Between Freedom and Control

An experimental Design Method

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Abstract

Architecture field is constantly fed by knowledge deriving from other disciplines and influenced by numerous technical and social factors. Given this situation, is there any freedom for the architect? What control can he exercise over the result of his work?
This thesis reasons about the concept of freedom applied to the field of architecture, trying to give an answer to these questions. The reasoning is based on Popper's lecture *Of Clouds and Clocks* in which the philosopher tries to give an answer to the problem of human freedom.
The reflections on the concept of freedom have been directly connected to the application of an experimental design method. The method provides for the decryption of the connectivity and visibility rules of an existing building and the encryption of these in a new context, which will therefore be redesigned.
The experiment was conducted on the Schwedenplatz area in the center of Vienna, using Tadao Ando's museum 21_21 DESIGN SIGHT as reference building.
The experiment carried out has made it possible to ascertain that the architect's freedom is the essential condition for the project to exist, but this must be balanced by adequate control over external impositions and the physical features of the project sight.

Introduction

The following dissertation introduces a new architectural design method developed by the lecturers Michael Robert Doyle and Matteo Riccardo Villa at the Technische Universität Wien within a Design Studio I attended last year, as an Erasmus student.

Although my work is inspired by my teachers' ideas and follows their footsteps as far as the application of the method is concerned, I am not sure that the interpretation I have given to the method itself reflects their own.

The application of the method, which is very peremptory, has in fact given rise to a reflection on the architect's freedom, which is based on Karl Popper's lecture *Of Clouds and Clocks*[1].
In this lecture Popper tries to give an answer to the problem of man's freedom, making an excursus on the various answers given to the problem in the history and using them to create a new theory. He adopts the image of a pendulum clock to objectivate a deterministic physical systems with regular, orderly and highly predictable behavior. Clouds instead represent an indeterministic physical system, which is highly irregular, disorderly and more or less unpredictable.

Neither the deterministic nor the indeterministic point of view admit the freedom of man. In the first case, each cause corresponds to an effect and the human being cannot intervene in any way on the final result. In the second case he is at the mercy of chance.

The experimental method explored in this work, which will be exhaustively described in the following pages, is like a designing machine that can lead to the creation of innumerable alternative scenarios. It feeds on architecture to create new architecture.

The first steps of the method bounce between determinism and indeterminism and the designer has no freedom. The only thing

[1] Karl Popper, *Objective Knowledge. An Evolutionary Approach* (Oxford: Clarendon Press, 1979), 206-255.

he can do is decide to turn on this mechanism and put the raw material inside this machine.

Raw material is an existing building, or more precisely connectivity and visibility rules that govern the fruition of its spaces. These are subjected to a decryption process, understood in the IT sense as the conversion of encoded data into readable text. Here the data are expressed by diagrams in which each room is identified by a node and their connections, physical or visual, are represented by edges.

Decryption is deterministic, a work of reading and transcription; no creativity is required. This is the aspect that Popper most reproaches from the deterministic vision of reality: the annihilation of human creativity.

In the next step the decrypted data must be re-encrypted in a new space. This space needs to have the same number of nodes of the building used as reference.

The building's nodes can be projected on the site according to a defined number of combinations which depends on the nodes total amount. It is completely impossible to predict how the nodes will distribute themselves on the project site, as much is impossible to predict the exact position of clouds in the sky.
This passage is consistent with a indeterministic worldview, which according to Popper is the prerequisite for being able to assert the existence of human freedom. In fact, indeterminism only states that not all effects can be foreseeable because the causes can hardly be fully known.

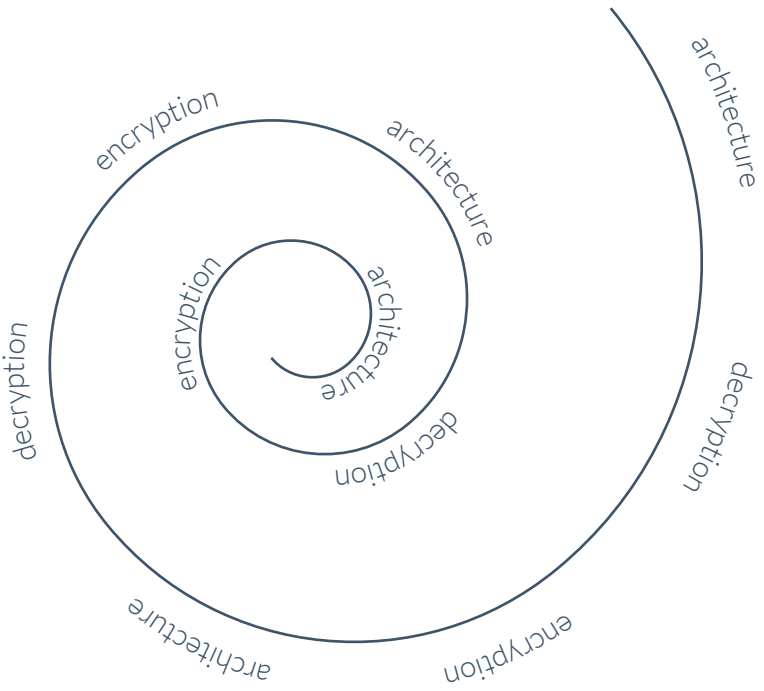
Until here, the method has little to do with architecture and architectural design. It is a mere act of obedience to external rules, dictated by the method itself, which replace those of reality. Whether the rules lead to predictable or totally random results, in both cases the designer has no freedom.
Popper's explanation goes further because indeterminism itself, seen as randomness, doesn't allow freedom. It would mean that man has no control over his actions, therefore he could not have merits or demerits and, as a consequence, no responsibility.

Control is the key to the explanation of human freedom and in this thesis I tried to apply the concepts expressed by Popper to the architecture field.

In the last phase of the method the designer takes indeed the control because he decides how to change the project site in order to make it obey to the diagram's rules. His creativity gives the machine the energy necessary to carry out the project.

However, being the method placed on an abstractlevel, when one enters the design reality there can be a clash between the two. The randomness with which nodes project themselves on the site can be a problem when the rules of visibility and connectivity must be embodied in a three-dimensional fabric that already has its own rules.

In this experiment I testerd the method using the museum 21_21 DESIGN SIGHT by Tadao Ando as reference building and applied it in the Schwedenplatz area, in Vienna.
Critical points of the method and design outcomes will be illustrated in the following pages.



Of Clouds and Clocks.
An approach to the problem of rationality and the freedom of man

The design method applied in this thesis work follows philosopher's K. Popper thoughts on human freedom, and in particular the lecture *Of Clouds and Clocks. An approach to the problem of rationality and the freedom of man*. This was held during the second Arthur Holly Compton Memorial Lecture at Washington University on 21 April 1965[1].

I think it might be useful to delve into the content of this text.

Popper, as the title suggest, address the problem of the freedom of men. The philosopher himself outlines that this is an ancient problem and that many thinkers tried to solve it; among them also Compton whose thoughts are used as a starting point for reasoning[2]. Nevertheless Popper, reconstructing the history of theories on the argument, tries to give a new personal solution to the problem. The answer he gives it is not only a defense of human freedom, but also of human creativity and rationality. Moreover it is a reminder of the responsibility that people have when they can choose and act freely[3].

To facilitate the reasoning on the issue, Popper uses the images of the clouds and the clocks. About clouds he says that they «represent a physical systems which, like gases, are highly irregular, disorderly, and more or less unpredictable», while clocks «represent physical systems which are regular, orderly, and highly predictable in their behavior»[4]. He asks the public to imagine a schema where some disordered clouds are positioned on the left and a highly precise pendulum on the right. In the middle there may be other elements, moved more or less towards one of the two extremes, depending on their

[1] K. Popper, *Objective [...]*. cit., 206.

[2] Arthur Holly Compton, *The Freedom of Man* (New Haven : Yale University press, 1935), *The Human Meaning of Science* (Chapel Hill: The University of North Carolina press, 1940).

[3] Peter Clark, 'Popper and Determinism,' in *Karl Popper: philosophy and problems* ed. Anthony O'Hear (Cambridge: Cambridge University Press, 1995), 149.

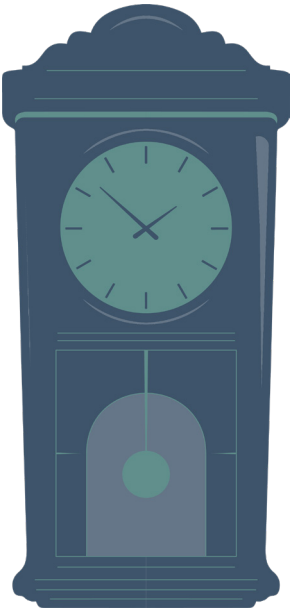
[4] K. Popper. ivi., 207.

highly irregular

disorderly

more or less unpredictable

open physical system



regular

orderly

higlhly predictable

closed physical system

degree of predictability. Ultimately clocks represent physical determinism, while clouds represent physical indeterminism.

Physical determinism is described by Popper as «the doctrine that all clouds are clocks». This expression wants to indicate the complete confidence, spread among the intellectuals of the time after the formulation of Newton's theories, in the fact that all the events that happen on Earth, including human behavior, could be explained scientifically. From this perspective, each cause corresponds to an effect and vice versa, everything is predictable.

The world is seen as a physically closed system, where the elements that constitute it interact only between themselves, according to pre-established laws, and do not allow external interactions.

> «[...]in the perfect deterministic physical world there is simply no room for any outside intervention. Everything that happens in such a world is physically predetermined, including all our movements and therefore all our actions. Thus all our thoughts, feelings, and efforts can have no practical influence upon what happens in the physical world: they are, if not mere illusions, at best superfluous byproducts ('epiphenomena') of physical events»[5].

This means that men have no freedom and that there is no room for creativity because anyone, being in the same starting physical conditions as, for example, Beethoven, to follow Popper, would have composed the Fifth Symphony. To get closer to the world of architecture, anyone who had found himself in the same conditions as Vitruvius would have written *De Architectura*, using the same words.
If there is no freedom there is no responsibility, because «one is free or morally responsible for what one has done only if one could have done otherwise than one did in exactly the same circumstances»[6].

Popper identifies such a world with a nightmare and he goes out of his way to explain, following Laplace, why the model can only be applied to a few limited cases. According to the two scholars, it is in fact possible to predict the effects only when it is feasible to fully know the initial conditions of the physical system that obeys Newton's mechanical laws. In other words, it is necessary to be able to quantify all its state variables, at a certain instant. But according to Popper, no machine or computer would be

[5] K. Popper. *Objective [...]*. cit., 217.

[6] Peter Clark, *Popper [...]*. cit., 152.

able to analyze this kind of data while being part of the physical system it is examining because this would imply also multiple degrees of introspective numerical analysis[7].

But deterministic conception was abandoned by most of physicists with the advent of the new quantum theories, to which Max Planck, Erwin Schrödinger and Albert Einstein made a great contribution.

The funny thing is that these scientists did not immediately abandon the deterministic view of the world, nor did Newton ever claim that his theories could explain everything[8].

Another contribution to quantum physics was given in 1927 by Werner Karl Heisenberg and his *uncertainty principle*, according to which it is impossible to know all the properties of an object at the same time. In particular it is not possible to know its position and its velocity at the same time with precision. The margin of error is small, so the principle takes on meaning only for atomic and subatomic particles. But this principle paved the way for physical indeterminism: as already mentioned above, not all events can be predetermined because it is not always possible to understand their cause in its entirety.

According to Popper, adhering to the physical indeterministic vision of the world is the prerequisite for giving an answer to the problem of human freedom. Physical determinism nullifies the problem. But indeterminism in itself is not enough, especially if determinism is opposed to chance, as Hume and M. Schlick did. Randomness does not give man freedom, but an excuse for not taking responsibility. It doesn't even give him credit when he deserves it[9].

Could chance explain actions of humans endowed with reason? For Popper the answer is no. He believes that it is undeniable that «nonphysical things as purposes, deliberations, plans, decisions, theories, intentions, and values, can play a part in bringing about physical changes in the physical world»[10]. In order to explain how, he traces a new general theory of evolution. The theory gives an answer to two problem: how human behavior is influenced by abstract meanings (Compton's problem) and how thoughts can have an influence on body movements (Descartes' problem).

Compton's theorized that human actions is not only chance, but

[7] Peter Clark, *Popper [...]*. cit., 154.

[8] K. Popper. *Objective [...]*. cit., 211-214.

[9] K. Popper. Ibidem, 226 - 227.

[10] K. Popper. Ibidem, 229.

a combination of freedom and control, that Popper called *plastic control*, in contrast with the rigi*d cast-iron control*. This is way, for example, we can feel forced to respect a commitment previously made, but the way we respect it is free. In addition, respect for the word given is a choice and a deliberations that require a process of maturation. They do exist sudden decisions, but deliberation works «by the method of trial and error-elimination: by tentatively proposing various possibilities, and eliminating those which do not seem adequate»[11].

With the plastic control theory also Descartes' problem can be explained. Popper indeed associates involuntary or voluntary movements of the human body with the lower functions of the language (distinction made by Karl Bühler): symptomatic or expressive and releasing or signaling function. These functions, which are always present, are common to animals and humans, while the highest, which have evolved over time, belong only to man. These are the descriptive and argumentative functions. While descriptive statements may be true or false, argumentative statements may be valid or invalid.

Argumentative function is considered by Popper the most powerful medium for biological adaptation. It is the basis for dialogue, critical discussion and the development of rationality. Critical arguments are suitable for the application of trial and error-elimination method, therefore they are a selection tool. Thus it is fundamental also for the validation of scientific theories, which must be submitted for discussion and respect the principle of non-falsifiability. In addition, the major functions exercise a plastic control over the lower functions and this is the explanation that Popper gives to Descartes' problem.

This leads Popper to say that human evolution and in particular the argumentative function of language, has led to the formulation of abstract contents. Drawing conclusions and abstract meanings that can be basis for our future behavior is part of the human attitude and has contributed to the evolution of the species and of consciousness. However, conclusions must be subject to critical discussion and open to re-evaluation. In this way they have control on us, but we also have control on them. Here stays the balance between freedom and control.

Argumentative language can be counted among the extra-personal tools that man has created in his evolution. According to Samuel Butler theory, while animals evolution proceeds mostly by developing organs, human evolution proceeds by the creation of instruments outside the body. Some animals do it too, but in a very rudimentary way.

[11] K. Popper. *Objective [...]*. cit., 232-234.

Among these tools the most interesting are those that help memory, like all objects that allow writing and ultimately computers[12]. In fact, writing can also be useful for organizing arguments, as well as a way to pass them on.

So the solution of the problem of men's freedom is somewhere in the middle between the pendulum clock and the clouds, between determinism and indeterminism, predictability and chance. If you position yourself more to the right or to the left in the initial schema, freedom will be a mere illusion.
≪Popper suggests that the behavior of the system as a whole is influenced in its large scale apparently deterministic properties by the behavior of the indeterministic variables≫[13]. The functioning of the pendulum is not indeed perfect, because even the most perfect of the clocks will be influenced by imperceptible physical phenomena and the behavior of the clouds of the climate are foreseeable phenomena for a short period of time.

Popper does not believe that his explanation is complete or definitive, but it seems to me that it can be easily applied to any type of project.

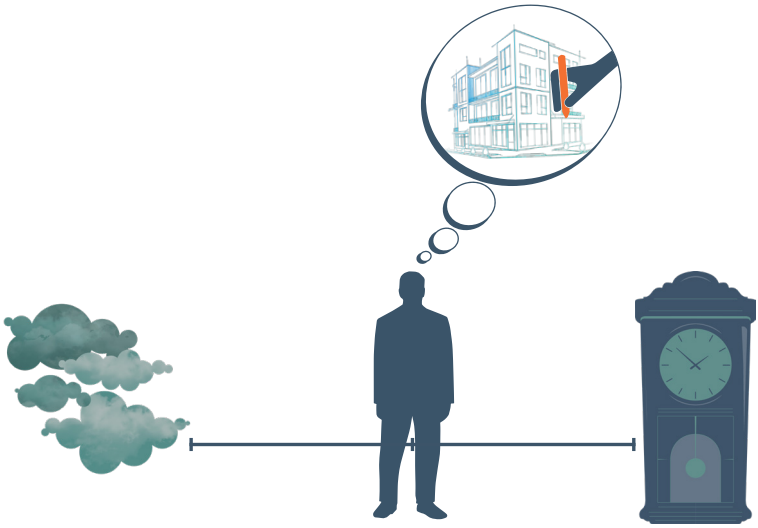
First of all, if man is not believed to have freedom and control, can he make plans?
If we think in a deterministic way every cause has an effect. Where stands the choice? At best, it can be said that, given the starting conditions, only one of the possible choices could actually be made. But this is not a plan. If we think in an indeterministic way, it is very difficult to predict what could happen in the future, therefore it is almost impossible to make plans. Maybe my conclusions are simplistic and certainly not up to Popper's, but I think the issue is of central importance in the field of architecture.

Architectural design is in fact a particular type of plan. Plans and architectural design can exist only if it is admitted that man has freedom and control, that there is freedom of choice. And, moreover, that man is a rational animal capable of arguing and criticizing his choices.
Who designs does not seek to predict the future, but to lay the foundations for this to be achieved. He has no control on the future, nor on the past, but he can control the design process. An architect who approaches a project tries to get to know the problem he is facing and begins to think about design hypotheses and a certain degree of creativity it may be needed. Alternatives of every detail are screened according to the trial and error

[12] K. Popper. ibidem, 235-239.

[13] Peter Clark, *Popper [...]*. cit., 162.

method, to reach the most suitable solution. Calculations and tests are carried out, verification of compliance with external and even personal standards. Architecture is indeed a 'weak' discipline because it involves relation between subjects and object[14]. Therefore it is not self-validating it can be assimilated to an open physical system.
During the design process new problems can arise, others can be solved almost by chance, still others can be insurmountable. However, this procedure can only be done during the project phases. Changes to the project can also be implemented during the construction phase and some adjustments can also be made later. But the moment of greatest freedom and control that the architect has is the moment of the project and therefore of the drawing. As indeed someone has pointed out, the architect does not produce buildings, but drawings[15]. And in their realization it uses not only its ability to solve problems, but also its own personal taste and its own interpretation of phenomena.



freedom

control

creativity

[14] Mark Cousins, 'Building an Architect'. ed. Jonathan Hill, *Occupying Architecture. Between the Architect and the User* (London and New York: Routledge, 1998),13–22.
[15] Jonathan Hill. *Immaterial architecture (Abingdon, Oxon: Routledge, 2006)*, 56.

Freedom in architecture

I would now like to go deeper into the reality of the architect. How much freedom does the architect really have in the practice of his profession? What are the factors that control it?

Up to now we have talked about the freedom of man, as if he were the only one to have plastic-control over himself. Though man hardly lives in an isolated context but within a society where there are always external, explicit or implicit, impositions. Laws, standards or norms, among others, are the explicit ones. It could be argued that, being such, the control is not of the plastic type, but rather very rigid. This may be true within dictatorial political systems, but not for the democratic ones.

In a democratic regime, rules and laws are the product of a common consciousness that has evolved over time. They must be accepted by citizens, who in this way partially deprive themselves of their power and their freedom for the common good. However, society is constantly evolving and the laws can be changed if the majority believes that they no longer have value. New laws can also be incorporated into the corpus. Control remains of the plastic type, since laws are continuously subjected to the trial and error method, but it is undeniable that it has a certain degree of rigidity.

With implicit impositions I mean instead the traditions, beliefs, customs, tastes, fashions that a society spontaneously shares. Everyone can create a personal opinion and go against the common one. And precisely the voices outside the chorus often led to important advances in the evolution of man's thought and knowledge or gave way to new currents in the artistic field. But this often had a personal cost: many of these revolutionary geniuses were misunderstood, criticized and marginalized at their time. The need to fit into a context and to please the public is in fact a limitation of the freedom of the individual, a kind of control with which anyone must deal daily, often unconsciously. However, it is our choice to decide how much weight to give to these social pressures and the way we react to them is a personal choice.

Plastic control, could be then subdivided in two categories to underline the fact that there are different degrees of control and freedom: *thermoplastic control* for implicit impositions and *thermosetting control* for the explicit ones.

Architecture among the other creative disciplines, is the less libertarian, as Owen Hopkin pointed out. There are indeed a lot of constrains in the practice of architecture linked, for example, to structural safety, sanitation requirements, performance of building components, building and urban planning parameters and standards. Furthermore, the architect's professional life is made up of collaborations, discussions and compromises. For these reasons, Hopkin believes that an architect can't have individual freedom[1]. But, as he also remarks, absolute individual freedom does not exist for anyone, we all have to deal with external imposition in every domain of our life.

Another issue closely related to that of architect's freedom is that he is often called upon to design spaces that can encourage users' freedom. But as Peggy Deamer points out <<architecture cannot produce spaces of freedom – public spaces, healthy spaces, accessible spaces, affordable spaces, sensually liberating spaces – for the society architects presume to serve if they are produced in unfree circumstances>>. Is it indeed impossible to give form to an unknown abstract concept[2].

In any case, the goal of promoting user freedom within a space is not easy to accomplish. There are many possible interpretations that architects can propose for the problem and many interpretations that users can give to architect's solutions. Moreover an architectural element can also take away freedom. For example a wall can trace a limit that before was freely crossable. But a wall can also be a means of protection, as in the case of retaining walls. Even the same wall can give freedom to someone, taking it away from others. For instance, the walls that delimit the garden of a school allow children to play freely, preventing access to strangers.

As we have seen, the concept of freedom in architecture is rather feeble. The risk for the architect to impose his own vision of reality is always lurking, together with the risk of taking too much freedom. This problem is outlined by Armando and Durbiano in their dissertation about the 'author architect', who as a connoisseur of the immutable laws of architecture, believes he can translate them into form with maximum

[1] Owen Hopkin, 'Architecture and the Paradox of Freedom', *Architectural Design* (88, no. 3, 2018), 6-15.

[2] Peggy Deamer, '(Un)Free Work, Architecture, Labour and Self-Determination'. *Architectural Design* (88, no. 3, 2018), 16–23.

freedom of choice[3]. This interpretation of the project does not reflect the personal one of the two authors. It is indeed seen as a tridimensional objectivation of ideal principles and therefore it is quite deterministic. The author architect, even if he places himself above the system he is analyzing, is the means by which the cause leads to the effect.

But we have already demonstrated that causes and principles are relative and that freedom can't exist without control, partially held by the society in which the architect acts.

So we could conclude that the architectural project is nothing more than a balance between different freedoms, personal and collective, as Hopkins also pointed out[4].

I believe that this is one of the most peculiar characteristics of the architect's profession, and that it is here that his responsibility towards what he designs also lies.

[3] Alessandro Armando, Giovanni Durbiano, *Teoria del progetto architettonico. Dai disegni agli effetti* (Roma: Carocci editore, 2017), 53 - 68.
[4] Owen Hopkin, *'Architecture [...]'.* cit.

An experimental method

The design method I experimented in this thesis work was envisioned by lecturers Michael Robert Doyle and Matteo Riccardo Villa at the Technische Universität Wien. Its application was explored within the Design Studio 'Ground' during the first semester of the academic year 2018-2019. The name was chosen to put the accent on the morphology of the design site and more generally on the fact that ground is not a two-dimensional plane on which carefully studied three-dimensional elements rest. Is it indeed a three-dimensional element itself that can be shaped. It must sound obvious for someone, but for me it was an epiphany. As a student in most cases I thought about the differences in height as nuisances to be eliminated. And when I had to deal with existing different altitudes or even when it happened to create new ones, I have always seen them as a necessity and never as an opportunity. As an element of service to the 'real project', and not an element with its own identity and dignity.

The method they thought is divided into two stages: the first which leads to the construction of a project and the second which builds a narrative frame for it, using excerpts of descriptive texts existing in the literature. These must be partially modified and adapted to the design context, which in turn is influenced by the text and enriched with details extraneous to it. For example, we used some extracts from Journey to the center of the earth by Jules Verne. Some lines described the species of plants seen by the protagonists during their exploration and these have been included in our project.

In my thesis work I focused on the first stage of the method as I found its connection with the previous discussion on architect's freedom very interesting. The application of the method is indeed articulated between determinism and indeterminism, trying to balance freedom and control.

The method starts from the analysis of an existing building that will function as reference for all the next steps. It can be any kind of building, of any age and with any function. At this stage of the process the only condition as regards the choice

of the building is the availability of information about its spatial organization. I refer to plans, elevations, sections, photos, videos; in general everything that provides information on how the various rooms interact with each other. The possibility of personally accessing the structure is certainly an advantage, but not a must. An unrealized project could also be used, if the drawings are sufficient to describe it in all its parts.

The number of possible reference buildings is indefinable. There is no certain data about it and not everyone has access to information equally. But all of us, from our personal experience, as we do nothing but move from one building to another continuously, can get an idea of how great this value can be. This means that this method, although rigid and schematic, is able to support the creation of infinite scenarios.

After the selection of the building, there is the decryption operation: encrypted data, namely the rules of connectivity and visibility, are translated into legible diagrams.

Each space of the building must now be identified with a node. These must then be inserted in a connectivity step depth graph where the connections between the nodes are represented by edges. In other words, the graph shows the paths that can be travelled inside the building starting from node 1, that matches the entrance.
In a second graph edges will instead represent the visibility between those spaces. To say, if two rooms are separated by a glazed door, the transparency of the glass allows two people standing on opposite sides of the door to see each other while this does not happen if the door is completely opaque. In the first case the nodes of the two environments are connected by an edge, in the second not.

Decryption is very deterministic: to every three-dimensional space existing in reality corresponds a node on the paper, to every possible path a set of lines. It works like Popper's pendulum clock, and as the pendulum it is not perfect. There could indeed be errors, or rather different interpretations, in identifying the nodes. Take the case of the toilets of a public building. It is up to those who identify the nodes to decide whether to consider the functional group as a whole or whether to consider each partition within it.

The rules previously decrypted and represented in the diagrams must then be re-encoded in another space. Both within the Design Studio and in my personal work, the method has been tested on public spaces. However, I have reasons to believe that it can also be used to create new buildings.
The choice of the reference building and that of the project site

do not have a temporal order. It is indifferent which is done first, but a precaution so that the rest of the procedure is facilitated can be to verify that it is possible to identify the same number of nodes both in the reference building and on the site. Certainly identifying nodes in an urban space is not immediate, and this is another criterion to be taken into consideration. There are no rooms clearly defined by walls, but there are clearings and flower beds, paths, different floors, canopies which can be equally recognizable. The site therefore cannot be totally empty, but must have obvious subdivisions.

Deciding that a portion of the site is a node means that most likely that portion will be modified by the project.

At this point of the procedure we have a reference building with a certain number of nodes and a project site with the same amount of partitions on which the knots can be projected. The projected nodes carry with them their connectivity and visibility properties. The design project in fact consists in modifying the urban fabric and the existing connections to make them adhere to the diagrams decoded by the reference building. The focus is placed on the connections, emphasizing the relationship between the spaces. The design of the spaces is secondary, but necessary, as inviting spaces can entice the user to move towards them. It makes no sense to build paths that lead to nothing, unless the void is intentionally meant to be the main attraction of a space.

The nodes projection occurs completely randomly, as if marbles were thrown from above towards the site and they went to lay each on one of the identified partitions. Nodes can therefore combine in different and unpredictable combinations. The only data that can be obtained a priori is the number of possible combinations (P) through the formula of permutations.

$$P_r^m = m(m-1)(m-2)\dots(n-r+1) = \frac{m!}{(m-r)!}$$

In this case m=r

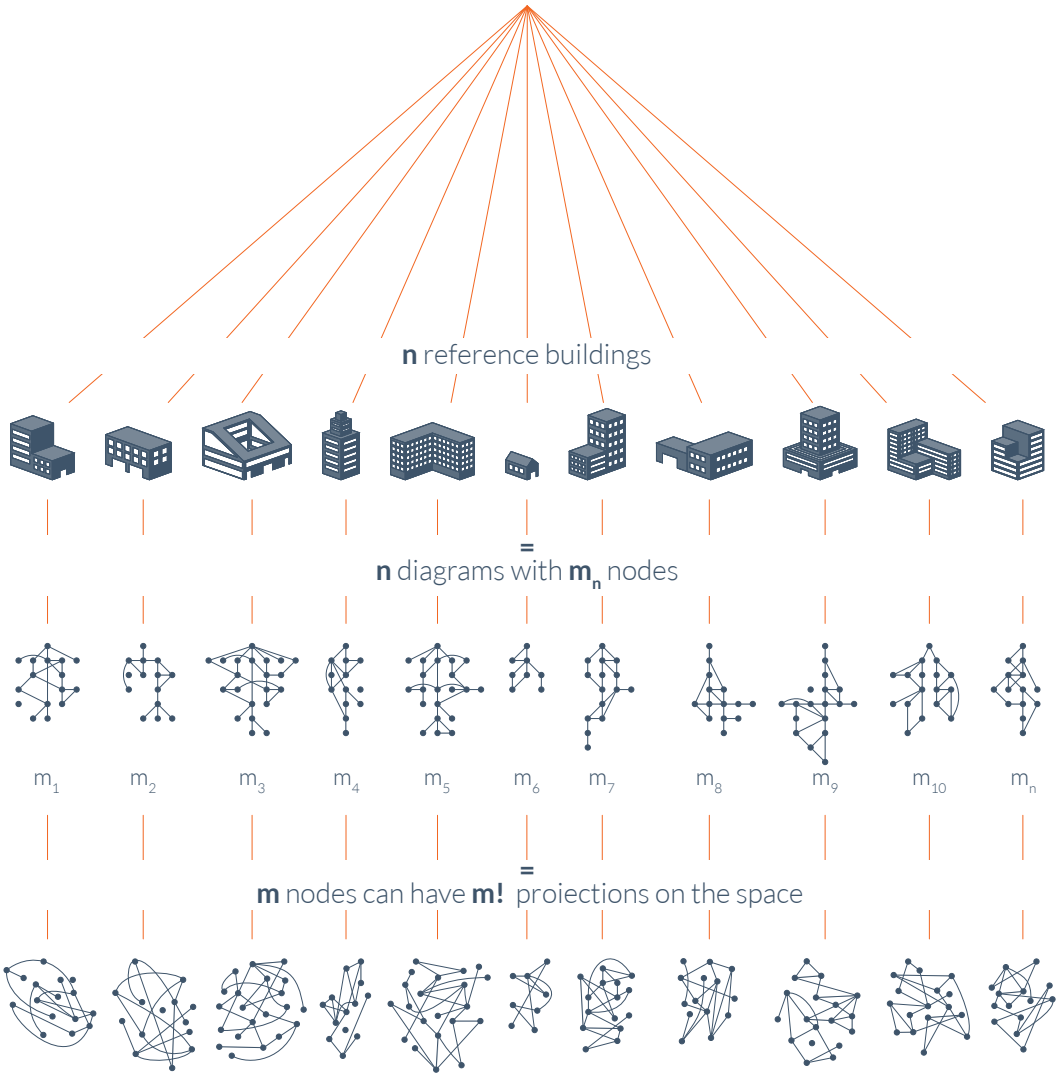
$$(m-r)! = 0! = 1$$

$$P_r^m = m!$$

$$m! = m \times (m-1) \times (m-2) \times (m-3) \times \dots \times 3 \times 2 \times 1$$

This step is dominated by chance and therefore indeterministic. The projections of the nodes are unpredictable as much as clouds.

METHOD



$$n * \sum_{i=1}^{n} m_i !$$

The value of n depends on the number of existing buildings having a number of nodes (m_i) useful for the purposes of the project. The value of n is not definable with the tools anddata existing today. However, it is easy to imagine that it has a very high value.

For practical purposes, one could therefore say that the number of design variants is infinite.

The results to which the method can lead are also unpredictable. They depend on the designer's choices. Even if the connections between nodes are fixed, it is up to the designer to decide how to realize them. There is therefore an external imposition, but at the same time the creativity of the architect, who exercises his freedom, is called into question. And this plays an even more important role in the design of the residual spaces between one connection and another.
Furthermore, the rules of visibility must not be forgotten in the design. Visual accessibility is often overlooked, unless there is a particularly pleasant landscape. But thinking about how all the components of the project relate visually, emphasizing some relationships and discouraging others creates a greater degree of dynamism.
This last phase, in which the designer intervenes personally, is the real design phase. In the previous ones, in fact, he was nothing more than a gear of this design machine.

To use this method means to deprive yourself of the freedom to create connections on the basis of personal considerations derived from the analysis of the real design context. This is a double edged sword. Once the accessibility between the nodes has been defined, the architect has enormous freedom in designing the nodes themselves and in designating a function for them. However, in the design phase the method also demonstrates its limitations related to the fact that the real design context is never taken into consideration during the process.

Choice of the reference building

The choice of the reference building is an important step because it predominantly affects the project that will be carried out. However, it is not possible to predict in advance how this will develop. Different buildings give input to different projects.

As previously explained, the fundamental requirement for selecting the reference building is the availability of information regarding its spatial characteristics. The latter are also the only information that will be used during the application of the method. Therefore all the others, such as dimensions, style, materials, function, place and time of realization are not relevant. However, it is necessary to take into account the number of nodes that are present both in the building and in the design site, which must be identical. This can help to discard a priori some options since, for example, buildings with a large number of rooms would be problematic to use for a small design site. On the contrary, a building consisting of a few rooms may not be sufficient to reorganize the characteristics of a very large site. In addition, in the case of a high number of nodes, the graphical representation of the diagram is also particularly complicated, especially in the visibility diagram, where there is a risk that the edges intertwine too closely and are not clearly legible.

I say this from experience, because during my research I had initially considered the Speelpleinstraat project by 51N4E (Fig 1). It is a circular kindergarten that develops around a concentric courtyard. The degree of visibility between the rooms of the building is very high since the facade is mainly made of glass. I identified 53 nodes in the building plan, despite the fact adjacent rooms with the same function have been aggregated under the same node. However, I have not even finished drawing the visibility graph, since I found myself at a point where what I identified as "node 1" was visible from other eighteen points and the edges were no longer distinguishable. Furthermore, with 53 nodes it is very easy to get confused and make a mistake, to forget a connection during the process.

And if decrypting the rules can be complicated, let alone encrypting them in the design phase when these nodes must be

Fig 1: Speelpleinstraat by 51N4E

Fig. 1

imagined in a real space and embedded as in a three-dimensional puzzle, without even being able to rely on the image on the puzzle box because the final image does not yet exist.

After various attempts and failures, I came to identify three possible reference buildings, equally valid for the purpose of the experiment. The first is Maison Louis Carré, a family house designed in every detail by Alvar Aalto for the gallery owner Carrè, from which it takes its name. The second is the Terme Vals, designed by Peter Zumpthor. Of this project, I considered the bath plan, which has a very particular spatial configuration since it is articulated as a rectangular plane from which parallelepipeds are extruded both upwards and downwards. Those extruded downwards have the function of swimming pools, those extruded upwards, arranged either around the pools or along the perimeter of the rectangle, offer different sensory and relaxation experiences or function as service structures. All the remaining space is used to connect the previous areas. It was therefore necessary to subdivide it into several nodes, on the basis of existing geometries, in order to create a readable diagram.

The last building is 21_21 DESIGN SIGHT, which is the one I used for the experiment conducted within this thesis work. This museum was designed by Tadao Ando in 2007 and inspired by Issey Myake's motto "A Piece of Cloth", which finds application in the study of the relationship between fabric and body. In this case it is declined in the conception of the roof, made of huge monolithic steel slabs. The building was created with the aim of promoting interest in the multifaceted world of design and

imagining prospects for its future. Its name comes from the expression "20/20 sight", used in the United States to identify normal visual acuity. The number has been increased to indicate the desire to look at design culture, present in everyday life, in a more careful and in-depth way.

The museum is located in Tokyo, inserted in the Midtown Garden, near Hinokicho Park. It spreads over two floors, the ground floor and the basement which occupies 80 percent of the total area. In 2017, Gallery 3 was opened in order to expand the offer. This was placed in the space previously intended for catering (see plan), however the experiment that follows is based on the previous planimetric setting[1].
The decryption of the three buildings is documented in the succeeding pages.

[1] 21_21 DESIGN SIGHT. http://www.2121designsight.jp/en/ [last access: 26.01.2020].

Maison Louis Carré

Architect: Alvar Aalto
Year: 1956-59
Client: Louis Carré
Location: Bazoches-sur-Guyonnes, France[1]

Fig. 2

Fig. 3

Fig. 4

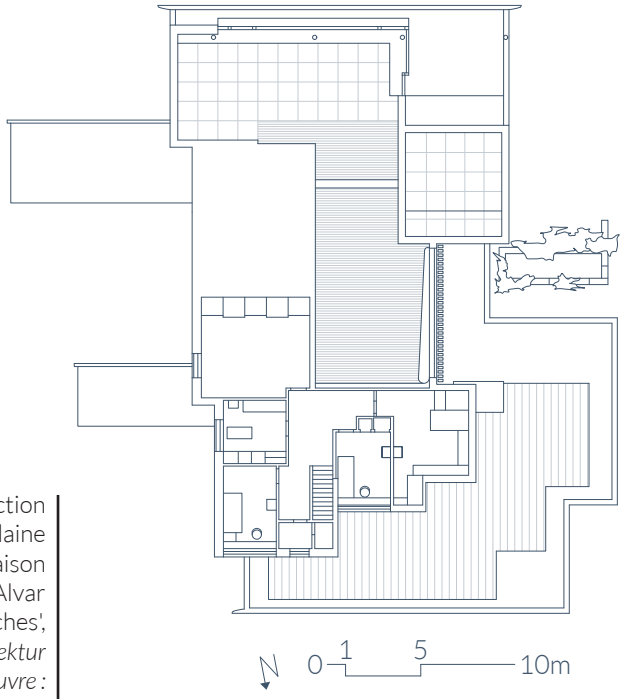
Fig 2: garden

Fig 3: entrance hall.

Fig 4: living room

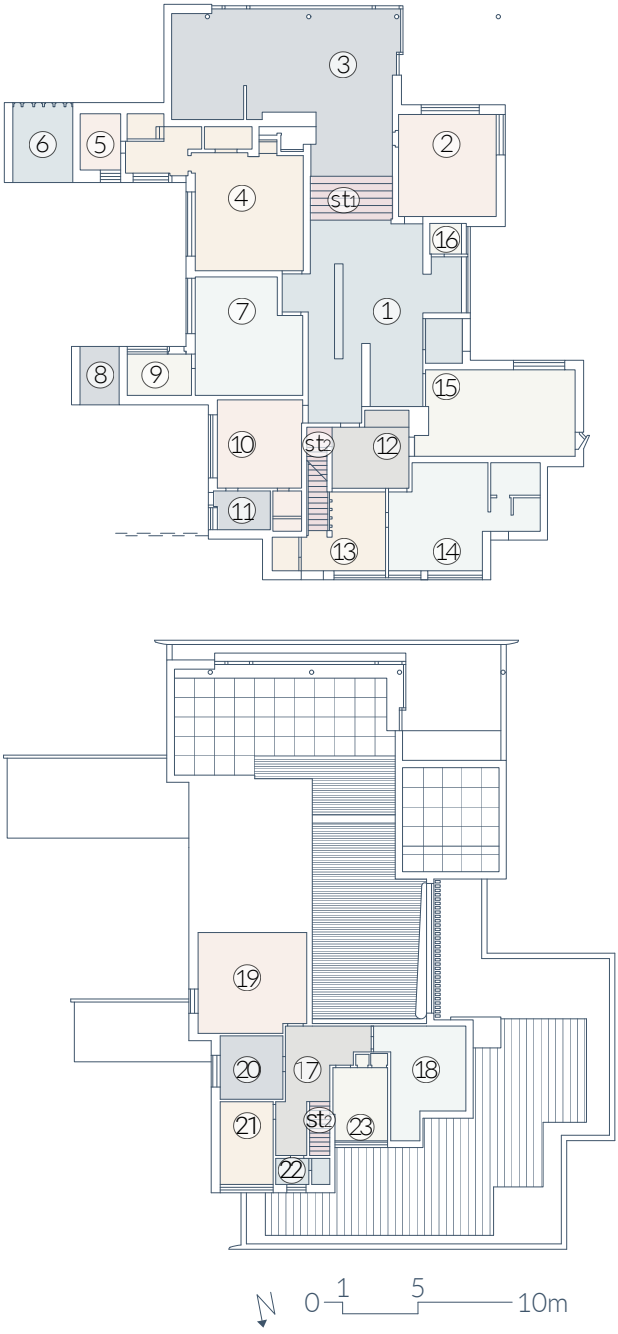
[1] Alvar Aalto, Karl Fleig, *Alvar Aalto. Volume I 1922 - 1962* (Basel: Birkhäuser, 1963), 236.

1st and 2nd floor plan |

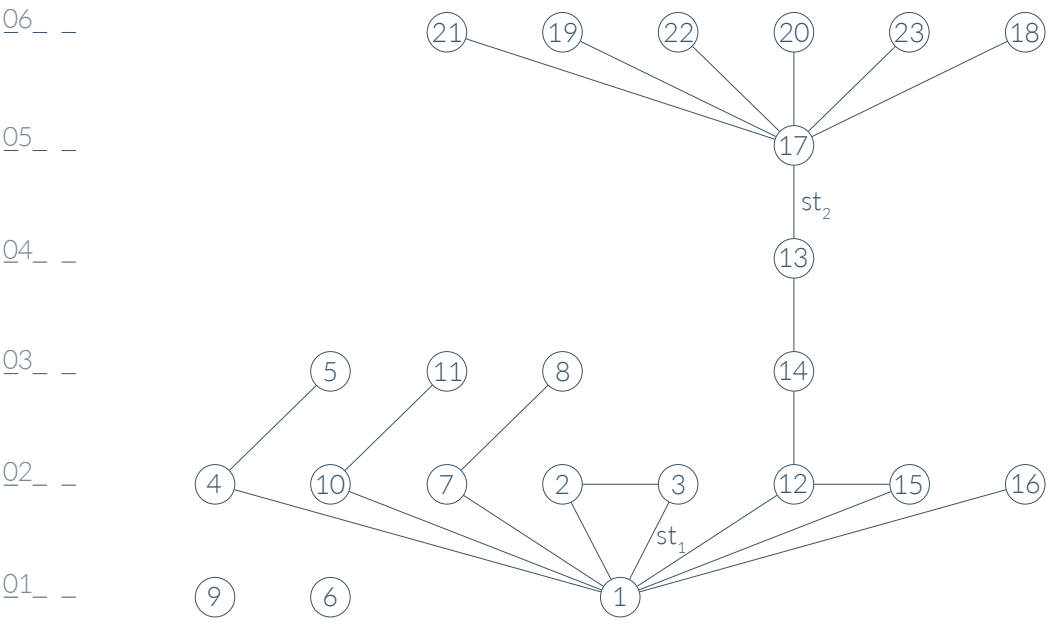


Author reproduction based on Marlaine Perrochet, 'La maison Louis Carré de Alvar Aalto à Bazoches', *Das Werk : Architektur und Kunst = L'oeuvre : architecture et art* (47, no. 12, 1960), 419.

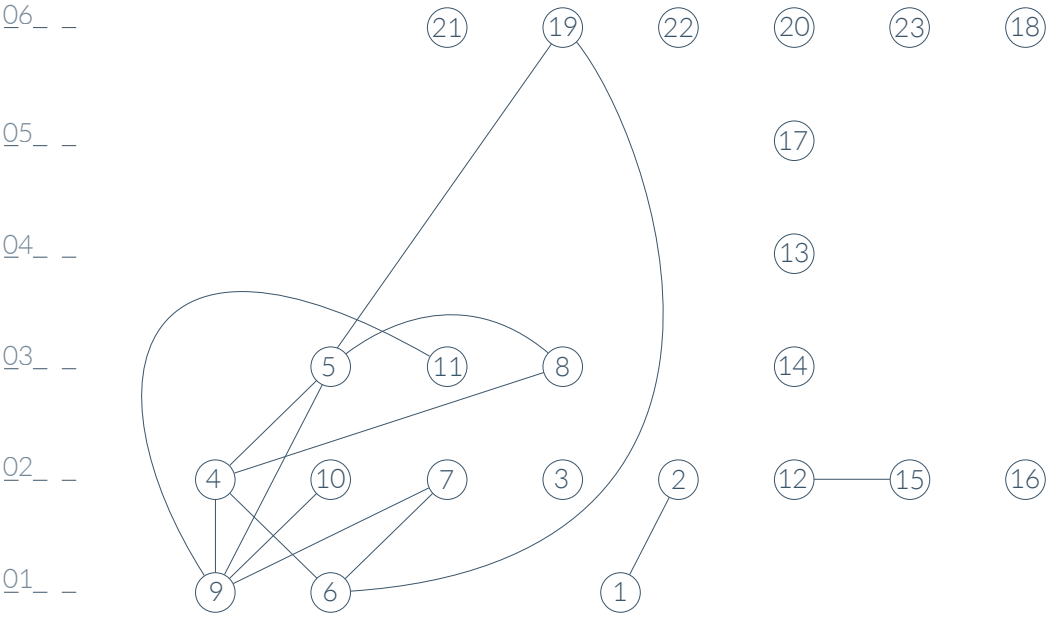
| Plan with nodes



Connectivity diagram



Visibility diagram



Therme Vals

Architect: Peter Zumthor
Year: 1993 - 1996
Client: Vals community
Location: Canton of Grisons, Switzerland[1]

Fig. 5

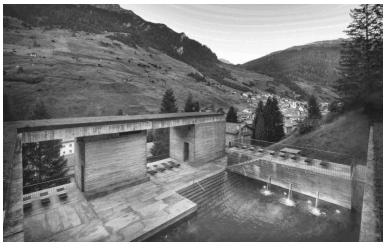


Fig. 6

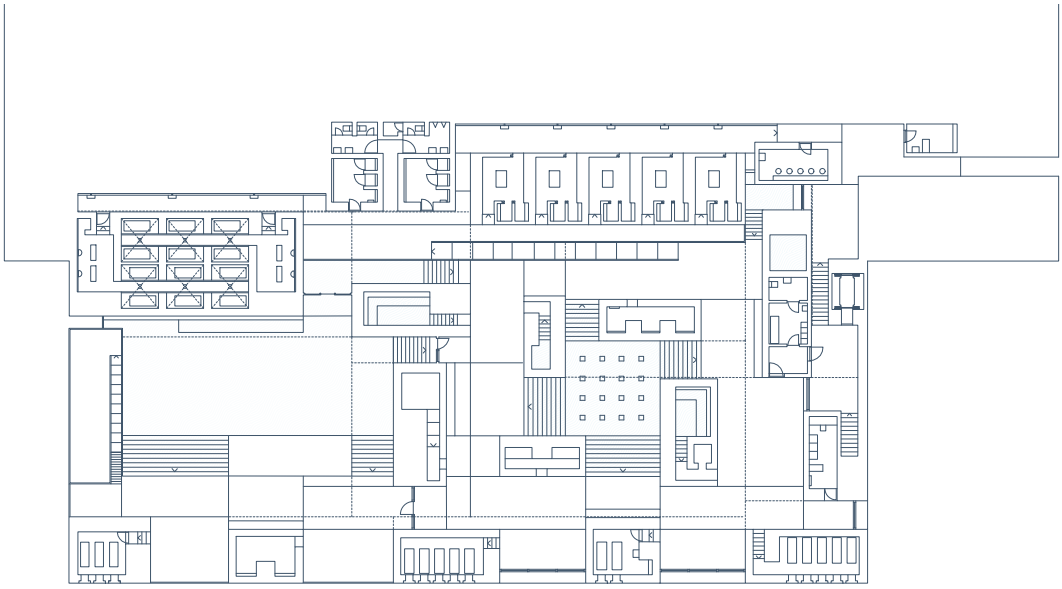
Fig. 7

Fig 5: facade

Fig 6: outdoor pool

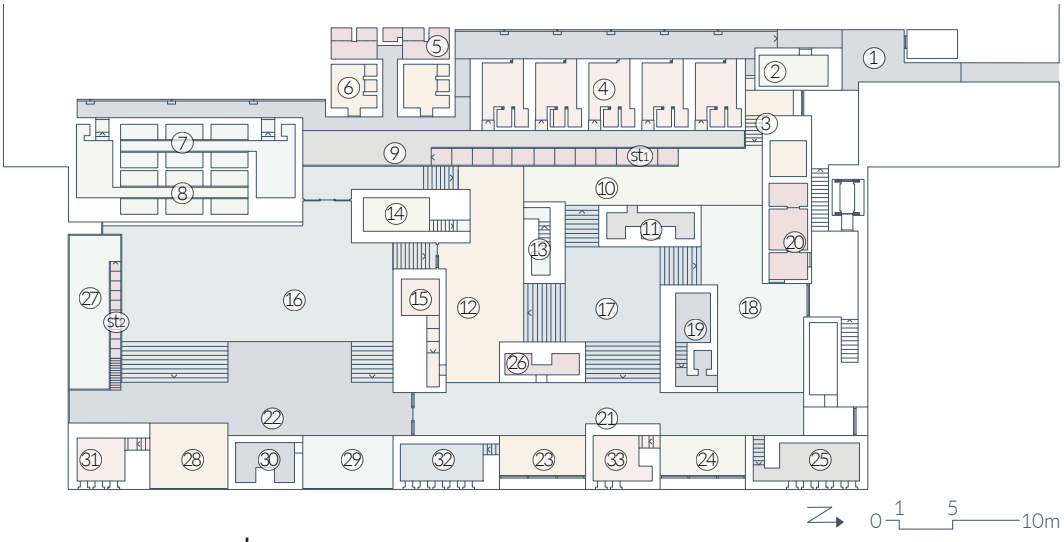
Fig 7: staircase

[1] Hélène Binet, Peter Zumthor, *Peter Zumthor works : buildings and projects 1979-1997. Photographs by Hélène Binet; text by Peter Zumthor* (Basel; Boston;Berlin: Birkhäuser, 1999), 163.



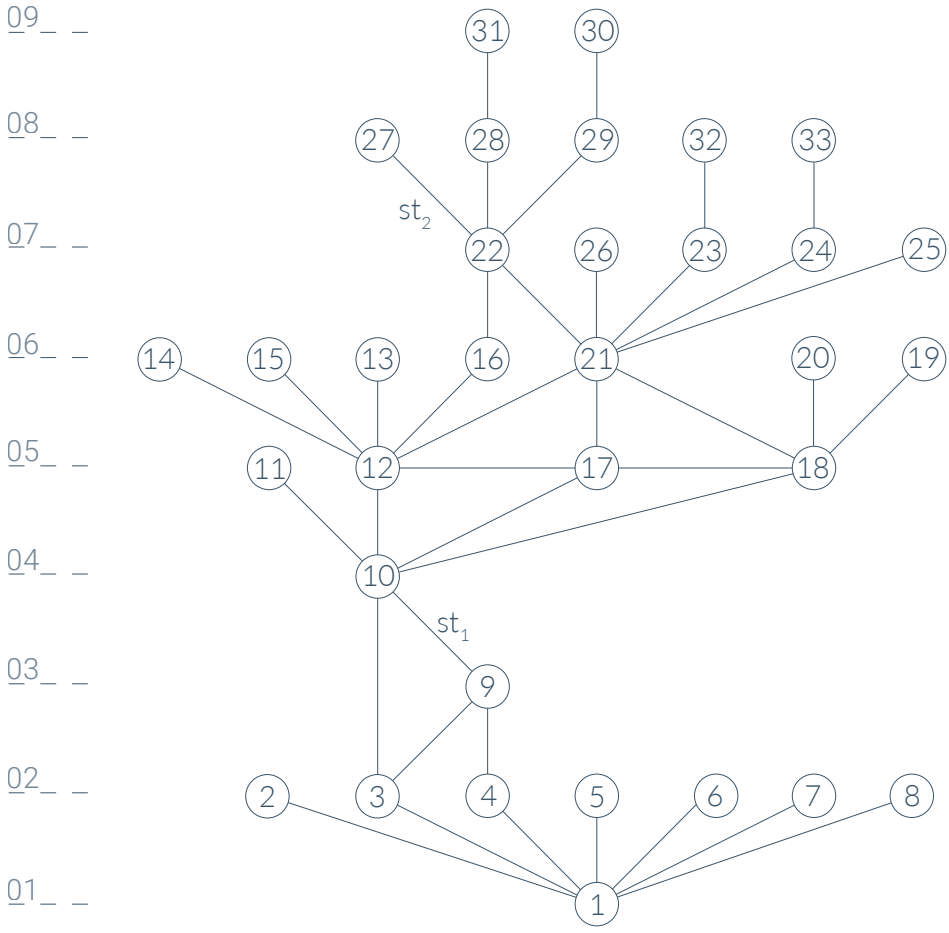
Plan of bathing level

Author reproduction based on Sigrid Hauser, Peter Zumthor et. al. *Peter Zumptor Therme Vals* (Zurich: Scheidegger and Spiess, 2007), 99.

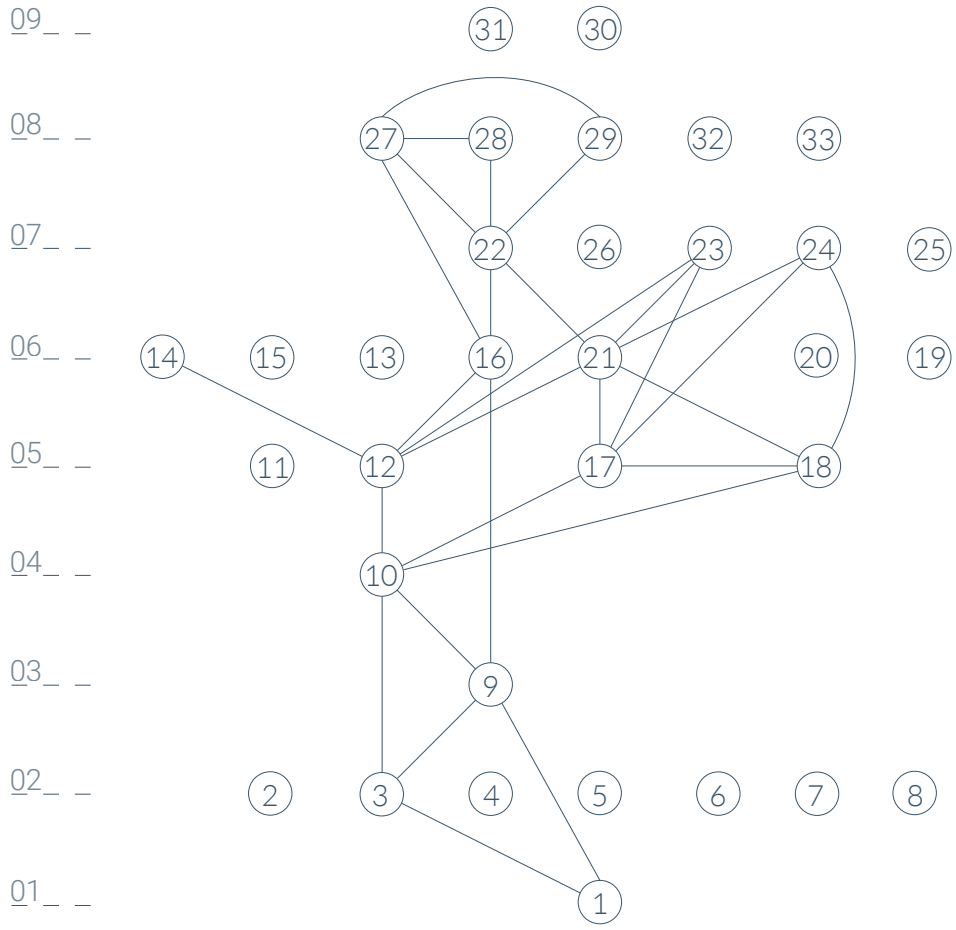


Plan with nodes

Connectivity diagram



Visibility diagram



21_21 DESIGN SIGHT

Architects: Tadao Ando
Year: 2004-05
Client: 21_21 DESIGN SIGHT
Location: Midtown Garden, Tokyo Midtown, Japan[1]

Fig. 7

Fig. 8

Fig. 7

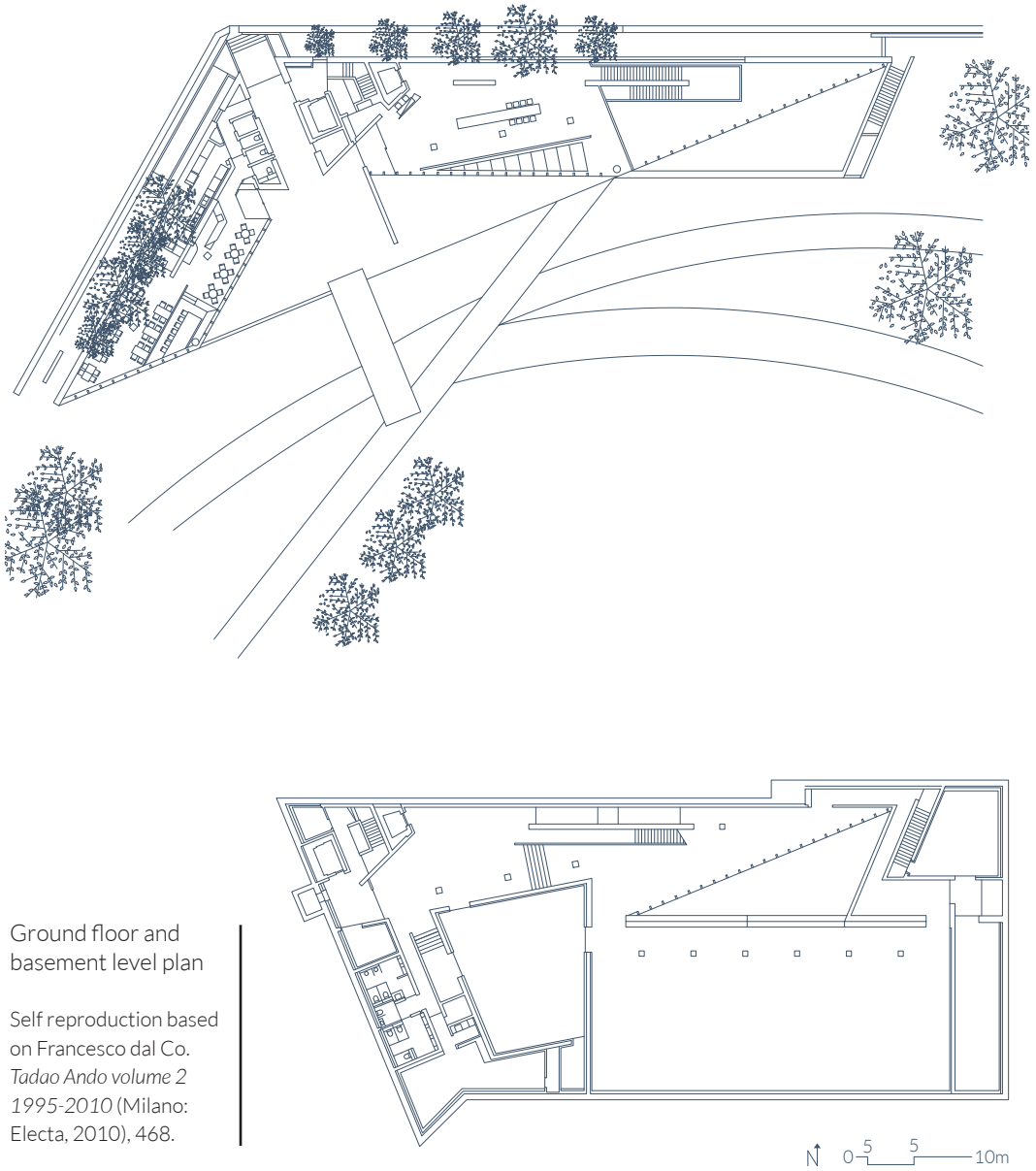
Fig. 9

Fig 8: Design Signt in Midtown Garden

Fig 9: Design Signt entrance

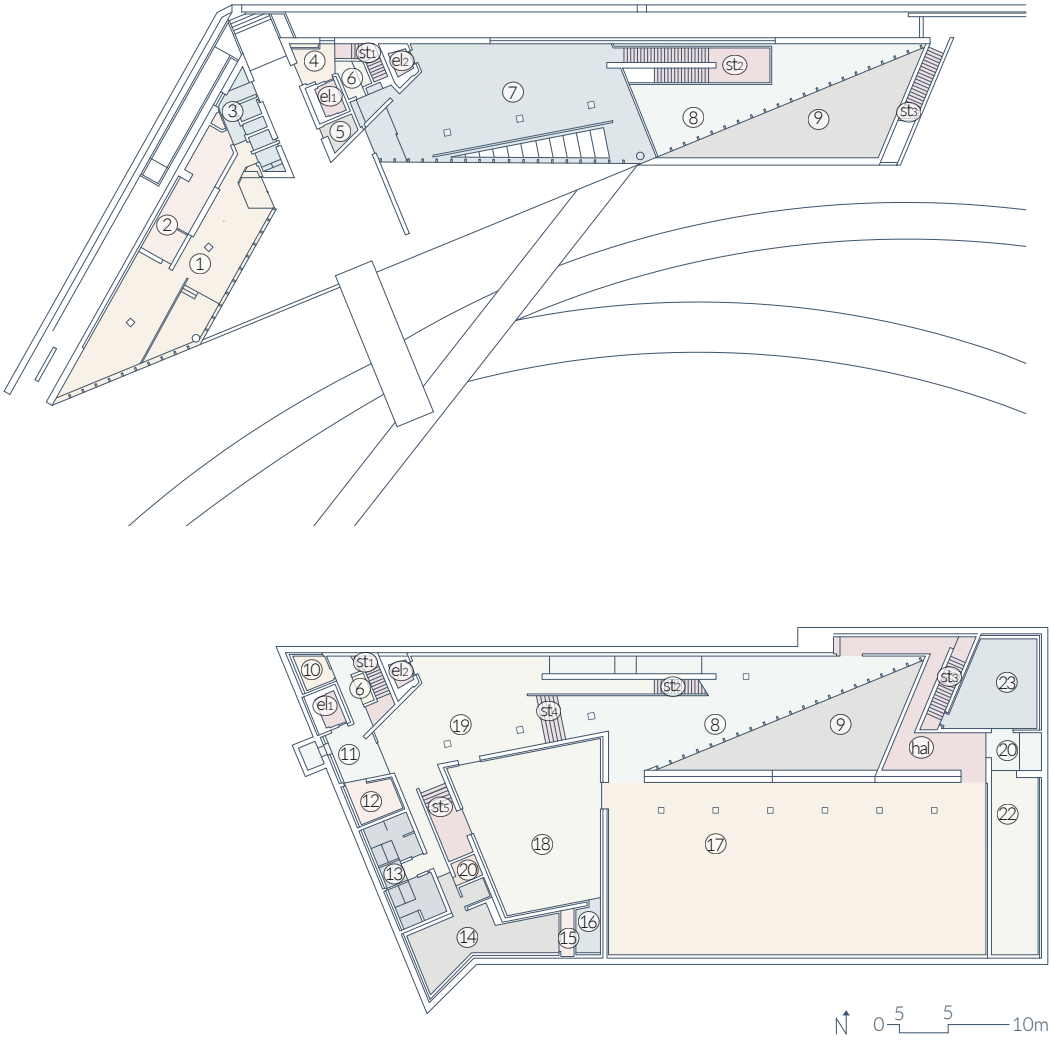
Fig 10: Gallery 3

[1] 21_21 DESIGN SIGHT, http://www.2121designsight.jp/en/ [last access: 26.01.2020].



Ground floor and basement level plan

Self reproduction based on Francesco dal Co. *Tadao Ando volume 2 1995-2010* (Milano: Electa, 2010), 468.



I Plan with nodes

Fig 11: node 1

Fig 12: node 1, enstrance

Fig 13: node 1, door node 2

Fig. 11

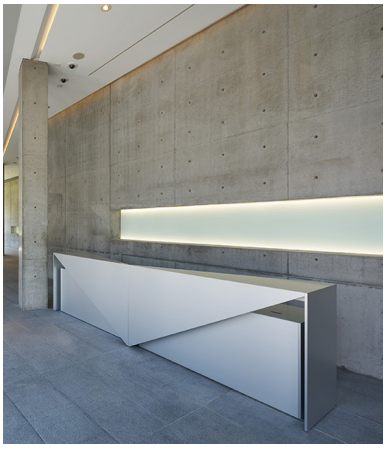


Fig. 12

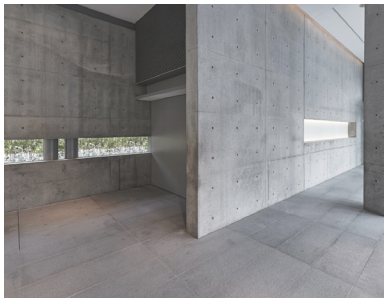


Fig. 13

Fig. 14

Fig. 15

Fig. 16

Fig 14: node 7

Fig 15: node 7, the staircase leads to node19

Fig 16: node 7, glazed door entrance

Fig 17: node 8

Fig 18: node 19, with node 8 in background

Fig 19: node 9 and 8, with the halloway entrance

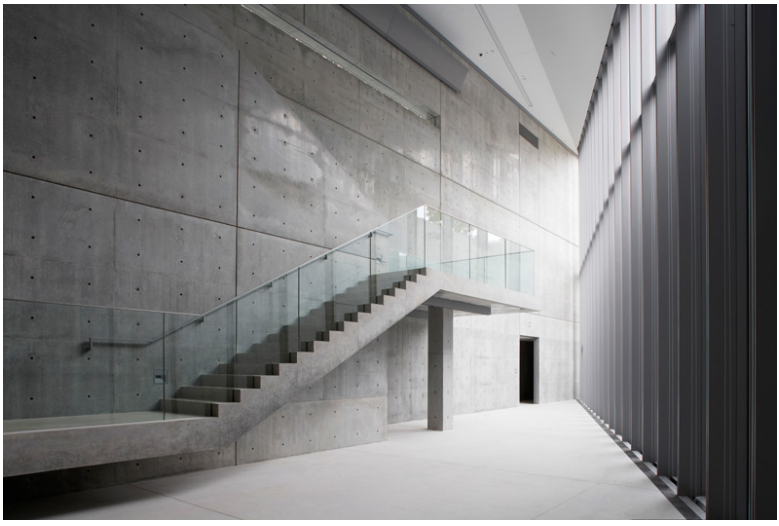


Fig. 17

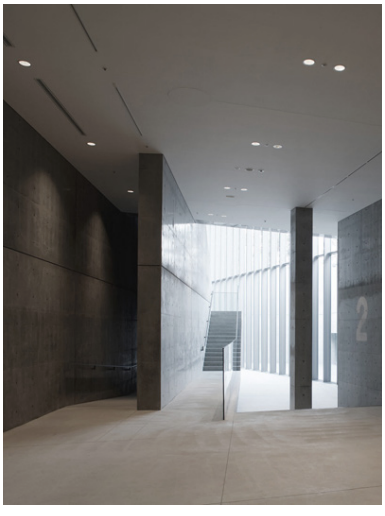


Fig. 18

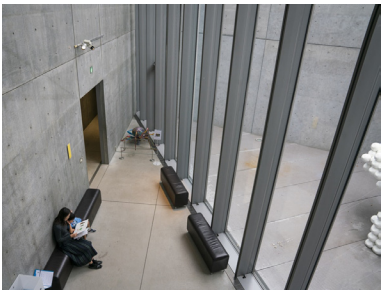


Fig. 19

Fig. 20

Fig 20: node 17

Fig 21: node 17, hallway entrance

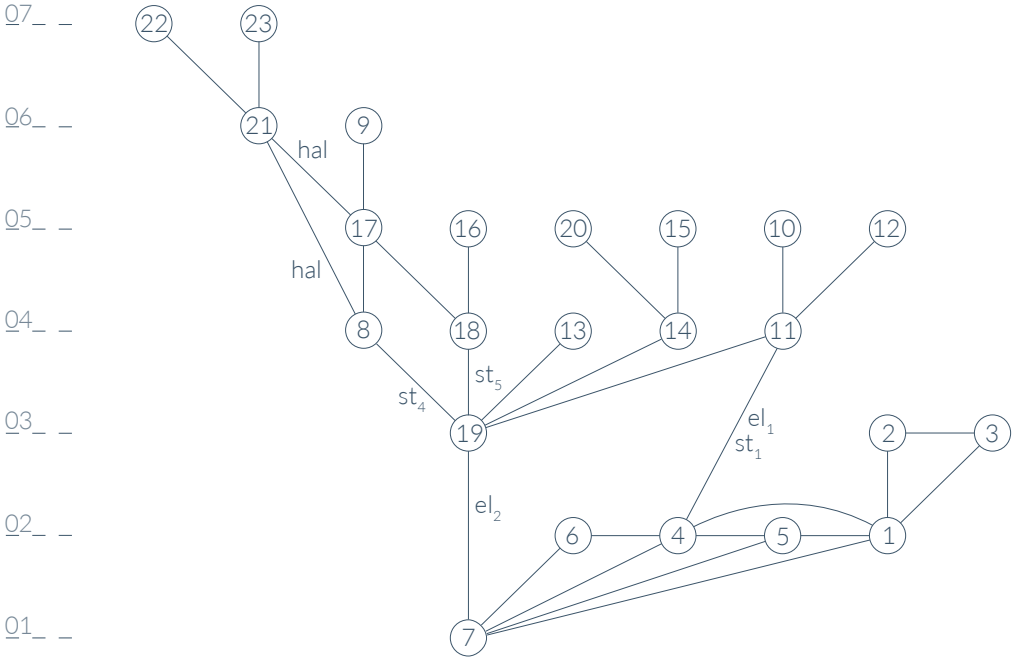
Fig 22: node 18, the front opening leads to node 17, the lateral opening to node 8

Fig. 21

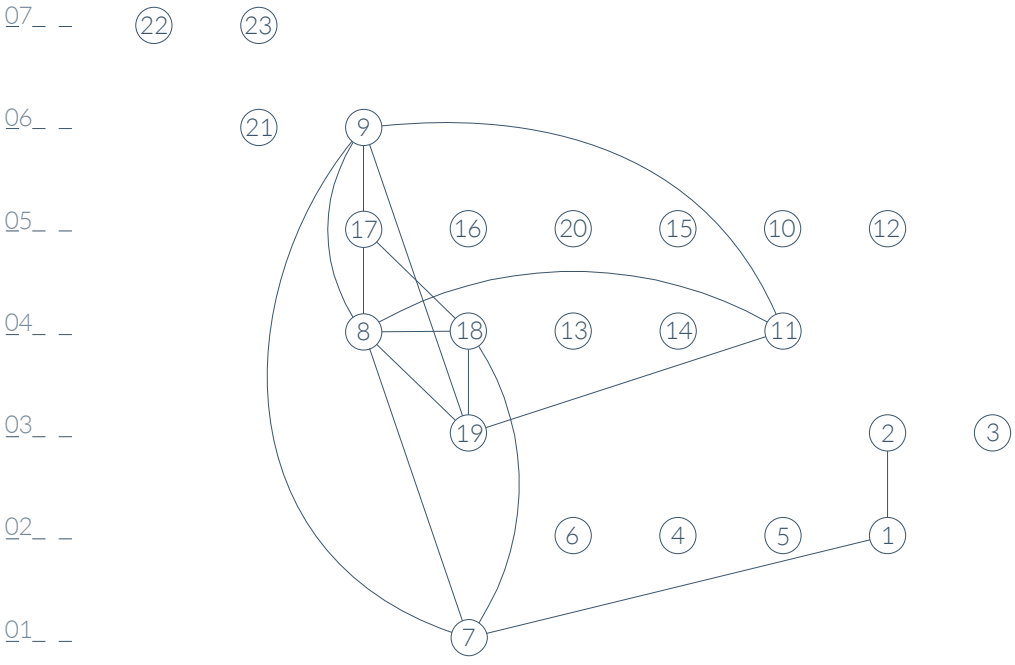
Fig. 22

For a better understanding of the space, some panorama tour are available on 21_21 DESIGN SIGHT official web site.

Connectivity diagram



Visibility diagram



Project Site: Schwedenplatz area

The site where the experiment takes place is located in the center of Vienna. An area of about 25'000 m^2, that consists of three adjacent squares: Schwedenplatz, that has a bigger dimension and notoriety and the smaller ones Morzinplatz and Ruprechtsplatz.
The area is crossed by Franz-Josefs-Kai street (Fig 29) that together with the Ring road, the famous boulevard which houses many of the most important Viennese architectures, delimit the perimeter of the historic city center. Schwedenplatz is indeed one of the entrance gates to Vienna's city center and it used host the ancient fortification walls of the city. Rotentrumstrasse (literally "red tower street", which connects Schwedenplatz with Stephansplatz and the homonymous cathedral, one of the main symbols of the city, owes its name to the gate once located in the area.
On the other side the area is bordered by the Danube canal (Fig 32). It is an artificial canal, built by the emperor Franz Joseph in the late nineteenth century[1]. Its docks were subsequently crowned with railings designed by Otto Wagner. Today the elegance of these railings clashes with the colorful murals that cover the walls, the sloppy urban gardens, and the noise of people who, especially during the warm seasons, stop to have a beer after a day of work in one of the bars along the canal. These contradictions between the taste of the past and the current one, between tradition and innovation, ancient and modern that characterizes the Viennese lifestyle is also reflected in the building architecture.
As many places in Vienna, indeed, the area presents a combination of old and new constructions. In Stephansplatz itself coexist the historic cathedral with the modern Haas House, designed by architect Hans Hollein and completed in 1990. Likewise in Ruprechtsplatz the church of St. Ruprecht (Fig 39), one of the oldest churches existing in the town rising on an escarpment, is surrounded by buildings belonging to the 1920s and 1930s and post-war buildings, like the Leopold Figl-

[1] Manfred Wehdorn, *Vienna. Una guida della città nel Patrimonio dell'umanità dell'UNESCO* (Vienna: Springer, 2004), 105-106.

Location of Schwedenplatz within the city of Vienna.

Hof (1963)[2] . But the greatest contrast is found if you look at the other side of the canal where high-rise buildings of more recent construction reside. Among these stand out in particular the office building Mediatower designed by Hans Hollein and completed in 2000 and the Nouvel Tower (Fig 30), known also as Sofitel Vienna Stephansdom (2005-2010), by the hotel that it hosts, together with shops and food outlets. In designing this 18-story building, architect Jean Nouvel intentionally wanted to play with contrasts in order to give to the elegant historic context a new meaning[3]. To achieve this, the architect did not rely only on the spectacular nature of the architectural form he created and the play of light reflection allowed by the glass surface, but also on important collaborations. The architect-landscaper Patrick Blanc has in fact enriched the project with a vertical garden and the swiss media artist Pipilotti decorated different parts of the building with animated video ceiling lights[4]. From Schwedenplatz it is clearly visible the spectacular ceiling of the restaurant at the last floor.
The ship station Twin City Liner (Fig 29, 31) that stands on the Danube bank along Franz-Josefs-Kai, near Marienbrücke, is also very peculiar. Designed by the fasch&fuchs architecture studio and realized between 2009 and 2010 after the victory of the competition held in 2006, the steel building itself resemble

[2] Ivi.

[3] Jean Nouvel. *Sofitel Vienna Stephansdom*. http://www.jeannouvel.com/en/projects/hotel-sofitel-vienna-stephansdom [last access: 11.1.2020].

[4] Das Loft. *Design*. https://www.dasloftwien.at/en/design/. [last access: 11.1.2020].

a boat, floating in the air and not on the water[5]. The building is raised on pillars and partially projecting above the canal, creating a privileged view towards water from the restaurant-café and its terrace and shelter for those who are at the bottom waiting for the next boat at the docking point. This iconic building acts as a connection between the square and the canal and between Vienna and Bratislava, the Slovakia capital[6].
Schwedenplatz - Morzinplatz area covers around 25,000 square meters and it one of the busiest parts of the city, as well as one of the most important transport hubs in Vienna[7]. Here different services and types of mobility meet: metro (lines U1 and U4) (Fig 26), 3 tram lines above ground and airport shuttles. During a working day above 150'000 people change line or the means of transport here[8].
Franz-Josefs-Kai is a four-lane street traversed by 45'000 cars a day and a section of the cycle path develops alongside it . The banks of the Danube canal, reached by stairs placed on the sides of the bridges, offer a space protected from heavy traffic, where cyclists and pedestrians can coexist. The canal itself, as mentioned above, also acts as a communication route[9].

The pedestrian part of Schwedenplatz houses two underground access facilities, some kiosks with street food and benches (Fig 25, 27). Morzinplatz instead it is characterized by large green spaces, interrupted by paths where the structures that allow access to the underground car park are located (Fig 34, 36, 37, 38) . The ground floors of the buildings that delimit the space have commercial functions, many of which are related to catering.

A part of the Franz-Josefs-Kai street is crossed by the cars and the other is crossed by tram lines. These two parts are separated by a large pitch occupied by a petrol station and a parking for buses (Fig. 41-43).

All these parts and functions work in parallel, resulting in a forced and disorganized coexistence. The space seems mostly empty and unattractive, especially during the colder months. The area certainly needs a spatial reorganization, so that it can perform multiple functions and make existing ones coexist in a more homogeneous way.

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[5] Fash&fuchs. architekten. *Schiffstation twin city liner*. https://faschundfuchs.com/bau_04.html [last access: 11.1.2020].

[6] Twin City Liner. com. *NEW Twin City Liner*. https://www.twincityliner.com/en/news/new-twin-city-liner [last access: 11.1.2020].

[7] StaDt Wien. *Zukunft. SCHWEDENPLATZ mischen Sie mit!* https://schwedenplatz.wien.gv.at/site/der-schwedenplatz/verkehr/. [last access: 11.1.2020].

[8] Ibidem.

[9] Ibidem.


PRICORNO

Fig. 23

This opinion is shared by the municipality of Vienna which has already promoted important initiatives for the area to be redesigned in compliance with the Smart City Wien Framework Strategy and Urban Development Plan STEP 2025[10] .

The first document sets out the guidelines for the development of the city with a view to environmental sustainability for the achievement of European energy and climate objectives scheduled for 2020, 2025 and 2050. The main objective is to reduce greenhouse gas emissions in 2050 in the EU by 80 to 95% as compared to 1990. Saving resources and protecting the climate should have a direct connection with improving the spaces of the city and the quality of life of citizens[11]. Actually, Vienna has already worked hard in this direction and for the tenth year in a row in 2019 it has been nominated the city with the best quality of life in the world by HR consultancy Mercer. The analysis involved 231 cities and focused on, among other macro-criteria, Natural environment and Public services and transportation[12].

STEP 2025, adopted by the Vienna City Council on 25 June 2014, is an action guideline and a strategic plan for urban growth, both physically and socially. The population of the city has in fact grown from 1995 to 2013 of almost 200'000 inhabitants and a similar increase is expected for 2025. Around 2030 Vienna should be able to host 2'000'000 inhabitants, to which commuter workers must be added[13]. Taking into account this factor and other social factors such as multi-ethnicity, economic, age and gender differences that characterize the population, the city aims to pursue the urban growth according to the following criteria: "urban density, high-quality green spaces, high architectural standards and a mixed-use approach"[14]. Another criterium is saving soil, focusing the attention on the development of already existing public spaces with potential. Another principle that guides the urban transformation is the

[10] Maria Vassilakou. 2016. "Vienna 2025 - Growing Through More Sustainability, More Open-Mindedness and Participation." Paper presented at Chapman University conference Local Government Reconsidered. Reimagining Local Government: Strengthening Democracy in Our Communities. February 25, 2016. http://digitalcommons.chapman.edu/localgovernmentreconsidered/strengtheningdemocracy/papers/13.

[11] Vienna City Administration. 2014. Smart City Wien Framework Strategy. https://smartcity.wien.gv.at/site/files/2019/07/Smart-City-Wien-Framework-Strategy_2014-resolution.pdf.

[12] Mercer. *Vienna tops Mercer's 21st quality of living ranking*. https://www.mercer.com/newsroom/2019-quality-of-living-survey.html. [last access: 1.12.2020].

[13] Vienna City Administration, Municipal Department 18 (MA 18) - Urban Development and Planning. 2014. STEP 2025, Urban Development Plan Vienna. https://www.wien.gv.at/stadtentwicklung/studien/pdf/b008379b.pdf.

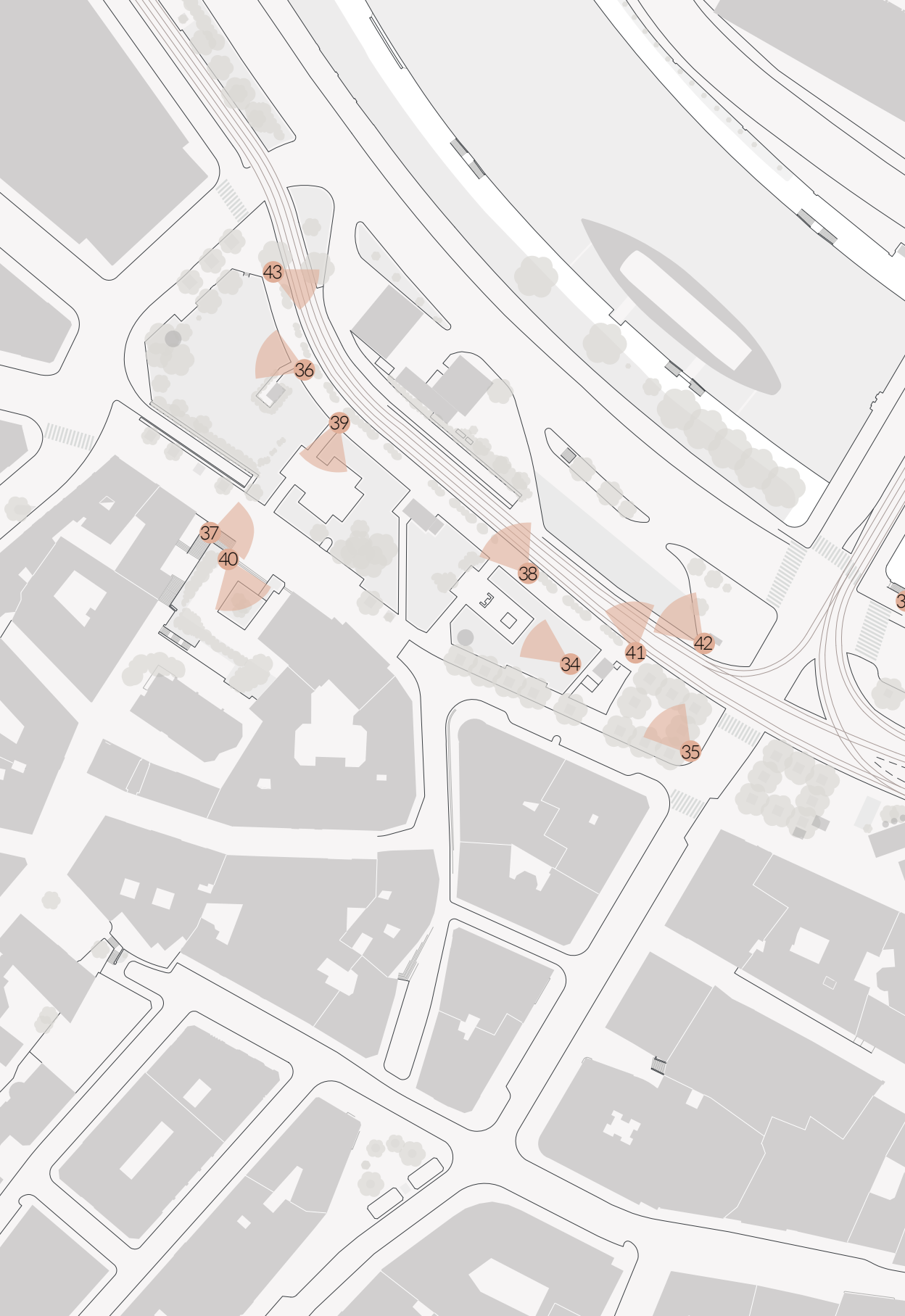
[14] Ibidem, 21.

participation of inhabitants in the decision-making process.

Some experiments have already been started and Schwedenplatz, having the characteristics mentioned above, was home to one of these. Between 2012 and 1013 citizens had the opportunity to express their opinion on the future of the square, on the activities and services that it should have offered. The summary of the claims of the population and the technical analyzes simultaneously carried out, provided the design principles on which the redesign of the area should be based. In September 2015, a competition was launched for the redesign of part of the area[15]. In May 2016, the jury elected the Munich office realgrün Landschaftsarchitekten GbR to be the winner among the 60 proposals[16].

[15] StaDt Wien. cit.

[16] Realgruen LANDSCHAFTSARCHITEKTEN. http://realgruenlandschaftsarchitekten.de/neugestaltung-schwedenplatz-morzinplatz/. [last access: 1.12.2020].


43
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34
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42
35

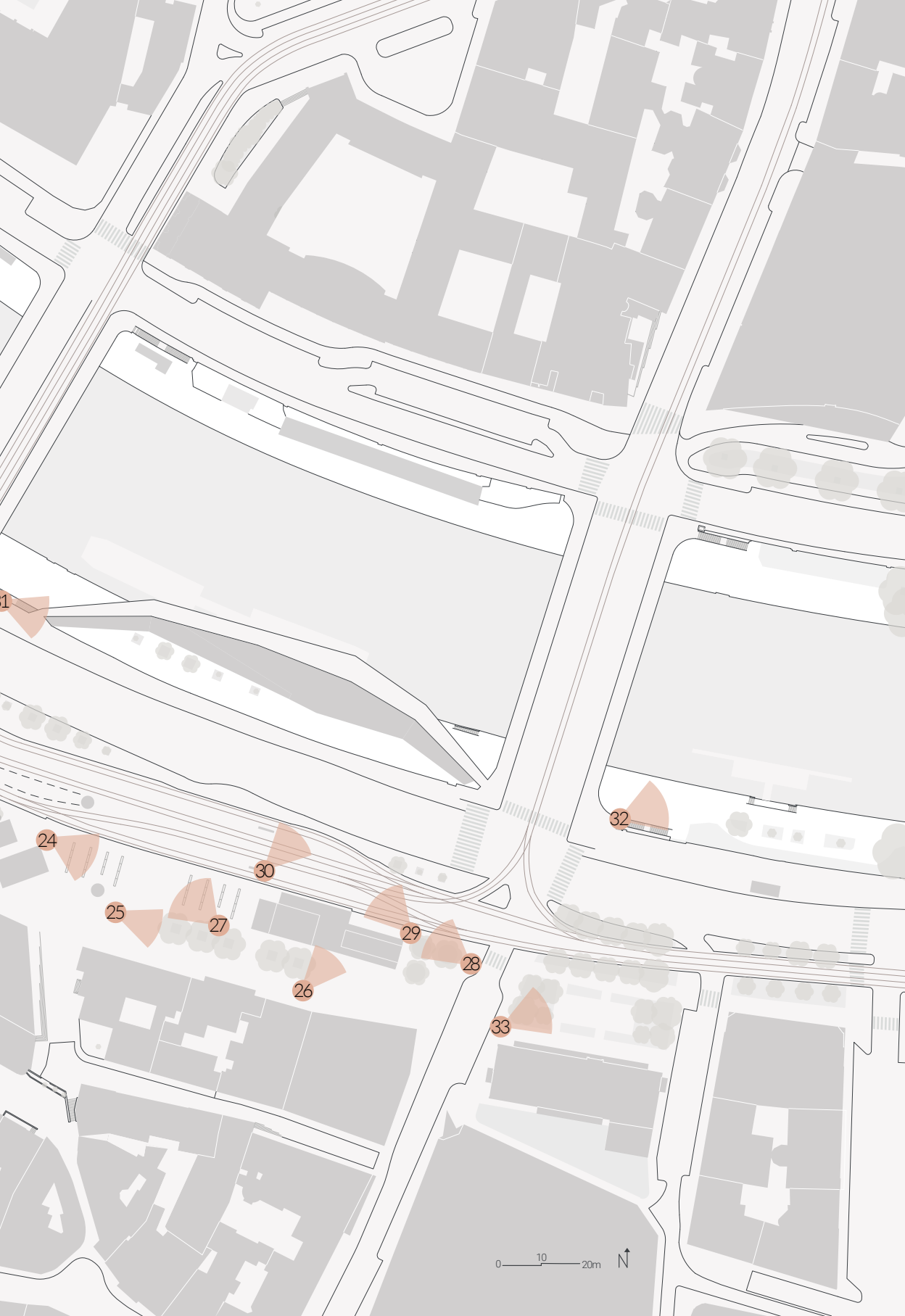

31
24
25
27
30
29
28
26
33
32
0
10
20m
N

Fig. 24

Fig. 25

Fig. 26

Fig. 27

Fig. 28

Fig. 29

Fig. 30

Fig. 31

Fig. 32

Fig. 33

Fig. 34

Fig. 35

Fig. 36

Fig. 37

Fig. 38

Fig. 39

Fig. 40

Fig. 41

Fig. 42

Fig. 43

Application of the design method

The experiment carried out consists in the design of the Schwedenplatz area, re-encrypting the connectivity and visibility rules derived from the reference building 21_ 21 DESIGN SIGHT.

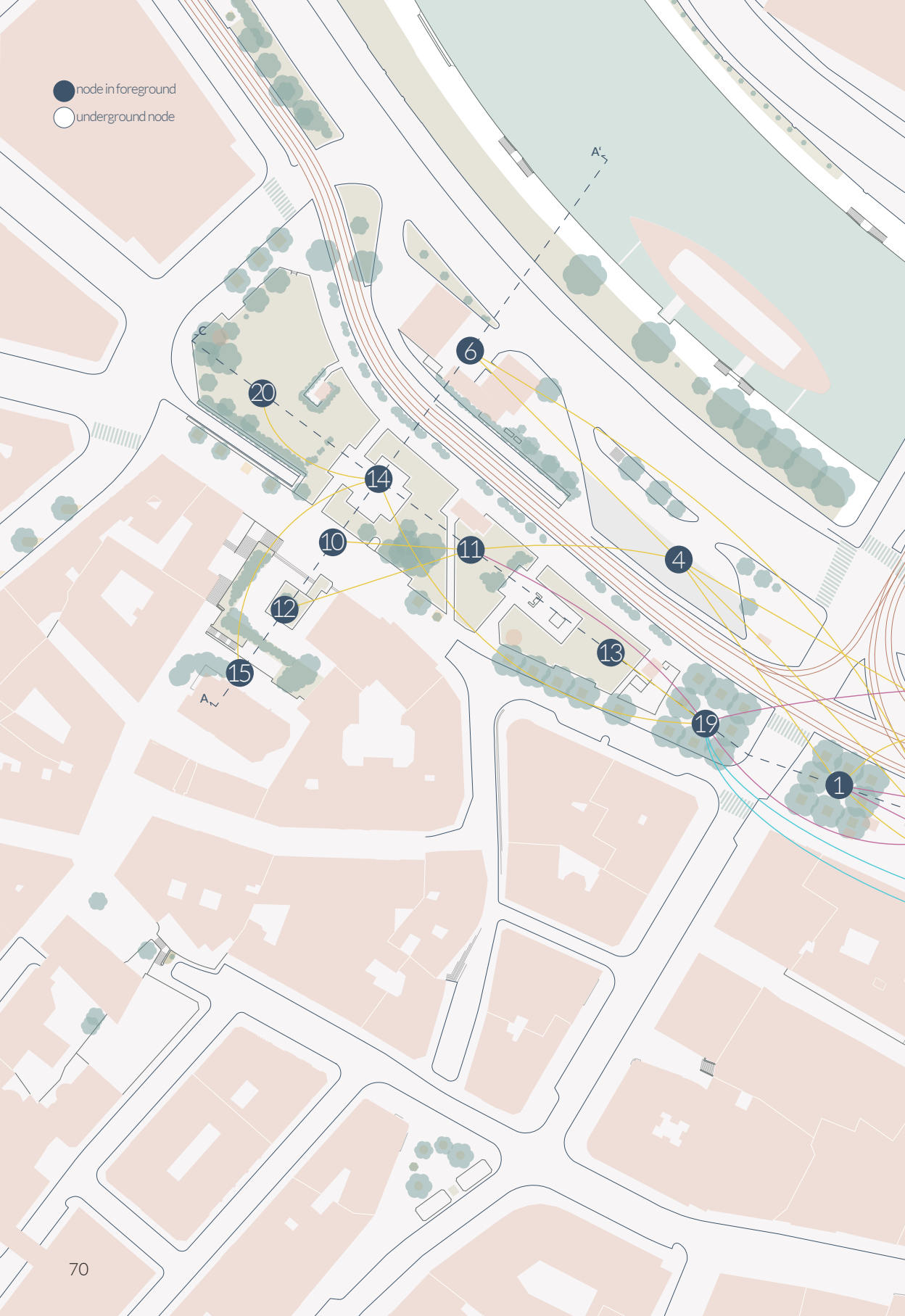
Twenty three nodes have been identified in the plan of the building, which can project them self on the design area in 25,852,016,738,884,976,640,000 different combinations.

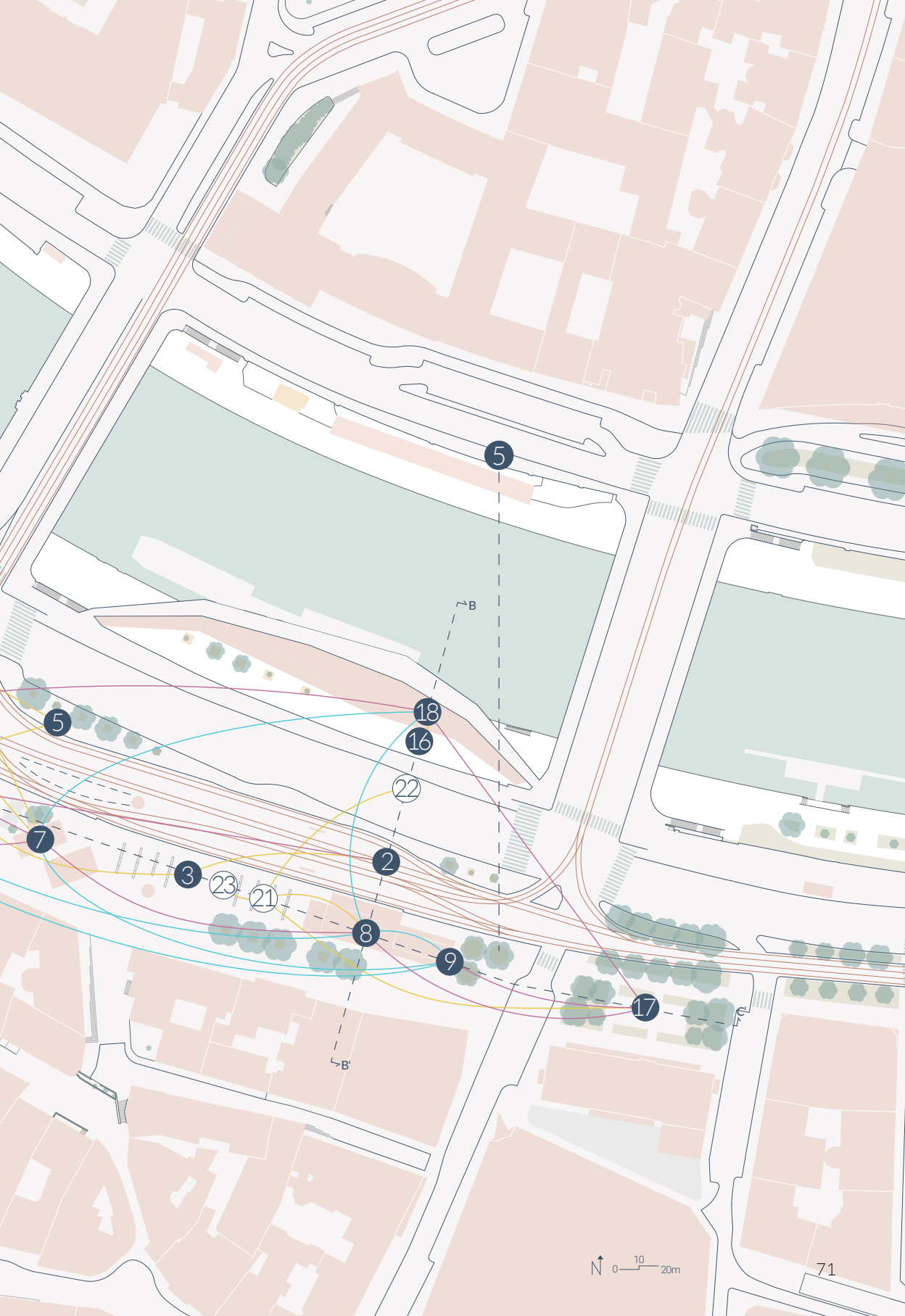
One of these, chosen entirely by chance, gave rise to the design of the new connections between the spaces of the square. The latter was considered as it currently stands, except for the underground parking. However, having this experiment the goal of demonstrating the potential and limitations of the method adopted, it was considered that the Schwedenplatz area, being already quite complex even without the underground parking, could be the ideal test bed.

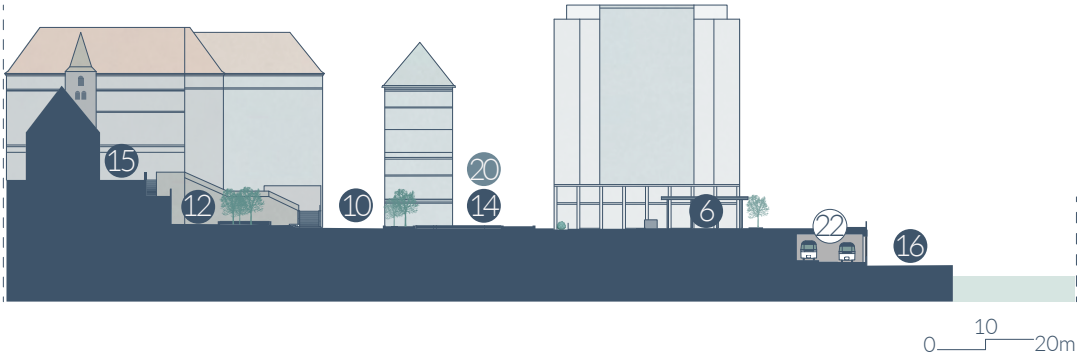
From the following sections of the current state of the square it is visible the complexity of the space, which has different altitudes, due in part to the presence of the metro station which spreads over two floors. Its irregular area stretches under the main road to the canal bank. The lines U4 and U3 cross at this point, the first follows the course of the canal in this section of the tract, while the second travels at a much lower altitude and passes below the canal. The canal itself contributes to making the area articulated, as well as the cliff on which the ancient church develops.

The layout of the metro station was outlined following a summary architectural survey of the spaces opened to the public. Being indeed a sensitive space for safety issues, architectural plans are not readily available. It was not considered that this fact was a problem, since the aim was not to define a project in its entirety by addressing all the technicalities, but rather a rough project, similar to the preliminary phase, of how space could be articulated and used.

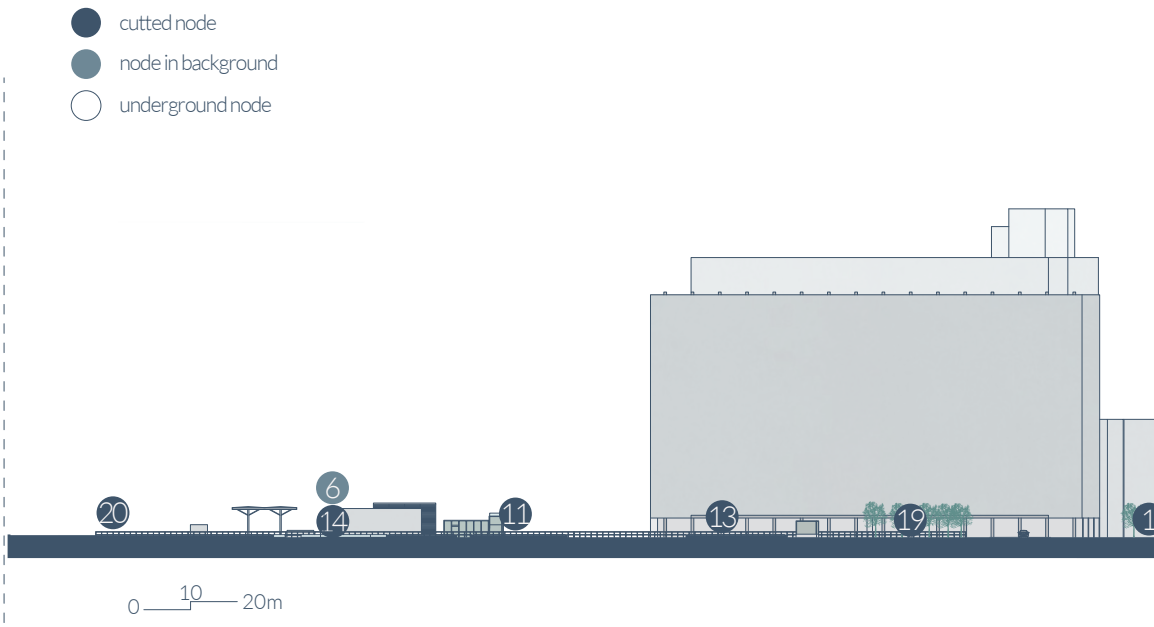
The twenty three nodes inside the square, visible in the


node in foreground
underground node
A
A'
C
1
4
6
10
11
12
13
14
15
19
20

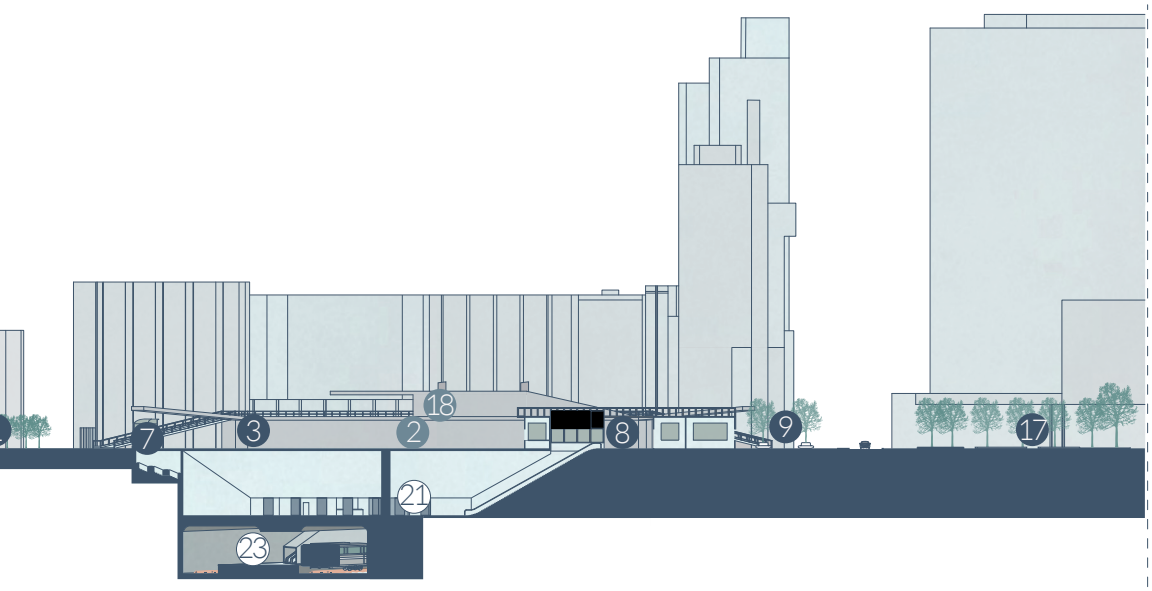

5
B
18
16
22
5
7
3
23
21
2
8
9
17
B'
N
0
10
20m


15
12
10
20
14
6
22
16
10
0
20m

Section AA'


cutted node
node in background
underground node
20
6
14
11
13
19
0
10
20m

Section BB'



Section CC'

NODES		CONNECTED, VISIBLE	CONNECTED, NOT VISIBLE	NOT CONNECTED, VISIBLE
1	→	2 – 7	3 – 4 – 5	
2	→	1	3	
3	→		1 – 2	
4	→		1 – 5 – 6 – 7 - 11	
5	→		4	
6	→		4 - 7	
7	→	1 – 8	4 – 5 – 6 – 19	9 – 18
8	→	7 – 17	21	9 – 11– 18 – 19
9	→	17		7 – 8 – 19
10	→		11	
11	→		4 – 10 – 12	9
12	→		11	
13	→		19	
14	→		15 – 19 – 20	
15	→		14	
16	→		18	
17	→	8 – 9 – 18	21	
18	→	17 – 19	16	7 – 8
19	→	7 – 11 –18	13 – 14	8 – 9
20	→		14	
21	→		8 – 17 – 22 – 23	
22	→		21	
23	→		21	

Tab 1: relationships between nodes

previous plan and sections, have been defined based on the existing structures and geometries. In some cases the nodes have clear limits, in others they are more vague, but they are still distinguishable by their function. Node three for example, does not have a precise perimeter, but it is a rest area equipped with benches.

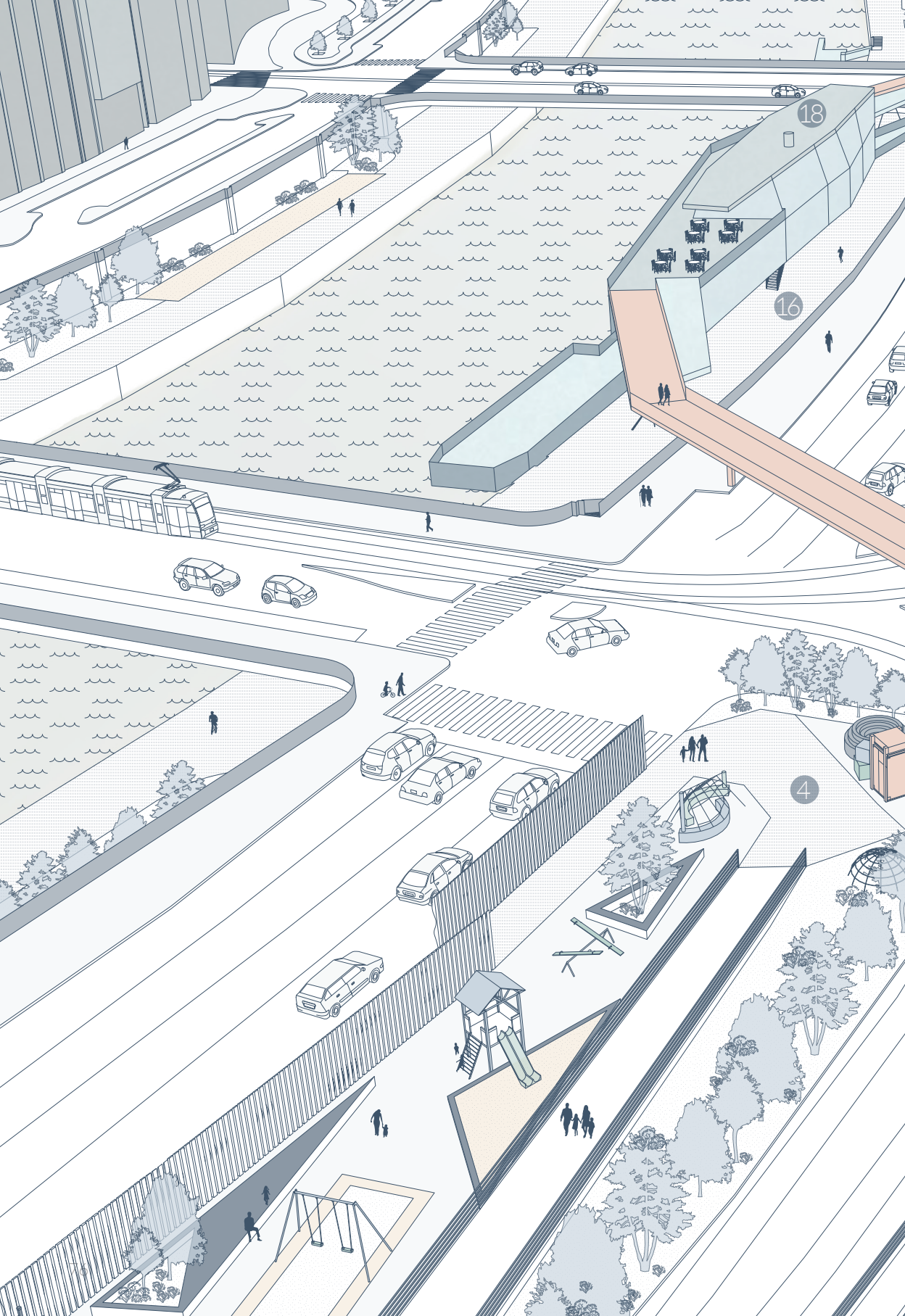
The arches that connect the nodes in the previous map have different colors to indicate the different relationships that can exist between two nodes. Two nodes can in fact be connected and visible to each other, which means that they are physically linked and that anyone who is located on one of the two nodes can see the inside space of the other and vice versa for those who find them self in the other node.

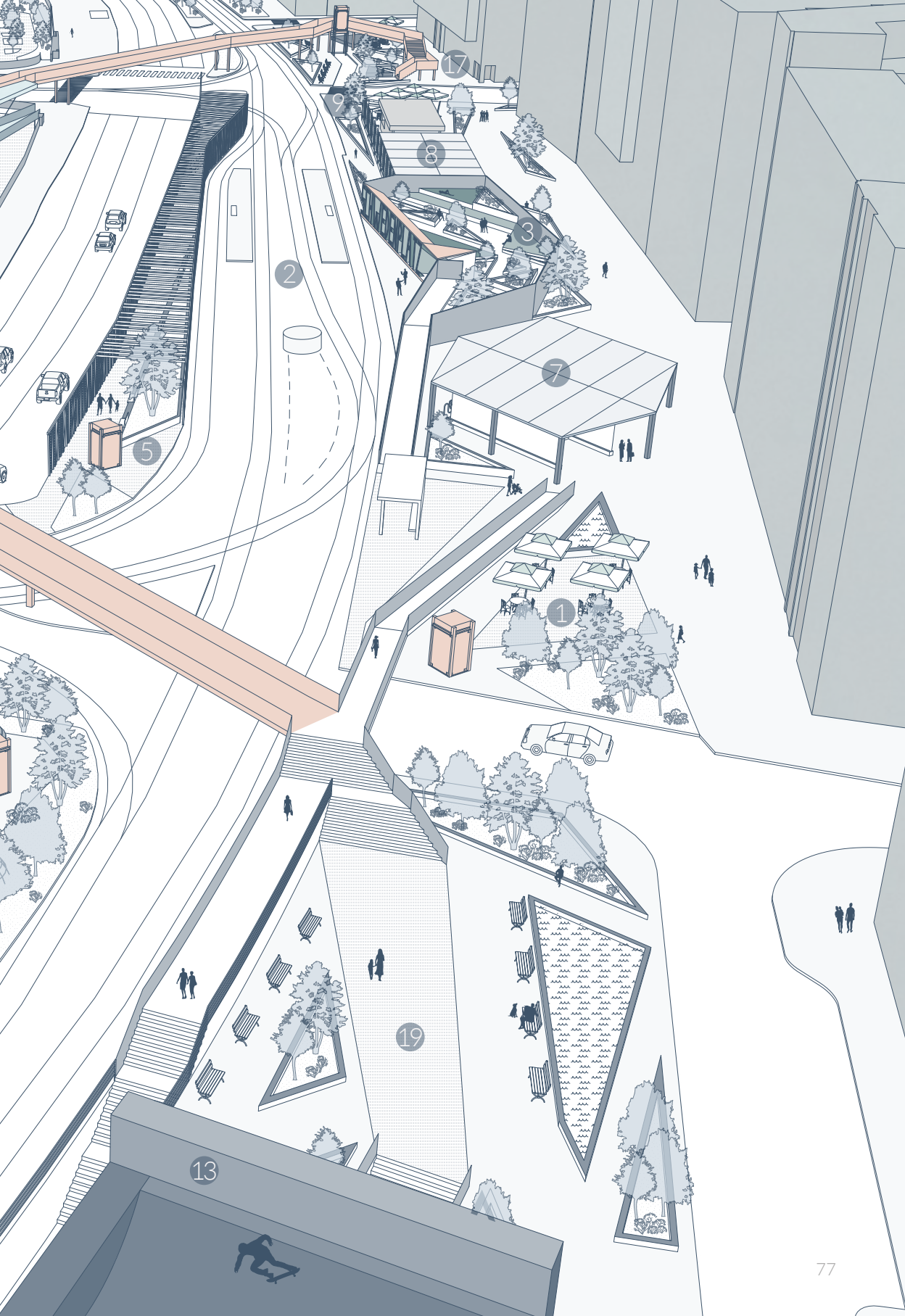
Similarly two nodes can be physically connected but visibility is obscured or there may be visibility, but the two nodes are not directly connected. Furthermore, it is possible that no relationship exists between the nodes, but this condition is automatically respected if the existing ones are designed.

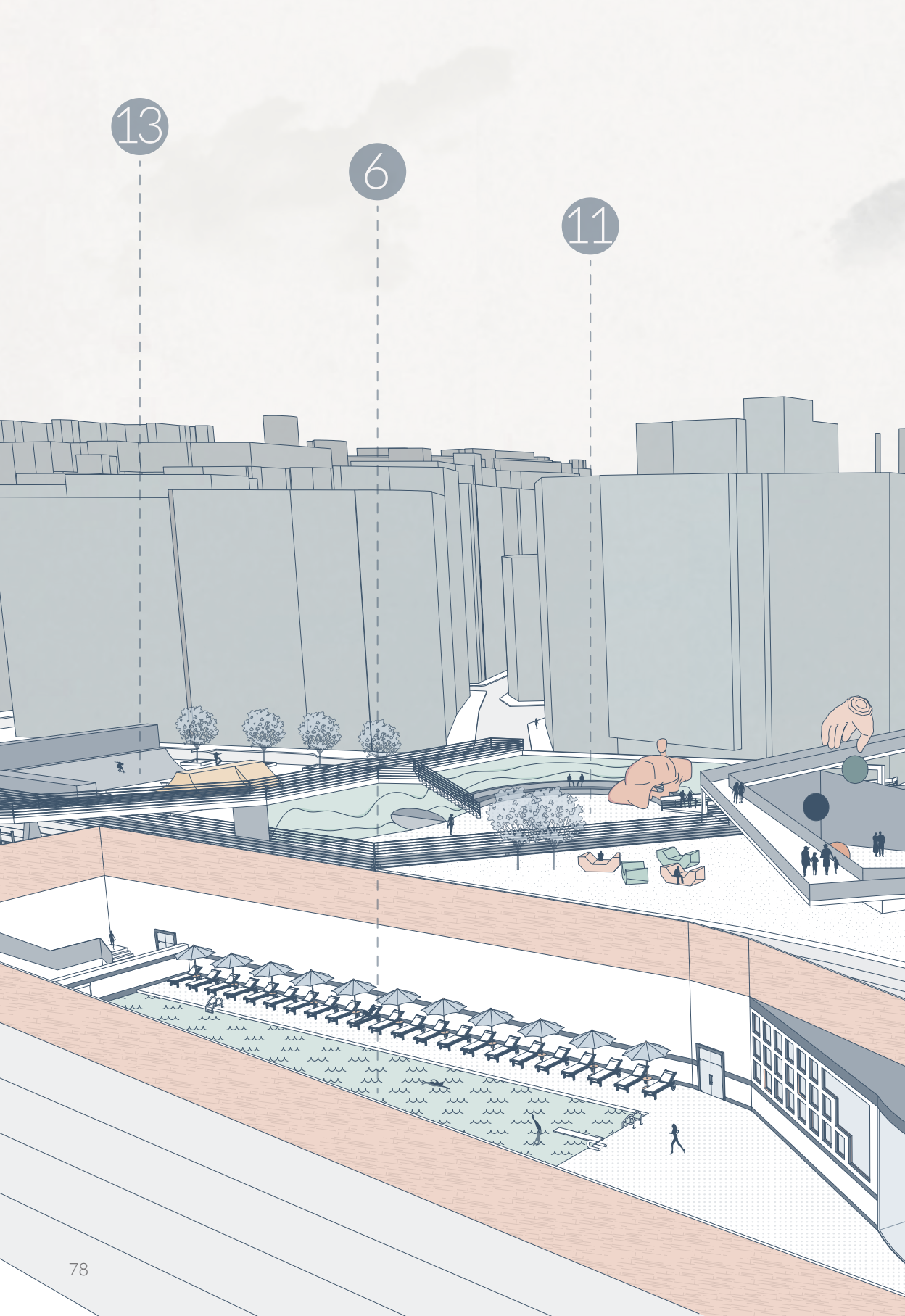
The relationships that exist in this specific case between the nodes are summarized in Tab. 1, which refers to the previous map.

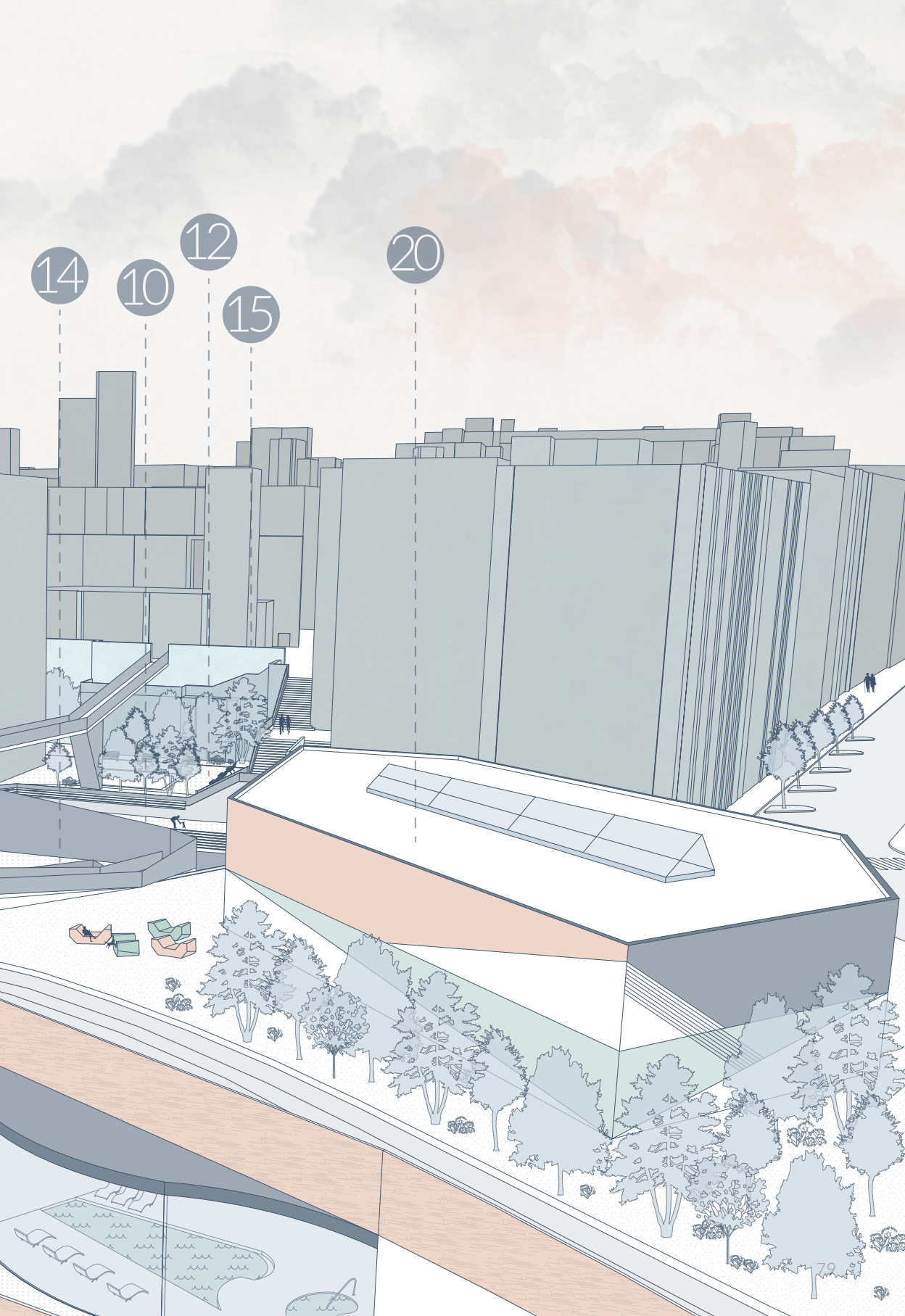
Out of twenty three nodes, fourteen must be completely invisible from any position within the area. This condition is not so strange since visibility rules derive from a building in which the rooms are divided mainly by opaque walls. However, translating this feature into an open public space is not immediate.

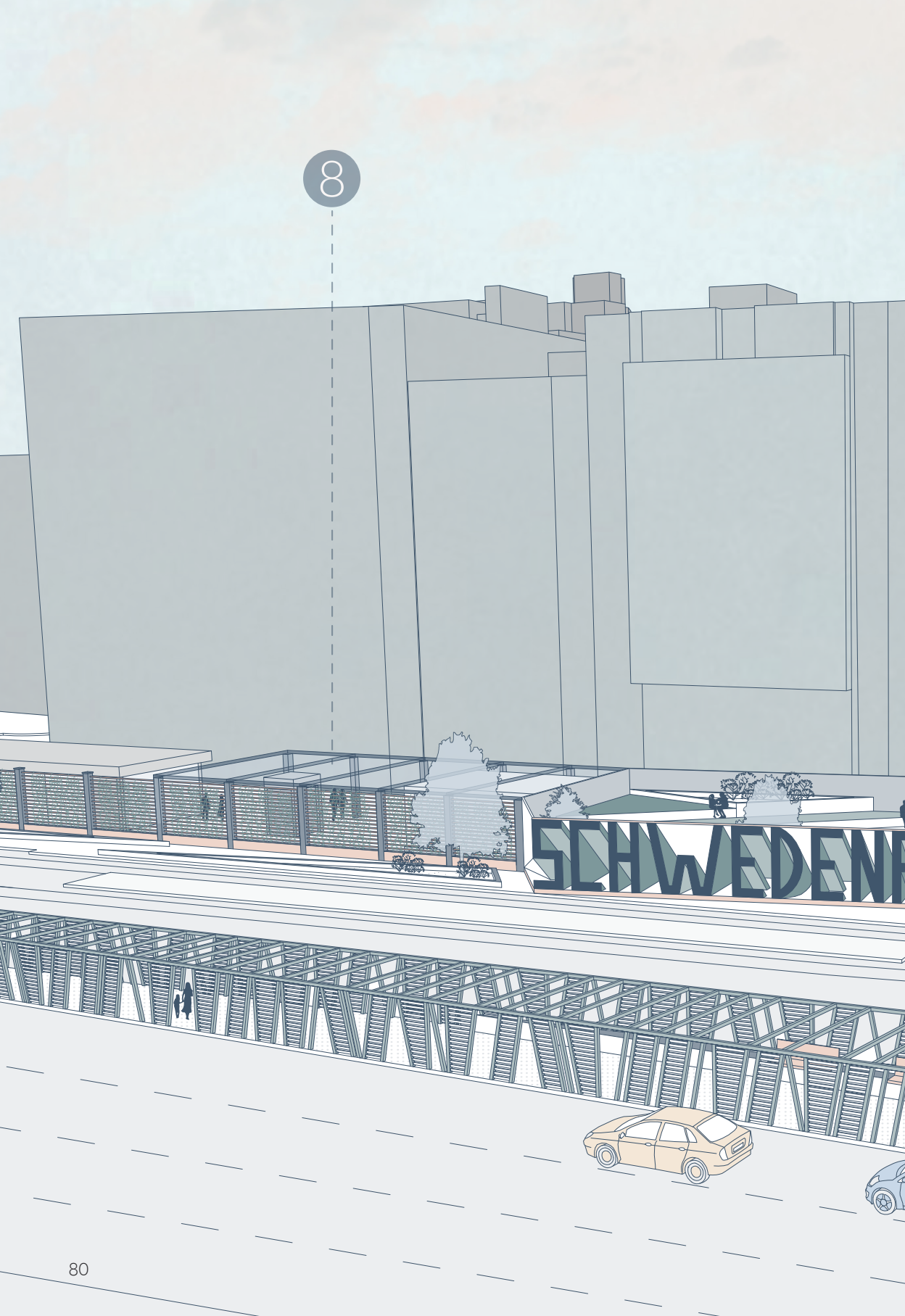
The result is a rather fragmented space, but also a space where numerous new functions intersect: a play area for children, a skate park, equipped rest areas, dehors, a completely opaque museum, a swimming pool, a hidden garden. In each of these spaces it might seem that you are not inside the city and surrounded by cars, but within an intimate environment, protected by the surrounding area through different shields and the use of vegetation. Walking along the catwalks and crossing the site, numerous elements catch the eye and arouse curiosity. The fact that the spaces are actually hidden leads the user to ask himself what is behind a wall, a railing, a row of trees. Numerous inclinations and geometries intersect creating great dynamism. There are few parallel or orthogonal lines as acute and obtuse angles prevail, which create tension and relaxation. If the square is currently a huge flat area with few articulated elements, such as the underground station, in the project the square is a highly articulated space with walkways and underground passages that allow to reach the various nodes.
The following images shows the new design of the square.

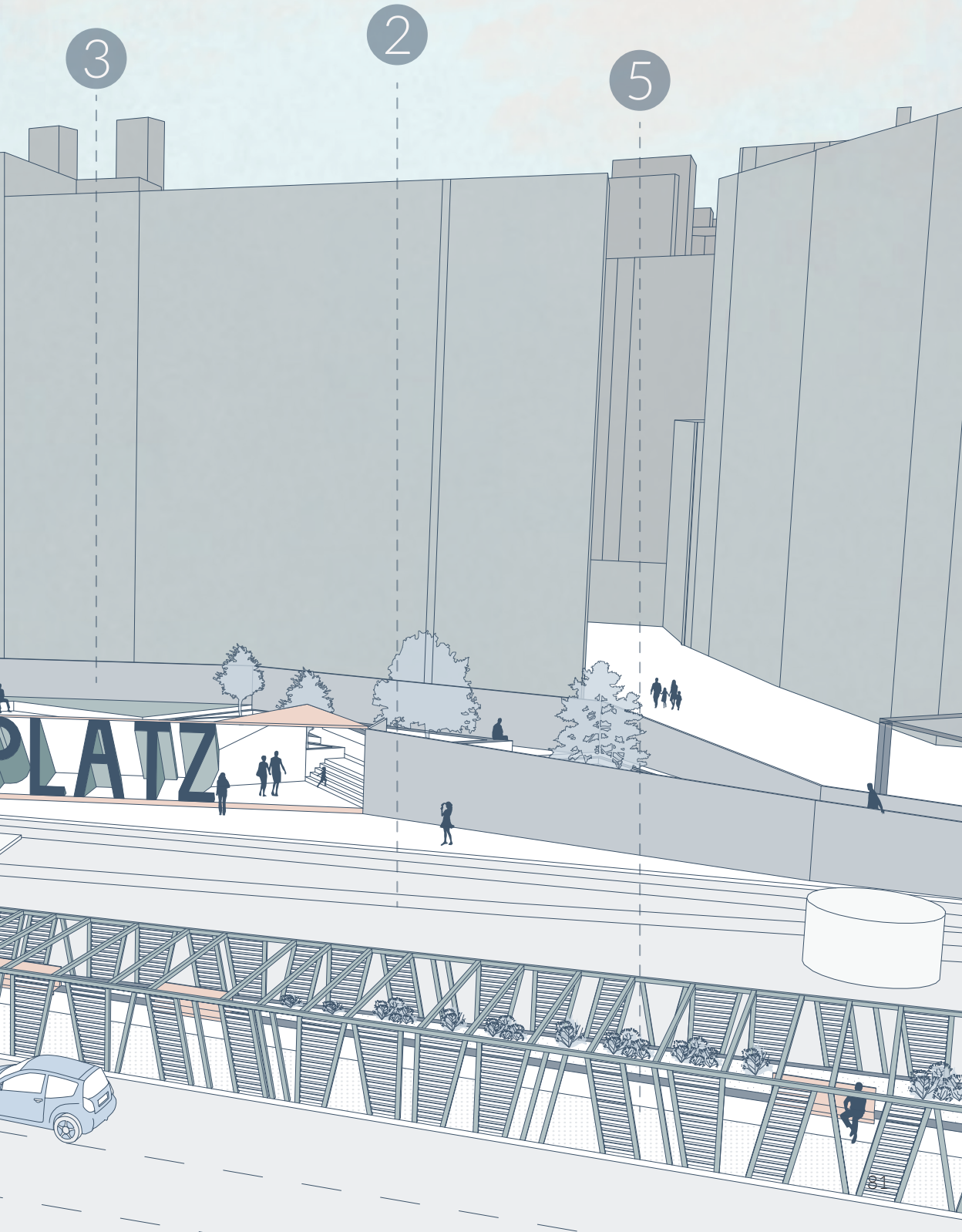

18
16
4

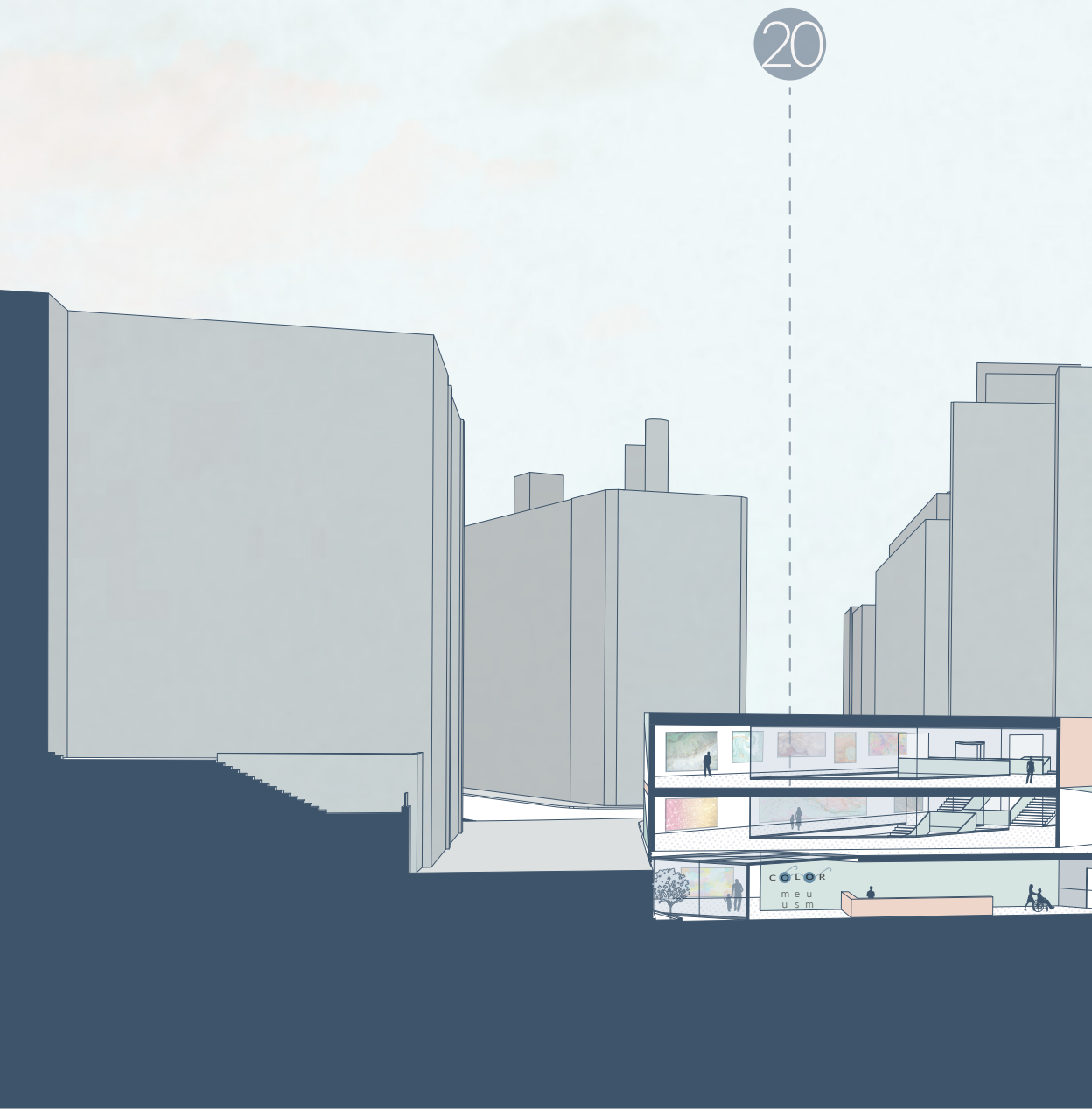

17
9
8
3
2
7
5
1
19
13

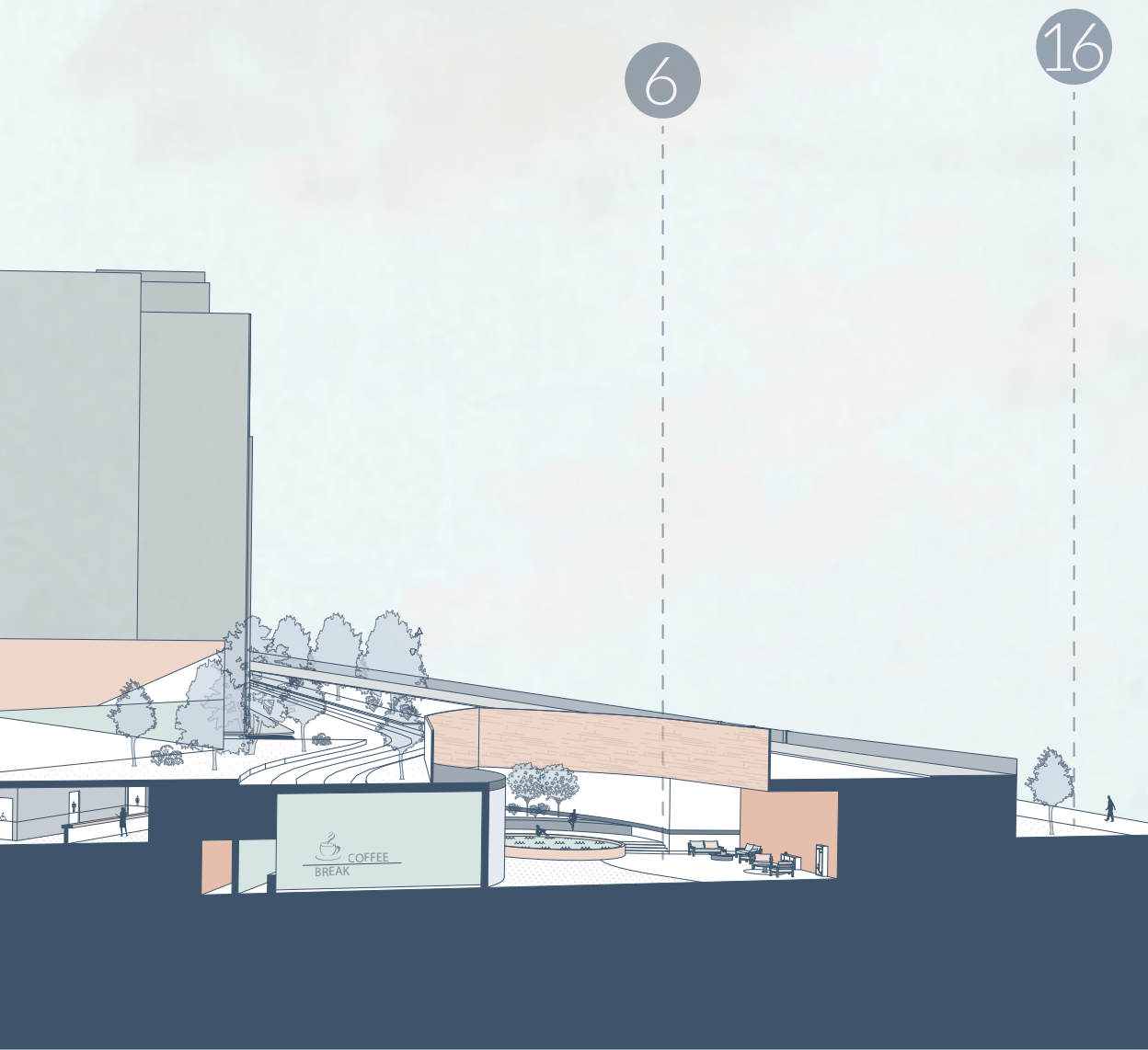

13
6
11


14
10
12
15
20


8
SCHWEDENR


3
2
5
PLATZ

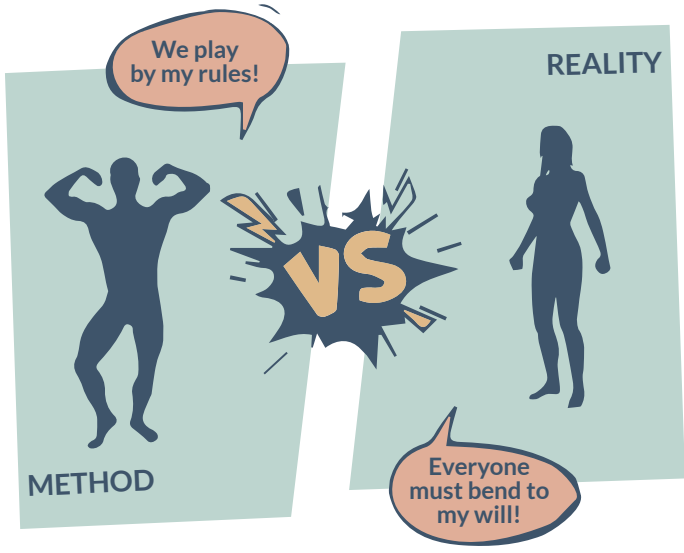

20
COLOR
museum


6
16
COFFEE
BREAK

Limits of the method

The method shows its limitations when, during the encryption phase, distant in space nodes, separated by elements that cannot be changed such as road infrastructure, must be phisically connected.

I called this problem *clash with reality*. The method indeed does not take into account the geometry of the site and nodes project themself on the area in a totally random way. This can lead to situations in which nodes at opposite corners of the site must be connected, but the same can also happen for nodes that are close to each other or already connected in reality. Neither situation is particularly beneficial for the project. In the first case, the risk is that of having to create unnecessary, superabundant connections, while in the second no project is it is truly required and this is at the expense of a space that needs to be redesigned.



The clash with reality occurred several times during the experiment carried out.

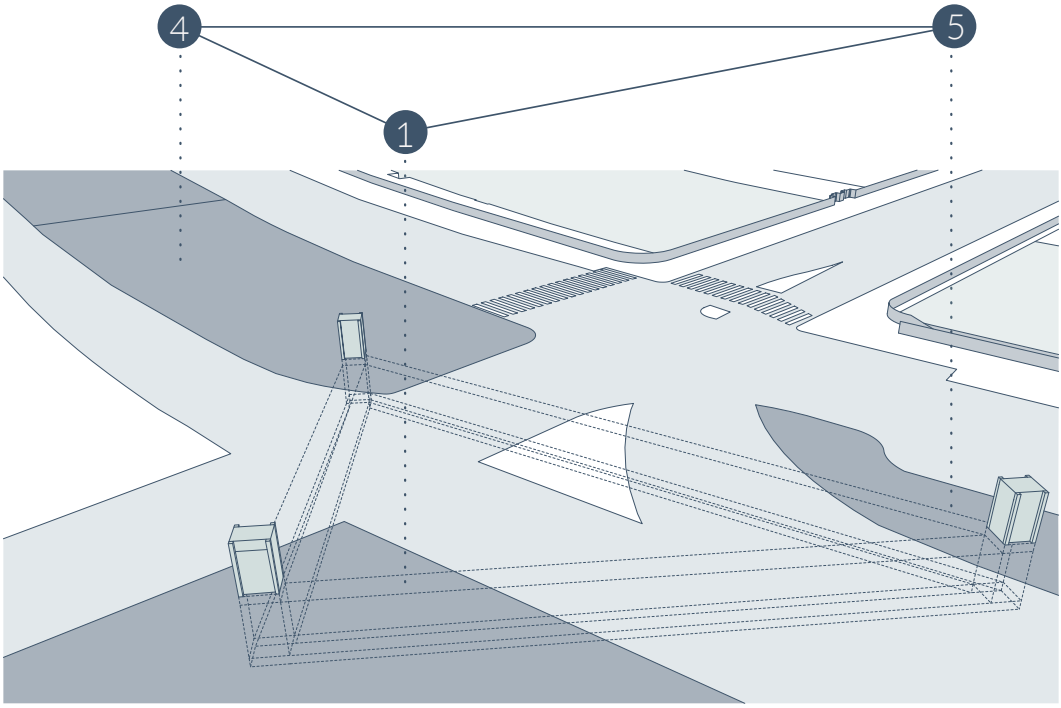
The first case was the link between nodes 6 and 7, being the first one located where now there is the gas station while the second is one of the entrances of the metro station. To solve this problem a very long underground tunnel was designed. Then node six became a swimming pool with spa, accessible also during the cold months. Node 6 it is also, completely blind to all other nodes and it has a lot of privacy. The swimming pool can become a place accessible to nudists on some days of the week, given that nudism is quite common in Austrian culture.
Since this place is located in the city center and can accommodate many people, given its strong attractiveness, it was considered that the underground tunnel connected directly to the metro station could be a useful addition to the project.

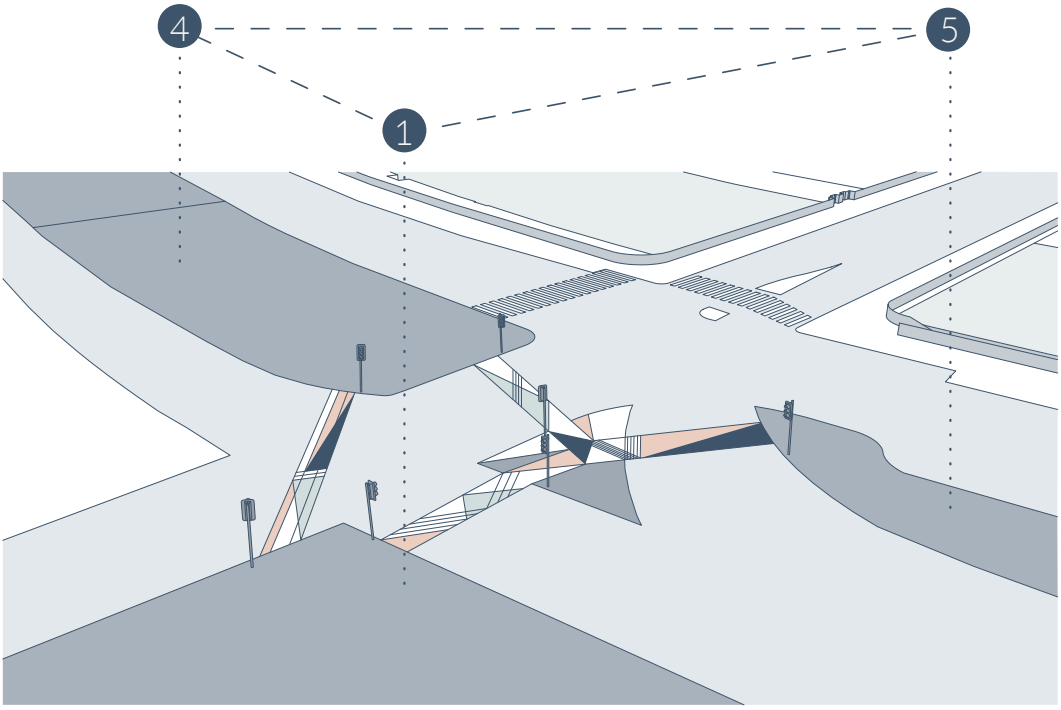
In other cases, however, for structural and cost reasons, some connections were considered not only futile, but also unworkable.

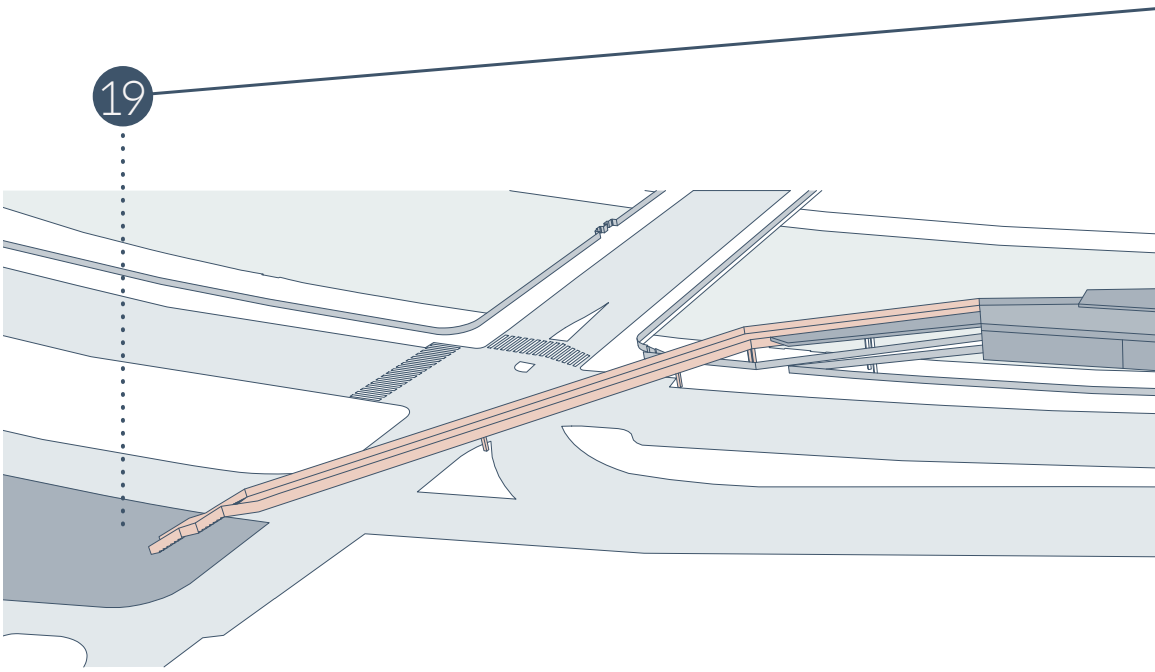
This is the case of the connections between nodes 1, 4 and 5. In the project, node 1 has maintained the dehor function it currently has, while node 4, which was previously a parking lot, has become a playground and node 5, which was a platform, has become a rest area hidden and protected by a pergola.
By following the connectivity rules derived from the method one hundred percent, the only plausible solution for connecting the three nodes directly was to build three underground tunnels, accessible by elevators. In fact, the nodes are located at opposite corners of a crossroads, where cars and trams pass continuously.
However, this solution, visible in the previous images, is not very elegant. In fact, it is a solution to a problem that does not exist in reality, but is generated by the method itself.

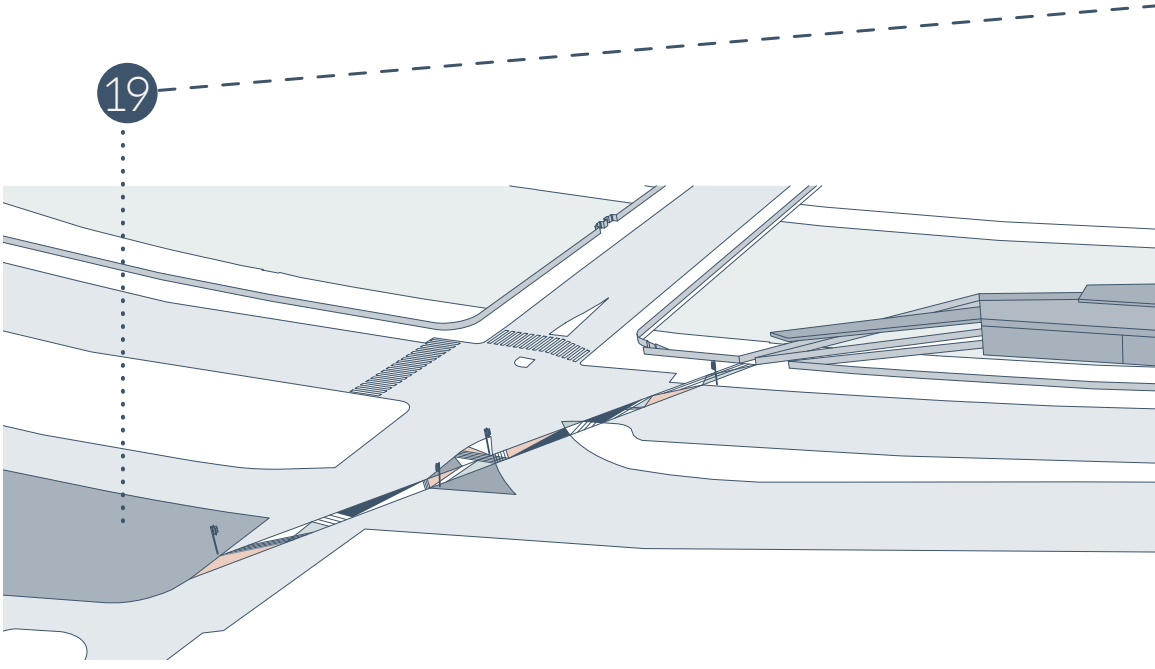
It was therefore deemed necessary to rethink these links. Alternative pedestrian crossings that allow easier use of the site, although not in full compliance with the rules of connectivity, were studied. These pedestrian crossings, which have an unusual diagonal development, visible in the following diagrams, allow you to move from one node to another, even if not directly because you are forced to cross existing elements.

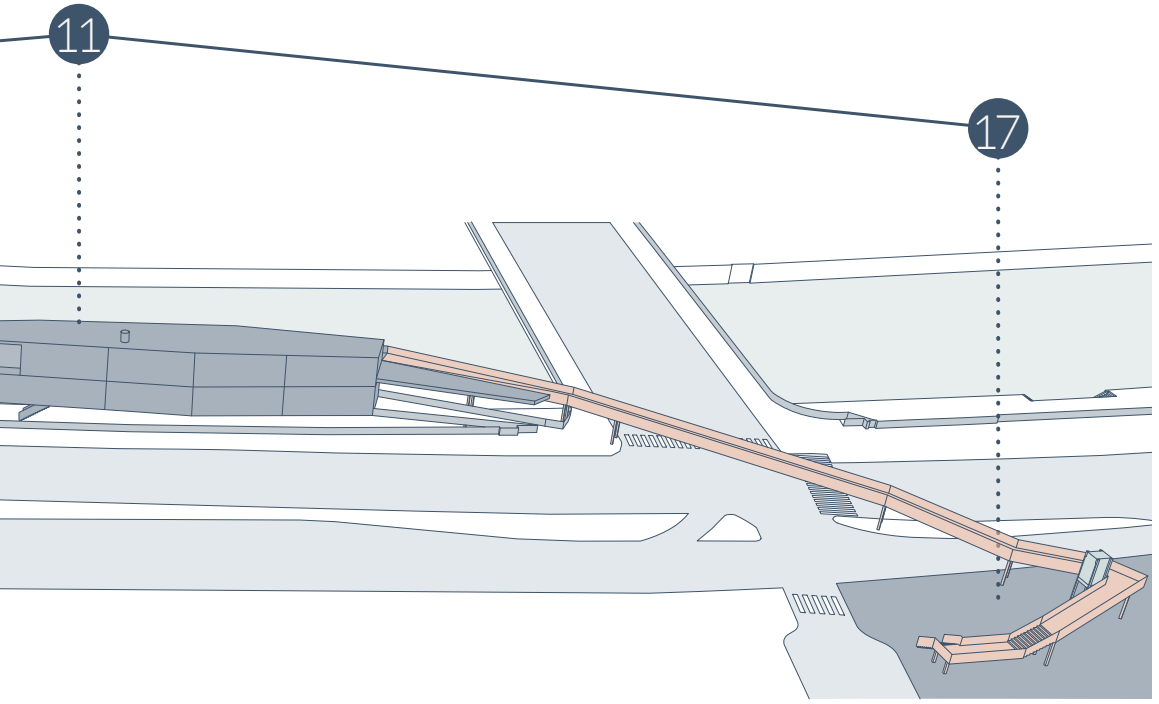
The same problem arose in the connection between nodes 11 and 19 and 11 and 19. Node 11 corresponds to the Twin City Liner ship station. It already has a walkway that connects it to the sidewalk. It was therefore thought to exploit this, changing its inclination and lengthening it, so that it could act as a connection with the other nodes.

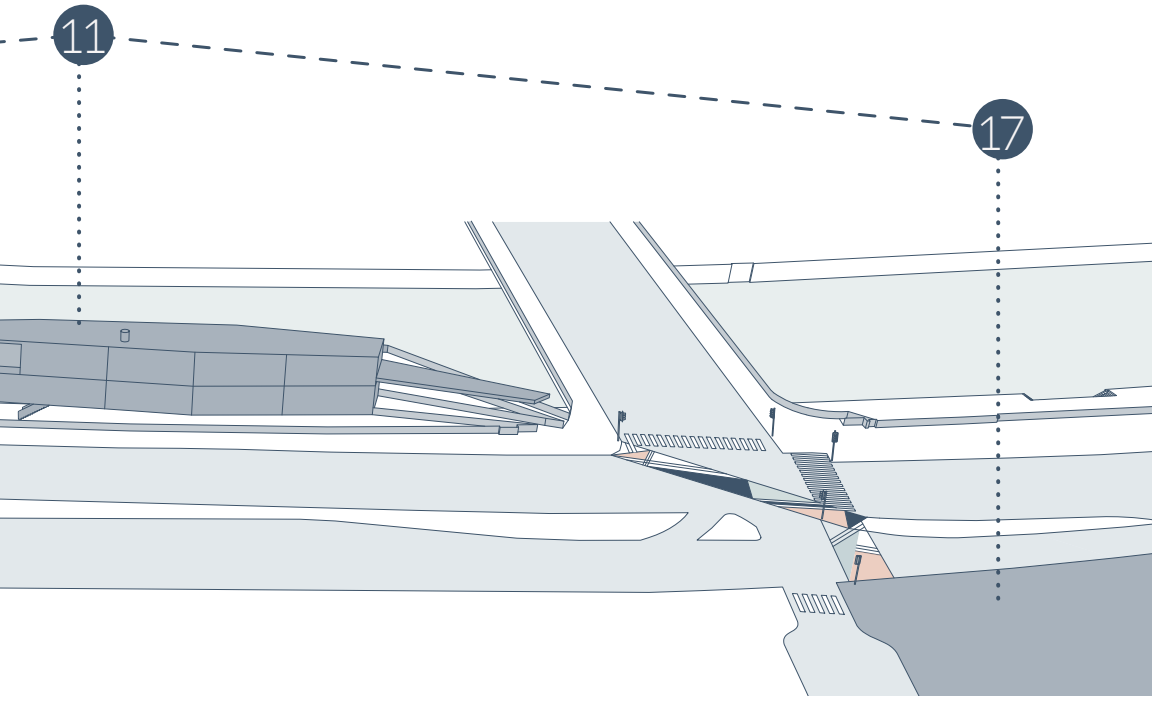

4
5
1


4
5
1


19


19


11
17


11
17

However, given the large distance between the nodes and the fact that these walkways are located above a very wide road, it was immediately believed that it could not be a solution to the problem. These walkways were only sketched to better understand the situation, as it can be seen in the previous immages, but the structure was not studied because it was impossible to position the pillars without hindering the passage to the car and trams. Exploiting the underground level in this case was not possible, as other obstacles would have been encountered.

Also this time it was decided to eliminate the elements that would have been necessary to respect the connectivity rules of the method and it was decided to connect the nodes indirectly. In this way the rules are still applied, but at fifty percent.

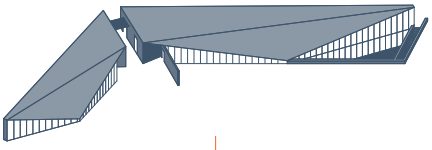
For consistency with the previous solution, it was therefore decided to create alternative pedestrian crossings in this case too.

Given the results of this experiment, which led to design choices if not interesting, at least unusual, it seems necessary to review the method used.

With this specific combination of nodes, it was not in fact possible to recreate all the connectivity relationships decrypted by the reference building 21_21 DESIGN SIGHT. The clash between method and reality meant that the latter prevailed and that changes had to be made in some points to ensure that the project did not present abstruse or unworkable elements.

METHOD

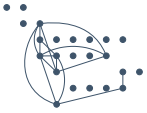
1 reference building



=

2 diagrams with **23** nodes

connectivity



visibility

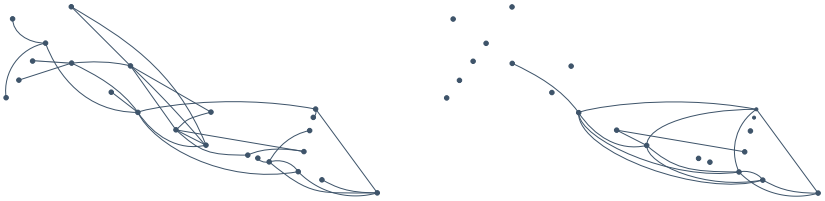
=

23 nodes can have **23!** possible proiections on the space

=

25,852,016,738,884,976,640,000 combiantions

development of one
combination



100% application
of connectivity and visibility rules

clash with reality

50% application of connectivity
and visibility rules

Conclusion

In this thesis work I tried to understand the meaning of freedom in the architecture field, applying theoretical research to an experimental design methodapplying theoretical research to an experimental design method.

The question about freedom may seem trivial and the answer obvious, but I believe they are not. It is in fact a delicate issue, which is often faced when the previous is lacking. But then it is too late. Si vis pacem, para bellum, recites a Latin phrase and I believe our best weapon is awareness of the freedom and limits we have.

However, I think there cannot be a scientific and univocal answer to the problem of freedom, which has many more facets than those emerged in this thesis. The conclusion to which this work has come is perhaps more a starting point than a point of arrival. But this is perfectly consistent both with the reasoning carried out and with the proposed experimental design method. In fact, according to Popper, every thesis must be subjected to the trial and error-elimination method to demonstrate its non-falsifiability. We start from a thesis to create a new one, as in the design method used we started from an existing architecture to create a new project.

On the question of freedom, on determinism and indeterminism, there are countless sources and theories, however here I have chosen to focus on Popper's lecture Of Clouds and Clocks because his reasoning lends itself very well to explaining the stages of the design method used.

The central question Popper tries to answer is why human behavior, although subject to numerous external forces, has a certain degree of autonomy. This autonomy is identified with the freedom of man, whose existence Popper does not question. Indeed, from the solution to which he arrives one could draw the conclusion that freedom is an essential factor for the evolution of the human species.

Where it was thought there were only predetermined paths,

which led directly to the effect from the cause, man was able to think of alternatives. Where there was no path, but only a random point of arrival, he was able to imagine it. Creativity, which can only exist if the existence of freedom is admitted, is an essential factor for understanding and transforming reality. Man's actions cannot be explained either by the deterministic view of the world that does not contemplate any freedom, nor by the indeterministic one where man is at the mercy of chance. Both scenarios relieve man of all responsibility and make meritocracy an alien concept. The actions of the free man endowed with reason are neither clouds nor watches, but are located on an intermediary plane.

The explored design method fits into this framework. The decryption of the rules of the reference building fruition is a deterministic act in which the designer decodes the rules without any personal intervention. The next step, in which nodes have been randomly projected onto the design site, took place in an indeterministic manner. In fact, nodes randomly positioned themselves in one of the numerous possible combinations. This property and the extermination the abundance of buildings to be used as a reference, make the method a sort of machine that can provide the basis for an infinite number of projects.

In the first stages, the designer is alienated from reality by inserting himself into the logic imposed by the method, thus depriving himself of the freedom of choice. However, in this thesis we reasoned about the intrinsic need for freedom of architectural project, which has the task of imagining alternative scenarios to the current ones. In the deterministic vision, any design proposal would be the only possible option. In the indeterministic vision, interpreted as pure chance, the idea of designing, understood as laying the foundations for something to be realized in the future, is impossible because the degree of randomization is not controllable.

However, Popper's reasoning ends with the theorization of a plastic-control of man over reality. This control is called plastic because man, through reasoning and argumentation, is able to create abstract thoughts that have a certain degree of control over reality, which in turn has control over him. Therefore, man creates rules that he assumes as true and respects until they prove to be fallacious. In fact, they are continuously subjected to the trial and error process and modified if their legitimacy fails. So man creates his reality, fixed points from which to move forward and progress, based on his knowledge and accept that it has control over him.

However, Popper speaks of man as an individual. The concept of freedom is closely linked to that of autonomy and personal

responsibility, but here I argued that it is not possible to extract man from the society in which he lives, where the freedoms of individuals are limited by external impositions, first of all the respect for the others' freedom.
This is perfectly reflected in the profession of the architect who in his daily practice submits his creativity to norms and standards and he is confronted with more abstract aspects such as the approval of his work by stakeholders and the public.

There is no doubt at this point that these external impositions exercise a certain degree of control over the actions of the architect and man in general. However, it has been argued that this control, within a democratic context, remains plastic. Regulations are a type of control that is certainly more dominant than that of public opinion. Plastic control has therefore been divided into two sub-categories according to the rigidity of external influences: thermosetting control for the most rigid impositions and thermoplastic control for the most malleable ones.

The last phase of the method involves the encryption of the rules previously decrypted by the reference building within a design site, which in this case are the 21_21 DESIGN SIGHT and the Schwedenplatz area.

This phase is influenced in a preponderant way by the previous ones, which exercise control over the project by replacing the control that external impositions have in real life. Nonetheless, the experiment has shown that simulating a simplified model of reality, where the rules to follow are few and clear, gives the designer enormous freedom, which however cannot be expressed one hundred percent once the veil of the abstraction is removed and the project is immersed in its real context that has its own rules.

The project derived from the application of the method has in fact some direct connections between pairs of nodes which are very forced. They have no real need to exist since the site already has alternative routes or they would be achievable with little effort if the connection would not be direct. Direct connection in these cases would demand the construction of bridges and underground tunnels which not only require expensive and bulky structural works, but they are also not very satisfying to the eye.

The reasoning and experiments carried out in this thesis work therefore lead to say that designer's freedom must be constantly balanced by the control that reality has over him and he has over the reality. And by reality we mean the conformation of the design site, but also, in a broader sense, all the external

impositions with which our freedom must constantly deal with.

This first method model could be implemented, so that it is less abstract and takes more account of the geometry of the design site. A solution could be to add constraints in the passage in which the nodes project onto the design site, to avoid situations in which nodes too far in space and separated from important infrastructures must be physically connected. In this way, the clash between method and reality would be smoothed out and the method itself would have greater efficacy in the redesign of an existing area, which inevitably has particularities that cannot be changed.

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Fig 11-14, 17-18, 20, 22
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Fig 15
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Fig 18
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Fig 21
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Fig 23
photo by author [25.09.2018]

Fig 24-27,30, 33-34, 37-42
photo by Bilal Alame [23.01.2020]

Fig 28, 31-32, 35-36, 43
photo by author [03.06.2019]

Fig 29
photo by author [18.12.2018]

Ringraziamenti

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