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Traces of Aydın Boysan's Architectural Practice in an Industrial City: The Case of Kocaeli

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Abstract

Industrial areas within a city are one of the important components of urban memory, shedding light on the economic and social life, architectural design and building technologies of their era. However, modern research by architects on the industrialization process of Kocaeli, one of the most important industrial cities in Turkey, which has left important traces in the city, is insufficient. Leading architects of the period played an important role in the city's path to becoming an "Industrial City". Architect Aydın Boysan is a valuable professional who realized the pioneering architectural designs of his period in Kocaeli and made significant contributions to the city. Boysan, who designed many industrial buildings in Turkey, is the architect of four large industrial sites built in Kocaeli. These four buildings were not only important centers of production in their respective sectors for the country, but also unique representatives of modern architecture that was influential all over the world. It is an important responsibility of architectural historiography to bring these works of modern architecture, which shed light on an era, to the agenda and into the literature before they are lost. This study examines the structural, formal and functional characteristics of the facilities and their status today through Boysan's architectural identity and design approaches to industrial buildings. These facilities started operations in the 1960s, an important historical threshold in Kocaeli's transformation into an industrial city. Research on these representations of Boysan's unique modernist architectural style expands our knowledge about the production of the built environment for an industrial city and reveals traces of an important architect of the period.

Keywords:
Architectural design, Aydın Boysan, Industrial buildings, Industrial city, Kocaeli.

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INTRODUCTION

Although the history of today's industrial cities dates to the 19th century, the major industrialization initiatives in cities began in the 20th century. With the industrialization process, a new historical layer was added to cities. Separating these historical layers, then understanding and interpreting the conditions, ideas, and contexts that shaped the process of architectural production provides a perspective that can shed light on the period. In an industrial city, these layers are shaped by the architectural form languages that represent the intellectual and ideological approaches of the architects designing the built environment. In this context, analyzing the architects and their products can offer a perspective for interpreting the period.

The 1960s, when industrialization gained great momentum in Turkey, were years in which contemporary and original technologies experimented with a modern style in building production with the influence of global post-war modernism (Elmalı Şen et. al., 2014). Rapid industrialization between 1960 and 1980 began to form the character of industrial cities in the country and these cities began to be populated with pioneering institutions for mass production. Kocaeli, the subject of this study, is one of the most important cities of Turkey that took great steps towards becoming an industrial city during this period (Müştak Sevindik and Şenyurt, 2023). Attracted to the city by the political policies of the period, the industrial investments with large domestic and foreign capital and the industrial organizations established in the city were designed by well-known pioneering architects of the period. It would not be wrong to say that these organizations' buildings, which are the first large-scale industrial enterprises of their sector, are also seen as prestigious representations and reflect the architects' unique modern architectural style along with the latest building technologies of the period.

Architectural research on the industrial buildings of Kocaeli, whose city image is based on a strong industrial identity, mostly focuses on the Paper and Cellulose Factories (SEKA), an important industrial enterprise of the early Republican period, and its transformation processes (Yurtoğlu, 2017; Çakır and Gönül, 2015; Oral Aydın and Çömlekçioğlu Kartal, 2010). Many industrial facilities were built in a modern architectural style between 1960 and 1980, when industrial breakthroughs took place in Kocaeli, which contributed to the city's industrial identity and have not yet been the subject of scientific research. Among these, the architectural works of Aydın Boysan, who is known by the public as a writer rather than an architect, have an important place and been the subject of only a limited number of studies (Altay, 2012; Batur, 2018; Bilsel, 2002; Okumuş and Ediz, 2022; Tuna and Yapıcı, 2004). This research gap constitutes the main motivation for this research.

Aydın Boysan is a pioneering architect who designed many large industrial buildings all over the country. Sütlüce Arçelik Refrigerator

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Factory, Bakırköy Unilever Margarine Factory, Yalova İpek Paper Factory, Orhangazi Döktaş Engine Block Casting Factory, Tuzla Alamsaş Facilities, Trakya Yarn Factory, Bisaş Bursa Yarn Factory and Bursa Dosan Canning Factory are just a few of the 29 large industrial facilities designed by him (Boysan, 1997; Bilsel, 2002; Boysan, 2017; Batur; 2018; Okumuş and Ediz; 2022). With Boysan's unique design approach, his signature can be seen in four large industrial buildings in Kocaeli. These buildings are valuable works of modern architecture that represent the contemporary construction technology of the period and Boysan's unique design approach. The fact there is limited data in the literature on such important buildings and one building has been demolished are among the factors that make the research difficult but necessary.

Within the scope of the study, texts, interviews and photographs obtained from printed and electronic sources such as books and journals were collected, and the research was supported by photographs and on-site observation data from field trips. This article creates a discussion ground for the transfer of important works of modern architecture by architects in an industrial city like Kocaeli to the future by making them visible before they are lost. It is thought that Aydın Boysan's original and poetic architectural and structural approach can guide and pioneer future designs.

AN INDUSTRIAL CITY: KOCAELI

The 19th century was undoubtedly one of the greatest "*change*" in the history of humanity. The industrial age, in addition to creating a new technical style, also gave rise to new techniques for tasks that completely transformed life. This is where the fundamental difference emerges between the technical developments throughout human history and the techniques of the 19th century industrial age. Industrial age techniques have infiltrated daily life, including objects used, working styles and social activities (Freyer, 2018).

Industrialization can be expressed as the transition from a socio-economic system in which agricultural activities are effective to a socio-economic system in which industrial activities are effective. The concept of industrialization is a multifaceted set of phenomena that cannot be explained only by a change in the mode of production, because industrialization has the power to directly affect and transform the city and society. According to Harvey (2012), "*Industrial Cities*" refers to a rationalized and automatized system for mass production and consumption. The "*tendency of industrial cities to be a completed system*" is also expressed by Lefebvre (2016). This is because industrial cities need to be organized like a living organism to survive and meet their housing, production and consumption needs. The main components of industrial cities are production structures, which are usually close to water sources, have accommodation units for workers and middleclass employees located close to the production structures, include

transportation networks (railways) and various streets and boulevards are built in the gaps left by loading stations (Mumford, 2017). With the industrialization process, a new historical layer is added to a city and this impact lasts for many years.

Understanding the historical background of Kocaeli's production relationships before it became an industrial city is important for interpreting the process. Kocaeli has held a strategically important position throughout history due to its location on an axis connecting Asia and Europe and its north–south coasts on the Black Sea and the Sea of Marmara. This has enabled the city to host many civilizations in its hundreds of years of existence. The history of the city dates to early antiquity (Pausanias, 1984). Until the 14th century when it came under the rule of the Ottoman Empire, Kocaeli was one of the most important trade cities of the Byzantine Empire for many years due to its proximity to Constantinople (Istanbul), location on important trade routes between Asia and Europe, and maritime connections (Texier, 2002). It can be said that Kocaeli's first steps towards becoming an industrial city of the future were taken during the Ottoman period. Industrialization movements in the city started in the mid-19th century (Ulugün, 2007).

In the first quarter of the 20th century, the Ottoman Empire was in a period of disintegration and the outbreak of World War I made industrialization difficult and resulted in the destruction of many industrial establishments when they took heavy blows during the war. The basic development policy of the newly established Republic of Turkey, within the scope of the principle of statism, was to open industrial enterprises in priority industries across the country, thus ensuring socio-economic development in cities and for the whole country. In this context, institutions such as the SEKA (paper and cellulose mills), which have an important place in the city's history, were established in Kocaeli (Kocabaşoğlu et al., 1996).

The Democrat Party came to power in 1950 and changed the previous economically balanced and protectionist approach (Tunç, 2016). The general approach that was effective in the country during this period was to support private enterprise and capital, to increase import and export volumes, and to increase foreign trade. Between 1950 and 1960, the Mannesmann - Sümerbank Pipe Factory, a large-scale industrial enterprise, started operations (Borusan Mannesmann, 2008). With the state's support of domestic and foreign private capital in industrial initiatives from the 1960s onwards, many companies that are pioneers in their sectors in Turkey started production activities in different parts of the city. Following the large-scale industrial facilities in the city, it can be said that industrialization movements spread towards the Gebze-Dilovası and Kartepe-Başiskele regions in the 1960s.

One of the most important steps towards Kocaeli becoming an *Industrial City* has undoubtedly been the yearly industrial fairs. Under the leadership of the Izmit Chamber of Commerce and Industry, the first Kocaeli Industry Exhibition was opened in 1966 with a grand ceremony

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and participation of 48 industrial organizations from Gebze to Köseköy (Kocaeli Sanayi Sergisi, 1969).

With all these successive developments in industry between 1960 and 1970, the identity of Kocaeli as an *Industrial City* became more established and the face of the city changed dramatically in this context. While İzmit was the center of industrialization movements in the city in previous years, they expanded to the east (Kartepe-Başiskele) and west (Gebze-Dilovası) of İzmit around the D-100 highway.

AYDIN BOYSAN'S ARCHITECTURAL PRACTICE AND DESIGN APPROACHES ON INDUSTRIAL BUILDINGS

Aydın Boysan, known as a writer by the majority of society, is also an architect who has a place in the history of modern architecture as an important actor in Turkey. For Boysan, who was preparing to start university in Istanbul during World War II, architecture was an alternative option to the medical school. After enrolling in both faculties, he decided to continue as an architect, following his interest in architecture (Boysan, 2008). He graduated from the Academy of Fine Arts, the only school on architecture in Istanbul at the time (Boysan, 2007).

Boysan's architectural practice is inspired by two main components that have been at the core of architecture throughout history: material and construction. It would not be wrong to say that Boysan's sensitivity to materials and structure dates to his early years as a student at the Academy of Fine Arts. He states his beloved teacher, Turgan Samis, whom he met during his Statics course, connected him to architecture (Bilsel, 2002). His search for bold structures from his student years continued throughout his professional life.

In his article "*A Series of Oddities*", Boysan talks about the importance of the correct use and application of contemporary and technological structural systems developed with steel and high-strength concrete materials. However, he also states that aesthetics should be considered after the structure and materials are designed with the right construction (Boysan, 1999). The fact that Afife Batur refers to Aydın Boysan as "*the architect who wrote the poetry of structure*" can be considered an indication that he is known for his unique style in the architectural community (Batur, 2018).

According to Boysan, all quality works that have survived to the present day have been designed with an honest and unforced use of structure and materials (Boysan, 1970a). In a 1993 speech, he expresses how masterfully and aesthetically Mimar Sinan used masonry construction for Süleymaniye Mosque with the building technology of the period and that Kenzo Tange skillfully designed an aesthetic building with a suspended construction design, the contemporary building technology of the period, with a similar approach in the Yoyogi National Sports Hall. He states that Mimar Sinan and Kenzo Tange, as architects belonging to different cultures and periods, were similar in

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the way they designed the aesthetic building fiction with the right materials and contemporary construction systems of the period to create quality architectural works (Boysan, 1970b). In this context, architecture is not only an aesthetic art object, but also an intricate phenomenon that has economic, social and technical aspects and imposes important responsibilities on the practitioner (Boysan, 1970a).

Boysan's architectural design principle is also based on the phenomenon of "*flexibility*". Creating flexible spaces and volumes with the idea that architecture has the potential to adapt to life as it changes and transforms, and does not have sharp distinctions, is a design approach that increases the functionality of architectural works by allowing them to be used for many years. One of the 20th century's most striking statements on architecture, Adolf Loos' "*Ornament is crime*", can be considered another fact on which Boysan's architecture is based. Boysan considers the ornamentation added by the architect as an attempt of deception that complicates people's perception of the building and goes beyond architecture. He clearly states that knowing how to stand at the limit of what is sufficient is also a work of courage and making building elements complex and inconsistent makes architecture arabesque and incomprehensible. Meanwhile, doing the simplest, least costly solution often emerges spontaneously (Boysan, 1987). The phenomena of flexibility and simplicity seen in Boysan's design approach are supported by the idea of modular design. Modular design, which facilitates the planning and production process and allows construction to be completed faster, refers to designing with internationally accepted standard dimensions.

Boysan points out that the human perception of the interior space is one of the main elements to be considered in architectural design. The correct perception of the space from the inside, the ability of people to visually comprehend their position in it and the interior of the building in its entirety, and to feel comfortable and safe with sufficient natural lighting are among the prerequisites for a good design (Boysan, 2017). Consequently, the building establishes a satisfying spatial relationship with its user beyond being aesthetic and functional.

Industrial buildings have an important place in Boysan's architectural practice. Although he does not find it right to define himself as an "*industrial architect*", he is among the few architects of the period who frequently designed industrial facilities in the 1950s and 1960s, when Turkey experienced the fastest industrialization process, and took an active role in their construction process.

Aydın Boysan's architectural design principles are also valid for industrial buildings. The main component of industrial organizations are production structures. The manufacturing flow diagram (layout plan) is the main determinant in the design of these structures. In the manufacturing flow diagram, the location of the machinery and other tools required for production, the area they occupy and their relationships with each other are shown. It also indicates the raw

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material inlet, the stacking location of the prepared product and transfer points for the finished product. Realizing a design in accordance with the manufacturing flow diagram should be the first criterion to be considered in industrial buildings. With this data in the diagram, the architect can decide on the approximate location of the production facility in the site plan, its average size, heights that may be required, number of floors and possible structural form. In the structural form of production facilities, highly effective architectural solutions can be produced with shell-folded slabs, suspended structural systems and space bearing systems. Collaboration with structural engineers is also important to realize successful structural forms (Boysan, 1970b).

Boysan draws attention to the necessity of considering "*flexibility*" in the design of production facilities. While the means and methods of production are improving daily, the production capacity in the sectoral market tends to increase over time. In this context, while designing, it should be considered that the production facility can increase capacity and grow in the future. In the facility design process, the architect should collaborate with electrical and installation engineers for the relationship to be established with ancillary facilities (such as the boiler room and transformer) required for proper functioning of the structure. In structures such as administrative and social facilities, which are not directly related to production, architects can make more individual decisions since they do not require separate technical knowledge (Boysan, 1970b).

MATERIALS AND METHODS

This is a qualitative study focusing on industrial facilities designed by Aydın Boysan and built in Kocaeli province: Kartonsan Cardboard Factory, Turkish Cable Factory, Arçelik Washing Machine Factory and Nasaş Aluminum Sheet and Foil Factory. The study methodology involves, in the first stage, a comprehensive review of archival materials, mainly printed and digital texts and photographs from the national literature. The archives consist mostly of books and journal texts prepared from interviews given by Aydın Boysan. Information and photographs of projects published by Aydın Boysan in Mimarlık journal were also accessed and used in the study. The book titled *"Boysan"*, published in 1997, which contains summarized information about Boysan's architectural projects throughout his professional life, was utilized. The aim was to create a basis for comprehensive understanding with the existing literature.

After this stage, which constitutes the basis of the study, the facilities were visited for on-site identification-observation with official permission within the scope of scientific study. In this process, identification and documentation work was carried out with photographs. The data obtained at this stage provided information about the buildings' current state and gave an idea about the changes they have undergone. With on-site observations and determinations

made, the data previously obtained from printed sources were overlapped with aerial photographs to visualize the changes by giving the legends “original factory area” and “current factory area”. The only exception is the Turkish Cable Factory, which was demolished.

The limitations of the study were lack of access to primary sources of information (Designer-Employer-Contractor) and the limited literature available. In addition, the fact that one of the facilities was demolished made the study difficult. In the light of all the written and visual data obtained, four facilities were examined according to their construction date, original function, total enclosed area, structural system of production and other buildings, architectural style and characteristics of geometry, lighting system and material, façade material and current status and function (Figure 1.).

The findings and insights gained from this research will not only document the modern architectural industrial heritage in Kocaeli, but will also contribute to the understanding of Boysan's timeless architectural and structural design at an international level, guiding and contributing to future designs.

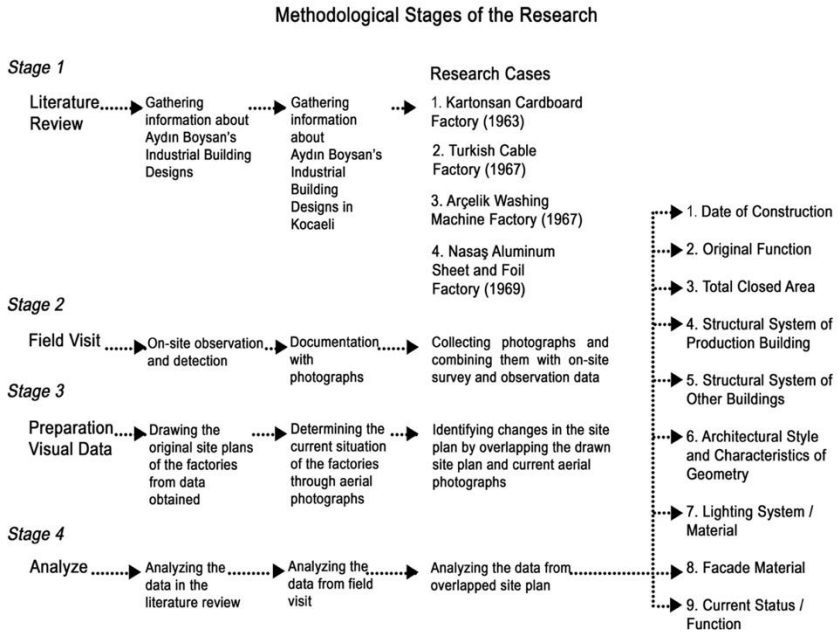

Figure 1. The methodological stages of the research

RESEARCH ON INDUSTRIAL BUILDINGS BY AYDIN BOYSAN IN KOCAELİ

In the 55 years he practiced architecture between 1945 and 2000, Boysan designed a total of 1.5 million m^2 of building space with various functions. Among these designed buildings, 29 large industrial buildings were constructed (Batur, 2018). Four of the industrial buildings are in Kocaeli (Figure 2.).

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Figure 2. Aerial photograph of the locations of industrial buildings designed by Aydın Boysan in Kocaeli

Within the scope of the study, the industrial buildings whose design belongs to Aydın Boysan are analyzed chronologically based on date of construction. The brief history of the industrial organization, location of the building group in the city, site plan and architectural design decisions, structural features and current status are discussed.

Kartonsan Cardboard Factory

SEKA are the most important initiatives of the industrialization steps of the Republican Era in the paper and cardboard sector and have been operating as the first and only large enterprise in the paper sector in Kocaeli for many years. Kartonsan Cardboard Factory, the second institution in Kocaeli to produce paper and cardboard after SEKA, was the first private large-scale production factory established in the city (Figure 3.).

Figure 3. Advertisements from 1971 and 1974 (Kocaeli Sanayi Rehberi, 1974; Kocaeli Sanayi Fuarı, 1971)

Designed by Boysan, the factory was built in 1963 in the Başiskele district of Kocaeli (Figure 4.). It is on flat land east of the Gulf of Izmit and south of the Kiraz Stream (Figure 5.). The entrance to the factory site is provided via Karamürsel Street on the south side of the land. The original building area consists of a 21,500 m^2 enclosed area consisting of the production facility, social facility, administrative facility, warehouses, transformer and boiler room (Boysan, 1997).

Figure 4. Southwest view (Boysan, 1997)

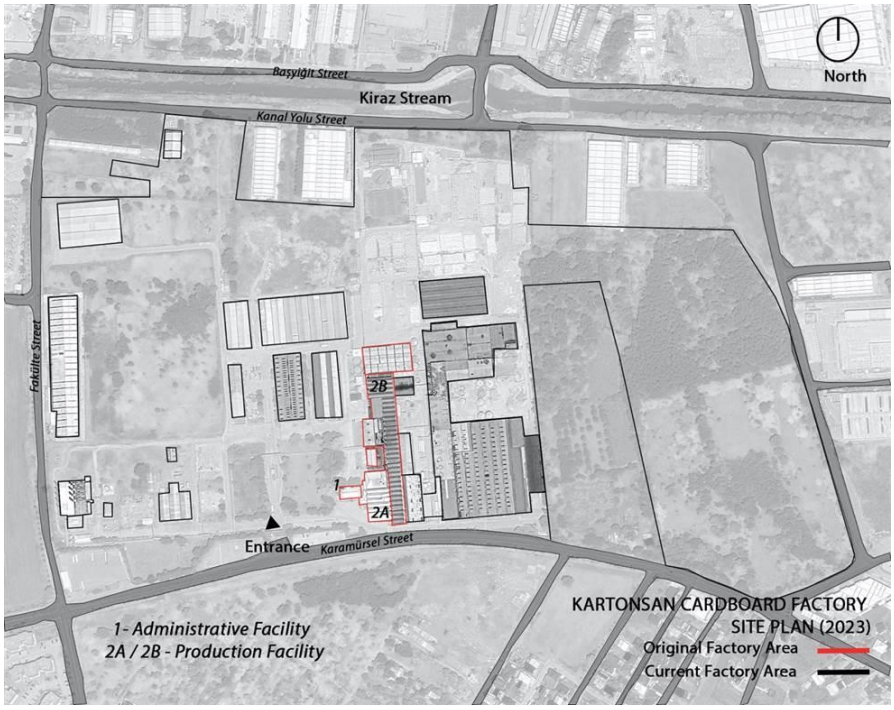

Figure 5. Current site plan (created by authors)

Starting from the entrance of the factory site, all facilities are on the eastern side of the land in relation to each other. In Boysan's approach, it is assumed the west side of the land was left as a development area in consideration of possible future growth potential. When the layout decisions are analyzed, the production facility and warehouses are on the north-south axis, while the social and administrative facilities are on the east-west axis in the opposite direction. It can be said the project aims to capture functionality, which is always prioritized in the relationship between buildings, with asymmetry that provides balance between the masses. The transformer and boiler rooms are to the east of the production facility. Within the factory site, there are open stock areas, raw and finished materials entry/exit areas, and a service road that surrounds the entire land and provides access to all buildings. Since the production facility requires a large spatial space for mass production machine lines, the modular reinforced concrete structural system is

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complemented with reinforced concrete folded gable roof slabs (Figure 6.).

Figure 6. Kartonsan Cardboard Factory administrative and production facility (Boysan, 1997)

The folded slabs create a three-dimensional geometric effect and strengthen the architectural effect of the roof. The natural lighting required in the space is provided by rhythmically repeating band windows above eye level between the modular structural system. In the administrative facility, a modular reinforced concrete structure is constructed with a terrace roof. The horizontal band windows in the production facilities are replaced by vertical windows with larger surfaces and sunshades in the administrative facility.

While the production facilities have a more geometrically emphasized structural expression, the administrative facility is designed in a more modest way. With this approach, the production facilities are the first to attract attention at the factory site (Figures 7. and 8.).

Figure 7. Southwest view (S. Müştak Sevindik Archive)

Thanks to Boysan's flexible and modular design principle applied in industrial buildings, the building maintains its functionality and production today. The fact its shell has the potential to respond to current needs over time has carried the building from the day it was built to the present day. With nearly 60 years of history, the building complex has evolved over time according to the contemporary production needs of the original structures. It still exists in the city as a valuable work of architecture with its simple and modern style of its period and qualified constructive architectural elements.

Figure 8. Administrative and production facility (S. Müştak Sevindik Archive)

Turkish Cable Factory

As with many other sectors, the 1960s were years when Turkey started new initiatives to catch up with the latest technologies in the electricity and telecommunications sectors. Instead of the old types of conductor cables with paper insulation and lead sheaths, modern aluminum conductor cables with plastic insulation, a new technology that had been used abroad for many years, began to be preferred. However, aluminum conductor cables, which could not be produced in the country during this period, had to be imported. This resulted in a high cost and loss of time, including the transfer process in product procurement. T to meet this need in the country, the Turkish Cable Factory was established in 1963 through the initiative of Etibank in partnership with Finland and the United States of America (NTV Haber, 2000) (Figure 9.).

Figure 9. Advertisements from 1974, 1975 and 1982 (Kocaeli Sanayi Fuarı, 1974; 1975b; 1982)

The factory site of Turkish Cable Company, which has an important place in the history of Turkish industry as its first initiative in this sector, was designed by Boysan and became operational in 1967 (Boysan, 1997) (Figure 10.). Turkish Cable Factory is in the Derince district of Kocaeli, south of the D-100 highway, close to the Gulf of Izmit. The entrance to the factory site is via Ergenekon Street, to the east of the site. The two production facilities built to produce aluminum wire and

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telephone cable, the administrative facility and warehouse building have a total enclosed area of 13,800 m^2 (Boysan, 1997).

When one enters the factory site by passing through the security checkpoint on Ergenekon Street, the administrative facility, built with a reinforced concrete frame system, is on the north side. Opposite this facility, where the administrative units are located, are two production facilities located side by side (Figure 11.).

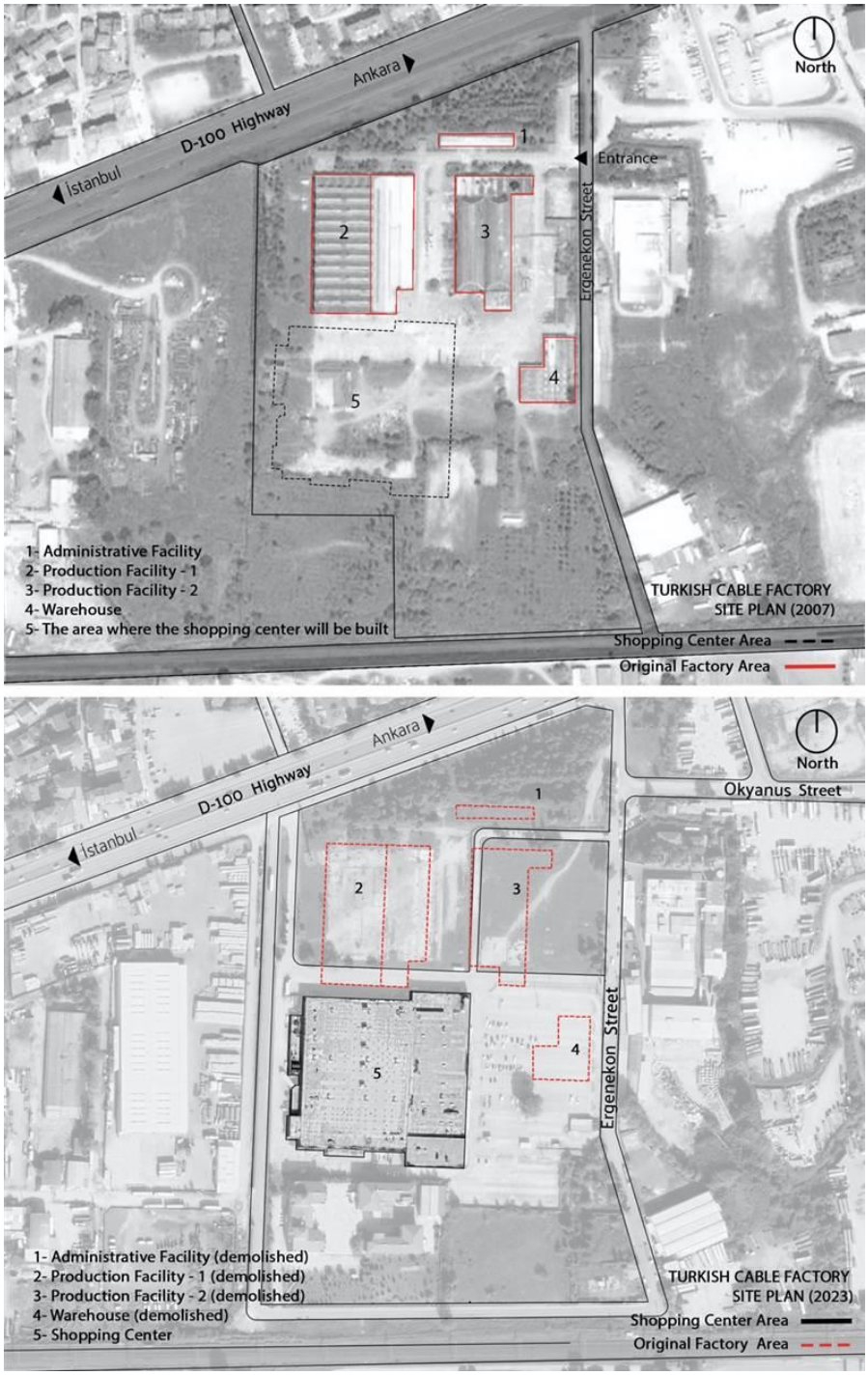

Figure 10. Site plan comparison for 2007 and 2013 (created by authors)

Figure 11. Northwest view (Boysan, 1997)

Constructed with a reinforced concrete frame system, the production facility utilizes Boysan's signature folded reinforced concrete slabs. The construction geometry, consisting of three-dimensional triangular folded slabs, which we will later see in the Arçelik Washing Machine Factory, together with the steel roof construction, forms the building's architectural characteristic. In the production facility, in addition to providing the ideal physical conditions required for manufacturing, attention is paid to the construction geometry and aesthetics in the architectural fiction. In doing so, the idea of designing flexible spaces and volumes that are not ossified, which Boysan is sensitive to in the design of industrial buildings, comes to the fore. In the facility design, he has aimed to produce a replicable module that can respond to possible future spatial needs. The potential to expand modularly over time is seen as the strongest aspect of the production facility design (Figure 12.).

In the production facility, skylights running linearly along the roof are used to illuminate the interior with natural daylight in the large openings crossed by the steel roof construction due to the manufacturing scheme. The interior space is also illuminated by horizontal band windows on the façade. These are designed as reverse transom windows opening to the outside and function as natural ventilation (Figure 13.).

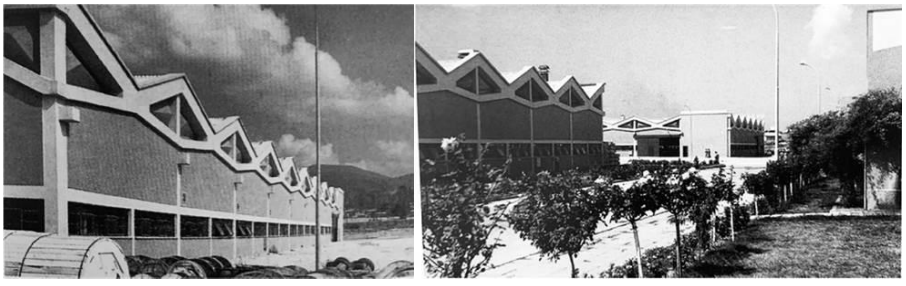

Figure 12. Reinforced concrete folded slab geometry of the production facility (Boysan, 1997)

Figure 13. Roof skylights and windows on the façade, which provide natural light to the interior (Boysan, 1997)

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It was reported in the press that production at the Turkish Cable Factory was halted in 2005 due to a financial crisis (Evrensel Haber, 2005). In 2007 aerial photographs, it was determined that facilities within the factory site were still standing. In the 2009 aerial photographs, it was determined that all buildings in the factory site, except for the administrative facility, had been demolished. In the 2011 aerial photo, it was seen that the administrative facility was also demolished. A shopping center and open parking lot were built on the south side of the factory land. The area to the north is still idle today.

Arçelik Washing Machine Factory

The opening of the economy to foreign markets with decisions taken by the political power in the 1950s increased imports of technological products into the country. In particular, many technological household goods used in daily life began to be imported from Western countries to large cities in Turkey after 1950. With support provided by the state in this period, it was aimed to attract domestic and foreign capital to the country and start production of these imported products in the country's market. One of these initiatives was the establishment of a multi-partner company called "*Erel Çelik Eşya A.Ş.*" in Sütlüce, Istanbul, with the aim of producing office furniture (Altay, 2012). The company name was later changed to "*Arçelik A.Ş.*". A pioneer in the field of machinery technology and production in Turkey, Arçelik produced the country's first domestic washing machine and refrigerator in its facilities in İstanbul - Sütlüce (Ovalıoğlu, 2007) (Figure 14.).

Figure 14. Advertisements of Arçelik (Durur, 2015)

Demand for these products, which are needed in domestic homes, increased as a result of frequent advertisements across the country and the production facility in Sütlüce, Istanbul, was unable to meet this growing demand. The decision was taken to build a new factory in Çayırova, Kocaeli, based on the idea of high-capacity production in a larger area. The new factory was designed by Aydın Boysan. The factory site, which has a enclosed area of approximately 50,000 m^2, includes production blocks, social facilities, warehouses, a transformer and a heat center. On the sloping north side of the plot, a total of 54 residential units were designed in nine blocks.

Built on a large plot of land north of the D-100 highway in Çayırova, the factory site is accessed via Yanyol Street on the south side (Figure

15.). After passing through the security checkpoint, the main production facility welcomes you. Providing physical conditions suitable for the production scheme, which is the main factor Boysan pays attention to in the design of industrial buildings, was the first component that shaped the design. The fact a mass production belt system will be used in the manufacturing process reveals the need for a high volume with wide openings that allow movement. At the same time, a steel roof system was preferred over a reinforced concrete frame system to accommodate the suspension and transfer systems that may be required in serial belt production.

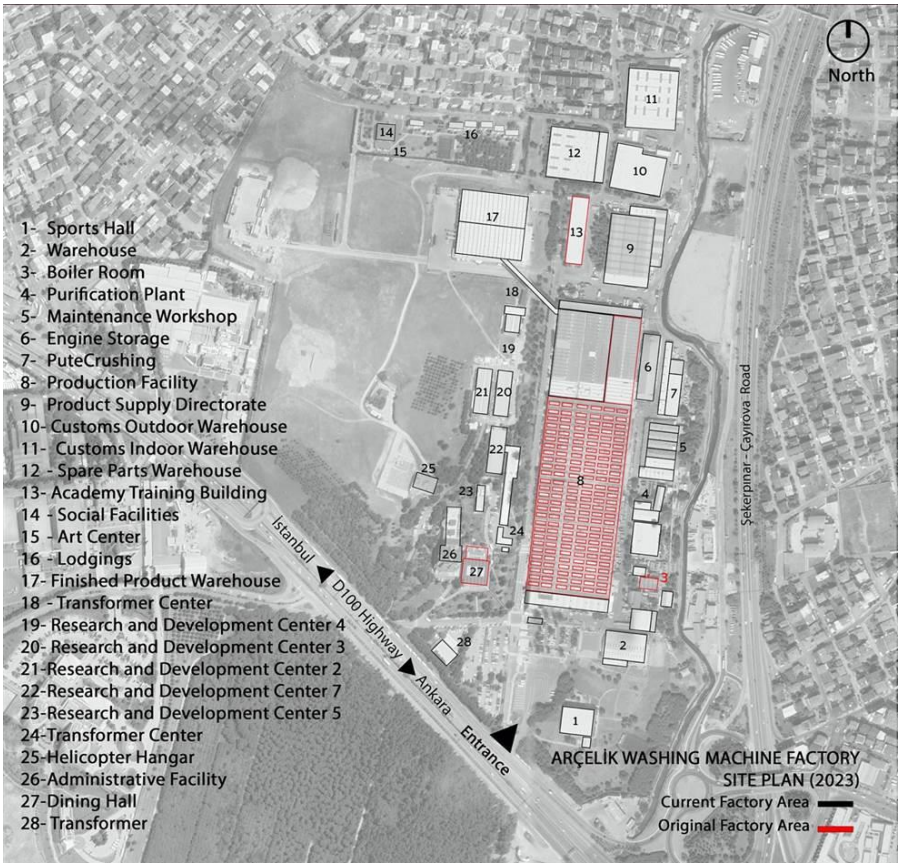

Figure 15. Current site plan (created by authors)

The production facility is equipped with an overhead gantry crane capable of moving in all directions and with a capacity of up to 10 tons. Since the steel roof carriers can also be used for suspension and transfer purposes, care was taken to ensure the roof covering is light so as not to create additional load. Designed to be compatible with different use cases in the future, the production facility is designed as a flexible volume for possible overhead crane movements and hanging conveyors. Modular column axis spacing is also designed to allow for future expansion of the production facility (Figure 16.).

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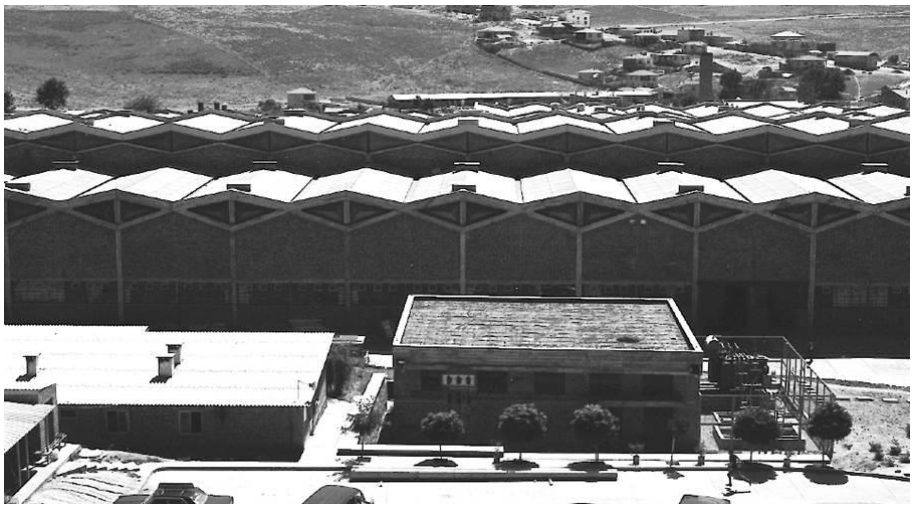

Figure 16. West façade of the production facility (TMMOB Mimarlar Odası İstanbul Büyükkent Şubesi, 2017)

To allow natural light into the interior space and support the lightness of the roof, fiberglass skylights were used in the ridge sections above the main trusses at a rate of 30% of the roof. In this way, in addition to the positive psychological effect of natural lighting in the interior, costs associated with artificial lighting are reduced (Figure 17.).

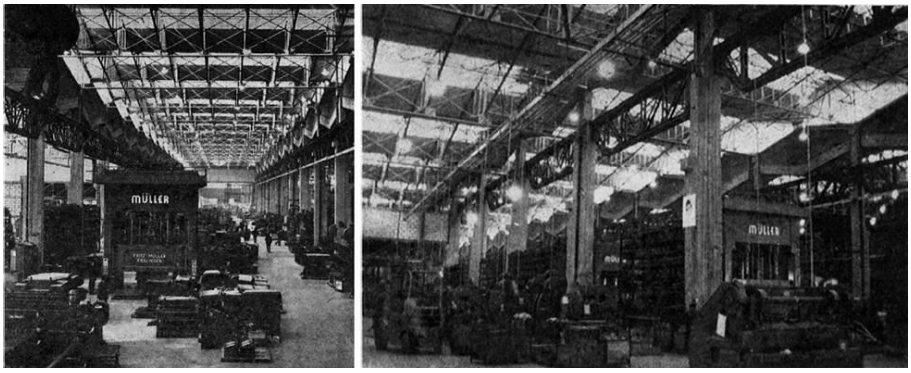

Figure 17. Interior of the production facility (Boysan, 1970c)

On the façade of the production facility, unplastered jointed brick and exposed concrete are used in a simple and plain style. The most striking architectural element on the façade of the production facility is the three-dimensional triangular folded reinforced concrete slabs, similar to those seen in the Turkish Cable Factory. Batur (2018) describes this poetic geometry as a "trio of triangles". This strikingly and precisely constructed structural combination directly reflects Boysan's understanding of architecture. The fiberglass skylights used in the interior space of these triangular reinforced concrete architectural elements allow natural light into the interior space, thus making the aesthetic structural construction functional.

A different construction of folded reinforced concrete slabs was applied in the social facility building. Especially in the "*Menza*" Hall (dining hall) of the social facility, the reinforced concrete folded plate roof system, cantilevered outward in both directions, carried by eight *"V"* shaped columns with triangular openings, strengthens the architectural effect of the mass. In this building, fiberglass skylights are

used between the folded reinforced concrete slabs on the roof. Menza Hall, with its folded reinforced concrete roof slabs and vertical sun shading elements on the façade, "V" shaped columns in the interior and roof skylights, creates an impressive architectural atmosphere indoors and outdoors. At the same time, with its roof and façade movements, it has an imaginary quality that is recognized in the general silhouette of the factory site (Figure 18.).

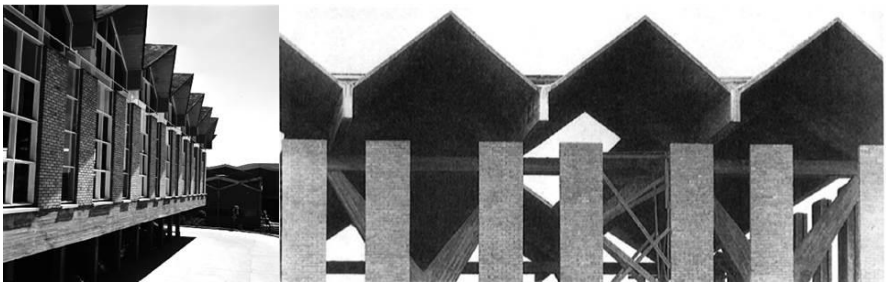

Figure 18. Façade of the social facility (Boysan, 1970c)

Designed in nine blocks on the northern slope of the factory site, 54 housing units are constructed with a reinforced concrete frame system, side by side in a north–south direction. Vehicular and pedestrian roads, parking lots and outdoor sports areas are designed in this section planned as lodging (Figure 19.).

Figure 19. Lodgings (S. Müştak Sevindik Archive)

The factory designed by Boysan is still in use today as it has been able to respond to spatial needs despite changing and evolving technological needs for more than 50 years. However, as a result of increasing production demand over time, some expansions were made in the production facility and additional structures were built within the factory site. Warehouses, research and development buildings, a service academy building where employees are trained, a workshop 4.0 building, an administrative facility, a new social facility and an art center were built (Figure 20.).

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Figure 20. Service academy and workshop 4.0 (S. Müştak Sevindik Archive)

Boysan's modular solution to this situation, which he had envisioned while designing the building, allowed the facilities to be expanded, but the expansions were realized with a different form than the original. Although a common architectural language was attempted on a material scale, the triangular geometric form on the façade, which Boysan envisioned and constitutes the main characteristic of the factory site architecture, was not maintained in the later expansions and additional buildings, which negatively affects the geometric effect of the entire factory site architecture (Figure 21.).

Figure 21. Expansion of the production facility (S. Müştak Sevindik Archive)

Of the bachelor's lodgings, infirmary and dining hall, which Boysan called the social group, only the dining hall units have survived to the present day. The bachelor's lodging was demolished and the infirmary was later resolved within the production facility. The cantilever section, which was designed in the dining hall section of the social facility building and gave the mass the effect of flying in the air, was closed. The air conditioning units added to the façade also damaged its architectural effect. The skylights on the roof were partially closed and the natural light received by the interior from the roof was thus reduced (Figure 22.).

Figure 22. Social facility (S. Müştak Sevindik Archive)

Arçelik Washing Machine Factory, one of the most important industrial initiatives of the 1960s, is an important milestone for the city and country as one of the first large-scale industrial enterprises to use the mass production belt system, which continues production uninterrupted from the day it was built until today. It is also a valuable work of architecture designed in the modern and simple architectural style of the period with a unique brutalist structure formed with triangular folded plates, which is Aydın Boysan's signature. The impressive architectural image of the preserved original structures can still be felt today.

Nasaş Aluminum Sheet and Foil Factory

Aluminum has been widely used in many sectors since the 19th century due to its properties of lightness, corrosion resistance and easy processing. Especially with the modern extrusion method developed in the 1920s, the use of aluminum in architecture gained momentum over time (Uz, 2019). In his article titled "*Metal Roof Coverings*" in *Arkitekt Journal*, Abidin Mortaş mentions that in new architecture, sloping roofs covered with materials such as tiles, eternite and slate are replaced by roofs constructed with metal materials such as lead, copper, zinc, iron and aluminum. The article states that aluminum, which is preferred especially in industrial buildings due to its high resistance to various gases as well as its light weight and ability to be bent into the desired form, is frequently used in America, Germany and Switzerland (Mortaş, 1931).

Although steel construction buildings with metal joinery and large glass surfaces, which was effective in the 1950s, attracted the attention of architects in Turkey, the lack of modern material knowledge and supply made it difficult to implement such buildings (Uz, 2019). In the 1960s, public and private sector initiatives on aluminum gained momentum. One of these initiatives was the Nasaş Aluminum Factory, which was established in cooperation with the private and public sectors. Nasaş Joint Stock Company was established with support from the Industrial Development Bank of Turkey, İş Bank of Turkey, Akbank, Turkish Commercial Bank, Civil Servant Retirement Fund, World Bank and individual capital (Arkitekt, 1973) (Figure 23.).

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Figure 23. Advertisement from 1975 and 1978 (Arkitekt, 1978; Kocaeli Sanayi Fuarı, 1975a)

Located north of the D-100 highway in Kocaeli's Dilovası district, the factory was designed by Aydın Boysan (Figure 24.). With a 40,000 m^2 enclosed area in a 200,000 m^2 factory area, Nasaş Aluminum Factory produces corrugated, trapezoidal and flat aluminum sheets for roof, façade and ceiling coverings from aluminum supplied from outside as raw material (Arkitekt, 1973).

The entrance to the factory site is via Dicle Street, 1010th Street, which is north of the D-100 highway. After the gate control point, there are administrative and social facilities designed side by side and interconnected with each other, and the production facility in the southwest direction. Boysan considered human–vehicle circulation and the possibility of the production facility growing over time while making site plan decisions regarding building locations (Boysan, 1974) (Figure 25.).

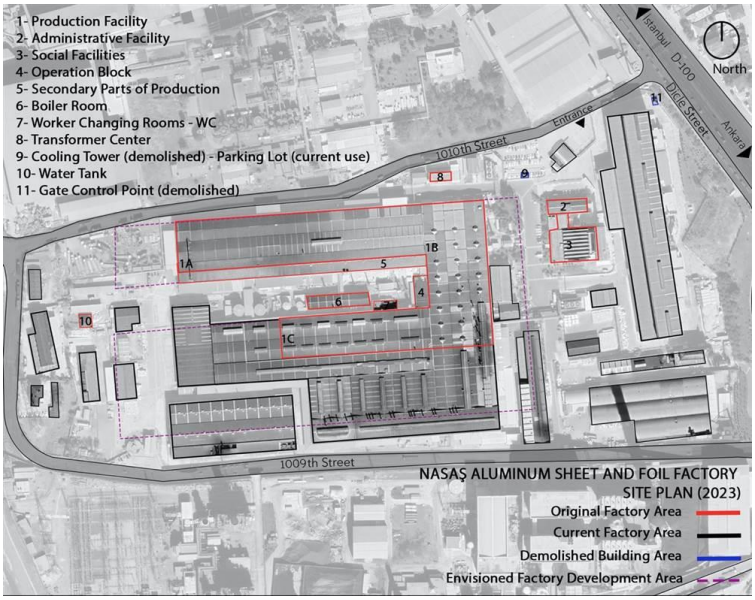

Figure 24. Current site plan (created by authors)

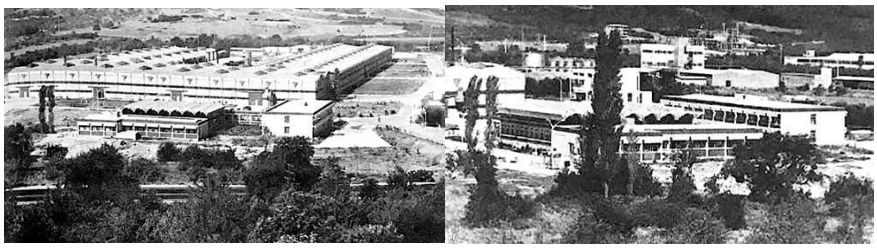

Figure 25. General view (Boysan, 1974)

The *"U"* plan design preferred for the production facility puts the heat plant (boiler room), one of the important components of the facility, at the center, along with the business offices and laboratories. This planimetric form is designed with the assumption that the building can expand in all four directions in the future. According to the flow of materials within the facility, the main circulation scheme is planned linearly according to the entry of raw materials from the east and exit of product to the west. When the ground survey of the design area was examined, it was observed that the ground's bearing capacity was quite low. On the other hand, the necessity of using heavy and mobile bridge cranes in the production facility due to the manufacturing scheme led to the choice of steel in the construction selection. The 21-meter span is formed by using two articulated frames and the construction system ends with a castella beam at the top point (Figure 26.).

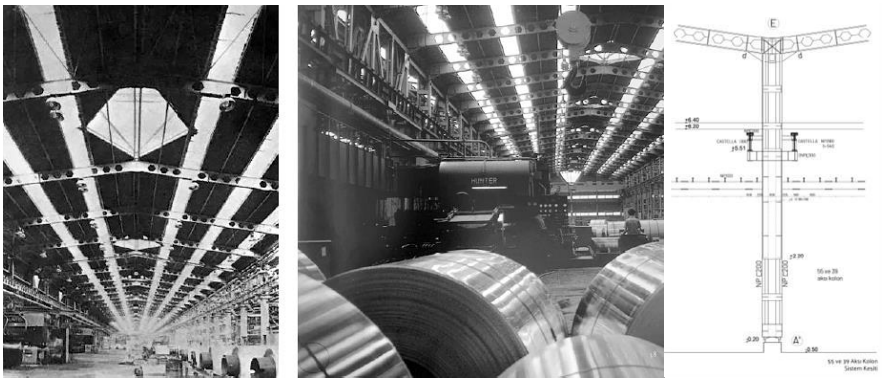

Figure 26. Production facility interior and castella beam detail (Boysan, 1974)

The main characteristic component of the production facility façade is the three-dimensional pyramidal skylights. In the production facility, which is built with a modular system seen in Boysan's other industrial buildings, the pyramidal skylights seem to be glued to the façade, which are used every two modules on average, adding an impressive sculptural architectural aesthetic. Similar to these elements, three-dimensional triangular roof skylights and double rows of band windows running horizontally along the façade provide light to the interior. The façade is clad in unplastered brick veneer with joints (Boysan, 1974) (Figure 27.).

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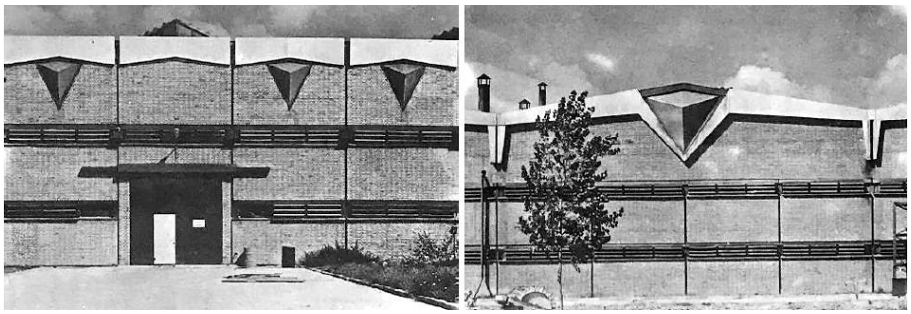

Figure 27. Façade of the production facility (Boysan, 1974)

The administrative and social facilities, which are analyzed in connection with each other, were built with a reinforced concrete frame system. In the administrative part of this section, which Boysan calls the social group, there is an information desk, administrative staff rooms and an exhibition area, while in the social part there is a kitchen, scullery, dining hall, changing rooms and toilets, storerooms and an infirmary. While a flat terrace roof was used in the administrative section, reinforced concrete folded slabs were used on the roof of the social section. The folded slab construction in the social section is supported by "*V*" shaped columns with triangular openings, similar to the one used in the *Menza* Hall of Arçelik Çayırova Facilities (Figure 28.). In both facilities, exposed concrete and constructive sunshades are preferred on the façade.

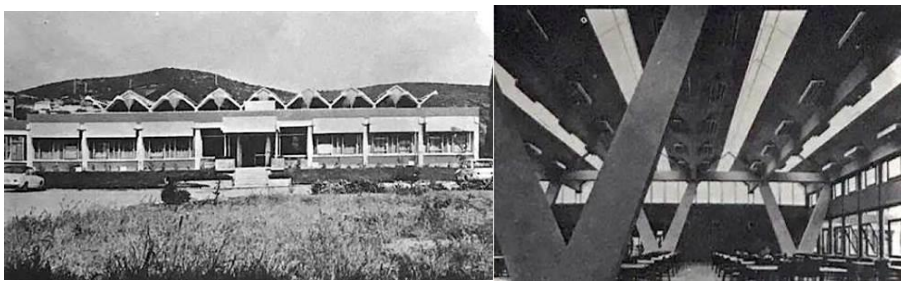

Figure 28. Interior of the dining hall in the administrative and social facility (Boysan, 1974)

The entire factory site is characterized by a functional, modern and simple modular architecture in which the construction system is at the forefront. The factory facilities have changed ownership many times due to the financial crisis (Vatan Gazetesi, 2006). The original designed facilities are still in use within the site today. As Boysan envisioned while designing, the building stock in the site has increased and the production facility has been expanded in line with the increasing market demand and developing technology over time (Figure 29.).

Figure 29. Additional building constructed on the factory site (Sayın İnşaat, 2022)

The new buildings in the factory site differ significantly from Boysan's buildings in terms of architectural form and materials. They have a steel construction with trapezoidal sheet metal cladding on the façade. When looking at the whole factory site, the original group of buildings belonging to Boysan and the large-scale buildings built later are visually differentiated. It is thought that the additional structures built in a different style within the same factory site negatively affect the original architectural characteristic. The original buildings designed by Boysan continue to exist in the factory site as nostalgic witnesses of history (Figure 30.).

Figure 30. Administrative facility (DGD Yapı, n.d.)

FINDINGS AND DISCUSSION

The findings obtained from the written and visual data collected on four industrial facilities designed by Aydın Boysan and built in Kocaeli throughout the research are summarized in Table 1.

Table 1. Research findings of industrial buildings designed by Aydın Boysan in Kocaeli

	1.Kartonsan Cardboard Factory	**2. Turkish Cable Factory**	**3. Arçelik Washing Machine Factory**	**4. Nasaş Aluminum Sheet and Foil Factory**
1. Date	1963	1967	1967	1969
2. Original function	Cardboard production plant	Cable production plant	Washing machine production plant	Aluminum sheet and foil production plant
3. Total enclosed area	21,500 m^2	13,800 m^2	50,000 m^2	40,000 m^2
4. Structural system of production building	Reinforced concrete system and steel roof	Reinforced concrete system and steel roof	Reinforced concrete system and steel roof	Steel frame construction system (castella beams and steel columns)
5. Structural system of other buildings	Reinforced concrete system	Reinforced concrete system	Reinforced concrete system	Reinforced concrete system
6. Architectural style / characteristics of geometry	Modernist / folded reinforced concrete slab	Brutalist / triangular folded reinforced concrete slab	Brutalist / triangular folded reinforced concrete slab	Brutalist / folded reinforced concrete slab

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7. Lighting system/ material	Horizontal band window/ glass	Pyramidal façade and linear roof skylights/ fiberglass	Pyramidal façade and linear roof skylights/ fiberglass	Pyramidal roof and façade skylights/ fiberglass
8. Façade materials	White plaster	Exposed concrete and red brick	Exposed concrete and red brick	Exposed concrete and red brick
9. Current status / function	Functional / coated cardboard production factory	Demolished	Functional / washing machine production factory	Functional / coil, sheet, foil and pre-painted aluminum production factory

The findings of this qualitative research not only provide important insights into the four industrial facilities and Aydın Boysan's architectural and structural approach but also reveal systematic relationships between the buildings. It is possible to see and interpret traces of the development of Boysan's professional practice in these buildings built in Kocaeli between 1960 and 1970. The common point in these buildings with different sizes of enclosed volumes for different industrial functions is that a large interior volume is covered with a light upper cover, as required by the industrial facility. For this purpose, a steel roof with a wide span was preferred in all buildings. In the main structure, a reinforced concrete system was used except for the Nasaş Aluminum plant. This preference may have been made because reinforced concrete is easier to apply and has a lower cost.

Built in 1963, the Kartonsan Cardboard Factory, the first facility in this research, differs from the other facilities in that the original façade material is white plaster. Considering the architectural features of the administrative facility, it can be said that Boysan designed using the modernist principles of the international architectural style in the early period, as he expressed in his interviews. Later, this approach was replaced by a more radical design approach in which the mass geometry became more radical and brutalist with a raw/industrial aesthetic. However, he also partially incorporated red brick on the façades, presumably to break the cold effect of concrete.

The prominent geometry characteristic in all the buildings is undoubtedly the use of modular folded reinforced concrete slabs. All buildings use folded reinforced concrete slabs in their production facilities, while some facilities (Arçelik Washing Machine Factory and Nasaş Aluminum Factory) also use this system in social facilities. While a more primitive version of this geometry can be seen in the Kartonsan Cardboard Factory, it is possible to observe that this geometry has evolved in the production process to create a more three-dimensional pyramidal effect, especially in Turkish Cable Factory and Arçelik Washing Machine Factory.

In this geometry, how light is admitted to the interior and the sculptural effect it creates on the façade have also been important. While

Kartonsan Cardboard Factory, the first facility examined, uses horizontal band windows made of glass material in line with modernist principles, the natural lighting system in Turkish Cable Factory has been replaced by linear fiberglass skylights on the pyramidal roof of the façade. The same natural lighting system was used in Arçelik Washing Machine Factory, but for Nasaş Aluminum Factory, three-dimensional pyramidal fiberglass skylights were preferred on the roof. Here, it can be said that Boysan aims to add sculptural geometry to the lighting and create an effective atmosphere in the interior. When we look at Boysan's design process, it is evident that he strives to use geometry in a more challenging way each time through the structure and capture an international industrial aesthetic.

CONCLUSION

In Kocaeli, one of the most important industrial cities of our time in Türkiye, it is known that the industrial development process accelerated between 1960 and 1980. This process created the city's unique characteristic of the built environment and industrial identity. Architects have undoubtedly played a major role in the formation of this characteristic of the city. In this context, analyzing the works of architects whose traces are found in the city is an important step towards understanding the architectural building technology and design approaches of this historical layer. Consequently, it is a professional responsibility to transfer these important buildings that have significant place in the urban memory to the future and make them visible. With this research, the limited architectural literature on industrial facilities built in the modern period in Kocaeli, known as an industrial city, has revealed that the subject is worthy of research.

The research on the analyzed facilities reveals Boysan's passion for geometry, albeit for a short period of his professional life, from the first industrial facility he designed in the city to his last. Emphasizing that he believed in international architecture under all circumstances, Boysan consistently designed industrial buildings for functional reasons with the dream of creating an "*industrial monument*" using different triangular elements and combinations. Believing that good architecture can be created with an aesthetic balance of material, construction and light, he succeeded in using concrete with a sculptural plastic effect. His passion for geometry in architecture, combined with an aesthetic construction, combined with the technology of the period and an international modernist style, enabled him to create innovative, timeless architectural works ahead of their time, many of which are still actively used today. Located in Kocaeli, a major earthquake zone, these buildings were not damaged in the 1999 earthquake (Boysan, 2007). This gives clues about the earthquake resistance of using structural geometry in this way and can guide future designs.

International standards and a "*flexible*" and "*modular*" design are other important factors that enable buildings to be transferred to the future.

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Except for Turkish Cable Factory, which was completely demolished, all other facilities have been expanded over time, but the original structures can still be used. These facilities, which can be described as pioneering in their sector for their period, differ from many industrial facilities produced in the same period with their aim to go beyond existing building technology in the country and push boundaries. When viewed chronologically, each building is an indication of Boysan's increasing specialization on industrial buildings in his professional practice. Boysan, who designed leading institutions of the city during the 1960-1980 period when Kocaeli's industrial identity was established, transferred his unique discourse on architecture to the city through these buildings.

NOTES

This article was published within the scope of Senem Müştak Sevindik's PhD thesis which was conducted under the supervision of Prof. Dr. Oya Şenyurt and completed in 2023 at Kocaeli University, Institute of Science and Technology, Department of Architecture, Doctorate Program in Architecture.

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Resume

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