

# Workshop

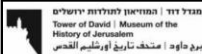
## Seismic Risk Preparedness and Mitigation of Archaeological and Historical Sites



Organization of the Firefighters Agency in  
Emergency

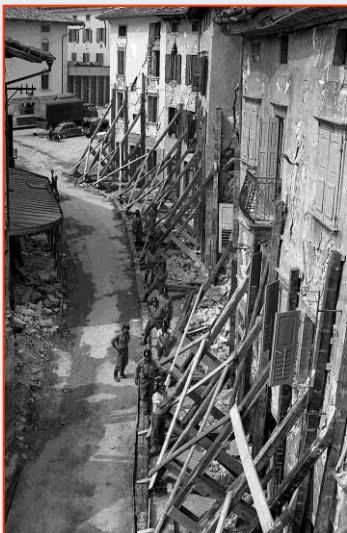
Tower of David Museum, Jerusalem  
19-20 January 2014

*Dott. Ing. Luca Ponticelli*



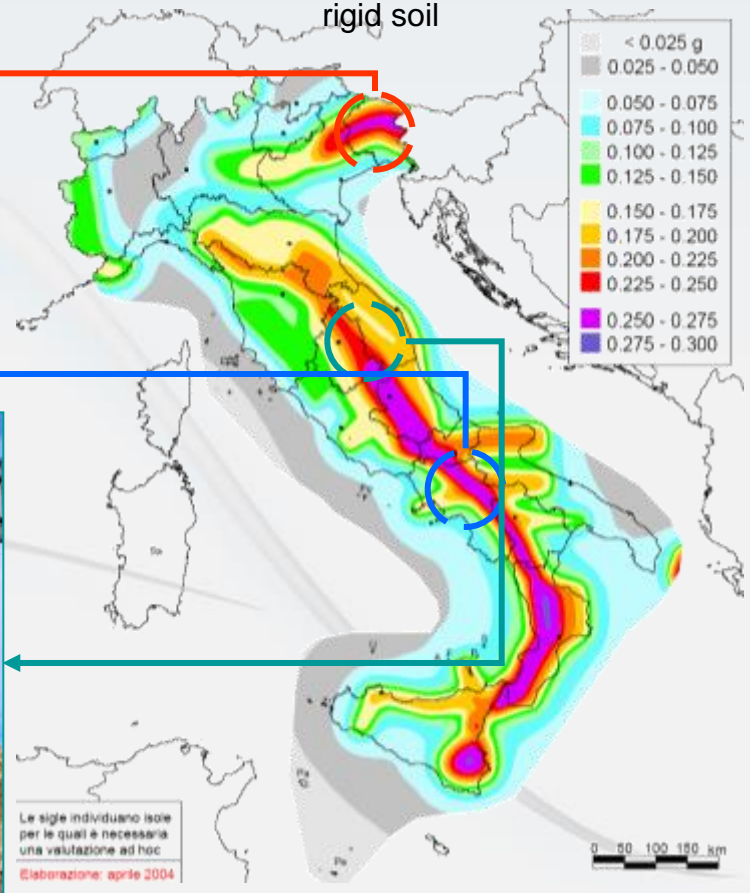
# SOME PAST EXPERIENCES

Friuli, 1976



Italy is a seismic country

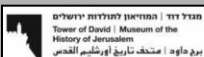
Peak Ground Acceleration (Tr 475 years)  
rigid soil



Irpinia, 1980



Umbria e Marche, 1997



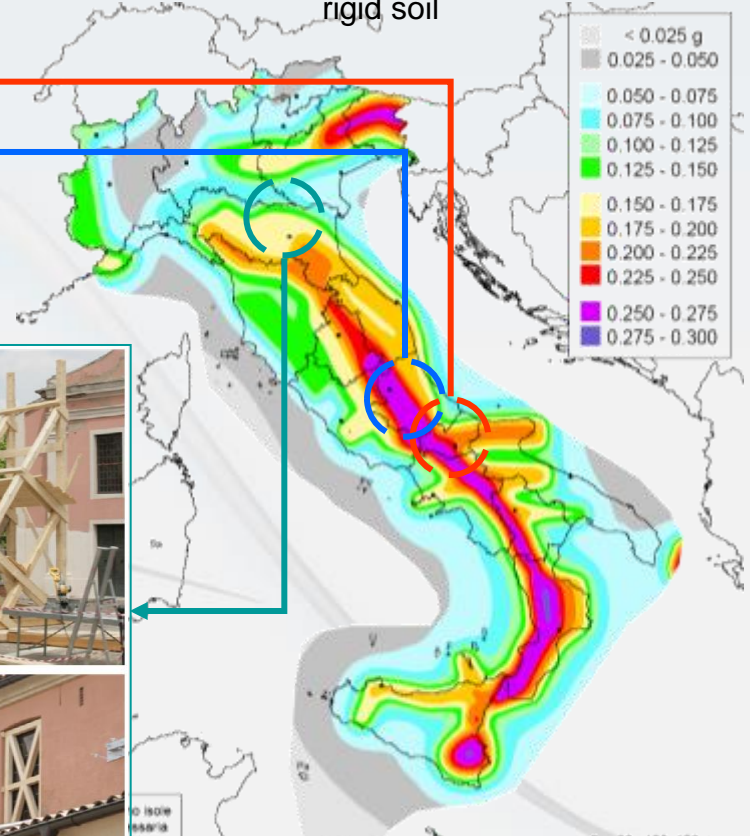
# THREE RECENT EXPERIENCES



Molise, 2002

Italy is a seismic country

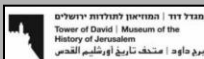
Peak Ground Acceleration (Tr 475 years)  
rigid soil



Abruzzo, 2009



Emilia Romagna, 2012





# THE WORK OF THE ITALIAN FIRE SERVICES AFTER AN EARTHQUAKE



U.S.A.R.



DEMOLITIONS



ASSISTANCE TO THE POPULATION



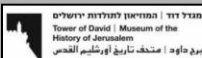
GENERAL COORDINATION (ROME)



INDIPENDENT COMMUNICATIONS



B.O.O.





# ... AND FOR THE HERITAGE ...



SHORES



RECOVER OF STATUES



RECOVER OF GREAT VALUE OBJECTS



La messa in sicurezza del patrimonio artistico e architettonico aquilano

RECOVER OF PAINTINGS



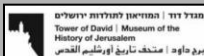
SPECIAL INTERVENTIONS



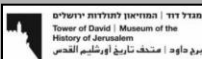
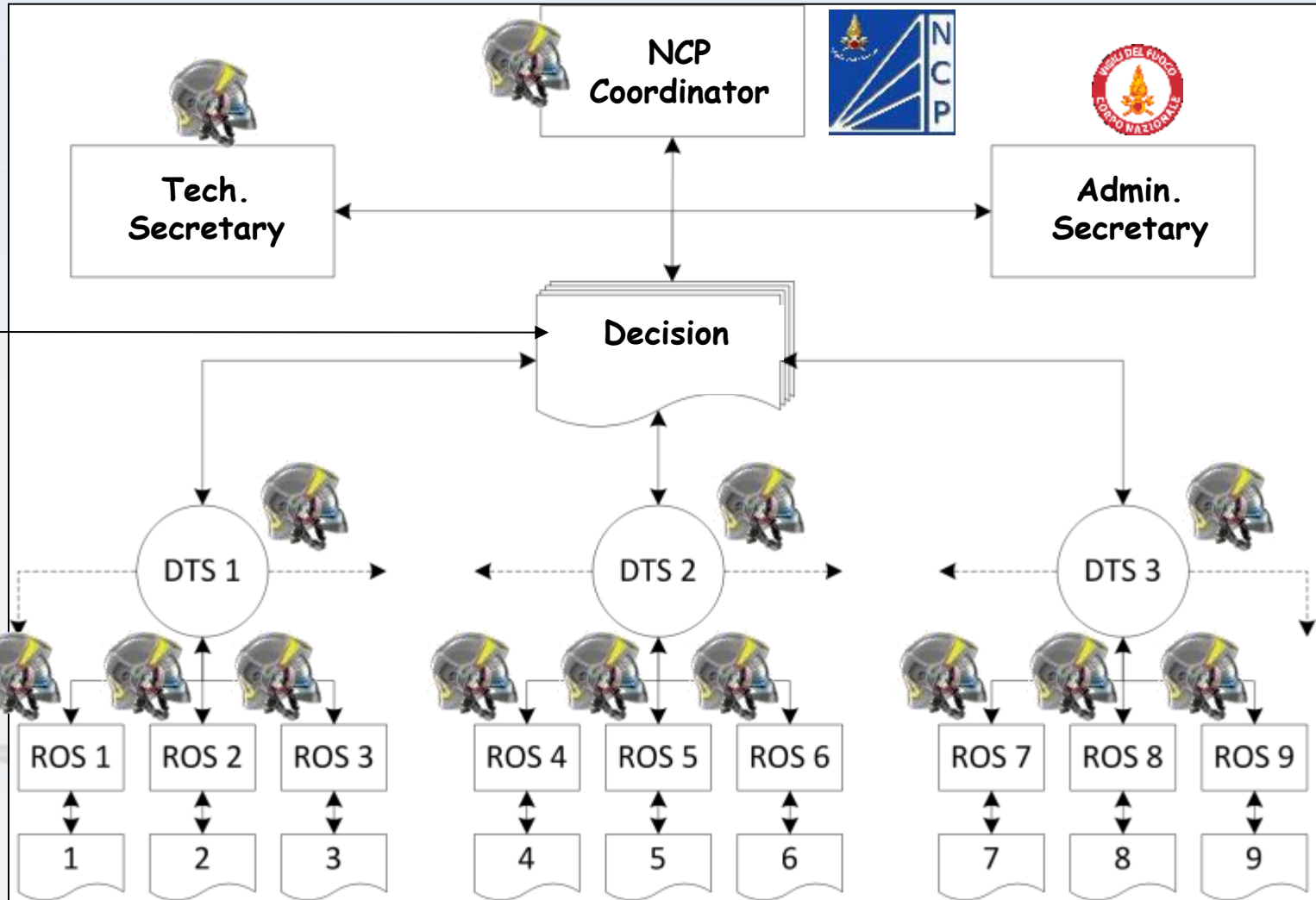
# ABRUZZO EARTHQUAKE - 2009

During the emergency due to the seismic event in 2009, a **special team** for shoring (NCP) was provided by the Italian Fire Services for:

- the coordination and implementation of shoring interventions;
- the collaboration with other Authorities (civil protection dept., heritage dept...);
- the definition of new standards for the shores;
- the monitoring of the interventions.



# NCP ORGANIZATION





# STANDARDIZATION OF THE SHORES

FEMA National  
US&R RESPONSE SYSTEM



OPUS Manual  
DPC-UNIBAS

Guide US-Army



Shoring  
templates  
operating  
procedures  
**STOP** procedure



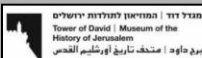
Available on the official web site of  
the Italian Fire Services  
[www.vigilfuoco.it](http://www.vigilfuoco.it) in the section  
**Home/Emergenza e soccorso/Schede  
Tecniche di Opere Provvisorie**  
In Italian, English and French  
**FREE** download of the **manual too**

Type  
**SIMPLE**  
Only one solution

No need of building  
details

Type  
**COMPLEX**  
More tech. solutions

Building details are  
necessary





# AN EXAMPLE OF SIMPLE SHORING PROCEDURE

TITLE

SIMPLE DESCRIPTION OF THE DAMAGE

SIMPLE SKETCH

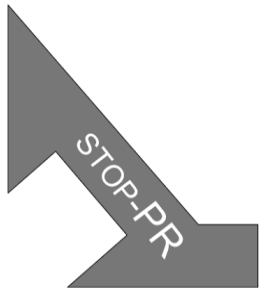
Ministry of Interior – CNVVF, Italian National Fire Service  
 Coordination team for temporary works  
**Shoring Templates and Operating Procedures**  
 for the support of buildings damaged by earthquakes

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VADEMECUM STOP

TIMBER RAKER SHORES



SOLID SOLE RACKERS: general recommendations STOP-PR/B

SOLID SOLE RACKERS: general recommendations STOP-PR/B

**Movement to contrast:**

**Description**

Potential out of plane rotation of a wall due to:  
 a) break of the joint between two perpendicular walls  
 b) break of the supporting perpendicular wall

Evidence of bulging on the external walls

**R1**

Function of the raker: to prevent further rotation or bulging of the wall

Table 2 – Main solid sole raker dimensions (cm x cm) for the type R1

R1	wall thickness $t_w$	$\leq 0.6$ m		$0.6 - 1.0$ m			
		seismic class (see Annex 1)		class A	class B	class A	class B
sole length B		1.5 m	2.5 m	1.5 m	2.5 m	1.5 m	2.5 m
span between shores D	$D \leq 1.5$ m	13 x 13	13 x 13	13 x 13	13 x 13	13 x 13	13 x 13
	$1.5 < D \leq 2.0$ m	15 x 15	13 x 13	13 x 13	13 x 13	18 x 18	15 x 15

If no Annex 1 is provided, seismic class A should be used

STRUCTURAL SKETCHES (the following tables shall be used for both solutions)

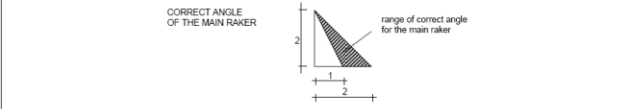
Shored wall area and supporting areas for each raker

**Table 1 – Selection of type depending on the height H**

Height H (m)	TYPE
$2.0 \leq H \leq 3.0$ m	<b>R1</b> (see table R1)
$3.0 < H \leq 5.0$ m	<b>R2</b> (see table R2)
$5.0 < H \leq 7.0$ m	<b>R3</b> (see table R3)
$H > 7.0$ m	Use laminated timber or steel. Specific design required.

**Other elements**

sole	same as the main raker
wall plate	same as the main raker
stiffening beams	2 lengths of 2.5 x 12 cm screwed/nailed on the struts by 3 screws $\varnothing 5 \times 100$ mm or by 3 nails L = 80 mm each end
diagonal braces	lengths of 2.5 x 12 cm screwed/nailed by 2 screws $\varnothing 5 \times 100$ mm or by 3 nails L = 80 mm each end
horizontal braces	lengths of 8 x 8 cm screwed/nailed by 2 screws $\varnothing 6 \times 160$ mm or by 3 nails L = 150 mm each end
stringers	lengths of 5 x 20 cm with 1 m as the max distance between centres placed on the continuous parts of the wall



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SIMPLE INPUT BUILDING PARAMETERS

DIMENSIONING TABLES (SQUARED TIMBERS ELEMENTS ONLY)



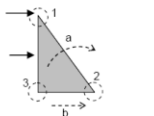
# AN EXAMPLE OF SIMPLE SHORING PROCEDURE

## SIMPLE INSTRUCTIONS

Ministry of Interior – CNVVF, Italian National Fire Service  
 Coordination team for temporary works  
**Shoring Templates and Operating Procedures**  
 for the support of buildings damaged by earthquakes

**SOLID SOLE RAKERS: general recommendations** STOP-PR/B

**Critical considerations**



**Global considerations**  
 a – global rotation  
 b – base sliding

**Local considerations**  
 1 – breaking of the top node  
 2 – breaking of the lower external node  
 3 – breaking of the lower internal node

**Global solutions**

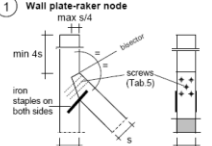
(a) (b)

x – installing a restraining system to avoid the base sliding outward  
 y – embedding the sole into the wall or anchoring the wall plate to the wall or, instead of y:  
 z – pinning the sole to the ground using solution A on page 7/15.  
 Nailing length shall be half the sole length and start from the wall end.

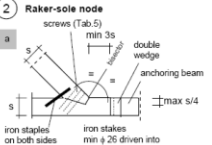
**WARNING:** the z solution shall be employed ONLY if it is not possible to embed the sole into the wall. In this case the wall plate to wall interface shall guarantee enough friction as to prevent the upward sliding of the shore.

**Local solutions**

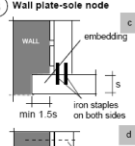
1 Wall plate-raker node  
 max s/4



2 Raker-sole node  
 screws (Tab.5) min 3s  
 double wedge  
 anchoring beam  
 max s/4



3 Wall plate-sole node  
 embedding  
 iron staples on both sides  
 min 1.5s



**Table 5 – Screws and bolts**

section	screws	bolts
13 x 13	5 φ 10x150	2 φ 16
15 x 15	5 φ 12x180	3 φ 16
18 x 18	5 φ 12x200	4 φ 16
20 x 20	5 φ 12x200	4 φ 16

**WARNING:** Iron staples min φ 8 or timber boards on both sides of the wall plate (2.5cm thickness, nailed or screwed)

**NOTE:** (c) and (d) are alternative solutions  
**WARNING:** embedding or anchoring are not necessary when using the z solution.

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**SOLID SOLE RAKERS: general instructions** STOP-PR/B

**TIMBER SOLID SOLE RAKER SHORES**

**Field of application**  
 These solutions shall be used to support buildings damaged by earthquakes.

**General assumptions**  
 These raker shores shall be employed to restrain load bearing masonry walls not exceeding 1m thick. Two solutions are proposed: the tables R1, R2 and R3 shall be used for both parallel or converging rakers having the same height H.  
 "H" is defined as the difference in height between the sole lower point and the raker upper edge. This edge should be placed at a corresponding insertion point on the other side of the restrained wall, for example a slab, a vault, an arch, or a perpendicular wall, in order to effectively transfer the forces to the raker shore.  
 Given the height "H", the raker shore type R1, R2, or R3 is therefore chosen using table 1 at page 2/15. When H>7.0m, using laminated timber or steel instead of ordinary timber is recommended, and specific design of the raker shore is required.  
 Given the thickness of the restrained wall "s<sub>w</sub>" and the seismic class (see Annex 1), once the span "D" and the sole length "B" are chosen, the raker shore shall be sized using table 2 for R1 type, table 3 for R2 type, table 4 for R3 type.  
 Many raker shore elements share the same section size to ease timber procurement and simplify the shore's connections.  
 On page 6/15 main construction critical considerations are listed, and corresponding solutions are showed. Some construction details of the shore's connections are proposed.  
 On page 7/15 two kinds of construction details for anchoring of the sole are shown. In particular the sole anchoring should:  
 - prevent the upward displacement of the sole-wall plate node;  
 - prevent the outward displacement of the sole-raker node.

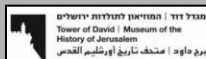
**WARNING**  
 All the provided dimensions are intended as minimum values. During the construction phase, thicker sections can be used, if available.

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...THE SHORE

## CONSTRUCTIONAL DETAILS



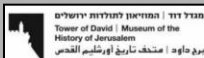
# THE D.R. H.O.U.S.E. PROJECT

From 2010 to 2013 the Italian Fire Services participated to an European Project (Development of Rapidly Hi-specialized Operative Units for Structural Evaluations) in partnership with the Italian Civil Protection Dept. and the EUCENTRE Fund. The aim of the project was to implement three modules for the rapid intervention after an earthquake, all over the world, focused on:

- B.S.A. Basic Structural Assessment (Civil Protection Dept.)
- A.S.A. Advanced Structural Assessment (EUCENTRE)
- S.T.C. **Short Term Countermeasures (Fire Services Dept)**



After 18 months of standby with no request, the project provided an international exercise in Patra (Greece 2012) and a final workshop in Alessandria (Italy - 2013).

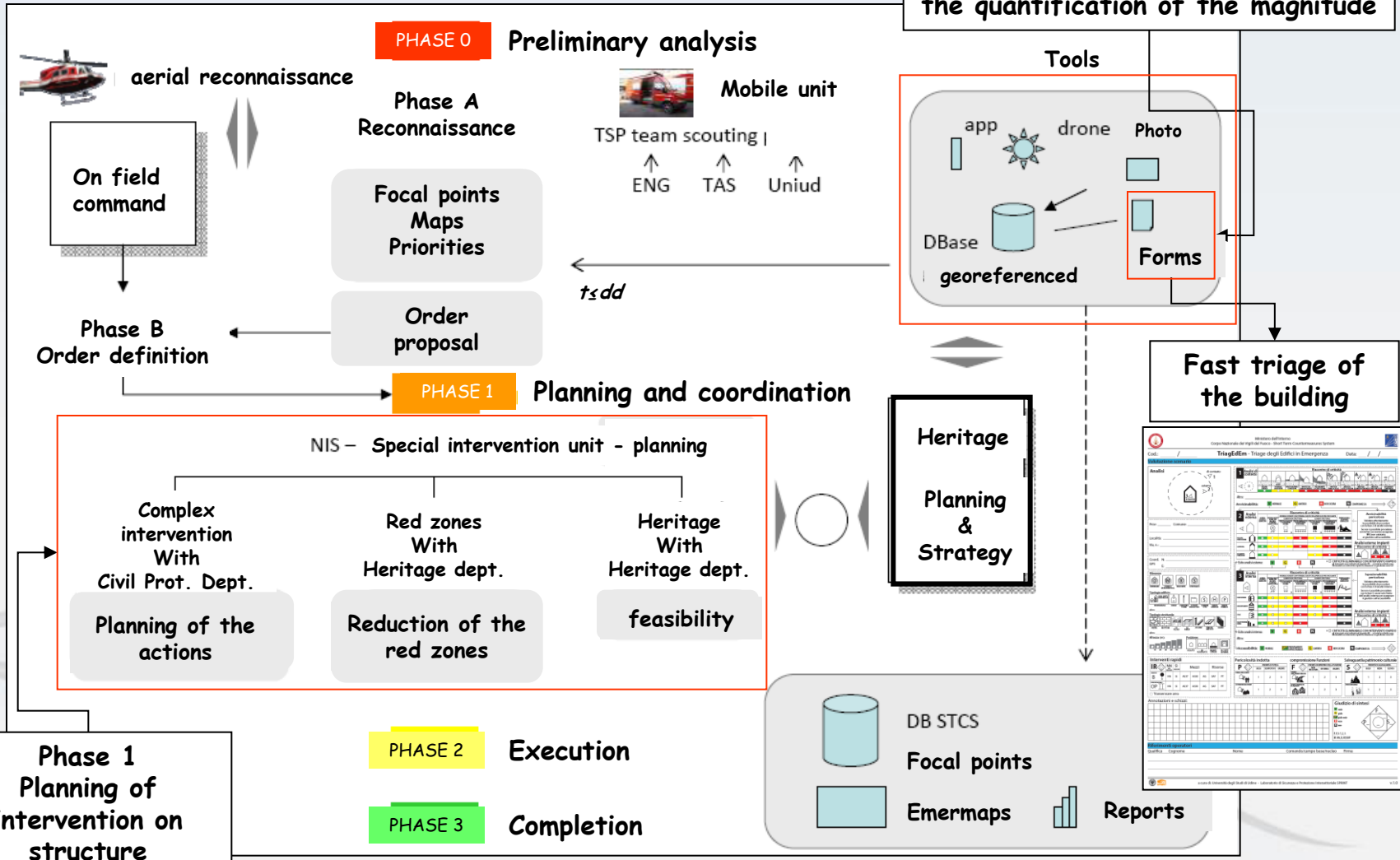




# THE CHALLENGE FOR THE FUTURE: THE Short Term Countermeasures SYSTEM



Fast check of the area for the definition of the red zoned and for the quantification of the magnitude



First test of the new System after the earthquake in Tuscany in 2013





Thank you for your kind attention

Dott. Ing. Luca PONTICELLI  
Central Directorate for Fire Prevention and  
Technical Safety  
Passive Protection Area  
Fire Resistance Sector  
Rome - Capannelle



[luca.ponticelli@vigilfuoco.it](mailto:luca.ponticelli@vigilfuoco.it)

