Impact of New Construction Technologies on Sustainable Hotel Design

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Abstract. One of the important trends in contemporary design of hotels is to obtain environmental compatibility. This is manifested on the one hand in the search for the special locations of these facilities, and on the other hand – in giving them a very sophisticated, organic form. The specific location means scenically attractive site, surrounded by spectacular natural forms. These can be, for example hardly accessible mountain slopes, old abandoned quarries, desert areas, or even the sea bottom surrounded by coral reef. Until relatively recently, both the construction process and operation of hotels in such locations was extremely difficult or even impossible for technical reasons. Also, nature conservation considerations constituted a serious obstacle, because often these areas are protected by law. Technological development enables to overcome these barriers, and limitation for designers is often only imagination. This is manifested in the second-mentioned aspect of striving for environmental compatibility – organic shaping the architectural forms. During several years of development of so called free-forms in architecture, often called "the Bilbao effect", have been developed appropriate design tools, which in combination with modern technologies open up completely new possibilities for architects. This article is an attempt to summarize the most important issues in this respect, illustrated with most characteristic examples.

Keywords: New construction technologies · Sustainable hotel design

1 Introduction

Travelling for various non-profit purposes is known since ancient times. Just to remind Pausanias and his "Description of Greece" (2nd century AD). But the term "tourist" appeared only in the nineteenth century, in Stendhal's novel "Memoirs of a Tourist" (*Memoires d'un touriste*), in 1838 [2]. Since then, the importance of tourism has increased greatly. Changed its definition and understanding, and significant changes took place within it.

Modern tourism is one of the most profitable businesses in the world, a phenomenon characterized by great dynamics of development, but also associated with adventure. Multifaceted and interdisciplinary nature of tourism means that it is defined in several ways. Tourism is of interest to many sciences, because it is a social phenomenon, psychological, cultural, economic and spatial. A different look at this area has a

M. Antona and C. Stephanidis (Eds.): UAHCI 2016, Part I, LNCS 9737, pp. 272–281, 2016.
DOI: 10.1007/978-3-319-40250-5_27

geographer, sociologist, economist and politician. Tourism is defined differently from various viewpoints, e.g. demand and supply. Modern tourism is also a kind of "escape from reality". The search for what we do not have at home. Tourism is searching for unexplored.

Changes occurring within the tourism were reflected in the architecture of objects generated for this industry. These changes concerned both function and form of buildings. The development of tourism generated an increase in the number of new investments. In recent years the phenomenon appeared in a sense the other way round. There arise architectural buildings – hotels, which are themselves generators of tourism development. They attract by their unusual form, location in hard to reach places, or the scope of the offered attractions. This was made possible through the use of new constructional technologies, as well as redefining the paradigm of tourist attractiveness.

2 Tourism and Its Form of Activities

Tourism refers to the activity of visitors [7]. According to United Nations recommendations IRTS 2008 [3], tourism is defined as a subset of travel, which in turn refers to the activity of travelers. A traveler is someone who moves between different geographic locations for any purpose and any duration, while a visitor is a traveler taking a trip to a main destination outside his/her usual environment, for less than a year, for any main purpose other than to be employed by a resident entity in the country or place visited.

Typology of tourism involves many aspects of this phenomenon and is very extensive. Due to the complex nature of tourism a one common model of its classification has not been developed yet. United Nations recommendations [3] provide its basic outline but in studies of many authors can be found much more extended versions.

The following three basic forms of tourism can be distinguished in relation to the country of reference: domestic tourism, inbound tourism and outbound tourism. These three basic forms can be combined in various ways to derive other forms: internal tourism, national tourism and international tourism.

Classification of tourism is related to the trip, which notion refers to a round trip. It's the travel by a person from the departure from his usual residence until he returns [7]. When taken by visitors they are tourism trips. They are usually associated with different forms of tourism, and may be characterized by [3]:

- main purpose
- types of "tourism product"
- duration of a trip or visit
- origin and destination
- modes of transport
- types of accommodation.

One of the most important of the above characteristics and from the standpoint of this paper – is the main purpose. It is defined as the purpose in the absence of which the trip would not have taken place [3]. According to this criterion, we can distinguish the following main purposes:

- personal
  - holidays, leisure and recreation
  - visiting friends and relatives
  - education and training
  - health and medical care
  - religion/pilgrimages
  - shopping
  - transit
  - other
- business and professional.

The main purpose of the trip is at the same time closely related to the specific types of "tourism products", such as culinary tourism, ecotourism, city tourism, sun-and-sand tourism, agro-tourism, health tourism, winter tourism, etc. One of the important tourism consumption products is accommodation service for visitors.

3 Accommodation Services for Visitors – A Challenge for Architecture

From the short list of "tourism products" presented above arise great diversity of forms of providing of accommodation services for visitors. Each type of tourist activity has slightly different requirements in this regard. This has a direct impact on the architectural form of facilities for accommodation [1].

Such facilities must combine different, often conflicting requirements. Hotels house a number of different functions at the same time. These functions depend on the standard of the hotel and are related to the operation of specific forms of activity. Their spatial interweaving affects the size of the rooms, the span of construction, loadings etc. Another very important aspect is to find the appropriate means of architectural expression and harmonious fitting of building into surrounding terrain. As a result, there are many possible configurations of functional layouts, which are shown schematically in Fig. 1.

Designing of such functionally complex objects must of necessity be a fully integrated process, in which all participating branches collaborate closely since the initial phases. Advantageous aspect of such organization of the design process is the possibility of use and harmonious integration of the latest technological advances in all branches [5, 6].

There are two trends in the application of new technologies. One of them is the so-called "architecture of exaggeration". Emerging objects manifest their largeness and extravagance. Their form is far from traditional, often flashy, exposes the functions located inside. A good example is the Marina Bay Sands Hotel in Singapore.

Second trend is the opposite of the previous one. It includes objects that try as much as possible to integrate with the surrounding environment. Often they use the natural spaces, e.g. caves or rock caverns. It can be divided into two sub-trends. The first is minimalist, preferring modesty and simplicity, and even – to some extent – poverty. The other, avoiding ostentation requires the use of sophisticated techniques due to the specific locations. In both can be seen desire to preserve the principles of environmental compatibility.

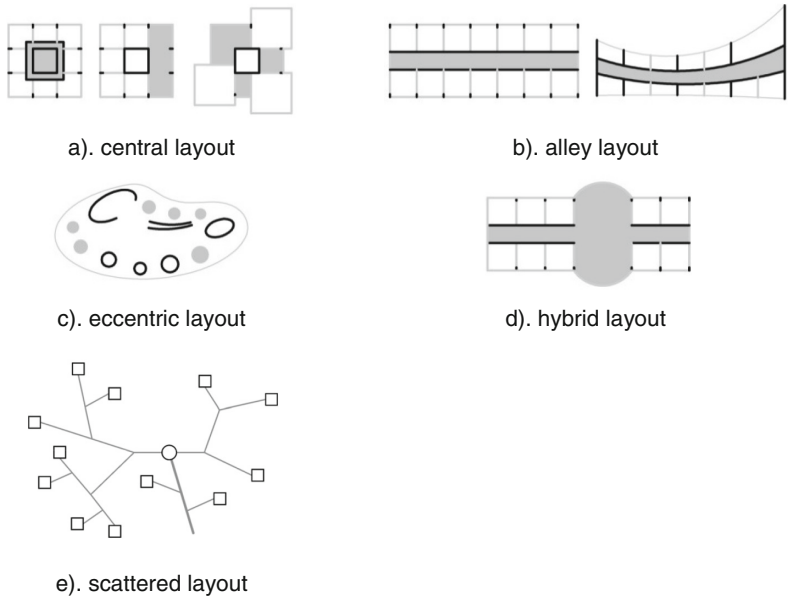


Fig. 1. Various functional arrangements of hotel facilities

4 Principles of the Theory of Environmentally Compatible Structures

The theory of environmentally compatible structures is an applied subject of environmental sciences in the field of civil engineering and architecture. It focuses on restoration of clean environment and minimization of any environmental pollution effect in the phases of design, technology and use of buildings and structures [6].

It is an extension of the classical theory of architectural and structural design. According to it, any design has to ensure [4]:

1. safe resistance of the designed structure against all external loads or effects, to which it may be subjected over the whole life span,
2. responsibility, that the structure will serve the purpose for which it was designed or redesigned, throughout the expected life cycle.

The third, supplementary environmental condition has to ensure, that:

3. during all phases of the life cycle of the structure, its environmental pollution effect is reduced to minimum. The last design condition is meant to protect the local, regional and global clean environment.

These three assumptions lead to the formulation of the three globally valid basic principles:

1. an axiom of global equilibrium: global lasting dynamic equilibrium in nature must be preserved

2. a statement ensuring sustainable development i.e. such, which satisfies the present needs without harming the needs of future generations
3. a theorem of "limits to growth and to resources": in a closed system of limited resources a lasting unlimited quantitative growth is not possible.

The first and the third principles are based on globally valid natural laws, which are independent on time and the locality. They express the dynamic global equilibrium of the diversity of all living and non-living components of nature existing within given natural limits, in accordance with the principle of preservation of mass and energy, such as clean atmospheric environment etc. The second principle is reflecting the general moral and social attitude for the need to maintain sustainable development with due regard to the economic and social activities [4]. For practical design purposes, these three fundamental principles must be transformed into a practically acceptable and applicable version. Such transformed versions of these principles are designated as "design characteristics" [4]. The design characteristics must be optimized in order to maximize protection of the environment.

The process of optimization is different for different problems, different objects and different types of structure. However, it is possible to formulate appropriate strategies in order to introduce formulated above principles into practice [4].

5 Influence of Environmental Compatibility on Architectural Design

Architectural design is a very specific field, located on the border between art and science of engineering. Its social impact is very large, as architectural objects because of their scale and function have a significant impact on both the daily human life and on the environment. They can help to raise its value or increase its degradation. They are an important element of the landscape. Therefore, the implementation of the principles of environmentally compatible constructing is particularly important.

Below are given few areas of the tourist activity, where can be observed such a design approach. They relate to embedding objects as close to the surrounding environment as possible, to ensure, of full contact residents of with Nature. They also include examples of rehabilitation of devastated environment both natural and man-made, and the location of accommodation in places previously inaccessible.

5.1 Embedding of Facilities in the Surrounding Nature

One of the most popular solutions for environmentally compatible structures is locating scattered accommodation units in almost untouched natural environment. This protects existing resources, avoiding e.g. cutting down trees. At the same time close contact with nature is the basis to create a completely different man-environment relationship.

Depending on the technology used and the characteristics of the specific location there are various optional solutions. Popular is locating apartments in a completely different way than traditional buildings. They can e.g. be stretched between the slopes of the ravine using

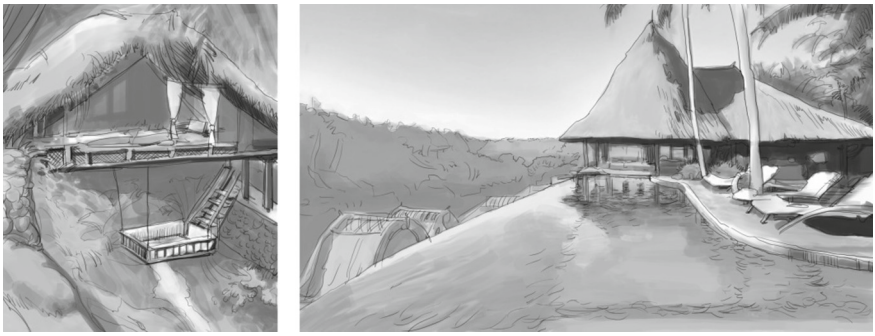


Fig. 2. Residential units and swimming pools interwoven with natural environment, Resort Spa Treehouse, Bali island, Indonesia [8]

a lightweight, non-invasive visually structure, leaving space to the maximum extent open to the environment, Fig. 2(a).

Fig. 3. Freestanding accommodation units among the trees, Resort Spa Treehouse, Bali island, Indonesia [8]

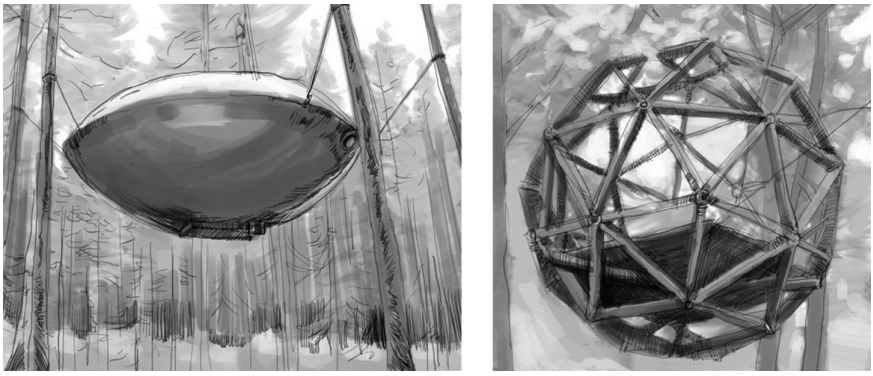


Fig. 4. Residential units suspended from trees, Resort Spa Treehouse, Bali island, Indonesia [8]

Very common is location of independent accommodation units scattered among the high forest, where their design gives the impression that they are part of the forest, Fig. 3. Alternatively, they may be suspended to trees, further increasing the impression Fig. 4. It is worth noting how diverse architectural forms can be obtained in these objects and how well they integrate with the environment. This method of location is applied not only to rooms but also to the supplementary functions, for example swimming pools, Fig. 2(b).

5.2 The New Facility as a Form of Rehabilitation of the Natural Environment

Locating hotel facilities in places where environment is degraded through intensive human activity, may be one of the roads leading to his rehabilitation. Substantial costs associated with the process of rehabilitation make that locating there standard housing construction is not economically justified. However, in the case of hotels, especially of high standard the bill of expenditures and payback time looks completely different. The rate for one-day stay in such a facility may be higher than the monthly rent for a multi room apartment. An additional source of income are different kinds of dedicated, specific tourism product oriented activities. Thus, despite the large amount of capital expenditures realizations of such objects are not at all uncommon.

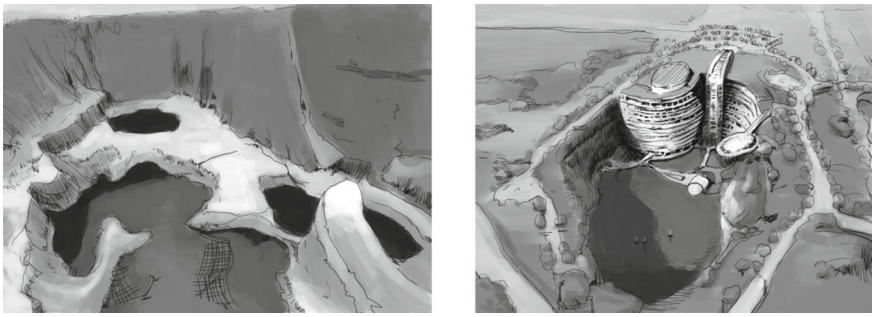
An example might be Songjiang Quarry Hotel, located within the one hundred meters deep abandoned and half flooded quarry near the base of Tianmashan Mountain in the Songjiang District of Shanghai, Fig. 5. The facility takes advantage of gorgeous location. The idea of realization of this unique object was presented by the international consulting firm Atkins and undertaken by Shanghai Shimao Property Group [9].

Undertaking such difficult construction works was possible thanks to the latest technology in the field of geotechnical and structural engineering. As a result, devastated environment of the quarry turned into a unique spot in terms of landscape, attracting tourists with its uniqueness. The facility is in the final phase of realization.

5.3 The New Facility as a Form of Rehabilitation of the Man-Made Environment

Old, abandoned objects whose functional usefulness already exhausted, can be for the environment as burdensome as the site of the intensive exploitation of natural resources. If these objects can be relatively easily subjected to demolition, the problem is of a smaller scale. If the demolition of such a facility and rehabilitation of land remaining after demolition is technically difficult and expensive, the problem becomes serious. One way to deal with such situations is practiced in cities transformation onto objects with luxurious apartments – lofts. In the case of objects located outside the cities, and those whose primary function is far from residential function, it is possible to convert them into tourist facilities.

An example of this is the development of an old fortress, Spitbank Fort, located one mile out to sea off the coast from Portsmouth Harbor in Hampshire, U.K. This 134 year old object, in the past part of the defense system of the British coast against enemy ships has been converted into luxury tourism facility, Fig. 6. It contains currently luxury guest rooms, bars, restaurants etc. [10]. The building, rather than pose a threat to the environment has become a valuable part of the tourism infrastructure.



a). Abandoned quarry in Tianmashan Mountain

b). Visualization of Songjiang Quarry Hotel

Fig. 5. Songjiang Quarry Hotel near the base of Tianmashan Mountain in the Songjiang District of Shanghai [9]

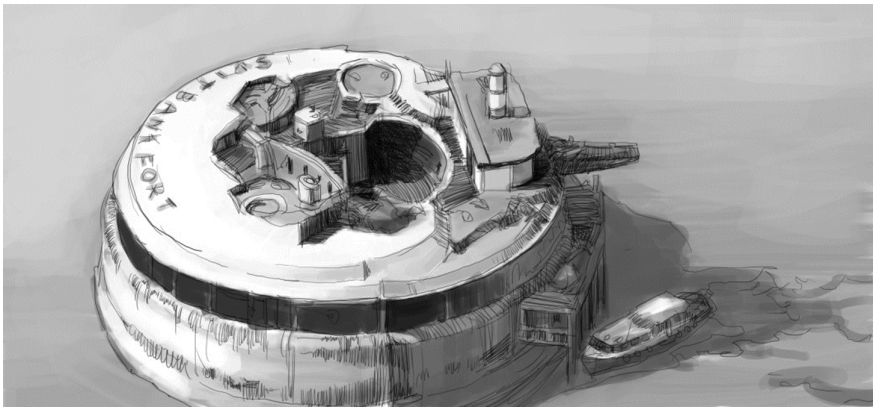


Fig. 6. Spitbank Fort – fortress off the coast near Portsmouth Harbor in Hampshire, U.K. [10]

5.4 Development of Facilities on Surface of the Seas

Futuristic plans to create floating islands have been created for a long time. Due to the feeling of insecurity caused by the alleged global warming, they have become recently popular again. There are many projects of floating habitats, units on the scale of a medium-sized city, able to function independently. Suffice it to mention in this context, projects of Vincent Callebaut.

On this wave also they began to emerge projects of smaller floating accommodation objects constituting a new form of hotel facilities. They are basically large boats, adaptable to a variety of outdoor activities, including the opportunity to observe the underwater world. An example of such a project, which is recently loudly presented in the media is the Solar Floating Islands in the Maldives developed by Michele Puzzolante from MPD Designs, Fig. 7.

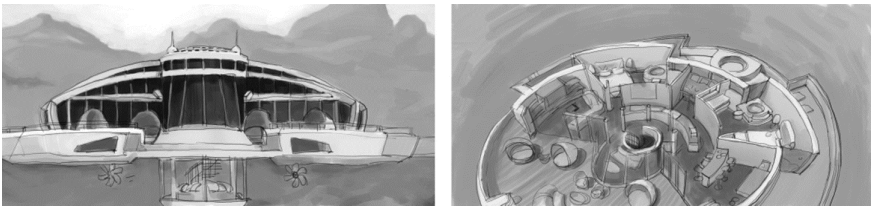


Fig. 7. Visualization of the Solar Floating Islands in the Maldives, developed by MPD Designs, U.K. [11]

According to this concept, the hotel would be a kind of a mooring station for the team of floating units, each of which is designed for four people. Its users can choose whether they want that their unit moves through the surrounding waters, or prefer to remain in the base, taking advantage of additional services [11].

5.5 Development of Facilities in the Depths of the Seas

The next step, after the of floating islands, in the development of water areas for tourism is locating permanent objects on the seabed. Particularly attractive are the areas of coral reef, due to the possibility of direct observation of outstanding natural beauty. Below is one of the projects of this type, which is in the initial stage of preparation for implementation. This is the Planet Ocean Underwater Hotel, a proposition of the company based on the Florida island of Key West, Fig. 8.

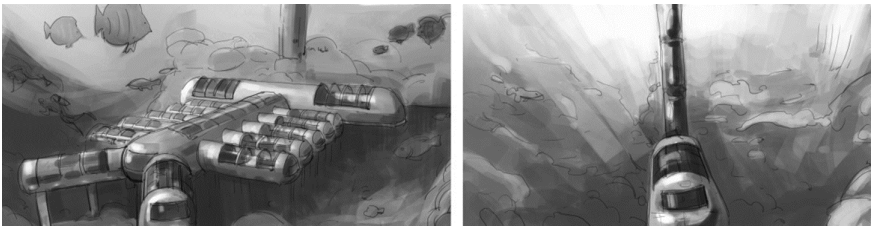


Fig. 8. Visualization of the prefabricated modular facility developed by the Planet Ocean Underwater Hotel, Key West, U.S. [12]

This is a modular structure which can be assembled in various configurations. The hotel will be deployed at a depth of around 8.5 m. In the facility will be located all the necessary functions, including rooms allowing organization of events such as meetings, weddings etc. [12].

6 Conclusions

Presented above basic principles of designing environmentally compatible facilities and examples of their practical implementation show how much they can contribute to the

architectural design. On the one hand it is possible to achieve a new level of protection of the environment from the adverse effects of human activities, and on the other hand, they trigger a great potential in the creation of architectural form.

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