ACTIVATION OF A WATERFRONT THROUGH IMPLEMENTATION OF FLOATING ARCHITECTURE

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Abstract: The aim of this research is to discuss the key elements of successful implementation of floating buildings with purpose to activate waterfronts for the public use. The challenge of utilisation of waterfronts and bodies of water that meet city shores seems to have a global presence. Policy makers, planners and practitioners seek to reintroduce the waterfronts as places of public benefit and enjoyment and seem to be sharing the similar guiding principle on which functions these places are able to accommodate. By following this principle, city shores and their water are becoming a functional mix of public spaces where one can come to work, play or simply relax. From the standpoint of increased quality of life, we thus deliver benefits across all of its aspects: social, cultural and economic.

Key words: water, architectural designing, floating architecture, public buildings, recreation.

1. Introduction

The biggest advantage of the floating buildings is making water activities more engaging with the users and also more accessible. It would be also be prudent to say that water is often a building block of a society since proximity of water dictated creation of settlements, cities, states and civilizations. The emphasis has to be placed on the user because society’s interest in floating architecture was ever present throughout the ages. On some occasions as envisioned and sometimes even obtained means of basic survival, while on some others a pure expression of art, joy and wealth. In its simplest form, the description of this elementary challenge remained the same to current day; how does one allow this specific land-based form of architecture to step onto the water in a way which is functional, attractive, but above all resilient and safe [1].

One of the modern-day incentives to revisit and redefine the architectural waterfront space and water seems to be the lack of building space in the very centers of the highly urbanized areas and the increased risk and frequency of water level oscillation which is most often attributed to global climate change. In addition to this, changes in global economic environment resulted in many harbors, canals, rivers and their walls being abandoned and so often completely unutilized even despite of the fact that they remained positioned in the very centers of the cities and this present a large opportunity for urban developing. Here it is important to note that we are not talking solely about the waterfront and the space of the available land. It is the integration of the floating architecture and the land-based structures that holds the key to creating the largest public benefit while providing high resilience and minimal environmental impact.

In accordance with the previous studies, it is possible to compare and discus results while considering different projects and conceptual ideas. Floating building is basically endurable to a change in water level in time of water related disasters and re-locatable and long-term usable due to mobility (…) therefore, floating building can have advantages from both environmental/economic and social/psychological aspects comparing with the building on land [2].

This paper aims to provide an insight into opportunities presented by utilization of available waterfronts and adjacent water spaces, but also, opportunities offered by floating objects themselves. Irrespective of whether the emphasis is placed on the fluid, moving environment (the water) of the specifics of the floating object, activation of waterfronts through implementation of floating architecture creates number of specific benefits which are discussed in further detail through this paper.
2. Engaging with the water

Key to successful waterfront planning is activating the water-searching for the balance between managing the flood risk and enjoying/engaging with the water. This can be defined in two ways:

- Physical engagement, such as activity and use of the water, as well as access to the water and the space along the waterside. It can be as simple as providing an area for people to swim (such as a beach), fish or sail; or extend to more intensive uses like a water taxi, ferry terminal, theatre or floating sport center;
- Sensory engagement, particularly views of the water, but also hearing the sound of the water or smelling the sea. Visual engagement/surveillance may also be very varied-from having footpaths along waterways.

The combination of the physical and the sensory helps to create vibrant and self-sustaining destination. Creating active uses of the water can help to bring revenue to contribute to the ongoing maintenance costs; it also maintains the need for the water in the hearts and minds of residents and visitors. The most successful waterfronts, those that leave a lasting memory and compel on to return, contain a healthy mix of both physical and sensory engagement. The common characteristic of all of these is public space. Although it may be desirable for developers or property owners to create private waterfronts, it is essential to create public space, as it is footfall that contributes to an active waterfront [3].

When it comes to floating architecture, according to Moon, there are three different aspects representing its advantages:

- Environmental dimension: flood resilience and adaptation to water level change, renewable energy (solar thermal collector, solar PV module, hydrothermal, biomass boiler), biodiesel generator, PCM, use of local material, restoration and conservation of natural environment;
- Both environmental and economic dimensions: long-term usage, water reuse and treatment, natural ventilation, external awning, collecting rainwater, thick insulation, self-sufficient system, low energy house;
- Economic dimension: relocatable, prefabrication and modular design, heat recovery system, reuse of plastic barrel, insulation made of recycled paper, prefabricated construction;
- Social dimension: solider security against crime, peaceful atmosphere, place-making for meeting and events, landmark, community development, livability, social support, community resilience, social capital, high sense of community [4].

In case of mega floats, there are three groups of suggested specifications:

- Technical specifications (overall mission statement, project objectives, system requirement, general layout plan, load/demand estimations, allocation of spaces and distribution of spaces);
- Economic specifications (mission and economic performance specifications);
- Social specifications (social mission and social performance specifications) [5].

Similar set of specifications can be applied in small-scale project or individual floating objects as well.

3. Potential of floating buildings in case of waterfronts

The waterfronts themselves can be divided into several different types depending mostly on the type of water that meets their shores (harbors, canals, rivers etc.). Different types of floating objects and their ability to support different types of activities and social ambitions are closely connected with the main characteristics of the water conditions (height of wave, stream, width of water area, tides etc.). One of the studies shows the potential correlation between the type of water and types of exploitation.
A summary of suggestions for successful waterfront planes [3]

| Activity                  | Buildings                                                                 | Uses                        |
|---------------------------|---------------------------------------------------------------------------|-----------------------------|
| Rivers                    | Should avoid conveyance zones, or where necessary not impede flows        | Mixed-use                   |
| Lakes and reservoirs      | Can support a range of densities with space between buildings. Visual impact within landscape important | Residential, leisure       |
| Canals                    | Up to the water’s edge or set behind public walkways                      | Private with inter-spersed semi-public buildings |
| Harbours and marinas      | Up to and over waterfronts, often with tall building                      | Mixture of commercial and leisure |
| Disused docks, wharfs and quays | Up to, and on occasion in the water. Disused docks can sustain dense development due to their scale | Mixture of commercial and residential |
| Coasts and deltas         | Set back with regular gaps in between                                     | Public, recreational        |

The positive characteristic of floating structures is that by their very nature they are not permanently positioned on any location, but instead they enable movement in a sense of following the ambition of community or financial ambition of the investors. A building may be relocated in the case of contamination on site, the reconstruction of a harbor or the quay where the construction is docked, or the repurposing of an urban settlement into whose function the construction no longer agrees with, but also in the event that the building at hand must undergo a shift in function which requires a different urban area [6].

4. Case study

The brief overview of three different projects of floating structures presented below demonstrates how even a small number of examples can illustrate a wide range of possibilities of use which are offered by these types of buildings. Revision of these examples can be offered through four selected parameters defined below:

1. Function
2. Location (according to the city)
3. Characteristics
4. Construction / Implemented systems

4.1. Fluctuart (2019)

Fluctuart (Architects: Seine Design; Location: Paris, France; Area: 1000 m²) is a museum (gallery) containing a specialized bookstore and a rooftop bar. It consists of different volumes that can accommodate temporary exhibitions, a permanent collection, in situ interventions, cultural events, creative workshops and a rooftop with bar and food.

It is located right next to the bridge Pont des Invalides, on the river Seine, equally distanced from the Eiffel Tower and Notre-Dame.
Floating museum is envisioned used like a “lively, dynamic, evolving place, a place of creation, exhibition, meetings and exchanges, inspiration and entertainment”. Enriched by occasional residencies of artists, it emphasizes the participation of all the actors of the urban scene by the presence of professionals of art and culture, artists, recognized or emerging, as well as institutions.

Fluctuart has modular three stories visually transparent, 40-m long and 11.40-m wide, completely made of steel and glass [7] (Fig. 1, 2).

4.2. Alles Sea Pool (2016)
Alles Sea Pool (Architects: Huttunen-Lipasti-Pakkanen Architects; Location: Helsinki, Finland; Area: 2600 m²) is a floating deck holding three swimming pools: two 25-metre and 1.6 meters deep swimming pools, one heated and the other filled with clean, filtered seawater. There is also a traditional heated pool for children 60 cm deep (Fig. 3, 4).

The complex is located close to the Helsinki Market Square Kauppatori, in the Historical Helsinki harbor (the city center, one of the most prominent properties in the country).

Alles Sea Pool is part of the complex that combines pool and cultural center (shore-side activity areas and roof-top terraces, a Baltic Sea Centre, a café, a restaurant, a sauna and a maintenance section).

The water in the sea water pool is pumped from farther away in the sea, from cleaner currents, and the water is filtered using UV technology. Second pool is heated to 27°C all years around and the children’s pool is works only throughout the summer season [8, 9].

4.3. Water Pavilion for the Yeosu EXPO (2012)
Water Pavilion (Architects: Daniel Valle Architects; Location: Yeosu, South Korea; Area: 30 000 m²) is exhibition building. It is divided in various sections where large connecting areas between spaces and combined with special material composition: fluid informational walls are translucent in different degrees so that they can deliver information at the same time that allows vision through them. There are two different modules of using (Fig. 5):
• During expo: Theme exhibitions, looking like aquarium (Marine Art, Marine Culture, Marine Technology, Marine City, Climate Environment, Recent Climate Environment);
• After exhibition: Multipurpose room, Laboratories, Dormitory, Restaurant, Water garden.

Proposed location for the pavilion is in marine close to the water tower in Yeosu, South Korea.

The pavilion is not an architectural object in relationship with the water but rather a nautical construction shaped by the movement of water. The movements of the building can be vertical. Each movement will create a different relation with the water defining new movements and usable areas on the pavilion’s upper platform. That can form three potential purposes for the platform (Fig. 6):
• Sea Gardens (Sea Gardens, Sea Plaza, Waterfall);
• Sea Park (Swimming Areas, Kid Pool, Sea Bath);
• Event Plaza (Event Stage).

The pavilion is a hydraulic machine system which allows manifesting various configurations in relationship with the water. By filling in deposits of water distributed along the structural body, it can gain or lose weight and therefore rise or lower its level with the water surface. The pavilion includes a water purification system that allows transforming saltwater into freshwater. The consumption of energy is reduced to the minimum thanks to an efficient cooling and insulation water system. Solar panels and micro turbines on the cascade collaborate to generate the energy needed for the pavilion [10, 11].

5. Discussion
In accordance to the projects mentioned above and project analyzed in previous studies, it is possible to have a further discussion.

5.1. Function
In addition to its primary function of a multifunctional and highly attractive exhibition space, business success of Fluktuart rests on its ability combine its primary function with highly profitable secondary functions such as open deck bar, bookstore and others.

In example of Allas Sea Pool on the other hand we can observe how close integration of floating building with its immediate land-based surroundings directly increased functionality of the project and created larger benefit for its users. Again, primary function of sport, recreation and relaxation in water is thus combined with a culture centre which accommodates a bar, restaurant and other complementary functions. Finally, it must be noted that integration between these two structures is not limiting to neither of them, while both structures retain the capacity to operate independently from one another.

Fig. 5. After Expo / Loading during Expo / Typhoon (left); Pavilion titled level during Expo for Water Show (right) [11]

Fig. 6. Sea Gardens (left); Sea Park (middle); Event Plaza (right) [11]
Multifunctionality of the floating structures leads to the higher level of utilization and flexibility, which further implies the high level of adaptability as well.

It is possible to have public building of all different sort of functions. Today, there are floating hotels, restaurants, cinemas, schools, museums, sport centers, swimming pools etc. One of the very specific that floating object accommodate is a floating mental hospital. Esquirol (Architects: Seine Design; Location: Paris, France; Year: 2011. Available at: http://www.ronzatti.com/architecture_flottante-26-en) is a daytime hospital that accommodates therapeutic working groups around various medias, but because of unusual location and design, it looks more like artist studios than a hospital, which gives domestic and warm atmosphere comparing to traditional objects of this type.

5.2. Location

Floating architecture encompasses the revitalization possibility of old urban declining area, offering the place to enjoy water-related leisure activities, natural view, and social support and activities [2]. In selected examples, two types of issues are presented:

- Central location where it won’t be possible to build, either because of the protected properties or lack of the space on land;
- Location where revitalization of the site is necessary to make it publicly attractive for different activities close to the water;
- Mobility and relocation as utilization strategy to make a building more profitable.

The project of the Allas Sea Pool complex has been an exceptionally complicated which resulted with venturing out onto the sea and into an area where building has previously been restricted. As the building solution couldn’t be permanent, it required temporary building permits (until 2023.) and their associated application processes [11].

After the expo, the pavilion could remain in its location or travel around the region. The future facility for the blue ECO-polis could travel along the region coastline facilitating on site-research [10]. Buildings of constant function and the possibility of relocation represent very ambitious new concept of long-term architectural and urban planning. Single or periodic use massive objects, in terms of an independent structure or a series of interconnected elements in a colossal complex of buildings, which are used at the one and the same locality make for inordinate investments which, in turn, results in the necessity of cost rationalization. This type of concept encourages space saving as constructions of this kind take up significant amounts of land [6].

The ability of relocation plays a fundamental role for investors with ambition to invest in areas which are protected by conservation societies as areas of high historical relevance. Public tenders issued by local authorities often limit the lease terms for such spaces to only five of ten years. Investments in large and attractive floating structures can require much longer payback periods, but the fact that they can be relocated and reused in alternative locations makes such projects feasible from the perspective of the entrepreneurs.

In example of Fluctuart, the floating structure is located in the historic center of Paris right next to the bridge Pont des Invalides, on the river Seine, equally distanced from the Eiffel Tower and Notre-Dame where all new developments (permanent and land based) are completely prohibited. Temporary nature of a floating structure allowed for this new project to be introduced into this specific environment. Apart from its ability to be relocated, the floating objects are characterized by generally low environmental impact since they do not require large interventions into their immediate surroundings in order to be safely moored and connected to the area of waterfront.

Dissimilar to floating exhibition space, but equally relevant example of how a floating object can accommodate different ambitions of the community is Urban Rigger (Architects: Bjarke Ingels Group; Location: Copenhagen, Denmark; Area: 680 m²; Year: 2016. Available at: http://www.urbanrigger.com/). A solution to challenge of growing number of students in their local area a lack of available space to accommodate them, sits in the core of their value propos-
The opportunity presented itself in a form of underutilized and underdeveloped areas of Copenhagen city harbor located in the heart of the city. By introducing a building typology optimized for harbor cities Urban Rigger team was able to introduce a housing solution that kept the students at the heart of the city instead of moving their presence into the suburbs. This or similar solutions can be located anywhere with water access and can easily be moved to wherever housing is needed but space is limited.

5.3. Characteristics

One of the most significant qualities of floating building is unique experience they offer to the users. This means that the water can add completely different context to the function as instability and fluidity of environment is reflecting on the object directly. Sometimes, it is not even possible to predict all the aspects existing in combination of these two elements that correspond with each other.

In a fashion of the Trojan Horse a floating building is able to appear virtually overnight and take the position in city’s prime location with a direct view on its most iconic sites. Looking at the example of Allas Sea Pool, these benefits are certainly comprised of views of the city, Presidential Palace and a line of ferries and cruise ships that glide in the vicinity while users are enjoying the water of the open pool (Fig. 7, 8).

Successful integration between the floating object and its immediate land-based environment needs to become one of fundamental goals when developing waterfronts and introducing different items of floating architecture. Instead of narrow bridge or a gangway which provide physical connection, but more often than not solely emphasize the boundary between land and water, designers need to search for more inviting, almost seamless solutions for this transition. This in not to say that one should try to hide the fact that user is stepping onto the water. On the contrary, user should feel invited, intruged, excited about exploring this transition and the floating structure at hand. By doing so, the user becomes an informed observer able to understand the fragile nature of not only this microenvironment, but also sensitive to the issues related to entire rivers, lakes, and seas. This positive introduction and exiting sensation of involved contributor which it creates, will inevitably have a long-lasting positive effect on the visitor and a positive attitude towards engaging with the water space. The Water Pavilion, although still in its concept development phase, is a strong example of how this can be achieved (Fig. 9, 10).

Apart from visual identity of the building, there are two types of mobility present in the example of Water Pavilion: ability of being able to re-locate and vertical mobility. Vertical mobility makes the building able to, depending of the water level, be functionally transformable completely as per example discussed in previous section. The key difference between land buildings and water constructions lies in the existence of a mooring system which allows free vertical movements, thereby ensuring synchronization with the fluctuation of water masses and/or payload requirements. This type of system represents an entirely new degree of sustainability and...
adaptation to the conditions of natural environments. Floating buildings, therefore, gain the capacity to endure the lack of stability inherently found along the body of a river or sea due to the consequences of climate change such as rising levels, increased rainfall, flooding and daily shift of the ebb-and-tide cycles. Such arguments speak in favor of the safety that floating structures thus introduce, as the surface of the building remains constantly above water levels [6].

5.4. Construction / Implemented systems

According to British Columbia Standards, the floating building can be defined as a structure which provides space for living/working that floats on water using a flotation system, is moored in a fixed place, doesn’t include a water craft for navigation, and has a premises service system (electricity, water/sewage and city gas) served through the connection by permanent supply/return lines between floating and service station on close land, or has self-supporting service facilities for itself [2].

In terms of hull construction material, the primary choice is still being made between steel and concrete with steel being heavily represented due to the accessibility of construction knowledge and the flexibility of use. In some practical examples the combination of these two construction materials is used. Such is the structure of Allas Sea Pool where the steel hull of the swimming pool is combined with multiple floating units of concrete pontoons. Apart from the two mentioned materials, in the last few years there are several other options being introduced into the market. Plastic and composite hull construction materials are only a couple of new possibilities available today.

Once the type of the hull construction material has been defined it is time to consider the design aspects of the hull which are heavily influenced by the locality in which building is to be positioned and the transportation routes which stand available for its delivery to the site. In some cases, a modular design of the hull and/or superstructure is the only feasible option. By accepting this approach, different modules of the floating object can be constructed at remote location and then transported to the site where the final assembly is taking place.

In the example of Fluctuart, single unit design of the steel hull is combined with multiple modules which connected together form a solid superstructure.

Apart from this primary consideration on construction material, construction of the floating building requires implementation of multiple safety systems and operating infrastructure. In terms of safety, fire suppression systems and emergency water extraction systems (often called the bilge system) require careful consideration. In some cases, designers need to consider a system of active or passive ballast which work to ensure the stability of the structure under different operational loads and provide comfort of use under heavy weather conditions.

In addition to safety systems, the extensive number of systems which form the operating infrastructure is required. These include, but are not limited to electrical distribution, black and grey water systems, fresh-water systems, UV water filtration technology, hydraulic machine system, water purification system, cooling and insulation water system, Solar panels and micro turbines and etc.
6. Conclusion
When it comes to society’s successful engagement with water two aspects of this engagement need to be taken into consideration. The first one related to physical use and a second one to sensory experience which designers aim to create. Successful combination of the two stands as a guarantee of the popular public space which attracts the high footfall and delivers an active waterfront. When it comes to advantages of the floating architecture, again we have several different aspects to consider but they remain concentrated around three main dimensions: environmental, economic and social. This is not to say that floating structure aims to deliver the benefits independently on its own. The design and the very nature of the floating object are heavily determined by the type of waterfront to which they are connected and the sea/water condition in which they exist. Rivers, lakes, canals or harbors all come with their specific set of limitation and operational requirements.

These differences are presented in the brief overview of three different projects of floating structures. The case studies presented in this paper demonstrate how even a small number of examples can illustrate a wide range of possibilities of use which are offered by these types of buildings. In terms of function, we have shown how a close integration of floating building with its immediate land-based surroundings directly increased functionality of the project and created larger benefit for its users. Multifunctionality of these projects also led to the higher level of utilization and flexibility, which further implies the high level of adaptability of floating structures when compared to other types of buildings. In terms of location, mobile nature of the floating object allows it to be positioned in the most attractive of the urban areas or in the areas which require minimum environmental impact and/or are protected by conservation societies as areas of great historical value.

This paper also shows that designers have the direct incentive to search for more inviting, almost seamless solutions for this transition between the land and the floating structure. This in not to say that one should try to hide the fact that user is stepping onto the water. On the contrary, user should feel invited, intrigued, excited about exploring this transition and the floating structure at hand. By doing so, the user becomes an informed observer able to understand the fragile nature of not only this microenvironment, but also sensitive to the issues related to entire rivers, lakes, and seas.

Finally, when it comes to construction of the floating object several different considerations need to be taken into account. Starting from hull construction material, type of hull and superstructure design and finally, choice between different safety systems and operational infrastructure. Each of these decisions has a potential to strongly define operational life of the structure and give a significant contribution the type of experience created for the final user.

Mindful integration of the above-mentioned elements all aims to transform the user from the role of passive observer into the role of involved contributor and thus inevitably create a long-lasting positive effect on the visitor and a positive attitude towards engaging with the water space.

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АКТИВИЗАЦИЯ НАБЕРЕЖНОЙ ЗА СЧЕТ РЕАЛИЗАЦИИ ПЛАВУЧЕЙ АРХИТЕКТУРЫ

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Аннотация: Целью данного исследования является обсуждение ключевых элементов успешной реализации плавучих зданий с целью активизации набережных для общественного пользования. Проблема использования береговой линии и водоемов для городских набережных является актуальной во всем мире. Политики, планировщики и практики стремятся вновь представить набережные в качестве мест общественного пользования и наслаждения и, как представляется, разделяют аналогичный руководящий принцип, в соответствии с которым функциональность этих мест может быть приспособлена. Следуя этому принципу, городские берега и их воды становятся функциональным сочетанием общественных пространств, куда можно прийти на работу, поиграть или просто отдохнуть. Таким образом, с точки зрения повышения качества жизни мы предоставляем преимущества во всех его аспектах: социальном, культурном и экономическом.

Ключевые слова: вода, архитектурное проектирование, плавучая архитектура, общественные здания, место отдыха.