The Lost Kinetic Architecture and How to Reintroduce it in the Landscape – The Case Study of the Drainage Windmills in the Vistula Delta

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ABSTRACT

Recreating the lost kinetic landscape of the Vistula Delta is a considerable challenge. The study aims to propose a method for reproducing windmills and their effect on the landscape. The paper suggests a method based on the transposition of the forms of movement from windmills historically present in the region to modern forms. The method is based on a series of analyses starting with the study of the region and its history followed by extracting and developing the characteristics and proportions of a windmill and its impact on the landscape and human senses. Newly introduced forms are not intended to recreate historical windmills but to become a reminiscence of the history and to create a significant landscape history. The impact of new forms of historical windmills creates a series of opportunities – starting from an architectural conservation approach and ending up with landscape preservation. It is a chance to bring back the lost landscape elements and to provide interactive installation forms.

Keywords: drainage windmills, kinetic architecture, kinetic landscape, landscape restoration, multisensory perception, value preservation, Vistula Delta, northern Poland

1. Introduction

The purpose of this study was to investigate drainage windmills, which are a lost landscape element of the Vistula Delta. The primary goal was to examine changes in the location and number of drainage windmills in the Cedry Wielkie Commune located in the Vistula Delta. This rural commune and its authorities created planning strategies for the protection of sites where there used to be drainage windmills. For this reason, the commune became the area of interest to the entire study presented in this paper. The secondary objective was an attempt to determine their characteristics and to present proposals for supplementing the landscape with new forms referring to historical windmills. The contemporary approach should respect the past, speak the up-to-date architectural language, and become a strong voice in the discussion about kinetics in landscape (Ginelli and Pozzi 2018; Nyka and Cudzik 2017; Schumacher, Schaeffer, and Vogt 2010; Zuk and Clark 1970).

The Vistula Delta is an area with specific qualities and unique problems, which cannot be found anywhere else in Poland. One of the most important features of this region is its genesis – the engineering process of large areas of land emerging directly from the sea. The heritage of the region is considered a crucial resource in the redevelopment process (Janssen et al. 2017, 2). The balance between maintaining land suitable for human existence and the sea is a never-ending topic to be discussed in every aspect of the research on the Vistula Delta. Due to the nature of the transformation of the area, there is a rare hydrotechnical infrastructure system (Nyka 2017). Its development, transformation, modernisation, reconstruction, and constant improvement is the craftsmanship of former and modern engineers, hydrotechnicians, and residents dealing with water on a daily basis. Engineering ingenuity led to the creation of a unique cultural landscape. Many characteristic landscape elements of the Vistula Delta entered the local culture (Brzezińska 2013). They became the building blocks of local identity and became signs of regional uniqueness. Highly advanced hydraulic technology that enabled polders to be built and made it possible to cope with adverse natural conditions of the area changed the natural landscape into a cultural one (Szafran 1981). As a result, all contemporary elements of the Vistula Delta landscape have been formed by man, which is particularly visible in the polder areas, where the hydrotechnical infrastructure changed the natural balance of water and soil (Cebulak 2010). Hydrotechnical infrastructure is mentioned as one of the basic elements of the landscape of the Vistula Delta next to patterns of roads and fields, settlement forms, structures, and artificially planted vegetation (Lipińska 2011). It includes facilities with a drainage and irrigation function as well as hydrotechnical structures (including embankments) that create an advanced system maintaining flood safety within polder systems. The vulnerability of the region to climate change highlights the need for future-oriented solutions towards the problem of flood-prone areas (Nyka and Burda 2020). Polders along with the hydrotechnical infrastructure are referred to as the natural and technical phenomenon on which the social, technological, and economic infrastructure of the Vistula Delta is supported.

The group of hydrotechnical infrastructure facilities with a great impact on the present-day layout and shape of the Vistula Delta includes drainage windmills. This technology appeared in the Netherlands around the fifteenth century (Hills 1996) and was probably brought by Dutch settlers shortly after that, but their number increased significantly in the sixteenth century (Kornecki 1966). Drainage windmills allow for planning and spatial development of the Vistula Delta, i.e., the construction of polders and drying of new areas. The movement of the sails and their entire upper parts (together with tail poles) determined their specific perception in the landscape. They were one of the first objects of kinematic architecture – unheard of in any other type of structure or building on such a scale up until the twentieth century, which saw the appearance of wind farms.

Drainage windmills became one of the most important hydrotechnical devices in polder areas over the next 400 years. The intensively developing technological progress initiated in the eighteenth century brought changes also in the technology used in draining polders. Steam pumps, followed by electric pumps, successfully displaced functionally outdated drainage windmills at the end of the nineteenth century. Some windmills that survived despite the technological changes were disassembled or destroyed during World War II. The last hollow post mill in an incomplete form was moved to space without appropriate context, where it was devastated at the beginning of the twenty-first century. Thanks to the efforts of residents – enthusiasts of the Vistula Delta region, the last hollow post mill was partially saved and its surviving fragments were deposited in the Żulawy Historical Park located in Nowy Dwor Gdanski. At the beginning of the twenty-first century, drainage windmills did not exist in the physical space of the region. Due to the lack of existing windmills, it is impossible to rebuild these characteristic elements of the landscape. The paper examines possible strategies to bring back the kinetics being an inseparable element of the Vistula Delta landscape.

2. Study Area

The Vistula Delta area (Figure 1) covers approx. 1700 km². Today, it is divided into 26 communes located in 2 voivodships – Pomeranian (21 communes) and Warmian-Masurian (5 communes). The planning documents adopted by these communes include, among others, guidelines related to the protection of existing historical objects, cultural areas and landscapes. However, only one commune – Cedry Wielkie Commune – included a reference to the places where drainage windmills were located in the documents. The municipality has also taken some measures to build a new windmill as part of a planned educational facility on flood prevention technologies. In addition, the area has a well-documented cartographic history of windmills – dating back to the seventeenth century. These materials make it possible to determine that a large number of windmills – both drainage and milling – were present in the municipality. For this reasons, the Cedry Wielkie Commune became a research field for which the structure of the historic windmill system and the possibilities of recreating this historic landscape element were analysed. It is the only example of such an approach towards windmill preservation in connection with spatial planning (Janssen et al. 2017, 1655).

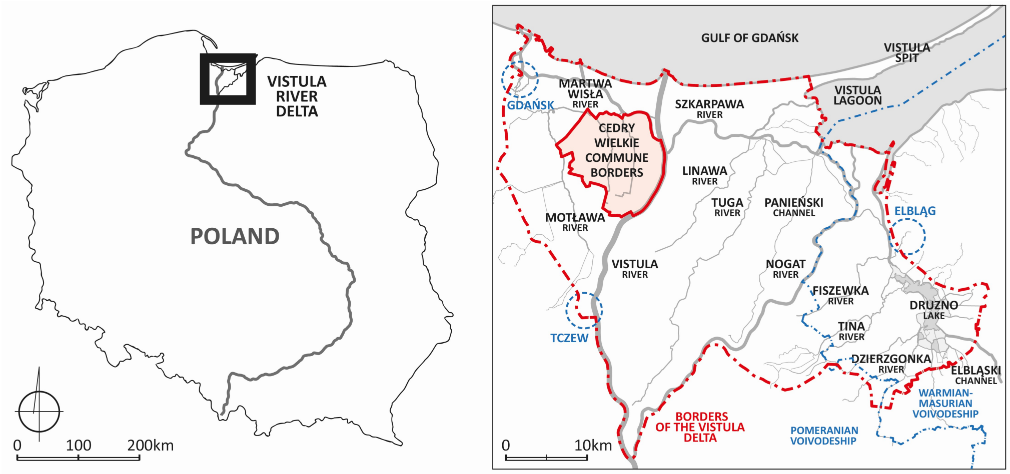

Figure 1. Vistula Delta area and Cedry Wielkie Commune.

Cedry Wielkie is a rural commune with an area of 124 km². The international road E77, which is one of the most important roads in the Vistula Delta region, runs through the commune. In terms of water systems, there is a part of the medieval system of channels called “Trichannels”. The name stems from the three most important channels – “Wysoki”, “Śledziowy” and “Piaskowy” (English: “High”, “Herring”, and “Sandy”). The “Trichannels” are one of the oldest and most valuable drainage channel systems in the west Vistula Delta region, which, despite technological changes, has survived to this day in a readable form.

The area of the commune is a flat area with slight height differences. The lowest part is the northern part of the commune, entirely made up of depressed areas with elevations up to 1.25 m above sea level. The surface area of depressed regions is approximately 4250 ha, which is 34.5% of the commune’s area. Meanwhile, depressed areas cover approximately 3430 ha, which is 27.8% of the commune’s area. In total, the areas prone to flooding amount to approx. 7680 ha, which is 62.3% of the commune’s area. The lowest-lying area is a depression in the village of Szerzawa, near the Herring Channel, located 1.90 m below sea level (according to the topographic map on a scale of 1:10 000 issued by the Chief Surveyor of the Country in 2001), which suggests that it is the lowest point in Poland.

In the commune's Spatial Development Conditions and Directions Study, the directions for the development of the pedestrian, bicycle, motor and water tourist-friendly network structure of international, national, regional, and local importance are described. New routes are planned, which include the Vistula Bicycle Trail along the Vistula River on both banks and the Iron Curtain Bicycle Trail (from the Barents Sea in Norway to the Black Sea in Bulgaria). All routes will form a dense network with junctions serving tourist traffic (Figure 8 (B)), in particular places in the zone of ecological corridors of the Vistula, Martwa Wisła and Motława, ensuring access to waterways. It also becomes important to promote the values of the cultural landscape of the Delta area as a unique tourism resource on a national scale.

In the northern depressive part of the commune, within two polders, the unique layout of the village of Szerzawa (German: "Breitfelde") is preserved. The village has a chain layout along the embankment located along the Herring Channel. The village was created as a result of the "Olęder" colonisation in the second half of the sixteenth century. This area can be considered one of the best-preserved traces of the history of the formation of the entire Vistula Delta, predestined to establish the "Szerzawa" Cultural and Landscape Park. The method makes it possible to preserve and develop a rich amalgam of past uses that could impact the development of the region (Van Der Valk 2014).

3. Methods and Materials

3.1. Method

The method applied in this paper consists of several steps. It starts with the study of the region (Figure 2(A)) and its most dominant historic landscape elements. The study is supported by an overview of historical materials (Figure 2(B)). In the same step, contemporary planning strategies and documents are studied (Figure 2(C)). Then, materials concerning historical windmills are analysed (Figure 2(D1)). The next stage involves the selection of characteristic elements repeated in a group of representative examples (Figure 2(D2)). Next, the acquired knowledge on the structure of the historical windmill is confronted with contemporary solutions in kinetic architecture and art. This form is developed with the use of historical knowledge and contemporary art and architecture solutions (Figure 2(D3)). Following the overview of planning strategies and documents (Figure 2(C)), historical cartographic materials are analysed (Figure 2(E)). As a result, the scope of locations is narrowed and the final locations are determined (Figure 2(F)). The source material were merged with the reference to the cartographic material, and show consistency in different data forms. All the steps are summarised by the final choice of possible contemporary measures to create a new form of windmill with its characteristic elements and its impact on the environment (Figure 3).

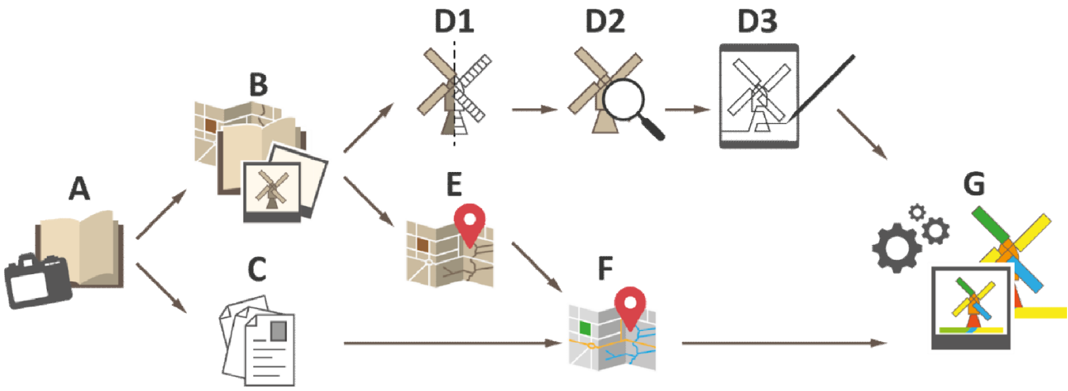

Figure 2. Research method, 2021. A: Study of the region and its features, B: Overview of historic source materials such as: literature, poets, geographers notes, C: Analysis of planning documents, D1: Analysis of the historical structure of the windmill (characteristic elements and details), D2: Selection of characteristic elements repeated in a group of representative examples; D3: Proposal for a new landscape windmill form; E: Analysis of historical cartographic materials, F: Scope of locations; G: Choice of contemporary measures to restore a windmill with characteristic features with the focus on its impact on the environment and human senses.

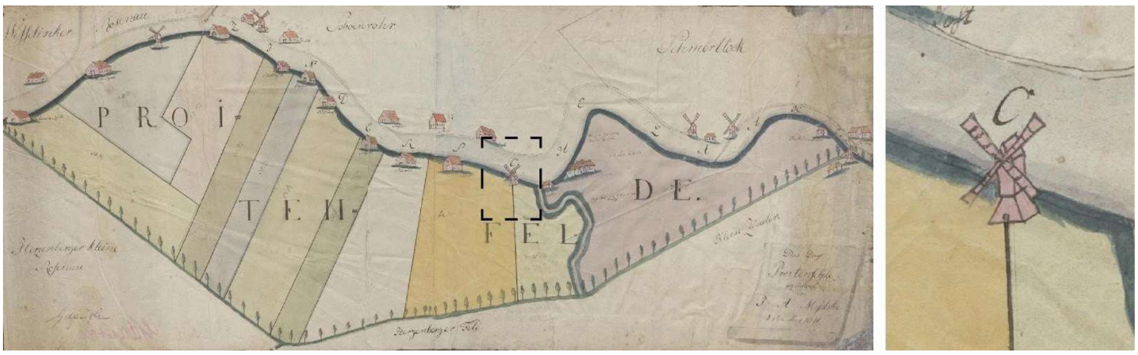

Figure 3. Szerzawa village, 1811. A: the entire map (State Archives in Gdańsk, 300 MP 16/230); B: fragment with one of the six hollow post mills along the Herring Channel located in the area of the village.

3.2. Materials

To examine the number of windmills and places where there were located, archive materials from the collection (including the State Archive in Gdańsk, the Institute of Geography of the University of Gdańsk, Digital Repository of Scientific Institutes (RCIN), Digital Library of University of Wroclaw, Polish Digital Libraries Federation (FBC), Map Archive of Military Geographical Institute from 1919 until 1949, Adam Mickiewicz University of Poznań – Faculty of Geographic and Geological Sciences) were used. Some of the maps included designations that made it possible to distinguish between drainage and grinding windmills (18th and twentieth century), while some maps only had general designations of windmills without specifying their type (16th and nineteenth century). The collected materials were grouped into 5 periods: 1659, 1774, 1871, 1905, and 1930. For each period, a map of the location of windmills was prepared and presented in the context of the contemporary Cedry Wielkie Commune (Figure 4). These maps have different accuracies and graphical markings, which is why a standardised contemporary map has been placed underneath, on which the locations of the windmills have been marked. Analysis of these maps made it possible to create a single map of all the places where windmills stood, which made their total number visible.

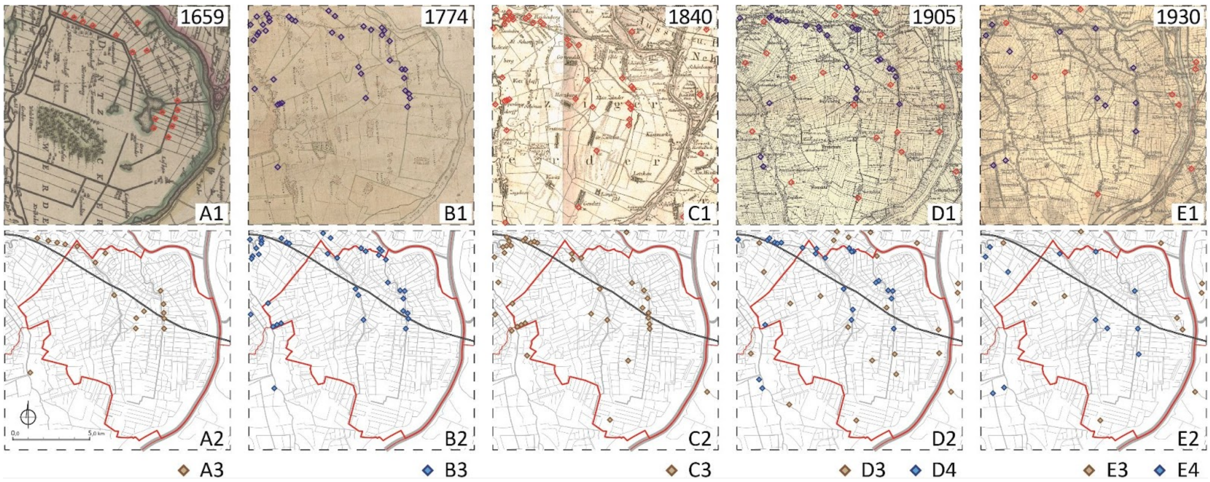

Figure 4. Cartographic analysis of the locations of windmills in the contemporary borders of the Cedry Wielkie Commune. A1: fragment of the map from 1659, A2: locations of windmills on the contemporary map, A3: symbols of windmills without specifying their type, B1: fragment of the map from 1774 (with symbols of the drainage windmills only), B2: locations of windmills on the contemporary map, B3: symbols of drainage windmills, C1: fragment of the map from 1840, C2: locations of windmills on the contemporary map, C3: symbols of windmills without specifying their type, D1: fragment of the map from 1905, D2: locations of windmills on the contemporary map, D3: symbols of grinding windmills, D4: symbols of drainage windmills, E1: fragment of the map from 1930, E2: locations of windmills on the contemporary map, E3: symbols of grinding windmills, E4: symbols of drainage windmills.

A picturesque description of the lands that now make up the Cedry Wielkie Commune is provided in a diary kept by Second Lieutenant Karol Gloger, who in 1831 came to the Vistula Delta (the area belonged to Prussia back then) together with other participants of the November Uprising (Morcinek 1966). As he describes, “there are many such [drainage] windmills on all the meadows, they are all built and maintained at the expense of the [state] treasury”. Poet and geographer Wincenty Pol (Pol 1989, 132–133) also vividly describes the landscape of the Vistula Delta when he was there in 1842:

A strange sight, then! Any breeze – which will extend across the smooth, green landscape, either from the sea or from the land – sets the sails of a thousand windmills in motion, all the colourful banners and flags, all the sails on the channels (…)

The multisensory kinetic landscape became a permanent element of regional heritage.

3.3. Types of Windmills

By analysing the available cartographic, photographic, and bibliographic (Stankiewicz 1958; Stokhuyzen 1963; Szymański 1985; Tomaszunas and Tomaszunas 1989; Vince 1985; Wailes 1979) materials, it can be determined that there were two types of drainage windmills on the Vistula Delta:

1. hollow post mills (Figure 5(A)) with the following features: (a) an open scoop wheel placed vertically outside the pyramid-shaped static lower part; (b) a slender rotating upper part topped with a roof (resembling an onion or a horseshoe in cross-section) and a long horizontal tail pole supporting the external stairs,

2. tower mills (Figure 5 (B)) with the following features: (a) a wooden base in the form of an octagon or hexagon, with or without a low gallery; (b) boat-shaped caps rotated by external mechanisms – a wind turbine or a tail pole; (c) a scoop wheel inside the windmill.

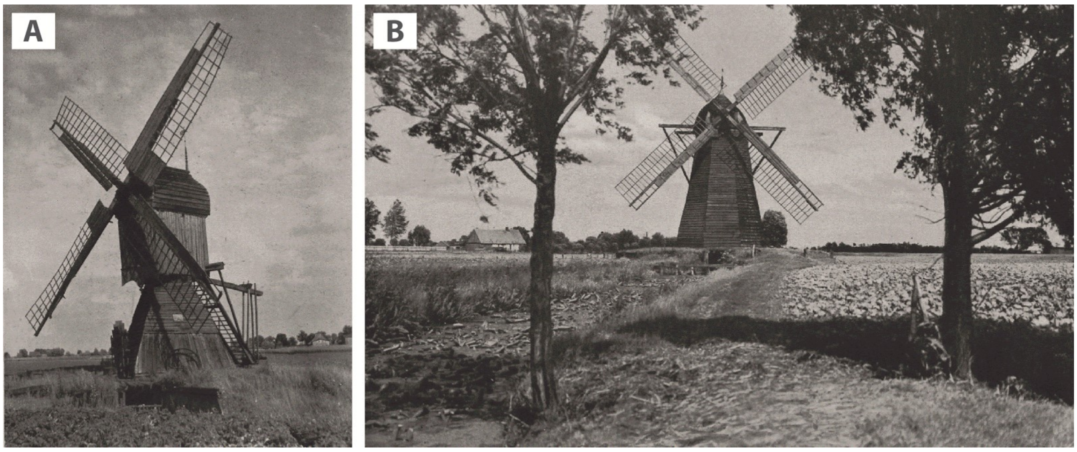

Figure 5. Drainage windmills from the Vistula Delta (Zirkwitz 1938, 72), A: Hollow post mill, B: Tower mill.

The analysis of the literature and cartographic materials (especially Figure 4(B1)) indicates that hollow post mills were the most common in this area and are the most representative type.

The kinetic analysis of the windmills shown in Figure 6 provides information that their movement was complex and multidirectional – from the rotation of a wing to the rotation of the cap, posts, tail beams with stairs, and hollow-post.

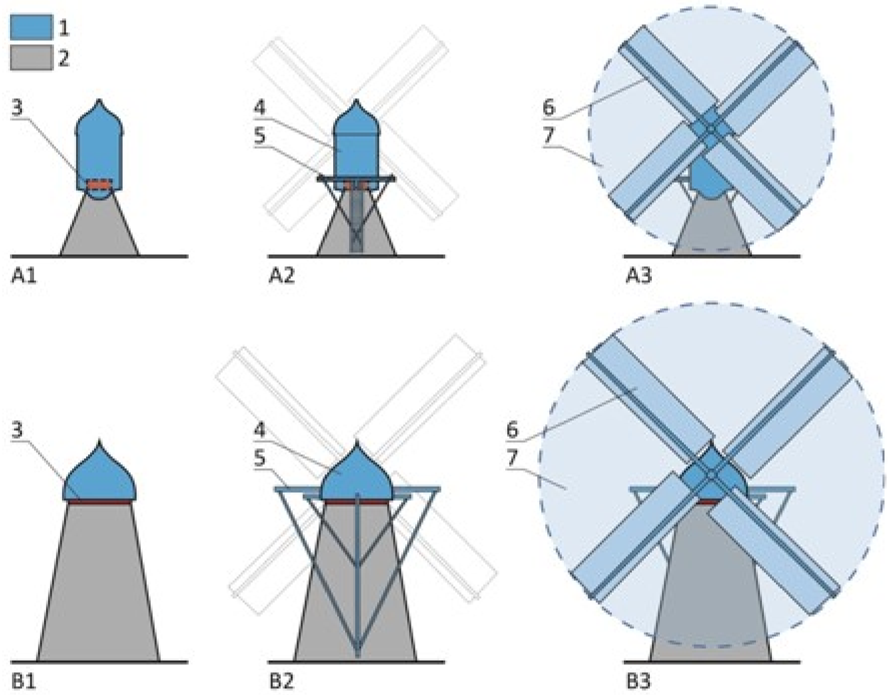

Figure 6. Diagram of the rotating parts of: A: hollow post mill, B: tower mill 1: rotating elements; 2: static elements; 3: elements enabling rotation; 4: rotating upper part; 5: tail beams connected to the upper part; 6: wing; 7: area of rotation of the sails.

3.4. Model Example of a Hollow Post Mill

A significant contribution to the concept of windmill protection (including drainage ones) was made by De Hollandsche Molen (Dutch Windmill Society) established in 1923. Their efforts to preserve Dutch windmills were probably the reason why similar activities were undertaken in the Vistula Delta in the 1930s. It was then that the issue of the disappearing evidence of the development of hydrotechnical technology was noticed by the authorities of Freie Stadt Danzig (Free City of Danzig), which decided to protect some of the windmills. For this reason, in 1933, a windmill in Neukrügerskampe (today "Grochowo Trzecie") was brought to Oliwa, where it became one of the several exhibits presented as part of an open-air museum in the Oliwa Park. It was the only drainage windmill from the Vistula Delta to survive World War II. The end of the year 1977 saw its partial destruction as the upper rotating part burnt down. The remaining pyramidal base was placed for 20 years in an area where the drainage function could not be performed. At the beginning of the twentieth century, it was restored and some of the original elements are part of the permanent exhibition at the Żuławy Historical Park located in Nowy Dwór Gdański.

In the middle of 1977, an architectural inventory of a conservator was prepared to perform necessary repairs of the sails (Hoffmann 1977). The drawing documentation is available in the National Heritage Board of Poland in Gdańsk and became the basis for the analysis of the structure and spatial proportions of the only representative of these windmills. The basic dimensions include the height of the windmill from the base to the ridge – approx. 10.00 m and the length of the wing – approx. 8.00 m. The proportions of the pyramidal base and the rotating upper part were compared with photos taken from historical albums and calendars (Bertram, Baume, and Kloeppel 1924; Danzig in schönen Bildern 1942; Danziger Heimatkalender 1927; Schwarz 1888; Zirkwitz 1938). The results reveal a strong similarity between the windmill in Neukrügerskampe and windmills in other areas of the Vistula Delta. As a result, the windmill was adopted as a model example of a hollow post mill from the Vistula Delta.

An interesting element of the windmill is the scoop wheel (Figure 7(D)) with the characteristic "S" shape of the scoop connectors, giving it a specific look. The diameter of the wheel was 4.10 m. The analysis points to the popularity of this scoop wheel arrangement in all Vistula Delta polder areas.

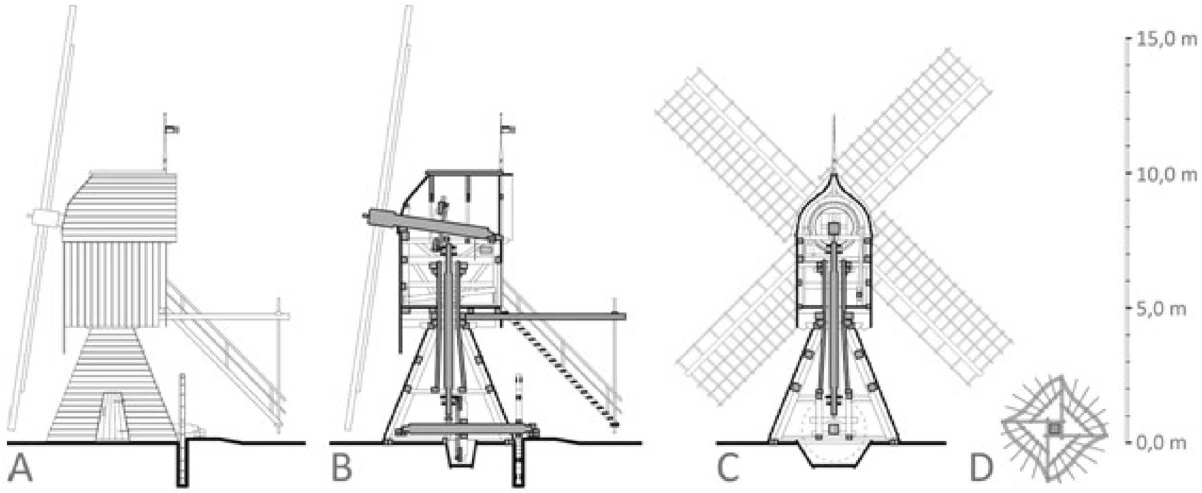

Figure 7. Facades and sections of the drainage windmill – based on the materials from the National Heritage Board of Poland. A: side view, B: cross-section perpendicular to the sails, C: cross-section parallel to the sails, D: side view of the scoop wheel.

3.5. Contemporary measures of windmill restoration

The first measure is based on keeping the historical form, together with details and materials. The traditional approach to conservation involves the renovation of existing windmills, which were often significantly damaged. Activities aimed at saving historic windmills are often initiated by enthusiasts and local organisations such as the Norfolk Windmills Trust formed in 1963 (Howes 1980). Actions are taken thanks to the awareness of residents and the physical existence of windmills – regardless of their technical condition. Renovation works related to windmills open up new opportunities for the local economy and increase tourist attractiveness – especially when restored windmills are in operation (Chamberlain 1987). A different approach is used to build new traditional windmills, the form of which closely follows the historical ones, but which fulfil a modern function. This approach was adopted for the "Noletmolen" windmill. This wind turbine was built in 2005 in Schiedam (the Netherlands) in the form of a traditional tower windmill with a gallery. The construction of a modern windmill that considers the forms of historical – and still existing – gallery windmills from Schiedan relates directly to the history and historic architecture of the city, at the same time using ecologically obtained energy for production purposes. There is a website that features basic real-time data such as: wind direction, strength and speed, positioning of the airfoils in relation to the sides of the world, and power plant data. This not only introduces the operation of the power plant and increases the popularity of the windmill, but also draws attention to the environmental aspects of using the traditional architecture of the region. It is recognised that the three-dimensional form of historical space even in the form of a movable computer model is more convincing than any picture or other form of reminiscence (Michon and Antably 2013).

The second measure is focused on the recreation of multi-sensory characteristics of the region. This solution is based on the introduction of a contemporary form symbolising a historical object that is standing in opposition to the traditional preservation model created in the nineteenth century (Germundsson 2005, 25). This approach has the potential to present the characteristics of historical buildings and their impact on the landscape without unwanted distortions and simplifications. The method of this type is applied in the Parisian Fouquet Barriere hotel designed by Edouard François. The form is recreated with concrete elements with no unnecessary detail simplification (Wesołowski 2014). The method is also consistent with the strategy of the landscape biography that considers research-based future landscape transformations involving historical heritage and means of landscape preservation (Kolen, Renes, and Bosma 2016). This approach led to a series of changes in the form that opened research and design process to contemporary solutions and materials.

4. Results

4.1. Potential Locations for New Landscape Windmills

The analyses made it possible to prepare a map showing the total number of places where windmills stood in the period from the 17th to the twentieth century in the modern rural commune of Cedry Wielkie (Figure 8). There were at least 50 places with windmills, 29 of which were probably drainage windmills. The density of windmills was 1 windmill per 2.48 km2, while the density of drainage windmills was 1 drainage windmill per 4.27 km2. These proportions show that windmills, which are kinetic objects visible in space, were a common and repetitive element of the landscape.

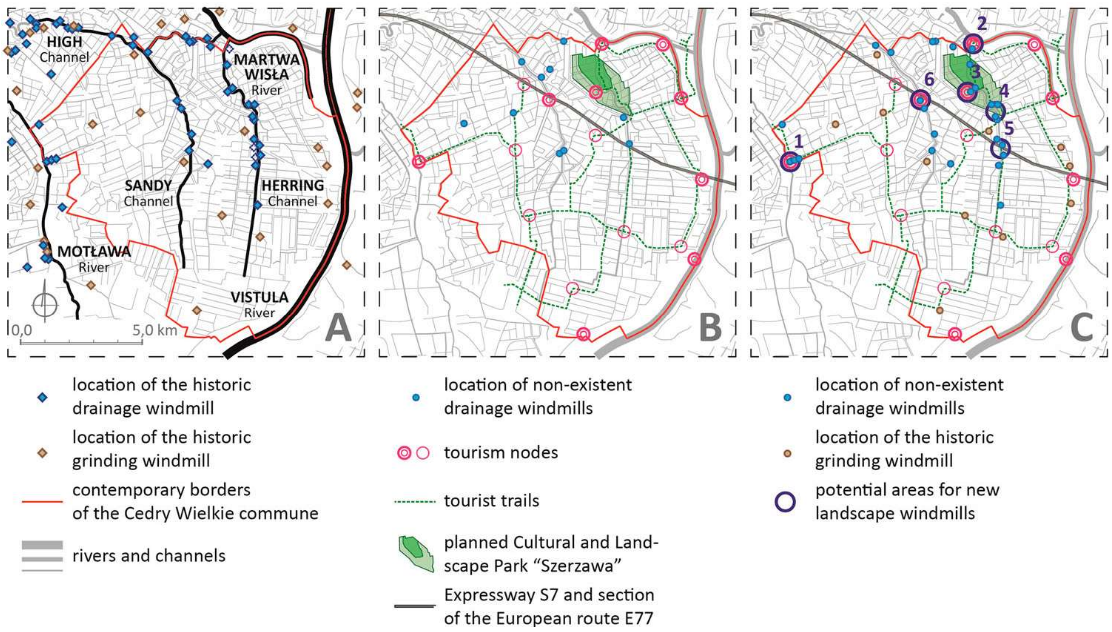

Figure 8. Spatial analysis of locations of windmills in the Cedry Wielkie Commune A: total number of historic locations of windmills resulting from the cartographic analysis, B: historic locations of drainage windmills resulting from the commune's Spatial Development Conditions and Directions Study, C: compilation of the current planning studies and the results of the cartographic analysis.

The recreation of the forms referring to hollow post mills is also partly an extension of the Cedry Wielkie Commune strategy. The commune plans to establish the "Szerzawa" Cultural and Landscape Park, where windmills are considered interesting landscape elements. The study found that not all historical locations within the region were marked, so they were added. The strategy did not provide any rules for windmill reconstruction, the issue of which is regarded as a challenging idea for future investigation.

Figure 8(C) shows the existing directions for the commune's development combined with the historical value of locations of former drainage windmills that were identified during the cartographic analysis. Location 1 (near the village of Grabiny-Zameczek) is situated on the Motława River; Location 2 (Trzcinisko) is situated on the Martwa Wisła river; Locations 3, 4, and 5 are situated the Herring Channel – the first two in the area of the village of Szerzawa; Location 6 is on the Sandy Channel and, as in the case of Location 5, is adjacent to the E7 expressway. Each of these locations has different advantages. Locations 1 and 2 are situated close to areas used for water tourism (sailing, canoeing, and fishing). These locations are important for a potential effect of the attractiveness of water tourism, which is a stimulus for the development of areas located by waters and increases the importance of waterways (Wasil 2015). Locations 3 and 4 complement the former landscape of the historic village – the planned "Szerzawa" Cultural and Landscape Park. As Lipińska points out (2011, 71–76), the high emotional strength of the image of the Vistula Delta requires the reconstruction of at least a fragment of the so-called "landscape with windmills" as part of the landscape of tomorrow, among which the human-creator will live. When creating the Park, it is, perhaps, necessary to include the creation of windmills in a historical form, or in a modern one – with the history of the place in mind. With the expressway, Locations 5 and 6 are characterised by good visibility and exposure to windmills for tourists as one of the characteristic symbols of the Vistula Delta.

4.2. Proposal for a New Landscape Windmill Form

The windmills in the Cedry Wielkie Commune were an important element of the landscape that was lost due to technological and historical changes. The construction of traditional windmills in such a number would be a very costly and unprofitable challenge. It would also constitute an undertaking on an unprecedented scale. The historic function of drainage windmills is inefficient compared to the modern capabilities of electric pumps. All things considered, the solution may be to build structures referring to windmills but without their historical function. Such structures should preserve the nature of historic drainage mills – their type, dimensions, and proportions.

The strategy has to be developed according to state-of-the-art technology to avoid historical distortion and to present a kinetic landmark in the landscape. It becomes more apparent that the development of kinematic architecture is entering a new phase. This is due to the development of design techniques accompanied by more complex movement, which allows architects to achieve innovative spatial solutions. Computer analyses that construct real and virtual prototypes or combine analytical and design processes make architecture reach for previously unknown forms and solutions. New technologies, which include generative or parametric design, make it possible to design sophisticated forms of objects and their constituent kinematic elements, which are becoming increasingly complex. The concept of liquefaction understood as a series of multiple particular movements of form elements of the same type is introduced to architecture (Cudzik 2019). It can strongly affect the landscape and create an interesting and unique character of open spaces. The use of kinetics in architecture makes the object less defined and more abstract. Movement is used both for operational reasons, for example to control light, and for spatial and aesthetic reasons. Kronenburg (2001, 42) argues that "The complex and mysterious architecture can increase our appreciation of the achievements of human creativity and emphasise the relationship it has with natural elements such as landscape, plants and light".

The analysis of the historical hollow post mill from the Vistula Delta identified five characteristic elements that should be preserved and adapted to the new landscape form. Stocks (Figure 9(A)) remain in a cross-shaped pattern with a modified layout of bars and uplongs resembling shutters in the shuttered type of sails; the historical length of the sails (approx. 8.00 m) is preserved. The proportions of the rotating upper part become slimmer because there is no need to place a massive break wheel and windshaft, which can be replaced by modern mechanisms; the height remained the same (approx. 5.80 m). The sides of the rotating upper part (Figure 9(B)) refer to the plank divisions found in a historic windmill by perforating a thin coloured aluminium layer (e.g., as in Mark Fornes "Thevertmany" Hyparbole). The front of the rotating upper part (Figure 9(D)) has the characteristic shape of a medieval shield that will be moved in a similar way to the sides. The tail pole on which the stairs are hung (Figure 9(C)) will be slightly transformed for functional reasons. The proportions of the pyramid-shaped base (Figure 9(D)) remain unchanged (height of approx. 4.70 m, side of the square base of approx. 5.00 m, inclination angle of the sides of 68°) – the structure is open and reduced to four corner beams and a central column (referring to the historic hollow post). Statics, materials, and colours are an additional complex issue that was not covered in this paper, and will be explored in future research.

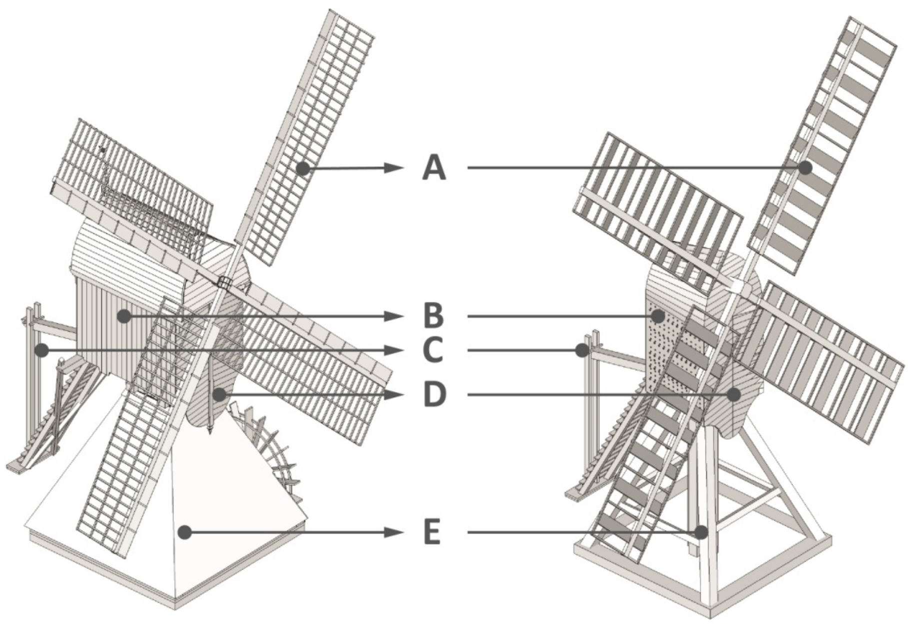

Figure 9. Diagram of the transfer of characteristic elements of a historic hollow post mill to the new landscape form. A: Sails, B: Sides of the rotating upper part, C: Tail pole, D: Front of the rotating upper part, E: Static pyramid-shaped base.

The new landscape windmills discussed in the results are one of the possible approaches to the issue. Heritage visions affect cultural identity and how people refer to their regional culture (Colomer 2017, 914). The study shows that landscape characteristics can be recovered, with emphasis being placed on creating the reminiscent of historical landscape with contemporary forms of windmills that could be supported by the new form of traditional windmills. This restoration model would make it possible to multiply kinematic sculptures in the landscape and, thus, may have a similar impact on the scenery as traditional windmills once had.

It is also possible to use new landscape structures as small wind turbines. As the first study showed (Kołodziejczak and Pacholczyk 2018), the scale of these structures requires appropriate siting due to exposure to wind conditions and appropriate rotor blade technology, but it is feasible and to some extent effective. Moreover new windmills could collect weather data that would be useful to monitor the effects of climate change.

The only element that remains unchanged is the overall dimensions and the range and type of movement used. For this purpose, a solution based on a light steel structure is proposed, strongly inspired by the works of Tinguely. The steel openwork form is completed with a full windmill upper part which, together with the propeller, will move around the static pyramid-shaped base. The propeller of the windmill will move in a way analogous to historical prototypes. Additionally, this form will collect climatic and weather information, which will be made possible enabled by additional research and analysis. The presented solution serves as management of future change rather than just protection of the past (Van Der Valk 2014, 159).

5. Discussion

The Vistula Delta area is an attractive location for harnessing wind energy and the wind power sector in Poland has good development opportunities (Igliński et al. 2016). The most important issue is to plan and implement such solutions in harmony with the history of the place and local residents. Until the 1920s, the landscape of the Vistula Delta was one with kinetic features and the residents there were familiar with windmills. The function of windmills – and hence their importance – was taken away by more efficient steam, combustion, and finally electric devices, which were located in buildings with static features. This led to the almost complete disappearance of windmills, which resulted in the loss of a valuable landscape feature – kinetics – for nearly 100 years.

One of the inspirations in the process of searching for formal solutions of a new form of windmills present in the area of the Vistula Delta may be forms of kinetic art. Preservation is justified by a basic human need to identify with the region in times of globalisation (Van Der Valk 2014, 163). An example of the effect of windmills on the creation of a kinetic landscape is the restoration of Lasithi Plateau's (Crete, Greece) windmills with perforated sails.

At the beginning of the twenty-first century, several wind farms were built in the Vistula Delta, affecting the landscape considerably (Figure 10). Further similar investments are planned and arouse controversy. It is a worldwide problem that still needs regulations and an operation model (Clarke 2009). In the area of the Vistula Delta, there are organisations and groups of residents actively opposing the construction of wind farms. The main arguments are the protection of ecological river corridors and the historical landscape, as well as the impact of wind farms on human and animal health (Baranowski et al. 2014). As research shows (Spielhofer et al. 2021), landscapes that can facilitate connections to energy facilities may be favoured by humans in visual terms. As Devine-Wright and Howes (2010, 278) point out in the context of wind farm approval by local residents, the strength of attachment to place does not inevitably lead to opposition to place change, but depends upon how individuals interpret change, with such interpretations being shaped by the social context, moderated by trust in key organisations. Climax thinking, place attachment, and attitudes towards wind farms largely depend on their recognition in the landscape, i.e., getting used to kinetic objects (Chappell, Parkins, and Sherren 2020). Recreating an element of the landscape (Figure 11), i.e., drainage windmills, may provide a historical and spatial context for the contemporary understanding of the importance of water control and adaptation to the acceptance of kinetic objects in the landscape. One of the main tasks for future landscape management is to acquire a better understanding of the process forming the present landscape so that future changes and what results can be expected from specific actions can be modelled (Ermischer 2004, 382). Inspiration for sustainable management can be derived from past traditional landscapes, which is useful when decisions have to be taken for the future management of landscapes and even for creating new ones (Antrop 2005). Stronger integration of the sense of place theory (Gottwald, Albert, and Fagerholm 2022) into planning practice will help planners to respect local meanings and values, to integrate residents as environmental stewards in the planning process (Gottwald and Stedman 2020), and to use potential landscape history benefits as a planning tool (Marcucci 2000).

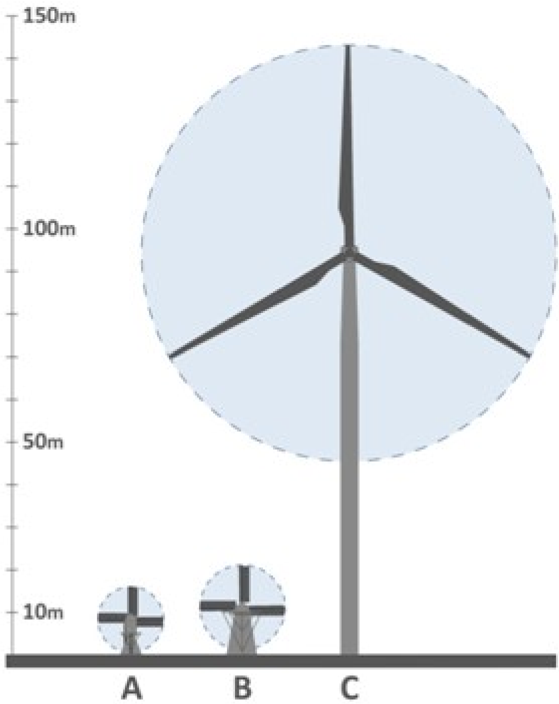

Figure 10. Windmill heights. A: Hollow post mill (drainage function), height = approx. 10 m, diameter of sails = approx. 16 m; B: Tower mill (drainage function); height = approx. 12.00 m, diameter of sails = approx. 20.00 m; C: Existing wind turbine in the Nowy Dwór Gdański Commune, mast height = approx. 95.00 m, rotor blade diameter = approx. 11.000 m.

Figure 11. Computer visualisation of a landscape with new forms of windmills (Figure 7(C) location 3).

As research shows (Spence 2020), space – including architecture – in which a human is located is read with all senses. This is important especially in the case of drainage windmills, the reception of which in space did not end only with visual aspects related to kinetics. Their impact on the sense of hearing – the sails moved by the wind and the regular sound of working windmills – were a clear message about the operation of the entire flood protection system. This was associated with a sense of security: if the windmill was not working, i.e., it could not be heard, there was a risk of flooding. An additional auditory aspect also included the rhythmic sound of pouring water tossed by an open scoop wheel. Recreating an element of the landscape – drainage windmills – in a modern form becomes a multi-sensual experience of space.

6. Conclusions

There are no more drainage windmills in the Vistula Delta area. This is a huge loss for culture and a missed opportunity for the development of local tourism. The concept of introducing new forms of drainage windmills aims not only to recreate historical windmills but also to bring back memories of the lost kinetic landscape.

The method applied in this study consist of an overview of historical materials concerning historical windmills with comparison to contemporary planning strategies and documents. The first step led to the selection of characteristic elements repeated in a group of representative examples that was confronted with contemporary solutions in kinetics. The final form is developed with the use of historical knowledge, accordance to planning strategies and documents, with contemporary art and architecture solutions. New kinetic objects can restore the idea of the centuries-old tradition and culture that grew up in this difficult space, creating a fragile balance between water and land. New forms of historical windmills open up a range of opportunities – starting from an approach to landscape based on architectural conservation that is in favour of restoring the lost elements of landscape and ending up with interactive installation forms that could have a positive effect on tourist attractiveness of the Pomeranian region. Recreating the kinetic landscape of the Vistula Delta, lost over the years, is an enormous challenge. The way of recreating windmills and the range of their movement affect not only the perception of the landscape but also can contribute to a significant increase in the awareness of the local culture.

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