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Aesthetic perception of steel-glass architecture in Japan

Nowadays, steel-glass designs usually prevail in modern architecture [1]. Glass has evolved from the material used mainly for windows into a material that is often combined with steel and used for curtain walls and various structural members in many types of structure, such as buildings, railway stations, airport terminals and passenger service centres on expressways ([2], [3], [4], [5]). Structural aesthetics, reflected in the beauty of objects of refined taste, is a major concern in both architectural and engineering forms [6]. Japanese aesthetics, based on tradition, has been widely shown in architecture itself as well in the world of engineering structures [7]. This contribution discusses the perception of the aesthetic qualities of steel-glass elements in buildings – considering their dimensions, visual lightness, texture, reflection, transparency, colour, light, translucence and design context.

Ästhetisches Empfinden der stahl-gläsernen Architektur in Japan. *Die Stahl-Glas-Konstruktionen sind heutzutage in der modernen Architektur vorherrschend [1]. Glas entfaltete sich von seiner Herkunft, dem Fensterbau, zu einem Material, das üblicherweise in Kombination mit Stahl verwendet wird sowie für Vorhangfassade und für verschiedene Konstruktionselemente in unterschiedlichen Bauwerken, wie Gebäuden, Bahnhöfen, Flughafen- und Autobahnterminals* ([2], [3], [4], [5]). *Die strukturelle Ästhetik, die sich in schönen und raffinierten Objekten widerspiegelt, ist von großer Bedeutung in der Architektur selbst, als auch in der Welt des Ingenieurbaus [7]. Dieser Beitrag behandelt die Wahrnehmung ästhetischer Eigenschaften von Stahl-Glas-Elementen in Gebäuden – in Anbetracht ihrer Dimensionen, ihrer visueller Leichtigkeit, ihrer Textur, ihrer Reflexion, ihrer Transparenz, ihrer Farbe, ihres Lichts, ihrer Transluzenz und ihrer Anordnung.*

1 Introduction

Steel-glass structures carrying the loads in buildings have been used for various types of roofing, walls, partitions, beams, floors and stairs. Depending on the specification of the glass, they also have certain visual qualities. Glass surfaces can be chemically coated, painted or laminated. Technological achievements in the production of increasingly thinner and more resistant glass, fulfilling various functions – such as smart glass (e.g. *UMU Switchable Light Control Glass*), antivirus glass (e.g. *Virus Clean Glass*) and vacuum glass (e.g. *Spacia (supēshia)*) – encourage the increasing use of this material both in the construction of buildings or arrangement of their interiors as well in the open countryside [8]. Among the new glass materials not only windows have been produced, but also structural members for curtain walls, different types of partition, railings, elevators, stairs, balustrades, roofs, roofing and flooring. Glass has even been used as a structural material alone for some remarkable buildings and interiors [9]. Contemporary architecture, in Japan, too, has without doubt experienced the "era of glass" that is usually paired with steel to create an explicit contemporary style [10].

2 Japanese aesthetic principles

In Japan traditional aesthetics and the perception of nature have a big influence on contemporary architectural and engineering design. The origins of that principle can be traced back to the specific soul of Japanese society [11]. There are several components representing that soul, the most fundamental value being harmony (*wa*), which implies a peaceful unity and conformity within a social group. Ancient ideas of *wabi* and *sabi* are the foundations of traditional aesthetics: *wabi* means transient beauty, *sabi* is beauty associated with aging. A third term, *yūgen*, means refined elegance and mystery. Transiency is very important and is reflected, for example, in the appreciation of blossoming cherry trees (*sakura*) and *hanami* viewing. Among the components of Japanese soul, the next are form (*kata*), the mode of gaining and expressing the skills, and path (*michi*), the spiritual advantage leading to strengthen the form. Other principles stand for skill (*waza*) and craft (*takumi*), the concrete know-how and spiritual values of the warrior's way (*bushidō*), together with seeking the truth (*gudō*) to accomplish the goals by hard study and training. They are followed by the invisible motion of energy (*ki*) and the transition (*setsu*), expressed by nodes (*fushime*) in human life – periods building one on the other. Feeling (*jō*) and loyalty (*chū*) are the other features of the Japanese soul. The former refers to various human emotions, such as joy or sadness, pleasure or suffering, etc., but also to obligation and duty. The latter underlines the readiness to respect the benefactors faithfully. Finally, sincere esteem for the Shintō religion combined with Buddhism is the basis for the relations between people; hereby beauty (*bi*) plays a particular role. The eternal and impersonal nature, in its large variety of matter, represents the cornerstone of the cosmos – the foundation of ideals, aspirations, desires and longings – as well as the motives and aims of people's actions. It is assumed that the position of humankind in the universe is a special one; in order to be perfect, humankind should proceed down the road (*tao*). The appreciation of nature has been fundamental to many Japanese aesthetic ideals. It led to the extraction of some natural phenomena and the contemplation of landscape in terms of *ka-cho-fu-getsu* (flower, birds, wind, moon), which represent particular occurrences admired by human senses, such as blossoming flowers, natural sounds and motion (e.g. due to water or wind), moonlight, etc. The formalization of the landscape experiences led to the development of a relevant consciousness that, for example, can be identified with the selection of the most beautiful views (*meisho*), the careful symbiosis of architecture and nature, the observed life-style and the variety of adequate contrasts. Traditional aesthetics embracing diversity and contrast coexisting with each other has been widely reflected in national architecture. Thus, on the one hand there is the grey and restrained architecture of tea pavilions, *chashitsu*, or that of the emperor's villa, *Katsura Rikyū*, in Kyoto, and on the other, the colourful and decorative Shintō shrine (*Tōshō-gu*) in Nikko, or the Golden Pavilion (*Kikaku-ji*) in Kyoto.

Traditional values have survived in contemporary attitudes towards planning, architecture and engineering design. Nowadays, aesthetics is characterized by novelty of structural form, compact and modular organization of a limited space, predominance of asymmetry (related to the ideals of the Japanese garden) and balance based on inner meaning, sympathy with nature in its dynamic appearance, the perfection and durability of workmanship and full regard for the materials. Each of those ideals can also be found in relation to steel-glass architecture in Japan.

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3 Influence of steel-glass combination on the aesthetic perception of architecture

Structural aesthetics, or beauty, has long since been a recognized and desired virtue of the architectural and structural forms of urban structures [6]. In urban contexts the aesthetic impressions originate due to the configuration of space, the formal and functional solutions of the object itself, and its relation with the environment.

The concept of aesthetics is not limited to visual qualities based on the principles of the formal analysis of an object's size, shape, space, visual lightness, texture, colour, composition, proportions, etc., but also recognizes subjective aspects such as usability, the intentions of the designer, reflections, associations, context, sense of place, etc. Such aesthetic aspects, as a perception of space, form, scale, colour, references to places and various semantic relationships, largely depend also on the steel-glass characteristics of built form, too, and its relation with the landscape. Steel-glass can evoke certain associations, e.g. that of luxury or of modern technology. The choice of glass within the combination of steel and glass depends on a particular function, such as, for example, the window function – when the material should be transparent, or function of the elevator, when its transparency is favorable for people's feelings of safety. Environmental needs may require that glass be coloured; the "landscape glass" may have different colours and various granules incorporated – inducing diverse aesthetic impressions. Several particular aspects of steel-glass objects have been discussed below.

3.1 Steel-glass combination in relation to dimensions, visual lightness and spaciousness

Many modern buildings are often huge and dominate the streetscape. Steel-glass combinations have often been used for curtain walls. These materials clearly have a calming factor even for high-rise buildings. The tallest building in Osaka – indeed in Japan – is "Abeno Harukas" (*Abeno harukasu*, 2010, 300 m), which with transparent glass looks less oppressive (Fig. 1). Its façades, designed by César Pelli (Pelli, Clarke, Pelli Architects) and Takenaka Corporation, run across different planes – greatly diminishing its visual dimensions and weight.

Fig. 1 Osaka – Abeno Harukas, 2010

Fig. 2 Tokyo – JP Tower, 2013

For high-rise buildings, steel-glass combinations not only reduce the visual weight and help the buildings to harmonize with the environment; they also have an impact on the

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perception of the façades as simple and elegant designs, where all the details are better exposed. The 38-storey JP Tower (*Jeipī tawa*, 2013), designed by Helmut Jahn (JAHN) and Mitsubishi Jisho Sekkei Inc., can be regarded as an example of such a building (Fig. 2). The tower was built on the site of the historic Central Post Office building in Tokyo (*Tōkyō chūō yūbinkyoku*). A part of the front of the five-storey building dating from 1931, designed by Tetsuro Yoshida, was reused within the new structure and developed into a multi-purpose centre, the "KITT", housing the headquarters of Japan Post (*Nippon Yubin*) and commercial services. The elevation of JP Tower is clearly distinguished on the background of historical and modern buildings of Tokyo Station (*Tōkyō-eki*) – "Marunouchi Building" (*Marunouchi biru*, 1914) and across the landscape of the central Tokyo located opposite the Imperial Palace.

Large solids where steel and glass predominate can become the characteristic points in a cityscape. There are several cases of large station buildings that have steel-glass curtain walls and big three-dimensional structures. Kanazawa Station (*Kanazawa-eki*, 2005), which serves the passenger traffic of the new Hokuriku Shinkasen high-speed train, has a gigantic steel-and-glass dome – the Motemashi Dome (*Motemashi dōmu*) – and a characteristic wooden entrance gate, the Tsuzumi Gate (*Tsuzumi-mon*, 2005), which is in the form of the traditional Japanese drum (Fig. 3). Both the dome and the gate are recognizable elements within the cityscape of Kanazawa. Further, the steel-glass structure strengthens the feeling of freedom and comfort for station visitors.

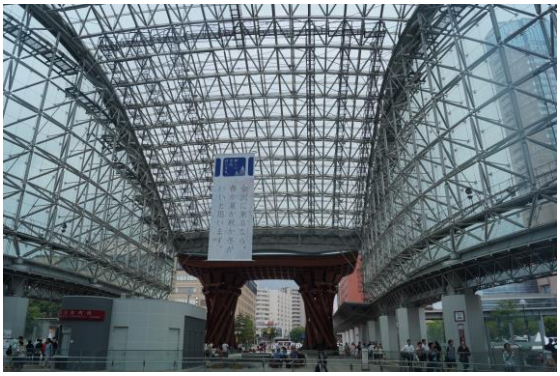

Fig. 3 Kanazawa – Kanazawa Station, 2005

Fig. 4 Nagoya – Nagoya Station, 1999

Fig. 5 Nagoya Station – top floor

Fig. 6 Kyoto – Kyoto Station, 1997

Steel-glass curtains walls develop the sense of spaciousness. High-rise buildings, such as JR Central Towers (*JR Sentoraru tawāzu*, 1999), increase this feeling. Towers with a

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height of 50 storeys, designed by Kohn Pedersen Fox Associates (KPF) are part of the Nagoya Station (*Nagoya-eki*, Fig. 4). Their structure is composed of concrete, steel and glass. Apart from transportation, these cylindrical skyscrapers also have other functions, such as the Marriot Associa Hotel, offices, commercial space (Takashimaya department store) and the Tower Plaza shopping mall. Formerly an observation deck, the top floor of the office tower has been converted into the "Panorama Salon", featuring a cafe, wine lounge, beauty salon and health spa with great views over the city. Likewise, the hotel tower offers a lounge and restaurant with lovely views from its top floor. One of the station's unique features is the "Sky Street", a huge airy concourse that connects both towers on the 15th floor. It opens up a dramatic vista of Nagoya through a massive bank of plate-glass picture windows. The glass curtain walls of the top floor offer a panoramic view of the mountains through the glass curtain walls, providing a sense of space and contact with the environment (Fig. 5).

Steel and glass are a perfect combination not only in the structural but also in the aesthetic one. Plain steel contrasts with transparent glass. They both look light, with glass often looking almost invisible, or sometimes adding some colour. Steel-glass combination also looks modern. The combination of steel and glass has an influence on the expression of architecture. The interior of the huge Kyoto Station (*Kyōto-eki*, 1997), designed by Hiroshi Hara (Hiroshi Hara + Atelier Phi), creates original inner landscape composed largely of steel and glass. Glass increases the perception of spaciousness and steel looks very solid and gives a feeling of safety. Thanks to its glass, the interior space appears transparent and light. The lattice structure gently rises over the lobby and descends along the cascades of stairs. Large structural elements of steel and glass have a lower visual weight and at the same time look attractive. The materials contrast not only in terms of their weight and the transparency, but also in terms of their colours (Fig. 6). Steel-glass combinations are often used for the qualities of transparency and lightness when architect wishes to diminish the impact of a building on the surrounding landscape. The Kanazawa 21st Century Museum of Contemporary Art (*Kanazawa 21 seiki bijutsukan*, 2004), designed by Kazuyo Sejima and Ryūe Nishizawa, is an example of a building that connects with its surrounding thanks to the steel-glass curtais walls built along the delicate circular layout (Fig. 7).

Fig. 7 Kanazawa – Kanazawa 21st Century Museum of Contemporary Art, 2004

Fig. 8 Osaka – Osaka National Museum, 2004

Large steel-glass objects appear to be perceived visually lighter not only because of the use of glass, but also thanks to the use of a suitable architectural form. The specific coordination of glass and steel also influences the expression of form. Sometimes a dramatic expression is the basis of the design concept. An example of a dynamic building form obtained through the use of steel-glass structures is one of the museums in Osaka, the Osaka National Museum of Art (*Kokuritsu kokusai bijutsukan*, 2004), designed by Cesar Pelli (Pelli

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Clarke, Pelli Architects). Reflecting the surrounding landscape, the architect created an exposed structure that looks like it is gently waving in the wind (Fig. 8). Glass fulfills an aesthetic function because it lends a structure lightness and texture, and is also useful because it admits daylight.

3.2 Steel-glass combinations in relation to texture, reflection, colour and light

Plain glass may have a smooth texture, but the surfaces of trusses, consisting of large number of elements, as in the case of the National Museum of Art in Osaka, can be perceived as having a texture. Basically, the texture may be attributed to modern technology. Printed laminated glass can be also viewed as a material with a texture. Examples of buildings with sublime elevations made of laminated glass include: "Dior Omotesando" (*Diōru Omotesandō*, 2003, Fig. 9), designed by the architectural duo Kazuyo Sejima and Ryue Nishizawa (SANAA, Sejima and Nishizawa and Associates) and "Christian Dior Ginza" (*Kurisuchan Diōru Ginza*), designed by the Spanish architect Ricardo Bofill (Ricardo Bofill Taller de Arquitectura, 2004), which has a façade modelled by the Japanese architect Kumiko Inui (Kumiko Inui Architects) [10]. The building is wrapped in the transparent glass walls set in front of a translucent wavy acrylic screen sandwiched between horizontal white steel bands at unequal heights. The facade of "Dior Omotesando", made of laminated glass, is partly transparent but opaque for the most part, harmonizing with Omotesandō Boulevard. In the evening it looks like a luxurious lantern.

Interesting effects of laminated glass within various planes, influencing the textures and colours, were used at the Dior and Louis Vuitton shops in Nagoya, Tokyo and Osaka. Nagoya's Dior shop is adjacent to the Louis Vuitton store. The Dior façade was designed by Kumiko Inui. The authors of the LV Nagoya Midland Square (*Middorando sukuea*) are Carbondale Louis Vuitton Mattelier, H&M and Nagaishi Architecture. The facade to Nagoya Midland Square, expressing the company logo and completed in 2007, has large steel-glass curtain walls in opaque laminated glass (Fig. 10).

Fig. 9 Tokyo – Dior Omotesando, 2003

Fig. 10 Nagoya – Nagoya Midland Square, 2007

Japanese architect Jun Aoki (Jun Aoki & Associates) has designed several masterpieces involving curtain walls with special effects, particularly for Louis Vuitton. Printed glass, which creates the impression of texture, was used at „Louis Vuitton Nagoya Sakae" (*Rui Vuiton Nagoya Sakae*, 1999), „Louis Vuitton Omotesando" in Tokyo (*Rui Vuiton Omotesandō*, 2002), „Louis Vuitton Ginza Namiki" in Tokyo (*Rui Vuiton Ginza Namiki*, 2004), „Louis Vuitton Fukuoka Tenjin" (*Rui Vuiton Fukuoka Tenjin*, 2011) and at the „Louis Vuitton" store at the "Matsuya department store" at Ginza. At the boutique in Nagoya, the

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exterior walls are made of double layers of glass, each of which has Vuitton's famous check pattern, which gives the wall an interesting three-dimensional depth (Fig. 11) [2]. The entrance and display windows exploit the 1.1 m depth of the double curtain wall. At the "Louis Vuitton" boutique in the "Matsuya" department store, Jun Aoki designed a new façade in 2013. The interior design was carried out by Peter Marino (Peter Marino Architect PLLC). The inspiration for the façade came from traditional geometrical motif of the *Edo-komon*, the Art Deco architecture popular in Ginza, and also from the monogram of "Louis Vuitton Damier". The theme curtain wall contrasts with undulating glass that accentuates the entrance and display windows (Fig. 12). The shop windows have screens installed as the background (Fig. 13). After sunset, built-in lighting illuminates the edges of the "Damier" theme made of aluminum. During the remodeling of the shop, the elevation was expanded to the eighth floor to give the impression that it is a separate building. In fact, it is a fragment the "Matsuya Ginza" department store, which was originally built in 1925, renovated in 2002 and then again in 2013 (Fig. 14). A curtain wall with laminated glass on steel structure has a white background and texture of dots. Designed by Kenya Hara (Hara Design Institute), it reflects the modern "brand design" that promotes fashion and style [12]. The glass façade with an attractive graphical pattern is illuminated by constantly changing LED lights. Colourful stripes give the impression of a texture on the white façade (Fig. 15).

Fig. 11 Nagoya – Louis Vuitton Nagoya Sakae, 1999

Fig. 12 Tokyo – Louis Vuitton, 2013

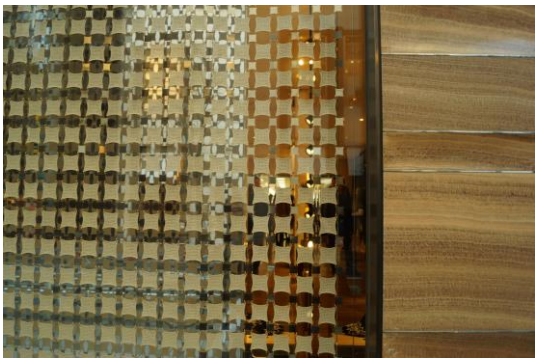

Fig. 13 Louis Vuitton – window detail

Fig. 14 Tokyo – Matsuya Ginza, 2013

In Ginza there are also many other buildings with steel-and-glass façades that create a luxurious streetscape typical for that part of Tokyo. Located in front of "Vuitton" is the "Chanel Ginza" boutique (*Shaneru Ginza*, 2004). Designed by the American architect Peter Marino (Peter Marino Architect), it has a black glass-and-steel "Chanel" façade of laminated smart glass. Behind the grey glass layer is a layer of light-emitting smart material – a switchable electro-optic system (PRIVA-LITE), which is composed of laminated glass panels

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arranged on rails and provided with double rows of LEDs [2]. The façade set for the day option has a transparent background and is reflects the elevations of other buildings (Fig. 16). At dusk it displays still images and video presentations. The glass façade is perceived as a large screen visible from the street (Fig. 17).

Fig. 15 Matsuya Ginza – detail of the curtain wall

Fig. 16 Tokyo – Chanel Ginza, 2004

Fig. 17 Chanel Ginza – at night

The matter of reflections in glass has been explored on the 12-storey “Kirarito Ginza” (*Kirarito* Ginza, 2014), designed by Jun Mitsui (Jun Mitsui & Associates). The building has a steel structure (although parts are in reinforced concrete) and features not only the large rooftop garden, atriums and other spatial settings expanding the limited space along with potted plants throughout the interior in order to provide public squares and greenery that the area previously lacked, but it has also an interesting façade with brilliant cut diamonds as its motif. The exterior of the standard floors has a steel-glass curtain wall in a folding screen style that is segmented and structured with consideration for the angles so that the view from inside allows both urban lines to be enjoyed at once (Fig. 18). The wall is designed to change its appearance as it reflects the sunlight at different times of the day (Fig. 19). It also contributes to the creation of additional visual value of the street front along the Chūō-dōri.

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Fig. 18 Tokyo – Kirarito Ginza, 2014

Fig. 19 Kirarito Ginza – reflections

Another example of how reflections can provide visual richness can be observed at the new building for "Tokyu Plaza Ginza" (*Tōkyū Puraza Ginza*, 2016). The 13-storey building was designed by Nikken Sekkei for high-quality fashion and various other goods. Its distinguished feature is a rooftop garden that provides new resting place and great view over Ginza. The exterior resembles *Edo kiriko*, a type of coloured cut glass that Tokyo has been known for. The "*Edo kiriko*" motif, which is the traditional craft of Japan born out of the combination of the glass technology of the Edo Period (1603-1868) and the Western-cut technology, has been adopted for the building to become a symbol of the fusion of "tradition" and "innovation" (Fig. 20). The expressive steel-glass elevation reflects this architectural concept. Glass installed at various angles in steel frames not only ensures reflections that increase the visual richness of the façade, but also changing colours. An interesting spatial façade steel structure can be admired from inside (Fig. 21). The visual qualities of reflection and colour can be also observed at the Ao Building (*Ao biru*, 2009) in the Tokyo district of Aoyama. A commercial building designed by Nihon Sekkei and Naoki Ījima (interiors), it consists of several parts of various heights and a garden on the top. The façades are covered by glass plates with differing degrees of transparency which reflect the shapes of the nearby buildings (Fig. 22). The glass has a bluish tint and is illuminated at dusk. The illumination designed by Masanobu Takeishi won the "International Illumination Design Award". A multi-member façade looks as if it covered by mosaic; it can be perceived differently in various light and weather conditions. Owing to its visual richness, the building has become a significant urban landmark.

Fig. 20 Tokyo – Tokyu Plaza Ginza, 2016

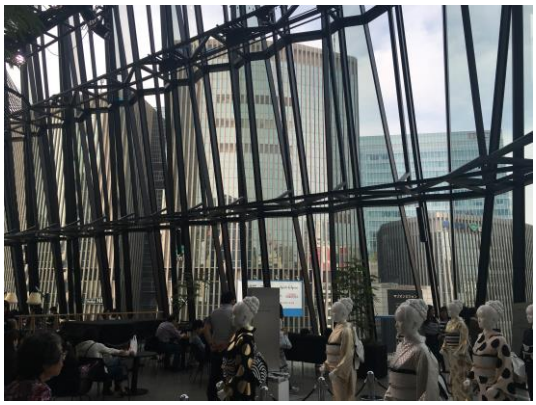

Fig. 21 Tokyu Plaza Ginza – detail

Our perception of colour depends on the surrounding, the colour of the glass itself and the conditions in which we perceive the object. Daylight, lighting, illumination, layers of glass, visual screenings and "3D projection mapping illumination" have an important impact on our

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perception of architectural objects. During the day, ordinary clear glass appears in shades of gray and green. Watching the landscape from the inside of the "Hidamari" pyramid in "Moeneruma Park" (*Moerenuma kōen*, 2005) in Sapporo, the glass wall seems "to borrow" the colour of its surroundings and becomes greenish grey (Fig. 23). The park was designed by sculptor Osamu Noguchi, who realized his idea of "a park, as the finished sculpture" [2]. The location and projection of buildings have an influence on our perception of the colour of the glass. Hitachi Station (*Hitachi-eki*, 2011) has a 139 m connecting corridor designed by Kazuyo Sejima and JR East Architects, Co. Ltd. [13]. The façade to the corridor, which is raised 8 m above the ground, is clad in 550 panes of glass. The idea of the corridor is to make one station on the both sides of the railway line. The corridor, which leads out towards the ocean, looks like a glass box floating above the water (Fig. 24). Thanks to the steel-glass façade, the link has become very delicate, providing not only functional fusion, but also connecting architecture with the landscape [14]. The glass curtain walls are completely transparent and together with the surrounding landscape provide an endless open space involving the ocean and the railway line. Owing to the scenic qualities of this project, "Hitachi Station and Free-Corridor" was awarded the "Good Design Award" in 2012.

Fig. 22 Tokyo – Ao Building, 2009

Fig. 23 Sapporo – Hidamari, 2005

Fig. 24 Hitachi – Hitachi Station and Free-Corridor, 2011

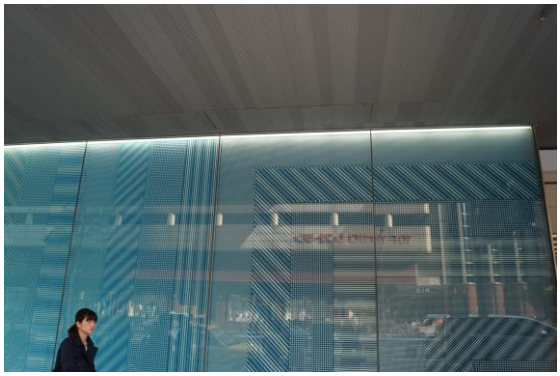

Fig. 25 Osaka – JR Osaka Abenobashi Station, 2010

The colour of the glass can be acquired during the production process through painting or printing. At Osaka Abenobashi Station (*Ōsaka Abenobashi-eki*, 2010) on the Kintetsu Line in Osaka there are walls made of laminated printed glass (Fig. 25). Such glass not only has informative function, but is also artistic. Transparent glass can also look colourful thanks to the background colour. In the entrance hall of JR Hakata City (*JR Hakata shiti*, 2011) the

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columns are located in steel-glass boxes made from transparent glass, through which locally made tiles in white and blue can be seen (Fig. 26).

Fig. 26 Fukuoka – JR Hakata City, 2011

The surrounding landscape gains when the glass facades have more sophisticated designs and interesting colours. Coloured steel-glass walls look different in daylight and at dusk, when they transmit the light from the inside, or when they are illuminated. Whereas a steel structure looks light and almost invisible, colours give a building a more vibrant appearance. A new building at JR Nara Station (*JR Nara-eki*, 2010) has coloured glass façade. During the day the curtain wall composed of vertical elements sparkles with all the colours of the rainbow (Fig. 27). At dusk the wall is illuminated and makes more subdued impression. The coloured glass contrasts well with the wooden interior finishes (Fig. 28).

Fig. 27 Nara – JR Nara Station, 2010 – in daylight

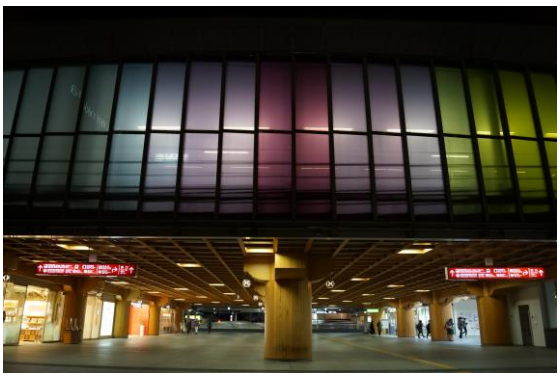

Fig. 28 JR Nara Station – at night

3.3 Steel-glass combination in relation to the perception of form and the translucency of glass

The perception of the form of a building or structure depends on the type of glass, colour and other attributes. The most important of those is translucency. Glass may offer different degrees of "visibility" of a building – from a distinct form in the landscape to one that blends in completely with its surroundings. A glass structure designed by Kazuyo Sejima as a part of the "Inujima Art House Project" (*Inujima ie purojekuto*, 2010) on the island of Inujima in Okayama prefecture has the quality of blending in with the landscape. Sejima designed new facilities and redeveloped old buildings to provide new public space. "S-Art House" (*S-tei*), which is made of completely transparent glass, is used as a venue for artistic installations (e.g. optical glass) that change with the seasons (Fig. 29). The building – from one side "visible",

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from the other “invisible” – enriches the surrounding landscape with its simple and robust form (Fig. 30).

Fig. 29 Inujima – S-Art House, 2010

Fig. 30 S-Art House – art seen through glass

Likewise, a completely transparent façade has also another building on the island of the Inujima – the Inujima Seirensho Art Museum (*Inujima Seirensho Bijutsukan*, 2008), designed on the site of a former copper mine by Hiroshi Sambuichi (Sambuichi Architects). Architecture using transparent glass combines the legacy of industrial Japan with the achievements of modern techniques and technology (Fig. 31) [15]. Such architecture appears to be very distinctive and expressive. No other material allows the presentation on multiple planes as well as translucent glass. While objects made of transparent glass connects architecture visually with its surrounding, buildings made of non-transparent glass are clearly distinguished from the landscape. A part of the mausoleum of the “Nagasaki National Peace Memorial Hall for the Atomic Bomb Victims” (*Kokuritsu Nagasaki Hiroshima peace memorial shibotsusha tsuitō heiwa kinenkan*, 2002), designed by Akira Kuryū (Akira Kuryu Architect & Associates), has its main part – the Hall of Remembrance – made of plain glass (Fig. 32). It is very well visible against the background of the water and greenery. The use of glass allows for both – absorption of the building in the landscape and its visual expression.

Fig. 31 Inujima – Inujima Seirensho Art Museum, 2008

Fig. 32 Nagasaki – Nagasaki National Peace Memorial Hall for the Atomic Bomb Victims, 2002

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3.4 Glass in context – sense of place

The examples of the projects on the Inujima Island are also related to the concept of place. “Sense of place” refers to the particular location, its characteristics, history, heritage, physical setting, landscape and meaning. The mausoleum in Nagasaki is an example of where the simplicity of form and material has symbolic overtones. Here, no other material could be simpler and more expressive, at the same time, than glass – reflecting the enormity of human suffering.

On the other hand, the example of Hitachi Station shows the visual property of steel and glass in use which harmonizes with the environment and blends in completely with the landscape. The technique of “borrowed scenery” (*shakkei*) which has been used in traditional Japanese gardens, has also been used in modern architecture. *Shakkei* means incorporating a background into the garden and the very close reflection of nature according to natural topography and local characteristics.

Glass is therefore a material that can be used according to the design concept for a certain place. Together with steel, it forms a structure that may refer to the meaning of the building or its surrounding. The building designed by Kengō Kuma and Research Institute of Architecture (RIA – *Āru ai ē*) in Toyama – “Toyama Kirari” (*Toyama Kirari*, 2015) to house the Toyama Glass Art Museum and Toyama City Public Library has its steel curtain wall finished with locally produced materials – glass, granite and aluminum (Fig. 33). The façade made of flat glass and panels arranged at different angles shines to resemble the ice dikes of Tateyama and the beautiful glass art made in Toyama and displayed in the museum (Fig. 34). Aluminum panels act like mirrors reflecting the light of the sun. Another museum, the Pola Museum of Art (*Pōra Bijutsukan*, 2002) designed by Nikken Sekkei, which is located in the Fuji-Hakone-Izu National Park (Kanagawa prefecture), employs glass walls to minimize human intervention in the natural environment. The building is located on a slope and totally adapted to the terrain conditions. The glass entrance leading to a bridge blends in with the natural surrounding (Fig. 35). Steel, which has been used here for the railings and other finishes, has a neutral visual impact. Glass walls allow the light penetrate into the interior on the lower levels.

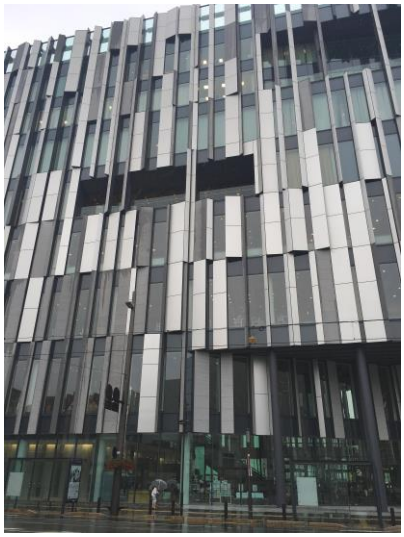

Fig. 33 Toyama – Toyama Kirari, 2015

Fig. 34 Toyama Kirari – arrangement of panels

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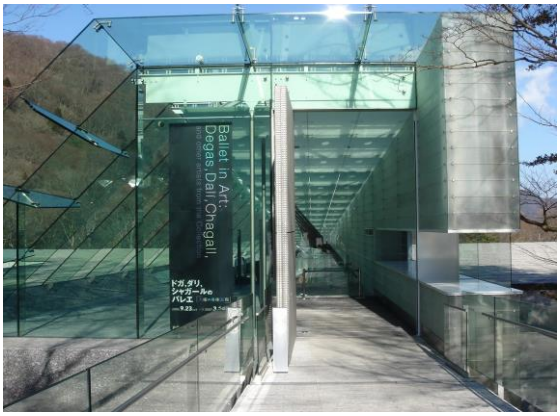

Fig. 35 Kanagawa Pref. – Pola Museum of Art, 2002

Fig. 36 Asahikawa – Asahikawa Station, 2011

The building for Asahikawa Station (*Asahikawa-eki*, 2011) is also a representative example of a landmark steel-glass infrastructure object, showing the trend to conform to the natural environment as much as possible. The building, designed by Hiroshi Naitō (Naito Architects & Associates), is located near the River Chūbetsu-gawa. Its glass façades enable an uninterrupted view of the outside world – the park and adjacent river (Fig. 36). The connection between the station and the river was part of the design concept. The steel-glass curtain wall made such a visual and contextual link possible.

4 Final Remarks

As it has been shown using the example of Japan, today, steel-glass structures are important components in the urban landscape. The attributes of glass in combination with steel have a major influence on our perception of architecture. We can enjoy its spaciousness, visual lightness, variety of texture and colours and different light admittance or reflection features. The expressiveness of glass directly influences an object's values. Depending upon the type of glass, the architectural forms being generated can be exposed or concealed.

Glass enables transparency to be dosed, which considerably affects the aesthetic impression of the construction as well. In addition, the use of glass allows architecture to be localized within the context of its surroundings and to create the "borrowed scenery" that becomes a part of the basic object. Thus, steel-glass architecture relates to the origins of Japanese gardens and architecture. As with traditional buildings, reflective glass enables a view from the inside and limits the visual penetration from the outside. Further, glass brings architecture closer to nature, since it allows the visual borders to disappear.

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