The Creation and Perception of Underwater Built Environment or Architecture

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Abstract. It is obvious that the underwater architectural space is formed as the result of the contemporary human construction activity. Underwater exists built environment available to the modern man. Below the surface of the water is a space that is shaped in a way that makes an architecture. The creation of underwater space has lots of ways and methods. There are significant desperation between the imagination of designers and the real construction made underwater. Also the problem of different perception of underwater spaces are significant problem. Human body is used to live in the air at the normal pressure of 1at, and in the environment of air. The water is not the natural environment for people so there are important differences of perception of architectural space existing below the surface. Physical conditions of underwater facilities are very different from the ground conditions and it must be considered by visionaries and concept makers to have a chance to implement them. The space of water below the surface is full of stuff which is placed or constructed by the people. Most of them are very simple construction, placed for the recreation purpose. There are dozens of futuristic visions of underwater habitats, but at present times, it is not possible to notice that designers find the way of development, which follow their imaginations. There are not exist the futuristic structures or glass domes. Most of the constructed underwater architecture is available only with the SCUBA equipment. The author as the licenced architect (since 1994) and the designer of several objects connected with water, and the instructor of the Underwater Activity Committee trying to find the purpose and the reason why the human being must (or try) to live at the enemy environment of underwater.

1. Introduction – The underwater built environment.

There is the human activity under water. From the middle of the 20th century it is possible for people to act below the water level and to get back to surface. Among the first were officer of French navy Jacques-Yves Cousteau and engineer Emilee Gagnon who constructed the breathing apparatus. The stuff allowed people to get to the underwater space [1]. After the years the system called SCUBA (Self Contained Underwater Breathing Apparatus) is enough safety and work properly.

Generally the divers are group of humans who is able to act in the sublevel space. The divers start to create something underwater instead only visiting or investigating. Also the people who have never be underwater starts to think about the underwater constructions. The two worlds are created: the world of real space underwater and the world of the imagination and visions. Despite of the point of view the underwater built environment is constructed [2], sometimes it is the sunk ship, or other wreck but sometimes it is the planned creation process.
2. The discrepancy of imagination vs real constructed objects

The significant discrepancy between the imagination of visionaries and the real created objects is notified [3]. The imaginations show lot of examples of great structures where people could live and work ‘figure 1’. The most famous are Poseidon Resort in the vicinity of Katafing Island, Fiji, by Bruce Jones, from U.S. Submarines, the Hydropolis hotel complex in Dubai, United Arab Emirates, based on the idea of Joachim Hauser, Water Discus Underwater Hotel by Paweł Podwojewski and lot other facilities are proposed. Those cases are referred to as "in progress" for several years. This indicates some troubles. Despite of many Years from creating they are in concepts phase. The visions are in virtual world.

![Figure 1](image1)

**Figure 1.**

a) Underwater Hotel Poseidon Resort near Katafing Island in Fiji on the concept stage by Bruce Jones from U.S. Submarines, [4]

b) Underwater hotel Hydropolis according to the vision of Joachim Hauser, [5]

c) Concept of The Water Discus Underwater Hotel by Paweł Podwojewski, [6]

The object what are realised under the water level are small scale projects ‘figure 2’. They are the experimental constructions. The underwater space is trying to build with the small efforts. Instead of the great resorts, there are the Jules Undersea Lodge in Key Largo, Florida. It is the non-operating Capsule Research Laboratory which was converted to a functional hotel but there are only two rooms. The most popular underwater structures are the objects what we can describe as small architecture. The training platform is the stuff which us constructed most often, it is used to learn and practice diving exercises. Other constructions like the cube are also constructed and they are the underwater attraction. Some kind of art we can find in those elements. The real art installation is underwater museum MUSA ‘figure 3’. It is the dozens of sculptures of human figure placed at the depth of several meter. The installation is the aim of many dives.

![Figure 2](image2)

**Figure 2.**

a) Underwater Experimental Hotel in Florid, In Key Largo [7];

b) The underwater platform built in Lake Gossau, Austria, (Source: archive of author);

c) Submersible cube for use in air equipment in Lake Attersee In Austria, (Source: archive of author)
Another significant group of underwater creating activity are memorials. The famous is the Neptune memorial Reef near Miami. There is the necropolis on the bottom of the sea (Figure 3b). Urns with cremated remains are placed in underwater obelisks. The memorial is built also in Zakrzówek lake near Crakow (Poland). A granite plaque is mounted under the surface of water in the flooded quarry (Figure 3c). It commemorates of Karol Wojtyla, later Pope John Paul II, who worked there as a worker during World War II. This simple element is the goal of excursion of many divers.

![Figure 3](image)

**Figure 3.**

a) Underwater museum of sculptures MUSA in Mexico, (Source: [8])

b) Neptune Memorial Reef underwater cemetery, (Source: [9])

c) John Paul II memorial plaque under water in the Zakrzówek creek, (Source: archives of the author).

Another kind of realised underwater space is the space of polls especially built for diving ‘figure4’. One of the first constructed objects especially for diving was Gasometer in the Rhura Basin. It was an empty, unused gas tank. It is equipped with the additional attractions for recreation. Another places are famous as the aim of pool diving it is Nemo 33 in Brussels and pools Y-40 near Milan. They are representing the submarine architectural space. That space is shaped in the buildings. So it is different from the space built in the natural water when divers surround the object from outside.

![Figure 4](image)

**Figure 4.**

a) Duisburg gas tank, where underwater space was built, (Source: [10])

b) Nemo 33 diving pool in Brussels (Source: archives of the author;

c) Y-40, diving pool. Underwater space for use in air equipment and without equipment - in a glazed tunnel, (Source: [11])

3. **The creation of underwater space.**

As it is shown above, the underwater architectural space exists. That kind of reality is the part of the built environment; it is a lot of questions about that kind of activity. The main is: Can the human activity
underwater be the part of sustainable development strategy in housing [12]. The water and especially the underwater environment is enemy for people, and it is the reason of the death more then the place for living. So the question which can zoom us to the answer is: What are the reason to try to build underwater?

The futuristic visions are aiming to create part of civilization under the water. It is not easy to find a reason that human being must be moved to the submarine spaces. It must be some kind of catastrophe or cataclysm that forced people to looking for place for living underwater. It is easier to live in the outer space then under the water. The main reason of this is the significant different physical condition at the surface, where the humans lives in the atmosphere then under the pressure of water but there are few possibilities to live under the water:

The first is to behave like the divers. It means to use personal equipment to breath, to keep warm, and resist to water pressure. The another is to use the special construction to create underwater rooms for living of groups of people. In the second one the pressure acts to the built structure instead the man. So the responsibility and the resistance of structure must be several times bigger than in the space emptiness what is experienced in the space out of atmosphere.

As was described above for present time any big submarine structure is not built. All of them are only imagination but there is some kind of architecture what exist underwater. The main purpose of creation in most of cases is recreation and the another one was memorial (as extravagant style of paying tribute). Those two activities are the main reason that people create the space underwater. The most of that kind of constructions is available using personal air equipment (SCUBA). There are several reasons that determine possibilities of built underwater space. The main is the physical influence of water to man and the structures and the second is the perception of underwater space.

4. Perception of underwater space and physical influence to man underwater and constructions.

Perception of an underwater space is most often shaped by imagery created on the basis of film footage rather than experience. Despite the great interest in staying in the underwater space and developing this area of recreation, a small part of society has experienced underwater space in fact. Therefore, the underwater space is commonly associated with crystalline visibility, freedom of movement, incredible freedom, beauty of views, comfort, etc. But reality is different.

Under the water man is influence by the laws of physic like at every place in the world. The hydrostatic pressure of water, visibility, temperature, propagation of sound is the main factor of perception of the underwater space. That factors enforce certain behaviours of man underwater.

Limited visibility is the first what the human finds in the water, even in pure condition it is not possible to see the far objects like on the surface after several meters the light not entering. After few meters the colours are losing, starts from the red at 5 meters’ depth and finishes at 70 m when practically only small part of violet enter, creating all in navy blue colour, or the suspension of plankton full stops the light. The construction of human eye makes all the objects underwater bigger or closer then they appear, because we need to have an eye in the air. So always between the eye and water is part of glass and air, that make the certain optical effects. If man do not use the barrier between the eye and water the picture is blurred.

Lower sensed temperature is another factor significantly influenced to the man underwater. The heat transition factor of water is so big that even in the water of 30 degrees centigrade it starts to be cold after certain time. Generally, it is never enough hot in water. Some methods of keeping divers hot exist but they need special technical solutions end to support lot of energy. The situation concerns both the underwater structures and scuba divers.

Mechanical parameters of water like density and viscosity make different in sound perception. It is not possible to describe the direction of sound, because of the speed of sound wave in water. The density of water make trouble to keep under the surface light materials or empty chambers. Huge viscosity makes trouble to move human body or constructed structures.

Hydrostatic pressure of water is the main factor creating condition of using the underwater space. Every 10m the pressure is higher of 1 atmosphere. It has huge influence to human activity under water.
The buildings must have proper resistance of construction. If the people are influenced of the water pressure at the depth. The pressure of water limited the kind of using the underwater space. The behaving of the man is strictly dominated by the regulations of decompression rules. It describes the depth and limited the time of being in the submarine spaces. So the perception is not like the freedom of movement. It is planned and must be realized because of healthy reason. The omitted proper decompression makes medical trouble and can finish with death.

5. Results and discussions
The all physical factors make different perception of human and having influence to human health underwater and to the creating constructions. There is the reason why the underwater built environment is so primitive. Despite of cost of creating the underwater space the health reason is most important. The visionaries show futuristic structures what not seem so beautiful if we start to think what would be the reason to push the civilization to move to the depth of seas. Is it radiation, collision with the meteor, loosing oxygen by atmosphere etc.? All of them are terrible but despite of any recreational purposes it could be goal to looking for underwater architecture to move the civilisation if in the earth surface living would be impossible.

At the present time the underwater architecture is associate with sport, recreation and some kind of extravagance. To create more developed structures for this purpose (not paying attention for catastrophic scenario) the designers must pay attention to the physical condition at the enemy environment not only for its beauty but especially for dangerous physical factors.

6. Conclusions
The present underwater space is constructed with very primitive methods. Created objects are simple, it is long way to construct any bigger living structure underwater.

The physical factors make the perception of underwater space significantly different then the space located on the earth surface. There not explicit reason to create the living places under the water surface. The main contemporary goal of being underwater is recreation and it is much different from the reason to build submarine habitats which seem to be reason of some cataclysm on the planet. The recreation reason is enough interesting to look for development of underwater architecture, but the objects must be developed paying attention to restrictions of physical laws influenced to user.

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