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# TENDENCIES IN SHAPING THE ARCHITECTURAL EXPRESSION OF ELEVATIONS MADE OF PRECAST CONCRETE ELEMENTS

## TENDENCJE W KSZTAŁTOWANIU WYRAZU ARCHITEKTONICZNEGO ELEWACJI WYKONANYCH PRZY ZASTOSOWANIU BETONOWYCH PREFABRYKATÓW

### A b s t r a c t

Concrete is a respected architectural material now. Its extraordinary popularity results from its universal design and aesthetic qualities. However, the specific character of concrete as a building material may be manifested by imperfections resulting from executive errors. Striving to achieve perfect executive quality while controlling financial outlays has contributed to the popularization of precast concrete façade elements.

The elevation, as the outer layer of the building, performs a representative function, so the creators' search for means that would allow the transformation of the "grey matter" into the perfect product is fully understandable.

The nature of technology, where prefabrication is the basic implementation component, is that the vast majority of façades made using precast concrete elements will be characterised by rhythmic, repetitive compositions and gradual divisions. However, when analysing contemporary projects, different conclusions can be drawn. They are characterised by great diversity, and architectural geometry does not necessarily have to be the result of the construction technology applied.

The analysis of directions in shaping the architectural expression has allowed three basic tendencies appearing in the architecture of façades finished with concrete prefabricated elements to be identified.

*Keywords:* *Precast concrete façade elements, rhythm, elevation composition, contemporary architecture, prefabrication*

### Streszczenie

Beton jest obecnie uznanym tworzywem architektonicznym. Jego niezwykła popularność wynika zarówno z uniwersalnych właściwości konstrukcyjnych jak i estetycznych. Specyficzny charakter

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betonu jako budulca może jednak objawiać się niedoskonałościami wynikającymi z błędów wykonawczych. Dążenie do osiągnięcia perfekcyjnej jakości wykonawczej przy jednoczesnej kontroli nakładów finansowych, przyczyniło się do popularyzacji betonowych prefabrykatów elewacyjnych. Elewacja jako zewnętrzna warstwa budynku pełni między innymi funkcję reprezentacyjną, dlatego w pełni zrozumiałym jest poszukiwanie przez twórców środków, które umożliwiłyby przemianę „szarej substancji” w produkt pod każdym względem doskonały.

Natura technologii, której podstawowym składnikiem realizacyjnym jest prefabrykat, pozwala sądzić, że zdecydowana większość elewacji wykonanych przy użyciu prefabrykowanych betonowych elementów będzie charakteryzowała się rytmicznymi, powtarzalnymi kompozycjami i miarowymi podziałami. Jednak analizując współczesne realizacje można wyciągnąć odmienne wnioski. Cechują się one dużą różnorodnością, a miarowość w architekturze wcale nie musi być wynikiem stosowanej technologii budowlanej.

Analiza kierunków w kształtowaniu wyrazu architektonicznego umożliwiła określenie trzech podstawowych tendencji pojawiających się w architekturze o elewacjach wykończenych betonowymi prefabrykatami.

*Slowa kluczowe: elewacyjne prefabrykaty betonowe, rytm, kompozycja elewacji, architektura współczesna, prefabrykacja*

## 1. Introduction

Prefabrication in construction means the process of pre-fabricating elements, which give a finished product upon assembling – e.g. a building<sup>1</sup>.

Thinking in terms of prefabrication took place before anyone began referring to this process as such. As it is associated with great savings, mainly of materials and time. Wherever the development of construction took place, whether on a large or small scale, the economic factor was taken into account. They were striving to build the most representative, solid, largest buildings as possible with the least amount of work, time, and, consequently, cost.

The breakthrough in the production of construction elements occurred in the 19th century, in the period of huge transformations, which opened up unprecedented possibilities to the builders. Materials, such as steel, cast iron, reinforced concrete, and glass began to be used in the large-scale architecture, mainly due to new processing methods – much more advanced – requiring specialised, heavy machinery and skilled craftsmen. Processing of raw materials on the construction site no longer made sense because of the increasingly complex processing process. Factories were created which manufactured repetitive semi-products based on detailed designs. These elements were then transported and assembled in the designated location. Most often, solutions of this type were used to create repetitive objects, e.g. factory halls and warehouses, as the production of steel or cast iron castings was considered to be profitable only if there was a need for a considerable amount of them.

It was natural to think about a building in terms of a product, assembled from pieces delivered to the construction site from different factories. Still working based on a modular system.

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<sup>1</sup> A. Paprocki, S. Szewczyk, *Prefabrykacja budowlana. Część I*, Wydawnictwa Szkolne i Pedagogiczne, Bielsko-Biała 1976, p. 7.

The ideal that was pursued was the construction of facilities on a principle similar to the production of cars. In 1918, Peter Behrens, an architect, in the paper entitled *Vom Sparsamen Bauen*<sup>2</sup>, proclaimed the need to increase the scale of industrialization of the construction process. He believed that it would be possible to minimize the costs of building small houses by standardizing the dimensions and forms of manufactured elements.

In 1928 there was the International Congress of Modern Architecture (Congrès Internationaux D'Architecture Moderne), one of the goals of which was to promote modern solutions, including rationalization and standardization, meaning the foundations of economic production and construction.

Le Corbusier implemented new techniques, exerting a tremendous influence on his followers. In 1923, *Vers Une Architecture (Towards Architecture)* he wrote:

*A great epoch has begun.*

*There exists a new spirit.*

*Industry, overwhelming us like a flood which rolls on towards its destined ends, has furnished us with new tools adapted to this new epoch, animated by the new spirit.*

*Economic law inevitably governs our acts and our thoughts.*

*The problem of the house is a problem of the epoch. The equilibrium of society today depends upon it. Architecture has for its first duty, in this period of renewal, that of bringing about a revision of values, a revision of the constituent elements of the house.*

*Mass-production is based on analysis and experiment.*

*Industry on the grand scale must occupy itself with building and establish the elements of the house on a mass-production basis.*

*We must create the mass-production spirit.*

*The spirit of constructing mass-production houses.*

*The spirit of living in mass-production houses.*

*The spirit of conceiving mass-production houses<sup>3</sup>.*

Already in 1914 he had developed the Domino House Project – a system based on reinforced concrete pillars and plates, which “has opened the way to creation of mass-produced houses”<sup>4</sup>. It was not a concrete project, but an ideological, general concept, a way of thinking about the architecture of times that were to come. In 1930, the construction of the Swiss Pavilion in Paris was completed, designed by the academician, Le Corbusier – a rectangular, four-storey building with a pillar construction, lightweight wall made of prefabricated concrete elements<sup>5</sup>. The introduction of façade concrete panels into public buildings had become a reality.

The next years were the flourishing of the planking industry. More and more perfect systems appear. First closed, which limit the designers’ ability to shape the mould due to a very small number of element types, over time they transform into open systems, offering much more freedom. At the same time, in countries with a better developed construction industry, the concrete prefabricated elements are commonly used for the construction of public buildings.

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<sup>2</sup> P. Behrens, *Vom Sparsamen Bauen, Ein Beitrag zur Siedlungfrage*, Berlin 1918, p. 59.

<sup>3</sup> Le Corbusier, *Towards a New Architecture*, Dover Publications, INC, New York, 2013., p. 250.

<sup>4</sup> M. Charciarek, *Twórcy architektury betonowej – „wynalazcy”*, Budownictwo, Technologie, Architektura 43, 2008, p. 19.

<sup>5</sup> S. Dawson, *Cast In Concrete. A guide to the design of precast concrete and reconstructed stone*. The Architectural Cladding Association 2003, p. 39.



The limitations of costs and construction times resulted in the immediate popularization of solutions based on the standardized technology of concrete prefabrication. However, this led to the distortion of ideas promoted several decades earlier in the Athens Charter. The emerging estates, which were supposed to meet the rapidly growing demand for cheaper housing, began to cover ever larger areas, transforming into megaliths of monotonous, dehumanized architecture<sup>6</sup>.

The consequence of the unrestricted confidence endowed to the modernist ideas and the lack of a rational approach to urban and architectural planning was the liquidation of the Pruitt-Igoe estate in St. Louis. The association designed in accordance with the recommendations of the International Congress of Modern Architecture, by Minoru Yamasaki, was founded in 1952–1955 and was one of many multi-pleated estates. The extremely rapid growth in crime and vandalism which took place there led to the decision to demolish it. On July 15, 1972, some blocks were blown up<sup>7</sup>. Currently, this date is considered to be the end of modernism. However, it is difficult to blame technology for this state of affairs, which was used in the construction of subsequent blocks or the aesthetics of the material used. The real reason for the collapse of CIAM congress was their apparent execution.

*Instead of functional estates of human scale and hygienic living conditions, the fiction and pathology of the objected society on an unprecedented scale was formed. (...) Communist blocks of flats with unified forms of housing, block and substandard housing from big plates have become caricatures of Le Corbusier's programmes, and incorporated into the totalitarian system, they are not only the “unthinkable modernism”, says the British economist (David Harvey – author's note)<sup>8</sup>.*

## 2. The meaning of rhythm in architectural composition

*“Architectural composition is the formation of an architectural work, which comprises the interaction of all components forming the composition – rhythm, number of shaping elements, structure, material, convention of shape (form), function, colour, chiaroscuro and time of penetration”<sup>9</sup>.*

Rhythm is the essential feature of composition which is extremely characteristic of prefabricated construction. The oldest known examples of architecture are characterised by the pursuit of order. This is especially evident in buildings with a cultural or representative character, also acting as a sign in their surroundings.

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<sup>6</sup> M. Leśniakowska, *Oczy Le Corbusiera*, [w:] Le Corbusier, *W stronę architektury*, Fundamenty, Fundacja Centrum Architektury, Warszawa 2012, p. 8.

<sup>7</sup> *Ibidem*, p. 8.

<sup>8</sup> *Ibidem*, p. 8.

<sup>9</sup> A. Satkiewicz-Parczewska, *Rytym w architekturze jako główny element kompozycji na tle analogii z muzyką*, Wydawnictwo Uczelniane Politechniki Szczecińskiej, Szczecin 1993 r., p. 11.

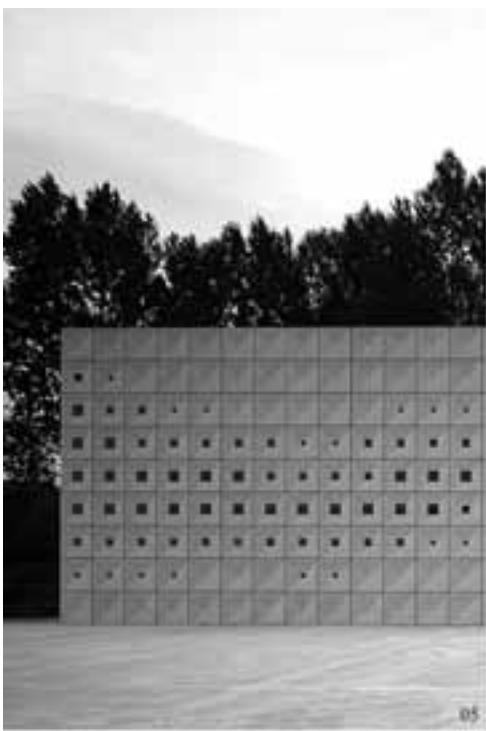
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III. 1. Author: P. Mika

III. 2. Author: R. Gindeya, source: <http://www.plataformaarquitectura.cl>

III. 3. Author: J. Lanoo, source: <http://www.archdaily.com>

III. 4. Author: J. Tiainen, source: <http://betoni.com/>



Each of the following epochs was characterised by a different style in architecture. However, rhythm was the common feature of all styles.

In the case of modern architecture, the existing styles have been mixed. We are dealing both with simple forms (brought to extremes, like in minimalism) and extremely complicated, both in terms of construction and aesthetics (e.g. deconstructivism – the design is almost against the laws of physics, which has hitherto been the “foundation” of any architectural work).

However, such diversity does not mean a departure from the basic element of the composition – rhythm. It has just been transformed. It is not always used in the form of “uniform measurable repeatability”<sup>10</sup>. The chapel in Ronchamp by Le Corbusier is an example of this, which is described by B. Szmida as:

*And so, in the Notre Dame du Haut chapel in Ronchamp by Le Corbusier we can immediately see the community of motifs in the architecture of the three towers, which spatial relations (and not only details) create a form, which would be difficult to tamper with in any way, through the alternation of their mutual position, or the change of details, they form a clear sequence<sup>11</sup>.*

The impression of rhythm is achieved not by the repetition of one motif, but through sequences, even of completely different views (sequences of sensations, tensions).

While it is not possible to speak of uniform style in modern times, it is possible to assume that characteristic schools (systems) are forms around the work of individual architects, who create their own unique direction while developing themselves, gaining followers.

*Among the modern architects we can find ‘rhythm masters’, such as Le Corbusier, Wright, Kahn or Alto. In their projects and implementations, the rhythm element always plays a dominant role in the architectural composition and is created in a particular and individual manner<sup>12</sup>.*

This tendency is mainly visible in Le Corbusier, who even developed a system of proportions, numerical relations, aimed to help achieve the perfection of geometry of form and function, known as Modulor<sup>13</sup>. Based on this, he built the Monastery of La Tourette and the Marseille Unit, which also started the fashion for using concrete as a finishing material.

The misinterpretation of Le Corbusier’s idea led to the emergence of the already mentioned, also widespread in Poland, large panel estates<sup>14</sup>. They caused a drop in interest in the technology of prefabrication itself for many years. Their rhythm, completely devoid of distinct emphasis, repeating one and the same motif, long monotonous façade strings, to this day are the detriment of the possibilities offered by the production of finished façade components

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<sup>10</sup> *Ibidem*, p. 60.

<sup>11</sup> B. Szmida, *Lad przestrzeni*, PIW, Warszawa 1981, p. 409.

<sup>12</sup> A. Satkiewicz-Parczewska, *op.cit.*, p. 65.

<sup>13</sup> P. Żuk, *Witruwiusz – Le Corbusier*, Czasopismo Techniczne, Z.1-A, cz. 7, Wydawnictwo Politechniki Krakowskiej, 2009, p. 603.

<sup>14</sup> A. Machaczka-Świadek, *Globalizacja w architekturze. Styl międzynarodowy – początki globalizacji architektury współczesnej*, Teka Kom. Arch. Urb. Stud. Krajobr. – OL PAN, 2006.

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III. 5. Author: Ch. Richters, source: <http://www.archdaily.com>

III. 6. Source: <http://www.renevanzuuk.nl/zilverparkkade/>

III. 7. Author: P. Mika

III. 8. Author: R. Halbe, source: <http://www.archdaily.com>

and correct composition using rhythm. However, in this case it is worth emphasising the fact that the final result is the result of the selected technology, which for economic reasons had very limited possibilities in terms of creating form and detail.

The changes that took place in the methods of producing facade precast concrete elements over the decade or so have allowed designers to rediscover the potential of this technology. Contemporary solutions, though based on previous systems, present a different approach to production and assembly. Very often, the whole system and types of prefabs are designed for a specific project. Only the connections between individual components remain standard.

The economic factor plays a huge role in the design and implementation process. Production of fewer types of components involves significant savings to the investor, but also some restrictions on the form and composition of the building's elevation.

### **3. Tendencies in shaping the architectural expressions of façades**

By analysing contemporary examples of objects with façades made using concrete prefabricated elements, three basic groups of compositions can be distinguished, which are used by architects while working on the specifics of the aesthetic nature of the object:

#### **3.1. Regular façades of repeatable elements**

##### **3.1.1. Strict adherence to the adopted modular network**

The desire to achieve the impression of perfect order, the rhythm of the same motifs. It can be assumed that such aesthetic expression is simply the result of the use of identical façade elements. However, it is not possible to construct a building using only one type of precast element, due to emerging door and window openings, lintels, edges and corners, or structural and functional layouts. Obtaining perfect regular divisions requires great discipline from the designer, industry coordination at each design stage and a series of fieldwork analyses so that the composition does not cause a feeling of monotony.

The City of Justice in Barcelona (ill. 1) is an example of a realization that shows the aspiration for perfect order. The complex of buildings was built in collaboration with the offices of David Chipperfield Architects and b720 Arquitectos. It consists of nine buildings up to 14 storeys above ground level, and 12 000 prefabricated concrete elements were used for their façades. The architecture of this district is characterised by the extraordinary legibility and simplicity of both the façade and the urban layout. The buildings vary in width, height and colour. Such a solution made it possible to avoid the impression of monotony. Simple, regular, but maintained in the "human" scale, architecture is meant to symbolize both the independence of the courts and the clarity of the law<sup>15</sup>.

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<sup>15</sup> *City of Justice, Barcelona and L'Hospitalet de Llobregat*, Spain 2002–2009, Architecture and Urbanism nr 473, 02 2010, p. 80–84.

### **3.2. Irregular façades from repeatable elements**

One of the main advantages of prefabrication is the possibility to reduce the costs of the façade. The use of a smaller number of element types will make the project more cost-effective. Based on the projects studied, a tendency towards the concealment of the true nature of the façade made of a small number of types of prefabricated elements is observable. These are usually optical procedures that involve blurring the repeatability of the façade elements. The basic measures used for this purpose are:

#### **3.2.1. Irregular form of the object**

This effect can be achieved, for example, by breaking the building's body into smaller fragments of different dimensions, differentiating the height of particular sections of the façade, or introducing irregular retractions or projections. Curved lines, spherical surfaces, facades led on arc lines or curved lines are also often used. In combination with the perspective shortcut, they allow us to break the network of divisions and blur the similarity between the elements.

Casa Pentimento (ill. 2), designed by the architects: Jose María Sáez and David Barragána, is a single-family house made of reinforced concrete prefabricated elements. These elements act as structures, baffles, furniture, ladders, and even pots. The form of varied height was entered into the natural plot tectonics. Individual, blanked spaces appear to penetrate each other creating a spatial sequence of terraced ledges in the solid. The form follows the organic shape of the terrain on which it is raised, and the surrounding elements, like rocks and trees. As the architects say, the project has taken on such a shape mainly due to the limited budget of the investor<sup>16</sup>. Technology based on prefabrication has proven to be very economical, primarily thanks to the maximally simplified system of structure assembly and high degree of freedom when making any changes.

#### **3.2.2. Reflective, mirror finishing**

The exposed face of the prefabricated element is subjected to treatment by grinding or polishing, or possibly covering with a coating, which allows a reflective surface to be achieved, which may reflect the building's surroundings. This treatment not only allows for a better embedding of the architecture in the context, but also breaks the repetitiveness of the elements by the images or light reflections appearing on them. In addition, with the change of the time of day, the character of the façade, and thus of the entire building, is constantly changing.

Prefabricated elements with polished façade surfaces were used in the museum building erected at the end of 2001 commemorating the victims of the Soviet camp at Sachsenhausen.

The single-storey building created between the barracks and the cemetery was sunk in the area so as not to dominate the existing low buildings. The restrained rectangular form,

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<sup>16</sup> J. Gillin, *Quito Parts*, Dwell 12/01 2013, p. 96–104.

designed by the Schneider+Schumacher office, was finished with a smooth, glossy concrete lining reflecting the environment. The lining was made of large-sized panels of the building's full height, to maximally limit the number of joints and divisions<sup>17</sup>. Those that were necessary were filled with silicone to form a monolithic body.

### **3.2.3. Rotating repeatable elements to each other**

The development of appropriately coordinated modular façade elements allows for the formation of an irregular grid of divisions. Individual prefabricated materials can be assembled together in a manner that will allow the small number of types to be masked. Rotating rectangular, trapezoidal or polygonal components by a certain value results in an impression of a façade made of a much larger number of element types.

This method was used by the designers of the Modostudio studio (Fabio Cibinel, Roberto Laurenti Giorgio Martocchia) in the administration and logistic centre in Nola (ill. 3), in Italy. The façade on the first floor was covered with reinforced concrete panels in the form of rhomboidal prisms. Four types of prefabrication were produced with different dimensions, but with the option of any direction of assembly. The entire façade is created by the free configuration of full and glazed elements with apparently random layout and very clear shading. The final effect may be associated with the walls of hewn stone blocks<sup>18</sup>.

### **3.2.4. Playing with colour or shade of particular elements**

Colour plays an important role in architecture. In this case, not so much the colour of the façade will be the centre of attention, but the manner of combining prefabricated elements of different colours, shades, textures. By using one form, it is possible to make items of identical size but with different colours or figures, without significant cost differences. A façade made of prefabricated elements of different colours takes on the character of a mosaic, a regular network of divisions moves back. The desired element colour can be achieved by adding a decorative aggregate or pigment to the concrete mass at the manufacturing stage or by coating the finished product with a dye solution, which penetrates a few millimetres. Possibly by coating the exposed surface with a paint layer<sup>19</sup>.

In the case of the Hameenlinna Provincial Archive (ill. 4), the task of the architects from the Heikkinen-Komonen office was to design a repository for collections of valuable historic documents, which fits into the historic character of the place. The modest, rectangular solid of the facility was covered with prefabricated panels with decorations

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<sup>17</sup> *Museum of Soviet Special Camp in Sachsenhausen*, Detail 04 2003, p. 332–335.

<sup>18</sup> L. Nicotera, Giorgia&Johns – *Office Building and Logistic Center*, l'Arca 279, 04 2012, p. 20–21.

<sup>19</sup> P. Bigaj, *Monolityczne technologie betonu elewacyjnego w architekturze współczesnych budynków mieszkalnych* [Monolithic technologies of façade concrete in architecture of modern residential buildings], dissertation, 2013, Krakow, p. 286.

in the form of signs, letters, fragments of sentences taken from ancient documents stored in this archive<sup>20</sup>.

The prefabricates were distributed on a regular grid; however, its rhythm was broken by motifs taken from the collections reconstructed in the technology of graphite concrete. Thanks to this treatment, the façade in this case acts as an informative element – it identifies the building with its function. It is not another office or storage facility of a neutral nature.

### **3.2.5. Increasing the number of element types**

The use of additional prefabricates with other shapes or textures significantly enhances the aesthetic appeal of the façade. It facilitates the breaking down of the regularity and monotony. It offers more freedom in terms of shaping the character and form of the building. However, in many cases, it involves increased investment costs. There are specialised frameworks that allow you to make simple elements in different variants – e.g. rectangular plates of different lengths or widths. Prefabricates with a more complex shape, especially spatial elements, require individual forms created for a particular investment.

Apart from the shape, the texture may be a factor that differentiates the components. The type of surface of the prefabricated element will be the result of the applied formworks, matrices or mechanical machining after removal from the mould.

The crematorium building (ill. 05) in Sint Niklaas in Belgium was created on a rectangular plan. To avoid similarity to the chimney or furnace, architects from the Claus en Kaan Architecten office gave it a strong horizontal form. Façades were made of prefabricated elements, with modular dimensions 1x1 m. The project used several types – full, whose surface was enriched only with square profiles, and glazed, with holes in 3 different sizes, corresponding to the assumed dimensions of the profiles<sup>21</sup>. Despite the regular layout of prefabricates – a regular grid of divisions on flat walls, various types of elements have been laid out freely. A bigger number of components with glazing was located near the corner and in the middle part of the wall. This way, the impression of the monotony of the prefabricated layout was to some extent broken.

### **3.2.6. Playing with chiaroscuro**

Using chiaroscuro in façade composition requires the incorporation of spatial elements in the design or the formation of a large-surface partition, where the openwork prefabricates will be the foreground, shading the background in the form of the full wall or glazing. Chiaroscuro will enhance the rhythm in the case of a façade with a regular network of divisions. With façades of free compositions – it will emphasise their irregularity, also increasing the effect with a variable image, depending on the lighting at the given time of day and year.

<sup>20</sup> C. Slessor, *Hameelinna Provincial Archive, Heikkinen-Komonen Architects*, Architectural Review 05 2010, p. 68–72.

<sup>21</sup> *Architecture in Belgium and the Netherlands, Crematorium Heimolen*, Architecture and Urbanism 475, 04 2010, p. 119–122.

At Silver Park Quay (ill. 06), Studio Rene van Zuuk Architektem, covered the façade plan with the structure of concrete prefabricates. Its form resembles stretched tree branches. The resulting grid is the effect of studies of patterns relating to the work of the Dutch graphic artist Maurits Escher. The hardest task was to translate the repetitive pattern into the smallest possible number of types of elements for prefabrication. At the same time, the designers wanted to avoid too obvious rhythmic repetitions<sup>22</sup>. The concrete curtain in front of the glazed curtain wall allowed the interior to be partially covered from sunlight and at the same time has become the showpiece of the office building. White elements go to the first plan of the façade, determining its aesthetic expression. The clear chiaroscuro, on the glazed glass in the back, thrown both by prefabricates and technical bridges, combined with reflexes and reflections, change the way we receive the regular grid of divisions.

### **3.2.7. Combining different methods**

Combining individual measures helps achieve the desired effect of irregularity. The application of several methods at the same time within one building or its façade offers an almost unlimited number of combinations, which are not necessarily associated with the proportional increase in the cost of implementation. This solution will be especially applicable to large-area buildings or in the case of building complexes, in order to avoid the impression of monotony and to facilitate the user's orientation in space.

The façade of the Diagonal 197 office building (ill. 07) designed by David Chipperfield is a multi-coloured mosaic. Reinforced concrete prefabricates of glazed fibres (GFRC) were used for its production. Elements are tinted in the mass into earthly shades<sup>23</sup>. All windows have a full storey height. Their varying widths, together with the accidental layout and colour scheme of vertical lining panels, create a seemingly chaotic mosaic, which perfectly softens the monumental façade of the office building.

## **3.3. Irregular façades of unusual elements**

### **3.3.1. Irregular, free network of connections, without a visible module**

A solution that involves the use of a large number of different types of prefabricates. In some cases, there is a complete lack of repeatability – each element is unique. Definitely the most expensive method, used when the perfect quality of the product is the prime goal. It requires the development of numerous disposable forms or a system of formworks with a modified geometry.

This system was used at the Perot Museum of Nature and Science (ill. 08) in Dallas that was designed by Morphosis studio. The volume of the rectangular building imposes

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<sup>22</sup> Ch. van Uffelen, *1000 x European Architecture*, Braun, Salenstein 2012.

<sup>23</sup> J. Luaces, <http://archinect.com/people/project/20515746/diagonal-197-campus-audiovisual/20539838>, (access date 10<sup>th</sup> may 2017 r.).

associations with a massive monolith. The surface of the walls, irregularly wrinkled, corrugated, with few perforations, resembles the natural stratification of rock formations<sup>24</sup>. The effect was achieved using 656 types of elements. The intensification of folds is much larger in the lower parts of the building. As the climb progresses, the surface smooths out, leaving the impression of fading against the sky. The BIM technology proved to be useful for performing the parametric model of the façade elements, based on which it was possible to carry out the panel forms quickly and accurately, and fix them accordingly. The forms were in the shape of wooden frames and fine plastic parts, from which the pattern of the external surface of the panel was laid on the bottom. Their layout was changed before each filling.

#### 4. Conclusions

The vast majority of façades finished with prefabricated concrete elements are characterised by rhythmic, repetitive compositions, gradual divisions. This is due to the nature of the technology, where the prefabricated element is the basic implementation component. The idea of mass production of repetitive elements, however, was born primarily from the economic account.

Rhythm in various forms has always been one of the basic elements of composition. It is a common feature of all architectural styles. Regardless of the material used, type of construction, function or scale of the object. Repetition in modern architecture appears as a means of ordering the space surrounding people<sup>25</sup>.

At the same time, many contemporary creators at all costs try to depart from the measure and repetition. However, this does not mean the abandonment of the rhythm. It simply takes on another form, e.g., a sequence of interrelated motifs.

When analysing the trends in shaping an architectural expression, it is possible to distinguish three basic directions followed by designers. One of them is an attempt to get the impression of a perfect order, even divisions. Since there is no way to produce façades from one type of prefabricates, the design process requires enormous consequences, discipline and numerous analyses.

The attempt to conceal the fact of using a limited number of element types is a different direction. Irregular façades of repetitive elements are a compromise, between the fully free compositions of unique components and the economic account. By using numerous resources, the designer is able to obliterate the impression of repetition of the few types of prefabricated elements.

The third trend is the complete rejection of the geometry in the façade composition. It involves the use of the number of element types that results from the developed design concept. The economic factor plays a secondary role here. In this case, one can talk about total compositional freedom.

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<sup>24</sup> N. Olsenberg, *Canyon to Cosmos*, Architectural Review 01 2013, p. 22–33.

<sup>25</sup> A. Mielnik, *Współczesne tendencje minimalistyczne w architekturze domów jednorodzinnych. Część trzecia. [Contemporary minimalistic tendencies in architecture of one-family houses. Part III.]* Przestrzeń i Forma nr 17, 2012, p. 252–253.

In summary – the prefabrication of façade elements in architecture is justified if its choice is the consequence of the aesthetic and compositional decisions of the designer. The form cannot be the result of the technology applied. Rhythm, which is the basic and most used element of composition, has existed in construction since the very beginning of its existence, before anyone could define the prefabrication process. Examples cited in the text at the same time show that a properly composed, rhythmic façade can be interesting and intriguing. It is wrong to argue that unattractive buildings with monotonous façades with repetitive motifs are the result of the applied technology.

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