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IMPRESSUM

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About the Journal

The journal aims to link interdisciplinary human habitat studies in the EURO-MED region, from architecture and urbanism to regional planning, including the relationship between human-dominated and natural systems. It seeks to pursue the goals of multi-stakeholder operations such as SUDs, UfM Action Plans and more, towards resilient cities and sustainable social structures.

The growing needs to foster a deeper understanding of standards and emerging aspects in the region lead to the need for a scientific platform in which academics, professionals and stakeholders work together to deal with and take action to address the rising forces in our cities. Therefore, governmental, and non-governmental organizations from different countries come together to lay the foundations and set pillars for achieving the goals and needs of today and tomorrow.

Accordingly, the journal provides science-led strategic insight and guidance for sustainable and resilient cities, with a general perspective on coastal cities, with a particular focus on the Mediterranean region. Topics draw on scientific knowledge and research to make regional policies and practices as future-proof as possible. The Schools of Architecture and Urbanism are considered as potential driving forces and hubs for the profound science-led transformation and integration in the region, and thus, the Journal aims to bring together schools of Architecture and Urban Studies from different regions, in one platform.

Coverages

The journal explores a range of academic and policy concerns including:

- Water and Land
- Dwelling and Communities
- Heritage & Vernacular Studies
- Environment and Sustainability
- Transportation Systems
- Coasts and Fortifications
- Education

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All research articles in this journal have undergone rigorous peer review, based on initial editor screening and anonymized refereeing by two referees.

The manuscript submission and peer-review process are broken down into the following steps:

The author submits a manuscript;
The Editor assigns Reviewers to the manuscript;
The Reviewers review the manuscript;
The Editor drafts a decision to be sent to the Author.

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EDITORIAL

"Journal of Mediterranean Cities" is dedicated to focusing on habitat studies and challenges facing our cities. The journal provides science-led strategic insight and guidance for sustainable and resilient cities, with a general perspective on coastal cities, with a particular focus on the Mediterranean region. Topics draw on scientific knowledge and research to make regional policies and practices as future-proof as possible. The Schools of Architecture and Urbanism are considered as potential driving forces and hubs for the profound science-led transformation and integration in the region, and thus, the Journal aims to bring together schools of Architecture and Urban Studies from different regions, in one platform. All articles are published in English and undergo a peer-review process.

Educational Technology

Journal of Mediterranean Cities has an international editorial board of eminent experts in their field from Algeria, Bangladesh, Botswana, Bulgaria, Egypt, Erbil, Finland, Iceland, Italy, Jordan, Latvia, Lebanon, Netherlands, Nigeria, Morocco, Palestine, Portugal, Prague, Saudi Arabia, South Africa, Spain, Turkey, United Arab Emirates, United Kingdom, and United States of America. We are confident that JMC will attract a great number of editors, eminent scientists in the field. The selection will be based on the activities of the editors and their desire to contribute to the development of the journal. *Journal of Mediterranean Cities* provides a platform for academics and scientists professionals to refer and discuss recent progress in the fields of their interests. Authors are encouraged to contribute articles that are not published or not under review in any other journal. Each submitted manuscript is evaluated based on the originality of its contribution to the field of scholarly publishing, the soundness of its theory and methodology, the coherence of its analysis and its availability to readers (grammar and style). The normal turn-around time for the evaluation of manuscripts is one to two months from the date of receipt.

Submission of an original manuscript to the journal will be taken to mean that it represents original work not previously published, that is not being considered elsewhere for publication; that the author is willing to assign the copyright to the journal as per a contract that will be sent to the author just before the publication and, if accepted, it will be published in print and online, and it will not be published elsewhere in the same form, for commercial purposes, in any language, without the consent of the publisher. The names and email addresses entered in this journal site will be used exclusively for the stated purposes of this journal and will not be made available for any other purpose or to any other party. The requirement for the submission of a paper implies that it has not been published before; that it is not under consideration for publication anywhere else.

When considering submitting an article, the Editors have provided the following criteria to assist authors with preparing their submissions:

Originality – The author should ensure that the manuscript has not been previously published nor is being considered by another journal.

Plagiarism - All articles are test ted with Turnitin software. Content should be properly referenced. Be sure to check the paper for possible accidental plagiarism. Some plagiarism checker websites include: http://www.turnitin.com/, www.antiplagiat.ru, www.grammarly.com, www.plagtracker.com or www.duplichecker.com

Writing – Please write in good English (American or British usage is accepted, but not a mixture of these). For non-native English speakers, and perhaps even for some native English speakers, grammar, spelling, usage, and punctuation of the texts are very important for an effective presentation. Hence, manuscripts are expected to be written in a clear, cogent, and readily understandable by an international readership.

Manuscripts must be submitted online. Electronic submission reduces the editorial processing and reviewing time. As part of the submission process, authors are required to check off their submission compliance with all the following items, and submissions may be returned to authors who do not adhere to the following guidelines:

-The submission has not been previously published or presented to another journal for consideration (or an explanation has been provided in Comments to the Editor).
-The submission file is in OpenOffice, Microsoft Word, RTF, or WordPerfect document file format.
-Where available, URLs for the references have been provided.
-Where available, DOI numbers for the references have been provided.

The text is single-spaced; uses a 12-point font; employs italics, rather than underlining (except with URL addresses); and all illustrations, figures, and tables are placed within the text at the appropriate points, rather than at the end. The text adheres to the stylistic and bibliographic requirements outlined in the Author Guidelines. If submitting to a peer-reviewed section of the journal, the instructions in ***Ensuring a Blind Review*** have been followed.

A manuscript goes through the peer-review process. Authors submit manuscripts to **Editorial office** via the online system. The acknowledgement letter should be sent to the author to confirm the receipt of the manuscript. The Chief Editor first

reviews manuscripts. Chief Editor is assisted by Section Editors (could also be Co- or Associate Editors). The Editor assigns a Section Editor to see the manuscript through the complete review process and return it with a recommendation or decision. The manuscript is checked to see if it meets the scope of the Journal and its formal requirements. If it is incorrect or unsuitable, the author should be informed, and the manuscript filed (or returned if requested) – direct rejection. Manuscripts that are not suitable for publication in the Journal are rejected. A Rejection letter is sent to the author stating the reason for rejection. If the manuscript conforms to the aims and scope of the Journal and formally abides by the Instructions to Authors, it is sent out for review. Depending on the type of paper, it could be accepted immediately for publication (invited Editorial, Book review etc.) by the Chief Editor. Check that the manuscript has been written and styled in accordance with the Journal style; that it carries an abstract (if applicable), keywords, correct reference system etc. and check that the correct blinding system has been used. If anything is missing, Editor in Chief through the associate editor will ask the authors to complete it before the manuscript is sent out for review. The manuscript is sent out for review. The reviewer reads and evaluates the manuscript and eventually sends a review report to the Chief Editor. The time for review can be set to 2-6 weeks depending on the discipline (more time is usually given to papers in the humanities and social sciences). Make sure to provide the reviewer with clear instructions for the work, e.g., outlined in the form of a Review report or several questions to be considered. Based on the reviewers' comments the Chief Editor decides to:
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An acceptance letter is sent to the author and the final manuscript is forwarded to production. Sometimes, the authors are requested to revise in accordance with reviewers' comments and submit the updated version or their manuscript to the Chief Editor. The time for review can be set to 2-6 weeks depending on the discipline and type of additional data, information or argument required. The authors are requested to make substantial revisions to their manuscripts and resubmit for a new evaluation. A rejection letter is sent to the author and the manuscript is archived. Reviewers might be informed about the decision. After review, a manuscript goes to the Copy Editor who will correct the manuscript concerning the correct referencing system, confirmation with the journal style and layout. When Copy Editor finishes his/her work they send manuscripts to the Layout editor. Layout Editor is responsible for structuring the original manuscript, including figures and tables, into an article, activating necessary links and preparing the manuscript in the various formats, in our case PDF and HTML format. When Layout Editor finishes his/her job they send manuscripts to Proof Editor. Proof Editor confirms that the manuscript has gone through all the stages and can be published.
This issue contains 2 articles. The editors seek to publish articles considering urban actions in the area of Littoral Territories, Urban Studies, Housing Strategies, Heritage & Vernacular Studies, Environmental Sciences, and educational systems in coastal regions.

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With kind regards,
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Can Our New Cities Survive?

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ABSTRACT

The developmental growth of home-improving devices and equipment has ceaselessly progressed from the Industrial Revolution until the present day. From heating systems to lighting equipment and air conditioning, we have now reached the Smart house age. However, in order to be efficient, such a kind of home demands a new city: A Smart City, with devices, networks, and infrastructures that would be fundamental requisites for its functioning. That is why the ancient cities, on the way to becoming an inconvenience for the development of the brand-new ones, are going to find their place in a desert, in a "tabula rasa" devoid of relics, ruins, and debris of their history. This contribution investigates the challenges that architects must put forth in trying to overcome such a condition of exclusion from the process of building a new human landscape.

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1. Introduction

Josep Lluís Sert, published Can Our Cities Survive? in 1942. In the introduction, Giedion pointed out that Sert presents in a manner comprehensible to everyone the present state of our urban life and its earlier development. It traces as far as it is possible the paths of future development and it points the way out of existing urban chaos. It shows that our cities have become unserviceable instruments but that at the same time they are eternal phenomena connected with every culture. In fact, in Sert's opinion, Civilization and city are words from the same root (Giedion, 1942: X).

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Figure 1. Cover of Josep Lluís Sert, "Can Our City Survive?" The Harvard University Press, Cambridge (1942)

In "Can Our Cities Survive?" Sert deals with the problem of modern cities, describing them as chaotic products of our civilization, nowadays as they were back then. Despite their unhappy elements, many of them are still the citadels of our culture, their roots reaching far into the past, and replacing them would involve a colossal undertaking. In particular, the cities occupying strategic geographic sites, are the focal points of convoluted networks of communication and transportation, whose modern technologies are constantly evolving. Even though they are endlessly emptying and overflowing into the countryside, all roads still converge upon them. As Sert writes, "The lesson of the past tells us that Troy was rebuilt on Troy, Rome on Rome, Paris on Paris. So, New York can and should be rebuilt on New York. Manhattan returned to the Indians" (Sert, 1942: 212). This could represent a fantastic conception of "the world of tomorrow," which assumes that our civilization will go on despite the devious processes of its evolution and that we shall "not return to the Dark Ages" (Sert, 1942: 212).

Needless to say, Sert believed in the necessity and the possibility of a complete transformation of cities. The signs of the times as highlights of such transformations, their enormous cost just a minor drawback. Sert also believed that cities were rooted in certain elements, expressions of something higher than the manoeuvres of speculation and individual gain. Around those living and eternal elements, he believed that the new cities of a future day to come tomorrow will rise like symbols of the spirit of man, out of the cities shattered by the war. Their civilization will have experienced a profound change, "but the continuity of the spirit and their heritage will be saved" (Sert, 1942: 214).

The first thing that Sert underlines in Can Our Cities Survive? is the importance of the CIAM way of working, that, since its foundation in 1928, had dealt with and discussed the fate of architecture and the modern city, and at that time Sert believed to "prove to be valuable for the reconstruction and rehabilitation work of the post-war period" (Giedion, 1942: XI).

After WWII, in 1947, the architectural debate resumed at CIAM VI, held in Bridgewater (UK), where participants discussed the strategies and the instruments to adopt in managing the destiny of the cities shattered by the war. During the following one, CIAM VII, held in Bergamo (Italy) in 1949, for the first time since they were drawn up, the principles of city planning, anticipated in the Charte d'Athènes (Le Corbusier, 1948), were put into question. The very same ones that will be contested again in 1951, as a discussion topic during CIAM VIII, in Hoddesdon (UK), whose intention was to deal with "The Heart of the City" (Tyrwhitt, 1952), see (figure 2). On that occasion – contrary to what Sert affirmed in Can our cities survive? – was shown yet again the inadequacy of the results of the "functional" planning devised in Athens (Le Corbusier, 1943), deemed to be ineffective to solve the problems of most cities, including the ones destroyed by the war and in need of reconstruction.

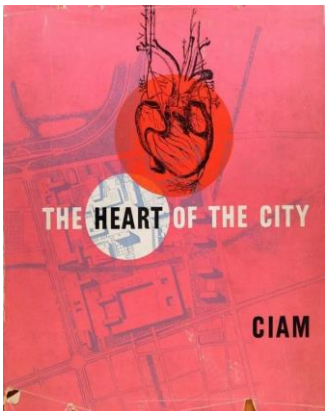

Figure 2. Cover of "The Heart of the City: Towards the Humanisation of Urban Life", Tyrwhitt, Sert, Natan Rogers, London, Lund Humphries (1952)

During CIAM IX, organised in 1953 in Aix-en-Provence (France), the processing of the Charte de l'Habitat (Bodiansky, 1953), revealed contrasting positions on the purposes of the congress'. Furthermore, in Aix-en-Provence, was asserted the increasing sense of failure concerning the instruments elaborated up to that moment by the CIAM, and the crisis of the fundamental premises of European civilization, its philosophical and scientific thoughts, its industrial and developing processes, and its anthropological ethnocentrism. Particularly pressing was the need to intensify the research for incentive solutions aimed at more favourable processes for the creation of more humane urban spaces and the organisation of the life of its inhabitants according to their biological, social, and cultural necessities. The proposal of young architects, Jaap Bakema, Georges Candilis, Aldo van Eyck, Sandy van Ginkel, Rolf Gutmann, Bill Howell, Gill Howell, Blanche Lemco, Alison Smithson, Peter Smithson, John Voelcker, Shadrach Woods, demonstrated, within the CIAM system itself, the coexistence of irreconcilable positions. On one side were those who adhered to the functionalist city planning expressed by the Charte d'Athènes, on the other one was those who criticised it, trying to include cultural and anthropological parameters instead of statistical standards. The young "contestants" got together in the infamous Team X group, later appointed to organise, at the 1956 CIAM X in Dubrovnik (Yugoslavia), the discussion Habitat: the problem of relationships.

It will be during CIAM XI, held in 1959 in Otterlo (The Netherlands), that Team X, because of the disagreements and the impossibility to have a partaken discussion, will formalise the dissolution of the International Congress and at the same time will celebrate, in Europe at least, the end of the hegemony of International modern architecture, seeking solutions for the new social community in the ones less evolved.

2. Blow it up!

While in Europe the hegemony of the CIAM's thought was dissolving, in the US, as Peter Blake pointed out, architects believed that the only solution to urban decay – and the only way to reconstruct cities bombed out in WWII – was to raze a large portion of what was left and replace it with something akin to the diagrams drawn up in the 1920s by Le Corbusier and others, in projects like Corbus's Ville Radieuse. Most architects accepted all that as a sort of modern urban catechism and rarely questioned it. Only a very few among them were ready to challenge Le Corbusier's diagrams, and the brightest of those critics was Jane Jacobs (Blake, 1977; 1993).

While politics continued to promote Urban Renewal, Jane Jacobs raised more and more questions until, in 1960, she challenged all the notions accepted until then. Jacob's book The Death and Life of Great American Cities (1961) completely altered the discourse on nature and the future of cities, see (Figure

3). She wrote that the urban renewal laws were an attempt to break this linkage in the vicious circles by forthrightly wiping away slums and their populations and replacing them with projects intended to produce higher tax yields or to lure back easier populations with less expensive public requirements – in that consists of the Gentrification process. The method failed, as Jacobs stated, because at best, it merely shifted slums from here to there, adding its tincture of extra hardship and disruption, and at worst, it destroyed neighbourhoods, "where constructive and improving communities exist and where the situation calls for encouragement rather than destruction" (Jacobs, 1961: 270-271).

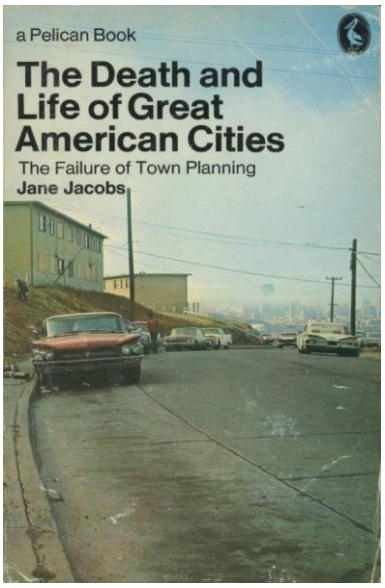

Figure 3. Cover of "The Death and Life of Great American City", Jane Jacobs, Random House, New York (1961)

Jacobs documented the failure of modern architecture to solve the problems of the congested inner city, advocating for the chaos of the unplanned urban centre over the ordered compositions of the modern cityscapes: "What will the projects look like? They will be spacious, park-like, and uncrowded. They will feature long green vistas. They will be stable, symmetrical, and orderly. They will be clean, impressive, and monumental. They will have all the attributes of a well-kept, dignified cemetery […]", in Jacobs' opinion this kind of project does not revitalise downtown; they do not deaden it, rather, they banish the street, its function, its variety, without exception; this kind of projects have one standard solution for every need "they take a part of the city's life, abstract it from the hustle and bustle of downtown, and set it, like a self-sufficient island, in majestic isolation" (Jacobs, 1958).

Similarly, to Jacobs, Peter Blake (1974, 1977, 1979) –and some years after Tom Wolfe (1981)– described the false truthfulness of modern theories proved by the exemplary 1955 Pruitt-Igoe housing project in St. Louis.

Signed by Minoru Yamasaki and built as a model for rational living, the Pruitt-Igoe complex was designed according to the most progressive ideas of the CIAM and with what Le Corbusier called the "three essential joys of urbanism": "streets in the air", safe from cars, only "sun, space and greenery". When it was designed in 1955, the Pruitt-Igoe won the AIA award, but by 1971, it had deteriorated into an uninhabitable and inhospitable welfare slum (Comrio, 1981; Bristol, 1991). When it was asked to the ones still living in it, what to do about it, they had no qualms about it: "blow it up! Blow it … up!" they loudly replied. In April 1972, the city of St. Louis considered the residents' wishes and blew Pruitt-Igoe up

with dynamite (Figure 4), "a historical moment", Wolfe recalled: "someone had finally asked the client for his two cents' worth", but "That part of the worker-housing saga has not ended. It has just begun", Wolfe pointed out (Wolfe, 1981: 82).

Figure 4. Minoru Yamasaki, public housing complex Pruitt-Igoe, St. Louis. Constructed in (1951-1955) was demolished in 1972-1976 (Source: U.S. Department of Housing and Urban Development)

At almost the same time that Pruitt-Igoe went down, the Oriental Gardens project, promoted by the Department of Housing and Urban Development and designed by Paul Rudolph, went up in New Haven, it was 1968. Oriental Gardens consisted of 148 units on 12.5 acres, but with the cause of construction problem, in September 1980, there were only seventeen tenants left and in 1981 the Department of Housing and Urban Development itself set about to demolish it.

3. New challenges: The failure of the house of the Future

The dream of a self-sustainable home or city, completely regulated, easily manageable and monitored throughout its developing future was, and still is, a feasible idea. It is a fair deduction that comes from

Witold Rybczynsky's studies (1986), who stated that the arrival of gaslight and ventilation, flawed as these technologies were, signified the beginning of the rationalization, and the mechanization, of the home. Domestic technology such as the heating and the ventilation duct represented an invasion of the home, not only by new devices but by a different sensibility, that of the engineer and the businessman. This was an invasion that most architects, not their clients, chose to ignore (Rybczynsky, 1986: 145). If architects were not prepared and interested to deal with those new devices and technologies, others would have been, as Rybczynsky recalls. In 1872, John Hayward, a doctor, built his own home to demonstrate his ideas of proper ventilation giving us an example of how new technology should have been integrated into architecture (Drysdale and Hayward, 1872). Another one was Henry Ruttan, an engineer, who published a book giving details on how many of his ideas, double glazing, for example, could have been applied to house construction (Ruttan, 1862). Not only did the architect get further away from technical problems and issues, Rybczynsky carries on, delegating them to technicians, engineers, or passionate amateurs, but he also moved away from what would have drastically influenced its comfort, its general layout, and its day-to-day management, leaving the Housewifery and the Domestic Engineering to interested and motivated housewives (Beecher, 1849, 1869; Frederick, 1914; Pattison, 1915; Balderston, 1921; Frederick, 1923).

However, the greatest challenge for architects was "The House of the Future", the 1927 Dymaxion House by Buckminster Fuller, the 1933 Space House, by Friedrich Kiesler, and the 1958 House of the Future by Monsanto Chemical Company (Figure 5), which wanted to convince the building sector to use the material most representative of the future: plastics.

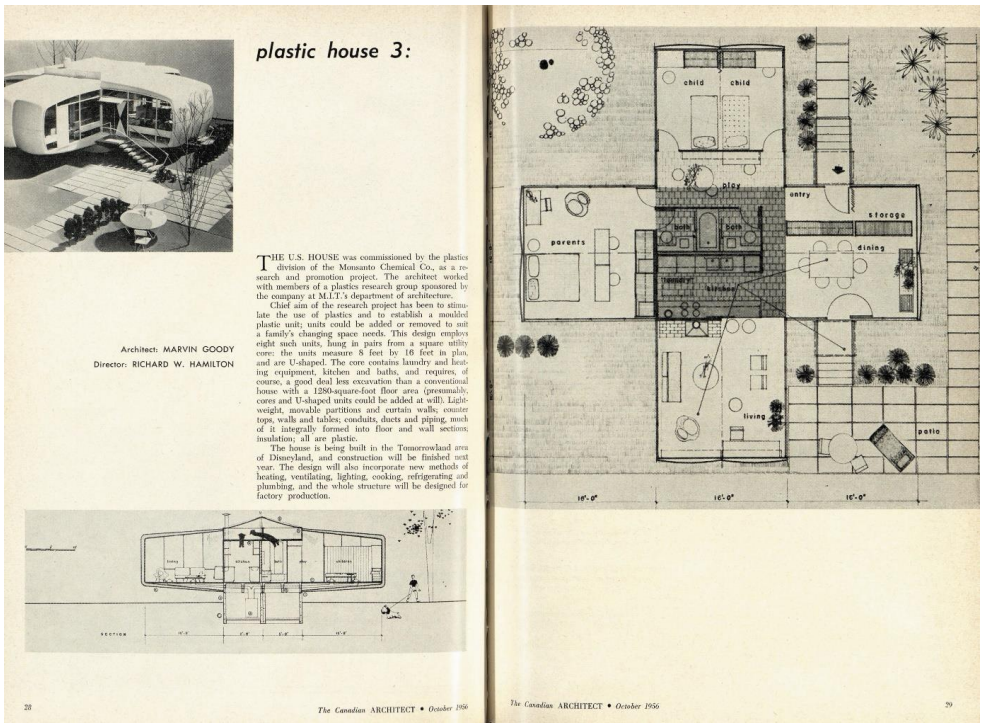

Figure 5. Richard Hamilton, Marvin Goody, and Albert G.H. Dietz, MIT Plastic Research Laboratory, "Monsanto House of the Future" project (1958)
(Source: The Canadian Architect, October 1956, pp. 28-29)

Discussing this sort of house in 1989, Alan Hess described the paradoxical condition of the 1950s, an era of technological progress and when solutions went in search of problems. Even so, the building industry

was not impressed by the gymnastics of a plastic house. And in the end, plastic did not turn out to solve structural problems more inexpensively or efficiently than traditional materials. As Alan Hess pointed out, "The House of the Future had answered a lot of questions nobody asked" (Hess, 1989: 75).

Also, Peter and Alison Smithson, in 1956, introduced, at the Daily Mail Ideal Home Exhibition, the prototype of the House of the Future (Figure 6), consisting of prefabricated tridimensional components built with new plastic materials.

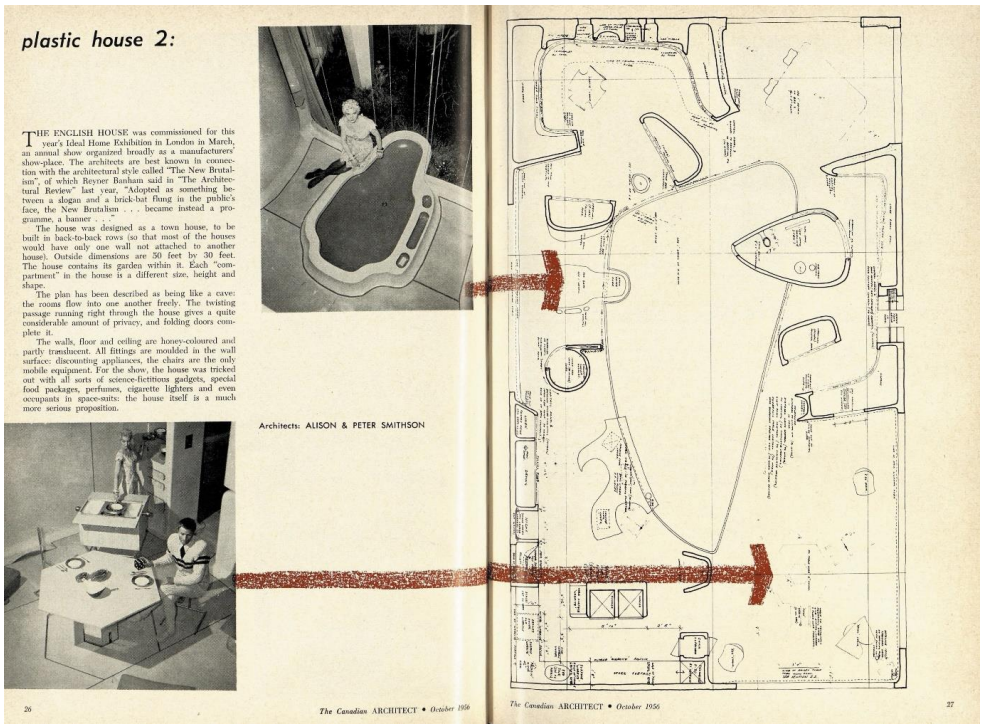

Figure 6. Alison and Peter Smithson, "The House of the Future" (Source: The Canadian Architect, October 1956, pp. 26-27)

A few months after that proposal, the Smithson, at the exhibition This is Tomorrow at the Whitechapel Art Gallery, put together an installation made of one small pavilion representing a house containing all the necessary things to survive after a nuclear war: a bicycle wheel. It revealed that the dissatisfaction, the instability, and the datedness of those projects, were directly proportional to the obsolescence of the technological structures on which their original premises were based, and the uncertainty about the future.

That is a theme though, that does not just belong to the past. From Adolf Loos's plumbers to Rem Koolhas Elements of Architecture, at the XIV Biennale Internazionale d'Architettura di Venezia (2014), the issue regarding the use of mechanical systems is a central topic in the history of modern architecture, as well as the one regarding materials. The actual threads of continuity are well demonstrated by Koolhas, who revealed and explained them in all their relevance at the stand organised in the Biennale's Gardens.

The problem of the relationship between systems and houses has always been a fundamental one in modern architecture. Banham dealt critically with the matter in 1965. In his article, he describes a modern-day home in which all the pieces of mechanical equipment could exist without the house itself. He reminds us that a Home is not a House (Banham, 1970), when a house contains such a complex of

devices, when it contains so many services that the hardware could stand up by itself without any assistance from the house, "why have a house to hold it up?"

The importance that equipment has in the construction, both regarding the cost and the dimensions, is equal to half of the house itself. Banham seems to be aware of this aspect, so much so that in his ironical assumption, the house could become a glass bauble, a wooden beam floor and column made of several pieces of equipment, as Buckminster Fuller clearly put forward at that time.

The house described by Ray Bradbury in There Will Come Soft Rains (1950), or the one in Jacques Tatì's Mon Oncle (1958), were, at the time, simple figments of the imagination. Nowadays, evidently, from heating systems to lighting equipment and air conditioning – together with electrical appliances and all kinds of devices engineered to lessen the domestic workload – we have reached the time of the eco-friendly and sustainable automated house, the Smart house age. A house respecting the basic environmental needs of our time, first and foremost the imminent depletion of non-renewable sources and the necessary reduction of global warming. For its actual efficiency, this kind of home asks for a new city: the Smart City, whose devices, networks, and infrastructures are the fundamental requisites for its functioning.

4. Debris, Relics, and Ruins

Purely in reply to the environmental Conferences and the many Protocols aimed at the planet safeguard – in order to convert a linear development into a circular and sustainable one – architects and urban planners together with scientists and the world's most important lab researchers, articulated sophisticated technological projects\proposals like smart homes and Smart Cities.

In real terms, general power consumption in Smart Cities – as well as in smart homes – employs reusable sources, artificial intelligence, and super high-tech devices, able to process enormous amounts of data that, applied to efficient urban projects, with passive planning elements, can achieve up to 70% energy saving compared to the consumption of "traditional" metropolis and homes. However, Smart Cities, built from nothing in a completely prescribed way – in them every single element must be regulated, defined, monitored, and calculated, as advocated since time immemorial – are extremely expensive products, as suggested by Richard Sennet in his book. They are cities "whose construction costs instead of decreasing is getting higher and higher" (Sennett, 2018: 162). That is why the most obvious question that comes to mind in planning terms is: why is it that a country like India, for example, where the population has hardly any drinkable water, where there is no sewage system or local communities' medical surgeries, is trying to pursue this road, inevitably doomed, and trying to plan 100 brand new Smart Cities? (Sennett, 2018: 162).

Besides the purely economical and operational aspects of the Smart Cities – which would inevitably be implied an outright exclusion from their fruition of the less developed countries – another relevant problem would also intrinsically present itself to many countries, even the most advanced ones, with a grand historical architectural heritage – inevitably ancient and obsolete for contemporary technological standards – often enough ill-fitting for transformations or technical adjustments, resulting utterly inadequate for Smart Cities. That heritage is unavoidably perceived as an inconvenience for the development of the new city, which will probably find its place in a desert, a "tabula rasa" devoid of the historical city's relics, ruins, and debris.

In a completely free context, Smart Cities could certainly appear as the most positive of all possible answers, but inescapably the largest section of the built environment would be ruled out because judged un-adjustable: Venice, Arezzo, Urbino, Cordova, and Istanbul are just some of the striking examples, although the list is much longer.

What is then the fate of those cities? What alternatives are beaming on the horizon? What alternatives have been devised and are now available? Is it possible that historical cities might be deserted

because it is impossible to turn them into environments like the Smart Cities? Will they simply be demolished to make on for the City of Bits, and Cyberspace? (Mitchel, 1995): "Troy was rebuilt on Troy" (Sert, 1942), see (Figure 7).

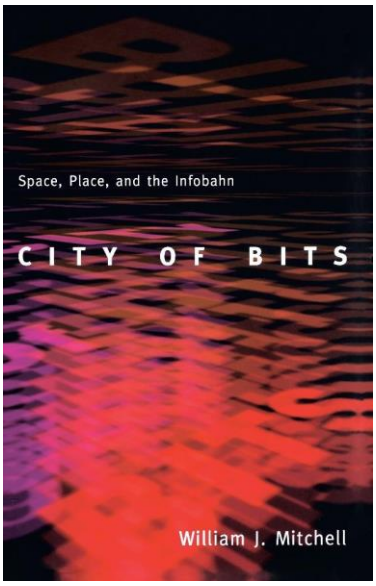

Figure 7. Cover of "City of Bits: Space, Place, and the Infobahn", William J. Mitchel, MIT Press (1995)

Will those very same Smart Cities, managed by the most advanced technologies, be able to upgrade, keep up and adapt through the evolution of time? Will they be able to regenerate, implementing the upgrading that new technologies constantly require? Will they just become obsolete? Are we perhaps all destined to turn into wandering nomads, forever looking for the newest and most advanced of places, leaving behind the debris of thousands of abandoned, inoperable cities?

5. What we need is a new way of living

Contrary to what architects, industry and science produced during the first age of the machine (Banham, 1960), the architect Bernard Rudofsky offered instead a subversive alternative (Rossi, 2016). In open contrast with the Existenzminimum norms and measures devised for the universal man, with the processes of industrialization, and with the international architecture without specific cultural and geographical connotations, Rudofsky put forth a new brand of architecture without architects, or names (Rudofsky, 1964), culturally distinguished and built on primitive elements: walls, pillars, fireplaces, pergolas and balconies, gardens, and yards, see (Figure 8).

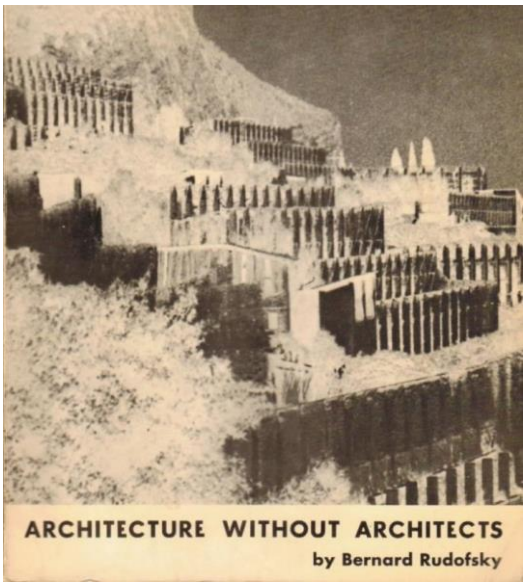

Figure 8. Cover of "Architecture Without Architects", Bernard Rudofsky, MoMA, New York 1964

As Ada Louise Huxtable affirmed, "the master iconoclast of the modern movement [Rudofsky] has spent a lifetime analysing and challenging all the conventional and received wisdom about the arts of living and design. In this wrap-up approach to the basic functions of eating, sleeping, sitting, cleaning, and bathing, he is as delightfully provocative and contentious as ever" (Huxtable, 1981).

Still acknowledging that technology could partially rectify the excesses of climate and provide several comforts – heating and air conditioning, for example, to make us believe that we have the upper hand on temperatures, or electrical appliances to ease the burden of daily domestic activities – Rudofsky lamented their influence on our lives and on how our homes were clattered with such devices and equipment. Clashing all together with the illusion offered by the planning of homes and cities in which science and technology would have bestowed happiness and the dissolution of any kind of problems, Rudofsky, was convinced that "Today's house is vulnerable, to put it mildly. It is not really a house but a machine that runs on electricity, and without it, simply, does not work" (Rudofsky, 1973: 5).

In his article What We Need is not a New Technology but a New Way of Living, and in several other ones that appeared in the February, March, and April 1938 issues of Domus, Rudofsky investigates the mythical and cultural side of architecture, demonstrating how the matter was not just about being modern, but rather about which kind of culture, probably more than just a single one, would realise and achieve coherent modernity. If on one side he sheds some light on the aporias and the contradictions of Modernity, addressing his critique of the way people dress, the footwear they wear and the western way of living altogether on the other he produces and elaborates a vocabulary to overcome the uniformity of the solutions provided by the mechanised and internationalist modernism.

Together with the article What We Need is not a New Technology but a New Way of Living, Rudofsky also publishes a project of his own called "Una casa per Procida" (a house for Procida), in which he explains the theoretical contents which are later going to become the expression of his entire architectural thought.

What is going to set that kind of home apart from the ones advocated by the CIAM, and by the architects supporting the scientific progress of the machine that marks that era, is the relationship that every single room establishes with the pursued ways of living adopted by the house occupiers. A house with a yard in which the patio is a room without a roof, a home in which conventional furniture has

almost disappeared. A new domestic custom that favours a mattress placed on the floor and a curtain hanging from the ceiling, like in Japan, to the traditional bed; spaces and floors are uncluttered because colourful rugs have replaced chairs and tables. Eating becomes a collective, convivial ritual, the food is prepared in the kitchen and is served on a big plate from which guests help themselves by hand, doing away with any kind of cutlery or tool, just like in Turkey and in the Middle East, or during the last supper, laying on the floor or on a triclinium. The traditional western bathroom is replaced by a Japanese one, which also recalls the ones in ancient Rome. It provides a simple washtub, or a bathtub encased on the floor, because it does not really serve a hygienic purpose (washing) but rather the meditating ritual of soaking into the water; for this same reason the other, more intimate, bathroom fixtures are placed in a separate space. Those constituent elements, and the several interconnected cultural relationships, shape the planning of houses that, each in its unique way, will evoke the different ways of living of the many Mediterranean cultures as well as the ones in the Middle and the Far East.

The elementary constants of his vocabulary are to be identified in the walls, the trellises, the windows, the niches, and the fireplaces. Here the design priority seems to measure up to the idea of the garden-house that Rudofsky calls Outdoor Conditioned Room (Figure 9).

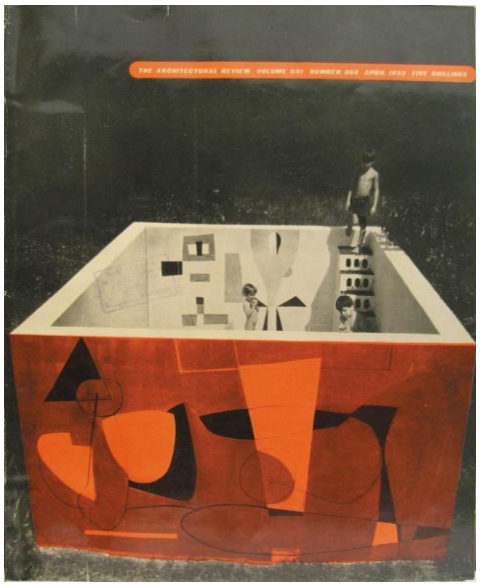

Figure 9. Cover of The Architectural Review, April 1952, with the project of the Nivola Garden-House in Long Island, NY (1950), by Bernard Rudofsky and Costantino Nivola

In Rudofsky's point of view, the luxury of a home is not determined by its technical appliances and fixtures: air conditioning, jacuzzi, televisions, vacuum cleaners, electric ovens, fridges and so on, but by the fact of being an open-air room where, like in the Garden of Eden, the occupants can, at the same time, work and sleep, cook and eat, play and relax, an environment with a natural climate determined by trees, water, and the light of the sun.

6. Conclusion

It is evident from the debates and controversies around architecture, cities, and houses, that the issue of the confrontation between cultures was only ever vaguely addressed, and the same went for any way of living not verging solely on mere quantities and figures regarding emissions, water consumption, number of inhabitants, parking spaces and acres of urban parkland.

Very often the debate and the proposals of architects dealt with the solution of the problem relating to the management and the shape and functioning of cities and housing in general, forgetting all together with a number of other transversal issues overlapping with the matter of the actual architecture of the house and planning of the city.

Most certainly, in Rudofsky's books and planning proposals we will not find the solutions for the mechanised and modernised, in one word globalised, society in which we live, and for a planet on the verge of collapse, but they could at least offer elements on which to reflect upon.

The current situation is inevitably leading us to consider a necessary U-turn when it comes to the relationship between different cultures, developing processes, the very same fate of our planet, and all the issues surrounding our chosen way of living within a given built environment, but also a rethinking of the strategies already as well as the ones that are going to be implemented in the very next future.

For quite a long while now, architects have been challenged with the attempt of trying to put forth different answers to the existing ones that have already proven to be detrimental failures, even though the solutions articulated thus far are just directing us into blind corners.

The situation of paralysis is due on one hand to the fact that old historical cities are excluded by the processes of development and industrialization (modernisation), and on the other, because the new cities, conceived to be monitored by a control room and artificial intelligence, will suffer a fast process of technological obsolescence that not everyone will be able to endure.

However, the old cities live on, and the new ones, built in rural or deserted areas, provide new empty buildings often in need of demolition, like the Pruitt-Igoe, a neighbourhood built on the model of the Radiant City by Le Corbusier (1936).

In actual architectural terms, technology and science have had minor effects if compared to the cultural and historical ones of the ancient cities. Even the new technologies, iron, glass, concrete, and plastic, so important for the affirmation of the Modern Movement, have led to a house and cities only marginally better than the ones built in the past (Rybczynsky, 1986).

Unlike any universal scientific and technological pattern, or the global economic one, cities and architectures possess the characteristics of a biotope, and they are the result of unique conditions, with their very own cultural landscape.

In Smart Cities, we see the actual possibility of a solution for the sustainability problem of the planet, but in those hi-tech new cities, operations are standardised and homologous, because the scientific and technological solutions are universal. We ought to remember that cities and architectures are not just machines to use for the purposes of living and inhabiting, but the actual experience of living and inhabiting, they do not relate to quantities and figures but to cultural landscapes and fragile ecologies (Banham, 1971).

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The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

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Studies involving animal subjects: No animal studies are presented in this manuscript.

Studies involving human subjects: No human studies are presented in this manuscript.
Inclusion of identifiable human data: No potentially identifiable human images or data is presented in this study.

Conflict of Interests
The author declares no conflict of interest.

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Designing Alternatives for Residential Apartments in Cairo Using Shape Grammars

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ABSTRACT

Through observation, it is noticed that the design solutions of the inner spaces of residential units in Cairo have circulation problems. These problems are represented in direct and indirect separation between different zones in apartments, whether private or semi-private. This is due to; reduced areas, site location, building policies, etc. Such problems obstruct resident's way of everyday life, and their living quality. After introducing such problems, this paper proposes a set of shape-grammars rules that facilitate designers, through their process to produce a range of design alternatives for the same area. Shape grammars' rules are set according to three aspects: a) required relationship between zones for Carians culture, b) building policies as a constrain, c) the given building area in different situations (attached to neighbours or free standing, etc.) That rule works as a design tool for any designer in Cairo to select the suitable alternative and facilitate his creativity through the process.

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1. Introduction

Lodging plays a basic part in well-being openings for individual laborers and their families, influencing current and future specialists, managers, communities, and territorial communities. The benefits of fitting and reasonable lodging and results when such lodging is inaccessible are most concrete at the person and neighbourhood level. In any case, as required for lodging mass generation increments and the lodging ventures gets to be more costly to deliver, its execution qualities have particular impacts on homes on all levels. This overview of the significance of lodging highlights a few associations between lodging, person well-being opportunity, workforce, and quality of social and social improvement that

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analysts have investigated. In any case, the impacts of homes—for case, measure, quality, area, and cost—extend past the cases given here.

People and families that make a domestic selection, choose their sanctuary with related characteristics, assets, civilities, and opportunities. On occasion, they select to get to particular schools, nearness to merchants and other shopping, vicinity to family and other imperative social systems, and opportunities for amusement and work out. Families select the appropriate lodging they can be stratified in and perform superior "packages" at the most suitable costs. In spite of the fact that lodging needs are not among the beat components influencing where family units select to live and work (Wang, Lyu & Xu, 2021), they have vital impact on their social response and improvement.

A community that needs amential and comfortable lodging regularly need lodging for the community's fundamental, low-income labourers. To supply high quality of life for all families, the territory and its locales must empower engineers and builders to create lodging that's fitting and fulfilling for families at each salary level. For those with the most reduced salaries, neighbourhood governments must combine their land-use devices and resources with state and legislative assets to supply easy access and suitable lodging and guarantee that low-income labourers can proceed within the community.

Planners have been since decades investigating conceivable outcomes for making expanded plans that fulfil the requirements and yearnings of clients. In lodging plans, a few techniques have been created to realize this objective of user-centeredness, such as counting tenants within the planning as in a participatory plan, and as creating plans that give several format choices for tenants to select from. The most point of the research described here is to investigate how shape language structures can fortify these existing procedures. It'll be examined how the use of shaping - as a linguistic tool- can consolidate inhabitants' wishes in a planning device for customizing their houses such that it complies with their wishes and styles, whereas at the same time encoding engineering information with respect to style and building directions. In this paper, we, in addition, concentrate on customizations by occupants of existing lodging designs.

2. Aim and methodology

The purpose of this study is to analyse the formal and syntactic information within the plan layouts of Cairo residential houses, to trace achieving the ideal zoning for residents. Separating residential private spaces from the semi-private ones can be defined as design language and presented through an interactive and visual expert system. In this study, shape grammar was chosen as a method, which can be used in analysing proposed design languages and producing new designs, that preserves Carians social needs for privacy.

The research seeks to solve issues concerning today's residential buildings that not mostly satisfy users with their living spaces and levels of privacy they need, that affect their emotional responses to the place, with respect to Carians customs, traditions and contemporary lifestyle. The goal of this paper is to propose a new model for a contemporary house based on the teachings of Cairo residential houses. Therefore, this study attempts to recognize the relationship between spaces is some houses in Cairo and propose a pattern for these houses using the shape grammar based that can be used in Shape grammar applications. Understanding the mostly ideal patterns of housing can be a pivotal step towards a better future. This is important in terms of both theoretical and practical aspects. From the theoretical point of view, it is possible to read and analyse the shape grammar theory in these residential houses, which can be pursued elsewhere in Egypt; the practical aspect is associated with design programs and activities in teaching architecture design.

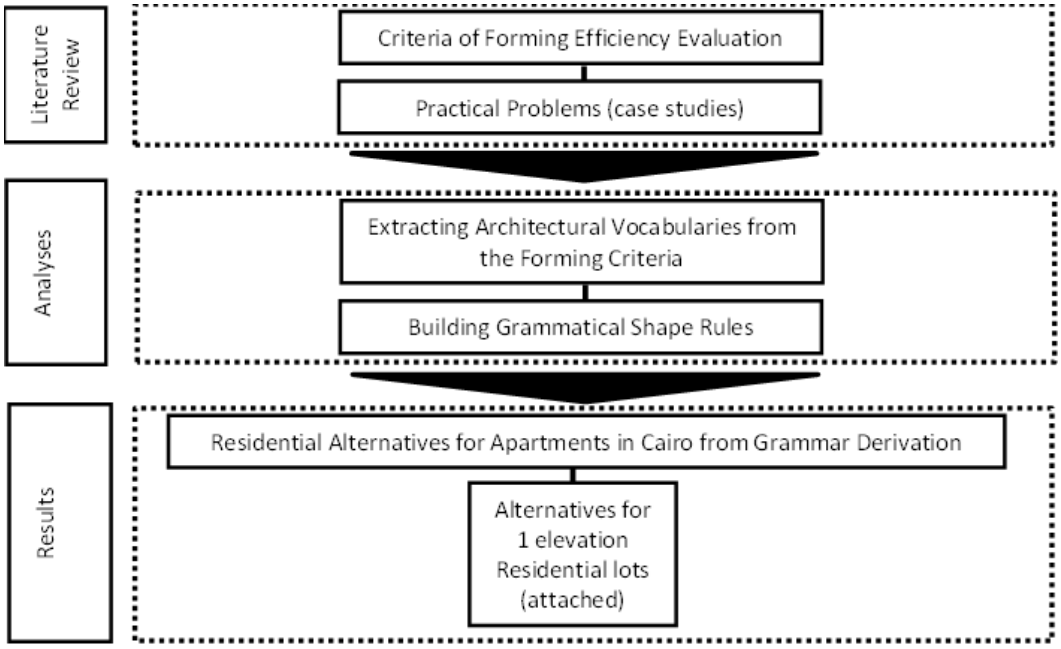


Figure 1. Structure of the Study

3. Criteria of forming efficiency evaluation

This study relies on three sources to ensure the design and construction efficiency of housing units in Egypt in general and Cairo in particular. The source for any architect in designing any qualitative building is the architectural standard books, which ensure that the standard dimensions are taken into account in the designs to achieve comfort for the user. Also, to design residential buildings in Egypt, the architect must fulfill the structural requirements mentioned in the Egyptian Building Law (Building Law, 2008). The third which the architect must take into consideration is the social and cultural aspects of the society, where the customs and traditions. In addition to the needs and requirements of the users of the housing unit and the design keep pace with their daily lifestyle.

These three sources guarantee the designer to develop alternatives to his design solution that achieve living efficiency, comfort and transcend the residents' sense of quality of life and thus positively affect their productive efficiency.

Regarding the first point (Standard books) like Time Saver and Neufert one can extract some important data regulating the design process of residential units such as the appropriate areas of different spaces of the apartment as well as the minimum and maximum dimensions of all spaces used in any apartment. These references also give useful data about the different spaces forming a residential unit and the functional relations between them. The data coming from these references is universal and can be applied on residential apartments built anywhere.

This automatically takes us to the second point (Egyptian Building Law) which provides us with all the specific regulations and restrictions applied on the residential buildings in Egypt. These rules provide designers with all the permissible and non-permissible during the design process. They for example give a clear constraint that all the living spaces including bedrooms, living rooms, and receptions should be either oriented outwards or towards residential courts with areas varying from around 20 squared meters and reaching more than 100 squared meters based upon the building height, to provide those spaces with proper natural lighting and appropriate ventilation (Building Law, 2008). Also those rules state that the service areas like kitchens, bathrooms, toilets, corridors and stairs should also gain natural lighting

and ventilation either form outwards or residential courts or preferably from service courts with areas varying from 7.5 to 15 square meters (Building Law, 2008). The rules as well regulate the areas and minimum dimensions of the open courts, the setbacks, and the residential pockets which are found mainly to provide natural lighting and ventilation to different living spaces (Building Law, 2008).

Then comes the third point which is related to the social and cultural aspects. In Egypt because of being an Eastern country with Islamic conservative culture; Privacy is highly valued especially in residential places. Therefore, the zoning that is considered appropriate for Carian residential units depends on depends on dividing the residential unit into three main zones according to privacy aspects (Tomah, Bani Ismail & Abed, 2016):

A. Private zone consisting of the bedrooms and bathrooms and sometimes internal living area.

B. Semiprivate zone which is the reception area consisting of saloon(s), living, and dining area.

C. Service zone consisting mainly of the kitchen and guest toilet.

Each of the three zones should be accessed directly from an entrance lobby which is directly accessed from the main entrance. Reaching one zone should never be done through another one.

The three mentioned points should be relied upon integrating the regulations coming from each in order to reach an appropriate architectural design of a residential apartment in cairo.

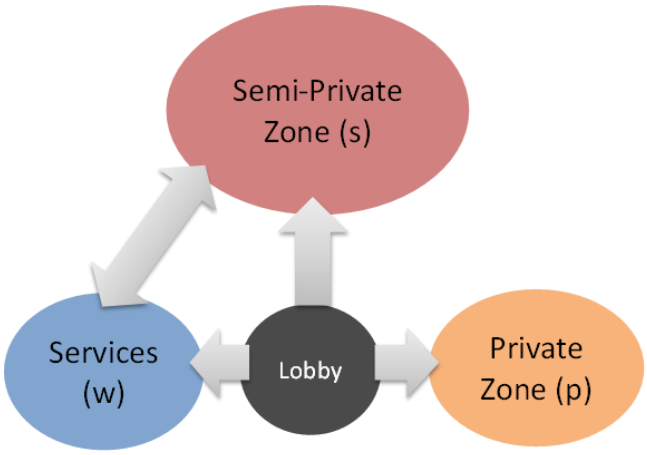


Figure 2. A proposal of appropriate zoning for Carian residential unit

4. Residential units currently offered in the real estate market in Egypt

Residential buildings being the type of buildings that every single resident or family in any country should own or at least rent one is fact that lets residential buildings to compose the greatest share of the building industry in any country. In Egypt this fact is accompanied by another fact stating that a huge sector of Egyptian residents and citizens deal with residential units as a source of future investment in which they save the value of their money. This gives a great importance and priority for the Egyptian Government, investors and developers to produce great numbers of residential buildings and offer them for sale especially in the new settlements surrounding Cairo such as Sixth of October City, Al-Sheikh Zayed City and New Cairo. A small sample of the residential units being offered for sale nowadays in the Egyptian market is going to be presented and analysed in this section.

(a) An example of the residential units being offered for sale through the Ministry of Housing

(b) Samples of residential units being offered by different investors of the private sector

Figure 3. Residential units currently offered in the real estate market in Egypt (Source: Egyptian new papers, ads sections, for the last 5 years, labelled by arrows by the authors)

The above examples are just a significant sample of a great amount of the residential plans being designed in Egypt nowadays. They are designed following the most common improper zoning being used recently. The selected examples have a common feature which is all the living spaces of the apartment being oriented towards a single elevation.

It is evidently clear from analysing the above examples that major design problems contradicting with the appropriate design measures and standards explained above that should be followed in residential units are committed repeatedly. One can conclude these problems mainly in improper zoning.

All of the above examples do not follow the proper zoning regulations. Almost in every single plan of them the bedrooms zone is always accessed through the reception not directly from the entrance lobby causing several problems inside the apartment the most significant of which are related to circulation and privacy.

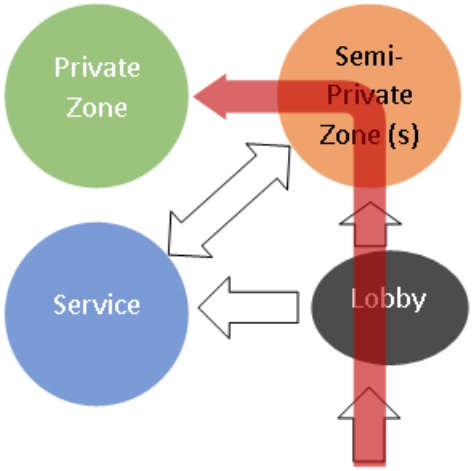


Figure 4. From analysing the current offered residential units in the real estate market, there is a common mistake concerning their design zoning, forcing user to cross a zone to access the other

The following plans are a just a trial to introduce design guidelines for residential units with different areas being oriented towards one elevation. The plans are generated from the proper zoning being explained above.

Figure 5. Proposed plans for residential units, having one elevation and various surface areas. All of them consider the appropriate zoning with different design (1 module equals 1 squared meter)

The above plans designed by the authors are just a trial to produce a design guide that can followed during the residential units' design process. The three models presented above are preliminary designs that can be easily modified to produce several other alternatives.

The important point is that these models were designed strictly following the regulation and standards coming from The Criteria of Forming Efficiency Evaluation. All the proper areas and dimensions for different spaces are used precisely, as well as following the regulations coming from the Egyptian Building Law, and finally being stuck to the appropriate zoning.

The entrance of each apartment leads to an entrance lobby with convenient area which leads to three main zones each of them to be reached directly from the lobby without crossing another one.

The living spaces in each apartment are all oriented outwards towards a single elevation providing them with natural lighting and ventilation. The services and wet areas are always oriented towards service courts with areas referring to the Egyptian Building Law.

The areas and dimensions of the different spaces are also extracted from the standard books and The Egyptian Building Law. Bedrooms and living rooms with areas varying between 13 to 20 square meters, with a minimum side dimension of 3.6 meters., while corridors width always vary from 1.2 to 1.5 meters.

As a result, the three models can be considered appropriate with respect to the regulations that should be followed in Egypt.

5. Shape rules to generate Carian residential houses plan layouts

Using grammatical rules for a certain building type helps the designer to generate new alternatives related to the same family and preserves its architectural features. Such rules can be used manually and also can be installed in some computer applications. However, computer applications designed for using "Shape Grammars" needs more detailed and precise information. Such applications help designers to generate more new alternatives. Also, they help designers to put their modifications on the rules themselves, considering new needs or to solve previous problems.

The derivation of a design in the grammar goes through three successive stages: defining the private areas (PA), defining the semiprivate areas (SPA), and defining the wet area (WA). As the outcomes of the private spaces continue, annotations are put on the semi-private. When the development of the semi-private zone wraps up, a state annotation changes, subsequently enacting generating of the wet zone. The enunciation between the development of the semiprivate zone and the wet area works in a comparable way. Each of these stages, in turn, incorporates a few steps. For occasion, the stages of the private zone are placing utilitarian zones, finding the staircase, separating functional zones (into rooms), and intiate detailings. Dividing them into steps is just explanatory, as there are no state annotations to go from one step to another, like those utilized to alter organize.

As it is mentioned in previous section, city governors and architects are committed with the local building regulations. However, architecture understood that the structure should contain cultural and social values, so they attempted to make integration between traditional costumes and contemporary life style.

5.1. Context

In the Carian residential shape grammars, the initial shape is a rectangle with a label `Lot' representing the area of the residential unit which varies between 12*14 and 14*19 m2, they can be clustered in plots. The plots are clustered together to make lodging aggregates. In most cases, these aggregates are in regular linear shapes, but they might take other shapes to fit the shape of curvilinear streets. As a result, in normal plots all but the front edge border other plots, but in a few plots edges other than the front edge might border a road, under certain restrictions. For occurrence, separated plots are not allowed. The sort of environment characterizes the urban setting of the parcel and affects the utilitarian organization of its house by limiting the number of facades with openings.

This paper works on residential units that can be designed on area with one elevation, which has one elevation and surrounded by three neighbours.

5.2. Composition

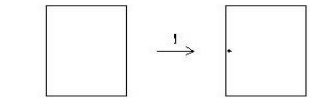
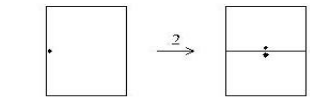
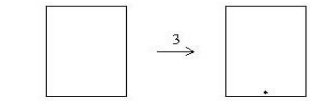
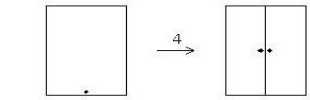
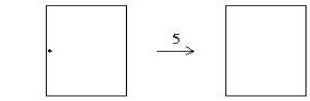
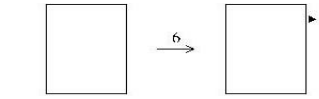
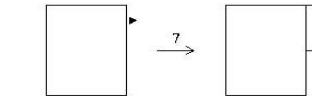
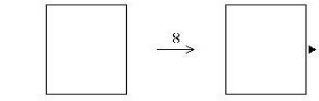
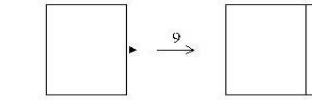
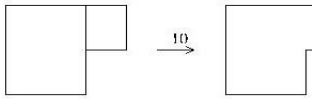
Generating grammatical shape rules for residential buildings in Cairo provides a tool of design for architects and educational tool for scholars. Before, many authors used shape grammar as a tool to

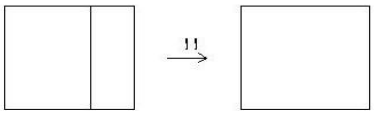
study and analyze residential units. One of the most famous is the basic composition rule schemata of the prairie houses that was designed by Frank Lloyd Wright (Koning & Eizenberg, 1981). By time many researched used that tool to put precise grammatical shape rules for certain cultures or locations, such as; Vasco Granadeiro (Granadeiro, Duarte, Correia & Leal, 2013) who worked on linking between the shape rules and the needed used energy, Wael Al-Azhari (Al-Azhari, 2020) who worked on extracting shape rules for Amman houses and others. Here, this research depended on the work of Jose¨ Pinto (Duarte, 2005) that dissert shape rules for the houses of Siza's houses at Malagueira. His rules schemata are considered as a good start to work on that for Egyptian houses.

Compositional standards behind the generation of a Carian house plan are based on the control of rectangles representing rooms by implying rules for slicing, combining, and expanding rectangles. To facilitate creating it for the peruser to get the compositional principles of the grammatical composition, a really streamlined set of shape rules is introduced in table 1. In this simple system, rules incorporate as it were the two-dimensional design component and lines are considered as borders.

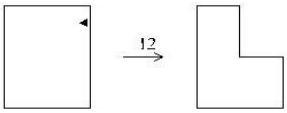
Such rules are deducted mainly from; a) standards of residential structures as a building type (Time-saver standards, 1954), b) Egyptian building code (Law No. 119, 2008), and c) considering social aspects concerning privacy and not to intersect between private and semi-private zones (Tomah, Ismail & Abed, 2016). Those considerations provide users satisfaction, well-being, and social satisfaction in addition of suitability with the contemporary life-style needs. Also, from the proposed plans of the residential units, and to be able to achieve the suitable dimensions, the total surface area of the unit must not be less than 100 m2.

Table 1. Shape rule schemata for Egyptian residential units

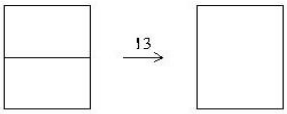
	For any rectangular space, whether the whole area of any room, this rule marks the side form which this space will be divided. The dot mark is a label that identifies the last line placed and indicates on which side the next dissection may occur. Rule 1 marks the larger side of the rectangle.
	Opposite separation is the initial compositional rule. In rule 2, separations are opposite to the wider edge of the rectangle.Next step can occur on both sides or one side according to the marked line.
	Rule 3 marks the shorter side of the rectangle.
	Rule 4 divides the space into two linear spaces. The added line is parallel to the longer side of the rectangular. Similar to rule 2, next step can occur on both sides or one side according to the marked line
	Rule 5 deletes the label, preventing further dissections.
	Rule 6 marks, using ► any side in the rectangle, indicating an addition on a part of that side.
	Rule 7 is an addition rule that applies on the labelled side in rule 6.
	Rule 8 marks, using ► on a side in the rectangle, indicating an addition along that side.
	Rule 9 is an addition rule that applies on the labelled side in rule 8.
	Rule 10 is a merging rule. It widens the space from a part of one of its sides.



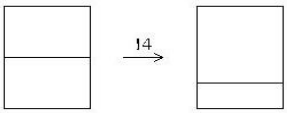
Rule 11 is a merging rule. It widens the space from a one of its sides.



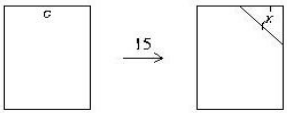
Rule 12 labels a side of one line in the space. The label ◄ looks inside the space. This is a subtracting rule, which cuts off apart from the space.



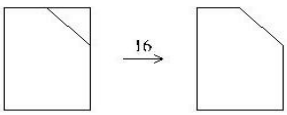
Rule 13 is a merging rule without expanding the area of the space.



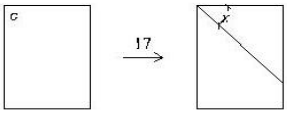
Rule 14 saves the whole area of two rooms, however, widening one and shrinks the other.



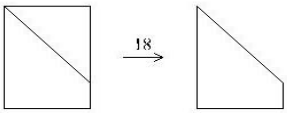
Rule 15 labels the center of one of in the space, by applying this rule at this part a chamfered line is drawn, where $15^{o} \leq x \leq 165$. The line divides the space into a polygon and a triangle.



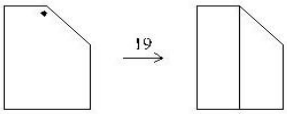
Rule 16 is a subtracting rule, that cuts off a triangle and keeps the polygon shape.



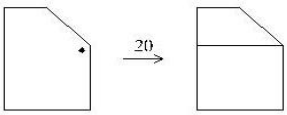
Rule 17 labels a corner in the space, by applying this rule at this part a chamfered line is drawn from that corner, where $15^{o} \leq x \leq 165$. The line divides the space into a trapezium and a triangle.



Rule 18 is a subtracting rule, that cuts off a triangle and keeps the trapezium shape.



Rule 19 is a dividing rule, that divides the polygon shape vertically.



Rule 20 is a dividing rule, that divides the polygon shape horizontally.

From the previous rule schemata in table 1, architects can derivate them as a systematic tool to produce different alternatives for the same unit. Figure 6 present how the derivation works.

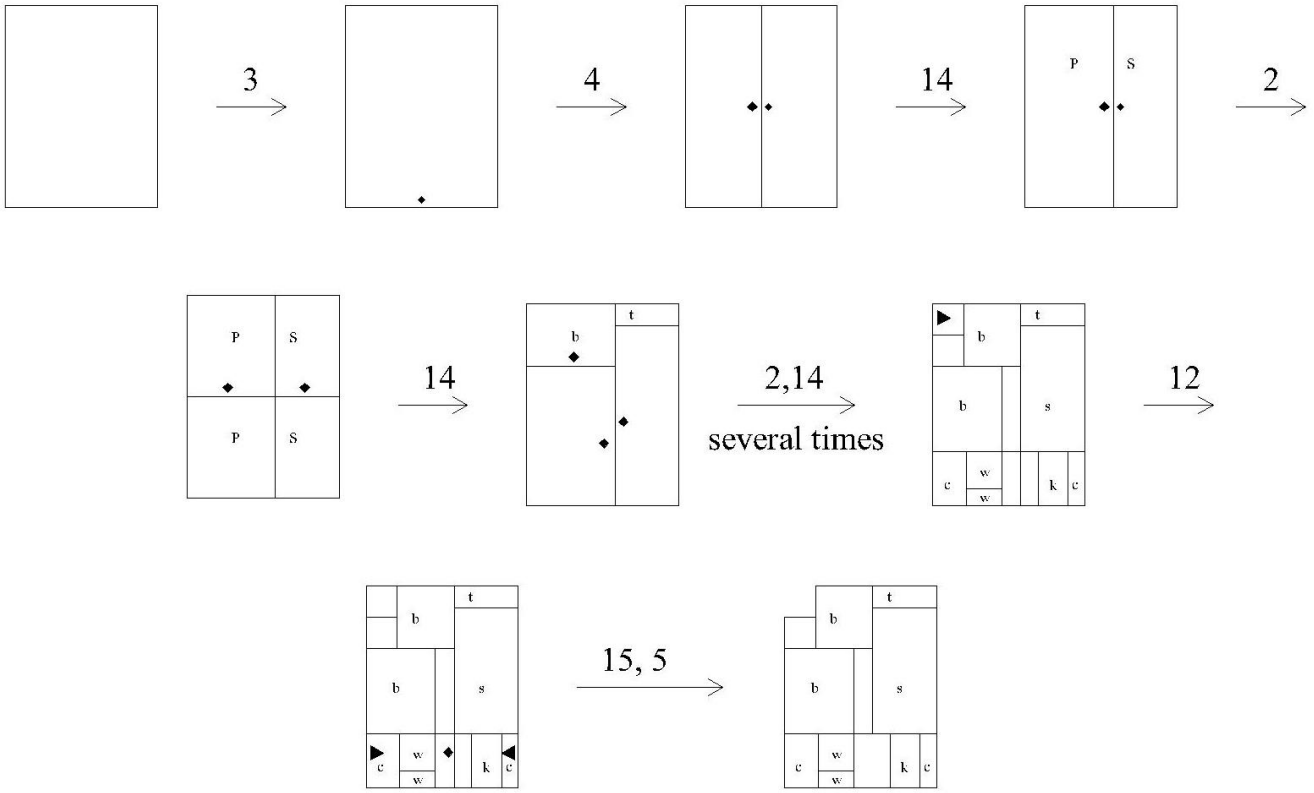


Figure 6. Derivation model proofing that the deduced primary rule schemata work

The steps included within the definition of the utilitarian organization of the floor plans are appeared in figure 7 (see over). The sketch takes the frame of a tree in which nodes are considered as the state of the plan and arrows are considered as the application of rules. The tree outlines how the application of rules to allocate functional zones creates the essential said forms behind the houses in Cairo. It identifies also how the diverse sorts in reasonable units infer from these designs by a diverse application of the rule to place the spaces practically. At last, it appears that subtypes vary from one another in little varieties of the format caused by distinctive applications of the rules for separating zones.

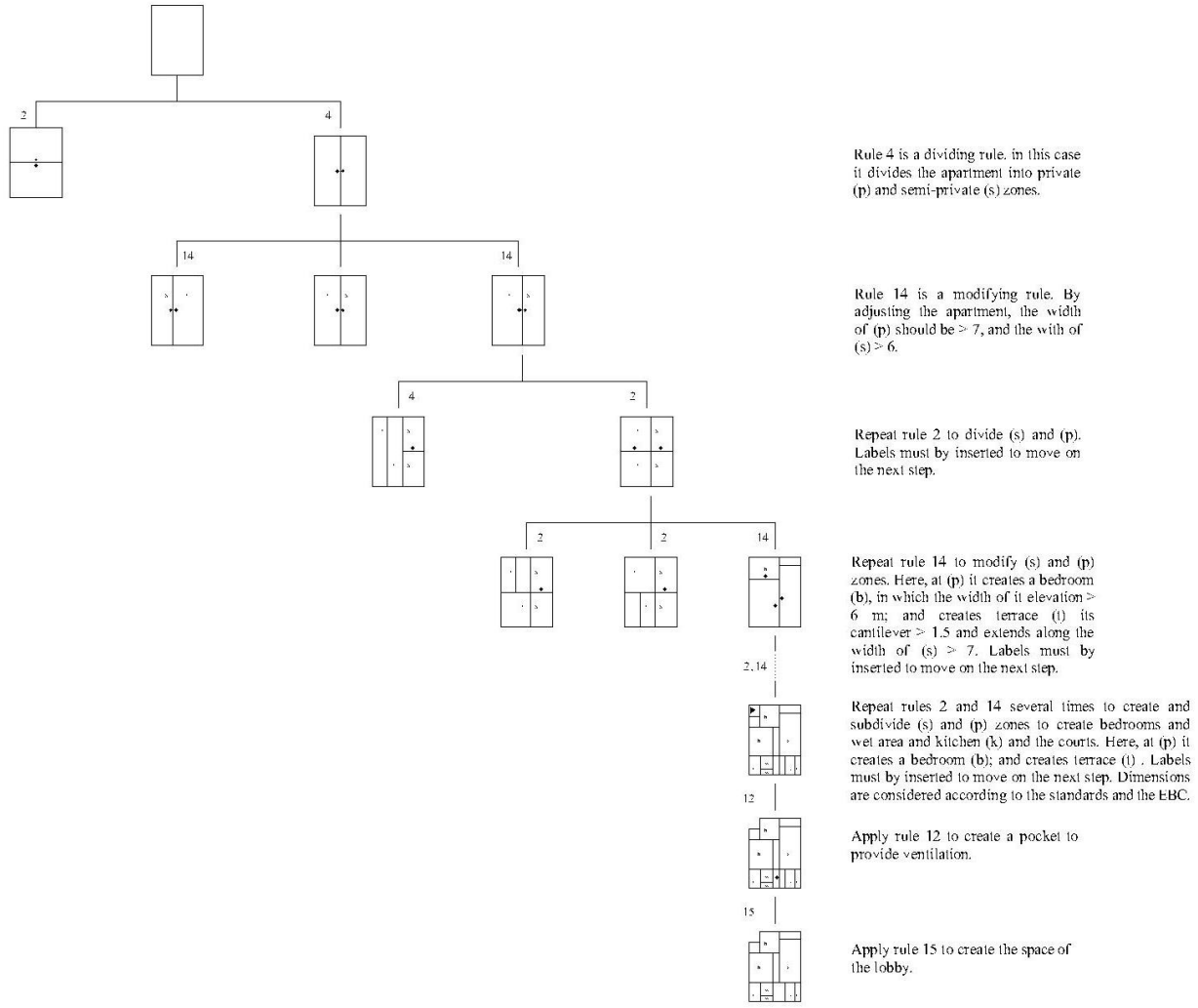


Figure 7. Part of the tree sketch represents the determination of essential designs, sorts, and subtypes. The designs are not dimensioned to stretch the commonalities among different sorts. The sketch incorporates suitable creative plans for Egyptian house buildings

6. Conclusion and recommendations

At the beginning of this paper argument about if shape language tool can give the design as a device to create Egyptian plan rules for private house units. This contention is settled with the introduction of a language structure taking into consideration the EBC, private building guidelines and considering social perspectives. The utilisation of straightforward compositional rules comprising the separation of rectangles to determine the type of style. The language structure accounts for the development and production of the ten houses considered within the corpus, as well as creative houses related to the same design family. These new designs were created both by the authors of the grammar rules, achieving the EBC and separates between the private and semiprivate zones in the apartments. Therefore, the grammar successfully works.

So, practically wise, architects can use the illustrated grammatical shape rules to find different design solutions that suit their ideas and satisfy users functionally and socially. On another hand, this can be a simple tool for the academics to teach students how to respect the EBC and find various design solutions for the same area or the same context.

Finally, the illustrated grammatical shape rules can be considered as primary pattern language for the Egyptian residential units. Such rules can take another layer of reviewing to generate more precise details such as inserting openings, defining the heights, applying the suitable surface areas for the inner spaces, ducts, and courts. etc. In addition, this paper introduces to generate more grammatical shape rules to consider different context conditions, where residential units having two or three elevations.

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Data availability statement
The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Ethics statements
Studies involving animal subjects: No animal studies are presented in this manuscript.
Studies involving human subjects: No human studies are presented in this manuscript.
Inclusion of identifiable human data: No potentially identifiable human images or data is presented in this study.

Conflict of Interests
The author declares no conflict of interest.

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Developing Urban Design Research with VINEX

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ABSTRACT

During the mid-1990s and the first two decades of the 2000s, the Netherlands underwent a super zoning programme called VINEX to redevelop peripheral areas. The initial objective is to change to an urban landscape design project for high-density housing, favouring places that tend to be elitist. This research looks first at the evolution of VINEX on urban landscape design and then at how the recent NR development programme has sought to correct housing speculation. Finally, by comparing the objectives of VINEX and the NR programme, this research aims to highlight how land reclamation can also be achieved through new policies of green landscape and social inclusion and not only through land consumption, a peculiar characteristic of Dutch planning.

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1. Introduction

The Netherlands has always been a place that has undergone profound transformations due to its predominantly flat orography, characterised by alluvial land below sea level. Water is a fundamental element in the management and formulation of spatial policies, which were initially conceived on a landscape level precisely to defend the territory from frequent flooding. This method of legislating in the function of self-defence has contributed to creating in the Dutch a solid social and civic sense towards public space, leading to the development of great respect towards the water element, which from being an enemy has become an integral part of land planning (Pungetti, 1991).

Urban development policies have always aimed at intensively shaping the landscape, densifying urban centres, creating new ones, and consuming a large part of space for agriculture. However, since the end of the 1980s and continuing into the 1990s and early 2000s, Holland has been hit by a new 'golden age' of building, which, through the contribution of big names in international architecture and anti-

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dogma signatures, has changed the urban design of the territories. However, this change in the design of the landscape and its almost total territorial saturation has brought to specific light problems due in part to the state's exit from territorial policies. The state has delegated management to local authorities and private organisations, which have reduced the budget for funds for the design of new neighbourhoods, resulting in immediate master plans and mediocre architectural quality.

2. Design methodology

The VINEX programme - Vierde Nota over de Ruimtelijke Ordening Extra (Fourth National Planning Guideline Document) designed for an extended period and a continuously developing society, showed all its shortcomings, especially in the second decade of the 2000s when Europe was hit by a long period of economic crisis. The fifth NR development programme was created precisely to address the problems left by the effects of the previous one and seeks to correct all the distortions of VINEX. This article analyses the nation's spatial problems by re-reading urban development reports and their approach to spatial development and evolution over time. In the first part, the programmes from the Amsterdam Housing Act of 1901 to the decentralisation programmes of the 1960s and 1970s are described, up to the issues of decommissioning and redevelopment that led to the birth of VINEX. This experience is then analysed and how its application transformed the national territory over twenty years, especially regarding the landscape's anthropisation.

This is followed by an analysis of the objectives of the fifth NR report and how spatial preservation policies were set up to correct the problems left by VINEX. After this chronological run through the development reports, differences in the procedure are compared using the comparison methodology so that the corrections made can be understood. In the concluding part, attention is drawn to how more excellent reflections on landscape and public space preservation policies can create greater social cohesion. The VINEX programme created de facto elitist neighbourhoods for the wealthy classes, a peculiarity that today's planning must no longer run into.

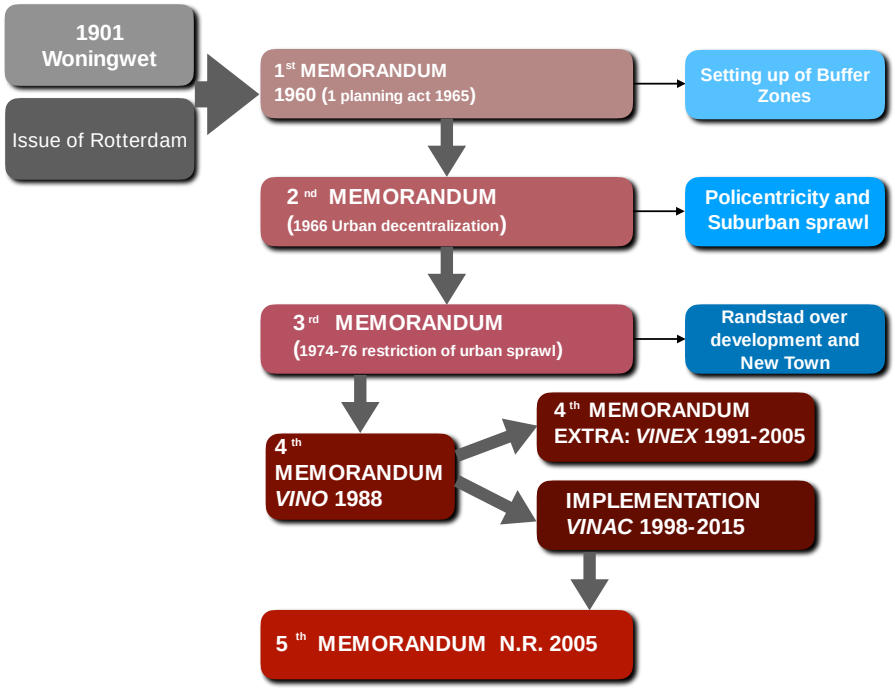

Figure 1. Structure of the study

3. The Dutch landscape and the planning and development reports

The transformation of the Dutch landscape has undoubtedly been influenced by the Planning and Development Reports drawn up in the early 1960s up to the present day and which have, in any case, had as their reference the fundamental pillar of the Woning Wet of 1901 (Ugolini, 1996), a law passed for Amsterdam, but which nevertheless helped to regulate the construction and land use.

Spatial transformation policies have always sought to favour urban compaction and the protection and preservation of green areas (Nabielek et al., 2013); since the years following the Second World War, planners have tried to develop policies to contain urban centres and curb dangerous sprawl. Since the Second World War, the Dutch economic structure has expanded enormously due to the economic and financial aid that relieved the disastrous national situation, characterised both by a severe crisis in the agricultural production system and, above all, by the severe housing shortage that led over time to the peripheral construction of buildings of dubious architectural quality that were utterly unrelated to the territorial typology; these include the ERA buildings and the emblematic example of the Bijlmermeer in Amsterdam (Figure 2).

Figure 2. Amsterdam, Bijlmermeer district (Source: Wikipedia)

The second report, drawn up by the VROM (Ministry of Land and Housing) in 1966, introduced the concept of 'clustered dispersal', in which the polycentricity of cities was favoured in favour of decongesting the central areas and preserving the rural fringes through peripheral redevelopment (Nabielek et al., 2013). However, this relationship favoured the expansion and saturation of the Randstad, which led between 1974 and 1978 to the creation of a new relationship, the third, which was responsible for the identification of areas for the construction of new towns such as Almere in the northeast of Amsterdam and Zoetermeer a few kilometres from The Hague.

The Randstad (a name first given by the founder of KLM Royal Dutch Airlines - a Dutch acronym for 'Koninklijke Luchtvaart Maatschappij', in English 'Royal Aviation Company' - Albert Plesman, during one of his flights over the country) which was initially divided into the north wing (Amsterdam-Utrecht) and the south wing (The Hague-Rotterdam), as it became more and more ring-like, so much so that it was given the appellation 'Delta metropolis', about the Rotterdam Delta region that contributes to the unique landscape configuration of the area (Bruinsma & Koomen, 2018).

One of the objectives of the first reports is to confront both the increasing number of inhabitants due to the phenomenon of the 'baby boomers' and the growth forecasts drawn up until 2000; in this analysis, it should be pointed out that the 1975 oil shock was ignored. The impact of population growth on architecture led to a sharp increase in the need for housing, the urban need to contain cities and many urban parks and the beginning of the expansion of the public infrastructure to contain the use of private vehicles date from this period. In the Randstad area, an urban-landscape reality begins to emerge within the ring formed by the cities; it is an agricultural and recreational area known as the 'green heart', one of the pillars of Dutch town planning and considered an inviolable element in subsequent development relations that will contribute to a linear west-east evolution of the Delta area. The problem of deconcentration, anticipated by the second report and continued in the third, underestimates the problem of the expansion of the new towns, an implication that Burke, in 1966, anticipates for these new centres, identified initially as garden cities and then becoming future dormitory districts highly dependent on the central cities that continue to be a catalysing centre. At the same time, however, the expansion of these cores leads to a worrying saturation of the Randstad and a consequent danger to the inner green heart (Evers, 2018).

This expansion makes it possible to elaborate on some thoughts about the uncontrolled development of cities, especially in the West Netherlands in which the most important centres are concentrated and, as with much of Europe, within its fabric, there has been the divestment of important productive activities with the consequent emergence of urban voids.

3.1. The design of urban development

The decommissioning that began as early as the mid-1970s led to a progressive loss of the identity of the places that had sprung up around the production functions, located for the most part in the areas of the 'inner cities' and, particularly in northern European countries, those functions linked to the port realities. The lack of investment after the Second World War to safeguard the centres also highlighted, around the 1980s, the degradation and high condition of social exclusion of the central areas of urban centres, numerically similar to that of many peripheral areas. In this situation of social, urban, and architectural decay, the Dutch government, through the VROM, implemented a series of measures to redevelop the social fabric that affected the brownfield areas, which had become highly critical points in the main cities over the years. Around 1985, therefore, a first draft of what was to become the 'fourth urban development report' took shape, which saw the light in 1988, better known by the acronym VINO (Vierde nota de Ruimtelijke Ordening). This programme would change the urban, architectural, and social face of many Dutch neighbourhoods to foster social inclusion through integrated and participatory design programmes. The primary aim, therefore, was to foster urban mix and the application of the concept of the 'compact city' so that territories could be stitched up and many competencies of the state redistributed to local bodies and private individuals (Hoff van den 2006; Nabielek et al., 2013; Bruinsma & Koomen, 2018).

The real turning point began in the period 1991-95 with the supplementary note to the fourth report, known as the extra note, and activating a programme better known as VINEX (Vierde nota de Ruimtelijke Ordening Extra), which aimed at stitching up the most extreme parts of urban centres with the central areas through infrastructural implementation and the creation of independent citadels characterised by a high number of both social and private housing (Evers, 2018). However, problems with VINEX begin to be encountered in the early years of the new millennium, when the districts built in various areas of the nation are presented not as examples of compact cities but as examples of diffuse and elite rather than mixed cities (Fratini, 2014); the absence of suitable connecting infrastructure causes the programme to be extended in a second implementation until 2015-2017 that bears the name VINEX 2 or VINAC (Hoff van de G.J.J, 2006; Bruinsma & Koomen, 2018).

During the termination phase of the VINEX programme through the VINAC implementation, the fifth planning and development report is drafted, which attempts to analyse and correct those criticalities caused during the decades of the extra note; the new face of the national territory after the construction of the new districts, which were nothing more than super zoning experiences, is observed (Garcia Barba, 2009).

The fifth NR report (Note Ruimte) began its study phase in 1999 and was drafted in 2002 in the entire VINEX operation. One of the objectives in the administrative field concerns the state's withdrawal from urban policies except by exclusive delegation, extending what had been anticipated in the fourth report and effectively consolidating the principle of subsidiarity. In addition to endowing the provincial and local authorities with exclusive competencies and favouring openness to private intervention, integrated planning for territorial policies is consolidated to carry out interventions that represent an economical use of space. The new report considers the construction experience of the VINEX period as over and focuses on the preservation of the landscape and the territory, operating through the motto "centralise what is necessary, decentralise what is possible" (Bruinsma & Koomen, 2018); in fact, stricter principles are applied about the execution of new constructions.

4. The case of the VINEX programme

The VINEX programme, as anticipated in the previous paragraph, represents the extra note of the implementation of the fourth planning and development report; it envisages, initially until 2005 and later in the VINAC implementation until 2015, the construction of "one million new houses" (Fratini, 2014).

Given the small land area of the Netherlands, the data received on the building density envisaged by the programme are impressive: from 1999 to 2004, 828,145 dwellings were built, contributing to a radical transformation of the landscape, mainly due to the construction of new districts on the periphery of urban fringes (Gibelli, 2011).

Local authorities begin to play an important role because they are called upon to manage territorial policies through a transfer of the State's competencies to the Provinces, the Municipalities, and private individuals with the condition that the construction of the housing stock respects the quotas of 70% private housing and 30% subsidised housing (Fratini, 2014).

The state's exit from the management of real estate production and the consequent entry of the private sector implies greater competitiveness in the construction sector, which essentially aims to fulfil two purposes: "contain social spending, focus on operations and diversify products" (Fratini, 2014).

One of its most controversial aspects is disregarding the goal of high-density and compact cities to chase high market interests and realise elitist low-density neighbourhoods (Hoof van den, 2006). This has generated one of Europe's most emblematic examples of super zoning and land consumption.

The different implementation in the fourth report is undoubtedly very complex because it was born in a context of high development in the country. When parliament began to define this interaction in 1991, the programme was already operational and focused on redevelopment of inner-city areas (Gibelli, 2011).

The first draft of the extra note was drawn up around 1993, but it was in 1995 that the programme was made operational; the first two key objectives consisted of infrastructural implementation and the construction of new housing allocated in districts often close to major motorway junctions (Fratini, 2014).

Regarding infrastructure, VINEX has focused heavily on the implementation and strengthening of motorway and railway arteries, local public tram, and metro links, and strengthening port and airport activities such as Schipol Airport. The strengthening of the airport is based on four fundamental points concerning economic development, the reduction of vehicle traffic, integrated neighbourhoods with

housing, services, public transport, cycle paths and, finally, the preservation of urban space (Kruithof & Teule, 1997).

The main characteristic is to go and build new districts in areas that are no longer productive or characterised by the presence of old suburban brownfield sites, maintaining the line of decentralisation, where the state retains the competence to 'circumscribe consistency of public funding' (Fratini, 2014). The provinces and municipalities, on the other hand, are responsible for drawing up structural plans, monitoring expenditure, the financial sustainability of contracting companies, and dealing with the implementation phase. Although covering the entire national territory, the VROM's choice for so-called 'VINEX-locations' concerns the Randstad area, where new neighbourhoods can fit in more urbanised areas and be more easily connected to the infrastructure system.

One of the peculiarities in the location of the districts was to have divided the areas into three types, defined as A-B-C, depending on the type of infrastructure system present and possible implementation. Category A belongs to the districts oriented toward public transport and close to a tramway or railway line; band B areas are those with intermediate proximity to a railway line; while band C areas are those that do not have a vocation for public transport but prefer the use of the car (Hilbers & Snellen, 2010).

4.1. The foundation of the control centres (BON)

To avoid the overlapping of tasks between provinces and municipalities, the competence assigned to local bodies for land management led to the establishment of BONs - 'Bestur Op Niveau' (Control Centre), which consist of an administrative division of seven regions with the task of coordinating and facilitating the work of the municipalities (Kruithof, Teule, 1998). These new control entities have more extraordinary powers under the current framework law. However, the problem with their operation was that they were not endowed with certain delegated powers over land management. Instead, they remained within the Ministry of the VROM, which remained a direct interlocutor because it had more transparent legislation (Kruithof & Teule, 1998).

The problem between the BONs and the VROM mainly concerns metropolitan areas and land management, landscape management and the price of land on which to erect districts, and the Ministry suggests a nationally uniform price. BONs, on the contrary, are more oriented towards local market prices.

Another issue is increasing density and agreement with the various municipalities, especially when the VINEX district is between the large centre and the immediately smaller one. The latter usually fears being contested by the population mass of the more critical centre that would inevitably occupy the new location. Moreover, the building typology preferred by large centres also differs from that of small ones: the former prefer more substantial buildings to favour the concept of a compact city. At the same time, the latter are inclined to smaller single-family or semi-detached buildings with gardens, already defining the affluent target of future inhabitants.

Despite the controversial aspects and the difficulties between the State, the various local bodies and the private sector, the programme is one of the Netherlands' most extensive land and landscape transformations, as described in Atlas VINEX, one of the most comprehensive texts published on the subject. However, in the first ten years of the report (1995-2005), dwellings were built at an "average low-density of 20/25 dwellings per hectare" (Fratini, 2014), where the most common type is the traditional terraced house with a garden. The redevelopment of the landscape outside the built-up areas in the old 'Brownfields' places aims to encourage green space not as a simple isolated case but as a system of connections between the various centres.

The enhancement of infrastructural connections and green infrastructures has been partly thwarted by the poor coordination between the various local authorities, which has favoured the emergence of poorly integrated citadels, where the concept of bottom-up planning has not been correctly applied

and where there has been the development of a kind of luxury ghettos of '8000-12,000 inhabitants' (Fratini, 2014).

Most of the areas interested in construction are generally divided into sub-areas of about 'two hundred to three hundred inhabitants', a choice that serves to facilitate the sale of building lots and facilitate access to investors, who, according to the agreements between states, Regions, and Municipalities, are obliged to fragment the areas within the planned timeframe to favour their buildability.

This principle, created to streamline bureaucratic procedures, creates pressure on administrations that are forced to produce masterplan schemes quickly and in a very simplistic way, with an excessive fragmentation of the various sub-areas planned as if they were 'frameworks' without urban homogeneity (Fratini, 2014).

4.2. The VINEX dwelling characteristic

The environment, considered the individual's living space, is a complex reality that greatly influences territorial policy questions. Therefore, in examining the context of the place in which to live, one must consider the importance this has in an individual's life, especially in being an actor and spectator of the evolutionary processes governing a place (Turri, 1998).

The territory thus constitutes the relationship between spatial arrangement and social structure, constituting the so-called 'social logic' of space; this is the condition for creating a habitat where residents can feel connected and part of a community (Januszewski, 2016).

Over time, criticism of the new district's concerns that they have favoured a tendentially residential vocation in sub-areas, with a prevalent presence of terraced houses that constitute a monotonous design with endless and disorienting perspectives (Hoff van't et al., 2006; Garcia Barba, 2009).

However, in surveys conducted within the citizenry, residents are delighted with their dwellings. Indeed, in many of the districts, there was no shortage of examples of high architectural design that represented the 'anti-dogmatic' splendour of super modernism at the turn of the millennium, which brought the affirmation of young architects who became a flagship for the nation.

The VINEX building typology, therefore, tends to be terraced. However, in some sub-areas, the style is sometimes very varied, ranging from 1930s-inspired retro design to modernist linearity to examples of super modernism. The variety of styles present constitutes a great example of what can be defined as 'postmodern patchwork' (Fratini, 2014).

The division into sub-areas means that there is a polarisation of building typologies, not guaranteeing a homogeneous variety; we go from compact buildings in the areas intended to be central to single-family terraced typologies in the more peripheral areas (Figure 3), up to luxury villas in Palladian style and inspired by the typical Dutch stately home (Hoff van't et al., 2006) (Figure 4).

Figure 3. Typical design of VINEX district (Source: Wikipedia)

Figure 4. Ypenburg, Boswijde sub-area (Source: Wikipedia)

The massive use of terraced housing, which tends to give homogeneity to the districts, responds to the desire of a large part of the population to have a private home with a garden, a general requirement of the average inhabitant that tends to create the typical European 1990s residential district design, not far removed from the similar typologies of the 1970s and 1980s (Ibelings, 2006).

As Isabella Fratini writes in her 2014 article, most districts are anonymous, so much so that many of them are not counted among the exemplary cases, given their small size. However, even among the most emblematic ones, some areas are typologically and architecturally anonymous (Donker, 2006).

One of the problems with the programme is that it has preferred the private ownership system to the rental system, as described in the 2001 memorandum "what people want where people leave", which is very much in favour of private owners rather than tenants. In the pre-VINEX period, the tendency of the average Dutch citizen was toward renting. However, the disengagement of the state from the management of housing policies and the takeover of the private sector resulted in the favouring of ownership and the encouragement towards the purchase of new houses, so much so that between 1998 and 2010, an increase in ownership of 65% was expected (Priemus, 2001).

The memorandum, therefore, marks the supremacy of the owner-occupied house with a garden, which guarantees the realisation of the citizen and his affirmation within society, even if modest in size. These appear to be the concepts that favour the typical typology of the new districts but also favour

experiences of super zoning with the consequent construction of purely elitist residential neighbourhoods.

Table 1. VINEX Housing stock (Source: Website of the Provinces)

Distribution for Provinces				
Total for Provinces	*Total VINEX-locatie*	*Extension*	*Sites for houses*	*% for regio*
Noord-Nederland	13.400	5.310	8.090	2,8
Oost-Nederland	61.670	18.093	43.577	15,3
Noordelijke-Randstad	125.700	47.750	77.950	27,4
Utrecht	44.300	7.200	37.100	13,1
Zuidelijke-Randstad	120.540	48.450	72.090	25,4
Zuid-Nederland	89.236	43.970	45.266	15,9

4.3. The role of landscape

Landscape in the VINEX programme has been of considerable importance, especially in the dynamics of the construction of the districts, which old Dutch rural landscapes have inspired mainly to amplify the concept of residential and recreational space.

The preservation of rurality is due to the preservation of the environmental quality and the rural space depending on the regional and socio-cultural context. Ecological and landscape diversity varies according to the variation of the urban scale to ensure a wide variety of spatial use.

In the forecasts of the fourth extra report, demands are clearly expressed not to distort the rural and original characteristics of the area but instead to develop political strategies for developing new ecosystems. The realisation of the districts was inspired by the characteristics of the old landscape, as shown by comparisons with old cadastral maps, even though they do not constitute a 'historicising concept' (Hoff van't et al., 2006).

The areas of the future districts, however, were former military sites or rural areas on the edge of which the countryside used for recreation began. Rurality was, without a doubt, one of the fundamental elements of the nation's culture; one only must think of polderisation, subsequent agricultural and bulb production, and finally, recreation, all of which contributed to the unmistakable appearance of the landscape (Figure 5).

Figure 5. Ypenburg, a typical VINEX landscape (Source: Wikipedia)

The landscape initially becomes the primary element of the programme and has been mapped according to four guidelines: green routes, yellow routes, blue routes, and brown routes.

In the green routes, an attempt is made to encourage the increase of biological networks to improve the ecological quality and use it as a guide for the spatial development of the regions concerned. On the other hand, areas with a solid agricultural vocation are considered yellow routes, and an attempt is made to keep them concentrated in certain areas. Blue routes, on the other hand, provide an opportunity to expand rural development and recreation and manage water resources.

Finally, brown routes seek to maintain scattered rurality to encourage new agricultural areas' growth. Some research carried out prior to VINAC shows the lack of infrastructural coordination between the districts and the primary centre, demonstrating in contrast to other surveys that flows to the workplace are not as frequent as in preliminary pre-masterplan surveys (Ibelings, 2006).

5. The fifth NR report

Following on from the experience of the extra note, the fifth NR report, which lays down its foundations between 2006 and 2008, seeks to correct the errors of land consumption by setting landscape as its starting point and territorial preservation as its primary objective; the motto for its launch is: "obtaining space for development".

The central State, at this stage, delegates more to local authorities the competencies of their territories, favouring, even more than in VINEX, the participation of the private sector in spatial development policies, trying to "decentralise what is possible and centralise what is necessary" (Dekker, 2006).

Land consumption, which occurred in the twenty years of the fourth report, shifts the attention of planners from the large cities of the Randstad, the subject of many interventions, to peripheral rural centres subject to alarming depopulation with the risk of entering the phenomenon of new desertification.

Based on these considerations and to achieve the objective of migration 0, the fifth NR report states that the VINEX experience ends the period of significant building interventions in large centres, except in targeted areas defined as red zones: territorial entities governed by planning instruments in which building construction and redevelopment interventions can be implemented.

After the 2008 crisis, Europe and especially the EU states had to come to terms with a phenomenon that was thought to be manageable, namely poverty as a concept thought to be circumscribed only to specific categories of the population. The sovereign debt crises, on the other hand, have brought to light a grey area of the population, that of the middle class, which despite producing income, is unable to produce development like the society of the 'glorious 30s': years of development after the Second World War.

Suppose up until the fourth report, society was in a state of continuous development. In that case, the fifth report shows a reversal of this trend, which, however, also has a backlash on urban development, highlighting the fragilities already present in the territories. Therefore, the new objectives include territorial preservation and landscape preservation beneficial for territorial regeneration and a more inclusive and sustainable society.

Landscape preservation takes place through the development of a green contour study, which began in the VINAC period but was little used. Nevertheless, some interesting data emerge from this tool, namely that 27% of the landscape areas fall within these contours, of which 17% are part of the national ecological network, and 3% are UNESCO-protected areas. From this, it can be deduced that the remaining 73% of the land has been used for agricultural activities while it has primarily been used for building expansion.

In order not to fall into the error of the VINEX long-term forecasts, the NR report sets 2020 as the final target, after which implementation is envisaged with a 2020-2030 memorandum, in which an attempt is made to limit housing expansion. However, one of the problems identified in the old reports is precisely that of housing, which, despite the large stock produced, mostly luxury, cannot meet the demand for housing. For this reason, municipalities and provinces must try to create collaborative processes to coordinate new zoning and regional plans to meet the goal of decentralisation and correct the excessive land consumption predicted by the fourth report.

5.1. Correction methodology of the NR report to the fourth VINEX extra note

The fifth report is based on the concept of a sustainable city whereby, unlike VINEX, the landscape as green and public space takes on a fundamental role and is not subordinate to a design accompanying the dwelling.

With the new NR, corrective methods take place first of all by modifying current planning instruments. One of these is the PBKs (critical planning decisions), which were created with VINAC and concern structural plans for green spaces; in the new NR, these no longer remain vague and intended for large spatial areas but must be specific to each area they are intended for with appropriate memoranda, such as those intended for the sea and rivers.

In the new NR, moreover, there is a more significant delegation of powers to local authorities, which allows better identification of local emergencies, which in VINEX had in part been introduced by the BON, but which had found it difficult to apply due to the significant role still played by the VROM. The landscape takes on an essential role at this stage and, unlike the fourth extra report, is no longer considered a national key but takes on a regional role and, in this sense, must follow development lines which meet the needs of the area in which it is located.

Only by meeting regional needs can that 'bottom-up' system be created to create a real national development network that considers a new ecological structure, new guidelines for water resources, buffer zones and infrastructure in general. Furthermore, the role of each stakeholder must be defined and in what time frame they can implement the regeneration goals. The main actors in this scenario are the local authorities that must operate according to specific competencies to avoid overlapping and field interferences. The provinces must operate according to a broader territorial interest, while the capillarity of local control is entrusted to the municipalities that play a primary role in this context.

To carry out a correct division of competencies, the first step is a revision of the laws that influence planning and which provide for a system of simplification in the drafting of spatial plans and where the first element is the control of the intervention budget that is allocated to three territorial areas that are considered fundamental sources of investment: rural areas, local and regional infrastructures, and urban renewal.

This is a central corrective system compared to VINEX, which operated, at least in its first part, under the 1965 Planning Act. When the new law was passed in 2007, specific intervention methods were revised, such as reducing technical approval times. In this scenario, the municipalities take on a significant role through a right of refusal on an active land policy whereby they purchase land and then allocate it to housing or private projects.

However, this procedure, which has been in place since 2004, allows municipalities to establish option rights for the realisation of non-agricultural spatial functions, which with the 2007 law is further enhanced through the use of expropriation. Furthermore, one of the means used for land management is competitive tendering and the use of European funds, especially for objectives aimed at landscape regeneration and enhancement and aligning with real estate market prices. The new land policy management tools, therefore, offer better opportunities to manage infrastructure and green systems

while respecting cost containment and implementing services and public spaces according to the directives of European frameworks.

In the NR report, the budget becomes fundamental and spatial development follows three specific directions: rural areas, urban renewal and that local traffic for which public transport is sought to be implemented. The issue of costs is not absolute but takes on flexible characteristics regarding the use of the budget, especially for sectors that intervene in landscape management, the preservation of national landscapes, the protection and implementation of buffer zones and the improvement of the country's agricultural areas.

In this context, the provinces play a crucial role in ensuring a capillarity in infrastructure connections so that the national ecological network can always be well preserved in the overall design. The principle of subsidiarity is thus the fundamental cornerstone of the fifth NR report, which, unlike the previous one, seeks to be closer to the needs of the citizen and to favour the implementation of public space to a greater extent, limiting building activity and especially the creation of large luxury districts.

6. Conclusions

The fourth extra note, called VINEX and its subsequent implementations, such as VINEX 2 or VINAC, have contributed to the total change in the design of the urban landscape, highly densifying the Dutch territory. The densification, unfortunately, did not take place, in contrast to the initial objectives, in a way that favoured compaction, but in a diffuse way, creating a design comparable to a postmodern collage (Fratini, 2014). However, not all of the experience has been negative because it led first and foremost to the redevelopment of areas and neighbourhoods that were then still grey areas or occupied by brownfield sites. On the other hand, what created distortions was the programme's conception over a long period of time, not taking into account economic crises and, above all, the lack of coordination of the private sector's entry into territorial policies. When the budget was reduced, preference was given to profit rather than quality and urban integration, sacrificing public space in favour of low-quality architecture, forming the backbone of VINEX neighbourhoods. In this contribution, the differences between the various planning and development reports are analysed, starting with the law of 1901 and then moving on to the subsequent post-war reports that contributed to the new design of the territory to avert the dangerous phenomena of building expansion. Over time, however, these reports have underestimated another element of strong land consumption due to agricultural and bulbiferous activity.

The fourth report, on the other hand, sanctions the end of the era of expansion to enter the era of redevelopment; the first part intervenes in the disused areas of the "Inner cities" but, with the promulgation of the VINEX extra note, redevelopment is extended to the peripheral areas, sanctioning the change in the face of the territory. The objectives and strategies of the programme were analysed up to its implementation, how there was a predilection for the isolated single-family dwelling that favoured the diffuse city rather than the compact one as initially proposed. In all this, the role of the landscape has always been to be subordinate to building activity.

The sovereign debt crisis then brought to light the flaws of this programme and the real speculative aims with the consequent excessive land consumption. Thus, to limit the damage, the RUIMTE was launched, which sought to make corrections through greater attention to land preservation. To do this, more delegations are given to local authorities, and the "Grand Immeubles" season is considered closed, regulating building activity in clearly defined red zones.

The fifth NR report corrects the errors of VINEX through the preservation of the landscape in the green systems, its infrastructure and water protection. In this scenario, PBKs are therefore enhanced, and BON errors corrected. Therefore, the local authority becomes a key player in preserving and regenerating the territory, avoiding long-term objectives, but providing clear information on who the actors will be, where they will operate, and the time frame for achieving results. Therefore, the fundamental pivot of

this relationship is strengthening the principle of subsidiarity so that there is the supervision of the necessary interventions to implement the public space as a place of integration and relations.

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Evaluation of the Wind Catcher in the Traditional Cairene Courtyard Houses' Integrated Passive System for Natural Ventilation and Cooling

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ABSTRACT

Many Islamic architectural features have been used continuously in Cairene Courtyard houses as one of the primary environmental standards. Wind catcher represents the keystone of passive green features among other used features. The response of chosen case studies to the thermal environment had proven to vary concerning the type of green features involved and its role in the whole integrated system. The evaluation matrix act as a model in assessing the performance of eco-architecture features regarding the type of integrated system. Wind catcher ended up being effective in expanding the efficiency of passive integration system for ventilation and cooling; especially when the opportunity is taken to involve other green features in the early design phase. It is recommended to take into consideration, the involvement of passive integrated systems in architectural projects. Accordingly, we can conserve energy, mitigate climatic changes, and achieve thermal comfort; besides preserving the local identity of the built environment.

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1. Introduction

The incorporated design system allows the consciousness and acquired knowledge by explanatory examination of designing are formulated, developed, and embedded into conception application (Heiselberg, P. 2007). The incorporated conception approach involves the identification of architectural features and their role in buildings to assess the performance of the thermal environment of the building's natural ventilation concerning environmental criteria in its context. So far, the structure procedure of the designing stage of buildings has obtained constrained approval. However, it is possibly conditional on drawing attention to interconnectivity with sub-systems of buildings commonly specified as self-sustenance. There are few perceptions on how the conception of various sub-systems can be incorporated to fulfil a broad range of building operations. Addressing the building like an intricate system, in which the entities interact to develop a rising performance that can be valued concerning its

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usability. Accordingly, it can support improving the performance of the building in terms of how a shift in one field impacts effectiveness in some other way (Baudains, et al. 2014). Consequently, this ultimately demanded the implementation of a process that highlighted the use of passive systems to satisfy the thermal comfort needs of occupants inside the buildings. Energy use in buildings can be decreased with limited cost of complicated techniques, but only through the effective incorporation of passive eco architectural features. The achievement of improved energy utilization through the integrated design approach of the building is associated with respect to the relation between the building, its environment, and the demands of occupancy. Furthermore, the integrated design system will secure an advancement in the optimum environmental fulfilment of the building. The uniqueness of Islamic historic houses that has given rise to independent spaces that have appropriate for various environmental modifications.

The originality of Islamic historic houses is a matter of conception that has generated independent spaces which adapted to different environmental changes (El Sorady, D. & Rizk, S. 2020).

The Egyptian traditional architecture had adapted to local climatic conditions through specific passive techniques; to fulfil a better thermal environment and occupant's comfort inside their houses by affording natural ventilation and cooling (Ficarell, I, 2009). Inheritance of old Islamic houses involves varied features concerning faith-based and socio-culture parameters along with the uniqueness of their local environment. In particular, Cairene houses were the predominant traditional domestic architecture in Cairo from the end of the Mamluk era (1259-1517) and across the Ottoman era (1517-1805). During these two periods, Egyptian architecture was dominated by Islamic principles, even though fulfilling its environmental context (Mohamed, G. 2014). These houses have several storeys that do not exceed three or four. Local building materials like stone and bricks were used to construct these houses. Particularly, the space arrangement of Cairene courtyard houses was affected instantly by Islamic regulations. Furthermore, some architectural features were generated as a response to the extraordinary environmental conditions of Cairo. They were exceptional so that it is patterning an emerging architectural trend that is diverse from the Islamic architecture in other countries (Abdelkader, R & Park, J. 2018).

Traditional spaces of Cairene courtyard houses (like Qa'a, Maqad, Takhtabush, etc.) were adapted to local climatic conditions. Many eco-features were used to induce natural ventilation through these houses. Such features include: a courtyard, Mashrabiya, wind catcher, Shokhshekha, and ventilated dome. Most previous studies on traditional Cairene courtyard houses had analyzed the role of previous features separately, not as an integrated system.

2. Literature review

Most of the previous studies did not address the concept of integrated systems as an entry point to improve the performance of the thermal environment of traditional Cairene courtyard houses. These studies were also limited to highlighting the environmental treatments used for these types of traditional houses. On the other hand, it did not address the role of wind catchers in integrated systems of buildings to provide natural ventilation and cooling. Maybe more, they were restricted to featuring the role of environmental treatment of wind catchers independently in raising the performance of the thermal environment of buildings.

A study by Dalia Al Shorady and others in 2020 investigates passive design elements used at Bayt Al Suhaymi concerning the organization of internal and external spaces. Shokhshekha at the hall of Bayt Al Suhaymi was used to promote warm air breaking out the inner spaces. Its roof surface supports heating the air utilizing direct orientation to the sun; to highlight an effective system for natural ventilation. In addition, Mashrabiya helps acquire the breeze to inner spaces of halls throughout the summer season.

The elements of passive design were presented in the halls of Bayt Al Suhaymi; especially with the incorporation of a courtyard, wind catcher, Takhtabush, and Mashrabiya to maximize the circulation of air (El Sorady, D. & Rizk, S. 2020). Another study in 2018 by Reem and others state that the environmental context of Cairo influences the space arrangement of traditional Carine courtyard houses in Cairo. Accordingly, the spatial principles of these houses were taken into consideration where the sun and wind direction were given priority in the environmental design process of these houses. Natural cooling is best accomplished by using high windows. In simple terms, the breeze passes to the inferior holes of Mashrabiya. However, warm air escaped outside the roof shaft, whether it was a Shokhshekha or a ventilated dome. In this case, Mashrabiya is used to enable continuous stream of wind by convection. It also identifies the interaction with Shokhshekha and the wind catcher in transit of wind circulation in Muhibb Al-Din house.

The study also highlights the role of the courtyard in reducing the warm climate by storing the breeze in the evening to prevent the warmth of daytime; besides, providing daylighting and cooling. Occasionally, plantations and fountains coexist to refine and cool the wind to fulfil the psychical convenience of residents (Abdelkader, R & Park, J. 2018). A study by Mady A. in 2018 proves the effectiveness of the courtyard with the Takhtabush in the hot arid region. It conducts the value of engaging the Takhtabush to improve the thermal efficiency of the courtyard (Mohamed, M. 2018). However, according to Nik Muhamad and others in 2017 discussed the elements used in the courtyard design of Bayt Al Suhaymi. The Takhtabush provides a cool sitting area in the morning, while the open courtyard functions as a temperature regulator and diffuses cool air into the rooms of the house (Nik Man, et al. 2017). Another review by Hanan Saleh and others in 2017, highlights the systems component of the architectural element of Bayt Al Suhaymi to obtain thermal convenience, as a premise of environmental architecture. This study attempts to draw attention to integrated systems used in many halls of the house including main, winter and summer hall. The analysis lacks the mechanism of work of these systems and the acting level of eco features, regardless of the absence of an assessment method to evaluate their performance concerning passive ventilation and cooling (Saleh, H. & Saied, S. 2017). El-Borombaly and others in 2015 stated the role of wind catchers in the middle east and old Islamic houses of Cairo. Respectively he considered a wind catcher as a sloped termination tower possessing an opening air edge that acts as an air shaft. Commonly it is upraised regarding the northern side of the building to grab the breeze and force it down inside inner spaces (El-Borombaly, H. & Fernando, L. 2015).

A study in 2014 by Nermine Abdel Gelil and others makes the best use of motion to achieve maximum possible cross-natural ventilation in Shokhshekha of Bayt Al Suhaymi; besides that, it declares the role of wind catcher as a separated eco feature for inducing natural ventilation inside inner space of the house (Mohamed, N. & Ali, W. 2014). In the study by Mohamed N.A.G in 2014, he states the role of Mashrabiya and its wooden lattice windows to fulfil daylighting control, thermal regulation, and sociable privateness (Mohamed, G. 2014). Another study in 2012 by Amanda Webb illustrates the eco features used in Bayt al Sinnari that embody thermal diversity (Webb, A. 2012). However, according to Mohamed Gamal in 2011, there was an investigation to the spatial order of Bayt al Suhaymi's principal Mandharah including a sitting area with natural lighting and ventilation circulation of the ventilated dome. Another study by Mohammed. M.A. in 2010 concluded the close relationship between the courtyard and the Takhtabush at the Sinnari house. The air heats up the backyard of the house over the courtyard causing warmed air in the backyard to draw the breeze from the courtyard through the Takhtabush, generating a constant refreshing air (Mohamed, M. 2010). However, the study by El-Shorbagy, in 2010 explained this relationship in another way. A steady breeze was acquired through convection by employing an inner courtyard and the Takhtabush. Wind warms up clearly in the uncovered courtyard regarding the backyard forming minimum air pressure. Warm wind shifts upright and pulls the breeze in contrast into the Takhtabush and in consequence creating a cold draft (El-Shorbagy, A. 2010).

However, an investigation by Reynold. J in 2002 concluded that the courtyard is considered the predominant compositional core in traditional Carine courtyard houses. Most of the rooms of these houses surround the open courtyard according to cultural and environmental factors (Reynolds, S. 2002). Before that, a study by Behrens in 1989 concluded that the courtyard is considered the dominant feature in providing ventilation, daylighting, and connection among varying facilities of old Islamic houses (Abouseif, B. (1989).

3. Methodology of research

The methodology of the research is composed of three main steps: description phase, analysis phase, and assessment phase. A coordinated framework of the applied methodology is presented in figure 1. Description phase starts up with types of passive integrated systems including natural cooling and natural ventilation employing passive techniques. It also discusses components of the integrated system and green architectural features applied in each case study. For the analysis phase, illustrated figures are used to examine the conceptual acting level and mechanism of working of applied green passive features. For the assessment phase, an evaluating matrix is proposed to assess the acting level of green passive features concerning a group of factors. Score ranking calculations are transformed into a classification matrix, that states the classified ranking of each case study, concerning the existence of green features and its criteria. The result of the assessment is used as a feedforward to identify weak points and opportunities for improving the acting level of the integration system in the future.

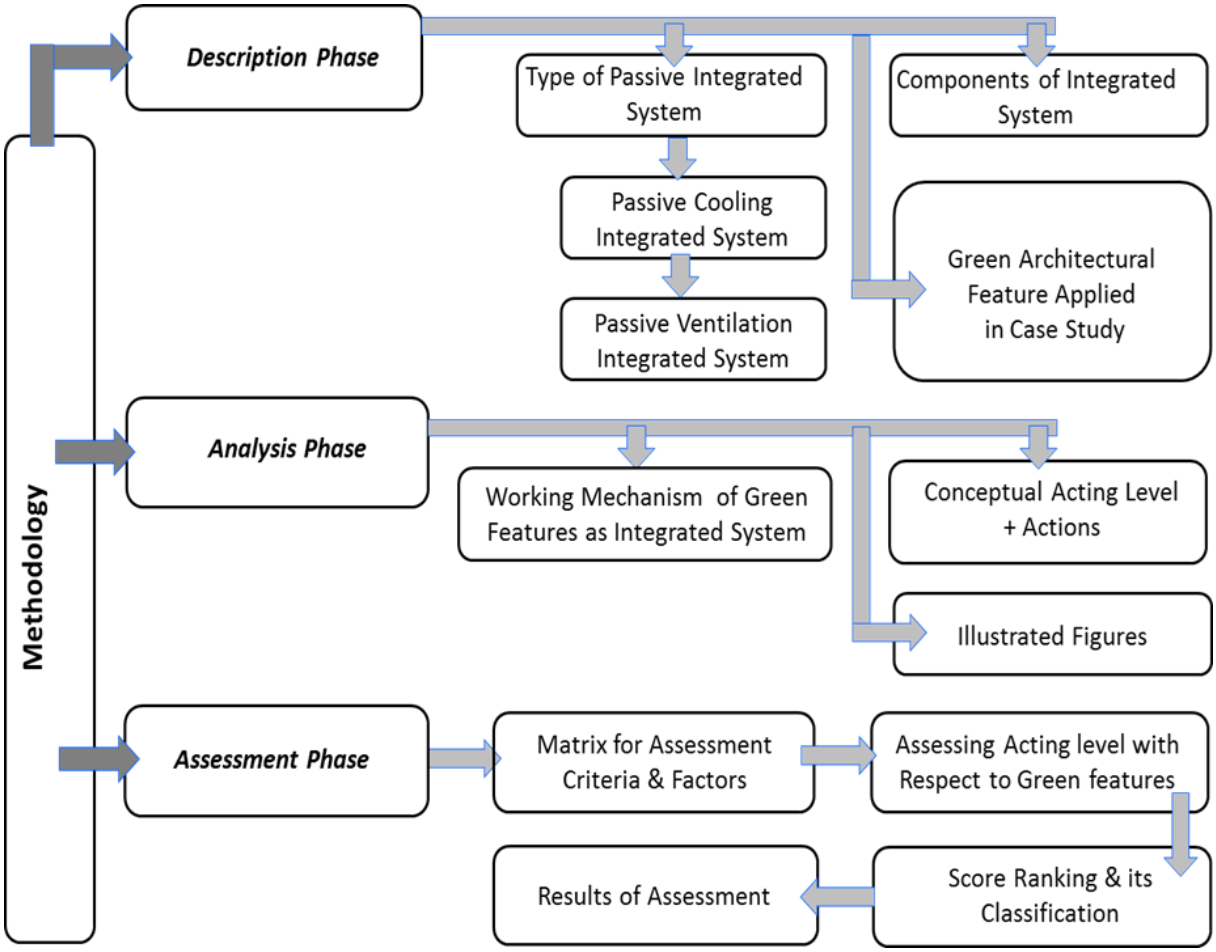


Figure 1. Conceptual diagram for methodology of the research

4. Case studies

Three houses related to Cairene Courtyard houses in old Islamic Cairo were chosen to be analysed and evaluated with respect to a passive integrated system used in ventilation and cooling:

Case 1: Qa'a of Muhib Al Din

Case 2: Hall 5 at Bayt al Suhaymi

Case 3: Main Qa'a at Bayt al Sinnari

The approach of choosing case studies is based on a group of variables and constants. Table 1 indicates the constants and variables of chosen case studies.

Table1. Categories and parameters for the constraints and variables of case studies under investigation

a- Constants		
Building Envelope	***Category***	***Parameter***
	Location	Old Cairo
	Context	Urban
	Orientation	The positioning of the house on its site that take full advantage of the climate.
	Building Layout	Main living area facing the breeze.
	Space	One space of the house is being investigated. Qa'a or hall
	Common used green feature	Wind catcher
	Thermal mass	High thermal mass
	Material used	Stones, wood and marble
	Window design	Mashrabiya with wooden lattice works.
Building services	Type of system	Integrated
	Operating regime	Passive
	Building use	Private resident
	Functionality	Natural cooling + natural ventilation
Socio-culture Dimensions	Social aspects	Life style and behavior*
		Social needs*
		Social pattern*
	Culture aspects	Family values*
		Culture needs*
		Architectural style and local identity*
		Similar spatial composition of houses*
		Space arrangement *
Environmental Considerations	Climatic conditions	Respect local climatic conditions
		Selected case studies have similar climatic zone
		Hot dry climates with low humidity levels
	Conservation of energy	Depends on passive design + techniques to create passive solar building.
		Depends on natural ventilation and cooling.
	Zero emission	Limitation of environmental pollutants
b- Variables		
Building Envelop	***Category***	***Parameter***
	Size	Varity in size of Qa'a or hall under investigation
	Green features	Variation in types, role and magnitude of effects of green feature used in each case study.

5. Analysis of case studies

5.1. The Integrated Passive System at Palace of Muhīb al-Dīn, known as Uthmān Katkhuda - AD 1350

The main Qa'a of the palace act as a living space with a rectangular shape with two Iwans facing each other on the main axis and a sadla on other edges. The central space between the Iwans, called Dorqaa is one step lower covered with marble and possesses a central fountain, and has a higher ceiling called Shokhshekha. The Dorqaa rooftop is on greater plane than the Iwan roofs. It lays on the drum, accentuated with windows subsequently permitting ventilation and daylighting into the hall. The north side Iwan had a "wind catcher" composed of a shaft between the two walls at the edge of the Iwan, roofed by an inclined roof and unsealed on its northern and western edges. Wind catcher was created to capture the breeze, which all the year-round blow-up along north-western. The wind passing by the inclined shift towards the bottom edge of the hall would supplant warmer air outside across the higher openings of the Dorqaa. Furthermore, the height of the ceiling supports the efficiency of natural ventilation. The mechanism of the Shokhshekha is illustrated in figure 2. Dorqaa acts to host the resident's owner's visitors and is arranged in the centre of the Qa`a. The Dorqaa is regarded as other form of courtyard that is not the hub of everyday routine. Hence it could be a minor sociable place that performs the function of a sitting room (Fathy, H. 1986). The integrated system of passive ventilation and cooling in Qa'a of Muhib Al-Din is composed of a- Iwan, Dorqaa, and Shokhshekha, b- Wind catcher, c- Mashrabiya.

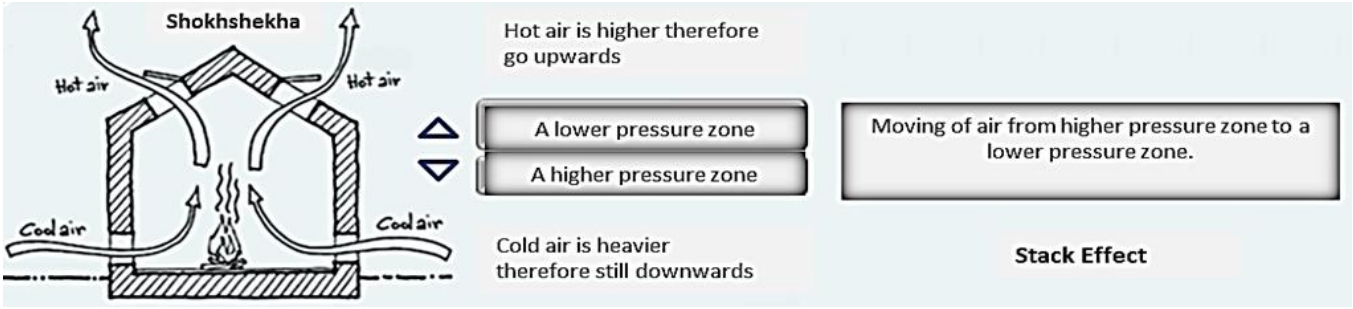


Figure 2. Conceptual diagram of Shokhshekha for mechanism of its working (Source: UN-Habitat, 2014, edited by author)

Mechanism of Working of the Integrated System in Qa'a of Muhib Al-Din

The conceptual acting level of the ventilation passive system in Qa'a of Muhib Al-Din is analysed as follows:

Action 1: Breezes enter from the inlet (a) through Wind catcher passing inside inner space.

Action 2: Dry air is cooled through the marble floor and fountain at Dorqaa, that distribute around the Iwan where residents actually sit. It intensifies the humidity in hot seasons.

Action 3: Cooled air remains downwards at the resident's user level, while hot air raised up to escape through high openings of the Shokhshekha by the stack effect.

Action 4: Upper openings of wooden Mashrabiya at Iwan help to get rid of hot air; thus, supporting the flow of air.

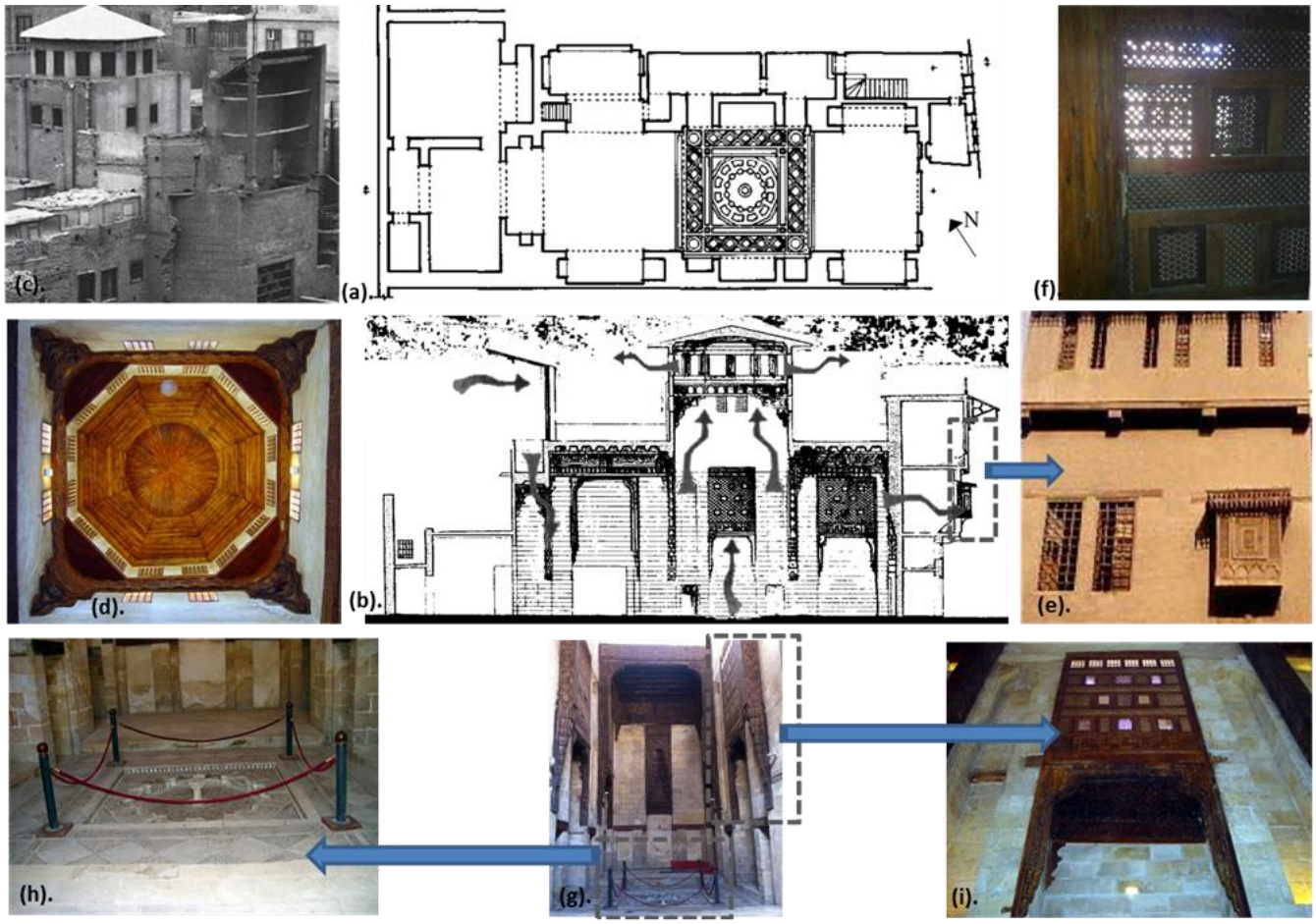


Figure 3. Integrated passive system for ventilation and cooling in Qa'a of Muhib Al Din (Source of a + b: Neet,et al., 2009, Edited by author); (c - i) visual survey

5.2. The integrated passive system in "Hall 5" at Bayt al Suhaymi

Bayt Al Suhaymi was originally constructed in 1648 CE with further modification in 1796 through the Ottoman period. At the present time, the house is intended to be an open museum for old Islamic architecture in Cairo (El Sorady D. & Rizk, S. 2020). The house serves as viable paradigm of sustainability that reflects the application of integrated passive systems for environmental thermal control and conservation of energy. The design had given rise to self-reliance spaces appropriated for various environmental variations. The inner courtyard operates as an optimizer for heat control of the house. Additionally, the Mashrabiya screen supports cooling the air in interior spaces over the warm season. Moreover, getting rid of hot air from upper openings screened by wide latticework thus creates a reasonable climate inside indoor spaces during flow of wind (Abdelkader, R. & Park, J. 2018).

With the intention of achieving thermal comfort of residents, the wind catcher is engaged in hall 5. It embodies an upper shaft than the surrounding buildings and closes upright with a wide opening to trap the breeze. It is erected on the northern edge of the hall to catch the cool air and force it below towards the inner space (El Sorady, D & Rizk, S. 2020). Wind catcher grabbed the breeze resembling the sails trapping the wind and drive it inside the space of hall 5 on the second level. Wind circulation is accelerating since the high position of the wind upon the floor increases its velocity. In this manner, it could freshen the air inside inner spaces that do not have openings outward from the hall. On the other hand, the wind catcher together with the Mashrabiya and courtyard ensures the steady flow of breeze (Abdelkader, R & Park, J. 2018). The integrated system of passive ventilation and cooling applied in "hall 5" in Bayt al Suhaymi is composed of the a- courtyard, b- Wind catcher, and c- Mashrabiya.

Mechanism of working of the integrated system in "Hall 5" at Bayt al Suhaymi

The conceptual acting level of ventilation passive system in "Hall 5"at Bayt al Suhaymi is analysed as follows:

Action 1: Dry air is cooled when passing through courtyard 1.

Action 2: Cooled air from courtyard is directed towards sloping vent of wind catcher towards the lower part of hall 5. Inlet of one-way wind catcher is composed of wooden lattice resemble Mashrabiya screen. Tight lattice work increases cooling of passing air by the effect of Venturi effect.

Action 3: Hot air raised up to escape through high openings of Mashrabiya with respect to the stack effect. Figure 4 illustrates this mechanism.

Key of figure

a. Plan of second floor where wind catcher is located
b. Image for wind catcher and Mashrabiya window beneath it.
c. Interior view showing height of wind catcher.
d. Inlet of wind catcher.
e. 2 Mashrabiya windows below level of wind catcher.
f. Details of lattice work of large Mashrabiya.
g. Exterior view of Wind catcher

Figure 4. Integrated passive ventilation in hall 5 between wind catcher, courtyard1 and Mashrabiya in Bayt al Suhaymi: (Sources: (a) Abdelmonem, M. 2011, edited by author; (b – g) Developed by author)

5.3. The integrated passive system at Bayt al-Sinnari

Bayt al-Sinnari was constructed in 1794 and is situated in the area of the Al-Sayeda Zainab Mosque. This house comprises most of architectural elements of traditional Cairene house including the courtyard, Maq'ad, and the harem hall that extends along the outlook of the street forward to sight of the Maq'ad from behind (Williams, C. 2002). The main Qa'a is located on the second floor of Bayt al Sinnari. It is composed of two Iwans; a large one with a flat roof and full height wooden Mashrabiya and the other one is small with a Mashrabiya and large-scale wind catcher at its top. Dorqaa is centered in the middle containing a marble fountain and a wooden Shokhshekha at its top.The integrated system of passive ventilation and cooling applied in "main Qa'a" at Bayt al-Sinnari is composed of the a- courtyard, b- Wind catcher, c- Mashrabiya, d. Dorqaa and the Shokhshekha.

5.4. Mechanism of working of the integrated system in main Qa'a at Bayt al Sinnari

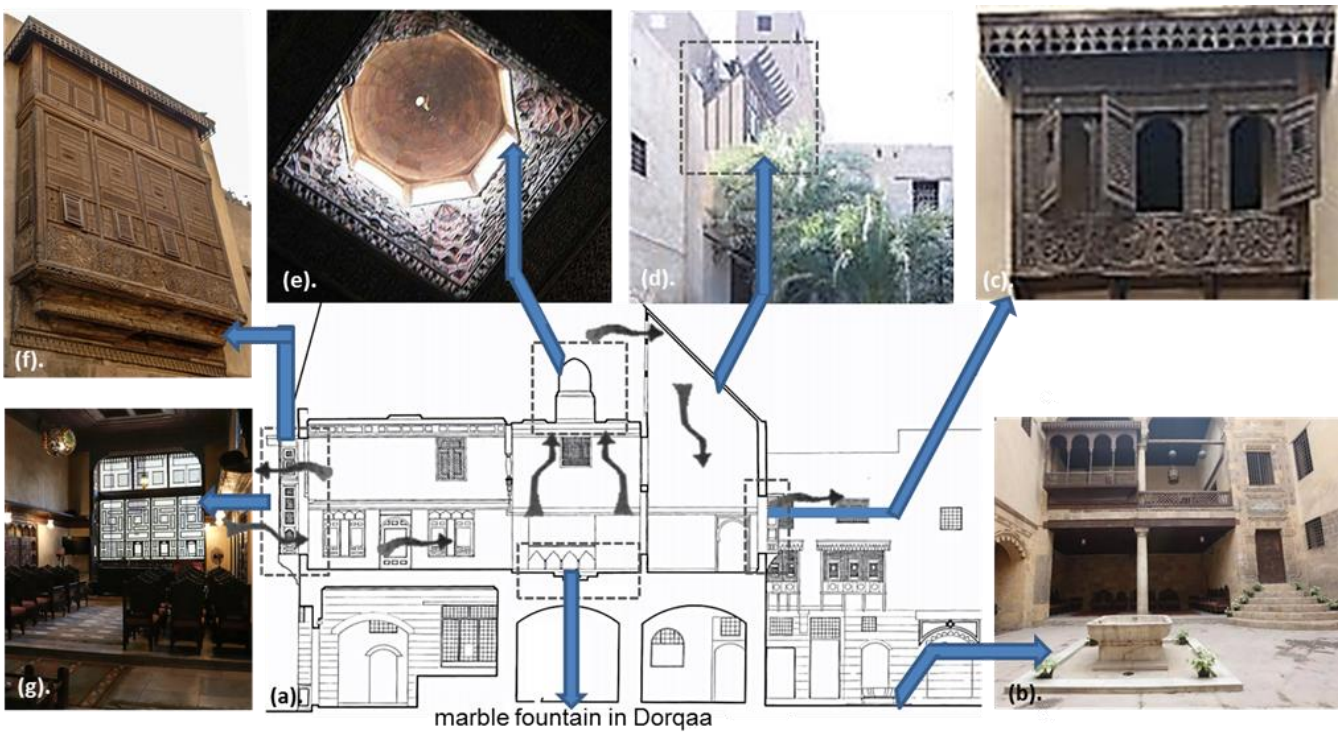
The conceptual acting level of the ventilation and cooling passive system in the main Qa'a at Bayt al Sinnari is analysed as follows:

Action 1: cool breeze is maintained by employing the phenomenon of the stack effect induced by the courtyard. An outdoor fountain is used to cool the air entering the court. It also increases humidity levels during the hot season.

Action 2: cross-ventilation occurred inside the Qa`a on the second floor between two Mashrabiya located on the edge sides of the Qa`a. Action 3: air entering the Mashrabiya is cooled by the effect of the Venturi effect. The lower section of Mashrabiya with tight lattice supports the cooling of air. On the other hand, the upper section of Mashrabiya with wide lattice supports the escape of hot air outside the Qa`a. The switching of wind among interiors and exteriors may happen through the same opening if it is a large opening. In this case, the lower part of the opening operates a supply process, and the higher part operates an extracted one.

Action 4: north part of Qa'a comprises a wind catcher with large inlets that allow the breeze to enter through the wooden latticework. Action 5: a cantered marble fountain located at Dorqaa to support cooling of the air at sitting level. In the upper part of Dorqaa; a wooden skylight act as Shokhshekha where hot air escape through its openings.

Air movement is indicated in figure 5 where the cooling effect and ventilation are enhanced through integration between green design features; wind catcher, courtyard, Mashrabiya, Dorqaa, and Shokhshekha.



Key of figure

a. Longitudinal section of Bayt al Sinnari
b. View of inner courtyard with central fountain/
c. Exterior view of wooden Mashrabiya.
d. View of Wind catcher.
e. Interior view of the Shokhshekha (wooden skylight).
f. Exterior view of Mashrabiya in north facade.
g. Interior view of Main Mashrabiya at main Iwan.

Figure 5. Integrated passive ventilation in Bayt al Sinnari (Source: Webb, A. 2012, edited by author)

6. Assessment of case studies

The assessment criteria of the integrated system of green features applied to case studies are based upon factors affecting criteria and value of scoring, as illustrated in table 2. On the other hand, table 3 represents the acting level of used green features, concerning their role in natural cooling and natural ventilation.

Table 2. Assessment criteria of the integrated passive system of green features of case studies under investigation

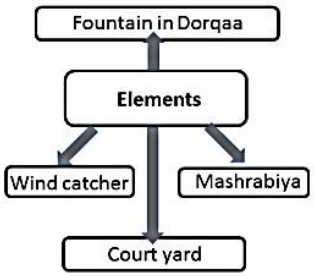
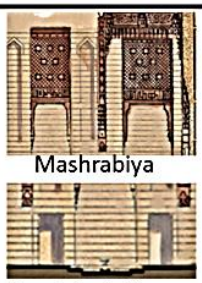
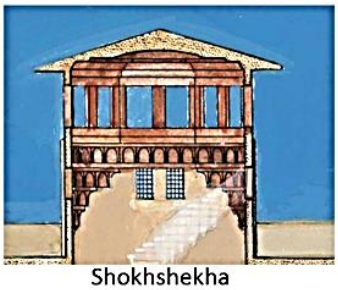
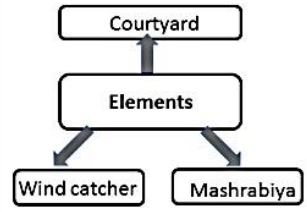
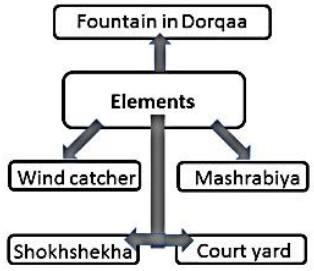
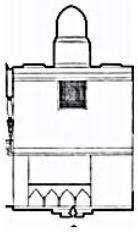
System	**Passive Cooling System**					
Green Fearture	***Factors Affecting Criteria***			***Value of Scoring***		
Courtyard	Out door water element			**1**		
	Out door plantation			**1**		
Mashrabiya	Tight lattice work			**1**		
Dorqaa	Marble floor			**1**		
	In door fountain			**1**		
Wind catcher	Tight lattice work			**1**		
	Cooling element inside wind catcher			**1**		
Total score of passive cooling system (optimum score)				**7 points**		
System	**Passive Ventilation System**					
Green Fearture	***Factors Affecting Criteria***			***Value of Scoring***		
Courtyard	Breeze is maintained by employing the phenomenon of the stack effect			**1**		
Mashrabiya	Size of lattice work			**1**		
	Position of openings			**1**		
Shokhshekha	Hot air escape from its openings			**1**		
Wind catcher	Induced breeze inside inner space			**1**		
Cross ventilation	Exchange of air between openings at same level			**1**		
Attic ventilation	Relative position of openings at different levels			**1**		
Total score of passive ventilation system (optimum score)				**7 points**		
Score ranking	**1-2**	**3**	**4**	**5**	**6**	**7**
Classification	**Very weak**	**weak**	**Medium**	**Good**	**Very Good**	**Excellent**

Table 3. Assessing acting level of case study under investigation with respect to green features

Case Study	**Passive Green Feature for Natural Cooling**							**Passive Green Feature for Natural Ventilation**						
	Courtyard		***Mashrabiya***	***Dorqaa***		***Wind catcher***		***Courtyard***	***Mashrabiya***		***Shokhshekha***	***Wind catcher***	***Cross ventilation***	***Attic ventilation***
Qa'a of Muhib Al Din	✓	X	✓	✓	✓	✓	X	✓	✓	✓	✓	✓	X	✓
Hall 5 at Bayt al Suhaymi	X	✓	✓	X	X	✓	X	✓	✓	✓	X	✓	X	✓
Main Qa'a at Bayt al Sinnari	✓	X	✓	✓	✓	✓	X	✓	✓	✓	✓	✓	✓	✓
Symbol used for evaluating acting level of passive green feature									X			✓		
Meaning of Symbol									Absent			Existence		

To show the comparison among case studies, the following table set the components of the integrated system used concerning figures of green features.

Table 4. Comprehensive scope of the integrated passive system in case studies under investigation with illustrations (Source: Neet, et al., 2009, Edited by author)

Case study	Component of green features involved in integrated system	Images of integrated green features
Qa'a of Muhib Al Din		 Wind catcher  Mashrabiya Fountain in Dorqaa  Shokhshekha
Hall 5 at Bayt al Suhaymi		 Wind catcher  Mashrabiya  Courtyard 1
Main Qa'a at Bayt al Sinnari		 Wind catcher Shokhshekha  Fountain in Dorqaa  Mashrabiya  Courtyard 1

7. Results of assessment

Main Qa'a at Bayt al Sinnari had reached the highest score ranking in the acting level of integrated passive systems used to achieve natural cooling and ventilation, in comparison with other case studies. Although 3 case studies had common Constants like environmental conditions, climates, architectural style, and general characteristics, their response to the thermal environment with the building envelope had proven to vary with respect to the type of green architectural features involved and their role in the whole integrated system. Green features of the design in Main Qa'a at Bayt al Sinnari had succeeded in achieving high performance towards climatic conditions, thermal environment, and comfort of occupants and their needs. Wind catcher, Dorqaa and Shokhshekha, besides; Mashrabiya did work together to enhance the air movement and cooling effect inside the space of Main Qa'a at Bayt al Sinnari. Such a system guarantees excellent natural ventilation and cooling through passive architecture elements and actions. Result of assessing acting level of case studies for integrated passive system used for ventilation & cooling is illustrated in table 5.

Table 5. Result of assessing acting level of case studies for integrated passive system used for ventilation & cooling

Case Study	Score ranking of passive green features for natural cooling	Classification	Score ranking of passive green features for natural ventilation	Classification
Qa'a of Muhib Al Din	5 points	Good	6 points	v. good
Hall 5 at Bayt al Suhaymi	3 points	Weak	5 points	Good
Main Qa'a at Bayt al Sinnari	5 points	Good	7 points	Excellent

8. Conclusion

The analytical approach of the research contributed to clarify the mechanism of suggested integrated systems with respect to role of each eco features as influencing factor in type of the ventilation strategy.

Evaluation matrix act as a model to assess the acting level of eco architectural features with respect to the type of the integrated system. Wind catcher proved that it is the keystone in a successful passive integration system for ventilation and cooling; especially when the opportunity is taken to involve other green features in the early design phase of the project.

As wind catcher affects positively the efficiency of attic ventilation in chosen case studies; however, Mashrabiya represents another keystone of passive green features concerning cross ventilation and cooling factor. It is recommended to take into consideration, the involvement of passive integrated systems in contemporary and future architectural projects. Accordingly, we can conserve energy, mitigate climatic changes, and achieve thermal comfort for building occupants; besides preserving the local identity of the built environment.

More research might be done to examine the integrated passive ventilation and cooling systems in other old Islamic homes across the world. In addition, the work of architect Hassan Fathy poses a significant opportunity to investigate applied ventilation systems. Wind catchers can be investigated thoroughly in these case studies to evaluate its role with mixed ventilation strategy.

Further, investigation can be carried out on similar case studies, with respect to environmental context and involving passive architectural features in early phase of the design procedure. Environmental efficiency should not be supplementary conception to architectural scheme process, however, act as essential component through life cycle of the building.

Other assumptions will be necessary integrated through determination of orientation, shaping, building materials, and other systems within the building including heat insulation, shading, and daylighting to fulfil functionality, thermal comfort, and energy efficiency.

The lessons learned from this study could be summarized as follows:

- Architectural passive elements of Traditional Courtyard Houses in Cairo; can be utilized in contemporary design practices.
- Need for a model to develop new Egyptian house designs concerning a comprehensive integrated passive system.

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Data availability statement
The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Ethics statements
Studies involving animal subjects: No animal studies are presented in this manuscript.
Studies involving human subjects: No human studies are presented in this manuscript.
Inclusion of identifiable human data: No potentially identifiable human images or data is presented in this study.

Conflict of Interests
The author declares no conflict of interest.

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Fire and Explosion Machine Learning Model for the Port of Los Angeles - California Safety Code and NFPA for Fire-Break Zoning

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ABSTRACT

A correlative Hazard case study of Los Angeles Port has been performed on a tremendous dock fire that occurred on 22nd September 2014 at the Wilmington Dock along with a proposed Machine Learning approach concerning remote sensing techniques, a time-related air quality survey, and port safety codes, which are assessed and based on a modern port governance emergency intervention. The methodology of this research embraces a possible case of high fire severity urban zoning of the Los Angeles Harbour, on the occasion of the severe application of Health and Safety Code Section 18930 by the State Fire Marshal to respond opportunely to the recent extensive ignition across California. Set rules, dispatched by LA Port System, are detected following a Landsat 8/OLI (Operational Land Imager) remote sensing-based geospatial comparison with ground-based air samples. In order to target opportunely risk barriers in favour of Oil Tankers and critical garrisons, an extensive pre-processing calibration of spaceborne datasets has been performed for enhancing minor changes on the platforms. Besides, intrinsic limits of the OLI definition do not permit appropriate accuracy of small-scale evaluations; a decision tree model has been therefore engaged by embracing high variance and low bias of these compensated datasets. In this manner, four Regions of Interest have been marked to strengthen the sub-samples of these features. The flexibility of RF computation delivers positive automation for the missing values, categorical and continuous values; on the other side time consuming and interpretability drawbacks, notice a disadvantage of the implementation in terms of computational training, validation, and testing. In defence of this intervention approach, an air-model geostatistical distribution carried out pixel values based on the pre-burn weighted trained model and finally ensembled to buffer protection zones, according to the Safety Code Section 18930 as an endorsement of further sustainable and financial liabilities that are vital parameters in the post-Covid-sars19 crisis and demonstrate growth limits of Ports as periodically issued to theirs Internal Consistency Analysis. The advisory assessment research moreover a hardware performance to support on-time prediction models, by listing variable dependent regressive accuracy samples.

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1. Introduction

1.1. Welding operations

Welding operations are essential for the logistic sector in the harbour settlements and are often executed by third-party companies. Special supervision (AF&PA. 2001. National Design Specification; AF&PA. 2003 Calculating the fire resistance of exposed wood members; American Institute of Timber Construction. 1984; An International Codes and Standards Organization. NFPA®30 2015; California code of regulations; California codes government code, section 51175-51189; Creosote Treated Timber, What you need to know, Wood Protection, West Yorkshire LONZA; White, R. H.; 2002; 2000 Emergency Response Guidebook) and flexibility of exercise are the main factors as follows the finding of the right carrier to move subsequently freights. Personal Protective Equipment (PPE) is a mandatory support for plasma cutter welding whose risk factors are highly highlighted by hot sparks, metal shards, shrapnel, and unintentional combustion. Regarding this last factor, it often occurs at shifting/restorage and lashing/unlashing operations in particular at the expense of unsorted goods that might not encompass sufficient shielding defence. As reported by local media, the dynamic of early ignition interested an important creosote coated timber volume triggered by a plasma cutter.

1.2. Government code

According to Section 18930 of the Health and Safety Code of California, pursued by the State Fire Marshal, building standards need to fulfil comprehensive space and structure defensibility in order to protect structures from the spreading of neighbourhood ignitions. In case of high fire severity, the jurisdiction is regulated upon Section 51182 by the Director of Forestry and Fire Protection. Consistent criteria of time-related factors such as this case study, buffer as indicators up to identifying the label of "State responsibility areas", in which the financial liability of fire prevention and suppressing are regulated by the Section 4125 (Repealed and added by Stats. 1965, Ch. 1144).

Monitoring and reviewing the effectiveness of process design and enforcement are led by the Director of Fire Protection whose quinquennial outcomes are synchronized with the general plan update; the results shall be reviewed under Sections 51178 and 51179. Fire-break zone are strategic drivers demanded to prevent the risks of high severity zones and are undertaken with a not less than 30 feet distance protection curtain along the property line, with regard to flammable goods and combustibles (API RP, 2021 - Management of Atmospheric Storage Tank Fires, 2006; NFPA 15 - Standard for Water Spray Fixed Systems for Fire Protection, 2007; NFPA 30 - Flammable and Combustible Liquids Code, 2012); insurance companies are not prevented from requiring wider buffer distances. High Severity Zoning was, besides, prompted for the first time by the Bates bill in response to the Oakland Hills Fire of 1991; the vertical hierarchy was hence a top-down policy-made in the prospective of duality between the Director of Fire Protection (top) and local jurisdiction (down). On behalf of the CAL FIRE Director, a final endorsement of evaluation is promulgated. New built or renewal constructions that are interested in structural damages by fire hazards shall obtain a certification of safeness that satisfies Section 51189 and relative insurance coverage.

In accordance with national and local building standards (City of Los Angeles. Department of Building and Safety; LADBS; County of Los Angeles, Department of Public Works Building and Safety Division; Disaster Management Areas, Cities, and Unincorporated Areas, Los Angeles County Operational Area; http://www.dec.ny.gov/regulations/regulations.html), a final inspection ratifies the appositeness; facades, whose implementation consisted of effective non-flammable usage of materials, shall be considered exempt by this evaluation. Transactions that are regulated under Section 1103 of the Civil Code, are subject to the Local Option Real Estate Disclosure Statement, as promulgated by the 1102.6a of the Civil Code, and the Natural Hazard Disclosure Statement as enacted by the Section 1103.2 of the Civil Code. A further shiftiness of hazard individuation shall lead to the Y/N marking by the transferor on the Natural Hazard Disclosure Statement, on behalf of technical attachments. Lands and waters of port

zoning are not subject to Section 51182 unless they include any habitat for endangered or threatened species by the state or federal government, parklands, and scenic values.

Because of the sensitivity of the Port Authority of California (Eleventh Coast Guard District Strategic Framework, 2019-2021) - five hundred meters as the crow flies not far away from the rising hills - fuel fossils storage has been included within FHSZ state-wide reflective fuels on the ground. Nevertheless, the limitations of the focus of FHSZ maps have demonstrated to undermine the adherence of insurers to fire protocols. To fill this gap, a Memorandum of Understanding (MOU) was signed by the Commissioner of the California Department of Insurance and the Director of CAL FIRE, in October 2007. Fuel storages express an important risk factor up to the direct correlation of the Hazard model itself, by designing a likelihood model that the area will burn over a 30-to-50-year period.

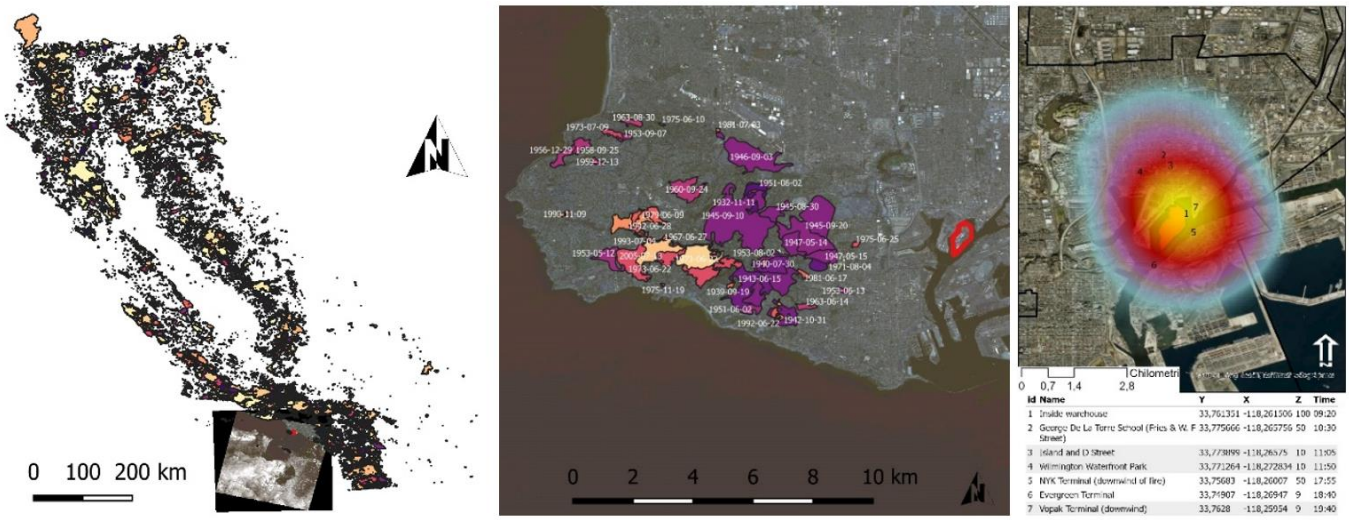


Figure 1. (a)California Fire Perimeters (map on the left), (b) LA Fire Perimeters (Map in the middle), and (c) SCAQMD inspection (Map on the right)

A crucial step for sustainability includes the possibility of productive entities being validated by insurance companies. Fire Hazard is the primary focus of the Fire Hazard Severity Zones (Frequently Asked Questions, FIRE HAZARD SEVERITY ZONES, FHSZ) maps, not Fire Risk.

Nevertheless, despite this ambiguity, the Fire Hazard model regulates the risk assessment, particularly for the fuel, slope, and fire weather, by considering the potential for damage based on fire spread. Mitigation protocols include, as stated in the previous paragraph, measures that comprehend defensible space, building design, ignition resistance building class, and ignition resistant construction technology. Managing risk is an iterative process finalized to deliver assistance as a key decisional for the whole management system. Its update faces off most recent technologies and the experimentation is fully capable of targeting human behaviour of external and internal criteria of corporate frameworks, nevertheless using remote data, spatially and temporally. Risk sources demand effectiveness and rapidity, especially for harbours in which combined storage can easily degenerate following cascading and cumulative effects (Ghasemi, A et al., 2017). The probabilistic methodology is hence a security measure and can be quantitatively computed, in the patterns of Likelihood Estimation.

The results obtained through modern approaches of computer vision algorithms demonstrate the possibility of getting deeper results and recovering obsolete grayscale values; the details quantify moreover a quantitative assessment which include highest accuracy. Finally, a ground model has been interpolated in order to get a visual comparison of both processes.

2. Methods

2.1. Port dock

The study case is searchable at Long. 33°45'35.3" Lat. 118°15'42.1" and interests 3,30 square kilometres; its area of ignition is extended to 1,21 sq. km. It lies behind the Wilmington-Harbour City urban system, at the boundaries of the following zonings: Light Industrial/M2, limited industrial/CM, M1, Community Commercial/C2, Public Facilities/PF, General/Bulk Cargo & Commercial/Industrial uses -non-hazardous/5A[Q]M3. As reported by Wilmington Waterfront Development Project Mitigation List (Transmittal 4), this bulk sector was provided with alternative evacuation and emergency routes which were addressed to immediate response during construction periods under the supervision of LAHD, LAFD, LAPD, LA Sheriff, and Fire Departments.

2.2. Image dataset

Image datasets are implemented in the research thanks courtesy of the U.S. Geological Survey.

2.3. Weather informations

On-ground events and dynamics are reconstructed by getting acquainted with personal witnesses and statements by major media agencies. National weather service and mesowest.utah.edu backed up relevant information already in 2014. Shapefiles are granted "without warranties of any kind, either express or implied, including without limitation, warranties of title or implied warranties of merchantability or fitness for a particular purpose" by the official portal of the City of Los Angeles. Surveys data are kindly distributed by the Los Angeles Fire Department. Four satellite scenes, selected before and after the hazard, present a modest cloud coverage but overall do not affect the case study. This fundamental condition has determined the start of the research.

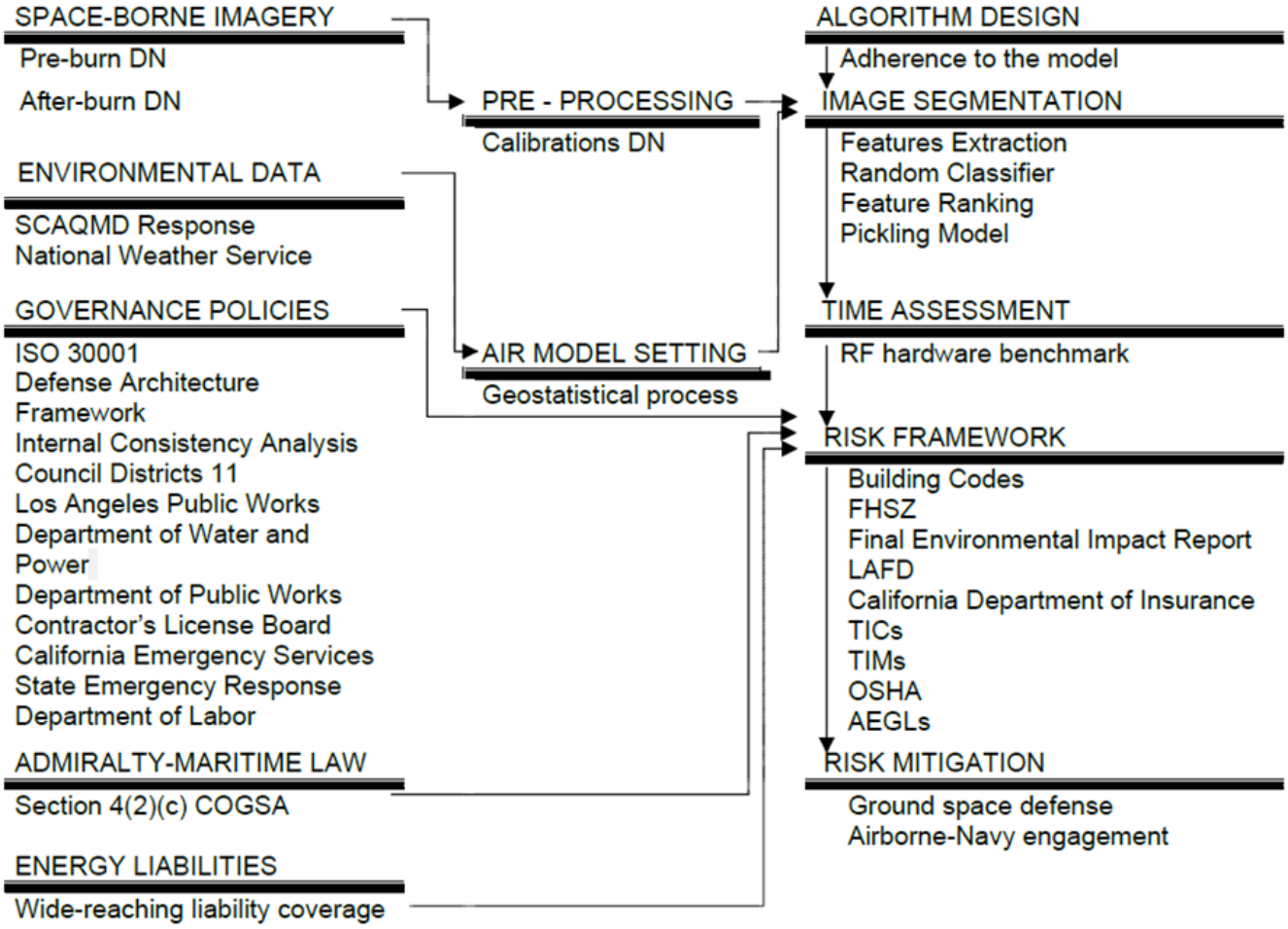
Table 1. Ground observations at 09/22/2014 (Source: LA International Airport, KLAX)

Pressure	2.0 Wet bulb temperature	10.0m Wind Direction	Weather conditions
29.82 in	63.7 ° F	WSW	Clear

Table 2. Spaceborne observations (Source: National Aeronautics and Space Administration, NASA and United States Geological Survey, USGS)

Date	08-20	09-05	10-07	10-23
CLOUD_COVER	59.41	43.53	36.24	2.92
CLOUD_COVER_LAND	8.77	1.32	15.79	1.18

Table 3. Framework of research



2.4. Ordinary Kriging

The response to fire at Port of Los Angeles (SCAQMD) evaluation started on the morning of 22nd September. Inspectors operated, since the beginning, at the Berth 177 by gaining air samples that were soiled by toxic hydrocarbons. The canisters, which were subsequently analysed, revealed elevated levels of Naphthalene due to the combustion of crude oil or coal tar associated with the stored timber stocks. In particular, the warehouse was reported to drive as a chimney of endless ignition. Furthermore, several inspectors were deployed in the neighbouring urban texture, whose instruments consisted of portable monitoring devices to assess particulate matter (PM) and hydrocarbons, by implementing gas chromatograph/mass spectrometer (GC/MS) measurements. The fine particulate matter was assessed to be larger than 2.5 microns and was mainly transported on the northwest side of the city by maritime winds under the clear sky.

The assessments were precisely vigilant over the maximum instantaneous activity due to the potential impacts on the community and embraced distant sites such as the George De La Torre School (Fig. 1c). This study strictly considers the toxic exposure of Naphthalene, whose heterogeneity consisted of benzene, and toluene compounds but disregards particulate matters measurements, estimated at 47 micrograms per cubic meter ug/m3, due to its chronic disturbance in the Los Angeles city. The measurements met the U.S. EPA standards regarding future comparisons against the National Ambient Air Quality Standards (NAAQS). In order to predict this Naphthalene distribution, an ordinary Kriging

method was preferred due to statistical usage of the same environmental Agency, with the estimation of prediction error rather than the Inverse Distance Weighting. Among seven correlated points (Fig.2), a prediction of the most probabilistic exposure along seven hundred meters was estimated, on behalf of true values, unbiased at each location, spatially autocorrelated, normally distributed, and stationary, by following the most stable algorithm of dispersion. Depending on how correlated the points are based on how distant they are located from one another, a correlation in known values was calculated and also predicted in further zones of the LA districts.

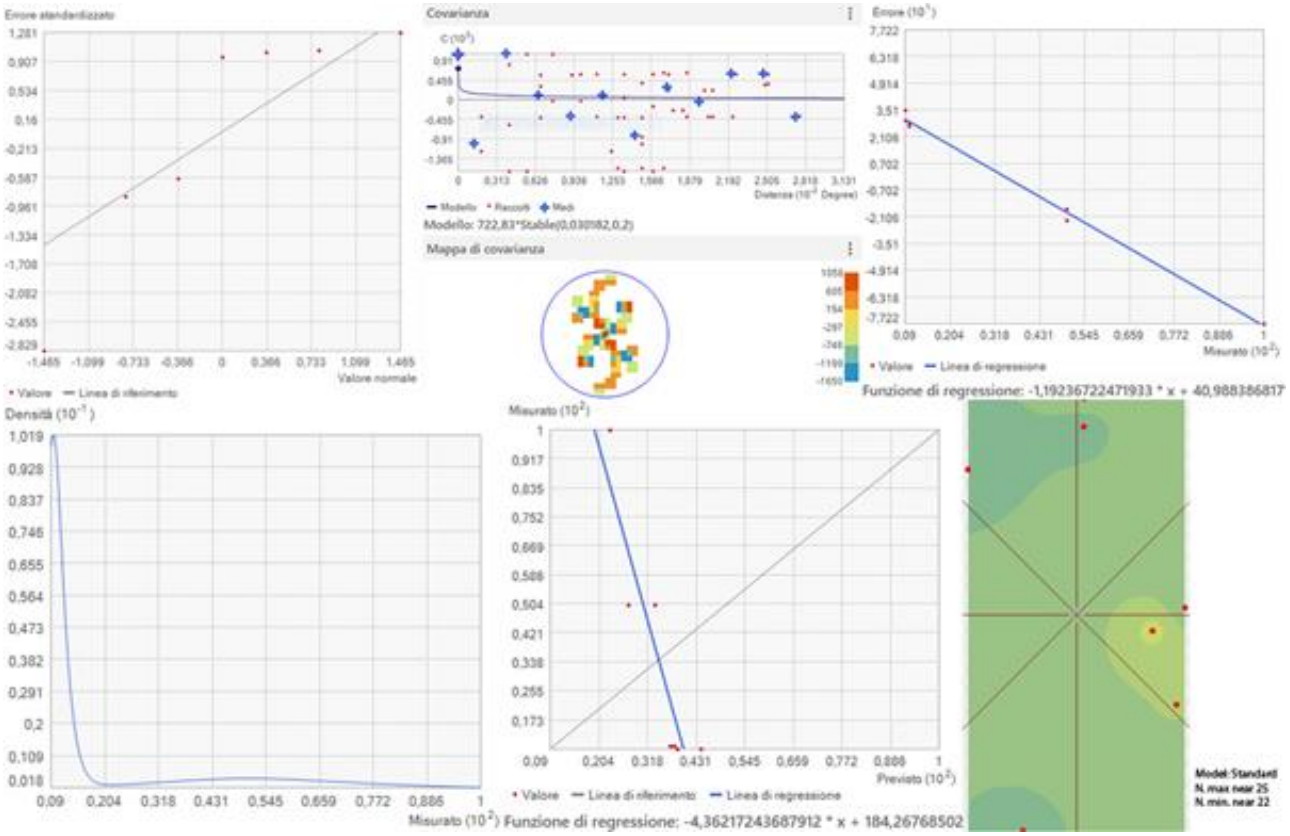


Figure 2. Kriging statistics

This linear-weighted averaging method was operated by the author under his own ArcGIS Pro license distributed by Esri. Additionally, as a result of the SCAQMD report, the local stationarity of the 7 surveys was guaranteed to start from the main emission located at Wilmington Dock, berth 177. Fire magnitude caused important structural collapses at the expense of the wharf and its Warehouse as declared and well-represented in the project description "Berths 177-178 Transit Shed Demolition Project, final initial study/negative declaration" prepared by: City of Los Angeles Harbour Department, Environmental Management Division (2016).

2.5. Radiometric and atmospheric image correction

As an essential part of radiometric and atmospheric image corrections, multiresolution (MR) remote sensing images require independent preservation of numerical details by each band (Benharrats F et al.; Brian L. et al.; Chander, G. et al., 2009; Landsat MSS, TM, ETM+, and EO-1 ALI Sensors). To deliver an adequate commutation into realistic environmental parameters with the purpose of overcoming

electromagnetic radiation (EMR) and subsequently comparing, four Landsat 8/OLI datasets prior to and successive to this hazard were considered.

The digital numbers (DN) were characterized by overall conformity of weather parameters except the third, whose cloud coverage nevertheless did not interest the region of study. Regarding extensive parameters, provided by the joint NASA/U.S. Geological Survey Landsat, an extended rescaling of values, was commuted into three physical units: at-sensor reflectance (Vermote E et al.) prior to the at-sensor radiance correction (%) (ToA), and the supervised Dark Object Subtraction (DOS) (Chavez, 1988, 1996; Gilmore S et al., 2015). This last was computed simultaneously with the Pan-sharpening refinement (Congedo L., 2016). In order to guarantee an enhancement of edge maps, panchromatic components were also included and subsequently with other morphological spectral, fused at the highest resolution. Low-definition multispectral MS sensors benefit from single panchromatic (PAN) bands at HR, in this case, 15 m, to re-enable consistency from spectral distortion, glaze and/or blur.

Table 4. Radiometric comparison

▷ Variable assigned to pixels		▷ At-sensor correction	
Rescaling 1 ToA	► Radiance correction	**Rescaling 2** ToA	►Reflectance correction
Require: DN **Values:** 1:M_p = Multiplicative rescaling factor (DN_reflect_mult_band_x) 2: Q_{cal} = Quantized and calibrated standard product pixel values (DN_cell_value) 3: $A\rho$ = Band specific additive rescaling factor (DN_radiance_add_band_x) **Ensure:** $p_{\Lambda'}$ cell value as radiance (Watts/(m^{2*}srad* µm))		**Require:** DN **Values:** 1: $p_{\Lambda'}$ = product of ToA reflectance without correction 2: Local sun angle = sin (θ_{se}) **Ensure:** p_{Λ} compensation of the solar irradiance Accurate reflectance calculations, can be also obtained by implementing per pixel solar angles rather than the scene center solar angle. Due to Landsat 8 products limitations, pixel solar angles cannot be currently obtained unless further calculations.	

$$p\Lambda' = M\rho * Qcal + A\rho \quad 1)a$$

At the early stage of the pre-processing research, an object-based method was considered essential because of the presence of determinate industrial elements that characterize this harbour sector. Otherwise from the manual radiometric correction, a semi-automatic DOS was performed simultaneously with the natural multi-band combination, to highlight urban features classification, i.e., industrial roofs and logistic elements.

A 4-3-2 pan-sharpened (6) set by four dates, was intrinsically considered less difficult to comprehend a harbour case unless an appreciable presence of vegetation for NIR composite was present. Besides, the study aims to deliver an adaptive guide case that can include also airborne/unmanned RGB/IR datasets operating in difficult conditions, i.e., smoke, fire, dusk, as support of time limited SaR intervention.

Table 5. Landsat metadata: (a) 08/20, (b) 09/05 (Source: developed by NASA and USGS)

	2014 - 08 - 20				2014 - 09 - 05			
	Radiance		Reflectance		Radiance		Reflectance	
Band	Gain	Bias	Gain	Bias	Gain	Bias	Gain	Bias
1	1.2265E-02	-61.32445	1.210700	-0.099980	1.2354E-02	-61.76958	1.210700	-0.099980
2	1.2559E-02	-62.79699	1.210700	-0.099980	1.2651E-02	-63.25281	1.210700	-0.099980
3	1.1573E-02	-57.86689	1.210700	-0.099980	1.1657E-02	-58.28692	1.210700	-0.099980
4	9.7593E-03	-48.79662	1.210700	-0.099980	9.8302E-03	-49.15082	1.210700	-0.099980
5	5.9722E-03	-29.86110	1.210700	-0.099980	6.0156E-03	-30.07785	1.210700	-0.099980
6	1.4852E-03	-7.42618	1.210700	-0.099980	1.4960E-03	-7.48009	1.210700	-0.099980
7	5.0060E-04	-2.50302	1.210700	-0.099980	5.0424E-04	-2.52119	1.210700	-0.099980
8	1.1045E-02	-55.22434	1.210700	-0.099980	1.1125E-02	-55.62520	1.210700	-0.099980
9	2.3341E-03	-11.67039	1.210700	-0.099980	2.3510E-03	-11.75511	1.210700	-0.099980
10	3.3420E-04	0.10000	1.210700	-0.099980	3.3420E-04	0.10000	1.210700	-0.099980
11	3.3420E-04	0.10000	1.210700	-0.099980	3.3420E-04	0.10000	1.210700	-0.099980

Table 6. Landsat metadata: (a) 10/07, (b) 10/23 (Source: developed by NASA and USGS)

	2014 - 10 - 07				2014 - 10 - 23			
Band	Radiance		Reflectance		Radiance		Reflectance	
	Gain	Bias	Gain	Bias	Gain	Bias	Gain	Bias
1	1.2572E-02	-62.86026	1.210700	-0.099980	1.2685E-02	-63.42480	1.210700	-0.099980
2	1.2874E-02	-64.36967	1.210700	-0.099980	1.2990E-02	-64.94776	1.210700	-0.099980
3	1.1863E-02	-59.31611	1.210700	-0.099980	1.1970E-02	-59.84881	1.210700	-0.099980
4	1.0004E-02	-50.01868	1.210700	-0.099980	1.0094E-02	-50.46789	1.210700	-0.099980
5	6.1218E-03	-30.60894	1.210700	-0.099980	6.1768E-03	-30.88383	1.210700	-0.099980
6	1.5224E-03	-7.61216	1.210700	-0.099980	1.5361E-03	-7.68053	1.210700	-0.099980
7	5.1314E-04	-2.56571	1.210700	-0.099980	5.1775E-04	-2.58875	1.210700	-0.099980
8	1.1321E-02	-56.60738	1.210700	-0.099980	1.1423E-02	-57.11576	1.210700	-0.099980
9	2.3925E-03	-11.96267	1.210700	-0.099980	2.4140E-03	-12.07010	1.210700	-0.099980
10	3.3420E-04	0.10000	1.210700	-0.099980	3.3420E-04	0.10000	1.210700	-0.099980
11	3.3420E-04	0.10000	1.210700	-0.099980	3.3420E-04	0.10000	1.210700	-0.099980

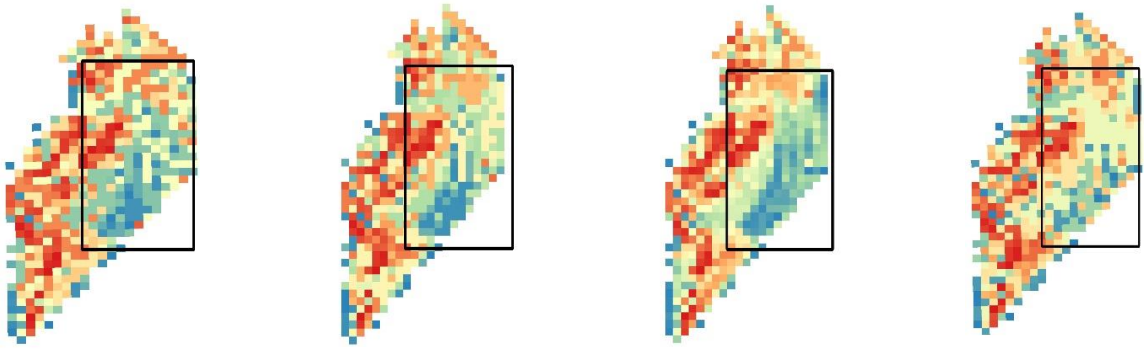
Unrectified OLI bands tend however to mislead and furthermore an accurate radiance adjustment benefits by picking up sun elevation values rather than solar zenith data since the latter might be affected by small anomalies (Yale University's Guide, 2013).
pΛ = (reflectance scale * cell value + reflectance offset) / sin theta

Table 7. Additional Landsat metadata (Source: developed by NASA and USGS)

	08 - 20	09 - 05	10-07	10-23
Sun elevation	60.79560196	56.99184431	47.39553813	42.23030775
sin	8,728846 E-6	8,385930 E-6	7,360443 E-6	6,721123 E-6

The Natural Color composite, (B04, B03, and B02 in the related red, green, and blue color channels), has surfaced the necessity of an Object-based image analysis whose iterative process has sought a merging and gradually filtering away process. The following supervised segmentation enhanced this coarse resolution and refined the augmentation by considering available references designed at higher resolution.

Figure 3. 0.630 – 0.680 - Red, 0.525 – 0.600 - Green, 0.450 – 0,515 - Blue (μ) at 08-20



a *b* *c* *d*

Figure 4. (4-3-2) Spectral definition. a - 08-20. b - 09-05. c - 10-07. d - 10-23

2.6. Kernel

The advantage of a Gaussian kernel function, (Air Force Institute of Technology, 1989) which is modulated by a sinusoidal plane wave (Bhattacharya D. et al., 2009) and multiplied by a Gaussian function, introduces flexible possibilities for edge detection. Due to the multiplication-convolution property, the Fourier transform of the Gabor filter is the convolution of the Fourier transform of the harmonic function in the matter of a sinusoidal function and the Fourier transform of the Gaussian equation.

1) $g(x, y; \lambda, \theta, \psi, \sigma, \gamma) = \exp\left(-\frac{x'^2+\gamma^2y'^2}{2\sigma^2}\right)\exp\left(i\left(2\pi\frac{x'}{\lambda}+\psi\right)\right)$

2) $g(x, y; \lambda, \theta, \psi, \sigma, \gamma) = \exp\left(-\frac{x'^2+\gamma^2y'^2}{2\sigma^2}\right)\cos\left(i\left(2\pi\frac{x'}{\lambda}+\psi\right)\right)$

3) $g(x, y; \lambda, \theta, \psi, \sigma, \gamma) = \text{sen}\left(-\frac{x'^2+\gamma^2y'^2}{2\sigma^2}\right)\exp\left(i\left(2\pi\frac{x'}{\lambda}+\psi\right)\right)$

4) $x^{\wedge}{}' = x\cos\theta + y\sin\theta$

5) $y' = -\mathbf{x}\sin\theta + \mathbf{y}\cos\theta$

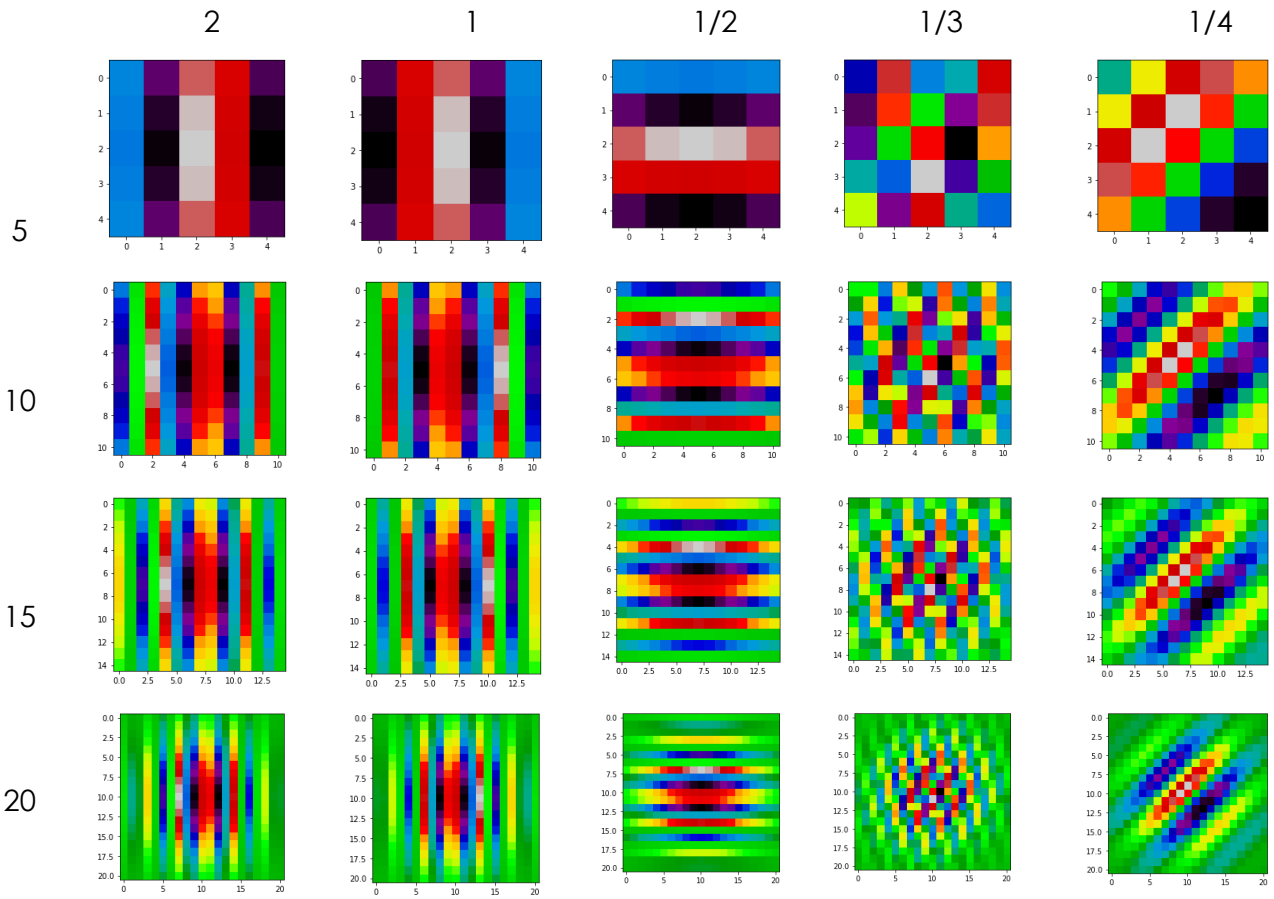
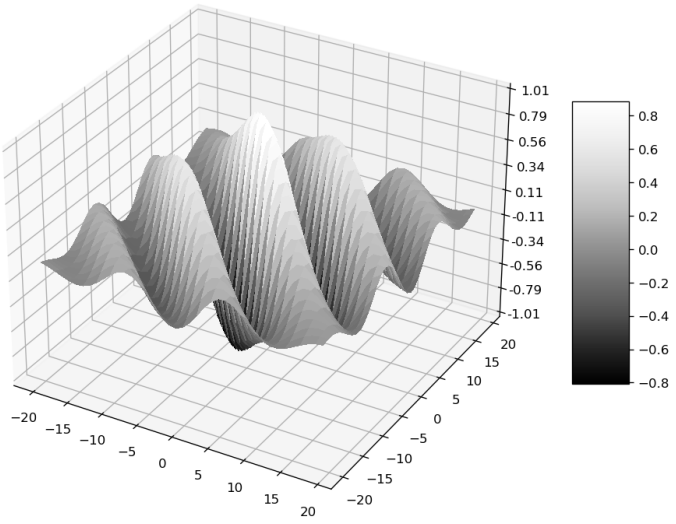


Figure 5. Pattern results

As prompted by a recent article (Ke Zhan, Hong You et al., 2020) the Gabor filter responses positively to the detection of translation, invariance to rotation and scale without requesting a high quality. In particular, the features determined by the Gabor filter, can derive from Gray-level images, and subsequently benefit of the implementation of the Random Forest Classifier (RF). Furthermore, its flexibility is well documented according to visual image research with regard of its similarity to the human visual system.

The scripting applied to Gabor filters has focused on five parameters: sigma, which establishes the size of the Gaussian envelope, psi, which determinates the phase offset, gamma, which is spatially necessary for the aspect ratio and adjusts the ellipticity, fx, or frequency of the sinusoidal component, nAngles, which characterize the number of filter orientations. The impulse response of these five parameters has delivered different combinations of a preliminary texture extraction. This strategy, organized in the matter of a filter bank, highlighted a numerous set of different sampling factors for a greyscale, which transmit the multi-resolution architecture of the Gabor pyramid.



▷ wavelet factors

Algorithm 1 ▶ frequency model

Require:

1: λ = Wavelength of the sinusoidal component

2: Θ = The orientation of the normal to the parallel stripes of Gabor function

3: Ψ = phase offset of the sinusoidal function

4: σ = standard deviation of the Gaussian envelope

5: ɣ = The spatial aspect ratio ellipticity of the support of Gabor function

Ensure:

Ksize

Because of the horizontal patterns of the map image, it was considered to endorse as primary parameter the theta wavelengths for the orientation of the normal to the parallel. The edges were well represented with regard of theta = 1*np.pi/4 which has to be implemented towards future ortho-aerial applications.

A wide set of gabor computations was performed to enhance the texture analysis, edge detection, feature extraction.

Figure 6. Pattern. Gamma = 0.9 Sigma = 5 Phi = 0.8

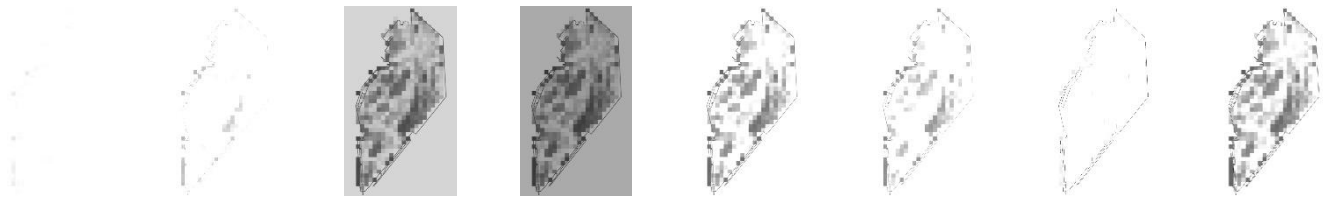


Figure 7. Feature extraction

2.7. Image Segmentation

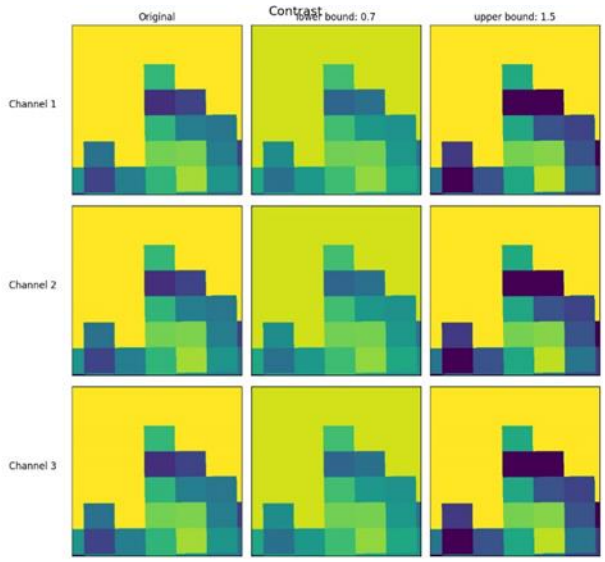


Figure 8. Contrast

Table 8. Inputs

Platforms	51367
Roofs	20748
Objects	53311
Oil Tankers Silos	24878

RF is a flexible algorithm (Xin-Ke Zhan et al., 2020) that delivers efficiency in the strict regime of low spatial references. Its minimalism and variety rely on both classification and regression methods. This combination of learning models, likewise multiple decision trees, is inclined to the fusion of different alternatives by cutting off the output variance. The training model in such a case was derived by the labelling of the 08-20 grayscale map whose base resolution was fixed in 2031*3673. The effective resolution, identifiable as squares, is much lower if scaled 1:1 (blocks to pixels). According to an extensive tagging of four regions of interest (ROI), a set of training examples, N= ((V1, V2, V3,…, Vn),y…), , whereby V indicates the feature of each sample and y the class label, was computed within the 2021-03-31, 15:18:25.

and 2021-04-01, 06:41.09 by means of a Carl Zeiss Microscopy GmbH Initiative, "From Image to Information". The node was entrusted to a Tesla K80, with 55 GB ram. The four labels that emerged in the following results, red for the objects, yellow for the platform, cyan for the roofs, and green for the oil tankers and silos, have determined the reading inputs as follows, in Table 9.

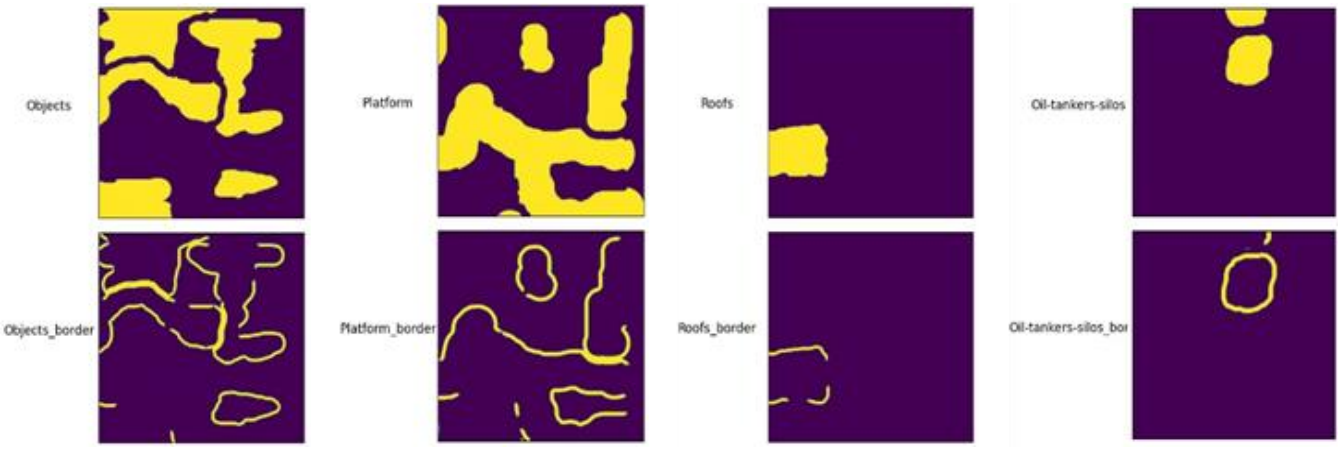


Figure 9. Edge detection

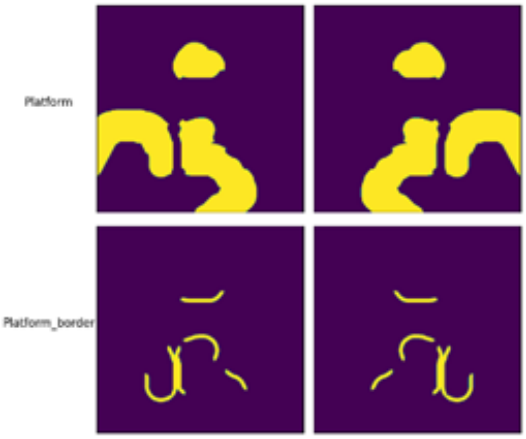


Figure 10. Flip left and right

Figure 11. Transpose

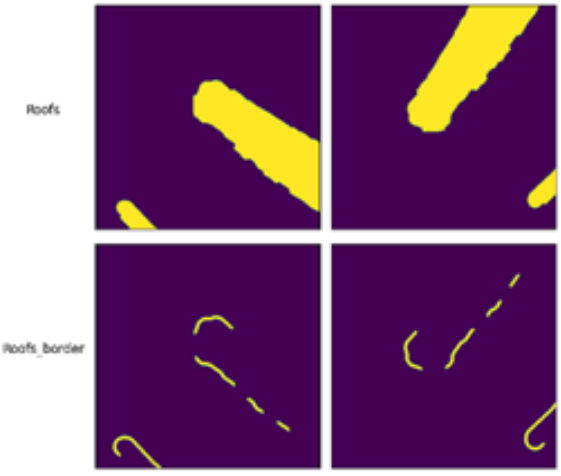


Figure 12. Rotation

In optimal conditions, a higher number of pixels determines divergent trends (Fig.13): for losses, both curves start at the top left and drop values at the bottom right; for accuracy, both curves start at the bottom left, rise rapidly, and constitute a form a plateau; likewise for both IOU curves.

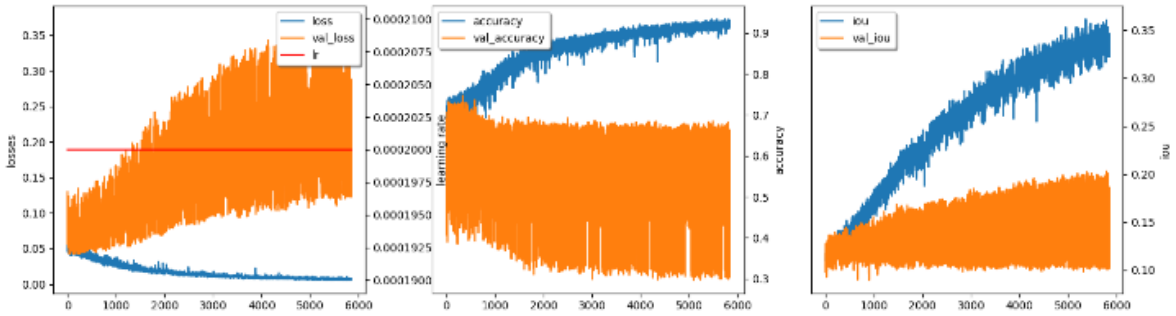


Figure 13. Training results. a – loss curves; b – accuracy; c – IOU index

2.8. Time assessment

Due to the nature of research, operating in crisis scenarios might require conditions that diverge from theoretical and indoor experimentations. By overcoming the initial underdevelopment of predictions, an increasing prediction benchmark regarding the hyper-parameterization of n_estimators and random_state is indicated as follows:

Table 9. Random Forest benchmark

N_estimators	Random_state	
10	42	*a*
9 min 51 sec A.T. 0.8347824591027939 A. 0.8189813086429848		
20	84	*b*
12 min 10 sec A.T. 0.8352199113611803 A. 0.8195540401870544		
25	105	*c*
13 min 46 sec A.T. 0.8352708506435664 A. 0.8197222737944989		
50	210	*d*
21 min A.T. 0.8353345247465491 A. 0.8201036479882678		
100	420	*e*
35 min 16 sec A.T. 0.8353508342536289 A. 0.8203194695882566		
200	840	*f*
1 H 3 min 15 sec A.T. 0.8353539621043018 A. 0.8203740952416699		
200	840	*g*
1 H 3 min 15 sec A.T. 0.8353539621043018 A. 0.8203740952416699		
400	1.680	*h*
1 H 57 min 13 sec A.T. 0.835354185522207 A. 0.8204250345012946		
800	3.360	*i*
3 H 51 min 05 sec A.T. 0.835354185522207 A. 0.8204022458851468		

The replicability of the number of trees was compromised after the "e" case by which the timing was not justified by the modest accuracy improvement. At the "I" attempt, the accuracy began to decrease. Besides, the scikit learn ML environment benefitted from additional other features matched with the data frame: Canny edge, Roberts edge, Sobel, Scharr, Prewitt, Gaussians with sigma equal to 3 and 7, Median and Variance with both sigmas equal to three.

Tested Hardware:

- Intel® Xeon® Processor E5-4650
1) 20M Cache, 2.70 GHz, 8.00 GT/s Intel® QPI
- Nvidia GeForce GTX 760
- 48 GB DDR-3 1600 ECC Ram
- 1 TB Samsung SATA III 850 EVO SSD

2.9. Machine learning geospatial comparison

To Assess an equal decision tree of the entropies that occurred under the four Geo-variations, the settings were addressed to the most convenient combination N-tree = 100, R-state = 420.

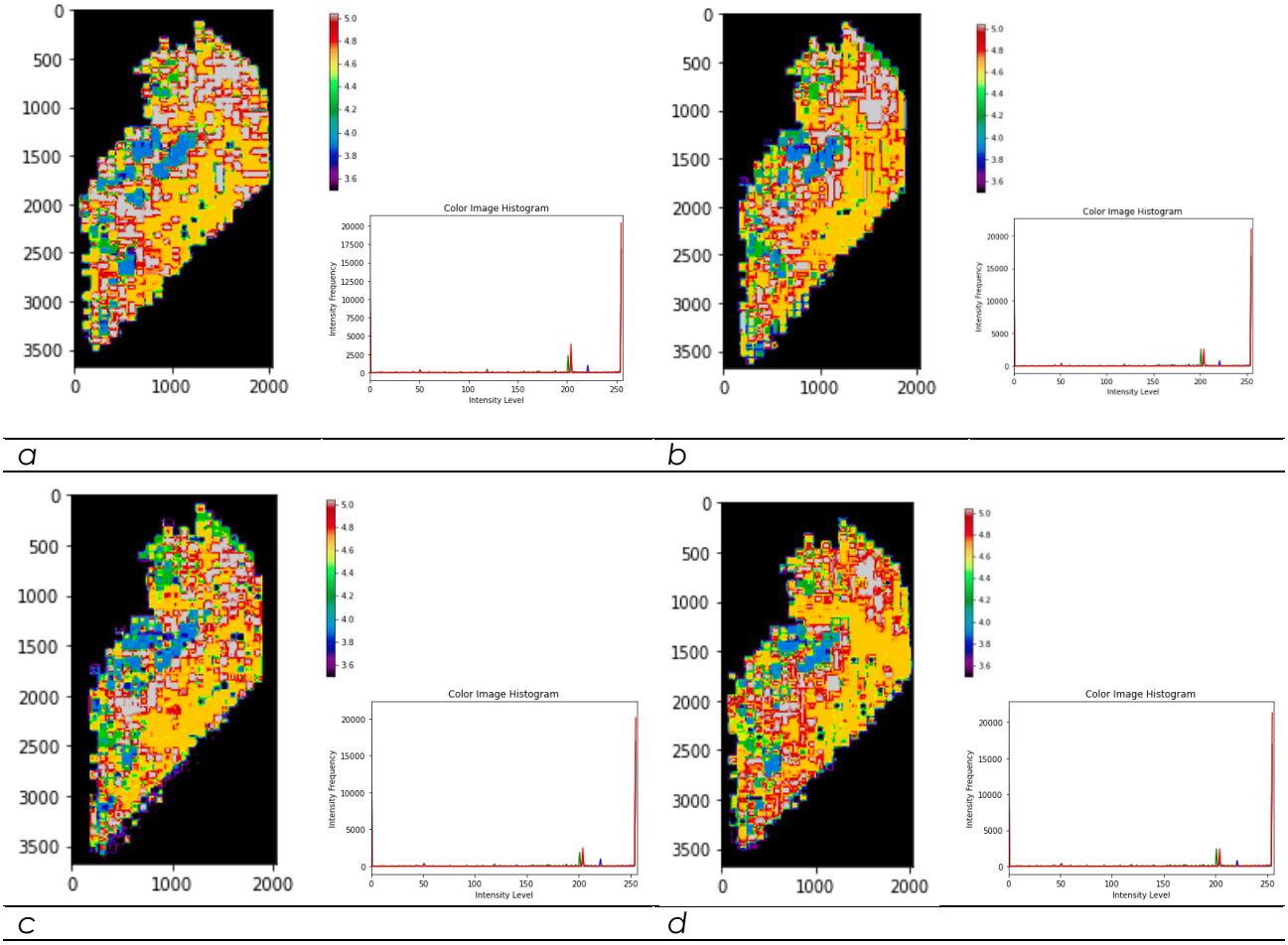


Figure 14. Random Forest Classification. a - 08 20. b - 09 05. c - 10 07. d - 10 23

The planned method generated four RF classification results, with an overall high sensitivity of 0.82031 % for the training result a, 0.764761 % for b, 0.81451 % for c, 0.78573 % for d.

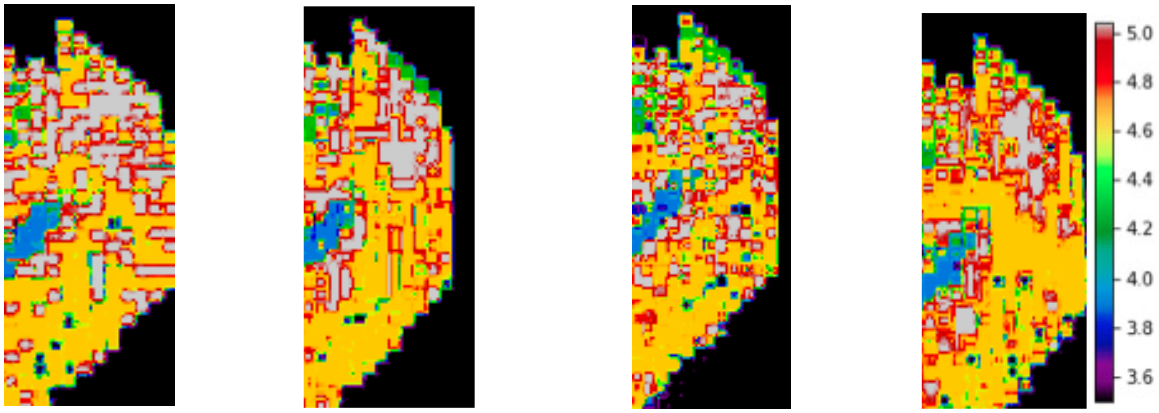


Figure 15. Entropies of fire at Wilmington dock. a - 08 20. b - 09 05. c - 10 07. d - 10 23

2.9.1. Hybrid augmentation

As a refinement of the Kriging air model, a superimposed model fixed at 2031*3673 was generated, by downgrading n-classes of the weighted average with neighborhood points, a – b. The research acquired a wide and precise strengthening based on the RF training: by partitioning the set of all points in X which maintain a distance inferior to the other sites Pj. J is any index dissimilar from k (c):

1) $R''k'' = \{x \in X \mid d(x,P''k'') \leq d(x,Pj) \text{ for all } j \neq k\}$

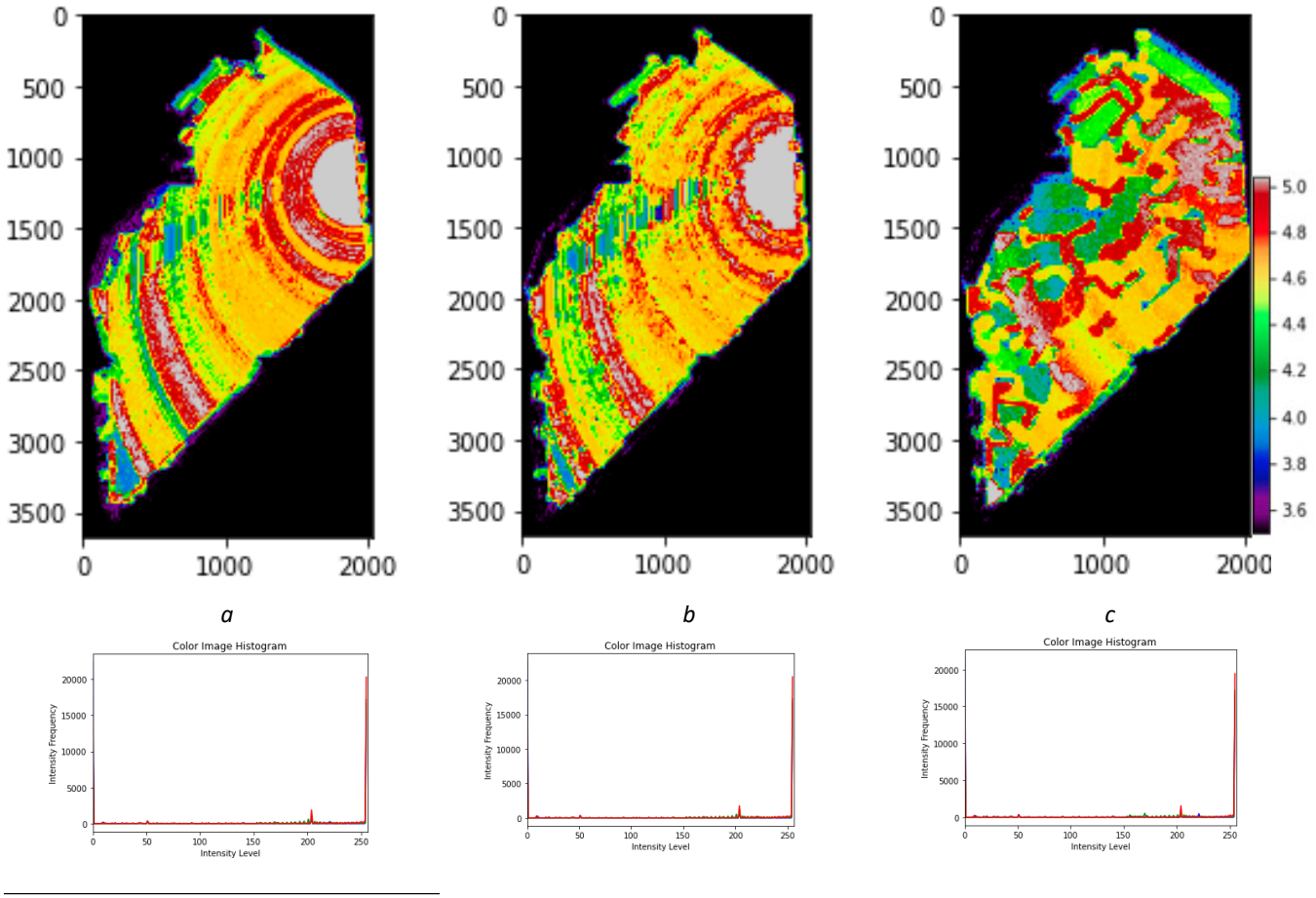
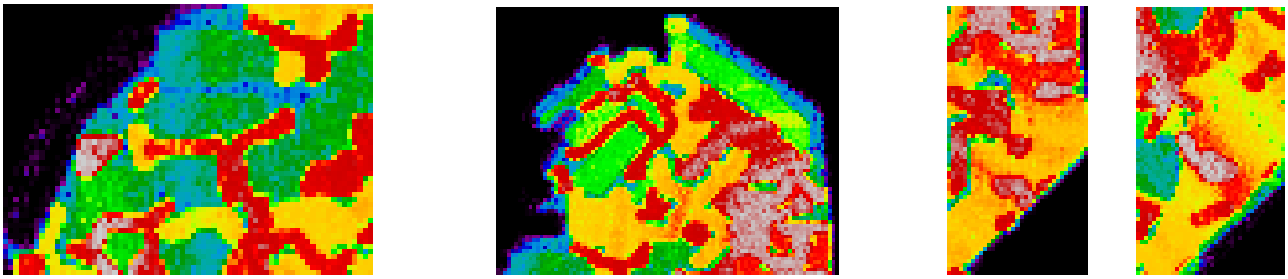


Figure 16. Superimposed model. a – below n. b – above n. c - decomposition of the air set

3. Results and discussion

As stated at the premise of the article, the study delivers a machine-learning-based prediction model whose criticalities can anticipate demands of multipurpose shifts in hazard scenarios. To conclude, a review insight has mediated among different research articles involved in the demand predictions of risk scenarios. As discussed by a recent article (R. Jenkins, J. Lunday, et al., 2020) on the subject of great-power conflicts (Army Field Manual No 3-9. Potential Military Chemical/Biological Agents and Compounds, 1990; Clive K., 2006; Herman S. Wolk, 1962), machine learning has been completely recognized as essential by its implementation in military scenarios: between 2001 and 2014, more than 4,500 U.S. military medevac were coordinated with regard of its accuracy.



a *b* *c* *d*

Figure 17. Risk augmentation. a – Shore Terminals. b - Access. c, d – Platform

The report, obtained from extracted logistical points, has guided the allocation of first aid and evacuation assets as intended to permit the quickest and safer search and rescue operations. Professional aerial firefighting assistance has subsequently benefitted from the military protocols ruling steady-state combat operations through the implementation of specialized equipment such as infrared cameras, hoist/lifting possibilities, projectors, applied robotics, which ensures full compliance within the degraded visual environment as regulated by the National Fire Protection Association (NFPA). Following the extension of health and safety policy, a large-scale fire safety management research (Wong, Xie, et al., 2014) has underlined the necessity of tailoring ad hoc approaches that correspond not applicable responsibilities for each different issue.

Ensuring safe evacuation and enclosing in partitions fire and explosions risks have determined the resilience of multipurpose docks. Containerization in particular demands own safety zones to assist the transferring of intermodal freight transport.

The Wilmington dock has waited two years until the demolition project of berths 177-178. This delay has consequently addressed further costs which are related to the utilization of traffic randomness. Its disseverance is inclined to the restraint of limited areas that may benefit by the garrisoning of the Oil Tankers sector from even more fatal risks (a). Financially, informatic models have outlined default risk under berth-based tasks, i.e., ship turnaround time, waiting time for bulk cargoes, containers, and trucks (Mir A. Wahed, Faghri, Li).

Due to the heterogeneity of the traffic utilisations, an informatic model has been performed in order to simulate supply chain tasks (ship turnaround time, waiting time for bulk cargoes, containers, and trucks) that assist berths maneuvers. The research stimulated the perceptiveness by listing a set of equations prompted by the United Nations Conference on Trade and Development (UNCTAD), held on 1985.

The current literature is resampling important theoretical models in conjunction with the reinforcement of hardware and information validation that has brought together premium estimation in the fire insurance along with random variables, e.g. severity, occurrence date, claim date) by predicting severity results using semiparametric bootstrap.

Table 10. Sectors and likelihood values

Driver	Function	Contingency	Free zone	Access
S Fries Ave Warehouse	Industrial/Commercial	Sufficient	Average	Average
Pasha Stevedoring	Breakbulk cargo	Sufficient	Resilient	Average
Pier A St	Marine related	Average	Average	Average
Shore Terminals LLC	Petroleum Division	Resilient	Resilient	Resilient
Falcon St	Chemical related	Resilient	Average	Average

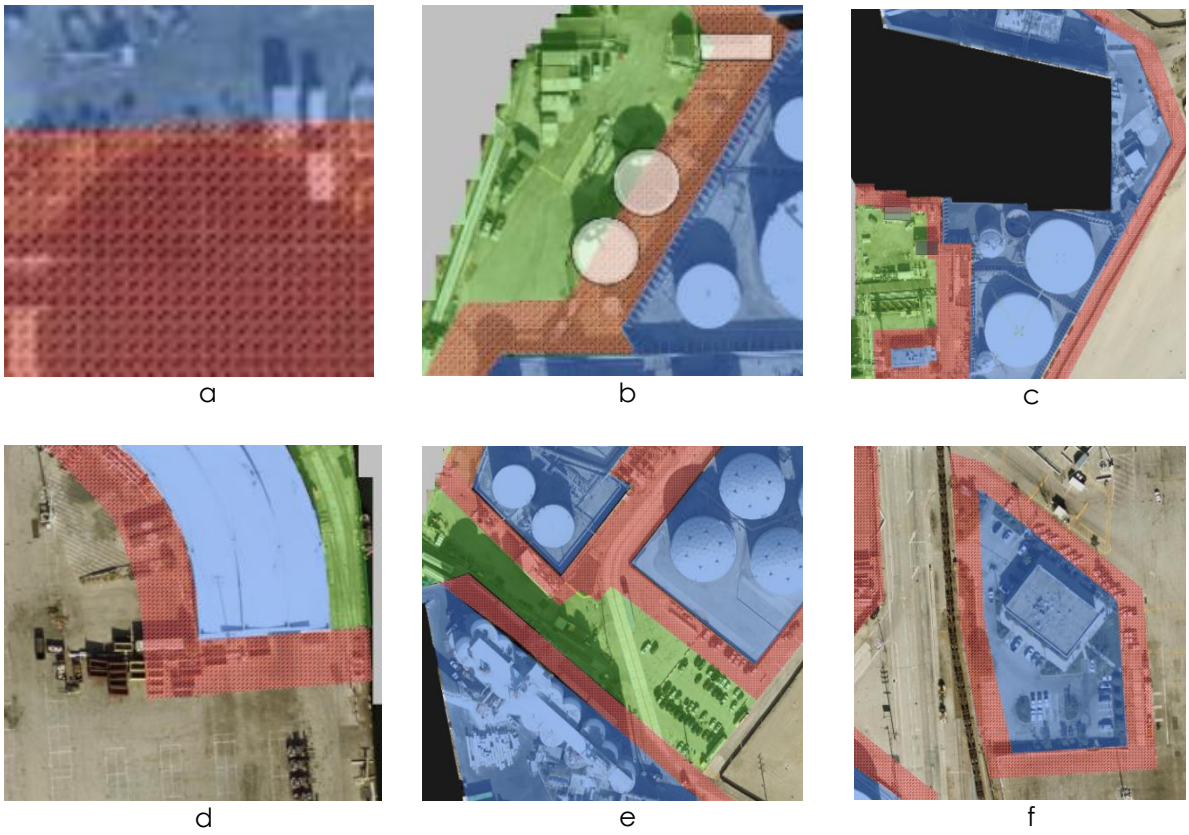


Figure 18. Buffer zoning: Blue as a free zone stands for normal conditions whereby the operations are guaranteed. Red as fire barriers, gateways. Green as checkpoints from the sea to evacuate the survivals

The study finally ensures adaptability of military implementation accompanied by special jurisdiction to be applied in Admiralty and Maritime Cases (R. Force, 2013) along with Defence Transformation capabilities (Kerr, Cambridge. 2006) with special mention of strategic national assets and Potential Military Chemical/Biological Agents and Compounds (Department of the Army, Navy, Air Force, 1990).

4. Conclusion

This proposed methodology lastly illustrates a resilience-based bibliography subscribing to the applicability of the prediction model to other regions in the Mediterranean basin, outside of California,

specifically referring to Harbourscape's core and its revolving zoning encompassing different examples through space and time.

This spatiotemporal identification of a defensive framework in the Mediterranean context has been recently corroborated crosswise a documental and historical investigation, conducted by a joint Italian-Arabic-Spanish program, also signed by the transnational academic agenda of the fifth issue of the International Conference on Fortifications of the Mediterranean Coast (FORTMED, 2020).

By enabling a Culture and Management census of defensive landmarks in the Mediterranean basin, academics acknowledge the support for the inseparable affiliation developed through time, in the dualism of both marine and terrestrial harbour scape (Moretti, B., 2017), as a result of cultural contrasts and positive alliances.

This primary value in the fortified coastal landscape (Cacudi G., 2020), was highly dependent on terms of internal core resilience to give a hand up in the ad of the architectural emergencies that occurred in the interior of the defensive perimeter, and thus, the necessity to assembly watertight compartments.

The article highlights the outstanding constructive superiority with the upgrading of newer walls techniques, and secondarily, the importance to hire religious orders of which talented persons capable to live in restrained core environments, hence preserving the privacy and military vulnerabilities of such military standpoints accomplished by own skilled workers; this dedication mastered the preservation of the elite moral group's integrity along the Italian peninsula (Cornell Per., 2020), without interfering the noisy environment of the city.

As the leadership of peace and prosperity in the Mediterranean was established, the fortified core, that constituted the main landmark of settled feudalism (Cecamore S., 2020), with its new revolving area, currently identified as retro-port as the proposed Machine Learning application conclusively discusses, began to function as a check-point with regard to trades, census's activities, and custom fee application; the urban sectorization in watertight compartments was thus extended in the peripheric ring of the fortified complex (Mollo G. et al., 2020), lastly emptied of its counter siege function (Molteni E. et al., 2020) by encompassing the allocation of institutional representation and core-warehouses.

The visual hierarchy constituted another infrastructural driver demanded from the builders; whether the natural cliffs did not consent to establish standpoints or not, the volume also includes the case regarding the erection of towers along the Tyrrhenian and Ionian coastlines, actually, Calabria of Italy, that successfully functioned as a traffic light tower chain, and that also permitted to operate and to take decisions by staying within the own fortification boundary, namely aree di incastellamento (Canonaco et al., 2020), a constructive matrix to the historical-functional one (Canonaco et al., 2018); this Mediterranean harbourscape is identified by the authors as paesaggio classico (Caniglia, 2017), that was particularly researched by the European aristocracy across the 18th-19th centuries in the occasion of the Grand Tour campaign.

This barricade-and-rescue narrative insists on an ancient territorial quality of harbourscape at present investigated (Moretti B. 2016-17), that has, in relatively recent times, undoubtedly inflated risk assessment frameworks commuted in the civil sector, as the newer European legislation, Seveso II Directive (Delvosalle C. et al., 2005), that has recognized the hazardous dualism between harmful installations and vulnerable residential areas, with the purpose of dismissing the adverse effects derived from industrial sites and susceptible suburban areas (Christou M., 1999).

From a core-system point of view, the article insists on the separation of distances as a safety protocol resulting in land use planning's (LUP) harmonization, backed up by the garrisoning of major accident hazards in the example of the Azote Fertilisant (AZF) factory's aftermath in Toulouse, considered by the French Authorities and the Joint Research Centre (JRC).

Article 12 of the Seveso II Directive, resulting from the Lille conference and the Amendment Directive 2003/105/EC introduced a new set of principles on a modern systematic basis, within a core area and a peripheral health effect threshold, for which the practitioners are called to propose their inventiveness, across four methodological approaches: a) deterministic strategy with the implicit judgment of risk, b) consequence-based approached, c) risk-based (or "probabilistic") approaches, d) semi-quantitative approaches.

In the Italian action program, from a national and legal perspective, the Port System Authority (AdSP) regulates the Port scheme, as declared by the legislative decree of 4 August 2016, and its related judicial police functions, addressed to public rescue service and fire prevention and extinguishing, also depending on the Ministry of the Interior, are ruled by the National Fire Brigade Corps (in acronym C. N. VV. F. and abbreviated as VV. F.) a highly equipped and civil body of the Italian Republic.

Its observances are mandatory to legally operate across a multi-scalar leadership, that has guaranteed security of institutions though the time, in the execution of economic, productive, and logistical survival assistance in the aftermath of internal or international crises; one research governance body, specifically contributing with the Italian fire-fighters, is the Istituto Nazionale Assicurazione Infortuni sul Lavoro (INAIL), with its Department of technological innovations and safety of human plants, products, and settlements.

A recent book released in 2020 (RISCHIO INCENDIO ED ESPLOSIONEIN EDILIZI, Prevenzione e procedure di emergenza, INAIL 2020) has summarized the most updated state of the art in terms of procedures and prevention in case of emergency.

Back to this manuscript's issue, the early hazard stage, developed in this tremendous fire threat that occurred in 2014 at Los Angeles's Wilmington Dock, was identified by forensics in the matter of sparks; according to INAIL guidelines, chapter 1, soldering works are included in the group of open flame activities, even though temporary, thus occurring in ambiances that are not equipped by proper shielding and smoke detection.

The aggravation of such an altered risk profile is entangled by unawareness and antiquity of the built environment heritage or general restoration. Thus, the book dispatches a list of best practices that acknowledge the current issue to prevent the usage of this Machine Learning research:

- To carry out welding operations outside, if this is not possible to ventilate abundantly the premises before, during and after the work;
- To remove all flammable materials in an area greater than 10 m around the welding point;
- If this is not possible, carefully cover everything with suitable and non-combustible devices;
- To do not carry out welding operations if there is a possibility that sparks will strike combustible or flammable material;
- To protect yourself and others from sparks and hot metal;
- To Be careful, sparks and hot materials resulting from the welding process can easily
- To enter through small cracks and openings and move to adjacent areas;
- To beware of possible fires (always keep a fire extinguisher available nearby);
- To be careful, as welding operations are carried out on ceilings, floors, retaining walls or
- To divide objects that can cause fires on the opposite side;
- To do not carry out welding operations on containers previously used for storage of fuels or closed containers such as tanks, cans or pipes, unless these are prepared appropriately and remediated;

- To do not carry out cutting operations on closed containers such as tanks and bins;
- To connect the work cable to the workpiece as close as possible to the welding area in order to
- To avoid that the welding current has to travel long distances, even out of sight, as this can cause electric shock and fire hazard;
- To do not use the welding machine to defrost pipes;
- To do not weld where the atmosphere may contain flammable dust, gases or vapors (such as those of gas);
- To do not weld cylinders, pipes or containers under pressure;
- If it is necessary to carry out operations on metal pipes, move away from them, along the their path, combustible or flammable materials eventually in contact.
- To care must be taken if these are wrapped with combustible insulating material;
- To wear non-oily protective clothing such as: leather gloves, heavy shirt, trousers without lapels, high shoes and a headdress;
- To do not place the machine on combustible surfaces;
- To remove all fuels, such as butane lighters or matches, from yourself before starting any welding operation;
- For Fire and explosion risk in buildings :
- once the work is completed, inspect the area and check for the absence of sparks, burning embers and flames;
- make sure that the escape routes are kept free and usable even during the operations welding;
- use only the correct fuses or safety switches;
- do not increase it in a way.

In the Mediterranean harbourscape, one introduces three hazards that occurred over the last years: in Italy (1), the cases of Ancona and, (2) the Torre Piloti of Genova, in the middle east (3), the Beirut blast.

The harbour of Ancona (1) was interested in a large fire with three powerful explosions identified in the commercial zone, whose ignition burned down three hangars. As reported by the technical dispatch (INCENDIO AL PORTO DI ANCONA DEL 16.09.2020; REPORT FINALE Sistema nazionale per la Protezione dell´ Ambiente), this methodology of capturing air-ground samplings, in the immediate hours of the event, 02:00 A.M., is equivalent to the Los Angeles report of research. The quantitative assessments also included metals and waters samplings and are eligible to repeat similar research outputs demonstrated in the case study of the paper.

A thesis on this harbourscape's heavy-industrial zoning has been highlighted in the article "The soundscape of the sectorization of Ancona Port" (1), whereas the research has been conducted with respect to ISO/TS 12913-2 technical specification: Soundscape Approach in the Seaport of Ancona et similia (Di Loreto et al., 2022; Cain R. et al.; Davies, W. et al., 2013).

The second scenario (2) occurred on the 7th of May 2013, regards the crash aftermath at the Port of Genova, with similar dynamics to the issue prompted by this paper's research: the merchant ship Jolly Nero, assisted by the tugs, was escorted out from the Port of Genoa. Due to human mistakes, it impacted from the stern against Molo Giano, and its standing Piloti Tower (Pilots Tower) (VTS). The over 40,000 tons of tonnage of the ship and the speed of approximately three knots, triggered off a tragic kinetic reaction.

Search and recovery (SaR) operations were perpetuated in the following 10 days of uninterrupted access by the firefighters (RISCHIO INCENDIO ED ESPLOSIONE IN EDILIZIA, Prevenzione e procedure di emergenza, INAIL 2020). Temporary Health care cores were allocated in shifts of 12 hours under the 118 Ligurian services. Tragically, the operations stopped with the discovery of the ninth victim still missing from the appeal.

In the third instance, an extremization of psychological and physical damage is represented (3) by the Beirut aftermath (Barrington L., 2017) of which a nuclear-like explosion (Chami, N. et al., 2021) dismantled the Port Authority of Beirut and its neighbourhood, in a radius of 4 km. By mentioning this latest scenario, the authors report the impossibility to ever return to "normality" with a significantly altered perception of safety and chronic stress.

The authors distribute a qualitative scheme of a survey of trauma-coping mechanisms and their time-related slower recovery patterns (El Sayed et al., 2015), previously conducted in 2000 by Steil & Ehlers for Beirut, analog to the case of the Gaza Strip.

Additional studies on the Beirut blast, testified an aggravating and chronic pain of accumulated alertness, stoically tolerated by its citizenship, and turned out to be an unsolved conciliation for Architects, Engineers, and Psychologists, to solve this current somatization also in economical (Beirut Post Blast Reconstruction) terms: the authors considered the real estate decadence of the city because of the SOLIDERE ("Société Libanaise pour le Développement et la Reconstruction du Centre-ville de Beyrouth") aggressive urbanization, in the decades gone by due to the war, collectively deteriorated with the socio-economic Lira inflation and its rampant social gap.

With this premise, this third scenario, proposed as avant-garde urban example in terms of independence of the Port core system, has been entangled in rivalry with the Beirut Central District. This political choice of urban assignment, merely identified as the inner island, was since the early concept assumed as controversial and repetitively reclaimed by urban citizenship, with a proposed masterplan that consumed 37% of the concerned area herewith labelled as new developments, 31% for Infrastructure and highways whereas 12% only was for retained buildings.

The new reconstruction of Beirut shall avoid this missing chance of reconnection between the Port and the city and thus, according to decree No.194/2020, which also blocked any future SOLIDERE replica to preserve what remains of the last architectural heritage: we consider that during the dismantling of the overall present war ruins, the 80% of buildings formerly scheduled in the safeguarding protocol promised by SOLIDERE were on the contrary pulverized (UN-Habitat, 2020).

Indeed, the computation of defense-oriented buffering zones through a Machine Learning methodology is an eligible investment to harmonize even annihilative bombing countereffects at the expense of vulnerable facilities, as a guidance to a masterplan designation of barriers and fords. Regarding the human lives, one suggests the conjunction with reinforced underground infrastructures that are proportionated to shelter citizens and traffic vehicles, in respect of reassignment of promenades and events on the surface, impacting positively on cultural memory having relevance on the chronic numbness and avoidance coping-mechanism.

Acknowledgements
The scope of this quantitative research is aimed to enlighten the modern approach of the image- and remote-sensing applications in favour of sustainable planning of port areas, with regard to engineering safety and Search and Rescue operations and as novel research in the Port Authority strategic planning. The author gives proper credit as enlisted in the references section.

Data availability statement
The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Ethics statements
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Social Hybrid Architecture for Water Regeneration in Rural Settlements: A Case Study in the Historic Landscape of La Vega del Guadalfeo, Spain

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ABSTRACT

This article combines two problems such as the eutrophication of seas and oceans with the spontaneous appearance of rural settlements and the infrastructures that support them. According to Koolhaas, the rural world constitutes the new space for work and research. After a bibliographic review of the possible strategies, a social hybrid building is proposed between an ecological purification infrastructure and a social recompositing artefact. As a case study, the problem of dissemination in historic landscape of the Vega del Guadalfeo is analysed. The results show the design of an ecological treatment plant that can recycle wastewater from illegal rural settlements through worm filters and a system of artificial wetlands. This is part of a building that makes up for the lack of facilities that is typical of the scattered one with an exhibition hall and public meeting spaces. The paper proposes recommendations to institutions on the scope of this type of infrastructure in Mediterranean landscapes.

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1. Introduction

Koolhaas (Fernández-Galiano, 2016) highlights the almost total lack of attention to the rural settlements and its transformation processes. Changes are occurring at a speed even faster than in the urban world in multi-scale, social, technological, ecological, and digital issues. A situation that can be observed in Europe (Adam-Hernández & Harteisen, 2020), Western Asia (Kornilova et al., 2021), China (Cheng, 2021) or India (Jakobsen & Nielsen, 2020). The technological advances initiated since the 19th century have facilitated a process of hybridization between the rural and urban worlds with important physical, environmental, and cultural impacts. The rural landscape has evolved from a static and scenographic concept towards a close reality, in continuous change, interactive with the urban and generating a rupture in the established orders of traditional planning.

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In this regard, Frampton (1995) warned that the rules inherited from classical urban planning -conceived to combat the problems that the Industrial Revolution generated in cities -, could no longer cope with how and in what way our cities should or should not grow. Therefore, how to act in the face of these new scenarios? How to intervene in rural areas subject to the influence of the urban? While the literature made important advances in the analysis of urban phenomenology in rural and peri-urban settings (Vallance, 2014), there is a research gap in the development of infrastructures that allow, on the one hand, to recover the ecological balance due to the effect of hypoxia, and on the other hand, to provide social facilities for the phenomena of sprawl in these peri-urban areas. The use of micro-hybrid architectures is a necessary response to these challenges. The concept is a reduction of the hybrid building - conceived as a large mixed public-private building located in dense urban areas - so that the micro-hybrid concentrates social and environmental functions in low-density areas.

The objective of this research is to develop methodologies aimed at developing architectures focused on processes related to the landscape, which can face the multi-scale problems that may arise and to demonstrate flexibility in terms of design strategies and urban intervention. All this, understanding the place in all its economic, social, ecological, and cultural complexity. From this study, the empirical analysis of a case study allows us to establish a project framework for the intervention of a social hybrid architecture as a response to the phenomena that have transformed the contemporary agricultural framework. The Vega del Guadalfeo is located on the southern coast of Andalusia (Spain) and was characterized by its wealth of non-nitrified groundwater thanks to the large flow of water from the Sierra Nevada. However, this situation changed drastically with the construction of a dam and the development of an intensive greenhouse agriculture and numerous dwellings in the rural area of the municipality without implications for rural activity. The project results allow us to establish a debate on how this type of architecture can respond to the initial problems and improve the quality of life of the inhabitants in these highly transformed rural spaces.

2. State of the art

2.1. Rural-urban hybridization

Urban hybridization is developing in the postmodern urbanism (Patkar & Keskar, 2011). The appearance of hybrid figures between the rural and the urban (Sastoque, 2005) is the result of the technological advances developed since the mid-nineteenth century, both in the excessive growth of the urban, and in the environmental impacts of agricultural technologies. Until the 19th century, the limits between the city and the rural world were clearly defined in the physical dimension (Fariña Tojo, 2015) and the socio-political dimension (Ortega y Gasset, 1963, p. 408). The Industrial Revolution of the 19th century began the hybridization between the rural and the urban world as a consequence of the development of transport and telecommunications (Choay, 1994). New urban models and activities that are ecologically distant from the locality (Antrop, 2004) are implanted in the rural world (Kujundzic & Vuckovic, 2019): A generalized low-density urbanization and a loss of weight of the traditional historical nuclei named as diffuse city (Precedo Ledo, 2004), edge city (Teaford, 2020), ruralbanization (Ruiz Rivera & Delgado Campos, 2008) or suburbanization. At the international level, this urban phenomenon has had different degrees of intensity: maximum in the sprawl of the American continent, contained in Europe and reduced in Africa (Mokunfayo & Babatunde, 2018).

The suburbanization of Mediterranean coastal cities has followed a different process from that of Europe (Dura-Guimera, 2003:387). It began explosively in the 1980s in the context of a post-industrial and globalized capitalism. Their growth system does not respond to historical growth patterns (centrifugal, isotropic, ...) and, within their apparent anarchy, they seem to follow quantum patterns (Rosado, 2008). That is to say, superimposed on a millenary agricultural structure, and without being able to predict their appearance since they are separated or arbitrarily connected to nodes and transport infrastructures. This is consequence by the recent impact of information and communication technologies (ICTs). ICTs have multiplied information exchanges exponentially, facilitating ubiquity and levels of social and work

relations. Choay (1994, p.70) defined the urban as a new physical and social system based on material and immaterial networks. Especially in the hybrid territory of rural peri-urban environment of cities, which involves incorporating the net sphere into the natural and urban spheres. The need for new social and environmental infrastructures that support these transformation processes stands out in this new context.

Castells (1995) recalls the need to generate a significant generation of social infrastructures and public spaces especially in the disjointed peripheral areas. The urban generates places where the formal and functional homogenization of the territories and the hybridization of their objects generate generic landscapes (Pintos, 2014). It shares the process of loss of identity suffered by cities due to generic growth highlighted by Koolhaas (1994). It is characterized by la anomie, or liberation from the social structure, a deconstruction of identity analogous to the concept of genderless in fashion. According to Ascher (2009), the sociological space of the polis has evolved into a metapolis whose spatial expression is a distended, discontinuous, heterogeneous and polynuclear space. A hybrid structure built on the basis of varied spaces and ways of life. Thus, new social infrastructures have to strength a new hybrid space, built from the flows of communication and energy to reassemble, without exclusion, the three spheres formed by the farmer, the urbanite, and the tele-citizen (Perea, 2012).

In the ecological field, the discovery at the beginning of the 20th century of anthropogenic nitrogen revolutionized the agricultural world with the incorporation of artificial fertilizers to increase production. However, these fertilizers are carried by irrigation return flows from cultivated land to rivers and groundwater. Anthropogenic nitrogen produces a major imbalance in the marine and river ecosystem with the proliferation of microorganisms that cause eutrophication and hypoxia. This is a major global environmental problem (Chang et al., 2019), that has been aggravated by human activity due to population growth, urbanization, and industrial practices in rivers and riparian basins (Shao & Wang, 2020). Although the developed world has treated more than 90% of its urban water, it is not taking adequate measures to address this problem. It is currently estimated to be responsible for three-quarters of nitrogen emissions (Mekonnen & Hoekstra, 2015). This issue is added to the environmental problem of the human ecological footprint and the recent tipping point of human consumption/capacity of the Earth. This makes it necessary to transform our consumption into a circular metabolism (van Broekhoven & Vernay, 2018) and the development of infrastructures that facilitate this recycling process.

2.2. Hybrid Architecture

According to Rogers (1997), technology can create sustainable and civilizing environments if it is used and promoted in an ethical manner, that is, if it is used for the benefit of the community, over and above individual interest. Hybridization can be a relevant tool, not only at the urban but also at the rural level. From a positive perspective, urban hybridization constitutes a tool for transforming urban space (Zanni, 2012). On the one hand, hybridization, understood as a mixture that increases the complexity of a system, was used to improve the regeneration conditions of monofunctional European neighbourhoods such as Bijlmermeer (Aquilué Junyent & Roca Blanch, 2019). On the other hand, urban hybrids have great potential to increase both the relationship between the different urban fragments and urban connections, stimulating and attracting urban vitality (Herrera Napoleón, 2009).

Fenton, (1985) defines the hybrid building as a multifunctional structure both in terms of uses, incorporating architectural and urban elements, as well as public and private actors. A hybrid building is characterized by a mix of different programs, developers, management, and different user profiles: it can be as diverse as a neighbourhood or a city. But the development of hybrid architectures is also due to spontaneous generation processes in areas, such as Japan, where there are no regulations on uses but on densities (Kaijima et al., 2003). Kaijima et al. (2003) make a catalogue of urban hybrids where the lack of land makes it possible to establish combinations and stacking of uses and architectures. The authors define a hybrid as an "environmental unit" where three conditions are present: category

(character of the building as infrastructure, architecture, or landscape), structure (physical configuration) and use (or management of its activities and flows).

The approach from the genetics of hybridization, allows us to define the hybrid building as a combination of known parts of architectures whose union produces a functional superiority (McGinley et al., 2015). A concept closer to the symbiotic association where the parts that compose the building are visible and recognizable. Symbiosis in the animal world associates species from different kingdoms for mutual benefit. Morphogenetic design is based on adaptive micro and macro structural aspects and on the ecological relationship of the building with its environment. (Mestre Martínez, 2012). When these relationships consist in the reuse of residues from another building or from the environment where it is located, we speak of metabolic symbiosis (Šijaković & Perić, 2018). An association that in the framework of architecture is scarcely analysed (Parisi, 2009).

3. Methodology

Based on the processes of transformation of the rural world described by Koolhaas and the environmental problems generated using nitrogen in agricultural activity, a methodology is proposed (Figure 1) based on three phases. In the first phase, strategies, or alternatives to three problems of the rural world are established, based on a bibliographic review and a selection of case studies of different actions in the landscape that have been developed during the 20th century. Their comparison with the different realities of the rural world described by Koolhaas allows us to analyse his contributions in relation to the ecological, economic, social, cultural and/or architectural dimension. In a second part, an application of these measures is carried out in a real case study, where the different problems detected in the traditional agricultural space are analysed. Finally, a proposal for a hybrid building is developed as an example of the potential of this type of architecture in the improvement of the aforementioned problems.

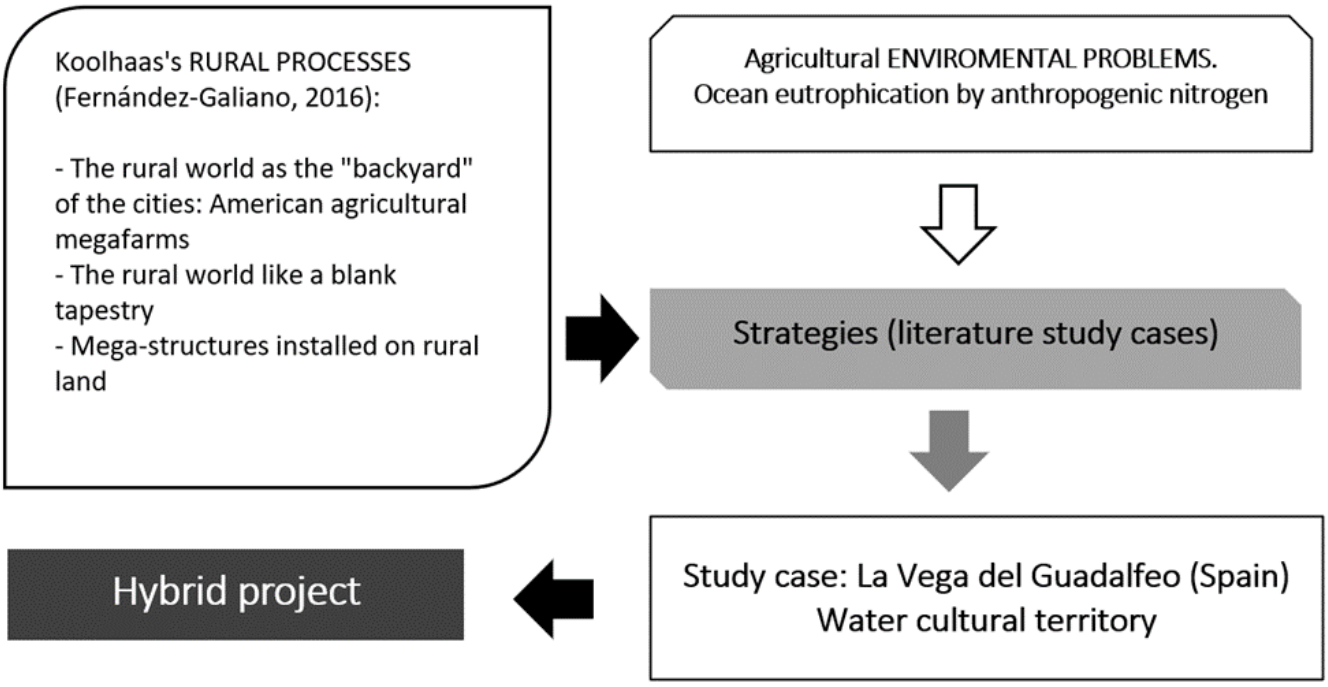

Figure 1. Structure of the study

4. Strategies to face the transformation processes in rural areas

4.1. Alternatives to the rural world as a "backyard" of the cities

The agricultural space contains the primary sectors (agriculture and livestock) that feed the city, but its technification implies the incorporation of productive processes closer to industry than to agriculture. An example is the use of greenhouses, where crops are grown even without soil, remotely controlled by the farmer via the Internet. In Europe, however, there is another productive tapestry, complete ly irregular in shape, chaotic, with a millenary irrigation system and inhabited in a scattered way. Secchi & Viganò (Viganò, 2001) describe the peri-urban landscape of the Territorial Coordination Plan of the Salento Region (Italy) as a continuous whole. A region in the south of Italy, whose traditional crop is olive trees and vineyards, and is visited by more than 2 million tourists per year, with a population of around 800,000 inhabitants. Both authors proposed as intervention strategies the conception of the territory as a great unique park and not so much as a protected landscape, but as a laboratory for habitat experimentation, always aimed at the ecological balance of the region. In contrast to the spatiality of the urban or rural space, Secchi & Viganò (Viganò, 2001) define peri-urban space as a third spatiality: "A space that could be inhabited by a society that aspires to a life in the open air, sharing the ecological and symbolic ideals of living in the countryside without leaving the city. An open society that seeks a collective dimension". And its main lines of intervention are:

a) Ecological: Protection of its historical crops and development of proximity agriculture, incorporation of activities based on a circular metabolism and the reduction of the human footprint on the Earth.

b) Economic: Maintain the agricultural area always productive, supported by tourism/agro tourism.

c) Social: Focus on the local population, revitalization of depressed areas by promoting agro-tourism and life in the countryside with ecological ideals.

d) Infrastructure: Connections between facilities, centres of interest and villages, which the region lacked.

In the peri-urban space, these strategies take precedence over any temptation of speculation and change in the local agricultural industry. It combines the solidity of an agricultural heritage with flexibility and a certain legal laxity when it comes to recognizing and integrating the urban development that has been settling in the countryside. All this without opposing the possibilities that a globalized world can bring and that is evidenced, in this case, through agrotourism.

4.2. The rural world like a blank tapestry

Agricultural policies like the Common Agricultural Policy of the European Union have been insensitive to the rural world's complex, multicultural and densely populated tapestry. A situation similar to the design of new capitals that emerged in the mid-twentieth century with principles far removed from the local reality, such as Brasilia or Chandigarh. The project The City of a Thousand Cities by Perea (2012) was winner of the New Multifunctional and Administrative City for 500,000 inhabitants' competition in Korea. It makes an interesting reflection on preserving a large central productive agricultural space, and building around it a ring of intermediate cities, where citizens can interact without the need for a motor vehicle, and count on the presence of the landscape. Perea (2012) affirms that the complex and intense sustainable city is not a consequence of zoning, but of "meshing in space, function and building matter" and where the net sphere must be superimposed on the natural and urban spheres.

4.3. Environmental micro-structures vs. mega-structures installed on rural land

Increasingly, the rural space is the area where mega-structures are implemented, such as Tesla's giga-factories located at Sparks (Nevada), Buffalo (New York) or Shanghai. They are a product of the

development of the fourth industrial revolution (Cooke, 2020), that is also taking place on the African continent with the development of megaprojects (Müller-Mahn et al., 2021). These processes of occupation of uses alien to the rural reality. Faced with this phenomenon, in the middle of the 20th century, the Agricultural City Plan of Kurokawa (1991) proposed a structure articulated by autonomous units. Their combination and growth allowed a progressive implantation on the rural landscape until generating a self-sufficient mechanism. Its flexibility allows intervention at different scales. So, it can be implanted in the rural environment according to the needs that are demanded.

Kurokawa's thinking therefore allows the development of microstructures or autonomous units that can help restore the ecological balance of water as a support to blue infrastructure (Wendling & Holt, 2020). It is about providing solutions to water problems, seeking agreements between the different interests of the actors and the scarce existing public resources (Sgobbo, 2018). In this regard, Oral et al. (2020) describes the case of The Gorla Maggiore water park, an urban wetland development with nature-based solutions where an area of 10% is intended for domestic water treatment, it reduces the nitrogen load by 0.4 t/yr and incorporates recreational areas with important social benefits.

5. The metamorphosis of the historical rural landscape in the case study of the Vega del Guadalhorce

The appearance, proliferation, and expansion of the urban sphere in the rural environment without administrative authorizations extends forming an infinite peri-urban zone. A process of occupation of the countryside with similarities to the Koolhaas (1994)'s Generic City in relation to four characteristics. First, it does not build a city a priori, but is generated in a quantum form. Second, the abandonment of obsolete agricultural structures (e.g., orchards, disused irrigation ditches, ...). Third, the anomie of all kinds of urban elements and uses. Fourth, a generalized process, which in the case of Europe inherits a specific morphology because of a tapestry formulated from the historical smallholding.

As an example of this type of process, La Vega del Guadalfeo has been selected as a case study. This historical agricultural area is located on the southern coast of Andalusia (Spain) and covers two areas: the western or Vega de Salobreña and the eastern or Vega de Motril. The metamorphosis suffered by the Vega de Motril during the 20th century transformed its continuous productive tapestry, structured by a millenary irrigation system, into a fragmented and sectorized system due to the construction of different infrastructures (Figure 2) and invaded by urban centres that grew in the form of industrial estates and the commercial port.

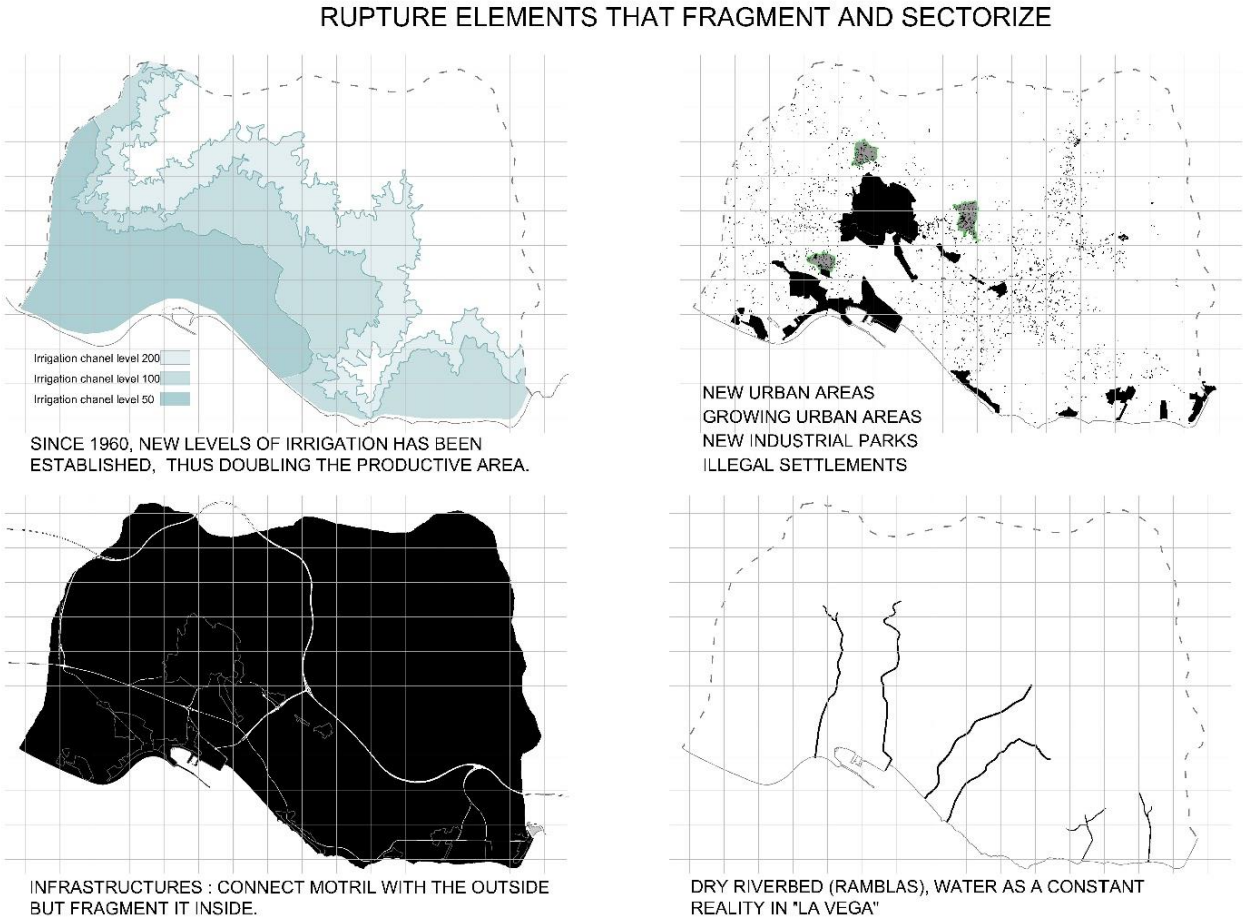

Figure 2. Articulating and transforming elements of La Vega del Guadalfeo in the municipality of Motril: irrigation canal, urban centres, highways, and wadis

In this way, a set of urban islands is generated, similar to the archipelago defined by Ungers (Hertweck & Marot, 2013), on a large non-urban productive green space with a productive agricultural character (Figure 3). The idea of a full urban space occupied by buildings versus a void or public space-landscape begins to be questioned due to the very complexity and active character of the void. The evolution of the peri-urban agricultural space is uneven, through illegal constructions that serve as leisure for the inhabitants of the nucleus, agro-industrial -especially with the hyper-development of intensive greenhouse agriculture, warehouses, small industries, but always subject to a historical plot structure, whose size and shape is conditioned by its agricultural production, and in turn by the capacity to be irrigated by the water from the irrigation ditches. The "marjal" is the agricultural measure that allowed an agricultural exploitation based on 24 furrows of ploughs, and that channelled the irrigation water, if it was guaranteed.

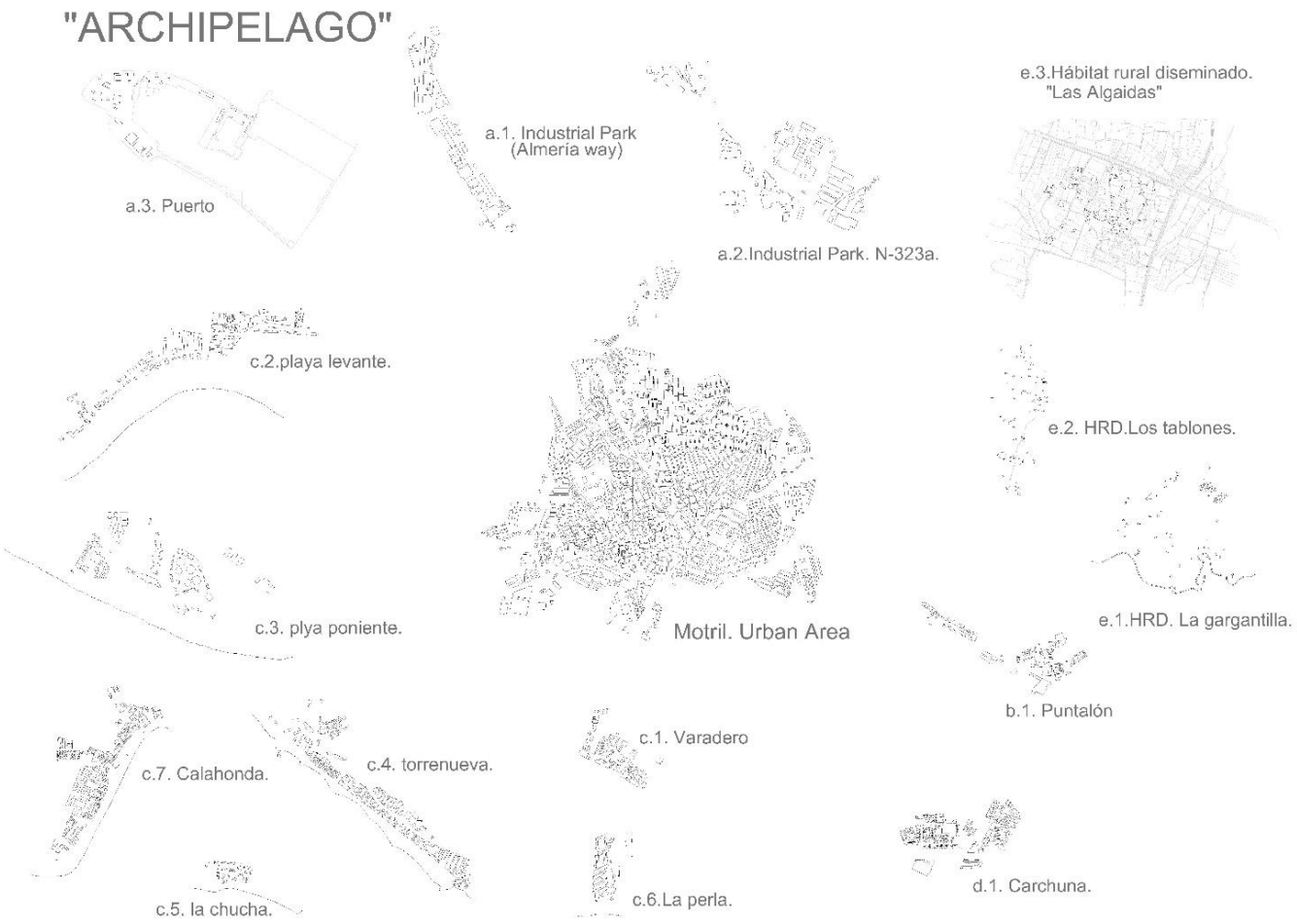

Figure 3. Archipelago of settlements in the municipality

The Vega is structured by a millenary system of irrigation ditches that is divided between a world that wants to maintain traditional cultivation (Figure 4, right), a system of intensive crops (plastics) and another semi-urbanized part with second homes (mostly illegal) and warehouses to support the nearby industrial park. All this chaotic variety is due to the irregular morphology of the plots and their small size (Figure 4, above). Water is the main element of identity in La Vega del Guadalfeo and is present in the irrigation ditches, in the wadis that cross the valley, and, in the aquifers, whose former abundance has been reduced by the construction of the dam.

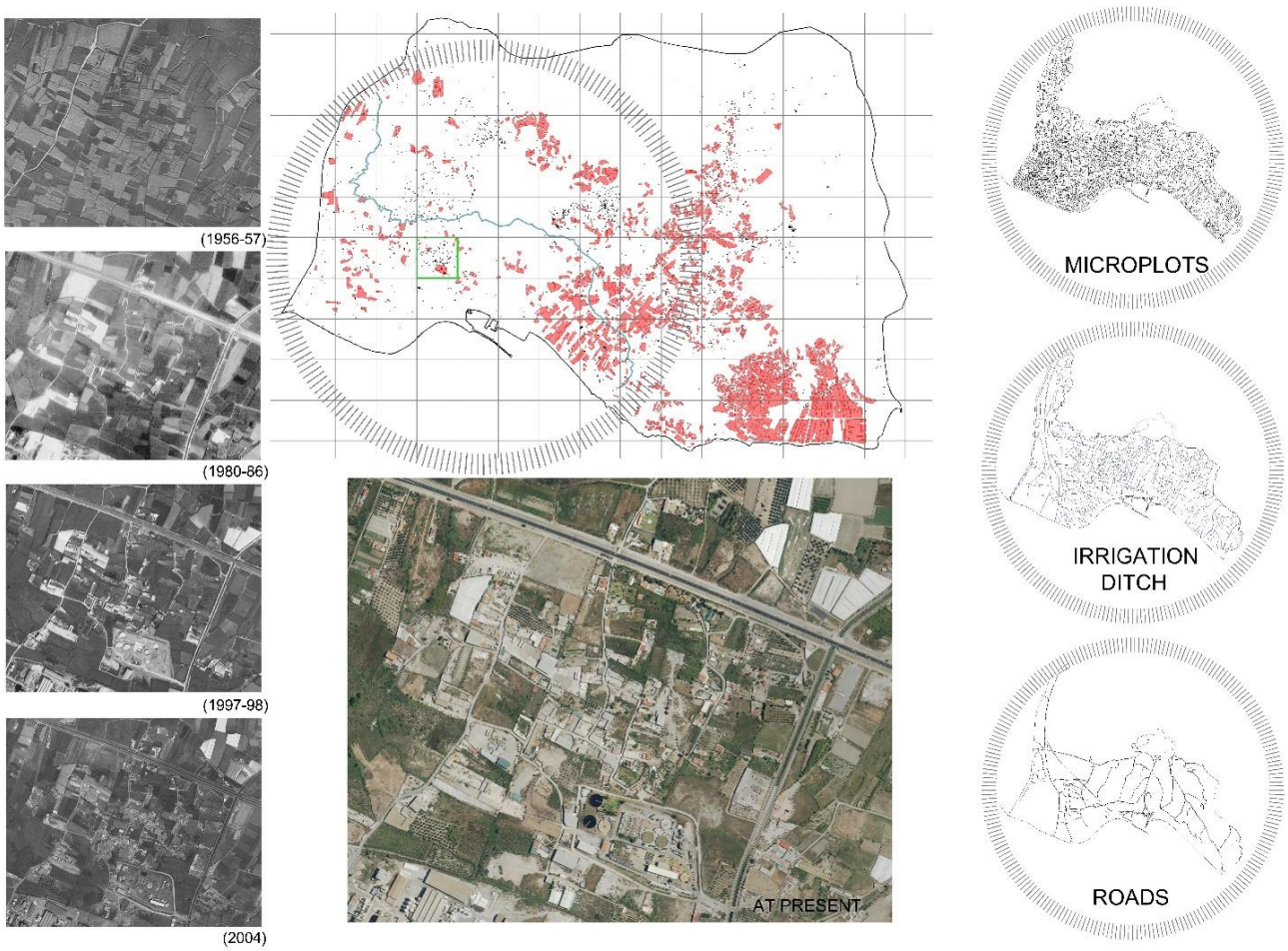

Figure 4. (Above) Transforming elements of the traditional agricultural landscape: Greenhouses (red) and illegal settlements (purple). (Left) Evolution of the study sector from its agricultural structure in 1956 to the current occupation of uses. (Right) Shaping elements of the traditional agricultural landscape: micro-plots, irrigation ditches and roads

The settlement of "Las Algaidas" is confined by a highway, the Rambla de las Brujas, an industrial park and a sewage treatment plant. It represents the spontaneous transformation, without previous guidelines, of a productive agricultural land to an urban reality lacking infrastructure, without facilities and infrastructures (Figure 4, left).

6. The micro-hybrid building as an environmental and social alternative

The construction of a hybrid building that houses an ecological purification infrastructure and a public facility makes it possible to respond to ecological and social problems through a relationship of metabolic symbiosis. As an infrastructure, the building treats wastewater from scattered settlements and manages the denitrification of irrigation return water that is discharged into rivers or wadis (delimited channels used by rainwater in torrential storms in the Mediterranean climate). Wastewater is collected through a vacuum sewage network designed to take advantage of the ditches of obsolete irrigation ditches and, after undergoing pretreatment, is treated by a dynamic aerobic biofilter system or lombifilters and a system of artificial wetlands. Crop water is treated only by artificial wetlands (Figure 5).

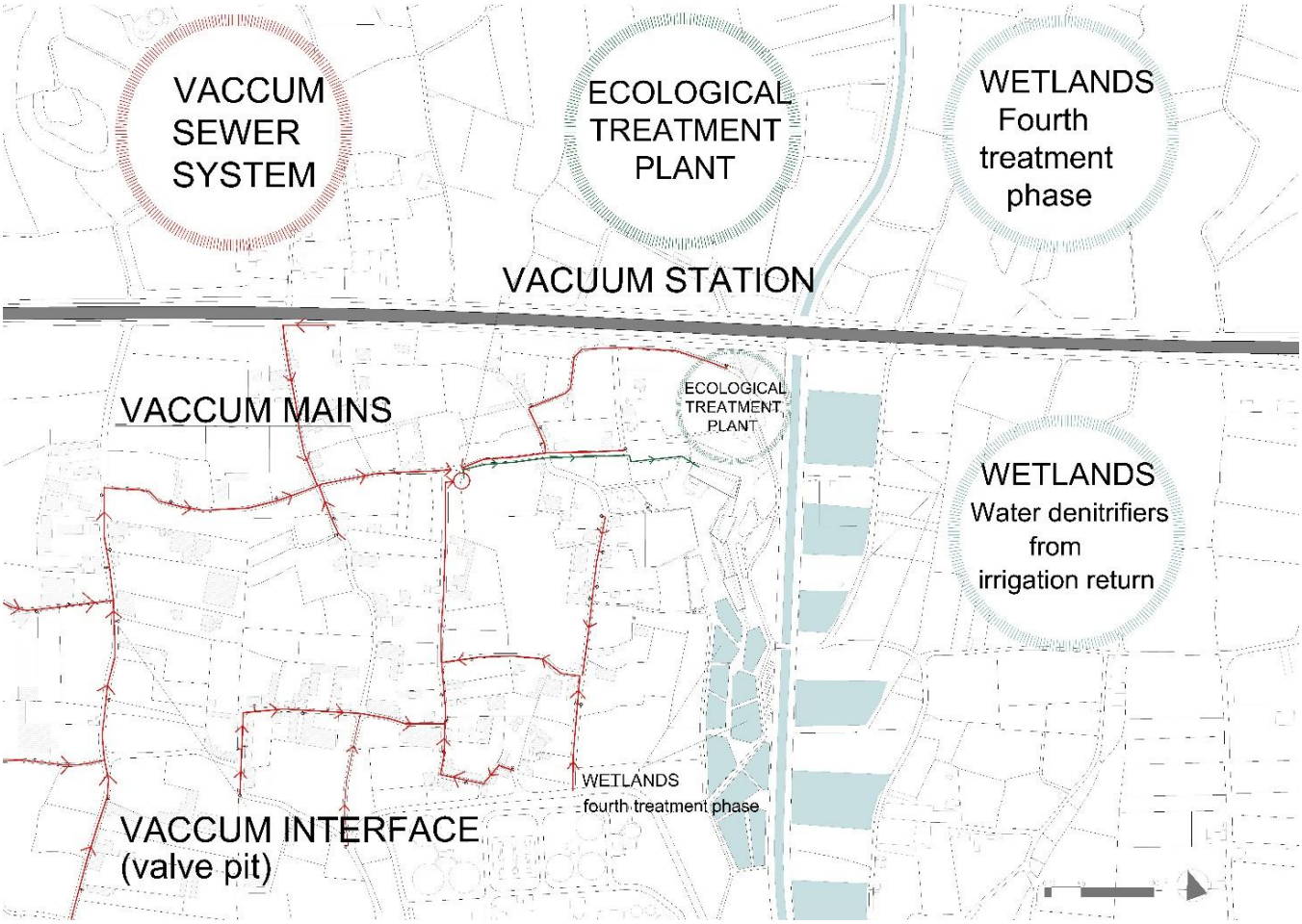

Figure 5. Sewage collection system and artificial wetlands for denitrification

From the Kaijima et al. (2003)'s approach, the hybrid building constitutes an environmental unit that manages two types of flows. On the one hand, the equipment solves the lack of endowment of the scattered areas by providing the settlement with a multipurpose space for the development of activities and social gatherings. On the other hand, the building manages an ecological water purification cycle. The ecological wastewater treatment plant treats wastewater through an initial pretreatment, a secondary treatment of lombifilters, and a tertiary treatment by artificial wetlands located in the southern part of the building. In its structure or physical dimension, the building is structured in a Research Centre and management of nitrified water in the central module, while the worm farm is located in the South module. The settlement's facilities are resolved with the North module, which houses an exhibition hall, a conference room and some classrooms-workshops, as well as two public spaces that are the west square of the complex and the large, elevated platform that connects the three modules. United by an elevated and common platform, which delimits and unites at the same time the two existing realities, the different pieces that make up the project are raised and oriented according to the scalar response (neighbourhood/municipality) in which they have been conceived and are united in a syntax that fits the environment, folding, forming ramps and slopes that link them together.

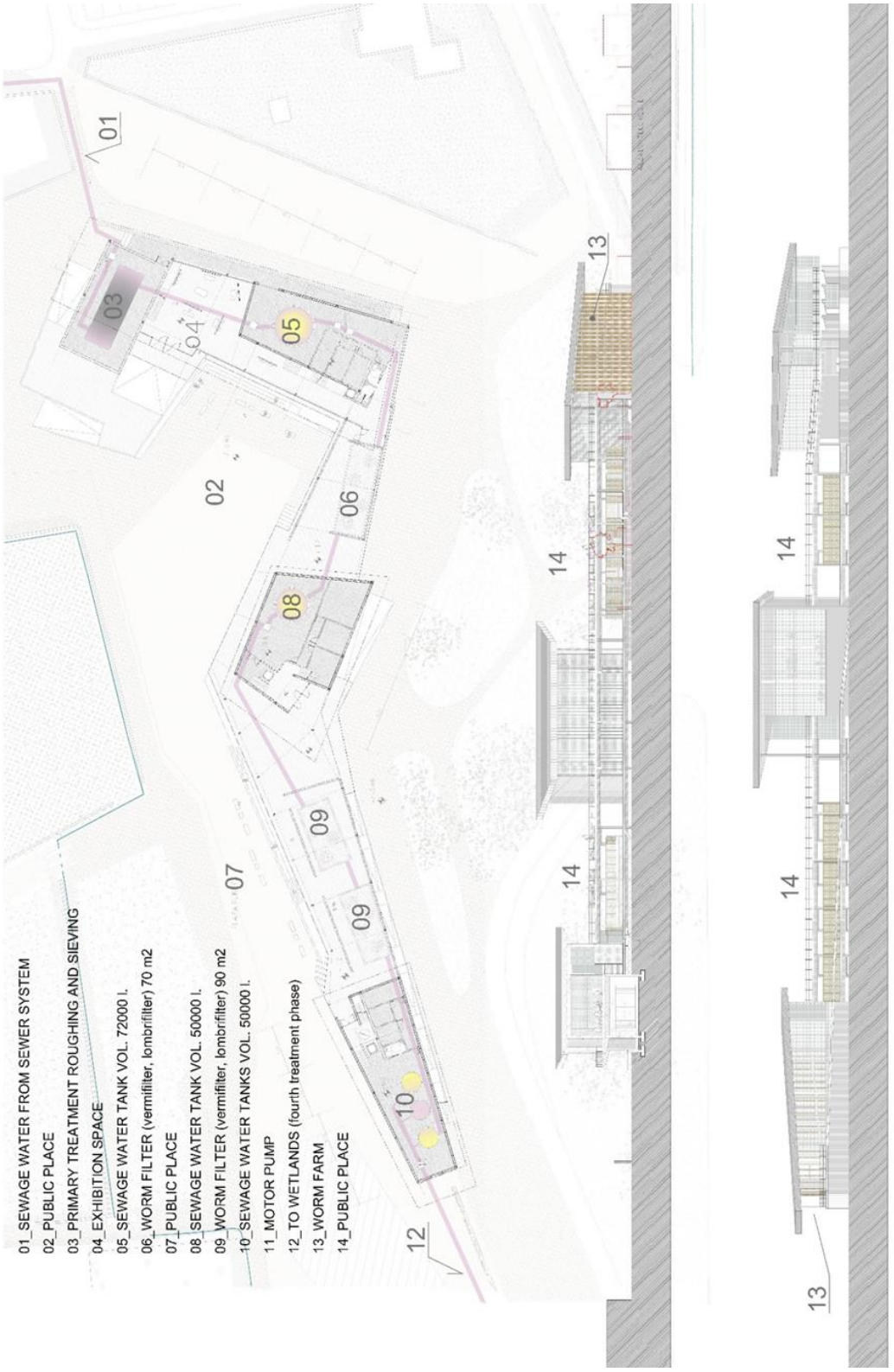

Figure 5. Plan, elevation, and section of the hybrid social architecture. The plan shows the water filtering infrastructure in the different components

Hybrid social architecture is opposed to the problems defined by Koolhaas for the rural world. As opposed to a concept of the "countryside as backyard", the hybrid building allows to support dispersed developments and allows to conceive them as experimental habitats in the environment of the urban periphery, as defined by Secchi & Viganò (Viganò, 2001). As opposed to urban infrastructures that segregate sanitation and purification facilities from social facilities, the hybrid infrastructure not only purifies the waste of dispersed settlements but also transforms them into elements of environmental purification of the territory. In this symbiotic relationship, the territory benefits from having these structures that improve the water cycle against the problems of eutrophication and hypoxia and the inhabitants of the third spatiality benefit from having both indoor and outdoor relationship spaces. In return, the residents must maintain the systems that support the purification flows, thus sharing the ecological ideals expressed by Secchi & Viganò (Viganò, 2001). Rural settlements need this infrastructure for environmental improvement; but, unlike the megastructures conceived by Kurokawa (1991) for his agricultural city. These hybrid architectures are dimensioned for the small scale, as the small is related to the rural dimension. Their architectural configuration avoids standardization and improves the rural habitat with a social program focused on the local inhabitant (Viganò, 2001).

7. Conclusion

Hybrid social architectures are micro-infrastructures specially designed to solve the problems of rural areas, insofar as they support their population and allow the ecological restitution of water cycles in order to avoid the problems of nitrification of the oceans. The architectures and infrastructures of the processes of dispersion in the rural world differ from the urban ones and must be directed to incorporate strategies of symbiosis in the territory.

The spatial example of the implementation of a social hybrid architecture for water regeneration allows visualizing the social and environmental benefits in European peri-urban areas with a historic landscape. As a social infrastructure, these are micro nodes that combine three vectors: (a) the creation of a public space for social relations, very necessary in enclaves where public space is normally limited to paths; (b) small public facilities supported by the ICT; and (c) spaces that can be rented to private initiative (sale of agricultural products) or to public centres that require it.

As an environmental infrastructure, it allows solving the problems of wastewater and nitrified water through ecological systems, covering small peri-urban sectors, where low density makes the implementation of traditional sanitation networks very expensive. On the other hand, the incorporation of solutions based on nature allows the creation of lagoons for water treatment with less impact on historical agricultural landscapes. Future research should analyse the validity of the model in other agricultural settings subject to environmental impacts.

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Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Ethics statements

Studies involving animal subjects: No animal studies are presented in this manuscript.

Studies involving human subjects: No human studies are presented in this manuscript.
Inclusion of identifiable human data: No potentially identifiable human images or data is presented in this study.

Conflict of Interests
The author declares no conflict of interest.

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Transit Oriented Development and Sustainable Land Use Theories Impacts on New Mega Transportation Projects in New Capital City in Egypt

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ABSTRACT

Transit-Oriented Development (TOD) land use theories have been applied in multiple countries both developed and developing areas of the globe. It has proven its strength in maintaining a more sustainable approach in both urban development and lifestyle. The greater Cairo Region is witnessing huge transportation projects such as Electric Elevated Train that connect old Cairo with the new Capital City in the Eastern desert of Egypt. The New electric Train line is foreseen as a major clean transportation for number of important areas in greater Cairo, nevertheless it lacks more broader urban planning vision to use the transit main spots as a potential of applying a land use planning approach to maximize the urban potentials of these sites. This paper is providing a land-uses planning approach to maximize the land uses around these transits stops by providing the theory of transit-oriented development and propose the suitable solution that TOD offer to create more comprehensive sustainable urban oasis. The paper theorizes TOD land use planning, and what suitable development could be provided for such spots. Analysis of the locations of main train stops are provided, recommendation for one stop TOD development as a replica for other main stops to create more sustainable urban oases in the eastern desert of Cairo New Capital.

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1. Introduction

Among the traits of metropolitan growth frequently associated with sprawl are unlimited outward extension of development, low-density housing and commercial development and fragmentation of land-use planning among multiple municipalities. In addition, there is reliance on private automobiles for transportation, segregation of types of land use; race and class-based exclusionary housing and employment; congestion and environmental damage; and a declining sense of community among area residents (Wheeler, 2004). This paper focuses on the problems related to the growth of cities and the concentration of human population in large metropolitan areas represents huge challenges for

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modern urban societies. Economic growth drives urban expansion in the form of construction of businesses, housing, roads, leisure centres, etc., and the metropolitan regions face the growing problems of urban growth, including a decline in natural vegetation, wildlife habitats and agricultural land.

2. Sustainable public transportation and land uses evolution

New development at the metropolitan edge creates transportation problems such as increased daily commutes in and out of the city due to the lack of job opportunities in these new developments, and the increasing rate of private transportation used due to the high- and medium-income target population (Camagni, Capello and Nijkamp 1998). These problems are challenges to sustainable communities that are meant to be self-sufficient, with decent places to live and work, low fuel consumption, and adequate public services. Ideas such as "smart growth" have grown in recent years in North America, which seeks to curb growth and shape it in a way that lessens the effects of sprawl, while in Egypt with its ambitious sustainable vision for 2030, many mega projects have been discussed to transform urban agglomeration of Greater Cairo Metropolitan region into new urban development towards the eastern Corridor. Creation of the new Capital City just 40 Miles away from Cairo, accompanied by Mega transportation Projects that connect the eastern corridor with the old capital raise many questions and opportunities to transform the Egyptian current land uses into more sustainable development driven by sustainable public transit. The paper focuses of taking advantage of public transit mega projects occurring in the last 3 years to replace the private car dependency land uses system with Transit Oriented Development TOD as a concept of mega public transit which had proven its sustainability and new land uses philosophy in international best practice which can improve the vast urban growth in the eastern corridor and provide healthy lifestyle to the Egyptian new generations.

3. Material and methods

The paper is applying the theoretical framework of sustainable communities and transit-oriented development land uses theory to the current public transportation mega projects in Egypt Eastern Corridor to frame a better sustainable urban future vision that could describe spatial characteristics of future Egyptian settlements allocation and new land uses theory. It can be summarized as follow:

1. Define Transit oriented Development TOD and illustrate its advantages in terms of land uses that fulfil small communities' development along Eastern Rail corridor as a smart growth policy that is suitable to expand urban growth towards undeveloped areas around the New Capital city.

2. Encapsulate the fundamentals of TOD land uses spatial distribution into new Egyptian land uses structure that is based on transit, sustainable and vibrant communities.

3. Weave the results in a pilot proposal of how develop TOD around the main Transit Terminals of the new rail line connecting New Capital city with Red Sea settlements.

3.1. What is Transit Oriented Development and smart growth

Transit-Oriented Development represented a rethinking of approach for the location of land uses or transportation strategies. To promote smart growth, TOD creates vitality and lifestyle choices in modern sustainable urban communities planning. Transit – Oriented Development emerged as a consequence tram evolution as a mass public transport into the 21st century urban sophistications. This transportation system is designed to separate people from private cars in the favour of public transport use. Meanwhile, a fundamental rethinking of the public transport surrounding area became a real concern. There is no general accepted definition of TOD, typically, the definition of TOD is the mix of uses, the densities and the vicinity of public transport. There are many ways to state the definition for TOD with

common elements though: a mix of uses at high densities within walking distances from public transport stations; but places that stand for this kind of development are sites with sophisticated and diverse characteristics (C.T.O.D, 2004). Therefore, a tendency to force a one-size-fits-all solution onto the different types of sites is not appropriate. The nature of mega cities urban issues is growth, in terms of land uses distribution, allocation and directions. The land uses model and spatial growth of mega cities focused on the form of polycentric growth due to many reasons, one reason is the social and economic characteristics of population spatial distribution and lack of developed lands for residents. Another reason is the high cost of residents in the inner city which why mega city like Greater Cairo planning the closest planning model to describe urban growth is the polycentric form. Figure 1 indicates the form of creating sustainable communities within the mega city's fringes. That takes to succeed an essential sustainable public transport to connect these nodes with each other's and with the mega city to maintain the job opportunities and more sustainable walkable nodes.

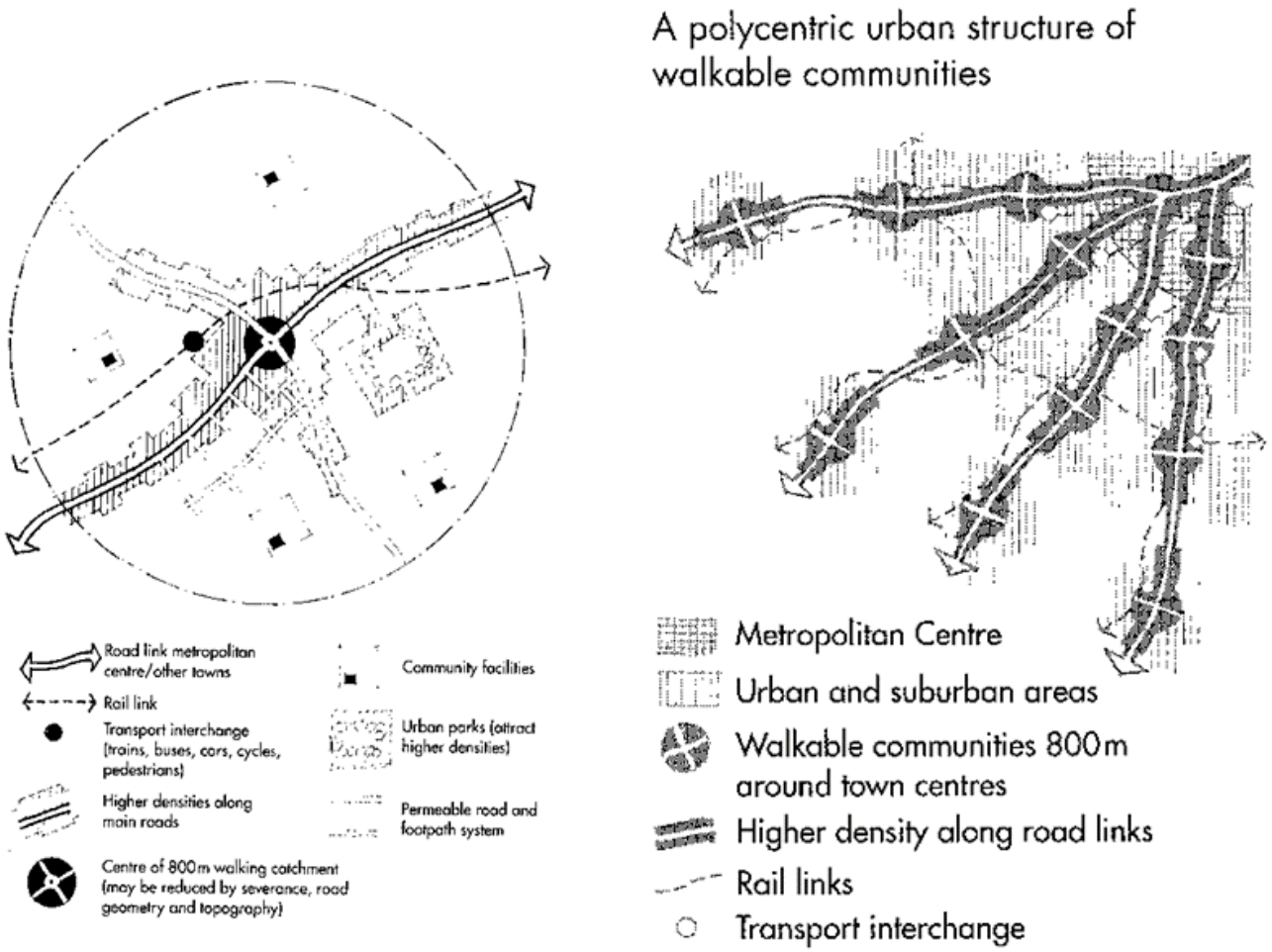

Figure 1. A polycentric urban structure of walkable communities and attributes of a walkable community (Source: Clarke, 2003)

3.2. Transit-oriented development TOD spatial land uses theory

The types of projects in the older parts of the city likely to be more different from the projects that are conducted in new development areas of city fringes, even with similar density goals (Youssef, M 2012).

We can categorize Transit – Oriented Development projects according to the project location of that depends upon the urban surrounding context, by analysing the level of densities, the level of land-use mixes and the public transport services (see figure 2). There has been, thus created a typology containing five categories. First mentioned in The New Transit Town: Best Practices in Transit Oriented Development (Gilbert and Ginn 2001), this delineation was further regarded as a starting point for defining TOD's typology.

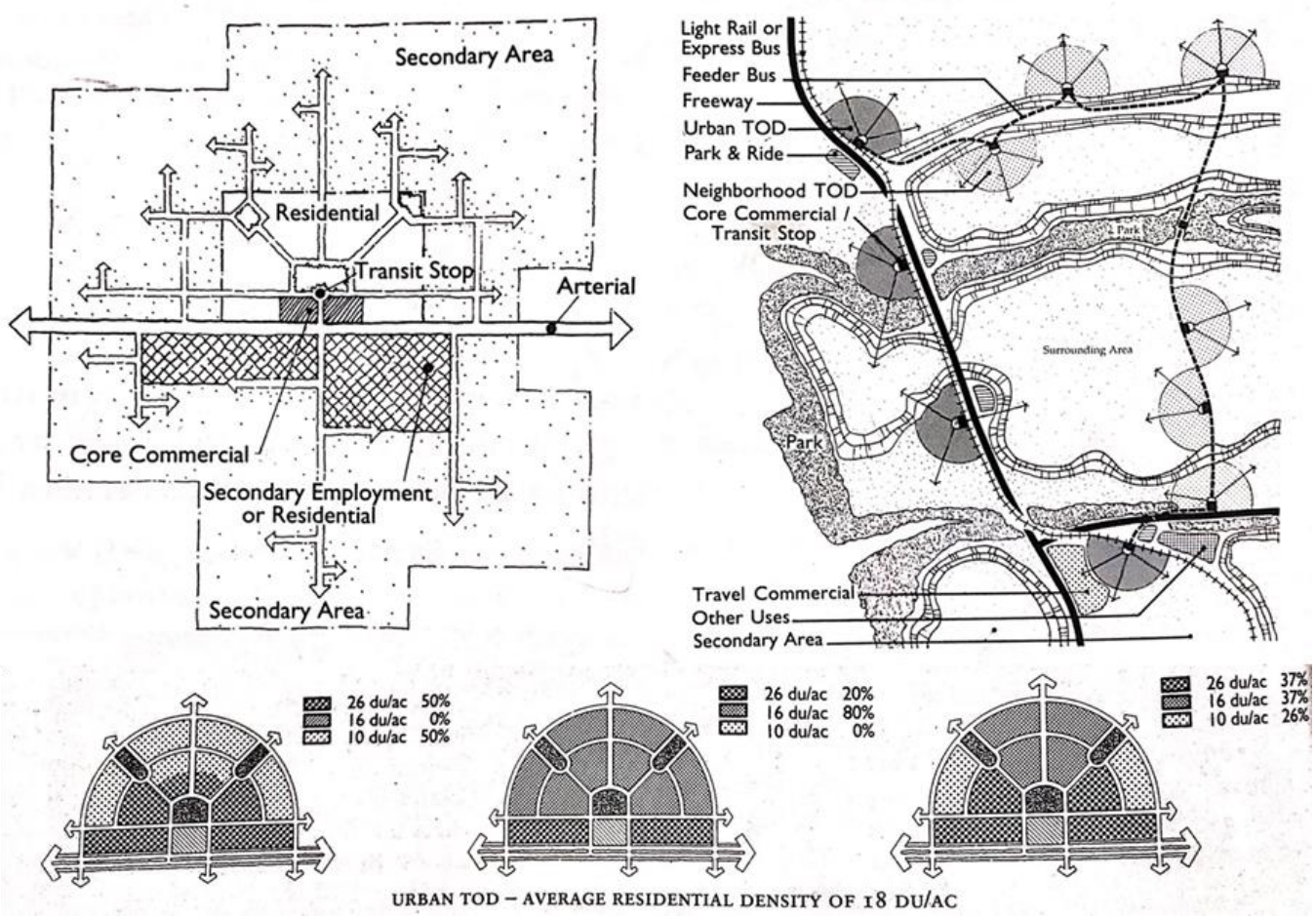

Figure 2. Transit oriented development TOD concept, land uses spatial distribution and building densities (Source: Calthorpe, 1993)

Land uses theories centralized around sustainability stated that, the urban form of a city is an important factor for achieving sustainability because the shape of the settlement pattern determines the patterns of private transport, fuel consumption and emission, and public transport. Breheny and Rookwood (1993) argued that the urban form might affect the rates of conversion of land from rural to urban. The urban form at all scales may be a significant determinant of sustainability. An environmentally desirable urban form may be seen as less desirable in economic and social terms, but Rogers (1998 p: 17) argues that mixed land uses can be acceptable within the successful sustainable urban neighbourhood. Adding to this, there is a conflict between high urban densities and the desire to green the city, therefore urban form and sustainability are linked in principle (Breheny and Rookwood, 1993).

It is possible to argue that some types of urban form are more sustainable than others. Thus, the urban form of the city will determine how successful sustainability will be in the city. It has already been

debated that compact cites have a big advantage in terms of saving energy and reducing automobile dependence by Elkin et al. (1991) and Breheny and Rookwood (1993), however, others argue that compact cities have their own downfalls, such as the acute impacts of pollution and other hazards on neighbouring activities (Ewing, 1997).

Beatley (2004) suggests three characteristics of urban form that make many other dimensions of local sustainability more feasible. These three aspects are public transit, walkable places and energy efficiency. However, these three policies are focused on the urban core and new development. In urban growth areas, he noticed that development studies always located these areas adjacent to existing developed areas. Cities such as Freiburg in Germany demonstrate the compact urban form, with a high density of new urban growth areas along the main corridors of its tram system (p: 250). In addition, urban growth should be planned in parallel with land uses. It is important to address land-use planning issues in relation to urban growth.

3.3. Land use planning and urban form to encourage public transit

The urban form of a city should be considered as an important factor in achieving sustainability. In fact, the shape of the settlement pattern determines the patterns of private transport, fuel consumption, emission and public transport. Breheny (1993) argued that urban form at all scales may be a significant determinant of the prospects for sustainability, Rogers (1998) argues that mixed land uses can be acceptable within the successful sustainable urban neighbourhood. It is possible to argue with some degree of certainty that some types of urban form are more sustainable than others. In that case, the urban form of the city will determine how successful sustainability will be.

3.4. Mega projects in greater Cairo metropolitan region and spatial land uses characteristics

The Egyptian urban context is strongly characterised by mixing of land uses within the community specially in older parts of greater Cairo, however new developments in greater fringes adopted more separation of housing areas and communities' services – surprisingly, the urban design characteristics of the elements of Islamic architecture encourage some of the current sustainability principles (Edward, 2006). In terms of mixed land use for instance, the Islamic urban form is characterised by mixing land uses at the neighbourhood design level, which reduces daily commuting to the city centre (Osman, 2006). It can be argued that the inner core of the greater Cairo Metropolitan region including low income and slum areas still preserve this concept. In the new development on the periphery of the city, the essence of Islamic architecture is still preserved, however, with more open and green spaces. As an example, the new development in the 6th of October, Elshrouq and New Cairo Projects represents these design characteristics.

However, mixed land use by itself does not provide sustainable urban development. Other aspects of urban development are crucial to the sustainability process at the neighbourhood level – aspects such as jobs, accessibility and environment protection. The existing urban development plans lack integration with other urban aspects. The crucial question is, with new transportation mega projects occurring by the government today; how far are they willing to restructure the planning regulations and procedures in order to achieve sustainable urban development? Aspects such as transportation planning, environmental protection and social aspects are still absent in the development process. Besides urban and landscape considerations in terms of open and green areas, Egyptian planners should focus more in the planning stages on issues such as mass transportation planning, providing job opportunities in the community, and decreasing the dependence on private automobiles. These planning considerations need solutions at different urban levels: regional, city and neighbourhood. Transportation mega projects which taking place in the Greater Cairo, new capital city and the eastern urban corridor are crucial for the land uses development of Egypt's future growth, although it lacks integrated vision with linking transport planning with land uses and urban growth.

The eastern corridor has a valued potential of being the future growth direction for Egypt's overpopulation issues. In order to face this problem, two of the major urban agglomerations area created, New Cairo City in the beginning of the nineties, and New Capital City in the new Melina. Both re located in the eastern urban corridor in order to link Greater Cairo with economic potentials and activities in located in the Red Sea region (Ain Sokhna Port City).

The main mega transportation projects currently running in New Capital City and Eastern corridor are consists of two major lines:

1. The elevated regional line which connects the Metro network lines within inner Cairo to the eastern border to expand public transport to new settlements in eastern Cairo which include Al Abour city, New Cairo City and New Capital City
2. The electric regional train which connects New Cairo City and New Capital City to reach the Red Sea for a distance of 100 kilometres to Ain Sokhna which is a major commercial port and an important node that connects Egypt with Asia and Europe.

These two lines is an ambitious project to provide connectivity and guide urban growth towards the eastern corridors. The advantage of creating these two lines should be maximised by creating number of urban nodes that can play a major rule in the new smart growth policy. Transit oriented development provides a planning model that can fit into these two transportation lines, TOD can be one of the methods of creating walkable sustainable urban communities along the 100 kilometres which can solve the over populated Cairo. Figure 3 indicates the new transportation mega projects and urban agglomerations in the Easter Corridor.

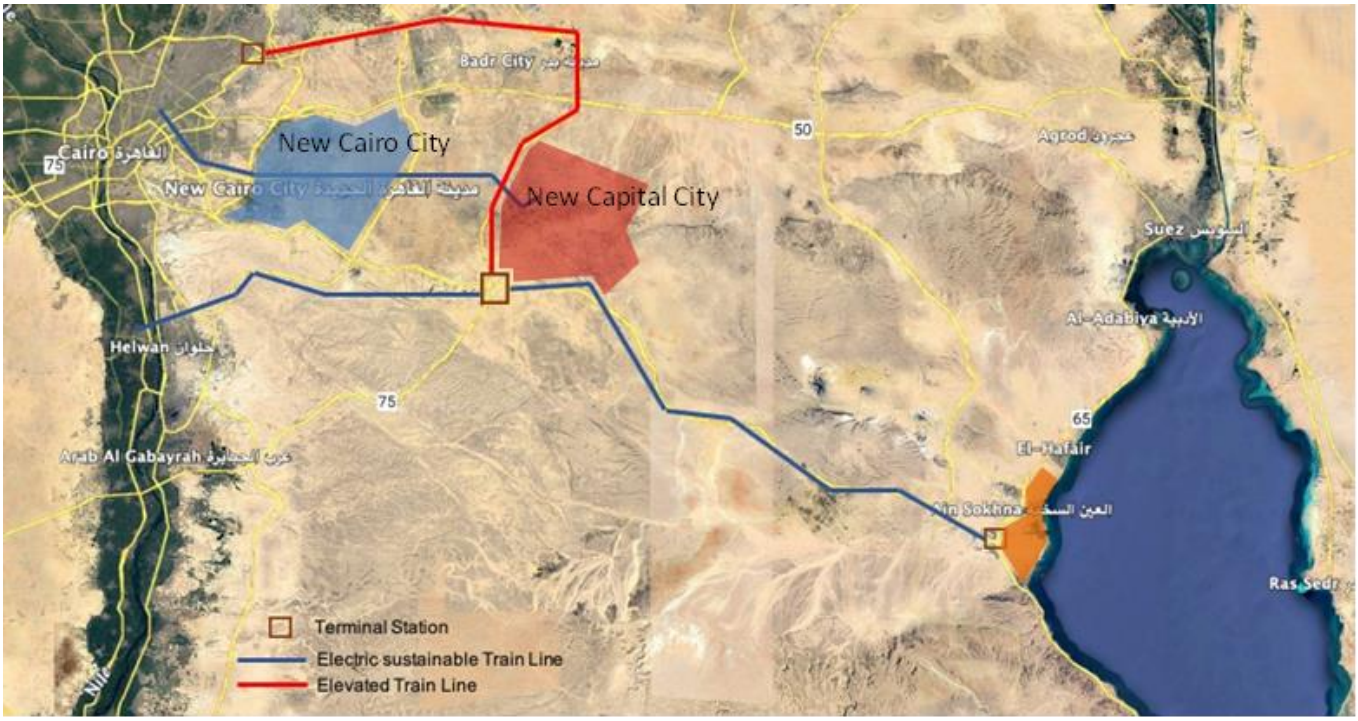

Figure 3. Mega transportation lines and urban settlements in Egypt eastern corridor

4. Discussion: Utilising transit-oriented development land uses theory in the Egyptian context

4.1. Transportation and land uses spatial distribution

Transportation systems have been a powerful force in determining the form of cities. Automobiles have accelerated the urban growth trend because they have allowed people to reach the city periphery in

a short time. Consequently, new towns and satellite communities have existed in metropolitan areas as an answer to the high density in the core city coupled with the availability of a good transportation network. However, later, conflicts became apparent between transportation growth and land use and the environment in the urban context. The city faced problems such as traffic congestion, air pollution due to daily car usage, daily commuting, generation of noise pollution, roads and parking area shortages, severe limitation of walking and cycling, public safety, etc.

In addition, evidence of urban growth should be planned in parallel with land uses are depicted in the last 10 years in such places like New Capital City, however comprehensive integration of land uses, and transportation is required for Greater Cairo region to make it more sustainable. In the 1970s Cairo Masterplan, zoning laws were set in place and Structural Avenues were designed to direct linear growth by attracting residential and commercial density along a mass transportation lane. In 1974, the main mass transit line began to operate along those avenues. This starts with a clear definition of the existing urban context assets and goes on to consider how they can be integrated into one holistic long-term framework (Youssef M., 2012). Transit-Oriented Development (TOD) advocates such as Peter Calthorpe (1993) describe TOD as consisting of residential and commercial Centres that are designed to maximise access by public transportation. A TOD neighbourhood has a centre with a rail or bus station, surrounded by relatively high-density development, becoming progressively less dense as it spreads outwards. For example, the neighbourhood centre may have a transit station and a few multi-storey commercial and residential buildings surrounded by several blocks of townhouses and small-lot single-family residential and larger-lot single-family housing farther away (Calthorpe, 1993): according to Calthorpe, the major TOD is characterized by these guidelines

- The neighbourhood is designed for cycling and walking, with adequate facilities and attractive street conditions.
- Streets have connectivity and traffic calming features to control vehicle traffic speeds.
- Mixed-use development that includes shops, schools and other public services, and a variety of housing types and prices, is a feature of each neighbourhood.
- Parking management is designed to reduce the amount of land devoted to parking compared with conventional development, and to take advantage of the parking cost savings associated with reduced automobile use (Calthorpe, 1993).

4.2. Urban growth policy and land uses international best practise

The international examples, especially those from North America, give much attention to smart growth. In addition, selection of best practise is carefully chosen to match the size and complexity of Mega cities that can be found in Greater Cairo, such as Portland, Greater Vancouver and Curitiba. The purpose of smart growth is not to curb the urban growth of the city, but rather to control this growth according to sustainable development principles by preserving the agricultural land, wilderness, important natural habitat and native species of fauna and flora (for Example Portland and Greater Vancouver). Urban growth is one of the most pressing challenges for sustainable urban development – cities cannot expand forever (Bell and Morse, 2003). However, the solution always has been to put into practice the regulations and management tools for controlling urban growth in the city. Uncontrolled growth causes many secondary problems such as private car use, congestion and pollution. Consequently, one of the policies for controlling urban growth is the "compact city". Advocates of the compact city, such as Breheny, suggest that the compact city can reduce automobile dependence and save energy through increasing the population density and mixed land use. The researcher agrees with Breheny, in the case of the Egyptian urban context, as the characteristics of the compact city exist in Cairo's urban core and part of the city periphery. The population density in these areas has reached

more than 1500 per square metre. In addition, daily commuting is generated because of a lack of job opportunities in these areas (Bell and Morse, 2005).

Apart from the compact city, urban growth policies suggest that land use and transport integration could control rapid urban growth. In Curitiba, Brazil, for instance, zoning laws were set in place and structural avenues were designed to direct linear growth by attracting residential and commercial density along a mass transportation lane. This allowed the city to meet strategic objectives that sought to minimise downtown traffic. In addition, the policy encourages social interaction by providing more leisure areas and pedestrian zones in the centre of the city. Also, the use of public transport and cycling is encouraged in order to achieve an environmentally healthy city.

In Vancouver Regional District, Canada, liveability remains the central guiding theme; this is embodied in its regional growth management strategy, the Liveable Region Strategic Plan (LRSP). This focuses on land use including the green zone, regional town centres and higher density centres including downtown Vancouver, and on transportation policies. Its aim is "to help the region develop in a way that maintains and protects the environment and at the same time guides the location of urban activities to create a high quality of community life" (GVRD, 2006 p: 15). The growth management focused on regional and municipal town centres. The policy's philosophy is that, by creating communities that are more complete, it would result in more jobs closer to where people live and accessible by public transport, and shops and services nearer to home. In addition, the policy advocates a compact metropolitan region, by increasing transportation choice through the use of public transport, walking or cycling. Another example is in Portland, United States: the strategy prepared for the region, referred to as region 2040, and developed through an extensive public process, is enabling the region to expand by encouraging urban form in the city. The policy is steering urban growth into a series of centres along the spine of the light rail system. The goal is for 85% of new residents to be within a five-minute walk of a public transport station.

4.3. Urban growth and land uses issues in Greater Cairo metropolitan region

With regard to mass transportation in the GCMR, both public transport and private vehicles are considered as vital means of transport in the Egyptian urban context. The excessive use of private vehicles is the result of the public transport system not being efficient enough to serve a large population such as Cairo has. Consequently, alternatives have been initiated to solve the need for daily transport such as private buses and mini buses. Yet the biggest project to have been conducted in the last 20 years is the GCMR underground with two lines connecting different parts of Cairo (apart from new towns). In addition, a third line is under construction. Although a large section of the population depends on the underground, the project itself did not prevent private automobile ownership increasing. This implies a critical question: is it a cultural issue and a matter of prestige in the GCMR to own a car or is there a lack of community education about how useful public transport is to protect the built environment? Actually, the answer to that question is complicated; it can be safely argued that: The notion of owning a car in Egyptian society is related to the concept "everyone is looking for prestigious social rank, and a car is one of the necessities, which is correlated to power, power in the sense of giving the impression of how important the citizen is in the society and how citizens are evaluated in Egyptian social life.

The concerns about mass transit transportation and Transit-Oriented Development, have been accepted within the Egyptian urban concept, and the starting point for this application should be the new towns and new development (Madbouly, 2006). The urban development characteristics of the new cities in terms of environment design, open spaces and mixed land match the principles of sustainable development, but still lack elements such as the connectivity in terms of public transportation. The current transportation system in the new towns is designed to encourage automobile dependence in these isolated areas (Fahim, S. 2006).

In addition, another reason that new towns are unsuccessful in attracting residents is the lack of job opportunities, as most of the jobs available are located in central Cairo. The urban policy fails to connect urban development in new towns with job opportunities and this creates a huge amount of daily commuting from new towns to the inner city. This discussion raises questions about the basic urban planning procedures that are followed when preparing master plans. The new urban planning movement is concentrating on action plans and small projects as a key for successful urban planning. This shift between master plans and action plans initiatives may be a step forward to achieve sustainable urban development in the GCMR. However, in order to achieve this, substantial changes need to be implemented in the old Urban Planning Law, as the Law has not been updated since 1982. The step towards changing the Law in a way to introduce sustainability is a first step; followed by specific, detailed regulations on how to alter the existing procedures and introduce a set of principles and tools to achieve sustainability, such as environmental planning, Strategic Environmental Assessment, ecological aspects. Box 1 indicates the 2030 Egypt sustainable vision objective regarding public transportation and sustainability, it depicts the government will to introduce clean and reliable public transportation means to the Egyptian by increasing the number of mass transport means to provide better life style to the Egyptians population.

Key Elements:

- Execute a project for increasing numbers of means of mass transportation in cities while increasing dependence on the private and non-governmental sector in provision of such services
-- Support roads with modern technological tools to monitor roads and traffic flow in order to enable responsible authorities to raise planning efficiency and manage traffic congestion in a better way.
- Adjust regulations and laws for increasing the quality requirements of means of mass transportation for private and non-governmental sectors
- Develop a national database to calculate numbers of users of modes of public transportation

Figure 4. Sustainable public transportation means objective in Egypt vision 2030

5. How TOD fits in with sustainable urban communities in the eastern corridor

Within the Egyptian urban context, many of the features of Transit-Oriented Development already exist in the new development projects in the GCMR, especially in the new settlements and towns, as a large section of private urban developers have recently become aware of the principles of environmentally oriented planning (Youssef, 2019). In addition, the government's biggest housing project "Youth housing project" is devoted to a healthy environment design. As part of an interview conducted with a number of government officials, one of interviewee pointed out that the missing ingredient of the TOD in the Egyptian urban context is "how to convince residents to alter private car usage and depend on public transportation alternatives when public transportation and connectivity is in urgent need of improvement first?".

Another interviewee stressed of an urgent need to update the Terms of References (TOR) and building regulations of urban housing projects is required from the Greater Cairo Region Authority to achieve sustainable urban form and to maintain a level of urban environment that is suitable for living (Youssef, 2019). In addition, the government should seek improvements to the public transportation network not only in terms of traffic management but also in terms of transportation planning of the existing

transportation network, to achieve connectivity of the different parts of the city and convince the residents to use public transportation (Youssef, 2019). The sustainable vision of Egypt 2030 has a great deal concerning public transportation, one of the major objectives of Egypt government must achieve is to Increase the capacity and quality of means of public transportation in cities: The 2017 Government Electric Mass Train proposal program aims to improve the quality of the urban environment in governorates through increasing citizen dependence on modes of public transportation (see Figure 4).

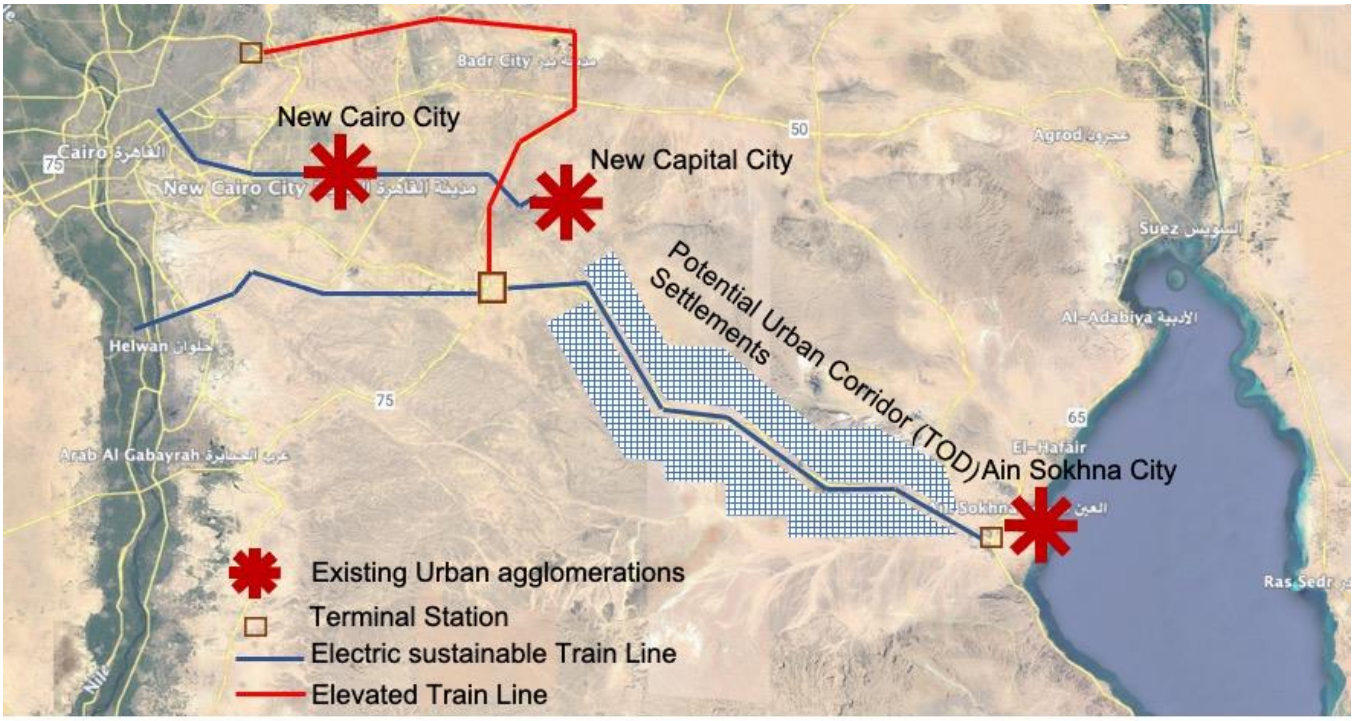

Figure 5. Proposed smart growth transit oriented development in Egypt eastern corridor (source: Government Development Vision, 2017)

6. Proposed land use model for Transit Oriented Development TOD in new capital transit corridor

Figure 6 describes the Author planning concept for each transit nodes inspired its shape of the human DNA which provide potentials in planning land uses and green industrial areas in a way each node contain a transit stop that works as a central area, followed by residential areas that will be walkable from transit stop and on the fringe of each node clean industrial parks are located.

The transit system proposed, above left connecting each land use with other areas with tow sub systems major transit line that connect each node with the other node and public transit with connect various land uses in each node. Each node can major a different economic base that allow multiplication of nodes with various planning economy that depends on each node's function in the transit system.

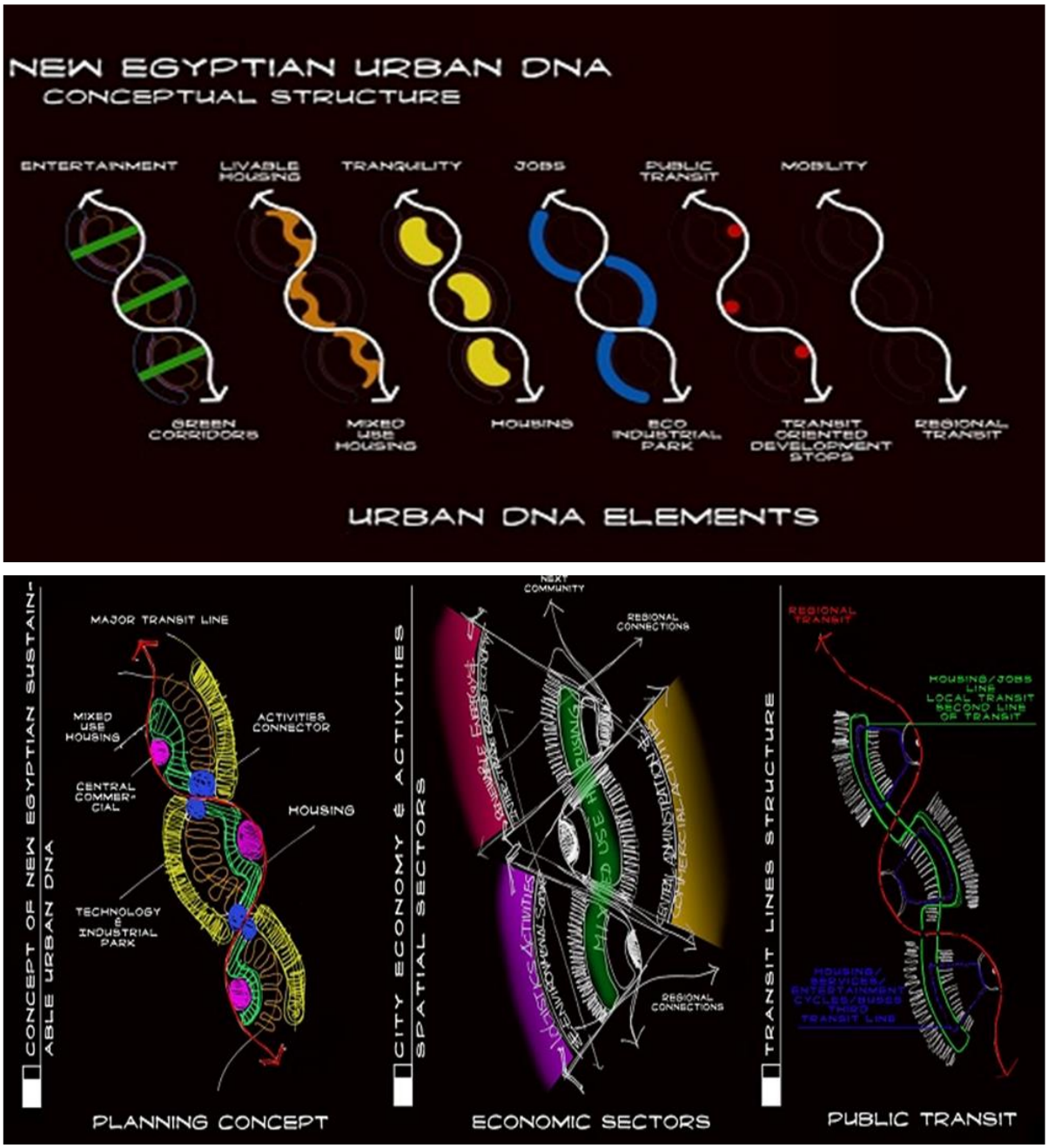

Figure 6. Proposed urban planning concept and design in one TOD in Egypt eastern corridor

The starting point of transit system is shown in figure below left close to Suez Canal and acts as ignition points for the proposed new sustainable urbanism that may suite the Egyptian urban growth model in the future. The spatial concept demonstrates the elements of new urban design DNA proposed for new Egyptian transit-oriented development system in Sinai, it shows the central area of major transit terminal surrounded by first ring of mixed use and commercial activities, the second ring contains the residential areas and the third rings shows the green industrial areas. The node centralized by green corridor integrates land uses together and creating major Green Park that utilized as a transition point for public transport system that divided the node to major previous mentioned land uses.

7. Conclusions

- Smart growth is the key element to create more sustainable new communities, it should be coupled with land uses management
- Transportation planning is essential when managing urban growth, public transit and alternative solutions should be introduced as an incentive for population to move to new communities
- Egypt 2030 in need of a smart growth management and TOD such in the case of connecting Cairo with new capital but in the same time cautions should be taken of a big agglomeration, in that case transit-oriented development could be one solution to avoid vast urban growth
- No clear adaptation of sustainable urban development policies and instruments to face transportation problems in both existing cities and new proposed cities. The 2030 vision is ambitious and has a good intentions of better urban development future but lacks integration with an overall systematic long term urban policy. The concept of public transit is introduced which is a further step for creating sustainable means of transportation in the near future which will help of targeting sustainability principles. Smart growth and transit-oriented development proved to be sound policies and instruments to achieve sustainable communities. providing these settlements with jobs and activities can achieve the spread of urban population from the 10% concentration of land to the 90 % vacant land. The 2030 strategy is very ambitious and full of good intentions, but reformulation of the strategy is essential in terms of settlements population size and urban planning spatial configuration. It should have a very realistic urban strategy that can achieve more sustainable new communities rather than big agglomeration media propaganda new communities. It should concentrate creating a small size new communities' network and connected with the right public transit.

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The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

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Studies involving human subjects: No human studies are presented in this manuscript.
Inclusion of identifiable human data: No potentially identifiable human images or data is presented in this study.

Conflict of Interests
The author declares no conflict of interest.

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