

Development Process and Factors of Floating Architecture

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Abstract

This paper aims to discuss the development process and factors of floating architecture through the chronological cases and to provide some reference ideas for new floating building projects. Floating architecture is basically enduring to a sudden or continuous rise in water level. Conclusions can be summarized as followings; shoddy houseboats have developed into almost all types of floating architecture around the world with extreme ups and downs; prefabrication and modular construction with factory production, minimum waste and little noise in site can be a development factor; environmental consideration with material usage, renewable energy application, water treatment system can be second development factor; enhancement of social sustainability with unique and comfortable place, natural view, social and psychological sense, role of revitalization catalyst in declined area can be third development factor.

Keywords: floating architecture; development process; development factor; sustainability

1. Introduction

Due to climate change like global warming, nowadays there have been severe and frequent natural disasters like heavy rain, hurricane and flooding. Residents on coastlines may become refugees due to rising sea level in near future. Meanwhile, people want to enjoy the activities or to live on water rather than on land according the improved level of living. Floating architecture can be a strong alternative solution for above 2 aspects.

This paper aims to discuss the development process of floating architecture through the analysis of case studies by time slots, to investigate the major development factors, and to provide some reference ideas for new floating building projects. Research method includes the review of related literatures and the search of architectural web-sites. Analysis is made for the available cases in terms of physical, environmental and social respects.

2. Floating architecture and brief history

2.1. Floating architecture

Floating architecture can be defined as a building for living/working space that floats on water with floatation system, is moored in a certain location, does not include a water craft designed or intended for navigation, and has a premises service system (electricity, water/sewage and city gas) served

through connection by permanent supply/return system or has self-supporting service facilities.

Floating architecture on the water is basically enduring to a change in sea or river water level, and can be relocated to different places when necessary due to easy movable characteristics. Floating architecture is advantageous to utilize the various renewable energies because solar, hydrothermal, wave and wind energies can be obtained easily on the water comparing with the building on land.

2.2. Brief history


There were primitive floating architectures made of reeds in the Marsh Arabs(Madan) of southern Iraq over 5,000 years ago, the area was self-sufficient and self-sustainable.

In Europe, houseboats were along the canals and rivers of Netherlands, France and Britain around 1800s, some standard of floating homes with urban utility services can be seen in Amsterdam since 1930s.

In US, waterfront living goes back as the 1880s, but houseboats with a certain standard as floating homes were permitted around Sausalito area near San Francisco from 1970s. Floating homes in Oregon Yacht Club were built as summer house and the year-round homes on the Willamette River in Portland since 1910s. Floating homes were built as permanent homes for families on Lake Union in Seattle since 1920s.

Nowadays almost all types of floating buildings such as house, hotel, exhibition hall, leisure facility, restaurant, water sport club, event hall, office, visitor center, swimming pool, school, dormitory and others have been built around the world.

Table 1 A Chronology of Floating Architecture

Year	Photo	Name	Function	Description
1910		Oregon Yacht Club, Portland, USA	residential	floating home community(38 units), psychological and social sustainability, conservation of natural environment, strong sense of community: against natural disasters, safety for fire & evacuation, negotiation of legal regulation conflicts with the city, security against crime
1920		Floating homes in Seattle, USA	residential	long history of extreme ups and downs, from home for fishermen/ boat makers/ bootleggers, Bohemian crowd/students, to artists/ writers/ photographers/entrepreneurs, number of houseboats decreased from over 2,000 to 400,
1960		Floating homes around Sausalito, USA	residential	floating home community(about 460 units), long history of extreme ups and downs, peaceful and comfortable atmosphere on the water within a good natural environment, strong sense of community, self-built floating homes
1975		Aquapolis, Japan	exhibition (Expo)	floating city for Expo '75 in Okinawa, Japan, built at Hiroshima for the International Ocean Exposition, keep the natural beauty of Okinawa free from pollution and soil erosion
1976		River Kwai Jungle Rafts, Thailand	hotel	floating bamboo lodge moored along the historical River Kwai Noi surrounded by lush green mountains and jungle, living without electricity and internet, sewage treatment system and wood raft from dead tree
1980		Sea Village Marina, USA	residential	floating home community(54 units), damaged during Hurricane Sandy in 2012Sidewalk decks were more severely broken than the floating houses themselves
1987		Ladner Reach Marina, Canada	residential	floating home community(19 units), marvelous view to the river or lake, a distant mountain, and migration habitats
1988		Four Seasons Hotel, Australia	hotel	long term usage from 1988, self-supporting floating building with desalination plant, sewage & waste treatment system, and a power plant
1989		Sakaigahama Marine Park Aquarium, Japan	leisure	comprehensive resort facility, opened in conjunction with the exposition of the sea and the island, composed of aquarium, penguin house, shell museum and sounds of Seth
1991		Floating Pier, Japan	ferry terminal	floating ferry terminal and restaurant, comfortable place for eating seafood with ocean view, night view of the Yokohama Bay Bridge
1996		Tenas Chuck Moorage, USA	residential	floating home community(32 units) in Lake Union, Seattle, psychological and social sustainability, good relationship with neighbors
1997		Jantzen Beach Moorage, USA	residential	floating home community(177 units) in Columbia river, Portland, largest floating home community on the west coast, psychological and social sustainability
2001		Fort Langley Residential Marina, Canada	residential	floating home community(30 units) in Fraser river, Langley, excellent natural view, psychological and social sustainability
2003		Nackros villa, Sweden	house	prefabricated floating home on lake in Kalmar, sustainability, constructed with material recycling potential, hydrothermal system, industrialization for prefab house
2003		Floating Café, Austria	café & play ground	an artificial floating "island" in the middle of the Mur river, Graz, to celebrate the occasion of Graz becoming the 2003 European Capital of Culture, symbolic structure, point of urban regeneration, local landmark
2005		Fennell Floating House, Oregon, USA	house	a reconstructed floating house in Oregon Yacht Club, ultra-low energy house, swirling and curved design, passive design with natural lighting & ventilation, prefabricated construction
2006		Waterline Floating Restaurant	restaurant	a floating restaurant on Tokyo canal based on Tokyo Waterfront City Project, a part of T.Y. Harbor brewery, barrier free design can accept wheelchairs
		Floating home in Hamburg, Germany	house	a prefabricated floating home on Elbe river in Hamburg for pilot project, great outside view, several prototypes of floating homes to meet the client's requirements
		Floating Homes in DoudenKust, Netherlands	residential	amphibious & floating home community(amphibious 32 units & floating 14 units), modular construction, jumping and swimming from the balcony of the floating home
2007		Floating Prison, Netherlands	prison	largest floating building project in Europe, 300 prisoners capacity, prefabricated modular construction
		Floating Stadium, Singapore	stadium	world's largest floating stage, made entirely of steel, place for sports, concerts, exhibitions, and the arts and cultural performances, prefabricated and modular pontoon of steel
2008		UBC Boathouse, Canada	boat club house	a floating facility moored along the banks of the historic Fraser river, all types of events from small meetings, corporate events, social gatherings and large formal events, serving as an athletic and social center
		KAI 10, Germany	event hall	a floating event and conference hall(capacity 350 people), affiliated with the four stars Mercure Hotel of Hamburg city, amazing illumination reflecting on the water surface
		Floating hotel "Salt & Sill", Sweden	hotel	hydrothermal energy system, local raw building material like pine wood, environmentally friendly building finish materials, consideration of water environment
2009		The Float House in New Orleans, USA	house	a floatable house against hurricane like Katrina, low-cost and prefabricated construction, traditionally modified and personalize vernacular house, sustainable factors like solar power generation, rainwater collection, geothermal energy system, and efficient energy system

2010		Floating Pavilion, Netherlands	event hall	place for various conferences and social events, remarkable shape as a landmark, solar heat panel, Phase Change Material(PCM), ETFE foil for roof, water treatment system, nearly self-sufficient building
		Floating Stage, Korea	stage	floating stage for various genre such as concert, play, musical and dance on the Han river, on-off hemisphere type roof, symbol of the restoration and creation
		Floating Office for Waternet, Netherlands	office	a floating office, building materials of reed and timber frame are re-usable or biodegradable, hydrothermal energy system, solar PV energy
		Seoul Marina, Korea	club house	a small complex floating marina club on the Han river, legally permitted as a first building in Korea, nice view to the river and spacious deck
		IBA Dock, Germany	exhibition hall	urban and architecture information center, prefabricated modular construction, hydrothermal energy system, solar PV energy
2011		Seoul Floating Islands, Korea	culture center	3 floating lantern Islands, revitalization of unused urban spaces in order to create places of rest, recreation and culture, cultural icon of Seoul, prefabricated structure, floating buildings express the flowers each
		Villiot Float Home, in Seattle, USA	house	reconstructed floating home in Lake Union, a case of old & shabby floating home replaced with new & luxurious one, prefabricated construction, good view and putting green on roof deck, client's intention of home: creative but harmonized design with neighbors'
		Floating Houses Ijburg, Netherlands	residential	detached and row floating houses community(75 units, 20,000 people)), prefabricated construction, transported by tug boat and installed on site, expected 18,000 homes for 45,000 people at the final stage
2012		Autark Home, Netherlands	house	European passive house certificate, self-sufficient system: solar heat panel, solar PV energy, water treatment system, bio-diesel generator
		AR-CHE Aqua Floathome, Germany	residential	floating home community(20 units), prefabricated modular construction, an innovative air-vapor barrier membrane and quality thermal insulation for the high performance, redevelopment of closed coal mine
		Floating Homes in Lelystad, Netherlands	residential	floating home community(8 units), united families in a collective partnership called "Float in Lelystad", eight different design but matching, color coordination in façade wall panels, strong sense of community
		Brockholes Visitor Centre, UK	visitor center	floating eco-village, recyclable & recycled building material like copper & newspaper, entirely natural ventilation, solar PV energy, biomass boiler, peaceful surrounding
2013		Floating Garden in Paris, France	garden	place for social interchange, unique and comfortable place to relax with a variety of vegetation, opportunity to infuse needed nature into the Parisian psyche
		The Egg Home, UK	workshop	built with traditional techniques out of local materials, a temporary, energy efficient self-sustaining work space for artist, solar PV energy, water treatment system
		Hasle Harbor Bath, Denmark	swimming pool	revitalization of the declining harbor, place for various social activities, special waterfront atmosphere and legendary sunset
		Arctia Headquarters, Finland	office	a floating headquarter office building, prefabricated construction in a dock, harmony of timeless and minimal design with the surrounding environment, an integrated water ballast system
		Makoko Floating School, Nigeria	school	solar PV energy, natural ventilation, recycle organic waste, collect rainwater, plastic drum pontoon, local building material like bamboo & wood, social support & community resilience
2014		Amphibious House, London, UK	house	the UK's first amphibious house adjacent to the Thames river, floatable house with dock-like foundations, triple height glazed facade allows views of the river from all floors
		Brisbane Ferry Terminals, Australia	ferry terminal	resilient solution for massive floods in Brisbane, 2011, reconstruction project, international design competition, single tall defensive pier-rotating gangway-pontoon for floating
		Floating Off-grid Greenhouse, Italy	greenhouse	prefabricated modular construction, solar PV energy, water by solar stills, recycled plastic drum pontoon
		Dutch Floating Bridge, Netherlands	bridge	a floating bridge for visitors' convenience of access and emergency exit, use of water resistant material, harmony the floating bridge with old and historical area
2015		Pavilion of Reflections, Switzerland	event hall	public place for biennale event, place for relaxation and swimming, Barrier free design for disabled swimmers
		Brooke Street Pier, Australia	ferry terminal	reconstruction project, revitalization of urban waterfront, local food market, community event space outside of the building, hydrothermal system
		Floating Kayak Club, Vejle, Denmark	kayak club house	a floating kayak club, enhancement of community activities, transformation old harbor into more active area
		Floating Restaurant, Helsinki, Finland	restaurant	a modern extension of the famous Workers House, a new &, exceptional restaurant in the historic milieu
2016		Urban Rigger, Copenhagen, Denmark	dormitory	urban revitalization, modular design, upcycled shipping container, solar PV energy, hydrothermal system

3. Development process and factors

A chronology of floating architecture can be summarized as Table 1. Floating architecture was mainly shoddy houseboat for temporary living at the beginning stage around 1900s, but almost all types of floating architecture have been designed and built around the world.

In US, early floating houses showed traditional and eclectic style and included regular home structures built on wood rafts on the lake or river. There were extreme ups and downs due to economy situation, legal problems, authority's policy and social atmosphere for a long time. Old and obsolete houses have been replaced by new and modern ones owing to prohibition of new construction and wealthier residents' preference to live in water space & natural environments.

Meanwhile, in Europe, a lot of people started to live in cheaper houseboats since the economic crisis around 1930s. From the 1980s, various floating houses and buildings with new technology and modern construction have been built along the canals, rivers and lakes.

Prefabrication and modular construction can be a development factor for floating architecture. As floating buildings are usually produced in a factory/dock, moved by water/road transportation, and moored to a certain place, construction waste on site can be saved to the maximum and peaceful atmosphere of the surrounding environment might be disturbed with noise in the minimum period.

Environmental considerations in floating architecture can be second development factor. Usually floating building applies material reuse & upcycling, use of local building material, water recycling & treatment, various renewable energy applications such as hydrothermal heat/cooling system, solar PV energy and solar heat panel, and heat recovery system. In some cases, floating buildings have nearly self-sufficient energy system. Features of long time use due to movability and re-locatability also can reduce the environmental damage.

Enhancement of social sustainability can be third development factor for floating architecture. When seen from the surroundings of most floating home community, there are unique and comfortable place to enjoy and live within nature, excellent natural view, good neighbors, social and psychological sense of stability, solid social spirit of strong unity, and social sense of security against the crime. Several cases of floating structure become the revitalization catalyst of historical but declining urban area, closed coal mines village and old harbor area, and provide some places for relax and food, water-related leisure sports, affordable student dormitory, and various social activities in urban space.

4. Conclusions

This paper aims to discuss the development process and factors of floating architecture through the chronological cases, to find recent trends, and to provide some reference ideas for new floating building projects. Floating architecture is basically enduring to a sudden or continuous rise in water level due to climate change.

Conclusions can be summarized as followings; shoddy houseboats have developed into almost all types of new floating architecture around the world with extreme ups and downs; (physical aspect) prefabrication and modular construction with factory production, minimum waste and little noise in site can be a development factor; (environment aspect) environmental considerations with material reuse, renewable energy applications, water treatment system can be a second development factor; (social aspect) enhancement of social sustainability with unique and comfortable place, good natural view, social and psychological sense of stability, role of revitalization catalyst in declined areas can be a third development factor.

According to the continuous rise of sea and river water level from global warming, not only floating architecture but also large floating city with self-sufficient system might be developed in the future in order to adapt the climate change and to find a sustainable solution, especially in lowland and coastal area.

In addition, disadvantageous aspects of floating architecture such as possibility of natural water disaster like typhoon & flooding, blocking the sunlight into the water environment, wet atmosphere to the human body and building itself, other various negative effects to the ecosystem should be investigated in depth and discuss effective countermeasures to resolve with other related professionals, need to be suggested through further research.

5. References

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