

Survey, analysis and representation as instrument for control and evaluation of the transformations resulting by retrofitting in the historic cities. A sustainable energy requalification through monitoring of the changes of the architectural heritage.

Gerardo Maria Cennamo

Abstract— Generally the Italian and Europe conurbation, in addition to the most important historical cities, is characterized by a large number of urban and suburban areas, nucleus and districts of cities that, although not are classified as historic center by urban planning often reveal a remarkable formal language, a synthesis of morphological and architectural archetypes and a good balance formal and functional which have developed in the succession of ages, usually inhabited and lived in our contemporary times.

In the range of the no-solved dichotomy between conservation and innovation, the thematic of regeneration of the historical cities can be located, in Europe as in other parts of the world, in functional and energetical terms. In an age during the which the social practice evolution becomes more and more united with the daily utilization of technology, once used exclusively by elite circles –scientific and professional community- the historical city, harbinger of a cultural, sociologic, iconographic and mnemonic heritage, ancestrally rooted in the conscience of civilization, addresses the complex path of the research of an equilibrium between the own essence and the new modernity needs. From the middle of the last century, the physical and social deterioration that for various reasons cause has influenced many urban

This work is in the interest of PRIN 2010/PEA4H8 and is supported in part by the MIUR (Italian Ministry of Instruction). It is part of a research carried by the author into the Engineering Faculty, civil and environmental department, of the International Telematic University UNINETTUNO (Rome, Italy) about the topic of the centrality of energy retrofitting in the historical city. In particular the research is studying the role of the representation as an instrument for control and evaluation of the processes of transformation in the retrofitting, principal through the survey and subsequent graphic simulation as a means of monitoring changes of the architectural heritage. The case study presented in this paper is the continuation and enlargement that one already submitted at 5th International Conference on Applied Economics, Business and Development (AEBD '13) in Chania, published in *Recent Researches in Applied Economics and Management - Economic Aspects of Environment, Development, Tourism and Cultural Heritage*, WSEAS Press, vol. Volume II.

Gerardo Maria Cennamo, architect, is professor of technical drawing, architectural survey and representation technique at the Engineering Faculty, civil and environmental department, of the International Telematic University UNINETTUNO, c.so Vittorio Emanuele II 39, 00186 Rome, Italy; phone: 0039-060669207639, e-mail: g.cennamo@uninettunouniversity.net.

areas, has expanded to a new suffering that showed a further condition of inadequacy of the public sphere. Individual buildings or entire urban areas and pieces of city, have begun to deal with a new one (in terms of perception) and postponed requirement, established by the need to embark on a path towards a logic of sustainability in terms of functionality and energy.

Keywords— Retrofitting, architectural heritage, historical cities, representation, knowledge, survey.

I. INTRODUCTION

THE scope in the fully interests of research are represented by many urban and suburban areas, nucleus of cities, districts and city of pieces that much characterize of the Italian and, in general, European conurbation that, although not are subject to specific preservation regulations and not classified as historic center by urban planning express, most times, a remarkable formal language, a synthesis of morphological and architectural archetypes which have developed in the succession of ages. Many European historical towns show a number of features, peculiarities and common traits to each other which, although in different places, have often contributed to give a common identity and similar conurbation. In such a state the architectural heritage often avoided every logic of performance, except of course from the gorgeous monumental, governative and noble buildings. Taking into account the fact that some of these peculiarities are still important distinguishing features of the urban centres of a certain historical concern, their recognisability and cataloguing, made through a samples research, become the base and the cognitive heritage useful to gain with the research for the best solutions, taking into account not only the extraordinary historical heritage but also the need to second that process of requirements, functions and conditions, forced or resulted by a contemporaneous fruition of the historical site.

The real question, in fact, for which this research seeks to

identify possible solutions or at least good practices and methodologies, does not affect strictly heritage and historical areas of most valuable historical interest or, for better said, those areas that are already subjected or protected by specific statutory regulations.

We are referring for example, on the Italian scene, at the buildings considered "monuments", in the interest of the Italian statutory regulations *Parte II Decreto Legislativo n° 42/2004, ex legge 1089/39*, the cultural heritage so specifically approved and classified or areas subject to specific regulations of landscape preservation or the areas classified as historic center by urban planning. Under these circumstances, in fact, the legislative system deepens and clarifies specific aspects, which most often privilege the immutability compared to other important needs, so not wanting to delve into these merits we take notes, however, that as soon as a specific protection regulation, the interventions of retrofit or even other new functional improvements to any level of detail, are put by law in a priority scale "lower" and subordinates, in any case, to the maintenance and often to the total immutability of the entire site or the buildings.

That's why for these areas, or better in such circumstances, the question of the control of the transformations resulting by retrofitting of the architectural heritage and consequent analysis of best practices, is effectively reduced, upstream, by the impossibility (by law) or almost to realize any intervention of transformation. This path is not easy, especially in the pleasant setting of formal and architectural balance in Italy and in Europe, recognized as a historical city; in fact this path cannot be abstracted by the clear definition, from a verse, of the extraordinariness of historical heritage and, from an other verse, by just as important identification of imposed -or deriving from a contemporary historical place- needs, functions, conditions system.

This contribution therefore aims to highlight the main procedural issues, planning and management authority relating to regeneration in the historic city, through the reading of an urban environment taken as an example, where specific and relevant formal features.

II. PROBLEM FORMULATION

Approach with method the problem of dissipation of non-renewable energy and, in general, environmental pollution is now an imperative condition at the international level.

The awareness that most of the historical heritage or however built until a few decades ago are the true responsible for a high proportion of environmental pollution and releases of carbon dioxide in the atmosphere, produced by their "lives passive", through the usual and daily use of domestic utilities and equipment has led to the attention of the scientific community and civil society in general the problem of retrofitting of the housing stock.

We can say that now there are already many technologies and procedures to be applied for this purpose in the new building, so the issue becomes very controllable in the event of

new buildings.

Likewise when it is possible to work in a decisive manner on the building, making necessary changes to the plant and architectural level, the action of retrofitting is a simple application. But in the case of historic heritage as it becomes possible to operate?

What choices such as shares, such assessments must be implemented in urban areas characterized by historical or however formal and architectural balance structured in a different historical periods?

As we said in the introduction, the scope in the fully interests of research are represented by many urban and suburban areas, nucleus of cities, districts and city of pieces that much characterize of the Italian and, in general, European conurbation that, although not are subject to specific preservation regulations and not classified as historic center by urban planning express, most times, a remarkable formal language, a synthesis of morphological and architectural archetypes which have developed in the succession of ages. It is precisely these the "essences", the *genius loci*, the most salient characteristics of the conurbation of our territories, Italians and Europeans in general, so that it was not wrong to use the definition of "historical city" wanting to synthesise, in this expression, the sum of the characters and archetypes we have mentioned. This is the test, this is the place of confrontation in which explore how annul, or at least moderate, the conflictuality and criticalities resulting across the great value of cultural heritage, to be preserved as it is, and the demands, not be postponed, of a contemporary living environmentally friendly and conscious that natural resources are quickly running out.

The historic city, a harbinger of a cultural, sociological, illustrations and mnemonic ancestrally rooted in the conscience of civilization, addresses this complex process of finding a balance between the essence and the demands of a new modernity through a delicate balance in which the conflict between conservation and innovation take predominates. In fact, this path cannot be abstracted from that and that a clear definition, on the one hand, the extraordinary nature of the historic and, on the other, the equally salient identification of that system requirements, functions, conditions imposed by or derived from a use contemporary historical site.

How and in what way it can be considered "sustainable" if the historical place related to an ecosystem characterized by the current conditions?

How and to what extent can change the perception of the site in relation to the pursuit of these objectives in terms of sustainable energy?

It's necessary to determine the priority of values, defining rules of conduct such as moderate, if not cancel, the resulting conflict that inevitably comes from the prelude and comply with the same, including the value of the past and expectations of the contemporary.

The identification of these "rules" and practices inevitably passes through the design of context that, as the primary

instrument of knowledge and simulation, takes the value predominant in these specific transformation processes.

III. PROBLEM SOLUTION

The issue, especially in Italy, it becomes urgent if not impelling, partly because of common sense of people and partly because the many directives, such as the UNESCO Recommendations HUL (Historic Urban Landscape), the Directive 2009/28/CE “20 20 2020” or the objectives of Horizon 2020. But this question is not already enabled and, especially, not systematically implemented by the Italian statutory regulations that interest urban development and construction industry.

I am often recalling circumstances of law not for glut of information, but since, especially in Italy, the building activity and transformations of the territories in general, are subject a structure of statutory regulations most times very complex; the result of the application of the structure of regulations in urban/housing area sometimes becomes complex as much the definition of a mathematical matrix, without having the certainty of the solution!

Yet it seems that in recent times the attention of regulators is still paid to aspects that do not appear to address the issues under discussion, which still are of interest exclusively of scientific communities. Continuing our main interest in the representation as an efficient instrument of knowledge, monitoring and analysis of the transformation of cultural heritage, we have sometimes researched items of interest in the urban planning area, but without satisfaction.

Instruments of guidance and urban planning, such in Italy as the *Piano del Colore*, could be contain valuable information and solutions for analysis and therefore the best practices for implementing the retrofitting in the historical cities, of course the finality that we want to follow for the “historical city”, that is not so much the best performance in absolute terms (in this case already exists a lot of good knowledge) but rather to the best balance across the need to preserve and innovate, between the value of the past and needs of contemporary life.

We would like to clarify that the scope of interest of this research is not precisely the project, (it would be in a specific field of competence of scientific sectors discipline already extensively studied with excellent results), but priority of knowledge, survey and analysis.

Thorough knowledge of the areas of intervention, in order to learn and recognize the most salient constitutive characteristics, the essences, the fundamental archetypes.

The genius loci, but also through a systematic approach, recognizing the momentous layers, influences that exist and can be found in the historical building.

Define the scope of intervention, representing the conurbation, the space complexity, the architectural composition, the compositional language, the colorimetric quality. That 's the first fundamental step of the work. Analysis of the potential transformations or, better said, the transformations compatible with areas of interest, the historical

city, resulting across application of the techniques of retrofitting already, as before mentioned, notes, studied in specific disciplines and of which are we take note of the results useful for our specific research, through the modelling and the graphic simulations the most better methodologies and the best practices.

In this direction, the "retrofit" of the historical city, as a sustainable regeneration, becomes an element able to initiate policies for restoration and urban innovation of the historic cities, to secure the housing stock obsolete and implement the construction sector.

Preliminary research activities will produce a report, resulting from a sampling of historic cities, about the status of the historical cities, analyzing the conditions of security, energy, environmental and quality of the urban habitat.

IV. CASE STUDY

The Giusso district is part of the Campi Flegrei, geographic area in the north of the city of Naples, characterized by a strong and clearly evident volcanic nature.

It is part of the Municipality of Bagnoli which is the tenth of the city of Naples.

The name derives from *balneolis*, because, before the realization of industrial settlements Italsider, Ilva steelworks, which has been active since the beginning of the '900 until the nineties, there were termal areas also with hot springs.

It is located next to the industrial settlements of Ilva and is enclosed between two railway lines, the Cumana railway to the south and the metro line to the north. The Giusso district is characterized by buildings dating from the early '900, Art Nouveau style. Common themes in the architecture Neapolitan *liberty* or *floreale* are the massive use materials like iron and glass, the recurring presence of towers and pilasters the widespread use of stucco and decorative floral motifs and ornamental plants, the curved shapes of the cement.

The Giusso district is structured like a chessboard, a Roman *castrum*, with major axes from south to north, in fact most of the area faces the South and proximity to the sea.

Along the main north-south street of Campi Flegrei is an elevation gain of 30 meters, which results in a good exposure of all isolates.

Considering the solar exposure, urban structure and construction type orientation, conurbation, the dimensions and characteristics of general climatic, as the winds in summer that are prevailing direction from quadrants SW, NE and NW, with average temperatures of 22 at 30 degrees for three hours in a day, the entire area has characteristics of high energy dissipation. According to the climate Italian classification, the area of Naples is situated in Zone C. (fig. 3 a, b)

So the case study analyzes, like continuation and enlargement that a paper already submitted, a second more the first portion of the area Giusso represented by the entire road axis, street named A. Maiuri / C. A. Pollione, fully exposed to the south for the entire development.

The main aim so, for the purpose of upgrading the energy

efficiency of action, is to moderate the thermal dissipation due to the particular exposure and climatic conditions of the area especially in relation to the type of construction, if that does not achieve of significant architectural quality particular performances in terms of transmittance. The main issue is that it does not negatively affect the view of the architectural features the district and define the right choices in this regard. A valley so of the analysis phase is fundamental the ability to simulate, through the representation of some hypothetical transformations, the possible forms in order to control the transformations and analyze the right responses. We have analyzed three different intervention solutions and simulated through the representation of the effect of the changes on the perception of the architectural heritage.

1 - Transformation implemented through the utilization of trees, positioned in a front and parallel to the curtain of buildings.

By the climate data is identified the opportunity to use Caducous leaves trees, so the positive effects are maintained during the transitional seasons and eliminate almost all the unfavorable effects during the winter.

Therefore we make use of broadleaved species foliage large and in the specific of *Tilia tomentosa* (Basswood), originating from Eastern Europe that is resistant to summer, drought and pollution. This type of intervention allows for various results. The first results consist of a totally naturalistic approach. Then considering that the area faces the South and very near from the sea, so with trees we have the effect of shading, the mitigation of temperatures, and a creation of air currents which increase the summer ventilation during the day.

During winter the Caducous leaf trees it avoid having shading but the presence of spin (trees with hemispherical shaped crown) allows, even without of leaves, to have a windbreak, like a wind barrier, that has still greater effect if we lower the distance among the trees. In fig. 8 and 9 (a,b,c,d) is simulated the change made to the visual perception by this change.

2 - Transformation implemented through the realization of solar greenhouses, working as thermal regulators.

These changes modify so on average the visual perception of the site, introducing changes that, in certain territory or places, do not adversely alter the architectural and formal balance of the site. In fig. 10 and 11 (a,b,c,d) is simulated the change made to the visual perception by this change.

3 - Transformation implemented through the installation of photovoltaic paneling of the new generation, with semi-transparent colored glass to 366 shades of color, positioned in a front and parallel to the curtain of buildings.

It's sure that this methodology introduces changes that strongly modify the visual perception of the site. This does not mean that these modifications negatively impact on the formal and architectural balance of the site, but surely they modify with a new perception colorimetric the perception of the buildings and generally of the site. In fig. 12 and 13 (a,b,c,d) is simulated the change made to the visual perception by this change.

V. CONCLUSION

Finally it is evident that now the issue of retrofit of the historic city, especially the European historical cities, cannot be further postponed. It is therefore necessary to identify, through research, the best practices, technologies and methods to be able to overcome the difficulties arising from the criticality between the necessity of implementing improvement measures and opportunities to preserve and enhance our architectural heritage. Especially in the areas of fully interests of the paper that are represented in many urban and suburban areas, nucleus of cities, districts and pieces of city that, although not are subject to specific preservation regulations and not classified as historic center by urban planning express a remarkable formal language, a synthesis of morphological and architectural archetypes which have developed in the succession of ages, our research check through the techniques of simulation and representation, the effects on the architectural heritage procured by the transformations necessary, in order to evaluate their impact on the vision and analyze the fairness and sustainability.

REFERENCES

- [1] G. Cennamo, "Il quartiere Giusso a Bagnoli", Unione Industriale - Gruppo Piccola Industria, Napoli, 1994
- [2] Truppi, C., "In difesa del paesaggio per una politica della bellezza", Electa, Napoli, 2011
- [3] R. Florio, (edited by) "Città storiche. Città contemporanee. Strategie di intervento per la rigenerazione della città in Europa", Clean, Napoli, 2012
- [4] G. Cennamo "The centrality of energy retrofitting in the historical city as a challenge for the immediate future. The role of the representation as instrument for control and evaluation of the processes of transformation; case study for a sustainable regeneration", in *Recent Researches in Applied Economics and Management - Economic Aspects of Environment, Development, Tourism and Cultural Heritage*, processing of the 5th International Conference on Applied Economics, Business, Development (AEBD '13) Chania, 2013, vol. II
- [5] G. Cennamo, "L'apporto dei fattori bioclimatici nella evoluzione della forma urbis, dalla matrice primigenia dei nuclei urbani alla rigenerazione della città storica attraverso la architettura solare", in *Città storiche. Città contemporanee. Strategie di intervento per la rigenerazione della città in Europa*, Napoli 2012
- [6] G. Cennamo, S. Savoia "The role of knowledge in the definition of analysis and design strategies. The approach to BIM - Building Information Modelling as a new frontier for the representation, simulation and management of the architectural heritage." in *Recent Researches in Applied Economics and Management - Business Administration and Financial Management*, processing of the 5th International Conference on Applied Economics, Business and Development (AEBD '13) Chania, 2013, vol. I
- [7] C. Truppi, G. Cennamo "Landscape Protection between Preservation and Change" in *Recent Researches in Applied Economics and Management - Economic Aspects of Environment, Development, Tourism and Cultural Heritage*, processing of the 5th International Conference on Applied Economics, Business and Development (AEBD '13) Chania, 2013, vol. II
- [8] A. Koiv, A. Mikola "Ventilating of Old Apartment Buildings", in *Recent Advances in Energy and Environment Integrated System, processing of the 2nd International Conference on Integrated Systems and Management for Energy, Development, Environment and Health (ISMAEEDH '13)*, Morioka City, Iwate, Japan, 2013
- [9] P. Mastny, Z. Mastna "Energy Systems for Modern Buildings" in *Environment, Ecosystems and Sustainable Development (EEESD '13)* proceedings of the 9th International Conference on Energy, Lemesos, Cyprus, 2013



Fig. 1, Napoli, orthophoto of Giusso district in Bagnoli's area



Fig. 2, Sun-path diagrams of Giusso district. The solar irradiation on the curtain of the buildings examined, particularly strong in the southern exposure

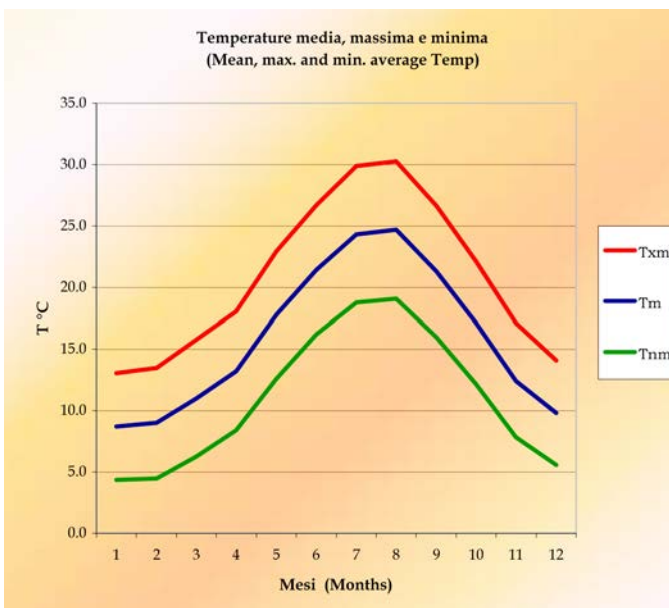


Fig. 3 (a) diagram of mean, max and min. average temp.

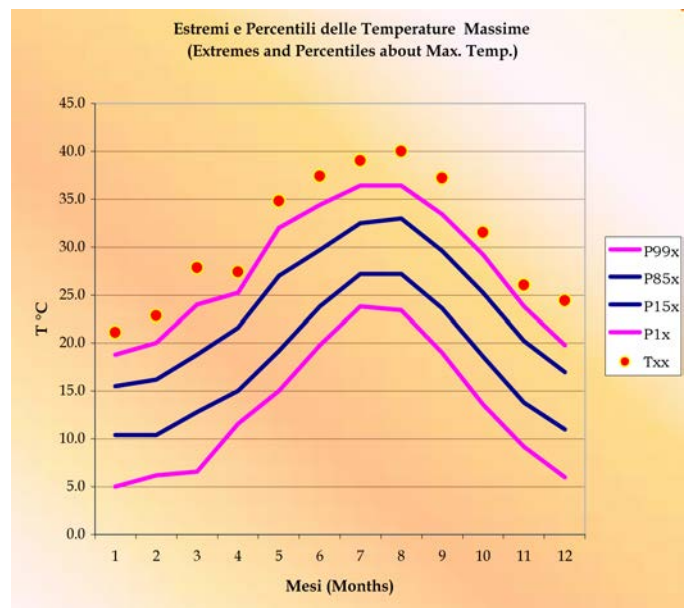


Fig. 3 (b) diagram of extremes and percentiles about max. temp.



Fig. 4, Detailed plan (with ground floor) and fronts of the buildings. Drawn from the architectural survey of the area



Fig. 5, Photoplan (*fotomosaicatura*) of the fronts of the buildings, so is evident also material and colorimetric aspects of the front of the buildings

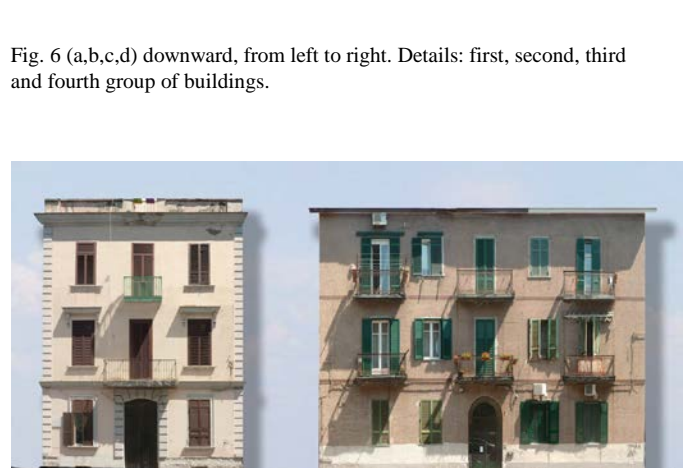


Fig. 6 (a,b,c,d) downward, from left to right. Details: first, second, third and fourth group of buildings.



Fig. 7, Analysis and proposal for intervention for 1/3; elements positioned parallel to the curtain of buildings (trees or photovoltaic panelling). Detailed plan



Fig. 8, Analysis and proposal for intervention n. 1; shielding by tall trees, study of the visual perception of the site



Fig. 9 (a,b,c,d) downward, from left to right. Details: first, second, third and fourth group of buildings.





Fig. 10, Analysis and proposal for intervention n. 2; construction of solar greenhouses with screening panels, study of the visual perception of the site



Fig. 11 (a,b,c,d,) downward, from left to right. Details: first, second, third and fourth group of buildings.



Fig. 12, Analysis and proposal for intervention n. 3; shielding by shielding by semi-transparent coloured solar glasses, study of the visual perception of the site



Fig. 13 (a,b,c,d,) downward, from left to right. Details: first, second, third and fourth group of buildings.

