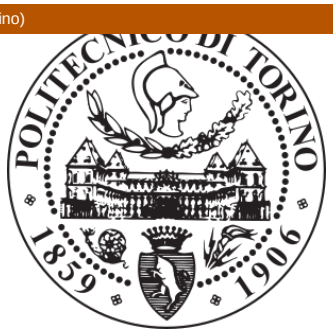

INTEGRATED APPROACH TO SUSTAINABLE BUILDING DESIGN PROGRAMMING

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INTEGRATED APPROACH TO SUSTAINABLE BUILDING DESIGN PROGRAMMING

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Abstract

This paper aims at analysing the relationship between aesthetic and technological aspects in the design process. 'Sustainability' is often a label associated mainly to technological systems aimed at achieving energy efficiency, without considering architectural quality of spaces or environmental and sustainable performances as a holistic approach. Since buildings are working as systems and not as simple sums of elements, this paper proposes an integrated building design methodology, which embeds and merges technological, environmental and esthetical aspects.

To this end, the paper presents the design teaching and research experience carried out with the students of final atelier of the Master of Sustainability, at the Polytechnic of Turin in 2014. In this atelier students were asked to design a building for the Architecture Faculty for The University of Melbourne. During this final atelier, a number of tools were applied throughout the overall design development to helps students in developing projects able to integrate aesthetic, environmental and technological aspects. For instance, one of these tools was the site microclimate matrix, which is a valid instrument for precisely defining master plans organizations, or placing volumetric solutions on sites, following a decision making process based on site-specific functional, technological and environmental aspects. This tool, as well as others that were adopted in the atelier, demonstrated to provide students the ability of developing projects characterised by efficient technical solution and high creative architectural designs.

1_Introduction

It is since the last two decades almost that a vast amount of studies has been carried out on sustainable architecture, both in practice and in the academic context (Stang, Hawthorne 2005; Taylor 2005: Williamson, Radford, Bennetts 2003). Projects categorized as 'sustainable' are often defined either according to the number and type of environmental systems and technologies utilised, as well as their efficiency, rather than their architectural design approach. This tendency seems to reflect both the state of art in both practice and teaching.

The contemporary examples of 'sustainable' architecture show a number of different aesthetic approaches that designers seem to have undertaken. These approaches span from the more literal design solution of 'environmentally aware' buildings, in which the relation with the natural resources was conceived as a design tool; to the more technology oriented approaches, where technologies and environmental artificial systems became expression themselves of an architectural aesthetic (Grosso, Chiesa, Nigra, 2015; Chiesa, Grosso 2015a). In spite the fact that, by-en-large, having an 'environmental awareness' is perceived as an obvious approach to design, and a number of teaching experiences have been carried out (Gürel 2010), the ability of merging technical environmental knowledge to the design process as an integrated design enriching tool seems to be far from being a consolidated approach, at least in the context of the Italian faculties of architecture.

2_The challenge of teaching sustainable architectural design in a changing world

In the final design studio titled Sustainable Design of a Building and its Services (SuDBuS), carried out during the first semester of the academic year 2014-2015 at the Polytechnic of Turin for the Master of Architecture and Sustainability, we faced the challenge of structuring a teaching method that could overcome the existing dichotomy between reaching technical efficiency and developing an aesthetic of sustainability. Specifically, the challenge was answering to the following question: 'Is it possible to teas out aesthetic design alternatives based, not only on the cultural context, normative framework and economic conditions, but also on the result of a set of technical analysis? Is it possible to utilize a 'technique-follow-form' approach today?' The novelty of this approach, at least for the Polytechnic of Turin, was to experiment with the students a design method, which could help them to use of their technical knowledge as a contribution, not only to the creation of fit for purpose projects, but also as a tool that can help define an aesthetic direction in the design decision process, and enrich their compositional skills, which are often left behind the technical priorities in the design studios (Nigra, Grosso, Chiesa 2015).

3_An integrated approach to sustainable design programming – a teaching and design method

The method utilised was to educate the students to consider environmental technical knowledge as an embedded aspect of the design decision-making process. This was achieve by defining a strategy based on establishing a sequence of the phases characterizing the design process in relation to environmental and technological aspects as shown in figure 1, as well as pointing out the relation between each phase and parameters and tools that students could use both to define effective technological solutions and refined aesthetic proposals, as an integrated objective, as shown in figure 2.

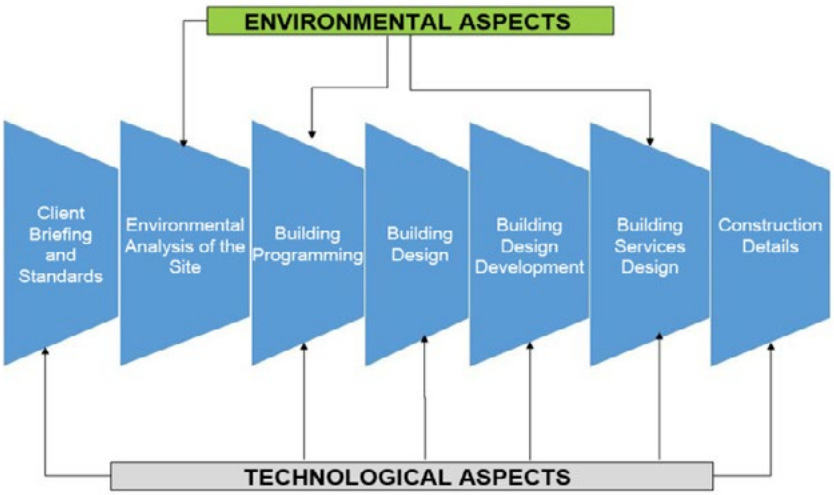


Figure 1. Sequence of the design process according to the sustainability approach (Nigra, Grosso, Chiesa 2015).

This strategy was actualized using a teaching method based on six jointed assignments. These six assignments were: 1) the analysis and design of social and functional sustainability of the spatial organization; 2) microclimatic and

wind analysis on the site to assist the volumetric alternative definition and design; 3) technological system research and architectural design definition; 4) façade, envelope, shading and solar systems design definition and analysis; 5) natural and assisted ventilation and evaporation system definition in conjunction to construction system design definition; and 6) construction details definition for the relation between architecture and technological systems. For each of these assignments, the students had to undertake research on existing built projects, understanding systems and design solution, and to design an innovative solution for each part, answering to the following questions: 'How does your design is sustainable? Why is it innovative? How does your design decision seek passives solution to the energy saving issue? What is the aesthetic of sustainability that your design solutions are trying to conceive?' These questions were posed for each assignment as reflection of each phase of a project design development. The significance of this method is that it allowed the students to merge the design process with the technical knowledge and data learned as a system to define creative guidelines to establish a direction for the definition an aesthetic of sustainability, on the top of the ability of proposing project solutions fit for purpose and energetically sustainable (Nigra, Grosso, Chiesa 2015).

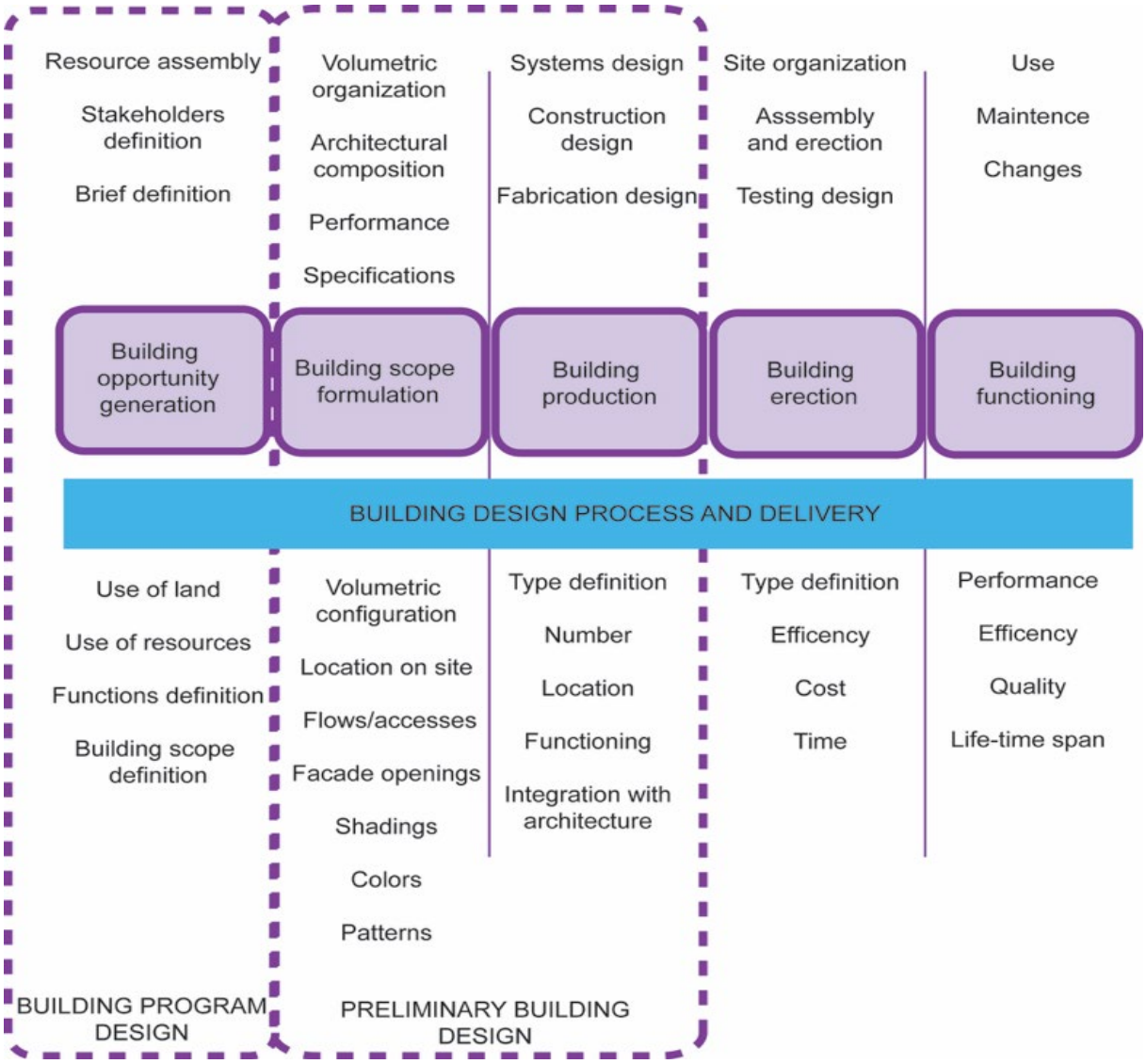


Figure 2. The image shows the design parameters that can be informed by the use of microclimatic analysis for each phase of the design process and delivery. Above the blue band, the design process is summarized in its phases and characteristics. Below the blue band the design parameters that be enrich/integrated by the use of the micro-climatic analysis are listed for each phase of the design process (Nigra, Grosso, Chiesa 2015; Grosso, Chiesa, Nigra 2015).

4_The Design Studio Results – A Critical Overview

The outcomes of the applied method in the design studio were the achievement of a number of outstanding projects that that demonstrated the ability of the students to propose design alternatives that respected the technical call for sustainable systems as well as the ability of exploring the aesthetic aspects of sustainability as general design approach. Each assignment produced a sequence of results: the first assignment allowed the understanding during the preliminary phase of the project of the implication of social sustainability in early design decision-making. The second assignment produced the identification of areas on the site that were the most suitable for the required project activities. This was possible by relying on the analysis of the environmental aspects, using the site microclimate matrix in order to localise correctly the building to be designed, considering solar radiation and seasonal prevalent wind flows (Chiesa, Grosso 2015c; Grosso 2011; Brown, Dekay 2001).

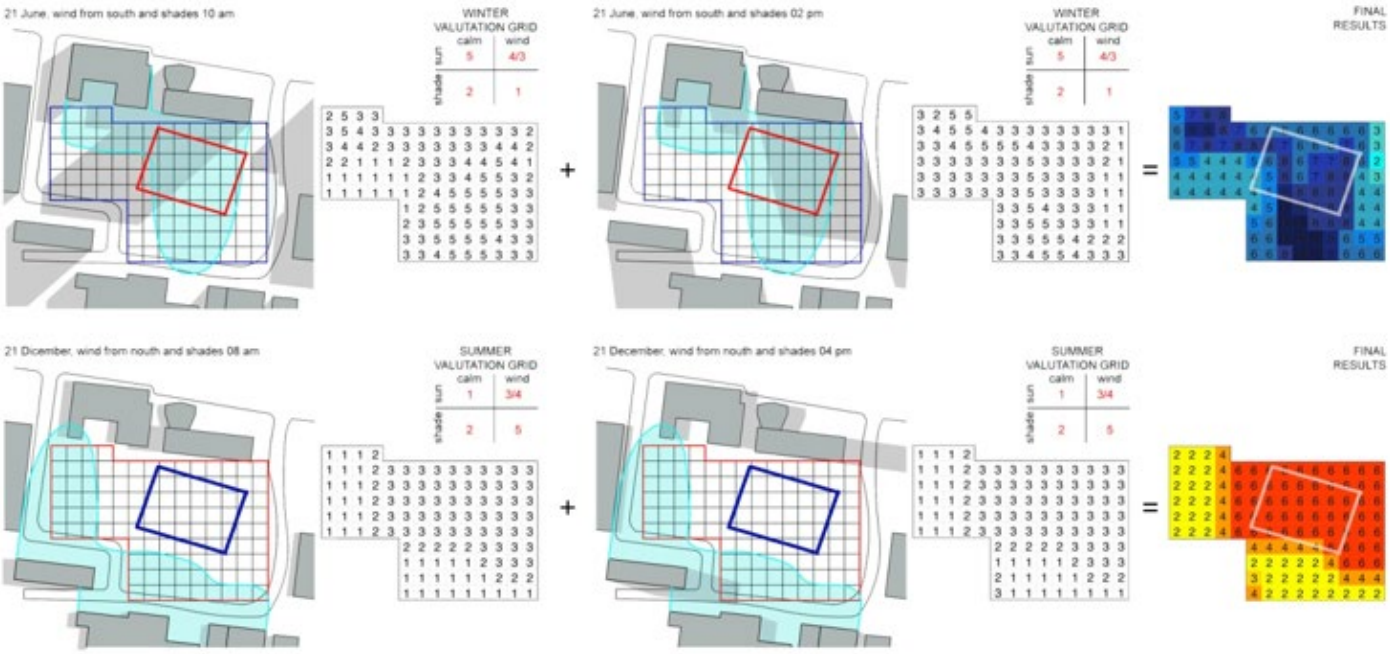


Figure 3. Site microclimate matrix analysis (proposal by Federico Brescia, Giacomo Del Bergiolo, and Silvia Sereno Regis).

On the basis of the data analysed a number of volumetric design alternatives were explored and defined in relation to the spatial distribution in the building. The result of the third assignment was the development of the student's ability to use compositional aspects – such as geometries, shapes, volumetric design, balance, harmony, et cetera – in relation to technological systems used, in such way that students could propose an architectural language that can represent a design language for sustainability. The fourth assignment allowed the students to utilize the wind ad site analysis to define design solutions that can both optimize the site conditions and create spatial design challenges and opportunities, such as the use of atriums, vertical circulation spaces not only as a design opportunity but also as solar chimney, wind tunnels and evaporative towers.

The fifth assignment focused on the use of the climatic analysis to determine the performance and specifications of the main façade components defined in

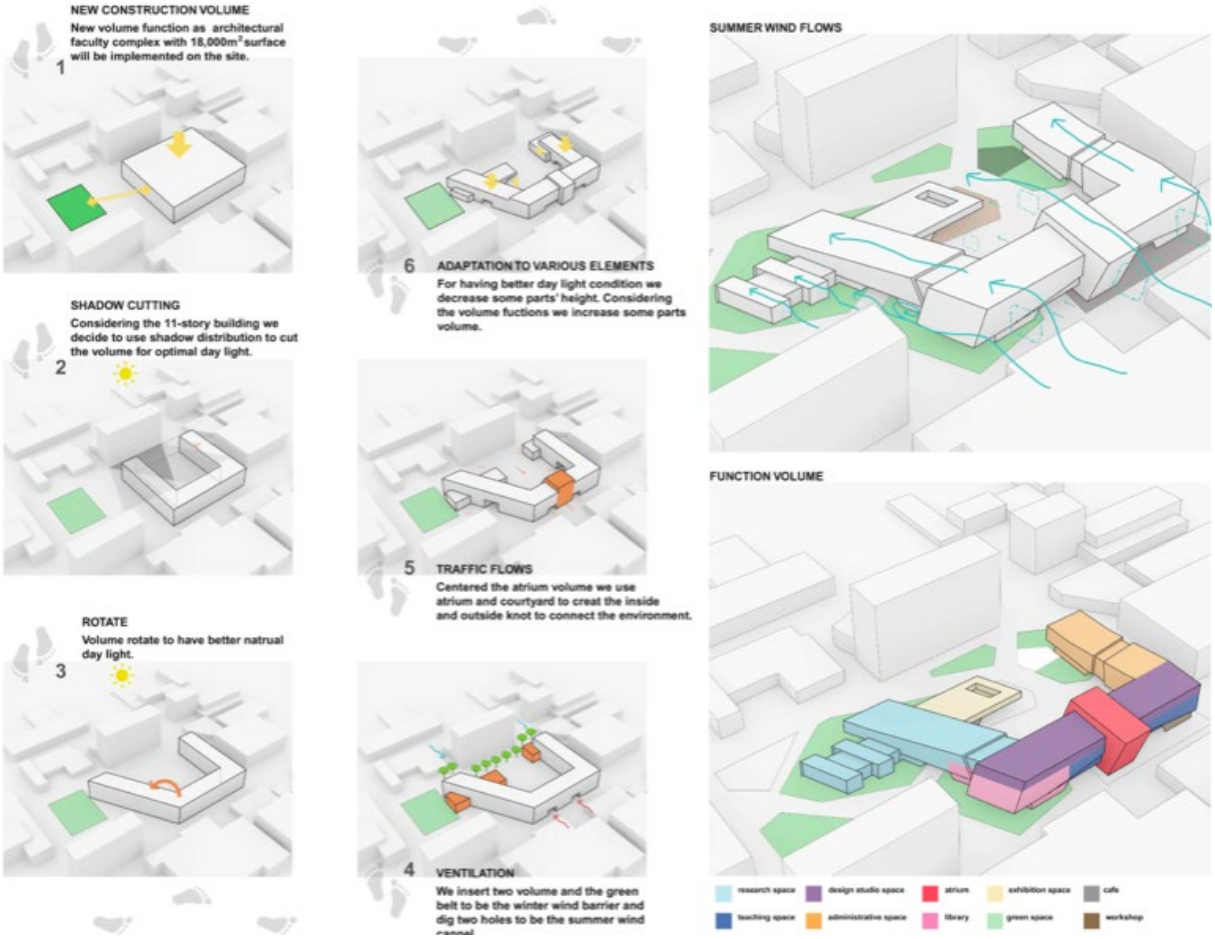


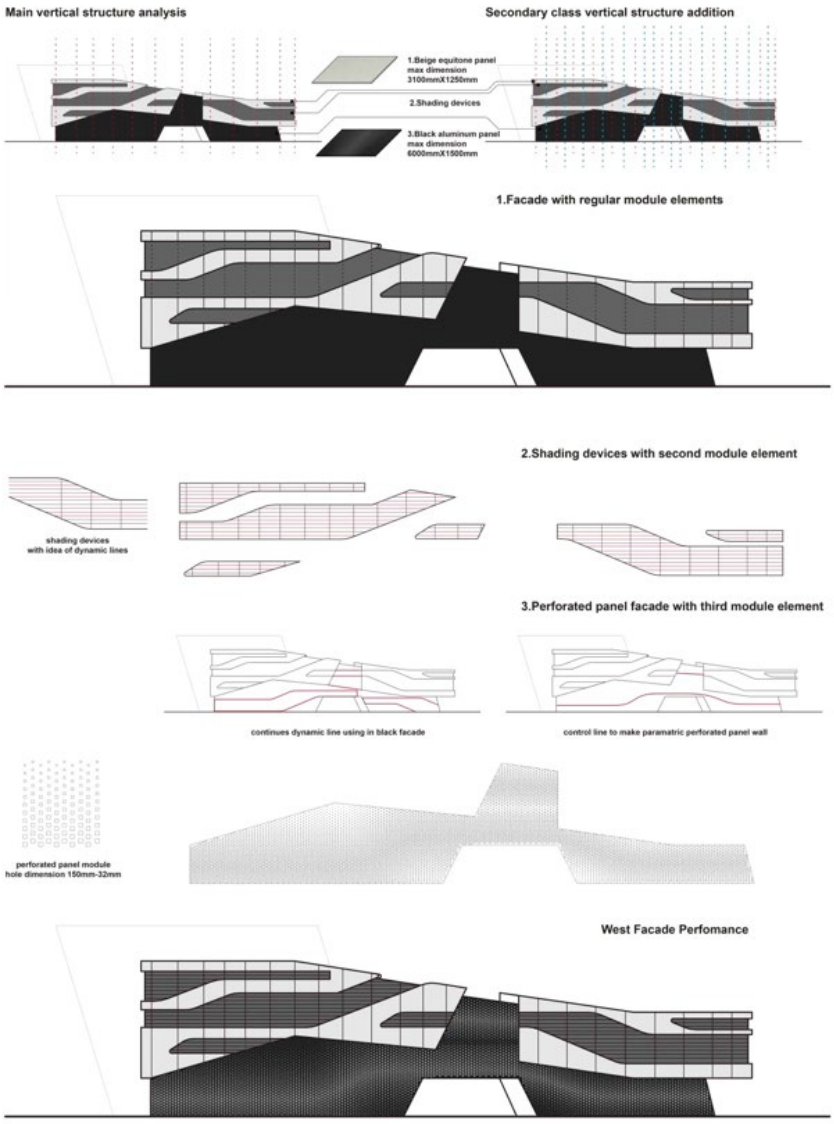
Figure 4. Site microclimate matrix analysis (proposal by Federico Brescia, Giacomo Del Bergiolo, and Silvia Sereno Regis).

the project proposal. Specifically, glazing characteristics, shading devices, and ventilated façade rain screen were selected ad-hoc for each façade, according the exposure and characteristics, elaborated in the micro-climatic analysis.
The sixth and last assignment allowed completing the project by offering the students the opportunity to develop construction details that both became essential for the overall design and architectural language definition, and defining ad-hoc technological solutions that could contribute to the technological sustainability of the project (Nigra, Grosso, Chiesa 2015).

5_Conclusions

The teaching strategy proposed, as well as the design methods utilised shaded light on the importance that environmental building programming and site-climate analysis have in the sustainability approach to buildings design. This is for at least three reasons: 1) having a number of design alternatives directly informed by the environmental context could contribute defining a new architectural language of buildings that could both limit energy consumption and resources depletion, and express the identity of sustainable architecture; 2) using the performance-driven approach since the preliminary design phase, is essential for considering these issues in the design process evaluating different compositional solutions and suggesting possible optimization procedures; and 3) providing the students with a structured design methods that merge technical and aesthetic principle provide them tools and abilities to link and manage complexity within the context of the design process.

Figure 5. Example of design process to establish modules, patterns and shading devices in a façade design proposed according to the solar analysis on the façade, based on the micro-climatic analysis (study by Mamak P.Tootkaboni, Danial Mohabat Doost, and Xiaochen Song).



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