

PROCEEDINGS BOOK

ICNTAD CONFERENCE

INTERNATIONAL CONFERENCE ON NEW TRENDS IN ARCHITECTURE & INTERIOR DESIGN

**8th International E-Conference on New
Trends in Architecture and Interior Design**

ICNTAD CONFERENCE

INTERNATIONAL CONFERENCE ON NEW TRENDS IN ARCHITECTURE & INTERIOR DESIGN

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Dear Colleagues,

I am honored to invite and send you this call for papers on behalf of the Congress Organization Board of “8th International Conference on New Trends in Architecture and Interior Design (8th ICNTAD’22)”, to be held in North Cyprus dates between May 16-17, 2022

The Conference will focus on a broad range of topics related to new trends in architecture and design. The Conference organizers invite papers and presentation proposals relevant to conference themes. Considering the theme of the conference, papers with any of the following or related subjects would be appropriate for presentation:

- Criticism of sustainability/unsustainability
- The architecture of philosophy/architecture without philosophy
- Professional settlement of interior architecture
- Human contact to space with furniture
- Intangible skin of space: lighting design
- Tangible skin of space: material
- Ideology in architecture or architecture of ideology
- Spaces without space: 3D design
- The artistic value of space
- Architecture without architect
- Cultural codes / architecture
- Post-COVID Architecture & Interior Design
- Post-COVID Design Education Models
- Spatial Reflections of Pandemics/Epidemics in History

The 8th International Conference on New Trends in Architecture and Interior Design Conference (8th ICNTAD’22), aims to bring together experts from several institutions such as universities, administrative organizations, architects, engineers and designers, at the framework of conference topics of building, architecture, interior design, product, material, etc. High-level academicians, professionals and design students from around the world will explore the intersection of design, architecture and best practices with leaders from the design professionals. The participation of early-career scholars and postgraduate researchers is also positively encouraged.

We kindly wait for your attendance at our congress to be held on May 16-17, 2022, with a hope to realize a satisfactory congress with its scientific ones and leaving a trace on your memories.

Regards

Prof. Dr. Burçin Cem ARABACIOĞLU
Mimar Sinan Fine Arts University – Turkey
Conference Chair

8TH ICNTAD'22 PROGRAM

16 May 2022 Monday

OPENING SPEECH A (10:00 – 11:00)

09:50 – 10:00

OPENING SPEECH : PROF. DR BURCIN CEM ARABACIOGLU
CONFERENCE CHAIR - MIMAR SINAN FINE ARTS UNIVERSITY

E-KEYNOTE SPEECH A (10:00 – 11:00)

10:00 – 11:00

E-KEYNOTE TITLE : 50 WORDS FOR REUSE
E-KEYNOTE KEYNOTE SPEAKER : PROF. GRAEME BROOKER

COFFEE BREAK (11:00 – 11:20)

SESSION A (11:20 – 12:20)

SESSION CHAIR: Assoc. Prof. Dr. Ceren BOĞAÇ

11:20 – 11:40

PAPER TITLE : NATURALIZATION OF THE CITY: A CONFRONTATION
AUTHOR(S) : SMARANDA MARIA TODORAN

11:40 – 12:00

PAPER TITLE : MULTI OBJECTIVE OPTIMIZATION OF OFFICE BUILDING THROUGH SENSITIVITY ANALYSIS
AUTHOR(S) : QODSIYE NAJAFI - PEIMAN PILECHIHA - YOUSEF GORJI MAHLABANI

12:00 – 12:20

PAPER TITLE : COMMUNITY INTERIORS POST-COVID 19 AS NEW NODES FOR OUR CITIES
AUTHOR(S) : MICHELE UGOLINI - STEFANIA VARVARO

LUNCH BREAK (12:20 – 13:20)

SESSION B (13:20 – 14:20)

SESSION CHAIR: Prof. Dr. Burcin Cem ARABACIOGLU

13:20 – 13:40

PAPER TITLE : LIGHT DESIGN STRATEGY OF MACERATA (ITALY)
AUTHOR(S) : MASCIA IGNAZI - FRANCESCA CECARINI - PIERGIOGIO CAPPARUCCI - ROSSANO GIROTTI

13:40 – 14:00

PAPER TITLE : THE ABSTRACT LAYER OF THE LIVING ROOM FURNITURE
AUTHOR(S) : ESRA BICI NASIR

14:00 – 14:20

PAPER TITLE : SECOND NATURE: RAGE AGAINST THE MACHINE
AUTHOR(S) : HUSNU YEGENOGLU - JUSTIN AGYIN

COFFEE BREAK (14:20 – 15:00)

KEYNOTE SPEECH B (15:00 – 16:00)

15:00 – 16:00

KEYNOTE TITLE : EMOTIONAL VORTEXES AND PLACE TRANSMUTATIONS
KEYNOTE SPEAKER : ASSOC. PROF. DR. CEREN BOĞAÇ, Ph.D

GALA DINNER

Salamis Hotel Departure : 18:30

***Gala Dinner invitation is valid for Full Registration Package holders only**

17 May 2022 Tuesday

FAMAGUSTA GUIDED CITY TOUR

Salamis Hotel Departure : 10:00

Return : 13:00

**8TH INTERNATIONAL CONFERENCE ON NEW TRENDS IN
ARCHITECTURE AND INTERIOR DESIGN**

NATURALIZATION OF THE CITY: A CONFRONTATION	2
Smaranda Maria TODORAN	
MULTI OBJECTIVE OPTIMIZATION OF OFFICE BUILDING THROUGH SENSITIVITY ANALYSIS	9
Qodsiye NAJAFI, Peiman PILECHIHA, Yousef Gorji MAHLABANI	
COMMUNITY INTERIORS POST-COVID 19 AS NEW NODES FOR OUR CITIES	21
Michele UGOLINI, Stefania VARVARO	
LIGHT DESIGN STRATEGY OF MACERATA (ITALY)	27
Mascia IGNAZI, Francesca CECARINI, Piergiorgio CAPPARUCCI, Rossano GIROTTI	
THE ABSTRACT LAYER OF THE LIVING ROOM FURNITURE	35
Esra Bici NASIR	
SECOND NATURE: RAGE AGAINST THE MACHINE	43
Hüsnü YEGENOGLU, Justin AGYIN	

NATURALIZATION OF THE CITY: A CONFRONTATION

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Abstract

In today's more and more ecologically conscious architectural world, there are voices who debate, or rather, as they put it, try to sustain architecture in the face of sustainability. A discourse on nature and all that is natural supported by the urgency of ecological matters, risks, in some authors' opinions, to foreclose, manipulate or minimize other legitimate subjects. The proverbial anthropized realm, the city is today also subject to naturalization. What does this mean for the the urban environment, for the life of citizens, for their wellbeing? Does nature, in its different forms of contaminating architecture in the city, become a means for public debate, an enhancer of a better public life or is it the final answer to ecological concerns?

To address the nuanced position of the ecological discourse and its stake for public life in the city, the paper engages on a two-fold analysis. First, it tries to establish a precedent for investigation, revisiting Tafuri's first chapter of 'Architecture and Utopia', 'Reason's Adventures: Naturalism and the City in the Century of the Enlightenment'. In Tafuri's understanding, the model of nature/forest/park legitimizes the emergent capitalist urban fragmentation. Within the city of the eighteenth century, the individual already has no other possibility, except 'global, voluntary alienation in collective form'. Critiques and adaptations of the park model of Laugier and Militia either predict the somber future to come, or idealize it based on a mythic past. This encounter between design, naturalization and the reality or projected reality of the city offers the framework for further discussing the next subject of the paper. In the case of recent developments in architecture at a global scale illustrated by the work of BIG, naturalization, the paper argues, is also evoked to justify the social agenda of architecture or landscape design, their stake in the public space. This evocation is either a legitimization of design that parallels the societal stakes of the project, or a transfer of public use from informal to formal, from vernacular to designed, from uncontrolled to controlled.

The case study shows how, as in the case of the bourgeoisie's eighteenth century anguish, nature seems a beautiful solution to another problem. A return to naturalization needs to be regarded with skeptical reservation and critical eye, nuancing its contribution to the enhancement of public space.

Key Words: *naturalization, public, society, democracy, use of vegetation in architecture projects*

1. Introduction

Does the ecological perspective encompass the essence of architecture's contemporary relationship with nature? Or do architecture and nature entertain a relationship today that is relevant beyond our concern with the impact of our buildings on the environment? Such questions are part of contemporary theoretical debate, as a recent collection of essays edited by Preston Scott Cohen and Erika Naginski demonstrate, under the suggestive title 'The Return of NATURE. Sustaining Architecture in the Face of Sustainability'. In the particular case of the present article, a third element appears as possibly illuminating the relationship between architecture and nature: architecture's public role.

The paper's premises come from two encounters. The public role of architecture, and the role of the architect as ideologist of society is discussed in Manfredo Tafuri's 'Reason's Adventures: Naturalism and the City in the Century of the Enlightenment', the first chapter of 'Architecture and Utopia'. It is a role that the architect assumes, in Tafuri's view, beginning with the Enlightenment, in order to conciliate the reality of the emerging capitalist world with that of the alienated individual. Nature appears as a model, first, from an ideological point of view, then, from a formal one. Its purpose is in both ways intrinsically related to an improvement of social life. Nature, architecture, and a betterment of social life is also a recurrent trio in projects by BIG. Can these two instances of architecture theory and practice be compared? Can one bring out new ways of reading the other? How does this comparative analysis further invite to reflection on the way nature and architecture play their relationship in our contemporary world and what kind of public life does this relationship propose?

These questions are addressed in the paper, not to provide a definite answer, but rather, to see how the public mission of architecture may evolve (or relapse) through its approach of the natural. The text of Tafuri is used then as a starting point in order to establish a set of arguments that can be verified, discussed, changed when reading projects by BIG, but also in order to open up possibilities for further debate.

2. Revisiting Tafuri: Reason's Adventures: Naturalism and the City in the Century of the Enlightenment

Revisiting Tafuri in the twenty first century represents in itself a subject matter for architectural theorists, as numerous articles and books dedicated to his work demonstrate¹. While his influence on architectural theory in the seventies (especially in the US), his 'undying reputation as a radical Marxist'[1] or his grim resignation in regards to the future of architecture within the capitalist development are common ground when referring to his work, revisiting Tafuri appears also as an illuminating background for debating contemporary architectural themes. In an article suggestively titled 'Is Tafuri still Valid? A Contemporary reading of *Architecture and Utopia*', the author suggests that there are two opposed ways of looking at Tafuri's arguments: rejecting them entirely as a proclamation of the death of architecture within a negative Marxist dialectic or analyzing his texts "in order to look for possible operative spaces, within a proposal that supposedly leads architecture to a degree zero." [2] It is within this last framework that the opening chapter of 'Architecture and Utopia' is approached here. The reading of the text aims to illuminate contemporary architecture's re-found interest in nature, with an emphasis on the role of architects as 'ideologists of society': how does architecture today make use of naturalistic approaches in order to fulfill the concern for the common good?

From the beginning, the question of a practice oriented towards the welfare of the general public emerges as central in 'Reason's Adventures...' The first paragraphs postulate the ethical exigencies of art in the Enlightenment and also its limitations [3, p.1.]. The purpose of bourgeoisie art would be, then, to ward off anguish – the anguish that comes from the "free" contemplation of destiny" by means of "understanding and absorbing its causes" [3, p.1.]. Warding off does not imply for Tafuri neither the achievement of catharsis nor the reconciliation of contradictions, but rather, the realization of a much-needed bridge between the anguish of the individual and the passivity of society [3, p.2.]. At this point, the role of the architect emerges, on one hand, as a mediator, the ideologist of society, as the text names him, one who, like other bourgeois intellectuals, works in the interest of common good, by reconciling the individual with society. On the other hand, this role is instantly de-masked as an impossible position. For, while the conflict between the alienated individual and the passive society may be sublimated on a formal plane, that sublimation only deepens the hidden nature of the cultural and social structures it expresses. The role of the architect appears as impossible around necessary desiderata – to create a sense of community in the context of the specifically early capitalist cleavage between society and individual. It is a contradiction in context: to realize this desideratum within the very conditions of early capitalist society, that is, within the realms of the metropolis.

The figure of the metropolis thus appears as the main character of the text, the field where everything is played regarding the public mission of the architect. Tafuri identifies the themes of Enlightenment architecture in and around it: the individualization of the areas of intervention proper to city planning, the persuasive role of form regarding the public, the self-critical role of form in regard to its own problems and development, the interrelationship and opposition – at the level of formal research – between architectural "object" and urban organization [3, p.3.]. Lingered behind these themes, one can inhale, lies the purpose each presupposes: to create (or mediate) within the city for the good of the many, whether by means of persuasion, of self-correction, of perpetual mediation between layout and objects, whole and fragments. The societal dimension of any architectural endeavor remains the main drive, regardless of the subsequent theme or method.

However, the method in which architects – the ideologists of society – are to accomplish their task is the next point in Tafuri's text and it is here that the question of naturalization is introduced through the reference to the text that initiated Enlightenment architectural theory, Laugier's 1753 'Essay on architecture'. The Abbé's famous words – "Whoever knows how to design a park well will have no difficulty in tracing the plan for the building of a city according to its given area and situation" – act on an abstract level. The unification of nature and reason serves the multiple themes to which Enlightenment architecture must respond. First, on a formal level, evoking nature is a helpful method to individualize areas of intervention in the city and to resolve the relationship (and opposition) between an orderly urban whole and its disparate architectural fragments. Secondly, on the ideological level, naturalism plays on the persuasive side as it serves to prove "that in fact there was no disparity between the value accredited to nature and that accredited to the city as a productive mechanism of new forms of economic accumulation" [3, p.8.]. Tafuri points out that on a formal level, due either to the immaturity of architectural thought (the case of Lisbon) or to the lack of administrative instruments (the case of London) or simply as proof that it was more efficient on the ideological level than on the formal, naturalization served to interrupt the development of Baroque urban schemes, and later to discourage, rather than inform, real models of development.

¹ To name a few: Esra Acan's 2011 *Manfredo Tafuri's theory of the architectural avant-garde*, published online by the Journal of Architecture, Diane Ghirardo's *Manfredo Tafuri and Architecture Theory in the U.S.*, published in *Perspecta* in 2002, Carla Keyvanian's *Manfredo Tafuri: From the critique of ideology to microhistories*, published in a number of Design Issues, in 2000, or the books by Andrew Leach, *Manfredo Tafuri: Choosing History*, and Marco Biraghi, *Project of Crisis: Manfredo Tafuri and Contemporary Architecture*.

The adoption of a discourse on the model of nature further involves the ideological aspect of the architects' endeavors as well. Within the city laid out as a forest, the fragments constituted by architecture assume a political role, that of inventing "advanced solutions, at the most generally applicable level". These solutions are in fact so subdued to previous formal models that, from the excessive symbolism of Ledoux or Lequeu to the geometric silence of Durand's building types – no real innovation, especially in the sense of utopianism, is achieved, but rather, as de Quincy's dictionary definition indicates, a lot of achievable (or already achieved?) realism.

Three areas of self-criticism are identified by Tafuri within the discourses of Enlightenment architecture: two of them related to formal quests, while the third, the unique case of Piranesi, bascules from a critique of form to a critique of society. The first two are exemplified by the anti-Europeanism (a refuge in the exotic) and the anti-typological (a refuge in the fabulous). Here also, although Tafuri does not emphasize this aspect, the compensation provided by the exotic and the fabulous to the excess of Reason does not completely elude the realm of naturalization. For the pagodas, Hindu temples and gothic ruins that fill the imagination of seventeenth century architects are mainly reserved to adorn natural landscapes – public parks or private ones, while the hallucinating fantasies of Lequeu, Belanger, or Piranesi draw from natural references. If nature were to be the model for urban development – offering a degree of freedom, only to be contradicted by the insertion of fragments that followed pre-established rules – then the exotic and the fabulous are in fact the continuation of this search for freedom of expression, freedom from formal references, within natural ones.

Piranesi's critique, on the other hand, eludes nature entirely as a possible refuge and escalates the implications of its abstractization. With 'Campo Marzio' and 'Carceri d'Invenzione', what is criticized is the fragmentation and rationalization implied by naturalism, first at a formal level, then reaching social dimensions. For not only does the series of drawings for 'Campo Marzio' depict the irrationality reached at the peak of rationality, "the struggle between architecture and the city, between the demand for order and the will to formlessness" [3, p.16.], his subsequent 'Carceri...', depict the situation of the individual within this society. As Tafuri concludes, "By now there is no other possibility than that of global, voluntary alienation in collective form." [3, p.18.]. The ideological role of the architect as social mediator, as revealed by the then not-understood Piranesi, would be doomed to fail. The quest for new forms of architecture in the layout provided by the marriage between Reason and Nature is un-masked as an impossible task which originates in its declared but impossible purpose: to provide a sense of the natural for the society of the emergent capitalist metropolis, conjugating the fate of the individual – anguished and alienated – with a passive urban community.

The question of form linked to that of ideology is further presented in the confrontation between two types of theoretical discourse, under the theme of communication and meaning. These are reflected by the 'Principi di Architettura Civile' by Francesco Milizia – basically, as Tafuri points out, a reiteration of Laugier's prescription, if not a plagiarism [3, p.20.], under the phrase "A city is like a forest" – and, on the other hand, "the pleas for a traditional adherence to rules" [3, p.20.], as expressed by Giovanni Antolini's criticism. While for Milizia, the city is a construct that feeds upon the mixture of order and chaos, regularity and irregularity, organic structure and the lack of structure – all these contributing to its complex set of meanings – for Antolini, the autonomy of the spaces designed in the city is meant to reject any contaminating influence, relying, for communication, on their orderly structure alone. For Tafuri, within these opposing positions, lie the beginnings of the distinctive paths modern art and architecture are to follow:

'It is, in fact, the inherent opposition within all modern art: those who search into the very bowels of reality in order to know and assimilate its values and wretchedness; and those who desire to go beyond reality, who want to construct ex novo new realities, new values, and new public symbols.' [3, p.24.].

While clearly Antolini's principles are consistent with a Vitruvian tradition which it tries to integrate in the bourgeois city, oblivious of its reality, Milizia's view would continue to illustrate the difficult position of the architect-ideologist trying to resolve or at least to be sensitive and make the best of the emerging metropolis, finding sensual pleasures in its contradictory values, a find made possible, again, by the adoption of the natural model.

But a third way for the development of cities presents itself in Tafuri's chapter: the two points of view, seemingly irreconcilable on European grounds, find a sort of (fragile) equilibrium in Jefferson's America. With the statesman-self-taught architect, naturalistic ideology and the utilization of classicism (in the sense of Vitruvian tradition) cohabit happily both at the level of smaller architectural endeavors and within the more ambitious plan for Washington. Although – as Tocqueville was to point out in his 'Democratie en Amerique', Tafuri notes, the unification of nature and reason for the purpose of accomplishing democracy of a utopian order presents itself as the very danger overhanging the democratic ideal [3, p.32.] – the merit of Jefferson and his accomplishments exemplified in the project for the nation's capital is twofold at least.

First, Jefferson is against the city as a product of industrial development. In the context of an industrial urban America. However, Washington's only chance stands in its being a sort of monument – untimely in its symbolic depiction of the new democratic order [3, p.33.]. As monument, it functions outside the reality of capitalist development – the rejections of the avant-garde architecture and city-planning accomplishments of the 20th century stand as proof [3, p.32.]. Secondly, under these premises, at last, the conditions for a more plausible unity between Nature and Reason are fulfilled. Nature's model is congruent with the ideological view of a democracy rooted in agrarian values and the grandeur of the American landscape

tamed and appropriated by man, as an expression of his diligence and ambition. Therefore, Nature's ideological and persuasive role comes easily into form ("The city in l'Enfant's Washington is really new nature" [3, p.32.]). Nature serves as a model for laying out the plan for the city: its schemes are full of symbolism and make way, literally and abstractly, for the insertion of classical architectural objects. Nature conquered, nature admired, nature as resource for vitality is congruent with an architecture of order and principles, heroic but domestic in its heroism, accessible and 'stripped of anything that might isolate it from civil life' [3, p.40.].

3. Tafuri and naturalization. A framework for contemporary analysis

Although Tafuri's focus, as reiterated in the opening phrase of the second chapter, is on the crisis of form (because of the emergency of the city in the age of the Enlightenment as an autonomous field of architectural intervention), the role played by naturalization in his interpretation of Enlightenment urban and architectural endeavors can serve as a basis for further analysis of contemporary examples. Several aspects can be retained to make up a framework for such an analysis.

First, there is a societal dimension associated to the naturalization project for the city. Invoking the natural as a model for the metropolis serves to ease anguish concerning its novelty and acts at the deep psychological level of the individual as well as at the level of the society in the context of the emergent capitalist world. While for Tafuri this aspect of naturalization is unable to resolve the conflicted relation between individual and society, what appears as significant is the role of a nature that induces comfort and ease, beyond any discussion on the transformations and transgressions of capitalism. As such, nature acts to give form to a layout of stable ground where our unstable existences can unfold. It is the ultimate form of essence, giving roots in the post-modern rootless world. [3] As Fredric Jameson sees it, re-contextualizing the nature revivals within the realities of the 21st century, whether our nature today is the same one the Enlightenment thinkers tamed or not, any such contemporary revival is in the center of a contemporary antinomy: on one hand, it is ideologically desirable, on the other, it reprises human impulses and thus, undesirable thorough its authoritarianism.[4] Jameson's text offers a further possible understanding for this sense of comfort – or, more modestly, warding off anguish – that Tafuri postulates from the beginning as the main purpose of the architect-ideologist in the eighteenth century. Evoking nature is a form of escapism that follows a sort of aller-retour path: when confronted with the limits of the natural model – building typologies – nature becomes again a way of escaping (the exotic and the fabulous can be interpreted as such), or, as in the case of Washington, the natural model that embraces classicist architecture resists change in order to preserve its authority. [3]

To complicate even more the equation, anguish in the contemporary world is directly related to the loss of nature, and the fear for our ecological future becomes generalized for the entirety of the global society. In this way, the welfare of the individual could be underscored in the name of ecological purposes. Is there still a right for private anguishes? Or these too are to be consumed within the specter of the globalized society? These are possible questions that, following in Tafuri's steps, further the debate on the difficulty of the architect-ideologist's mission.

Secondly, the age of the Enlightenment proposes the natural model – the layout of the park (Laugier) or forest (Milizia) for urban planning. It is an infrastructure, not entirely technical, many times exquisitely symbolic (again, Washington serves as an example) – but still an infrastructure of "squares, crossroads and straight and spacious streets in great numbers" [3]. It is a network where "infinite unexpected episodes" offer "great order in details, confusion, uproar and tumult in the whole", in Milizia's words [4]. Architecture is what constitutes the fragments to be installed in this network, the bourgeois city natural layout. While the architectural objects are still viewed within a classical tradition, as in the manuals of Durand, it is the layout that breaks through as a novelty and yet as a return to the real essence of spatial experience – nature itself. Can this interrelation and opposition between urban layout/infrastructure and building typology be discussed in contemporary architecture? How has it evolved since the age of the Enlightenment, and can Tafuri's text be illuminating in this regard?

A third point can be made, touching both previous aspects: the confrontation welfare/freedom versus authoritarianism and urban layout / architectural fragment. While the natural model attains a certain level of abstraction both in Milizia's and Laugier's prescriptions, the question of form, of design, cannot be ultimately eluded: it appears as the final way of revealing the conflicts within the architect's mission as ideologist of society. The fragility of Washington – only possible as a monument, almost in the legal sense of an untouchable object – demonstrates how an ideal expression of democracy can endure. [3] Are today's means of architectural persuasion still related to a type of democratized, accessible heroism? If so, is there a certain monumentality associated to the forms such architecture takes? And ultimately, can the anguish be warded off under such premises, under a controlled, definite and unchangeable form? Can nature itself be the means we reach a certain level of deformation, or at least the illusion of it? Once again, *Reasons's Adventures...* proves to offer a fertile ground for a plurality of debates. These questions are to be further addressed around the case of Bjarke Ingels Group's recent projects.

4. BIG and the naturalization of the architectural object

In the last article of Krista Sykes' 2010 anthology, Roemer van Toorn turns to the subject of architectural utopia, especially in the context of turn-of-the millennia Dutch architecture. Projective practices – as described by Whiting and

Somol – in contrast with deconstruction or Critical Regionalism – focus on the method – on ‘how’, rather than ‘what’ or ‘why’. Using diagrams or other types of analysis, reality is investigated, its latent beauties sometimes excavated, and, if possible, idealized to a utopic state. But the embrace of reality by Dutch pragmatism fails to deliberately dream – utopias happen only randomly. The conclusions of the article invite to grander ambitions. If it is an accepted fact that architecture is happening today within the practices of late capitalism, its relationship to the market still constitutes an ethical and political matter, that transcends pragmatic, technical or esthetical terms. Where we to dream new forms of democracy, we might go beyond the status quo, van Toorn concludes : maybe it is indeed time to wake up and dream again of utopia.[5]

The work of Bjarke Ingels, through his formation in the proximity of Rem Koolhaas and the Dutch school of the nineties as well as through his diagrammatical / Minecraft-like approach to reality, could be confronted with van Toorn’s affirmation. A reflection on utopia and pragmatism by Bjarke Ingels comes almost as an explicit response:

‘Utopia is the concept of a world that is so perfect as to be entirely impossible. Pragmatism takes stock of reality and its conditions, exploring how to handle them. When you combine these two things it sounds like an oxymoron, but it is this very combination that reminds us with every new project: we have a little piece of the world here that we can turn into our own idea of utopia. That is how fiction can become factual. [6]

The meeting between pragmatism – with its marge of rational approach – and utopia is, from the beginning, close enough to merit a comparison with Tafuri’s description of the Enlightenment. Utopia within the projects of BIG is not strange, as many projects demonstrate, from a societal dimension: the question of public space, of public use and enhancement of a better public life is present in a variety of projects, ranging from the power plants in Copenhagen and Uppsala, The Plus Factory, The ‘back to the future’ approach of Brooklyn Bridge etc. What appears as a constant concern in these projects is the immediate role nature, or rather, vegetation, plays in conveying programs, with apparently no natural vocation, with a sense of comfort, of attractiveness. Copenhill, a purely utilitarian program, becomes an attractive meeting point as a skiing slope in winter or a promenade scenery, almost a meditative landscape in spring – as shown in the photographs of the project on the firm’s site. The dome of Uppsala also changes with the seasons, but its transformation goes beyond its exterior surroundings and invades the utilitarian space proper, when, in summer months, the public is invited not only to learn about the program and become more sensitive to its ecological purpose, but also to enjoy its facilities, and become reflexive on its top, admiring the view over the old Swedish city. In Penang, a former power plant’s construction material provides the means for a project that promotes biodiversity in a public square. The connection between public use and natural environment is essential in other industrial programs, either by their particular sites – the Plus factory in the forest is presented as a background for children playing – or, at the very least, by the adornment of their interiors or roofs (e.g., the AI City for Terminus Group). In two New York cases at least, the proposal for the BQP Park and for Brooklyn Bridge, it is the transport infrastructure that is transformed into a more friendly environment. If the infrastructure loses its role completely, as in the case of the BQP Park, a complete eco-system comes to replace it entirely. If there is still a transportation stake, then the newly envisioned system must accommodate pedestrians and at least some form of plants – as is the case with the Brooklyn Bridge. Numerous housing projects in Denmark or New York, the master plans for the islands of Zir or Penang, allude to natural landscapes in their very form – the mountain is a recurrent allusion [7] – a choice that can be interpreted as a compensatory manner of building in certain natural landscapes (almost via Norberg-Schultz’ concept of *genius loci*).

A particular case of utopian project is the Mars Science City developed in the Arabian desert, as a form of vernacular Martian architecture. [7] Here, the conditions for utopia are met almost in the sense of science fiction proposed by Darko Suvin [8]. Science and rationality in the *tabula rasa* context of Mars open up three fold perspectives: first, such a project reflects on the ecological and social relations of our real Terran world; secondly, the dream presupposed by utopia is made possible, like in Moore’s work, by a projected distance, in terms both of time and place; thirdly, these new chronotopes and their protagonists keep reflecting themselves in the original world they depart from. It is this distance however that makes possible the utopian ideal: its rooted un-rootlessness, a possible demonstration of continuous searches for finding the right conditions to fulfill it. In this project, the question of natural processes is completely rationalized, submitted to scientific endeavors, for nothing can go wrong. But the final purpose of a Martian approach is not the sublimation of rationality itself, but the achievement of a natural ecosystem, one that accommodates a happy society, not unlike the strives described by Kim Stanley Robinson in the Mars trilogy, as interpreted by Fredric Jameson.[9]

The relationship between public space – as a space of interaction for groups of people – and nature presents itself as an evidence in the Danish group’s projects. However, what may be remarked even from Bjarke Ingels’ statement, quoted above, is the change in scale of these approaches, as opposed to the situation described by Tafuri. It is *little pieces of the world* that these projects attempt to transform into utopian situations, it is the fragments of the city that are targeted. Even the master plans for the islands of Zir and Penang, while having an overall ecological approach that includes green areas in abundance, play, at the scale of the object, with architectural forms that are themselves allusions to natural objects or phenomena (the seven peaks of Azerbaijan for Zir, hilly-like structures or buildings covered in vegetation for Penang). But in interventions limited to the architectural object, it is the very design of the object that attempts to become an infrastructure for a natural environment. This is not an ecological approach – it could be argued. Masterplanet, the project

recently launched by BIG as an initiative to change the scale of ecological interventions, seems to state that relevant ecological changes are possible, in Ingels' view, only at the conjugated global level [10]. Then, although they could be regarded as pieces of a grander plan, architectural objects are interesting to discuss beyond the ecological agenda.

If the point about them can be made around their goal to establish public places that can, as in the Enlightenment city, ward off anguish and integrate individuals in society – than the discussion on how they innovate formally to achieve this goal is also relevant in the context of Tafuri's text. The crisis of form announced in the seventeenth century relates to the fact that, while the layout of the city is open to the possibility of naturalization, the fragments that fill it are inspired by pre-established typologies. However, the quest of architects in the realm of the exotic and the fabulous already indicates an option for eluding the pre-established typologies in the proximity of nature. The much-discussed topic of type, in the sense postulated by Quatremère de Quincy [11], was already rooted in the model of nature, seen as an ideal that one can strive not to attain, but rather to work according to its principles. If the seventies interpretation of type – linked to the efforts of neo-rationalists to return to architecture itself as an ideal – cannot be separated from a criticism of modernist functionalism, it can be argued that an abstracted version of nature endures within Rossi's understanding of typology. However, the work of the rationalists was centered in and around the traditional European city and was concerned with traditionally established architectural programs. Whereas the power plant, for instance, appears as a non-referential typology from the beginning, its re-connection with the model does not need the historical detour: if it is inspired by something, it is nature in its purest form, a nature that it serves by transforming waste into energy, a nature that it imitates, topography and vegetation comprised.

In the process of analyzing BIG's projects, following the framework extracted from Tafuri's text, it has become apparent that, on one hand, there is a societal task when using natural elements, and, on the other, that this elements, reverse the relationship city as a forest – architectural fragments, a reversion generated by reducing the scale of utopian projections to the object itself, and also by the programmatic innovation that plays out in favor of an unmediated reference to nature. How are then these two aspects – the societal and the formal – linked? In the case of Washington, Tafuri asserts, we come closest to a kind of un-conflicted marriage between Reason and Nature. This was made possible by conceiving the American Capital as a sort of monument: a natural layout for Palladian architecture that would have to remain unchanged in order to maintain its symbolic character. Therefore, the democratized heroism it achieved – the only way it could implement Reason within Nature – remained somehow, an illusion.[3] Yet, what Washington's classical architecture did not seem to make place for – alterations – comes already played out in the architectural object now transformed into nature. How does this operation take place?

Architecture's monumental vocation implies a certain fear of disappearance, if we understand the term monument under its legal definition (the question of danger is invoked by every protection law, national or international [12] since the 18th century). In Tafuri's description of Washington, this fear is double folded: on one hand it is the form itself – one that has been legitimized through the encounter of Nature and Reason – that may be altered, on the other hand, it is the symbolic content of a whole democratic nation that is at peril.[3] In the projects of BIG, inverting the position of Nature seems to act as an answer to these problematic issues. First, form is generated by applying nature to the architectural object: it is the architectural fragment in the city – the *little piece of the world* – that supports nature, and not the naturally inspired layout that supports architectural insertions. Secondly, the stasis that architecture implies as a monument for a democracy that should be enacted with restrictions, is replaced by a feeling of change induced by nature, one that invites to participation. For when the slopes of Copenhill are no longer covered by snow, one can appropriate them in a spring-time promenade. Nature does allow for a certain kind of deformation of the architectural object, without giving up the marriage of Nature and Reason, a reunion thus made from different positions. The MV housing project in Copenhagen, like other housing projects by BIG that allude to natural forms, displays the Nature-Reason relationship at a more abstract level. Unlike Le Corbusier's Unité at Marseille which models itself on historical references ranging from the Parthenon to the monastery of Emma and Fourier's Phalanstery, the model of a mountain inspires a series of apartments built over a parking, transgressing historically imbued references. While for Charles Jencks, speaking of the Unité in his 1971 *Modern Movements*, what is at work in Le Corbusier's project is a transfer of public matters to private life – a private life which is thus elevated at the status of monument [13], or a form of accessible heroism, in Tafuri's words, for a project like The Mountain, if there is heroism, it is in an abstracted version of a conquered nature, a habitable mountain. But what seems to be conquered is the city itself, even its sense of democratized public space, now devoid of any public purpose, for its fragments are now fragments of nature, that comes back to reclaim it in small interstices. Whether the ideology of such endeavors, based on the inversed position of nature and architectural object, works or not to the benefit of our public lives, remains to be seen. However, in a world where the boundaries between artificiality and reality are less and less clear, the merest, or the most abstract allusion to a form of living, real nature, may indeed ward off – at least some – anguish.

Conclusion

The forms in which nature and architecture meet today, in an ecologically conscious era, invite to a reflection on the implications of their present encounter, considering their complex relationship over time. The paper is such an invitation, proposing the comparison of two moments in the nature-architecture encounter: the age of the Enlightenment, as described

in Tafuri's first chapter of *Architecture and Utopia*, and contemporary architectural design by BIG. The paper argues that a common ground for an approach on how this relationship appears in these two instances, is nature's relevance for the public mission of architecture. Tafuri's text offers a three-fold basis for analyzing the projects by BIG. First, the natural model appears to induce a sense of ease in the emergent capitalist city: the city like a forest is meant to persuade individuals that they function in a *natural* environment. A quick survey of the Danish firm's projects showcases multiple situations where, in different forms, nature is associated with an encouragement of better public life. Secondly, Tafuri identifies in the model 'natural layout for the city plus architectural fragments (typologically defined)' an impossible association, evident in the failure of its declared social mission, that culminated in the late modernist developments. But what we witness today is a reversed position of architecture and nature. It is not the city that is rethought of as a utopian world, but rather, its very fragments, and, subsequently, architectural objects, regardless of their program and liberated from typological burdens, become a sort of infrastructure for nature itself. Thirdly, this repositioning also rewrites the relationship between architecture, nature, and public life: unlike the frozen and symbolic quality of Washington, naturalization of architecture appears as a form of heroic appropriation of the city, not by the public, but by nature itself. If a sort of democratized heroism is achieved, the question appears now to be, if there is still a public mission for architecture and the city, in the way it reprises nature. For now, the city itself, as a ground to be reconquered by nature (may it be in sporadic episodes) seems to be slowly going easier on its ambition to be the quintessential public place.

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MULTI OBJECTIVE OPTIMIZATION OF OFFICE BUILDING THROUGH SENSITIVITY ANALYSIS

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Abstract

The building geometry plays a vital role in controlling energy and daylight, so it is necessary to optimize the building geometry. Building optimization is effective in finding optimal design solutions and improving building efficiency. The building design optimization process is associated with uncertainties. However, sensitivity analysis has been widely applied in the context of the building energy model. Few studies investigate the performance of sensitivity analysis (SA) methods to the level of uncertainty in building energy models. Sensitivity analysis in various input parameters is carried out to identify the most critical contributors to measure the energy level. Standard Regression Coefficient (SRC) is an approach to identify the most critical parameter between the optimal design solutions and reduce the optimization process time. In this method the effective parameter selected based on adjusted R^2 . The proposes of this research is to perform the novel approach of building optimization. This research performed in two step: sensitivity analysis and multi-objective optimization based on effective parameter. The sensitivity analysis result indicates that length and width are the most important variable parameter. Optimization leads to an increase in the UDI and a decrease in EUI.

Keywords: Daylighting, Energy Efficiency, Multi objective optimization, Sensitivity analysis.

Nomenclature			
SA	Sensitivity analysis	WWR	Window to Wall Ratio
SRC	Standard Regression Coefficient	DGP	Daylight Glare Probability
PRCC	Partial rank Correlation Coefficient	ENSES	Non dominated sorting Evolution Strategy
UDI	Useful Daylight Illuminance	EPW	Energy Plus Weather File
EUI	Energy use intensity	HVAC	Heating, Ventilating and Air Conditioning
MOO	Multi Objective Optimization		

1. Introduction

Nowadays, climate change and energy consumption are caused by critical conditions all over the world. Climate change cause increased use of fossil fuel consumption and increasing an average yearly rate of about 8%. However, a thermoelectric power plant (the ability to supplying 60% of its electrical energy) can produce this deficiency. Unfortunately, due to the abundance of gasoline and oil, government policies in this area are not comprehensive [1], [2].

The amount of energy consumption in the field of building design is significant that parameters such as building shape, window to wall ratio (WWR), building proportions, and construction material will have a significant impact on building performance [3], [4], [5], [6].

One of the most critical decisions in building design is to designation the shape of the building. This factor in addition to the impact on the aesthetic and performance of the building will also affect energy consumption and daylight [7], [8].

According to the importance of roof shape in solar reflection and daylight glare probability (DGP), these factors will be effective in energy consumption and daylight [9], [10], [11], [12], [13].

Construction and orientation are the other factors that will lead to the adjustment of temperature, which will increase thermal comfort and reduce energy consumption [14], [15], [5]. Research on daylight analysis indicates that the shading depth, material, shading distance from the window and shading number effectively impact daylight and DGP Today to analyze the impact of shading and its optimization in building use simulation software such as Design Builder, Energy Plus, based on genetic algorithm and sequential search algorithm [16], [17], [18], [19], [7].

Building optimization is a process that is now automated by simulation and stochastic population-based optimization algorithms, including genetics and particle swarm [20], [21]. Designers often use thermal simulation before the construction process to evaluate energy consumption. The effect of weather and user behavior in calculating energy consumption and uncertainty about the design parameters should be evaluated in the design. In different decades, simulation has been of great help to the building designer. Researchers also can use these tools to analyze the behavior of the building. However,

knowledge of computational in this field can improve intelligent simulation and also manage simulation time. (SA) is one of the statistical methods that can calculate the relationship between input and output parameters. This method categorizes the effective parameters, and the best solution is selected using multiple linear regressions [18] SA have an essential role in better understanding building simulation issues. Because its purpose is to find out how the performance of design parameters (various) affect, the research of these parameters is also effective in the development of the optimal building [22], [23].

In this study, geometry parameters such as length, width, height, WWR, shade number, shade depth and shade angle are various. SA is useful to investigate the effect of input parameter on building performance and then performed the optimization with the simplification of design various input parameters.

1-1 SA in building optimization

Different approaches are used in SA, which can be separated according to the research and design approach [24]

Statistical methods examine the effect of these parameters by examining many output parameters relative to the input parameter [25]

Saltelli classified different approaches of SA: local method, global method, screening method.

- I. **Local method:** Changing one parameter at a time cause other parameters to being set [26]. This method provides quantitative results determining the weight of each input parameter on the output parameter.
- II. **Global method:** This method examines the effect of the parameter of around an interval despite the local method and used widely in building simulation. This method is two principal types. The first such as Standard Regression Coefficient (SRC) and Partial Rank Correlation Coefficient (PRCC), is based on regression. The second such as Sobol, is based on variance decomposition [27], [28].
- III. **Screening method:** All effective input parameters are set to use the most influential parameters and iterate the simulation. This method examines qualitative results in terms of the importance or relative impact of one parameter on others without considering the overall result of each parameter [28]

One of the most important methods in SA is the Morris method. In 1991, Morris proposed a method that would be effective if the number of uncertain parameters or model analysis was high. In 1991, Morris proposed a method that when the number of uncertain parameters or model analysis was expensive is well-suited [29], [23]

1-2 Optimization

Optimization is the process of finding the best solution between the other ones. The history of optimization traced back to 300 B.C. Euclid discussed the term optimization in the 17th century, and gradient changes led to mathematical optimization. Newton and Leibniz followed this subject with more detail, and Gauss in 1809 then proposed the quadratic method (the standard approach of regression analysis) [20].

Building optimization is a process that is performed using simulation and based on a stochastic algorithm such as genetic algorithms, particle swarm and evolutionary. These algorithms based on inputs such as various and objective functions perform the optimization process [3], [30]

This method depends on the validity of the simulation algorithm and the number of the input parameter, climate file, material, occupancy [31]

Multi-objective optimization is a common practice in building performance analysis, and its purpose is not to identify a single solution but to achieve a set of solutions based on specified criteria to the solution of the problem [32]

There is lack of knowledge about SA potential and building geometry optimization studied that examine the energy consumption and daylight performance at the same time. This research aim is to establish a novel building geometry optimization method for designer. In this paper an optimization is executed for office on 2 level:

- (1) Building geometry (length, width, height dimension), building envelope (WWR), shade number, shade depth, shade angle).
- (2) Energy and daylight efficiency

For this propose, at the first determine the SA between variable parameter then performed optimization based on effective parameter. This approach helps to reduce the optimization time and balance between daylight and energy consumption. This approach is tested trough the case study that is one office in Tehran ([Figure1](#)).

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PROCEEDINGS BOOK

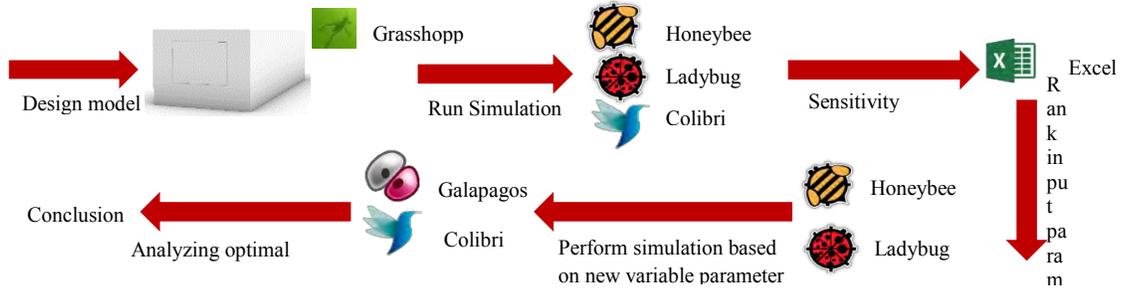


Figure1: Sensitivity-based building design optimization

2. Method

The building design is always affected by climatic conditions, so today, designers' special attention to climatic design and look for confronting weather conditions and achieving thermal comfort in the building. In the past, this science has been achieved through practical experiments and over time. These experiments are a long time and expensive, but today with the help of simulations can be saved in time and cost. Considering the objective of this research that is multi-objective optimization of daylight and energy so that can minimum Energy Use Intensity (EUI) and maximum Useful Daylight Illuminance (UDI) represent the optimal energy and daylight performance. So it is necessary to use population-based optimization algorithms or calculation based optimization algorithm.

Due to the lack of knowledge about optimization and uncertainties of design parameters, designers must ensure the default values, significantly affecting the simulation result. This effect will be small if the purpose is to compare several design options. If these parameters are examined for the optimization process, the effect will be longer; therefore, if these parameters are not selected correctly, simulation time and design cost will be increased [33]

Also, due to the time-consuming optimization process and the uncertainty of the desired parameters, it is necessary to SA before optimization. While Using SA, the effective parameters can be set in optimization, and other parameters can be constant. SA means examining the dependence of input parameters on output parameters. SA is used in different fields and is performed based on different methods (Figure2).

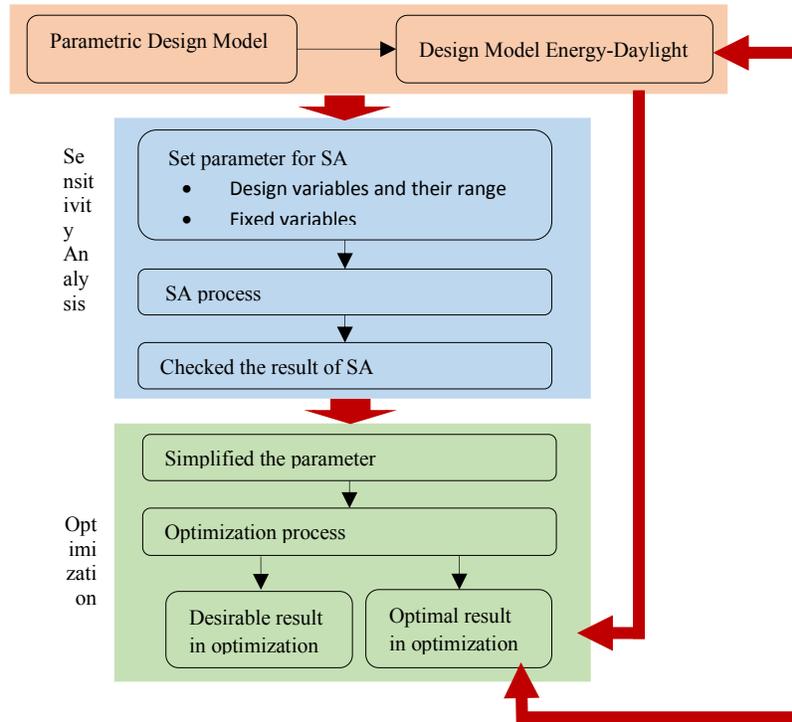


Figure 2: The procedure of the proposed method for the simulation process.

The SA method in this study is based on the local sensitivity method and SRC.

SRC: Standard Regression Coefficient gives the strength of the correlation between output and input through a linear regression model [21] ,[34].

Y can be calculated as follow:

$$y(x) = f_0 + \sum_{j=1}^k f_i(X_i) + \sum_{j>i}^k f_{ij}(X_i, X_j) + f_{1,2,\dots,k}(X_1, \dots, X_k) \quad (1)$$

$$y \in (y_1, y_2, \dots, y_N) \quad (2)$$

$$(x_i) = b_j x_{ij} + \varepsilon_i \quad (3)$$

Where y is an output, X_j is input through a linear regression model, ε_i is the error, where N is a sample size.

$$F(x) = f_0 + \sum_{i=1}^k f_i(X_i) \quad (4)$$

Input and output parameters are standardized using the variance of the model response $V(Y(X))$ and the variance of the corresponding input parameter $V(X_i)$ to make the estimated regression coefficients comparable.

$$SRC_i = \frac{f_i V(x_i)}{V(V(X))} \tag{5}$$

The absolute value of SRC represents the importance of SRC values indicating the significant influence on the output. To measure how the approximated linear model fits the building model, can use the coefficient of determination R^2 , which indicates how much of the building model variance $V(Y(X))$ can be explained by the variance of the linear model $V(F(X))$:

$$R^2 = \frac{V(F(X))}{V(Y(X))} \tag{6}$$

Low R^2 indicate a poor fit of the regression model with the outcome of the building model. The value range of R^2 between -1.0 and +1.0 [35], [36], [37].

After SA and set the effective parameter, optimization is performed based on the genetic algorithm. This method is selected based on the number of possible cases of the sample population that are more coverage to the better solution. Each population iterating the simulation, the more coverage population will be selected for the next generation. This process continues until the best solution.

A genetic algorithm is a subset of an evolutionary algorithm, and they find the best solution similarly. The genetic algorithm consists of generation options, evaluation them [38]. This algorithm is one of the practical optimization algorithms. This algorithm is based on the non-dominated sorting Evolution Strategy (ENSES) that John Holland proposed to optimize the building [20]

3. Theory

This research is based on Reinhart's office in Tehran. The representative city is chosen as the case study location: Tehran (35.68°N, 51.38°E), representing a hot climate. According to the research approach based on SA and then optimization, it is necessary to apply changes based on the primary model's research objectives: change the climate, change blind to fix shading, change door in the north-faced to the window (Figure3).

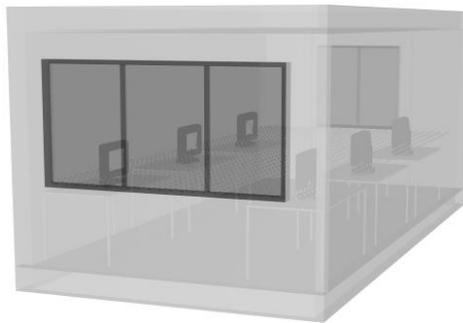


Figure3: Case study building.

The geometric model was designed in 3D modelling software Rhinoceros, which was then parametrized in Grasshopper. Grasshopper plugins, Honeybee and Ladybug, are the simulation engine. Ladybug imports standard EnergyPlus weather files in Grasshopper. This plugin allows users to work with validated simulation engines such as EnergyPlus, Radiance, Openstudio and Daysim to provide simulation daylighting and energy result validation. It also provides a variety of 2D and 3D graphics to support the result Roudsari et.al [39].

3-1 Energy modelling

After designed the office model, the thermal load and occupancy schedule is selected. The daylight and energy model are an open plan office that built with honeybee and ladybug. There is one set of building construction materials for the model in the climate zone: ASHRAE 90.1- 2010 (Table1).

Table1: Building material

Construction	U-Value (W/m2.K)
Wall	0.65
Window	3.69
Roof	0.28
Floor	0.16

thermal properties.

The office climate zone is 3B. The office is occupied daily from 8 AM to 6 PM. The number of people per area is 0.01. Ventilation rate per person is 0.0018 m³/s person. During the hour of occupation heating and cooling, set points are 20°C and 24°C, and respectively setback temperatures are 18°C and 28°C.

3-2 Daylight modelling

Since the lighting is automatically controlled, it is worthwhile discussing how the daylight simulation should be set up. The authors are using a combination of the Radiance based DAYSIM program Ward [40]

Daylight sensors are placed on a grid 0.8 cm above the floor in parametric model. The number of the sensor varies between 36 and 72, and the grid size is approximately 0.40*0.40 cm, depending on the shape of the building. Lighting measurement IES LM-82-12 promote climate-based daylighting metric Iesna [41]. The resulting lighting power density for the office of 10.1 W/m². The target work plane illuminance is 300 lux.

3-3 SA setting

After designed the geometry, selected the design parameter. These parameters are fix and various. Various parameter that selected based on climate, Building type and research objective. Climate, building shapes such as cube or rectangle, scale, building compression, number of the floor, occupancy hour, the material's thermal resistance, window shape, window type, shading type (fix, dynamic), and HVAC are fix parameters. Building Length, Building Width, Building Height, WWR, Shade Number, Shade Depth, Shade Angle are various parameters. The early stage is to perform the SA based on various parameters. The SA generated for 864 random design option that shown in (Table 2).

Table2: Parameters variation range for the SA process.

Parameter	Range	Number of Parameters
length	4-5.4	3
Width	4.2-5.5	3
Height	3-3.2	2
North_ WWR	0.15-0.23	2
South_ WWR	0.17-0.29	3
Shade number	1,2	2
Shade- Depth	0.05-0.1	2
Shade- Angle	16-28	2
Population	864	

SA calculated EUI and UDI in the base model based on various parameters. the terminated SA, required to analyze the result and rank them. The solutions result in the SA automatically export to an Excel file with using of TT Toolbox Deb [42]. This file used to create a data plot and understand the relationship between input and output parameters. The SA indicator for this study is (SRC). The SRC's result indicate a significant impact of various parameters on the performance index.

3-4 Optimization setting

When the SA process is terminate performed optimization with the simplification of design variations (Table 3).

Table 3: Parameters variation range for the Optimization process.

Design variable	Range	Description	Number of Parameters
length	[2.6-4.6]	0.2	10
Width	[7.2-9.2]	0.2	10
North_ WWR	[0.14-0.30]	0.04	4
South_ WWR	[0.21-0.41]	0.04	10
Shade number	[1-2]	1	2
Shade- Depth	[0.05-0.15]	0.05	3
Shade- Angle	[15-35]	10	3
Population	119790		

The design input parameters are connected to the Genetic algorithm for Galapagos engine, and the results of daylight and energy simulation are connected to the fitness input. Building geometry is connected to Grasshopper, and material connected to a Honeybee-Ladybug perform the analysis. Galapagos is a single objective optimization engine in

Grasshopper. The evolutionary solver determines the optimum genome that is based on a genetic algorithm. The genetic algorithm applies the principles of mutation, selection and inheritance in population generation. Population virtually equated with several individuals that form generation and when new generations are created kept the best individuals until the offspring get closer to peak value. An individual is a genome. Genes form genomes every time that a gene changes, a new genome is created.

Optimization calculated EUI and UDI in the model to calculate the relationship between design variable parameter. (Table 4).

Table4: Optimization setting

Parameter	Value	Description
Population size	50	More than recommend
The population of first-generation	250	More than recommend
Crossover probability	75%	By default
Maximum generation number	100	By default

The both of simulation result and optimization solution are analyzed when the optimization is finished. The result of each solution in the optimization automatically export to an Excel file with using of TT Toolbox [42]. This file used to create a data plot and find the best solution. Also, Galapagos show all of the solutions on a graph to find optimal design solution between them. With clicking on each solution and reinstate all of the solution can find the best solution for building geometry performance. The design geometry of the optimal solution is visually compared to the other candidate solution. Galapagos engine record and analyze the daylight and energy simulation. When the optimization is not terminated the Galapagos engine reset all design variable for the next design option and simulation continues.

4. Results

4-1 SA

SA is typically performed before the optimization process to select various parameters. This process is essential to building operation and also simplifies the optimization and reduce the simulation time [43], [44], [22].

Figure S1 show a brief of the simulation performed for SA. The simulation considered the change rate of heating and cooling energy to investigate the relationship between input and output parameters.

To measure the approximate linear model fits correlation coefficient is used for all parameters shown in Table 5.

Table 5: R² rank by Heating, Cooling, UDI.

Parameter	Heating (R ²)	Cooling (R ²)	UDI 100_2000 (R ²)
Length	54*10 ⁻²	55*10 ⁻²	16*10 ⁻²
Width	44*10 ⁻²	44*10 ⁻²	52*10 ⁻²
Height	14*10 ⁻⁷	1*10 ⁻⁶	13*10 ⁻²
North_ WWR	16*10 ⁻⁷	1*10 ⁻⁶	18*10 ⁻²
South_ WWR	3*10 ⁻⁷	2*10 ⁻⁸	75*10 ⁻²
Shade number	15*10 ⁻⁷	1*10 ⁻⁶	98*10 ⁻³
Shade_ Depth	15*10 ⁻⁶	1*10 ⁻⁶	13*10 ⁻²
Shade_ angle	14*10 ⁻⁷	1*10 ⁻⁶	12*10 ⁻³

4-2 Simulation model selection

TT Toolbox engine can find the optimum solution based on parallel optimization. This plugin allows the user to select the result manually based on its purpose. For this purpose, can use the Excel file that automatically saves during the optimization, then upload the Excel file on.

4-3 Daylight analysis result

The daylight simulation result shows that the daylight optimized in the space. The optimization indicate the improvement of daylight compared the average value. According to the fact that WWR on both the north faced and south faced are considered as various parameters, the efficiency and performance of the daylight also increase. The result shows the UDI less than 100 lx is about 2%, UDI 100-2000 lux is 86%, and UDI more than 2000 lux is 8.70%.

UDI proposed by [45] This factor is a dynamic daylight performance measure that is also based on a work plane. The purpose of it is to determine when daylight levels are helpful for the occupant. That is, neither too dark (<100) lux nor too

bright (>2000lux). The suggested range is based on the upper and lower thresholds of 2000 lux and 100 lx [45], Reinhart et.al [46].

4-3-1- window proportion

The simulation result shows that radiation in summer increase the cooling load, also increase the heating load in winter. So the optimum dimension of the window is essential to reduce the DGP. Also, according to the need to obtain uniform light in the office, the window is continued.

The simulation result shows the optimum solution for WWR for North and South faces is between 14% to 26% and 21% to 31%, respectively.

4-3-2- Shading

Shading could help to receipt the beneficial daylight so that it could be effective on equipment load. The simulation result shows the optimum solution for shading that follows:

- 1- Shade number:1
- 2- Shade depth between 0.05 cm to 0.10 cm
- 3- Shade angle between 15° to 25°

4-4 Energy analysis result

The energy simulation result indicates the equipment load such as Heating, Cooling, Electric light, Electric Equip (Kwh) for all design options.

The EUI is a factor that is energy performance in simulation which is Building energy consumption. This factor calculated by dividing the total yearly energy load (the sum of the building's heating, cooling, lighting load and equip load) on its floor area [47].

4-4-4- Building geometry

Comparing the energy consumption in different proportions indicates that the lower size of length and the higher size of width lead to decreased energy consumption. The simulation result shows the optimum solution for building geometry that follows:

1. Length dimension is between 3 cm to 3.4 cm.
2. Width dimension is between (8.4–9) cm.

5. Discussion

To find the optimum solution based on parallel optimization **Figure 4** use the daylight simulation performed with Daysim.

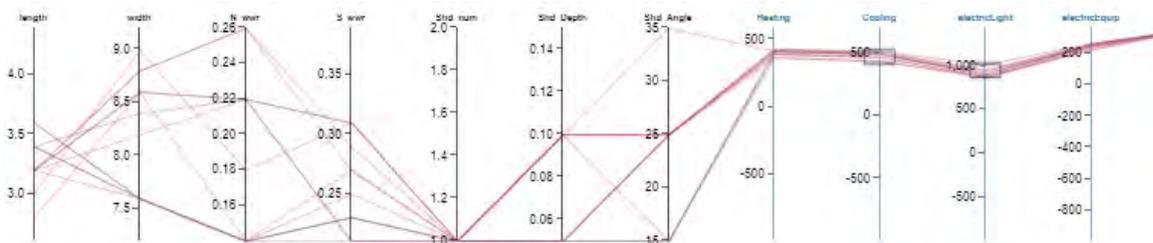


Figure 4: Parallel coordinates plot for the Selective result

The work plane grid size is approximately 0.40*0.40 cm. Different metrics have been proposed to assess daylight performance. This research-based on the hour-by-hour daylighting simulation result, yearly performance indices were developed in order to characterize a building design with a small number of performance criteria. The criterion is an annual glaring index (AGI).

AGI calculate the percentage of the work plane surface area that receive illuminance higher than 2000 lx during the occupancy hour [48]. A value above the 2000 lx causes glaring.

$$AGI = \frac{\sum_{\text{occupied hour}} \frac{A_{\text{above 2000 lx}}}{A}}{\text{(number of occupied hours)}} \quad (7)$$

AGI is always between 0 and 1. AGI of 0 means that there is no glare during occupation hour, and the AGI of 1 mean that the work plan surface is always above the recommended threshold during occupation hour. **Table 6** presents calculate of the AGI based UDI for optimum selective solutions. After calculating the AGI, calculate the energy use intensity (EUI). **Table 7** presents the calculation of the EUI for the optimum selective solution. According to this, the optimum solution has the following characteristic, length:3.2, width:8.6, height3, North WWR:0.22, South WWR:0.31, Shade-number:1, Shade-Depth:0.10, Shade Angle:25.

Figure 5 show the graphical result of daylight and energy. **Figure 5 (a)** shows the percentage of time during the active occupancy hours that the test point receives less than lux.

Figure 5 (b) show the percentage of time during the active occupancy hours that the test point receives between 100 to 2000 lux. **Figure 5(c)** show the percentage of time during the active occupancy hours that the test point receives more than 2000 lux.

Table 6: Calculate the AGI for selective optimum solution

Optimum solution	length	Width	Height	North_WWR	South_WWR	Shade-number	Shade-Depth	Shade-Angle	AGI
1	2.8	8.6	3	0.14	0.27	1	0.10	25	69*10 ⁻⁵
2	3	9	3	0.18	0.31	1	0.10	25	81*10 ⁻⁵
3	3.2	8.8	3	0.26	0.27	1	0.05	25	108*10 ⁻⁴
4	3.2	8.6	3	0.22	0.31	1	0.10	25	94*10 ⁻⁵
5	3.2	8.8	3	0.26	0.29	1	0.10	25	105*10 ⁻⁵
6	3.2	8.6	3	0.22	0.31	1	0.10	35	95*10 ⁻⁵
7	3.2	8.2	3	0.22	0.21	1	0.05	25	95*10 ⁻⁵
8	3.2	7.6	3	0.14	0.21	1	0.10	15	95*10 ⁻⁵
9	3.4	8.4	3	0.22	0.21	1	0.05	25	108*10 ⁻⁴
10	3.4	7.6	3	0.14	0.23	1	0.05	15	96*10 ⁻⁵
11	3.4	7.6	3	0.14	0.23	1	0.05	25	10*10 ⁻⁴
12	3.6	7.6	3	0.14	0.23	1	0.05	15	11*10 ⁻⁴
13	3.2	7.6	3	0.14	0.25	1	0.05	15	11*10 ⁻⁴

Table 7: Calculate EUI for selective optimum solution.

Optimum solution	length	Width	Height	North_WWR	South_WWR	Shade-number	Shade-Depth	Shade-Angle	EUI
1	2.8	8.6	3	0.14	0.27	1	0.10	25	79.585
2	3	9	3	0.18	0.31	1	0.10	25	78.012
3	3.2	8.8	3	0.26	0.27	1	0.05	25	77.041
4	3.2	8.6	3	0.22	0.31	1	0.10	25	75.847
5	3.2	8.8	3	0.26	0.29	1	0.10	25	76.485
6	3.2	8.6	3	0.22	0.31	1	0.10	35	75.859
7	3.2	8.2	3	0.22	0.21	1	0.05	25	78.445
8	3.2	7.6	3	0.14	0.21	1	0.10	15	78.402
9	3.4	8.4	3	0.22	0.21	1	0.05	25	78.442
10	3.4	7.6	3	0.14	0.23	1	0.05	15	76.833
11	3.4	7.6	3	0.14	0.23	1	0.05	25	76.824
12	3.6	7.6	3	0.14	0.23	1	0.05	15	76.824
13	3.6	7.6	3	0.14	0.25	1	0.05	15	84.767

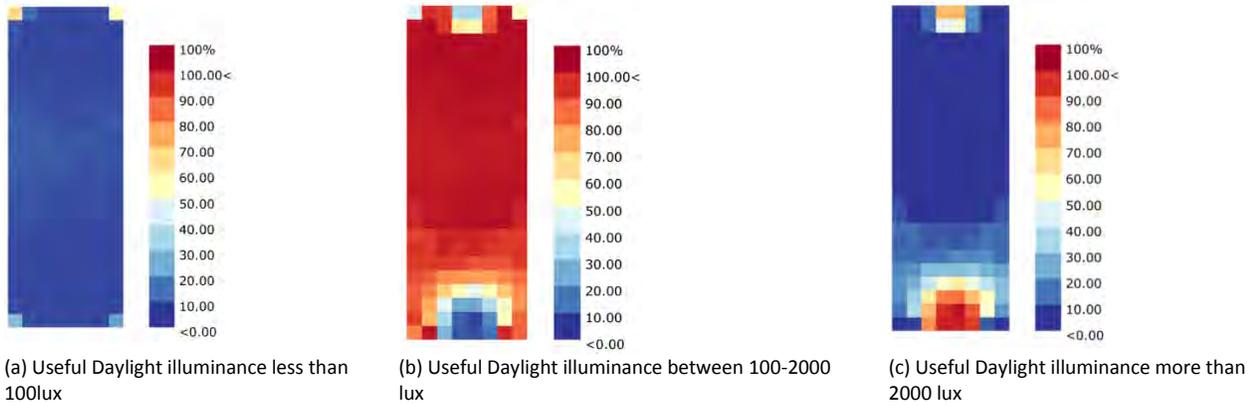


Figure S4 : Useful Daylight illuminance for the optimum model

6. Conclusion

Our result shows a clear relation between geometry energy consumption and daylight, so if the simulation process is performed before building design, the building efficiency will be improved. A building simulation has been developed to help design and operate the building. This research presents an integration of different digital tools, Rhinoceros, Grasshopper, TT toolbox, honeybee, ladybug. They were used to develop one algorithm that is intended to be used for optimal building shape. This research approach is a multi-objective optimization building process for simultaneous building and multi-objective optimization. The optimization process is based on a genetic algorithm. The SA calculate and analyze the relationship between the design parameter and building performance. The parameter ranking based on the SRC from linear regression analysis is overall in good agreement with the building simulation, despite being only defined for linear components of the model. This method could also help the simplified optimization process. The design variable shows a different level of influence in daylight and energy performance. The optimization result applied to the building indicates that the small dimension of length and the high width dimension were consistently the optimal shapes. For the future work can use SA to evaluated optimization based on thermal and visual comfort. Although the investigation presented relates to office buildings in Tehran (IRAN), the approach and methodology employed in this study can be applied to other locations and building types.

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COMMUNITY INTERIORS POST-COVID 19 AS NEW NODES FOR OUR CITIES

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Abstract

We bring attention to the reality of the Community Centers in this paper, presenting some results of the research project "Coltivare Salute.Com" funded by Politecnico di Milano as part of the Polisocial Award 2020 Program. It is proposed to present some aspects relating to the role of design and architecture after the pandemic.

The originality of the proposal consists in recognizing in the Community Centers an opportunity to provide, especially in urbanized settings, an opportunity for urban and social regeneration through a project that considers construction or reconfiguration as a primary instance, in the case of an existing context, yielding a space open to the community with a high identity value. An intrinsic specificity of the public nature of these structures is perceived in the relationship between inside and outside and an exploratory potential for the interior design in the reception.

Methodologically, the original definition of Health Center is proposed and we briefly tell how these structures are born, making a specific reference to the Italian context.

The reasons for an experimental and extremely current potential of the Community Centers are highlighted: on the one hand the substantial funding that is making it possible to implement numerically on the territory; on the other, their public value and openness to the community. Structures up to now attributable to a functionalist logic, dictated by the management of essentially health aspects, rarely in Italy represent opportunities for an investment in terms of the quality of the architectural project and interiors. One of the reasons relates to an all-Italian character regarding the presence of a conspicuous public historical heritage. The consequence of this is the reuse of existing structures with a regulatory and performance project, which can respond quickly to the provision of the health service. The transformations that are now being proposed for these structures should fully satisfy the concept of health as a person's psycho-physical well-being, adhering to one of the founding principles of the World Health Organization and encouraging preventive care and the promotion of health.

Through the analysis of case studies, some design strategies are developed to make the potential of the Community Centers manifest at an urban and architectural level.

Key Words: *health; interior; open spaces; community; multi-scale*

1. Introduction

This paper presents some results of the "Coltivare_Salute.Com" research project funded by the Politecnico di Milano as part of the Polisocial Award 2020 Program. The study aims to redefine the design approach to Healthcare Centers, now Community Centers, from structures that only provide access to primary health services in the area, to multi-faceted, more inclusive places for the community, providing opportunities for urban regeneration. On the one hand, the regenerative and catalytic role that a basic health service, especially in times of pandemics, can have in the context of urban planning is supported. On the other hand, it is highlighted how the renewed interest in these places can be an opportunity for a design redefinition capable of bringing these structures from outpatient clinics to spaces of high architectural quality, iconic, attractive and inclusive.

1.1. What are the Community Centers

To give a definition of Community Centers, it is necessary to frame the precursors of a welfare system whose development and reconfiguration has been forced by the pandemic. The original model of Health Centers had an Anglo-Saxon origin [1], then spread to other countries - in particular European countries characterized by universal health care - and now represents one of the main tools for territorial strengthening of the health and social system.

A fundamental step in the implementation of this reality at the national level was the policy promoted by the Ministry of Health (Minister Livia Turco) in 2006, which indicates the Healthcare Centers as the operational tools in the area capable of providing services, but above all of integrating the health and social aspects, of preventive care and educating about health, making people responsible for a healthier, more conscious lifestyle [2].

According to Bruno Benigni, the Healthcare Centers represent a radical and positive change in local welfare: "The Healthcare Center is an essential condition to make possible, through the spatial continuity of services and operators, the unity and integration of essential levels of basic health and social services" [3].

Taking care of the person in every aspect is consistent with the idea of the World Health Organization since its establishment in 1948: health, as a state of physical, mental and social well-being and more than the absence of disease or infirmity, is a fundamental human right.

In Italy even today, even after more than one pandemic wave, the Decree of the Regional Council of Emilia Romagna No. 291 in 2010 represents the most advanced and complete reference for the definition of the organizational model of territorial assistance services.

In fact, it is here that the guidelines for the design of the Healthcare Centers are explained. The declared goal is to direct designers towards "basic elements of homogeneity and recognition". Functional schemes and layouts refer to aseptic manuals that are badly combined with the high intent of configuring a place for cultural change, in which it is possible to propose preventive care and health promotion; not only setting up spaces to provide health services, but arranging places to involve the population to become an active and aware part of an evolving process. The indications are limited to "considerations on the sizing and distribution functionality of some rooms that are considered decisive for the proper functioning of the structure as well as for its recognisability." [4]. The guidelines make an explicit reference to the English Health Building Note 11-01 [5] which, moreover, proposed a concrete example through some images taken from significant case studies whose filing will be systematized in the subsequent update of the Health Building Note 11-01 in 2013 [6].



Fig. 1-2-3 Welcoming and common spaces: Kentish Town Health Centre, London UK. AHMM, Allford Hall Monaghan Morris Office Projects (source: Health Building Note 11-01 updated 2013)

This methodology, which proceeds through the comparison of studies by taking together the analysis of functional programs, the services offered and the spaces assigned to them, allows us to infer concrete characteristics and conditions, going beyond the abstractness of the Italian health system's regional regulation. The resources invested in health by the European Union focus attention on these territorial structures, capturing their great potential. It is precisely in this sense that the NPRR, National Plan of Recovery and Resilience [7] sees the opportunity and the historic moment to change the name of the Healthcare Centers into Community Centers.

We want to capture what was most disregarded in the previous model which responded well to the provision of health services, but was unable to fully satisfy the socio-health and social component or become a promoter of the cultural change brought about by health promotion.

The goal is to change the paradigm, emphasizing the role and importance of the Community. Community Centers can provide support for the idea of health understood as the psycho-physical well-being of people [8], intrinsically linked to the reconstitution of a healthy environment, where preventive care and health promotion can deal with the themes of old age and chronic diseases, which are constantly increasing in our societies.

It should be emphasized that, while the aspects most relevant to the provision of the health service (without which the Healthcare Center / Community Center would have no reason to exist) are the most tested and studied and follow the frequent changes in functional health models, nevertheless, the architectural aspects of space have never been a basic prerogative.

The Community Centers have the potential to become the place to host this physical transformation. They are capable of making explicit and operational the until now partially disregarded set of activities and functions for which they were born. They must set up attractive spaces in which a culture of health is promoted. The figures called to give concreteness to the potential of such a complex structure, referring specifically to the fields of sociology, medicine, medical-health management and organization, and its communication, can operate starting from a meticulous choice of location. They also can begin from a structure whose spatial arrangement conveys a sanitary certainty together with a sense of a primary welcome, consistent with the ideas of De Carli [9]. Indeed, De Carli, an important post-war Milanese architect and dean of the Politecnico di Milano during 1968, theorized that building a space means configuring the place where "the gesture of man" is welcomed and where the architectural form guides the experience of environments and their sequences.. The intrinsic character of the architecture is perceived in the interior which, in the specific case of the Community Centers, becomes particularly important.

4.1.

2.The Community Centers: an occasion of designing an architectural and urban interior

In this paper we focus on the Community Center by reading aspects of interest in relation to the role of design and architecture after the pandemic. On the one hand, these are structures whose usefulness, as a basic unit for primary care, has been greatly strengthened by the pandemic, to assist in the management of COVID 19, from disease to vaccination. They are being implemented in a variety of ways throughout Europe thanks to the huge resources allocated by the NPRR. It is therefore not exactly a new reality, but one whose diffusion will be greatly expanded in the next 10 years.

On the other hand, being public structures, or in any case realized for the public, they have the possibility of constituting new propulsive nodes within the urban fabric and have the predisposition, responsive to their function, of building physical and social relationships with the neighboring context, bringing out their strategic value.

Bassanelli wrote about the recent pandemic highlighting the dichotomy that is inherent in the very need to inhabit a place and to create limits between the sphere of relationships that concern the outside world and the inside of the house. The reasoning [10] is even more relevant today, a moment of transition in which we have (almost!) learned to live with the virus in its many manifestations and it is even more responsive, if we think of all those public places that have needed to be transformed to host large flows of people.

COVID 19 has emphasized the importance of open spaces in general, in all public structures intended as systems of daily life and as places of collective hospitality, of all covered but open mediation spaces and spaces of relationship next to the building. The virus has allowed us to visualize a sort of ideal osmotic membrane recognizable as belonging to the building itself, but external to it.

The project in the post-COVID 19 era is called upon to modify consolidated spatial arrangements to be able to respond to new emergency situations, both in cases of reconfiguration of existing spaces, and in the case of new realizations, precisely considering the structure and its surrounding membrane. Thus, on the one hand, the opportunity to affect the places connected to the Community Centers and the potential material and immaterial relationships that it can establish is highlighted. [I took out the § break] On the other hand, the possibility of designing the thresholds of a building, its edges and recognizable spatial sequences capable of weaving relationships between exterior and interior is identified. The spatial devices of the architectural project such as porticoes, canopies, thresholds, windows, together with the devices of the design of the open public space such as squares, green spaces, paths, equipment identify regenerative potential in the reconfiguration of the relationship between urban open space and internal space, as places of welcome for the community.

A double scale implicitly arises: the building-scale and the city-scale. The internal-external relationship is a kind of proximity, when it is reread linked to all the architectural devices of access points, thresholds, atriums, covered passages, shelters, etc. The Community Center contributes to creating a system, a kind of urbanity [11], when it relates to places such as squares, green spaces, avenues, and other public buildings.



Fig. 4- 5 Connected public square and inner courtyard: Waldron Health Centre, London, Henley Halebrow Rorrison
(source: photographer Nick Kane)

3.Methodology

Following the example of the Health Building Notes, it was considered effective to deduce the criteria of good practice from the analysis of concrete cases. The research considered a selection of Healthcare Centers deemed significant. We analyzed and systematized the themes and elements of the urban, architectural and interior context project, capable of constituting a reference for a strategic definition of places, from the scale of the building to the scale of the city, in order to underline the importance of the boundary between inside and outside, between the space of the the Community / Health Center and the urban space.

We try to derive some ordering principles that relate to a general quality of the project, not as an end in itself, but according to an intertwining of values that aim at a specific objective: that of transforming the Community Centers into urban reference points, in which citizens recognize each other and that they can also attend as active and healthy people.

The focus is on recognizing some potential of the architectural form, spaces and urban relationships that transcend health care methods to focus on the characters capable of working on the habitability of a place.

The criteria that are specified below are based on the idea that providing a service and doing it efficiently, whether of a health, socio-health or social nature, is not enough. Urban and architectural design can add value to the construction of a new Community Center.

The goal is to transform these places into buildings to promote the culture of health, rethinking the spaces and their use: intended not only for health services, but to become places for meeting, exchange and interactive learning. In this vision, the Community Centers become "urban catalysts" capable of attracting different people with different interests, not necessarily

linked to a poor state of health, arranging new architectural and furnishing solutions, structuring a significant internal and external relationship, responding in a precise way to the needs of a community.

4. Some criteria for a Post-COVID 19 planning of the Community Centers

With a view to assuming the Community Centers as new reference poles and engines of urban regeneration, by virtue of the collective and public mission that distinguishes them, some criteria worthy of particular attention are listed below.

- Building a systemic relationship with the public space.

The Community Center becomes an urban piece around which to put functions and themes into a system: health, social, scholastic, cultural, green, open spaces. It sets up a collective public space in the neighborhood, an integrated service center and a health culture center where prevention, promotion, training, information and socialization are carried out. It becomes comparable to places that in the collective imagination refer to the market square, the oratory, the playground, a space around which the life of the local community takes shape and develops interactions between cultures, social strata and generations, fueling social cohesion.



Fig. 6-7 The Healthcare center contributes to a part of the city: Centro de Saúde in Valenzá, IDOM (source: photographer Aitor Ortiz)

- Enhancing the existing historical heritage.

The choice of a building with an identity value facilitates the sense of belonging and recognition by the Community. It also proposes a form of sustainability in avoiding land consumption and a need to use an existing abandoned or disused public heritage that characterizes the whole of Italy in particular, but also all of Europe. The project interprets the vocation of the existing spaces and their appropriateness in relation to the new functions, enhancing their memory through the new use. Projects belonging to completely different contexts, such as the Matta sur Community Center in Santiago de Chile with the recovery of a high school, the Medical Office Renovation in Entrambasaguas in Spain, with the transformation of the old library of the small city or the De poort van Borne in the Netherland with the conversion of the Saint Theresa church, testify to a concrete approach.

- Expressing a high quality of the spatial architectural project.

It aims to integrate functions open to the community, articulating their hierarchy, different levels of privacy and relationship with the open space, through architectural choices that have as a priority the physical-behavioral dimension of the patient / user / citizen. This is the case of the Ballarat Community Health Primary Care Center in which the structuring of the double or triple heights, the internal views, the skylights, the stairs, the furnishings constitute a readable integrated system.



Fig. 8-9 Interior squares as common spaces: Ballarat Community Health Primary care, Lucas Australia DesignInc. (source photographer Dianne Snape)

- Expressing a sense of generous hospitality and contributing to the definition of an identity character for the community. This is intended to give value to the architectural project by considering that character of interiority as a foundation that alludes to the possibility of welcoming people's lives, be it an open, covered or closed space, in a multi-scale idea of the integrated project. [12].

5. Conclusion

The study of international and national experiences underlines how some characteristics of the space project are foundational in the redefinition of places generally entrusted to a functionalist-performance logic.

These reflections form a premise for the founding idea of Polisocial research which, by studying the Community Centers in an urban setting, sees them as opportunities for environmental, urban and architectural regeneration and, in this sense, builders of urbanity.

In defining new Community Centers urban design must start from within these realities by promoting new lines of action: new standards of functional organization, spatial definition, new relationships that configure spaces for the community to structure less vulnerable and more sustainable cities.

It also clarifies how it cannot be a self-referential, introverted space, indifferent to the context in which it is placed, but on the contrary it is constitutively predisposed to weave relationships with other large public systems. The COVID 19 pandemic, highlighting the fragility of the basic territorial health system, has generated the possibility of completely rethinking these structures dedicated to receiving primary care. The Community Centers, through this double register, the urban one on one side and the architectural and interior one on the other, summarize a complex project which, due to the influence it can have in the context in which it is inserted, moves at the scale of the territory, but which finds its specificity in the precise definition of all the spaces that compose it.

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LIGHT DESIGN STRATEGY OF MACERATA (ITALY)

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Abstract

Light Design Strategy and executive project: The Light Design Strategies (together with the Master Plans) are currently the most effective tools identified in order to rationalize the design interventions and control of the systems dedicated to urban lighting. The Light Design Strategy allows to intervene on the city, modifying it and requalifying it, through targeted interventions. Without making use of large urban planning studies and with the possibility to act quickly on the city with short / medium term planning. In addition, the Light Design Strategy also incorporates the "classic" themes of Lighting Design for Architecture and the city, but regenerates and reinterprets them, with the aim of changing and improving the parameters of use. Light Design, in fact, allows you to design light even with different instruments and shapes compared to the classic Lighting Design, such as composite materials that react to light, themed lighting, bright or self-illuminating objects, transparent or semi-transparent materials, light-graphics and other tools. **Executive project:** This is the first executive project created for an urban area examined in the Light Design Strategy, the objectives have been respected, from the interpretation and full exploitation of the potential of the architectural environment, up to the correct nighttime use of a space for collective use in addition to the energy, economic and management efficiency of the system. Particular attention was paid to the typological characteristics of the places, the routes, the colors and the materials and not least the dimensional and shape relationships. An overall view of the architectural space has been achieved with light. Only this uniform vision meets the objective of making the entire urban fabric homogeneous, respecting the evident material and color differences of the architecture. The quality of the light is deliberately divided between the horizontal planes and the vertical building facades. The testimonial value of the architectural emergencies of historic buildings was taken into account. We have chosen to use lighting techniques that would allow us to underline the peculiarity and distinct monumentality and architectural signs of these extraordinary architectures. This same need having a particular attention for daytime vision. We have tried to integrate the equipment as much as possible, choosing appropriate sizes, colors and shapes, where the care has also extended to the implementation of the entire system. For the Theater building alone, in addition to the white architectural light, the only one that enhances the historical aspect of the building and which will always remain in regular operation, we have used variable and colored light technologies. The colored lights will be used only for particular cultural, commemorative and social events or related to the artistic events of the theater to communicate important activities to the citizens.

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1. Introduction

The Light Design Strategy (hereinafter referred to as LDS) is a general planning document, useful for the client, because it provides strategic-planning indications for future executive projects. In particular, the LDS determines the general recommendations (but does not have specific projects) of a technical-functional and expressive-communicative nature on the night image of the city. For this reason, the conceptual models indicated are measured in relation to the performance values related to the new nocturnal perceptive use of the city. The strategy is expressed in achieving the right visual coherence of public spaces in relation to the perceptive functions of the places.

The LDS was prepared by the Light Design Course of the Academy of Fine Arts in Macerata. The program document was developed in collaboration with the Technical Office of the Municipality of Macerata, which provided the technical and documentary support necessary for the drafting work.

1.1 Light Design Strategy: not just Lighting

The LDS allows to intervene on the city, modifying and redeveloping it, through targeted interventions. Without making use of large urban planning studies (such as the Lighting Regulatory Plans) and with the ability to act quickly on the city with a short / medium term planning. In addition, the LDS also incorporates the "classic" themes of Lighting Design for Architecture and the city, but regenerates and reinterprets them, with the aim of changing and improving the parameters of use. Light Design, in fact, allows you to design light even with different tools and shapes than the classic Lighting Design, such as composite materials reacting to light, themed lighting, luminous or self-illuminating objects, transparent or semi-transparent materials, light-graphics and other tools. A further conceptual element that identifies the term Light associated with the culture of Design and where the design process of transformation becomes more evident, is the new relationship between form and function. This is carried out not only in the quality of the shape, but above all in the "skin" of the container, through sequences of luminous textures that define the product as an "architectural object". In this phase of changing reality, the architectural object is proposed as a new trend played on the use of Light, implementing a perceptual fusion of the urban scene, as a possibility of solution to the problems of today's cities. Finally, the term Light in English also means lightness. This implies at the design level the full awareness that light, as a material of the project, has its full legitimacy, if associated with concepts such as image, provisional element, transparency, loss of gravity, immateriality.... In any case, it is a *mise en lumière* of the architectural object, according to a particular vision of the culture of Design and not of Architecture. The cultural foundations of building space and function weigh on the latter, while for Light Design (and the culture of Design) the architectural subjects are only the object on which the design solutions focus.

2. Analysis

Observations on the analysis of other light (or Lighting) Design Strategies

In the first instance, we have carefully examined some LDSs. At the basis of these observations there is a patient and careful analysis of other program documents compiled by various professionals in the design of Light Design, object of reflection by the project group of the Course of Light Design of the Academy of Fine Arts of Macerata. .

We have imposed on ourselves the dual role of citizens interested in the future of the city of Macerata and of professionals with specific experiences and roles, destined to interact closely with the cultural and operational aspects of the new vision that our LDS bears.

2.1 List of LDS subject to analysis:

Creating the canvas reating the canvas for public life in bath (United Kingdom) - Plan lumière de la ville de beaune (france) - Light + darkness in the city / a lighting vision for the city of london (united kingdom) - Lighting design strategy of derby city (united kingdom) - The city of perth - lighting design strategy (australia) - The ghent light strategy in the spotlights (belgium) - Gloucester lighting strategy (united kingdom) - Lighting master plan toronto (canada) - Public lighting strategy melbourne (australia) - Streetscape design manual lincolnshire (united kingdom)

The analysis work is the first step towards a real approach to the project, useful for composing a concrete general framework of reference to define the "character of the theme" in all its aspects. On the one hand, the analysis is useful in defining the field of possible choices and on the other it constitutes an indispensable starting point and stimulus for the subsequent development of the work. For these reasons, the analysis phase is never a simple collection of generic news, but already the beginning of the project, because the information collected takes on meaning and importance and when combined together they determine a system that as a whole it is necessary to interpret, evaluate and to select. The preliminary analyzes that we have performed are of a different nature, but substantially they can be traced back to three main themes: criticalities, perceptual levels and night and day readability. For all the themes produced, it was essential to identify the privileged points of observation (focal points) and to produce day and night photographic shots respecting the same point of view, with the aim of highlighting the set of functional and morphological relationships that the subjects (buildings and more) establish with the surrounding context. Particular attention was paid to the typological characteristics of the places, to the paths, to the colors and materials and, last but not least, to the dimensional and shape relationships. The main objective of these analyzes is not the simple mapping of the sites (intended as a purely physical conformation of the subjects and the context) but rather of "places", which tend to embrace a wider dimension, not only from a physical point of view, but also mental, because they contain the characteristics of history, climate, human behavior, the ways of use that characterize the defined portion of space to which the sites are part.

2.2 Relief of criticalities

The criticality analysis is concerned with making visible the inconsistencies of the existing light in relation to the architectural environment. In particular, the red X sign on the images indicates a series of evident inconsistencies present on the places during night use, such as:

- The totality of the dimly lit place
- Excessively contrasting areas for lighting

- Relationships of visual hierarchy non-existent or not suitable for the subjects
- Poor control of the luminous flux of existing luminaires
- Excessively obvious or dazzling lights
- Functional or parasitic or polluting lights
- Wrong directions of the lights
- Dissonance of the equipment

The indications on the reference image determine the main criticality relating to the nocturnal use of the analyzed subject, similarly to the comparison with the daytime image (identical focal point).

2.3 Visual comparison of colors and materials

The images that represent the materials and their colors are linked to daytime and nighttime visual analysis. The first examines the correlation of visual perception in conditions considered "ideal" with the help of natural light incident on the surfaces. The second is the visual characteristics of the surfaces themselves, conditioned by the artificial light produced by the current artificial sources.

2.4 Visual comparison of textures

The "skin" of the building, that is the external surface, depending on the technical-constructive method of the facade, can produce particular textures, as evidence in the "urban scene" of a grammar of the members, which highlights a direct relationship with the chromatic values and architectural. The daytime and nighttime comparison of the images is therefore indispensable, as it clearly represents the peculiarities of the coloring and of the material to be respected in visual terms in the nocturnal use.

2.5 Visual comparison of equipment

It was decided to represent with detailed images the comparative analysis between the current lighting equipment, their location, size, shape and color, in relation to the individual buildings and the architectural context.

2.6 Relief of light

The measurement of the light produced by the existing pre-existing systems, during night operation, is the central part of the analysis work. During the inspections, a double survey was carried out: the night image produced in photographic shooting from points of view considered strategic for visual use (which made it possible to analyze night readability); and the instrumental survey, carried out with the aid of a luxmeter / thermocolorimeter.

To determine the lighting levels and color temperatures, point by point, in each room it was necessary to carry out a certain number of measurements, taking care to first prepare a planimetric drawing of the place (or front in the case of building facades), arrange a "graphic grid" for the survey and on the intersection of the lines place the instrument for the detection of the value.

The detection with the luxmeter / thermocolorimeter produces measurements on two fundamental parameters for light relief:

- measurement of illuminance (emitted flux Φ per unit of surface S), of the region in question (expressed in lux, unit of measurement of illuminance ($lx = \text{lumen} / \text{m}^2$)).
- measurement of the color temperature of the light source (temperature expressed in Kelvin degrees) and display of the X and Y coordinates of the CIE trichromatic diagram which determine the two basic characteristics of color: wavelength and purity (or saturation).

By exemplifying the technical descriptions, with this instrument it is possible to have the numerical results corresponding to the quality (K) and quantity (E) of the light present at the time of the survey.

These methods of measuring light, using instrumentation, allow, from a design point of view, to create an overall mapping of the "luminous climate" in which the entire architectural environment detected is subjected only with the aid of the artificial light present, produced by current pre-existing systems.

Once all the data deemed necessary had been collected, it was decided to return the numerical results directly on the night images of the various places, indicating the location of the survey with lines of different colors and numerical values, which represent the qualities and quantities of light measured.

2.7 Survey of the perceptive planes

The lines that identify the various perceptive planes on the floor plans are useful for defining the different levels of perceptibility of the places in question.

In each field of observation, the subjects that compose it (i.e. everything that we are able to visually explore) are configured as belonging to different perceptual planes, or sets of subjects placed at the same average distance from our point of view.

Perceptual planes are "planes of perspective depth", which provide the information necessary to realize one's position within the context.

Basically, the "object / background" relationship is defined with the perceptual relief, that is the relationship between subjects that are distributed in space at various distances and having different positions, meanings and functions, in a succession of perceptive planes, where the last one is it can define "background" or in perceptual / cognitive terms a spatial limit of interest. In this way, the configuration of an architectural environment is made up not only of the different "objects" contained, but also of their spatial relationship and their organization in depth scenes.

The design aspects deriving from these definitions are of two orders of magnitude:

- it is important for the user / observer to maintain a clear visual relationship and to have a good perceptual control of proximity. This allows him to easily orient himself in the environment and to evaluate the spatial relationships with adjacent "objects", but first of all to identify areas of potential danger (escape, protection, advantage).

- Perceptual depth control is also important for the observer, as he activates our sense of orientation to see, if possible, as far as possible.

Basically, everything that falls within our "foresight" is of fundamental interest for a further overall assessment of the environment, even if it cannot be explored immediately. It can only be estimated from our ability to amodal completion (in other words, our ability to reconstruct and recognize with the imagination what is hidden in various portions by one or more visual obstacles).

The lines display at least three perceptual planes: first, second and third, according to different modes of function. The first floor always represents the main subject of perception, the second the context in which the subject is placed and the third the background space, less distinguishable but still present in the perception process.

2.8 Analysis of day and night readability

This analysis operation concerns the identification of one or more geometries related to the structural character of the architectural environment in question, to guide the new strategic choices of the LDS.

We have analyzed the urban structure that makes up the various places indicated by the Municipal Administration, in relation to the routes, accesses, squares, "strong" points of reference and any "panoramic views". The aspects taken into consideration, related to a system of visual connections, are:

- the regularity or irregularity of the routes
- their discontinuity or continuity
- their geometric configuration
- structural complexity

Therefore it is possible to affirm that there is a system of connection of the urban structure when they are present, a direct visual relationship between the elements and a direct functional connection between them. The connection system helped us to identify the physical forms contained in the images and to classify them into five types of elements making up the space:

- the paths and the "building wings" • the systems of squares and large spaces • the margins • the areas • the nodes • the references

Daytime readability

The paths and the "building wings"

They are the channels along which the observer habitually, occasionally or potentially moves.

They can be roads, pedestrian streets, public transport lines, canals in some cases even railway lines. The concentration of uses or activities along a road can give it clarity in the minds of observers.

Spatial attributes of breadth or narrowness derive part of their importance from common mental association. The façade features such as vegetation details (abundant trees can effectively reinforce the image of a path), proximity to special features of the city, the visual exposure of the path itself, are also important for identifying paths. The visibility of other parts of the city. That they also have continuity is an obvious functional necessity. Long streets all have an individual character while crossbeams function as terms of visual measurement.

The continuity of the "fifth building" of Macerata was the main constant of the analysis on the daytime readability. To this constant, present in all the places surveyed, corresponds a consequent great uniformity of materials and colors, which, despite the variations present in some specific cases, favors reading, visual stability and regular constancy.

Unfortunately, it is necessary to underline that the reading of the elements that make up the street furniture (benches, shelters, advertising billboards, signage, commercial lighting, etc.) is not equally stable, which overlap in form and function and highlight different choices over time and not connected by a single furnishing plan of the urban space.

2.9 The systems of squares and wide

These are the areas of the city with a "mental extension of the image" in which the observer enters "perceptively inside", which are recognizable as some strong characteristic of identity, history and customs are widespread. The analysis of the places covered by the LDS configure clear geometries of the urban space that identify the square and wide systems.

We have identified three morphological categories:

- A. the "closed" squares, which interrupt the architectural continuity of the access roads and are defined on all sides by "building wings" (such as Piazza della Libertà);
- B. the "open" squares, which develop alongside a path, which maintain their functional and architectural identity (another model is Piazza Nazario Sauro);
- C. the "wide" ones that are formed by more or less regular deformation of the road section of the path that crosses them (the Hemicycle Towers in Corso Garibaldi is a demonstration).

2.10 The Margins

They are the linear elements that are not used or considered as paths by the observer. They are boundaries between two different phases, linear interruptions of continuity: banks, communication lines, building development margins, walls. Margins of this nature can constitute barriers, which divide one area from another, or they can be sutures, lines according to which two areas are related and joined to each other. The strongest margins are those which are not only visually prominent, but also continuous in form and impenetrable to transverse movement.

The structure of the ancient city walls of Macerata is still strongly present throughout the stretch of the ring road around the historic core. Some parts testify to the presence of original construction elements, which over time have been demolished or incorporated into the housing constructions that have overlapped them. The visual continuity of the perimeter that accompanies the ring road is given by the sum of episodes constructed and differentiated over time. The unity of materials and color is the true unifying element of the entire city walls. Not least for their presence, still significant from a historical / morphological point of view, they have the entrance doors to the historic city: Porta Mercato, Porta Montana, Porta San Giuliano. Finally, it is necessary to observe the green path that follows the geometry of the entire ring road and to a lesser extent leaning against the wall structures and largely present on the areas for pedestrian traffic (viale Leopardi, viale Trieste and viale Puccinotti) to complete the that "walls / green" system that identifies (also in the external panoramic view) the historic core of the city.

2.11 The accesses

They are the points, the strategic places in a city, they are the intensive focal points towards which and from which the observer moves. First of all, they can be ancient gates to the city, places to enter and exit a square, a crossing or a convergence of paths (such as the junction area of the "gates" of Macerata), moments of exchange from a structure architectural to another, or simply concentrations of some use or some physical-environmental characteristic (the case of vicolo Consalvi seemed emblematic to us in this regard, a sort of "tunnel" that connects two streets with great public use, via Gramsci and Corso Matteotti).

2.12 The strong points of reference

They are another type of visual elements and generally consist of a simply defined physical object. In some cases the reference point may be far away (as in the case of the Monument to the Fallen, which is also visible at a long distance from Piazza Garibaldi), usually visible from a plurality of angles and distances. Other landmarks are made up of smaller elements (such as sculptures or bas-reliefs, moldings or decorations) and are used as a visual reference by citizens. The key feature for this category is its singularity, but the role they express as a reference to the "strong image" of the city is undeniable (just think of the characteristic Loggia dei Mercanti in Piazza della Libertà).

3. Objectives of the Light Design Strategy

The overall strategy of the LDS aims to achieve a number of objectives. In particular he wants:

- Indicate new criteria for executive design
- Improve nocturnal perception with a balance of qualitative and quantitative contrasts
- Build night images of places in harmony with existing public lighting

The general strategic approach takes into account the complex articulation of the places and the proposed solutions are addressed to project priorities, which look, in particular, at the themes of functionality, cultural enhancement and today, very important, sustainability and energy saving.

3.1 The functional aspects

Functionality like security. Good public lighting helps prevent potential conflicts in public spaces. Viability, walkability, use of space, commerce, etc. these are activities that benefit directly with a correct and adequate quality of light and the balance of vertical and horizontal quantities. We also know from specific studies that have been underway for some time

that lighting plays a key role in crime prevention through real support for the surveillance of public places if they are properly illuminated. A reduction in contrast and glare, together with a significant improvement in the quality and rendering of colors and materials, can help to greatly reduce vandalism within the city's public spaces.

Functionality such as accessibility. All citizens must be guaranteed the optimal use of the public space at night and in particular to those groups of the population who often "require" interventions that are not thought of even to their needs. Elderly citizens, children and even people with disabilities can experience particular "fatigue" in living the night city. A better balance of the quantity and quality of light, consistent commercial lighting, correct street lighting uniformity, can help improve accessibility even to these categories of users. A series of measures that allow general lighting that after sunset, allows you to easily perceive the places and help orientation and movement.

Functionality such as readability. Perceiving the city at night by combining intuition and recognition to help orient oneself in space. During the day some "visual clues" are used by citizens as points of reference. These same "signs" must also be visible at night and only if the streets and the space are properly lit, the places of the city remain intelligible even in the night.

3.2 The cultural aspects

Light communicates the city. Good lighting should create a positive experience and not just satisfy the functional aspects. Good qualitative and quantitative lighting requirements must serve to reveal the public spaces and architectures that make up the urban fabric of the city. Balancing the light of the vertical and horizontal surfaces helps to improve the readability and specific identity of the place.

Light tells the story. The peculiar character of the city of Macerata is composed of a number of distinct architectural environments, which are identifiable by history and styles that combine in a spatial continuum that connects them, at different time scales, through streets, wide streets, squares and alleys. A homogeneous and coherent approach to lighting restores compositional clarity, balanced hierarchies of vision, proportionate intensity, balanced contrasts and colors of light and the visibility even at night of the "signs" of the city's history.

Light facilitates tourism. Lighting can play a key role in revealing heritage cultural heritage of the city and also contribute to improving tourist use. Therefore a Macerata Light Design Strategy.

3.3 Vision & Concept

Correct lighting design must be used not only to ensure the "functionality of the lighting" of the streets and buildings of the city, but also to promote and contribute to tourism growth, through balanced and effective "interpretations" of the places. For this reason we have included a variation in the color of the light in the lighting project because the Sferisterio monument is an open-air theater where shows are held in the summer season, thus giving the possibility to customize the events on the bill (Fig. 1).

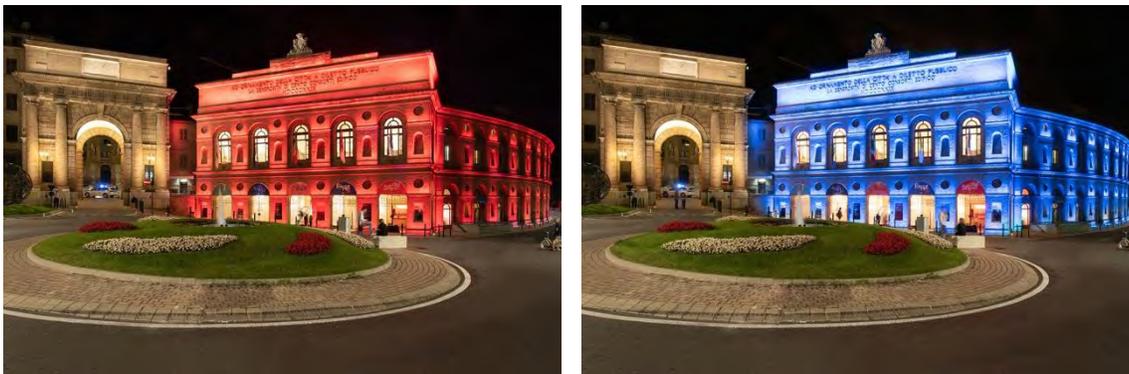


Fig. 1. (a) photograph taken after the realization of the lighting project using the red light scene and; (b) blue light scene

3.4 The economic aspects

Strategic marketing with lighting. A major economic aspect emerges in designing light for the city, because lighting can help support economic development

activities related to social life and not only through the improvement of safety. Light becomes a basic element to promote the city's economy. The lights of the shop windows shape the surrounding landscape and seduce passers-by, they are configured as meeting points, a sort of "urban room" of "social interior" where people meet, entertain relationships, spend time. Designing light for a shop also means intervening on the urban lightscape.

Environmental design with lighting. With proper lighting design, the goal of reducing energy consumption is also achieved. The strategy must be oriented towards a complete control of every form of irradiation of artificial light outside

the areas to which it is functionally dedicated and in particular towards the celestial vault. Furthermore, it is also necessary to check any direct illumination produced by the lighting systems on objects or subjects that do not need to be illuminated. Finally, it is necessary to adopt selection criteria and maintenance parameters on lighting technologies. It becomes important to measure the luminous efficiency (lm / w) which is the ratio between the emitted flux, expressed in lumens, and the absorbed electrical power expressed in watts. It expresses the efficiency of a lamp or a lighting fixture. Therefore, the higher the luminous efficiency, the cheaper the operation of the light source.

3.5 *The objectives of light*

The criteria recommended below are based on the technical-functional and expressive-communicative contents of the project strategy and are intended to provide guidance on the measures to be adopted in executive projects. The indications on the lighting techniques, the color temperatures, the visual hierarchies, the photometric functionality of the equipment, the types of lighting technologies, are understood to refer to the individual intervention methods to be adopted in the places covered by the LDS, under penalty of non-veracity of the simulations. Failure to comply with the recommendations will result in negative and opposite results in relation to the LDS strategy.

In addition, the criteria set out were based on the intention of finding unique descriptive methods, while maintaining particular attention to the uniqueness of the places as "network elements".

A coherent approach to the lighting of these "network elements" will help create the right visual cohesion which is the primary objective of the LDS. For example, while the quantity of light is distinguished for each type of subject, the use of the quality of light tends to recompose the whole set of places in a coherent vision.

From concept models to the identification of visual hierarchies

The purpose of the development of the concept models was to represent the system of new visual hierarchies that the analysis of the places has allowed us to identify. They constitute the conceptual basis of the technical-functional choices of the LDS and in this sense they are to be considered as the first useful recommendation for directing executive interventions. The perceptual schemes on which they are based have the task of defining the main visual relationships that bind the articulations of the places that the night lighting must make perceptible. At the same time, they are the tools for checking and controlling the light design system on an expressive and communicative level and the models recommended for interventions relating to technical-functional lighting.

Some general indications of the LDS emerge from the models devised:

- structure the night image of the city, with adequate differentiation of quality and quantity of light (different recommendations for horizontal and vertical planes)
- make the indications on the technologies of light sources uniform
- the enhancement of vertical floors and "building wings"
- the enhancement of the walls and doors
- the tendency to make the equipment as "coherent" as possible with the architectural environmental context, in terms of morphology, size and color.

3.6 *Lighting techniques*

The LDS indicates below the lighting techniques to be applied in executive projects. Given the countless situations, it seemed necessary to analyze the visual needs of each and give indications on the general characteristics of the lighting fixtures, to obtain the best result (fig.2).

The lighting techniques, in our opinion useful for the technical and visual needs of the city of Macerata, can be grouped into five general categories:

- Projection light
- Accent light
- Grazing light
- "Characterizing" light
- "Effect" light



Fig.2. (a) analysis board; (b) visual light concept

4. Conclusions

Our vision stems from a way of approaching the LDS project that is based on the interpretation of the city, connected to the concreteness of the visual experience, because in this way the urban scene appears to the observer as a perceptual configuration. This new approach no longer aims, therefore, at creating a composition of light controlled only by apparent "aesthetic laws" or worse still purely functional, but rather at design methods that have as their main objective that of making "recognizable and visible" the identity elements of the city (Fig.3).

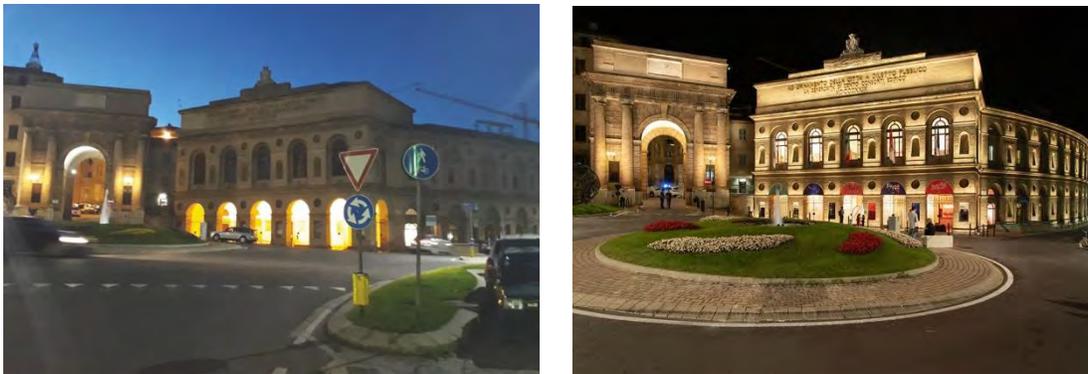


Fig.3. (a) before the lighting project; (b) after the realization of the lighting project

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THE ABSTRACT LAYER OF THE LIVING ROOM FURNITURE

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Abstract

Abstract space, according to Lefebvre, is defined as spaces created by planners, engineers, architects, investors, geographers, urbanists, and similar professionals and technocrats [1]. Abstract space has become the dominant space in capitalist society because it is intrinsically dependent on the relations of production. When it comes to the abstract dimension of the living room and its furniture, the elements to be considered are the "living room" setup created by designers, interior/architects and similar professionals, and the reduction of daily life by these professionals in question. In this paper, the living room spaces, and furniture introduced and produced by external actors are investigated in relation to fieldwork conducted with eight middle-class households based in the urban quarters of Istanbul. Through the interview analysis, it is possible to examine the first theme under the heading of the 'Living Room Norms of the Furniture Industry'. Designs made by abstracting and reducing the daily practices of the users in the living room, within the logic of mass production, and the norms disseminated through furniture store showcases, furniture and housing advertisements mostly created this theme in the users' eyes. Most of the participants acquired their furniture in the form of dining sets and sitting room sets, as offered by the furniture industry. An additional theme 'Spatial constraints and orientations' emerged, which is related to the living room space created by external actors and the directions and restrictions of the living room space to users. It takes into account the relations and problems of the user regarding the living room plans, setups and features.

Key Words: *living room, furniture industry, furniture design, material culture, abstract space*

1. Introduction: The Abstract Dimension of Living Room Furniture

Conceptually, 'home' encompasses many different qualities and possibilities [2]. Being first and foremost a shelter, it is a place that people use to escape from the outside world, and to rest and relax. In this sense, the home embodies a variety of private and personal practices [3]. It does, however, have common and formal aspects as well. The living room is often referred to as the most public space of the house in literature [4-5-6]. The living room is primarily and profoundly the area where house members remain at home with strangers, convey information regarding themselves to other house members and the world outside and present their identities and social status. The ambiance of spaces, objects and furniture in the house is also affected by spatial notions and concepts.

According to Lefebvre's definition of abstract space, abstract space is space produced by planners, engineers, architects, investors, geographers, urbanists, and similar professionals and technocrats [1]. Abstract space is the dominant space of capitalist society because it is internally dependent on the relations of production and the order that these interactions necessitate and, accordingly, on knowledge, signs, codes and opposing associations. It can also be defined as connecting consideration of time and space to social practices such as industrial production, architecture, and urban studies. Reduced models constructed by a particular expert are abstractions designed with reductive application in mind and require establishing a specific order and defining its components. Therefore, Lefebvre emphasizes that abstract space is the space of capital: it plays the main role in the production of space and has a distinctive effect [1].

When it comes to the abstract layer of the living room and its furniture, the elements to be considered are the "living room" setup created by designers, architects, planners, engineers, investors, industry-related investors, and similar professionals, the "living room furniture" components defined in this setup, and the daily life reduced by the professionals in question.

As Lefebvre states, abstract dimension holds an extremely important place in the production of the living room and the furniture it contains, since it is the prevailing space of the capitalist system [1]. It disseminates the norms and standards on what furniture will be in a living room, what actions will be taken with the furniture, how the furniture will be placed and arranged on a people-to-people level. When designing and marketing living room furniture; that is, when one is involved in the industrial production and consumption chain, it is impossible to avoid making predictions, reductions, and abstractions within the context of the users' actions in the living room and daily practices. Industrial production brings certain standardizations and stereotyping in terms of both product and space setup. Thus, the furniture and other units that users acquire for their living rooms become products based on industrial production references and criteria. The capitalist system, as it does with other products, continues the consumption of industrially produced furniture by appealing to the consumption ideals of the users through cultural industries.

In this paper, living room spaces, and furniture introduced and produced by external actors, i.e., designers, architects, investors, geographers, urbanists, and similar professionals, will be investigated in relation to the fieldwork conducted with eight middle-class households based in the urban quarters of Istanbul. The implications of the abstract layer of the living room on the participants' definition and acquisition of the living room will be discussed.

2. Research Methodology and the Fieldwork

After a preliminary study involving thirty-seven people, semi-structured in-depth interviews were conducted with a sample of six married and two single participants, and participant observations were made in the participants' living rooms between the years 2013-2016 [7]. The interviews each lasted between 45 minutes to 2 hours. As McCracken stated, the number eight is a sufficient number for in-depth interviews – which comprise the main focus of this paper [8].

Table 1. Demographic properties of the fieldwork participants

	Occupation	Education	Age	District
Participant 1a	Engineer	M.A.	36	Kozyatağı
Participant 1b	Engineer	M.A.	36	Kozyatağı
Participant 2a	Design-Academician	Ph.D.	34	Etiler
Participant 2b	Design-Academician	Ph.D.	34	Etiler
Participant 3a	Architect	Ph.D.	33	Pendik
Participant 3b	Engineer	B.A.	33	Pendik
Participant 4	Insurance Regional Manager	B.A.	41	Batı Ataşehir
Participant 5a	Design-Academician	Ph.D.	47	Batı Ataşehir
Participant 5b	Engineer	B.A.	43	Batı Ataşehir
Participant 6	Interior Architect	Ph.D.	40	Teşvikiye
Participant 7a	Fashion Designer	B.A.	35	Gayrettepe
Participant 7b	Sales Manager	B.A.	40	Gayrettepe
Participant 8a	Primary School Teacher	B.A.	35	Feneryolu
Participant 8b	Senior Consultant	Ph.D.	35	Feneryolu

The research covers the furniture in the living room area of middle-class houses in the city of Istanbul. Theoretical sampling method was used for the selection of the living rooms where the research would be conducted. The goal was to create a representative sample of the social group that can serve as new cultural mediators or cultural entrepreneurs with the potential to transfer the cultural practices they have adopted to other social groups [9]. Interviews were conducted with

married couples with the participation of both men and women. In some couples, while one of the spouses was the dominant interview actor, the participation of the other spouse was somewhat limited. Among other couples, participation was much more balanced. During these interviews, although the couples often made statements that supported each other, they did disagree on some points. These distinctions were noted during the interview process and in the subsequent analysis phases.

First, demographic questions were asked. Then came the questions revealing the perceptions of the 'abstract' dimension of the living room and furniture. This section examines the norms related to the living room and living room furniture, which have been imprinted into the minds of users by the furniture industry. Therefore, an effort was made to elicit abstract ideas about furniture from the participants regarding the living room space. The questions asked were:

How would you define the living room part of the house?

What are the elements that make the living room a living room?

What element if removed, would stop the living room from being a living room?

How did you decide to purchase your current living room units?

As a result of the qualitative analysis conducted within the scope of the field study, it has been determined that the 'effects of external actors on the user' is an important dynamic in the transformation mechanism of living room furniture. Here, external actors include all the people, institutions, professions, and social norms other than the user, who plan and design the living room, furniture, and life. In this sense, patterns defined as 'room norms of the furniture industry' and 'spatial restrictions and orientations' emerged among the sub-divisions of this dynamic.

3. Emerging Repetitive Patterns Referring to the Abstract Dimension

Through the qualitative analysis of the fieldwork, two themes emerged corresponding to the effects of external actors such as designers, architects, manufacturers, planners, and market forces on the idea of the living room in the eyes of the user: the setup of the living room and its content, and their relationship with all these. It is possible to examine the first theme under the heading of the 'Living Room Norms of the Furniture Industry'. As previously stated, abstract space, is the space of architects, designers, bureaucrats, and technocrats where everyday life is abstracted and designed through reduction [1]. This model is based on the relationship between the configurations created by market actors and the personal and private practices of the user; it provides insight into how these configurations affect the user's personal uses. The second theme 'Spatial Constraints and Orientations', addresses the living room space created by external actors, as well as the directions and restrictions that the living room space imposes on users. It included the user's relationship and issues with living room layouts, settings, and features. It dealt with the process of arranging furniture designed by architects and designers in a space created by the user.

3.1. Living Room Norms of the Furniture Industry

'The Living Room Norms of the Furniture Industry' appeared as an important pattern in the analysis of the participants' furniture acquisition process and dynamics. Designs created by abstracting and reducing the daily practices of the users in the living room, within the logic of mass production, and the norms disseminated through furniture store showcases, furniture and housing advertisements, interior design and magazines about decoration created this sub-theme on the user. This sub-theme appeared frequently, in the eyes of the participants, particularly in the analysis of the layers of the living room concept and the dynamics of acquiring living room furniture.

Stereotypes of the furniture industry such as armchairs and dining tables, actors of the industry; the life of businessmen, designers, producers, and managers in the living room are included in the norms of the "abstract living room" which is created by reducing it within the framework of certain assumptions and certain standards. The effect of these norms on the users has been frequently encountered, both in their perceptions of the living room and in the process of furniture acquisition. Participants mostly used these norms and stereotypes when describing the living room.

Table 2. Companies from which the participants purchased their furniture.

Living Room 1	Living Room 2	Living Room 3	Living Room 4	Living Room 5	Living Room 6	Living Room 7	Living Room 8
IKEA	A furniture store in Antalya	Modoko Furniture Site–Tuna Botoso	Modoko Furniture Site	Siteler Furniture Site	Siteler Furniture Site	Masko Furniture Site	Modoko Furniture Site

		Furniture					
Mudo Concept				Tepe Home	Warehouse		
Ünal-İş				A furniture store in Maltepe, İstanbul	Mozaik Furniture		
				Kelebek Furniture	IKEA		

As seen in Table 2, all the participants purchased their living room furniture from mass-production furniture companies. This situation also highlights the impact of the furniture industry's fiction and norms on the physical layer. Tables 2 and 3 show the list of furniture in the living rooms of the participant group for whom fieldwork was conducted after all interview analyses were completed.

Table 3. Dining Room Furniture (S refers to Set Furniture).

Dining Room Furniture							
Living Room 1	Living Room 2	Living Room 3	Living Room 4	Living Room 5	Living Room 6	Living Room 7	Living Room 8
1 dining table (S)	1 dining table (S)	1 dining table (S)	1 dining table (S)	1 dining table (S)	1 dining table	1 dining table (S)	1 dining table (S)
1 dining bench (S)	6 dining chairs (S)	6 dining chairs (S)	4 dining chairs (S)	8 dining chairs (S)	6 dining chairs	6 dining chairs (S)	8 dining chairs (S)
3 chairs		1 sideboard (S)	1 bank	1 sideboard (S)		1 sideboard (S)	2 showcase cabinets (S)
			1 sideboard (S)				1 library

Table 4: Sitting Room Furniture (S refers to Set Furniture).

Sitting Room Furniture							
Living Room 1	Living Room 2	Living Room 3	Living Room 4	Living Room 5	Living Room 6	Living Room 7	Living Room 8
2 double couches (S)	1 double couch	2 triple couches	1 triple couch	1 double couch (S)	1 double couch (S)	1 L Couch	2 double sofas (S)
1 TV unit	2 bergere	2 bergere	2 bergere	1 triple sofa (S)	2 single chairs (S)	1 centre table	2 bergere (S)
4 wall shelf	1 TV unit	1 TV unit	1 TV unit	1 TV unit	1 centre table	1 TV unit	1 TV unit
1 bookcase	1 bookcase	1 bookcase	1 centre table	1 centre table		1 bookcase	1 TV stand
2 corner cabinet	1 centre table	1 centre table	1 coffee table	3 coffee table			1 centre table (S)
1 coffee table		4 nesting table	1 service unit	1 display cabinet (S)			1 coffee table (S)

			2 wall shelves	2 wall shelves			1 display cabinet (S)
			1 wall storage unit	1 pouffe			1 child's table and chair

As can be seen in Tables 3. and 4., the furniture units of the participants consist of furniture stereotypes belonging to the furniture industry. Furthermore, the living rooms are divided into sections such as the dining area and the sitting area. These again point to the living room norms established by the furniture industry. The furniture of the participants whose furniture units are sets are marked as (S). The purchase of furniture from a specific set made an emphatic reference to the execution of norms.

A common point that emerges in terms of the way participants attain their sofas is that the shopping is made from companies that manufacture furniture in mass quantities.

As shown in Table 2, all participants purchased living room furniture from companies that use mass production methods. This situation points to the influence of the fictions and norms of the furniture industry.

The armchairs and couches of the participants consist of single, double, and triple sitting units or their combinations. Wing chairs are also added to the double and triple couches. In Living room 1, Living room 3, Living room 4, Living room 5, Living room 6 and Living room 8, it was observed that the combinations related to the armchairs were the combinations recommended by the furniture company from which the purchase was made. As seen in Tables 3 and 4, the participants purchased their seating units in sets. This again refers to the stereotypes and norms of the industry.

Through the fieldwork, participants were asked, "What do you think are the elements that make the living room a living room?" or "What element if removed, would stop the living room from being a living room?" The texts containing the answers to the questions were coded and the effectiveness of the norms and stereotypes established by the furniture industry in the eyes of the users were determined. The participants answered the question "What do you think are the elements that make the living room a living room?" Various answers to the question are as follows:

"Well, of course the seating units. If I'm on my own, I desperately need the TV. Seems like it's about loneliness. For example, I care about having sound there, even if I'm not watching it. This may be replaced by the radio from time to time. Armchairs, comfortable seats. I find comfort from the dining table as well. I think it's important."
(Participant 6)

Participant 5a, who acquired her furniture as a set, stated that each piece of this set is necessary for the living room: "Seating elements. Horizontal plans. A table...well...chairs. For eating. There are also the storage units. Need it all. (Looks at the furniture in her living room) So, this is everything you need." (Participant 5a)

The researcher next reworded the question and asked, "Well, what element if removed, would stop the living room from being a living room?" The answer to the question by Participant 5a was as follows: "Seats are in first place. You need to sit. With just a table, it wouldn't be a living room. You can get rid of storage units if needed, but if a number of seats or a number of tables were to be removed, the living room would no longer be a living room." (Participant 5a)

Participant 6 frequently used familiar, conventional living room furniture and layout patterns while defining and determining the elements that make up the living room. This situation is exemplified by elements defined by participant 6 such as sitting units, the television, and the dining table. Particularly, the partition of the living room into a dining and sitting area and the emphasis on establishing relations between these areas is representative of adopting the conceptualized living room layout pattern. However, there are cases where Participant 6 goes beyond these conventions. Defining the working unit in the living room is an example of this. In addition, the fact that participant 6 does not include units such as the sideboard, showcase and nest when counting the basic elements that make up the living room demonstrates that not everybody is dependent on all the living room furniture patterns.

Participant 7a, while listing the elements that define the living room, counted the seats first and then the dining table: "I don't know, but it might be an armchair. Could be wide seats. Again, a guest table if it can fit. It could be the dining table." (Participant 7a) For Participant 1b, the basic elements that define the living room are the armchairs and the dining table.

Most of the participants bought their furniture from the stores of furniture companies which manufacture furniture using industrial methods. In fact, it has become common to buy furniture from furniture companies such as Masko, Modoko and Sitelcer. When looking at the living room setups and furniture offered by these furniture companies and their websites, certain standards and stereotypes can usually be seen. The living room is generally divided into two basic parts, the dining area, and the sitting area. Certain units were designed for both parts, typically in groups. Sitting groups were produced for the sitting area, and dinner sets were produced for the dining area. Dinner sets usually includes a dining table, chairs, a display cabinet, a sideboard and a coffee table while the sitting group covers furniture such as sofa sets and TV units.

Abstract living room norms make references to the living room life of the users through the living room setup and furniture stereotypes presented to the market in this way. In this context, the constructed living rooms roughly refer to practices such as hosting guests in the living room, sitting, resting, and watching television.

Within the scope of the sample, the living, eating, drinking and entertainment units envisaged for living room life are mostly in the living rooms, as set by the furniture industry. Participant 3a conveyed the way she acquired the armchairs using the market's 'sitting group' terminology: "That's why we liked the furniture as two doubles or two triples. We looked at their size. We found the dimensions were appropriate, for our living room. I had already drawn it." (Participant 3a, female)

Participants 5a and 5b went to a furniture site with mass production furniture stores to select and purchase furniture. This purchase went together with their marriage. The furniture they bought entailed the living room furniture stereotypes of the furniture industry: "The sofas are from Tepe Home. The coffee tables are from a furniture store in Maltepe. The table, chairs, sideboard, and that display cabinet are from Kelebek Furniture." (Participant 5a).

Two situations can be highlighted here. First, the purchased furniture consists of familiar patterns: the sideboard, display cabinet, coffee table, dining table, etc. Moreover, these items are purchased from firms (Tepe Home, Kelebek Mobilya, etc.) that mass produce and maintain the system that reinforces the stereotyping of the furniture (hence the living room space).

Dining table and chairs, the sideboard and display cabinet are in the form of set furniture. Participants 5a and 5b physicalized the stereotypical dining area setup of the living room within the framework of their own living room, by acquiring a complete dining room set as a whole. Along with marriage, the activity of buying furniture and building a house also complies with the norm of complete marriages mentioned by Ayata (1988)[5] and Ulver-Sneistrup (2008)[6]. The dining table they bought is collapsible. This is a common feature for dining tables which allows for expansion and hosting more people when guests arrive.

Participant 1b (female) describes this situation regarding living room stereotypes from her own point of view: "Well... in the past... err... for the first time, I wanted to buy myself like some nice things, here they are... I bought a dining room set from a butterfly... A Kelebek (the name of a Furniture company in Turkey which literally means butterfly) dining room set, and here are two three-and-a-half sofas." (Participant 1b, female)

Participant 5a (female) describes the seating arrangement in her former and current home in the language of market stereotypes:

"Our previous furniture was made up of a triple, a double, and two singles. But we didn't want that layout, that arrangement here. So, this side and this side. One is long, one is slightly shorter. Just two long sofas. They call this one a double, but this is two and a half. It's longer." (Participant 5a, female, designer – academic)

Parallels can be drawn on how the participants purchased furniture sets; they kept their furniture shopping limited in terms of time and place, and showed a tendency of buying complete furniture sets from a store that they trusted or had reliable reference on.

Participant 3a and 3b bought all their living room furniture from the same furniture store and all as a set: "From Modoko. Tuna Botoso Furniture... We bought all of them from the same place... so, the dining table and chairs, the dining set, the sideboard... err... the sitting group... these are two three seaters. Two wing chairs. We bought the TV unit, the coffee table, and the side tables all from the same thing." (Participant 3a, female, architect-academic)

Participant 8a and 8b followed a similar path to Participant 3a and 3b. Again, they bought a complete set of furniture from a furniture store they liked on the Modoko Furniture website.

Participants 7a and 7b also purchased their furniture as a set, in a very short period, from a furniture store they determined on the Masko Furniture Site: "When it comes to living room furniture, I believe it's a hasty decision. Because we don't have a lot of time or options." (Participant 7a, female, fashion designer)

The norms of the furniture industry have been remarkably effective in the participants' perceptions of the living room and the way they acquire their furniture. However, when the experience layer of the participants' living rooms is analysed, it is observed that together with the practices made possible by these norms, a wide variety of different daily routines and needs such as working, ironing, playing games, and doing sports are also in effect.

3.2 Spatial Constraints and Orientations

The size and borders of the living rooms played a key role in the participants' choice and placement of the furniture. Hence, they paid particular attention to the dimensions of the furniture they bought and avoided buying extremely large furniture.

"...It is necessary to choose the items very carefully. Because every square centimetre here has value for us. For example, if you ask us how the selection of the sofas was for us, when I look at the sofas, the furniture is exceptionally large. There is a lot of volume both on the back and on the sides where you put your arms, which actually doesn't work for us." (Participant 1a, male, engineer)

Participant 3a (female) avoided acquiring large couches with non-functional areas:

"First of all, they seem very bulky and do not look very elegant. I mean, its contours are so big...Err... and linear... well... that's why the sitting area is just too much. It's not useful. For example, the arm rests are very big, very wide, but they do not serve a purpose. They have no real function... Or the area where we are sitting is very wide, there are too many pillows. It's a waste of space..." (Participant 3a, female, architect-academic)

Spatial constraints were found to have a profound influence on the acquisition of living room furniture by participants 1a and 1b:

"...when changing the table, 'unfoldable', solid, but still not too large, for example this table is 180cm x 90 cm. Usually, there isn't this measurement. It's usually around 200cm. So, it's like a temporary fix, it shouldn't stick out or block the way, but at the same time, it should provide the features I want. Yes, it won't seat 10 people but we are never 10 people in the living room anyway, or very rarely does this ever happen." (Participant 1a, male, engineer)

"Even this lamp's... First, we look...how many meters it opens, how much it extends. For example, it is coming from that end. Does it prevent you from coming in and going out? Are you tripping over the marble, are you bumping your head? Unfortunately, we have to think about these things. When it is a limited space. I'm sure if we had had a 55-meter square living room, we would have been freer in getting and placing things. However, when your limits are obvious, you have to think twice when placing things." (Participant 1a, male, engineer)

The size and layout of the living rooms played a significant role in the selection and placement of furniture for participants 5a and 5b. For example, they did not find some of the units (single seats) included in the new seating group suitable for their living room:

"Actually, this living room is not a very big living room. It's a small living room, just over thirty square meters. When we put the singles of this here, this place becomes a narrow living room. It's a very tiny place. But in terms of feeling...we chose them low so that they look wider. They had to be low because there is a window behind them. Let light in. Had it been a high seat, it would have blocked it." (Participant 5b, male, engineer)

One of the criteria that participant 1a and 1b considered when buying seats was that they fit in the living room and that they did not fill up the living room by occupying large spaces. When they were looking for armchairs in furniture stores, they found the existing products to be too large: *"For example, if you want to know how the armchair selection process went for us... looking at the armchairs now, the items are extremely large. There is a lot of volume both in the back and at the sides where you rest your arms, which is quite useless for us." (Participant 1a, male, engineer)*

The example given for the furniture that both participant 1a (male) and participant 3a (female) described as large and bulky and avoided having in their living room was "Collectable Furniture": *"Straight, linear, somewhat bulky. Bulky, big... too many unused elements on it. The armrests are very wide and come all the way down. The width of the sofas are too large. We tried not to show preference for items like that. As we do not have the room." (Participant 3a, female, architect-academic)*

Spatial functionality and orientation of the space were some of the most important criteria that Participant 6 was influenced by when setting up the living room and making decisions.

"...that's the kitchen, the open door. So, it's easy to serve people. I mean, functionally, it seems very counterproductive to serve food and drinks by navigating through the sitting area. So, that's the first thing. Another thing, the dining table is typically the least used area in the living room. I didn't want to fill the front area with it. I mean, I spend most of my time here. Consequently, there's more natural light and a stronger bond with the street on this side. It is like an L shape here. It's separated by the beams and stuff over there. It has a definition of its own. It makes me feel like this space has a function. I can sit here and do my work there. Since it was set up, since I first moved in, it's been like this. This arrangement has never changed. In other words, by considering its functions..."

Through the analysis, it is possible to see how the produced space is influential and determining while the participants set-up their living rooms and the relevant furniture.

4. Discussion

Both the furniture industry and society itself have produced norms and standards for the living room furniture and life. Many of the participants in this study were influenced by these elements and internalized them to a certain extent and at various levels.

While defining living room space and acquiring living room furniture, the participants mostly referenced the codes, terminology, and norms of industrial and partly social productions of the living room. However, in the layer in which the furniture is experienced, a dominant individuality performance has been detected in terms of the daily practices of the participants. It has been observed that in the living rooms where the effect created by these external actors is established by

internalization, many routines and activities appear that are different from the living room life indicated by the aforementioned norms.

Different participants coped with this contradiction in different ways. After purchasing a conventional dinner set, participants 1a and 1b realized that working in their living room is more important and effective than hosting guests. They have acquired a new table and new chairs that may be suitable for the act of working. Participants 2a and 2b, 5a and 5b, 8a and 8b used their tables with conventional dining table features (including expandability) as semi-built work units.

The fact that the influence of industrial and social external actors is not left out by internalization has created an interesting reference point and is an important finding within the scope of the current qualities, consumption patterns and aesthetic taste of the new middle class. Furthermore, furniture consumption showed that the participants did not put their individual and unique tastes and preferences into play during the consumption phase [10]. Even though more conformist in acquiring furniture, there is a more individually oriented faction (and any other factions this faction may represent) while interacting with it.

Obtaining living room furniture as a full set, envisioning the living room space using mass production constructs and succumbing to sectoral norms such as sitting groups and dining room sets can also be considered a social norm. Particularly, entire living room sets purchased within the scope of marriage preparations are a symbolic consumption that indicates the value given to marriage in a way [5]. Therefore, in this sense, it can be pointed out that there is a relationship between the productions of the industry and the maintenance of social acceptance and norms. The normed products and fictions at the intersection of these two phases dominated the living room understanding and furnishing of the living room at various levels. The execution of mass production standards and norms can also be observed in this respect. Mass production furniture, which is referred to as "designed through the reduction of everyday life", took its place in the living rooms of the participants [1]. Most of the participants acquired their furniture in the form of dining sets and sitting room sets, as offered by the furniture industry. Acquiring the units as a team underlined the compliance with the abstract norms.

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SECOND NATURE: RAGE AGAINST THE MACHINE

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Abstract

Where technology and nature are traditionally seen as opposed, they now appear to merge into a *hybrid* network. This impacts not only the natural and human systems of our world, but they are also intertwined in all aspects of frontier technologies like big data, the internet of things, machine learning, robotics, and biotechnology to create new dimensions of sustainability. In this paper, the seemingly unprecedented opportunities for the implementation of sustainable developments with recent technological innovations are exemplified by design approaches, known as biomimetics, biomimicry, and sustainable hedonism. These are also discussed critically as they pose considerable ethical and ideological concerns about the environment, privacy, security, and data ownership. All this *hybridity* opens up challenging questions about architecture's position: will it be able to be involved in these developments in a critical way, or will it just serve it?

Key words: *Late-Anthropocene; frontier technologies; architecture; sustainable hedonism, parametricism*

1. Introduction

The advancement of digital technology shakes the principles of architecture to the core, requiring a radical reconceptualization of its practices for sustainability in the Late-Anthropocene age. The key hypothesis of this paper is that contemporary and future architectural manifestations of sustainability will be exclusively driven by artificial relations and technological innovations. First, this process is examined by evaluating the major role of technology in the changing nature of conceptualizing sustainability, shifting from the confined role of being instruments that serve human needs by doing *physical* tasks, to the more far-reaching figure of smart artifacts that do *mental* tasks by using the technology of machine learning that seems to be becoming man's *second nature*. Second, the impact of this development is explored through two perspectives of contemporary sustainable design. The first is *biomimetics* and *biomimicry* that claim to go beyond using nature as mere inspiration for aesthetics and shape but instead applying structural principles that are found in natural environments and species. The second is known as *sustainable hedonism* based on the assumption that design and architecture can be economically profitable as well as environmentally sustainable, which improves the quality of life and leads to human enjoyment and pleasure. Furthermore, the practical application of both perspectives is briefly explored and illustrated by a discussion of architectural projects. In a concluding critical and speculative reflection, both parts are synthesized, and our superposition is explicated.

2. Technology as man's *second nature*

Over time, the effect of technologies has become increasingly influential on all facets of the natural environment and human activity, a subject critically discussed in depth by philosopher Martin Heidegger in his text *The Question Concerning Technology*. According to Heidegger the increasing dependency on technology makes us "unfree and chained to [it], whether we passionately affirm or deny it. But we are delivered over to it in the worst possible way when we regard it as something neutral; for this conception of it, to which today we particularly like to do homage, makes us utterly blind to the

essence of technology.”[1] With the advent of cybernetics, the impact of artificial intelligence is becoming limitless by creating a new relationship between humans and technology.[2] At the beginning of the twenty-first century, the Heideggerian artificial-natural *dichotomy* seems to be replaced by a new kind of human, that is characterized by a *synthesis* between man and machine, also known as *Homo-ex-data*.”[3] This process appears to be so powerful that *Homo-ex-data* experiences the world of technologies as a vital source or even as his *second nature*.[4] This transition is pervasive, as it impacts not only all natural and human systems of our world, but it is also intertwined with all aspects of technology-driven sustainable innovation. According to the United Nations “rapid technological change involves, among others, technologies like big data, the internet of things, machine learning, artificial intelligence, robotics, 3D printing, biotechnology, nanotechnology, renewable energy technologies, and satellite and drone technologies. These represent a significant opportunity to achieve the 2030 Agenda and the Sustainable Development Goals.”[5] What does this development mean for the design of contemporary and future architectural artifacts?

3. The rise of biomimetics and biomimicry

Originally the terms *biomimetics* and *biomimicry* are derived from ancient Greek: βίος (*bios*), life, and μίμησις (*mīmēsis*), imitation, from μιμεῖσθαι (*mīmeisthai*), to imitate, from μῖμος (*mimos*), actor. In the 1950s and 1960s, the biophysicist Otto Schmitt and the psychiatrist Jack E. Stelle developed the idea of *biomimetics* as “the science of systems which have some function copied from nature, or which represent characteristics of natural systems or their analogues”.[6] The term *biomimicry* was popularized to a broader audience by the biologist Janine Benyus as a “new science that studies nature’s models and then imitates or takes inspiration from these designs and processes to solve human problems.”[7] In order to differentiate between the two terms, first a brief explanation. Biomimicry is attended to inspiring and teaching people how to look at Nature as a “model, measure, and mentor” including how Nature defines the *lifeworld* of living creatures in the broadest sense.[7] Consequently, biomimicry is focused on the encouragement and ideation in the first instance, “with the explicit goal of sustainability and reconnecting man with Nature”.[8] Biomimetics, on the other hand, refers to the technical and formalistic realization of functional strategies used by biological organisms or systems in Nature. The goal for biomimetics is to apply frontier technologies, that lead to process-oriented efficiency but also empower the imitation of Nature’s living structures. It is therefore not surprising that biomimetics is becoming an appealing approach for design disciplines including applied arts, architecture, and industrial design. However, sustainability as such is not an explicit or primary goal of biomimetic design, but above all the mimesis of the visual appearance of natural phenomena.[8] The use of natural shapes in architectural design has been around much longer. The Sagrada Familia church designed by Antoni Gaudí is a well-known example of the implementation of nature’s forms and structures. Another example is the pioneering work on natural structures by structural engineer Frei Otto. The development of smart technologies including robotics, automatization, and the rise of computational design, however, brings a whole new dimension to gestalt-imitation and allows new design strategies that were not considered to be possible in the past.

4. Parametricism - The concept of imitation and mimesis

This development is discussed briefly by the ideas of Patrik Schumacher, a theorist and the principal architect of Zaha Hadid Architects (ZHA). According to Schumacher, “we are confronted with a new style rather than just with a new set of techniques. The techniques in question – the employment of animation, simulation, and form-finding tools, as well as parametric modeling and scripting - have inspired a new collective movement with radically new ambitions and values. [...] The parametricist sensibility aims for a maximal emphasis on conspicuous differentiation and the visual amplification differentiating logics. Aesthetically it is the elegance of ordered complexity and the sense of seamless fluidity, akin to natural systems, that is the hallmark of parametricism.”[9] Schumacher understands the ultimate objective of parametric design as the implementation of Nature’s ideas of sustainability as derived from the Latin *sustinere* (to maintain, to uphold, and to evolve), than just the functional application of parametric software for the sake of ecological durability accomplished through time efficiency and higher productivity. This approach seems open-minded; however, one may still wonder if the mimesis of natural phenomena by design has something to do with Nature’s principles of ecology en evolution. Originally, the term *oecology* comes from the Greek *oikos*, meaning “habitation dwelling, and place”, and has been defined by the zoologist Ernst Haeckel as “the branch of science dealing with the relationship of living things to their environments.”[10] The term *evolution* comes from Latin *evolvere*, meaning “to unroll, to unfold, and expand.”[11] Both notions represent a process of self-sufficiency and continual change preceding death. Hence, they represent the primary condition that distinguishes organic from inorganic subjects. They represent *natural life*.

The *Riverside Museum* serves as an example for a closer look into the typical design strategies embedded in the work of Schumacher and Hadid, to find out to what extent their design concepts comprise any principles of continual change or self-sufficiency. The building is located in a former shipyard on the banks of the River Clyde in Glasgow and its architecture is inspired by the ripples of sand dunes in the desert and the ripples water, as this museum was built on the banks of a river.[12] Except for the fact that Glasgow has little in common with a desert landscape, the iconic landmark positions itself

symbolically as a complex and fluid shape, as the building's most distinctive external feature is its asymmetrical *zig-zag* profile that "can be interpreted as a cityscape or as an imitation of the form of waves on water." [13] From an aesthetical point of view, the parametric design of the building can be seen as exceptional, and even as a "third metallic river" according to Hadid. [14]



Fig. 1. (a) Model of the Riverside Museum, ZHA [14]; (b) Arum Shells, ZHA, 2012 Venice Biennale [15].

Meanwhile, artificial mechanisms are capable of imitating natural phenomena better than ever which, in effect, means, that the distinction between the original and the imitation is becoming hard to distinguish. A good example of this is another project of ZHA: the installation *Arum Shells*, which has been presented at the 2012 Venice Biennale. The artifact consists of several complex shells made from pleated metal, evolved on the basis of 'algorithmic form generation' which generates "organic coherence and fluidity of the forms and spaces", as well as "structural logic". [15] In this light, we can assume that the technological devices of the Late-Anthropocene should no longer be viewed as just *servicing objects* but as being *inquiring subjects*, capable of imitating natural phenomena in an almost authentic way, however, completely depending on and determined by frontier technologies. Despite the further development of smart machines, the equitation between the original and imitation, between the *first* and *second* nature is still on a metaphorical level, at least in the field of architecture. A building can imitate natural forms, functions, and processes based on complex biologically inspired technologies, regarding the immutability of its physical tectonic it can, however, never act as a *natural* ecosystem or as a *living* organism that can adapt, evolve, and transform at different levels and at different rates. [16]

5. The concept of sustainable hedonism

Hedonism can be seen as the *philosophy of happiness*. It is a general term for all theories of conduct in which the criterion is a form of *pleasure*. The notion is derived from the Greek *hedone* (pleasure), from *hedys* (sweet or pleasant). At the beginning of the 21st century, sustainability is becoming commonplace resulting in the transformation of the self-centred *homo oeconomicus* to *homo sustinens*, who is interested in the development of products and services, that minimize the use of natural resources while bringing a better quality of life for everyone. Consequently, the *hedonic potential* as a driver of brand extendibility is becoming a powerful aspect of contemporary brand strategies, to promote the eco-responsible quality of a wide range of objects and services ranging from an ordinary toothbrush to a monumental building. [17] The impact of this substantial transformation on the discipline of architecture is the key subject of the book *Yes is More*, written by architect Bjarke Ingels, principal and founder of the Bjarke Ingels Group (BIG), who states that the architects of the new millennium should mediate between diametric opposites by "investigating the overlap between radical and reality, and designing "a pragmatic utopian architecture that creates socially, economically, and environmentally perfect places as a practical objective." [18] According to Ingels architecture is often seen as the "antithesis of nature and a contradiction to sustainability. But in recent years, global innovations have reimagined sustainability not only in terms of the environment, but also in terms of the quality of life and prosperity of its inhabitants. Hedonistic sustainability encapsulates this approach." [19]

An example of this approach is the *Maritime Youth House* project, a combination of a sailing club and a youth center, located in Copenhagen. The building is the result of these two demands. The elevated double-curved wooden deck is tall enough to allow for boat storage underneath while providing an undulating landscape for the kids to run and skate on. Following BIG's ideals, the Maritime Youth House escapes the notion that buildings are a passive background and ensures the involvement of the users. Instead of a two-dimensional, a three-dimensional urban condition is created which allows the public to emerge themselves with the narrative by using pleasure as the bridging principle. BIG uses the positive associations people have with natural elements to create a new environment filled with pleasure and playfulness. However, even though the deck – and thereby the building – seems natural and thus sustainable to the public, this is not the case in a material-technical sense. The deck is constructed of tropical hardwood, a non-local material. The aluminum, concrete, and

glass have a high embodied energy and there is little consideration for modularity, optimization, and energy efficiency, which are all considered to be foundational sustainable principles.[20]



Fig. 2. (a) Copenhill, BIG, Copenhagen [21]; (b) Maritime Youth House, BIG, Copenhagen [22].

Copenhill is another building designed by BIG and gets promoted as the “cleanest waste-to-energy power plant in the world”. The building is topped by an artificial ski slope and climbing wall that is open all year round.[21] The building is a “crystal clear example of hedonistic sustainability – that a sustainable city is not only better for the environment – it is also more enjoyable for the lives of its citizens.”[21] Hence, the power plant seems to illuminate the story behind BIG’s buildings through sub-conscious cognitive triggers, which positively influence the discussion making process of clients, the appropriation of users, and the admiration of critics, by synthesizing technology with (artificial) nature, and pragmatism with positiveness. What sets Ingels apart, according to architecture critic Aaron Betsky, is “his ability to use the right move at the right time in the right place. [Ingels’ design] is architecture lite, architecture as a rewriting of the script of our modern world, architecture skating, surfing, and doing parcours up and down the modern city.”[22]

6. RAGE Against the *Second Nature*

While the continuing advances of the technological revolution seem to offer unprecedented opportunities for the implementation of sustainable developments, they also pose considerable ethical and ideological concerns about the environment, privacy, and data ownership. Man is increasingly losing his autonomy to artificial intelligence-related technologies and digital network services. This progress can be viewed as one of the main subjects of the Late-Anthropocene age leading to “the unilateral claiming of private human experience as free raw material for translation into behavioral data” and are “designed to keep [man] ignorant.”[23] Furthermore, perspectives based on frontier technologies present environmental sustainability as a more resource-efficient version of the *status quo*. However, we are convinced that a reasonable level of sustainability requires a fundamental change of the socio-cultural and politico-economic system.

Second, we are critical about the ever-increasing dominance of frontier technologies in general and in architectural design in particular and propose a *Heideggerian* view on the relationship between nature, technology, and man, defined by a “genuine sense of belonging to our natural and built places”.[24] To distinguish their efforts grounded in natural forms based on the ideas of biomimetic, biomimicry, and parametric design, architects should use an appropriate form language beyond designs that merely mimic “natural form rather than arise authentically from it.”[25]

Third, the upgrade of algorithm-driven thinking to the most genuine perspective of contemporary sustainability cannot disguise that those biomimetic and parametric-driven architectural concepts are based on technocentric thinking. The logic behind this is at its core functional rather than environmental in the original meaning of *sustinere*.²⁶ As a result, we share the view which states that “biomimicry is Nature for the digital world – one that has lost any real connection with materiality, context, and the environment – or, what it is like to be embodied. It sterilizes the natural world through algorithms, edits out the bits that we can’t deal with, and then calls the product *sustainable*.”²⁷ We assume, that the fundamental difference between living organisms and a living technology will remain, at least until the rise of the perfect Homo-ex-data created by the smartest artificial devices of biomimetic and parametric thinking.

Fourth, ZHA’s parametric approach as well BIG’s sustainable hedonism are powerful design concepts as well as innovative brand narratives, leading to iconic artifacts with complex architectural configurations. However, in practice and seen from the point of imitating nature in a way that transcends the symbolical and metaphorical their projects are far less persuasive. ZHA’s Riverside Museum and Arum Shell object should be self-sufficient or adaptable to changing parameters in one way or another. In practice, however, it is exactly the opposite; they are permanent and immutable in their content. BIG’s

designs as examined in this paper have yielded some of the most eye-catching projects that are incorporated in business-friendly sustainability that can attract high-end real estate developers as well as wealthy governments without any pain. However, apart from this hypocritical attitude, from the perspective of spatial scenography some of BIG's designs also have eliciting qualities. They are highly theatrical and entertaining by combining the ordinary with the exceptional, and the functional with the spectacle. One might object that the ski sloop on the roof of Copenhill, and the folded landscape on the top of the Youth House are trivial, obtrusive, and might be even boring after having seen them more than once. Yet, despite all justified objections, both projects represent a certain level of frivolity and cheekiness that pleases, be it only for a short time. But who cares anyway, as at the beginning of the 21st century the experience of sustainable hedonistic moments are very ephemeral.

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