Systems in Motion

Modular Architecture for Conflict and Civilian Transition

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AR4EA010 EXTREME Graduation Studio

Graduation Report

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Foreword

This Graduation Report presents the pre-design research for my architecture graduation project, which takes the planned German brigade base at Rūdninkai, Lithuania as a testing ground for rethinking the military base as an adaptable field network rather than a single fixed camp. The work sits at the intersection of architectural theory, military basing doctrine and territorial design, and is intended to prepare a rigorous framework for the design phase of the project.

The research grew out of a long-standing interest in architectural systems that are deliberately incomplete: structures that anticipate change, negotiation and drift rather than finality. Encounters with the work of Cedric Price, Archigram, Yona Friedman, Constant Nieuwenhuys, N. John Habraken and Buckminster Fuller revealed a body of twentieth-century projects that already grapple with networks, megastructures, open building and planetary limits. Bringing these visions into dialogue with contemporary defence infrastructures on NATO's eastern flank has raised both disciplinary and ethical questions that shape this project.

This report is the first step in translating that dialogue into a design practice. It develops a comparative framework based on systemic architecture, using case studies, thematic dimensions and scalar analysis. Supported by two complementary modes of research: a top-down framework analysis and a bottom-up unstructured analysis. These are then condensed into designable actions that can guide later spatial decisions about how the Rūdninkai base network might adapt, hide, appear and withdraw over time.

Keywords: Adaptable Military Base, Rūdninkai, Lithuania, Multi-Scalar Design, Modular Architecture, Radical Architecture, Temporality, Spatial Organisation, Autonomy and Self-Reliance, Territorial Networks

Part 1: Introduction

Problem Statement

NATO's eastern flank is being reshaped around renewed fears of large-scale land conflict, particularly in the Baltic region. Lithuania has agreed to host a large multinational brigade, with the main German brigade base under construction at the Rūdninkai training area and additional facilities at Rukla (Bundeswehr, 2025; Ministry of National Defence of Lithuania, 2025). In parallel, Estonia, Latvia and Lithuania are developing the Baltic Defence Line of fortifications, obstacles and supporting infrastructures along parts of their borders with Russia and Belarus (Blachford, 2025; Institute of Central Europe, 2025; Lund et al., 2025). These developments signal a return to heavy, long-term military infrastructures in forested and border landscapes, even as current doctrine increasingly prioritises dispersion, resilience and hard-to-target force posture.

This creates a clear architectural problem. Contemporary military thinking often promotes dispersed basing, Agile Combat Employment and Expeditionary Advanced Base Operations as alternatives to the fixed camp, yet the spatial and architectural consequences of these concepts remain underdeveloped (Echols, 2020; Sick, 2017a; U.S. Marine Corps, 2023). In practice, the elements of such systems are still often imagined as generic camps, logistics sites or temporary clusters rather than as carefully designed spatial systems with different scales, lifespans and degrees of dependence.

The graduation project addresses this gap within the specific brief of the Rūdninkai brigade base. Rather than treating the base as a single, static camp, it investigates how a system of architectural base elements can be conceived as an adaptable, hard-to-locate and reconfigurable field network. The central challenge is therefore to move from a fixed camp model towards a distributed military landscape that can phase, shift and reorganise itself over time.

Fig 1 _ Fixed military camp model as the spatial problem addressed by the project.

Part 1: Introduction

Relevance

The design of large military bases in Europe is politically, socially and spatially sensitive. Such infrastructures influence forest clearance, patterns of access, levels of visibility and the perception of security and threat in surrounding communities. They are long-term territorial commitments whose spatial logic can intensify or reduce environmental disturbance, strategic rigidity and public controversy. Rethinking the fixed military compound is therefore relevant not only for defence actors, but also for broader debates on landscape stewardship, territorial planning and the relation between security infrastructures and society.

For architecture as a discipline, the topic offers an opportunity to test how conceptual and experimental traditions can be mobilised in a contemporary, high-stakes brief. Twentieth-century projects by Cedric Price, Archigram, Yona Friedman, Constant Nieuwenhuys, N. John Habraken and Buckminster Fuller all explored architecture as something open, networked, incomplete and capable of change over time (Mathews, 2006; Sadler, 2005; Friedman, 2011; Wigley, 1998; Habraken, 1972/1999; Fuller, 1969). Although these projects were not designed for military settings, they offer architectural thinking on flexibility, infrastructure, distributed organisation and temporality that is relevant to the Rūdninkai brief.

The project therefore contributes in two ways. First, it contributes to architectural quality by proposing that a military base can be designed through spatial and temporal strategies rather than only through engineering, logistics and force-protection logic. Second, it contributes to knowledge production by translating conceptual architectural case studies into an operative framework for contemporary military basing.

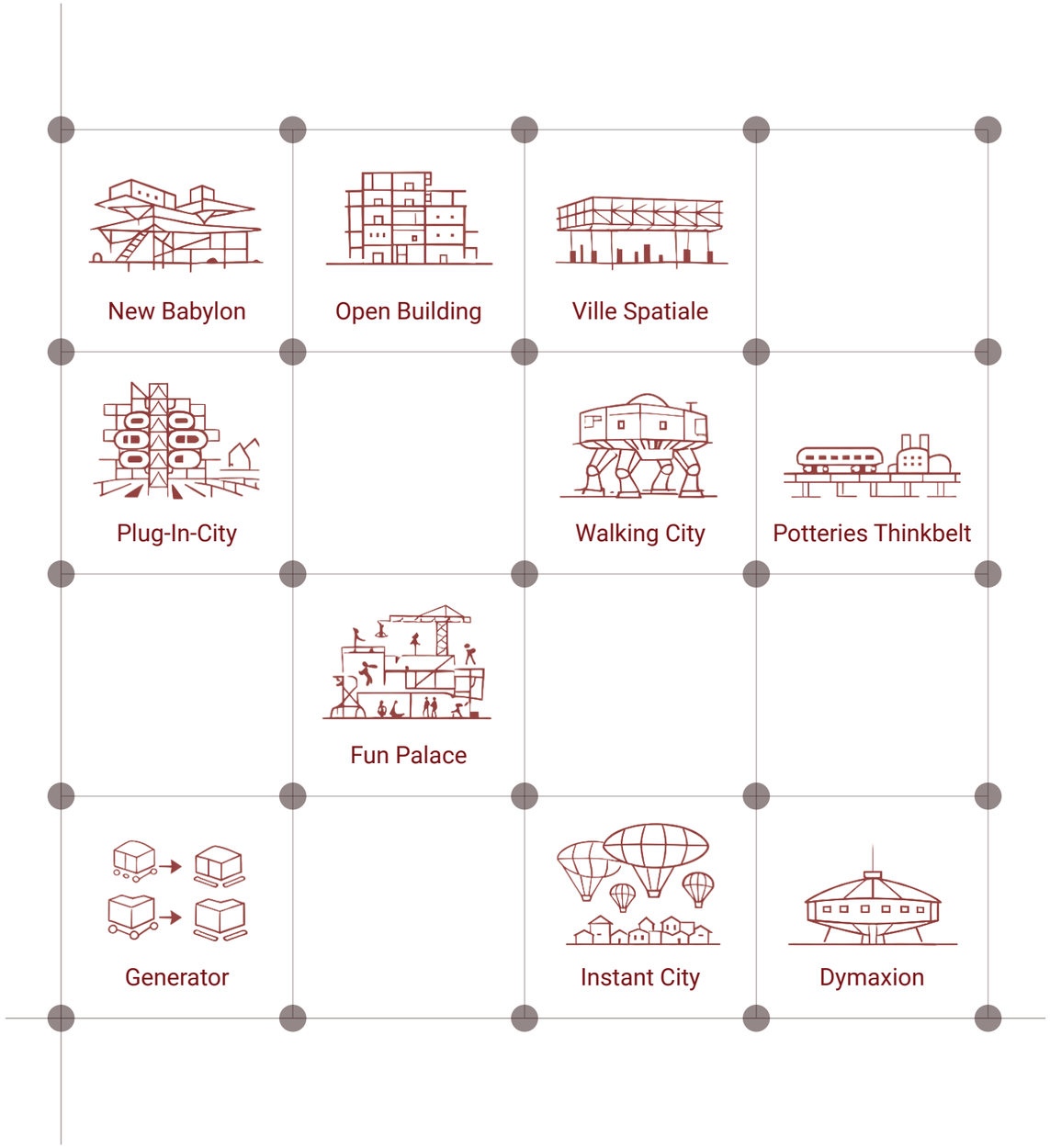


Fig 2 _ Corpus of case studies grouped into four systemic families.

Part 1: Introduction

Objective and Motivation

The objective of this graduation project is to develop a multi-scalar design framework for an adaptable military base at Rūdninkai. This framework aims to clarify which parts of the base remain long-life and relatively stable, which parts are short-life and reconfigurable, how these parts are linked through infrastructure, and how the overall base can operate as a distributed field rather than a single legible camp. The intended shift from static camp, to base elements, to adaptable network is an underpinning theme for this design.

My motivation for this topic comes from a longstanding interest in architectural systems that are unfinished by design. Projects such as Fun Palace, Potteries Thinkbelt, Plug-In City, Ville Spatiale, New Babylon, Open Building and the Dymaxion House all challenge static conceptions of buildings and cities, presenting infrastructures for change, drift, repetition and user agency instead (Landau, 1985; Cook & Webb, 1999; Nannini, 2017; Kendall & Teicher, 2000; Cohen, 2020). Bringing these ideas into dialogue with contemporary military basing offers a way to approach the Rūdninkai brief architecturally rather than treating it as only a technical or operational problem.

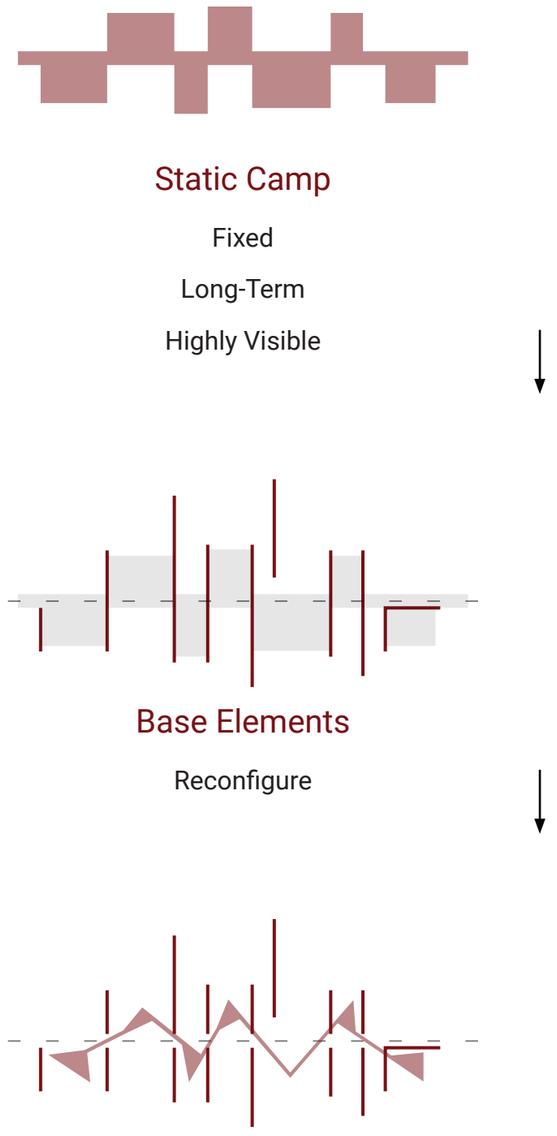


Fig 3 _ Research aim: from static camp to base elements to adaptable network.

Part 1: Introduction

Research Question

The graduation project is guided by the following main research question:

How can systemic architecture inform the multi-scalar design of an adaptable military base in Rūdninkai, Lithuania?

This formulation reflects the current direction of the research, in which two definitions are crucial. In this project, systemic architecture refers to architecture understood as a system of interconnected flows, rules, feedback loops and stakeholders rather than a standalone form. Multi-scalar refers to architecture understood through different levels of size and time, and especially through the ways these levels affect one another. The main question is unpacked into the following sub-questions:

1. Change
How does systemic architecture stage change over time, and what roles do different spatial scales play in those transformations?

2. Field Relations
How does systemic architecture organise relationships between elements and their wider territories?

3. Self-Reliance
How does systemic architecture inform the degree of self-reliance of base elements and clusters?

4. From Case Studies to Framework
How can the strategies identified in the case studies be translated into a design framework for an adaptable military base at Rūdninkai?

Together, these questions allow the research to move from conceptual analysis towards architectural application. They establish the basis for comparing case studies and for translating their scalar, temporal and systemic behaviours into a design framework for the site.

How can Systemic Architecture inform the Multi-Scalar design of an Adaptable military base in Rūdninkai, Lithuania ?

Change

How does systemic architecture stage change over time ?

Self-Reliance

How does systemic architecture inform the degree of self-reliance ?

Field Relations

How does systemic architecture organise relationships between elements and their wider territories ?

as a System

- interconnected flows, rules, feedback loops, and stakeholders - rather than a standalone form.

as a Dimension

- levels of size and time - and crucially how they affect each other.

Part 1: Introduction

Scope

The research is primarily theoretical and comparative with a pre-design orientation as its focus. Its empirical field consists of a curated set of case studies: New Babylon, Open Building, Ville Spatiale, Plug-In City, Walking City, Potteries Thinkbelt, Fun Palace, Generator, Instant City and Dymaxion. These case studies are selected because they fall under the broader umbrella of systemic architecture.

The thematic scope of the study is organised through four lenses: adaptability, spatial organisation, self-reliance and unpredictability. The scalar scope is defined through four working levels: S1 element or pod, S2 building or cluster, S3 larger architectural or infrastructural framework, and S4 territorial network. These scales are paired with temporal bands ranging from short-term change to long-term transformation.

The spatial scope of the design application is the Rūdninkai training area and its wider Lithuanian context. The programme is the future brigade base and its associated operational, logistical and support elements, approached not as a single permanent camp but as a distributed field of base components. At this stage, the project does not yet undertake a fully developed site analysis, environmental modelling, operational planning or engineering specification. Instead, it focuses on the conceptual and methodological groundwork needed to turn systemic case studies into a design framework that can later be tested on the site.

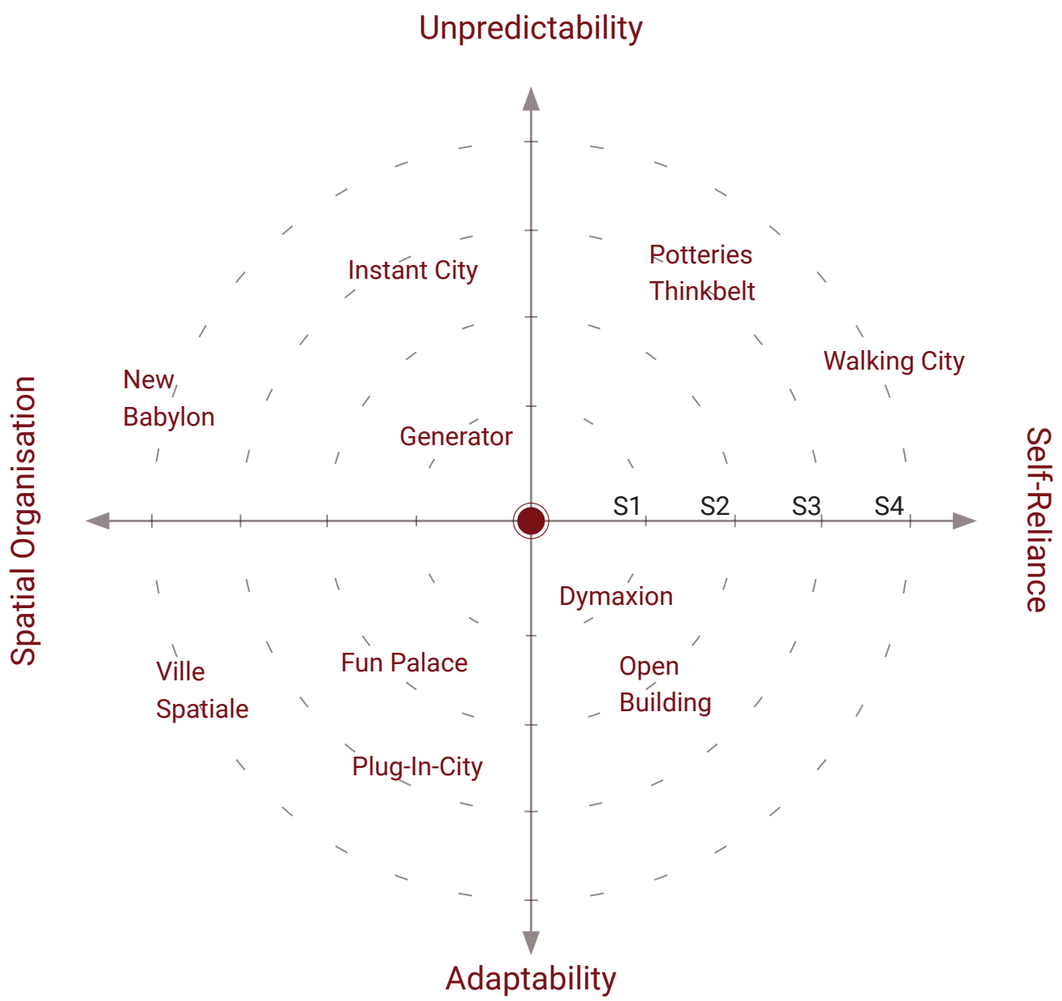


Fig 4 _ Analytical structure linking the case studies, the four dimensions and the scalar ladder S1-S4.

Part 2: Approach

Methods: Research and Design Strategy

The graduation project uses a qualitative, comparative and design-oriented research strategy. The method is structured to move from case study selection to analytical comparison, to the formulation of designable actions and, ultimately, to a design.

The first step is the identification of systemic architecture as the conceptual umbrella for case-study selection. Rather than choosing case studies because they are formally similar, the project selects cases that treat architecture as a system of interconnected units, flows, rules and actors. This establishes the corpus and frames the project in architectural terms.

The second step is the construction of four analytical dimensions: adaptability, spatial organisation, self-reliance and unpredictability. These dimensions provide a common lens through which all case studies can be compared. They help identify where each case study performs strongly, where it is weaker, and which behaviours may be useful for a future military base network.

The third step is the division of the analysis into two complementary parts. The first is a framework analysis, which follows a top-down logic. In this step, the selected case studies are assessed across the four dimensions and positioned in relation to four scalar levels. This allows the projects to be compared systematically and makes visible where each case study is most active. The second is an unstructured analysis, which follows a bottom-up logic. Here the project looks more closely at four narrower dimensions: decision locus, main flows, temporal profile and transformation. In this exercise the case studies are not only compared as complete systems, but also dissected in terms of how change is triggered, what flows through the system, what temporal rhythm the system follows, and how components or clusters move between fields.

The final step is formulation. After both analyses are completed, the findings are synthesised into a set of designable actions for each case study. These actions translate conceptual projects into possible architectural moves for the studio phase. They do not replicate the case studies formally; instead, they identify usable strategies for interiors, facades, compounds, infrastructural lines, thresholds and territorial distributions.

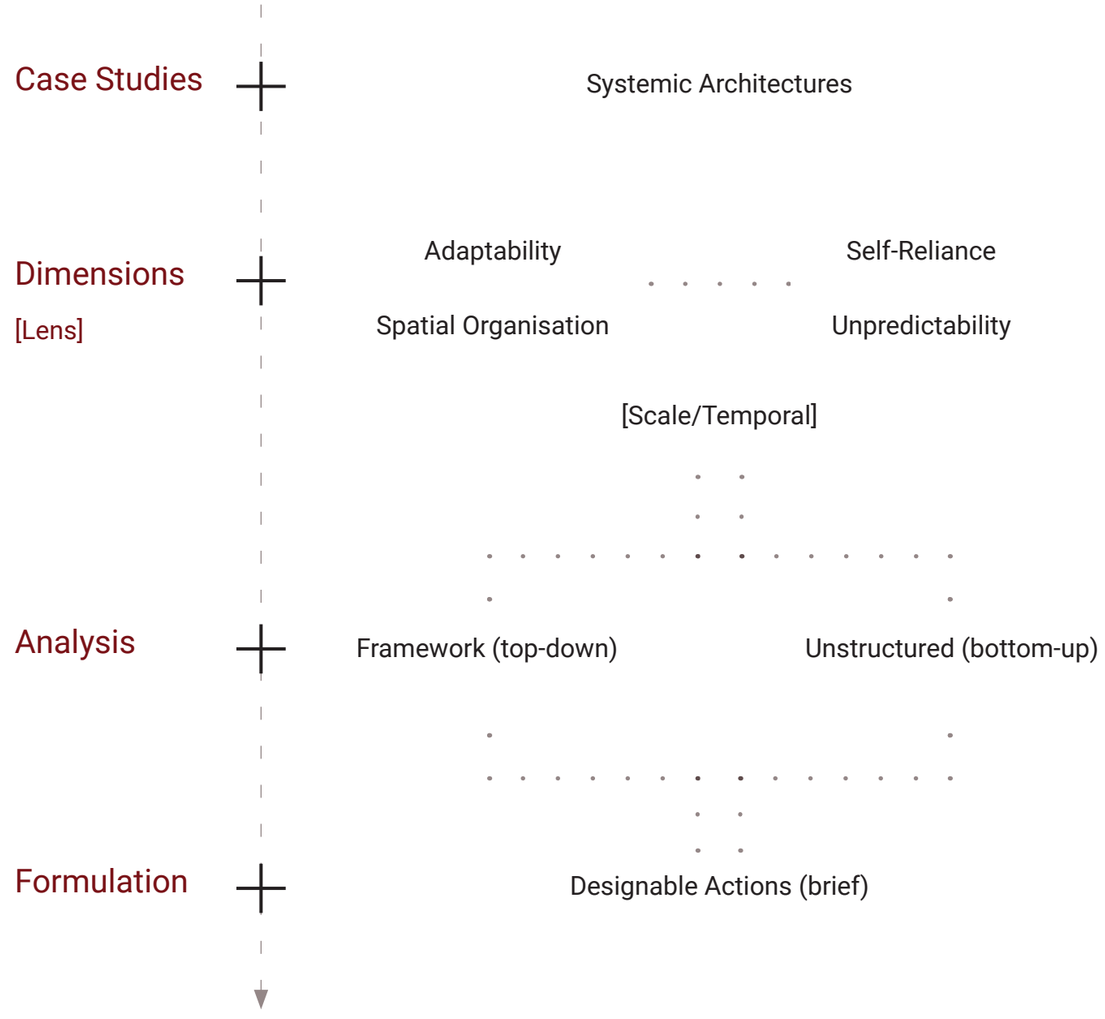


Fig 5 _ Research process from systemic case studies to designable actions and a brief.

Part 2: Approach

Planning

The planning of the graduation project follows the same logic as the method: research and design develop in parallel and inform one another iteratively. The A1 phase has focused on defining the problem, selecting the case studies, establishing the analytical dimensions and producing the first diagrams and matrices. This phase culminates in the research paper, the first brief and the A1 presentation.

The following phases shifted gradually from comparative research towards design translation. The planning continued through the development of the matrices and icons, followed by sketch design, site-based testing and more detailed design exploration. This stage included site visits, fieldwork, modelling and façade tests, which were used to confront the conceptual framework with concrete spatial and material decisions.

Planning in this project is therefore not linear but iterative. Early research outputs generate design hypotheses, while early design tests feed back into the interpretation of the case studies. The process is best understood as a staged loop between research and design rather than as two separate sequences.

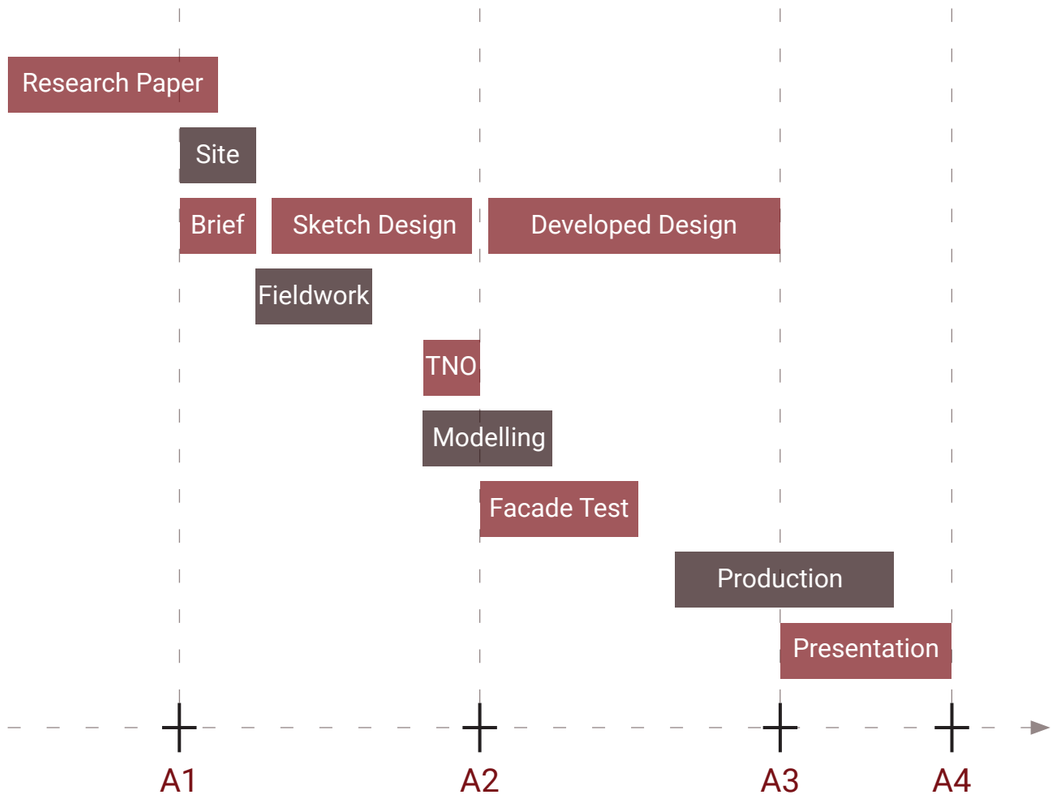


Fig 6 _ Planning timeline showing the relation between research outputs, design phases and testing.

Part 2: Approach

Theoretical Framework: Literature and Case Studies

The theoretical framework provides the conceptual background for the project and clarifies how the selected case studies are related. It also forms the basis of the pre-design research by defining the corpus, the analytical dimensions and the first comparative diagrams.

A first strand concerns enabling frameworks and cybernetic environments. Cedric Price's projects are important here because they treat architecture as an enabling structure that can host changing uses and respond to different forms of occupation. Landau interprets Price's work as a philosophy of enabling rather than fixing (Landau, 1985), while later scholarship on Fun Palace and Generator stresses their cybernetic and feedback-based logic (Hernández, 2015; Sweeting, 2019). These sources help frame adaptability as something organised through systems and rules rather than through a general idea of flexibility.

A second strand concerns megastructures, mobility and event-cities. Archigram, Yona Friedman and Constant all propose architectures made from interconnected units whose meaning depends on their relation to larger fields or networks. Plug-In City, Instant City and Walking City foreground infrastructure, circulation and movement (Cook & Webb, 1999; Steiner, 2009), while Ville Spatiale and New Babylon extend this into distributed spatial systems shaped by user action, wandering and shifting situations (Friedman, 2011; Duyul, 2017; Wigley, 1998). These case studies support the project's focus on field relations, spatial organisation and unpredictability.

A third strand links orders of the ordinary and planetary systems. Habraken's Open Building work provides a model for how different parts of the built environment change at different rates and under different decision-makers (Habraken, 1972/1999, 2000; Kendall & Teicher, 2000). Fuller's Dymaxion House and "Spaceship Earth" contribute a systemic understanding of dwellings and settlements as parts of larger resource and infrastructural cycles (Fuller, 1969, 1981; Cohen, 2020). Together, these sources make it possible to discuss self-reliance, support systems and temporal layering in architectural rather than purely technical terms.

These theoretical strands are translated into the grouped case-study corpus, where the case studies are organised into four broad systemic families. They are then positioned through the analytical structure, which relates the case studies to the four thematic dimensions and the scalar ladder from S1 to S4. The first comparative output of this framework is the top-down framework analysis, where each case study is assessed across the four dimensions of adaptability, spatial organisation, self-reliance and unpredictability. This does not yet produce final design conclusions, but it reveals where each project is most operative and where it is less useful.

The second output is the bottom-up unstructured analysis, which examines each project through decision locus, main flows, temporal profile and transformation. Here the focus shifts from broad thematic comparison to how the systems actually behave: who triggers change, what moves through the system, how long parts persist and by what means they transform. Together, Figures 3,4,7 and 8 show that the case studies do not offer finished formal models, but a repertoire of systemic behaviours that can be compared, selected and translated into design.

Part 2: Approach

Theoretical Framework: Literature and Case Studies

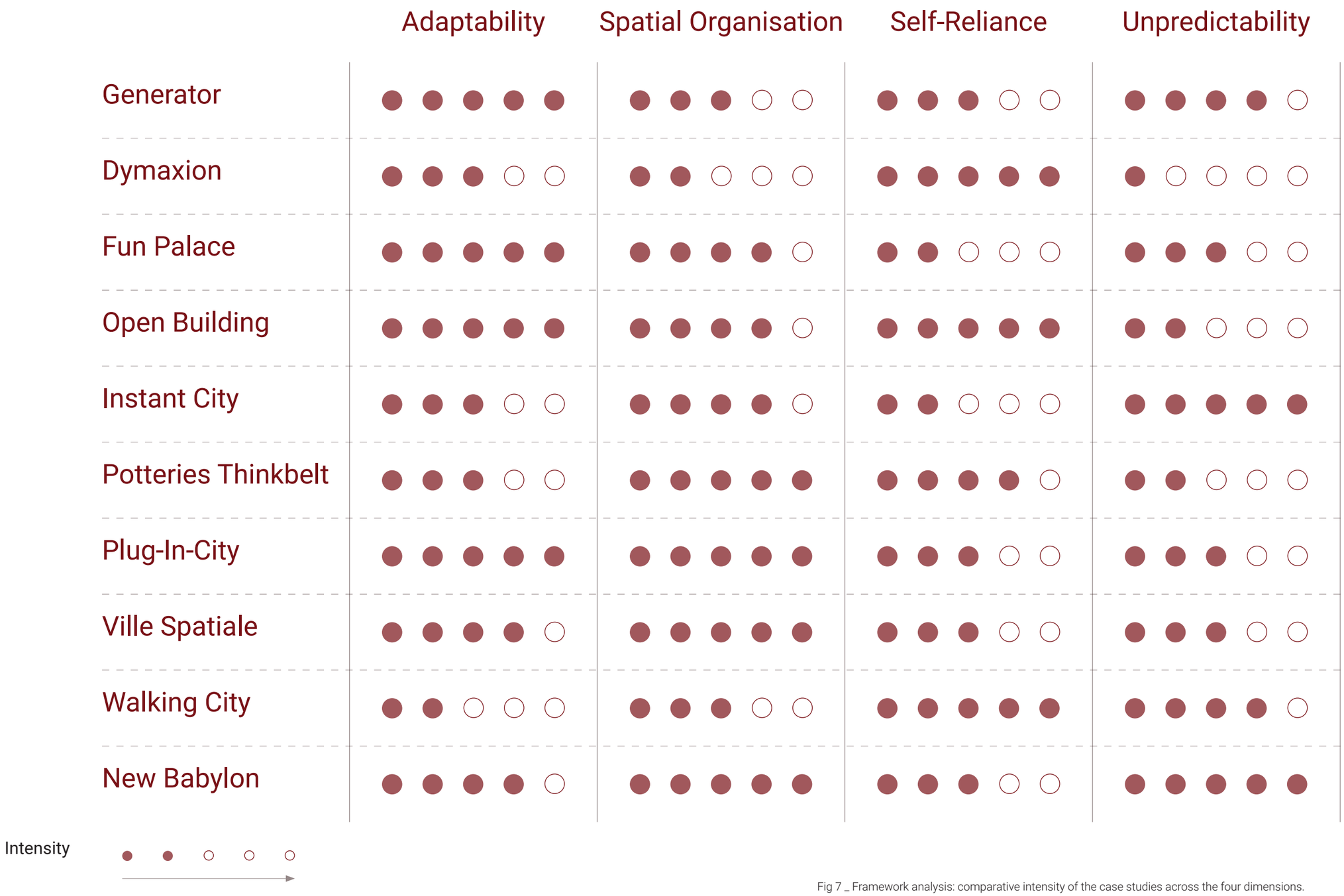


Fig 7 _ Framework analysis: comparative intensity of the case studies across the four dimensions.

Part 2: Approach

Theoretical Framework: Literature and Case Studies

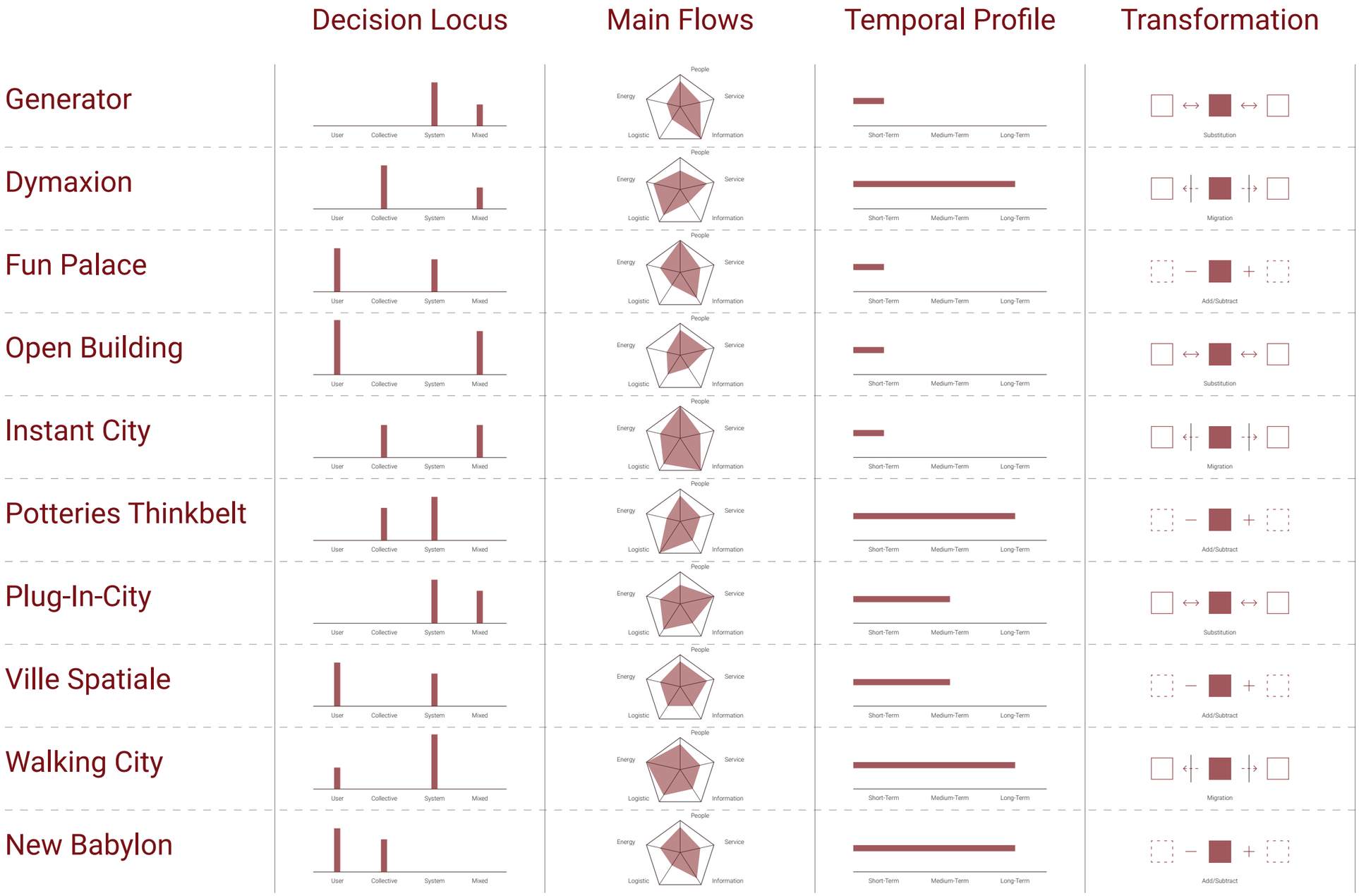


Fig 8 _ Unstructured analysis: decision locus, main flows, temporal profile and transformation across the case studies.

Part 2: Approach

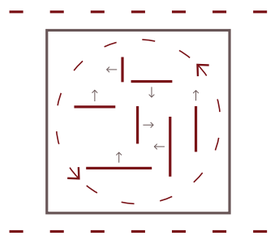
Preliminary Design: Translation and Transition

The pre-design research does not end with comparison alone. A central aim of this project is to translate the analytical findings into architectural strategies that can guide the later studio phase. The first step in that translation is where each case study is condensed into a designable action. These actions function as operative seeds for the project. Rather than copying the case studies formally, they extract usable architectural moves: reconfigurable interiors, selectable compounds along infrastructural lines, responsive module fields, clipable facades, temporary overlays, self-reliant clusters, replaceable infill systems, and variable degrees of permeability or shared support.

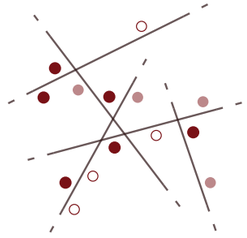
At this stage, the project moves from interpretation towards application. The case studies are no longer treated only as theoretical references, but as sources of spatial and temporal behaviours that can be reassembled into a framework for Rūdninkai. In this sense, the designable actions are the first point at which the research begins to operate as design.

An early sketch of this transition is visible below, where several of these attributes are brought together in a preliminary project vision. This image is not yet a resolved proposal. Instead, it shows how infrastructural lines, clustered operations, layered facades, changing interior use, movement between sites and long- and short-life elements may begin to coexist within one military landscape.

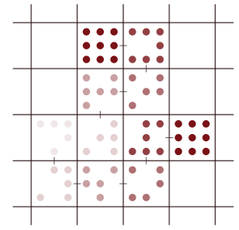
This section also prepares the shift into Part 3, where site analysis and design development become more explicit. The systemic and scalar findings established here will next be confronted with the actual conditions of Rūdninkai: topography, forest cover, existing clearings, access routes, visibility and territorial thresholds. Part 3 will therefore focus on how the pre-design research, together with site-based observations, begins to shape concrete spatial decisions and the emerging design of the project itself.



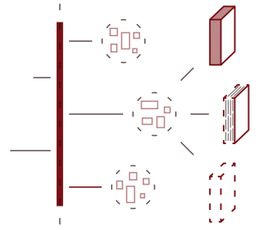
Fun Palace



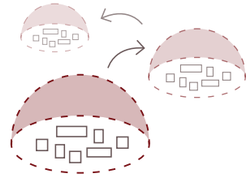
Potteries Thinkbelt



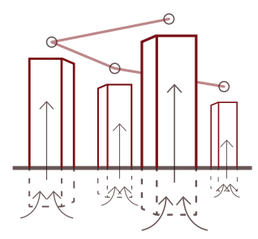
Generator



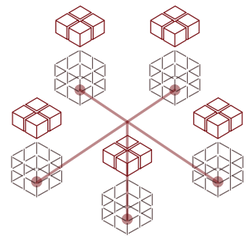
Plug-In-City



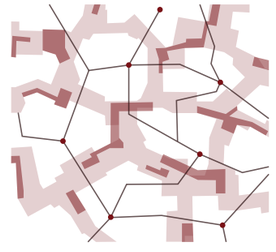
Instant City



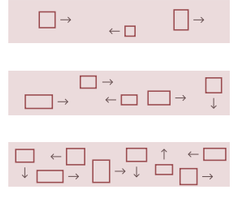
Walking City



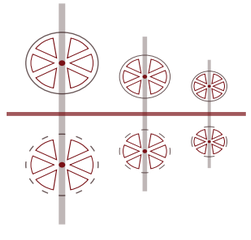
Ville Spatiale



New Babylon



Open Building



Dymaxion

Fig 9 _ Preliminary designable actions derived from the case study analysis.

Part 2: Approach

Preliminary Design: Translation and Transition

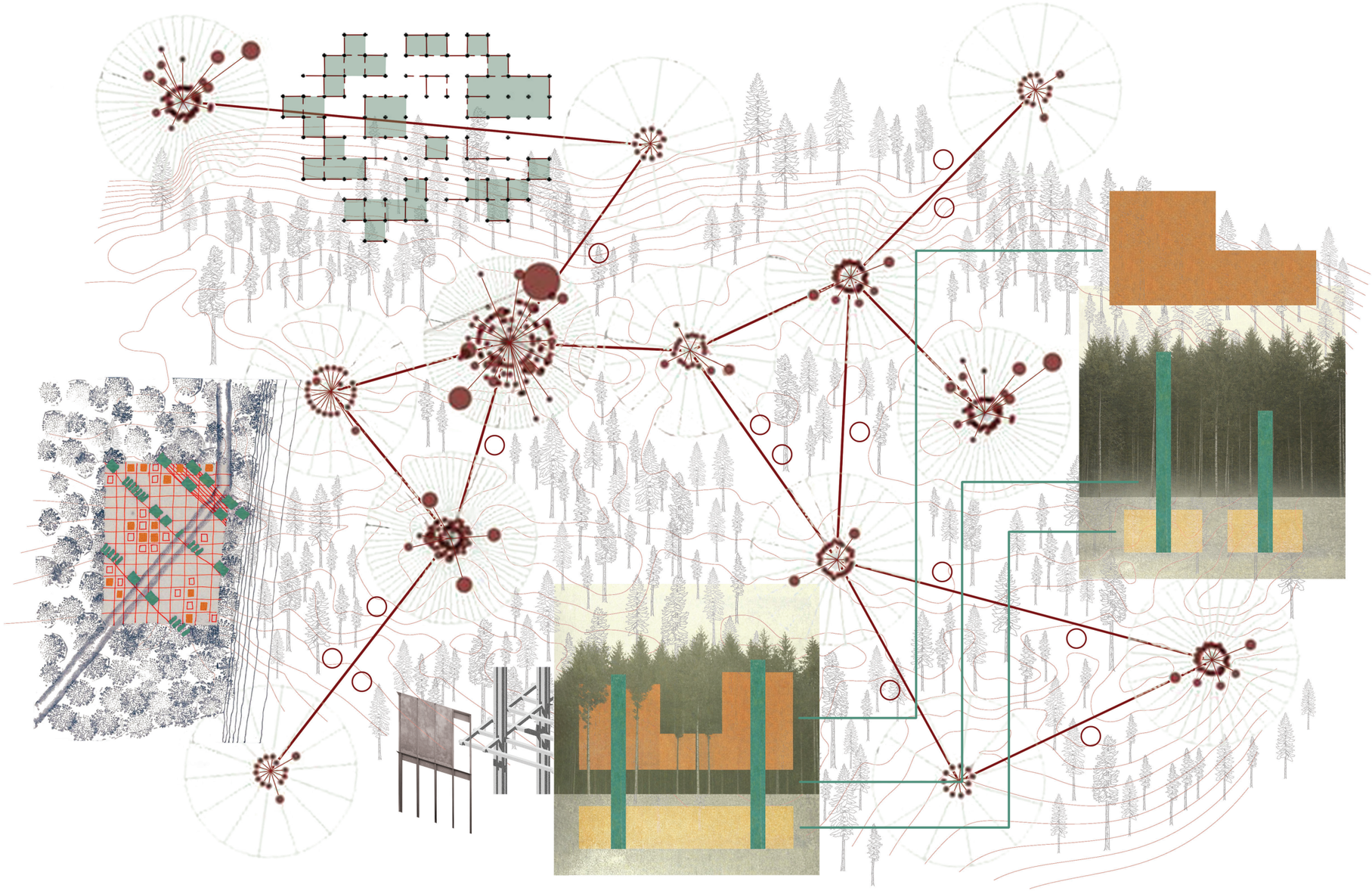
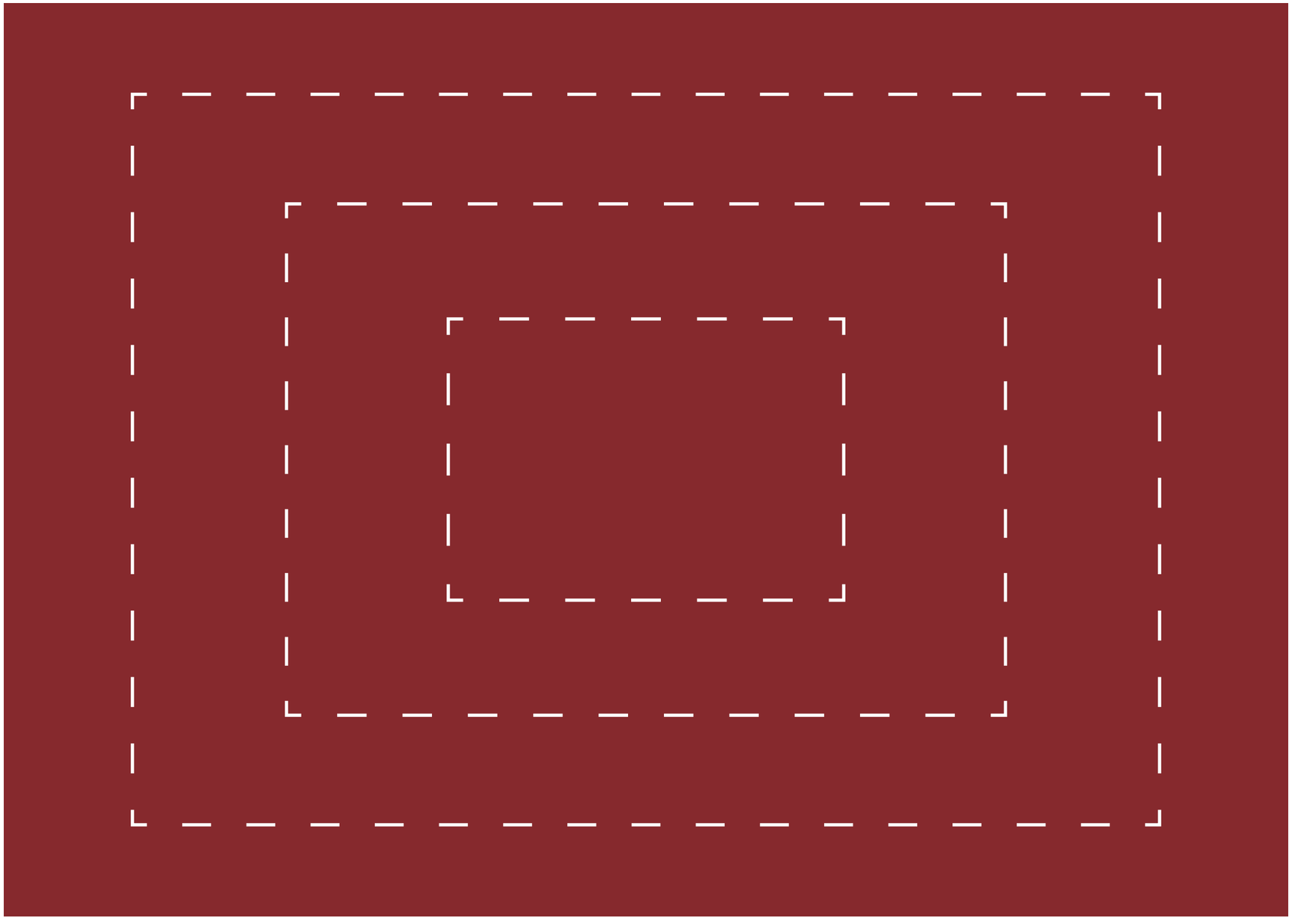


Fig 10 _ Early project vision: sketch collage of scalar, temporal and systemic attributes to be developed in design.

Story Through Scales

Scale _ 4



Part 3: Results

Territorial Field and Site Reading

This chapter presents the architectural design as an outcome of the research by design process. Although the work developed non-linearly, moving back and forth between drawings, models and tests, it can be explained clearly through a sequence of scales. This is important because the project's central claim, established in Parts 1 and 2, is that the military base should be understood as a multi-scalar system rather than a single fixed camp. The design process therefore moved from the territorial field to the organisation of clusters, to the phased life of a single building vs a cluster formation, to programme and interior, climate, detailing and construction. The project is a selective translation of the earlier research: not all of the precedent strategies were carried forward equally, but the design consistently develops the dimensions that proved most useful in the pre-design work, especially adaptability, spatial organisation and self-reliance.

The first design step was to read the site as a field of unequal conditions rather than as a single plot for a camp. The chosen area, south-west of the Rūdninkai training ground, is structured by two smaller rivers joining into a larger meandering river, by variations in topography, and by dense pine forest interspersed with scattered farms and homesteads. In the site analysis, elevated and sheltered positions were read as potential defensive locations, while more open river-adjacent areas suggested faster movement, greater exposure and more aggressive positions. The same analysis also mapped material presence in the landscape, including clay, stone, gravel, timber and wool. This transformed the site from background into a system of positions, resources and movement corridors. In terms of the research framework, this is the first point at which the project begins to operate clearly at S4, while giving spatial form to the themes of field relations and controlled unpredictability established in Parts 1 and 2.

At this scale, the project most clearly aligns with the research dimensions of spatial organisation and unpredictability. The aim was not to place one dominant object in the landscape, but to build a territorial logic of distributed occupation. Seen against the analytical diagram, this territorial reading shifts the project away from the fixed-camp model introduced in the introduction and closer to the distributed, relational logics identified in the case-study research.

Part 3: Results

Territorial Field and Site Reading

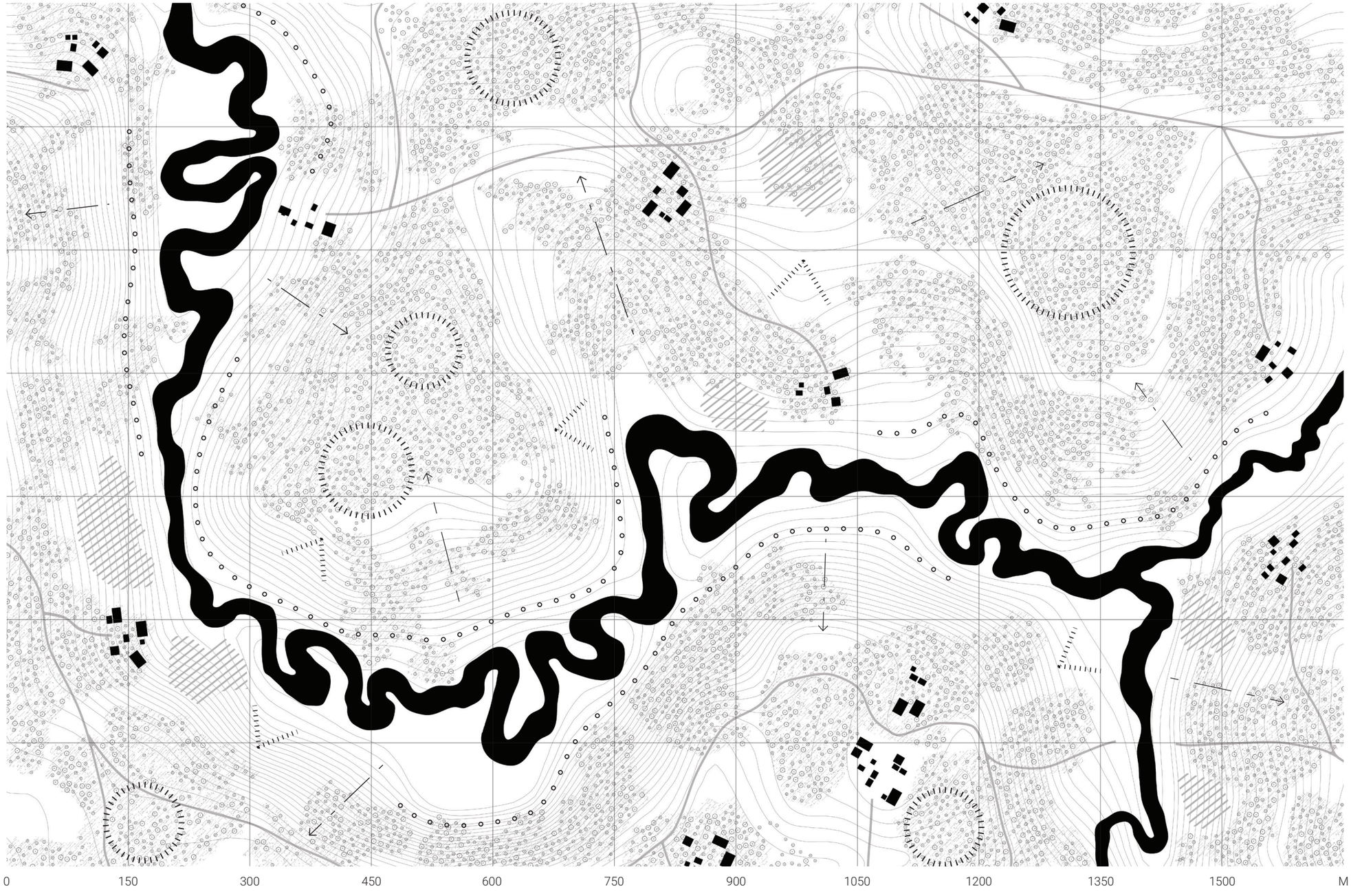


Fig 11 _ Analysis of chosen site, southwest of Rudninkai training area.

Part 3: Results

From Case Study to Dispersed Occupation

The second move translated the case study research into a spatial proposition. Early concept models explored a gridded support with a central core and multiple module combinations, strongly influenced by Ville Spatiale. These models were not searching for one finished form. They were testing how many different organisations could emerge from one underlying logic of support and attached units.

When these studies were reintroduced into the site, the project proposed a more specific system: clusters placed along lines of movement, underpinned by permanent but hidden basement nodes connected across the landscape. These basements remain inactive until activated by a prefabricated core and lightweight infill above. This is one of the clearest returns to the research from Part 2. It adopts the support-infill distinction from Habraken and Friedman and combines it with the project's own concern for concealment. The long-life layer is buried and territorially distributed; the visible occupation is lighter, repeatable and adaptable. The arrangement of clusters also echoes the pattern of surrounding farms and homesteads, blurring the distinction between civilian and military occupancy when read from above. At this stage, the project is working most strongly between S3 and S4, where the research themes of spatial organisation, concealment and selective activation begin to converge in a site-specific proposal.

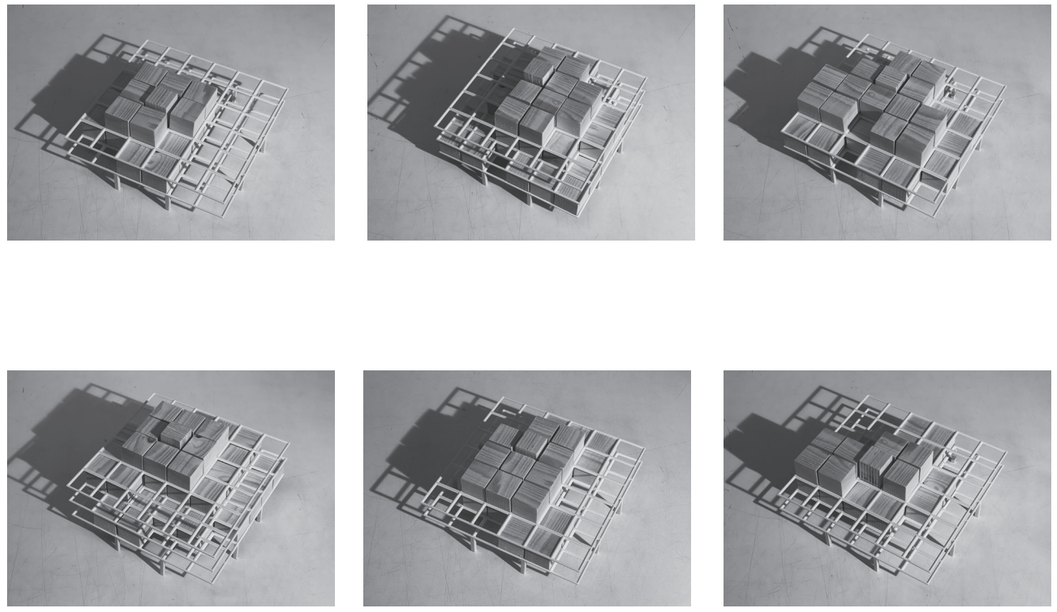


Fig 12 _ Series of iterative module organisations formed at a concept stage.

Part 3: Results

From Case Study to Dispersed Occupation

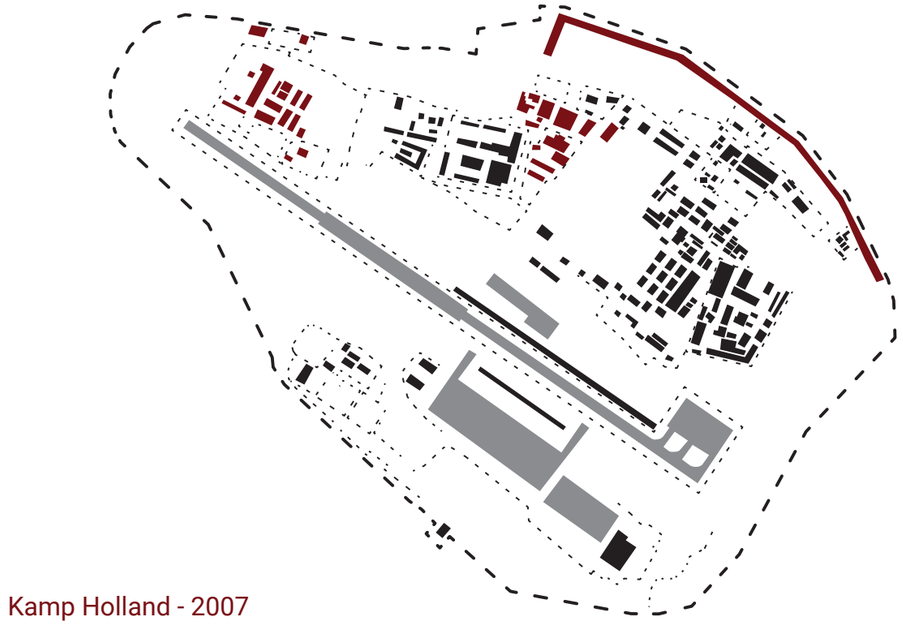
Fig 13 _ Site plan with organisation of clusters and basement nodes.

Part 3: Results

Camp Holland to Scenario Testing

A major shift in the design process came through the study of Camp Holland in Tarin Kowt. After the discussion with TNO, adaptability had to be tested not only as a conceptual ambition but as a response to real military transformation. The Camp Holland diagrams showed repeated phases of growth, replanning, intensification, consolidation and afterlife between 2005 and 2024. The key lesson was that military bases do not remain stable: they expand, thicken, harden, shrink and sometimes outlive their intended purpose entirely. This observation gave the research framework a concrete design test, because adaptability could now be measured not only as a conceptual ambition but as a response to the actual life cycle of military occupation.

That lesson was then translated into a series of scenario tests for the proposed base: sudden deployment, troop surge, threat escalation, mission wind-down, closure and legacy, humanitarian occupation, and political or health emergency. Through these scenarios, the cluster became the first real operative unit of the design. It could grow, disperse, compartmentalise, consolidate or reduce its footprint. These scenarios are not only formal variations; they are tests of how dispersed clusters behave in relation to each other and to the site. The diagrams showcase a simple lesson of cause and effect, with the scenarios being the cause and the way the clusters move to anticipate or react being the effect.



Kamp Holland - 2007

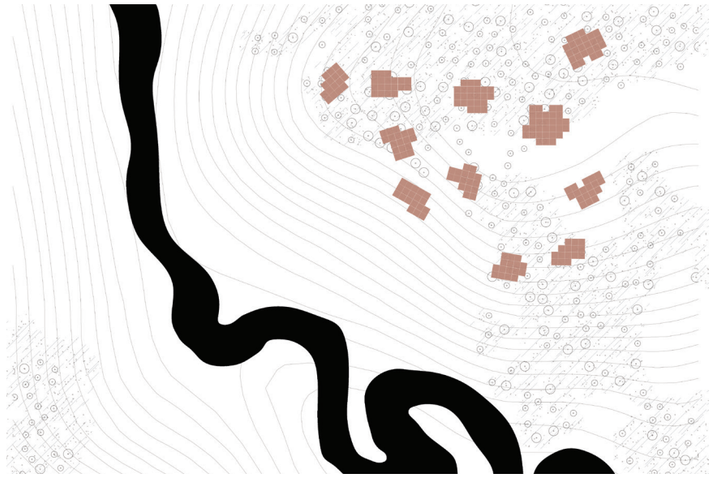
Kamp Holland - Late 2012

0 250m 1:10000

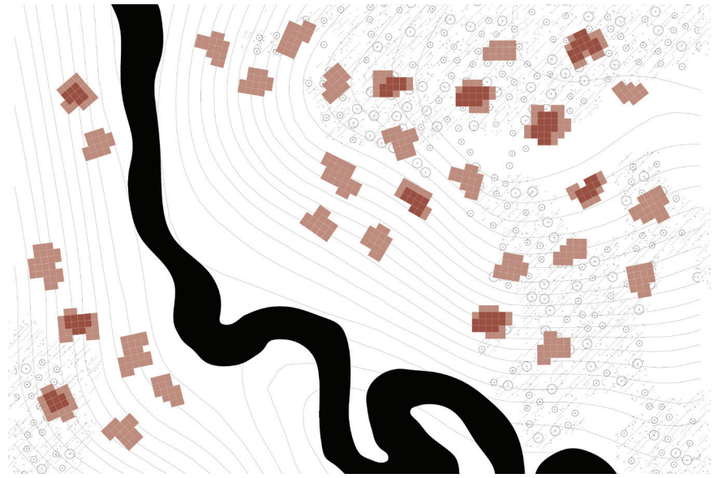
Fig 14 _ Two snapshots of Camp Holland in Afghanistan during specific years.

Part 3: Results

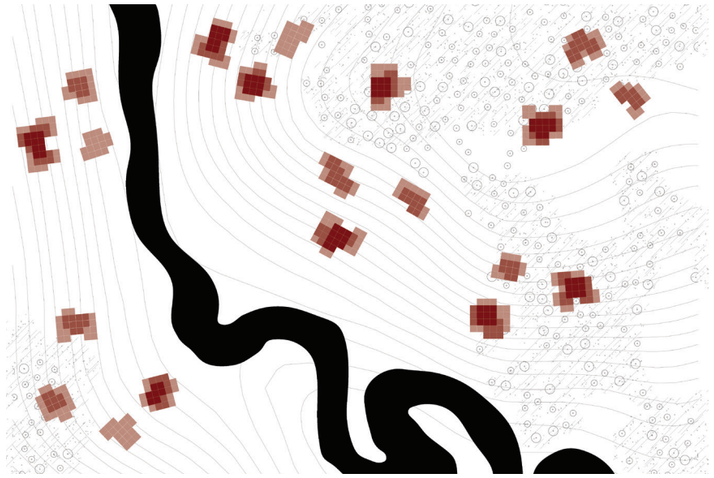
Camp Holland to Scenario Testing



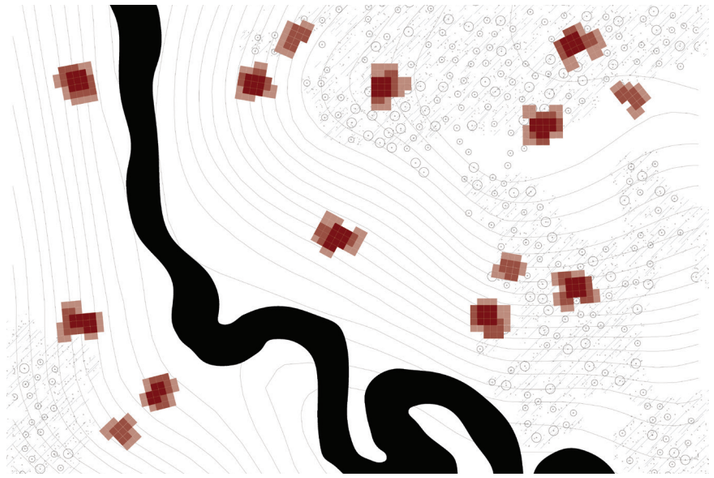
Sudden Deployment Order



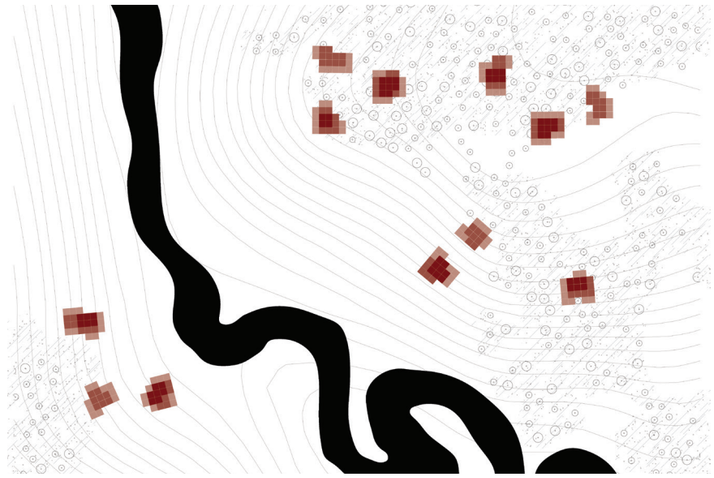
Force Surge (Major Troop Increase)



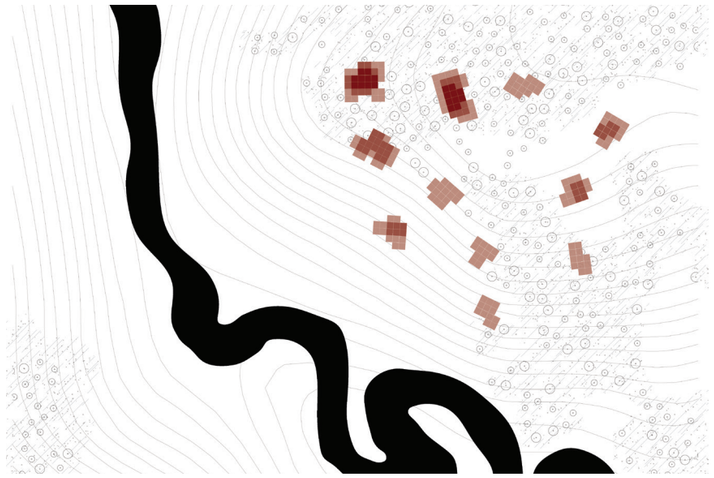
Threat Escalation



Mission Wind-Down



Closure/Legacy



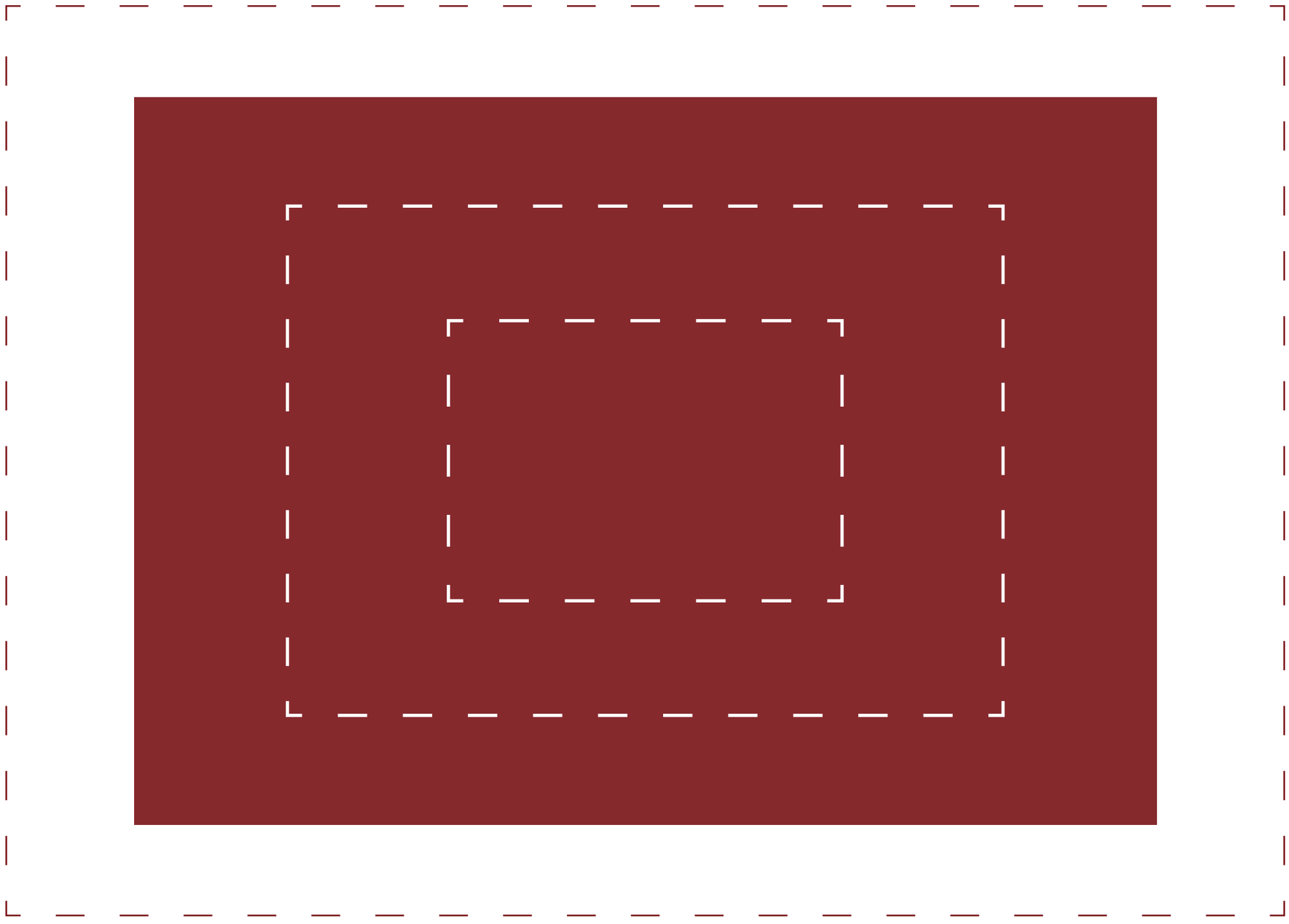
Humanitarian/Civilian

0 25m 1:1000

Fig 15 _ Series of scenario testing: Cause and Effect of clusters to external or internal situations.

Story Through Scales

Scale _ 3

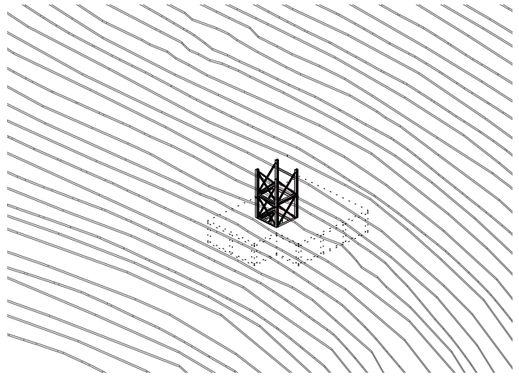


Part 3: Results

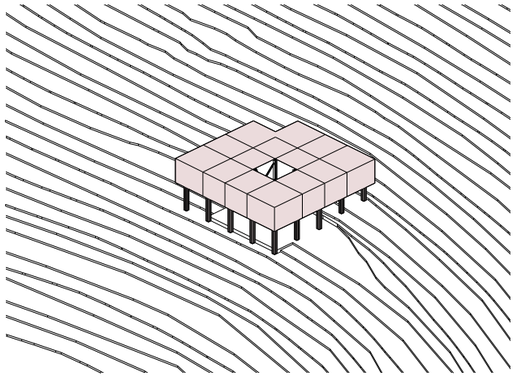
From Building Phasing to Cluster Reconfiguration

The next step condensed the scenario logic into the life of a single building. This is where the research most clearly becomes architecture. The building is not treated as a fixed type but as a phased system: Place, Activate, Use, Expand, Protect, Harden and Transform. The result is a building organised from the outset around different rates of change. Basement and core are relatively fixed while floors, modules and façade layers are flexible or adaptable. Read through the bottom-up analysis from Part 2, this is also the point where the project's dominant transformation mode becomes clear: it relies primarily on add/subtract logics, with movement and reassembly appearing as secondary operations.

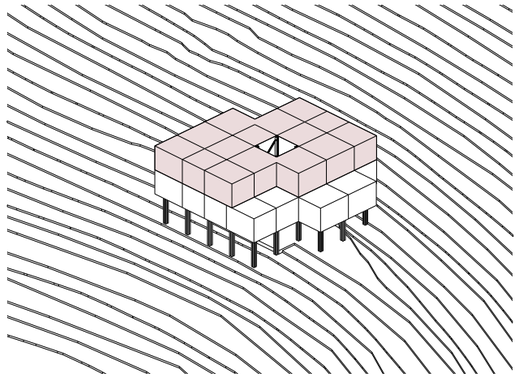
A further development of the phased framework was the cluster-sequencing exercise, which tested how a building behaves not only as an individual object but as part of a wider formation across the Pre, During and Post-Conflict phases. In this exercise, each building is limited to a fixed set of forty-five modules, and the design question becomes how those same modules can be rearranged rather than continually added to. This introduced a clearer circular logic into the project: the system grows, compresses, disperses and regathers through reconfiguration rather than expansion alone. It also made the in-between spaces of the cluster more important, because the shifting of modules began to produce sheltered exterior rooms, smaller auxiliary structures and changing thresholds between indoor and outdoor occupation. As a result, the cluster is no longer understood as a stable group of separate buildings, but as a reconfigurable field in which the same material and spatial resources are repeatedly redistributed according to changing military and post-conflict needs.



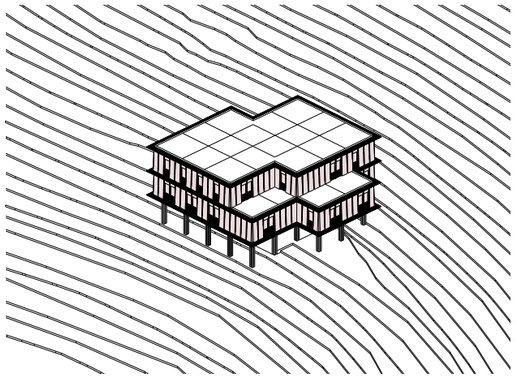
Activate (Fixed)



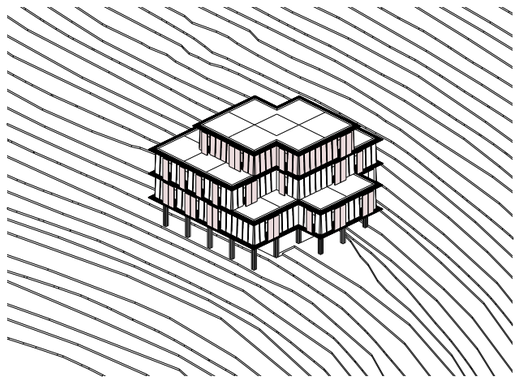
Use (Flexible)



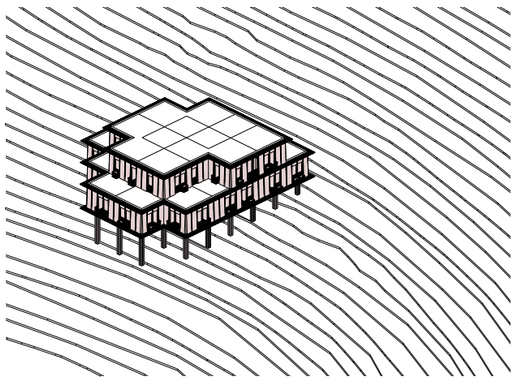
Expand (Flexible)



Protect (Flexible)



Expand (Flexible)

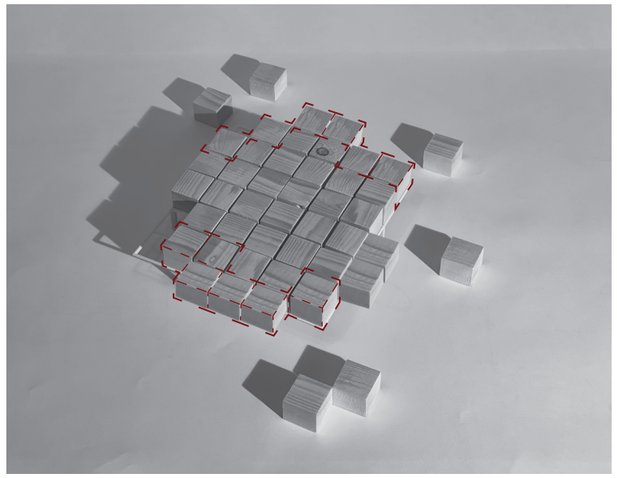


Protect (Flexible)

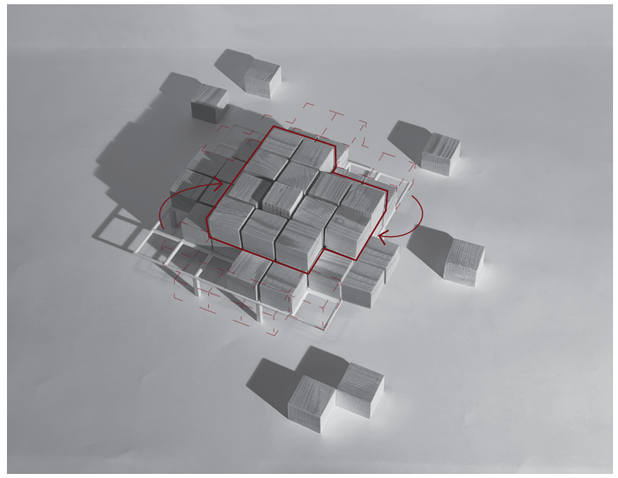
Fig 16 _ Life cycle of an individual building over multiple phases.

Part 3: Results

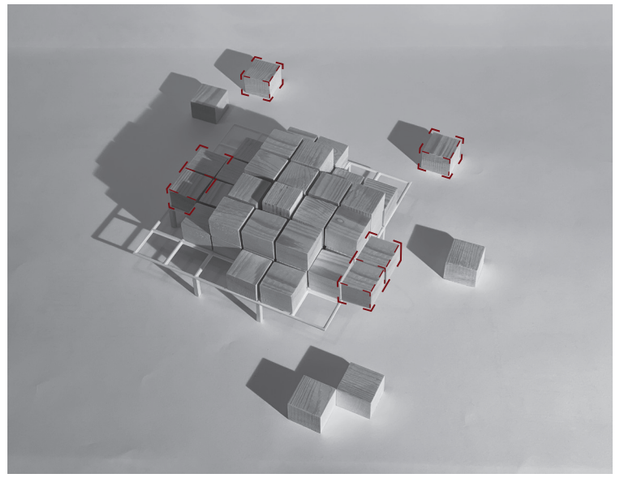
From Building Phasing to Cluster Reconfiguration



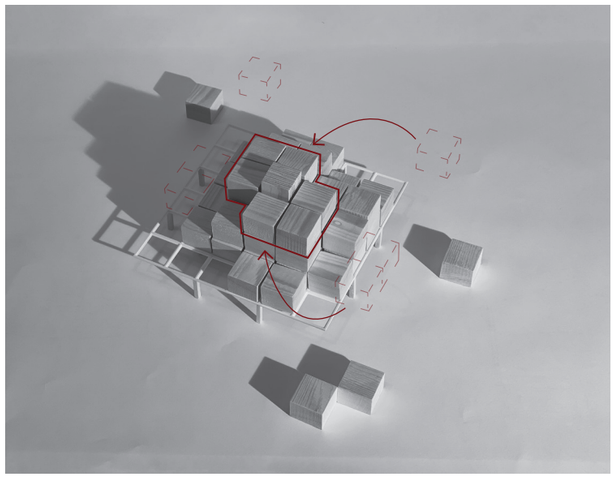
Pre-Conflict Transition



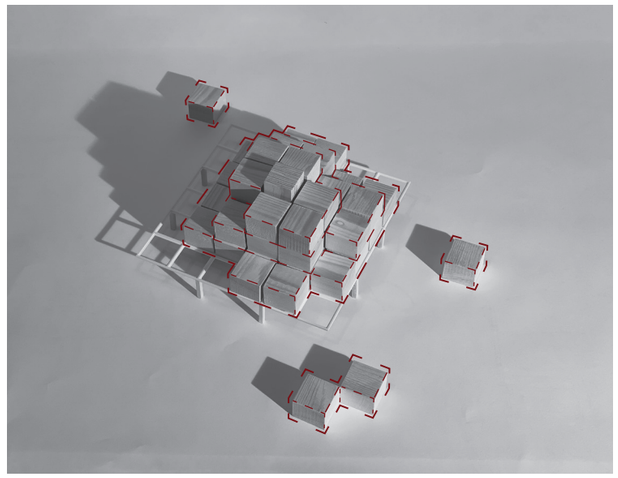
Pre-Conflict Module Configuration 2



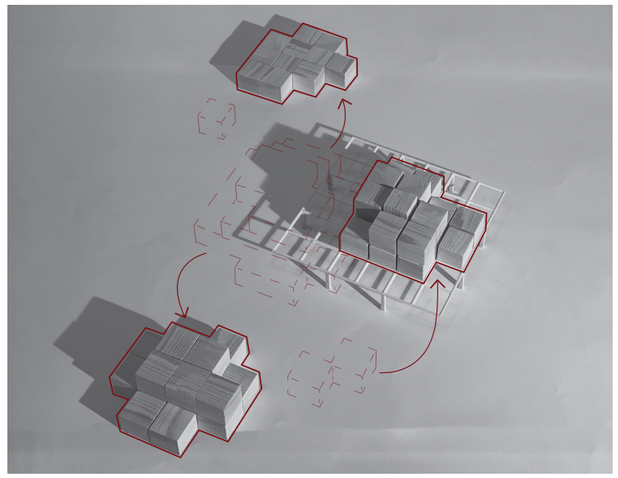
Pre-Conflict Transition to During Conflict



During Conflict Module Configuration 1



During Conflict Transition

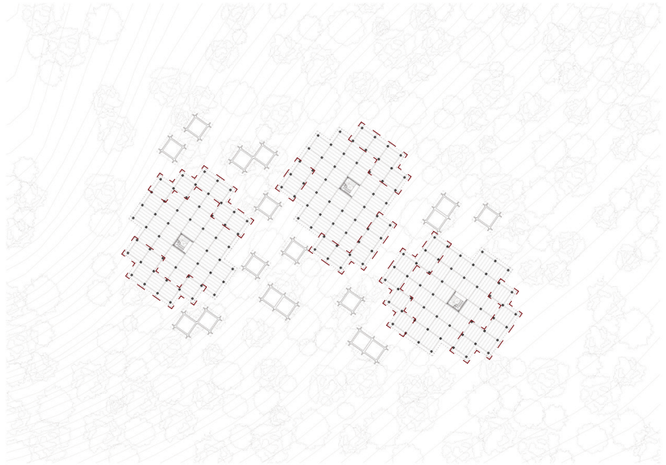


During Conflict Module Configuration 2

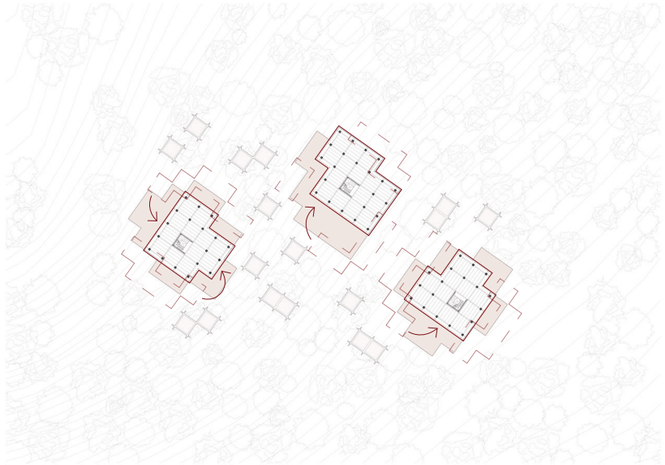
Fig 17 _ Images of original concept model used to illustrate the movement of modules.

Part 3: Results

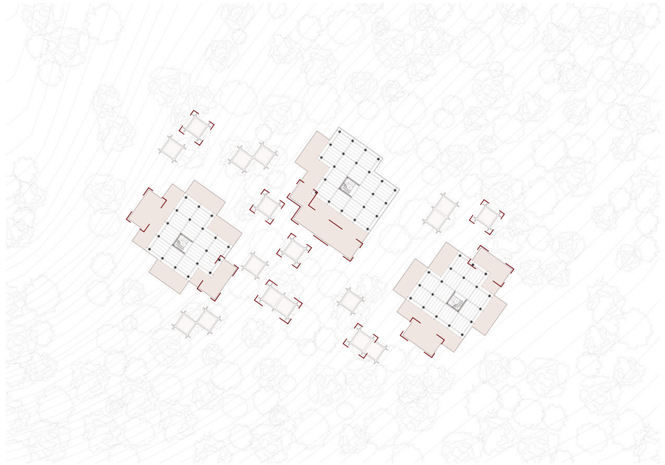
From Building Phasing to Cluster Reconfiguration



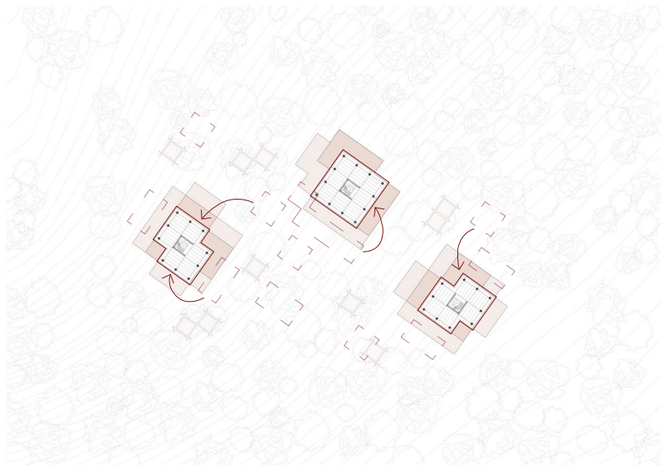
Pre-Conflict Transition



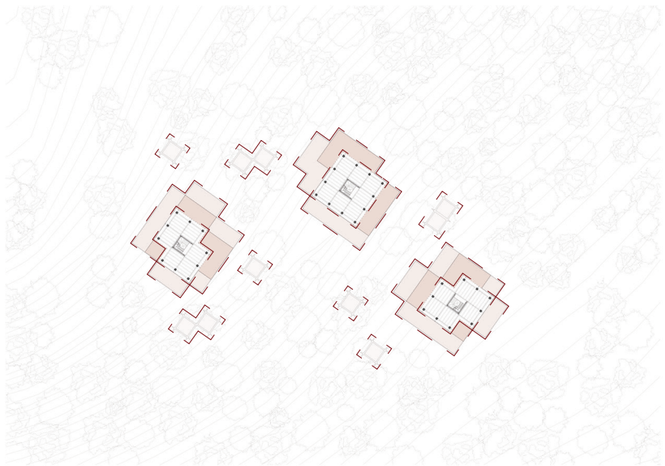
Pre-Conflict Module Configuration 2



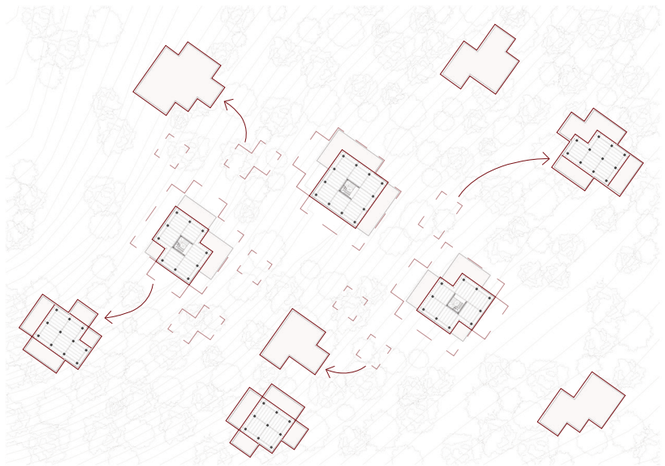
Pre-Conflict Transition to During Conflict



Pre-Conflict Transition



Pre-Conflict Module Configuration 2



Pre-Conflict Transition to During Conflict

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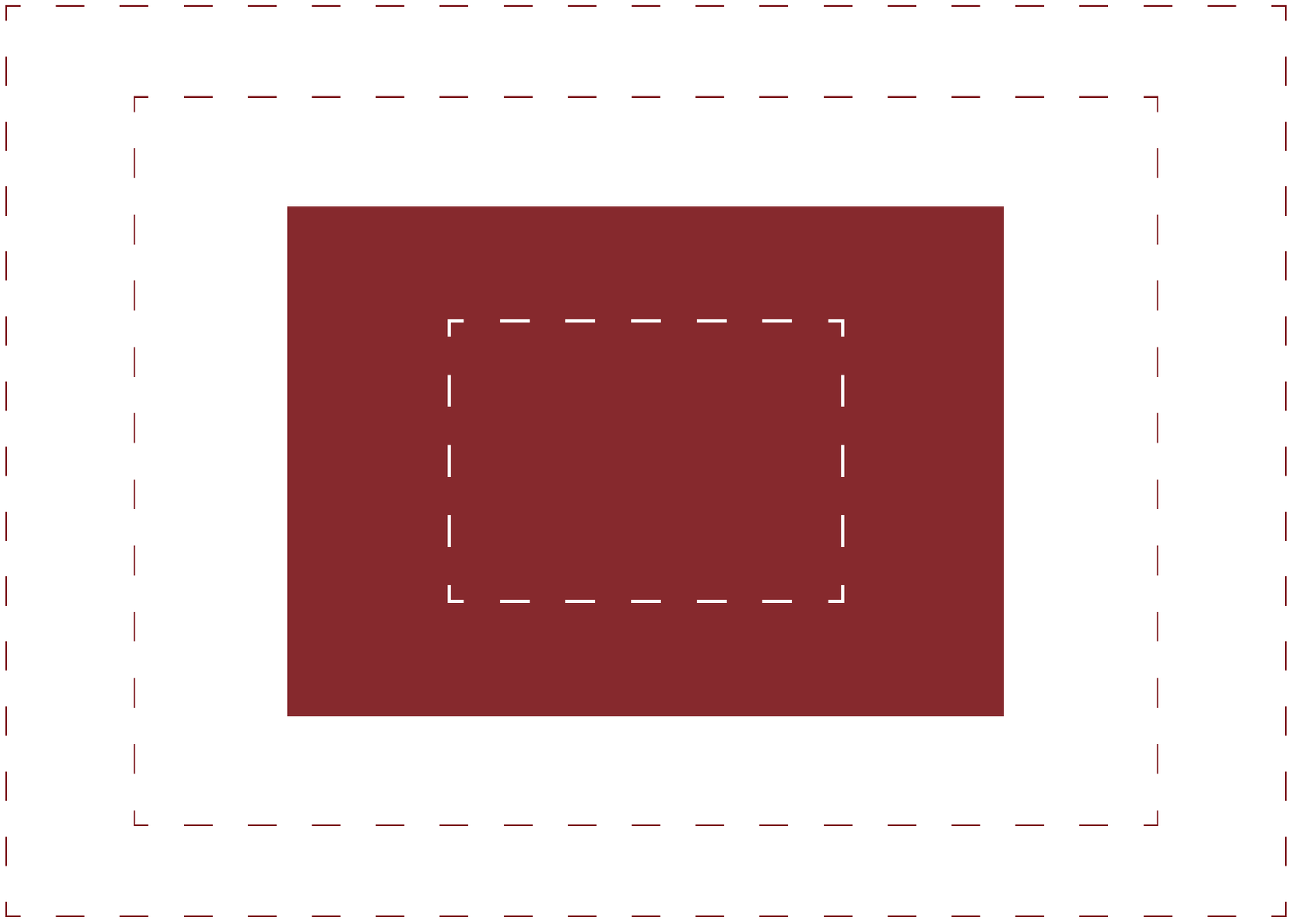
Fig 18 _ Plans of a cluster used to illustrate the movement of modules.

Story Through Scales

Scale _ 2



Part 3: Results

Operational Resilience, Climate and Adaptive Occupation

The programme of the battlegroup or platoon-sized building develops the research theme of self-reliance most directly. The project proposes that each building should house nearly the full operational needs of a platoon at a limited but resilient scale. The basement contains the most secure and private uses, including headquarters, communication rooms, operations and utilities. The ground floor holds workshops, maintenance, heavy logistics and exterior kit areas. The first floor contains the most public interior uses, including readiness rooms, kitchens, medical spaces and work rooms. The upper floors provide bunks, sanitary rooms, laundry and decompression spaces. This structure can then be repeated to form a larger company-sized cluster.

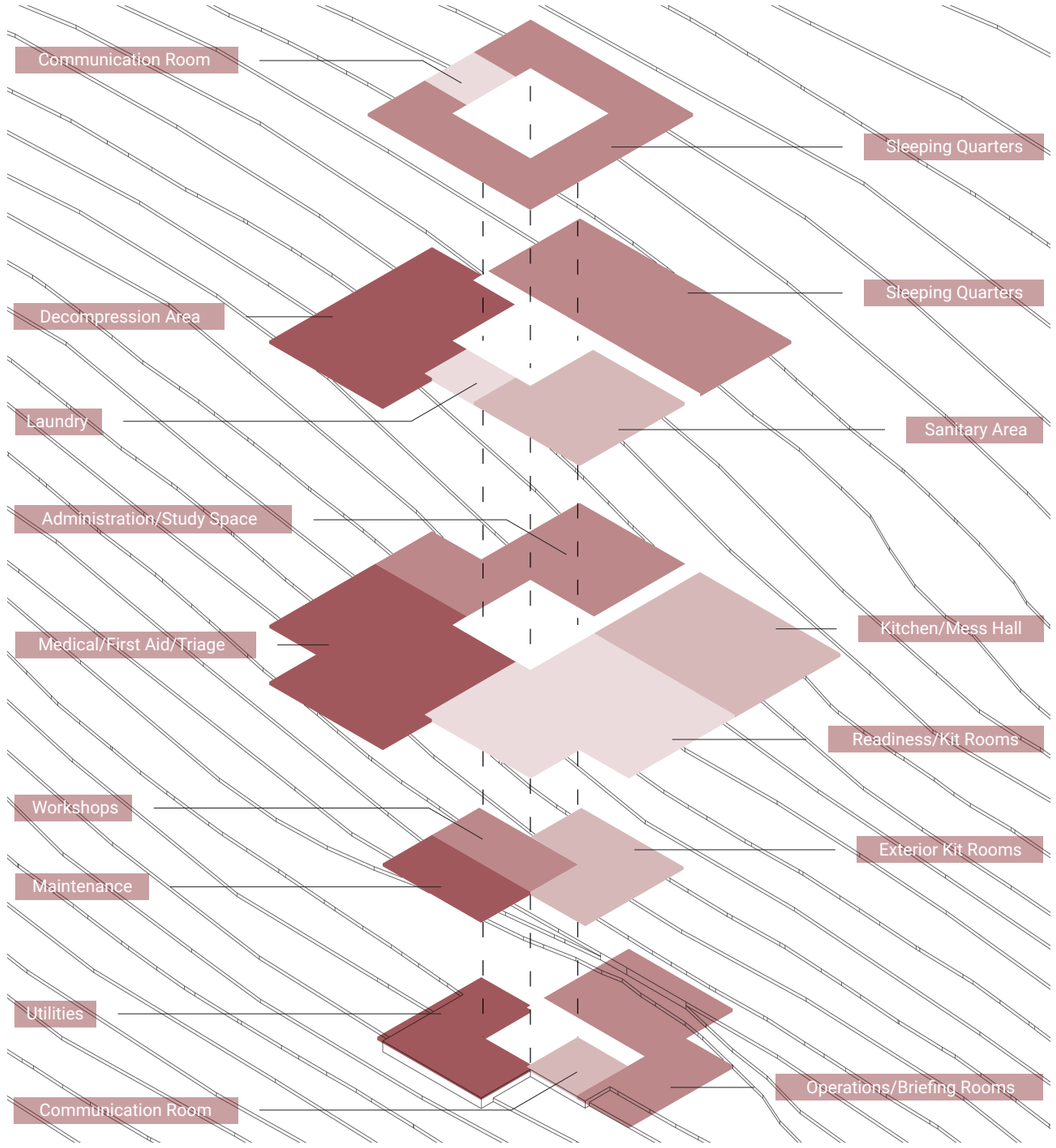


Fig 19 _ Diagram showcasing the interior functions of a building in the during conflict phase.

Part 3: Results

Operational Resilience, Climate and Adaptive Occupation

The during-conflict plans test how this organisational logic works when the cluster is fully operational and under pressure. Rather than sitting as isolated objects, the buildings are positioned in relation to the site's slight changes in elevation and the dense surrounding forest, so that each building can maintain its own operational role while still participating in a larger defensive arrangement. This creates strong visual relationships between the buildings across the cluster, even where direct physical links have not yet been resolved. The possibility of underground or above-ground connections remains open, and conceptually recalls earlier case studies that explored exchange between separate units through shared flows of resources, information or energy. At this stage, however, the most important quality of the plans is that they show how a cluster can remain coherent without becoming a single monolithic object: each building is self-reliant to a degree, but still legible as part of a larger spatial and operational system.

The climatic strategy shows that resilience is not only military but also environmental. Thermal mass, earth coupling, earth tubes, insulation, elevated floors, cross-ventilation, convection through the core, overhangs, forest shading, solar chimney effects and winter gardens all contribute to making the building habitable across different phases with limited reliance on active systems. In the post-conflict phase, these same systems become especially important, because the building is no longer oriented only towards protection, but also towards comfort and civilian life.

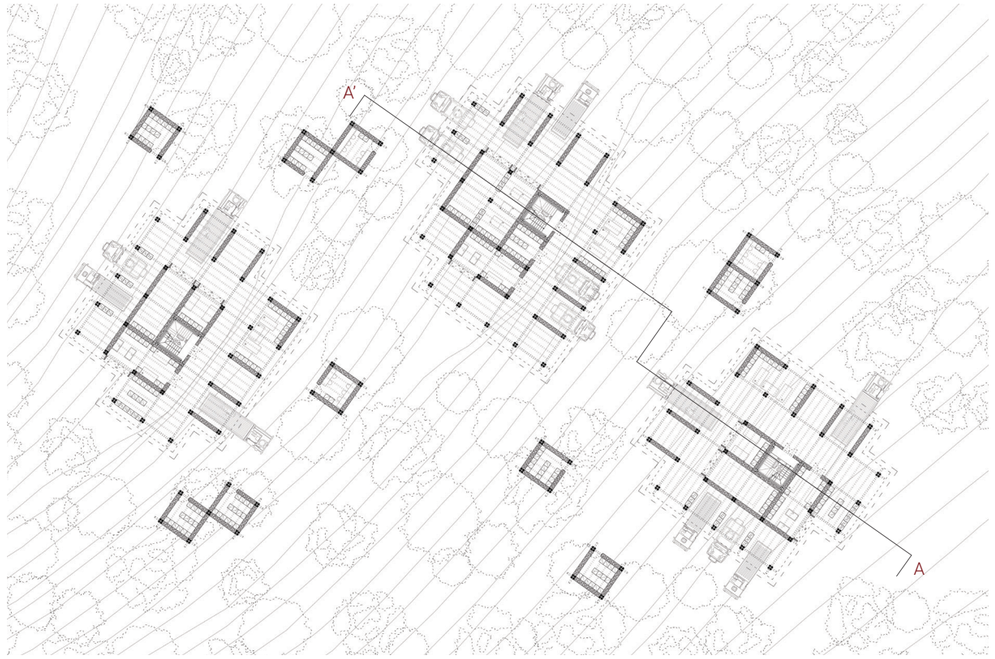


Fig 20 _ Ground floor and Second floor plans of a during conflict phase cluster.

Part 3: Results

Operational Resilience, Climate and Adaptive Occupation

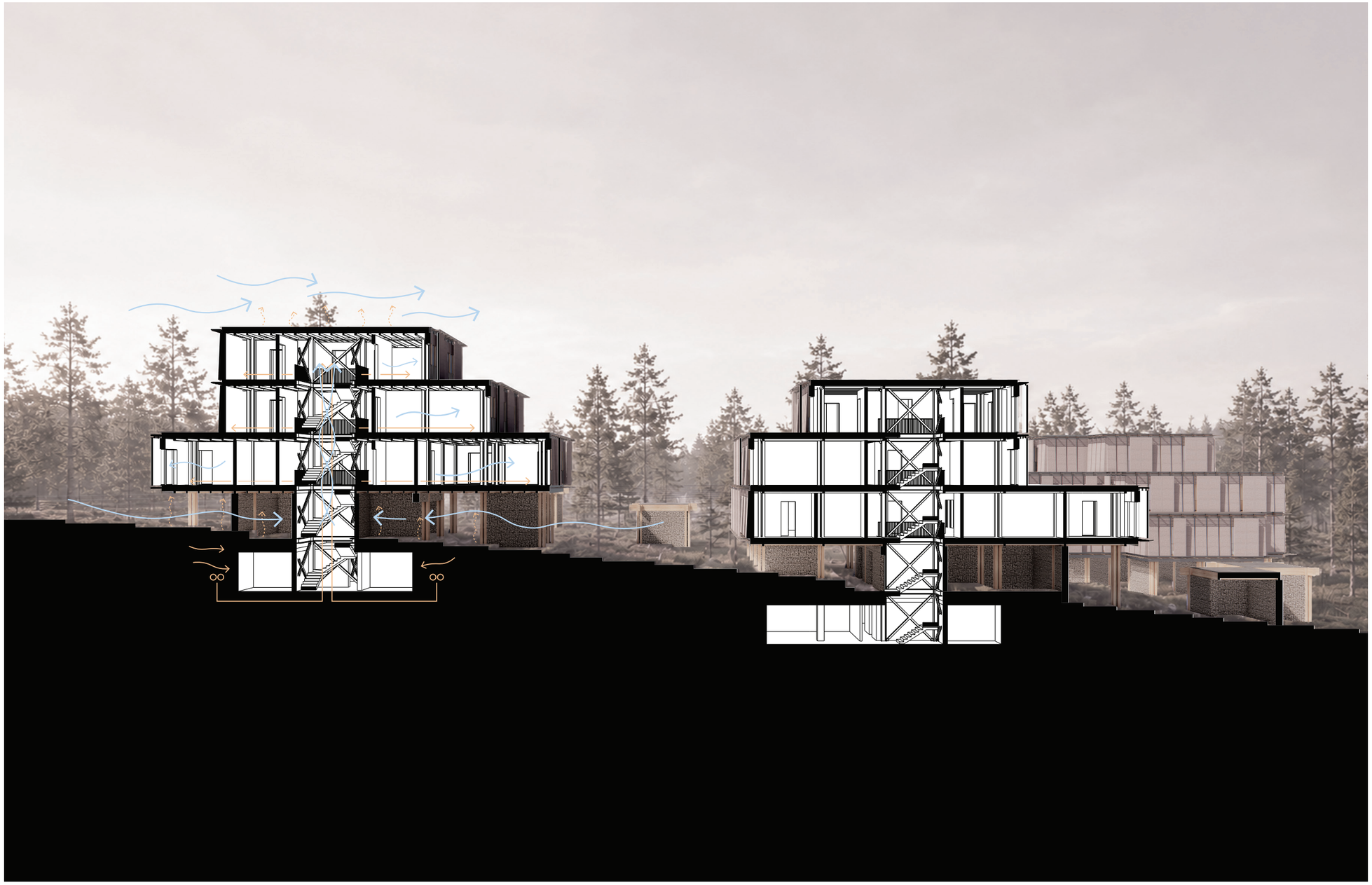


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Fig 21 _ Section AA' of a during conflict phase cluster.

Part 3: Results

Operational Resilience, Climate and Adaptive Occupation

The post-conflict plans extend this adaptability inward by asking not only how the exterior form changes, but how the interior can be reinterpreted for a new user. Here the design shifts from a military model of protection, efficiency and operational hierarchy towards a civilian model that places greater value on community, domestic comfort and connection to the outdoors. The project therefore distinguishes between what remains fixed and what can change: the more durable structural and service elements continue to organise the building, while lighter internal arrangements, façade openings and exterior additions are allowed to adapt.

This also opens up the question of affordance, in the sense that elements designed for one use in the military phase can support another in the civilian phase. Parts of the previous conflict configuration are dismantled and reassembled into smaller huts or outdoor units placed in the spaces between buildings, where they begin to support sheltered communal activities, gardening, greenhouse occupation and informal gathering. In this way, the post-conflict cluster does not simply soften the military layout; it reuses its material and spatial logic to produce a more open and socially active environment. This is also where the project most clearly returns to the research question of what remains fixed and what changes, since the post-conflict plans show that adaptability applies to interior use and social occupation as much as to outer form.

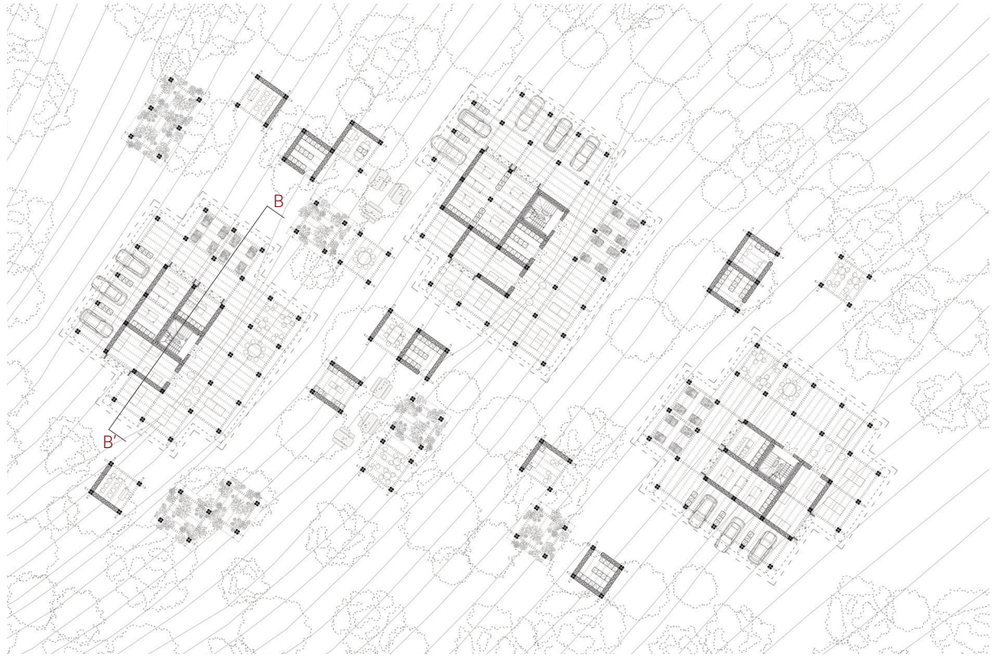

Fig 22 _ Ground floor and Second floor plans of a post-conflict phase cluster.

Part 3: Results

Operational Resilience, Climate and Adaptive Occupation

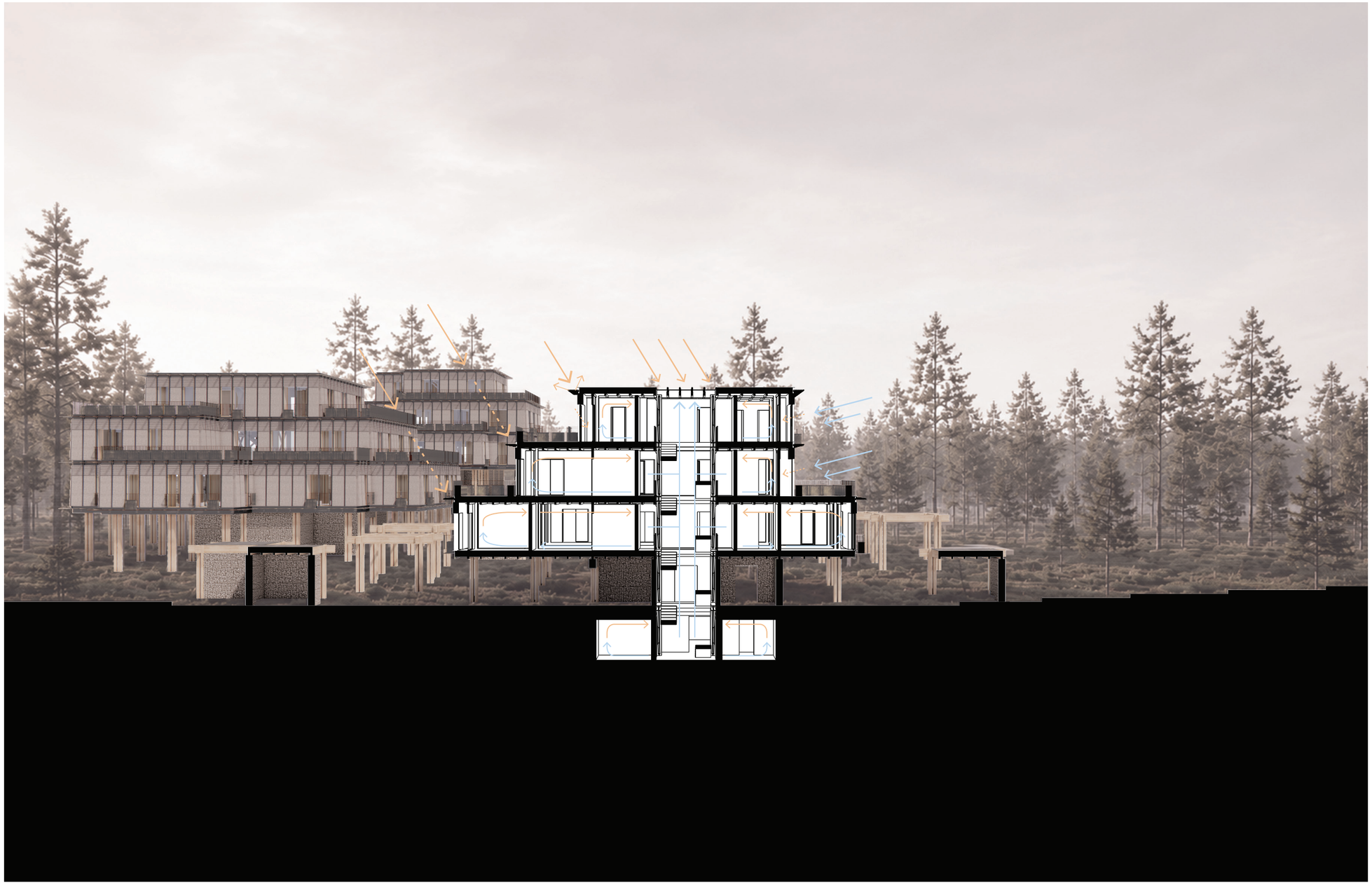

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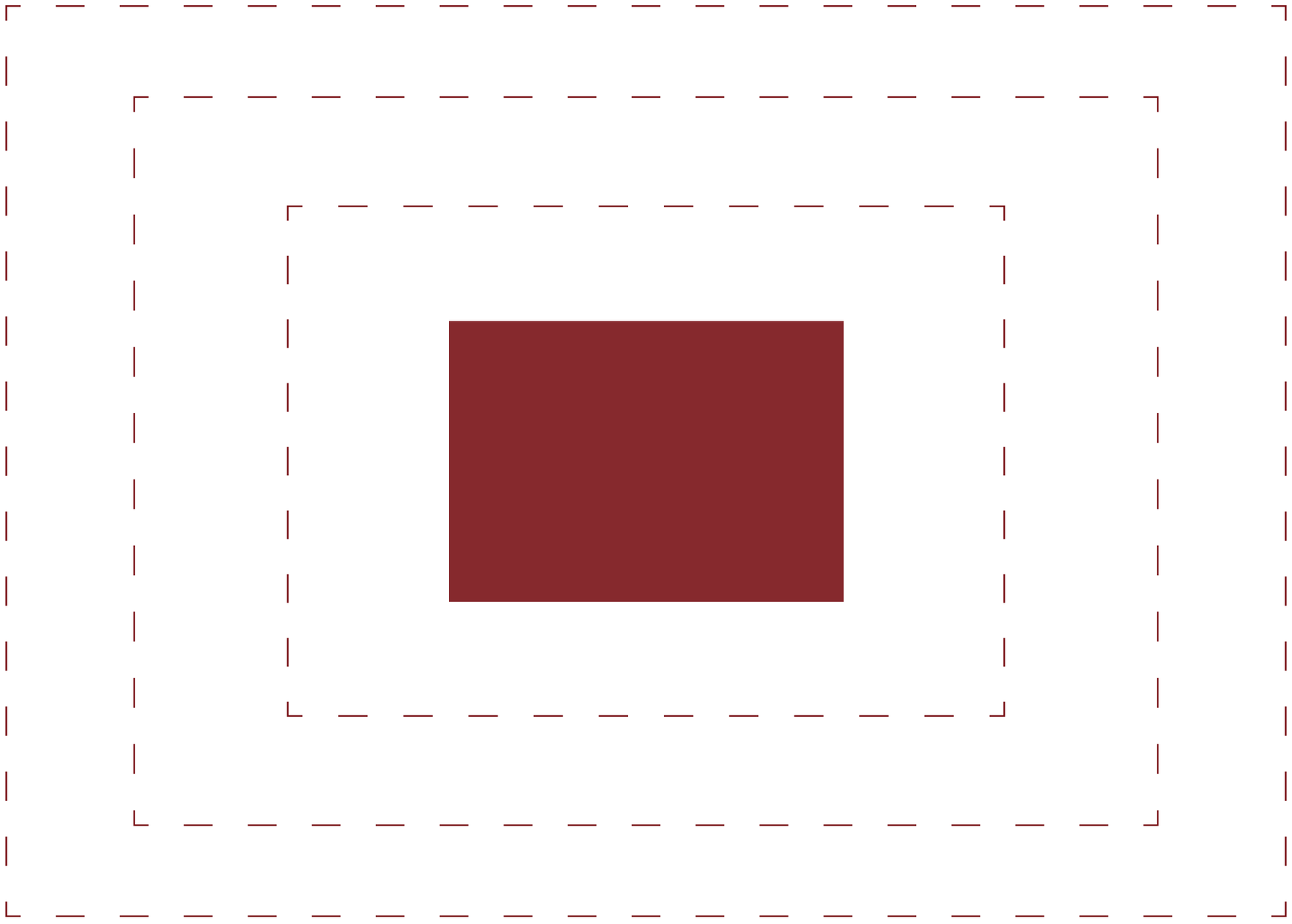
Fig 23 _ Section BB' of a post-conflict phase cluster.

Story Through Scales

Scale _ 1

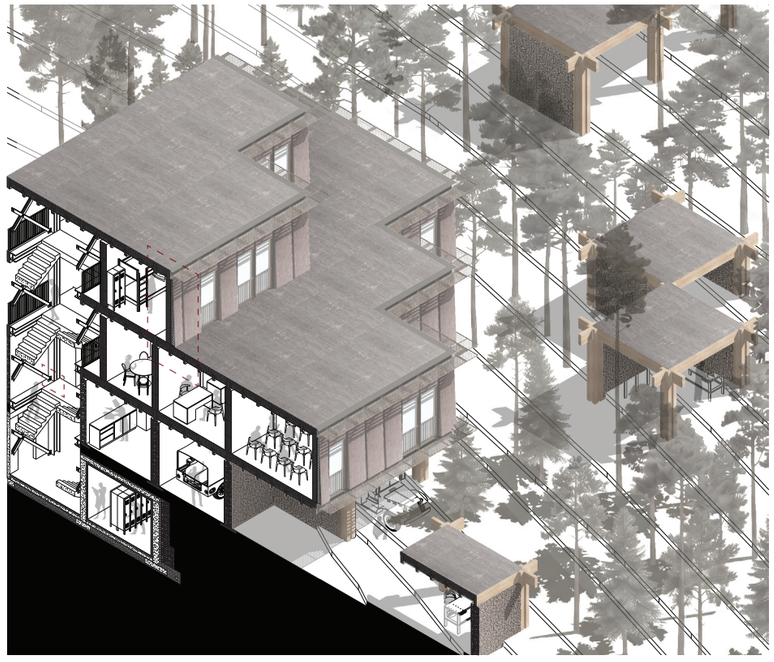


Part 3: Results

Making Transformation Legible: Section, Façade and Material

The sectional axonometric drawings of the pre-conflict and post-conflict phases help to compare the project at the scale of the whole building rather than at the scale of plan or detail alone. They make legible the changes in overall massing, in façade openness, in the arrangement of interior spaces and in the way users occupy the building over time. In the earlier phase, the building reads more clearly as a compact operational object, while in the later phase it becomes more open, inhabited at the edge, and more closely tied to the life of the cluster around it.

The comparison also reveals that change is not limited to the envelope itself: the areas surrounding the building become more active, and smaller hut-like units begin to occupy the in-between spaces as part of a more dispersed and communal post-conflict landscape. These drawings are therefore useful because they show transformation at once as architectural, social and spatial. They demonstrate how the same underlying system can support different forms of mass, use and atmosphere without losing continuity with its earlier phases.



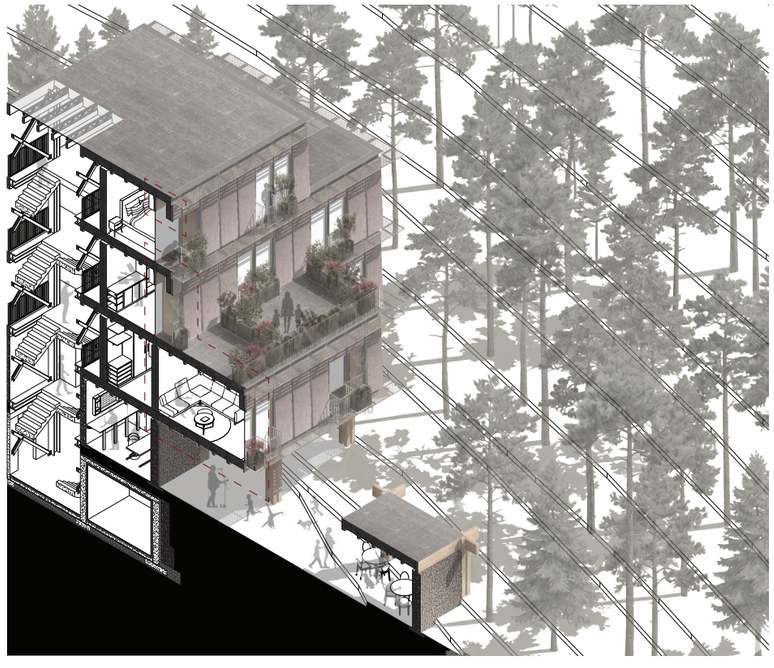


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Fig 24 _ Pre-Conflict sectional axonometric (top), Post-Conflict axonometric (bottom).

Part 3: Results

Making Transformation Legible: Section, Façade and Material

The façade fragments make it possible to understand the project at the point where adaptability becomes construction. Across the three phases, the façade is not treated as one finished assembly, but as a layered system that can become more open, more protective or more socially generous depending on the needs of the user and the situation of the building. This is important because the project's larger argument about fixed versus flexible parts is most clearly tested here. The more durable structural and service logic remains relatively constant, while the outer layers, openings, screens and occupiable edge conditions are allowed to shift. The façade therefore becomes the medium through which the building negotiates climate, visibility, security and comfort over time. The pre-conflict fragment presents a more permeable and habitable edge, the during-conflict fragment tightens and thickens that edge, and the post-conflict fragment reopens it towards occupation, planting and everyday domestic use.

This detailed study also became the point at which material sourcing was brought more directly into the design. The local-materials mapping shows an effort to root the building in Lithuanian supply chains and nearby deposits, including construction timber, CLT timber, clay plaster, hemp insulation, fieldstones, sand and gravel, while accepting a smaller number of strategic imported or industrial materials such as steel sections and UHMW-polyethylene for specific protective functions.

The calculations in the materials study suggest that the timber elements contribute strong biogenic storage, while the transport study frames the module as something whose embodied impact must also be understood through sourcing distance as well as material choice. This reinforces the project's interest in self-reliance: not as total isolation, but as a careful preference for local, renewable and low-transport materials wherever possible, combined with more specialised components only where their performance is necessary. In this way, the earlier research theme of self-reliance is translated into material terms, shifting from an abstract systemic principle to a question of sourcing, assembly and embodied impact.

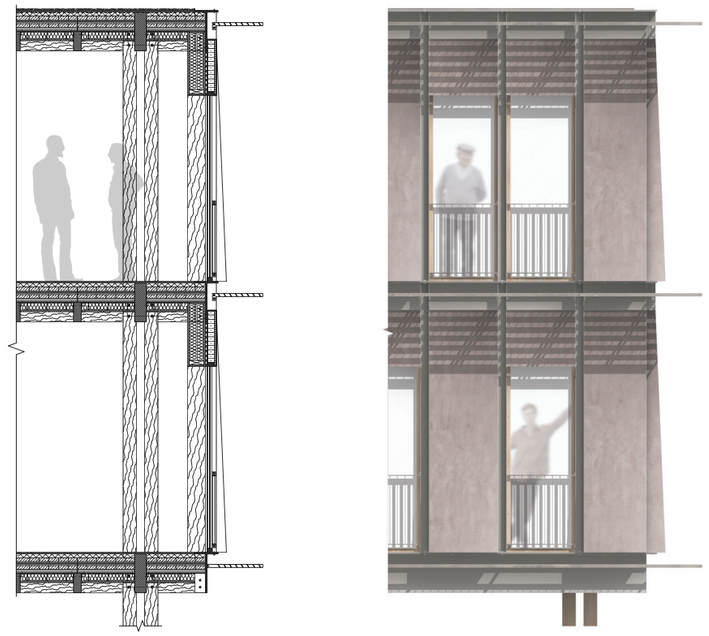

Fig 25 _ Pre-Conflict facade fragment (top), During Conflict facade fragment (bottom).

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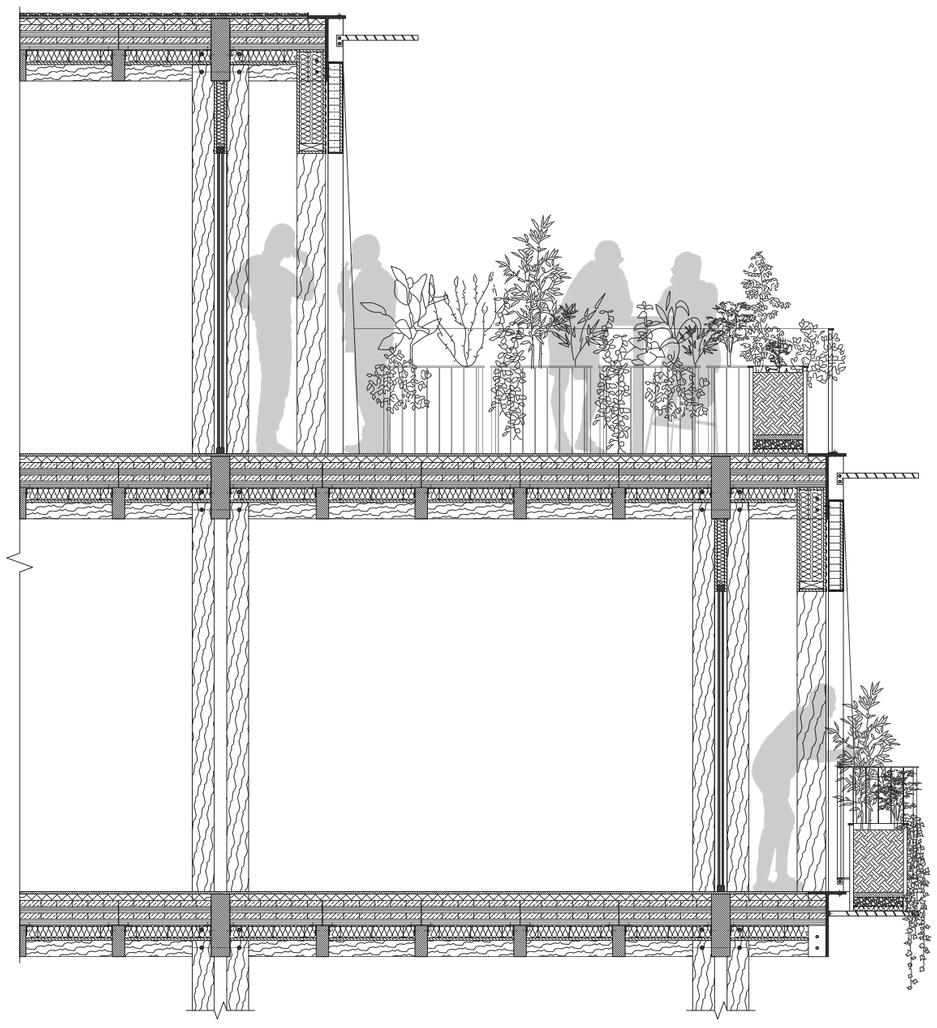
Part 3: Results

Making Transformation Legible: Section, Façade and Material



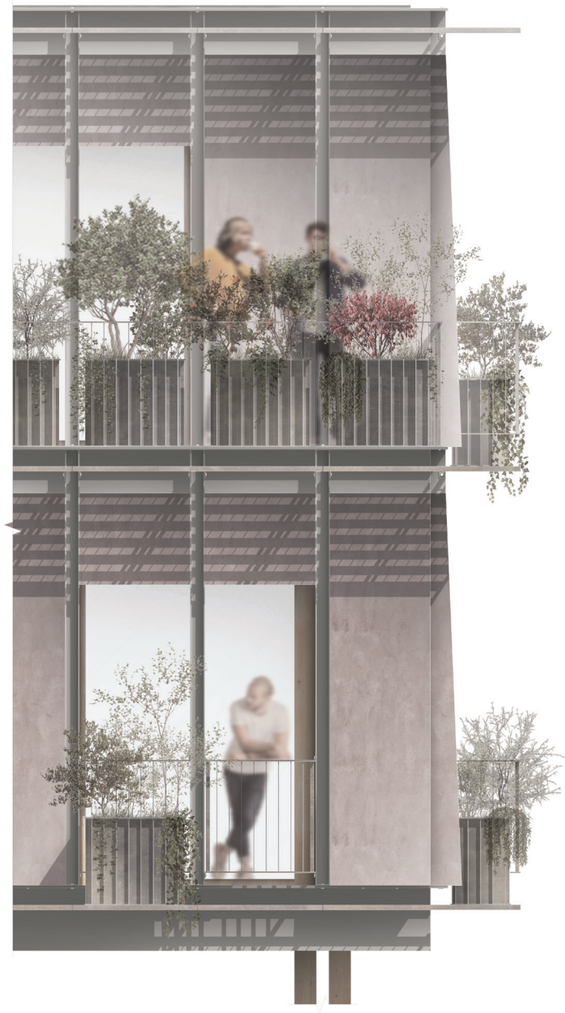


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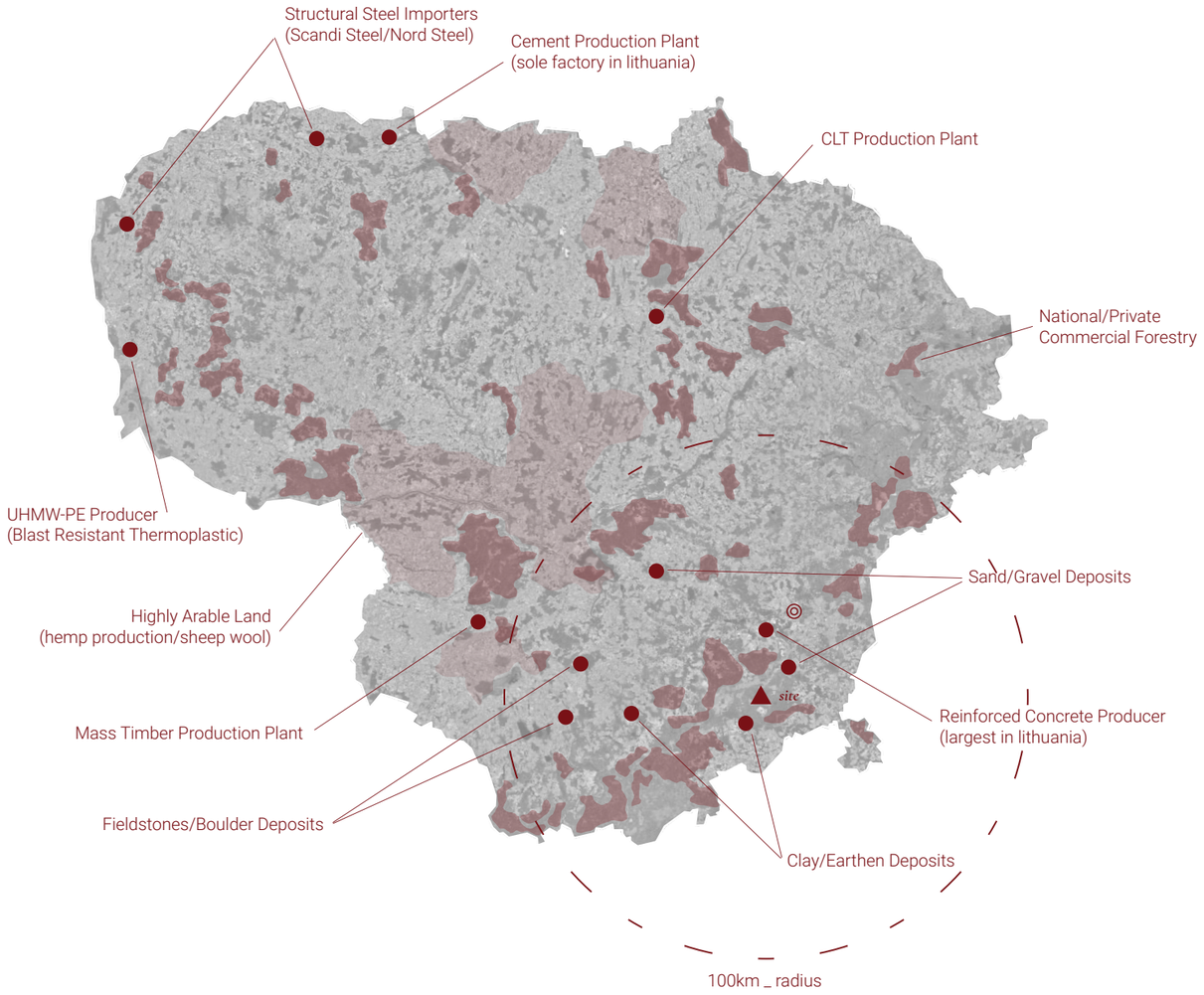
Fig 26 _ Post-Conflict facade fragment.

Part 3: Results

Making Transformation Legible: Section, Façade and Material



CO2 Impact Calculations (Per Module Material)

Material	Group	Volume m^3	Results kg CO2 eq/m^3
Construction Timber	Tree	1.52	- 1035
CLT Timber	Tree	7.59	- 5040
Clay Plaster	Mineral	0.20	20
Hemp Insulation	BioBased	6.10	90
UHMW-Polyethylene	Plastic	4.20	450
Wood-Aluminium Frame	Component	0.15	90
Structural Steel Sections	Metal	0.55	2975

Average CO2 Impact Calculations from Material Pyramid (CINARK)

= -2450 kg CO2 eq/m^3

CO2 Transport Calculations (Per Module Material)

Material	Weight kg	Distance km	Results kg CO_2
Construction Timber	835	184	14.95
CLT Timber	3795	168	62.25
Clay Plaster	360	40	2.95
Hemp Insulation	244	179	4.05
UHMW-Polyethylene	4075	327	75.55
Structural Steel Sections	4320	340	83.25

CO2 Calculations are an Average based on Weight and Distance covered from manufacturer/deposits to site (carboncare.org)

= 243 kg CO_2

Fig 27 _ Map of Lithuania showing local resource network (left), Material/Transport carbon impact calculations (right).

Part 3: Results

Phase-Dependent Enclosure and Modular Assembly

At the 1:20 and 1:5 scale, the façade fragments also clarify how the building responds to changing user needs over time. In the pre-conflict phase, the envelope is semi-permeable: it allows daylight, ventilation and a degree of visual openness suited to everyday military occupation. In the during-conflict phase, that same envelope becomes more defensive. Openings are retained only where necessary for light and air, while blast screens and additional protective layers stand in front of vulnerable glazing and reduce the risk of fragmentation or impact.

In the post-conflict phase, the façade opens again, but not as a simple return to the original condition. Instead, it becomes more socially and climatically accommodating, supporting planting, buffering spaces and a greater connection between interior life and the outdoors. Read in this way, the façade is not simply a technical enclosure. It is a small-scale expression of the project's central idea that the needs of the user are phase-dependent, and that architecture should be able to register those shifts through a controlled relationship between fixed structure, adaptable layers and changing interior programme.

The construction and transport studies extend the same argument. Standardised connections, prefabricated elements, interchangeable panels and efficient packing into transport containers test whether modules and façade layers can genuinely be assembled, removed and moved. It keeps replaceable infill, central service cores, temporary overlays, and layered façades; it largely abandons total roaming mobility and overly speculative mega structural imagery. The result is a design that remains ambitious in its transformations, but grounded in buildable, repeatable operations.

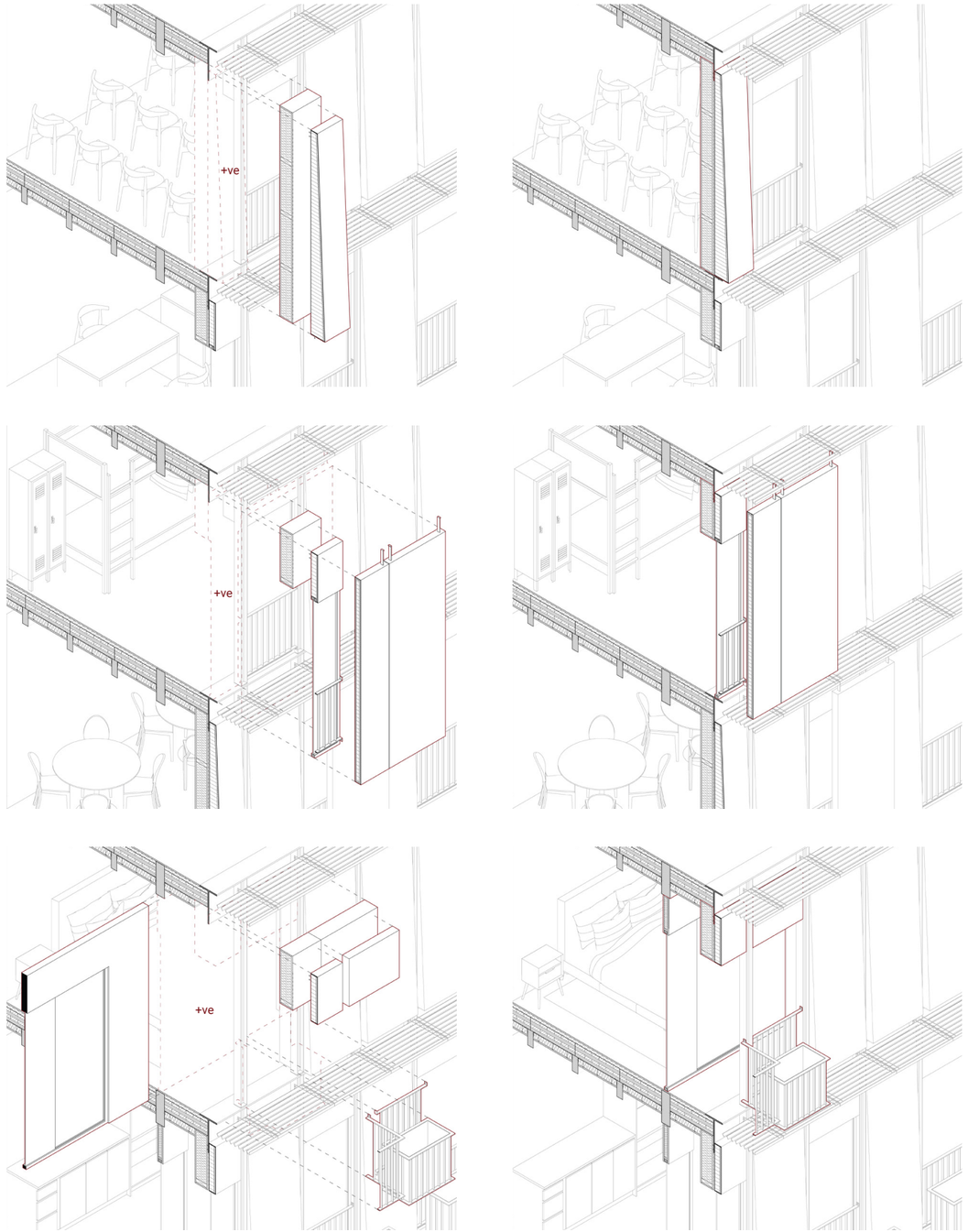
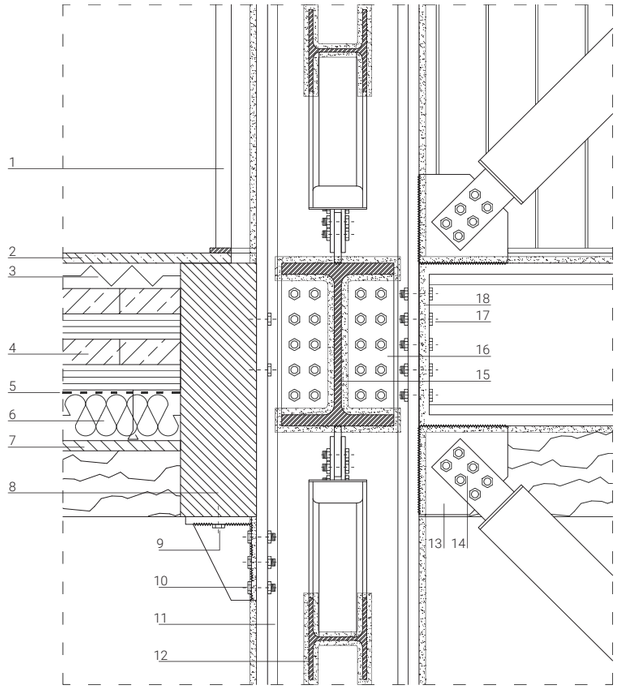


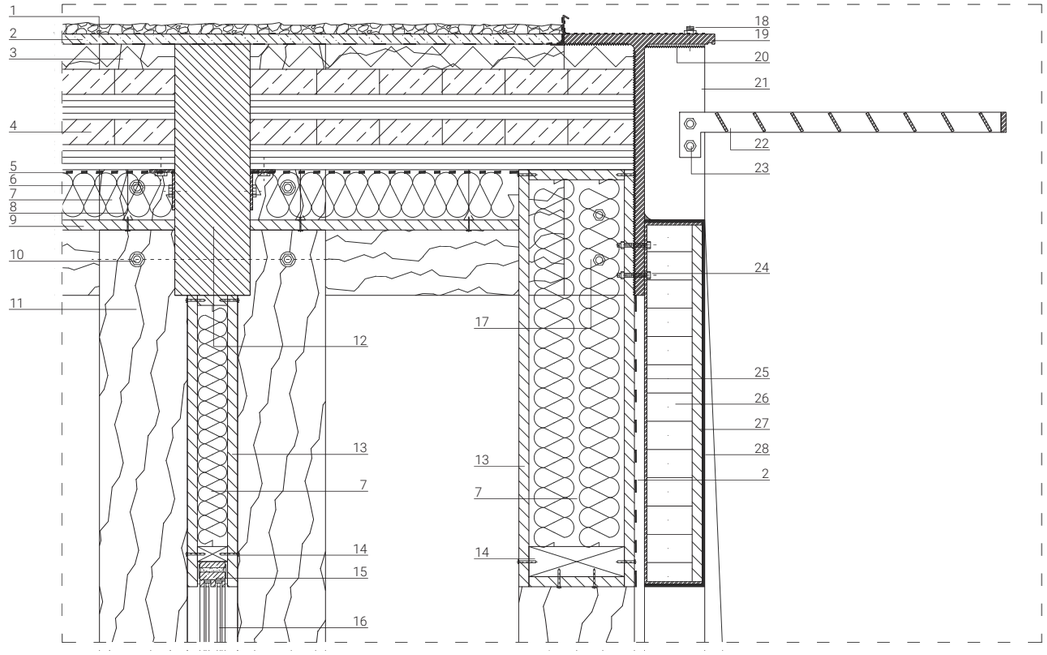
Fig 28 _ Series of diagrams showing how facade modules are inserted into the structure, from pre to post-conflict.

Part 3: Results

Phase-Dependent Enclosure and Modular Assembly



1. Steel Railing Surrounding Core
2. Internal Floor Finish
3. Rigid Insulation
4. Cross Laminated Timber (CLT) Roofing Panels
5. Vapour Barrier
6. Fibrous Hemp Insulation
7. Interior Ceiling Finish
8. Primary Timber Beams
9. M14 Bolted Connection (Steel Support Flange to Beam)
10. Steel Support Flange Bolted to Steel UC
11. Steel Universal Column (UC)
12. Steel HEA-120 Diagonal Bracing
13. Steel Flange Welded to UC and UB
14. M14 Bolted Connection (Steel Flange to HEA-120 Bracing)
15. Steel Universal Beam
16. Steel Capping Plate Welded to UB
17. M14 Bolted Connection (UB to UC)
18. Spray-Applied Fire-Resistant Coating



1. External Protective Roof Finish
2. Air Cavity and Waterproof Membrane
3. Rigid Insulation
4. Cross Laminated Timber (CLT) Roofing Panels
5. Vapour Barrier
6. Steel Mounting Bracket (CLT to Timber Beam Connection)
7. Fibrous Hemp Insulation
8. Ceiling Suspension Wires
9. Interior Ceiling Finish
10. M14 Through Bolts (Column to Beam Connection)
11. Timber Column
12. Primary Timber Beams
13. Interior Plywood Finish
14. M4 Wood Screws and Horizontal Timber Blocking
15. Sliding Door Frame
16. Double Glazed Sliding Door
17. Steel Flange Welded to Steel T-Section
18. M12 Bolted Connection (T-Section to HEA-120 Beam)
19. Steel T-Section with Drip Ledge
20. Steel Capping Plate Welded to HEA-120 Beam
21. Steel HEA-120 Beam
22. Steel Grating Platform/Shading
23. M12 Bolted Connection (Steel Grating to HEA-120 Beam)
24. M8 Bolted Connection (Exterior Facade Panel to T-Section)
25. Steel Frame for Exterior Panel
26. UHMW-PE Blast Resistant Thermoplastic
27. Timber Backing Board
28. Clay-Lime Exterior Render

0 0.125m 1:5

Fig 29 _ 1:5 detail of steel core connection (left), 1:5 detail of representative facade to roof connection (right).

Part 3: Results

Atmosphere as a Measure of Adaptability

The interior views across the three phases are intended to show that transformation is not only spatial and technical, but also atmospheric. In each case, the interior remains tied to the same outward orientation, yet the relationship between room and landscape changes noticeably. In the pre-conflict phase, the interior still retains a sense of calm and openness, even if that calm is provisional. In the during-conflict phase, the room becomes more inward and compressed, with the outside world filtered through layers of protection rather than directly seen. In the post-conflict phase, the relationship reverses again: the interior begins to open onto greenery, communal roof spaces and a more inhabited exterior landscape.

The purpose of these renders is therefore not to dramatise emotion for its own sake, but to show that the architecture can register wider changes in circumstance while still meeting the needs of its current users. In this sense, the interior becomes another measure of adaptability: it reflects changing conditions outside the building, while carefully recalibrating comfort, privacy and connection in response to each phase of life. The interior views therefore complete the return to the research: they show that the project's concern with change over time is not only territorial or technical, but also experiential, and that the shift from military occupation to civilian afterlife must be legible in atmosphere as well as in form.

Fig 30 _ Pre, During and Post-Conflict (top to bottom) interior views looking outwards taken from same angle.

Part 4: Conclusion

Discussion

This graduation project began with a clear architectural problem: contemporary military basing still tends to oscillate between the strategic need for dispersed, resilient networks and the spatial reality of fixed, legible camps. In response, the project asked how systemic architecture could inform the multi-scalar design of an adaptable military base at Rūdninkai. The final design does not answer that question by proposing one finished masterplan. Instead, it answers it by developing a framework of relationships across scales, lifespans and degrees of permanence. In this framework, the base is no longer understood as a single camp, but as a field network composed of concealed long-life supports, adaptable cluster formations, phased buildings and changeable envelopes.

The project therefore returns directly to the ambitions set out in the introduction. Architecturally, it shows how a base can be organised through support and infill, distributed occupation and reconfigurable clusters rather than through one dominant object. Technically, it tests how this adaptability can be carried into programme, façade, construction logistics and material sourcing. The territorial reading of the site established a dispersed system of positions and routes; the cluster studies demonstrated how the same modules can be redistributed across phases; the building framework showed how one structure can grow, harden, disperse, shrink and transform; and the later detail studies proved that these shifts can be tied to climate, protection, prefabrication and circular material use. In that sense, the final design is not simply inspired by the research. It is the point at which the research becomes spatial, material and testable.

The project also clarifies what kind of adaptability it advocates. It does not pursue total indeterminacy or extreme mobility for their own sake. Instead, it argues for a more controlled adaptability: one that distinguishes clearly between fixed and flexible parts, between concealed permanence and visible temporary occupation, and between military use and potential civilian afterlife. This makes the project both more architecturally precise and more realistic as a design proposition.

Implications and Recommendations

The significance of the project for the architectural profession lies in its refusal to treat military infrastructure as a purely technical or logistical problem. It suggests that architecture can contribute to such briefs not only through enclosure and accommodation, but through temporal thinking, spatial organisation and material strategy. The project therefore has relevance beyond the specific case of Rūdninkai. It proposes that infrastructures designed for uncertainty should not be imagined only as short-life objects or defensive machines, but as layered systems capable of adaptation, contraction and reuse. This is especially important in politically sensitive landscapes, where long-term military presence can otherwise produce rigid, highly visible and environmentally disruptive territorial forms.

A second implication concerns circularity and afterlife. By limiting buildings to repeatable modules, reusing those modules across phases, and combining local bio-based materials with selectively imported high-performance components, the project opens up a more nuanced idea of self-reliance. Self-reliance here does not mean total autonomy. It means reducing dependence where possible, preferring local and lower-transport materials, and designing systems that can be dismantled, redistributed and socially reoccupied after conflict. The post-conflict phase is therefore not treated as an afterthought, but as a design condition present from the beginning.

The main recommendation for further development is to strengthen the project at the two ends of the scalar ladder. At the larger end, the territorial implications of the network could be developed further through more detailed site analysis, mobility studies and relations to broader defence and civilian infrastructures. At the smaller end, the technical behaviour of the façade, the prefabricated joints and the environmental systems could be tested more rigorously through prototyping and performance simulation. These next steps would not replace the current framework, but deepen its architectural and technical credibility.

Part 4: Conclusion

Reflection

The design process confirmed that the most productive method for this project was not a linear one, but a repeated movement between research and design. The combination of top-down framework analysis and bottom-up unstructured analysis proved especially useful. The framework analysis helped identify which themes mattered most across the case studies, while the unstructured analysis revealed how those themes operated through decision, flow, time and transformation. The later design process then worked best when it selectively translated these findings rather than trying to copy the case studies directly. This was perhaps the main methodological lesson of the project: precedent research becomes most useful when it is treated as a set of operative logics rather than as a library of formal images.

At the same time, the project also revealed the limits of its current development. Some parts of the proposal are still stronger conceptually than technically, especially where unresolved questions remain around exact cluster connections, site-specific infrastructural integration and the detailed performance of certain adaptive components. The project is also strongest at the middle scales of building and cluster, while the territorial network still needs further consolidation. This is not a failure of the approach, but a clear indication of where the next design phase should focus.

Overall, the project demonstrates that research by design can operate as more than a way of generating form. In this case, it has worked as a method for testing how military infrastructure might be rethought through architecture: not as a fixed camp, but as a field of changing relations between landscape, structure, use and time, tested through the lens of three distinct and user centric phases.

Appendices

Section A. General considerations	yes	no
1. Is the graduation project conducted as part of an internship (at a company), or as part of a research project at TU Delft? If a student's graduation project is conducted at a company or as part of a research project at the university, questions of data ownership and intellectual property rights need to be addressed in a written graduation or internship agreement before the project begins. Students and their supervisor should consult the Intellectual Property Rights of Students webpage. Additional information can also be found in the Extended Personal Research Data Workflow.		✔
2. Does the project involve conducting (part of) the research outside the Netherlands? Students who intend to travel abroad (even to other EU countries) for study, exchange, research, internship, or graduation project purposes need to follow the Travel Safety Protocol. This includes attending a mandatory Travel Safety Training Session: see the Disclaimer.		✔
3. Will the research involve processing data from humans, such as running a survey, conducting interviews or workshops, collecting data through social media or internet forums, or re-using existing datasets about humans provided by a third party? (If 'yes', see follow-up questions 4 to 13 in Checklist B.) Students who work with data from human participants must complete the next section and apply for and receive ethical approval from the Human Research Ethics Committee (HREC) before conducting the research.		✔

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