

# SPACE

*the future is all about communication*

*Mario Daudo*

*Stefano Grisoglio*

A blurred background image showing a person's hands working on a colorful architectural model or drawing, possibly made of clay or plasticine, featuring various geometric shapes and colors like red, blue, and green.

**TODAY MANY ARCHITECTURE STUDIOS DECIDED**

A blurry background image of a person wearing a virtual reality headset and holding a controller, suggesting a gaming or immersive experience.

**TO INVEST IN VIRTUAL REALITY BECAUSE OF**

A blurry background image showing a man in a grey t-shirt standing in front of a large group of people. The scene appears to be an indoor event or conference.

**THE GREAT IMPACT IT HAS TO CLIENTS AND**



**PROFESSIONISTS THEMSELVES. THE GOAL OF OUR**



**WORK IS TO UNDERSTAND WHY!**





# SPACE

*the future is all about communication*

An Architecture master thesis



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**In collaboration with:** SYSTEMA srl



To every single person I met during this path

To Battista Grisoglio & Ferruccio Perissinotto



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To my friends, to every single one of them, because I felt their motivation and I keep feeling it to achieve everyday's goals.

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### **Stefano**

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## About us

### **Mario Daudo**

Born in Torino, Italy, 21st August 1993.



I see Architecture as the opportunity to make the world a better place to live in.

That's why it requires a deep analysis of the surrounding conditions, such as the site morphology and the people living there, with all their traditions and needs.

Architecture should aim to solve all those aspects, letting the building enrich the area, enhancing the lives of the ones who both live or just pass by it.

## **Stefano Grisoglio**



Born in Ivrea, Italy, I have always been interested in buildings since I was a child. During the University years, I have started to develop interest in recent State of the Art technologies and how new tools can fit in a possible new way of doing architecture.

I believe that architecture is all about challenges; technologies, materials and up-to-date tools, can really help architects to create very complex new spaces by understanding that the limits can be used to do something better able to look forward to the future.

## A new method?

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About the word SPACE  
Conversion system in human mind  
Talking about virtual and augmented reality

# INTRODUCTION

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## About the word "SPACE"

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*We shape our buildings, and afterwards our buildings shape us.*

W.Churchill

**S**PACE.  
An ordinary and predictable title for a master thesis of architecture.

Space as the pure essence of architecture, or as Bruno Zevi would say, "protagonist of architecture", makes this topic quite obvious at first sight, as it makes this practice different from all other artistic practices (if it is), but in reality is not at all. The reassuring certainty that space is something that can be manipulated by architects makes this term a fundamental category of

architecture and architecture only, but this disappears when we realize that it has not always been this way.

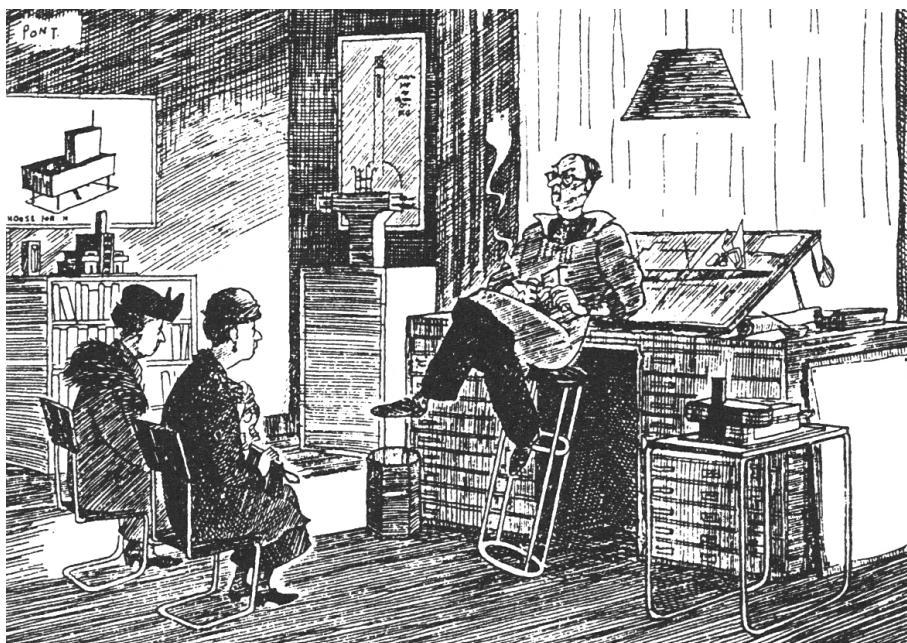
*"What really interests me is to design the architectural space"*  
Neil Denari, 1993

Any meaning to the term before 1892 would have been meaningless since before this date the term did not exist in the architectural vocabulary. The use of the word is closely connected with the evolution of modernism, so much so that it can speak, as Adrian Forty emphasizes, as a "triad of the

"modern movement" where space, together with form and design, finds its place.

Modern architecture, in fact, in addition to representing a new approach to architectural matter also from a constructive point of view, has also represented a completely new way of talking about architecture by introducing the use of metaphors and specific terms in a specific vocabulary where

words exist in relation to the others. Speaking of space at the time of the Pantheon of Agrippa, for instance, would have made no sense because no one would have understood the Pantheon in spatial terms. Talking about the 'Pantheon's spatiality' would have had no meaning for all those who had put hand to the construction of the building. In fact, we did not work with the space but with modules and the 'empty space'



*"Did I really understand you, Miss Wilson, to use the expression,  
'A cosy nook' in connection with the house you wish me to  
design for you?"*

Pont, *The British at Home, 1939*.  
Modern architecture, apart from introducing a completely new style, defined a new way of speaking about architecture itself.

did not exist, because the whole void was occupied by a modular grid where everything found its commensurate, to quote Vitruvius, or like Greek used to say: its symmetry. This linguistic lack is very complicated, it will not be the purpose of this thesis to shed light on this topic because other people already dealt with, but it is important to make some clarifications because the way of talking about architecture and above all communicating it to whoever is or is not of the profession, is at the center of this scripts.

The architectural space originates from the 19th century German debate and it was the German architect and theorist Gottfried Semper who defined before anyone else<sup>1</sup> the term space as the main theme of modern architecture. Semper argues that the first impulse of architecture is that of circumscribing space, a theory probably derived from Hegel<sup>2</sup> for which circumscribe is a function of architecture. This theory was the source of conception of space for many German architects including, to make an instance known to all, Adolf Loos, who in his article The

*Principle of Cladding*, 1898 states, in the footsteps of Semper, that "the architect's general task is to provide a habitable and welcoming space" and that "the effects are produced both by the materials and the shape of the space "<sup>3</sup>.

Remember, for instance, the observation of Adolf Hildebrand, destined to change the whole conception of the form in architecture (another modernist term), that in architecture the form is the space and must be first identified through spatial experience.

This conception of the term is perhaps the closest to what we have today, according to which the meaning of architecture does not lie in the matter of the solid elements that compose it, but in the space that these elements define it.

It is therefore essential to spend a few words on the elements that an architect has at his disposal to define a physical space, that is to define that volume of air delimited by walls, roof and floor, in short, a simple room.

These elements belong to two categories; the category of opaque elements (walls, whether perimeter

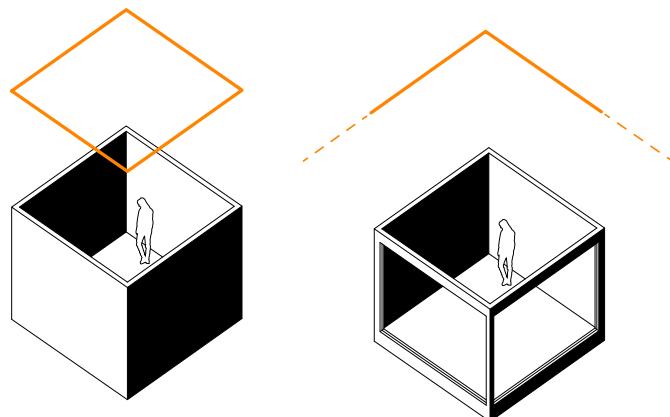
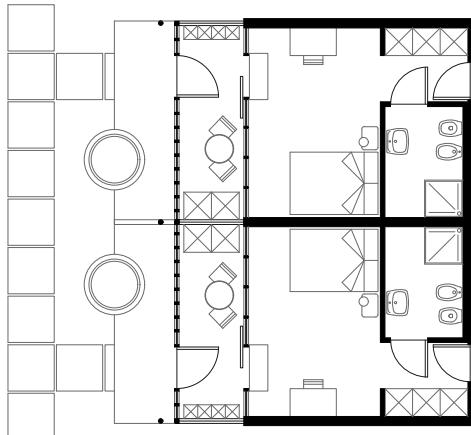
or partition) and that of transparent elements (identified in glazed elements or a void).

All this may seem trivial, but a wall on a plant is an indelible sign that has the function of clearly separating two environments; take for instance the layout of a hotel, two people sleep in rooms with beds resting on the border wall that are actually ten

centimeters apart from each other, but despite this they perceive their room as intimate and private.

If an opaque element has a closing effect, a transparent element produces the exact opposite effect and, in the case of a glazed wall, the perceived space extends beyond the physical limits of the building, stretching to infinity.

In addition to the opaque-



transparent combination also the furniture and the materials with the relative chromatic scale influence the spatial experience; for instance, by inserting fixed furniture elements, the circulation inside the room is influenced, a room with black walls

produces a different psychological effect compared to the same room with white walls and so on<sup>4</sup>.

Today with the advent of technology and the introduction of new materials and technologies, it is possible to talk about the concept of flexibility

according to which in architecture it is possible not to define the exact function of the spaces, making sure that an element can perform more than one function; think about the Neoplasticism icon Schroder house made by Gerrit Rietveld in Utrecht, built in 1924, where mobile walls are used to define the spaces on the upper floor that are constantly changing.

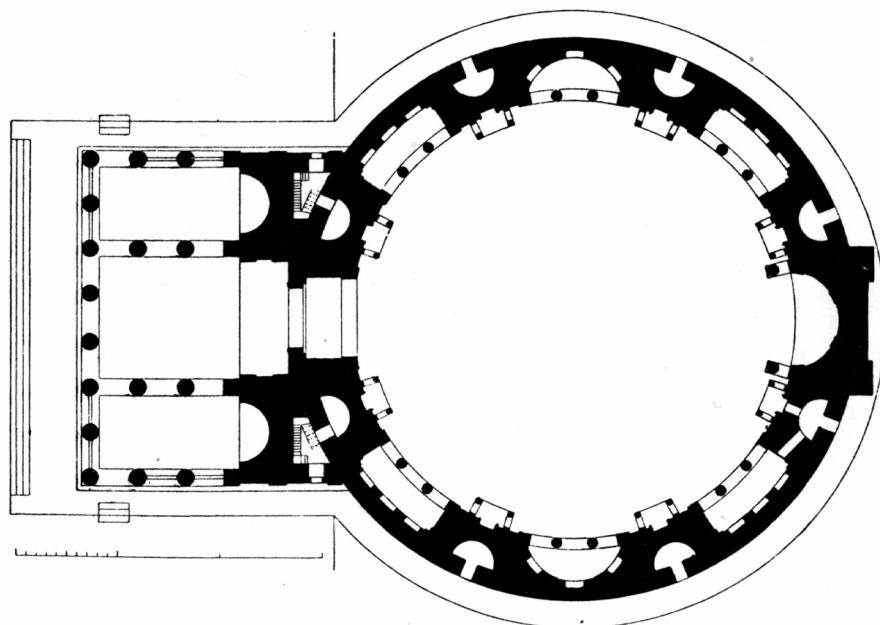
We realize how the architect has in his hands a power that can be controlled by the behavioral habits of the user and this influence becomes even stronger if this faculty extends

from the individual buildings to a larger and therefore urban scale.

The considerations regarding the space intended as delimitation mentioned above, are applied by the Viennese architect, also of German language and disciple of Semper, Camillo Sitte<sup>5</sup>, who considers the urban design "art of space" and where other architects considered the delimiting the space thinking of the interior, Sitte adapted this theme to the outer space. In this way, the opposition of positive and negative spaces can be introduced, where

*Right, a plan view of the Pantheon, situated in Rome and built between the 113 and the 124 AC.*

*On the opposite page, a picture representing the internal richness of the space, which can't be from the drawing.*





positive space means buildings and with negative space the air left free between buildings in order to create squares, parks and streets.

The question then arises spontaneously: since space is something extremely complex that holds more elements linked, be they psychological, physical, material and so on, how is it possible to communicate this experience? Plants, elevations, sections, axonometries, three-dimensional models are able to communicate correctly the pure spatial essence without losing that infinite number of information that are created during the construction process? Are these the only tools that an architect/engineer has or exists of the other that can completely upset the current way of communicating architecture, focusing precisely on the spatial dimension?

This is what we will try to understand in these pages where space experience is at the center of our interest. ■

e edifici, un vocabolario per l'architettura moderna, Monica Turci e Marco Zecchi, Edizioni Pendragon, 2004, pag. 268).

**2.** Nato da modesta famiglia, Georg Wilhelm Friedrich Hegel (Stoccarda, 27 agosto 1770 – Berlino, 14 novembre 1831), fu un filosofo tedesco e rappresentante più significativo dell'idealismo tedesco. L'intento speculativo di Hegel è quello di connettere universale e particolare nella convinzione che la verità non possa che essere nella loro unità: "Il vero è l'intero", scriverà nell'ultima opera pubblicata a Jena.

**3.** ADOLF LOOS, *The Principle of Cladding*, 1989. Tratto da Spoken into the void: collected essays, 1897-1900, published for the Graham Foundation for Advanced Studies in the Fine Arts, Chicago, Ill., and the Institute for Architecture and Urban Studies, New York, N.Y., by MIT Press. Introduction by Aldo Rossi, translation by Jane O. Newman and John H. Smith, pag 66-69.

**4.** From ANNA MAROTTA's article, Therapeutic Architecture: color, decoration, movement in humanization in hospitals, in: TELEMEDITALIA, vol. IX n. 7, 2013.

**5.** CAMILLO SITTE (Vienna, 17 April 1843 - Vienna, 16 November 1903), Austrian architect, urban planner and painter, was one of the most important figures in the international debate on the enlargement and urban planning of cities between the 1800s and '900.

#### Notes

1. ADRAN FORTY, *Words and Buildings. A vocabulary of Modern Architecture*, Thames & Hudson Ltd, Londra (UK) 2000 (trad. It. Parole



## Conversion system in human mind

*Il compito del progetto architettonico è di rivelare, attraverso la trasformazione della forma, l'essenza del contesto circostante.*

V. Gregotti, 1966

In the first chapter of his book *The ignorance of architecture*, Bruno Zevi<sup>1</sup> recounts the lack of interest in the public towards architecture by claiming that "the public is interested in painting and music, sculpture and literature, but not in architecture. That intellectual who would be ashamed not to know a painter of the level of Sebastiano del Piombo and would turn pale if he was accused of ignoring a painting by Matisse or a poem by Eluard, feels perfectly at ease in confessing that he is not Buontalenti or Neutra"<sup>2</sup>. This could be explained by two considerations:

1. The current methods of communication do not do justice to the true essence of the architectural space that, to be told, must exist so that the user can experience it.
2. The architecture, unlike other artistic activities, is the only one strongly linked to a context and it is obviously impossible to transport a building made in a specific place for an exhibition as you do for a painting, or even, you can perform the works of Bach in every part of the world but to experience the architecture of Michelangelo, it is necessary to go on site. It is

necessary to have an innate interest and a strong passion for the topic so as to push the traveler to face hours of travel to observe closely the work that interests him.

Such interest is not always present also because of a often present strong spatial in-education as previously mentioned, this pushes to make reflections about the fact that perhaps modern methods of representation of space are not adequate or perhaps not totally sufficient to allow an adequate story of the architectural structure, whether it is a project, a building site, or already built.

Taking up with the greatest respect the Platonic idea for which the idea is always superior to its representation<sup>3</sup>, we can affirm that perhaps the only methodology that best represents the idea in itself, abstract and free of any contamination, is the sketch. However, when we try to bring the representation of the idea from the sketch to the actual realization, we produce drawings in a disproportionate quantity and less abstract, so that on the one hand the technical constructibility is shown

on the other , convey an emotion. This basic concept inevitably leads to another, which is the dilemma between language and design quoted by Adrian Forty in his book<sup>4</sup>. Let's think, for instance, of having to explain a story; to transmit the final concept to the interlocutor, it is obliged to continuously follow the entire speech from beginning to end. This is perhaps not what happens in architecture when visiting a building made? Going through the plan of an apartment means in fact, following, room by room, the succession of spaces and only after completing the tour, the user can be satisfied with the spatial experience.

The common methods of representation are not able to effectively represent this complexity because the design offers an immediate image so if to understand a speech you have to listen or read everything, the drawing is shown in its entirety erasing, or minimizing, any emotional factor produced by the influence of the temporal dimension in the experience of architectural space. This does not mean that a plant is not necessary

in order to understand a project because it is exactly the opposite; an axonometric cross-section, for instance, is perfect for studying the distributional aspect of a building or how people can circulate within that space but is nevertheless able to transmit any information that deviates from the purely technical sphere.

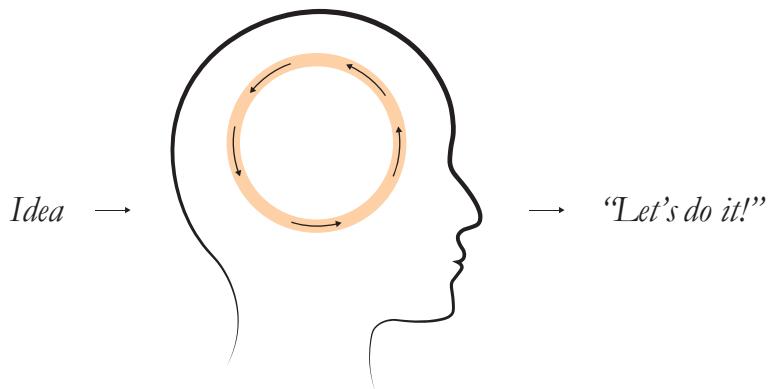
As Le Corbusier said: "I would like to express all my devotion for the perspective design [...]. Architecture is in space, in extension, in depth, in height: it is volumes and circulation. Architecture becomes inside one's head. The sheet of paper is useful only for fixing the drawing, to transmit it to the client and to his manager "<sup>5</sup>.

This thought can be traced back to the Neoplatonic tradition mentioned above to lead us to consider the design with a double face; on the one hand he was confide with the responsibility of transferring the idea from the designer's mind to the building he built, on the other hand he was considered inferior to the idea itself with the risk of degrading it. Take for instance the project of Villa Savoye<sup>6</sup> signed by Le

Corbusier and developed in 1928-1929. The villa is a white volume that interposes itself between the earth and the sky and where this passage is mediated by a series of intervals, suspensions that make such transposition almost an ethereal experience. The promenade in Villa Savoye thus relates the land, on which it is slightly anchored by slender pilotis, with the terrace roof which in turn merges with the sky. All this drawing is not able to tell it; this concept exists in the mind of the architect and only once the building has been constructed can one evaluate the correct execution of the same or not. In Villa Savoye Le Corbusier forces the inhabitant to follow his directions (remember the famous phrase "architecture is circulation"); entering the villa and going along that promenade that the architect has shown us is the only way to live in the house. Continuously owning Villa Savoye means therefore to circulate according to an itinerary that the architect elaborates. Consequently, wherever there is a real spatial experience to live as in this case, no representation is sufficient; we

must be included in space and feel part of the architectural organism to fully understand its functioning and possible faults. "Everything else is useful, didactically, practically necessary, fruitful intellectually; but it is mere allusion and preparatory function of that hour in which we [...] live the spaces with an integral and organic adhesion. What is the time of architecture "<sup>7</sup>.

If we now analyze that are the common methods of architectural representation available today and how they are used in common practice, we can see how the profession of architect today seems to be deeply rooted around the design, a 'universal' tool, that uses symbolologies and known codes. The famous phrase by Bernard Tschumi (1980-1981) for which "architecture



does not exist without drawing"<sup>8</sup>, is today solid and truthful so much that no architect or designer would ever dream of not considering it as a single and fundamental work tool.

It is enough to quote an observation by the famous Italian architect Carlo Scarpa (1906-1978) who elevated the design tool to a very

high level of importance by claiming that his "architecture is made with the architect's instrument which is drawing and drawing only "<sup>9</sup>. It seems almost ironic to say that in reality it has not always been this way because in the historical periods prior to the Renaissance in fact the drawings had a minor role. The turning point is precisely this

period of history where the design acquires importance so as to become the unique instrument of architecture.

Taking up Scarpa's quote, Adrian Forty creates a scheme with the aim of summarizing the whole architectural practice.

*Idea* —> *Drawing* —> *Building* —> *Experience* —> *Language*

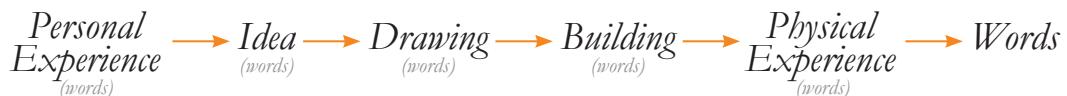
"The practice summarized in this scheme begins with the client who tells the architect what he wants; the architect transforms these desires into an idea of work, which is transposed into a drawing; the drawing is finally translated into a building where people live or where they meet. In turn, they articulate their experience by talking or writing about the building itself (or by drawing or photographing it) "<sup>10</sup>.

However, this scheme presents an error; language is not only at the end of the process but is also present in all the other phases. From the moment in which the customer contacts the architect to provide him with the commission and before arriving at the realization, a sequence of words will be made that is greater than the number of drawings. Here the scheme begins to take on a different form.

*Idea* —> *Drawing* —> *Building* —> *Experience* —> *Words*  
(words) (words) (words) (words)

This scheme, which appears to be coherent and correct, does not however consider an initial act that is how the idea comes to the architect. In fact, the customer does not commission an idea but rather a building he needs. The answer to the question of how the idea comes to the designer is connected to another word of the "Experience" scheme. In fact, the word experience is a word that is extremely important in architecture and it is possible to find a double application: personal experience and physical experience. Personal experience is the one that in a certain way precedes the phase of the idea because it is strictly related to the personal experiences of the designer; experiences that derive from travel, from the teachers that every

student chooses according to their ideals and from which he draws ideas and inspiration, from the readings, from the relationship with the place, with the people and so on. Physical experience, on the other hand, is linked to matter and to the real fruition of the space finally created. The scheme therefore presents itself in a different way.



The most delicate passage that most encompasses the soul of architecture is the passage that exists from the idea and its representation, because as previously mentioned, as you progress through the phases of the architectural process, the drawings become more and more detailed and suffer of a gradual process of abstraction. It would be ideal in some way to be able to bring the physical experience of the constructed space between the phase of the idea and the phase of its representation by making the diagram above the following.



The possibility, which until a few years ago was considered a utopia, to live and experience a space even before it was built could on the one hand control the transition from the original idea to its realization and on the other hand could reduce the possibility of making mistakes by making sure that the final space is compatible and similar to the idea originally conceived. So simplifying the initial scheme,



it remains to be seen how much is the gap between the final and initial stage of the process.

We arrive with this brief introduction to the main theme of these pages according to which as specified by Zevi "today is missing spatial communication". It is therefore necessary a completely different communication method that takes into account, as far as possible, what space requires. To date, virtual reality seems to fulfill this task as demonstrated by several renowned architectural firms (think for instance at the dutch studio Mecanoo).

This reality, albeit virtual, is perhaps able to fill that gap that separates the real language from the abstractness of a design that is completely silent by nature, except for those purely technical information. The difference between language and design is useful for understanding what the former succeeds in and what the second fails:

1. The drawing follows the codes defined while the ambiguity of the language is freed from the extreme precision of the first and allows expressing nuances and moods.

2. Language is a linear and orderly sequence of words while the drawing offers an immediate

image. Reading a drawing pushes people to project an imaginary body movement around the design of a plant or a section and this, if imagined, as previously said, leads to reading the building exactly as if listening to a step by step discourse follow the ranks.

3. Generally it is believed that the drawing is easier to understand than the language but the subject and the object are always separated from the surface of the paper and while the language acts directly on the mind, without requiring intellectual conversions, drawings no.

In shorts, plants, elevations, sections, axonometrics, perspective, are nothing more than representations of a reality that is too complex to be instantly told because each of these tools are outside the wall of material, physical and really really constructed building. ■

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#### Notes

1. Bruno Zevi (Roma, 22 gennaio 1918 – Roma, 9 gennaio 2000) è stato un architetto, urbanista e politico italiano, noto soprattutto come storico e critico d'architettura. Si laureò in architettura alla Harvard University con

W. Gropius e diresse i Quaderni italiani del movimento Giustizia e Libertà. Tornato in Italia (1943), partecipò alla Resistenza, poi fondò l'APAO (1945) e la rivista Metron-architettura (1945-54), esercitando anche dalla cattedra (dal 1961 prof. di storia dell'architettura nell'Istituto universitario di architettura di Venezia).

**2.** Tratto da BRUNO ZEVI, *Saper vedere l'architettura. Saggio sull'interpretazione spaziale dell'architettura*, (1948) Giulio Einaudi editore s.p.a, Torino, 2009, capitolo primo, L'ignoranza dell'architettura, pag. 13.

**3.** Tratto dal Libro X della Repubblica. *La Repubblica* è un'opera filosofica in forma di dialogo, scritta approssimativamente tra il 390 e il 360 a.C. dal filosofo greco Platone, la quale ha avuto enorme influenza nel pensiero occidentale.

**4.** *Words and Buildings. A vocabulary of Modern Architecture*, Thames & Hudson Ltd, Londra (UK) 2000 (trad. It. *Parole e edifici, un vocabolario per l'architettura moderna*, Monica Turci e Marco Zecchi, Edizioni Pendragon, 2004).

**5.** Tratto da ADRIAN FORTY, *Words and Buildings. A vocabulary of Modern Architecture*, Thames & Hudson Ltd, Londra (UK) 2000 (trad. It. *Parole e edifici, un vocabolario per l'architettura moderna*, Monica Turci e Marco Zecchi, Edizioni Pendragon, 2004, pag. 30).

**6.** Villa Savoye, manifesto più conosciuto del movimento moderno, è una residenza privata progettata da Le Corbusier (pseudonimo di Charles-Edouard Jeanneret), maestro dell'architettura razionalista, e da Pierre Jeanneret, costruita tra il 1928 e il 1931 su commissione di Pierre Savoye.

**7.** Tratto da BRUNO ZEVI, *Saper vedere l'architettura. Saggio sull'interpretazione spaziale dell'architettura*, (1948) Giulio Einaudi editore s.p.a, Torino, 2009, capitolo terzo, La rappresentazione dello spazio, pag. 48.

**8.** Tratto da Architettura e disgiunzione, Bernard Tschumi Edizioni Pendragon, 2005 pag. 83. Citazione completa: "l'architettura non esisterebbe senza disegni, allo stesso modo in cui non esisterebbe senza testi".

**9.** Citato da Adrian Forty in *Words and Buildings. A vocabulary of Modern Architecture*, Thames & Hudson Ltd, Londra (UK) 2000 (trad. It. *Parole e edifici, un vocabolario per l'architettura moderna*, Monica Turci e Marco Zecchi, Edizioni Pendragon, 2004, pag. 29).

## Talking about augmented and virtual reality

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*Come non esiste un'adeguata propaganda per diffondere la buona architettura, così non esistono strumenti efficaci per impedire la realizzazione di brutture edilizie.*

B. Zevi, 1948

The first decade of the 21st century has produced some of the most dynamic and spectacular works of all time, having pioneers architects from all over the world<sup>1</sup>.

The complexity of these works has prompted architects, engineers and builders to embark on a way in which the use of computers seems to have incorporated the soul of architecture today so that it may seem almost impossible to do architecture without using a laptop. This finds an explanation when one approaches iconic buildings,

uprooted from the context and where, as Paolo Portoghesi claims, the curse of the tabula rasa makes of the beautiful architecture a "malign architecture"; today we have the claim to want to absolutely design something new and innovative, this pushes young minds to the creation of increasingly complex and authoritative spaces. "Architecture must return to being a discipline, [...] without the relationship with the place architecture navigates, like a flying saucer" (Paolo Portoghesi interview). This is why architects need to be able to control new

software and exploit them in such a way that they do not make mistakes; but before tackling this, we need to take a small step backwards.

Before 1980, the computer was not on the list of instruments of the architect whose pencil played the primary role; from 1980 to today the construction industry has begun to feel the need to deal with different technologies so as to abandon, or almost, paper, pen and technician. Below are the main stages of this short trip:

1. 1980. AutoCAD moves the design process from pen and paper to the computer<sup>2</sup>.
2. 1982. Era of documentation, 2D drawings are almost completely replaced by digital versions, making elaborate graphics processing faster.
3. 1990. Era of simulation, in line with the increase in computer power, there was a shift from 2D CAD to 3D modeling systems. This helped the designers to visualize and dynamically simulate their projects<sup>3</sup>.
4. 2007. Era of communication, it becomes essential to communicate the enormous amount of information that is produced during the entire

design process. Mobile tools such as iPad or tablet, become indispensable to allow all the subjects involved in the project to communicate efficiently. From here we start talking about Cloud, a sort of data store from which everyone can get useful information.

5. 2016. Era of immersing computing. A large number of high-performance VR<sup>4</sup> headsets appear on the market for the first time (Oculus Rift in March 2016, HTC Vive in April 2016, Playstation VR in November 2016) and it became essential for professionals to understand what software was needed to design in the world virtual. And talking about "world" is not an exaggeration; the glasses represent a real access portal in a parallel reality in which there is a simulated reality approximately identical to the real one in which projects from scratch, restorations or redevelopment can be placed simulating the future behavior once made.

Let's think about how useful it would be from an educational point of view; in a course in architectural history, having the opportunity to

enter the original project of the Bank of England of John Soane today demolished for instance, or create a simulation of what appearance could have taken the original Pantheon of Agrippa, would be useful experiences with the aim of bringing the public closer to a subject, which as claimed by Zevi, is not particularly interesting to the public.

It is on this last point that we have based this writing; Can Building Information Modeling, Game Technology and Virtual Reality influence Modern Architectural Practice?

The technology allows us today to model in the 3D environment models for details very similar to the final product, which we can take care about textures, materials, lights, trying to simulate the behavior of what we designed once built. Modeling software, in particular those that exploit the BIM environment, are combined with external plugins or applications that are able to calculate the physical performance of the designed products, as well as the shading caused by them

and the impact of sunlight on the comfort of the interiors. These tools are of undoubted usefulness mainly because they increase the degree of accuracy of energy calculations, simplifying and in many cases implementing the effectiveness of the architect's interaction with these aspects of absolute importance, especially regarding the sustainability of the process and of the architectural structure.

So today we can get to know the project before its construction, we never get to a direct comparison with it, we never have a 'direct' experience of the project. The views that are extracted from the project are static, filtered by a rendering engine, which in spite of trying to simulate the realistic behavior of the materials and the lights, tends too often, especially with the increase of the renderist's skills, to provide an image perfected and therefore mendacious of the architectural artifact.

This is the criticality that has led us to try to introduce virtual reality also in the process of creating the architectural space, not limiting it to a visualization tool of architecture,

but to litmus paper to get a direct experience of what has not yet been realized, to be able to explore their architectures and, through a direct mental confrontation with the visited and really experimented building, make choices aimed at improving the quality or evocative effectiveness of the spaces.

At this point, however, a legitimate question arises: how did architects, up to nowadays, design quality spaces without the help of virtual reality?

Making architecture, in particular, making functional and aesthetically effective architecture means being able to combine a series of factors such as, for instance, the control of geometries and modules, the management of the proportions between the elements, adopting design methodologies that allow to achieve quality results, all of which are obviously enriched by a strong artistic component, which must necessarily enter into the design, without however taking the place of absolute protagonist.

These characteristics are suitable for all those who are considered

important architects of the past, those who have added, each in their own way, a piece in the huge puzzle represented by world-class architecture. The designers who, therefore, have been able, through an in-depth knowledge of what was built and designed up to them, to implement the architectural discourse, experimenting and enriching concepts such as space and form, adapting them according to the needs of society. If we were to make a name for all to provide a concrete explanation of this figure, it would undoubtedly be Charles-Edouard Jeanneret-Gris, best known under the pseudonym of Le Corbusier (1887-1965.)

With regard to this first point then the role of virtual reality in architecture can not succeed in making all the architects of the 'good' or the best professionals in architecture, but rather it can help and enhance our three-dimensional vision, which will be able through a direct control of the spaces, to make us improve the quality of the same to achieve the desired result in a more precise and complete.

To this first argument in favor of the

introduction of the use of virtual reality in the conception of architectural space, a second one is added, of a more practical nature. In fact, if you think of the large building types, from the buildings of worship to those reserved for residential mass housing, there are cases of particular interest for each case, for the most disparate reasons. However, for how many virtuous cases can be identified, there are as many, if not a greater number, mediocre, which have a value because they have historical memory, but that do not represent an equally consistent instance for what concerns the built spaces, the materials used or the ability to perform its function in a particularly effective manner. These experiments are made possible by the possibility of raw materials, money and manpower that is no longer possible and imaginable from an ecological and sustainable point of view. In short, it is as if today it is impossible to make mistakes, so much so that a building like the famous Fire Brigade barracks in Vitra designed in 1993 by the Zaha Hadid Architects studio represents a unique instance of the history of recent architecture. An

architectural intervention is first and foremost an operation whose main purpose is to make life better for those who live in those places. In the case of the intervention of Zaha Hadid this fundamental condition did not find satisfaction, but rather, as soon as the project was completed, the building suffered strong complaints from the firemen who should have been the first and in fact the only users. To tell them the forms and several details, such as crooked walls and inaccessible bathrooms, did not help their most elementary operations, to the point of forcing them to abandon the building in favor of the old barracks a few days before the inauguration.

Without having to change the intended use of a place due to the perhaps too virtuous design, to the spasmodic search for a strong aesthetic, the architect's eye and in some way life often puts us in front of design cases lacking that perhaps, with the help of virtual reality and the consequent direct (though virtual) experience of architecture, they could have been avoided.

The thesis of spatial education,

previously quoted and supported by Zevi, could perhaps today be questioned by virtual reality systems as a tool of real architecture and not only. ■

#### Notes

1. Tratto da DAVID WATKIN, *Storia dell'architettura Occidentale*, quarta edizione Zanichelli, giugno 2012 (trad. it. Francesca Piccarreta). Capitolo II XXI secolo, pag. 752.
2. Prima di tale data, ogni tipo di elaborato veniva elaborato a mano allungando i tempi di realizzazione degli elaborati grafici. La tecnologia CAD ha consentito di ovviare a questo problema velocizzandolo tramite PC.
3. Progetti dalle forme sempre più complesse e dalle tecnologie sempre più performanti richiedono, per una più corretta performance futura, simulazioni e controlli in ambiente virtuale. Oggi questo è possibile grazie ai nuovi software.
4. The VR mainly provided VR devices for medical, flight simulation, automobile industry design and military training purposes from 1970 to 1990.

The 1990s saw the first commercial releases of consumer headsets. By 1994, Sega released the Sega VR-1 motion simulator which could track head movement and featured 3D polygon graphics in stereoscopic headset for arcade games and the Mega Drive console. During the 2000s the technological growth around VR's world has been of course faster and bigger, starting back in 2007 with Google introducing Street View, showing panoramic views of a still increasing number of worldwide positions, and which also features a stereoscopic 3D mode, introduced in 2010.

In the 2010 Palmer Luckey designed the first prototype of the Oculus Rift, which as only capable of rotational tracking. However, it boasted a 90-degree field of vision that was previously unseen in the consumer market at that time.

2014 sees the birth of Google's Cardboard,

a do-it-yourself stereoscopic viewer for smartphones. The users place their smartphone in the cardboard holder, which can they wear on their head.

In February-March 2015, HTC and Valve Corporation announced the virtual reality headset called HTC Vive and controllers.

By 2016 there were at least 230 companies developing VR-related products and all the main brands in the world such as Google, Apple, Amazon, Microsoft, Sony and Samsung had dedicated AR and VR groups.

The first VR's uses, as we have previously said, regarded mainly medical and military applications, but in the late 1980s the University of North Carolina modelled its Sitterman Hall, home of its computer science department, in virtual environment. Nowadays, several companies such as IrisVR and Floored provide services to allow users to convert files created in CAD programs like Google's Sketchup or Autodesk's Revit into files viewable with an Oculus Rift, HTC Vive or a common smartphone. These are 'one click' softwares, which don't require any need of complex tiered workflows or knowledge of game engines such as Unity3D or Unreal Engine.

These softwares can provide a huge number of benefits both for architects and their clients. During the design process, architects themselves can use VR to actually experience they are working on before they are built. In particular, seeing a design in VR can help architects have a better sense of scale and proportion. Having a VR models also eliminates the need to waste time and resources constructing physical miniatures to examine a design concept to clients or the public, having it ready-made in the virtual world.

## Case Study: a new church in Norway

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Architecture of Norway  
Personal experience as a first step  
A church in words

# FIRST STAGE OF THE PROCESS

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## Architecture of Norway

*Architecture isn't just the result of materials and functions, but more of the variable spirit of variable eras. It's the spirit of an era which pervades its social life, its religion, science and art. Gothic style doesn't exist because someone invented arches with ribs. Modern Architecture wasn't created because steel structures and concrete building have been invented. Those were created because a new spirit was claiming for them.*

Nicolaus Pevsner, 1976

### **P**rehistoric times

The oldest traces of human settlements in Norway date back to 9000 BC. and are located on the mountainous regions near the Myvatn Store, located in the southern part of the country, a few kilometers from Pulpit Rock<sup>1</sup>. Excavations have been carried out on this site that have brought to light portable homes probably transported there from nomadic hunter tribes. Traces of similar dwellings made up of tents have been found in other places along the west coast, such as Fosenstraumen and Hordaland,

in which archaeological evidence indicates that the tents used in these territories around 6500 B.C. they recall in their forms those still used by the Sami nomads, tribes that inhabit the Arctic area of the territories of Norway, Sweden, Finland and Russia.

The first cases of fixed houses are dated between 3000 and 2000 BC, thanks to the increasing diffusion of the practice of agriculture in Norway. Many sources<sup>2</sup> available highlight the use of wood as the preferred material for construction, thanks to the high availability and



greater ease of processing. During the Iron Age, the construction of longhouses spread in which, in order to guarantee better heating, men and animals coexisted, albeit in separate rooms.

### *Viking and medieval eras*

Subsequently, with the refinement of construction techniques and tools for processing raw materials, in Norway there were two different construction methods: log buildings and stave buildings. The first seems to have been introduced by Eastern Scandinavia and consists

of overlapping horizontal trunks embedded in the corners of the building. The second one has its origins in the constructive tradition previously mentioned of the long houses, with the pillars that support the roof planted in the ground. In spite of the scant evidence of the construction of these first permanent structures, the remains of the Viking ships, such as that of Oseberg, suggest a high mastery of woodworking and of the related construction techniques<sup>3</sup>.

Nowaday, 28 stave churches and at least 250 wooden houses before

Above left, a Sami family poses in front of a typical shelter made with wood branches and animal leathers.

Above right, a traditional long house which used to combine spaces both for humans and for animals in order to maximize the heat production.

*The marvelous wooden interior of Borgund stave church.*

*It is a clear demonstration of Norwegians' ability to master wooden structure manufacturing.*



the Black Death of 1350<sup>4</sup> have been virtually intact; most of these are log houses, which sometimes feature additions such as galleries and arcades. It is assumed that during the Middle Ages more than 1000 stave churches were built throughout Norway, most of them between the 12th and 13th centuries<sup>5</sup>. At the beginning of the nineteenth century only 150 remained, many of which were destroyed by a religious movement that preferred simple and pure lines and did not like the

practice of some pagan rituals that were often kept within them<sup>6</sup>. Thus at present, as previously stated, only 28 stave churches survive intact on Norwegian territory, even though most of the destroyed ones have come up to us numerous technical drawings made before their demolition.

This type of church owes its longevity to the numerous technological innovations in the architectural field that have protected these enormous

and complex wooden structures from marking, from precipitation, from wind and extreme temperatures. Among the many, the most important was the introduction under the pillars of impressive window sills to prevent the rotting due to water infiltration. With the advent of the Reformation the construction of the stave churches ceased, which gave way to churches built in stone or with the construction technique of log buildings. Most of them disappeared due to abandonment, forgetfulness or deterioration, or because they were too small to accommodate large groups of faithful and to respond to the ever-increasing demands dictated by the cult<sup>7</sup>.

The earliest churches in Norway made in stone have the distinctive traits of the Romanesque, imported from the Anglo-Saxon missionaries, in particular by Bishop Nicholas Breakspear (1100-1159)<sup>8</sup>, who later became Pope Adrian IV. Also the churches built later report continental influences, such as those of Ringsaker or Kviteeid. Many of these churches were later lost or rebuilt in Gothic style, but numerous

instances still survive today as the Trondenes Church in Troms, which is also the northernmost stone church in all of Norway.

The most important instances of Gothic architecture in Norway are due to structures built in the Romanesque style, later modified or enlarged according to the changed canons of the religious architectural style and therefore bearing decorations or structural apparatus of a Gothic nature. Of particular interest are the cathedral of Hamar<sup>9</sup>, now in ruins, and that of Stavanger<sup>10</sup>, as well as the cathedral of Nidaros, one of the most important pilgrimage destinations in medieval Europe.

#### *Under the Danish rule*

In the late Middle Ages, Norway suffered a major collapse, which forced it to make a pact of union with Denmark and Sweden, known as Kalmar Union starting from 1397<sup>11</sup>. The king of this union resided in Denmark, relegating Norway to a simple state-province, to be devoted solely to the exploitation of raw materials and not worthy of investment in monumental



Founded in 1070, Nidaros cathedral is one of the most important examples of Gothic architecture in Norway.

architecture. This is why the ambitious Renaissance architecture projects are extremely rare in Norwegian territory. At this time you can still trace the characteristics and colorful buildings of the Bryggen, in Bergen, UNESCO World Heritage Site<sup>12</sup>, born as commercial buildings for the Hanseatic League, dating back to the sixteenth century and built with

the technique of log buildings that combines in this case treats natives with others of Germanic origin. Already after the Black Death, which struck Norway around 1350<sup>13</sup>, the construction of monumental architecture in Norway had suffered a substantial block that would last until the 16th century under the Danish administration. There

are therefore few instances, as already mentioned, of Renaissance architecture in Norway, with some exceptions such as the Rosenkrantz tower in Bergen. Under the leadership of King of Denmark Christian IV, due to a devastating fire in 1624, the city of Oslo was moved to a new location and rebuilt as a fortified city with an orthogonal setting surrounded by defensive bastions, and then renamed Christiania. The foundation of the commercial city of Kristiansand, named in his honor<sup>14</sup>, is due to the king himself.

Although most of the residences were still built according to the dictates of the vernacular tradition, some residences suffered the influence of the Baroque taste. Only the city of Christiania had a building code that forbade the construction of wooden buildings, for obvious reasons, so that a large number of continental-style city buildings were built here. The churches of this period see the use of brick, the most important are those of Bergen, Christiania and Roros<sup>15</sup>. Probably the most famous and important baroque building in Norway is the royal residence of Trondheim, one of the largest

wooden structures in northern Europe<sup>16</sup>.

With the advent of Rococo, there is a short but significant period for Norwegian architecture. Initially the style is applied by decorative arts, mainly for interiors, furnishings and luxury items in silver plated, glass and stone. In the cities of the most central districts during this period there was a progressive coverage of log walls with protective boards, a practice made possible by the spread of sawmills, often placed near watercourses to exploit their driving force to drive gears of wood cutting machines. These buildings soon proved to be better thermally insulated and more effectively protected by the hostile climate. However, the main reason for the wide and sudden diffusion of this practice is to be found in the most pleasant aesthetics of the plank walls, more suitable than the walls in trunks to be adorned with details and decorations borrowed from classical architecture.

### **19th century**

At the dawn of the nineteenth

century, following the Napoleonic wars, which led to the separation between Norway and Denmark in 1814, the Norwegian state could count on a handful of architects, most of them military officers with expertise in civil engineering<sup>16</sup>. The market for architects was in fact limited to a sparsely inhabited nation and without a capital, a court and the most important and fundamental government institutions. However, this is the period when wealthy merchants and landowners, seeing their fortunes gravitate, decided to build numerous residences outside the city, often in neoclassical style. Romantic nationalism also influenced Norwegian architecture from 1840 onwards. Following the German guide, many classicist architects designed red brick buildings recalling the glories of the medieval era. At the same time, the Romanesque and the Gothic were considered suitable for the construction of churches, public buildings and factories, such as the Johanneskirken in Bergen (1891-1894). One of the first proposals of this medieval revival is to be identified in the proposal by Hans Linstow (1787-1851) for a square

surrounded by public buildings, divided by a course between Christiania and the new royal palace. Christian Heinrich Grosch (1801-1865) was the first to convert to historicism by creating red brick buildings after his visit in 1838 in Berlin, where he had the opportunity to meet Karl Friedrich Schinkel. Among its most important buildings are the Stock Exchange (1826-52), the Bank of Norway (1828) and the University (1841-52). Most of the residential buildings continued to be built following the classical tradition, with plastered brick walls. The repertoire of historical styles was however extended to Homansbyen, the first residential expansion of Oslo consisting of independent villas, planned by Georg Andreas Bull (1829-1917), to which most of the built residences, ranging from the medieval, must also be attributed. to the classic, to the exotic.

From 1840 onwards, architects began designing wooden buildings in the manner of Swiss chalets, a construction method that originated in Germany, a country in which Swiss popular culture was widely

and widely admired by romantics. Elements such as jutting roofs, verandas and timpani were inspired by Alpine vernacular architecture. Railway stations and churches, designed by experienced architects, were distributed throughout the rural districts and helped to make this popular and living style in popular tradition even after it became obsolete among the architects themselves.

The German influence that arrived

in Norway with neoclassicism subsided with the conquest by the Scandinavian state of complete independence in 1905. In this period a new generation of Norwegian architects who had received an education in Sweden began to develop an architecture with distinctly national characters, in an attempt to break the German historicist tradition. The Jugendstil, a variant of the Art Nouveau, had a significant influence on new buildings

*The city of Alesund hosts the majority of Norway's Jugendstil buildings due to the fact that it has been completely rebuilt after a burning in 1904.*



Norway's architecture today rhymes with Snøhetta. Above, the Norwegian National Opera and Ballet, situated in Oslo and completed in 2008. Below, Tverrfjellhytta, Norwegian wild reindeer pavilion, situated in Hjerkinn and completed in 2011.

in Norway at the beginning of the 20th century. For instance, the city of Alesund, following a fire in 1904 that almost completely reduced it to ashes, was completely rebuilt according to the dictates of this national variant of Art Nouveau, so much so that it still exists today, together with Riga and Brussels, one of the most obvious instances. Other instances of Art Nouveau architecture can be found in Trondheim, while Oslo, the capital, does not show any instances of this architectural period due to an economic crisis and the stagnation of the real estate market of those years.

Around 1920 Modernism entered Norway, brought by Scandinavian architects. In Scandinavia this architectural movement acquired the denomination of functionalism (colloquially 'funkis' in Swedish and Norwegian). The Modern Movement gathered a large number of followers among young architects, especially those from Norway, so the turning point came in fact with the Stockholm Exposition of 1930, after which the majority of architects from all over Scandinavia actually

converted to the canons dictated by the Modern Movement. Contrary to the Art Nouveau period, Oslo saw the proliferation of functionalist structures, including the Skansen restaurant, designed in 1926 by Lars Thalian Backer (1892-1930), demolished in 1970, the Kusternes Hus art gallery by Gudolf Blakstad (1893-1985) and Herman Munthe-Kaas (1890-1977), built in 1930, still showing some vestiges of the influence of the historicist taste of the 1920s. ■

#### Notes

1. The Pulpit Rock, also known as Preikestolen, is located in the municipality of Forsand in Rogaland county, Norway. It is a steep cliff which rises 604 metres above the Lysefjorden. Its main peculiarity consists of a flat top which measures 25 by 25 metres.
2. Remains of those buildings have been excavated at Forsand in Ryfylke, near Stavanger and several other locations.
3. M.C. TORRICELLI, R. DEL NORD, P. FELLI, *Materiali e tecnologie dell'architettura*, Editori Laterza, Bari, 2012, pp. 91-99.
4. The Black Death was one of the most devastating pandemics in human history, with an estimate number of deaths which ranges from 75 to 200 million people in Eurasia from 1346 to 1353. Norway seems to have been reached by the lethal bacteria around 1350.
5. Here is a list of the stave churches we have any evidence of:  
Borgund stave church, Sogn og Fjordane;  
Eidsborg stave church, Telemark;  
Flesberg stave church in Flesberg;  
Fåvang stave church in Ringebu, Oppland;



Garmo stave church, Oppland;  
Gol stave church in Gol (now at Norsk Folkemuseum, Oslo), Buskerud;  
Grip Stave Church, Møre og Romsdal;  
Haltdalen stave church, Sør-Trøndelag;  
Hedal stave church, Oppland;  
Heddal stave church, Telemark;  
Hegge stave church, Oppland;  
Hopperstad stave church, Sogn og Fjordane;  
Hylestad stave church, Setesdal;  
Hære stave church, Oppland;  
Høyjord stave church, Andebu, Vestfold;  
Kaupanger stave church, Sogn og Fjordane;  
Kvernes stave church, Møre og Romsdal;  
Lomen stave church, Oppland;  
Lom stave church, Oppland;  
Nore stave church, Nore og Uvdal, Buskerud;  
Øye stave church, Oppland;  
Reinli stave church, Oppland;  
Ringebu stave church, Oppland;  
Rollag stave church, Rollag, Buskerud;  
Rødven stave church, Møre og Romsdal;  
Røldal stave church, Hordaland;  
Torpo stave church, Ål, Buskerud;  
Undredal stave church, Sogn og Fjordane;  
Urnes stave church, Sogn og Fjordane;  
Uvdal Stave Church, Uvdal, Buskerud.

**6.** One of these churches is actually located in Tiveden, Sweden. It's been demolished since some pagan rituals used to be held in it. In fact, sacrifices were often given in recognition of having received help. Despite protests of the parishioners, the Diocese had the church demolished in 1826, to be rebuilt more than 120 years later, in 1960s.

**7.** The Reformation was a schism from the Catholic Church initiated by Martin Luther and continued by John Calvin and Huldrych Zwingli in 16th century Europe. It is based on the 95-thesis posted by Luther on the doors of Wittenberg Cathedral in 1517. They related to most of the practices held by Catholic Christians in those years trying to discredit them proposing a new way to establish the private relationship between every person and God.

**8.** Pope Adrian IV (1100-1159) is the only Englishman to have occupied the papal throne. From 1152 and 1154 he was in Scandinavia as papal legate, establishing an independent archepiscopal see for Norway at Trondheim. This led him to create the Diocese at Hamar and to

form cathedral schools in Norway's bishopric cities.

**9.** The church was erected as a result of Hamar achieving city status in 1849. The interior is characterized by an elevated nave, inspired by the basilica structure and the central feature of the building is the altar, made by Henrik Sorensen (1882-1962) inspired by a Nordic archetype.

**10.** It is Norway's oldest cathedral. Bishop Reinald is said to have started construction of it around 1100. It was finished around 1150 but the city of Stavanger counts 1125 as its year of foundation.

**11.** The Kalmar Union was a personal union that from 1397 to 1523 joined under a single monarch the three kingdoms of Denmark, Sweden and Norway, including its overseas dependencies (Iceland, Greenland, the Faroe Islands and the Northern Isles).

**12.** Bryggen (the dock) is a series of Hanseatic commercial buildings lining in the eastern side of the Vagen harbour in Bergen. It has been on the UNESCO list of World Cultural Heritage sites from 1979.

**13.** See note 4.

**14.** Kristiansand is a city and municipality in Norway. It is the fifth largest city in Norway with a population of 88598 as of June 2016.

**15.** Stiftsgarden is the royal residence in Trondheim, originally constructed in 1774 by Cecile Christine Scholler. It is possibly the largest wooden building in Northern Europe with its 140 rooms for a total of 4000 square metres.

**16.** The most important architects of this period in Norway are Carl Frederik Stanley (1769-1805), Christian Collet (1771-1833), Hans Linstow (1787-1851) and Christian Heinrich Grosch (1801-1865).



## **Personal Experience as a First Step**

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*Sarà necessario percorrere il luogo e ritornarci, stimolati da ciò che lo spazio contiene: forme, colori, texture, rumori, odori che rivelano, rimandano a qualcosa, così gli elementi del presente risvegliano spazi di memoria tali da rendere evidente la domanda che il luogo contiene e rivolge a noi.*

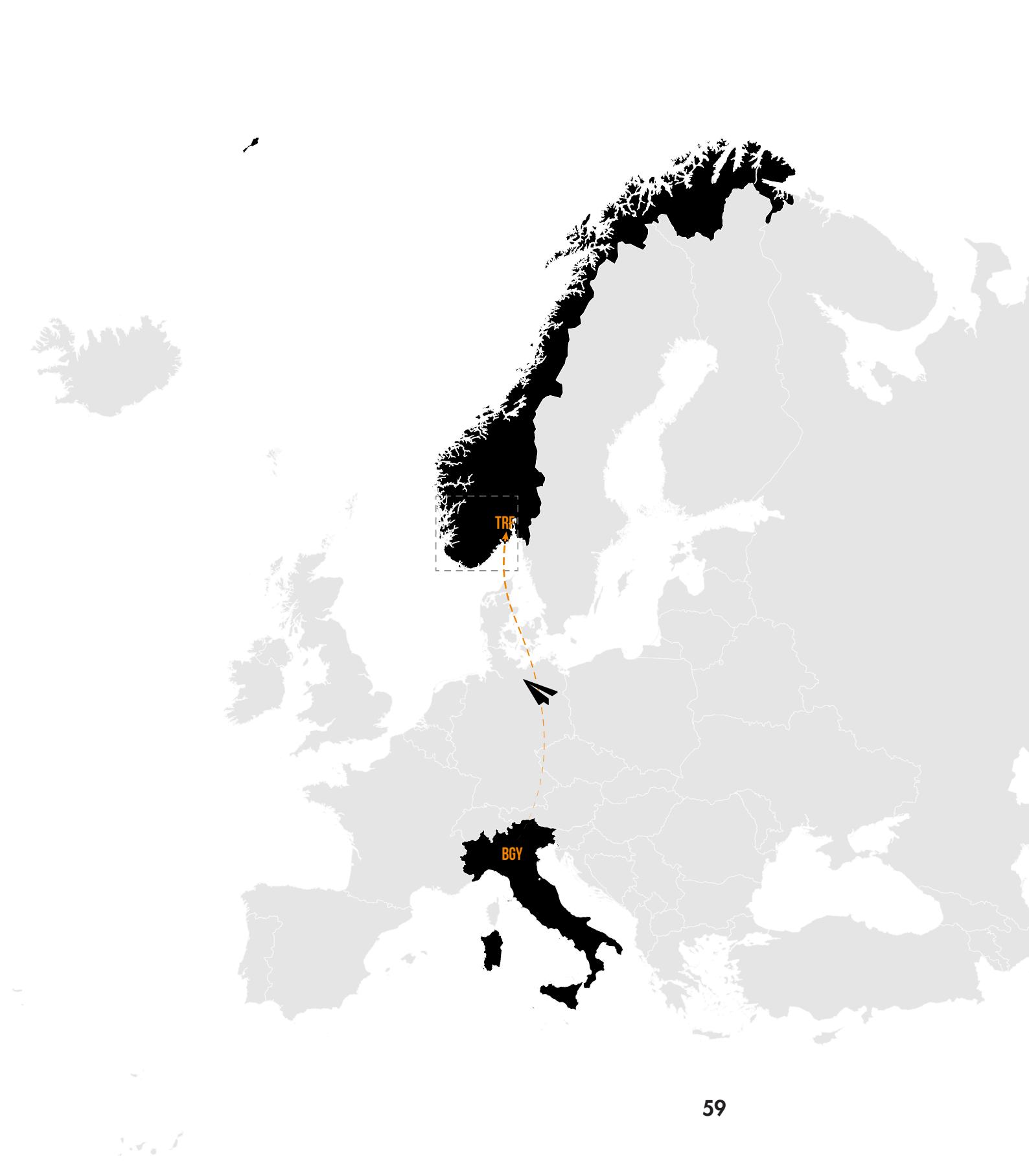
Silvia Gron, 2015

**S**ince the Renaissance, between artist it was an usual practice making travel, more or less distant, with the unique purpose of enriching their baggage of images and forms. Artists of all kinds but mainly sculptors, painters and only in a next phase architects also moved for a few years from their cities to know what was happening outside of there, to try to expand their knowledge through vision and more sometimes the transposition on a sheet of the artworks of other artists.

From the 17th century, this practice

takes the name of Grand Tour, going to connote a long trip, affordable only by the rich young men of the European aristocracy, whose purpose was precisely to try to extend their knowledge, with departure and arrival in the same city. The duration of the trip could vary indifferently from a few months to a few years, because the low of efficiency of the means of transport at the time, and It has Italy as the favored destination.

These trips for cultural purposes allowed artists from all over Europe to get in touch with both past history



(the ruins of Rome, as well as those of Pompeii and Ercolano) were visited, building a rich baggage of classical forms, both with their contemporary, thus broadening its views and opening up to the architecture of an 'international' style.

Traveling seems therefore to be, and in fact it has always been, the best way to expand your own culture. And it seems to continue to be so even nowadays, when from any apartment, if you have a computer and an internet connection, you can virtually travel in a click from the remote peaks of the Tibet, to the dense forests of the equatorial belt, or even to the chaotic life of New York.

Being able to touch with hand a Roman column, which performs its structural task for hundreds of years, as well as warning the proportions of the Sagrada Familia designed by Antoni Gaudí and be positively overhung, to experience the scents and sounds of a Moroccan souk, are experiences impossible to perceive through the screen of a laptop, however high its resolution can be. For this reason we decided to go to Norway, to be able to observe

closely what is the constructive tradition, what are the materials, the relationships that architecture has established with one of the most characteristic and emblematic landscapes of all of Europe: the fjords.

We structured the trip so that we could visit both the unspoiled nature, which represents most of the Norwegian territory, and the city, in which we could also understand the relationship between the population and the cult, between the spaces reserved for it and those reserved for the community and for sociality. We also visited some points of interest regarding the history of Norwegian religious buildings.

From the first day nature has revealed itself in front our eyes in all its magnificence. It is undoubtedly the protagonist on a stage in which human intervention tries to cover the minor role, starting from the size of the streets, maximum with a lane in each direction, in an attempt to mark the territory as little as possible: kilometers and kilometers between high pine forests that occasionally interrupt their dense compactness to frame mirrors of crystalline water



A photograph of a two-lane asphalt road curving through a dense forest. The road is marked with a solid yellow center line and dashed yellow lines near the edges. The forest consists of tall evergreen trees on both sides, with some deciduous trees interspersed. The sky is overcast and hazy, creating a soft light. The overall atmosphere is serene and natural.

*From the very first day nature has revealed  
itself in front our eyes in all its magnificence*

in which the hills are reflected with absolute fidelity. Between the heights and the plains there are a few and lost constructions, made with similar geometries but always personal traits, in a serial that can not get bored.

The cornerstone of our experience in Norwegian territory was obviously the walk to the point where we chose to place the chapel, the Prekestolen, or Pulpit Rock, but for the first day we thought to go a little further, facing the climb towards the Kjeragbolten. This was the occasion

to measure ourselves against the uncontaminated nature of Norway, to make contact with the bare rock, to fall into the shoes of those who decide to face these walks, to feel closer to the earth, and to have the opportunity to see unpublished scenarios from privileged locations. Few signs, human intervention in this case is only understood in a few points, the most difficult to climb, where we are required to use the support of chains to tackle otherwise inaccessible slopes. The goal of the walk is revealed before

*On the opposite page, long roads run through miles and miles of woods and forests.*

*Below left, a beautiful view we couldn't help to capture during the walk to the Prekestolen.*

*Below right, the Prekestolen, an oval rock set in a fjord, at almost 1000 meters above the sea level.*



our eyes when, after four hours, we can see the rock embedded in the gorge of a fjord after the combined action of post-glacial rebound and sea level rise about 50,000 years ago. Below the boulder, about a kilometer away, is the Lysefjorden water. The danger of a fall exists, but not for this reason we thought to place networks under it going to

disturb the natural balance: it is as if the relationship between man and the mountain does not need caution or precaution, but bases solely on man's unilateral respect for it.

This can be defined as the first lesson we learned in Norwegian territory, which, like all the lessons we learn in the course of our lives, has had logical repercussions on our design.



The walk that we face the following day is on the simplest charter, passing in fact from a level of difficulty that the guides define 'strenuous' to a more comforting 'demanding'. Getting to Pulpit Rock, however, is not an experience allowed to everyone. Although they do not require the use of chains, the paths are often bumpy and therefore imply a good state of

physical health, as well as a certain familiarity in tackling mountain walks. After about two hours of walking you reach the rock, which has the characteristics of a real pulpit facing the fjords, with sharp edges that characterize it and make it unique compared to the surrounding nature. The place, thanks also to the different degree of difficulty of the

*Another breathtaking view of the fjords during the Preikestolen experience.*





*After about two hours of walking  
you reach the rock, which has the  
characteristics of a real pulpit  
facing the fjords*

walk, is richly populated, so much so that you do not feel that aura of mysticism and absoluteness that would approach a place of worship and that had impressed us so much in the case of walking the previous day. This is also a lesson that only

direct experience has allowed us to learn and then exploit to make some planning decisions.

With the Prekestolen, the naturalistic parenthesis of our Norwegian experience was closed to give way to two very characteristic cities that



we visited in the following two days: Stavanger and Bergen. In both cities it has clearly emerged an intense use of wood for the construction of almost all buildings, of which only a small part is reserved for worship or religious practices.

The second indispensable

destination of our trip is the church of Heddal, the largest stave church in all of Norway. This type of church is typical of north-western Europe and distinguishes a large number of religious buildings built in medieval times and made entirely of wood. The name seems to derive from the

*The Pulpit Rock, a preferred spot on the Lysefjord which attracts hundreds of visitors every day.*



Above, the peculiar and coloured houses of Bergen's harbour.  
On the opposite page, Heddal stave church stands in its natural contest with an admirable harmony.

structure that characterizes these churches, in which the main pillars, often made of pine, were called *stafr* in ancient Norwegian, then stood in the most modern diction.

These wooden churches are the most characteristic architectural *topos* in Norway, where in fact the remaining buildings of worship, when they are not confused with the residential buildings of which they inherit the colors, the materials and often also the shape and size, are made according to the canons of Gothic architecture and consist of

large cathedrals such as those of Stavanger or Nidaros.

The external shape that distinguishes these churches is given by a series of portions arranged orthogonally with a hut section, whose dimensions grow proportionally on the four sides towards the center of the plant, which is not however always central. The interior, of which we could not take any picture, is characterized by a massive wooden framework with large trusses. The decoration, both inside and outside, is reduced to a minimum, limited to the frames



69

*Mountains, luxuriant vegetation, water and typical shelters: Norway recap in a picture.*

of some windows that show floral motifs and sometimes busts or anthropomorphic faces.

Each element seems to have been designed to last over time, to resist atmospheric agents in a strongly hostile climate characterized by heavy rains and snowfalls, as well as winds of considerable strength and speed. The church seems massive, and although we can decipher the presence of some restoration work, most of the elements date back to the era of construction.

The choice of materials also in this case allows the construction to not

blend with the landscape, to live with it without going to violate it. This is obviously an obligatory choice, given the abundance of raw material and a manufacturing tradition that sees and has always seen in the cutting and processing of wood one of its points of greatest strength. In any case, however, along the long Norwegian roads there has been revealed before the eyes an anthropized landscape of a quality in terms of integration with the context seen only rarely in Italy (in part perhaps in Trento and Bolzano) as well as abroad, to underline that



often it is not only a cheap choice from an economic and ecological point of view, but also choices made to protect and respect the natural context.

The personal experience of the places, as well as of the things is therefore a fundamental aspect of the architect's work, citing the words of Silvia Gron: "It will be necessary to travel the place and return, stimulated by what the space contains: shapes, colors, textures, noises, smells that reveal, refer to something, so the elements of the present awaken spaces of memory such as to make evident the question that the place contains and addresses to us "<sup>1</sup>.

However, despite visiting a place can provide important and fundamental information about the existing, both anthropized and natural, the architecture student is, today as in the past, to proceed by analogies and comparisons regarding design. ■

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#### Notes

1. S. GRON, M. CAMASSO, *Impronte urbane\_02 A.A.A. stanze cercasi*, Politecnico di Torino, Torino, 2015, pp. 5-7.

## A church in words

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*L'architettura sta alla muratura come la poesia sta alla letteratura; in altre parole essa si distingue per il suo drammatico entusiasmo verso l'arte.*

*Claude-Nicolas Ledoux, 1804*

The trip to Norway gave us important input from the natural environment, but also from the anthropized one, filling our eyes while traveling by car between the different destinations, numerous instances of sacred and non-vernacular vernacular architecture. By combining these acquired skills with a study of the history and architectural tradition of the Scandinavian peninsula, we realized that we had sufficient foundations to proceed with the design of an architectural building in Norway.

However, when it comes to having to make choices in a sensitive area such as that reserved for worship and religion, it is necessary to deepen the studies, specifically looking for those that are the most successful instances of such architectural *topos*, in our case the chapel.

The chapels are born as rooms, inside larger buildings, reserved for prayer. In fact, one or two people could gather in prayer even without being part of a religious congregation. It was therefore a question of places in which to seek peace and relaxation away from

the stress of everyday life, without being disturbed by the presence of other activities.

The term seems to derive from the Latin *capella* and then from the relic of San Martino di Tours. It seems in fact that this saint, when he was still a soldier, tore his cloak in half to donate a part to a beggar who needed it. The other half returned to cover his shoulders like a small cloak, a chapel. Legend has it that the beggar was Jesus Christ, and that Martin had a sudden conversion becoming initially a monk, then an abbot, and finally a bishop. The cloth fell into the hands of the kings of the Franks, who took him with them to war. The curtain inside which the cloth was kept was called a chapel and the priests who recited the mass inside were known as chaplains. From these two terms, through ancient French, the names 'chapel' and 'chaplain' were obtained.

A chapel must therefore allow those who decide to enter it to find a protected and intimate environment, in which they can seek a moment of contemplation and intimate reflection. Its features must, however,

from an architectural point of view, enhance its shape, creating an environment that evokes certain feelings and a greater closeness to one's spiritual dimension, regardless of the religion to which one decides to belong. For this reason, when it came time to approach the planning, we decided to imagine a chapel in words, to go and list what, from the outside as well as from the inside, a place like this we would have liked to evoke us. The input is derived once again from the reading of the book by Adrian Forty entitled 'Words and buildings', which contains a short written text of the Italian group Archizoom in which we try to describe a project in the form of verbal description: The objective of this text is to allow anyone who reads it to create its own 'mental' castle, arriving in fact to an infinite number of different proposals, whose peculiarities will be derived from the creative inspiration from the background of previous knowledge of each individual.

Archizoom's experiment, however, seems not to be the only one of its kind because even the English architect William Alsop created a

*Senti, penso che sarà qualcosa di veramente straordinario. Molto spazioso, luminoso, davvero ben organizzato, sai, senza angoli nascosti. Ci sarà una bella illuminazione, davvero brillante, che farà risaltare in modo chiaro tutti quegli oggetti disordinati.*

*Tutto sarà semplice, senza misteri, e nulla costituirà un elemento di disturbo. Magnifico! Davvero molto bello – molto bello – molto bello e molto grande. Proprio straordinario! Là dentro sarà pure fresco, con un immenso silenzio. Mio Dio, come posso descriverti tutti quei bei colori! Vedi, molte cose sono difficili da descrivere, specialmente perché verranno utilizzate in un modo totalmente nuovo... Vedi, ci saranno un sacco di cose meravigliose, eppure sembrerà quasi vuoto, sarà così grande e così bello... Come sarà bello... come trascorrere l'intera giornata senza far nulla, senza lavorare o null'altro...*

*Vedi, davvero grandioso.*

*(Ambasz, 1972, 234)*

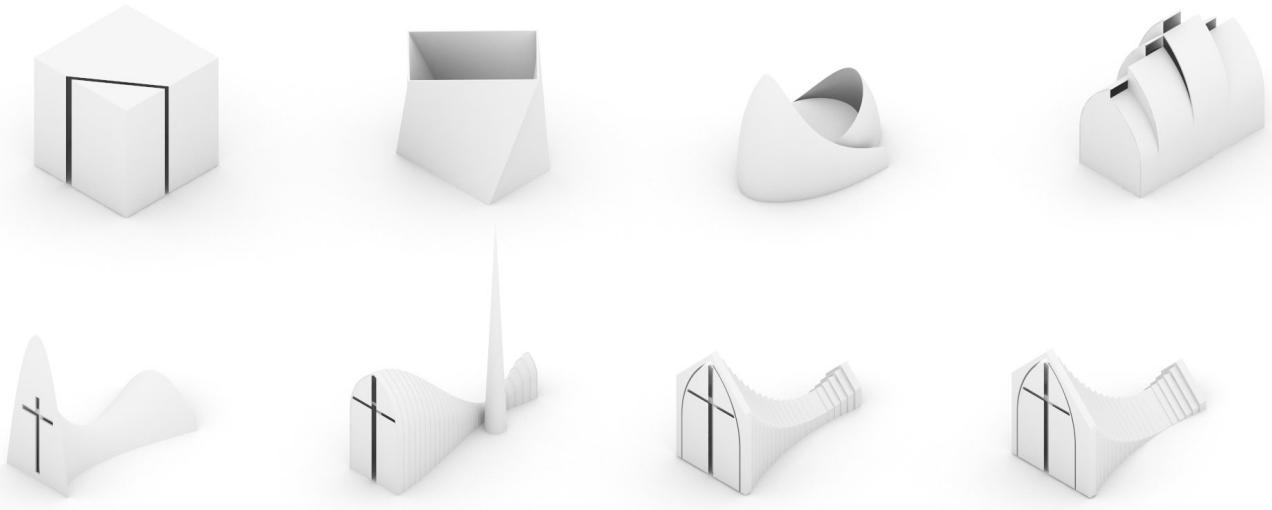
project entirely in words called The Other Room and the project for the diploma of the French architect Jean Nouvel was entirely written.

For this reason we have given ourselves sensory guidelines, thinking of the cult space in its distinctive features, imagining that we need to create a space that enhances the architectural and luminous component, elevating it to a cathartic element. This procedure has allowed us to come to conceive of six very sacred 'concepts' of sacred space that are very heterogeneous with each

other, but shared indirectly by the direct experience of the places, by the common university education, but made unique by that baggage of forms and images that through research and study each architect assimilates in his own way.

In detail, the main characteristics we wanted to attribute to the sacred space are:

- Cosy space
- Enveloping architecture
- Natural light with a strong emotional component
- Space is not easy to understand

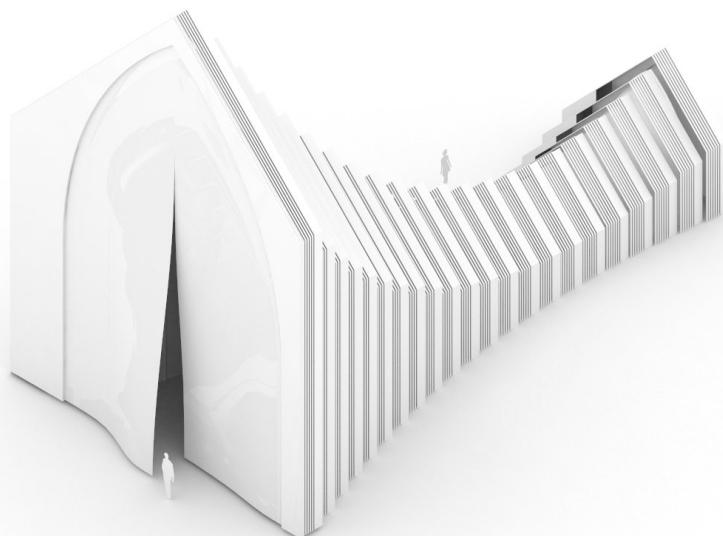


And it is at this stage that we have begun to introduce virtual reality into the design process. In fact, we found ourselves faced with six different valid compositional solutions of the *topos* 'chapel', among which it was therefore very difficult to make a choice dictated by sensory motivations, which was in fact our goal for what concerns the choice of the form of the chapel.

We have therefore crossed the limits dictated by the materials, the construction details, to go in fact to immerse ourselves in the various proposals and it must be said, to

be for the first time in our university course to deal with the designed building next to us in 1:1 scale it has caused strong emotions. The tactile component is undoubtedly the biggest current lack of VR, but the glance when you find yourself immersed in the virtual space is really difficult to explain in words. We did a methodical process exploring all the proposals in turn and reporting on a spreadsheet all the sensations that the spaces and the interaction of natural light with them gave us, marveling at how much direct correspondence there

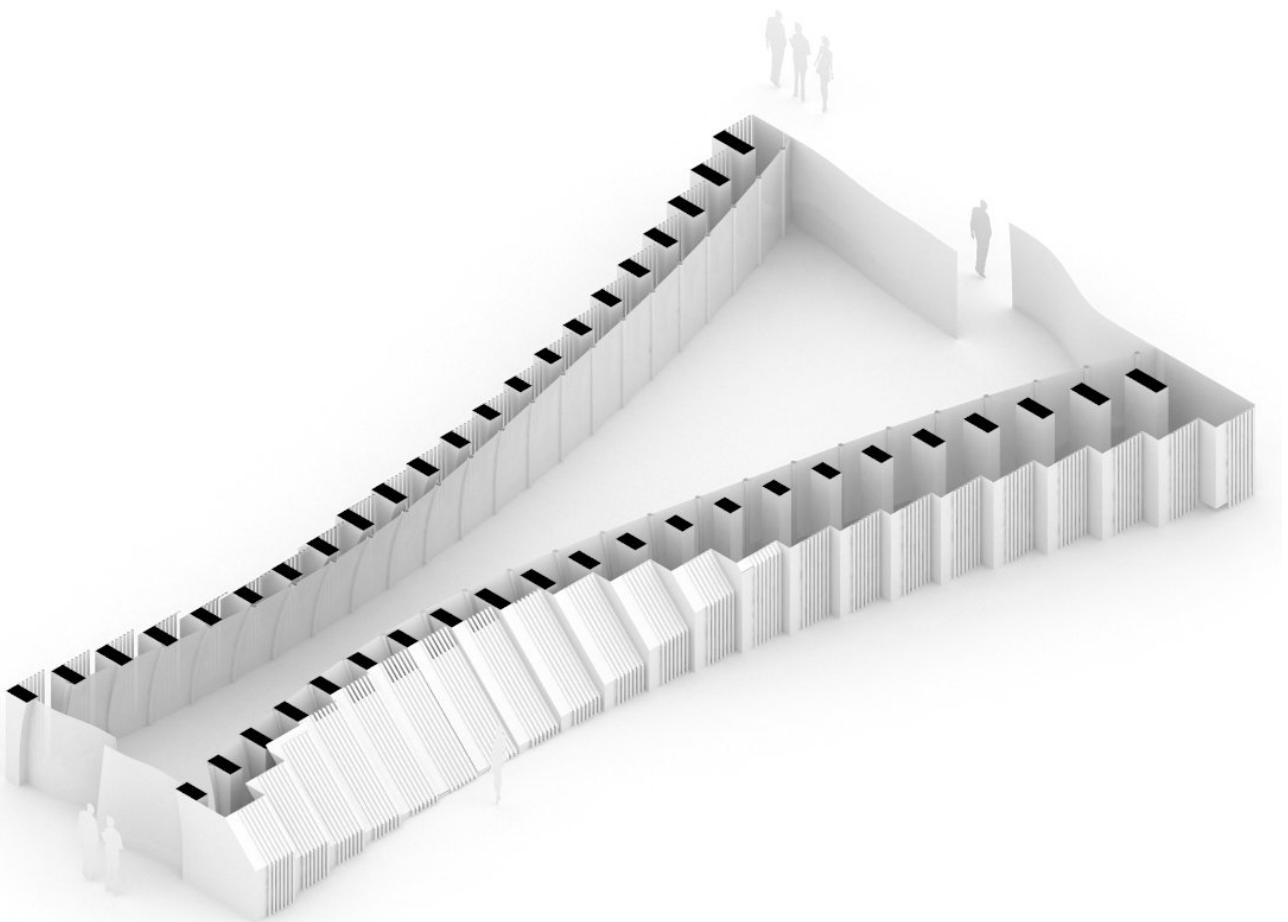
*The six starting cases we designed and visited in VR. The four below are consequent evolutions of the same idea.*



On the top of the page, the project has been repeatedly modified during our VR experiences basing our decisions on our feelings about space's dimensions and its relationship with light.

Above and on the opposite page, these three axonometric drawings represent a middle step in the developing of the final design. A translucent white cloth divided the inner from the outside preventing the visitors from feeling the surroundings. Wide clothes let people inside and outside the chapel, lightly moved by the wind.





were between our current physical measures and those of our virtual counterpart.

Another noteworthy element is the fact that the choice, at least as regards this specific case, guided as told by the sensations received in

VR, was not difficult to decide: we first reduced the number of cases to two, immediately discarding those of which we were less satisfied and convinced, and then return to the virtual environment to make the final choice. ■

## The aim of communication

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Talking about communication in general

Focus on the project:

From smallest to largest scale (the importance of the detail)

Drawing methods

BIM, Cl3ver, Live and Stingray (expression of the new method)

Comments

## SECOND STAGE OF THE PROJECT

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## Talking about communication in general

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*Non ho nessun bisogno di disegnare i miei progetti.  
La buona architettura, come qualcosa che deve essere  
costruito, può essere scritta. Il Partenone si può scrivere.*

Adolf Loos, 1924

**T**oday the weight of words is very underestimated and we tend to leave almost all the communication work on the paper surface (we think of the famous phrase "the sheet must speak"). John Evelyn, in his *Account of Architects and Architecture*, states that architecture's know-how is embodied in four kinds of people<sup>1</sup>:

1. *architectus ingenio*, that is the architect of ingenio, the one that supervises the project, the educated and expert man who makes the idea come true and realizes it;
2. *architectus sumptuous*, the

patron, the one who pays to carry out the work and complete the architect's idea, is therefore the one who articulates a chapter of expenditure to the idea;

3. *architectus manuarius*, craftsman and worker, or the one who physically puts his hand to the work;
4. and, last but not least, the *architectus verborum*, the one who adds words, is expert in the art of language and before, during and after the realization of architecture has the task of talking about it.

As we mentioned in the first part of the introduction of this paper, mo-

dernity has in some way sought to erase this last figure by supporting the thesis that architecture, like any other art, should speak for itself. This principle, if brought to date, can be considered the cause, or one of the causes, of the shortcomings in communication that, in the construction industry, leads to errors several times.

The language commonly used today in teaching and working environment is a language created by architects for architects and only after having tried to communicate the project to people who are not of the trade, such as a customer, we realize how the essence of the project may be in certain circumstances, depending also on the level of complexity, misunderstood. The various software that architects today

have to communicate as we have seen before they have improved more and more and have always had the sole purpose of increasing and optimizing the communication of how a certain designed space would become or should have become.

The countless instances of ugly buildings built in the 21st century, lead

us to understand that the building industry is characterized by a continuous lack of communication, especially when we are faced with changes to be placed on the project or the creation of different scenarios; show the customer the reality of how the light of a room can change by altering the size of the windows is an instance. If we focus on the construction process, we notice that there are several actors involved and each of them adopts their own evaluation criteria: there is the architect with his vision, the engineer who thinks about numbers and how the building can rise and the customer who only wants to know how the space presents itself and how it can use it. Speaking with various professional architects, the situation is presented over and over again in which the client asks to make changes after having made the work; would not it therefore be appropriate to somehow prevent this from happening? It is easier to change a pixel rather than an entire wall once it has been built.

Here again the dilemma at the beginning reappears: what happens in the transition between idea and reality?

The expectation of a space often does not correspond to reality and many errors occur on site precisely because of this weak communication between professionals; BIM has made its fortune by managing to minimize the possibility of making mistakes thanks to the fact that it has a unique central model containing the result of all the disciplines involved. As we said earlier, drawings and illustrations are illusions and can not be compared with virtual reality that more than anything else comes close to the architect's original feeling. The addition of VR applications to the BIM does nothing but further reduce any risk as it is able to provide greater control over the project in the first person.

The synergy that exists between society, architecture and technology is what most fascinates this matter and virtual reality brings all this together. Through this it is possible to create a sort of virtual platform in which the different actors can communicate with each other in a parallel world where the new space exists in relation to its context, the society can take vision, talk about it, comment and criticize if necessary; this revolu-

tion could therefore also be applied to the wave of the 'Open Source'<sup>2</sup> movement for an open and participated design.

In conclusion, virtual reality is definitely an instrument very close to us able to connect society and architecture in the deepest way ever existed, it represents what would make it possible to fill that spatial in-education that Bruno Zevi talks about in his book, saving money , materials and not to create false expectations. The world is moving towards this frontier, day by day we witness the ever more marked passage from flat representations to the complete immersion in the environment to be designed and the virtual or augmented reality can give numerous opportunities for growth, it is a revolution that concerns us a lot close.

This concludes the introduction to this topic; let's see now an instance of application. ■

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#### Notes

1. Tratto dal capitolo introduttivo di Adrian Forty in *Words and Buildings. A vocabulary of Modern Architecture*, Thames & Hudson Ltd, Londra (UK) 2000 (trad. It. *Parole e edifici, un vocabolario per l'architettura moderna*, Monica Turci e Marco Zecchi, Edizioni Pendragon,

2004, pag. 11).

**2.** CARLO RATTI, *Architettura Open Source*.

*Verso una progettazione aperta*, Giulio Einaudi editore s.p.a, Torino, Traduzione di Barbara Del Mercato, 2014.

## Focus on the project

*Poets make poems, painters paintings, and musicians music. Architects, however, do not make architecture; they make drawings and models of it – representations meant to direct the development of something conceived into something constructed.*

David Leatherbarrow, 1998

**A**s previously stated, expressing in written or spoken words what is transmitted from an experience lived through virtual reality is a practically impossible task. Furthermore, we needed to go directly to test all the main tools that technology has put and continues to make available to our discipline for the realization of virtual and augmented reality scenarios.

To satisfy both these problems we needed a case study, to go and create a new space that would bring with it and in itself the reasoning

that from day to day were going to enrich the pages of this thesis.

So we started a research among the main channels for architectural competitions for students, finding particular interest the proposal coming from AWR Competitions concerning the conception of a small cult space in a very particular and fascinating place like the Pulpit Rock.

The brief let complete freedom to the designer, specifying only the need to provide the structure of a bell tower and a sacristy, bearing in mind the context of the Pulpit Rock, one of the



**FROM  
ROCK**

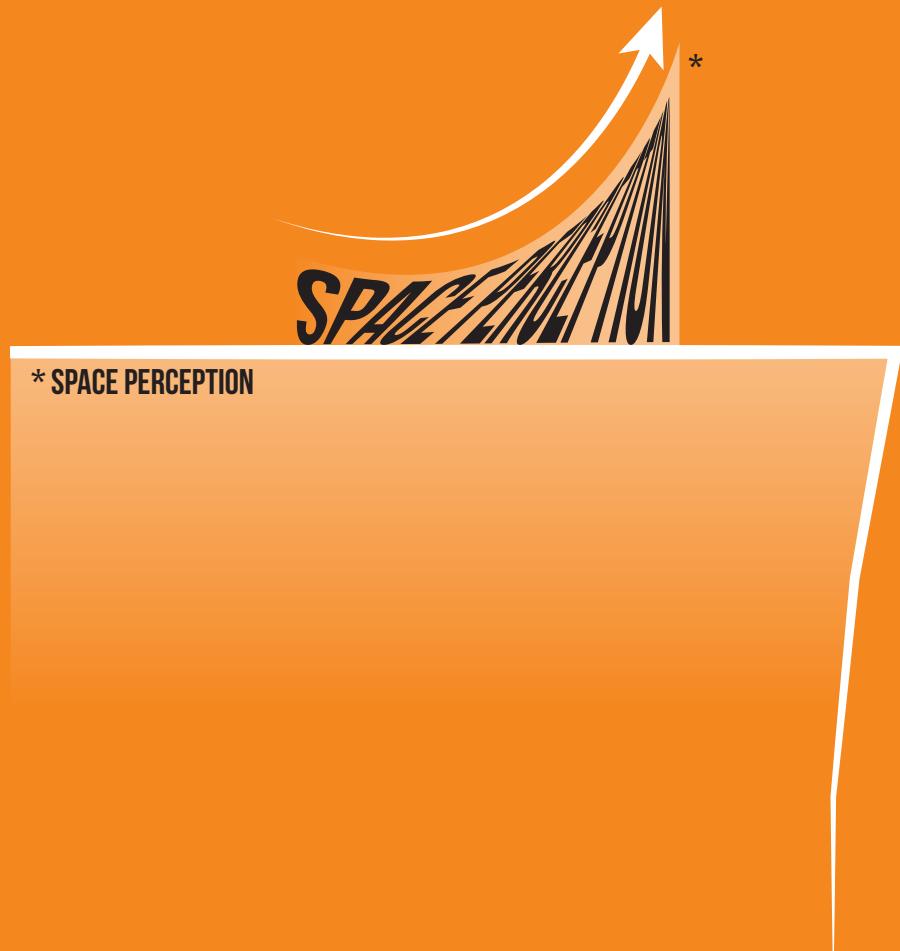
**TO  
SEA**



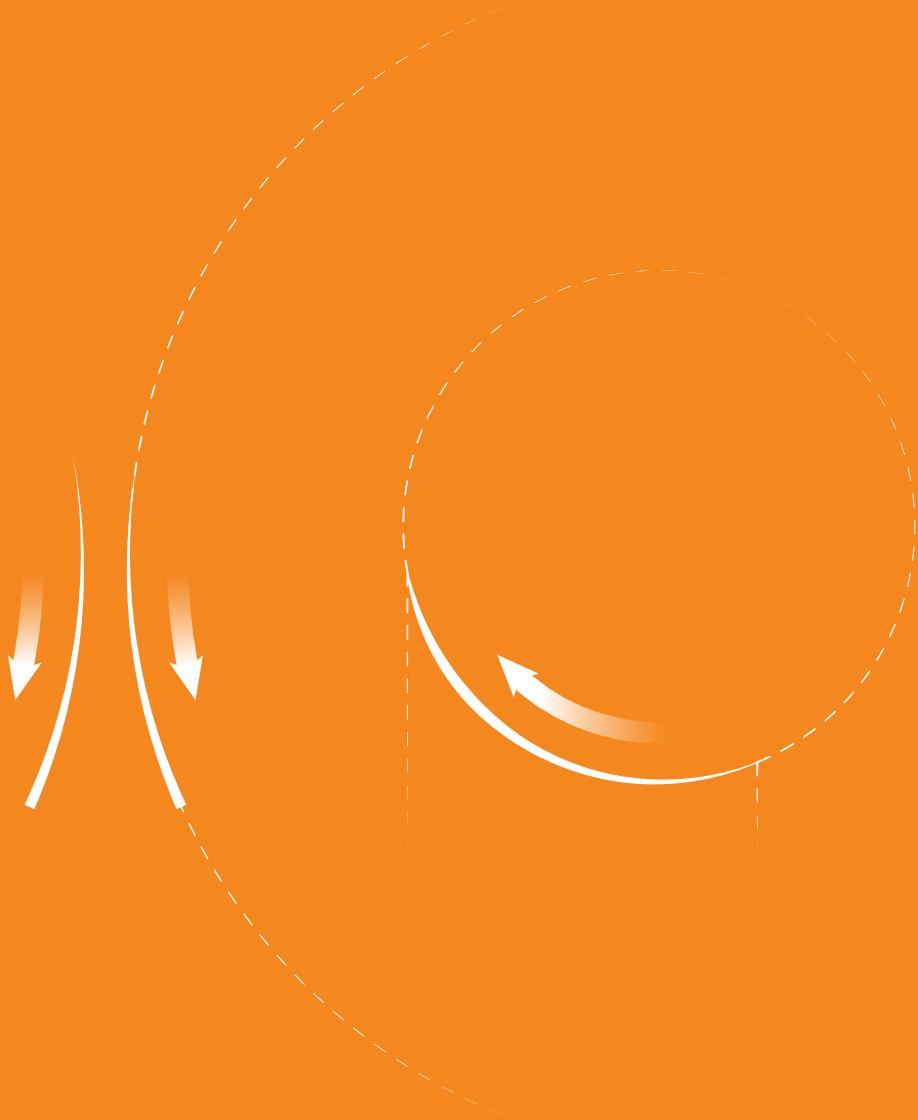
The first choice we had to make concerned the path the visitors would have had to follow while visiting the chapel. We decided to bring them from the solidity of the rocks to the evanescence of the landscape



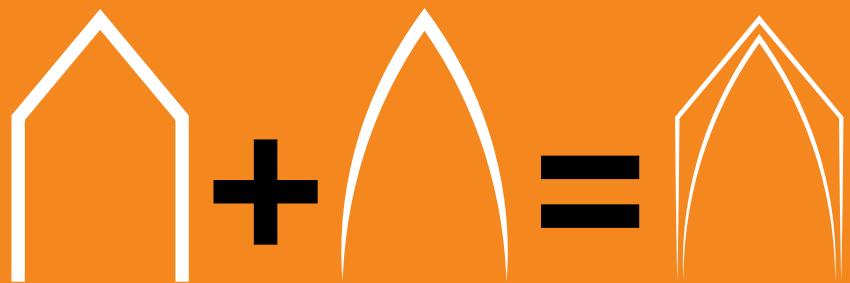
Inspired by Dante's masterpiece, the Divina Commedia, we designed a path which leads the visitor from the current situation, the Purgatory, passes through the tiny and dark Hell's portal, and finally reaches Heaven and light



The perception of the space and its  
understanding can only be achieved and felt by  
walking through the chapel



The lines of the church derive from circles and the final shape resembles an hyperbolic paraboloid

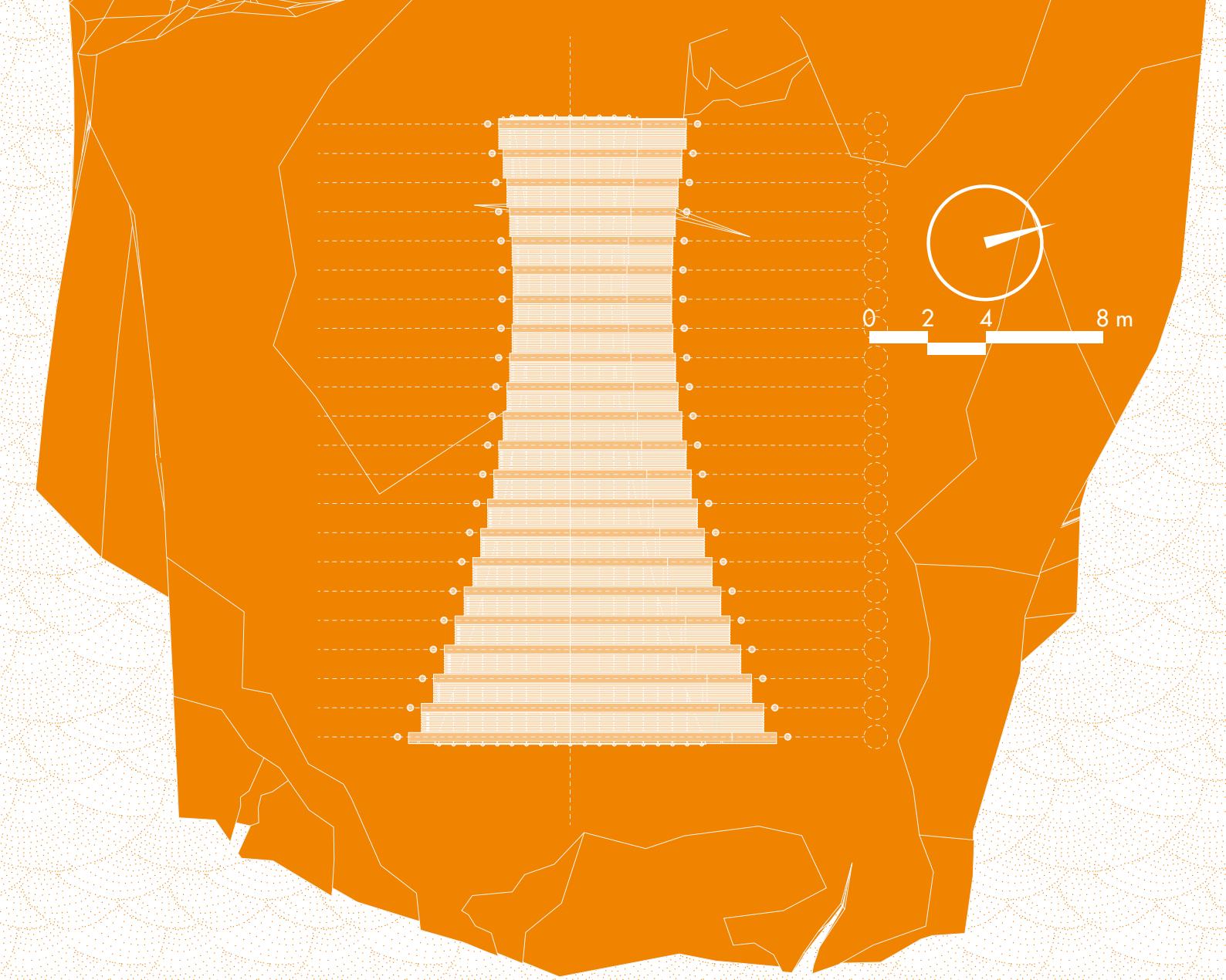


The final shape of the portals derives by the union of the hut facade taken from the traditional stave churches and the gothic arc. This solution allowed us to have two different spaces in the same building, both outdoor and indoor

# 22 PORTALS



Seriality has been a focal point in the entire process of design of the chapel, as long as we wanted it to be an easily structure to be built and above all, to be transported



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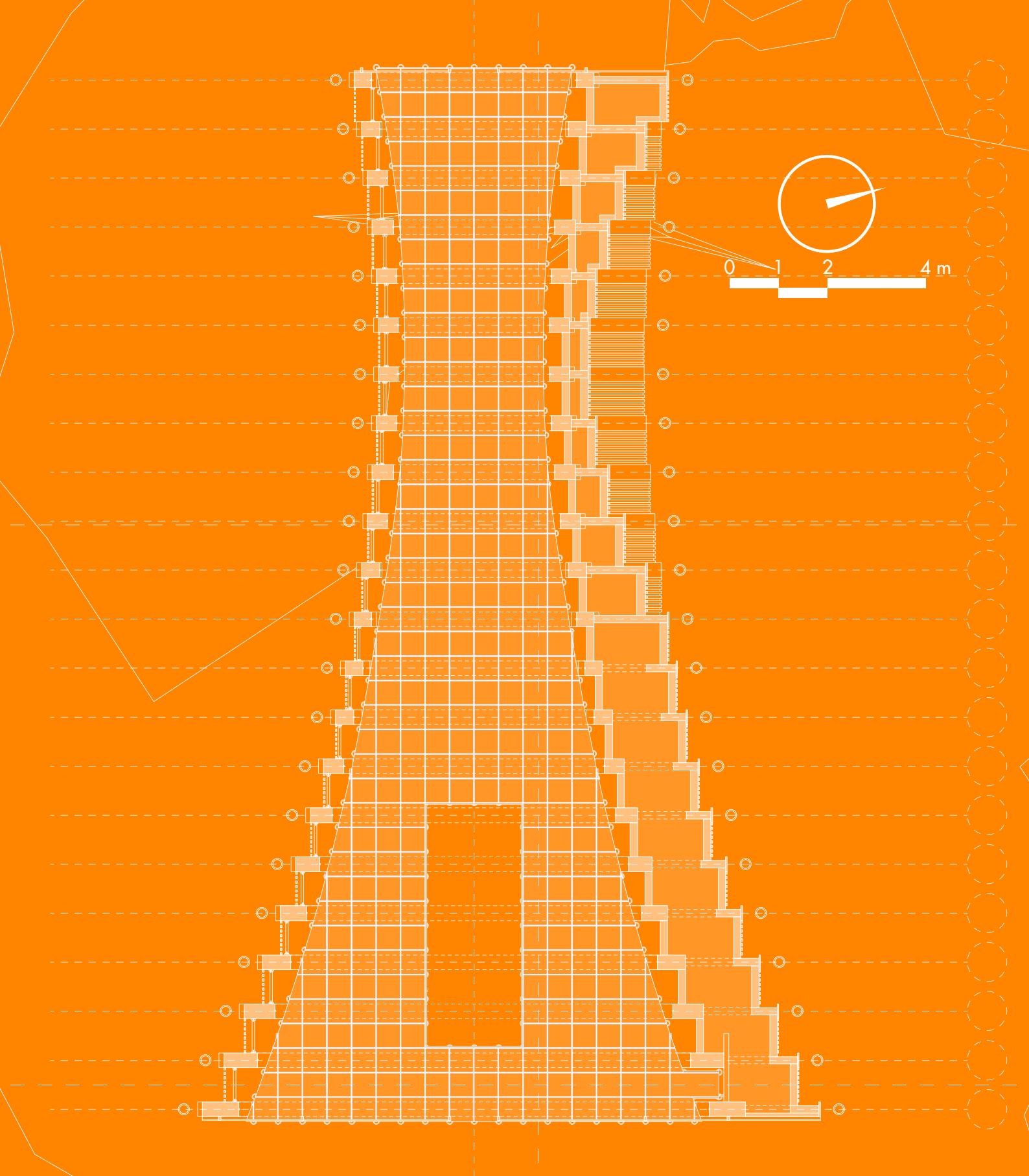
# SITE PLAN

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Preikestolen is one of Rogaland county's most visited attractions, and one of the country's most spectacular photo subjects. Preikestolen has been named one of the world's most spectacular viewing points as long as it rises 604 metres above the Lysefjord letting the visitors enjoy the view of the entire natural surroundings.

The mountain plateau of about 25 x 25 metres was most probably shaped by the expansion of ice some 10.000 years ago. Water that froze in the crevices in the mountain broke loose large edged blocks of stone that the ice glacier brought along on its course, in a similar way as the one which originated the peculiar Kjeragbolten. In the old days, the name of the plateau was Hyvlatånnå (planed tooth), and was already then well known as a landmark for fjord travellers in the Lysefjord being clearly identified even from the sea level. It was not until around 1900, that the first tourist travelled to the top and Preikestolen as a touristic destination was discovered.

The main target of our design consists in respecting the aura coming from this particular site, trying to enrich it enhancing its character despite the human intervention.



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# PLAN VIEW

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**A**s specified at the beginning of the script, the plant is abstracted because it is outside of any concrete spatial experience. At the same time, however, it is the most reliable means by which to judge the entire architectural organism: dimensions, volumetric relationships, connectivity, etc. All this makes the plant one of the fundamental means of architectural representation. But, as specified, we speak of "representation"; what exactly does a building plan represent? Bruno Zevi in Knowing how to see architecture, makes an instance that best describes this concept: "A professor of history of literature does not give students a complete and unpublished edition of the Divine Comedy saying: " Here is the masterpiece - read and admired. " There is an introductory preparation for the reading of the poem, during which we learn the Dante's arguments from the various summaries that make literature texts, and we follow the poet's language through the songs and the passages reported in the anthologies ". So we return to this concept with our general spatial in-education of which we have spoken so much before, supporting the thesis that a plant like the



*Curiosity*

*Surprise*

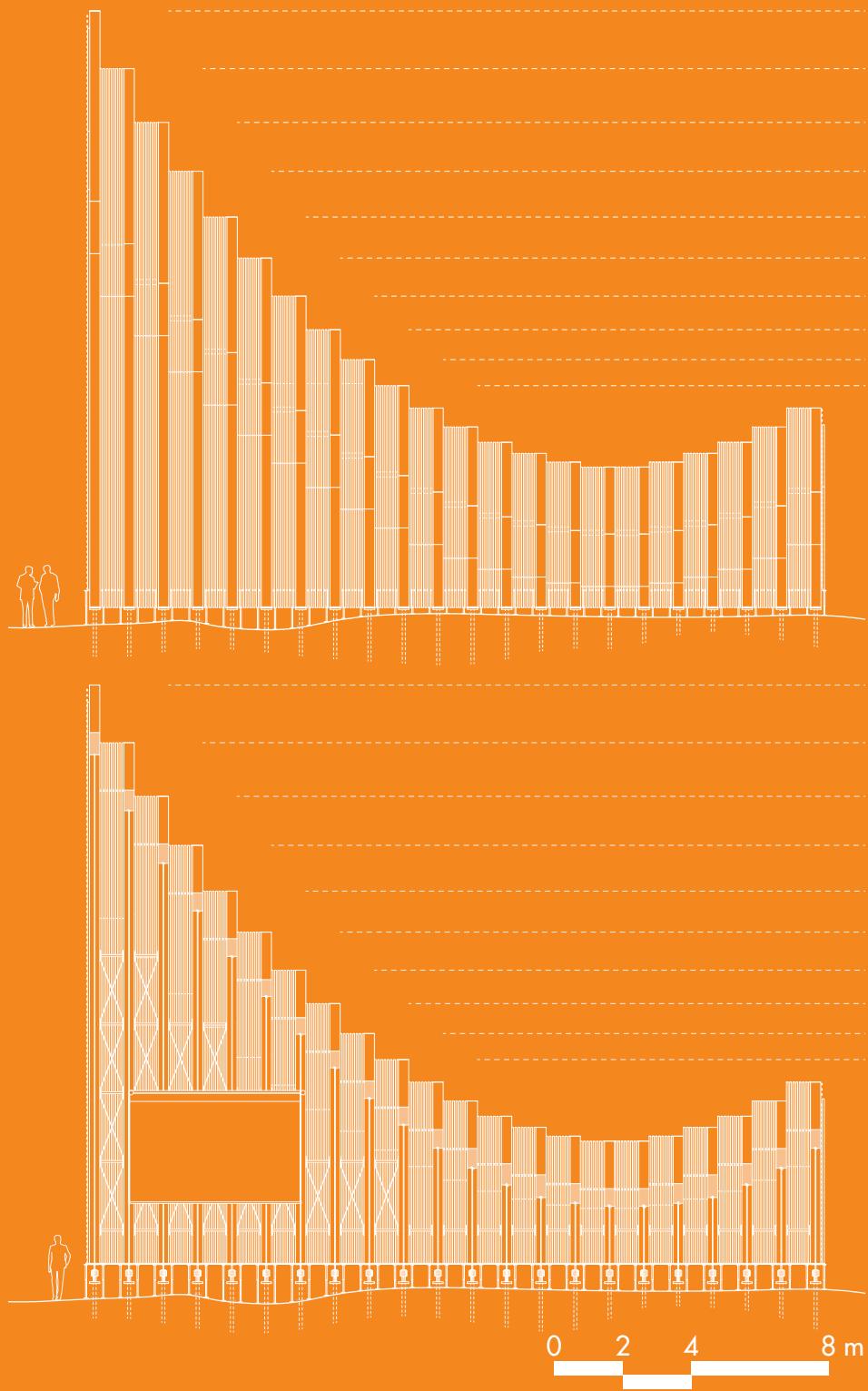
*Ritual space  
falling of loneliness*

*Peace*

?

?

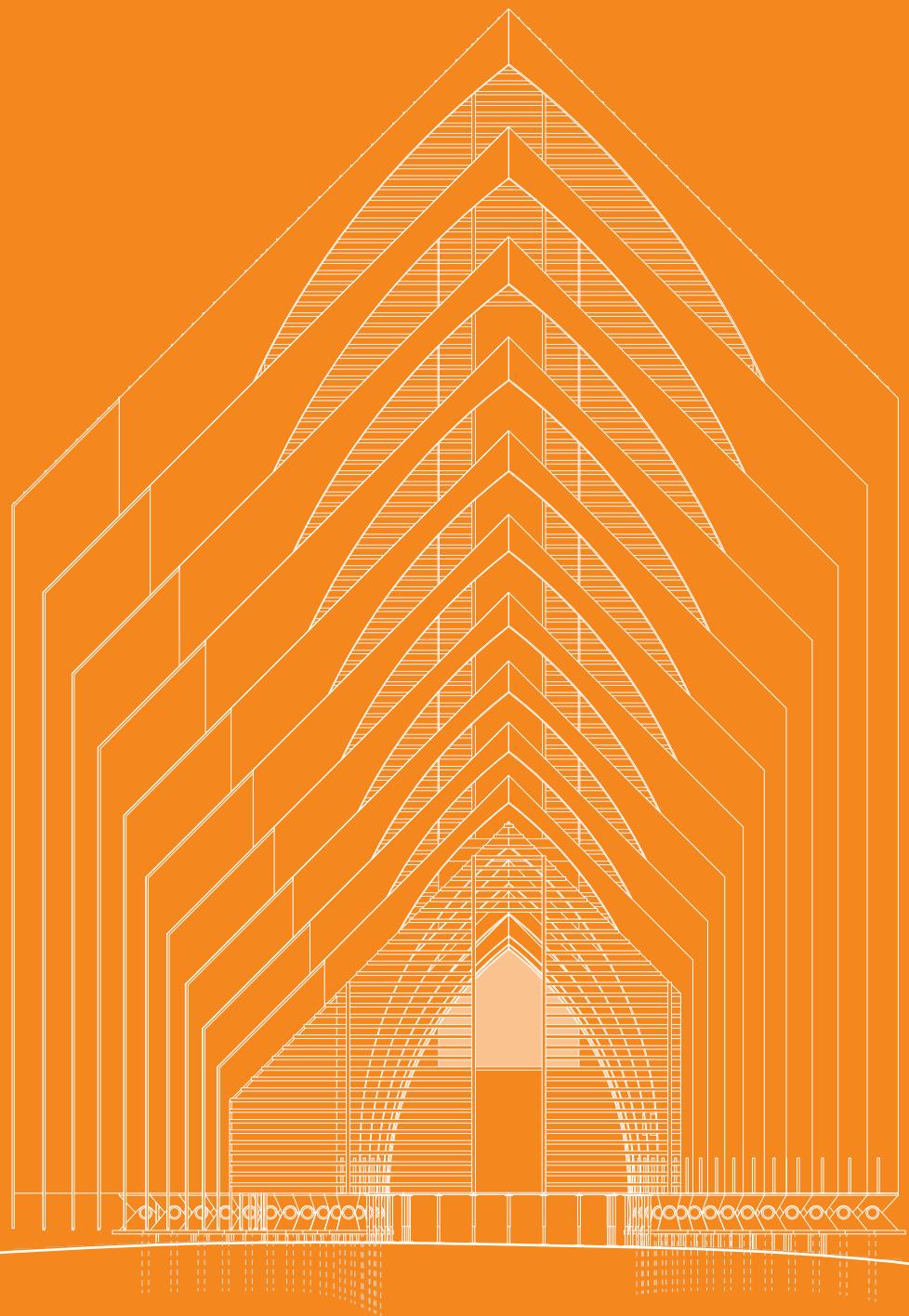
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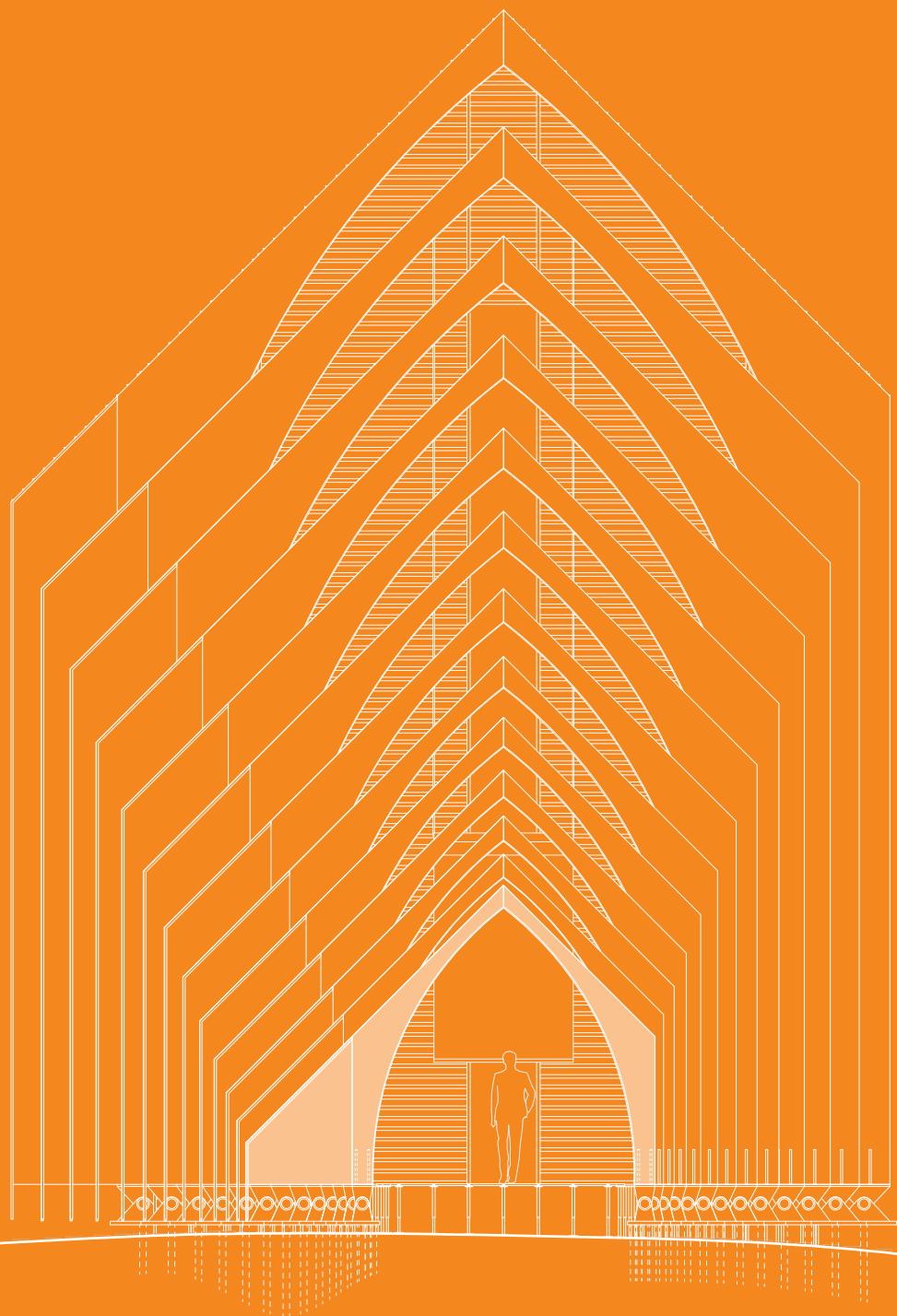


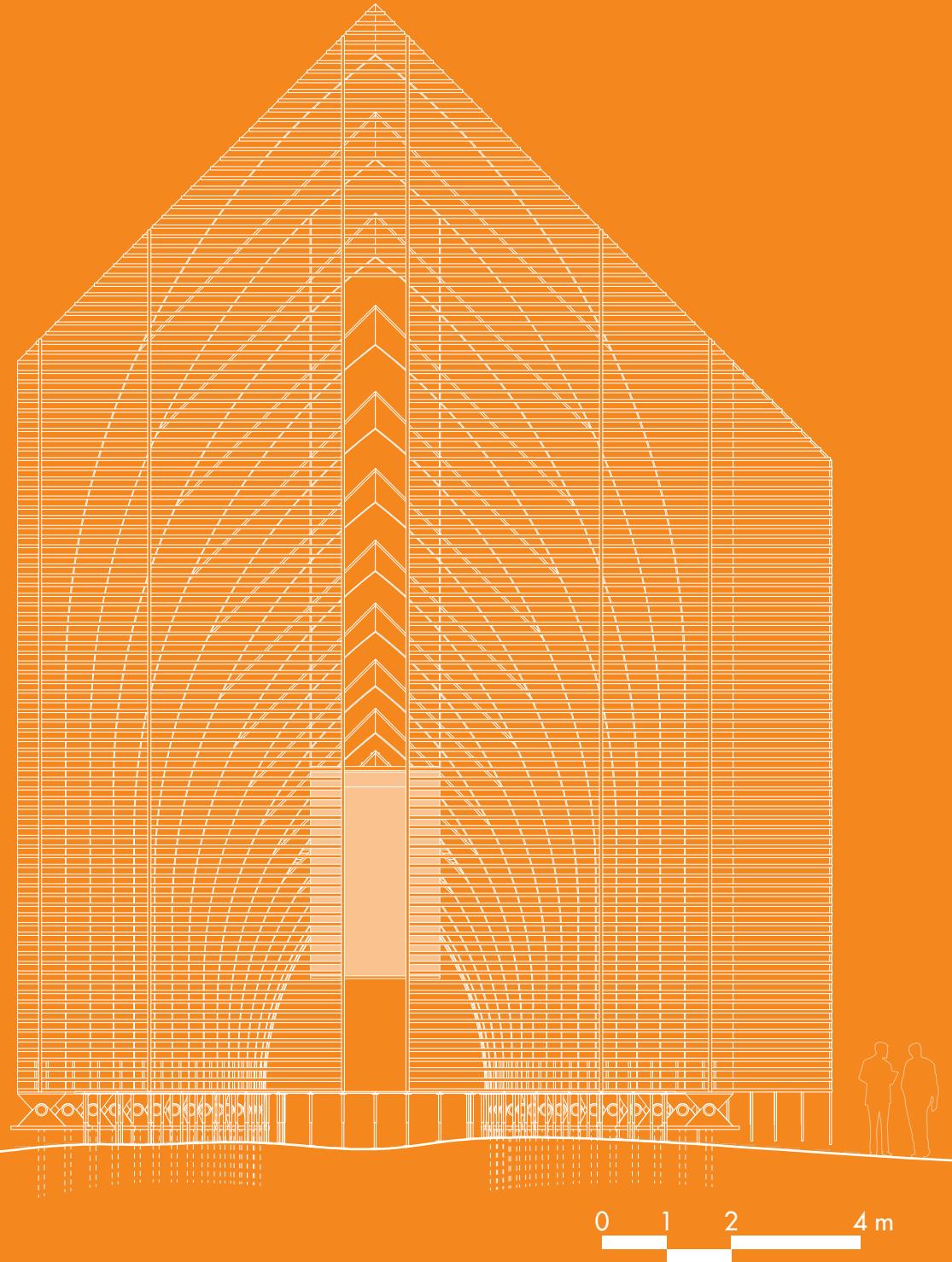
# ELEVATIONS & SECTIONS

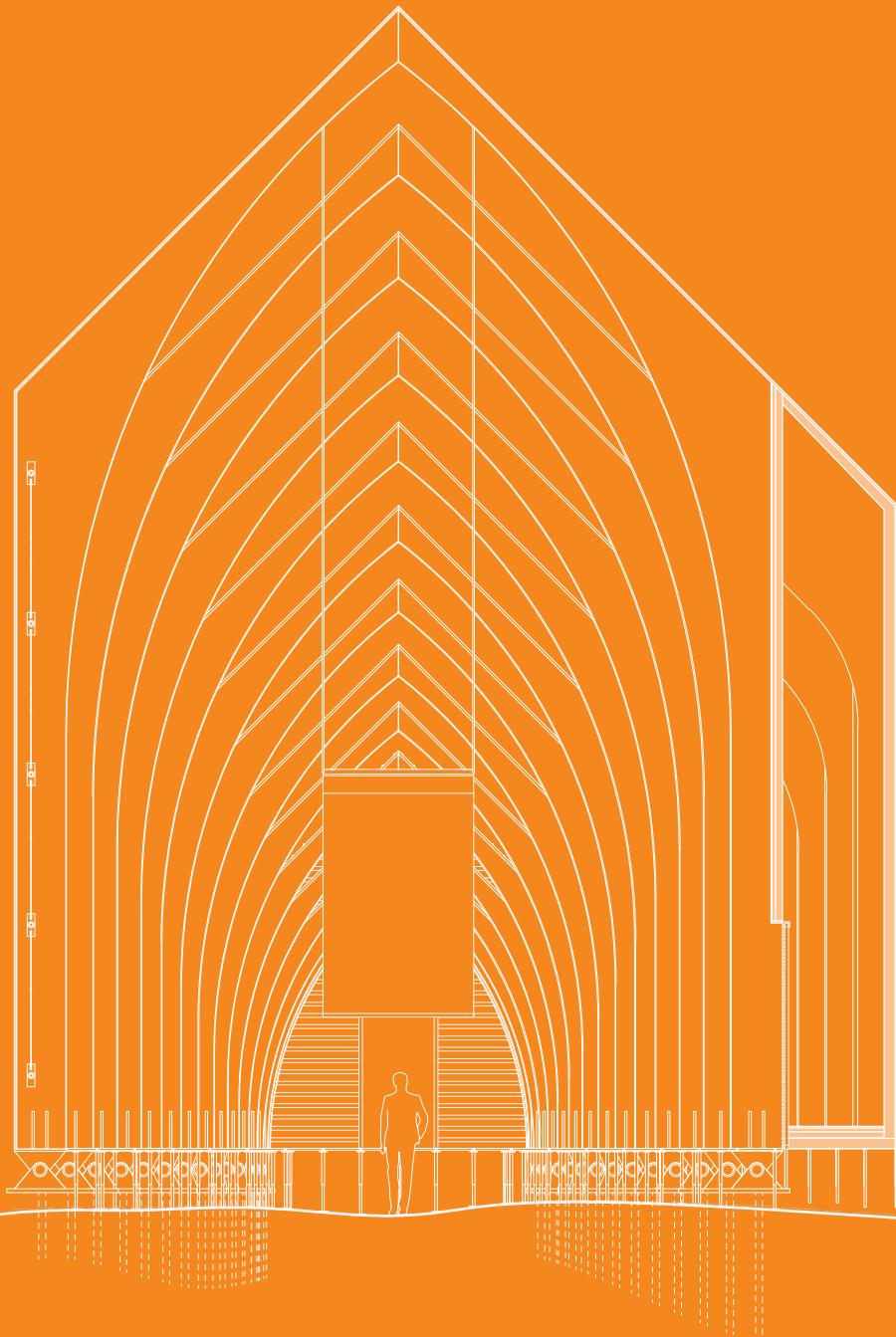
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The reasoning performed for a plant repeats itself exactly for the representation of a high, be it a prospect or a section. Especially in a design of this type it will be important to represent the full and empty spaces, any projections and recesses, the different materials and their perception through the lights and shadows that are projected inside or outside the building in the different hours of the day. For how detailed and realistic a prospect can be will only encourage the customer to seek the three-dimensionality of the object thus requiring axonometry, rendering and physical models. While the other types will always remain static, the physical model is the one that most faithfully tells the project in all its faces; in fact, the modeling is extremely useful and widely applied in schools, universities and studies, but it will never fully satisfy our need to live a space because it does not consider a key factor in spatial conception, that is the human parameter. ■



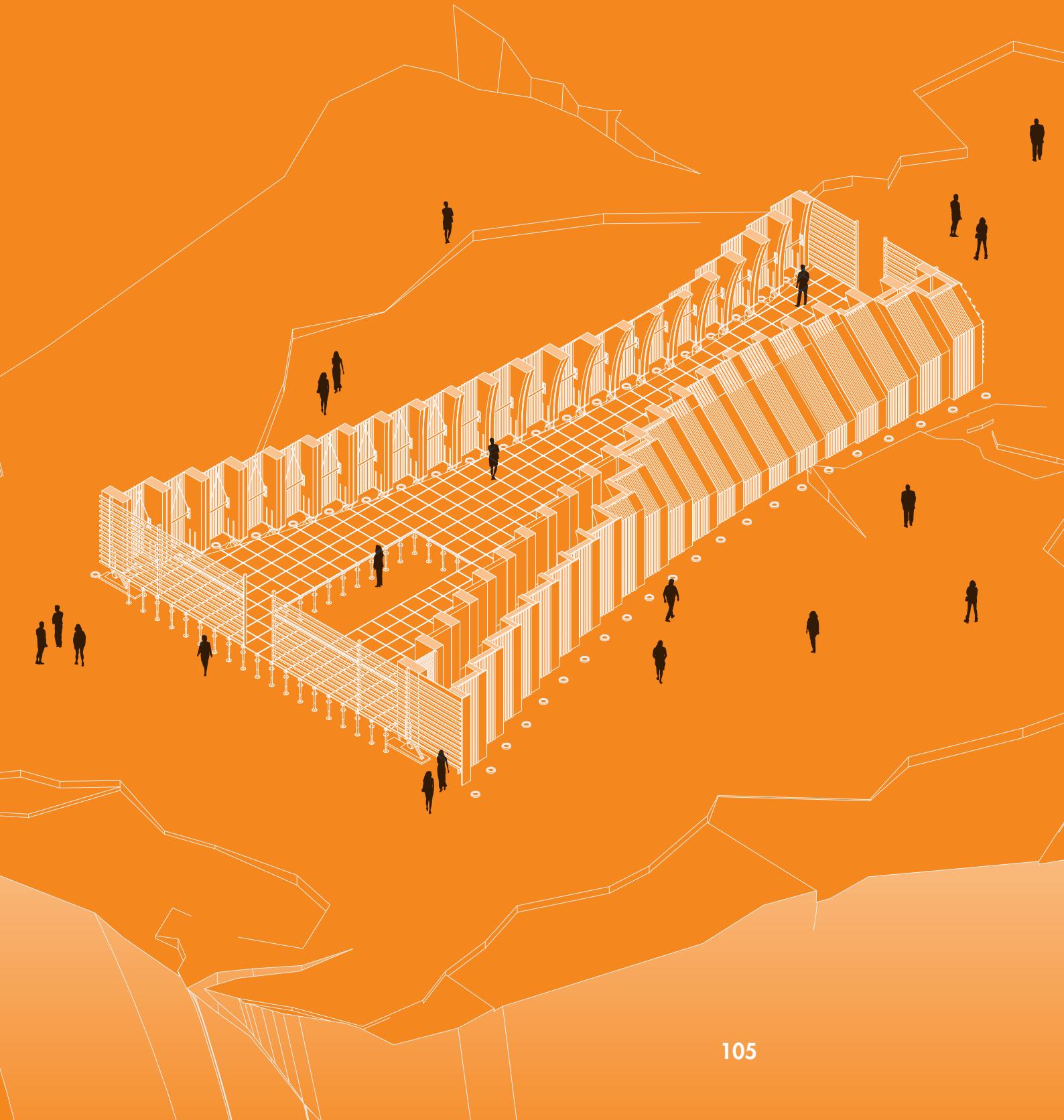








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# DETAILS

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Designing and building is the same thing; the idea that the form and the perception of space is a consequence of its actual realization was what led this thesis. As we have specified the physical model, this is closer to the story of the project because it abolishes the surface of the paper as a barrier between the client and the materialization of the project but, due to its reduced scale, obviously does not consider the human parameter. A building built, that is 1:1 scale, has details that a small-scale model will never show. The idea of Adolf Loos to consider a space as a bundle of walls that define it, is lost when considering the fact that behind that layer of plaster there are junctions, wires, pipes, cables that guarantee the correct functioning of the building; some of these are hidden, others, partly by choice and partly by necessity, are left exposed to influence spatial perception. For instance, in the case of this chapel, it was important to study the attachment of the individual portals, their horizontal connection, the arrangement and the size of the floor tiles since, being an open structure, everything influences its perception. ■



1. Wooden profile, section 3x5cm
2. Portal n. 20 (xlam structure) 68x30cm
3. Horizontal steel connection Ø 5cm
4. Connection steel plate between the wooden portal and the steel horizontal profile
5. Diagonal steel connection
6. Steel hinge
7. Steel plate, level 0
8. Foundation system, ground anchor
9. Floating wooden floor (50x50cm)
10. L steel profile, anchoring of the wooden floor
11. Punctual framework for floating floor
12. IPE steel beam
13. Floor insulation layer, RWR
14. Installations
15. Parquet (sacristy floor)
16. OSB panel
17. Exterior insulation, RWR (8cm)
18. OSB panel
19. Zinc coating
20. Exterior wooden profile
21. Interior door (sacristy access)







1. Wooden profile, section 3x5cm
2. Horizontal steel connection Ø 5cm
3. Portal n. 20 (xlam structure) 68x30cm
4. Steel plate, level 0
5. Floating wooden floor (50x50cm)
6. Rock ground
7. Artificial light



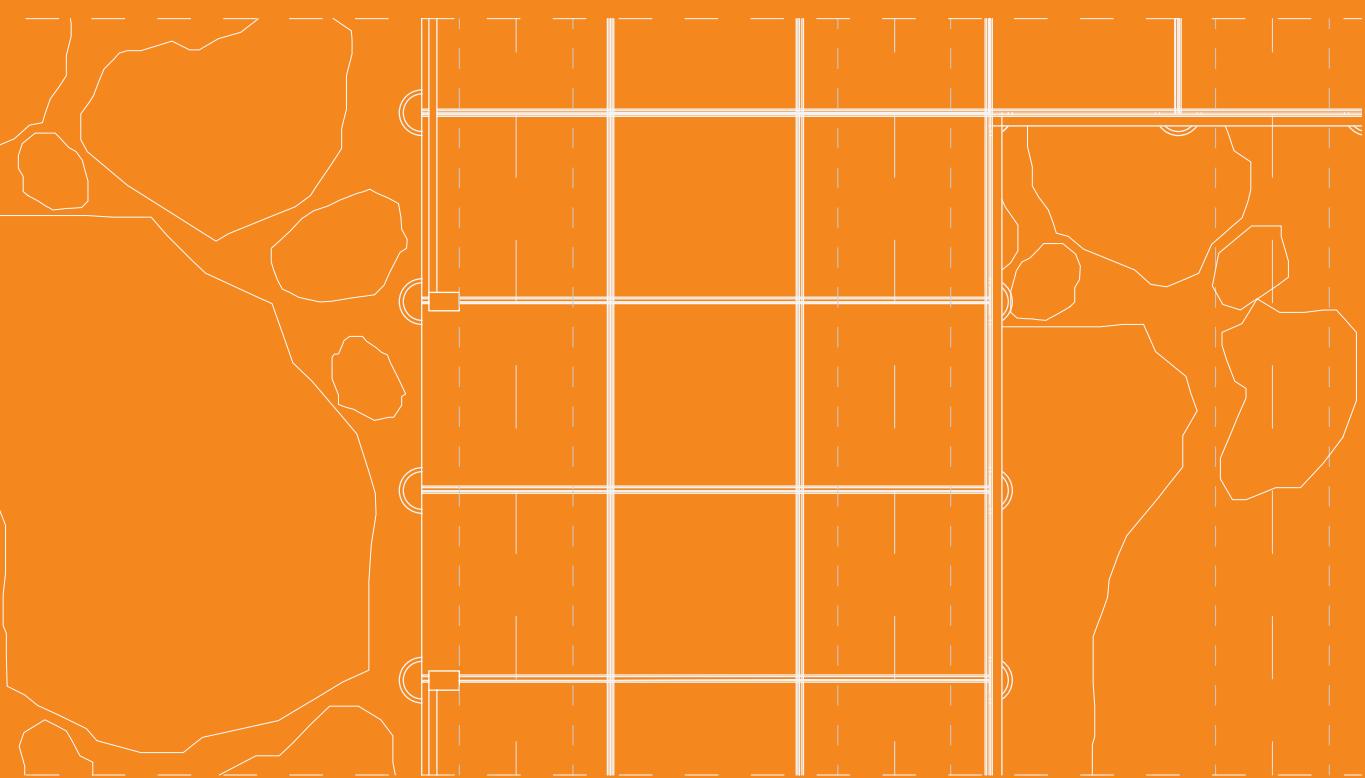


1. Wooden profile, section 3x5cm
2. Horizontal connection, xlam structure  
0 5cm
3. Portal n. 20 (xlam structure) 68x30cm
4. Floating wooden floor (50x50cm)
5. Sagresty floor, parquet
6. OSB panel
7. Exterior insulation, RWR (8cm)
8. OSB panel
9. Zinc coating
10. Exterior wooden profile
11. Interior door (sacristy access)
12. Wooden portal, xlam structure
13. Rock ground
14. Artificial light



0    0.2                    0.8 m

1. Floating wooden floor (50x50cm)
2. Rocky ground (ritual space)
3. Rocky steps
4. L steel profile, anchoring of the wooden floor
5. Steel support for the wooden facade





1. Cloth defining the ritual space
2. Diagonal steel connection
3. Horizontal steel connection 0 5cm
4. Portals (xlam structure)
5. Wooden profiles, section 3x5cm
6. Led light
7. Steel support for the wooden facade
8. Horizontal wooden system (profiles 2x5cm)
9. Steel hinge
10. Steel plate, level 0
11. Foundation system, ground anchor
12. Floating wooden floor (50x50cm)
13. Rocky ground (ritual space)
14. Rocky steps
15. L steel profile, anchoring of the wooden floor
16. Wooden panel (50x50cm), cover of the structural mesh

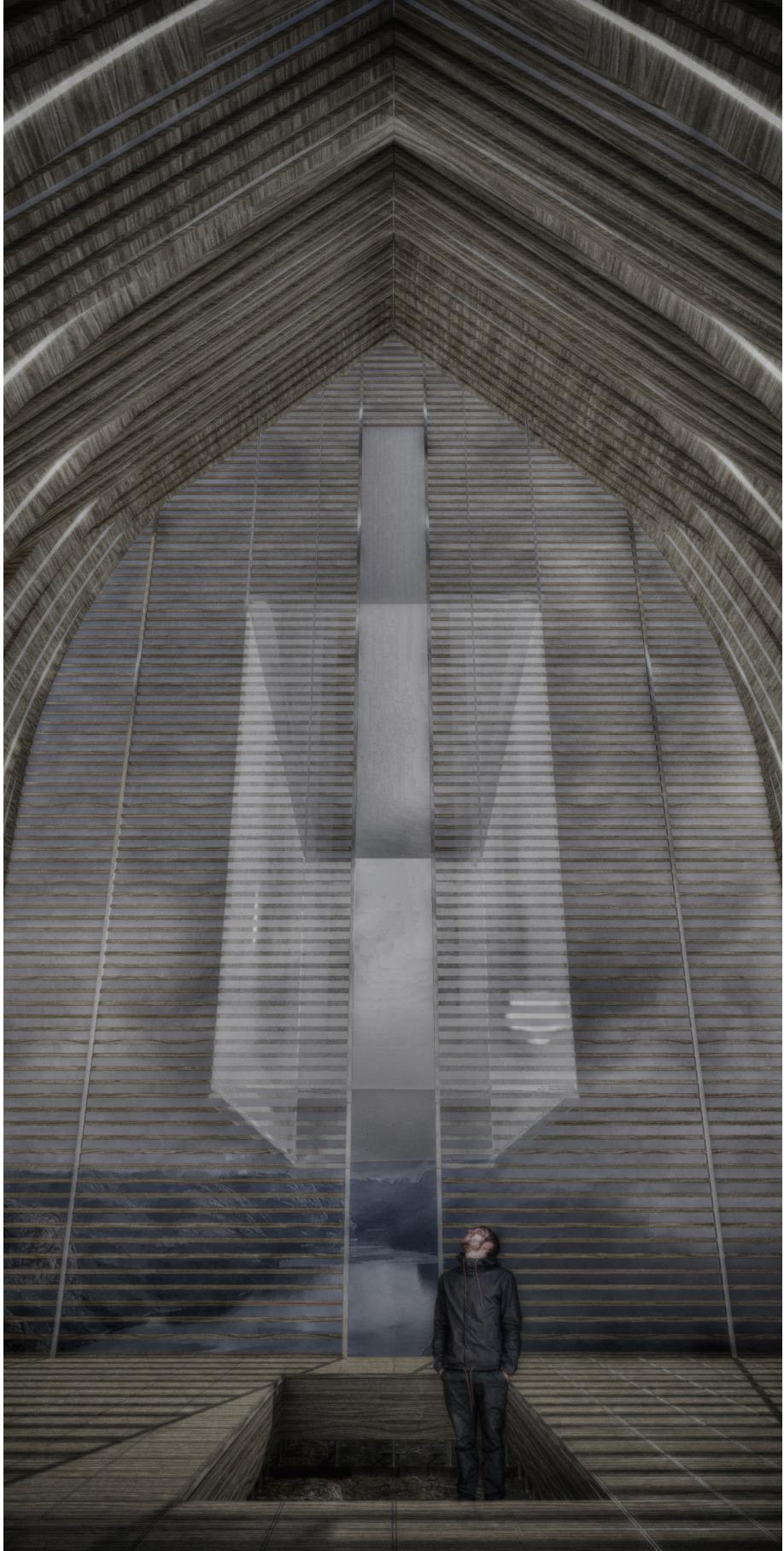












Looking forward to the future

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VR and AR: future applications

## FUTURE APPLICATIONS

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## **VR and AR: future applications**

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*"The primary political and philosophical issue of the next century will be the definition of who we are"*

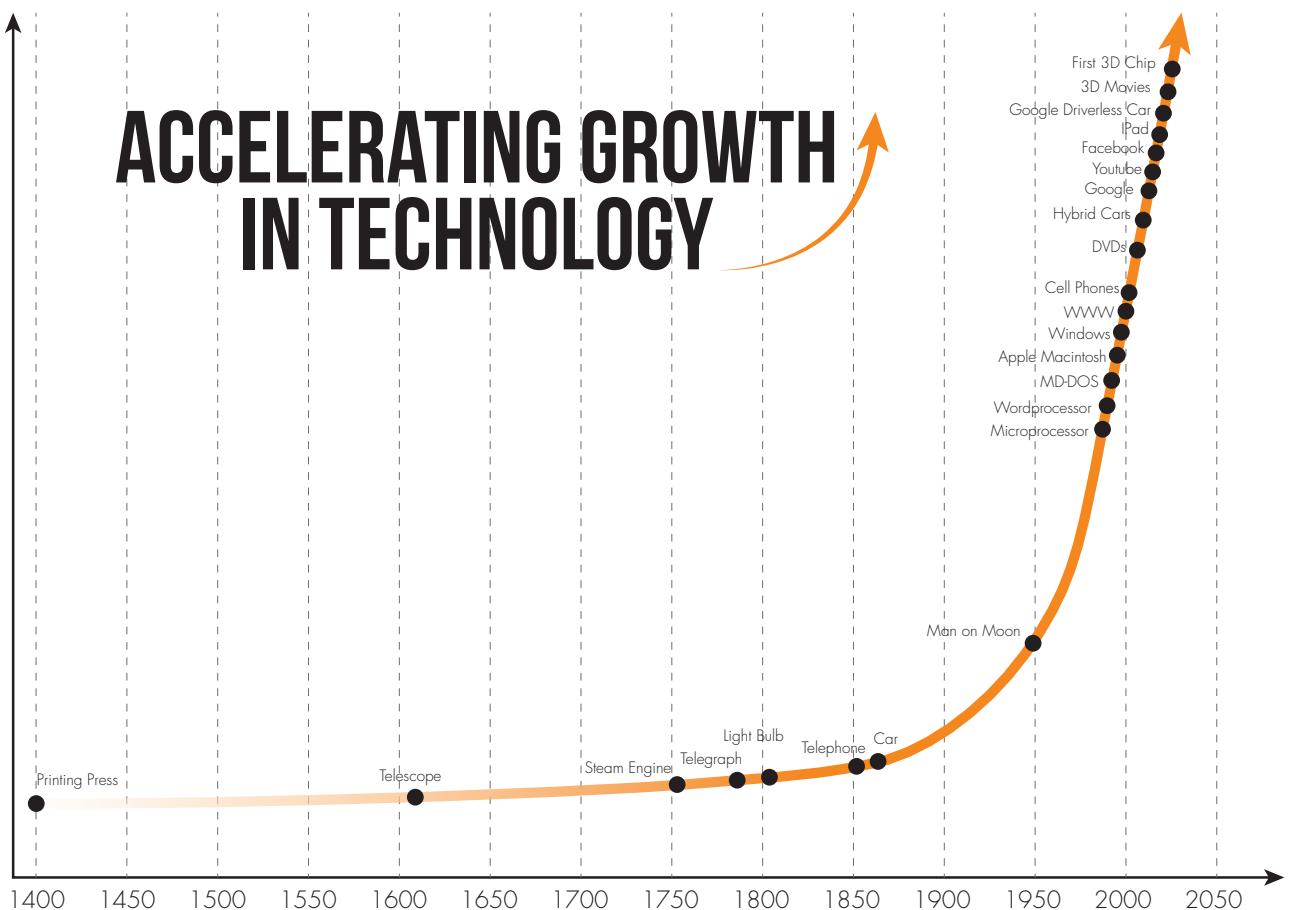
R. Kurzweil

"Technology is an exponential process": these are the words of Ray Kurzweil, inventor, computer scientist and essayist who was a pioneer in optical recognition of characters, as well as in text-to-speech, and now becomes the spokesman of the new progress that humanity will live: the one of its integration of his technologies.

Starting from the historical analysis of technological progress, Kurzweil points out that this is not a linear, but exponential process, this is because, according to the American, an evolutionary process, such as biology

or even technology, accelerates over time. This acceleration is due to the fact that they work by interaction, thus creating a functionality, which they then use to take the next step. If, the pillars of first and human biological evolution are put into a logarithmic scale, then a very clear tendency is deduced: a radical and profound acceleration of the evolutionary process.

This sudden speed about the technological evolution has repercussions also on aspects such as diffusion and consequently the cost of technologies and to explain



this concept, Kurzweil talks about transistors:

"As we make smaller and cheaper transistors, electrons have less distance to travel. They are faster, we have an exponential growth in the speed of the transistors, so the cost of the cycle of a transistor is decreasing, with a half-life of 1.1

years. Add other forms of processors innovation and design, get a value for money in computers that doubles every year.

The result is in practice a deflation, a deflation of 50%. And it's not just with computers. It's true for DNA sequencing, it's true for brain CT scan, it's true for the Internet. "<sup>1</sup>

*The trend of this graph underlines the constantly decreasing time between the developing of new technologies.*

Making the technology available to a large and ever-increasing number of people is precisely the goal that many companies are now trying to pursue, investing in research and development departments to be able to compact and simplify the hardware and software components of the products thus obtaining a lowering of production costs and therefore of final sales to the customer as a final result.

Regarding the world of virtual reality, it is recent news the next release on the market, scheduled for the beginning of 2018, of the Oculus Go, a visor that is presented as the low cost alternative to today's Oculus Rift and HTC Vive. Presented on 11/10/17, will have a price of about \$ 199, functional to the goal stated by Mark Zuckerberg to bring a billion people to virtual reality by the end of next year<sup>2</sup>.

As for the world of augmented reality and its growing and increasingly widespread use in non-specialized sectors, we can mention for instance the app developed by Swedish IKEA called Place, which allows, after a scan through the camera of the smartphone of the desired space,

to place with the correct perspective and size almost any object in the company's catalog.

Even the latest software update released by Apple has introduced the possibility for cameras of the latest Californian smartphone and tablet models to perform functions similar to the field of augmented reality, in particular applied to gaming. It seems that the next operating system will be identified by the initials ROS (reality operating system) containing important innovations regarding virtual and augmented reality applications, with a viewer that will be released on the market probably not before 2020. Apple has also recently introduced ARKit, a platform for creating augmented reality apps for iPhone and iPad. On the dedicated page within the parent company's website it is possible to find some interesting resources that allow you to start programming the basic scenarios in computer language, learning how to manage the fundamental components for creating augmented reality applications.

However, the expansion of the diffusion of these technologies to



*The Oculus Go is believed to be a focal point in the diffusion of VR technologies among common people. With an estimated price of \$199 it will be available by almost a billion people in the next few years.*

non-specialized users poses an ethical problem. The professional is more and more often waiting for the release of new software and new technologies in order to use them professionally to implement what are their capabilities and the services offered by the company to the customer. The investment that the architect is called to support in order to achieve a concrete and high capacity in managing the processes of the ever-new and complicated technologies at the service of the profession is therefore of considerable importance, offering the professional a twofold solution: rely on a paid and specialized

external collaborator or invest time and resources in the first person between video tutorials and direct experience.

Our direct experience in the case of virtual reality, for instance, has led us to learn a series of concepts belonging to specialized spheres not related to our studies, such as computer programming, to obtain the results that most likely, in a few months, will be obtainable by clicking on a button.

It therefore remains to be seen whether what the architect should invest in today is technological training, in order to guarantee a service that is in step with the times, if not in some

cases anticipating some tendencies, or rather on the improvement of those timeless capabilities which, today as in the past, they are necessary for the creation of architectural spaces of functional and formal quality. The trend is ever closer to ensuring an efficient and particular communication of ideas, too often to the detriment of the actual goodness of the same, and it is precisely for this reason that the thesis did not just want to treat the use of virtual reality in communication of the architectural project but also integrate investigating the practical possibilities of the application of this technology for the physical design of the same.

As a result of the increasing diffusion of hardware and software technologies for virtual reality, we also note an ever-widening spectrum of VR applications in the most diverse fields of application. The use of these technologies is particularly suitable for instance for the treatment of phobias such as acrophobia because although the patient knows that what he is seeing with his eyes in the viewer does not belong to reality, unconsciously both the mind and the

body behave as if the opposite were true. The therapy consists in making the patient face obstacles increasing difficulty, overcoming which they realize the fact that their fear of fact does not manifest itself because they are in fact safe. What emerges from these studies is that virtual reality has the same effectiveness of bringing people to face real situations. In fact, bringing an individual affected by acrophobia to a glass elevator of a skyscraper, for instance, provokes in it the same reactions (increase in heartbeat, stomach contractions, panic attacks) that would actually rise towards the top of the London Shard. Other therapeutic applications of this technology concern disorders such as arachnophobia, or aerophobia, or fear of flying, as well as post-traumatic stress disorder.

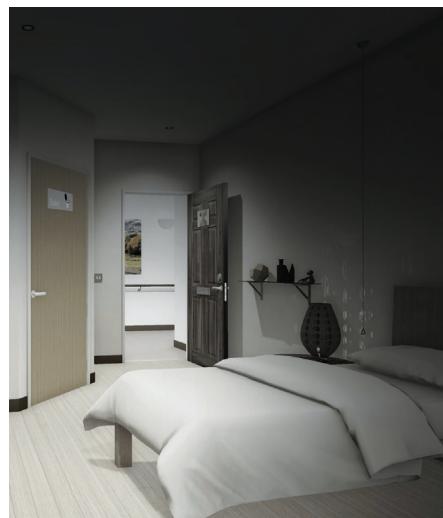
A hybrid use of these technologies, between architecture and medicine, has been experimented by the Scottish architect David Burgher<sup>3</sup>, who has developed a virtual reality application that aims to simulate the differences in visual perception that afflict affected patients. from dementia, so as to help architects to design better spaces. Burgher

collaborated with researchers from the Dementia Center and with the company CGI Wireframe Immersive to create the tool called Virtual Reality Empathy Platform (VR-EP). By wearing the viewer, the architect is able to experience firsthand some symptoms of dementia, such as the reduction of light perception and vivid colors. Burgher therefore believes that this tool can help designers to provide appropriate lighting supplies, to improve the quality of the designed spaces as well as that of homes, hospitals and sheltered housing. Considering that currently there are more than 800,000 people with dementia

in the United Kingdom, estimated to increase to about 1.7 million in 2051, with an estimated cost of their assistance of £ 26 million, it seems very important to be able to improve the design of spaces reserved for the treatment of this disease, and to do so before they are built.

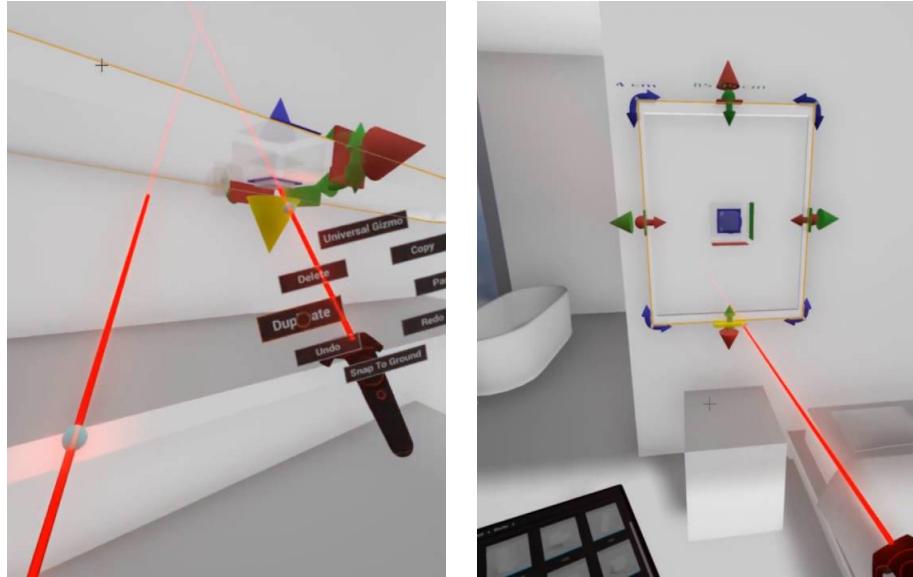
"As well as reducing anxiety, improving the quality of life. Dementia-friendly design," says Burgher." In fact, by using VR-EP, designers will get it right first time and therefore reduce costs. <sup>4</sup>

Returning to the purely architectural sphere, important aspects are materializing in both VR and AR. As for the first, the London studio



*Two 3D views of the same space which underline the different perception of it for dementia-affected people. Rooms seem darker and their colours less brilliant.*

A couple of screenshots taken from VRtisan demonstration video in which they show a completely new way to design space from the VR space by using HTC Vive controllers.



VRtisan<sup>5</sup> offers a tool that allows architects to design spaces in an intuitive way in virtual 3D space through the controllers combined with the viewers that in jargon are called 'wands' (sticks). Their project exploits one of the most widespread software of evolution of virtual reality for gaming Unreal Engine, one of the most widespread with Unity 3D, combined with the set produced by HTC. In the demonstration video we see an operator intent on shaping the space around him by modifying shapes, geometries, dimensions and materials of his surroundings, with

a direct and complete control on the impact that the choices made have on the morphology of space and quality of the same: it is indeed very difficult to explain in words the reliability that the perception of virtual spaces demonstrates in relation to the space actually built. What for now is in fact a proposal, a scenario for the future, according to Ekke Piirisild, a member of the London studio, it seems in fact to be the next frontier of computer design<sup>5</sup>. Designing the spaces within them will probably enable us to relate more closely with them, leading to

greater room quality.

The possible applications concerning these technologies are seen as a very large number, so that through the reading of articles you are daily aware of new studies and research on augmented reality and virtual reality, so it is easy to think that soon these will become components essential of our daily life, going to integrate and enhance actions that so far we carry out in a purely traditional, such as, for instance, shopping or going to the dentist. Virtual reality will

therefore try to interact with real life, and the boundaries between these two similar entities but in some ways decidedly opposed is perhaps one of the most important issues above all ethical regarding these new technologies.

As for the most imaginative forecasts of virtual reality, a film by Steven Spielberg entitled *Ready Player One*, set in 2045, is scheduled for next year, when the American director imagines a society in disarray, living

This artwork drew by a Spielberg's fan clearly illustrates the contrast between the messy real world and the relief coming from the virtual experience.



in the city by the now too developed dimensions, where confusion and crime reign. The only place to find a shelter from the pitfalls of reality is the Oasis, a parallel universe beyond the limits of reality itself and imagination, in which every person can be what he wants, even a superhero, darting through the streets of this world parallel at full speed on futuristic means.

The hypothesis of a parallel world, in which to live one's life in the guise of a virtual alter ego is a reality already experienced in the most famous cases of Second Life or The Sims. The first is defined by the creators as a platform in which to live a parallel life in which, on the other, it is necessary to go to construct architectures, to personalize them according to one's taste.

Nvidia has recently presented a project to create a virtual space called Holodeck (the hologram bridge made famous by the Star Trek film series) in which designers, colleagues and customers will be able to collaborate fully in the 3D environment. In this way the company plans to remove the geographical barriers allowing remote teams to

carry out product reviews, obtaining visual, vocal and gestural feedback with greater ease in real time. The evolution of the products, even as regards the architectural artifacts, in the near future, will therefore undergo significant implementations, both as regards the ease and speed of execution, both for the accuracy and completeness of the understanding of the choices made above all by part of the client who, as mentioned previously, does not always manage to project a two-dimensional drawing into space.

The multinational KPF<sup>6</sup> studio, with offices in New York, London, Shanghai, Hong Kong, Seoul and Abu Dhabi has already begun to develop some of the latest projects on this platform, these are the words of Cobus Bothma, Senior Associate Principal and Applied Research Director of the study: 'NVIDIA Holodeck is going to be able to deliver on this potential, with amazingly accurate visuals and physics. And, the twill allow us to collaborate with designers in our worldwide offices, our partners, and our clients, in real time. That's a powerful game changer for our

industry. <sup>7</sup>

In this final chapter we have collected a series of instances regarding the future of these technologies in fields of application that are in some way similar to the world of architecture, it's up to us now, both as technicians and above all as human beings, to succeed to reconcile virtual and 'real' reality, so that the first helps and possibly improves the second one, without ever going to replace it completely. ■

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#### Notes

**1.** R. ESPOSITO, Kurzweil: La tecnologia è un processo esponenziale, in «strategy.it», <http://startegy.it/kurzweil-la-tecnologia-e-un-processo-esponenziale/>

**2.** J. D'ALESSANDRO, Facebook ci riprova. Arriva Oculus Go, il visore per la realtà virtuale low cost, in «repubblica.it», [http://www.repubblica.it/tecnologia/prodotti/2017/10/11/news/facebook\\_ci\\_riprova\\_arriva\\_oculus\\_go\\_il\\_visore\\_per\\_la\\_realta\\_virtuale\\_low\\_cost-178013930/](http://www.repubblica.it/tecnologia/prodotti/2017/10/11/news/facebook_ci_riprova_arriva_oculus_go_il_visore_per_la_realta_virtuale_low_cost-178013930/)

**3.** J. MAIRS, New virtual reality tool helps architects create dementia-friendly environments, 22 February 2017, in «dezeen.com», <https://www.dezeen.com/2017/02/22/virtual-reality-empathy-platform-tool-help-architects-create-dementia-friendly-environments-david-burgher-aitken-turnbull-wireframe-immersive/>

**4.** See note 3.

**5.** <http://www.vrtisan.co.uk/>

**6.** Watch the video at the following URL: [https://youtu.be/ey9FOk\\_Nmf0](https://youtu.be/ey9FOk_Nmf0)

**7.** <https://www.kpf.com/>

**8.** R. GRASSO, NVIDIA Holodeck, nuova piattaforma per la VR, in Early Access, 10 October 2017, in «hwupgrade.it», [http://www.hwupgrade.it/news/skvideo/nvidia-holodeck-nuova-piattaforma-per-la-vr-in-early-access-video\\_71627.html](http://www.hwupgrade.it/news/skvideo/nvidia-holodeck-nuova-piattaforma-per-la-vr-in-early-access-video_71627.html)

How does this process work in real life?

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From 'why' to 'how'

# APPENDIX

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## From 'why' to 'how'

*"We shape our buildings, and afterwards ours buildings shape us."*

W.Churchill

**A**s we have seen, using virtual reality to communicate ideas and information related to the architectural project, is a huge field of experimentation on which to invest time and resources. Thanks to its immediacy of message and communicative effectiveness, the question arises: how do you approach a virtual experience? The fact that today there is a large number of software capable of satisfying this need makes it really difficult to understand what is the most appropriate approach to the type of result you want to achieve.

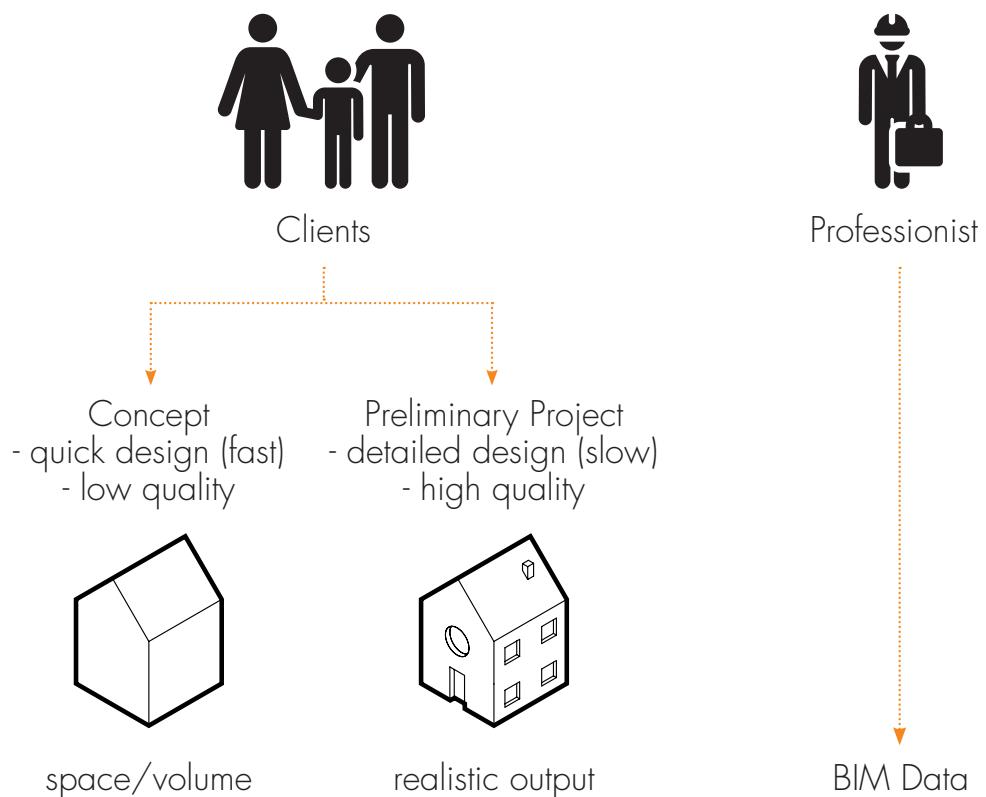
This opens up two deeply different scenarios for two different recipients: the client and the professional. As mentioned in the introduction, Le Corbusier himself had said that "the design is useful only for communicating the idea to the client or to the company"; but this communication should not be different depending on the subject you are addressing?

For instance, the client needs to understand how the designed space will be presented in the future, while the manager, given the experience in the sector and in reading technical

drawings, is more interested in the project objective 'datum', be it a quantity, a cost, a work schedule.

The service that the architect can offer to the customer, however, changes depending on the phase of the project in which it is working: during the concept phase it will be important to see if the volume designed conforms to the evolution of the idea and therefore will need

to have a workflow that allows a rapid and effective communication, during the following phases instead, for instance for a preliminary project, when the idea is consolidated and the project begins to reach a definitive stage, it will be important to define materials, lights, textures as much as possible reality. Speaking therefore in terms of graphics, it will be different depending on the scenario in which



you are. This is summarized in the following diagram.

This opens up the infinite world of software available on the market today. The following are the main programs analyzed by us with pros, cons and potential present and future.

These software are plug-ins or external applications and this means that they rely on the main modeling software. In particular, Autodesk Revit and Graphisoft ArchiCAD are the most widespread BIM programs that have the greatest investments in order to constantly improve their performance, also improving the interaction of the technician with the program itself in order to make

the modeling process as fluid and as possible. effective. As has been specified, these are only modeling programs and therefore not usable for the purpose of obtaining a virtual reality experience. In fact, to create a virtual reality scene, other special software is required that requires pure programming efforts to obtain even the simplest result: UnReal Engine, Unity 3D and Autodesk Stingray are three instances. Let us now analyze the main pros and cons.

We can divide these applications, as quoted by Maurizio Unali, in two different types of interactivity: linear structure systems and non-linear narrative structure systems. In the former, "the communication of



ArchiCAD

open and efficient system  
to share files among BIM  
softwares through IFC format



Revit

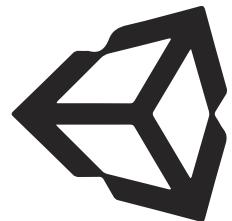
poor IFC compiling leads to loss  
of infos and errors in the compi-  
ling of object categories



ArchiCAD



BimX



Unity 3D



Unreal Engine



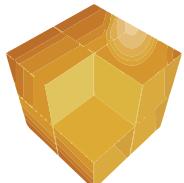
Revit



Live



Stingray



Enscape



Cl3ver



Iris

the project follows a pre-established path and the observer has a passive attitude towards the dynamic representation he witnesses" ; in the seconds instead, "the paths are decided freely by the user". Another way of subdividing these applications is that between mobile applications and those that need fixed locations. Let's start from the first:

### **BimX**

This application is linked to the ArchiCAD software and can be considered a non-linear narrative structure system as it is possible to navigate the entire model without having to create a pre-established path. Resulting from a BIM software, the export keeps most of the information deriving from the intelligent model. To such information contained by default it is possible to add notes and useful links to other professionals that can allow the architect to communicate, for instance, choices regarding furniture or finishes in a more effective and immediate way to the company on site. The export also keeps all the graphic works attached to the

model (plans, elevations, sections and details) with the possibility also to take measures directly on the exported model. In conclusion, this app, currently available for both iOS and Android operating systems can be considered an excellent solution for all those who use ArchiCAD as primary software; the possibility instead of using it starting from a model developed in Revit brings with it the problems related to the export and the subsequent import into ArchiCAD through IFC format, which could almost certainly lead to the loss of important data concerning the BIM elements and the materials applied to them . VR viewing is not currently permitted.

### **Cl3ver**

It is also a mobile application, but it is part of the family of linear structure systems because the navigation takes place by preset points, which we can essentially associate with the 3D views that are saved in the modeling software. Being an online application created to create project presentations, it is possible to access this platform from any BIM and non-BIM software, for which

on the site appear also compatible software such as Google Sketchup or Rhinoceros.

A negative feature of this solution, which nevertheless presents considerable merits in terms of navigation and communication of different possible configurations (for instance, for the cladding of a façade or the layout of an office) of parts of the building, is that it does not preserve the BIM information linked to the original model and for this reason they must be entered manually by the operator, making the procedure long and cumbersome making the use of a BIM software for modeling substantially useless. The latest version of Cl3ver, of recent release, allows visualization in VR with interesting ways of interacting with the model.

### **Revit Live**

This non-linear narrative structure allows to export directly from Revit the BIM model with all the related information through a cloud service, through which a native .lvmh file is then delivered that can only be read by this application. The speed of export obviously depends on the

size of the original file and the times can be very long, a sore note in case a rapid communication of the project is necessary (in some cases the export took up to 30 minutes). Revit Live allows you to view the project on a mobile device or in virtual reality through the use of a workstation or a laptop, maintaining textures, lights and animations.

### **Enscape**

Native in Revit, this nonlinear system allows you to view and edit the model in real time displaying it simultaneously on both laptop and VR. This feature would make Enscape the best choice among all those treated thanks to its speed and effectiveness of communication, however, the failure to view the information BIM within the plugin makes it a perfect application for communication to the customer rather than for an impresario or builder.

### **Iris**

Native in Revit, Iris was born for the visualization of the model in VR. A high level of photorealism is not achieved but, unlike all other software, it is possible to interact

with the model by investigating the names of the BIM elements, turning on display layers that are inherited from the BIM hierarchical structure and making key notes by writing in 3D directly in the three-dimensional model. It has the ability to interact in real time with the position of the sun changing the time of day, thus verifying the interaction of sunlight with the materials, textures and spaces. Another feature that makes it extremely competitive is the possibility to create section plans that can help the project communication, which can also be reduced in scale up to the 'plastic' format for a complete view, both in walkthrough mode.

### ***Stingray, Unreal Engine and Unity 3D***

Unlike the software mentioned above, which do not have a high quality graphic display, these three are born with the intent to achieve very high levels of photorealism, necessary when talking about video games.

However, it should be stressed that the construction of a VR scene is not immediate, it is in fact necessary notions of computer programming

(Autodesk Stingray uses for instance the language LUA, which is not even among the most widespread in the gaming environment) in order to achieve the desired effect and for this reason the use of such software appears to be still very far from the skills and possibilities of a medium-sized architecture firm.

While Unreal Engine and Unity 3D, being external to the BIM world and designed exclusively for the creation of virtual games, do not maintain information and data of the project, Stingray is the one that could most satisfy the important need for data communication in a virtual environment. Being part of the new workflow developed by Autodesk called Live Design, Stingray is in fact able to maintain the information contained in the BIM model even after exporting through the cloud even if, given the difficulties encountered as previously mentioned in the writing of the programming strips, we have not had the opportunity to put into practice a project that has remained unchanged.

In order to choose the most suitable workflow it is necessary to consider the temporal factor above all, ie

how much time a program requires to the operator in order to reach the desired result. For a client, especially in the initial phase of the project, it is important to show the object of study in virtual reality immediately and it is therefore essential to have software that allows a quick export of the latest updated version of the model. This is not at all simple and taken for granted especially when considering the constant application of changes to the project during construction. Thinking of investing time and resources in building a virtual scene that, most likely, will have to be redone for the following meeting with the client, obviously does not make sense as it would represent a waste of time and resources. For this reason it is important to immediately evaluate the amount of hours required by the scene to be presented keeping in mind the "design-communication" binomial. The following is a time-effort analysis for each of the aforementioned software in order to evaluate the most effective workflow. Following this analysis, the Live Design workflow seems to be the one that most respects the

prerogatives of which we spoke at the beginning of this chapter for what concerns the relationship and communication of the designer with the manager. Once the BIM project in Revit has been modeled and defined, it is possible through a simple, but as we said not always instantaneous export reach the Live platform that supports both the mobile version of the model (with all related information, which however can not yet be filtered but they come in the form of a scrolling list) and the VR version is not photorealistic but in any case manages to convey a clear idea of the configuration of the designed space. With the subsequent passage in Stingray and the consequent setting up of a scene for which it demonstrates, as already stated above, the mastery of the programming language is necessary, the final result undergoes a remarkable implementation for what concerns the fidelity of the materials and the lights, to the logical detriment of an important use in terms of time.

Therefore, the workflow developed by Autodesk seems to be able to cover, although through three

different softwares, all or almost the spectrum of communication needs highlighted both by the research conducted on this type of software, and through the direct experience gained on the occasion of the preparation of this Master's thesis in Architecture Building City. ■

