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HISTORICAL OVERVIEW OF THE IMPORTANCE OF BUILDING MATERIALS IN ARCHITECTURE

HISTORYCZNY PRZEGLĄD ZNACZENIA MATERIAŁÓW BUDOWLANYCH W ARCHITEKTURZE

A b s t r a c t

The title of the conference *Defining architectural space – Games and play of architecture* should be regarded as a kind of intellectual provocation, given that without a profound comment, these "games and play" should above all be understood as extremely costly ones. However, taking for granted the "game" motif (in the sense of artistic manipulation of the structure's shape and detail embedded in space), the author has decided to raise the subject of the role that building and finishing materials play in the design concept and practice of the architect.

Keywords: autochthonous materials, properties of building materials, universality, eternity of the stone, artistic thought, art, humanistic message, cathedral, church, temple, tomb, new technologies.

A b s t r a k t

Tytuł konferencji: *Definiowanie przestrzeni architektonicznej – gry i zabawy architektury* uznać trzeba, jak sądzę, za swego rodzaju prowokację intelektualną, zważywszy, że bez głębokiego skomentowania trzeba by je rozumieć jako „gry i zabawy" przede wszystkim niezmiernie kosztowne. Biorąc jednak za dobrą monetę motyw „gry" (w sensie artystyczno-plastycznej manipulacji kształtem budowli i detalem osadzonymi w przestrzeni), podjęłam temat roli, jaką w zamyśle projektowym i praktyce architekta pełnią materiały konstrukcyjno-budowlane i wykończeniowe.

Słowa kluczowe: materiały rodzime, cechy materiałów budowlanych, uniwersalność, wieczność kamienia, myśl plastyczna, sztuka, przesłanie humanistyczne, katedra, kościół, świątynia, grobowiec, nowe technologie

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1. Introduction

Buildings have always been special challenges for all kinds of creative thought – both engineering and artistic. It has been and will probably always be this way. It has to be mentioned, though, that everything that was related to art and architecture was usually based on autochthonous materials, and to a lesser degree on imported ones. As a result, the processes and methods of acquiring and processing a variety of materials used in construction determined every implemented structure. Thus, people living in different corners of the world processed the obvious and relatively cheap the materials available to them directly – such as wood, stone, earth (clay, sand), various minerals, etc. Using them, they created works of art – often including buildings – which even today fire our imagination, arousing curiosity and justified delight. The creative inventiveness of construction artists was based very specifically on a variety of materials – diverse in terms of quality, durability (resistance to physical factors), weight (important for structural analysis), ease of processing, but also in terms of artistic value (e.g. texture, colour – light reflection etc.). Hence, it was important to the artist or builder whether he had linden wood or ebony, limestone, basalt or granite at his disposal.

The kind of universality of solutions and architectural forms applied by people from different continents may be surprising. Their contacts were very limited and information from travel rather scarce and available only to selected recipients. What is more, residents of Europe and the Americas had remained in utter ignorance about one another until Columbus and the conquistadors. Yet, buildings of similar use were constructed there at roughly the same time, while local builders used similar building materials of native origins.

2. Historical overview based on selected examples

In order to grasp the enormity of the cultural heritage in this field retrospectively and stimulate the imagination, the author wishes to recall the chronology of the most important selected examples of shaping space as a primeval benefit surrounding the individual and human communities. Man took the first step towards architecture probably approx. 350 thousand years BC in Africa, building primitive huts of detritus. This was the beginning of the work that continues to this day, and the effects derived from his technical idea have reached an unimaginable scale at the beginning of the twenty-first century. Around 8 000 BC, the use of mud for making bricks, then dried in the sun, became the turning point. Although the boundary between construction as such and architecture is quite clear, the moment when construction ends and art begins is very subtle and difficult to identify unambiguously[1].

It is impossible not to take into account in this intellectual journey the prehistoric art leading to ancient Egypt with its unique buildings, pyramids, gigantic temples and other facilities, as well as interesting buildings in other countries. The Egyptians mastered the art of construction and creation with the use of accessible stone. It seems that everywhere in the world

[1] Jonathan Glancey proposes an interesting definition of the art of building in his book Historia architektury (The Story of Architecture), Wydawnictwo Arkady, Warszawa 2002, p. 9. He writes among other things that (…) People create architecture. To put it bluntly it is the science and art of construction, and speaking more poetically – the moment when the building is infused with magic that transforms it from an ordinary shelter into a conscious work of art. This art may offend, embarrass, but also delight.

the idea of using stone (regardless of different religious or scientific and astronomical functions) stemmed from its timeless – on a human scale – durability, which became an inherent part of the eternal problem of the opposition between existence and death – the transience of human life and the eternity of the stone.

In turn, the architectural art of ancient Greece – with its humanistic message and attention to beauty and proportions – also paved the way for the stone buildings of the Roman Empire – with the famous triumphal arch in Rome erected to commemorate the victories of Emperor Constantine who reigned from 306 to 337.

After the fall of the Roman Empire, Roman civilization continued to grow. A great example of this period is the extraordinary work of human genius – the Hagia Sophia in Constantinople – originally a Christian church built during the reign of the Emperor Justinian in the years 532–537, which is a treasure trove of construction and architectural craft as well as detail. The technical solutions in the construction of the dome applied here and the introduction of buttresses were a huge step forward in the history of architectural thought. The short period of construction of this huge temple inspires no less admiration.

The Middle Ages is replete with examples of Romanesque architecture, based on a number of solutions derived from ancient Rome. A classic example of Romanesque art is the eleventh-century church of Sainte-Foy in Conques in France, at the Benedictine Abbey. What especially delights is the working of stone as the main building material.

The later mediaeval years were dominated by the Gothic style. The Gothic style introduced unique skeleton construction systems, which consisted of arched cross-ribbed vaults, resistance arches, buttresses, etc. A particular example of the Gothic construction is one of the largest and finest achievements of the Gothic, Notre Dame Cathedral in Chartres (1194–1225) in France – with lancet windows, soaring roof and equally soaring towers as well as unique stained-glass windows. Absolute mastery was achieved here in stone processing, sculptures, stained-glass windows and rosettes. Similarly, Siena Cathedral in Italy (1258–1285) presents the highest craftsmanship of stone processing – using various colour, mosaic and incrust combinations.

At the same time – in parallel – a massive architectural bloom followed in other parts of the world, which refers to Ethiopian (Coptic), Indian, Chinese, Cambodian, Inca, Japanese and other examples of architecture. Also there the dominant building material is stone. Sometimes the human genius allowed a stone temple to be carved (with rich veins of minerals) by hollowing the whole mountain from the inside [2][2]. Impressive works of art were created using different colour types of stone for encrustation, geometric mosaics, openwork and arabesque decorations; light, sound and water were used to potentiate artistic experiences.

From the late fifteenth century (the end of Gothic and Middle Ages), the sixteenth century was dominated by the art of the Renaissance in architecture, whose chief message was to draw attention to the power of human thought and perception of man as a kind of "centre" of the world. The more that fine arts, literature, music, sculpture, painting and architecture were supported by the new philosophical currents – focused on the legacy of Greek and Roman antiquity. The cradle of Renaissance art was Italy. The magnificent Cathedral of Santa Maria del Fiore in Florence is an excellent example of the architecture of that period. The basic building material here is stone with wonderful mosaic and sculptural compositions, spiral columns, etc.

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[2] The author writes about Mount Kailas here. The Kailasa temple of Lord Shiva was created from it in this way. [5, p. 81 and further].

Ill. 1. Prehistoric structures about 35 000 years BC (Fiona MacDonald, Budownictwo, od szałasów do wieżowców, Arkady, Warszawa 1998, s. 8); Ill. 2. Frank O. Gehry Guggenheim Museum in Bilbao (1993–1997) (Rolf Toman, Historia Architektury, Paragon, 2009, s. 328); Ill. 3. Richard Rogers and Renzo Piano – Paris – Centre Pompidou (1971–1077) (Rolf Toman, Historia Architektury, Paragon, 2009, s. 308) Ill. 4. Burj Khalifa – The Tower, Dubai (2010) United Arab Emirates (http://www.abc-dubaj.pl/drapacze-chmur/burdz-chalifa.html)

Around that time, in 1410, a great palace complex for the imperial family of the Ming Dynasty (Forbidden City) was built in Beijing.

At the end of the sixteenth century a new style called Baroque was born in Italy. This style spread throughout Europe and lasted until the mid-seventeenth century.

In the second half of the seventeenth century the classical style evolved, which was a kind of opposition to the lavishness and gilt which dominated the Baroque. Splendid examples of

this style include the Church of Santa Maria della Salute in Venice (1681), the White Heron Castle in Himeji in Japan (1608), the Palace of Versailles (1678) and Shah Abbas' Mosque in Isfahan, Iran (1628).

The beginnings of the nineteenth century in architecture and construction were dominated by the industrial revolution, which, in simplest terms, changed the world. The buildings of that period were adjusted to technological and production needs of large industrial plants and factories. Above all, new types of building materials, in particular iron and glass, had an impact on the industrial revolution. They created new possibilities for architects. Extremely durable metal frameworks were created of iron, and the spaces between the steel frame elements were filled with brick, concrete or glass. New technologies initiated the era of skyscrapers, as exemplified by the first (ten storeys, which seems tiny now) skyscraper in the world – the Home Insurance Building in Chicago (1871) of steel structure filled with bricks. Peculiar buildings of that period were also the Crystal Palace (1851), a giant exhibition pavilion of glass and steel (designed by Joseph Paxton) for British inventions at the World Exhibition in London and the 300-metre-high Eiffel Tower (1889) in Paris, the highest building of the time, a symbol of the greatest technical capabilities.

The beginning of the twentieth century is a special period for technological challenges, being the leaven of a new architectural style called Modernism. Modernist buildings were characterised by simplicity and functionalism. Every metre of the surface was carefully designed in that respect. New building materials were constantly improved through the use of e.g. chrome, plastic, etc., which was conducive to the creation and implementation of increasingly bolder visions. And thus, Antonio Gaudi (1903) builds a remarkable work of architecture in Barcelona – the Sagrada Família church. By combining different technologies and construction materials, bold spatial solutions, sculptural works, mosaic decorations, etc., he achieved an effect that surpassed all perceptions referring to the contemporary understanding of art.

In the years 1929–1931 the tallest building at the time was erected in New York – the Empire State Building (designed at the Shreve, Lamb and Harmon architectural firm) with 102 storeys. Apart from glass and brick, precast concrete slabs placed directly on the steel skeleton (according to an innovative system) were used to fill the openwork structure of the skyscraper.

The beginning of the twentieth century is also a great variety of architectural ideas and architectural styles, and at the same time a kind of manifesto of the independence of architectural thought, which does not refer to the past intentionally, having the ambition to provide completely innovative solutions. One of the examples, otherwise very spectacular, is the city of Brasilia in Brazil (1955, since 1960 the capital of Brazil) built from scratch with its innovative architecture and urbanism (according plans and designs by L. Costa and O. Niemeyer and other eminent architects), characterized by imaginative architectural forms in close liaison with sculptures and paintings (the city was inscribed on UNESCO's World Heritage List).

An undoubted highlight in the sphere of development of architectural thought was the movement called functionalism. According to its assumptions the shapes and forms of the buildings were completely subordinated to their functions. A leading example of this way of thinking is the Centre Pompidou in Paris (designed by Richard Rogers and Renzo Piano, 1976). The structure, communication, function and technical infrastructure of the building were fully brought to the fore, i.e. "thrown" outside. Norman Foster presented a similar way

of thinking with the implemented design of the Hong-Kong and Shanghai Bank in Hong Kong (1979–1986).

As it turned out, these achievements, and also spatial and architectural experiments, resulted in the formation of postmodern buildings (or were a kind of reference point for some other quests). These were often an attempt to "make fun of the past"; architects made use of the latest achievements in construction and technical thought and contemporary materials and technologies (metal, including copper and aluminium, glass, brick, concrete, etc.).

New technological possibilities and new construction materials mean that there are basically no boundaries for contemporary architectural projects. Architects and investors – especially in Asian cities like Hong Kong, Shanghai, Beijing or Tokyo – participate in a peculiar race for ever taller buildings. The imposing skyscrapers of the Petronas Tower in Kuala Lumpur, Malaysia (452 metres, 1999) aroused widespread admiration for their design thought not so long ago. Currently the undisputed first place belongs to the Burj Khalifa structure (829 metres high) in Dubai (2010, United Arab Emirates). And it is common knowledge that there are plans to build other height record-holders.

3. Conditions of visions and selection of architectural implementations

These conditions are as different as are human values and personal motivations, as well as the economic capabilities of investors (principals) or backers (sponsors) of buildings. Sometimes, the choice of work is influenced by seemingly simple and existential arguments like love of your beloved (the Taj Mahal palace-tomb in Agra, India, 1631–1648); the desire to possess a haughty tomb (not only in the form of pyramids – beautiful, though miniscule in comparison to the pyramids, examples can be found at the Warsaw Powązki Cemetery or the Lychakiv Cemetery in Lviv and many other cemeteries); the intention to distinguish oneself, show off; prestige, and very often megalomania or just a peculiar whim – e.g. the famous Neuschwanstein castle in the Alps erected by King Ludwig II of Bavaria.

Even today, these motivations and expectations present architects and engineers with ever new challenges related to building materials, new technologies, statics of the structure, function and originality of architectural vision.

It sometimes happens that pure accident becomes decisive in those fields, as occurred in the case of the unprecedented invention of reinforced concrete by the French gardener Joseph Monier who patented it in 1867 as a… reinforced concrete flower pot. And today? Today, we know and use several hundred types of concrete, aerated concrete and reinforced concrete, and also hundreds of types of building, construction and decoration glass, a range of extremely durable and flexible structural metal alloys, self-bonded carbides, multiple species of bricks, sheet metal, grain and decorative stonework etc. Technology and space technology deliver new material solutions every single day. Science progresses in quantum leaps to provide opportunities for underwater or underground construction (including tunnels) or construction in the permafrost zone. In the light of modern material possibilities, in terms of artistic expression, and even different "whims", architecture knows no bounds.[3]

[3] According to Dariusz Kozłowski: (…) "Architecture consists in constructing fictitious objects in such a way that they look real". *Pomiędzy światłem i ciemnością (architektury)* [2, p. 29].

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