



*Tower of David Museum,  
Jerusalem, ,19-20 January 2014*



*Workshop - Seismic Risk Preparedness  
and Mitigation of Archaeological and  
Historical Sites*

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



**PROTEZIONE CIVILE**  
Presidenza del Consiglio dei Ministri  
Dipartimento della Protezione Civile

*Prof. Mauro Dolce*  
*Italian Department of Civil Protection*

## 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

## Floods of Florence - 4 November 1966



**LACK OF A CENTRAL  
STRUCTURE IN CHARGE OF  
CIVIL PROTECTION TASKS**

**In the first days, voluntary  
helps only:**

**“MUD’S ANGELS”**



## Friuli Earthquake – 6 May 1976



**EMERGENCY MANAGED  
BY A SPECIAL  
COMMISSIONER**



**EMERGENCY MANAGED  
BY A SPECIAL  
COMMISSIONER**




**Irpinia Earthquake  
23 November 1980**

# Umbria-Marche Earthquake - 26 September 1997



**SPECIAL COMMISSIONER  
FOR THE CULTURAL  
HERITAGE OF UMBRIA  
AND MARCHE**

**Coordination among  
National Civil  
Protection Dept. (DPC),  
Regions, Prefectures,  
Provinces and  
municipalities and local  
Cultural Heritage  
Departments.**



**SPECIAL COMMISSIONER  
FOR THE BASILICA OF  
SAN FRANCESCO**



- **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**



## Emilia Earthquake – 20-29 maggio 2012



**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 OF 1981** 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....

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**

## Competence centres of DPC

- **INGV**



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

- **RELUIS**



(Emergency technical support, Earthquake engineering research projects)

- **EUCENTRE**

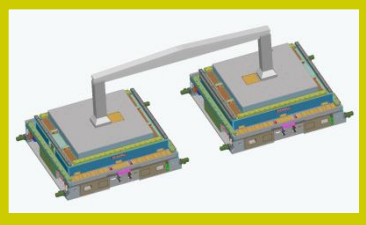


(Emergency technical support, Earthquake engineering research projects)

In the period 2004-2013,  
PC funds for seismic risk research amounted to ~65 M€



# RELUIS (Network of Eq. Engineering University Labs)



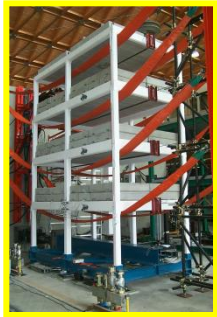
**Università di Napoli  
Federico II AMRA**

**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**



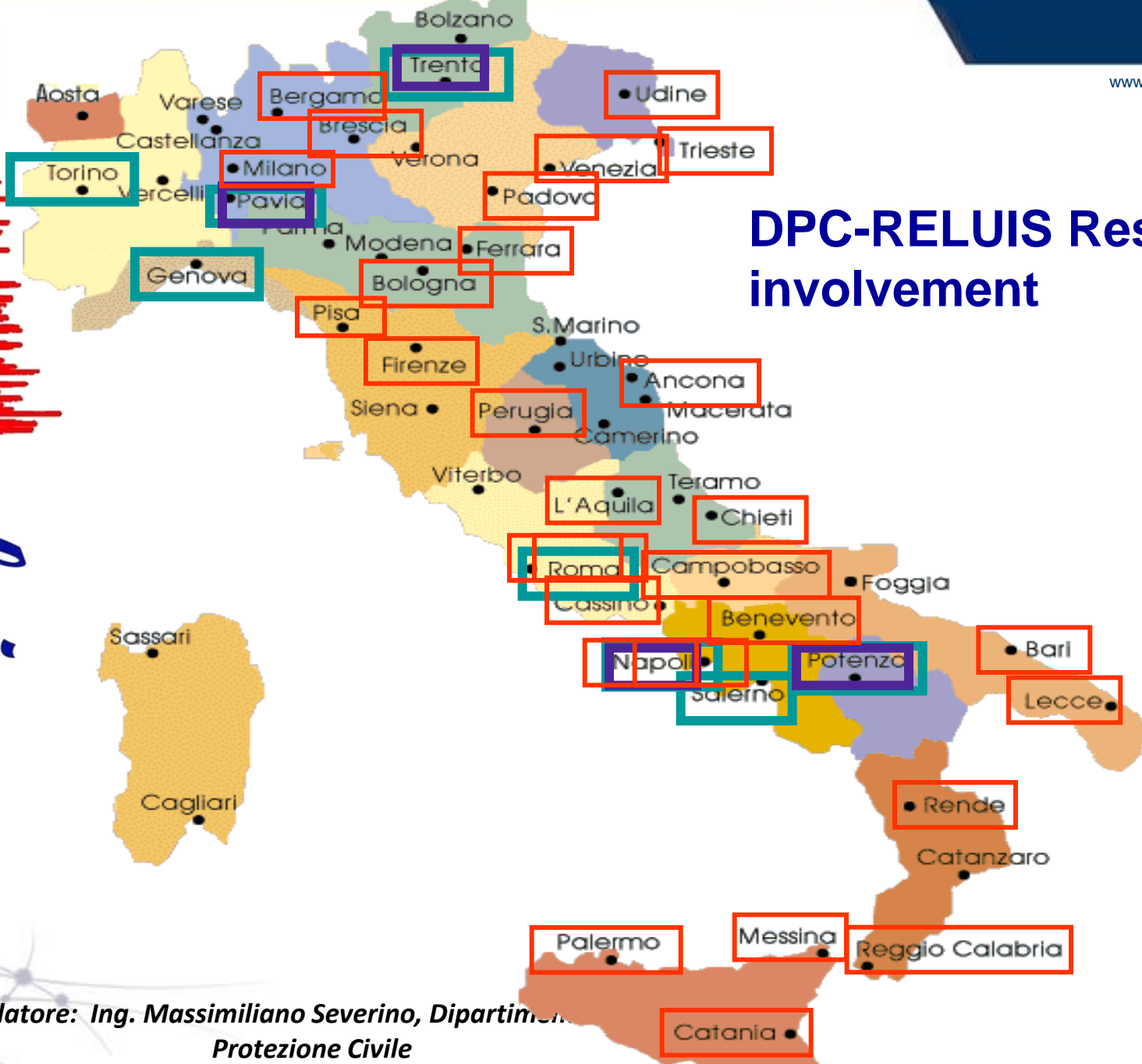
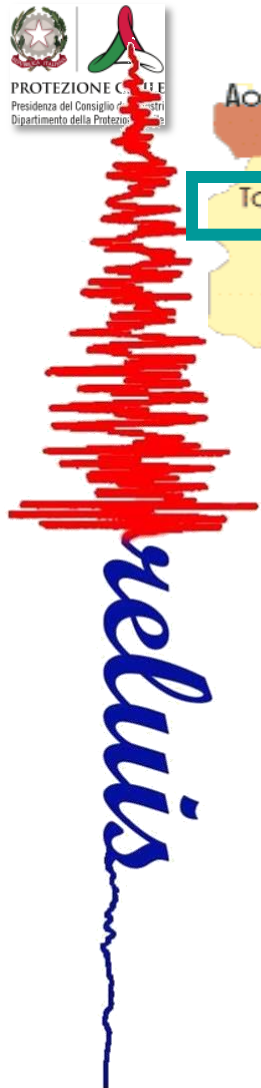
**Università della Basilicata**

**Large reaction wall:  
Real Scale  
Pseudodynamic Tests**



**Università di Trento**

**Large reaction wall:  
Real Scale  
Pseudodynamic Tests**

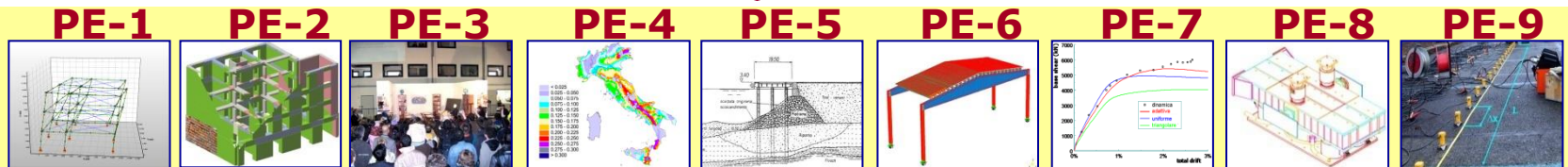
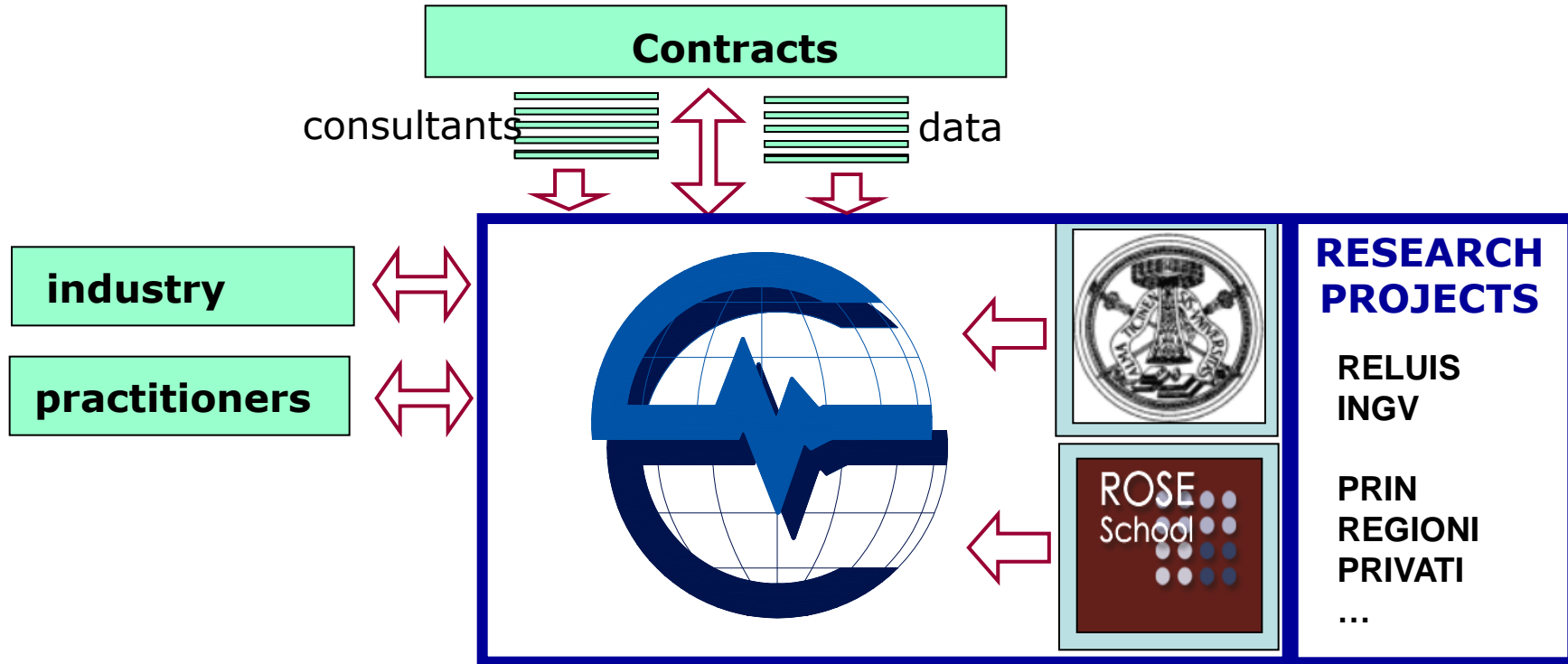


## DPC-RELUIS Research involvement

## ***MAIN RESEARCH THEMES***

- ***Vulnerability of Existing Structures***
- ***Advanced Design Criteria***
- ***New Technologies on Risk Mitigation***
- ***Emergency Management***





- **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**

**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**

*Relatore: Ing. Massimiliano Severino, Dipartimento della*

*Protezione Civile*



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

### OPCM 3274/2003

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

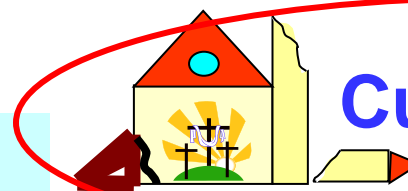
**1) Buildings and infrastructural constructions of strategic interest, as their functionality after an event is fundamental for civil protection**



Town halls,  
Hospitals  
Barracks



Bridges



Cultural Heritage

Schools



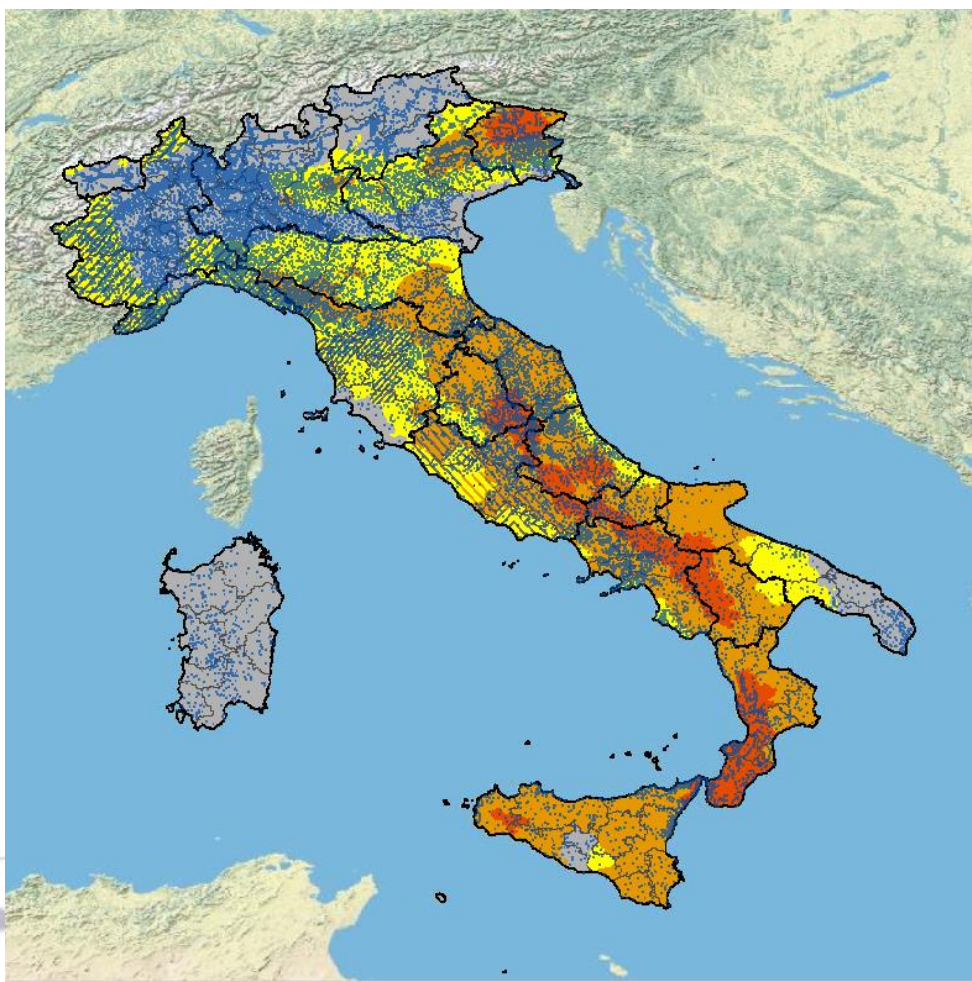
**2) Buildings and infrastructural constructions that can be critical in relation to the consequences of their collapse**

# a) Improvement of the knowledge on vulnerability and risk of historical centres

[www.protezionecivile.gov.it](http://www.protezionecivile.gov.it)

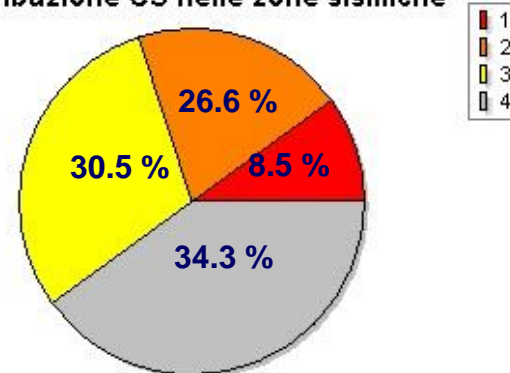
## The CSRS WEB-system Seismic Risk of Historical Centres

The Italian historical centres in Italy are 22.698  
(Source MiBAC – ICCD)



2010 Seismic Classification (simplified)	No. Of Historical Centres
1	1934
2	6038
3	6929
4	7789

Distribuzione CS nelle zone sismiche





# The CSRS WEB-system

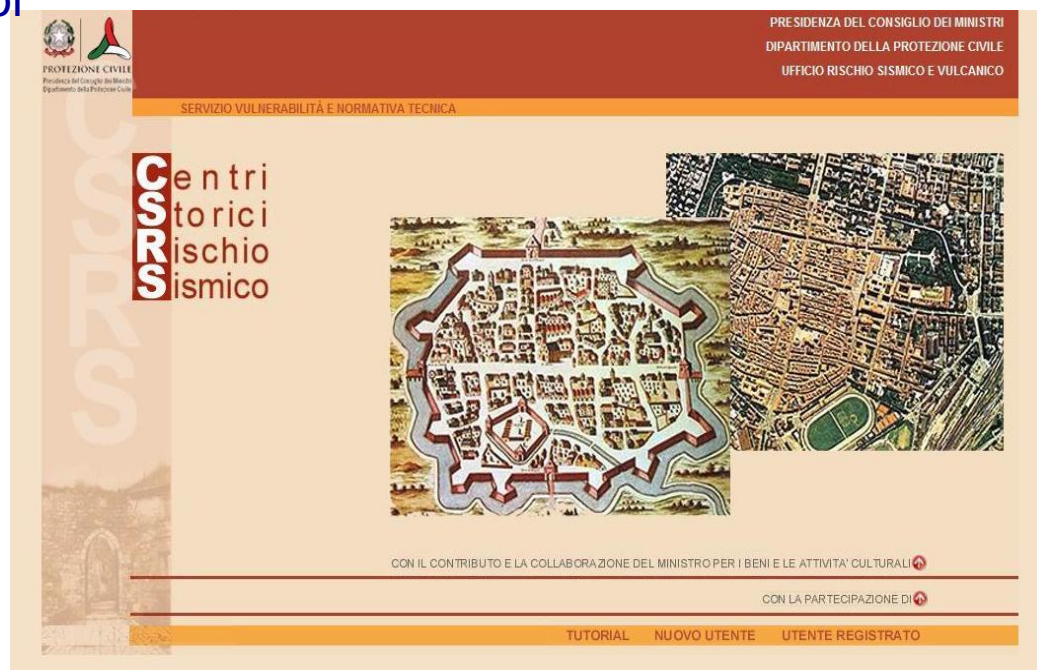
## Seismic Risk of Historical Centres

www.protezionecivile.gov.it

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

**WEB SYSTEM CSRS**

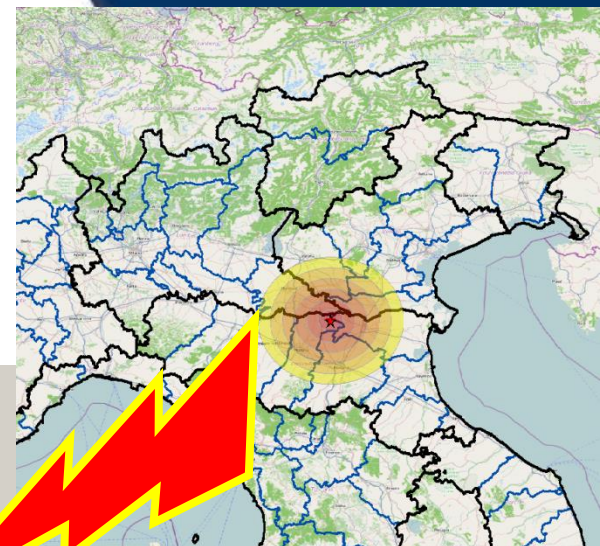
- Integration and updating of the list of historical centres
- Integration and updating of the list of the buildings of cultural interest
- Georeferencing, perimetrazione, consistenza
- Assessment of the cultural interest of the centre
- Vulnerability of the historical real estate
- Risk evaluation (scenarios)
- Production of thematic reports



# The CSRS WEB-system

## Seismic Risk of Historical Centres

### Emergency Report – Historical Centres



PRESIDENZA DEL CONSIGLIO DEI MINISTRI  
Dipartimento della protezione civile  
Ufficio Rischio sismico e vulcanico

#### Dati di Esposizione e Vulnerabilità

<b>Provincia</b>	Cosenza
<b>Comune</b>	Cosenza

Centro storico	Int. Calc. (MCS)	Num. Ed. CS	Num. Beni Cult.
Aoquappesa		2	
Aori		1	
<b>TOTALE</b>		<b>3</b>	

Centro storico	Int. Calc. (MCS)	Num. Ed. CS	Num. Beni Cult.
Aoquappesa		2	
Aori		1	
<b>TOTALE</b>		<b>6</b>	
<b>TOTALE</b>		<b>6</b>	

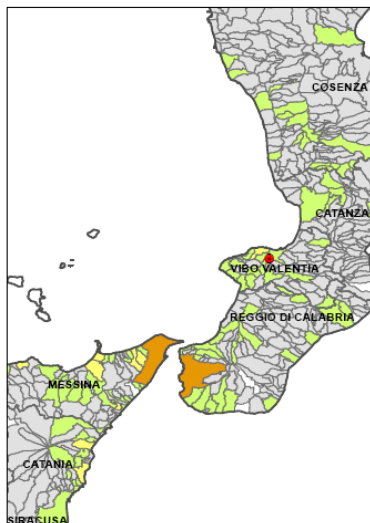
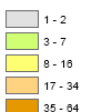


Fig.2 Centri storici (ICCD)



Presidenza del Consiglio dei Ministri  
Dipartimento della protezione civile



PRESIDENZA DEL CONSIGLIO DEI MINISTRI  
Dipartimento della protezione civile  
Ufficio Rischio sismico e vulcanico

#### RAPPORTO E.S. – C.S.

Rapporto Emergenza Sismica per i Centri Storici  
di città di Cosenza

**5**  
Scala d'impatto del sisma sui Centri Storici

#### Evento sismico

Comune epicentrale Vibo Valentia (Vibo Valentia)  
Data ..-11-2011 Longitudine 16.07 Profondità 10  
Ora 0.0 Latitudine 38.67 Magnitudo MI 7.1

#### Quadro territoriale patrimonio culturale esposto

Numero centri storici (ICCD – CSRS)	999999
Numero edifici ante 1945 (CSRS)	999999
Numero beni culturali immobili (ISCR-DSPA/BAC)	999999
Interesse culturale dei Centri Storici (min-max)	0 B
Esposizione culturale dei Centri Storici (min-max)	E A

#### Stime complessive

(Attenzione: scenario sismico su una profondità media ipocentrale di 10 km)  
Probabile intensità (MCS) massima raggiunta IX  
Probabili Soprintendenze da allertare 9 99  
Comuni afferenti ai COM 999

#### Definizioni della scala di impatto del sisma sul patrimonio culturale dei CS

Effetti	Azioni	Soggetti
<b>0</b> Assenza di perdite	Contatto telematico	(INGV-DPC-MBAC)
<b>1</b> Protuberanti picchissimi danni sia agli Edifici ante AS che alle Emergenze	Sopraluoghi	Soprintendenze locali. Eventuale supporto DR.
<b>2</b> Danni limitati sia agli Edifici ante AS che alle Emergenze	Sopraluoghi N. Verifica condizioni organizzative. Eventuali ricoveri per BCM.	Soprintendenze locali. Supporto DR. Eventuale supporto DPC.
<b>3</b> Danni estesi. Protuberanti perdite di Interesse Culturale in centri di medio e basso Interesse Culturale	MBAC, CO.MI, rilevamento danni. Ricoveri provvisori BCM.	MBAC, Supporto DPC. Centri di Competenza. Valorizzato.
<b>4</b> Danni gravi. Grave perdita di Interesse Culturale per perdite agli Edifici ante AS e alle Emergenze	Rilevamento danni. Ricoveri provvisori BCM.	MBAC, Supporto DPC. Centri di Competenza. Valorizzato.
<b>5</b> Danni catastrofici su grande scala.	Rilevamento danni. Ricoveri provvisori BCM. Aiuti internazionali.	Anche soggetti esterni (UE)

Indicatori patrim. culturale CS	
Int.cult	Esp.cult
<b>0</b> Nulla/Non rilevata	<b>0</b> Nulla/Non rilevata
<b>E</b> Discreta	<b>E</b> Basso
<b>D</b> Buona	<b>D</b> Medio-Basso
<b>C</b> Molto buona	<b>C</b> Medio
<b>B</b> Elevata	<b>B</b> Medio-Alta
<b>A</b> Molto elevata	<b>A</b> Alta

Data di stampa: D4/10/2012 8.25.15

(Vibo Valentia ..-11-2011)

pagina 3

Data di stampa: D4/10/2012 8.22.27

(Vibo Valentia ..-11-2011)

pagina 1

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 assesement and the reduction of the seismic risk of the cultural heritage

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

**2005: OPCM 3431/2005– MODIFICATIONS AND INTEGRATIONS OF OPCM 3274**

**2007: DIRECTIVE OF THE PRIME MINISTER (PCM) 12 OCTOBER 2007 – APPROVAL OF THE GUIDELINES**

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

**2010: APPROVAL OF THE NEW GUIDELINES - 23 LUGLIO**



**Linee Guida**  
per la valutazione  
e riduzione  
del rischio sismico  
del patrimonio culturale

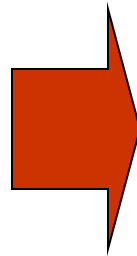
# Prevention activities

## Guidelines of the assesement 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.



from  
FULL UPGRADING



To SEISMIC  
REHABILITATION

**The Guidelines define:**

- 1. The LIMIT STATES** suitable for historical buildings
- 2. THE EVALUATION LEVELS** suitable for historical buildings
- 3. THE SAFETY LEVES** acceptable for historical buidings



# Prevention activities

## Guidelines of the assesement and the reduction of the seismic risk of the cultural heritage

### 3 ASSESSMENT LEVELS: LV1 – LV2 – LV3

In case of intervention, corrisponden 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



Interministerial Decree 3 May 2001, published in the GU of 21 May 2001 n 116

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

THE MODELS TO CATALOGUE AND SUVEY 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

Presidenza del Consiglio dei Ministri  
 Dipartimento della Protezione Civile  
 Gruppo di Lavoro per la Salvaguardia e la Prevenzione dei Beni Culturali da Rischi Naturali

Ministero  
 per i Beni e le Attività Culturali

EMERGENZA POST-TERREMOTO  
 SCHEDA PER IL RILIEVO DEI BENI CULTURALI - DANNO AI BENI MOBILI

Modello N°-BM

**C<sub>1</sub>**  
 Data: / / N° progressivo: N° Scheda:

**C<sub>2</sub> - COMPILATORE SCHEDA**  
 Cognome: Nome: Tipologia:

**C<sub>3</sub> - RIFERIMENTO SCHEDA DEL DANNO ALLE CHIESE**  
 N° Scheda: Data: Compilatore:

**C<sub>4</sub> - MANIFATTO**  
 Numero d'ordine: N° Scheda di riferimento edificio: N° Scheda regione: N° Scheda Ente locali:

**C<sub>5</sub> - LUOGO DI COLLOCAZIONE (CONTENITORE)**  
 Tipologia: stesa palazzo castello Convento altro  
 Proprietà: Utilizzatore:

**C<sub>6</sub> - LOCALIZZAZIONE GEOGRAFICO AMMINISTRATIVA DEL CONTENITORE**  
 Indirizzo: Prov.: Città: Comune: Località: Sezione censuaria:

## C.H. BUILDINGS

### DAMAGE INSPECTION FORM FOR PALACES

Presidenza del Consiglio dei Ministri  
 Dipartimento della Protezione Civile  
 Gruppo di Lavoro per la Salvaguardia e la Prevenzione dei Beni Culturali da Rischi Naturali

Ministero  
 per i Beni e le Attività Culturali

EMERGENZA POST-SEISMICA  
 SCHEDA PER IL RILIEVO DEL DANNO AI BENI CULTURALI - PALAZZI

Modello B - DP  
 Prima sezione

**B<sub>1</sub>**  
 Data: / / N° progressivo: N° Scheda:

**B<sub>2</sub> - RIFERIMENTO VERTICALE**  
 Bene complesso: Bene Individuo:  
 Denominazione bene complesso:  
 Numero schede beni componenti: Codice livello superiore:  
 Tipologia: palazzo castello torre torre archeologica altro  
 Pianta: regolare con corti ad al aperte lineari

**B<sub>3</sub> - LOCALIZZAZIONE GEOGRAFICO AMMINISTRATIVA**  
 Regione: Città: Indirizzo: Prov.: Comune: Località: Sezione censuaria:

**B<sub>4</sub> - COORDINATE UTM**  
 Quadsim: Longitudine Est (x): Latitudine Nord (y): Lettura GPS:

**B<sub>5</sub> - OGGETTO**  
 Denominazione bene: Denominazione storica: Datazione: anno secolo epoca Ultime trasformazioni:

### DAMAGE INSPECTION FORM FOR CHURCHES

Presidenza del Consiglio dei Ministri  
 Dipartimento della Protezione Civile  
 Gruppo di Lavoro per la Salvaguardia e la Prevenzione dei Beni Culturali da Rischi Naturali

Ministero  
 per i Beni e le Attività Culturali

EMERGENZA POST-SEISMICA  
 SCHEDA PER IL RILIEVO DEL DANNO AI BENI CULTURALI - CHIESE

Modello A - DC  
 Prima sezione

**A<sub>1</sub>**  
 Data: / / N° progressivo: N° Scheda:

**A<sub>2</sub> - RIFERIMENTO VERTICALE**  
 Bene complesso: Bene Individuo:  
 Denominazione bene complesso:  
 Numero schede beni componenti: Codice livello superiore:  
 Tipologia: chiesa convento palazzo castello torre torre archeologica altro  
 Pianta: regolare con corti ad al aperte irregolari altro

**A<sub>3</sub> - LOCALIZZAZIONE GEOGRAFICO AMMINISTRATIVA**  
 Regione: Città: Indirizzo: Prov.: Comune: Località: Sezione censuaria:

**A<sub>4</sub> - COORDINATE UTM**  
 Quadsim: Longitudine Est (x): Latitudine Nord (y): Lettura GPS:

**A<sub>5</sub> - OGGETTO**  
 Denominazione bene: Denominazione storica: Datazione: anno secolo epoca Ultime trasformazioni:





# Preparedness → EXERCISES



**2006  
(volcanic eruptions)  
“Mesimex”**



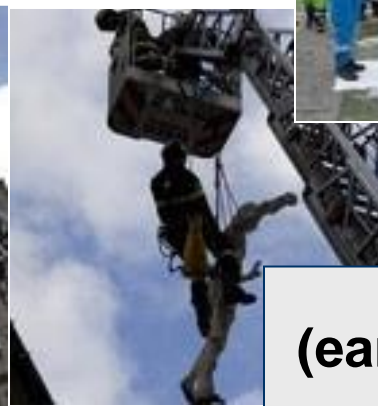
**2013  
(tsunamis)  
“Twist”**



**2005  
(earthquakes)  
“Euroshot”**



**2006  
(floods)  
“Arnus 2006”**



**2010  
(earthquakes)  
“Terex”**





*Tower of David Museum,  
Jerusalem, ,19-20 January 2014*



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