

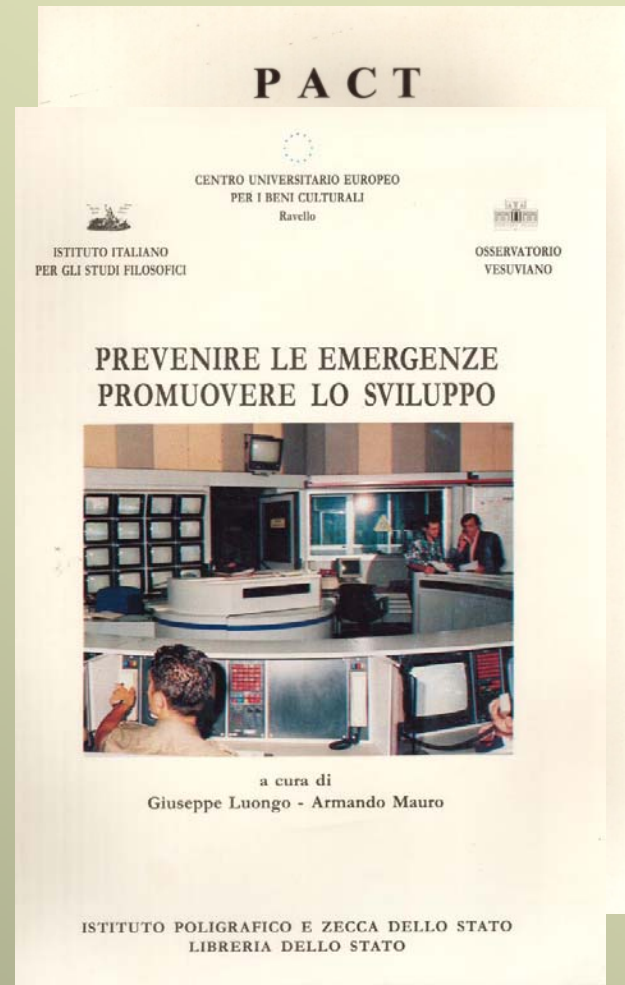
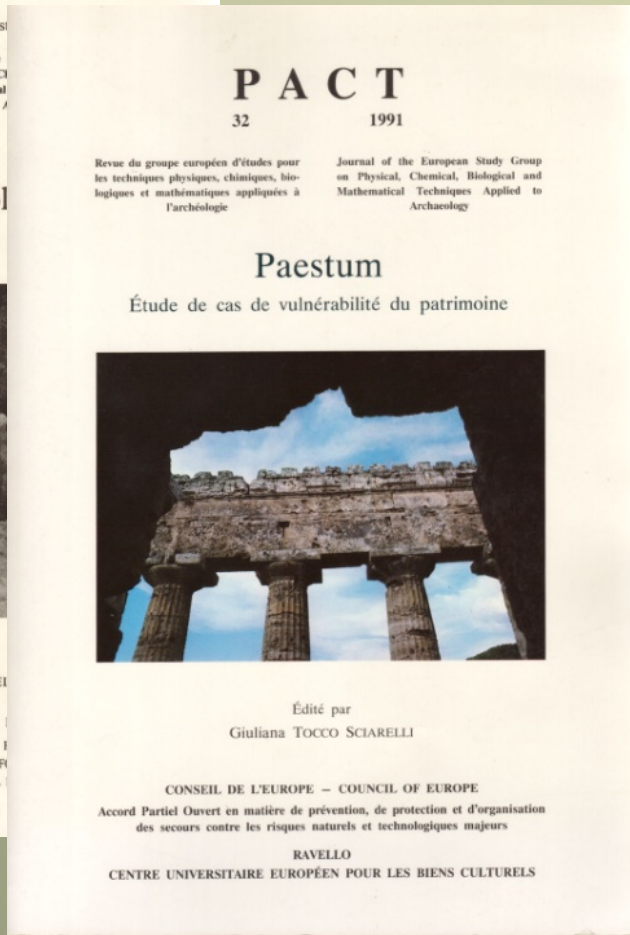
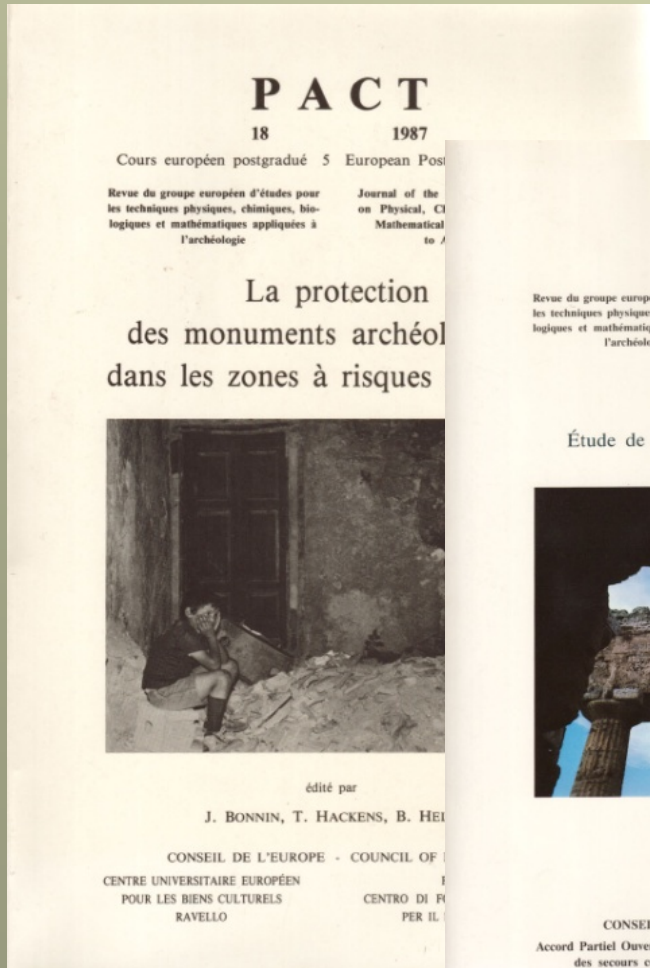
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REDUCING THE VULNERABILITY  
OF ANCIENT BUILT UP IN SEISMIC REGIONS  
BY RECOVERING THE  
**LOCAL SEISMIC CULTURE**  
AN INTEGRATED APPROACH

by F. Ferrigni

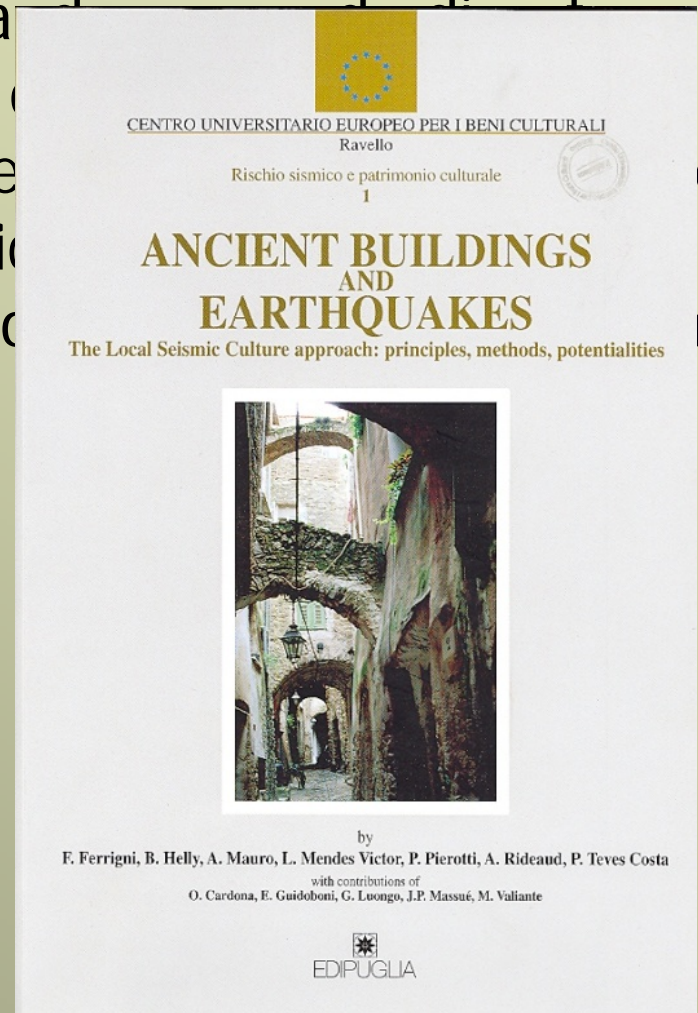
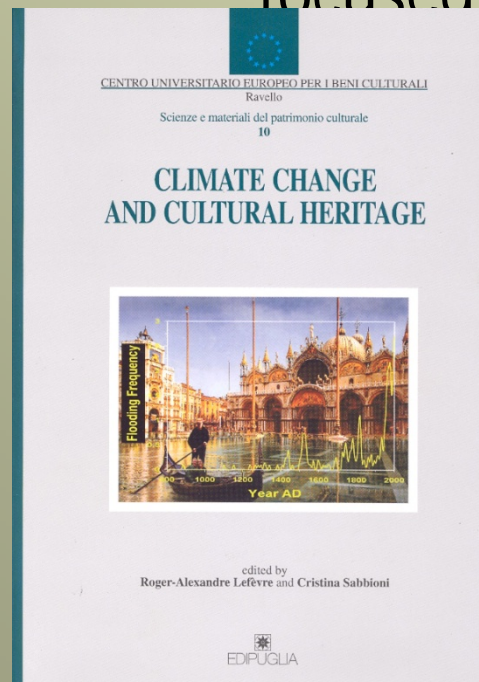
*Ravello, May 09-11 2012*

Since his foundation Ravello's activities has been based on the multidisciplinary approach



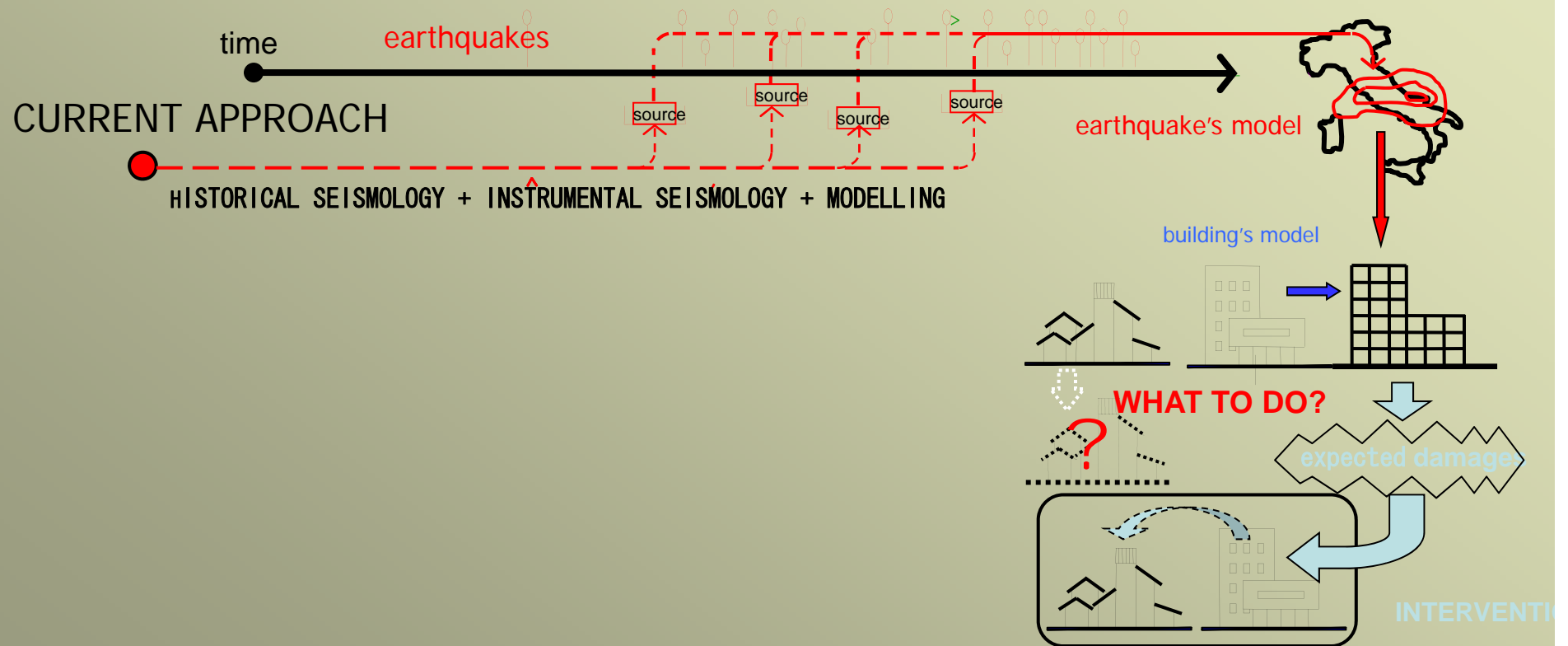


- When the Council of Europe launched the “Open Partial Agreement” (1982), a program finalized to reduce the impact of natural and technological risks, the task of the protection of the heritage in seismic risk focused on



# THE PROBLEM

# WHAT CAN BE DONE TO PROTECT THE ANCIENT BUILT-UP? THE CURRENT APPROACH



# THE LIMITS OF THE CURRENT APPROACH (in protection of historical built up)

The approach of the seismic engineering is based on two main statements:

- the model is representative of the object
- the material is omogenous

But, for the ancient built-up . . .

...it's very difficult to utilize the tools of seismic engineering to evaluate the strength of a whole of irregular and non-homogeneous buildings like the



# HISTORICAL VERNACULAR ARCHITECTURE

# THE RESEARCH



## MOVING FROM SOME “BANALITIES”, LIKE:

- Earthquakes exist since ever
- In regions regularly hit by earthquakes communities has been obliged, obviously, to develop seismic proof techniques
- If today we has to protect the ancient built-up it's just because the buildings strenght to all past earthquakes.....

The question “*what to do to protect the ancient built-up?*” has been reformulate as

**WHAT HAS THE ANCIENT BUILDERS DONE TO MAKE BUILDINGS SEISMIC RESISTENT?**

THE COMPARATIVE ANALYSIS  
OF MONUMENTS AND VERNACULAR ARCHITECTURE  
IN SEISMIC REGIONS  
HAS SHOWN  
MANY HISTORICAL SEISMIC PROOF TECHNIQUES

# STANDING UP BY REDUNDANCY



Benevento



Evora



Ariano irpino  
17/05/2012



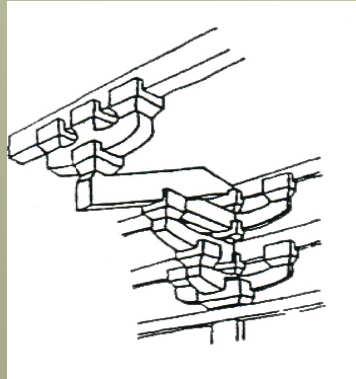
Evora

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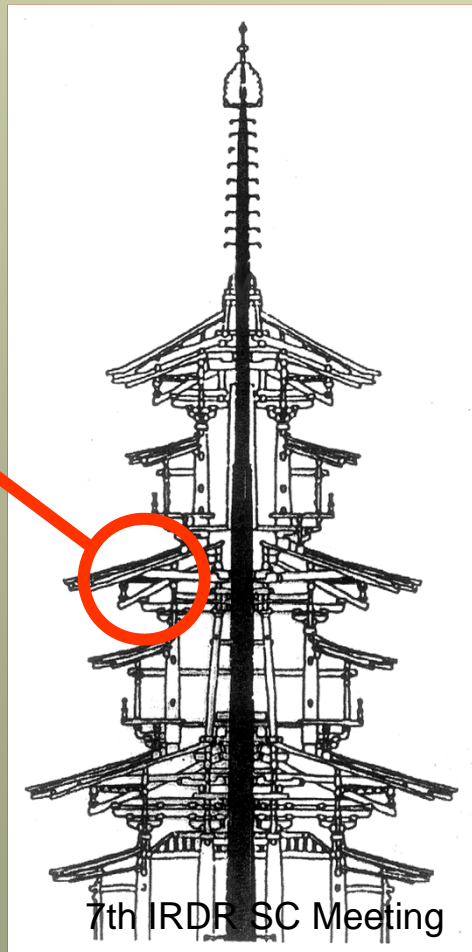


S. Lorenzello

# STANDING UP BY DEFORMABILITY

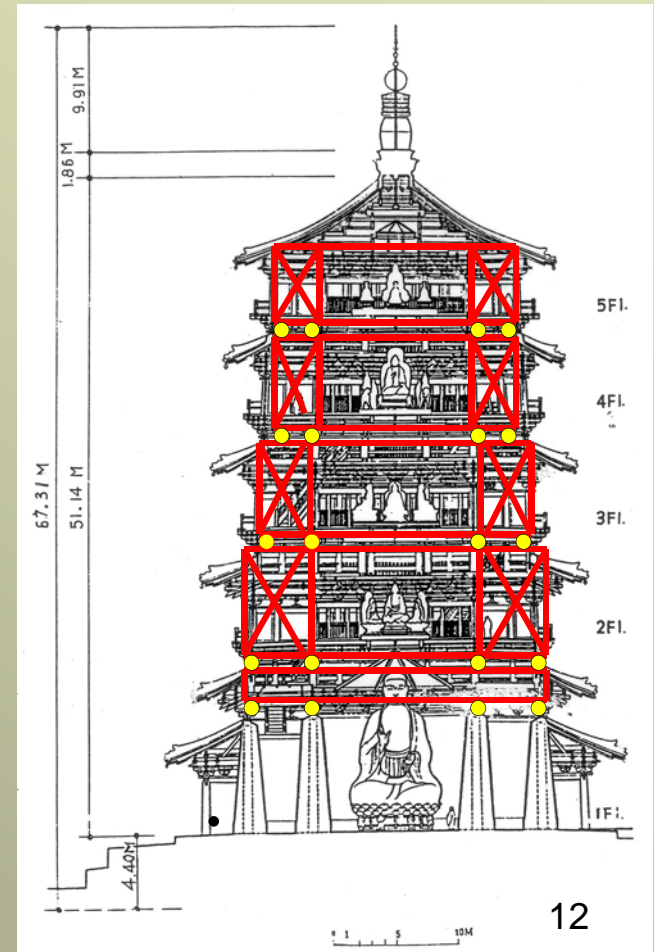


JAPAN XIV



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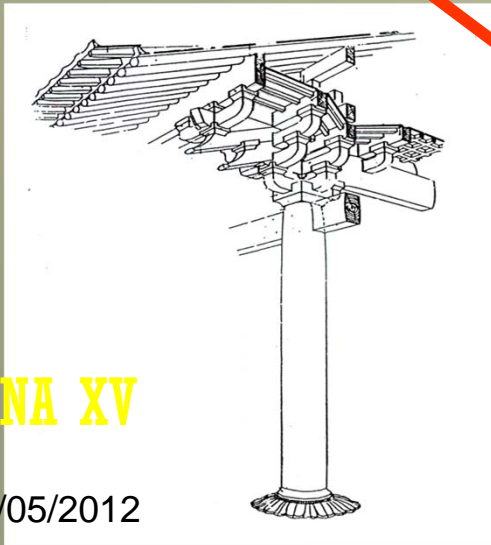
CHINA XVI



12

CHINA XV

17/05/2012



# STANDIG UP BY ABSORBING THE HORIZONTALS FORCES



ALGER (Algeria XVIII)

17/05/2012



MYTILINI (Grèce, XIX)



AKROTIRI (Grèce; XXV BC)

13

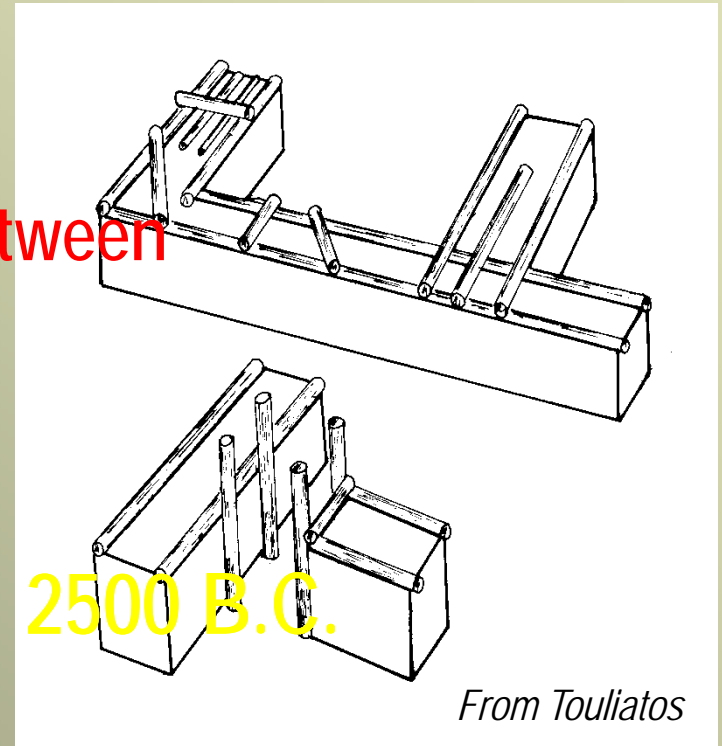
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# PERSISTENCE of TRADITIONAL TECHNIQUES 1



MYTHILENE 1800 A.C.

43 centuries between

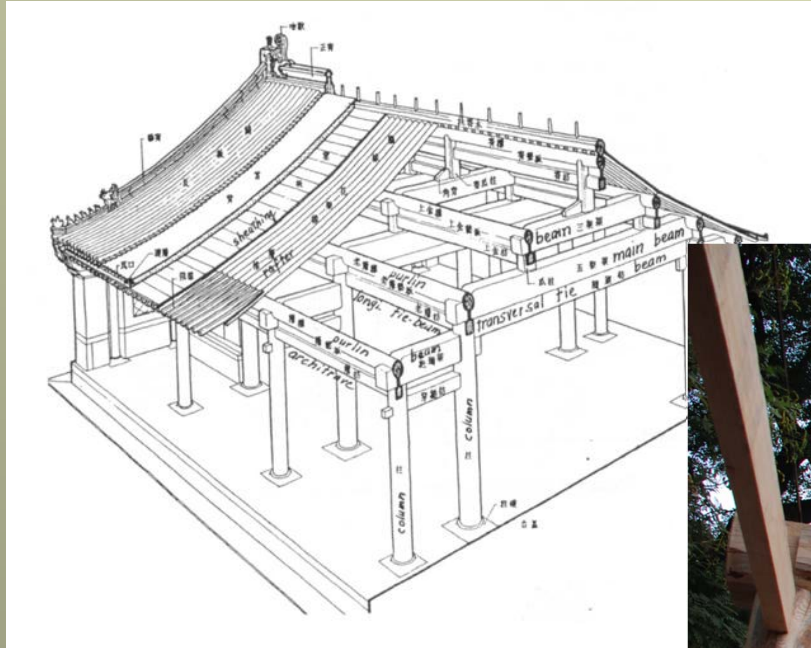


THIRA 2500 B.C.

*From Touliatos*

# PERSISTENCE of TRADITIONAL TECHNIQUES

STANDARD CHINESE TEMPLE, 1600 **2**



BEIJING, 2007



# THE LACK OF THE LOCAL SEISMIC CULTURE AND HIS EFFECTS



# SOME RECURRENT MISUNDERSTANDINGS



(L'Aquila earthquake 2009)

Are the pushing structures dangerous in seismic regions?



# ARE THE VAULTS TO BE REINFORCED?

(L'Aquila earthquake 2009)



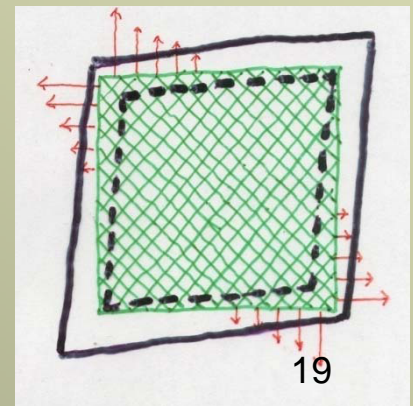
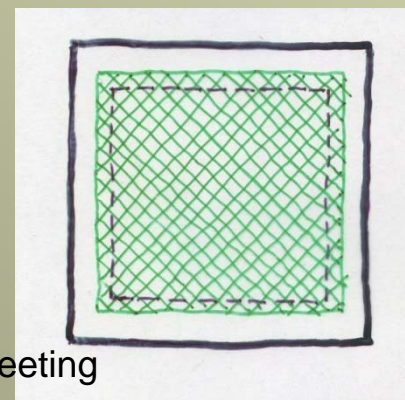
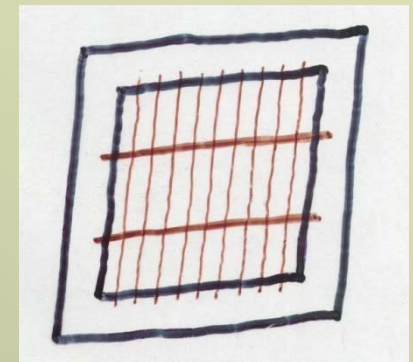
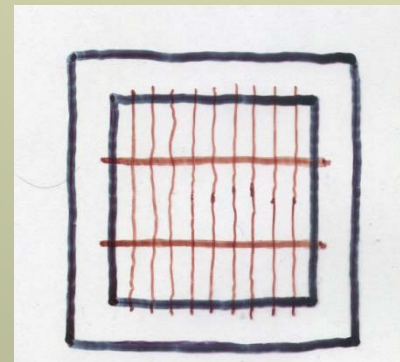
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# WE ADOPT DANGEROUS (but legally imposed) REINFORCEMENTS.....

(Sellano, Umbria earthquake 1996)



# TODAY SEISMIC CODES IMPOSE NEW TECHNIQUES TO RETROFIT OLD BUILDINGS .....

(Sellano, Umbria earthquake 1996)

the roof stay intact, but ....



the new floor  
remain in place....



.... just two floors lower

.....the old wall is destroyed

# THE "REINFORCED" ROOF



(Onna, L'Aquila earthquake 2009)

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# MODIFICATIONS INCREASING / REDUCING THE VULNERABILITY

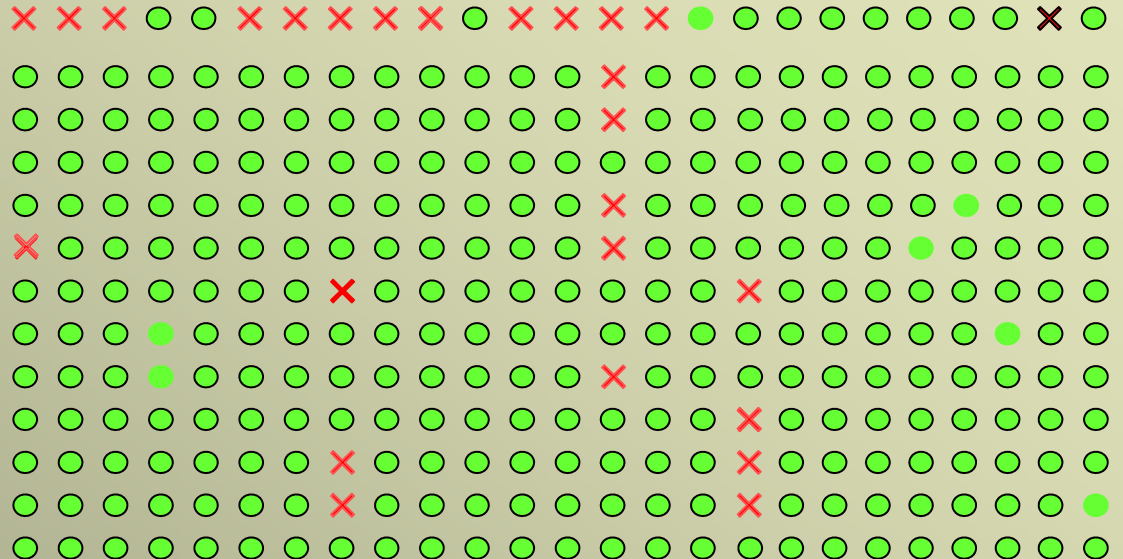


## AND HITS LEGITIMACY IN TOWN PLANS

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

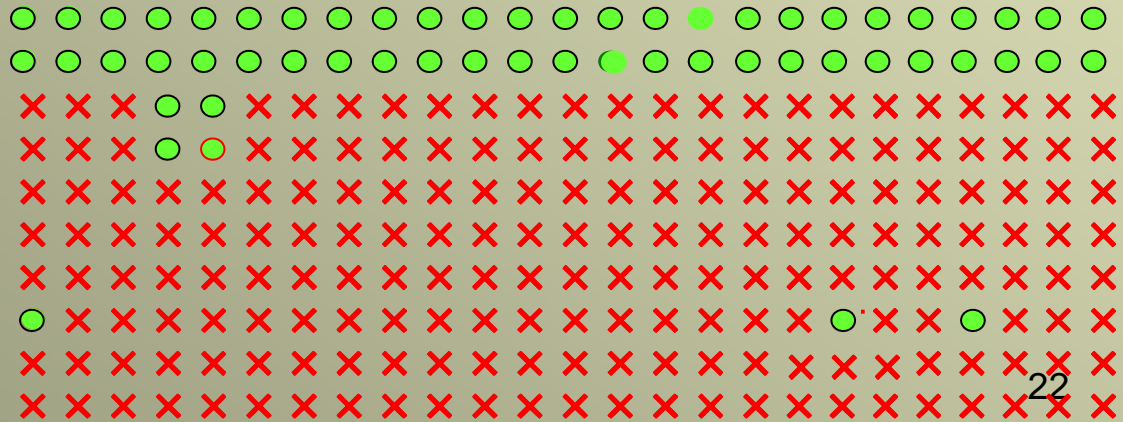
### A) VULNERABILITY INCREASING '

- 1. A single house
- 2. A small house
- 3. A medium house
- 4. A large house
- 5. A house with a porch
- 6. A house with a garden
- 7. A house with a driveway
- 8. A house with a carport
- 9. A house with a garage
- 10. A house with a swimming pool
- 11. A house with a tennis court
- 12. A house with a basketball court
- 13. A house with a hot tub
- 14. A house with a fire pit
- 15. A house with a fireplace
- 16. A house with a walk-in cooler
- 17. A house with a walk-in freezer
- 18. A house with a walk-in pantry
- 19. A house with a walk-in closet
- 20. A house with a walk-in linen closet
- 21. A house with a walk-in wardrobe
- 22. A house with a walk-in bathroom
- 23. A house with a walk-in shower
- 24. A house with a walk-in tub
- 25. A house with a walk-in closet



### B) VULNERABILITY REDUCING

- 1. A single house
- 2. A small house
- 3. A medium house
- 4. A large house
- 5. A house with a porch
- 6. A house with a garden
- 7. A house with a driveway
- 8. A house with a carport
- 9. A house with a garage
- 10. A house with a swimming pool
- 11. A house with a tennis court
- 12. A house with a basketball court
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- 24. A house with a walk-in tub
- 25. A house with a walk-in closet

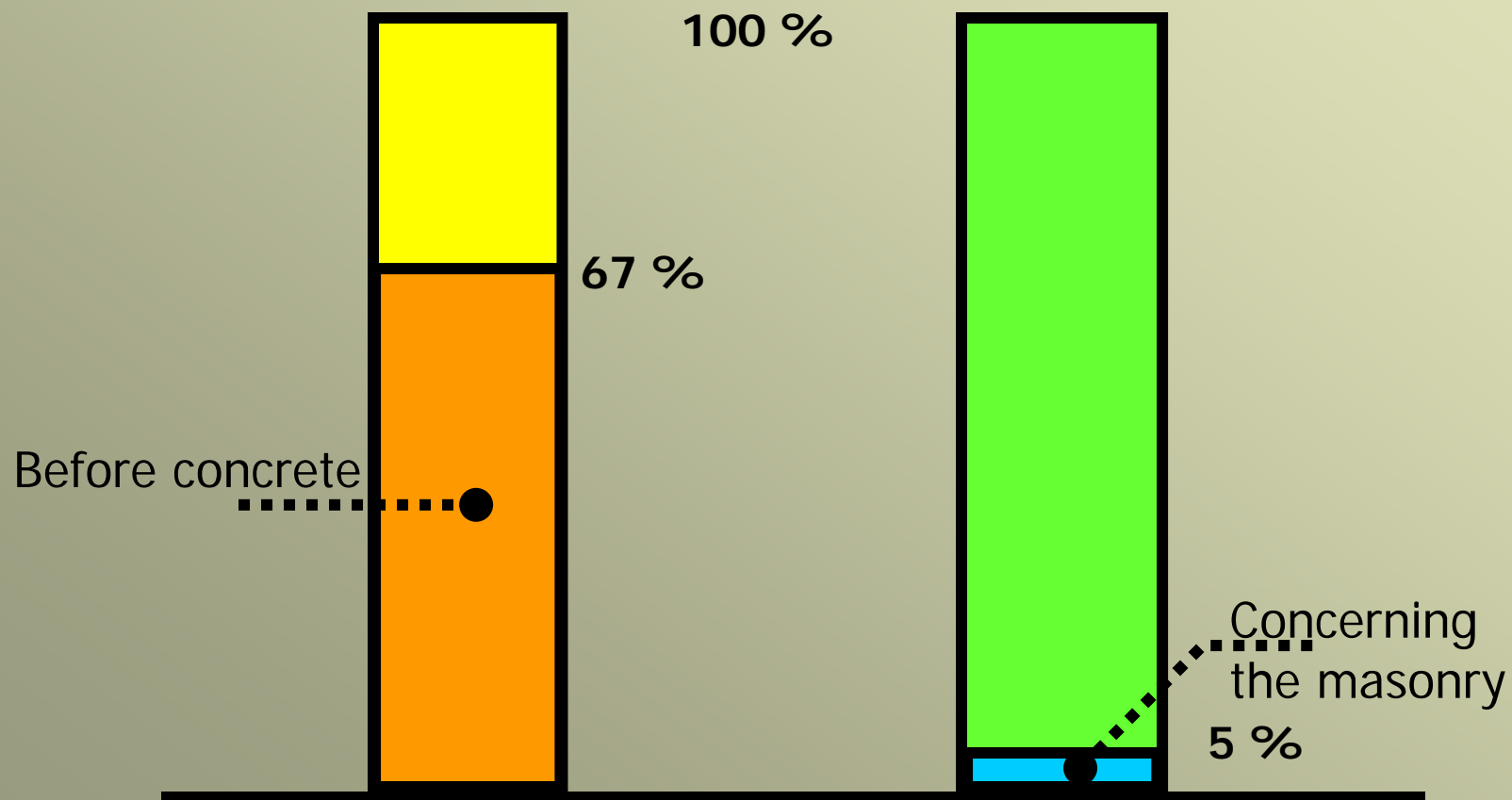


# HISTORICAL BUILT-UP AND UNIVERSITY

## APARTMENTS

## STRUCTURES

## COURSES



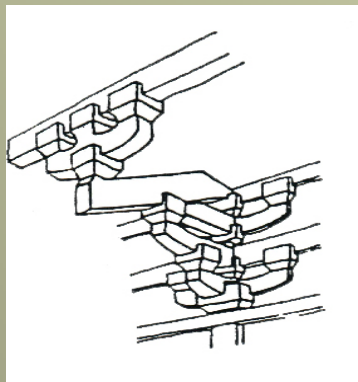
TO SUPPORT  
AN INTERDISCIPLINARY TRAINING  
A “NO-DISCIPLINARY” LANGUAGE  
IS NECESSARY



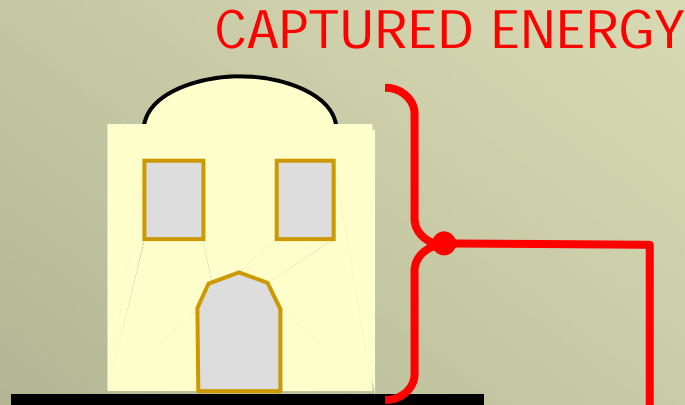
# TO IMPROVE THE SEISMIC RESISTANCE:

IMPACTING ENERGY

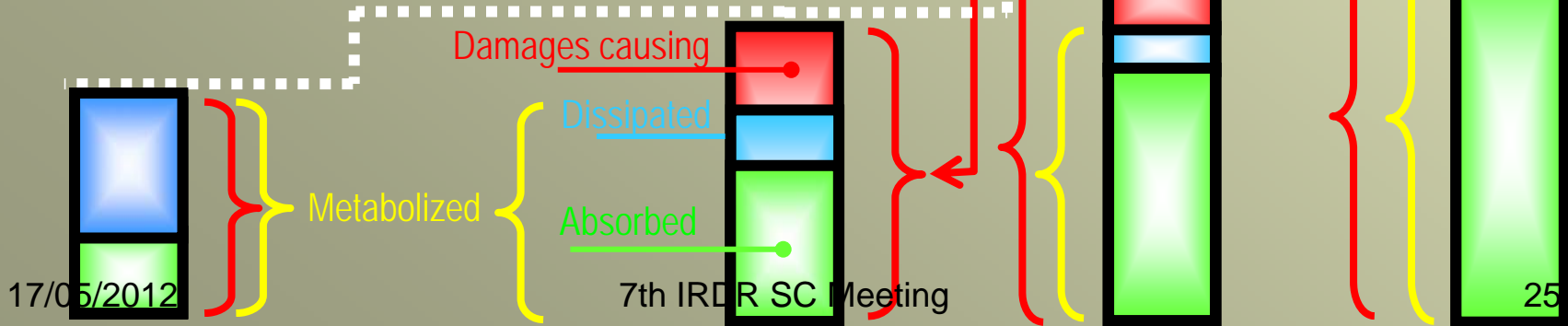
## TWO APPROACHES



**DEFORMABILITY**  
(Resistance by friction)



**MASS**  
(Resistance by redundance)



# TECHNIQUES AND REPARATIONS



ALGIERS (Algeria)



PEROU



Evora



MYTILENE (Greece)  
17/05/2012



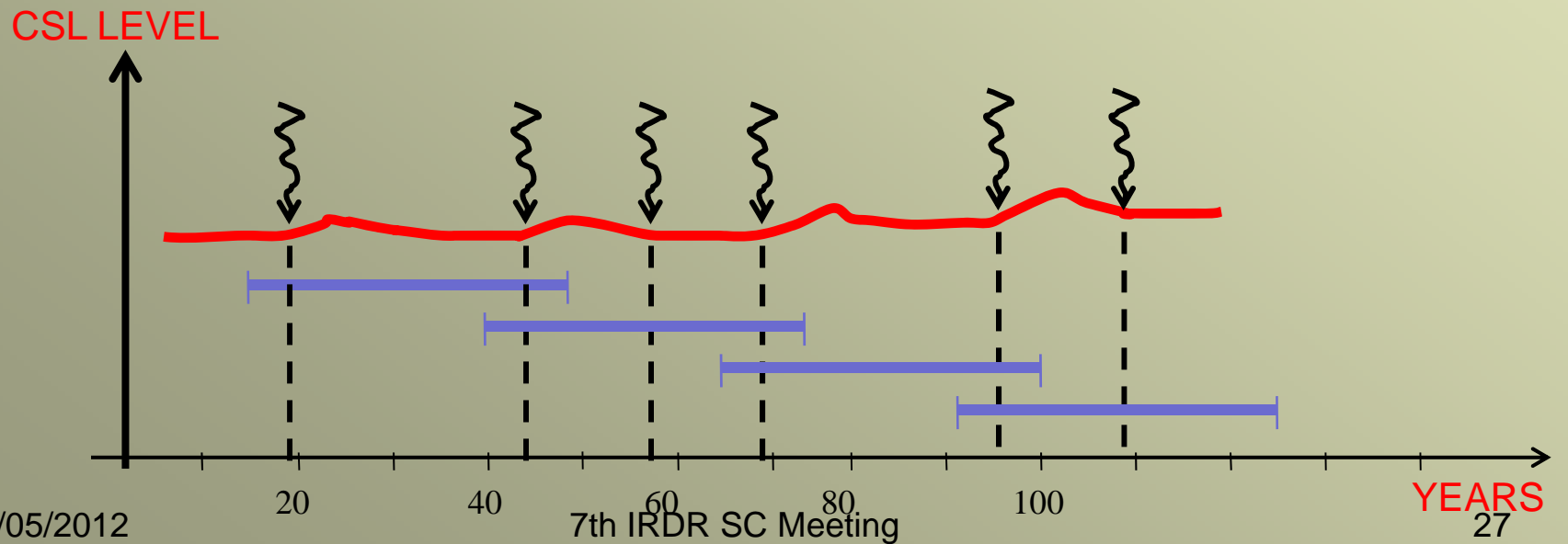
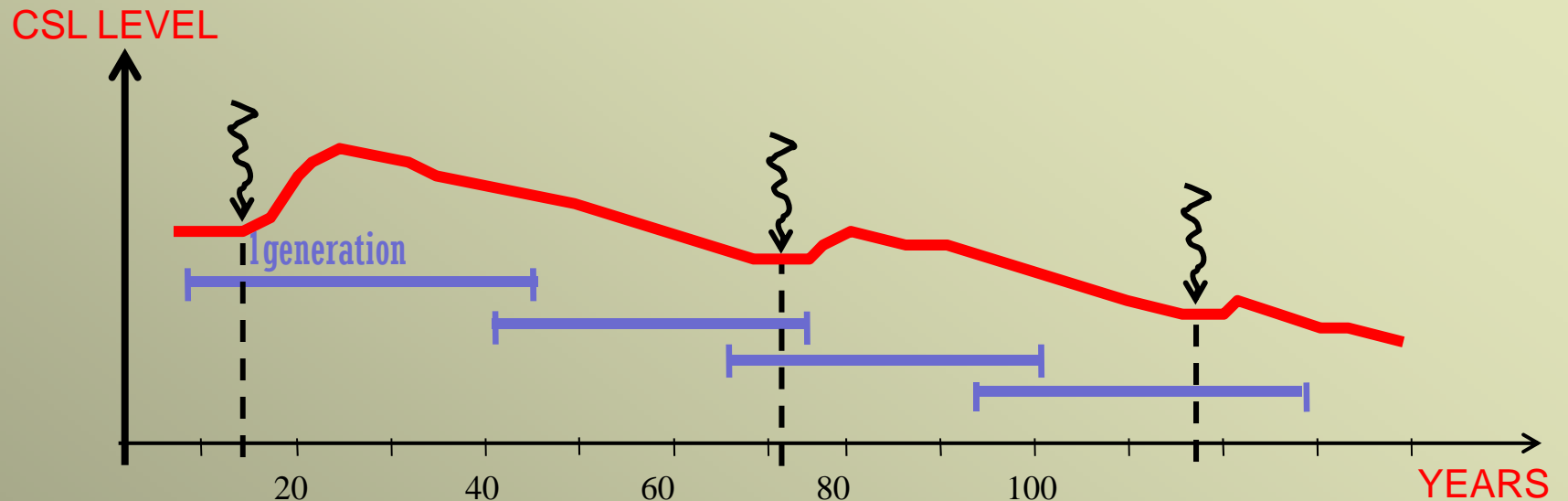
Benevento

7th IRDR SC Meeting

Taurasi (Italy)



# RECURRENCE OF EARTHQUAKES AND LEVEL OF THE LOCAL SEISMIC CULTURE



# RECURRENCE/INTENSITY and VARIOUS KINDS of LOCAL SEISMIC CULTURES

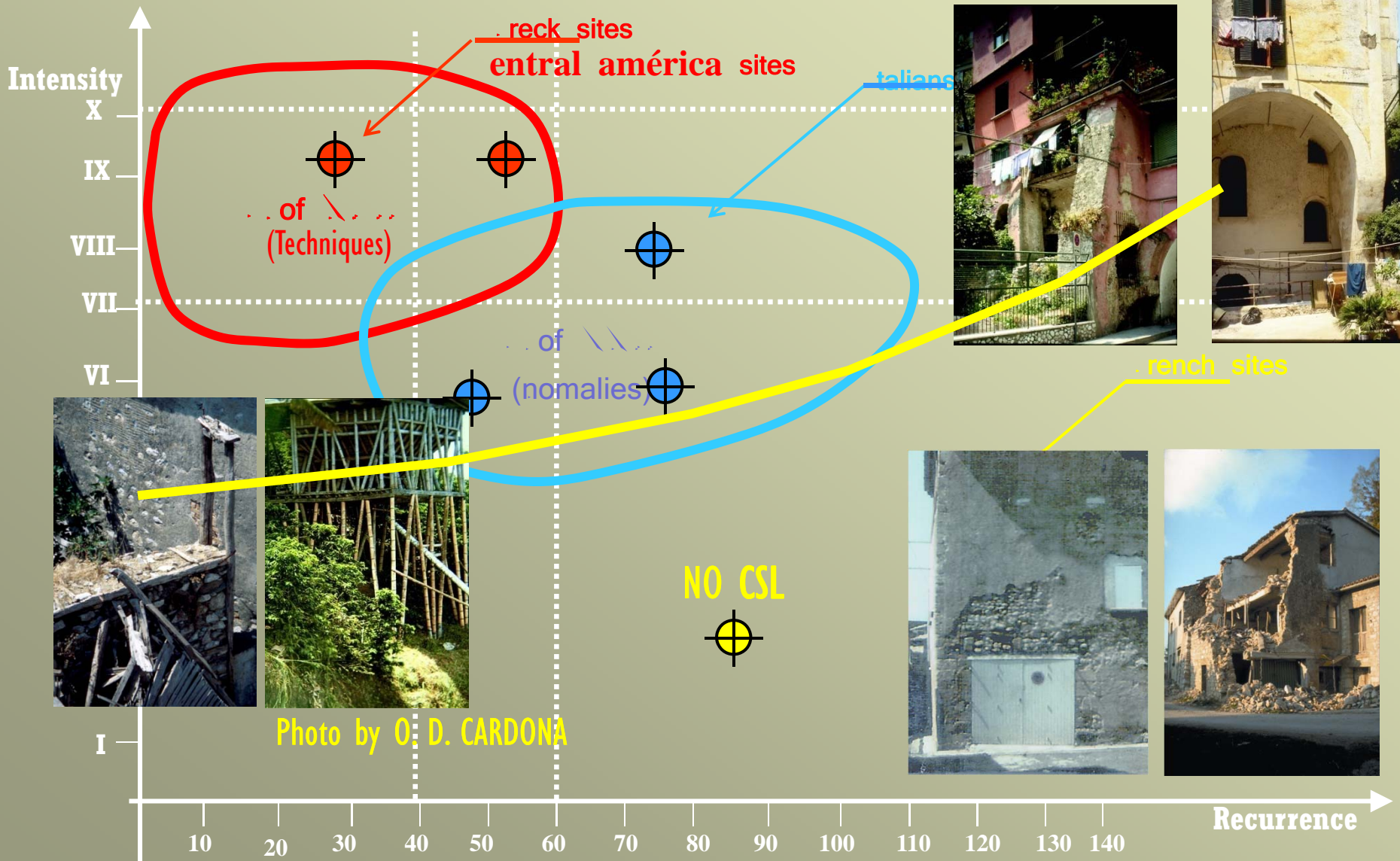
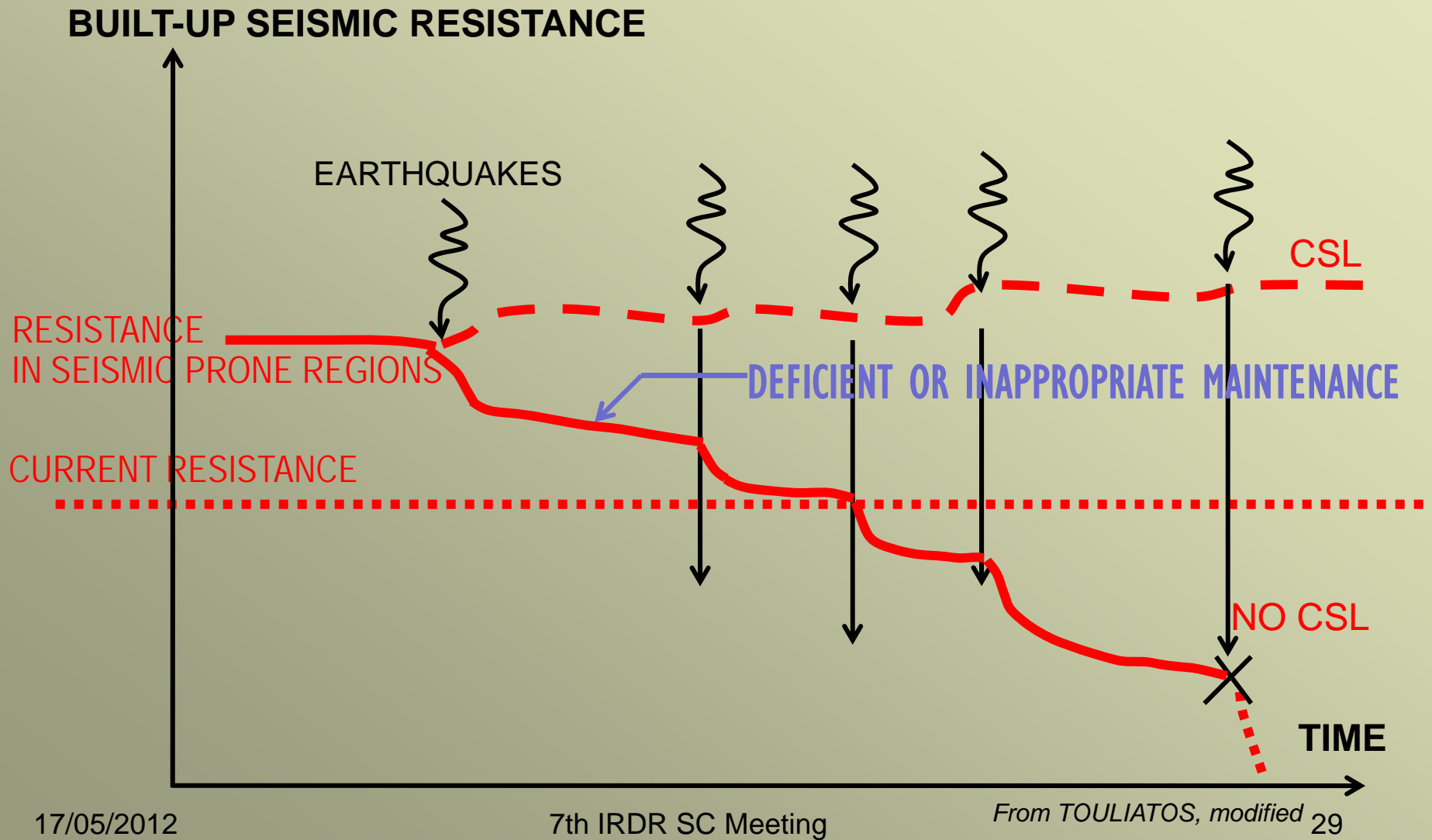
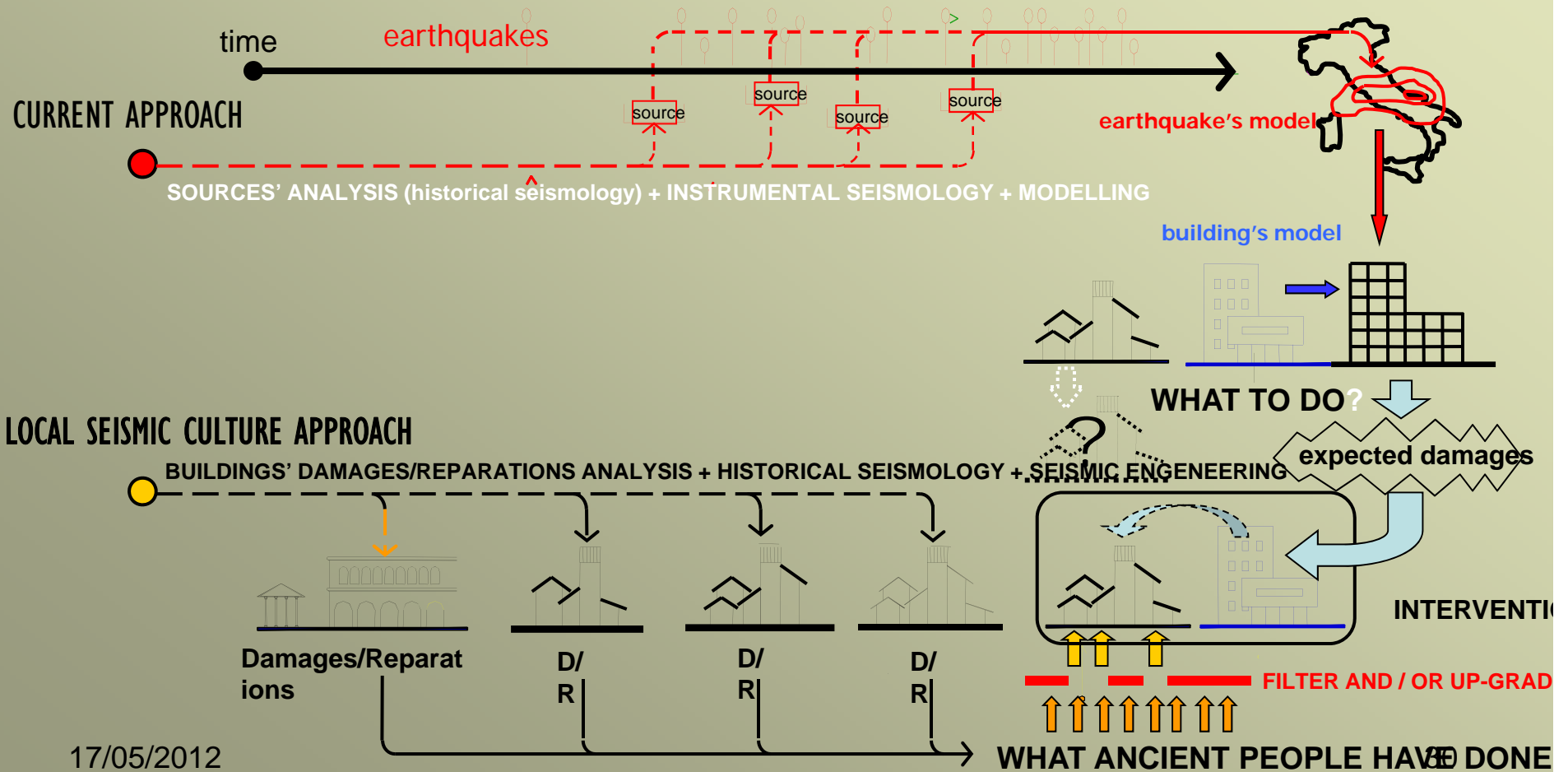


Photo by O. D. CARDONA

# LOCAL SEISMIC CULTURE AND BUILT-UP SEISMIC RESISTANCE



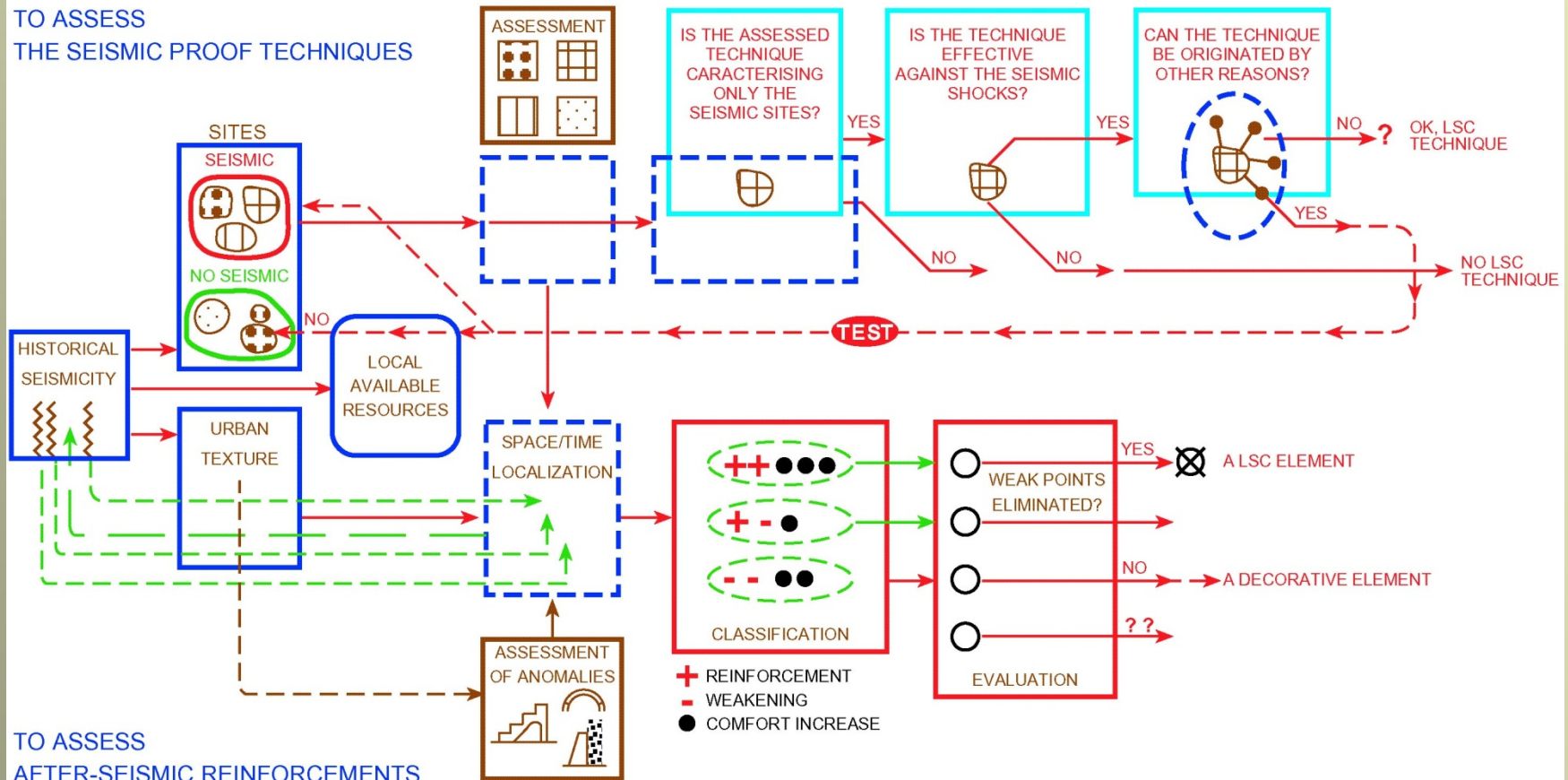
# WHAT CAN BE DONE TO PROTECT THE ANCIENT BUILT-UP ENVIRONMENT? TWO COMPLEMENTARY APPROACH



LOOKING FOR  
THE VARIOUS LSC

# LOOKING FOR THE VARIOUS LSC

TO ASSESS  
THE SEISMIC PROOF TECHNIQUES



The flow chart shows the full cycle to recognise the seismic proof “techniques” (*above*) or the “reparations/anomalies” (*below*).

Both involve **seismic engineers, architects, historians, historians of materials, seismologists, geologists, anthropologists, economists.**

# THE LAST RESEARCH LINE





MORPHOLOGY + CLIMATE + LOCAL CULTURE  
=  
A PERFECT GRAPHIC WORK

(and an efficient agricultural system +  
an effective landslides prevention )

