Seismic risk prevention of architectural heritage promoted by the Italian Civil Protection

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SUMMARY

1. Short history of Civil Protection in relation to Cultural Heritage

2. Actions for risk mitigation
   a) Improvement of knowledge
   b) Reduction of vulnerability and exposure
   c) Mitigation of effects
In the first days, voluntary helps only:

“MUD’S ANGELS”

LACK OF A CENTRAL STRUCTURE IN CHARGE OF CIVIL PROTECTION TASKS
Friuli Earthquake – 6 May 1976

Irpinia Earthquake
23 November 1980
Coordination among National Civil Protection Dept. (DPC), Regions, Prefectures, Provinces and municipalities and local Cultural Heritage Departments.

- DAMAGE SURVEYS,
- DIGITIZATION OF COLLECTED DATA,
- PROVISIONAL WORKS TO SAFEGUARD C.H. AGAINST RESIDUAL RISKS
- IDENTIFICATION OF MOVABLE HERITAGE
- PROVISIONAL WORKS FOR CHURCHES AND MONUMENTAL BUILDINGS
Abruzzo Earthquake - 6 April 2009

DI.COMA.C. (CULTURAL HERITAGE FUNCTION)

DEPUTY COMMISSIONER FOR THE CULTURAL HERITAGE
The emergency activities on C.H. was not included among Civil Protection Activities according to the very recent Decree-Law 59/2012

The C.H. Ministry MIBAC managed the emergency with the NATIONAL CRISIS UNIT AND THE REGIONAL CRISIS UNITS (Decree of the Secretary General of MIBAC n.7/25 May 2012)
EVOLUTION OF C.P. REGULATIONS

Law N. 996/1970 needing executive regulations

D.P.R. N. 66 OF1981 after the 1980 Irpinia Earthquake …

EXECUTIVE REGULATIONS OF THE LAW No. 996 OF 1970

norms on the rescue and assistance of the populations hit by calamities – p.c.”

Law N. 225/1992

ESTABLISHMENT OF THE NATIONAL SERVICE OF CIVIL PROTECTION

Art. 1 comma 1:
“The *Servizio nazionale della protezione civile* is established in order to protect the integrity of life, *goods*, settlements and the environment against damage and the risk of damage due to natural calamities, catastrophes and other disastrous events”.

D.L. 59/2012 is enforced on 17 May 2012 (three days before Emilia Eq

URGENT PROVISIONS FOR THE REORGANIZATION OF THE CIVIL PR.

Art. 5, comma 2: …with ordinances can be only ordered in relation to the organization of *rescue and assistance services* for subjects hit by the event, as well as to the *PROVISIONAL INTERVENTION STRICTLY RELATED TO THE FIRST NEEDS*, within the limits of the available purposely allocated resources.
Law n. 100 of 12 July 2012
Law conversion, with modifications, of DL 15 May 2012, n.59,
URGENT PROVISIONS FOR THE REORGANIZATION OF CIVIL PROTECTION

ART. 5, COMMA 2

…. Ordinances are finalised to the organisation and the activation of the rescue and assistance services of the population involved by the event, the SAFETY MEASURES of public and private buildings and of CULTURAL HERITAGE SEVERELY DAMAGED OR THREATENING PUBLIC AND PRIVATE SAFETY…. 
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   a) Improvement of knowledge
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   c) Mitigation of effects
a) Improvement of scientific knowledge

Competence centres of DPC

• INGV
  (Seismic surveillance, Emergency technical support, Seismological research projects)

• RELUIS
  (Emergency technical support, Earthquake engineering research projects)

• EUCENTRE
  (Emergency technical support, Earthquake engineering research projects)

In the period 2004-2013, PC funds for seismic risk research amounted to ~65 M€
RELUIS
(Network of Eq. Engineering University Labs)

Università di Napoli
Federico II AMRA

2 DOF, Dual table system:
2 tables 3x3 mq, 20tx2,5m, 1.0 m/s

Università di Pavia
Eucentre

1 DOF, Large mass table:
5x7 mq, 300tm, 1-1.5 m/s
L-shaped reaction wall

Università della Basilicata

Large reaction wall:
Real Scale
Pseudodynamic Tests

Università di Trento

Large reaction wall:
Real Scale
Pseudodynamic Tests
DPC-RELUIS Research involvement
DPC-RELUIS Research Projects

MAIN RESEARCH THEMES

• Vulnerability of Existing Structures
• Advanced Design Criteria
• New Technologies on Risk Mitigation
• Emergency Management
Eq. Eng. Research Products

- Proposals for seismic code improvement
- Proposal for new norms
- Guide-lines for innovative approaches
- Handbooks and codes of practice
- Advanced methods and procedures for seismic assessment and design
- Data Bases
DPC-EUCENTRE Program – Service products

Development of databases, scenarios and national seismic risk evaluation and support of DPC activities

**d0** – Set up of an integration module of the Eucentre databases within the IT system of DPC

**d1** – Evaluation of the Italian seismic risk (dwelling buildings)

**d2** – Prioritization for seismic risk mitigation of schools

**d3** – Integration of satellite data in the cycle of seismic emergencies

**d4** – Seismic risk of the national transportation system

**d5** – Seismic vulnerability and risk of harbour structures

**d6** – Seismic risk of earth dams
The Ordinance 3274 of 20.03.2003 introduces the obligation for seismic verification of strategic and important (for the consequences of their collapse) buildings:

1. Mandatory for the owners within 5 years → the term has been delayed until 31.12.2012
2. Buildings and infrastructure which are strategic and with significant consequences in case of collapse
3. Priority for seismic zones 1 and 2 and buildings made before 1984 or in municipalities with new classification

a) Improvement of the knowledge on vulnerability and risk of buildings

OPCM 3274/2003
a) Improvement of the knowledge on vulnerability and risk of buildings

OPCM 3274/2003

1) Buildings and infrastructural constructions of strategic interest, as their functionality after an event is fundamental for civil protection

2) Buildings and infrastructural constructions that can be critical in relation to the consequences of their collapse
The CSRS WEB-system
Seismic Risk of Historical Centres

The Italian historical centres in Italy are 22,698
(Source MiBAC – ICCD)

<table>
<thead>
<tr>
<th>2010 Seismic Classification (simplified)</th>
<th>No. Of Historical Centres</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1,934</td>
</tr>
<tr>
<td>2</td>
<td>6,038</td>
</tr>
<tr>
<td>3</td>
<td>6,929</td>
</tr>
<tr>
<td>4</td>
<td>7,789</td>
</tr>
</tbody>
</table>

Distribuzione CS nelle zone sismiche

- 1: 34.3%
- 2: 26.6%
- 3: 30.5%
- 4: 8.5%
The historical centres constitute fundamental parts of the cultural heritage. It is necessary to assess their **historical-artistic interest and the risk of loss they are exposed**, for the intervention strategies on C.H. in case of a seismic event.

**CSRS is a common tool for investigating exposure, vulnerability and risk**

- **National network** for the information exchange among the different level of territorial government (Dept. Of Civil Protection, C.H. Ministry, Regions, C.H. authorities, Provinces, Municipalities)

- Data Bank “**Atlas of historical centres exposed to the seismic risk**”

- model for the analysis of the risk of loss of the cultural interest fo the historical centres
The CSRS WEB-system
Seismic Risk of Historical Centres

OBJECTIVES

• Integration and updating of the list of historical centres
• Integration and updating of the list of the buildings of cultural interest
• Georeferring, perimetrazione, consistenza
• Assessment of the cultural interest of the centre
• Vulnerability of the historical real estate
• Risk evaluation (scenarios)
• Production of thematic reports
When an earthquake occurs, a report can be automatically produced, given the epicentral coordinates and the magnitude provided by INGV.
Prevention activities
Guidelines of the assessment and the reduction of the seismic risk of the cultural heritage

2003: OPCM 3274/2003 – TECHNICAL STANDARDS FOR SEISMIC DESIGN OF STRUCTURES


2008: TECHNICAL NORMS FOR THE CONSTRUCTIONS (INCLUDING SEISMIC DESIGN) – NTC2008 FULLY ENFORCED IN JULY 2009

2010: APPROVAL OF THE NEW GUIDELINES - 23 LUGLIO
Prevention activities
Guidelines of the assessment and the reduction of the seismic risk of the cultural heritage

Provides indications for assessment and strengthening interventions, which is conceptually similar to that set up by technical norms for ordinary constructions, but suitable for the Cultural Heritage.

The Guidelines define:
1. The LIMIT STATES suitable for historical buildings
2. THE EVALUATION LEVELS suitable for historical buildings
3. THE SAFETY LEVELS acceptable for historical buildings
3 ASSESSMENT LEVELS: LV1 – LV2 – LV3
In case of intervention, correspond between:
LV2 (guidelines) – repairing or local intervention (NTC2008)
LV3 (guidelines) – seismic rehabilitation (NTC2008)

LIMIT STATES:
SERVICE LIMIT STATES (SLE):
SLO – operational limit state
SLD – damage limit state (of buildings)
SLA – damage limit state of artistic goods
ULTIMATE LIMIT STATE (SLU):
SLV – Limit state for the safeguard of human life
SLC – Limit state for the prevention of collapse
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Post-Earthquake Damage Inspection Forms

"APPROVAL OF THE MODELS FOR THE SURVEY OF THE DAMAGE TO CHURCHES AND MOVABLE CULTURAL HERITAGE GOODS"

THE MODELS TO CATALOGUE AND SURVEY THE DAMAGE TO CULTURAL HERITAGE, WHICH WERE CONCEIVED AFTER THE UMBRIA MARCHE EARTHQUAKE, ARE MADE OFFICIAL AND UNIFORM AT NATIONAL SCALE BY THE G.La.Be.C. WORKING GROUP

DECREE OF THE PRIME MINISTER 23 February 2006
“APPROVAL OF THE MODELS FOR THE SURVEY OF THE DAMAGE, IN THE AFTERMATH OF CALAMITIES”

- THE INSPECTION FORM FOR MOVABLE GOODS IS CONFIRMED
- THE CHURCH’S DAMAGE FORM IS IMPLEMENTED BY INCREASING THE COLLAPSE MECHANISMS FROM 18 TO 28
- THE PALACE FORM IS INTRODUCED.
### Schede per il rilevamento del danno

#### MOBILE C.H. GOODS

- **Damage Inspection Form for Mobile C.H. Goods**

#### C.H. BUILDINGS

- **Damage Inspection Form for Palaces**

- **Damage Inspection Form for Churches**
Preparedness ➔ EXERCISES

2005 (earthquakes) “Eurosof”

2006 (volcanic eruptions) “Mesimex”

2006 (floods) “Arnus 2006”

2013 (tsunamis) “Twist”

2010 (earthquakes) “Terex”
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