Open Access Publishing Series in
PROJECT | Essays and Researches
ISSN print 2704-6087 | ISSN online 2704-515X

FROM MEGA TO NANO

THE COMPLEXITY OF A MULTISCALAR PROJECT

edited by
Francesca Scalisi

PALERMO UNIVERSITY PRESS

Open Access Publishing Series in
PROJECT | Essays and Researches

4

FROM MEGA TO NANO

THE COMPLEXITY OF A MULTISCALAR PROJECT

Edited by
Francesca Scalisi

PALERMO
UNIVERSITY
PRESS

Open Access Publishing Series in

PROJECT | Essays and Researches

Volume 4

Edited by Francesca Scalisi

FROM MEGA TO NANO: THE COMPLEXITY OF A MULTISCALAR PROJECT

Palermo University Press | Palermo (Italy)

ISBN (print): 978-88-5509-188-6 ISBN (online): 978-88-5509-189-3
ISSN (print): 2704-6087 ISSN (online): 2704-615X

Printed in September 2020 by Fotograph srl | Palermo

Editing and typesetting by DEMETRA Ce.Ri.Med. on behalf of NDF
Book cover and graphic design by Cesare Sposito

Promoter
DEMETRA Ce.Ri.Med.
Centro Documentazione e Ricerca Euro-Mediterranea
(Euro-Mediterranean Documentation and Research Center)
Via Alloro n. 3 | 90133 Palermo (Italy)

On the Book Cover: *Spiral dots. Vector-art illustration (credit: Amicabel).*

Contents

Publishing Series in PROJECT | Essays and Researches
From Mega to Nano
The Complexity of a Multiscalar Project
vol. 04 | 2020 | introduction | pp. 5-9

ISSN (print): 2704-6087
ISSN (online): 2704-615X
ISBN (print): 978-88-5509-188-6
ISBN (online): 978-88-5509-189-3

INTRODUCTION

The present book collects essays, studies, research and projects on the subject entitled 'From Mega to Nano: the Complexity of a Multiscalar Project', inextricably linked to the ever-increasing request of trans and multidisciplinarity of the project. The ability of 'change of scales', work on more different scales – multiscalarity – create new ones or change the meaning of the scales commonly accepted, it is common practice in the approach to the project and has always concerned architects, engineers, designers and artists for the multiple symbolic and real meanings of the size of a territory, a city, an architecture and an object. However, it can provide a range of opportunities even in different contexts such as economy, politics, culture, etc.

The concepts of scale and size are fundamental to link, in a systemic point of view, the detail with the big picture, the detail with the group, to interpret and represent, to discretize and recompose elements and parts that stand in a hierarchy or interconnection relation, to investigate the physical and social, to outline critical issues and potential, but especially to establish the importance of relational aspects between the group and its component as a way to understand their identity, their nature and organization, their regulation rules and the role played in different contexts, namely the fundamental elements to identify the form and structure of a territory, a city, an architecture and an object.

The concept of scale in Architecture regulates the size of the anthropic space, always keeping human dimension as reference. The choice of the scale inevitably becomes a conceptual selection of what the project actually wants to represent. When using multiscalar representation, we try to show the complexity of reality, by using as many regulation criteria and specific evaluations as we can, not only by describing its size and geometric aspects but most of all by significantly highlighting its qualitative aspects and those related to identity, culture and history. This means that there is not just one scale to represent a territory, a city, architecture, an object or a detail; however, in terms of a necessary multiscalarity, the project chooses the most fitting scale to develop practices, on a case-by-case basis. Therefore, logically the scale influences the project: thanks to the progress of technology in the field of design at all levels, it is probably the component of the project on which the designer works the most, simultaneously coordinating real and virtual relations; these relations do not end when the form is created, but continue over time and modify the management of the object's complexity.

The papers in this volume, dealing with many disciplines, should be read in this

sense. The essay written by Nicola Campanile entitled 'The appropriate form – The analogy between the architectural and urban scale' gives a reasoned point of view in the architectural field on the concept of multiscalarity and its operational implications in the architectural project, trying to carry out a resemantization operation while relating this concept to the subject of analogy, a conceptual operation supported by the analysis of Aldo Rossi's architecture which, in relation to the subject, can be considered paradigmatic.

Another key to understanding the subject is given by Ermelinda Di Chiara that in 'The City of Agrigento – The form and the space of the city: an interscalar approach' sees in the interscalar approach to the project a dimension and an operational principle through which it is possible to know the territory and its relations with urban systems in order to understand its principles, nature, organization and the role it plays in different contexts. The concept of interscalarity is explained through the case study of Agrigento, analysed from an 'oversized' dimension (the temples) to the infinitely small (the houses).

Next, Bianca Andaloro presents a paper entitled 'Multiscalarity of adaptive architecture – The efficiency of micro and the resilience of macro in contemporary design'. It investigates the relation between the efficiency of micro and the resilience of macro in contemporary design starting by questioning which type of architecture is willing to welcome a constant comparison between different scales, materials and practices. Through the study of three recent projects, emblematic for their spatial and systemic complexity (Hardingham's Generator, Carlo Ratti Associati's Currie Park, and Reset), the essay identifies resilient architecture as the type capable of elaborating innovative characters through adaptive processes. The paper suggests that, in managing the complexity presented by an adaptive approach working in the interrelation between elements of different scales, an important role can be played at the micro-scale by the technological components which, added into the building and working at the medium scale, can capture information from an external base and return a response to improve environmental conditions and human needs.

Also, the paper written by the editor of this volume deals with the compelling environmental issue and the concept of adaptiveness, since it investigates the relation between Adaptive Facade and Phase Change Materials (PCMs) as a new paradigm for a sustainable approach in the building industry. The researchers and designers currently focus on new types of envelopes characterized by dynamism, adaptiveness, smart control, responsiveness, integration-hybridization, biomimicry, etc., fostering new subsystems not intended anymore as elements opposing to a flow, but – on the contrary – as 'filters' (between different scales) that receive by controlling, or oppose in a 'smart' way to, the external weather stresses by intercepting and capturing them in different directions depending on the seasons and the exposures, therefore assimilating the frontier envelope to a 'technological Janus'. In this research context, the paper focuses on the characteristics and potentialities of

Phase Change Materials (PCMs) that change to 'answer' to temperature variations, changing their state, from solid to liquid and vice versa, depending on the amount of heat they absorb. In particular, it highlights the characteristics, advantages, limits, and fields of application of PCMs, focusing specifically on current research and future scenarios, mostly in relation to the contribution given by nanotechnology to boost the property of these materials used in the building industry.

The paper entitled 'Climate risk management in the big data era – A multiscale, multidisciplinary and integrated approach' by Maria Fabrizia Clemente highlights that in Architecture the research is pushing towards the integration of quantitative variables to support decision making processes. The introduction of enabling technologies and the dissemination of big data have enriched the projects with new inputs, but their added value lies more in the ability to extract, analyse and interpret the requested information through a multiscalar, multidisciplinary and integrated approach, rather than in the volume that characterizes these data. In the context of climate risk management to support resilience projects, plans and policies, the acquisition and processing of an increasing amount of information is required to understand the complexity both of the territories and of natural events; however, there is a gap between the complexity of the models and the abilities of the users. Among the different natural phenomena, the paper focuses on flooding, one of the most complex and dynamic phenomena.

Francesca Albani and Matteo Gambaro in the essay 'Multiscalar approaches to re-appropriating the Visconti-Sforza Castle in Novara between conservation and reuse' describe the case of the Castle of Novara. In this case study, even with some outstanding issues, the multiscalar and cross-disciplinary approach of the process has led to its re-appropriation to the city and it has become emblematic for the definition of new strategies for Cultural Assets which represent an important cultural and economic resource. To preserve the marks of their transformations and ageing represent the will of the modern city to take back the many 'stories' that these places can tell, enjoying them and making them part of the urban dynamics of a community that has been waiting for too long an answer to these issues.

Roula El-Khoury Fayad and Silvia Mazzetto in 'Nation-building macro-narratives from Lebanon and Kuwait – The journey of Sami Abdul Baki' report about the Golden Age, between the 1950s and 1960s, in Lebanon, when talented Lebanese architects having studied architecture abroad came back and made numerous successful collaborations between local and foreign architects; and in Kuwait where it has represented an interesting experimental ground for testing new ideas, projects and building techniques, together with the contributions of Western architects. Although the story of the modern architectural development of these two countries has been mainly characterized by great narratives, other works made by professionals who are not members of the dominant culture have made an important contribution. This is the case of Sami Abdul Baki designer of eclectic architectures in significant

places both in Lebanon and Kuwait, author of parallel micro-narratives that can contribute to a better understanding of the complex context of the two countries.

Then, Paolo Carli, Roberto Giordano, Elena Montacchini and Silvia Tedesco present the research entitled 'Experiential tourism – Research, experimentation and innovation' carried out at Alta Scuola Politecnica in collaboration with the industry, whose objective is to simultaneously carry out research and teaching by experimenting and prototyping new solutions and answers to real tourism problems and its most recent evolution: 'experiential tourism'. Highlighting the potential of a multiscalar approach used as a tool to handle complexity, through a specific experimentation the paper leads the way both to ensure the quality of higher education and research activities in universities, at the same time committing to achieve its application, and to promote the ability to enhance the intersecting between supply and demand for innovative knowledge and technologies.

Paolo Di Nardo and Alessandro Spennato in 'Design(ing) – The multiscalar project', through a series of emblematic case studies, refer that the research of a new way of understanding the contemporary creative and scientific project does not begin with – as it was in the past – the demolition of already defined and experimented works, but it aims to establish precisely on such research an ideation path capable of grafting contemporary elements onto an already structured knowledge. Therefore, it should not be chosen, for example, technology alone as a solution to renewal, but all those contemporary requests – including the sustainable aspect to respond to the climate crisis – that know how to update multiscalar and multidisciplinary knowledge.

The volume ends with a paper by Daniela Anna Calabi and Elisa Strada entitled 'Design of the atmospheres and the narrative dimensions – Literary Writing and Visual Writing' which reports a translation experimentation from text to images to prove that the atmospheres related to the narrated space can be a guide to the territories and can transform into visual experiential text, an 'atmospheric text'. In the atmospheric texts it is possible to trace two connotations: one concerning the style that characterizes the image and which relates to the choices made by the author; the other concerning the recognition of stereotypes so that an image, associated with an oral text, can determine the attribution of a meaning increasing that of the source text. The final result is a design increasing the editorial text experience, but also the understanding and hence the identity of narrated spaces.

In conclusion, the essays and research published show that if measuring, using the scale as a tool, means understanding the things in the world by establishing some differences, therefore 'off-size' can be the basis for new theoretical assumptions in which both the infinitely large (mega) and the infinitely small (nano) contribute to defining crucial topics, such as environmental, social and economic sustainability, resilience, territory government, the idea of space, aesthetics, use, development of new products, services and materials, etc. Therefore, the multiscalar ap-

proach can be considered as an important design working tool that, in a systemic point of view, can foster the proposal of adequate strategies for action and planning of sustainable actions, developing new methods, working techniques and shared measurements, through well-considered hierarchies of priorities necessary to optimize the choices of the project and to determine the reliable cost/benefit balances (especially of environmental nature).

Francesca Scalisi
Arch. Ph.D.
Head of Department of Research
DEMETRA Ce.Ri.Med.
(Euro-Mediterranean Documentation and Research Center)

Publishing Series in PROJECT | Essays and Researches
From Mega to Nano
The Complexity of a Multiscalar Project
vol. 04 | 2020 | paper 1 | pp. 10-27

ISSN (print): 2704-6087
ISSN (online): 2704-615X
ISBN (print): 978-88-5509-188-6
ISBN (online): 978-88-5509-189-3

THE APPROPRIATE FORM
The analogy between the architectural and urban scale

Nicola Campanile

section
ARCHITECTURE

typology
ESSAYS & VIEWPOINT

DOI
doi.org/10.19229/978-88-5509-189-3/412020

ABSTRACT
The contribution aims to offer a point of view, argued in connection with the architectural field, on the concept of multi-scalarity and its operational implications for the architectural project, by trying to undertake an operation of re-memorization in relating the concept to the theme of analogy. Multi-scalarity thus understood is analyzed in-depth at a theoretical level under the lens of 'positive realism', focusing in particular on the connections that the theme of 'scale', and therefore of measurement, establishes with the analogy, and on the way in which it can enter into a relationship with architecture. The contribution concludes with a reflection conducted on the theoretical assumptions investigated, to verify their general validity, through the analysis of some architectural designs of Aldo Rossi which, concerning the themes of multi-scalarity and analogy, can be considered paradigmatic.

KEYWORDS
scale, measurement, realism, analogy, architectural composition

Nicola Campanile, Architect, provides teaching assistance of Theory of Architectural Design Course and Laboratory of Architectural and Urban Composition I at the University of Naples 'Federico II' (Italy). Mob. +39 335/60.77.510 | E-mail: nicolacampanile@live.it

The contribution aims to offer a point of view, argued in connection with the architectural field, on the concept of multi-scalarity and its operational implications in the architectural project, investigating the full meaning of the term and trying to operate re-memorization concerning the generic and indefinite meaning today commonly attributed to it. If, in the first instance, it is possible to affirm that architecture, since ancient times, has expressed its 'multi-scalar' quality, as the well-known definition recalls, according to which the city is like a big house, and the house in turn is a small city (Alberti, 1485). It is also important to note how the evolution of meaning undergone by the Albertian concept over the centuries has led to the expansion, or rather the transcending, of the field of investigation of architecture, traced initially by the treatise writer up to the present day including, within this, not only art made architectural, but in general, every modification realized on earth by man, in view of his needs (Morris, 1963).

The equally well-known slogan 'from the spoon to the city' can be understood today as the extreme synthesis of this homologous way of understanding the role of the architect and his or her skills in the field, which, regardless of any size and scale, include as his responsibilities all that surrounds mankind (Bonfanti, 1963). In this sense, today the authentically multiscale attitude of architecture seems to have been lost or at least tarnished. Architecture is understood not only – in its fundamental meaning – as a shelter for man, but also as an element defining the shape of the city, of which the Italian culture of urban studies is a witness, among others. This has significantly contributed – particularly in the second half of the twentieth century – to raising the question of architecture on the city level, and it will be discussed again in the following text.

New and modern in architecture | The architectural works of our time are distinguished by the attention paid by designers to the formal and figurative profile. The propensity of architecture to difference, to extravagance, seeking distinction from the context, connotes a certain contemporary architectural production that seems to have set itself the goal of attracting attention. This propensity does not derive from a transformation of the process entirely within the field of architectural and urban design, but rather appears as the effect of an external will which predisposes architecture as a suitable vehicle for the diffusion and circulation of images. There seems to have been no historical period that, like ours, was characterized by a collective desire to communicate and exhibit the construction of society. In this sense, the majority of the architectural production, which represents only one aspect of a more complex reality but which constitutes its ultimate effect (Rossi, 2011), is invested in the present by actions aimed at indicating as its purpose the communication and presentation of itself.

The thesis advanced is not new, as the connection between the ways of production of society and changes in the structure of human settlements has been highlighted for some time. Already Samonà (1978) has pointed out how the transformations of the nineteenth-century city could be judged objectively only by detecting their close con-

nection with the will of the dominant bourgeois class, which, due to the privileged position that they had obtained, was able to differentiate their way of living with characteristics defined from one country to another, and which had the power to translate their ways of life into coherent urban structures. While taking into account the errors of that historical period, it should be noted that the openings in the fabric of the historic city, the geometric scheme of the urban additions, the residential organization with stately homes, the embellishment of the city with large public parks, were authentic manifestations of the constructive power of the bourgeoisie of the time, capable of giving concrete expression to the modern city.

The authenticity of the modern city seems to have been transformed, today, into an accumulation of exhibitions (Debord, 2002), the effect of an immense concentration of capital, so as to 'become an image', a show. If displaying capital means making an aspect of our society spectacular, the image becomes the transmissible commodity, materialized in the iconic skylines of contemporary cities. The concept of the icon seems to be the protagonist of the urban landscape of the twenty-first century, transforming a large part of the current architecture from an artefact with a use-value to an object with a novelty value, in which the new – which in the modern era was a coherent expression of shared ideas – in contemporary society describes a marked individuality of the architectural object. The phenomenon of 'iconic buildings' is the result of the propensity of capital to invest in commodity-architecture (Biraghi, 2019). These singular landmarks are conceived as celebratory symbols, characterized by the autonomy of their image with respect to any content, such as to release the form from its 'function', in other words, they are incapable of representing the theme of architecture.

It is no coincidence that we often resort to terms unrelated to the architectural sphere, performing an operation that we could define as multiscale – although with a completely different meaning than that described above – to focus on the singular iconic forms of these buildings: the 'shard' in London of Piano, the 'cucumber' designed by Foster in the city centre, the 'ring' that the O.M.A. he has built-in Beijing as a CCTV site are just a few examples of the same phenomenon. Precisely the O.M.A. studio, in 2006, with the Dubai Renaissance project, reflects on the authenticity of the architecture of our time, expressing the ambition to conclude the 'age of the icon', inspired by a new 'simplicity', even if the culmination of the project results in a false reaction to architectural idolatry and which is distinguished only by its white appearance and uniform features. While renouncing the expressiveness of forms and the impact of colours, the Dubai Renaissance is animated by the same desire to amaze like other iconic buildings (Biraghi, 2019).

After all, the same phenomenon of the 'iconic buildings' constitutes only a particular case and perhaps faded today, of a broader discourse, within which a part of today's architectural culture is seeking a form of autonomy, understood as a critical 'detachment' from the present time. A detachment to be understood not as a nostalgic return to an assumed past order, but as a distancing – equivalent to an awareness – of the

present time, and which precisely by virtue of this anachronism allows you to perceive, to 'see' (Agamben, 2008), the contemporaneity. On the other hand, it is not possible to judge an attitude aimed at renewing the world from the inside, according to fashion, as contemporary. That is, leaving it as it is (Benjamin, 1979).

Inside and against the contemporary | Within this 'inside and against' attitude the contemporary can be attributed to the exhibition curated by Èric Lapierre for the V Lisbon Architecture Triennale in 2019, entitled The Poetics of Reason (Lapierre et alii, 2019). Lapierre's research, denouncing the iconic speculation of the last century, tends to reaffirm the autonomy of architecture as a rational discipline. The exhibition, showing a series of selected architectural references and arranged in a timeless sequence, seems to seek the logical and transmissible essence of the architectural discipline, linked to the figure of 'the architect of reason'.

Lapierre's intention can be included in that branch of architectural culture which, starting from the path dictated by the masters of reason, defines the exact 'function' of the intellectual architect: that of developing a theoretical apparatus that can be used in view of a practical action, not contaminated, however, by a 'subjective' vision, but rather shared by the greatest number of people, and therefore socializable. In these intentions, it is possible to perceive a link with a certain architectural culture, which emerged in the second half of the twentieth century and can be summarized, in some ways, in the figure of Aldo Rossi. It is no coincidence that within the exhibition curated by Lapierre we find, in sequence, the Analogous City by Aldo Rossi and the Field of Mars by Piranesi: two works distant in time but united by the demonstrative intent to recognize a transmissible logic, and therefore always actualizable, in the forms of architecture, beyond their historical condition. A logic in which the past has never definitively passed, but rather has been assimilated to a field of forces whose potential can be reactivated and is capable of transforming the present.

On the other hand, the Project of Autonomy is also the title of the first book by Pier Vittorio Aureli (2016), an architect who supports the necessary re-proposition of a theory within the architectural debate, to be understood not as a hermetic dialectic but as an operating field, autonomous from reality but precisely for this reason capable – through its detachment – of representing a form of knowledge and understanding of things, which simply means the possibility of changing the space in which we live. In this sense Aureli is convinced of the fact that architecture must return to having a sense and role in the construction of city spaces, a belief that tries to frame the problem not on the figure but on the 'function' – not naive – to which architecture must respond.

It seems that, among the many problems deriving from the process of commodification that has assaulted architecture during the last century, one of these is the forgetting of the role of internal space as the protagonist of the architectural fact (Zevi, 2009). Zevi, in wondering how to distinguish architecture from non-architecture, replies that the most precise definition that can be given today of architecture is that

it is that which takes into account internal space (Zevi, 2009), that space that has as its peculiarity the fact of being real, appropriate, which visually evokes appropriacy (Lukács, 1970).

The thesis that we intend to support is that, starting from a precise angle of view that defines architecture as a discipline linked inescapably to the design of space (Schröder, 2015), there exists a multi-scalarity of architecture to be understood not only, in a static way, as a relationship of homology at different scales, between the ways of composing the building and the ways of composing the city (Visconti, 2016), but also as an analogy intimately connected to the formal world of architecture, which, in the passage between scales, becomes a dynamic concept capable of 'requalifying' architectures distant in time and space, ready to emerge formal equipment, a mnemonic heritage, for new dispositions, adapted to the themes assumed for the architecture of the city (Capozzi, 2017).

Analogy and the architectural project | The figure of Aldo Rossi can be taken as a paradigm of this way of understanding the architecture of the city, so much so that in the following text we aim to investigate this particular 'multi-scale' quality within the design activity and how it can still contribute, in an original way, to tracing possible future lines of research in the field of architectural composition and urban studies. We can begin by pointing out that Rossi's intellectual activity, both at a design level and in the form of writings, can be understood as a procedure that starts from a systematic knowledge of the city and on this knowledge is grafted a thought made of memories, associations and analogies (Monestiroli, 2018), analogies of thought, more or less rational, which manage, in a synchronic reading of his work, to formally match elements of the city of history with new buildings and, in turn, new buildings with individual design objects[1], in a continuous flow of references and associations where 'naive functionalism' (Rossi, 2011) gives way to the analogical method, all understood as the search for 'responsive forms' (Monestiroli, 2018).

Tracing, within Rossi's work, a precise dividing line between 'logical' and 'analogical' thinking (Rossi, 1975) – both present, to varying degrees depending on the years of activity of the architect – is not a simple operation at all, even if the question has, in the end, relatively secondary importance in the reflections developed within this text. We can certainly refer, as a starting point, to Rossi's article published in edition 13 of Lotus in 1976, entitled The Analogous City: Board (Fig. 1). The article is the response to the architect's invitation to discuss the similarly titled table exhibited that same year at the Venice Biennale: 'a collective work' completed with his friends Eraldo Consolascio, Bruno Reichlin and Fabio Reinhart, a text accompanied by an image, a «[...] relatively arbitrary editing» (Rossi, 1976, p. 7) which still today has a strength, in the opinion of the writer, consisting in its succinct capability to bring together in a single drawing, in a figurative form, the answers that Rossi had given to the questions – emerging in those years but rightly

Fig. 1 | Aldo Rossi, Eraldo Consolascio, Bruno Reichlin and Fabio Reinhart, 'La Città Analoga' – Board, 1976 (source: www.monoskop.org, 2020).

still present today – not only around the heartbeat of the city but above all on the question of 'how to make the city' and therefore architecture.

The theme of 'scale', from mega to nano – 'mega' understood as referring to the city and 'nano' to the single architectural object – can be identified in the mesh of the Analogous City and therefore in the discourse on architecture and the city, assuming, with the concept of 'scale', not so much the instrumental knowledge of reality at the various scales, but rather the concrete action of 'reverberation' that some architectural artefacts possess due to their shape and morphology: this notion is intended to add depth to the implications focusing precisely on the concept of analogy.

The concept of scale between the 'natural' world and the 'social' world | It is important, for our discussion, to dwell on the connections that the theme of the 'scale', and therefore of measurement, establishes with analogy and how it can enter into a relationship with architecture. In the first instance, it is possible to affirm that the act of measuring – therefore of putting two objects in relation – can be understood both as a quantitative relationship, in the sense that it is possible to know one object, taking as founding data those provided by perception, and as a qualitative relationship, in which we no longer refer to the means of perception, but this time to an intellectual relationship.

To deepen the question it is useful to introduce briefly the distinction proposed by Maurizio Ferraris (2014) between 'natural objects' and 'social objects', meaning, with the former, objects that exist in space and time independently of subjects, and with the latter, objects that exist in space and time depending on subjects. Concerning the former, epistemology performs a purely reconstructive function, limited to taking note of something that exists independently of knowledge. Concerning social objects, on the other hand, epistemology has a constitutive value (Ferraris, 2014). This distinction introduces a practice of 'social objects' – among which, in a 'problematic' way[2], we also place the architectural project – within a new season of thought that places the concept of reality at the centre of its reasoning.

'Positive realism' puts in comparison two spheres: on the one hand, a 'natural' world outside the conceptual frameworks, in which man's only possible action is a 'critically'[3] cognitive action towards something that exists independently of itself and is implemented through the specific forms of the senses and the intellect, and, on the other, a 'social' world where new objects are produced with an operation that is performative and not purely constative, as occurs in reference to natural objects (Ferraris, 2014). In this perspective, the concepts of scale and measurement relate in a problematic manner to the binomial 'natural world' and 'social world', as there is a fundamental distinction in the way in which these concepts are expressed in the natural sphere and the social sphere.

It is reasonable to state that 'measurement' in the natural sphere means knowing an object specifically in its dimensional attributes. It is the relationship that mathematically establishes a measurement relationship between two objects, in the sense that the relationship between two homogeneous quantities provides the measurement of the first quantity with respect to the second, taken as a measuring unit. Now, this way of understanding measuring certainly belongs to the sphere of the natural, since it provides a datum, the dimension of an object, which it is reasonable to assume as unamendable, that is, invariant with respect to conceptual schemes. The discipline of the architectural survey, for example, bases its foundations on the scientific method, observing and restoring a knowledge of the material object which is based solely on the constitutive data ascertaining the measurement thus understood. But entering the 'social' field, the concept of measurement can also take on the meaning of analogy, understood as the equality of two relationships, that is, the association of two different

objects that possess something common. It is the subject component that must be linked to the concept of analogy that introduces the latter in full right into the 'social' world, since it does not rely only on logic, but is also associated with memory.

If investigating the form is the only objective of the architectural project, then the analogy is that of the 'compositional-memorial technique'[4] which allows the discovery, through the appropriate forms, of a formal response to the themes of architecture. On the other hand, as Roberto Masiero[5] said, not only the architectural project but also designing in general means 'measuring oneself', it means opening up possibilities, tracing paths, identifying a way of life, a way of being. This is not typical only of the architect, but I think it is part of what we call 'human nature'.

Architecture is the buildings | The observations conducted so far on the concept of scale are based on the premise, that was intentionally assumed, that the relationship between analogy and architectural design is possible only to the extent that the project is considered primarily as a collective fact, that is, the work of human construction, which, however – precisely insofar as it is social interaction – does not constitute a purely subjective production (Ferraris, 2014) but contains an idea of architecture that is a collective heritage , an asset that is not inseparable from the culture of the time otherwise it is a refusal of our work, a general indifference to it» (Monestiroli, 2002).

It is logical, from such a discourse, to discern that architecture, precisely by virtue of its 'sociality', is invested with conceptual schemes, that is, it resolves into a science understood as the construction of paradigms (Ferraris, 2014). On the other hand, such a thesis has already been proposed by Rossi himself when he highlights the need to distinguish 'the architecture of the city' from 'architecture itself' (Rossi, 2012). In the first case, it is a collective process, slow and detectable over a long time, in which the whole city participates. An evolution, therefore, that underlies a 'detection' and understanding of the processes of modifications and permanence. In the second case, on the other hand, we mean architecture that develops principles, that is transmitted according to certain rules which make it autonomous (Rossi, 2012). If the theoretical relationship is that in which we understand things in their generality (Hegel, 2017), then architecture, understood at this point as 'art in and for itself', lies in the means, in the sense that it has as its object sensitivity, but establishes a theoretical relationship with this sensitivity, taking an interest not so much in the matter as in its sensitive manifestation, that is, in its form, in its figure. Departing from an image of naturalistic imitation, it is placed within a historical vision, since the idea in its being for itself, the idea as 'conscia sui' produces itself in the creation of second nature (Hegel, 2017).

In addressing the object of its study only to itself, architecture identifies itself as an autonomous discipline, which looks for its forms starting from the reality of its time, placing itself critically towards this. Taking reality as a knowledge base of oneself means placing oneself in a condition of knowledge not only of the space around us but also of history, in the aesthetic sense of it as 'realization of the idea of freedom'

(Hegel, 2017). In this sense, a synchronic attitude towards the works of the past is typical of architectural design theory, from whose study it is possible to obtain, in a logic of immutability of the principles and logical statements that underlie their design, an ever-current lesson. For this reason, the thesis according to which 'architecture is the buildings' (Grassi, 2003) is considered correct and the study of the past is important.

However, if architecture can and must be understood as a science, its conclusive moment is also based on subjective elements. Although I consider all architecture to be a positive fact, a concrete topic, I think that in the end, we clash against something that cannot be fully rationalized, this something is a largely subjective element (Rossi, 2012). On the other hand, the first principle of theory, following the rossian interpretation, would consist precisely in the personal obstinacy that every designer should have on some themes, that is, identify a theme to develop make a choice within architecture and always try to solve that problem (Rossi, 2012). Now it can be said that the intrusion of this subjective datum into a logical discourse on architecture is not necessarily to be understood as an exception, but rather it is the essential link that allows us to legitimize the analogy as a compositional technique of the architecture. The analogy, appealing to memory, allows the convocation of known forms, with which look for an order with whom objects are together.

Some considerations about the architecture of Aldo Rossi | In conclusion, as an example of these arguments, an analysis is proposed about some of Rossi's architectural projects, that can be considered paradigmatic of a possible relation between multi-scalarity and analogy. The analysis has been performed through drawing, intended as a unique instrument to understand architecture, both in the meaning of re-design as a cognitive approach to the project and as analytical de-sign intended as a project sign.

Analogy, as a relationship that the intellect captures between two objects with common features, connects the concept of multi-scalarity with compositional practice. In other words, we can speak of multi-scalarity as that intimate property of artefacts, that permits an association of some type between them. This movement of reflection and propagation of a unique content that permits the association of multiple containers could be summarized, in a specifically architectural context, as the aspiration to 'type', that is as recognition in every kind of building of its own identity represented with fixed and repeated elements, precisely with typical elements (Monestiroli, 2002). Multiscalarity thus understood is investigated not only in its purpose cognitive of reality, of which it becomes an objective tool capable of grasping the relationships be-

Next page

Fig. 2 | David Griffin and Hans Kollhoff, 'City of Composite Presence', 1978 (source: Koetter and Rowe, 1979).

Fig. 3 | Giovan Battista Nolli, 'Nuova Pianta di Roma': detail of the Flavian Amphitheater and San Giovanni in Laterano, 1748 (source: wikipedia.it, 2020).

tween things but also as a connection between phenomena and concepts, between idea and forms, interested in recognizing in these the persistence of present value. It has been said that multiscalarity is connected to the compositional practice of the architectural project, and this occurs in general when the subjective datum enters the compositional exercise, that is when, in the presence of a given problem, appealing to memory, those forms, in the past deemed adequate in solving this problem, are summoned.

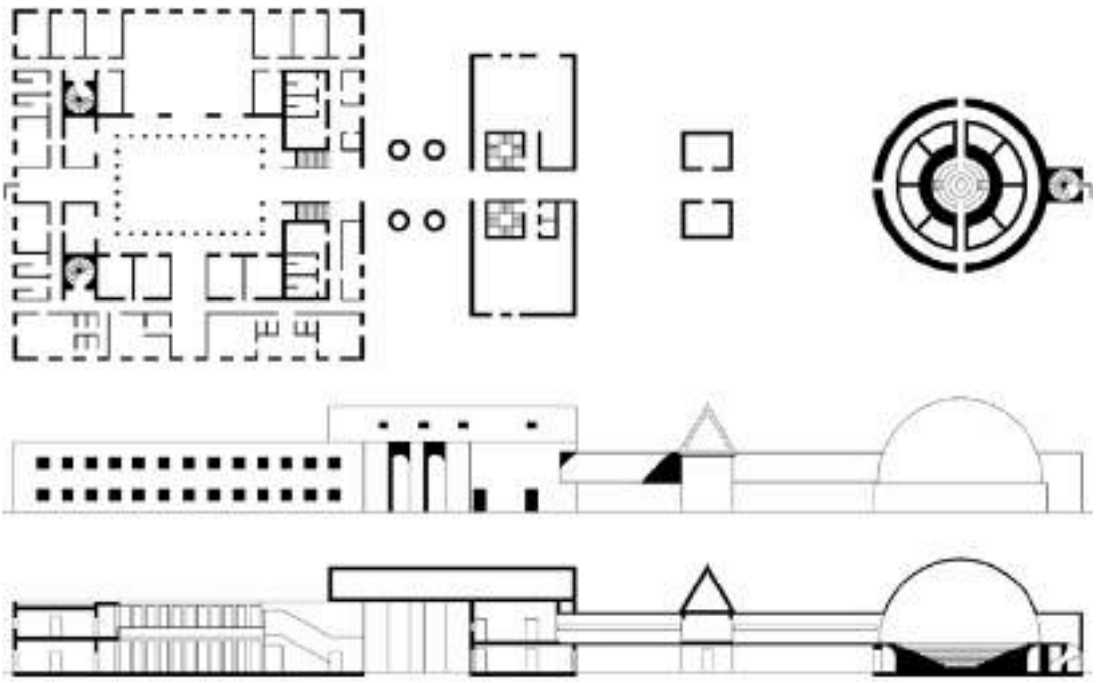
It is right to emphasize the importance given to form and its autonomy in the design project. In this regard, the exercise that Hans Kollhoff experimented for the City of Composite Presence (Koetter and Rowe, 1979; Fig. 2), the representative icon of Collage City, the ideological and intellectual work of Colin Rowe on the city is important, both selecting fragments of shapes which, due to their appropriateness, manage in a graphic representation to construct what can be defined as the plan of a similar city. In the drawing we find the shapes, sectioned as in a typological relief, of the most disparate architectures different in space and time, juxtaposed by reason of a refined balance, abstracting them from their spatial and historical context. It should also be noted, for the purposes of our presentation, that if on the one hand, Kollhoff will summon certain architectures almost as tributes to the teachings received from his masters Ungers and Rowe – as noted in a recent essay (Braghieri, 2019) – on the other hand, the work of the City of Composite Presence is the result of an empirical approach.

Just like the Analogous City of Rossi – a composition in which each form appears to have a suitable location – in Kollhoff's work the Via Nuova of Genoa, for example, is perfectly matched with a gap between the arches of the Lucca Amphitheatre, thus managing, despite empiricism, to summarize a formal structure that is not unusual between the shapes of the circle and the line. If you examine the plan by Nolli specifically for the area of the Colosseum (Fig. 3) you will notice that the relationship that existed in 1748 between the Flavian Amphitheatre and the opposite 'happy road', which connected the Amphitheatre with S. Giovanni in Laterano, is completely 'analogous' to the composition of Kollhoff. It should be added that the reference does not seem random, given that Giovanni Battista Nolli's New Topography of Rome, designed for Benedict XIV and completed after a major campaign of architectural design, is a con-

stant presence precisely among Colin Rowe's work tools, which focused exactly on the sector around the Colosseum during the 'analogy' works carried out in Rome (Carl et alii, 1979) in the same year as the publication of the Collage City.

And yet, in a general 'multiscalar' exercise of formal references, it turns out that this way of composing is also similar to certain architectures of Rossi which, by assembling the shapes of the circle and the line, derive their typological structure defined as 'a skewer' (Bonfanti, 2001). One example is the 1968 project for the Scandicci Town Hall (Figg. 4, 5) – significantly before the Kollhoff experiments – where various elements of the architecture are connected by a sky-bridge (the line) ending in a dome (the circle). Rossi himself, regarding the Scandicci project, declared his explicit formal affinity with the project for a country house at Charlottenhof by Schinkel (Ferlenga, 1999; Fig. 6), in which we find the analogous alignment of the elements of the house and the surrounding wood. Rossi defined the Scandicci 'line' as an 'urban gallery', in which – together with the central courtyard plan of the administrative offices and the dome of the board room – we can see the hypotactic[6] role concerning the other elements of the composition.

On the other hand, Rossi, using the central plan type and the corridor as solutions to the problem of the Town Hall as a public building par excellence never clearly separated



Figg. 4, 5 | Aldo Rossi, Massimo Fortis and Massimo Scolari, Project of Scandicci City Hall, 1968 (drawings by the author, 2019).

from the external spaces [which] can be passed through by a visitor freely without hindering the work that takes place there (Ferlenga, 1999), indirectly testified how the analogous procedure, in its resemblance to the composition of Kollhoff of the Via Nuova of Genoa and the Amphitheatre of Lucca, does not only address the formal problem but also the thematic value guarded by such forms and their reconciliation with types.

These arguments are supported by the constant use of the central plan type – single or double in the shapes of the square and the circle – and the corridor-gallery, which frequently return to Rossi's work on the public and collective building (Visconti and Capozzi, 2019; Fig. 7) and can be defined in all examples as the 'primary elements' of the composition, those that remain in the forms and in the sense to which the secondary elements are aligned in a hypotactical type scheme (Fig. 8). An example is the project for the Deutsches Historisches Museum in Berlin (Fig. 9), where the two main elements are significantly the circular foyer and the long central corridor, which 'rises' in importance compared to the surrounding environments orthogonal to it thanks to a considerable difference in height, in a dimensional relationship in which a similar reference to the large spaces of the Gothic cathedrals can also be found (Fig. 10).

In the project for the new Congress Palace in Milan, the reiteration of the design is made even more explicit by the radical disproportion of the primary elements com-

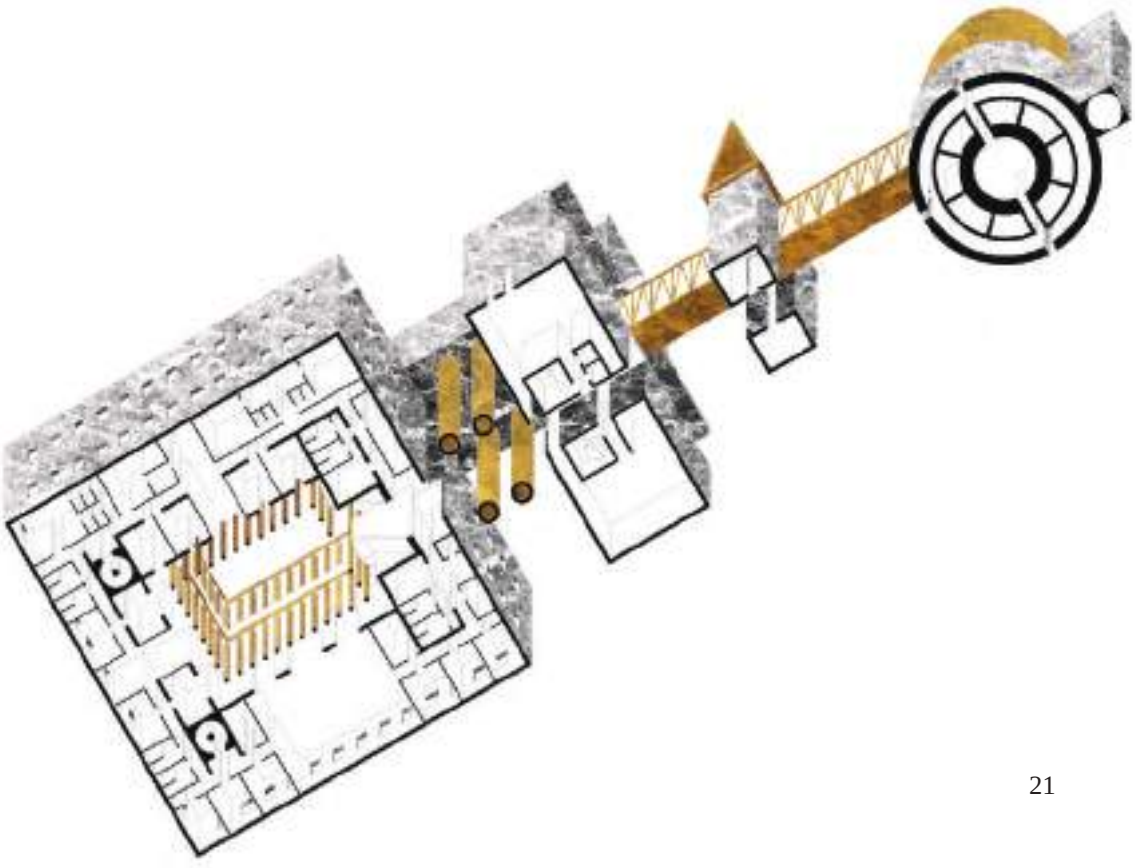
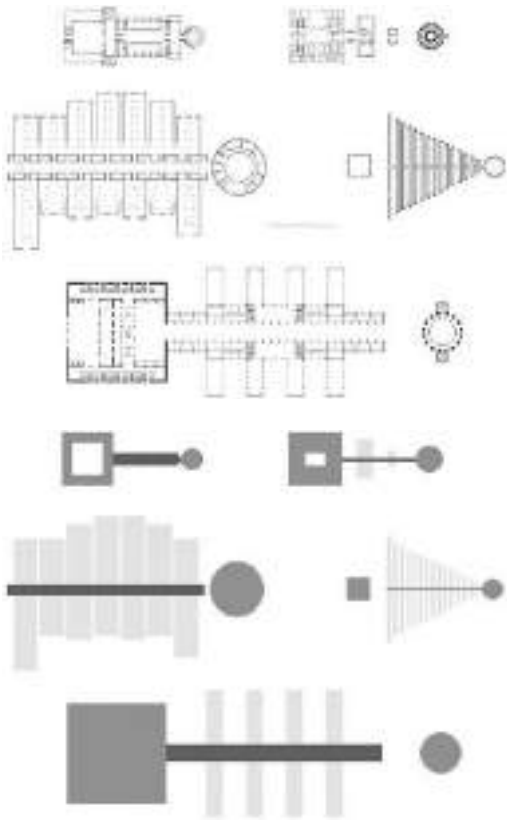


Fig. 6 | Karl Friedrich Schinkel, Project of a Country House in Charlottenhof, 1758. The linear organization of the system is highlighted (drawing by the author, 2019).



Figg. 7, 8 | Skewer buildings, dimensional comparison and syntax of figures: Civic Library in Seregno; Scandicci City Hall; Cemetery of San Cataldo; Deutsches Historisches Museum in Berlin; Congress Palace in Milan (drawings by the author, 2019).

pared to the secondary ones, where the long internal gallery, connecting with the square conference room, relates, this time only at a distance, with a conical tower, recalling with its forms an analogous Milan united by the great Gallery (Ferlenga, 1999). The Civic Library in Seregno is an exception, where the role of the gallery is this time translated into the large reading room of the library, with explicit analogous references to the National Library Hall designed by Boullée (Fig. 11) in which, in turn, Raffaello's vision of the School of Athens is famously proposed (Fig. 12). But it is significantly in Rossi's most famous project that the 'skewer' design achieves its clearest essence. In the Cemetery of San Cataldo, two elements with a defined shape are identified: a cube and a cone. These two monumental elements, naked and impoverished of any particularism, are symmetrically aligned by a void, a central spine that crosses the whole cemetery and which is defined only through the relationship that is established between the two elements. In addressing the cemetery architecture project as an interpretation of the residential project, Rossi expressed the compositional reasons of the city in the elements of the cemetery – intended as the 'city of the dead' – indirectly verifying the possible expression of multiscalar relationships intimate with the doing of architecture, as Alberti remembered centuries before.

Conclusions | An attempt has been made to demonstrate how the concept of analogy can play an important role in architectural design studies, as a procedure that allows the project to resolve the themes of our time, investigating the solutions that history has offered for those themes, and updating them with respect to our historical moment. This special relationship with the past allows architecture not to adhere perfectly with its own time, but to place itself, with respect to it, in a detached position – further away – but precisely for this reason in a critical, anachronistic, in a word contemporary, way (Agamben, 2008).

In this sense, the example study of some rossian public architectures, in which it is possible to trace the constant use of the central plan and corridor type, allows us to outline the two essential functions of the space, that is, being and crossing. If, in fact, at the scale of the house, the function of staying has been identifiable since ancient times as the space with the hearth – that is to say the nucleus of the ancient house –, thus associating the function of crossing to those connection spaces such as corridors and porticos, at the urban scale the functions of staying and crossing are translated respectively into the construction principles of the city: the square and the street. The public building is that type of architecture that stands at an intermediate scale between the nano of the single house and the mega of the city, allowing a multiscale connection between the architectural interior and the urban interior. Through this multi-scale feature, of which the public building becomes the example, the places manage to retain – despite the continuous change of scale – the intrinsic reason for their spaces.

This way of looking at the spaces of architecture and of the city can open up further insights for studies on the contemporary city, especially in a historical moment in

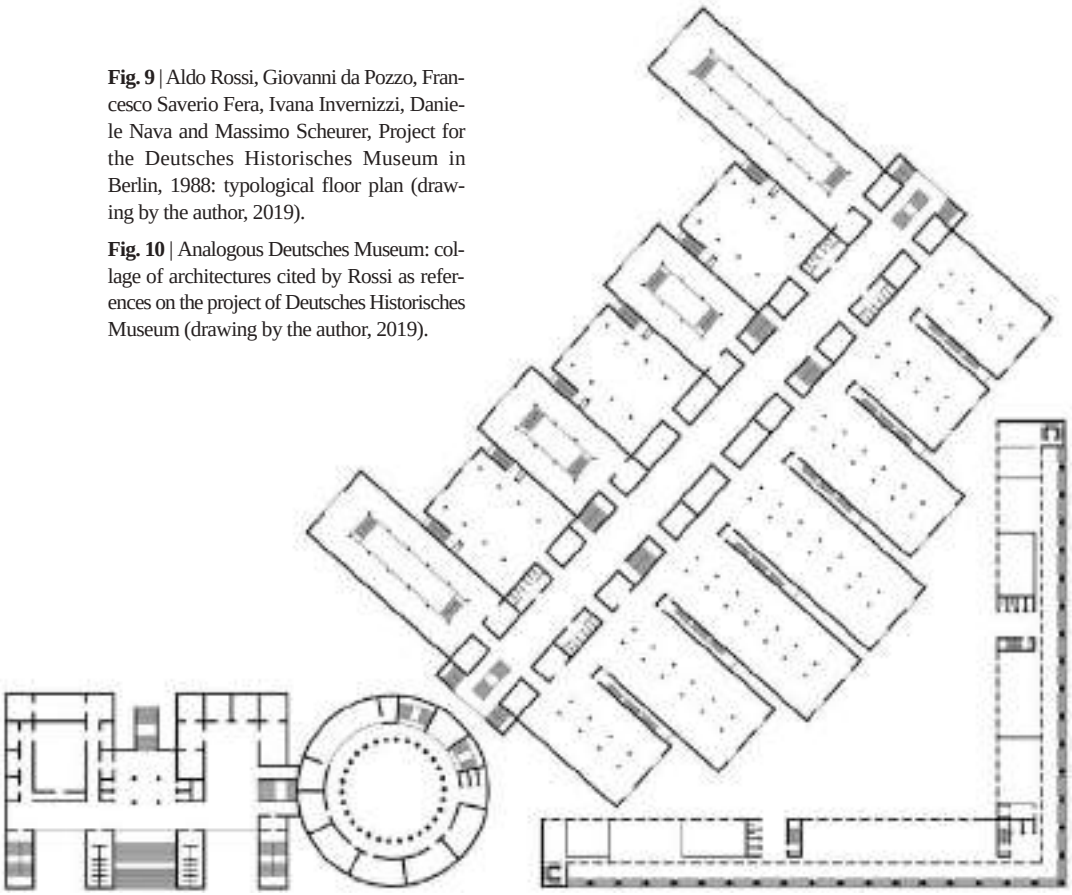
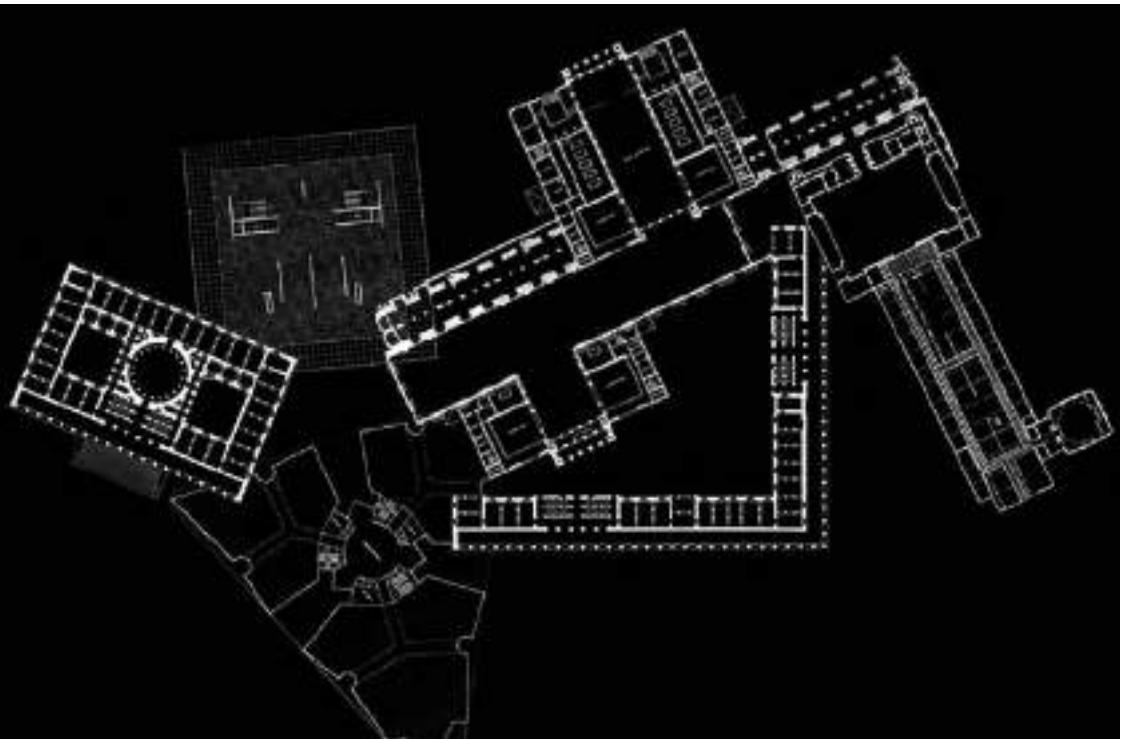


Fig. 9 | Aldo Rossi, Giovanni da Pozzo, Francesco Saverio Fera, Ivana Invernizzi, Daniele Nava and Massimo Scheurer, Project for the Deutsches Historisches Museum in Berlin, 1988: typological floor plan (drawing by the author, 2019).

Fig. 10 | Analogous Deutsches Museum: collage of architectures cited by Rossi as references on the project of Deutsches Historisches Museum (drawing by the author, 2019).



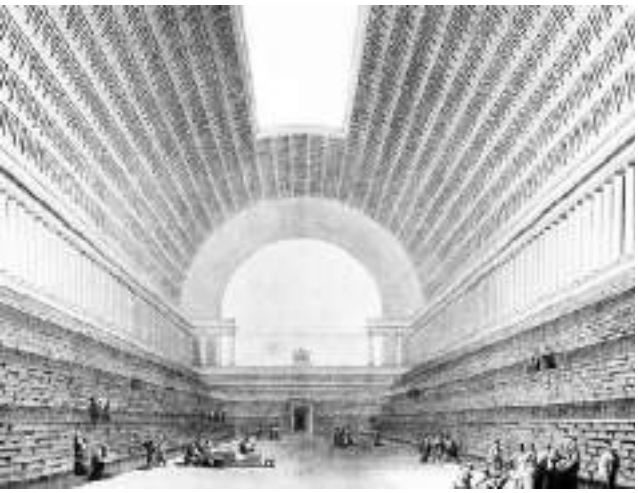


Fig. 11 | Étienne-Louis Boullée, Project of the Hall for the extension of the National Library, 1785: perspective view of the second variant (source: www.gallica.bnf.fr, 2020).

Fig. 12 | Raffaello Sanzio, 'Scuola di Atene', 1511 (source: www.wikipedia.it, 2020).

which the ancient socio-cultural role of public places in the city seems to be increasingly replaced by a form of virtual sociality, distinguished by its characteristic changeability, relativity and temporary nature. It, therefore, seems important to try to develop an idea which, in returning to reasoning on the principles of the architectural space, reaffirms the real problems of our time; in particular, the current situation linked to the health and safety of the urban space requires today's society to reflect critically on the places and spaces of the city. Rethinking the role of urban space today, with its conditions of crossing and being, cannot ignore profound research on the current meaning of these spaces, on their ability to still be representative of the spirit of the time or, to put it à la Rossi, 'the fixed scene of human affairs'.

Notes

1) Think of the Ca' del Duca of Venice and that column of Filarete encased at an angle that repeated almost obsessively in Rossi's projects. One example for all is the residential unit in Friedrichstadt in Berlin in 1981. It is not by chance that the cylindrical element is repeated on a smaller scale, later also in the Conica of Alessi, which in turn contains an explicit reference to the project for the Theatre of World.

2) Architecture – as an allusive artefact to natural objects, but by no means a work that derives from an intentional transformative process by man –moving from principles and norms (ideal objects) slowly sedimented, is an agitated activity par excellence that in its 'affirmative' it produces concrete and immanent objects (physical objects) which however want to represent meanings and values (social objects) (Capozzi, 2013).

3) The 'positive' or 'modest' realism is to be understood as a proportional mean between the 'naive realism', of those who in ascertaining an ontological foundation of reality passively accept some kind of natural law, and the 'post-modernism' of those who intend the supremacy of the concept over reality. Positive realism instead conceives the real as a critical constraint, a resistance against any falsification produced by man.

4) The definition is attributed to Prof. Renato Capozzi.

5) The text is taken from the speech by Roberto Masiero entitled What Architecture Is held at the Palamostre Theatre in Udine on October 16, 2014, during the first edition of the Mimesis Festival.

6) By hypotaxis, it is meant the importance that Rossi seems to attribute – to be verified whether this is concerning an autobiographical reason or not – to the decisive elements of his architecture compared to others. The hypotaxis thus understood is effective in placing the projects that work with these elements in synchronic succession, tracking the almost constant permanence, in the positions and relationships, of the 'prime' shapes of the circle and the line concerning the 'submissive' rectangles. Bonfanti's analysis in describing the rectilinear succession of the rossian projects is, in this sense, confirmed, but a possible different reading has been found compared to that made by Bonfanti when he indicates the additive and paratactic procedure as the compositional technique of rossian architecture.

References

Agamben, G. (2008), *Che cos'è il contemporaneo?*, Nottetempo, Milano.

Alberti, L. B. (1485), *De re aedificatoria*.

Aureli, P. V. (2016), *Il Progetto dell'Autonomia – Politica e architettura dentro e contro il capitalismo*, Quodlibet, Macerata.

Biraghi, M. (2019), *L'architetto come intellettuale*, Einaudi, Torino.

Benjamin, W. (1979), *Avanguardia e rivoluzione – Saggi sulla letteratura*, Einaudi, Torino.

Bonfanti, E. (2001), "Elementi e costruzione. Note sull'architettura di Aldo Rossi", in Bonfanti, E. and Sabatino, M. (eds), *Nuovo e moderno in architettura*, Bruno Mondadori, Milano, pp. 343-358.

Bonfanti, E. (1963), "Architettura moderna", in Macorini, E. (ed.), *Enciclopedia della Scienza e della Tecnica*, Mondadori, Milano, pp. 169-176.

Braghieri, N. (2019), "Alcune indagini e riflessioni intorno a City of Composite Presence", in *Piano b. Arti e culture visive*, vol. 4, n. 2, pp. 61-87. [Online] Available at: doi.org/10.6092/issn.2531-9876/10600 [Accessed 10 March 2020].

Capozzi, R. (2017), "AR_Analogia come utopia", in *Viceversa | L'attualità dell'utopia*, n. 6, pp. 226-227.

Capozzi, R. (2013), "Architettura, ragione, realtà", in Caja, M., Malcovati, S. and Suriano, S. (eds), *Nuovo realismo e architettura della città | New realism and architecture of the city*, Maggioli, Rimini, pp. 49-63.

Carl, P., Di Maio, J., Peterson, S. and Rowe, C. (1979), "Nolli: Ottavo Settore", in Sartogo, P., Dardi, C., Grumbach, A., Stirling, J., Portoghesi, P., Giurgola, R., Venturi, R., Rowe, C., Graves, M., Krier, L., Rossi, A., Krier, R., Argan, G. C. and Norberg-Schulz, C., *Roma interrotta*, Officina edizioni, Roma, pp. 136-150. [Online] Available at: monoskop.org/images/a/a5/Roma_interrotta_1978.pdf [Accessed 12 March 2020].

Debord, G. (2002), *La società dello spettacolo*, Massari, Viterbo.

Ferlenga, A. (1999), *Aldo Rossi – Tutte le opere*, Electa, Milano.

Ferraris, M. (2014), *Manifesto del nuovo realismo*, Laterza, Roma-Bari.

Grassi, G. (2003), "L'architettura come mestiere", in Tessenow, H., *Osservazioni elementari sul costruire*, FrancoAngeli, Milano, pp. 21-68.

Hegel, G. W. F. (2017), *Estetica – Il manoscritto della «Bibliothèque Victor Cousin»*, Einaudi, Torino.

Koetter, F. and Rowe, C. (1979), *Collage City*, MIT Press, Cambridge.

Lapierre, E., Fabi, A., Piovene, G., Fabrizi, M., Lucarelli, F., Marot, S., Esmilaire, L. and Chadney, T. (2019), *The Poetics of Reason: 5th Lisbon Architecture Triennale*, Ediciones Polìgrafa, Barcelona.

Lukács, G. (1970), *Estetica*, Einaudi, Torino.

Monestiroli, A. (2018), *Il mondo di Aldo Rossi*, LetteraVentidue Edizioni, Siracusa.

Monestiroli, A. (2002), *La metopa e il triglifo – Nove lezioni di architettura*, Laterza, Roma-Bari.

Morris, W. (1963), "Il futuro dell'architettura nella civiltà", in Morris, W., *Architettura e socialismo – Sette saggi*, Editori Laterza, Bari, pp. 3-42. [Online] Available at: morrissociety.org/worldwide/ ITALY/italyArchitetturaEsocialismo.pdf [Accessed 12 March 2020].

Rossi, A. (2012), "Architettura per i musei", in Rossi, A., *Scritti scelti sull'architettura e la città 1956-1972*, Quodlibet, Macerata, pp. 323-339.

Rossi, A. (2011), *L'Architettura della Città*, Quodlibet, Macerata.

Rossi, A. (1976), "La città analoga: tavola | The analogous city: panel", in *Lotus*, n. 13, pp. 4-8. [Online] Available at: monoskop.org/images/0/01/Rossi_Aldo_1976_The_Analogous_City_Panel.pdf [Accessed 8 March 2020].

Rossi, A. (1975), "La arquitectura análoga", in *2C | Construcciòn de la Ciudad*, n. 2, pp. 8-11. [Online] Available at: issuu.com/faximil/docs/1975-2c-02 [Accessed 8 March 2020].

Samonà, G. (1978), "Alle origini dell'urbanistica moderna: le trasformazioni della città nell'Ottocento", in Samonà, G., *L'urbanistica e l'avvenire delle città*, Laterza, Roma-Bari.

Schröder, U. (2015), *I due elementi dell'edificazione dello spazio – Scritti scelti*, Aiòn, Firenze.

Visconti, F. (2016), "L'Ipostilo e il progetto della città", in Capozzi, R., *L'architettura dell'Ipostilo*, Aiòn, Firenze, pp. 183-187.

Visconti, F. and Capozzi, R. (2019), *Kahn e Mies – Tre modi dell'abitare*, CLEAN, Napoli.

Zevi, B. (2009), *Saper vedere l'architettura – Saggio sull'interpretazione spaziale dell'architettura*, Einaudi, Torino.

Publishing Series in PROJECT | Essays and Researches
From Mega to Nano
The Complexity of a Multiscalar Project
vol. 04 | 2020 | paper 2 | pp. 28-43

ISSN (print): 2704-6087
ISSN (online): 2704-615X
ISBN (print): 978-88-5509-188-6
ISBN (online): 978-88-5509-189-3

MULTISCALARITY OF ADAPTIVE ARCHITECTURE
The efficiency of micro and the resilience of macro in contemporary design

Bianca Andaloro

section
ARCHITECTURE

typology
ESSAYS & VIEWPOINT

DOI
doi.org/10.19229/978-88-5509-189-3/422020

ABSTRACT
Dealing with the multiscalar approach of contemporary architectural design raises the question of which architecture today is willing to accommodate a constant comparison between different scales, materials, and practices. It is believed that the processes that best show this purpose are related to resilient architecture, which elaborates innovative features through adaptive processes. With the introduction of external factors to the building as design materials, adaptive architecture can be considered as a transformative condition for some invariants of the discipline. The resilient and adaptive approach, therefore, uses technological elements, whose scale is Micro, embedded in the building and operating at the medium scale, to capture information from an external basin and return an improved response to environmental and human conditions.

KEYWORDS
adaptive architecture, resilient architecture, responsive architecture, interface architecture, digital infrastructure

Bianca Andaloro, Architect and PhD Candidate at the University of Palermo (Italy), has been a Member of the In_Fra lab Research Unit since 2016. She has been visiting student at the Lectoraat Play and Civic Media of the HvA in Amsterdam, researching on the topic of interaction design. Her actual research concerns adaptive architecture and digital infrastructures, the relationship between infrastructure, the city and public space. Mob. +39 347/57.15.617 | E-mail: bianca.andaloro@unipa.it

Defining and identifying the contemporary architecture project, which is increasingly confronting and integrating with urban systems now progressively Smart or Intelligent[1], appears today a topic of fundamental importance for our discipline. In fact, the concepts of scale and measurement have always been fundamental tools for the project, because of their capacity to relating the particular with the general and to setting hierarchies and relationships between different built systems. Nowadays we can use the notion of multiscalarity, which is a predominant feature of some architectures, as a means to understand the relationships between architecture and the macro and microsystems with which it dialogues and interacts. It is therefore intended here to refer to processes of adaptive or responsive architectures, capable of responding to the needs of resilience to which environmental circumstances and contingencies refer today, in order to prepare an early reaction to environmental changes. Adaptive design, in fact, implies the integration of material and immaterial elements of different nature and scale into the architectural project constitute an integrated, adaptive and therefore resilient result.

Implementing these processes, however, does not mean to attribute an exclusive design scale a contemporary project, but, on the contrary, it implies to find in the multiscalarity an element able to define it: from the immateriality of the digital infrastructure and information to the complexity of specific territorial and environmental contingencies, the adaptive architecture incorporates systems of integration and data processing, to elaborate projects with a strong systemic complexity, that are also multi-dimensional, multi-scalar and multi-material. Through the study of three emblematic projects for their spatial and systemic complexity, such as the Generator (Hardingham, 2016), the Currie Park (Carlo Ratti Associati, 2016) and Reset (UNSense, 2017), it is intended to show the complexity of the adaptive approach operating in the interrelation between elements of different scales, in order to highlight the related characteristics and methodology.

Evolution of Adaptive Architecture | Nowadays adaptive architecture is considered as an evolution of the Responsive Architecture[2] (Negroponte, 1970), a field of research and application of processes that, starting from the identification of certain external environmental conditions, elaborate adequate response systems capable of modifying the shape, colour or, more generally, specific characteristics of the building[3]. In these projects it is possible to always recognize two fundamental elements: the inputs, i.e. those technological components, usually sensors, that capture information from outside, and the outputs that, on the contrary, process and allow the response of the building.

Born as a pioneering approach referring in particular to energy improvement systems for buildings, today, thanks to the rapid technological evolution, it is no longer limited to regulating the interaction between the building and the outside exclusively with a passive approach. On the one hand, in fact, recent adaptive systems allow the building to communicate with its users, capturing data and adapting its characteristics to them in real-time; on the other, the building itself can be connected through IoT (Internet of Things) systems to a virtual network of information that changes over time and is capa-

ble of revealing changes at different scales. The purpose of this experimentation, initially developed as an exclusively technological artefact, but that today reveals strong socio-cultural implications, is to guarantee a higher performance to the buildings – in the beginning – and to the individual devices – nowadays. However, the application of such a system within a widespread digital infrastructure network reveals an intent to share information to contribute to the improvement of all aspects of individual users and communities' lives under loads of aspects.

It is therefore essential to clarify, through two concepts, the passage of scale from Responsive Architecture to Adaptive Architecture: the first one reflects the ability of architecture to be constantly connected to a network, physical or digital, capable of managing a multiplicity of data over time; the second, however, shows the duality of the relationship between the data and the project. This aspect is revealed in the nature of the project itself to be able to develop an adequate response to the data collected. Moreover, since the time factor is crucial in the definition of this process, it is possible to consider this field of research in close relation with a design process that aims to be resilient, in which the building should face, for example, catastrophic environmental conditions. As it will be seen later, the frequency of natural disasters must be a warning event for architecture to carry out transformations that are not only political and community-oriented but that rather have a semantic nature. It is believed that, by incorporating the macro-processes of infrastructural digitalization and by embedding micro-devices capable of communicating with the external entities, the architecture project can provide a resilient response to natural events.

It is, therefore, now possible to better specify what is meant by adaptive architecture: defined among changing architectures[4] (Fig. 1), it is an architecture capable of reacting independently, dynamically and in real-time to oscillations in certain environmental conditions. It is possible to always recognize five main elements: the adaptive components, the ability to perform reactions, the intentionality of the process, the preservation of renewable resources and adaptation to environmental factors and/or catastrophic events. In particular, spatial configurations, enclosures and structures are considered as adaptable components, in other words, all those elements capable of reacting through the material properties of actuators (Schmidt III and Austin, 2016; Fig. 2).

The technological and digital elements, however, are no longer post-design components, but they should be considered as fully-integrated features: one, as a means of data capture and a vehicle of interpretation, the other, as a necessary condition for the elaboration of the response, capable of defining a real learning process for men and buildings. In this way, the building becomes part of a living data network that can itself contribute to forming, generating information about what happens inside it – the temperature, the variation of influx according to events, etc. – and defining itself as a multi-material element, made up of physical elements and immaterial data.

At the same time, with a multi-scalar approach, the architectural space exploits technology to build connections and interfaces, to respond both to the bio-physical needs of

its inhabitants and to external living conditions or environmental disasters. A continuous succession of scales connected by bonds and interdependence relationships is thus emerging. If we consider the relative character of the design scalarity, it is evident how the project of a single building reveals both an individual and collective dimension: on the one hand, through the relationship with the large scale (not only of the natural and urban environment in which it is inserted but also of the virtual and digital environment that composes it), on the other hand, through the relationship with the users who interact with it. Thinking of architecture as a multiscale mixture of complex and heterogeneous materials and phenomena, finally, represents a way to constantly integrate the physical, material, and visible spatial components with the immaterial, invisible dimension of data and users that are the main protagonists of space.

In the reality of contemporary built architecture, there are lots of projects shown as the results of researches focused on the ability of the digital element to be able to induce the adaptive transformation of such architectural elements canonically considered fixed, as the horizontal surfaces of the floors or even the structural systems[5]. Designing this type of response determines a necessary transformation, semantic and spatial, of these building materials after external stress. Therefore, the new definition of these elements is part of a design process that must use computational components to plan, verify and manage all the changes in advance. Some elements, as mentioned above, lend themselves more than others to hosting this technological upgrade: understanding what adaptivity implies and

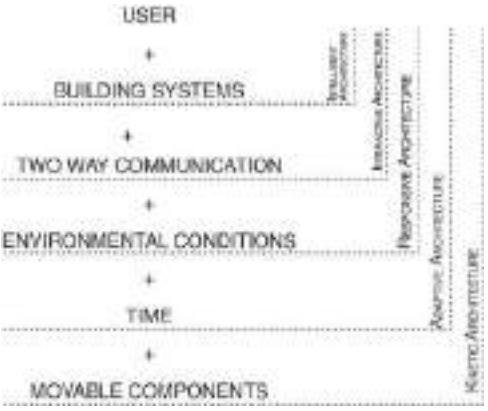


Fig. 1 | Elaboration of the relations generated by the different degrees of interaction between architecture and user/environment (graphic elaboration by the author based on Elmokadem, 2016).

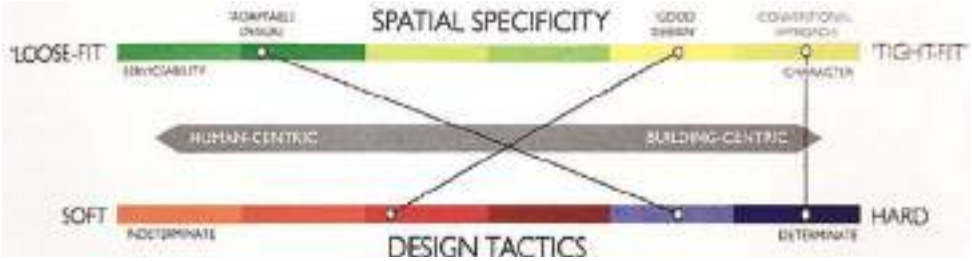


Fig. 2 | Harmonizing approaches model (credit: R. Schmidt III and S. Austin, 2016).

how it modifies the architectural element through interscalar ideation and cognitive process, allows us to understand the contemporary evolution of resilient architecture. However, it is necessary to understand which process has guided the insertion and the subsequent definition of digital culture in architecture and how it has influenced the processes of defining space. This makes it possible to define the systemic design complexity that implements the reflections on the multi-scalarity of contemporary design.

Influences and processes of the digital approach | The definition of a multiscalar idea of the architectural project, that takes into account infrastructures or superstructures of different nature, material or immaterial, requires a comparison with projects from the Sixties and the Seventies between Europe and America. With the overcoming of certain characteristics of the Modern Movement, the exaltation of the concepts of self-determination and individual and collective responsibility and the birth and development of numerous avant-garde movements, there has been a prolific production of projects whose value lies in the mixture of different scales, i.e. the relationship between two and three-dimensional planes. It is easy to mention projects such as the Archigram Group's Plug-in City (1960-74), Yona Friedman's Spatial City (1958-59), or the projects of the Japanese Metabolists, to realize how central the interrelation between the small, human scale and the large scale of urban infrastructure was.

However, the crucial moment that more than any others has guaranteed the development of a thought that would transport the infrastructure from a real and material dimension (the city and its physical networks) to an a-dimensional one (related to information) has been due to the introduction of digital systems. The development of information technology, which took a rapid leap forward during the Second World War and the Cold War, made it possible to introduce some of the guiding principles of these new technologies into the architectural field. Norbert Wiener's theories[6] on the relationship between the environmental and natural world which resulted in the first scientific applications of cybernetics, opened the way to new experimentations, starting from Gordon Pask's theories about the real possibility of applying these concepts in architecture (Picon, 2010).

One of the first personality that understood these theories was Cedric Price, undoubtedly a point of reference for all those who, still today, want to deal with architectures capable of changing (in time and space) and of being related to systems and procedures of different nature. The insertion of a physically micro dimension, but referring to a macro-structural system, into architecture has largely allowed identifying new design components that have contributed to the redefinition of spatial and temporal conceptions. These elements can be summed up with themes such as language, command, control and the ability – both active and passive – to learn. The latter, which in Price's projects becomes the main guide to understanding space, today is fundamental, as mentioned above, for understanding the mechanisms that make adaptability and reactivity of changing architectures possible.

In fact, many of Price's projects modify their spatial conditions by adapting the building to the users' needs, constituting a real learning process by the building. In addition to making these changes physically feasible, in fact, these mechanisms give further value to adaptive architectures, making them a means of knowledge of the environmental facts, of the conditions inside the building, and even of the (inter)relationship with the users, through interface devices. Adaptive architectures, therefore, constitute a means of understanding reality and contributing to its augmented restitution (Fig. 3). It should also be specified how the transition from the information age, with reference to the period between the two wars, to the digital age also marked an evident passage of scale – interdisciplinary – from the culture of the anonymous consumer masses to the individual dimension of the individual (Negroponte, 1970). This passage is relevant in the reading of adaptive multi-scale projects, harbingers of further twofold interest, on the one hand for the communities, to which the projects are destined, and on the other for individuals, whose individual needs may be the reason for architectural changes.

The dimension of Resilience and interscalarity in Architecture | For some decades now, the theme of resilience has been a key theme of contemporary architecture that is called to confront a natural environment increasingly dangerous and unpredictable. The

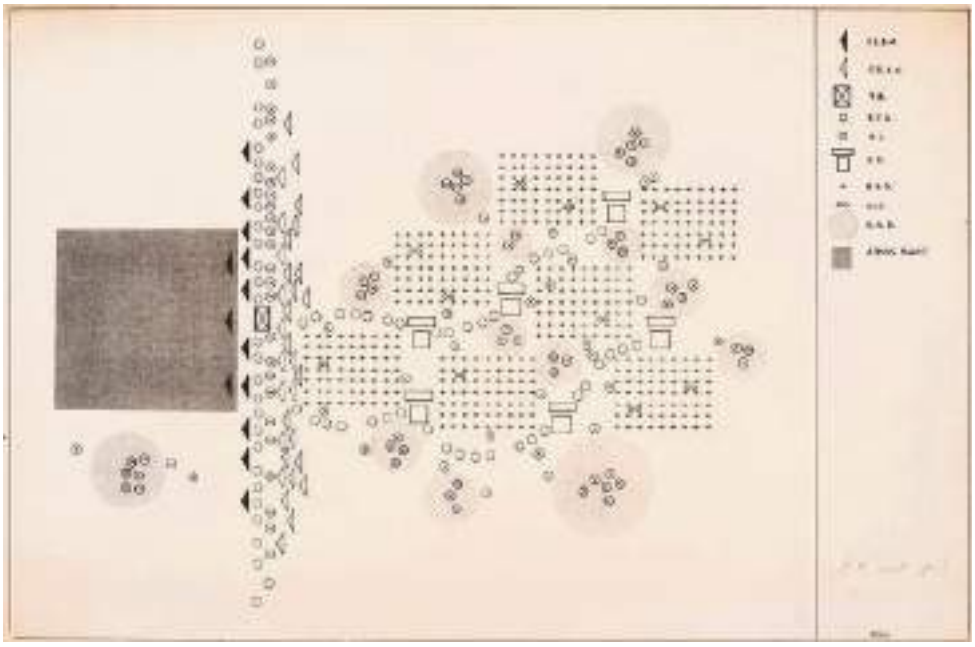


Fig. 3 | 'Atom: diagram illustrating the distribution of educational facilities throughout the town in phase 3', ATOM by Cedric Price, 1966 (credit: CCA Canadian Centre for Architecture, Montreal, 'Cedric Price fonds, 1903:2006, predominant 1953:2000', DR1995-0233-020).

sequence of natural disasters that we have witnessed in the last twenty years, starting with the Tsunami in Thailand in 2004, passing through Hurricane Katrina in 2005 up to the recent earthquakes in Albania (2019), is a sign of an increasingly rapid climate change whose effects prove to be exponentially dangerous. After Hurricane Katrina, which destroyed the United States and has had economic and social repercussions for a long period, resilience has been considered as a design theme also in the architectural field, thanks to the institution of the design competition.[7]

Talking about resilience in the architectural field, as a constitutive and transformative element, implies the involvement of all the elements that define the project, and therefore also the scales and the ambits, in order to constitute beforehand systems capable of absorbing changes and adapting proactively to them to configure a new state of balance. Resilience, design and environmental challenges are therefore three themes that are now increasingly interconnected and linked. It is possible to consider that, the main link between these three macro-environments that represent an innovation in the processes of project design is the presence of quantitative and qualitative information. The technological (non-technical) innovation applied to architectural design is, with speed and efficiency, collaborating in the definition of new paradigms of innovation, through the interscalar dimension of the project and the addition of intangible elements. Therefore, although it is known that resilience represents today a macro field of experimentation and research in different sectors, including architecture, it is interesting to deepen an approach that binds together different scales of the project, in few words, the connection between resilience and digital networks. This, not to propose a unique solution, but to read some architectures that cohesively incorporate the digital technological element, as one of the possible solutions for resilient design.

Resilient cities are cities where the smart city paradigm is already outdated: there is more and more talk of ‘intelligent city’ (Gausa, 2017) or ‘senseable city’ (Claudel and Ratti, 2016). Cities must not only process or read technological or digital data: they must be reactive, able to capture, understand, read and intuit the data. Three components can define their responsive and innovative character: digital communication networks, the ability to process data and the presence of sensors and project application software (Gausa, 2017). Big Data, today, are increasingly complex, complete and publicly available, and therefore can and must be put at the service of processes of a different nature.

In this sense, therefore, it should be considered the topicality of research about the multi-dimensional approach of adaptive architecture applied in resilient environments, considering as possible a greater or different interaction between architecture, the macro environment and the technological micro-sector of the digital infrastructure. The article then aims to show and compare some projects whose approaches are considered valid to outline and investigate the characteristics and constants that define adaptivity through multiscalar processes. The proposed projects – referring to a time horizon between 1976 and 2017 – are the Generator (Hardingham, 2016), the Currie Park (Carlo Ratti Associati, 2016) and Reset (UNSense, 2017): although in their dimensional and functional

diversity, they show the methodological uniformity that guides the adaptive process. In this way, by capturing from the outside different types of information such as the presence, position or even the mood of a user, these examples show how it is possible to define a system of interscalar relations between different elements and contexts. Designing in a resilient way is certainly a topic that has been widely dealt with in different design occasions both by Carlo Ratti Associati, UNSense and UNStudio. These two projects have been identified because of their evident mixture between the technological element, that tends to an infrastructural macroscale, and the architectural element, that directly confronts the average scale of the user. The most distant example, instead, the Generator by Cedric Price, is a precursor of the interrelation between the external necessity and the architectural material, a project whose intent is to periodically re-establish a new balance to overcome a moment of boredom or, we would say today, of difficulty.

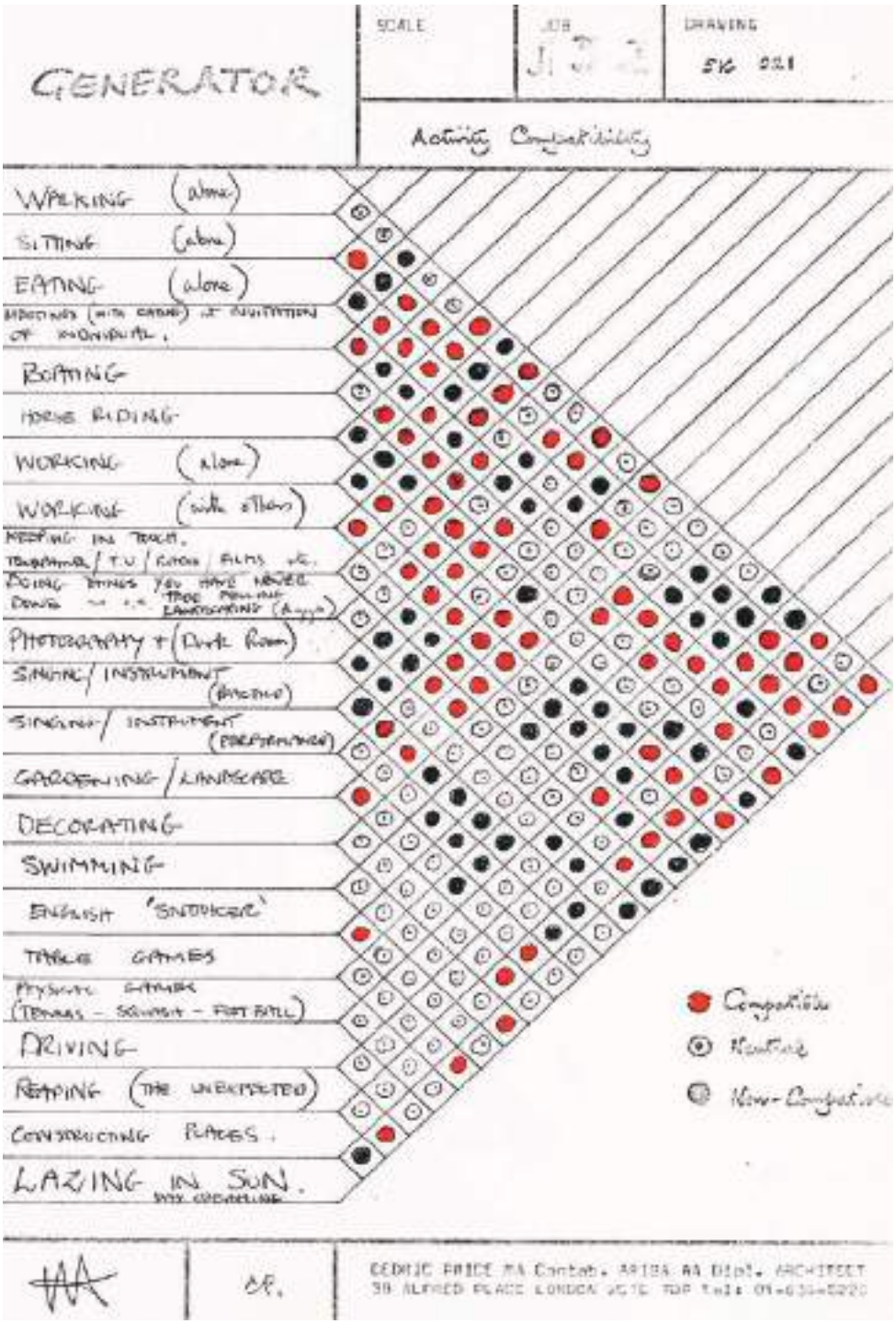
The Generator project: adaptability as a solution for boredom | In a mature phase of his career (1976-79)[8], Cedric Price developed the Generator project in collaboration with John and Julia Frazer, today considered the leading exponents and pioneers of intelligent and interactive architecture. The innovation brought by this project should be read as the result of long project experimentation that began with the Fun Palace (1960-66) and continued with the Potteries Thinkerbelt (1964) and ATOM (1966): although it was never completed, the Generator has made tangible the systematic and complex nature of the digital architectural design. It has therefore created a system capable of linking the scale of the micro technological components to the architectural scale of the building, and again to the macro scale of the digital infrastructure. The Generator prefigures, with clarity and simplicity, the ubiquitous computing and artificial intelligence systems that today architecture is (re)introducing in its spaces through IoT technologies. This space, in fact, is no more just the place of physical relations between the users but it also hosts interactiveness moments, between the building and the users.

By adding to the (inter)action-reaction capability of the Fun Palace the infrastructural complexity of ATOM, Price and Frazer defined the first intelligent building. With its silent and invisible data megastructure, almost an ‘omnipresent intelligence’ (Price and Obrist, 2003), the Generator constitutes its visionary value around the realization of interrelation through interface systems. These elements can also be considered in their dual, physical and digital, value: on a hand, the building becomes an interface with the man who is called to confront it and with the crane system capable of moving the one hundred and fifty cubic units that make up the project, from one point to another of the foundation grid; and on the other, the employee of the White Oak Plantation, for whom the project is intended, uses a digital interface to communicate directly with Factor, the mobile mechanism of the crane. The official presentation of the Generator[9], which has been the visual reference of the project over the years, has been made with a physical prototype of the grid and modular units, an inventory to provide feedback on spatial configurations (use and position), a microprocessor to communicate with the structure

(through a screen) and a recorder to store possible future configurations (Fig. 4). Thus, the question of learning reveals again its importance, together with all the characters that cybernetics had introduced (language, command, control and the ability – active and passive – to learn) and that are fundamental for all adaptive and reactive projects where the digital component is preponderant.

The intelligent system that defines the Generator is therefore endowed with the ability to learn: it has a memory system and the ability to process responses to external (user) stress as well as to redefine its limits or paradigms, through a continuous (generative) re-programming of transformation rules[10]. Finally, the system reaches the maximum autonomy of self-determination instead of the lack of interaction by users: if, in other words, the system does not receive any indication of movement within a given period of time, it can automatically generate, based on its experience, an adaptive response, and put it into practice through the mobile crane element (Fig. 5). The project reveals great potential in defining a very complex system that would lend itself well to reflections on the resilient purpose of adaptive architecture. In fact, combining the ability to store information and learn from it, with the possibility of acting simultaneously at

Figg. 4, 5 | Generator by Cedric Price, 1976-79: The working electronic model; Activity compatibility (credits: CCA Canadian Centre for Architecture, Montreal, 'Cedric Price fonds, 1903:2006, predominant 1953:2000', DR1995-0280-108 and DR1995-0280-651-004-007).


GENERATOR
SCALE
JOB
DRAWING
Activity Complexity
WALKING (alone)
SITTING (alone)
EATING (alone)
BATHING
HORSE RIDING
WORKING (alone)
WORKING (with others)
PHOTOGRAPHY + (Dark Room)
DECORATING
SWIMMING
TABLE GAMES
DRIVING
LAZING IN SUN.
Competitive
Routine
Non-Competitive
CP.

different scales according to different interfaces, foreshadows a perspective, a horizon, in which it is possible to delineate the shape of a contemporary architectural project capable of exploiting technological advancement following a computational process.

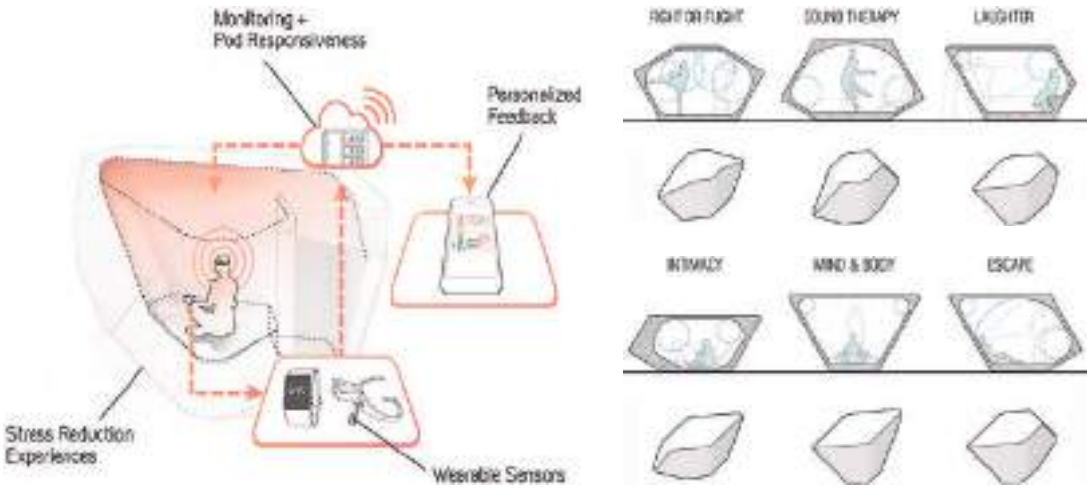
Currie Park and Responsive Flotation: experiments for adaptive structures | A different approach, instead, is shown in the project for the Currie Park Plaza, a part of the Masterplan for West Palm Beach (Florida, USA) developed in 2016 by the Carlo Ratti Associati firm (Fig. 6), whose construction should have been completed in 2018 but has not yet been completed. The Masterplan covers an area of nineteen hectares along Worth Lagoon and is expected to accommodate residential, commercial and low-density public space (Carlo Ratti Associati, 2016). What constitutes an interesting element, however, is the circular platform of the floating Plaza, straddling the water level and exemplifying the possibilities of applying adaptive digital technologies to a resilient purpose. The project is the result of researches conducted by the same studio in collaboration with the Senseable Lab of MIT and exhibited in 2015 with a prototype at the Architecture Biennale in Tallin (Estonia, EU) named Body Building (Carlo Ratti Associati, 2015).

The prototype, called Responsive Flotation (Fig. 7), shows the operation of a floating platform that recalibrates its position in real-time, based on the number of occupants and other additional loads. The mechanism adopted is that of the submarines itself,

Figg. 6, 7 | Currie Park (Plaza) in West Palm Beach (2016) and Responsive Flotation Exhibition in Tallin (2015) by Carlo Ratti Associati (sources: carloratti.com).

which mutates the process of determining the equilibrium carried out also by the human body through the labyrinth of the inner ear. The actuators are therefore nothing more than a series of air chambers placed under the water level inside a shell, which open and close automatically, releasing or aspiring water as required. This allows the square to become a catalyst for activity, hosting public buildings, a restaurant, a swimming pool and an auditorium on the water surface.

This project shows us the adaptive architecture's propensity to intelligently process data, to put it into a system within a larger information network that can respond to phenomena such as rising water It is therefore interesting to read its potential, which certainly does not lie in the mere technology use, linked not only to the world of military naval engineering but also to a long tradition of construction on the water of which countries such as Holland are centuries-old references; the innovation brought by Ratti's project lies in the search for constant interactivity between the user, the environment and architecture. Making a public space accessible by overcoming the problem of the oscillation given by the unstable surface of the water, lays the foundations for a design that seeks a comparison with natural materials and adapts to them, modifying its spatial characteristics. Moreover, as the prototype Responsive Flotation had already made clear, the new stasis condition on the water's edge allows real-time monitoring of the natural elements through the collection of data on chemical pollutants, biological pollutants,



Figg. 8-10 | Reset by UNSense, Milan, 2017 (source: www.unstudio.com).

living conditions of plants and animals, temporal conditions, etc., all elements that can potentially be incorporated in the project and be useful for a future further definition. Once again, the interscalar potential of the adaptive approach, capable of creating links and relationships between materials belonging to different scales, can be noted.

Reset: the adaptivity of the human dimension | The last example gives a particular dimension at a different scale. Born from the collaboration between the Dutch studio UNSense (an experimental research unit of the architecture firm UNstudio, B. van Berkel) and the American architecture firm SCAPE (K. Orff), Reset is a modular and mobile unit conceived between architecture and design and created to provide customized space for stress reduction in the working environment[11] (Shelden, 2020; Fig. 8). It is made up by a series of small-scale architectural devices, real rooms, conceived in series according to modular modules and declined in six sub-themes or categories. The adaptability of the project lies in the response that each of these pods (the rooms) gives to the interlocutor, according to his specific physical needs.

Through the use of wearable technologies (head and heart sensors), able to detect the biological conditions of the user and to report the data to their reference pod, an adequate response is elaborated to favour the reduction of stress according to the specific theme of the space in which they are located. Reset (Responsive Emotional Transformation) is, therefore, presented as a device to rebalance, reorganize and reset (UnSense, 2017), showing itself as a study prototype for future devices useful in everyday life. The research carried out by UNSense, in fact, aims to explore the best blend of architecture and technology.

In addition, the data collected as a result of the application of these adaptive actions

are communicated to the user who thus receives immediate feedback on their activity, as well as providing personal feedback. Especially in this project we see a double definition, physical and digital, of interactive action. If, on the one hand, the user is encouraged to experience the device through a sensory path, on the other hand, through the use of the de-stress app, he can retrace the path in digital form at a later time. Intimacy, Mind&Body, Escape, Fight or Flight, Sound Therapy and Laughter (Figg. 9, 10) are the six themes to which the six units correspond and that differ in terms of interior finish and spatial configuration, as well as the type of experience proposed. Also, in this case, it is possible to find some of the characters previously illustrated, which define complex and interconnected systems: among them, the different languages, in this case related to the senses, the control element, the feedback loop and the recursiveness of the modular feature. In conclusion, the algorithm measures 'the resilience of the user' to stress and identifies among its transformation possibilities the best method of resolution.

Conclusions | The comparative reading of the three case studies presented show the versatility of the results that an architecture capable of modifying its characters can tend to, keeping the interest for a resilient purpose. From this point of view, the theme of the scale of the project remains central and has to be understood more and more as a tool of the designer to implement and give value to his project. Designing with time and in a constantly changing space (both the physical space of the environment and the virtual and mental space) imposes a paradigm shift in order to create an architecture that is able to welcome a constant comparison between different scales, materials and practices.

From the three projects shown, therefore, there is a common divider in the mixture of the parts that make up the entire project and that are not limited to the technological elements, but rather to the dual reality lead by the introduction of the digital element. In this way, the multiscalarity, defined through the transversal relationships between the dimensional areas, is a necessary character of architecture. The dependence between the individual scales, in relation to the human component demonstrates the constant search for the interactive character of adaptive projects, both in their physical and virtual dimensions.

In all cases, however, the combination of material and immaterial characters allows an efficient interchange between the architecture project and the user who approaches it. Knowing how to establish a relationship between the different architectural components and the vast world of data is the challenge of contemporary architecture. Recent studies carried out at the University of Stuttgart, TU Delft and MIT, show a real and current interest in this field of research, which can lead to a real and fruitful integration in the architecture of reality, the digital one, which today has already spread widely in many areas of experimentation and production. This further shift of scale -the interaction of architecture with digital networks- allows identifying the last level, higher than the environmental Macroscale, that corresponds to the definition of resilient projects attentive to environmental dynamics.

Notes

1) The Smart City paradigm, which has spread rapidly among scientific communities in recent decades, refers to a Smart and Reactive City capable of integrating multiple levels of technology, information and communication, and managing urban practices. There is, however, a formal distinction between Smart and Intelligent Cities that attributes to the former the pure informational management of data and to the latter its organization and management in a network.

2) The first to speak about Responsive Architecture is the American computer scientist Nicholas Negroponte (1970) in The Architecture Machine, whose cultural heritage was recently collected by Tristan d'E. Sterk (2005). He showed the limit of Negroponte's definition as it does not yet include integration with robotics and artificial intelligence systems.

3) Among the reactive buildings that are now considered canonical, there are the Institut du Monde Arabe (J. Nouvel, 1980), the Blur Building (Diller & Scofidio + Renfro, 2002) and the Hyposurface (dECOi, 2016); among the adaptive ones, on the other hand, reference can be made to some of the winning projects of the Re-build by Design competition, including the Living Breakwaters (SCAPE, 2014) and The Big-U (BIG, 2014).

4) The classification of architectures capable of interacting at different scales with different levels of external agents allows identifying five categories: intelligent, interactive, reactive, adaptive and kinetic architecture. Each of these has different and unique relationships between the built, the user and the external environment (Elmokaden et alii, 2018).

5) In addition to the projects presented in the second part of the article as case studies, reference is made here to Bernard Tschumi's projects and experimental research realities in Stuttgart, the Institute for Lightweight Structures and Conceptual Design (ILEK) and the Institute for Computational Design and Construction (ICD) of the TU University of Delft and the Canadian Centre for Architecture.

6) Reference is made here to the volume entitled Cybernetics, or Control and Communication in the Animal and the Machine in which Wiener (1948) presented for the first time the relationships of correspondence and analogy between neuroscience and computer science, between the brain and the computer and therefore between neurons and bits of information.

7) A possible response to these phenomena began to take shape in the United States in 2012, following Hurricane Sandy, with the establishment of an architecture competition and the subsequent formal constitution of the group Re-build by Design, and the following year with the establishment of the group 100 Resilient Cities by the Rockefeller and Arup Foundation. Over the years, they both have set the goal of identifying strategies and designing projects capable of responding to future environmental and climate contingencies in a resilient manner. However, what emerges from the study of the work of these realities is a clear interest in intervening in a preventive manner on the urban fabric and soils and the practices of the citizens of the communities involved. An evident problem of scale is then outlined: we pass from the urban macro-scale to the small scale of the man to whom the practices are destined. Therefore, there is often a lack of in-depth analysis specifically referring to the intermediate scale of the building.

8) The project of the Generator was elaborated by Price starting from 1976 and only at the end of 1978 Frazer's consulting report became official. Moreover, although the project was completed in 1979, numerous writings testify a copious correspondence report until 1980 between the two, for a further definition of some aspects of interactivity of the Generator.

9) Between April and June 1980, the publications Building Design and RIBA Journal launched a long series of publications on the Generator that lasted until the following year, underlining the innovation brought by the 'first intelligent building' in history. In December 1980, however, an intervention by Price himself in the magazine Architecture d'Aujourd'hui entitled Au Delá du High-Tech, was necessary to underline the importance of the systemic complexity of the project, beyond mere visual characters (Furtado and Gonçalo, 2008).

10) Frazer's role in this sense was fundamental because it allowed the transition to an automatic-generative system based on the 'user- machine' dichotomy (Furtado and Gonalo, 2008).

11) The project was presented at the Salone del Mobile in Milan in 2017 (Work 3.0 – Joyful sense at Work); research funded by the Dutch Agency for Enterprises for the design and implementation of a prototype that applies the methodology of Reset in everyday situations is currently underway.

References

Carlo Ratti Associati (2016), *Currie park*. [Online] Available at: carloratti.com/project/currie-park/ [Accessed 20 July 2020].

Carlo Ratti Associati (2015), *Responsive Flotation*. [Online] Available at: carloratti.com/project/responsive-flotation/ [Accessed 20 July 2020]

Claudel, M. and Ratti, C. (2016), *The City of Tomorrow – Sensors, Networks, Hackers, and the Future of Urban Life*, Yale University Press.

Elmokaden, A. Ekram, M., Waseef, A., and Nashaat, B. (2018), "Kinetic Architecture: Concepts, History and Applications", in *International Journal of Science and Research (IJSR)*, vol. 7, issue 4, pp. 750-758. [Online] Available at: doi.org/10.21275/ART20181560 [Accessed 20 July 2020].

Furtado, C. L. and Gonçalo, M. (2008), "Cedric Price's Generator and the Frazers' systems research", in *Technoetic Arts*, vol. 6, n. 1, pp. 55-72.

Gausa, M. (2017), "Advanced Urbanism. Conceptual Keys", in *Ka-au | Knowledge alliance for advanced urbanism*, vol. D3.3, pp. 18-21. [Online] Available at: www.ka-au.net/deliverables [Accessed 30 July 2020].

Hardingham, S. (ed.) (2016), *Cedric Price Works 1952-2003 – A Forward-minded Retrospective – Articles and talks*, Architectural Association Publications, London and Canadian Centre for Architecture, Montreal.

Negroponte, N. (1970), *The architecture machine – Toward a More Human Environment*, MIT Press, Cambridge (USA).

Picon, A. (2010), *Digital Culture in Architecture – An Introduction for the Design Professions*, Birkhäuser, Basel.

Price, C. and Obrist, H. U. (2003), *Re: CP*, Birkhäuser, Basel.

Schmidt III, R. and Austin, S. (2016), *Adaptable Architecture – Theory and practice*, Routledge, London-New York.

Shelden, D. R. (2020), *The Disruptors: Technology-Driven Architect-Entrepreneurs*, John Wiley & Sons, Oxford.

Sterk, T. d'E. (2005), "Building upon Negroponte: A hybridized model of control suitable for responsive architecture", in *Automation in Construction*, vol. 14, issue 2, pp. 225-232. [Online] Available at: doi.org/10.1016/j.autcon.2004.07.003 [Accessed 30 July 2020].

UNSense (2017), *Reset Interactive Platform*. [Online] Available at: unsense.com/solution/reset/ [Accessed 20 July 2020].

Wiener, N. (1985), *Cybernetics, or Control and Communication in the Animal and the Machine*, The MIT Press, Cambridge. [Online] Available at: uberty.org/wp-content/uploads/2015/07/Norbert_Wiener_Cybernetics.pdf [Accessed 20 July 2020].

Publishing Series in PROJECT | Essays and Researches
From Mega to Nano
The Complexity of a Multiscalar Project
vol. 04 | 2020 | paper 3 | pp. 44-69

ISSN (print): 2704-6087
ISSN (online): 2704-615X
ISBN (print): 978-88-5509-188-6
ISBN (online): 978-88-5509-189-3

ADAPTIVE FACADE AND PHASE CHANGE MATERIALS (PCMs) A sustainable approach for building materials

Francesca Scalisi

section
ARCHITECTURE

typology
ESSAYS & VIEWPOINT

DOI
doi.org/10.19229/978-88-5509-189-3/432020

ABSTRACT

In the building industry, the building envelope can be crucial to reduce energy consumption and CO_2 emissions in the atmosphere, contributing – with adequate technical and technological solutions and energy-efficient materials – to a prospective energy saving that the European Union estimates at 32.5% by 2030. Creating 'adaptive' envelopes in highly energy efficient buildings is an already available option, with thanks to some materials such as Phase Change Materials (PCMs), developed by the research at 'micro' and 'nano' scales. PCMs give the possibility of reducing the daily fluctuations of the room temperatures through the reduction of indoor temperature peaks. This paper highlights the characteristics, advantages and limits of PCMs, focusing in particular on current research and future scenarios, mostly in relation to the contribution given by nanotechnology to boost the property of these materials used in the building industry.

KEYWORDS

adaptive facade, phase change materials (PCMs), thermal energy storage (TES), nanotechnology, sustainability

Francesca Scalisi, Architect and PhD, is a Co-Founder and Head of the Research Department of DEMETRA Ce.Ri.Med. (Euro-Mediterranean Documentation and Research Center), Palermo (Italy). She is a Member of the Editorial Board of 'Agathón | International Journal of Architecture Art and Design' and a Member in several International Steering Committee as well as a Reviewer for various scientific Journals. She carried out research on Green Materials, Innovative Materials for Architecture, Nanomaterials, Energy Saving in Buildings. Her main Research Projects are 'Natural and artificial innovative materials for architecture', 'Nanotechnologies for unfired clay bricks (tradition, innovation and sustainability)', 'Recovery and conservation of Architectural Heritage using nanostructured materials and innovative technologies'. E-mail: demetracerimed.scalisi@gmail.com

By 2030, the planet we live in will be different: Thomas L. Friedman (2016) observed that the three main forces of our Planet – Moore's Law (technology), the Market (globalization) and Mother Nature (climate change and biodiversity loss) – are all pressing at the same time, with inevitable consequences for territories, cities and buildings that will be designed and created in the future. The 17 2030 Sustainable Development Goals presented by the United Nations (2015) provide an important answer to this time horizon, tracing the path towards a development model for a better and more sustainable future for everyone. But will these Goals be able to accelerate sustainable innovation? However, it is clear that how our planet, its landscapes, cities and architectures will be in the future will mostly depend on the decisions we make today, on our level of 'vision', on how the research will evolve and on how we will deal with the subject of sustainability with respect to the aforementioned Goals.

Going beyond 2030, imagining 2050, according to the United Nations (2019) we will have to deal with a population growth, it will reach ten billion people, 75% of which will be concentrated in cities and urban areas; and if the cities of the future become crucial metropolises for the sustainability of the whole planet, the population increase will determine a greater demand for energy and higher CO_2 emissions in the atmosphere, which have already increased in the last 20 years respectively by 49% and 43% (IEA, 2019a). Other data require some considerations: in 2018 the building industry has absorbed 36% of global energy consumption and produced 39% of annual greenhouse gas emissions. These data surely are very alarming, but are nothing compared to the 2050 outlook, when the energy demand will increase by about 50% and the demand for building cooling will triple compared to 2010 values (IEA, 2019b).

In response to the rise of Earth's temperature, there are many recommendations suggested by international non-profit Bodies and Organizations: to dynamically respond to ongoing change processes and the effects caused by exogenous or endogenous distresses such as climate change and the progressive shortage of resources (EC, 2017), and also to increase the resilience and ability to adapt to the climate, together with ecosystem quality and the overall environmental performance aimed primarily at climate mitigation, CO_2 reduction and energy efficiency, starting from urban and environmental redevelopment and regeneration projects, to be implemented following the Green City Approach (OECD, 2016).

In the building industry, the building envelope can be a crucial building subsystem to reduce energy consumption and CO_2 emissions in the atmosphere, contributing – with adequate technical and technological solutions and highly energy efficient materials – to a prospective energy saving that the European Union estimates at 32.5% by 2030 (European Parliament and The Council of the European Union, 2012, 2018). The strategic role of the building envelope is also confirmed by the Global Alliance for Buildings and Construction (IEA, 2019a). It reports, among the various actions to be implemented (strategies, construction techniques and resilient materials), also the creation of adaptive envelopes useful to overcome the progressive limitation and non-renewability of natural resources and to

create buildings with high energy efficiency and low CO_2 emissions, allowing to contain, on the one hand, the increase in the average global temperature well below 2 °C compared to pre-industrial levels, and on the other, the growing energy demand for cooling. These guidelines must certainly be coupled with adequate policies that the countries will have to implement and the dissemination of best practices in which heating and cooling are regulated by adaptive and 'passive' envelopes (Tucci et alii, 2019).

In the light of these premises, the paper, after having highlighted the importance of 'adaptive' envelopes as a possible solution to the environmental issues, focuses on the characteristics and potentialities of Phase Change Materials (PCMs) that change to 'answer' temperature variations, changing their state, from solid to liquid and vice versa, depending on the amount of heat they absorb. In particular, the paper will highlight the advantages, limits and fields of application of PCMs, as documented in reference scientific literature, especially in relation to the research carried out at micro and nano scales to enhance the properties of PCMs to be used in the building industry.

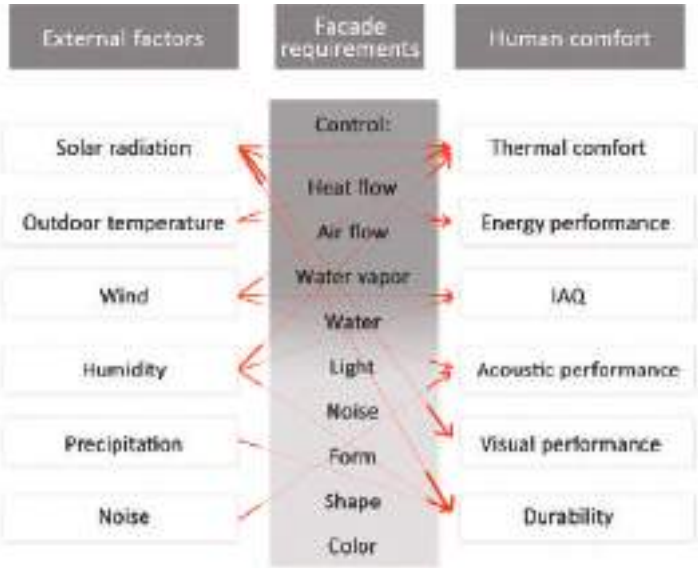
A new paradigm: the facades, from envelope to osmotic and adaptive membrane | In the second half of the 20th century, architecture has experienced a period of extreme linguistic, aesthetic and semantic, as well as technical, innovation thanks to the introduction of technologies that have allowed the creation of self-supporting domes, remarkable overhanging bodies or volumes with particularly complex geometries, but also the use of metal surfaces and plastic materials in building envelopes. This was possible with thanks to new building techniques and innovative digitization processes. In many of the above-mentioned architecture elements we can find a will to express a 'semanticity' that goes beyond the other expressive and technological 'constants', to create 'living-spaces', no more linked to a vision based on 'normal' three-dimensionality, but multiplied by points of view that often deviate from any pre-existing model and from what is the normal human 'perception' (Dorfles, 2007), to communicate a more marking than stylistic value, to take on the role of 'symbol-buildings' (to mention two well-known examples: Agbar Tower in Barcelona by Foster and the Guggenheim Museum in Bilbao by Gehry) having two essential characteristics: they are 'marks' in the urban confusion that surrounds them; and also to replace the 'modest' monuments of the past (Dorfles, 2007).

This great attention given to formal and aesthetic issues has led architects to often neglect the energy performance of the envelopes and the potential benefits they could have provided to the environmental issue (Addington, 2009), delegating to 'active' systems the air heating, ventilation and cooling necessary to compensate for the indoor thermohygrometric conditions caused by the indiscriminate use of large glass surfaces.

Starting from the mid-1990s, the gradual awareness on the environmental emergency (and of the repercussions in human, social and economic terms) reverberating on buildings through 'macro phenomena stressing the whole building system', the growing cost of energy and the demand for a higher-quality thermohygrometric well-being made by

the users have pushed the researchers and designers towards new envelope concepts in general and facades in particular, accelerating innovative practices with new approaches characterized by dynamism, adaptiveness, smart control, responsiveness, integration-hybridization, biomimicry, etc., fostering a new paradigm (Perino and Serra, 2015). In this paradigm, these sub-systems are not intended anymore as elements opposing to a flow, but – on the contrary – as 'filters' (Favoino et alii, 2014) that receive by controlling, or oppose in a 'smart' way to, the external weather stresses by intercepting and capturing them in different directions depending on the seasons and the exposures (Addington and Schodek, 2005), therefore assimilating the frontier envelope to a 'technological Janus' (Lucarelli et alii, 2020; Tab. 1).

The 'mitigation' strategy, among the strategies identified to respond to these solicitations, is consolidated, but many experiments and recent achievements suggest the need for it to be coupled with an 'adaptation' strategy, using a range of 'adaptive solutions' involving the 'micro' scale (Lucarelli, 2018) through the use of components (often derived from transfer of technology) capable of providing increasingly extreme performance responses to external stresses (in terms of indoor comfort) with low energy consumption, or the 'nano' scale with materials already used in the first biomimetic applications in envelope systems. The resilient attitude of biological systems to respond in an adaptive, reactive and dynamic way to hostile and adverse external stresses, aiming to minimize the system's vulnerability rather than safeguard the full integrity of the system at all costs – that is, to ensure that it can preserve its vital functions with minimal



Tab. 1 | Schematic role of adaptive facade (source: Aelenei, Aelenei and Vieira, 2016).

losses (Belpoliti, 2013) – it starts to interest the building industry since it is so effective and efficient that it aims to be a new paradigm from which draw inspiration to design the functioning of artificial systems (Benyus, 1997).

In this sense, the aim of the project goes beyond the configuration optimization of the object following specific conditions – expected, static or predictable within a limited range of variation – favouring resilient behaviours throughout their whole service life answering variable environmental stresses (Antonini, 2019) to be implemented with an adaptive and dynamic attitude, and through a range of progressive tactics and actions, proportionate to the stress (Oguntona and Aigbavboa, 2017). Some examples of resilient facades are: 'dynamic' envelopes, which control the relation between the external environment and the building by managing the different energy flows through integrated systems (materials and components) capable of changing their shape, alternating functions and organizing spaces (Pesenti et alii, 2015; Luible and Overend, 2018); 'smart' envelopes capable of improving the energetic and environmental management with sensors and built-in actuators connected through the devices of the IoT thanks to the real-time analysis of data on the operating conditions of the envelope (Arnesano et alii 2019) and by 'biomimetic' envelopes that, by mimicking animals and plants nature as 'model, measure and mentor' (Benyus, 1997) and learning from its behavioural and performance paradigms, use only techniques and technologies, materials and components that react to environmental stimuli in an 'organic' and 'passive' way (Tucci, 2017). Even with their relative peculiarities, all the aforementioned types of envelope can be included in the 'adaptive' envelope category, defined by the EU COST Action TU 1403 Adaptive Facades Network (Luible, 2015) as closing systems made up by multifunctional (preferably 'passive') and highly adaptive systems capable of changing their functions, characteristics, properties, performances, configurations or behaviours in a fixed period of time, responding to variable boundary conditions and with the aim of improving the overall performance of the building.

The most common solution is to integrate mobile devices into the artifacts, although the environmental issue should lead us to rethink the use of large motor-powered and energy-intensive elements and to think on the complexity of these systems also in relation to building and maintenance costs. In this respect, some examples are the Institut du Monde Arabe, designed by Jean Nouvel in 1987 in Paris, in which the 30,000 metal diaphragms inspired by the mashrabiya are moved by engines managed by a central computer and require constant maintenance due to frequent mechanical failures; or the Al Bahar Tower in Dubai, built in 2012 with a project by Aedas and ARUP in which the structural elements of the adaptive facade will reach physical obsolescence in the fiftieth year of their operation and the many components that make it move (such as actuators and bearings) will not last more than fifteen years (Karanouh and Kerber, 2015).

Therefore, the research is oriented towards biomimetic applications emulating, through materials designed at a 'micro' and 'nano' scale, the behaviour of living organisms originating a functional, morphological variability of the objects concerned, and

Fig. 1 | Q1 – Thyssenkrupp Quartier, JSWD Architekten, 2010, Essen Germany (credits: www.jswd-architekten.de/projekte/thyssenkrupp-quartier/).

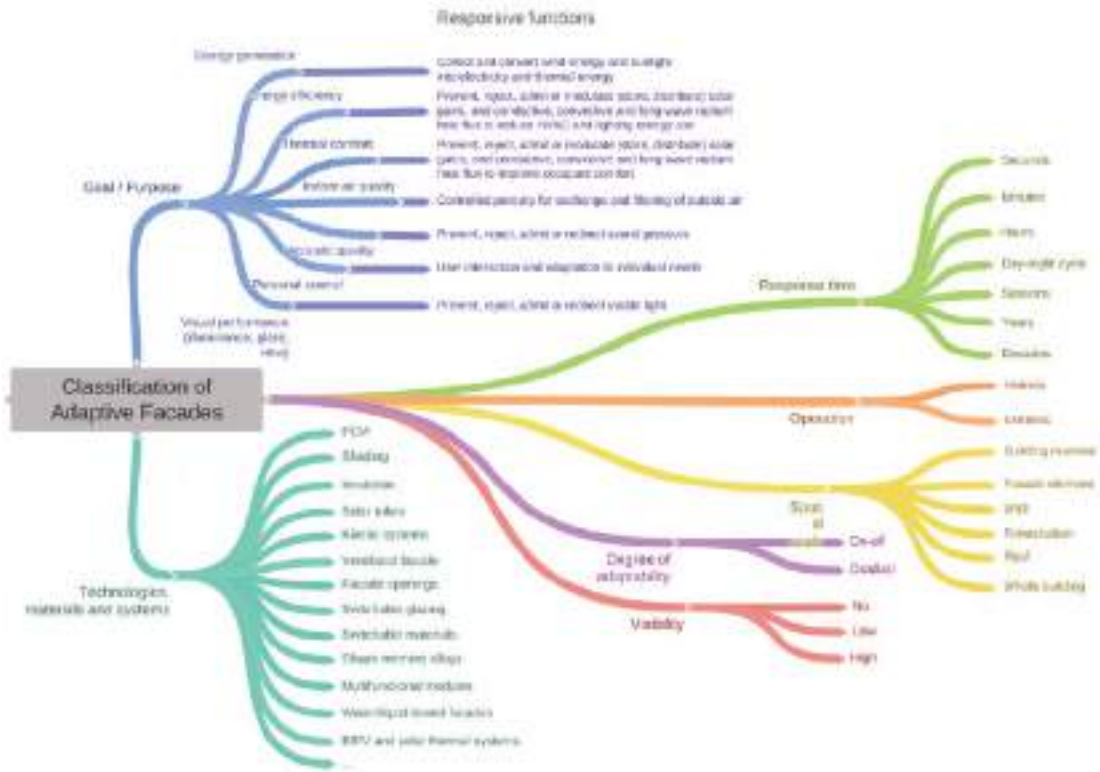
Fig. 2 | Shiver House designed by NEON: a kinetic 'animal like' structure which moves and adapts in response to surrounding natural forces, Korppoo, Finland, 2019 (credits: www.neon.uk/?utm_medium=website&utm_source=archdaily.com#/shiver-house/).

Fig. 3 | Al Bahr Towers, Abu Dhabi, 2012 (credits: www.arup.com; www.re-thinkingthefuture.com).

Fig. 4 | Adaptive Sola Skin, self-supporting solar collection façade: prototype with removable panel (credits: danielraznick.com/about/adaptive-solar-skin/).

often also to their appearance (Persiani, 2019). Consequently, the dynamism is no more linked to the action of a mechanic actuator hidden from view but, for example, to photochromic coatings that regulate glass transparency, or to brise-soleil moved by phase-change actuators or even to external coating membranes that change their geometry and volumes, according to the incident solar radiation on surfaces (Wayne, Santoso Mintorogo and Sigit Arifin, 2019; Figg. 1-4).

Regardless of the type of adaptive facade, its design – mostly in case of critical or vulnerable environments – it must be preceded by an investigation on the dynamics that influence the vulnerability of the buildings, the analysis of the available natural resources (sun, wind, breezes, climate, etc.) and by simulations and tests on their use to evaluate the adequacy of the responses considering the energy efficiency aim. It can be achieved with a new concept in which the best facade is not the most insulated but the one allowing to correctly regulate the flow of transmitted heat, capture or release energy, control the flow rate of the ventilation and, finally, regulate its permeability according to the season, working conditions and user preferences. Nowadays, the mar-



Tab. 2 | Conceptual overview of a classification scheme for adaptive facades (Aelenei et alii, 2019).

ket and the research offer different types of facades characterized by an extraordinary level of innovation (Bendon et alii, 2019) mostly on the functionality and active responses of materials and components.

Besides the different definitions (Romano et alii, 2018) and specificities (Loonen et alii, 2015), every type of facade goes through three stages: (i) detect the environment (ii) process the acquired information and (iii) take physical action (movement or change in material property) to optimize internal environmental qualities in response to adverse external conditions. The level of adaptability (gradual or immediate) can be uniquely linked to the reaction time (seconds, minutes, hours, day-night cycle, season, year, ten-year span) and to the spatial scale (nano, micro and macro) according to when and where the change occurs. Daniel Aelenei et alii (2019; Tab. 2) have presented a classification scheme that combines the strengths of the different typologies through seven objectives/purposes that, on the one hand, help to understand the peculiarities (and philosophies) of the different adaptive facade systems, and on the other, define the tasks that an adaptive facade can perform, usually by balancing overall energy consumption, CO_2 emissions and life-cycle costs. In general, the adaptive components are controlled and managed in two ways (Loonen et alii, 2013): an 'intrinsic control', self-regulated and triggered by environmental stimuli that allow low-cost operations and maintenance (typical of passive systems); an 'extrinsic control' which can start after finding information (through sensors) and data processing with actions to be taken (through actuators).

Although the need for greater energy efficiency has regulated in recent decades a series of mandatory requirements aimed at implementing nearly Zero Energy Building (nZEB) or Zero Energy Building (ZEB), the facades of buildings must now meet new and more stringent requirements. Traditional materials with 'static' characteristics are no longer adequate to meet them, because they have optimal performance for specific needs, since they are optimized to ensure only one of the well-being conditions of cooling, heating or daytime lighting (Kasinalis, Loonen and Costola, 2014). Instead, facades should be more resilient and heating, cooling, lighting and energy production should be requirements handled by the envelope, planned since the design stage with new functions and peculiarities, with unprecedented performance and being an 'osmotic', 'selective', 'dynamic' and 'multifunctional' membrane (Goia, Haase and Perino, 2013), in other words 'adaptive', able to control and manage the variables of 'macro' phenomena through 'micro' and 'nano' responses, new scales of interest in the project.

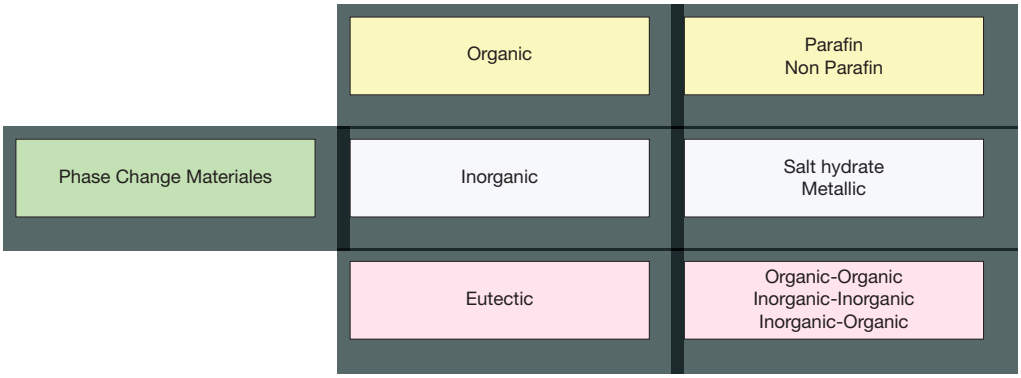
Adaptive responses from 'micro' and 'nano': the PCMs | Among the different materials developed with the research at 'micro' and 'nano' scale, the Phase Change Materials (PCMs) can be a possible solution to reduce the energy demand in the building sector by reducing heating and cooling demand of buildings (Parameshwaran, Harikrishnan and Kalaiselvam, 2010). The Thermal Energy Storage (TES) systems allow to 'store' a certain amount of energy in the accumulation stage to be used at a later time

Thermo-physical Requirements	Kinetic Requirements	Chemical Requirements	Economical & Environmental Requirements
Appropriate melting temperature in the required operating temperature range	High nucleation rate in order to avoid super cooling of the liquid phase	Long term chemical stability of the PCM	Low price and effective availability
High latent heat of fusion	High rate of crystallization to satisfy demands of heat recovery from the storage system	No degradation after freeze/melt cycles	Non-polluting
High specific heat		Complete reversible freeze/melt cycle	Low environmental impact
High thermal conductivity of solid and liquid phases		No corrosiveness	Good recyclability
High density		Non-flammable, non-toxic, non-explosive materials for safety	Low embodied energy
Congruent melting of the PCM			Facility of separation from other materials
Cycling stability			
Small vapor pressure			
Small volume changes			
Little or no sub-cooling during freezing			
No segregation			

Tab. 3 | Thermo-physical, kinetic, chemical, economic and environmental requirements of PCM (source: Konstantinidou, 2010).

(Arce et alii, 2011), and among the different methods used for the heat energy storage, the Latent Heat Thermal Energy Storage (LHTES) uses the characteristics of phase change materials. The PCMs are materials capable of changing their status from solid to liquid and vice versa, depending on the amount of heat they absorb which becomes 'latent heat' during warm weather and 'released heat' during cold weather (Soares et alii, 2013). These materials are in a solid state at room temperature, but when it rises, they become liquid and accumulate energy in a latent form. The cycle is inverted when the temperature decreases again, they return to the initial temperature. In this case, the PCMs return to a solid state and in this phase change they release the previously stored energy as heat in the environment. Their thermal storage ability is higher than the one of a traditional material having with a certain mass. Thermoregulating materials represent an innovative technological solution in building design, as they give the possibility to reduce the daily fluctuations of the room temperatures through the reduction of indoor temperature peaks, and therefore of the energy consumption necessary for air conditioning the rooms. Furthermore, as a not negligible advantage, it must be noted that they are functional and operational without any type of external power source, and give dynamism and adaptation flexibility to external weather conditions.

One of the first PCMs used in passive solar systems is water. The Water Drum Wall – tested for the first time at the end of the 1940s by Hoyt Hottel and Massachusetts Institute of Technology of Boston's students – works in a rather simple way: the rays of the sun crossing the glass surface are intercepted by a mass of water or another liquid



Tab. 4 | PCM classification (source: Memon, 2014).

Organic (paraffins and non-paraffins)	Inorganic Salt hydrates	Eutectics
They are available in a range of temperature	They possess high volumetric latent heat storage capacity	They exhibit application-specific sharp phase change temperature (melting temperature)
Values of latent heat of enthalpy are high (e.g., acids have much higher heat of fusion than the paraffins)	They possess low vapor pressure in the melt state	Exhibit slightly high volumetric thermal storage density than the organic compounds
Supercooling degree or superfusion effect is normally low during freezing process	They are non-corrosive, non-reactive, non-flammable, and not dangerous	They possess low or no segregation. Thermal reliability is good with congruent phase transition characteristics
Relatively low segregation even after several thermal cycles (thermal reliability). High thermal stability, congruent phase transition process	Have good compatibility with the conventional construction materials. Recyclable, cost-effective, and ease of availability	
Show self-nucleation and growth rate properties	Exhibit high latent heat of enthalpy and sharper phase transformation. High thermal conductivity with lower volumetric changes during phase change. Safe to the environment in terms of handling and disposing when compared to the paraffins	

Tab. 5 | Merits of the LTES materials (source: Parameshwaran and Kalaiselvam, 2016).

Organic (paraffins and non-paraffins)	Inorganic Salt hydrates	Eutectics
Density, thermal conductivity, and latent heat of fusion are inherently lower	Relatively high supercooling properties	Analysis of eutectics for thermal energy storage applications is limited due to the insufficient and non-availability of the thermophysical property data
Inflammable, less compatible with plastic containments	Low degree of nucleation (requires nucleating additives and thickening constituent materials)	In some cases, fatty acid eutectics evolve pungent odor, making them less suitable for PCM wallboard thermal energy storage applications in indoor environments
Larger volumetric changes are possible during charging and discharging (applicable to some grade of organic compounds); expensive by nature	Incongruent phase change and dehydration occur during freezing and melting cycles	
	Decomposition associated with phase separation. Compatibility with some building materials is limited. Exhibit corrosion properties when subjected to most metals. Slightly toxic in nature	

Tab. 6 | Limitations of LTES materials (source: Parameshwaran and Kalaiselvam 2016).

that converts them into heat, distributed by convection or radiation from a ventilated cavity to the served room, through the wall's internal face. The relation between the heat exchange surface and the indoor environment and the accumulation mass also determines the extent of the thermal transfer and its delay. Convective heat transfer through the liquid mass is faster than by conduction within a wall. Therefore, unlike what happens in the Trombe Wall, the heat transfer to the indoor environment by radiation and convection from the inner face of the wall is almost instant (Simmons, 2011).

In order to control convective motions, controls delaying heat transfer are necessary: on the inside of the water wall it is necessary to provide an insulating screen with openings at its top and base, while on the opposite side a mobile insulating screen that prevents overheating or, if necessary, outward heat loss (Emmitt, 2012). Starting from Hoyt Hottel pioneering initiative, through the years, other scholars have made an important contribution to the research and experimentation of Water Drum Wall (Briga-Sáa et alii, 2014; Zhongting et alii, 2017), entailing the thought that in the near future we might use water as real building material. «Build with water will represent a new frontier for sustainable architecture, provided that it is based on a new energy model, able to enhance the thermal mass and energy medium of the natural green fluid characteristics. The new architecture must be conceived as a living organism independent from the energy distribution networks, as a trans-structure, energetically self-sufficient, made of multitasking materials, capable of real-time responses for preserving the indoor comfort» (Sposito, 2017, p. 124).

Many studies have been, and still are, carried out on the use of PCMs in buildings to store heat energy, demonstrating the considerable interest for these materials allover the world (Kalnæs and Jelle, 2015; Cabeza et alii, 2011; Baetens, Jelle and Gustavsen, 2010). However, to use the PCMs we should verify a series of thermo-physical, kinetic and chemical requirements, those that have the greatest impact on their effectiveness, among others, are: High latent heat of fusion, High specific heat, High thermal conductivity of solid and liquid phase and liquid phases, little or no sub-cooling during freezing, non-toxic, low price and effective availability (Navarro et alii, 2018; Konstantinidou, 2010; Tab. 3). The various types of PCMs known to us do not have all the caracteristics listed in Table 3. The PCMs are categorized in organic, inorganic and eutectic: paraffin and non-paraffin are: organic PCMs; salt hydrates and metallics are inorganic PCMs; eutectic PCMs are divided into organic-organic, inorganic-inorganic and inorganic-organic (Tab. 4).

The PCMs – whether organic, inorganic or eutectic – have some lacks of performances, as stated in Tables 5 and 6 (Parameshwaran and Kalaiselvam, 2016). As it can be deduced from the Tables 5 and 6, the organic PCMs are available in a wide range of temperatures, are chemically stable, non-corrosive and nontoxic, do not undergo supercooling or segregation and have a high latent heat of fusion; at the same time they have a low thermal conductivity that could be improved by using a thin encapsulation. Inorganic materials have a good thermal conductivity and a high latent heat of fusion, and are not expensive and non-flammable, but for example salt hydrates have some limita-

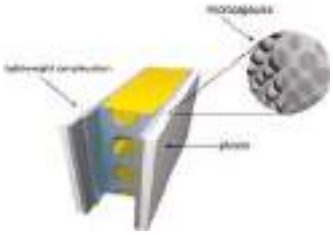


Fig. 5 | BASF's Micronal phase-change microcapsules enhanced gypsum board (credit: materialdistrict.com/material/micronal-pcm/).

Fig. 6 | GAIA PCM Energy Storage Ball: encapsulation of Phase Change Materials in a spherical shape with a diameter of 63, 80, 100 or 125 mm (credit: www.global-e-systems.com).

Fig. 7 | Macroencapsulation CSM (Compact Storage Modules): PCM in aluminum case (credit: www.rubitherm.eu/en/index.php/productcategory/makroverkaspelung-csm).

Fig. 8 | Schematic view of lightweight wall with PCM microcapsules integrated into the interior plaster (source: Schossig et alii, 2005).

tions such as supercooling, segregation and corrosion. On the other hand, metal PCMs do not have a suitable temperature range to be used in the building sector.

Among the most significant criteria for the selection of PCMs there is the melting temperature, whose value has to be compared with the climate zone where the materials will be used in the buildings. Several studies agree that high melting temperatures of PCMs seem more effective for warmer climates, while low melting temperatures can be more efficient for colder climates. Specifically, for the Mediterranean climate the best melting temperature range in winter goes from 18 °C to 22 °C, while in summer it goes from 25 °C to 30 °C (Xiao, Wang and Zhang, 2009; Cabeza et alii, 2011). Paraffin is the most used PCM for indoor cooling, even if in some cases salt hydrates and fatty acid were used. In the future, it would be advantageous to use within the same material and/or components, PCMs with different melting temperatures, to improve the energy performance both in warm and cold seasons (Souayfane, Fardoun and Biwole, 2016).

Given the above-mentioned limits, many studies to ameliorate the mechanism of latent heat energy storage of PCMs have been carried out. They focus on the integration methods of PMCs in building materials such as plaster, plasterboard, cement, insulation and glass (Ascione et alii, 2014; Goia, Perino and Serra, 2013) and the use of nanotechnologies (Jamekhorshid et alii, 2014; Parameshwaran and Kalaiselvam, 2016). PCM incorporation methods are mainly divided into two categories: direct and indirect methods. The direct methods of incorporation, both the wet mixing and immersion (Soares et alii, 2013), were mainly used in the past and have been abandoned due to the possible loss of PCMs and the direct interaction between PCMs and building material which can cause the deterioration of the mechanical and physical characteristics of the materials

(Cabeza et alii, 2007). To avoid loss and incompatibility problems caused by the direct contact between building materials and PCMs, most of the studies carried out in recent years have focused on indirect methods, that involve PCMs encapsulation. The encapsulation methods are mainly of three types, based on the size of the capsules: macro-encapsulation, micro-encapsulation and nano-encapsulation (Figg. 5-8). These sizes influence the stability of the PCM, since the smaller the capsule size is, the more durable a product is (Liu et alii, 2015).

The macro-encapsulation method consists of integrating the PCM in containers such as tubes, bags, spheres, porous materials or panels which are generally bigger than 1 cm (Cabeza et alii, 2011). Some of the containers developed as PCMs capsules are steel spheres (Cui et alii, 2017) or porous structures of light-weight aggregates – LWA (Cui, Memon and Liu, 2015; Niall et alii, 2017; Ma and Bai, 2018) to them is usually applied a highly conductive protective coating material to avoid leaks and at the same time increase the speed of heat transfer. Microencapsulated PCM refers to PCM particles enclosed in a thin solid shell (microcapsule) which is usually made of natural and synthetic polymers ranging from 1 μm to 1,000 μm (Navarro et alii, 2016) which prevents the leakage of the phase change material during the solid to liquid phase. Besides preventing PCM leakages during phase change, microencapsulation provides a quick heat transfer through its great surface area per unit of volume (Memon, 2014; Zubair, Hafiz and Shahab, 2018), improving chemical stability and thermic reliability, since the phase separation within the material, during the phase transition, is limited to microscopic distances (Navarro et alii, 2016).

Microencapsulated PCM can also be integrated in concrete. Most of the studies that have integrated microencapsulated PCM in concrete have used the replacement method – replace a specific quantity of fine aggregates with PCMs in the concrete mixtures (Jayalath et alii, 2016; Cao et alii, 2017), since they have a lower loss in resistance compared to mixtures in which PCM is used as an additive (Meshgin, Xi, 2012). Integrate PCM in concrete (Bentz and Turpin, 2007; Jayalath et alii, 2016; D'Alessandro et alii, 2018; Berardi and Gallardo, 2019), especially organic paraffin (Rao, Parameshwaran and Ram, 2018), can increase its heat storage ability, although PCMs can have some negative impacts on physical and mechanical properties of concrete, which depend from the PCM integration method used during the creation of the composite PCM-concrete (Cao et alii, 2017).

Researchers currently tend to reduce the size of the encapsulation to the nanoscale, to maximize the effects of its size and the surface area involved in the heat transfer (Khadiran et alii, 2016). Nanotechnology is the understanding and control of matter at dimensions between approximately 1 and 100 nanometres (a nanometre is equal to one billionth of a metre), where unique phenomena enable novel applications (National Nanotechnology Initiative Strategic Plan, 2011). On this level, fundamental properties such as force, surface/mass relation, conductibility and elasticity can be improved to create materials that can provide a better performance than present materials. In the architectural field, the advent of nanostructured materials concerns the entire building, from the

basic structure to the wall-coatings, from lighting to energy production, and most important of all, it is considered crucial for energy efficiency in buildings.

The nano-enhancement of PCMs can be achieved with their encapsulation inside a nano-shell (Sari, Alkan and Bilgin, 2014) or a nano fibre (Moghaddam, Mortazavi and Khaymian, 2015): there are several experimentations that have used PCM nano capsules to improve the thermal properties of cellulose nano fibres (Alzoubi, Albiss and Abu sini, 2020) or PCM nano-encapsulated in a silica shell (De Matteis et alii, 2019), highlighting how the use of nanomaterials can help overcome some limits of PCMs, such as low thermal conductivity (Fang et alii, 2013; Ma, Lin and Sohel, 2016). Other researches concerned the improvement of paraffin thermal conductivity through the dispersion of titanium dioxide nanoparticles (Sami and Nasrin, 2017) but also the development of new phase change materials enhanced with carbon nanotubes (C-PCM) and with a polymer-organic hybrid shell which reduce internal temperature variations and absorb more heat (Cheng et alii, 2020).

Final considerations and future developments | In the near future, the building industry will have to make a meaningful contribution to the protection of ecosystems vulnerable to collapse and the reconstruction of those that have already been affected, also through a significant reduction in the energy required for building operations. 'Passive' systems can play, in this sense, a strategic role, especially if the research will give value to bioengineering and naturalistic engineering methods and techniques tending towards practices designed «[…] to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits» (Cohen-Shacham et alii, 2016, p. 5). This change of perspective will lead the way for a new paradigm that will overturn current approaches: the aim of the projects will no longer be to control natural phenomena to subject them to contingent short-term needs but to support the (unpredictable) dynamics of natural systems, ensuring the operating conditions of systems, subsystems, components and building materials in the long term.

In this sense, Ernesto Antonini (2019) observes that the new paradigm given by biomimetic adaptive envelopes will generate two relevant consequences. The first will be to replace the 'economic benefits' objective for those who fund and build a single building with a long-term vision that will concern 'collective benefits' mostly for future generations, strengthening the idea that if the planet is a 'common good' it needs a development model capable of fixing the catastrophic effects caused by the indiscriminate use of non-renewable resources and the emission of CO_2 into the atmosphere (Tirole, 2017). The second will concern the methods of analysis of natural phenomena: action strategies and intervention planning will have to be systemic and multiscalar, employing shared operational and metric techniques to assess credible cost/benefit balances with the tools provided by Environmental Product Declarations (EPD) methods, of the Life Cycle Assessment (LCA) and their extension to investigate the social aspects (s-LCA)

that come into play (Sala et alii, 2015). A vision that analyses the physical area at different scales (resources, materials, buildings, cities, ecosystems and planet) and the social sphere (psychophysical well-being, work, production, consumption, mobility, etc.) and that is aware of the interconnectedness between global and local level is the unprecedented element of this innovative approach that can be implemented immediately thanks to pioneering good practices, as the RELi – REsilience action List by Perkins+Will (Eskew+Dumez+Ripple, 2014) or the REDi – Resilience-based Earthquake Design Initiative for the Next Generation of Buildings by ARUP (2013). Even if they use different methods and standards for assessing resilience, can both be integrated with the most common Sustainable Building Rating Systems.

The great number of published scientific papers and experimental research carried out in the last decade show that the change is occurring and that the future trends in technologies for adaptive facades can be divided into four main categories (Attia, Lioure and Declaude, 2020): 1) Human-centred Design – New ways of working, living and learning, increased knowledge on the well-being and health of users and a higher productivity boost the demand for comfortable and instantly customizable environments (Attia, Garat and Cools, 2019, Luna Navarro et alii, 2020); 2) Smart Building Operating Systems (SBOS) – an increasing number of components and building elements are managed through the BOS: a software platform for smart facades that implements the use of the IoT and digital applications in buildings by providing services and connectivity to SMACIT technologies – social, mobile, analytics, cloud, smart grid and IoT – to boost user interaction (Dery, Sebastian and van der Meulen, 2017); 3) Service-driven solutions – the risks and uncertainties linked with the functioning of adaptive facades are pushing the users to outsource performance optimization, monitoring and maintenance services directly to suppliers and manufacturers, because they know the design and engineering of facades in depth (Azcarate-Aguerre, Den Heijer and Klein, 2017); 4) Circularity and materials – European Union law making on circular economy, fosters the industry to produce efficient adaptive facades but using materials providing an environmental gain during their life cycle and that are recyclable within closed and 'regenerative' economic cycles (Ellen MacArthur Foundation, 2013).

Currently the nZEB and ZEB represent less than 5% of new buildings. This percentage is higher in some Countries, such as France, that has very restrictive energy regulations. In the 'rapid transition' scenario for a sustainable future promoted by the International Energy Agency high-performance and near-zero-energy buildings will be more than half of new buildings in 2030, more in advanced economies. If, in the next decade, every country implements specific energy standards for each geographical area, nation, region and climatic zone, especially by enhancing passive adaptive systems and innovative materials for insulation to limit heat loss in cold climates and reduce solar gain in hot climates. To this purpose, it is essential to organize a strategic plan to lead the building industry in a (quick and aimed) transition stage towards clean energy, low energy consumption and reduced CO_2 emissions and based on three key pillars (IEA,

2019c): Sufficiency – reducing the energy demand and limit expensive unnecessary technological/plant investments through adequate and careful planning and design of buildings without reducing (on the contrary, improving) the well-being standards for users; Efficiency – improve the energy performance of building materials, components and technologies through market policies and actions encouraging the transition to efficient and innovative solutions; Decarbonisation – development, promotion and immediate marketing of already tested technologies that allow to enhance renewable energy sources. The implementation (that is reaching the goals) of this strategic plan is technically possible if the best performing products already available on the market are used since the beginning, through specific 'mandatory performance targets' and 'incentives' useful to cut the high costs of these new materials.

The research on PCMs – which can play an important role in controlling energy consumption for heating and cooling in indoor environments – certainly refers to these three pillars. Taking into account the experimentation and afore-mentioned research, PCMs can take the role of new 'thermoregulatory' paradigm for architecture. To do so, it will be necessary to invest more in research, reasonably assuming that the return on the investment will not only be economic (management costs are significantly lower than mechanized adaptive systems) but also social and environmental and examine in depth a number of issues on various subjects. About environmental issues, it will be necessary to define a new 'adaptive' energy model, based on the physical and thermo-hygrometric characteristics of PCMs, tending, due to their high capacity to absorb latent heat, on the one hand, to the almost energy self-sufficiency in relation to the heating and cooling needs of a building, on the other, to the transfer of surplus heat energy to neighbouring more energy-intensive public buildings, through a system of heat storage and networks.

Conversely, regarding the technological issues, some research areas can concern the creation and development of new PCMs for specific geographic and climatic contexts and building elements and components in which integrate them. It would be important to focus on materials having PCMs with different melting temperatures, to improve the performance of buildings both in warm and cold seasons (Souayfane, Fardoun and Biwole, 2016). Regarding the environmental issue, it should not be overlooked that these innovative storage materials/systems should be analysed especially by taking into account their whole life cycle. Currently, there are only few LCA studies and researches available, limited to paraffin which has significant Global Warming Potential and Totala Use of non-Renewable Primary Energy Roseurces impacts, and to salt hydrates that have a minor impact (Kylili and Fokaides, 2016; Horn et alii, 2018; Nienborg et alii, 2018; Di Bari et alii, 2020).

For the elements and components integrating the PCMs it will be necessary to research on 'multifunctionality' requirements, minimizing the number of technical, durability and endurance elements, while evaluating the overall performance of the system according to an adaptive response to variable (and not always predictable) mechanical and thermal stresses. Moreover, since the new multifunctional components will charac-

terize future architectures with their own shape, size and section, it will be necessary to deepen studies on manufacturing systems – for example digital manufacturing (Sposito and Scalisi, 2017) – allowing, according to the individual needs of designers, the personalization of the components and an adequate integration with PCMs, and also a linguistic and formal variety, suited to the intervention background.

In conclusion, to use PCMs as 'thermoregulatory' materials to be integrated into 'adaptive facades' there is definitely a long road ahead but, with thanks to the above-mentioned experimentation and research, it seems set. On the one hand, it seems that, thanks to the use of nanotechnologies, the limit of these materials can be found in the visionary skills of researchers, and on the other, we still must understand how much and when these technologies and materials will be widespread enough to allow a significant reduction of the energy necessary for heating and cooling buildings.

References

Azcarate-Aguerre, J. F., Den Heijer, A. C. and Klein, T. (2017), "Integrated facades as a product-service system: business process innovation to accelerate integral product implementation", in *Journal of Facade Design and Engineering*, vol. 6, issue 1, pp. 41-56.

Addington, M. (2009), "Contingent behaviours", in Architectural Design, n. 79, issue 3, pp. 12-17.

Addington, D. M. and Schodek, D. L. (2005), *Smart Materials and New Technologies – For the architecture and design professions*, Architectural Press, Oxford. [Online] Available at: bintian.files.wordpress.com/2013/01/smart-materials-new-technologies-for-the-architecture-design-professions.pdf [Accessed 12 August 2020].

Aelenei, D., Aelenei, L., Loonen, R., Perino, M. and Serra, V. (2019), "Adaptive facades", in Asdrubali, F. and Desideri, U. (eds), *Handbook of Energy Efficiency in Buildings – A Life Cycle Approach offers a comprehensive and in-depth coverage of the subject with a further focus on the Life Cycle*, Butterworth-Heinemann, Oxford, pp. 384-411. [Online] Available at: doi.org/10.1016/B978-0-12-812817-6.00039-5 [Accessed 12 August 2020].

Aelenei, D., Aelenei, L. and Vieira, C. P. (2016), "Adaptive facade: concept, applications, research questions", in *Energy Procedia*, vol. 91, 269-275.

Alzoubi, H. H., Albiss, B. A. and Abu sini, S. S. (2020), "Performance of cementitious composites with nano PCMs and cellulose nano fibers", in *Construction and Building Materials*, vol. 236, pp. 1-9.

Antonini, E. (2019) "Incertezza, fragilità, resilienza | Uncertainty, fragility, resilience", in *Agathón | International Journal of Architecture Art and Design*, vol. 6, pp. 6-13. [Online] Available at: doi.org/10.19229/2464-9309/612019 [Accessed 12 August 2020].

Arce, P., Medrano, M., Gil, A., Oró, E. and Cabeza, L. F. (2011), "Overview of thermal energy storage (TES) potential energy savings and climate change mitigation in Spain and Europe", in *Applied Energy*, vol. 88, issue 8, pp. 2764-2774.

Arnesano, M., Bueno, B., Pracucci, A., Magnagni, S., Casadei, O. and Revel, G. M. (2019), "Sensors and control solutions for Smart-IoT facade modules", in *2019 IEEE International Symposium on Measurements & Networking (M&N) – Catania, Italy, 8-10 July 2019*, IEEE, pp. 1-6.

ARUP (2013), *REDI Rating System – Resilience-based Earthquake Design Initiative for the Next Generation of Buildings*. [Online] Available at: www.arup.com/perspectives/publications/research/section/redi-rating-system [Accessed 12 August 2020].

Ascione, F., Bianco, N. De Masi, R. F., de' Rossi, F. and Vanoli, G. P. (2014), "Energy refurbishment of existing buildings through the use of phase change materials: energy savings and indoor comfort in the cooling season", in *Applied Energy*, vol. 113, pp. 990-1007.

Attia, S., Garat, S. and Cools, M. (2019), "Development and validation of a survey for well-being and interaction assessment by occupants in office buildings with adaptive facades", in *Build Environment*, vol. 157, pp. 268-276.

Attia, S., Lioure, R. and Declaude, Q. (2020), "Future trends and main concepts of adaptive facade systems", in *Energy Science and Engineering*, vol. 08, issue 9, pp. 3255-3272. [Online] Available at: doi.org/10.1002/ese3.725 [Accessed 12 August 2020].

Baetens, R., Jelle, B. P. and Gustavsen, A. (2010), "Phase change materials for building applications: a state-of-the-art review", in *Energy and Building*, vol. 42, issue 9, pp. 1361-1368.

Baur, X., Marek, W. and Ammon, J. (1994), "Respiratory and other hazards of isocyanates", in *Internal Archives of Ocupational Environmental Health*, vol. 66, pp. 141-152.

Bedon, C., Honfi, D., Machalická, K. V., Eliášová, M., Vokáč, M., Kozłowski, M., Wüest, T., Santos, F. and Williams Portal, N. (2019), "Structural characterisation of adaptive facades in Europe – Part I: Insight on classification rules, performance metrics and design methods", in *Journal of Building Engineering*, vol. 25, 100721. [Online] Available at: doi.org/10.1016/j.jobe.2019.02.013 [Accessed 12 August 2020].

Belpoliti, M. (2013), "Resilienza: l'arte di adattarsi", in *Domenica del Sole24 Ore*, newspaper, 18 December 2013.

Bentz, D. P. and Turpin, R. (2007), "Potential applications of phase change materials in concrete technology", in *Cement and Concrete Composites*, vol 29, issue 7, pp. 527-532.

Benyus, J. M. (1997), *Biomimicry – Innovation Inspired by Nature*, W. Morrow & Co, New York.

Berardi, U. and Gallardo, A. A. (2019), "Properties of concretes enhanced with phase change materials for building applications", in *Energy and Buildings*, vol. 199, pp. 402-414.

Briga-Sáa, A., Martinsc, A., Boaventura-Cunhad, J., Lanzinhaa, J. C. and Paiva, A. (2014), "Energy performance of Trombe walls: Adaptation of ISO 13790:2008 (E) to the Portuguese reality", in *Energy and Buildings*, vol. 74, pp. 111-119. [Online] Available from: doi.org/10.1016/j.enbuild.2014.01.040 [Accessed 12 August 2018].

Cabeza, L. F., Castell, A., Barreneche C., de Gracia, A. and Fernández, A. I. (2011), "Materials used as PCM in thermal energy storage in buildings: a review", in *Renewable and Sustainable Energy Reviews*, vol. 15, issue 3, pp. 1675-1695.

Cabeza, L. F., Castellón, C., Nogués, M., Medrano, M., Leppers, R. and Zubillaga, O. (2007), "Use of microencapsulated PCM in concrete walls for energy savings", in *Energy and Building*, vol. 39, issue 2, pp. 113-119.

Cao, V. D., Pilehvar, S., Salas-Bringas, C., Szczotok, A. M., Rodriguez, J. F., Carmona, M., Al-Manasir, N. and Kjøniksen, A.-L. (2017), "Microencapsulated phase change materials for enhancing the thermal performance of Portland cement concrete and geopolymer concrete for passive building applications", in *Energy Conversion and Management*, vol. 133, pp. 56-66.

Cheng, J. et alii (2020), "Preparation and characterization of carbon nanotube microcapsule phase change materials for improving thermal comfort level of buildings", in *Construction and Building Materials*, vol. 244, pp. 1-8.

Cohen-Shacham, E., Janzen, C., Maginnis, S. and Walters, G. (2016), *Nature-based solutions to address global societal challenges*, IUCN, Gland. [Online] Available at: doi.org/10.2305/IUCN.CH.2016.13.en [Accessed 12 August 2020].

Cui, H., Memon, S. A. and Liu, R. (2015), "Development, mechanical properties and numerical simulation of macro encapsulated thermal energy storage concrete", in *Energy and Building*, vol. 96, pp. 162-174.

Cui, H., Tang, W., Qin, Q., Xing, F., Liao, W. and Wen, H. (2017), "Development of structural-functional integrated energy storage concrete with innovative macro-encapsulated PCM by hollow steel ball", in *Applied Energy*, vol. 185, part 1, pp. 107-118.

D'Alessandro, A., Pisello, A. L., Fabiani, C., Ubertini, F., Cabeza, L. F. and Cotana, F. (2018), "Multi-functional smart concretes with novel phase change materials: mechanical and thermo-energy investigation", in *Applied Energy*, vol. 212, pp. 1448-1461.

De Matteis, V. et alii (2019), "Nano-encapsulation of phase change materials: From design to thermal performance, simulations and toxicological assessment", in *Energy and Buildings*, vol. 188-189, pp. 1-11.

Dery, K., Sebastian, I. M. and van der Meulen, N. (2017), "The digital workplace is key to digital innovation", in *MIS Quart Executive*, vol. 16, issue 2, pp. 135-152.

Di Bari, R., Horn, R., Nienborg, B., Klinker, F., Kieseritzky, E. and Pawelz, F. (2020), "The Environmental Potential of Phase Change Materials in Building Applications. A Multiple Case Investigation Based on Life Cycle Assessment and Building Simulation", in *Energies*, vol. 13, issue 12, pp. 1-26. [Online] Available at: doi:10.3390/en13123045 [Accessed 24 August 2020].

Dorfles, G. (2007), "L'architettura contemporanea fra estetica e semantica", in *Agathón | Notiziario del Dottorato di Ricerca Recupero e Fruizione dei Contesti Antichi*, pp. 7-10. [Online] Available at: docplayer.it/126682517-Agathon-universita-degli-studi-di-palermo-dipartimento-di-progetto-e-costruzione-edilizia.html [Accessed 12 August 2020].

EC – European Commission (2017), *Implementation of the Circular Economy Action Plan*, EU Publishing, Brussels. [Online] Available at: ec.europa.eu/environment/circular-economy/implementation_report.pdf [Accessed 12 August 2020].

Ellen MacArthur Foundation (2013), *Towards the Circular Economy – Economic and business rationale for an accelerated transition*. [Online] Available at: www.ellenmacarthurfoundation.org/assets/downloads/publications/Ellen-MacArthur-Foundation-Towards-the-Circular-Economy-vol.1.pdf [Accessed 12 August 2020].

Emmitt, S. (2012), Architectural Technology, 2nd Edition, John Wiley and Sons, UK.

Eskew+Dumez+Ripple (2014), *A framework for Resilient Design*. [Online] Available at: www.eskewdumezripple.com/assets/pdf/Fellowship/A%20Framework%20for%20Resilient%20Design.pdf [Accessed 12 August 2020].

European Parliament and The Council of the European Union (2018), *Directive (EU) 2018/2002 of the European Parliament and of the Council of 11 December 2018 amending Directive 2012/27/EU on energy efficiency*. [Online] Available at: data.europa.eu/eli/dir/2018/2002/oj [Accessed 12 August 2020].

European Parliament and The Council of the European Union (2012), *Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC*. [Online] Available at: data.europa.eu/eli/dir/2012/27/oj [Accessed 12 August 2020].

Fang, Y., Yu, H., Wan, W., Gao, X. and Zhang, Z. (2013), "Preparation and thermal performance of polystyrene/n-tetradecane composite nanoencapsulated cold energy storage phase change materials", in *Energy Conversion and Management*, vol. 76, pp. 430-436.

Favoino, F., Goia, F., Perino, M. et alii (2014), "Experimental assessment of the energy performance of an advanced responsive multifunctional facade module", in *Energy and Buildings*, vol. 68, part B, pp. 647-659.

Friedman, T. L. (2016), *Thank You for Being Late – An Optimist's Guide to Thriving in the Age of Accelerations*, Picador, New York.

Goia, F., Haase M. and Perino, M. (2013), "Optimizing the configuration of a facade module for office buildings by means of integrated thermal and lighting simulations in a total energy perspective", in *Applied Energy*, vol. 108, pp. 515-527.

Goia F., Perino, M. and Serra, V. (2013), "Improving thermal comfort conditions by means of PCM glazing systems", in *Energy and Buildings*, vol. 60, pp. 442-452.

Horn, R., Burr, M., Fröhlich, D., Gschwander, S., Held, M., Lindner, J. P., Munz, G., Nienborg, B. and Schossig, P. (2018), "Life Cycle Assessment of Innovative Materials for Thermal Energy Storage in Buildings", in *Procedia CIRP*, vol. 69, pp. 206-211. [Online] Available at: doi.org/10.1016/j.procir.2017.11.095 [Accessed 04 September 2020].

IEA – International Energy Agency (2019a), *2019 Global Status Report for Buildings and Construction – Towards a zero-emission, efficient and resilient buildings and construction sector*, Global Alliance for Buildings and Construction, United Nations Environment Programme. [Online] Available at: www.iea.org/reports/global-status-report-for-buildings-and-construction-2019 [Accessed 12 August 2020].

IEA – International Energy Agency (2019b), *World Energy Balances – Database Documentation*. [Online] Available at: iea.blob.core.windows.net/assets/fffa1b7d-b0c5-4e64-86aa-5c9421832d73/WORLDBAL_Documentation.pdf [Accessed 12 August 2020].

IEA – International Energy Agency (2019c), *Perspective for the Clean Energy Transition – The Critical Role of Buildings*. [Online] Available at: www.iea.org/reports/the-critical-role-of-buildings [Accessed 12 August 2020].

Jamekhorshid, A., Sadrameli, S. M. and Farid, M. (2014), "A review of microencapsulation methods of phase change materials (PCMs) as a thermal energy storage (TES) medium", in *Renewable & Sustainable Energy Reviews*, vol. 31, pp. 531-542.

Jayalath, A., San Nicolas, R., Sofi, M., Shanks, R., Ngo, T., Aye, L. and Mendis, P. (2016), "Properties of cementitious mortar and concrete containing micro-encapsulated phase change materials", in *Construction and Building Materials*, vol. 120, pp. 408-417.

Kalnæs, S. E. and Jelle, B. P. (2015), "Phase change materials and products for building applications: a state-of-the-art review and future research opportunities", in *Energy and Buildings*, vol. 94, pp. 150-176.

Karanouh, A. and Kerber, E. (2015), "Innovations in dynamic architecture – The Al-Bahr Towers Design and delivery of complex facades", in *Journal of Facade Design and Engineering*, vol. 3, pp. 185-221. [Online] Available at: doi.org/10.3233/FDE-150040 [Accessed 12 August 2020].

Kasinalis, C., Loonen, R. C. G. M. and Costola, D. (2014), "Framework for assessing the performance potential of seasonally adaptable facades using multi-objective optimization", in *Energy and Buildings*, vol. 79, pp. 106-113.

Khadiran, T., Hussein, M. Z., Zainal, Z. and Rusli, R. (2016), "Advanced energy storage materials for building applications and their thermal performance characterization: a review", in *Renewable and Sustainable Energy Reviews*, vol. 57, pp. 916-928.

Konstantinidou, C. V. (2010), *Integration of Thermal Energy Storage in Buildings*, The University of Texas, Austin. [Online] Available at: repositories.lib.utexas.edu/handle/2152/44399 [Accessed 05 September 2020].

Kylili, A. and Fokaides, P. A. (2016), "Life Cycle Assessment (LCA) of Phase Change Materials (PCMs) for building applications: A review", in *Journal of Building Engineering*, vol. 6, pp. 133-143.

Liu, C., Rao, Z., Zhao, J., Huo, Y. and Li, Y. (2015), "Review on nanoencapsulated phase change materials: Preparation, characterization and heat transfer enhancement", in *Nano Energy*, vol. 13, pp. 814-826.

Loonen, R. C. G. M., Rico-Martinez, J. M., Brzezicki, M., Menezo, C., La Ferla, G. and Aelenei, L. L. (2015), "Design for facade adaptability – towards a unified and systematic characterization", in *Proceedings of the 10th Conference on Advanced Building Skins*, pp. 1284-1294.

Loonen, R. C. G. M., Trčka, M., Cóstola, D. and Hensen, J. L. M. (2013), "Climate adaptive building shells: state-of-the-art and future challenges", in *Renewable and Sustainable Energy Review*, vol. 25, pp. 483-493.

Lucarelli, M. T. (2018), "Verso una nuova centralità ecologica dell'ambiente costruito", in *Eco Web Town*, n. 18, vol. II, pp. 7-12. [Online] Available at: www.ecowebtown.it/n_18/pdf/18_02.pdf [Accessed 12 August 2020].

Lucarelli, M. T., Milardi, M., Mandaglio, M. and Musarella, C. C. (2020), "Fenomeni macro vs risposte micro. Approcci multiscalari nei rapporti dinamici tra involucro e contesto | Macro phenomena vs micro responses. Multiscale approaches in the dynamic relationship between envelope and context", in *Agathón | International Journal of Architecture, Art and Design*, vol. 7, pp. 26-33. [Online] Available at: doi.org/10.19229/2464-9309/732020 [Accessed 12 August 2020].

Luible, A. (2015), *COST action 1403 – Proceedings of energy forum 2015*, Bern, Switzerland.

Luible, A. and Overend, M. (2018), "COST Action TU1403 – Adaptive Facades Network", in Luible, A. and Gosztonyi, S. (eds), *Facade 2018 – Adaptive! | Proceedings of the COST Action TU1403 – Adaptive Facades Network Final Conference, Lucerne University of Applied Sciences and Arts Lucerne, Lucerne Switzerland, 26-27 November 2018*, TU Delf Open, pp. 19-23. [Online] Available at: tu1403.eu/wp-content/uploads/COST_endconference2018_webversion.pdf [Accessed 12 August 2020].

Luna-Navarro, A., Loonen, R., Juaristi, M., Monge-Barrio, A. M., Attia, S. and Overend, M. (2020), "Occupant-Facade interaction: a review and classification scheme", in *Building and Environment*, vol. 177, art. 106880.

Ma, Q. and Bai, M. (2018), "Mechanical behavior, energy-storing properties and thermal reliability of phase-changing energy-storing concrete", in *Construction and Building Materials*, vol. 176, pp. 43-49.

Ma, Z., Lin, W. and Sohel, M. I. (2016), "Nano-enhanced phase change materials for improved building performance", in *Renewable and Sustainable Energy Reviews*, vol. 58, pp. 1256-1268.

Memon, S. A. (2014), "Phase change materials integrated in building walls: a state of the art review", in *Renewable and Sustainable Energy Reviews*, vol. 31, pp. 870-906.

Meshgin, P. and Xi, Y. (2012), "Effect of phase-change materials on properties of concrete", in *ACI Materials Journsl*, vol. 109, issue 1, pp. 71-80.

Milardi, M. (2018), "Adaptive Models for the Energy Efficiency of Building Envelopes", in *Journal of Technology Innovations in Renewable Energy*, vol. 6, n. 4, pp. 108-117.

Moghaddam, M. K., Mortazavi, S. M. and Khaymian, T. (2015), "Micro/nano-encapsulation of a phase change material by coaxial electrospray method", in *Iranian Polymer Journal*, vol. 24, pp. 759-774.

National Nanotechnology Initiative Strategic Plan (2011), *National Science and Technology Council, Committee on Technology, Subcommittee on Nanoscale Science, Engineering and Technology*, p. 1. [Online] Available at: www.nano.gov/sites/default/files/pub_resource/2011_strategic_plan.pdf [Accessed 12 August 2020].

Navarro, L., Solé, A., Martín, M., Barreneche, C., Olivieri, L., Tenorio, J. A. and Cabeza, L. F. (2019), "Benchmarking of useful phase change materials for a building application", in *Energy and Buildings*, vol. 182, pp. 45-50.

Navarro, L., de Gracia, A., Niall, D., Castell, A., Browne, M., McCormack, S. J., Griffiths, P. and Cabeza, L. F. (2016), "Thermal energy storage in building integrated thermal systems: a review – Part 2. Integration as passive system", in *Renewable Energy*, vol. 85, pp. 1334-1356.

Niall, D., Kinnane, O., West, R. P. and McCormack, S. (2017), "Mechanical and thermal evaluation of different types of PCM-concrete composite panels", in *Journal of Structural Integrity and Maintenance*, vol. 2, issue, 2, pp. 100-108.

Nienborg, B. et alii (2018), "Life Cycle Assessment of thermal energy storage materials and components", in *Energy Procedia*, vol. 155, pp. 111-120. [Online] Available at: doi.org/10.1016/j.egypro.2018.11.063 [Accessed 25 August 2020].

OECD (2016), *Green Cities Programme Methodology, ICLEI Local Governments for Sustainability, European Bank for Reconstruction and Development*, EBRD Publishing, London-Paris. [Online] Avail-

able at: www.ebrd.com/documents/technical-cooporation/green-city-action-plan-in-tirana.pdf [Accessed 12 August 2020].

Oguntona, O. A. and Aigbavboa, C. O. (2017), "Biomimicry principles as evaluation criteria of sustainability in the construction industry", in *Energy Procedia*, vol. 142, pp. 2491-2497. [Online] Available at: doi.org/10.1016/j.egypro.2017.12.188 [Accessed 12 August 2020].

Pacheco-Torgal, F. (2016), "Introduction to Nano- and Biotech-Based Materials for Energy Building Efficiency", in Pacheco-Torgal, F., Buratti, C., Kalaiselvam, S., Granqvist, C.-G. and Ivanov, V. (eds), *Nano and Biotech Based Materials for Energy Building Efficiency*, Springer, pp. 1-16.

Pacheco-Torgal, F., Fucic, A. and Jalali, S. (2012), *Toxicity of building materials*, Woodhead Publishing Limited Abington Hall, Cambridge.

Parameshwaran, R., Harikrishnan and S., Kalaiselvam, S. (2010), "Energy efficient PCM-based variable air volume air conditioning system for modern buildings", in *Energy and Buildings*, vol. 42, issue 8, pp. 1353-1360.

Parameshwaran, R. and Kalaiselvam, S. (2016), "Nanomaterial-Based PCM Composites for Thermal Energy Storage in Buildings", in F. Pacheco Torgal et alii (eds), *Nano and Biotech Based Materials for Energy Building Efficiency*, Springer International Publishing, Switzerland, pp. 215-243.

Perino, M. and Serra, V. (2015), "Switching from static to adaptable and dynamic building envelopes: a paradigm shift for the energy efficiency in buildings", in *Journal of Facade Design and Engineering*, vol. 3, issue 2, pp. 143-163.

Persiani, S. (2019), *Biomimetics of Motion – Nature-Inspired Parameters and Schemes for Kinetic Design*, Springer Nature-Springer International Publishing, Cham.

Pesenti, M., Masera, G., Fiorito, F. and Sauchelli, M. (2015), "Kinetic solar skin: a responsive folding technique", in *Energy Procedia*, vol. 70, pp. 661-672. [Online] Available at: doi.org/10.1016/j.egypro.2015.02.174 [Accessed 12 August 2020].

Rao, V. V., Parameshwaran, R. and Ram, V. V. (2018), "PCM-mortar based construction materials for energy efficient buildings: a review on research trends", in *Energy and Buildings*, vol. 158, pp. 95-122.

Romano, R. (2020), "Materiali intelligenti per edifici nZEB – Opzioni tecnologiche adattive per il progetto sostenibile | Smart materials for nZEB buildings – Adaptive technological solutions for sustainable projects", in *Agathón | International Journal of Architecture, Art and Design*, vol. 7, pp. 124-131. [Online] Available at: doi.org/10.19229/2464-9309/7132020 [Accessed 12 August 2020].

Romano, R., Aelenei, L., Aelenei, D. and Mazzucchelli, E. S. (2018), "What is an Adaptive Facade? Analysis of Recent Terms and Definitions from an International Perspective", in *Journal of Facade Design and Engineering*, special issue, vol. 6, n. 3, pp. 65-76. [Online] Available at: doi.org/10.7480/jfde.2018.3.2478 [Accessed 12 August 2020].

Sala, S., Vasta, A., Mancini, L., Dewulf, J. and Rosenbaum, E. (2015), *Social Life Cycle Assessment – State of the art and challenges for supporting product policies*, European Commission, Joint Research Centre, Institute of Environment and Sustainability, Publications Office of the European Union, Luxemburg. [Online] Available at: doi.org/10.2788/253715 [Accessed 12 August 2020].

Sami, S. and Nasrin, N. (2017), "Improving thermal characteristics and stability of phase change material containing TiO_2 nanoparticles after thermal cycles for energy storage", in *Applied Thermal Engineering*, vol. 124, pp. 346-352.

Sari, A., Alkan, C. and Bilgin, C. (2014), "Micro/nano encapsulation of some paraffin eutectic mixtures with poly (methyl methacrylate) shell: preparation, characterization and latent heat thermal energy storage properties", in *Applied Energy*, vol. 136, pp. 217-227.

Schossig, P, Henning, H. M., Gschwander, S. and Haussmann, T. (2005), "Micro-encapsulated phase-change materials integrated into construction materials", in Solar Energy Materials and Solar Cells, vol. 89, pp. 297-306.

Simmons, H. L. (2011), *Olin's construction: principles, materials, and methods*, John Wiley & Sons, UK.

Skarping, G., Dalene, M., Svensson, B., Littorin, M., Akesson, B., Welinder, H. and Skerfving, S. (1996), "Biomarkers of exposure, antibodies, and respiratory symptoms in workers heating polyurethane glue", in *Occupational and Environmental Medicine*, vol. 53, issue 3, pp. 180-187.

Soares, N., Costa, J. J., Gaspar, A. R. and Santos, P. (2013), "Review of Passive PCM latent heat thermal energy storage systems towards buildings' energy efficiency", in *Energy and Buildings*, vol. 59, pp. 82-103.

Soares N., Gaspar A. R., Santos, P. and Costa, J. J. (2014), "Multi-dimensional optimization of the incorporation of PCM-drywalls in lightweight steel-framed residential buildings in different climates", in *Energy and Buildings*, vol. 70, pp. 411-421.

Souayfane, F., Fardoun, F. and Biwole, P.-H. (2016), "Phase change materials (PCM) for cooling applications in buildings: A review", in *Energy and Buildings*, vol. 129, pp. 396-431.

Sposito, C. (2017), "Construire con l'acqua: nuovi paradigmi dell'architettura sostenibile | Building with water: new standards of sustainable architecture", in *Agathón | International Journal of Architecture Art and Design*, vol. 2, pp. 117-126. [Online] Available at: doi.org/10.19229/2464-9309/2162017 [Accessed 12 August 2020].

Sposito, C. and Scalisi, F. (2017), "Strumenti e materiali per la fabbricazione digitale in architettura | Instruments and materials for digital manufacturing in architecture", in *Agathón | International Journal of Architecture Art and Design*, vol. 1, pp. 117-126. [Online] Available at: doi.org/10.19229/2464-9309/1222017 [Accessed 12 August 2020].

Tirole, J. (2017), *Economia del bene comune* [orig. ed. *Economie du bien commun*, 2016], Mondadori, Milano.

Tucci, F. (2017), "Paradigmi della Natura per Progettare Involucri architettonici | Nature's Paradigms for Designing Architectural Envelopes", in *Agathón | International Journal of Architecture, Art and Design*, vol. 2, pp. 47-54. [Online] Available at: doi.org/10.19229/2464-9309/262017 [Accessed 12 August 2020].

Tucci, F., Baiani, S., D'Olimpio, D., Altamura, P. and Turchetti, G. (2019), "Resilience, adaptation and mitigation under a green building approach", in Tucci, F. and Sposito, C. (eds), *Resilience between mitigation and adaptation*, Palermo University Press, Palermo, pp. 156-191. [Online] Available at: doi.org/10.19229/978-88-5509-096-4/3102020 [Accessed 12 August 2020].

UN – United Nations (2019), *World Population Prospects 2019 – Highlights*. [Online] Available at: population.un.org/wpp/Publications/Files/WPP2019_Highlights.pdf [Accessed 12 August 2020].

UN – United Nations (2015), *Transforming our World – The 2030 Agenda for Sustainable Development*. [Online] Available at: sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf [Accessed 12 August 2020].

Wayne, B. M., Santoso Mintorogo, D. and Sigit Arifin, L. (2019), "Biomimicry Kinetic Facade as Renewable Energy", in *Advances in Civil Engineering and Sustainable Architecture*, vol. 2, n. 2, pp. 1-10. [Online] Available at: publication.petra.ac.id/index.php/acesa/article/view/9958 [Accessed 12 August 2020].

Xiao, W., Wang, X. and Zhang, Y. (2009), "Analytical optimization of interior PCM for energy storage in a lightweight passive solar room", in *Applied Energy*, vol. 86, issue 10, pp. 2013-2018.

Zhongting, H., Wei, H., Jie, J. and Shengyao, Z. (2017), "A review on the application of Trombe wall system in buildings", in *Renewable and Sustainable Energy Reviews*, vol. 70, pp. 976-987.

Zubair, A. Q., Hafiz, M. A. and Shahab, K. (2018), "Recent advances on thermal conductivity enhancement of phase change materials for energy storage system: A review", in *International Journal of Heat and Mass Transfer*, vol. 127, part C, pp. 838-856.

Publishing Series in PROJECT | Essays and Researches
From Mega to Nano
The Complexity of a Multiscalar Project
vol. 04 | 2020 | paper 4 | pp. 70-83

ISSN (print): 2704-6087
ISSN (online): 2704-615X
ISBN (print): 978-88-5509-188-6
ISBN (online): 978-88-5509-189-3

CLIMATE RISK MANAGEMENT IN THE BIG DATA ERA
A multiscale, multidisciplinary and integrated approach

Maria Fabrizia Clemente

section
ARCHITECTURE

typology
ESSAYS & VIEWPOINT

DOI
doi.org/10.19229/978-88-5509-189-3/442020

ABSTRACT
In Architecture, as in other disciplines, research is moving to the integration of quantitative variables to support decision-making processes. The introduction of Key Enabling Technologies (KETs) and the diffusion of big data have enriched the projects with new inputs, the added value lies not in the volume that characterizes these data but in the ability to extract, analyze and interpret the required information through a multiscalar, multidisciplinary and integrated approach. In the context of climate risk management to support resilience projects, plans and policies, the acquisition and processing of an increasing amount of information are required to understand both the complexity that characterizes the territories and that of natural events. Among natural disasters, flood is one of the most devastating, complex and dynamic, remote sensing data and social media data offer as strategic assets for risk management.

KEYWORDS
big data, climate change, risk management, flood risk, multiscale approach

Maria Fabrizia Clemente, Architect, is a PhD Candidate in Architecture at the Department of Architecture of the 'Federico II' University of Naples (Italy). She carries out research activities mainly in the field of environmental design, sustainable technologies, recovery and representation of architecture and environment. Mob. +39 335/62.27.636 | E-mail: mariafabriziaclemente@gmail.com

With the spread of Key Enabling Technologies (KETs), project analysis, monitoring and management are increasingly dependent on the integration and processing of data, models and simulations to support decision-making processes. In Architecture, as in other disciplines, scientific research is increasingly moving to the integration of an increasing number of quantitative variables, through a multiscale, multidisciplinary and integrated approach. The environmental design offers as a discipline and methodological instrument to address the complexity of this new design approach, to address the complex interactions between urban design, environment and sustainable development; in this context, the condition of multiscalarity becomes a fundamental and specific component of the discipline (Losasso, 2017). The local knowledge process represents an advancement of research developments to investigate and characterize the relationship between vulnerability, adaptation and resilience, using broad and distinct cognitive frameworks derived both from databases and direct and systematic investigations on statistically relevant samples (D'Ambrosio and Leone, 2015).

The mass of data supporting processes and projects is defined by the term big data (Fig. 1). The notion of big data relates directly to the large size, in terms of memory, that is volume, that characterizes the data. The main characteristics can be summarized in the three V concept: volume, variety and velocity (Russom, 2011). However, such large volumes often correspond to a certain degree of confusion and uncertainty compared to more standardized datasets, which leads to the integration of a fourth and fifth V in the first definition: veracity and variability (Kitchin and McArdle, 2016; Fig. 2). In the processes of climate risk management and prevention, the theme of knowledge of the territories requires the integration of knowledge in both the technical and operational fields, reinforcing projects with tangible and intangible technical contents (Cangelli, 2015). Big Data has enriched processes and projects with new inputs, making new technological tools and practical implementations necessary for data management, accompanied by the development of new professional figures such as big data scientists. In the context of the use of such data, Big Data Approaches (BDA) refers to the combined use of historical datasets and data streams through the use of specific technologies during the acquisition, processing, management and transfer of information (Pollard, Spencer and Jude, 2018).

Key Enabling Technologies, linked to recent digital culture and Industry 4.0 scenarios – such as the Geographic Information System (GIS), web-based GIS platforms and smartphone applications – have rapidly transformed the modalities of use, visualization and interaction between users and data. Key elements of this shift were the georeferencing, the association of attributes to cartographic elements, the conversion of maps from 2D to 3D and user-defined parameterization and, more recently, the introduction of virtual reality and visualizations updated in real-time (Semmo et alii, 2015; Fig. 3).

In environmental design, climate resilience[1] enhancement projects are being implemented in many urban contexts and strategies over large areas are being refined through downscaling processes (D'Ambrosio, 2016). The role of the architect, like other specialists, remains to interpret and compare the information with the needs of

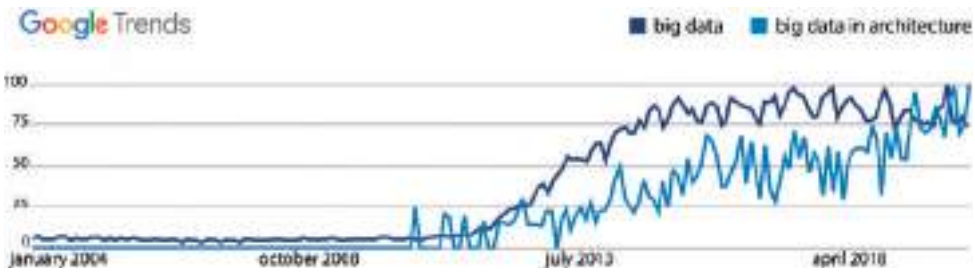


Fig. 1 | The use of big data (source: Google trends).

Fig. 2 | The meaning of big data world.

Fig. 3 | Sea level rise simulation viewer on Nice (credit: itownsresearch.github.io/sealevel/).

Fig. 4 | The contribution of big data in climate change studies, processing on (credit: Hassani, Huang and Silva, 2019).

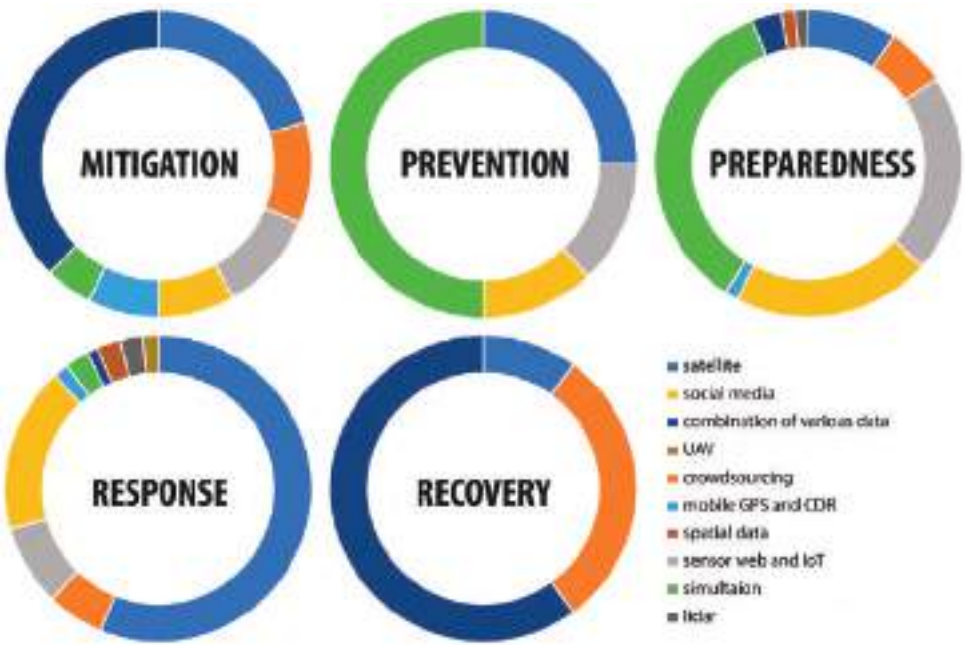
Fig. 5 | From global to regional climate model, processing on (credit: Vautard, 2018).

the local community[2]. The territory is considered as a multiscalar assembly of materials and natural and anthropic phenomena, complex and heterogeneous, and therefore, it is evident the need to use innovative methodologies and models to keep people safe and maintain resilient our cities. The multiscalarity that characterizes territories relates to the multiple scales, dimensions and plurality, and it is the relationship between the different scales that reveals their specificities (Russo, 2015).

Big data and climate change | In climate risk management, the acquisition and processing of data and models are essential to analyze historical and current climate conditions, and to predict future climate trends and impacts, to prevent risks and improve emergency management; the use process is structured in four phases: data creation, acquisition, archiving, and finally analysis (Emmanouil and Nikolaos, 2015). The predictive capabilities of natural event simulation models are becoming increasingly reliable thanks to big data, translating into concrete adaptive responses. Data, in the context of climate science, add value in four aspects: observation and monitoring, analysis, prediction and planning; the techniques of use do not differ from other fields of application and can be grouped into four categories: clustering, classification, regression, extraction by specific rules and, in recent times, Social Network Analysis – SNA (Hassani, Huang and Silva, 2019; Fig. 4). The value, as in other disciplines, derives not only from the volume that characterizes the data but from a rigorous approach to its use, especially for the aspects of selection, analysis and interpretation (Faghmous and Kumar, 2014).

The climate risk analysis is based on the acquisition of data and their implementation in complex mathematical models that make available a wealth of information on future trends. The IPCC (Intergovernmental Panel on Climate Change) is the institution responsible for providing rigorous scientific information to decision-makers. By approving IPCC reports, governments acknowledge the authority of their scientific content and use it as political support, without any prescriptive value (Schnase et alii, 2016). Global Climate Models (GCM) simulate the Earth's climate through physical equations that govern atmospheric, oceanic and biological processes, such as their interactions, providing accurate information to analyze past, present and future climate. From global-scale models, local scale information can be obtained through dynamic or statistical downscaling operations (Fig. 5). The first approach is based on Regional Climate Models (RCM) that integrate global scale model data with more detailed information, providing high-resolution climate change scenarios specific to the regional context examined. The second approach is based on the definition of empirical relationships between large-scale historical atmospheric characteristics and local climate characteristics, defined and validated these relationships, climate projections of GCM are used to predict climate trends in local contexts (Zhang and Li, 2020).

Big data and climate risk management | In the climate risk management cycle four



Figg. 6, 7 | Risk management, processing on (credit: Alexander, 2002); The support of big data for risk management, processing on (credit: Yu, Yang and Li, 2018).

phases can be identified: mitigation and prevention, preparedness, response and recovery (Alexander, 2002; Fig. 6). Each phase relates to the acquisition and use of specific data. A state of the art analysis shows that for the mitigation phase a significant contribution is provided by the combined use of remote sensing data and other types of data, while in the prevention phase, the data provided by computer simulations become the instrument to understand climate impacts. In the disaster preparedness phase, a key role is played by social media; in the response phase, it is possible to distinguish between an initial settlement phase where remote sensing data make a significant contribution and a post-disaster coordination phase where social media play a key role in communication to citizens. Finally, the integration of multiple data becomes necessary for the recovery phase (Yu, Yang and Li, 2018; Fig. 7).

The numerous open-source geo-referenced data datasets allow to carry out homogeneous and simultaneous analyses on large territories, integrating into the climate risk assessment also multiple socio-economic aspects such as the identification of vulnerable population groups, the economic status, the urban settlement characteristics of the territories and the location of critical infrastructures. Increasing open-source data, programming languages (such as R and Python) and analytical platforms (clouds and clusters) are making big data increasingly accessible. In the context of climate adaptation projects, two approaches for the use of big data can be distinguished. A first 'data-driven' approach uses large datasets to explore models and trends, heuristically and without a preliminary hypothesis, through inductive investigation, and then selects small datasets to investigate the observed models. The second 'theory-driven' approach begins with adaptation theory and case study analysis to identify hypotheses to be tested by using datasets to identify generalizable insights and empirically test the prevailing theories (Ford et alii, 2016).

The integration of an increasing number of variables has required updating in the visualization, sharing and transfer of information from specialized operators to users. In the processes of climate risk management, the communication of areas at risk is, in fact, a fundamental component of the process and in the last decade has become the subject of scientific experimentation; new fields of research such as Data Visualization or Information Visualization have been created (Roth, 2012). In this context, web-GIS platforms are becoming an effective decision support tool and interactivity is becoming a fundamental requirement. The more accurate predictions are, the more they help both in the definition of climate adaptation policies and projects and in emergency management. Static instruments have become dynamic and geospatial big data have opened new horizons in GIS systems, expanding the field of application that currently ranges in different sectors, from government agencies to large commercial companies (Ki, 2018).

The contribution of remote sensing | In the era of big data, remote sensing data represent a strategic asset to analyze, monitor and manage both variables related to extreme natural events and the complexity that characterizes territories through a multiscalar, multitemporal and multisource approach. By using digital and smart processes, it is possible to extract data with a global and continuously updated coverage, without needing in-situ analysis. The information, qualitative and quantitative, of the environment, built and natural, are acquired through the recording, operated by sensors, of the electromagnetic radiation emitted, reflected or transmitted of objects and phenomena, the data are returned in the form of a multispectral image (Brivio, Lechi and Zilioli, 2006).

The satellite industry is growing exponentially, and more and more space missions will be launched, in the last decade Petabyte and even Exabyte of global-scale data available in a multitude of spatial, temporal and spectral resolutions have been collected. In 2008, the U.S. Geological Survey launched the era of open-source satel-

lite data, making available the Landsat-8 satellite image archive collected over 40 years. The European Space Agency (ESA), with the launch of the Sentinel constellation, started an even more ambitious program, making available both the data and the information content produced by their processing with the Copernicus program. Specific programs such as Copernicus Land Monitoring Service launched in 2012, or Copernicus Marine Environment Monitoring Service in 2014, were created to promote and encourage the acquisition and use of such data (Figg. 8, 9). Although open-source systems have eliminated the financial obstacle, there is still a gap between the skills required of professionals specialized in data analysis and processing and the preparation of users (Ceriola, 2019; Fig. 10).

At global level, the intergovernmental group GEO (Group on Earth Observations) aims at systematizing Earth observation systems to make information sharable and usable to support decision-making processes through the definition of standards; among its

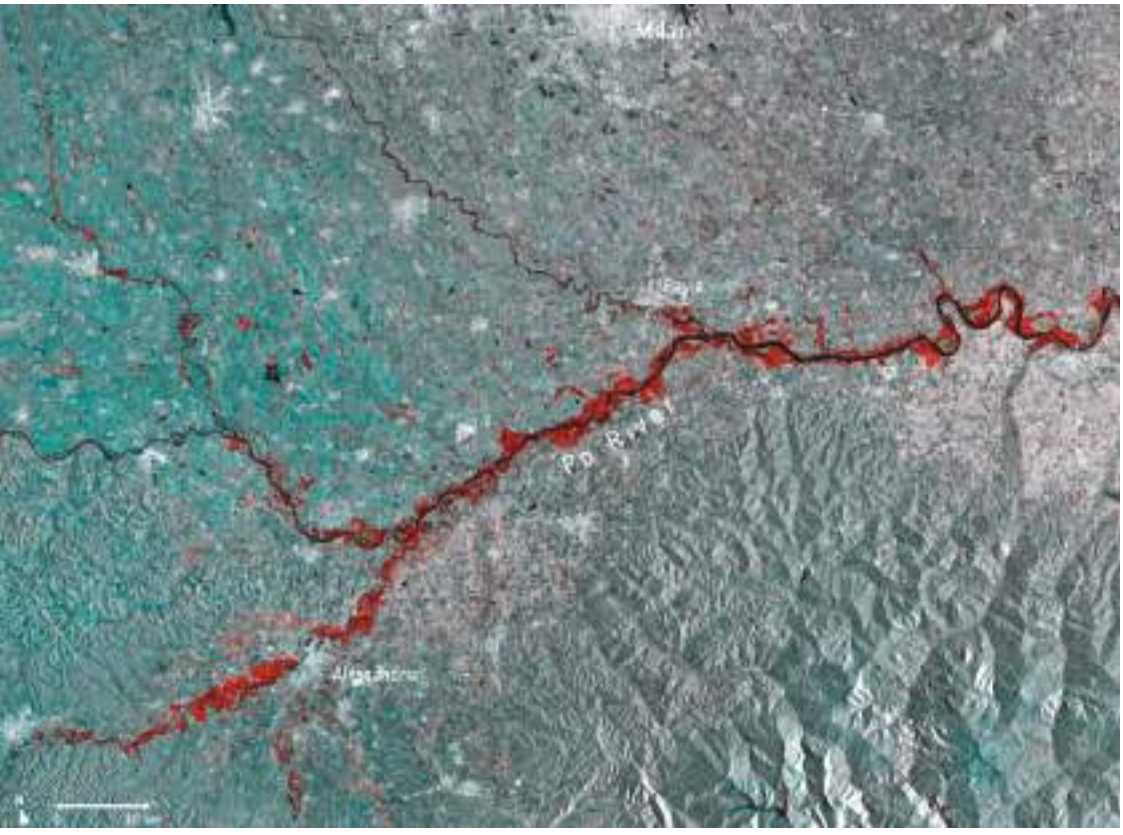


Fig. 8 | Flood in northern Italy, Copernicus Sentinel-1 mission November 2019 processed by ESA (source: www.esa.int).

partners, there are several international organizations such as NASA, ESA and WMO (Nativi et alii, 2015). The combined use of remote sensing and GIS techniques becomes essential to transfer data from climate science and geospatial information to urban and spatial design. The integration of remote sensing data with other databases requires the aid of enabling technologies and the need for a multiscalar approach for the homogenization of data derived from large and distinct cognitive frameworks, and for processing and transformation into usable models and support systems. The integrated analysis allows collecting information that is difficult to detect from the analysis of individual databases. The definition of the degree of approximation is necessary for the use of remote sensing data, to transform the volume of data into added value and to benefit of large-scale analysis to support processes and projects focused on specific local contexts.

Focus on floods | Flood is one of the most devastating, complex and dynamic natural

Fig. 9 | Rice fields in Vietnam, Copernicus Sentinel-1 mission March 2019 processed by ESA (source: www.esa.int).

hazards, it's difficult to predict, but proper emergency management can significantly reduce the damage to people and buildings. Many anthropic and natural causes can lead to this type of hazard such as, among others, flash floods. Decision-makers in areas subject to this type of event have a dual challenge: to assess and prevent the risk and to carry out effective emergency management measures should the event occur. The identification of areas at risk and the degree of vulnerability of these areas are thus a fundamental component for risk management and the planning and design of uses and spaces (Forkuo, 2011).

Critical infrastructures, among others the road system and the electricity system, are particularly vulnerable to this risk mainly due to their spatial scale and location, often in lowland areas. Another critical aspect is due to the interconnected and networked nature of the infrastructure that causes damage to propagate beyond the perimeter of the flooded areas, crossing spatial boundaries, a condition that highlights the need to investigate the risks, direct and indirect, qualitatively and to evaluate the impacts both in the area directly and indirectly affected (Pant et alii, 2018). In the case of a risk event, it is essential to keep critical infrastructure resilient for its strategic function, to increase adaptive capacity and prevent possible indirect effects.

Traditional methods of flood risk analysis provide useful information, but they are not sufficient to obtain a complete view of impacts and possible measures to increase resilience, which require more holistic approaches (De Bruijn et alii, 2019). Designing in a flood risk context is therefore very complex and requires an approach based on multiple variables, spatial and temporal. In recent years there has been a paradigm shift and the overcoming of the myopic one-dimensional approach of 'keeping water away' in favour of new, more strategic, holistic and long-term approaches aiming at

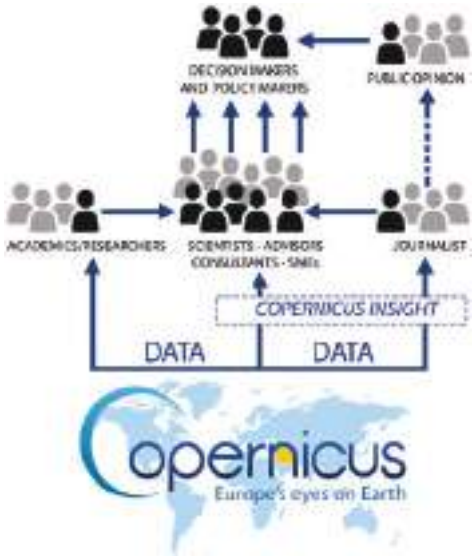


Fig. 10 | User model, processing on (source: www.copernicus.eu/en/services/climate-change).

mitigation, adaptation and increased resilience. The new approaches are characterized by different functional objectives that can be summarized in three concepts: persistence, adaptation and transformation (Lennon, Scott and O'Neill, 2014).

The integration of environmental monitoring and analysis data is a key component to identify areas in which water can accumulate. Modelling and analysis are a complex exercise that uses conceptual, physical and mathematical models to consider multiple factors (Samanta, Pal and Palsamanta, 2018). At the same time during a risk event the possibility of acquiring big data in real-time allows the authorities to intervene promptly in the most critical areas and using GIS and GPS systems it is possible to contribute to the safety of the population. In particular, social media is a strategic asset, especially when combined with effective graphics processing unit (GPU) as tested at Newcastle upon Tyne, where the support of data from citizens such as tweets, CCTV images and integrated information from local authorities, rescuers and public sector organizations contribute to delineate new perspectives for the real-time management of flood emergencies, an approach already widely adopted in the case of road accidents (Smith et alii, 2017).

Another study conducted in Australia, through a survey submitted after the Queensland and Victorian floods in 2010 and 2011, reveals how Facebook has been a more effective channel for sharing information than the official ABC Emergency communication channel (Bird, Ling and Haynes 2012). However, even in the case of social media, data must be properly selected, there are four approaches: selection by keywords or geographical queries, selection through crowdsourcing, automatic selection and finally through an interactive visual/spatial/temporal analysis/geo-visual analytics (Fohringer et alii, 2015). The possibility of an automatic association between social media data and satellite images offers significant research opportunities: social media can integrate the wide perspective provided by satellite images with information collected locally, be it textual, audio or visual (Ahmad et alii, 2019a). In this context, the research aims to achieve real-time visualization of flooding on road networks (Ahmad et alii, 2019b). Awareness of the potentialities of social media in emergency management has led the Federal Emergency Management Agency (FEMA) of the United States to develop the document The Flood Safety Social Media Toolkit to provide guidelines to citizens for writing and sharing messages in case of flood emergencies.

In a context of evident need and richness of information, the traditional methods of visualization and communication of the analyses sometimes appear obsolete due to the impossibility of governing and representing the high dynamism that characterizes floods, in terms of intensity, frequency and scale, as well as the complexity that characterizes the territories of contemporary cities (Barroca and Serre, 2018). In the flood risk management process, the communication aspects are linked to the prevention and preparedness phases, while the response and recovery phases are rarely investigated (Charriere and alii, 2012). In new decision support models, interactivity is becoming a fundamental requirement and, as a result, simulation performance has become a crucial as-

pect. A key innovative element has been the introduction of georeferenced 3D images, this step has allowed capturing simultaneously two aspects not investigated in 2D cartographic evaluations. The 3D geo-visualization simultaneously provides both the topographical complexity that characterizes the territory and land uses and the simulation of water flows, computed using hydraulic models (Jaquinod and Langumier, 2010; Fig. 11).

Conclusions | To prevent and manage climate risks, the acquisition and processing of a growing quantity of information from differentiated acquisition processes are required to support projects, plans and policies. Big data, in architecture as in other disciplines, have enriched the design processes with new inputs, the value of data should be sought not so in their volume as in the ability to analyze and interpret information. New disciplines and new professional figures are emerging to transform the volume of information into values and aspects of hierarchy and definition of the degree of approximation of information become essential. For the prediction, prevention and management of flood risk, research is moving to the integration of an increasing number of quantitative variables into risk assessment models that are translated into specific decision support systems through a multiscalar, multidisciplinary and integrated approach. The objective is to investigate both the complexity that characterizes natural hazards and the complexity of territories and, in this context, the condition of multiscalarity, typical of territories, becomes a strategic asset. Thanks to the support of Key Enablement Technologies and the introduction of big data, new aspects of flood risk can be investigated. The remote sensing industry is a strategic asset in combination with the analysis of social media data. Critical infrastructures, such as road transport networks, are particularly vulnerable to these phenomena and it is difficult to evaluate in advance the direct and indirect effects that go beyond the spatial boundaries of the area directly affected by the event. Even social media data for geo-localization and real-time updating, combined with data on a larger scale, become a strategic asset for the monitoring of past events, the prediction of future events and the correct management of ongoing emergencies.

In conclusion, the communication and visualization aspects of big data, whether they are beings from classifications made on satellite images, from analysis of social media or other databases, then processed in complex models, outline future research perspectives to improve the ability to transfer and share information from the scientific community to the community of decision-makers.

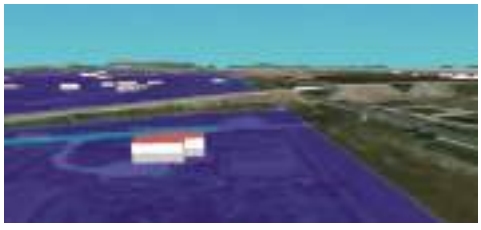


Fig. 11 | 3D flood visualization (credit: Jaquinod and Langumier, 2010).

Notes

1) Although the meaning and notion of the concept of resilience are at the centre of the academic debate, the paradigms that need to be considered in climate risk management do not differ significantly and can be identified in five key points: adopting a system's approach, looking at beyond-design events, building and preparing infrastructure to remain functional, increasing resilience by looking at social and financial capital and finally remaining resilient in the future (De Bruijn et alii, 2017).

2) The 2016 European Union Report, titled Analysing the Potential for Wide Scale Roll Out of Integrated Smart Cities and Communities Solutions, highlights the potentialities and criticalities of this new design approach increasingly linked to the use of technologies.

References

Ahmad, K., Pogorelov, K., Riegler, M., Conci, N. and Halvorsen, P. (2019a), "Social media and satellites", in *Multimedia Tools Applications*, vol. 78, pp. 2837-2875 [Online] Available at: doi.org/10.1007/s11042-018-5982-9 [Accessed 19 May 2020].

Ahmad, K., Pogorelov, K., Riegler, M., Ostroukhova, O., Halvorsen, P., Conci, N. and Dahyot, R. (2019b), "Automatic detection of passable roads after floods in remote sensed and social media data", in *Signal Processing: Image Communication*, vol. 74, pp. 110-118. [Online] Available at: doi.org/10.1016/j.image.2019.02.002 [Accessed 19 May 2020].

Alexander, D. (2002), *Principles of Emergency Planning and Management*, Dunedin Academic Press, Edinburgh. [Online] Available at: geo.unibuc.ro/dm/Documents/[David_Alexander]_Principles_of_emergency_planning.pdf [Accessed 29 March 2020].

Barroca, B. and Serre, D. (2018), "Risks revealed by cartography – Cartography renewed by the geovisualization of risks", in *International Journal of Cartography*, vol. 4, issue 1, pp. 1-3. [Online] Available at: doi.org/10.1080/23729333.2018.1444376 [Accessed 30 March 2020].

Bird, D., Ling, M. and Haynes, K. (2012), "Flooding Facebook – The use of social media during the Queensland and Victorian floods", in *Australian Journal of Emergency Management*, vol. 27, issue 1 pp. 27-33.

Brivio, P. A., Lechi, G. and Zilioli, E. (2006), *Principi e metodi di Telerilevamento*, CittàStudi Edizioni, Torino.

Cangelli, E. (2015), "Declinare la Rigenerazione. Approcci culturali e strategie applicate per la rinascita delle città | An up-close look at Urban Regeneration. Cultural approaches and applied strategies for the rebirth of cities", in *Techne | Journal of Technology for Architecture and Environment*, vol. 10, pp. 59-66. [Online] Available at: doi.org/10.13128/Techne-17501 [Accessed 11 March 2020].

Ceriola, G. (2019), "Open Data satellitari", in *Geoexpirience* vol. 15, pp. 16-17. [Online] Available at: www.planetek.it/newsrisorse/geoxperience/magazine [Accessed 15 March 2020].

Charriere, M. K. M., Junier, S. J., Mostert, E. and Bogaard, T. A. (2012), "Flood risk communication: Visualization tools and evaluations of effectiveness", in *FLOODrisk 2012 – The 2nd European Conference on FLOODrisk Management – Science, Policy and Practice: Closing the Gap, Rotterdam, The Netherlands, 20-22 November 2012*, TU Delft Library. [Online] Available at: resolver.tudelft.nl/uuid:02a043cd-69a9-4e37-b719-145ccaf1c924 [Accessed 30 February 2020].

D'Ambrosio, V. (2016), "Conoscenza del sistema urbano e progetto ambientale climate adaptive | Knowledge of urban system and climate adaptive environmental design", in D'Ambrosio, V. and Leone, M. F. (eds), *Progettazione ambientale per l'adattamento al Climate Change – 1. Modelli innovativi per la produzione di conoscenza | Environmental Design for Climate Change adaptation – 1. Innovative models for the production of knowledge*, Clean Edizioni, Napoli, pp. 26-37. [Online] Available at: www.sitda.net/downloads/biblioteca/Environmental%20Design%20for%20Climate%

20Change%20adaptation.%201.%20Innovative%20models%20for%20the%20production%20of%20knowledge.pdf [Accessed 11 March 2020].

D'Ambrosio, V. and Leone, F. M. (2015), "Controllo dei rischi del cambiamento climatico e progettazione ambientale per una rigenerazione urbana resiliente. Il caso applicativo di Napoli Est | Climate change risks and environmental design for resilient urban regeneration. Napoli Est pilot case", in *Techne | Journal of Technology for Architecture and Environment*, vol. 10, pp. 130-140. [Online] Available at: doi.org/10.13128/Techne-17509 [Accessed 11 February 2020].

De Bruijn, K., Maran, C. Zygnerski, M., Jurado, J., Burzel, A., Jeuken, C. and Obeysekera, J. (2019), "Flood Resilience of Critical Infrastructure: Approach and Method Applied to Fort Lauderdale, Florida", in *Water*, vol. 11, issue 3, article number 517, pp. 1-21. [Online] Available at: doi.org/10.3390/w11030517 [Accessed 22 April 2020].

De Bruijn, K., Buurman, J., Mens, M., Dahm, R. and Klijn, F. (2017), "Resilience in practice: Five principles to enable societies to cope with extreme weather events", in *Environmental Science & Policy*, vol. 70, pp. 21-30. [Online] Available at: doi.org/10.1016/j.envsci.2017.02.001 [Accessed 15 February 2020].

Emmanouil, D. and Nikolaos, D. (2015), "Big data analytics in prevention, preparedness, response and recovery in crisis and disaster management", in *Recent Advances in Computer Science – Proceedings of the 19th International Conference on Computers (part of CSCC '15), Zakynthos Island, Greece July 16-20, 2015*, pp. 476-482. [Online] Available at: pdfs.semanticscholar.org/c1f1/5011a85428ceeca788053a2e9daccc868ca2.pdf [Accessed 4 May 2020].

Faghmous, J. H. and Kumar, V. (2014), "A Big Data Guide to Understanding Climate Change: The Case for Theory-guided Data Science", in *Big Data*, vol. 2, pp. 155-163. [Online] Available at: doi.org/10.1089/big.2014.0026 [Accessed 18 February 2020].

Fohringer, J., Dransch, D., Kreibich, H. and Schröter, K. (2015), "Social media as an information source for rapid flood inundation mapping", in *Natural Hazards and Earth System Sciences*, vol. 15, issue 12, pp. 2725-2738. [Online] Available at: doi.org/10.5194/nhess-15-2725-2015 [Accessed 18 May 2020].

Ford, J. D., Tilleard, S. E., Berrang-Ford, L., Araos, M. R., Biesbroek, R., Lesnikowski, A. C., MacDonald, G. K., Hsu, A., Chen, C. and Bizikova, L. (2016), "Opinion: Big data has big potential for applications to climate change adaptation", in *Proceedings of the National Academy of Sciences*, vol. 113, issue 39, pp. 10729-10732. [Online] Available at: doi.org/10.1073/pnas.1614023113 [Accessed 1st March 2020].

Forkuo, E. K. (2011), "Flood Hazard Mapping using Aster Image data with GIS", in *International Journal of Geomatics and Geosciences*, vol. 1, n. 4, pp. 932-950. [Online] Available at: www.ipublishing.co.in/jggsvol1no12010/EIJGGS2051.pdf [Accessed 30 January 2020].

Hassani, H., Huang, X. and Silva, E. (2019), "Big data and Climate Change", in *Big Data and Cognitive Computing*, vol. 3, issue 1, pp. 1-17. [Online] Available at: doi.org/10.3390/bdcc3010012 [Accessed 8 March 2020].

Jaquinod, F. and Langumier, J. (2010), "Géovisualisations 3D en action dans l'aménagement du territoire. Stratégies et usages de l'outil à l'occasion de l'étude d'un Plan de Prévention des Risques Inondations | The use of 3D geo-referenced representations in territorial planning. Strategies and uses of this tool in the study of a Prevention Plan for Flood Risks", in *Géocarrefour | Les études d'urbanisme: territoires et usages sociaux des savoirs urbains*, vol. 85, issue 4, pp. 303-311. [Online] Available at: doi.org/10.4000/geocarrefour.8163 [Accessed 30 January 2020].

Ki, J. (2018), "GIS and Big Data Visualization", in Rocha, J. and Abrantes, P. (eds), *Geographic Information Systems and Science*, IntechOpen, pp. 775-787. [Online] Available at: doi.org/10.5772/intechopen.82052 [Accessed 15 January 2020].

Kitchin, R. and McArdle, G. (2016), "What makes Big Data, Big Data? Exploring the ontological characteristics of 26 datasets", in *Big Data Society*, vol. 3, issue 1, pp. 1-10. [Online] Available at:

doi.org/10.1177/2053951716631130 [Accessed 20 January 2020].

Lennon, M., Scott, M. and O'Neill, E. (2014), "Urban Design and Adapting to Flood Risk: The Role of Green Infrastructure", in *Journal of Urban Design*, vol. 19, issue 5, pp. 745-758. [Online] Available at: doi.org/10.1080/13574809.2014.944113 [Accessed 15 January 2020].

Losasso, M. (2017), "Progettazione ambientale e progetto urbano", in *Eco Web Town*, n. 16, vol. II, pp. 7-16. [Online] Available at: www.ecowebtown.it/n_16/pdf/16_02-losasso-it.pdf [Accessed 13 February 2020].

Nativi, S., Mazzetti, P., Santoro, M., Papeschi, F., Craglia, M. and Ochiai, O. (2015), "Big Data challenges in building the Global Earth Observation System of Systems", in *Environmental Modelling & Software*, vol. 68, pp. 1-26. [Online] Available at: doi.org/10.1016/j.envsoft.2015.01.017 [Accessed 5 May 2020].

Pant, R., Thacker, S., Hall, J. W., Alderson, D. and Barr, S. (2018), "Critical infrastructure impact assessment due to flood exposure", in *Journal of Flood Risk Management*, vol. 11, issue 1, pp. 22-33. [Online] Available at: doi.org/10.1111/jfr3.12288 [Accessed 22 April 2020].

Pollard, J. A., Spencer, T. and Jude, S. (2018), "Big Data Approaches for coastal flood risk assessment and emergency response", in *WIREs Climate Change*, vol. 9, issue 5, pp. 1-14. [Online] Available at: doi.org/10.1002/wcc.543 [Accessed 1st March 2020].

Roth, F. (2012), *Visualizing Risk: The Use of Graphical Elements in Risk Analysis and Communications | Focal Report 9: Risk Analysis*, CSS ETH Zurich. [Online] Available at: css.ethz.ch/en/publications/risk-and-resilience-reports/details.html?id=/f/o/c/a/focal_report_9_visualizing_risk [Accessed 1st March 2020].

Russo, M. (2015), "Multiscalarità. Dimensioni e spazi della contemporaneità", in *Archivio di Studi Urbani e Regionali*, vol. 113, pp. 5-22. [Online] Available at: www.academia.edu/16574174/Multiscalarit%C3%A0._Dimensioni_e_spazi_della_contemporaneit%C3%A0 [Accessed 9 March 2020].

Russom, P. (2011), *Big Data Analytics*, TDWI Best Practices Report, Fourth Quarter 2011. [Online] Available at: vivomente.com/wp-content/uploads/2016/04/big-data-analytics-white-paper.pdf [Accessed 6 March 2020].

Samanta, S., Pal, D. K. and Palsamanta, B. (2018), "Flood susceptibility analysis through remote sensing, GIS and frequency ratio model", in *Applied Water Science*, vol. 8, article number 66, pp. 1-14. [Online] Available at: doi.org/10.1007/s13201-018-0710-1 [Accessed 15 January 2020].

Schnase, J. L. et alii (2016), "Big Data Challenges in Climate Science: Improving the next-generation cyberinfrastructure", in *IEEE Geoscience and Remote Sensing Magazine*, vol. 4, issue 3, pp. 10-22. [Online] Available at: doi.org/10.1109/MGRS.2015.2514192 [Accessed 5 May 2020].

Semmo, A., Trapp, M., Jobst, M. and Döllner, J. (2015), "Cartography-Oriented Design of 3D Geospatial Information Visualization – Overview and Techniques", in *The Cartographic Journal*, vol. 52, issue 2, pp. 95-106. [Online] Available at: doi.org/10.1080/00087041.2015.1119462 [Accessed 10 February 2020].

Smith, L., Liang, Q., James, P. and Lin, W. (2017), "Assessing the utility of social media as a data source for flood risk management using a real-time modelling framework", in *Journal of Flood Risk Management*, vol. 10, issue 3, pp. 370-380. [Online] Available at: doi.org/10.1111/jfr3.12154 [Accessed 6 May 2020].

Vautard, R. (2018), "Regional Climate Projections", in Troccoli, A. (ed.), *Weather & Climate Services for the Energy Industry*, Springer International Publishing, pp. 139-149. [Online] Available at: doi.org/10.1007/978-3-319-68418-5_10 [Accessed 18 May 2020].

Yu, M., Yang, C. and Li, Y. (2018), "Big Data in Natural Disaster Management: A Review", in *Geosciences*, vol. 8, issue 5, article number 165, pp. 1-26. [Online] Available at: doi.org/10.3390/geosciences8050165 [Accessed 18 February 2020].

Zhang, Z. and Li, J. (eds) (2020), *Big Data Mining for Climate Change*, Elsevier.

Publishing Series in PROJECT | Essays and Researches
From Mega to Nano
The Complexity of a Multiscalar Project
vol. 04 | 2020 | paper 5 | pp. 84-101

ISSN (print): 2704-6087
ISSN (online): 2704-615X
ISBN (print): 978-88-5509-188-6
ISBN (online): 978-88-5509-189-3

THE CITY OF AGRIGENTO
The form and the space of the city: an interscalar approach

Ermelinda Di Chiara

section
ARCHITECTURE

typology
ESSAYS & VIEWPOINT

DOI
doi.org/10.19229/978-88-5509-189-3/452020

ABSTRACT
The interscalar approach to the project is a dimension and an operative parameter through which it's possible to know the territory and its relations with urban systems in order to understand its principles, nature, organization and role played in different contexts: however, it's very often understood as a mere technical tool that allows you to show details and relationships between the parties and to identify adequate strategies for action and planning of interventions. The following contribution aims to bring the concept of intercalarity to morphological and typological as well as spatial characters, taking the city of Agrigento as a case study, analyzing it starting from an 'oversized' dimension (the temples) up to infinitely small (the house). An interscalar approach, therefore, intended as a key to understanding all those factors indispensable for understanding the form and space of the «[...] city the most beautiful of the many hotels that are mankind [...]» (Pindar, XII Pitica).

KEYWORDS
Agrigento, form, space, interscalar approach, city

Ermelinda Di Chiara, Architect, is a PhD Candidate in Architecture and Construction (Urban Morphology curriculum) at the 'Sapienza' University of Rome (Italy). Among the research topics, there's the relationship between contemporary architecture and historical context, examined in depth, in particular, to the case of Venice and a project for Palazzo Venier dei Leoni. Mob. +39 346/65.79.431 | E-mail: ermelinda.dichiara@uniroma1.it

The ancient city, a city in which the principles that define public spaces and private spaces are very clear and recognizable, is a paradigmatic example of the application of the concept of inter-scale intended not as a mere operational or technical tool but as an element capable of to relate the morphological, typological and spatial characteristics of the city. The same term 'morphology', after all, contains in itself a level of description and design at a higher dimensional scale and complexity of relationships than the individual building element and its form as an object (Gregotti, 1985), which instead should be traced back to the term 'typology' which indicates the aggregation rules of the building types that preside over the formation of fabrics and parts of the city (Gregotti, 1985). The interscalar approach, therefore, intended as a relevant tool to understand the form of any city – in this case of Agrigento – and its spatiality, if we mean the architectural 'form' conceived only as 'appearance form' of space [Erscheinungsform des Raumes] (Schröder, 2015a), and if, as Schröder himself points out, the term 'appearance' doesn't mean what veils or hides the reality but what is shown to the eye.

Recalling the recent study conducted by Federica Visconti on the ancient city of Pompei (Visconti, 2017), it intends to analyze the city of Agrigento starting from the infinitely large – the 'mega' – which can be identified in the form of the city, then moving on to the insula form, and thus reaching the infinitely small – the 'dwarf' – which is recognized in the form of the house. In the specific case of Agrigento, moreover, we find ourselves dealing with an 'other and superhuman' dimension, that relating to the Valley of the Temples on which many Doric temples and sanctuaries still lie – some now only in ruins and others instead, such as the Temple of the Concordia, in an excellent state of conservation – necropolis, fortifications and parts of the Hellenistic-Roman quarter: the scale with which we are confronted in this perspective, therefore, can be conceived as a sort of 'oversize' for the city of our time, a unique and exceptional dimension.

The study of the form, conducted through the mentioned interscalar approach, is accompanied by some reflections on the concept of space, which cannot be separated from the urban form, as it's precisely the architectural space that is considered as the structured and essential one of the architecture, through which the architectural form is put back to its service (Schützeichel, 2010). For the study of the architectural and spatial qualities of the city and its places, Uwe Schröder (2015b) has codified a mode of representation, supported by a theory of space and architecture of the city, in which the interscalar component takes on relevant importance: it provides, in fact, a graphic coding that returns different tones of colour by virtue of progressive levels of 'interior' or 'exterior' of the spaces depending on what is intended to be highlighted, by the relationship of a large scale between cities and territory, between the city and the house up to the relationship 'an architectural scale' between the house and the room, between the wall and the opening.

And it's with these tools, therefore, that we intend to discuss a necessary interscalar approach that allows us to study the relationship between urban morphology

and building typology, in an original and unavoidable relationship of the ancient city of Agrigento with spatiality. This study will be conducted through an analytical methodology, which is based on codified urban analysis tools, such as the Straßenbau (the street plan), the Schwarzplan (the black plan, therefore the built plan) and the Rotblauplan (the red and blue plan), of more recent experimentation and used in its different scales of representation. A methodology, therefore, which uses drawing as 'specific, critical and unique form of knowledge' (Ugo, 2008), as a manner of representation and knowledge of the forms and spaces of the city based on an abstraction operation (Moccia, 2016), which allows transferring the elements that make a city knowable, describable and objectivable, particularly interesting in the case of a city rich in history and archaeology as in the case of Agrigento.

The form of the city | The foundation of the ancient city of Akragas dates back to 582 BC when a group of colonists from Gela, originating in the islands of Crete and Rhodes, landed on the southern coast of Sicily, first founding the city of Gela and then, going more and more north-west, the ancient city of Agrigento. The colonists from Gela, however, weren't the first 'inhabitants' of the city. In fact, some archaeological excavations have found traces of ancient villages of huts that suggest that the area had already been inhabited in prehistoric times: the evidence inherent in this era, however, appears somewhat obscure and devoid of relevant supporting documents. Since the Greek origins, the city of Akragas is surrounded by walls that lay on the sharp and cut rock that is partly so by nature, partly has been adapted by the hand of man (De Miro, 2010), whose perimeter – at times still existing – is then strengthened with square towers and equipped with eight accesses to further increase the defence of the city.

In addition to the consolidation of the works, further significant interventions for the ancient city are attributed to this period: firstly the development of a dense road network that crosses the pòlis from north to south and subsequently a series of works relating to the completion of the hypogea, to the strengthening of the port – which will make Agrigento one of the most important trading centres in the entire Mediterranean – to build the first quarters of houses. Furthermore, belong to this era, the oldest Agrigento necropolis, located near the coast, and the Sanctuary dedicated to Demeter and Persephone, completely excavated within the hill, the only example of religious construction present at that time in Akragas. In the following century, and in particular after the victory over the Carthaginians, the appearance of the city changes significantly: expansion ceases and an intense period of constructive fervour begins, which leads to the construction of eight temples[1], all in style Doric, over about ninety years.

The end of this period of great construction intensity coincides with the decline of the ancient city because of the siege by the Carthaginians; few elements of the walls and, most likely, an altar east of the Temple of Olympian Zeus located in the Valley of

the Temples date back to this period. The resumption of construction activity is recorded after the second Punic war when the city was conquered by the Romans: it's in this period that the city becomes precisely 'Roman', changing not only its name from Akragas to Agrigentum, but also typologies and building techniques, now precisely according to the 'Roman character'. Two monumental tombs (Oratorio di Falaride and Tomone di Terone), numerous houses with atrium and peristyle, painted plaster and mosaics, and the restoration of the Temple of Hercules, the Temple of Era, the Temple of Concordia and the Temple of Aesculapius belong to this period.

The sacking of the city by the Barbarians coincides with the end of the Roman era and marks the beginning of different dominations to which the city is subjected over time: the Byzantine and the Arab ones, a period in which the city took the name of Girgenti. These events and those that followed gave rise to a slow decline of the ancient city, which no longer knew the splendour of the times spent with the Greeks first and then with the Romans. The inhabited centre initially settled in what was once the ancient acropolis[2] and, afterwards, it was reduced more and more until it corresponded only to the city of Girgenti. It's, therefore, possible to affirm that two different cities existed: the first which corresponds to the ancient Akragas and the second which corresponds to the city consolidated on the Colle di Girgenti, which however doesn't even remotely recall the splendours of the ancient Agrigento: from the plain, it's true, its appearance is picturesque, its houses are elegantly arranged in an amphitheatre on the mountain; but when you enter the sad reality soon it's reveal to your eyes (De Nervo, 1989).

Leaving aside the historical and archaeological events, although relevant to understand respectively the evolution of the city and the ways of life within it, it intends to look at the form of the ancient city, in which, instead of what often happens in the contemporary city, it's possible to deal with the relationship between the different scales of the project, noting how the form of the city influences the form of the block which is its elementary part, the form of the block derives from the form of the house which, in turn, is identifiable in a specific building typology. In substance, it intends to get to know the structure of the city through the study of forms (Rossi, 1975). In an attempt to understand the structure of forms that characterizes the ancient city, it's of fundamental importance to start from a specificity that concerns it, that is the relationship which is established between the forms of architecture and the forms of the substratum orographic (Moccia, 2018) and, therefore, the relationship between forms of construction and the geography of places (Orfeo, 2018), a relationship that in the Mediterranean area always plays a primary role in the construction of architecture.

The Greek historian Polybius (cit. in De Miro, 2010, p. 33), who most likely in the early 2nd century BC he found himself visiting the ancient city of Akragas, describes its topography as follows. The city of Agrigento differs from many other cities in many ways; but still for its fortress and above all for the beauty of its buildings. It's 18 stages from the sea so that no one doesn't benefit from the advantages of it. Its circuit

is equipped excellently and by nature and by art: the walls turn on a high and steep rock, which in part is so by nature, in part it was made such by the hand of man. And it's surrounded by rivers: at noon flows what has the same name as the city, on the west side and south-west wind the one called Hypsas. The upper part of the city overlooks it from the side facing the summer east; limited inside by an inaccessible ravine, from the inside only one road leads you to the residential area. On the top is a sanctuary of Athena and Zeus Atabirio, as it's also in Rhodes. The city is also magnificently adorned with temples and arcades. And although the temple of Olympian Zeus hasn't been completed, by invention and size it's not considered inferior to anyone else in Greece.

More recently, the archaeologist Ernesto De Miro (2010, p. 409) describes the same geographical condition as the place of settlement of the city: Agrigento stands on a plateau consisting of a quay of calcarenite superimposed on Pliocene blue clays,

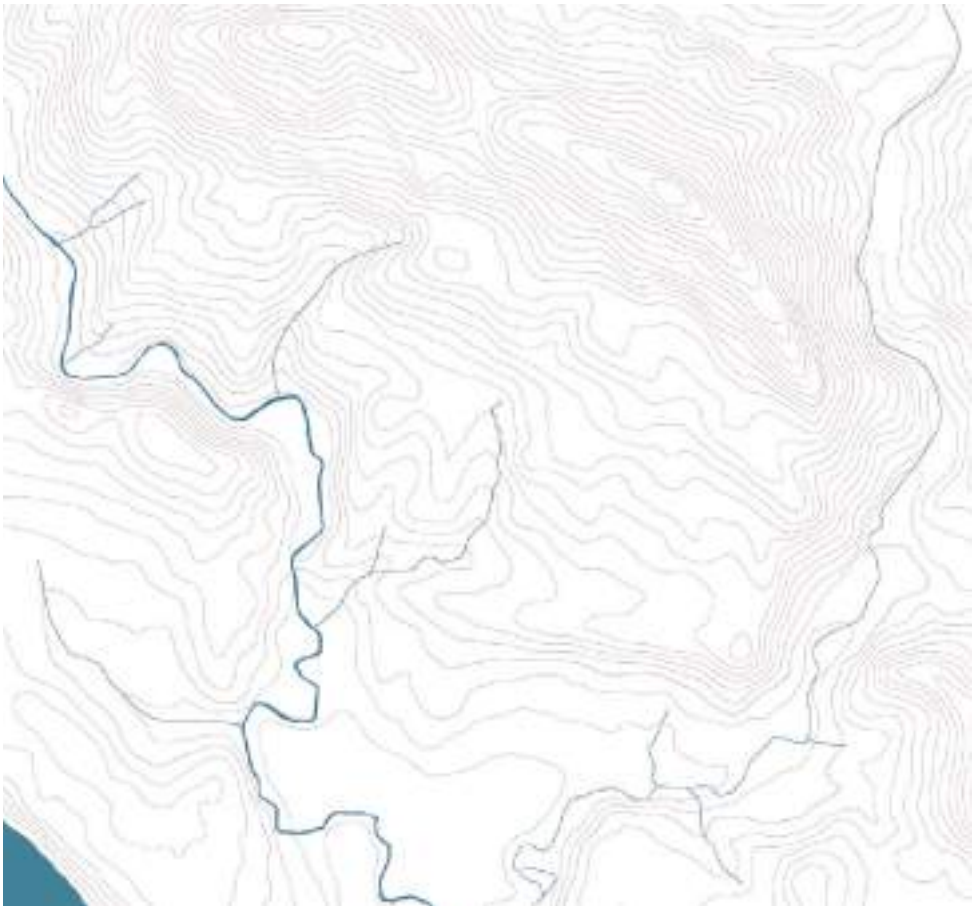


Fig. 1 | Agrigento: Mountain system (credit: E. Di Chiara, 2019).

with a large north-south slope. The city is delimited to the north by the rocky slopes of the Girgenti Hill and the Rupe Atenea, an acropolis in the Greek period; to the east, from the rocky rib that dominates the course of the Akragas river (today S. Biagio), to the west from the rocky ledge on the Hypsas (today's Drago); to the south by an ancient marine shore (on whose edge is the series of temples), at the foot of which extends a vast alluvial plain of the recent Quaternary up to the mouth of the Akragas river (today's S. Leone), where was the port of the ancient city. Agrigento, therefore, rises in a singular place as it's located on a plateau marked by the presence of two rivers (Akragas that flows to the east and Hypsas to the west) which flow into the sea at the same point, and protected by two morphological conditions steeps (the first is the Rupe Atenea and the second the Valley of the Temples) where the level curves thicken almost to describe a protected condition to the rest of the city (Fig. 1).

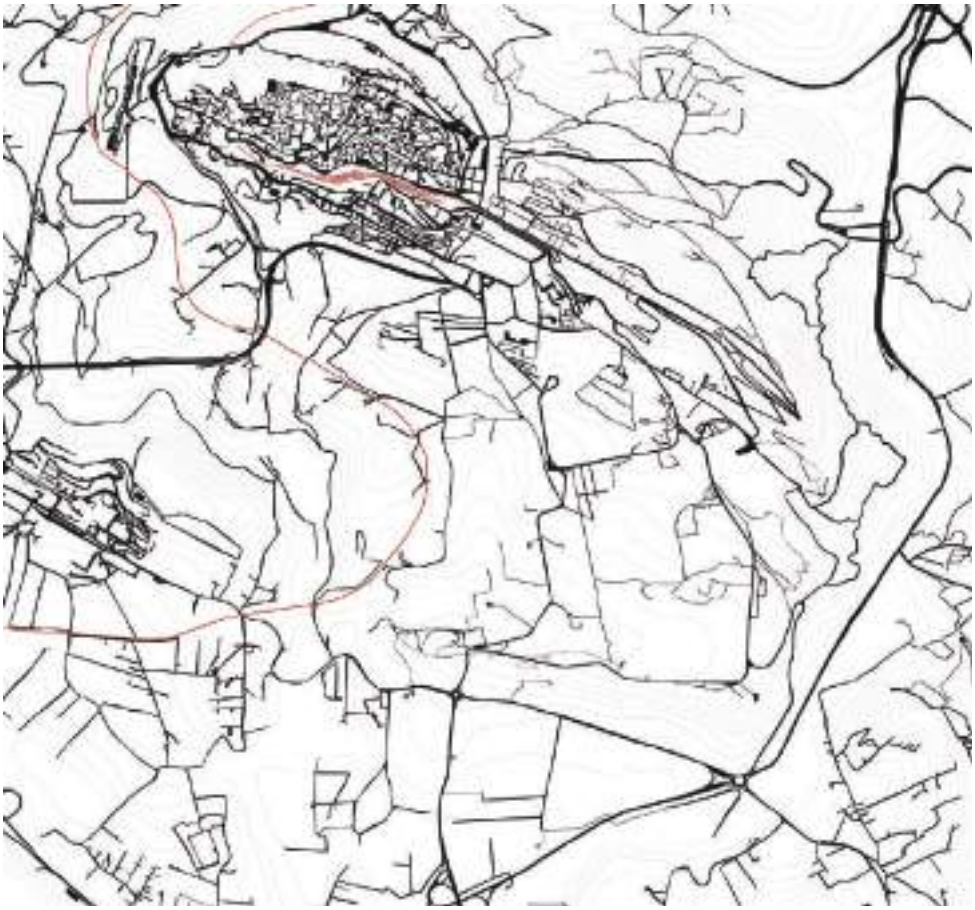


Fig. 2 | Agrigento: Straßenbau and mountain system (credit: E. Di Chiara, 2019).

The drawing of the Straßenbau (from the German 'construction of the roads') related to the trend of the level curves (Fig. 2) and to the form of the soil on which the city was built allows us to deduce the structure of Agrigento: isolating the Straßenbau, that is, the construction of public land, means isolating the constituent elements of the city as architectural facts, it means considering the city above all as a construction, as a stratification and as a composition of formally identified elements (Grassi, 1967). In the city of Agrigento it's possible to identify three different modes of 'subdivision of the urban land' to which, as the drawing of the built space will illustrate, correspond as many different forms of the settlement. At the Girgenti Hill and the Rupe Atenea, the layout, in its apparent irregularity and lack of order, returns the image of a dense and compact city: a city that determines its form starting from the block, in which the drawing of the undeveloped spaces, therefore of the streets, squares and pedestrian

Fig. 3 | Agrigento: Straßenbau and layout of the Hellenistic-Roman quarter (credit: E. Di Chiara, 2019).

paths, represents both the negative of the built – which stands out by inversion – and the form of the public space.

The irregular layout of the upper city contrasts with the drawing of the regular layout of the Hellenistic-Roman residential quarter of the ancient city of Agrigento (Fig. 3), little or almost not excavated at all, with a system of cardi and decumani. This area of the city is organized on a regular level of wide roads plateiai crossed by stenopoi; arteries of considerable importance are determined, such as the east-west M-N plateia that connects the eastern access II with the southern V access, passing through the agorà area after marginalizing the sacred hill to the north; and the stenopos, corresponding to cardo I, as well as that corresponding to cardo III of the Quarter, connecting the residential area with the sacred hill (De Miro, 2010). If the irregular layout of the city on the hill and the regular layout of the residential quarter are typical of the

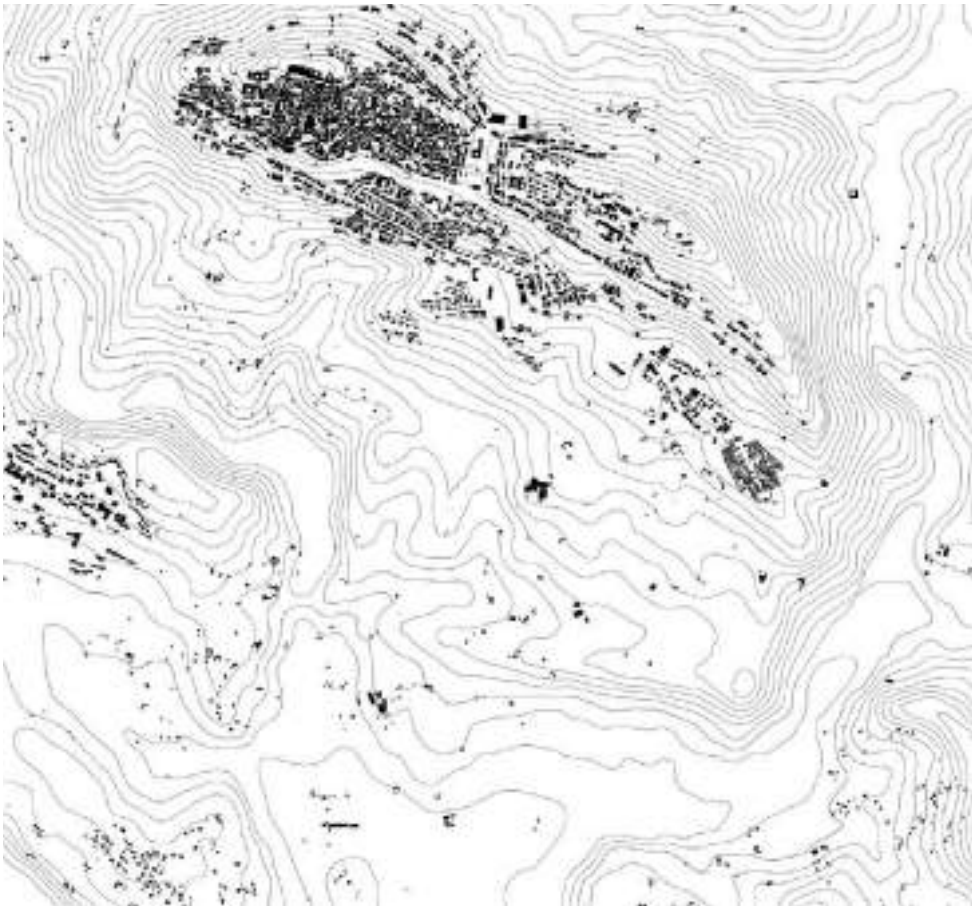


Fig. 4 | Agrigento: Schwarzplan and mountain system (credit: E. Di Chiara, 2019).

ancient city of Akragas, the layout that affects the remaining part of the city, on the other hand, describes a condition typical of the contemporary city: a layout capable to give an order to the forms of the settlement and to constitute a fundamental component of the urban composition is no longer legible.

If the undeveloped spaces are represented by the street level, the built space is returned by a further codified urban analysis tool, that is to say the Schwarzplan (Fig. 4) which represents all the elements of the building in black and it eliminates any other information immediately allowing a first reading of the 'figure' of the city against its background (Visconti, 2017). The three different ways of 'subdivision of urban land' observed in Straßenbau correspond to as many forms of the settlement. The historic city of Agrigento, in correspondence of the Girgenti Hill and the Rupe Atenea, is dense and compact thus highlighting a close relationship between building typology and urban morphology for which the Straßenbau and the Schwarzplan constitute the one the negative of the other; and even if the inadequate archaeological documentation doesn't provide sufficient documentation regarding the Hellenistic-Roman quarter, it could be said with certainty that this same condition also occurs in the ancient residential quarter, even if in completely different forms.

The city on the hill appears characterized by the tortuous forms that often characterize the settlements in the upland of medieval origin while the Hellenistic-Roman quarter has a geometric drawing based on a narrow and extended rectangular insula. This image of a dense and compact city is then contrasted by that of a more recent expansion, in which it begins to take hold a drawing of the city apparently based on principles such as the negation of the street as a place of view of the house, the overcoming of the block as an elementary part of the city, the assumption of nature as a place of habitation and the natural landscape as a place of its view (Monestiroli, 2002), but which almost seems to flow in a sort of uncontrolled dispersion. In fact, the recent expansions based on large blocks inside which residential buildings are arranged appear like subdivisions aimed at realizing the maximum possibilities of use of the building land, unable to define an urban drawing, while, in even more peripheral areas, the forms of the settlement are those characteristics of urban sprawl.

As Aldo Rossi states, the city is made up of dwelling areas, located in Agrigento both at the Girgenti Hill and the Rupe Atenea and at the Hellenistic-Roman quarter, but it is also made up of monuments, and that is persistent urban facts, whose persistence or permanence is a result of its capacity to constitute the city, its history and art, its being and memory (Rossi, 1982): the temples (Fig. 5), in their being 'physical signs of the past' but also 'persistence', are monuments and, as such, are a part of the city that cannot be suppressed because they constitute it (Rossi, 1982). These large artefacts are mainly arranged in the area at the foot of the Acropolis, now called the Valley of the Temples, closed to the south by the low ridge and parallel to the sea (De Miro, 2010), and organized as an extensive sacred area divided into several sanctuaries, of which the temples are the monumental expression.[3]

The monuments of a city are, however, also those places representative of the values of a community; the Agorà and the Acropolis as regards the Greek city and the Forum as regards the Roman city are two different but completely comparable representations to which correspond as many different and complementary urban paradigms: opposing isolated objects and open to the landscape or spaces defined and delimited as exceptions within the fabric (Capozzi, 2017). These places in the ancient city of Agrigento have left a faint trace identifiable in the flat area east of the Temple of Olympian Zeus for the agorà, near the Temple of Hercules for the Forum and on the Rupe Atenea for the Acropolis. This representation of the city of Agrigento intends to analyze, and therefore, re-describe in order to understand the urban form and think possibly of its possible transformation (Martí Arís, 2007), and it's for this reason that cannot be separated from analysis also of the spatiality of the places of the city.

The space of the city | Next to the description of the city analyzed taking into consideration its 'formal image', it, therefore, seems appropriate to also consider the spatial aspect of architecture, as it's believed not only that the form and space are two inseparable concepts, but that it's precisely the space to generate the form that defines it (Schröder, 2015a). For this reason, it was intended to address the study of 'urban facts' through a spatial interpretation of the city using the Rotblauplan tool, codified by Uwe Schröder. This approach allows you to understand the spaces of architecture by distinguishing them into 'warm' spaces, defined as interior spaces, and 'cold' spaces, exterior space. But to understand when space can be defined as an interior or an exterior, it's essential to refer to two concepts: the concept of limit and that of relationship. Ungers believes that when man consciously detaches from the infinitely large and boundless space of nature an isolated piece and clear boundaries and in some way delimits this piece – albeit only with a gesture – he's already creating architecture, even if in its broader sense (Ungers, 1982).

In the first place, therefore, the concept of limit that defines a space and establishes a demarcation between internal and external space represents a basic notion to debate the architecture of spaces. Next to the concept of limit, then there is that of 'relationship': space is defined as an interior or an exterior based on the section relationship that is established between the height of the buildings and the space between the buildings. A space-delimited by architectural constructions but uncovered (squares, streets, widenings, courtyards) is to be understood as an interior space when certain relationships occur between the undeveloped and the constructed space. When, however, these relationships fail, space is no longer to be understood as an interior but as an exterior. In the specific case of the city of Agrigento, there are interior spaces, but above all exterior spaces (Fig. 6). The spaces of the interior mainly concern the buildings, but also the urban exteriors present in the dense and compact city in which the sectional relationship between the height of the buildings and the size of the street gives them an internal condition. The exterior spaces, on the other hand, mainly concern the large part of the

territory surrounding the city of Agrigento in the current condition, also because of a substantial part of the Hellenistic-Roman quarter has not been brought to light.

As already anticipated, the analysis of urban spatiality through Rotblauplan moves between the different scales, offering, for each of them, the possibility of adding further levels of knowledge. In particular, in considering the scale that highlights a portion of the city, two different shades are used: dark red and light red, dark blue and light blue. The first coding (dark red / light red) concerns the interior spaces and, therefore, those spaces that indicate 'closure' but are covered (in the case of dark red) or uncovered (in the case of light red). The second coding (dark blue / light blue), on the other hand, concerns the exterior spaces and, therefore, those spaces that indicate 'a rural link or landscape' (in the case of dark blue) or 'an urban link' (in the case of blue clear). Not only the shades but also the graphic signs take on a fundamental

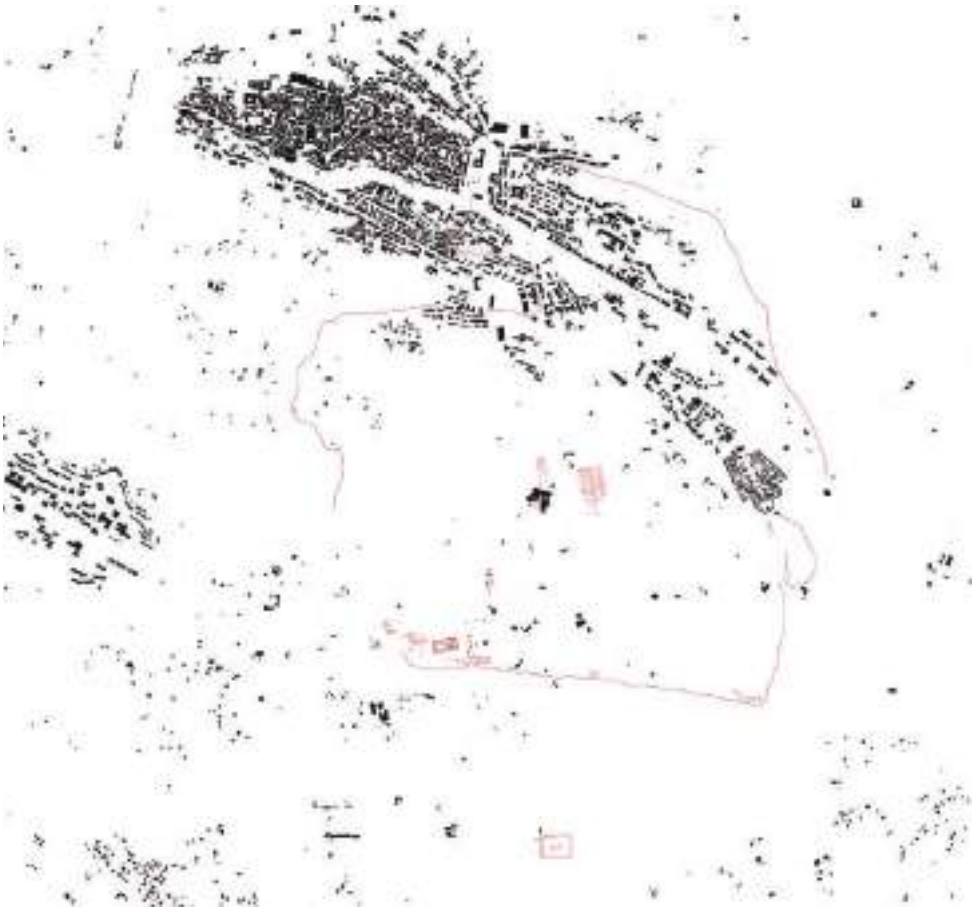


Fig. 5 | Agrigento: Schwarzplan and archaeological evidence (credit: E. Di Chiara, 2019).

meaning: while the white lines (the walls) represent the 'active boundary' in the formation of space, the black lines (the borders) symbolize the 'passive boundary'. The city of Agrigento certainly takes on an interior character in correspondence with the Girgenti Hill, while the remaining part of the city – both the expanding one and the one occupied by archaeological findings – is, today, an exterior space.

The form and the space of insulae and domus | If the form and space of the infinitely large are clearly legible by means of the analytical tools that have been debated to now, the possibility of formal and spatial reading of the infinitely small, that is of the insulae and, even more, of the domus, appears more complex, as at present the archaeological knowledge is not, for this purpose, still sufficient. In particular, as it stands, the excavations have revealed only three insulae, not even in their entirety, of the Hel-

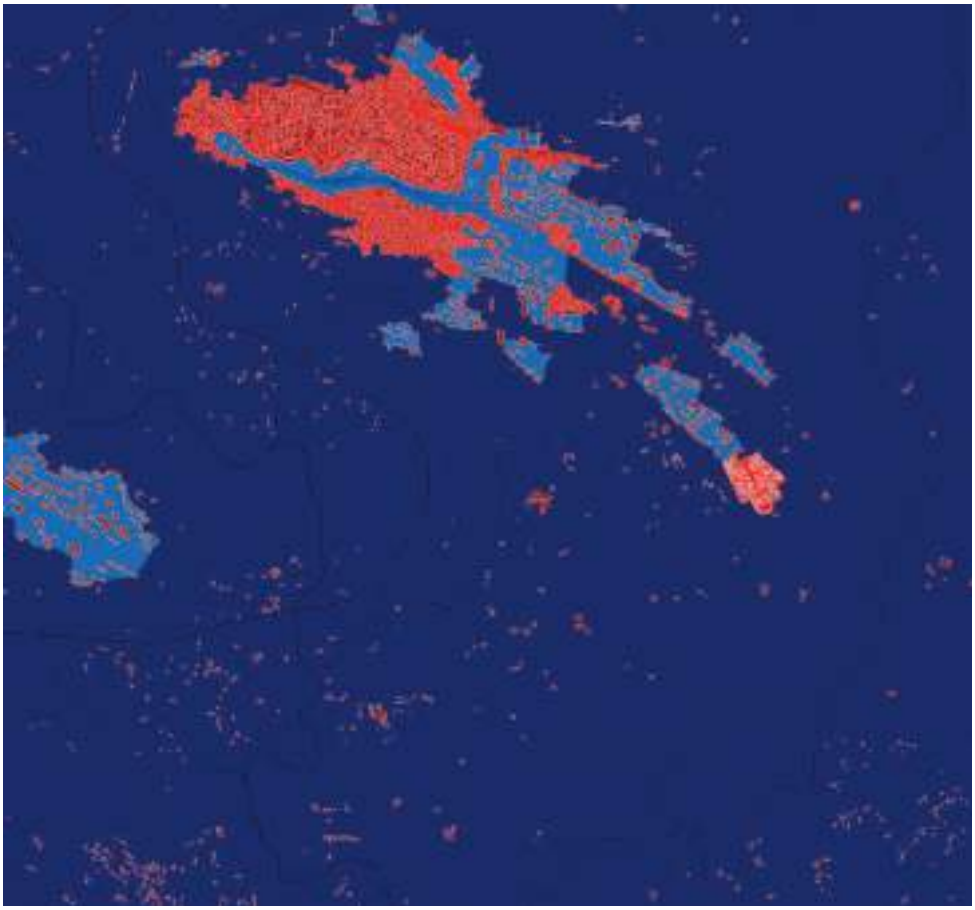


Fig. 6 | Agrigento: Red-blue plan, plan segment 'city' (credit: E. Di Chiara, 2019).

lenistic-Roman residential quarter, included between the complex of public buildings to the west and the housing quarter closest to the slopes of the Rupe Atenea. Looking at the city of Agrigento and, more precisely its residential part (Fig. 7) – the Hellenistic-Roman quarter – it's noted that this is inserted in an 'urban mesh' marked by main east-west streets (plateiai-decumani) and from north-south secondary streets (stenopoi-cardines), whose regularity contrasts with the layout of the city on the high ground. The axes define rectangular, very narrow and extended insulae, whose size is equal to 295 x 35 metre with a ratio of about 1:8.50 between the width and the length, whose north-south orientation presents a divergence of 10° west.

The three insulae highlighted by the archaeological excavations are delimited to the north by the decumanus maximus and to the south by the terracings that reach the foot of the Valley of the Temples, except for insula III, which has a somewhat uncer-

Fig. 7 | Agrigento: Reconstruction of the Hellenistic-Roman quarter (credit: E. Di Chiara, 2019).

tain southern limit, due to the suspension of the excavation, where a consistent landslide has left few monumental traces, while to the east and west they are delimited by the cardini thus assuming as width the distance between them (equal to about 35 m). The three insulae, instead, are different respect to the number of houses: the insula I comprises seven houses, among which, due to its size and its monumentality, emerges the House of the Peristilio which, although in its current incompleteness, occupies an area of 1,084 sqm; insula II, instead, includes ten houses while insula III comprises nine houses and four shops located near the decumanus maximus.

The Hellenistic-Roman quarter, thus outlined although in its condition doesn't integrate, therefore, would take on a different spatiality (Fig. 8): no longer an exterior space, but an interior space. From this perspective, the Rotblauplan tool, considered in its multiscalarity, no longer analyzes a portion of the city but the relationship between

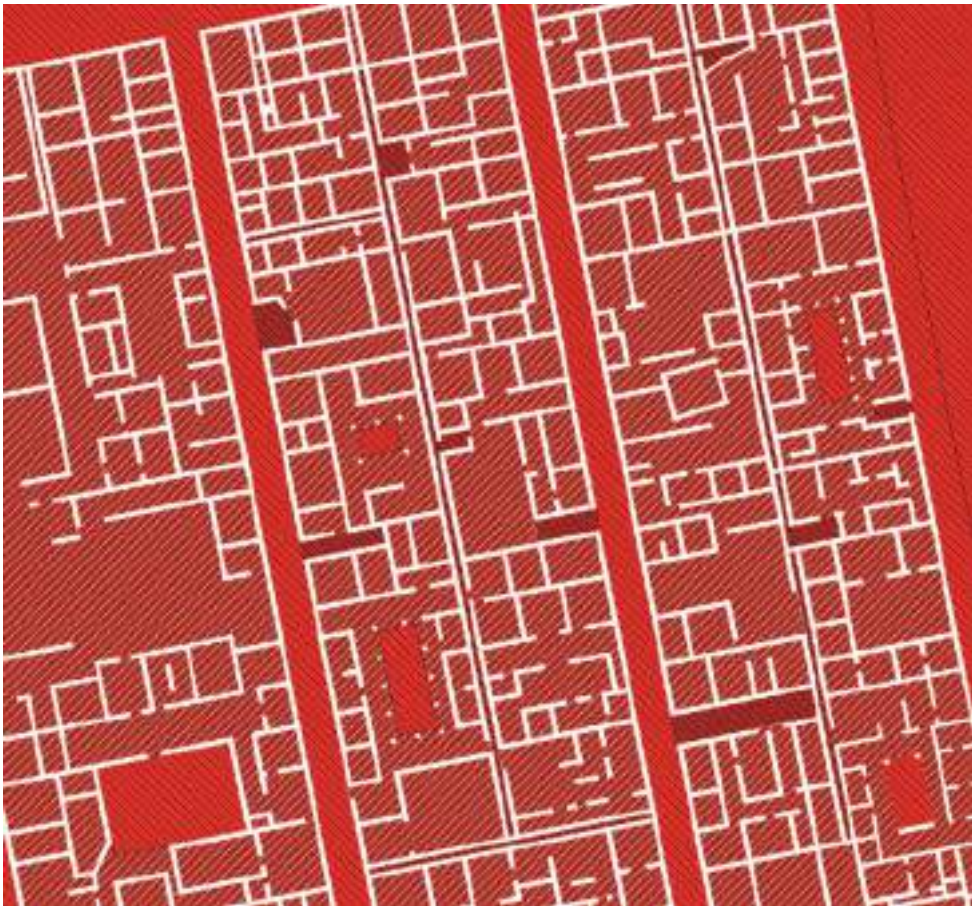


Fig. 8 | Agrigento: Red-blue plan, plan segment 'city and house' (credit: E. Di Chiara, 2019).

'the city and the house', in whose coding, next to the different colour tones that represent progressive levels of interior and of the exterior, further 'graphic symbols' appear: the black hatching, representing an inclusive 'dedication'[4], and the white hatching, which instead indicates an exclusive 'dedication'. This drawing is enriched with further meanings when there is a change of scale and, therefore, when the relationship between 'the house and the room' is highlighted, as in the case hypothesized here of the House of the Cryptoporticus[5] (Fig. 9), located in Insula II, where even the inclusive 'dedications' are identified within the house itself.

Conclusions | The study of the city of Agrigento, conducted through an interscalar approach in reference to the morphological, typological and spatial characters, allows us to know the form and the space of the city under investigation. The form certainly

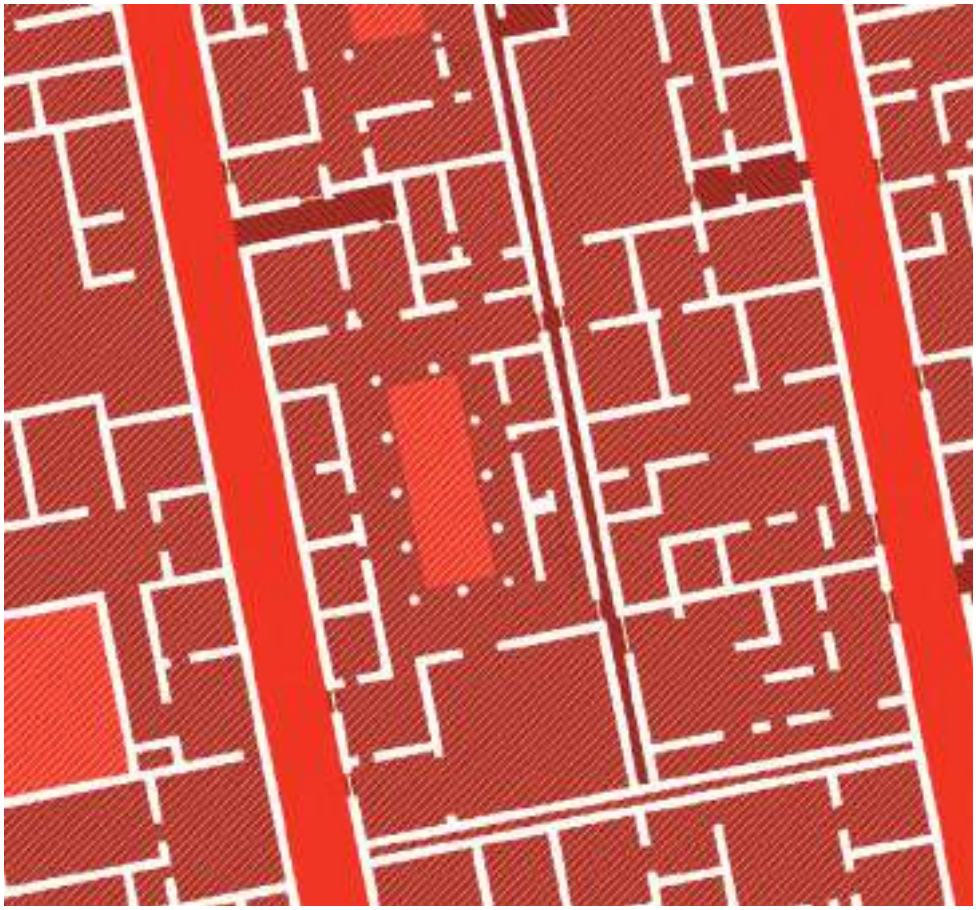


Fig. 9 | Agrigento: Red-blue plan, plan segment 'house and room' (credit: E. Di Chiara, 2019).

suggests an undeniable value in the relationship of the Agrigento city with the morphology of the soil but also in relation to the different historical moments that the city has lived from its origins until today: it's precisely for this peculiarity that Agrigento could be read as a 'cities by parts', which express ideas of different cities but which are simultaneously represented by the 'formal image' of the city.

Next to the form, the interscalar analysis conducted on the characteristics of the urban spaces of the city of Agrigento assumes a role of fundamental importance, in particular, if this is attributed to the Hellenistic-Roman quarter which, even if the scarce archaeological documentation to supporting, allows us to understand the interior character that characterizes the form of the domus, in some cases built around the spaces of the atrium and peristyle, empty spaces chosen to represent the place of being (Moccia, 2017). Agrigento is also certainly a 'city by layers', yet to be discovered but certainly full of forms and, therefore, of spaces, a condition to be studied from that point of view that Aldo Rossi suggested to us when he said that, although there are different ways of looking at the city, it emerges as autonomous only when we take it as a fundamental given, as a construction and as architecture (Rossi, 1982).

Finally, the study of the form and urban spaces of the city of Agrigento provides a broader reflection related to the city project of our contemporary era. As the drawing of the Straßenbau and the drawing of the Schwarzplan have highlighted, in the city of Agrigento it's possible to identify three different 'ways of dividing the urban soil' to which correspond to the same different 'city ideas'. The historic city, located mainly at the Girgenti Hill, in its dense and compact appearance, certainly manifests a happy condition because the relationship that is established between the urban space and the built space is clear, but at the same time it deprives itself of that void system and that natural condition that has always represented an 'archetypal' of living. In the 'modern' city, instead, that system of relations between the building typology and the urban morphology typical of the historical city is lacking, generating an amorphous condition that turns into the impossibility of defining a clear urban design.

And finally, the archaeological city, corresponding to the ancient Hellenistic-Roman quarter, which, in its system of relations between public spaces and private spaces, between spaces open to nature and spaces of architectural construction, between the 'void' and the 'full' represents a great lesson from which to glean for the contemporary city. Looking at the forms of the past and, in this specific case, at the forms of the ancient city of Agrigento, it can, therefore, move away from the idea that the city of the 'modern' has become 'hopeless' (Ungers, 1997) and aspire to the model of the city proposed by Uwe Schröder (2015b) in Pardié: a city as a 'montage' of parts, a 'collage' made from the clippings of the cities of Parma and Saint-Diè by Le Corbusier, in which open spaces can be introduced into consolidated contexts and contemporary forms can take on a defined urban design. This is the greatest lesson we learn from the application of the interscalar approach to the ancient city of Agrigento: to study its characters and its form to make it a matter of design for the city of our time.

Notes

1) The temples built in this period are the Temple of Heracles, built-in 510 BC, considered the most archaic in the Valley of the Temples; the Temple of Demeter, built on the slopes of the Rupe Atenea in 480-460 BC; the Temple of Athena, the Temple of Era Lacinia, the Temple of Concordia, the Temple of Vulcano, the Temple of the Dioscuri and the Temple of Aesculapius. Many of these temples appear today in a state of ruin or few columns remain, except for the Temple of Concordia which appears in an exceptional state of conservation thanks to its transformation into a Christian church, which took place in the 6th century AD.

2) As Superintendent Ernesto De Miro reports in the Historical-Archaeological Report on the city of Agrigento on the occasion of the discussion on the local strategic plan, one of the oldest topographical problems of the archaeological literature of Agrigento is that relating to the location of the acropolis, for the which the Girgenti Hill and that of the Rupe Atenea were proposed from time to time. In particular, starting from three ancient references – Polybius (2nd century BC), Diodorus (1st century BC), Polyenus (2nd century AD) – and from more recent studies it seems it can be concluded that the position of the acropolis of the Greek city, with the Sanctuary of Zeus Atabirio and Athena, it's located on the current Rupe Atenea (De Miro, 2003).

3) The Doric sanctuaries and temples found in the Valley of the Temples are: the Temple of Juno, at the eastern extremity; the Temple of Concordia; the Temple of Heracles near access IV; the terrace of the Sanctuary of Chthonic Deities, the Temple of Vulcano, at the western extremity.

4) 'Dedication' would seem to be the best translation of the German term 'widmung'.

5) The House of the Cryptoporticus, whose dimensions are 38.60 x 18.00 metre, has a structure dating back to the 2nd century BC, even if the last changes are recorded in the last decades of the first century BC. The access, located on the west cardo, consists of a vestibule that leads into the portico of a central transverse peristyle with five columns on the long sides and three columns on the smaller sides. The rooms of the domus are arranged around the peristyle and, specifically, on the west, north and east sides the main ones.

References

Capozzi, R. (2017), "Imparare dalla città antica. Lo spazio pubblico | Lernen von der antiken Stadt. Der öffentliche Raum", in Visconti, F., *Pompeji. Città moderna | Moderne Stadt*, Ernst Wasmuth Verlag, Tübingen/Berlin, pp. 79-92.

De Miro, E. (2003), *Relazione Storico-archeologica*, elaborato 1e) del Piano Particolareggiato del Centro Storico del Comune di Agrigento (Leggi Regionali n. 70/76 e 34/85) rielaborato a seguito voto CRU n. 603 del 29/01/98. [Online] Available at: www.comune.agrigento.it/AGRIGENTO/SERVIZI/Urbanistica/PP-Centro_Storico/ppcs/1/1_6RelStoArcheo.pdf [Accessed 4 May 2020].

De Miro, E. (ed.) (2010), *Agrigento – IV. L'abitato antico – Il quartiere ellenistico-romano*, Gangemi Editore, Roma.

De Nervo, G. (1989), *Viaggio in Sicilia 1833*, Fondazione Culturale Lauro Chiazzase Della Sicilcassa, Palermo.

Grassi, G. (1967), *La costruzione logica dell'architettura*, Marsilio Editori, Padova.

Gregotti, V. (1985), "Morfologia, materiale", in *Casabella*, n. 515, pp. 2-3.

Martí Arís, C. (2007), *La cèntina e l'arco – Pensiero, teoria, progetto in architettura*, Christian Marinotti Edizioni, Milano.

Moccia, C. (2018), "Architettura: misura della Terra", in Monestiroli, A., Schröder, U., Linazasoro, J. I., Moccia, C. and Semerani, L. (eds), *Lectiones – Riflessioni sull'architettura*, CLEAN Edizioni, Napoli, pp. 58-59.

Moccia, C. (2017), "L'occhio innocente è cieco | Das unschukdige Auge ist blind", in Visconti, F., *Pompeji. Città moderna | Moderne Stadt*, Ernst Wasmuth Verlag, Tübingen/Berlin, pp. 10-13.

Moccia, C. (2016), *Realismo e astrazione e altri scritti*, Aión, Firenze.

Monestiroli, A. (2002), *La metopa e il triglifo – Nove lezioni di architettura*, Laterza, Roma.

Orfeo, C. (2018), "Natura, suolo e città nell'architettura di Carlo Moccia", in Monestiroli, A., Schröder, U., Linazasoro, J. I., Moccia, C. and Semerani, L. (eds), *Lectiones – Riflessioni sull'architettura*, CLEAN Edizioni, Napoli pp. 61-67.

Rossi, A. (1975), *Scritti scelti sull'architettura e la città – 1956-1972*, CLUP, Milano. [Online] Available at: monoskop.org/images/4/42/Rossi_Aldo_Scritti_scelti_sull_architettura_e_la_citta_1956-1972.pdf [Accessed 02 May 2020].

Rossi, A. (1982), *The Architecture of the City*, MIT, Cambridge. [Online] Available at: web.dfc.unibo.it/paolo.leonardi/materiali/vc/RossiAC.pdf [Accessed 13 July 2020].

Schröder, U. (2015a), *I due elementi dell'edificazione dello spazio – Scritti scelti*, Aión, Firenze.

Schröder, U. (2015b), *Pardié – Konzept für eine Stadt nach dem Zeitregime der Moderne | Pardié – Concept for a City after the Time Regime of Modernity*, Verlag der Buchhandlung Walther König, Köln.

Schützeichel, R. (2010), "La teoria come fondamento del progetto architettonico | Die Theorie als Fundament des architektonischen Entwurfs", in Malacarne, G. and Tognon, A. (eds), *Uwe Schröder: Architettura degli Spazi | Architektur der Räume*, CLUEB-Ernst Wasmuth Verlag, Bologna-Tübingen/Berlin, pp. 29-37.

Ugo, V. (2008), *Sulla critica della rappresentazione dell'architettura*, Maggioli Editore, Milano.

Ungers, O. M. (1997), *La città dialettica*, Skira, Milano.

Ungers, O. M. (1982), "Prinzipien der Raumgestaltung", in *Arch+*, n. 65, pp. 41-48.

Visconti, F. (2017), *Pompeji. Città moderna | Moderne Stadt*, Ernst Wasmuth Verlag, Tübingen/Berlin.

Publishing Series in PROJECT | Essays and Researches
From Mega to Nano
The Complexity of a Multiscalar Project
vol. 04 | 2020 | paper 6 | pp. 102-123

ISSN (print): 2704-6087
ISSN (online): 2704-615X
ISBN (print): 978-88-5509-188-6
ISBN (online): 978-88-5509-189-3

MULTISCALAR APPROACHES TO RE-APPROPRIATING THE VISCONTI-SFORZA CASTLE IN NOVARA BETWEEN CONSERVATION AND RE-USE

Francesca Albani, Matteo Gambaro

section
ARCHITECTURE

typology
ESSAYS & VIEWPOINT

DOI
doi.org/10.19229/978-88-5509-189-3/462020

ABSTRACT
At the beginning of this century, after more than a hundred years of controversy, the Novara city administration finally recognized the great potential of the Visconti-Sforza castle to increase the quality and prestige of the city and ruled that it should be renovated for use as a museum. This long-term project, delineated over the years from 2005 to 2016, was supported by an interdisciplinary process of information-gathering involving a wide range of professionals (archaeologists, architects, historians, engineers, chemists and petrographers) with a multiscalar approach to the city and the details. The project required a multiscalar approach because of the 'urban' dimension of the intervention. Indeed, the castle, which coincides with the ancient layout of the south-west corner of the city, plays a crucial role in the new urban dynamic that can evolve thanks to its connection with Piazza Martiri and, in general, with the entire historic city of Novara, as well as for the many 'stories' that the walls can tell.

KEYWORDS
stratification, conservation, re-use, enhancement, Visconti-Sforza Castle

Francesca Albani, Architect and PhD, is an Associated Professor in the Architecture and Urban Studies Department of the Politecnico di Milano (Italy). Since 2003, she has focused on issues involved in the preservation of the architectural, urban and cultural landscape with reference to traditional and 20th century architecture. Member of Faculty Board of the Doctoral Studies in Preservation of the Architectural Heritage, she teaches at the Politecnico di Milano and the Accademia di Architettura, Italian Swiss University. She has published scientific books, essays and articles. E-mail: francesca.albani@polimi.it

Matteo Gambaro, Architect and PhD, is an Associated Professor in the Department of Architecture, Built Environment and Construction Engineering at the Politecnico di Milano (Italy). He carries out research and design trials with public entities and institutions, primarily related to technological innovation in building and urban renewal processes. He has been a member of the Faculty Board of Doctoral Studies in Design and Technologies for Cultural Heritage and author of scientific books, essays and articles. E-mail: matteo.gambaro@polimi.it

For several decades, the city administration was asking the government to cede the old buildings and the entire area of approximately 22,000 sqm to the Municipality; at the time, the fortress was used as a district prison, and its awkward presence seemed to compromise the development of the urban centre (Andenna, 1982). Writing in 1982 in a text that remains the best source of information on the Visconti-Sforza Castle, Giancarlo Andenna used these words to describe how the Castle was perceived in the city of Novara. After more than a century of controversy about the proper role for the Castle within the dynamic of the city and the transfer of the prison in 1973 to a building better adapted to contemporary hygiene and social requirements, it was not until 2005 that a process began, ending in 2016, that shaped a new role for this significant fortified complex, whose walls tell countless 'stories' about urban, social, political and economic matters.

The Visconti-Sforza Castle is a historic Visconti-era fortress that guarded the western border of the Duchy of Milan. Situated in the south-west corner of Novara, it was enclosed by a large crenellated wall made with elements from the pre-existing Roman and early-medieval city walls. The complex, built in the second half of the 13th century (Corio, 1565), had an L-shaped block known as the Rocchetta, towers to guard the entrances and ring wall (Pellini, 1902). As it was built in an area with many pre-existing structures – brought to light since 1983 by a series of excavations – the complex had one of the best-preserved archaeological stratifications in the city. It was 'modernized' and reinforced between 1473 and 1476 with the construction of the Ghirlanda, a large fortified wall with keeps and corbels protected by a deep, wide moat (Morandi, 1912). The old walls surrounding the castle, no longer fulfilling any defensive role, were re-used in the construction of stables and service buildings, and the entrance system was modified. Whereas previously the castle could be entered from each side, after the construction of the Ghirlanda, entry from the city was possible only on the north and from the countryside, on the south (Bianchini, 2003).

In the mid-16th century, the Spanish, having been defeated by the French, converted the city into a stronghold to defend Milan and its territory by building a great bastioned wall (Gavinelli, 1976; Fig. 1), thereby setting in motion the transformation of Novara[1]. The strategic role of the castle itself also changed as it now stood between the city and the new ring wall (Andenna, 1982). In 1643, during the last phase of the Thirty Years War, all that remained of the suburban areas was razed, and new structures began to appear designed to bolster the defence system, of which the castle was also a part (Piccoli and Pruno, 2010).

The evolution of the art of war, along with political changes, soon made the new fortifications obsolete, so, in the second half of the 1700s, the city walls and its bastions were gradually torn down (Morandi, 1923). Converted into a prison in 1803, the castle itself was untouched by the construction that brought major changes to the south-west portion of the city. Public walkways were created around it (Viglio, 1924) and a large square, called Piazza Vittorio Emanuele II (now Piazza Martiri della Liber-

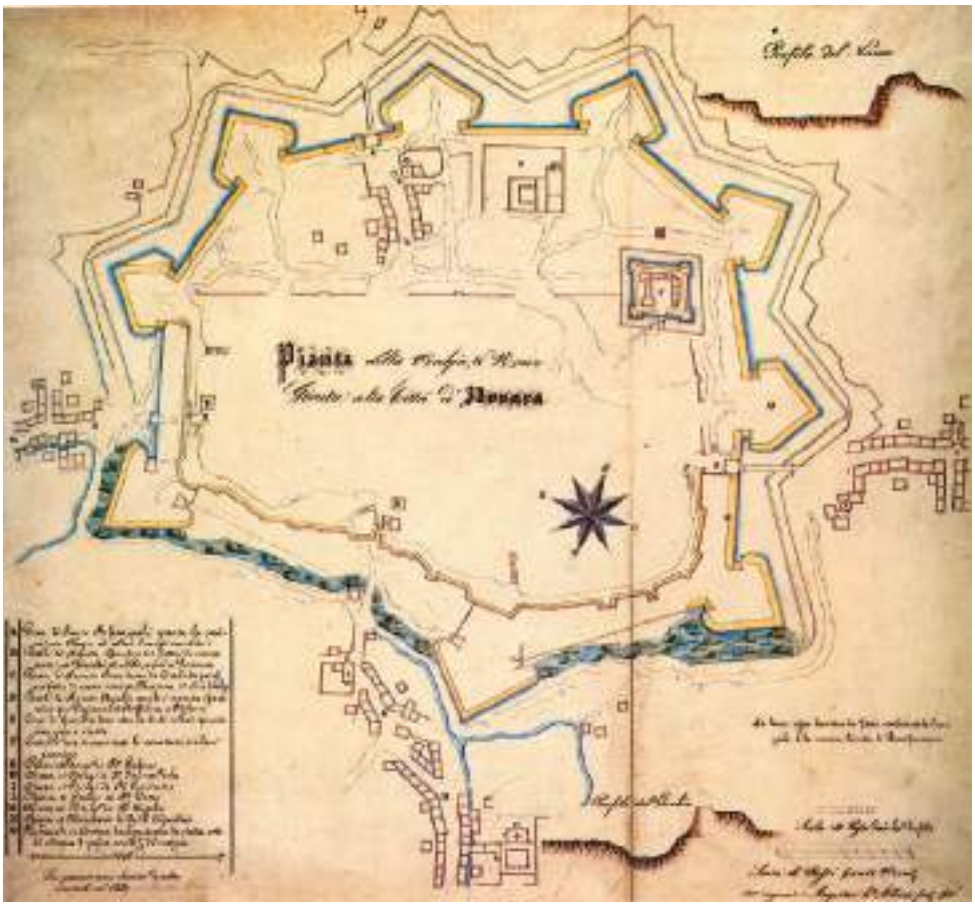


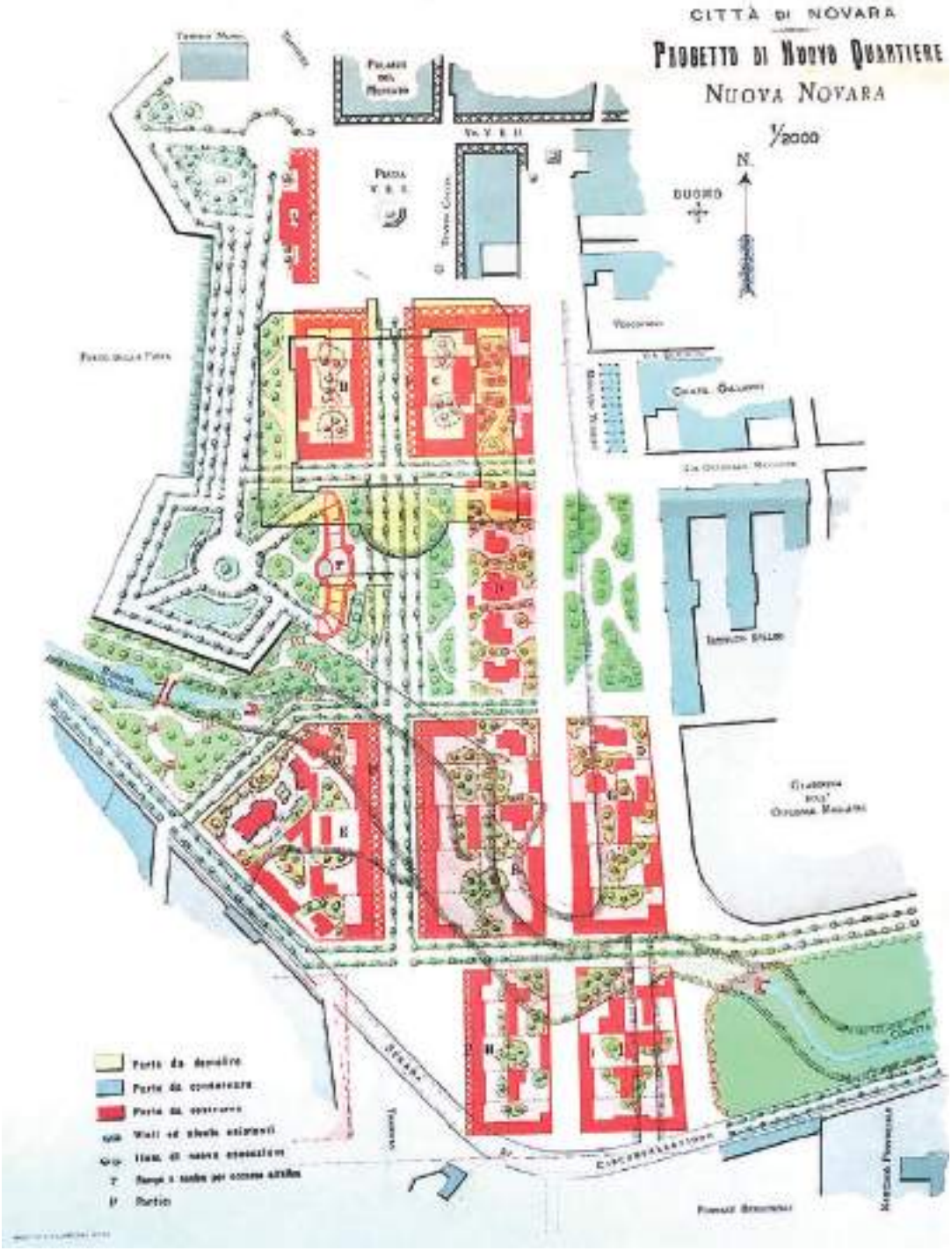
Fig. 1 | Moment of transition between the fortified system of the medieval city and the new ring wall with bastions (source: Alberti, A., 1610, *Pianta della Vecchia e Nuova Gionta alla citt‡ di Novara*, Novara, an 1852 copy by the surveyor Nasi, G., Archivio di Stato, Disegni, L/1; Archivio Storico Novara).

Next Page

Fig. 2 | Plans for Nuova Novara requiring the demolition of the Castle (source: Gazzetta di Novara, 22 October 1989).

tà), was built on the northern front, which definitively changed the perception and axis of the relationship between the fortress and the city (Perogalli, 1969). This period of introversion gradually isolated the castle from the 19th century life of a city during a profound transformation, although of course such a significant element as the castle could not be completely ignored.

20th century controversies and projects | At the end of the 19th century, in the wake of widespread discussion about conserving and upgrading monuments in general, an


CITTÀ DI NOVARA
PROGETTO DI NUOVO QUARTIERE
NUOVA NOVARA
1/2000
N.
BUONO
Parte da demolire
Parte da conservare
Parte da costruire

extraordinary, productive debate began about the future of the Visconti-Sforza Castle. Critical considerations, reflections, studies and projects followed one another throughout the early years of the 1900s, though without converging on a workable strategy to enhance and re-use the building. Only after the Castle no longer functioned as a prison, in 1973, did a lengthy process begin that eventually – in the early 21st century – resulted in a project to re-use the Castle as a museum and venue for cultural activities. This project was completed in 2018. Over the years, especially at the end of the 1800s, some people had advocated for the demolition and clearing of the area in order to build new public structures as well as a new residential district, named Nuova Novara[2], which involved redesigning public spaces, green areas and, in general, the entire area within the south-west bastion (Fig. 2).

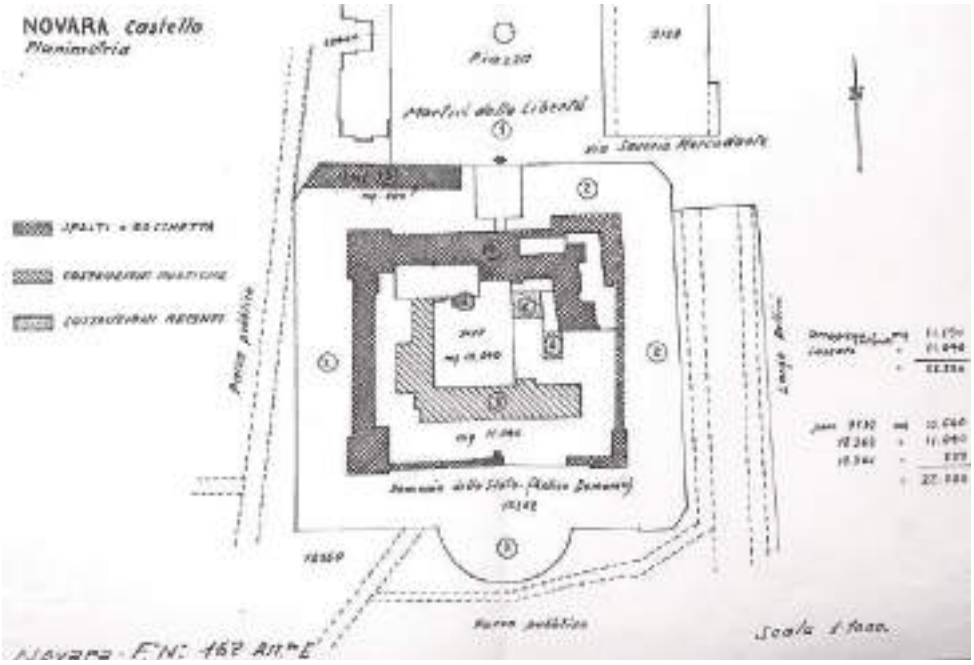
The group associated with the weekly magazine La Libertà had been urging since 1887 that the shapeless, cracked mass of medieval bricks be eliminated to make room for new buildings to beautify the city (Andenna, 1982). In 1902, when it was believed that demolition was imminent, a group who expressed their views in La Gazzetta di Novara and Il Corriere di Novara, along with influential studies such as that by Silvio Pellini originally published in episodes in La Gazzetta di Novara and later in an anthology (Pellini, 1902), set in motion a process in which Luca Beltrami and the Nuova Antologia and Emporium reviews became involved. In Turin, Alfredo d'Andrade, Director of the Office for the Conservation of the Monuments of Piedmont and Liguria, refused to allow the castle to be sold to the municipality by the government department that manages the state-owned property, writing: «Nel giugno 1894 previa visita al monumento, lo scrivente comunicò al Governo che il Castello possiede ancora abbastanza resti interessanti da meritare di essere conservato, che salvo un bisogno urgente non converrebbe venderlo, e qualora le condizioni finanziarie lo permettessero sarebbe il caso di addivenire al restauro del monumento nell'interesse non solo dell'arte e della storia, ma anche della citt‡ di Novara»[3] (cit. in Biancolini Fea, 1981).

In the same years, Luca Beltrami also supported restoration, writing in the Corriere della Sera: «Oggi a Novara si rinnova ciò che, vent'anni or sono, si verificò a Milano [...] anche qui si voleva, come ora a Novara, mutilare il castello allo scopo di tracciare un'arteria stradale per dare il passo all'aria salubre dei monti: anche qui si trovava che il castello era spoglio di qualsiasi pregio artistico, e solo ricordava la triste dominazione straniera: anche qui si distruggevano vecchie piantagioni per far posto a case a cinque piani; eppure bastarono pochi anni per darci una misura dell'errore irreparabile che si sarebbe commesso attuando quel piano, per quanto, al pari dell'attuale di Novara, avesse riportato il voto favorevole delle solite Commissioni competenti»[4] (Beltrami, 1900).

Beginning in 1893, a variety of well-developed proposals were advanced, from that of Opera Pia Omar, which sought to build new schools, followed in 1912 by architects Rizzotti and Bergomi, who proposed using it as the seat of the city government upon its restoration and expansion in a matching style (Fig. 3). Just a few years later, in 1925, the mayor supported a project to create a museum in the castle and

transform the grounds into a Parco della Rimembranza. In the early 30s, before the new Urban Development Plan was issued, there was a proposal to demolish the castle to build a new main post office, which was in fact later built by the architect Angiolo Mazzoni in the immediate vicinity on the site of the demolished Politeama Theatre.

Visione del Castello secondo il progetto Bergomi-Rizzotti del 1910



Figg. 3, 4 | Plan for the realization of the seat of the city government in the Castle, 1912 Rizzotti and Bergomi (source: Archivio Storico di Novara); Plan for the re-use of the Castle as a museum, Medardo Arduino, 1982 (source: Archivio Corrente della Soprintendenza di Torino).

The new Urban Plan issued in 1934, drafted by the engineers Marco Cassinis and Federico Magistrini and the architect Oscar Prati, sanctioned the conservation approach, which had always been strongly supported by the Superintendence, and designated the area of the Castle as a public park for the common good (Oliaro and Coppo, 1983).

Although the previsions of the Urban Plan left no doubt about the intended use, three other proposals were still put forth for the construction of the new city government seat: the first in 1936, designed by the architect Carlo Nigra; the next in 1939 by the architect Rizzotti and the last in 1952 by the architect Giovanni Lazanio. In 1964, the Municipality of Novara announced an important competition for the new municipal headquarters in the area of the Collegio Gallarini. Among the participants was a team coordinated by Guido Canella, which drew up a project to convert the moat and basement of the castle into commercial and parking spaces. Finally, in 1981, Medardo Arduino, commissioned by the City, drew up a project calling for the castle to be used as a museum, requiring substantial demolition work on the more recent structures, which was, in fact, carried out, as well as restoration of the Rocchetta and the North Wing, which was not (Fig. 4). Nothing further was done, and the question of the use of the castle remained for several years at the centre of a local political and cultural controversy until regional financing was obtained in the 2000s and the re-use project was begun, coordinated by Paolo Zermani (Novelli, 2018).

From brick to the city | Having abandoned the idea of partially or totally demolishing the fortified complex to make room for new construction – years after other places with Visconti-era fortifications had made such a decision – they finally began to consider how to re-use the fortress and integrate it into the life of the contemporary city. The first step, taken in 2005, was to organize a complex information-gathering process about this little-known place. It had been entirely closed until that moment, so the few existing worthy studies had not had the opportunity to observe the actual construction directly, focusing instead on historical events and the political role of the castle. The building offers itself – precisely through the apparent chaos of its superimpositions – to be deciphered as an actual text written in stone (Torsello, 1997). In architecture such as that of the Visconti-Sforza Castle made of numerous stratifications, the actions that affect the building are based on varying levels of intentionality.

The enlargement of a block, the subdivision of internal spaces and the opening of new windows are all conscious actions that manifest a precise intention, a given historical-cultural environment and a specific technical context. On the other hand, lack of maintenance, land subsidence, and signs of deterioration – which themselves make up part of the building's history – are not the result of intentional acts. In order to identify a correlation between the phases of construction, processes of deterioration, and modifications due to changes in designated use, the stratigraphic analysis was used to study, record and time the various phases in the life of the building (Harris, 1983, 2003). This correlation between the stratigraphic diagram and the project is use-

Fig. 5 | Wall standing alone inside the Castle (credit: Albani, 2005).

Fig. 6 | Internal side of the wall (credit: Albani, 2005).

Fig. 7 | Stratigraphic survey of the western facade of the wall (credit: Albani, Gambaro and Mittermair, 2005).

ful to identify a methodological approach that will allow in-depth knowledge of the building, a fundamental pre-condition for drawing up a precise, well-developed project, designed specifically in response to the characteristics of the building.

Emblematic of the repercussions that this now-consolidated relationship between archaeology and architecture can have on the project are the vicissitudes of the wall, which stood isolated inside the courtyard in the west side, precisely at the place where the new museum wing was planned. In order to understand the role that was, or was not, played by the historic wall in the plans for the new structure, it was essential to understand all the various stratifications of the building[3]. This approach necessarily involved focusing on the building materials, and thus, on individual examples of brickwork, or better still, on a single stratigraphic unit. Luckily, the building was easily analyzed as it was even possible to measure the thickness of the walls and because the only plastered area was the lower part on the eastern side. Thus, commissioned by the Municipality of Novara, a study was launched to combine data from archival sources and information from the stratigraphic analysis of the elevation[6] (Figg. 5-7).

After localizing and determining the perimeters of the various stratigraphic units, identified thanks to discontinuity in the walls, the data was plotted in graphs and data sheets to guarantee uniformity, thoroughness, and easy interpretation. The data sheets included information on materials, construction techniques, morphological characteristics of the elements and the physical relationship between the stratigraphic units[7]. This made it possible to determine a relative sequence that reconstructed the different phases of construction and transformation of the walls.[8]

A comparison of the data gathered from different investigations (of the structure and in the archives) revealed complex usage and stratifications beginning in the Roman/early medieval period and continuing through to interventions in the 1900s. The existing wall stands on top of the ring wall of the Roman/early medieval city, as confirmed by archaeological excavations carried out in 2005[9] (Figg. 8, 9). Located in the south-west corner of the raised city walls, it has a sentry walkway[10] built in a later epoch[11]. On the south facade of the Monicione Tower, situated to the east in the Rocchetta, traces of these early medieval walls were found, suggesting the theory that it was not laid out in a straight line, as had been assumed, but that there was a sort of 'recess or indent', probably related to the configuration of the terrain[12] (Motta, 1987).

Later, in the Visconti period, it was used again in the construction of the first fortified circuit, at which point it was raised and a second walkway was created, higher than the first[13]. Significant portions of this first fortified circuit remain in the south and east areas of the castle, where a massive entrance with a drawbridge and smaller pedestrian entrance is visible. The wall, which stood isolated in the middle of the courtyard as a result of demolitions carried out by the Civil Engineering Department after the prison was moved, is the only testimony of this effort to provide defence for the city, which continued to use the same stretch of the city wall from the Roman

Fig. 8 | Phases of construction from the early medieval period to the 20th century (credit: Albani, Gambaro and Mittermair, 2005).

Fig. 9 | Detail of the crenellated walls that rose above the wall of the early medieval city (credit: Albani, 2005).

Fig. 10 | Castle entrance in the early 1900s when it was a prison (source: Archivio Storico di Novara).

period to the 14th century, raising and reinforcing it periodically. All this lost its relevance when the Ghirlanda was built in the mid-1400s and later with the presence of the ramparts of the new fortified ring wall. The wall, therefore, no longer represented the 'limit' of the city's defence, but served instead as the ring wall of a building, having been reused in a newly-constructed service block.

There is evidence of the use of this building during the period in which it functioned as a prison. In 1803, when the prison was moved into the castle, numerous works were carried out to transform and maintain the entire complex (Fig. 10). A

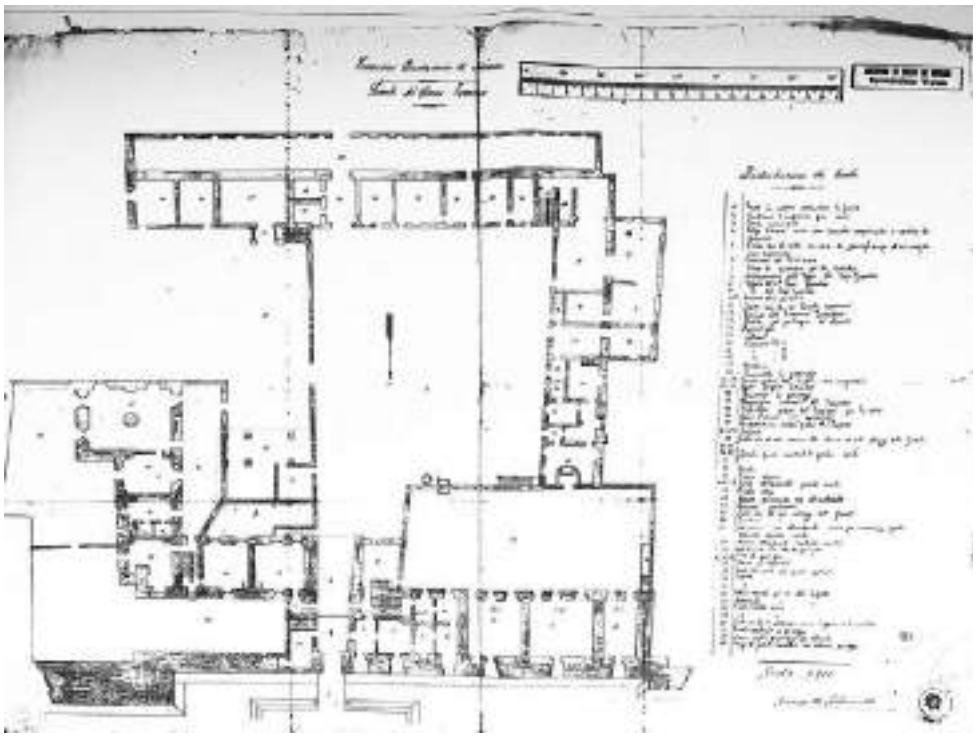


Fig. 11 | The ground floor of Visconti-Sforza Castle, 28 February 1882 (source: Archivio Storico di Novara).

Fig. 12 | Buildings built up against the wall of the early medieval city re-used in the fortress and demolished in the 1980s (source: Archivio Corrente Soprintendenza Archeologia Belle Arti e Paesaggio for the Provinces of Biella, Novara, Verbano-Cusio-Ossola and Vercelli).

survey of the ground floor of the Visconti-Sforza Castle carried out on 31 October 1814 by the royal surveyor F. Baglione, kept in the ISCAG archive in Rome, shows that it was a two-storey building with five rooms and two gun storerooms on each floor. Around the end of the 19th century, when the needs of the prison had changed, the building underwent another series of transformations. Records show that the windows were modified as interior spaces were partitioned differently to correspond to new functions. In fact, a floor plan of the Castle dated 28 February 1882 and kept

in the State Archive of Novara shows an oratory and a series of storerooms on the ground floor and a surveillance room on the first floor (Fig. 11).

When the prison was moved elsewhere in 1973, the entire complex was abandoned. A series of images found in the Current Archives of the Superintendence of Turin[14] shows several buildings supported directly by the early medieval city walls that had been reused in the fortifications. These buildings were abruptly demolished in the 80s, probably without anyone realizing the importance of those walls that bear the traces of almost 2000 years of history of the city of Novara (Fig. 12).

The (partial) re-appropriation of the Castle | The process of re-appropriating the historical structure began in the 80s, both institutionally, with the transfer of ownership – after ten years of complicated negotiations – from State Property to the Municipality of Novara, and physically, with its designation and temporary use as the seat of the Forestry Authority. However, a broader-ranging project to reuse and increase the value of the Castle was not launched until the beginning of the 2000s, when regional financing was obtained and a competition was announced for proposals to restore and reuse the Castle as a museum and cultural centre, won by a team coordinated by Paolo Zermani.[15]

The interdisciplinary information-gathering campaign – still ongoing – revealed a highly stratified palimpsest and has gradually contributed to a recognition of the importance of the Castle's rich history and role within the identity of the city. Therefore, clear limits were set as to the transformations possible to fulfil the needs of its new use. The project to re-use the Castle as a museum and cultural centre was the culmination of a debate that had begun in the late 1900s. It was based on in-depth knowledge of the site, although it only involved one portion of the fortified complex. Specifically, the intervention called for the restoration of the north wing and the east Rocchetta, re-composition of the buildings to the south and reconstruction of the west wing built along the existing medieval wall, in correspondence with the ancient Roman wall, which represents the backbone of the new structure and is visible at all levels from the basement to the two floors above ground (Mugnai, 2019).

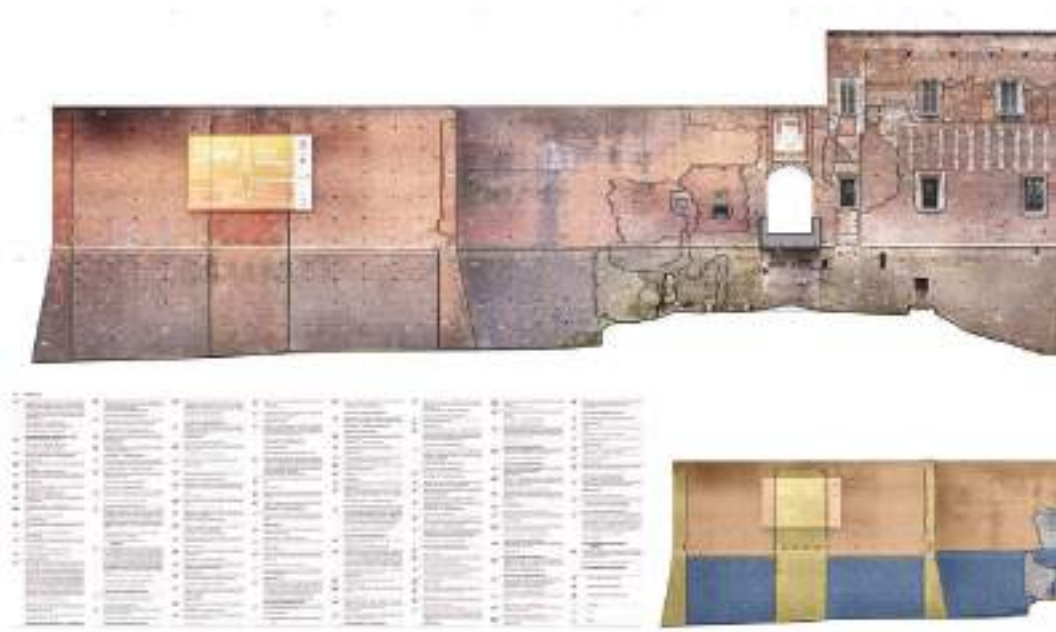
Another important decision was to build the tower above the north-facing entrance, at the point with traces of the medieval tower, in order to create a scenic viewpoint overlooking the city and its principal monuments: Piazza Martiri, Teatro Coccia, the Baptistery and the Dome of San Gaudenzio by Antonelli (Savorra, 2018). The compositional intention was to complement the pre-existing structures with the new ones, in a unified logical plan, progressively revealing the stratifications of the construction. The origins of the building and the stratigraphy of the Roman, Visconti and Sforza constructions can also be appreciated from the basement of the new west wing, from where one can gain access to other Roman remains discovered during the archaeological excavations as well. The Castle will house the archaeological collection of the Mu-

Fig. 13 | The new museum wing by Paolo Zermani, 2016 (credit: R. Emili, 2020).

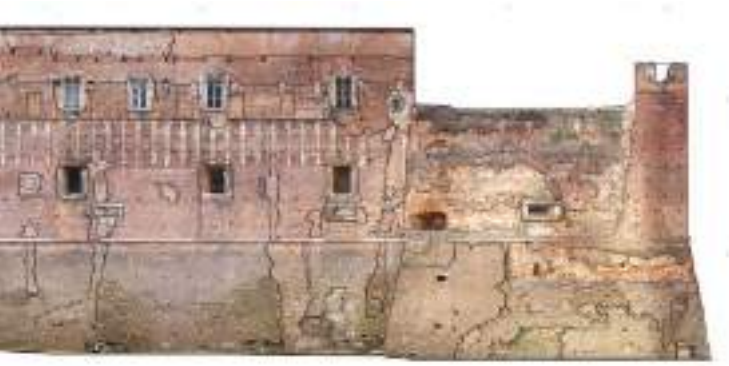
Fig. 14 | Southern entrance to the Castle (credit: R. Emili, 2020).

Fig. 15 | Views of the Castle from the city today (credits: R. Emili, 2020).

Fig. 16 | Views of the Castle from the city today (credits: R. Emili, 2020).



Figg. 17, 18 | Stratigraphic survey of the North facade of the Castle; Decay survey and maintenance project of South-North facade of the Castle (credits: Politecnico di Milano, DASTU and ABC Departments, F. Albani, M. Gambaro, 2018).



nicipality of Novara, the Civic Museum and a contemporary art gallery – the only venue that has operated so far, mounting temporary exhibitions.

The project took more than a decade to complete and involved a diverse group of scholars, archaeologists, professors, architects and engineers who contributed over the years in varying scales. Unexpectedly, however, the citizenry was divided in their reaction to the intervention. On the one hand, the importance of conserving the fortified complex was (finally!) widely acknowledged; on the other, however, the symbolic value of the additional storey of the tower with the coat of arms facing towards the city rather than towards the interior, as dictated by the medieval art of war, was not well-received. In fact, the castle continues to be a place that is not exactly 'of the city' and only partially included within its borders.

In 2019, after further European financing[16], a new phase of study and research began on the Castle moat and the San Luca and San Giuseppe bastions, which form the perimeter of the Spanish fortifications on the west. This second phase of the intervention will create a connection and greater integration between the city and the restored structure, now re-opened to the public. The re-appropriation of the complex will be completed with the renovation and installation of safety features in these sites that have been inaccessible for so many years and were originally built for defensive purposes, while also offering a unified vision of Novara's little-known fortified defence system (Fig. 13). Meanwhile, an anthology of all the studies carried out over the past fifteen years is being published, which, along with the various cultural events being planned, will allow the city to experience and 're-interpret' this important site, capable of generating social, economic and spatial synergies and dynamics in the city of Novara.

Open questions | After the controversy lasting more than a century, which culminated in the construction of the new museum wing and the conservation of the medieval structures, the city of Novara has finally 're-appropriated' this site (at least physically), with its great value and significance. From the very beginning, its position within the city, proximity to large public parks, and easy access ensured the presence of a large, enthusiastic public. The construction of the bridge on the southern side in 2002 created a permanent connection between Piazza Martiri and the Allea di San Luca. The bridge played a decisive role in the relation between the city and the Castle and created a spatial sequence between the entrance on the ravelin, the inner courtyard and the park on the bastions (Fig. 14). For almost twenty years now, the people of Novara have been able to enter and fully enjoy a site that had previously been off-limits. Furthermore, thanks to the activity of the Fondazione Castello Visconteo Sforzesco, for the past five years there have been frequent, often world-class cultural events, both permanent and

Fig. 19 | 3D Laser Scanner Survey (Tracciatori s.a.s., Brescia, 2018).

temporary. Thus, the Castle has assumed an entirely new role: whereas once it was a place of exclusion, it is now a place of inclusion that has revitalized the city museum circuit and a tourist place of cultural interest, with social and economic repercussions.

There are still numerous issues to confront within this dynamic, including the relationship of the Castle and the Park, and specifically, the conservation and enhancement of the Ghirlanda surrounding the fortress. After the construction of the bridge spanning the moat from the park, the question of restoring relations with the surrounding spaces became more urgent, but especially with the still-existing fragments of the Spanish wall hidden within the Parco dei Bambini. This relationship, still only partially explored (Gambaro, 2019), offers a valuable opportunity for the Visconti-Sforza Castle to redefine its interaction with the contemporary city. Studies began in 2018[17] – before the 2019 competition[18] – revealed the cultural, spatial and relational complexity of this area of Novara, which still awaits proper interpretation, where new uses and stratifications can be added to the many stratifications of the past.

The example of the Visconti-Sforza Castle and the multiscalar and multidisciplinary approach of the process that led to its re-appropriation by the city can serve as a model in the search for new strategies for managing our cultural heritage,

which represents such an important cultural and economic resource. For Novara, and more generally, for Piedmont and Lombardy, the dynamics of the case can serve as a model in the debate about the future of fortified architecture, which has traditionally been excluded from the development of the city. The delay in this process of re-appropriation compared to other national and international examples is due to local matters that resulted in the transfer of the prison being delayed by more than fifty years, although it had been recognized since the early 1900s as unable to guarantee even minimal standards of hygiene and health. This delay created a distance between the people of Novara and this austere place, which was lacking in artistic elements or stories of famous characters that could make it more readily appreciated.

The process began about twenty years ago to 're-connect' the Castle and the city in a variety of ways was largely based on the interdisciplinary, multiscalar information-gathering about the construction, which demonstrated the importance of conserving the signs of transformation and, in general, of the passage of time. These ongoing dynamics are an example to be studied by other places facing a lack of connection between historical sites and a society that has become too artificial and hectic to take the time to appreciate and understand their surroundings. For such places, a methodological approach and a strategy of enhancement can be an example and an inspiration. When the architectural project is fundamental to attaining the goal, the implementation of strategies on several distinct scales reflects the contemporary city's desire to re-appropriate the many 'stories' that these sites can tell, seeking to experience the sites fully and integrate them into the urban community dynamics, which have been waiting far too long for the resolution of these issues (Figg. 15-18).

Acknowledgements

This article is the fruit of the authors' joint reflection; however, the paragraphs 'introduction' and 'From brick to the city' should be attributed to Francesca Albani, '20th century controversies and projects' and 'Re-appropriation of the Castle' to Matteo Gambaro, and 'Open questions' to both authors.

Notes

1) In the 16th century, before the new fortress was built, the city was defended by a massive wall and a moat known as 'fossatum Novariense'. Access was gained through five main gates: S. Stefano on the north, Sant'Agabio on the east towards Milan, San Gaudenzio on the west towards Vercelli, Santa Maria, also known as the Cittadella, to the south, and Porta Nuova by the Church of Sant'Agnese. There was also a series of posterns for convenience. Many buildings stood along the communicating roads, especially near the city by the wall; the further from the city, the more deteriorated the buildings (Frasconi, 1995).

2) The Nuova Novara project was presented to the Municipality of Novara on 23 May 1899 by the architects Giachi and Andreoni on behalf of a group of entrepreneurs.

3) The English translation of the text is as follows: «In June 1894, upon visiting the monument, I informed the Government that the Castle still has enough interesting remains to merit its conservation. Thus, unless there were an urgent need, it would not be advisable to sell it, and assuming financial conditions allow, it would be the case to initiate restoration of the monument in the interest not only of art and history but also of the city of Novara».

4) The English translation of the text is as follows: «Today, in Novara, we see a repetition of what happened in Milan more or less twenty years ago [...]. There, as now in Novara, some wanted to sacrifice the integrity of the castle in order to lay a roadway that would allow healthy mountain air to blow through: here too the castle was believed to be devoid of any artistic value, serving only to recall the unfortunate foreign domination: here too old farm estates were destroyed to make room for five-storey apartment buildings; and yet it took only a few years to understand the scope of the potential irreparable damage of the plan if, like the current plan in Novara, it had been approved by the usual competent Commissions».

5) A stratigraphic unit refers to what remains of a part constructed as a single unit in a building, that is, laid in a single act of construction.

6) In 2004, the Municipality of Novara, specifically the Qualificazione Territorio e Ambiente Department, with the architect Roberto Guasco in charge of the procedure, commissioned scientific research overseen by Francesca Albani, Matteo Gambaro and Martin Mittermair. The work, which lasted into 2005 and 2006 in order to complete the archival research, included a stratigraphic analysis of the Visconti complex (Visconti Tower, Monicione Tower, the Rocchetta and South Wing), an analysis of signs of deterioration, and guidelines for the conservation of the structures in elevation.

7) From the beginning, the research clearly revealed the delicate balance between the complexity of the information and its quality. This widely-recognized problem was discussed repeatedly. The weak link of the system is certainly the set of hundreds of U.S.M. data sheets and the increasingly complicated and hard-to-interpret matrix; these research tools have been reduced over time to a sort of 'certificate of quality' ritual, whereas in fact, they are merely a summation of the data with no practical function for the project (Pertot, Tagliabue and Treccani, 1996).

8) As for the Visconti-Sforza Castle, questions were raised as early as the first phase of the research project about whether Harris's simple two-dimensional diagram was capable of representing the many interrelations between the stratigraphic units of an architectural complex with so many distinct parts. This debate on the question of the matrix applied to architectural analysis is ongoing, with some proposing that it be simplified and others that it be abandoned entirely (Giannichedda, 2004; Parenti, 2003; Gallina, 2012).

9) U.S.M. 852 is made with gravel and a brick course, which ensure that the laying surface is level. It has the same characteristics as the walls discovered in the archaeological excavations. The perfect alignment of the walls virtually proves that they were built at the same time.

10) The masonry of the battlements has a thickness of 46 cm while the surface supporting the wood beams of the walkway is 45 cm thick. The walkway probably had a wooden gallery supported by beams, though no trace remains today. Thus, the parapet of the battlements, recognizable on the west façade, was about 72 cm high. The merlon was able to protect an area about 73 cm above the parapet, for a total height of 145 cm. Such are the dimensions today, but it is quite probable that the upper parts, being more vulnerable to deterioration, were eliminated during successive transformations. A geometric survey showed that the space between one merlon and another varies between 108 and 117 cm.

11) The 94-cm rubble masonry wall, identified as U.S.M. 804, is made of two brick facings of about 14-14.5 cm filled with river pebbles and brick fragments with whitish lime mortar with good bonding strength and a fine-grained aggregate.

12) A reconstruction of the perimeter of the wall surrounding the Roman city (Motta 1987).

13) Unlike U.S.M. 804, this U.S.M. 801 wall is made with 3 headers brickwork and has exactly the

same thickness as the earlier wall, that is to say, slightly less than one meter. The bricks, approximately 29.5-30 x 6-6.5 x l 1.5-12 cm in size, are a darker red than those in U.S.M. 804 and are laid with an irregular header/stretcher pattern. The greyish lime mortar has excellent bonding strength and a sandy/pebbly aggregate with small limestone fragments. The joints are smooth, flush with the brick, and vary in size between 2 and 2.5 cm. The wood sentry walkway rested on thickness of about 45 cm. while the merlon is 46-48 cm thick. The crenelations were 225 cm above the floor and the parapet offered protection up to 106 cm. Given that the space between merlons measured between 118 and 120 cm., it is reasonable to assume that there were also wooden closing elements for this battlement.

14) Archivi Correnti Soprintendenza Archeologia Belle Arti e Paesaggio for the provinces of Biella, Novara, Verbano-Cusio-Ossola and Vercelli and the Soprintendenza Archeologia Belle Arti e Paesaggio of the Metropolitan City of Turin.

15) The design team included Paolo Zermani (team leader), Alberto Andreis, Giuseppe Arena, Carmela Barillà, Mauro Grimaldi, Ezio Mancini, Fulvio Nasso, and Alberto Tricarico.

16) POR FESR 2014-2020 Asse VI – Azione VI.6c.7.1 – Interventions to safeguard, enhance and digitalize the cultural heritage, both material and immaterial, in strategically important areas of attraction in order to consolidate and promote development.

17) 'Studi e ricerche per la definizione delle opere di conservazione, valorizzazione e fruizione delle mura del Visconti-Sforza Castle e dei bastioni di San Luca e San Giuseppe'. Research contract stipulated in 2018 between the Politecnico of Milan (scientific leaders Francesca Albani and Matteo Gambaro) and the Municipality of Novara, Servizio Lavori Pubblici e Sviluppo del Patrimonio Immobiliare.

18) POR FESR 2014-2020 Asse VI – Azione VI.6c.7.1 – Open tender for the procurement of professional engineering and architectural services involved in the design and determination of seismic vulnerability for restoration and conservation work on the walls of the Visconti-Sforza Castle and the San Luca and San Giuseppe bastions in Novara.

References

Andenna, G. (1982), *Da Novara tutto intorno*, Milva, Torino.

Arduino, M. (1981), "Il Castello Visconteo Sforzesco", in Aa. Vv., *Alla scoperta della Città*, Archivio corrente Soprintendenza di Torino.

Beltrami, L. (1900), "Il Castello di Novara", in *Corriere della Sera*, newspaper, 4-5 September.

Bianchini, F. A. (2003), *Le cose rimarchevoli della città di Novara – Precedute da Compendio storico (dalle origini al 1828)*, Lampi di Stampa, Milano.

Biancolini Fea, D. (1981), "L'attività Alfredo d'Andrade tra il 1884 e il 1915: da regio delegato a Soprintendente", in Cerri, M. G., Biancolini Fea, D. and Pittarello, L., *Alfredo d'Andrade – Tutela e restauro*, Vallecchi, Firenze, pp. 71-96.

Corio, B. (1565), *L'Historia di Milano*, Venetia.

Frasconi, C. F. (1995), "Topografia antica di Novara e i suoi sobborghi", in *Bollettino Storico per la Provincia di Novara*, anno LXXXVI, fasc. 1, pp. 140-144.

Gallina, D. (2012), "Sillogismo deduttivo o abduzione? Alcune proposte per l'abbandono/superamento del matrix di Harris nell'analisi dell'architettura", in Redi, F. and Forgione, A. (eds), *VI Congresso Nazionale di Archeologia Medievale – Sala Conferenze 'E. Sericchi', Centro Direzionale CARISPAQ 'Strinella 88' – L'Aquila, 12-15 Settembre*, All'insegna del Giglio, Firenze, pp. 75-81. [Online] Available at: uberty.org/wp- www.academia.edu/1907374/D._GALLINA_2012_Sillogismo_deduttivo_o_abduzione_Alcune_proposte_per_l_abbandono_superamento_del_matrix_di_Harris_nell_analisi_dell_architettura [Accessed 20 March 2020].

Gambaro, M. (2019), "The Green Heart of Novara: the public spaces system from the Castle to the Children's Playground to the City's Boulevards", in Fanzini, D., Tartaglia, A. and Riva, R. (eds), *Project*

challenges: sustainable development and urban resilience, Maggioli, Sant'Arcangelo di Romagna, pp. 149-158. [Online] Available at: hdl.handle.net/11311/1125605 [Accessed 20 May 2020].

Gavinelli, C., Bandi, G. and Caimo, E. (eds) (1976), *Novara e Antonelli – Lo sviluppo urbanistico e architettonico di Novara nell'Ottocento e l'opera di Alessandro Antonelli – Mostra iconografica, Novara, Palazzo Broletto – Archivio di Stato di Novara, Comune di Novara, Regione Piemonte*, Catalogo, Direzione generale degli archivi di Stato, Firenze.

Giannichedda, E. (2004), "L'incorreggibile 'Harris' ed altre questioni", in *Archeologia dell'Architettura*, vol. IX, pp. 33-44.

Harris, E. C. (2017), *Principles of Archeological Stratigraphy*, Carocci, Roma.

Harris, E. C. (2003), "The Stratigraphy of Standing Structures", in *Archeologia dell'Architettura*, vol. VIII, pp. 9-14.

Morandi, G. B. (1923), "Breve storia delle mura bastionate di Novara", in *Bollettino Storico per la Provincia di Novara*, anno XVII, pp. 324-325.

Morandi, G. B. (1912), *Il Castello di Novara dalle origini al 1500*, Stabilimento tipografico G. Cantone, Novara.

Motta, M. (1987), *Novara medioevale – Problemi di topografia urbana tra fonti scritte e documentazione archeologica*, Istituto Lombardo di Scienze e Lettere, Milano.

Mugnai, F. (2019), "Ai piedi del Monte Ros – Il Castello di Novara nel progetto di ricostruzione di Paolo Zermani | At the foot of Monte Ros – The Castello di Novara in Paolo Zermani's reconstruction project", in *Firenze Architettura*, n. 2, pp. 18-27. [Online] Available at: doi.org/10.13128/FiA-11076 [Accessed 20 May 2020].

Nigra, C. (1937), *Torri, castelli, e case forti del Piemonte dal Mille al secolo XVI*, Novara.

Novelli, F. (2018), "Novara, Il Castello Visconteo Sforzesco e l'intervento di Paolo Zermani", in *Ananke*, n. 83, pp. 84-87.

Oliaro, A. and Coppo, A. (eds) (1983), *Novara – L'evoluzione urbanistica attraverso l'iconografia storica*, Comune di Novara, Novara.

Parenti, R. (2003), "Alcune considerazioni in nota a The Stratigraphy of Standing Structures di Edward C. Harris", in *Archeologia dell'Architettura*, vol. VIII, pp. 15-16.

Pellini, S. (1902), *Le fortificazioni di Novara*, F.lli Miglio, Novara.

Perogalli, C. (1969), *Castelli della Lombardia*, Tamburini Editore, Milano.

Pertot, G., Tagliabue, R. and Treccani, G. P. (1996), "Sperimentazioni didattiche tra archeologia stratigrafica e conservazione del costruito", in Biscontin, G. and Driussi, G. (eds), *Dal sito archeologico all'archeologia del costruito – Conoscenza, Progetto e Conservazione – Atti del Convegno di Studi, Bressanone 3-6 luglio 1996, Padova*, Arcadia Ricerche, pp. 61-74.

Piccoli, P. and Pruno, S. (2010), *Il Castello e le mura di Novara – Storia e progetti per una città fortezza tra il XVI e il XVII secol*o, Interlinea edizioni, Novara.

Savorra, M. (2018), "Paolo Zermani. Il restauro del Castello Sforzesco Visconteo, Novara", in *Casabella*, n. 881, pp. 52-62.

Torsello, P. (1997), "*Scritture di pietra"*, in Doglioni, F., *Stratigrafia e restauro tra conoscenza e conservazione dell'architettura*, Lint Editoriale, Trieste, p. 7.

Viglio, A. (1924), "Quando furono piantati i primi viali del pubblico passeggio a Novara", in *Bollettino Storico per la Provincia di Novara*, anno XVIII, pp. 178-183.

Publishing Series in PROJECT | Essays and Researches
From Mega to Nano
The Complexity of a Multiscalar Project
vol. 04 | 2020 | paper 7 | pp. 124-137

ISSN (print): 2704-6087
ISSN (online): 2704-615X
ISBN (print): 978-88-5509-188-6
ISBN (online): 978-88-5509-189-3

NATION-BUILDING MICRO-NARRATIVES FROM LEBANON AND KUWAIT
The journey of Sami Abdul Baki

Roula El-Khoury Fayad, Silvia Mazzetto

section
ARCHITECTURE

typology
ESSAYS & VIEWPOINT

DOI
doi.org/10.19229/978-88-5509-189-3/472020

ABSTRACT
The golden age between the 1950s and 60s in Lebanon witnessed the return of talented Lebanese architects who pursued their architectural studies abroad and numerous successful collaborations between local and foreign architects. This period was characterized by maturity in modern architecture that was described as an 'assimilation' of the modern ideals. Similarly, Kuwait represented an attractive experimental ground for testing new ideas, designs and construction techniques, that were closely associated with Western architects' contributions. The history of modern architectural development both in Lebanon and in Kuwait has been dictated with these grand narratives disregarding the lived experiences and professional works of those who are not part of the dominant culture or main plot. This paper examines the case of the prominent but not well-known figure Sami Abdul Baki. The aim is to reconstruct one portion of the narrative of cultural exchange between the two countries that was not properly covered by the dominant narratives.

KEYWORDS
modern architecture, nation-building, dominant narratives, micro-narratives, corporate architecture

Roula El-Khoury Fayad is an Assistant Professor of Architecture at the Lebanese American University. Her research interests include Material Manifestation of Global Influences in the Middle East, Representation of Capital in the City, Representation and Design, and the Representation of Alternative Public Spaces in the City. She was also recognized by numerous awards such as the Peter Cook Honorable mention, the Azar, and the Areen Award. She also won the first prize in several competitions: Thinking Housing, Revisiting Dalieh, and the design of a Municipal headquarters for Fidar. E-mail: roula.elkhoury@lau.edu.lb

Silvia Mazzetto is an Assistant Professor at the School of Architecture and Design, at Lebanese American University in Beirut. Her research interests focus on heritage restoration, adaptive reuses, environmental and sustainable design approaches, multidisciplinary collaboration projects between the Architecture and Urban Planning, integrating the socio-cultural and behavioural aspects of design and research into education and professional practice. E-mail: silvia_mazzetto@yahoo.it

In the past centuries, Lebanon has been continuously reinvented and transformed by the long historical sequence of migrations, conquests, trades, and internal conflicts. The Lebanese state borders mutated frequently and the current capital Beirut has been part of numerous empires and systems of government including, Phoenician, Persian (6th-4th century BCE), the realm of Alexander the Great (4th BC), Hellenistic Seleucid Kingdom, Roman (1st century BC, part of the Roman province of Syria), Byzantine, Crusader, Mamluk, Ottoman and French mandate. More recently, in 1943, Beirut has become the capital of the Republic of Lebanon. Although characterized by a long sequence of historical events and urban transformations, today, it remains a unique city, not comparable, out of the ordinary and out of every norm.

In the literature, we can find many debates about multiple re-construction phases of Beirut, which mainly refer to the Ottoman and French proposals of regeneration, in the after-effects of World War I (Bou Khaled, 2018; Kassir, 2010; Davie, 2001; Nasr and Verdeil, 2008; Larkin, 2009; Alaily-Mattar, 2008). Some authors argue that Beirut was mainly the result of the Ottomans urban planners, who were responsible for the first phase of Beirut modernization (Kassir, 2010; Davie, 2001). The Ottoman reshaping plan, called Tanzeemat (1830s-1910s), modernized Beirut's building norm and upgraded its infrastructure. Until the mid-19th century, Beirut persisted in being a small provincial Ottoman town, but later on, a series of governmental reorganization progressively changed its configuration. The urban migration from Mount Lebanon rushed the growth of Beirut, especially in the 1860s during the civil war between the Druze and Maronite population (Davie, 1991; Kassir, 2010; Saliba, 1998; Salibi, 1990).

After the World War I, the new capital was chosen by the French as the principal city of Lebanon, Beirut thus was recognized as the dominant regional trade centre, an international node for air-sea-land transport and communication, a prominent historical and touristic place and a dominant core for banking and professional services. The new condition of the Lebanese capital was the complex result of a broader cities modernizations framework (Sawalha, 2010; Hanssen, 2005) and the spread of new town colonial planning ideas. The demand to modernize the city indeed came from abroad, but it also met the wish of the Lebanese elites. The new urban projects in Beirut, completed by the end of the 19th century, also had the purpose of staging the new Lebanese nation (Verdeil, 2001; Nasr, 1999; Rowe and Sarkis, 1998; Al-Harithy, 2010; Ghorayeb, 1994). However, the political tension increased overtime to reach the 1975-1990 Lebanese war. Today the city development remains driven by the private sector with little monitoring by the State.

The first traces of human settlements in Kuwait date back to 6500 years BC to the first regional maritime commercials interactions and trade connections between Mesopotamia and Eastern Arabia. Kuwait City, located in the Persian Gulf, established its origin by trading with some eastern African regions and Indian coasts. The Kuwaiti territory was colonized in the 4th century BC by the ancient Greeks and later

on the city was part of Alexander the Great's Empire. In 224 AD Kuwait was under the rule of the Sassanid empire when the city was a famous port and fertile area frequented by the pilgrims and caravans as a resting place on the way from Mesopotamia to Arabian Peninsula. In the 18th century, Kuwait City became one of the most frequented trade centres in the maritime route with Constantinople, Baghdad, and Aleppo, and it remained a prosperous port until the nineteenth century. In the twentieth century, Kuwait City grew as one of the most important centres for commerce, pearling, and shipping in the Persian Gulf, and later on between 1946 and 1982, it became the most significant economic centre among the Middle East, by experiencing a period of prosperity called the 'golden era' (Fabbri, Saragoca and Camacho, 2018, 2016). At that time the Kuwaiti rich merchant families started a tradition of international cultural exchanges between Eastern and Western regions that grew rapidly in other countries.

With the end of the British protectorate, in 1961, Kuwait became independent by establishing a new constitution and the first parliamentary elections were held in 1963. Since the 1950s and until Kuwait was invaded by Iraq in 1990, Kuwait has witnessed an accelerated modernization growth thanks to the National Development Program (DP) that imposed the fundamental modern guidelines for planning and constructing the urban development. Many architectural ideas and technological inventions in the architectural field were imported from Western culture and adapted by British experts working abroad. The Kuwaiti urban planning institutions renewed the old master planning schemes and diffused the ideas of Modernity through the construction of many nation-building projects to represent the new growing middle class. The Kuwait City urban transformations and renovations were spectacular by adopting the innovative architectural and urban planning ideas to express the reached independence of the country and the establishment of a new Nation identity. During the 'golden era', many foreign and local architects exchanged ideas and collaborated in the construction of many relevant modern architectures.

Dominant Narratives of two Nation-building projects | Lebanon is a country with a disputed history, contradictory narratives, and a multitude of collective memories (Bou Khaled, 2018). The capital, Beirut, is a place where past and future events are intertwined, documented through told and untold stories, and the works of known and unknown people. It is so expected that its built environment, including a wide range of specimen architectural projects and memorial structures, do not reflect neatly its complex map of knowledge and cultural exchange nor represent precisely the project for building the nation. However, there seems to be a consensus that after its independence in 1943, Lebanon adopted a Liberal economy and instituted a relatively democratic political regime which attracted private enterprises, intellectuals and artists from around the region and the world fostering cross-cultural exchange and making Beirut a regional centre. While the country was observing this prosperous period also called the 'golden age', political elites and intellectuals have expressed a strong desire for modernity.

Talented Lebanese architects who have pursued their architectural studies abroad returned to their homeland and established numerous successful collaborations with foreign architects. This period is widely acknowledged for its maturity in terms of modern architectural development that was described as an 'assimilation' (Arbid, 2014) of the modern ideals in the local construction and praised for its commitment to social improvement through design. During this period, Kuwait was witnessing a restructuring of the state to overcome several challenges to the sovereignty of the country. Sheikh Abdullah Al Salam Al Salem opted then for modern reforms and capitalized on the revenues earned from the discovered oil as a mean to build a new capital city that represents his aspiration for an independent and modern state. This process was driven by the 1952 Development Program (DP) with an ambitious social, economic and political agenda for the entire country (Al-Ragam, 2015). The implementation of the DP heavily relied on the management of the British experts who imported their design and planning principles to an environment that is not familiar and a country they barely knew.

The adoption of the DP resulted in an unprecedented urban renewal and an expansion of the country's infrastructure creating numerous social and economic opportunities for the Kuwaitis and ensured the hegemony of the state over a heterogeneous society in an unstable region (Al-Ragam, 2015). A new architecture (also referred to as 'Al Imara al Haditha') that is radically different from the traditional vernacular construction emerged and soon became emblematic of the project for building the nation and the backdrop of the most dominant narrative in the history of Kuwait.

Literature review | The term narrative comes from a philosophical field that strands aside from architecture and urban planning. In the 20th century, many authors nurture a flourished discuss the concept of narrating the urban growth and development of modern cities through the comparisons of various disciplines such as sociology, philosophy, architecture and urban planning. The debate reached the highest level of contributions around the 70s, when many thinkers and philosophers in Europe, such as Henri Lefebvre (1996), Jean-Francois Lyotard (1984), and Kevin Lynch (1960) adopted the narrative as a strategic tool for analyzing, observing and interpreting the urban growth of modern and post-modern cities and the urban phenomena.

Recently Wachsmuth (2014) referred to this term to express the design intentions related to the dynamism of the urban space. In the contemporary cultural debate, the narrative is also interpreted as a tool to enhance the value of architectural design discipline. In this way, the architectural and urban narratives fully interact with design practices, by proposing new ideas that anticipate planning strategies inside the urban complexity, and also promote and stimulate new debates inside a cultural frame that usually lead to decision-making models through the formulation of innovative urban and architectural theories. As an instrument that operates on/with urban practices, the narratives fulfil various roles: on the one hand, they are methods for understanding the ongoing transformations in the city; on the other hand, they are approaches that work

as a social and cultural incubator activating transformative phenomena in the city while developing new urban strategies for it.

The methodology of research | A series of semi-structured interviews with family, colleagues, friends and collaborators were conducted to collect relevant accounts depicting the discourse on modern architectural production in Lebanon and Kuwait and to identify main tendencies, inspirations and ideologies that shaped the work of Architect Sami Abdul Baki. Previous interviews with the deceased architect, his biographical notes and academic thesis project were also considered as primary sources. Equal importance was attributed to the unbuilt projects, as they also do contribute to a better understanding of the ideas that were not so well-received by the public and of the struggle between the political elites/decision-makers as well as the architect's relation to them. A comparative analysis between relevant projects was developed based on photographs taken by the authors on-site or other visual documents while sketches and drawings did not constitute the primary method for the analysis.

Finally, seminal texts describing the historical evolution and the physical transformation of both Beirut and Kuwait were consulted to reconstruct the dominant narratives of modern architectural development in the region. The professional journey of Sami Abdul Baki and other anecdotes related to his education, commissions and personal relations were verified against these dominant narratives and conclusions with regards to whether they fit within these accounts or not as well as whether they have an impact on or are just submissive to the process of nation-building will be described in the results of this paper.

The case of Sami Abdul Baki | The absence of urban planning and architectural regulations in Beirut and the implementation of the Land Acquisition Program in Kuwait permitted extensive freedom of expression and experimentation during the 50s (Maskineh and Pedrazzoli, 2018; Alnajdi, 2014). Modern architectural production represented the architects' cultural backgrounds, talents, passions, and freedom in interpreting contemporary trends and experimenting with new materials and technologies. Authors of these projects are not all as famous as Antoun Tabet, Farid Trad, Joseph Philippe Karam, John Harris, Scott & Wilson, Ernst Von Dorp, Michel Ecochard and Sayyed Karim. Some are less known, and among these architects is Sami Abdul Baki, a Lebanese Druze architect who graduated with an MSc. in Civil Engineering from the American University of Beirut (AUB) in 1947 and who was able to seize important architectural opportunities in some of the most significant places in Beirut and symbolic of the new nation-state in Kuwait.

Politics, ideology and belief | Sami Abdul Baki was born in 1926 when the first Lebanese constitution was promulgated and modelled after the French Third Republic. He grew up in a wealthy and well-educated family from the mountains in Lebanon,

who strongly believed in an independent Lebanon within a unified Arab State. His father Mohamad Abdul Baki was an active member of Osbat Al ‘Amal Al Qawmi (which translates in English as the National Duty League), whose members explicitly fought against the mandate of the British and the French. He died in 1940, just a few years before Lebanon’s independence. In his biographical notes, Sami Abdul Baki puts forward his injury while carrying the New Lebanese Flag in the front rows of the demonstrations against the French during the independence marches in 1943 in Beirut. He enrols at AUB in the program of civil engineering this same year and graduates in 1947 within a rising concern of the administration towards Arab Nationalism and the promotion of the Pan Arab state in the country.

In his final year thesis supervised by Dr Khosrof Yeramian, Sami Abdul Baki clearly expressed his concern with regards to the new architectural language that was being imported from the west at the expense of ‘continuing past construction techniques and architectural forms’. His research focused on the evolution of residential palaces in Europe and the Middle East through which he expressed his interest in the new opportunities that emerged from new materials and technologies and argued that they have released the construction from the burden of thick masonry walls and enhanced the relationship between inside and outside. In the concluding chapter of his thesis, he describes his design of the New Palace of Baal in Ain Baal as a mixture between world tendencies and a ‘reluctance to abandon traditions of planning and architectural style’. It is thus important to situate Abdul Baki’s thesis in the context of the architectural discourse development in Beirut at the time to better understand his position.

Since the declaration of greater Lebanon, the new state has been seeking a new identity to represent the modern nation that is independent of the Ottoman Empire. There seemed to be a consensus that modern architecture is a good and acceptable representation of this national aspiration. While some have argued that in the 1950s a balanced coexistence between modern and traditional construction was achieved through the oversimplification of details and exposed structure also described as a process of ‘assimilation’ (Arbid, 2014), others considered modern architecture to stand as a reminder of the French colonial period that preceded the independence and symptomatic of Lebanon’s dependency on and attachment to the West. It is very probably that Sami Abdul Baki’s political affiliation and ideological beliefs resulted in him siding for those who were willing to develop an Arab national identity and incorporate regional styles in architectural projects.

Trends and influences | Sami Abdul Baki’s professional practice mostly flourished in the 1950s when he was active both in Lebanon and in Kuwait. His journey naturally started in Lebanon where he was commissioned several projects in the most significant places of the city and/or sitting on highly visible sites. While these projects are not comparable in terms of construction techniques, craftsmanship and character they stand out because of their inspiration from other architect’s work and close reproduction of

iconic architectural forms (Fig. 1). One of Sami Abdul Baki's earliest commissions was a vacation house for businessman Chaffic Qassem. The project is located on a beautiful plot by the sea and along the main coastal road linking Beirut the capital to the south. It is referred to as the Umbrella by the residents of the area, about its pure concrete geometric shapes, and is believed to be a replica of an Italian villa that the client has visited during his trips to Europe. In fact, the project was completed in 1953, one year after architect Ferdinand Dagher completed a Chalet for Dr Raja Saab in Acapulco beach on the southern coast of Beirut. The similarity between the two projects in terms of location, program, as well as architectural language, is remarkable! It is important to note that the project designed by Dagher was considered to be an icon of modern architecture at the time and represented the new desired lifestyle of the country's elite. Interestingly, one of the surviving relatives of Sami Abdul Baki's first client mentioned that the Qassem family held numerous social events and extravagant parties in the Villa.

Another project designed by Sami Abdul Baki during his early years of practice was a centre for the Druze community in Beirut on an elevated site overlooking a large portion of the city. The project was initiated by Sheikh Al-Akl Mohammad Abou Chacra, one of the most inspiring figures of the Druze community who sought to unify its different factions and build its institutions. In the absence of any reference or design guideline for a Druze place of worship or prayer, Sami Abdul Baki could express his interpretation freely. While the interior organization of spaces and the circulation inside the building did not reflect any clear strategy or quality, a great deal of attention was given to the design of the two facades facing the main roads.

The revival of the classical order was clearly expressed through the repetition of modernized classical elements and their perfect symmetry which was not reflected in the layout of the plan. The monumental facades casted an overwhelming presence on top of the hill and communicated with a language of pride and control with its surrounding. Other projects built around the same time in Lebanon such as the building of the National Museum, the UNESCO palace and the Jaffet Nami Library at AUB, and abroad such a many Fascist and Nazi buildings, the Palais de Tokyo and the Palais de Chaillot in Paris, have also used a similar language and better integrated it within the overall design. Whether the revival of the classical order was inspired by these projects representing a nationalist culture or simply a common architectural trend at the time, the design of the Druze community centre certainly did not seek any origin or influence from the mountains or the traditions of the Druze community.

Similarly, the proposal for the martyr's square memorial designed in 1953 by Sami Abdul Baki – also president of Osbat Takrim Al Shouhada' (the league for the commemoration of the martyrs), exhibited similar tendencies and was inspired by other iconic projects namely the Arch of the Empire designed by Ludovico Quaroni and the

Fig. 1 | Sami Abdoul Baki's projects: proposal for Martyrs Square Memorial, Villa Chaffic Qassem and Druze Community Centre (credit: Authors, 2019).

Missouri Gateway designed by Saarinen. The project won the first prize in a competition and was never executed partly because of its over-ambitious design and the difficulty of its execution but also because it did not really meet the expectation of the public. In fact, both the revival of classical style and the new modern forms in the representation of their national identity did not appeal to the Arab nationalists nor to the other group that was supposedly more tolerant towards the west.

Projects in Lebanon during the 1950s often looked at the future expressing technical or spatial properties and were very conscious of their modernity. This modernity was to provide all aspect of modern social life in addition to guaranteeing the best image for the nation-state. Unfortunately, it is repeatedly interpreted in its aesthetic dimension and opposition to the traditional. While some architects were convinced that they were breaking new grounds with their exploration and that their search would promote a new lifestyle and lead to social improvement and eventually spread the ideals of social justice, they very often created otherness rather than a homogeneous core.

Personal Relations and Business | Sami Abdul Baki mastered six languages which facilitated his studies and travel abroad and helped him establish business collaborations with foreign partners. In fact, after he graduated from AUB in 1947, Sami Abdul Baki pursued a Master degree in Heidelberg University in Germany between 1953 and 1956. While most of his fellow student colleagues have opted to go to France or the United States for their more advanced studies, Sami Abdul Baki thought that Germany was a more 'natural' ground for him. In an interview with George Arbid in 1998, Sami Abdul Baki said that it was not his first time in Germany and that he held strong ties there. One of his relatives mentioned that his father who was active during the quest for the independence of the country in the middle of the 30s also had a network of connections in Germany. Correspondence between him and Hitler was also mentioned but no record of or more details about it was provided. During his stay in Germany, Sami Abdul Baki claims that he has partnered with the famous German Architect Ernst Von Dorp, based in Bonn, and delivered several projects together of which the Embassy of the Federal Republic of Germany in Rio de Janeiro in 1956 and other residential and institutional projects in Bonn.

In the meantime, Kuwait was witnessing an unprecedented urban renewal and building its institutions led by British experts. This period coincided with the Nakaba and the subsequent rise of Arab Nationalism. Sheikh Fahd Al Salem Al Sabbah, who was the President of the board of development and known for his opposition to the ruler and the British interventions in Kuwait, appointed the brother of Sami Abdul Baki – Fouad, as an inspector general at the public works department in 1953. One year later, Shaikh Fahd was also able to shift the development politics of the country in favour of Kuwaiti contractors and Arab experts. Both events created a favourable environment for Sami Abdul Baki to capture important commissions for governmental building in Kuwait namely the Municipality complex and the Ministry of Information and guidance.

The Municipality complex was the tallest structure in Kuwait when it was delivered in 1959. Although it housed the seat of the National Assembly and became Kuwait's national symbol after the country's independence in 1961, the project was mostly recognized for its state of the art construction technologies characterized by its reinforced concrete structure, underground parking, the latest mechanical engineering systems and curtain wall façade covered with a densely articulated pattern. The Ministry of Information and Guidance, delivered in collaboration with Ernst Von Dorp, was also characterized by its adoption of the international style. It was characterized by a volumetric mass floating on pilotis, repetitive and modular sun breakers on its façade and a canopy on the rooftop that departs from the main geometry of the building. Both projects were featured on the cover of Arab newspaper and magazines as a symbol of the Arab pride and development. Despite the highly symbolic significance of these projects they mostly reflected an international approach to architecture.

There is a general consensus among theorists that the process of modernization cannot be dissociated from the West (Gaonkar, 2001) and that there is very often an explicit link between modernity and nation-building. The case of Kuwait is an excellent example of this 'catching-up' process through which the symbols of the Nation adopts forms and material from the West that are deemed capable of projecting the image of a modern nation and society (Al-Ragam, 2015). However, nuanced reading of the stakeholders and the circumstances of the commission of both the Municipality and the Ministry of Information projects to Sami Abdul Baki could lead to a slightly different conclusion. The blunt adoption of modern forms and principles is highly symptomatic of a deeper identity crisis between the different factions of the Kuwaiti elites. This statement is also an assertion of Peter Osborne's argument that 'the problematic of the modern purely applied, can help replace the problematic of national culture' (Osborne, 2000).

On this note, it is important to mention that Sami Abdul Baki was not commissioned any new project in Kuwait after the sudden death of Shaikh Fahd in 1959. During his active years in Kuwait, Sami Abdul Baki participated in several activities that go beyond his technical expertise. In fact, his negotiation skills and quality as a moderator along with his strong political connections allowed him to participate to many important petroleum-related negotiations between the state of Kuwait and other oil-producing countries before the establishment of OPEC. In parallel to his accomplishments in Kuwait, he also served as the honorary consul of Costa Rica in Lebanon for twenty-three consecutive years and run for the parliamentary elections in Lebanon twice in 1960 and 1964 as an independent candidate.

Conclusions | Sami Abdul Baki produced a range of eclectic architectural projects that occupied significant places in the city both in Lebanon and Kuwait during the peak of modern architectural development. These projects presented contrasting architectural languages, and sometimes contradictory ideological discourses. They were highly in-

fluenced by trending forms, techniques and expressions and were often associated with other architects' work. The paper attempts to describe these works in a visual comparative diagram (Fig. 2). The paper also asserts that modern architectural development in Lebanon in Kuwait is dictated by dominant or single narratives attributing it to their process of nation-building, sometimes describing it as being 'assimilated' by the local culture and in other instances representing a strong affiliation to the West. Through the case of Sami Abdul Baki, this paper argues that despite the dominance of these grand narratives, an account of parallel micro-narratives does exist and can contribute to a better understanding of the complex context of the two countries.

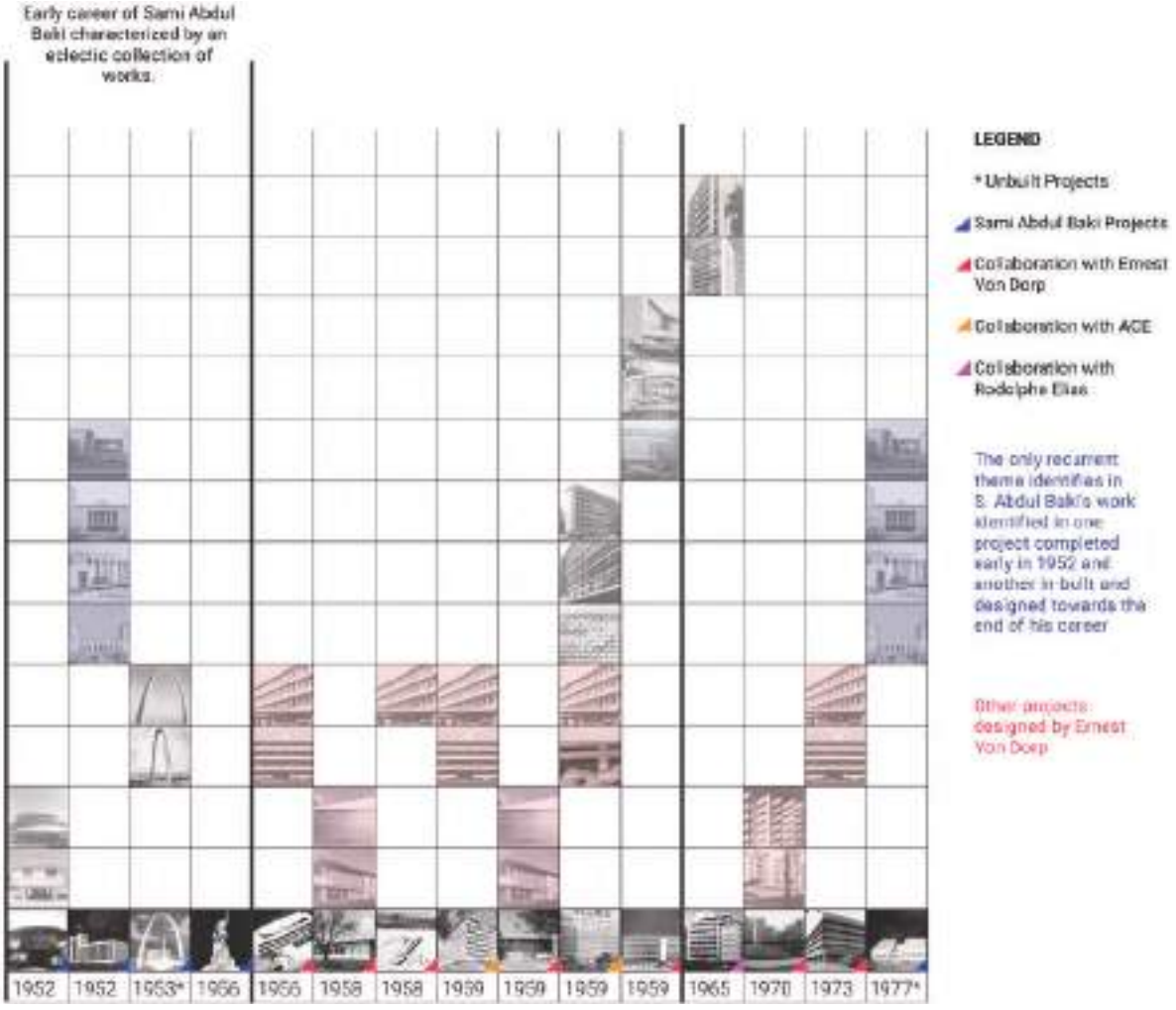


Fig. 2 | Comparative analysis of Sami Abdul Baki's projects (credit: Authors, 2019).

BEFORE		Sami Abdul Baki's projects		AFTER
The rise of Arab Nationalism Discourse on building national identity in Lebanon Discourse on regional architecture Revival of classical order in Europe and Lebanon Institution building in Lebanon	1947	**The palace of Baal in Ain Baal**		Assimilation of modern principles in Lebanon
Assimilation of modern principles in Lebanon Discourse of new lifestyle Italian/European Architecture as a role model	1952	**Villa Chaffic Qassem**		Lifestyle associated with modern construction
Assimilation of modern principles in Lebanon Discourse on building national identity in Lebanon Revival of classical order in Europe and Lebanon Institution building in Lebanon	1952	**Druze Community Centre**		Modern architecture in the representation of religious Institutions in Lebanon
Assimilation of modern principles in Lebanon Revival of classical order Bitterness towards the Ottoman period Discourse on confessional unity in Lebanon	1953	**Martyrs Square proposal**		Intolerance for new forms as part of Lebanese National identity
Kuwait modernization led by the British	1956	**Municipality Complex**		National Identity crisis
The rise of Arab Nationalism				Nostalgia about tradition construction
Resignation of British Political Agency				Project commissions to Arab consultants and contractors
Shift in the development of politics in Kuwait				In the flux of German Technical consultants to Kuwait
First Curtain Wall application in Beirut				Kuwaiti Sheikhs Architectural commissions in Lebanon
Kuwait modernization led by the British	1958	**Ministry of Information**		National Identity crisis
The rise of Arab Nationalism				Nostalgia about tradition construction
In the flux of German Technical consultants to Kuwait				Project commissions to Arab consultants and contractors

Tab. 1 | Narratives and micro-narratives framing Abdul Baki's work (credit: Authors, 2019).

While many have argued that modern architecture was adopted as an ideological tool for the promotion of political, social and economic changes, we believe that in many cases modern architecture was accepted without any prejudice, as an alternative to the past and representing a pure desire for innovation, novelty and avant-garde culture. In some other cases, modern architecture was simply rejected because of its affiliation to the West and the premises it promoted. The survey of Abdul Baki's work presents a good example of the disparate and sometimes conflicting narratives that described the development of modern architecture in Lebanon and Kuwait. These narratives not only describe the works of the architect themselves but can better describe the local circumstances, the interaction between the different stakeholders and the influences and trends that were circulating in a specific context. Narratives as thus are considered to be an efficient interpretative and investigative tool in understanding urban interventions and architectural manifestations.

Finally, by framing Sami Abdul Baki's work with the different narratives that coexisted at the time, this paper argues that these stories in some cases preceded the work of the architects and influenced it but in other cases, they might have emerged later as a reflection to it and other architect's work (Tab. 1). We believe that more research shall be conducted on the use of narratives in the analysis of the architecture and urban planning disciplines. We also think that more case studies should be undertaken in a context such as Lebanon and Kuwait to better reconstruct the circumstances that led to the development of modern architecture in the Middle East.

Acknowledgements

The contribution is the result of a common reflection by the authors who would like to acknowledge the support of LAU Lebanese American University for creating an environment that encourages research, and to express gratitude to professor George Arbid and Claudine Abdelmassih, at ACA Arab Center for Architecture. Special thanks to Abdul Baki's family members, friends and colleagues, to Ricardo Camachio, Sabah Al Rayess and Aabah Abi Hanna for their support. The paper has been based on the critical consultation and analyses of the author's drawings, writings and documents, available at the ACA Arab Center for Architecture in Beirut.

References

Al-Harithy, H. (ed.) (2010), *Lessons in Post-War Reconstruction – Case Studies from Lebanon in the Aftermath of the 2006 War*. Routledge, London.

Al-Ragam, A. (2015), "Critical nostalgia: Kuwait urban modernity and Alison and Peter Smithson's Kuwait Urban Study and Mat-Building", in *The Journal of Architecture*, vol. 20, issue 1, pp. 1-20.

Alaily-Mattar, N. (2008), "Segregation for aggregation? Detachment and concentration in networked nodes of affluence in the city of Beirut", in *Urban Design International*, vol. 13, issue 4, pp. 263-271.

Alnajdi, A. A. (2014), *Shaikh Abdullah Al-Salim Al-Sabah, 1985-1965*, Doctoral thesis, University of Texter. [Online] Available at: core.ac.uk/download/pdf/43093612.pdf [Accessed 19 May 2020].

Arbid, G. (2014), *Architecture from the Arab World: 1914-2014 (a selection)*, Ministry of Culture,

Manama-Kingdom of Bahrain, Bahrain.

Bou Khaled, M. (2018), *Contested history, conflicting narratives, and a multitude of initiatives – An analysis of the Mapping of Initiatives addressing Past Conflicts in Lebanon*, Civil Society Knowledge Centre, Beirut. [Online] Available at: doi.org/10.28943/CSKC.002.60001 [Accessed 19 May 2020].

Davie, M. (2001), *Beyrouth 1825-1975 – Un siècle et demi d'urbanisme*, Ordre des ingénieurs et architects de Beyrouth, Beirut.

Davie, M. (1991), "Demarcation Lines in Contemporary Beirut", in Schofield, C. H. and Schofield, R. N. (eds), *The Middle East and North Africa – World Boundaries Volume 2*, Routledge, London.

Fabbri, R., Saragoca, S. and Camacho, R. (2018), *Essays, Arguments & Interviews on Modern Architecture Kuwait*, Niggli, Salenstein.

Fabbri, R., Saragoca, S. and Camacho, R. (2016), *Modern Architecture Kuwait 1949-1989*, Niggli, Zurich.

Gaonkar, D. P. (ed.) (2001), *Alternative Modernities*, Duke University Press, Durham.

Ghorayeb, M. (1994), "L'urbanisme de la ville de Beyrouth sous Mandat français", in *Revue des mondes musulmans et de la Méditerranée*, vol. 73-74, pp. 327-339. [Online] Available at: doi.org/10.3406/remmm.1994.1685 [Accessed 5 June 2020].

Hanssen, J. (2005), *Fin de siècle Beirut – The Making of an Ottoman Provincial Capital*, Oxford University Press, Oxford.

Kassir, S. (2010), *Beirut*, University of California Press, Berkeley (US).

Larkin, G. (2009), "Reconstructing and Deconstructing Beirut: Space, Memory and Lebanese Youth", in *Divided Cities/Contested States*, Working Paper n. 8, University of Exeter. [Online] Available at: www.conflictincities.org/PDFs/WorkingPaper8_21.5.09.pdf [Accessed 5 June 2020].

Lefebvre, H. (1996), *Writings on Cities*, Wiley-Blackwell, Oxford.

Lynch, K. (1960), *The Image of the City*, MIT Press, Cambridge.

Lyotard, J.-F. (1984), *The Postmodern Condition – A Report on Knowledge*, Manchester University Press, Manchester.

Maskineh, C. and Pedrazzoli, R. (2018), "Fossil Beirut. A Case of Vernacular Modern Architecture (1943-1975)", in *Journal of Comparative Cultural Studies in Architecture*, vol. 11, pp. 14-24.

Nasr, J. (1999), "Reconstruction", in Huybrechts, E. and Douayhi, C. (eds), *Reconstruction et réconciliation au Liban*: *Négociations, lieux publics, renouement du lien social*, Presses de l'Ifpo, Beirut, pp. 13-21.

Nasr, J. and Verdeil, E. (2008), "The reconstructions of Beirut", in Jayyusi, S. K., Holod, R., Petruccioli A. and Raymond, A. (eds), *The City in the Islamic World*, Handbook of Oriental Studies, Brill, Leiden, pp. 1121-1148.

Osborne, P. (2000), *Philosophy in Cultural Theory*, Routledge, London.

Rowe, P. and Sarkis, H. (eds) (1998), *Projecting Beirut: Episodes in the Construction and Reconstruction of a Modern City*, Prestel Pub, Munich.

Salibi, K. (1990), *A House of Many Mansions – The History of Lebanon Reconsidered*, University of California Press, Berkeley (US).

Saliba, R. (1998), *Beirut 1920-1940 – Domestic Architecture Between Tradition and Modernity*, The Order of Engineers and Architects, Beirut.

Sawalha, A. (2010), *Reconstructing Beirut – Memory and Space in a Postwar Arab City*, University of Texas Press, Austin.

Verdeil, É. (2010), *Beyrouth et ses urbanistes – Une ville en plans (1946-1975)*, Presses de l'Ifpo, Beirut.

Wachsmuth, D. (2014), "City as ideology: reconciling the explosion of the city form with the tenacity of the city concept", in *Environment and Planning D: Society and Space*, vol. 32, issue 1, pp. 75-90. [Online] Available at: doi.org/10.1068/d21911 [Accessed 05 June 2020].

Publishing Series in PROJECT | Essays and Researches
From Mega to Nano
The Complexity of a Multiscalar Project
vol. 04 | 2020 | paper 8 | pp. 138-153

ISSN (print): 2704-6087
ISSN (online): 2704-615X
ISBN (print): 978-88-5509-188-6
ISBN (online): 978-88-5509-189-3

EXPERIENTIAL TOURISM
Research, experimentation and innovation

Paolo Carli, Roberto Giordano, Elena Montacchini, Silvia Tedesco

section
ARCHITECTURE

typology
RESEARCH & EXPERIMENTATION

DOI
doi.org/10.19229/978-88-5509-189-3/482020

ABSTRACT
The aim of the experience developed within Alta Scuola Politecnica, in collaboration with the world of industry, was to simultaneously implement research and teaching, through experimentation and prototyping to identify new solutions and answers to the real problems of tourism and its most recent evolution into 'experiential tourism'. A description of the experience and an assessment of the results achieved (in terms of research, production and academic education – highlighting the potential of a multiscale approach to the management of complexity – is part of the debate on the role of Universities in training and research and on synergies with industry, seeking to provide answers to the following questions: How can the quality of higher education and research activities in Universities be guaranteed, while working towards their practical application? How can we promote the ability to make the most of the meeting between supply and demand for innovative knowledge and technologies?

KEYWORDS
systemic approach, innovativation, research, experimentation and prototyping, experiential tourism

Paolo Carli, Architect and PhD, is a Researcher at the Department of Architecture and Urban Studies at Politecnico di Milano (Italy). He carries out research activities mainly in the field of environmental design on an urban scale and buildings. E-mail: paolo.carli@polimi.it

Roberto Giordano, Architect and PhD, is an Associate Professor at the Department of Architecture and Design at Politecnico di Torino (Italy). He carries out research activities mainly on issues related to the design, production and assessment of the eco-compatibility of building products. E-mail: roberto.giordano@polito.it

Elena Montacchini, Architect and PhD, is an Associate Professor at the Department of Architecture and Design at Politecnico di Torino (Italy). She carries out research activities mainly on issues related to environmental sustainability, the rational use of resources, and the health and safety of users. E-mail: elena.montacchini@polito.it

Silvia Tedesco, Architect and PhD, is a Researcher at the Department of Architecture and Design at Politecnico di Torino (Italy). She carries out research activities mainly within the sphere of the experimentation and prototyping of innovative building products. E-mail: silvia.tedesco@polito.it

Tourism has always stood in opposition to the productive model of society. Despite having always existed to some extent, in the twentieth century and this initial phase of the new millennium, we have witnessed its rebirth in the modern sense, its transformation from being an elitist phenomenon to something available to the masses, its commercial development, and its further diversification. More importantly, we have also witnessed the transformation of 'travellers' into 'tourists' (d'Eramo, 2019). The trajectory of the transformation of travel into tourism runs parallel to that of the economic and productive development of Western society. In other words, it has led to an almost compulsive increase in tourism opportunities, to the detriment of environmental resources, and often the quality of tourist products (poor-quality package holidays for example). As time has gone by, however, tourism has diversified its production, allowing a wide range of choices of destinations, accommodation, activities, and above all quality.

Tourism also has numerous ties with both territorial and architectural design, in a transversal and trans-scalar way, making it a subject with extensive scope for research: from the design of long-distance infrastructures to territorial development plans, from the design of hospitality and service facilities to the design of the services to be provided. This last aspect, relating to the integration between the hospitality facilities and the experiences offered to the traveller-tourist, has been the subject of further investigation by Let'Set: a challenge-driven practical teaching activity and research-action (Cognetti, 2016), offered by Alta Scuola Politecnica (ASP), with the cross- disciplinary participation of researchers, teachers and selected students from Politecnico di Torino and Politecnico di Milano, and the active involvement of professionals and the world of industry.

Experiential tourism: new temporary living models | Mass tourism is by no means approaching its end, yet the habits of tourists have changed, especially when it comes to the amount of time and money they can spend (Albanian, 2013). As the time that people can devote to holidays has decreased, their spending power had grown, steering tourism initially towards exotic destinations and then, when these became exhausted, partly due to the international geopolitical situation, towards tourism which is more aware of both the environment and local cultures. This trend was highlighted by a TripAdvisor survey carried out in 2014 (Booking Blog, 2020) and aimed at its users. According to the data collected, 71% of those interviewed travel 'to broaden their horizons', 36% 'to soak up the local culture' and 55% 'to have a unique and interesting experience'. Similarly, it is worth mentioning a study published by the Journal of Consumer Psychology which explains how the experience of travel makes people happier and more satisfied than the purchase of material goods (Gilovich, Kumar and Jampol, 2015). This opinion is shared by Brian Chesky, CEO of AirBnB, the online portal that connects supply and demand for short-term accommodation, who says that the vast majority of new generation tourists (Millennials) prefer to spend money on an experience than on material goods (Kutschera, 2019).

Talking about AirBnB, the sharing economy has contributed massively to the rapid transformation of tourism in recent years. The possibility for people with 'extra space'

to enter the global accommodation market has transformed the very meaning of tourist accommodation, taking it outside traditional hospitality structures, which are separate and clearly identified within the building heritage, and into the heart of the various territories, into people's homes and right into the depths of different cultures. The combination of the elements highlighted is that there is now a segment of tourism that responds to the name of 'experiential tourism', a form of tourism characterized by four main factors, which allow a taxonomy unencumbered by the issues related to the geographical destination. According to Moreschi (2017), these are: 1) short duration of stay, 2) fullness of the experience, 3) close interaction with tradition and local ways of life, whatever they may be, 4) attention to the conservation of the territory and the environment.

From the point of view of the new 'living models' linked to accommodation and hospitality, experiential tourism represents a unique opportunity for design and innovation, for professionals and companies involved in this sector, because it allows the imagination of temporary and flexible scattered solutions with a low environmental impact, solutions that can be adapted as and when necessary to suit the requirements of incoming travellers-tourists. It also allows the same flexibility in terms of the business models and activities that can be pursued, allowing entrepreneurs, especially young people, to enter the market with less capital than is needed in traditional tourism services related to the hotel model.

Let'Set: a challenge-driven project | The context described above is the perfect container for Let'Set – Choose, Build, Experience – a project with a title that encompasses the intention to propose the organization of a tourism model that responds to the challenges of: 1) identifying key areas for innovation; 2) formulating activities interconnecting teaching and research; 3) defining a new community of users; 4) designing spaces and managing a program of tourism; 5) process and product innovation. Four points related to a challenge-driven approach which consist of a set of processes, business rules, workflows, tools and principles that provide a framework and methodology for innovation based on diversity, to identify problem areas and targeted opportunities and to develop solutions (Bellini et alii, 2018). An approach that is unusual in architectural design alone, but extremely contemporary when the design of an inhabited space is strongly interconnected with other factors, such as the design of the tourism service, the identification of a proposal characterized by value (what kind of service is offered and what makes it unique) and the management of visitor flows. Starting with the assumption that tourism is the most important industry of the century, both the last one and this (d'Eramo, 2019), and that it is also a sector in perpetual evolution (Gemini, 2008), the Let'Set team decided to investigate the transformation of tourists in recent years and, above all, of their requirements and willingness, particularly with regard to accommodation.

Goals and key areas of innovation | The theme of experiential tourism has been an opportunity for research, experimentation and innovation to identify new solutions and new responses to market demands. The general aim of the project consisted in the de-

velopment of a new service for experiential tourism, involving the design and construction of spaces for temporary accommodation characterized by technologies that can be easily assembled, disassembled and transported, made with easily interchangeable materials and components, in order to ensure the most effective adaptation to different geographical and climatic contexts (seaside, mountains, cities). Thanks to its flexibility and adaptability, the technology, or rather the technological dimension of the project, offers 'tourists' tailor-made hospitality services consistent with their need to enjoy unique experiences in the place they are visiting.

The challenge was launched, together with the ASP research group, by the project's partner company, LAM Ambiente Srl (Arezzo). A company active in the field of dry-assembled buildings for residential use, intending to expand its reference market. This led to a specific goal, which defines the area of innovation addressed by Let'Set: the design of small modular units that can be adapted and integrated according to a receptive model based on the scattered hotel. Living spaces that are not ready-made, to which the user adapts, but spaces that are created virtually, associating a framework of requirements with possible solutions, and then built in one of the places destined to the tourism experience. In order to fulfil the aims described, the Let'Set's team involved a wide range of professionals who work in the tourist hospitality sector: architects Paolo Scoglio and Alessandro Trevisan, hospitality companies such as Eco Bio Agriturismo La Bella Vite – Camere Con Vigna in Carpeneto (Fig. 1), and of course LAM Ambiente, which has consolidated experience in the residential and tourism construction sector.

Fig. 1 | Eco Bio Agriturismo La Bella Vite – Camere Con Vigna in Carpeneto – The Ne[s]t Living Studio (credit: Let'Set, 2019).

Definition of the reference contexts | The identification of different landscape and climate contexts (seaside, mountain, city), was based on a characterization of current tourism trends in Italy. Seaside tourism in Italy is a growing sector: research carried out by the CNA Balneatori Association (2017), among the 457 owners of bathing establishments in 59 Italian coastal areas, shows that between June, July and August of that year there were about 90 million visitors, +16% from the 75.6 million of 2016. Recent research carried out by the Mountain Tourism Observatory of the Valle d'Aosta on data provided by the Valle d'Aosta Regional Tourism Department, relating to presences and arrivals in 2018, shows that 'desire to spend time in the mountains' has also grown: recording 20% more arrivals and 11% more presences than just 10 years ago (Valle d'Aosta Tourism Observatory, 2018). Lastly, the growth trend for presences or interest in staying in certain places also concerns tourism in the small and characteristic Italian towns.

The following were carried out for each context: an analysis of the main climatic variables, referring to the typical climatic conditions of the Mediterranean, Alpine, and continental environments; a hypothetical orographic characterization of the soils; a survey of the prevailing type of vegetation. A geographical and climatic reference environment was also identified, in which to subsequently define specific places, in order to analyze the most appropriate design parameters for the application of a receptive model based on the 'scattered hotel'.

The identikit of a new user community | To create an identikit of the users, reference was made to the demand-performance approach, starting with the definition of the characteristics and activities sought by 'new tourists' in accommodation facilities, identifying their needs within a planning framework for tourism based on specific guidelines. A careful study of the literature available and a series of direct surveys, through questionnaires, made it possible to analyse experiential tourism trends in terms of supply and demand and to establish the characteristics of the user (or users) of reference. Data gleaned from literature data revealed the following trends.

Beach tourists are mainly represented by families or groups of friends (L'Osservatorio Findomestic, 2019) two categories which clearly have different expectations, but which are, nevertheless, united by the search for high-quality spaces and recreational activities; the average stay is 7 days. Mountain tourists, on the other hand, have been represented in recent years by families with children (53.1%), who mostly seek environments capable of decisively opposing their chaotic and stressful workplaces. Families are looking for environments that can express a concept related to well-being, the environment and personal care, from body treatments to nutrition. The average stay is estimated to be around 5.2 days (Osservatorio Turistico Valle d'Aosta, 2018). Lastly, tourists looking for experiences in cities are extremely heterogeneous (students, families, couples, singles, the elderly, etc.); the average stay is 5.5 days, ranging between 4 and 7, depending on the type of city (big, medium or small) and the type of services it offers (the city with artistic vocation, the city with industrial vocation, the city with a vocation

for services). In small Italian towns, it is increasingly common for people and families to stay for even just for one night (Baldazzi, 2014).

Parallel to the indirect analysis of the data found in literature, direct analyses were carried out using a questionnaire. The direct analysis aimed to reconstruct the framework of the activities and behavioural patterns of tourists by identifying their habits and outlining the type of experience they expect from their trip, based on their specific destination (seaside, mountain, city), in order to contribute to the complete definition of the framework of demand. Google Forms, a tool that enables the performance of online surveys, was used to carry out the questionnaire. The social networks and WhatsApp were used to promote the survey, conducted in Italian and English, making it possible to reach all the contacts available to the team. The survey consists of eleven questions aimed at investigating the age of the respondent, the number and type of travelling companions (friends, relatives, children, colleagues, etc.), preferred/usual destinations, length of stay, the purpose of the trip (culture, leisure, business, etc.). The respondent is also asked to assess, on a scale of 1 to 5, the importance of contact with nature during the stay and to select three essential services, from a list of options, that an accommodation facility should have. The questionnaire received 220 responses and the majority of respondents are between the ages of 35 and 45. In general, the results are in line with the conclusions drawn from the analysis of literature (Fig. 2).

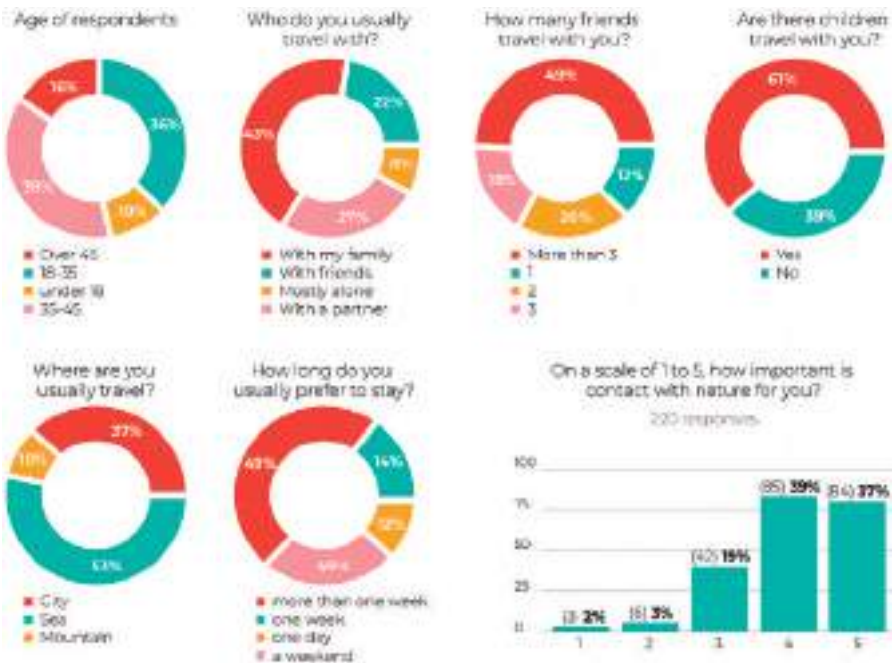


Fig. 2 | Results of the questionnaire on tourist behavioural models (credit: Let'Set, 2019).

Fig. 3 | Example of a community of users who intend to take a few days' holidays. The figure is divided into three sections: Needs, which identifies the necessities in brief; Requirements, which establishes the living space requirements; Solutions, which defines the project guidelines (credit: Let'Set, 2019).

Families represent the main category of tourists, tending to consist of mother and father and 1-2 children. Friends also travel in small groups, usually in 3-4 or more people. Another confirmed figure regards the average stay, which was about one week, or a little less, while the percentage of those who decide to spend more than one week on holiday is 49% of the total. Depending on the type of experience that new tourists expect from their trip, it emerged that contact with nature is an essential value, together with the desire to relax in a peaceful environment. The data emerging from the indirect and direct analyses have been summarised in a series of identikits of tourists – i.e. the user community – to which the project guidelines are associated (Fig. 3).

Case study analysis | In order to further characterize the user community, a phase of the Let'Set project focused on the collection of case studies compliant with the environmental and climate contexts defined. In line with the general aims of the project, the case studies were selected based on geographical, climatic, morphological, distributive and constructive criteria responding as closely as possible to the needs of the new user community. For experiential tourism by the sea, for example, the two main demands that emerged from the surveys and the main features of the collected case studies are a sea view and the articulate use of outdoor spaces. From this point of view, the Hut On Sleds project by Crosson Clarke Carnachan Architects in New Zealand in 2007, where the wooden shading system of the main façade creates a roof over the space in front of

the living module when it is open, enhancing the view allowed by the double-height interior space (Frearson, 2012), was emblematic. As was the experimental Koleliba mini house (measuring just 2.4 meters long) created by Hristina Hristova in 2005, with the addition, alongside the project's aim to create a natural visual and material connection between interior and exterior, of the theme of transportability (Tebbutt, 2015).

As regards the mountains, the focus was on attachment to the ground, as these minimum living modules are often similar to shelters and are built-in inaccessible places. These structures have to be designed to withstand avalanches and landslides, as well as the change in stability and compactness of the soil due to climatic fluctuations between winter and summer. Most importantly of all, they have to be able to tackle the problems of transport to and assembly at high altitudes. Based on these points of view, the case study of the New Gervasutti Shelter is emblematic: the module, designed by Luca Gentilcore and Stefano Testa, is part of the LEAP (Living Ecological Alpine Pod) project and was built in 2011 above Courmayeur (AO) at an altitude of 2,835 meters above sea level. It is a cantilevered tube measuring 8.00 x 3.40 x 2.40 m, for a total of 30 square meters, which was entirely prefabricated, transported (when it was practically finished) and installed with the help of a helicopter (Frearson, 2011).

Another project which is important for research purposes is the Alpine Shelter in Skuta, designed by the architects OFIS and AKT II, with the support of a team of students working within a teaching module of the Harvard Graduate School of Design, in 2014 in Slovenia. In this case, the attachment to the ground adapts to different slopes in the project area, as the module was divided into three parts to simplify transport and subsequent assembly, respect the variation of the slopes and separate the interior functions.

The case of urban experiential tourism, on the other hand, differs from the previous two, as the dimension of 'slow tourism', which often coincides completely with experiential tourism, is partially missing here. Of course, urban experiential tourism is always about participating in different ways of life, but this is why it also encompasses the concept of business travel and short breaks. In this context, the most relevant characteristics found in the case studies investigated are those of architectural parasitism and scattered hospitality. The Loft Cube designed by the Berlin-based studio Aisslinger in 2016 is one of the most successful experiments in this field. Located on top of the Hotel Daniel in Graz, it is completely prefabricated, with a structure so light that it can be positioned on the roof, in strategic points to offer a view of the city.

Although designed for stable forms of housing, the 3BOX project by Stéphane Malka Architecture, created in 2016, is also a very interesting case study to explore the theme of hospitality in cities, starting with the role that roofs can play in terms of minimizing ground consumption and technological integration (Paragoy, 2016). In this case, too, the modules are built off-site, then transported and put into operation quickly, thanks in part to the technical consultancy work of the experts from Les Toits du Monde.

Workshop for the design and construction of the modules and management of

tourism | In the logic of combining theory and practice, academic education and research, and in line with goal 4 of the Challenge-Driven approach – Designing an Appropriate Tourism Offer, the team physically tried to 'inhabit' four small buildings in the middle of a vineyard at Eco Bio Agriturismo La Bella Vite in Carpeneto (Alessandria, Piedmont), in close contact with nature. The modules, created by The Ne[s]t Living Studio, are the result of the partnership between the architectural studio and the owner of the winery, who also owns the land on which they stand. The small houses allow travellers to spend a night in the vineyard and the experience offered during their stay includes trying their hand at winemaking, a visit to the winery and the grape harvesting itineraries, as well as the chance to taste the estate's wines and local products.

The countryside and vineyards, elements that characterize the territory, enter the holiday homes, distinguished by solutions that enhance the panoramic views and incorporate the vegetation into the design: an outdoor terrace, shared by different modules, becomes a unifying element, a space in which to relax and contemplate the landscape; a glass façade frames the vineyard directly from the bedroom; a tree becomes an essential part of the housing module, by which it is incorporated and enveloped.

Metadesign | The Carpeneto experience provided an opportunity to create the first Let'Set workshop aimed at studying the morphological-dimensional aspects of the buildings, along with the interior layout and the arrangement of the modules in relation to one another. The workshop also analysed the technological characteristics of the envelope elements and the technological systems, in relation to the microclimatic conditions of the site (Figg. 4, 5) in order to develop a concept for the design of the living spaces and the tourism service.

Thanks to these activities and the direct interaction with the designer – architect Paolo Scoglio – and the owner, important foundations were laid for the subsequent design, which incorporated and implemented the project guidelines. A strategic aspect that influenced the subsequent phases concerned the development of a module concept based on the principle of flexibility (to guarantee maximum adaptability to user requirements), modularity (to favour the standard production of elements that can be added to or removed from the module, depending on specific site conditions) and lightness (to guarantee transportability even in inaccessible places and onto roofs of existing buildings). Some issues related to the management of the prefabrication of the modules – particularly in relation to transport and the verification of certain technological details such as the connection between the closing elements and the surface foundation – and others related to the development of the hospitality service and relative business were of particular importance.

The design-construction and management project | For further investigation of certain issues, related to critical aspects that emerged during the immersive experience in Carpeneto, and related to the construction, assembly and transport of modular residential

modules for experiential tourism, the team had the opportunity to organize and participate in a workshop in which the main technical elements of the housing modules were designed and built at LAM Ambiente's headquarters (Fig. 6). The organizational details of the workshop were related to research and action methods and tools, favouring the community generation of knowledge and skills related to the feasibility of the design proposals. The design of a technical element, like the methods used in the design of the systems that connect elements and materials, was immediately verified thanks to construction actions – or to be more precise, attempts at construction – by the group of ASP students, teachers and experts. The continuity between the definition of possible design solutions and construction feasibility allowed the constant assessment of and reflection

Figg. 4, 5 | Survey and redesign of the modules designed for Carpeneto by The Ne[s]t Living Studio; A working moment during the Let'Set meta-design workshop (credits: Let'Set, 2019).

Fig. 6 | The Let'Set design-construction workshop at the headquarters of LAM Ambien (credit: Let'Set, 2019).

on the strengths and weaknesses of the temporary housing module, encouraging the immediate and continuous identification of possible solutions.

The conditions of modularity, flexibility and lightness led the research team to prioritise a wooden frame system, consisting of uprights and transoms, 2.80 x 1.00 m tall. The depth is, of course, variable in relation to the climatic context without, however, changing the frame elements. The modular system has been conceived to define both the vertical closing elements and partitions and, thanks to certain adaptations, also the roofing system. The predominant type of material (wood or wood-based components) was suggested by the industrial partner involved in the project, which has specific know-how in the design and construction of wooden buildings. LAM also made the necessary spaces, tools, supervision of manpower and materials available to the team in order to test: 1) the different stratigraphy of the modules for the different seaside, mountain and city contexts; 2) the most efficient design possibilities related to the connection between the modules. In order to supply a further technical-scientific contribution to the Let'Set team, architect Alessandro Trevisan, designer of ARCA (ARchitettura Comfort Ambiente, a certification system specifically for wooden constructions), was invited to participate. The setting up of teams with interdisciplinary skills made it possible to define not only the characteristics of the technical elements but also of the services (heating, electrical wiring and hot water), as well as the relative methods of technological integration.

As already mentioned, the aim of the workshop was the design and almost contextual construction of four mock-ups (scale 1:1): that of the junction between the modules and

those related to the stratigraphies of the external walls of the types of modules to be used in the three environmental contexts of reference. The workshop, which lasted three days, proved to be strategic in exposing design errors and weaknesses and in rapidly identifying improvement and corrective actions. For example, the dovetailed wooden joint, without carpentry supports, designed by the team, which seemed to work in theory, turned out to be structurally inefficient and complicated to use for the installation of the modules during the workshop.

The practice and the direct experience of construction proved that it was impossible to use the dovetail joint in a wood alone due to the anisotropic and hygrometric characteristics of the material. In order to facilitate the assembly and disassembly of the residential modules, the team opted for a dovetailed steel interlock, made in the workshop. This type of joint accelerates the positioning of the modules by facilitating their connection, also ensuring almost perfect adhesion between the modules and, therefore, the possibility to cover up the connection gap directly on-site using conventional technologies (plaster or other finishes). The design of the external walls of the three different types of modules (seaside, mountain, city) proved to be more correct, both from a structural and thermo-hygrometric point of view while highlighting all the difficulties of the transition from design to construction.

The Let'Set workshop in Arezzo was a central experience of the project, not only in terms of the technological-constructive aspects but also because it allowed a real comparison with the entrepreneurial aspects of construction, management and deconstruction (taking into account the temporary nature of the housing module). The organisation of a meeting focused on the management aspects of the accommodation service, with particular reference to the phases of off-site production and production in place with LAM CEO Andrea Ceparano, was an opportunity to investigate and resolve some key issues related to the research project. Starting with the procurement of materials and components, moving on to the procedures related to processing times and costs, and then defining the methods used to store and preserve the technical elements produced.

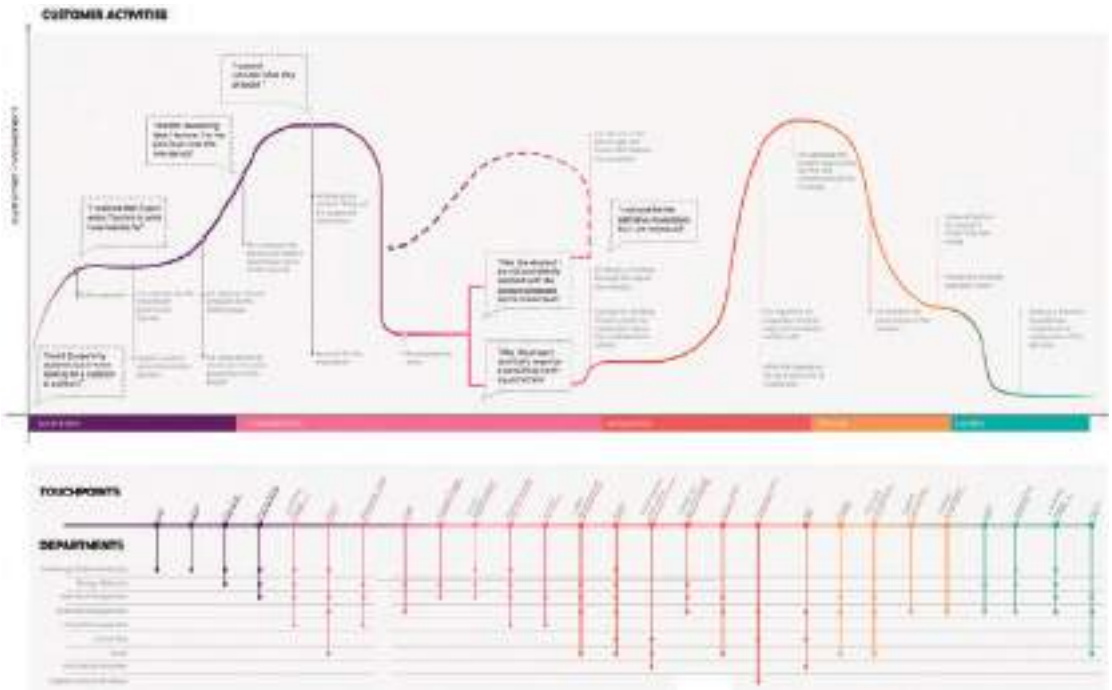
The Let'Set configurator: an innovation of process and product | The results achieved in the Let'Set workshops, and during the analysis that preceded them, formed the basis on which the last phase of the project was set up, oriented at developing its innovative content. This phase led to the design and development of a configurator capable of relating the variables that characterize the project and the construction/deconstruction of the module together with the planning and implementation of the tourism offer. It also involves the development of a tailor-made product and process service for experiential tourism. The configurator was conceived as a virtual professional service application offered by LAM Ambiente to its customers (design studios or other direct investors acting as intermediaries with tourists), which allows the user community to visualise the planovolumetric project of the module through an 'online planner', on the basis of general initial indications provided by users (relating to the context), with the

gradual provision of more detailed options. At the same time, the company displays the technical elements from its premises, along with its component materials (Fig. 7).

The configurator is not limited to the mere definition of the morphological and distributive characteristics of the module and the selection of the technical and technological elements but provides a management section capable of almost synergistically linking the user and the designer, the designer and the companies, the companies and the managers of the spaces destined for tourism. There is a series of functions that make it more advanced than other 'online planners'. The Let'Set configurator offers numerous functionalities in a single application: it reduces the delivery time of the customised module to a few weeks, thanks to an effective interface between all the players that are involved in the design, production and organisation of the service.

Three families of residential modules designed for three different climatic and landscape contexts were developed. The research team decided to associate each module with the name of tree species that characterise mountain, seaside and urban environments. The mountain module is called House Tree Abies because the fir is the tree that best represents the Italian and European Alps; at the opposite extreme we have the Maritime Pine, which represents all the Italian and southern European coasts, hence the name House Tree Pinus Pinaster. Lastly, the Chestnut tree, the urban tree, with characteristics of tremendous durability and longevity, representing a very powerful urban landmark, defines the city module, which is called House Tree Castaneis.

More specifically, the House Tree Abies, being designed for a climatic and environmental context that consumes a lot of energy in winter and requires active heat production systems, posed numerous problems related to the aspects of indoor thermo-hygrometric comfort and energy self-sufficiency. Its inclusion in the context also plays



a decisive role, focusing on the connections with the ground of House Tree Abies, in a continuous interaction between slopes and exposure, the shadows cast around it, winter and summer solar paths, landscape inclusion and accessibility. The configurator of the House Tree Abies module proposes an internal distribution in relation to typical tourist activities (trekking, skiing, hiking, rafting, etc.) based on the project guidelines while allowing users a certain amount of flexibility in defining specific requirements.

In the House Tree Pinus Pinaster (Fig. 8) the theme shifts from energy for the supply of active heating systems to passive cooling and ventilation systems. The House Tree Pinus Pinaster is lighter and more adaptable, it requires fewer technological systems, especially when it comes to air conditioning because it works with the sea breeze and night/day thermal inversion. Also, in terms of its distribution layout and function, the House Tree Pinus Pinaster allows the user greater freedom. It can be a free plan 'cabanon' or a compartmentalised dwelling; it can be a service structure for bathers on the seafront or a portion of a scattered hotel. The House Tree Pinus Pinaster works around a more extended holiday time dimension than House Tree Abies, losing its connotation as a warm, protective and compact nest in favour of a more open view and adaptability of spaces, in line with a carefree lifestyle, typical of a beach holiday, of acceptance, hospitality and conviviality.

Thanks to the modularity and lightness of the system of uprights and transoms, the House Tree Castaneis can be installed in the city in a multitude of situations, ranging from ground support to placement on the roof of existing buildings and installation in disused industrial structures. The House Tree Castaneis aims to promptly respond to specific urban problems related to accommodation, however temporary. The strength of this interpretation is that it is a tool to solve specific urban problems, from housing

Previous Page

Fig. 7 | Representation of the flowchart of the Let'Set configurator (credit: Let'Set, 2019).

Fig. 8 | View of the House Tree Pinus Pinaster modules installed on a beach (credit: Let'Set, 2019).

for people in difficulty (from migrants to the poverty-stricken) to the clustering of several modules to accommodate students and employees working away from home, on a temporary or permanent basis. In terms of performance, the House Tree Castaneis is midway between the House Tree Abies and House Tree Pinus Pinaster, having to guarantee indoor thermo-hygrometric comfort in both winter and summer according to a logic that is not necessarily off-grid but can be combined with urban networks, as well as rapid assembly and disassembly, and a variety of possible and defined solutions for its urban integration.

Conclusions | By means of a description of the experience of the Alta Scuola Politecnica and an assessment of the results achieved (in research, the world of production and teaching) – highlighting the potential of a multi-scale approach (Perriccioli et alii, 2018) as a tool for managing complexity – the contribution is part of the debate on the role of the University in training and research and on synergies with industry: How can the quality of higher education and research activities in Universities be guaranteed while working towards their practical application? How can we promote the ability to make the most of the meeting between supply and demand for innovative knowledge and technologies? (Torricelli, 2014).

The challenge-driven approach – albeit with the necessary adaptations to the specific context in which the work was carried out – made it possible to conduct a unique experience, generating interactions between operators in different sectors related to the design of tourism and unusual relationships between cultural and professional areas, starting from an educational project capable of interacting with research themes, and research themes that have developed in weak settings straddling the production of manufactured goods and the production of services. A body of cross-disciplinary research and actions, which have allowed not only students but the entire Let'Set team to co-generate new skills and knowledge and exploit them in an end 'product' that is hard to define. Both a building and an industrialised and complex technological system made up of modular and composable technical elements. And, also, a tool that tends to reduce the design, production and construction times of the modules to zero, as well as a service capable of satisfying the experiential tourism needs of a community of users in a unique way. More generally, it is an opportunity to develop the meeting between supply and demand for innovative knowledge and technologies (tangible and intangible).

In the challenge-driven logic, Let'Set faced several challenges, some defined with methodological rigour in the start-up phase, others unplanned and unprogrammable, encountered phase by phase, always with the ability to draw on diversified knowledge to solve problems efficiently. The timing imposed by the Let'Set project (about 24 months) did not allow the launch of a process of prolonged monitoring of the effectiveness of the responses to the challenges. However, these are activities that, thanks to new hybrid forms, which will once again include teaching, research and design, find a time and a way to be developed in the near future.

References

Albanese, V. (2013), "Slow tourism e nuovi media: nuove tendenze per il settore turistico", in *Bollettino della Societa` Geografica Italiana*, Serie XIII, vol. VI, pp. 489-503. [Online] Available at: societageografica.net/wp/wp-content/uploads/2016/08/PDF_3-2013_Albanese.pdf [Accessed 15 May 2020].

Baldazzi, B. (2014), *L'analisi dei flussi turistici – Strumenti, Fonti e Metodi*, Edizioni Nuova Cultura, Roma.

Bellini, O., Ciaramella, A., Daglio, L. and Gambaro, M. (eds) (2018), *La progettazione tecnologica e gli scenari della ricerca*, Maggioli Editore, Santarcangelo Di Romagna.

Booking Blog (2020), *TripBarometer 2014: è boom di Turismo Esperienziale* [Online] Available at: www.bookingblog.com/tripbarometer-2014-e-boom-di-turismo-esperienziale/ [Accessed 15 May 2020].

CNA – Confederazione Nazionale Artigiani Balneatori (2017), *Ombrelloni presi d'assalto a Ferragosto. In cinque giorni dieci milioni di turisti negli stabilimenti italiani.* [Online] Available at: www.cna.it/ombrelloni-presi-dassalto-a-ferragosto-in-cinque-giorni-dieci-milioni-di-turisti-negli-stabilimenti-italiani/ [Accessed 15 May 2020].

Cognetti, F. (2016), "Ricerca-azione e Università. Produzione di conoscenza, inclusività e diritti", in *Territorio*, vol. 78, pp. 40-46.

D'Eramo, M. (2019), *Il selfie del mondo – Indagine sull'età del turismo*, Feltrinelli, Milano.

Frearson, A. (2012), *Hut on Sleds by Crosson Clarke Carnachan Architects.* [Online] Available at: www.dezeen.com/2012/07/13/hut-on-sleds-by-crosson-clarke-carnachan-architects/ [Accessed 4 May 2020].

Frearson, A. (2011), *New Refuge Gervasutti by LEAPfactory*. [Online] Available at: www.dezeen.com/2011/12/03/new-refuge-gervasutti-by-leapfactory/ [Accessed 15 May 2020].

L'Osservatorio Findomestic (2019), *I mercati dei beni durevoli e le nuove tendenze di consumo.* [Online] Available at: www.osservatoriofindomestic.it/media/Osservatorio2019.pdf [Accessed 4 May 2020].

Gemini, L. (2008), *In viaggio – Immaginario, comunicazione e pratiche del turismo contemporaneo*, FrancoAngeli, Milano.

Gilovich, T., Kumar, A. and Jampol, L. (2015), "A wonderful life: experiential consumption and the pursuit of happiness", in *Journal of Consumer Psychology*, vol. 25, issue 1, pp. 152-165.

Kutschera, S. (2019), *Le statistiche sul travel e il turismo da conoscere per il 2018-2019*. [Online] Available at: www.trekksoft.com/it/blog/le-statistiche-sul-travel-e-il-turismo-da-conoscere-per-2018-e-2019 [Accessed 15 May 2020].

Moreschi, C. (2017), *Experiential Tourism: what it is and what it is for.* [Online] Available at: www.claudiamoreschi.it/en/news/experiential-tourism-what-it-is-and-what-it-is-for/ [Accessed 4 May 2020].

Osservatorio Turistico Valle d'Aosta (2018), *2018: l'anno migliore per il turismo valdostano degli ultimi 10 anni*. [Online] Available at: www.osservatorioturisticovda.it/blog/dati-turismo-valledaosta-2018/ [Accessed 15 May 2020].

Paragoy, B. (2016), *Parasitic Apartments Are Taking Over Paris Rooftops.* [Online] Available at: www.architecturaldigest.com/story/parasitic-rooftop-apartments-paris [Accessed 15 May 2020].

Perriccioli, M. and Ruggiero, R. (2018), *La didattica della tecnologia dell'architettura nella formazione dell'architetto*, Clean Editore, Napoli.

Tebbutt, L. (2015), *Mobile holiday home by Hristina Hristova offers an antidote to Bulgaria's seaside resorts.* [Online] Available at: www.dezeen.com/2015/09/27/koleliba-mobile-holiday-home-hristina-hristova-antidote-bulgaria-rampant-seaside-development/ [Accessed 15 May 2020].

Torricelli, M. C. (2014), "Tecnologie dell'architettura ricerca e sviluppo | Architectural technologies research and development", in *Techne | Journal of Technology for Architecture and Environment*, vol. 7, pp. 6-10. [Online] Available at: doi.org/10.13128/Techne-14525 [Accessed 15 May 2020].

Publishing Series in PROJECT | Essays and Researches
From Mega to Nano
The Complexity of a Multiscalar Project
vol. 04 | 2020 | paper 9 | pp. 154-169

ISSN (print): 2704-6087
ISSN (online): 2704-615X
ISBN (print): 978-88-5509-188-6
ISBN (online): 978-88-5509-189-3

DESIGN(ING)
The multiscalar project

Paolo Di Nardo, Alessandro Spennato

section
DESIGN

typology
ESSAYS & VIEWPOINT

DOI
doi.org/10.19229/978-88-5509-189-3/492020

ABSTRACT
The term 'design(ing)' moves on a play on words in which the noun 'design' becomes a verb, synthesizing in one word two terms, defining a multiscalar and transdisciplinary conceptual dynamism. Designing as a transversal disciplinary bridge, but with a wider cultural meaning, wanting to emphasize that often in the art of composing there are no fences, belonging as the Italian language does with design: a cultural and methodological synthesis between being and doing. The term design, therefore, takes on an important cultural value because it goes beyond the disciplinary fences by combining art, architecture and design in a single concept, capable of designing vertically in the different scales of definition and horizontally from discipline to discipline. In the history of design and architecture many virtuous examples testify to this cultural attitude.

KEYWORDS
design, design scale, design culture, material, rules

Paolo Di Nardo, Architect and PhD, is a Contract Professor of Interior Design at the Department of Architecture of the University of Florence (Italy). Visiting Professor at several foreign Universities and Director of the magazine AND, in 2002 he founded Studio ARX which deals with architectural design and research; he is also the author of numerous articles and essays on architecture and design. Mob. +39 335/56.17.170 | E-mail: paolodinardo@and-architettura.it

Alessandro Spennato, Designer and subject expert, is a Technologist in Design at the Department of Architecture of the University of Florence (Italy). Since 2013 he is Scientific Coordinator of the Models Laboratory for Design. From the beginning to University education in the field of design he has developed interests and studies in the field of graphic and generative design. Mob. +39 338/19.50.170 | E-mail: alessandro.spennato@unifi.it

It is important in a historical period like the present one, aimed at sharing paths of innovation in the vast field of the creative world, to look for increasingly multidisciplinary research paths, to be able to respond to the demands of a crisis, which is not only climate or lack of content but also the absence of global social and political expectations. The text is therefore intended to offer an opportunity to reflect on a new way to tune the 'culture of the project' with these expectations, trying to make room for all disciplines open to creative involvement without placing defined and self-celebrating disciplinary margins. Perhaps the critical moment of sharing resilient paths is based on this very absence of sharing by following paths, established in the not too distant past, which were based on disciplinary certainties that today no longer find the safe and defined margins of research and creative 'doing'. This search for creative sharing therefore moves horizontally, opening up to all scientific disciplines without cultural or belonging fences and vertically according to a scalar axis of materialization of thought.

In the so-called 'culture of design' there is no partial scale of reference, study and application, but rather its world of rules and relations between the parties refer to ideological paths that over time, albeit with contemporary variables, are always the same regardless of the scale of intervention: from design to architecture and vice versa. Ernesto Nathan Rogers amplifies the concept of design and therefore of the project, through the well-known definition of the operative field of a creative aimed at overcoming specialist knowledge: 'from the spoon to the city' (Rogers, 1946). A broad definition of the work of the contemporary designer that becomes at the same time an exhortation to expand, not only the disciplinary knowledge but the fields of the application themselves, ranging from the object to the city and vice versa.

In reality, Rogers' definition implies that the compositional rules over time are always the same and vary only for the application scale. In the Italian language the word 'design' is closely linked to the sphere of interior design. It is a noun inextricably linked, in Italian culture, to industrial design, which in turn is a precise and defined design and professional discipline. In the English language, and therefore in the parts of the globe where this language is adopted, the word 'design' means project, to devise the action of connecting thought, idea, concept to the project, which is conveyed through design and realized with matter and technology. In this sense the English language, therefore, makes no difference in scale because design, or the ability to compose, can go from 1:1 to 1:1000 and vice versa.

The term design(ing) moves on a play on words in which the noun 'design' becomes a verb synthesizing in one word two terms and defining a multiscalar and transdisciplinary conceptual dynamism. Designing therefore becomes a disciplinary bridge tending towards English linguistic interpretation, but with a more defined and broad cultural meaning, wanting to emphasize that often in the art of composing there are no disciplines, distinctive features, affiliations, but above all different places or scales of intervention to be defined individually, as the Italian language does with design: a cul-

tural and methodological synthesis extended between being and doing. The term design, therefore, takes on an important cultural value because it goes beyond the disciplinary and cultural fences of belonging, combining art, architecture and craftsmanship in a single concept, capable, separately and individually, of designing a strong belonging and compositional richness in a 'multiscale' sense.

The design between rules and reference scales | It is appropriate to give a fitting example of the wide scope of design(ing) through Bruno Mathsson's Superellisse (1964) table. In 1959 the city of Stockholm commissioned Piet Hein, a Danish philosopher, poet and mathematician, to design a physical system to streamline car traffic in Segel Square (Fig. 1). Hein tried a roundabout, of course, but noticed that the solution for the urban layout of the square did not succeed in the intention for which it had been designed. He naturally brought the circle to lengthen until it became what he then called 'ellipsoid', succeeding as a mathematician to give a numerical definition through the formula $(x/a)\ n + (y/b)\ n = 1$. The new geometric shape, derived from the formula whose value 'n' was equal to 2.5, became the famous 'ellipsoid', or elongated circle or square blunt on two faces.

Bruno Mathsson, an ultra-modern designer and expert Swedish craftsman, saw this new shape, even though it was made on urban space, and thought of transporting it into the field of design, intuiting its revolutionary potential and value. From this transposition, or estrangement, derived the famous Superellisse table (Fig. 2), composed of slender and easily removable legs, a metaphor for the shape of the roundabout in Piazza Segel. The table was an enormous success until it was chosen as the table for the 1965 Peace Conference in Paris to resolve the Vietnam crisis. This example is emblematic of design because it demonstrates many things: that intuition has no scale of intervention; that number as a measure, rather than a formula, regulates the balance and grace of an object both on a scale of 1:1 and 1:1000. But above all, it shows that the scale is irrelevant if there is as a creative starting point thought and research capable of spanning even distant disciplines: mathematics and design.

The transhumance of rules and concepts also takes place horizontally between different disciplines as well as vertically between different scales of representation and application to demonstrate that beyond the single disciplinary definitions (design, architecture, painting, sculpture, music, poetry, etc.) there is a 'project culture' that covers every conception: design.

Le Corbusier is perhaps the artist who, more than any other, has codified some 'regulatory tracks' to determine the secret code that exists behind every work of art, as it exists in chemistry for the elements and their relationships: vertically from one scale to another and horizontally from one discipline to another. A research that is independent of the artistic zones to which it belongs, so one can acquire the rules from historicized painting to design the door of a contemporary church like Notre-Dame du Haut in Ronchamp (1950-1954). In this sense, a fitting example is a con-

nection of 'distance' which considers iconographic and temporal aspects as simple vectors of a research tending towards balance and therefore objective beauty. It is therefore not important what is iconographically represented or in what era it was created, but that hidden drawing, sometimes totally invisible and sometimes only perceptible in filigree, which puts the parts about each other and with the whole: different works in terms of images or historical period they belong to are actually and magically the same thing. Le Corbusier's work has always sought geometrical, numerical, relationship and rhythm references linked, however, by emotion, on the subjective side, which conveys the work towards objectivity: «[…] Stone, wood, cement are used; houses, buildings are made of them: this is building. Ingenuity

Fig. 1 | Piet Hein, Sergel Square, Stockholm (credit: Map data – Google, Maxar Technologies).

Fig. 2 | Bruno Mathsson, 'Superellisse' table, 1964 (credit: P. Di Nardo, 2019).

Fig. 3 | Le Corbusier, 'The Same Beauty' (source: www.fondationlecorbusier.fr).

works. But suddenly, my heart is moved, I am happy, I say: it is beautiful. That's architecture. Art is here» (Le Corbusier, 2003, p. 178).

In the words of Le Corbusier there has always been the search for certainties, for rules through the regulatory tracks and emotion as the final result: «Architecture is par excellence the art that reaches a state of platonic greatness, mathematical order, speculation, perception of harmony, through relationships that solicit emotion. This is the goal of architecture» (Le Corbusier, 2003, p. 87). Ronchamp's front door is perhaps the manifesto of this attitude of Le Corbusier to enter, through the analysis of traces and relationships, within an already existing composition, which his sensitivity as a painter and therefore as a designer, judges to be the bearer of beauty and balance. In this research of the fresco's compositional rules, the painter/architect synthesizes his multi-scalar qualities as an artist, succeeding in defining a plot of lines and geometries based on the importance of the subjects, their interpersonal relationships, their symbolic value in the communication of faith (Fig. 3). After extrapolating the weft, as in a carpet, Le Corbusier carries out a real process of compositional and chromatic mutation to define the final design of Rochamp's door: two completely different images, but so empathically identical thanks to that hidden design that goes beyond time, the four hundred years of temporal difference: the distance from the image and the period has therefore magically created a story based on scalar transpositions, the designing.

In the Ronchamp Chapel, it is the 'what we don't see' more than the 'what we see'

Fig. 4 | Pier Giacomo and Achille Castiglioni, lamp 'Arco', 1962 (source: www.outletarredamento.it).

that acts as a trace, as a narrative, of the entire building, both in the individual parts, as in the entrance door, and the understanding of the whole as space: from the scale of design to that of architecture. This interdisciplinary, multi-scale journey is based, rather than on a compositional technique, on a cultural approach that takes nothing for granted, but that captures the essence of the works of art, as well as their hidden design to replicate new realities in continuity with the ancient and recent past. A continuity that is expressed through geometry, as in Le Corbusier or through the metaphor applied around the work, whether it is an object or an architecture: a real genetic mutation.

Mutation in design | If we search for the meaning of 'mutation', the word is immediately linked to the term 'genetic mutation', defined by Wikipedia: «Mutations are the basic elements by which evolutionary processes can take place. Mutations determine the so-called genetic variability, i.e. the condition in which organisms differ from each other in one or more traits. Natural selection operates on this variability through genetic recombination, which promotes favourable mutations at the expense of unfavourable or even lethal ones» (Wikipedia.org).

It is interesting how the term mutation is linked to 'evolutionary processes' (Fig. 4) characterized by a 'variability' that can give 'character' and therefore difference among organisms. In the field of medicine these characters become basic elements to be able to implement a 'natural selection' that can establish which mutations are 'favourable' or 'unfavourable'. Therefore, 'mutation' or 'copy' (Fig. 5), in the sense of

Fig. 5 | Franco Zavarise, 'Arc' floor lamp, 1962 (source: www.archiexpo.it).

considering a new work starting from another one, can only determine evolution in any field, provided that what derives from it is a new diversity, a synthesis of the previous ones. Only the spoken language cannot specify the 'favorable' meaning of the 'copy', limiting it to the 'exact reproduction of an original'. To 'copy' actually means to understand, to investigate, to know the hidden design of a natural element, of a painting, of architecture, of an object, of any creative act determining a 'favourable' action. The first commitment for a scholar, and therefore all the more so for a designer, is to know how to investigate and re-knit all those creative invariants present in the tradition of discipline to produce and add a new chapter of creativity. For a 'designer' the field of action does not vary as the scale changes from object to city and vice versa.

In the inaugural Lecture given at the Collège de France in 1977, Roland Barthes, through the metaphor of the child and the mother, establishes the limit of that area of interpretation of the city for a contemporary project: « [...] I would therefore like the words and the listening that will be intertwined here to resemble the coming and going of a child who plays around his mother, who moves away from her, then comes back to her to bring her a stone, a thread of wool, tracing in this way around a safe centre an entire play area, within which the stone, the wool, after all, imports less than the gift that is made with them» (Barthes, 1978, p. 9). If in Barthes' metaphor the mother is the city or the history of design, then the child is the figure of the creative person who finds in the cultural habitat all those objects of knowledge to be able to add a new chapter, but always in continuity, even episodic, with the identity matrix physically

represented, in this case, in the city. Roland Barthes' inaugural lecture wanted to clarify his approach to creativity in a broad sense, warning students that nothing comes from nothing, but that everything comes from something else already thought and conceived before.

The interdisciplinary nature of references often effectively resolves the design of an object through a process of transformation and alienation capable of exalting those aspects that in the original reference was either relegated to a secondary role or not exalted. In its design transfer the character of an object regains a new life often for completely different uses. George Nelson's 1960 Sling sofa (Figg. 6, 7), produced by Herman Miller, is a fitting example of how references from different interpretations can become creative ingredients for producing a completely different object. Nelson was attracted and fascinated by the design of the seats in his Citroën 2CV (Fig. 8) and this interest led to the design of the Sling sofa seat.

But at the same time his interest in Marcel Breuer's work led him to use the 1925 curved metal tube as the structure of his new sofa, triggering an assembly of two citations: one taken from the automotive industry, the other from the innovation of a father of modern design. The result of this combination is a furnishing element that is an excellent example of advanced technique and detachment from the two previous designs, made of tubular metal and padded respectively. If analysis means 'starting to design', then a compositional technique for mutation as a design practice is certainly that of 'tracing plots'. A transversal technique in the field of design because it is the

Figg. 6, 7 | George Nelson, sofa 'Sling', 1960 (source: www.sbandiu.com).

Fig. 8 | Citroen 2 Cv, 1948 (source: commons.wikimedia.org).

narrative tool, whether we are talking about literature or architecture and design.

Gianni Rodari (1992), in Grammatica della Fantasia, effectively introduced, for those who want to learn how to tell or write 'stories', the technique of 'tracing' with which one obtains from an old fairy tale 'a new fairy tale in various degrees of recognizability, or with total transfer to a foreign land'. The procedure has illustrious precedents, among which is the illustrious Joyan tracing of the Odyssey. Reduced to a game, the procedure loses nothing of its nobility and its capacity for excitement. A well-known fairy tale is reduced to the pure plot of her story and her internal relations: «Cinderella lives with her stepmother and sisters [...]». The second operation consists in further reducing the plot to a purely abstract expression: «A lives in B's house in a different relationship from C and D who also live together [...]». Let us now give the abstract expression a new interpretation and we can obtain, for example, this scheme: «Delfina is the poor relative of Mrs Notabilis […]» (Rodari, 1992, pp. 66, 67).

In this example, the second operation, the abstraction of the formula of the given fairy tale, seems almost superfluous, so much so that the new fairy tale follows the first one, introducing simple variations. If we try, once we have obtained the formula, to forget as much as possible the original fable, we can arrive at this suggestion: «[...] the boy Charles is the groom of the Count» (Rodari, 1992, p. 67). And with this we are far enough away from the original Cinderella who enters the new story in-depth, like a secret fabric, to live in her innards and inspire unthought-of things from there. The essential moment of the Ricalco is the analysis of the given fairy tale. An operation that is both analytical and synthetic and goes from the concrete to the abstract and from there back to the concrete. The possibility of such an operation arises from the very nature of the fairy tale. From its structure strongly characterized by the presence, the return, the repetition of certain compositional elements that we can also call themes. This compositional technique, precisely because of its ultimate goal, knowing how to tell stories, can be applied to many artistic disciplines or belonging to the creative world.

Architecture, like design, cannot therefore be exempt from its application in the composition of the project, assuming in-depth knowledge of ancient as well as contemporary architectural culture. In continuity with the metaphorical reference to Rodari's 'tracing plots' (1992), the first operation consists in transforming a building, or rather an architectural work to the 'pure plot of its history and its internal relations'. In architecture, a fitting example of 'tracing plots' is the comparison between the 'Malcontenta' by Palladio (Villa Foscari in Gambarare, Mira, Italy) and Villa Stein by Le Corbusier in Garches.

In his essay The Mathematics of the Ideal Villa and Other Essays, Colin Rowe (1977) geometrically demonstrated the exact architectural correspondence between these works, which are so distant from each other, both in terms of stylistic language and, above all, in terms of the period they belonged to. Perhaps the epoch in which these two works were conceived is the most discriminating magical demonstration that there exists in the composition a road that leads to the narrative beyond the image and peculiarities of the time, always marginal and culturally static due to an inherent necessity in man to always set cultural and social rules. In this case we are witnessing a real process of 'mutation' at the macro scale, referring to the experience of the search for the hidden and invisible plot of the Boulbon panel and the entrance door to Rochamp: the multiscale project from micro to macro scale. It might seem heresy to compare these two architectural works so distant from each other in terms of age, style and technology, but knowing Le Corbusier's

Fig. 9 | Michele De Lucchi, 'Tolomeo', 1987 (source: www.artemide.com).

search for ‘rules’, the suspicion that it may be a ‘tracing plot’ may be legitimate.

Rowe applies an accurate scientific research by identifying, through the relationships between the parts and among them and the whole, an identical musical score without worrying about the instruments, such as the constructive technology or the eighteenth-century organizational setting of symmetry, against the search for asymmetry of the early twentieth century: both attitudes are aimed at the definition of Beauty, but in ages and styles distant from each other. It is a scientific analysis of a surgical nature made by Le Corbusier on Palladio’s Malcontenta to identify those compositional plots that secretly structure this important chapter of architectural culture.

The parallel comparison is impressive both for the organization of the plants and for the definition of volumes and elevations. In the plans, even in the presence of completely different structural technologies, a sequence of steps and identical spaces emerges through the alternating rhythm A-B-A-B-A and consequently also the distribution of spaces, up to the position of the staircase, underline embarrassing equality. Asymmetrical planimetry is identified with another asymmetrical planimetry hiding within them a completely identical rule and rhythm. Even the size of the external staircase is part of this path of identity more as a role of passage, as a filter between the outside and the inside, than as a planimetric position that becomes superfluous, but perhaps the aspect in which this historical and stylistic distance is most evident are the elevations: the image. In this case it is like being in the presence of the writing of the first ‘fable’ and the one derived through the

Fig. 10 | Jac Jacobsen, ‘Naska Loris’, 1937 (credit: FontanaArte Spa).

game of ‘tracing plots’: a known fairy tale is reduced to the pure plot of its story and its internal relations. The relationship between solids and voids follows the same ‘plot’ both vertically and horizontally while maintaining each one its particular expressive singularity linked to history and to the architect who conceived them, but this does not alter the fact that in both the architectural DNA is the same: A : B = B (A+B).

For ‘mutation’, as an interdisciplinary and therefore multiscale process, the greatest danger is formalism and aesthetic complacency, the ambition of the final product regardless of the scale of realization. Design requires an ethical approach based on research for the clarity of the final message in which self-referential invention cannot find room for manoeuvre as Giovanni Michelucci recalls (cit. in Barocchi, 1990): «[…] stylistic perfection, invention or structural purity have never had any interest for me. On the contrary, what convinced and convinced me most in a work are the ‘ruptures’, the signs of thought suddenly coming to a halt as new possibilities, new paths to take». The search for ‘new possibilities’ or creative and compositional paths is the intrinsic aim of the multiscalar ‘mutation’. In this sense there are two designers Michele De Lucchi and Martino Gamper, so different for the type of research and final product, but equally equal in the process of knowledge of what has already been done before, following the cultural path of Bruno Munari (1998, p. 132): «[...] When someone says this I can do it too, it means that I can do it again, otherwise I would have done it before».

Fig. 11 | Richard Sapper, ‘Tizio’, 1972 (source: www.artemide.com).

Figg. 12, 13 | Martino Gamper, '100 chairs in 100 days', 2009 (source: joyofdesign.cargo.site).

The evolution of the project | Michele De Lucchi, in contrast to the egocentricity of the designer who waits for the critic and the researcher who knows how to find and tie the mesh of a design hidden from the present, honestly already declares the genesis of his Ptolemy: «[...] I did the Ptolemy because I had always had a Naska Loris in front of me and I thought 'I want to do a Naska Loris too'. Richard Sapper had become famous for having designed the Tizio and I said to myself: 'I want to make a Tizio too'. I tried to make a lamp that was a Tizio and a Naska Loris together, I evolved two ex-

isting projects» (Di Nardo and De Lucchi, 2010, p. 45; Figg. 9-11). De Lucchi makes Ptolemy a true manifesto of mutation at all scales, micro and macro, taking an interest in what will happen after the appearance of his lamp through the work of young designers who continue the story with new and ever-changing chapters: «[...] Making something influential means much more than making something that works well, all young people should not worry about copying, but that of being copied» (Di Nardo and De Lucchi, 2010, p. 47).

In Gamper every idea comes from a previous story in which the copy becomes a ploy to understand, know and then create. With the assembly of chairs (Figg. 12, 13), Gamper implements a real cultural revolution in the approach to design, overcoming the limits of recycling to trigger a metaphorical process of mutation of what already exists and which does not lose its meaning through one of the most fascinating techniques, alienation (Annichiarico, 2009). This creative process in which plastic backrests, velvet seats, metal legs, wooden armrests, leather seats, iron feet, etc. are mixed, takes on an important social and aesthetic value. One does not stop individually at pure form or a specific function, but, through a different process of assembly, the common aesthetic hierarchies are subverted, so much to create a short circuit in the public, not only concerning the normal perception of the object, but, more importantly, its symbolic meaning.

His chairs specifically seem to want to communicate their aesthetic value to us at the very moment when they have exhausted their original potential for use. The world in which Gamper rediscovers forgotten forms, interrupted creative desires, functions extinguished by time are the London garbage bins or antique markets in the street. In a different way from De Lucchi, who is more fascinated by the technology and composition of the lamps, Gamper extrapolates from what exists the essence of things by working on the individual parts to be assembled and which have lost their initial value to give a new life to the story: in both the path is one of mutation of the present beyond the final product without worrying about the scale of intervention, but implementing a cultural path of design.

A student, in 1992, during a lecture at the University of Venice, asked Bruno Munari the following question: «[...] since thousands of chairs have been designed [...] does it still make sense to continue designing these things?» Munari answered him provocatively, but pointing out a new way on which to look for different forms of stories: «[...] I made a chair for Zanotta created for very short visits with a very inclined seat. It had no function because this is not a chair but an art object in the shape of a chair». Therefore, the design is not concerned with the scale of intervention but with oxygenating and regenerating the design culture in every age. The contemporary challenge of the contemporary designer is that current modernity does not have long times but seconds of application and verification. Design finds in the ‘mutation’ (Figg. 14-17) the vector of the narrative that manifests itself through the different compositional experiences and that in this reflection ‘from macro to micro’ is expressed through

Figg. 14-17 | Gianluca Gimini, 'Sneakered graphic project', 2017 (source: www.gianlucagimini.it/).

techniques such as ‘tracing plots’; the ‘regulatory paths’, the ‘metaphor’ and the ‘estrangement’ always without worrying about the scale of the conception, but deepening and vitalizing the contemporary ‘design culture’.

As the examples cited demonstrate, the search for a new way of conceiving the contemporary creative and scientific act does not start, as in the past, from the demolition of what has already been defined and experimented, but wants to base precisely on such research an ideological path that can graft contemporary elements to a knowledge that is already structured. For example, it is not a question of choosing technology alone as the solution to renewal, but all those contemporary instances, including the sustainable aspect and response to the climate crisis, that can update a multiscale and multidisciplinary knowledge.

References

Annichiarico, S. (2009), *Martino Gamper – Stanze e camere – 100 chairs in 100 days*, Mondadori Electa, Milano.

Barthes, R. (1978), *Leçon: Leçon inaugurale de la chaire de sémiologie littéraire du Collège de France, prononcée le 7 janvier 1977*, Edition du Seuil, Paris.

Barocchi, P. (1990), *Storia moderna dell’arte in Italia – Manifesti polemiche documenti*, Giulio Einaudi Editore, Torino.

Di Nardo, P. and De Lucchi, M. (2010), “Designing and me – Il Chiosco. Uno spazio privato”, in *AND*, vol. 17, pp. 36-43. [Online] Available at: https://and-architettura.it/index.php/and/article/view/226 [Accessed 28 February 2020].

Le Corbusier (2003), *Verso una Architettura* [orig. ed. *Vers une Architecture*, 1923], Longanesi, Milano.

Munari, B. (1992), *Un’altra sedia*. [Online] Available at: www.youtube.com/watch?v=bfP1BNUHZBc [Accessed 30 March 2020].

Munari, B. (1998), *Da cosa nasce cosa: Appunti per una metodologia progettuale*, Editori Laterza, Bari.

Rodari, G. (1992), *Grammatica della fantasia – Introduzione all’arte di inventare storie*, Einaudi Ragazzi, Torino.

Rogers, E. N. (1946), “Ricostruzione: dall’oggetto d’uso alla città”, in *Domus*, vol. 215, pp. 2-5.

Rowe, C. (1977), *The Mathematics of the Ideal Villa and Other Essays*, MIT Press, London.

Publishing Series in PROJECT | Essays and Researches
From Mega to Nano
The Complexity of a Multiscalar Project
vol. 04 | 2020 | paper 10 | pp. 170-187

ISSN (print): 2704-6087
ISSN (online): 2704-615X
ISBN (print): 978-88-5509-188-6
ISBN (online): 978-88-5509-189-3

DESIGN OF THE ATMOSPHERES AND NARRATIVE DIMENSIONS
Literary Writing and Visual Writing

Daniela Calabi, Elisa Strada

section: DESIGN
typology: RESEARCH & EXPERIMENTATION
DOI: 10.19229/978-88-5509-189-3/4102020

ABSTRACT
Thanks to the character of verbal writing, which attracts and evokes images, it is possible to imagine the places, the characters and the atmospheres of a literary text. The implicit ability to conceive forms from the linguistic content is due to the characteristic figurativeness of the texts, which lend themselves to the reader's comprehension, allowing him to perceptually portray the verbally cited referents. However, the sensitive identity of literary places maintains a connection with the spaces, a connection created through 'suspended' realities, as it isn't possible to truly represent these spaces. The research question raises the issue of the representation of the author's places. Therefore, design acts as a translation tool, which allows the atmospheric content of literary places to be visible.

KEYWORDS
communication design, landscape, translation, literature, photography

Daniela Anna Calabi is an Associate Professor at the Design Department of the Politecnico di Milano (Italy). She carries out research mainly in the field of Communication Design, in particular to the design of the perception, atmosphere, geocriticism and identity of the territories. E-mail: daniela.calabi@polimi.it

Elisa Strada is a Communication Designer. She carries out researches on the possibility of creating experiential formats for publishing by viewing narrated places. E-mail: elisa.strada@mail.polimi.it

Speaking of the 'literary' means understanding every genre, every author and every possible 'translation' from the text to other visual languages. The research's design tool is communication design, which, in the literary plots, investigates verbal languages to test their visual translation potential, graphic and multimedia potential signs, semantic declinations and relations, and possible cross-media relationships. A design that 'pools' digital technologies and interfaces alongside traditional publishing, or 'illustrates' and designs the thresholds and accesses to the textual narration, with its cover page and other paratexts. The dimensions of the narrative and the connotations of the narrated space are at the centre of the following reflections. If imagining the environments of literary narratives is inherent to reading, visualizing the spatial dimensions and atmospheres is not.

The hypothesis is to 'make the invisible visible': the spatial atmosphere in the texture of the text. Other languages are needed to do this: film adaptations, illustrations, and animations. It is necessary to increase the writing from the alphabetical sign dimension to the spatial dimension, so as to make the characters of the narrated territory perceptible, memorable and significant, and with them the author of the book and the identities of the places. The study identifies real identity characters in the narrated representations. Going beyond the events and the protagonists, the literary story is considered a special guide to real territories, thanks to the iconic references to landscapes. The possibility of transforming them into another perception and another narrative language is therefore addressed. Much literature interprets and describes the identity of places, stratifying real and imaginary events. In this way, it feeds memories and culture on the territory, also geographically, to the point of inducing in the reader the desire to see the imagined experience with their own eyes and perceive it with their senses.

Through cultural tourism, or 'tourism of the 21st century' (Garibaldi, 2014), aimed towards urban space, the relationships between literary descriptions and physical places find their definition in 'geocriticism', which focuses on the close connections with reality, and in map design, which produces georeferenced communication artefacts. The georeferencing of the places in the story responds to the need for a 'spatial relationship' between author, reader, narration, narrated territory and geographical territory. So much so as to return – if not new identities – a new point of view on identities which become explicit, and on urban places with an important density of spaces dedicated to publishing and literature.

Recent extensive research – a prelude to the nomination of Milano as Creative City for Literature UNESCO[1] – has seen the skills of communication design and economics (DCxT research group of the Design Department of the Politecnico di Milano and the ASK Research Centre of Bocconi) mapping thousands of data and transforming them into communication. The map has acted as a basic georeferencing tool and has produced the international recognition of Milan as a UNESCO literary city. All the places linked to the publishing world that correspond to the literary stratifications have been identified in the Milanese territory: libraries, publishing houses, bookshops. Other maps, such as the Milan Literary Map (MLM) of Quarto Paesaggio[2], have pro-

vided the geolocalization of hundreds of points corresponding to ‘quotations’ taken from literary works. The new communication paradigms, linked to literature and territory, have generated design studies in favour of an experiential publishing approach. The production of literary maps and their design is inscribed in the epistemological process known as ‘spatial turn’, a concrete turning point with respect to the concept of space in the human environment.

With the work on atmosphere design, a different passage in terms of quality and expression is hypothesized, defining, in an experiential way, the connection between real and virtual places, their communicative representation and their networking. The discussion centres on emotional relations, and therefore perceptive, visual and haptic relations, between atmospheres of the territory that include the literary, the urban, the reader and the inhabitant. We are talking about a ‘design of access’ to the landscapes of authors in order to define, in addition to the geographical destination, the sensitive atmosphere of literary memories and fantasies. The possible methodology is that through which design can be interpreted. Thus, the hypothesis of an atmosphere design of literary places has been consolidated: one imagines an instrument of exploration of the world through the literary. It is not necessary, in fact, to know the places of the narratives; on the contrary, book and atmosphere design can both be ‘predictive’ with respect to the possible physical exploration following the readings.

In fact, it seems clear, even if only by common experience, that even when the geographical references and spatial characteristics of the places of literary events are not known, the texts still make it possible to establish an implicit link with the images evoked by the description of these landscapes. Images, which are always subordinate to the semantic value of words. In other words, there is a sort of direct mental passage from the writing to the visual form, which accesses both the semantic memory of each individual and the experience of similar places. In fact, in the absence of precise references, the reader adapts the ‘atmospheric image’ learned from the text to the connotations of other places, already present in his worldview. Imagination is still in the semantic memory, so the individual who remains involved in the literary image is ‘immersed’ in the description, ‘absorbs’ the details and is ‘imbued’ with impressions.

Translative Palimpsests | Literature, as a whole, offers a sort of atlas of imagined places, dear to the epistemology interested in the ‘perceptive depth of the narrated space’ (Lancioni, 2009). In detail, the levels of empathy and inner involvement are constantly modulated by the relationship that is established between reader and author: through the plot and the represented environment, personal spaces of semantic exchange are created. The ability to mentally elaborate the literary space is certainly favoured by the effectiveness of the ‘figurativeness of the texts’; an interesting semiotic characteristic that allows the passage to the mental image. An image that becomes engaging and memorable; the reader, suddenly able to see the plot and its interweaving

in space, becomes ‘visionary’. To quote didactically: «Figurativity allows to localize, in the conversation, the particular effect of meaning consisting in making reality sensitive» (Bertrand, 2002, p. 99). In other words, according to one of Bertrand’s definitions of figurativeness, it is possible to identify everything that can be traced back to the traditional senses within the literary text.

The narrative interpretation is therefore innervated in the perceptive experience of each reader, reaching his or her sensorial capacity. This is because the stories, as already described, evoke emotions and images and lead to ‘presume’ not only the semblance of any narrated space but also the perceptive stimuli, creating an intimate relationship between the dimension of the text and the personal sensitive experience of the world. Figurative narration can make the ‘identity’ of literary places imaginable, together with the image of them. But, above all, it manages to become the threshold for experiential immersion within the real place without realistically reaching the senses. For these reasons, after an engaging session of reading, literary pilgrims develop the desire to personally experience the environments of the narrative and places described, which become ideal destinations. The contact between imaginary and real environment creates a ‘meta-narrative’ that prolongs the pleasure of reading; precisely because the literary story, anticipating the perceptive experience, takes on the role of ‘unconventional tourist guide’.

The ‘intersemiotic translations’ that concern the passage from verbal language, which describes the spaces of narration, to the language with which real spaces can be visualized are interwoven with the instances of design that deepens the identity of places. An identity that is made accessible precisely by communication design (Calabi and Scuri, 2015). It must be said that, concerning the link between the figurativeness of the text and the narrative atmosphere, epistemological models are important and varied, and many of them are of reference for the design of atmospheres. Narratological and semiotic reflections with sensitive reality at the centre (Pezzini, 2014) and studies that determine the link between geographical space and the arts (Bruno, 2015; Moretti, 1997) represent an effective synthesis. Along the plot of the text, it is possible to trace the descriptive environmental parts with relative simplicity and the textual descriptions alone are, in fact, able to communicate ‘the narrative atmosphere of places’. Narratological analysis has been hypothesized to give back in-depth analyses of methods able to prepare the intersemiotic translation between text and visuality.

Having therefore chosen the ‘prototext’ – a literary tale to investigate to focus on the atmospheres of the narrative spaces – the ordered selection of atmospheric traces makes it possible to hypothesize the creation of an ‘immersive palimpsest’, through which it is possible to experience the sensitive reality that emerges from the text, and which will produce the ‘metatext’. Immersive because the research is based on the assumption that, to understand the atmospheric contents, the image of a place must be ‘immersive’, i.e. provide an ‘aesthetic’ experience of the landscape, facilitating access to the cultural content interwoven with identity and experience.

It should be noted that technology in itself does not constitute immersivity. What the research investigates, and is understood here, is rather the figurative value of the text concerning the design of perceptual experience, sensations and emotions and cognitive stimuli. Design capable of generating an immersive 'dominant aesthetic' through the convergence of multimedia content (Ortoleva, 2009). The relationships between textual and visual (or multimedia) language and the constituent translating values applied to atmospheres, therefore, represent the object of study. These relationships, at the centre of the studies of communication design, establish the passage between the two different semiotic systems (written and visual) and are the translative design place of reference. The palimpsest is intended as a selective rewriting and 'guiding instrument' to the narrated landscape, which 'excludes' events and characters to focus on the sensitive. Organized in sequences, the palimpsest selects the 'sensitive atmospheres' present in the written text to interpret and transport them into a 'visual text'.

What emerges is a new text that is however completely identical, even in its semantic content, to the original staging of the literary atmospheric landscape selected in the text, which narrates only spatial atmospheres. From this verbal text, design initiates the visual translation, leading to another text and another language, in which there are different linguistic signs, registers and codes. The literary landscape is seen as having a leading role, which in fact stages and welcomes the narrative atmosphere; a protagonist divided between writing and image, as Calvino and Pavese recall (Bertone, 1994), with a profound identity value, rewritten by narration (Calvino, 1947). From writing to space, from interiority to atmosphere, from page to landscape, the contribution of design experiments formats to communicate the relationship between literary, map and representation of space, starting from the atmospheres of literary works. It relies on the translation experience and, with the 'literary scene', interprets the text with 'aesthetic' expressiveness through the sensitive and multimedia experience.

Design and Photographic Text | Roman Jakobson defines 'intersemiotic' translation as an interpretation of linguistic signs by means of non-linguistic sign systems (Zingale, 2016). It includes the translation from writing to theatrical or cinematographic adaptations. It identifies the interpretative tool capable of realizing the hypothesized sign palimpsest and implements a translation from linear writing, by means of 'transmutation'. Jakobson distinguishes three possible ways to interpret a linguistic sign. The intersemiotic translation is, within the three possibilities, the most suitable tool to carry out the transformation from textual to 'sensorial' involvement. The other translation modalities differ according to whether the translation takes place within the same language, or if the passage is to another language. In the latter two cases, it will be possible to have, respectively: an 'endolinguistic' translation, since the signs are the same, also called 'reformulation'. Or the result will be an 'interlinguistic' translation, that is what occurs between different signs. Both translations take place within the same semiotic space.

Transmutation, or intersemiotic translation from text to image, determines instead a particular leap of scale; it is, in fact, a «translation between semiotics with different subjects» (Dusi, 2006, p. 6). Design, particularly in this case, implements a transformation whose effects are received by the reader and where the landscape changes dimension: from textual space, which takes shape in the inner world, it becomes visible space. In intersemiotic translation applications, it is design that guarantees the quality of the result, while maintaining the objectives of meaning. The translation from text to the photographic image is a virtuous example of this. Photography is an example of a visual text. It is not uncommon to use verbal text to confirm the potentially ambiguous meaning of an image. In these cases, the verbal element acts as an anchor, to avoid ambiguous or inconsistent readings. The same anchorage could be used in some verbal systems which, to be clarified, require an image with mainly didactic and referential functions.

Text and image confirm a deep relationship. Duane Michals, an American photographer, plans his images with caption and title. Therefore, he inserts several languages into his visual design, each of which contributes to the aim of maintaining meaning, and further enriches the whole with multiple significances (Eco, 2003).

Mario Giacomelli, in his interpretation of the poem Caroline Branson from the Spoon River Anthology by Edgar Lee Masters, follows two lovers for three years. He makes them the subjects of his photographs as if they were the two suicidal lovers protagonists of the poetic narrative. The images created do not follow the temporal development of poetry, since the aim of the project is to interpret the emotions, rather than the story. The photographic story translates emotions and feelings, while the sensations evoked in the viewer assume the connotations of the two real lovers. In these cases, photographic art and verbal writing become poetic and engaging interpreters of the places portrayed, making the atmosphere of the story fully experienceable.

To understand the ‘atmospheric representation’, it is necessary to remember that photography is the result of the impression of perception, albeit from the point of view of the photographer. As the text represents the view of the writer, photography allows capturing the single elements, transforming their dimensions of meaning and highlighting the particularities and details. Photography is a form of narration that requires immersion in the space of the image, in the perceptible atmosphere. The atmosphere is what arouses the feeling, relatively objective and intersubjective, encountered both inside the narrative environment and outside of it (Griffero, 2010). The translation of the narrated space is, therefore, a translation of the narrated atmospheric space. Griffero defines an atmosphere by identifying it as that which produces participation and involvement: «[…] a situation that touches us considerably through its salience, i.e. through the action it exerts on us emotionally» (Griffero, 2009, p. 51). Regardless of our state of mind, the narrated atmosphere captures, involves and authoritatively induces an emotion (Vitale, 2013). The atmospheric space of the narrative, visual or textual, can guarantee an unexpected involvement by which we allow ourselves to be seduced.

Atmosphere Design | The observation of reality can give rise to intense emotions (Griffero, 2016); in the same way, reading can imprint images and sensations, modifying the emotional condition of the involved viewer. The sensation of immersive identification can be experienced in figurative texts (iconic or verbal), as in plastic texts (abstract images); this happens in music, cinema, photography and the arts in general. Here it is possible to define a potential translation of atmospheres into photographic images, in which the design of the emotional space is 'condensed' (Marmo, 2018) and anchored to verbal atmospheric nodes.

The choice falls on Anna Maria Ortese's book: Una Notte alla Stazione from Silenzio a Milano. Dense with figurative verbal descriptions, the narrative is mainly 'atmospheric narration'. The choice of this text made it possible to investigate many different narrative sequences with objective references to real contexts, exponentially increasing the variety of objective references (atmospheric realities). While in fact the recognition of the referent in a photographic image implies an intuitive and immediate operation, the reverse path that leads from the text to the image is more complicated. What was exploited was, therefore, the previously described circumstance for which every verbal text possesses that sort of implicit 'iconic-semantic virtuality' that attracts images to the mind, evoked by reading (Lo Feudo, 2013). The photographic images have therefore been defined through communication in the relationship between the atmosphere evoked by the text and the documentable reality; therefore, through the construction of rhetorical figures in relation to the two writings.

The protagonist of the narrated landscape is the Milan Central Station (Fig. 1) which identifies and is part of, the urban scenarios; but also which remains distant from the rest of the urban landscape due to the variety of otherness present in a historical space full of memories. The narratological analysis identifies, within the essay, some dominant themes; these have constituted the narrative traces for the design of the representation of atmospheres. Among the fundamental themes is the description of silence, oppressive and pervasive. The author describes the effects that silence has on travellers, while it also reverberates on the imposing architecture; further still, even on the photographer who accompanies her during the exploration and on herself.

Here it is necessary to highlight a further essential scalar leap: only the descriptive components on the places are extracted from the entire plot of the text. Therefore, the smallest and most indispensable key elements for the selection of atmospheric characters are enucleated from the detailed vision of the narrative: the nodes in the interweaving of the text. The word **'**text**'**, which has a broad and vague meaning, derives from the Latin **'**fabric**'**, developing a metaphor in which the parts of the writing appear as a succession of graphic meanings – such as letters and punctuation marks – con-

Fig. 1 | Milan Central Station, photographed during an inspection (credit: E. Strada, D. Calabi, Politecnico di Milano).

necting the 'narrative nodes' (Segre, 1985). Barthes writes: «Text means fabric; but where up to now we have always taken this fabric for a product, a veil already made behind which, more or less hidden, lies the meaning (the truth), now we accentuate, in the fabric, the generative idea for which the text is made, we work through a perpetual interweaving; lost in this fabric the subject disintegrates, similar to a spider that dissolves itself in the constructive secretions of its canvas. If we love neologisms, we could define the theory of the text as a hiphology (hyphos is the fabric and the spider's web)» (Barthes 1999, p. 124).

The analysis of the 'literary fabric' presents a vast literature, which is interesting to configure the methodology of the research; it is enough to include the theories of Russian formalism, the studies of Propp, Genette, Lévi-Strauss, Todorov and Greimas, as well as the structuralism and post-modernism. However, it was Segre and Barthes' studies in particular that inspired a method of segmentation of the story's plot, a linguistic-functional method, to define a design suitable for representing the literary atmospheres of places. From here it has been possible to identify the latest scalar change in the story, from the plot of the text to the individual descriptions of the spaces constituting specific literary atmospheres.

From the studies on narratology, which Torodov defines to designate the functional study of narratives (Segre, 1985), we learn that narratological sequences are divided into categories. Simple sequences are architectures characterized by the fact that in their

narration, and their communicative purpose, it is possible to identify unique characters that make them classifiable in a single type of sequence. The mixed sequences, more frequent, are characterized by the presence of more than one typology, so the result is crucial; they correspond to the parts of the narrative in which there is an action, and are therefore defined as dynamic. Dialogue sequences correspond to the parts of the text in which the characters exchange information; they can be static or dynamic depending on the type of dialogue. Descriptive sequences have the purpose of enriching the narration with information about an object, a place or a living being, without allowing the action to progress (therefore they are called static sequences); they can have secondary purposes, from background to atmosphere evoking. Finally, reflective sequences contain the reflections of the characters or the author and are defined as static, since they represent a moment of pause.

To overcome the subdivision into sequences, inadequate for the analysis of the semantic value of the atmospheres, we, therefore, arrive at the smallest and most transversal element of the narration. Barthes defines the smallest element as the 'nucleus of the text'; it is the single statement, irreducible without compromising the meaning and logic of the expression it contains (Barthes, 2019). The 'expansions' are the parts of the text that are articulated around the nucleus. The nuclei are separated from each other by elements that give them specificity, add information and help contextualize the story in a given time and space. Each expansion allows us to understand the nucleus to which it is associated, its context, qualities and characteristics.

Design Application | Photographing the urban environment and interpreting Ortese's book-reportage, meant first of all understanding the written text (and then fragmenting it) in figurative sense nodes, with the aim of translating them into a communicative format. The book evokes the particular aesthetics of the Station's transit spaces, which are also places dense with historical memory. The author describes the great Station in the occasion of an inspection of which she reports the experience, where the sudden transformations of the landscape, punctuated by busy rush hours and moments of standstill, are striking.

The segmentation of Segre's text consists of identifying writing sections by linguistic function. The individual parts, or 'sequences', represent indivisible units of meaningful text. Literature theorist Cvetan Torodov defines them as «[…] a combination of propositions describing the transition from one initial state to another» (Souiller and Troubetzkoy, 2002, p. 22). In Ortese's text, the nuclei, within each sequence, are the key elements of the narrative and strictly define the themes contained therein (Fig. 2). Once these nuclei have been identified within the text, the parts describing the places are selected. These parts are here defined as 'atmospheric nuclei', as they refer to the atmosphere of the spaces in which the story takes place. Each one of them is contained within an 'atmospheric sequence', a portion of the text, which, through an intersemiotic process, will be translated and rendered

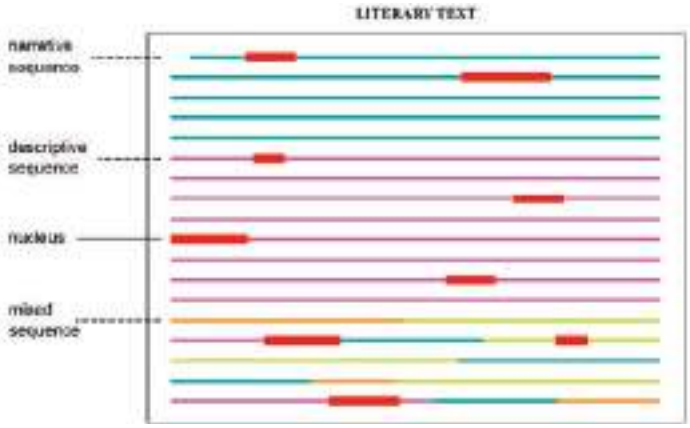


Fig. 2 | Analysis of the literary text (credit: E. Strada, D. Calabi, Politecnico di Milano).

Fig. 3 | Identification of literary atmospheres (credit: E. Strada, D. Calabi, Politecnico di Milano).

visually (Fig. 3). The separation of the atmospheres from the narrative fabric and their sequential reading has returned a verbal narrative which is necessarily shorter than the author's original text; an evocative synthesis.

The translation has produced a narrative dedicated to the Station and to the places in the book, which highlights its deep identity and historical character. The choice to use images depicting the current Station (Ortese's text depicts the Station at the end of 1950) redefines the sense of space in a synchronic time. The atmospheric nuclei represent fundamental pivotal elements, without which the description of urban space would lose its meaning. Elisa Strada, the co-author in this text, created the photographic interpretation of the analysis of atmospheric nuclei. The images highlight the opposition values that are present in the book, which have become semantic dominants in the photographs.

Figg. 4, 5 | Crowded Train Tracks; Train Rails Emptying (credits: E. Strada, D. Calabi, Politecnico di Milano).

The alternations between daylight and darkness of the night-time interiors in the Station are evident; but also the fullness of the busy areas and the emptiness of the platform square when all the travellers have vanished; the synaesthesia of the 'noise' of the crowd and the silence of their absence; the iron of the tracks and the stone of architecture (Figg. 4, 5).

Fig. 6 | The Gloomy Atmosphere of the Station (credit: E. Strada, D. Calabi, Politecnico di Milano).

All the elements of the image are enhanced thanks to the preference for black and white, whose duality is consistently added to the other alternations. Ortese's entire narrative unfolds in a single night, from eight o'clock in the evening until the following morning. The author tells the places and feelings of this time, as well as the atmosphere of the fervour of the multitude of people and also the silence. Presences, noises, confusion, agitation and the return to calm after the last train are described in great detail. The alternation of silence and noise takes place in the evening and at dawn; two moments with completely different atmospheres, marking the beginning and end of the day. The story ends with silence, when everyone has left and the Station temporarily ends its function as «[…] door of work, bridge of necessity, the estuary of simple blood» (Ortese, 1998, p. 44). The alternation of semantic oppositions, such as crowd and desert, calm and anxiety, light and darkness, combines with the sensations linked to the cycle of daily oppositions.

Ortese proposes a rather detailed description of Milan's Station, though describing spatial amplitude that cannot be experienced. The darkness of the night and the irregularity of the mass of people, as well as the alternation between fullness and voids inside the spaces, do not allow identification of a static form rather an environment in constant mutation. This, together with the lack of colour and contrasts, creates profiles of reality, which are dematerialized, unreal in the immobile plastic representation (Fig. 6). The reader of the book can add the new visual writing to the text, visual writing whose photographic language and contents he recognizes, without fear of being disappointed. If anything, the reader is amazed by the new writing, which enriches the overall aesthetic experience.

The photographic images are edited in a video sequence that follows the linearity of the narration and the atmospheric nodes. The narrator's voice, which reads the extracted

Fig. 7 | First nine frames of the visual text taken from Ortese book (1998, p. 7): «[...] That part of the City of Milan, those five black canopies, that hill of five black semicircles, that vast square covered with a dense network of tracks, small poles and steel toll booths, those wagons still as stripes of shadow, those workers' houses that could be seen in the distance, exact and joyless stone, were a face, details of a rounded face, hard, strangely aged and lost. Wrinkles [...]» (source: www.youtube.com/watch?v=05ewveKNWA8&feature=youtu.be).

Next Page

Fig. 8 | «Details of a round, hard, strangely aged and lost face, wrinkles» – analogy (credit: E. Strada, D. Calabi, Politecnico di Milano).

text, is 'anchored' to the images (Fig. 7). Among the numerous photographers of inspiration are the exponents of documentary photography; in particular, for the atmospheres, Gabriele Basilico, Sebastião Salgado, Gueorgui Pinkhassov and Duane Michals. The time spent by Elisa Strada in Milan Central Station to take the first photographs after reading the story did not follow any predefined times or even a schedule. She only outlined some fundamental first impressions; atmospheric emotions, real perceptions and evocations from reading led to the realization of the language choices. Photographic language is seen as translation design and therefore as a creative act, making it necessary to become an interpreter between personal memories and emotions that arise from the book. The final video sequence (visual and sound) neatly reproduces the images, while a female voice recites the text.

The narrator's voice and the images offer the anchor for the visual story: the voice marks precise cadences and the photographs follow because it is the rhythm of the read-

ing that defines the exposure time to the atmosphere of the Station. The rhetorical figures present in Ortese's text, especially analogies and similarities, are visual elements that are evoked: the decision to translate them photographically with the descriptive texts was taken to ensure that literary words guide perception (Figg. 8-11).

Conclusions | In the translative experimentation presented, the aim was to demonstrate that the atmospheres related to the narrated space can be a guide to the territories and can transform into an experiential visual text. An 'atmospheric text'[3]. In atmospheric texts it is possible to trace two types of features: one related to the style that characterizes the image and that concerns the choices made by the author; the other related to the recognition of stereotypes for which an image, associated with a verbal text, may determine the attribution of meaning that increases that of the source text. The final result is a design that increases not only the experience of the editorial text but also the understanding, and with it the identity of the narrated spaces. Immersive tests, which feature video projections in the virtual space of the CAVE (Automatic Virtual Environment) of the Design Department of the Politec-

nico di Milano, are underway. The CAVE could, in fact, be installed in libraries and bookshops in the future, using the immersive environmental potential to enjoy the parallel narrative.

In fact, the editorial promotion could be a practical application, especially if linked to the experience of the city's places. With the awareness of being in the early stage, the research will have to direct the experimentation to other literary genres and authors. The future of these experiments is linked to the future of publishing and how it will be possible to explore the territories. The secure assumption is that,

Fig. 9 | «These walls, as high as mountains, these times as high as clouds» – similarity (credit: E. Strada, D. Calabi, Politecnico di Milano).

as the image is something to see but also to read, similarly the writing, besides being something to read, is also something to see.

Acknowledgements

The contribution is the result of a common reflection of the Authors. However, the introductory paragraphs, 'Translative Palimpsests' and 'Atmosphere Design' are to be attributed to D. Calabi, the paragraphs 'Design and Photographic Text' and 'Design Application' to E. Strada.

Fig. 10 | The canopies «black as rain clouds on the bed of a dried river» – similarity (credit: E. Strada, D. Calabi, Politecnico di Milano).

Fig. 11 | Visual narration inside the CAVE, EDME Laboratory, Campus Bovisa Politecnico di Milano (credit: E. Strada, D. Calabi, Politecnico di Milano).

Notes

1) The DCxT Research Group of the Department of Design of the Politecnico di Milano took part in the nomination proposal. The group, which includes G. Baule (Scientific Manager), D. A. Calabi, M. Quaggiotto, C. Galasso, S. Mondello and V. D'Abbraccio, is a partner promoting the candidacy in a national team. With the appointment in 2017, the city of Milan has entered the Creative City Network UNESCO. For more information, see the webpage: www.comunicazionedelterritorio.it/site/ [Accessed 6 May 2020].

2) Milan Literary Map (MLM) of Quarto Paesaggio is available at: www.google.com/maps/d/viewer?mid=1lcKbgYlhzPEH3ru12P7fhcr2ZSs&ll=45.46354225960377%2C9.188527700000009&z=14&fbclid=IwAR2qj_jgxwg0SGd8Jkw1OFzZnVXsowN3p2AYnL7RdvhI3en8LXWRh0wkqCU [Accessed 6 May 2020].

3) Design of the atmospheres created by Ortese's book (credit: E. Strada, D. Calabi, Politecnico di Milano) is available at: www.comunicazionedelterritorio.it/site/portfolio/illustrare-atmosfere-racconto-letterario/ [Accessed 25 July 2020].

References

Barthes, R. (2019), *Sul racconto – Una conversazione inedita con Paolo Fabbri*, Marietti, Bologna.

Barthes, R. (1999), *Variazioni sulla scrittura seguite da Il piacere del testo*, Einaudi, Torino. [Online original French text] Available at: palimpsestes.fr/textes_philo/barthes/plaisir-texte.pdf [Accessed 15 July 2020].

Bertone, G. (1994), *Italo Calvino – Il castello della scrittura*, Einaudi, Torino.

Bertrand, D. (2002), *Basi di semiotica letteraria*, Meltemi, Roma.

Bruno, G. (2006), *Atlante delle emozioni – In viaggio tra arte, architettura e cinema*, Bruno Mondadori, Milano.

Calvino, I. (1947), *Il sentiero dei nidi di ragno*, Einaudi, Torino.

Dusi, N. (2006), *Il cinema come traduzione – Da un medium all'altro: letteratura, cinema, pittura*, Utet Università, Novara.

Eco, U. (2003), *Dire quasi la stessa cosa – Esperienze di traduzione*, Bompiani, Milano.

Garibaldi, R. (ed.) (2014), *Il turismo culturale europeo – Città ri-visitate – Nuove idee e forme del turismo culturale*, FrancoAngeli, Milano.

Griffero, T. (2016), *Il pensiero dei sensi – Atmosfere ed estetica patica*, Guerini e Associati, Milano.

Griffero, T. (2010), *Atmosferologia – Estetica degli spazi emozionali*, Laterza, Bari.

Griffero, T. (2009), "Atmosfericità. Prima impressione e spazi emozionali", in *Aisthesis*, anno II, vol. I, pp. 49-66. [Online] Available at: www.yumpu.com/it/document/read/3808645/atmosfericita-aeuroeprima-impressioneaeur-aisthesis-rivista-di-estetica- [Accessed 6 May 2020].

Lancioni, T. (2009), *Immagini narrate – Semiotica figurativa e testo letterario*, Mondadori, Milano.

Lo Feudo, G. (2013), "Dall'iconico al verbale: traduzione intersemiotica e corrispondenze estetiche. Una ricerca empirica", in *Rivista Italiana di Filosofia del Linguaggio*, vol. 7, n. 1, pp. 58-92. [Online] Available at: www.rifl.unical.it/index.php/rifl/article/view/6 [Accessed 6 May 2020].

Marmo, L. (2018), "Fotografia, aura e atmosfera: l'esperienza filtrata ai tempi di Instagram", in Menduni, E. and Marmo, L. (eds), *Fotografia e culture visuali del XXI secolo*, RomaTrE-Press, Roma, pp. 537-554.

Moretti, F. (1997), *Atlante del romanzo europeo – 1800-1900*, Einaudi, Torino.

Ortese, A. M. (1998), *Silenzio a Milano*, La Tartaruga Edizioni, Milano.

Ortoleva, P. (2009), *Il secolo dei media – Riti, abitudini, mitologie*, Il Saggiatore, Milano.

Pezzini, I. (2014), "Semiotica del paesaggio. Recensione a 'Paesaggi di Calvino' di Fabio Di Carlo", in *E/C | Rivista dell'Associazione Italiana di studi semiotici*, pp. 1-3. [Online] Available at: www.ec-aiss.it/index_d.php?recordID=700 [Accessed 6 May 2020].

Scuri, S. and Calabi, D. (2015), "Communication design for accessing cultural landscape | Design de Comunicação para o acesso à paisagem cultural", in *Strategic Design Research Journal*, vol. 8, issue 1, pp. 29-35. [Online] Available at: revistas.unisinos.br/index.php/sdrj/article/view/sdrj.2015.81.05 [Accessed 6 May 2020].

Segre, C. (1985), Avviamento all'analisi del testo letterario, Einaudi, Torino.

Souiller, D. and Troubetzkoy, W. (2002), *Letteratura comparata – Volume II – I generi e il testo*, Armando Editore, Roma.

Vitale, M. G. (2013), "Sul concetto di 'atmosfera' – Intervista a Tonino Griffero", in *La Critica*, anno XII, n. 39. [Online] Available at: www.lacritica.net/griffero.htm [Accessed 20 March 2020].

Zingale, S., (2016), "Come una traduzione – La traduzione nel senso del design", in Baule, G. e Caratti, E. (eds), *Design è Traduzione – Il Paradigma Traduttivo per la Cultura del Progetto*, FrancoAngeli, Milano, pp. 71-94.

Visit our catalogue

www.unipapress.it
www.newdigitalfrontiers.com

Printed in
September 2020
by Fotograph s.r.l | Palermo

Editing and typesetting: DEMETRA Ce.Ri.Med. on behalf of NDF
Book cover design: Cesare Sposito

The ability of 'change of scales', work on more different scales – multiscalarity – create new ones or change the meaning of the scales commonly accepted, it is common practice in the approach to the project and has always concerned architects, engineers, designers and artists for the multiple symbolic and real meanings of the size of a territory, a city, an architecture and an object. However, it can provide a range of opportunities even in different contexts such as economy, politics, culture, etc. The concepts of scale and size are fundamental to link, in a systemic point of view, the detail with the big picture, the detail with the group, to interpret and represent, to discretize and recompose elements and parts that stand in a hierarchy or interconnection relation, to investigate the physical and social, to outline critical issues and potential, but especially to establish the importance of relational aspects between the group and its component as a way to understand their identity, their nature and organization, their regulation rules and the role played in different contexts, namely the fundamental elements to identify the form and structure of a territory, a city, an architecture and an object.

Therefore, the multiscalar approach can be considered as an important design working tool that, in a systemic point of view, can foster the proposal of adequate strategies for action and planning of sustainable actions, developing new methods, working techniques and shared measurements, through well-considered hierarchies of priorities necessary to optimize the choices of the project and to determine reliable cost/benefit balances (especially of environmental nature). In this regard, the book 'From Mega to Nano: the complexity of a multiscalar project' collects essays and critical thoughts, researches and experimentations on the subject providing some starting points for debate for the international scientific Community.

Francesca Scalisi, Architect and PhD, is a Co-Founder and the Head of the Research Department of DEMETRA Ce.Ri.Med. (Euro-Mediterranean Research Center). She is a Member of the Editorial Board of AGATHÓN (International Journal of Architecture, Art and Design) and a Member in several International Steering Committee as well as a Reviewer for various scientific journals. She carried out research on Green Materials, Innovative Materials for Architecture, Nanomaterials, Energy Saving in Buildings. Her main Research Projects are 'Natural and artificial innovative materials for architecture', 'Nanotechnologies for unfired clay bricks (tradition, innovation and sustainability)', 'Recovery and conservation of Architectural Heritage using nanostructured materials and innovative technologies'.

Promoter
DEMETRA Ce.Ri.Med.
Euro-Mediterranean Documentation and Research Center