ISSN 1828-5961

Antonella Versaci
Assistant Professor in Restoration, Head of the Laboratory of 'Diagnostics and Restoration of Architectural and Cultural Heritage' at the KORE University of Enna and Associate Researcher at IPRAUS, Université de Paris-Belleville. Her research activity focuses on the conservation, recovery and valorisation of the historical, architectural and landscape heritage.

Alessio Cardaci
Researcher of Drawing at the School of Engineering at the University of Bergamo, where he is also Head of the SABE Laboratory (Survey & Analysis of Buildings and Environment). His research interests are related to the themes of syrvey, 3D modeling and representation of the architecture and cultural heritage.

The survey for conservation and the valorisation of rural villages of Central Sicily: the case study of Borgo Lupo in Mineo

Il rilievo per la conservazione e la valorizzazione dei borghi rurali della Sicilia centrale: il caso studio di Borgo Pietro Lupo a Mineo

The essay, focusing on the study of Borgo Pietro Lupo in Mineo, Sicily, in all respects a small historical centre, intends to propose a pilot project for both its revitalisation and the functional and structural adaptation, based on a rigid documentation protocol and analysis, also carried out by innovative technologies. Through this case, the paper aims to highlight the role of the survey - the first essential step of the conservation process - in view of the prevention or reduction of seismic risk in areas exposed to the repetition of calamitous events. It seeks to show how imperative is that the cognitive moment be carried out by operators who, in addition to properli execute the measurement activities, have the technical and cultural baggage needed to 'read' and understand the architecture.

Il saggio, incentrato sullo studio di Borgo Pietro Lupo a Mineo in Sicilia, a tutti gli effetti un piccolo centro storico, intende proporre un progetto pilota per la sua rivitalizzazione e il suo adeguamento funzionale e strutturale, basato su un rigido protocollo di documentazione e analisi, realizzato anche grazie all'utilizzo di nuovi strumenti di indagine. Attraverso tale caso, il lavoro si propone di mettere in evidenza il ruolo del rilievo - primo essenziale episodio della tutela - in vista della prevenzione o riduzione del rischio sismico in zone esposte al ripetersi di eventi calamitosi. Esso vuole mostrare come appaia imprescindibile che il momento conoscitivo sia condotto da operatori che, oltre alla corretta esecuzione dell'attività mensoria, abbiano il bagaglio tecnico/culturale necessario per leggere l'architettura.

keywords: Integrated survey, Conservation, Valorisation, Rural villages.

***Parole chiave**: Rilievo integrato, Conservazione, Valorizzazione, Borghi rurali.*

(cc) BY-NC

ISSN 1828-5961

1. INTRODUCTION

In Sicily, rural villages represent an important heritage that has characterised the growth and development of the inner areas of the island, resulting in an intricate interwoven between architecture and landscape, whose signs are still largely decipherable in the territory. A particular form of sprawling settlement born in the early decades of the last century under the program of regeneration of agricultural areas, with the aim of combating the land-type approach - seen as the main cause of the island's tumults - and spreading the worker's stay on the land with the consequent restructuring of crops.
The first set of small towns was built on the initiative of the lictorian Ente per la Colonizzazione del Latifondo Siciliano (ECLS) but these, too distant from each other and completely free of civil services, did not favour the stable settlement of farmers in the countryside. At the end of the war, ECLS's action was taken forward by the new Ente per la Riforma Agraria Siciliana (ERAS) [1], which built rural houses and villages equipped with the services needed for socialisation and collective life. However, the failure of the reform, coupled with the launch of industrial polarisation policies, has caused considerable imbalances in the agricultural sector since the 1960s and, consequently, the weakening of the farmers' number.
Thenceforward, the villages have resorted to an inexorable decline, and today there are fifty-four surviving settlements - fourteen built in the 1940s by the ECLS and some forty built in the 1950s by the ERAS [2] - many of them unfinished and characterized by a few service buildings, others still limited to housing functions (fig. 1). The latter, then redeemed by the assignees, are often unidentifiable because in time they have been affected by transformations that have altered their architectural and typological peculiarities, as well as being inserted into an already changed cultural and environmental context.
Except for some miserable exception, these small urban aggregates are about to disappear because they are no longer densely inhabited and actively integrated into the life of the region and, subsequently, threatened by devastation, atmospheric aggression, earthquakes and vandalism acts. The villages are in fact now 'at risk' as exposed to processes of alteration

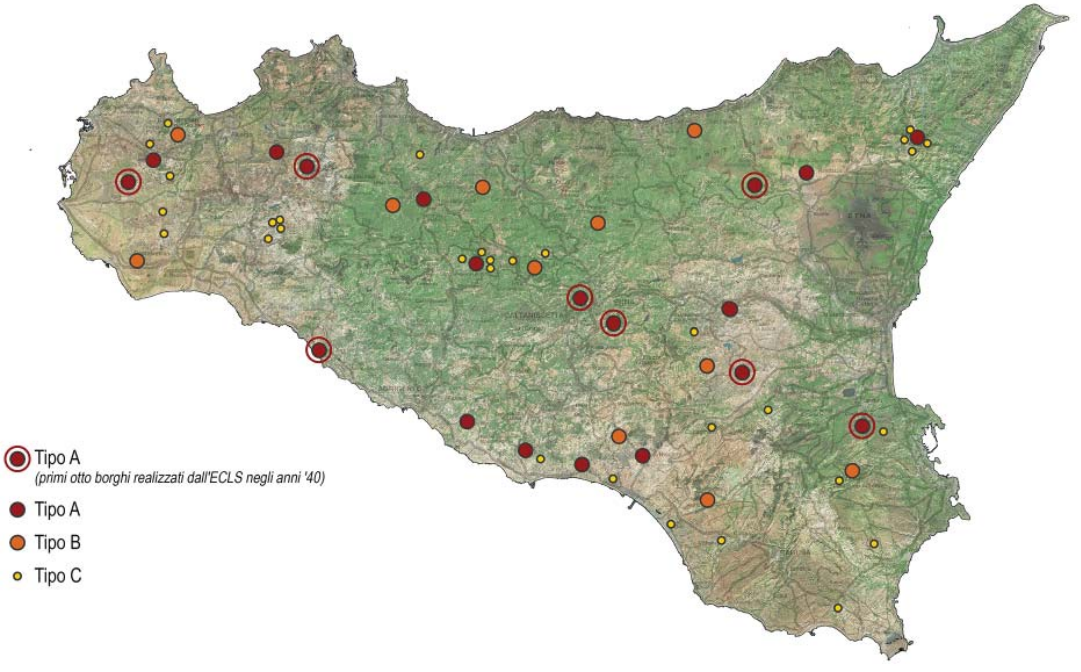


Fig. 1 - The map of rural villages in Sicily according to typologies A, B and C, differentiated by their size, importance and number of service buildings.

and physiological degradation and, at the same time, 'fragile' goods, characterised by a high degree of precariousness, in particular, when human care is lacking. They are 'weak' structures - often built without antiseismic criteria - placed in an land unstable by its nature, both because of active faults and by the proximity to the Etna volcano, which exposes them to repeated and frequent telluric actions.
Over the last few decades, there has been a consolidation of the collective interest in safeguarding rural architecture and, specifically, towards these particular building fabrics dispersed in a stratified landscape of which they constitute, however, a qualifying element. It was understood that, if appropriately studied, protected, reused, and reconnected to the territory, this heritage could strengthen local cultural identity and contribute actively to improving the socio-economic conditions of the sites and communities concerned.

In this sense, this essay, by deepening the case study of Borgo Pietro Lupo in Mineo, in the province of Catania, Sicily intends to propose a pilot project for the revitalisation and the functional and structural adaptation of the centre, based on a rigid documentation and a protocol of qualitative and quantitative analysis, also realised through the use of innovative tools for cognitive investigation. Through the present case, it aims to highlight the role of the survey as a precious instrument for scientific reflection aimed at reducing seismic risk, recovering and reusing a place in danger, also because little studied and understood in its historical, architectural and symbolic values.

2. THE RURAL VILLAGES OF SICILY BETWEEN DEGRADATION AND ABANDONMENT

The present state of great neglect and/or oblivion of

BY-NC

ISSN 1828-5961

structures now considered unnecessary but still constitutive of the landscape, is far-back requiring for the establishment and implementation of concrete actions of global retrieval and regeneration, useful to ensure that these testimonies of an important page of the island's history reap the sense of their founding reasons and therefore a new role in the economic and social development of the region.
These complexes are the result of a multifaceted constructive relationship between man and nature and, moreover, of specific modes of use of the territory perhaps no longer shareable. However, their proper reintegration into contemporary life could, on the one hand, contribute to the containment of soil consumption through the reuse of the existing building and, on the other hand, to the definition of modern techniques for sustainable use of agricultural areas, suitable for maintaining or strengthening the natural values of the landscape.
Addressing and deepening the theme of rural architecture means, therefore, to launch a relatively new research field, in many ways still to be explored and invented, especially from the design point of view. In fact, it is a sector that only recently seems to have overcome obvious marginal conditions to assume a strategic function in the re-balancing and development of the territory, but also a scientific and cultural interest, full of possible innovative values.
In this regard, it is indeed possible to observe a certain attention from the Sicilian Region and the local administrations in relation to the agricultural landscape, seen as a resource to be protected and promoted, together with other related sectors such as culture, food, tourism, ecology, health and well-being, to which the EU's policy initiatives have made a significant contribution in recent decades.
Specifically, since 2006, the Centro Regionale per la Progettazione e il Restauro has initiated the LIM project aimed at the establishment of a regional map of identity and memory's places3. Considering that the traditional tourism model, which in Sicily focuses on few monumental emergencies or on some of the urban areas, or even on the main tourist resorts of the coast and islands, is the main cause of an anthropic load causing evident wear problems, the map proposes a radical reversal of the trend. Applied throughout Sicily, it aims to mitigate the pressure on the most worn out areas, while providing new opportunities for marginal territories as compared to the main streams of visits, offering unexplored routes, through places and paths that characterise the rich complexity of the regional cultural landscapes.
The Leader II program has envisaged among its activities the cataloguing of artistic, archaeological and natural heritage to be made available to tourist flows. These activities have also focused on identifying some thematic itineraries such as the naturalistic path of the water mills. The axis III Quality of life in rural areas and diversification of the rural economy of the Rural Development Program - Sicily 2007/2013 has made extensive funding available for the protection and upgrading of rural heritage through the restoration of sites of high natural and landscape value (ponds, bushes, hedges, monuments of monumental trees) and of cultural elements of the traditional agrarian scenery (isolated rural buildings with historical and architectural interest to be used for public enjoyment, dry stone walls, terraces, drinking taps and other artefacts that are evidence of agricultural work and collective life).
Also under the same program, in 2009, the Sicilian Region drafted a pilot project for the recovery and enhancement of ESA rural villages called the Via dei Borghi, which only recently saw a first concrete manifestation in the redevelopment of Borgo Bruca, starting point of the itinerary, located in the territory of the municipality of Buseto Palazzolo, in the province of Trapani (Basiricò, 2016).
All these initiatives, which are not exhaustively listed, but are merely an example, are therefore important elements of a process already under way, which considers rural landscape as a cultural asset also in function of memory, collective identity, and recognizability of which it is direct expression, representing the «form that man, in the course and for the purpose of his agricultural production activities, consciously and systematically imprinted on natural landscape» (Sereni, 1982). However, these actions are lacking in global operational coordination aimed at the recovery of this heritage and based on its recognition through the survey and analysis of artefacts and sites in the context in which they are used. By using, on the one hand, the census and cataloging, and on the other hand, a direct, critical, extensive and detailed reading of such goods based on analytical-documentary and type-morphological assumptions but closely related to the landscape. An approach that sets out as an indispensable starting point for any subsequent critical evaluation and representation of the built space as well as for any design proposal coherent both with the valorisation of the existing built and with the needed adjusting of the values likely to change in order to make them consonant with today's needs, in harmony with the environment and the complexity of settled relationships in the area.
The planning of these interventions must inevitably go through the understanding of the existing, through the implementation of detailed and accurate knowledge activities, also in order to study and implement effective measures for risk prevention and safe use. In this perspective, the rural villages of the ECLS have for some time been the subject of didactic and research activities, set up in accordance with a close integration with participation policies aspiring to the involvement of local populations in the necessary processes of value recognition and development opportunities.
These experiences have already concerned Borgo Antonino Cascino in Enna, Borgo Baccarato-Salioni in Aidone, Borgo Lupo in Mineo. The first has recently benefited from a recovery program thanks to a specific measure of the Community's structural funds and seems destined to become a kind of permanent display window for agri-food products in the area (fig. 2). The second is today a ghost town, as well as one of the twelve Sicilian rural villages, for which the Region has decided to proceed with the private alienation (fig. 3) as well as the third, only to a small extent occupied by a farm which has adapted some buildings to their own needs, after being literally vandalized by abusive residents (fig. 4).
The latter has been subjected to more accurate research as case study aimed at designing harmonious and sustainable forms of revitalisation to re-establish such memories from the past in the current and future living cycle, able to 'keep innovating' goods in a state of decadence or under-used in order to 'reassemble' them with new ethical and social meanings.

3. THE CASE STUDY OF BORGO LUPO IN MINEO

The foundation of Borgo Pietro Lupo is closely linked to the will of the Fascist to combat the social malaise caused by the 'rural question' of the latifundium and to

BY-NC

ISSN 1828-5961

highlight the presence of the State, particularly in the internal areas of the island most affected by the mafia hegemony. It is one of the eight rural villages built by the ECLS between 1940 and 1941, «each one in each of the eight provinces of Sicily and consecrated, by the name, to the memory of a fall of wars or of the Fascist Revolution» (Gadda, 1941). The regime, by expressing in action the will and directives of the Duce planned, through the creation of special rural centres, to provide the primary services needed to peasant communities, to fight the abandonment and the consequent depletion of the countryside. This gave rise to «a surreal urban passage, consisting only of services in the absence of residential fabric in the immobility of the Sicilian countryside (Barbera, 2002, p. 147), of which this small building complex is one of the most interesting examples.

Its constructive story is controversial and still to a certain extent unclear. A first project was drawn up by the engineer Filippo Marino at the end of 1939, at the request of the Consorzio di Bonifica of Caltagirone. Exposed at the Latifondo and Agricultural Education Exhibition inaugurated in Palermo by the Minister Bottai in February 1940, he presented «in a minor degree this concern to make art and not building», which characterised the work of colleagues (Accascina, 1940).

The site chosen for the construction was located in the Salto district, «a pleasant and healthy place, easily accessible through reclaiming road no. 5» (Dufour, 2005, p. 366) between the Ramacca and Raddusa towns and the new road which led from Catania to Caltagirone.

The management of the ECLS, which took over the consortium, maintained both the project and the designer, but decided to change the location of the village, perhaps for economic reasons, linked to the fragmentation of properties and/or the division of the farms (Eras, 1964). The choice of a different location of the centre, strongly demanded by the economist and agronomist Giuseppe Tassinari - then Minister of Agriculture and Forests - was motivated by the will to relocate the new village in a visible and easily identifiable area in the territory. Despite the impossibility of finding a site that could fully meet the demands of the Ministry, a new yard entrusted to the Santagati Enterprise in Catania was however commenced on 20 March 1940 in the district Mongialino and the previous one abandoned.

Fig. 2 - Today's pictures of Borgo Cascino in the municipality of Enna (photos authors).

Fig. 3 - Current pictures of Borgo Baccarato in Aidone, province of Enna (photos authors).

BY-NC

ISSN 1828-5961

The constitution of the Mongialino farm, owned by the ECLS, was shortly afterwards, as evidenced by a notarial act of 18 July 1940. The date of completion of the works, initially scheduled for the 31 May 1940, is unknown but it most likely delayed. The shipyard continued in 1941 (in the months of February and April, ECLS required a building concession to the municipality of Mineo for the construction of some buildings) and in the years 1944-1945 the main access road was completed.
The original project of Marino envisaged only ten buildings and was based on an urban design set on two large axes orthogonal to each other. The first - the primary access route - was thought to be a 'prospective telescope' linking the reclamation road (at the checkout point) to the square; the main prospect of the church was the backdrop of the 'vision machine'. The second - orthogonal to the first - intercepted the second square and led, in both directions, toward the countryside (fig. 5).
The buildings, with some limited exclusion, had been designed with an unusual asymmetrical and articulated system. As a matter of fact, for a village of such limited extent, as already mentioned, there were two courts: a layout typical of models, already elaborated in previous years but for larger villages (Mangano, 1937). The two squares, in fact, divided the village in two different areas, with distinct hierarchical values: the 'public square', overlooking the church, the lictorian palace, the school, the outpatient clinic, the post office, the Carabinieri barracks, the tobacconist's shop, and the artisan's square with the mill and the workshops. From a constructive point of view, edifices were designed to either one or two elevations with a single or double body.
Regarding the technological characteristics, according to the era in Sicily, the buildings were made of mixed structures in masonry carriers (in local stone or pressed brick and mortar) and reinforced concrete and hollow tiles mixed floor poured in place and toothed to the masonry by concrete kerbs (Sapienza, 2010). The design of the gardens arranged around the two fountains - with a circular bathtub the first and with a drinking water the second -, the lack of alignment of the edges of the buildings along the streets and the varied design of the plants of the buildings, presuppose that the particular figuration has been the result of an adaptation,

Fig. 4 - Borgo Pietro Lupo in Mineo, province of Catania, today (photos authors).

as well as a resizing, of the spatial conformation originally conceived for the first site. The hypothesis is supported by the immediate need for completion of the hamlet, probably appeared already under construction or soon after and that was realised in September 1941. The project, also in this case drawn up by Marino, provided for the construction of new buildings (the institution headquarters, the housing for the employees, the sanitary ware and some warehouses).
The construction works, initially entrusted to the Ferrobeton society5, however, stalled in 1943 for the fall of the regime following the Allies' landing, and were then completed in two successive stages between 1946 and 1949. Later, modifications to the barracks and to the church (realisation of the choir, the enlargement of the rectory and the closure of the porch), to adapt to the needs of a village in the fullness of its activities were made. In addition, the warehouse and its worker's house were built and in 1957 the veterinary clinic was completed (fig. 6).

BY-NC

ISSN 1828-5961

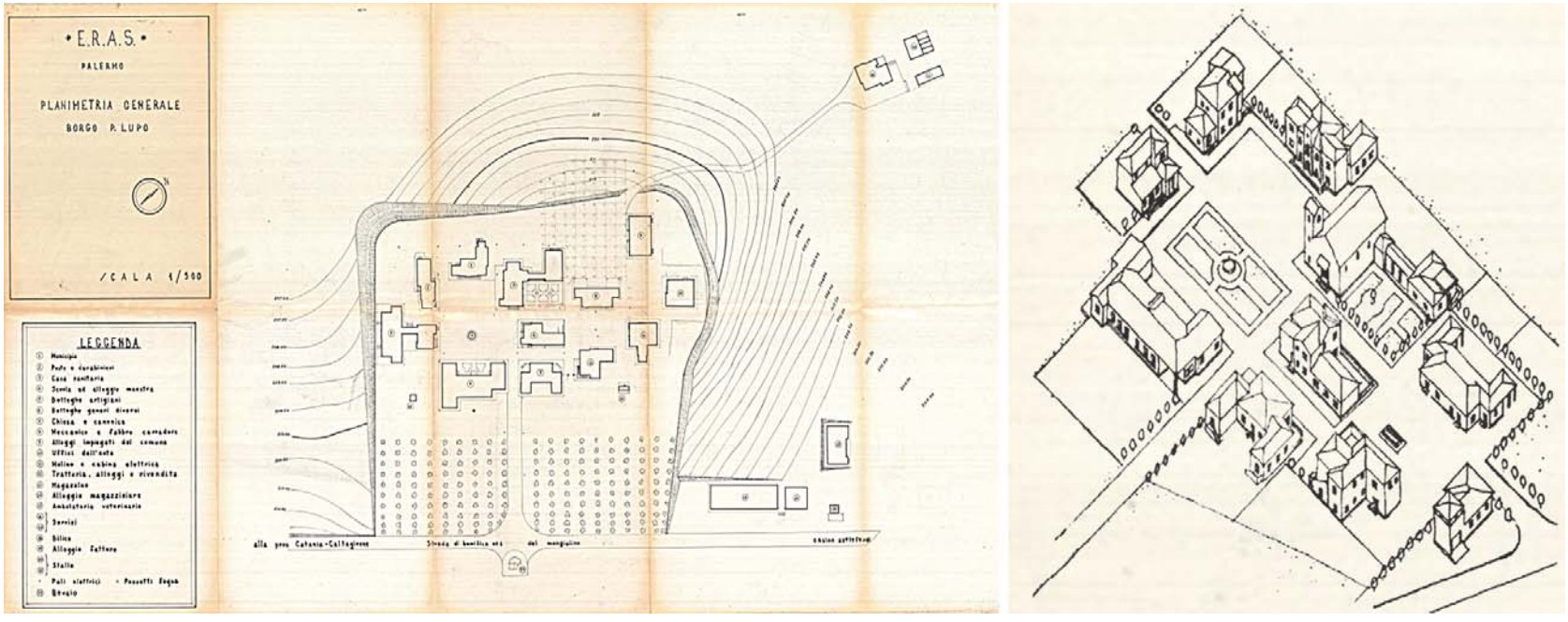


Fig. 5 - The first project of the village in the district Mongialino (1940): planimetry and axonometric view (Historical Archives of the Agricultural Development Agency of the Sicilian Region - ESA, based in Prizzi, province of Palermo).

Extraordinary maintenance plans were nevertheless necessary between 1959 and 1962 as a result of a worrying static disaster that had affected many buildings. The building of the village on a specially prepared surface, perhaps implemented too fast without giving way to the soil to compact and settle, had caused differential shedding with recesses and elevations of the terrain. In particular, due to the melting water infiltration in the soil, the reeling clays had an increase in volume in relation to the imbibition. In the summer season, their drying had led to the cracking of the foundation plan, resulting in masonry, floors and roofs imbalances. The damaged buildings - the school, the surgery, the mill, the transformation booth, some shops and workshops - were the nrestored, with heavy repairs (fig. 7). The ECLS headquarters and housing for the employees, and the church were completely demolished and, therefore, rebuilt according to very different structural and aesthetics characteristics (fig. 8).

In addition to the serious economic engagement, the intervention deeply altered the appearance of the village by introducing a new architectural language far away from the idea of 'organicity' and integration with the territory that the village should have possessed. A unique, homogeneous and unified architectural style was in fact considered as a tool to enhance the character of the site and to guide the site's recognizability. The partial loss of identity and the change in socio-economic conditions in the post-war period caused the abandonment of the hamlet. Between the end of the 60s and the beginning of the 70s of the last century, the post office, the school and the barracks closed the doors. Some families to which the parcels of Mongialino farm (already dismantled in the mid-1950s) had been assigned occupied the forsaken buildings, transforming them into temporary residences, while others were used as barns, even only in order to acquire the ownership by the continuous use of the property.

On the night of 13 December 1990, a strong earthquake struck the south-eastern part of Sicily causing considerable damage. The earthquake, sadly known as 'Carlentini earthquake' (the name of the place where seventeen victims were killed because of the collapse) or the 'Santa Lucia earthquake' (as it happened during the night of the celebration of the patron saint of Syracuse) had its epicenter at sea, in the Gulf of Noto, was 5.6 Richter magnitude and short-lived (fig. 9). The violence of the telluric event was, however, much more intense in some areas where, due to the nature of the terrain, the effects of the shocks were amplified and therefore assessed - on the basis of their visible effects on the construction - equal to 8/9 grade of the macroseismic Mercalli-Cancani-Sieberg scale (Bernardini & Meletti, 2015).
The earthquake affected about 250 cities in the provinces of Catania and Siracusa - including Borgo Pietro Lupo6 - causing the unattainableness of over seven

BY-NC

ISSN 1828-5961

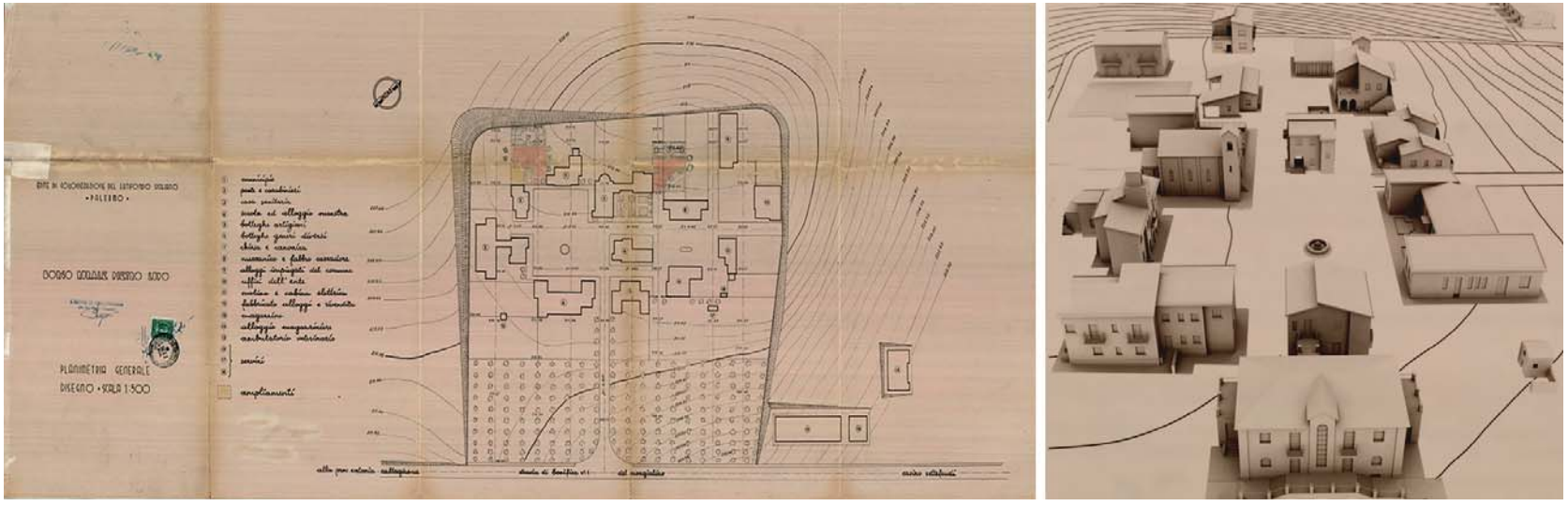
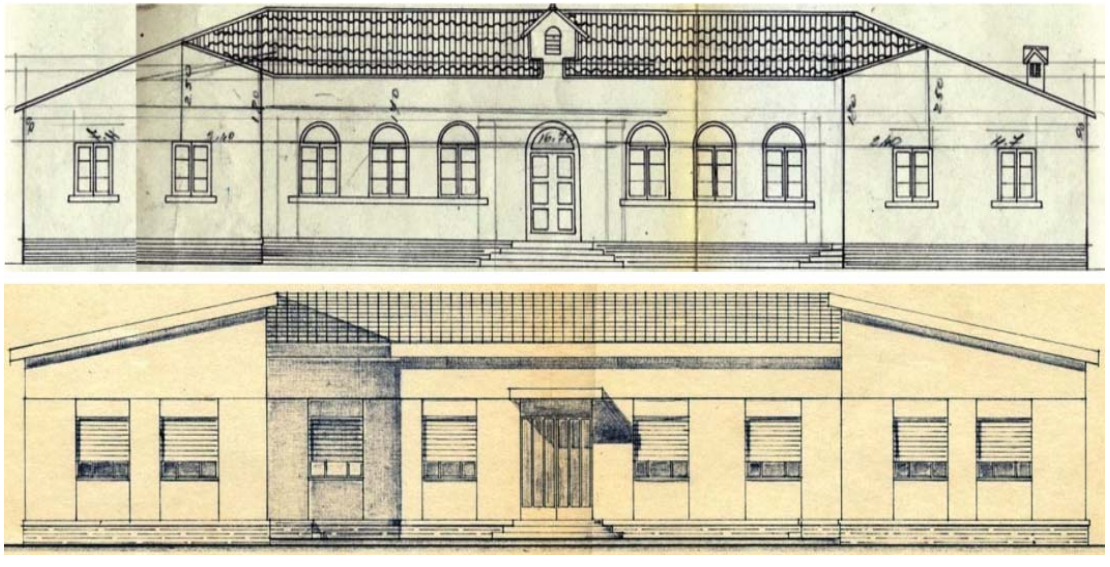


Fig. 6 - Borgo Pietro Lupo's Plan (ESA Historical Archives) and axonometric reconstruction of the 1957 project.

thousand buildings between homes, schools, public and private buildings. In particular, in several centres, «both very serious building defects and the negligence in the assessment of the characteristics of the land for the choice of foundation systems were found». In less well-populated and/or abandoned rural areas, the damage was even greater because «many buildings were crumbling and maintenance-free [...] or restructured in the interiors without considering static and anti-seismic criteria» (Boschi & al., 1997).
Today, the village, affected by both several decades of oblivion and disasters, also devoid of water and public lighting is pouring into a state of serious degradation. The property, still of ESA, should be transferred to the municipality of Mineo, which does not seem to want to engage in a somewhat complex and burdensome situation. Nonetheless, such an aggregate building, an expression of Italian culture of the 20th century, deserves to be interested by respectable forms of recovery in the spirit of a possible maintenance of the production function (fig. 10). It, therefore, seems necessary to define new design proposals for its requalification and reuse. Due to the complexity of the site and its current

Fig. 7 - The school with the teachers' house: the original project and the new reconstruction (ESA Historical Archives).



BY-NC

ISSN 1828-5961

Fig. 8 - The village church: above, on the left, the original building, in the center and on the right, as it appears today after reconstruction. Below, the project of enlargement of the rectory of 1954 (Historical Archives of ESA).

conditions, such proposals need to be based on the formulation of a strict protocol of analysis and documentation aimed at the prevention and reduction of earthquake risk - historically important here - and the energy conversion. Activities that see, first of all in the process of knowledge, through architectural and urban surveying, a primary tool for scientific reflection aimed at maintaining and enhancing the site in its historical, architectural and symbolic values.

4. ITHE PROCESS OF KNOWLEDGE AND THE SURVEY FOR PREVENTION AND CONSERVATION: METHODOLOGICAL ASSUMPTIONS AND OPERATIONAL GUIDELINES

Since the early 70s of the last century, there has been a growing awareness of the need for prevention and protection, no longer only applied to the monumental heritage 'at risk' but also to the historical centers and widespread goods, primary sources of memory and important information, extended to the natural and anthropic environment, and vehicles of understanding and valorisation of the whole existence. It was, therefore, necessary to initiate pathways of knowledge of these assets in order to plan and implement effective precautionary defence actions through analysis and inventorying activities.

The specialist literature was then enriched with manuals and codes of practice that were more attentive to the original technology in order to adapt the current interventions to. By opposing the «fortified approximations required by the use of formulas to describe the behavior of materials and structures other than traditional ones, Antonino Giuffrè's studies in the first place, have in turn promoted the comparison with the multiplicity and specificities of the historic built» (Fiorani, 2010, p. 6), through deductive processes that, from the knowledge of building and constructive typologies, led to the modalities of their conservation and

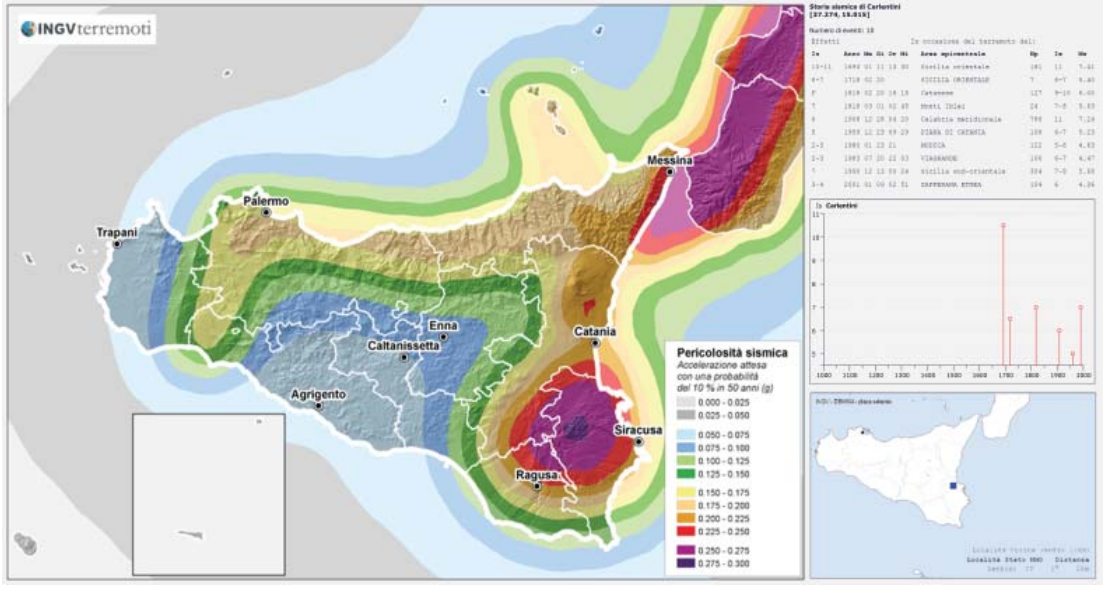
BY-NC

ISSN 1828-5961

Fig. 9 - Borgo Pietro Lupo: a comparison between yesterday and today images and the reconstruction of the salient phases of its history.

security (Donatelli, 2010).
To this end, a number of tools have been studied to highlight the main elements of degradation and to evaluate the risks (seismic, chemical, hydrogeological, meteoclimatic, anthropic) and the potential vulnerabilities of heritage in order to make appropriate conservative decisions. Within a systematic and programmatic framework, the pioneering Pilot Plan for the Scheduled Preservation of Cultural Heritage in Umbria, promoted in 1976 by Giovanni Urbani, then director of the Central Institute for Restoration, unfortunately, failed for political-bureaucratic reasons, came to the project for the Risk Map of Cultural Heritage in Italy, activated in 1987 under the direction of Pio Baldi, allowing the charting of the distribution of cultural goods and the intensity of deterioration factors. It was then created an impressive array of maps and alphanumeric databases that led to the creation of a «territorial information system, perhaps conceptually the most advanced and widest ever conceived for the cultural heritage» (Della Torre, 2002, p. 18), also attentive to the interrelations with the territory, to support the definition of strategic planning choices, protection and programming of interventions.
This work regrettably uneven in its results at the natio-

Fig. 10 - The map of the seismic hazard of Sicily with highlighted the most critical areas where also Borgo Pietro Lupo falls. On the right, the major earthquakes that hit the area until the earthquake of the 1963 (INGV Earthquakes).



BY-NC

ISSN 1828-5961

nal scale, but in spite of this essential for the purpose of identifying the consistency of the heritage and its geo-referenced map depiction, has seen a wide and interesting experimental application in Sicily and Calabria conducted by the Istituto Superiore For Conservation and Restoration: a vast effort of data collection on the vulnerability, exposure and seismic hazard of 3,000 goods, set up on a qualitative census, consistent with the Guidelines for Assessing and Reducing Seismic Risk of Cultural Heritage (Moro, 2006). This latest document, which was refined in 2010 to comply with the new Technical Building Regulations issued by the Ministerial Decree of 14 January 2008, has highlighted how the understanding of each artefact is a fundamental prerequisite both for a reliable assessment of its present safety and for the choice of effective improvement intervention.

In this regard, the 'path of knowledge' must be developed through the following phases: the identification of the constructions and their location especially in relation to particular areas at risk, the geometric survey of constructions in their current state, understood as a complete stereometric description of the edifices, including any cracking and deformation phenomena, the evolutionary analysis of the buildings, i.e. the reconstruction of the sequence of the various stages of buildings transformation (from the original hypothesis to the present), the identification of the constituent elements of the resistant body in their technological and constructive values, the recognition of materials, of their state of degradation and physical and mechanical characteristics, the knowledge of the subsoil and the structures of foundation, with reference also to the variations in time and their weaknesses.

Special care must be taken to examine the relationship between buildings and their surroundings, through the description of the so-called architectural complex, whether isolated or not isolated, and the characterization of spatial and functional relations with any contiguous artefacts. The fabric study should allow hypothesizing the constructive hierarchy and the relationships between the constructions and the context, also through the analysis of the visible prospects and the plano-altimetric articulation.

This attention to the aggregate appears to be of paramount importance, even in the light of the seismic events that have struck the centre of Italy in the last century and have led to a reflection on the necessity, especially for historic buildings, to study and intervene on the scale of the urban fabric instead of that of the single building.

Architectural complexes - constituted by the association of multiple bodies and defined as 'structural aggregates' in a structural key - are the set of several interconnected units that can interact with each other under dynamic action; reciprocal influence mechanisms are then triggered for any established connection both in elevation, through more or less effective contact between the masonries, and in the foundations, especially if the buildings insist on the same ground.

This aspect, already highlighted in the Guidelines for Survey, Analysis and Design of Buildings Repair and Strengthening Aggregates elaborated by the Laboratories University Network of seismic engineering (ReLUIS) in May 2010, which provided a methodological and operational tool allowing a correct evaluation of mechanical behavior through the «reading of its constructive system, the interpretation of the causes of damage, the detection of structural anomalies and structural precariousness affecting seismic response, in order to formulate more suitable modes of intervention to achieve an adequate degree of improvement in seismic behavior» (Reluis, 2010, p. 3).

Both of the cited guidelines stress the importance of survey - in its broader definition of a critical act aimed at the historical, evolutionary, geometric and material understanding - as a prioritarian and fundamental tool for the knowledge of the structural structure of an urban fabric, as well as an element of addressing subsequent consolidation and restoration activities. It is important to propose «to regulate not so much the outcome of the process but to pave the way for a conservation project for the single building and the urban artefacts» (Giambruno, 2002).

5. APPLICATION ON THE CASE STUDY

It is from these assumptions that the activities have been set. They were based above all on the awareness that the origin and the constructive history of a consolidated building fabric are of great importance for the full understanding of seismic risk. The structural analysis and the study of interventions to counteract its progressive degradation and the effects of a possible earthquake are therefore crucial factors to any possible redevelopment.

The understanding of the many values of Borgo Pietro Lupo (documentary, material, historical-constructive, symbolic, emotional, affective, etc.) has required a complex and varied approach that has benefited from interdisciplinary support. It has moved from the questioning of documentary and archive sources, the study of constructive techniques, the re-reading of past analyses on aggregate buildings, the consultation of existing seismic catalogues, and then continued with new and accurate recognitions and investigations. An extension of the concept of 'survey' (Docci et al., 2009), not limited to the only geometric and historical-critical analyses of the architectural goods, but understood as a means of reading the changes over time to clarify their constructive vicissitudes, to distinguish the tampering, to understand the causes of disarray.

In the village, in fact, many of the static criticisms assessed on the buildings can be traced back to discontinuities due to the complex and articulated evolution of the edifices, to the changes over time due to the phenomena of damage resulting from human transformation, natural aging and/or desertion, then accentuated and accelerated by the succession of natural calamitous events. Starting from the belief that the construction of a mathematical model of reliable computation, but above all responding to the historical-constructive reality of the site, is indispensable for all stages of the examination of the seismic vulnerability of the buildings (Bertocci, 2013) and that in the absence of a clear consciousness of the factory, «it is almost useless to use sophisticated calculation models as the data from the analysis will not correspond to the constructive consistency of the monument and therefore the results of the calculations will not be related to its mechanical reality» (Galli, 2015, p 3), the survey was first aimed at obtaining a comprehensive picture of the centre in its localization in the territory, in order to identify its sensitivity to the various hazards. Measurements that have never been mechanically operated but have been appropriately planned based on precise choices dictated by the site cognition obtained from the study of available documents and cartography.

In this sense, they were therefore conducted both

BY-NC

ISSN 1828-5961

with the direct method, integrated with 3D laser scanning technology and 3D image-based reconstruction applications7. The production of a three-dimensional model (both discontinuous by points and continuous by mesh), the spatial projections and the graphic elaborations resulting from the methodological-operational apparatus developed by the conservation discipline (Cardaci et al., 2015) became the geometric structure for the identification, study, representation and cataloging of matter as well as for the recognition of alterations and critical factors (fig. 11).

A further study was carried out to determine damage by following a methodological approach - based on the geometric survey, the structural elements, and the features of the constructive means - in order to develop an analytical model capable of recreating 'faithfully' or at least 'ostensibly', the behaviour of structures. In particular, according to the directions contained in the guidelines mentioned above, the survey was organised in several phases focusing on specific features: geometric, material and structural-constructive, damage state and disadvantage.

The 'geometric survey' provided the plane-altimetric detection of the constituent elements of the aggregate and highlighted the spatial relationships of the structures in adherence. The restitution was made through the representation of plans, elevations, cross-sections and schematic three-dimensional models. The chosen scale (1: 200) allowed the general description of the entire agglomeration with the distribution of spaces (internal and external), the average dimensions of the elements (carriers and non-carriers), horizontal and vertical links, and the indication of slabs and specific weakness characteristics (niches, cavities, chimneys) or local stiffenings (spurs, wall reinforcements, monolithic elements).

The 'material and constructive-structural survey' has been addressed to the overall reading of the materials and construction techniques used, as well as to carry out a punctual study of the resistive elements, aimed at identifying the structural pattern. It has seen the formulation of specific mapping on scale 1:50 dedicated to the recognition, the evaluation of the quality and the state of preservation of materials and constituent elements, the realization of abaci, the systematic and schematic analysis of frames and masonry, floors, roofs and connections. All elements which were observed from the inside by the operator (Giuffré, 1993), through direct survey, small essays and non-destructive indirect investigations (thermography, etc.) also to verify their correspondence with the best practice (fig. 12).

On the other hand, the 'survey of the state of damage' allowed the instability analysis through the reconstruction of the whole crack mapping, where the lesions were classified according to their trend (horizontal, vertical, diagonal and curvilinear) and entity (extension, development, amplitude and depth). The drawings have, moreover, depicted the structural desorders (detachment, rotation, sliding, off-plane shifts) and the deformations (out of the lead, lowering, swelling, sprains, floor depressions). Their representation on a three-dimensional graphic support has finally facilitated the description of the kinematics by detecting the eyelash opening direction and the direction of the fractures which, read at the same time in the whole volume, allowed to locate the rotation centers of the masonry blocks and the evolution of the resulting collapses (fig. 13). In fact, lesions manifest themselves in the proximity of material variations, rarely within homogeneous areas. It is therefore important to identify inconsistencies - as they are an additional factor of fragility, determining a preferential pathway for the

Fig. 11 - Rendering of some façades of the centre.

BY-NC

ISSN 1828-5961

Fig. 12 - The graphic rendering of the ground floor plans with the indication of the functional distribution and the technical-constructive characteristics of the whole village.

BY-NC

ISSN 1828-5961

Fig. 13 - The graphic rendering of the first floor plans with the indication of the functional distribution and the technical-constructive characteristics of the whole village.

BY-NC

ISSN 1828-5961

Fig. 14 - The material-pathological survey with the indication of conservation interventions.

activation of collapse mechanisms - and classify them according to the geometric discontinuity (presence of fumes, openings, fills) and to the material discontinuity (different materials or constructive techniques).
A critical comparison between the overall geometry of the building fabric, its structural characteristics and the damage occurring highlighted by the cracking map has therefore led to the identification of the most probable rupture mechanisms. A simplified initial analysis, however, allows the formulation of preliminary and qualitative hypotheses, on active damage and on probable causes of triggering. The quantitative verification of the hypotheses formulated has been entrusted to the subsequent analytical modelling which, due to the extreme variability of the structural characteristics and the mechanical parameters governing them, may have an exact wording only on the correct interpretation of the data of the investigations described above.
In addition to the bi- and tri-dimensional graphics, for each building unit, synthesis sheets has been realised and specially designed to be implemented in the near future within a geo-referenced archiving and consultation system to be made available to public bodies and private persons responsible for the protection and management of such goods: a kind of 'identity card' which may allow them to assess and comparing the information in an exhaustive manner, allowing both to formulate a coherent project design, and to verify its suitability and feasibility (Bertocci, 2015).

6. CONCLUSIONS

The research here summarised, has intended to underline the main role played by the survey in view of the prevention or reduction of seismic risk in areas exposed to the repetition of calamitous events. The case study on Borgo Lupo, in effect a small historical center, showed that it is imperative that the cognitive act - the first essential step of protection process - be carried out by skilled and careful operators who, in addition to the correct application of the measurement activities, have the necessary cultural and technical background

BY-NC

ISSN 1828-5961

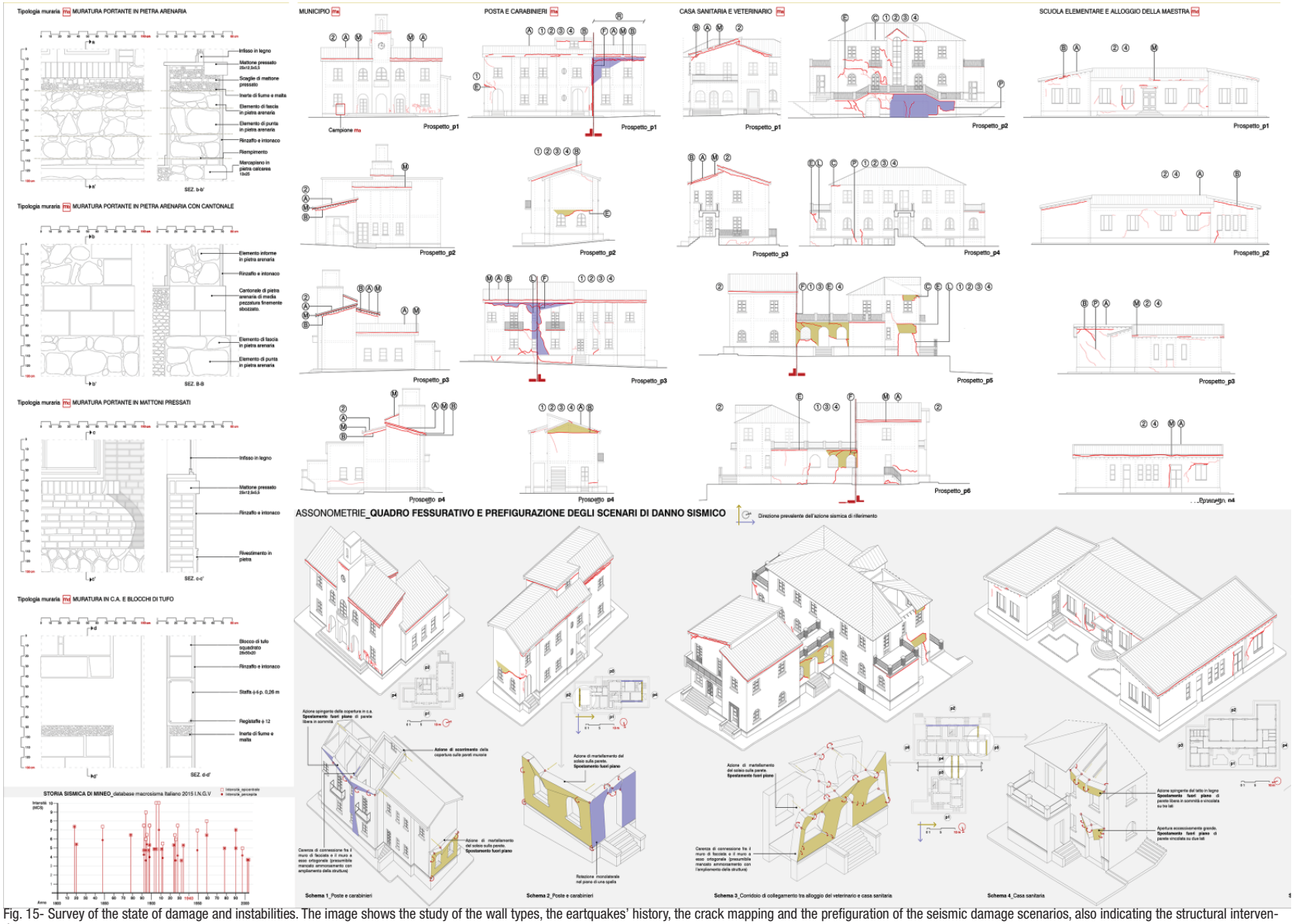


Fig. 15- Survey of the state of damage and instabilities. The image shows the study of the wall types, the eartquakes' history, the crack mapping and the prefiguration of the seismic damage scenarios, also indicating the structural interventions.

BY-NC

ISSN 1828-5961

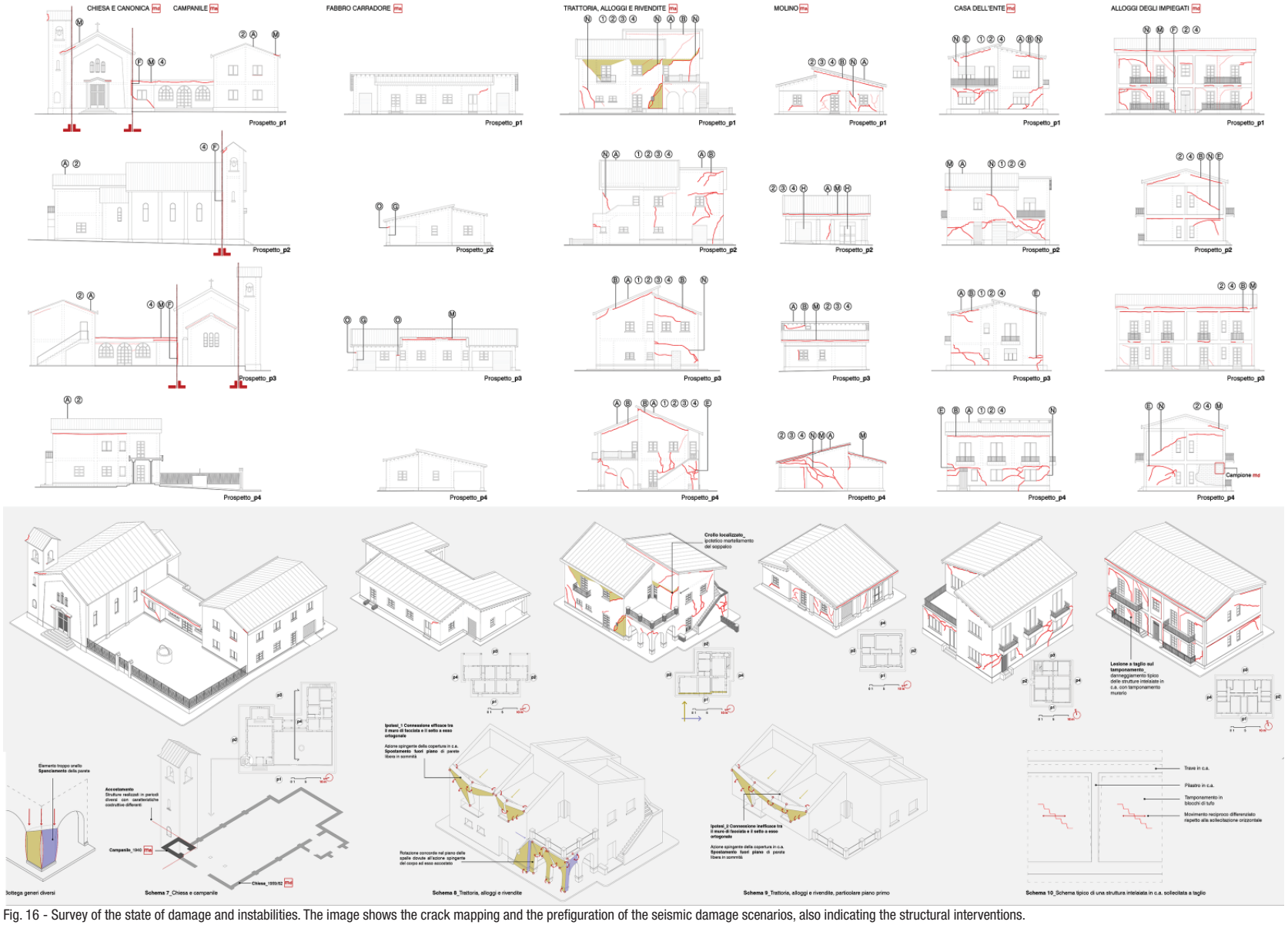


Fig. 16 - Survey of the state of damage and instabilities. The image shows the crack mapping and the prefiguration of the seismic damage scenarios, also indicating the structural interventions.

BY-NC

ISSN 1828-5961

to read and understand 'the book' of the ancient, modern architecture (Giuffrè, 2010). Too often, perhaps for the sake of some economic convenience, these activities are delegated to 'measuring technicians' that confuse the simplification required by the representation of the survey (which is a critical stage in evaluating and selecting meaningful information) with the simplification of the investigations.

The work of investigation and understanding conducted, not limited to individual buildings but extended to the entire building fabric and the environmental context, allowed to set up a plan of intervention, recovery and reuse (fig. 14). The model returned from the study campaigns has in fact provided a complete database on the architectural, morphological, typological, figurative, metric and geometric aspects of the rural centre. It has also allowed a reading of structural damage and map cracking of the masonry of the complex as a result of the frequent earthquakes that, as already mentioned, affected the area for the purpose of prevention and increased security.

This in order to make this heritage suitable for satisfying the civil, cultural and environmental needs and therefore reinterpreted to involve it in the contemporary, by streamlining the forms of protection of the authenticity and the physical and symbolic functions inherent in the local tradition, which means 'adherence to the territory', since it is a rationalist architecture, but which however expresses explicit figurative references to the rural heritage of the region and a will of integration with the surrounding landscape.

Fig. 17 - Design of the reuse project.

BY-NC

ISSN 1828-5961

NOTES

[1] In compliance with the law no. 104 issued on 27 December 1950 by the Sicilian Region, which established the Agrarian Reform on the island.

[2] By the law no. 9 of 5 April 1954, the Sicilian Region entrusted the ERAS with the task of completing the villages whose construction had been interrupted by the war and erecting new ones. The decree no. 33 of 10 July 1954 defined their characteristics by dividing them into three types - A, B and C - differentiated according to the number of buildings and linked to a sort of hierarchical dependency (B and C were considered 'satellites' of A).

[3] The Regional map includes among the 'historical events of the early 20th century', also the Borghi del Duce: Borgo Fazio (Trapani), Borgo Borzellino (Monreale), Borgo Filaga (Palermo), Borgo Schirò (Monreale), Borgo Cascino (Prov. Enna), Pergusa (Prov. Enna), Libertinia (Ramacca), Borgo Pietro Lupo (Mineo), Borgo Regalmici (Castronovo di Sicilia).

[4] The eight villages, designed by Sicilian architects, including members of the so-called Scuola di Palermo as T. Basiricò, 2009 remind us, are respectively borgo Fazio (prov. Trapani) designed by the architect Luigi Epifanio, borgo Gattuso (prov. Caltanissetta) designed by the architect Edoardo Caracciolo, borgo Cascino (prov. Enna) designed by the architect Giuseppe Marletta, borgo Lupo (province of Catania), designed by the engineer Filippo Marino, borgo Giuliano (prov. Messina) designed by the engineer Guido Baratta, borgo Schirò (prov. Palermo) designed by the architect Girolamo Manetti Cusa, borgo Rizza (prov. Siracusa) designed by the architect Pietro Gramignani.The province of Ragusa was excluded from this program because did not have any landfills.

[5] The company, founded in 1908 by the Marquis Carlo Feltrinelli, was one of the most important Italian design and construction companies. He made works of great prestige, such as the foundation works of the first Milan Underground, the marinas in Naples and Genoa, the Velasca tower in Milan, the Mille skyscraper in Catania. He was also a trusted company of ECLS, who also awarded the construction of the villages Bonsignore, Guttadauro and Rizza.

[6] The documentation of Borgo Lupo's damage seems to have been lost (due to the uncertain property of the village) but it is still possible to know the damage from the relations of neighboring cities such as Mineo, Pelagonia and Ramacca.

[7] The surveying campaign was conducted in May-July 2016, from the team of the Laboratorio di Diagnostica e Restauro dei Beni Architettonici e Culturali of the University Kore of Enna in close collaboration with the Lab_Sabe (Survey & Analysis of Buildings and Environment) of the University of Bergamo.
3D laser scanning activities have been operated through about 120 scans to complement visual recognition, direct survey and photogrammetric systems utilization, covering all external and internal spaces of most abandoned buildings. The data processing and modeling were conducted by the Laboratorio di Diagnostica e Restauro dei Beni Architettonici e Culturali of the University Kore of Enna by the arch. PhD Luca Renato Fauzìa which also conceived the figure 1. All the drawings were elaborated by Raffaele Rubens Iudica in the framework of its master thesis directed by Antonella Versaci (University of Enna Kore, Faculty of Engineering and Architecture, a.a. 2016/2017).
Regarding the editorial responsibility of the essay, as far as the authors have shared the methodological approach followed, its premises and conclusions, the paragraphs 3 and 5 have been written by Alessio Cardaci and the paragraphs 2 and 4 by Antonella Versaci.

REFERENCES

Accascina, M. (1940). La mostra del latifondo e dell'istruzione agraria. Giornale di Sicilia, 4 febbraio 1940.

Barbera, P. (2002). Architettura in Sicilia tra le due guerre. Palermo, Italia: Sellerio.

Basiricò, T. (2009). Architettura e tecnica nei borghi rurali della Sicilia occidentale. Palermo, Italia: Fotograf.

Basiricò, T. (2016). Sicilia: è partito il recupero della Via dei borghi rurali. Ananke, 78, 118-123.

Bernardini, F., Meletti, C. (2015). I terremoti nella storia: il catastrofico terremoto dell'11 gennaio 1693 nella Sicilia orientale, l'evento più forte della storia sismica italiana. INGV Terremoti. Link: https://ingvterremoti.wordpress.com/2015/01/

Bertocci, S. (2013). A survey database for the control of the seismic vulnerability: Acciano in the earthquake area of Abruzzo (Italy). In S. M. Alonso-Muñoyerro, A. R. Márquez de la Plata, P. A. Cruz Franco (a cura di), Reuso: Actas del congreso internacional sobre documentación, conservación y reutilización del patrimonio arquitectónico (pp. 37-46). Madrid, Spagna: c2o Servicios Editoriales.

Bertocci, S. (2015). Il contributo del rilievo urbano dei centri storici italiani per il recupero e la prevenzione della vulnerabilità sismica: alcuni casi studio in Abruzzo, Toscana ed Emilia. In A. Marotta, G. Novello (a cura di), Disegno e città. Cultura, arte, scienza, informazione (pp. 397-405). Roma, Italia: Gangemi.

Boschi, E., Guidoboni, E., Ferrari G., Mariotti, D., Valensise, G., & Gasperini, P. (1997). Scheda evento. Catalogue of Strong Italian Earthquakes from 461 BC to 1997 – CFTI. http://storing.ingv.it/cfti4med/quakes/42011.html#localities

Cardaci, A. Liuzzo, M. Versaci, A. (2015). Sul ruolo del disegno nel progetto di conservazione: il caso studio del castello di Lombardia ad Enna. DISEGNARECON, 14(8), 14-24.

Della Torre, S. (a cura di) (2003), La conservazione programmata del patrimonio storico architettonico-Linee guida per il piano di manutenzione e il consuntivo scientifico. Milano, Italia: Guerini e Associati.

Docci, M., Maestri, D. 2009, Manuale di rilevamento architettonico e urbano. Roma-Bari, Italia: Laterza.

Donatelli, A. (2010). Terremoto e architettura storica: Prevenire l'emergenza. Roma, Italia: Gangemi.

Dufour, L. (2005). Nel segno del Littorio. Città e campagne siciliane nel ventennio. Caltanissetta, Italia: Lussografica.

Ente per la Riforma Agraria Siciliana (a cura di) (1964). Verità sull'ERAS. Palermo, Italia: La Cartografica.

Fiorani, D. (2010). Introduzione. In A. Donatelli, Terremoto e architettura storica: Prevenire l'emergenza (pp. 11-13). Roma, Italia: Gangemi.

Gadda, C. E. (1941). La colonizzazione del latifondo siciliano. Nuova Antologia, 76, 281-286.

Galli, C. (2015). Miglioramento sismico e ragioni del rilievo critico. DISEGNARECON, 8 (14), 1-11, <http://disegnarecon.univaq.it/ojs/index.php/disegnarecon/issue/view/08.14.2015>.

Giambruno, M.C. (2002). Verso la dimensione urbana della conservazione. Firenze, Italia: Alinea

Giuffrè, A. (a cura di) (1993). Sicurezza e conservazione dei centri storici. Il caso Ortigia. Roma-Bari, Italia: Laterza.

Giuffrè, A. (2010). Leggendo il libro delle antiche architetture. Aspetti statici del restauro saggi 1985-1997, Carocci C., Tocci C. (a cura di), Roma, Italia: Gangemi.

Mangano, G. (1937). I centri rurali: elemento necessario per la trasformazione fondiario-agricola e per il popolamento delle regioni a coltura estensiva. Studi, Monografie, Rapporti dell'Istituto V.E. III per il Bonificamento della Sicilia. Palermo, Italia.

Moro, L. (a cura di). (2006) Linee guida. Per la valutazione e riduzione del rischio sismico del patrimonio culturale. Roma, Italia: Gangemi.

Dipartimento della Protezione civile, Rete dei Laboratori Universitari di Ingegneria Sismica (ReLuiss), Ufficio del Vice-Commissario Delegato per la messa in sicurezza dei beni culturali e Struttura tecnica di missione (2010). Linee guida per il rilievo, l'analisi ed il progetto di interventi di riparazione e consolidamento sismico di edifici in muratura in aggregato. http://www.reluis.it/images/stories/LG_aggregati_12ott2010.pdf

Sapienza, V. (2010). La colonizzazione del latifondo siciliano. Esiti e possibili sviluppi. Caltanissetta, Italia: Lussografica.

Sereni, E. (1982). Storia del paesaggio agrario italiano. Roma-Bari, Italia: Laterza.

Versaci A. & Cardaci A. (2015). Tra passato e presente, il colore dei borghi rurali della Sicilia centrale: il caso studio di Borgo Baccarato. Agribusiness Paesaggio & Ambiente; Agribusiness Landscape & Environment, XVIII (2): 112-120.

BY-NC