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Daniele Fabrizio Bignami

Towards a Territorial Multi- Disaster Buildings' Resistance Certification



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Introduction

Managing risks from natural disasters requires better management of exposure to natural hazards, through urban and land-use planning. A disaster management policy needs to encompass prevention, resilience and reduction of individual vulnerability and strengthening eco-systems. In hazard-prone areas, property owners will have to invest even more in property risk reduction measures.

European Commission¹

Despite the huge availability of publications and initiatives concerning knowledge, and subsequently potential actions to be taken, on disaster risk and its consequences, large possibilities of improvement are still in front of us to find ways of analysis and valid methods to implement real large-scale strategies in responding to disasters.

The present book outlines a possible approach for developing an operational new scheme that addresses, specifically, recognised deficiencies and aims at implementing proper actions to obtain an effective risk reduction, especially in the context of built urban areas.

In order to reach this goal, the book offers and illustrates a *multidisciplinary* proposal by uniting and merging different disciplines and fields of study, such as the disaster risk analysis (DRA) techniques, the sustainable land-use and urban planning policies, the environmental assessment methods, the different buildings safety topics, the certification and auditing management systems tools.

Along these lines our text, not thought as a manual, brings together the initial results of a research scheme aimed at testing a new feasible strategy in promoting buildings' safety. The proposal is to achieve a *Certification of the Predisposition of Resistance of Edifices to Disasters—CE.P.R.E.D.* (referred to, in the text, also as *P.R.E.D.* certification or rating/management system). To put it more simply, a more communicative name for the certification was *Safe House* (in Italian: *Casa Sicura*), the title chosen for it when, in 2008, active consideration on this theme began its route thanks to the official and economic support of the Province of Milan.

The idea is still to try out a new tool, an original scheme to be applied in the field of anti-disaster safety measures. Our scheme is meant to offer support to the

¹ Green Paper on the insurance of natural and man-made disasters, Strasbourg, 16.4.2013.

community in defending it from catastrophes. Its basic starting point is the assessment of the multi-risk situation of existing buildings (both from the point of view of hazard and from that of vulnerability). This estimate is to be carried out at different territorial levels and scales: district, province, local/proximity and the buildings themselves. The estimate itself, favouring the building's benchmarking, would thus encourage and guide preventive and protective renewal in built-up areas. Such areas have, with alarming frequency, been struck by catastrophes such as floods, landslides, earthquakes, forest fires, industrial accidents, gas explosions, structural collapses and other natural and man-induced calamities.

Our choice of presenting this proposal of new buildings' certification and rating system in a book is due to the decision of conducting its design and run in, not only by a phenomenological or mathematical/logical point of view, but also through a comprehensive approach including hypotheses and solutions concerning many different aspects of the problems. The aspects under investigation include: the perception and the communication issues related to the needs of a modern disaster risk management (DRM); the audit and the certification management systems' requirements and guidelines presently in force at an international level; the real availability and the exploitability of data bases and maps on different kinds of disasters and related components; the proper ways to carry out the necessary surveys' activities on the ground and "around and/or in" the buildings; the right balance between the effort to obtain final results and the depth of the required examinations; the link with the economical aspect of damages and losses caused by disasters.

The methodological key elements of our work are: a hybrid approach to face a complex field of applications of the risk analysis methods; the introduction of both the logic of the market forces and that of the bottom-up logic on the topics of building safety and disaster risk reduction; a modern communication and perception disaster risk solution; and, in general, a potential and additional new strategy in order to try to contribute to activate effective risk reduction and thus obtaining more sustainable levels of public finances.

As already mentioned, the work was and is still developed in Italy. Therefore what we present and discuss here is a revised, upgraded and critically reviewed work of both theoretical and on-the-field research path, that have already been followed for some years in Italy. The aim of this work is to extend and to validate the results of the investigations at an international level and to try to give an original contribution to the debate regarding the European Commission "Green paper on the insurance of natural and man-made disasters" of April 2013. It also aims at giving an additional point of view, or even a further element, to complete "a strong European Union Disaster Risk Management policies that aim to build resilience against disasters and mitigate their most severe effects" [EC 2013]. As a matter of fact, the PRED certification, here described, could represent a useful answer to complete the EC framework, since it attempts to point out to the omitted or underrepresented aspects of the Green Paper closing question: "This paper addresses specific aspects related to the prevention and insurance of natural and man-made disasters. Have any important issues been omitted or underrepresented? If so, which?".

Along the Research Path

The reflections, in this text, also bring together some significant material from previous studies, which we have adopted and broadened. We refer to:

- The EU project “interreg Medocc” *Qualité dans le Territoire—QUATER* which was finished in 2004. The project² (carried out by the Lombardy Region, in cooperation with various departments of the Milan Polytechnic with, as partners, the Piedmont Region, the Parco delle Madonie’s Organisation, Spain’s Valencia and Baleari Islands communities and France’s P.A.C.A. region) was intended to gather material for a collective manual evaluating territory risks as well as showing and controlling the relationships between the various risk-analysis indicators with regard to the critical level of different territory risks—such as chemical industrial areas, forest fires, hydro-geological areas, transport of hazardous goods, coastal erosion and unloading contaminating waste in coastal seas.
- The 5th Civil Protection book *Prevention of risk of collapse in residential buildings*, published in 2001 by the Lombardy Region with the Milan Polytechnic. This book³ shows an effort to tackle a delicate and complex subject, the risk to buildings, which depends on the ageing of supporting structures and the problems of intervening for safety. This text tried to tackle the subject in simple terms but with scientific accuracy, offering a guide for an individual to make his own definition of the possible signs or “symptoms” of eventual structural faults.

As a further step in this research path, the first pilot project for applying the “Safe House” scheme ran from spring 2008 to spring 2009. It was carried out in Milan Province territory and was possible thanks to the co-financing of the *Direzione di Progetto Diritti, Tutele e Cittadinanze Sociali*, of the *Assessorato Tutela dei Consumatori—Protezione Civile* and also thanks to the working support of the *Assessorato al Piano Casa Metropolitano* of the province administration.⁴

Research and development for the initiative have gone ahead on the lines of the ampler Italian-Swiss EU interreg project⁵ *MIARIA—Monitoraggio Idrogeologico Adattativo a Supporto del Piano di Rischio Integrato Alpino* (hydro-geological monitoring in support of the Alpine Integrated Risk plan), begun in 2009 and carried out by the Lombardy Region, in cooperation with, as partners, the Milan Polytechnic (Lecco Campus), the Lecco Province, the Milan Polytechnic Foundation, the University of Italian Switzerland and the University of Applied Sciences and Arts of Southern Switzerland. The plan was intended, among other

² Project web site: <https://quater.reteunitaria.piemonte.it>.

³ Available at www.protezionecivile.regione.lombardia.it (protezione civile—pubblicazioni—quaderni di protezione civile).

⁴ Project web site: www.fondazionepolitecnico.it (eventi trascorsi/past events—2009).

⁵ In the framework of European Regional Development Fund—ERDF. MIARIA project web site: www.miarialombardia.it.

aims, to “coordinate and improve the efficiency of the whole system of risk—and emergency—management”. Second, it aimed to “strengthen the public’s involvement as to sensitivity to and perception of risk—with regard to self-preservation in emergencies and in land use”. These aims are to be achieved through dynamic scenarios of integrated risk in mountain settings so as to plan intervention and control emergencies and, on the whole, strengthen resistance to disasters.

Milan, September 2013

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Chapter 1

Territory, Buildings, Sustainability and Disaster Risks: The Necessity of New Answers

1.1 The Roots of the Problem

How safe is the building I am in? A question like this is what every member of the public probably asks himself when he comes across media articles describing the catastrophes that continually strike conurbations on our planet.

But can we define the risk level of our private home or the public buildings where we spend our day? And are there technologies that could help? At the moment, such information is very hard to come by. But if we could get hold of it before buying a house or judging what restructuring to do (or before beginning a school year!) it would be extremely useful.

Here we shall focus on the crucial theme of the necessity of reinforcing the relationship between the land planning and the edifices' disaster risk reduction activities. One of the most relevant outcomes of our work resulted in the need of an integrated approach to the subject matter. As part of the community of researchers in the environmental sciences, and wanting to put theory into action, the most difficult problem was (and still is) to identify, and subsequently offer operational tools useful for the implementation of our integrated approach. In other words, the pivotal point today is still to propose functional solutions to the above questions according to this integrated view; our proposal could be one of the modern ways to trigger a modern mechanism capable of overcoming the situation of waiting, or inaction, in our fight against disasters' effects and consequences.

1.1.1 Overcoming Limits by Taking Action: Simulating Stress Tests Also for Buildings

In need to practice a competitive sport, an athlete has to undergo specialist medical inspections at regular intervals as is determined by his sport's medical body if he is to stay qualified. This is in order to minimise health risks or harm during competition or training. Such inspections are different from those usually given to

amateurs to certify their health and fitness. A professional inspection includes some tests carried out “under stress” so as to check the organism’s response to fatigue. These tests are not the same as our daily movements of physical effort.

In the past, ad hoc laws and regulations have fixed hygiene, health and safety standards for buildings (above all in the richest countries). Such standards have intended to reduce possible accidents as regards both basic functions and further risks such as fire. These norms have for some time, in a generally satisfactory way, ensured daily activities for hygiene and the commonest bad weather conditions. But very often as the years have passed and many new factors have come into play, these norms or standards, generally, no longer ensure a regularly updated contextual evaluation of the strength of a building when subject to a calamity and therefore to extraordinary stress.

We can list the factors that compromise the protective performance that buildings should offer. This list is long and, among other facts, includes the original inadequacy of the norms and the construction’s features, obsolete design decisions, ageing structures, norms never updated, structural imperfections, degradation of buildings due to misuse, risky modifications, uses unforeseen by the original architect, as well as unpredictable development in the status of buildings and localities. Whatever the situation, there are many “new” or “regulated” buildings that should have been (but were not) able to stand up to all the quakes that have happened, for instance, in Italy from the Seventies till now, when the first real anti-quake norms came into force. Similarly, today’s regulations do not give enough enforcement to the checks, the care, the maintenance and (if necessary) strengthening of *existing buildings*—even though these often have features that are anything but satisfactory. And in spite of this fact, these buildings form the vast majority of Italy’s inherited constructions. Probably, the situation may be quite similar in many disaster-affected portion of our planet. New regulations concentrate, above all, on new structures.

Exaggerated trust in modern building techniques, the fragmentation of specialist knowledge, of competence and responsibility, the way too many project aims depend on minor importance market choices when faced with scarce or hard-to-get resources, all those factors taken together with the supposed variety of calamities and crude overestimate intervention costs have led to an outstanding effect. The first consequence was the delegation of responsibility, and then to lose, or turn a blind eye to, what remains one of our basic instincts—testing and maintaining the safety of our own habitation, our “shelter”. Such an instinct, in a modern version, has to be recovered and strengthened.

The main aim of this research is to achieve the above. Our paper illustrates the work that was involved in inventing a proposal for eventual certification of buildings’ strength against disaster risk. The certification would be an integrative element of the current regulations and codes (not necessarily legislated) thanks to an *innovative methodology*, which would be non-invasive, based on precise collection, analysis and organisation of existing information and knowledge.

1.1.2 Our Perspective in the Framework of Initiatives to Reduce Disaster Risks in Support of Civil Protection Activities

The reflection and research illustrated in these pages lead to the proposal of a new voluntary system of evaluating risks to buildings and urban assets. Thus, these studies chiefly initiate from the combination of three research fields.

The first and primary of these regards strategies and methods for *reducing the disasters risk* (or Disaster risk management—DRM) which in Italy is dealt with by the National Civil Protection Service (and, similarly in EU, for instance, by the coordination of the Emergency Response Centre—ERC of the Humanitarian Aid and Civil Protection DG of the European Commission; in the USA, by the Federal Emergency Management Agency—FEMA). The second relates to the long and mid-term *land-use planning* policy for built-up areas, to be reinforced as a fundamental tool to the territorial safety. The third concerns *assessment and certification techniques*, because of a few critical aspects of its implementation to the edifices and their territories. The latter proposal aims to define, as far as it is verifiable, the potential disaster-resistance of the building investigated; this potential resistance would be certified as predisposition in defence against eventual calamity phenomenon of a structure during a disaster.

In short, the idea is to invent a project scheme that starts from certification methods for the *product* (cf. Vertinsky et al. 2000; Foglio 2008) and for minimising disaster risk from an up-to-date multi-risk viewpoint (cf. Kron 2005; Grünthal et al. 2006; Ritchey 2006; Schmidt et al. 2011). The purpose of these methodologies is, through well-defined *indices*, to simplify and summarise the performance, in a specific functional situation, of a particular good so as to ascertain its conformity to a precise discipline. There are significant examples of such methods applied to the building industry: e.g. the ‘energy’ certifications of buildings (cf. Dall’O et al. 2008; Pérez-Lombard 2009) such as, in Italy, those emitted by Bolzano Agency *CasaClima* (www.agenziacasaclima.it) or by the Lombardy-Region *CENED—Certificazione Energetica degli Edifici* (www.cened.it) scheme, or the environmental certifications of buildings such as the US *LEED—Leadership in Energy and Environmental Design* (www.usgbc.org/leed) or the UK *BREEAM—Building Research Establishment Environmental Assessment Method* (www.breeam.org) systems.¹ Nevertheless, as we will show in the following pages dealing with Disaster Risk Management, we are facing a more

¹ Other relevant examples of energetic or environmental sustainability systems are (inter alia): the Swiss *MINERGIE* sustainability standard; the German *Passivhaus* energy standard; the German *DGNB—Deutsche Gesellschaft für Nachhaltiges Bauen* sustainability system; the French *HQE—Haute Qualité Environnementale* green building standard; the US Energy Star (energy); the Japanese CASBEE (sustainability); the Canadian Green Globe (sustainability); the Australian Green Star (sustainability).

complex multi-dimensional problem requiring knowledge and experience from a wide range of disciplines.

The proposal of our certification has been developed at the Milan Polytechnic on the basis of collaboration between the Milan Polytechnic Foundation, the Architecture and Planning Department and the Department of Building Environment Science and Technology. This certification is meant to safeguard the public, the “consumers” of the built “good”, by means of an evaluation, rating and labelling system. The proposal tackles the problem of spreading knowledge and awareness of buildings’ safety. This is to be done in various ways achieving in the end a *labelling* system with “*Blue shields*”—from one to five shields indicating the construction’s resistance strength against disasters.

Damage brought by a disaster does not only depend on the phenomenon’s violence but also on the building’s structure features and its locality. The proposed certification takes into account a variety of risks and events. These include earthquakes, landslides, floods, avalanches, weather extremes, industrial and hazardous-goods-transport accidents, forest-fires, etc., as well as the technical nature of the building material used, of the inbuilt installations and their maintenance and conservation. The gathering and analysis of all this information available to us mean we can more precisely single out the high-risk land areas and most vulnerable structures—and as a result we are able to give the public and the local administrators more information and awareness.

The chosen target for observation and inclusive evaluation of these interactions is the building itself—since it is here that the considered events concentrate. Such events may have international import like hurricanes or floods but they may also derive from urban or suburban factors such as industrial accidents or forest-fires, or from individual sites or structures like landslides or gas-leak explosions. Secondly, the building (house, home, refuge) is what attracts the individual’s greatest attention in its function as a basic constituent of human presence where the owner or administrator is responsible for his own safety and that of his family or other dwellers there.

Thanks to this undoubted role, the building as structure can itself become the initial and guiding impulse to achieve, now at last with a telling impact, what has been called, in Italy, the “*greatest of all public works*” (Gruppo 1996, p. 183), meaning, with a *logical strategy based on priority maintenance and prevention*, the creation of all-round safety for the country or, rather, a *general increase in the nation’s safety*. Similarly, the PRED certification’s approach may represent, within the scientific on-going debate at the European level, an important component in which it is underlined the need that persons endowed with policy decisional powers may be able to prepare the ground for such policy changes, well ahead of the calamitous events which normally would only be able to put them in force with immediate effect (Penning-Rowsell et al. 2006); it can also be seen as one of the alternative proposals to the environment and economy integration, either for climate policy improvement or for strategic environmental assessment activities (cf. Murphy et al. 2000; Kuik et al. 2008; Therivel 2012).

The approach taken in the clearly fundamental and indispensable territorial risk-mapping, also an essential preparation for the scheme described in this text, was not on its own successful, i.e. not successful in creating the conditions essential for converting the acquired knowledge in active intervention. *CEPRED* thus could constitute one of the basic elements for finalising and activating the information for acquired as well as energizing action in tackling a problem that is, by now, well-known but to solve which, action has been slow-paced both collectively and individually—and not only in Italy.

As well as detailing our proposal and research, a complementary but not secondary aim of this text is to help to revive the debate on feasible interventions to reinforce the *safety culture* of buildings and thus of the whole country (and its impact as overall disaster risk reduction culture). This debate should take place among institutions, owners, building-sector and insurance representatives and the bodies involved in protecting the land from disasters. Nowadays, the debate seems too often concentrated on the problem of reacting to emergencies or on the difficulties of restoring the localities affected by disasters. Instead, we should be dedicating the same amount of attention to a well-timed *reducing* and *not increasing risk*. This would encourage territory and town-planning as well as a more knowledgeable and innovative building industry. It would also lessen the damage and the mourning that future calamities will inevitably bring. In this way, our work also proposes itself as a contribution to one of the most relevant debates on the topic of disaster risk reduction, highlighted by the European Commission “Green paper on the insurance of natural and man-made disasters” of April 2013. The Safe House (Casa Sicura—PRED Certification or Rating System) initiative can, in fact, have a direct effect in creating attention on structure and land maintenance, which should be formative and stimulating in rendering wider reaches of society and institutions more conscious and responsible—without going against market mechanisms but, in the long run, helping to save public and private wealth.

1.1.3 Do We Need New Strategies to Protect Our Houses from Catastrophe?

In Italy, just a few days after the 2009 earthquake of L’Aquila and Abruzzo, an increasing debate was started on the possibility of knowing in advance the resistance of a building, before being ravaged by a calamity. Our work, in its first “version” had just been presented a week before.² Naturally, it was not yet ready to be applied on a large scale but that debate encouraged us to continue our

² The meeting to present the first project results was held on 31st March 2009 in the Audition of the Milan Polytechnic, via Pascoli 51.