LIVENARCH + livable environments & architecture JOURNAL

KTU 1955
KARADENİZ TECHNICAL UNIVERSITY
FACULTY OF ARCHITECTURE
DEPARTMENT OF ARCHITECTURE
F.ARCH

Research Article

Indicator and Indicated: Sampling Semiotics in Architecture Through Three Station Structures

Pınar ÖKTEM ERKARTAL

Interior Architecture and Environmental Design, İstanbul Atlas University, İstanbul, Türkiye, pinar.erkartal@atlas.edu.tr

Received:15.04.2024, Received in Revised Form:13.06.2024, Accepted:02.07.2024.

Keywords

Architectural Design, Icon, Index, Symbol, Station Design.

Abstract

Architectural form is shaped in the light of many different parameters. This process is influenced by the environmental context as well as the message the architect wants to convey through the building. In terms of revealing how an architectural structure communicates with its environment, semiotic concepts have been a guidance throughout history. This study deals with semiotic concepts in architecture through station buildings. The reason for choosing station buildings is that these buildings are nodes that are introductory, orientating and character-emphasizing for their surroundings. In the study, the concepts of icon, index and symbol, which constitute the three main branches of semiotics, are examined by interpreting three different case studies that are seen as their equivalents in architectural design. The results of the analyses reveal that these three concepts create form formations of different characters in architecture, but they are effective on the user in terms of the character of the environment, the expression of its historical or unique aspects.

*Corresponding author.
E-mail address: pinar.erkartal@atlas.edu.tr (IAU).

Cite this article;
Öktem Erkartal P. (2024). Indicator and indicated: Sampling semiotics in architecture through three station structures. *LivenARCH+ Journal, 1*(2): 205-220. https://doi.org/xxxxx

1. Introduction

Architecture, beyond meeting the physical, social, or psychological needs of individuals, possesses semantic references through various features such as form, tectonic structure, or façade. It has the potential to engage in communication by demonstrating and indicating relationships and transmissions, extending beyond the mere fulfilment of basic needs. The language of this communication, namely the representational form of architecture, can be explained in the context of the relationships and transmissions of indicator and indicated. For this reason, architectural design has been interpreted through semiotics for years, or approached with its concepts and definitions.

The concepts of icon, index, and symbol are crucial in the field of semiotics, which is the study of signs and their use or interpretation. Developed by Charles Sanders Peirce, a pioneering American philosopher and semiotician, these concepts are indispensable in all reasoning. In Peirce's semiotic framework (1931, p.369), an icon “exhibits a similarity or analogy to the subject of discourse”. It is a sign that resembles the physical object it represents, like a picture of a “heart” indicating “love”. On the other hand, an index, “like a pronoun demonstrative or relative, forces the attention to the particular object intended without describing it” (Peirce, 1931). Indexical signs establish a direct and causal connection with their referents and this relationship is not based on similarity, as in the case of icons, but on cause-and-effect process. For instance, smoke is an index of fire. Symbols, the third category, rely on conventionalized associations between the sign and its meaning. Peirce (1931) describes symbol as “general name or description which signifies its object by means of an association of ideas or habitual connection between the name and the character signified”.

The exploration of the tree main concepts of semiotics in architecture draws upon seminal works in the field of architectural theory. Various theorists explored how signs and symbols function within the built environment. Key references include Venturi’s (1966) *Complexity and Contradiction in Architecture*, and Rossi's *The Architecture of the City* (1966), which show how semiotic principles can be integrated into their discourse and how signs and symbols contribute to the richness of architectural language. Similarly, Charles Jencks (1977) described the linguistic aspects of post-modern architecture, underlying the symbolic and communicative dimensions of architectural form. Umberto Eco, in his work titled *The Role of the Reader* (1979) explained how signs and symbols contribute to the interpretation of texts, including architectural structures. Tschumi (1996) explored the disjunction between architectural elements and their intended functions, in the context of the symbolic and semiotic aspects of architectural design. And in *The Space of Encounter* (2001), Liebeskind emphasized the symbolic and experiential dimensions of architectural space, mentioning the communication potential of built forms.

These and various similar studies (Medway&Clark, 2003; Ferreira, 2011; Shoja&Sajadzade, 2015; Huang&Zhou, 2020) also explore the semiotic dimensions of architectural space analysing how architectural forms function as semiotic systems that transmit meanings, reveal the subtle interplay between architectural design and semiotic categories and provide a means to grasp the layered meanings embedded in the built environment. These studies, located at

the interface of semiotics and architecture, deepen and enrich our understanding of the deep and multifaceted representation that structures spatial experiences.

In architecture, icons are structures or buildings that are intended to closely represent a particular idea, concept, or purpose. Just as in semantics, architecture icons visually reflect or remind the qualities of the intended meaning. This makes it possible to establish a clear and tangible connection between the sign and its referent. These buildings telling stories and evoking emotions are typically immediately recognizable and visually distinctive, making them landmarks in their surroundings. Buildings like Sydney Opera House, Beijing National Stadium, and the Lotus Temple in New Delhi are examples of the application of the iconic sign in architecture.

In the use of iconic signs in architecture, the meaning intended to be reflected by the architect or designer is most likely to be perceived by the viewer due to the visual relationship of the icon with the signified. There is no need for the existence of a common vocabulary between the architect and the viewer (Kalpaklı, 1998). However, this is not the case in exceptions when also the signified cannot be defined by the viewer. In this case, to clarify the relationship between the icon and the signifier, it is necessary to give information about what is intended to be shown and why it is intended to be shown.

In architecture, indexicality may manifest through features, elements, or expression such as form, material, colour, scale, detail, façade, ornamentation, or articulation and include clues of a specific context, history, or function. It provides information or evidence about an unobservable phenomenon and unlike an icon, which has a similarity or resemblance to its referent, an index is linked to its object through cause-and-effect or correlation. Thus, a building or a structure that is capable of being an index offers users perceptible clues about the environment or activities associated with the space.

A symbol is a sign whose relationship with its meaning is based on convention, agreement, or cultural understanding (Zappulla et al. 2014). Unlike icons and indices, symbols have an arbitrary connection to what they represent. Symbols in architecture can be socio-cultural, functional, religious, economic, and even political (Mankus, 2014). For instance, a dome in architecture might symbolize grandeur and importance in some cultural contexts, while the use of certain colours or patterns could be symbolic of cultural or religious meanings. Symbolic associations are more subjective than iconic associations since the perception of form and gestalt can vary according to the viewer's personal characteristics and momentary state (Göldeli, 1984).

It is possible to see symbolism in architecture since the earliest periods of history. Buildings can be consciously symbolic, while at other times they spontaneously become a forceful symbol. The Egyptian Pyramids are not only monumental tombs, but also an indication of the power of the emperor. The colonnaded system surrounding St Peter's Square in Vatican City reflects the embracing nature of religion. The Eiffel Tower proudly displays steel that reflects the spirit of its time. The Turkish Grand National Assembly is not only a state structure but also a symbol of national will. The Barcelona / Mies Van der Rohe Pavilion, which remained open in Barcelona only for a certain period, was so adopted that it was rebuilt and now is identified

with the city. These and many other countless similar examples reveal the symbolic character of architecture.

This paper discusses the relationship between signifier and signified in architecture through three station structures. In this context, the aim of the study is, first, to explain the language of representation that architecture has, beyond creating a physical volume, in the context of a type of building that a person can experience every day in daily life routine. The study deals with the architectural design-context dialectic with the concepts of icon, index, and symbol, examining how they manifest in the built environment, convey meaning, and contribute to the overall architectural experience.

2. Material and Method

The material of this study is three station structures designed by different architects in different geographies. The station buildings were selected as case studies due to their role as critical nodes that facilitate the circulation of daily life for large numbers of people, and their potential to evolve into significant memory sites within the urban landscape.

The case study method is a research approach in which a particular case or example is studied thoroughly and in detail (Gerring, 2007; Yin, 2014). The main purpose of a case study is to provide a comprehensive understanding of a particular problem, phenomenon, or situation, allowing researchers to investigate the interaction of various factors in real-world situations. In architecture, case studies can be used to examine specific buildings, design approaches and develop urban development projects. These provide insight into the impact of architectural decisions on the design process, user experience, and built environment.

Each case was chosen to illustrate the concept that constitutes the main triad of semiotics. The first example was chosen from the Ruhr region, which regionally attributes value to its industrial heritage, identifies with it and highlights it. Traces of the region's semantic ties with its industrial heritage were sought in the station structure. The second example was chosen from Finland, a country characterized by wood in terms of its natural richness, cultural heritage, traditional and contemporary built environment. The semiotic reflection of the semantic value of wood for the country is analysed. Lastly, the last example was selected for its architect, Santiago Calatrava, who employs semiotics in his architectural designs to convey meaning and evoke emotional responses. The third case examines how he transforms architectural form into a semantic element.

2.1. *Station Architecture as an Urban Node*

Stations are nodes that regulate people's movements, support them in this flow, and at the same time, according to Lynch (1960), are one of the five elements that have an important place in terms of the legibility and image of the city, especially as nodes where pedestrian and vehicle traffic intersect within the urban pattern. They serve as critical transportation hubs, connecting different places, cities, regions, and sometimes even countries. In fact, over time, these special places have not only defined and directed flows, but have also become centres for various commercial activities, cultural spaces, and social interaction.

When discussing station architecture, we can cover a broad range of topics, including rail systems, wheeled vehicles, sea transportation, and aviation. Although each has distinct and common features, all these structures have been both functional and aesthetic spaces that have left their mark on cities' image and history, even literature and visual arts from past to present. The design of ferry piers, airports, train stations, bus terminals and bus stops have been the subject of various studies (Snegar&Džidić, 2019a; Edwards, 2005; Binney&Hamm, 1984). The cases in the scope of this article are the transfer points of railway systems.

Throughout history, cultural aesthetics, technological breakthroughs, and the necessity for functionality have all had an impact on the architecture of railway stations. Architects strive to create structures that are not only efficient but also visually appealing. Utilitarian architecture, which prioritized functionality over architectural beauty, was a common feature of early railroad stations. As the railway network grew, particularly in the wake of the industrial revolution, stations started to exhibit the architectural designs of the times in which they were built. Grand and elaborate architectural designs, such as Beaux-Arts, Neoclassical, and Gothic architecture, are characteristic of many old railway stations. These designs frequently exuded grandeur and importance, which was appropriate given the importance of rail transportation during the height of the industrial revolution. In the early 20th century, railway stations in some regions embraced Art Nouveau and Art Deco styles. These styles emphasized decorative elements, streamlined forms, and modern materials. With the advent of modern architecture, railway station design evolved to emphasize functionality, efficiency, and clean lines.

Contemporary stations frequently have striking forms that conceal inventive and distinctive structural design (Snegar&Džidić, 2019b; Džidić&Snegar, 2019). Considering the station's role in shaping the urban environment, new stations have an emphasis on integration with their surroundings through translucent façades and positive voids. Some modern train stations use green and sustainable design concepts such as green roofs, eco-friendly materials, solar power systems, and energy-efficient lighting after environmental issues have gained popularity (Rzepnicka&Załuski, 2017).

In brief, although train station architecture has evolved and transformed over time to reflect the demands of a changing society, technological developments and historical aesthetic preferences, the purpose of these buildings has always been to create places that are efficient and hospitable, and that add to the character of the cities they serve.

The three examples, which will be mentioned in detail, have also different meanings beyond their function and represent their regions in different ways. These station structures indicate another phenomenon besides their own existence within the scope of the relationship between the signifier and the signified and constitute an example of the reflection of the three main concepts of semiotics in architecture.

2.2. *Case 1: Oberhausen Neue Mitte Train Station, Germany*

The first case, the Neue Mitte Station, is located in Oberhausen, Germany. Completed in 1996, the station (Figure 1) was designed by Christoph Parade and Partners. Referring to the history of its location, the design is formally a trackwork icon, consisting of stacked steel bars and plates.

The steel structure with its tubes, lattice supports, metal elements and randomly stacked surfaces was designed to look like a demolished building and was not intended to be "pleasing" but “provoking”. A former freight railway line, which had not been used since the 1990s, was converted into a local public transport route connecting the newly created district to Oberhausen city centre. The Neue Mitte Train station, built on this line, has become both a landmark and an icon that emphasizes the historical context with its eye-catching architecture resembling a chaotic pile of rubble.

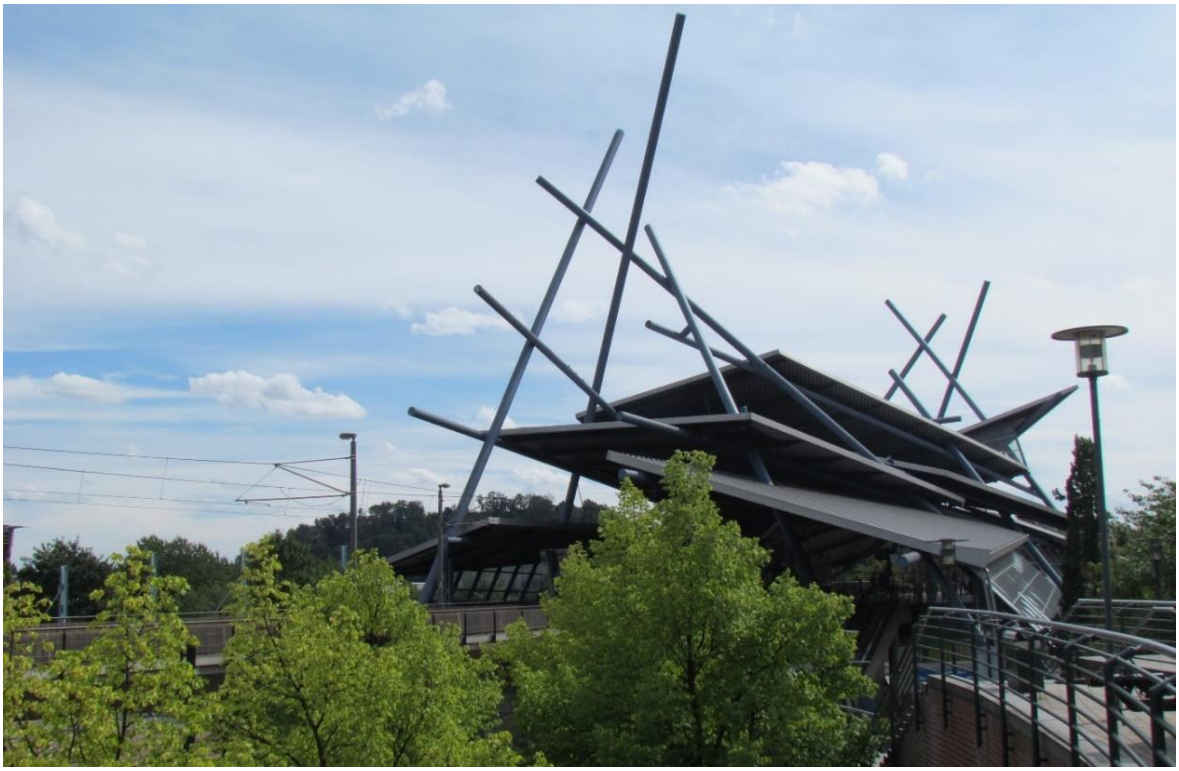

Figure 1. Neue Mitte Train Station, Oberhausen (Photo taken by the author, 2018).

The background to Parade’s design was the history of the Ruhr region with its "environmentally destructive interventions and artificial landscapes in the form of blast furnaces, winding towers and factory chimneys, railroad lines and overhead line pylons" (Figure 2). Steel pipes and beams support the roof sculpture. Metal roof panels and seemingly floating glass façades form the platform's shell. Beneath this is the customer centre in a solid structure (Figure 3). Architects aim to design a place where people stop inside - in memory of decades of steel production that points the way to the future (Knümann, 2014).

Figure 2. Neue Mitte Train Station, Oberhausen (Photo taken by the author from the information board at the station, 2018).

Figure 3. Neue Mitte Train Station, Oberhausen, under the Roof (Photo taken by the author, 2018).

This station serves as a visual representation of what the area has endured, reminds destroyed steel factories and collapsed carriers once stood here. The end of coal and steel marked the beginning of a profound structural change. Thus, this structure also indicates change instead of finality. It acts as a cultural memory marker, preserving the collective memory of the community. By incorporating the demolished building aesthetic, it becomes a tangible

representation of the regions' industrial heritage. It invites people to engage with the history of the place in a unique and thought-provoking way. The station has already been awarded the prize of the NW Chamber of Architects as an exemplary building (1997), the German Steel Construction Prize (1998) and the NRW Architecture Prize (2000).

2.3. *Case 2: Kohta Train Station, Kosta, Finland*

Kohta Train Station (Figure 4), designed by 17 students at Aalto University Wood Program to serve Koria's 2019 Housing Fair, is an index of Finnish lifestyle, wood construction mastery and sustainability. Inspired by a walk in the forest, the structure reflects the inseparable union between nature and life in Finland. With its straight, curved and twisted wooden elements, it resembles a modern and aesthetic dwelling in nature. The structure consists of modules with different geometric compositions that serve as serving areas and a large roof plane that holds them together (Figure 5). Each module has three walls and a roof. Thanks to the diversity of organization that the modules have, the station allows the user to choose their own experience while waiting for public transport. It features bike racks and information screens and a sitting area. The station provides cooling during the hot days and offers shelter during windy and rainy weathers.

Figure 4. Kohta Train Station (Aalto University Wood Program, Tuomas Uusheimo).

Figure 5. Different Modules of Kohta Train Station (Aalto University Wood Program, Tuomas Uusheimo).

The Kohta train station is also unique in terms of implementation. Each piece that makes up the structure was prepared by digitally defining and CNC manufacturing each wall piece, followed by cutting with a table saw to a unique angle and length. Each element is individually assembled in the workshop with high precision, achieved through a combination of digital and traditional techniques. The modules were then transported to the site where the fixings were used and assembled in one day. Originally designed as a temporary facility, it has become a permanent landmark of the city.

Kohta began as a study for a train station and provided a valuable learning opportunity for its architects throughout its design, development, manufacture, and installation. The structure is an index of the Aalto Wood Program and at the same time reflects the emphasis on timber construction in the country itself. Finland is known for its rich forestry resources and a strong tradition of using wood in construction. Finnish architect Alvar Aalto, one of the most important representatives of Modern Architecture, who gave his name to the programme, is also identified with wooden designs (Isohauta, 2013). The Alvar Aalto Wood Program continues his legacy and works on the design dynamics and application areas of wood (URL-1). Through the physical structure of the station the university showcase their expertise and research initiatives as well as the potential of wood in terms of design and applicability.

Kohta is, therefore, not only a station but also an indexical representation of Finland, Alvar Aalto and the Alvar Aalto Wood Program. The choice of building materials is often influenced by architectural preferences, environmental considerations, and regional building practices. The choice of building material here is entirely the result of the natural richness of the region, the presence of the architect and the educational program identified with the region.

2.4. *Case 3: Stadelhofen Station, Zurich, Switzerland*

An example where we can see the symbolic meaning is Stadelhofen Station (Figure 6), redesigned and renowned by Santiago Calatrava and reopened in 1990. The major railway station located in the eastern part of Zurich, Switzerland, serves as a crucial transportation hub, connecting various rail lines and serving both regional and national train services. The structure's location near Lake Zurich and the city centre, a vibrant area with its shops, restaurants, and other amenities, enhances its accessibility for residents and visitors, thus it plays a crucial role in facilitating the movement of commuters and travellers in Zurich and beyond (Calatrava, 2024; Jodidio, 2015).

Figure 6. Stadelhofen Station (Photo taken by the author, 2013).

Calatrava's design is characterized by his unique and modern curves (Figure 7), featuring a glass and steel canopy that spans the tracks, allowing natural light to illuminate the platforms (Figure 8). The extensive use of glass in the station's design allows natural light to flood the platforms, creating a bright and airy atmosphere. The station is designed to be accessible to pedestrians and cyclists, promoting multimodal transportation. The design is often considered a symbol of movement and dynamism because of its sweeping lines and canopy that resembles the wings of a bird in flight. According to Tzonis (1999), the paths and passageways in the stations are creating a smooth-flowing circulation and directing different types of movements. This dynamic and fluid design creates a sense of motion and suggests the idea of progress, transportation, and connectivity. Calatrava's asymmetry and organic forms precisely embrace the sense of endless flow and continuity experienced within the city. The economic, social, and cultural mobility of the city is symbolized by the station's nature-

embracing form, rhythmic structure, and different elevations. Stadelhofen Station's location as a major transportation hub in Zurich further reinforces its symbolic role. As a central point for rail connections, the station embodies the idea of people and goods constantly moving in and out of the city.

Figure 7. Stadelhofen Station, Curves (Photo taken by the author, 2013).

Figure 8. Stadelhofen Station, Different Levels and Materials (Photo taken by the author, 2013).

3. Findings

Gaining meaning with the context in which it exists, architecture reveals the relationship it establishes with its surroundings through various features such as its form, façade, function, and orientation. One of these ways of communication is to utilize semiotic concepts in design. The three examples, in which the reflections of icon, index and symbol in architectural form are interpreted, reveal that there are aspects in which all three concepts differ and have similarities. Findings obtained after examining the three station structures are tabulated in Table 1.

Table 1. Findings of the Case Studies.

	Iconic Architecture	**Indexical Architecture**	**Symbolic Architecture**
Definition	Architecture that resembles or has similarity to the object, event or whatever it represents.	Architecture that has a direct, causal connection or correlation with the object, culture, event or whatever it represents.	Architecture that represents something by convention or agreement, with an arbitrary connection between the sign and its meaning.
Semiotics Context	Semiotic sign based on visual similarity.	Semiotic sign based on a direct relationship or connection.	Semiotic sign based on cultural or conventional associations.
Message	Direct representation through visual similarity. For this reason, what the structure describes is often easy to understand. It can be a method to be used especially in narratives related to the past.	Representation through a direct connection or correlation. What it indicates may not be obvious at first glance because there is no visual similarity. Nevertheless, it has clear messages, especially for indigenous people, because of its strong connection to what it wants to relate to.	Representation through cultural, conventional, common-agreed or predictable meanings. Compared to others, the message it conveys is the most open to interpretation and discussion. It is possible to say that the more the structure reflects what it symbolizes, the more interesting and memorable it is.
Design Tools and Character	Form is shaped by visual relationship. This relationship can be quite literal or abstract according to the designer's interpretation. In one-to-one representations, there is a high risk of the structure becoming kitsch.	Form does not depend on any visual similarity. Nevertheless, since the structure must show a cause-and-effect relationship, it must provide this through material, colour, detail, ornament, or form.	Form has infinite alternatives. It is often expressive and memorable. It can reflect what it symbolizes through form, structure, material, colour or any detail. It is open to interpretation for those who experience or see it.
Impact	It contributes to the recognition of the region and acts as a visual document or affective scenery for its environment, especially when it represents something important.	Since it is based on cause-and-effect relationship, it exhibits and introduces the characteristic (cultural, technological, historical, etc...) features of the environment. Thus, it contributes to heritage transmission.	Symbolic architecture is engaging and intriguing and has the potential to become a landmark not only of what it represents, but also of the environment and the city in which it is located. In this way, there is also an increase in the recognition of the environment and urban image.

4. Conclusion

Architectural forms are never shaped independently of their location, environment, function, in short, their context. This shaping is related to the parameters required by the context as well as the way the architect who shapes it interprets the context and the message to be conveyed. Throughout history, the discourses of buildings on time, culture, geography, environment and definitely nature have been made visible through various methods. One of these methods is

semiotic concepts. By employing icons, indices, and symbols intentionally, architects can contribute to the creation of spaces that convey specific messages and enrich the cultural and social significance of the built environment.

In this context, icons utilise the relationship of one-to-one visual similarity, while indices provide a cause-and-effect situation, and symbols provide a relationship through concepts and associations. Thus, the messages conveyed explicitly or indirectly can be read just like a text. However, as in all fields related to language, meaning and cognition, what the architectural work tells and how the perceiver comprehends this message may not always coincide. Interpretation depends not only on the way the sign is constructed, but also on subjective qualities such as the character, culture and knowledge of the receiver.

Stations, which can be seen as important nodal points especially in terms of urban image and character, can act as a means of communication about the history, importance and distinctive feature of the place where they are located. The three examples analysed in this paper show reading alternatives for how and for what purpose different semiotic concepts can be integrated into architecture. Icon stops create visual similarities, and they can affect users by acting as realistic scenes. In these designs, rather than the visual aesthetics of the form, its resemblance to what it is indicative of and its potential to evoke it gain importance. Indexical structures, on the other hand, construct indirect message through the characteristic features caused by the signified. In this way, they provide information about the character, style, richness, cultural and historical heritage of the signified and contribute to the indirect transmission of these elements to future generations. As in all indirect messages, the level of knowledge and awareness of the perceiver in indexed indicators affects the success of message transmission. Structures using symbolism can be more memorable and intriguing with the aesthetic power of their forms. They play an important role especially in increasing the recognition of their surroundings due to their high potential to become landmarks. These structures, which convey variable messages depending on the user's interpretation, are good examples of the effects of cultural and environmental context on architectural form.

In conclusion, semiotic concepts are not necessary or mandatory in architectural form, but are useful for guiding the form production, for ease of perception, conveying information and character, recognition, and discourse creation. As the user of architecture, human beings are in constant interaction with physical, social and cultural contexts and produce semiotic objects that reflect this interaction in the built environment they create. The architectural form, which offers the opportunity to give a message directly to those who use it or to others about those who use it, becomes a cognitive content at the same time as it envelops people spatially. This semiotic feature facilitates the specialization and characterization of architecture in line with a specific context such as place, culture, history, or in line with the values that society attributes to a phenomenon for completely different reasons; in other words, it becomes semantically unique.

Declaration of Ethical Standards

Ethics Committee Approval was not required for the study.

Conflict of Interest

There was no conflict of interest between the authors during the research process.

Authors' Contributions

All authors contributed equally to the article.

Declarations

The authors take full responsibility for the content and any modifications made during this process.

Acknowledgement

I would like to thank Pekka Heikkinen and Aalto University Wood Program for sharing information and images with me about Kohta Train station.

Originality Report

According to the originality report obtained from the iThenticate software, this article's similarity rate is 4%.

References

Binney, M., & Hamm, M. (1984). *Great railway stations of Europe*. Thames & Hudson.

Calatrava, S. (2024, March 28). *Stadelhofen Station*. Retrieved from Santiago Calatrava Architects & Engineers : https://calatrava.com/projects/stadelhofen-station-zuerich.html

Džidić. S., & Snegar, L. (2019). Modern steel structures for bus stations. *International Scientific Conference on Production Engineering Development and Modernization of Production*, 268-273.

Eco, U. (1979). *The role of the reader*. Indiana University Press.

Edwards, B. (2005). *The modern airport terminal: New approaches to airport architecture.* Spon Press.

Ferreira, M. (2011). Interactive bodies: The semiosis of architectural forms. *Biosemiotics*, *5*, 269 - 289. doi: 10.1007/s12304-011-9126-0.

Gerring, J. (2007). *Case study research: Principles and practices.* Cambridge University Press.

Göldeli, İ. (1984). *Mimarlık göstergesi, mimarlık göstergesinde düzanlam ve yananlam* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon, Turkey.

Huang, J., & Zhou, H. (2020). Analysis on the application of architectural semiotics in design. *IOP Conference Series: Earth and Environmental Science*, 510. doi:10.1088/1755-1315/510/5/052023.

Isohauta, T. (2013). The diversity of timber in Alvar Aalto's architecture: Forests, shelter and safety. *Architectural Research Quarterly, 17*(3-4), 269–280. doi:10.1017/s1359135514000086

Jencks C. (1977). *The language of post-modern architecture*. Rizzoli.

Jodidio, P. (2015). *Calatrava: Santiago Calatrava, complete works 1979-today.* Taschen.

Kalpaklı, Ü. (1998). *Mimarlık göstergesi-nesne ilişkileri (işaret - belirti - simge) üzerine bir inceleme* (Unpublished doctoral dissertation) Yıldız Technical University, Istanbul, Turkey.

Knümann, A. (2014, March 10). *Haltestelle Neue Mitte Schafft's ins Stadtmuseum Düsseldorf*, WAZ. Retrieved April 2, 2024 from https://www.waz.de/staedte/oberhausen/haltestelle-neue-mitte-schafft-s-ins-stadtmuseum-duesseldorf-id9102654.html

Liebeskind, D. (2001). *The space of encounter.* Universe Publishing.

Lynch, K. (1960). *The image of the city.* MIT Press.

Mankus, M. (2014). Manifestations of symbolism in architecture of postmodernism. *Journal of Architecture and Urbanism*, *38*(4): 274–282.

Medway, P., & Clark, B. (2003). Imagining the building: Architectural design as semiotic construction. *Design Studies*, *24,* 255-273. doi:10.1016/S0142-694X(02)00055-8.

Peirce, C.S. (1994). The triad in reasoning. In J. Deely (Ed.), *Collected Papers of Charles Sanders Peirce* (pp. 369-371). Harvard University Press (Original work published 1931)1994.

Rossi, A. (1966) *The architecture of the city*. MIT Press, 1984.

Rzepnicka, S. & Załuski, D. (2017). Innovative railway stations*, IOP Conf. Ser.: Mater. Sci. Eng*. 245. doi:10.1088/1757-899X/245/8/082009

Shoja, H., & Sajadzade, H. (2015). Application of Semiotics and its Concept in Architecture. *European Online Journal of Natural and Social Sciences, 4*, 539-541.

Snegar L., & Džidić, S. (2019a, April). Bus stations - architectural expression, structural systems and materialization. *Paper presented at the 7th International Conference "Contemporary Achievements in Civil Engineering*", Proceedings (pp.811-824).

Snegar, L., & Džidić. S., (2019b, March). Innovative concrete structures for modern bus stations*, Paper presented at the 7th International Scientific-Professional Conference "SFERA 2019 – Technology of Concrete*".

Tschumi B. (1996). *Architecture and disjunction*. MIT Press.

Tzonis, A. (1999). *Santiago Calatrava: The poetics of movement.* Universe Publishing.

Aalto University Wood Program. (2024, March 28). Retrieved March 28, 2024, from https://www.aalto.fi/en/wood-program

Venturi R. (1966). *Complexity and contradiction in architecture.* MoMa.

Yin, R. K. (2014). *Case study research design and methods* (5th ed.). Thousand Oaks, CA: Sage.

Zappulla, C., Suau, C., & Fikfak, A. (2014). The pattern making of mega-slums on semantics in slum urban cultures. *Journal of Architecture and Urbanism*, *38*(4), 247–264. doi:10.3846/20297955.2014.987368