



SUEMoT

SUE-MoT Conference 2007

**International Conference on Whole Life
Urban Sustainability and its Assessment**

Glasgow, UK

27-29 June 2007

Conference Proceedings

Editors: M. Horner, C. Hardcastle, A. Price, J. Bebbington

First published in Great Britain in 2007 by Glasgow Caledonian University

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All papers were double blind reviewed.

ISBN-13 978-1-905866-13-7

ISBN-10 1-905866-13-5

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Sustainable buildings in significant architectural contexts: a proposal for the area of “La Martella” in Matera.

© *Antonella GUIDA*¹ & *Fabio FATIGUSO*² & *Antonello PAGLIUCA*³

¹ Associate Professor, Department of Architecture, Planning and Infrastructures for Transport – School of Engineering, University of Basilicata, Viale dell’Ateneo Lucano – 85100 Potenza (Italy), antonella.guida@unibas.it or architetto.guida@virgilio.it

² Researcher, D.A.U. School of Engineering – Politecnico di Bari (Italy) - Via Orabona, 4 70125 Bari f.fatiguso@poliba.it

³ PhD Student - D.A.U. School of Engineering – Politecnico di Bari (Italy) - Via Orabona, 4 70125 Bari
a.pagliuca@poliba.it

ABSTRACT

An architectural project is generally arranged as an organised process according to a sequence of phases, which are in turn characterised by different procedures - from the initial cognitive analysis till the critical synthesis and the definition of the most suitable construction techniques and materials – in order to make it possible to characterize and manage the proposal. Within the project, each phase is connected to the previous and the following ones according to different criteria but not necessarily to a temporal relations.

The modern bioclimatic project is characterised by two specific factors: the former concerns the necessary attention to the reaction of each individual element and of the whole building to physical phenomena; the latter requires the occupants to be provided with a high level of satisfaction. Each choice during the planning is dependent on the physiological and psychological well-being of possible users.

The building plan cannot exclude evaluations regarding the consequences connected to choice of specific constituent methods and materials. Another fundamental requirement of the building materials is their durability and maintainability in order to avoid energy and economic waste.

Sustainable planning is based on the environmental awareness which belonged to traditional construction traditions. Their reproposal today does not involve a return to the past but a modern rereading of their use, as a normal evolution of techniques whose final aims are both the reduction of energy consumption and the restoration of a cultural identity characterised by a general state of well-being.

According to these criteria, the sustainable planning implemented over this research has demonstrated an application in an area with significant environmental-architectonic characteristics: the village of La Martella of L. Quaroni in Matera (Italy).

Key words: Environmental sustainability; bioclimatic project; sustainable buildings; durability; maintainability.

1 INTRODUCTION.

The relationship between a settlement and the surrounding environment has always been governed by specific rules whose respect is the main condition to survive inside the "man-nature" system.

The environmental and ecological equilibrium between the possibilities and the limits of the resources and the necessities and the desires of the man, relatively to his need "to live" a place and the limited availability of resources "in loco", have given as a result to privilege the employment, as construction elements, of available materials in the immediate proximities of the places of building.

The characteristics of the human settlements and the architecture, in their formal, morphological and technical-constructive aspects, have been substantially conditioned therefore by the specificity of the places in which they have been realized and by the availability of natural products, (wood, clay, stone, straw, etc.).

During the time, but mainly with the Industrial Revolution and the production of electric energy, the human settlements have evolved more and more in very complex open systems whose inputs are the energy and the materials and the outputs other materials and refusals in a lot of different forms. Such evolution has also seen the dramatic growth of the quantity of the inputs and, accordingly, of the outputs, due both to the technological progress and the availability of energy, not perceived as a exhaustible resource.

This has determined the break-up of the symbiotic relationship between places and materials of the building and the loss of the permanence of the natural building products in their original place, guarantee of the operation of a cyclical trial of collecting, use and re-release in the global ecosystem, historically supported by the continuous activities of recycle and recovery of materials and buildings.

The construction of the settlements, more precisely the building activity, has so widened its role in the environmental impact as consumer of territory, raw material, energy (around 50% of the materials and 40% of the energy) and as producer of voluminous heavy and partially dangerous wastes (around 50% of solid wastes): the buildings cycle of life dramatically influences, therefore, the cycle of life of the whole planet: the speed with which the man environment has exploited the natural environment, in fact, has produced the diminution of the "changing capacity", more precisely the ability of the planet to absorb the construction wastes.

As a consequence, the rate of consumption of renewable material, water and energy resources must not exceed the rate of reconstitution assured by the natural systems, as well as the rate of consumption of non renewable resources must not overcome the rate of substitution of renewable resources: environmental sustainability means, therefore, to preserve and to use at the best the natural capital of the system in relationship to the processes of economic, social and productive development.

As the sector of the constructions assumes a remarkable incidence in the planetary energetic equilibriums, the diffusion of the sustainable architecture becomes very important: an architecture that can satisfy the building performance demands, through the employment of suitable technologies and planning criteria for new buildings and for the energetic recovery of existing ones.

The sustainable architecture deals with the study of the typological solutions and with the performances of the technological systems that mostly meet the environmental and bioclimatic requirements of the site and allow to reach conditions of comfort inside the buildings; such objectives are pursued through a planning activity that is aware of the use of the available resources. By analysing the origin of the term bioclima, and accordingly the adjective bioclimatica that comes from it, we can see that it is composed of two Greek words: bios that means life and clime that literally means inclination of the earth from the equator to the poles and in the current meaning the complex of the meteorological conditions of a given zone.

The bioclimatic term comes from the meeting of the architectural regionalism and the bioclimatology, and it expresses a type of approach aimed to face, with interdisciplinary contributions and with orderly and systematic methodology, the problem of the regulation of the climate: furthermore, we get the concept of bioclimatic architecture as an architecture that limits the environmental pollution, by minimizing the necessary energetic consumptions for the climatization (heating, summer conditioning and illumination over the day).

As a result, the bioclimatic architecture can be seen as a complex of planning solutions, which allow to assure the maintenance of environmental comfort conditions inside a building - in terms of control of the indoor microclimate, of the natural illumination of the buildings – and to limit strongly the intervention of plants involving energetic consumptions from conventional sources. Such architecture basically submits to the structure, to the physical conformation of the building, to its orientation and the climatic context in which it is realized, the assignment to catch or to relay the solar radiations and to exploit the local (for instance the prevailing winds) microclimate to get the environmental comfort.

2 METHODOLOGICAL APPROACH TO THE BIOCLIMATIC PROJECT.

The methodological approach for the definition of planning criteria within a bioclimatic project moves from the analysis of the principles of the environmental sustainability and founds it on a complex system of values that links to the traditional indicators of the quality in the building process, in terms of economy of the resources, Life Cycle Design, Human Design and refurbishment of the natural and built environment, the traditional criteria of the design itself, conceptually considered an application of the principles of sustainability.

An architectural project is generally arranged as an organised process according to a sequence of phases, which are in turn characterised by different procedures - from the initial cognitive analysis till the critical synthesis and the definition of the most suitable construction techniques and materials – in order to make it possible to characterize and manage the proposal. Within the project, each phase is connected to the previous and the following ones according to different criteria but not necessarily to a temporal relations.

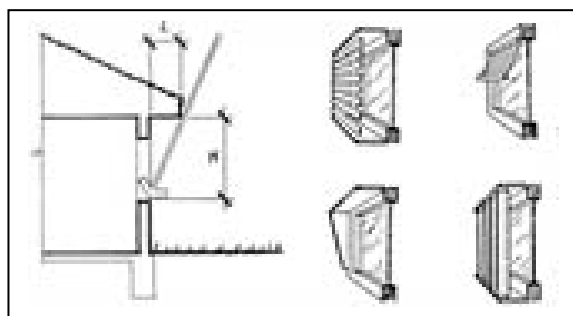
The modern bioclimatic project is characterised by two specific factors: the former concerns the necessary attention to the reaction of each individual element and of the whole building to physical phenomena; the latter requires the occupants to be provided with a high level of satisfaction. Each choice

during the planning is dependent on the physiological and psychological well-being of possible users.

Even if every buildings by now has to guarantee comfort conditions is, in the bioclimatic case, the interest is predominant toward the general levels of the optimal status of the users into the environment. The other principal character of the bioclimatic project that differentiates it from the conventional one, concerns the control of a building during the whole cycle of life. Today many buildings plans ask for deep studies related to the systems of control of an organism that works to satisfy some demands and to make the carrying out of some activities possible: one of the most important among such systems, it is the control of the indoor environmental conditions, both microclimatic and visual.

Nevertheless it doesn't exist a standardized modus to proceed, because it is difficult to find a solution that is more biocompatible than the other in absolute sense: to build in dogmatic sense avoids the possibility to have intelligent and appropriate solutions.

Different criteria and guidelines are necessary, from time to time, in order to create, through technical solutions, suitable conditions of habitability and conformity to the user needs. The general aim is to guarantee the shadowing (brise-soleil, vegetation with leaf trees, etc.), the ventilation, the isolation and the thermal inertia, the cooling (related to the shadowing and the ventilation), the humidification and/or the dehumidification, the defence from the winds and from the precipitations, the reduction of the thermal dispersion, the solar (active and passive) captation, the natural illumination and the conservation of heat, as the bioecologic architecture doesn't accept supinely the leadership of technology on the nature, but it tries to let the building interact with the external elements.



Figures 11-2: Shadowing systems

Further planning criterion is the "recycling" (which introduces the double advantage to limit the negative effects due to the disposal of the waste and to satisfy with the recycled ones the consumption of the raw material of the elements) even if the process must be realized with the awareness that you never get from these elements the original quality of the material, that must necessarily be destroyed after some cycles (down cycling).

3 BIOCLIMATIC PLAN AND CONTEXT (ARCHITECTURAL).

The fundamental elements of the bioclimatic plan, as already said, are the air (thermo-igrometric comfort) and the light; to these it has to be added another

element that becomes fundamental to guarantee the compatibility of the intervention in relation with the surrounding environmental context: the time, defined as the fourth dimension of living, that allows a procedural passage of notable importance: the passage, from a static conception to a dynamic architecture.

The dichotomy concerns the conservation of the behaviour and the functioning of the building and the transformation of its characters to improve its performance requirements. It becomes, therefore, essential a typological, material and architectural analysis of the surrounding environmental context, to deduce some suggestions for the definition of the bioclimatic project.

Nevertheless an operation of this type is not always possible; in fact, due to the lack of the studies on integration of the bioclimatic project with significant architectural contexts and due to the objective difficulty of conjugation of the bioclimatic rules with rigid architectural rules, dictated by the presence of a particularly notable area, it becomes complex to insert, for instance, a greenhouse or a plant photovoltaic plant in a building connected to an architectural context already defined and characterized by peculiar material-formal choices.

And although the architecture is "an exercise of resolution of problems" (Le Corbusier) not always, through the use of various forms and different dimensions, it succeeds in facing the huge problem casuistry list that introduces a bioclimatic project.

A further critical aspect derives from the attribution to the building of defined performance requirements, coming from the conformity to the laws and the demands of the users related to the specific destination of use, and to the possible problems of compatibility of the choice made according to the surrounding environment. In fact the missed definition of a system of congruencies that ties the system of the values (the limitations that the existing architectural context sets to the possibilities of change without losing the original characteristics) and the system of the uses (all the technical and technological choices coming from the demanded performances), involves a substantial compromise of the correctness and the compatibility of the project that, as said, is connected to the sustainability of the whole way of the project.

Anyway, the complexity of the problem of this field immediately shows the limits appraised of the concept of compatibility and makes necessary to refer to the ampler concept of appropriateness.

The appropriateness, in fact, in comparison to the compatibility, better defines the congruence, in terms of technical and cultural acceptability, of a way of action, because it doesn't contrast the bioclimatic principles and the surrounding context as two autonomous factors, but it values them as they condition themselves mutually.

4 THE CASE OF LA MARTELLA SUBURB IN MATERA.

4.1 La Martella and the modern architecture: the origins.

The first half of the last century has been for the Italian architecture a moment of meaningful changes in which the experimentation of original architectural languages and the application of the modern principles of urbanism have been, on the one hand, characterized by the use of new materials and

technologies and, on the other hand, tied up to particular social, political and economical conditions coming from the war events and the necessary reconstruction. The architectural patrimony of Basilicata has strongly been characterized by this experimentation of the "Modern", from the applications of the first decade of the 1900 in the diffused manufactured articles of specialistic architecture on the territory to those ones over extraordinary operations of Reclamation and Land Reform that in the '50s of the same century have had their amplest development.

The authorities who carried out the intervention basically made use of their own technicians, but they also collaborated, through direct assignment or contract, with numerous planners, already affirmed or future teachers of engineering, urbanism and contemporary architecture. These planners were external to the administrations and came from every part of Italy. They elaborated new organizing schemes, new forms of settlement on the territory, relationship with it and exploitation, starting from the resolution of hydrogeologic problems through important works of engineering, up to the definition of real housing models inside specific formalities of settlement. In few years a new image defined the identity of these new places, by replacing the dimensions of the latifundium with those ones of small and middle properties and the fortified farms, namely masserie, with the Centres of Service. The choice of the settlement model for the population of the dispossessed countries was the theme of the strong debate, from the end of the '40s till the middle of 50's, among the authorities on the territory of Basilicata. The centralized settlement model, favourably seen by urbanists and agrarian economists, was realized as an inhabited nucleus, placed in the centre of mass of an area, by considering extension of the path that every day the farmers had to covered to get to the fields. The suburbs of La Martella and Venusio are referable to this last model.

The village La Martella in Matera is not only a contribution to the solution of the building problem. It is also and above all the symbol of a way to act. The Suburb La Martella belongs to the numerous projects effected at the beginning of the '50s to relaunch the whole southern territory destroyed by the war; for Matera, particularly, an innovative architectural project was elaborate in order to re-propose, with better conditions, the life of the ancient Neighbourhoods Sassi and to transfer, without violent traumas, the big part of the population then resident there.

The history of its birth is the story of the birth of a human being: an extraordinary

fact, complex and delicate, but in conclusion, "a natural fact." When in 1950, the

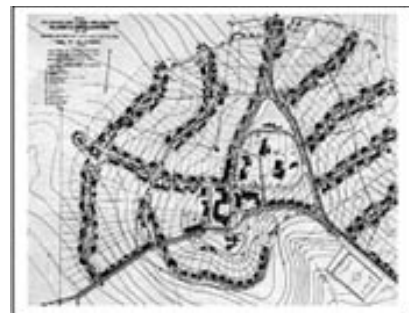
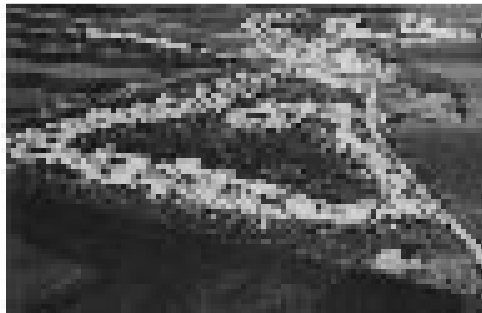
UNRRA-CASAS had an allotment of 5 million from the Liras ERP fund, it was

defined, among the other initiatives, an intervention in Matera. In 1950, the

President De Gasperi visited Matera, as well as the building and drainage works in

that area, among which there was the project La Martella. Then, the President of

the Council announced, in his speech, a program for the total improvement of the unhealthy districts of caves in Matera. La Martella was inserted in this program and represented, already in action, the signal of opening.



Figures 3-4: La Martella: the original planning

4.2 Architectures and technologies.

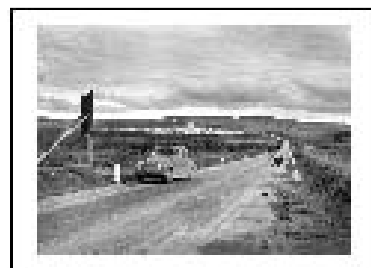
The main issues concerning the village foundation, particularly referred to a typological scheme aimed at preserving the life way of future habitants, lead to spread a sort of "neorealism" in which, reproducing the neighbourhoods of the Sassi, it has tried to get the peculiar characters of the country life translating them in architecture; nevertheless invading and equivocal ways are not missing: the "spontaneous" that aims to exhume the disappeared signs of ancient settlements, the "neoliberty" that expresses an artificial effort to recover a past experience of the European art and the "environmentalism", that expresses the obsession to link up with the ancient dimension even before having created a new one.

The arrangement of the village reminds the "star shaped" settlement typology in which the streets, following the morphological course of the ground, they divide radially from the centre toward the countryside, by connecting the blocks of houses. The buildings are opportunely joined in small groups that repeat, in the social situation, the spontaneous groupings that were consolidated in the Sassi. Also the roads have been projected so that, widening in determined places, they become points of meeting of the population in which the community life is developed.

Nevertheless the public buildings and the residential housing unities don't follow slavishly this traditional model; in fact, the buildings show slightly diversified dimensions, even if they get a sort of standardization of the types, also by maintaining some recurrent elements, as for instance the stall, equal for all the buildings.

Furthermore, to break the monotony of long lines of very similar houses, it has been used to connect rectangular dwellings by the short side and sometimes by the long side. As a result, there are almost square short volumes or lengthened rectangular volumes, that make the space perception heterogeneous.

A planning, that is inserted in a so characterized context, cannot leave out of consideration from the knowledge of materials and constructional technologies employed for the realization of the analysed architectural heritage. Researches, dealt with the analysis of the residential typologies of rural suburbs built for the Land Reform, have revealed a general description of the static project of these buildings and they have underlined that the early 90's building production has been affected by an even innovative process with the use of new materials, such as cement bindings steel. In Suburb La Martella, the constructional technique overlaps to the described one, with the typology of the load bearing masonries with square blocks of local stone and slabs with iron beams and hollow tiles and, sometimes, especially in stalls and barns, with irregular wooden beams and partition. Outside the finishing is the typical "scialbatura" on the mortar, that reminds the traditional "hygienic" treatments of the façades, already used just in the ancient Sassi Suburb.



Figures 5-6: the "La Martella" work-site

4.3 The settlement today.

Originally born as rural suburb, La Martella is considered at date as the natural extension of Matera city, thanks to a series of industrial and manufacturing activities that tried to connect physically the suburb with the city as a urban district of it. Today the Suburb is rather homogeneous both for formal and for type features, even if each building unit has undergone several typological and morphological changes and shows different forms of decay. A meaningful intervention of urban recovery - the contest EUROPAN - realized in the 90's, before, and the recent lotting out - ECOPOLIS - later, have given a new image to La Martella as a modern urban district located in a meaningful urbanistic frame, characterized by the indelible sign of arch. L.Quaroni.



Figure 7: the "La Martella" today

5 A PROPOSAL FOR LA MARTELLA.

5.1 The origin of the proposal.

The proposal of a bioclimatic intervention in the suburb of La Martella enters the wider plan of "Programma di Quartiere", a program financed by the Italian Government whose strategic aims are the building refurbishment, the social requalification and the economic growth of the suburb through high quality interventions, in terms of architectural image, typology and relations with the environment, referred to the public residential building.

Within a national competition on the planning of 8 dwellings with biocompatible characteristics, a previous work proposal has been developed, according to methodological guidelines underlined in paragraph 3.

5.2 The project.

In order to place the buildings into the lots, given planimetric and dimensional ties, the relationship with the free space and the relationship with the solar run over the year have been considered. For this specific planning pattern the shades has been taken into account, as they can give possible obstructions for the correct use of passive and active solar systems, especially in the winter period. The second step concerns the definition of such form that allows the solar rays to enter in the winter period and the tall rays to be screened in the summer, by preserving and conforming the building to the surrounding built environment and landscape. In fact the architectural sign and the site history are strongly intrusive elements in the formal architectural approach. The architectural project of the new buildings comes just from the typological and volumetric change due to the modern architecture of Quaroni and let the insertion image in the landscape and in the built environment prevail as a non extraneous element. The project has been realized through different heights of volumes - a typical sign of the Quaroni planning – that are alternated with empty parking lots, that accent the visual penetration among the building blocks. The southern main façade marks the final image of the architecture and acts as basic element of the bioclimatic functioning of the dwelling. The northern back façade denies the main image, with few surface glass, in order to get a the balance of ventilation and natural illumination, required by the project criteria. The south façade shows big glasses, behind the external surface of the floors, in order to optimise the winter picking up and the summer protection from the sun rays. Similarly, in the rear volumes, the glass doors have been decentralized on the perspective plan for improving and optimising the inclination of shadowing of the shades reproduced by the anterior volumes. Solar control is increased by a system of thin movable plates, the brise-soleil. The whole architecture is thought in "green" and the final image characterized by the garden roofs, links form and function in the spirit of energetic optimisation, that is proper of the "bioclimatic." As the general form has been defined, defined, the spaces that have the maximum requirement of heating and illumination, have been placed on the southern side of the building, such as the living room, at the ground floor, and the three bedrooms, at the upper floors. Just the different heights of

the levels with the internal staircase have allowed the positioning of all the principal rooms, with glass doors directed to south. On the north side the zones that less need the sun has been located, such as the kitchen, the baths, the staircase. To let the sun penetrate the whole space through the windows, the depth of the spaces along the south side didn't overcome twice and a half the height of the windows from the floor (result of the studies effected by the Illuminating Engineering Society): this empirical rule also guarantees a suitable illumination of the indoor space. Besides, the ratio of 1 to 8 between the floor surface and the transparent surface, as well as the factor of average diurnal brightness, has been respected. The arrangement of the spaces has been studied in such a way to meet the requirement of solar light, as in the winter period less electric energy is exploited for illumination and heating. The eastern and western sides don't have any opening to prevent the strong heating during the afternoon hours in the summer. The architectural planning concerns both the functional-spatial aspects and the technological features. Natural ventilation and illumination, internal and external colours, have considered the criteria of microclimatic comfort of all the environments, as well as the reflecting effects of the colours of the horizontal and vertical inside surfaces. The windows, from the planimetric point of view, have been positioned only on two sides, the north and the south ones, to allow a good ventilation. The southern windows, with big surface in comparison with the northern ones, they have been projected so that the solar thermal profit, in winter, is greater of their thermal dispersion. The use of rolling blinds has been provided so that in summer the direct radiation and, as a consequence, the thermal gains can be minimized, by allowing the light to enter. The entrance to the single unities is placed on the southern private garden, by the great glass door of the living room. In order to reduce the thermal exchanges with the external environment, both for conduction and for infiltration, a double entrance has been provided with two doors that open one toward the outside and one toward the inside of the building, so that a zone "pad" is created. In the bedrooms that have a blind external wall exposed to north, a wardrobe has been inserted with function of thermal isolation. The planning also concerns the external spaces of the building, as, for instance, the private green, coherently with the "bioclimatic techniques of the green" to be exploited in the summer period. All the external floorings are permeable to allow the recharge of the underground water table. The following footstep has been the search of the most proper system to allow the best conditions of thermoigrometric comfort and the choice of the bioclimatic systems, on the basis of the previously highlighted issues. The building has been conceived as a passive system in which the building becomes a collector. Its form has to be open toward the south and close toward the north and it has to have a great mass for the accumulation of energy. The accumulator of energy is the same building and the heavier the system the more efficient is the building. An important role is performed therefore by the materials. To prevent phenomena of overheating a more or less whole of complex systems of control of the natural thermal flows has been provided, from the screening of the openings to prevent the solar profit till the inside artificial ventilation that, if necessary, can be also climatized through a system of air treatment by a solar thermal source.





Figures 7-8: The project of "La Martella"

5.3 The project and the context

Taking back the concepts previously stated in the paragraph 3, a fundamental consideration must be done on the place, as context with many interactions, in which the project takes place.

The first evaluation is related to the winds from which to defend in the winter period and to exploit for the ventilation in the summer period. To regulate the air flows plays a very important role the type of vegetation and its place on the territory. For the protection from the winter cold winds coming from north, in fact, there have been selected some evergreen essences that have been positioned in the northern part of the buildings to create a protective barrier. On the south side, instead, vegetation has been selected that is composed of deciduous trees that work as regulator of the solar radiation, producing shade in the summer and letting the solar rays to enter in winter when the trees have already defoliated to make the accumulation of solar energy possible. The fundamental elements that meaningfully influence the microclimate and, accordingly, the conditions of thermal comfort, can be natural, such as the morphology of the ground, the materials, the water and the vegetation, or artificial such as the systems of shadowing. In this case, it has been provided the planting of small deciduous trees along the paths to allow the enjoyment of the sunny days in winter and the shades of the trees in summer. The planning of the public green has been aimed at the constitution of an open space in relation with the environment. For this purpose, the public green has not been separated from the private one, almost giving them the impression that the public green penetrated among the private gardens and, in the same way, the private green ideally prolonged the public one through the pedestrian paths. The general aim was to create a natural space of quality, never monotonous, that induced the people to move and to relate each other. The arrangement of relax areas have been provided to harmonize the relationship between residential outside and inside.

Particular care has been set in the choice of materials able to define the local microclimate, as the choice of unsuitable materials, for instance on a pedestrian public space, as well as a street or a square exposed to south, can create, in some conditions, an island of heat that discourages the will to live the place, contributes to lower the level of comfort and makes it less enjoyable. In the centre of the public green a level space has been placed for children activities, health paths, cultural events and popular folk meetings. To facilitate the use of the equipped green areas, during the diurnal hours in the summer period, the parking lots have been provided by some arbours with climbing essences to guarantee shaded areas for the parked cars and to act as elements of urban furnishment. Besides, the arrangement of the green has been studied in such way to attenuate the noises coming from the traffic. The disposition of trees and hedges along the roads has been carefully evaluated in order to filter the acoustic waves.

6. FINAL REMARKS

The project tries to give an answer, univocal and repeatable at the same time, to a project idea, that conjugates new constructive approaches and environmental settlement, with an architectural context, planned with great wisdom and mastery of the knowledge of the vernacular traditional architecture, and so planned in the environment, with the environment, with the full respect of the most canonical criteria of sustainability.

The bioclimatic planning is not only energy saving, but a way to live in harmony with the environment and its changes, because, unlike the traditional planning, it doesn't defend itself but it communicates with the environment and its energetic flows. This form of communication could be extended even to the formal aspects in meaningful architectural contests. Only in this way, the man can recover the equal relationship with nature, even artificial, but valuable, which by now has been lost for a long time.

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