Built to be ruins

Master Thesis of Architecture, Lund University of Architecture

ELIN SCHNIPPER

LUNDS
UNIVERSITET
Lunds Tekniska Högskola

Master Thesis of Architecture, Lund University of Architecture

Examiner: Christer Malmström
Supervisors: Jesús Mateo
Børre Skodvin

CONTENTS

Introduction

The Rise and Fall

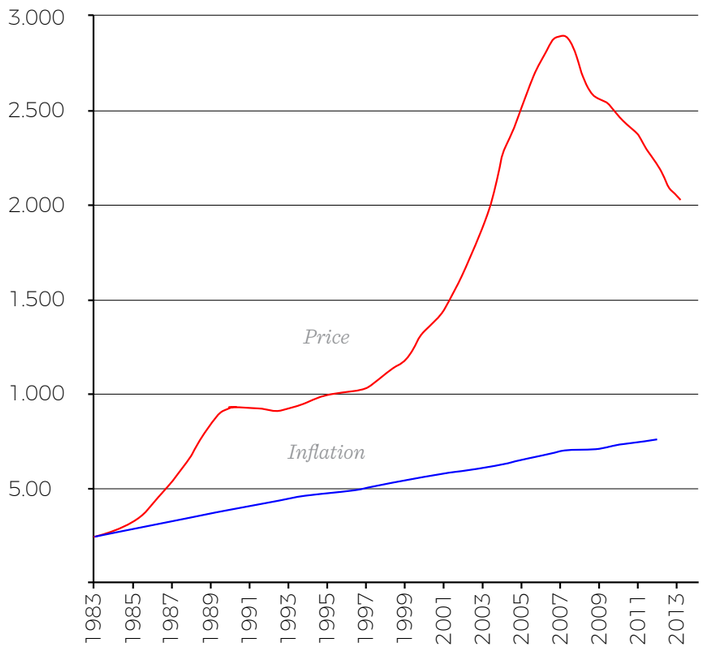


Figure 1: Evolution of the price of square meter in Spain, in euros

1

THE RISE AND FALL

In 2003 my family and I moved to Costa del Sol in Spain. This was during a time when tourism was booming and many tourists like ourselves had decided to make a permanent home for themselves on the sunny coast. Construction companies were thriving and building more than ever to suit the needs of the thousands of tourists that were arriving every year.

From 1996-2007, the price of housing in Spain had risen by 200%. The price development was stimulated at first by an expanding economy that benefited from EU membership but also due to the activity of lenders. Mortgagors who traditionally focused on local customers took part in this expansion, providing financing for much riskier (but potentially higher paying) loans for apartments and second homes. [1]

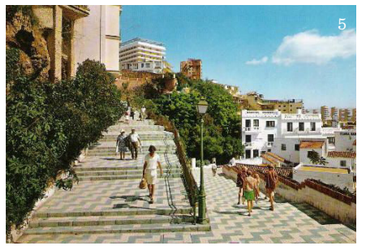
In 2004, 509,293 new properties were built in Spain and in 2005 the number of new properties built was 528,754. Between 2000-2009, 5 million new housing units had been added to the existing stock of 20 million, while the population grew by only 6.25 million (to 46million.). In a country with 16.5 million families, there are 22–24 million houses and 3–4 million empty houses. [1]

As the boom began to slow, new units were added at about twice the rate of absorption. In 2008 the prosperous future of Spanish architecture took a turn when the financial crisis hit. The real estate market started to drop fast and housing prices decreased dramatically by 8% in that year. A 37% drop in price was seen over the years from 2007-2013. [2]

In February 2014, Rupert Neate wrote for "The Guardian" in his article "Scandal of Europe's 11m empty homes" that Spain has 3.4 million empty homes. [3] The Spanish newspaper El País wrote in November 2015 that Spain has 389,000 vacant homes that have never been inhabited. [4] Today one sees skeletons of unfinished buildings scattered throughout the country as well as finished buildings uninhabited due to corruption and diminished investment opportunities.

But this isn't just an issue for Spain. As stated in "The Guardian"'s article, Europe has collectively 11 million empty homes. Many European tourist destinations have tragically

Photographs taken by author:
Two abanboned villas in Cancelada



experienced the same rise and fall as that of Spain and whom now look out over their countrysides that are littered with empty buildings. To mention a few examples: "Holidays after the fall" written by Elke Beyer, Anke Hagemann och Michael Zinganel tells the tale of Seaside Architecture in Bulgaria and Croatia. [5] A website called www.failedarchitecture.com shows a photo essay of concrete skeletons from Albania. [6] The website "VICE" has an article with the title "All the empty buildings you pass on the way to see the fancy bits in Greece." [7] And photographer Amélie Labourdette has a series of photographs that she calls "Empire of dust" that shows abandoned buildings from Italy. [8]

Much like Amélie Labourdette, there are a few individuals who are able to look at these abandoned buildings as works of art. Indeed there is something intriguing about derelict concrete structures against a picturesque landscape. But there is also somethings that is saddening when these structures that carry so much potential are not put to use.

Figure 2: Torremolinos 1950
Figure 3: Marbella 1960
Figure 4: Torremolinos 1975
Figure 5: El Bajondillo. 1961

Photographs taken by author:
Two abanboned villas in Nueva Andalucia

Figure 6 & 7:
Amélie Labourdette's photography series "Empire of dust" from Italy

Figure 8 & 9:
"Holiday after the fall" Hotel Haludovo in Malinska. Croatia
Architect Boris Magas, 1972 -2012

Figure 10 & 11:
Concrete skeletons in Albania

Figure 12:
Photograph from a demonstration in Seville against evictions
(El País 2013)

2

REASONS FOR SAVING ABANDONED BUILDINGS

RESOLVING THE PROBLEM

One way of handling the dilemma of empty houses in Spain is to keep them and not demolish them. The environmental impact of demolishing 3,4 million homes and reconstructing after demand would be detrimental and clearly unrealistic. Therefore keeping the structures and using what material is available is a solution that is much kinder to the environment.

This diploma of architecture investigates an abandoned concrete structure in southern Spain with the intention of changing its function. This diploma aims to prove the flexibility of concrete structures and how they are able to adapt and fulfill current needs of the community that it inhabits and therefore prove the social and environmental sustainability of abandoned structures.

SOCIAL SUSTAINABILITY

We can no longer expect that the buildings we design will inhabit the same program throughout their lifetime. This statement does not mean to encourage generic design but encourage an awareness that in order to ensure socially sustainable architecture there is a great value in the flexibility of buildings. This does not solely concern architects, but the government of countries affected by these high numbers of empty homes need to ease and help facilitate the bureaucratic process of changing buildings functions from their initially designated program in their building permission.

ENVIRONMENTAL SUSTAINABILITY

EU countries have agreed on a new 2030 Framework for climate and energy, including EU-wide targets and policy objectives for the period between 2020 and 2030. These targets aim to help the EU achieve a more competitive, secure and sustainable energy system and to meet its long-term greenhouse gas reductions target.

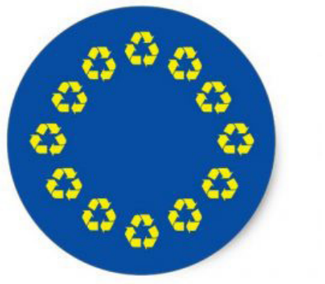


Figure 13:
Image from an EU recycling campaign

Targets for 2030:

A 40% cut in greenhouse gas emissions compared to 1990 levels

at least a 27% share of renewable energy consumption

at least 27% energy savings compared with the business-as-usual scenario. [9]

The EU 2030 Energy Agreement is another reason why it is important to transform the abandoned concrete structures. Spain's total amount of greenhouse gas emissions for 1990 were 282.8 Mt (Metric tonnes) Mt CO2-eq. [10] Meaning that by 2030 this needs to be 169,68 Mt CO2-eq.

In her article "Emissions from the Cement Industry", Madeleine Rubenstein writes that "Concrete is the second most consumed substance on Earth after water. On average, each year, three tons of concrete are consumed by every person on the planet. " [11]

She also explains that "The production of cement releases greenhouse gas emissions both directly and indirectly: the heating of limestone releases CO2 directly, while the burning of fossil fuels to heat the kiln indirectly results in CO2 emissions. " Given that cement is the main component of concrete it seems bizarre to suggest building more concrete buildings when there is clearly an abundance of empty ones that should be put to use.

It is important to state that if there was ever a positive outcome of the financial crisis in Spain, it was the decrease in GHG emissions from 2008-2010. The effect of the financial crisis on the building industry will certainly effect the levels of GHG emissions, however Spain cannot rely on the decline of the building sector to meet the 2030 requirements. By transforming the existing abandoned buildings in Spain and using what is already there (instead of demolishing and reconstructing), the GHG emissions could be pushed even lower as the building industry starts to get back on its feet.

3

PURPOSE OF THE DIPLOMA

PURPOSE OF THE DIPLOMA

The 3,4 million empty houses in Spain presents the country with a problem. The answer is not so simple as to allow the buildings to stand unused until the population is large enough to absorb the housing stock. These buildings are not being maintained and therefore their deterioration is inevitable and either they will reach a point of no return and have to be demolished or this deterioration can be prevented.

ASSIGNMNENT

Clearly there is no need for more housing in Spain so in order for these structures to be put to use their purpose and function needs to be altered. This diploma of architecture would like to illustrate an example of this procedure. By choosing a derelict building in Spain and changing the function of that building, the project aims to prove the flexibility of that structure and therefore to apply the same strategy to other buildings.

The chosen example for this project is a shopping center in the south of Spain in Cancelada. This small village was promised a shopping center and 25 years ago the construction of the building came to a halt. The reason for incompletion is unknown.

METHOD OF WORKING

To be clear, there is no current plan for the existing building in Cancelada. The project begins with a site analysis to understand the environment in the village and to establish what program would be best suited for the existing building and also enrich the community.

An analysis of the existing construction is conducted to understand the structural potentials of the building. Having understood the current situation, the project begins to examine the possibilities of transformation for the building. This is executed by testing variations of wall placement, extraction of the existing slab and articulation of openings. An exterior and interior volume analysis is also made that not only looks at the existing grid but the entire building and plot. The variations are then compared and a conclusion is made about the findings of each examination. This method of working not only documents the project's process but also makes the work more applicable to other similar transformation ventures.

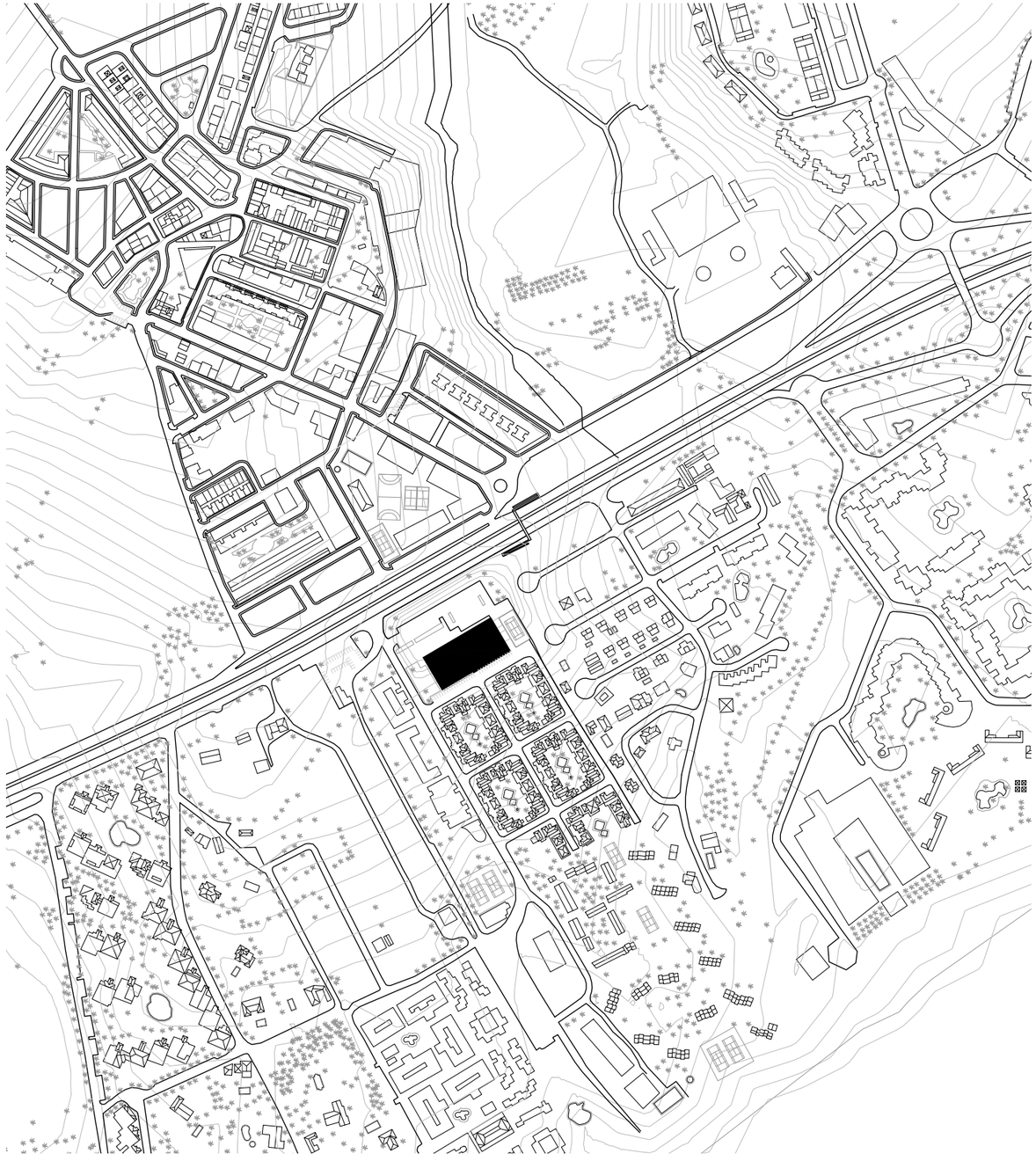
From these findings a proposal is then put forward.

Project Background

Site Analysis, New Program & Existing Building

- Site plan -
1:5000

N



4

THE SITE

THE BUILDING

The existing building was designed as a shopping center but was never completed. It has been standing still for 25 years and was therefore constructed prior to the financial crisis in 2008. A real estate agent that once tried to sell the property has provided drawings of the building. The reason for incompletion is unknown.

LOCATION

The site of the project is located in Cancelada, Andalucia, Spain which lies on the Costa del Sol. "La autovía del Mediterráneo" also known as the A7 motorway starts in Barcelona and continues along the east-coast of Spain all the way down to the south of the country to Algeciras (see photograph on next page.) The existing building is situated alongside this motorway on the northern side and it is the main route of transport along the whole of the Costa del Sol. Its existence is very dominant in the urban development as it divides the coast into a northern and southern part.

NORTH & SOUTH OF THE MOTORWAY

In the case of Cancelada, the north of the motorway is predominantly populated by Spaniards whereas the south consists mainly of hotels and tourist apartments. The Spanish have established a well functioning society for themselves with a primary & secondary school, sports center, doctors, pharmacy, church, lawyers, fish mongers, butchers, grocery shops, town hall as well as several restaurants. Every year they have swimming and equestrian competitions as well as a huge fiesta in August. Although Cancelada is small they are certainly a tight community.

As one walks through Cancelada one constantly discovers pockets of greenery that invite you into the courtyards of residential areas and public spaces. There are many benches to be found where one can take a rest from the blazing sun and converse with a neighbour.

The situation south of the motorway is very different. Firstly, if you are not a hotel guest or staying in one of the holiday apartments there is nowhere for you to go but straight down to the beach. There are no benches to rest on, no parks, no shops or kiosks. The high level of security of the hotels and apartment blocks means that you often meet a tall wall that prevents anybody unwanted from entering. The need for security is understandable because there are many robberies that occur in this area. However there is a dire need for public spaces on the south side, especially when the temperature is nearing 40 degrees celsius in the summer and finding shade is your main mission.

The existing building resides on the south side of the motorway and has holiday apartments west and south of the plot. East of the plot are holiday villas. North of the building is a large area that was intended to be used for parking. South of the building is a gated residential area.

This page:
Photograph taken by author
From bridge looking over the motorway of Costa del Sol. The building on the left of the image

Next page:
Photograph taken by author
Northern facade of building

Photograph taken by author:
Southern facade of building

Photograph taken by author:
Close-up of Southern facade

Photographs taken by author:
North of the motorway

Photographs taken by author:
North of the motorway

Photographs taken by author:
North of the motorway

Photographs taken by author:
North of the motorway

Photographs taken by author:
South of the motorway

Photographs taken by author:
South of the motorway

Photographs taken by author:
South of the motorway

Photographs taken by author:
South of the motorway

5

THE NEW PROGRAM

There is a clear social divide between the polar ends of Cancelada. Where the Spaniards occupy the north and the tourists occupy the south. Given that Cancelada does not have an upper secondary school this project proposes that a school overtakes the existing shopping center. The school's subjects can be used to activate the south of the motorway by allowing certain facilities to be open to the public. For example the library, IT room and art room/ gallery can be used by the public as well as the students. The assembly hall can host speeches, theater productions and concerts. Group rooms can be booked by students, teachers and locals. The religious studies classroom can offer a chapel available for everyone. This proposal hopes to provide the southern part of the motorway with more facilities, increase public space and reactivate the derelict building.

Cancelada currently has one primary school and one secondary school. Students that continue to upper secondary school need to travel to either Estepona or San Pedro which takes roughly 30 minutes by car. Although this is not a long journey, the establishment of an upper secondary school in Cancelada would greatly benefit the children and community.

Given that students attending school will be aged between 16-18 the suggested concept of allowing certain areas of the school to be open for the public is more plausible than a school with younger pupils. This age group is transitioning into becoming adults and therefore putting them in an environment that includes the community could be very beneficial for their development. There will be a security system that will allow areas of the building to be closed off and therefore protected.

By offering public spaces to find shade, to read a book or browse the net the project hopes that the southern side of the motorway can become more integrated with the Spanish community and that the sharp divide between permanent residents and tourists becomes more diffuse.

The categories of users of the building can be generalised into two groups, students and visitors. Visitors can obviously not partake in lessons and therefore the architecture will need to establish boundaries where visitors will not have access. Students however will have access everywhere.

Photograph taken by author:
Cancelada Primary School

Photograph taken by author:
Cancelada Secondary School

Photograph taken by author:
Close-up of Southern facade

6

THE EXISTING BUILDING

CONSTRUCTION

All that is standing on the site today is a grid of columns that support a waffle slab and a simple facade. There is a ground floor (2600m²), first floor (2600m²) and half a basement floor (1000m²) that total to an area of 5300m².

The waffle slab and columns consist of reinforced concrete. The waffle slab is a monolithic construction of slab with narrow beams spanning in both directions. The grid spans 8 x 7.2m. The beams are 150mm x 300mm. Columns are only found on the ground floor. There is no roof over the building, only the continuous waffle slab of the first floor. The facade reaches up to the first floor. The waffle slab of 40cm thickness and columns of also 40cm offer a very sturdy structure strong enough to withstand the weight of 5KN/m² that a shopping centre requires. A school requires 2.5KN/m², therefore the existing structure can withstand double the load of what it will be used for. [12]

Around each column, the waffle slab is further reinforced with a concrete infill (5 x 5 boxes). A row of waffle boxes are also filled with concrete along the length of the building, passing through each column (see photograph on page 45 and plan on page 49.) This is slightly odd as one would think that this reinforcement would run along the short sides of the building like most beams in any building. But then again the cause of construction termination is unknown in the case and there are many bizarre aspects of this building that could well have been the cause.

CONDITION

The concrete waffle slab and concrete columns are in good condition. There seem to be no signs of damage and therefore should still be capable of providing the necessary strength that a shopping center requires. The facade however isn't toughing it out quite as well as the slab and columns. As can be seen in the picture on the left, the reinforcement bars are peaking through and showing signs of corrosion in several places.

Photograph taken by author:
Ground floor of existing building

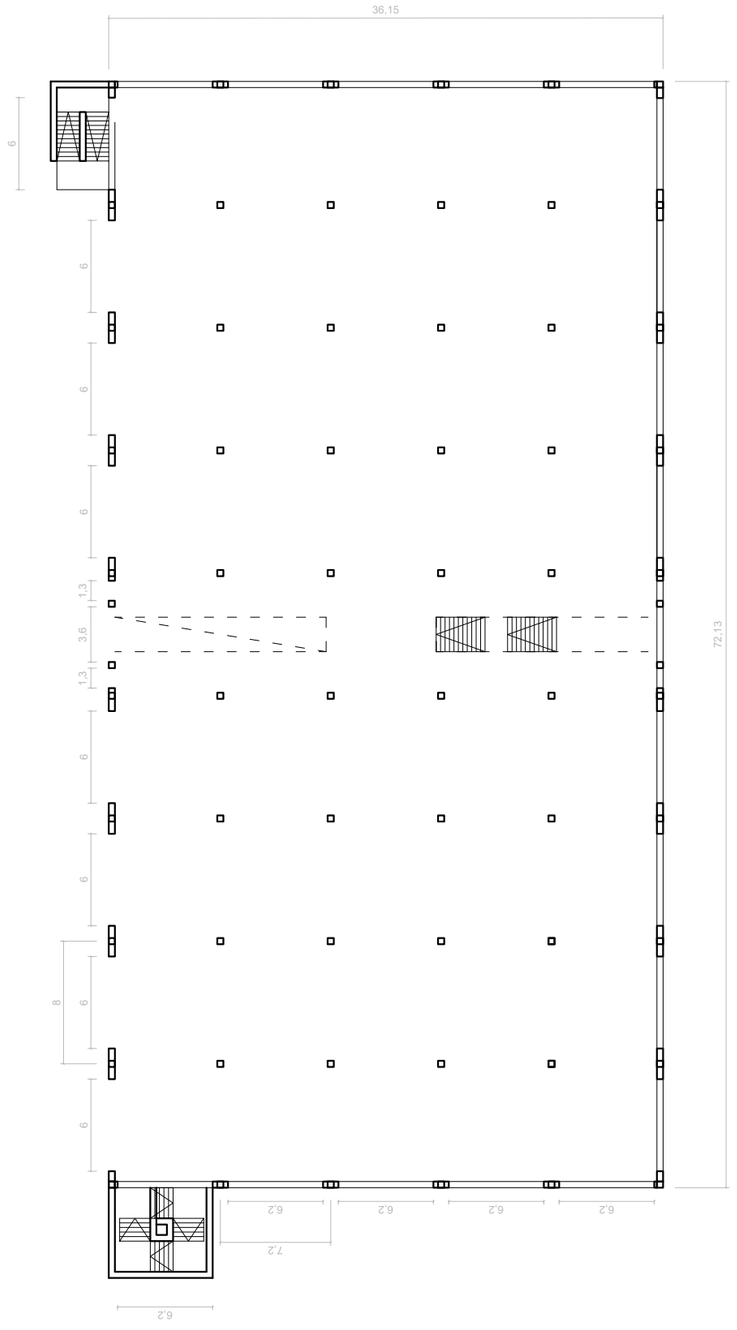
WHAT TO KEEP AND WHAT TO DISCARD

In this transformation project, the existing building has no historical value. It is not a building that has been used by the local population and therefore has no nostalgic value. The only association that people have with this building is their experience of it from afar. There are also no ornaments, decorations or architectural gems that reside in this building that would need to be preserved or restored.

A transformation project needs to decide what stance the new architecture should take in relation to the existing structure. Given that there are no elements of precious value one could say that the architect could discard anything that stands in the way of the new. There is no need for visitors or users of the building to see that the school was once a shopping center.

However it is interesting from an architect's point of view to understand what happens when two types of architecture meet. How will the materials behave together? How will the two types connect and what joints will be formed? What structural potentials does the existing building have that be enriched with an additional structure?

N



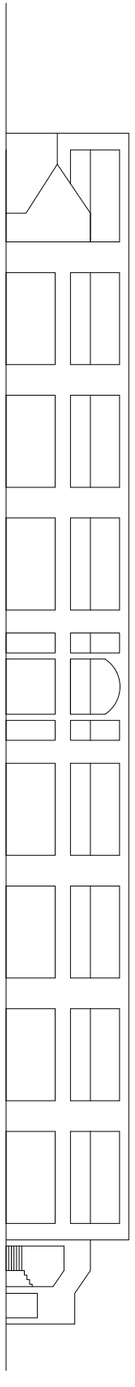
- Plan 0 -
1:400

- Plan 1 -
1:400

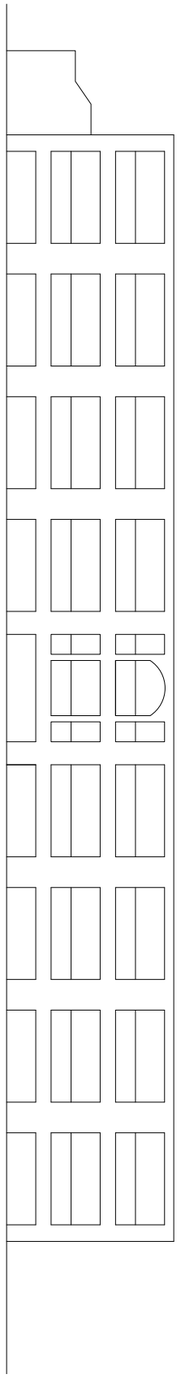
- Plan -1 -
1:400

Waffle slab ceiling (concrete infill in grey)
1:400

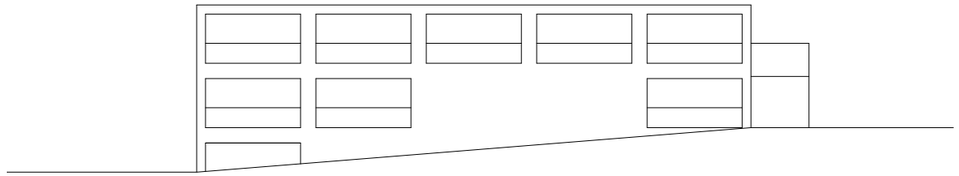
- Detail of existing waffle slab construction -
1:30



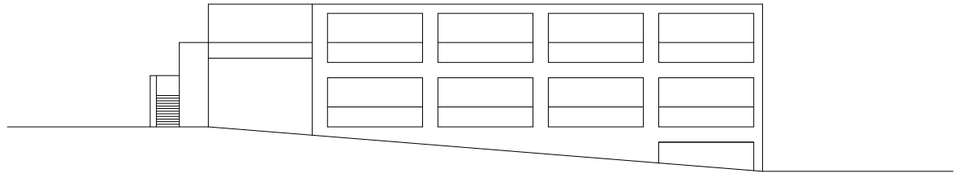
Northern Facade
1:400



Southern Facade
1:400



Eastern Facade
1:400



Western Facade
1:400

Spatial Analysis

Studies and Reflections

7

SPATIAL ANALYSIS

In order to prove the flexibility of abandoned concrete structures there was primarily a need to understand the existing construction and explore the possibilities that were available for the transformation project. By initially disregarding the program of the school an examination could be conducted that solely looked at the architecture of space rather than architecture as a consequence of program. It was also important that the program didn't hinder the design process too early on. The aim of this examination was to provide an array of solutions that could be discussed and compared. By excluding program this method of working also provides solutions that could be adopted for other transformation projects regardless of their function.

The spatial analysis explores how to approach the transformation of the existing building. This method of working has helped document the design process of this diploma and by constantly working with alternatives the decisions that have been made are a conclusion of these examinations.

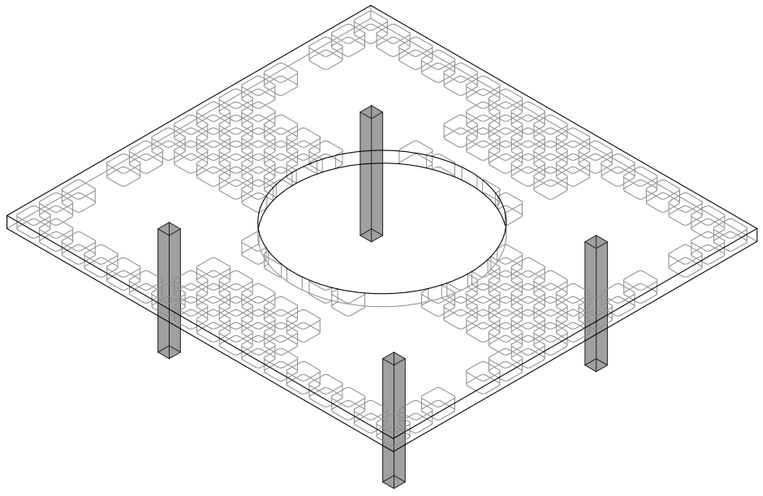
Any options that are disregarded are not forgotten and will hopefully be used in another project, in another time, in a different place.

These topics of transformation have been examined:

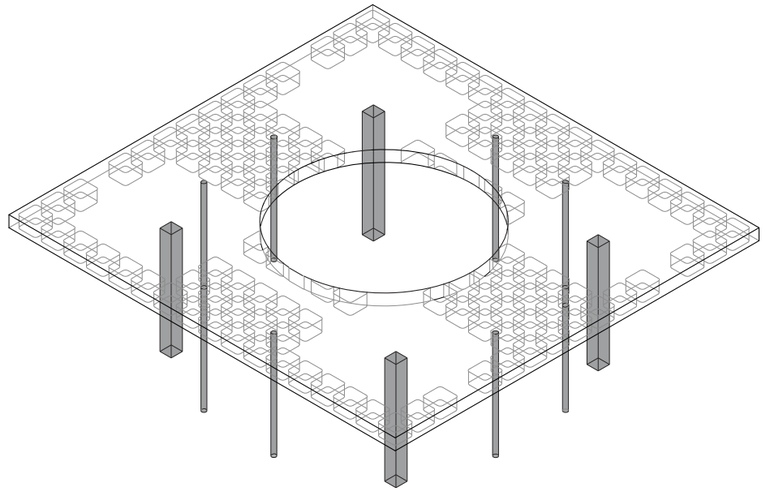
1) Extraction of waffle slab

2) Placement of walls

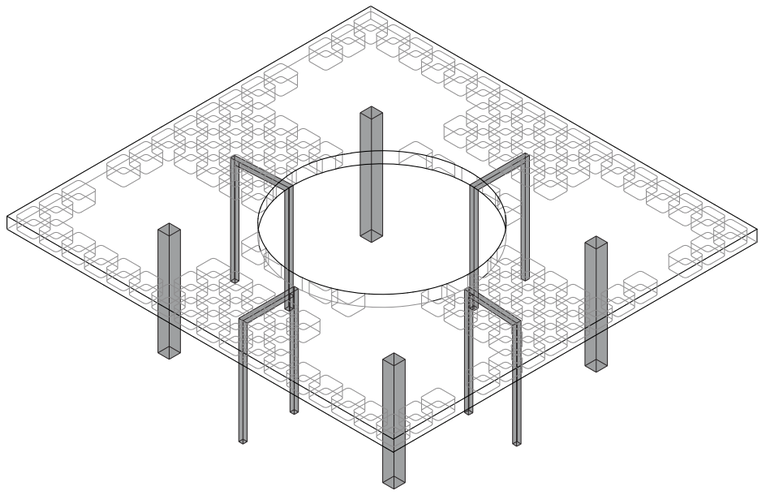
3) Articulation of openings



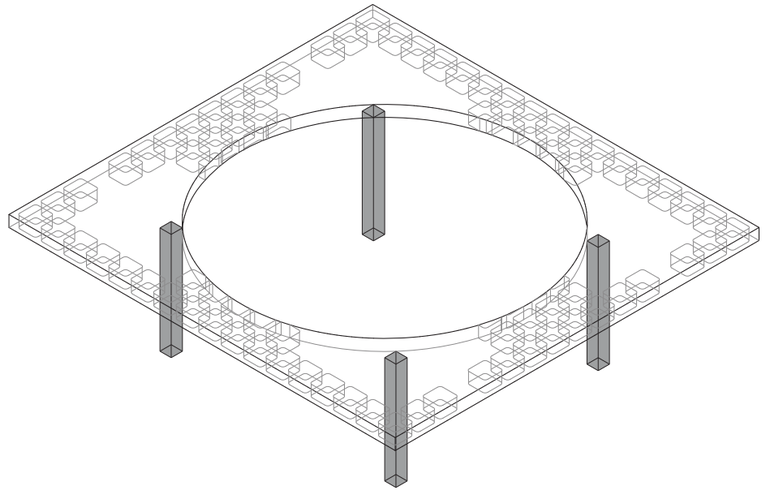
- Waffle slab extraction 1 -



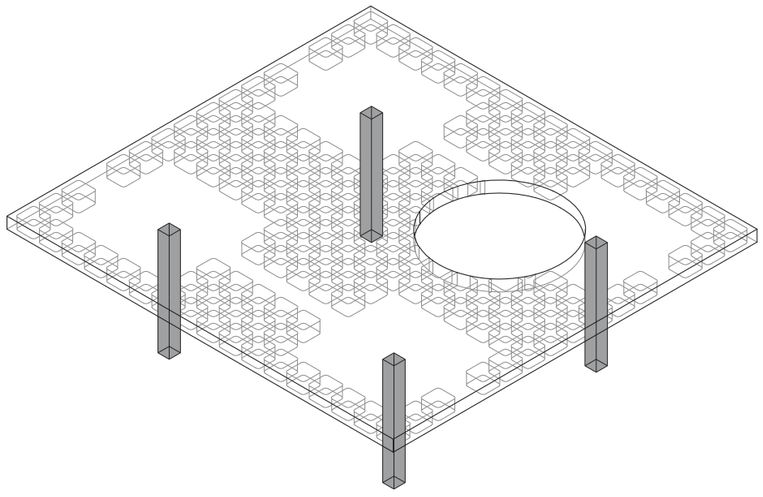
- Waffle slab extraction 2 -



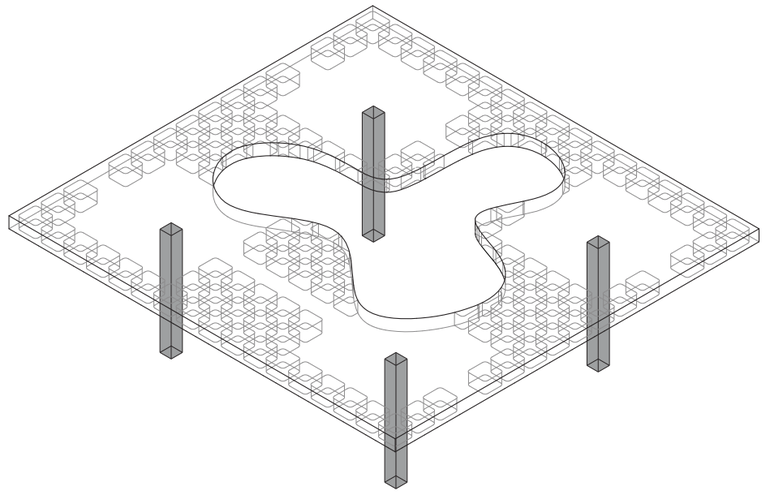
- Waffle slab extraction 3 -



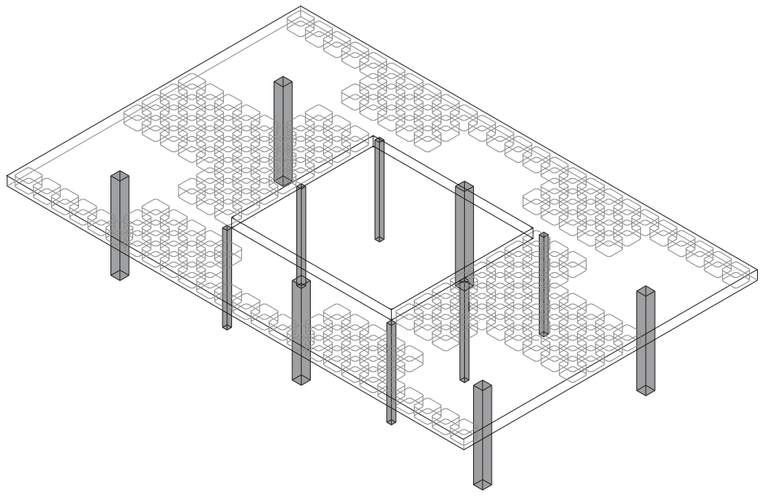
- Waffle slab extraction 4 -



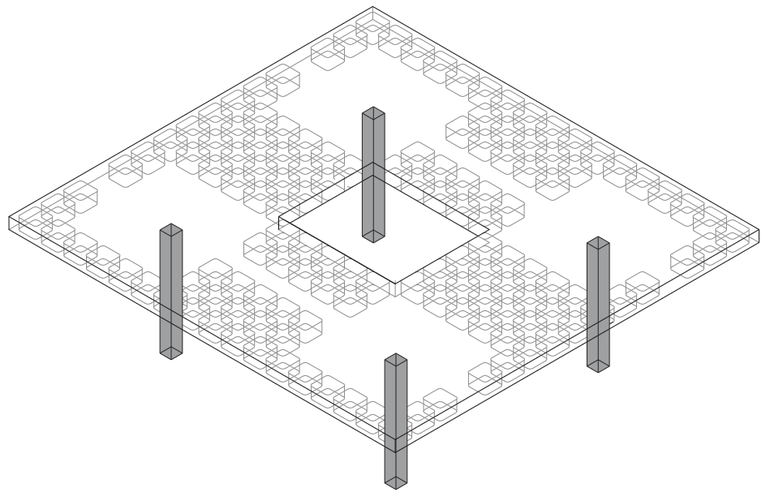
- Waffle slab extraction 5 -



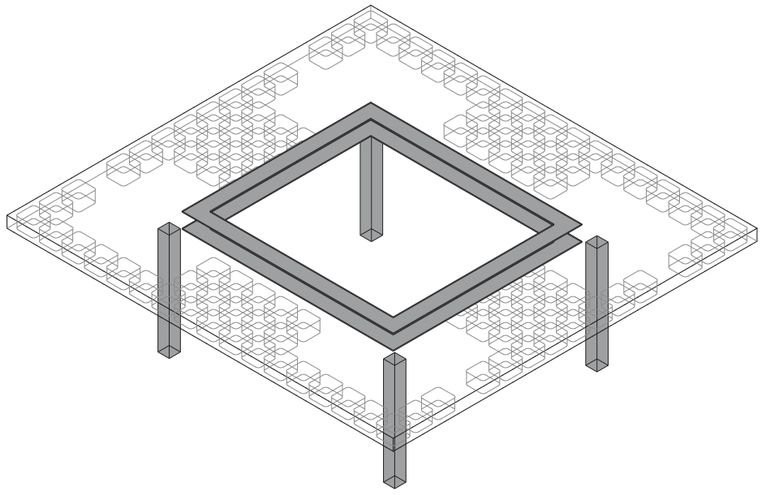
- Waffle slab extraction 6 -



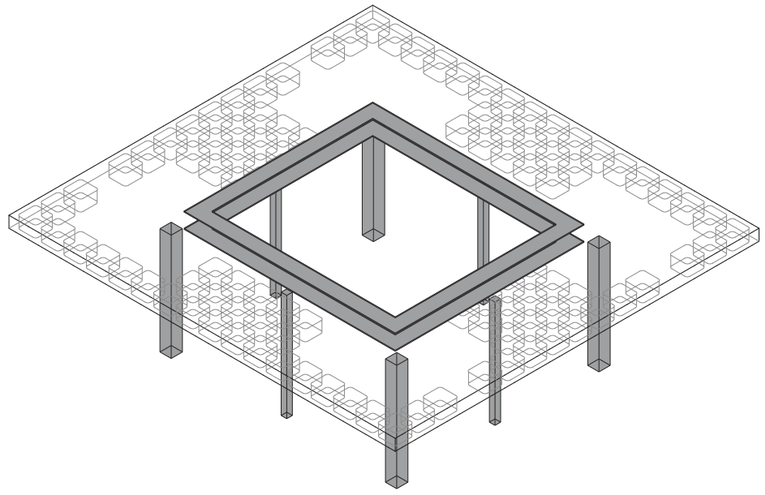
- Waffle slab extraction 7 -



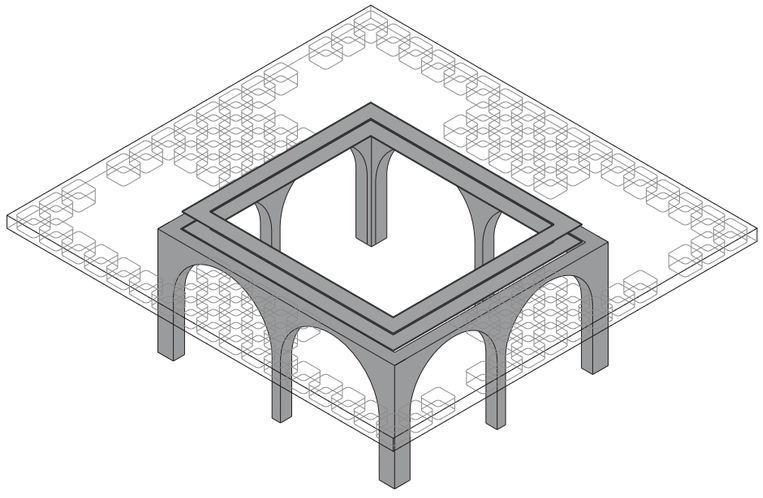
- Waffle slab extraction 8 -



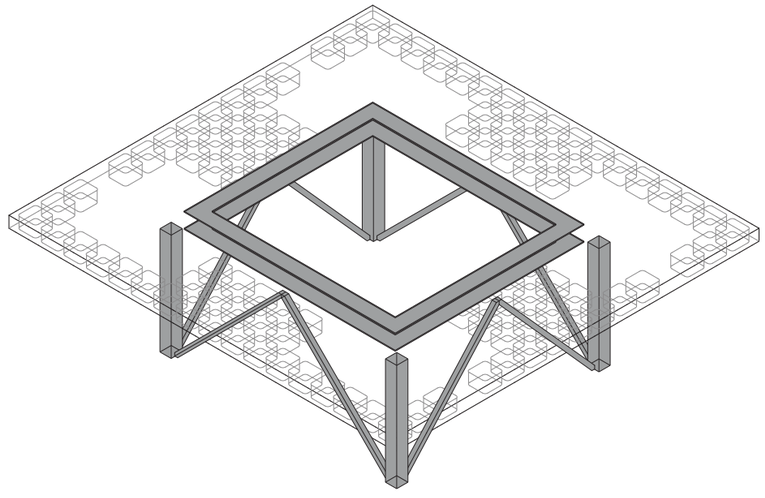
- Waffle slab extraction 9 -



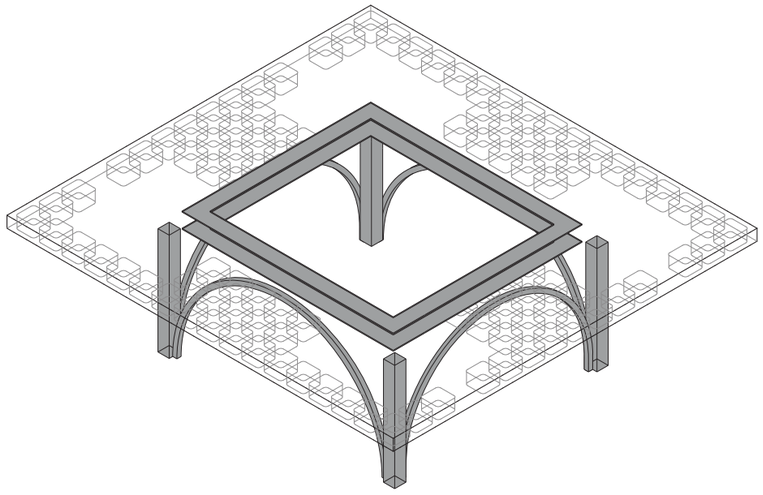
- Waffle slab extraction 10 -



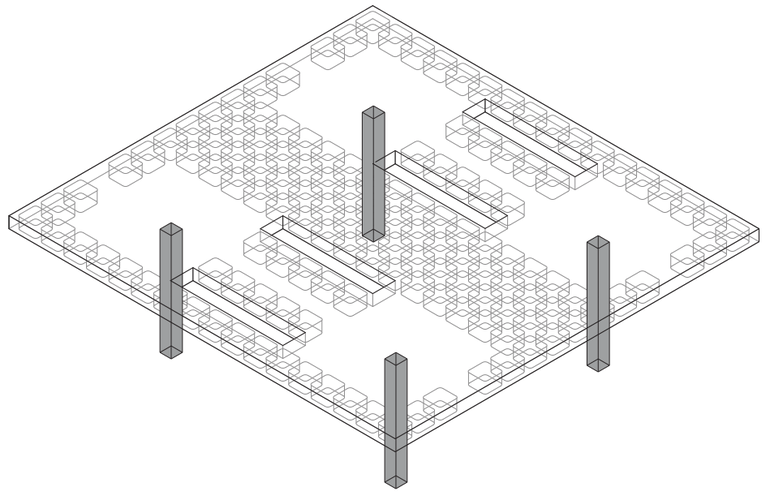
- Waffle slab extraction 11 -



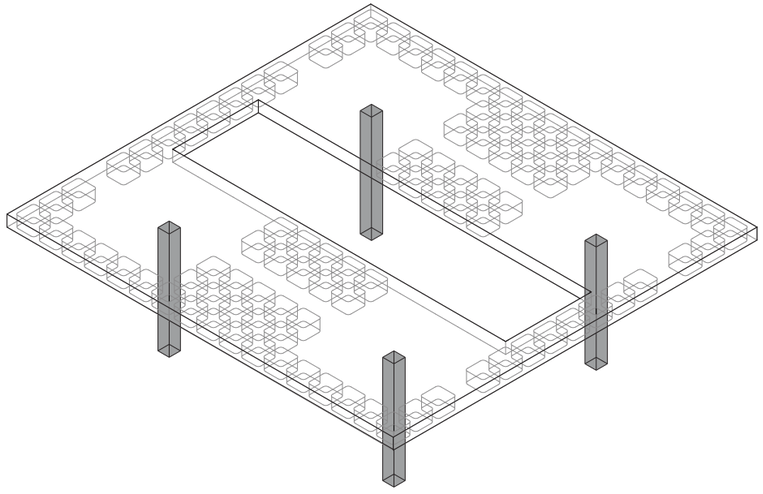
- Waffle slab extraction 12 -



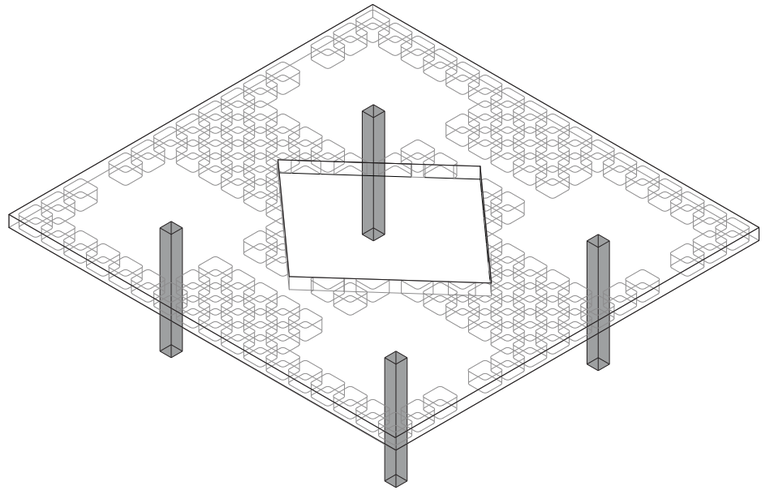
- Waffle slab extraction 13 -



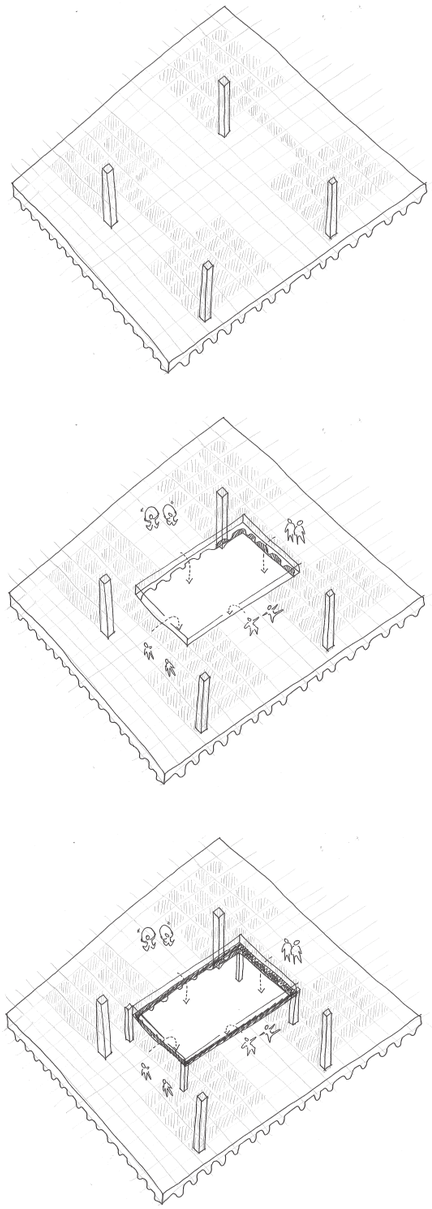
- Waffle slab extraction 14 -



- Waffle slab extraction 15 -



- Waffle slab extraction 16 -



- Illustration showing cut in waffle slab and additional supportive structure -

8

REFLECTIONS OF WAFFLE SLAB

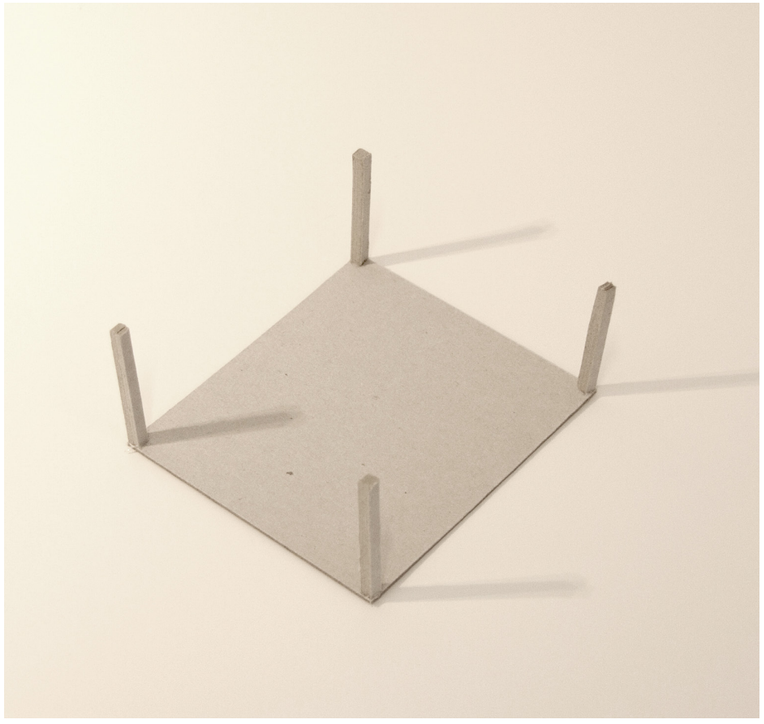
As previously stated the existing waffle slab and columns are comprised of reinforced concrete and are able to withstand a load of 5KN/m² according to the requirements of a shopping center. The new program being an upper secondary school only requires 2.5KN/m². [12] This does however not mean that one can eliminate half of the waffle slab.

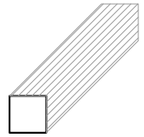
The drawings to the left show the effect of loads on the waffle slab after the cut. The beams in the waffle slab span perpendicularly in two directions and form a continuous system where all loads are spread across the slab and then taken down into the columns. When a beam is cut, this force can no longer be carried and therefore the waffle slab can become deformed and start to "dip" inwards. The extent of this deformation depends on different factors.

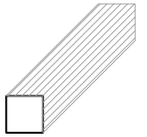
The shape of the cut can determine the extent of deformation. In example 1 and 4 one can see circular cuts, whereas in example 10 and 14 the cuts are rectangular. A circle is a much more stable shape in terms of taking loads than a rectangle because it has no corners. This could mean that a circular cut could require less structural support. On the other hand a circular cut will slice through more beams and all in different places which results in an irregular distribution of forces.

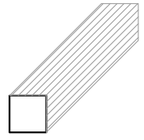
A large void in the waffle slab will mean that several beams have been cut through as can be seen in example 10. Whereas small holes will cut through fewer beams and therefore the waffle slab will be less effected (example 14). It is also important to understand that the areas of the waffle slab that have a concrete infill around each column and spanning in rows across the length of the building, are experiencing the largest strain and are taking up the majority of the loads. Cutting in these areas will result in a larger deformation than cutting in areas without the concrete infill.

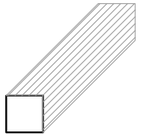
In all cases the size and shape of the void will determine the extent of structural support needed. Annika Mårtensson (Professor in Structural Engineering, LTH) has been the primary advisor for the existing and additional construction of this diploma.



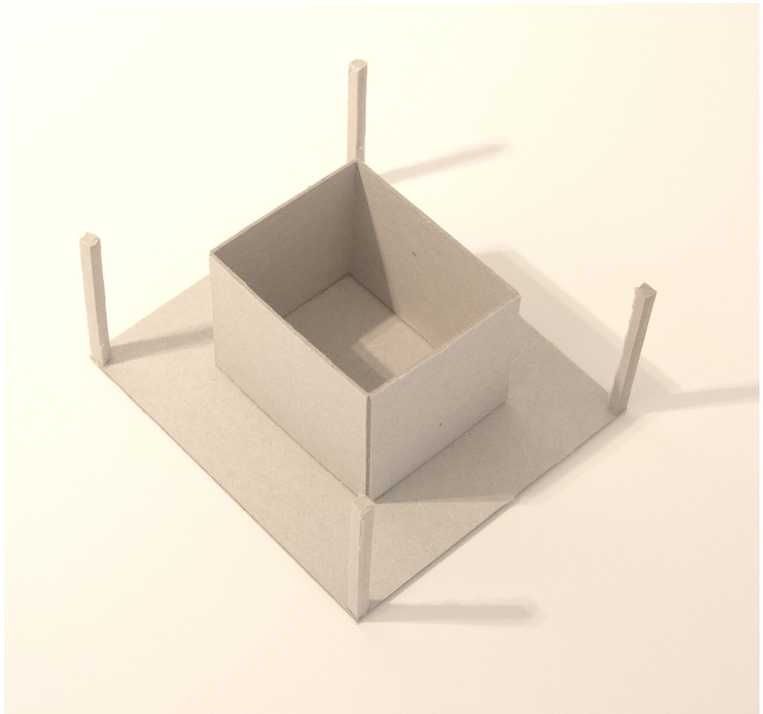


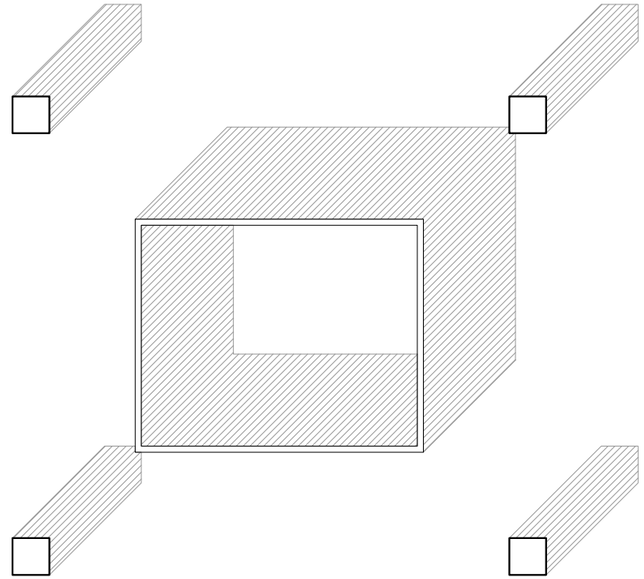




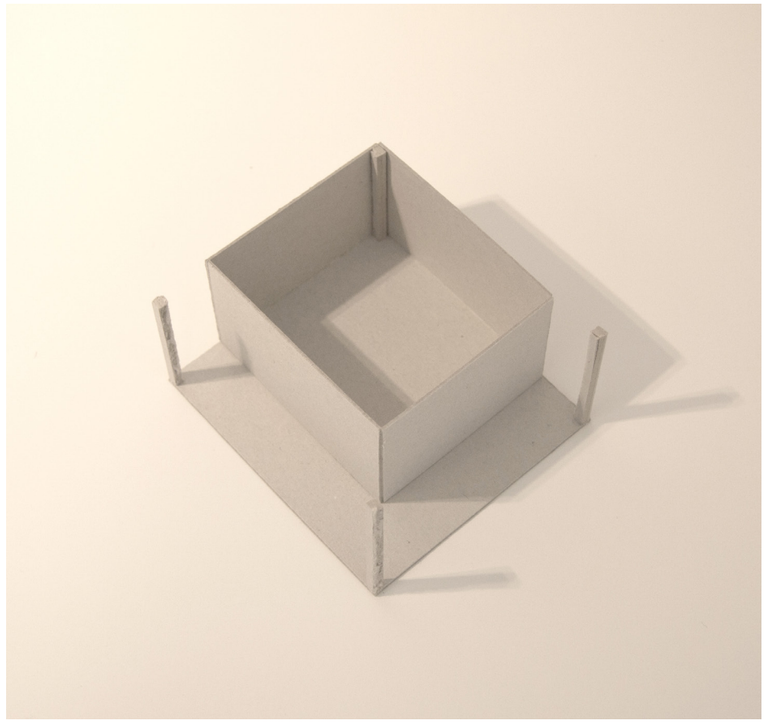


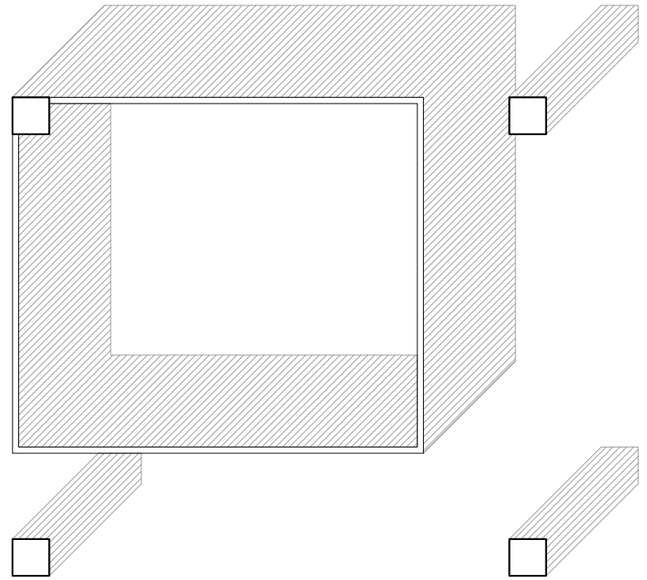
- Placement of walls -
Current situation



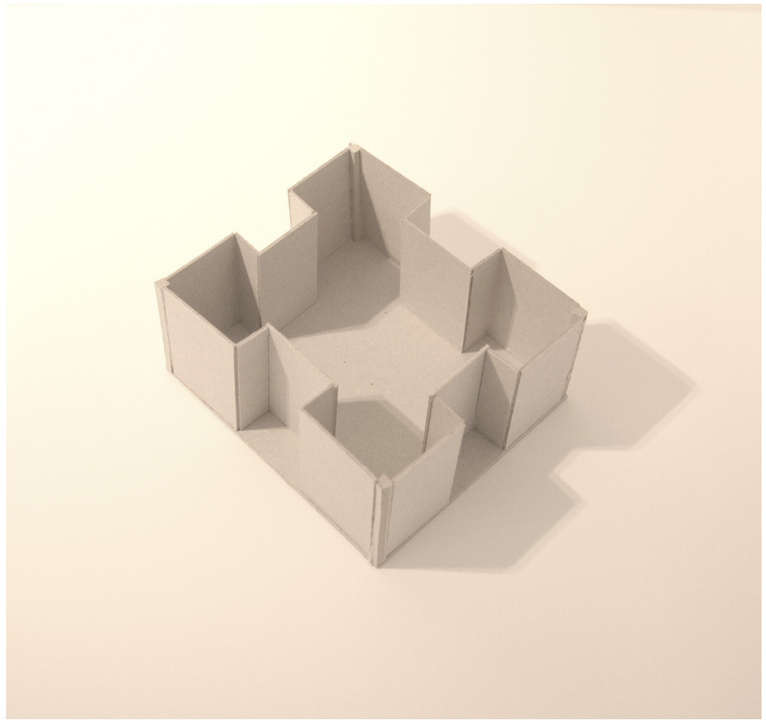


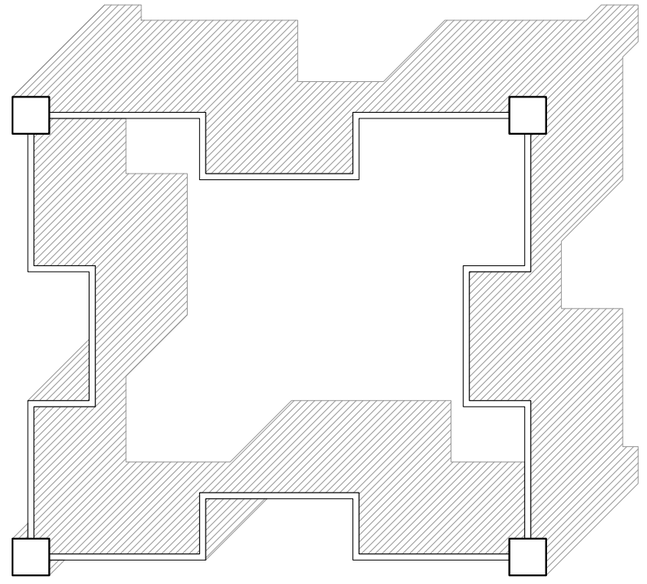
- Placement of walls -
Example 1



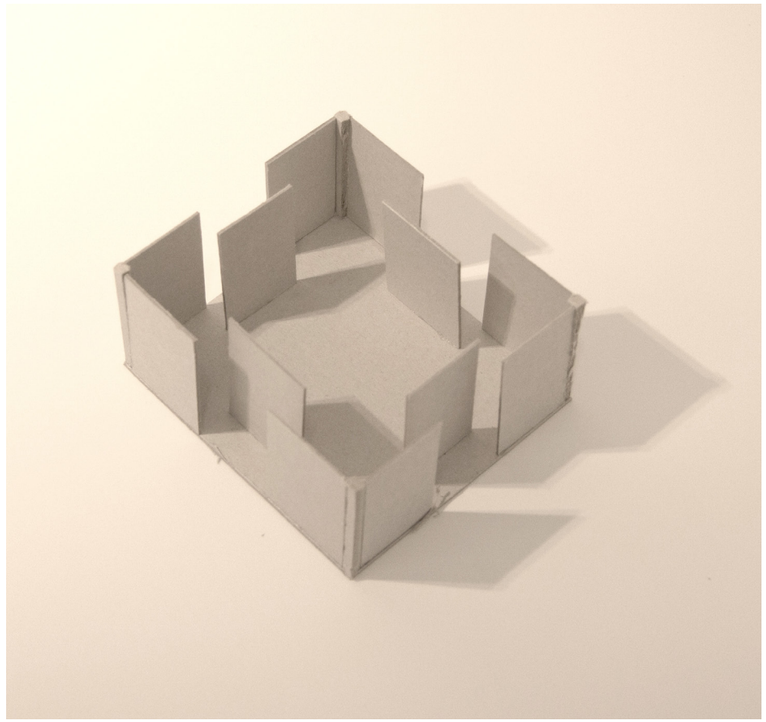


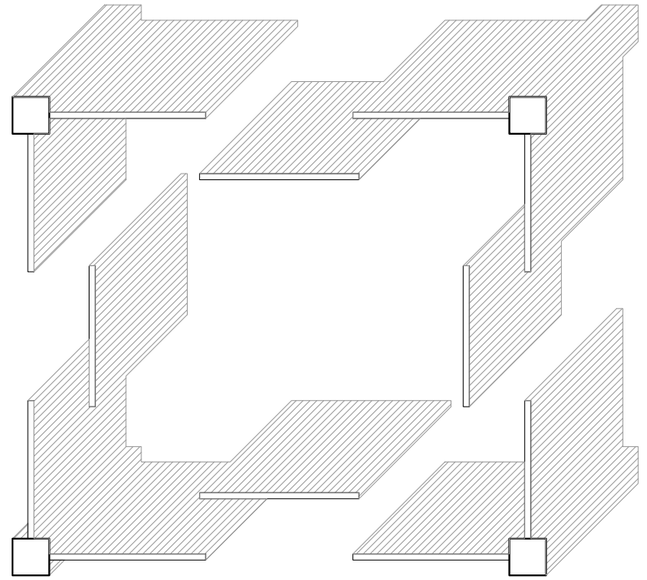
- Placement of walls -
Example 2



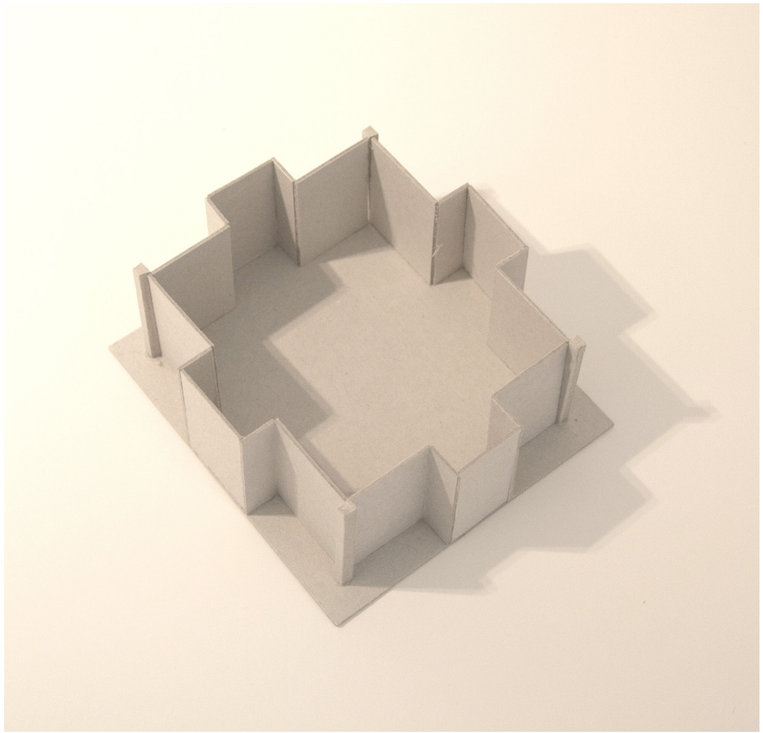


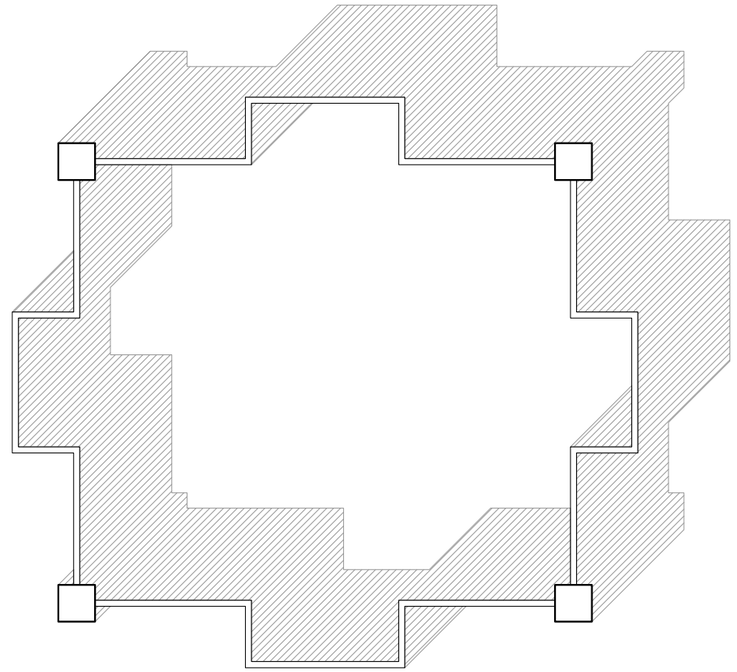
- Placement of walls -
Example 3



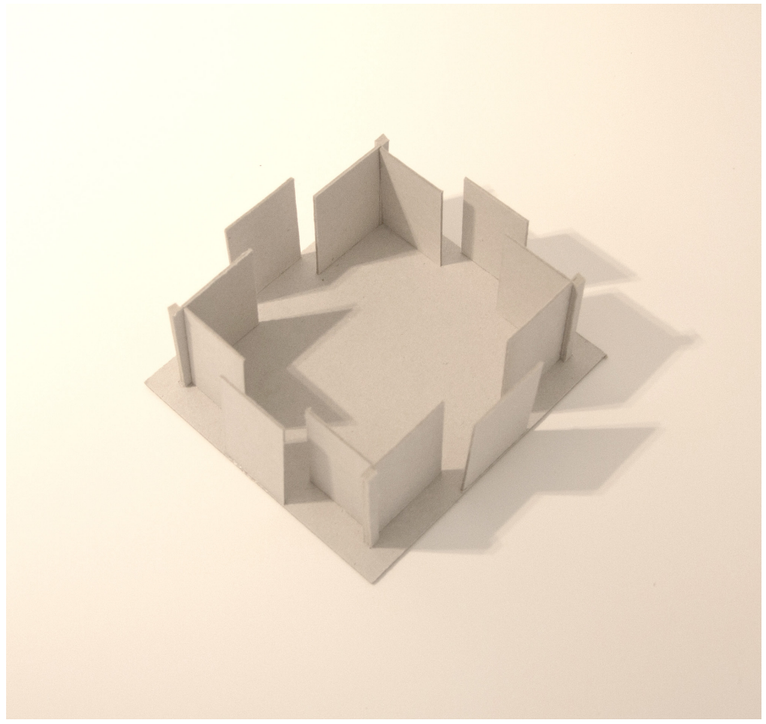


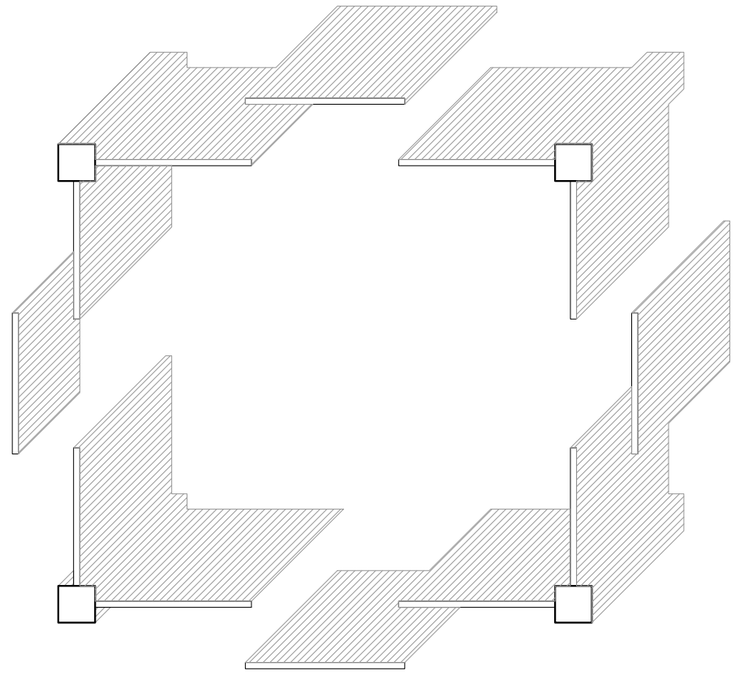
- Placement of walls -
Example 10



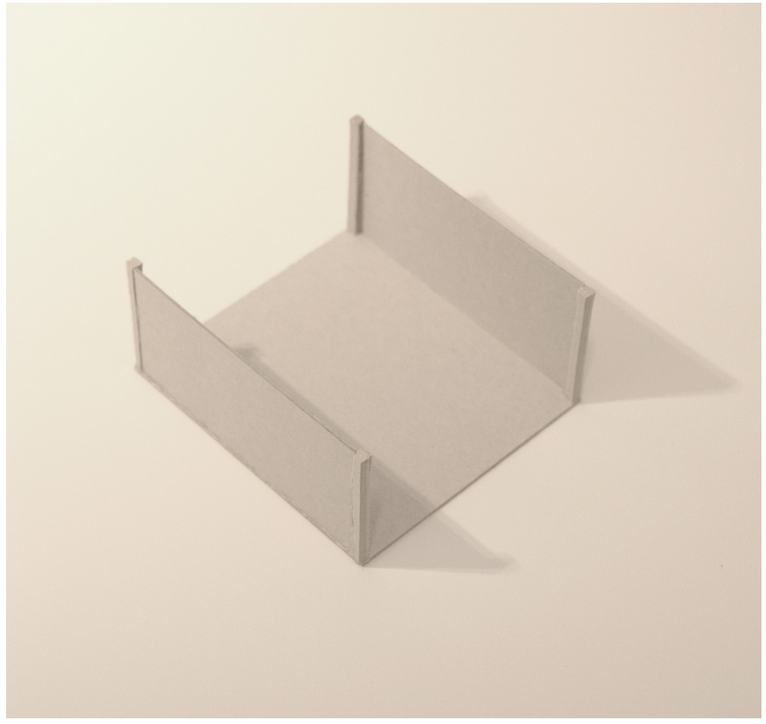


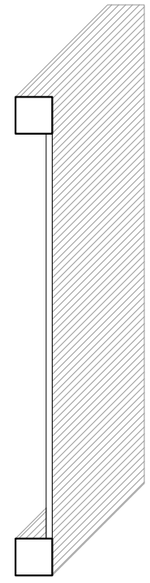
- Placement of walls -
Example 11

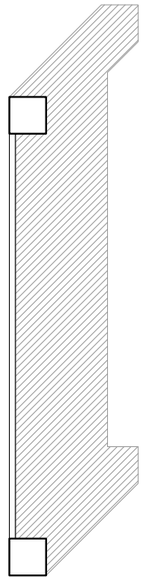




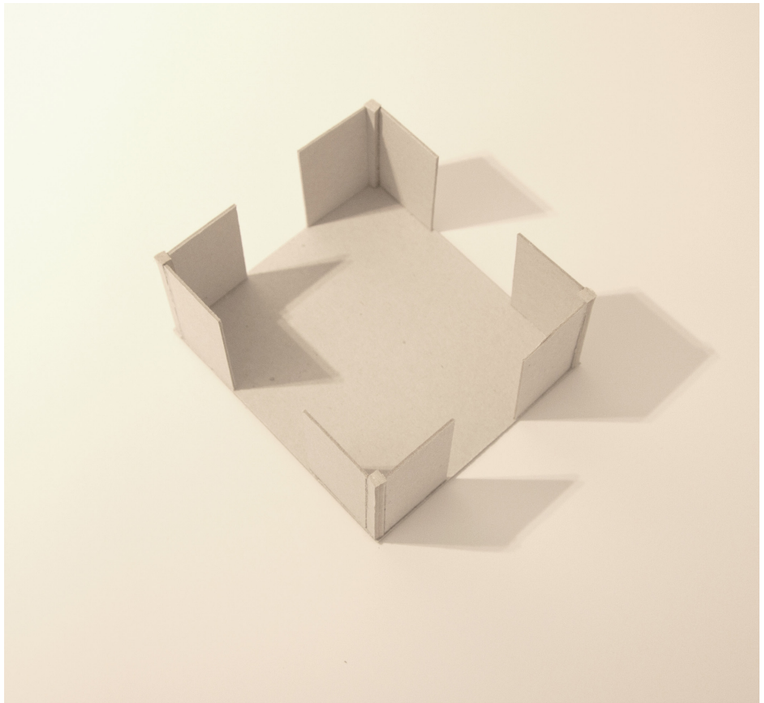
- Placement of walls -
Example 12

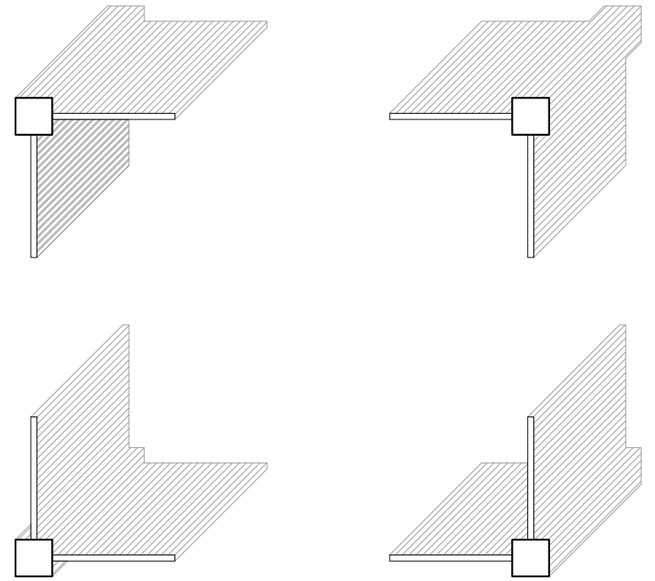




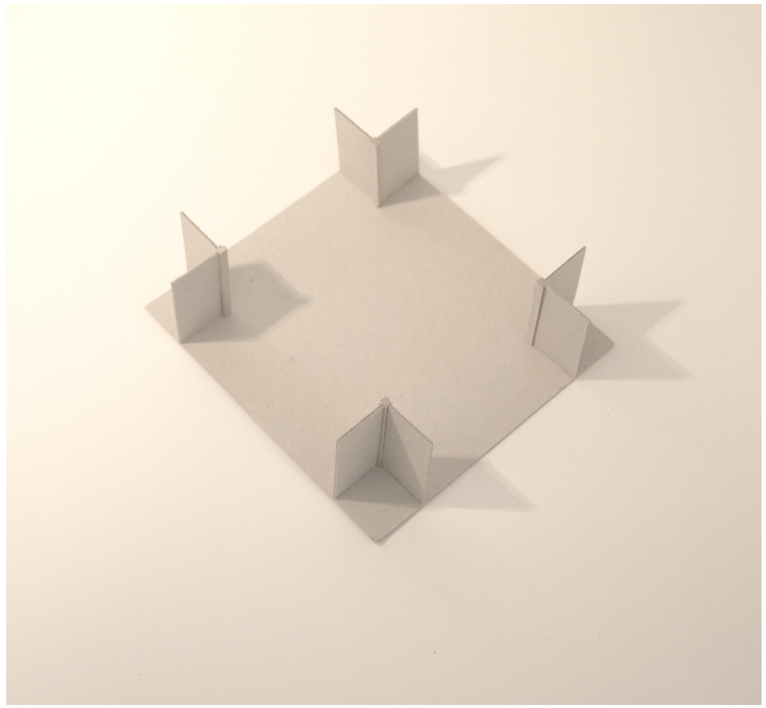


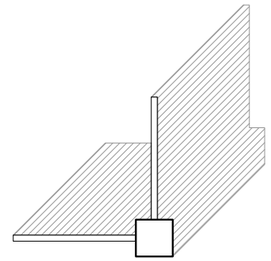
- Placement of walls -
Example 13

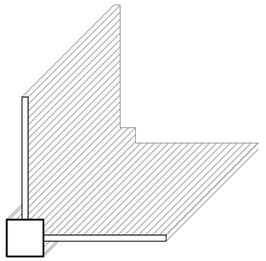


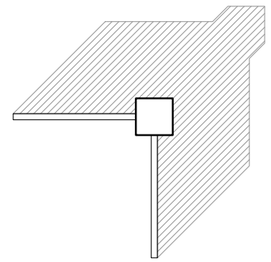


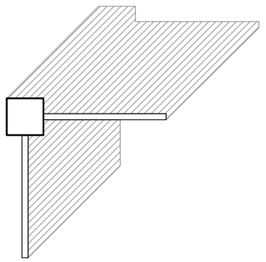
- Placement of walls -
Example 14



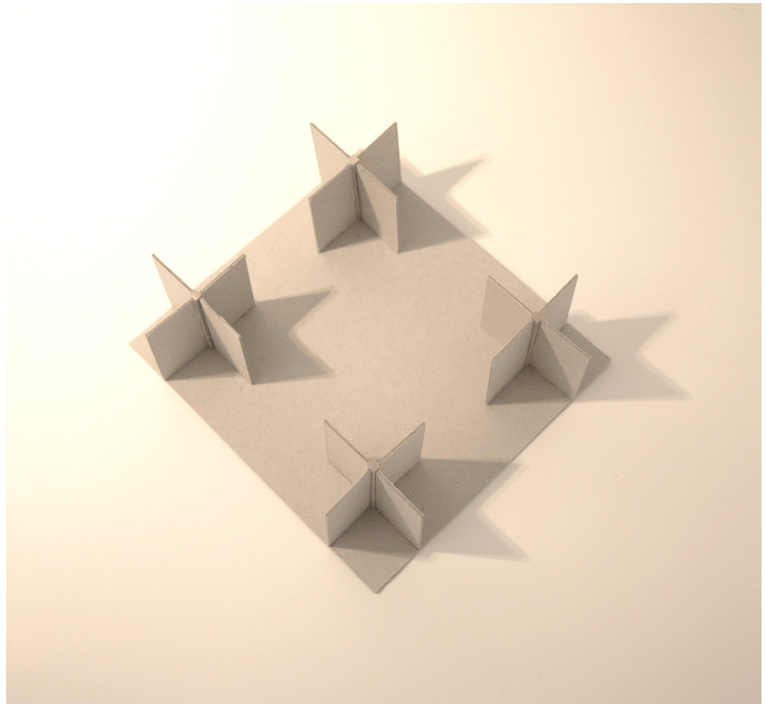


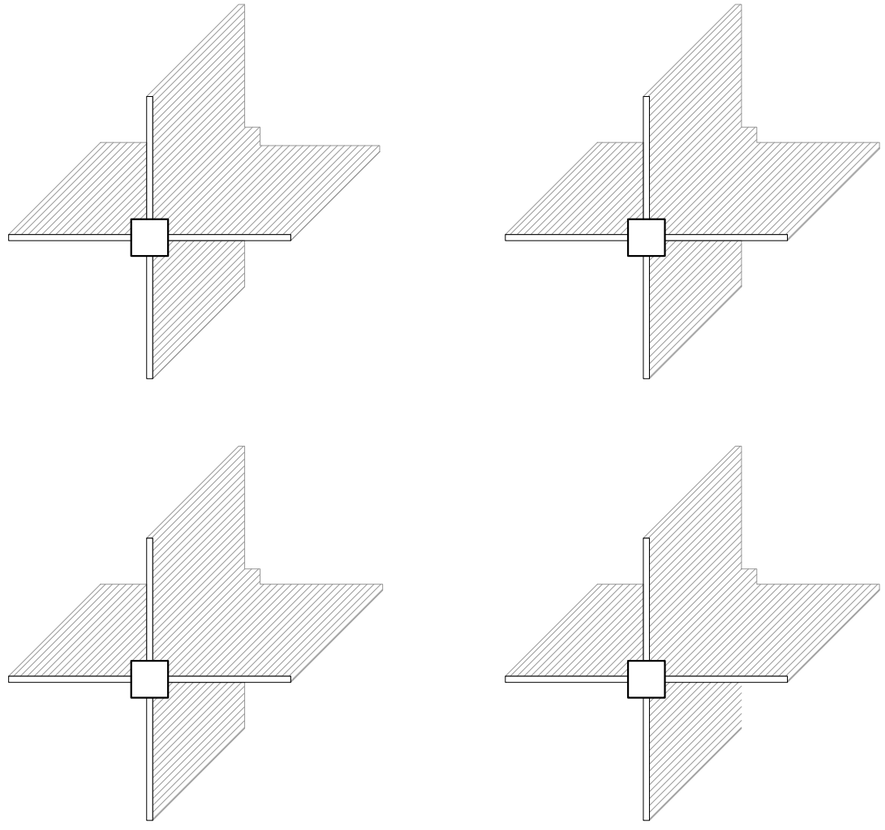




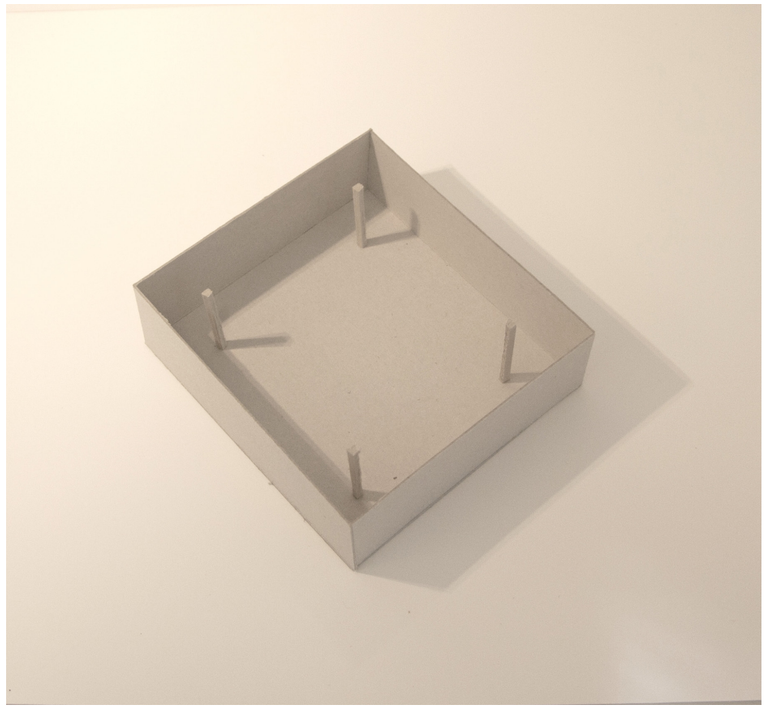


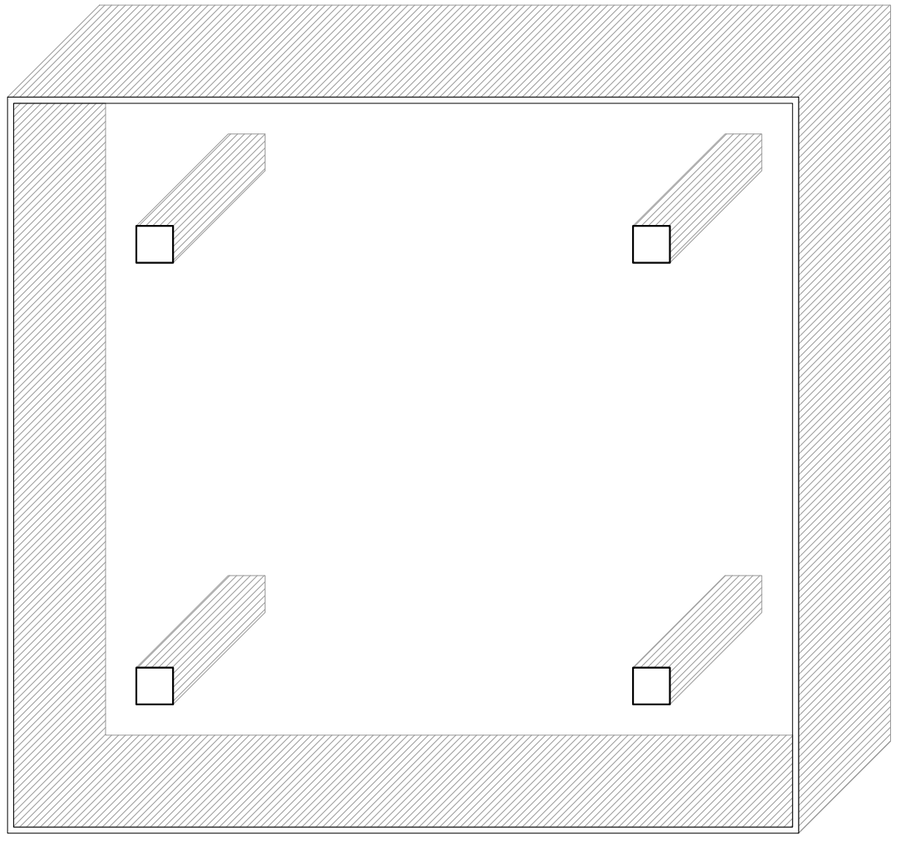
- Placement of walls -
Example 15



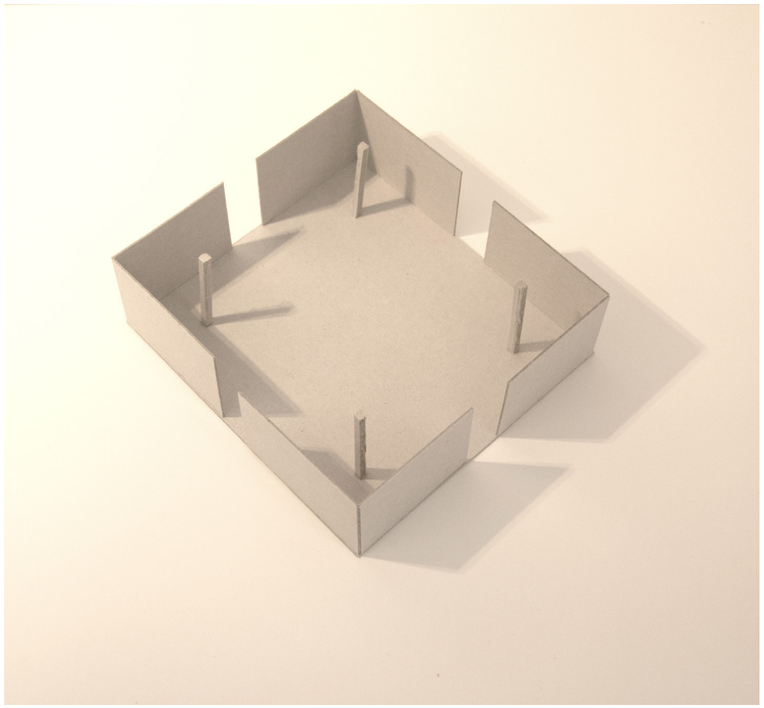


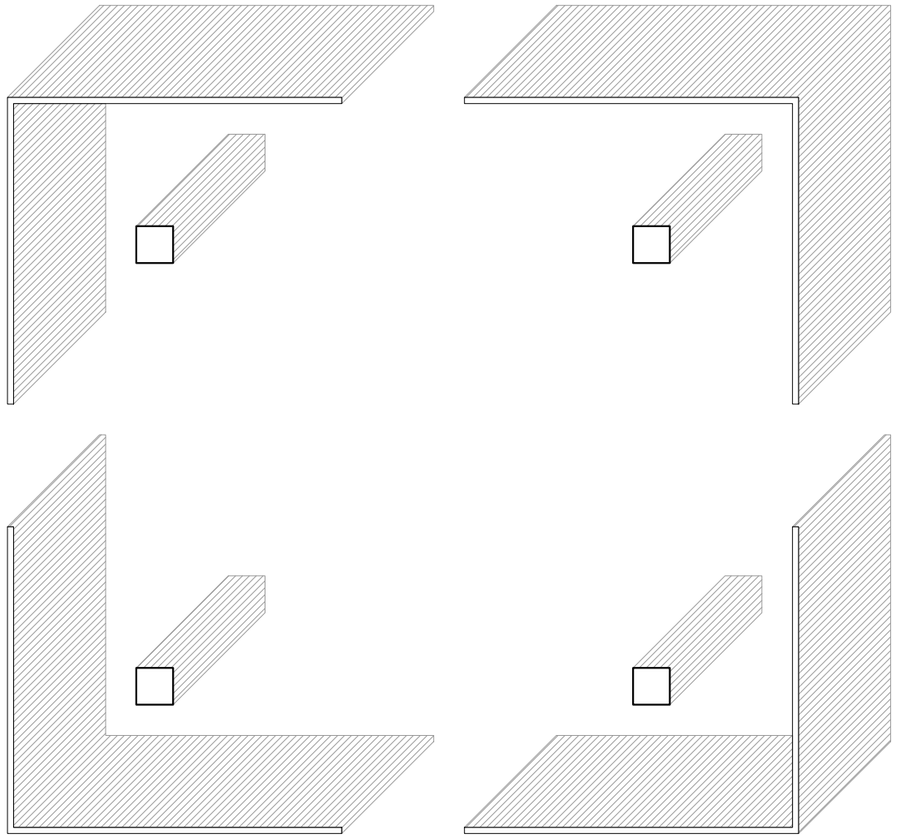
- Placement of walls -
Example 16



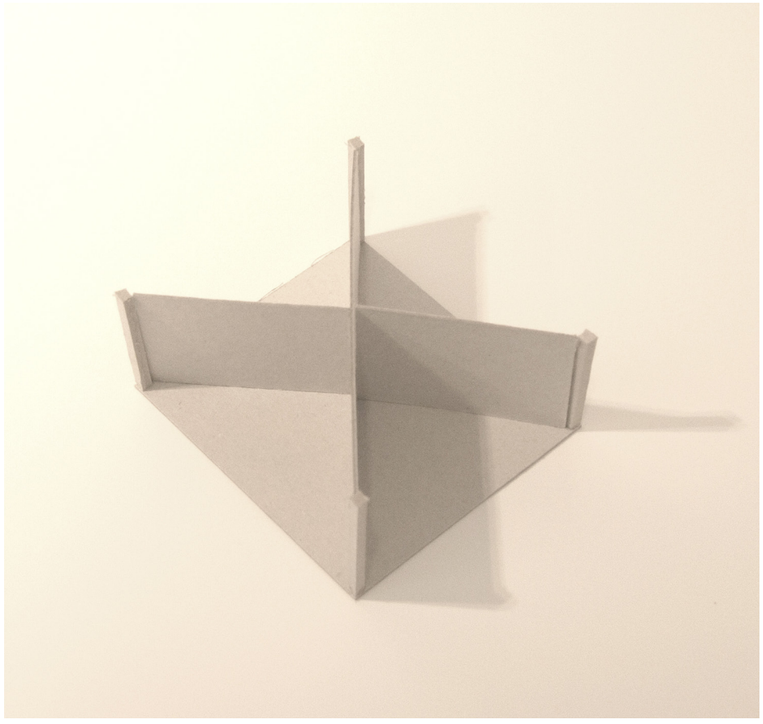


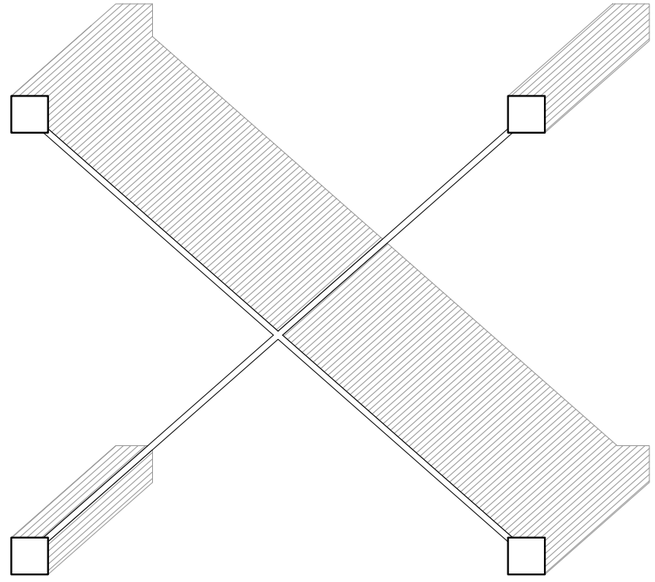
- Placement of walls -
Example 17



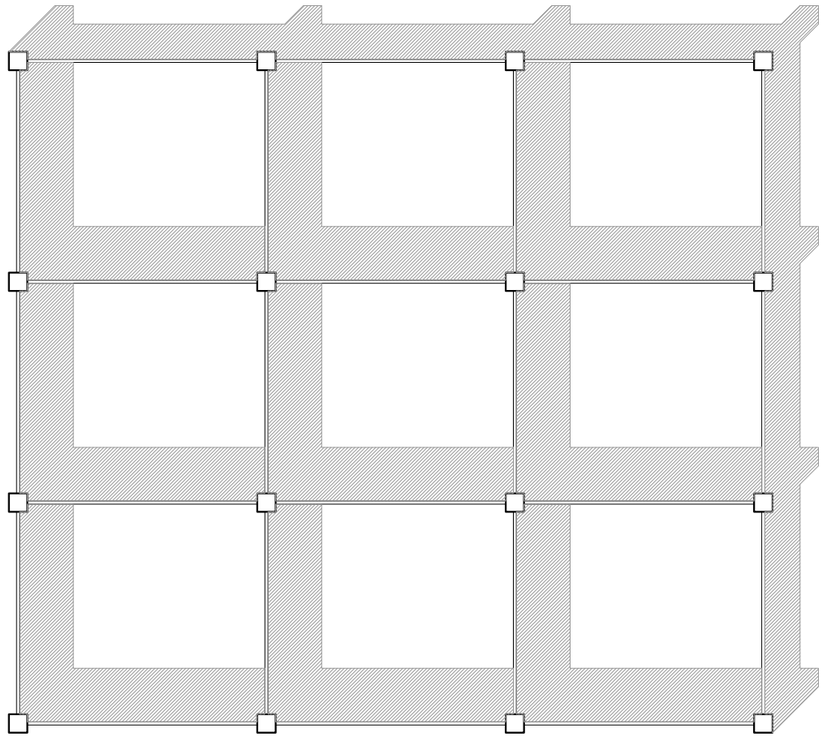


- Placement of walls -
Example 18

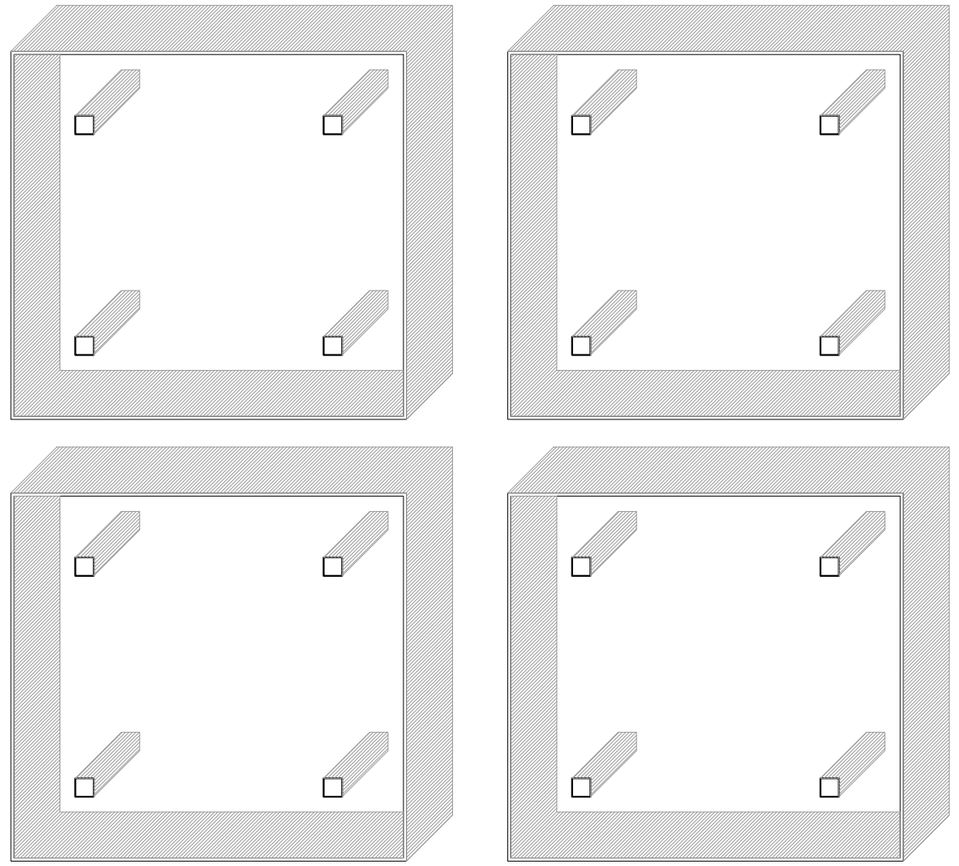




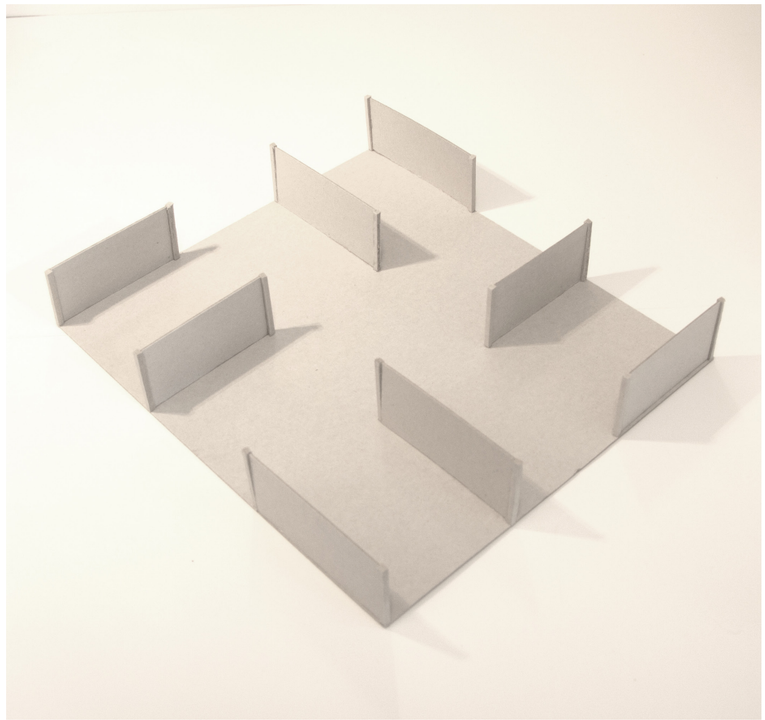
- Placement of walls -
Example 19

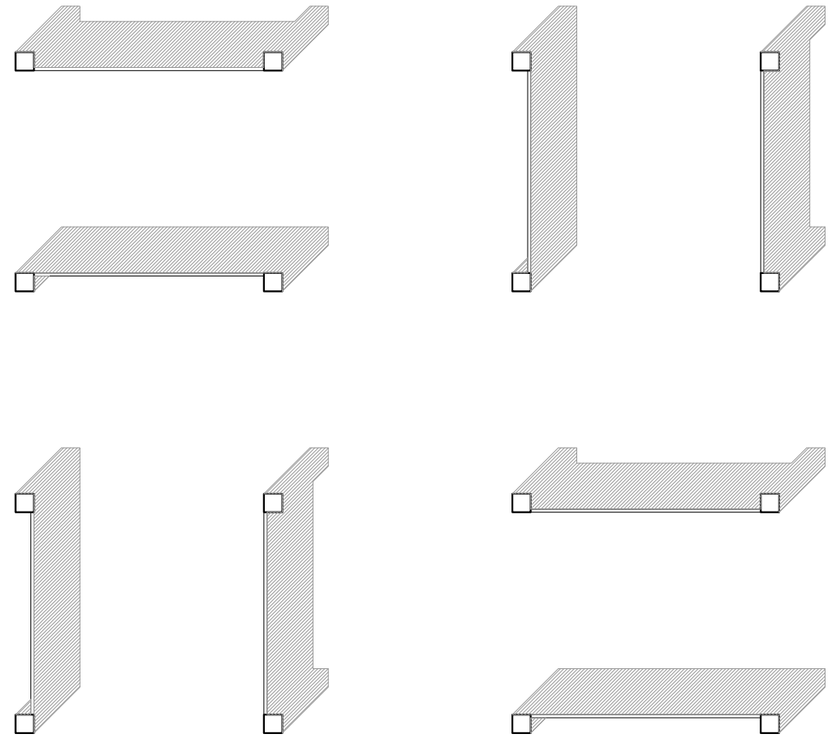


- Placement of walls -
Example 20

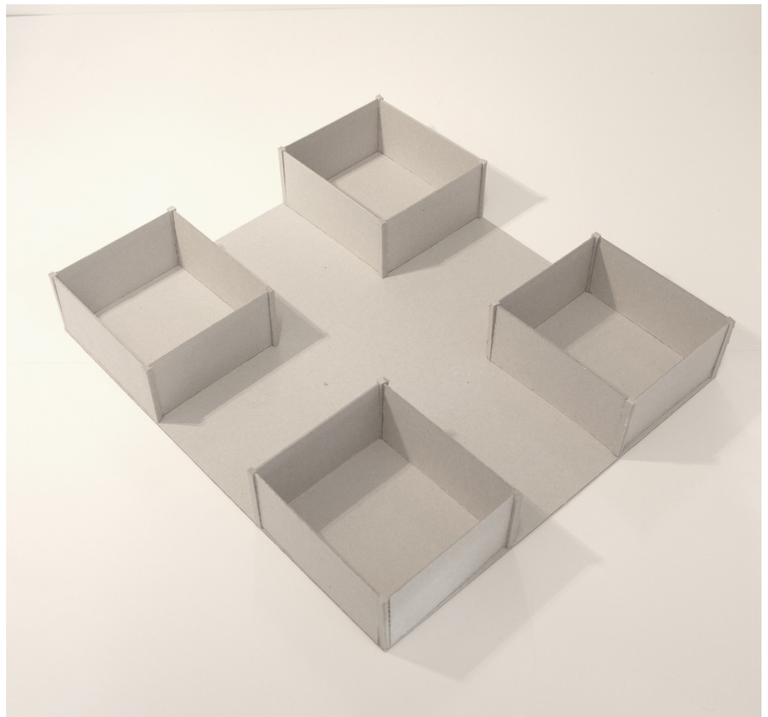


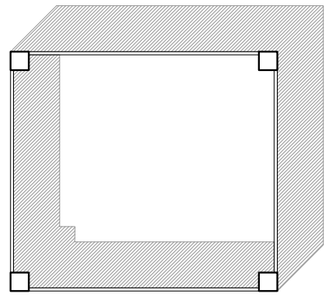
- Placement of walls -
Example 21

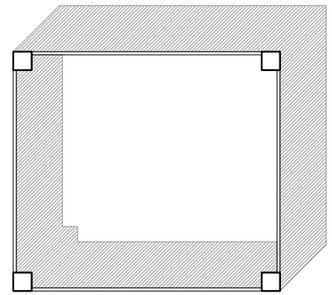


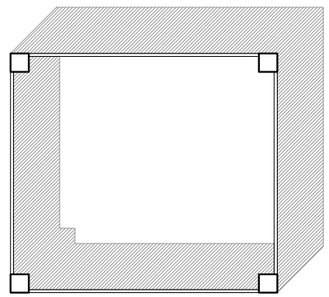


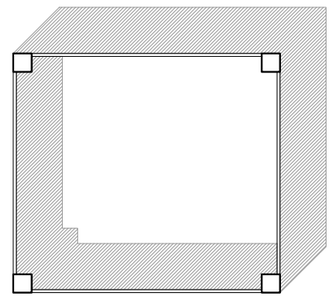
- Placement of walls -
Example 22



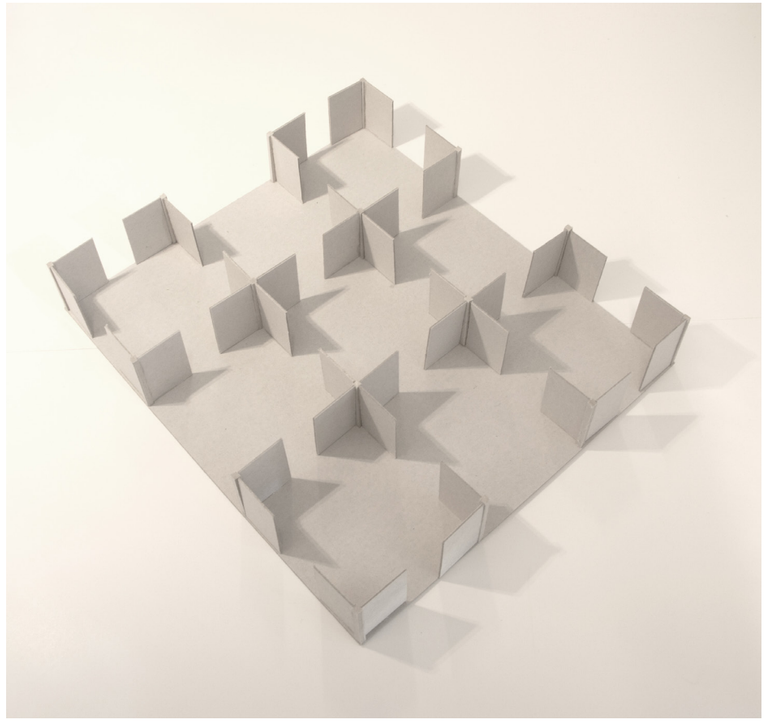


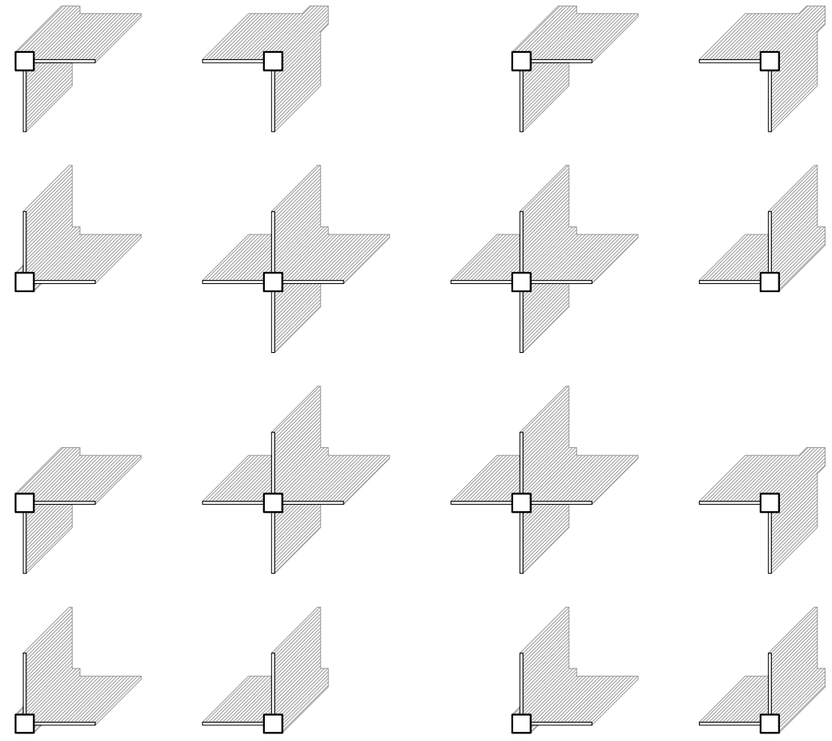




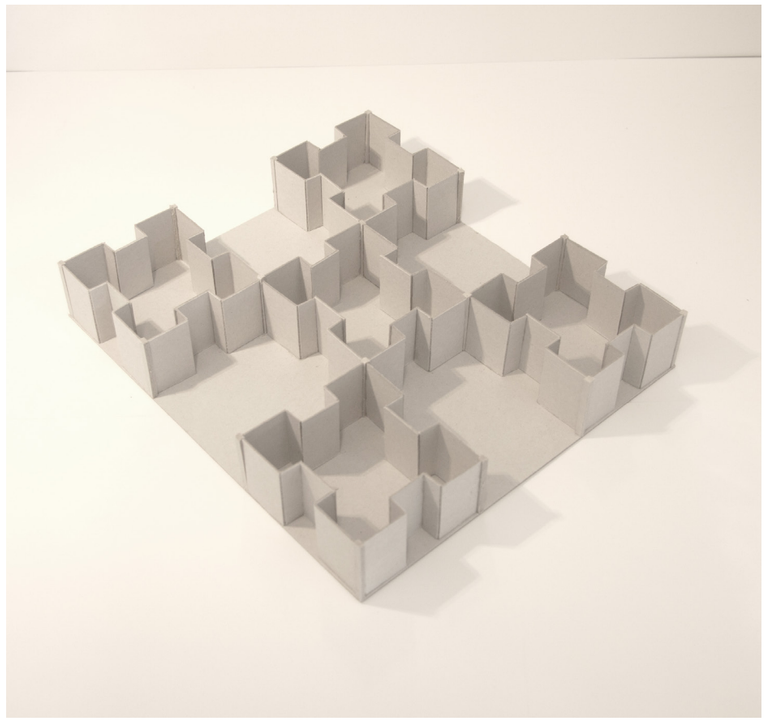


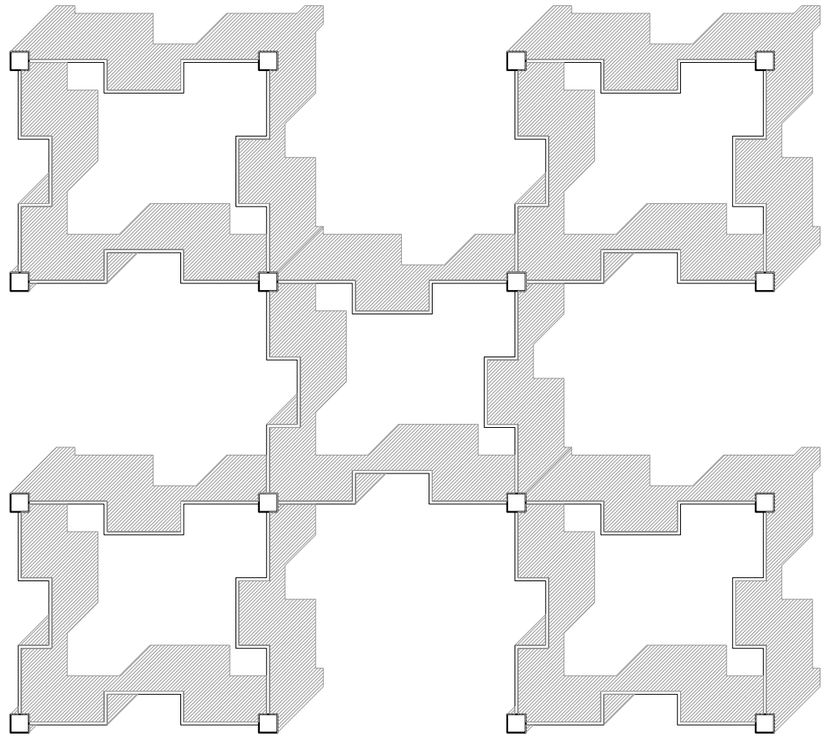
- Placement of walls -
Example 23



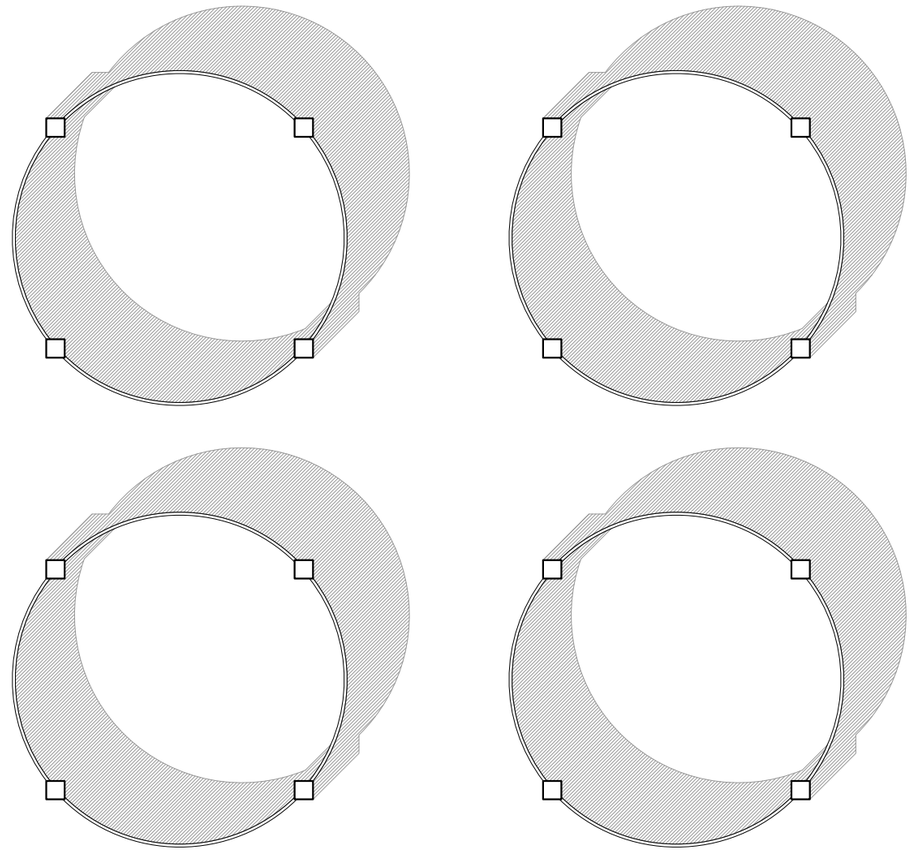


- Placement of walls -
Example 24

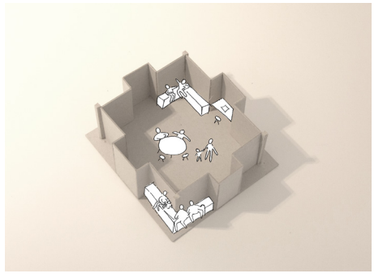
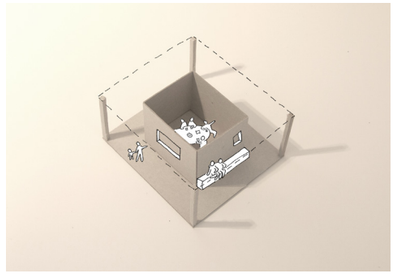
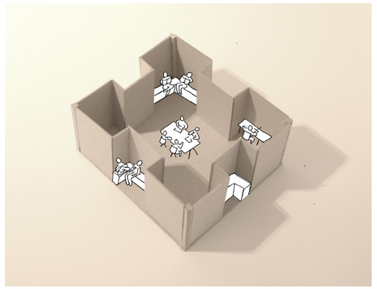
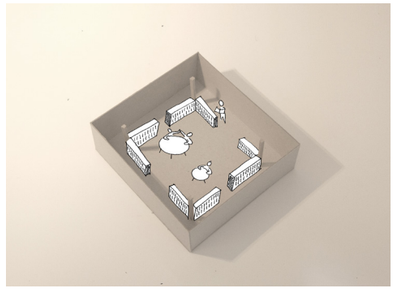
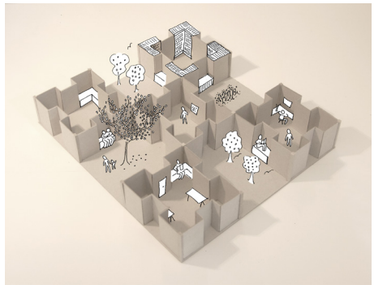
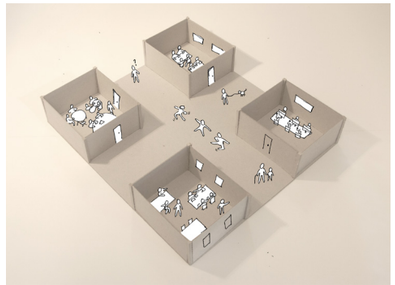
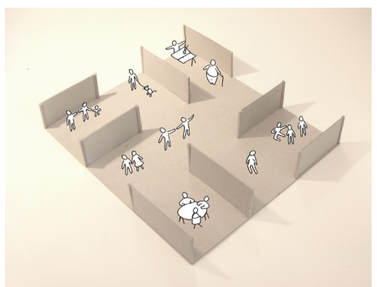
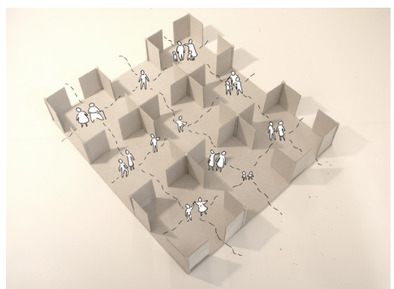




- Placement of walls -
Example 25



- Placement of walls -
Example 26

Illustrated model photos to exemplify spatial qualities

9

REFLECTIONS OF PLACEMENT OF WALLS

The primary aim of the examination was to explore how one should place walls within an existing grid and what were the consequences of placing these in different ways.

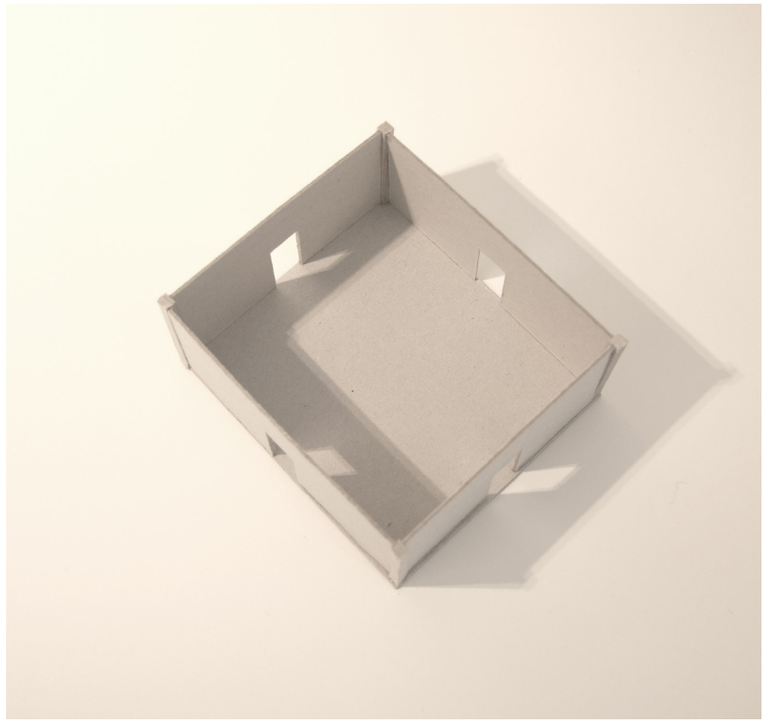
How can one use the column as an asset to the room? Will the column divide the room? Will the column create a niche in the room? Can furniture be placed between columns? Do we want to show the column at all or should it be hidden? Do the columns decide the dimensions of walls in the project?

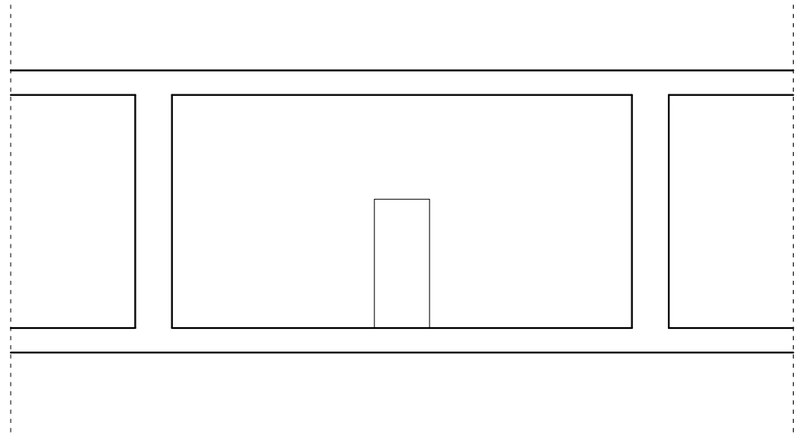
During this study it became apparent that the articulation of a wall will determine how activated that wall becomes. This effects the interior of a room by deciding how furniture can be placed, where one wants to sit and read a book alone, where one can sit in a group with others and so on. The exterior of the room is equally important. How is a corridor interpreted? Where can one stop to take a rest? How does one experience architecture sequentially from space to space?

Does a room have to have closed walls in order to be a room? This study proved that our experience of a room is not necessarily defined by closed walls.

The study of placement of walls does consist mainly of examples that are dependent of the column grid. Meaning that most examples show the wall connected to a column. Had the study been executed again, it would be valuable to explore more examples that are independent of the grid as shown in example 1, 17, 18 and 21.

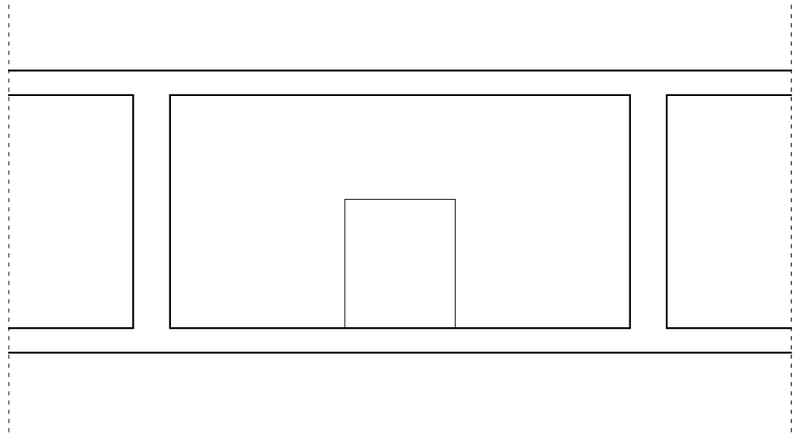
The illustration on the left has gathered the examples that were explored and introduced furniture and people in order to summarise the conclusion of the study.



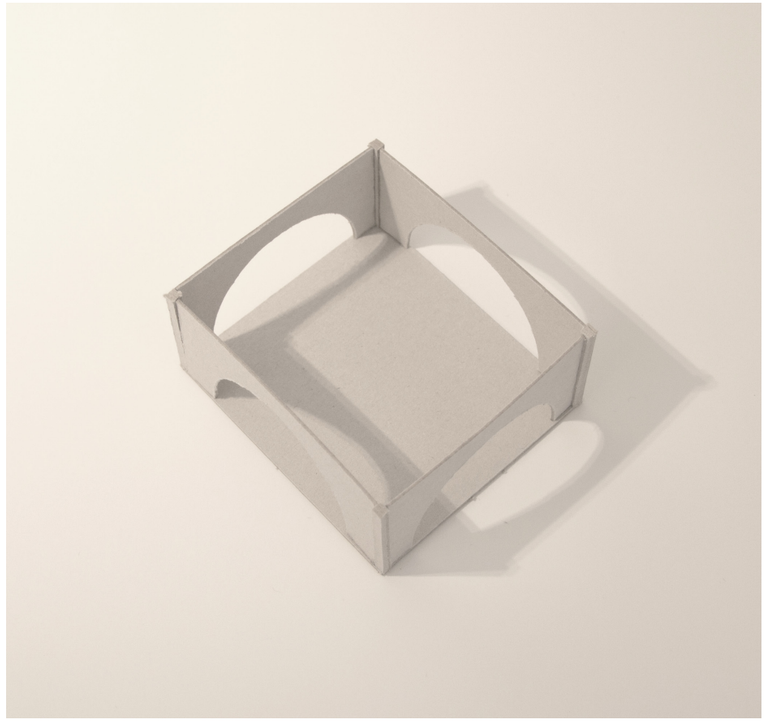


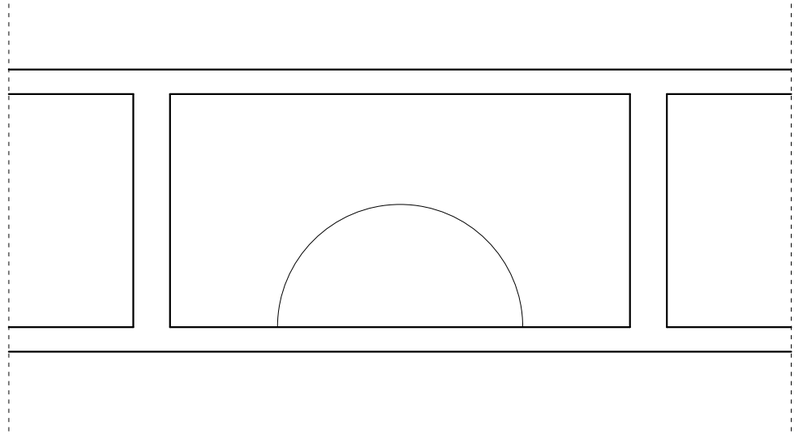
- Articulation of Openings -
Example 1

Figure 14: Andrew Trotter, Masseria Moroseta

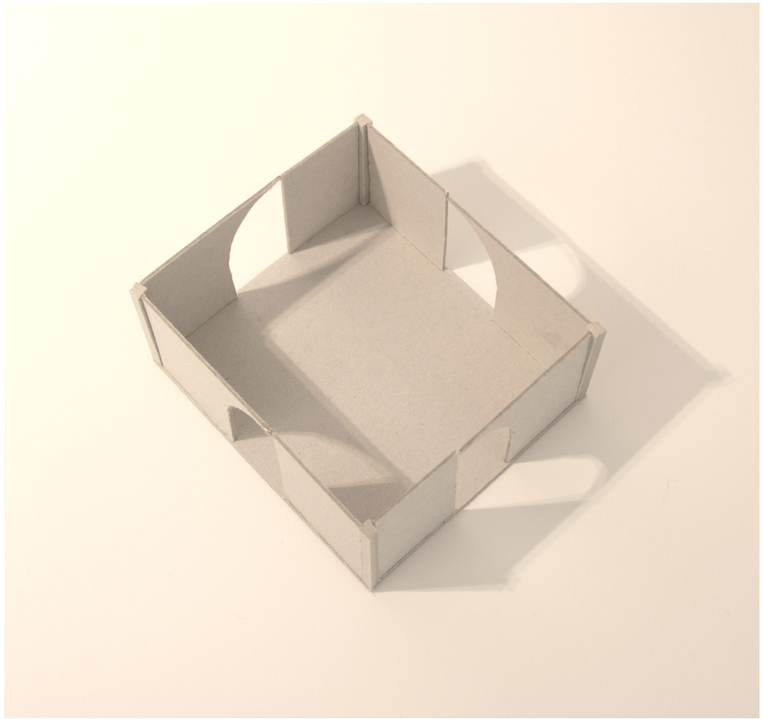


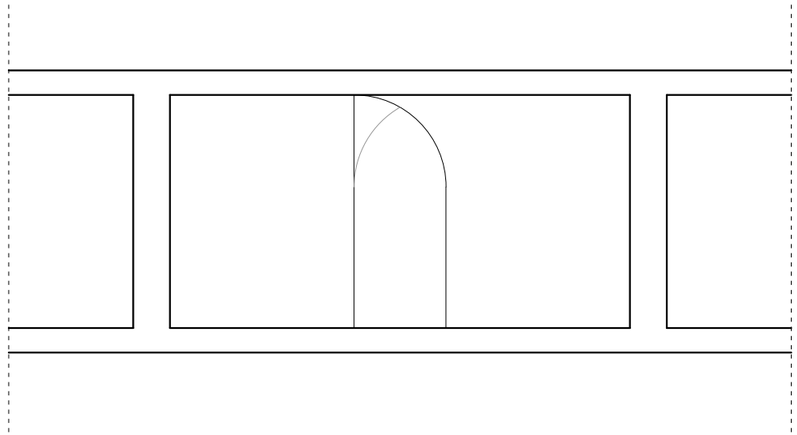
- Articulation of Openings -
Example 2



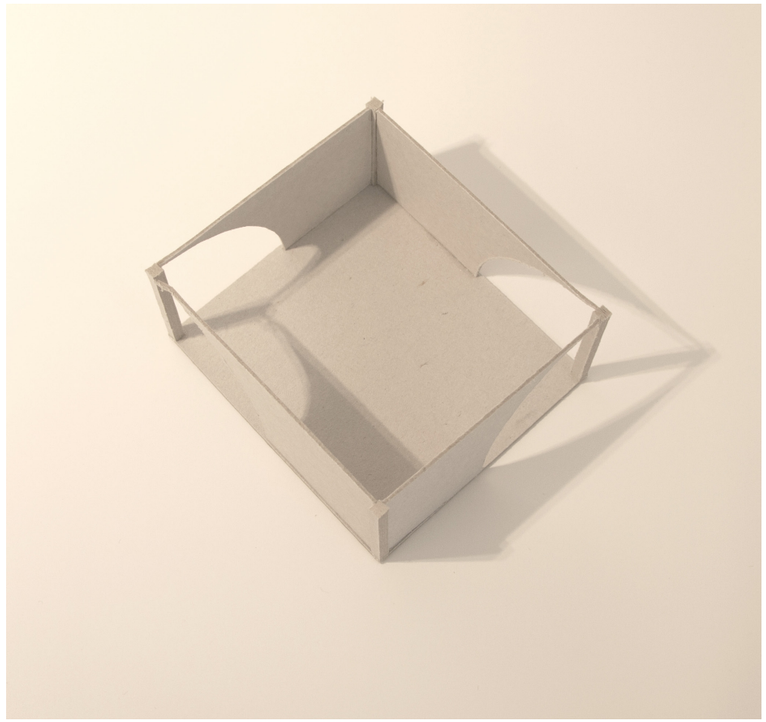


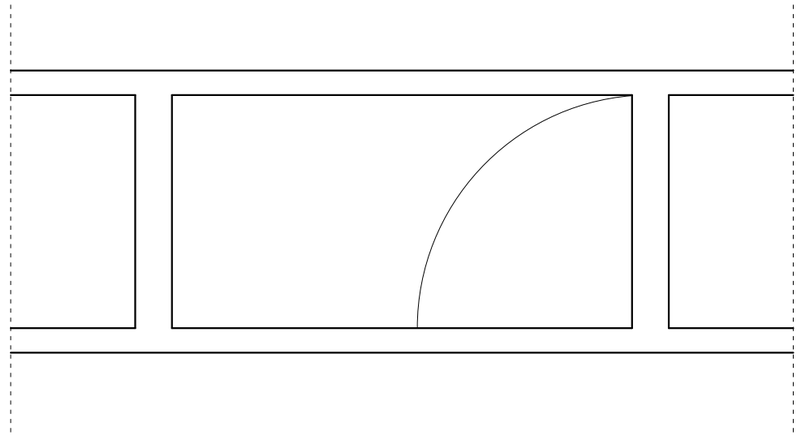
- Articulation of Openings -
Example 3





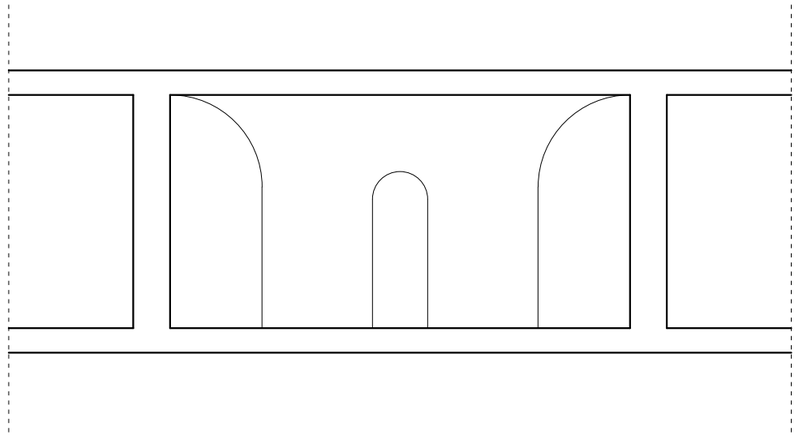
- Articulation of Openings -
Example 4



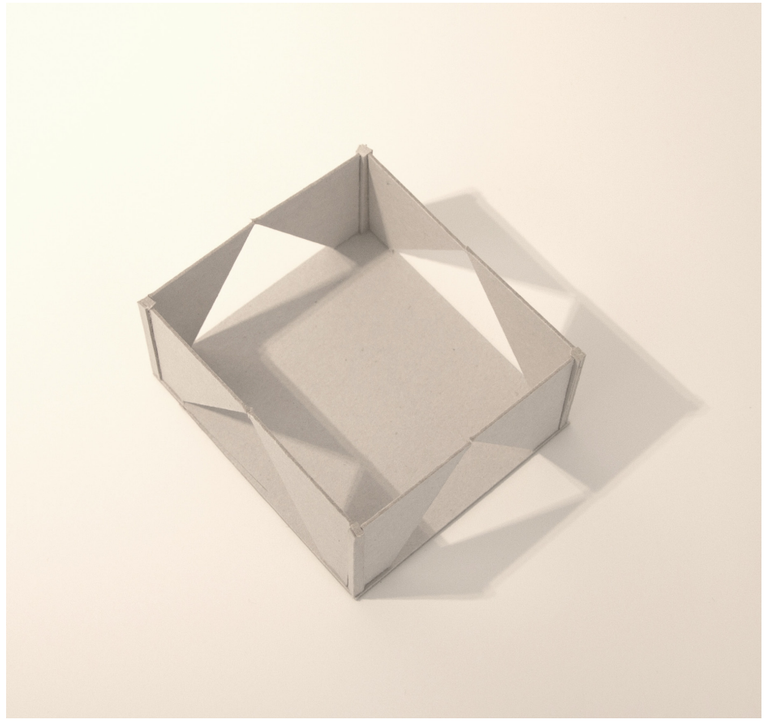


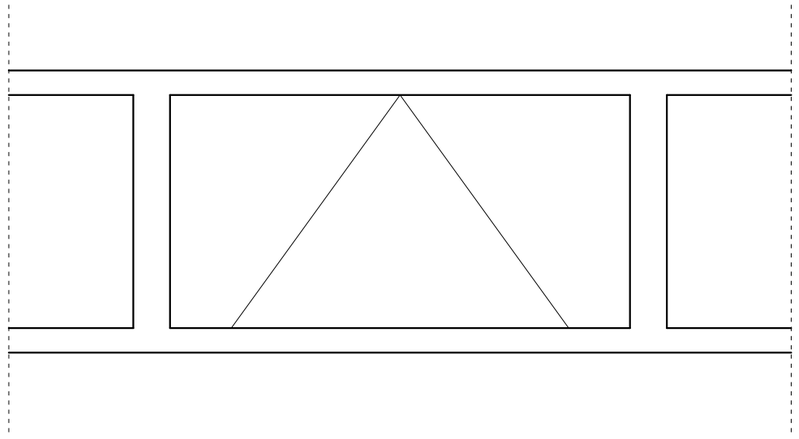
- Articulation of Openings -
Example 5

Figure 15: John Pawson, Moritzkirche



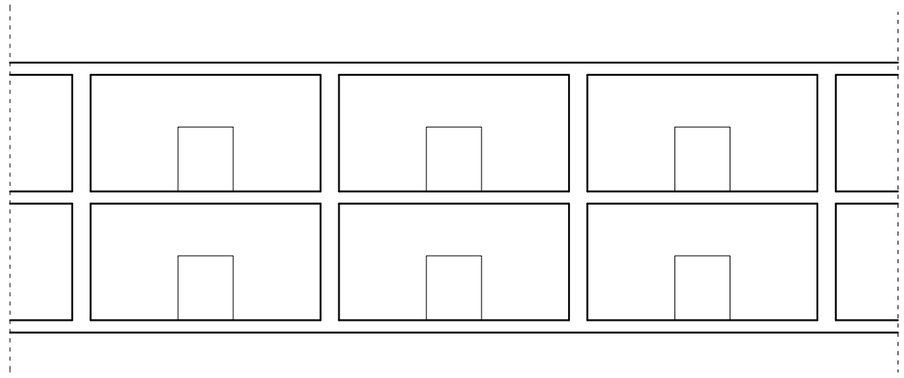
- Articulation of Openings -
Example 6





- Articulation of Openings -
Example 7

Figure 16: Pezo von Ellrichshausen, Meri House



- Articulation of Openings -
Example 8

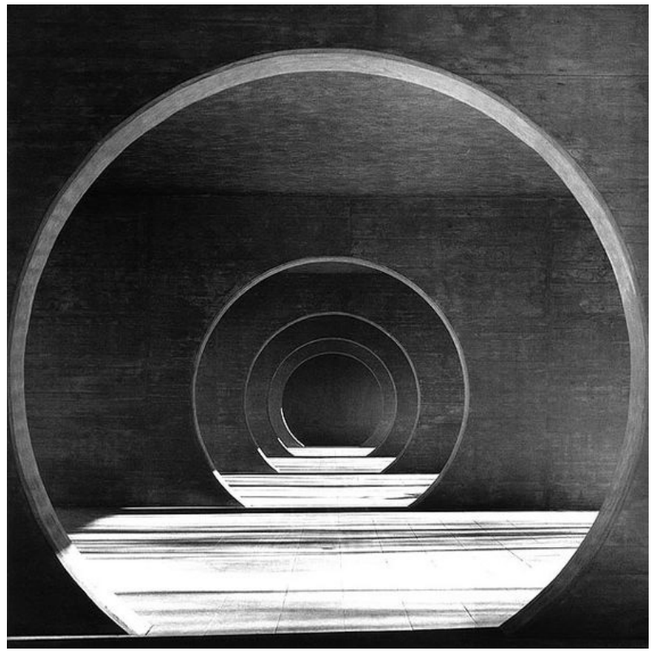
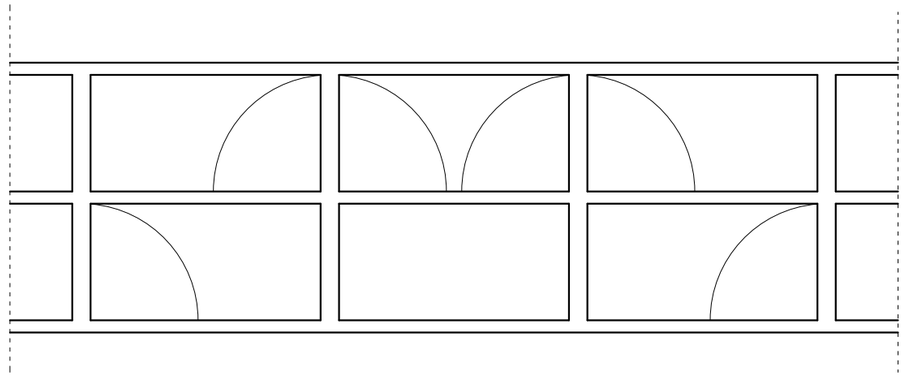
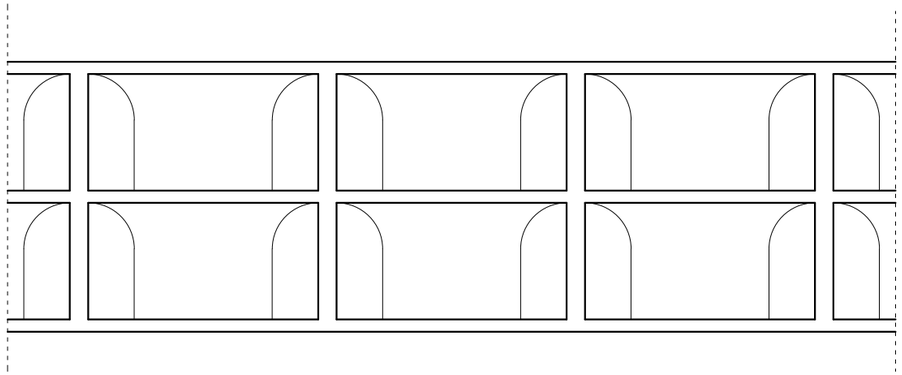


Figure 17: Mario Botta, Wohnsiedlung in Novazzano



- Articulation of Openings -
Example 9

Figure 18: San Cristobal Fortress: Puerto Rico



- Articulation of Openings -
Example 10

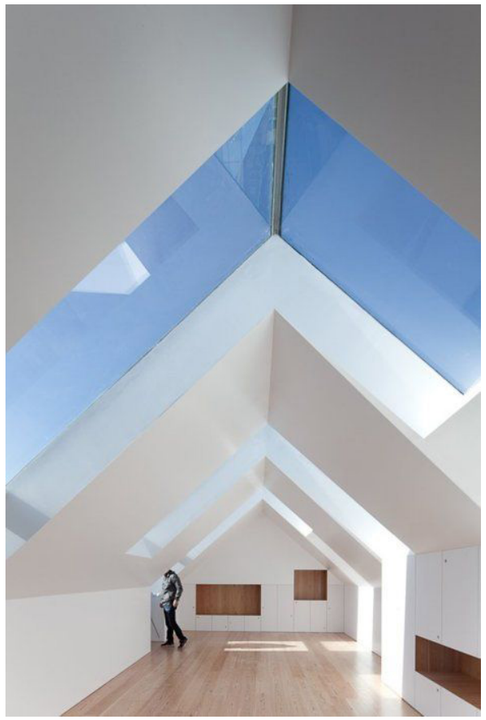
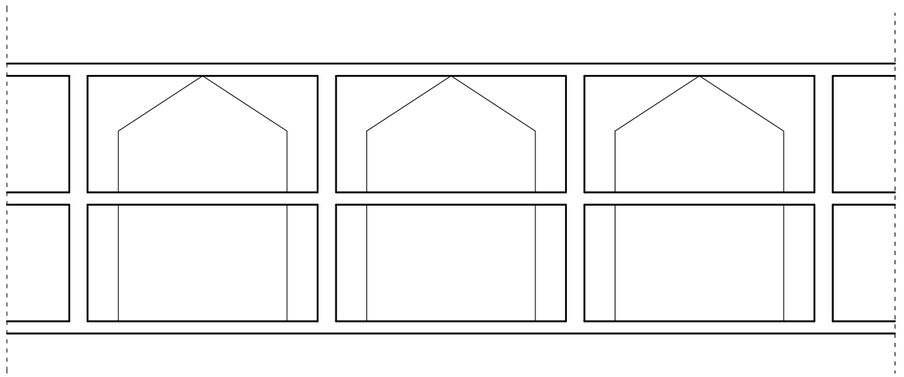
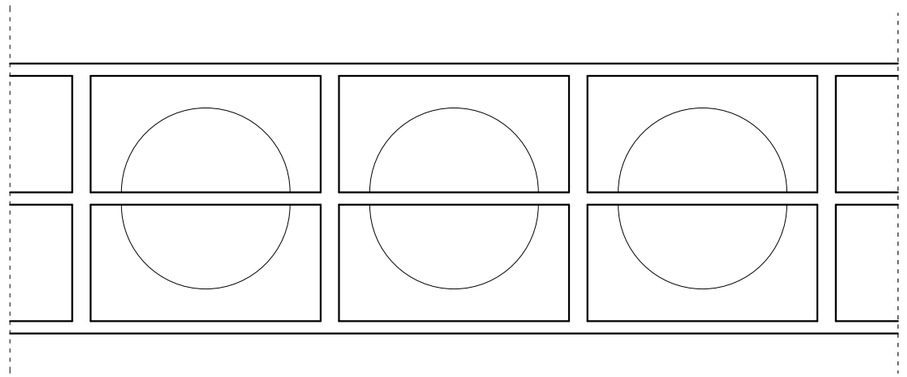


Figure 19: Barbosa & Guimarães, Fonte Da Luz



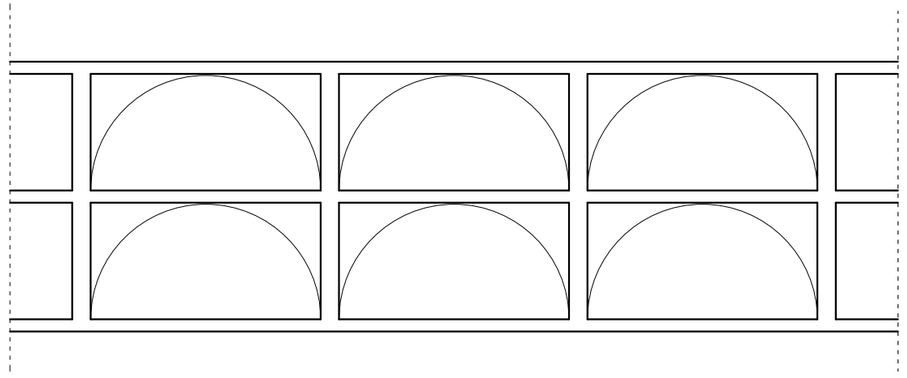
- Articulation of Openings -
Example 11

Figure 20: Louis Kahn, Bangladesh National Capital



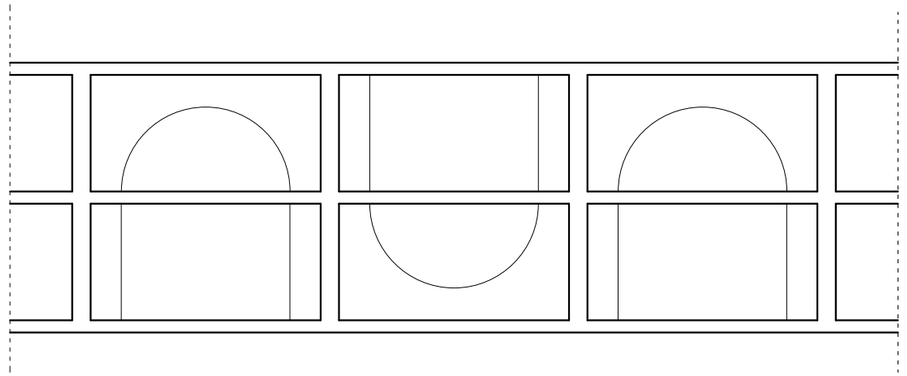
- Articulation of Openings -
Example 12

Figure 21: Toyo Ito, Tama Art University Library



- Articulation of Openings -
Example 13

Figure 22: Oscar Niemayer, Palacio de Alvorada



- Articulation of Openings -
Example 14

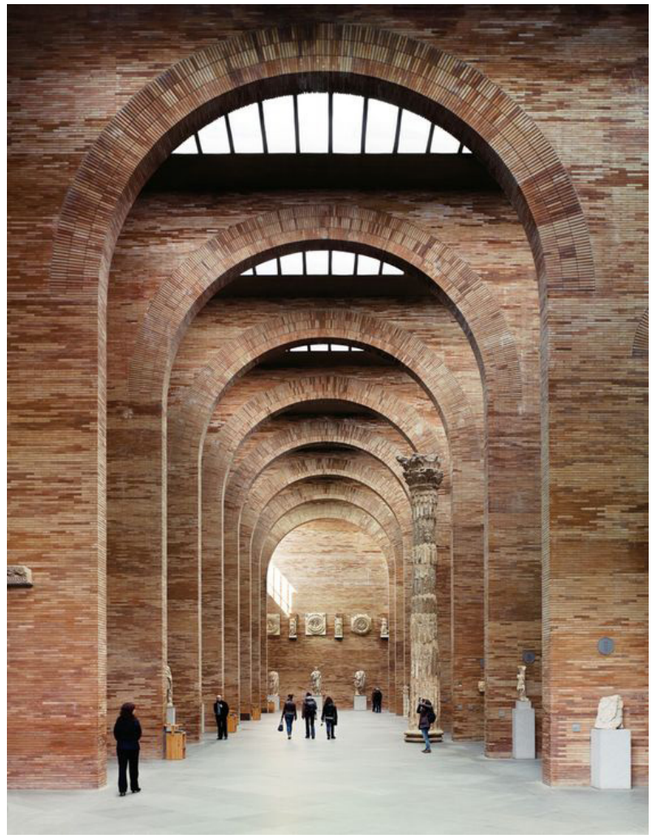
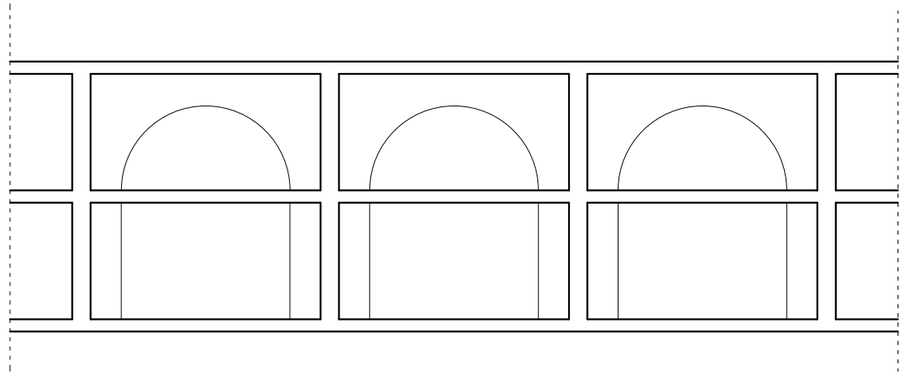
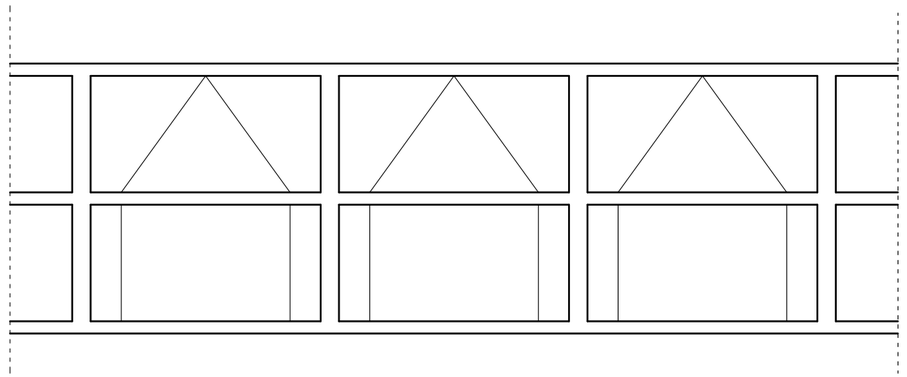


Figure 23: Raphael Moneo, National Mueseum of Roman Art, La Merida

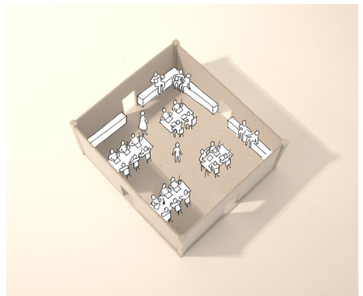


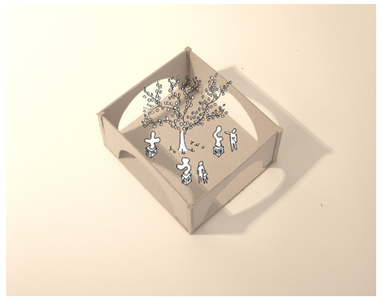
- Articulation of Openings -
Example 15

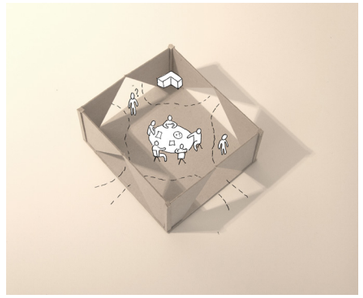
Figure 24: mA-Style Architects, Koya No Sumika

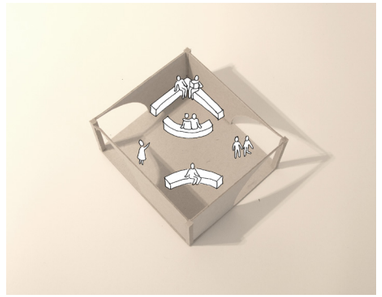


- Articulation of Openings -
Example 16









Illustrated model photos to exemplify spatial qualities

10

REFLECTIONS OF ARTICULATION OF WALLS

This study looks at the articulation of openings and the effects of them. This chapter is not dependent of the existing grid and therefore should perhaps not even be included in this examination. However it does address an architectural expression that is valuable for the project and has proved rewarding and therefore it has not been excluded.

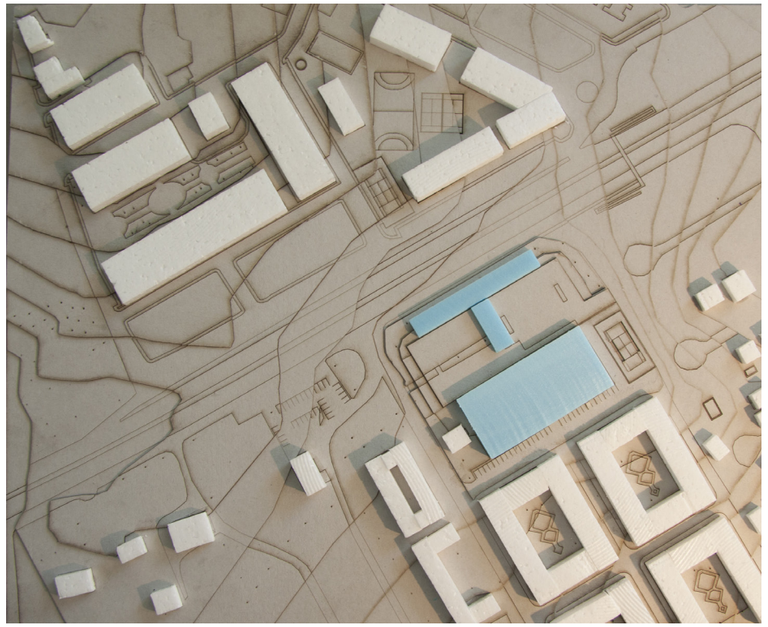
How does the size and shape of an opening dictate the visitors entrance and exit? Does a large opening signify the importance of the room you are about to enter? Or does a large entrance create a space that is difficult to furnish? How are your sight-lines affected by the opening? Does a large opening reveal your surroundings and contribute to your sense of security and awareness? Will a small opening entice you to take a step into the unknown? Or does a small opening contribute to your sense of calm when there are fewer distractions to witness?

The shape of an opening will determine how light falls into the room and the shadows that are cast. A shape much like a material can carry nostalgic qualities along with it. Will a triangular opening appeal to those who have grown up in a gable roof house? Or will an arch feel homely to a person brought up in a country with ancient Roman heritage?

This use of media for this study has combined paper models, drawings and project references. Existing projects were introduced in this chapter to get a sense of how the examples can be applied in reality.

- Exterior Volumes -
Example 1

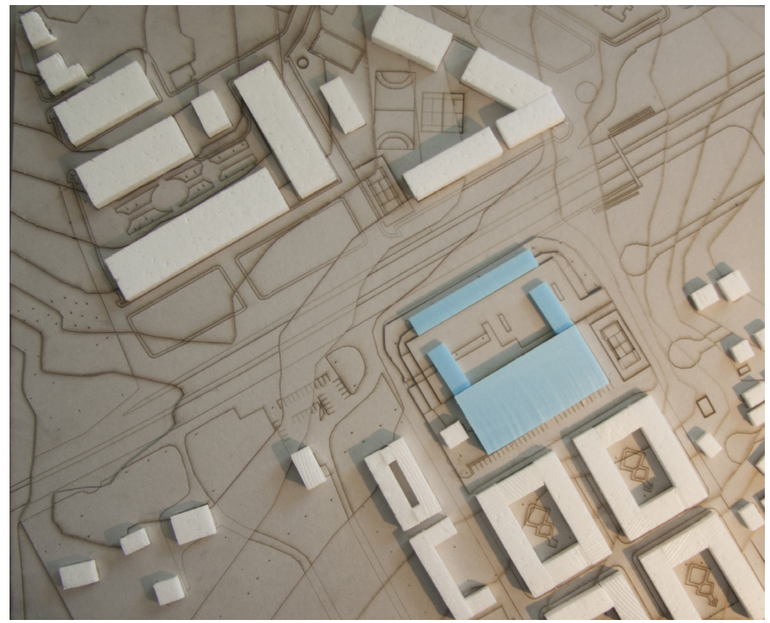
- Exterior Volumes -
Example 2



- Exterior Volumes -
Example 3

- Exterior Volumes -
Example 4

- Exterior Volumes -
Example 5



- Exterior Volumes -
Example 6

- Exterior Volumes -
Example 7

11

REFLECTIONS OF EXTERIOR VOLUMES

The motorway that runs along the entire Costa del Sol just north of the site is incredibly dominant for the project. There was a necessity for the project to frame in the site and by doing so preventing the need to look out over the motorway. The need for a handball pitch with a size of 20 x 40m, established a generous space to work around and in the examples, volumes have been placed according to this pitch.

The placement of these volumes is also important in order to not close off the road west of the site. The site analysis concluded that the south of the motorway consisted largely of enclosed spaces that had no interaction with street life. Therefore it is very important for the building to be more inviting than the rest of the street and the placement of volumes can help direct this.

The placement of volumes is also a reaction to where the majority of people will be entering the site from. The bridge just north of the site connects the north and south side from Cancelada. There is also a bus-stop on either side of the motorway where the bridge lands and therefore one entry point will certainly be from this direction.

Students and visitors that are not arriving by foot or by bus will be arriving by car. There will therefore need to be a drop-off point on the site. The most important entrance point will be from the street. This project needs to break the pattern along the rest of the street of closed facades and create an inviting space for the public person.

- Interior Volumes -
Example 1

N 1:400

N 1:400

- Interior Volumes -
Example 2

- Interior Volumes -
Example 3

N 1:400

N 1:400

- Interior Volumes -
Example 4

- Interior Volumes -
Example 5

N 1:400

- Interior Volumes -
Example 6

N 1:400

- Interior Volumes -
Example 7

N 1:400

N 1:400

- Interior Volumes -
Example 8

- Interior Volumes -
Example 9

N 1:400

- Interior Volumes -
Example 10

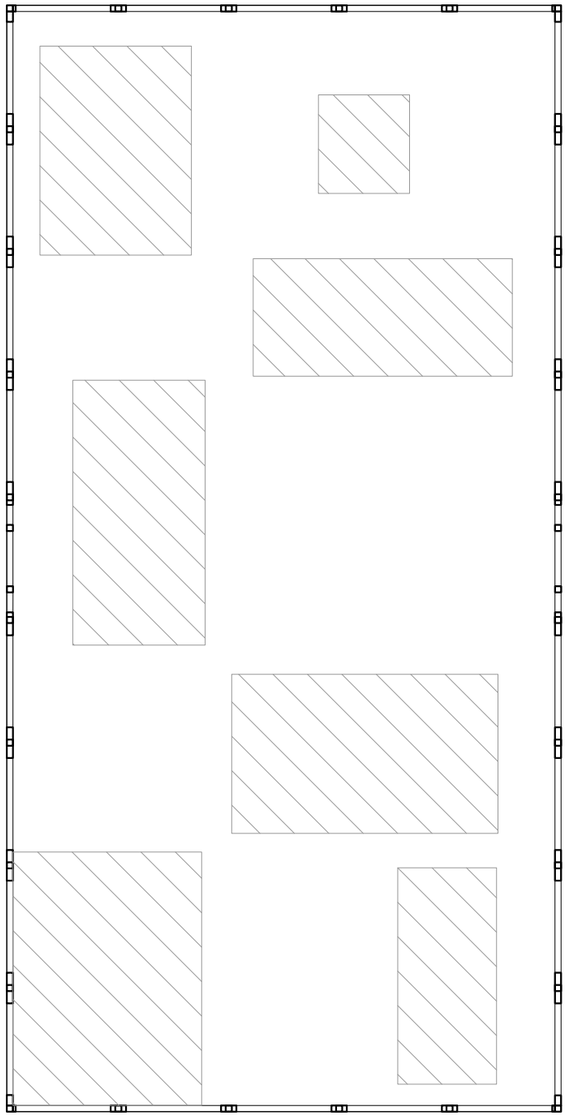
N 1:400

N 1:400

- Interior Volumes -
Example 11

N 1:400

- Interior Volumes -
Example 12



- Interior Volumes -
Example 13

N 1:400

12

REFLECTIONS OF INTERIOR VOLUMES

The study of the interior volumes examines how spaces can be articulated within the structure. The study also examines interior and exterior spaces. What is also explored is the consequence of leaving the grid and allowing volumes to be both inside and outside of the existing structure.

In order to create an inviting environment where users who are not students can wander through the public spaces of the building the interior volumes needed to correspond to the choice of exterior volumes by establishing spaces that encourage wandering and exploration.

A concept that could fulfill this requirement was one that mimicked a site plan. Cities, towns and villages encourage a circulation where you are guided from experience to experience for example from a main road, to a street, to a courtyard and then to a park. Although urban planning is at a much larger scale than this project, the building is large enough to host a similar experience. This concept has the potential to suit the need of the visitor in finding their public space and the need of the student in finding their private study space.

The desired effect of the plan is to have volumes that are essentially understood as individual buildings that will accommodate the schools classrooms and facilities. The spaces that are formed between these buildings define the public space where visitors reside.

This is the last study of the grid analysis chapter. The amount of examples and variations that one can come up with are infinite and after a certain amount of them, one cannot proceed in the project without introducing program.

Cultural Value

Through form and material

Figure 25: Mosque of Córdoba

13

UNDERSTANDING FORM

The chosen program of the project is aimed to better the life of the people of Cancelada. Given the fact that the building's facilities will partially be open to the public, the building is not only a school but essentially a community center. It therefore became very important that the architecture appealed to the community and all the social categories of people that will visit the building. Hence the cultural value of the architecture is of great magnitude.

Collectively Andalucia has been ruled by earlier Iberians, Carthaginians/ Phoenicians, Greeks, Romans, Vandals, Visigoths, Byzantines, Muslim Moores and the later Castilians and Christians. [13] The name Andalucia is derived from the Arabic name "Al-Andaluz" meaning Muslim Iberia. [14] Spain and Portugal were governed by the moors at various times between 711 and 1492. Today the architecture of Andalucia speaks strongly of Roman and Moorish origin. Examples include the palace and fortress complex of Alhambra in Granada and the Great Mosque of Córdoba. Interestingly the Great Mosque of Córdoba was originally a small temple of Christian Visigoth origin. When Muslims conquered Spain in 711, the church was divided into Muslim and Christian halves. This sharing arrangement of the site lasted until 784 when the Christian half was purchased by the Emir Abd al-Rahman I, who then proceeded to demolish the original structure and build the Great Mosque of Córdoba. Córdoba returned to Christian rule in 1236 and the building was converted to a Roman Catholic church. [15]

The use of arches in Roman and Arabic architecture is very common and often seen in Andalucia. Understanding how arches work was very important for the project if they were going to be incorporated. Without delving too deep into the history of arches, this section highlights how arches work and illustrates a few different types of arches.

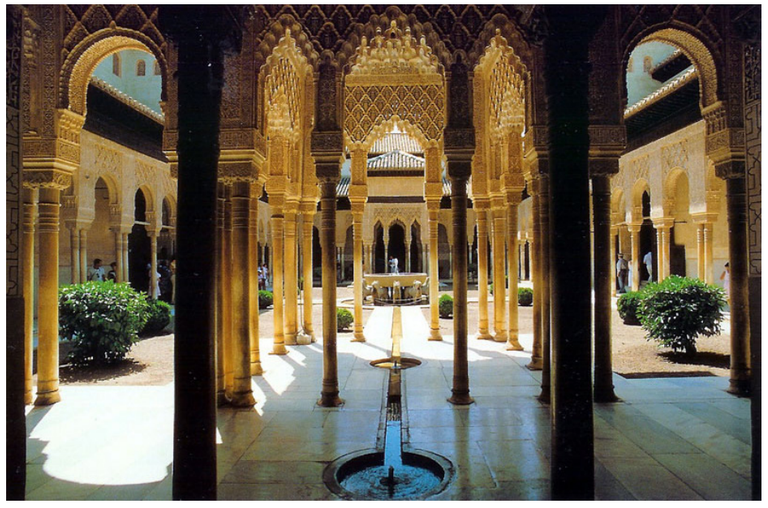


Figure 26: Alhambra gardens

Figure 27: Alhambra gardens

THE TRUE ARCH

A true arch is a funicular structure, meaning that it achieves an equilibrium state by adopting a mechanism of "right form" (shape/ geometry) corresponding to the applied loads. Much like a suspended cable, the arch also shares the same principle. While the cable is in pure tension, the arch is in pure compression.

In order to achieve a stable structure, the geometry of the structure needs to be funicular (i.e. reciprocal) to the loading condition . The process of tailoring the geometry (form) of the structure to be funicular to the loading condition is called 'form finding'. Funicular structures' geometry could be said to be derived from the funicular polygon, a term from graphic statics.

A french mathematician Pierre Varignon (1654-1722) introduced the funicular polygon and the polygon of forces. He described a way to construct the form of a hanging rope with attached weights graphically. Based on this principle, a technique called graphic statics was developed in the 19th century. [16]

CORBELLED ARCHES

One of the earliest methods of constructing arches is known as corbelling. The arch is constructed by offsetting successive courses of stone (or brick) at the springline of the walls so that they project towards the archway's center from each supporting side, until the courses meet at the apex of the archway (often, the last gap is bridged with a flat stone.)

Although an improvement in load-bearing efficiency over the post and lintel design, corbeled arches are not entirely self-supporting structures, and the corbeled arch is sometimes termed a "false arch" for this reason. Unlike "true" arches, not all of the structure's tensile stresses caused by the weight of the superstructure are transformed into compressive stresses. Corbel arches and vaults require significantly thickened walls and an abutment of other stone or fill to counteract the effects of gravity, which otherwise would tend to collapse each side of the archway inwards. [16]

VOUSSOIR ARCHES

Unlike corbelled arches, voussoir arches are self-supporting structures and therefore considered to be "true arches." The bricks are shaped like wedges and are narrower closer to the opening., bricks cut to this shape are called voussoirs. The wedge pushes out onto its neighbour which causes compression through the entire arch. This causes reaction forces on each side perpendicular to the joint and if these were not perpendicular, slippage would occur. The components of these reactions are vertical load (due to gravity) and horisontal load (due to thrust.)

When building an arch, one uses scaffolding that the massonry can rest upon. When the keystone is added (the stone at the top of the arch) this allows the stones to fall next to one another. With the keystone in place, the arch is now stable and the scaffolding can be removed.

The initial shape of the arch usually experiences uniform loading. However if non-uniform loading is applied, (for example if one person stands at one end of the arch) the other stones will be pushed out of position and the arch will collapse. To prevent this, material must be placed on top of the arch. This prevents the stones from pushing out away from its orignal shape. In this way the loads are channeled to the ground as intended. [16]

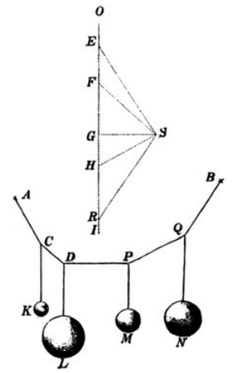


Figure 28: Pierre Varignon
Funicular polygons

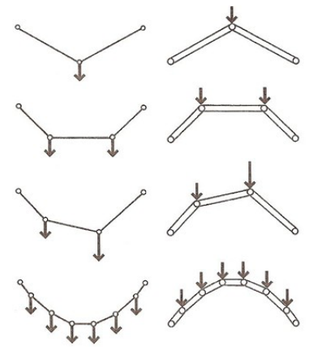


Figure 29: Funicular suspension cables and corresponding arches

Figure 30: Royal Palace of Ugarit Entrance
North western Syria
15-13th century BC

Figure 31: Tomb of Clytemnestra,
Argolis, Greece
1200BC

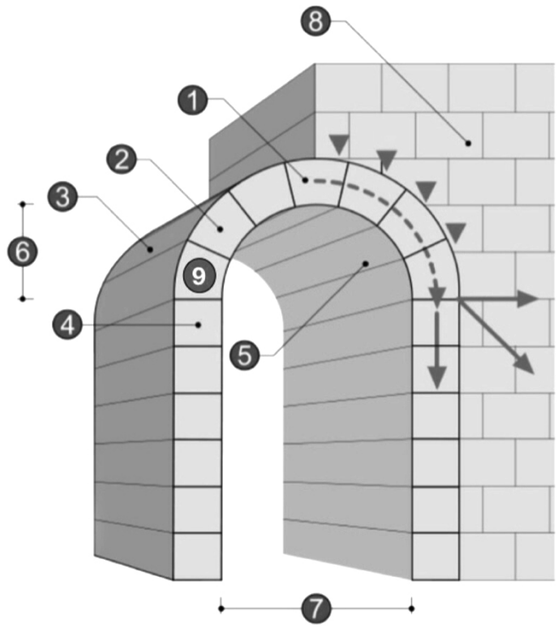
VAULTS

A vault is more stable than a series of adjacent arches, because some of the load is distributed at an angle to other parts of the vault. Like a "true arch" a vault is designed to be in compression (not tension), through shear resistance.

Cylindrical vaults which curve in only one dimension can be either barrel (semi-circular), catenary or pointed (Gothic).

There will be outward lateral thrust at the base of vaults which can create some instability. By using a thicker wall at the base to provide support one can improve the stability. Other examples that will increase stability include:

- adding more material to the lower section of the vault known as a haunch.
- adding a flying buttress.
- adding a tie between the two sides of the vault. [16]



1. Keystone
2. Voussoir
3. Back
4. Impost
5. Intrados
6.Rise
7. Clear span "Bay"
8. Abutment
9. Springer

Figure 32: Feautures of the arch

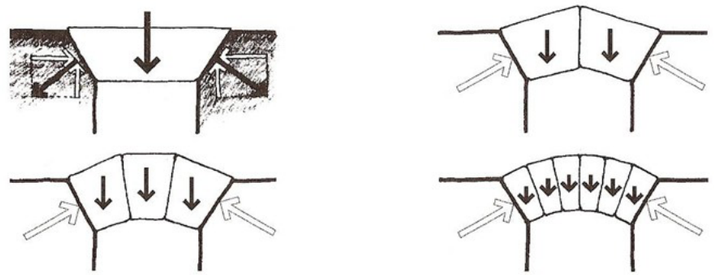


Figure 33: Force distribution in an arch

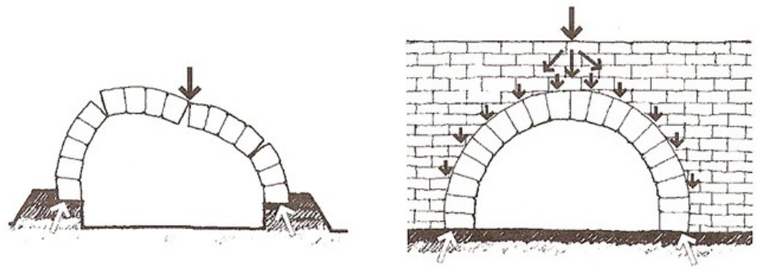


Fig. 34: Making the arch shape permanent

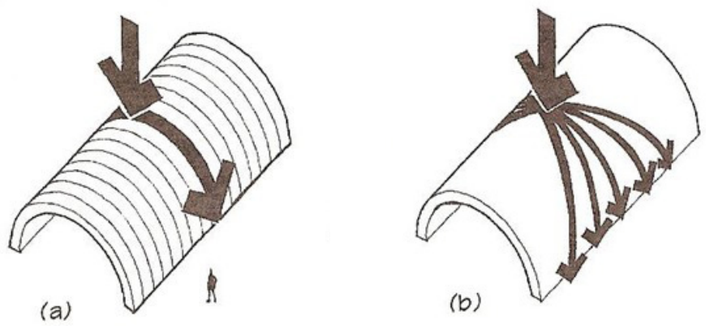


Figure 35: Load distribution in a) independent arches and b) a vault

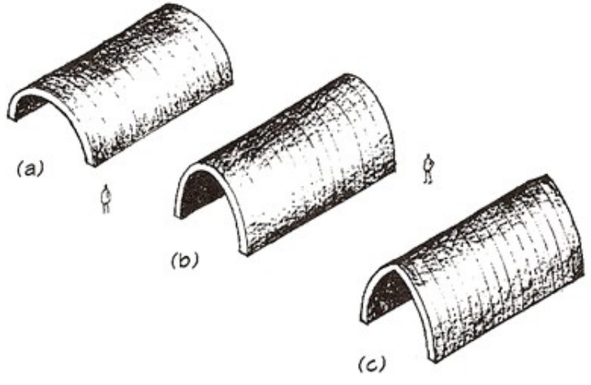


Figure 36: Cylindrical vaults a) barrel,
b) catenary or c) pointed

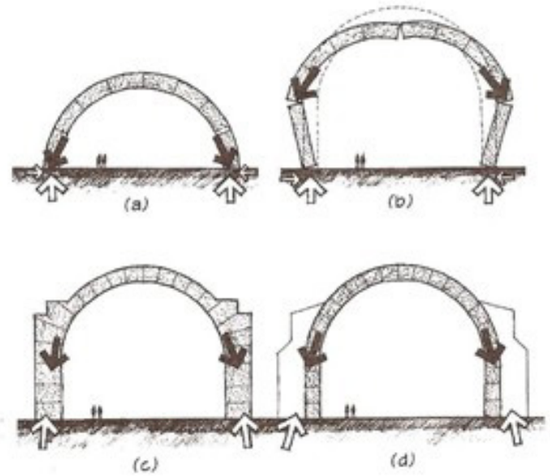
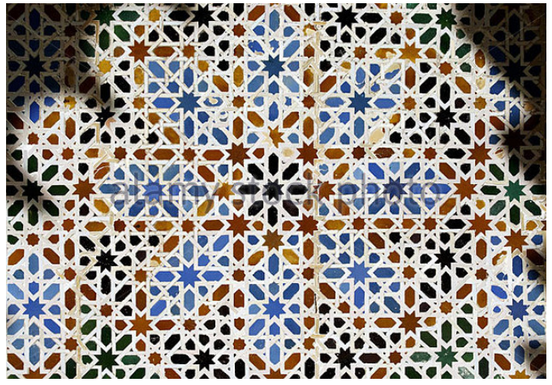


Figure 37: Means of resisiting lateral thrust in vaults:
a) friction of foundation, b) tendency of vault resting on vertical walls to spread,
c) Roman semicircular vault with thickened haunch and thick walls, d) Romanesque solid buttresses e) Gothic flying buttresses and f) Metal ties.



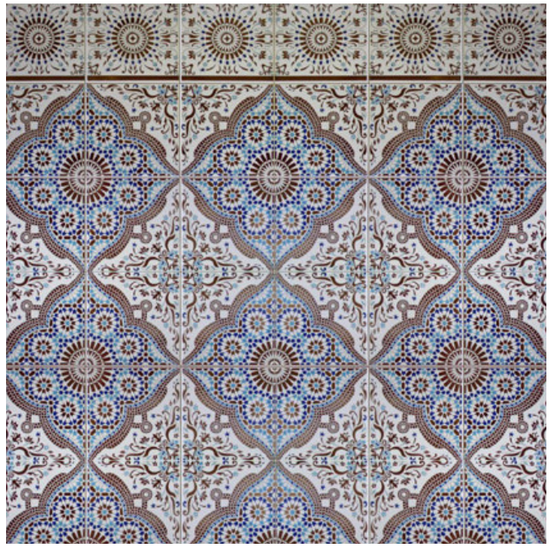


Figure 38 & 39: Spanish ceramic tiles

14

UNDERSTANDING MATERIALS

In Andalucia one often sees white houses. The use of white reflects the sunlight and prevents the houses and buildings from becoming too warm. The main structural materials that are used are concrete, stone and brick.

Ceramic tiles are widely seen in Andalucia both inside and outside. It is a material that is cold and soothing during the summer, it is easy to clean and with different colours and patterns it is aesthetically pleasing.

With the aim of incorporating arches, the use of brick became a natural choice of material. Another appealing feature with the material is it's ability to store thermal mass which proves very rewarding in a climate with very high temperatures. The thickness of the wall can be regulated by number of bricks and the the thicker the wall the more thermal mass is stored. During the day the brick will absorb heat and during the evening this heat will be transferred into the interior of the colder room.

As stated previously in the introduction of this diploma the EU Targets for 2030 state that countries of the EU need to reduce their GHG emission levels by 40% compared with their levels from 1990. [9] Hence it was very important in this project that the choices of material were environmentally conscious. Marwa Dabaieh who is a researcher at the University of Lund in the department of Architecture and the Built Environment, suggested that earth bricks could be used for this diploma. She offered her help and guidance and explained how earth bricks were made and as a result experiments were conducted to try to make a brick.

First of all soil samples were collected from 5 different locations, 2 from Bjärred and 3 from Lund in Skåne, Sweden. The soil samples were analysed by putting in parts 1/3 soil and 2/3 water in a plastic bottle. This was then shaken thoroughly and left to stand for 24 hours. The mixture then starts to separate and one can see how much clay, sand, silt and organic waste the soil sample contains and therefore one can decide whether the soil is suited for making bricks or not.

Further tests include the bracelet test, the cigar test and the stone test. The bracelet test involves taking a soil

Photograph taken by author from Marbella

Photograph taken by author from Ronda

Photograph taken by author from Córdoba

sample and making it into a pancake and placing it within a bracelet. This is then left for 24 hours and the next day one can see how much the pancake has shrunk. If it has left a gap between the bracelet and itself and it is very hard to break then it contains a lot of clay. The cigar test involves rolling the soil sample into a cigar and placing it at the edge of a table. Gently push it as though to push it off the table, as it is hanging off the edge of the table if it breaks early then the sample has too much sand and if it hangs without breaking for a long length then it may have too much clay. Finally in the stone test, one forms a ball of the soil sample and throws it down on the table. If the soil breaks and splatters it contains too much sand and if it remains intact it contains a lot of clay.

Bjärred B soil sample was the winner of the test proving to have the best combination of sand, clay and silt so more soil from that location was fetched. One sample of soil was mixed with cut up pieces of straw, limestone and more silt and sand. The mixture was roughly 1/3 soil, 1/3 sand and 1/3 clay a pinch of limestone and a handful of straw. This was enough to produce one brick. This brick was moulded by using a styrofoam form and placed in the oven at 40 degrees celsius. 20 hours later the brick was dry. But unfortunately the brick showed cracks and after a week it broke.

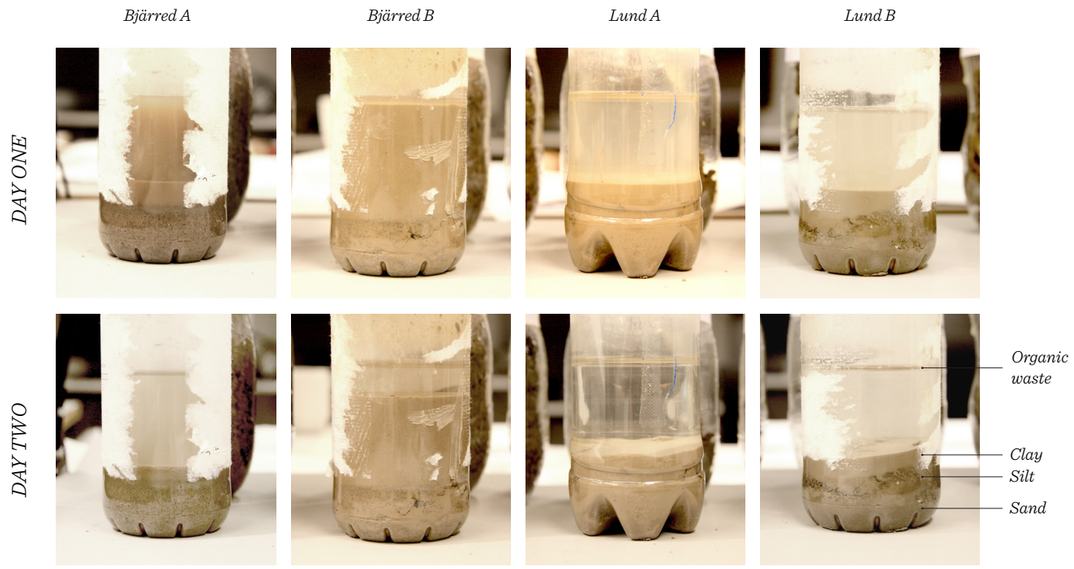
Therefore another test was conducted with three different mixtures. One that consisted of the same proportions as initially tested but with more hay. The hay is able to take tension and strain much like reinforcement bars in concrete. Another sample had majority soil from the site and the last example had majority sand. This time the result proved that the first mixture gave the best outcome showing least cracks.

Material collected for soil testing and brick making

Stone test

Bracelet test

Cigar test



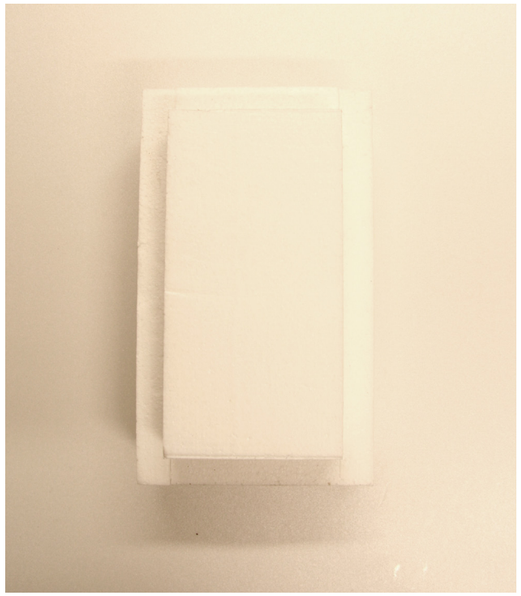
Brick mixture of majority sand

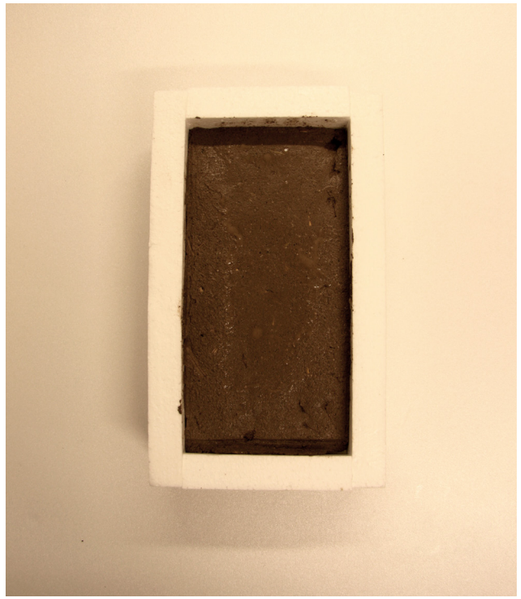
Brick mixture of majority soil

Brick mixture of 1/3 soil, 1/3 sand and 1/3 silt

Oiling the polystyrene cast

Brick mixture compressed in form





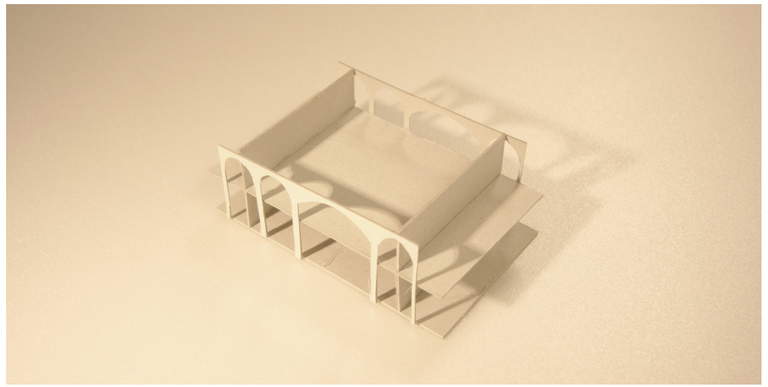
Brick before going in the oven

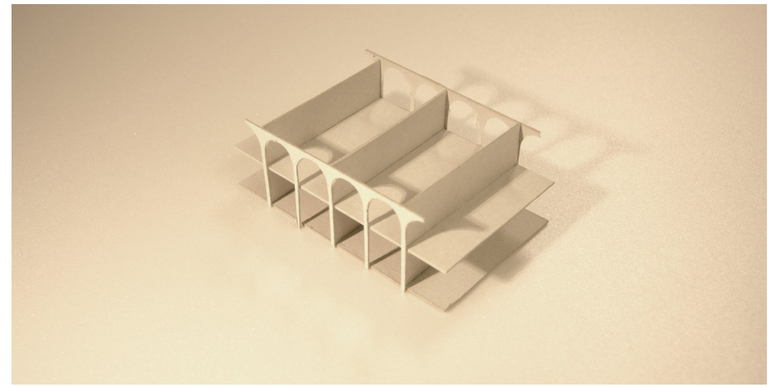
First attempt

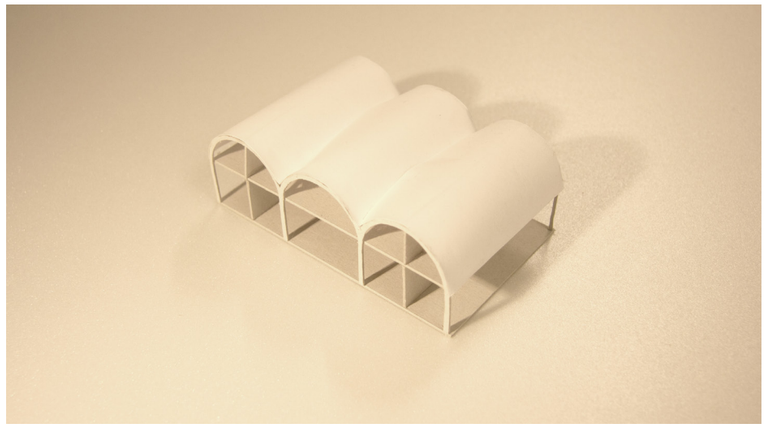
Brick with majority sand

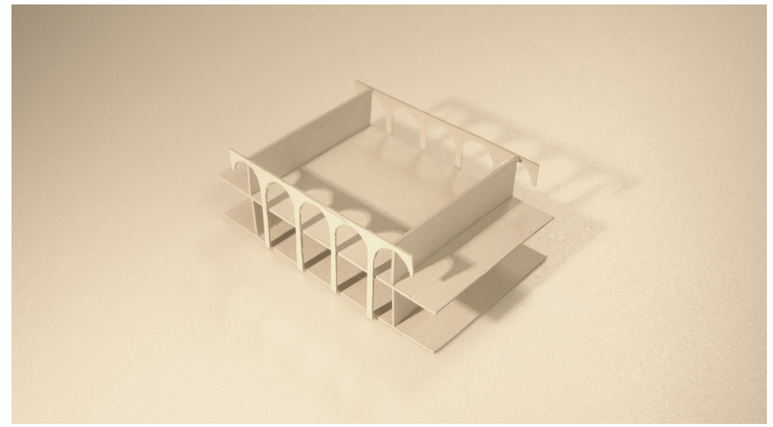
Brick with majority soil

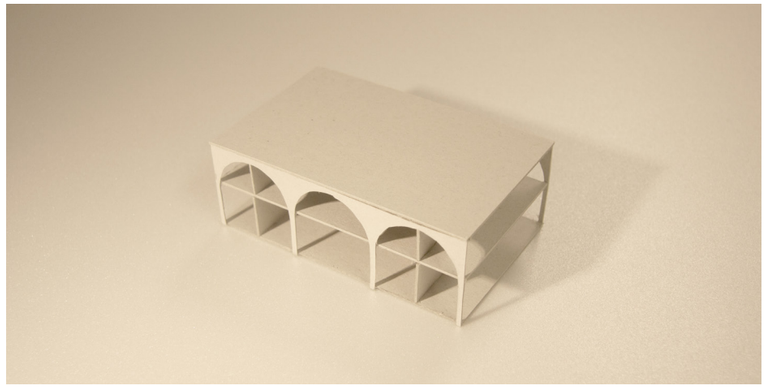
Brick with 1/3 soil, 1/3 sand and 1/3 silt

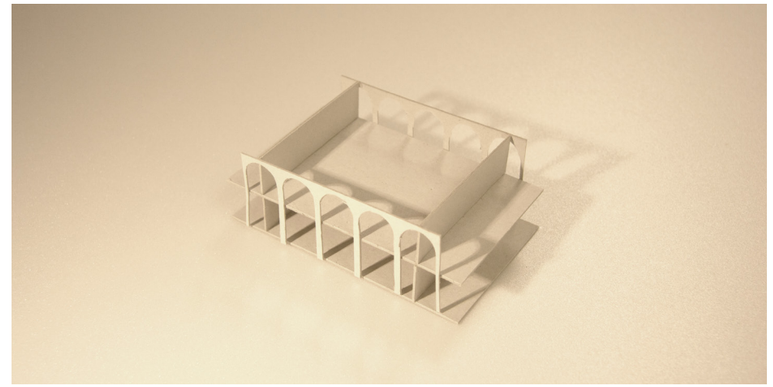












Sketch models of arches

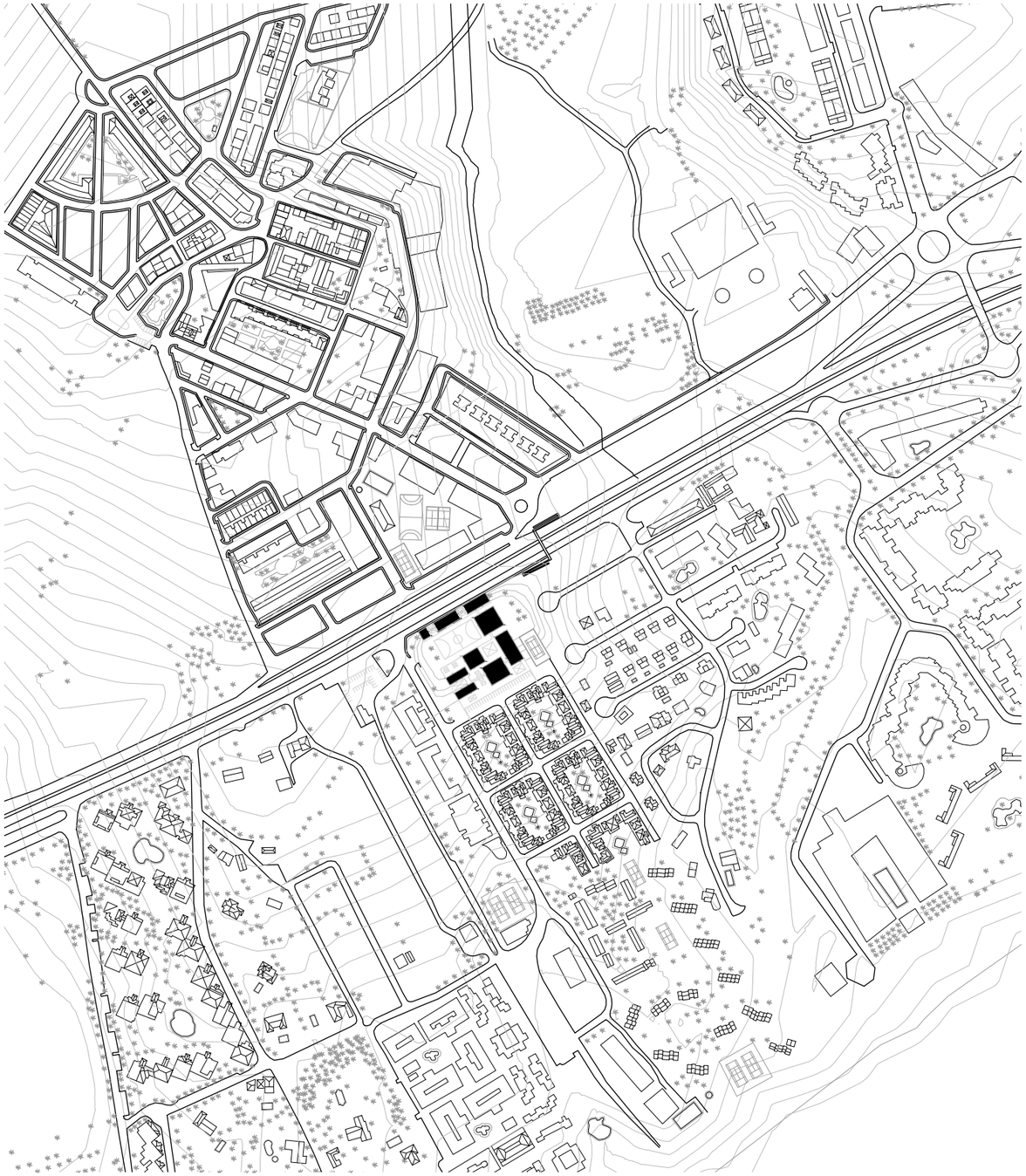
Sketch models of arches

The Proposal

Studies and Reflections

Site plan
1:5000

N



15

WHAT TO KEEP AND WHAT TO DISCARD

From the site visit it was apparent that the existing facade had been rather damaged by weathering and the salty winds from the sea certainly accelerate the rate of corrosion. The reinforcement bars were starting to creep through and the plaster was crumbling off. The facade proved to be an obstacle for the project and was a clear barrier in the building that was creating divisions where they were not wanted.

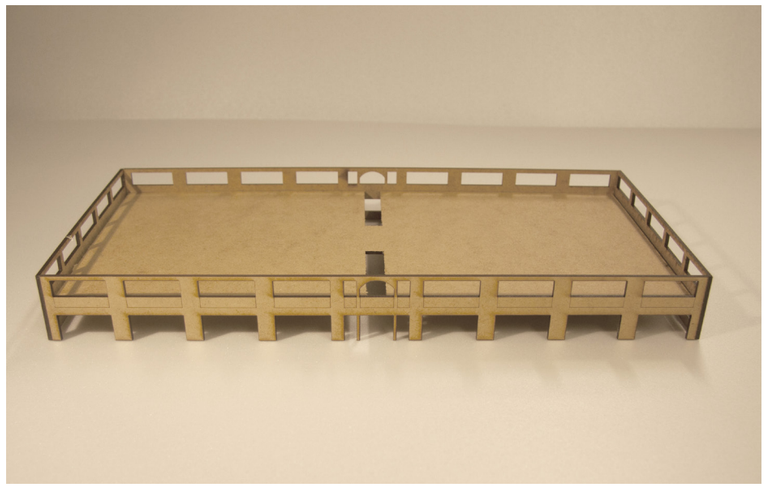
As earlier mentioned this transformation project offers a certain freedom for the architect to decide what to keep and what to discard. This is not to say that there is room for carelessness. For a long time the project included the facade and staircases but instead of enhancing the project their placement was awkward. Therefore the facade and staircases where finally removed.

One reason why their placement was so awkward was that the project grew larger than the extents of the existing building. This was due to the large public spaces that were desired for the project and that the school did not have a classic institutional layout of corridors and classrooms. This meant that the plans stretched beyond the facade and therefore the facade intersected with rooms.

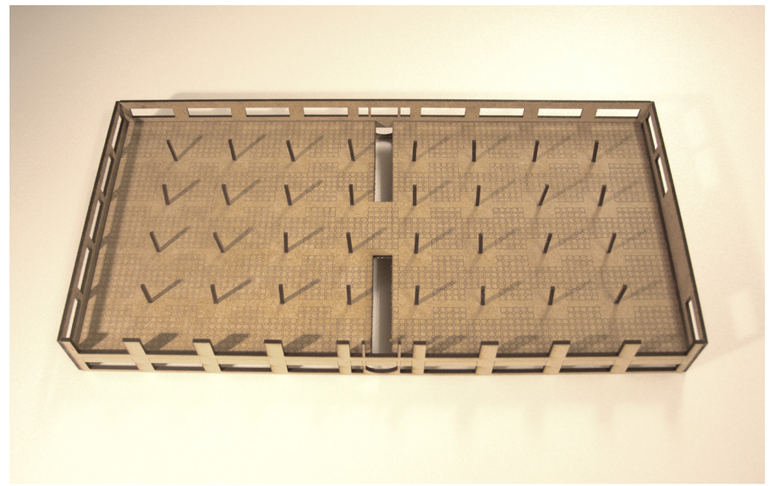
Although the existing stairs are evenly spread out in the building which would be ideal the middle staircase was faced away from the entrance. Therefore the circulation upwards from this staircase wasn't very logical. The two exterior staircases were not too problematic but they were not drawing visitors into the building. Now if one is arriving at the site and needs to go straight to the first floor it would be convenient to not have to go into the building to get to a staircase but just walk straight up. However the concept of the building aims to draw people in.

As a critique of the final proposal. The staircase in the library is in fact only a few meters away from the original placement. So this staircase could probably have been saved in reality.

As mentioned the new plan drawing exceeded the existing floor plan. This extension has maintained the grid pattern by adding on another row of columns along the length of the building on its northern facade. However this row of columns do not consist of 40cm thick reinforced concrete blocks but instead I-profile steel columns measuring 15x15cm. This choice was made to create a contrast between the heavy and solid existing construction and the new lightweight construction.



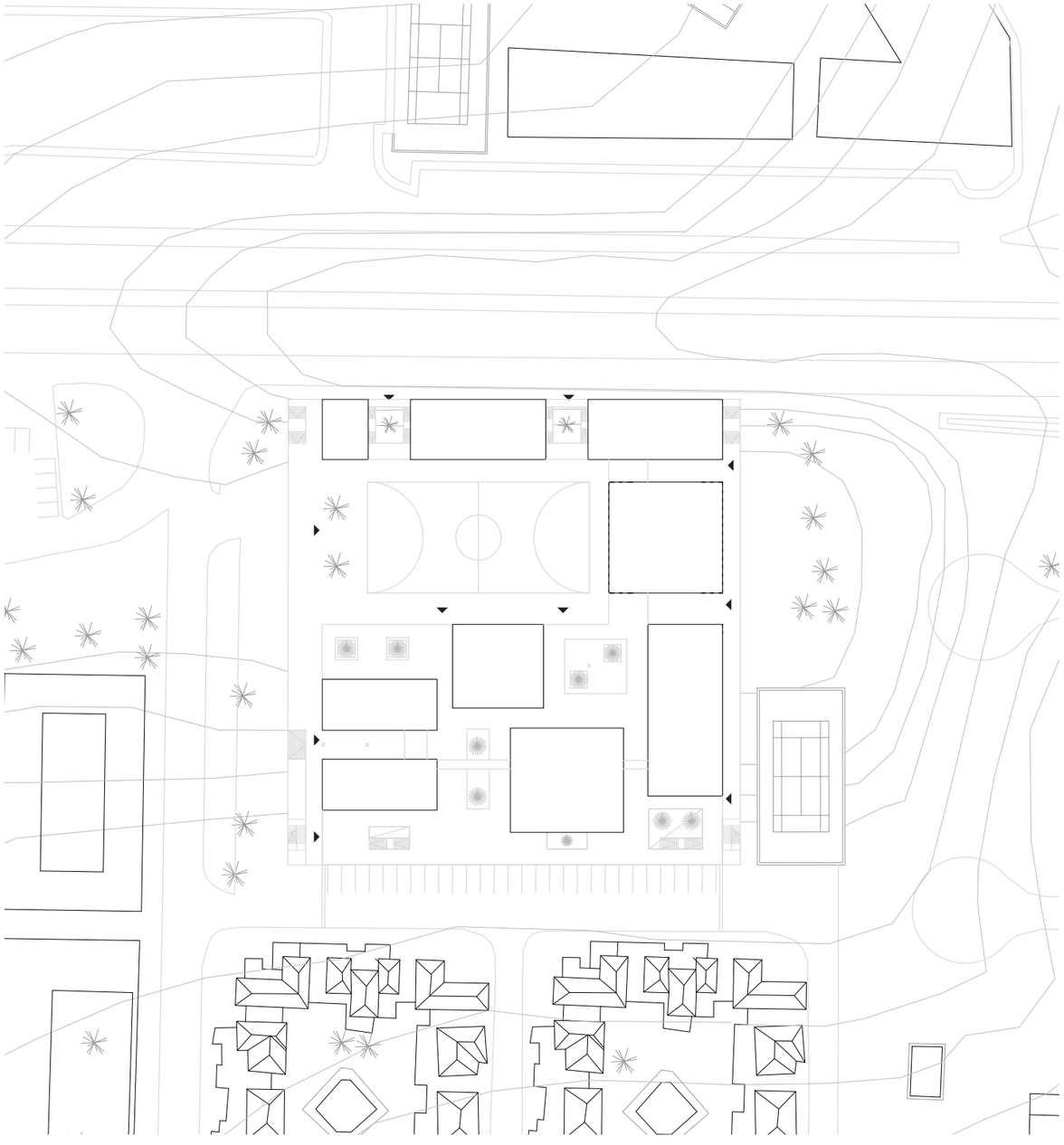
Model of existing shopping center



Model of existing shopping center

Site plan
1:1000

N



16

SITE PLAN

The total area of the project is 12050m². Of that area 46% is circulation space, which amounts to almost half of the building. However given the program of the building and that it is not only a school but a public place, it was important for both of these activities to take place without interrupting the other. The school is large enough to sustain 500 pupils.

Basement floor
Circulation space: 603m²
Programmed space: 399m²

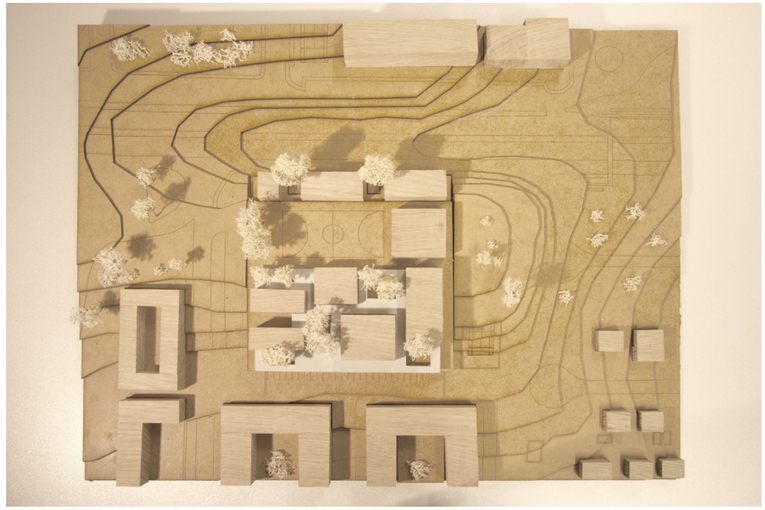
Ground floor
Circulation space: 2852m²
Programmed space: 3200m²

First Floor
Circulation space: 1819m²
Programmed: 1827m²

Second floor
Circulation space: 294m²
Programmed space: 1056m²

Total circulation space: 5568m²
Total programmed space: 6482m²
Total space: 12050m²

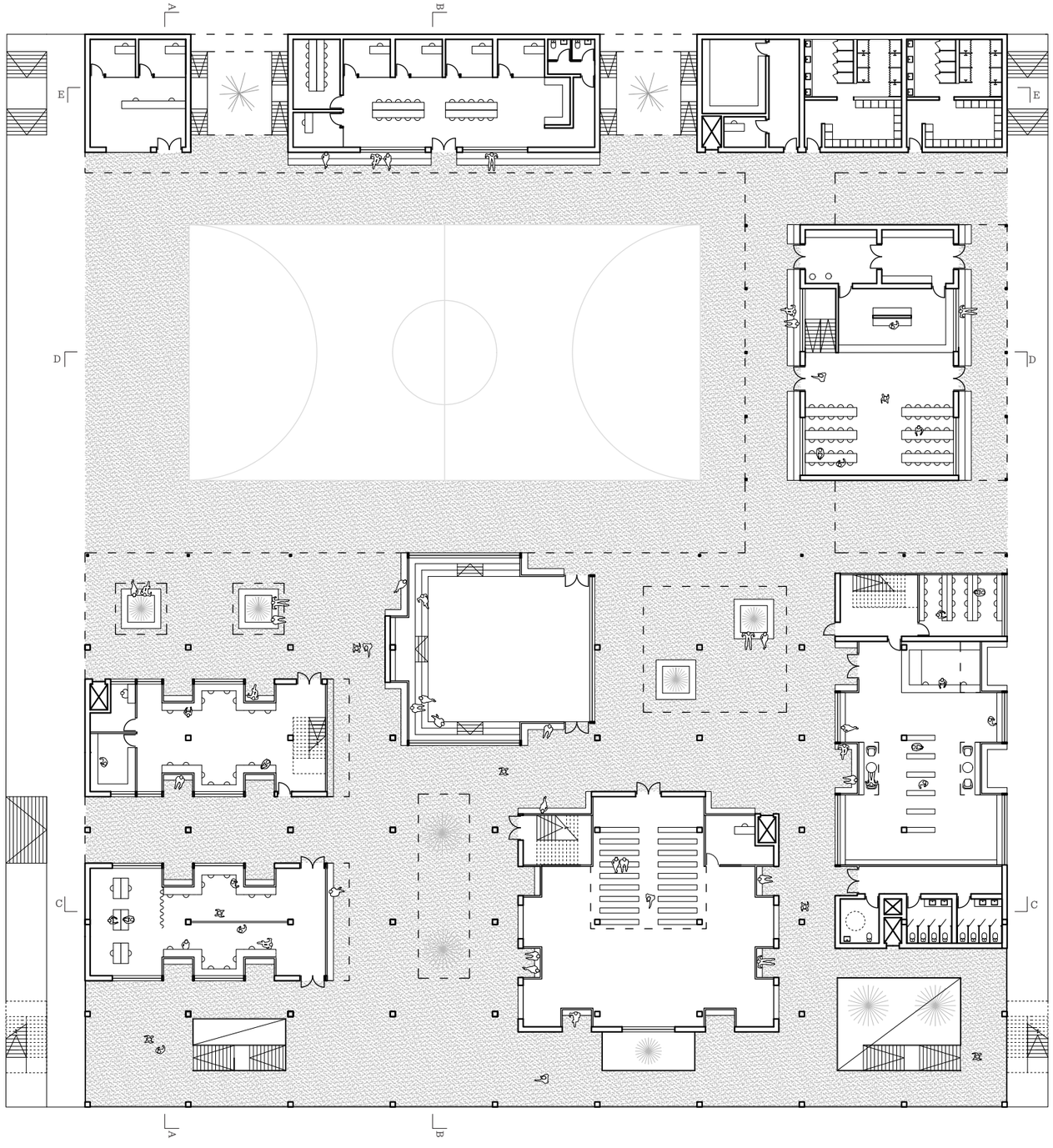
The volumes that are introduced on the site hope to answer the needs of the street to become more open while at the same time closing off the motorway. The entrances therefore occur between the buildings that lie on the perimeter of the site. This has been established by placing the administration and changing rooms for sport lessons as a long rectangular volume alongside the motorway. A school canteen is placed right of the handball pitch that helps frame the pitch while also creating two spaces of entrance for those coming from the bridge or by bus between the canteen and changing rooms and the canteen and existing building. Visitors arriving by car or parents that are dropping of students can come off the motorway via an existing exit and park underneath the administration and changing rooms. They can then take an elevator up to the ground floor or take the stairs that lie between these rectangular volumes. The trees that are viewed next to the staircase by the administration and changing rooms are existing palm trees. The volumes are therefore also planned around them allowing them to still exist.



Site model 1:500

Plan 0
1:400

N



17

PLAN 0

The interior volumes within the existing structure consist (from left to right) of art classrooms, an assembly hall, a chapel and a library. Between these volumes are the public spaces where visitors are free to wander. Staircases are placed within these volumes so that if there is a necessity to close off the first floor one can do so by simply closing the doors to the staircases. The access to classrooms can be controlled by either being open, locked during lessons or that students have keycards that allow them access but not visitors.

The grid analyses studies proved to be of great help in the final proposal of the project. What was taken from those examinations was the interest of how a wall is activated on both sides which is highly important in this project where the public and private space are both of great importance. Therefore the use of niches that provide spaces to reside in on both sides of the wall became a language that is seen throughout the project in the existing building.

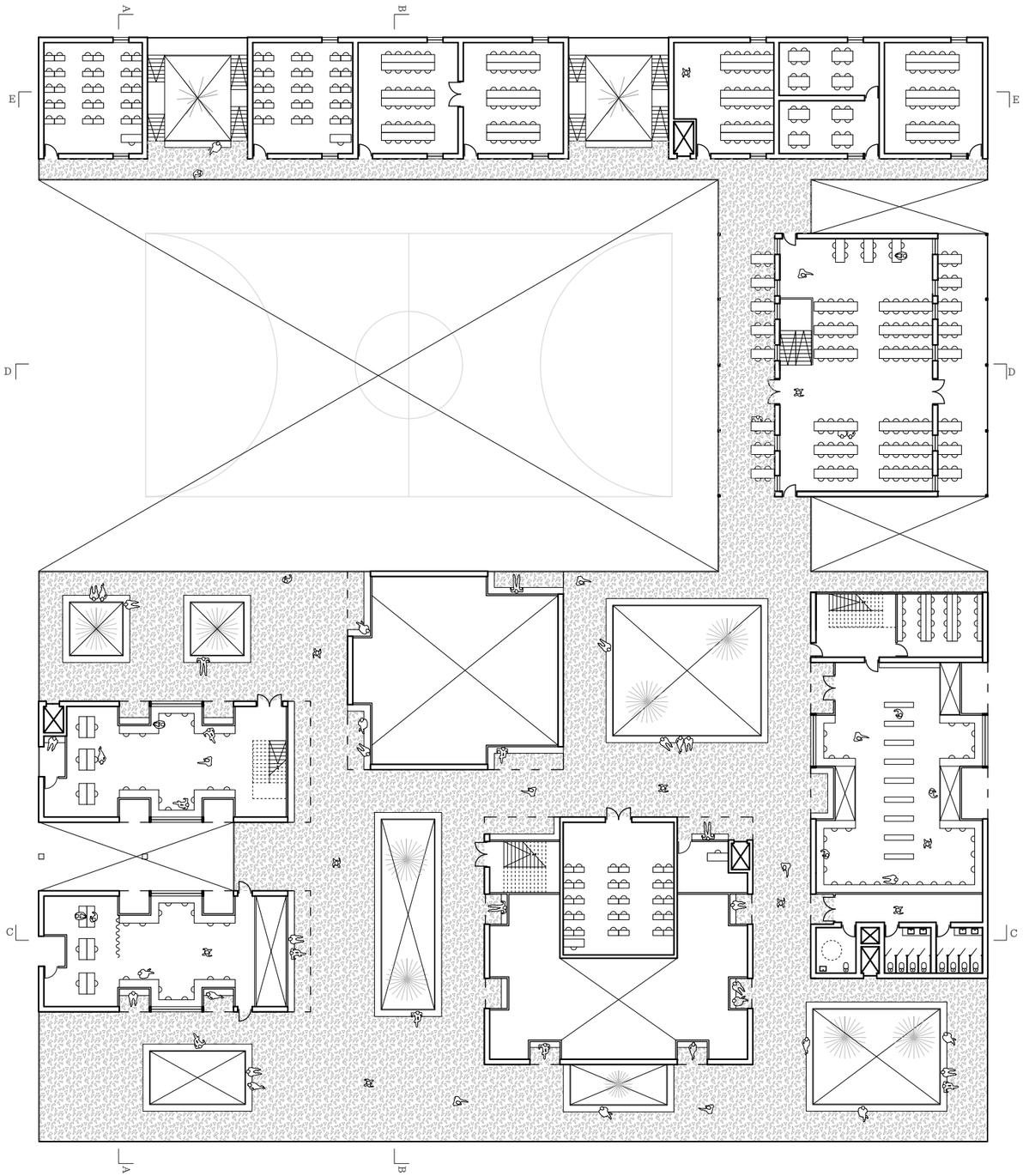
The most interesting aspect of the existing building on the ground floor has been that the existing columns and waffle slab withstand the structural load of a shopping center which as previously mentioned is double that of a school.[12] So any additional structure that is implemented on the ground floor will only be supporting itself. This means that all of the walls on the ground floor can be very thin. However the climate in Spain is incredibly hot during the summer with temperatures reaching up to 40 degrees celsius and around 10 degrees celsius in the winter. Traditionally southern Spanish houses have very little insulation so although the lowest temperatures only get to about 10 degrees so do the inside temperatures. Most homes have therefore portable radiators but this isn't particularly environmentally friendly. Therefore thick walls are very beneficial because they provide thermal mass absorbing the heat from the sun during the day and releasing the heat into the room when the temperature declines.

The walls of the project therefore became thick and thin. The outer walls are thick and the inner walls forming the niches are thin. In order to provide an environmentally sustainable material for the building that can also provide substantial thermal mass, the proposed wall material is earth bricks. Earth bricks can be made from soil on the site and the manufacture of these is later mentioned.

The public spaces of the ground floor are covered in albero sand which is traditionally used in bullfighting rings. The sand is compact and therefore one can easily roll a pram, wheel-chair or zimmerframe over the surface but it is also soft and very pleasant to walk on. The classrooms have a ceramic floor. These materials have been selected because they suit the needs of the place where they are used but they are also typically Spanish which suits the building culturally.

Plan 1
1:400

N



18

PLAN 1

The first floor is very similar to the ground floor in plan. The art classrooms and library continue on the first floor. The assembly room is open up to the first floor so no access is available there. The chapel has a religious studies classroom on the first floor. The public spaces of the first floor are covered in a terrazzo flooring. This material is slightly grey so as to not be too blinding with the reflections of the strong sunlight.

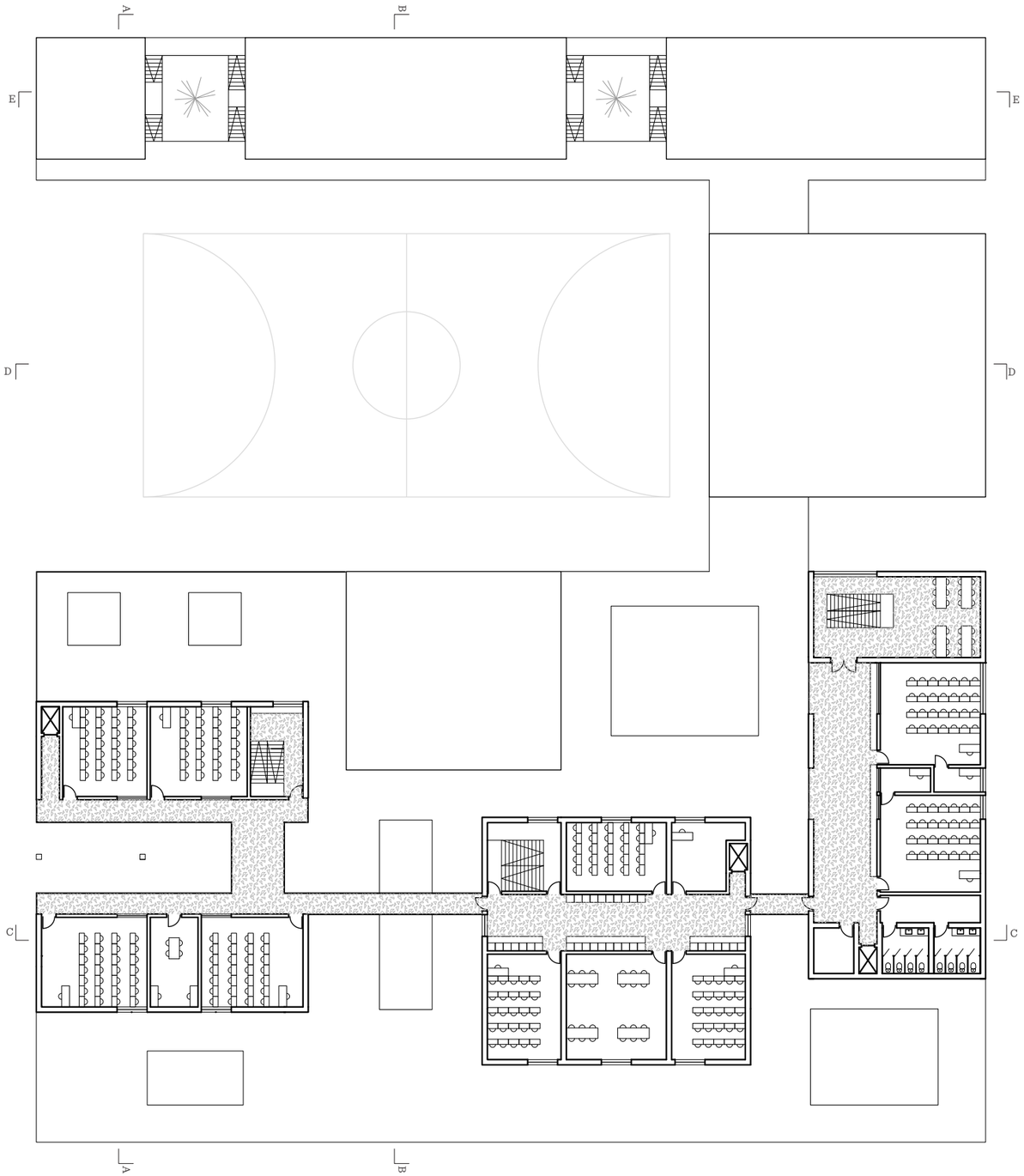
The waffle slab has been cut in several places to allow light to reach down to the ground floor. These atriums have trees placed in them and on the first floor one can sit under the crown of the tree shaded from the blazing sun.

The niches in the walls on the first floor curve to meet a pane of glass that connects to the ceiling. One can sit in these niches and be shaded while the light that enters the room is broken and reflected onto the curved surface offering soft light for the classrooms.

By the library a bridge takes you across to the second level of the canteen. From here one can take a another bridge to arrive ontop of the changing rooms and administration rooms where one finds the laboratories of Biology, Chemistry, Geology and Physics as well as two mathematics rooms.

Plan 2
1:400

N



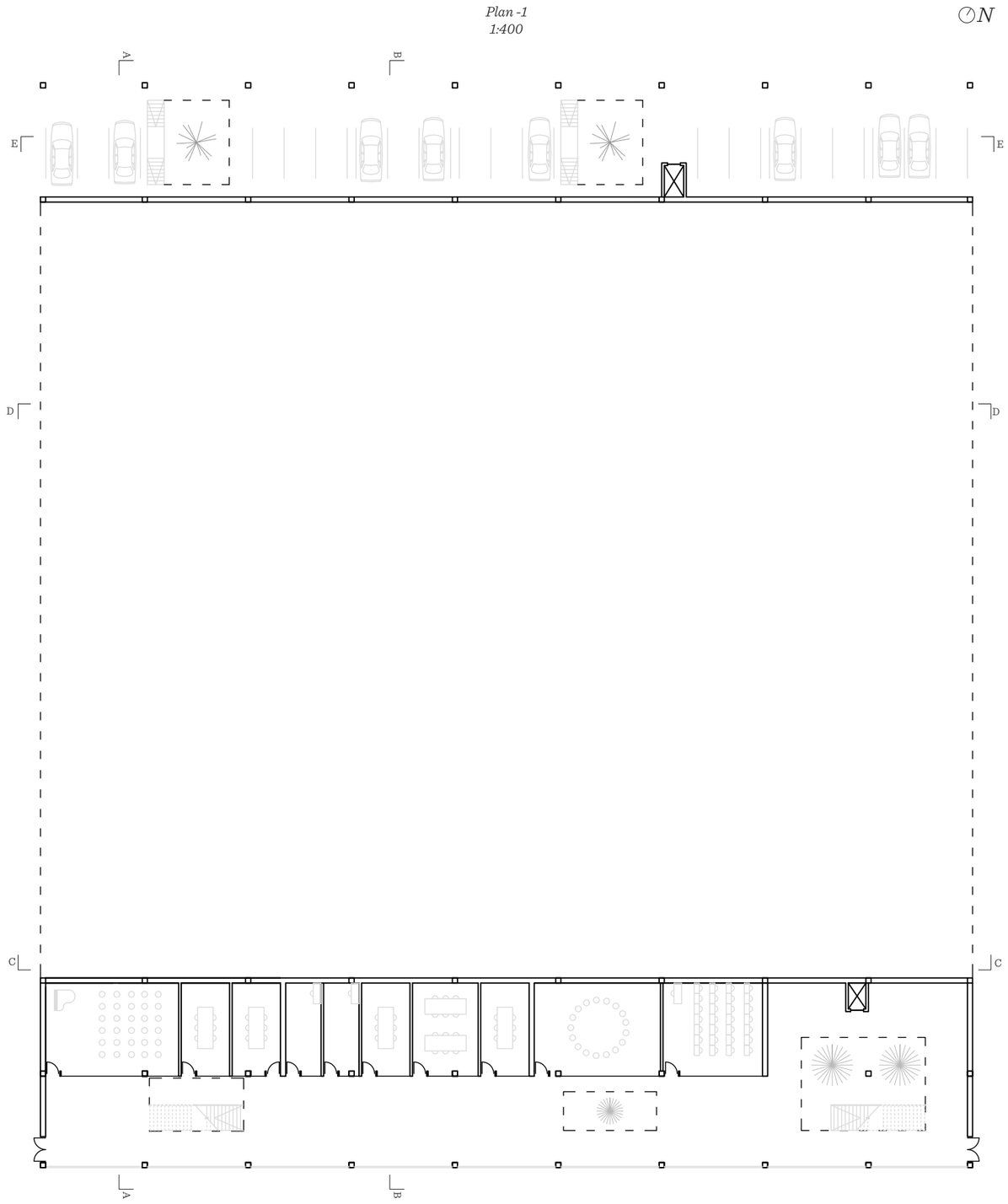
19

PLAN 2

The second floor of the existing building consists only of classrooms. The literature rooms are found above the library. The humanity subjects of history, geography and business studies are found above the chapel. Four language rooms are located above the art classrooms. All of these are accessible via the staircase and elevators.

All classrooms have group rooms located close to them. Given that education now consists of more group work than in previous years, this was something that was important to acknowledge in this modern school environment. Teacher's offices are also placed close to the classrooms which aims to better the teacher and student relationship. If a student needs to contact a teacher, it could seem embarrassing or uncomfortable to have to walk to the administrations office when everyone can see you doing so.

Plan -1
1:400



20

PLAN -1

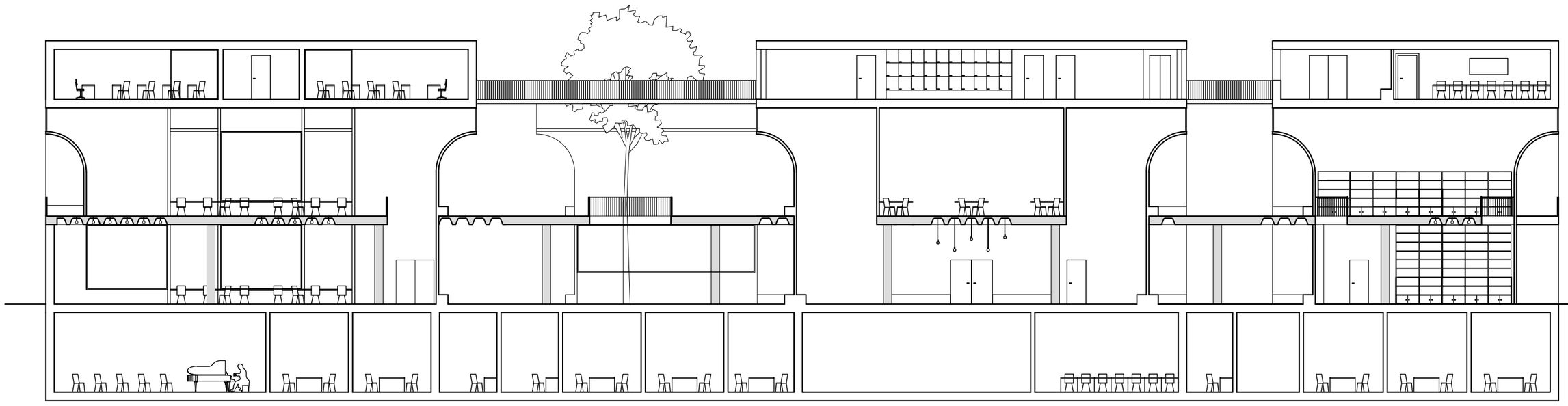
The basement of the building provides the school with music and drama rooms. This level is also an access point for those who struggle with the steep level of the street. Here one can take an elevator to the ground floor.

This level is rather dark and therefore the classrooms have a glasswall facing to the corridor which should supply the rooms with adequate lighting. The southern facade of this building has a railing which means that the entire circulation space is open and allows the cool breeze to enter the basement.

This plan also shows the car park and how one can either take the staircase up to the ground floor or the elevator.

Section A
1:200

Section B
1:200



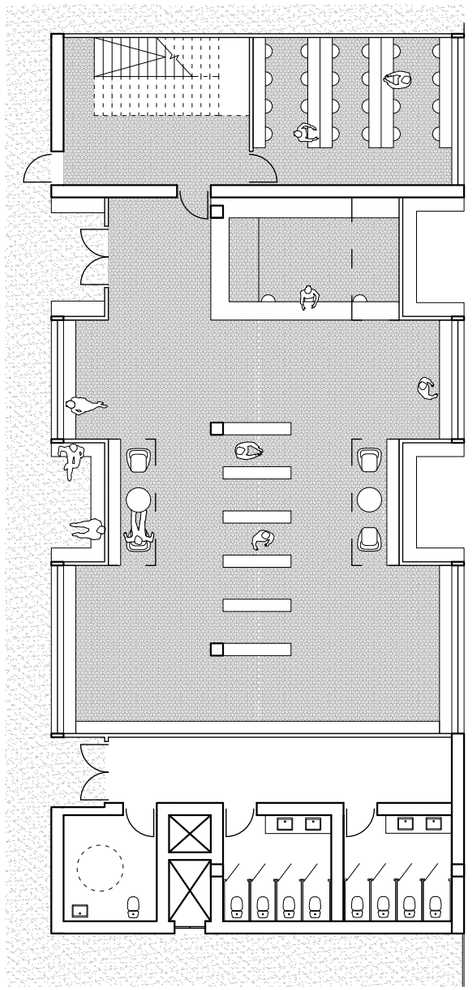
Section C
1:200

Section D
1:400

Section E
1:400

Western Facade
1:400

Southern facade
1:400



Library
1:200

21

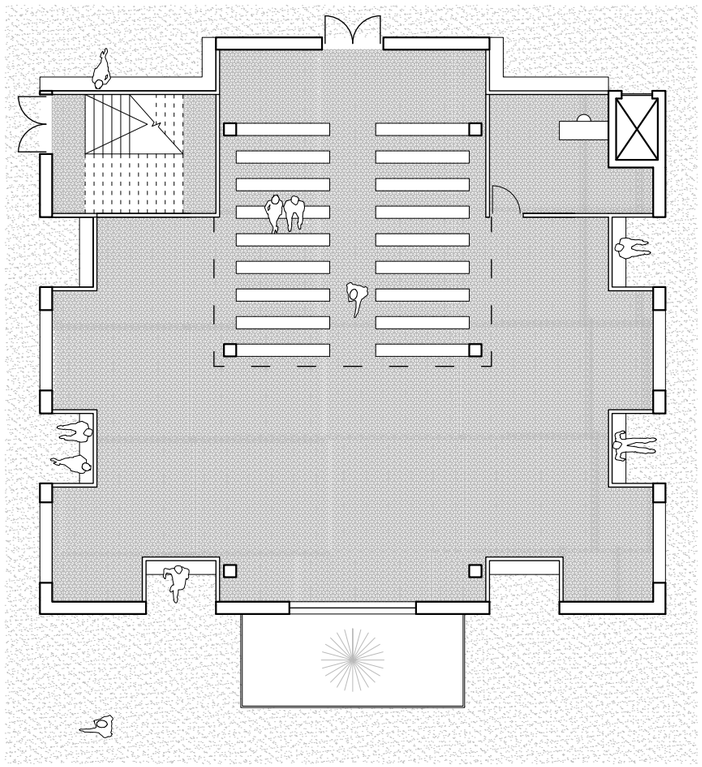
LIBRARY

The library is situated on the eastern side of the building looking over the greenery on the side of the plot. By using the niches found through out the project one can sit both on the inside and outside of the niche. These pockets make good reading spaces where one can sit alone or in groups. As can be seen in the plan, where the armchairs are placed, the waffleslab ceiling has been cut to allow light from the curved niche walls to fall down onto the book that you are reading. The ground floor of the library offers seating areas for casual reading and browsing whereas the first floor offers a more quite space with tables and chairs for studying.

The existing pillars of the concrete skeleton are used here next to the bookcases.

The IT room is also found of the ground and first floor attached to the north end of the library. These rooms will be available for classes and when the rooms are not booked, the public will be able to use them.

The toilets and elevator are found south of the library and on every floor..



Chapel
1:200

22

CHAPEL

The chapel has a central placement in the plan where one must pass one of three courtyards in order to arrive at the entrance. Again the niches allow seating on both the inside and outside of the room so that one can sit and overlook the courtyard or inside of the chapel.

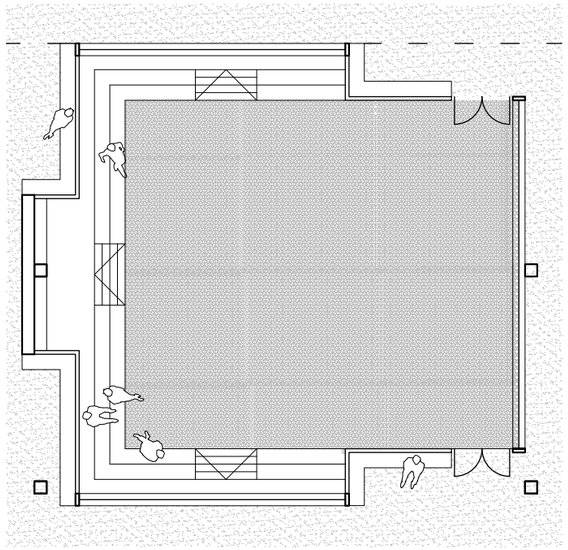
The existing concrete pillars play an imporant role of carrying the religious studies classroom on the first floor. Under this classroom one can sit and look out through a window to see the crown of a cherry blossom in bloom. The waffle slab is exposed under the classroom and here lighting can be placed if needed.

The rest of the chapel space has a high ceiling that allows light to enter via the curves of the niched walls and drop all the way down to the ground floor.

In this volume one also finds a staircase, elevator and office. Given the height of the room one sees the difference in the laying of bricks which will later be explained.

Perspective illustration of library

Perspective illustration of chapel



Assembly hall
1:200

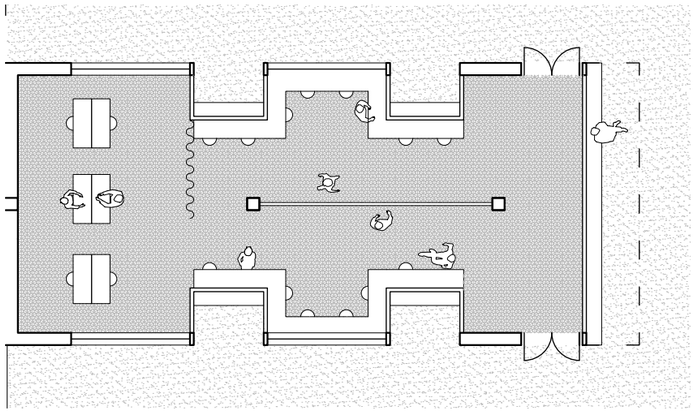
23

ASSEMBLY ROOM

The assembly room is a large space that can be used for registration, speeches, concerts and other events. Because of the large span of the room steal H-profile beams are placed as a cross in the ceiling.

The need to have a room of this large size in the school means that a column has been removed between the two that are visible in this plan.

There is intentionally no podium in this assembly hall to ensure accessibility by everyone. As one sits on the brick steps one can look out towards the trees of the courtyard.



Art room
1:200

24

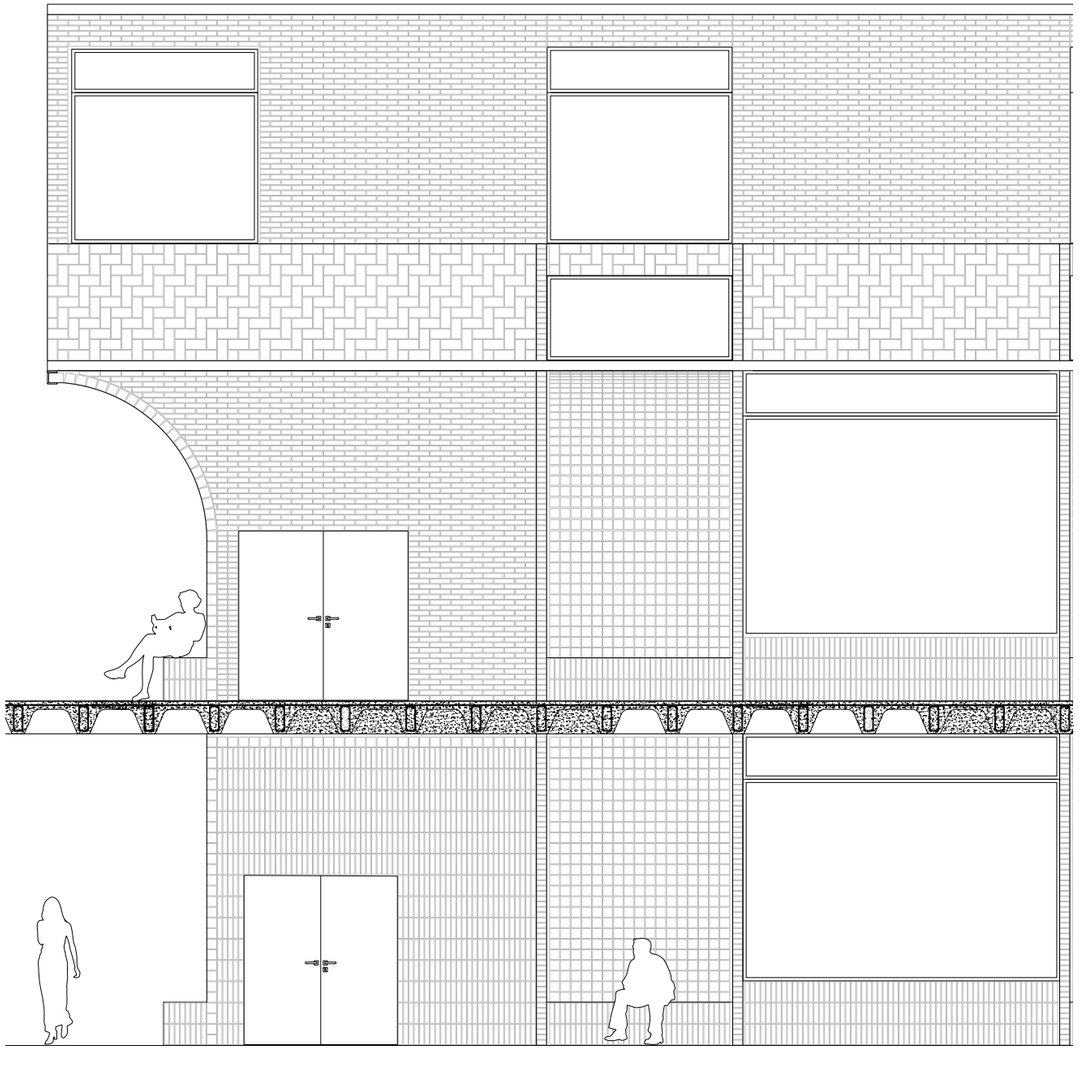
ART ROOMS

This plan shows one of the art rooms that accomodate 16 students. Therefore two art rooms are found on the ground floor and another two on the first floor which equates to one full class of students per floor. The reason why they have been seperated into two volumes is that firstly the subject requires more space than standard classrooms. Secondly between the classrooms on the ground floor is an entrance space where art can be exhibited and visitors can view the work that the students have produced.

In this case, the niches of the walls provide the desk pace for the students on the inside. The existing pillars can be used to hang large canvases or display work. On the west side of the room, group tables are found that can be arranged to suit the needs of the activity.

Perspective illustration of assembly hall

Perspective illustration of art room



25

DETAILS

The detailing of this project has been very important to establish the connections between the old and the new.

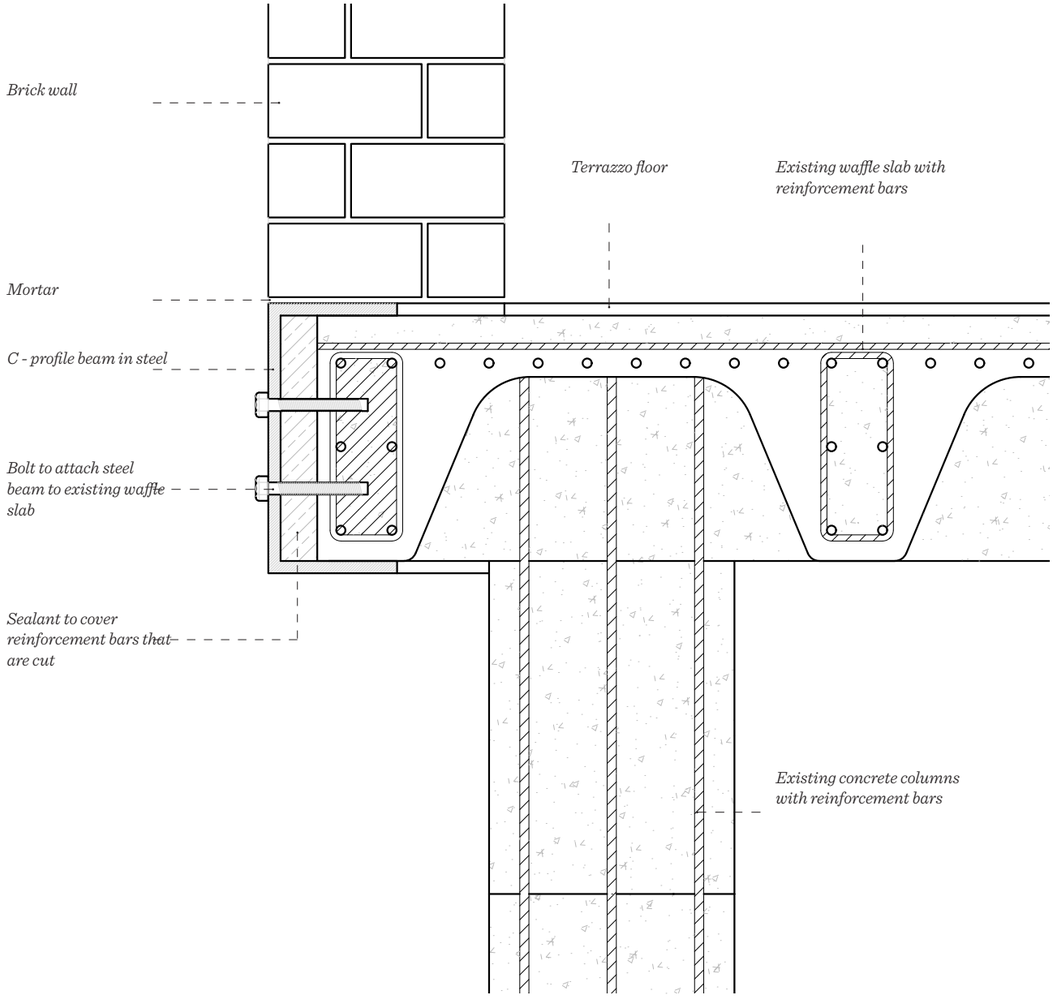
The waffle slab has been cut along the beams of the grid. Because reinforcement bars are cut these need to therefore be coated with a type of sealant that prevents oxygen and water from creeping in and causing corrosion. Thereafter a steel beam is placed around the perimeter of the opening to prevent deformation from loading. This beam is bolted into the waffle slab.

As previously mentioned one very interesting fact about the waffle slab was that it offered double the necessary structural strength to support the program of a school. Therefore the walls of the niches are only one brick thick and the detailing of this can be shown on page 248.

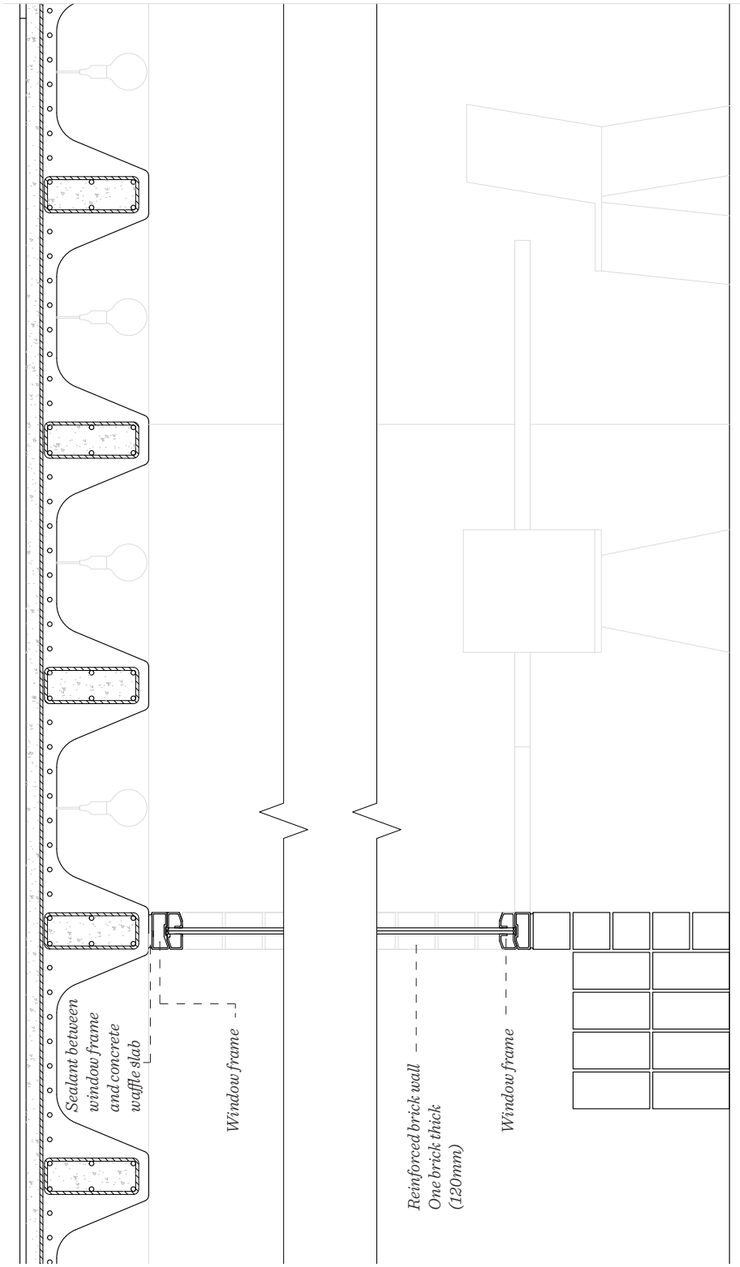
The niches that characterise the plans of the project are partially curved on the first floor. The detailing of this curvature is inspired largely by Eladio Dieste's brick roofs. The method that has been taken on board consists of placing reinforcement steel bars between the bricks in both the latitudinal and longitudinal direction. When in place, concrete is then cast over the bricks and reinforcement bars to lock the shape in place. The top of the brick arch meets a C-profile steel beam that runs along the sides of the entire volume and distributed the forced to thicker walls that can take larger loads. The bricks would be too fragile to be bolted, so a concrete piece is cast attached to the last brick and the steel beam is then bolted into this concrete.

Going back to chapter 13 it is important to identify the type of arch that is being applied. A true arch is in pure compression. The arch used for the niches here is therefore a false arch. The loads which the arch wants to transfer are not being transferred by the arch itself. Instead these loads are being transferred to the beams. The principle of using an arch in this way can be discussed because it is not being used constructively.

The laying of bricks also identifies where loading is taking place in the building. The ground floor has bricks placed vertically because they are only taking the load of themselves. On the first and second floor however the bricks are overlapping and are therefore structurally stable.

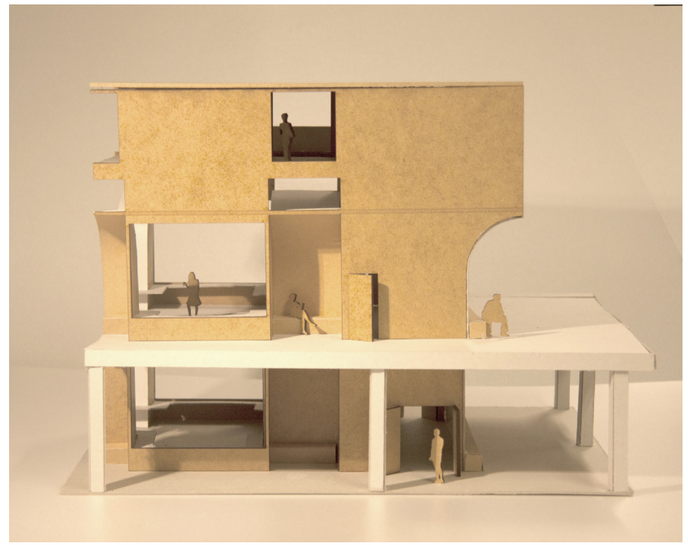


- Detail of cut waffle slab -
1:10

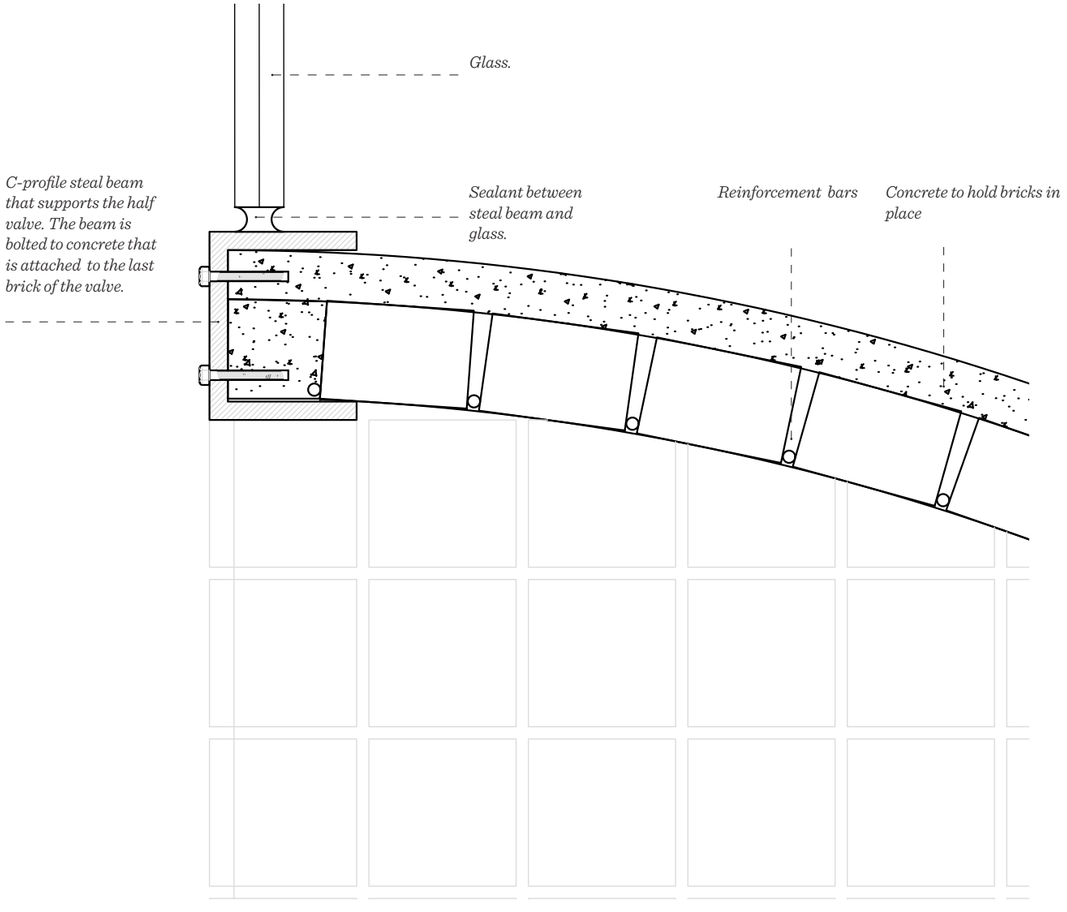


- Detail of one brick thick niched walls on ground floor -
1:20

Perspective illustration of window into art rooms

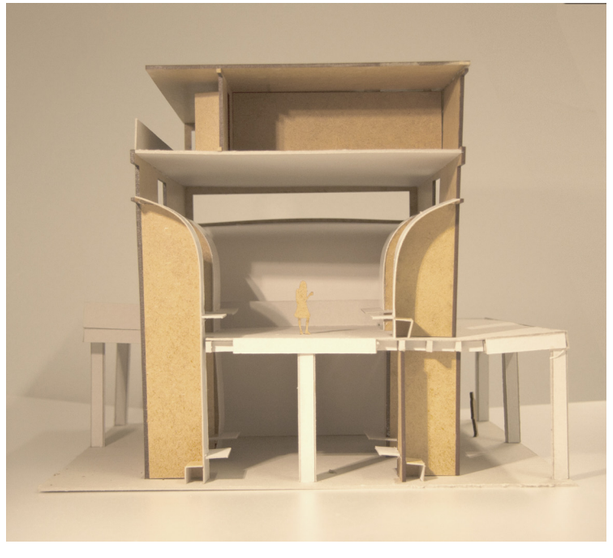


Photograph of 1:50 model of art room volume



- Detail of curved walls - 1:5

Figure 40: Photograph of Builders composing a curved roof of an Eladio Dieste project

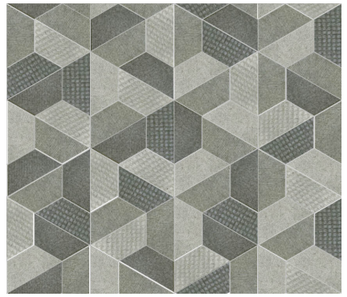


Photograph of 1:50 model of art room

Existing concrete columns and waffle slab

Albero sand in the circulation areas of the ground floor

Terazzo in the circulation areas of the first and second floors



Ceramic tiles in rooms

Earth bricks

Steel as additional supported structure

Special Thanks

Thank you so much for your support
and words of guidance along the way.

Marwa Dabaeih
Jesús Mateo
Annika Mårtensson
Børre Skodvin

Text References

1. Bardhan, Ashok., Edelstein, Robert., Kroll, Cynthia.
"Global Housing Markets: Crises, Policies, and Institutions"
Wiley Publications
(2011-10-27)

2. Karaian, Jason.
"The Pain in Spain"
Quartz
(2013-09-13)
https://qz.com/124088/spanish-real-estate-has-lost-more-than-a-third-of-its-value-but-its-still-overvalued/

3. Neate, Rupert
"Scandal of Europe's 11m empty homes"
The Guardian
(2014-02-23)
https://www.theguardian.com/society/2014/feb/23/europe-11m-empty-properties-enough-house-homeless-continent-twice

4. Unknown Author
"España tiene 389.000 viviendas nuevas vacías"
El País
(2015-11-25)
http://economia.elpais.com/economia/2015/11/25/actualidad/1448444765_560297.html

5.Elke Beyer, Anke Hagemann och Michael Zinganel
"Holidays after the fall"
Jovis
(2013)

6. Antiforum
"Photo Essay: Albania's Concrete Skeletons"
Failed Architecture
(2016-06-21)
https://www.failedarchitecture.com/photo-essay-albanias-concrete-skeletons/

7. Duck, Jo
"All the empty buildings you pass on your way to see the fancy bits of Greece."
(2016-11-17)
https://www.vice.com/en_au/article/all-the-empty-buildings-you-pass-on-the-way-to-see-the-fancy-bits-of-greece-vice-weekends

8. Labourdette, Amelie
"Empires of Dust"
(2015)
http://www.amelie-labourdette.com/empire-of-dust/

9. Unknown Author
2030 Energy Strategy. European Commission
(23/01/2017)
https://ec.europa.eu/energy/en/topics/energy-strategy/2030-energy-strategy

10. Unknown Author
European Environment Agency GHG trends and projections in Spain
(2012-10-24)
http://www.eea.europa.eu/publications/ghg-trends-and-projections-2012

11. Rubenstein, Madeleine
"Emissions from the Cement Industry"
Earth Institute at Columbia University.
(2012-05-09)

12. Mårtensson, Annika and Isaksson, Tord
Byggkonstruktion : regel- och formelsamling
(2017)

13. Reinhart, Anne and Dozy, Pieter
"Recherches Sur L'Histoire Et la Littérature de L'Espagne Pendant Le Moyen Age."
(2009)

14. González Jiménez, Mauel
"Sobre los orígenes históricos de Andalucía"
(2012)

15. Armstrong, Ian
"Spain and Portugal."
(2013)

16. Gaynes, Roy
"Arches, Vaults, and Shells"
(2007-11-27)
http://slideplayer.com/slide/3986670/

Image References

1. Evolution of the price of square meter in Spain, in euros
https://en.wikipedia.org/wiki/Spanish_property_bubble#/media/File:Vivienda_n_jun2009.png

2. Torremolinos 1950
http://memories-of-torremolinos.blogspot.se/p/a-brief-history-of-torremolinos.html

3. Marbella 1960
http://www.playle.com/listing.php?i=SCVIEW458473

4. Torremolinos 1975
http://memories-of-torremolinos.blogspot.se/p/a-brief-history-of-torremolinos.html

5. El Bajondillo. 1961
http://www.guateque.net/0torremolinos60.htm

6. "Empire of dust" - Palermo, Sicily
Amélie Labourdette
http://www.amelie-labourdette.com/

7. "Empire of dust" - Blufi, Sicily
Amélie Labourdette
http://www.amelie-labourdette.com/

8. Hotel Haludovo in Malinska. Croatia, 1972
Elke Beyer, Anke Hagemann och Michael Zinganel
"Holidays after the fall"
Jovis
(2013)

9. Hotel Haludovo in Malinska. Croatia, 2012
Elke Beyer, Anke Hagemann och Michael Zinganel
"Holidays after the fall"
Jovis
(2013)

10. & 11. Concrete skeletons in Albania
"Photo Essay: Albania's Concrete Skeletons"
Failed Architecture
(2016-06-21)
https://www.failedarchitecture.com/photo-essay-albanias-concrete-skeletons/

12. Photograph from a demonstration in Seville against evictions
Martínez, Juan Carlos
El País
(2013)
http://economia.elpais.com/economia/2013/04/18/actualidad/1366281899_838814.html

13. Image from an EU recycling campaign
http://toddpak.co.uk/2016/11/eu-2030-recycling-targets/

14. Andrew Trotter, Masseria Moroseta
http://divisare.com/projects/323132-andrew-trotter-salva-lopez-masseria-moroseta?utm_content=buffer9fc75&utm_medium=social&utm_source=pinterest.com&utm_campaign=-buffer

15. John Pawson, Moritzkirche
http://www.johnpawson.com/works/moritzkirche/

16. Pezo von Ellrichshausen, Meri House
http://www.archdaily.com/555513/meri-house-pezo-von-ellrichshausen/543721bf-c07a80a74a000051-meri-house-pezo-von-ellrichshausen-image

17. Mario Botta, Wohnsiedlung in Novazzano
http://www.daco-verlag.de/de/fotoeditionen/mario-botta/wohnsiedlung-br-in-novazzano.html

18. San Cristobal Fortress, Puerto Rico
http://readcereal.com/

19. Barbosa & Guimarães, Fonte Da Luz
http://www.archdaily.com/120813/fonte-da-luz-barbosa-guimaraes

20. Louis Kahn, Bangladesh National Capital
http://www.domusweb.it/en/shop/digital_archive.html

21. Toyo Ito, Tama Art University Library
http://archeyes.com/toyo-ito-tama-art-university-library/

22. Oscar Niemayer, Palacio de Alvorada
http://www.moderndesign.org/2011/03/palacio-da-alvorada-by-oscar-niemeyer.html

23. Raphael Moneo, National Mueseum of Roman Art, La Merida
http://www.archdaily.com/office/rafael-moneo

24. mA-Style Architects, Koya No Sumika
https://www.dezeen.com/2013/09/23/koya-no-sumika-house-extension-by-ma-style-architects/

25. Mosque of Córdoba
https://commons.wikimedia.org/wiki/File:Mosque_of_Cordoba.jpg

26. Alhambra gardens
https://www.eyeonspain.com/blogs/bestofspain/16801/the-alhambra-in-360o.aspx

27. Alhambra gardens
http://elsaest.blogg.se/2016/may/alhambra.html

28-37. Gaynes, Roy
"Arches, Vaults, and Shells"
(2007-11-27)
http://slideplayer.com/slide/3986670/

38-39. Spanish ceramic tiles
http://spainatm.com/art-spanish-ceramic-tiles/

40. Eladio dieste
http://www.materialsfordesign.com/2015/02/06/eladio-dieste/