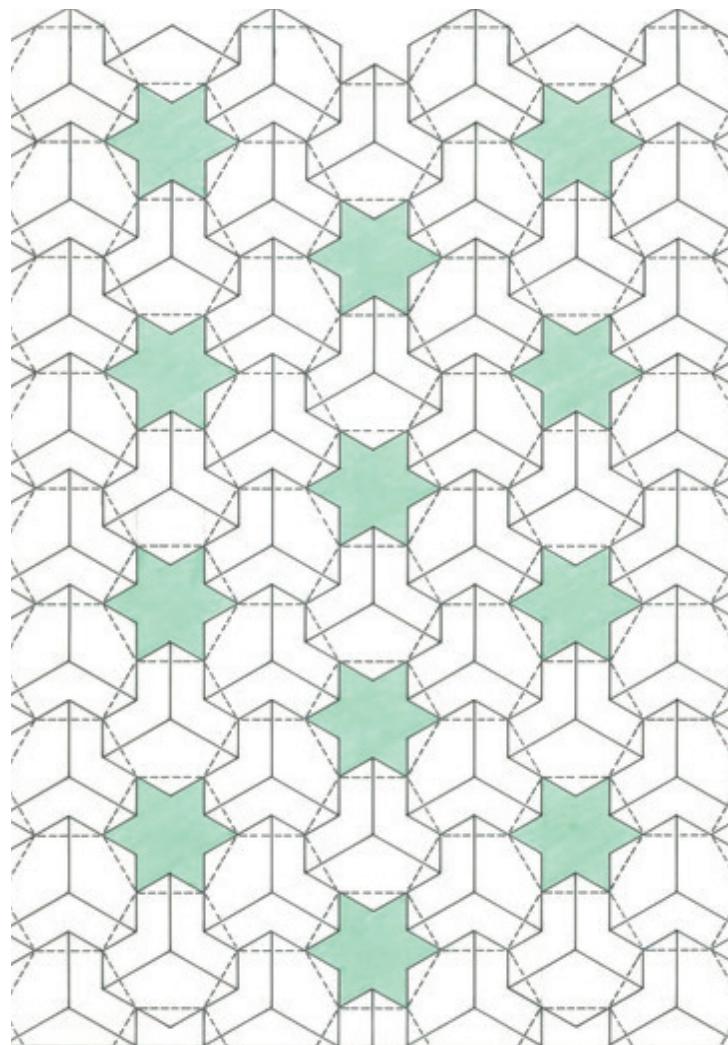


**DWELL IN THE CUBE FOREST:
Habitat Concept and Configurative Design in Piet Blom's Cube Houses**



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Figure I. (Front Cover) Piet Blom's final design with design grids from the Woningenwoud (The New Institute: Piet Blom, 1972-1977), showing Piet Blom's cube house concept in the Helmond project, <https://zoeken.hetnieuweinstituut.nl/en/archives/scans/BLOM/1.2.24.13/limit/25>.

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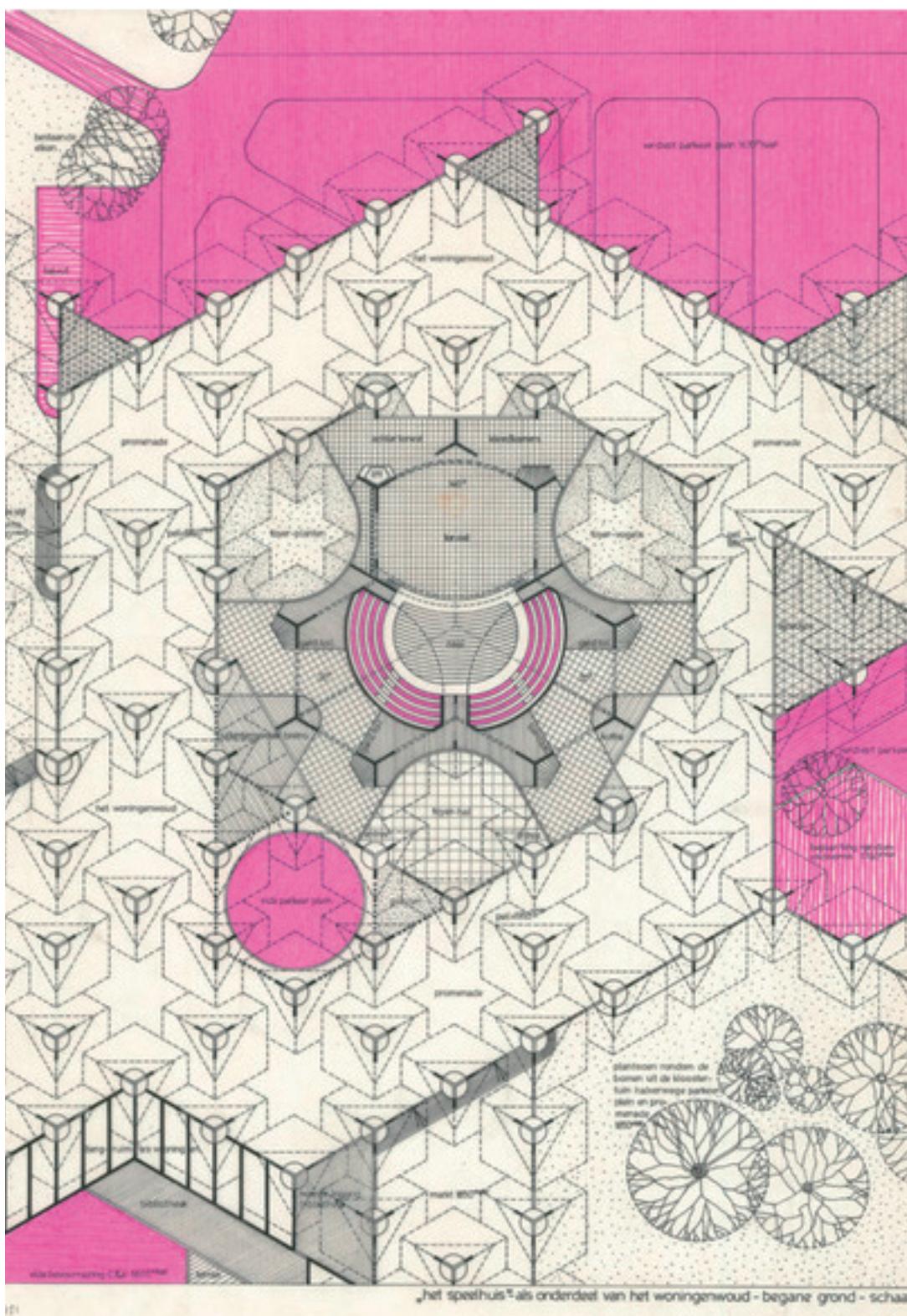


Figure II. Piet Blom's specific design plan in the Wonen en Woud (The New Institute: Piet Blom, 1972-1977), showing Piet Blom's cube house plan in the Helmond project, <https://zoeken.hetnieuweinstituut.nl/en/archives/details/BLOM/path/1.2.24.13>.

Introduction

In the past two decades, there has been renewed interest in structuralism in architecture and urban planning. These discourses regard structuralism as non-hierarchy, flexibility, and openness (Stevenson-Brown et al. 2018, 7). Meanwhile, the configurative discipline proposed by Aldo van Eyck (1962, 328) has also evolved into a rule-based design (Valena, Avermaete, and Vrachliotis 2011, 6-9) based on language and sets of computational rules. With these rendered technoscientific labels, the central concept of “Habitat” in Structuralism and the social structure is relatively ignored. This paper analyses one of the most representative and controversial architecture in Dutch Structuralism: Piet Blom’s Cube Houses. It aims to reveal how Piet Blom expressed the habitat concept and social structure through configurative design in the context of the post-war Dutch welfare state and Dutch Structuralism.

The Cube Houses series is one of Piet Blom’s most significant masterpieces. It is famous for the oblique cube dwelling units and the forest-like integration of city and architecture. It includes two built projects: the Het Spheelhuis en Woonwoud in Helmond (1972-1978) and the Cube houses in Rotterdam (1978-1984). The former only left a few cube units due to the fire in 2011, but the latter has become Rotterdam centre’s hotspot. Besides the physical architectures, lots of Piet Blom’s Cube Houses concept manuscripts are collected in the New Institute, which provides a precious opportunity to analyse his design concept and methods systematically.

In order to investigate the drawings and architecture, this thesis reviews literature from primary and secondary sources. Most of the literature discusses Piet Blom’s work from drawing styles, mat-building concepts, and form aesthetics. Karin Jaschke (2008, 191) analyses Piet Blom’s student project ‘Noah’s Ark’ and challenged the Structuralism features in his work. Ellen Smit (2018, 87-99) compares several structuralists’ drawings, including Blom’s, to show the innovation in colours, grids and configurations. Dirk van den Heuvel (2018) examines Piet Blom’s Kasbah housing complex as the influence on current megastructure. However, it still lacks an in-depth and detailed analysis of Piet Blom’s cube house, exploring how its complex spatial typology responds to the concept of habitat.

For the first time, this research analyses Piet Blom’s design philosophy transformation through his initial drawing period in the 1960s to the architectural projects period in the 1970s and 1980s. The concepts such as ‘habitat’ and social structure are closely discussed under Structuralism and Dutch Welfare society. Several research questions are proposed:

1. Compared with other structuralism drawings in the 1960s and 1970s, what is Piet Blom's design method's uniqueness?
2. How does Piet Blom create a sense of community in cube houses to demonstrate his habitation concept?
3. Does Piet Blom's work bring new interpretation possibilities to Dutch Structuralism?

The following is divided into three chapters. The first chapter analyses social context. It includes three subchapters: the concept of 'Habitat' from Team 10, the configuration design in Dutch Structuralism from the 1960s to the 1980s, and the experimental housing program under the Dutch welfare state period. The 'Habitat' influenced Piet Blom's concept, the configuration discipline shaped his design method, and the experimental housing program determined his primary design contents. The second chapter is the analysis of Piet Blom's drawings. The interpretation of drawings could help reveal the unique cultural structure behind the physical architecture. Piet Blom provided a more similar three-dimensional perspective through multi-layer and angle, different from the drawings from architects like Aldo Van Eyck and Herman Herzberg. As the cube house creates a brand-new topological relationship between units, sizes, access, layouts and connections. The third chapter is the analysis of architecture and space. Cube house redefined the space pattern from units to urban spatiality, creating a new kind of habitat. In contrast to the slab blocks of uniformly stacked flats that dominated contemporary residential developments, cube house units broke the common architectural elements such as walls and floors. Through the organisation of heterogeneous units, the tree-like semi-open courtyards were created, accompanied by new social and living forms.

Approaches such as literature research, comparative analysis and field research are applied. The archive drawings from the New Institute about cube house are represented in spatial depth analysis and compared to normal experimental housing in the same period. The photographs of the cube house's construction and interviews about spatial experience are recorded for qualitative indicators for architectural analysis.

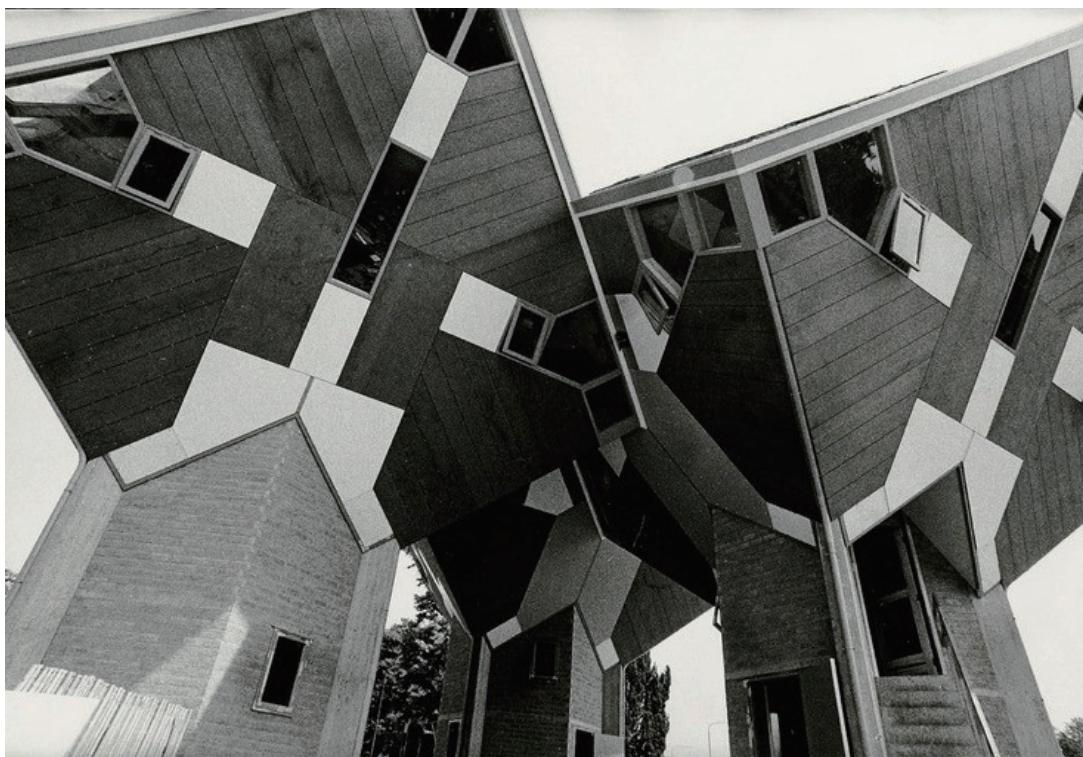


Figure III. Piet Blom's photos of the trial houses in the Woningenwoud (The New Institute: Piet Blom, 1972-1977), showing Piet Blom's cube house units in the Helmond project, <https://zoeken.hetnieuweinstituut.nl/en/archives/details/BLOM/path/1.2.24.13>.



Figure IV. Piet Blom's Cube House in the Rotterdam
(The Kijk Kubus Museum, 1997-1998), showing Piet Blom's cube house complex renovation in the
Rotterdam project, <https://www.kubuswoning.nl/archief.html>.

Chapter 1: Social context of the Cube houses

In the 1950s, Team 10 began to reflect on the standardisation and the separation of functions from CIAM. It introduced new ideas such as the “habitat”, which referred to the environment’s total spiritual and physical fulfilment. In 1959, Aldo van Eyck, an active member of Team 10 and Dutch magazine Forum’s editor, developed a design method called ‘configurative discipline’, aiming to integrate the built environment into coherent configurations. A host of projects achieved by structural and formal configurations in the 1960s and 1970s have been generally gathered under the label of Dutch structuralism (Jaschke 2008, 181). As Aldo van Eyck’s excellent student, Piet Blom was influenced by his configurative design and habitat concepts. Blom’s schemes such as “The Cities will be Inhabited like Villages” were published on Forum in the 1960s. In these schemes, he proposed innovative modular units and typology configuration to achieve the inhabitable environment and social forms.

Meanwhile, with the growing welfare state in the Netherlands after the post-war, large amounts of residential districts were established. However, residents began to be dissatisfied with standardised houses, and the voices for personalised and humane homes became higher and higher. From 1968 to 1980, the government issued an experimental program (De Vletter 2004, 41) for housing renewal and urban regeneration, leading to lots of experimental and influential housing projects such as the Kasbah in Hengelo and the Cube houses in Helmond designed by Piet Blom.

This chapter discusses three main factors of Cube Houses in chronological order. The first is the ‘Habitat’ concept formed in the 1950s, which shaped Piet Blom’s design philosophy. The second is the influence of configuration design on Blom’s student work in the 1960s. And the final subchapter is the promotion of innovative architecture through the experimental housing program in the 1970s.

1.1 The ‘Habitat’ Concept

In the early 20th century, CIAM (Congrès Internationaux d'Architecture Moderne), as the influential international congresses of modern architecture, proposed concepts like “functional city” to change the unhealthy living conditions for low-income groups. However, after World War II, the disadvantage of standardisation and function separation in the Athens Charter raised significant social problems and controversy.

The emergence of Team 10, which was made up of young CIAM members, led to the dissolution of the CIAM and shifted the social and cultural context of modern architecture. Their founding concepts were based on the “Statement on Habitat” (Figure 1.1) at a meeting held in Doorn, Holland in 1954 (Pedret 2001, 167). The Doorn Manifesto suggested replacing the CIAM grid with the ‘Scale of Association’ (Charitonidou 2019, 73). Architects should mix different functions in a humane way instead of separation. As Uribe et al. said, “*The concepts introduced by young CIAM members brought about a sharp turn in modern architecture, calling for greater diversity and stronger relationships with climate, social, economic, and political conditions.*” (Uribe et al. 2020, 3). Team 10 members reflected on the separated function city and they were committed to creating a sense of unity and diversity for the whole built environment.

Before the Doorn meeting, the concept of habitat had already been discussed but not explicitly proposed through several meetings. These meetings below paved way to the approval of the ‘Habitat’ concept. Architects CIAM 6 in 1947 discussed the need to humanise modern architecture. They stated to “*enlarge and enrich the aesthetic language of architecture to provide a contemporary means whereby people’s emotional needs can find expression in the design of their environment*” (Pedret 2001, 58). They put forward an emphasis on aesthetic and emotions but not yet proposed a unified measure. In 1952’s Sigtuna meeting, many young architects in CIAM generally agreed that habitat referred to an environment that could accommodate the total and harmonious spiritual, intellectual, and physical fulfilment of its inhabitants (Uribe et al. 2020, 2). They hoped this concept could encourage architects to consider both material and spiritual needs. And Annie Pedret analysed that this agreement was a sentiment expressed by members from very different contexts who began for the first time collectively to express their dissatisfaction with cities as they were being developed using CIAM’s functional method (Pedret 2001, 107).

With the establishment of the ‘Habitat’ concept in the 1950s, Team 10 proposed a more humane design approach that influenced modern architecture in the Netherlands. The

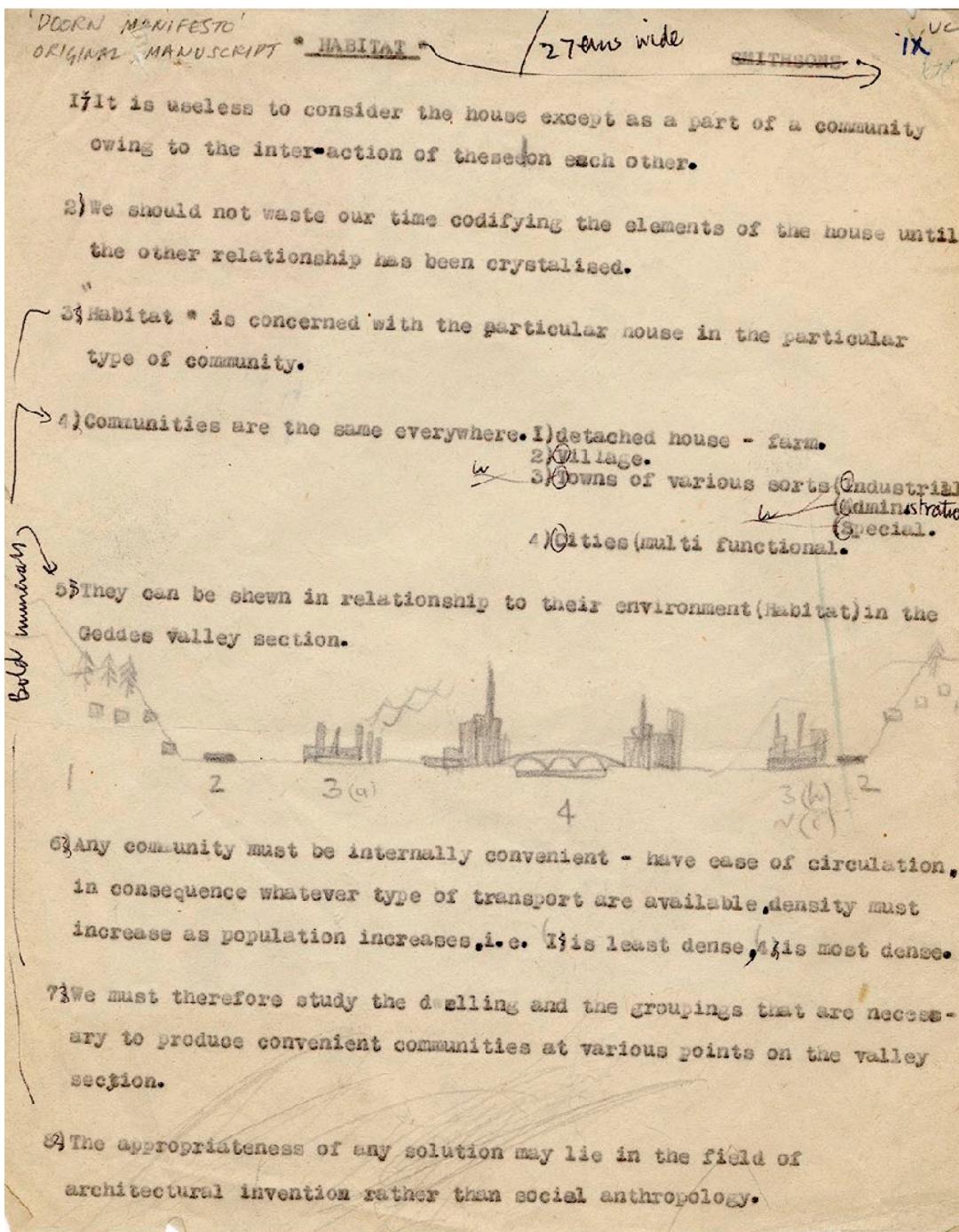


Figure 1.1. The content of "Statement on Habitat" in Doorn meeting (The New Institute: Team 10, 1954)

founding members, such as Aldo van Eyck also brought the idea of social structure and anthropology from architecture. As the Dutch magazine Forum's editor, van Eyck used this platform to disseminate the ideas of Team 10. Piet Blom, as Aldo van Eyck's outstanding student, was also influenced by these design concepts. His student projects such as "The Cities will be Inhabited like Villages" (Figure 1.3) and "Children's Village" (Figure 1.2) were published on the Forum. In van Eyck's view, Blom's projects were a powerful, humane declaration against the postwar standardised architecture in the Netherlands. Blom stated, "*I hate the word dwelling because it is directly associated with the idea of a roof over your head. Dwelling is also the neighbourhood, the street, the communal facilities, and the atmosphere of a quarter*"(Hiddema 1984). Piet Blom expanded the boundaries of dwelling from independent living space to a social network, including surrounding communities and facilities. This kind of design concept also ran through his experimental built projects like Kasbah in Hengelo and the cube houses in Helmond and Rotterdam. As he said, "*Architecture is more than creating a place to live. You create a society.*"



Figure 1.2. Piet Blom's winning scheme Prix de Rome "Children's Village" (Forum vol.17 no.3: Piet Blom, 1962)

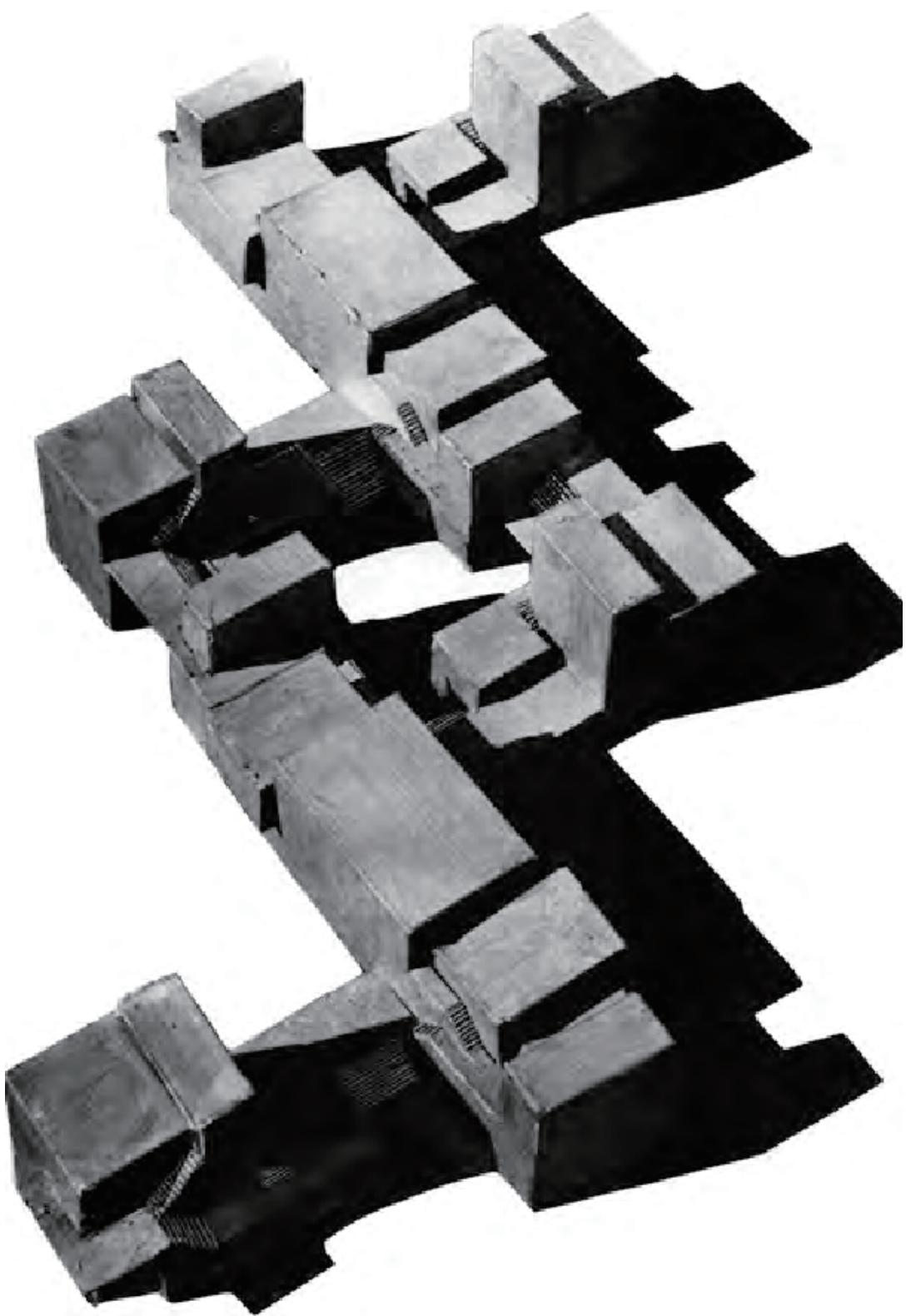


Figure 1.3. Piet Blom's study project "The Cities will be Inhabited like Villages"
(Forum vol.14 no.7: Piet Blom, 1958)

1.2 Configuration design in Dutch Structuralism

To enhance the ‘Habitat’ concept, in 1962, Aldo van Eyck proposed the configuration design in his essay entitled “Step towards a configurative discipline”. Instead of pointing to a specific architectural project, he stated in a more theoretical way:

“A city should embrace a hierarchy of superimposed configurative systems multilaterally conceived (a quantitative not a qualitative hierarchy). All systems should be familiarized one with the other in such a way that they combined and interaction can be appreciated as a single complex system – polyphonic, multi-rhythmic, kaleidoscopic and yet perpetually and everywhere comprehensive. A single homogeneous configuration composed of many subsystems, each covering the same overall area and equally calid, but each with a different grain, scale of movement, and association potential. These systems are to be so configurated that one evolves out of the other – is part of it. The specific meaning of each system must sustain the meaning of the other.” (Van Eyck 1962, 340)

In van Eyck’s opinion, configuration design combined with these dualistic meanings: small and large, part and whole, unity and diversity, simplicity and complexity. These meanings were composed as a hierarchy system, including primary and secondary ones. The secondary systems were designed by a similar simple space design. They were integrated into the whole complex system through different configuration methods, composed of several structurally similar but rhythmically different subsystems. The complexity of the system also meant freedom, bring different scales, movements, and connections. It was just like the relationship between city and architecture. As he said, “a house must be like a small city if it’s to be a real house, a city like a large house if it’s to be a real city”. Aldo van Eyck’s configuration discipline was a mental shift of design methods to integrate urban fabrics and architecture.

At that time, Aldo van Eyck’s configurative discipline became a mature discipline in the design education field. This theory and projects like the Amsterdam Orphanage building largely influenced his student Piet Blom when the latter studied at the Amsterdam Academy of Architecture. In van Eyck’s essay, he highly commented on Piet Blom’s housing projects: “Nor do these projects depend on the current narrow views of what inside and outside, individual and public space mean; nor for that matter on the frozen quartet of functions and the foolish severing of urbanism from architecture into two conflicting disciplines. They successfully demonstrate the validity of a way of thinking and a corresponding design process which I have advocated for many years.” (Ibid., 328)

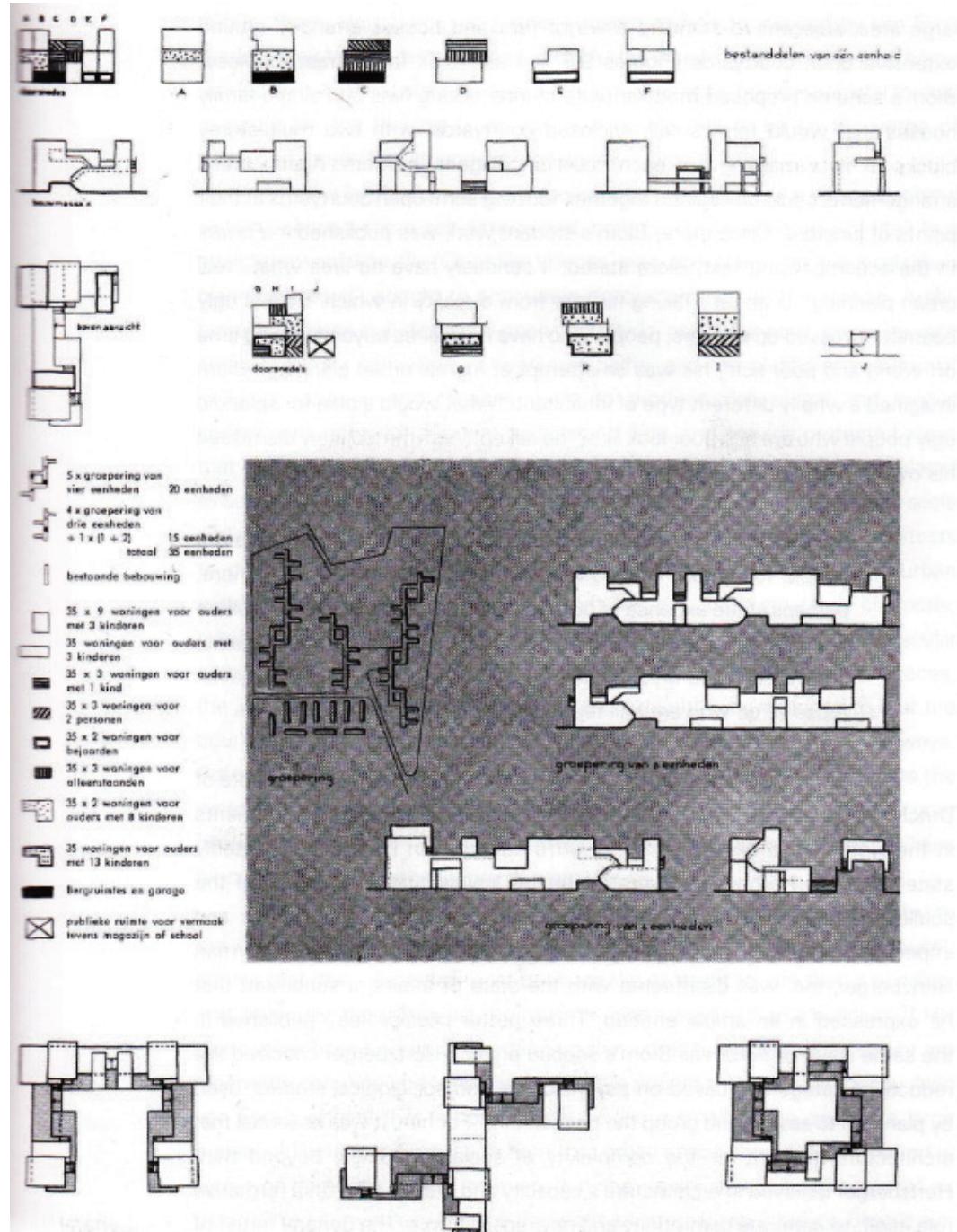


Figure 1.4. Piet Blom's study project "The cities will be Inhabited like Villages" (Forum vol.14 no.7: Piet Blom, 1958)

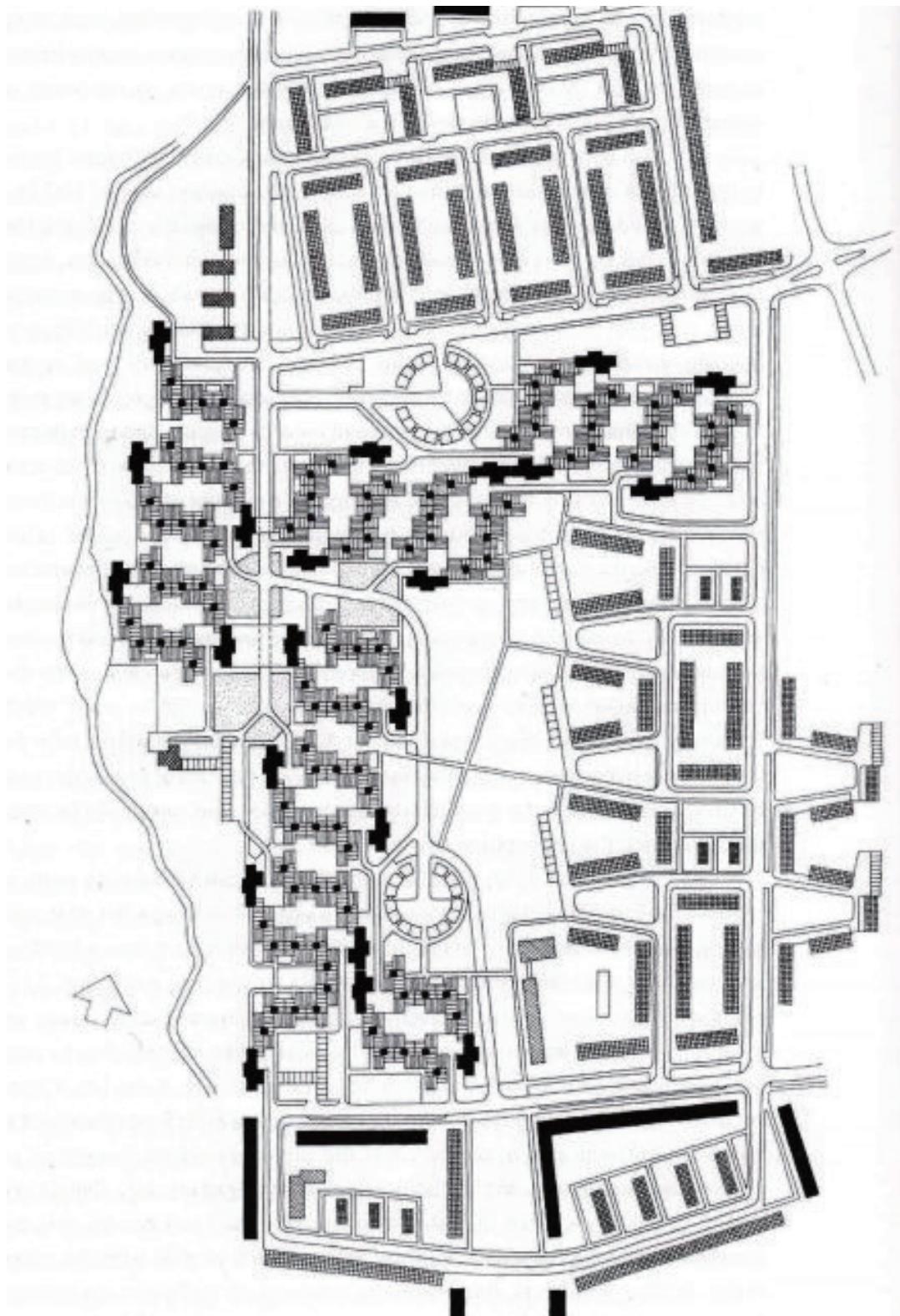


Figure 1.5. Piet Blom's study project "Practical Planning Exercise"
(Forum vol.15 no.5: Piet Blom, 1959.)

Piet Blom's student work (Figure 1.4,1.5) in the late 1950s was consistent with the principles of configuration design. It didn't narrowly divide the interior and exterior of the building. Instead, it shaped the 'in-between' space Aldo van Eyck proposed. There was also no clear separation between private and public space. When dealing with housing on an urban scale, Blom tended to conceive urban components on the ground pattern. Similar patterns were organised as a cluster, and several clusters were gathered as the whole system. To avoid the homogeneity of clustering, Blom introduced the rhythm to integrate these smaller and larger urban components. For example, different building types with the changes in size, form, and connection represented the dynamic rhythms. The spatial complexity was often realised through employing additive, repetitive principles of composition.

However, the Team 10 meeting in 1962 was the starting point of van Eyck and Blom's disagreement in configurative design. At this meeting, van Eyck highly appreciated Piet Blom's student project 'Noah's Ark' (Figure 1.6) as an extreme experiment of configurative design. However, some other Team 10 members expressed their critiques, especially Alison Smithson. Smithson found that the complex interlacing would in practice amount to a pre-programming of all functions and activities and to a generalized control of everyone, which was like 'fascist' (Strauven 2007, 12). Smithson expressed concern about the control power of the configuration in 'Noah's Ark'. When Piet Blom learned of the "fascist" criticism, he destroyed the whole 'Noah's Ark' project. After this meeting, Blom started to reflect on van Eyck's configurative discipline and went his own way.

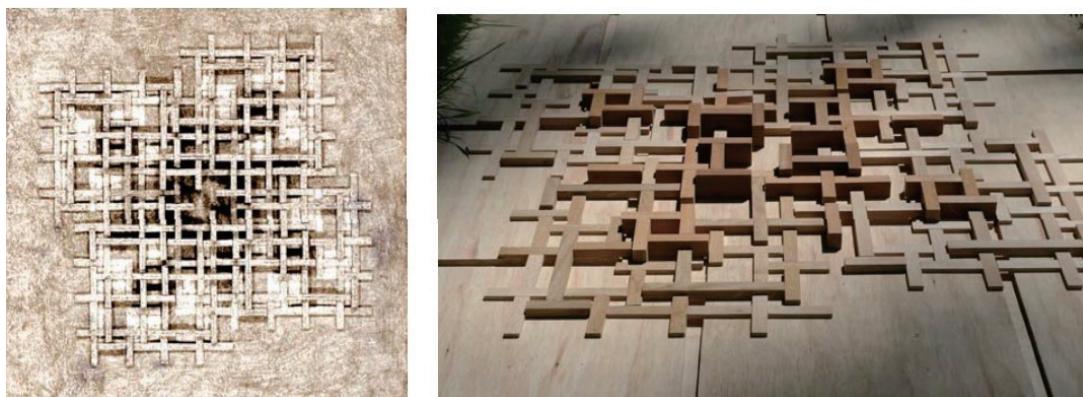


Figure 1.6. Piet Blom's study project "District unit of Noah's Ark"
(Forum: Piet Blom, 1962)

Blom's Noah Ark was a vast urban structure for a million inhabitants. It consisted of two superimposed motifs (Figure 1.8): a centripetal square and a centrifugal pinwheel pattern, which looked like an immense crystalline organism(Ibid.). A centrifugal pinwheel pattern was a block subsystem, holding dwelling houses along the roads and enclosing a central courtyard (Figure 1.7). And multiple blocks were connected and overlapped to fill with the whole urban site. This work showed the genius of imagination and intense rational composition, but at the same time, it fell into the vicious circle of excessive structural solidification. The extreme pursuit of form and aesthetic could constrain the possibility of space and people's behaviour in it.

In the 1960s and 1970s, the configurative approach was further developed by Blom, Hertzberger, and others. The architectural projects and manifestoes gathered in that period were later known as Dutch Structuralism. The original configuration design was more regarded as a hierarchically ordered system through the spatial organisation. Later, Herman Hertzberger developed it into flexibility, which has been known by us today. Oxman (Oxman, Shadar, and Belferman 2002, 323) commented, "*The Forum group's interpretations through precedents and complex geometric structures anticipated the rich architectural potential that would later be realised by themselves and other members of Team 10.*" Piet Blom also applied the configuration discipline in his own way. For him, the core of configuration design was still about the relation and social structure behind the physical structure. It designed the way human interacted with each other, and also how the society worked.

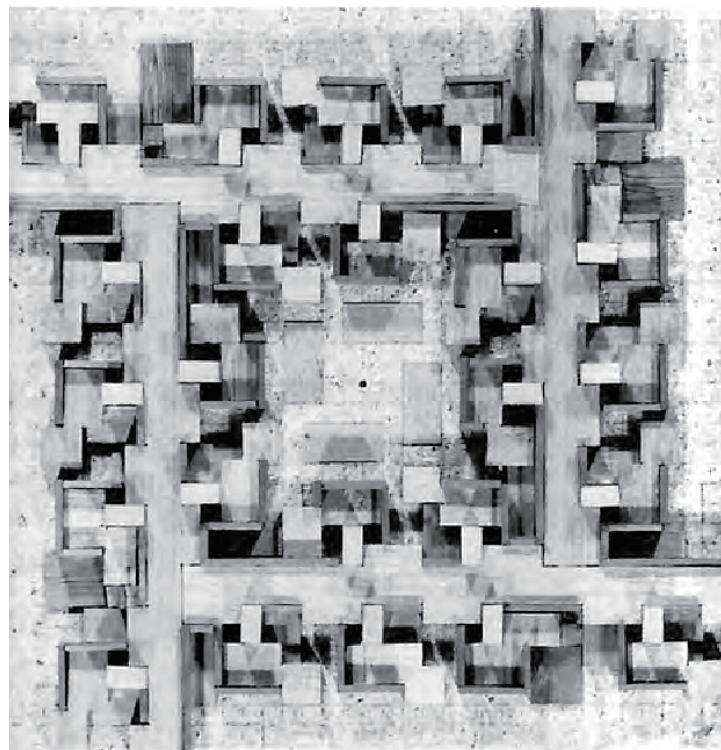


Figure 1.7. Piet Blom's study project "Noah's Ark" with basic unit photography (Forum: Piet Blom, 1962)

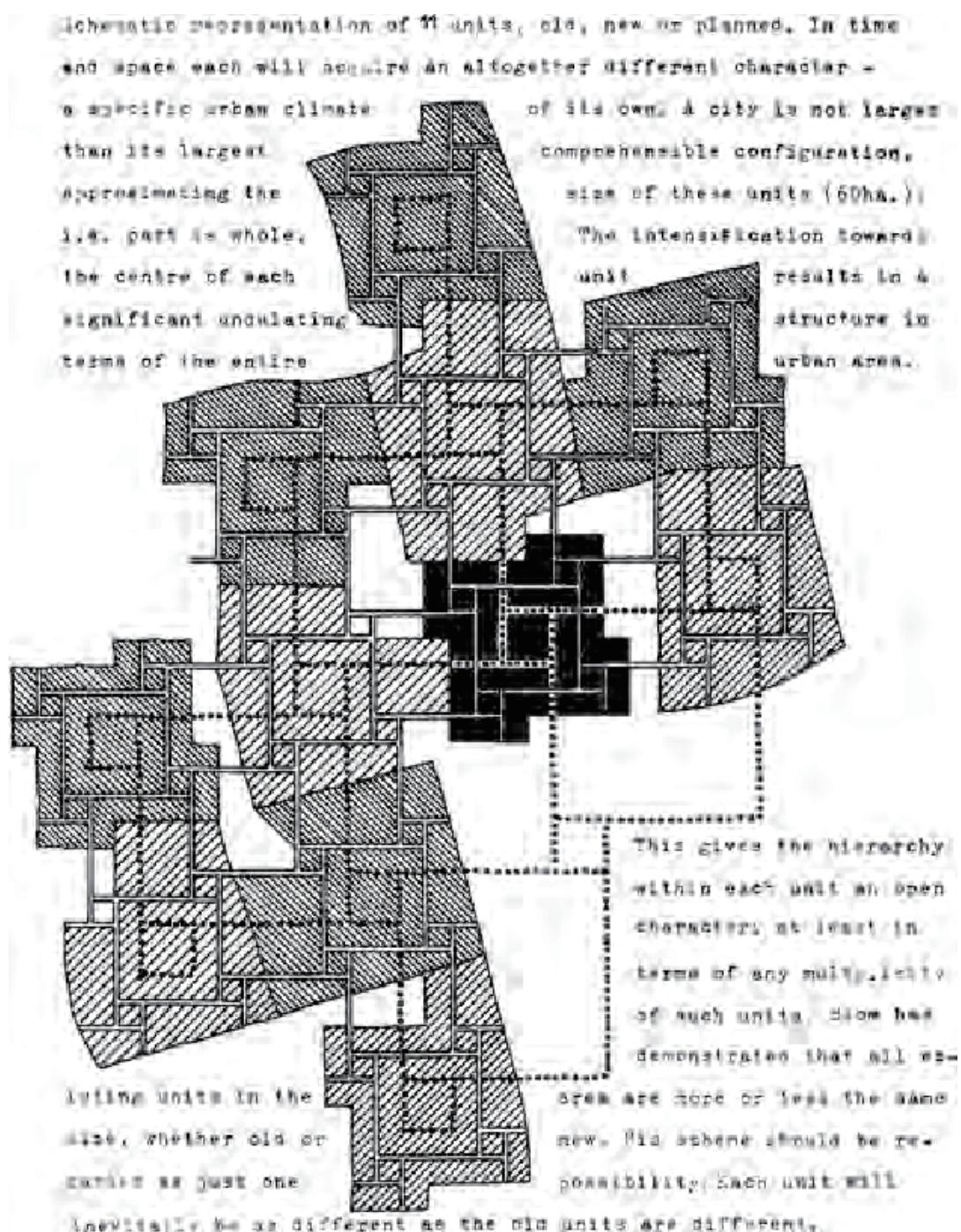


Figure 1.8. Piet Blom's study project "Noah's Ark" with comments
(Forum: Piet Blom, 1962)

1.3 Experimental housing program

After the bombardment of 1940, there was a severe housing shortage in the Netherlands. The Dutch modernist New Building movement was organised in groups like De Stijl, De Opbouw and de 8. The plan was committed to Le Corbusier's functionalist ideals and the CIAM movement (Bianchini and Parkinson 1994, 49-50). However, in the 1950s, the Western population's higher economic level and wellbeing promoted the appearance of new ways of life, which favoured more personalised solutions in contrast to excessive standardisation. (Risselada, and van den Heuvel 2005)

In the late 1960s, with democratisation and socialisation, the public grew dissatisfied with the city centre's overly rigid and rational organisation. The spatial separation of living, traffic, recreation and work functions, as propagated by the CIAM, was considered excessively authoritarian and was rejected (De Vletter 2004, 41-43).

As a result, in 1968, minister Schut introduced the 'experimental housing' program. It appealed for more consideration for individual housing wishes through the smallness of scale and differentiation. Special subsidies were granted to develop new ideas for the home interior, construction, building materials, dwelling forms and layout (*Ibid.*). Sixty-four experimental housing projects were realised between 1968 and 1980. Over 10,000 homes lived in such unique experimental houses. This experimental housing program led to the innovation in public housing and urban renewal in response to the large-scale and monotonous residential areas from the 1950s and 1960s (Barzilay, Ferwerda, and Blom 2018).

The architects proposed great numbers of innovative typologies, space, and living patterns to achieve more humane architecture. Many of their designs were listed as structuralist configuration, which was later known as structuralism. Piet Blom's projects in this experimental housing period were the Kasbah in Hengelo (Figure 1.9) and the Housing Forest in Helmond (Figure 1.10).

In the Kasbah project, Piet Blom realised his idea of "Living as an urban roof", which could be traced back to the configurative design. He wanted to create a vibrant urban environment with the whole roof as one communal space. This idea also influenced the latter project Housing Forest. To combine the cultural and living functions, Blom designed this kind of tree houses with public space at the ground level and living space at the upper level. As Blom said, "For every moment of the day and for every mood, there is a separate

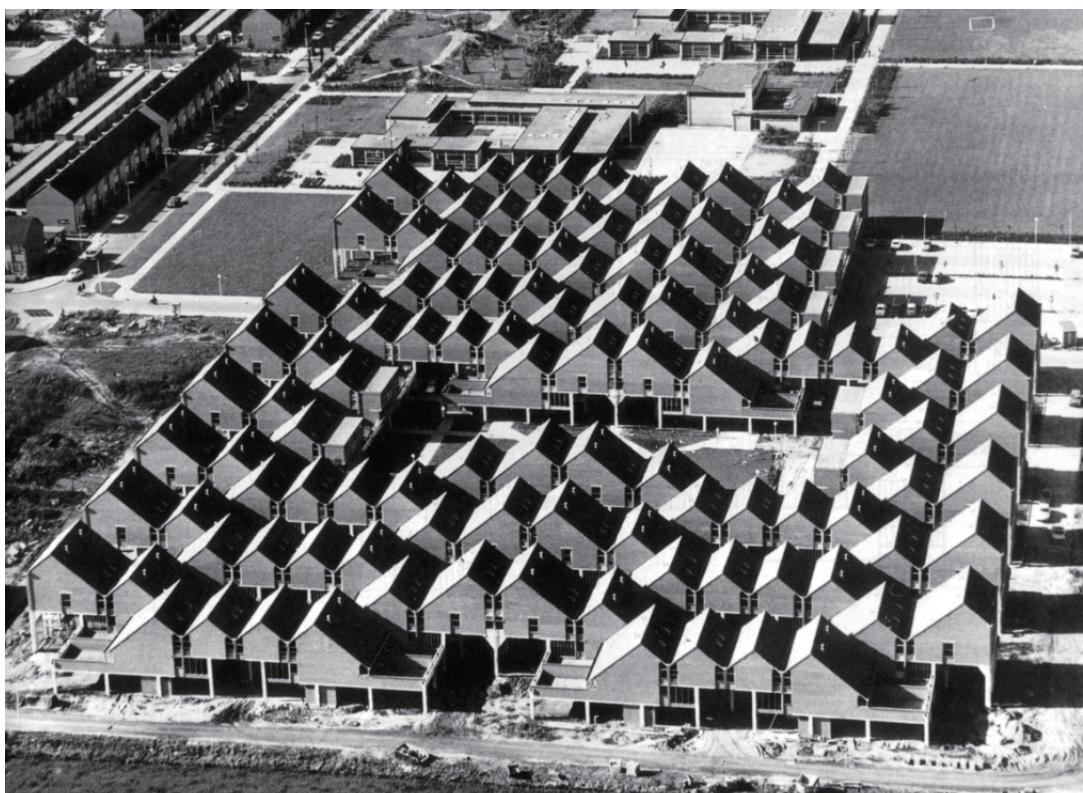


Figure 1.9. Piet Blom's project Kasbah in Hengelo
(News agency C.de Boer, 1973)

level to come to yourself.” Although the experimental housing program ended in 1980, the housing renewal and urban regeneration continued. In 1984, appointed by the Rotterdam government, Piet Blom designed another cube house near the old harbour, which was the main research object of this paper.



Figure 1.10. Piet Blom’s Housing Forest in Helmond
(Rijksdienst voor het Cultureel Erfgoed, 1977)

Chapter 2: Configuration Design in Cube Houses Drawing

Piet Blom's design philosophy was formed when he studied at the Amsterdam Academy of Architecture. During that time, he was influenced by Team 10's 'Habitat' concept, Forum platform, and especially his tutor Van Eyck's configuration discipline. After the 'Noah Ark' event mentioned in the former chapter, Piet Blom began to rethink the configuration design with the geometric aesthetic problems. Herman Hertzberger pointed out that it was Piet Blom who actually succeeded in developing a next step in this new 'configurative' direction in an attempt to solve the issue of the greater number (van den Heuvel 2018). Piet Blom continued the grid, modulus, and axes concepts in configurative design and rethought the balance between the classical aesthetic form and the open social relationship in architecture. The cube house was a typical example of renewal in configuration design for its unique concrete physical form and abstract social form. This chapter aims to analyse Piet Blom's cube house drawings, digging into the innovative topological and social relationship between units, sizes, accesses and layouts.

2.1 Drawings of Cube Houses in Helmond (1972-1978)

The assignment in 1972 for the cube house or known as ‘Housing Forest’ in Helmond, was part of the experimental housing program. The program provided significant support for architects to develop innovative housing ideas. It was also Piet Blom’s first practice of the Cube Houses. Although the design of ‘woonwoud’ (living woods) was not fully realized, large amounts of drawings were left. The drawings provided the opportunity to analyse Blom’s architectural concepts and design methods.

Piet Blom’s design concept was to shape a sense of neighbourhood in the building complex. Public functions were mixed with private dwellings to achieve the diversity in the whole surrounding. To achieve this, he eliminated the separation between cultural space like theatre centre and small dwelling space (Barzilay 2016). After the discussions with local inhabitants and the government, Blom prioritized spending the budget on public facilities to create the whole community. He called the theatre ‘the circus tent’ (*Ibid.*) as the communication and transportation hub. Due to the limited budget and parking adjustment, the dwelling number reduced from 118 in the initial plan to 60 (Figure 2.1). The super cube holding the public theatre was damaged in 2011 due to a large fire, leaving only some tiny cubes.

The cube house in Helmond consisted of three layers: the public space on the ground, the dwelling units in the middle and the outhouse with balconies or small gardens on the top. Piet Blom continued his “living as an urban roof” concept from Kasbah and expanded it into a more layered and vibrant environment. The most eye-catching super cube was the cultural centre with foyers and changing rooms on the ground floor. In this ground layer (Figure 2.2), Piet Blom controlled its plan in a regular hexagon, but the smooth curved walls broke the interior boundary, further blurring the transition areas between indoor and outdoor spaces. The super cube’s side length was 4.5 times of the similar small dwelling cubes surrounded it, forming a logical connection in the configuration pattern. In the middle layer (Figure 2.3), most of the cube units were independent of interference. Moreover, small cubes connected to the super cube formed three public space, providing platforms for communication with the top and bottom. In the top layer (Figure 2.4), the hexagonal unit of the Cube House organized like a crystal duplicating itself. The cubes bit each other on the middle point of the neighbouring 45-degree inclined cube panel. Although the cubes had the same height and orientation, they expanded like biological tissues and created irregular outdoor space, breaking the originally mechanical repetition. The configuration design provided various starring outdoor space surrounded by forest-like cubes.

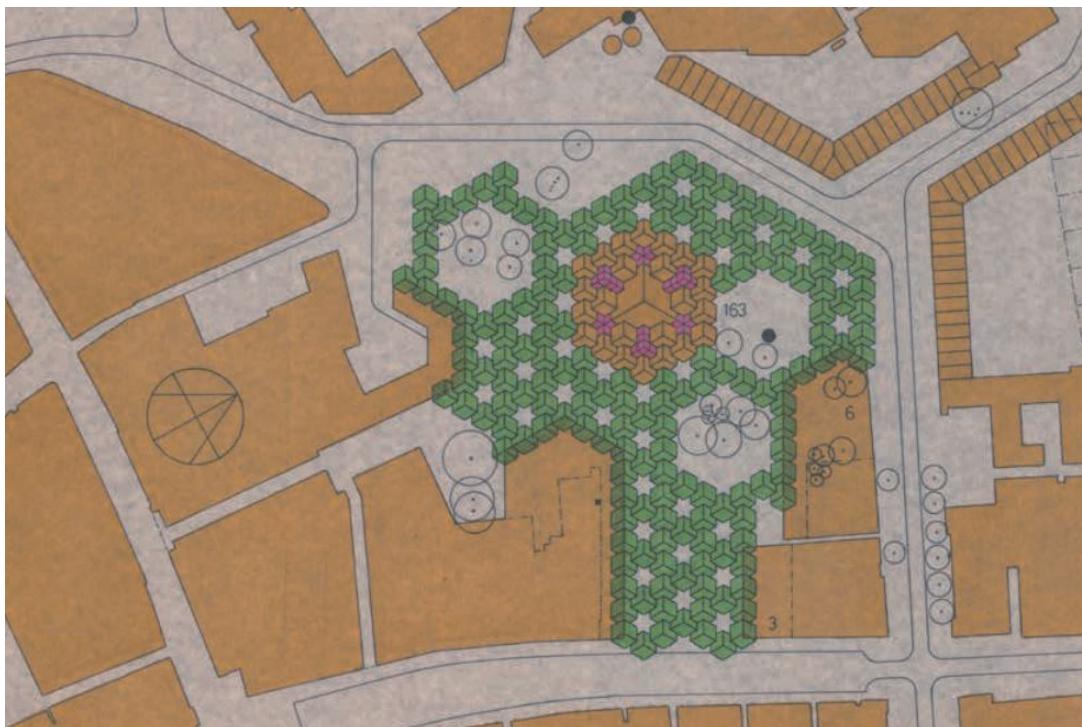


Figure 2.1. Piet Blom's initial site plan of Cube House in Helmond (The New Institute: Piet Blom, 1973-1975), <https://zoeken.hetnieuweinstituut.nl/en/archives/details/BLOM/path/1.1.2>

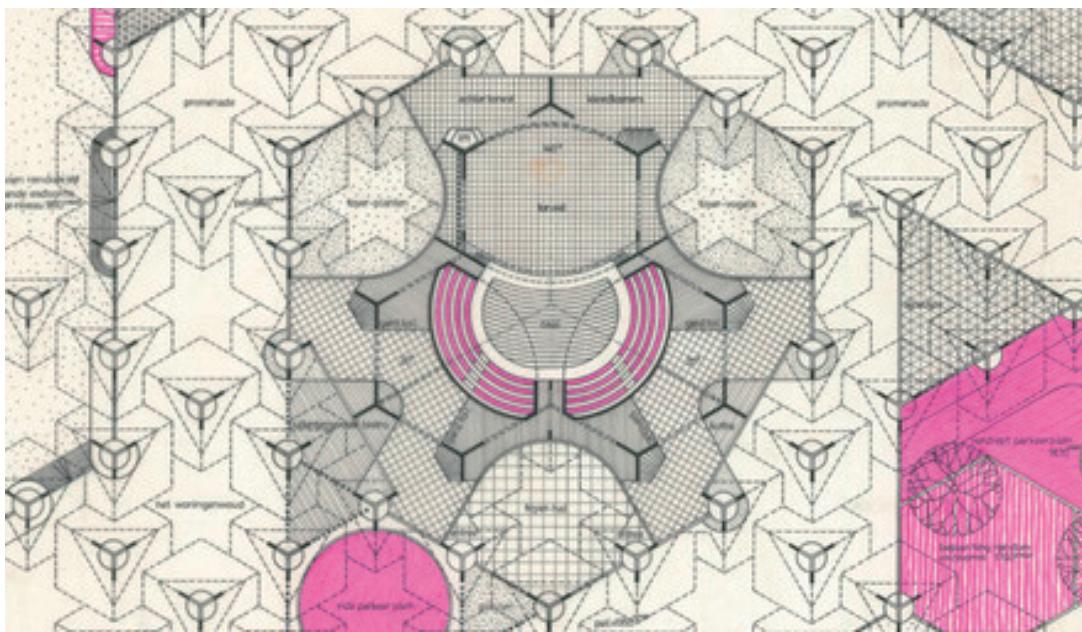


Figure 2.2. Piet Blom's ground floor plan of Cube House in Helmond (The New Institute: Piet Blom, 1973-1975), <https://zoeken.hetnieuweinstituut.nl/en/archives/details/BLOM/path/1.1.2>

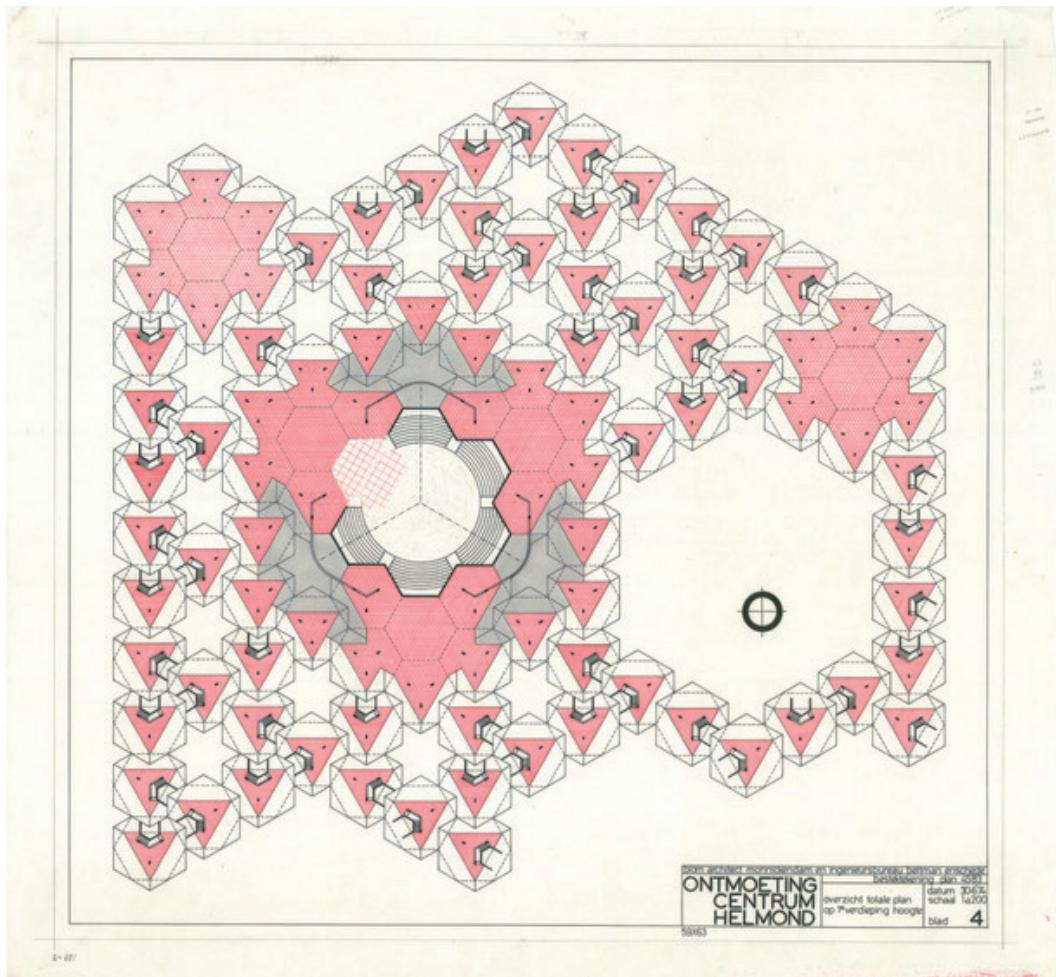


Figure 2.3. Piet Blom's first floor of Cube House in Helmond (The New Institute: Piet Blom, 1973-1975), <https://zoeken.hetnieuweinstituut.nl/en/archives/details/BLOM/path/1.1.2>

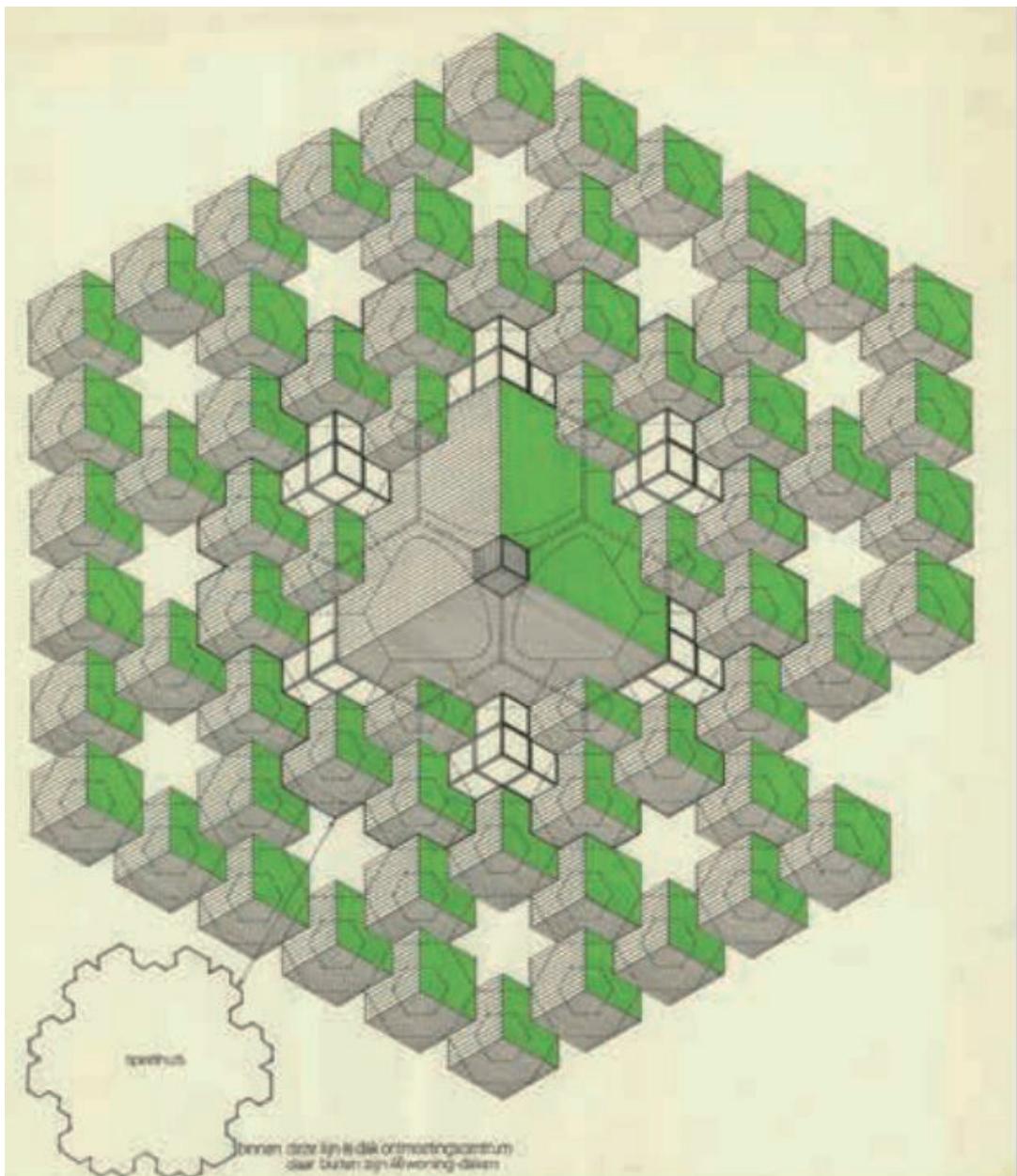


Figure 2.4. Piet Blom's top plan of Cube House in Helmond (The New Institute: Piet Blom, 1973-1975), <https://zoeken.hetnieuweinstituut.nl/en/archives/details/BLOM/path/1.1.2>

For the configuration method, Piet Blom chose similar elements to duplicate, move, and reduce them to form public space and void courtyards. Since the Cube House prototype was tilted, on the one hand, the horizontal sections would change from triangle to hexagon and back to triangle in different heights (Figure 2.5). The floor shape changes would generate more public space on the ground floor and connections on the upper floors when organizing a more extensive configuration or morphology. Blom selectively removed some small cubes near the super cube to create three foyers and others separated outside space. This strategy introduced more semi-public or ‘in-between’ space to break the clear public and private space, thus creating the ‘village’ concept proposed by Piet Blom. On the other hand, the vertical sections increased multiple levels of complexity and spatial richness. The connection between inclined walls and stairs for different height levels were the fundamental problems to be solved. Piet Blom’s intelligence was in using the various irregular space to create a sense of vibrant habitat.

During the design project in Helmond, instead of traditional housing, which distinguished streets, squares, gardens, and houses zones, Piet Blom integrated the urban and architectural functions. It broke the repetitive unit patterns and introduced the richness of the living environment. Blom combined a mathematically designed order and an intuitive and subjective architectural impression (Smit 2018, 100). Unlike the common configuration patterns such as rectangular rotating and overlapping, Blom created some new spatial geometric systems in cube house diagrams, with more complicated spatial organization and community experience. Ellen Smit said, “*Blom entered a different world – that of an individual desire, struggle, communal and sensibility – aimed at communicating his design in a more human and accessible manner*”(Ibid.).

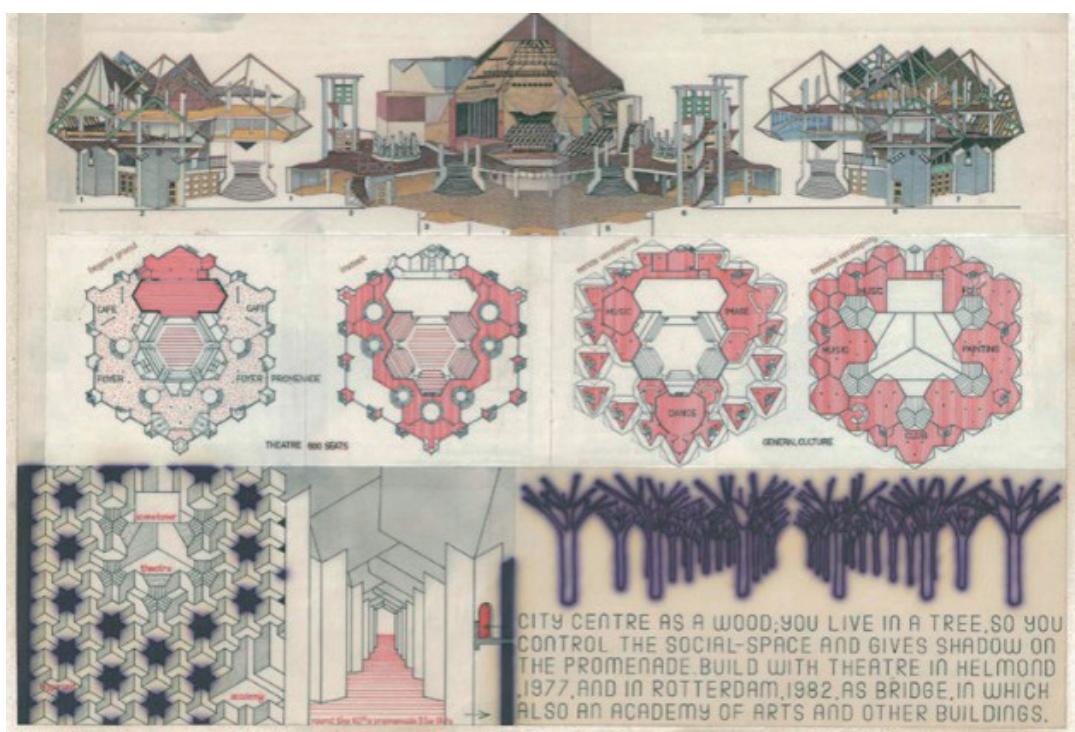


Figure 2.5. Sections and concepts of Cube House in Helmond (The New Institute: Piet Blom, 1973-1975), <https://zoeken.hetnieuweinstituut.nl/en/archives/details/BLOM/path/1.1.2>

2.2 Drawings of Cube Houses Units

Piet Blom's configuration design was not only in the external architectural form but also the inner life. It was reflected through the cube house unit design. The unique form of the unit was a hexagonal concrete column connected with a tilted timber cube. The floors were not regular quadrilateral, and the walls covering the cubes were also not vertical. The irregular layouts challenged the architect's spatial imagination to design unprecedented three-dimensional space on the two-dimensional drawing. The finally presented unconventional space indeed changed residents' accustomed lifestyle, bringing a sense of freshness and new communication possibilities.

In order to expand the public space on the ground floor, Piet Blom reduced the area of the concrete pillars. This strategy brought the complexity of interior circulation. The main circulation between different layers was integrated into the core structure to minimize the space for stairs, and the staircases were arranged in this concrete hexagon. It can be seen that Piet Blom designed a more compact method of rotating the stairs upwards in figure 2.7 than in figure 2.6, which expanded the flexible use space for each floor. In Piet Blom's design, the stairs extended through the interior to the exterior on the ground floor, which blurred the interior's boundary. The exposed one-story stairs made these independent cube units like an inclusive community in the whole environment.

Piet Blom's concept of individual lifestyle was presented in the layout design of different floors. Each cube house's total floor space was around 106m², and it was mainly distributed to three floors. The floor plans continuously changed from triangle to hexagon and triangle, and the floor areas also changed from small to large and then small. This kind of layout was different from commonly rectangular layouts and, to some extent, contained Piet Blom's rebelliousness against the convention. Due to the hexagonal configuration, three radial lines were drawn with an angle of 120 degrees. Along the axes, structural columns were added through each floor, distinguishing the traffic and free space. Piet Blom subdivided the plans into several equilateral triangles and parallelograms. Some parts were separated into private spaces such as bathrooms, and others were combined into public spaces such as living rooms. The walls sloped outward in the lower floors and inward in the higher floors also influenced Piet Blom's layouts. Piet Blom placed the open kitchen and living room on the lower floor, where the outwardly inclined window was the best intermediary to communicate with the outdoor environment. The distinction between each floor's function and life vision corresponded precisely to the layered life Piet Blom proposed.

The compact configuration in the cube unit shows Piet Blom's talent for organizing complex physical space and conceiving innovative lifestyles. The drawings showed the experiment for people's ordinary life, responding to the experimental housing program. The characteristic of superstructure extended from outside to inside as one whole inter-locking design.

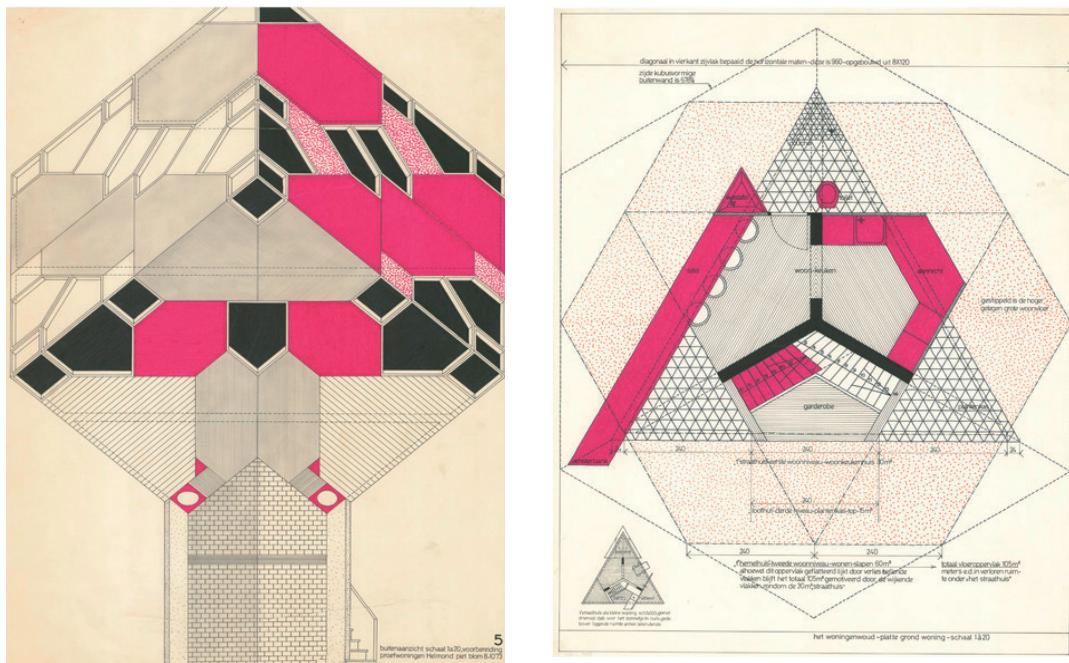


Figure 2.6. Piet Blom's Cube House unit in Helmond (The New Institute: Piet Blom, 1974-1976),
<https://zoeken.hetnieuweinstituut.nl/en/archives/details/BLOM/path/1.1.2>

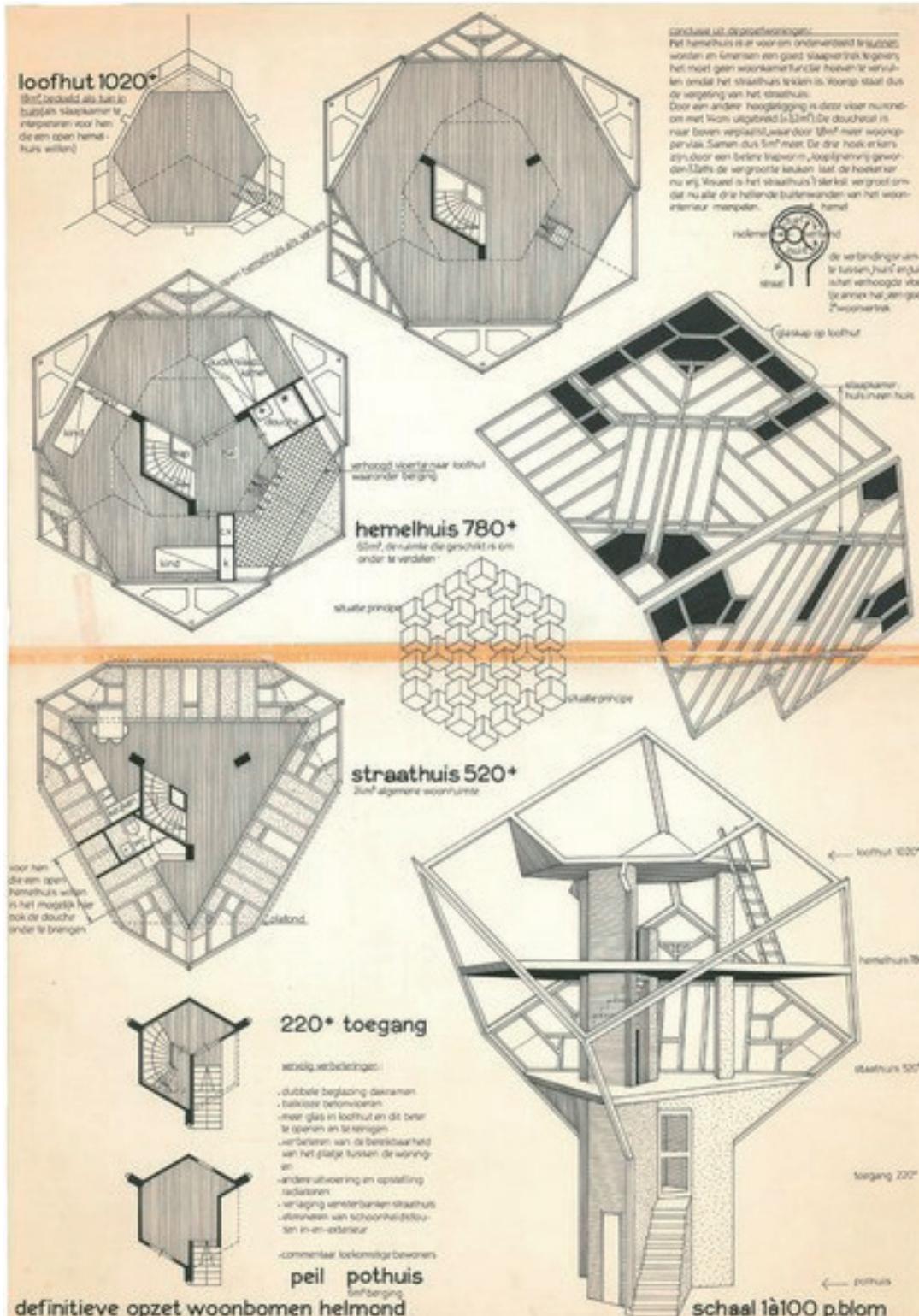


Figure 2.7. Piet Blom's Cube House unit diagram in Helmond (The New Institute: Piet Blom, 1974-1976), <https://zoeken.hetnieuweinstituut.nl/en/archives/details/BLOM/path/1.1.2>

Chapter 3: Cube Houses Project in Rotterdam

The cube house in Rotterdam, also known as the Blaak Forest, was Piet Blom's second cube house project. Since only a few parts of Blom's scheme were realised in Helmond, this Rotterdam project was a more successfully grounded practice and a more controversial one. The cube house was not considered as a typical structuralist architecture. As Wim J.van Heuvel commented in Structuralism in Dutch Architecture, "Although the tilted dwelling forms form a configuration with each other, the design cannot be called structuralist because of the lack of a space-structuring construction and the not very flexible layout of the dwellings; the multiple land use is only fragmentarily applied here." (Van Heuvel 1992, 24) However, it was worth noting that the term 'Structuralism' was introduced by Herman Hertzberger in 1966, and the similar topic projects from the 1959-1980 period were gradually gathered under this label. So, Piet Blom's cube house may be seen as one development direction of early structuralism. It was related to Aldo van Eyck's social structures instead of the open and flexible concepts emphasized by Hertzberger. This chapter will analyse both the structural openness and social openness of the cube house.

This chapter mainly discusses the openness assessment of the Cube House structure, the in-depth analysis of the space, and the complex's overall atmosphere based on the field research. These three discussions attempt to present the relationship between architectural structure, spatial organization and human experience. It helps reveal whether Piet Blom's configuration design promoted the 'Habitat' concept and residents' acceptance.

3.1 Structure of Cube Houses

In the late 1970s, Blom received a government commission for a large-scale housing project, connecting the library with the old harbour dock. The design (Figure 3.1) needed to avoid the broad highway and provide dwellings and easy access for residents. To cross the highway, Piet Blom designed the bridge with the edges spaces for small shops, boutiques, bars and restaurants(Van Heuvel 1992, 24). Visitors could also walk through the cube house forest from the market to the old harbour. The cube forest created an organic urban living environment for this urban renewal program.

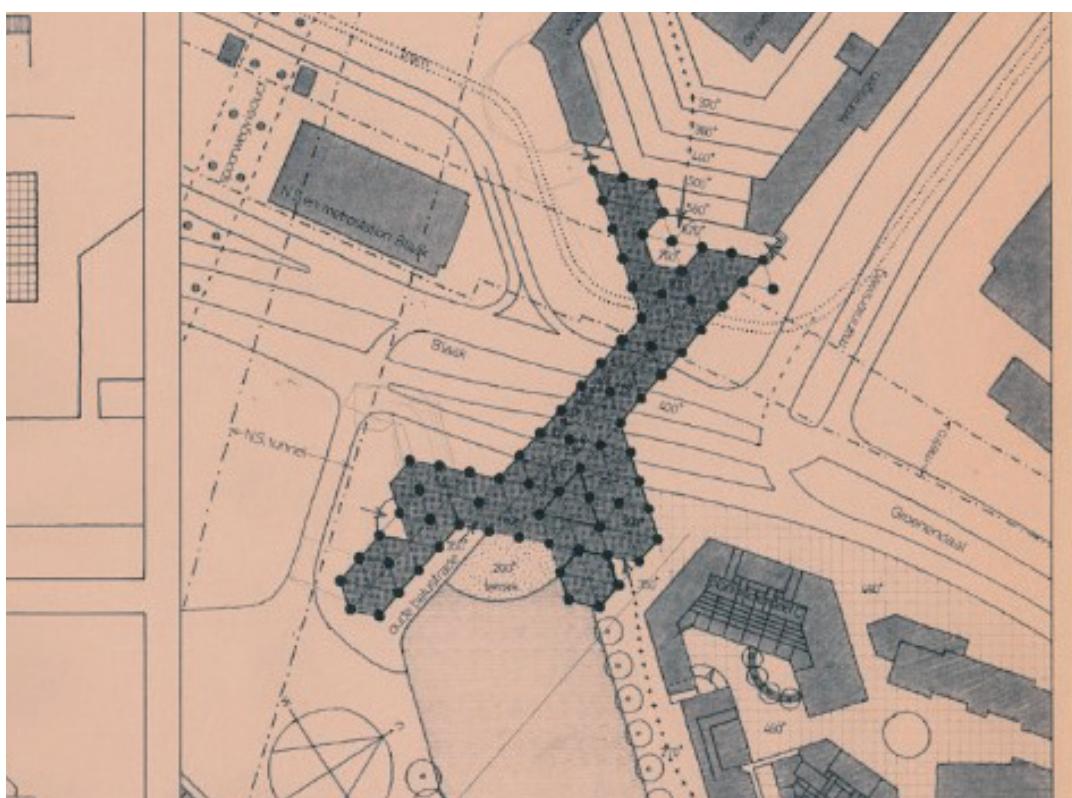


Figure 3.1. Booklet of urban renewal in Rotterdam centre (Koningsdam, 1978-1984)

The construction of the cube house in Rotterdam (Figure 3.2, 3.3) was mainly on-site rather than prefabricated because of the particularity of the structure and site situation. The bridges with floors and columns were made of reinforced concrete. The structure was like a honeycomb, enhancing its stability. The total gross floor area was about 20,000m².

Three concrete columns supported the concrete floors in a triangular arrangement. The connected floor slabs were built in hexagons, and others were built in separated triangles. Due to the floors' irregular shape, it had little latent to become an open and flexible structure, as some architects criticized. Compared with Hertzberger's Centraal Beheer Apeldoorn, Cube House's structure was unlike the repetition of rectangular plans, which had the possibility of redefinition and expansion. It was a set of fixed systems and contained Piet Blom's ideas of typical social structure.



Figure 3.2. Concrete core structure of cube house in Rotterdam (Kijk-Kubus Museum, 1982-1984),
<https://www.kubuswoning.nl/archief.html>



Figure 3.3. Concrete floors of cube house in Rotterdam (Kijk-Kubus Museum, 1982-1984), <https://www.kubuswoning.nl/archief.html>

The skeletons of 38 cube houses were made of fir (Figure 3.4, 3.5). They were installed after the completion of the concrete structure. 18mm thick plywood was stuck outside of the skeleton. The whole texture of wood gave the whole site a sense of life, as if the cubes like forests could naturally interact, grow and adapt to society. The scattered windows on wood skeletons provided various opportunities for sunlight, ventilation. Besides these physical requirements, the windows facing down provided communication with residents in outdoor atriums, and the skylight windows provided the possibility of dialogue with the whole city.

Although the cube house's physical structure was a closed system, since it was difficult to change the cube's size, location and orientation once it was built. However, the spatial and social structure of the cube house was an open system: the courtyard relationship and the communication between inside and outside were full of possibilities and variability.



Figure 3.4. Timber courtyard of cube house in Rotterdam, (Kijk-Kubus Museum, 1982-1984),
<https://www.kubuswoning.nl/archief.html>



Figure 3.5. Timber structure of cube house in Rotterdam, (Kijk-Kubus Museum, 1982-1984), <https://www.kubuswoning.nl/archief.html>

3.2 Space Analysis of Cube Houses

The configuration strategy in Rotterdam was similar to the one in Helmond. Thirty-eight tilted cube houses held the main residential space and two super ones included 1050m² commercial space and 2200 m² business space. The only significant difference was that it added a traffic space layer for cars under the bridge than the former triple-layered space (Figure 3.6). The height change of floors erected by the bridge brought more unexpected space experience in the entrance. The information on configuration design could refer to the previous chapter. Here, the spatial depth and relationship would be analysed.

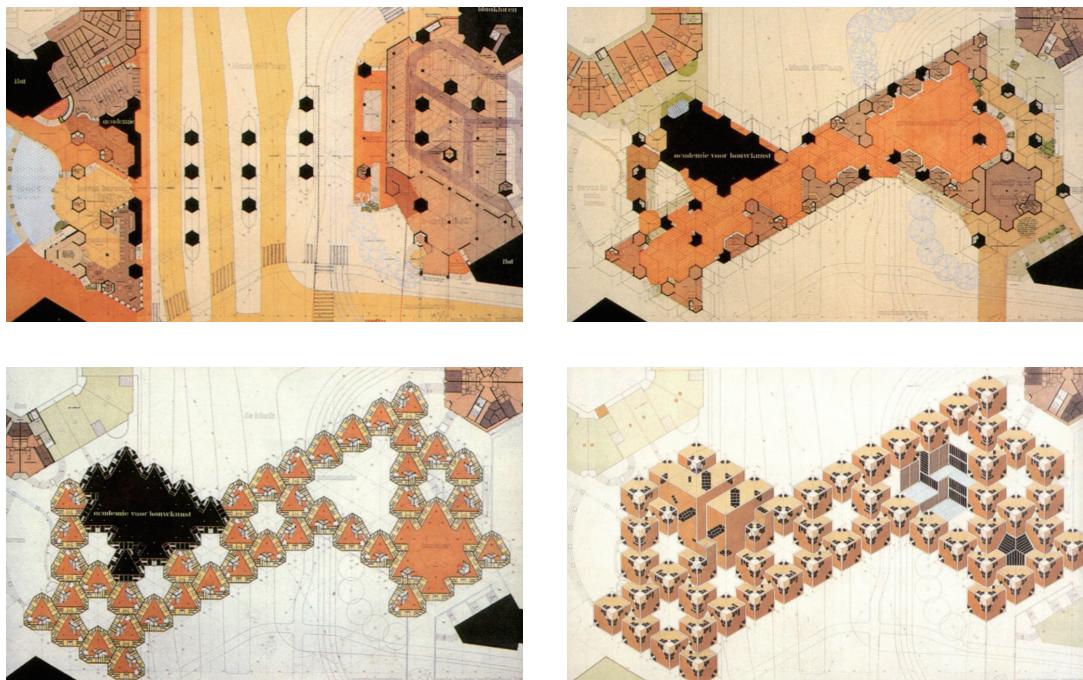


Figure 3.6. Floor plans of cube house in Rotterdam (Piet Blom, 1978-1984. ArchDaily accessed April 8, 2021 <https://www.archdaily.com/482339/ad-classics-kubuswoningen-piet-blom>)

To analyse spatial network's effectiveness and diversity in cube house, the method of spatial configuration (Nourian 2016, 31) has been used here. As Nourian said, "We aim at developing indicators that clearly refer to physical quantities such as probability of presence of people, closeness to some points of interest in the sense of temporal distance." (Ibid.) This method could reveal the spatial relationship between these cubes, such as the probability of social encounter and the efficiency of the outdoor atrium. The spaces of the cube houses are abstracted and connected as a network. The lines shown in Figure 24 mean the two spaces can reach each other. The spatial network could be used to simulate the patterns of movement in the whole buildings.

The result (Figure 3.7, 3.8) shows that the outdoor atriums are the most prominent parts of this building complex. They occupy large areas and are connected to keep the main circulation from the market to the old harbour. The small residential cube units were surrounded these atriums and gathered in a cluster of three. The units both shared the public space in the cluster and the outdoor atriums.

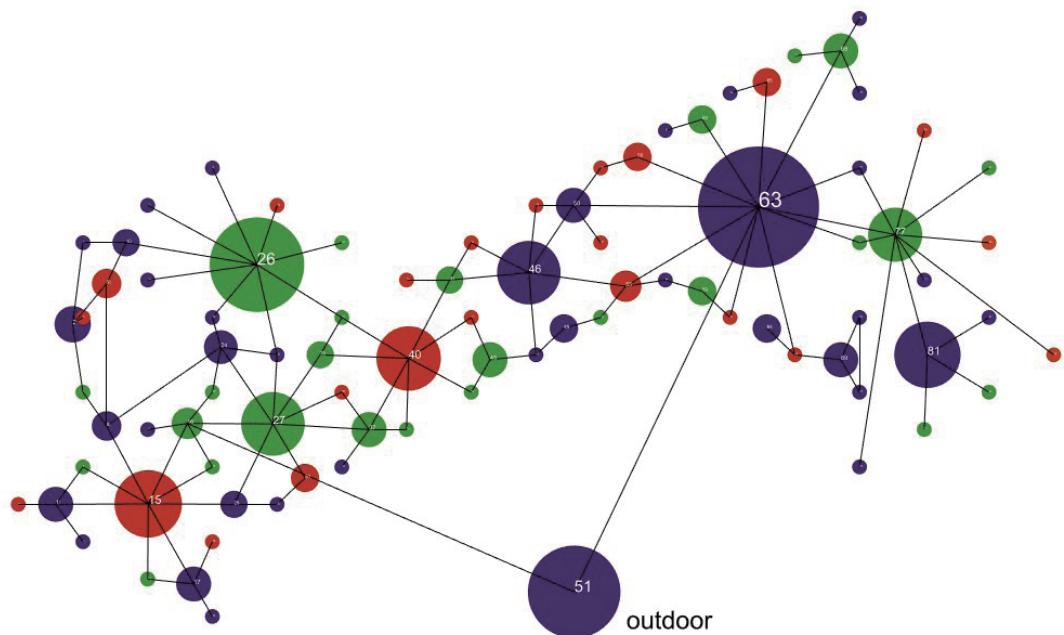


Figure 3.7. Spatial network analysis of cube house in Rotterdam.

Based on the spatial network diagram, the spatial depth (Figure 3.8) is calculated. Space depth is a common tool for evaluating spatial accessibility in the architectural and urban study. In Cube House, it takes the entrance as the starting point where depth is equal to 0. Most of the space could be reached within five spatial depth, which shows high accessibility. And more than half space could be reached within three spatial depth. This also means that the spatial configuration has a certain degree of flexibility.

The whole building is not a combination of the common corridors and units but a more organic and living organism-like environment. There are no typical corridors just for walking. The outdoor corridors are integrated with the courtyards, and the interior ones are changed into hybrid space like small shops and painting space. It largely forms the current organic spatial network.

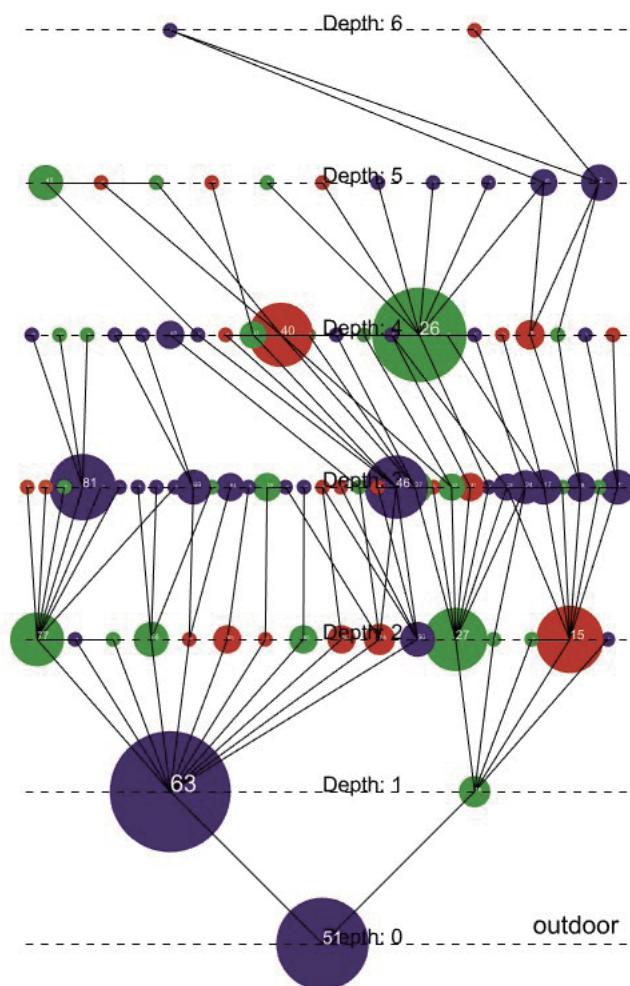


Figure 3.8. Spatial depth analysis of cube house in Rotterdam

3.3 Social Openness of Cube Houses

If the former spatial analysis is more inclined to the designer's intention, this part of social openness analysis based on field research focuses on people's actual movement patterns and spatial experience in this complex architecture.

Through the field research, cube house is highly recognizable by their vivid structures, the composition of small units, and a spatial organization like a city. The way it connects the city is like what Aldo van Eyck proposed to repair the original urban fabric with streets, alleys and building lines. The Cube House complex provides a perfect path for visitors to visit the harbour from the market. The entrance near the market and library appeals to visitors to walk into this cube forest. The sloped stairs in the entrance to harbour (Figure 3.9) and the cube's changing height provide a comfortable feeling of being in nature.



Figure 3.9. Entrance of cube house in Rotterdam (ArchDaily accessed April 8, 2021 <https://www.archdaily.com/482339/ad-classics-kubuswoningen-piet-blom>)

The outdoor atriums (Figure 3.10) surrounded by tiny cube houses are the most popular space. Considering that the on-site investigation was during the lockdown period due to Covid, the activities like painting workshops, shopping, and exhibitions were closed. Plants are put in the middle of the atrium to increase the sense of nature. Visitors are willing to stay and talk with others for a while, feeling the sunlight through the cubes. The cube unit's windows on the downward panels provided residents to observe the external space, and at the same time, visitors can vaguely see what is happening inside from the outside. The void space between the concrete columns is enveloped by the glass, which provides good lighting and communication with the outside city. The total courtyard atmosphere is bright and comfortable.



Figure 3.10. Site visit of outdoor atriums in cube house in Rotterdam.

Most cubes have changed their functions into museums, shops and hotels. For example, the super cube has been renovated into a youth hotel. A new elevator has been installed inside, and the rooms were re-divided to meet the needs of multi-person rooms. This also shows the adaptability of the inner space. In the rooms, sloping walls and unconventional window force occupants to adopt a creative approach to furnishing (Figure 3.11). Curtains are installed in an innovative way to deal with the tilt problem. From the windows, it is clear to see the outside road, market and the old harbour from different orientations, which connect to the city to some extent.

Piet Blom's Cube House in Rotterdam influences people's movement in the city centre. It creates an urban forest among various buildings. It is like habitat in the city, bringing a sense of calm and natural intimacy. People walking in it can feel the natural skylight sprinkled by the wood-like roof, and those living in it can experience an unusual living experience.



Figure 3.11. The interior room of the super house in Rotterdam.

Conclusion

As a controversial architect in the structuralism movement, Piet Blom expanded the concept of 'habitat' through architectural projects. His design philosophy was to dissolve the boundary between architecture and city, making the space inhabited like villages. To achieve his architecture philosophy, Blom used his spatial configuration talent to imagine human's communication patterns in space and build a particular social structure. Although he learned configuration design method from Aldo van Eyck, he jumped out of van Eyck's obsession with aesthetic numbers and reflected on the limits of what architecture can do in a social sense. Compared with other structuralists in the 1960s and 1970s, Piet Blom paid attention to the construction of the units and the relationship between them, and the relationship was not limited to the two-dimensional aesthetic theory but the perception and creation of the three-dimensional space.

Piet Blom designed the whole internal social structure to create a sense of community. As Piet Blom's representative work, the cube house was born in the period of Dutch Structuralism exploration. Due to the experimental housing program's promotion, Piet Blom and other structuralists had much freedom in designing innovative living patterns. However, the cube house was different from the evaluations such as open structure and flexibility, which the structuralist critics emphasised nowadays. The cube house had a fixed structural pattern, but the spatial configuration design was open and accessible. The cluster of units and the continuity of public space shaped the compact space social network in various ways. This kind of openness could also apply to the internal social structure. Piet Blom creates a sense of community in cube houses to demonstrate his concept of habitation. To some extent, Piet Blom's cube house expanded the boundary of structuralism. Its space design still has reference value for today's architectural design.

To conclude, Piet Blom's drawings reveal the unique cultural structure behind the physical architecture. He succeeded to convert this configuration design into a brand-new topological relationship of human's actual living ways. The Cube House series redefine the space pattern from units to urban spatiality, creating new habitat. These all bring new interpretation possibilities to Dutch Structuralism.

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