Restoration of Tactility of Architectural Glass: Perceptual & Sensible Tactility

- Focused on the Analysis of Laminata Glass House -

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Abstract

The study of the expression of architectural glass has recently expanded due to various factors such as the development of architectural technology, the reinforcement of environmental standards, an increased interest in energy saving, and the commercialism of the exterior of buildings. The background for restoring the tactile capability of the sense of sight has been prepared by agitating oculocentricism pertaining to the Renaissance era. The restoration of tactility can be considered in two ways. One is the tactility 'perceived' through complex experiences and the other is the tactility 'sensed' from the challenges on the materiality of the glass itself. Perceptual tactility is achieved from compound visual experiences and connecting these complex experiences in the brain. Sensible tactility, in contrast to perceptual tactility, is a more direct tactility which works within the nervous system, bypassing the brain. This is attained by reversion of the materiality, tectonics and connection method of the glass. Among rare examples, Laminata House built in Leerdam, Netherlands is a fine example of direct and sensible tactility. In this paper, the process of restoring tactility in architecture is studied at each stage based on the restoration of tactility in painterly aesthetics.

Keywords : Glass, System, Materiality, Interaction, Technology

1. INTRODUCTION

1.1 RESEARCH BACKGROUND

Exterior materials of contemporary architecture have become more diversified and have expanded in their complexity of expression due to the destruction of ideology, the rise of commercial marketing, the consciousness on environmental issues, and the development of architectural technology. Architectural design, especially form-making started pursuing liberated forms, relieved form gravity with helps from development of structural and building information modeling techniques. As form becomes more sensual and unrestricted, skin design requires more innovative and detailed techniques to accommodate fabrication of complicated geometry. BIM technology utilizing CNC¹ machine enabled a technical control of this requirement, and architectural glass is no exception, whereby many possibilities of expression have begun to be studied. Glass was able to have curved surfaces and was applied to diverse design areas. Environmental aspects resulted from extensive use of glass was easily controlled by various glass systems that will be discussed in the followings.

The fascination with how the expression of glass has changed stems from the fact that the materiality of glass has always been focused on the study of transparency and the transparency of glass represents the composition and interpretation of reasonable space under the concept of oculocentricism that had continued after the Renaissance

period. Diverse connections created from the use of glass systems in contemporary architecture have not simply expanded the range of the visual expression of glass but have created new values by challenging the materiality of glass itself. Among these many values, the value discussed in this paper is that of the restoration of a tactile vision, that is, 'visual tactility' of the eye. In this paper, tactility is studied from two perspectives: the tactility 'perceived' through complex experiences; and the tactility 'sensed' through the challenges on the physical properties of the glass itself.

Tactility through 'perception' is related to the systemization of glass. Modern glass always consists of a system according to various functions and demands, and through interactions such as juxtaposition or repetition of the components comprising the glass system. It can evoke tension and attract the eyes of the observer. These interactions diversify the methods of perceiving glass and preclude rational analysis. Hence, in contemporary architecture, this enables the experience of glass through 'complex perception' beyond rational analysis according to the Cartesian perspective pertaining to the Renaissance period. Although this direction is a visual perception of a visual experience, it induces visual tactility through complex experiences. More direct tactility is obtained when sensibility works directly on the nervous system, bypassing the perception process.

In this paper, these sensibilities are studied by analyzing Laminata House, established in 2002. Laminata Glass House, built in Leerdam, Netherlands, changes the senses conveyed by the architectural glass and the method with which the observer receives it by reverting and recomposing various conventions of the glass itself. It restores the

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¹ CNC stands for Computer Numeric Control.

tactility that works directly on the nervous system while bypassing the brain, breaking away from oculocentricism, which translates the object by perceiving it through the optical mechanism of clear communication with the brain. The restoration method of complex perception and tactility shows many commonalities with the concept of 'changes of the perception process', as asserted in aesthetics theories developed from paintings after Modernism by Merleau-Ponty and Deleuze. In this paper, an analysis is provided of how these aesthetic theories apply to contemporary architecture. The objective of this study is to examine how the 'perception' of these tactile senses occurs, how the tactile 'sensibility', which is experienced through the reversion of materiality of architectural glass, the reversion of tectonics, and the reversion of connection, is achieved and what the possibilities and limitations are.

1.2 STUDY METHOD

To study how visual tactility through complex perception and challenges of materiality is achieved in contemporary architecture, this paper is divided into the following stages: first, a study is presented on how oculocentricism is destroyed and the concept on visual tactility is restored in the history of paintings through theoretical analysis of Merleau-Ponty and Deleuze; second, examples of 'complex perception' are studied through several examples of architectural glass systems, while the process of achieving visual tactility is studied; third, the process of overcoming the customs of the observer of architectural glass is studied in stages by analyzing the Laminata Glass House built in Leerdam, Netherlands and tactility, that is the direct sense achieved through the glass, is analyzed; finally, these stages are summarized in the conclusion. Although contemporary architecture shows visible diversity in its forms through various experiments, this study is limited to formatively simple and concise architecture in order to focus on the expression of the architectural exterior.

1.3 AREA OF RESEARCH AND LIMITS

The area of this study does not include formal analysis, not to avoid a meaning of analyzing perception in terms of formal variation, but to provide a fair and focused background for analyzing mechanism of perception of glass systems. Requirements of the samples included in this study are: 1. Forms should have simple geometry, preferably a box-shaped 2. Surfaces to be perceived should have planar, rectangular boundary.

2. OCULOCENTRICISM AND RESTORATION OF TACTILITY

The dominating visual style has its foundation in perspectives originating from the Italian Renaissance of the 15th century, and has remained the dominating style. In the law of perspective, in which an attempt was made to accurately recreate three dimensional space and objects on a two-dimensional plane, the vision that rationalizes the

space was realized². This is also described as 'the Cartesian Perspectivalism' because the perspective drawing identifies the point of vision to the vanishing point and composes the space rationally (Figure. 1).

In this law of perspective, the objectivity of the object world becomes distinctive and the boarder world becomes more defined as the subject organizes, creates and possesses the objective world³. This distinctiveness has a close relationship to the expressionistic style of modern architecture. In particular, it creates distance in the forming of the relationship between architecture and people, focuses the form and outline of architecture through the visual system, and explicitly defines the materiality that each material has.

Figure 1. Durer's Grating Plate and Backsight,
A Man Drawing a Lying Woman

Merleau-Ponty introduced the concept of 'chair' in the 'phenomenology of perception' and criticized the Cartesian perception process, in which the subject interprets the object through stable perception via 'contemplation'. Instead of the Cartesian perception he suggested the 'cogito of the body' and emphasizes the senses that are experienced compositively in its behavior⁴. To explain the compositive perception experienced through this behavior, Merleau-Ponty uses the paintings of Paul Cezanne. Cezanne's paintings do not have a single view point and this originates from the realization that we do not recognize the whole object when we first see it with our eyes. Our method of perceiving the world is to receive and organize the partial experiences compositively, thus destroying the concept of Cartesian Perspectivalism, in which explicit analysis is made of objects and of the perception of objects, and relates to Deleuze's introduction of the 'tactile sense beyond perception'.

Deleuze summarizes the history of art by using the paired concept, 'tactile-optical'. He takes the example of an Egyptian bas-relief as a kind of visual 'tactility'. Here, we are able to tactically explore the outline of the bas-relief with our eyes, a concept that existed before modern times⁵. However, as explained above, people were concentrated on exploring the optical space in the modern era, whereby the tactile function inherent in the visual senses gradually disappeared and the function of perceiving by

² Joo, E. (2003) *Vision and Modernity*, Seoul: Hannarae Publishing, p.138

³ Joo, E. (2003) *Vision and Modernity*, Seoul: Hannarae Publishing, p.238

⁴ Jin J. (2003) *Lectures on Contemporary Aesthetics: Duet of the sublimity and simulacra*. Paju, Korea: Artbooks, p.190

⁵ Deleuze, G. translated by Hah, T. (2008) *Francis Bacon Logique de la sensation*, Seoul: Minumsa, p.141

‘looking’, rather than ‘feeling’ is emphasized. Marshall McLuhan also proposed a similar assertion.⁶ According to him, in the primitive era people possessed a balance between the visual, auditory and tactile senses; however, with technological innovation, the function of vision has developed, thereby creating vision-oriented people. Deleuze explained that a ‘sense’ has no distinction between the object and subject. This, he believes, differs from the relationship between the object and subject distinguished by ‘perception’ and he asserted the conversion into the tactile background from the visual horizon through ‘the vision felt through the eye’. To escape from the visual horizon of the modern era, the model of reproduction and concreteness shall be destroyed and the method shall be used whereby the subject is deconstructed through the process of destroying the custom, for example, by erasing the face from the body⁷.

Figure 2. Self-portrait, Bacon, 1971

In explaining the method of restoring the visual tactility outside of this oculocentrism, the painting by Francis Bacon is cited (Figure 2). Deleuze destroys reproduction and lyrical implications through the isolation of forms to restore tactility in paintings. In the self-portrait of Bacon, the reproductive recognition model is destroyed and deterritorialized, going beyond the conventional percep-

tion of the ‘subject’ and achieving new senses. The effect of newly achieved senses is ‘tactile’ and strikes those that look at this eccentric form. This shock is not perceived through the brain but works directly on the nervous system. Furthermore, his works attain the status of a subject for tactile experience, and are no longer the subject of visual contemplation⁸. In this paper, a study is carried out on how the process of overcoming the reproductivity and lyrical implications of the painting and restoring the tactility according to the analysis of Deleuze works on the process of restoring tactility by converting the materiality of glass in contemporary architecture. Before we begin analyzing direct tactility through analyzing the Laminata Glass House, we will look at the tactility perceived through compound experience and how the Cartesian Perspectivalism is upset in the glass system of contemporary architecture.

3. PERCEPTUAL TACTILITY THROUGH COMPOUND PERCEPTION ON ARCHITECTURAL GLASS SYSTEM

⁶ Jeon, Y. and Kim, S. (2008) A study on Representation Techniques of Visual Tactility in the Surface of Contemporary Architecture, Seoul: Journal of KIID, Vol. 17, No. 3, p.142

⁷ In Francis Bacon’s painting Pope Innocent X, head is erased from the body. The meaning of the body without its head becomes vague, thus enables destruction of the concept or reproduction and lyrical implications.

⁸ Jin J.(2003) Lectures on Contemporary Aesthetics: Duet of the sublimity and simulacra. Paju, Korea: Artbooks, p.196

Before studying the restoration of the direct tactility of glass through the reversion of materiality in the next chapter, it is necessary to attend to the complexity of expression shown by the glass system to discuss the perceptual tactility. This is important because the complexity of expression facilitated diverse experiences that cannot be expressed by glass when focus of the materiality of glass is only the transparency in modern architecture. The transparency of glass in modern architecture emphasizes the purity of transparent and smooth physical property and at the same time, it shows respect for the technology that enabled the transparency. The glass in Mies van der Rohe’s Farnsworth House is an important example that shows the relevant declaration (Figure. 4). Here, the glass proceeds towards ‘non-existence’ and performs the role of a frame by conveying the collage of inner components along the pillar and roof slab. The glass is not the subject ‘to be seen’ but it is the existence of ‘permeating’ to see other subjects, which is the metaphysical element rather than the existential. The materiality of glass, here, is transparent, non-physical, explicit and dependent (Figure. 3).

Figure 3. Glass Experience on the Farnsworth House

Figure 4. Farnsworth House

Although many architectural glass designs inherit this materiality, it changes the design of architectural glass due to various influential conditions as described earlier, such as the interest in energy efficiency, more stringent environmental regulations, and commercial marketing of the exterior of buildings. This change diversifies the visual effect of the glass exterior itself without touching the basic materiality of the glass. This is because modern glass is used as a glass system⁹ rather than as a singular material (Figure. 5).

⁹ A simple exterior glass window in contemporary architecture is actually a unit, called an Insulating Glass Unit (IGU). Insulating glass incorporates two or more sheets of glass separated by a hermetically sealed space for thermal insulation and condensation control. The airspace between the sheets of glass can be filled during the manufacturing process with either dry air or a low- conductivity glass. (Bell, V. (2006) Materials for design. New York: Princeton Architectural Press, p.17)

Figure 5. Insulating Glass Unit / Typical Curtainwall assembly

Since the glass system is comprised of more than two layers, diverse architectural experiences are made possible through the appropriate replacement and connection of components of the glass system¹⁰. Each component of the system creates a very effective expression and function according to each connection. In the case of the Des Moines Library project by David Chipperfield, the metal mesh is inserted in the general double layer glass system to facilitate the control of solar light and solar heat, which justifies the system as a functional element not simply as an aesthetic decoration¹¹. Other than this functional role, numerous openings in the mesh grills ensure a level of transparency within a short distance and opaqueness at a longer distance, creating ambiguity at the boundaries. From a certain distance, the metal mesh and transparent glass visually struggle for leadership and the fine holes create the Moiré effect, as visually perceived by audiences, creating variegated waves inside the smooth surface of glass. Moreover, the neighboring buildings reflected on the exterior, appearing as other glass buildings, form another formative layer, whereby the reflections that hang on the canvas of the metal mesh and glass surface are read as a single pattern, somewhat losing their distinctive characteristic. Of course the diversity of reading can happen independently. However, when experienced at a certain distance, various experiences are integrated through perception in the brain. The integrated senses have an ambiguity of depth and transparency, continuously playing with the surface of the eye, which is never fixed, and the function of touching, that is, visual tactility, is restored (Figure 6).

Figure 6. Compound Perception Diagram

¹⁰ In the separate study conducted presently, the study is being developed on analyzing the materiality of architectural glass as a system. In this paper the term 'materiality' still refers to that of each plane that constitutes a system.

¹¹ Lee, S. Editor(2007) *Matters of materials: Concrete Glass Steel*, Seoul: Spacetime Publishers, p.126

Furthermore, the compound perceptions experienced through the connection of the system of layers of glass is shown variously in architectural examples. These are as follows¹².

Table 1. Example of Compound Perception

Name	Compound Senses	Connection Element
O-Museum, Japan, SANAA, 2002	The system conveys oscillating sense of integration and differentiation	The glass system with identical composition but different density of silk-screen
Pharmacological Research Biberach Germany, Sauerbruch Hutton 2002	The composition becomes fragmented pixels with ambiguous depth and articulations	The operable glass louvers of eight different colors are layered in front of the glass façade
Des Moines Library, Iowa, David Chipperfield Architects, 2002	The surface, change of transparency, Moire effect, change of reflection perceived differently according to the direction and distance of approach	The perforated metal mesh is inserted in between the glass unit
Dior, Tokyo, SANAA, 2003	The smoothness of the frontal glass and irregularity of back-side acrylics is perceived variously according to the distance and lighting	On the back of the glass surface, the irregular acrylic is layered
Galleria Hall West, Seoul, UN Studio, 2004	LED lighting changes diversely to lead the change of street contents	The changing LED lighting is attached inside the glass discs decorated in front of the solid exterior

¹² Detailed analysis on each example is avoided and replaced by the exterior analysis of Des Moine Library to avoid possible distractions.

Similarly to the example of the Des Moines Library, the above examples also restore visual tactility through diversifying the color of glass, changing the surface texture, and distorting the sense of depth by contrasting other textures that are integrated with the glass system in contemporary architecture.

4. RESTORATION OF SENSIBLE TACTILITY THAT WORKS DIRECTLY ON THE NERVE SYSTEM

Tactility experienced through compound perception is significant because it restores the eye's function of touching. However, this compound perception is still the perception of the brain based on the vision. Also, although the glass system shows diverse connections, the materiality of each glass does not change. The tactility that goes beyond is achieved through direct senses and through a direct challenge. How then is this sensible tactility achieved? As mentioned previously, in the theory of painting Deleuze used the example of Francis Bacon to introduce new senses by destroying the reproductivity and lyrical structure of paintings, through destroying conventional experience. In this case sensible tactility is experienced rather than perceptual tactility. In architectural cases, it is not easy to find an example whereby this tactility is realized. The Laminata Glass House completed in 2002 provides a good example for the analysis of this direct tactility. This building was designed by Kruunenberg Van der Erve Architects and it was a winner in a design competition hosted by the Local Housing Agency in Leerdam in 1999. It shows several key innovations in using glass in architecture. In this paper, the study is conducted with the focus on how the Laminata Glass House destroys the convention of modern glass and restores direct tactility. The analysis was conducted in the following four areas.

- a. (Subversion) of materiality
- b. Tectonics
- c. Connections
- d. Senses

4.1. SUBVERSION OF MATERIALITY

The wall of the Laminata Glass House is comprised of stacked sheets of 10mm thick glass of various depths. The average depth of this laminated glass wall reaches 330mm and the thickness of the thickest part is 1700mm¹³ (Figure. 7). The importance of this building in this paper is not because the space and form of the building has significance

Figure 7. Partial Floor Plan (south)

in architectural history, but because the method of using material and construction shocks the senses through a new materiality that escapes the original conventions of the use of glass. The pure material is universal and the method of assembly is simple. Nevertheless, through infinite repetition of new attempts, this architectural wall reflects a new horizon in the materiality of architecture.

The contrast between this glass wall design and past modern architectural glass walls is intriguing. In the Glass House by Phillip Johnson and in Farnsworth House by Mies van der Rohe, the use of glass maximized its transparency, achieving de-materialization, which was a declaration of modern architectural technology. The transparency of glass creates a perfect frame for the collage shown through the composition of the interior design elements. Here, the materiality of architectural glass is transparent, non-physical, explicit and dependent. Also, rather than emphasizing the materiality of glass itself, it functions as one major element that forms the whole (Figure. 8).

Figure 8.
Glass House by Johnson

Figure 9. Corridor of
Laminata Glass House

Although the transparency of this architectural glass is regarded as an important issue not only in modern architecture, but also in contemporary architecture, the use of glass becomes diversified by coating, application of ceramic patterns, louvers that block solar light and so on according to functional needs. However, the sense provided by the glass is that of visual transparency and the interpretation of architecture only depends upon the vision of observers.

In contrast, in Laminata, the purity and transparency of this glass and the general properties of other glass is somewhat subverted (Figure. 9). Here, glass refuses de-materialization and strongly asserts the physical existence of glass itself. The walls that are only comprised of the section of glass relinquish their transparency, showing roughness rather than smoothness. Although the glass permeates light, it blocks the vision and fragments the sunlight and vision to expand on the ambiguous sense of depth. Through this manipulation, the new materiality of glass in this project can be enumerated as follows: physicality, ambiguity, changeability, tectonics or solidity.

4.2. TECTONICS

The new materiality of glass from Laminata was brought from the subversion of the method by the glass was constructed. Breaking away from the method by which the glass is generally used for screening and inserting, in the Laminata, one single sheet of glass is treated as

¹³ Bell, V. (2006) Materials for design. New York: Princeton Architectural Press, p.22

brick or concrete block (Figure. 10). The glass wall constructed sheet-by-sheet gives the sense of solid weight, any, in a way, showing the primitive grandiose (Figure. 11).

Figure 10.
Generally
Constructed Wall

Figure 11.
Constructed Wall of
Laminata Glass House

In fact, the interesting attempt to show tactile materiality of glass walls beyond vision was shown through experimenting with the interior space composition of architecture rather than with the exterior design. 'Another Glass House', the winner of "Glass Vessel" of Shinkenchiku Residential Design Competition in Japan, 1999 is consisted of glass panels with 320 layers. They are incorporated into the section, and by connecting the void surface of each glass panel, the interior space is created (Figure. 12). The exterior wall does not exist separately in this project and the edge of each glass panel naturally creates the exterior wall.

Figure 12. Perspective and Cross Section of Glass Vessel Project

The judge of the aforementioned competition, Jeffrey Kipnis, criticized this piece of work by suggesting that it is limited to a diagram of material/space and it would have been better if it could provide solutions for the problems that arise when the diagram is met with tectonic realizations with sufficient development of this project¹⁴. Indeed, although this project presents a conceptual proposal on the composition of interior space by contemplating the abstract space of a layered unrealistic single glass panel, the construction of the real building is, surprisingly, not very different from the context of this diagram when the new connection of this glass in the Laminata Glass House is finally realized.

4.3. CONNECTIONS

How did this tectonics change the method of connection between architectural elements? In typical buildings in which glass was applied, the following common elements were required to create one exterior system using glass: 1. Insulated glass unit connected with more than two panels; 2. Curtain wall frames that support the glass and connect to architectural structures; and 3. The sealant and gaskets enabling the expansion, contraction, and movement of each different element. Undoubtedly, when there are different elements other than glass, more complex connections are required. (Figure. 13)

Figure 13.
Section of General
Curtain Wall

Figure 14.
Section of Laminata
Glass House

However, in the connection of the exterior wall in Laminata House the exterior wall has a simple connection of stacked glass panels glued with sealants (Figure. 14). This sealant facilitates the movement of each glass panel to avoid cracking and transformation. The stacked glass section reduces the level of heat transfer, creating an insulating effect which is sufficient, without the use of other insulators. Although this configuration limits transparency, the light transmission into the interior space is sufficient. Moreover, the unified glass wall is structural member that supports the entire building. The classification of the structure of the insulated glass, the building structure, the curtain wall frame, and the gasket is no longer required because one connection serves all the roles.

There was a slightly different challenge to the experience of the glass. Channel Glass (Figure. 15) in contemporary architecture is prevalently reviewed as a new challenge in the use of architectural glass. But this configuration simply shows a new interpretation of an existing insulating glass system and it is yet to be a direct challenge to the materiality of glass itself. However, the connection of glass becomes simpler, and because it supports the weight of the glass itself without a frame, it is a very important example of reorganizing the materiality of glass.

Figure 15. Channel Glass

¹⁴ Yoshida, Y. Editor (1992), Japan Architect, Tokyo: Shinkenchiku-Sha, P.16

4.4. SENSE: RESTORATION OF TACTILITY

As has been studied so far, the Laminata Glass house subverts the relationship between materiality, tectonics and the connections of modern architectural glass. As explained above, Deleuze opened the way for new senses through deleting and transforming familiarity as a means of restoring tactility and breaking away from the reproductivity, mentioning the examples of Bacon's paintings such as 'Self-Portrait' (1969) and Pope Innocent X (1953). Laminata Glass House subverts our conventional experiences of existing glass buildings and emancipates them from conventional perception, enabling us to restore the tactility of buildings by achieving the vision of 'touching' with the eye. When looking at the exterior wall of this building, the observer cannot think of familiar buildings familiar, meet a mass with the possibility of open interpretation. The eye of the observer evokes tactile reactions when confronted with the external walls of the building. The observer feels interest and confusion when looking at this building and this evokes an 'unstable' sense (or perhaps frightening). This new sensation "works directly on the nervous system"¹⁵ rather than occurring through the analysis of certain visual works. This is because it is emancipated from the convention of general glass walls through 'non-familiarity' of the materiality which is shown twisted. By repeatedly exposing the side of the glass, which is typically hidden, it isolates the convention, and shows the surface connected purely with glass. Observers give up recognizing this glass system as a reproduction of existing materiality and take feelings as it is. Therefore, the observer contacts with flesh of glass that never had contact with the outside, and it is sensed with utmost touch, creating nervousness (Figure 16).

Figure 16. Wall detail

The order of experiencing this tactility is conducted in the opposite order of subverting the convention. First, the building is perceived as one unified object, not as a connection of various elements. This is experienced as the subversion of 'connection' in the process of removing the convention. Second, one unified unit provides a 'foreignness' to the observer's vision and this is achieved through the subversion of tectonics. Lastly, this newly constructed mass conveys new sensibility, that is, the

tactility for the observer to restore the vision of investigating, which occurred through reinterpretation of the materiality of the glass itself. This sense can be explained as follows by transforming the diagram applied above (Figure 17).

Figure 17. Blocking of Conventions to achieve direct tactility

5. CONCLUSION

The study of the expression of architectural glass has recently expanded due to various factors such as the development of architectural technology, the reinforcement of environmental standards, an increased interest in energy saving, and the commercialism of the exterior of buildings. The background for restoring the tactile capability of the sense of sight has been prepared by agitating oculo-centrism pertaining to the Renaissance era. The restoration of tactility can be considered in two ways. One is the tactility 'perceived' through complex experiences and the other is the tactility 'sensed' from the challenges on the materiality of the glass itself. Perceptual tactility is achieved from compound visual experiences and connecting these complex experiences in the brain. Sensible tactility, in contrast to perceptual tactility, is a more direct tactility which works within the nervous system, bypassing the brain. This is attained by reversion of the materiality, tectonics and connection method of the glass.

The perceptual tactility diversifies the visual experience by applying and comprehending layers that variously comprise the glass system and this diversified experience is perceived through the brain. The senses integrated in the brain have an ambiguous sense of depth and transparency and the eye that is never fixed endlessly explores the surface in order to restore visual tactility. However, this compound perception is still limited to a brain perceiving objects based on vision and the materiality of each glass does not change. The tactility that goes beyond is the tactility attained through direct senses via direct challenges on materiality.

In this aspect, the use of glass at Laminata Glass House, Leerdam, Netherlands is a worthwhile study. Conventions of the glass wall in architecture are removed through subversion of the materiality of glass, subversion of tectonics, and subversion of connection. And through this removal of conventions, it conveys new senses, namely, direct tactility, to the observer to restore the sense of touch that is borne in the eye.

¹⁵ Jin J.(2003) Lectures on Contemporary Aesthetics: Duet of the sublimity and simulacre. Paju, Korea: Artbooks, p.190

These architectural attempts are significant because they expand the range of expression not only superficially but also radically. In this paper, architectural glass has been chosen as the representative material in modern and contemporary architecture; however, the study of materiality is not limited to glass. Many other materials are expanding their possibility in more interesting directions and the study on their possibilities could be considered in future research. Furthermore, such remaining work could serve to harmonize with the construction program, the surrounding environment and contexts rather than limiting the exterior of buildings to commercial wrapping by excessively clinging to the expression of building skins, as is taking presently place in form experiments in architectural practice.

As suggested in the introduction, this paper restricts analysis relating forms, not to avoid a meaning of analyzing perception in terms of formal and spatial variation, but to focus on the detailed analysis of the mechanism of perception of glass systems. Perceptual analysis related to form and space will be discussed in the following research. Researches regarding surfaces, forms and space can be combined together for more comprehensive analysis of architecture.

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