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 man-made disasters on the task of protecting the protection of the cultural and natural heritage in seismic areas.
THE PROBLEM
WHAT CAN BE DONE TO PROTECT THE ANCIENT BUIT-UP?
THE CURRENT APPROACH

CURRENT APPROACH

WHAT TO DO?

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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 strengh 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

Evora

S. Lorenzello

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STANDING UP BY DEFORMABILITY

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STAND UP BY ABSORBING THE HORIZONTAL FORCES

MYTILINI (Grèce, XIX)

ALGER (Algeria XVIII)

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CEPPALONI (Italy, XX)

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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

BEIJING, 2007
THE LACK OF THE LOCAL SEISMIC CULTURE AND HIS EFFECTS
SOME RECURRENT MISUNDERSTANDINGS

Are the pushing structures dangerous in seismic regions?

(L’Aquila earthquake 2009)

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ARE THE VAULTS TO BE REINFORCED?

(L’Aquila earthquake 2009)
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 new floor remain in place....

the roof stay intact, but ....

.....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

A) VULNERABILITY INCREASING

B) VULNERABILITY REDUCING
Before concrete

Concerning the masonry

100%
67%
5%
TO SUPPORT AN INTERDISCIPLINARY TRAINING A “NO-DISCIPLINARY” LANGUAGE IS NECESSARY
TO IMPROVE THE SEISMIC RESISTANCE:

IMPACTING ENERGY

TWO APPROACHES

DEFORMABILITY
(Resistance by friction)

CAPTURED ENERGY

MASS
(Resistance by redundancy)

Damages causing Dissipated Absorbed Metabolized

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TECHNIQUES AND REPARATIONS

ALGIERS (Algeria)

PEROU

Evora

Taurasi (Italy)

MYTILINI (Greece)

Benevento

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RECURRENCE OF EARTHQUAKES AND LEVEL OF THE LOCAL SEISMIC CULTURE

CSL LEVEL

YEARS

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RECURRENCE/INTENSITY and VARIOUS KINDS of LOCAL SEISMIC CULTURES

LSC of PREVENTION (Techniques)

LC of RARTION (nomalies)

NO CSL

Intensity

Recurrence

Photo by O. D. CARDONA
LOCAL SEISMIC CULTURE AND BUILT-UP SEISMIC RESISTANCE

EARTHQUAKES

RESISTANCE IN SEISMIC PRONE REGIONS

CURRENT RESISTANCE

DEFICIENT OR INAPPROPRIATE MAINTENANCE

BUILT-UP SEISMIC RESISTANCE

TIME

CSL

NO CSL

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From TOULIATOS, modified
WHAT CAN BE DONE
TO PROTECT THE ANCIENT BUILT-UP ENVIRONMENT?
TWO COMPLEMENTARY APPROACH

WHAT ANCIENT PEOPLE HAVE DONE

LOCAL SEISMIC CULTURE APPROACH
BUILDINGS’ DAMAGES/REPARATIONS ANALYSIS + HISTORICAL SEISMOLOGY + SEISMIC ENGINEERING

CURRENT APPROACH
SOURCES’ ANALYSIS (historical seismology) + INSTRUMENTAL SEISMOLOGY + MODELLING

earthquake’s model

expected damages

WHAT TO DO?

INTERVENTIONS
FILTER AND / OR UP-GRADING

WHAT ANCIENT PEOPLE HAVE DONE

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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)