

Redesigning the Physical Boundary: The Emergence of the Glass Age of Museum Architecture from the 1990s

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1. INTRODUCTION

Contemporary museum architecture is seeing an age of glass. Both renovation projects and new constructions have been exploiting glass extensively, as if it is the best solution to serve the spatial functions, present the architects' concepts, and address the institutions' missions and social expectations. Prominent examples include the Louvre Pyramid by I. M. Pei (1989) and SANAA's designs for The 21st Century Museum of Contemporary Art, Kanazawa (2004) and Louvre-Lens, France (2012). This trend of increasing use of glass by museum architecture deviates from the previous model of museums, temples and shrines, with grand staircases and formidable look. A new physical boundary of museums, glass walls with their possibility to mediate visual penetration and similarity with media interfaces that interact with the surrounding and the spectators, is designed in contrast with the older type that stresses the

buildings' exalted status. This kind of extensive glazing has become an almost indispensable part of the new generation of museum architecture.

By contextualizing the phenomenon of extensive glazing in museum architecture, this paper aims to discern its connections with the museum situation and the contemporaneity and locality of Japan. It argues that the increasing exploitation of glass in museum architecture demonstrates the influence of Neoliberalism on the public institutions and the architects to embrace visually appealing, technologically demanding, and commercial elements. It challenges the pre-dominant association of glass with transparency and modernity and argues for a contextualized reading of glass. Previous research in the field of architectural studies focused on glass employment in all types of buildings and overlooked the specific situation of museums; while museum studies

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showed more interest in exterior and space design and neglected the buildings' materiality. This research adopts an interdisciplinary methodology including visual analysis of museum buildings, literature review of policy papers, prior theories and architects' discourse, and site observations.

It starts with perspective clarifications, offering close-up discussions on museums as architecture typology, architecture in the theoretical discourse of museum studies, the definition of museum used in this paper, and the reasons for selecting the timeframe from the 1990s; followed by brief historical accounts of architectural glass and previous

theories elucidating the material's social meanings. Then it moves to the analysis of glass use in museum architecture, with a focus on Japanese examples since the 1990s. This paper contends that the increasing employment of glass in museum buildings in Japan is mainly a result of architects' design preference, which is made possible by technological development and reflects the social climate celebrating Neoliberalism. The extensive glazing reveals the architects' ideal of museums. By redesigning the physical boundaries, the architects and their commissioners aim to establish a less elitist profile for the museum.

2. PRE-REQUISITES FOR DISCUSSIONS

1) Museum as architecture typology

Museums occupy an important position in the architectural world. This can be seen in architecture education and design manuals that assume "museum" as one self-referential type. As Igarashi Taro remarks on architecture education, college students majoring in architecture usually start with designs of private houses followed by art museums, schools, and collective housing (2002, 228). Design manuals, e.g. *Building Type Basics for Museums* in the American Wiley's *Building Type Basics* series (Rosenblatt 2001) and the Japanese *Data Files of Architectural Design & Detail*

(*Kenchiku Sekkei Shiryo*) (Architectural Thought Research Institute 1995) and *Space Design Series* (Space Design Series Editors, 1995), configure museums as a particular "program", or function of building, and highlight issues specific to museums.

Probably because of this long held belief and design practice attempting to conform to architecture typology, unconventional projects pose challenges to architects. Recalling the process of proposing a design for Sendai Mediatheque, a public facility encompassing gallery space, library and information center, Ito Toyo mentioned the

difficulty of creating an unprecedented model and selecting particular techniques to accommodate the various functions (Sendai Mediatheque Project Team 2003, 21) . The

2) Architecture in Museum Studies

Architecture can be seen as the largest piece in the collection of a museum that reflects the institute's identity. It has been an integral part in the discourse of museum studies to analyze exterior and spatial designs, visitor behavior and social impact. Tony Bennett and Margaret Lindauer are two prominent scholars who pay attention to museum architecture. Bennett develops his argument over museums' disciplinary power based on Michel Foucault's celebrated theory of Panopticon architecture (1995) . Inspired by Foucault's *Discipline and Punish: The Birth of the Prison* (1977) , Bennett ascertains that museums in the nineteenth century functioned as a governing apparatus similar to asylums, clinics, and prisons, in which the visitors' behavior was disciplined from above and by mutual gazes (1995; Crimp 1993, 44-65) . Margaret Lindauer lists architecture as the first check item for a "critical museum visitor" to examine

3) Definition of museum in this paper

This paper follows the definition of museums given by the International Council of Museums (ICOM) and focuses on those

bi-lateral influence between the changing museum and architecture spheres will continue to be a focal point of discussions in this paper.

(2006, 203-25) . Lindauer suggests museum literacy include scrutiny over the museums exterior resemblance with other institutions and visitor experience precipitated by the architecture.

Architectural theories have also been increasingly borrowed to understand museum space. Bill Hillier and Kali Tzortzi's *Space Syntax: The Language of Museum Space* (2006) and Koike Shihoko and Nakagawa Osamu's research on the inner spatial design of public art museums in Japan (2011a&b) are examples that try to comprehend museums' inner space by employing Space Syntax, a set of theories for analyzing spatial configurations. These previous studies shed light on the possibility to apprehend museums from the perspective of architecture. However a dearth of works focusing on the material of museum buildings can also be identified and this paper aims to fill this gap.

with physical space. It does not distinguish museums of various types. A burgeoning literature has pointed out the fluidity and

multi-layeredness of the concept of museum (Hooper-Greenhill 1992, 1-2; Murata 2014, 24-25) . To smooth the following discussions on architectural glass in museum buildings, this paper adopts the ICOM' s definition of museums:

“non-profit, permanent institution (s) in the service of society and its development, open to the public, which acquires, conserves,

4) Reasons for the timeframe from 1990s

The timeframe of the research is targeted on the 1990s to the present for three main reasons, from the perspectives of cultural policies, museum administration and architecture. As a first reason, the 1990s and 2000s has witnessed museum transformation under the changing policies of governments. Prominent examples include Thatcher's and Reagan's policies; and in the Japanese context, the *Act on General Rules for Incorporated Administrative Agency* (*Dokuritsu gyousei hojinho*; abbreviated as IAA Act) promulgated in 2001 and the *Designated Administrator System* (*Shitei kanrisha seido*; abbreviated as DA System) were introduced in 2003.

IAA Act was introduced as a part of The Basic Law on the Administrative Reform of the Central Government (*Chuoshochoto kaikaku kihonho*) in 2001 (E-government, Japan 2011) . The central government reform was born in the late 1990s climate of

researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment” (2007) .

This definition, acknowledging the diversity of museum activity and purpose, serves well as the premise of the discussions in this paper.

economic recession and a pressing need to re-evaluate the efficiency of government performance in the country (Kato et al. 2001, 16-17; MIC 2007) . Abiding by the IAA Act, national museums and research institutions were re-organized as Incorporated Administrative Agencies and granted a new identity between public and private sectors. The reform aims at not only improving the institutions' administrative efficiency and downsizing the central government to a smaller one (*chiisanaseifu*) , but also at attracting funding from outside the government (Kato et al. 2006, 16-17) .

DA System also reveals a hands-off approach of the government but on a more local level. Introduced as a part of the Local Autonomy Law (*Chiho jichiho*) in 2003, this system establishes a new administration model of public institutions including cultural facilities such as cultural halls, theatres, and

museums. Taking a further step from the 1991 Usage Fee System (*Riyoryoukin seido*) which allows the so called “third sector” , or a mix of public and private funders/administrators, to take a portion from the institutional revenues, the DA System allows the appointed organizations including private foundations or companies to carry out a managerial role for a designated period of time (Katayama 2007, 1-29) .

Largely as a response to the changing policies, and as a second reason, museum administration has undergone commercialization under the influence of Neoliberalism and the worldwide-celebrated doctrines of Thomas Krens, director of the Guggenheims between 1998 and 2008. The commercialization scheme, fueled by public budget cuts, involves commoditization of culture and arts, branding of museums, and stronger connection between museums and regional revitalizations agendas. In Japan, the oldest public museum, The Tokyo National Museum, opened the first museum shop in the country in 1990 and many other museums have followed suit.

A final reason lies in the change of museum architecture. This paper regards the 1990s as the starting time of the new museum architecture paradigm (see Appendix) . These museums with extensive glass exteriors and simplistic forms, such as Kirchner Museum in Davos, Switzerland (1992) and Kumanokodo Nakahechi Museum (1998) , mark a paradigm shift of museum architecture. They deviate from the three generations of museums articulated by Isozaki Arata: the First Generation as power institution embodying nationalist ideology, the Second Generation as universal space flexible and abstract, and the Third Generation as site specific with unique characteristics (1996, 39-43) . Arguably, a Fourth Generation started to appear from the 1990s with extensive glazing and simplistic form, which will be elaborated later. It falls on the extension line of the Second and Third Generations but distinguishes itself in its visual humbleness and resemblance to everyday facilities (Fig. 1) .

	Emergence Time	Ideology	Feature	Model	Example
First Generation	Late 18th Century	Nationalism	Monumental, with Neoclassical decoration and grand staircases	Shrine, temple	The Louvre
Second Generation	Early 20th Century	Modernism as critique of academism	Abstract and flexible, with universal space (white-cube gallery)	Box, <i>Dom-ino</i> System (Le Corbusier)	Museum of Modern Art, New York (1939)
Third Generation	1960s	Post-Modernism as critique of Modernism	Site-specific, sculptural, interaction between art displays and architecture	Disneyland	Guggenheim Museum Bilbao (1997)
Fourth Generation (Glass Age)	Mid-1990s	Late Post-Modernism, declining Post-Modernism	Simple geometric form with extensive glazing, adjacent to the street	Convenience store, shopping mall	Sendai Mediatheque (2001)

Figure 1. Four Generations of Museum Architecture (Developed based on Arata Isozaki, 『美術館』, 『造物主義論—デミウルゴモルフィスム』, 東京: 鹿島出版会, 1996, 39-59; *a+u*, 『チャールズ・ジェンクス: 象徴的建築をめざして』, Jan. 1986, 212-13.)

3. HISTORY AND MEANING OF ARCHITECTURAL GLASS

1) Brief history of architectural glass in the world

The historical development of architectural glass in the world can be roughly divided into five periods: the Gothic Age (twentieth-sixteenth century), the Industrial Age (mid-nineteenth century-WWI), the Modern Age (1920s-1960s), the Postmodern Age (1960s-1980s), and the Late Postmodern Age (1990s-present). The respective paradigms are the Gothic churches; shop windows and ferrovitreous

buildings such as palm houses, arcades and railway stations; curtain wall (non-load-bearing outer membrane made of glass) office buildings; iconic landmarks of major cities; and serene glass buildings. In each age, glass takes on different meanings and serves the ethos of the respective times. The focus of this paper, the Fourth Generation museum, falls into the category of the serene glass buildings of the Late Postmodern Age.

2) Brief history of architectural glass in Japan

Architectural glass shares a similar trajectory of development with the local museums in Japan: they both began with importation and later interacted with the indigenous context. The earliest glazing for houses in Japan is perhaps for the residence of Date Tsunamune (1640-1711), the third feudal lord of Sendai clan, in Shinagawa, Tokyo. It is said that more than 400 pieces of flat glass were imported as windowpanes for this Japanese timber structure (Aqura 2015). The Meiji Era (1868-1912) unveiled the age of bulk imports of glass to fulfill the government's ambition to build Western-

style architecture at home. Also possibly because of the large openings of Japanese traditional houses, *engawa* veranda places, the glass industry soon found a large market in Japan. Today the prevalence of curtain wall structures, best represented by the arrays of official buildings in Marunouchi and boutique stores in Ginza and Omotesando, Tokyo, reveals the contemporary popularity of glass architecture in Japan (Kido and Cywinski 2013, 229-37). Two Japanese companies, Asahi Glass and Nippon Sheet Glass, are among the largest glass companies in the world.

3) Meanings of architectural glass

Glass buildings have diverse social roots and implications, among which strong

connections with technology development and commercial experience are noteworthy.

Influence from material and building technology has been persistent in the development of glass architecture. Gothic churches were sustained by a newly matured structure composed of stone frames, flying buttresses and vaults that made possible large openings for stained glass and sacred light (Wigginton 1996, 14-15) . Epitomizing the Industrial Glass Building, the Crystal Palace designed by Joseph Paxton at the first Great Exhibition in London in 1851, was not just for the industrial machines and art displays contained inside; it was also an excellent demonstration of the most updated materials, the possibility of artificial rendering of daylight, and more importantly, as the earliest prefabricated construction, the rationality underpinning the making process (Ibid., 3-35; Hix 1974, 105-09) . Technological development also prepared the way for the prevalence of curtain wall glass architecture. Since the 1950s, with the wide availability of steel-and-concrete structures that free the walls and mass productivity of flat and transparent glass, curtain wall architecture and skyscrapers sprung up around the world. As Yamamoto Gakuji argues, the presence of architectural glass along with concrete and steel witnessed to the great potential of artificial rendering of natural materials and continuous scientific pursuit for modern life and space (1966, 162-3) .

Glass architecture has also been strongly associated with creation of commercial life. Contextualizing the industrial glass buildings in nineteenth-century European society, Walter Benjamin and Wolfgang Schivelbusch provide illuminating interpretations of glass architecture. By examining the Parisian arcades in Paris, Benjamin's *Passagen Werk* found the city-like arcades incubating consumer culture and modern metropolitan life that embody both errors and utopian dreams of the bourgeoisie (Benjamin 1999; Buck-Morss 1990, 39) . Echoing Benjamin's finding and investigating the Crystal Palace and glass architecture of all types in the nineteenth century, Schivelbusch stresses that the introduction of glass into architecture and invention of artificial light led to a re-organized sensibility of space (Schivelbusch 1986, 45-51; 1988, 138-54) . The new sensibility dissolved the customary contrasts between the inside and the outside, light and shadow, and reality and fantasy. In particular, shop windows with overflowing light during night create spatial ambiguity and illusionary affordability, instigate desire in the spectators, and symbolize the beginning of consumer culture. The two features, connections with technological development and commercial experience, will remain as the focus in the discussions about glass employment in museum architecture.

4. ARCHITECTURAL GLASS IN MUSEUMS

1) Before the 1990s

Foregrounding the previous discussions on development of architectural glass, glass in museum architecture takes on particular meanings in the museum context. Since the early nineteenth century, introducing skylight from glazed ceilings has been established as an integral part of art galleries (Suzuki 2001, 83) . Two early museums, Krøller Müller Museum, Otterlo (1954) and Louisiana Museum of Modern Art, Copenhagen (1958) show more extensive use of glass to incorporate picture windows and harmonize with their natural environment (Persner 1974=2014, 252-3) .

More radical employment of glass however can be seen in the Museum of Modern Art in New York (MoMA) (1939) and Center Pompidou in Paris (1977) that depict the institutions' visions to use architecture and glass elements to build up distinguishing visual identities. The original MoMA building designed by Edward Stone and Philip Goodwin in 1939 adopted a curtain wall structure, which was not yet prevalent at the

time, and translucent glass for its façade. The glass surface lent the building a modern appearance in stark contrast to the brownstone townhouses in the neighbourhood. This visual appearance manifests the concept of "modernity" that underpins the institution (Murray 2013, 40-49) . When built, Center Pompidou designed by Renzo Piano and Richard Rogers, with its superstructure composed of steel lattice, exterior escalators, and glassy walls, looked totally alien in its stony environment. The large area of glass overspreading the building not only serves as a blank canvas to set off the steel skeleton and colored parts, such as blue for circulating air, yellow for circulating electricity and red for circulating people, but also completes the institution's machine-like look and expresses its futuristic vision. Glass assists with the two museums' visual statements, one upholding modernity and one looking towards the future to set themselves apart with the conventional images of museums when they were built.

2) Emergence of the Fourth Generation Museum after the 1990s

A parade of museum architecture, arguably the Fourth Generation, adopting extensive glazing and simplistic forms, started to surface in the 1990s and became fully fledged

after 2000. These buildings tend to restrain from making strong statements and show less visual distinction from commercial building types. This long list includes

Kirchner Museum in Davos, Switzerland designed by Annette Gigon and Mike Guyer in 1992, Kunsthaus Bregenz, Austria by Peter Zumthor in 1997, Sendai Mediatheque by Ito Toyo in 2001, and the art museum oeuvre of SANAA.

In the global museum scene, rather than replacing the former three generations, the Fourth Generation is produced along with the other three that have not yet lost their validity and appeal. The museums of the Glass Age deviate from the tradition in their distinguishing agenda, to be closer to daily life by incorporating commercially well-adopted language. At first glance, their appearance seems to bear resemblance with the Second Generation modernist box-like museums. It is however apparent that the Second and the Fourth were born in entirely different contexts. The Second Generation museums, e.g. the 1939 MoMA and Center Pompidou, echoing the anti-institutional art movements instigated by Dadaism emerging in the mid-1910s, decries the monumental and palace-like First Generation museums. Their functionalist spatial design and white-

cube galleries provide neutral backgrounds for the displays, aim to create the best spectator experience with minimal distraction, and advocate rationality and order. The Fourth Generation, receiving inspiration from the spectacular Third Generation epitomized by The Guggenheim Museum Bilbao designed by Frank Gehry and opened in 1997, seems to return to Modernism in its form but with attempts to reappraise and formalize the commercial elements. To put it in other words, the Second Generation was born as a denunciation of the exalted palace-like First Generation Museum while the Fourth inherits the capitalism-oriented Third Generation but with less interest in interrogation of Modernism and visual spectacularity. If the Third Generation looks up to Disneyland and Postmodern playfulness, the Fourth, or declining Postmodernism, seeks references from both Modernist simplicity and everyday facilities such as convenience stores and shopping malls.

3) Relation between the Fourth Generation Museum and glass architecture

A closer inspection at glass leads to a clearer understanding of how the Fourth Generation museum shares the features of glass architecture in terms of its close relation with technological development and

creation of commercial life. As previously discussed, museums occupy an important position in the architectural world. An ambition to use or stimulate the invention of new technology and materials has often

accompanied the design process of museums. Sharing the architectural manifestation of the Crystal Palace, MoMA, and Center Pompidou to exploit the most updated building and material technology at the time, recent museum projects also show their vibrancy to stimulate industries to develop new materials and building methodology.

The most prominent example is Sendai Mediatheque designed by Ito Toyo and opened in 2001. This shelf-like building, composed of slabs (floors), vertical steel lattice columns, and glass façades, takes one more step forward than Le Corbusier's *Domino* House System. By utilizing ship building technology, the design not only frees the walls of buildings and turns them into a "skin" but also replaces the structural columns with seaweed-like tubes that accommodate staircases, elevators, and light shafts (Ito 1997, 9). The double-glazed façade allowing visual penetration from the outside completes an aquarium-like cube that showcases the activities and physical structure inside and blurs the boundary between the outside and the inside. The building becomes an embodiment of the institution's barrier-free image, Ito's "blurring architecture" concept, and possibility of technology to achieve the two.

In addition to the continuous exploitation of technology similar to glass architecture in history, the Glass Age museum architecture

also ties closely with commercial space. If the nineteenth-century shop windows and arcades created a new space and sensation of consumption, the Fourth Generation museum architecture consciously incorporates the language of commercial space. While the Second Generation museums correspond with Modernist buildings in which architectural glass often stresses order and creates cage-like space and the Third celebrates early Postmodern lightheartedness with glass mainly playing a subsidiary role in shaping the exterior, the Glass Age museums return to visual serenity and formalize the commercial space as an integral part of museum experience.

The glass space, often not for display of art but accommodating amenities such as atriums, shops, cafes, and restaurants, quotes the language of shop windows and arcades. Evidence can be first seen in the recent projects at two prominent museums, the Louvre and The British Museum. With its famous skylight, Carrousel du Louvre, a shopping mall opened in the Richelieu Wing of the Louvre in 1993, shows remarkable reminiscence of arcades. It provides one of the entrances to the Louvre and echoes architect I. M. Pei's positive attitude towards the mixture of "art, culture and commerce" (Sancton 1993, 59; cited by McTavis 1998, 175). The Great Court of The British Museum designed by Foster and

Partners and opened in 2000 is another strong example. This extended space offers a glazed canopy for the entrance hall and shops. It resembles a railway terminal where visitors separate and embark on their own journeys to different galleries. The naturally lit-up and glassy space, conforming to the tradition of mass culture consumption space, expresses the two museums' vision to enhance their accessibility and promote a less elitist profile by embracing low or non-art.

Examples can be further found in Japan with both coherences with the two fore-mentioned renovation projects and distinguishing features. In the case of the National Art Center, Tokyo, designed by Kurokawa Kisho and opened in 2007, there is similarity in its spatial design with the former two examples. The gallery space is set back from the undulating glass façade and retains a character of universality of white-cube galleries. The atrium accommodates shops, cafes and restaurants on each floor. During the day, the natural light coming in from the glass façade lends a sense of temporariness to the commercial space. During night, the building glows and becomes a lantern. One of its restaurants, Paulbocuse, on the third floor, stays open

after the Museum closes. The glass space offers a choice of consumption in addition to art appreciation as the conventional experience of a museum.

The 21st Century Museum of Contemporary Art, Kanazawa (abbreviated as Kanazawa 21) designed by SANAA and opened in 2004 is the epitome of the Glass Age museum architecture. It is different from the former examples with its democratic and empowering inner spatial design. Inside its extensive and clean glazing, discrete exhibition halls and un-ticketed areas are allocated. Along with multiple entrances connecting with the main streets and the park, Kanazawa 21 allows choices and encourages visits. It looks both like a spaceship floating in the old townscape of Kanazawa and a convenience store with immediate physical and visual accessibility. While the National Art Center, Tokyo separates the consumer space and gallery for art appreciation, with the former allocated to a glassy area and the latter to more artificially controlled boxes, Kanazawa 21 intermingles the two. It proposes a new kind of museum experience with intermittent encountering of glass areas, non-art-display space, surrounding of the building, and closer to everyday life.

5. AESTHETICS AND DESIGN CONCEPTS OF ARCHITECTS AS THE MAIN REASON FOR THE EMERGENCE OF THE GLASS AGE OF MUSEUM ARCHITECTURE

Architects, especially those heavily exposed to media and award-winning architects, are often commissioned by governmental officials or private foundations to build museums. The aesthetics and concepts of architects play a strong role in promoting the Glass Age museums, which is often neglected in the discourse of Neoliberalism.

The discussion among architects about the employment of glass can be traced back to the Modern Age when glass had been mainly associated with “transparency” - simultaneous perception of different spaces. In Colin Rowe and Robert Slutzky’s celebrated theory, glass embodies two kinds of transparency, the literal and the phenomenal, with the former existential and the latter involving imagination (1963) . Based on Rowe and Slutzky’s argument, Cesar Pelli puts forward a more complicated reading requiring both the eye and the mind to understand both space and time, the co-presence of reflections, the glass itself, the inside, and things further behind the building (1976) . Many museums of the Second Generation are endowed with the concept of “transparency” and incorporate glass to create diverse optical effects and spatial orders.

More recently, especially in the case of the Fourth Generation museums, the fervent passion for transparency seems to be replaced by an emphasis on nature and temporality. Contemporary architects have rediscovered the ambiguity and plurality of the meaning of architectural glass (Hasegawa and Kurokawa 1977; Yagi 2001, 42-106) . The concept of “architectural phenomenology” demonstrates a new kind of utilization of glass to interact with natural light and create a sense of passing of time. One of the best examples is the translucent glass façade of Kunsthaus Bregenz, Austria designed by Peter Zumthor. Along with the building’s simplistic form, it coheres with Zumthor’s concept of phenomenology and the material glass lends atmosphere and ephemerality to the building (Zumthor 2006) .

Japanese architects with their popularity at home and abroad are also important designers of the Fourth Generation museums. A glance at their discourse leads to an understanding of their ideal image towards architecture, humble and submissive, e.g. “blurring” and “permeable” by Ito, “weak” by Fujimoto So, and “erasing” and “defeated” by Kuma Kengo in the early 2000s. In the case of the Glass Pavilion

of Toledo Museum of Art designed by SANAA and opened in 2006, the low and flat building almost entirely covered by clear glass is a solution not only paying tribute to the glass making history of Toledo but also addressing the neo-classical 1912 main building of the Museum and Gehry's 1992 Center for the Visual Arts. A similar approach can be seen in SANAA's Kumanokodo Nakahechi Museum (1998), Kanazawa 21, and the winning proposal for the New South Wales Art Gallery expansion, Sydney (2015). Their signature, extensive glazing, blurs the boundary between the inside and the outside; low, flat and simple shape minimalizes the buildings' presence, creating gradational space and respect to the genius loci rather than sheer intrusions (Editorial Department of SD 1999, 102-07; *GA JAPAN* 2015, 168).

However, the preference of the architects is not always economical. After the Great East Japan Earthquake on March 11 2011, energy and architectural sustainability has become an increasingly pressing issue within Japan and has gained attention. Towada Art Center designed by Nishizawa Ryue, is criticized by Mae Masayuki and Dana Buntrock (2015). It courts controversies for the building's high maintenance cost partly due to the low insulation and energy performance of the extensive glazing and the institution's heavy budgetary reliance on

"Power Generation Regional Plan Subsidy-related Grants", money collected from nuclear waste recycling and treatment in Aomori Prefecture. The sustainability issue and suitability of all-glass spaces for art display continues to be a heated topic of debate in both the architecture and museum worlds. Pressured to shrink their budgets, museums are expected to balance aesthetic consideration and maintenance cost and assume social responsibility.

Some architects are well literate about the situation of museums (Ito et al. 2013). Rather than blindly pursuing their passion for glass, workshops with the commissioners and museum curators lead to consensus on design details and employment of glass. Yamamoto Riken, designer of Yokosuka Museum of Art (2007), is one of the prominent figures that invest time in collecting voices from the curators (2003). When talking about his Oita Prefectural Art Museum design (2015), Ban Shigeru also expresses his concern over museums' elitist image and concomitant inaccessibility for ordinary people, and financial straits especially for provincial museums outside Tokyo (*GA JAPAN* 2015, 72-74). Ban mentioned his particular awareness of the openness of pharmacy shops and electronics retail stores (Ibid., 72). His proposal included foldable glass doors that can turn the Museum's entrance hall into a semi-

exterior plaza, and flexible spatial design that accommodates adjustable gallery spaces and income-generating amenities. The design expresses his vision towards museums as a part of the street, the city, and everyday life.

6. CONCLUSIONS

To sum up, this paper investigates the phenomenon of increasing exploitation of glass in museum buildings. It challenges the predominant association of glass with transparency and modernity and argues for a contextualized reading of glass. It establishes that the increasing employment of glass in museum buildings from the 1990s witnesses to a paradigm shift in museum architecture. This is mainly a result of architects' design preference, which is made possible by technological development and reflects the

By blurring the physical boundary between the inside and the outside, the architects of the Fourth Generation museums aim to establish a less intimidating and elitist image of museums.

social climate celebrating Neoliberalism. The extensive glazing of the buildings reveals the architects' ideal of museums, as open and accessible. By redesigning the physical boundaries, the architects and their commissioners aim to establish a less elitist profile for the museum. A few questions remain for future research regarding how effective glass is at boosting attendance and generating actual revenue and the response from the users including museum staff and visitors.

¹ Notes: Japanese names in this paper follow the natural Japanese language with family names before the given names.

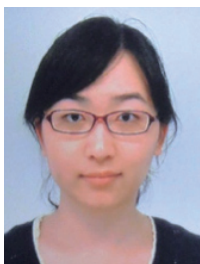
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APPENDIX Time line of major museum architecture projects exploiting glass

1989	Pyramids at the Louvre, Paris (I.M. Pei & Partners); Tokyo Sea Life Park and Crystal View, Observation House (Taniguchi Yoshio)
1992	Kirchner Museum, Davos, Switzerland (Annette Gigon and Mike Guyer)
1996	Anpanman Museum (Furuya Nobuaki)
1997	Kunsthau Bregenz, Austria (Peter Zumthor); Auguste Rodin Museum, Seoul (KPF Associates); Hiroki Oda Museum, Shiga (Ando Tadao)
1998	Kiasma - Museum of Contemporary Art in Helsinki (Steven Holl); Kumanokodo Nakahechi Museum (SANAA)
1999	Gallery of Horyuji Treasures, Tokyo National Museum (Taniguchi Yoshio); Midori no naka, Nemunoki Art Museum, Shizuoka (Ban Shigeru); Ogasawara Museum (SANAA)
2000	Great Court of British Museum (Foster and Partners)
2001	Sendai Mediatheque (Ito Toyo)
2002	Modern Art Museum of Fort Worth, Texas (Ando Tadao); Pola Museum of Art (Nikken Sekkei)
2004	Expansion of Museum of Modern Art, New York (Taniguchi Yoshio and KPF); 21st Century Museum of Contemporary Art, Kanazawa (SANAA)
2005	Nagasaki Prefectural Art Museum (kengo kuma and associates)
2006	Glass Pavilion, Toledo Museum of Art, Ohio (SANAA); Musée du quai Branly, Paris (Jean Nouvel)
2007	New Museum, New York (SANAA); Bloch Building Addition, Nelson-Atkins Museum of Art, Kansas City (Holl); National Art Center, Tokyo (Kurokawa Kisho); Yokosuka Museum of Art (Yamamoto Riken)
2008	Towada Art Center (Nishizawa Ryue)
2009	New building of Nezu Museum (kengo kuma and associates)
2011	Hiroshi Senju Museum, Karuizawa (Nishizawa)
2012	Louvre-Lens, France (SANAA); Paper and Material Institute (PAM) in Shizuoka Prefecture (Ban Shigeru)
2014	Annex of Tokyo Metropolitan Teien Art Museum (Tokyo Metropolitan Government and Kume Sekkei Co., Ltd.); Heisei Chishinkan Wing, Kyoto National Museum (Taniguchi Yoshio)
2015	Mudec Museum of Cultures, Milano; Oita Prefectural Art Museum (Ban Shigeru); SANAA chosen to design New South Wales Art Gallery expansion, Sydney



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Redesigning the Physical Boundary: The Emergence of the Glass Age of Museum Architecture from the 1990s

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Contemporary museum architecture is seeing an age of glass. Both renovation projects and new constructions have been exploiting glass extensively, as if it is the best solution to serve the spatial functions, present the architects' concepts, and address the institutions' missions and social expectations. Prominent examples include the Louvre Pyramid by I. M. Pei (1989) and SANAA's designs for The 21st Century Museum of Contemporary Art, Kanazawa (2004) and Louvre-Lens, France (2012). This trend of increasing use of glass by museum architecture deviates from the previous model of museums, temples and shrines with formidable look. A new physical boundary of museums, glass walls that interact with the surrounding and the spectators, is designed in contrast with the older type that stresses the buildings' exalted status. This kind of extensive glazing has become an almost indispensable part of the new generation of museum architecture.

By contextualizing the phenomenon of extensive glazing in museum architecture, this paper aims to discern its connections with the museum situation and the contemporaneity and locality of Japan. It argues that the increasing exploitation of glass in museum architecture demonstrates the influence of Neoliberalism on the public institutions and the architects to embrace visually appealing, technologically demanding, and commercial elements. It challenges the pre-dominant association of glass with transparency and modernity and argues for a contextualized reading of glass. This research adopts an inter-disciplinary methodology including visual analysis of museum buildings, literature review of policy papers, prior theories and architects' discourse, and site observations. This paper contends that the increasing employment of glass in museum buildings in Japan is mainly a result of architects' design preference, which is made possible by technological development and reflects the social climate celebrating Neoliberalism. By redesigning the physical boundaries, the architects and their commissioners aim to establish a less elitist profile for the museum.

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