7th IRDR SC Meeting

REDUCING THE VULNERABILITY OF ANCIENT BUILT UP IN SEISMIC REGIONS BY RECOVERING THE **L**OCAL **S**EISMIC **C**ULTURE

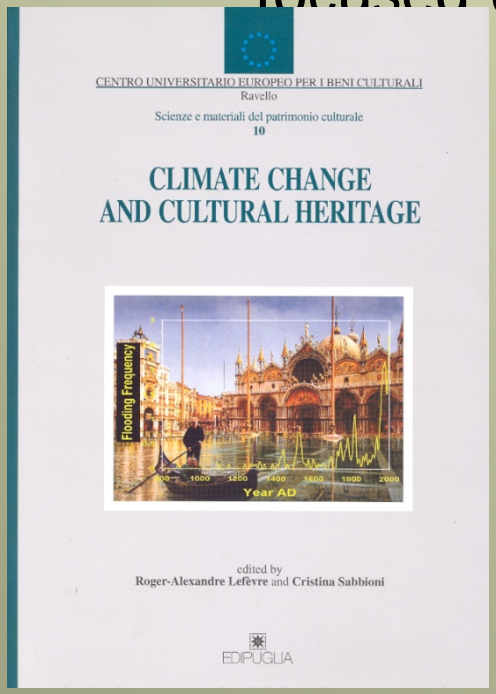
AN INTEGRATED APPROACH

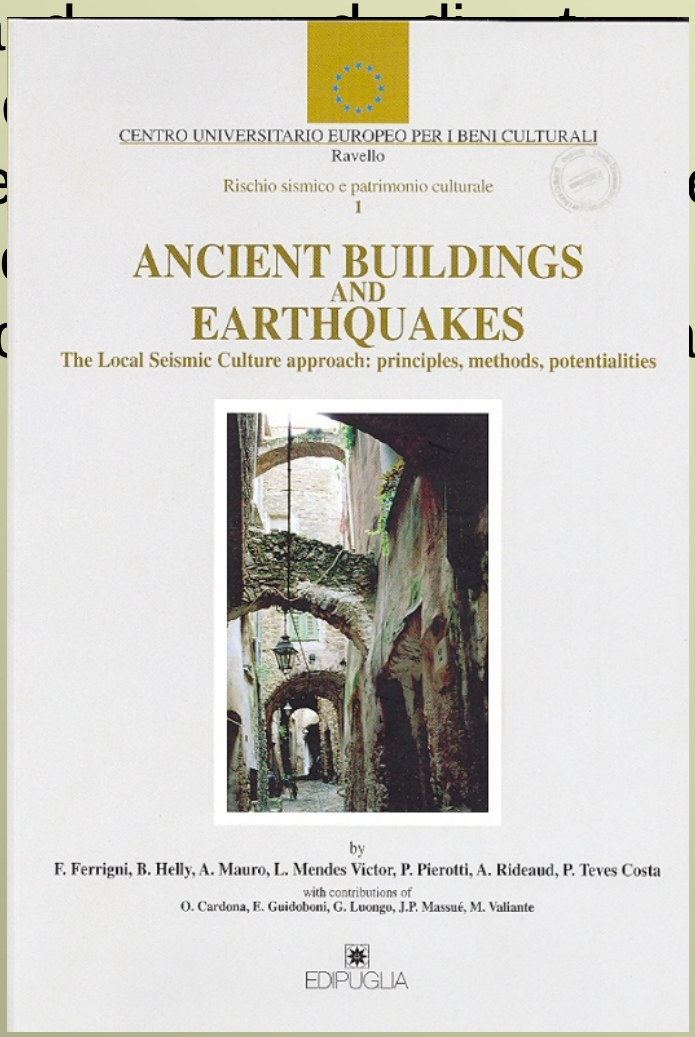
by F. Ferrigni

Ravello, May 09-11 2012

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

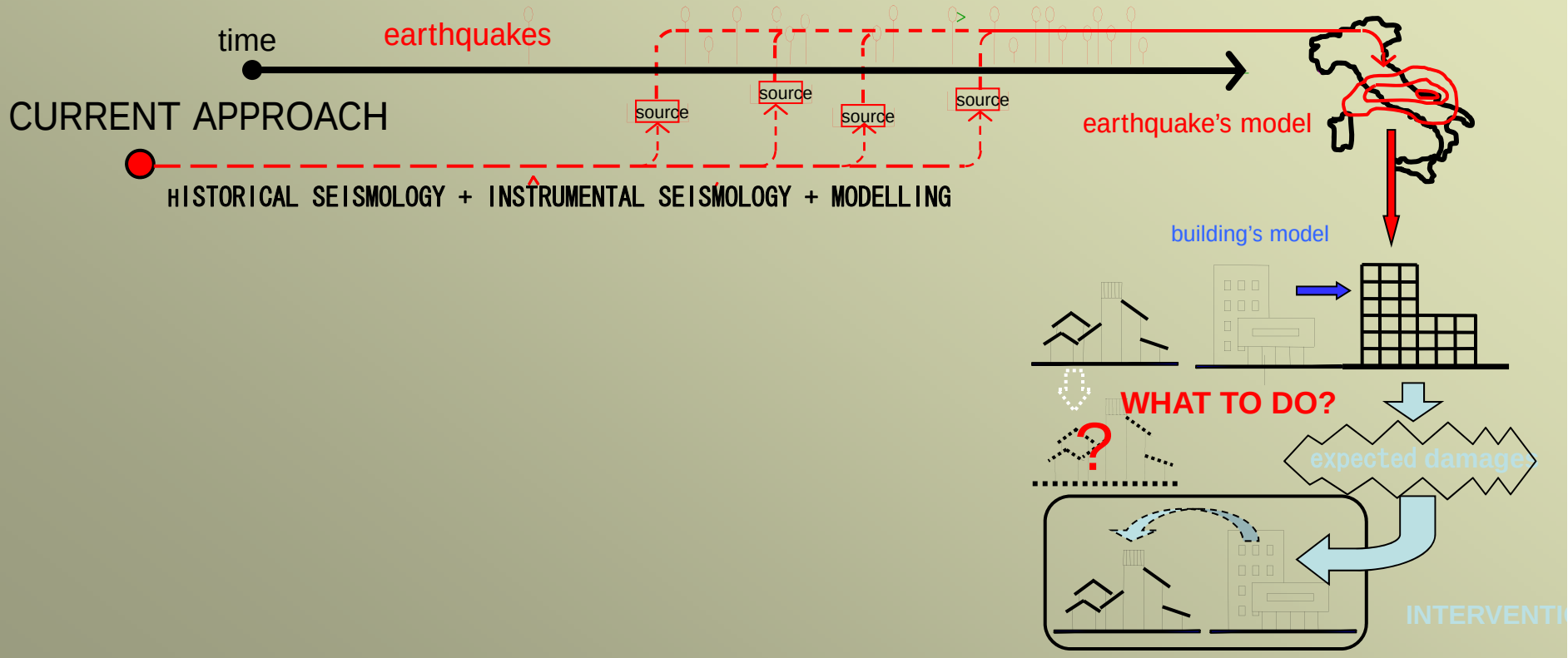
- When the Council of Europe launched the "Open Partial Agreement" (1982), a program finalized to reduce the impact of natural a
the task
the prote
in seismi
focused





THE PROBLEM

WHAT CAN BE DONE TO PROTECT THE ANCIENT BUIT-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 no-omogeneous 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 obbliged, 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.....

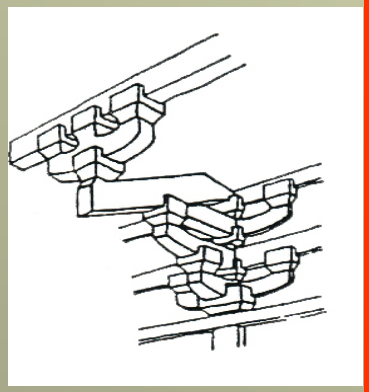
The question “*what to do to protect the ancient built-up?*” has been reformulate as

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

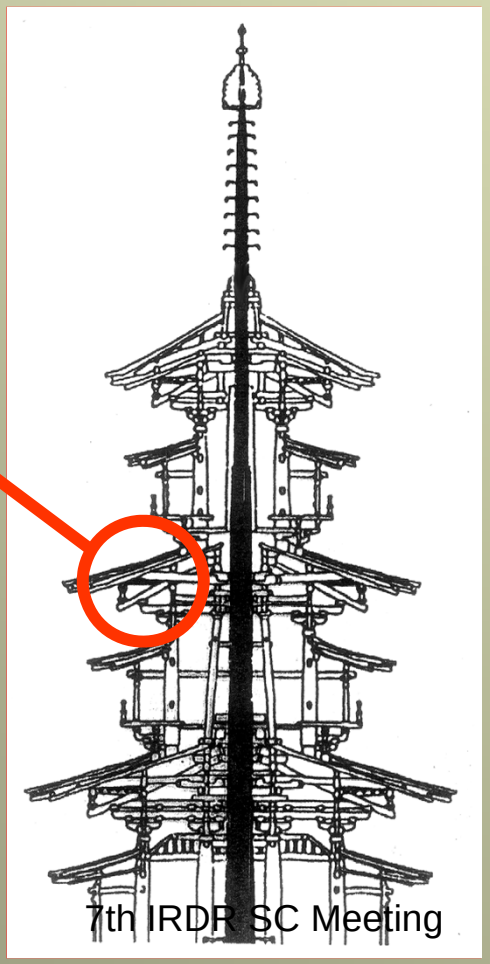
THE COMPARATIVE ANALYSIS
OF MONUMENTS AND VERNACULAR ARCHITECTURE
IN SEISMIC REGIONS
HAS SHOWN
MANY HISTORICAL SEISMIC PROOF TECHNIQUES

STANDING UP BY REDUNDANCY

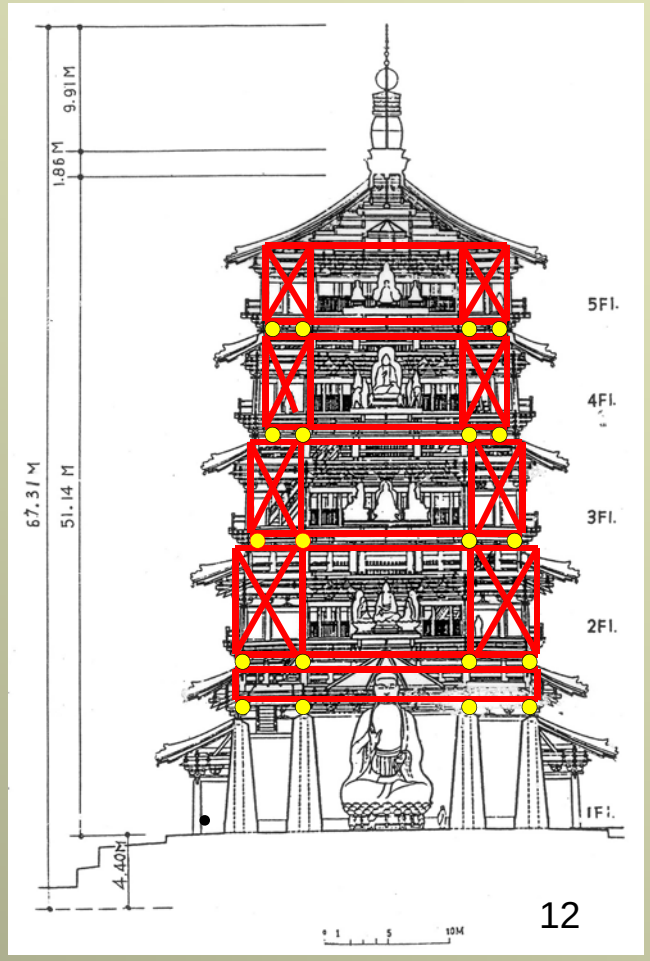
STANDING UP BY DEFORMABILITY

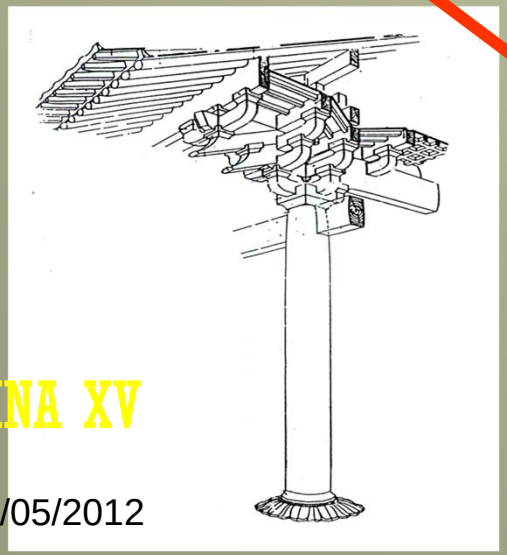


JAPAN XIV



CHINA XVI



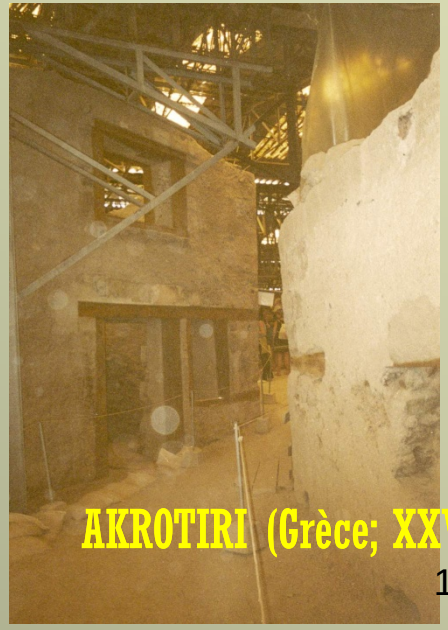


CHINA XV

STANDIG UP BY ABSORBING THE HORIZONTALES FORCES

ALGER (Algeria XVIII

MYTILINI (Grèece, XIX)

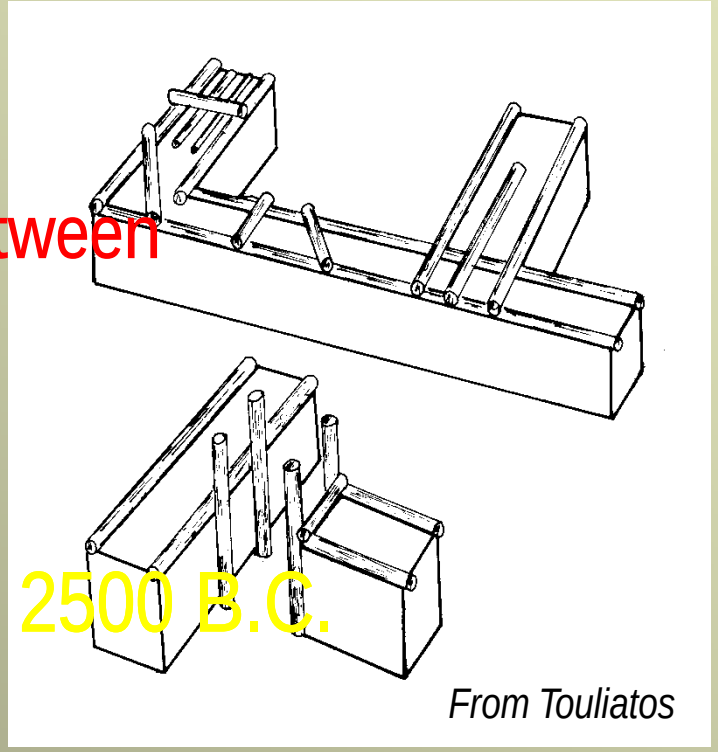


AKROTIRI (Grèce; XXV BC

PERSISTENCE of TRADITIONAL TECHNIQUES 1

MYTHILENE 1800 A.C.

43 centuries between

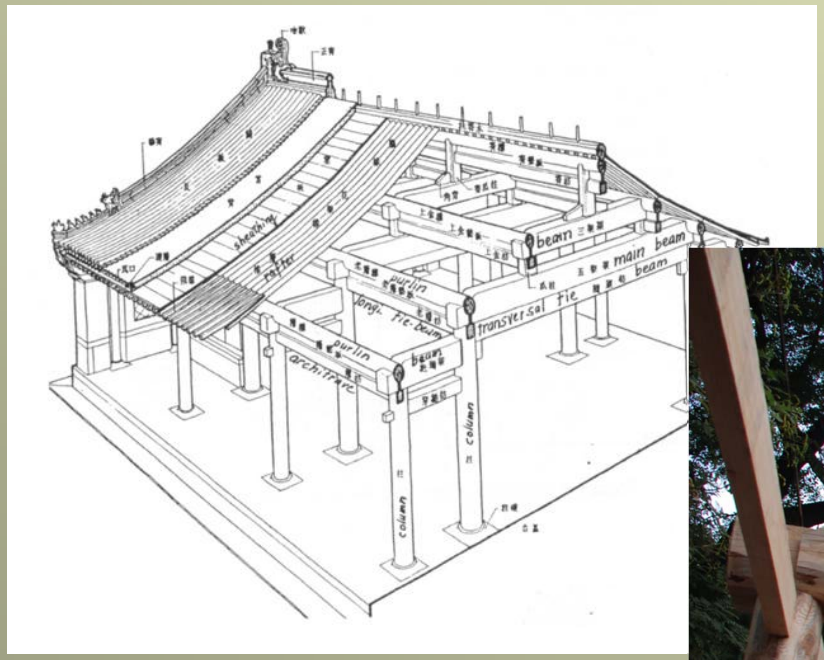


THIRA 2500 B.C.

From Touliatos

PERSISTENCE of TRADITIONAL TECHNIQUES

STANDARD CHINESE TEMPLE, 1600 **2**



BEJING, 2007

THE LACK OF THE LOCAL SEISMIC CULTURE AND HIS EFFECTS

SOME RECURRENT MISUNDERSTANDINGS

(L'Aquila earthquake 2009)

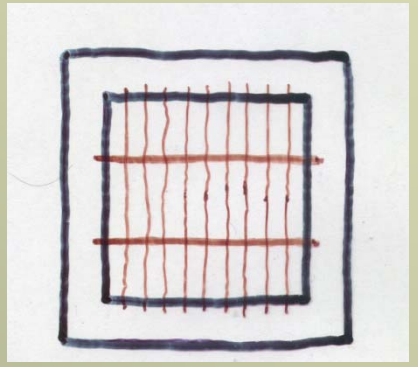
Are the pushing structures dangerous in seismic regions?

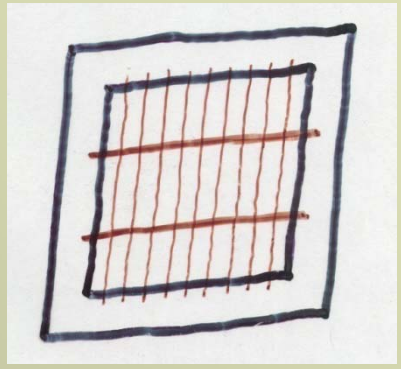
ARE THE VAULTS TO BE REINFORCED?

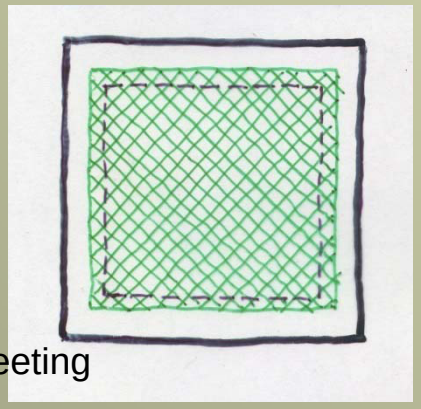
(L'Aquila earthquake 2009)

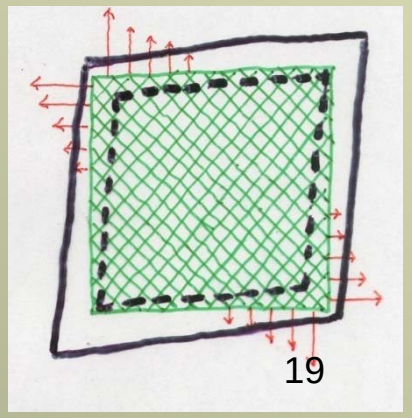
WE ADOPT DANGEROUS (but legally imposed) REINFORCEMENTS.....

(Sellano, Umbria earthquake 1996)









TODAY SEISMSIC CODES IMPOSE NEW TECHNIQUES TO RETROFIT OLD BUILDINGS .....

(Sellano, Umbria earthquake 1996)

the roof stay intact, but ....

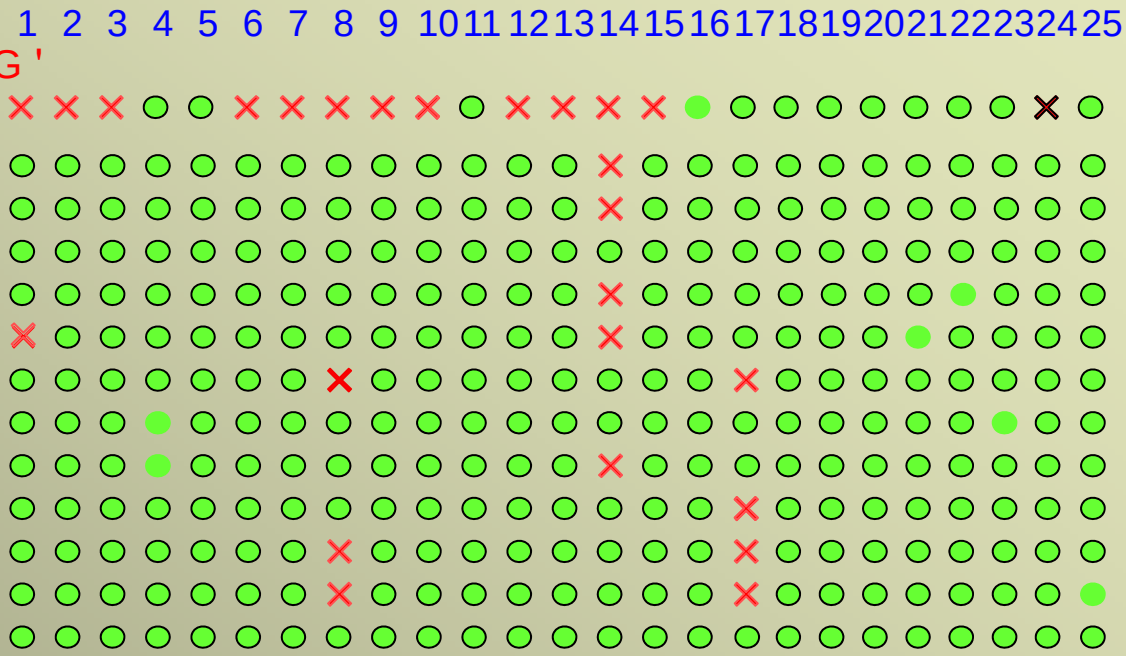
THE “REINFORCED” ROOF

(Onna, L’Aquila earthquake 2009)

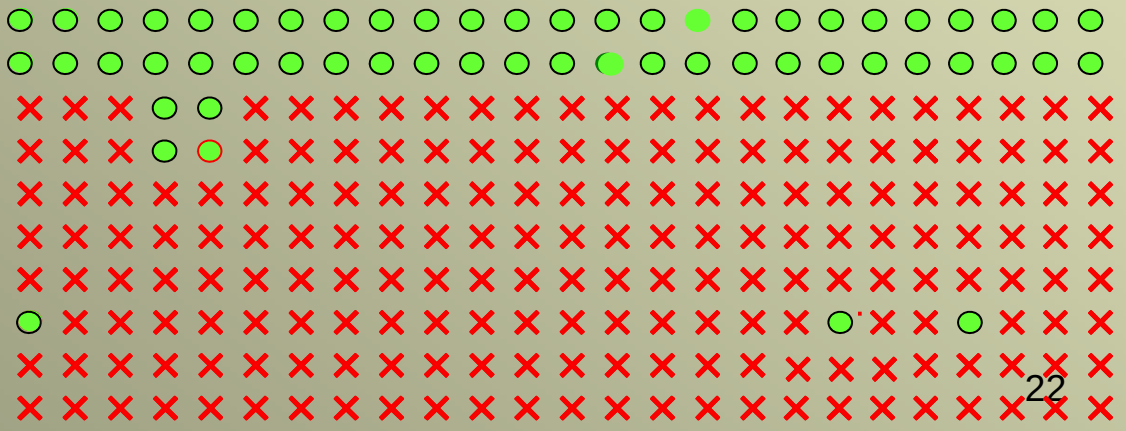
MODIFICATIONS INCREASING / REDUCING THE VULNERABILITY AND HITS LEGITIMACY IN TOWN PLANS

PERMITTED
PROHIBITED

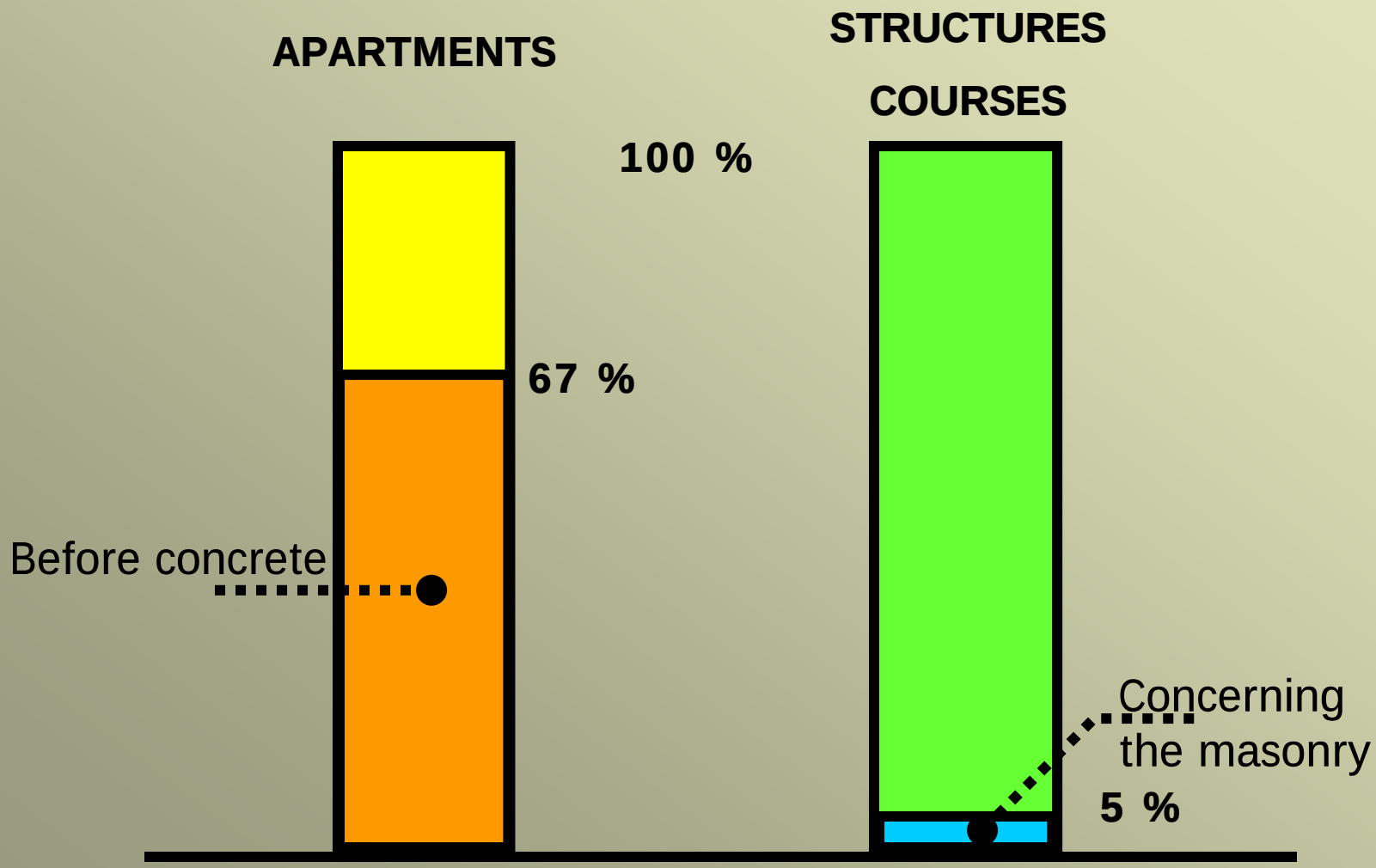
A) VULNERABILITY INCREASING '



B) VULNERABILITY REDUGING



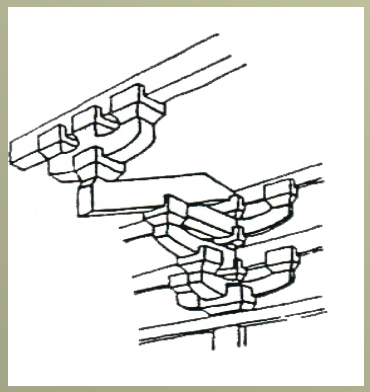
HISTORICAL BUILT-UP AND UNIVERSITY



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

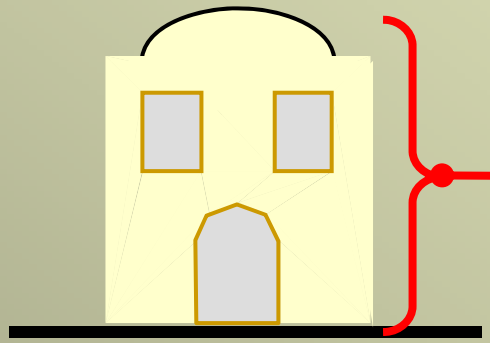
TO IMPROUVE THE SEISMIC RESISTANCE: TWO APPROACHES

IMPACTING ENERGY

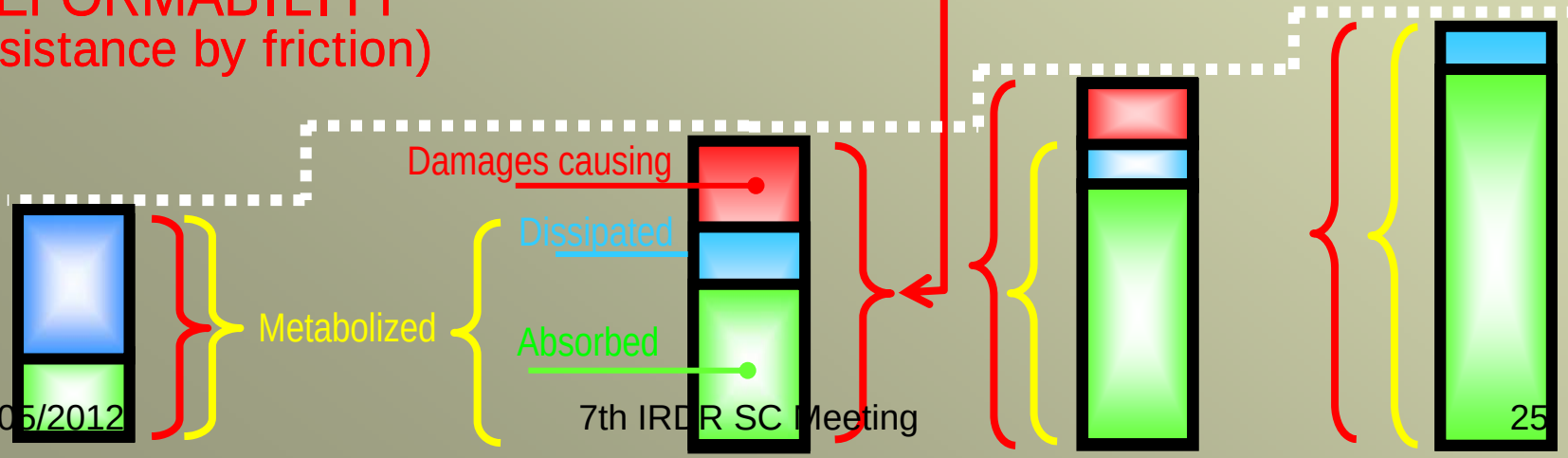


DEFORMABILITY
(Resistance by friction)

CAPTURED ENERGY



MASS
(Resistance by redundance)



TECHNIQUES AND REPARATIONS

ALGIERS (Algeria)

PEROU

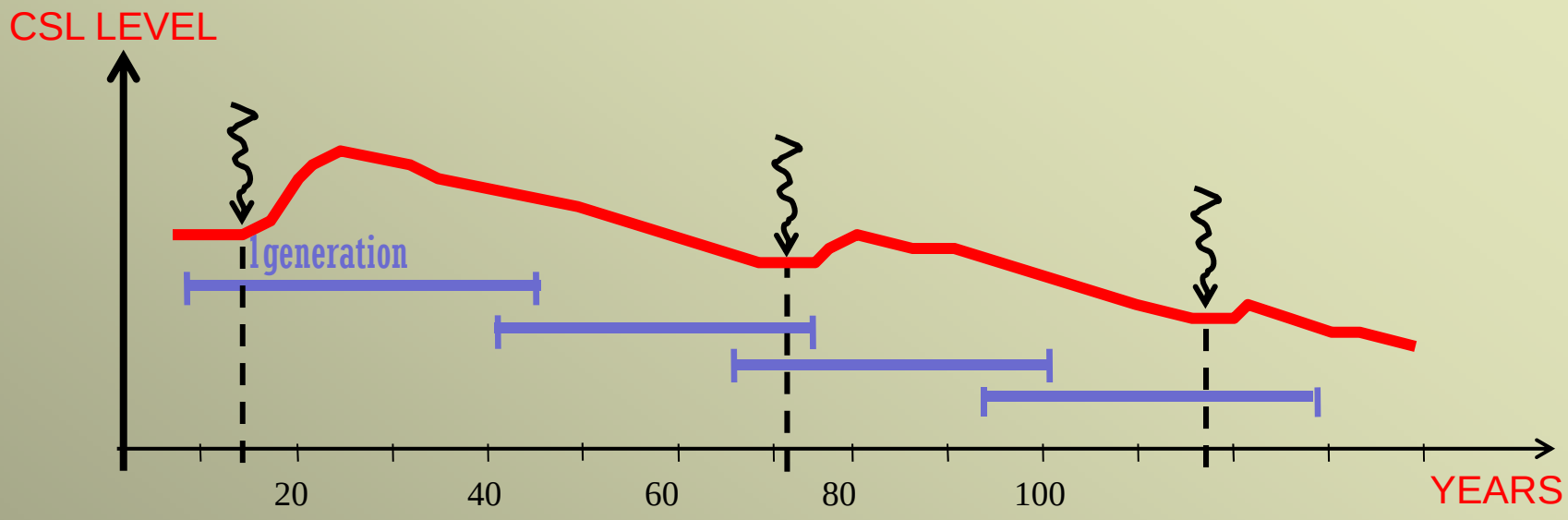
Evora

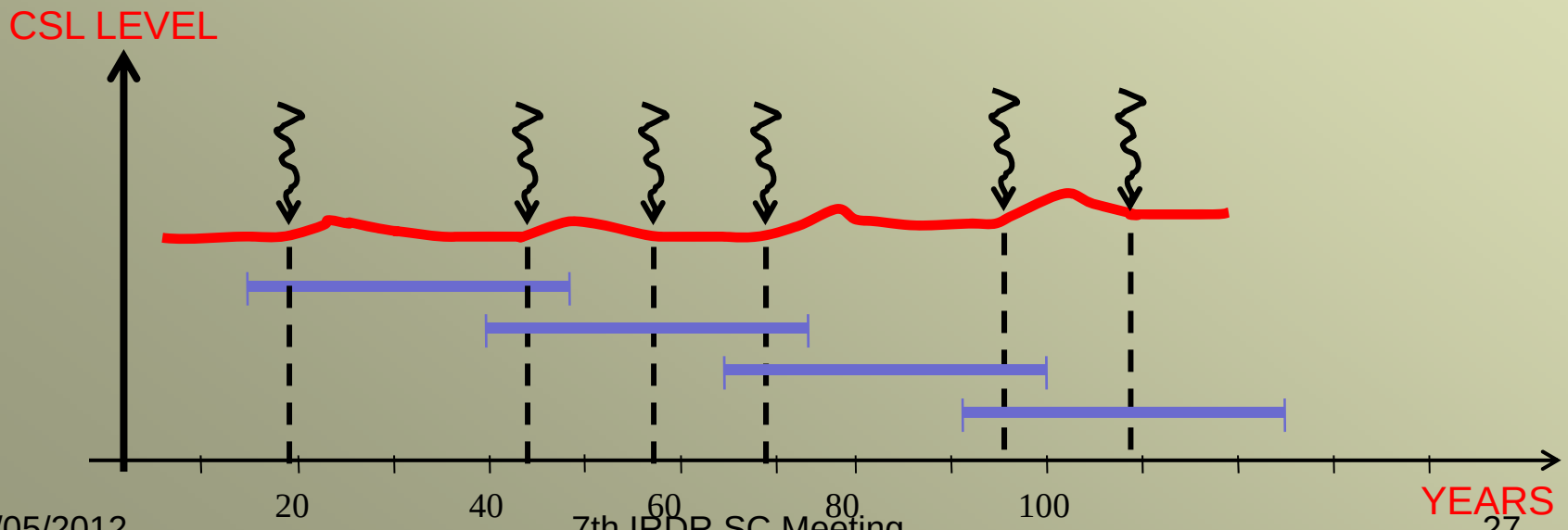
MYTILINI (Greece)

Benevento

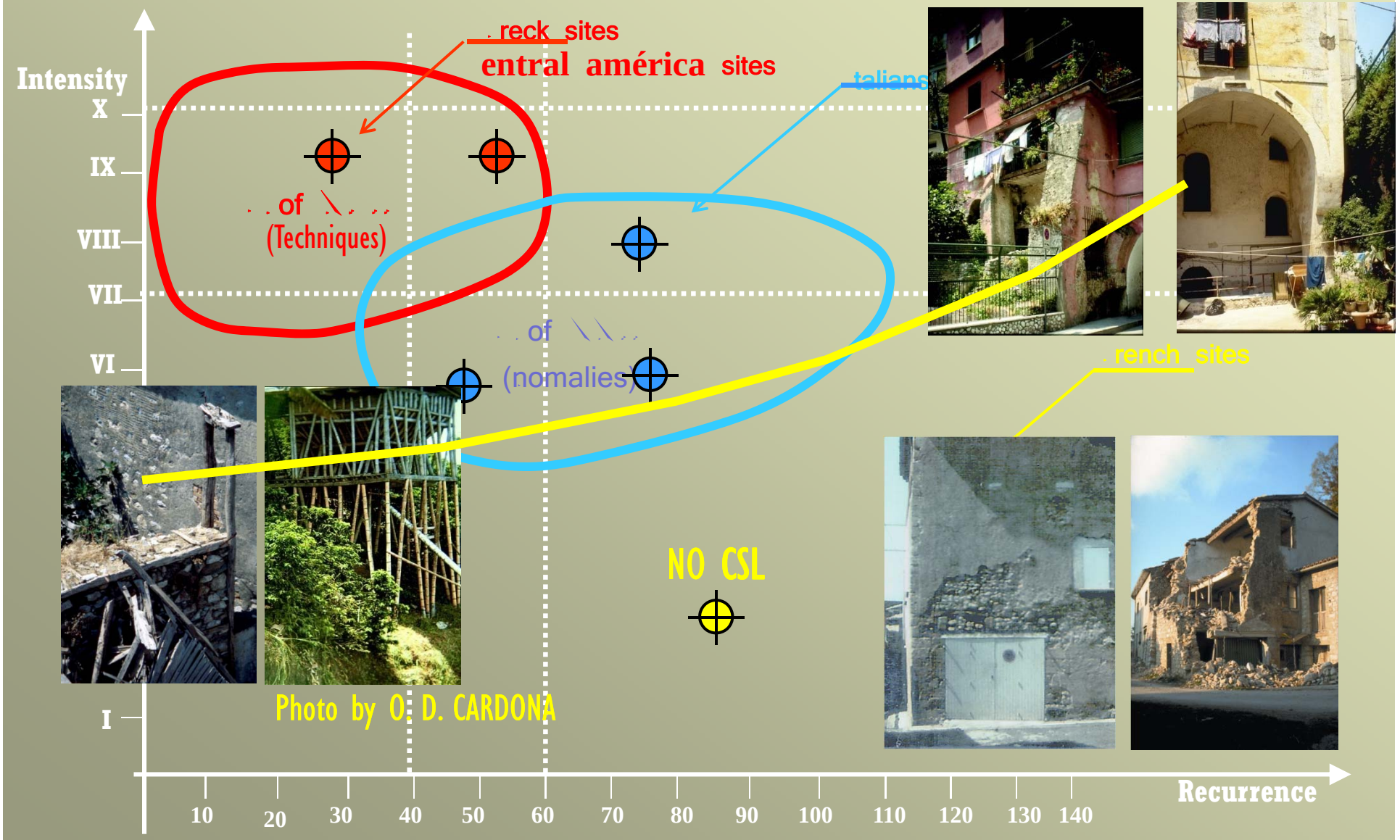
Taurasi (Italy)

RECURRENCE OF EARTHQUAKES AND LEVEL OF THE LOCAL SEISMIC CULTURE

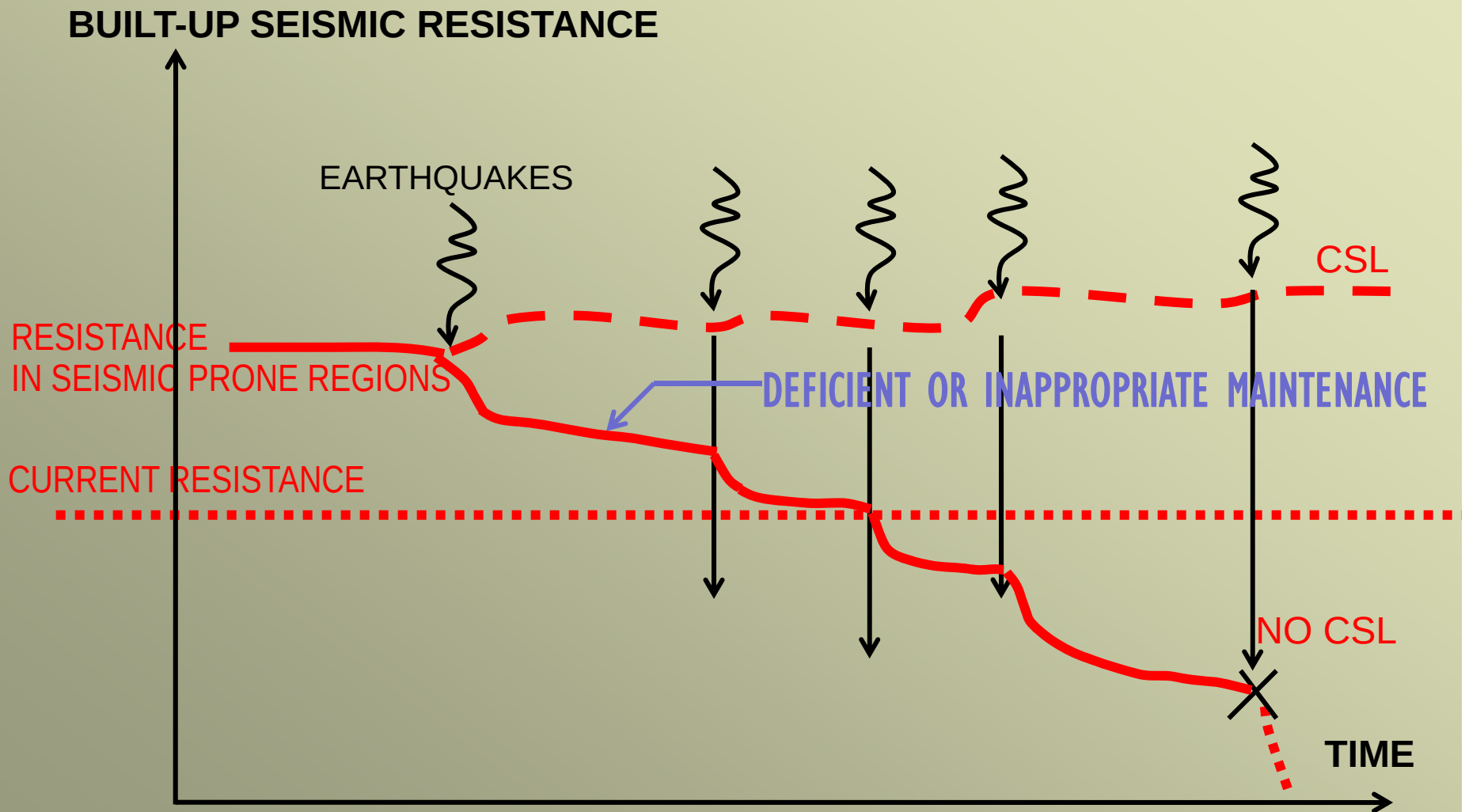




RECURRENCE/INTENSITY and VARIOUS KINDS of LOCAL SEISMIC CULTURES

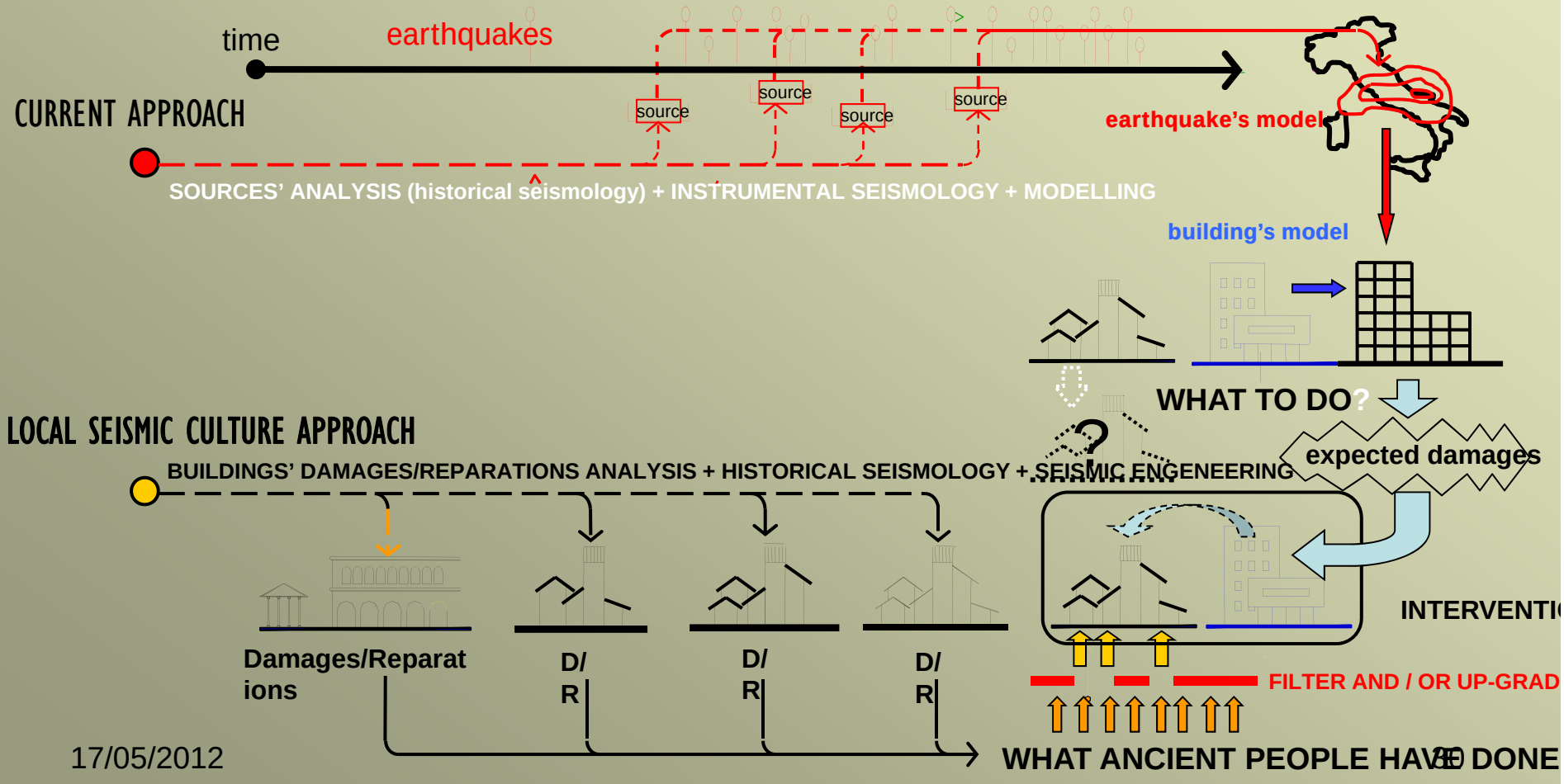


LOCAL SEISMIC CULTURE AND BUILT-UP SEISMIC RESISTANCE

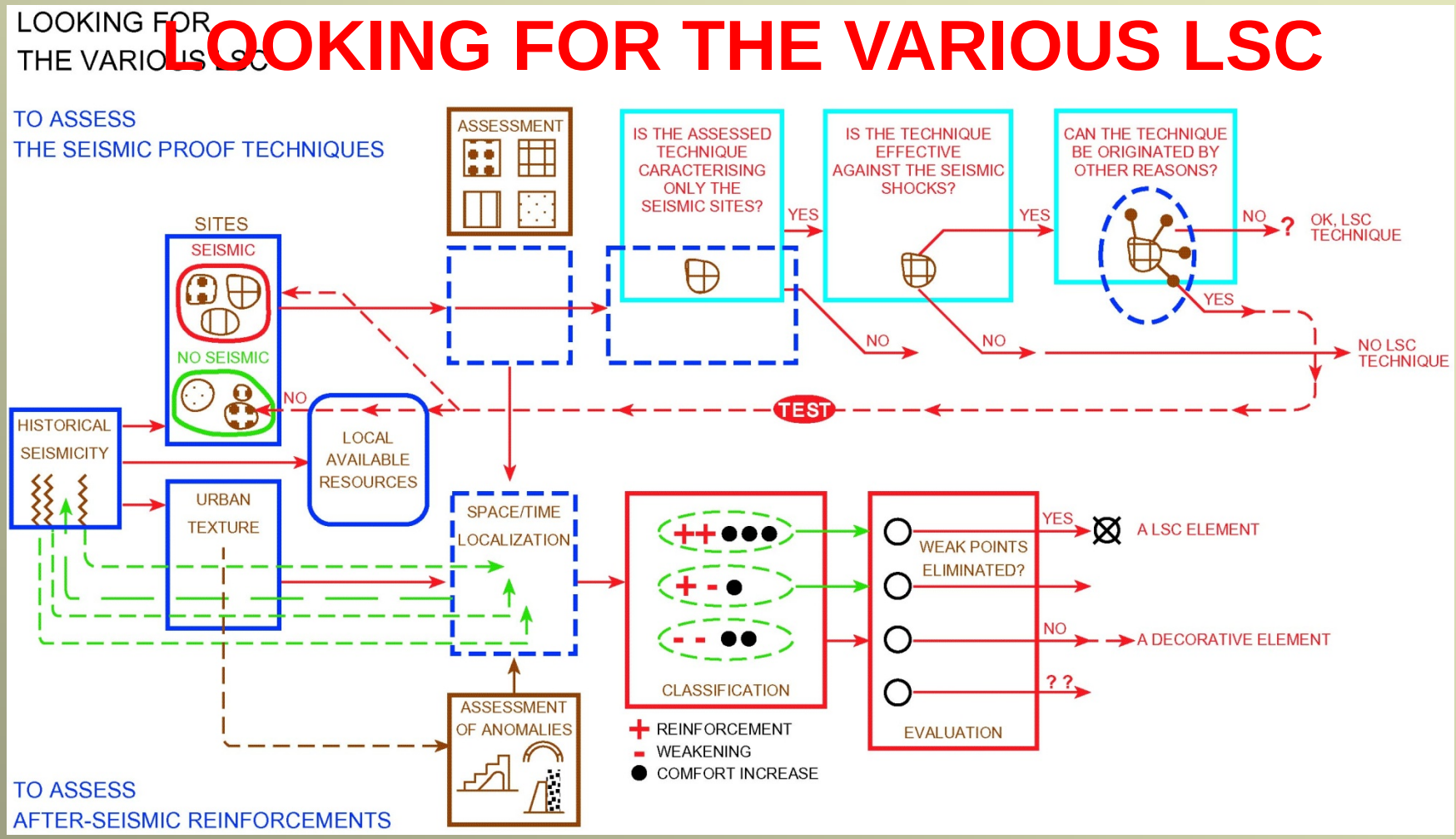


From TOULIATOS, modified

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



LOOKING FOR THE VARIOUS LSC



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 agricoltural system + an effective landslides prevention)