

A Study on the Floating Building as a New Paradigm of Architecture

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Abstract : According to climate change, deficiency of usable land, large water portion of the Earth surface, and improvement of income level, floating architecture is emerging as a strong & attractive alternative. The aim of this study is to suggest some related applying ways for new building projects around waterside. New paradigm of architecture can be described as a new model and/or system of architecture with new concept and Zeitgeist like sustainability and green building. Floating building is already a new paradigm of architecture comparing with the preconception of building only on the land and current building regulations. New paradigm features from the sample projects can be summarized as new concepts of building, application of various renewable energy resources(water, solar, wind), modular construction, use of local raw material, dual purpose usage, long term and relocatable usage, and special building materials for green building.

Key words : Floating building, Water friendly building, New paradigm, Sustainability, Climate change

1. Introduction

Owing to climate change like global warming, the water level of sea and river has been rising. The 70% of the Earth is covered with the water. Meanwhile people want to live and enjoy leisure activities near or on the water according to the increase of economic income level. Therefore, water friendly building will be strong alternative architecture and needed more and more in the future.

People have thought that buildings should be constructed only on land. Usually building regulation permits the building design only on land. But for example, the Dutch has lived on houseboat for a long time. And immigrants in Seattle have started to live on the floating homes made of wood raft and wood structures.

The aim of this study is to investigate the new paradigm features of floating building through planned and realized projects, and to suggest the applicable item and way for the new building projects on water.

Research methods include the review of the related literatures to set the framework of new paradigm concept, the navigation of floating building related homepages, and the site-visits of some floating buildings in Europe & USA.

Sample buildings of realized and planned projects are selected through the search on internet like Google(<https://www.google.com/>) and the related articles of online architecture

magazine like Inhabitat(<http://inhabitat.com/>) and ArchDaily(<http://www.archdaily.com/>).

As conclusion, the advantageous and new respects of floating building comparing ordinary building on land are to be suggested for new building project and architectural paradigm shift.

2. Concept of floating building and new paradigm

According to the British Columbia Float Home Standards(Office of Housing and Construction Standards, Ministry of Energy and Mines, British Columbia, Canada, 2012), float home means a structure incorporating a floatation system, intended for use or being used or occupied for residential purposes, containing one dwelling unit only, not primarily intended for, or usable in navigation and does not include a watercraft designed or intended for navigation(Moon, C., 2012).

New paradigm of architecture can be described as a new model or system of architecture with new concept and Zeitgeist like sustainability and green building(The Free Dictionary, 2012).

In this paper, sample floating buildings are to be analyzed and new paradigm features are suggested in terms of new

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concept, sustainability(focused on renewable energy) and green building concept.

Floating building itself is already a new type of architecture and there are a lot of possibilities in terms of sustainability and green building. Therefore floating building can be a good example in new paradigm of architecture.

3. Outline of sample floating buildings

3.1 Realized Projects

1) IBA dock

- Region: Hamburg, Germany
- Completion time: 2009
- Story & floor area: 3 story, 1,623m²
- Date of visit: 2011.8.6

This building was the headquarters of the IBA (international building exhibition) Hamburg GmbH as well as an information and event center for the IBA. Now the building is being used for Urban and Architecture information center in Hamburg(see Fig. 1).

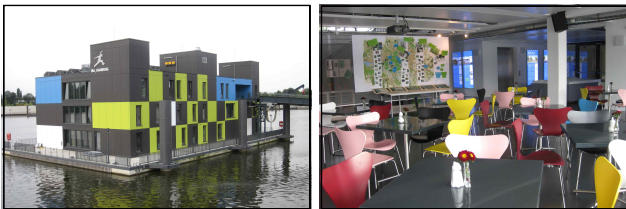


Fig. 1 Overview and interior of IBA dock

This floating building is a steel-construction on concrete substructure pontoon. The superstructure of building was made in a prefabricated modular construction, and it also used a ready-made heating and cooling ceiling elements in the entire building.

This building was planned that air conditioning might be possible without conventional energy sources such as oil and gas. Several measures were reviewed to provide energy supply for the IBA dock from the water temperatures of the Elbe, solar heat panel, and solar photovoltaic cells (Immosolar, 2013).

New paradigm features from this building can be summarized as new concept of office and exhibition building, application of various renewable energy system, and adoption of modular construction.

2) Floating hotel "Salt & Sill"

- Region: Island of Klädesholmen, Sweden
- Completion time: 2008
- Story & no. of rooms: 2 story, 23 rooms(46 beds)
- Date of visit: 2011.8.9

This floating hotel is located near the famous seafood restaurant "Salt & Sill". The hotel consists of six two-story wooden buildings on floating concrete pontoon(see Fig. 2).

The hotel is very popular even though it is located in rural & coastal area. So there are many visitors all the year over.

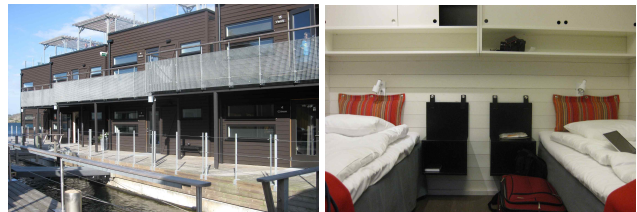


Fig. 2 Overview and interior of Salt and Sill

The hotel was designed with the mind of environmental sustainability as heating energy is generated from the warm sea water underneath the hotel in winter.

The building used local raw materials such as the pine wood from Swedish forests, and environmentally friendly paint. They have even used the left over quarrying stone to build a new lobster reef under the pontoon(Voyatzis, C., 2008). And the raised floor system was applied for easy installation & maintenance of service lines.

New paradigm features from this building can be pointed out as new concept of hotel and consideration of sea life, adoption of hydrothermal energy in winter, and use of local material & raised floor for easy maintenance.

3) Oregon yacht club

- Region: Portland, Oregon, USA
- Completion time: 2009
- No. of homes & area of water property: 38 homes, 8 acres
- Date of visit: 2012.8.19.



Fig. 3 Google satellite map and walkway of OYC

The Oregon yacht club(OYC) is a floating home community located on the Willamette River in Portland. It is close to downtown with a pastoral setting, so became one of the premier floating home moorage(see Fig. 3).

The OYC has more than 100 years' history. The original purpose was to foster and encourage yachting. After 1910, OYC started allowing houseboat living in summer, eventually evolved to the year-round homes of today.

OYC is now a modern houseboat community, with a predominance of two-story buildings replacing the traditional one-story residences. The club is currently comprised of 38 floating homes that are permanently situated on the moorage and the walkway.

There are gratings in walkway for light influx to the water. This is a kind of consideration for the eco-system under the floating home. The community also has great interesting in conserving the natural environment like restoration of wild birds, clean marine program, watershed re-vegetation program, and others.

New paradigm features from this floating home community can be suggested as high sense of community and environmental conservation like grating installation in walkway for light influx and related activities for natural environments.

3.2 Planned Projects

1) Floating cemetery

- Region: Hong Kong
- Design time: 2010
- Story & floor area: -

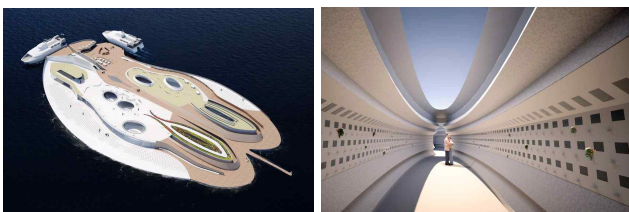


Fig. 4 Overview and interior of floating cemetery
(Source : LaBarre, S., 2010)

This floating cemetery gives totally new concept of burial at sea. It is really difficult to find a place in Hong Kong for cemetery(see Fig. 4). As burial grounds are very limited, private cemetery space is extremely expensive and there is a long waiting list for public burial site.

According to Buddhist tradition, people wants to provide good resting places for dead ancestors. There are some debates whether to build a multi-story columbarium or develop the land for cemetery.

So the architect proposed a floating cemetery near harbor. Visitors can go to the columbarium by boat and keep the ashes in a designated niche or scatter them over the sea.

There should be quite different atmosphere comparing with the existing cemetery on the land. This structure can be a sort of artificial park and provide good seascape to the prayers(LaBarre, S., 2010).

New paradigm features from this project can be summarized as new concept of cemetery and provision of artificial park for good seascape.

2) Floating pool

- Region: Vltava river, Prague
- Design time: 2012
- Story & floor area: 1 story, 810m²



Fig. 5 Overview of floating pool



Fig. 6 Summer and winter view
(Source: Meinhold, B., 2012)

This floating circular pool project came from the idea to clean the polluted river water and also to offer the recreational facility for the residents(see Fig. 5 & 6).

The historic Vltava was a popular swimming and skating place before industrialization. The circular pool structure will function like a giant floating strainer to filter its contaminated water, so that the residents can swim and skate there as before.

The architects proposed to create several floating recreational islands with the purifying facility of textile membrane. Users can access by boat and/or floating

pedestrian bridge.

The pool is located in the center of the building and is surrounded by subsidiary facilities like a bar, private cabins, changing rooms, rest rooms, shower & sauna rooms, and mechanical room. A small and shallow pool is also provided for younger kids.

The river water can be filtered through a textile membrane on the bottom of the pool. In the winter, the pool can be converted into an ice rink for continued use all the year round (Meinhold, B., 2012).

New paradigm features from this project can be suggested as new concept of recreational facility (swimming and skating), installation of purifying facility for the polluted river and dual purpose usage by different seasons.

3) Floating off-shore stadium

- Region: Worldwide
- Design time: 2010/2011
- Floor area & no. of seats: 260,000m², 65,000seats



Fig. 7 Overview & Sectional View
(Source: Sebastian, J., 2011)

This stadium was developed by the German architects “Stadiumconcept” for the FIFA World Cup 2022 (see Fig 7). The floating off-shore stadium can be relocated to seaside place across the oceans (Sebastian, J., 2011). Therefore this stadium can be used by more effectively than usual on-shore stadium.

The stadium can be operated by divers renewable energy resources such as hydrothermal use of water, wind power and solar energy. As floating structures are located on the sea or lake and there is no obstacles, wind and solar power is easy to obtain. And sea water can be used as cooling material in summer in the Middle East region.

Its global mobility, long-term utilization and various economic efficiency show great advantages and so can be a new model for 21st century sports facility. Once a big sports event such as World Cup or Olympic Games was completed, operation and maintenance of the stadium raises economic problems due to low utilization.

Almost all the countries of the world have access to the sea. This unique floating stadium can be one of the most

innovative and sustainable facility worldwide due to economic efficiency and long-term utilization.

New paradigm features from this project can be summarized as new concept of mobile sports facility, adoption of various renewable energy system (hydrothermal, solar energy and wind power) and long-term usage by different relocations by different people in need.

4) Floating mosque

- Region: Palm Jebel Ali, Dubai, UAE
- Design time: 2007
- Story & floor area: 1 story, -

This floating mosque has traditional Islamic arches and two rows of transparent plastic columns that support the roof and give daylight through the prayer hall. The mosque could be floating by the large pontoons made of concrete & styrofoam (see Fig. 8) and self-supporting as possible in terms of energy.



Fig. 8 Perspective & interior of floating mosque
(Source: Reinl, J., 2007)

Roof and columns are made transparent by composite material. Sea water is purified and pumped from outside through the building components like floor, wall & roof, and it flows out again over the roof via the columns. A transport controller ensures that the transparent columns always keep the water in full, to give continuously visual attraction (Olthuis, K. and Keuning D., 2010).

And the floating mosques are also eco-friendly, pumping water from the sea through a vein-like system cools down the building by 15 degree Celsius, in other words, saving air conditioning cost by as much as around 40 percentage.

The roof and walls could not absorb the heat because of porous exterior material, consisting of a spongelike ceramic substance with highly low density. The fat external walls have a high accumulative volume due to their extraordinary density and great size (Reinl, J., 2007).

New paradigm features from this project can be suggested as new concept of mosque with light on water, adoption of renewable energy system (hydrothermal energy usage and solar panel system in cooling), and application of maximum daylight influx & special exterior wall material.

Table 1 New paradigm features of the sample floating buildings

Name of floating building	New Paradigm Features		
	New building concept	Renewable energy	Green building concept
IBA dock, Hamburg	floating office and exhibition	hydrothermal energy, solar heat panel, solar photovoltaic cell	modular construction, ready-made equipment element
Floating hotel "Salt & Sill", Sweden	floating hotel, fish reef under the pontoon	hydrothermal energy	local raw material, raised floor for service lines
Oregon yacht club, Portland, USA	floating home, high sense of community	-	grating in walkway for light influx to water
Floating cemetery, Hong Kong	burial at sea	-	artificial park for good seascape
Floating pool, Prague	floating pool & ice rink	-	purifying facility for the polluted river water, dual purpose usage
Floating off-shore stadium, Qatar	floating sports facility	hydrothermal energy, wind power, and solar power	long-term utilization, relocatable stadium
Floating mosque, Dubai	floating mosque	hydrothermal energy, solar energy	use of maximum daylight influx, special exterior wall material

4. New paradigm features from the samples

New paradigm features of architecture through the study of concept(Chapter 2) are suggested as following three factors: new building concept, sustainability (focused on renewable energy), and green building concept.

In this paper, new paradigm features of floating building on water rather than those of usual building on land are primarily discussed.

On analyzing the sample floating buildings, new paradigm features with the framework of new concept, renewable energy and green building can be summarized as followings(see Table 1);

- New building concept: floating building itself comparing with same function on land. Especially floating burial at sea in small land country and floating stadium for global mobility & economic efficiency
- Renewable energy: hydrothermal energy, solar energy and wind power. Especially hydrothermal energy for heating and/or cooling due to floating building on the water.
- Green building: modular construction, ready-made equipment elements, raised floor, local raw material, grating in walkway, artificial park, dual purpose usage, long term and relocable facility, special wall material.

As floating buildings are constructed on the water, new

concepts of building had to be introduced spontaneously. Renewable energy systems were employed in many cases due to no obstacles around the site. Especially hydrothermal usage under the pontoon was adopted in most samples. Prefabrication and modular construction method without building waste, usage of local materials, long-term usage by different location by different people and others were introduced for environmental conservation.

5. Conclusions

Floating building on water has been emerging as a strong & attractive alternative architecture. Floating building on the water is already new paradigm comparing with the preconception of building only on the land and current conservative building regulation.

New paradigm features from the sample projects can be extracted as building itself on the water, use of hydrothermal energy, solar energy and wind power(renewable energy), introduction of modular construction and ready-made equipment elements, use of local raw material, dual purpose usage, long term usable and relocable facility, use of special wall material(green building).

Therefore the floating buildings could contribute to the development of major new paradigm features such as the various concept of renewable energy and green building concepts. Especially, use of hydrothermal energy and modular construction would be expanded more and more considering the location of the building.

In case of new floating building design, hydrothermal energy source among renewable energy system need to be considered at least, proper modular & prefabrication methods should be considered for green construction and maintenance.

Further research for the meaning, significance and characteristics of floating building including cultural & social respects should be continued.

In addition, the concept of floating building needs to be changed from “building on the water” to “making the floating land and building on the land” for the easy understanding and realization. And more scientific and practical research related should be continued.

Acknowledgements

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