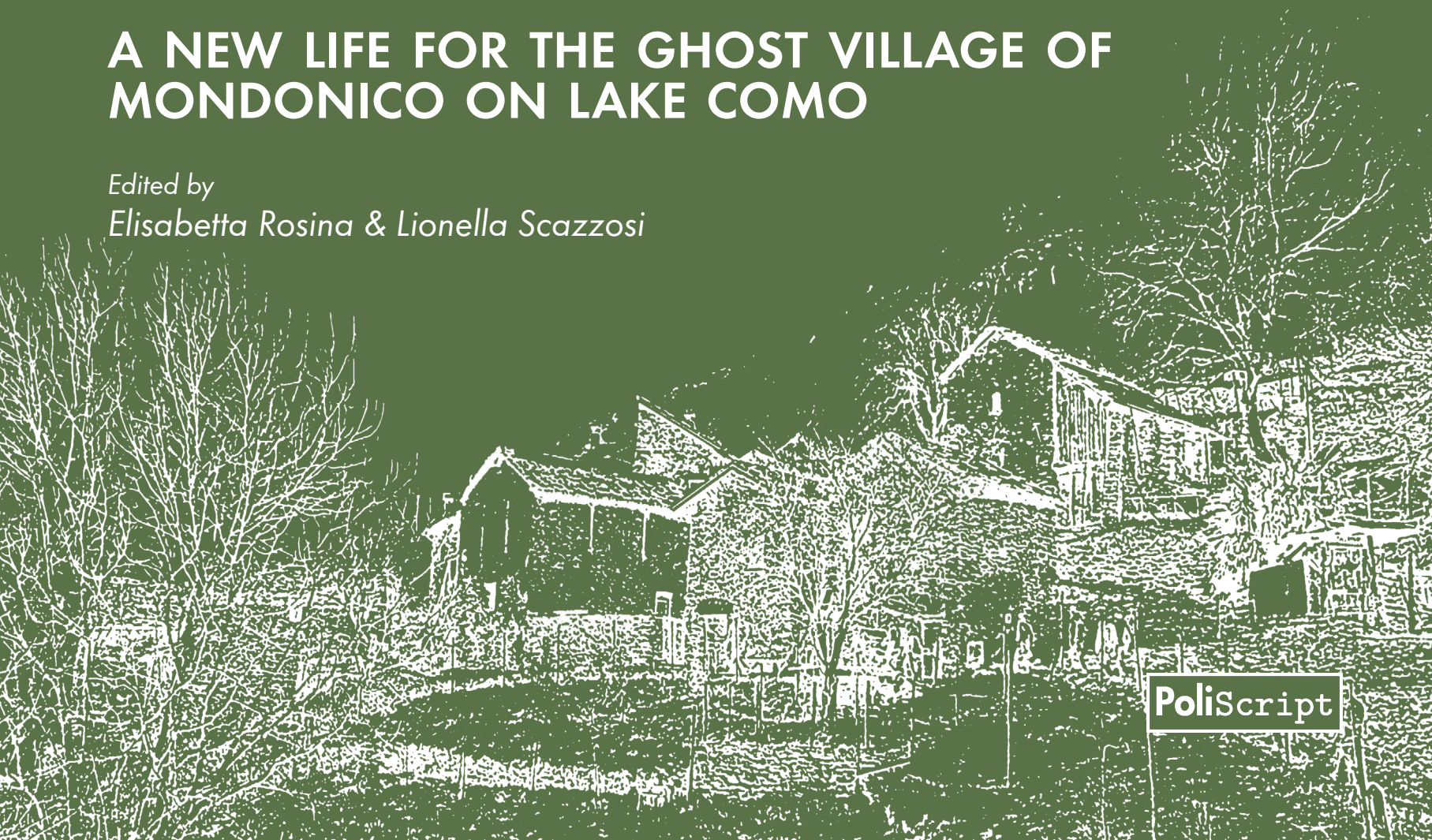


THE CONSERVATION AND ENHANCEMENT OF BUILT AND LANDSCAPE HERITAGE

A NEW LIFE FOR THE GHOST VILLAGE OF
MONDONICO ON LAKE COMO

*Edited by
Elisabetta Rosina & Lionella Scazzosi*



The conservation and enhancement of built and landscape heritage. A new life for the ghost village of Mondonico on Lake Como

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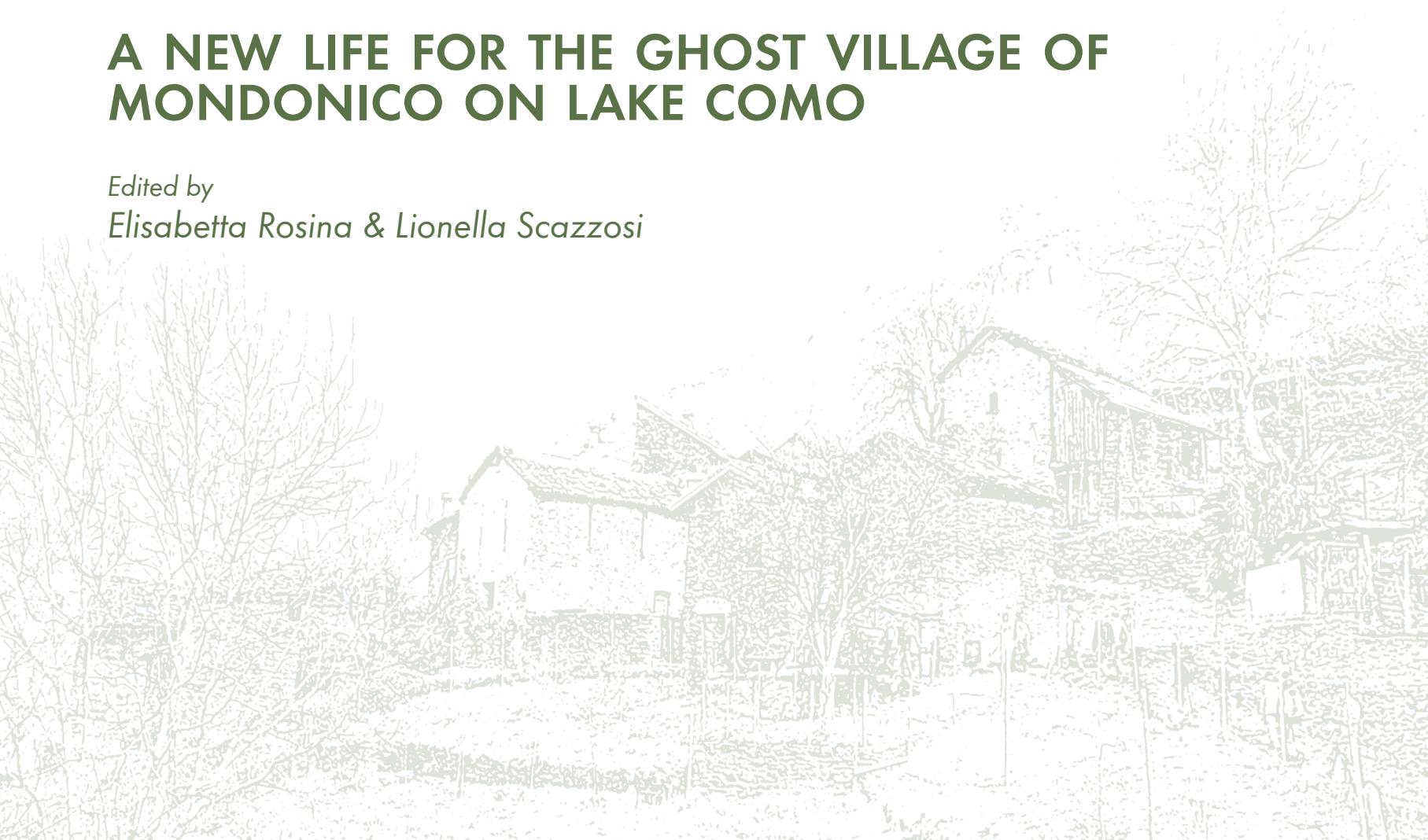
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Guidelines for preservation of a landscape system. A handbook for the historic village of Mondonico

Paola Branduini

Introduction

As illustrated in the Lavisio text, the first condition before starting any intervention of recovery is taking care of the landscape characteristics, concerning both buildings and open spaces. The previously explained landscape reading is the right way to determine sensitivity to change.

The landscape of Mondonico is fragile: its fascination is due to a combination of natural and human factors that have built a unique landscape over time that today captures our gaze for its harmonious colours, materials, forms and connections. The availability of natural elements combined with the people culture produces similar but different landscapes from others even in very close by territories: this allows us to give some suggestions for preserving them but it reminds us to adapt these suggestions to the specific characteristics of each place.

Methodology

The suggestions for preserving landscape comes from the long standing and accurate work undertaken by English heritage in defining sensitivity to change and specific characters of rural heritage (English Heritage, 2006 and 2011); it was also carried out by the applied research undertaken by Lionella Scazzosi and the author for the Italian Ministry of Culture concerning the suggestions for designing and evaluating the landscape compatibility of transformations (Scazzosi, Branduini, 2014).

Who can benefit from these guidelines?

They can be addressed to technicians (architects, engineers and agronomists) in charge of designing a landscape project and of drawing up a landscape report, of evaluators of the same landscape reports; but it can be useful also for farmers and owners of

rural buildings and agricultural land who want to plan changes to their property; it could be helpful for administrators and citizens' associations engaged in the preservation of rural heritage and landscape quality. (Everybody can have an active role in recognizing and transmitting rural heritage / CEMAT).

General principles

Because we are working on a common heritage, it is important to have a great respect of the historical subject and some general principles, usually applied to the buildings, can guide operations on the landscape too:

A_ It's better to maintain than to repair. Repair is work to put right significant decay or damage that has already occurred whereas maintenance is the continuous protective care of the building. Maintenance can be carried out either on an 'as needs' basis or as part of a proactive cyclical plan (Historic England). Annual care of the dry stone walls avoids the collapse of entire parts of the terraces; a periodical cleaning of the drainage canals avoids risk of flood.

B_ It's better to recover than build new construction. The reuse of the existing building or of the existing landscape structure like the terraces is always preferable to the construction of the new: this is a general principle to avoid land consumption and the alteration of morphology.

C_ It's better to adopt reversible solutions than irreversible ones. Light additions with contemporary materials have to be preferred to stable/fixed solutions with traditional materials and mimesis of forms. New cultivations on the terraces can be helped by contem-

porary lightweight materials; where they can prosper without modifying the form and the connection of the terraces; new vegetation can integrate the existing with native or naturalized species.

Any new addition should be in dialogue with the existing landscape and not in contrast: the project is not written on a white page, but on a text composed and re-elaborated time after time. Any new addition should be appropriate for the context and not be taken from other project and simply bolted on: any solution should come from the attentive reading and comprehension of the specific characteristics of the site.

In order to accomplish that you should avoid any form on mimesis of solutions concerning forms, materials and techniques of the past: you should be inspired by the process of research of the past but use contemporary materials in order to declare the authenticity of the present intervention.

The main criteria for preserving landscape are shown below and they are suitable to the Mondonico landscape: they can be applied in any rural context, in the mountain and on the plain. The correct application depends on a deep and accurate landscape reading (as explained in Laviscio chapter).

How to preserve a rural settlement

1_ Respect the existent relationship between open spaces and construction, understanding character, significance and context.

This advice should guide the adaptation of any farmstead in the landscape. It involves understanding the essential features of the settlement, its relationship to the wider landscape setting and its sensitivity to change. Only then should a designer start to address the issues associated with adapting the buildings for a new use.

A characteristic of Mondonico is the clear division in the agricultural use of landscape: the mixed cultivations below the settlement, shown on terraces, the vineyard above and the grazing land in the upper part. The permanence of this historic division should be kept as distinctive spatial character: in a renovation plan the agricultural function should be preferred in order to help maintaining it.

The meeting places of the Mondonico settlement are spaces left free from construction: there are no private spaces in an alpine village, the passages between houses becomes small squares and places to stop and talk. They should keep the continuity of movement in the village and not be separated from the other spaces. Old but still productive vegetation act as shelter, meeting points and symbols of ancient uses. Retaining walls of ancient vegetable gardens become seats for meeting point.

2_ Respect uniqueness, specificity of each landscape construction, acquired over time and in relation with its context.

A thorough understanding is needed of how the landscape system works: terraces, irrigation, vegetation,... At the same time a thorough understanding of the building techniques, materials and their conditions is needed.

For example, when a dry stone wall meets a spring, it should let it pass to avoid a risk of infiltration in the wall and rupture in the winter time: so the spring becomes a small canal and in the wall a window is opened to let it pass. This is a specificity detail in Mondonico walls. Closing this open canal or redirecting it cause the loss of the knowledge of this simple technique.

Vegetable gardens in the alpine villages can be besides the houses or frequently on a part of the terraces: they are protected from the winds by walls or they can



Fig. 1 - The open space is still a productive space because it is well maintained: fields and terraces for agricultural and livestock production; forest for fruit and wood production. The new use of the space should maintain the relationship between the open space and the settlement. (photo: Andrea L'Erario)



Fig. 2 - Open spaces left free from construction were used for rest and talk between inhabitants: today they are suitable space for sociable occasions. (photo: Andrea L'Erario)

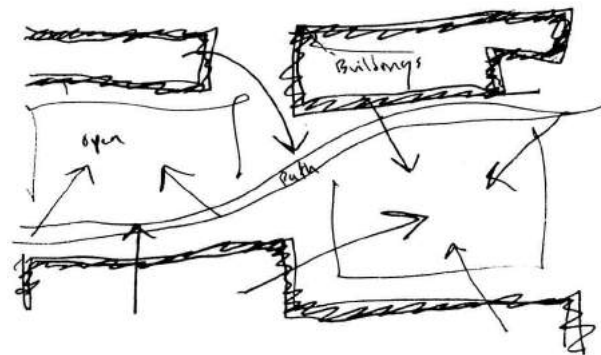


Fig. 3 - A scheme of open spaces of the settlement.

Fig. 4 - Ancient canalisation help the draining system of the drystone wall. (photo: Andrea L'Erario)



Fig. 5 - The enclosures around the settlement are for the vegetable garden: this is a specificity of alpine villages. (photo: Andrea L'Erario)



Fig. 6 - The Viandante pathway in the south part from Mondonico to Dervio does not conserve historical characteristics: dimensions have been changed for being vehicle accessible and historical elements now include concrete reinforcements. The new wood railing is too smooth and its forms belongs to wood industry not handcrafted production. (photo: Andrea L'Erario)



be under the ground level. This specificity should be kept with uses that maintain the isolated and precious character of this artefact.

3_ Respect formal characteristics of the landscape in order to maintain formal unity, even if concerning only a part of the whole.

You should minimise changes. Altering features that give the landscape its historic or architectural importance should be avoided. If significant features have already been lost, the case for reinstatement can be only if providing that there is good evidence for their former existence (Historic England).

As explained in the analysis (Lavisio chapter), formal unity is due to the horizontality of terraces that link Mondonico to the villages along the mezzacosta path, the Viandante path: this character is readable from the lake view. The Mondonico village is hidden behind trees: its colours are completely integrated in the natural colours of stones, grazing pasture and vegetation. Dorio houses are painted with light colours and are evident from the view lake. Only the Mondonico church is visible from the road and the lake as are most of the churches on the Como Lake in an old system of communication. Painting even only one of the Mondonico houses with colours should change this relationship and its significance.

4_ Keep the functions the construction was built for readable and comprehensible.

Even where a building needs a change of usage, the character of site, architecture, materials and details should be kept in order to allow future generations to understand the reasons why this building was conceived and its role within the territory.



Fig. 7 [left, top] - The wide angle vertical landscape unit: lake, Dorio settlement, terraces, Mondonico settlement, forest. (photo: Andrea L'Erario)



Fig. 8 [right, top] - The close landscape unit: Mondonico settlement and its terraces. (photo: Andrea L'Erario)



Fig. 9 [left, bottom] - View from Mondonico: the lake as part of the landscape unit. (photo: Silvia Erba)



Fig. 10 [right, bottom]- The first nucleus of this building is the stable and hay barn and the following additions are nevertheless recognisable in becoming a woodshed. (photo: Andrea L'Erario)

5_ Respect sobriety and pure essentiality of rural buildings.

Any enrichment or decoration not belonging to the history of places and of local building types should be avoided. Rural architecture is essential and is far from excess and decoration. The scarce availability of protection material like mortar left the facades bare, but it is the regular display of stones to form a wall or stairs that can be considered decorative: it does not need any addition. Decoration belonging to other

architectural languages should be avoided.

6_ Prefer maintenance and regular integration to complete substitution of parts or total landscape artefacts or building.

Minimising loss of and intervention in significant historic fabric: usually the fabric of the building will embody its character and interest (Historic England). It is better to retain as much original material as possible. The replacement of historic components and features

Fig. 11 [left] - Sophisticated additional elements not belonging to the sobriety of the rural settlement.
(photo: Andrea L'Erario)

Fig. 12 [right] - The quality of this building lies in the uniform material display in a unique texture with the old technique.
(photo: Silvia Erba)



can undermine the historic value and authenticity of a building. Contractors who have the right building skills can usually repair decayed or failed components rather than having to replace them (Historic England). New materials should be used only to replace existing materials where necessary and should be close matches for those being repaired or replaced. Where the cost of using matching materials could jeopardise the viability of a repair project it may be appropriate for the planning authority/grant giving body to consider alternative materials.

One of the alteration risks in a rural village like Mondonico is the change of rooftop materials. Rooves as

well as walls are fundamental elements of the construction to be monitored in order to avoid risk of collapse: they are also evident identity elements visible from high positions. Changing the flat stones covering the wood structure of the roof is a significant modification of the village character: if it is repeated, it can start an irreversible chain of alteration of the whole village. In these cases it is important to use new materials with a similar colour to the existent to guarantee landscape integration on a large scale. On a small scale, texture and form should assure good compatibility.



Fig. 13 [left] - The substitution of part of the railing is a necessary integration: a better solution should be the substitution of only some of the horizontal or vertical boards and with non shiny treatment of the surface. (photo: Andrea L'Erario)

Fig. 14 [right, top] - It is better to avoid complete substitution of materials. (photo: Andrea L'Erario)

Fig. 15 [right, bottom] - The maintenance of as much as possible existent material contributes to preserving the historic subject and the readability of techniques. (photo: Andrea L'Erario)

7_ Only use a modern material if it helps to retain original features.

Modern materials, such as stainless steel ties, can be the best solution if they allow significant historic fabric to be retained and avoid the need to dismantle parts of the building. This approach can answer to the need of a reversible solution. Resin repairs to timbers can sometimes help retain more material than traditional methods and so aid future interpretation of the building's history.

It is important to achieve high standards of design and craftsmanship: matching the new use to the building, assessing the impact of changes and carrying

out sensitive and appropriate repairs require the skill and knowledge of those qualified and experienced in conserving historic buildings. You may take professional advice before carrying out major repairs. The conservation and repair of traditional buildings often requires specialist skills if mistakes and unnecessary damage are to be avoided. You have to use appropriate methods and materials. A key feature of traditional farm buildings is the use of 'breathable' materials in their construction. Permeable materials coupled with the good ventilation inherent in most traditional farm buildings allows moisture to escape without causing damage to the building fabric. Serious damage

Fig. 16 - Reinforcement of a beam with a new material.
(photo: Andrea L'Erario)



can result from the use of incompatible materials that restrict this ability of the building fabric to 'breathe'.

How to add new constructions

New buildings often entail a substantial change of landscape. They should be designed with the aim to not decrease the quality of the place, but, as far as possible, improve it, without sacrificing the technical and architectural performance required by innovations. Interventions must therefore be implemented which are appropriate to the character of the landscape in which they are located. A range of choices should be studied and verified at different scales (large, intermediate, approximate), taking into account the specific, historical or contemporary, characteristics of sites.

The integration of new buildings is not the imitation of traditional models: the goal is to get a functional and modern design suitable to the characteristics of built local history. It can be seen that an intervention searching for mitigation fails from the beginning to seek innovative and appropriate solutions for his insertion in the landscape.

It is worth remarking that in the case of the draft of a new agricultural building, it is essential to verify the congruence with the rules of the agricultural sector, to know the legal frameworks of EU, state and regional legislation in agriculture (CAP), planning (local urban plan), environment and human and animal health (Reg.CE 1804/99).

1_ Tune the new construction to the large landscape system.

The fundamental principle to insert a new building in the large and intermediate context is to situate it in relation with the existing "landscape systems" and avoid the effects of "intrusion, division, fragmentation,

Fig. 17 - Is the door in ondu-line necessary or could it be made of wood?
(photo: Silvia Erba)



Fig. 18 - Same technique to form a railing to contain stones, but with a new material.
(photo: Andrea L'Erario)



reduction, elimination of visual relationships, cultural historical, symbolic" (DPCM 12/12/2005, Technical Annex, Note 8). The new volumes should have dimensional ratios such as to respect the rules of already existing settlement aggregation and the functional, historical, visual, symbolic relationships existing between them.

The check of the correct position of a new building in Mondonico on a large and intermediate context have to be verified from the lake. No high building in the middle of the settlement should be proposed, otherwise it symbolically competes with the church. Due to the compact character of Mondonico, a new building should be adherent to the existing settlement, so to avoid sprawl: it should be placed following main alignments that structure morphology of the agricultural landscape, along the contour lines. It should be placed in the mezzacosta location so to allow integration with the colours of the background and be less visible from above or below. It should be integrated in the vegetation, that means not completely hidden by the trees but partially visible.

2_ Adapt new construction to orography.

When you look at the close up context, the new building should be in relation with the formal and material characters of the entire settlement. It should therefore be adapted to the orography, avoid carry-over of land and earthworks and comply with the dominant directions of the settlement.

3_ Keep the rhythm between full and empty spaces.

Consider the relationship between full and empty spaces and propose the same rhythm/alternation. The check should be made from the lake, from the Dorio settlement and from the pathways driving from Dorio to Mondonico. As every alpine village, Mondonico



Fig. 19 - The meaning of the open space dividing Dorio from Mondonico returns to the formation of the two settlements and to the transhumance of cattle from the lake to the *maggengo* (May pastures) until the Alpine pastures. It is a spatial division belonging to an agricultural and cultural use. These open spaces should be kept. (photo: Andrea L'Erario; graphic elaboration Paola Branduini)



Fig. 20 - The consolidated open space should be kept free of construction and dedicated to open-air activities. (photo and graphic elaboration Paola Branduini)



Fig. 21 - New constructions should be placed along horizontal lines (terraces): red ovals are spaces full of wood and not empty spaces to be built up with constructions. (photo: Andrea L'Erario; graphic elaboration Paola Branduini)

is located in a terraced clearing, with crops below and grazing above: no building should be realized in these two open spaces that divide and define Mondonico village from Dorio (down) and from wood (up). The upper part is partly covered by vegetation: it should be cleared so to redefine the proper space historically belonging to the village.

4_ Accord the formal characters of new construction to the existing landscape.

In the conception of a new building the simple functional response to the agricultural needs often generates the juxtaposition of new volumes to existing ones, without an overall architectural design and badly placed in the landscape: the size, orientation, position of the new building should be continuously checked at different scales so as to verify the correct insertion in the existing settlement.

The main dimensions (height, length, width, slope of the roof) have a significant impact on the perception of the building and its relationship with the other buildings. Simple solutions, with buildings not too wide and varied in correspondence to different functions, enable us to understand their functions and fit most appropriately in the settlement and in the context. Conversely, buildings which are very long or wide often recall the models of industrial or commercial spaces.

So you can follow simple but wise rules:

Avoid alteration of the coverage geometry: slopes of rooves, fitting between the rooves of adjacent buildings, continuity of the shell. The slope of the roof depends on the regional climate characteristics and by internal needs of ventilation and external descent of rain or snow;

Keep the proportion/relationship existing between the dimensions of the existing volumes in the new construction;

Respect the alignments of buildings with local roads and the vertical and horizontal movements of people and related connections.

5_ Use contemporary materials without mimesis.

The choice of materials for new buildings is predominantly based on technical criteria (support, lightness, resistance to fire, frost, fragility, sound insulation, thermal insulation, ease of implementation, etc.), duration (maintenance, aging) and economy (production costs and maintenance costs), which may vary from place to place. Materials should be contemporary and answer to present-day necessities but in texture and colour should suit existing materials.

6_ Tune the colours with the existing landscape with sobriety.

The matching of colours help shape the perception of the building in the landscape, make it possible to reduce the visual impact, so as to integrate it.

Many factors affect the colour of new constructions nowadays and in the past: the construction materials and their surface treatment, the surface quality and its ability to reflect light, the colour tone of the surfaces, its stability and its sensitivity to acquire a patina of aging, etc.

The colour can be used to prioritize the formal character of a building, for example making clear the entrance or attenuating the difference between the openings. A plain colour make the building homogeneous, while the distinction between the roof and walls accentuates the volume; a dark roof on light walls has a visual effect of making the construction lower. A wrinkled surface absorbs most light of a smooth and it appears darker; while a smooth or shiny surface is very clear, both near and far.

The roof is the part that, in general, is more visible

from a distance; a dark and opaque roof attracts the eye less, while a shiny one attracts it. When using new materials, such as metal, it is suitable to use neutral colours and dark rather than bright.

In the tradition of building techniques, there is a large variety of materials in the face of architectural solutions that are similar in several Italian sites, successful adaptation of the buildings to the specific local availability of materials, technical skills, etc ...

Mondonico has a uniformity in colour and texture due to the only two main materials it is made of: stone and wood. New construction should use contemporary material but select a colour and a texture according to the brown nuances present in the settlement. New buildings should have their own personality and be the fruit of the contemporary age, but should not be emerging from or in contrast with the existent. The quality of design lies in these details.

7_ Link the construction to the landscape with local vegetation.

Vegetation helps to organize the space and the architectural composition of a farming settlement and define its role in the landscape at all scales. From the point of view of landscape, vegetation has an equally important role to that of construction in characterizing the landscape, sometimes even more important.

It signals function (a tree that marks an access or a cross), a reference point, an ornament (a hedgerow or an alignment tree following an entrance pathway, etc.) and often also has a productive function or environment (for example, slope stabilization through the tree root).

In the case of expansion or addition of new buildings, the existing plants should integrate organically with the new volumes in the context (a trees group near large buildings mitigate volume more effectively than low



Fig. 22 [left] - Respect the vertical and horizontal movements of people and related connections.
(photo: Andrea L'Erario;
graphic elaboration Paola Branduini)



Fig. 23 - Dominant colours are nuances of green and brown: the accord between them is cultural (because the material belongs to the local nature) and visual because they are opaque.
(photo: Andrea L'Erario)



Fig. 24 - Isolated fruit trees create shadow near the houses and provide fruit; spatially, they balance the weight/dimension of the building in the open space.
(photo: Andrea L'Erario)

Fig. 25 - Enclosures were historically used for animals or vegetable gardens. (photo: Andrea L'Erario)



and long hedges): the vegetation should not mask or cover the artefact, but be an integral part of the project. Native or naturalized species have, in general, to be preferred to formal elements and botanical species in urban areas: for example, low hedges, cut in the regular form, generally used for gardens of small residences, create foreign characteristics in the rural landscape.

Fences should be limited to animal paddocks and vegetable gardens or orchards: these should have a light shape and be made with simple and uniform materials.

8_ Define circulation spaces without enclosure.

It is important to take care of the indoor and outdoor

spaces of the villages, especially the areas of movement, storage and parking: they should be defined, organized, and, over time, kept in order. It is preferable to use permeable paving (clay, gravel, etc.) limiting as much as possible the impervious surfaces (concrete, asphalt etc.). It also preferable not to divide the areas of circulation with hard enclosures so as to keep the permeability of the agricultural space.

9_ Hiding the storage building with vegetation.

Storage buildings are preferably accompanied with vegetation, painted with neutral colours (dark and opaque allows them not to emerge visually in a predominant way), without covering in plastic material.

References

- English Heritage (2006). *The conversion of traditional farm building: a guide to good practice*.
- <https://content.historicengland.org.uk/images-books/publications/conversion-of-traditional-farm-buildings/traditional-farm.pdf>
- English Heritage (2011). *The maintenance and repair of traditional farm buildings: a guide to good practice*. <https://content.historicengland.org.uk/images-books/publications/maintenance-repair-trad-farm-buildings/acc-maintenance-repair-traditional-farm-buildings.pdf>
- ICOMOS-ISCS (2015). *Illustrated glossary on stone deterioration patterns*.
- http://www.icomos.org/publications/monuments_and_sites/15/pdf/Monuments_and_Sites_15_ISCS_Glossary_Stone.pdf
- Scazzosi, L., Branduini, P. (2014). *Paesaggio e fabbricati rurali. Suggestimenti per la progettazione e la valutazione paesaggistica*. Ministero dei Beni e delle Attività Culturali e del Turismo. Santarcangelo di Romagna: Maggioli Editore

The degradation of a dry-stone wall and repairing steps

Paola Branduini

The degradation of a dry-stone wall

The forms of alteration of the walls can be divided into:

- Instability: alteration of the balance of the static structural construction model;
- Degradation: deterioration due to chemical, physical and biological causes with destructive effects on materials.

This instability principally gives rise to the following events:

- Bulging;
- Crumbling;
- Collapse.

The causes are endogenous, due to construction defects, or exogenous, due to external causes of anthropogenic and/or animal overload, or to pressures generated from natural components (excess of water). These are usually a combination of various forces simultaneously applied to the wall that cause the collapse of one or more points.

The most frequently exogenous causes encountered are:

- Physical: ice formation resulting from stagnation of water inside the masonry increases in volume and generates driving forces between the stones;
- Mechanical: excessive strain on the above floor caused by animals or mechanical loads cause the movement of stones.

Goats, while not being heavy, are particularly harmful, because they stand on the edge of the wall to eat, moving stones crowning the wall itself. The roots of forest trees, although the younger roots can help to hold the stones, at maturity can generate thrusts threatening

the stability of the wall and cause the collapse. Many trees grow in fact close to walls and, without a regular maintenance, cause disruption. The uprooting of a large tree, e.g. due to wind, causes the collapse of the wall. Landslides triggered by a defective circulation of water, occur during heavy or abundant rainfall. Together with this instability, the phenomena of stone ware and consequently formation of gaps in the masonry can occur: crack (Individual fissure, clearly visible to the naked eye, resulting from separation of one part from another), detachment (partial or total separation of stone layers), features induced by material loss (erosion or mechanical damage) (ICOMOS, 2015).

The stages of deterioration and the interventions to be made

Different stages of deterioration of a dry stonewall have been identified due to the combination of structural disruption and texture degradation: damage is followed by different forms of recovery.

A_ Localized degradation of crowning elements.

This is the loss of stability in a precise point of upper stones, which can fall to the base of the wall. It is usually accompanied by an excess of vegetation that grows between the interstices of the wall itself.

In such a case, the solution is just a cleaning of the vegetation on the upper part of the terminal wall and repositioning the last layer of stones as far as the area affected by the landslide (possibly re-shaping the water gutters if existing or re-building it if the wall is of more than 2 meters high). The action to be performed is routine maintenance.

B_ Widespread degradation on the top of the wall.

This is the loss of stability of the upper wall which can

lead to small collapses.

In this case, it is necessary to disassemble the upper part of the wall until the layer of loose stones and rebuild the wall, juxtaposing the layers of stones and then filling with drainage material. The dismantling of the wall involves only the unstable or collapsed part and does not involve the entire vertical section of the wall. The action to be performed is partial reconstruction of the wall.

C_ Bulging of the wall.

It is the swelling of the wall, which tends to detach from the rear draining layer. It may concern only the half top of the wall, or affect the whole vertical section.

In the presence of this instability it is necessary to disassemble the entire portion of the wall affected from bulging and rebuild it according to the traditional technique. The action to be performed is dismantling and reconstruction of the structure in respect of shape and layout, if possible by improving the drainage conditions of water flows.

D_ Collapse of part of the wall.

The collapse affects the entire vertical section of the wall.

In this case, the reconstruction of the entire collapsed portion, according to the traditional technique, is always required. It is important to pay attention to the lateral junctions of the wall to rebuild: it is preferable, to dismantling the wall, to maintain a "stair" profile to allow a more stable engagement of the new masonry. The action to be performed is the total reconstruction of the portion of the wall.

How to repair a dry-stone wall

The recovery technique of the wall has been brought

together from interviews with some builders and farmers. The recovery includes the following steps:

- Removal of the damaged wall and preparation of foundations;
- Selection and fixing of the stones in the wall;
- Completion of the wall.

1. Partial or total dismantling of the damaged/collapsed wall and preparation of foundations

The reconstruction of a wall starts from the removal, accumulation and selection of the stones of a collapsed or unsafe wall. Before starting the construction, it is useful to select stones in size, thickness or length. They can be placed in small piles in order to facilitate the selection of individual stones: thereby it will be easier to choose the right stone at different times and to understand how much original material is possible to recover or whether you need more stones.

Foundation. In most cases, foundations already exist or should be clean. If they have to be built up it is better to draw the area to dig, with pegs and ropes, on the ground. The trench should be around 20/40 cm deep and slightly leaning towards the mountain with a width of about 1/3 of the height of the wall. It is helpful to accumulate on the ground the dug up soil: it will subsequently be useful for planting.

At the base of the wall, the more resistant and heavier larger stones have to be placed first both for the difficulty of displacement, and to create a solid base for the wall. Foundations do not need a flat surface but it is good that the stones are firmly inserted into their housing. In restoring the soil for the foundation, it is necessary to remove the vegetation and especially stumps to avoid unstable foundations.

Consolidation technique. To consolidate the soil behind the wall, it is useful to stick one or more poles transversely to the wall, to increase the resistance of the wall itself to the push of the soil. During installation, short stones are alternated with long stones to give stability at the wall: the long ones should be fixed in the ground behind, placed slightly inclined upstream to oppose bulging and roll over pressures. The longer the stones positioned perpendicular the wall, the greater gripping between the masonry and the ground behind is and thus lower the risk of collapse and bulging.

Filling. In the empty spaces it is important to use crusher sand or gravel avoiding river sand or gravel with rounded corners: this last material does not build a solid structure, while friction is lower. In the case of a junction with an existing wall, the stones should be removed and set out as a stair, as already mentioned, to obtain a greater junction surface. If there is a large boulder, the joint should be prepared by slotting the stone to form as flat a junction as possible for the wall; moreover it can be useful to anchor the wall using iron "clips" fixed in the rock. The wall must be removed not just at the point where it collapsed, but at least for 0.5-1 m from both sides.

Space upstream should be progressively and carefully filled in, as the wall grows, with pieces of stone and soil to facilitate the flow of rainwater, as well as the growth of the vegetation and the future residence of insects and small animals.

The filling is essential to have good drainage through the wall and avoid excessive thrust of soil that would undermine the stability of the wall: small stones for the drainage should be placed perpendicularly the wall to facilitate the proper water runoff.

Stone set up. To help the alignment, lay two tables or rods at the ends of the wall and then stretch a cord between the two supports at the upper edge.



Fig. 26 - The background of the wall. (photo: Andrea L'Erario)



Fig. 27 - Look at the structure to help follow the alignment and the arrangement of stones at the foundation of the wall. (photo Alessia Silveti)

2. The choice and the laying of the stones

The correct stone to be used is the local one, which you can recover in the proximity: this prevents the presence of irregular patches and keeps the characteristics of the existing wall. In case the material is difficult to recover or insufficient, you should try to obtain stones of the same rock. The suitable stones for the wall are with large and flat faces: they are easier to lay and offer a constant support to the entire wall. The stones less suited can be used as filler material. It is good to have plenty of material to allow an easy option at the time of installation. The choice and the laying of each stone should avoid shear forces, especially if the wall is characterized by veins that would impair resistance. Furthermore, the visible side of the stone should be the smoother, well squared and presenting pleasing veining to the eye, in order to maintain the surface of the wall as regular as possible. The aim is to obtain not only a resistant product but also a pleasant artefact. Successive horizontal layers form the wall: they are posed on fine gravel and bedded with a hammer or a rubber mallet to the rear. No joint should appear either vertically or horizontally; it is essential to offset the vertical joints so as to better distribute loads. They must be arranged as carefully as possible and immediately reach maximum stability, so to avoid the slightest movement, if charged. To accomplish that it would be necessary to smooth out the shape of certain stones with a chisel and a mallet. To avoid accidents when handling the chipped stones, you should wear gloves and appropriate footwear with steel toe cap resistant to falling rocks.

The stones have to be placed horizontally in even constancy to the upper profile: the height of each row is determined by the bigger stone, used as a stone-guide. Each layer must be carried out with stones that



Fig. 28 - Section of a wall under construction: here the horizontal lay out of stones are clearly visible, the vertical alignment helped by a wood post, the difference between the big stones in the front and the small stones for the drainage at the back. (photo: Andrea L'Erario)



Fig. 29 - In the foreground, the junction of a previous wall to a new part. (photo: Andrea L'Erario)



Fig. 30 - Two level junctions in the wall are visible in the red circle. (photo: Andrea L'Erario)



Fig. 31 - Accomplishing the repair of a wall provides great satisfaction! It is proud work! (photo Andrea L'Erario)

have similar height and levelled with shaved stones, before moving to the next layer.

The inclination of the facade is usually about 10% upstream. The thickness of the wall should progressively decrease: from a base of 60-70 cm to a head of 20-30 cm (for high walls about 1 m above the ground - for higher walls greater thicknesses are needed). To achieve this, just move back the thread of the front progressively and tilt stones upstream. That allows a greater resistance to tipping and avoids the slippage of the stones outwards when pushed by the soil behind. In the case of a curved wall, to maintain a correctly curved profile a set of guides constituted by vertical axes at regular intervals and fixed upstream and downstream should be prepared.

3. *The completion of the wall*

It is appropriate to terminate the cap of the wall with flat stones and add the grass, separated at the early stage. In the case of division walls or in the construction of a building, you should proceed to the realization of double head or double-sided walls, with internal filling of waste stones (small stones or splinters) and junctions carried out by large and long flat stones passing from one side to the other.

Work times

The time necessary for construction of a wall varies depending on stone availability, although it is averagely considered to be about 2 m² (1 m³) per day, having locally stones selected already available, ordered and ready to use. It is, in effect, a very demanding activity in terms of manpower. Should you need more stones, times will increase. The optimization of operations and fatigue is when you can reuse all the stones of the existing wall.