

# Structure & Adaptability

The influence of load-bearing structures on the adaptability of  
20<sup>th</sup>-century Dutch Police stations.

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## Introduction



Figure 1, *The Hague Police station construction* [photograph], (Haags Gemeentearchief, 2021).

# 1. Introduction

## 1.1. Research purpose

The focus of the research is concentrated on the theme of vacancy in heritage architecture and specifically on that of buildings owned by the Police in the Netherlands. Through the research, the aim is to investigate building typologies, not based on their function which is the common norm but according to their spatial attributes. It is important to highlight the reason for this deviating approach; history has proven that buildings are initially designed for a specific purpose, but their original function is bound to change, as the needs of society alter over time (Zijlstra, 2020). Comprehending the material and immaterial values and characteristics of these buildings, it is critical for an objective approach towards the transformation of these structures. Therefore, the research regards space as the central theme of examination.

My individual research examines the role of structure in the adaptability of former 20<sup>th</sup>-century Dutch Police station. The choice of the selected theme is justified by the realization that structure constitutes an essential element of an existing building, whose potential needs to be thoroughly identified in order to transform it for future uses. The contribution of structure to the spatial organization, qualities, and form of existing buildings, will be researched during the upcoming academic quarters (Azizi et al., 2015). With the commencement of this research, the starting points of the design ideas will be gradually formulated, for my graduation project.

## 1.2. Personal fascination

My personal fascination for the HA Lab and the SBT stems from my experience both in academia and in practice, which have shaped my perspective of architecture and the direction it is heading towards in the foreseeable future.

Having been raised in Greece, and specifically in Athens, the regional earthquake conditions limit the life cycle of existing buildings, as a structural system cannot remain unaffected by the earth's constant movement. At the same time, the dense urban fabric cannot tolerate extensive demolition. Therefore, a different approach is needed to ensure the sustainable growth of the city. The architectural interventions in existing buildings have

become the most ubiquitous architectural topic nowadays, whose presence will only become stronger in the future. In addition, rarely do these transformations depend on the former function of the building, and as the SBT research line states, space is the most substantial factor of a building.

The need for interventions is neither a unique, nor a regional phenomenon; the global population increase, in combination with the urbanization and the climate crisis that our planet faces, will require the adaptability and re-use of the existing built environment. A series of questions then arises that architects need to respond to with their designs, concerning ethics, performance standards, and appropriate response to the history and values of the existing.

### **1.3. Course structure**

The research consists of two parts; during the first part, through group work, eight case studies will be analysed, according to the overarching studio theme, that of space. By analysing the spatial attributes in a series of case studies, similarities and differences among these buildings will be revealed, which will then be compared, and conclusions will be drawn.

At the same time, each student chooses a topic of his interest, linked to the concept of space, that will later be researched, in parallel with the design studio, hence shaping and contemplating the graduation design project. This period comprises the second part of the research.

## 2. Individual research

### 2.1. Problem explanation

The core of the problem lays in the real estate issue, that Police in the Netherlands is facing. In 2013, the National Police was formed, and aspired to a new concept of an organization that would operate in fewer buildings, in which larger teams would collaborate by leveraging the technological progress of the current era.

Therefore, this reformation demanded the restructuring of the Police organization. Consequently, it is predicted that approximately 700.000 sq.m. will become vacant, whereas 200.000 sq.m. of new buildings will be constructed. (Weessies, 2017). On top of that, 30% of these buildings with heritage value are in the need of new programs and redevelopment (Weessies, 2017). To that end, the optimal management and preservation of the values of these buildings become of paramount importance. Not only is it an emerging architectural problem, but it becomes simultaneously a societal and financial issue as well.

On the other hand, with the main topic being structure, it is crucial to define both terms 'structure' and 'architecture', and highlight their relation. Firstly, 'structure' refers to the system of load-bearing elements of a building, counteracting gravity. Meanwhile, 'architecture' is the science and art of constructing & articulating space. So, structure can function without necessarily contributing with architectural qualities; but architecture, cannot exist without structure. Hence, it is undoubtable, that structure is the essence of architecture and has a transformative ability of space.

When dealing with existing buildings, architects need to question how architecture can emerge through structure. Materiality holds a major position in this debate. The role of structure in architectural space has been subject to technological development and new materials. The industrial revolution introduced reinforced concrete and steel, increasing dramatically the structural and spatial possibilities. The heavy and thick structures that were often concealed in the past, were displaced by the lighter and more resilient materials, that enabled bigger spans, taller spaces, and larger buildings. In the end, as Azizi et al. (2015) state, the optimal result is achieved through the synchronization and coordination of both structure and architecture.



Figure 2,The Hague, façade construction  
(Haags Gemeentearchief, 2021)



## 2.2. Research goal & problem statement

*“By virtue of its composition-making and space-making qualities, structure introduces visual interest and character.” (Charleson,2005, p.208)*

The theme of investigation aims to address the potential of structure, as a means of enriching architectural qualities. Interpreting structure not by its utilitarian purpose, but by its architectural impact, can provide new insights and perspectives when dealing with existing buildings (Charleson, 2005). Therefore, it is worth investigating structure in terms of its limits and re-design opportunities regarding the adaptation of new functions in heritage architecture.

Transforming an existing building, equals modifications of its space plan, circulation system, but also exterior alternations. In the case of the Police stations, which compose a sum of introvert, large-scale buildings, the change of their strict character becomes rather important. In the case that an institutional building is converted into a public one, this entails the re-establishment of the building's relationship with the city. Hence, any change, either internal or external, is directly connected to the existing building, and therefore to its load-bearing structure.

Structure and architecture are two inextricable but not utterly separate domains. Creating space, predominately means creating an enclosure; according to Ching (1979), the qualities of space, including form, scale, and proportion, depend on the enclosure of space. But where do all building-elements rest on? Structure is the common denominator of each space, with not only support capabilities, but it can express an architectural intention, define and divide space, create rhythm and proportion.

Transformations of existing structure are often accompanied by the need of supporting extra loads that cannot rest merely on the extant skeleton, and new supports are needed for the accommodation of new programs. The interference of new supports with the existing ones generates design questions and ideas, of highlighting existing and introducing new spatial qualities.

## 2.3. Research question

The individual research question is related and derived from the overarching question of the SBT course, which is: *''How and why do specific series of spatial aspects on four scale levels influence the design possibilities regarding the redesign of a specific group of buildings erected for a specific function?''*. Hence, this will be researched on eight case studies from the SBT research, and finally for the Hague police station, which is the selected building for my graduation studio.

Therefore, the research question of my graduation project, based on the problem explanation, personal fascination, and research goal, is described below.

*Research Question:*

*To what extent does the load-bearing structure in 20th-century Dutch police stations, influence their re-design options, in comparison to other office buildings of that era, in the Netherlands?*

*Sub-questions*

1. What are the characteristics of the structures of the 20th-century Dutch police stations and of other Dutch office buildings respectively? to which spatial typology do they belong?
2. Which strategies do architects use in the 21st century when dealing with existing structures in transformation projects of the era and spatial typology of the case studies?
3. How does the structure affect the enclosure and qualities of space in the Hague's Police station?

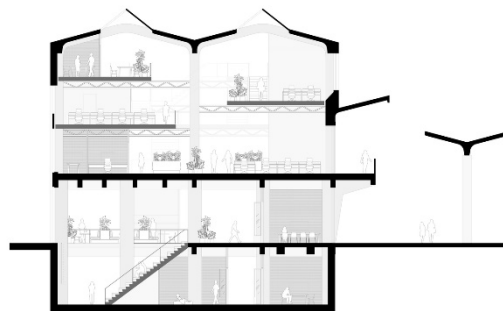
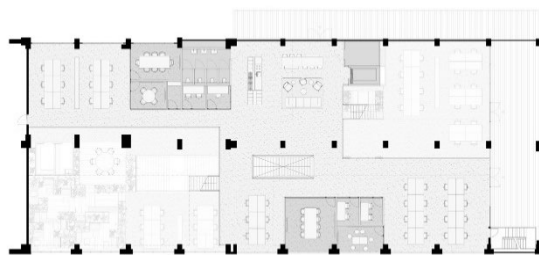
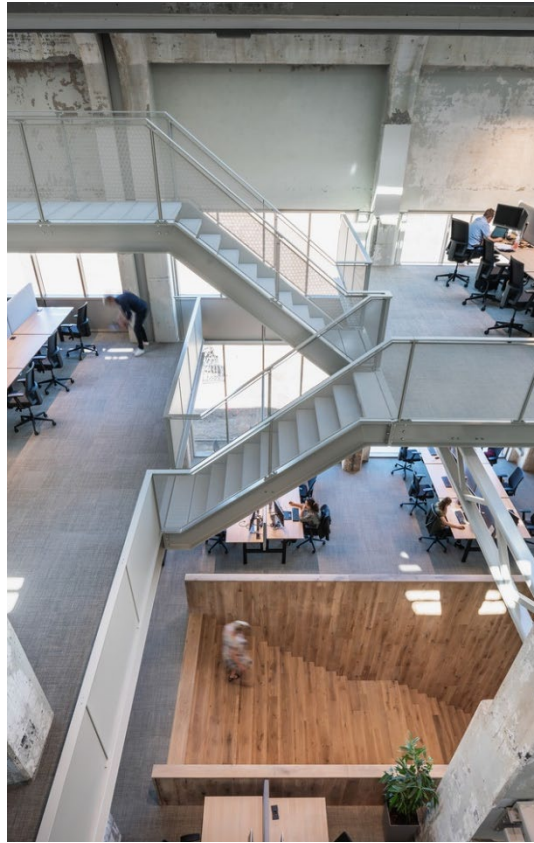


Figure 3, Roon M. (2020)., New structural system integration, creates new conditions of the section & space plan, in Arnhem.

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### 3. Theoretical framework

#### 3.1. Literature review & key theories

Having the research question and sub-question clarified, it is crucial to investigate and set the theoretical framework, upon which, the research will be based. The point of departure is that of a comprehensive literature study; in the book *Architectural research Methods*, Lucas (2016) inquires through the theoretical framework, which of the examined theories and authors have contributed to the articulation of the research, including theories that the researcher both agrees and disagrees with.

Regarding the main theme of structure & adaptability the research departs from the principal theoretical framework of Steward Brand (1994). Via a Shearing Layer diagram, Brand showcases the various interdependent layers that compose a building (Kuipers et al, 2017). Each of these layers has different properties and life span than the rest, yet all layers operate simultaneously. Kuipers et al. (2017) argue that with the examination of each layer individually, the architect can assess and estimate the impact of his proposed intervention. At the same time, structure constitutes the principal layer of this hierarchy (Kuipers et al., 2017). As Cramer et al. (2007) claim, identifying the opportunities, limitations, and risks of the existing structure, is a major part of a transformation project.

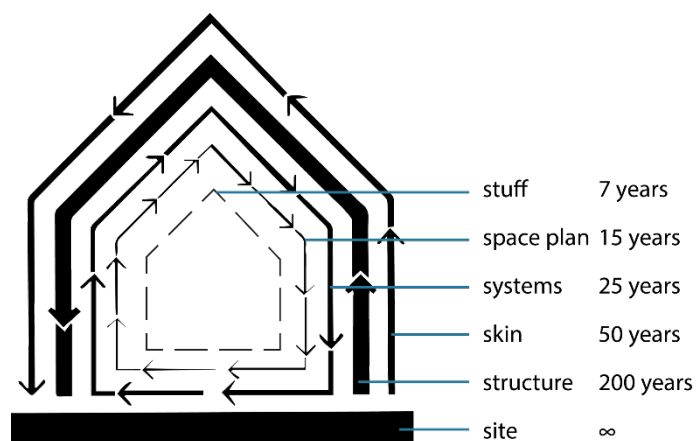


Figure 4, Shearing Layers. (Brand, 1994)

Valuable insight into the research was given by the Ph.D. thesis, titled RE-FACE; Ebbert (2010), discusses technical improvement of office facades through refurbishment strategies. Although the thesis is devoted to existing facades, it is important to explain that the façade refurbishment is directly linked to the existing structure and its integrity; therefore, the strategies discussed in the paper, are of great value to the examined theme.

In the book *Out of Office*, Remoy (2010) discusses long-term vacancy reasons in office buildings and proposes various recommendations for vacancy prevention. The author draws attention to 'soft' factors, such as *spatiality* and *visual quality*, as being the most valuable aspects of an office building. It is added that the office typology has little transformation potential, due to high costs, but on the other hand, Remoy (2010) highlights the architectural quality, as the aspect that designers should focus on; specifically, the quality of the façade, the spatiality of the ground floor and the layout are critical factors. A strong link with my personal theme, is derived from Remoy's claim that the transformation potential depends on the structural system, and by extension, on the transformable and removable building components; hence, the inquiry that arises, is how does structure influence and facilitate transformability of the layout?

Finally, in the book 'The European office', van Meel (2000) investigates the relationship between office design and national context, taking as case studies selected European cities. Factors that shape the spatial qualities of the workplace layout are explained, such as the floor depths, daylight, and views. Consequently, it is worth considering how these aspects interfere with the load-bearing structure, and by extension, with the re-design opportunities.

## **4. Methodology**

The methodology constitutes an integral part of the research, and each method should relate to the research goals and contribute to answering the research questions. The research framework stems from Lucas' (2016) book, *Research Methods for architecture*, Groat et al.'s (2013) book *Architectural Research Methods*, and the lectures of the *Research Plan* course.

### **4.1. SBT research**

As already explained in the introduction, the graduation studio initiates with the *Spatial Building Typology*, based on which, a personal research topic is formulated and investigated in parallel with the design process.

#### **1. Location Analysis**

For the SBT research, eight case studies in the Netherlands have been selected, that will be analysed and compared based on four scale levels and eight spatial aspects on each level. To achieve consistency, the drawing style draws inspiration from the *Hausmann method*, used in the reduction drawings of Jallon et al. (2017) book. Once the location analysis is completed, a comparison of the findings will follow, that will determine the spatial similarities and differences among the case studies.

#### **2. Historical Research**

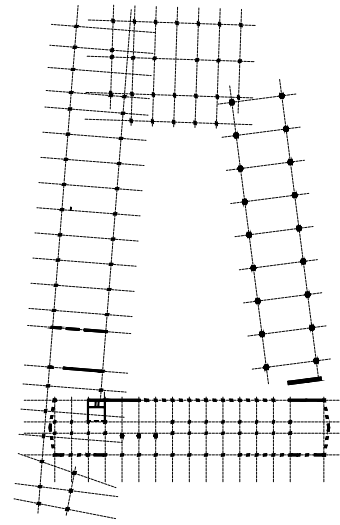
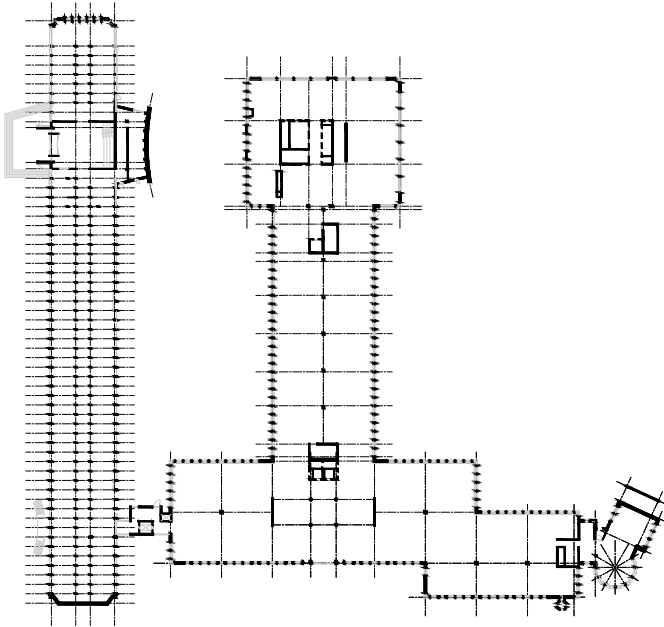
In parallel with the location analysis, each group will conduct historical research by searching for relevant information regarding the eight case studies in national archives (N.A.I. & The Hague City Archives), municipal documents, and publications regarding the buildings and their architects.

#### **3. Model Makings**

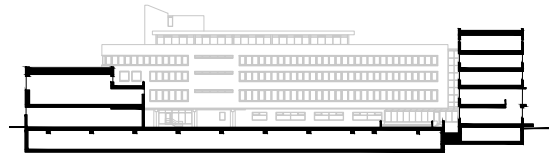
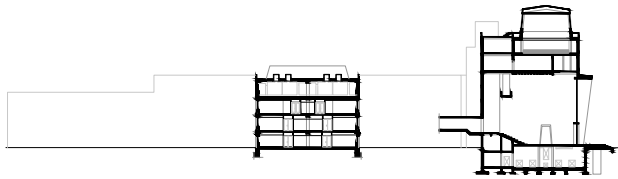
The essence of each case study, will be visualized via physical models, underlining the most essential aspect of each building. That way, it is possible to prioritise and form a hierarchy of the most valuable building components.

## The Hague

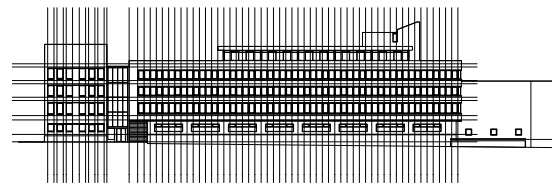
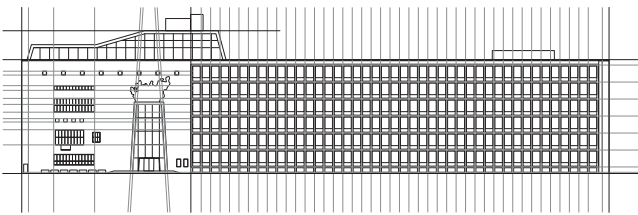
## Groningen



Structural grids



Sections



Facade compositions

Figure 5, Comparison of Den Haag & Groningen Police stations (SBT, 2021)

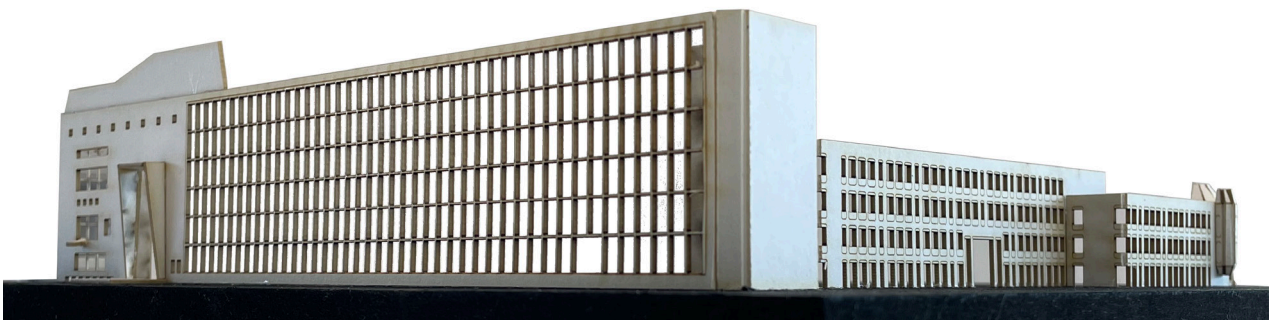


Figure 6, Essence model, Mexis & Boenders

## **4.2. Individual research**

For the personal research, initially the topic will be researched on the eight case studies of the SBT, and eventually on the Hague police station. From the location analysis' conclusions, I will emphasize on the floor plan layout and sections, as these drawings can provide a solid basis for examining the re-design options of the load-bearing structure. Nevertheless, a combination of different methods will be employed for the research topic and design development.

### **1. Literature research**

Via literature research, the aim is to gain an objective and holistic understanding of the significance of the historic and architectural components of the building and its structure. Therefore, it is vital to examine the load-bearing characteristics of 20<sup>th</sup>-century Dutch police stations through literature, as explained in the previous chapter.

### **2. Value Assessment**

Proposing a transformation in heritage architecture, requires a deep understanding of the existing. The value assessment is an objective method of evaluating the building in layers, prioritising values, and then taking an architectural position towards the transformation approach. Kuipers et al. (2017) explain Brand's system of shearing layers, and how values are mapped on each building layer.

### **3. Case studies**

For the achievement of a research-based design, in parallel with the testing of my personal ideas, I will analyse case studies, and especially strategies that are used in transformations of typologically similar projects. Therefore, comparative case studies of selected projects will be conducted, with a specific focus on plan and section analysis, to determine the role of structure in creating spatial qualities.



#### **4. Sketching**

During the preliminary phase of the design, sketching will be used as a means of intuitively and effectively testing design ideas. Rough and quick sketches are an efficient design method, as through their abstraction, it is possible to generate new ideas.

#### **5. Model making**

Models will be used in various scales to analyse and evaluate different architectural aspects in each case. Both digital and physical models will facilitate a more efficient research procedure; the materialization of an idea from 2D to 3D space gives input concerning the areas of improvement.

#### **6. Technical analysis**

With the examined topic being load-bearing structures, it is apparent that the technical analysis is an integral part of the research. Apart from the theoretical examination, the transformation opportunities of the load-bearing structure should be examined in practice through construction analysis and details.

### **4.3. Reflection on methodology**

The chosen methodology intends to provide a solid research framework, for a research-based design. The selected methods cover the spectrum needed to answer the research question and fulfil the research goal while engaging with the design process. However, deep knowledge regarding structural engineering would certainly be of great benefit, but with the assistance of the Building Technology mentor, I will be able to comprehend the subjects of the load-bearing system that are needed for the conduction of the research.

## **5. Relevance**

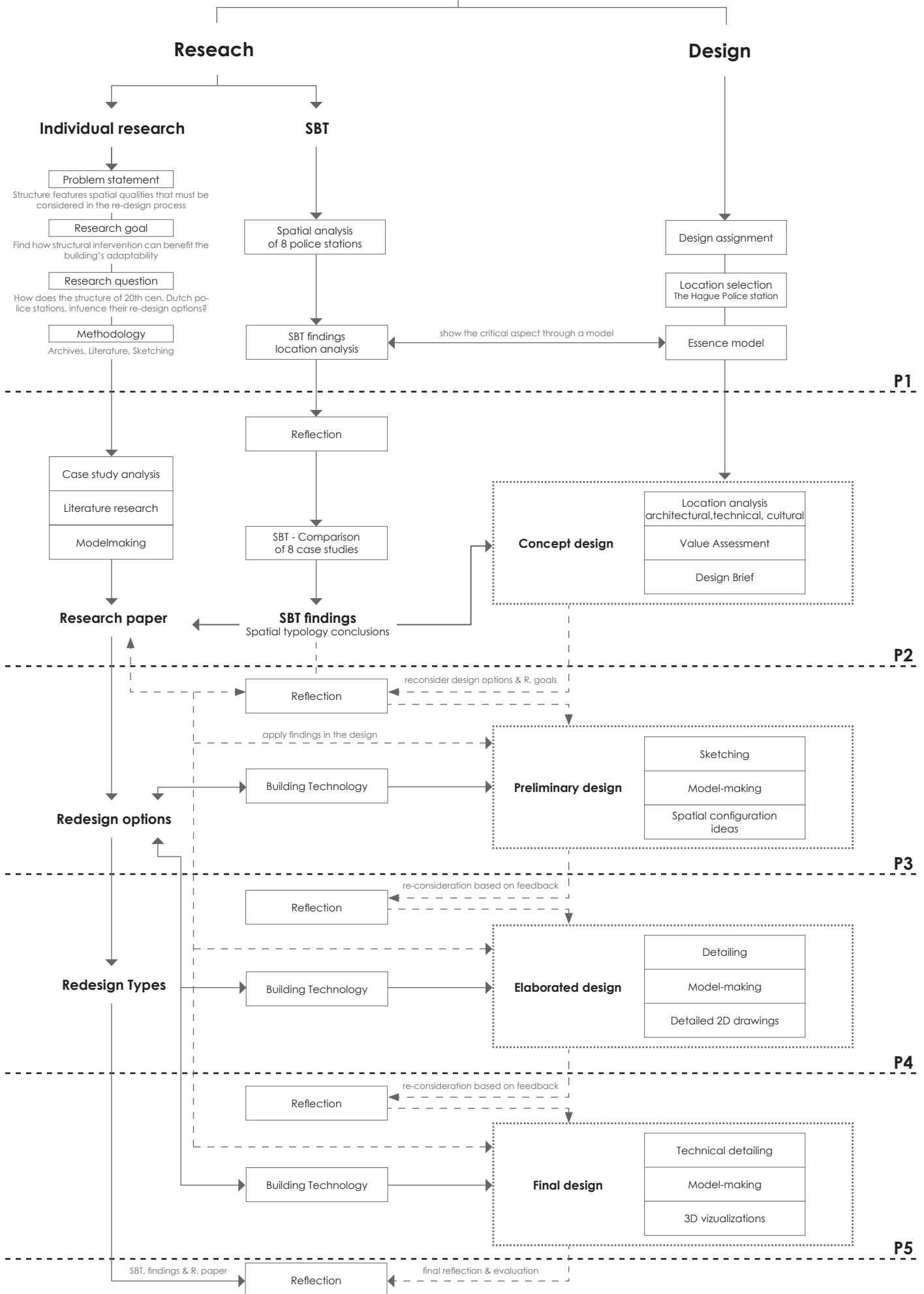
### **5.1. Relevance of SBT research**

The foundations of the SBT research lay in the realization that the attributes of space are central in the design approach of transformation projects. This theory requires more consideration and attention in the architecture discipline, which predominately relates building typologies to functions (Zijlstra, 2020). On the other hand, urban densification and technological development, guarantee the urgency of adaptive reuse in architecture. Even unpredicted factors, such as COVID 19, led to accelerating vacancy rates of culturally significant buildings. To that end, the Vacant Studio and SBT address this crucial architectural and societal problem. This problem is investigated through research that commences with the analysis of selected case studies, based on their spatial characteristics. Categorizing these aspects will enable us to explore their potential in the adaptive re-use of the Dutch police stations and showcase through this research, a different design approach.

### **5.2. Relevance of individual research**

The individual research intends to draw attention to the core of every building – the load-bearing structure. Either solely as a supporting mechanism or as an architectural feature, structure possesses a substantial role in the adaptability of the built environment. Exploring the structural limits and possibilities enables the architect to change an existing space and prolong the life of heritage buildings, adapting them to current needs. Therefore, the research-based design will showcase how the intentions and ideas for the transformation of vacant buildings, can be materialized through spatial interventions that are related to existing structures. Although the research investigates Dutch police stations, the findings of this study can be applied in other projects that share similar spatial characteristics, originating from an existing structure. Finally, unveiling the potential of the load-bearing systems constitutes the central theme of the research that relates to the escalating problem of vacancy.

**Studio theme**  
Vacancy of Dutch police stations



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