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## CONCRETE – MATTER AND FORM IN THE MODERN ERA

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### BETON - MATERIA I FORMA W CZASACH WSPÓŁCZESNYCH

#### Abstract

The aim of this article is to show the possibility of the transmutation of concrete and its significance in the reception of contemporary space based on the example of selected works. Concrete is a material that creates new meanings and shapes through conversion (transmutation). An observer can perceive its values and stylistics. This material was appreciated by designers and their works shaped the architecture of the 20<sup>th</sup> century. At present, concrete as a material is integrated into the extensive stylistics of the contemporary architecture. Examples include the minimalist designs of Tadao Ando or Steven Holla's exposed concrete façades. The architect-creator shaping the architectural works brings the material properties, such as endurance and durability to the foreground, and shows the possibilities of its formation. It should be added that the art of concrete formation enables considerable arbitrariness in the creation of the geometry and the structure of the buildings. An interesting example is the sculptural coating of the Bosjes Chapel designed by the Steyn Studio.

Formal expressiveness and structural capabilities of concrete show how the art of constructing buildings is linked to the architectural composition. Peter Zumthor believes that the sense given to the material lies outside the boundaries of the principles of composition, while the tangibility, the smell, and the manner of acoustic expression are only the components of the language, which we are meant to speak<sup>1</sup>.

*Keywords: concrete architecture, transmutations, concrete, matter and form*

#### Streszczenie

Celem artykułu jest pokazanie możliwości transmutacji betonu i jego znaczenia w odbiorze współczesnej przestrzeni na przykładzie wybranych realizacji.

Beton to materiał, który przez przemianę (transmutację) tworzy ciągle nowe znaczenia i kształty. Obserwator może postrzegać jego walory i stylistykę. Tworzywo to zostało docenione przez projektantów a realizacje przesądziły o kształcie architektury XX wieku. Aktualnie materia

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<sup>1</sup> Zumthor P., *Myślenie architekturą*, Karakter, Kraków 2010, p. 11, 21.

betonowa wpisuje się w rozległą stylistykę architektury współczesnej. Przykładem mogą być minimalistyczne projekty Tadao Ando, ażurowe betonowe elewacje Stevena Holla. Architekt-twórca nadając kształt rzeczy architektonicznej wydobywa właściwości materiału takie jak np. wytrzymałość i trwałość, a także pokazuje możliwość jego formowania. Należy dodać, że sztuka formowania betonu pozwala na znaczną dowolność tworzenia geometrii i struktury obiektu. Ciekawym przykładem może być rzeźbiarska powłoka betonowa kaplicy Bosjes Chapel wg projektu Steyn Studio.

Wyrazistość formalna jak i możliwości konstrukcyjne betonu pokazują jak sztuka budowania powiązana jest z kompozycją architektoniczną. Chociaż Peter Zumthor uważa, że sens który należy nadać materialnemu tworzywu, leży poza granicami reguł kompozycyjnych, a namacalność, zapach i sposób akustycznego wyrażania materiałów to jedynie składniki języka, w którym mamy się wypowiadać.

*Słowa kluczowe: architektura betonowa, transmutacje, beton, materia i forma*

## 1. Introduction

For the architecture, the beginning of the 21<sup>st</sup> century is a difficult, but an extremely interesting period of time. We are now experiencing an incredible variety of forms, techniques, technologies and experiments in a rapidly changing post-industrial world full of social and environmental problems. At present, the matter of concrete is integrated into the extensive design of contemporary architecture. The formal expressiveness, as well as the structural capabilities of concrete, decided that architecture became the art of overcoming the boundaries – the physical ones, related to the physics of the buildings, and those strictly aesthetic, related to architectural composition. There are many types of transmutation effects.

The architect shaping the architectural works brings the material properties of concrete such as endurance and durability to the foreground, and shows the possibilities of the material formation to manifest its nobleness. Peter Zumthor believes that the sense given to the material lies outside the boundaries of the principles of composition, while the tangibility, the smell, and the manner of acoustic expression are only the components of the language, which we are meant to speak<sup>2</sup>. He also believes that architecture is exposed to life. If its body is sufficiently sensitive, it can achieve the quality that will guarantee the reality of past living.

## 2. Transmutations – form – stylistics

Concrete is a material that creates new meanings and shapes through conversion (transmutation). It is worth mentioning, though, that this material has had to wait for its time. Le Corbusier was the first person to notice and appreciate the severity of this material. Frank Lloyd Wright used natural, clean and honest materials, including blocks of concrete. At the end of the first quarter of the 20<sup>th</sup> century, the so-called *textile block system* was one of the

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<sup>2</sup> P. Zumthor, *Myślenie architekturą*, Karakter, Kraków 2010, p. 11, 21.

most expressive and architecturally original systems based on the principles of standardisation and modularity.

Worth noting is the way Wright treated the texture of concrete (ornamented blocks of concrete), making it an important element of the aesthetic expression of the construction. He also used concrete inside the facilities, which can be seen and admired in his residences (Millard House, Pasadena, Ennis House in Los Feliz). It is safe to say that concrete architecture shaped the architecture of the 20<sup>th</sup> century. In the Pessac house complex near Bordeaux (1926), Le Corbusier used external walls that only played the role of screen curtains. They were laid on poured concrete floors, while the load-bearing elements in the form of pillars were laid inside the building. The Pessac settlement was a consistent attempt to change the perception of concrete architecture, to make it optically light, by tearing the outer wall away from the supporting structure. In the years 1946–1952, Le Corbusier built the famous Marseille Unit, which revolutionised the architectural design and launched a new direction in architecture called brutalism. Louis Kahn also belonged to the first generation of brutal architects. According to Le Corbusier, it seemed indeed possible to treat concrete as if it was reproduced stone, worth being displayed in its natural state<sup>3</sup>.

It is commonly known that Le Corbusier was a proponent of simple forms, but he also conceived the building as a sculpture in concrete, as exemplified by the chapel of Notre Dame du Haut in Ronchamp. The chapel in Ronchamp differs from Le Corbusier's other accomplishments – both the modernist pre-war villas with smooth plaster, glass, steel, and structures based on geometric figures, as well as his later brutalistic buildings. It is difficult to find right angles there, because most of the walls, as well as the roof and the floor, are based on irregular, dynamic curves. Le Corbusier has been criticized for excessive irrationality, but in retrospect, Notre Dame du Haut is considered one of the most outstanding achievements of the 20<sup>th</sup> century sacred architecture.

Forming the concrete matter, Le Corbusier assembled static and non-static elements, and believed that the relationships between forms need not be practical<sup>4</sup>. Several decades later, at the end of the 20<sup>th</sup> century and at the beginning of the 21<sup>st</sup> century, the beauty of concrete architecture expressed by Le Corbusier found other admirers. Concrete became the fascination of the Japanese architects such as Tadao Ando, who appreciated minimalism and architectural asceticism, as well as the deconstructivist Zaha Hadid. Mario Botta also admits to having been inspired by Le Corbusier's designs.

Today, it is difficult to imagine architecture without concrete. This material has again been appreciated by the architects, and their works surprise with interesting solutions. The innovative use of concrete for the creation of original forms can be traced back based on several examples. Concrete is the material used for artistic experiments, as shown by the work of Richard Serra in King City (1970), in which the author placed a zigzag in an empty field, which was a form of his self-expression.

As mentioned earlier, Tadao Ando was fascinated by Le Corbusier's works from the very start of his career, which can be seen at the Azuma House in Osaka and the Church of the Light in Ibaraki. One of Tadao Ando's latest projects is the adaptation of the art museum building into a hotel facility (2002) on Shikoku, the smallest Japanese island. The design

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<sup>3</sup> S. Giedion, *Przestrzeń, czas, architektura, Narodziny nowej tradycji*, PWN, Warszawa 1968, p. 572.

<sup>4</sup> W. J. R. Curtis, *Le Corbusier: Ideas and Forms*, London 2001, p. 54.

includes bright concrete surfaces, sea view rooms and straight lines, and as such, it reflects the typical Ando's minimalism. A characteristic work created in the same style is the Pringiers House (2011), located on a cliff on the southern tip of Sri Lanka. In his first New York work, a building in Manhattan (2015), he created a residential condominium, in which – just like in the case of his previous designs – he used his favourite material: concrete, combined with glass panels and steel structures. Concrete is exposed outside and inside the construction, so the precision of concrete pouring and forming has been treated with special attention<sup>5</sup>. Tadao Ando's architecture is stripped of colours. These are only created by the custom colours of the materials.

In turn, in Steven Holla's designs, concrete is used to create exposed forms. Examples include the Sliced Porosity Block in Chengdu, China and the Linked Hybrid in Beijing. In the latter, the architect decided to face the issue of housing complexes. Linked Hybrid is a modern housing complex, one of the most ecological in the world. In both projects, the façades are made of white concrete frames, and the light additionally shines through the holes and recesses between the buildings. It is worth adding that the Linked Hybrid complex was built in the centre of Beijing, near the historic centre of the Chinese capital. The area of more than six hectares houses a complex of eight apartment blocks connected by a characteristic coloured footbridge. Therefore, transmutations have different faces, and these works manifest the lightness of the material.

A slightly different, but still exposed concrete stylistics, is manifested in the façade of a university building Experimenta 21 Tower designed by Morini Arquitectos in Córdoba, Argentina. Irregular, polygonally shaped holes illuminate the interiors. The facade, which reaches over forty meters in its height, was built in just fourteen days<sup>6</sup>. Prefabricated pre-stressed concrete panels were supplied to the construction site, where they were mounted to metal brackets attached to the perimeter of the building.

Another interesting example of concrete transmutation and the transition into a wavy form is the Bosjes Chapel (2016) in South Africa, designed by the Steyn Studio. The roof that was made of bows, resembles a sinusoid and gives the chapel the shape of a flower. The façade is almost entirely glazed, which enables people to admire the incredible mountain views from practically every point of the building. Window frames create wooden crosses. The chapel is located in the vineyard, and the sculptural form reflects the outline of the surrounding mountain ranges. The wavy shape of the roof seems to almost touch the surface of the water in the pool located near the building, while the corners are raised to resemble wings.

The one-storey building is erected on a pedestal. The chapel borders with a pool, which creates light reflections and highlights the apparent weightlessness of the building. The white concrete form is conceived as a lightweight and dynamic construction that seems to float in space.

Concrete can also be an inspirational and intriguing structure when used, for example, in the form of a skate park placed on a roof. There are many concrete skate parks in the world, and the original solution can be found on the roof of one of the buildings in Berlin.

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<sup>5</sup> B. Bosker, *Luminous in concrete: Architect Tadao Ando's Manhattan tour de force*, source: <http://www.afr.com/lifestyle/home-design/luminous-in-concrete-architect-tadao-andos-manhattan-tour-de-force-20170418-gvmyw1> (access 5.06.2017).

<sup>6</sup> M. Kulawik, *Eksperymentalna wieża, uniwersytecki budynek edukacyjny, Edificio Experimenta 21 w Córdoba*, *Architektura&Biznes*, nr. 3/2017.

Modern works are increasingly innovative in the way they apply the most versatile and the richest material of all – concrete. The richness of stylistics manifests itself in works ranging from lightweight constructions to full buildings with solid walls and contrasting glass elements as seen in the Kubota Architect Atelier design in Japan. Of course, for some, concrete may have negative associations due to the fact that it recalls the large-panel prefabricated housing settlements. Many communities still live in such places that are now being renovated, refurbished and adapted to the demands of the modern world.

There are architects who are particularly strongly associated with the concrete architecture and this is their favourite material. Concrete is not only a building block but also a means of expression. Especially, the deconstructivists use and discover the potential of expressivity of concrete forms, creating often controversial and innovative concepts of space shaping. The art of concrete formation now enables considerable freedom in creating the geometry and structure of the objects. The severity of the finish – or its lack – is intended to exacerbate the impression exerted upon the recipient.

### 3. The matter of concrete and its use

Concrete is one of the most common and cost-efficient materials used in the modern construction. It was already known in the ancient times. Concrete technology makes the industrial production of building elements possible thanks to the use of prefabrication. This helps to achieve the economic benefits, as well as to fulfill the architect's intentions. Formworks enable the precise creation of even very complicated and sophisticated concrete and reinforced concrete castings. The basic characteristics of concrete are high durability and excellent workability, and the way it is used depends on the creator's idea. It is true that plain concrete is heavier than water<sup>7</sup>.

Concrete is currently experiencing arebirth, and the modern types of concrete ranging from light and insulating types to scratch-resistant and high-pressure types, have various applications. Compared to other materials, concrete has unique properties – it is created in a fluid form, which transforms it into a solid, massive and durable matter. Concrete and formworks are closely related. For this reason, individual concrete parts require precise formworks. For Le Corbusier, the traces left by the formworks created a noble aesthetic effect. Uncovered concrete reveals the smallest inaccuracies in the assembly of boards, the wood fibres, the knots, etc.<sup>8</sup>.

According to Koren and Hall, concrete is a beautiful and instructive visual search for materials often regarded as dull and cold, but at the same time full of spectacular potential that can be revealed in reality<sup>9</sup>. Concrete is often used both as a façade material and other interior and exterior elements, and as a part of the interior design.

Architectural concrete can be divided into two types: the monolithic and the prefabricated one. The former type is used in the elements that are created on the construction site. It is poured into formworks or, in the case of floors, in the form of the self-levelling screed.

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<sup>7</sup> U. Knaack, S. Hickert, L. Hildebrand, *Concrete*, Netherlands Architecture Institute (NAi Uitgevers/Publishers), 2015.

<sup>8</sup> Jencks Ch., *Le Corbusier. Tragizm współczesnej architektury*, Warszawa 1982, p. 155.

<sup>9</sup> Koren L., Hall W., *Concrete*, Phaidon Press, 2012, p. 92.

Such forms are strengthened by various types of reinforcements, usually made of steel. It is worth noting that the monolithic concrete makes the construction process faster and enables to achieve very good parameters of energy efficiency of the building, as well as very good acoustic and fire retention properties. Moreover, concrete is a renewable material.

Prefabricated concrete is ready-made elements, such as concrete panels. Therefore, the best effect is guaranteed by the use of prefabricated elements, which allow to fully enjoy the quality and the aesthetics of concrete.

Existing concrete production and impregnation technologies allow the use of ready-made panels even in rooms such as bathrooms. Concrete is used as the material for kitchen countertops, fireplace enclosures, and even bathtubs or washbasins. Very often, it is also used to produce some very surprising decorative items, as well as lamps or dishes. The decorative-ness of concrete can be achieved through the use of four basic techniques of creating the surface texture: leaving it in its natural form, mechanical texturing, delaying the surface binding process chemically, and, finally, by a combination of these methods. Leaving concrete in its natural form is currently taking two directions. The first direction is executed by means of a proper technological regime aimed to produce a surface without pores and discoloration. The second direction is intended to achieve an effect of the natural discolouration and blistering of concrete, which is then used as the background for other architectural solutions.

Architectural concrete has a smooth and uniform structure, thanks to which the shaped concrete surfaces do not require additional finishes. The use of suitable matrices enables to additionally achieve the effect of, for example, wood textures. The texture of wood and knots left in concrete is unique. In addition, the technique itself, often set individually for a given application, provides excellent control of the nature of the surface. This applies to the very way of producing concrete elements, the possibility of pouring concrete in layers, the right choice of the aggregate.

Concrete is the contemporary stone. Like natural stone, it is used as a construction and a cladding material. Zana House in Lublin is an example of a building in which concrete is structurally true – it is the construction and the finishing material.

Transmutations (transformations) concern not only the use and, as a result, the form, but also the very matter of concrete. Concrete can be mixed with superplasticizers such as, for example, synthetic resins which reduce scratches and cracks on the concrete surface. Thanks to this, highly durable concrete can be produced, and an example of such a material can be found, for example, in the construction of The *Tenerife* Space of Arts in Santa Cruz, designed by Herzog & De Meuron (2007).

Concrete, which gives the feeling of its own mass, when used as a modern artificial stone and appropriately applied, creates the impression of ascetic nobility. The play of lights in concrete constructions, already seen and willingly used by the modernist avant-garde, fosters the creation of a unique atmosphere of the designed architectural works. Still attractive, the concrete technology remains in constant development. It is worth mentioning that MIT researchers are working on developing a new formula for concrete using natural materials such as, for example, shells, bones and deep-water sponges<sup>10</sup>.

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<sup>10</sup> J. Chu, *Finding a new formula for concrete*, MIT News Office , May 25, 2016, source: <http://news.mit.edu/2016/finding-new-formula-for-concrete-0526> (access 3.06 2017).

It has been observed that biological materials are exceptionally durable. If we can replace cement, it will be the next step of using materials that exist in nature, and thus promoting sustainable development. Innovative solutions do not stop solely on improving the physical properties of the materials, such as their endurance. The development also reaches the aesthetics of the solutions, which provides architects with new tools to create the character of space. A well-known example is a product called LiTraCon, created by a team of experts from Hungary, which contains glass fibres embedded in the concrete mass, allowing light to penetrate through the elements made of this material. It was used in a transparent concrete wall proposed by Boleslaw Stelmach in the international competition for the design of The European Solidarity Center in Gdansk<sup>11</sup>. Semi-transparent concrete is used in the designs of, among others, Kengo Kuma. It is worth noting that various admixtures and technologies used in the production of concrete support the idea of sustainable development<sup>12</sup>. This way, buildings become cost- and energy-efficient<sup>13</sup>.

Aerated Autoclaved Concrete is the only material that often has two functions – it is the construction and the insulation, which enables the buildings to be energy-efficient and to have good acoustic parameters.

Colourful concrete is more and more frequently used as a construction material. It is coloured using inorganic pigments such as inorganic iron oxide or chromium oxide pigment. Simon Astridge used pigmented concrete to create an interesting pink façade of a building in the north of London. Architects from Barclay & Crousse used red-pigmented concrete in simple geometric forms of the Museum of Archeology in Peru.

#### 4. Conclusions

Through transmutation, concrete continuously creates new meanings and shapes. Concrete is not only a construction material enabling a considerable freedom in the form and structure of an object, but it is also a means of expression. It is used not only for facades, but also for a whole range of other elements such as ceilings, beams, columns or stairs, which become the elements of the design, as well as inner battens or wall panels.

Transmutations of concrete illustrate its artistic, sculptural properties. The versatility of this material is best demonstrated by the willingness of architects to represent different styles (neo-modernism, deconstructivism). Through a specific material compactness of the form, the monumental and uniform nature of concrete is emphasized. Thanks to its severity, concrete is also a popular means of expression for architects who carefully operate the atmosphere of the buildings they design.

The ability to obtain a variety of textures and the appropriate choice of formworks make it possible to create a range of subtle effects and details. Transmutations of concrete as a technological-structural material and as a finishing material are very diverse. Concrete gives the

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<sup>11</sup> B. Stelmach, *Zastosowanie betonu we współczesnej architekturze*, Budownictwo Monolityczne nr. 1/2010 p. 15–16.

<sup>12</sup> [http://pol.sika.com/pl/group/zrownowa\\_ony-rozwoj/rozwi\\_zania/sustainability-concrete-technology.html#sthash.fQ2BkIC1.dpuf](http://pol.sika.com/pl/group/zrownowa_ony-rozwoj/rozwi_zania/sustainability-concrete-technology.html#sthash.fQ2BkIC1.dpuf) (access 5.06.2017).

<sup>13</sup> G. M. Sabnis, (Ed) *Green Building with Concrete: Sustainable Design and Construction*, CRC Press, 2011, p. 92.

opportunities to shape various visual effects. This is important for the reception of architecture. Concrete that combines structural features with aesthetic expressiveness brings great variety and freedom to the process of designing architecture. Hence, no one is surprised by the return of the concrete fashion and the desire to use this material, especially among architects seeking an individual means of expression in their domain of art.

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