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THE NEW LOOK OF CONCRETE

NOWY WYMIAR BETONU

A b s t r a c t

The transformation of concrete is connected with the new image of the material, associated with modernity and severity. Architectural concrete gives the form a timeless dimension that is not limited by the detail of a specific canon or brieffashion. The simplicity and elegance of the concrete are its greatest assets, which perfectly emphasise the shape, character and monumentality of an architectural object. Due to its solemnity, concrete triggers a strong visual impression, often perceived as durability and stability. A slightly different nature of the material is gained with the use of photovoltaic technology. It creates unlimited possibilities for depicting motifs, ornaments and graphics on the surface of the material. Though it still amazes with its austerity, concrete transforms into a painting, a plane reproducing a product, sometimes a work of art. We may discuss whether the effect of these activities lessens the impression that pure concrete – devoid of detail – so perfect in its form provides. However, on the other hand, the new look of this material is not only limited to *photoconcrete technology*. It is one of the possibilities that can accompany concrete. Used rationally, they often provide a visually attractive effect – a new dimension of the material. The aim of this article is to indicate the additional possibilities that photoconcrete creates and the analysis of selected examples.

Keywords: *photoconcrete, modularity, screen printing, photoengraving*

S t r e s z c z e n i e

Transformację betonu należy upatrywać przede wszystkim w pozyskaniu przez materiał nowego wizerunku, który kojarzony jest z surowością i nowoczesnością. Beton architektoniczny nadaje formie ponadczasowy wymiar nieograniczony detalem odwzorowującym określony kanon, czy krótkotrwałą modę. Prostota i elegancja betonu to jego największy atut doskonale podkreślający kształt, charakter, monumentalność obiektu architektonicznego. Beton za sprawą swej patetyczności wyzwala silne wrażenia wizualne, które często odczuwane są jako trwałość i stateczność. Nieco inny charakter materiał zyskuje przy udziale technologii fotobetonu jakiej może być poddawany. Stwarza ona nieograniczone możliwości obrazowania motywów, ornamentów, grafiki na jego płaszczyźnie licowej. Choć nadal zachwyca swą surowością ulega transformacji stając się obrazem, płaszczyzną odtwarzającą produkt, czasem dzieło sztuki. Można dyskutować, czy efekt tych działań nie odbiera wrażeń, jakie wyzwala beton czysty, pozbawiony detalu, będący tak doskonały w swej formie. Jednak z drugiej strony nie skazuje go tylko na ten możliwy dzięki *photoconcrete technology* nowy wizerunek. Jest on jedną z odsłon, możliwości, jakie mogą towarzyszyć betonowi. Wykorzystane w sposób racjonalny stanowią często atrakcyjny

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wizualnie efekt – nowy wymiar materiału. Celem artykułu jest wskazanie dodatkowych możliwości, jakie stwarza fotobeton oraz analiza wybranych przykładów.

Slowa kluczowe: fotobeton, modularność, sitodruk, fotograwerowanie

1. Introduction

Concrete, commonly known as a construction material, has also been used in shaping the form, character and the architectural expression of contemporary concrete structures (reinforced and compressed) in construction and engineering (cubature and linear). It is applied not only to the creation of the facades of objects of various uses but also in their interiors. Identified with elegance, it has become an icon of modernity and stability, and to some extent also “dignity”. The examples of concrete architecture include both simple buildings and those with a more complex form, resulting from the technological process used in the production. This process is perceived as a necessary element determining the form of an object and its aesthetic essence¹.

The following stages of the formation of concrete objects are considered as an act of building an architectural work at a particular location. The proof of this thinking is Peter Zumthor's Brother Klaus's Chapel and the Truffle Ensemble Studio building. The use of concrete in the shaping of architecture is a phenomenon that exposes the materiality of the form, as well as the atmosphere of extraordinariness and artistic expression. The unity of a matter and form made strongly visible by the monolithic technology make it impossible to interpret them individually. Understood as one organism, they tend to harmonise often with artistic, even sculptural expression. Although concrete is associated with modernity, it has its own history, in which it is difficult to miss the work of Frank Lloyd Wright, who sought to create a modular element with the right reinforcement. The architect recognised the value of the concrete fabrication used in architecture, and despite the fact that the works were not appreciated (Alice Millard House, John Storer's House, Samuel Freeman's House, Charles Ennis House), they became a breakthrough in the use of concrete aesthetics. Similarly, Le Corbusier perceived the beauty of natural concrete, which he compared to the stone worth exposition in its natural form. The possibilities of concrete (reinforced concrete) were presented, among others, in the Domino building, which allowed the formulation of the “Five Principles of Modern Architecture”, resulting in the creation of the Villa Savoye.

Le Corbusier often compared the naturalness of the material with all its imperfections to the nature and life of man, which is, after all, full of deviations from excellence. When writing about concrete, it is hard to omit Japanese architect Tadeo Ando, who found concrete formwork technology an important factor, contributing to the intended perception of the object's idea.

Another dimension is attributed to photo concrete technology, which has been developed since the 1980s. Its progress is related to the capabilities of the modern concrete (in-

¹ P. Bigaj, *Created from concrete – about the meaning of the design intent in shaping the architectural idea of the object* in: *Monographs of concrete*, vol 1 technology, Assosiation of the Cement Manufacturers 2016, p. 37.

cluding geopolymers), advances in the technology of complex forms, as well as the availability of advanced chemistry for concrete mixtures.

Graphics visible on the surface of the photo concrete can be obtained using a groove system or screen printing technique. The latest technologies allow for permanent printing, resistant to external factors such as VV rays. It is worth mentioning that in addition to photo concrete, architectural concretes include transparent concrete. This was patented relatively recently. The idea of obtaining "transparent" concrete focuses on introducing continuous fibres (optical fibres) or other transparent elements (for example glass rods) into the concrete matrix, in ordered or random manner—depending on the architect's concept. Both these technologies have been used so far only in prefabricated elements, additionally enhancing their usability advantages, meeting even the high expectations of the architects. The popularity of these solutions is growing despite relatively high costs. Concrete is a material that gets old and scratches—that is its nature. In order to reduce the negative effects of these phenomena, we may use the so-called self-service concrete, both in the photovoltaic and transparent form. This concerns self-repair and self-cleaning. To implement the idea of self-repair we may place the repairing material within the composite, already at the stage of manufacture, that is, before it was damaged. Therefore the repairing measure is available at the place and time when it becomes necessary to reconstruct the concrete structure, i.e., to introduce the repairing material into the interior of the component. It also allows to repair the structure at an early stage of degradation before irreparable damage has occurred. Once this phenomenon was called Kaizer's effect. However, it only occurred in the case of a relatively young concrete. Self-service properties are also expressed by the concrete containing titanium compounds. Due to their properties, titanium oxides catalyse the processes of disintegrating pollutants penetrating from the atmosphere onto the surface of the concrete and change them into hollow compounds such as oxygen, water, carbon dioxide, nitrates and sulphur. These issues have more significance for buildings, but they can be transferred to the bridge engineering and used during the repairs. The self-purification concept assumes that unwanted products are removed from the concrete surface; Gases—spontaneously, and solids are washed out by the rain water. By using self-cleaning concrete, concrete surfaces are not dirtied as fast as traditional concrete, which allows architectural features to be maintained without extra cleaning.

2. Methods changing the image of the concrete

New technologies give the opportunity to change the look and perception of concrete. It can be distinguished by its brutal character and, at other times, subtlety owed to its smooth surface with the texture of natural cement. It can also reveal the aesthetics of the aggregates².

By applying paint coatings we can obtain colouring, which sometimes exposes or otherwise masks the faults of the cast. Thanks to the diverse imagery of architecture, we may redefine the aesthetics of contemporary form by using the appropriate texture and colour of the concrete. The texture is obtained in two ways—as a result of the formwork or as a result of further processing of its surface. The colour of concrete results directly from the natural

² P. Bigaj, *Technologies of forming a texture and colour of exposed concrete, Concrete days. Tradition and modernity*, Association of the Cement Manufacturers, Cracow 2014, p. 987.

colour of the components (binder –cement, extenders –aggregates, gravel), or is obtained by special dyeing (mass, surface, coating).

Another example of using new technologies is concrete photography –photo concrete. It provides the opportunity for graphic display on the surface of the material without the need for surface coating or application of other dye materials. The black and white image is a result of the use of the light and shadow of the diverse texture of the material.

The Fotolith method is created as result of the photo transfer onto a foil placed in the boarding. This method uses a screen printing technique. The foil is sprayed with a chemical substance that causes the mortar at the imprinted site to remain chemically unbound. The photoconcrete method is associated with screen printing. It differs only in composition. The paint is replaced with an admixture that delays the binding of the concrete. The photograph of the analogue form is transformed into a numerical form. Then it is processed into a film used to produce a screen for the screen printing in the size of the concrete image. Next, the matrix is coated with a surface inhibitor to prevent cement bonding. The untreated slurry is removed, resulting in a dichroic image on the surface of the concrete – light colours are created by a non-rinsed mixture on the surface of which the binding process takes place, and in the dark places we can see the aggregate of the cement slurry, revealed by the rinsing. The delaying dopants are the decisive factors necessary for the image projection. The appropriate colour is obtained by using the appropriate colour of aggregates, additives and cement.

Photo-Graviertechnology relies on a computer processing of any image into a three-dimensional image which is later transferred to a mould model by means of the milling process and using CNC technology. This model is used to create a matrix of the polyurethane elastomers. The image is created by the interaction of the light and shadow. It is legible thanks to the length of the shade cast by the groove and the corresponding angle of the light incidence (45°)³.

New capabilities in architectural concrete –including photo concrete – are provided by the 3D printing of concrete elements. At this stage of technology, it is possible to apply this method for the publication of prefabricates, whose role and importance in the construction industry are yet again significant. The 3D technology can be used for serial production as well as for unique elements such as architectural details.

It is worth adding that architectural concrete is increasingly used in bridge construction. This fact has been highlighted in recent publications⁴. In Poland, there is no uniform definition of the architectural concrete used in bridge engineering. One of the definitions is as follows: Architectural concrete is a concrete specially designed at the stage of the documentation creation, which determines the requirements for its surface. As a result of exposure, it influences the visual nature of the object. Architectural concrete also includes concrete, the surface of which has been subjected to a coloration with the preservation of the texture, and the processing, for example by grinding, grouting, sintering, etc. According to the definition given, architectural concrete also includes concrete surfaces obtained, for example, by exposure of the aggregate or polishing.

Another definition claims that architectural concrete is a type of concrete, defined as concrete surfaces with specified requirements in terms of appearance. Architectural concrete

³ W. Jackiewicz-Rek, *Photo concrete – possibilities and applications*, www.inzynierbudownictwa.pl

⁴ K. Furtak, *Concrete in bridge engineering – past, present, and future*. Bridges, 3–4/2017 and J. Gólaszewski, *New generation concrete in bridge engineering*. Bridges, 4–2016.

guarantees the same strength and durability, but its appearance is more aesthetically pleasing and does not need to be covered with plaster or other finish. Three categories of architectural concrete for bridges are defined in the paper. This multitude of the definitions points to the need of ordering the nomenclature⁵.

3. Analysis of the selected examples

One of the projects using photoconcrete is the municipal library in Lons-le-Saunier, France, created in 1986. Prefabricated panels with graphical decorations were used on the facade of the building. The Centre for Nature and Wildlife, also situated in France, presents the possibilities of the photoconcrete. The walls of the construction, created on-site, present graphics of local animals. This manner of work is not commonly used due to the limited quality control of graphic designs, which are much more often prepared in a pre-fabrication facility.

Eberswalde Technical College is considered one of the most famous buildings created with the application of photoconcrete elements. Using screen printing, the architects –Herzog and de Meuron have decided to place multiple images of Thomas Ruff on the reinforced concrete walls of the façade. The photos were laid out in strips, where each stripe differs in the format of the image. Reflecting light differentiates the “stripes” in colour. The most prominent element of the façade includes three strips of the most expressive and brightest photographs, placed successively above the level of the window openings. Screen printing had so far been used on glass. To transfer this technology to concrete surfaces was the idea of the architects who participated in the research and technical experiments of the new technology.

Another example is the building of the Paul Sabatier University library in Toulouse, where the architect Milani used the Photo-Gravure method (screen printing) to place the photographs presenting research directions on the façade of the University. In this case, one photograph is presented on a couple of concrete blocks, not as in the case of the aforementioned Technical College near Berlin, where each concrete module was a separate and a multiplied image.

Photos arranged vertically and horizontally do not differ in colour.

Also worth mentioning is the example of the photoconcrete application on the facade of the University of Montreal. The photographs reflected on the façade were symbolic –their task was to recall the youthful associations of a student room decorated with posters that exemplify individual preferences and interests, often related to art, automotive, etc.

Photoconcrete not only applies to the moulding of the façade of architectural objects. It can be also used in engineering projects such as the Metro station in Nürnberg, Germany, where the walls of the subway station were decorated with the concrete photographs arranged in a single, vertically oriented module. This composition resembles an image suspended on an empty, horizontal wall.

Other interesting examples of the described technique are the prefabricated, coloured, concrete slabs of the Bleisjwijk cactus breeding ground in the Netherlands. The horizontal

⁵ K. Furtak, *Concrete in bridge engineering – past, present and future*, Bridges, 3–4/2017.

layout of the wall is largely filled with the photographs placed vertically. The facade of the wall is partly covered by the three-dimensional, reinforced concrete letters making the OVATA signature. The photographs themselves reflected on the concrete bring the association of the corten colour and become an important element of the interior.

4. Conclusion

Concrete undergoes a systematic transformation that affects the perception of this material and the form of the object. Its character, associated primarily with the simplicity, strength and stability, encourages to it in order to create modern architecture. Architectural concrete provides a timeless dimension, does not fit into a certain style, which does not limit its capabilities, but extends it. The different variations of the texture become its detail, and the form created is usually perceived as simple and elegant, durable and stable –not enclosed within any frameworks.

A slightly different image of the material is gained with the use of the photography printed on the concrete surface. Simple reinforced concrete planes covered with photographs, images and information are called photoconcrete. This technique allows the architecture of the object to be interpreted in a completely different way. Importantly, the reflection of the photograph does not condemn the material only to the form of the exposure. It is just one way of revealing the potential of the concrete, which transforms from the raw, unadorned material into an artistic image or background of multiple images. They are often created as a symbol of values related to the functioning of the object or as a way of presenting information, frequently of an educational nature.

One of the most interesting examples of using photoconcrete technology is the Eberswalde Technical College, which was designed by two great architects, Herzog and de Meuron, who were the first to use the screen printing technique on concrete. It was an innovative undertaking that enabled to present multiplied images of Thomas Ruff. The simple solid of the object corresponds well with the decorated facades. The possibilities of presenting some content, often with an artistic dimension with the use of the photoconcrete technology are endless. They are interesting solutions used in shaping modern architecture, perceived as symbols of expression. Particularly interesting and forward-looking may be the use of the 3 D technology, enabling precise performance of the components, both in serial production and architectural detailing. This technology allows to create different, even very sophisticated shapes, with a great precision. Due to its technological advantages, it is remarkable.

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