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How to face
the scientific communication today.
International challenge and digital technology
impact on research outputs dissemination

edited by

MARCO MEDICI

VALENTINA MODUGNO

ALESSANDRO PRACUCCI

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Integration of passive systems to improve the environmental comfort in historic buildings: the natural ventilation. Definition of operational and design models

GAIA TURCHETTI

PhD

Università di Roma La Sapienza

Rome, Italy

Abstract

In the process of protecting and preserving the architectural heritage, the research of balance between structure and form, old and new intervention is an ongoing challenge which aims to respond to modern needs, understanding that it is no longer possible to disregard the understanding of the environmental comfort problems applied to improve the efficiency and compatibility of the intervention.

Well-founded in theory the need to intervene on heritage with measures to ‘improve’, the problem that persists in practice consists in calibrate the proper ‘weight’ of concurrent factors: architectural heritage, functional equipment to ensure, assessment of feasibility of the intervention.

Therefore, the research will investigate the issues of improvement of the comfort conditions in historical buildings inside the discipline of restoration, especially in its design lapel, where G.C. Argan (1986) has highlighted a disconnection problem between theory and practice.

The target is to understand the application of passive systems for reducing the use of active ones, source and cause of problems of compatibility and reversibility, paying attention to ventilation as a passive form of cooling and heating. Underlined are the fallouts in terms of design, with emphasis on the ‘space limits’, where the triggered mechanisms can determine the variations that are useful to define the right interior comfort.

In this context it must be assessed not only an objective component, represented by measurable parameters, from compositional aspects of space or technical installations, but also all that part of sensorial

components that, if evaluated properly, it can have a positive effect on energy reduction in the buildings.

Focal point of the research is the identification of real cases that can provide the basis for the research of a share methodology.

It is essential that the matter be extended to the whole context, addressing the issue of ventilation from the confined space until the urban scale, and vice versa, evaluating the contributions that are the boundary that will influence the dynamics, without losing sight of the *entire* and not the *all*.

Keywords

Comfort, natural ventilation, architectural restoration, filter space.

Introduction

The design act, since the beginning of constructive knowledge, aims to identify the conditions of satisfaction with the environment, the definition of a feeling of physical and mental health, the search for that set of conditions which regulate the mechanism of self-regulating on human body¹, in order to merge, into a single architectural gesture, the technological constructive, environmental climatic, organizational and figurative subsystem (Los 1990) and mediate between the needs of use and comfort.

The ‘algebraic’ definition of those parameters that define this thermal sensation has been the subject of studies that from Fanger onwards have concentrated on the definition not only of factors objectively measurable but especially of those subjective, of more complex definition but of an equal weight and importance.

If we add to this multiplicity of factors another ‘degrees of constraint’ arising from the recognition of different scales of values² attributed to the architectural opera, it is quite clear the difficulty of translating into practical act a theoretical assumption in itself already complex and unlikely delineable, calibrating the right ‘weight’ of the contributing factors.

Considering that just over 19%, amounting to 2.150.259 units of the Italian building stock appears to have been built before 1919 (Ambrogio and Zuppiroli 2013; ISTAT 2001), and at least 46,025 of these units are classified as heritage architectural protected³, are immediately evident both the problems that the future potentialities of intervention on this legacy in terms of improving the characteristics

of environmental comfort⁴.

On the one hand the difficulties of integration between improvement measures and the features of historical buildings (De Santoli 2014; MiBAC 2015), especially protected, and the limitations when evaluating the performance -not only energetic- of this buildings, on the other the ‘value’ of these assets that should be evaluated not as a ‘constraint’, but as an ‘opportunity’ to project, in view of a ‘performance’ not only energetic but also ‘cultural’.

In this context, it is developing my research work, dwelling on the need of calibrating the concepts of environmental comfort with the act of the restoration project.

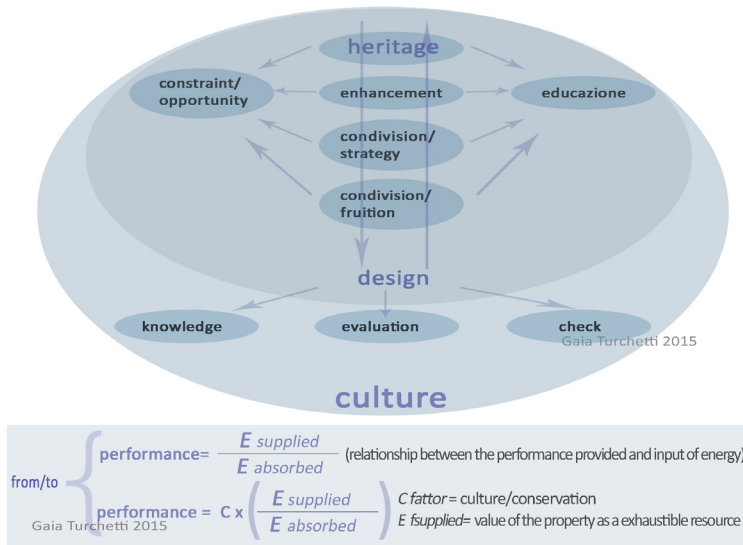


Fig. 1 Cultural performance and ‘C factor’

Integration of passive systems in historic buildings: natural ventilation.

The research revolves around the issues of improvement of environmental comfort, rediscovering on the one hand the wisdom of traditional techniques and technologies, on the other analyzing and evaluating the ‘new’ ones that help to the definition of the conditions of

comfort that respond to modern needs, deepening on the analysis of the mechanisms defined ‘passive’ which influence, the feeling of well-being sought. In this area we have chosen to focus on the theme of natural ventilation as a form of passive cooling, one of the parameters that, with the thermal inertia and solar radiation, affect the environmental conditions. (Puppo 1972; Grosso 2008; Tucci 2012)

If a vernacular architecture, very rooted in the territory, has seen in the history the development of collection or extraction of mass airflow systems to solve the problems of *salubritas*, even before those of comfort (Butera 2007) -related to ventilation and air supply-, with the diffusion of industrial technology applied to confined spaces, the attention has been moved always to the architecture isolated from context. Nevertheless the research and experimentation, from the 60s onwards, has tried to re-introduce the external factors in the definition of interior comfort. (Olgyay 1963)

Close to studies focus on the rediscovery and eventual possible re-activation of traditional ventilation systems, alongside research that propose these traditions in a contemporary way, freely interpreting vocabulary and syntax.

In this context, there are some interesting studies on the mechanisms of natural ventilation that starts from the definition of the problems from the urban to the building scale. Following this line of research, my investigation focus on the analysis of boundary between building and urban environment, carefully analyzing the ‘filter space’ between outside and inside, where take place the mechanisms that can determine, when triggered at the level of airflow and thermal gradient, the variations that are useful to determine the right interior comfort.

Starting with a historical analysis in relation with context, the goal is to intervene on the “orientación energética”(Serra Florensa and Coch Roura 1991), on dynamic and flexible elements that, acting with coherence of constraints and potential of the historical heritage, can be shaped or reshaped to achieve the standards of comfort and reduce consumption, aware of the need to address the issue in a holistic perspective in which you can appeal to the versatility as a synergistic action between actions for improvement and protection.

Focal point of my research is the identification of real cases that can provide the basis for the search of a common methodology, leading from an interpretive theoretical analysis, based on the collection and analysis of data, to a phase of evaluation of selected study cases, explaining on the range of possible *modus operandi*, those that respond

to the needs and requirements of each case. This design phase is accompanied by a check before and after the intervention, performed through the use of fluid dynamics simulation software⁵ applied both to the understanding of internal cooling conditions both to the constructions surroundings. This phase will allow to evaluate *ante operam* the efficacy and feasibility in terms of efficiency and *concinntitas* (Vitiello 2012) of the intervention.

Applied methodologies

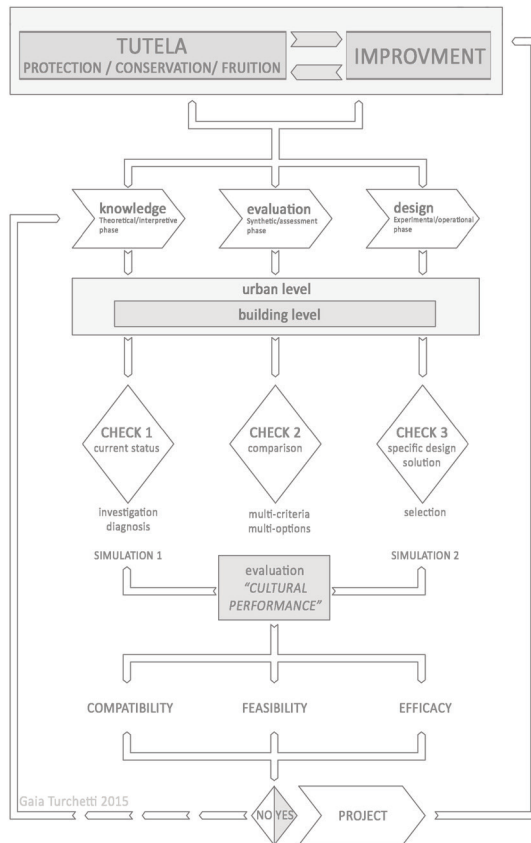


Fig. 2 Integrated approach to the planning of the restoration according to criteria of the sustainability'

The main phases of investigation can be outlined, in detail, in the following points (Figure 1):

- a) Theoretical/interpretive phase
 - a theoretical interpretive evaluation about definitions of some key terms of the speech, deepening the fundamental issues related to the comfort of architectural heritage, from the urban scale to the single building.
 - a reflection on the state-of-the-art of the Italian and European research and experimentation on the subject, with specific reference to the methods of diagnosis and simulation and design of real cases.

- b) Synthetic/assessment phase
 - interpretation and assessment of data acquired
 - at urban scale, an interpretation of the dynamics of ventilation determined by different conformation of the urban fabric through CDF analysis of the surroundings;
 - at building scale, an analysis of the architectural elements of filter (outside/inside), evaluating the possible design interventions aimed to enhance the existing features or assuming optimal design solutions.

- c) Experimental/operational phase
 - the definition of the methodology of the research and the evaluation of design that, starting from a fast survey until the definition of computer simulations suitably calibrated according to the peculiarities of historical buildings, could provide results as faithful as possible to real case. From the processing of real data, it will be defined a model on which, after appropriate verifications, they will be made comparisons of the possible design solutions that increase the benefit of natural ventilation.

Targeted research stakeholders/beneficiaries

I considered that it's necessary to identify a professional that can mediate between the user requirements and the propositions of operators from installation sector, proposing a dialogue in the speech through a junction figure and, at the same time, of mediation, that

knows how to find the right weight for each contributing factor, between tutelage and reduction of resources. The ‘improvement’ of historical heritage should be done through dialogue between users- in order to make visible and more easily assessable those positive contributions that a careful analysis of natural ventilation can produce in the environment- and the various parties involved, promoting a unified planning between the needs of conservation and ‘innovation’.

Expected outputs and future developments

The objective is, as mentioned, to make a reflection in ‘cultural performance’ terms in historical buildings, understanding the benefits of natural ventilation as minimization of dependence on active implants, source and cause of many problems of compatibility and reversibility at structural level until formal ones (only to name a few).

Starting from the analyzed points in the preceding paragraphs, the research aims to highlight at different scales the problems of integration and evaluation of the intervention for the comfort improvement in contexts established and protected. It could be schematize by points the expected results as follows:

1. Global: look for a redefinition of some terms of the issue.
2. Global: provide research methodological tools and unified planning between different problems.
3. Particular/global: define an abacus of possible design solutions, evaluating the flexibility and compatibility features with the historical environments protected.
4. Particular: transpose into real examples some analyzed systems and assessing their efficiency in comparison with traditional intervention practice.

Publishing strategy adopted for checking/ diffusing the research

I think it is important starting to publish, even into individual parts, the research work, sharing the progress and verifying directly the interest of a specific public. During the survey work, inevitably they will be identified the intermediate steps, little moments of reflection from which they can derive interesting considerations, the lifeblood of the research. It is useful and important to share this progress, through articles, posters or participation in conferences, seeking for a direct confrontation even with experts not closely related to the architecture field.

Conclusions

The research should provide the tools to think about how in relation to the every single intervention (from the urban staircase to that of the single building), can be identified a strategy shared ante- during and post intervention, strategy able to consider those ‘shadow values’⁶ that characterize the historical buildings and introduce the ‘historical factor’ in a shared logic evaluation. This means, at first, identifying possible ways to improve the knowledge level of comfort conditions on the historical heritage, basis for any possible intervention which relates to the actual behavior and the real needs of comfort, integrating in the phase of investigation and diagnosis also the environmental aspect, so as to facilitate the holistic reading of the analyzed building. To achieve this first objective, it is necessary to dwell on a terminological clarification of certain definitions, useful to improve the dialogue between different professionals involved in the process. Finally, under the operational aspect - aware that in relation to architectural heritage any action must be the result of a careful analysis and critical assessments, dealing with a unique example of matter and form, structure and appearance where “qualsiasi intervento [...] è anche intervento sul modo di trasmettersi dell’opera stessa nel tempo”(Brandi 1975) -it was decided to evaluate the potential and limits of digital simulation as a tool of verification of the *ante operam* project, in a context where any ‘error’ could mean risking to lose important ‘data’ of the opera itself. From this assessment can be extrapolated relevant data useful for the evaluation of the potential of passive systems, especially on the natural ventilation, aimed to improve the indoor comfort as an alternative of the use, sometimes harmful and oversized, of active systems in historical contexts and protected.

Notes

1. This are some definition that we find in the ASHRAE Standards, in the European Passive Solar Handbook and in the writings of B.Givoni and reported in many texts as a clarification of the concept of thermal comfort. Cifr. Grosso (2008), Sala (1992) and others.
2. From values as ‘memory’, own of the opera, to values defined ‘contemporaries’ that disregard the ‘past’, derived from the ability of the own opera to satisfy also ‘contemporary’ needs. Cifr. Riegl, A. (1903) European Environment Agency
3. Data taken from the publication *Minicifre della cultura 2012* of

the Mibac (1909-2004) Department for Environment, Food and Rural Affairs

4. Is not used in this case the 'energy improvement' term but 'comfort improvement', finding a meaning beyond the performance evaluations related to the 'numeric' definition of energetic efficiency, but faithful to the evaluation of components also qualitative that influence the perception of the environmental situation.
5. Interesting is to assess the potential and limits of digital simulation in relation to historic buildings, aware of the difficulties in the collection and evaluation of data
6. It takes the concept of 'shadow prices' relative to economic analysis of the intervention, where the shadow price corresponds to the quantization of a social parameter unlikely quantifiable except through indirect values.

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