Intervention strategies in historical regional architecture: a case study – the internal area of Abruzzo

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Abstract

This research aims to investigate the rules, resources and tools related to the introduction of principles of sustainability in the rehabilitation process of minor centre. The theme is complex because, besides the energetic, technical and plant engineering aspects, we need to consider the cultural problems arising when the presence of values don't allow any invasive actions. The study of the state of art shows that all the examples always refer to the single historical building and that there is a lack of references when the project must be carried out on the built fabric having its historical, environmental, landscape values, architectural and technical ones, ... Therefore the method we applied in our research started from the knowledge of the context of urban fabric studied in order to allow the building to reach its full potential whilst at the same time meeting the environmental requirements of today.
Keywords: rehabilitation building process, sustainability, values, compatibility, building envelope.

1 The study of the state of the art

Actually, the implementation of a process of physical recovery of the minor centres cannot ignore the issues that are identified in the definition of environmental sustainability. But the promotion of the so-called "political" sustainability becomes particularly complex when we work in a context of historical, with a strong cultural identity, presence of architectural, landscape values, technical and structural restrictions, ... For this reason, we proceeded to study the state of the art so as to identify examples and to recognize design strategies aiming at the introduction of energy-environmental solutions.

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The field that has been investigated concerns the theme of "building on built" namely the rehabilitation of the built heritage. The study tried to emphasize the principles that have guided the architectural choices, distribution and functional goals of the designers but also the "green" ones that would like to be achieved.

The research also wanted to put in evidence how energy choices and architectural ones influence each other, by showing how the design process has become the result of teamwork between specialists from different disciplines like technical architects, structural and plant engineers, ...

Thanks to the study of the state of the art we can identify the six following different operating modes [1]: addition, introduction, substitution, integration, overlap, and interposition, could be identified, fig. 1.

Figure 1: Examples of interposition "The Urban Centre", Fonatatelier; integration "The Norwich Cathedral", Michael Hopkins; addition "Cultural Centre" in Wurzburg, Brukner & Brukner.

The 'addition' strategy aims to add to the original building one or more complete volumes and enables solving issues relating to the energetic or spatial-functional adjustment. The strategy of "introduction" considers the pre-existing envelope as a container into which a new technological independent nucleus can be put it as if it were a box. This strategy is used mainly to provide energetic and structural adjustment of the building with no changes in the formal and aesthetic perception of the envelope. The "substitution" can involve the single constructive components or it can be extended to the whole building unit. The strategy of "integration" allows us to increase performance levels of the existing building. This operating mode consists of the integration between this one and the new constructive - functional components.

The "overlap" is a strategy that should be used only if there is a serious performance deficit or a deep lack of architectural quality. This is because the overlap approach involves a high level of invasiveness together with a complete loss of the existing building perception.

Lastly, the "interposition" strategy is very similar to the overlap one. This strategy entails the introduction of a new envelope joining the pre-existing one. It interposes itself totally or partially to the existing envelope and does not modify the original structure but allows a significant improvement in its performance levels.

Each of these strategies has different degrees of reversibility and transformability.

The study of the state of the art shows that all the examples in which a prevailing strategy is possible to identify always refer to the single historical building.

This happens because when the project is carried out on the single building stead, it easy to find the right methods and economic resources. On the contrary, the study of the state of art has shown that there is a lack of references when the project must be carried out on the built fabric having its historical, environmental, landscape values, architectural and technical ones, ...

Despite this awareness, we deepened our study by applying the above mentioned strategies to a section of the urban fabric in the minor centre of Caporciano, located in the Abruzzo Region, Province of L'aquila.

2 Methods used

A series of factors can influence the choice of the strategy like the use of the building, new users' needs, environmental issues, but above all the context and values not to destroy or damage. In fact as described above, some strategies are more invasive, others are lighter and reversible. So, if the project does not take into consideration all the mentioned components it could seriously compromise the conservation of the values of the minor centre.

Therefore the method we will use in our research will start from the knowledge of the context of urban fabric studied in order to allow the building to reach its full potential whilst at the same time meeting the environmental requirements of today. This strategy must respect the existing context with its architectural, historical, environmental values and find solutions to preserve the identity of the place by exploiting its climatic context as well as the most recent technological innovations.

In this way the strategies adopted will not be invasive but compatible because they will result from a synthesis between old values, components that can be transformed, potential aspects, technological solutions, environmental critical aspects.

If we focus on environmental aspect, the methodology used defines two kinds of surveys: the bioclimatic survey, namely the study of the level of sunshine and ventilation and any relationships between the urban fabric and climate; the biophysical ones, that focuses on the ground, vegetation and water basins.

The fusion of these studies is then used to draw up a map of "critical conditions" for winter and summer that identifies the "zones at climate risk".

A further investigation will lead to the chart of the critical climatic mapping of the whole minor centre.

The aim of this map is to identify homogeneous zones in terms of bioclimatic, biophysical behaviour but also critical and potential aspects. This map is an important instrument in the designer's hands to work out a rehabilitation project.

The components of the critical climatic map are the altitude, the density of the urban fabric, the level of sunshine on the facades and on the roofs in winter and summer, the winter exposition and the soil dampness, fig. 2.

Figure 2: The critical climatic map of the minor centre called Caporciano.

Thanks to the climatic map it is possible to guess the green strategies to develop. For example, the section we have studied is totally included in the "F-zone" that encloses on the south and east side a large green area not yet built.

This green area stretches along the "A-zone" and part of the "B-zone". Considering that this area is empty and free from any form of obstacle, this could be the ideal place where to install systems that exploit the renewable forms of energy.

Following this direction, a project aiming at requalifying this area could be implemented with the introduction of bioclimatic niches, green boulevards, photovoltaic arbours and trees, as well as mini-wind turbines. In this way the energy produced could be used by the green park to be energy self-sufficient or anyway as a form of energy conservation.

As the built fabric is very dense and mainly made of block houses having small courtyards and internal paths for pedestrians, the rehabilitation project could aim at improving the visual and lighting comfort in the deeper part of the built fabric by using light-coloured floors and paintworks. Moreover the above mentioned strategies could help to fix the soil dampness issue by using igloos and the drainage technique. As the facade of the terraced houses in Via Piedi La

Terra is partially affected by cold winter winds, a solution could be to develop strategies aiming at protecting it.

3 The project

The minor centre of Caporciano is about 30 km far away from the city of L'Aquila and is located in the area of the Navelli plain. It arose at the end of the XII century and its origin was deeply influenced by the neighbour village of Bominaco with its well-known monastery. Its medieval nucleus dates back to the XIV century is made of the main castle whose most peculiar aspect is the quadrangular tower [2].

The medieval walled town of Caporciano is crossed by a north- south axis: on top of its triangular shape at 850 mt above sea level stands the ancient tower.

The castle has a strategic defensive position: it monitored a large part of the surrounding land that was crossed by the major route named "Claudia Nova". In the following periods the village expanded outside the medieval walls, following the land's shape by "spotting" some rings of expansion that can be easily indentified thanks to the presence of "shoes" and counterforts near each ring [3].

In the last phase of its urban evolution, the village expanded eastwards, in direction of a plain area known as "Piedi La Terra". This area is characterized by a group of disused buildings, whose state worsened after the earthquake of April 6th, 2009 that affected the whole Province of L'Aquila.

The urban fabric of Piedi La Terra is very dense but there are some empty spaces on the borders, even green areas. This means that the process of building construction preferred the flat valley rather than the adjoining section of land which is morphologically unfriendly. Our study will focus on this section of land.

3.1 Description of the section of the land studied

The portion of the fabric we have studied is located in the area of Piedi La Terra. Its structure consists of open and closed courtyards, covered passages and a green area that marks the west side borders, fig. 3. As we already pointed out the overall condition of the urban fabric is not good in fact many buildings are in a state of decay, with no roof or horizontal closures and are covered only by plants.

Despite this, we can identify some key elements of great value from an architectural and spatial point of view which are the fruit of our precursors' knowledge. The data gathered showed that the structure of the urban fabric in the section we have studied is rather simple because the development of the spacial cell is horizontal. Local raw materials have been used to build the components of the building because they were available on site. The limestone rock formations promoted the use of rough bondstones as the main component to build the structure of masonry [4]. Bigger and squared bondstones have been used to make quoins and "shoes".

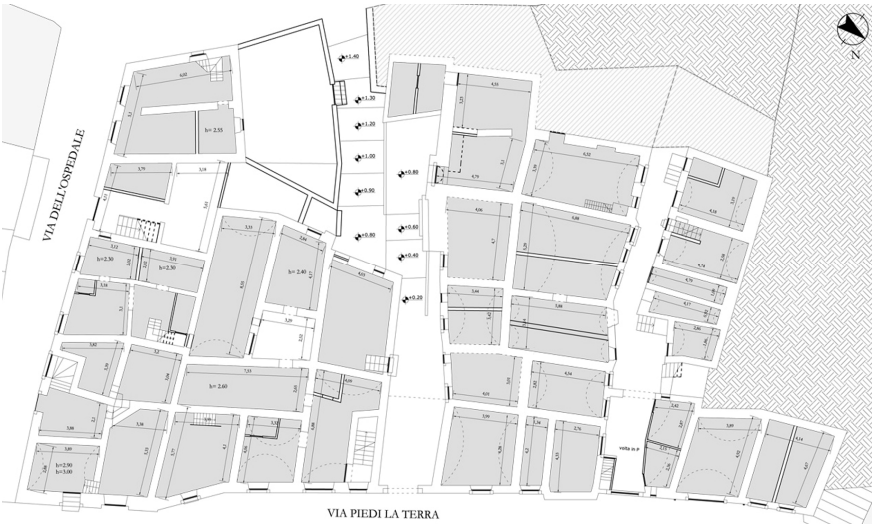

Figure 3: Survey of the section of the urban fabric – ground floor plan.

All the values have been recorded in files according to the kind of closures (horizontal and vertical), technical components of the facade, the decorative components, the quoins and the seismic devices, fig. 4.

Figure 4: Survey of the section of the urban fabric – facade.

The survey allowed us to make a distinction between the key components and the ones that could be changed. The last ones have been identified by taking into consideration the superfluous additions, the level of degradation of the building and, most important, if they are isolated components or key components of a whole. This survey enabled us to draw up a "transformability map".

The above mentioned survey is an important instrument because it allows the designer to preserve the historical heritage.

From a climatic point of view we have studied the following fundamental factors. The predominant natural ventilation of the section we have studied consists of very cold winter winds coming from north and north-west; on the contrary in summer the winds generally come from the south-east and do not reach high temperature.

The irradiance depends from altitude, latitude and longitude of the minor centre and it is quite positive. Last, the soil permeability depends from the surface material and the level of inclination. This last aspect is of course the result of the shape of the urban fabric.

The bioclimatic study of the section we have studied allowed us to divide the main issues into two categories linked to the main seasons: winter and summer. In winter time the impermeable and flat soil is mainly shady, this involves a high level of dampness both inside and outside the building.

Furthermore, as the fabric is very dense there is poor lighting in the external facades as well as inside the building.

Lastly, the cold winds blow against the facades of the buildings in Via Piedi La Terra. In summer time the most critical condition is that some facades are exposed to the sunshine for most of the day and the overheating of the upper floors, fig. 5.

Figure 5: Survey of the critical environmental conditions.

3.2 New uses and strategies

In the area we have analysed we have proposed new uses for the existing buildings, for both public and private settings. This enabled us to recreate real life scenes of the past of this village, fig. 6. In particular the new uses proposed refer to arts and crafts sector, but there is also reference to other support activities such as shops, residences, restaurants, cafes, ... as well as to a music auditorium with outdoor cavea, fig. 7.

The design strategies used are the interposition, the addition, the integration and finally the insertion.

Figure 6: New uses in the rehabilitation project.

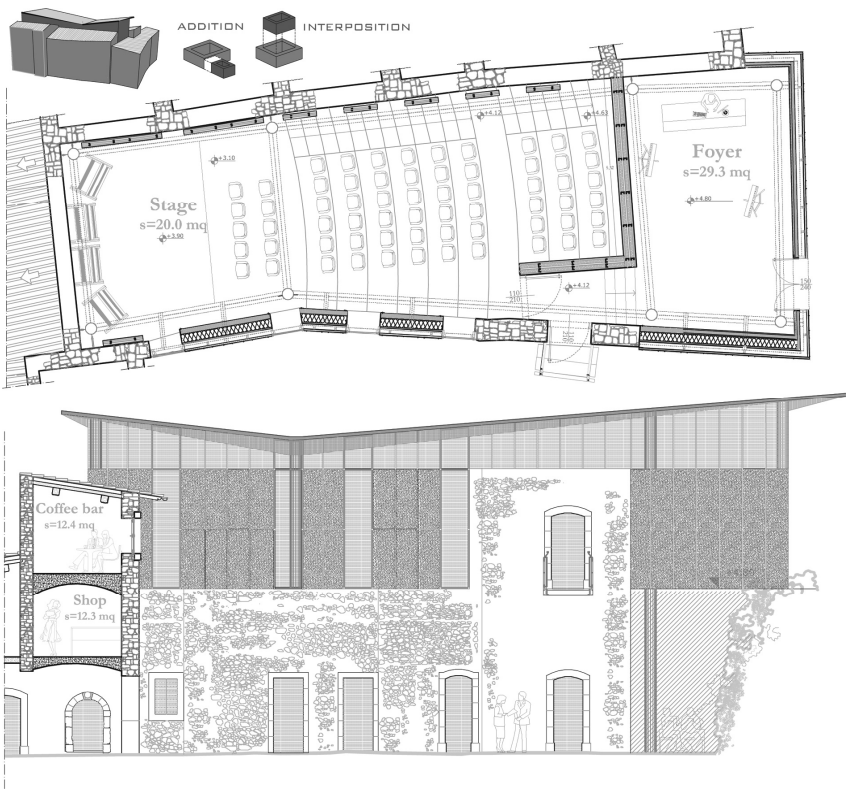

Figure 7: The project of auditorium.

The addition approach has been used to create an entrance foyer. Thanks to this new volume addition we have achieved important results and been able to adjust the space to the dimensional standards; from an architectural point of view the new glass volume brings the auditorium hall to the visitor's attention.

This approach also helps to improve the internal lighting and proposes the use of inclined roofs to collect rainwater.

The structure of the new volume is made of steel, a prefabricated type, and it has just been put into the already existing "box".

This strategy has allowed us to reinforce the structure saving the historical masonry.

The interposition strategy has been used to improve the performance level of the vertical and horizontal closures of the auditorium, by putting a ventilated wall in the missing sections of the masonry.

Finally, a careful study of the inclination level of the new volume surface [5] enabled us to propose "the best shape" to satisfy the both design needs and the PV cells integration on the roof, fig. 8. In fact the photovoltaic system is perfectly roof-integrated because it is flat and follows the roof orientation and inclination.

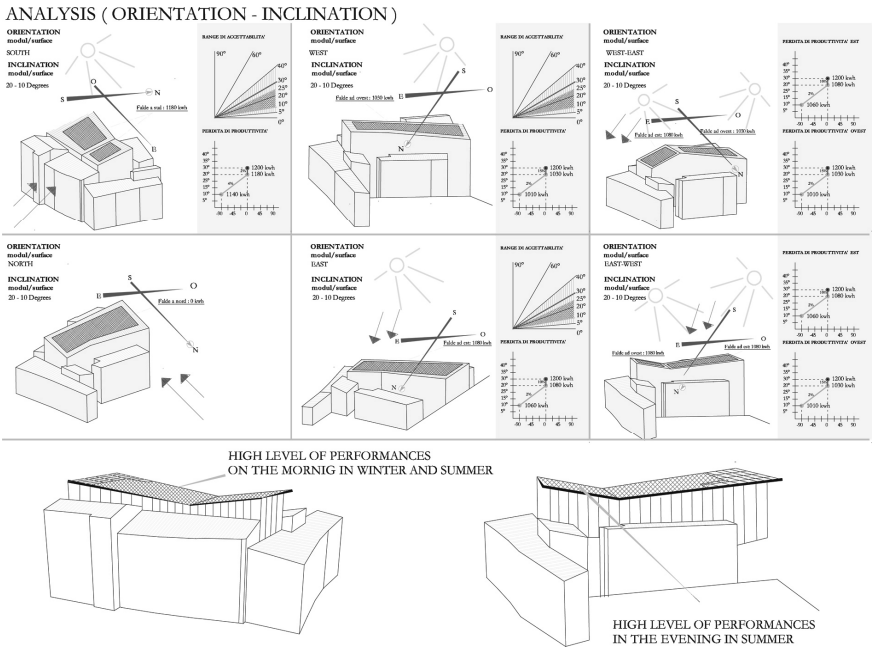

Figure 8: Study of the inclination level of the new volume surface.

This photovoltaic system produces nearly 18.678 KWh/a of electricity annually.

A fast survey reveals that the electric consumption is equal to 14.976 KWh/a, therefore an important part of it could be produced thanks to the roof PV system.

4 Conclusions

The implementation of the above mentioned design approaches could be the way to achieve a sustainable rehabilitation process of the urban fabric in the minor centre. In fact these strategies allowed us the adjustment to dimensional standards, the improvement in the performance level of the envelope but also the exploitation of renewable energies in order to carry out a "green" project even in the rehabilitation of the built heritage.

It is very useful to point out that the recent legislation does not allow us to carry out any of the projects described above.

The study of the legislative tools used by local councils as a reference and guide to promote the territory development does not take into account any elements of sustainability concerning contexts of environmental and historical value.

In fact in the historical contexts, the legislation has always allowed us to preserve the heritage in the urban fabric but, at the same time, has denied us to promote the sustainable "green" design.

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