CONSERVATION—RECONSTRUCTION

SMALL HISTORIC CENTRES
CONSERVATION IN THE MIDST OF CHANGE

Rodica Crisan
Donatella Fiorani
Loughlin Kealy
Stefano Francesco Musso

Editors
EAAE
European Association for Architectural Education

ENHSA
European Network of Heads of Schools of Architecture

This project has been funded with the support of the European Commission. This publication reflects only the authors’ view, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

EAAE Transaction on architectural education no. 64

Editors
Rodica Crisan, Donatella Fiorani, Loughlin Kealy, Stefano F. Musso

Copy-editor and proof readers
Marta Acierno (French texts)
Anna Kealy (English texts)

Graphic layout
Emanuele Gabellini · Quasar

Published by EAAE · Hasselt, Belgium · 2015
Printed in Italy · Arti Grafiche CDC srl
ISBN 978-2-930301-63-1

Copyright © 2015 by the authors · All rights reserved
No part of this book may be reproduced in any form, by print, photoprint, microfilm or by any other means without written permission from the publisher.
<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
<th>Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>235</td>
<td>VALORISATION ET CONNEXION. De l’échelle du territoire aux petits hameaux</td>
<td>Laurent Debailleux, Hugues Wilquin</td>
<td>University of Mons, Belge</td>
</tr>
<tr>
<td>243</td>
<td>FEATURES OF SMALL HISTORIC CENTERS. Conservation and new functions</td>
<td>Pietro Matracchi</td>
<td>Università degli Studi di Firenze, Italy</td>
</tr>
<tr>
<td>251</td>
<td>CONNECTIVITY FOR CONSERVATION: a comparison between the small historic centers of Irpinia and the case of Castelvecchio Calvisio</td>
<td>Andrea Pane</td>
<td>Università degli Studi “Federico II” di Napoli, Italy</td>
</tr>
<tr>
<td>263</td>
<td>STRATEGIES FOR THE CONSERVATION and enhancement of old town centers</td>
<td>Fabio Todesco</td>
<td>Università degli Studi di Messina, Italy</td>
</tr>
<tr>
<td>273</td>
<td>SUPER-MUNICIPAL POLICIES FOR CONSERVATION and enhancement of local identities: strategic plans for “revitalization” of small historic centers</td>
<td>Eugenio Vassallo and Sara Di Resta</td>
<td>Istituto Universitario di Architettura di Venezia, Italy</td>
</tr>
<tr>
<td>281</td>
<td>HISTORY AND TIME</td>
<td>Rita Vecchiattini</td>
<td>Università degli Studi di Genova, Italy</td>
</tr>
<tr>
<td></td>
<td><strong>C. Structural and building issues</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>293</td>
<td>SMALL ABANDONED HISTORIC TOWNS between conservation and reconstruction: critical issues and possible scenarios</td>
<td>Aldo Aveta</td>
<td>Università degli Studi “Federico II” di Napoli, Italy</td>
</tr>
<tr>
<td>301</td>
<td>THE STUDY OF BUILDING CHARACTERISTICS and stratigraphic analysis: a contribution to structural verification in seismic areas</td>
<td>Anna Boato</td>
<td>Università degli Studi di Genova, Italy</td>
</tr>
<tr>
<td>313</td>
<td>THE CONSERVATION OF THE SMALLER HISTORICAL CENTERS between use and seismic safety</td>
<td>Maria Teresa Campisi</td>
<td>Università degli Studi “Kore” di Enna, Italy</td>
</tr>
<tr>
<td>323</td>
<td>CASTELVECCHIO CALVISIO. Remarks on the knowledge of historic building fabric for safety and preservation</td>
<td>Caterina F. Carocci</td>
<td>Università degli Studi di Catania, Italy</td>
</tr>
<tr>
<td>335</td>
<td>REDUCING THE COSTS AND PHYSICAL IMPACT of structural reinforcement and seismic protection of architectural heritage: possible applications in Castelvecchio Calvisio</td>
<td>Francesco Doglioni</td>
<td>Istituto Universitario di Architettura di Venezia, Italy</td>
</tr>
<tr>
<td>347</td>
<td>CASTELVECCHIO CALVISIO and the earthquake vulnerability of old villages</td>
<td>Luca Giorgi</td>
<td>Università degli Studi di Firenze, Italy</td>
</tr>
<tr>
<td>359</td>
<td>CASTELVECCHIO CALVISIO: stratégies de connaissance, stratégies d’intervention</td>
<td>Alberto Grimoldi</td>
<td>Politecnico di Milano, Italy</td>
</tr>
</tbody>
</table>
CHARACTERISTICS OF HISTORIC BUILDINGS in seismic-prone regions. Case study of Kotor; 'lessons learned' for Castelvecchio Calvisio
Ilja Lalosevic
University of Podgorica, Montenegro

DIMENSIONS OF PERFORMANCE as a revitalisation strategy for Castelvecchio Calvisio
Maria Leus
University of Hasselt, Belgium

FILLING THE GAPS? The problem of integrating the lacking elements in historic centers damaged by earthquakes
Giulio Mirabella Roberti
Università degli Studi di Bergamo, Italy

TRADITIONAL HISTORICAL PRECAUTION against earthquake
Barbara Scala
Università degli Studi di Brescia, Italy

CASTELVECCHIO CALVISIO: from structural reading to mechanical modelling
Cesare Tocci
“Sapienza” Università di Roma, Italy

ACCESSIBILITY AS A DESIGN RESOURCE for tourist enhancement of lesser-known cultural sites
Alberto Arenghi, Ilaria Garofolo, Antonio Lauria
Università degli Studi di Brescia, Italy

RECOVERING THE CONNECTIONS: territory–settlement–identity. Intervention in the historic and artistic village of Pazos de Arenteiro, Galicia, Spain, and a visit to Castelvecchio Calvisio, Italy
Miguel Angel Calvo Salve
School of Architecture, Marywood Univ. Scranton, Penn, USA

CASTELVECCHIO CALVISIO VILLAGE: past and recent absences, past and recent presences
Maurizio De Vita
Università degli Studi di Firenze, Italy

CHALLENGES FOR CONSERVATION due to changing lifestyles and the loss of intangible meaning
Fintan Duffy
Waterford Institute of Tecnology, Ireland

FROM ‘GHOST TOWNS’ TO ‘PLACES OF MEMORY’, a process of re-signification
Giovanna Franco
Università degli Studi di Genova, Italy

TO BUILD OR NOT TO BUILD - That is the question
Alfonso Giancotti
“Sapienza” Università di Roma, Italy

THE AWAKENING OF THE SLEEPING CITIES
Caterina Giannattasio
Università degli Studi di Cagliari, Italy

CASTELVECCHIO CALVISIO: et pourquoi pas un scenario ruskinien?
Claudine Houbart and Stéphane Dawans
University of Liège, Belgium

THE GAP IN HISTORICAL SETTLEMENTS AND THE SPATIO-CULTURAL DIMENSION. The character and contribution of restoration in their rehabilitation
Sofloki Kotsopoulos
Aristotle University of Thessalonki, Greece
Seismic vulnerability in old towns

There is a growing awareness of the need to safeguard our cultural heritage, both in private institutions and among the general public. In areas prone to earthquakes, particularly, the conservation and protection of cultural assets have become prime objectives. Experience confirms that it is important to have in place a policy that can prevent such damage; to pursue a policy of prevention. This must be based on a better understanding of how earthquakes affect not only buildings but also the behaviour of resident populations.

Such an understanding is needed in encouraging prompt and effective action and in minimising damage.

This paper reflects on how to protect our old buildings, which are part of our cultural heritage.

The first concern is to raise the awareness of the human community exposed to earthquake risk. It is well known that in areas of traditional seismicity, earthquakes have always been seen as events one can neither prevent nor resist.

In the past the affected community had only one option: to rebuild what had been destroyed. Recurring disasters were the only available way of testing earthquake-resistant building methods. They provided an opportunity for renovating and improving buildings and living conditions.

Whilst earthquakes cannot be prevented, we can protect ourselves against their effects and limit the damage. However, that can only be done if we can predict their effects.

This change in the approach to earthquakes underlines the emphasis on prevention. Refinement of these methods of protection is closely linked to an understanding of how buildings behave during a seismic shock. That understanding can only be gained from modelling numerical simulations. However, the availability of simulation techniques – widely proven and used today – solves only some of the problems.

It is not always possible to construct a credible and reliable mathematical model of building behaviour. Specifically, the difficulty increases depending on whether one is dealing with a simple archaeological structure, a single building, a large-scale structure or the architectural fabric of historic centres, not only because the structural complexity increases, but also because it becomes harder to determine the phases of development of buildings. It also becomes more difficult to represent in the model the structural anomalies that arise.

Problems arise because we are using modern aids to knowledge while, at the same time, we are progressively losing empirical knowledge. So the measures we take may be less appropriate than traditional measures would have been.

The vulnerability of a building depends not only on its inherent abilities to resist but, critically, on the actions of the inhabitants before and after the earthquake. It is unanimously acknowledged that irrespective of the specific features of the local system (availa-
ble resources, techniques used, etc.), the best way of protecting cultural heritage in earthquake zones is always to maintain it properly, i.e. to work on it regularly, at the same time respecting its architectural characteristics.

Nowadays architectural heritage is no longer understood as being comprised of buildings of artistic and historic importance. It also covers vernacular architecture as a living witness to the local culture.

There has been a gradual acceptance of privately owned cultural assets as an integral part of the national heritage. The burden of protection thus has to be shared with their owners, in exchange for certain grants and, above all, tax concessions.

This is all the more desirable since people visiting these buildings care less about their legal status than about their existence as historic houses. It is important to know that they are maintained and are lived in (whether by their owners or someone else) – that these buildings are still residences and not museum pieces.

Another aspect of the cultural change we are witnessing is that architectural heritage is no longer seen merely as providing aesthetic pleasure; increasingly, it is seen as having an economic and social function. Recent earthquakes led researchers to observe similarities between the regional variants of various types of old building (timber-frame, earthen, poorly bonded masonry, etc.). These similarities appear to correlate with the conditions in which the various types of materials were used, independently of region or time, but influenced by one common factor: seismic risk. In other words, in all regions where there is a major risk of earthquakes, an understanding of this risk by the population seems to mean that for any given material the architectural solutions employed will be very similar, and the same building methods will be used.

Another feature of the earthquake risk, the fact that it recurs over time, prompts us to examine not only the geographical aspect but also the historical aspects of this recurring risk.

Buildings may be regarded as structures which are born out of the response of the population, and which:
are influenced by an ever-present physical phenomenon;
use local materials;
reflect a well-defined pattern of social and cultural behaviour.

Research on old buildings in earthquake zones must thus span extended periods of time and must seek to:
understand both the physical reality of the phenomenon (drawing on seismology, geology and other sciences dealing with different aspects of seismicity) and its temporal reality (seismic history) on both a regional and local scale;
understand the resources available (materials and building methods) in terms of their physical reality and their use over the centuries (materials science, architecture, archaeology);
identify the behavioural patterns of the community.

Clearly, the methods chosen by a community over the centuries depend not only on the resources available, on the cultural capacities of that community, on how forcefully the authorities insist on specific measures and so on, but also on the overall level of affluence (the best methods are often the most expensive ones). The proportion of resources spent on regular maintenance is crucial, something determined by the degree to which such measures are perceived as useful.

For this reason, it is of paramount importance that methods of earthquake protection that are tailored to the specific characteristics of the local architecture should be revived and developed, and their use encouraged. A population which properly understands the buildings it uses and knows how these have reacted or might react in future to earthquakes, and which successfully revitalises traditional methods of reinforcement, repair and conversion will be better equipped to safeguard its cultural heritage. And its organisational capacities – before, during and after the earthquake – are bound to be better as a result.

Recent disasters have shown that most damage to buildings results from failure to include relevant technical features and from legislative constraints that create unnecessary extra cost. In plain terms, the local culture seems to have lost its former understanding of earthquake resistance methods, and specifically of their effectiveness. The result is a perverse process of impoverishment of the community, culturally to begin with, but then materially too, culminating in situations which appear to be paradoxical. Ordinary privately owned buildings that are not monuments or in the public domain, and thus do not qualify for any institutionally organised restoration measures, tend to become even more vulnerable. They are unlikely to receive any preventative or systematic assistance, and are far more likely to suffer inappropriate modifications or repairs.

So if effective protection is to be ensured, it is necessary not only to define and popularise the best possible earthquake resistance techniques, but also to get the local community to identify and apply spontaneously ‘its own’ techniques, techniques which have been tested in every earthquake the community has experienced and which are thus probably the ones best suited to the local system.

How do we identify these in buildings which have been changed through centuries of use? How do we identify and measure the anti-seismic effectiveness of things which became ‘decorative’ as the memory of the earthquake faded, and with it the understanding of their original purpose?
It is, of course, essential to understand the old buildings if we are to protect them. Whilst those who specialise in historic town studies may conduct historical, stylistic and economic analyses that are exceptionally well researched and thorough, they rarely use interdisciplinary methods. The deterioration occurs firstly as a result of inappropriate action, and secondly because regular maintenance is not carried out. The way in which a community uses (and re-uses) its buildings is a major feature of the community’s earthquake culture.

Identifying the local rules for earthquake control is an essential but insufficient requirement for reducing the vulnerability of the system. If the community has no reason to care about maintenance (because housing is rented, for example), or if it does care but its concern proves incompatible with architectural features (for example where gateways need widening to make garages), the result is neglect or decay, which ultimately has implications for vulnerability.

As long as preventive structural measures remain the responsibility of property owners, and reconstruction the responsibility of the authorities, it is obvious that no preventive programme will work, given the reluctance shown by property owners.

One of the most important factors influencing our understanding of architecture is without doubt the ability to predict how buildings – and especially all the buildings in a given place – will react to stress. Generally, when analysing vulnerability, structural models of buildings are used primarily to assess stresses in the event of seismic shock, to compare them with the maximum resistances of materials, and thus to deduce how safe the whole structure is.

Another factor in increased vulnerability is the changes which are known, or can be seen to have been made, to a building over the ages. It is most important to know the history of any modifications to a building, as this will help not only to choose the right measures to strengthen or repair it, but also to ensure that the project proceeds along the right lines. Town planning and earthquake control regulations are, paradoxically, factors that can adversely affect vulnerability. The problem clearly arises when these are too lax or inappropriate, but also when they are too inflexible or too restrictive. Where this is the case, they push up the cost of any measures and prevent old buildings from being adapted to present-day needs; this leads to behavioural patterns on the part of the community which further heighten vulnerability.

**Castelvecchio Calvisio and its earthquakes**

In our attempt to understand how the problem of earthquakes was addressed in the past, it is a good idea to look at the marks left by the various earthquakes on local buildings. However, in order to know how the culture was gradually altered by experience, we need to know the location and distribution of dwellings at the time of each earthquake.

It is useful to consider urban development in the historic centre of Castelvecchio Calvisio in relation to the main earthquakes (those which left traces in the archives and the local folk memory) rather than in relation to different periods of history.

This kind of analysis requires no special investigation. It is enough to organise differently the factors one usually studies when tracing the town planning history of a centre, that is, to check and compare:

a) a morphological analysis of the urban fabric;
b) a typological and stylistic analysis of the buildings;
c) an analysis of building methods;
d) historical records;
e) the oral tradition

These factors should then be related to the findings of historical seismology, and the whole lot compared with the major recorded earthquakes.

When assessing and planning measures to alter an old architectural fabric (maintaining it, strengthening it, modernising it, etc.) it is vital to understand the dynamic behaviour of buildings. We have already seen that it is difficult, if not impossible, to use models when dealing with historic centres. It is thus no coincidence that static tests (and the measures subsequently taken) usually look at individual buildings and do not take account of the way in which buildings behave as an ensemble.

This is an aspect of earthquake culture that has major implications for the vulnerability of the system.

Erstwhile building methods enabled specifically targeted, additional measures to be carried out which were always reversible and compatible with others of their kind. Measures applied to one unit did not mean that similar measures had to be applied to neighbouring units. In particular, building and conversion techniques were based on an empirical understanding of the group as a whole.

Methods and materials

For a long time, the materials used were those found locally. The types of masonry and horizontal structures used are not remarkable in terms of their resistance to earthquakes. The way in which the strata are placed may incidentally help earthquake resistance (by lowering the building’s overall barycentre, that is, the centre of mass).
The construction typology gives rise to a compact village with narrow streets, ordained by virtue of a unitary conception.

The arrangement of the urban tissue is a very good example of structural composition at two levels: single cells are aggregated in single or double rows, and the aggregates are disposed regularly on the top of a hill from the central main street in a herringbone pattern, forming an ideal system for dealing with problems like earthquakes.

Furthermore, arches or vaults crossing the streets counteract the movement or the eventual collapse of the façades, creating an efficient system of interaction between different aggregates, so that the entire village can be regarded as a single aggregate.

The foundations of the buildings do not seem to give rise to problems, because the site is built on quite solid rock.

The only covering over basements or semi-underground spaces is the ceiling vault, usually a single structure. At ground-floor level it is used for porches and large rooms. At first-floor level, wooden floors predominate. Roofs are of wood and pantiles. There is really just one type of window: rectangular, with a shaped sill of dressed stone.

Critical local observations of the buildings reveal that the original structures were strong enough to give an adequate response to earthquakes. Starting from the end of the 15th century (there was a strong earthquake in 1461), most of the buildings were constructed to prevent seismic problems. You can find, for example, wooden ties inside the main walls of the buildings that were constructed shortly after this earthquake, with iron keys on the corner. The builders knew the critical points of the construction system.

Some weaknesses can be detected: in many cases the façades of the buildings are not connected to the transversal walls nor tied to the floors; particularly on the top of the buildings, transversal walls often cut the façades and are not structurally connected to them, because these walls are simple enclosures of original open attic store rooms. Also, the wooden ties in a few cases cannot be considered still efficient, due to wood deterioration. On the other hand, the interventions in reinforced concrete after the 1915 earthquake, like buttresses or new floors, are sometimes very large and may be not so effective in preventing new damage.

Rediscovering earlier cultures

Obviously, earthquakes are extremely good tests of methods and materials, and as such generate innovations which reflect our expanding knowledge. This is how a community’s earthquake culture comes into being. Then, as memories of the earthquake fade, awareness of the earthquake-resistant function of certain measures fades too, as those measures are absorbed into everyday building practice and become part of the repertoire of ornamental architecture. This is an inexorable physiological process which helped earthquake culture to take root in the past, but which makes it far more difficult in modern times to understand the full range of the earthquake resistance methods applied to a given building in earlier times.

In reality things are ambiguous. Buttresses, wall bracing and tie-beams are all commonplace features which are virtually ubiquitous and help buildings to resist earthquakes, but they are also measures of general reinforcement.

However, identification of standard methods from the outside and the lists and monographs issued by the experts are not enough to revive the community’s earthquake culture. If the community’s understanding of its architecture is to influence its behaviour (and if all
this is to create an ‘earthquake culture’), the community has to be encouraged to rediscover its own techniques. This objective can be more easily attained through a standard procedure whereby the local community can understand the specific techniques that are evident in the buildings it uses, compare them with the resources and requirements of the time, and update them in response to the requirements and resources of the present day. This procedure reveals how a given community, in a given context, will have successfully combined immediate benefits (improved amenities) and future benefits (reduced vulnerability to earthquakes).

**Traditional reinforcement factors in Castelvecchio Calvisio**

Special features that eliminated earlier vulnerability factors, and can thus be regarded as reinforcement techniques forming part of Castelvecchio Calvisio’s earthquake culture, are as follows:

1. Wall bracing, angled or vertical, is a general preventive measure (Fig. 1);
2. Tie-beams, terminating in tie bolts and plates (Fig. 2);
3. Vaulted passageways made of stone. Originally additions which combined static reinforcement with improvements in amenities, these became a regular feature of the architectural repertoire and are now incorporated into new structures right from the start (Fig. 3);
4. ‘Contrast’ arches made of stone, at the topmost point of buildings, probably serve as a preventative measure against cracks caused by the thrust of the roof or the rotation of the walls (Fig. 4).

Architecture is a living thing. As the habitat of a community, it must protect that community and satisfy the various needs of its occupants. To that end it is the object of two kinds of measures. Some are designed to strengthen buildings vis à vis their environment. These include structural reinforcement and earthquake resistance work, weatherproofing or routine maintenance. Other measures are a response to the needs of their occupants, such as improvements to amenities, extensions, new doors and windows or interior refurbishment.

And whilst the traditional rules for protecting historic buildings evolve slowly, with certain types of knowledge being lost over the years, the demands of their occupants vary unceasingly and follow the rhythm of technical, economic and social progress.

Changes to old buildings over the years reflect this duality between reinforcement, on the one hand, and adaptation and improvement on the other. Measures taken as a result should be complementary and not contradictory.

**Behaviour, regulations and financing**

The further the date of a major event recedes in time, the more likely it is that architectural conversion work will be done without any reference to reinforcement. The community gradually forgets the risk to which its buildings are potentially exposed, and regards as essential only that work which is designed to adapt buildings to its own needs. But by rehabilitating architecture in earthquake zones, one also gives it the power to resist.

This prompts us to look at a whole range of rules designed to reduce the vulnerability of buildings to the risks they may have to withstand, and it is essential to enrich our body of knowledge by comparing analyses conducted in all the countries concerned.
Our current experience leads us to reflect on two factors: the way in which these rules are used by the community; and the scrutiny to which building work is subjected.

As far as use is concerned, the rules are nearly always rigid and self-contained for everyone, including the technical specialists involved. They are, however, based on the most commonly found types and models. Consequently, they are standard rules, which apply nationwide. It is thus unsurprising that, rather than being an integral part of the community’s culture, they are perceived as constraints imposed by a remote authority.

It would be preferable for these rules to be flexible and simple in their application, because they need both to reduce vulnerability and to allow occupants to adapt their buildings in line with their own desired lifestyles.

Of course, any changes to old buildings should be based on a collective understanding of the dangers.

Grants given to private individuals are clearly an important factor in the planning of any work proposed and any subsequent checks on it. These checks provide a framework for dialogue between occupants and officialdom (property owners, government departments, communes, engineers, architects, etc.) aimed at deciding which types of work should be done to reduce the vulnerability of buildings, whilst at the same time satisfying the aspirations of their occupants. Not only will the project be better adapted to the local ‘system’ (community + architecture); scrutiny of the building work done will be easier as well.

Supporting funds are important, then, but they are usually given only after a relatively serious event. Preventive maintenance is the best form of reinforcement. Today we can compute the cost of preventive reinforcement work on buildings, and it may seem frightening. But we know full well that doing nothing is not the best way of saving money. Imagine the long-term cost, both financially and socially, of failing to carry out regular and appropriate maintenance on these building.

Notes
