

Research plan

# Growing architecture

Explore Lab

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## **Abstract**

This research plan offers an overview of the research project that is being completed as part of my graduation project for the MSc Architecture, Urbanism and Building Science at TU Delft. At this stage, the research plan provides a draft outline of the research paper. The introduction outlines the problem statement, research questions and relevance, followed by the research method and the expected results. Additionally, it discusses design possibilities and a timeline in which the research and design projects start to come together to inform one another.

# INTRODUCTION

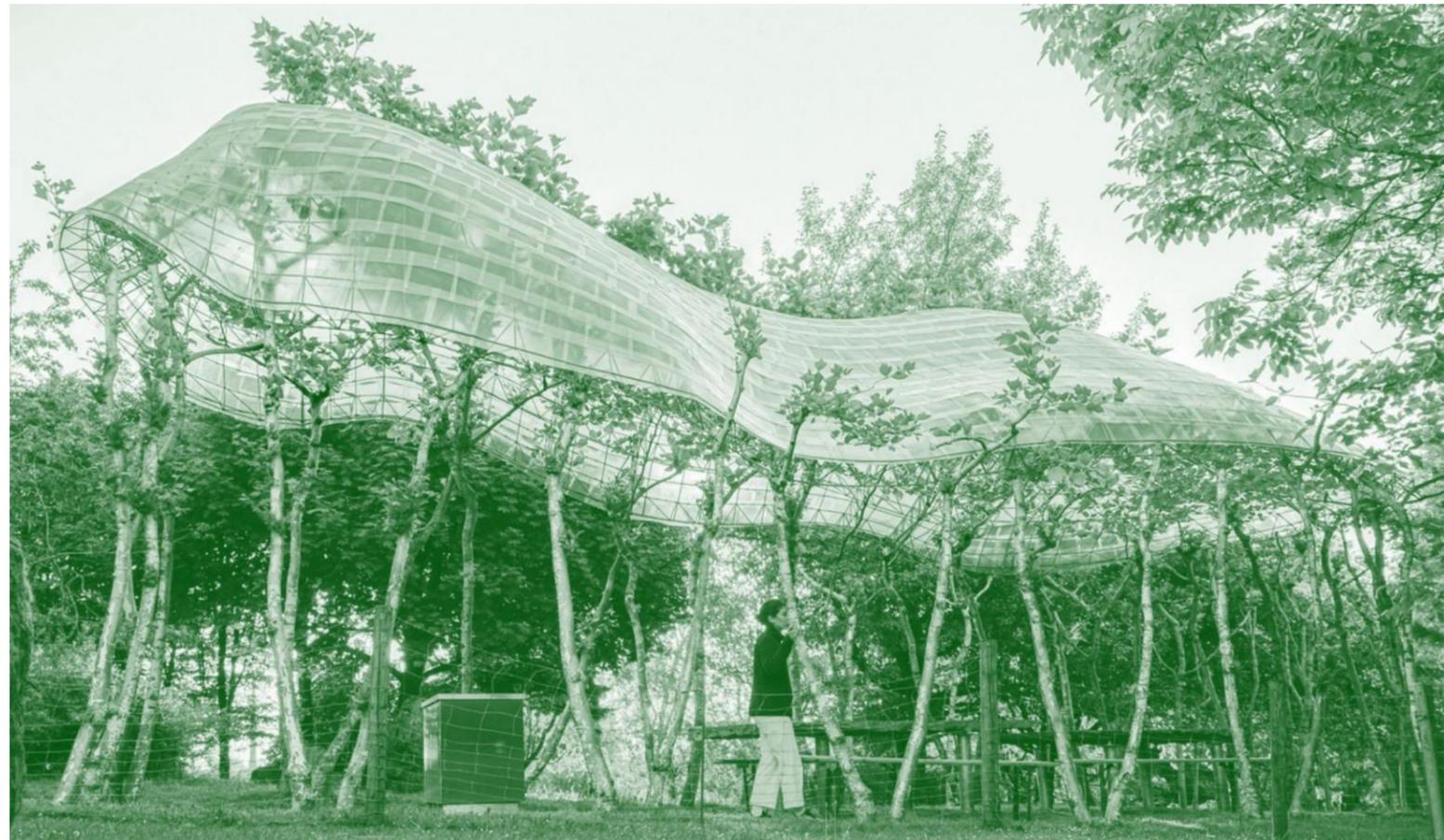
# 01

## Relevance and background

In our long-standing tradition to reimagine and reinterpret the relationship between architecture and nature, a new and exciting building approach has emerged known as *Baubotanik* - a German term that translates to *build* and *botany* (Ludwig, 2023).

Combining aspects of architecture, landscape and structural design, it presents an interesting challenge in current architectural practice by using living trees as a building material to form living structures. But what can you actually do with it? What forms can it take? What are its potentials and limitations?

This research project aims to take a closer look at these intriguing questions.



▲ 2 Recent structural experiment: Arbor Kitchen, Germany  
(Ludwig, 2023)

## Problem statement and research question

Inspired by the vernacular living root bridges in India (Fig. 1), and building on the work of predecessors in related fields (Ludwig, 2023), Baubotanik is now being investigated rigorously as an architectural and construction method at the Technical University of Munich, Germany.

When it comes to available knowledge, Baubotanik is a relatively new building approach. It is not very established, it is still at the early stages and it is very experimental. In recent years, there has been a lot of progress in the structural and technical research side of things (Figs. 2 & 3) (Ludwig, 2023). But less explored is the viability and design applications of this approach in the urban context. This will be the focus of this research paper, with the following research questions defining the scope of investigation:

**What role can living Baubotanik structures play in the urban context?**

- What spatial functions can they accommodate?
- What are the temporal implications of this?

The points of focus are thus: **trees, space and time.**



▲ 3 Recent structural experiment: Baubotanik Tower, Germany  
(own photo)

# METHOD

# 02

## Overview

The starting point of the research is an fixed parameter - a location. This is the basis for the core of the research, which is the spatial analysis. The structure is summarised in Figure 1 and explained below in more detail.

## Location

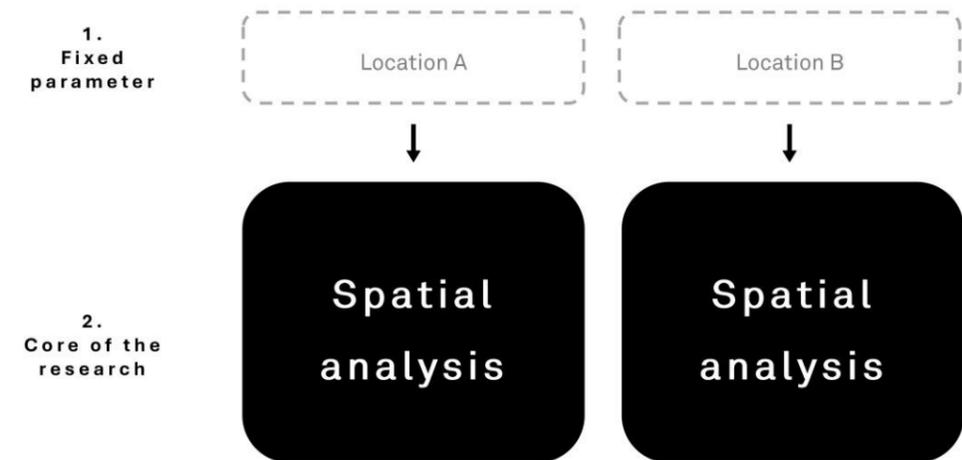
For the purpose of this research, considering the importance of location in and the contextual nature of Baubotanik (Ludwig, 2023), 2 locations with distinct climates are proposed as the starting point for the spatial analysis part. This parallel exercise allows for a range of spatial and temporal variations to be explored and later compared.

Rather than choosing 2 fixed urban locations, a broader approach is taken by selecting 2 climate zones, according to the Köppen-Geiger climate classification (Fig. 2): temperate and tropical (Piesik, 2023). In principle, this allows for the results of this paper to be applied on a wider scale, as long as the conditions are met.

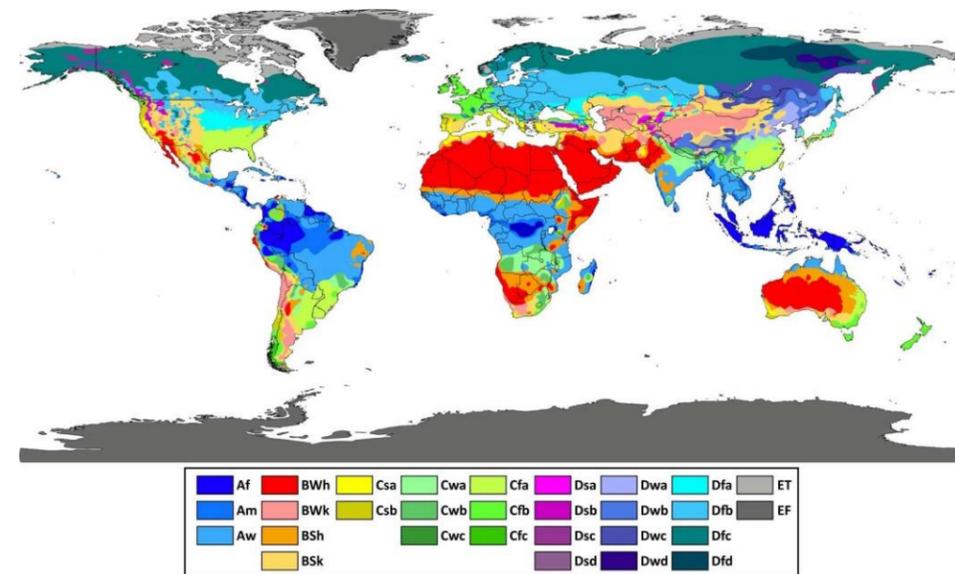
The choice of climate zone is based on 2 key aspects:

- 1- Contrasting tree species (that are suitable for Baubotanik)
- 2- Contrasting climatic conditions (and seasonal extremes)

From a Baubotanik perspective, these aspects directly influence spatial use and spatial requirements over time and, together, set the basis for the spatial analysis part of this research, where spatial and temporal relationships are investigated. Additionally, it provides the necessary criteria for the selection of relevant projects in the main part.



▲ 1 Research method overview



▲ 2 Köppen-Geiger climate classification

Climates are classified into 5 main groups: A (tropical), B (dry), C (temperate), D (continental), E (polar). ("Köppen Climate Classification", 2025)

## Spatial analysis

Within each climate zone, the spatial analysis will look at two things (Fig. 3):

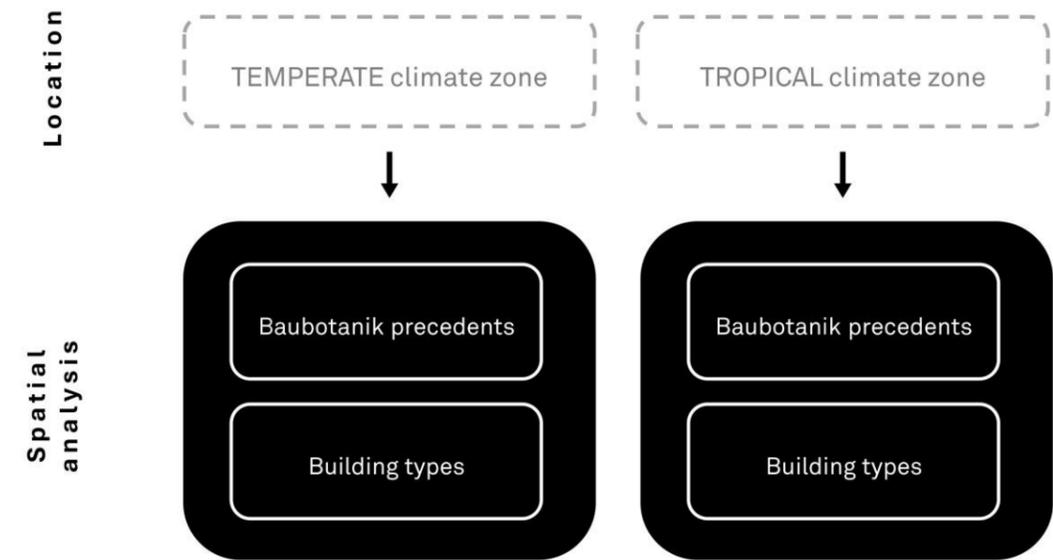
1. Baubotanik precedents
2. Building types (housing, school, pavilion etc.)

In other words, the spatial analysis concerns itself with two key aspects:

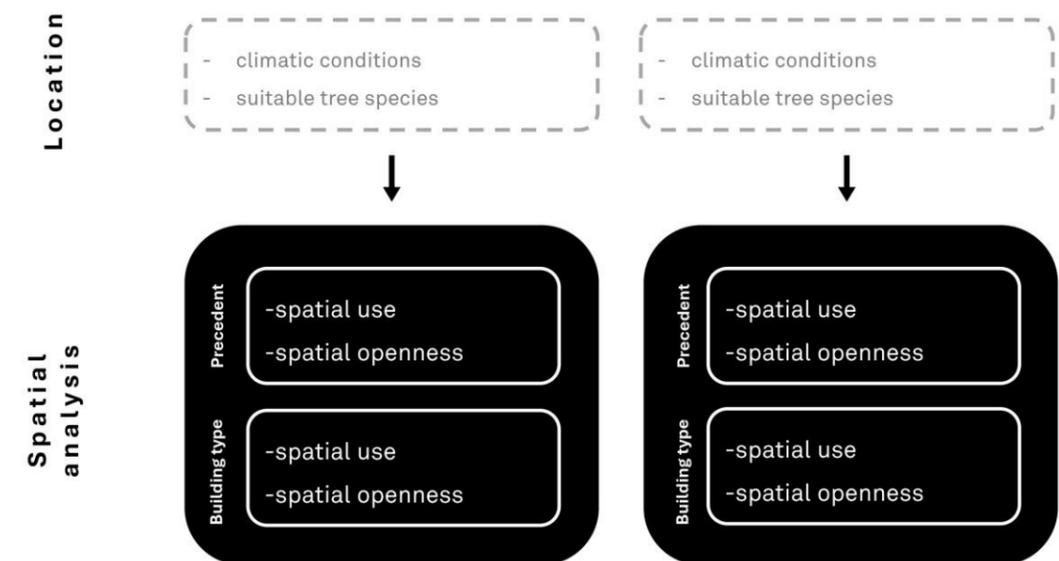
- What can Baubotanik do?
- What do spaces need?

As outlined in the information output diagram (Fig. 4), spatial use and spatial openness are analysed for each of these spaces at different points in time. For this purpose, the spatial openness gradient shown in Figure 5 is implemented. Projects containing multiple spaces or rooms are separated into individual spaces in order to properly assess their spatial qualities.

This allows to examine how spatial use and spatial requirements change over time and to explore spatial and temporal relationships.



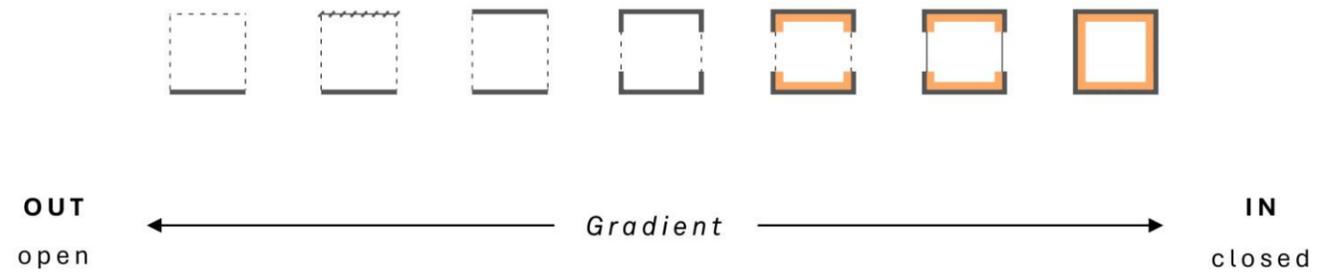
▲ 3 Research method in more detail



▲ 4 Information output

**5 Spatial openness gradient** ▶

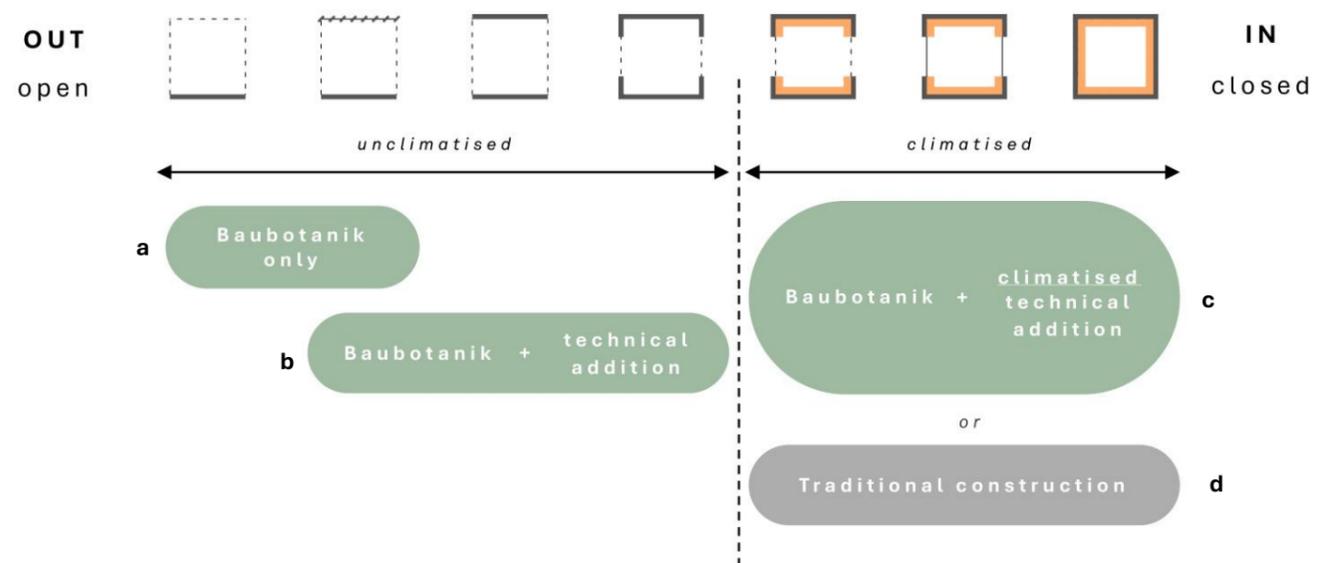
With this gradient, spaces are analysed in terms of openness and climate comfort, going from outdoor to indoor.

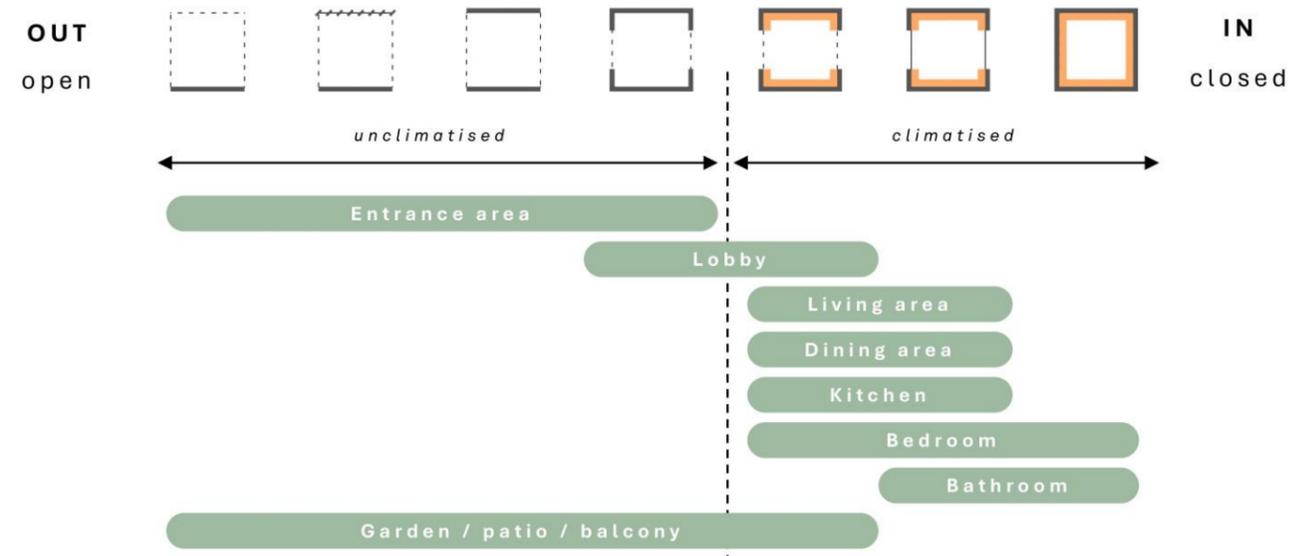


**6 Baubotanik precedents** ▶

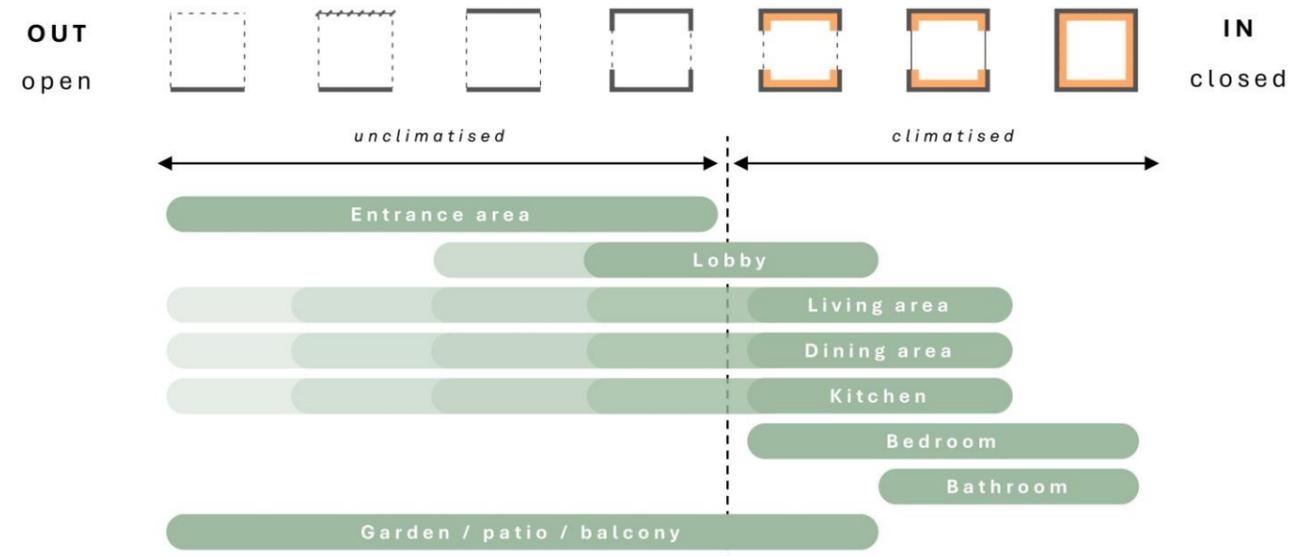
Here, some initial findings from the Baubotanik precedent analysis in the temperate climate are shown using the gradient.

- a. On the left side of the scale, a purely baubotanical structure is enough to create these spaces.
- b. For these spaces, Baubotanik works well as the primary structure, but some sort of technical addition is necessary to create solid divisions like a roof or a wall.
- c. Once the climatized threshold is crossed, Baubotanik still works as the primary structure, but the technical elements themselves would need to be climatized.
- d. Alternatively, these spaces could be created using traditional construction..





▲ 7a Housing in winter



▲ 7b Housing in summer

**7a & 7b Building type analysis** ▲►

This example illustrates the analysis of a 'building type', in this case housing, in a temperate climate zone. Here, the winter and summer situations are chosen (climatic extremes) to observe how spatial use and spatial requirements change over time. The building type is broken down into individual spaces or rooms, in order to better assess these changes. In winter, most of the core spaces are concentrated towards the inside. In summer, many of these spaces become more flexible and more open towards the outside.

# EXPECTED RESULTS

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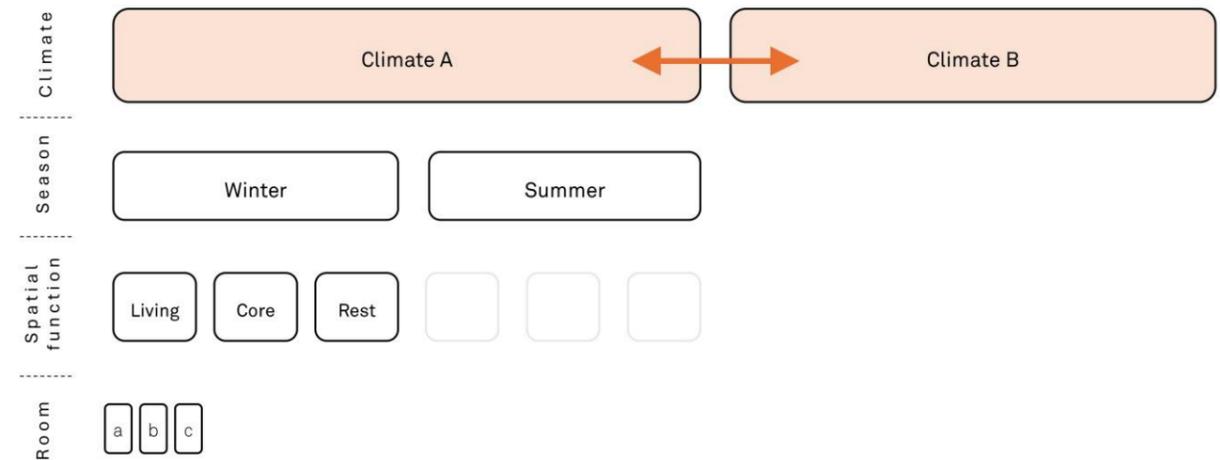
## Expected results

In general, the type of results expected for the research questions are advice for designers. This will be presented in written and visual format.

More specifically, the results themselves will be a combination of spatial + temporal possibilities and spatial + temporal requirements. This will provide an indication of spaces suited for Baubotanik, or, in other words, advice on suitability.

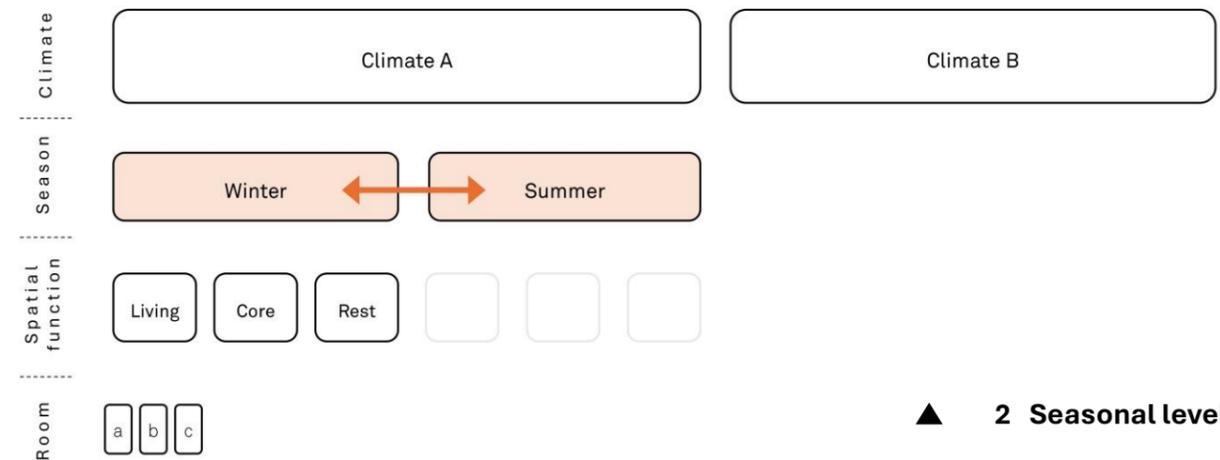
## Organisation of results

Given the array of results, each concerning suitability at different scales, the advice is to be organised and presented in a layered way, to facilitate its application in design. This layered advice will have the following (provisional) levels: climate, season, spatial function and room. In addition to being able to validate or exclude spaces in a yes/no fashion, with this layered approach, a comparison of results can take place to formulate comparative advice within each layer. The diagrams in Figures 1-6 illustrate how this could work.



### ▲ 1 Climate level

At climate level, Climate A and Climate B will be compared. From this, the advice could be: For Baubotanik, Climate A is more suitable than Climate B.

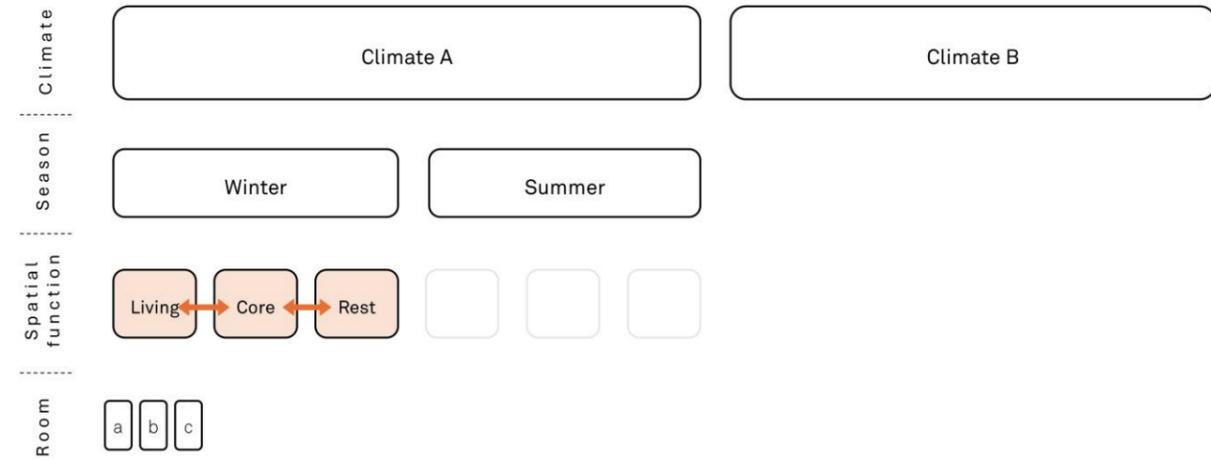


### ▲ 2 Seasonal level

At seasonal level, summer and winter will be compared, for example (in Climate A). From this, the advice could be: For Baubotanik, summer is more suitable than winter.

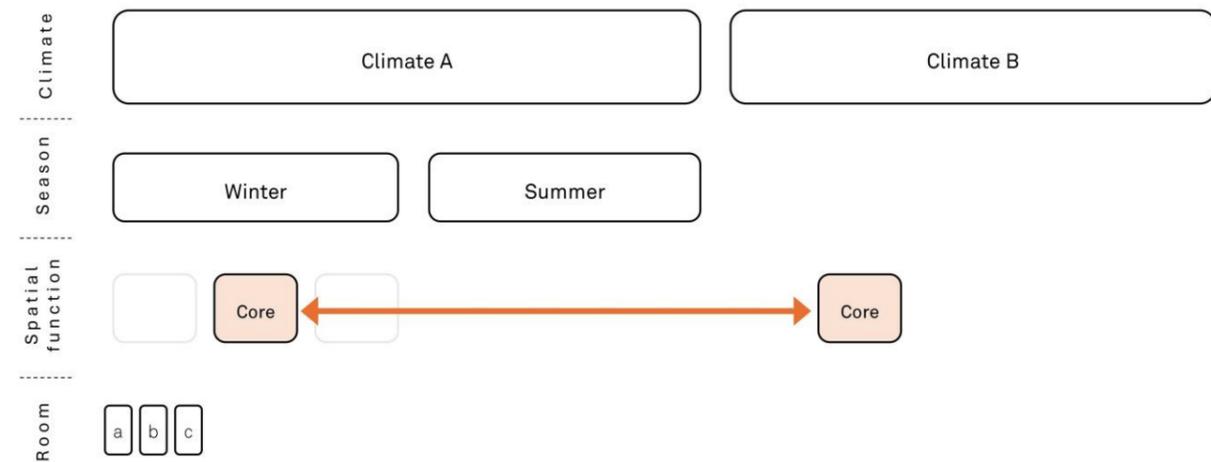
**3 Spatial function level** ▶

On a spatial function level, the advice could be: For Baubotanik, 'living' and 'core' functions are more suitable than the 'rest' function.



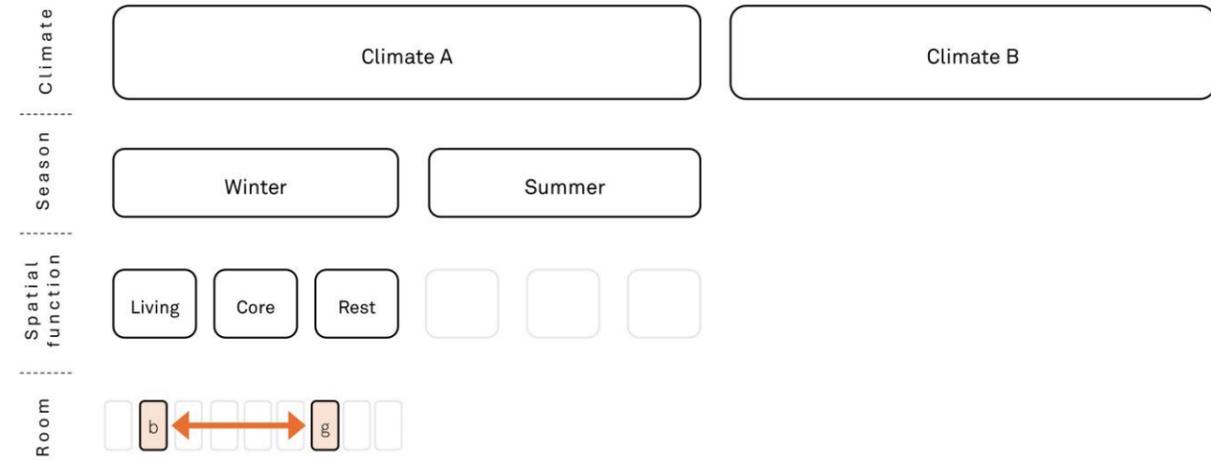
**4 Spatial function level** ▶

Alternatively, it could also be that spatial functions are compared across seasons or across climates.



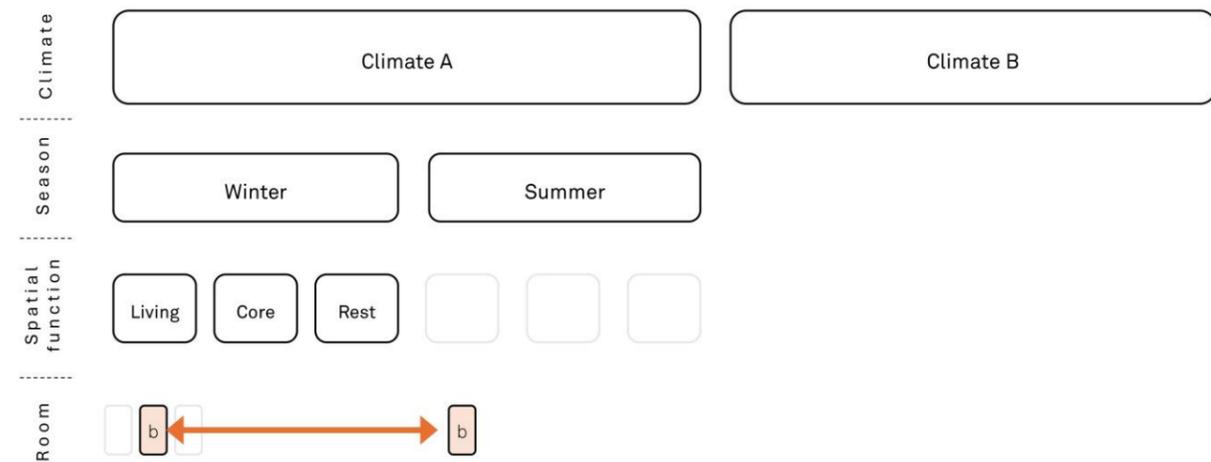
**5 Room level** ▶

At room level, different rooms could be compared, for example, dining room and bedroom. The advice in this case could be: For Baubotanik, living room is more suitable than bedroom (in winter, in climate A).



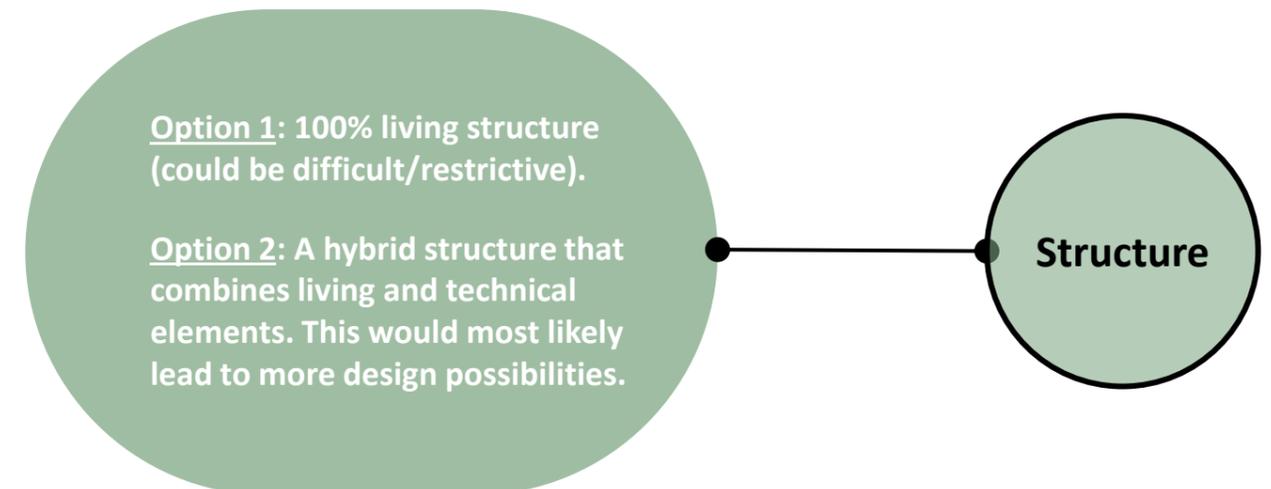
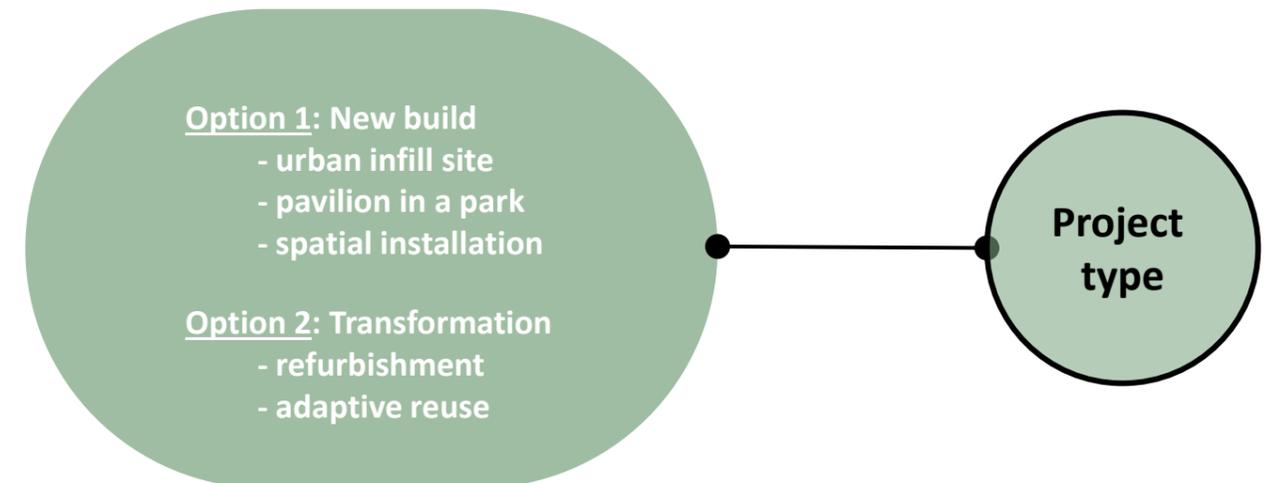
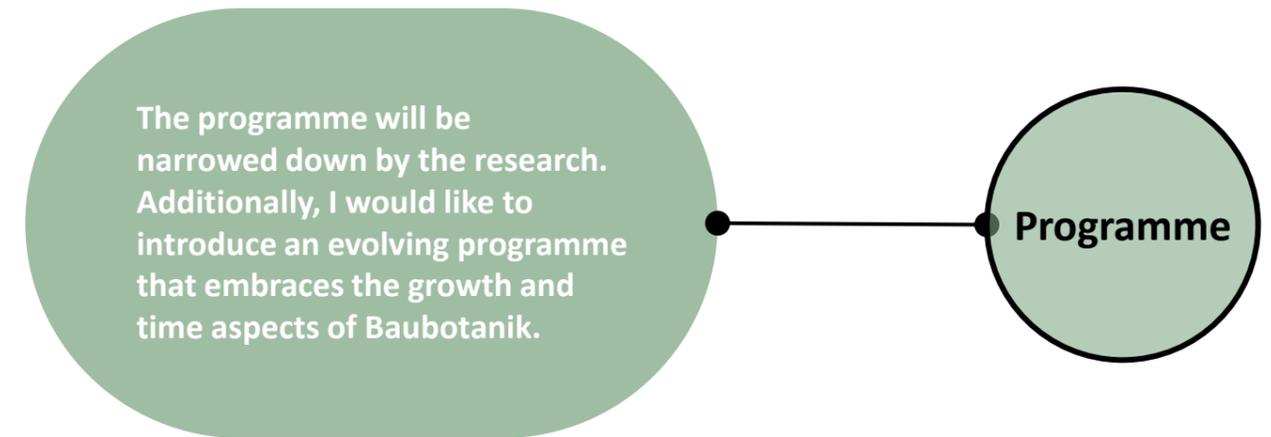
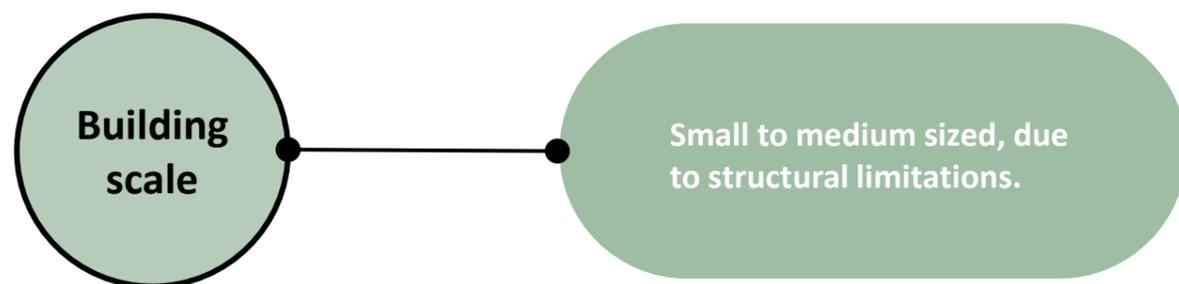
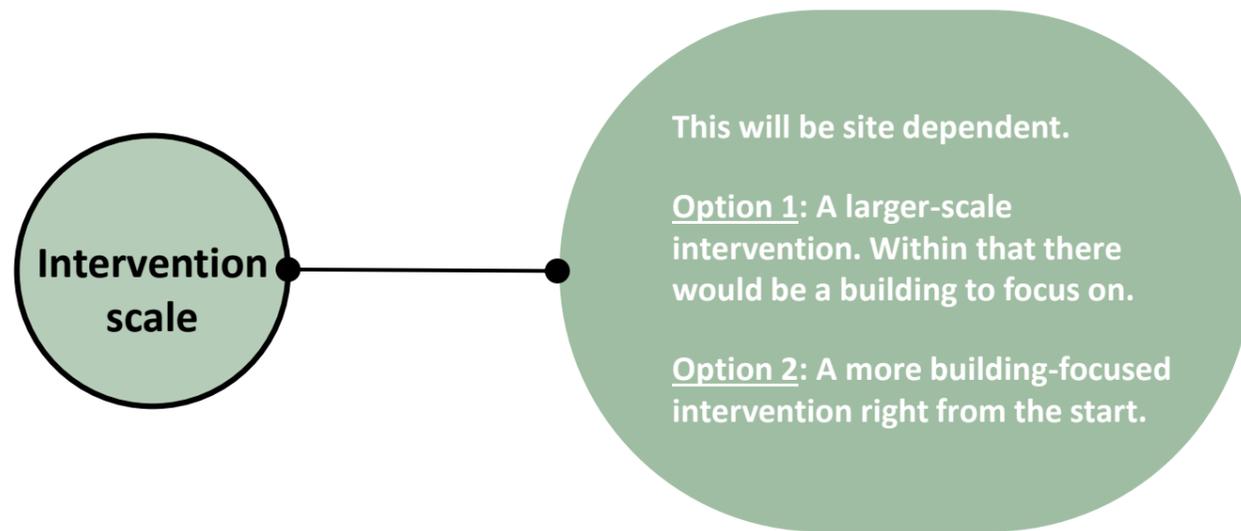
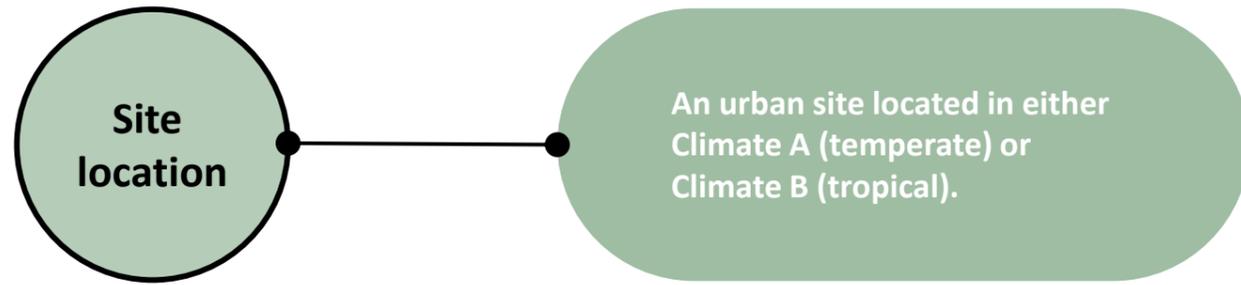
**6 Room level** ▶

Alternatively, it could also be that the same room is compared across seasons or across climates.



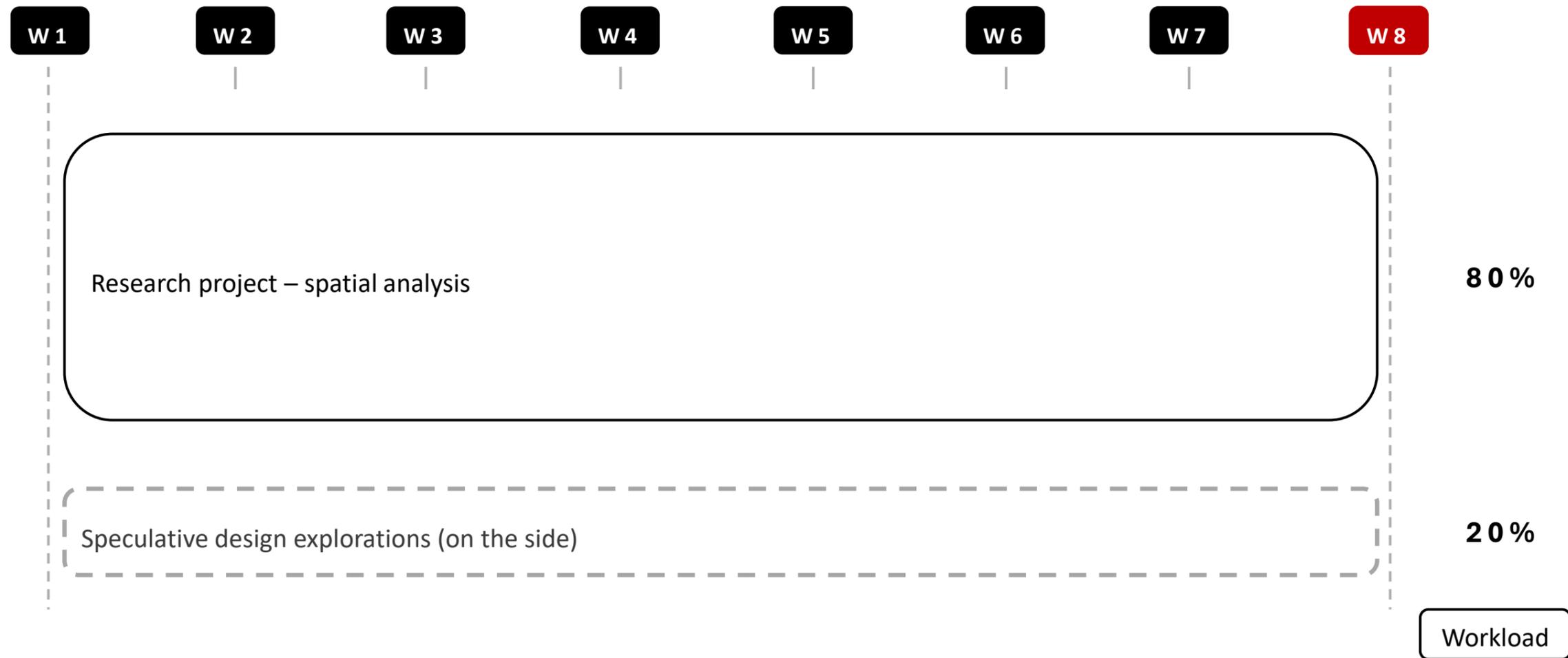
# DESIGN POSSIBILITIES

# 04



# NEXT STEPS

# 05



## Timeline

This is a timeline outlining the weeks following P1, leading up to P2. The plan is to spend approximately 80% of my time on the research project, which mainly consists of the spatial analysis.

On the side, I will work on speculative design explorations, i.e. testing ideas and coming up with concept spatial layouts. This will be about 20% of the workload.

# REFERENCES

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## References

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