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Disturbance of transparency in the architecture of contemporary glass façades. Part 2

Introduction

Architecture communicates with the viewer through the façade. Façades, apart from their function of the cover and illumination, are the hallmark of the building – they communicate its meaning and prestige. However, the complexity of the relationship between the different architectural “forms” and the “messages” makes contemporary architecture not easy to understand or value. However, the designers of “transparent” architecture do not always push the glass/façade to be more and more transparent. Recent trends may be found, in which – along with significant formal transformations – the pane of glass is losing its basic optical feature of light transmission. In those façades, the transparency is deliberately disturbed, and glass is no longer chosen solely because of its basic function of light transmission, but also because of its other optical properties.

In the first part¹ of the paper a distinction was made into homo- and heterogeneous disturbance of transparency: two sub-trends were observed. The former one takes place where the whole surface of the pane is the source of the same optical distortion. A good example of this phenomenon is a light-scattering pane that makes objects located behind optically blurred. Homogeneous distortion usually occurs when translucent, etched, or sandblasted glass or acrylic) panes are used. Heterogeneous disturbance – in contrast – takes place when some areas of the pane change the path of the ray of light, while others do not. This type of disturbance is therefore not uniformly

distributed over the whole surface of the pane but is present only in selected regions. It is usually observed in the case of screen-printed panes with the pattern or when selective acid etching is applied to the regions of the pane.

First part of the paper addressed the issues of methodology, definitions and proposed the simplified typology of light-disturbing envelopes in contemporary architecture. Matrix approach, case studies and the characteristics of sub-trends based on the conducted analyses are demonstrated by the author in the presented second part of the presented paper.

Case studies

Matrix approach

The definition of the classic trend model in architecture is based on characteristic features of the buildings belonging to the trend [1]. It is therefore common to rank or group buildings in a specific order, e.g., chronological. The disturbance of transparency is different. Presented case-studies include façades that simultaneously represent features of homogeneous and heterogeneous disturbance, and those features are visible in different intensity. This rich diversity makes it impossible to make an unequivocal typological assignment, as case-studied [...] *usually show only some characteristic features, which are considered to be representative for a given trend* [1, p. 89]. The model of the trend should include that variation as proof of the internal trend’s evolution.

Typologically – from the perspective of the considered optical phenomena – all presented case studies with transparency disturbances can be shown in the form of a relational matrix – see Figure 1. The matrix illustrates the relation of the two criteria: the percentage of light scattering and the density of the pattern. All intermediate values can

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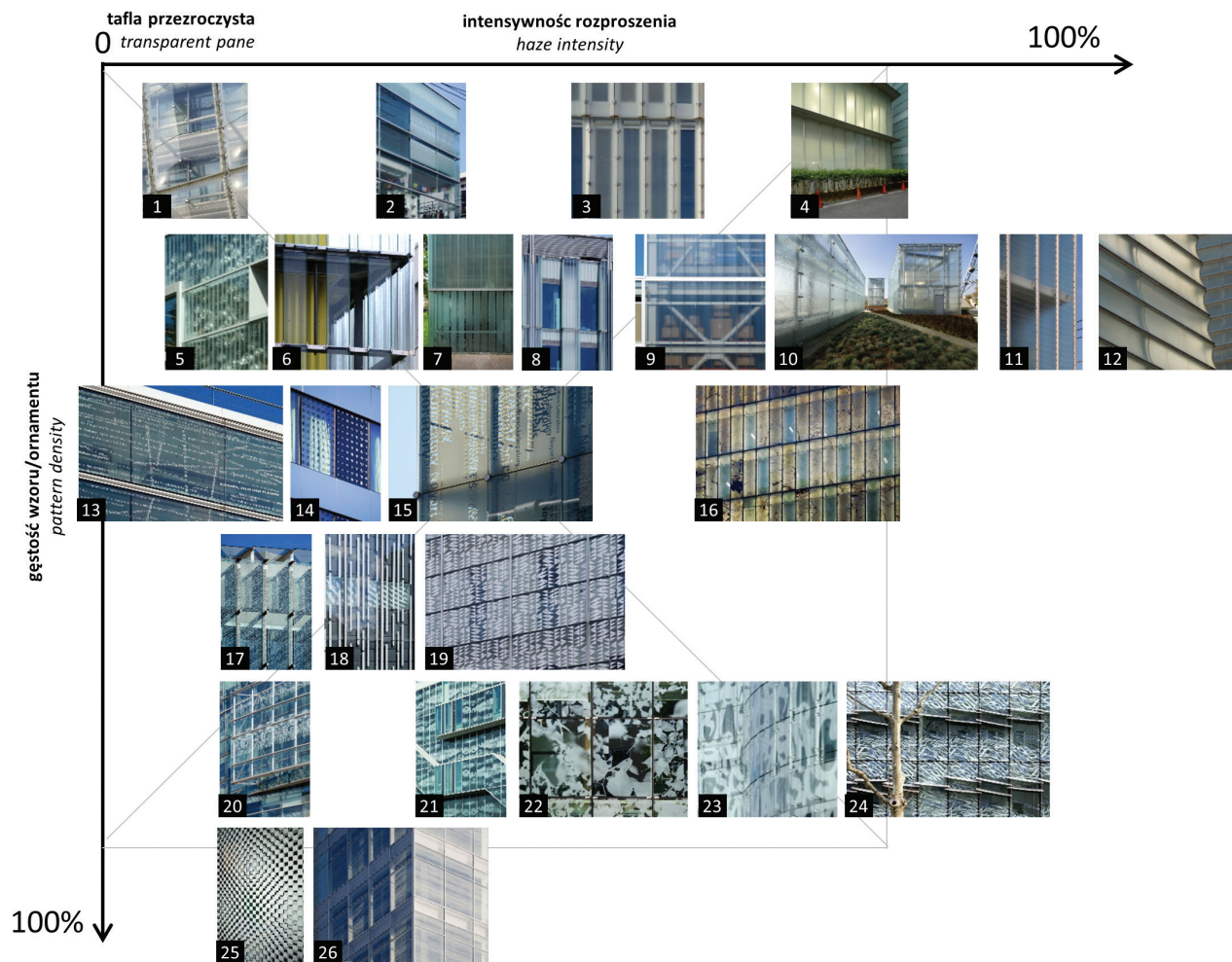


Fig. 1. Matrix approach to the typology of case studies. Horizontal axis shows a gradual transition from transparent to translucent panes.

Vertical axis shows gradual transition from transparent to opaque glass through all intermediate stages of heterogeneous disturbances (the densification of pattern). Case studies include: 1. Unilever Haus in Hamburg; 2. Building F, Tokyo;

3. Department of Nursing Takarazuka University, Osaka; 4. New Deichman Library, Oslo; 5. Museum of Transport, Lucerne; 6. Dorint Novotel Messe, Munich; 7. Museum in Winterthur; 8. Pier 17, New York; 9. Headquarter Sotax AG, Aesch; 10. Silesian Museum, Katowice; 11. Space Block Nozawa, Tokyo; 12. Kursaal, San Sebastian; 13. Basque Regional Library, Bilbao; 14. InterContinental Hotel, Ljubljana; 15. Noyori Material Engineering Laboratory, Nagoya; 16. LVMH, Osaka; 17. Software and Biotechnology Plants, Derio; 18. Tipotie Health Center, Tampere; 19. Clinique du Parc, Lyon; 20. Plaza Bizkaia Building, Bilbao; 21. TU Delft Building Department, Delft; 22. Town Hall, Alphen an den Rijn; 23. IKMZ, Cottbus; 24. Jean Mermoz Hospital, Lyon; 25. Louis Vuitton, New York; 26. Kirarito Ginza Department Store, Tokyo. The case studies presented are described in detail and shown in the chapter "Case studies" (photo by M. Brzezicki)

II. 1. Układ macierzowy studiów przypadków. Oś pozioma pokazuje stopniowe przechodzenie od tafli przezroczystej do przeświecalnej.

- Oś pionowa pokazuje stopniowe przejście od szyby przezroczystej do tafli nieprzepuszczającej światła przez wszystkie pośrednie etapy zaburzeń niejednorodnych. Opis przypadków: 1. Biurowiec Unilever Haus, Hamburg; 2. Building F, Tokio; 3. Wydział Pielęgniarstwa Takarazuka University, Osaka; 4. Biblioteka New Deichman, Oslo; 5. Muzeum Transportu, Lucerna; 6. Hotel Dorint Novotel Messe, Monachium; 7. Muzeum w Winterthur; 8. Dom handlowy Pier 17, Nowy Jork; 9. Siedziba firmy Sotax AG, Aesch; 10. Muzeum Śląskie, Katowice; 11. Budynek mieszkalny Space Block Nozawa, Tokio; 12. Sala koncertowa Kursaal, San Sebastian; 13. Baskijska Biblioteka Regionalna, Bilbao; 14. Hotel InterContinental, Lublana; 15. Laboratorium Inżynierii Materiałowej Noyori, Nagoya; 16. Dom handlowy LVMH, Osaka; 17. Centrum rozwojowe Software and Biotechnology Plants, Derio; 18. Centrum Zdrowia Tipotie, Tampere; 19. Szpital Clinique du Parc, Lyon; 20. Biurowiec Plaza Bizkaia, Bilbao; 21. Wydział Budownictwa TU Delft, Delft; 22. Ratusz, Alphen an den Rijn; 23. Biblioteka IKMZ, Chociebuż; 24. Szpital Jean Mermoz, Lyon; 25. Dom handlowy Louis Vuitton, Nowy Jork; 26. Dom handlowy Kirarito Ginza, Tokio. Przedstawione studia przypadków zostały szczegółowo opisane w rozdziale „Case studies” (fot. M. Brzezicki)

be mapped. The horizontal axis refers to the gradual transition from transparent (top left) to translucent (top right) panes with all the intermediate steps that include panes with an increasing degree of translucency (or – from the optical perspective – an increasing degree of haze). The vertical axis refers to a gradual transition from transparent (top left) to opaque (bottom left) pane through all the

intermediate steps of heterogeneous disturbance (patterns or ornaments gradually becoming denser). In simple terms, it can be said that the horizontal axis illustrates an increase in haze/scattering of the image, while the vertical axis illustrates the increase in the density of the ornamental pattern. Thus, the presented matrix allows assigning case-studies depending on their optical characteristics.

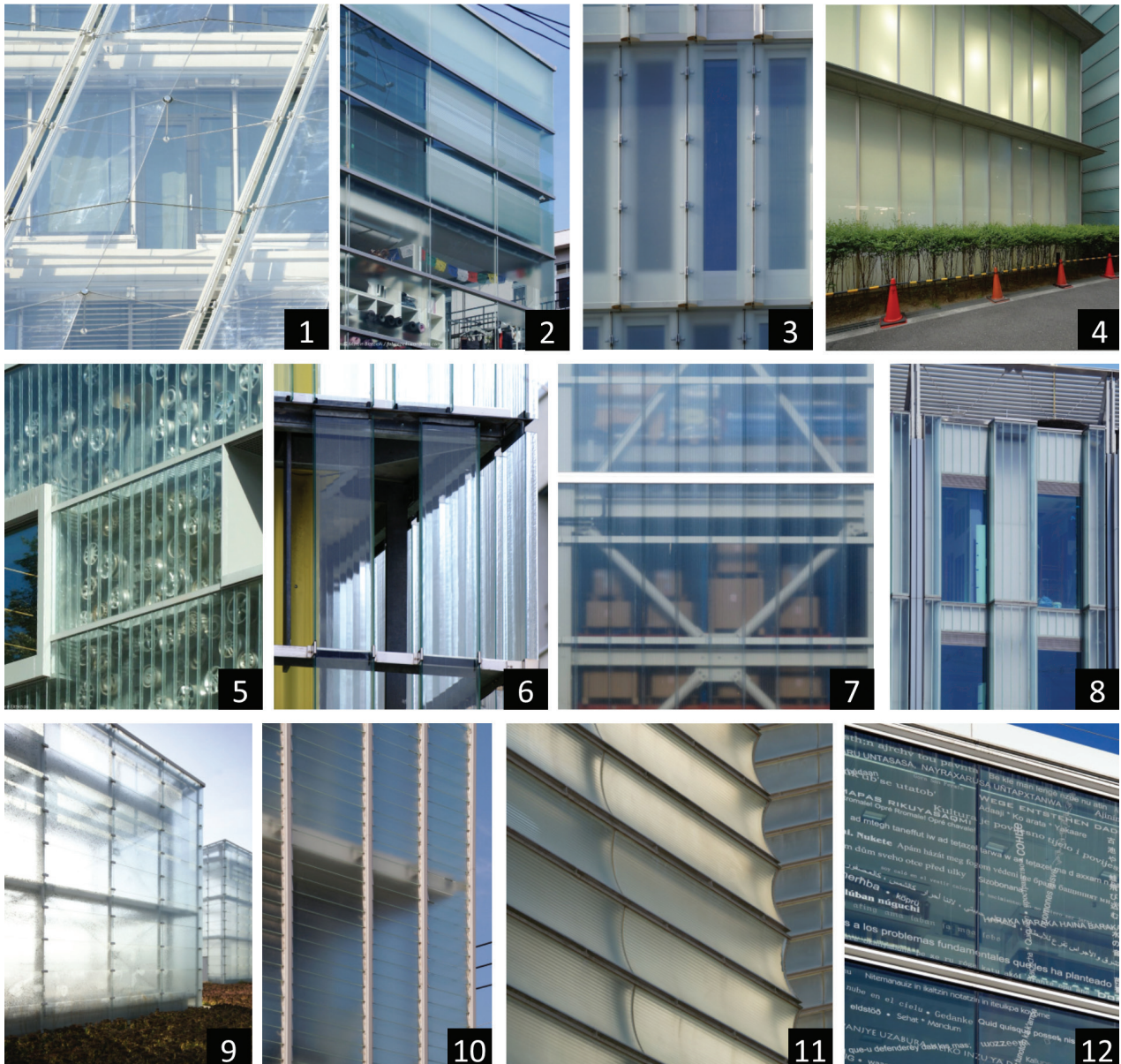


Fig. 2. Case studies arranged according to the original position in the matrix:

1. Unilever Haus; 2. Building F; 3. New Deichman Library; 4. Department of Nursing Takarazuka University;
5. Museum of Transport; 6. Dorint Novotel Messe; 7. Headquarter Sotax AG; 8. Pier 17; 9. Silesian Museum;
10. Space Block Nozawa; 11. Kursaal; 12. Basque Regional Library (photo by M. Brzezicki)

II. 2. Studia przypadków w układzie analogicznym do tego pokazanego w macierzy studiów przypadków:

1. Biurowiec Unilever Haus; 2. Building F; 3. Wydział Pielęgniarstwa Takarazuka University;
4. Biblioteka New Deichman; 5. Muzeum Transportu; 6. Hotel Dorint Novotel Messe; 7. Siedziba firmy Sotax AG,
8. Dom handlowy Pier 17; 9. Muzeum Śląskie; 10. Budynek mieszkalny Space Block Nozawa;
11. Sala koncertowa Kursaal; 12. Baskijska Biblioteka Regionalna (fot. M. Brzezicki)

The scattering of the transmitted light can be manifested in different degrees of haze. Plastic membranes, due to optical parameters are characterized by a low haze of approx. 5–10%. This type of almost all-transparent membrane was used in the headquarters of the German food corporation Unilever Haus in Hamburg (arch. Behnisch Architekten, 2009). The building is located in Hamburg's harbour and is exposed to violent gusts of cold wind. An envelope made of ETFE foil was developed to protect the building and lower heat losses. The membrane is stretched on a tensioned stainless steel substructure. The unique

optical effect of a low haze is visible for both people standing close to the building and observing from a distance. The ETFE membrane is not perfectly transparent and the contours of the building visible behind it are gently but noticeably blurred – see Figure 2.1.

Small Building F (arch. Toyo Ito, 1991) located in Tokyo is an example of the gradual blurring of the image visible behind the glass façade. The degree of scattering changes with the height of the building. At the eye level, the glass is transparent, but the haze changes with the height – the higher, the more scattered the image is. The effect is

interesting because the details of the interior visible through the glazing gradually blurred upwards – see Figure 2.2.

On the other hand, the Faculty of Nursing of Takarazuka University in Osaka (arch. Tadao Ando, 2002) shows the visual effect of full, homogeneous scattering of light by the building's envelope. In this case, a standard curtain mullion-and-transom wall was constructed of light scattering panels. The effect of the dematerialization of the building's interior is absolute, no interior details are visible. After dusk, the building turns into a lampshade and radiates delicate, scattered light. In Oslo, the New Deichman Library (arch. Lund Hagem Architects, Oslo Atelier, 2020), features a similar façade but composed of the panes of slightly different scattering parameters (haze). The panes are placed one next to the other, which results in a characteristic mosaic effect on the façade – see Figures 2.3 and 2.4.

Frequently, light scattering that takes place in the building's envelope is not as homogenous as in the case-studies described above. Such a light scattering effect was achieved in the residential building Space Block Nozawa in the suburb of Tokyo (arch. C+A Coelacanth and Associates, 2005). The small building houses small, single-person apartments. An additional external envelope made of light-scattering glass louvers was placed at a distance of 60 cm from the actual façade of the building. This space between the actual façade of the building and the envelope is “similar to the traditional Japanese verandah *engawa*” [2]. The effect of “hanging curtain” is undeniable here, but the light scattering is not uniform at the envelope. While details of the interior are blurred, the external appearance of the building constantly changes depending on how the residents operate the glass louvers, see Figure 2.10. In contrast – the office and warehouse building of Headquarter Sotax AG company (arch. Itten+Brechtbühl, 2013) In the year 2013, constructed in Aesch, Switzerland in 2013 – features a permanent façade, but with the similar effect. The production part of the building was clad with an industrial curtain wall made of cellular polycarbonate panels. The cladding scatters the light and the image of the building's interior is blurred, especially when direct sunlight falls on the façade and the joints of the polycarbonate panels are clearly visible – see Figure 2.7. A similar effect has been achieved by using a translucent envelope of the Kursaal building in San Sebastian (arch. Rafael Moneo, 1990). The entire functional program of the building was divided into two auditoriums. Those two volumes are surrounded by a translucent envelope made of corrugated ornamental glass, which is convex. The envelope blurs the image of the interior both during the day and at night when the building looks particularly attractive after dusk – see Figure 2.11.

Characteristic haze can also be observed when light is scattered in the mass of the material. The department store of luxurious brand LVMH in Osaka (arch. Kengo Kuma & Associates, 2004) – see Figure 3.2, was covered with panes of glass, between which 4-mm onyx panels were laminated. The stone plates are so thin that the light transmitted through shows an internal, milky, and veined structure, unique to each plate. The architect emphasizes

that [...] *light-permeable stone panels show the process of transforming opaque material into an abstract and transparent envelope by changing the expression of light night and day* [3].

In macro-scale ornamental panes are characterized by irregularities of the surface much greater than the wavelength of light. Those irregularities should be regarded as a set of adjacent optical elements: plates, prisms, concave and convex lenses. Both, the way they are positioned and the size of their curvature, visibly influence the quality image distortions visible for the observer. In the ornamental glass, the image distortion always pertains to the rays that are transmitted and is almost imperceptible regarding reflected rays.

Depending on the size of the lenses used in relation to the thickness of the pane, the visual effect of transparency distortion may be different. In the Dorint Novotel Messe Hotel in Riem Arcaden, Munich (arch. Allmann Sattler Wappner Architekten, 2004), large glass “pleated” channel profiles were used to form a light-transmitting envelope which visibly distorts the image of the façade located behind. The architects compare the façade to a “stage curtain” that waves and waives away [4], [5]. In contrast, fine pattern panes were used in the building of the Silesian Museum in Katowice (arch. Pysal Ruge Architekten, 2013). In this building, the elements of the building's infrastructure were enclosed in cuboid volumes made of ornamental glass. Due to the scale of the pattern, these panes, observed from a distance, seem to be homogeneously translucent, distorting the image of the objects located behind – see Figures 2.6 and 2.9.

Glass channel profiles are also manufactured in a version that uniformly scatters light. Already in the 1990s, architects Annette Gigon and Mike Guyer used them as an envelope for the Museum building in Winterthur, Switzerland (arch. Gigon/Guyer, 1999), and then – in a similar way – for the Museum of Transport in Lucerne (arch. Gigon/Guyer, 2005) – see Figure 2.5. In the latter case, the translucent envelope also serves as a showcase through which exhibits related to the transport museum's collection could be observed – a kind of shadow box [6]. In both cases, the translucent envelope creates additional in-between space surrounding the building. The building in Lucerne is one of the best examples of the establishment of additional depth within the building's façade. The façade, very similar to that of the Winterthur Museum of Art, was designed and built at the Pier 17 shopping centre (arch. SHoP Architects, 2018) in New York. The envelope made of translucent glass channel profiles delivers additional depth to the façade, which is particularly well visible in the sunlight – see Figure 2.8.

In the proposed typological matrix approach, the heterogeneous disturbance is illustrated on the vertical axis – gradually from clear, transparent panes (at the top) to those covered with a dense lace-veil ornament (at the bottom). One case study that seems to combine translucent envelopes with dense ornament is the façade of Noyori Material Engineering Laboratory at Nagoya University (arch. Iida Archiship Studio, 2004). The northern façade of the building is enclosed by an envelope made of sandblasted

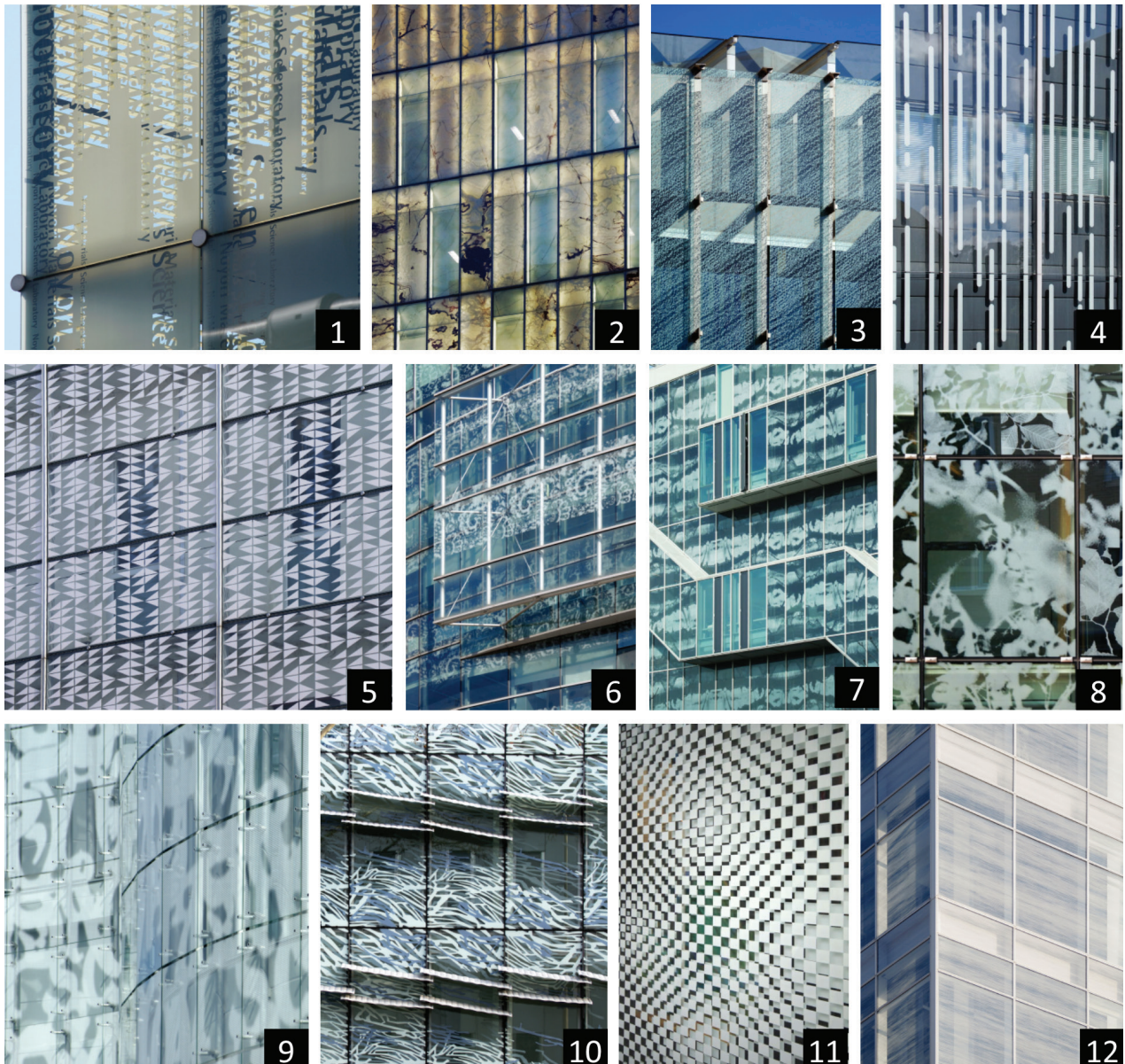


Fig. 3. Case studies arranged according to the original position in the matrix:

1. Noyori Material Engineering Laboratory; 2. LVMH; 3. Software and Biotechnology Plants; 4. Tipotie Health Center;
 5. Clinique du Parc; 6. Plaza Bizkaia Building; 7. TU Delft Building Department; 8. Alphen an den Rijn Town Hall; 9. IKMZ;
 10. Jean Mermoz Hospital; 11. Louis Vuitton; 12. Kirarito Ginza Department Store (photo by M. Brzezicki)
- II. 3. Studia przypadków w układzie analogicznym do tego pokazanego w macierzy studiów przypadków:
1. Laboratorium Inżynierii Materiałowej Noyori; 2. Dom handlowy LVMH; 3. Centrum rozwojowe Software and Biotechnology Plants;
 4. Centrum Zdrowia Tipotie; 5. Szpital Clinique du Parc; 6. Biurowiec Plaza Bizkaia; 7. Wydział Budownictwa TU Delft;
 8. Ratusz Alphen an den Rijn; 9. Biblioteka IKMZ; 10. Szpital Jean Mermoz;
 11. Dom handlowy Louis Vuitton; 12. Dom handlowy Kirarito Ginza (fot. M. Brzezicki)

glass. The panes, however, are not uniformly translucent, but they feature overlaying typographic transparent inscriptions: “Noyori Materials Science Laboratory”. As a result, visual effects vary depending on where the light penetrates the envelope. In some regions, the interior of the building is blurred, while in the others, clearly visible and easily identifiable. A similar visual effect is also visible from the interior, see Figure 3.1.

However, very often [...] *transparent panes serve only as a scaffolding/framework to create a sort of visual veil* [7, p. 10]. Patterned prints on the glass are commonly

made with the screen-printing technique using ceramic paint, which melts with the glass when exposed to the temperature of approx. 600 deg. As a result, print is durable and resistant to environmental factors. Light-coloured (grey and white) inks are the most common because they allow printing binary patterns (binary means that no halftone is used). Such low-density typographic patterns have been applied to the façade of the Basque Regional Library (arch. IMB Arquitectos, 2007) in Bilbao or to the façade of the InterContinental hotel in Ljubljana (arch. OFIS arhitekti, 2015) – see Figure 2.12. On the contrary,

slightly denser, non-typographic prints were used at the façade of the Tipotie Health Center in Tampere, Finland (arch. Sigge Arkkitechdit Oy, 2013) and the Software and Biotechnology Plants in Derio, Spain (arch. Coll-Barreu Arquitectos, 2006). The figures illustrate the effect of the veil, which was achieved by applying the pattern on the glass pane in the façade of the building in Derio – see Figures 3.3 and 3.4.

Denser patterns entail different visual phenomena. In the case of the Clinique du Parc building in Lyon (arch. Xanadu, 2007), a white geometrical pattern inspired by Alexander Girard's fabrics – the “Checker Split” pattern – was applied to the entire glass envelope of the building [8] – see Figure 3.5. The pattern is so dense that it is difficult to recognize the details behind it. Moreover, even denser ornaments are also used (with a density of over 40–50%). The glass panes at the façade of the Jean Mermoz hospital in Lyon (arch. F.-H. Jourda, 2008) have been repeatedly overprinted in several colours – see Figure 3.10. This operation leads to the unique visual effect of gradual transparency: in the upper part, the pane is almost transparent, while on the lower part of the pane patterns are denser and overlaid. In both cases, the dense pattern acts like a patterned veil, making it difficult to see what is hidden behind.

However, there are screen-printing techniques available, that allow producing halftones with the use of small dots. The dots of different size or spacing simulate a gradient by means of density. In this way, the light transmission is not binary as in the case-studies above – but gradual, in many intermediate steps. These printing techniques make the glass look similar to the traditional silk curtain that is hung in the windows. They also work very similarly in optical terms. Such halftone prints depicting stone blocks in cross-section were showed on the façade of the Building Department of TU Delft (arch. Jeanne Dekkers Architectuur, 2007). Just as it is the case with an envelope surrounding almost the entire town hall building in Alphen an den Rijn (arch. Erick van Egeraat associated architects, 2003), where the glass is printed in a leaf-like pattern with varying degrees of light transmission. The effect of the veil is visible both from the outside and the inside – see Figures 3.7 and 3.8. The architect addresses the envelope used as follows: [...] *glass envelope, comparable to a gauze veil – an element of fashion that conveys a mysterious lack of definition. Yet indicates or proves insights into what is behind* [9, p. 007].

New trends in architecture do not reject ornament, but an ornament in its historical version is not used anymore. As seen above, new screen-printed ornaments take the form of regular patterns, free-form shapes, including typographic ones. They often represent the so-called mimetic ornament, i.e., the ornament that is closely related to the function of the building (mimetism – the act or art of copying or imitating closely; mimicking). Halftones allow also to reproduce pictures, photographs, and drawings. This type of halftone print was used in the building of the IKMZ Technical Library (Informations-, Kommunikations- und Medienzentrum) in Cottbus of Brandenburg Technical University (arch. Herzog & de Meuron, 2004) – see Figure 3.9.

The façade of the building was completely covered with a double-skin glass envelope. The two panes of glass, one behind the other, are printed with the typographic patterns mimicking upper and lower case letters, which [...] *have become so close to each other that they merge into a single ornament that they cannot be distinguished* [10, p. 62]. It works in such a way that [...] *the printed pattern breaks the reflection, removes the hardness of glass and homogeneous body makes the building* [11]. In this way, light-transmitting layers of the glass envelope create a specific optical buffer. The façade is not “flat”, its depth is defined by the doubled pattern applied to both surfaces of glass skin. A similar effect of multi-layered “lace” was produced on the façade of the office building Plaza Bizkaia in Bilbao (arch. Soriano & Arquitectos Asociados, 2006) – see Figure 3.6. Building's façade is enveloped in screen-printed curved glass ribbons that simultaneously shade office spaces. In this case, as in no other, the visual effect of many parallel veils is perfectly visible, where [...] *these surfaces tease the eye with no more than hints and glimpses of the building's inner life* [12, p. 1].

Although it seems to be no longer useful in terms of illumination of interior, there are also façades in which the screen-printed patterns occupy by percentage more area than the part that is transparent. In those cases, the pattern becomes more important than the glazing itself. Examples include the Louis Vuitton store on 5th Avenue in New York City (arch. Jun Aoki) or the Kirarito Ginza department store (arch. Jun Mitsui & Associates, 2014) – see Figures 3.11 and 3.12.

Discussion

The author of the presented paper believes that architectural research should not be narrowed to the discussion on façade's optical parameters in detail only, but should also formulate the answer to the question of architects' motivation. The first part of the answer is formulated above: the panes that disturb light transmission – if used skilfully – create an intermediate dematerializing zone between the building and its surroundings. However, the reasons behind such dematerialization seem to be very different depending on the architect. For some, the envelope is the intermediate zone where the volume of the building merges with its background. This technique allows to skilfully blend buildings in with large volume or unusual shapes with the surrounding. Translucent envelopes “transmit” the colour of the environment and thus favour a gentle blend with the existing context (especially in the case of buildings with a small depth). In this way, architecture “borrows” the context from neighbouring buildings, and the formal merge of the old with the new is smoother. This method is universal and it is used both in industrial and public buildings. A positive by-product is the spectacular “lantern” effect, which is invisible during the day, but dominant after dusk. Buildings illuminated from the inside radiate the light in the night.

The second part of the answer follows from the observation that light disturbing envelopes, in general, differ from classical stone or brick façades in a way that a different set

of stylistic devices is used. Non-light transmitting façades get their final form once that they are built, and their appearance for the observer is determined by the play of light and shadow. In contrast, light-transmitting façades are much more light dependent than solid-material façades because the light transmission and reflection through glass is much more unpredictable and – so to speak – chaotic. Therefore, a slight change in the lighting conditions might result in a fundamental change in the façade's appearance. It is also frequently observed that the elements of the building located behind the glass envelope are either hard to spot or so distorted that they are almost unrecognizable. Usually, the purpose of such a stylistic operation is to play with the observer, to mobilize the imagination, as in some cubistic and impressionistic paintings, where the viewer is invited to play a game of guesswork and willingly takes part in one. However, the intentions may be different. In the case of ornamental glass or rich printed patterns, the architect's intention seems to be focusing the observer's attention on the envelope, not on what happens behind it. It's a technique of formal distraction, where architect provides a more aesthetically comprehensible message, instead of the difficult to accept minimalist simplicity.

The third part of the answer is related to an evident trend of "redundancy" in the architecture of contemporary transparent façades, which was already observed, analysed, described, and published by the author of the presented paper [7]. The trend is characterized by the architect's need to introduce phenomenal or literal depth within the façade. Many people (including users and clients) are simply not willing to accept flat, glazed curtain walls, cold and impersonal. They are looking for the experience of depth, the third dimension strongly associated with the classical façade, the depth which could be achieved with the use of various architectural stylistic devices and aesthetical means. The light-disturbing envelope laid over the actual building's façade might be considered an answer for such a pursuit.

Conclusions

The literature studies and case-study analysis conducted by the author show that the main idea of the new trend is manifested in the departure from the literal message that is conveyed through conventional façade. This direct and clear message – as in the case of the transparent glass – is replaced by a vague and hazy image displayed on the envelope, something unsure and temporary [13]. The dominant effect is the loss of obviousness and perhaps ambiguity. This questionable character of the façade is moved to a higher level, not only is nothing certain but even what one might suppose seems unobvious. This can be understood as an architectural interpretation of the current condition of the world, full of anxiety and challenged paradigms. The main ideas of postmodernism are defined by scepticism, irony, and rejection of the great narratives and ideologies of modernism, often undermining various assumptions of Enlightenment rationality. Similarly, the building envelope, as the main arena of architectural expression, has become a place of [...] *the production of*

surficial effects, both as an environmental and a security device and as the vehicle that will produce the building's facialization [14, p. 158].

The very new transparency is characterized by the promise that the façade makes to the observer. The promise of exposing something. As Pelkonen writes: *The veil [...] implies wrapping that can be removed. It suggests secrecy yet promises revelation* [15, p. 122]. Glass ceases to be a "mediator" which connects the interior and exterior space but becomes a bearer of a completely new content. Giving up the transparency in favour of its disturbance, the appearance of the building will be shaped by optical phenomena that have not been used in architecture so far, and envelopes that block the penetration of light rather than support it. As Mies van der Rohe wrote, the image of façades built of transparent materials consists of rays of light passing through and reflected [16]. Therefore – as stated above – the appearance of a translucent façade is determined by scattering, multiple reflections, refraction, the phenomena that are much less predictable. As Kengo Kuma wrote, [...] *architects today are more sensitive to the fact that glass is always caught up between the various phenomena that take place on its two sides, and are eager to experiment with a new type of transparency while developing increasingly ambiguous definitions of enclosure* [13, p. 30]. And further – not to quote literally – Kuma writes that glass panes contribute to the smooth and changeable quality of the architectural space, they build and at the same time they destroy. As a result: [...] *boundaries are blurred not only between inside and outside but also between what is perceived as real and virtual* [13, p. 30]. These repeated attempts to experiment with a light-transmitting envelope are also one of the important characteristics of the trend in question.

From the perspective of visual effects perceived by the observer, a transparency-disturbing envelope is used at least in several spatial scales. They can be divided into those that are applied to the whole volume of the building, and those that interact on a smaller scale of a single pane. Concerning the whole volume of the building – as it was addressed above – the envelope is often used to soften the boundaries between the interior and the exterior. At the scale of individual panes, its influence may be different, depending on the specific degree of transparency disturbance of a given pane.

Assignment of case-studies

All the analysed case studies have been assigned by the author to the trend of transparency disturbance. Two clear sub-trends could be distinguished within the main trend: homogeneous and heterogeneous disturbance. The former includes case studies 1–12 and 16, while the latter includes case studies 13–14 and 17–26, with the case-study number 15 being characteristic for both sub-trends. However, it seems that in order to explain the intricate structure of various optical phenomena, it is much more useful to organize them in a matrix system, which allows determining the gradual occurrence of the features of these sub-trends in a given type of envelope. As a result, both

the extremes and intermediate states find their typological assignment. This operation was performed in section “Matrix approach”.

Definition of the main trend and sub-trends

Based on the presented analyses, it is possible to define a model of the main trend by giving its characteristics features. The main feature of transparency-disturbing envelopes is the variability of visual effects produced on the façade in different lighting conditions. Indeed, a transparent façade is also susceptible to the change of light, but this change is not qualitative, but quantitative. The affirmation of the achievements of material engineering that allows changing the optical parameters of the pane might also be mentioned as an important common feature of the presented case-studies. This advanced material technology is frequently used to achieve even more pictorial graphical results on the façade providing tools for a new understanding of transparency as a feature of the façade itself. Those new technologies of printing, laminating, and dyeing allowed us to obtain new formal and visual appeal in envelopes. A focus of the observer’s attention on the envelope is also typical for the presented case-studies. A brief analysis also shows that innovative materials imply the emergence of new, diverse architectural forms – especially new types of additional envelopes that attract the attention of the public. It can be assumed that the common goal of the main trend is to achieve innovative visual effects, with a great variety of architectural forms. The similarity of the works built by different architects is visible when they try to solve a similar problem, using materials of similar parameters. The primacy of the form over the structure is also characteristic of the presented examples. The structure is used in a purely utilitarian way, it serves as a scaffolding, to which translucent or patterned panes are mounted.

It also seems justified to state that the architects [...] *at all stages of the design process, in addition to the rational premises, also took into account the formal ones* [17, p. 54]. They had to take into account all the factors that usually determine the appearance of the façade and, additionally, those related to the application of a light-disturbing envelope. This process requires, for example, careful analysis of significant changes in the way the façade operates in optical terms, which may affect workplaces illumination. The prediction of light-transmitting qualities of the façade calls for the determination of the feature named envelope’s *directionality*, i.e., what should be seen from the outside and how the building’s façade should be perceived from the inside. This is a legitimate approach, certain façades are designed from scratch with the night appearance in the mind.

The main trend of transparency disturbance consists of two sub-trends, which have their separate distinctive features. Homogeneous disturbance sub-trend is characterized by the reduction of transparency of the envelope towards translucency (usually with the use of light scattering materials) over its entire surface (different degree occurs in different cases), while the heterogeneous sub-trend is

characterized by the local blockage of light transmission, disturbed through the pattern, printing, ornament. The latter sub-trend is also characterized by the use of typography and mimetic ornaments. Envelopes that homogeneously disturb transparency are usually perceived by the audience as restrained, calm and even metaphorical, while those heterogeneous are considered dynamic and, due to their expressive pattern, sometimes even aggressive. Jadwiga Sławińska used to describe this type of approach as “decorative facadism” [18], which is a kind of protest against the use of plain modernist transparent curtain walls.

The use of light-disturbing envelopes seems to be unrelated to the function of the building. The case-studies presented in the paper fulfil the function of both private houses and public buildings, offices, and department stores. However, it should be noted, that 3 out of the 26 case studies represent health care facilities (cases 4, 19, 24). This may be related to the need for increased privacy, but this relationship has not been proven and should be treated as a coincidence.

Trend development in the time

Based on the presented summary made to create a simplified typology, it could be concluded that the experiments with the disturbance transparency started in the early 1990s and reached their apogee in the middle of the first decade of the 21st century. However, this conclusion is not entirely valid. Currently both trends – homogeneous and heterogeneous disturbance of transparency – are active in architecture. For confirmation, one can rely on the recently completed buildings, such as the office and warehouse building of Headquarter Sotax AG, the Pier 17 shopping centre in New York, and the New Deichman Library in Oslo.

Future research

The presented article demonstrates only a small excerpt of the database of façades surveyed by the author. This database is still being expanded. The author plans to deepen the study of various, currently developing formal trends. It is justified to ask the following questions for: (i) architectural theory issues based on architects’ statements and analysis of critics’ opinions; (ii) technical issues – dimensional analysis of façades in cross-section, proportions, and spatial relations; (iii) functional issues – e.g., what implications the disturbance of transparency poses for the building’s users.

Summary of part 2

An envelope “rich in ornamentation” and a “tempting veil” are two different design strategies in the disturbance of transparency, leading to different visual phenomena. Their characteristics based on conducted analyses are presented by the author in chapter “Definition of the main trend and sub-trends”. However, a complete, final and finished formulation of the trend’s model seems to be impossible. The basic reason for this is the fact that the discussed

trends in architecture are still active and constantly changing, e.g., there is plenty of still ongoing construction (cf. chapter “Trend development in the time”). The clear image of the trend is also blurred by the fact that many of the original solutions are later copied by imitators, degenerating initial ideas. An example of such an activity is the common practice of filling modernist mullion and transom curtain walls with post-modern translucent glass. This leads to a kind of dissonance, in which a technical solution primarily created to ensure perfect transparency is used to contradict it.

The process of the gradual erosion of transparency has led not only to the devaluation of the initial meaning of the term on the semantic level (both optical and organizational) but also to a real loss of transparency in favour of other optical phenomena. Manipulation of transparency [...] *be it through colouring, veiling, tilting, or warping, has become the new curtain wall standard. The ideal crystalline transparency at the heart of the original curtain wall assemblage has recently been replaced, yet incrementally, by the acknowledgment and celebration of a necessarily distorted, diverse, and heterogeneous mix of effects and affects – a new reality* [19, p. 915]. This entails consequences

not only for the way the architectural form is perceived, but also for its meaning. The form is not finally defined by the designer but influenced by the momentary state of the atmosphere (daylight) or artificial internal lighting. In architecture, transparent glass oscillates between the transmission of light and its total reflection, while light-scattering pane – between translucency and total opacity. Envelopes that scatter, refract or block the course of the light rays, symbolically compete with the direct message communicating the intentions of the “sender” – an architect or a client. As a result, transparency and the associated continuity of architectural space – perhaps the most important achievement of modernism in architecture – have suffered most. However, in contrast to reflective glass acting as a one-way mirror, the disturbance of transparency works in two directions, it affects both people who are outside the building and those who are inside. In this metaphorical view, the light disturbing envelope does not prefer anyone, the trend is much more “democratic” than others that are present in contemporary architecture.

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Various elements of simplified typology have already appeared in the author’s previous publications [7], [20] but were not described in such detail. The case studies shown there have not been systematized in the form of a matrix system before.

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Abstract

Disturbance of transparency in the architecture of contemporary glass façades. Part 2

Over the last two decades, new trends have emerged in the design of translucent façades. Those trends result from the dynamic technological progress and achievements in material engineering. The trends that are associated with the use of envelopes that interfere with the transmission of light through the façade are particularly interesting. This is strongly related to the significant transformation that took place in the dialectic of the building, the transformation of the “façade” into an “envelope”. The paper presents the author’s original distinction between the two most characteristic main sub-trends, distinguished based on optical phenomena occurring within the façade. The proposed division includes two main groups of disturbances: homogenous and heterogeneous. The former is present where panes of glass are used to disperse/diffuse light evenly, while the latter in façades with strong – usually printed – ornamentation. The article systematizes the issues of transparency disturbance in contemporary architecture and presents the typology of light-transmitting façades, in which this phenomenon takes place. The author also presents a matrix of relations that systematizes the presented case studies. Only this type of matrix makes it possible to illustrate an issue in which more than one variable is present. An assignment of the case studies to the trends and the determination of trend models are also included in the paper. The first part of the paper (published in March 2021) presents the introduction, methodology and simplified typology, the second one presents case studies, discussion and conclusions.

Key words: transparency, theory of architecture, façade glazing, printing on glass, coatings on glass

Streszczenie

Zakłócenie przezroczystości w architekturze współczesnych szklanych fasad. Część 2

W ciągu ostatnich dwóch dekad pojawiły się nowe nurty w projektowaniu przezroczystych fasad. Są one wynikiem dynamicznego postępu technologicznego i osiągnięć w dziedzinie materiałoznawstwa. Szczególnie manifestują się te nurty, które związane są z zastosowaniem powłok zakłócających przenikanie światła przez fasadę. Wiąże się to silnie z istotną przemianą, która dokonuje się w dialektyce budynku, z przemianą fasady (ang. façade) w obudowę/powłokę (ang. envelope). W artykule przedstawiono dokonane przez autora rozróżnienie zjawisk optycznych, które zachodzą w obrębie fasady. Proponowany podział obejmuje dwie główne grupy: jednorodne i niejednorodne zniekształcenia przezroczystości. Te pierwsze występują tam, gdzie zastosowano tafle równomiernie rozpraszające światło, te drugie natomiast w fasadach o silnej – zazwyczaj nadrukowanej – ornamentacji. Artykuł systematyzuje zagadnienia zniekształcenia przezroczystości w architekturze współczesnej i przedstawia typologię tych fasad przepuszczających światło, w których występuje to zjawisko. W artykule przedstawiono też macierz relacyjną, która systematyzuje opisywane studia przypadków. Jedynie ten typ macierzy pozwala na pokazanie zagadnienia, w którym obecna jest więcej niż jedna zmienna. W tekście dokonano również przypisania studiów przypadków do nurtów, a także charakterystyki samych nurtów – stworzenia ich modeli. Pierwsza część (opublikowana w marcu 2021 r.) zawiera wstęp, opis metodologii oraz uproszczoną typologię, a w drugiej znajdują się studia przypadków, dyskusja oraz wnioski.

Słowa kluczowe: przezroczystość, teoria architektury, szklana fasada, nadruk na szkle, powłoki na szkle