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PETER RICE – TRUTH AND ORIGINALITY OF ARCHITECTURAL FORM STRUCTURES AND THEIR DETAILS

PETER RICE – PRAWDA I ORYGINALNOŚĆ KONSTRUKCJI FORM ARCHITEKTONICZNYCH I ICH DETALI

Abstract

The paper analyses selected projects by Peter Rice focusing on their originality, and the truthfulness of materials and technologies. The purpose of this work is to highlight the importance of Rice's legacy and its influence on contemporary designers. The conclusions drawn from the study the method of solving material-related problems elaborated by Rice has produced solutions that emphasize the truthfulness of the structure and the clarity of design ideas.

Keywords: structural engineer, architectural detail

Streszczenie

Praca analizuje wybrane realizacje Petera Rice'a pod kątem ich oryginalności, prawdziwości materiałów i technologii. Celem pracy jest podkreślenie znaczenia twórczości Rice'a i jego oddziaływania na współczesnych projektantów. W wyniku badań wyciągnięto wnioski, że przyjęta przez konstruktora metoda rozwiązywania problemów materiałowych prowadziła do rozwiązań podkreślających prawdziwość struktury i czytelność idei projektowych.

Słowa kluczowe: inżynier konstruktor, detal architektoniczny

1. INTRODUCTION

Peter Rice (1935–1992) is one of those structural engineers who have left their major mark on contemporary architecture. The Royal Gold Medal (in 1992), a prestigious award conferred by the Royal Institute of British Architects in recognition of his input to the development of architecture, is just one proof of the relevance of his work. The engineer has contributed numerous new and creative material-related and technological solutions to projects by renown architects. Their buildings reflect modernity and are timeless, going beyond ephemeral fads and established schemes. Many of them have become iconic landmarks, bringing new value to the space of their cities.

In his creative work, Rice combined modernity and deep reflection, talent and knowledge, boldly venturing new solutions to complex structural problems. Being highly open-minded

and daring in putting his innovative ideas into practice, he actively followed new discoveries in science and technology. His desire for creative experiments, probing the boundaries of accepted norms, seemed insatiable. From a very early age, he developed a skill of independent life-long learning. Already as a child, he would find odd pieces in junkyards and use them creatively in his experiments. When studying aviation engineering at Queen's University in Belfast, he became interested in new, light structures and materials; from there on, the pursuit of lightness, immateriality, became the signature feature of his works.

Of numerous publications dedicated to Rice's projects, two books stand out. One of them, entitled *An Engineer Imagines*, was put together by the author himself, and then completed and published *post mortem* by his family. It is a precious source of author's records documenting the development of design concepts to their final realisation. It includes preliminary sketches, photographs of models and prototypes, technical documentations (projections, sections, structural details), photographic documentation of the construction process stage by stage, as well as photos of completed projects, including their details. In 2019, BBC Channel 4 aired a film made by Marcus Robinson under the same title. The second book was published in 2017, accompanied by yet another film and an exhibition. It puts together contributions from architects, close collaborators, friends and relatives on Rice's legacy analysed from a contemporary perspective. Press articles¹ summarizing Rice's achievements published shortly after the engineer's death as well as his own papers in specialist journals offer a precious source of information as well.

The purpose of this work is to highlight the importance of Rice's legacy and its influence on contemporary designers. Additionally, it also aims to present structural solutions applied to projects in which he identified the internal truth of the works designed by architects. At the same time, this truth became the personal truth of the creator – structural engineer.

The adopted traditional research method (literature research, study of photographs) made it possible to present major projects and carry out a comparative analysis (8 major structures created in the period 1972–1992). The examples have been selected so as to illustrate the search for truthfulness (Rice “saw it his way”) and originality of structural solutions, understood as the result of a tension between the complexity of the design idea, logical order and the “simplicity” of solutions, their lightness that conceals advanced structures. In the case of Rice, originality goes hand in hand with the beauty of the form. However, it was not dominated by the individualistic, ostentatious pursuit of originality, which was never the ultimate goal. Rather, it emerged naturally from the creative endeavours and the fruitful exchange of thoughts between architects, the structural engineer and the client.

2. THE TRUTH OF MATERIAL

The process of identification of design concepts led Rice to use materials in innovative ways and apply trailblazing technologies. Every single project was unique, the engineer shaped building structures in an individual, one-of-a-kind and ingenious way. Like a chameleon, he adapted to architects' visions, enriching their forms and making them more expressive. As a result, the clash of reality, the truth of materials, the in-depth analyses of their characteristic features and the engineer's imagination produced “...honestly expressed and supremely

¹ Among others in the journals: The Independent, The Irish Times, Irish Examiner.

imaginative structures.”² Depending on their use, the physicality of materials, their authenticity, may come into spotlight. Rice “...explored the use of novel ways in assembling and configuring structures and the materials.”³ His unique analytical skills helped architects to probe problems that emerged at the project implementation stage.

The engineer treasured craftsmanship and appreciated the traces of handwork in material processing (*les traces de la main*), so many elements in his structures were hand made. This fact makes the works deeply humanistic, bringing them close to people. They show their author’s sense of space, sensitivity to light and the texture of materials. Architectural details played an important role in defining the scale of buildings and their perception.⁴ Rice owes this level of attention to detail to John Utzon. The first work by Rice, very young at the time, was the elaboration of the roof of the Sydney Opera House (project by Jørn Utzon, 1959–1973) – a challenging, lengthy project, which taught him how to understand architects’ ideas, be precise and consistent when solving problems, and pay attention to detail.

The engineer examined a variety of materials, analysing their characteristic features. The exploration and extensive analysis of materials opened the door to their innovative applications. Rice searched for oppositions to commonly known material features – heaviness of the stone, monolithic concrete structure, limited application of larger glass walls, etc. This is how he crossed boundaries and accepted design norms.

One example of the innovative use of a steel structure is the Pompidou Centre (a cultural centre with cyclical exhibitions) in Paris (project by Renzo Piano and Richard Rogers, 1972–1977), referred to as modern “Gothic”. In the case of this building, the truth of the structure has been integrated with architecture (Ill. 1–3).

The use of glass in his structures is just one example of his innovative approach. In the case of the design for the Science and Industry Museum (Ill. 4) in Parc De La Villette in Paris (project by Adrien Fainsilber, 1981–1986), the transparency of huge glass surfaces ensured the panoramic view of the park, and created an illusion of the opening the building’s interior and its “non-materiality”. What is more, it also ensured “...maximal passage of natural light into an interior with minimal perceptible structure”⁵ made of polycarbonate and stabilized with cable truss. The design makes creative use of the elasticity of glass – “...the system is achieved by having two counteracting axes of rotation, along the axis of the glass, and where the cables cross.”⁶ New technologies have enabled the creation of a light structure, optically defying gravity, play against gravity – the truth that reveals the magical illusion of immateriality. Obviously, this truth is the truth of the creator – structural engineer fascinated with new discoveries. His innovation involved an intelligent interpretation of the idea of transparency important to the architect.⁷

Rice also obtained the lightness, ephemerality of the cloud using glass fibre and steel. The membrane entitled “Clouds”, hung inside La Grande Arche in La Defense in Paris

² J. Glancey, *Obituary: Peter Rice*, The Independent, 29 October 1992 [in:] P. Rice, *An Engineer Imagines*, Batsford, London 2017, pp. 179–180.

³ J. Zunz, *Peter Rice, engineer* [in:] K. Barry (ed.), *Traces of Peter Rice*, The Lilliput Press, Dublin 2017, p. 18.

⁴ P. Rice, *op. cit.*, p. 28.

⁵ G. Kerr, *Peter Rice: Performing Instability* [in:] The DS Project 2015, <http://thedsproject.com/portfolio/peter-rice-performing-instability/> (access: 21.04.2020).

⁶ *Ibidem*.

⁷ P. Rice, *op. cit.*, p. 112.

(project by Johan Otto von Spreckelsen – concept design, Paul Andreu, 1982–1989), was made of coated glass-fibre fabric (PTFE) – “...the membrane is stressed against the cable trusses using flying struts.”⁸ This structure ensures the mutual stabilisation of elements subject to compression and extension, which was important given the exposure to wind in open space. By introducing the “Cloud”, the architect wanted to add a human dimension to the new space contrasted with the immensity of the arch structure. The new structure, free from vertical supports, symbolises lightness and freedom, floating canopy. Interruptions in the continuity of the “artificial cloud” structure frame the view of the architecture in its surroundings and force the observers to look up – towards the interior of La Grande Arche. Viewer’s attention is also caught by an interesting detail, which contrasts with the smooth wall of the arch.

The design of the Inverse Glass Pyramid inside Louvre in Paris (project by Ieoh Ming Pei, 1993) is a poetic play, characterised by lightness and deprived of seriousness. The experience of walking on a glass surface at the street level creates the illusion of immateriality. This structure, operating like a periscope, introduced unexpected reflections of the sky in the underground space. The Inverse Pyramide “...is both, a remarkable piece of structure and an engaging optic device. The tensilegrity net of rods and cables support four planes of low-iron glass that form the pyramid.”⁹

Concrete columns in a very high building, home to the Lloyd’s Building in Londyn (project by Richard Rogers & Partners, 1978–1986), enhanced the lightening of its interiors. This form is a perfect reflection of modernity. Beams in the structure of floors are hierarchically arranged, in line with the distribution of load. The monolithic material (concrete) cast on site was applied similarly to steel, emphasizing structural elements, and thus the Lloyd’s building became known as a steel structure made of concrete – “Lloyd’s is a steel building built in concrete.”¹⁰ It is not, however, one material faking a different one, but an articulation breaking down the monolithic structure, used in an innovative way. Details of connections between specific elements emphasize the scale and add expressiveness to the building among others bracket, yoke, bearing, bracing.

An innovative approach may be also found when it comes to the application of stone. The new façade of the Cathédrale Notre Dame de la Treille in Lille (project by Pierre-Louis Carlier and Peter Rice, 1999) is lined with very thin marble and alabaster, laminated on white glass. The use of translucent stone created stunning artistic effects in the interior. In this “stained glass” made of stone visitors can make out the symbolic form of a fish. The project clearly proves Rice’s fascination with the structures of Gothic cathedrals – “...the central bay of translucent stone bonded to glass is suspended from a stone arch with a stainless steel tension bracing system, prestressed so the stone is always in compression.”¹¹

Another example of an innovative use of stone was the “Pavilion of the Future at Expo ‘92 in Seville (project by David Mackay and Peter Rice, 1988–1992). The investor expected something spectacular of the project. Rice, together with the architect, proposed a line of huge stone arches, which form a kind of an openwork screen added to one of the facades of the pavilion. The structure was inspired by stone aqueducts and overpasses. By creating

⁸ *Ibidem*, p. 101.

⁹ A. Sedwick, *Peter Rice, lighting engineer* [in:] K. Barry (ed.), *op. cit.*, p. 36.

¹⁰ P. Rice, *op. cit.*, p. 116.

¹¹ *Ibidem*, p. 49.

a “modern” ruin, the authors also made a reference to Spain’s history. The apparent lightness of the screen contradicts the common qualities of stone – weight and massiveness – “...the form and the shape of the arches derived from the best shape to support the roof load.”¹² To create the project, it was necessary to use software to draw non-linear structures and ensure utmost precision in preparing stone elements of specific sizes and forms. For this purposes, standard granite blocks were used (Rosa Porina granit, 20x20x140 cm). The texture, colour and binding connecting the blocks created an interesting surface structure. One unforeseen problem that came up at the stage of construction was the natural rift plane of the stone, remedied by ensuring maximum variety of directions in which specific blocks were laid. In this case, Rice relied on his previous experiences of working with glass – “...stone, like glass, is very strong in compression, but fragile and prone to cracking.”¹³

The innovative contribution involved the development of existing structural ideas (stone arches in bridges and aqueducts, where the weight of the stone ensured structural stability) and their application in a modern lights structure with steel cross-bars of supporting towers. Key aspects that played major role in the selection of materials for this project were the availability of the stone, its advanced processing and access to high quality craftsmanship in this area of Spain.

3. THE TRUTH OF STRUCTURE INTEGRATED WITH ARCHITECTURE AND ITS FUNCTION

By providing in-dept solutions to structural problems, Rice enriched the perception of forms designed by architects. They are characterised by a dynamic articulation of space with the use of “authentically” applied structural materials, the emphasis on light and the texture of details. His structures ensure elasticity of interiors, as well as structural visibility and clarity – its shape is “...almost a structural diagram of the forces within it.”¹⁴ They were determined by the process of manufacture (the elements were often processed locally, relying on highly skilled local craftsmen) and the transport method (the size of elements).

Rice “...like a pianist who plays with his eyes shut, he understands the basic nature of structures so well that he can afford to think in the darkness about what might be possible beyond the obvious.”¹⁵

The Pompidou Centre – the example mentioned before – was supposed to be a building open to everybody (rather than just confined to elitist art) and a “living” structure. Because of the structural elasticity, the user becomes a participant and an actor in the mutable space of the building. He is attracted to the inside by novelties and their new iterations. This is a proof of the deeply humanistic intention of both the architects and the structural engineer. The nearby square is a meeting place for those who wish to observe dancers or magicians, performing against the background of the highly unusual facade of the building, reminiscent of a “huge screen”. Observing people moving within the Pompidou Centre becomes in itself a sort of a performance for the onlookers at the

¹² *Ibidem*, p. 120.

¹³ *Ibidem*, p. 119.

¹⁴ *Ibidem*, p. 33.

¹⁵ *Ibidem*, p. 179.

square. The building expresses its structure in the most comprehensive and integral way. The steel structure has ensured visual and structural unity, emphasizing the function of the building at the same time – open to everyone, nothing to hide. Cast steel was used with full awareness of the role of the space in between elements, which introduces light and exposes their connectors and size – “...as in music, where the space between the notes defines the quality, here it was the space between the pieces which defines the scale.”¹⁶ The purposeful use of double booms beams was to extract visual effects and add lightness. The characteristic Beaubourg structure makes use of the *gerberettes*, which perform the role of supporting beams. They are pinned to columns – “...the outside row of columns, rather than having to hold up the trussed beam, instead hold the gerberette down, becoming tension ties. The weight of the floors is transferred to the outside of the building. Slender diagonal cross bracing adds lateral stability.”¹⁷ In the case of this work, the structural engineer was inspired by the spatial structure of the 1970 Osaka World Fair designed by Kenzo Tange. He was also fascinated by the 19th-century engineering structures and Fin-de-Siecle stations of Paris underground with their unique cast-iron decorations and cast joints, meticulously produced by human hands.

Another feature of Rice’s structures is the fact that they ensure good light access to the buildings. A project which perfectly illustrates this aspect of his work is the Menil Art Collection Museum in Houston (project by Renzo Piano, 1980–1986). Mrs. De Menil, the investor, wanted the collection of artworks to be admired in natural light. An in-depth analysis and simulations with the use of a prototype made it possible to develop an optimum profile of the roof, ensuring limited access of daylight “moving along” in the interiors. It was made of ferro-cement, employing the plasticity technique. What was important to achieve was the elegant shape of the recurring element, the grainy texture of the surface and porcelain-like fragility. The roofing above the profile was made of glass. The surface of profiles reflects light, which prevents it from falling directly on paintings, and thus potentially causing damage. Factors that influenced the decision on the selection of materials and technology included the fact that Houston is famous for its yacht-building tradition. Because of this background, the project is characterised by the high quality of the materials manufacturing process. The building structure illustrates the concepts behind the project – conscious control of the availability of natural light to appreciate the true colours of paintings and the textures of sculptures. At the same time, works of art are protected against damaging direct UV rays (and lit only with reflected light). Pieces which are not currently on display are stored in complete darkness, at the basement level.

In many of his projects Rice used screens correlated with the movements of the sun, ensuring appropriate flow of light to the interiors. A variety of translucent and transparent materials were used, for example, in the Tate Pavilion in London, Bull Gambetta in Paris and in Louvre. According to Richard Rogers, “...like his great predecessors, whether Brunel or Brunelleschi, Peter Rice is able to step outside the confines of his professional training, transferring technical problems into practical solutions. His design combines order with delight, science with art.”¹⁸

¹⁶ *Ibidem*, p. 34.

¹⁷ G. Kerr, *op. cit.*

¹⁸ A. Brown, *Engineer’s Contribution to Contemporary Architecture*. Peter Rice, Thomas Telford Publishing, London 2001, p. 17.

4. COLLABORATION BETWEEN ARCHITECT AND STRUCTURAL ENGINEER

Peter Rice skilfully developed architects' projects, making his constructions full of both visual, and more general, poetic inventiveness. Ideas budded from a creative exchange of ideas, making the ultimate authorship of the final work a shared enterprise. When the engineer realised that an architect really cares about working with him, he exerted more influence on the project and took more initiative. Rice emphasized the importance of equality and true partnership in a relationship between an architect and a structural engineer for the effectiveness of their work, exploration of the best solutions and openness to modifications to the design.¹⁹ Good teams are made of people who – thanks to the diversity of approaches and independence of views – complement each other, accepting the contribution of every member and taking their comments into account. According to Rice, "...the difference between the engineer and the architect by saying the architect's response is primary creative, whereas the engineer's is essentially inventive."²⁰ The collaboration of architects with the engineer meant a journey into the unknown. According to Barbara Campbell-Lange, "...the result would always reveal something unexpected, something new, something true."²¹ Renzo Piano compares working with Rice to a continuous game of ping-pong and to guessing games.²²

During the ceremony of the Royal Gold Medal Award in London in 1992, the constructor said that "...structural engineers have been expected to play the role of Shakespeare's Iago, who undermined the love of Othello and Desdemona [...] The engineer has been seen to reduce every unreasonable and soaring idea an architect might have."²³ Meanwhile, according to Rice, "...the true role of the engineer, was not to reduce, but to explore materials and structures as had the great Victorian engineers and medieval cathedral-builders he so admired."²⁴ An engineer "...is exploring the nature of the materials and using that knowledge to produce a special quality in the way materials are used."²⁵

5. RICE'S INFLUENCE ON CONTEMPORARY DESIGNERS

Rice really enjoyed working with young people, appreciating their boldness and intransigence. Many of his students and young collaborators emphasize his huge influence on their later work. The legacy of the engineer continues to inspire current designers, who never crossed paths with Rice. It is a consequence of the timeless nature of his structure and his approach to design, equally valid today – an extensive exploration of a problem, search for new solutions, inspiration with the best works, experiments with materials, pursuit of the authentic nature of materials and the clear "true" image of forces that are at play in a structure – "...design freedom via calculation."²⁶ According to Kevin Barry, the constructor,

¹⁹ M. Rice, *Memories of Peter* [in:] K. Barry (ed.), *op. cit.*, pp. 11–12.

²⁰ P. Rice, *op. cit.*, p. 72.

²¹ B. Campbell-Lange, *Cameo V* [in:] K. Barry (ed.), *op. cit.*, p. 91.

²² K. Barry & J. Greitschus, *Renzo Piano in conversation* [in:] K. Barry (ed.), *op. cit.*, p. 24.

²³ J. Glancey, *op. cit.*, p. 180.

²⁴ *Ibidem*.

²⁵ P. Rice, *op. cit.*, p. 77.

²⁶ P. Heppel, *Cameo VI* [in:] K. Barry (ed.), *op. cit.*, p. 105.

“...influence has shaped a new generation of architects and engineers, who renew through their own work his exploration of materials, his commitment to the integrity of a structure, his refusal of precedent and his courage as a designer.”²⁷

In Ireland, a museum dedicated to his work has been launched, while workshops (e.g. *Re-imagining the works of the Irish engineer Peter Rice* in 2013 and the exhibition entitled *Traces of Peter Rice*) and exhibitions presenting designs and models for his structural solutions continue to attract the public (e.g. *Traces of Peter Rice* in London, Paris and Dublin in 2013, *Peter Rice Exhibition at Arup Phase 2 Gallery* in London in 2013). Contemporary exhibitions showcasing Rice’s works still creatively inspire young designers. Models and prototypes clearly illustrate the combination of the building structures, modern technologies and architectural concepts. The widespread use of models helps to expose any potential construction problems intrinsic to the designed forms. Preliminary sketches are a record of evolving thoughts and the search for original solutions, forming a track of constant feedback in design.

What is more, awards named after Rice motivate young people – structural engineers working today – to excel in their projects. Two of them have been founded: the annual Silver Medal²⁸ (since 1996) conferred by the Dundalk Institute of Technology in Rice’s hometown and The Peter Rice Prize awarded by the Harvard University Graduate School of Design (since 1994).

According to Jonathan Glancey, “Rice was, perhaps, the James Joyce of structural engineering. His poetic invention, his ability to turn accepted ideas on their head and his rigorous mathematical and philosophical logic made him one of the most sought-after engineers of our times and an inspiration to the legion of young engineers who followed in his wake.”²⁹ According to Peter Buchanan, “An architect ignorant of permanent value cannot create the value himself. Instead, he will pursue short-term fame in frivolous formalism chasing fads and create works that attract attention only for a moment, rather than reward with longer acquaintance.”³⁰ Rice identified what a permanent value of architecture is, and his works unchangingly attract our attention, and thus continue to be relevant and inspiring.

6. SUMMARY

The conclusions drawn from the study support the view that the creative exchange of ideas within the framework of teamwork established by the structural engineer with architects, as well as the pursuit of new sources of inspirations in the design process contributed to the innovative and original quality of solutions developed by Rice. The method of solving material-related and technological problems elaborated by Rice (the use of sketches to record

²⁷ J. Greitschus, *Preface and acknowledgments* [in:] K. Barry (ed.), *op. cit.*, p. 1.

²⁸ *Annual Peter Rice Engineering Medal Awarded*, 11 January 2019, Dundalk Institute of Technology, <https://www.dkit.ie/news/annual-peter-rice-engineering-medal-awarded.html> (access: 21.04.2020); *Dkit Announces Winner 2019 Peter Rice Engineering Award*, 12 December 2019, Dundalk Institute of Technology, <https://www.dkit.ie/news/dkit-announces-winner-2019-peter-rice-engineering-award.html> (access: 21.04.2020).

²⁹ J. Glancey, *op. cit.*, p. 179.

³⁰ P. Buchanan, *Milenium po modernizmie*, Architektura-Murator, 1997, no. 12, pp. 10–21.

thoughts, verification of ideas using models, in-dept analyses, feedback-based methods) have produced solutions that emphasize the truthfulness of the structure and clarity of design ideas. The truth and logic of a structure referred to the function of buildings, while their aesthetics, rather than being a result of an apparent game of truth, was truly authentic. It was elaborated in the process of concretisation and clear expression of design models. Rice's search for truth, the discovery and exposure of new structural possibilities, the deep understanding of the nature and properties of materials, produced both original and poetic forms. As a result, it led to the discovery of the beauty of structures inseparably, truly bound with the form. The only illusion that observers cave into was the illusion of immateriality and lightness of forms, in reality supported by a complex and thought-through structural system. However, the illusion was the personal "truth" of the author who probed boundaries and always played tricks on perception.



Ill. 1. The Pompidou Centre in Paris – view from the Eiffel Tower (photo by the author, 2009)



Ill. 2. The Pompidou Centre in Paris – view from the Notre-Dame cathedral (photo by the author, 2009)



Ill. 3. The Pompidou Centre in Paris (photo by the author, 1986)



Ill. 4. The Science and Industry Museum in the Parc de la Villette in Paris (photo by the author, 1986)

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