(Bio)diversifying Post-War Identity

Leveraging urban biodiversity to enhance the identity of post-war apartment blocks.

Abstract:

The question addressed by this thesis is: ***how can urban biodiversity be leveraged to enhance the identity of a typical Dutch post-war apartment block and its immediate surroundings in its transformation process?*** *This research preliminarily develops a framework based on the existing discourses on the theme of identity in architecture. This framework serves as a tool for analysing the "identity" of existing sites for which restoration is deemed necessary, as is the case for many post-war housing estates. The analysis results indicate areas of improvement, which then guide the redesign of a post-war apartment block. We demonstrate the framework's application in a case study of a typical late post-war neighbourhood in the suburbs of Haarlem, Netherlands. As a second step, we focus on biodiversity, and study strategies to enhance it in the context of the case study. This research concludes by identifying potential synergies between identity-enhancement and local biodiversity. These strategies are proposed across five architectural levels: the plot, the plinth, the facade, the roof, and the interior. Findings indicate significant potential for synergy in four of these areas. The identified overlaps provide strategic entry points for a socially and environmentally resilient redesign of the case study.*

Keywords:

urban biodiversity, architectural identity, post-war housing, transformation

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1. Introduction and Problem Statement

The Second World War left many cities in Europe heavily destroyed, marking the start of an unavoidable era of large-scale reconstruction. Between the urgent need for large amounts of housing, material scarcity, damaged infrastructure and financial limitations, this was a task of immense complexity (Diefendorf, 1989). Despite the many challenges it brought, this historical backdrop presented an opportunity: a sort of *tabula rasa* allowing to rethink society, "in a material and non-material sense" (Blom et al., 2017) and break free from the shortcomings of pre-war life. In the Netherlands, as in many other European cities, the main priorities were to address housing shortages and to support economic recovery (Blom et al., 2017). This was closely followed by an aspiration to integrate technology and rising modernism into new architectural and urban forms.

A considerable share of the total housing stock of most EU Member States was built during the Post-War period (1946-1980), up to 60% of it in certain countries such as Italy, Slovakia, Bulgaria and Romania (Archive: People in the EU - Statistics on Housing Conditions - Statistics Explained, 2020). Although there were many types of dwellings developed at the time, the need for large amounts of affordable housing meant that multi-storey apartment buildings were particularly suitable and have thus become very common, particularly in cities. Their focus was often the same across regions: prioritizing practicality and simplicity, rapid construction methods, emerging technologies, and forward-thinking urban planning. Hence, despite each country having their own variations, these buildings globally share comparable features which collectively provide an accurate reflection of the so-called "post-war housing blocks".

In contemporary Europe, the built environment sector faces challenges that echo those of the post-Second World War era: urban populations are rapidly expanding, continuously pushing the need for more affordable housing in cities (European Commission - Joint Research Centre, 2019), further emphasised by the geopolitical tensions of the last few years as well as the economic instability induced by the covid pandemic. This housing shortage must be solved within the context of the even more pressing issue of climate change. Thus, mirroring the post-war recovery years, architects and urban planners must search for ways to reconcile time constraints, financial limitations, environmental considerations and new technologies, all while trying to meet the growing housing demand.

While technological advancements are key in addressing these challenges, they often sustain an approach to design focused dominantly on technical parameters, taking, for example, energetical performance or CO2 emissions. Through globalization, the way modern buildings control these parameters has become increasingly similar across the globe. As a result, the look and architectural language of new buildings has uniformized. So much, in fact, that the resulting "bland uniformity" was chosen as the focus of the 2014 Venice Architecture Biennale. The exhibition's curator, Dutch architect Rem Koolhaas, pointed out how national identity in the built environment has been "sacrificed to modernity", a process which according to him, started as early as 1914.

Fig. 1: *Map of similar looking apartment blocks across Europe dating from the post-war era (black & white photos) and from the 20th century (renders). (By author; image sources can be found in the references).*

Indeed, the same lack of identity can already be observed among European residential apartment blocks built in the post-war years (1946-1980). Today, most of these do not meet modern environmental or social standards anymore. They require renovation, and many of them even risk demolition due to their perceived ugliness and inefficiency. The neighbourhoods they are in are often seen as problematic, unhospitable and potentially unsafe to pedestrians. As Ferreira & Tostoes (2017) put it, they are "infrastructurally and socially disconnected from the city" (p.45). However, despite their flaws, they still house countless residents, which is why destroying them is in many ways counter-productive considering the housing crisis many cities face. Luckily, the last decade brought about a growing academic interest in the heritage value of post-war residential estates, consequently shifting the trend towards preservation and transformation, rather than complete demolition (Blom et al., 2017, p.5).

The need for refurbishing post-war apartment buildings extends beyond mere structural improvements; it encompasses the potential to reinvigorate their neighbourhoods into spaces that perform better both socially and environmentally. Given the ubiquity of these blocks across Europe and their shared attributes, strategies for their renewal could feasibly be replicated, thus facilitating widespread adoption and amplifying the impact of such transformations.

Within this framework, the research further explores how specific environmental considerations can reinforce this "identity" in the context of a post-war residential block transformation. This research is founded on the belief that environmental considerations are inherently site-specific, which is why they have the potential to infuse project sites with a unique, local dimension. Specifically, this study focuses on urban biodiversity, as a reaction to the bland patches of grass commonly found around post-war apartment blocks (Braae et al., 2021). These open stretches of green embraced modernist ideals at the time, although today, they reflect instead a missed opportunity to utilise space more creatively (by filling them with more diverse vegetation or useful public amenities, for example). While acknowledging that there are many aspects to take into account when aiming for a socially or environmentally resilient building transformation, this study is narrowed down to the intersection of identity and urban biodiversity only, in order to reach a greater level of detail in the research and its outcomes.

The main question that is addressed is: **How can urban biodiversity be leveraged to enhance the identity of a typical Dutch post-war apartment block and its immediate surroundings in its transformation process?**

To reach more tangible conclusions, the research uses a case study within the Dutch context. The goal is to present a practical transformation framework that could stir a broader application for post-war housing blocks across Europe. This study advocates for a holistic approach to transformation, going beyond isolated aspects, and proposing instead a range of improvements that support each other and revitalize post-war neighbourhoods at multiple levels at once.

2. Methodology

a. Organisation of the research

The structure of this research is twofold: on one hand, it develops a framework around the concept of "identity" which is to guide a more socially considerate design process. On the other hand, it explores biodiversity-enhancing strategies for the transformation of post-war apartment blocks. Both aspects are applied and tested through a case study.

The identity framework draws from contemporary academic literature and the insights of prominent figures like David Lynch, Jane Jacobs, and Herman Hertzberger who have addressed the subject of identity in space and architecture. It serves as an analytical tool, which is used in the case study to identify characteristics of identity and listing considerations for its improvement. As a demonstration of its application, it is used to assess the identity of the case study; this analysis is structured into five focus points (plot, plinth, façade, roof, and interior) and is based on observation and literature.

The second part investigates design interventions that foster biodiversity, focusing on preserving local species that are building-reliant, with particular attention paid to endangered species. This aspect is also integrated into the case study and analysed across the same five structural elements.

In conclusion, findings from both parts of the study are synthesized in a final list of considerations and design strategies (organized into the aforementioned 5 sections) that may directly inform the redesign of the case study. The conclusion explores how biodiversity-enhancing design solutions in post-war apartment blocks can be adapted to maximize the identity of a site.

b. Case study: Boerhaavewijk, Haarlem (Netherlands)

Fig. 2: *Map of Schalwijk (left side), with Boerhaavewijk is indicated in dotted lines and map of Boerhaavewijk (right side) with project side indicated in dotted lines. The 3 buildings used for the case study are highlighted in red on both maps. (By author)*

Schalkwijk is the largest district of Haarlem and is distinctly identifiable in the city fabric because it is separated by landscape boundaries like the Spaarne River to its western side and the Ringvaart Canal to the east and south. It is bordered by a national road to the North as well as fields or forests from virtually all sides. With approximately 6,500 residents, it is the largest district of Haarlem, mostly dedicated to housing built in the 1960s as a response to housing shortages at the time.

Boerhaavewijk, in the south of Haarlem (Netherlands), is a neighbourhood of Schalkwijk. It is mainly residential but does include several schools, a grocery store, a community centre, a church, a fire station, and an elderly home. Developed mainly between 1960 and 1970, it features typically post-war geometric urban design with vast patches of grass. Stretching between two green areas (the banks of the Spaarne to the west and Poelpolder-North - a nature and recreation area to the east), the Floris van Andrichemlaan is the main organizational axis of the neighbourhood. All public functions of the area, as well as the building complex that serves as the case study for this research are located along this street.

The case study subject consists of three identical gallery flats, characteristic of the era's industrial system-built concrete structures. They are organized linearly, parallel to the Floris van Andrichemlaan with a perfect North-South orientation. They were erected in 1969 and designed by architect Piet Zanstra (known for the "Maupoleum" in Amsterdam). The apartments are aimed at middle to low-income families, all with 2-3 bedrooms, small balconies, ample greenery on one side of the building, and parking on the other. The plans, sections and elevations of these buildings can be found in Appendix A.

3. Theoretical framework: "identity" in architecture

In its isolated form, "identity" refers to the distinguishing characteristics of an object, making it unique. The dictionary definition also suggests an aspect of wholeness – as such, identity encompasses the collection of features which make something different from others, but also unify its elements within (Miriam Webster Dictionary). Therefore, identity relates to both what the object conveys (which determines its wholeness) and how its otherness is perceived (Ylmaz, 2006).

This fundamental definition is the common thread among most approaches developed around the concept of identity in architecture. Whilst this explanation is relatively easy to understand, in practice, it demonstrates its limitations in encompassing various aspects it is often associated with, such as meaning, culture, expression or physical form. The more it is analysed, the more the concept becomes intricate and multifaceted (Brahman & Torabi, 2013, p.107).

A generally agreed-upon assumption is that "every community's architecture contributes to establishing its identity because it conveys the message, idea, and distinctive characteristics associated with the community in which it originated" (Alavi & Tanaka, 2023, p.551). In other words, the "identity" of architecture is both affected

and affects local culture, people and lifestyles (Ylmaz, 2006; Lynch, 1960). The “distinctive characteristics” of a space and its architecture exist as an intangible glue for communities because they relate to something that differentiates them from other communities. Hence, if identity is tied to the quality of being distinguishable, then architecture with a strong identity carries the potential to support the formation and preservation of communities.

Beyond its clear social significance, the concept of identity in the architectural domain has been the subject of multiple interpretations, some more pragmatic and concrete, others concerned with more intangible, psycho-social aspects (Abel, 2012; Alzahrani, 2022). Recent research regularly presents it as an all-encompassing term that gathers both tangible and intangible aspects of a place. For example, Ylmaz defines architectural identity as the set of “geographical formations [as well as] cultural and social characteristics of man-made formations” (2006, p. 142). “Identity” is generally linked to temporality, whether it pertains to historical heritage or the representation of contemporary attributes. Ultimately, as several publications suggest, architectural identity is present when a building expresses the characteristics of its context. Thus, identity is created if these contextual attributes are actively integrated into the conceptual, spatial, and material development of a building (Ylmaz, 2006; Alzahrani, 2022; Brahman & Torabi, 2013; Alavi & Tanaka, 2023). Fig. 3 displays the collection of various “characteristics of identity in architecture”, collected from the works of Brahman & Torabi (2013) and Alavi & Tanaka (2023).

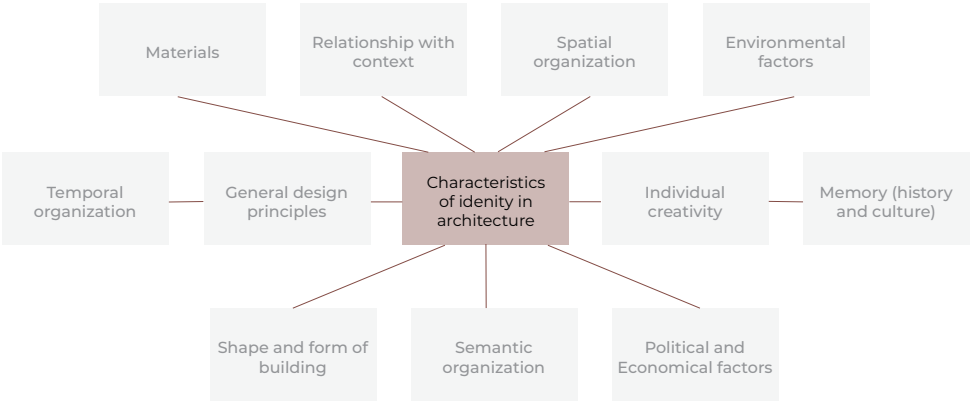


Fig. 3: *The collection of various “characteristics of identity in architecture”, collected from the works of Brahman & Torabi (2013) and Alavi & Tanaka (2023). (By author)*

The problem with such definitions of identity in architecture is that they deal with notions that are arduous to understand and control, let alone translate into the physical space. These characteristics overlap and exert influence upon each other. As Ylmaz indicates, identity is about “how you are seen and how your otherness can be observed” – a statement which underscores the connection of identity to perception (2006, p.141). The subjective nature of perception complicates the comprehension of identity, which can, if the notion is misused, eventually lead to spaces that are detrimental to communities. Hence, frameworks like these are useful to describe ideas and perceptions that concern the built environment, but often fail at informing a design process or physical structure (Hauge, 2007).

In his book The Image of the City (1960), Kevin Lynch introduces a distinction between “identity” and “meaning”, which helps to work with the former concept in more tangible ways. In Lynch’s work, “identity” has to do with spatial organization – specifically, “its distinction from other things, its recognition as a separable entity [in the sense of oneness]” (p.8). The spatial clarity it provides helps users orient themselves and understand the space they evolve in, thereby strengthening their engagement and attachment to it. “Meaning”, on the other hand, pertains to the significance or value that is attributed to an object. As such, “meaning” encompasses all the psycho-social aspects of a place, such as memory, history, culture and more. Fig. 4 illustrates in a simplified manner these two concepts in relation to a door. Together with the notion of “structure” (the spatial relation of a user to an object), meaning and identity from the total image of the object.

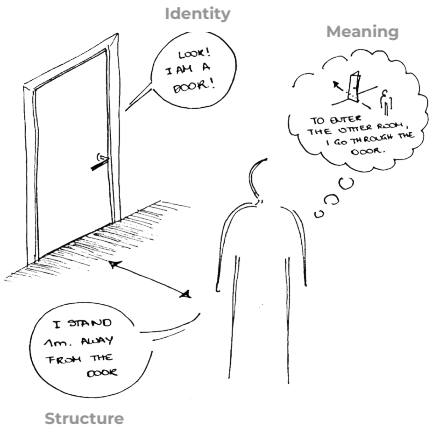
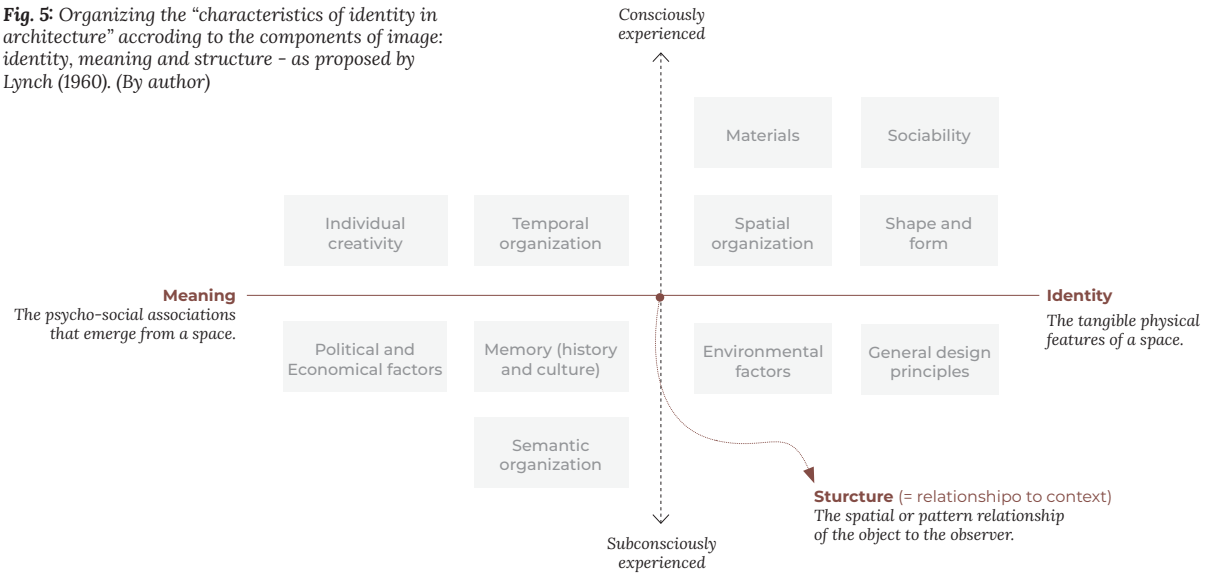


Fig. 4: *According to Keven Lynch (1960), the image of an object is composed of its identity, its meaning and the structure that relates it to its environment. (By author)*

It is undeniable that identity and meaning are intricately linked. However, because of the inconsistency of meaning, it is easier to shape designs focusing on identity, and then letting meaning develop by itself. At least at the start of the design process, emphasis can be placed on the physical characteristics of space, as these are the foundational elements upon which meaning takes shape (Lynch, 1960, p.8). While this approach does not disregard the significance of psycho-social aspects of identity, it allows for a more tangible exploration of it. Lynch's framework predominantly addresses scales beyond individual buildings, focusing on cities or neighbourhoods, however, it can inspire an alternative approach to architecture on a smaller scale as well, one that considers the cognitive impacts of a well-organized sequence of spaces that support their intended use. The work of Lynch somewhat aligns with the ideas of structuralism star Herman Hertzberger: according to him, building aesthetics may not profoundly influence individuals; instead, the functional quality of spaces that meet people's needs, foster natural human connections, ensure physical safety and offer a clear spatial organization play a much more essential role (Herman Hertzberger: "the Origin of Architecture Is in the Public" | the Strength of Architecture | From 1998, n.d.). Thus, it is wise to view identity as the ability of architecture to ensure these aspects. In this research, the ideas of Lynch and Hertzberger will serve as a base for the development of a usable framework to think, design and evaluate the presence of physical identity in a design. socailly engaging acrhitecture.

In light of these theories, this paper proposes a dual categorization of the "characteristics of identity in architecture", as presented in other previously mentioned literature (Brahman & Torabi, 2013; Alavi & Tanaka, 2023). This duality encompasses, on one side, the physical aspects of space, and on the other, the abstract psycho-social associations that emerge from it. This approach allows us to identify a subset of characteristics that are tangible and manipulable, offering a path for the development of design principles aimed at transformation. This subset constitutes the "identity" (as opposed to "meaning") as distinguished by Lynch (1960), in the sense of attributes that allow one to organize a space and orientate themselves in it.

Fig. 5: *Organizing the "characteristics of identity in architecture" accroding to the components of image: identity, meaning and structure - as proposed by Lynch (1960). (By author)*



When comparing to the initial "characteristics of identity" put forth, two key modifications have been implemented. Firstly, the aspect of "relationship to context" has been intentionally excluded from this framework (represented in Fig. 5 above). Context, as Tanaka explains, is the combination of "all events and conditions" that give rise to architecture, including the geographical, cultural, historical, and social elements pertinent to a given place or entity (Tanaka, 2023, p.551). In other terms, it entails the collection of experiences of each individual or community within its environment. While some authors (Brahman & Torabi, 2013; Alavi & Tanaka, 2023) see "relationship to context" as a distinct facet of architectural identity, this thesis suggests it be considered as a separate category. This category somewhat aligns with Lynch's interpretation of "structure" in The Image of the City (1960), where it is described as "the spatial or pattern relationship of the object to the observer". Thus, the "relationship to context" has been omitted from the scheme presented above, as it includes and goes beyond identity and meaning, and could potentially be seen as the element that unites both.

The second adjustment in the characteristics list is the introduction of 'sociability.' Sociability is identified as a space's capacity to foster social connections. The way spaces are arranged can either encourage or inhibit interactions among individuals. While a building alone might not be the sole reason for community formation, it may offer the necessary amenities or spaces to sustain both intentional and non-intentional interractions within it.

Characteristics such as shape, materials or spatial organization are useful points of analysis, but on their own, they do not indicate their contribution to the space. A way to assess whether they have a positive impact or not is still necessary. Based on the previously elaborated ideas, a “good” space must support its intended use, foster social engagement, and allow users to orientate themselves in the space, thereby providing a feeling of safety. The complete framework (as outlined in Figure 6) therefore uses legibility, functionality, and sociability as metrics to evaluate a space’s identity—defined as the quality of the relationship between users and space. Legibility assesses spatial understanding, functionality measures how well space meets user needs, and sociability gauges the facilitation of interaction. This evaluative tool helps both the analysis of existing sites and informs future design decisions. Detailed definitions of all the concepts used in this section are provided in Appendix B.

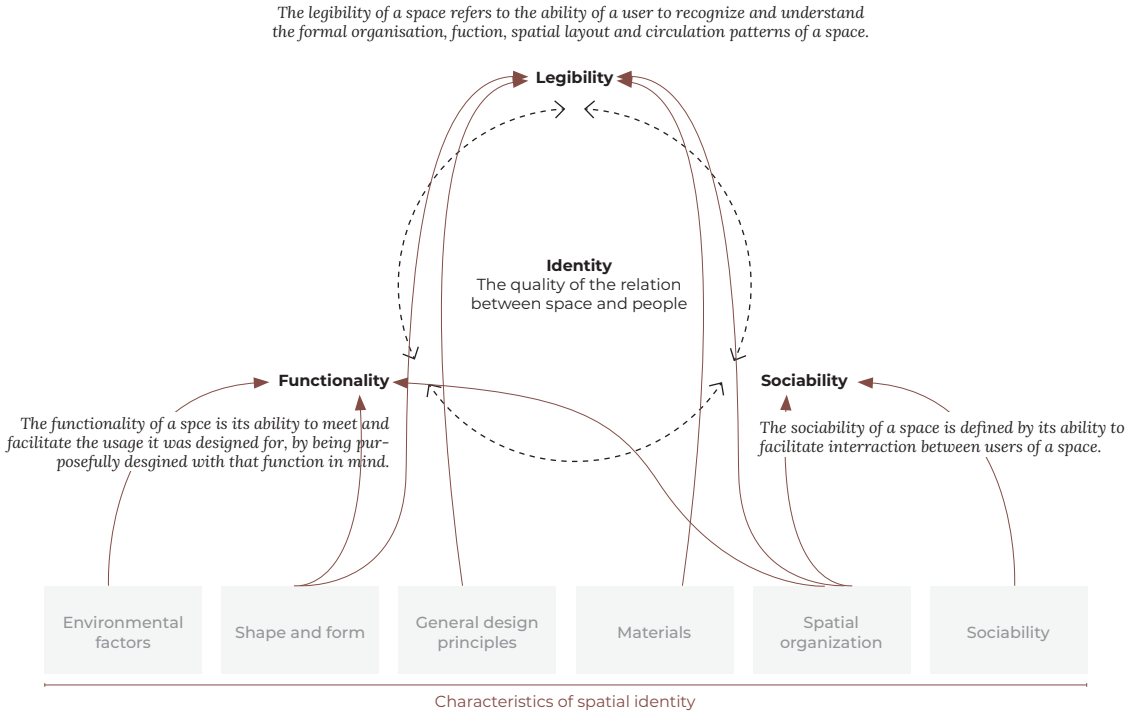


Fig. 6: *The collection of various “characteristics of identity in architecture”, collected from the works of Brahman & Torabi (2013) and Alavi & Tanaka (2023). (By author)*

4. Identity in post-war neighborhoods

a. Context

Europe’s post-WWII reconstruction era was in great part defined by the ambition to provide housing for everyone, as highlighted by governmental strategies such as L’habitat pour le plus grand nombre in France (Ferreira & Tostoes, 2017, p.45) or welfare states which funded mass housing complexes in which a lot of the European population still lives today (Braae et al., 2021, p.451).

In the Netherlands (and other European countries alike), this rebuilding phase was seen as somewhat of a blank slate, an opportunity to break away from the shortcomings of the pre-war era (Blom et al., 2017). The period was marked by tensions over the direction of urban development: while some planners sought to reconstruct historical sites, others had instead the ambition to completely transform and modernize the urban fabric (Diefendorf, 1989). New housing models were being conceived to cater to the changing lifestyles characterized by population growth, increasing comfort, and rising consumption levels.

The increasing presence of the automobile played an important role in shaping the urban fabric as well: it made it increasingly normal for people to swap their inner-city apartments for larger ones with more surrounding greenery (Blom et al., 2017, p.47). Furthermore, the rebuilding of inner cities often came hand in hand with the enlargement of car infrastructure. To leave space for larger roads, only a part of the buildings destroyed during the war were rebuilt. This further justified the expansion of cities beyond their inner rings, especially in the form of lower-income housing. Historic city centres were increasingly viewed as nests of social decay and danger in case of war. As a result, new policies of decentralization allowed to move away from these old urban configurations and develop new areas which offered generous space and greenery with

separate working and living zones and extensive car infrastructure. These new spatial planning approaches aimed to provide all citizens with access to the conveniences of the modern era while adopting an urban structure that was seen as safer in case of bombardments (Blom et al., 2017, p.47).

In the early stages of post-war reconstruction, Dutch urban planning was heavily influenced by the "neighbourhood-unit concept." This concept was characterized by urban sub-structures, each with its necessary functions and amenities. It facilitated a modular approach to urban expansion, where near self-sufficient communal units could be systematically organized and replicated within a hierarchical urban framework. While the neighbourhood unit concept originated in the Netherlands, comparable models were to be found in other places in Europe, including in the suburbs of Eastern European cities. These were influenced by internationally recognized frameworks such as Ebenezer Howard's Garden City movement, reflecting a collective ambition to cultivate healthier living environments with more light, greenery and space (Blom et al., 2017; Havinga et al., 2020).

This neighbourhood-unit concept was abandoned as early as the 1950s because the social idealism it was built on was proved to be unrealistic: while the ambitions of planners were respectable, disorganized political structures and economic problems only allowed the implementation of a much more primitive version of these plans. These limitations were common to many countries impacted by WW2 (Blom et al., 2017; Diefendorf, 1989).

Braae et al. (2021, p.451) highlight that post-war housing estates are still defined today by their imposing size and the broad green spaces around them, often connected to larger parks through various pathways. The end of the reconstruction era, especially from 1965 to 1980, saw a surge in industrial methods that made high-rise buildings increasingly common. These were typically constructed quickly and efficiently from prefabricated concrete, targeting lower-income residents on city outskirts. Yet, these areas remain limited in their functions, mostly residential, with limited public services and a weak link to city centres, a concern noted by Diefendorf (1989, p. 139).

b. Applying the identity framework to the case study

Most of the Boerhaavewijk neighbourhood in Haarlem was built between 1960 and 1970 (to the exception of a few row houses built in the 21st century) – i.e., in the later part of the post-war reconstruction era (Netherlands Building Ages, n.d.). As indicated by Braae et al. (2021), the neighbourhood features indeed many relatively high buildings (5 floors and above), which is higher than the standard for historical Dutch cities. There are many large-scale buildings, with large windows on the upper floors and a prominent use of prefabricated concrete elements which can be seen from the regularity of façade designs. Most of these buildings are social housing, organized in a regular, orthogonal and spaced-out layout. In between them, there are a lot of paved areas, many of which are meant for parking. While there is quite little pedestrian infrastructure, there are many large plains of grass which hint at the ideas of the neighbourhood-unit concept. In the same spirit, all the public functions of the neighbourhood are functionally gathered in one place. These characteristics make a Beorhaavewijk a representative pot-war neighbourhood sample, with certain aspects that function very well, and others that fall short, such as the provision of pedestrian amenities.

Within this context, this section proceeds to the systematic evaluation of the three linearly arranged gallery flats located on the Floris van Andrichemlaan. They too are representative of the era: they follow functionalism and social minimalism principles both in their look and their interior organisation. We will use the "tangible characteristics of identity" as presented in the Theoretical Framework as starting points of the analysis, and assess them based on their legibility, functionality and sociability. Where we see that some of these aspects fall short, we will be able to conclude design considerations for improving the site's identity. The complete analysis can be found in Appendix C and the technical drawings in Appendix A. The structure of the analysis is as shown in Fig.7, and the resulting interventions are organized accordingly.

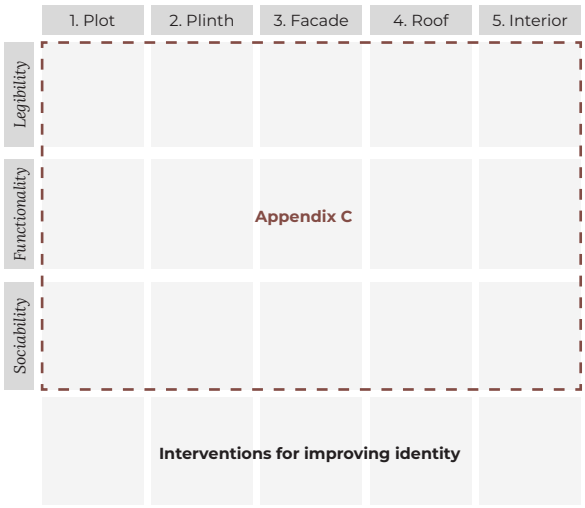


Fig. 7: *Framework of identity in use: organisation of the analysis. (By author)*

It is important to note that Floris van Andrichemlaan gathers most of the area's public amenities, hosting three schools, a community centre, a burger kiosk, a fire brigade, a grocery store, a physiotherapy clinic, and a church. These facilities are central to the neighbourhood's public life and are all positioned along the same artery as the case study. Thus, the case study is crucially located and holds the potential to heavily influence the neighbourhood's vibrancy. The fact that several of these public functions (including the kiosk, fire brigade, community centre, and church) face potential destruction due to being underutilized illustrates even further the pressing need for social revitalization in the neighbourhood.

1. Plot

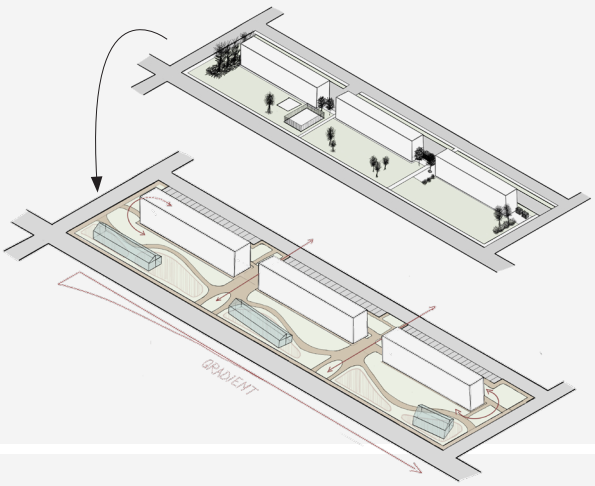
Visual and physical connection between the back and front of the plot: keeping the line sight open in the space between buildings.

Pedestrian infrastructure: path going around and between buildings, leading up to them and their entrances. Seating and lighting along the paths.

Densify or give clear functions to unused space: allowing to give a back a human scale back to the plot and use it for social engagement. The south side remains for stationary activities, and the north one for movement and connectivity.

Minimize space for car infrastructure: change the access to parking places to gain useful space on the northern side of the plot.

Ensure material contrast: different pavement for different transportation modes.



2. Plinth

Material contrast between the plinth and upper floors.

Opening the façade of the plinth: strengthens the visual connection between the inside of the building and the outdoors, at the pedestrian level.

Clear & visible entrances: provide spatial indicators for entrances to the building.

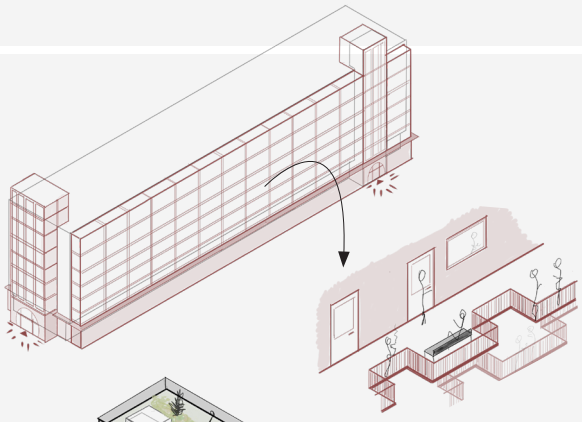
3. Facade

Adding a new façade layer beyond balconies & loggias: enlarges the apartments and solves thermal bridge problems.

Interruption of regular façade rhythm: structural elements, colour, brickwork and depth variations to provide a rhythmic façade with punctual irregularities to provide visual interest and legibility.

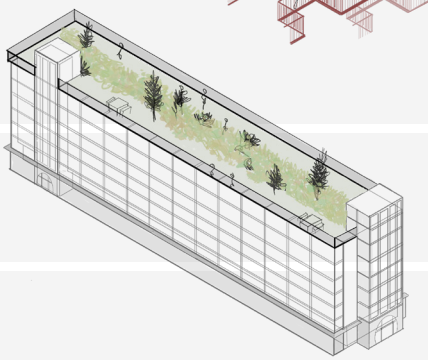
Purposeful East/West facades: give a functional and visual purpose to the sides of the buildings.

Giving social purpose to the gallery: places to stop along the gallery which create opportunities for interaction whilst interrupting the regularity of the façade.



4. Roof

Accessible roof for building residents.

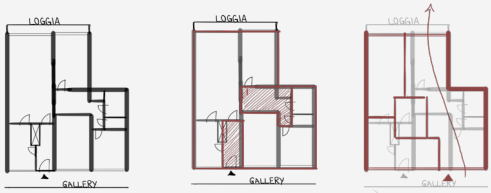


5. Interior

Change function ground floor: Sacrifice the storage on the ground floor to make pleasant, shared spaces, or dwellings that are open to the street.

Optimize interior spaces: increase the size of the kitchen, minimise space lost to halls and corridors, and create space for storage which is lost to the change in function on the buildings' ground floors.

Improve accessibility: create new entrances with their own halls (interphone, letterboxes, elevators), in addition to the existing ones.



5. Biodiversification strategies

a. Definition

The construction methods employed by our contemporary society are responsible for 30% of global biodiversity loss (World Economic Forum, 2020; Ning Li, 2021). Hence, it is urgent to recognize that the construction sector must adopt measures to actively contribute to the regeneration of biodiversity. This thesis presents "biodiversification strategies" as architectural solutions enhancing biodiversity in post-war gallery flats, addressing specifically habitat degradation, which has been recognized as the most consequential driver of biodiversity loss (IBPES, 2019).

Biodiversity is typically categorized into three main groups: genetic, species, and ecosystem biodiversity. Due to time constraints, a comprehensive examination of all three categories is not feasible. Thus, this study is narrowed down to the biodiversity of species, specifically terrestrial fauna and flora.

While human activity, particularly construction, has indeed led to the destruction of natural habitats, it is important to note that a number of species have, in fact, adapted to the built environment, in certain cases even making their survival dependent on it. These so-called "building-reliant species" (which include birds, bats, many plants, insects and some rodents) have been impacted in recent years by new building standards, which require buildings to have sealed and air-tight shells to save on energy and CO2 emissions. While energy-saving constructions are essential, current methods fail to recognize the dependence of biodiversity on building imperfections to survive in our nature-hostile cities (Sullivan & Lusby, 2021; Gunnell et al., 2019). Thus, this study aims to highlight some key building features or concepts that can help support such species. Although the built environment may not replace the natural landscapes from which these species originate, varied elevations, the use of stone-like materials and occasional greenery in cities may imitate them, which attracts these species. Thus, cities must contain sufficient nesting sites and feeding opportunities to ensure these species' survival (Gunnell et al., 2019).

Since biodiversity is inherently tied to local environments, the research will propose interventions directly aimed at and applicable to the case study. Therefore, we will look at the most common Dutch-native species of birds, bats and insects whose populations have been recognized as declining, as well as building-reliant vegetation that may benefit them. Other mammals will not be looked at because they are not directly dependent on buildings to survive in cities (despite them sometimes appearing in them). Similarly, rodents are not considered due to their presence in buildings being typically associated with contamination risks and damage. Besides, as indicated by Gunnell & al. (2019): "bat and bird populations are considered to be a good indicator of the broad state of wildlife and landscape quality because they utilise a range of habitats across the landscape and are sensitive to pressures in urban, suburban and rural environments. Targeting bats and birds as beneficiaries of landscape design will benefit a host of other wildlife and will ensure there is a biodiverse, multi-functional green infrastructure", which is why they are given priority.

b. Biodiversity-enhancing interventions for case study

i. Birds

Birds are some of the most visible and common animals to use buildings – mostly for nesting, and in some cases for breeding. In the Netherlands, only a few building-reliant bird species are on the Dutch Red List, however, many are in constant population decline. The House Sparrow is particularly important, as it regularly nests in building crevices, yet its populations are seriously threatened by our new air-tight ways of building. Other, less threatened species include the Starling, the House Martin, and the Common Swift. Other species such as the Blackbird, the Mallard or the Peregrine Falcon are also present in cities, yet their populations are not endangered. Similarly, the parakeet and house crow are also not protected as they are not native species, meaning that the growth of their populations is monitored (Soortenrijkdom Stedelijk Gebied Biodiversiteit Vogelrichtlijn Habitatrichtlijn, 2014). The Eurasian Skylark and the Crested Lark are red-listed species that sometimes appear in Dutch cities as well (Rudyklaassen, 2022), however, they nest mostly away from human activity, in open fields or on the outskirts of cities, which is why their presence in cities is mostly related to feeding opportunities.

In order to cater to a part of the species, buildings must integrate box-like shielded spaces which can act as nests. Different species require a different height for nesting, and the size of the nests' openings is also species-dependent. The Sparrow, the Starling and the House Martin require ledges or eaves onto which to attach their (clay) nests, which implies that the design must account for bird droppings (Gunnell et al., 2019). In each of these cases, the more nesting opportunities are provided, the more likely it is that the building will indeed attract these birds, and most species prefer their nests to not be oriented south. Gunnell & al. (2019) provide a detailed list of requirements for a number of these species – their suggestions for the ones relevant to the Netherlands can be found in Appendix D.

ii. Bats

Bats are usually temporary users of buildings, taking advantage of the warmth they provide for breeding or roosting. Bats can also use them as transition places between their summer and winter nests or resting places in between their feeding periods. All the 19 species found in the Netherlands feed on insects and hunt at night (BAT - EWS Group - Nederland, 2020). All 19 are protected: this is because their populations have been declining, especially since the 1980s, mainly due to the use of pesticides in agriculture, large-scale landscape changes and the disappearance of habitat ("Veel Gestelde Vragen Over Vleermuizen," 2020). The Pipistrelle and the Noctule are two of the most common bat species in the Netherlands, which represent a different set of needs: unlike the Pipistrelle, the Noctule requires timber joists or beams on which to roost (Gunnell et al., 2019). Other bats may also use external features such as tiles, weatherboarding, fascias, soffits and barge boards (Gunnell et al., 2019). Some species (such as the Natterer's bat) require flying space as is generally found under sloped roofs for example. However, because the roofs of the case study buildings are flat, they offer no suitable cavities for such bats. The detailed nesting requirements for the Pipistrelle and the Noctule can be foud in Appendix D.

A variety of ready-made nests for both bats and birds exist, many of which can be integrated into building structures with minimal impact on their looks. In principle, most of these products consist of a small opening (with dimensions adjusted for individual species) that minimally shows on the surface of the building and an enclosed nest-like cavity behind it. For bats especially, many of these products consist of alternative roof tiles or bricks which seamlessly merge into traditional ones, while allowing animals to enter a cavity meant for them. Although ready-made products do exist, these are generally very localized interventions. The integration of nesting opportunities into the structure of a building through purposeful detailing rather than isolated products can increase both their aesthetic value and their density across the building façade.

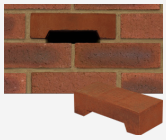


Fig. 8.1: *Bat access brick*

Fig. 8.2: *House Martin ready-made nest*

Fig. 8.3: *Swift box*

Fig. 8.4: *Bat access tile*

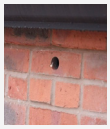


Fig. 8.5: *House Sparrow box*

Fig. 8.6: *Bat roost*

Fig. 8.1-8.6: *Various ready-made products for bat access and bird nesting. (Gunnell et al., 2019)*

iii. Insects

While nesting is key to attracting birds and bats to a site, enough feeding opportunities in proximity to the nests are also preferable. As most species of building-reliant bats and birds predominantly feed on insects, including features in the building which attract them can be beneficial to local biodiversity on many levels at once. Insects play crucial roles in ecosystems as well due to their functions as pollinators, pest controllers, and decomposers. Pollinating insects are particularly important, as 80% of global species of flora depend on them for their survival. Bees, specifically, are the notorious backbone of thriving ecosystems; yet bees, along with other pollinators like butterflies, moths and hoverflies are currently disappearing in the EU as well (Limb & Reuters, 2023).

Walls provide many opportunities to attract pollinators, as it is relatively easy to integrate features that replicate the microhabitats they need. This includes, for example, so-called "bee-hotels" or even "bee bricks" that can be placed on sunny walls (Gunnell et al., 2019).

Fig. 9.1: *Bee brick (Bee Brick®, n.d.)*
Fig. 9.2: *Insect hotel (Gallery of Insects Hotel | Batlleiroig | Media - 1, n.d.)*
Fig. 9.3: *Bee hotel (Meinhold & Inhabitat, 2013)*
Fig. 9.4: *Insect pavillion (Englefield & Dezeen, 2022)*


Fig. 10.1


Fig. 10.3

Fig. 10.2

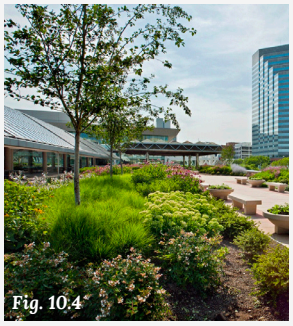


Fig. 10.4

Fig. 10.1: *Cable trellises with climbing plants are a simple way to create a living wall. (Gunnell et al., 2019)*
Fig. 10.2: *CP = climbing plants, SM = substrate modules. (Madre et al., 2015, p.224)*
Fig. 10.3: *Extensive green roof. (Roofingmagazine.com, 2019)*
Fig. 10.4: *Intensive green roof. (Proarkitects.co.uk, 2022)*

Green facades are also commonly recognized as a good biodiversity-enhancing feature: these facades support the growth of vegetation on vertical surfaces. Madre et al. (2015) studied the impact of different types of green walls on spiders and beetles. They concluded that substrate module walls (hydroponic systems filled with sphagnum for example) were the best-performing biodiversity-wise, as they provide the most structurally diverse vegetation. However, these types of walls have a high ecological footprint. Thus, the authors suggest using climbing plants (according to Gunnell et al., (2019), preferably along trellis), which also attract satisfying populations of insects while being less demanding in terms of irrigation and maintenance.

When it comes to attracting insects outdoors, leaf litter benefits ground-bound insects, while for flying pollinators, the presence of native evergreen and nectar-producing plants throughout the year is crucial (Gunnell et al., 2019). Daniels et al. (2020) highlight that plant (notably, flower) diversity in both shaded and sunlit areas is essential to accommodate a wider array of pollinating insects. Finally, Daniels et al. (2020) recognize that community gardens (with native species of vegetables or plants and some untouched parts) are very beneficial to insect biodiversity in cities as they mimic the qualities of rural environments.

Green roofs should be primarily aimed at insects and their supporting flora since the loss of these elements make roofs unattractive to bird and bat populations (Rumble & Gange, 2013; Coulibaly et al., 2023). There is greater biodiversity on intensive roofs compared to extensive ones, which typically feature a limited array of plants like mosses and sedum. In contrast, intensive roofs have more intense greenery concentrated in smaller parts of the roof. Such a system is convenient for the design of an accessible “roof-garden”, as it allows space for circulation spaces (Porjazoski, 2019).

iv. Flora

Interventions for increasing flora biodiversity in the built environment involves strategic species selection and optimal use of green space. The objective across ground, roof, and facade is to boost biodiversity holistically, benefiting both flora and fauna. Native plants, their diversity and floral species that provide pollen and nectar all year-round are all important in order to cater to the different seasonal needs of local insects, birds and bats (Royal Botanic Gardens Kew et al., 2020). Considering each species’ unique ecology, an ecologist’s guidance is crucial for precise interventions. However, some of the following generic strategies can be a useful starting point before developing more detailed ecological plans.

Continuous patches of diverse species, particularly floral vegetation, significantly contribute to invertebrate presence and thus, broader biodiversity. The Kew Royal Botanic Gardens (2020) suggest implementing wildflower meadows and Daniels et al., (2020) propose community gardens as strategies to foster abundant ecosystems. A similar strategy can be applied at the plinth level: strategic placement of floral species alongside bee hotels or bricks can increase the presence of pollinating insects.

Many plants have adapted to nutrient-poor soil conditions, which allow them to grow on stone-like surfaces of buildings. These plants, when integrated into living facades, offer ecological benefits, but might also cause damage to the structures they grow on (Gunnell et al., 2019). Utilizing trellis systems allows for controlled growth of these plants, while limiting their potential damage. This is especially true in the case of ivy, which provides nectar and shade all year round, but might damage the building’s façade if not controlled properly.

Roof spaces can be differentiated into intensive and extensive green roofs. Intensive green roofs have been proven to be more beneficial as they can support more diverse vegetation and thus, enhance overall biodiversity (Coulibaly et al., 2023). The principles for plot-level vegetation organization similarly apply to roof gardens: patches of floral plants or community gardens are suitable practices for increasing the presence of wildlife.

iv. Conclusions: biodiversity interventions for the case study

	Biodiversity Intervention	Link to Identity Intervention
1. Plot	Patches with diversity of native species of flora, with a focus on evergreen and floral species Presence of water is preferable to atrract birds Insect hotels Integrate wildflower meadows or communal gardens	**Use vegetation patches and/or water to guide pedestrian circulation.** **Create clearly delineated spaces dedicated to biodiversity such as insect hotels or communal gardens** **Maximize the space attributed to diverse vegetation (instead of plain grass)**
2. Plinth	Integeration of insect hotels or bee bricks on Southern plinth. Floral patches or hedges	**Use insects bricks (which are see-through) to open up the grond floor and create material contrast with the upper floors** **Use flower compositions or hedges around entrances to highlight them.**
3. Facade	On non-southern facades, above plinth level, create ledges, eaves with nesting cavities with holes of varying sizes for birds. On Southern facades, create cavities for bats Create living wall using trellis (preferably Ivy)	**The edges of the gallery can integrate ledges suitable for bird nesting.** **The localized placement of either bat or bird roosts in the facade can break its regularity.** **The localized use of trellis with vegetation along the facade can break its regularity.** **The east and west facades can be used for growing native vegetation along trellis as well as for bat roosts.**
4. Roof	Create intensive green roof: patches of diverse native plants. Integrate bird nests: for species nesting at higher altitudes such as Peregrine Falcons. Integrate wildflower meadows or communal gardens	**Create an intensive green roofs as those are preferable for making accessible roof gardens.** **Use vegetation patches to guide pedestrian circulation through the roof.** **Create communal gardens to enhance the sociability of the roof.**
5. Interior		**Identity interventions may be carried out indepedently from ones aimed at biodiversity.** **Interiors can support education on local biodiversity or include native indoor species.**

To address the initially posed research question, we identify synergies between biodiversification strategies and architectural identity enhancements. Our findings suggest that biodiversity interventions can reinforce identity across four architectural levels, excluding the interior where wildlife is often unwelcome, as indicated by Madre et al. (2015).

The synergy is less evident at the plot level, where biodiversity essentially relies on selecting suitable plants and maximizing their coverage, with their shape being a secondary consideration. Thus, to enhance identity on the plot level through biodiversity, appropriate identity-oriented landscaping must be done. The same applies to roofs: although it is clear both from an identity and biodiversity aspect that an intensive roof is preferable, the actual layout is independent of biodiversity strategies, provided that a variety of native species is present. This means that the identity of the roof mainly depends on the arrangement of plants on it. Nevertheless, defined spaces for features like wildflower meadows or community gardens contribute to the site's educational, social, and environmental value whether on the plot or the roof.

The plinth and façade-level biodiversification strategies show clearer synergies with identity. Opening the plinth and adding unique-looking see-through insect bricks on the plinth level can create a material contrast with upper stories, aiding site legibility and sociability. Maiju Suomi and Elina Koivisto beautifully demonstrated the architectural potential of such insect bricks in their Alusta pavilion in Helsinki (Englefield, 2022). Furthermore, unique features like bird or bat nests or plants on a trellis can benefit the identity of the facades by disrupting their monotony and aiding orientation.

Building orientation affects both flora and fauna, an aspect that is also crucial to the identity of post-war structures, which often allocate different sides of the building to different functions. In this case, the northern gallery side is dedicated to routing and the southern one is for balconies and greenery. Assigning the South to bats and pollinators (which prefer direct sunlight) and the North to birds (which prefer shade) can reinforce this functional distinction while aligning with the needs of these species.

However, some identity improvements, like “giving social purpose to the gallery” may not intersect with biodiversity enhancements. Similarly, selecting plants under an ecologist's guidance for biodiversity may not impact identity, suggesting that sometimes these aspects must be approached distinctly.

6. Conclusion

This research began by reviewing some available definitions of identity in architecture, based on which a framework for assessing identity was developed. This framework aims to ground this abstract concept in tangible terms. Its utility is demonstrated in the case study of the Boerhaavewijk neighbourhood, Haarlem (Netherlands) – a representative neighbourhood of the post-war era where is located an ensemble of three gallery flats in need of renewal. The analysis offers strategies to enhance the identity of this site.

The second part of this research focuses on biodiversification strategies directly applicable to the case study: these strategies focus on attracting diverse fauna and flora to the site, specifically, building-reliant species whose populations are endangered or in decline.

Both identity enhancement and biodiversification strategies were organized into five architectural levels: the plot, the plinth, the façade, the roof and the interior. This allowed to find synergies between these sets of strategies at each of these levels. However, at the interior level, this synergy was lacking. On the other hand, plinth and facade interventions appeared to be particularly useful in reinforcing identity. At plot and roof levels, strategic landscaping appeared as the main tool to support both identity and local biodiversity.

The research products include, on one hand, a novel definition of architectural identity and a framework to assess it. On the other hand, it includes tangible recommendations for the redesign of the case study. Although specific to Boerhaavewijk, the methodology used could inform the transformation design of other post-war housing sites, considering factors beyond mere technological performance.

However, findings are specific to Boerhaavewijk and may not be generalised. Implementing these findings into a real design would require additional ecological expertise and engagement of locals. Furthermore, other important factors like public lighting, energy efficiency, and resident preferences should not be left uncovered to ensure a truly environmentally and socially resilient design.

Future research should broaden these strategies’ application and assess their long-term impacts, questioning the relevance of legibility, sociability, and community acceptance of local wildlife. It should also consider the economic, infrastructural, and social implications of renovation. This study promotes a multifaceted approach to redevelopment, offering a starting point for a wider discussion on architectural transformation.

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b. Images

Fig. 1: Map of similar looking apartment blocks across Europe dating from the post-war era (black & white photos) and from the 20th century (renders).

Colored images, from top to bottom, left to right:

Beta Office. (2020). Leidsche Rijn, Utrecht. https://beta-office.com/wp-content/uploads/025-leidsche-rijn/beta-leidsche-rijn-e5-render-vaduzdijk-corner-image-filippo-bolognese.jpg

UAU Collectiv. (n.d.). VM Brugge 6/14. https://uaucollectiv.com/wp-content/uploads/2021/04/508_VM-BRUGGE_FACADE7.webp

Lan Paris. (n.d.). The Gunsbourg block, Ivry, 245 housing units, shops. Lan Paris. https://s3-eu-west-1.amazonaws.com/lan-test/projects/project_gallery/ivry/_900xAUTO_crop_center-center_55/IVRY_VUE-09.jpg?mtime=20210910080056

Apartments in Norway , & Prishchep, D. (2019, June 10). Apartments in Norway The property is located near Oslo, in a green area overlooking the forest. Behance. https://mir-s3-cdn-cf.behance.net/project_modules/2800_opt_1/59383481364431.5cfdd37537620.jpg

Nagele, M., & Miliauskas, M. (2018, November 23). "Donelaitis apartments" exterior visualizations CGI. Behance. https://mir-s3-cdn-cf.behance.net/project_modules/2800_opt_1/71216b72939209.5bf867c749611.jpg

Sadovsky Architects. (2020, July). Mlynske Nivy, Sadovsky Architects, Bratislava, Slovakia. Monolot Studio. https://monolot.studio/wp-content/uploads/2020/07/mnlt_200528_sda_vnutroblok_final_oprava-scaled.jpg

Black and white photos, from top to bottom, left to right:

RIBA Collection, & Hall, J. (2001). Alton West Estate, Roehampton, London: the eleven-storey maisonette slabs (1959). RIBA. https://www.ribapix.com/alton-west-estate-roehampton-london-the-eleven-storey-maisonette-slabs_riba6114#

Stadsarchive Rotterdam. (n.d.). The RVS flat for single women seen from the Beukelsdijk. Platform Wederopbouw Rotterdam. https://wederopbouwrotterdam.nl/uploads/_large/055-vrouwenflat-NL-RtSA_4273_L-3369.jpg

LOTTO-Foundation Berlin. (n.d.). Altonaer Straße 3–9 Schwedenhaus Fritz Jaenecke – Sten SamuelsonFront facing south, Ullstein Bild. Hansaviertel Berlin. https://hansaviertel.berlin/wp-content/uploads/2019/03/20_jae_IMG__ullstein_02603911.jpg

Tony. (2019, December 10). Lessons from the Swede's massive post-war housing boom. YES PLZ. https://images.prismic.io/yesplz/NGFjZmQyZjMtOWRlMi00YTQ0LWE5MTYtZmM2NTJiNzNiMDJm_holma_malmo___by-jorchr-own-work-cc-by-sa-3.0.jpg?auto=compress,format&rect=0,0,1400,1050&w=1400&h=1050

Kukacos01. (2010, January 16). Gyöngyös city Pesti Street (Hungary). Wikimedia Commons. https://upload.wikimedia.org/wikipedia/commons/0/03/Gy%C3%B6ngy%C3%B6s_Pesti_%C3%BAt.jpg

Fig. 2: Map of Schalwijk (left side), with Boerhaavewijk is indicated in dotted lines and map of Boerhaavewijk (right side) with project side indicated in dotted lines. The 3 buildings used for the case study are highlighted in red on both maps. (By author)

Fig. 3: The collection of various "characteristics of identity in architecture", collected from the works of Brahman & Torabi (2013) and Alavi & Tanaka (2023). (By author)

Fig. 4: According to Keven Lynch (1960), the image of an object is composed of its identity, its meaning and the structure that relates it to its environment. (By author)

Fig. 5: Organizing the "characteristics of identity in architecture" accroding to the components of image: identity, meaning and structure - as proposed by Lynch (1960). (By author)

Fig. 6: The collection of various "characteristics of identity in architecture", collected from the works of Brahman & Torabi (2013) and Alavi & Tanaka (2023). (By author)

Fig. 7: Framework of identity in use: organisation of the analysis. (By author)

Fig. 8.1-8.6: Various ready-made products for bat access and bird nesting.

Fig. 8.1: Gunnell, K., Williams, C., & Murphy, B. (2019). Ibstock Bat Roost Entrance Arch Brick. Design for biodiversity: A Technical Guide for New and Existing Buildings (p.32). Routledge.

Fig. 8.2: Gunnell, K., Williams, C., & Murphy, B. (2019). House Martin ready-made nest. Design for biodiversity: A Technical Guide for New and Existing Buildings (p.52). Routledge.

Fig. 8.3: Gunnell, K., Williams, C., & Murphy, B. (2019). Ecosurv Swift Box. Design for biodiversity: A Technical Guide for New and Existing Buildings (p.46). Routledge.

Fig. 8.4: Gunnell, K., Williams, C., & Murphy, B. (2019). Habitat Clay Bat Access Tile. Design for biodiversity: A Technical Guide for New and Existing Buildings (p.31). Routledge.

Fig. 8.5: Gunnell, K., Williams, C., & Murphy, B. (2019). Bat access brick. Design for biodiversity: A Technical Guide for New and Existing Buildings (p.54). Routledge.

Fig. 8.6: Gunnell, K., Williams, C., & Murphy, B. (2019). Habitat Bat Box. Design for biodiversity: A Technical Guide for New and Existing Buildings (p.35). Routledge.

Fig. 9.1: Bee brick. Bee Brick®. (n.d.). Bee Brick®. Greenandblue.co.uk. https://www.greenandblue.co.uk/products/bee-brick

Fig. 9.2: Gallery of Insects Hotel | Batlleiroig | Media - 1. (n.d.). Archello. https://archello.com/story/49792/attachments/photos-videos/1

Fig. 9.3: Meinhold, B. (2013, June 2). [Bee hotel]. AtelierD's Giant Honeycomb Bee Hotel Attracts Pollinators & Humans Alike. Inhabitat.com. https://inhabitat.com/atelierd-builds-a-giant-honeycomb-pavilion-to-attract-bees-humans-alike/

Fig. 9.4: Englefield, J. (2022, September 13). [Insect pavillion]. Maiju Suomi and Elina Koivisto design "insect hotel" Alusta Pavilion in Helsinki. Dezeen.com. https://www.dezeen.com/2022/09/13/maiju-suomi-elina-koivisto-insect-hotel-pavilion-helsinki/

Fig. 10.1: Gunnell, K., Williams, C., & Murphy, B. (2019). [Cable trellises with climbing plants are a simple way to create a living wall]. Design for biodiversity: A Technical Guide for New and Existing Buildings (p.9). Routledge.

Fig. 10.2: Madre, F., Clergeau, P., Machon, N., & Vergnes, A. (2015). [The proposed vegetated façade typology based on technical specifications]. Building biodiversity: Vegetated façades as habitats for spider and beetle assemblages (p.224). Global Ecology and Conservation, 3, 222–233. https://doi.org/10.1016/j.gecco.2014.11.016

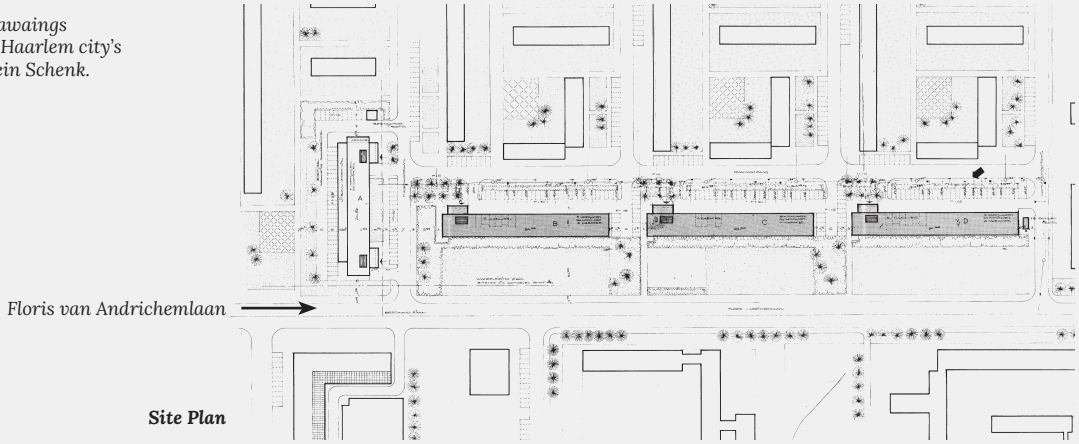
Fig. 10.3: Extensive green roof. ROOFINGADMIN & Roofingmagazine.com. (2019, March 26). Four Views From a 44th Floor Manhattan Green Roof. Roofingmagazine.com. https://roofingmagazine.com/four-views-from-a-44th-floor-manhattan-green-roof/

Fig. 10.4: Intensive green roof. Proarkitects.co.uk. (2022, January 19). THE TWO TYPES OF GREEN ROOFS: EXTENSIVE VS INTENSIVE. https://www.proarkitects.co.uk/the-two-types-of-green-roofs-extensive-vs-intensive/

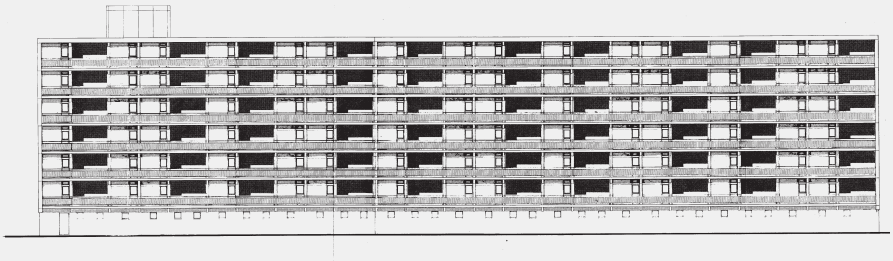
9. Appendices

Appendix A: case study drawings

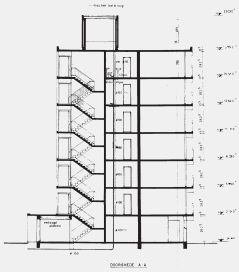
Source: *Archival drawaings provided by former Haarlem city's architect Willem Hein Schenk.*



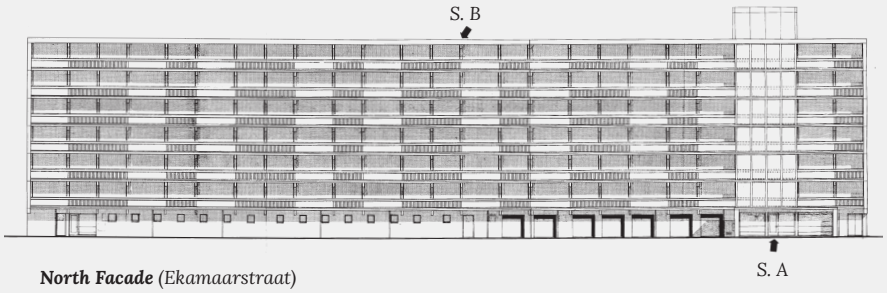
Site Plan



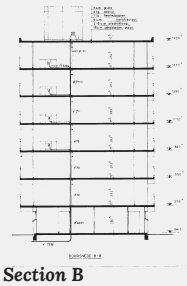
South Facade *(Floris van Andrichemlaan)*



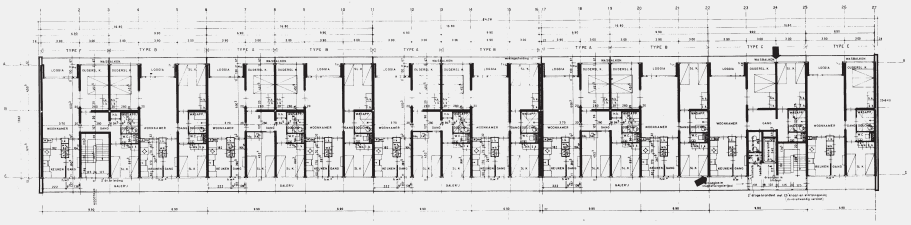
Section A



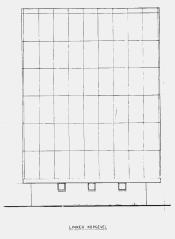
North Facade *(Ekamaarstraat)*



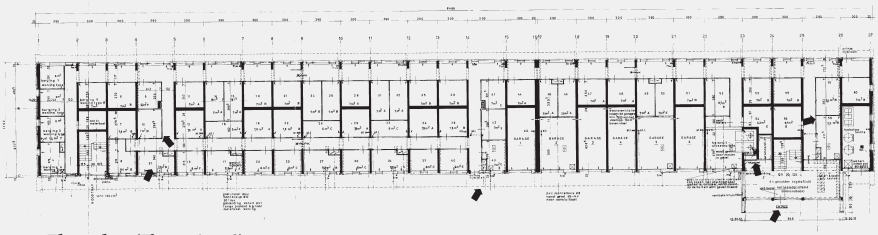
Section B



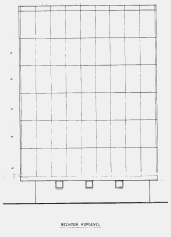
Floorplan *(Ground floor)*



West elevations



Floorplan *(Floors 1 to 6)*



East elevations

Appendix B: glossary

Characteristics of Identity in Architecture
(Brahman & Torabi, 2013; Alavi & Tanaka, 2023)**:**

Materials: They are the foundational element of any building or space. The character and physical properties of materials, ranging from their outlook to their texture or technical performance, all contribute to the identity, to its legibility and functionality. Although materials are physical in nature, they may influence the meaning of a place as well. (Brahman & Torabi, 2013; Alavi & Tanaka, 2023)

Relationship with Context: The physical surroundings, as well as the cultural, historical, geographical setting are all encompassed in the notion of "context". It is the essence of the meaning that develops around spaces, and their very source of inspiration. Context exists before a building is created and is changed once it is erected. (Brahman & Torabi, 2013; Alavi & Tanaka, 2023)

> ***Context = structure (as per Lynch) = the way all other characteristics relate to the building.***
> Context is all encompassing and overlaps with other characteristics of identity. Since context is here defined as a relationship, it is considered an intangible feature which is both consciously and subconsciously experienced. It also does not belong to meaning nor identity, as defined by Lynch, why it is difficult to place it on the graph.

Spatial organization: The sequence and placement of areas within a structure: the flow of spaces ensures the functionality of the space by guiding the interaction and communication between elements. (Brahman & Torabi, 2013)

Shape, form and function: The physical appearance of a building, its intended function (and how that translates into space) as well as "the activities or needs of those [...] using the building. It pertains to both the visual qualities of a space, but also its practical aspects such as construction, program, organization and actual use of it. (Brahman & Torabi, 2013; Alavi & Tanaka, 2023)

Environmental factors: These are characteristics of a space which allow to satisfy the current generations' needs in a sustainable manner, ensuring that those same needs can be met over a long period of time. It is related to diverse aspects, many of which relying on technology, all with an outlook towards environmental resilience. (Alavi & Tanaka, 2023)

Temporal organization: Temporal organization refers to a building's capacity to withstand the passage of time and adapt to the evolving historical and cultural shifts it encounters. This aspect points to the structural features of a space that either facilitate of hinder its adaptation to changing requirements over successive generations. (Brahman & Torabi, 2013)

General design principles: The abstract thought from which originated the creation of a building or space. They provide coherence among the diverse contextual inputs which serve the architect-designer. (Brahman & Torabi, 2013)

Individual creativity: Every individual involved in the elaboration of a space owns the power of projecting his/her own perspectives into the design. Individual creativity pertains to the unique ideas or concepts of designers and their ability to generate distinct, original architecture out of it. (Alavi & Tanaka, 2023)

Memory (history and culture): The memory of a place are the physical manifestations of society's historical and cultural baggage, which might be present in obvious ways such as through monuments, or in more implicit ways, such as the lifestyle of people in a certain location. (Alavi & Tanaka, 2023)

Semantic organization: The ability of a space to convey meaning, embody symbols and ideas related to its users and society as a whole. (Brahman & Torabi, 2013)

Political and Economical factors: Power dynamics and financial structures always exert a certain level of control over the development of an architect's ideas. Political authority as well as the economy are tied to the memory of a place as well as its physical shape, which, unavoidably, impacts identity and meaning. (Alavi & Tanaka, 2023)

Sociability: The sociability of a space is defined by its ability to facilitate intentional and non-intentional interraction between its users.

Identity Assessment Tools:

Legibility: refers to the quality of a building or space that makes it easy to understand and navigate. It's about how well a person can read or interpret the environment around them.

> Several architectural features and design principles that can contribute to it: clear spatial organization, visibility, intuitive layouts, consistency in design, dinstinctive features, human scale.

Functionality: refers to how well a building or space serves its intended purpose, meeting the practical needs of its users effectively and efficiently.

> Several architectural features and design principles that can contribute to it: efficient connectivity and accessibility of spaces, comfort, durability, security, fexibility and adaptability, and good utility of spaces.

Sociability: defined by its ability to facilitate intentional and non-intentional interraction between its users. Sociability contributes to the liveliness and community engagement within a space.

> Several architectural features and design principles that can contribute to it: human scale which allows visual connection, communal spaces, open and interractive spaces, connectivity of spaces, spaces that can be used in different ways at once (polyvalence).

Appendix C: assessment of identity in case study

1. PLOT

Legibility

The area's legibility is strong thanks to the straightforward linear placement of the three buildings. The edges of the plot are equally clear, as it is encircled by roads from all sides. However, the expansive grass fields at the southern side of the buildings do not have any pathways, which diminishes the plot's legibility: pedestrians are left feeling small and directionless amidst the vast green space. The height and scale of the buildings contribute to this impression. Additionally, the visual connection between the buildings' southern and northern sides is unclear: the spaces between the three buildings are blocked by either trees, bushes, or the playground that can be seen on the map Fig. X. The lack of distinct materials to differentiate between parking, pedestrian, and bicycle areas on the southern façade of the building further complicates the understanding of access points and routing around the buildings' plinths. Lastly, the plot follows the neighbourhood's main street's trajectory. Still, it fails to provide a sense of progression or destination, as it lacks any notable landmarks or features to guide or orient visitors through the plot.

Functionality

The plot's design offers relatively few facilities catering to pedestrian needs: there are almost no benches, no pathways through the greenery and narrow sidewalks (if any). On the other hand, the site is designed with cars in mind: there is ample parking space (in front of the building, with a separate road to access it).

The southern and northern sides of the plot have completely different functions: the former is for sedentary activities, thanks to a sun-filled field of grass. This part offers a playground and a basketball field – notable features considering that there are 3 schools on the opposite side of the street – as well as two sitting areas with some benches. The latter is meant for transit and movement, whether on foot or by car. There is a complete disconnect between the area in front of and behind the three buildings, which could benefit from a better visual and functional link. This is especially true considering that the large undefined grass fields display a lack of purpose, and are, realistically, indeed unused.

Sociability

While the plot has been designed with certain social and functional aspects in mind, such as playgrounds and small plaza-like areas, it falls short in terms of pedestrian facilities (notably paths and sidewalks), connectivity and scale, which, if anything, discourages social interactions. There is a lack of safe areas, shielded from cars where people could naturally meet, especially on the northern part of the plot, and at the level of the main entrance, which has nothing but brick pavement and bins in front of it.

2. PLINTH

Legibility

The ground floor of all three buildings is visually separated from the upper levels: the plinth consists of a closed brick façade (which hides shared storage spaces and garages), whereas the upper floors have large windows and, blue doors, light yellow concrete elements. This material difference emphasizes the division of buildings' public and private zones. The plinth on the northern facades presents only uniform, small windows spaced at regular intervals and 3 irregularly placed doors: these smaller doors resemble interior doors and are ambiguous in function, serving as access points to storage areas and garages rather than inviting residential entries. In contrast, the southern facades are more communicative, with their main entrance clearly indicated by large, full-length window panes situated on the right side of each building. Entrances are highlighted further by adjacent electric blue garage doors. Additional entrances exist on the left sides of southern façades, but these are far less obvious and seemingly unwelcoming.

Functionality

The functionality of the single, prominent entrance at one extremity of the building is questionable considering the linear shape and gallery circulation of the building: some people may have to walk the entire length of the building to reach their homes. Although there are other entry points, they lack the practical features of the main entrance, such as an intercom system, a designated waiting area, or postboxes, which diminishes their utility and practicality for everyday use. Furthermore, there is no clear path leading up to the doors on the southern side of the building, raising the question of whether they were meant to be used at all. Finally, the current plinth appears in many ways as a wasted opportunity to bring visual interest to pedestrians on ground level.

Sociability

The closed plinth, a feature typical of many post-war buildings, can be traced back to the modernist aspiration to elevate living spaces above the ground. However, this aspiration, drawing from Le Corbusier's principle of pilotis, was often translated into a massive closed-off ground floor on top of which housing is stacked. As a result, there is a noticeable absence of physical and visual connections between the inside of the building and the surrounding pedestrian environment, which effectively isolates the residents from street-level activities and interactions, thereby reducing the building's sociability. The main entrance is thus left as the only place where exchange between the residents and passers-by can happen.

3. FACADE

Legibility

The facade has a regular and organized structure, with varying depths which give it a rhythmical quality. Concrete beams extend at regular intervals all across the facade, and floor slabs create lines that visually frame the building. The main entrance is particularly prominent in the facade, featuring vertical windows that span the entire height of the building, providing light to the main stairwell and contributing to the vertical circulation's visibility. The facade's colour scheme is consistent and harmonious, with shades of pastel blue, yellow, electric blue, the brown of the bricks, and the grey of the exposed concrete. The sides of the buildings are completely uniform — a plain yellow concrete surface above a red brick base — but lacking any features with visual interest. Despite the well-organized and straightforward façade design, the uniformity, especially when replicated across three large buildings, offers no distinctive features to help users orientate themselves or remember specific elements.

Funct.	The character of the northern and southern facades is determined by their contrasting functions. The southern façade, which gets a lot of sunlight, has balconies across its entire length that exhibit private life to the outside world; the more pragmatic northern façade does not receive any direct sunlight and is dedicated to gallery circulation, access and movement. Both facades are very open. The façade detailing is also typically the reason for thermal bridges.
Sociability	The gallery on the northern facade is narrow, limiting the potential for residents to pause and engage in social interaction with neighbours. This constricted space conveys a sense of movement alone. Furthermore, the linear routing without any intersecting routes, minimizes chances for spontaneous, unplanned encounters among residents or visitors. Without areas for people to comfortably gather or at least linger, community formation and interaction are not facilitated, except for the main entrance and stairwell.

4. ROOF

Leg.	The only notable feature of the roof is the top of the main stairwell, which rises above the rest of the roofline. This element creates a distinctive element that could act as a landmark for those who have access to the roof, helping potential users to orientate themselves on the roof. Nevertheless, this element is not visible from the street level, thus not useful to passers-by.
Funct.	The only clear purpose of the roof is energy production through solar panels. It can be accessed through the main stairwell. Its rubber covering absorbs heat under direct sunlight, which could make the roof uncomfortable and impractical for occupancy or extended use, especially in summer.
Soc.	The flat roof represents a missed opportunity to create a space usable by residents, with the potential to foster social dynamics between them. The absence of amenities such as seating, shading, or greenery underscores its purely functional role and likely inaccessibility to the residents.

5. INTERIOR

Legibility	The ground floor is as difficult to navigate, due to the numerous corridors intersecting like in a labyrinth, and numerous of doors leading to garages or storage spaces with no daylight – one must know the place to orientate himself in it. The apartments can be accessed through galleries: featureless outdoor corridors that offer no points of reference to residents due to the uniform façade along which they run – users are left without a sense of location across the entire length of the building. The organization of apartment interiors is functionality divided, with the enclosed kitchen and a bedroom placed toward the gallery side, and the living room as well as the other bedrooms, towards the loggia on the southern façade. The private zones and public areas are separated: the bedrooms and the bathroom on one side, the kitchen and the living room on the other. This rigidly functional design is logical, comprehensible and readable, although the hall through which bedrooms are accessed has no clear function.
Functionality	The ground floor is dedicated to storage, parking and building installations. The fact that only 6 garages are present for a total of 60 apartments raises the question of their overall utility, especially considering that there is ample parking space outside the building. Additionally, there seems to be a disconnection between the fact that there is ample greenery and the ground floor, which has the most connection to it, is completely closed off from it. The ground floor offers the potential for creating shared spaces that could enhance the quality of life for residents. The building accommodates only family apartments, with 2 to 3 bedrooms. The rooms are small, which is a common characteristic of social housing designed for maximum utility within constrained budgets. Bedrooms and bathrooms can be accessed through a small hall, to which a lot of space is lost: a more strategic entrance placement could have conserved space for living areas and reduced the dominance of the windowless hall with no clear function. The kitchens are in enclosed separate rooms and are very small according to modern standards. The entryways to these apartments are adjacent to the kitchens, creating narrow and cramped entrance halls. The apartments all have loggias and narrow balconies spanning their entire length. Whilst these considerably add comfort to these apartments, they are also the reason for thermal bridges, as is usually the case in buildings of the same construction period.
Soc.	The design of the building's interior does little to encourage social interaction. Meeting spaces are limited to areas next to the main entrance, with no provisions for communal gathering elsewhere on the ground floor, or the upper floors. The corridors, being narrow, serve only the purpose of circulation and do not offer spaces for residents to engage with one another. With the building's singular function being housing, opportunities for fostering a sense of community are limited.

Appendix D: nesting requirements for Dutch building-reliant birds and bats (endangered or declining populations).

	Characteristics	Building Intervention
House Sparrow	Often nest in the eaves and crevices of Dutch homes. Important because on the red list. (Rudyklaassen, 2022). Uses buildings for nesting.	180x300x180 – min dimensions of nest. 45mm hole with bottom of hole at least 180cm from bottom of box. At least 2m above ground for sparrows, 3m for starlings. Ideally, integrated to soffit or eaves level. External boxes also possible. Out of direct sun, preferably east. (Gunnell et al., 2019)
Starling	Rapidly declining population but not on Red List (Wikipedia contributors, 2023c). Also makes use of holes in buildings to nest or roost. Predominantly uses crevices and holes in buildings to breed. Feed on insects, fruit and grains.	
House Martin	Declining population trend but not protected (soortenrijkdom stedelijk gebied biodiversiteit Vogelrichtlijn Habitatrichtlijn, 2014). Builds dome-shaped mud nests, usually under eaves of a house.	60-65mm x 25mm to enter. Nest 180mm diameter. Precast nests are available, to be placed under eaves, but not above windows. Several nests together. North or east-facing. Avoid placing where droppings are an issue. (Gunnell et al., 2019)
Common Swift	Least conservation concern but steep decline in last years in the UK (Gunnell et al., 2019). Swifts are known to nest under roof tiles and in the cavities of buildings. (Rudyklaassen, 2022). They nest in colonies and are site-faithfull (Sullivan & Lusby, 2021) Predominantly uses buildings to nest, feeds on insects. Swifts and Starlings may not nest in the same place.	Boxes or compartments of the right dimensions: at least 65x33mm (w.h). Bottom of hole no more than 5cm above the floor of the nest. Headroom at least 75mm.Nest preferably integral to the building. In shade, no sun, far from human windows. At least 5m above ground. Multiple sites are necessary. (Gunnell et al., 2019)
Common Linnet	On the red list because of declining population (Wikipedia contributors, 2023b). Linnets build neat bowl-shaped nests at the end of a branch or stem that hangs over water. It may also build it in gorse bushes, walls, trees with holes and sometimes in abandoned nests. Cannot compete with sparrow for nests because smaller size. (Bryant, 2021).	Boxes or compartments of the right dimensions: at least 65x33mm (w.h). Bottom of hole no more than 5cm above the floor of the nest. Headroom at least 75mm.Nest preferably integral to the building. In shade, no sun, far from human windows. At least 5m above ground. Multiple sites are necessary. (Gunnell et al., 2019)
Common Pipistrelle	Crevice-dwelling bats (that tend to be hidden from view)	Crevices in buildings of around 20-30mm, at 2-7m height. Preferably south-facing and with good thermal properties. These crevices must have rough surfaces for grip (therefore, use of untreated timber, natural stone or masonry is preferred). No artificial lighting in the direction of the nest's entrance. (Gunnell et al., 2019) The Noctule requires rough beams or joists on which to roost. (Gunnell et al., 2019)
Common Noctule	Crevice-dwelling bats which requires beams to roost on. They use buildings for hibernating because of the heat they provide and they roost in large groups. (Wikipedia contributors, 2023a)	