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Portcityscapes as Liminal Spaces: Building Resilient Communities Through Parasitic Architecture in Port Cities

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ABSTRACT: Port Cities are historically the places for paradigm shifts, radical changes, and socio-economic transitions. In particular, the interaction zone between the port infrastructure and urban activities creates liminal spaces at the forefront of many contemporary challenges. In these liminal spaces, the port's flows, form, and function intertwine with urban contexts and conflict with the living conditions. Conceptualizing the portcityscape and harborscape as liminal space and urban thresholds leads to (re)thinking about innovative participatory methods and technologies for building community resilience in port cities. Additionally, inevitable constant development in port cities requires adaptability and resilience from the waterfronts to the hinterlands and city centers. Such confrontation of port infrastructures and urbanization is socio-politically and spatially challenging, specifically in historic port cities. Therefore, as the approach to exploiting energy and human resources changes over time, the physicality of the built environment in port cities and how we (re)use the resources need to be redefined. This research investigates key socio-spatial features and challenges of port cities by examining how the port's proximity to the city requires coordination, collaboration, transparency, and community dialogue. The introduction and background literature discuss three domains and notions of port city studies, building community resiliency through participatory frameworks, and parasitic architecture. By building upon this analytical framework, the paper presents case studies developed within the research-led design studio focusing on building resilient communities in four port cities, including Amsterdam, Constanta, Alexandria, and Rio De Janeiro. This research focus on the community-enabled application of emerging technologies, innovative approaches, and co-designing and co-building participatory methods. The selected case studies introduce an integrative and multi-scalar pedagogical framework for building resilient communities in liminal spaces of port cities.

KEYWORDS: Port Cities, Resilient Communities, Liminal Spaces, Parasitic Architecture, Industrial Infrastructure

INTRODUCTION

The spatial logic of port cities provokes the appearance of liminal spaces and transitional urban thresholds. Perceiving portcityscape and harborscape as liminal spaces throughout the city, from the waterfront to the hinterlands, leads us to (re)think about the proximity of urban living ecosystems next to port city activities. While the juxtaposition of the two (Urban and Port) may provide opportunities for the adaptive reuse of port infrastructure, it may also result in challenging conditions and sometimes disastrous incidents. Cases such as the Beirut Blast that happened on 5 August 2020 show how a coherent understanding of the interplay of spatial, social, economic, and cultural dimensions in a dense and historic port city is critical for urban planning and design (Mehan & Jansen 2020). With so many casualties among citizens, the disaster painfully indicates the proximity of a port to the city requires coordination, collaboration, transparency, and community dialogue. Beirut's massive explosion has shown us -once again- the impact a port disaster can have on a city and its inhabitants—spatially, socially, economically, and culturally (Mehan et. al 2022; Hauser et. al 2021). Conceptualizing liminal spaces as part of the portcityscape (spatially and socio-culturally) allows for an alternative understanding of resilient communities and the advanced application of collaborative design practices. The characteristics of liminality can be explained through both objective parameters such as spatial, geographical, and administrative and as well as subjective criteria based on traditions, social norms, and everyday practices. For port city citizens, the essential liminal border concerns the boundary between the port and the city, between the waterfronts and the hinterlands (Teschner 2018). This research is built upon the premises that it is possible to reconsider the conventional dichotomy of 'city-port' by outlining a vision in which the port city is a *forma Urbis* in progress: a composite, plural, and open figure affected by the speed of changing processes and influenced by the many factors that every day are embodied in its socio-spatial setting (Mehan & Abdul Razak 2022a; 2022b). The body of this article includes a literature review, research methods, and pedagogical case studies that together provide frameworks for analyzing and designing liminal spaces of portcityscapes. The case studies utilize the notion and concept of parasitic architecture as an adaptive reuse strategy that can blur the boundaries between port and city. In this context, parasitic architecture is conceived as a transitional form of architecture that is associated with integrating new structures into existing buildings and infrastructures (Fard and Mehan 2018). Moreover, the study addresses challenges and presents examples of integrated design-to-production workflows for resilient communities in socio-spatial port cities.

1.0 LITERATURE REVIEW

The literature review covers three main areas: port cityscapes and liminality, building resilient communities, and parasitic architecture as adaptive reuse, spatial analysis, and design strategy.

1.1. Port Cityscapes as Liminal Spaces

Port cities are seen as interconnected networks which have historically been gateways for cultural change and windows to the wider world (Hoyle 2002, 14). Especially the emergence of Globalization studies over the past twenty years has been seen as the primary catalyst of attention for the significance of port geography to bridging worlds, which stimulated the circulation of people, goods, ideas, technology, and global connectivity (Sassen 2012, 918-937). Port cities are sensitive to larger political, economic, and technical transformations. Therefore, any serious analysis of port cities must take an integrated approach to the complex interactions between a port city's-built environment, metropolitan spatial form, urban planning actors, and economic and commercial land and sea networks (ibid, 805). Port cities are paradigmatic and constitutive liminal spaces and places of otherness. In particular, the area where the port and city, or the port and the surrounding landscape engage with each other – requires focused study and new planning concepts. Scholars from humanities, social, and design sciences have proposed different terms to identify this port city-state in different disciplines, such as seascape (Bentley et al. 2007), harborscape (Russo 2016), portcityscape (Hein 2016), portuality (Moretti 2019), and maritime cultural landscape (Westerdahl 1992).

The urban coastal land and waterfronts in decaying port facilities have been globally recreated as public spaces in numerous redevelopment efforts. Such liminal spaces hold the potential to play a key role in improving the quality of urban life, intrinsic to vital, sustainable urban communities, and a platform for diverse activities (Degen & Garcia 2012). And a more global port city, the more widespread within its fabric are what may be referred to as 'liminal urban spaces.' These 'liminal urban spaces' act as trans-border and transnational social networks for ethnic communities that emerge in spatial development, economic exchange, or political structures (Krathke & Lanz 2012, 33). It is important to examine the material manifestations of liminality in port cityscapes, its consequences for the physical transformation of spaces as arenas for the diverse development actors and trans-border activities, on the emergence of social and economic networks, and on the creation of narrative and discursive spaces that are born out of adaptable space production and the emerging technologies.

1.2. Building Resilient Communities in Port Cities

Ports, cities, and surrounding regions are striving to find solutions to the global and local challenges they face. These challenges include but are not limited to climate change, the economic shock related to the coronavirus pandemic, rapid automatization, sociocultural transformation, and energy transitions. To respond effectively, rapidly, and meaningfully to upcoming port city challenges, diversified stakeholders in the port city region, such as port authorities, governance agencies, educational institutions, legal entities, cultural organizations, private and public actors, as well as Non-Governmental Organizations (NGOs), and residents are required to provide coordinated responses. Providing the holistic and multi-benefit response from this wide variety of actors with different interests to a diverse, complex, and sometimes unpredictable range of changes is a major challenge to overcome, but opportunities do co-exist (Mehan & Mostafavi 2022; Mehan 2020). The thrive to building resiliency has a long history in the port cities' local communities. Such efforts are embedded in the port city culture around shared values based on a strong and dedicated collaboration among various groups of public and private actors from different backgrounds on diverse social and environmental challenges (Garcia 2019; Dahl 2019). Enhancing the adaptive capacity of the communities over time is crucial to respond to the growing uncertainties and complexities associated with major threats and hazards in port cities (such as environmental, political, and economic). Consequently, the concept of resiliency is continuously evolving to appropriately respond to the societal, political, cultural, and ecological needs of the people and society (Mehan & Mehan 2022; Repellino et al 2016). In another definition, community resilience is the "capacity of a distinct community to absorb disturbance and reorganize while changing to retain vital key elements of structure and identity that preserve its distinctness" (Fleming & Ledogar, 2008). So, in this definition, maintaining the collective identity is critical in resilient systems. This will lead to the co-creating of scenarios and future-proof design strategies for sustainable and resilient coexistence in the port city regions (Mehan & Abdul Razak 2022c). Considering contemporary challenges and to provide a close examination of socio-cultural impacts and the integration of port and city regions, new holistic development approaches and spatial design solutions are required to ensure resilient development in the port-city region. Through various case studies in four port cities of Amsterdam, Constanta, Alexandria, and Rio de Janeiro, this research utilizes innovative methods such as the parasitic architecture approach and adaptive reuse strategies to respond spatially and socially to these challenges.

1.3. Parasitic Architecture and Adaptive Reuse

The term "parasitic architecture" is usually explained as "fill-in architecture" and "informal architecture," which have a parasitic origin and evolve through time to become mutually beneficial for the host or the old and the expansion or the new (two refs). In the context of this research and the following case studies, the notion of parasitic architecture is used as a strategy for the adaptive reuse of port infrastructure and harbor thresholds. Often parasitic architecture is synonymous with extensions and annexed architectures and adaptations. In this sense, parasitic architecture can be defined as an approach to developing a symbiosis of the existing built and natural environment with the new

architecture. The descriptions broadly define parasitic architecture as a new room or building attached to an existing larger structure, while there is a difference between the two. This is limiting as parasitic architecture is thrown around to describe unusual expansions or something that solely benefits the host building. However, parasitic architecture can be thought of as more complex and as something that has the potential to affect the entire city and, in the context of this research portcityscapes.

In his article, Given (2021) uses the case study of train lines in Tokyo to seek the true definition of parasitic architecture and specify the concepts and foundation of this term. While the host shelters the parasite, the parasite draws attention and interaction to the site. At first, a one-way benefit for the parasite, the symbiosis of the two begins to spark communities and commercialism within an existing urban area. Due to the tendency of Japanese railway companies to build their tracks above ground, there exists a new zone between the trains and the ground. This possibility allowed for the parasite, which drew more commercialism to a frequently used area, benefiting its host. Given (2021) adds:

> "Focusing on how parasitic architecture has produced urban growth and development of a community within Tokyo as the primary case study, the reclassification is based on pre-existing architectural development and the nature of actual, living parasites. This reclassification of architectural parasites produces three separate types of parasites; the 'structured,' 'symbiotic,' and the 'hyper transient.' Through redefinition and reclassification, parasites in an architectural or urban planning context can then be manipulated as a tool for propagation within the existing built environment (Given 2021, 164)."

Another case study brought up by Given (2021) to distinguish parasitic symbiosis versus open parasitic architecture is the Shard and London Bridge Station. Unlike the Ameya-Yokochō case study, this case shows a community of parasitic additions with mutually beneficial and singularly beneficial examples. The Shard draws interest to the area and constantly attracts droves of people, acting as the general host. Symbiotically, the Bridge Station and restaurants used this influx of people to gain business and, in turn, further promote attraction to the site. To put it clearly, the Shard originates the interest; the symbiotic parasites use existing interest to develop a foothold and eventually become semi-hosts. The transient parasites come in to draw attention to themselves exclusively, rarely drawing people to the site as a standalone business and often detracting attention from the symbiotic relationship present. These stores, coffee shops, and hotels singularly benefit and fit into the more widely spread definition of a parasite. Similarly, Baroš and Katunský (2020) discuss how parasites fundamentally create diversity in their environments and either lead to the extinction of the host or stimulate the host's immune system and growth rate. This concept is also genuine for parasitic architecture, where the parasite diverts resources from the host and changes the energy flow through a system, altogether affecting the function of a building. On one side, a host building may lose attention to its parasites, but on the other hand, the parasitic additions may funnel more attention to the building. He also describes how when the scale is increased. Most architecture may seem to have parasitic expressions compared to the neighboring built environment. Baroš and Katunský (2020) put forward the idea of urban acupuncture as "the idea of micro intervention in the urban structure to improve the overall functioning of urban organisms." The concept of urban acupuncture is to work in tandem with designers and the community to highlight areas of stress in the built environment accurately. Just as acupuncture eases tension in the body, urban acupuncture eases tension in the city. This acupuncture is slotting a system within an existing urban environment, specifically to be of aid, which classifies as parasitic symbiosis. This acupuncture can be defined as the urban porosity allows to shed light on the intricate interplay between the formation of urban form and its subsequent capacity to "include" diverse forms of urban life (Stevens 2020, 61). The parasite "respects the host and at the same time enriches it," leading to a beneficial relationship (Baroš and Katunský 2020, 21). In this way, the fewer materials and more design-based approach focus on parasitic architecture could lead to the least negative impact compared to its benefit.

2.0 RESEARCH-DESIGN METHODOLOGIES AND STRATEGIES

With the provided background and literature above, this research reports and discusses the outcomes of a research-led architectural design studio conducted at graduate level at the Bauhaus university. The projects examine the spatial and experiential potentials of building resilient communities in port cities through parasitic architecture with a special focus on, adaptive reuse, resiliency, and application of integrated participatory design-to-production systems. This studio intended to explore the adaptability and resiliency in port cities at the forefront of climate change challenges, technological progress, and socio-economic paradigm shifts. The studio projects started by looking into port cities that need adaptive reuse and community resilience building. To respond to this urgent need, the theoretical framework of design studio focused on the spatial definition of 'symbiosis': where two organisms living in one system benefit from each other without any adverse effects (Kozlowski et al. 2020). This liminal, binary, and hybrid conceptualization of portcityscape would allow the port and the city to grow and expand to sustain the urban fabric without harming each other. Here the port infrastructures are defined as the material forms that allow for the possibility of an exchange over space. They are the physical networks through which goods, ideas, waste, power, people, and finance are trafficked (Larkin 2013). To keep and maintain the existing infrastructure while intensifying land uses and building the void, there is an urgent need to embody specific characteristics in the system to be more flexible and resilient in front of unexpected challenges and environmental threats. The parasitic architecture approach has been selected to decode and adapt to the existing infrastructure and create a new flow system juxtaposed with the current typology, aligning the need for creating resilient infrastructures and freeing the port city tensions (Mostafavi and Mehan, 2023). In this way, the idea of symbiosis and parasitic approach would allow for more sustainable infrastructural developments in port cities' liminal spaces.

The studio design workflow has been framed around four scales: mega, macro, meso, and micro. In mega-to-macro scales, projects start with mapping site-specific port-related socio-spatial challenges and potentials and then continue with exploring layout design and developing modular systems that, by considering different user profiles, create interactions between portcityscapes and urban thresholds. Moreover, projects are looking into existing port infrastructures and waterfront thresholds as potential host contexts for parasitic architecture proposals. From the macro-to-meso scale, the projects are looking into environmental and structural performance analysis to effectively integrate into the host building and respond to site analysis and the surrounding hosts' facades for future extensions, additions, and development. In meso-to-micro scale projects are looking into material tectonic and circular and innovative design materialization strategies using local resources and communities. The following section will focus on four port city projects as part of the graduate level studio titled ‘Cobotic Production of Resilient Communities in Port Cities’ taught at Dessau Institute of Architecture at Bauhaus located in Amsterdam, Alexandria, Constanta, and Rio de Janeiro.

3.0 CASE STUDIES

In the following section, in four case studies, socio-spatial challenges in different port cities are highlighted, and corresponding solutions are explained. Additionally, each project has developed an integrated computational design workflow for participatory fabrication, which this paper will not discuss in detail. Descriptions are divided into two parts: background, where site-specific socio-spatial factors are identified, and design strategies to address the liminality and the threshold of port and city.

3.1. Amsterdam: Background

In the past, ports and their cities have seen substantial spatial change. Over time, both spatially and functionally, they became increasingly separated. The port has evolved from a distinct space to a single, fixed, and spatial entity. A Port is a place ‘‘where synchronic forces strive for common internal and external goals among a pluralistic port community” the case of Amsterdam shows that the Port Authority in Amsterdam is stabilizing the amount of land in the port area available for expansion of firms. At the same time, the Municipality of Amsterdam has a substantial target to build houses in the existing built-up area. In spatial terms, this means that while the expansion of the port area has stopped, urban development is gradually encroaching on the current and fixed harbor area. As a result, there are many challenges and conflicts over the land supply, future growth, and the development of the existing activities in the port city of Amsterdam, besides the environmental issues. The main aim is to study and design an adaptable parasitic architecture by providing a circular system for assembly and disassembly. This research brings new life into the portcityscape of Amsterdam through parasitic architecture.

Bearing the above-mentioned challenges in mind regarding densification and lack of available land for residential units, the location choice of the project is based on the critical transitions and mix-used development raised in Houthaven docklands in west Amsterdam. Houthaven was originally established as a trading hub and seaport in1876 connected to the North Sea. Its contemporary look (with several modern buildings) contradicts that history. Houthavens is notable for its piers stretching out into the River IJ and the Pontsteiger building. The sites are typified by a mixture of old and new functions and structures, which makes the urban threshold unique in terms of the proximity of modern and historical textures.

3.1.1. ‘Urban Plug-In’ Project: Design Strategies

In response to the density of the site context, the starting point of design strategy was to find the most optimum unit model for future expansions. As the result, the truncated-octahedral unit was selected due to the number and type of faces (total 14 faces, 6 square faces, and eight hexagonal faces) and the three-dimensional growth and size variations. Thus, two main typologies of this unit have been addressed in terms of sizes and due to the functional spaces and their requirements in the Amsterdam port city interface. One cluster consisting of twelve modules in two different sizes was chosen for structural analysis and optimized the thickness variations of the timber beams for better performance and use of the material. Then, some mutated modules were added on the cluster to release the load and distribute it effectively to reduce the wide range of thickness between beams at the end.

Due to high radiation and view analysis, the passive external wooden skin system was introduced. This skin system is designed to minimize the effects of the sun on the modules and supports natural ventilation and energy consumption. The passive shading system reacts to the daily sun path to shade the interior of the modules from intense radiation. A wooden surface structure that adapts its porosity to changing humidity levels has been developed. While studying the pattern, the sun's radiance on each cluster's surface has been analyzed. As a result, the parasitic surfaces have been divided into two groups: the ones that get more radiance for responsiveness and those that get less radiance for fixed opening. Moreover, the cross-ventilation has been provided through the lower opening on one side and the upper on another in each module.

3.2. Alexandria: Background

Since antiquity, Alexandria has been the intellectual and cultural center of the region, and it is considered Egypt’s second capital. For the study, the project site was chosen near the corniche, where most of Alexandria’s contemporary port city challenges exist. The corniche is a waterfront promenade that runs along the eastern harbor, as one of the major traffic corridors in Alexandria. This site is occupied by buildings and industrial heavy infrastructures that have disconnected the people from the sea. This has resulted in overcrowding of people especially in the roads which have

access to the shore. Due to the lay of the land, rising sea levels, and constant erosions, the site is always under threat of being flooded by rain or high tides. Also, the dramatic uneven urban development along the shore caused saltwater intrusion, which contaminated the region's freshwater resources.

3.2.1. 'Upturned Jeopardy': Towards a Resilient Waterfront in Alexandria: Design Strategies

To achieve community participation and engagement in the design process, the focus of design strategies is co-creating a resilient port city community. A parasitic system that could spread through Alexandria was envisioned on the mega-scale. The first attempt was to create a growing system that could produce 'chaos' to show the port city's existing challenges. The component system has been suggested to make various alternatives and adapt to the context using a parasitic approach. The chaos was designed by point cloud to be adaptable and extendable to multiple contexts. The team optimized and evaluated the design process to assess the potential of adding more spatial constraints. As a result, the design process was initiated with a base grid based on zoning, program planning, and site access (Husar et al, 2023). In addition, this base grid has been defined to build the primary masonry concrete compression-only structure by simulating a funicular structure. In the next step, local artisans introduced a wooden frame using traditional shipbuilding techniques to enclose the space. As a result, an architectural living parasitic structure has been designed based on environmental, functional, structural, and societal factors.

Figures 1 & 2: Urban Plug-In Project, Houthaven, Amsterdam, The Netherlands. Source: Authors.

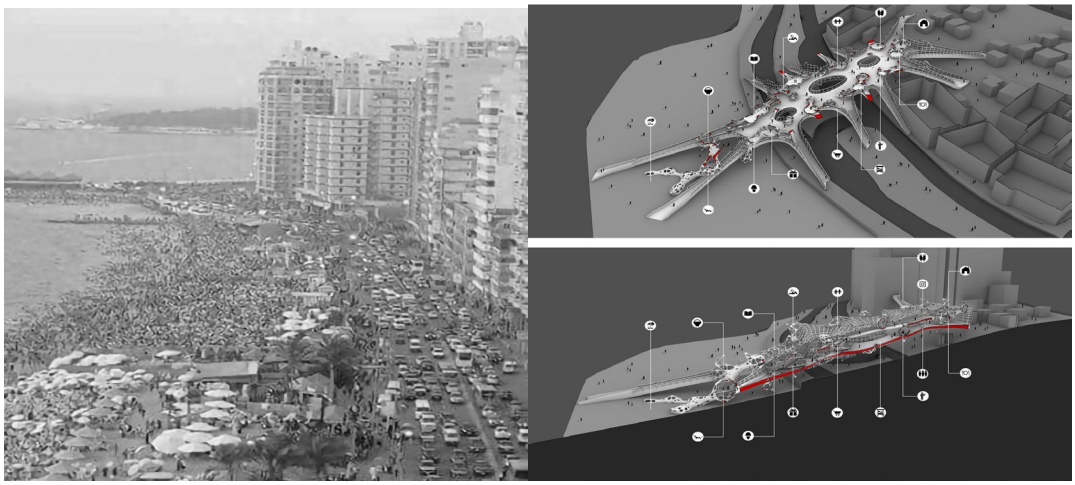

Figure 3 & 4:'Upturned Jeopardy': Towards a resilient waterfront in Corniche, Alexandria, Egypt. Source: Authors

3.3. Constanta: Background

The Port city of Constanta, located on the East side of Romania, has become the subject of interest because of its favorable geographical position and the importance of its port, the largest on the Black Sea and the 17th largest in Europe. The location choice of the project was based on the particular interest in East European studies and the need for this historic port city's development strategies. Also, because of Constanta's numerous port city challenges such as migration, climate change and abandoned industrial sites and infrastructures, it gives room for various directions to choose and adapt improvement solutions. The site for the project is in the middle of Constanta, the part separated from

the rest of the city by railway connections but in close reachability from the main railway station; in the area, where a chaotic settlement of Roma people is based, currently surrounded mostly by abandoned post-industrial territories with leftovers of concrete silos previously used for oil storage.

3.3.1. 'Path of Roma' Project: Design Strategies

The project "Path of the Roma" was created as an answer to one of the crises points of Constanta, namely the discrimination of the Roma people community. A high amount of homeless people, their occupation of abandoned industrial and historical sites and buildings, and constant social conflict between the city and the ethnic groups make it a significant obstacle to Constanta's future development. The project's point is to create a space for Roma people where they can have their community and a particular lifestyle to sustain themselves, with the possibility of interaction with people outside of their community. The design idea lies in using existing silos and complementing them with parasitic parts to make the space habitable. Four silos of two types (600 m2 and 300 m2) were selected as the focus of the project site. Inside and outside the silos, solid free-form geometries were created for the co-habitation of the Roma People community. Closed spaces with openings that have the function of doors and windows consist of 4 elevations of different planning and area sizes. Outside the silos, the semi-opened structure is created, represented as a path that will manage the flow of people's movement and spaces for interaction. The free-form wooden structure with a weaving basket-like pattern provides a temporary space for the Roma Community to adapt. The project has two types of parasitic systems: The first type of parasitic architecture is the Solid Spaces, which are the permanent areas that are 3d-printed with mud. For reinforcement, prefabricated wooden layers are milled with robots and provided in pieces. These parts are fabricated in the lab into chunks to be transported easily. The layers bear more as the structure is created with cross-laminated timber, while the other layers can be created out of recycled plywood. Small pickets are provided to develop spans between layers and space for the extruder to print the mud between them. As a result, the semi-closed area is created from a structure of frames and a weaving basket skin.

Figures 5 & 6: Path of Roma, empowering marginalized communities in the Port City of Constanta in Romania. Source: Authors

3.4. Rio de Janeiro: Background

Throughout Rio de Janeiro's development, this port city has experienced abrupt transitions to modern life, regulations, and constant changes in urban government. As a result of the uneven port city developments, a marginalized immigrant group couldn't find a place in the port city and built houses in slums called favelas. Largely ignored by local government, the favelas residents are defined as marginalized and underrepresented communities hence their basic needs, such as clean water, and employment issues, are left poorly attended to (de-Lima-Santos and Mesquita, 2021). The research for a parasitic architecture that could help the favelas was intended for this project, and Vidigal – a neighborhood and a favela in Rio De Janeiro close to the sea- was selected as a project site or a close scope. This overpopulated area has several flaws in that their houses are stacked on top of one another without proper construction methods and are disorganized. Lack of government intervention led to inefficient sewage systems, inaccessible potable water, electricity, and waste management systems. However, their strengths are that Favela occupants are survivors and highly independent. They could stack houses on top of one another by using local materials. Favelas are popular tourist places, and they capture several potential opportunities in agricultural and water-harvesting.

3.4.1. 'Cube Clouds of Rio' Project: Design Strategies

The parasitic design approach will likely adopt potential strengths and opportunities that this site holds, starting with a small pocket urban farm in the favelas that will envision multiple clusters of programmable urban areas in the future. This process flows in stages from analyzing the site potentials, sourcing supplies, construction on-site, local assembly,

and creating local job opportunities in this small economy of urban pocket farms. The ‘Cubes of Rio’ project proposes a programmable system for the participatory revitalization of marginalized favelas in Brazil's port city of Rio de Janeiro. With sets of user-driven inputs and quantitative environmental analysis data, the proposed system searches for multiple optimum solutions a customizable, aiming to turn research scarcity and socio-spatial challenges into opportunities for the regeneration and revitalization of favelas through urban farming.
The first step in executing design on the site is to create a solid base of the load-bearing capacity structure that connects to host buildings around the central pocket area. The base structure should act in a way that it appears as if it is ‘engulfing’ the host buildings. The application of the pavilion as a new layer in design is to provide shade for the urban farm, especially for the core circulation in the center of the urban farm. The distribution of the vegetation planter box is placed along the exterior wall of the parasitic units, which faces the sea, and on the ground planter box. These plants are classified by color codes of their ideal temperature habitat. The relationship with the agricultural production was designed based on ‘Market Hall,’ which is an opportunity to attract public attention and local communities to the site, benefiting economic and social sustainability. There are only four types of voxels throughout the design, categorized by their function. The overall design is based on applying these four sizes of voxels to create a principal uniform format, making variety in a uniform method. Water catchments are being placed on the top of the pavilion voxel, a perfect site to collect the rainwater and storm water as it goes down the pavilion and will be directed to the main pipe towards ten units of water tanks. This method is cost saving in production and maintenance, making it feasible and sustainable.

Figures 7 & 8: Cubes of Rio: Programmable and participatory design to production systems in Vidigal favela neighborhood, Port City of Rio De Janeiro, Brazil. Source: Authors

CONCLUSION

Through the different case studies, a new spatial typology is designed and analyzed through a parasitic architecture approach to resist the existing conflict and show the hybridity beneath the port and city relationships. By focusing comparatively on four port cities, including Amsterdam, Constanta, Alexandria, and Rio De Janeiro, this research represents the parasitic architecture approach to tackle the existing contemporary challenges and build resilient communities in liminal spaces of port cities (Mehan 2022). In addition to the work presented in this paper, a series of one-to-one prototyping exercises were conducted as supplementary research in a course called "Cobotic Matters." The outcomes of these exercises are examined in a separate paper that specifically addresses the technical and methodological aspects of human-robot collaborations (Mostafavi et al., 2023). While the parasitic systems in Amsterdam and Alexandria's projects responded to the densification and space scarcity in the historical port city and liminal spaces developments, Rio de Janeiro and Constanta’s design strategies mainly focused on responding effectively to the local community needs and urgencies within the favela neighborhoods and Roma People community. Using the comparative and analytical frameworks, parasitic architecture in this article is represented as a transitional form in liminal port city space associated with integrating and adapting new structures into existing buildings and infrastructures. The results of this research introduce an integrative and multi-scalar adaptive framework for building resilient communities in liminal spaces of port cities across different contexts.

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