

EXPLORING THE POSSIBILITIES FOR CONTEXT-SPECIFIC INDUSTRIAL HOUSING THROUGH SPECIFICITY AND REPETITION

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ABSTRACT

This paper investigates the dichotomy between specificity and repetition in the architecture of housing projects to find a strategy for designing context-specific industrial housing. A case study of context-specific housing projects within the Netherlands, supported by the theory of Critical Regionalism, forms a list of rules for designing context-specific housing. The findings are categorised into four categories: tectonics, place-form, the fabric of the site and the tactile. A case study of wooden prefabricated industrial housing is used to form a list of prefabrication methods for designing industrial housing. Out of the projects, six methods are identified that combine 1D, 2D or 3D modules or a combination of (some of) the three. These methods can be used to redesign context-specific housing projects with repeating prefabricated modules, showing that prefabricated modules can convey context-specific design elements.

KEYWORDS

Context-specific housing, Critical Regionalism, Industrial housing, Repetition.

1. INTRODUCTION

Industrially produced homes offer a more sustainable way of building and will be able to increase the building stock and thus reduce the housing shortage more quickly. The prefabrication shortens the construction process by 50%, reducing CO2 emissions from the construction process by 40% and waste production by 50%. (Bertram et al., 2019) However, the primary concern of this process is that these industrial houses are being designed and developed without a context. The context is chosen only on the availability of a vacant site. The industrial production process also means that the houses only have to be designed once; the efficiency of the industrial process lies partly within the ability to repeat a particular design. (Julia de Ruiter and Martin Koning, 2023) This repetition helps with the production methods, and going through the design process once also helps reduce the cost of houses. We risk, however, that by rapidly expanding the housing stock through this process, industrial housing will create a repetitive and serial urban quality. This phenomenon already occurred during the first impulse of the industrialisation of the construction process in the 1970s. Kenneth Frampton criticised this in 1983 in his essay on Critical Regionalism. Frampton wrote critically of the universalisation that results from the optimisation of architecture through industrialisation and, in contrast, pushes for an architecture formed out of the peculiarities of the site. (Frampton, 1983)

By investigating the dichotomy between specificity and repetition in architecture, this paper aims to find a strategy for designing context-specific industrial housing using prefabrication techniques. It is hypothesised that investigating the design rules for specificity through context and the rules regarding repetition through prefabrication can formulate a strategy for designing context-specific industrial housing.

This paper will first explore how a case study of context-specific housing projects in The Netherlands can visualise the theory of Critical Regionalism. Then, it will give insight into which architectural components can be identified as elements of repetition through a case study of industrial housing projects. Lastly, this paper answers how these elements of repetition can be used to follow the design strategies of context-specific architecture.

2. METHODOLOGY

The main question answered in this paper is as follows. How can the dichotomy between specificity and repetition in architecture open the opportunity for designing context-specific industrial housing? Two case studies are conducted to answer this central question. The first case study answers the first sub-question: How can context-specific housing projects in the Netherlands visualise the theory of Critical Regionalism into design strategies? Three context-specific housing projects within the Netherlands are analysed using the theory of Critical Regionalism formulated by Kenneth Frampton. The second case

study includes six industrially produced housing projects; these projects are analysed to answer the second sub-question: Which architectural components of industrial housing projects can be identified as elements of repetition? The projects, with different industrial production methods, are dissected into elements of repetition, and how these elements repeat throughout is analysed. The findings of these two case studies are used to answer the final sub-question: How can the elements of repetition of industrial architecture be used to achieve the design strategies of context-specific architecture?

3. DESIGN RULES OF SPECIFICITY

This chapter answers the question: How can context-specific housing projects in the Netherlands visualise the theory of Critical Regionalism into design strategies? The theory of Critical Regionalism is used to give insight into the approach of designing context-specific architecture, this theory is outlined in Kenneth Frampton's essay *Towards a Critical Regionalism*. By analysing three case studies, Critical Regionalism is visualised by a list of design strategies, which form a list of design rules for context-specificity. The case studies are selected on the prerequisites of being designed with a contextual dialogue, located within The Netherlands, and all with a different housing typology.

The projects analysed are the apartment building Spaarndammerhart in Amsterdam designed by Korth Tielens architecten and Marcel Lok_architect, Punt Komma in Den Haag, a portiekflat designed by Alvaro Siza, and Engelse Park in Groningen, a row housing project designed by Bedaux de Brouwer.

3.1 The Theory of Critical Regionalism

Critical Regionalism was born out of the desire to push against the dehumanising aspects of modernisation and the kitsch of post-modernism. (Canizaro, 2007) It is a counter-current to the placelessness in architecture that is caused by mass culture while at the same time resisting the recreation of vernacular and historic architecture. The term was first described by Liane Lefaivre and Alex Tzonis in 1981 in their essay *The Grid and the Pathway*, but more famously explained by Kenneth Frampton. In his essay, Frampton defines Critical Regionalism as resisting the universalisation of architecture by designing with the elements arising indirectly from the peculiarities of the place. (Frampton, 1983)

Kenneth Frampton starts *Towards a Critical Regionalism* with a quote from philosopher Paul Ricoeur, taken from his book *History and Truth*, published in 1955. This quote explains the phenomenon of universalisation. Stating that modernisation is creating a civilisation of mediocrity, gradually making the great civilisations of the past wear away. The quote ends on this paradox: 'How to become modern and return to sources; how to revive an old, dormant civilisation and take part in universal civilisation.' (Frampton, 1983, p. 1) Frampton's six points reflect on this paradox from an architectural and urban standpoint.

With the first two points Frampton makes, he explains the contextual and cultural framework of the modern and industrial architecture, which he criticises. The first point is titled Culture and Civilization. Frampton starts this point by stating that modern buildings are now universally conditioned by optimised technology, limiting the possibility of creating significant urban forms. Modern architecture is shaped by its ways of production. This 'high-tech' approach forces restrictions through automotive distribution and interventions led by production limitations. Then, to cover up this systematic approach, the façade functions as a superficial veil hiding the reality of a universal system. In point two, The Rise and Fall of the Avant-Garde, Frampton describes the history of avant-garde in architecture. Philosopher Herbert Marcuse explained the fall of the avant-garde in his book *One-Dimensional Man*, in which he states that when the universal form of production is formed by technics, it limits culture.

It is in point three, Critical Regionalism and World Culture, where the definition of Critical Regionalism becomes apparent. At the beginning of the paragraph, Frampton explains that architecture can only create a resistant, identity-giving culture and use universal technology from an *arrière-garde* position by distancing itself from the optimisation of technology and nostalgic historicism. Critical Regionalism can achieve this through elements taken indirectly from the peculiarities of the place, taking inspiration from things such as the topography, local light or the tectonics of a structure. The intervention of universal technique can be done by introducing limits to the optimisation of technology.

Point four is named The Resistance of the Place-Form. The modernistic urban planning strategy reduces city planning to look mainly at the allocation of land use and the logistical distribution through the city. This results in a phenomenon of universal placelessness. Frampton uses the philosophy of Martin Heidegger to advocate for a certain place-form in architecture. The here-mentioned place relies on clearly defined boundaries; the boundaries are meant to be the place from which elements begin to appear. These elements can then be used to form the architecture. Frampton gives the example of the

well-known perimeter block, from which introspective typologies such as the galleria, the atrium and the forecourt can be formed.

In point five, Critical Regionalism becomes tangible. Frampton starts by giving a necessary quality of Critical Regionalism; the architecture needs to have a more dialectical relationship with nature. He starts by explaining this dialectical relationship between nature and the site. Absolute placelessness in architecture is created by bulldozing an irregular topography into a flat landscape; in contrast, this topography can be used within the architecture to create a sense of cultivating the site. The topography can reflect the history of the site, and, in this way, history becomes inscribed into the building. This way of handling pre-existing topography can also be applied to existing urban fabrics, climate conditions and local light. Lastly, tectonics is named a primary principle of architectural autonomy, using the load-borne and bearing forces to indicate a structural poetry in contrast to the re-presentation of a facade.

The last point, number six, is titled The Visual Versus the Tactile. Critical Regional architecture should be read through senses other than sight alone. These complementary senses include light intensity, the feelings of temperature and humidity, the body's momentum or the sound of footsteps. Addressing these tactile perceptions counters the tendency to interpret the environment only visually. The combination of the tactile and the tectonic can surpass the appearance of the technical.

3.2 Critical Regionalism within Dutch housing projects

The first case study analysed through the theory of Critical Regionalism is Spaarndammerhart. The first element of Critical Regionalism integrated into the design of the housing complex is returning to a former urban fabric; this idea can also be found in point 5 of Frampton's essay. The original street within the neighbourhood was lost with the construction of the Spaarndammerschool in the 70s. (Geo-informatie Amsterdam, 1997) The newly built housing complex returns the two façades on the street sides. (Dienst der Publieke Werken, 1922) This is visualised in Attachment 1. Another urban aspect taken from the context and added into the design of Spaarndammerhart is the addition of a courtyard typology within the neighbourhood. Frampton discusses this in point 4, where he explains that introspective types of urban forms can be used to create Critical Regional architecture. The courtyard typology can be seen as an introspective typology of the surrounding perimeter blocks.

The façades of the housing complex are designed according to the local architecture style of the Amsterdamse School. (Marcel Lok_Architect, n.d.) The design of Spaarndammerhart incorporates characteristics of the early 1900s architectural style by using entrance gates, contrasting brick colours, alternating brickwork masonry, waving façades, strong horizontal orientation and the incorporation of typographical styles into the architecture. The expressive use of the brick in these different ways of brickwork expressions can be tied to point 3 of the essay, where Frampton discusses finding inspiration from tectonics derived from a peculiar structural mode. The analysis of these is shown in Attachment 2. The contrast in tactile finishes from the bricks within the courtyard and the outer facade can be related to what Frampton calls, in point 6, to initiate the impulse to touch, addressing another sense of the body besides sight.

The second case study analysed is the project Punt Komma. The first use of contextual influence in the architecture of the building is the use of the *Haagse portiek*. A housing typology that emerged at the beginning of the 20th century, based on the traditional Dutch upstairs-downstairs house, was then adapted so that each house had a separate front door with direct access to the public street. ("Typologie van portiekwoningen," n.d.) This can be tied to point 4 of Critical Regionalism, where Frampton discusses the place-form. The Haags portiek can be used as an element that can define the boundary to create an architecture of resistance, elaborated upon in Attachment 3.

Another context-specific element of the architecture that can be identified is the indenting corner of the housing block. This can be seen in some of the surrounding housing blocks around the Punt Komma and the rest of Den Haag. This design element relates to the point about urban forms that Frampton numbers as point 4. However, here, in a more indirect approach where just one aspect, the corner solution in the housing block, mimics the surrounding urban forms. These forms are shown in attachment 4.

Incorporating the courtyard typology of the housing blocks can also be related to point 4 of Frampton. This typology can be seen in many other parts of the city, initially built for charitable housing and later as a way of city densification. No permit was needed to build behind existing streets, and the Industrial Revolution called for an increase in worker homes. (Botine Koopmans, 2015) This way of densification formed these courtyard-type housing formations around Den Haag, especially within worker districts.

The last case study is Engelse Tuin. The first way this design incorporates the theory of Critical Regionalism is by using the present historical urban structure of the site. The row housing is situated along the Helperlinie, an old defence line south of Groningen. (Hattinga, 1698) Using this historic urban line follows what Frampton has explained in point 5 of his essay; this is shown in attachment 5. In point 5, Frampton also stresses using the site's existing topography to cultivate the site. In attachment 6, it is visible how the natural topography of the site is maintained throughout the row housing.

Another way Engelse Tuin is in dialect with its context is through mimicking the structural poetics of the architecture found in the adjacent neighbourhood and other buildings in Groningen, such as the work of former city architect Siebe Jan Bouma. (Bedaux de Brouwer Architecten, n.d.) Frampton calls this the tectonics derived from a peculiar structural mode in point 3 of his essay. We can see this in the expressive verticality of the buildings, shown through apparent chimneys on the façades and vertical brickwork ornamentation, diagrammatically shown in Attachment 6.

Lastly, it is visible how the tactile is incorporated within the architecture of Engelse Park, which Frampton talks about in point 6 of the essay. The natural slope of the topography is used in the pedestrian routing to connect the housing to the natural area surrounding the Helperlinie. The natural sloping of the site is incorporated into a ramp within the routing towards the housing; the ramps slow down the movement of the body when walking towards the housing. This influence of the body's speed when walking around the site adds a layer of sense to the perspective view we are used to experiencing.

3.3 The design-rules of Critical Regionalism

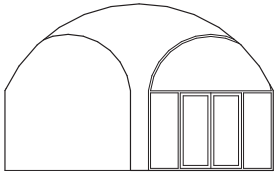
To translate the case study findings into a design strategy, a layer of abstraction has to be applied to the points of context-specific architecture found within the three projects.

By analysing how the theory of Frampton can be recognised in housing projects within the Netherlands, the list of six points can be reduced to 4 categories in which the theory becomes physical in architecture. The first is tectonics, which is a way of structural poetics that can be used as a form of inspiration. Category two is the place-form, showing how certain elements can form a boundary to which the building belongs or how an urban form can open the opportunity for introspective typologies. The third category is the fabric of the site; it is about how urban fabric or topography can foster architecture. The last and fourth category is the tactile, showing how addressing multiple bodily senses is a way to surpass the appearance of the technical aspects of building.

The following list of design strategies of context-specific architecture is concluded by exploring the aspects of context specificity through the filter of these four categories. Which elements of the case studies have translated into the particular rules of specificity are elaborated upon in Attachment 7.

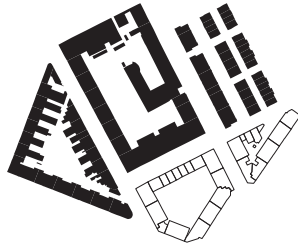
tectonic

finding inspiration from tectonics



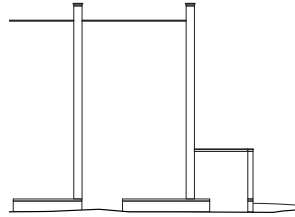
place-form

finding inspiration from urban forms



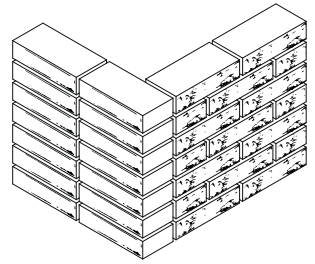
fabric of the site

finding inspiration from the structure of the site

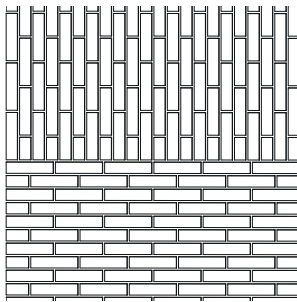


tactile

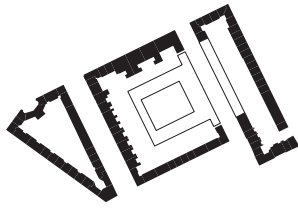
finding inspiration from sensory perceptions



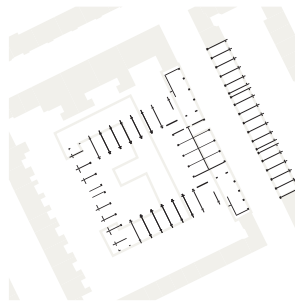
fenestration forms



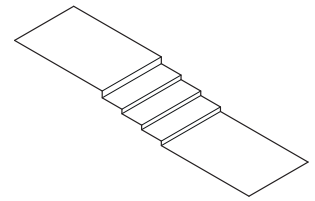
local building block typologies



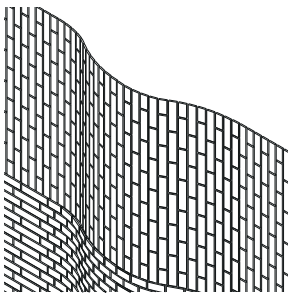
maintaining existent topography



impulse to touch



material expression



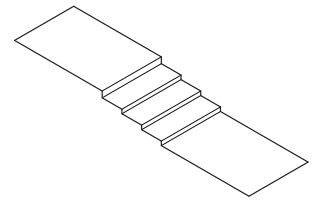
introspective types of local urban forms



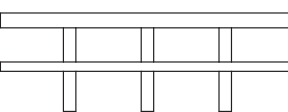
returning to former urban fabric



the speed of your body



facade sculpturing



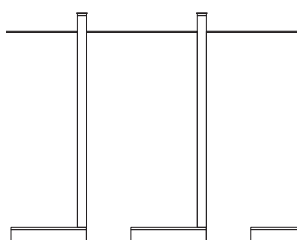
mimicing details of surrounding urban forms



using present historical linearities



structural poetics



ornamentation

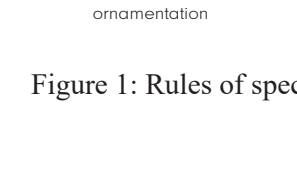


Figure 1: Rules of specificity

4. DESIGN RULES OF REPETITION

The second case study was conducted on six industrially produced housing projects to answer the sub-question: Which architectural components can be identified as elements of repetition within a selection of industrial housing projects with varied production methods? The six industrial housing projects are dissected into elements of repetition, and how these elements are repeated throughout the projects is analysed.

4.1 Industrial production techniques

The prefabricated modules form the elements of repetition the projects uses. Three different spatial forms of prefabricated elements exist: 1D, 2D and 3D. (Hermann et al., 2018) 1D elements form the simplest prefabricated elements, consisting of beams and columns. The 2D elements are formed by planar elements like the walls, floors, and ceilings; these elements are the most frequently prefabricated elements of buildings. As joints between elements often remain visible, the grid of the 2D panelling greatly influences the building design. The use of 2D modules comes with a significant amount of flexibility. Completely assembled room modules form 3D modules, and the slabs and joints can be prefabricated entirely, saving a lot of on-site construction. The modules can be assembled with interior fittings and technical installations included.

4.2 Repetition in industrial housing projects

The projects that form the case studies' database have been selected with a few prerequisites. The case studies were selected to include a method of prefabrication, be constructed with a (semi) wooden construction method, and the program must include some form of housing. On these criteria, the following housing projects have been selected: Zollfreilager, designed by Rolf Mühlethaler; Résidence Sociale Toulouse, designed by PPA Architectures; Horizon, designed by Heijmans, Katharinenhof, designed by Johannes Kaufmann Architektur; Sozialzentrum Pillerseetal, designed by Sitka.Kaserer.architekten and Student Association Heidelberg, designed by LiWood.

Each project is dissected into the elements of prefabrication and repetition, and each project is evaluated on four criteria. The first element analysed is whether the repetition concept of the building is intended to be local or global, meaning whether the modules are used or intended to be used only on the project's site or if they are intended to be built elsewhere as well. Second, it is examined whether the modules used are 1D, 2D, or 3D prefabricated elements. Third, its analysed how much variation happens within the prefabricated modules. Fourth, how many of these modules are repeated throughout the buildings? In the following paragraph, each project is looked at more thoroughly and dissected into the elements that form de prefabrication systems of the buildings.

	①	②	③	④	⑤	⑥
global / local	local	local	global	global	local	global
1D / 2D / 3D	2D	2D + 3D	2D +3D	3D	1D + 2D + 3D	2D to form 3D
variation	atleast 9 types	3 types	4 base types	4 types	1 type	1 type
repetition	at most 135	type 1: 30 type 2: 24 type 3: 4	endless	type 1: 15 type 2: 12 type 3: 12	78	76

Figure 2: Repetition in industrial housing

The first case study analysed is Zollfreilager. The building is dissected into its prefabricated elements in Attachment 8. The housing complex in Zurich features prefabricated 2d façade elements with a few variations. This creates at least a diversity of nine different prefabricated 2D façade panels that are repeated throughout the three buildings. Other elements of the buildings made of prefabricated elements are the façade claddings and the dowel laminated timber ceiling panels. (Hermann et al., 2018, p. 208) The housing complex Résidence Sociale Toulouse, case study number two, consists of staggering four different types of prefabricated 3d modules, analysed in Attachment 9. There are two base modules, each housing one apartment. The modules adjacent to the prefab concrete elevator and stairs core are expanded with a third module. (Huß et al., 2019, p. 89) Additional thermal insulation was prefabricated into 2D timber frame panels as high as the building.

Case study 3 consists of the single-family row housing constructed with the prefabricated system designed by Heijmans named Horizon, shown in Attachment 10. The system consists of a combination of 2D and 3D systems to form various single-family homes. (Heijmans, n.d.) The base of the building is a combination of 3D modules that contain the stairs and hallways of the house and form the core of the house. These 3D core elements come in four sizes. The rest of the house, the floors, facades, and roof consist of 2D elements. The façade and roof elements are interchangeable to create different outcomes of houses.

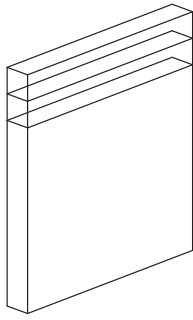
The fourth case study is Katharinenhof, a hotel designed with four different prefabricated 3D modules, analysed in Attachment 11. Three of the four modules are different-sized prefabricated hotel rooms; the fourth module contains the stairs and the elevator centrally placed within the building. (Huß et al., 2019, p. 72)

The elderly home in Fieberbrunn, the fifth case study, shown in Attachment 12, was constructed using 3D room modules within a reinforced concrete skeleton. (Huß et al., 2019, p. 69) The 3D modules include the furnishings of the room. The façade of the building is made up of prefabricated 2D elements, later installed on site. The reinforced concrete skeleton consists of a combination of concrete slabs, a 2D element, and reinforced concrete columns, a 1D element.

The sixth case study is the Student Association built in Heidelberg, shown in Attachment 13. The building was constructed using a basis 3D prefabricated module. (Huß et al., 2019, p. 74) This module is repeated throughout the buildings to form a single flat or combined with two or four modules to form bigger apartments. The modules were constructed on-site, and the concrete and timber 1D and 2D elements and building service elements were delivered to the site by local contractors. These elements were assembled on-site into open-top room modules and then mounted with a mobile crane.

4.3 The design-rules of repetition

The six analyses of the projects are used to form a set list of rules to turn the case studies into design rules. Each project system of prefabricated and on-site built elements is summarised into four rules that can encompass the system. The first rule always relates to the repetition in the project, the second to the prefabrication, the third to the exception and the fourth rule to the elements built on-site.



①

Zollfreilager

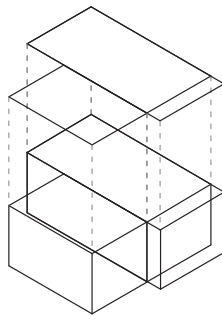
VARIED 2D ELEMENTS

1: site specific 2D elements with variation in story height and fenestration.

2: 2D facade elements, covered with 2D facade cladding panels.

3: The variant story height on the plinth and top floor, and the varying windows sizing based upon facade orientation creates exception within the building.

4: the concrete cores and the floors are built on-site.



②

Résidence Sociale Toulouse

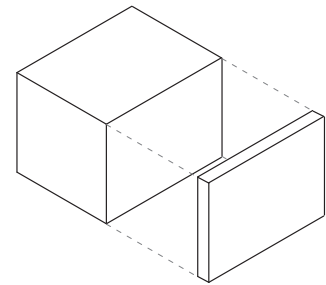
VARIED 3D ELEMENTS

1: a repetition of different 3D modules, staggered in a way to form a building, with the empty space in between forming the routing.

2: four different 3D modules, enclosed with 2D insulation elements.

3: by taking away a few modules within the repetition rhythm on the ground floor, an exception can be made for the entrance.

4: the entrance and the facade cladding is built on-site.



③

Horizon

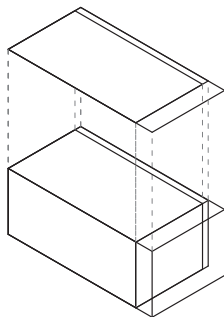
VARIED 2D WITH 3D ELEMENTS

1: a generic system of 3D and to 2D modules to be repeated on different sites.

2: A core of 3D modules enclosed by a variety of 2D elements.

3: the combination of different prefab elements can cause a varied outcome.

4: no element is built on-site.



④

Katharinenhof

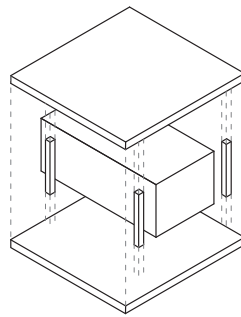
3D WITH ON-SITE EXCEPTIONS

1: a repetition of different 3D modules, staggered in a way to form a building, with the empty space in between forming the routing.

2: a variety of four different 3D modules that form the individual rooms and the vertical routing.

3: the concrete plinth and basement built on site form an exception to the repetition of the modules.

4: the plinth, basement and the facade cladding is built on-site.



⑤

Sozialzentrum Pillerseetal

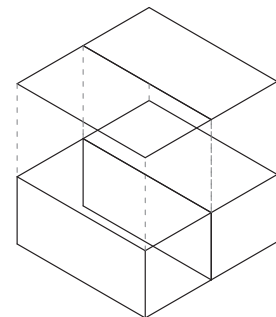
3D WITHIN A 1 D/ 2D FRAME

1: 3D modules are repeated within a concrete frame.

2: 3d modules placed within a frame of a 1D and 2D concrete structure enclosed in 2D facade elements.

3: within the concrete frame where no modules have been placed, individual walls are built on-site to form supporting rooms of varied sizing.

4: supporting rooms and the cores of the building are build on-site.



⑥

Student Association Heidelberg

SINGULAR 3D ELEMENT

1: one 3D module staggered in a way to form a building, with the empty space in between forming the routing.

2: 2D elements combined on-site to form 3D modules.

3: one singular model can be combined with more modules to form larger rooms.

4: the stairs core, floors and facade cladding are built on site.

Figure 3: Rules of repetition

5. DESIGNING WITH SPECIFICITY AND REPETITION

The results of the case studies are used to close the gap between specificity and repetition. The rules for repetition and prefabrication methods are used to recreate the context-specific projects of the first case study. The projects Spaarndammerhart, Punt Komma and Engelse Park are redesigned to be made of prefabricated industrial modules while still upholding the context-specificity rules found in the projects. To find the suitable prefabrication method, an analysis has been made where prefabrication methods are tested on the ability to follow the context-specificity rule, shown in the table in figure 4 on the following page.

Spaarndammerhart is redesigned with the rules of prefabrication methods 1 and 4. This results in a system of varied 2D façade modules combined with varied 3D room modules and on-site exceptions. The worked-out modules can be seen in Attachment 14. Five of the seven rules of context specificity found within the project can be executed with the prefabricated modules. The other two are incorporated into the project using the on-site built exceptions.

The project Punt Komma is redesigned using the prefabrication method 2 of varied prefabricated 3D modules that include the façade materialisation and on-site exceptions. The redesign of the buildings using the prefabricated modules is documented in Attachment 15. Two out of three rules of context-specific housing expressed in the architecture of the housing block can be built using methods of prefabrication.

The project Engelse Park was redesigned using prefabrication method 3, which combines 3D modules and a system of varied 2D façade modules. The drawings of this can be seen in Attachment 16. By adding a system of prefabricated 1D elements to the prefabrication modules, four of the four rules of context-specific housing found within Engelse Park can be executed using prefabricated elements.

	TECTONICS				
	fenestration forms	material expression	facade sculpturing	structural poetics	ornamentation
system 1: varied 2D elements	✓	✓	✓	✓	✓
system 2: varied 3D elements	✓	✓	✓	✓	✓
system 3: varied 2D with 3D elements	✗	✓	✗	✗	✗
system 4: 3D elements with on-site exeptions	✓	✓	✓	✓	✓
system 5: 3D elements within a 1D / 2D frame	✗	✓	✓	✓	✗
system 6: singular 3D element	✗	✓	✓	✗	✓

	PLACE-FORM		
	local building bock typologies	introspective types of local urban forms	mimicing details of surrounding urban forms
system 1: varied 2D elements	✓	✓	✓
system 2: varied 3D elements	✓	✓	✗
system 3: varied 2D with 3D elements	✗	✗	✗
system 4: 3D elements with on-site exeptions	✓	✓	✗
system 5: 3D elements within a 1D / 2D frame	✓	✓	✗
system 6: singular 3D element	✓	✓	✗

	FABRIC OF THE SITE		
	maintaining existant topography	returning to former urban fabric	using present historical linearities
system 1: varied 2D elements	✗	✓	✓
system 2: varied 3D elements	✗	✓	✓
system 3: varied 2D with 3D elements	✗	✓	✓
system 4: 3D elements with on-site exeptions	✗	✓	✓
system 5: 3D elements within a 1D / 2D frame	✓	✓	✓
system 6: singular 3D element	✗	✓	✓

	TACTILE	
	impulse to touch	the speed of your body
system 1: varied 2D elements	✓	✓
system 2: varied 3D elements	✓	✓
system 3: varied 2D with 3D elements	✗	✓
system 4: 3D elements with on-site exeptions	✓	✓
system 5: 3D elements within a 1D / 2D frame	✗	✓
system 6: singular 3D element	✓	✓

Figure 4: Analysis of suitability of prefabrication system and context-specificity rule

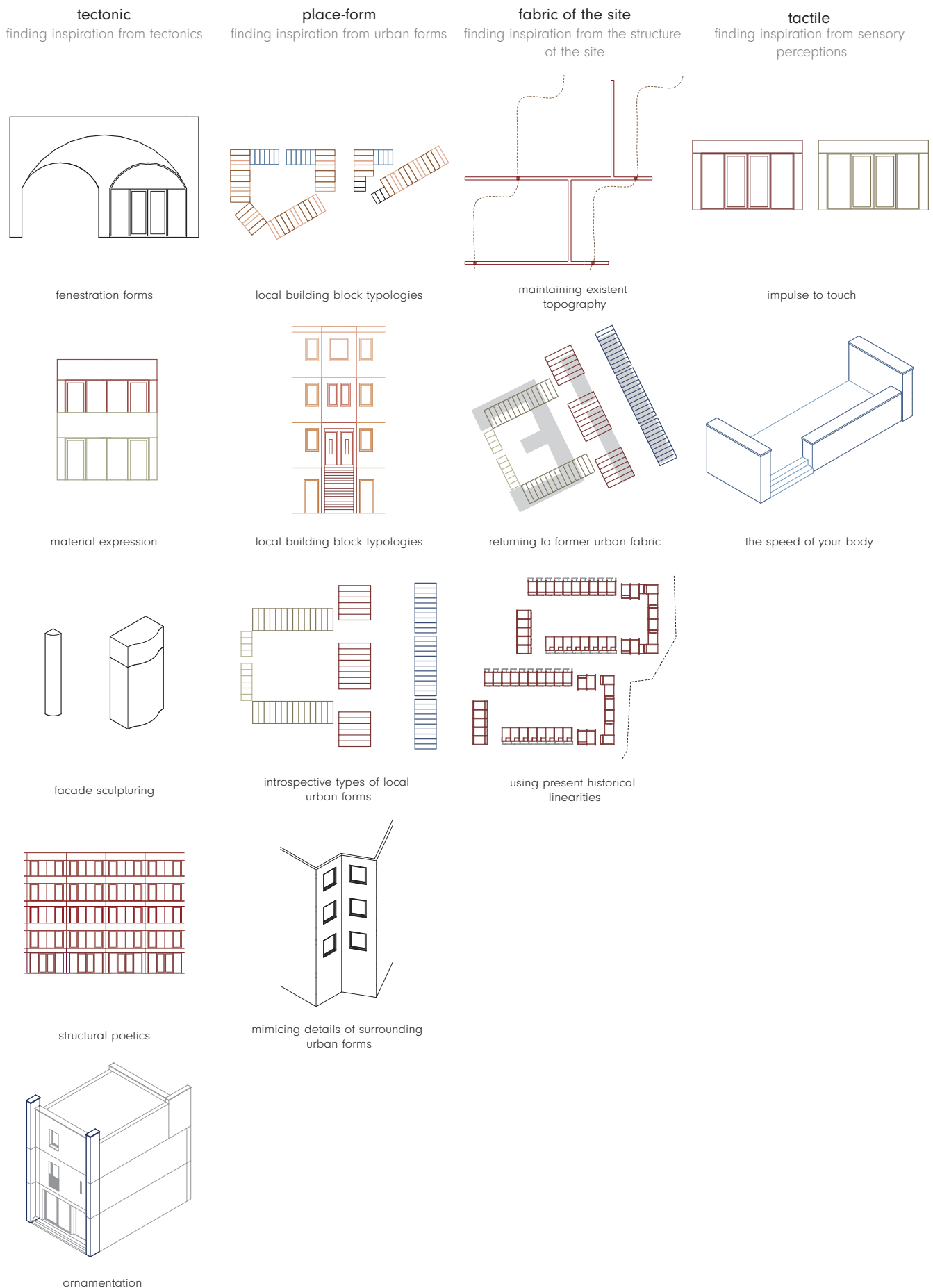


Figure 5: Rules of specificity followed with prefabricated modules (coloured) or built on site elements (black)

6. DISCUSSION

By researching specificity and repetition within the architecture of housing, through the theory of Critical Regionalism and a case study of Dutch context-specific housing projects and through industrial production techniques for construction and a case study on industrial housing, a set of rules regarding specificity and repetition can reconcile the dichotomy between specificity and repetition that opens up the possibility of adhering to the rules of context specificity whilst using the methods of prefabrication. This study gives new insight into how industrial architecture can move towards a more rooted and context-led architecture and move away from its utilitarian and production-led design that creates a sense of genericness within the architecture. However, it must be acknowledged that by addressing this subject through the ways of a case study, the results are limited by the result of the chosen case study selection. This poses the question of when the case studies are carried out with different projects, the result will differ from the result of the case studies of this research.

6. CONCLUSION

By using Frampton's theory on Critical Regionalism and a case study on context-specific housing within the Netherlands, a list of rules for designing context-specific housing is formulated. Thirteen rules could be identified from this study. These rules can be categorised into four main subjects taken from the essay Towards a Critical Regionalism. The subjects are tectonics, place-form, fabric of the site and tactile. The rules of the tectonics are fenestration forms, material expression, façade sculpturing, structural poetics and ornamentation. The rules of the place-form are local building block typologies, introspective types of local urban forms and mimicking details of surrounding urban forms. The rules regarding the fabric of the site are maintaining existent topography, returning to former urban fabric and using present historical linearities. The rules of the tactile are the impulse to touch and the speed of your body.

The second case study analysing repetition within industrial housing projects resulted in a list of six different approaches to prefabrication. The first consists of a catalogue of varied 2D façade modules. The second is a system of fully assembled varied 3D room modules. The third is a system of varied 2D façade modules combined with varied 3D shaft modules. The fourth consists of varied 3D room-only modules. The fifth system combines a single type of 3D room-only module placed within a 1D structure enclosed with a single type of 2D façade module. The sixth and last system is a single type of 3D room-only module.

The project of the first case studies can be redesigned using the systems of prefabrication to show that 10 out of the 13 rules of context specificity within these projects could be expressed using prefabrication methods.

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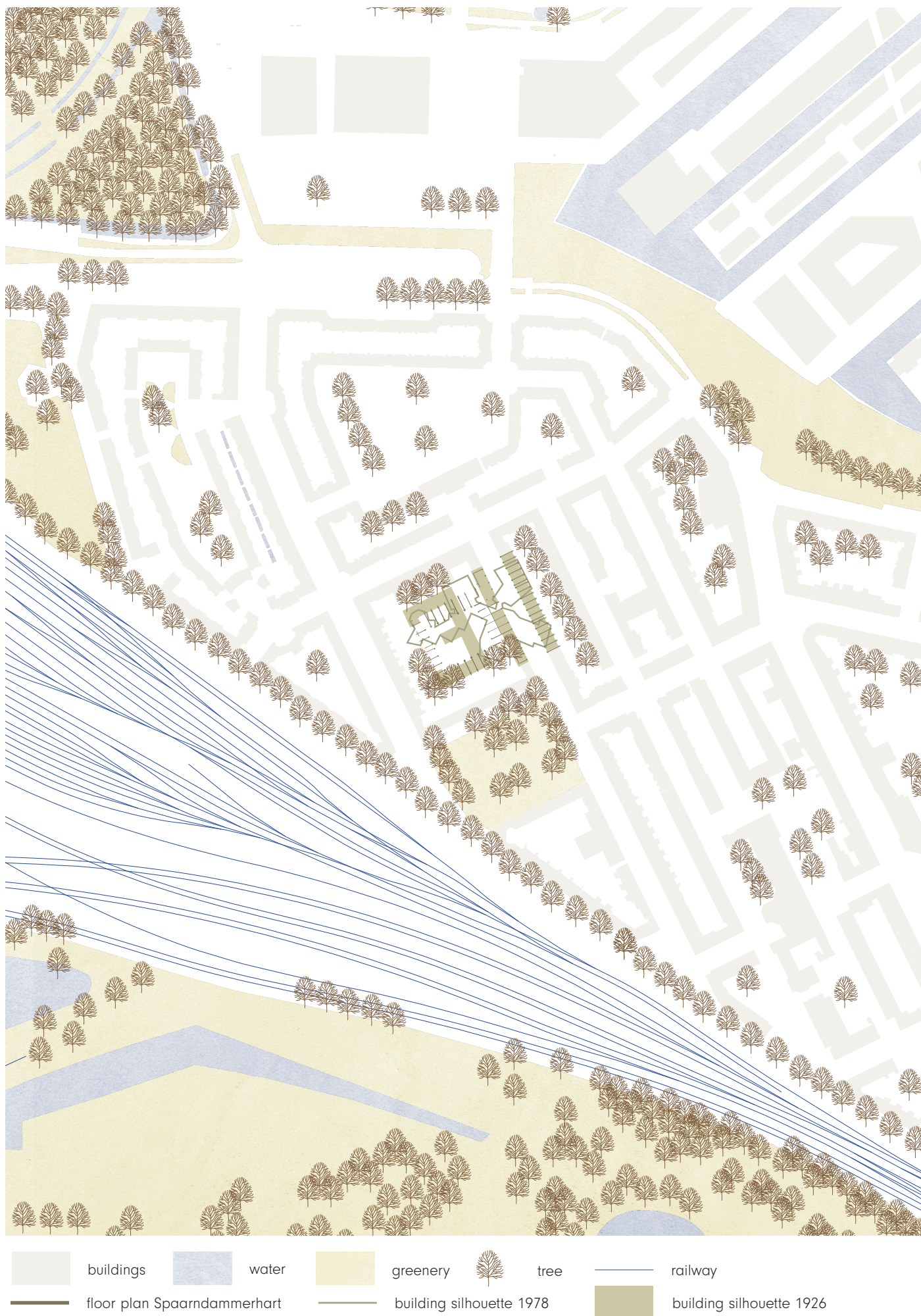
Exploring the possibilities for context-specific industrial housing through specificity and repetition

Attachments

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Delft University of Technology
Julianalaan 134, 2628BL Delft
v.vanheijst@student.tudelft.nl

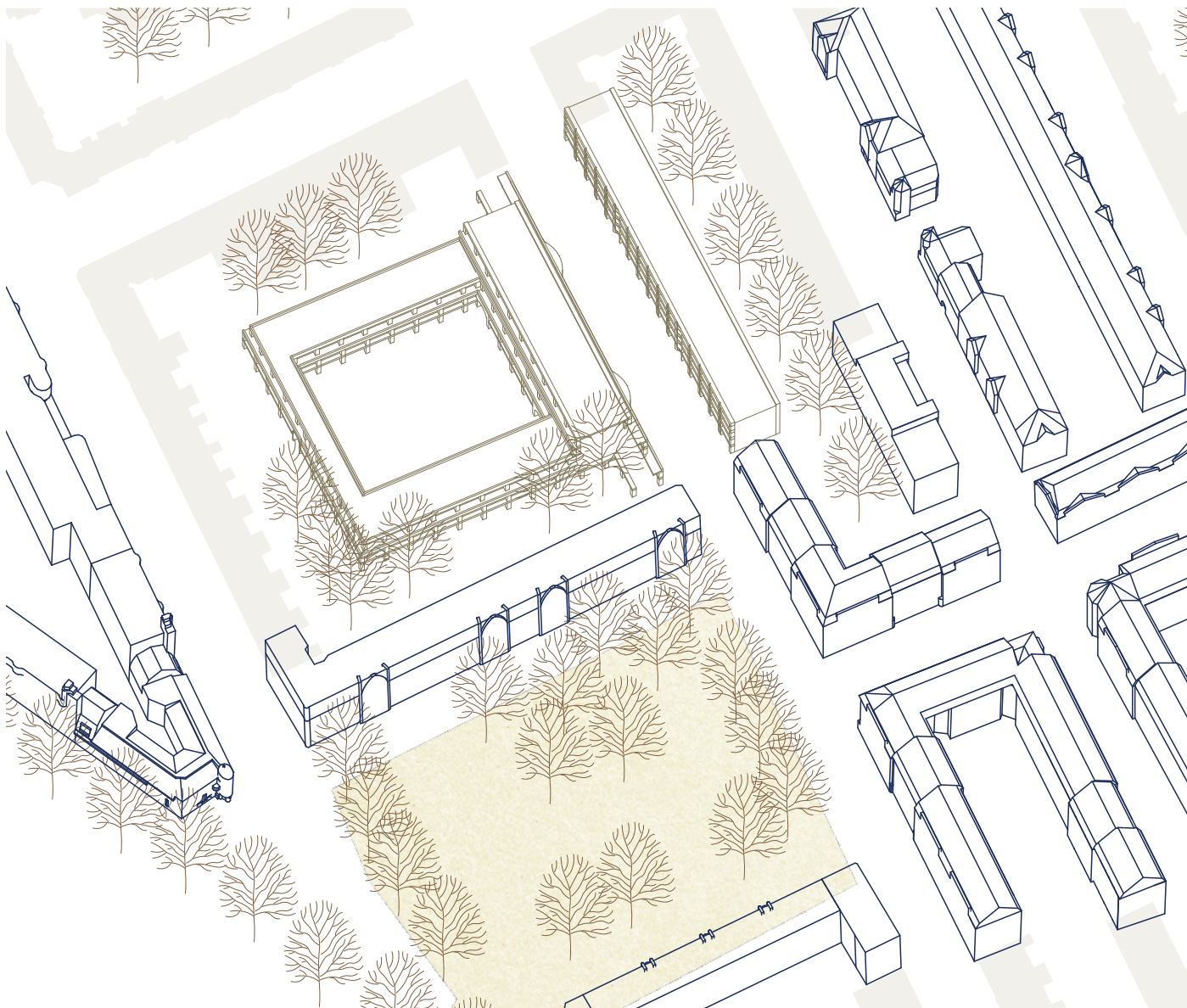
Attachment 1: Urban analysis of Spaarndammerhart



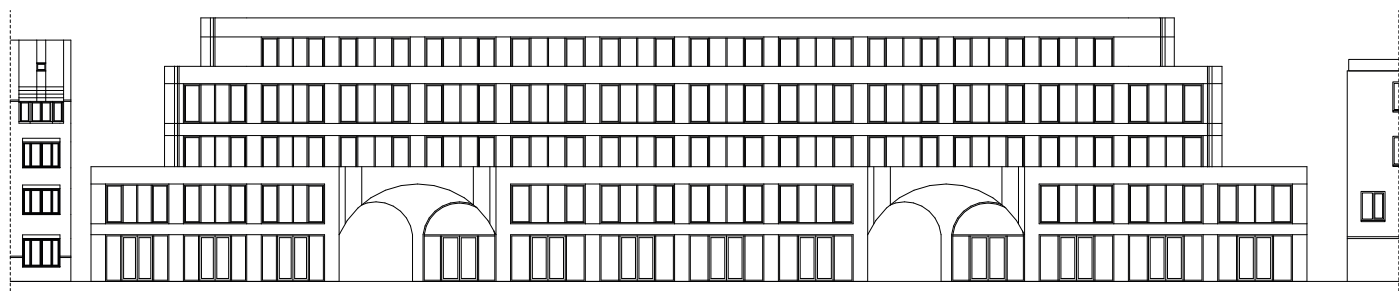
Attachment 2: Immediate context of Spaarndammerhart



South-west facade along Krommeniestraat (secondary building block)

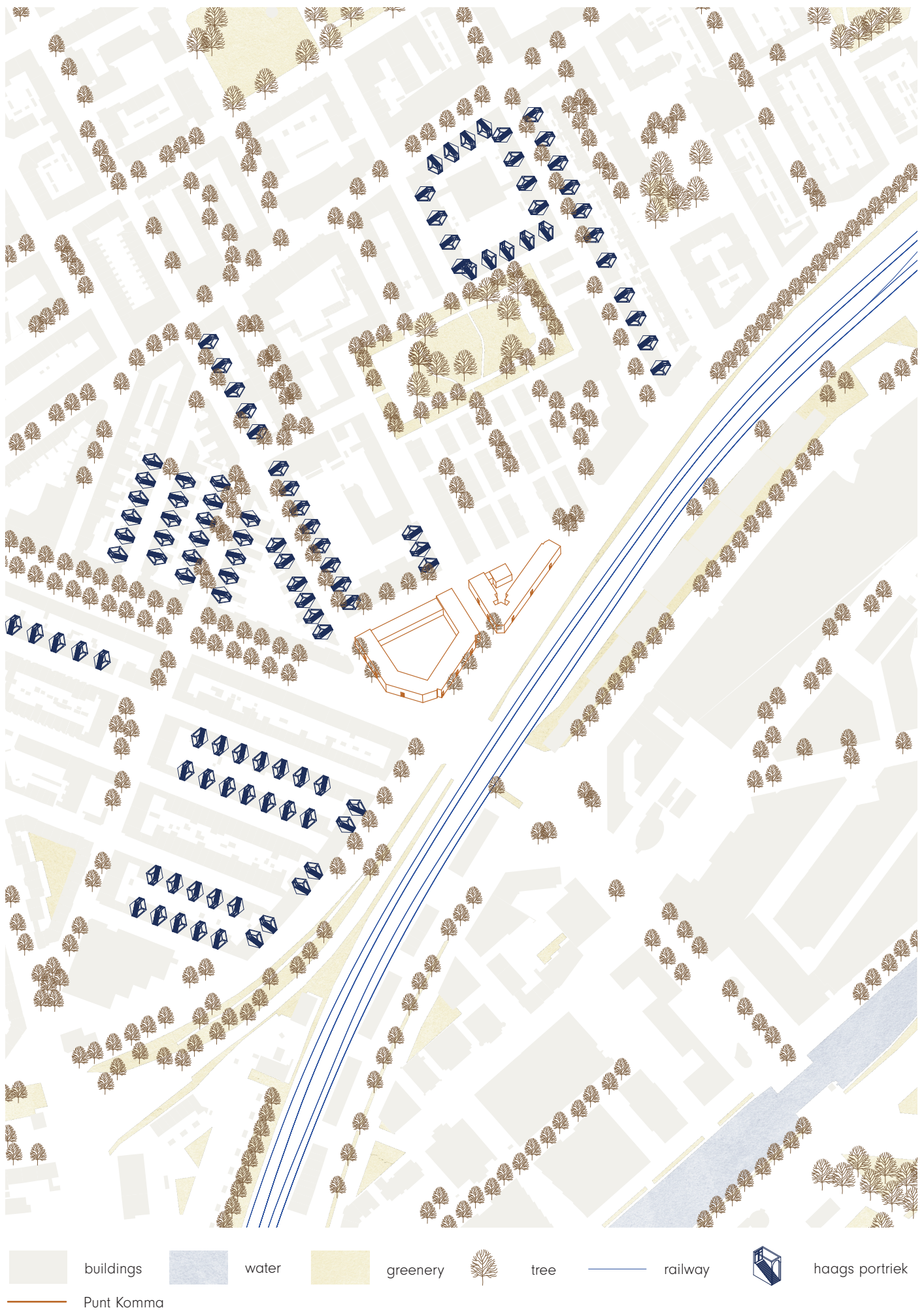


buildings greenery tree Spaarndammerhart Amsterdamse School architecture



North-east facade along Krommeniestraat (main building block)

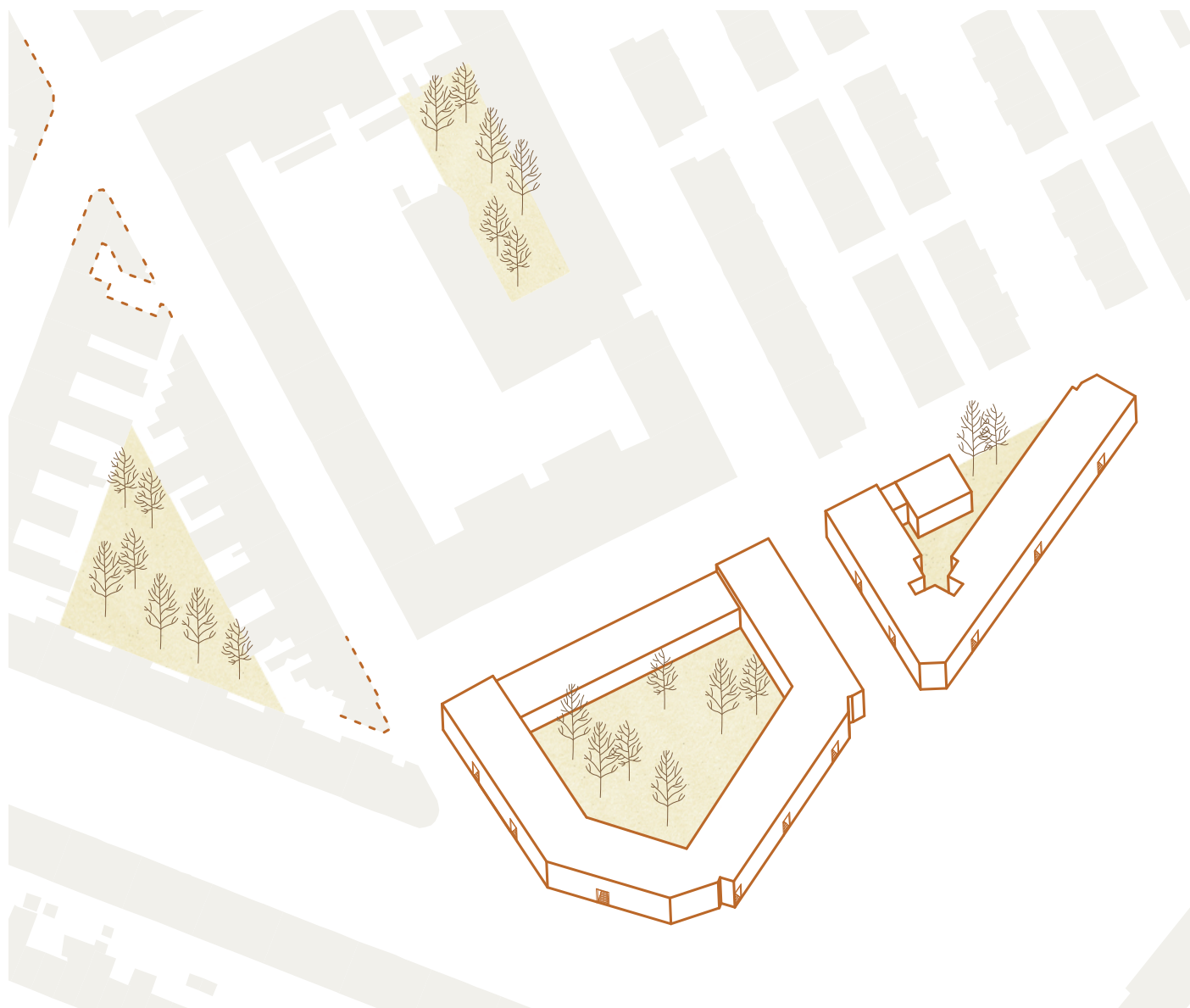
Attachment 3: Urban analysis of Punt Komma



Attachment 4: Immediate context of Punt Komma

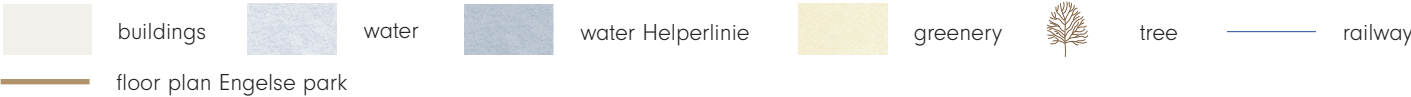
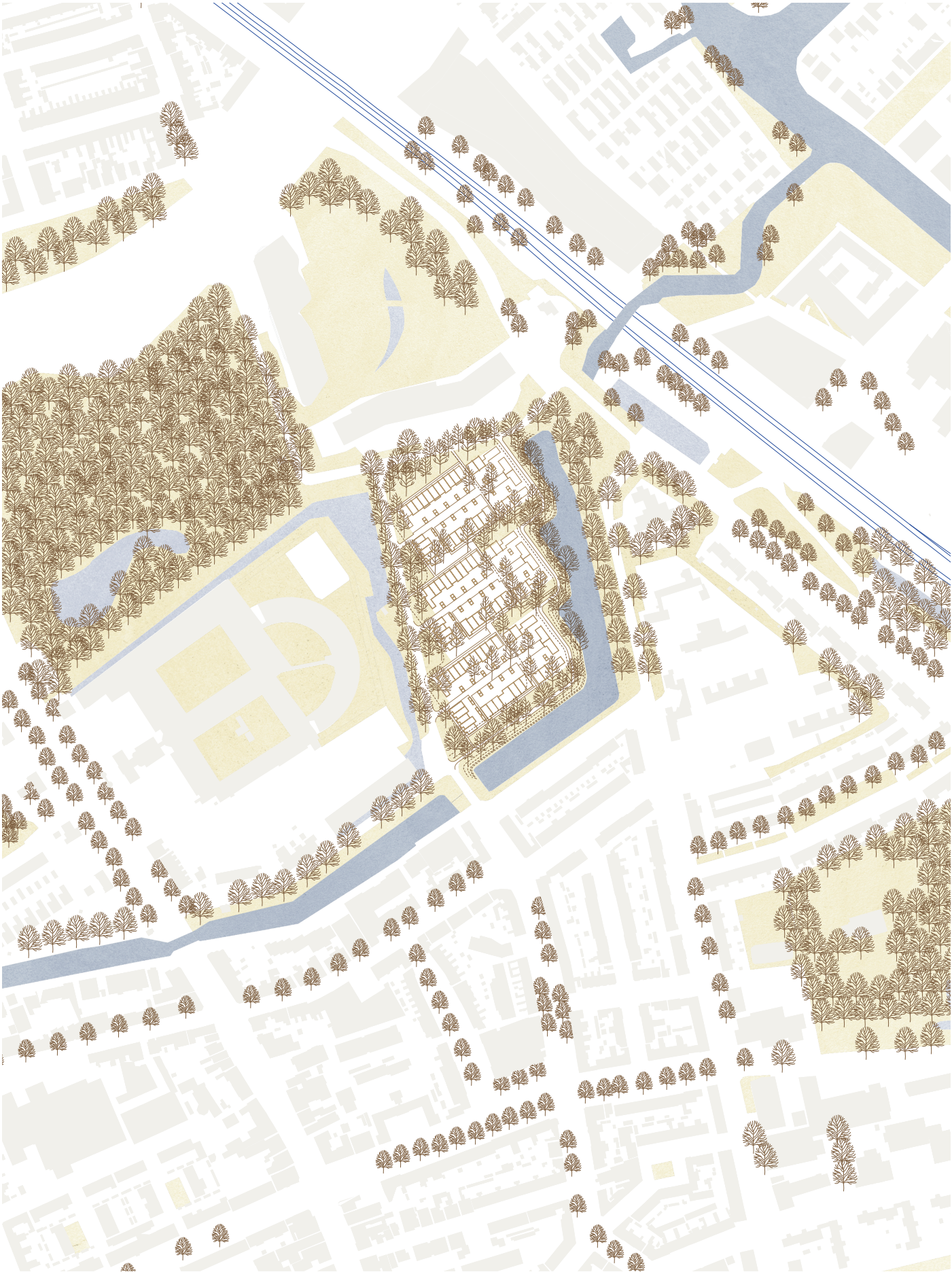


Facade of Punt Komma (right) and adjacent facade with Haags portiek along Jacob Marisstraat (left)

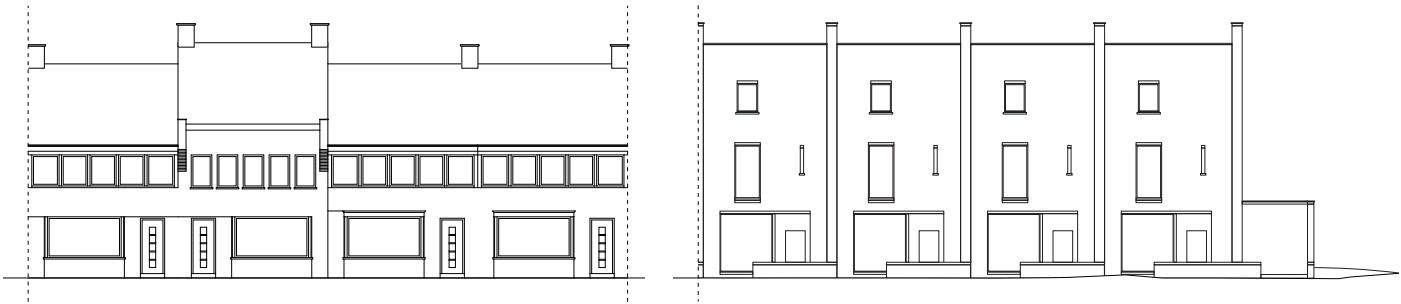


buildings courtyard gardens tree Punt Komma urban form influences

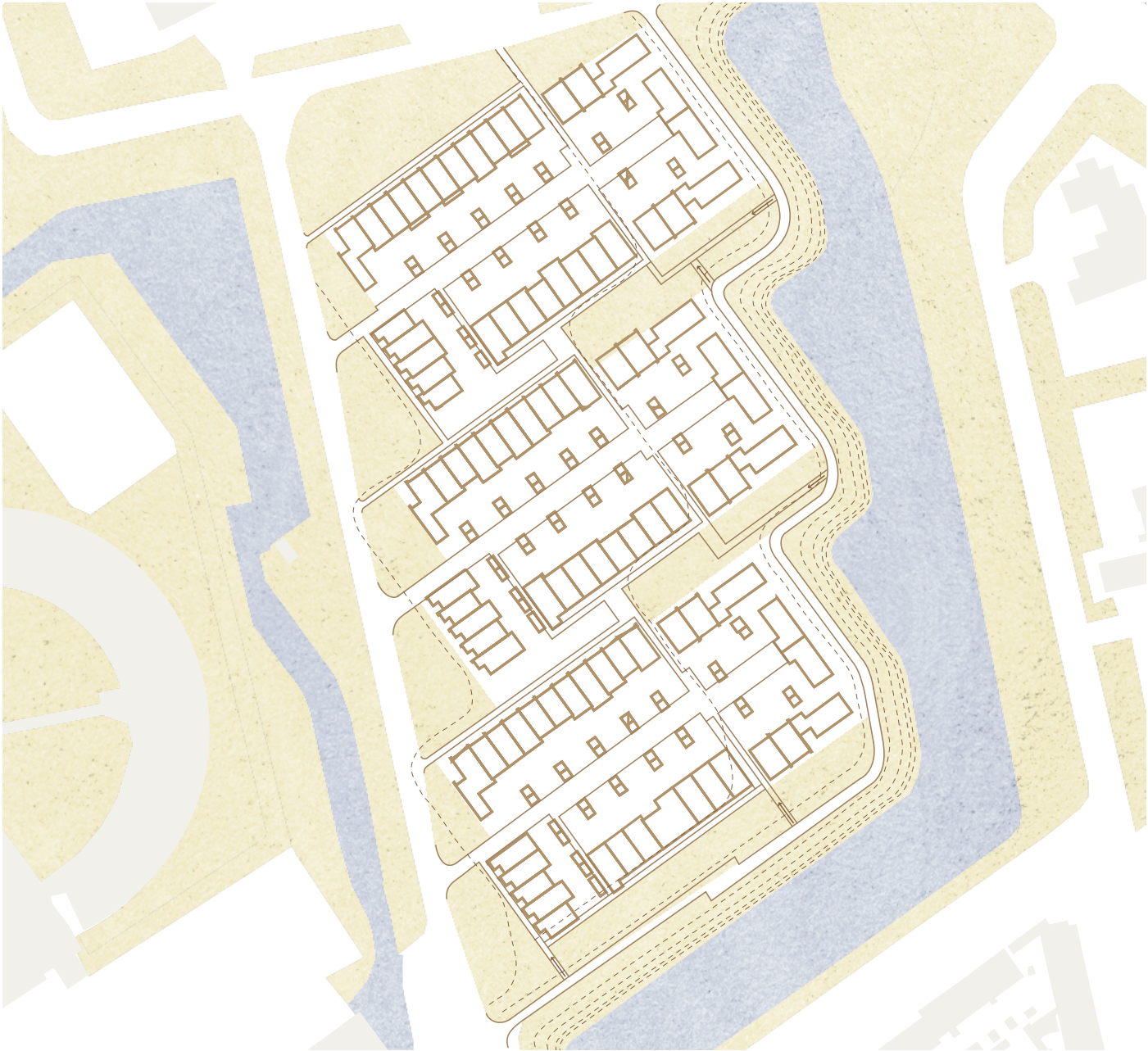
Attachment 5: Urban analysis of Engelse Park



Attachment 6: Immediate context of Engelse Park

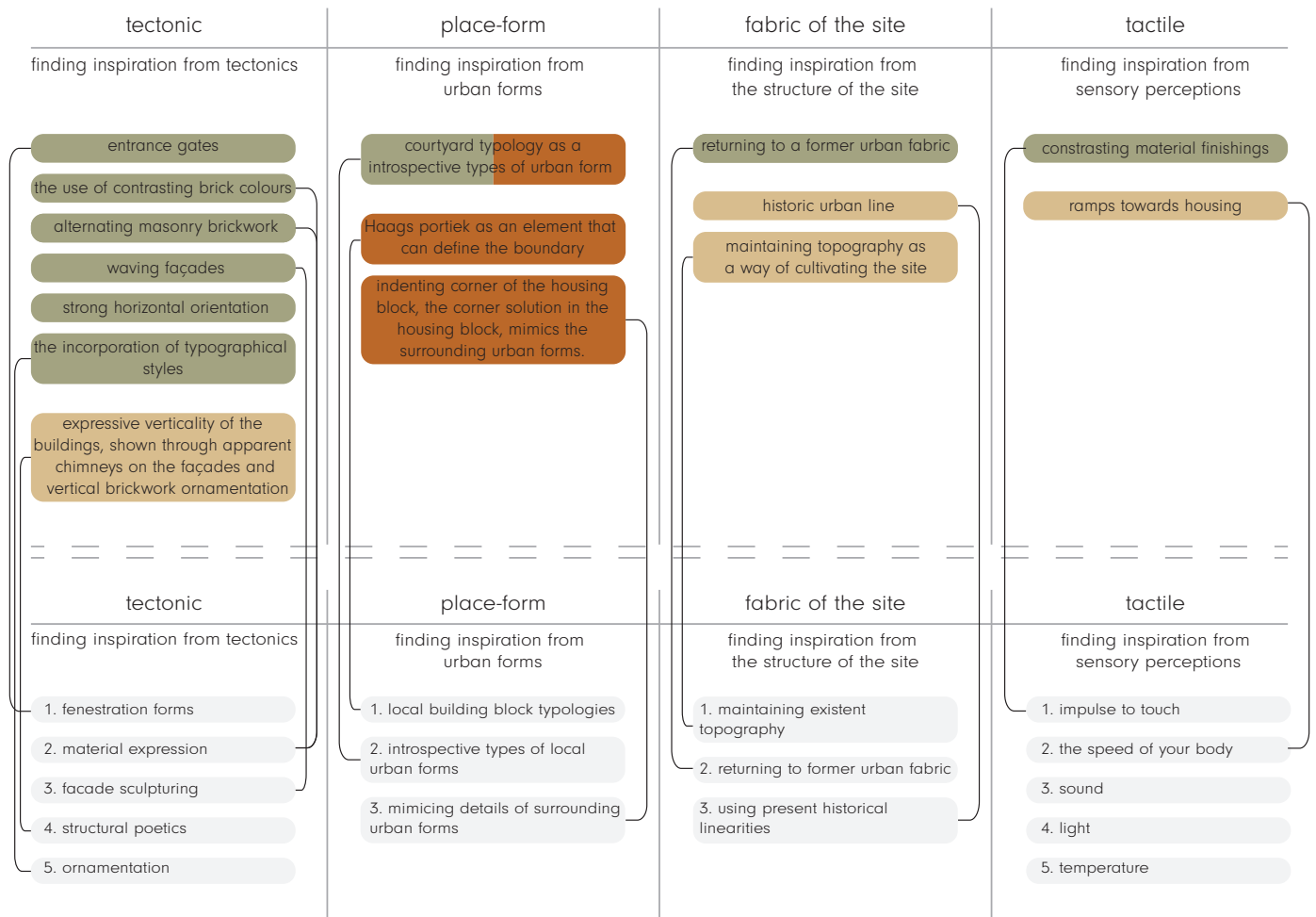


Facade of Engelse Park (right) and adjacent row housing along Bachkade (left)

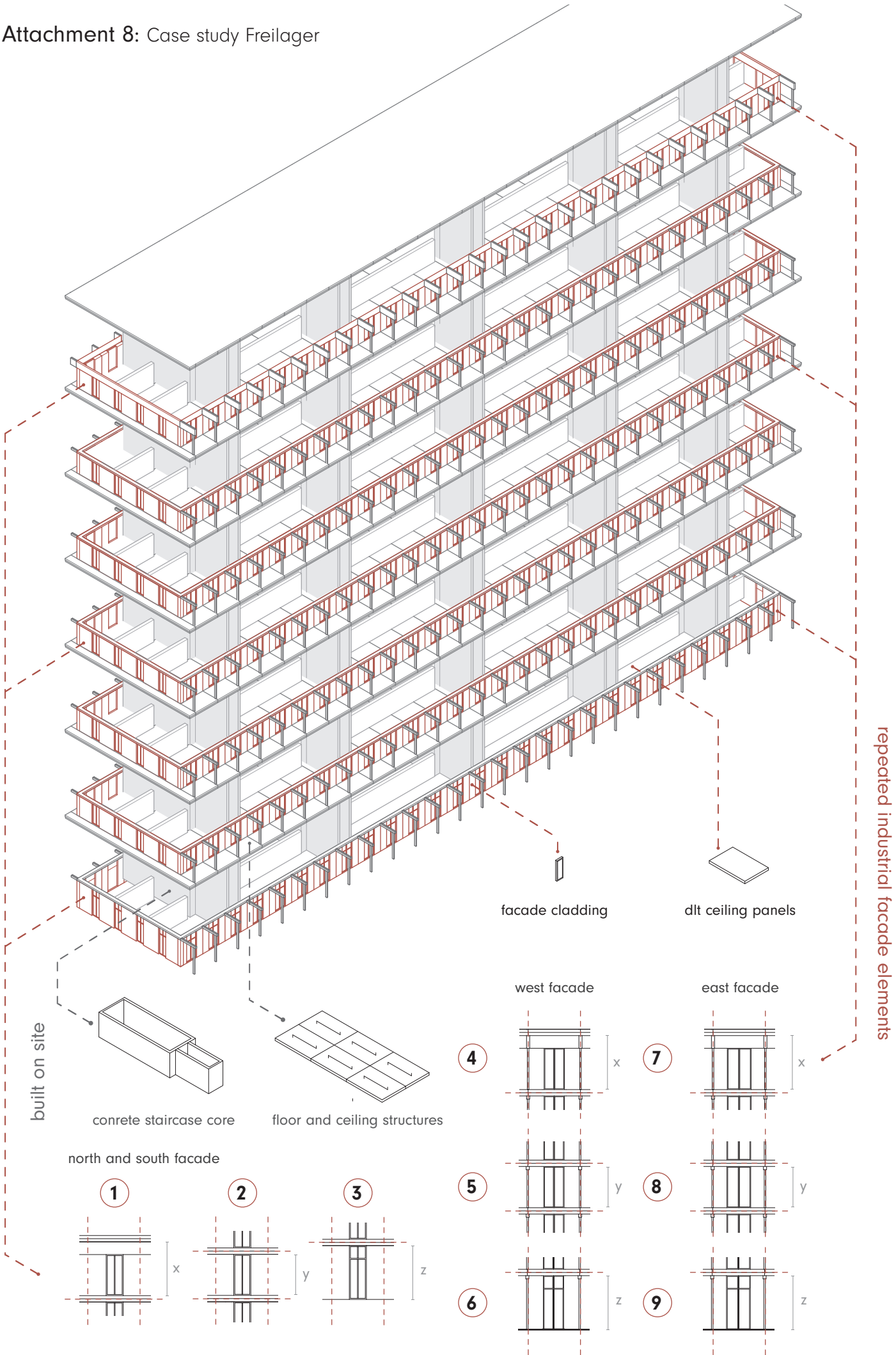


- buildings
- water
- greenery
- diagrammatic representation of the topography
- floor plan Engelse park
- walking paths
- ramps

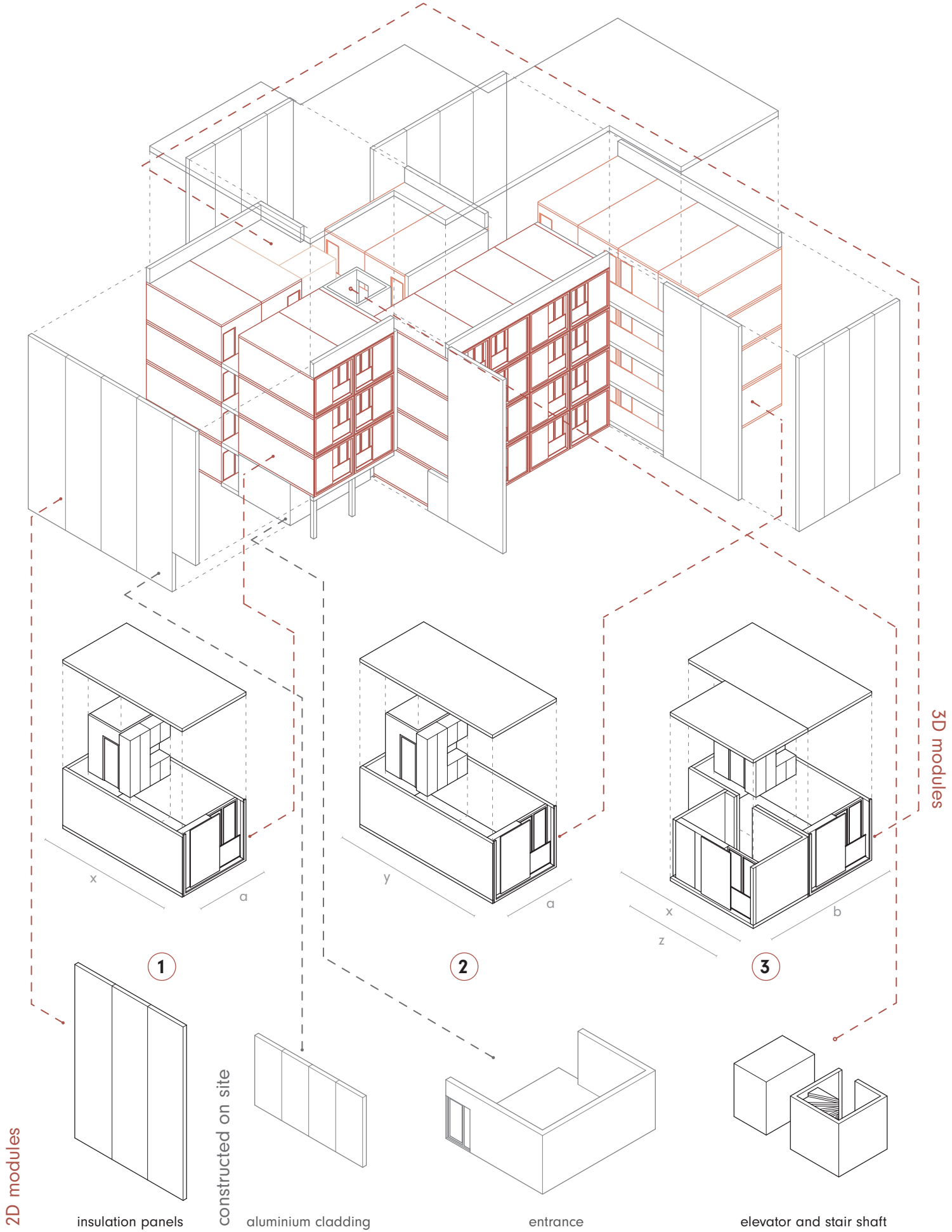
Attachment 7: Case study results abstracted into rules of specificity



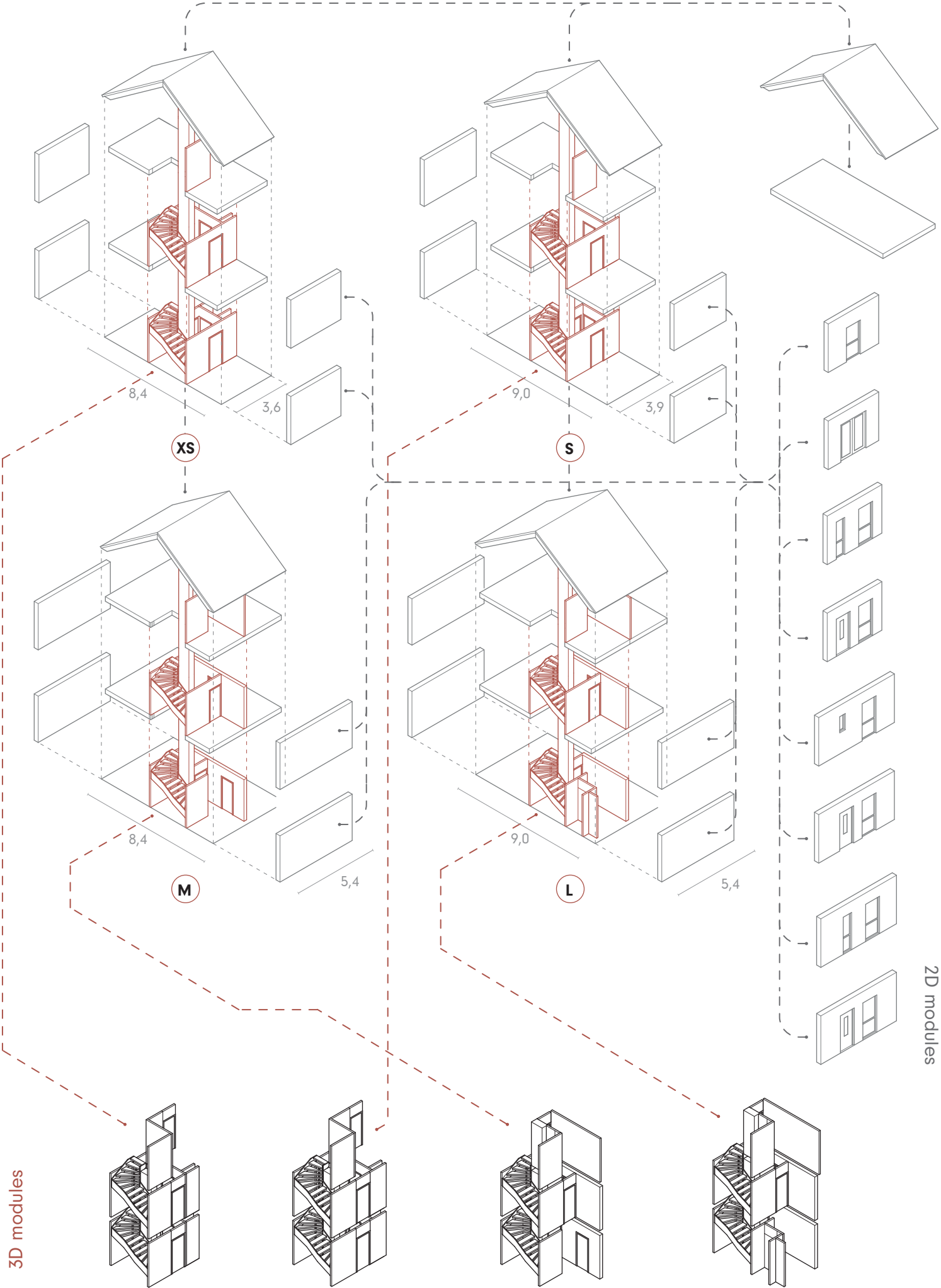
Attachment 8: Case study Freilager



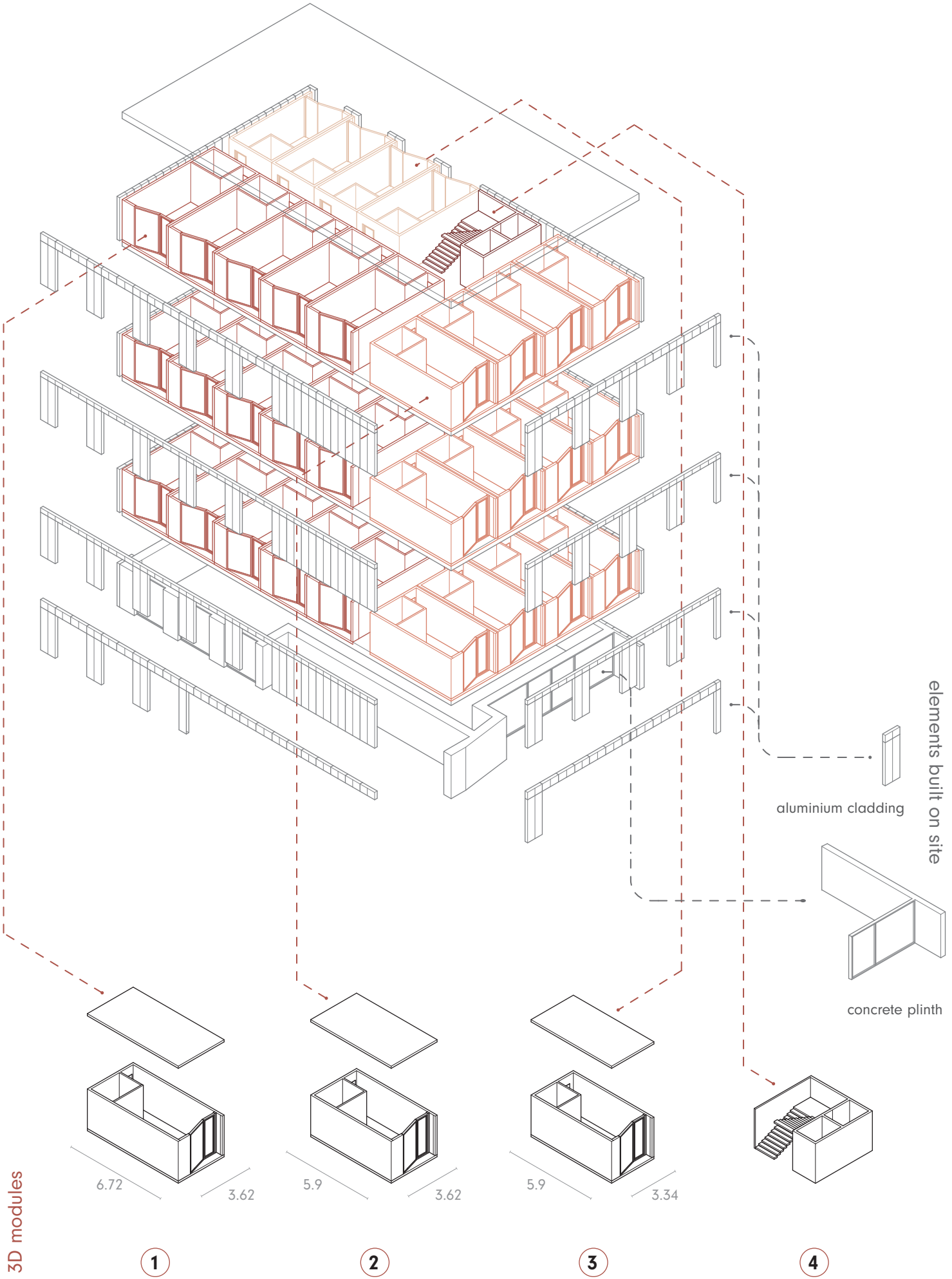
Attachment 9: Case study Toulouse



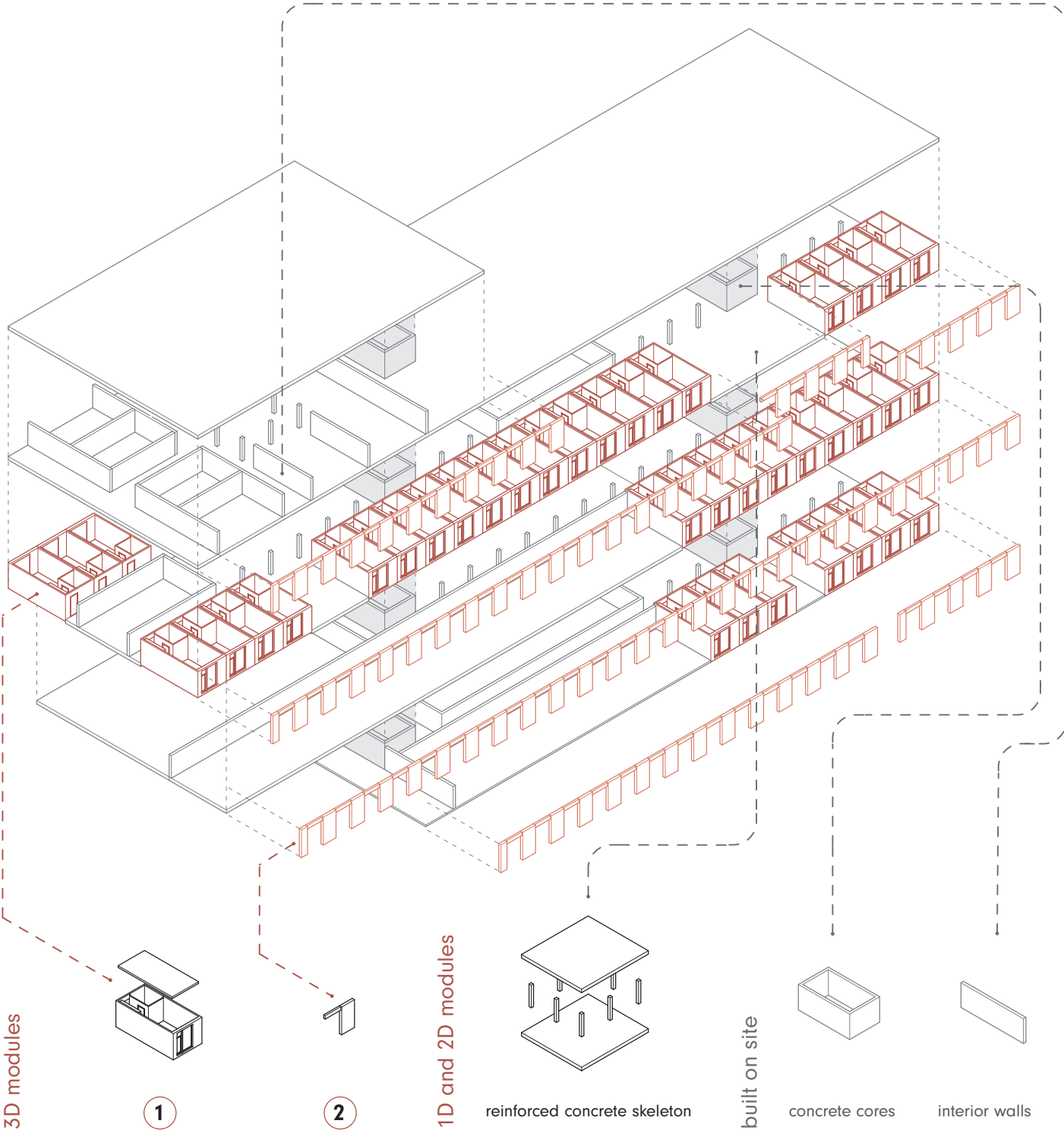
Attachment 10: Case study Horizon



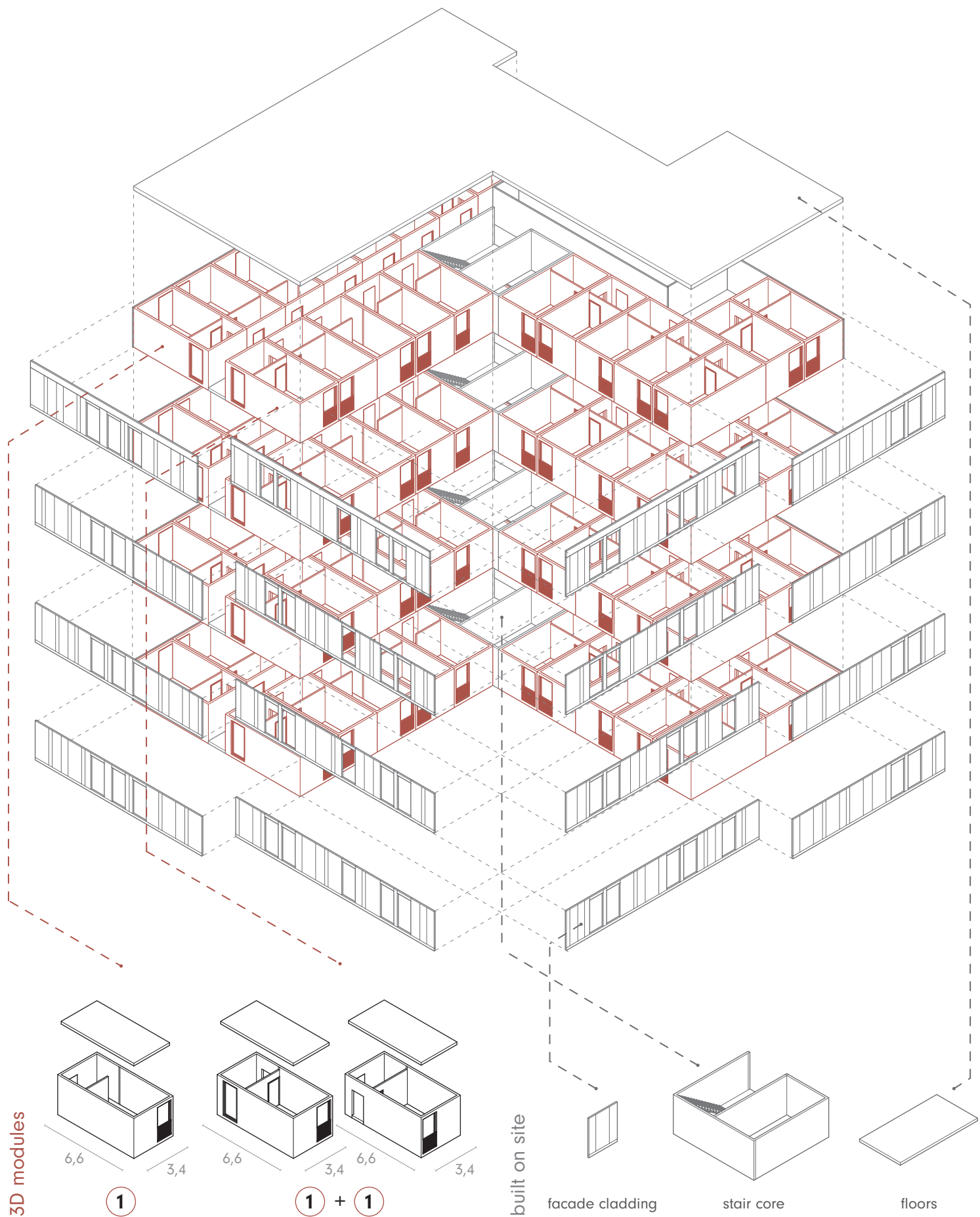
Attachment 11: Case study Katharinenhof



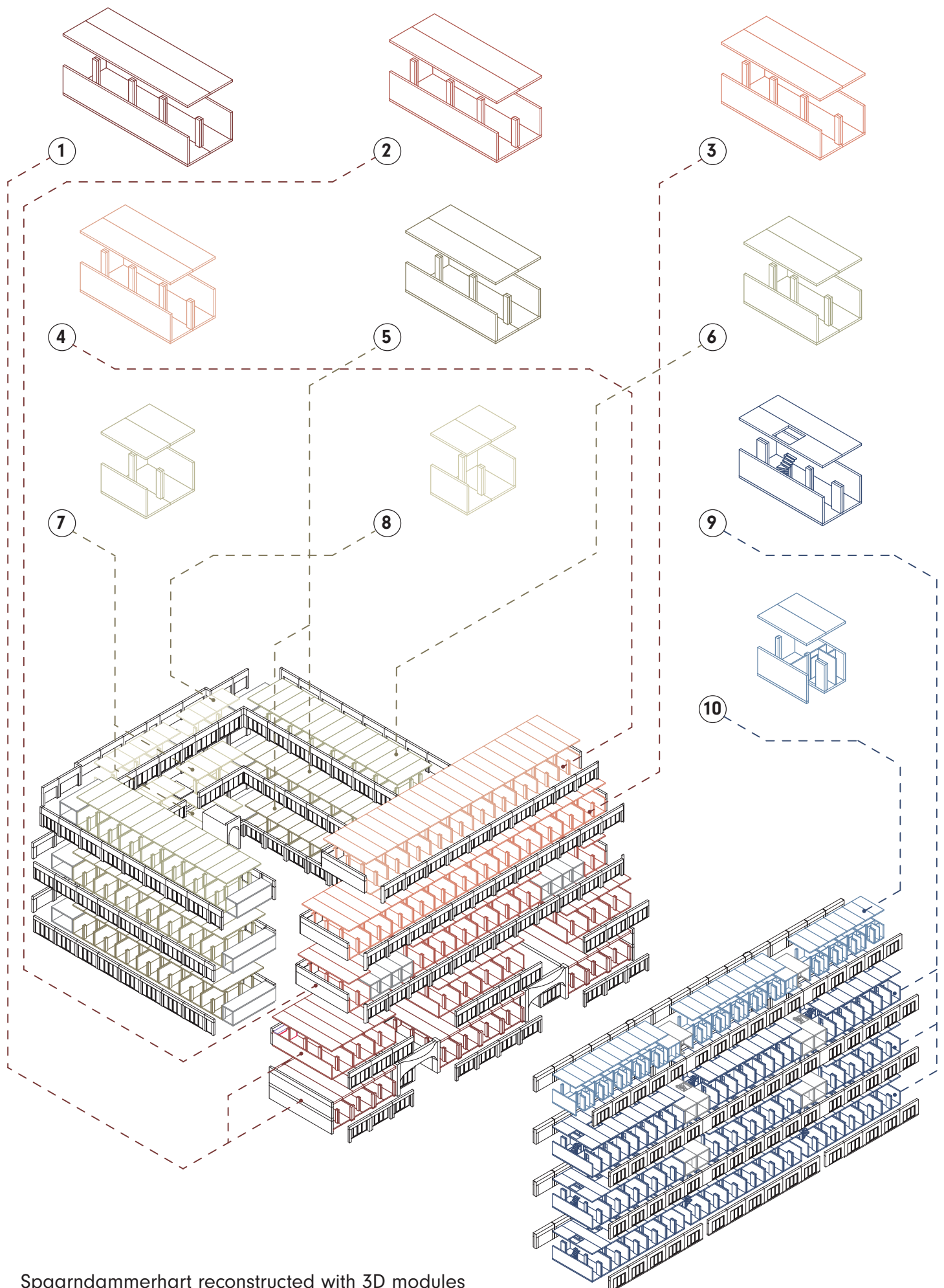
Attachment 12: Case study Nursery home



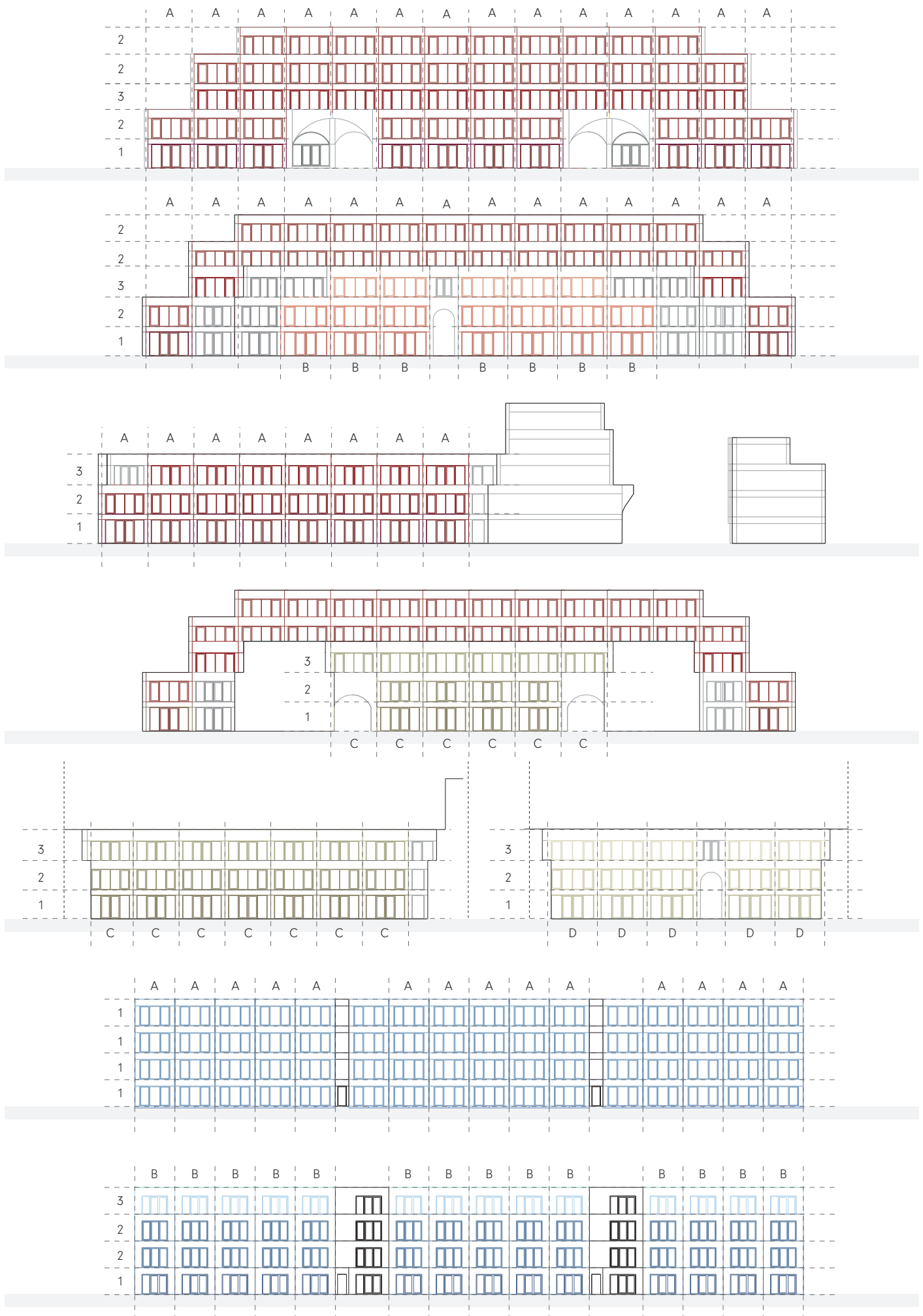
Attachment 13: Case study Student Hostel



Attachment 14: An industrial approach to Spaarndammerhart

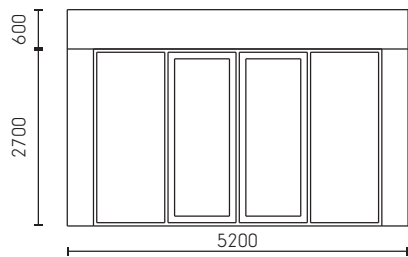


Spaarndammerhart reconstructed with 3D modules

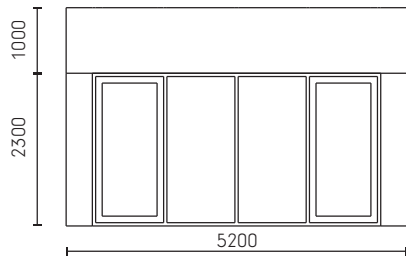


Facades of Spaarndammerhart reconstructed with 2D facade modules

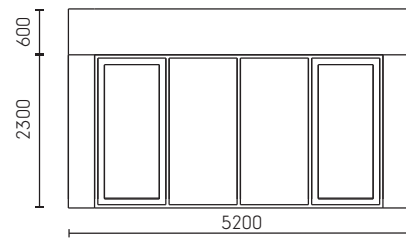
block 1



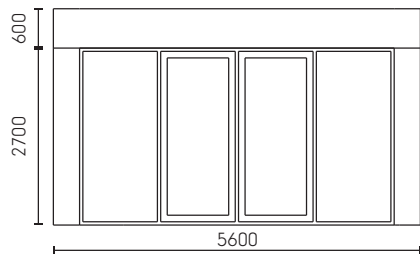
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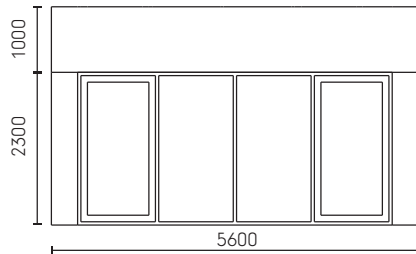
(A.2)



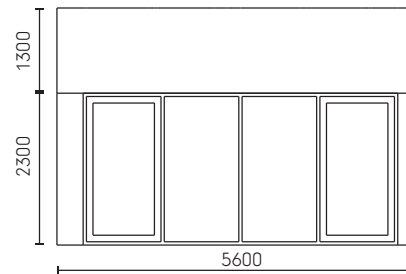
(A.3)



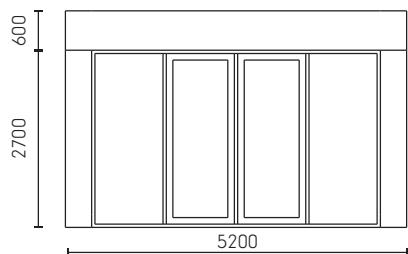
(B.1)



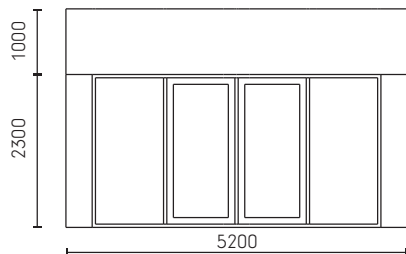
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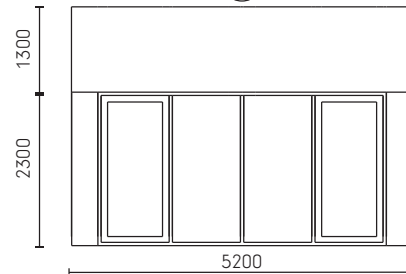
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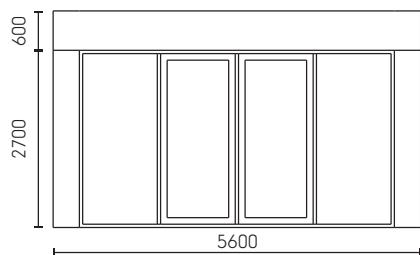
(C.1)



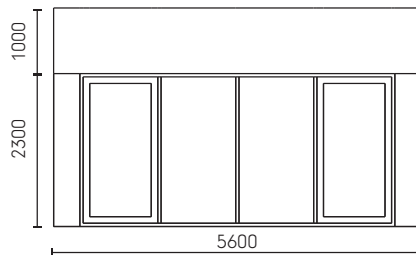
(C.2)



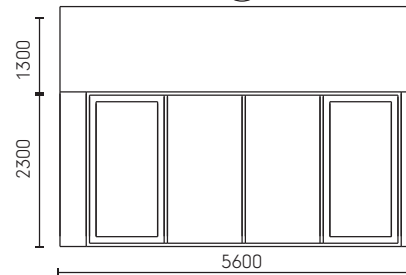
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(D.1)

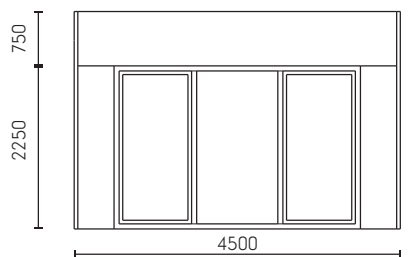


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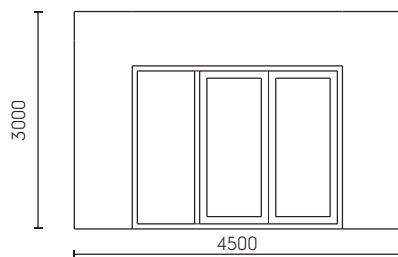


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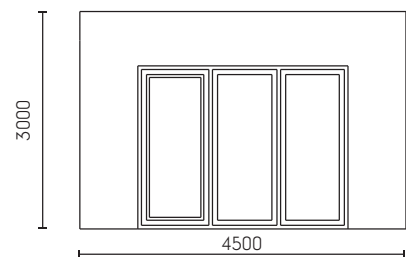
block 2



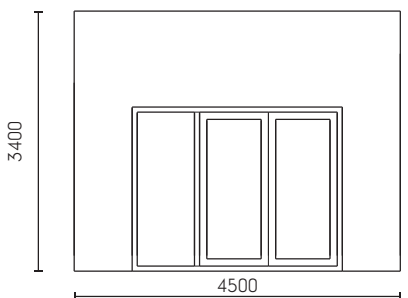
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(B.1)

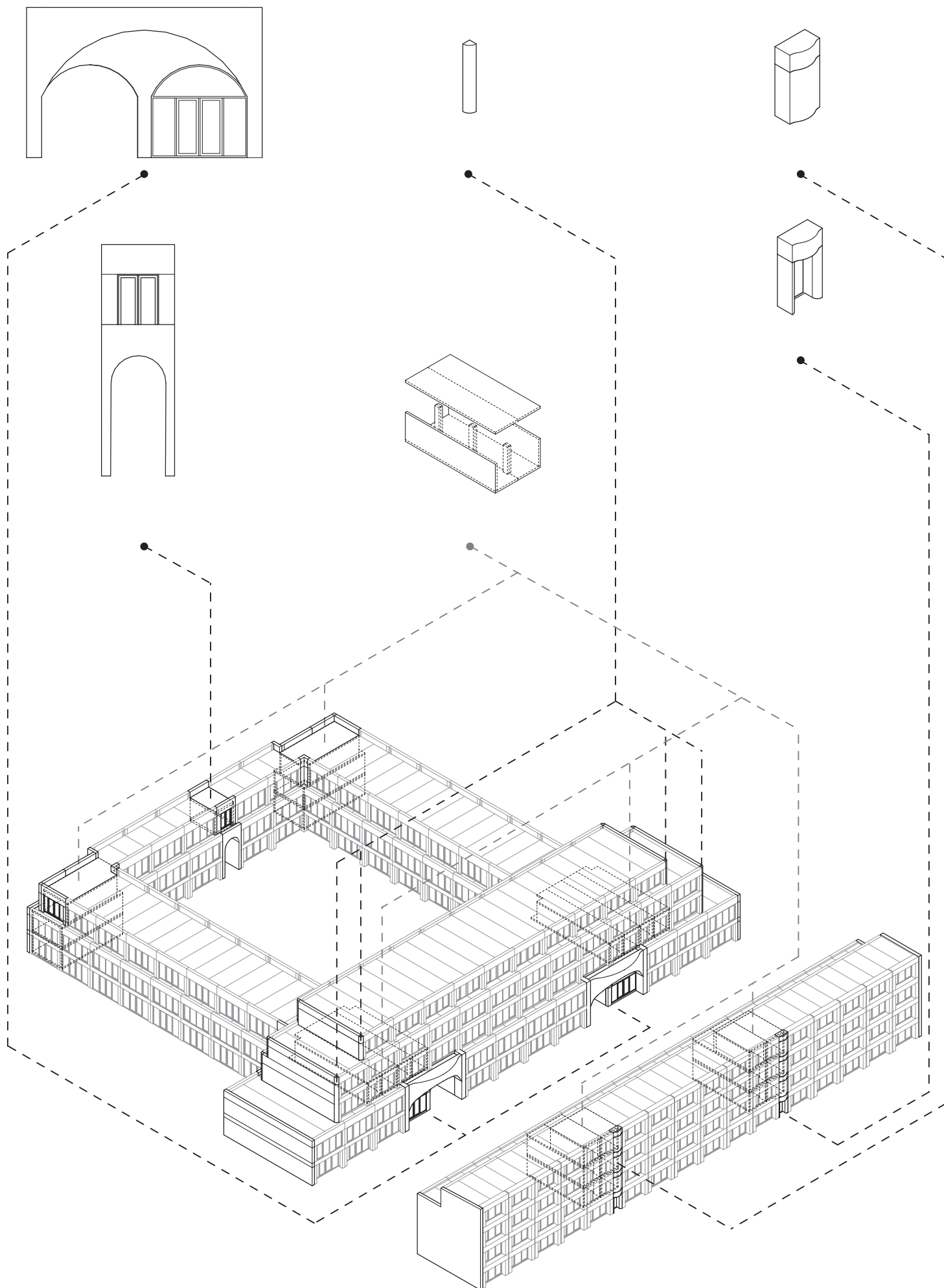


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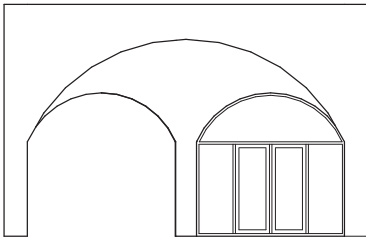


(B.3)

The needed variety in 2D facade modules to reconstruct Spaarndammerhart

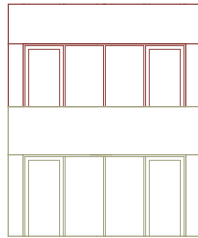


On-site exceptions needed to reconstruct Spaarndammerhart



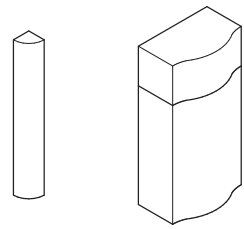
fenestration forms

entrance gates



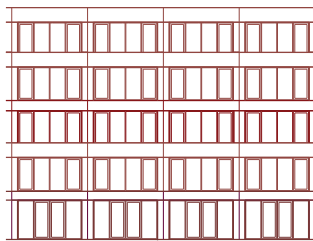
material expression

the use of contrasting brick colours and alternating masonry brickwork



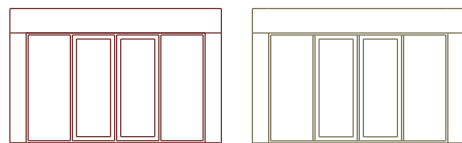
facade sculpturing

waving façades



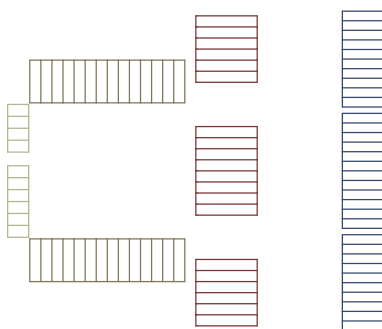
structural poetics

strong horizontal orientation



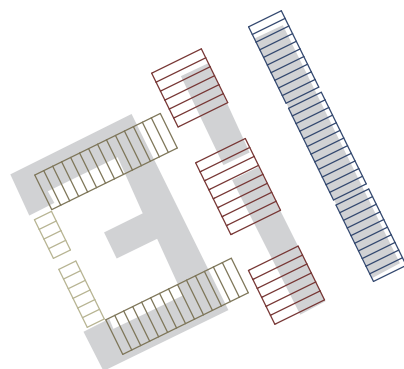
impulse to touch

contrasting material finishings



introspective types of local urban forms

courtyard typology as a introspective types of urban form from the perimeter block

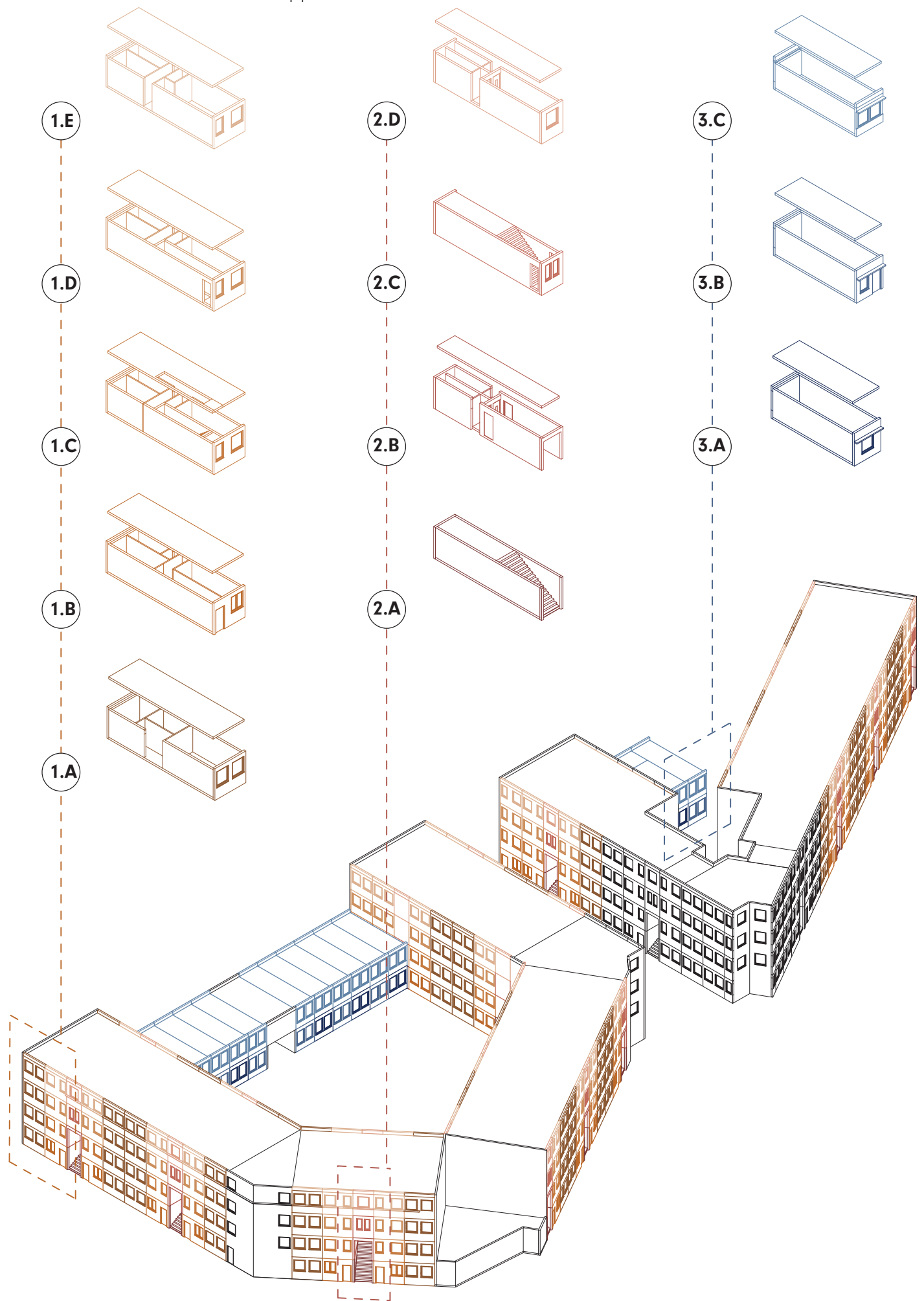


returning to former urban fabric

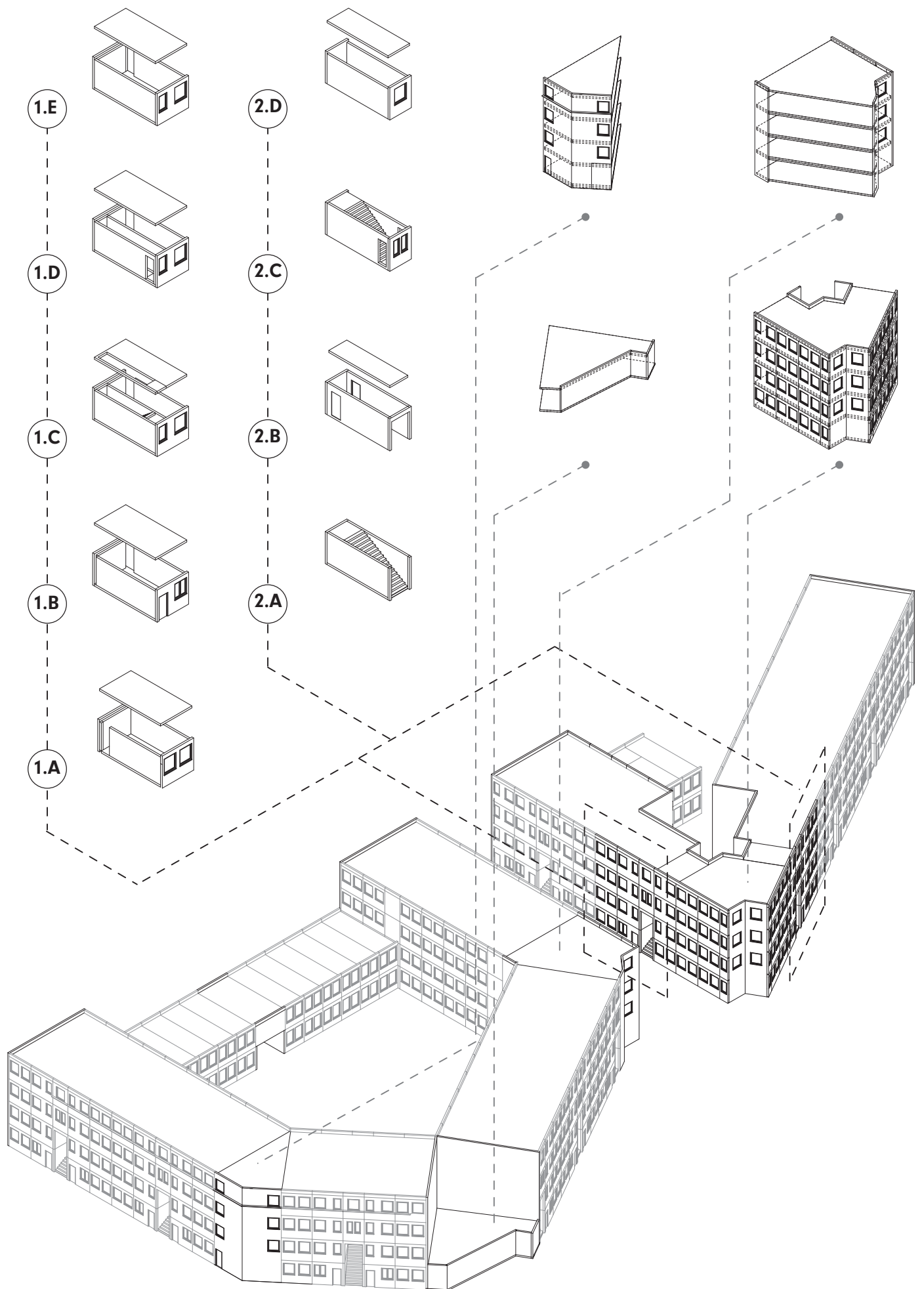
returning to the urban fabric of 1926

Context-specific design rules found in Spaarndammerhart executed by prefabricated modules (coloured) and on-site exceptions (black)

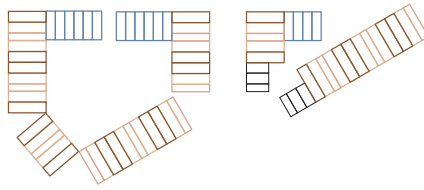
Attachment 15: An industrial approach to Punt Komma



Punt Komma reconstructed with 3D modules

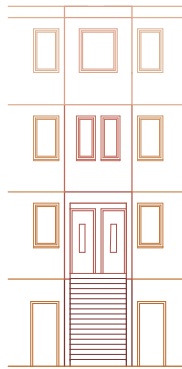


On-site exceptions needed to reconstruct Punt Komma



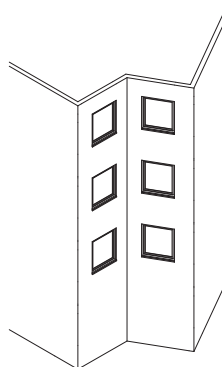
local building block typologies

courtyard typology as a introspective types of urban form



local building block typologies

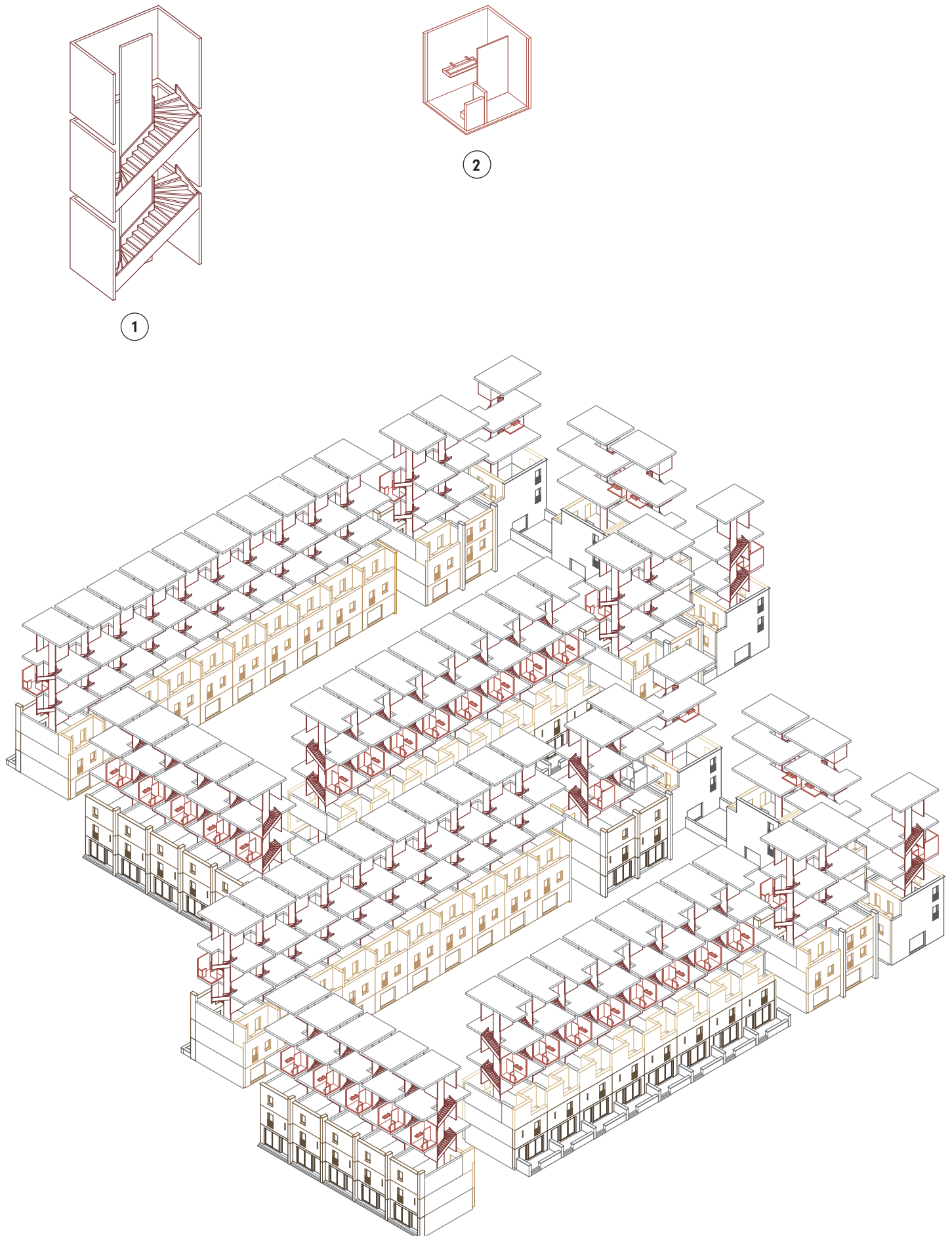
Haags portiek as an element that can define the boundary



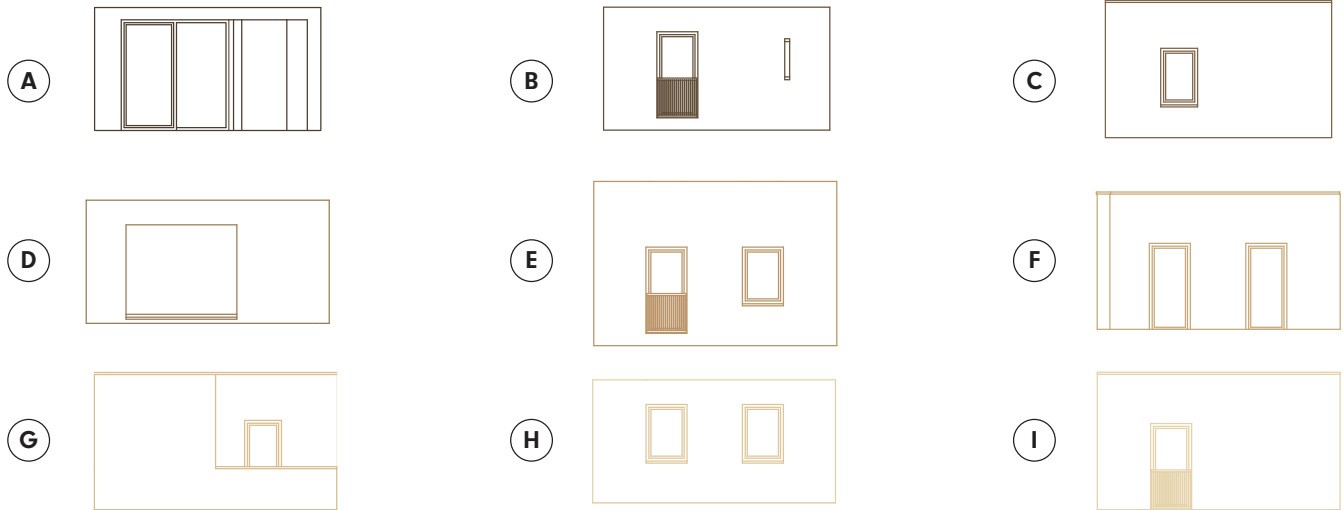
mimicing details of surrounding urban forms

indenting corner of the housing block, the corner solution in the housing block, mimics the surrounding urban forms.

Attachment 16: An industrial approach to Engelse park



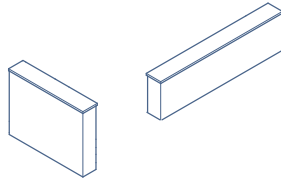
Engelse Park reconstructed with 2D and 3D modules



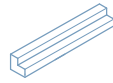
The needed variety in 2D facade modules to reconstruct Engelse Park



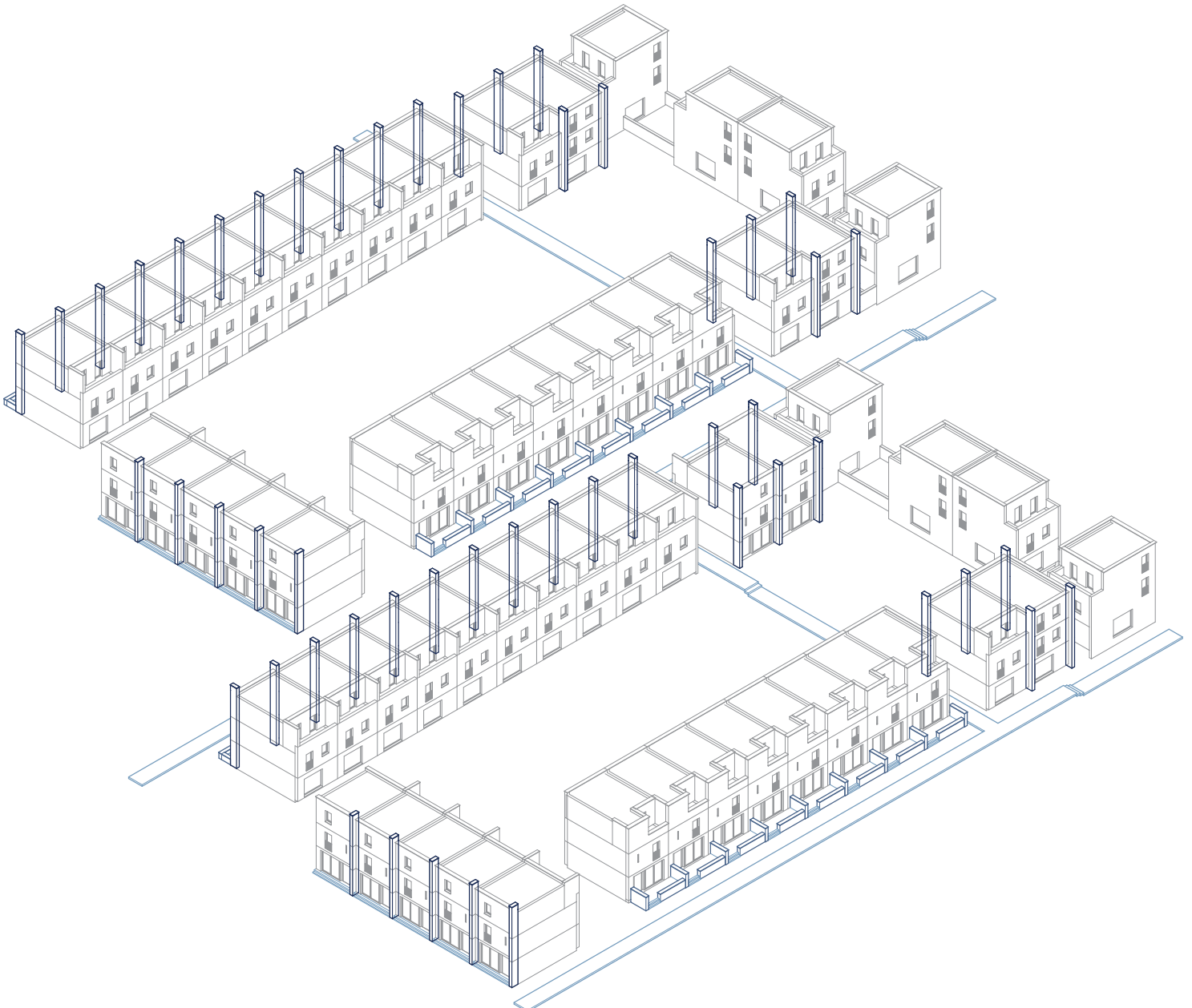
1



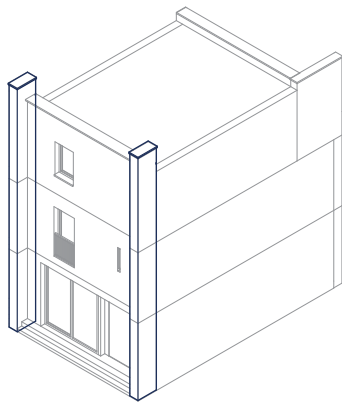
2



3

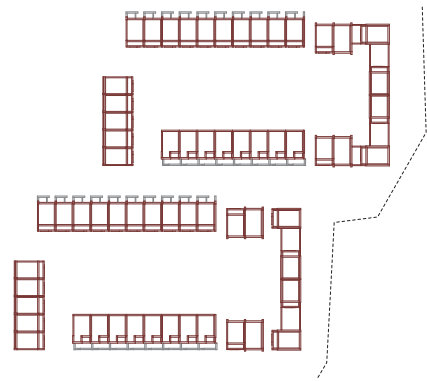


The needed variety in 1D modules to reconstruct Engelse Park



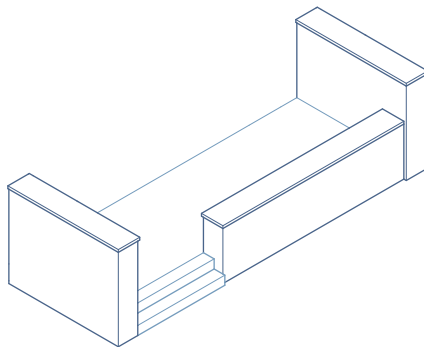
ornamentation

expressive verticality of the buildings, shown through
apparent chimneys on the façades and vertical
brickwork ornamentation



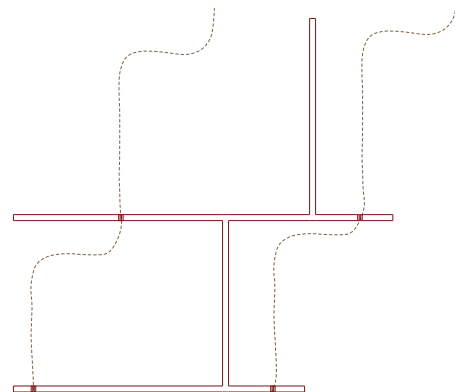
using present historical linearities

following historic urban defense linie



ramps towards housing

the speed of your body



maintaining existent topography

maintaining topography as a way of cultivating the
site