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8

LIVIO PETRICCIONE

Il "dov'era e com'era" nella ricostruzione del teatro Galli di Rimini

36

TEODORO SEMERARO,
ROBERTA ARETANO

Rigenerazione territoriale: un processo senza fine

79

NADIA FAVA

Barcelona's Port: the Construction of the "Spectacle of the Sea"

Controsservatorio ambiente e territorio

14

CLAUDIA BATTAINO,
LUCA ZECCHIN

Intersezioni fra visibile e invisibile. Scavi tracce indizi per (ri-attivare) Aquileia

28

ANTONELLA VERSACI,
ALESSIO CARDACI

Il Waterfront di Messina. Maregrosso, cuore della città, tra evoluzione e involuzione

43

PAOLO MIRA

Il duomo "incompiuto" di Alessandro Antonelli a Novara

66

DANIELA CACACE

Il disegno come strumento di conoscenza. Modificazioni antropiche e naturali nella Valle del Sarno tra XIX e XXI secolo

Paesaggio e risorse

22

LOREDANA FICARELLI,
MARIANGELA TURCHIARULO

The Landscape Form as Act of Visual Perception

51

ALESSANDRO RANIERI

The Tourist Attraction Through the Cultural Valorization. Sannio and its Villages: from Paradise Lost to Smar-Touristic Land

58

ALESSANDRO PREMIER

Originality vs. Imitation. Technologies and the Influence of OP Art in the Design of Contemporary Façades

72

CARLO DAL CORTIVO

La soggettività del bello

Recensioni e informazioni

86

Associazione IPSAPA

87

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Originality vs. Imitation

Technologies and the Influence of OP Art in the Design of Contemporary Façades

Originality vs. Imitation. Technologies and the Influence of OP Art in the Design of Contemporary Façades. Building façades can reproduce virtual dynamism despite being realised with static components. This is the case with some façades that have been designed to exercise a perceptive dynamic effect on the observer. Such effects are inspired by Optical Art (OP Art). The aim of this paper is to propose a taxonomy of original technological solutions to obtain dynamic effects on static façades in relation to the different contexts in which the buildings are located, in contrast to the recurrent reinterpretation of stereotypical patterns. The study will make use of significant examples of different building façades to explore this aspect.

Keywords: Colour, façade design, environmental design, architectural technology



ALESSANDRO PREMIER

The globalisation of construction techniques has brought with it, for many years now, the realisation of apparently very similar buildings to all latitudes, gradually reducing the value of regionalism and the concept of Genius Loci (Norberg-Schulz, 1980). In fact, the Genius Loci is constantly changing according to the change in citizens' life styles (Zennaro, 2009, p. 56). In our age of *Liquid Modernity* (Bauman, 2000), everything is changing rapidly and even that which is static, like buildings, must continuously change, or must at least give the appearance of doing so. Architecture is not exempt from this demand, since "architecture should speak of its time and place" (Gehry, 1993, p. 43), and it is, above

all, the façades of buildings that tells this story.

Today we have many solutions at our disposal to achieve façades that are able to continuously change, thanks to moving elements activated by electronic, mechanical, and smart technologies. We call these dynamic façades. However, not all dynamic façades must necessarily involve moving elements in order to achieve an ever-changing appearance: in fact, there are façades that make use of mechanical dynamism and façades that make use of perceptual dynamism (Gasparini, 2011, p. 56). Perceptual dynamism can be achieved through the creation of images through the use of electronic technologies (such as lights, projectors, etc.). However, façades can also reproduce virtual dynamism even if they are static. It is in this particular type of façade that we are interested for the purposes of this research.

Whilst Kinetic Art represents the cultural reference for mechanical dynamic façades, the cultural reference for static façades with virtual

dynamic effect seems to be Optical Art (Op Art). “Optical art is a style of visual art that uses optical illusions” (Atkins, 1997). Typically, Op Art paintings and drawings give the viewer the impression of movement, hidden images, flashing and vibrating patterns, or of swelling or warping. These effects can be achieved on 2D or 3D static surfaces using specific colour combinations and patterns. Many of the effects that are employed today in building façades were first experimented in the nineteen-sixties. Designers can make use of black and white contrast to generate hidden images, as in Bridget Riley’s works. A much-discussed example of this is the façade of the Swanston Square Apartment Tower by ARM Architecture, located in Melbourne (2015). This is the so-called “Barak Building”, owing to the face of William Barak, the celebrated indigenous leader, that appears between the southern and eastern façades. The image of the face is obtained through the contrast of white panels bolted onto black balcony slabs, which reproduce a black and white pattern. Designers can make use of colour contrast and specific patterns to achieve a warping effect as in, for example, Victor Vasarely’s works. An emblematic example of this kind is the façade of the Research Laboratory at the University Medical Centre in Groningen, designed by UNStudio (2008). Simulation of virtual movement and tension can be achieved through other combinations of shapes, such as in Getulio Alviani’s works. A significant example of this is the main façade of the Richard Desmond Children’s Eye Centre in London, designed by Penoyre & Prasad and Lightscape Projects (2009). These kinds of effects can also be achieved working only with colour contrasts, as in, among other examples, the famous ceramic envelope of the Brandhorst Museum in Munich (2008) or the Prairiefire Museum at Overland Park, USA (2014).

1. Static Façades vs. Dynamic Façades

Dynamic façades are characterised by moving

elements of different shapes, materials, and colours, that can be put into action through the use of different technologies: electrical, mechanical, smart, etc., very often combined together. Generally, the goal of these façades is to be able to adapt to different environmental conditions, and to optimise building envelope performances. The effect perceived by the observer is of a surface in constant flux. Elements of different colour, depending on their combination, may increase the complexity of the façade. This can be very important, for example, in peripheral or industrial contexts, where grey tones dominate the environment. A truly sustainable façade design must deal with this problem, creating man-made artefacts that are able to enhance the quality of the environment through the use of special design strategies.

Sometimes, in order to reduce costs, it is necessary to adopt less complex technological solutions even if the designer is still interested in retaining the perception of movement and dynamism. The effect of movement (or dynamic effect) can be very important, since it can bring “life” to humdrum neighbourhoods. This can also be achieved using cheap technological solutions. These are static façades with dynamic effects. In these kinds of façades, colour design and the shape of cladding elements are the most important features.

Colour combinations can create vibrant contrasts that are able to generate certain effects of dynamism. This can be seen in both 2D and 3D façades. For our purposes, the term 2D façade refers to those architectural envelopes that are characterised by a flat skin, whilst 3D façade refers to those that are characterised by a skin consisting of three-dimensional parts or cladding elements.

As previously stated, the cultural references for this type of design solution seem to be drawn from Optical Art (Op art). Generally, these effects are achieved on 2D static surfaces. For the most part, these effects were experimented during the nineteen-sixties, but many optical paintings were already being created in the nineteen-thirties. These are being applied today in architecture where, following Op Art

techniques, designers can make use of black and white or colour contrasts to achieve their goals.

To generate the perception of image or movement, as in Bridget Riley's works, designers can use the contrast of black and white. An example of "perception of movement" is the famous painting "Hesitate" (1964), which is composed of black dots fading on a white background, simulating two opposite curved surfaces (<http://www.tate.org.uk/art/artworks/riley-hesitate-t04132>). An example of "hidden image" is the famous "Zebra" by Victor Vasarely (1950), in which black and white diagonal lines change the shape to create the image of a zebra (<https://www.wikiart.org/en/victor-vasarely/zebra-1950>).

Victor Vasarely also used colour contrast to enhance certain shapes, generate warping, or create the perception of movement. An emblematic example of simulation of movement is the famous painting "Majus" (1973). This is a composition of circles inside squares that uses the contrast of hot and cold colours to create the sensation of a vortex (<http://www.galleriesinparis.com/exhibitions/victor-vasarely/>).

The sensation of tension and movement can also be achieved with other types of pattern. In Bridget Riley's "Nataraja" (1993), the tension is created by a dense network of diagonal polygons of various colours. It looks like a sort of "rain of colours", mainly using red, green, blue, and yellow tones (<http://www.tate.org.uk/art/artworks/riley-nataraja-t06859>).

In Bridget Riley's "To a Summer's Day 2" (1980), the sensation of movement is created by a flow of undulated lines of different colour over a white background (<http://www.tate.org.uk/art/artworks/riley-to-a-summer-day-2-t03375>).

As previously said, this research has concentrated on the analysis of examples of architectural façades with the aim of finding a taxonomy of technological solutions to obtain dynamic effects on static façades in relation to the different contexts in which the buildings are located.

2. Methodology of the research: surface design and constructive innovation

Different architectural projects have been studied following a precise scheme, namely: a) façade technology; b) components; c) pattern; d) colour strategy; and e) final effect.

The goal is to provide a reading of the design strategies achieved through Op Art as innovative tools for the construction of contemporary façades, highlighting the relationships between these strategies and some of the most important issues of façade technology: empty vs. full, closed vs. opened, matt vs. translucent, quality vs. quantity, heavy vs. light, and dynamic vs. static.

a) Façade Technology. This is important because its choice is strategic for the realisation of the cladding of the façade. It is the fundamental part that generates the relationships between the building and the environment. In the above-mentioned Barak Building in Melbourne (<http://armarchitecture.com.au/projects/barak-building/>), for example, the glass cladding is strategic for the final effect of the façade because it constitutes the black background on which the white balconies are fastened and, together, these elements realise the final design of the façade.

b) Components. These are important because, as single elements, they together form the façade pattern that is one of the most important aspects of regular composition. Components can be the same or be different from each other (in terms of shape, size, colour, etc.). Their colour and surface finish can be very important for the relationship between the façade and the natural light. Light reflection and absorption and shadows and shades can completely modify the appearance of the façade. This feature is clearly visible in the Parking Structure Art Façade, in which the metal components are folded in different ways, and are coloured in yellow and blue to obtain a specific effect on the surface of the building: the changing gradient of colour (Fig. 2).

c) Pattern. According to Rudolf Arnheim,

patterns are repetitive models (Arnheim, 1954, p. 45). They are important in art as in architectural design, especially in façade design. They create hierarchies in a composition as well as specific visual effects. In façade design, patterns can be created by the repetition of the components of the façade itself. Sheets and panels of different materials, sizes, and colours constitute the components of a façade cladding, and their combination - the pattern - creates the rhythm. However, windows, too, can constitute the basic element of a pattern. The pattern of the famous Brandhorst Museum in Munich is composed of thin ceramic tubes overlapping to a metal cladding: the tubes are in different colours, defining a very dense rhythm that is in contrast with the continuous glazing that divides the façade in two parts (Fig. 3).

d) Colour strategy. Johannes Itten's colour theory remains invaluable in the study of the colour strategies used by artists or architects. The "seven colour contrasts" can be employed to enhance a building in its context, or to accentuate certain parts of it, whilst colour agreements (or chords) can be used to harmonise it within its context. Both are used to create specific graphic or artistic effects on the façade, the latter being what we are trying to describe in this paper. Colour is the most important feature of a static façade with dynamic effect, because the effect is mainly generated through colour. In all the buildings we have analysed, colour is strategic. For example, in the case of the Prairiefire Museum, the colours of metal sheets and dichroic glass panels are calibrated to reproduce the appearance of fire (<http://www.vernerjohnson.com/portfolio/prairiefire/>).

e) Final effect. This is what we perceive when looking at the building. Visual perception in architecture is determined by different variables that may include the weather conditions (especially light conditions), the point of view of the observer, the mental conditions of the observer (induced interpretation vs. solipsistic interpretation), etc. All the buildings we have analysed seem to take advantage of these aspects. In a certain way, the final effect is not

only the sum of parameters a, b, c, and d, but also what the building can produce in the mind of the observer: in this sense, this reading has the ambition to represent an average vision of the actual situation.

According to these strategic parameters, we have presented the results of our research in the form of a taxonomy of technological solutions for achieving a dynamic effect on static façades.

3. Results: taxonomy of technological solutions

The study of the case studies, following the parameters previously described, has led to the identification of 8 different strategies used by designers to obtain specific dynamic effects on static façades. We may say that these strategies can be used in both 2D and 3D façades where the complexity of the form is another issue that affects the overall design and perception of the building itself.

The identified chromatic strategies are:

- No. 1: images created by contrast of black and white or light and dark;
- No. 2: sensations created by contrast of black and white or light and dark;
- No. 3: tension generated by colour contrasts;
- No. 4: figures created by colour contrasts;
- No. 5: contrasts created by variation of lightness and saturation;
- No. 6: changes of colour gradient made with elements of different shape;
- No. 7: tension created by particular shapes combined together;
- No. 8: movement simulated by gradient of reflection.

Each strategy is described below, together with an example of a building compared to a significant work of Op Art.

3.1 Strategy No. 1: images created by contrast of black and white or light and dark

This is the typical solution inspired by Op Art. Black and white patterns or lines are used to

create drawings and images. The façades are composed of panels, fins, or louvers shaped so as to create large hidden images on the external surface. An example in which we can find this technique is the so-called Barak Building in Melbourne, AU (2015), designed by ARM Architecture. The peculiarity of this building is the face-façade: the face of William Barak is represented on the south-east façade of the building. The image on the façade is realised with white panels bolted onto black balcony slabs (<http://armarchitecture.com.au/projects/barak-building/>). The panels (up to 6 meters long and 2 meters high) are an engineered surfboard-like composite material 140 mm thick: a PET foam core with fibre mesh and vinyl-ester external coating. The panels are white, and are superimposed onto the glass envelope. From a certain distance the glass envelope is perceived as black. Thus, the scheme is of an image created by the contrast of black and white lines, exactly as in the black and white works of Bridget Riley or Victor Vasarely (<https://www.wikiart.org/en/victor-vasarely/zebra-1950>). From an architectural point of view, we can refer to this as a contrast between empty parts and full parts.

3.2 Strategy No. 2: sensations created by contrast of black and white or light and dark

We may find this solution, for example, in perforated or laser cut claddings. A typical example is that of the Bent Façade in Amsterdam (2012). The façade was designed by Chris Kabel for a residential building, designed by the architectural firm Abbink X de Haas, in the centre of Amsterdam. The external cladding is composed of aluminium plates perforated by use of a special punch that folds the cut plate upwards or downwards. The small bent hexagonal surface may reflect light or create shadow. This "pointillist" technique enables the creation of drawings on the metal plates while avoiding the high costs of laser cutting technologies (Fig. 1).

3.3 Strategy No. 3: tension generated by colour contrasts

We can find this solution on the façade of the lobby of the Prairiefire Museum, the American Museum of Natural History designed by Verner-Johnson Architects located in Overland Park, KS, USA (2014). The "fire effect" is created by the colour contrast in the pattern of the cladding. The panels of dichroic glass are yellow, green, and orange, whilst the metal cladding is gold and purple. The tones change according to the weather conditions and the point of view of the observer. The final effect is generated by the contrast of hot and cold colours (<http://www.vernerjohnson.com/portfolio/prairiefire/>). The composition of the lobby's façade again recalls Bridget Riley's works of the nineteen-nineties (<http://www.tate.org.uk/art/artworks/riley-natarajata06859>). The trapezoidal panels in different colours are positioned vertically rather than diagonally, but the effect is vibrant and very similar.

3.4 Strategy No. 4: figures created by colour contrasts

Through colour contrast, particular shapes and figures can be created on a building's façade.



Fig. 1
Bent Façade in Amsterdam by Chris Kabel (2012). Photo © Hans Peter Föllmi for IC4U

An emblematic example of this is the Parking Structure Art Façade designed by Urbana Studio, located in Indianapolis, USA (2014) (Fig. 2). The façade is clad in bent metal plates coloured in yellow and blue. Looking at the façade from a frontal position, the observer may perceive flowing figures generated by the contrast of blue and yellow elements (the contrast of pure colours). From a chromatic point of view, the colour scheme is relatively simple since the west side has a deep blue colour and the east side has a golden yellow colour. The different angle of the panels is sufficient in itself to create the illusion of other shades. To achieve the desired effect, the designers had to work on the repeatability of the pattern or through combinations of it that allowed them to create the right alternation, necessary for the same perception from various angles (Fig. 2).

3.5 Strategy No. 5: contrasts created by variation of lightness and saturation

The effect of a vibrating surface can also be obtained by using elements with colours of different levels of lightness and saturation. An example of this is the Brandhorst Museum in Munich by Sauerbruch Hutton Architects (2009). The façade is clad with thin ceramic tubes of different colours positioned very close to each other: the effect is of a vibrant surface. The difference in lightness and saturation of

colour is not only between the single tubes of the façade but between the basement, the crown of the building, and the taller volume (Fig. 3).

3.6 Strategy No. 6: changes of colour gradient made with elements of different shape

An undulating pattern can be used to obtain this effect. We may see this on the façade of the Research Laboratory in Groningen (NL) designed by UNStudio (2008). The grey metal cladding composed of regular elements can be curved to obtain a vibrant effect on the surface of the façade. The lower part that remains can be coloured so as to create a chromatic shift between two colours (in this case, between green and yellow). In this building, this is an original solution to highlight an important architectural problem: the corner solution (<https://www.unstudio.com/en/page/3203/research-laboratory>).

3.7 Strategy No. 7: tension created by particular shapes combined together

A specific façade pattern can be designed to create an effect of tension, as in some famous works of Op Art, despite being static. An example of this technique is the façade of the Richard Desmond Children’s Eye Centre of Moorfields Eye Hospital in London, designed by Penoyre & Prasad and Lightscape Projects

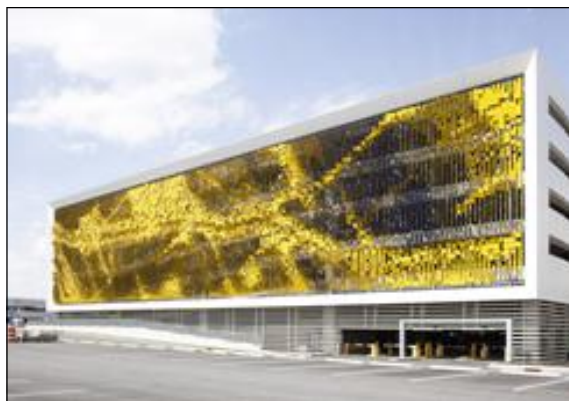


Fig. 2
Parking Structure Art Façade in Indianapolis by Urbana Studio (2014). Photo © Serge Hoeltschi



Fig. 3
Brandhorst Museum in Munich by Sauerbruch-Hutton (2009). Photo © Alessandro Premier

(2009). The glass façade is protected from the sun by a construction made of stainless steel cables and apparently freely placed folded aluminium plates. The aluminium plates change in the light in accordance with the architects' plans, creating a sensation of tension in the façade: they look like the distribution of stresses in a static scheme. Coloured lighting draws attention to the façade at night (<http://it.archello.com/en/project/richard-desmond-children%e2%80%99s-eye-centre>). The glazing of the façade becomes the background of the work of art. There is a strong contrast between translucent parts and opaque parts, and the volumetric window is the element that breaks the pattern continuity.

3.8 Strategy No. 8: movement simulated by gradient of reflection

We may find this solution when architects use mirror claddings or highly reflective claddings. The effect is amplified by a micro-3D surface with different angles of reflection. The effect is also amplified in the presence of water. In fact, we may frequently find this strategy in waterfront design. An example is the great ceiling of the B Pavilion at Genoa Fair (Italy), designed by Atelier Jean Nouvel (2009). The ceiling is made of undulated metal. Light and the movement of water are reflected on the ceiling, creating a continuous sensation of movement on the surface (<http://www.archilovers.com/projects/11419/padiglione-b-fiera-genova.html>). In this case, not only is there the sensation of movement produced by the art design of the architect, but we can also find a strong relationship between the surface of the building and the environment in which it is located.

4. Conclusions

It seems that design strategies to create a static façade with dynamic effect can be inferred from works of Op Art from the Twentieth Century. They consist of reproducing designs using pattern and light-and-dark contrasts, but also

of creating very strong colour contrasts that give a sensation of movement, tension, or create specific images, patterns, and drawings. From a constructive point of view, static façades are less complex than dynamic façades. They have static elements that compose the façade claddings. There may be a lower technological content, but there must be more design content, especially in terms of ideas, concept, experimentation with architectural composition and combination of cladding elements, and a deep expertise in the use of colour, texture, and pattern. The final result can actually be more complex than that of a dynamic façade. We have also seen that all the architectural elements of the façade, combined together, coincide to create the final result, including the opaque parts, glazing, shading elements, claddings of different shapes and size, the crowning, the basement, etc. In general, we can confirm once again, looking at this kind of architectural solution, the contemporary desire to oppose static things and play to the flux of our liquid society. □

Sommario

Dinamicità, fluidità e continuo cambiamento sono caratteristiche tipiche della nostra società contemporanea. L'architettura riflette questi caratteri nelle facciate, attraverso superfici cangianti e dinamiche. Alcune tipologie di facciata perseguono questi obiettivi pur essendo realizzate mediante componenti statiche. Si parla quindi di facciate statiche ad effetto dinamico. La progettazione di queste facciate sembra ispirarsi all'arte Optical (OP Art) sviluppatasi perlopiù negli anni Sessanta del Novecento. Questa ricerca, attraverso un'indagine sostenuta su un congruo numero di casi studio, ha individuato 8 strategie diverse utilizzate da progettisti internazionali per raggiungere gli obiettivi prefissati: creare sensazioni di tensione, movimento, immagini nascoste, pattern vibranti, rigonfiamenti o deformazioni. Tali obiettivi sono raggiunti mediante l'opportuno accostamento di particolari soggetti astratti o sfruttando contrasti cromatici che si traducono, nella costruzione di manufatti edilizi, nell'accostamento di elementi architettonici caratterizzati da particolari forme o colori. Il paesaggio contemporaneo è così "frequentato" da figure iconiche sempre molto discusse o discutibili ma che rappresentano il continuo cambiamento della nostra società liquida occidentale.

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