

Article

Learning from the Past: Urban Landscape Transformation Praxis on the Example of Interwar German Housing Estates

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Abstract: In this paper, the incorporation of formerly existing built environment and natural elements was studied in eight housing estates from the interwar period in the Weimar Republic as a part of broader research on landscape transformations. The data on the original state of land development were collected using the comparative cartographic analysis method. The analysis was supplemented by a comparison with iconography, such as aerial photographs, orthoimagery, and, in some cases, manually drafted plans. The results suggest that pre-existing conditions significantly influenced the functional dispositions and urban layout of the estates. These findings add to our understanding of the development of housing estates of the interwar period in the Weimar Republic and the posture of designers and urban planners towards the natural conditions of the respective project sites. This work can be valuable for adding to existing guidelines or principles of urban planning.

Keywords: natural environment; landscape transformations; urban planning; land development; housing estate; Berlin; Breslau; Frankfurt am Main



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1. Introduction

The topical initiatives taken within the framework of the European Green Deal are focused on economic growth without the cost incurred by the natural environment and without overtaxing natural resources. The focal project in terms of urban development, the New European Bauhaus [1], is an idea that assumes establishing itself on the legacy of the Modern Movement or the New Objectivity and transferring it to the present day, looking for new ways of creating sustainable places. The references of the New European Bauhaus initiative—such as establishing new principles of designing the architectural and urban structures developed, among others, in the Bauhaus School, during the Weimar Republic period—should not be considered without the economic and social context of that time, as well as the state of knowledge of the designers. Simultaneously, being well aware of the context, one can draw a parallel between the past and the present, especially since the current situation of a prevalent housing shortage, high rent prices, the migration crisis, and the issues of living in healthy, green, ventilated cities has given rise to those comparisons.

The situation and living conditions in German cities after the First World War—among them in Berlin, Frankfurt am Main, and Breslau (present-day Wrocław, Poland), to which this paper refers—were harsh. Not only did such a large number of people lose their relatives in an armed conflict, often the ‘workforce’ of their families, but the country had also been economically destroyed by the years of war. Urban areas became overpopulated due to the migration of people from rural regions who had no longer been able to feed themselves. In the 1920s, Breslau had the highest population density in the Weimar Republic. People lived in squalid conditions, with entire families with multiple children often sharing a single room, without access to running water or daylight. In 1925, Breslau had the highest general mortality rate among all large cities in the country, the fourth place in infant mortality, and the fifth place in the number of pulmonary tuberculosis infections [2] (p. 69).

Thus, housing reform was driven by the growing demand for flats and the poor health of the public. In architectural terms, a new urban scheme was developed. Urban planners and designers abandoned the peripheral block layout in favour of linear housing estates or open-block systems. They perceived it as a remedy for the lack of air and light, as the new housing estates were opened to a large amount of common greenery and ventilation of the spaces between buildings was made possible. The north–south layout of the buildings was considered optimal, and the entire ‘new way’ was regarded as a solution to the health problems of the urban population [3]. In terms of construction, new materials and techniques, along with maximizing the economy in flat layouts, allowed the rationalisation of the pace of the construction phase. This was mainly influenced by US construction methods [4] and [5] (pp. 18–30) and resulted in an overall cost reduction.

In the interwar period, the role of women in society began to change. Economist Erna Meyer proposed a model of a kitchen connected to the flat for the Werkbund exhibition in Stuttgart. This combination was postulated in order to limit the isolation of women while they performed household activities [6] (p. 230). Viennese architect Margarete Schütte-Lihotzky, who had been invited to collaborate on the vision of the New Frankfurt, worked on a model of kitchen that could make household duties quicker to complete. Kindergartens included in the urban plans and programmes of the new districts allowed women to be relieved of some of their responsibilities and to join the workforce.

At the same time, theorists and practising designers presented new perspectives on greenery, mostly adopting an English perception of the garden city movement. In his 1915 dissertation, Martin Wagner, later the chief city planner of Berlin, developed the term ‘sanitary greenery’, describing the connection between green spaces and health. In the interwar period, this theory became widely known. In 1924, Hugo Richter, the head of Urban Gardening in Breslau, wrote about the ‘hygienic’ necessity of establishing new green spaces [7]. His observations about the role of greenery in urban planning—developing strolling paths allowing for further walks and spending free time in rural areas, using any available space for growing one’s own food, planting the streets with trees so that green strips connecting larger park areas are established, so as to form systemic linkages—appear to still be relevant and to have a reflection in the present day.

Today, the resilient urban development is demanded to be implemented along with sustainable use of ecosystems. Although environmental values and territorial layout are the conditions for the development on many geographical, spatial and temporal scales [8–10], urbanization alters the environmental patterns and natural elements are often perceived as obstacles. According to the New European Bauhaus’ guidelines and assumptions, contemporary designers should follow the principles of the Modern Movement, developing their own way of adaptation and implementation. While much is known about architectural heritage itself, there are fewer studies on the design of open areas, and researchers hardly focus on the design phase in the context of using terrain conditions. The aim of this paper is to examine to what extent the natural conditions influenced the urban layout of Modernist estates on the examples from three German cities that saw intense development during interwar period. The assumption is that since design on the urban and architectural scale of this period in Germany is considered exemplary, the initial design phase was also carried out with respect to existing conditions and, as such, could be a model for contemporary urban development.

2. Materials and Methods

This paper is a part of broader research on the landscape transformations of interwar-period housing estates. The first phase of the investigation focused on the development of housing estates located in Wrocław, formerly Breslau. The aim of the subsequent phase was to collect material for comparative research on the housing estates built during the same period in Berlin and Frankfurt am Main. It allowed placing the previously studied local patterns in the broader context of the Modern Movement in the period of the Weimar Republic. The spatial development of Breslau during the interwar period was conducted in

reference to the advance of other German cities, also by the activity of the same housing development companies guided by equal societal and economic interests across the country [11]. Therefore, two dynamically developing urban centres were chosen as study cases. In Berlin, there were designers who also worked in Breslau, and in Frankfurt am Main, a large-scale urban planning program—New Frankfurt (German: Neues Frankfurt)—was initiated and implemented at the turn of the 1920s and 1930s under the guidance of Ernst May, who took up the position after years of professional involvement in Breslau. His plan of satellite estates implemented in Frankfurt am Main had its roots in his application for the design competition concerning the spatial development of Breslau.

The land development of the housing estates has not yet been comprehensively investigated and is a complement to the studies on the architecture of these estates, which are extensively described in the literature. The aim of this research is to provide additional insight into the landscape transformations of the estates and five indirect objectives can be distinguished:

- Investigate the original land development state, that is, before the housing estates were built;
- determine the original form of the surroundings of the buildings;
- compare the original and contemporary development states and assess the degree and character of any changes;
- compare the estates with each other and find potential land development patterns;
- identify historical solutions, which could be currently perceived as blue or green infrastructure.

Especially the original land development state, which is the focal point of this paper, is, to a high extent, not clearly visible in the field and can be reconstructed on the basis of archival materials. Eight housing estates from Berlin, Breslau and Frankfurt am Main were selected for the purpose of this paper. Five of these are directly embedded into the period of the Modern Movement (German: Neues Bauen). These are the Britz housing estate in Berlin, the Klein Tschansch and An der Hundsfelder Strasse housing estates in Wrocław, and the Praunheim and Roemerstadt housing estates in Frankfurt am Main. Berlin Britz and Frankfurt Praunheim were the first modern large housing complexes in their respective cities. These five estates represent the last phase of the building industry of the Weimar era, described by Celine Kress [12] as ‘euphoria and the end’. Although large modern housing estates were characterised by the use of new materials and formal rigour, the principles of their urban development were obviously rooted in the tendencies that had preceded them. In these housing estates, the influence of the garden city movement is clearly visible. Therefore, the housing complexes of the preceding phases were included in the comparison:

- The Staaken Garden City, whose construction began in 1914 on the outskirts of Berlin, had a model effect on the later housing estates built in Berlin and which urban layout was based on the previous design experiences of Paul Schmitthenner in Breslau.
- The Lindenhof housing estate, which was the first complex built after the First World War by Martin Wagner, who used it to test the rationalisation of construction techniques [4]. The complex represents the initial phase of the post-war urban development in Berlin and the neighbouring districts.
- The Paddenpuhl housing estate in northern Berlin, which represents the middle phase of urban development in the Weimar Republic of the time of ‘stabilisation and normalisation’, following the terminology of Celine Kress.

The metrics and basic data of the housing estates that are subject of this study are compiled in the table below (Table 1).

Table 1. The metrics and basic data of the housing estates under study.

Name of the Housing Estate	City	Dating	Authorship of Architectural Projects	Authorship of Landscape Projects
Staaken Garden City	Berlin (at the time of building: Staaken village, since 1920 in Berlin)	1914–1917 and 1924–1929	Paul Schmitthenner, Karl Derleder	Ludwig Lesser
Lindenhof	Berlin (at the time of building: Schoeneberg village, since 1920 in Berlin)	1918–1921	Martin Wagner	Leberecht Migge
Paddenpuhl	Berlin	1927–1929 and 1936–1937	Fritz Beyer, Josef Scherer, Erich Dieckmann	Erwin Barth
Britz	Berlin	1925–1930	Bruno Taut, Martin Wagner	Leberecht Migge, Ottokar Wagler
Klein Tschansch (now: Księże Małe)	Breslau (now: Wrocław)	1928–1929	Paul Heim, Albert Kempter, Hans Thomas, Gustav Wolf, Rudolf Sack	unknown
an der Hundsfelder Strasse	Breslau (now: Wrocław)	1928–1930	Theo Effenberger, Hans Thomas	unknown
Praunheim	Frankfurt am Main	1926–1930	Ernst May, Herbert Boehm, Wolfgang Bangert, Eugen Kaufmann, I. Becker, Anton Brenner, Carl-Hermann Rudloff, Martin Weber	Leberecht Migge, Max Bromme

The data on the original state of land development were collected using the comparative cartographic analysis method. This analysis is commonly used in landscape studies [13] (pp. 36–39, 54–77) and [14,15] to trace landscape changes using mainly cartographic data. The physical elements recorded in the cartographic materials are compared with each other over time and investigated by superimposing consecutive transformations over each other. In the case of this study, the comparative cartographic analysis aimed to assess the incorporation of the previously existing land development and natural elements into the original urban layout of the estates under study. The landscape transformation was described using the retrogressive method [13] (p. 67) (Figure 1), which is focused on the exact point in time, allowing the juxtaposition of the landscape elements with the position of built structures in a precisely defined period. The comparison was carried out to juxtapose current open spatial data and historical topographic maps from 1877 [16]. The GIS data concern the actual urban layout of the buildings, which contributed to the precision of mapping and showing the contemporary state of the estates. In the analysis, the buildings were separated into originally built and those built in the following transformations, which helps contemporary observers to tell them apart in the diagrams. The historical maps from the year 1877 were selected specifically due to the fact that this source covers the entire country, and maps from subsequent years do not.

The maps provided data about not only the elements of the natural environment, such as a topography with a 1 m interval and natural land cover, but also the elements of the built environment. The study focused on types of land cover that could be distinguished on the map: meadows, wetlands, water systems, and existing groups of trees. The analysis included also formerly existing built-up areas—represented as a built-up plot—and a network of roads that were recognisable on the maps. The analysis was then supplemented by a comparison with iconography, such as aerial photographs, orthoimagery, and, in some cases, manually drafted plans. The aim was to verify in a different source the data obtained on the basis of the topographic maps (Figure 2). It mainly concerned groups of trees incorporated into the urban layout, as their arrangement cannot be read directly from the maps. The additional data collection is presented in the table below (Table 2). The direct field observations of the housing estates under study, combined with photographic documentation, were complementary to the analysis. The aim of the current observations was

to identify and confirm the structures detailed during desk research, assuming that some landscape elements are ‘constant’, that is, an assumption typical for that kind of analyses. The effect of the comparison is presented in the form of diagrams, which accompany the description in the following part of the paper.

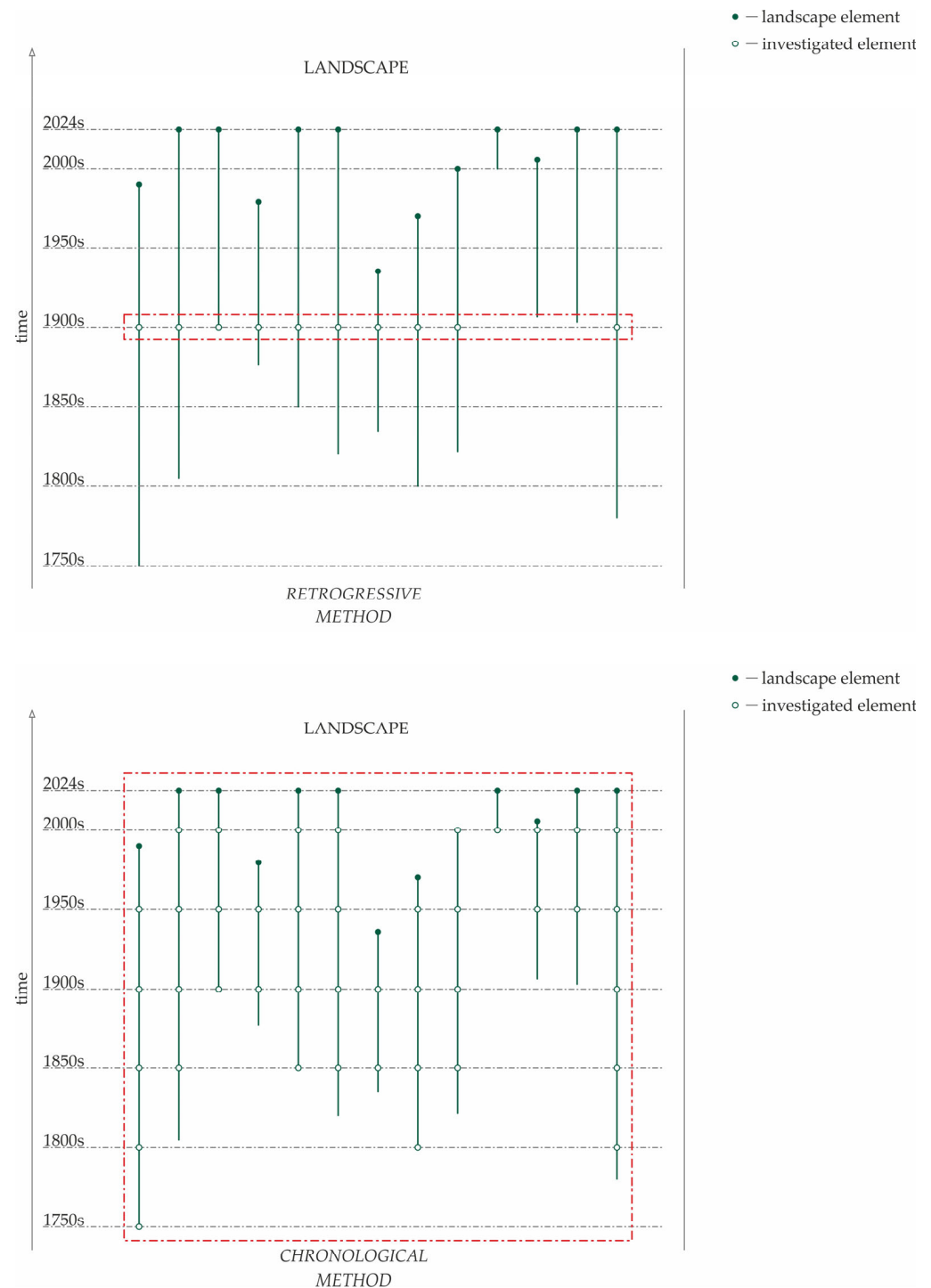


Figure 1. The difference between retrogressive and chronological method; the range of investigation marked with the red box—diagram elaborated after Stahl Schmidt et al. (2017) [13].

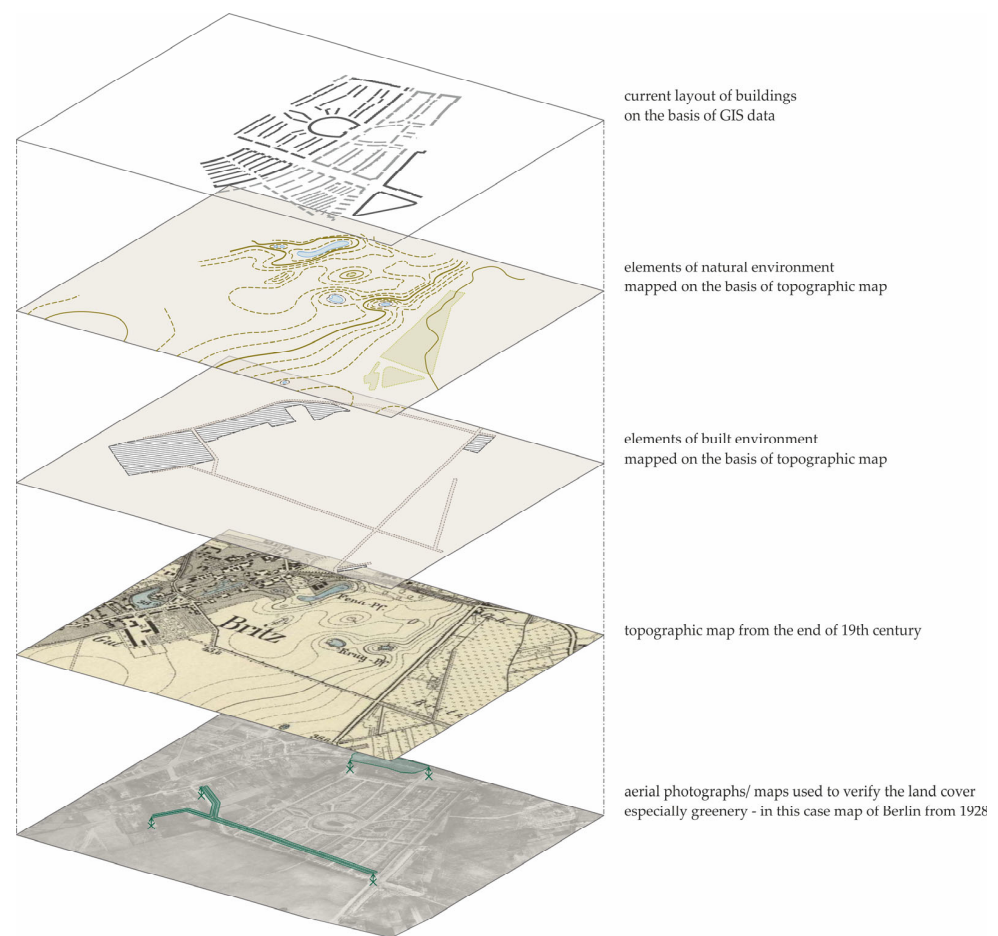


Figure 2. The analysis procedure—graphical explanation on the example of Britz housing estate.

Table 2. The additional data collection.

Source Name [References]	Publishing Body	Dating	Associated Locations (Housing Estates)
aerial black and white orthogonal photographs of Berlin [17]	Senatsverwaltung fuer Stadtentwicklung, Bauen und Wohnen Berlin	1928	Staaken Garden City, Lindenhof, Paddenpuhl, Britz
aerial black and white orthogonal photographs of Berlin [18]	Senatsverwaltung fuer Stadtentwicklung, Bauen und Wohnen Berlin	1953	Staaken Garden City, Lindenhof, Paddenpuhl, Britz
manually drafted plan of land development [19]	Architekturmuseum. Technische Universitaet Berlin	1928	Paddenpuhl
manually drafted plans and aerial black and white perspective photographs [20]	Argon Verlag GmbH Berlin	1876–1930	Britz
aerial black and white perspective photographs [21,22]	Herder Institute for Historical Research on East Central Europe	1929, 1931	Klein Tschansch, an der Hundsfelder Strasse
manually drafted plans of sewage systems [23,24]	Municipal Water and Sewerage Company in Wroclaw Archive	1929, 1931	Klein Tschansch, an der Hundsfelder Strasse
manually drafted plan [25]	Wroclaw Construction Archive of Museum of Architecture	1929	an der Hundsfelder Strasse
black and white aerial photographs [26,27]	Das neue Frankfurt Int. Monatsschrift für die Probl. Kult. Neugestaltung	1928	Praunheim, Roemerstadt
black and white aerial, orthogonal photographs of Frankfurt [28]	Hessische Landesamt fuer Bodenmanagement und Geoinformation	1952–1967	Praunheim, Roemerstadt

3. Results

The Staaken Garden City was developed on open land, enclosed by railway roads from the south and north, and a road with a tree alley that neighbours from the west (Figure 3). The topography, with a difference of approximately 2 m between the highest and lowest point of the area, on a section over 800 m long, did not determine the estate's layout to a large extent. It was the network of watercourses, water bodies, and wetlands that influenced the layout of the housing estate. However, the watercourse that ran along the railway on the southern border of the estate was hidden in a pipe below the ground, and the wet meadow area in the north was transformed into a recreational area with two large meadows framed by tree alleys and an oval-shaped water reservoir, also surrounded by trees (Figure 4). The road adjacent from the west was incorporated into the layout of the housing estate. The building line was set back, and this created a space for an extra row of trees between the buildings and the formerly existing road (Figure 5).

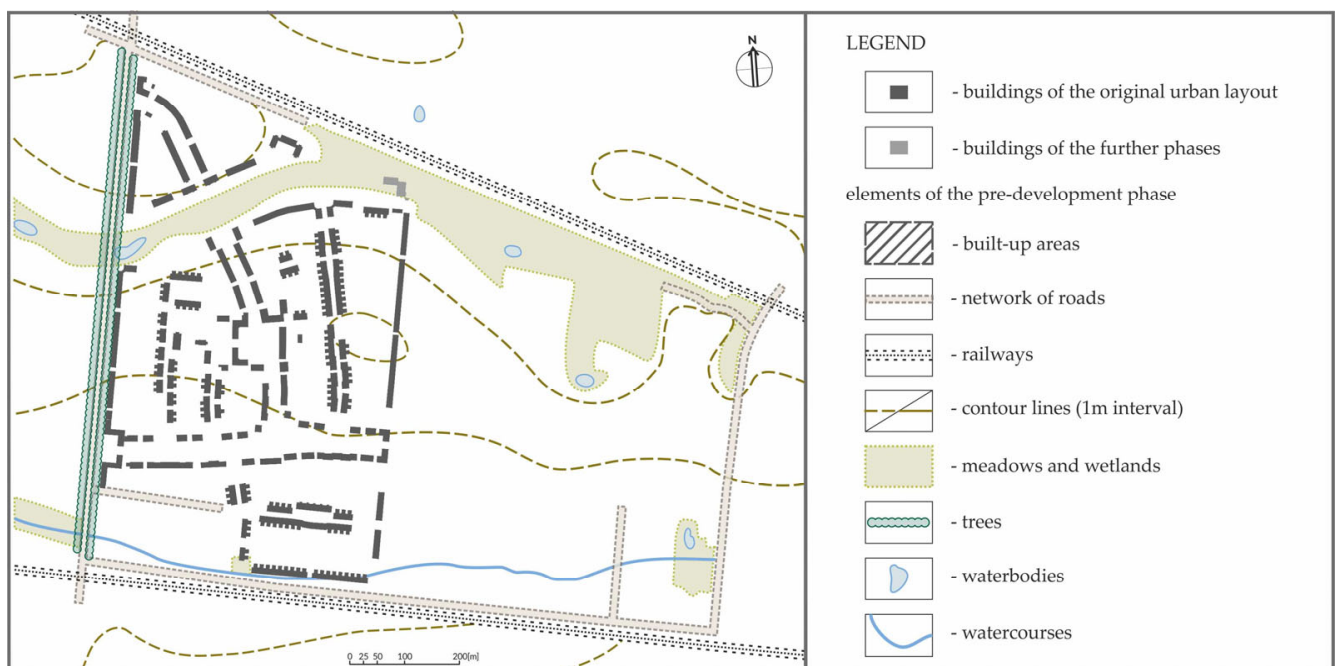


Figure 3. Staaken Garden City housing estate analysis scheme.

The Lindenhof estate was built upon the area of the ice factory. Formerly existing buildings of the factory had been probably designated for demolition. The southern part of the housing estate was adjacent to the built-up plot and cemetery that exists today. The estate was developed in a respect of existing road and railway tracks, which neighboured the estate from the west (Figure 6). In addition, the 'zigzagging' road, connecting the factory with the railway, became a canvas for the layout of the estate: it was ended with a building hanging over the road with a gateway to the core of the housing estate. The central part of the development was designed on the basis of previously existing natural objects: a waterbody that had been used for the production of ice, and a small park, probably arranged as a part of the factory's establishment. These elements became semi-public recreational areas of the newly developed estate.



Figure 4. The public greenery area was established due to natural conditions. Water was directed into an oval-shaped pond. Comparison of the aerial photographs from 1928 and 1953 [17,18]. Data licence Germany—attribution—Version 2.0.

The alley road with rows of lime trees on the sides, which had separated the built-up area and the park, was also incorporated into the development. The roads were planted with lime trees, which contributed to retaining the name of the estate, 'Lindenhof'. Translated from German, it denotes a courtyard of lime trees. The natural topography of the area, with slopes descending towards the water reservoir, determined the arrangement of the buildings. The southern part of the housing estate was inscribed in a triangular shape, the buildings, their backyard gardens, and the recreational area were placed on a plateau adjacent to the nearby cemetery, with a front arranged on a slope with a height difference of approximately 3–4 m between the entrances to the buildings and the street (Figure 7). The part neighbouring the water reservoir from the north was designed as a mirror layout along the south–north axis, with backyard gardens between the rows of the buildings, which were elevated about 1 m above ground level, compared to that measured near the pond (Figure 8). The northern part of Lindenhof, with the rows of the buildings arranged symmetrically along the diagonal street, was designed parallel to the slope of the terrain. The western building line, destroyed during the Second World War, was replaced with detached multifamily housing blocks arranged perpendicular to the contour lines. The height difference had to be levelled with a slope and a small retaining wall adjacent to the pavement.



Figure 5. The contemporary state of the adapted road on the western side of the housing estate. The row of trees between the buildings and the formerly existing alley planted with horse chestnuts. At present, the space is used as a car park. Summer 2023.

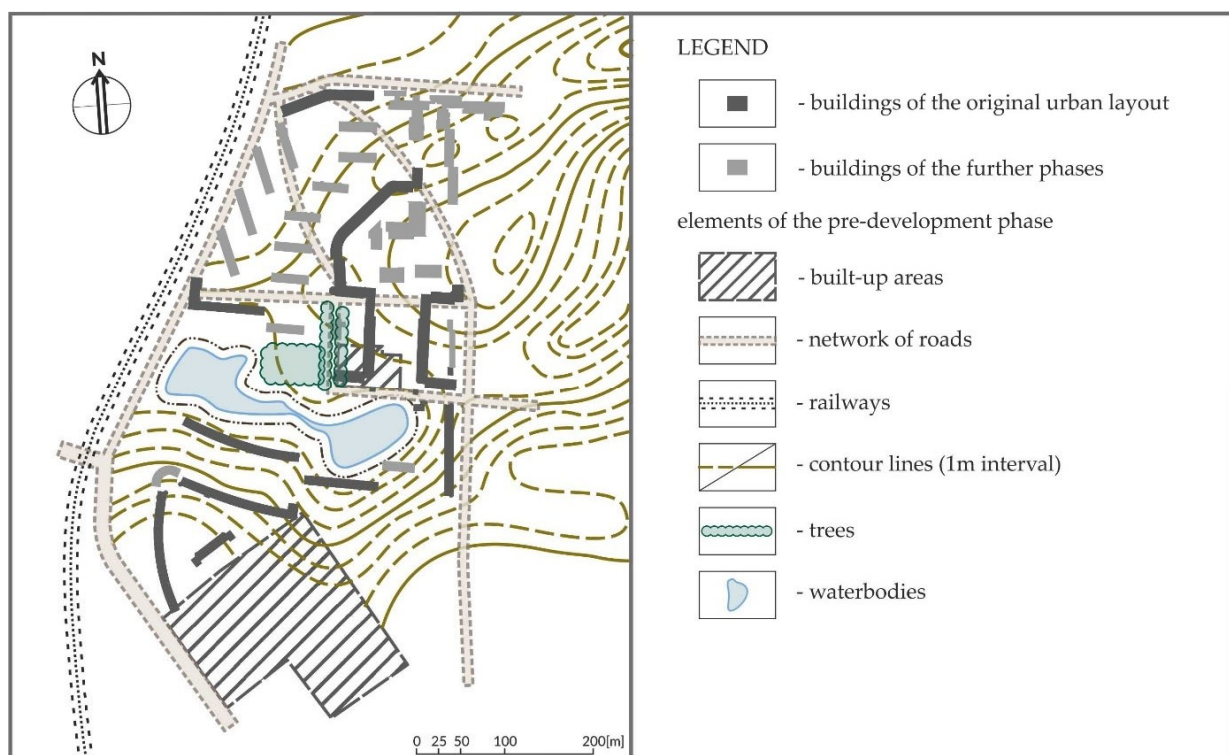


Figure 6. Lindenhof housing estate analysis scheme.



Figure 7. The terrain difference in the southern part of the housing estate: the entrances to the buildings are about 4 m higher than the street level. Summer 2023.

The Paddenpuhl housing estate was built in the vicinity of a former Reinickendorf village. It was inscribed in an empty triangular plot and developed along the road that extended the main street of the village, connecting it with the neighbouring Schoenholz estate (Figure 9). The road was adopted into the new housing estate; however, it was widened: the rows of trees that had been planted by the road were then encompassed by the one-way streets and were put in the green area separating the roads. The built-up plots on the western side determined the new building layout in this part: the arrangement of the buildings was designed to fit into the building line from the street side, to create a gate to the housing estate, and to extract as much backyard space as possible. The inner part of the urban layout was determined by the presence of a wetland area with a small pond in a depressed portion of the terrain. The entire proposal assumed a pond expansion and

geometric regulation of the edge of the water reservoir (Figure 10). The western building line was curved. The northern and southern lines were delineated to be closer to each other from west to east by narrowing. The building line was to repeat the shoreline of the water reservoir, which constituted the central recreational point of the housing estate (Figure 11). The regulation of water conditions also assumed the burying of a drainage ditch section in the north-east part. The left part of the watercourse became a boundary for the public park.



Figure 8. The terrain difference in the central part of Lindenhof: retaining wall between public square adjacent to the pond and private gardens. Summer 2023.

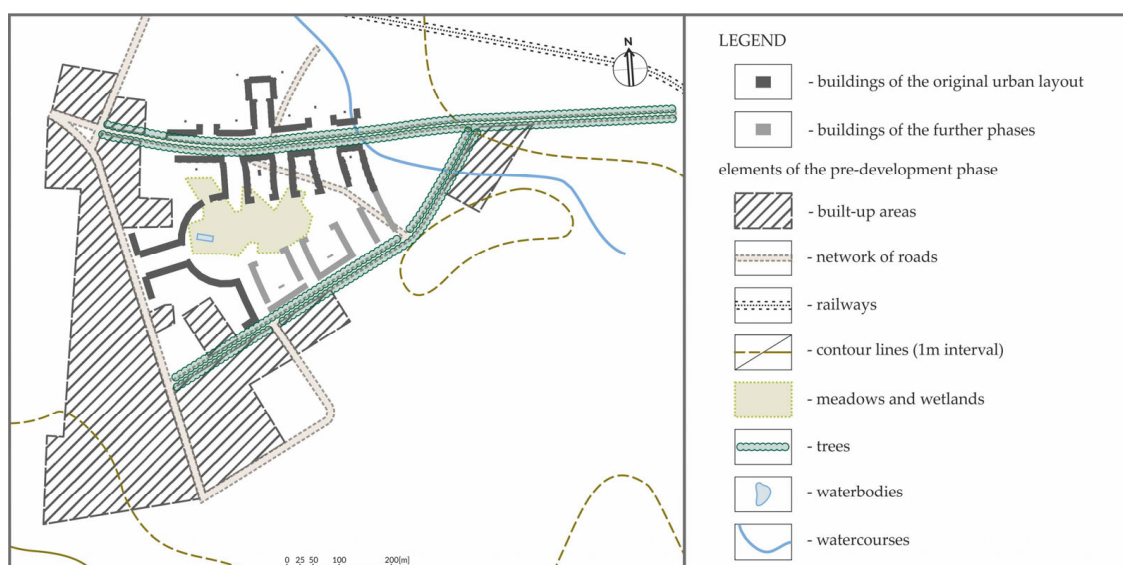


Figure 9. Paddenpuhl housing estate analysis scheme.

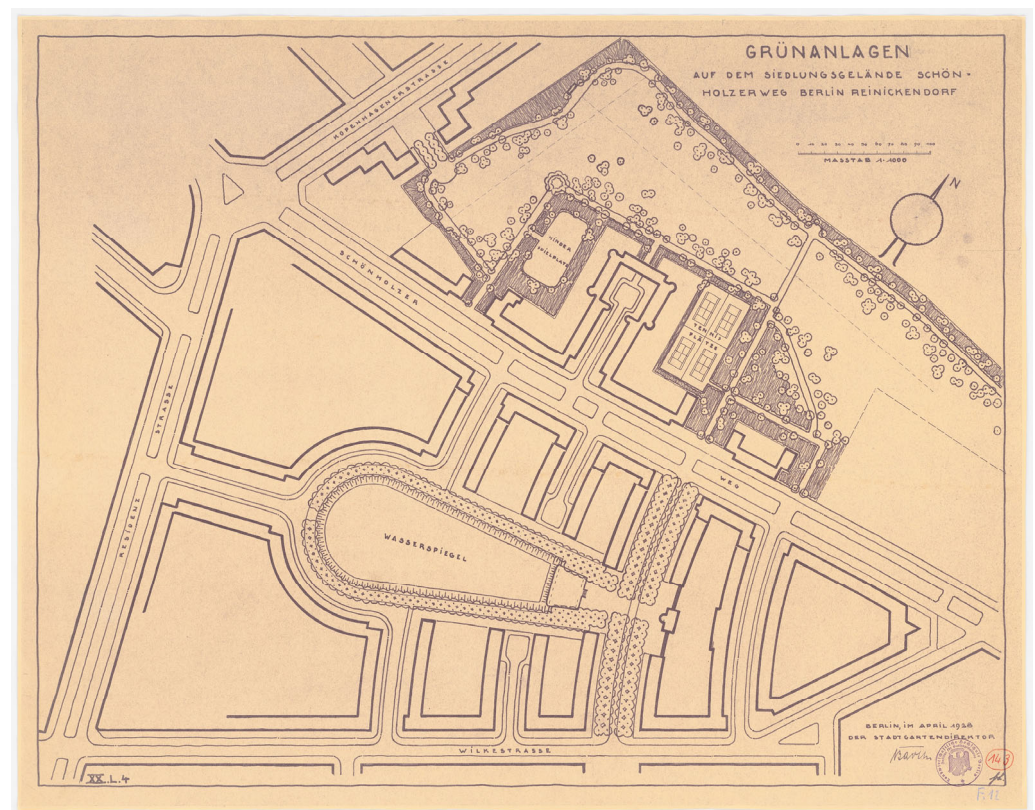


Figure 10. Land development plan of the greenery areas by Erwin Albert Barth from 1928. Natural pond transformed into a regular water body as a central part of the housing estate [19].



Figure 11. The edge of the pond became irregular over the years due to natural processes. Summer 2023.

The Britz housing estate was developed on agricultural land that had been part of the Britz manor. The development was located east of a former village and grange, on both sides of a road leading to the estate (Figure 12). The road, marked out between rows of trees, was replaced and moved outside the rows, so that the trees would have separated one-way carriageways. The northern part of a new housing estate was marked by a cluster of trees, which were converted into a park (Figure 13), which separated the estate from the road. Although the topography did not challenge the designers in the southern and eastern part of the housing estate, the complexity of the landform in the central part influenced the urban layout. The shape of the building, which constitutes the focal point of the whole estate, was created as a result of fitting it into the contour lines, as it surrounded the natural pond. The water body was extended and formed in a regular shape resulting from the repetition of contours of the building line (Figure 14). This was a deliberate correction of the existing topography. However, as the original plans and cross-sections survived, it could be stated that the correction was not significant [29].

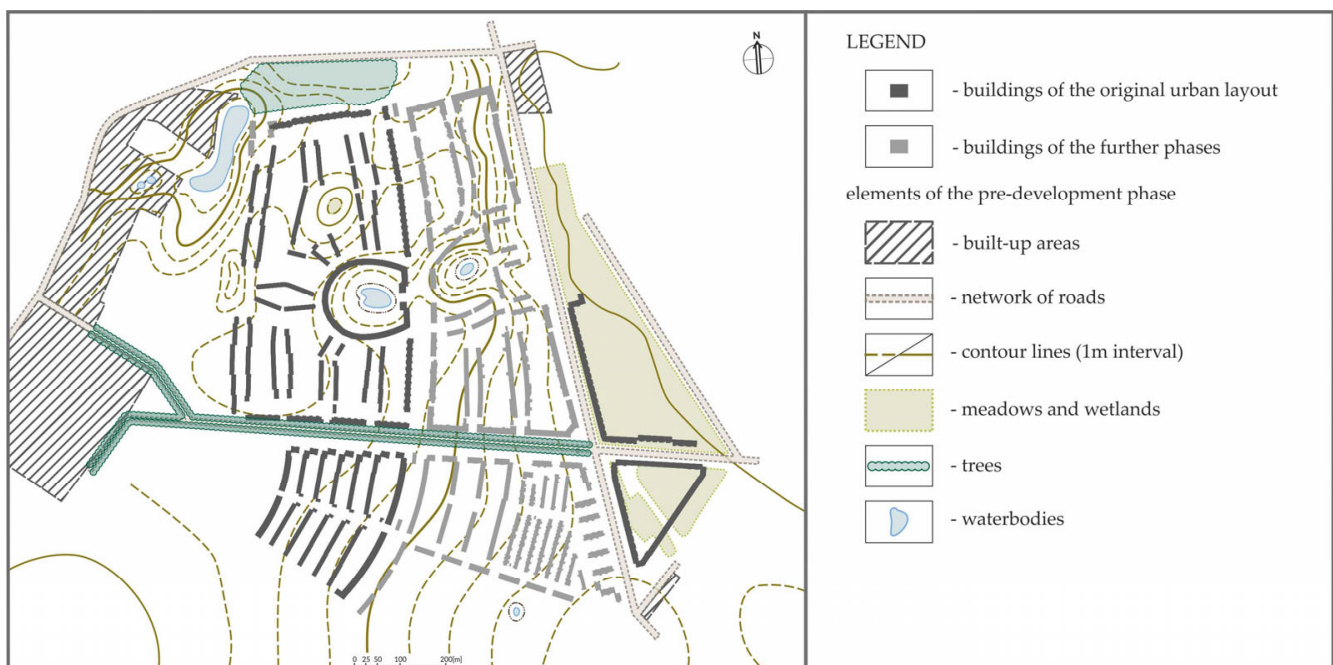


Figure 12. Britz housing estate analysis scheme.

The concavity of the wetland, north of the pond, was converted into a recreational green square. It also resulted in a more complex layout of the building lines. The pond had been part of the square development plan. It probably dried up during the construction works [20] and [30] (p. 184) and had to be replaced with a plane surface after the building phase was completed. The water body, planned as an oval-form shaped structure with semi-circular bench niches around, was then formed to an opposite to organic, geometrical form. The stagnant pond between the new estate and the former village became an extension of a public greenery areas adjacent to the estate. It is worth mentioning that the former regulation urban plans from the end of the 19th century envisioned the area as drained, as there were orthogonal networks of roads planned [20]. Therefore, modern urban planners, making their designs after about 50 years, were more aware of the natural values of the area.



Figure 13. The group of trees marked on the historical map with a name ‘false acacia little forest’ (German: Akazienwaeldchen) was transformed into public greenery area. Function and species composition remained unchanged until today.



Figure 14. The pond in the central part of the housing estate: visible repetition of building line and landforms. Summer 2023.

The new housing estate was placed west to the former Praunheim village, on the plots expropriated under the regulations in force [26]. At that time, the neighbourhood had not been developed to a great extent (Figure 15). However, the soil conditions had predisposed the area towards the establishment of quarries and brickworks. Thus, two factories were in the vicinity of the new development. The central part of the estate had to be placed, omitting the plot occupied by grange buildings. The main road network became a grid for the housing estate. Nevertheless, the main determinant of the new urban grid was the topography. The western part of the development was placed on a relatively flat area, hence the regular, rectangular outline of that part. The central part of the estate was designed in a similar way. The eastern part of the housing estate was planned on a slope descending towards the River Nidda (Figure 16). The height difference in this place reaches up to 7 m. Therefore, the housing estate has a wedge-like shape in the eastern part. The buildings run parallel to the contour lines, and only short sections of buildings were located on the steepest slope. The whole estate was placed out of the reach of the floodplain.

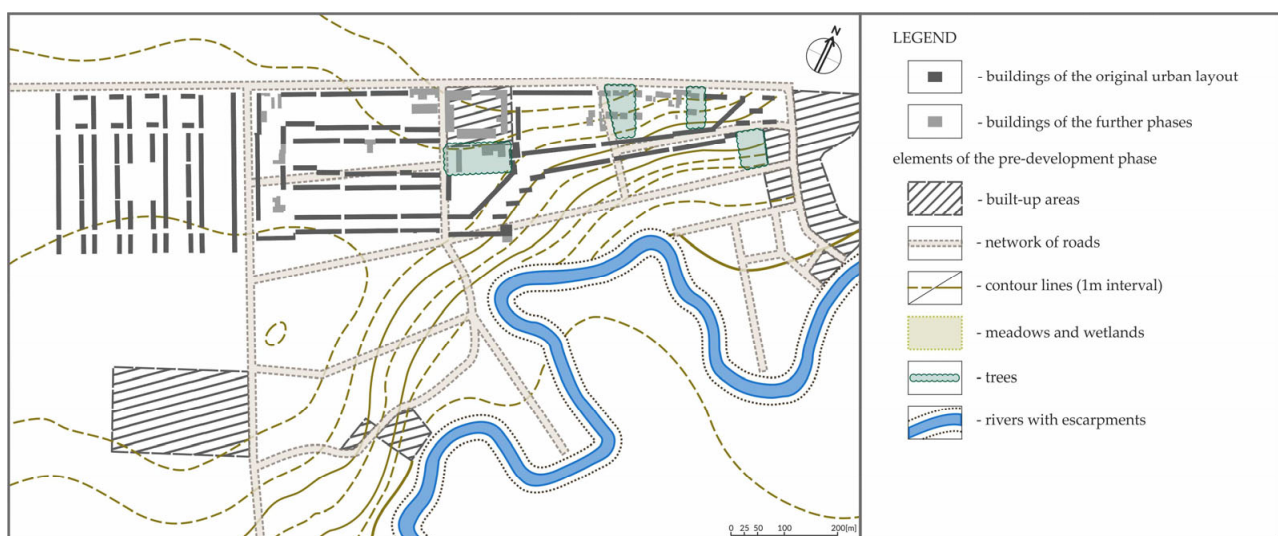


Figure 15. Praunheim housing estate analysis scheme.

The fact that the urban layout is derived from the topography of the area is noted in modern descriptions of the housing estate [31] (pp. 8–13) and [32,33]. However, the specification from the time of the building is focused on the technical details of floor plans and house types [26]. Analysis of the aerial photograph from the time of the estate's construction [26] and comparison with the map led to the identification of the clusters of trees left among rows of buildings. It seems highly probable that the group of trees in the central part, adjacent to the plot occupied by the grange, was to be incorporated into the urban layout, as the graphical description of the design provides greenery in this place.

The Roemerstadt, placed between former villages Praunheim and Heddernheim, was developed on the meadow slope that had been the Nida Roman camp in ancient times. That fact was recognised and consolidated in the name 'Romerstadt', which is visible, e.g., on the older map from 1876 [34], and was also well-known among the designers of the estate [27]. The new housing estate was placed south to the main road, which connected the villages and divided the area of the former camp into the northern and the southern parts. The new estate had to be developed with respect to the cemetery area in the central part (Figure 17). In the western part, the buildings were designed on the previously developed plot. The entire estate was set on a new network of roads, attached to the formerly existing main road. As in the case of the Praunheim estate, the topography was also the main condition that determined the urban layout of Roemerstadt.



Figure 16. The Praunheim housing estate seen from the edge of a nearby oxbow lake. Visible terrain difference. Summer 2023.

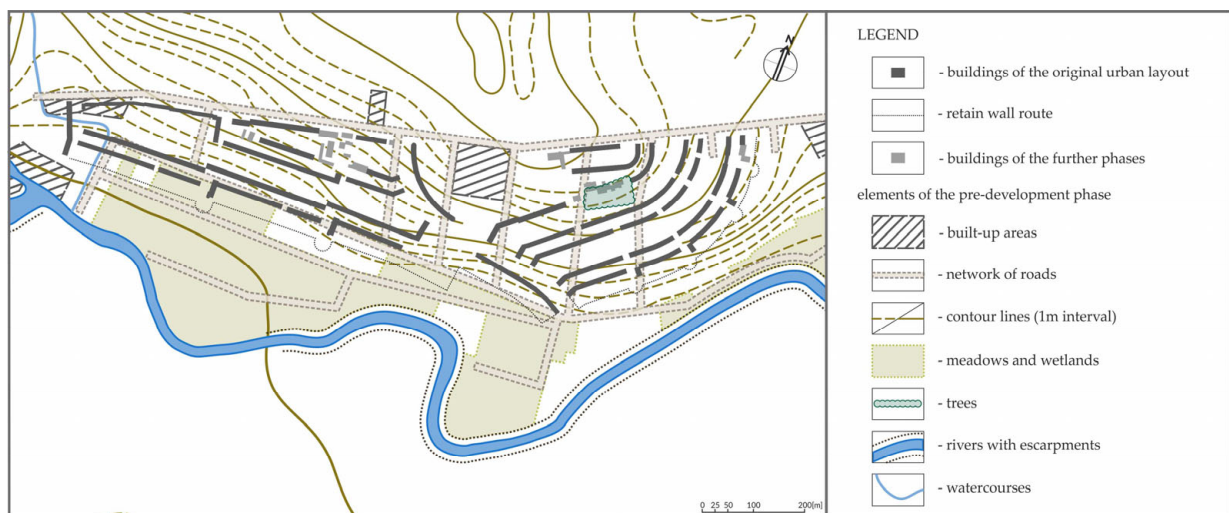


Figure 17. Roemerstadt housing estate analysis scheme.

The difference in elevation between the road and the flood plain is 12 m. The buildings were arranged mainly along contour lines. In the eastern part, the street network organically follows the slope. The rows of buildings are arranged on levels that descend towards the river, and the roads on the neighbouring levels are linked by paths perpendicular to the slope. The semi-public paths are short cuts accompanied by tree alleys that are finished with so-called ‘bastions’ planted with lime trees. The whole estate is encircled by a retaining wall from the river side (Figure 18), along the course of a historical Roman road, and the wall is equipped with the semi-circular bastions creating the viewpoints towards the River Nidda and the city centre. The layout of the wall refers to an earlier, unimplemented design of

the main urban planner of the housing estate, Ernst May for Leobschuetz (now Głubczyce in Poland), in which buildings were arranged in a bastion-like shape and distributed rhythmically on the side of the country border [32] and [35] (p. 152).



Figure 18. The retaining wall visible from one of the ‘bastions’. Summer 2023.

The wall was designed mainly to support the different levels of backyard gardens of the last row of terraced buildings and allotment gardens in the floodplain. It also creates unique character of the estate, described as ‘castle-like’ [36] or recalling medieval relics in northern Italy [37], and plays an important role in the scale of the local greenery network, as the bastions are spots with large trees and alleys that lead inside the estate (Figure 19). As the comparison of aerial photographs from the 1920s [27,36] and original design [27] reveals, apart from landscape architecture design and the implementation of new greenery, there was most likely the preservation and adaptation of existing trees provided by urban planners. The ‘bush’ was to be adapted to a park next to a planned church with a monument in the centre. However, the green square was replaced by single family houses, built after the Second World War.

The schemes of Praunheim and Roemerstadt housing estates show the River Nidda in its state in 1906. At the time of the construction of the estates, the river was channelised, which was planned to reduce the risk of flooding as far as before the First World War. The river had been straightened, so the natural bends were cut off and became oxbow lakes. In the time of the construction of the housing estates, there were also designs of the river valley development drafted by Max Bromme and Leberecht Migge, a landscape architect hired by Ernst May. Max Bromme, the landscape architect and head of the Urban Green Space Planning Office, as a designer who was attentive to the natural features of the site [38], opted for the preservation of wildlife habitats. Therefore, he tried to convince the public to reconnect the oxbow lakes with the channel of the river [38,39]. He also wanted the river valley to be a place for swimming, recreation, beekeeping, and gardening [39].



Figure 19. Pathways link adjacent levels and lead to the 'bastions'. Summer 2023.

The Klein Tschansch housing estate was built on former agricultural land, next to one of the main roads out of Wrocław. A road with a tree alley and a dirt road north and south to the new estate were adopted into the development (Figure 20). The topography with a ground level difference of about 1.5 m did not pose a difficulty for the designers, in contrast to groundwater conditions [23]. The area is placed in the catchment of the Grune Brook and River Ohle, neighboured by small ditches to the west and east (Figure 21). Although the estate was not placed directly on, but in the vicinity of wet meadows, the groundwater table located near the surface necessitated making buildings with shallow basements. Also, for this reason, the green areas were equipped with retention basins that collect rainwater from the roofs (Figure 22) [40].

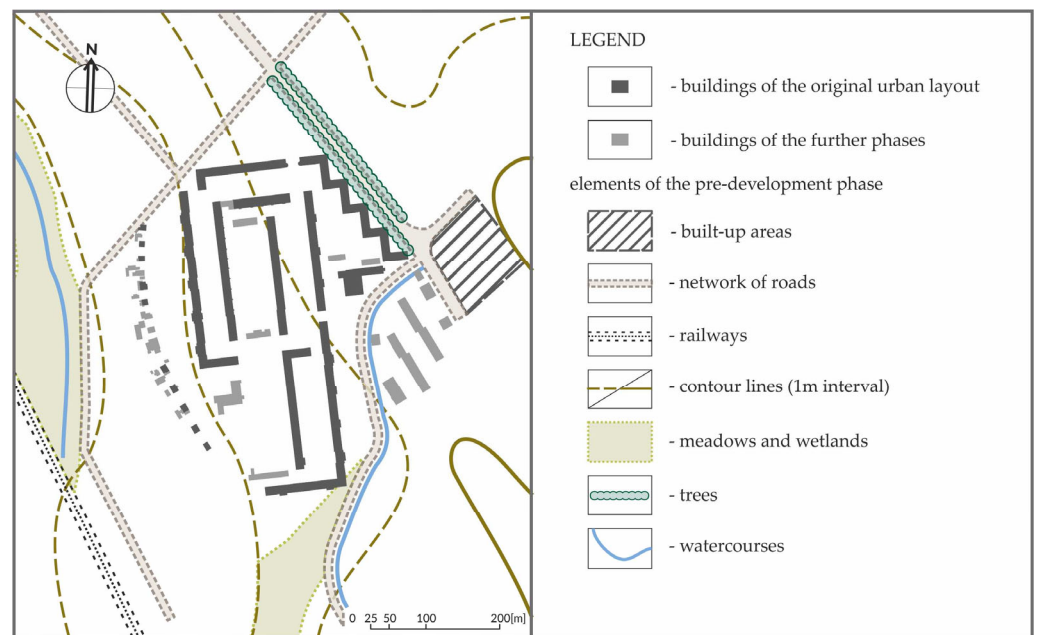


Figure 20. Klein Tschansch housing estate analysis scheme.



Figure 21. The housing estate on an aerial photograph from 1929. View from the east. In the background, we can see meadows with a watercourse [21].

The An der Hundsfelder Strasse housing estate was placed in an undeveloped area of meadows (Figure 23). There were a few brickworks in the vicinity of the new housing estate. Hence, the water reservoirs visible on the map are probably flooded clay pits. The road planted with two rows of oak trees became a northern border of the new estate. The conceptual design assumed the remodelling and adaptation of the road, so that the southern row of trees became the northern row of a new roadway (Figure 24). The topography, with small elevation differences, but descending towards the watercourse south to the new development, created conditions for urban zoning and rainwater management. It should be mentioned that only a part of the building development was constructed, and the design had assumed the implementation of a mirrored part on the western side. The whole estate was zoned: the buildings were placed near the old road, and the first row consisted of a four-storey building; the next two rows consisted of three-storey buildings. The part of the development was geometrically arranged allotment gardens with terrain descending

towards the watercourse. The existing reservoirs were filled in, as were the drainage ditch next to the new buildings. The watercourse that became a part of landscape development of the housing estate was replaced and delineated parallel to the building line. The rainwater and stormwater drainage system of the estate was designed in such a way that the rainwater is drained into the watercourse (Figure 25).



Figure 22. The ‘blue infrastructure’ of the Klein Tschansch housing estate. Autumn 2020.

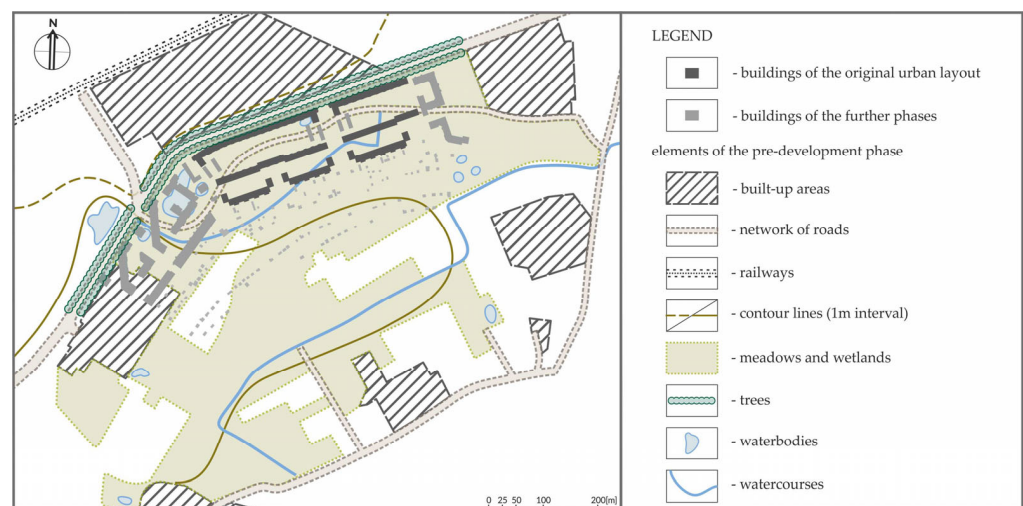


Figure 23. An der Hundsfelder Strasse housing estate analysis scheme.

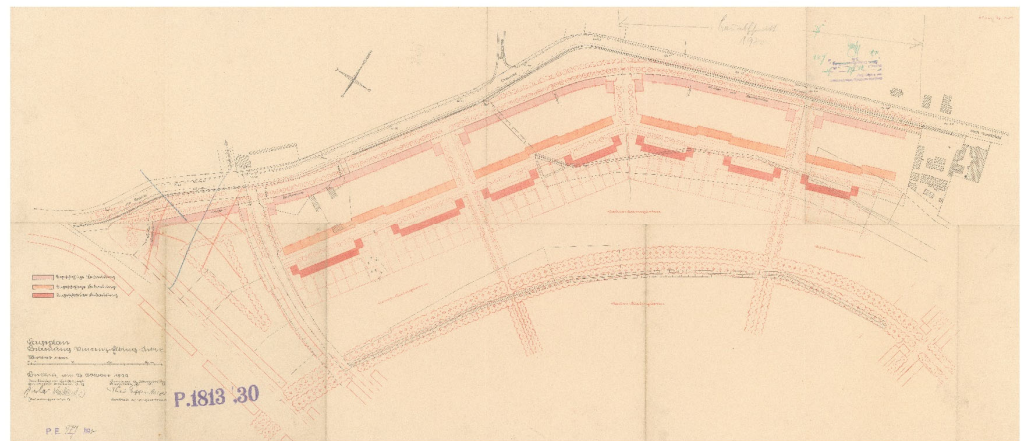


Figure 24. Urban development plan for the An der Hundsfelder Strasse housing estate by Theo Effenberger. The planned change of the trace of the road in the northern part [25].



Figure 25. The housing estate during construction phase or shortly after. The system that drains rainwater to the ditch visible in the central part [22].

4. Discussion

The incorporation of a formerly existing built environment and natural elements was studied in eight cases of housing developments from the interwar period to find out to what extent these conditions influenced the spatial disposition of the elements of the housing estates. The summary and comparison are presented in the table below (Table 3). The issues of the pre-development phase of the estates appear to be only touched on in the literature, especially compared to the studies on the form and function of buildings. However, natural conditions visibly influenced the functional dispositions and urban layout of the housing estates, or even the whole cities, which has been referenced in other studies [41,42]. The comparison of the different housing estates built in Germany in the times of the Weimar Republic shows that it is not an isolated case but a kind of practice. As noticed in the research on the Britz housing estate [20], topography and water conditions influenced the shape of the main building of the complex. However, there was a discussion on the

range of work needed, and the question of adaptation versus creation presented itself. As noted in this paper, the verification of the plan revealed a small range of earthworks. In all the cases studied, there was a visible adaptation to the topography, which is a strong determinant of the urban layout in general [43,44]. Relatively large terrain differences, as in the case studies of Lindenhof, Britz, Praunheim, and Roemerstadt, visibly influenced the arrangement of buildings. If needed, buildings were adjusted to the contour lines instead of in connection to daylighting, for instance. This could have been influenced by the general principle at the time since all processes were rationalised and verified along with economic values. Meanwhile, earthworks are technically and economically complex. In the cases of Staaken Garden City, Paddenpuhl, Klein Tschansch, and an der Hundsfelder Strasse, the terrain was relatively flat and did not pose difficulties compared to, e.g., the water system. In these four examples, the adaptation to watercourses and waterbodies is clearly visible: the buildings are arranged around the preserved natural elements or, as in the case of an der Hundsfelder Strasse, the rows of houses are descending along with terrain and are placed parallel to the watercourse. The integration of the terrain features into the urban fabric influenced also aesthetic perception of housing estates of the late phase of the Weimar Republic development, which is characterized by the buildings arranged in rows. These estates are not repetitive or monotonous in their perception. It can be noticed while comparing the southern and northern part of the Britz estate and was also observed in other comparisons [45]. Furthermore, it can be assumed that the rejection of the general urban design principle of the turn of the century—the spatial disposal of quarters of similar size—contributed to the preservation of natural elements. The manner of design present in the studied cases suggests that the urban planners and architects had been examining the building site and the former analyses resulted in adaptation of natural elements. The urban design, in line with principles applied before the First World War, was required to miss out small groups of trees or waterbodies while arranging the perpendicular grid of streets and regular housing quarters, as in the case of the first urban design for Britz estate.

Table 3. The comparison of the housing estates under study.

Name of the Housing Estate		Staaken Garden City	Lindenhof	Paddenpuhl	Britz	Klein Tschansch	An der Hundsfelder Strasse	Praunheim	Roemerstadt
built environment	formerly existing built-up areas	not applicable	demolition (?)	not applicable	not applicable	not applicable	not applicable	incorporation into the new layout	incorporation into the new layout/demolition
	network of roads	adaptation of the majority	adaptation of the minority	adaptation to the main roads	adaptation to the main roads	adaptation to the main roads	adaptation to the main roads	adaptation of the minority	adaptation of the minority
level of incorporation natural environment	topography	adaptation to pre-existing conditions							
	water system (rivers, watercourses and waterbodies)	adaptation and remodel	adaptation and remodel	adaptation and remodel	adaptation and remodel	adaptation to the groundwater state	adaptation and remodel	adaptation to the floodplain	adaptation to the floodplain
	meadows and wetlands	transformation into public greenery	not applicable	transformation into public greenery site	transformation into semi-private greenery	transformation into public greenery site	transformation into semi-private greenery	not applicable	transformation into semi-private and public greenery
	greenery (trees)	adaptation of formerly existing rows of trees	transformation into public greenery	adaptation of formerly existing rows of trees	adaptation of formerly existing rows and groups of trees	adaptation of formerly existing rows of trees	adaptation of formerly existing rows of trees	transformation into public greenery (attempt)	transformation into public greenery (attempt)

The presence of water seemed to be a significant determinant in the spatial disposition of uses. It is especially visible in the case of Frankfurt am Main, where the proximity of a river determined the location of the estates. This is consistent with the pattern of influence of the rivers on the shape and location of the settlement units [46,47]. In the cases studied,

wet or damp areas were intended for greenery sites. However, water was usually regulated: water reservoirs inscribed in new, geometric frames, and watercourses partly enclosed in pipes, which is highly visible in all the case studies from Berlin. In the cases investigated, many solutions, which would now be described as blue infrastructure and are currently required measures in terms of urban development, were driven by the necessity of dealing with water. In the examples from Breslau, rainwater was collected in the retention basins or treated as a resource to supply surface waters. In terms of pre-existing greenery, such as groups and alleys along roads, in the housing estates under study, such clusters were adapted or transformed into new recreational areas. Similar principles were observed in the housing complexes, despite differences in the time of their construction. In case of the housing estates from Frankfurt am Main, however, the subsequent transformations led to covering the original urban concepts and a loss of public greenery areas. Thus, the spatial development of the housing estates under study is rooted in an esteem for previously existing structures and their careful conversion. The shift of the design principles after the First World War and, as a consequence, the adaptation of the natural elements in the examined cases, led to the preservation of pre-existing forms in the urban landscape that are present to modern day, as well as the construction of housing estates perceived as exemplary in terms of balance between built elements and greenery areas.

5. Conclusions

This paper focuses primarily on the initial design phase and the disposal of built structures in the context of using previously existing terrain conditions and natural elements. The results of this study suggest that pre-existing conditions influenced the urban layout of the housing estates to a large extent. These findings add to our understanding of the development of housing estates of the interwar period in the Weimar Republic and the posture of designers and urban planners towards the natural conditions of the respective project sites. It can be concluded that the urban planning of that time, influenced by the garden city movement, was programmed not only for designing greenery areas, but also using natural resources as a base for the urban layout of the estates. That contributed to the subsequent perception of these estates, as adaptation of elements such as landform, water, and greenery often determine the unique character—genius loci—of them. The presence of water in the housing estates influences their microclimate conditions, which is especially crucial nowadays, in times of climate change. Low-cost, effective solutions for rainwater retention, such as historical projects from Breslau, are now highly desirable as a part of the built environment.

The preservation of the elements of the pre-existing landscape and its incorporation into the urban fabric—in the case of Berlin, even postglacial—bear traits of environmental approach according to current perception. In the sight of the New European Bauhaus, it can be treated as a historical role model for future developments. This study was limited to a few cases, and additional data collection would help determine the extent of this tendency. However, this work can be valuable for adding to existing guidelines or principles of urban planning.

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