the monument, again on three levels (high, medium, low), for the evaluation of the priorities;
- definition of the priorities by means of graduated classes (three: high, medium, low, or otherwise five: very high, high, medium, low, no intervention) by cross comparison of the data relevant to seismic risk, decay and value;
- continuous distinction, up to the final output (included), of the single factors that concur to the definition of the priorities, in order that the mechanisms which take to the proposals for decisions were always clear.

The implementation of the method as Expert System [20,21] has been conducted using the shell NEXPERT OBJECT of the Neuron Data.

### 3. GUIDELINES FOR INTERVENTIONS ON MONUMENTAL BUILDINGS

The discussion within the Committee on how to increase the seismic safety of monuments and ensure the goal of preservation has both produced many individual contributions and papers [01,04,05,08,09,11,12,15,18,22,23] and two official consecutive documents, first a text of "Recommendations" [06], then a text of "Guidelines" [07].

The main consideration which is at the basis of such documents is the following: today the engineers are used to operate on new constructions, that they themselves design, verify and construct according to principles and technical codes aiming to assure, first of all, the security; but when the engineers are called to deal with a monumental building they must confront two specific circumstances that should modify completely the approach to the problem:

- a) the monument is an existing building;
- b) the monument is a building with an "identity" and a "value" that should be conserved. The architects that deal with the



monuments are well acquainted with such circumstances: the science of restoration, in fact, has to do with the relevant problems; but when the security is in question, the different exigencies often come into conflict that can be substantial and not likely to be resolved. Such conflicts can also depend on the fact that the above principles and technical codes, thought as they are in view of the new constructions, do not consider the specific problems relevant to the existing buildings in general and the monumental buildings in particular. That is why it is necessary that the interventions on monuments, whenever they imply problems of security, will be confronted with specific principles and regulations, studied and defined on purpose.

In the Guidelines [07] such principles are the following:

- 1) The estimate of seismic risk concerning values exposed in the monuments should be part of an overall risk estimate that examines all the important hazards.
- 2) The estimate of risk should take into account, rationally, all the available sources of knowledge about the monuments and their environmental and sociocultural context with special reference to the historical source.
- 3) The balancing of the seismic risk concerning cultural values, as that of other risks, should be considered not as an insolated objective but as one of the exigencies to satisfy in the multidisciplinary context of monument restoration.
- 4) The restoration of monuments should be inserted in a continuous temporal process of programmed monitoring and maintenance
- 5) Interventions on monuments should tend, in principle, to abate vulnerability added by degradation.
- 6) Decisions concerning interventions which modify the intrinsic vulnerability of monuments must emerge from a very strict interdisciplinary confrontation.
- 7) If the diminution of risk to human lives through the reduction of the vulnerability of a monument involves interventions detrimental to the cultural values, this diminution is to be instead found through uses of the monument which reduce the exposure of those lives.
- 8) Interventions on monuments should allow our successors to express restoration and preservation cultures different from ours.
- 9) Ways to intervene implying a wide use of traditional techniques are firmly counselled for monuments.

Such principles seem to be very similar to those proposed in Skopje [24] and by the State of California [25], and they have been proposed inside a Project Team working for the preparation of the seismic EuroCode 8 [19].

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