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WORK OF ARCHITECTURE – BETWEEN INTUITION AND RATIONALISM

DZIEŁO ARCHITEKTURY – POMIĘDZY INTUICJĄ A RACJONALIZMEM

A b s t r a c t

The research spanned a dozen or so selected sites considered significant for the development of architecture. They were constructed through a combination of a stroke of creative genius and rational understanding of the available technical resources, and that is also why they survive to this day. They differ in the epoch during which they were erected, the group of people engaged in their establishment as well as the materials and equipment used. Both intuition as well as rational thinking are required to create a ground-breaking building. That is how the oldest vernacular structures and Gothic cathedrals came to be, not to mention the roofing of the Olympic Stadium in Munich or the rustling sun-blinds of the student centre at the University of East Anglia. The architects' intuition was shaped by the conditions afforded by subsequent epochs. The expanding scope of scientific and technical disciplines used changed the paradigm of modernity. Those engaged in creating modern architecture also operate between an intuitive and rational understanding of problems.

Keywords: development of opportunities, aesthetic preferences, technical advancement, knowledge, experiment

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

Przeprowadzone badania dotyczyły kilkunastu wybranych obiektów uznawanych za istotne w rozwoju architektury. Wszystkie zaistniały dzięki błyskowi geniuszu twórczego i racjonalnemu rozeznaniu możliwości technicznych; dzięki temu istnieją do dziś. Czynnikiem, który je różni, jest epoka, w której powstały, krąg ludzi zaangażowanych w realizację, wykorzystane materiały i sprzęt. Stworzenie przełomowej budowli wymaga zarówno intuicji, jak i racjonalnego myślenia. Tylko tą drogą powstały najstarsze wernakularne konstrukcje, gotyckie katedry, o monachijskim przekryciu olimpijskiego stadionu i szeleszczących żaluzjach studenckiego centrum w University of East Anglia nie wspominając. Intuicję architektów kształtowały warunki, jakie stwarzały kolejne epoki. Tym samym rósł zakres wykorzystywanych dziedzin nauki i techniki, które zmieniały paradygmat nowoczesności. Również i ci, którzy współtworzą współczesną architekturę, działają pomiędzy intuicyjnym i racjonalnym rozumieniem problemów.

Słowa kluczowe: rozwój możliwości, estetyczne preferencje, postęp techniczny, wiedza, eksperyment

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1. Introduction

The subject of participation of intuition and rational thinking in the act of creating architecture entails the basic questions: What is intuition of form? What is rational thinking about form? This arrangement generates the next question: does the sphere of intuition verify the sphere of rational perception and can the reverse situation occur in the design process? What was historical development like, traced up to the point which we are today?

It is difficult to consider the first two issues without a background in the humanities fields of philosophy and psychology. One may endeavour to answer the subsequent questions by performing an analysis of example ground-breaking solutions, typical of subsequent epochs, where traces and information as to the design process still remain today.

Thematic research was limited to public use buildings in a broad sense, as in the author's opinion they posed and still pose challenges, where the boundaries of aesthetic conventions are most often breached and new conceptual solutions are employed. It does seem that here intuition has to be verified by rational thinking. However, some notions survive which point to the reverse process, where rational premises for changes were sifted through a sieve of intuitive prerogatives, which in these cases can be referred to as habits.

Initially it may be assumed that during the course of creating works of art, intuition and rationalism mutually verify but also inspire one another. The catalyst for this process is the background of a given epoch, and to be more precise the possibilities and aesthetic inclinations and conventions encompassing culture in a broad sense[1].

2. Intuition and rational reasoning in a contemporary understanding of science

The question of intuition and rational thinking in situations where decisions have to be made, opens up a vast area explored by humanities' disciplines: philosophy, psychology, sociology – but also the theory of architecture.

Monika Walczak in her article *Intuition as a cognition, knowledge and disposition*[2] states that "Intuition as understood by psychologists has both a conscious as well an unconscious dimension"[3]. She also quotes vary diverse ancient and contemporary definitions and notions. In Platonic and Neoplatonic philosophy intuition was considered to be *the highest level of cognition, which requires no methods, composing or dissecting into parts, or proof*[4]; however, from the 18th century onwards (Kant) in various definitions intuition was taken as the existence of knowledge, analogous to perception, which makes one "familiar with universals and the relations between universals" (Russell)[5], all the way to stating that "the close rela-

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[1] A. Colquhoun, *Collected Essays in Architectural Criticism,* Black DOG publishing, London 2009, p. 323.

[2] M. Walczak, *Intuicja jako typ poznania, wiedzy i dyspozycji,* Zagadnienia Naukoznawstwa, 2 (188), 2011.

[3] M. Walczak, *ibidem,* p. 143.

[4] M. Walczak, *ibidem,* p. 130.

[5] M. Walczak, *ibidem,* pp. 136–137.

tion between procedural memory with implicit learning constitutes the basis of intuition"[6] (Czesław Nosal, as cited in: M. Walczak p. 142).

Research on the role of intuition in architectural works encompasses the emotional, theoretical, practical and technical spheres, as well as management. One has to revert to specialist literature, where the role of intuition in actions which give rise to real works are analysed. In the chapter entitled „Intuition as a factor supporting decision making processes in extreme conditions"[7], Edward Markowski writes about two interpretations of intuition as a category: the first is a pragmatic approach, results of scientific research, and the second is an approach which "favours spirituality, considering intuition to be a 'gift from God'". Here Markowski quotes D. G. Myers[8], who in his research on the intellectual abilities of humans stated that, "Thinking, memory and attitudes function on two levels (conscious and purposeful as well as unconscious and automatic) – contemporary researchers call this *dual processing of information*". Further on E. Markowski cites examples of correct choices made under pressure driven by intuition. He defines both the strengths and weaknesses of intuition driven decisions. Both in the past as well as today this is reflected in research on decisions typical for the design and construction process. An optimal decision may be made by "activating cells with tacit knowledge and its application in a given situation" (E.M.), which takes place both in the design and management process, as referred to by Edward Markowski.

Research on the relationship between intuitive and rational strategic decision making has been presented in numerous works, amongst other by a team comprising Giulia Calabretta, Gerda Gemser and Nachoem M. Wijnberg in an article entitled The Interplay between Intuition and Rationality in Strategic Decision Making: A Paradox Perspective[9]. It considered issues associated with designing objects, where for making design decisions the authors suggest building teams comprising individuals with an intuitive approach to a problem and individuals who represents the rational approach[10]. When working as part of a team, each one of them has to modify their way of perceiving the problem. In psychology this is referred to as "paradoxical thinking".

Krzysztof Leja presents a similar problem with reference to management. In managing a university he identifies logical thinking and creative thinking. Both categories have to be made use of in different decision making spheres at a university. The author highlights the exploitation sphere and the exploration sphere[11], which can be looked upon as the spheres

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6 Cz. Nosal, as cited in: M. Walczak, *ibidem*, p.142.

7 E. Markowski, *Intuicja jako czynnik wspomagający proces podejmowania decyzji w warunkach ekstremalnych*, in: *Zarządzanie kapitałem intelektualnym w organizacji inteligentnej*, edited by W. Harasim, Promotion University in Warsaw, Warsaw 2012, pp. 26–44.

8 D. G. Myers, *Intuicja, jej siła i słabość*, [Intuition: Its Powers and Perils] Moderator, Wrocław 2004, p. 401 et seqq.

9 G. Calabretta, G. Gemser, N. M. Wijnberg, *The Interplay between Intuition and Rationality in Strategic Decision Making: A Paradox Perspective*, Organization Studies, 2017, Vol. 38(3–4), p. 376–377 and 395, DOI: 10.1177/0170840616655483, access on: 04.07.2018. http://journals.sagepub.com/doi/pdf/10.1177/0170840616655483

10 G. Calabretta, G. Gemser, N. M. Wijnberg, *ibidem*, pp. 376–377, p. 395

11 K. Leja, *Zarządzanie uczelnią: Koncepcje i współczesne wyzwania*, Wolters Kulwer Polska S.A., Warsaw, 2011, pp. 287–289.

of rational and intuitive actions. For each one, decisions should be made in a different manner.

2.1. Evolution of the design and construction processes: variables values and constant values

For the French Gothic cathedral, the relation between the rational and intuitive factors enjoys its own, often very complex dynamics. The primary change as compared to antiquity was that many specialists were employed in the construction process: workshops which participated in the entire construction process. And thus the need to manage arose. The chief architect together with assistants performed this task[12].

A combination of a ground-breaking vision (intuitive) supported by knowledge within the scope of materials and construction experience (rational premises) has often led to the creation of ground-breaking buildings. A vision which was not supported by sufficient experience led to a construction disaster.

The spectacular collapse of a part of the choir at the Beauvais Cathedral in 1284 was one which was most thoroughly documented. Today it is thought that the cause lay in the slim structure and a failure to adopt it to Normandy's climatic conditions: strong winds generated vibrations which exceeded the resistance of the stone structure. The masons of the day were also aware of this – in rebuilding the choir the frequency of supports was doubled and sexpartite vaulting was constructed[13].

When William of Sens rebuilt the fire ravaged Canterbury cathedral, as a French architect in England he was unfamiliar with the quality of local stone. He imported blocks from France, from the quarries around Caen which he was familiar with, to construct the elements subject to most loading. Other French architects did the same, until the deposits around Stamford were tested empirically[14].

For some more recent European historic monuments, original notes, documents, plans and even „detailed drawings" in various forms survive to this day. They talk about the changes implemented during the construction process, and sometimes about conflicts and failures. And here a reoccurring process emerges, where intuitive concepts are verified by technical constraints; according to K Leja – the exploratory sphere by the exploitation sphere.

The description of the complex situation which occurred just as Gothic art was being subsumed into Renaissance art following the completion of the design for the construction of Florence Cathedral's eastern section is particularly accurate. The conflict applicable to the technical side of the construction occurred between Florence city council and architect Filippo Brunelleschi and Lorenzo Ghilberti, who came second in the contest but was designated by the City Council to assist the winner. A hundred years later Vasari described

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[12] A. Erlande-Brandenburg, *The Cathedral Builders of the Middle Ages*, Thames&Hudson, London 1995, pp. 89–96.

[13] S. Murray, *The collapse of 1284 at Beauvais Cathedral*, [in:] *The Engineering Medieval Cathedrals, Vaults and Supports*, edited by Lynn T. Courtenay, Aldershot, Hampshire, 1997, pp. 141–161, http://www.learn.columbia.edu/ma/htm/ms/ma_ms_bc_discuss_collapse.htm

[14] A. Erlande-Brandenburg, *op.cit.,* p. 106.

the conflict between the artists[15]. Ghilberti was aware of the spatial concept for the vault designed by Brunelleschi (a wooden model which could be dismantled as well as drawings were made) and he was also present at the construction site. Despite all this he was unable to independently oversee the construction in Brunelleschi's absence. With an intuitive (conceptual) idea in the form of a model and drawings, he was unable to make decisions on how to solve technical problems which master craftsmen confronted him with. Lack of "tacit knowledge" (E.M.) meant he was unable to understand the structure on a relational level.

On the other hand, the construction of St. Peter's Basilica in Rome on the site of an early Christian church is an example of a confrontation between the attitude of the architect and the investor. The notion to change Bramate's and Michelangelo's Basilica's layout appeared within the Vatican circles and stemmed from theological premises rather than artistic or architectural reasons. The layout adopted for Jesuit temples was to be in the shape of a Latin cross and that is the shape the Basilica was to assume[16]. Three nave bays and an imposing façade by Carlo Maderno concealed the dome from pilgrims, when they were approaching the Basilica. The conceptual change resulting from a departure from the architectural paradigm of simultaneously creating the temple interior and shaping the town space brought negative consequences[17].

The structures of the domes erected by Guarino Guarini[18] during the late Baroque are an excellent example of the use of a ribbed structure. The structure itself, Gothic in spirit, was used to create Baroque, opulent "sculpted" forms, emphasised by changing light. The architect used an old structural method (rib) in a manner which made it possible to extend the height of the structure and perforate it at the same time. This solution spans the intuition of the Baroque designer and the rational cognition of structures which was known – and its adaptation to the epoch's aesthetic needs.

Building methods changed further with the appearance of new materials. Cast iron, iron and steel made it possible to change the nature of structures. The lightness of structures, large areas suitable for glazing were shown most profoundly in the construction of London's Crystal Palace exhibition pavilion in 1851. This undertaking is thoroughly described, thus the decision making process for the first investment of this type can be followed. The impulse determining its character as an international exhibition came from Prince Albert and Sir Henry Cole[19], and the idea was rationalised by the Duke of Devonshire[20]. From that moment on, the gardener John Paxton relied on his own intuition as a constructor, verified earlier when

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[15] G. Vasari, *Żywoty najsławniejszych malarzy, rzeźbiarzy i architektów*, [The Lives of the Most Excellent Painters, Sculptors, and Architects] PIW, Kraków 1980, pp. 138–151.

[16] W. Tomkiewicz, *Piękno wielorakie: sztuka baroku*, Wiedza Powszechna, Warsaw 1971, p. 36–37.

[17] A correction, or the creation of an approach to the façade with a colonnade in the yard space was completed approximately 40 years later by Gian Lorenzo Bernini.

[18] Domes of the Royal Church of Saint Lawrence in Turin (1668–87) and the Chapel of the Holy Shroud (1668–94).

[19] For whom the gardener John Paxton has just completed the construction of a 100 m long conservatory at the Chatsworth gardens, within the property of the Duke of Devonshire; Giedion S.; *Czas, przestrzeń, architektura – narodziny nowej tradycji* [Space, Time and Architecture: The Growth of a New Tradition]; Arkady, Warsaw 1968, pp. 279–280.

[20] K. Frampton, *Modern Architecture: a critical history*, Thames and Hudson 1994, p. 34.

building conservatories. He repeated the structure which he used in the past, albeit on a larger scale, however timber was used to construct the barrel-vaulted transept. Most probably the constructor's knowledge (rational thinking) made him turn to timber – a better known and more plastic material.

Similar tensions between intuitive solutions for bridge forms and the feasible construction methods can be observed in the late nineteenth and early twentieth centuries. The wedge form, historically ascribed to arch structures appears in many versions, made out of cast iron or iron. In those days bridge building was a construction discipline requiring a culmination of imagination and top engineering abilities. And even the best made mistakes, as demonstrated by the collapse of the Tacoma Bridge in the USA. The tried and tested suspension bridge structure was subject to improvements and attempts to reduce the cost of construction. Engineers Leon Moisseiff and Frederick Lienhard were let down by their intuition, trusted calculations based on Josef Melan's new deflection theory, which did not take into account the aerodynamic conditions in the bay. In 1940 the road section of the bridge, due to wind induces oscillations, successively snapped the cables and spectacularly fell into the Puget Sound – just four months after the structure was opened for use[21].

Ill. 1. The head of the Nyugati train station in Budapest, August de Serres, phot. T.B-B

[21] D. B. Steinman, S. Ruth-Watson, *Bridges and their builders*, Dover Publications Inc., New York 1957, p. 356–367.

Ill. 2. Hala Stulecia in Wrocław, Max Berg, phot. T.B-B

The first train stations featured glazed iron and cast iron halls of vast spans and eclectic or historicising entry zones and façades[22]. This is an example of, on the one hand, intuitive and on the other rational shaping of a building. In the entry zones passengers were afforded the expected luxury of the ticket hall interiors and waiting areas, which often included a hotel[23]. The only possible, "industrial" solution was used for the areas designated for alighting and disembarking trains. The steam age aesthetics in such a composition was to everyone's liking. The construction by Eiffel of the Nyugati train station in Budapest in 1874 was a breakthrough[24]. Two side "stylish" sections constitute a frame for the glazed hall with train platforms, visible from the street.

The Hala Stulecia in Wrocław is the most magnificent example of early (1913) use of reinforced concrete. The logic behind it is the result of a search for a structure covering a cupola spanning a 65 m diameter. Years later, the designer himself wrote: *I was astounded by a certain fact, namely the precision of various proportions demonstrated by*

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[22] The St Pancras trainshed in London (1863–65) by W.H. Barlow and R.M. Ordish spanned 74 m; Frampton K., *op.cit.,* p. 34.

[23] K. Frampton, *op.cit*. Gilbert Scott was the designer of the neo-Gothic representative part of the train station, p. 34.

[24] DesignAugust de Serres, budowa Eiffel Company of Paris. Csaba Csáki C., https://welovebudapest.com/.../the-shining-history-of-budapests-nyugati-railway-station

this building…[25] This means that in striving to create a universal and functional structure, the ultimate questions of the form were a derivative of calculations rather than aesthetic speculations. Elsewhere Max Berg writes: *I tested the presence of proportions in the cross section and projection of Hala Stulecia which I designed. All mathematical manifestations are magical symbols of truth and beauty in association with faith and religion…*[26] Logical and creative thinking (K. Leja) interspersed one another during different decision making instances in the process of designing and constructing the Hala Stulecia. However, the consequences of creative thinking, combined with the designer's experience were assessed by Berg *ex post*. This also coincides with E. Markowski's research results on decisions in stress situations.

The Munich Olympic Stadium, designed by architect Günther Behnisch (Behnisch & Partner) and constructor Frei Otto, was an important point in the development of lightweight tent architecture. The German (West Germany) pavilion for the 1967 Montreal Expo (Otto and Gutbrod) was the solution's prototype. The suspended roof concept takes root in Otto's wartime experiences, and the technological capabilities (i.e. acrylic) facilitated its translation into the language of modernist architecture[27]. The model constructed in a traditional manner was tested experimentally, and CAD calculations were performed simultaneously (Fritz Leonhardt and Wolf Andra) to confirm the legitimacy of the assumptions. Thus, the intuition-rational thinking relations enters a phase where computer based calculations are used to control innovative structures created intuitively and in "analogue". During the course of design works "paradoxical thinking" discussed by Calabretta, Gemser and Wijnberg occurred[28] within the scope of *internally contradictory thinking*. A number of teams, with different research tools and professional experience had to reach a consensus. A new form of cooperation emerged in architectural design and construction.

The Students Arts Centre, University of East Anglia; Sainsbury Centre in Norwich, designed by Norman Foster, opened in 1978. The concept for marrying function and structure was innovative: an open space cubic form provided flexibility of the interior. Mezzanines and an underground passage along the building made it possible to establish a separate spaces workshops and auxiliary premises. The building was entirely prefabricated and assembled at the site. The trussed wall/ceiling structure provided access to installations laid in those spaces. Sensor controlled sun-shades were mounted at the roof-lights. This was the result of taking into account the rapid technological progress within the scope of digitalisation and automation of control systems which then determined the Centre's functional qualities. The method adopted for shaping the building was the result of the architect's experience and knowledge of the situation within technology disciplines in the 1970s[29].

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[25] As cited in: Ilkosz J., *Hala Ludowa (dawniej Hala Stulecia) dzieło Maksa Berga*, Wydawnictwo Via Nova, Wrocław (no date), p. 18.

[26] As cited in: J. Ilkosz, *op.cit.* p. 18.

[27] As a student Frei Otto stayed in the USA, where he met Eero Saarinen and engineer Fred Severund, who worked with Maciej Nowicki. This was in 1950, when Nowicki died. The interest in the Arena in Raileigh meant that Otto's PhD dissertation as well as his creative searching were associated with suspended roofing. Meissner I., Frei by Name, Frei by Nature, http://www.uncubemagazine.com/magazine-33-15508949.html#!/page11

[28] https://pl.scribd.com/document/283512558/Sainsbury-Centre-for-Visual-Arts-Foster-Partners-pdf

[29] J. Steele, *Architecture Today*, Phaidon Press Limited, London 1997, p. 79.

Ill. 3. Roofing of the Olympic complex in Munich, phot. E. Tarka

Ill. 4. Students Arts Centre, University of East Anglia, Norwich, phot. T.B-B.

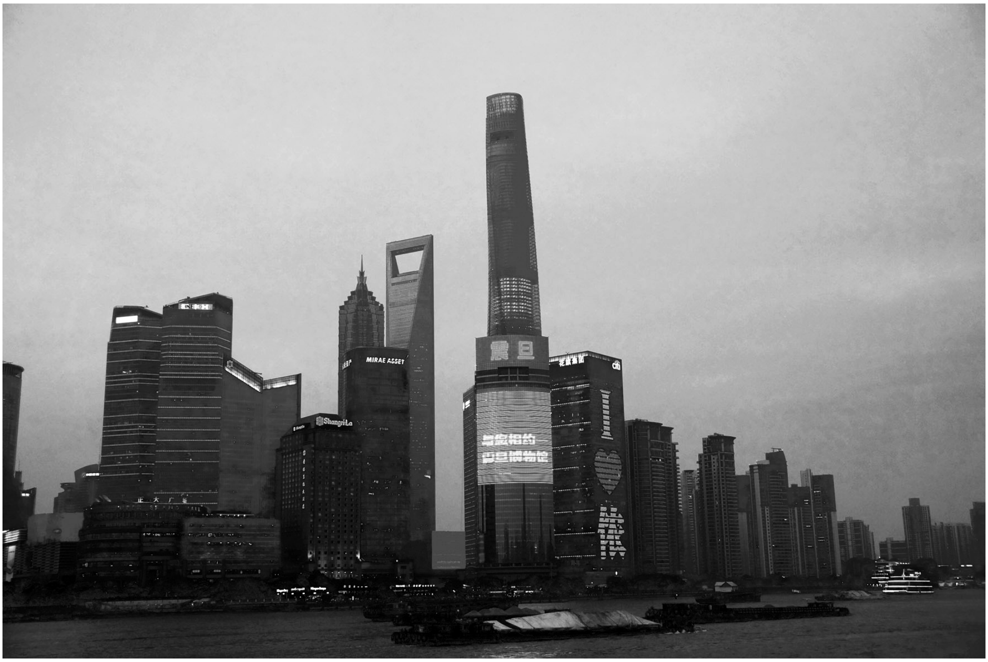
Further trends evolved in late 20th and early 21st century architecture as a result of environmental hazards and rapidly developing technical capabilities: sustainable architecture, blob architecture and megastructures. Whereas the first trend explores the technological capacity to limit pollution emissions, energy self-sufficiency and the establishment of communities which use common systems, the other two are primarily based on the development of computer-based techniques in design and production as well as changes in the construction materials and building furnishings markets[30].

London's BedZED (Zero Energy Development, Hackbridge) housing estate was designed by Bill Dunster Architects in 2000–2002. The housing development is distinguished by gardens on roofs, winter gardens, colourful wind cowls, photovoltaic batteries, and a biological sewage treatment facility which became symbols. The design and construction entailed a spectrum of issues and cooperation with numerous specialist companies and institutions which had a large impact on architectural and urban planning solutions[31]. The saying that an architect does not have to be able to do everything, but has to know about everything, has assumed particular significance now that buildings are brimming with technological equipment.

Ill. 5. The BedZED housing development, the form exhibits the eco-friendly solutions in place at the estate, phot. A. Bonenberg

[30] R. Koolhas, *Śmieciowa przestrzeń*, [in:] *Teorie i manifesty architektury współczesnej* [Theories and Manifestoes of Contemporary Architecture], edit by. Ch. Jencks, K. Kropf, Grupa Sztuka Architektury, Warsaw2013, p. 408.

[31] https://www.bioregional.com/wp-content/uploads/2016/04/The-BedZED-Story.pdf



Ill. 6. Shanghai. Multifunctional megastructures in the Pudong create the shape of the new city, phot. T. B-B

A group of specialists, who entertain contradictory concepts, arriving at a solution was of a paradoxical thinking nature (Calabretta, Gemser and Wijnberg).

The purpose of the design was to establish a local community: people cooperating with one another co-creating the estate's future.

The conceptual assumptions of the „blob" architecture movement are different. At its foundation lies the feasibility of creating soft, curvilinear forms, provided by the application of advanced computer software in the design and production of the structure's elements. The movement's representatives include Peter Cook, but primarily Frank Gehry and Zaha Hadid. The first European building which attracted the interest of critics was the Kunsthaus Graz (2003). The idea for the form was not a new one, Cook referred to theoretical designs which were created within the Archigram group in the 1960s[32]. For the Kunsthaus to be created, new versions of graphic computer programs and new software for plants producing structural elements and claddings were developed. Another professional group, included in the architectural design and construction cycle was breaking through barriers. The synchronisation of intuitive and rational actions of programmers, similar to other groups that had been part of the construction cycle in the past, made it possible to create this work.

Towards the end of the 20th century, globalisation and changes in the investment system for expanding offices and institutions led to the creation of multi-functional buildings of vast

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[32] K. Frampton, *op.cit.,* p. 281–282.

dimensions: megastructures. These constitute expressive accents in the urban space, and the race for height, which the creators admit to, followed not only by the world of architects and engineers, is underway. The construction of megastructures is a challenge for an ever-growing group of specialists. Stringent safety requirements and varied functions mean that even once the buildings enter use, their management constitutes another significant discipline of knowledge and actions[33].

3. Summary

Theoretical designs and models stand testament to the fact that architects in almost every epoch were aware of the technical limitations their own visions were subject to[34]. Some of these, such as the forms created by futurists and Archigram were only interpreted tens of years later, in a different technological reality, when the visions were no longer bound by technical capabilities.

The pursuit of creating the perfect building in the eyes of an architect and confronting that vision with the rational look at technological capabilities were and currently are dependent on the external situation.

In the 20th and 21st centuries the complexity of the design process has rocketed as well as the range of dilemmas associated with the ultimate solutions – both in terms of the design and the construction itself. Buildings furnished with an ever-growing plethora of equipment, require the engagement of more co-designers. And they also verify their own concepts once juxtaposed with other industry specific designs and technical constraints posed by their own discipline.

The above review of a dozen or so significant architectural projects allows us to argue that the designer's intuition and rational thinking are intertwined and this applies equally to the work of the architect, as well as the specialist co-authors of an architectural work. The mutual relations between intuitive and rational thinking have a lot in common with DNA's double helix, where one strand determines the shape of the other through transmitted information. And as such, the intuition and rationalism themes in creating architecture are complementary.

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