

DETERMINING FACTORS IN THE CONVERSION OF POWER STATIONS. THE CASE STUDY OF NORDKRAFT POWER PLANT (AALBORG) IN COMPARISON TO OTHER PLANTS AROUND THE WORLD

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ABSTRACT

Due to the processes of deindustrialization and urban regeneration, former industrial buildings, especially former power plants, have been converted to new, often cultural purposes. Specifically, this paper addresses the conversion of power plants, which is considered to be a very important topic, as hundreds of decaying, non-functional power plants can be found throughout the world. It is important to rescue some and, by converting them, give them a new touch and a new use.

This paper strives to discuss the most important factors that affect the conversion of power plants aimed at finding new functions for these former industrial buildings.

Firstly, the article describes the power plants in Aalborg, and Nordkraft in particular. It deals with the complex history of the building which, due to the increasing consumption of electricity, had to be extended several times. Secondly, the paper also addresses the issues of finding a use for such large buildings and preventing their decay before the investor finds a suitable function for them. Thirdly, the paper deals with the reconstruction of the power plant from the point of view of architectural solutions and details, organisational aspects of the conversion, approach to the immediate surroundings, and financing options. Finally, some trends and opportunities for the reconstruction of similar buildings around the world are outlined in order to show the options for saving them by means of conversion.

KEYWORDS

Nordkraft, Industrial heritage, Power station, Conversion, Aalborg

INTRODUCTION

Coal-fired power plants have been abandoned due to their outdated technology, poor condition of the buildings and, most importantly, massive production of smog in the city centres. After losing their original purpose, they often found different temporary uses, with minor architectural interventions. The interest in the conversion of power plants began in the early 1990s. They are single-purpose buildings which require different uses and diverse architectural solutions but, nevertheless, have been frequently rebuilt. All of these interventions depend on the history of the buildings, the buildings themselves (material, character, condition of the original buildings, heritage protection), the location and its transformation, funding and new uses.

In this article the aim is to find key factors in the rebuilding of power plants, with the case of Nordkraft as the focal point. The article is written from the perspective of a foreign architect dealing with industrial heritage, its preservation and conversion. Therefore, the focus of the article is to describe the entire local and historical context. Thus, focusing both on the architectural design and the material solutions of the power plant. Their age and period of construction need to be taken into consideration. Another key factor could be the length of time for which they were not used and were empty, as well as the condition in which they have been preserved. An integral part is the area where the buildings are located, and the development of their surroundings. We cannot forget the economic and social conditions that dominate in the vicinity of the building. We should not neglect the new purpose, but also the original purpose (electricity for residents, hospitals, factories, mines and public transport). I look at Nordkraft as a point in the structure of the city without discussing its urban function. Neither do I address the exact technological equipment of the plant during its operation.

I have defined several key factors that I further examine in all of the selected buildings. The aim is to determine the factors that are crucial for the conversion of power stations. On the other hand, I identify factors that do not affect the conversion. For this article I have used the method of exploring the various stages of the Nordkraft power plant, from its construction to its conversion. The same method has been used to look at the architectural solution of the conversion of the building, especially of the interior and the surroundings. The method of comparison has been used to identify the trends and key factors. For greater clarity, an illustrative table has been added.

DEVELOPMENT OF POWER PLANTS

Public power plants began to emerge as electrical lighting and other electrical appliances found their place in private homes and small businesses, as well as factories and public institutions. Before long, electricity became a part of everyday life. At that time, a large number of coal-fired power stations were built, most often on the banks of rivers, lakes and fjords. The technology in these buildings was often modernized, but today most of them do not serve their original purpose. Some of them were fortunate enough to be rebuilt to a new use. Some former plants still need to find new opportunities to be used and saved for future generations. The best form of saving industrial buildings is to find them suitable contents, either in the form of museums or converted buildings.

DETAILED ANALYSIS OF NORDKRAFT POWER PLANT IN AALBORG

Aalborg is a medium-sized city located on the banks of the Limfjord, North Jutland, Denmark. It has about 200,000 inhabitants (2010) and, for many years, the place for large-scale industry for cement, distillery and shipbuilding occupied the waterfront on both sides [1]. Aalborg is a good example of a city where transformation from an industrial city into a cultural city is ongoing. Especially in the city centre, the transformation of the former industrial areas into culture related facilities, office space or housing estates is in progress. . The harbour at the waterfront has been turned into public buildings, which include university buildings, the House of Music and restaurants. With the construction of the House of Music in 2000, the conversion of the central waterfront started. This is where the power plant, the slaughterhouse and other historic buildings are situated [2].

Characteristic of Nordkraft

Nordkraft is a former coal power station transformed into a cultural hub. Today we can only see parts of the former power plant. The larger part of the building houses a cultural centre and is

open to visitors. This section of the power plant was built between 1942 and 1980. Because of the long construction time the building is characterized by a mixture of different architectural styles [3].

The centre has a size of approximately 30 000 m² [4], therefore it offers enough space for various facilities. For example inside the building there are a cinema, restaurants, a fitness centre and other facilities. Nordkraft is located at the central harbour front (behind the House of Music) in Aalborg (Fig. 1.). Originally, it was located on the borderline among the city, the harbour and the industrial zone and was built to supply the industrial sector, as well as the city itself with hot water and electricity. Next to Nordkraft, and on the other side of the harbour, was located the former Tivoli (Karolinelund), now a public park. Therefore, this place has the potential to connect these different places, different groups of people, and different activities.



Fig. 1: Local plan of Aalborg; Legend: 1. Nordkraft, 2. The central Harbour Front - transformation 2006-14, 3. Østre Havn - transformation 2013-15, 4. House of Music – construction 2010-2013

Lighthouse

Using the term of urban scholar Gitte Marling Aalborg Nordkraft could be defined as a kind of a lighthouse. In this context, the expression “lighthouse” is a metaphor, not a real lighthouse on the coast. In order to understand the authors’ intention it is necessary to read the definition of a lighthouse by Marling, *The City Experience*

“We label projects “lighthouse” if the project contains a cluster of programmes localized within a relatively confined area in the city. These are expressions of a public strategic intervention and they are related to large investments. Lighthouse stirs large local attention and often has a massive local backing. They function as motors for existing activities and generate new cultural products and activities.” [5] Nordkraft as a “Lighthouse”

Based on that definition, Nordkraft as a lighthouse matches various criteria, such as:

- identity of the city, nearly the only remnant from the days when Aalborg was a significant industrial city;

- cultural dynamo for the whole region, serving the residents and also the people in the nearest neighbourhood in the region, and tourists in Aalborg; the tourist information centre;
- place for various cultural events for different groups of people;
- prominent landmark, well apparent in the cityscape.

History of Power Plants in Aalborg

Three thermal power plants were built in the history of Aalborg and its surroundings. Their status changed with the changing needs of the population, the industry and the protection of the environment. The oldest plant is located in the very centre of Aalborg, producing direct current, unlike the other two. The second plant, Nordkraft, was situated on the outskirts of the city next to the industrial zone and on the harbour front. The third power plant, still functional, which has been producing energy since 1977, is located on the other side of the Limfjord and far outside the city. This section outlines a brief history of the oldest power plants, followed by a more detailed description of Nordkraft and its transformations.

The light station

The first power plant (1895-1909) in Aalborg, in Doktors Gyde, was private. “The light station”, as the station is popularly called, was originally only for 54 clients [3], most of them lived in its vicinity. [6] The central location in the city centre became impractical due to the supplies of coal. This power station produced direct current, which was subsequently exchanged for alternating current. That was another reason for the creation of a new power plant. (Fig. 2.)

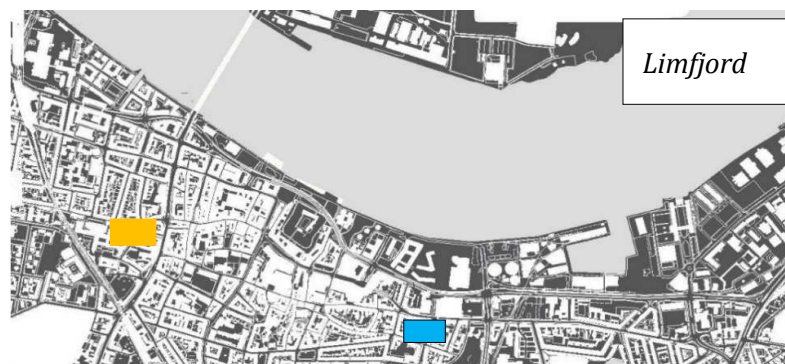


Fig 2. Local plan of power plants in Aalborg; Yellow - The light station; Blue - Nordkraft

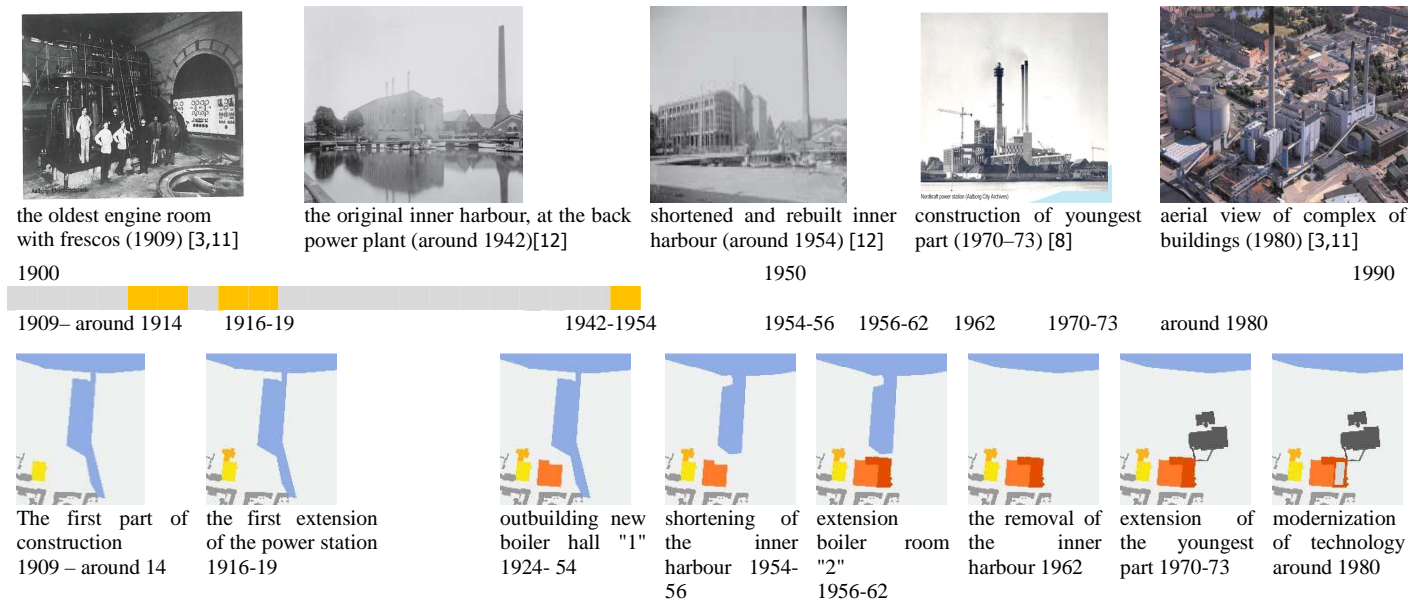
In 1889 the old brick factory was demolished and replaced by a newly planned power plant built in 1909 [3]. This power plant was built close to the Limfjord, due to the transportation of coal. It was easy to access via the inner harbour and it was outside the city. The rearmost part of the inner harbour was shortened. In this place was created a new coal store for the new plant. It was necessary to rebuild the harbour only for shipping industrial raw materials for power plants and small fishing boats, which were there before, were not allowed any more. Today, due to the urban growth, the area is located in the centre of Aalborg and the harbour-related activities are moved further to the east and to the periphery of the city.

Nordkraft – Power Plant

Nordkraft was designed by many architects and engineers. Therefore, the construction was divided into several stages. In 1909 Architect J. Jørsensen designed the oldest part of the power

plant with the red brick style romanticism and national features. The elements are made of bricks in light colours and they harmonize with the window frames. The selection of the material and the proportions are based on their surroundings and the historic city centre. The machine room has also large arched windows. In addition to it, the industrial building was decorated with frescoes which are exactly related to electricity. [3] In 1916 there was another extension of the building. The engine room, the boiler rooms and new chimneys were built. The engine room was decorated with new frescos of mermaids; one of them has a hand sign of the city of Aalborg. The building was completed in 1919. In the 1930s the city acquired a new building plot next to the existing power plant. The new site eastwards of the power plant was necessary to be created because of the increasing consumption of electricity [3].

The new larger boiler room "1" and the turbine hall were built eastwards from the engine room, across the street, in 1942. The construction was only finished in 1954 due to the rationing of steel, needed for reinforcement, during World War II. At this point, the plant was also equipped with technology to supply hot water for the city of Aalborg. [3] In the boiler room four boilers were installed, three boilers at the end of the 1940s and the last one at the beginning of 1950s. [7] The architectural model for that part of the plant was the Spritfabrikkerne distillery, also placed in Aalborg [3]. Therefore, the building is built of red bricks, has industrial windows that visually support the height of the building. A concrete frame system with three coal containers is hidden behind them. Between 1954 and 1956 the inner harbour had to be vanished due to the planned expansion of the power plant. It was necessary to build a new coal depot. [8]



In the summer of 1956 the new boiler room "2" with turbines was built. First three boilers were ready for use after two years, and the rest, with 72 MW turbines, were put into operation in 1962. This part has a distinctive checked pattern façade, formed by white plaster and windows. The façade hides a concrete bearing structure, once again accompanied by concrete containers. During this period new chimneys were built for that section, which dominated the city skyline for nearly 40 years. [3] The next expansion, between 1958 and 1959, was a new large oil tank [7].

In 1970 the plant was extended for the last time by architect Arne Kjær Tegnstue. The inner harbour had to be completely abolished. It was situated north of the oldest part of the power station. The extension site was across the road and bridges were used to connect it with the older buildings. That section, with a production capacity of 269 MW [9], was officially opened on 10 May

1973. It was built of monolithic concrete and clad with trapezoidal sheets, which was typical for industrial buildings at that time. Also it was the tallest chimney in the city [3].

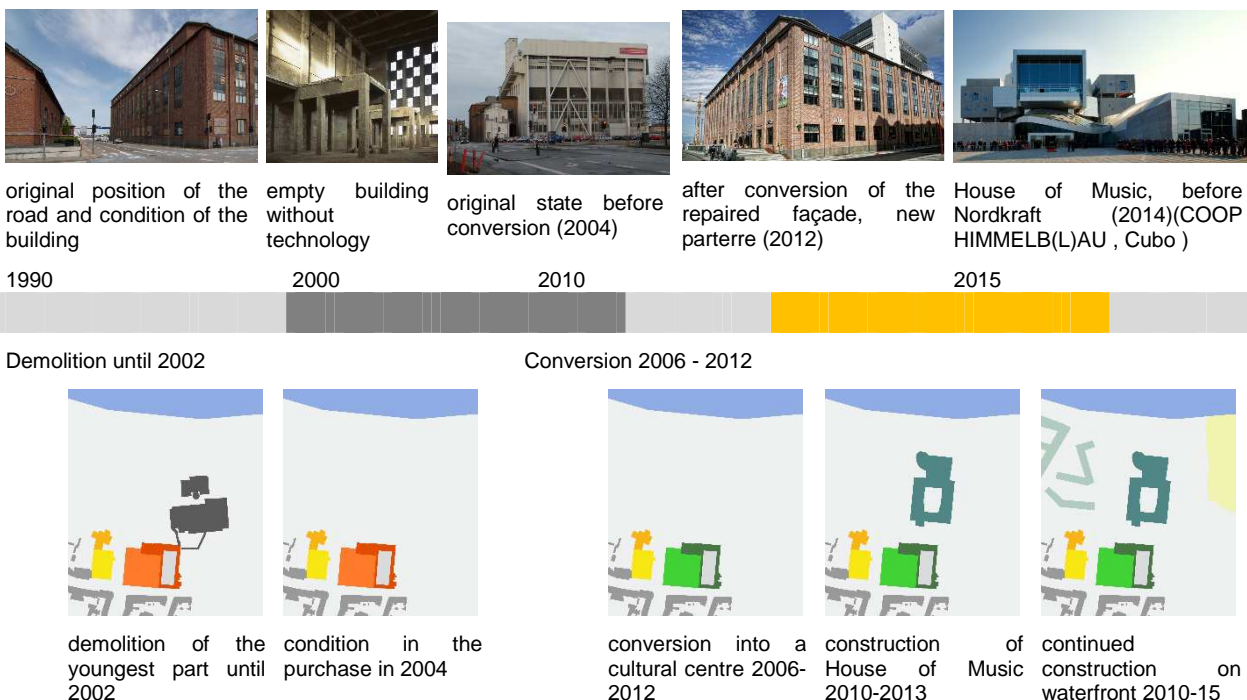
In the 1980s the façade of boiler room “2” was completed from outside with a reinforcing steel structure, on the grounds of new and better technologies for coal processing [10]. The production of electricity and hot water in Nordkraft ended in 1990 [3].

Nordkraft – the Cultural Centre

The transition of Nordkraft from a power plant into a new cultural lighthouse was not easy. Nordkraft barely escaped total demolition. Nordkraft was indeed rescued by the decision that it would be a shame to demolish the building, but the new purpose it should serve was not clear.

Nordkraft was out of use for 16 years, from 1990. At that time it just stood there empty, unused, and was going to be slowly devastated and partially demolished. The dilapidated and dirty complex with boarded-up windows threw a bad light on the city and its skyline. This created an extensive area of bad land/wasteland on the shore. The area looked chaotic, lacking a typical urban structure. It was composed of paths, rails and the coal store. In 1999 a plan for reusing one of the oldest parts of the plant as the "Techno Vision" Technical Museum was drafted, but the proposal was not successful, mainly because of financial difficulties [2].

The youngest part of Nordkraft with the city’s highest chimney was removed between 2000 and 2001. At the same time, a general debate about the use and protection of Nordkraft took place and, as a result, the demolition works were stopped in early 2002 [3]. In 2003 plans for preservation and conversion of Nordkraft were signed by the city. One year later, the City of Aalborg bought Nordkraft from the company Elsam A/S. At the time of the purchase, only the oldest part, in a devastated condition and without the chimney and technology, was standing. The



proposal to place the monument under heritage protection was unrealistic from the beginning. At that time it was not usual to declare an old industrial building a heritage site.

Afterwards, in 2005, an architectural competition for the conversion of the power plant was announced. [2] The competition was won by the architectural firm Cubo Architects in January 2006. Their concept of preserving the original structures was unique because of their understanding of the needs of the stakeholders, for whom they sought to find the right place in the building. Their philosophy was characterized by love and simultaneously empathy to form the different areas and connect various levels of intervention in the original structure. The result was pure, raw and functional architecture. In the same year, the city introduced a comprehensive plan for the central harbour, with parks, the Utzon centre and a promenade [2]. According to the plan Nordkraft was supposed to be surrounded by a green space [14].

The conversion of the power plant was divided into three phases. The transformation of the square in front of Nordkraft was part of the first phase and was completed in 2009. The second phase, the boiler room and turbine hall, was completed in 2010 and was officially opened a year later on 10 October. In 2012 the eastern connection between Nordkraft and Teglgards Plads was built, making it possible to walk through the building. [2] The architectural office was awarded the 2013 Renovation Prize for the conversion of Nordkraft [16].

The oldest part of the power plant (1909-1919) was not included in the conversion, because it still served as a heat exchange station. Another part of the building was converted into an office space [16]. In March 2014 the House of Music was opened near Nordkraft. In 2015, once the Østre Havn eastwards of Nordkraft is finished, the transformation of the waterfront in Aalborg will come to an end. The new area with the new buildings is described as a small Manhattan in the planning documents [2]. Nordkraft itself is a project that won't be finished in the near future because the transformation will continue bringing the need for minor changes and adjustments.

Specific Features of the Conversion of Nordkraft

With point of departure in the historical development of Nordkraft, I turn to the conversion of the power plant from different perspectives. I focus on the architectural solutions and the interiors of the building itself, as well as on the surrounding public space. All this is set in the context of the economic and political situation and support from the city of Aalborg. Nordkraft could be described as a single-purpose building. Thus, finding a new use is more difficult than in a multi-purpose building such as a textile factory or a warehouse. The power plant has big halls to provide enough space for the necessary turbines and other technology. Today, it is a challenge to find a suitable follow-up usage for such a large space. Moreover, it is necessary to preserve some parts of the old power plant in order to show the original purpose of the building.

Economic and Political Background of the Project

This project is special because of its long transformation process (from 1996 until today and even further).

Political and Public Debate

Throughout the public debate about the preservation of Nordkraft, two decisions were made to preserve the building. Regarding to the first decision, the City of Aalborg had to decide whether to preserve Nordkraft as a formative building for the city skyline or to demolish the building. In the end, the city decided not to demolish the old power plant, because the building was already an inherent part of the skyline.

The second major decision, inspired by the history of Emscher Park, was crucial. The park in Germany is a good example of old industrial properties which are open to the public today. In industrial areas, the reuse of old industrial buildings can give rise to a new phenomenon. We can visit such places, we can see old buildings used in a new way, and cleaner nature and

surroundings. In this new area a new identity for the inhabitants and the city has been created. The idea behind the preservation of Nordkraft was to create something similar to Emscher Park. For this park, the initial idea came from the government, the surrounding cities, and not from private institutions. The same was necessary for Nordkraft, only on a much smaller scale.

Public Presentation of the Project

The **3T** method - talent, technology and tolerance of conservation of the power plants was used for the project. The presentation of the project was public and, therefore, open to everybody. For example, politicians, citizens and planners had access to planning documents, metaphors, sketches and other relevant plans [2].

Economic issues

Nordkraft was planned during the economic boom, around the year 2002. This project played a key role in Aalborg's transformation into a cultural city. The Municipality, as the main investor, was economically responsible for the whole project. The renovation and conversion of the older industrial building involved the highest financial risk. At the time of the crisis it was necessary to replace a company gone bankrupt with government and municipal institutions. Economic worries persist until today, even when the University uses some rooms in Nordkraft and pays rent [2].

Architectural Design

This conversion is primarily about a substantial change of the function, not so much about architectural intervention. There has been no significant change in the appearance of the building; no new expressive forms have been added which could make the building more pronounced or give it another dimension. The main interventions were made inside, connected with the reuse of the building. Three new floors were installed in one part.

Historic Façades

The façades were cleaned up, but they still look original. The windows were repaired without changing the proportions or the material. [2] Subsequently, exterior lighting was installed in order to enhance the character of the building at night. The same approach was adopted with the historic façade of the protected building where a coal conveyor belt was preserved on the south façade. The façades were equipped with factory clocks to emphasize the atmosphere.

The Interior

The conversion could be characterized as a "room in a room", using boxes – elements placed in unheated free space. Inside the building we can see the contrast of new and old material, both in texture, colour, scale and processing of the details. The architects mainly retained the scale in the entrance hall, where you can still feel the original raw structure, the monumental and open space. This preserved space is therefore the most impressive room in the whole building. Moreover, the concrete tanks are still there, with cafés and restaurants beneath them.

Another element used in the interior is a three-floor box suspended in boiler room "2". This allows a better use of enormous height of the room, and supports the contrast between the new boxing and the raw concrete tanks. Some elements have been retained as reminders of the original function, such as the crane, indicators, and others. Due to the diverse and original architecture the space may seem slightly chaotic. Nevertheless, the feeling of raw architecture and the mixture of old and new material creates a unique atmosphere and light in this new centre of Aalborg.

Activities

One of the main purposes of Nordkraft is to provide space for activities, office space and public space where people can meet in groups and have enough room for various activities. Nordkraft hosts a lot of activities linked with Aalborg, but also with its surroundings. It offers a broad range of cultural opportunities for the entire region of northern Jutland as its main cultural centre and a living city organism. It is supposed to be a place for exchanging views between different social groups [5].

Actors

Nordkraft houses 25 facilities such as restaurants, music and sports facilities, theatres, an art school and an exhibition space, a music school, a university, a youth club, a cinema and education centres and offices related to culture and sport [4]. It is a mixture of features which are not easy to coordinate, but if it works, Nordkraft will never be empty. With a variety of interests, the house can be used by a wide range of age groups, from sporting children, young people and older people who go to the health centre. Underground rooms are suitable for clubs, cinemas, and theatres, while the upper floors, with enough daylight, are used as office space [2].

Municipal Cultural Centre

Nordkraft as a municipal cultural centre offers, especially in the boiler hall, enough space for markets, performances, shows, concerts, lectures and workshops. Therefore, Nordkraft forms an efficient and inspiring neighbourhood.

Surrounding Public Space

The surroundings of Nordkraft are densely built-up, due to the lucrative location in the centre of the city. In the process of transforming the central waterfront the planners and architects were always concerned with the whole area and paid attention to the development of the whole area.

Parterre

A part of the conversion was to solve the problem with traffic. A busy road was suitably moved towards the east, and thus created a public space between the original buildings of the plant. The selection of materials corresponds with the interior solution: corten and concrete. The difference in elevation between the street and the entrance was solved by using concrete ramps and stairs. There we find benches, bike racks and a couple of trees. [2] Unfortunately there is no industrial imprint and no industrial atmosphere like inside. This space is open to every road user. The main reason is the car park in the yard of the oldest part of the power plant. With the opening of the parking lot under the House of Music, the park may be closed. The traffic then would be very limited, with only a few cars entering the yard when absolutely necessary.

Parking Solutions

As with every conversion, parking is very challenging. It is almost impossible to build an underground parking lot, as is the case of Nordkraft. The solution is to create parking spaces around the building. It is therefore advantageous for the city authorities to oversee the transformation of the whole area, as this makes it possible to find a comprehensive parking solution for the whole area. This is also the case of Nordkraft in Aalborg where you can park in the vicinity, under the House of Music and other places.

Interconnection of Cultural Institutions

The original Nordkraft was in contact with the fjord, (the Limfjord). This contact has not been preserved but, at least, an interesting waterfront could be created, serving for people, and attractive buildings could be built. A big drawback I see in Nordkraft is that it is not linked with the House of Music. There are ordinary road crossings, but since there is a large underground parking under the House of Music and both buildings have a rich cultural life, there should be a suitable interconnection between these cultural institutions to support their cooperation.

Solution of Greenery Around

Greenery is an important element in the conversion of buildings; therefore, we should keep it in mind and make use of it. It helps us to understand the scale of the building, because its size is well known to us. At the same time we create a green space for relaxation in dense urban areas. In Nordkraft we can see an effort to have greenery in the immediate surroundings of the building. Such surfaces are suitable for small industrial footprints such as overgrown rails, wagons, parts of cranes and others. Nordkraft aims at distributing a diverse cultural atmosphere throughout the city of Aalborg and the region of Northern Jutland, much like hot water and electricity used to be distributed in the past [2].

COMPARING THE CONVERSIONS OF SELECTED POWER STATIONS

For this comparison I have chosen different conversions of power plants at different times, with different functions, methods of funding, with different locations in the city and in the world. The selection illustrates different approaches to conversion, as well as specific features of new use of former power plants. These examples were chosen from a wider portfolio of researched objects. (Tab. 1)

Brief characterization of selected power plants

The Charles H. Shaw TLC (Technology and Learning Centre), former Sears, Roebuck and Co. Power House (Chicago, the USA), was selected because of the atypical use. The conversion to a school (9 and 12 classes) and community centre is a rare case. Along with other old and new buildings, the power plant, located in an old industrial area, was transformed into a campus surrounded with public space. An important reason for conversion is the preservation of technology, machinery, and piping as an inducement for students. [18] I think the original industrial building is a fitting place for a school. Students learn to appreciate history, even though the conversion is complicated.

Another selected power plant is the *Canberra Glassworks*, former Kingston Power House (Canberra, Australia). One of the reasons why I have chosen this museum is the need to add a new function in order to secure funding. Another reason is the fact that the conversion concept is similar to that of the Red Dot centre in Essen. Monumental spaces of the old power house are contrasted with the lightness, transparency, fragility, vivid colours and small scale of the artistic glass objects. Another reason for choosing this power station is its new chimney, which corresponds to its original form. It is made of glass and serves as a light tower for the museum. [19, 20]

At the time of its construction, *Ottawa Street Power Station* (Michigan, USA) was an important building built in art deco style. The building was characterized by its state-of-the-art equipment, hidden smokestacks and stunning flame-like designs on the façade. A remarkable masonry scheme symbolizes the combustion of coal. Thus, the plant is both a monumental sculpture and a fluid painting in masonry. Huge stacked-design windows echoed the building's silhouette, further tightening the unity of form. Many smaller details are added to the design,

among them a huge set of burnished metal doors emblazoned with Oz-like lightning bolts. [21] It has retained a few details and structural elements, but has lost its original appearance, including the patina and the colours. But this is a typical example of a power plant converted to an office space, its potential lying in its central location and in the character of the building itself (many floors with universal appearance of the interior, and space that is easy to change).

Tab. 1 Comparing the Conversions of Selected Power Stations

Name	Nordkraft [2,3]	The Ch. H. Shaw TLC [18]	Canberra Glassworks [19,20]	Ottawa Street Power Station [21]	Tate Modern [22]
history					
construction	1909-1973	1905 - 1906	1913-1915	1937 -1946	1953-1963
source	coal, oil	coal	coal	coal	coal
termination	1990	1973	1957	1992	1980
without the use	16	34	48	15	17
conversion	2006 - 2011	2007 - 2009	2005 - 2007	2007 - 2011	1997 - 2000
architecture					
material	red brick	red brick	concrete building	multicolour brick	red brick
characteristic	big steel factory windows				
	collage of buildings	slightly decorated	interpretation of classical architecture	art deco	axially symmetric expression
	modern style of industrial architecture				
building location	itself	old industrial area	old industrial area	itself	itself
	new district around	new district around	new district around	new district around	small interventions
immediate surroundings	new public area	new campus	cultural area	public "linear" park	public park
regeneration	harbour	old industrial area	old industrial area	old industrial area	small quarter
transformation	new building	new building	surrounding public space	new building	surrounding public space
supply	ship	rail	rail	ship	ship
conversion	inside intervention, minimal outside (entry, arrival and staircase)				
heritage protection	No	Yes	Yes	Yes	No
smokestack (now)	0	1	1	0	1
founds	public private partnership	The Homan Square community	artsACT	The Christman Company	Tate Gallery
activities	25 actors cultural, sports	school assemblies, community events	glass art production and workshops	office space	Tate Modern with café and shop
	mix used	education	cultural events	office	cultural events

The oldest reconstruction I have chosen is the *Tate Modern*, former Bankside Power Station (London, United Kingdom). As a power station it was an icon in the 20th century: a monumental building with a modern, symmetrical façade. As an exhibition space it has become an icon of conversion. A concept of the conversion is very similar to Nordkraft, especially the minimum interference with the exterior and the empty space in the interior. With its preserved chimney Tate Modern is a landmark in the city's skyline. [22]

Results of Comparing the Reuses of Different Power Stations

In this part of the article I mention the results of my research and comparison with Nordkraft, following the same structure as in the table.

History

Large power plants were built in the 19th and 20th century, mainly in the early 20th century. All around the world, the overwhelming majority of these plants are coal-fired, some exceptions are gas-fired. The first public power plant, which was gas-fired, was built in the USA by T. A. Edison and G. Westinghouse. As a consequence, large power plants were built earlier in the U.S.A. than in the rest of the world.

Architecture

Most of these buildings are examples of modern industrial style. There is not much diversity among countries in the same period. Boiler rooms make the buildings clearly legible within the urban environment. A boiler room is the heart of the plant, characterized by extremely high industrial steel-framed windows. A chimney (or chimneys) is also a typical feature. Another common feature is a brick retention wall, even in areas where such structural elements are not quite typical.

Nordkraft, with its red brick and large steel-framed factory windows can be classified as a typical plant built before the World War II.

Building Location

Power plants were often built outside cities, either close to water or with a connection to the railway because of the need for coal supply. As cities grew, the plants became part of them and today they are often situated in the centre. Plants built in areas with heavy industry are an exception. You can find just workers' colony, not a functional city in their surroundings. Urban power plants were surrounded by other manufacturing buildings that had lost their meaning, and thus these areas are significantly transformed. Power plants in such places can serve as drivers of new construction, as well as remnants from history. After regeneration the coal store, which occupied a large area near the river, is either transformed into a park (such as the Tate Modern), or new buildings are constructed there (such as Nordkraft, where the House of Music was built. Nordkraft became attractive for its location, like most power plants, which were built for cities and their residents, for the light industry and for transport (trams, suburban trains, underground).

Conversion of power plants does not differ significantly across the world. Similar methods of work are used. Most interventions are made in the interior, little is changed outside. To my mind, for a conversion to be successful, it is important to maintain the rawness of the architecture and to use materials which differ from the original and characterize the present time. Often, there is no need to add new features, since the original structures are already complicated enough. An important point is to maintain the scale of the building and the interior. This primarily applies to the boiler hall, which should be preserved in its full size. Nordkraft is a suitable example of such approach.

Heritage Protection

Nordkraft and the Tate Modern are examples of buildings without heritage protection. There was a major investor determined to preserve the genius loci. Heritage protection makes it more difficult to find an investor and, therefore, the buildings decay, like the Canberra power plant.

Smokestack

It is difficult to find any purpose for the chimney; therefore, many of them have been pulled down. The plant thus loses one of its typical signs and it becomes difficult to tell its original purpose. Chimneys have an impact on the skyline, and bringing them down can help, but also cause damage. Is the smokestack the "leitmotif" for the power station? Nordkraft lost its chimney very early, but there is a chance a new chimney will be built, like in Canberra Glassworks. It is a modern concept of the same size and in the same place as the original smokestack.

Funds and Activities

Funding is closely linked with the use. Financing of power plant conversion is significantly influenced by the economic situation. In times of economic boom it is not a problem to find funding for a single-purpose building. This can be seen at the Tate Modern: a typical example of cultural use during economic boom, now pretty much infeasible. The more recent conversion of the Canberra plant had to accommodate workshops in order for the project to be viable. Recently converted buildings are mostly used as office buildings, which are easy to adapt so that they can be rented out and ensure profitability. A number of recent conversions opt for mixed use (sport, relaxation, school, restaurants, clubs, etc.). Nordkraft is a typical example of mixed use. In order to carry out the project, cooperation with a private investor (DGI) was established. In the USA it is possible to draw on subsidies to fund the conversion of power plants.

Influence of Individual Factors

We can find little difference between the character of coal-fired power plants built between the wars and just after the Second World War. This architecture is characterized by red brick, with high windows in large industrial buildings that are part of extensive complexes. The spacious interiors of these buildings give rise to specific requirements for the new use. The dimensions of the rooms give them a specific atmosphere which can be enhanced by the conversion. The age of the power plant, therefore, is not a significant factor. On the other hand, the condition of the building is a key factor. The length of time for which the building is not used does not have such a great impact as its condition, even though those two factors are very closely related.

Another important factor is the location of the building: a number of power plants located outside the city were demolished, such as the Stella Power Station in Newburn, UK. A very important factor is the use of the immediate surroundings, which can aid in financing the reconstruction due to new construction, as we can see at the Battersea Power Station in London. The location of the power plant at the waterfront is often taken advantage of, as the waterfront is often cited as the most lucrative place in the city. The method of conversion is not essential and often does not differ in character from the others. Heritage protection or the numbers of chimneys do not play a role in the conversion. The most determining factor is finding the right investor who has a vision for a suitable use, as we can see in most conversions of all types of industrial buildings.

CONCLUSION

The feasibility of conversion is a factor that is composed of the original state of the building, the location, the new use and the possibility to use the surrounding space of the plant. We should

not forget that even after conversion the genius loci and the identity of the place can be preserved. These factors include economic aspects (financial requirements of the conversion and new use, the use of the immediate surroundings and accessibility), architectural aspects (especially if this building could become an icon for the city and an important architectural component which has a piece of history in it, creating an atmosphere that fascinates people) and historical aspects that are closely related to the architecture, the site and the owners. There is also the factor of the city's attitude towards the building and the willingness to support its preservation. Nordkraft satisfies all the requirements and has therefore been retained and converted into a cultural lighthouse.

ACKNOWLEDGMENT

This work was supported by the Grant Agency of the Czech Technical University in Prague, grant No. SGS 14/019/OHK1/1T/11" and acknowledgement the Cubo architects for the provision of photographic documentation, Lea Louise Holst Laursen from Department of Architecture, Design and Media Technology at the Aalborg University and Tomáš Šenberger from the Czech Technical University in Prague.

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