

# DESIGN PRINCIPLES OF TIME PERCEPTION

## APPLICATION ON EDUCATIONAL ARCHITECTURE

Merve Sertogullarindan 961986  
Supervisor: Prof. Elvio Manganaro

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Politecnico di Milano  
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*to me,  
who worked hard to make my dreams come true*



## **ABSTRACT**

Perception defines how we experience world and react upon it which Merlau-Ponty expresses as “The body as the primary site of knowing the world”. It is unignorable input of design which is impossible to remove from eventhough theoretical thinking is treated as luxury which only a few offices/architects are eligible for it in age of competitiveness and limited time. The visual perception dominates in architectural design process with creating images of spaces in mind, yet secondary senses -auditory, tactile and etc.- or time perception is generally outcasted. In this article, factors related to time perception and their spatial characteristics are studied through pyschological approach after phenomenological and scientific approaches examined and design principles brought up that can be applied in architecture -especially educational facilities since the school experience has temporal importance in human life as it is a long and crucial period of human life for human development as well as it is an international experience as experience of time.



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# INTRODUCTION

Time as the fourth dimension of space, is one of the most important inputs for experience of space along with senses of human body which should be involved in design process of built environment, especially in educational architecture for serving student well-being by controlling the boredom and anxiety levels in learning environment.

Perception is started to be considered in design of architectural spaces after the modern movements that place human experience/use of space at the center. User perspective and comfort has put into the center of design. Yet in general, a holistic method is not achieved since the domination of visual perception obtains the main attribute of design. Quality and satisfaction of design depends on how much it serves to all senses of people who live inside. A building should provide a set of well thought and balanced stimulants to other senses as hearing, touch, smell and taste. Time is also an inseparable part of life experience while it is unfortunately disregarded. As time perception in architectural design is rather new topic for literature, in this study, different approaches to time perception as psychological, phenomenological and scientific will be examined to find most appropriate method while the spatial requirements related to contemporary pedagogical theories in relation to time are searched. Within the combinations of two fields, some principles of design process can be brought up.

Design Principles of time perception have put on use in a design project. A public primary school that requires reconstruction in Milan is chosen and design principles applied while the programme and context conditions are met.



# **PART I PERCEPTION**

PERCEPTION in  
Architecture -  
INTRODUCTION TO NEW SPACES IN ARC-  
HITECTURE  
CLAUDIA PERREN AND MIRIAM MLECEK

Perception is the holistic system of interpretation of the information that is gathered through senses from the environment to interact with it. It is primary condition of all human experiences since a set of reactions required to build an experienced situation such as being in a society, being in a space. The body is more than just a place to observe the universe from a central vantage point, and the senses are more than passive recipients of inputs. The body does not serve as the site of cognitive thought; rather, our bodily being—including our senses—structures, generates, and stores silent information. Sensual and bodily modes of being make up the entirety of who we are in the world (Pallasmaa,2007)

Perception contains objective and subjective features. Objectivity of perception is related to the stimuli caused by the environment and the subjectivity is how it is experienced by the observer depending on his/her internal conditions, emotional state, past experiences and future expectations. Received information of world, the objective input, is solely sensational and physiological; only after the mental process, sensation becomes perception.

Mechanism of perception starts with separation of an attended stimulus from an environment by attributed organ of the sense and transformed to electrical signals. Mental procedure constructs the perception by processing the neural data. But procedure of perception is not finished. Recognition of perceived thing by the help of previous experiences is necessary to completely grasp its features. Then the process is ended with reaction.

The mechanism of perception is unconscious. As Pallasmaa says "Atmospheric characteristics of spaces, places and settings are grasped before any conscious observation of details is made' (2012). It can be expressed as mind of body. Richard Rorke (quoted by Pallasmaa,2012), expresses that if we could have grasp the notion of body, the importance of mind would have been questioned.

## Spatial Perception in Architecture

Spatial perception is required for one's orientation and circulation in an environment and to do so spatial dimension is needed to be perceived and understood. It is also an important factor for perception of other things since three-dimensional Euclidian space creates the context of things in relation to one and other. Yet new understandings of space of perception enters to discussion as a collective entity of physical, visual, acoustic and virtual factors (Perren, C. & Mlecek, M., 2015).

Relation between two fundamental objects of architecture is constructed by perception; person and space therefore a notion of architecture is not conceivable without understanding of sensual experience of space. As Pallasmaa explains, the base for perception and the horizon of experiencing and comprehending the world are provided by architecture, which is fundamentally an extension of nature into the man-made sphere (2012).

Architecture hold capability of shaping the structure of daily life therefore the living and in a bigger picture the dynamics of societal life. Therefore it a great importance of on the experiential being of human .

### Primary and Secondary Senses of Perception

The dominion of the sensual experience in overall is on sight/visual-perception. The importance of data gathered by seeing is undeniable yet, a satisfactory experience cannot be achieved by ignoring the rest. Although reseptors do collect information through different senses seperately, our understanding of environment is constructed holistically which expressed by Merlau-Ponty (cited in Pallasmaa, 2016) as "a unique structure of thing that speaks to all senses at once".

As the sight being a dominant sense, the emphasis on visuality that already started with the use of perspective is also increased rapidly in modern times due to innovations on photography and television. The visual propaganda and rapidness of our age, caused art and architecture to lose its qualities in order to catch the time. Architecture has changed from being a bodily

situational experience to being an art of the printed image established by the hurrying eye of the lens. We observe the world from outside as viewers of images projected on the retina, rather than perceiving it as it is (Pallasmaa, 2012). Montagu (cited in Pallasmaa, 2016) expresses this as "neglegted senses" and Pallasmaa him self expresses this as "narcissistic and nihilistic eye". The nihilistic eye actively promotes sensory and mental isolation, while the narcissistic eye sees architecture only as a method of self-expression and as a game of intellectual and aesthetic skill that is cut off from important mental and social relationships. (2012) .

A satisfactory experience is not achievable with mere vision. One cannot have a full knowledge with only seeing but not being able to hear, smell, touch or taste. All senses are required to contribute and fuse into each other for a complete experience of a thing and especially of architecture. Importance of hearing in spatial perception is mostly neglegted as well as other senses but it can add different qualities to space with its contrast to sight as vision is directed, whereas sound is omni-directional; sight isolates, whilst sound embraces. Whereas the sense of sight suggests exteriority, the sense of sound produces an impression of interiority (Pallasmaa, 2012). Touch of skin to surface and bodily movement in space are two essentials of haptic experience of space. Materiality and textures of surfaces that awake a desire of touch and a form, a light that creates a certain movement serves for a valuable spatial experience. The texture and color of material can awaken a desire of oral exploration as colors and matter obtain a feeling of taste. And we can unintentionally enter a region that our retinal memory has totally forgot when a certain smell causes us to; our noses awaken a lost vision, and we are drawn into a very real daydream. Eye is reminded by nose (Pallasmaa, 2012). Encounter with architectural space is only complete when all five senses are included and united in the experience as in Bruder Klaus Field Chapel by Zumthor. Textured surfaces of walls awakens a desire to touch and feel, while the sight is put into service of touch by underlining the pattern with help of infused light from the opening on the ceiling. The silence of the hills and fields passes through the thick concrete walls and smell of burnt wood works as a room freshener.



Fig.1. Brauder Klaus Field Chapel by Peter Zumthor, 2007,



Fig.2. Brauder Klaus Field Chapel by Peter Zumthor, 2007,

Other modes of being are holding a potential to enrich the bodily experience of space. As Pallasmaa indicates space, matter, and time come together in memorable architectural experiences to form the fundamental material of being, which permeates human awareness. We associate ourselves with this space, this place, and this moment, and these dimensions come to constitute who we are (2012). The consideration and thought of time perception as it cannot be separated from the experience of bodily being in a place should be further investigated.





# **PART II**

# **ARCHITECTURE , TIME & TIME PERCEPTION**



## Time

Time is a phenomena that used for locating series of events in space. Its use can be seen as a measurement of duration or as a conscious experience. In both cases it cannot be separated from being part of human experience.

Time consist of moments which are positions that we locate events. To be able to reach a consciousness level by grasping the momentary images; moments are constituted in a time order and create a temporal serie that we organise events in a relation to another- before or after. Understanding of time as an sequence of events/moments also leads us the past-present and future conception. Each moment has the features of past, present and future since every moment was once future, now present and will be past and time as being effector of change it becomes change itself (McTaggart,1908; James,W., 1886).

Change is acknowledged as consequence of time movement likewise the movement in space is related to time. As a result, it is com-

monly observed in linguistics that the words.

## Architecture and Time Relations

Space and time are two fundamental requirements of being. As Minkowski says "Henceforth space by itself and time by itself, are doomed to fade away into mere shadows, and only a kind of union of the two will preserve an independent reality." (quoted by Gideon,S., 1959). Yet, the term of "time" in architecture is very generic topic without specific definitions of time and architecture are determined. Time in relation to architecture can have plenty interpretations as "project, performance, organisation or transformation factors" (Lucarelli, M.T., 2020). On the point of certain time interpretation is specified, interpretation of architecture can transform the relation. Faroldi asserts that the significance of time and how it is perceived in contemporary architecture have changed; time is now seen as something that is subject to clear limitations, and disparities, discrepancies, and dissonances are more and more linked to a changeable, never linear, temporal dimension (2020). Broadness of subject, requires a wider

investigation in subject. Therefore literature research on the various approaches to time or relations with time and architecture is done by considering the issue called “Tempo/Time” of *Techne* magazine as a base point due to its being a contemporary therefore up-to-date work (dated 2020) and extended by further investigations. Literature search brought up various time interpretations depending on numerous dynamics. In this research the found interpretations are mapped according to their relativity to the building production process in order to emphasize the relation of time perception with user and therefore with the usage phase.

### **Design Process**

The definition of term “time” can be described as “project factor” when it is considered in relation to design. Tools and elements of design are interpreted as time-variable factors which also gives “time” a transformative value.

Designing for changing future requires a thought of present as well as future and potential functions are becoming time variant as in Le Corbusier’s aim for achieving free plan in *Domino House* (1914-15) to allow prospective alterations. Climate being a seasonal time variant on its own creates even bigger challenge when the climate being subject of change itself. Light being imposer of time, creates a tool that allows constant transformation of design throughout the day and becoming time itself.

### **Construction Process**

Time works as performance and organisation factor during construction phase whether it is caused by the property of material itself - required duration of production, curing etc.- scheduling and organising of production events in site or prefabrication.

### **Architectural Object**

Architectural Product contains all factors and values of time in its substance as it is outcome of the design and construction processes and object of use. Being source of memory is defined as its being in certain time duration- from past to present and to future - and connecting through time being static historical object in continuum, Timeless architecture, contrary to the term itself- holds all the time by resisting through adapting. The timelessness feature also often valued as source of aesthetics as Harries states as building a beautiful structure will assist to replicate the basic feeling of being at home that man’s body denies him while subjecting him to time. To create a beautiful item is to connect time and eternity (1982). Suspending time by not finishing a phase, having an architectural product but not a product of use holds negative performance value as well as reverse transformation value. Time allows contextualising of architectural event or product by giving a location in time dimension in relation with simultaneous and past events to understand the development of the idea behind it.

### **Usage Phase**

User experience of time in architectural space has performance and transformation value. Marks of use and signs of time on the material itself can be seen by the natural process of substance’s decay. Sequences of daily use shapes the space and vice versa the architecture shapes the routine of daily life. As Faroldi explains given that it is a component with times tied to physiological rhythms of use, the architecture of time serves as a guide for defining, implementing, and designing a place (2020). The term of time in time perception in architecture refers multiple performative and transformative values as it depends on subjectivity of different users’ experiences. It focuses on how one’s perception of time is affected or changed by spatial qualities.

### **Life Cycle**

Life cycle refers the time interval of the buildings’ use therefore has project and performance or transformation values. While preservation and adaptation of use has the time term more relevant with performative and transformative; aim of temporary or permanent use has project value since it also affects the content and substance of architectural materiality.

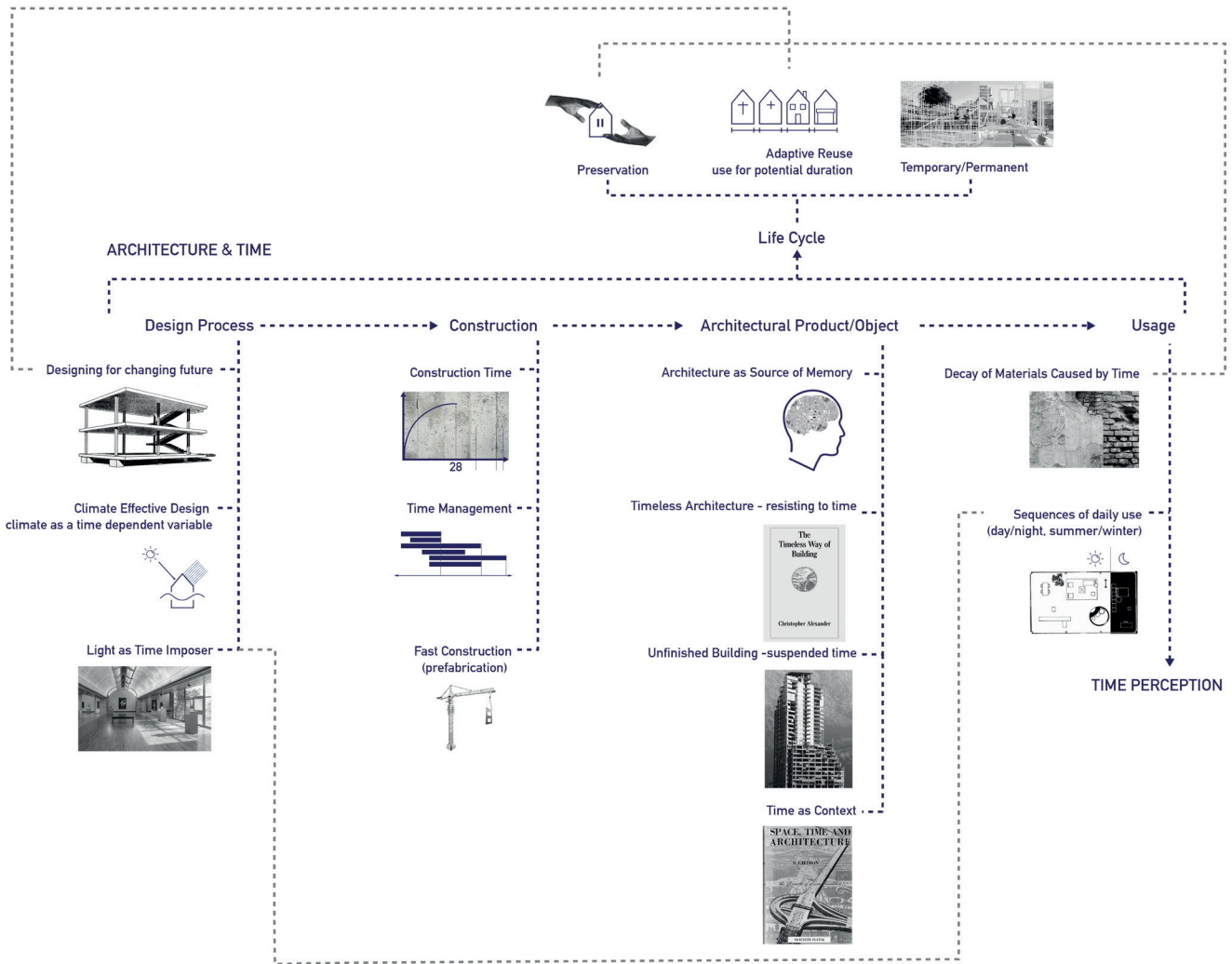


Fig.3. Mapping of Architecture and Time Relations

## Time Perception

Time as a mental construct, cannot be separated from subjectivity of individuals. It is not perceived as a rigid-equally segmented-real time, thus every unit of time (seconds, minutes, hours, years..) have different duration for every person. As Merleau Ponty explains as the problem of sensoriality, or of finite subjectivity will be resolved only by considering time and demonstrating how time only exists for a subjectivity—without which, the past would be gone and the future would not have begun—and how, despite this, this subjectivity is time itself, or how we can follow Hegel in saying that time is the existence—of time (2012).

Experience of time is changing from individual to another while it also transforms and changes in the boundary of one single person. Temporal perception of a situation reverses as it is thought in a relatively short time after the situation and relatively long time after the situation. A certain duration which is perceived as a long period (a moment of waiting) will be remembered shorter when considered retrospectively (Wittmann, M., 2009).

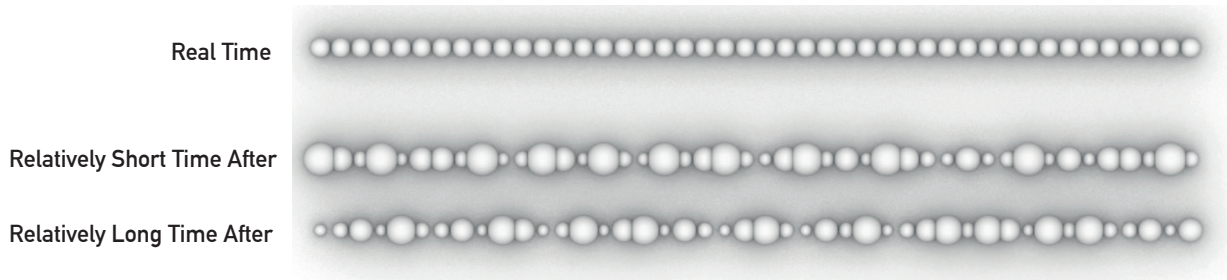


Fig.5. Relative Perception of Time

In every moment, there is perception related to now, but also memory of previous perceptions and anticipated perceptions of future, which in all defines our interpretation of time (McTaggart, 1908).

Perception of time is parallel to perception of space. As Einstein (quoted in Buehner & Humphreys) says “Time and space are modes by which we think and not conditions in which we live.” and as Bishop (1982) expressed that “awareness of time is as elementary dimension of existence as is our sense of orientation in space” thus proves the binary conditions of perception of space and time.

## Different Approaches to Time Perception

### I. Psychological Approach to Time Perception

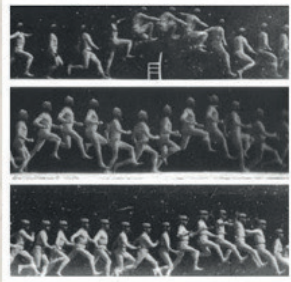
Psychological understanding of time is based on the perception of synchronicity, sequence or pace of internal or external durations by individuals (Zakay, 2015). Temporal information is gathered by receptors of different senses since there is not a specialised neuron structure in human brain devoted to perception of time. As visual perception dominates the holistic perception of environment, data gathered through auditory senses dominates the temporal perception (Van Vassenhove, 2009)

Time perception is inflected by the subjective state of the individuals; concentration, sentimentality, amount of stimulants, complication level of task are some of many factors that have possession of great influence on subjective time (Van Vassenhove, 2009). Increase of stimulants generated by emotions cause heart to beat faster, therefore time is perceived to move faster depending on the internal clock model ( a model for estimation of duration). Opposingly, if the amount of stimulants are extremely high, due to the attention which is oriented to emotional data, heart beat is lost and time perceived shorter.

瞬間·時空  
Time Space Continuum



Greek Ancient Foot Racing, 776BC



Marey's Photography & Movement, 1880s



Sports, contemporary



Time Space Continuum, 2012

Capturing the slices of life at moments in time.

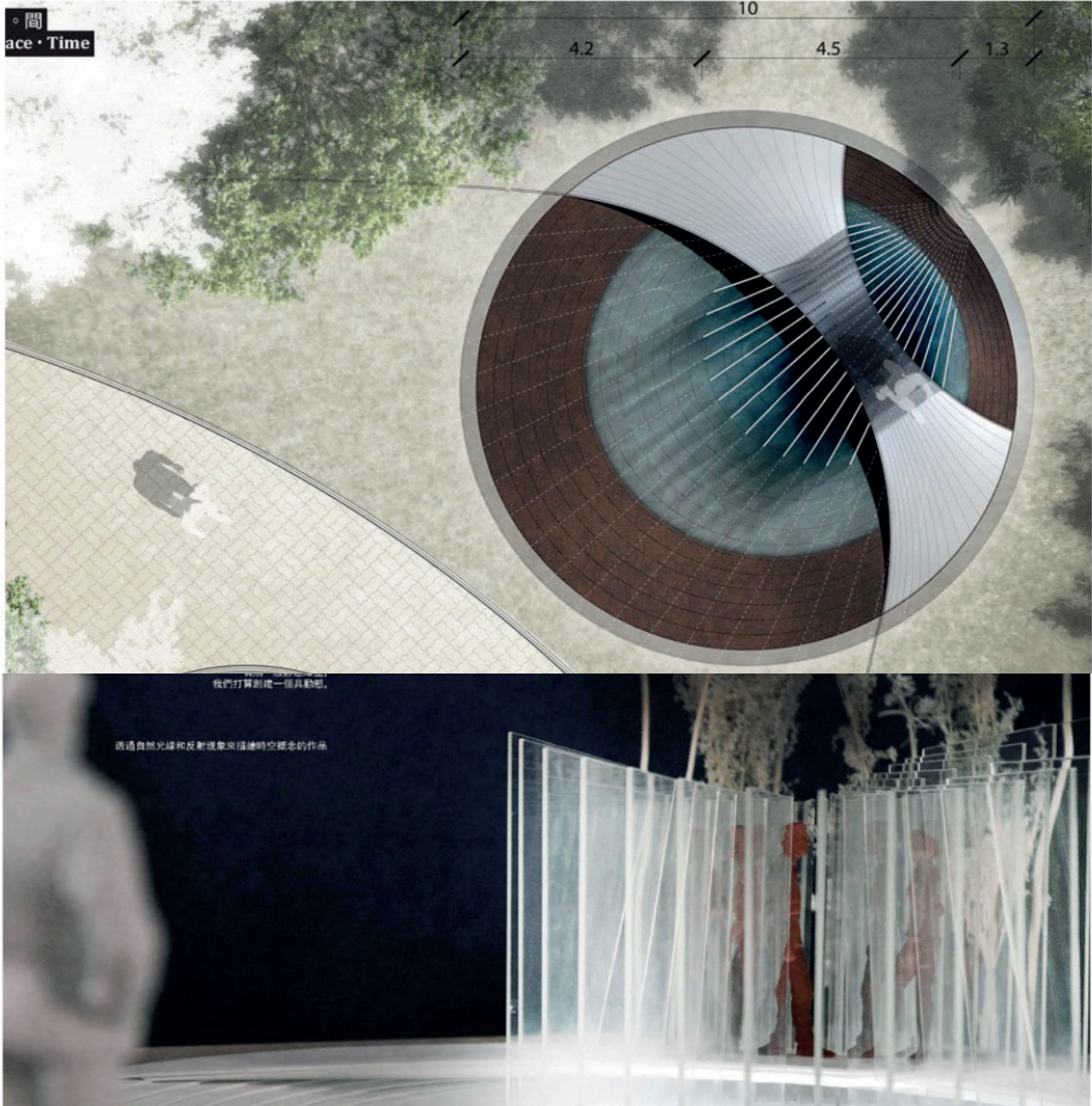


Fig.4. Time Space Continuum by Nomad Architects  
Hong Kong, China

Time is experienced in small units (2-3 seconds) of present (Pöppel 1997). Time Space Continuum by Nomad Architects is an installation project for Hong Kong, China. The architects explain space and time as two fundamental paradigms of sport and then slice the movement in time. This could also be reinterpreted as capturing the «now»s of the movement.

## II. Phenomenological Approach

Phenomenological approach categorizes time to three segments; objective time, subjective time and the time consciousness. Time consciousness is the mostly concentrated segment since consciousness makes the experience of time possible according to this approach.

All experiences have temporal aspects. Spatial substances, either subsequent or at a stand still are experienced temporal as well. But the relation is not reciprocal - all temporal objects do not have spatial features.

William James' Spacious Present and Husserl's Consciousness of Time is two important base of phenomenological time perception. In the concept of Spacious Present, it has come to conclusion of to be able to unify an experience which is longer than a few seconds since now is duration of 2-3 seconds, the retention -not remembrance- of very-recent-past is necessary - (remembrance is a conscious act but retention is reflexive) .It is emerged that now extends towards not-anymore-now and not-yet-now; and the boundary between them is not certain (Kelly, nd.).

Husserl's Consciousness of Time, Past-Now-Future concept leaves its place to Not-Anymore-Now, Now and Not-Yet-Now which considers the temporal existence as sums of nows that consecutively follow each other. And now is considered as the ultimate spot of orientation. Husserl shifts his focus to the lived experience of consciousness, specifically to the frameworks of consciousness at level one that enable the union of the varied moments of the act of perception at level two and the observed object at level three(Kelly,nd).

## III. Physics Approach

Time is investigated by science to be able to measure and discover the order and organisation of universe as the fourth dimension. Therefore it is generally represented by number since the age of Aristotle (Annas, 1975). It does not obtain subjective properties, the number is same for everyone -objective time.

Newtonian time was based on objectivity, continuity, linearity, universality, and reductivity. Time was constituted by same-length units consecutively in a linear way that does not change depending on location or duration. This understanding is broken down by Einstein's relative time theory although the general understanding is still used as the base of objective time.

Einstein's relative time is experienced differently depending on the distances between celestial bodies and gravitational forces applied which break the singularity of space-time universe concept to space-times universe.

## Method - Chosing of Appropriate Approach

Psychological approach to time perception is found most appropriate to implemented in this research by means of;

- Being prone to subjectivity of time therefore the comprehension of perception of time is examined.
- Applicability of experiments depending on different factors affecting the cause consequently the possibility to acquire principles related to design of space
- Scale of the space in relation to time (Unlike the Space in Pyhsics approach, the term of space is applicable to architectural or urban environment in pyschological approach)

Collective research of built environment with time can work on "transformation of architecture over time", "retrospective or prospective look to a period from a certain moment" or "consciousness of time in certain architectural space." Existing literature is rarely focus on spatial-temporal perception in present moment, even if do so, the research is somehow lead to first or second options. The aim of this paper is to examine the factors that have impact on temporal experience and develop design principles to manage time flow in built environment.



## Experiments on Time Perception

Duration is estimated shorter if the concentration is diverted from temporal information. In this case less amount of heart beats are counted -internal clock model (Hansen,J.,&Trobe,Y.,2012). Which in the opposite case, if there is a time indicator in certain place, as the attention will be drawn to time; time will be perceived longer. This situation directly can be applied to public squares with clock tower (an architectural time indicator). Clock towers are generally becomes the visual attraction point in squares for the following reasons; firstly being placed in a critical part of the square and secondly being higher than their surrounding buildings. Also most of the clock towers are not satisfied with connecting people to time with visual channels, they also consolidate this connection with auditory channels by being bell towers in the same time. Time will be slowed down in a square with clock tower because of the unavoidable attention to time.



Fig.6 Clock/Bell Tower at Del Campo Square in Sienna



Fig.7 Clock/Bell Tower at San Marco Square in Venice

Time is conceived shorter when more changes and actions exist in a condition. (Hansen, J., & Trope, Y., 2012). Perception of time is distracted if person focuses on multiple sensation or data simultaneously since the significant influence of hippocampus on coding of consecutive data is proven by researchs (Özgör, Özgör, Duru, Isoglu-Alkaç, 2018)

Spaces which allow multiple occurrences in visual area would cause the time to be perceived shorter as the subject tries to compensate multiple occasions of large space at the same time. Open office concept which is born by Frank Lloyd Wright's building for SC Johnson Wax in 1936, creates communal shared working places gathering multiple employee groups in a single space. The lack of visual barriers or sound-proofed isolated spaces causes distraction as well as perception of faster flowing time.



Fig.8 SC Johnson Wax Headquarters by Frank Lloyd Wright, 1936, USA



Fig.9 SC Johnson Wax Headquarters by Frank Lloyd Wright, 1936, USA

Negative stimulants perceived longer than positive or neutral stimulants due to vital importance of negative situations, there is more attention to the details of situation. (Özgör, Özgör, Duru, Isoglu-Alkaç, 2018)

Duration of demonstration is estimated longer if it is viewed from a distant location compared to near location (Predebon, J. 2002). In comparison of three music halls, the layout of the seats are crucial to determine the viewing distance. Although all buildings are related to an auditorial performance, the visual attention of the listener is still directed to stage. To be able to provide similar time experiences for audience, instead of increasing the viewing distance by placing seats far from the stage, Berlin Philharmonic Hall's layout is more reasonable in case of placing seats in similar distances from all sides of the stage.



Fig.10 Berlin Philharmonic Hall by Hans Scharoun, Edgar Wisniewski, 1963

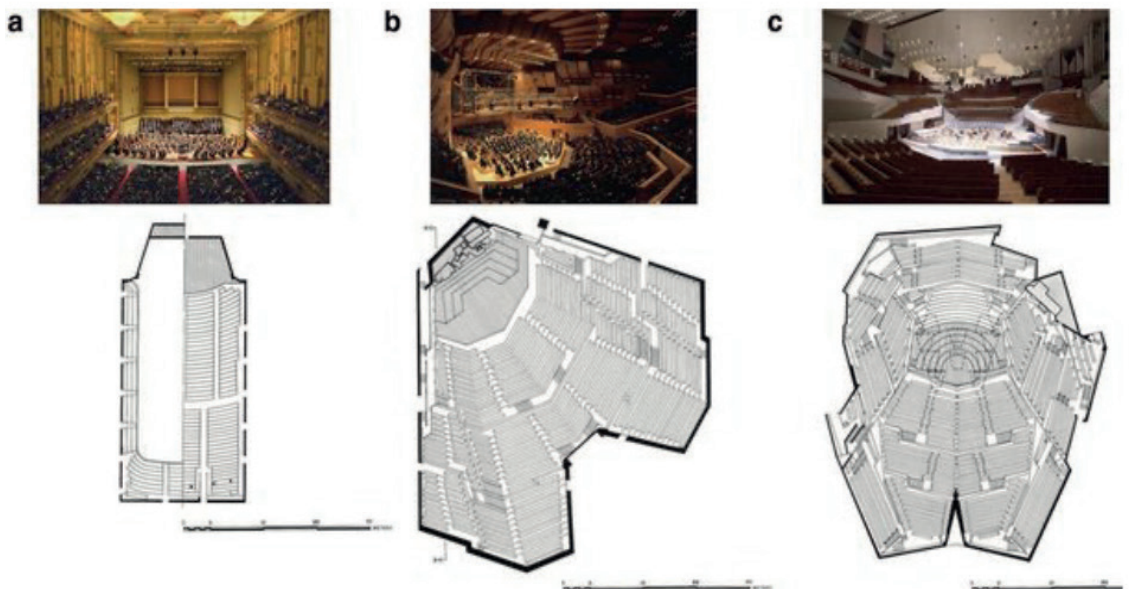


Fig.11 Comparison of Music Hall Layouts

Expressed judgement of period escalates as the area of visual demonstration reduce (Bobko and Davis, 1986 quoted in Predebon, J. 2002).

Smaller representational space in mind causes the time to be experienced faster in comparison to larger representational space (Zach, P., 2008)

Estimation of time span in bright (100% brightness) environment is shorter compared to dim-lighted (20% brightness) environment (Darbari, S., 2019). A same length of ritual duration can be perceived longer in Ronchamp by Le Corbusier than Riola Parish Church by Alvar Aalto due to the amount of light that enters to main hall.



Fig.12 Ronchamp by Le Corbusier, 1954, Paris/France



Fig.13 Riola Parish Church by Alvar Aalto, 1978, Bologna/Italy

Changing of the scale of environment causes proportional alteration in estimated time. ( $E = \text{Estimated Time}$ ,  $T = \text{Objective Time}$ ,  $x = \text{reciprocal of scale}$  -ex. for 1/2 scale  $x=2$ ;  $E=x(T)$ ) (Delong, A.J., 1981). In case of studies comparing the time perception of children and adults, this factor has important influence and the outcomes of researches are supportive to each other.

Limiting the mobility of subject results in sense of fast flowing time (Kock, Zhou, Joiner, Wiener, 2021). Labyrinths by Gijs Van Vaerenbergh and BIG could slow down the time for the people who are wandering inside the installations by limiting their movement and directions.

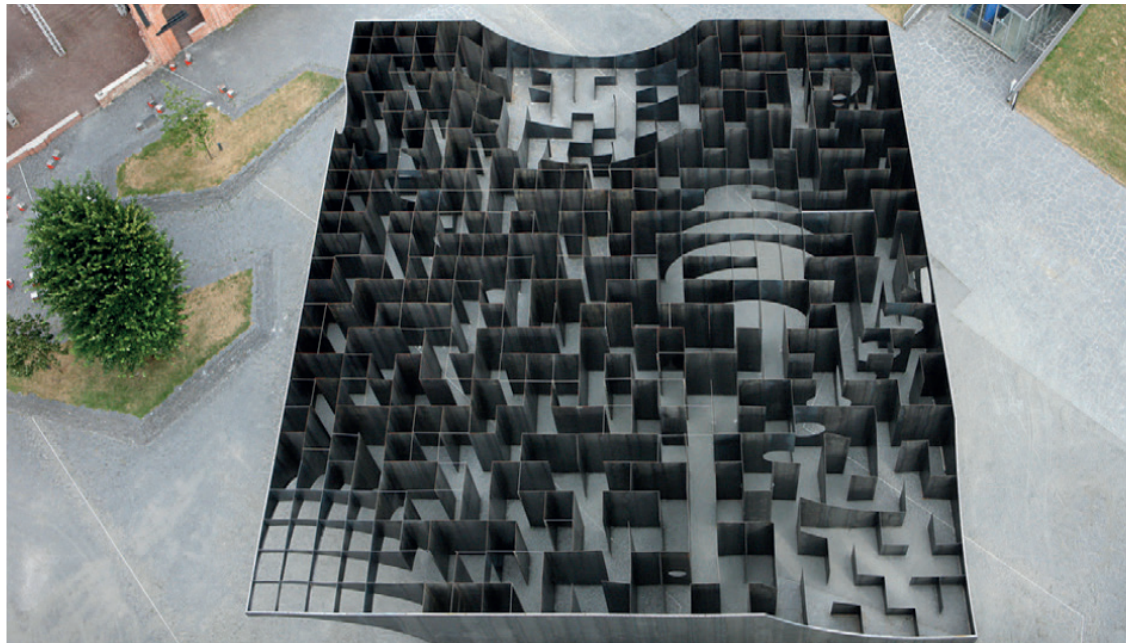


Fig.14 Pieterjan Gijs and Arnout Van Vaerenbergh, 2015, Belgium

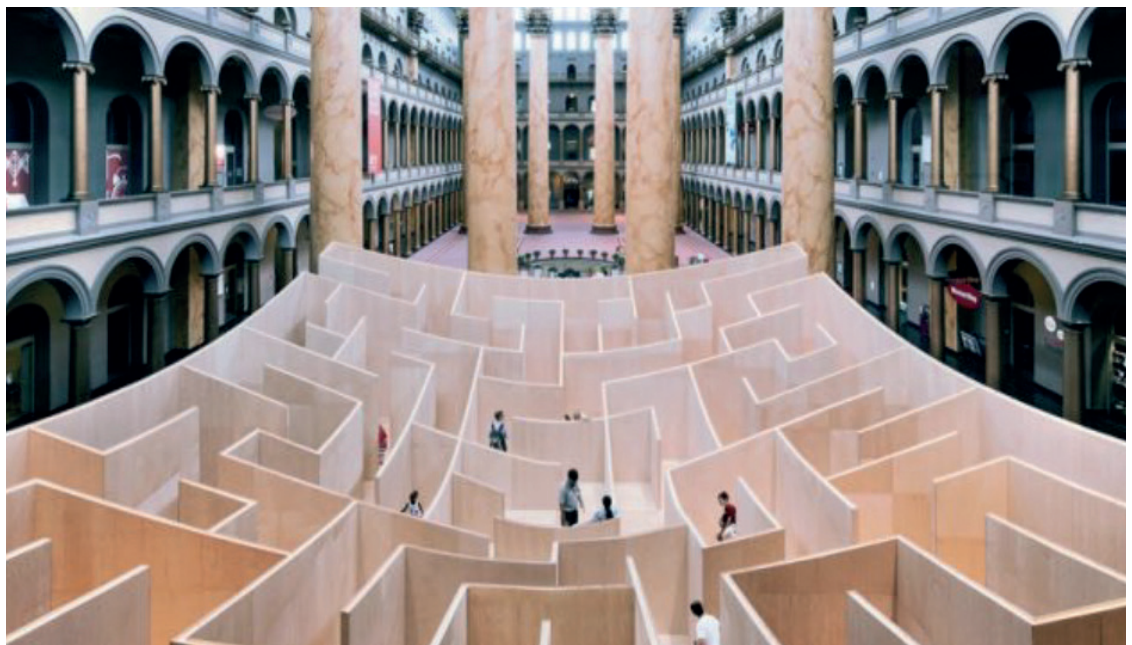


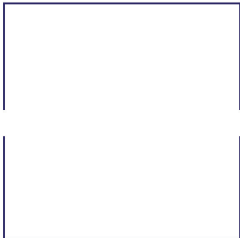
Fig.15 Big Maze by Bjarke Ingels Group at the National Museum, USA

The time span of demonstration is perceived longer respectively in constant speed, decelerating speed and accelerating speed of the object (Skylark, W., 2011).

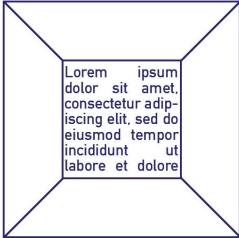
**Faster**



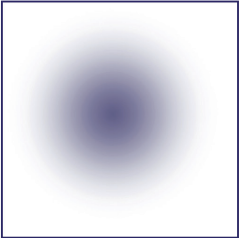
**Concentration on Time**



**Limiting Movement**



**Distance of Display Surface**

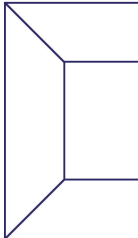
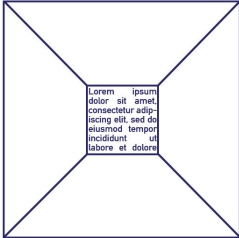
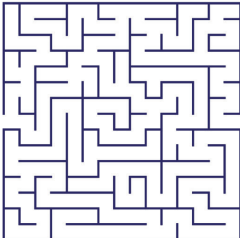


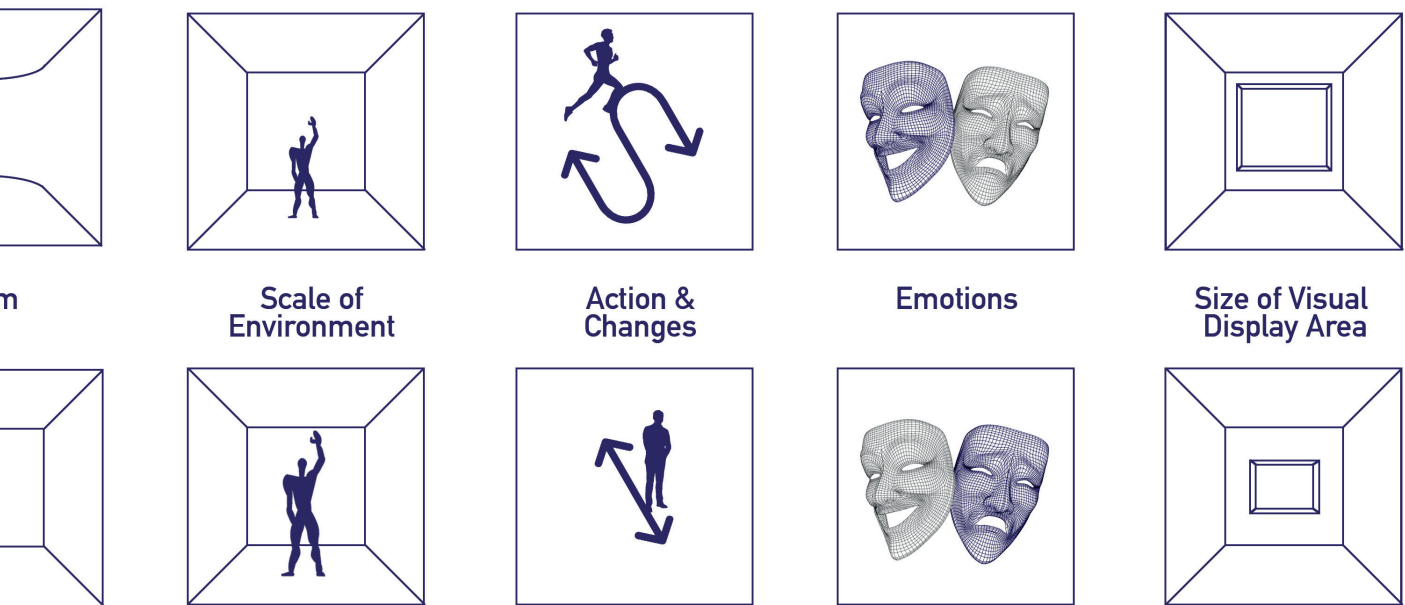
**Brightness**



**Form**

**Slower**





Scale of Environment

Action & Changes

Emotions

Size of Visual Display Area

Fig.16 Results of Experiments on Time Perception





# **PART III**

## **EDUCATION AND ARCHITECTURE**



Education is the main tool and asset for human and public development as it is considered second input after health in Human Development Reports by UN. Average expected years of education is reached 12.7 years in worldwide by 2019 as the average life expectancy reaches 72.8 which shows a person who was born in 2019 is expected to spend 17.4% of his/her life in educational environments (UN, 2019). On the point of it is being a long part of human life, considering the compulsory education is generally between age 6 and 18, it is also a crucial phase for personal development from childhood to adulthood.

Terms of learning environment and learning facilities are separated for referencing social (relation between staff and student, socio-economic and cultural values) and physical (structural conditions of educational building) aspects of educational environment in research literature (Gislason, 2007). In this part, the effects of learning facilities on learning environments therefore its effect on student wellbeing will be explained.

Peponis & Wineman states that "built space can be defined as a field of structured copresence, coawareness and encounter" and boundaries or connections regulate one's behavior or movement whether interact with others or isolate themselves through positioning of a group of actors in locations (2002). Learning environment generated by architecture (learning facilities) can shape the relation between teacher and student or between pupils socially (privacy, security, identity) and politically (supervision, controlling) while forming actions. Eventhough the architecture itself is not the teacher of knowledge, it can generate significant influence on students' welfare and competence to learn. (Gislason, 2007; Bland, Hughes & Willis, 2013)

Dalpin implies the psychological aspect of learning facilities is avoided as an "architecture for children", rather the attention is towards physical contentment of students like acoustics or thermal conditions and adaptation to developing technology. Moreover Dalpin suggests the collective work of pedagogy and architecture have have potential to increase the li-

mits of students knowledge in fresh and exiting ways(2007). In lack of this approach, feeling of confusion, discomfort or boredom due to unsatisfactory match between students and buildings, may end up with under-potential student performances (Bland, Hughes & Willis, 2013)

## Design Practice

Flexible -Designing of educational facilities is a responsive process that will be frequently returned to when the practicality of buildings are questioned. Aforementioned situation, places learning spaces in a cyclic process of constant application and development (Bland, Hughes & Willis, 2013).Herztberg (cited in Turel & Gur, 2019) states that the production system of built environment that follow and keep pace with educational models rather than architectural matters will affect the cognitive, mental and social development of the children. For this reason, spaces should not be overdesigned to allow flexibility during use, as well as for future modifications.

Participatory-Collaboration with educational staff and students; provide user insight for design development process as well as helps to enhance the relation between curriculum / educational perspective of school and the building.

Totality of Educational Spaces- Classrooms are considered as the places of teaching/ learning activities are performed in a secluded area with a group of students and single or multiple tutors. Universal model of classroom (a room, rows of learnes) that has similarities with first known classroom from 5000 years back, is surprisingly still preeminent. The indicated type of learning space is designed only considering one type of learning environment: "learning is being thought- teacher as the only source of information". Yet in last century, researches focused on new learning environment understandings: "learning is individual sense-making – learner makes sense of individual experiences and reflects information to past or future practices" and "learning by doing things with others – social learning rather than individual learning". Understanding of learning environment shapes the management of classroom and therefore shapes architectural form of the classroom(Watkins, 2005). Getzels (cited in Gislason)

states that the rectangular form, by taking attentiveness to the tutor who occupies spatial and pedagogical center, heavily supports the teacher-centered learning system(2007). Today different layouts are considered for classroom space that are more relevant for new learning environments as open-plan spaces and etc.

All spaces are learning spaces when the second and third way of learning is considered. Library is an additional space to classroom which permit expansion of formal learning range for students (Bland, Hughes & Willis, 2013); corridors becomes learning spaces depending on the pedagogy accepted by the school (Tunçok Sariberberoglu & Ünlü, 2018); playgrounds as "play contributes to physical, social, emotional and intellectual development as it allows students to practice the skills of conflict resolution, co-operation, sharing and problem solving" (Blackmore, Bateman, Loughlin, O'Mara & Aranda, 2011); school landscapes as an intense and seminal potential resource for formal and informal improvement of youth (Clark, 2002).

## Temporality of Educational Environment

Usage and effectiveness of learning environments are shaped and regulated by its temporality as well as its spatiality. There is two different type of temporality of learning environments; temporality based on real time, schedule organization, long term/short term expectations and based on subjective time, time perceived by people during educational process. Subjective time alter according to how people designate time in their minds with past or future orientation, anxiety and etc.(O'Neill,2002; Blackmore, Bateman, Loughlin, O'Mara & Aranda, 2011)

Walberg and Fredrick (1980) explains that the amount of time given for learning activity is main determinant of the amount of knowledge gained and Walberg (1988) states that the time is the only limited source when the amount of accesible knowledge and capability of human mind is considered infinite. The amount of time needed to capture certain information is also subjective. As Bloom (cited in Walberg and Fredrick) evaluates the slowest learners (10%) require five or six times more time compared to fastest learners of 10% (1980). "Sense of time urgency" will be sensed when different pace

of learners and competitiveness among pupils combined which will lead on psychocological disorders that eventually can cause coronary heart disease. As it is known that time moves almost five times faster for a ten-year-old compared to sixty-year-old person (O'Neill, 2002), the organization of facilities according to time perception is crucial for students' well-being.

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# **PART IV**

## **DESIGN APPLICATION**





The aforementioned literature research proves that time perception is an important design factor that should be considered in architecture; although some literature works started to combine both areas together it is unclear how it can be applied to architectural design process.

The context of educational buildings are chosen for application of subject depending on the following facts;

- Educational environments are places where similar activities are performed in different parts of the world which makes it an international experience.
- The duration of education covers an important amount of human life (over 15% of average human life) therefore influence of any improvement in the environment cannot be denied.
- It is an experience which is located in most crucial period of human life that a person develops to be an adult from childhood.

Learning environment can serve for student well-being with keeping education away from being boring (time that slows down) or being worrisom (anxiety by sense of lack of enou-

time - time that flys) by incorporating time perception aspect into facility design. Due to the subjective nature of course, primary approach is to allow individuals to locate themselves in their physical and social surroundings as it also serves the contemporary understanding of educational environment that emphasize the individual or collective experiences of students in learning process.



Fig.17 Bremen College Middle School by Hayball, 2018,Australia



Fig.18 Bremen College Middle School by Hayball, 2018,Australia

## Design Factors

### Flexibility/Wieving Distance

A classroom with mobile furnitures can create a learning environment that individuals can decide their relation and distance with other individuals, tutors or subjects. Oppose to traditional classroom that locates individuals to certain distances from center of the focus (Tutor, screen, board and etc.), mobility of new system supports students to realise their changing needs and respond to them. It also allows students to locate themselves to optimum distance depending on their consentration level or attraction to subject.

### Size of Display Surface

Visual display area of classroom can be enlarged by openings to allow students to peak in times of boredom and speed up the time.

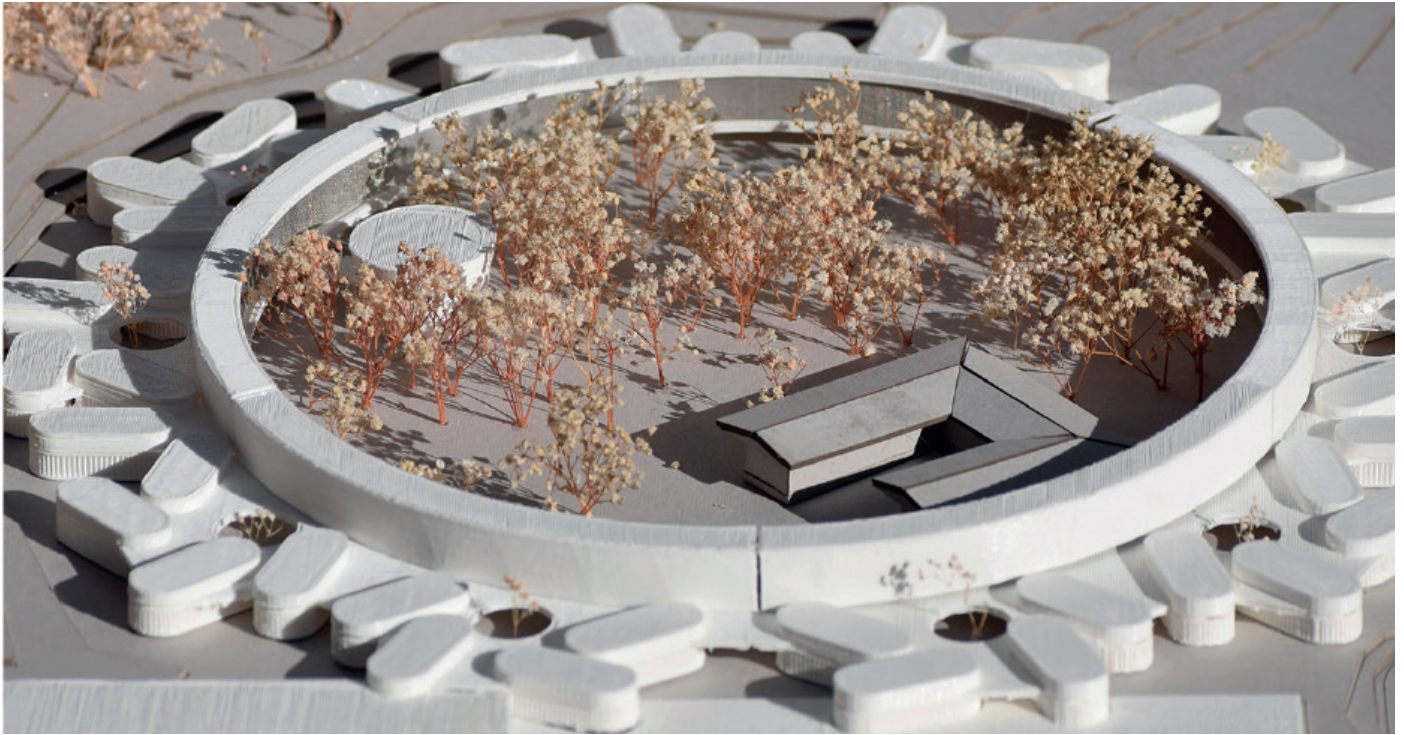


Fig.21 La Enseñanza School by El Equipo Mazzanti, Antioquia, Colombia

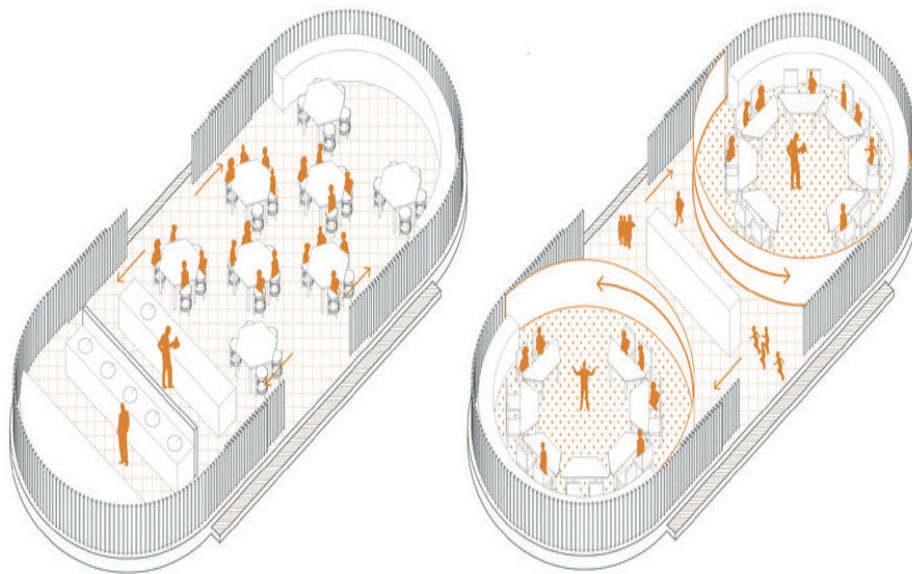


Fig.22 La Enseñanza School by El Equipo Mazzanti, Antioquia, Colombia

### Curvilinear Form

Curvilinear lines and surfaces can be used when the desired pace of time is faster while prismatic forms are used in opposite conditions.

### Scale of Environment/ Child's Perception

There is a relative connection between scale of environment and subjective time according to DeLong's experiment (1981). In extent of this search, it also implies the duration time will be perceived shorter by children in a adult scale environment due their smaller sizes. The dimensions of space (width, length and height) should be considered to create an appropriate proportion depending on the age group of education.



Fig.19 Marista Santo Antonio School by Hype Studio, 2020, Brazil

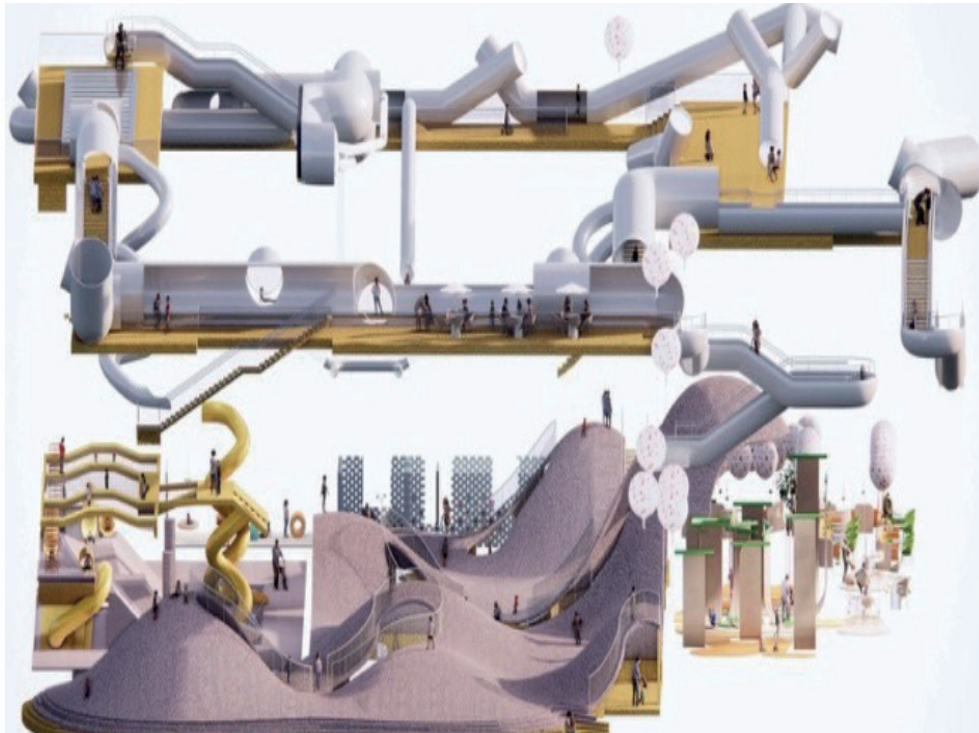


Fig.20 School Landscape of Children's Community Center by waa, 2021,

### **Leisure Time Activity/ Restriction on Movement**

It is possible to emphasize the leisure time activity by elongating perceived time with imposing restriction of movement outside the classroom. Instead of creating a blank open space in circulation areas or school landscape, some restrictions can be implemented with the help of mobile furnitures. Changing layout of informal learning spaces could also create possibilities of new experiences, therefore new source of information for students.

### **Light**

Importance of lighting, the level of brightness in the interiors are known for its influence on learning. It is also a factor that affects the perception of time. A well illuminated space can help students learning in addition to experience time faster.



# FASTER

## Bigger Scale of Environment



School Complex  
MoDus Architects, 2016



Los Pilares School  
Dovat Arquitectos, 2018



Borgafjellet Elementary School  
LINK arkitektur, 2021

SCALE  
ENVIRONMENT

## Bigger Visual Demonstration Area



Collodi Primary School  
Settanta7, 2021



Suresnes Open-Air School  
Marcel Lods, Eugène Beaudouin, 1935

VISUAL  
DEMONSTRATION  
AREA

## Decelerating/Accelerating Speed



Ai Saleggi Primary School  
Studio Vacchini, 1972-78



Hellerup School  
Arkitema Architects, 2011

SPEED  
MOVEMENT

## Curvilinear Form



Rosa Nursery School  
Mario Botta, 2001-04



Mary Lyon Elementary School  
Erickson McGovern Architects, 2019



Shenzhen Hongshan Middle School  
CAPOL, 2022

FORM

# SLOWER

## Smaller Scale of Environment



Early Childhood Center  
Mahlum Architects, 2012



Benfeld Aristide Briand Primary School  
Lionel Debs Architectures, 2015



Lucie Aubrac School  
Coldefy & Associés, 2013

## Smaller Visual Demonstration Area

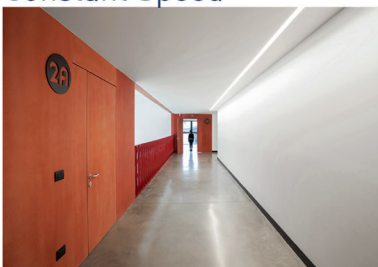


Ai Saleggi Primary School  
Studio Vacchini, 1972-78



Weissenstein New School Building  
Ernst Niklaus Fausch Partner, 2020

## Constant Speed

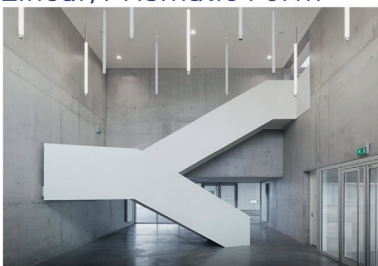


G.Zanella Primary School  
Giulia de Appolonia, 2016

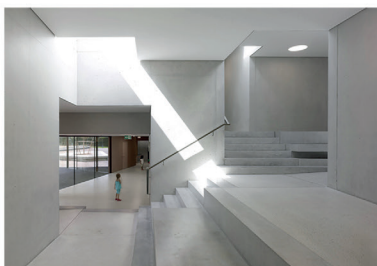


Fuji Kindergarten  
Tezuka Architects, 2007

## Linear/Prismatic Form



School Group Paulette-Deblock  
zigzag architecture, 2015



Prangins Kindergarten  
Pierre-Alain Dupraz, 2015



Suresnes Open-Air School  
Marcel Lods, Eugène Beaudouin, 1935



Hellerup School  
Arkitema Architects, 2011



Benfeld Aristide Briand Primary School  
Lionel Debs Architectures, 2015



Learners Hall-International School  
Mahlum Architects, 2016

### Bright Light

LI



Fuji Kindergarten  
Tezuka Architects, 2007



Leutschenbach School  
Christian Kerez, 2009

### Unlimited Movement

RESTRI  
MOVE



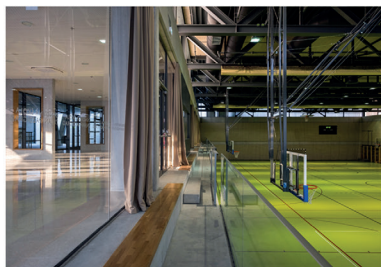
Ai Saleggi Primary School  
Studio Vacchini, 1972-78



Joseph D. Jamail Lecture Hall  
LTL Architects, 2017

### Closer Display (View) Area

DISTA  
DISPLA



Žnjan-Pazdigrad Primary School  
x3m, 2017



Mary Lyon Elementary School  
Erickson McGovern Architects, 2019



Borgafjellet Elementary School  
LINK arkitektur, 2021

### More Changes & Actions

CHAN  
ACT

## FASTER



IGHT

### Dim Light



YNS Yamaikarashi Nursery School  
Takeru Shoji Architects, 2021



Los Pilares School  
Dovat Arquitectos, 2018



Morbio Inferiore Middle School  
Mario Botta, 1972-77

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### Limited Movement



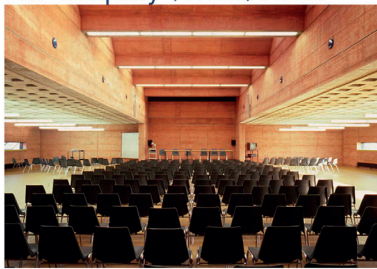
Thomas Deacon Academy  
Foster+Partners, 2007



Hellerup School  
Arkitema Architects, 2011

NCE OF  
AY AREA

### Far Display (View) Area



Morbio Inferiore Middle School  
Mario Botta, 1972-77



Suresnes Open-Air School  
Marcel Lods, Eugène Beaudouin, 1935

ANGES &  
CTIONS

### Less Changes & Actions



Salmtal Secondary School Canteen  
SpreierTrenner Architekten, 2012



Early Childhood Center  
Mahlum Architects, 2012



Leutschenbach School  
Christian Kerez, 2009

## SLOWER



Fig.24 Milan City Map

## Experimental Site and Context Input

In direction of application of aforementioned design principles, it is decided that a real context to be appointed rather than designing a prototype. A real context with urban characteristics and requirements would create a challenge with additional inputs by requiring a balance of design principles and urban conditions.

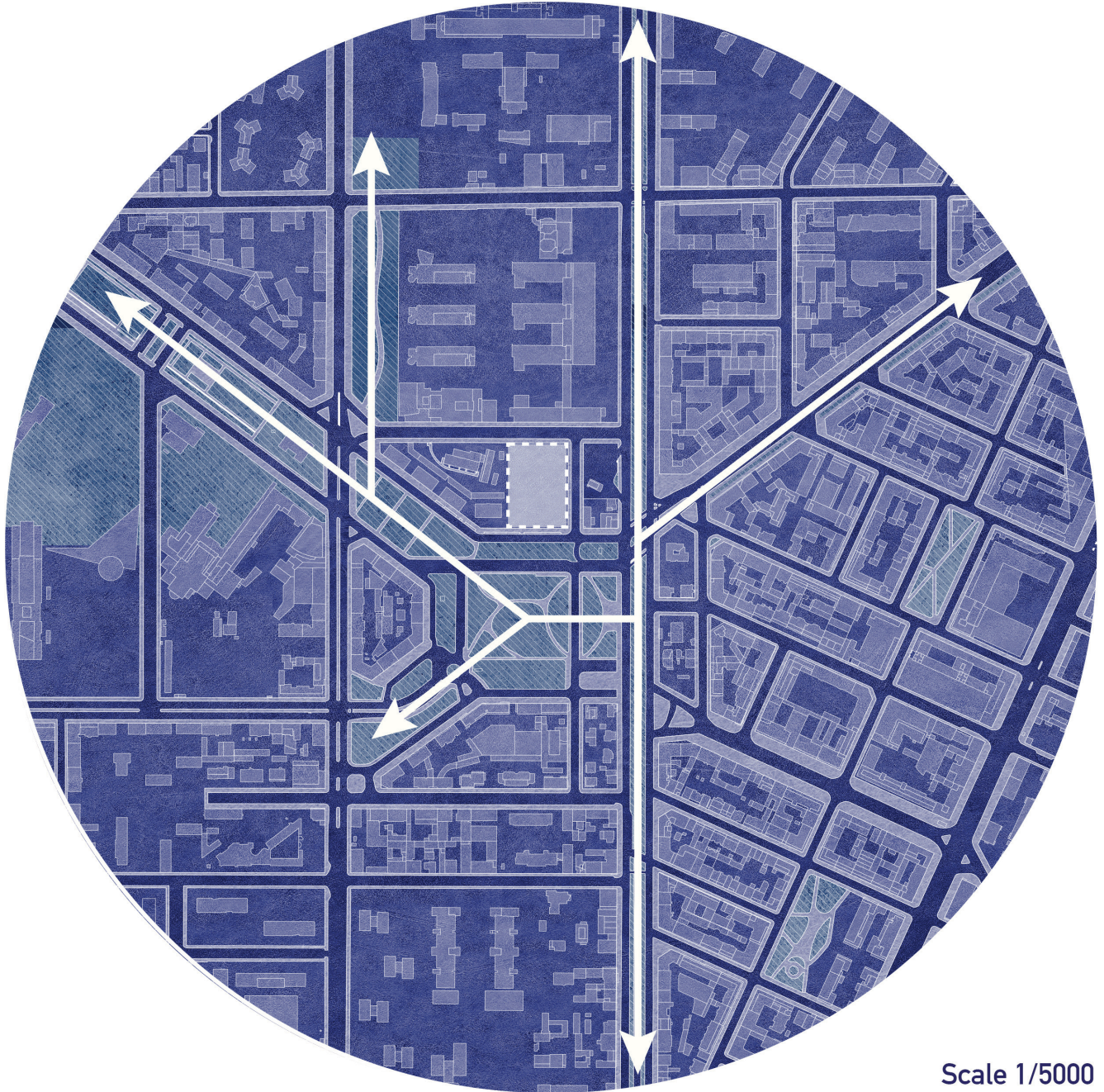
School site is selected in Milan to allow the author to experience the site and surroundings since the perception theme is emphasized in research. School is selected from the catalog of "Inventing Schools- school as big as the world" which is a project between Municipality of Milan and Politecnico University of Milan that creates a platform to experiment and search on public schools which are in need of renovation, regeneration or reconstruction.

Primary school named as Istituto Comprensivo Statale-Cardarelli Massaua (State Comprehensive Institute) is chosen for the factors of;

- being a project of reconstruction rather than renovation
- closer location to city center which allows denser urban context and more urban inputs possible
- size of site that allows exploration on topic in exterior space/courtyard
- being primary school since the presence of extensive school programme compared to kindergarden or creche while targetting younger age group as to secondary or highschools.
- possible future improvements and connections with neighbour kindergarden (infanzia) and creche (nido), allowing opportunity of further investigations on topic with different age groups.

The State Comprehensive Institute Cardarelli Massaua is located on Via Massaua,5 in southwest of Milan. Site is positioned near the exterior ring road in border of Zone 7 and 6. School is protected from traffic of ring road by a narrow barrier plot and faced to a public square that mainly consist of green space. School shares the plot with several residential buildings and a creche. Urban context is further investigated based on potential inputs of near-site features in 2000 scale.

# GREEN CONNECTION

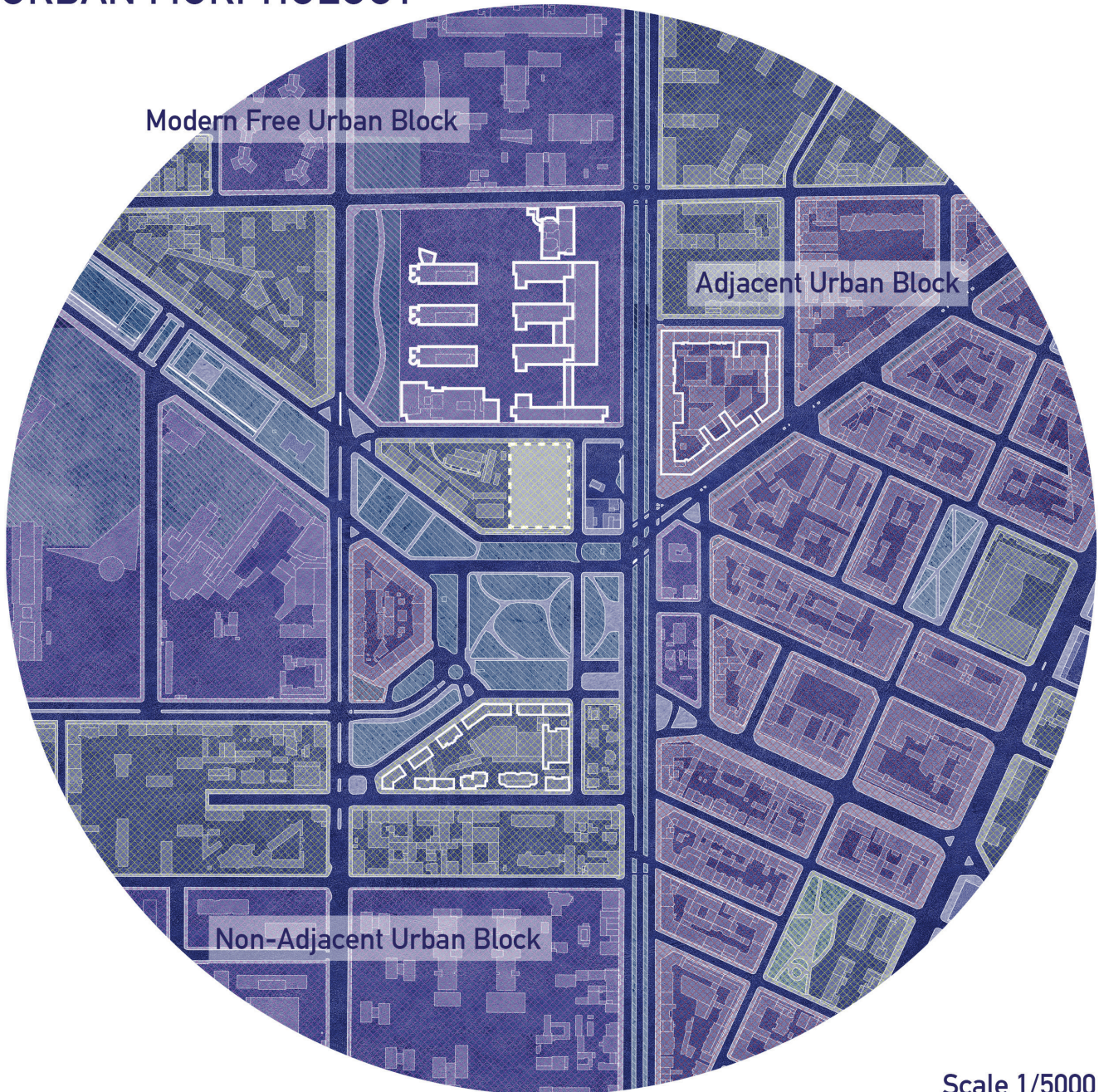


Scale 1/5000

Fig.25 Green Connection Map

Piazzale Tripoli, a green public park, is where the surrounding routes of green lands and lines of trees are connected, resembles a green power center for close neighbourhood. School network seems to be located at the intersection points and cutting the complete open connection of green lands. Considering their public aspect, these sites can work for strengthening this network of public parks rather than debilitating it.

# URBAN MORPHOLOGY



Scale 1/5000

Fig.26 Urban Morphology Map

Site being in a transitional area of historical city center to area of modern era expansion, neighborhood has three types of urban plots. Adjacent urban plot is the urban plot that is surrounded by buildings on exterior line with courtyards at the interior part of plot that are facing each other and it is most commonly seen in the area closer to city center shows resembles to historical city texture of Milan. Non-adjacent building block is the block type that buildings are tracing the outline of plot with separation from each other. It creates a middle ground between adjacent block of historical times and modern free block. Modern free block is also seen near the site, that has no certain reference to the shape or perimeter of the urban block for the placement of buildings. Urban plot of project site is non-adjacent building block with residential buildings and existing school building following the outline of plot.

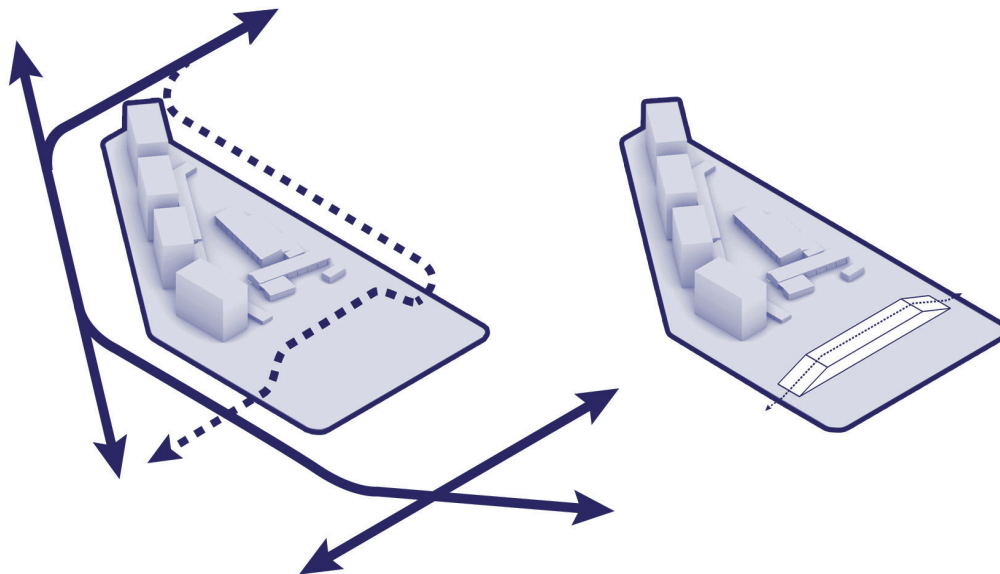
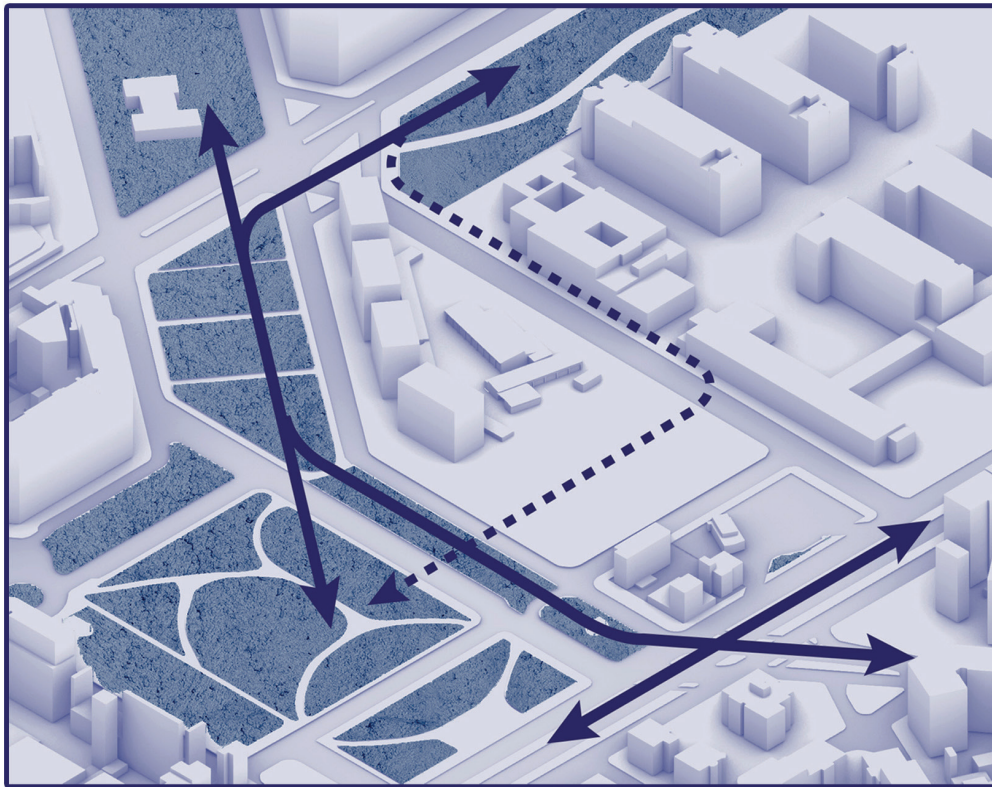


Fig.27 Green Connection Strategy

A new alternative route of green is planned to pass through site that connects Piazzale Tripoli and Park BPM in the aim of strenghtening the green network while connecting neighbour schools. This green public pass will provide an alternative connection not only for the project school but also the creche (nido) and users of surrounding commercial and residential areas. Public pass is elevated due to security consideration of school and requirement of seperation between exterior school spaces and publicly accessed spaces. A set of possibly shareable functions with adjacent school are placed underneath the passage.

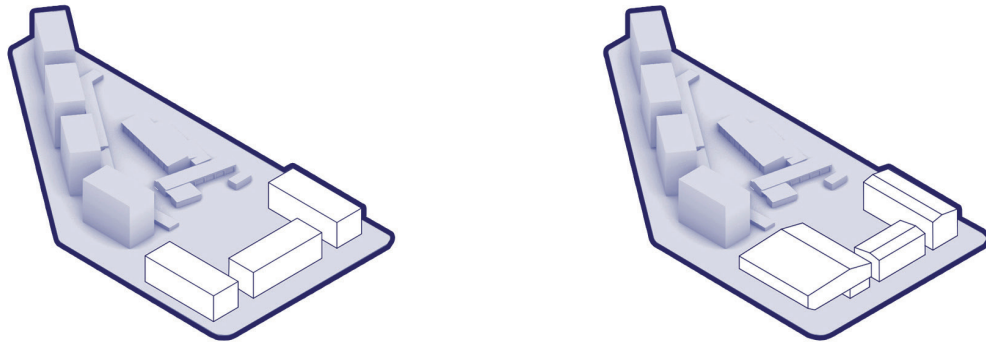
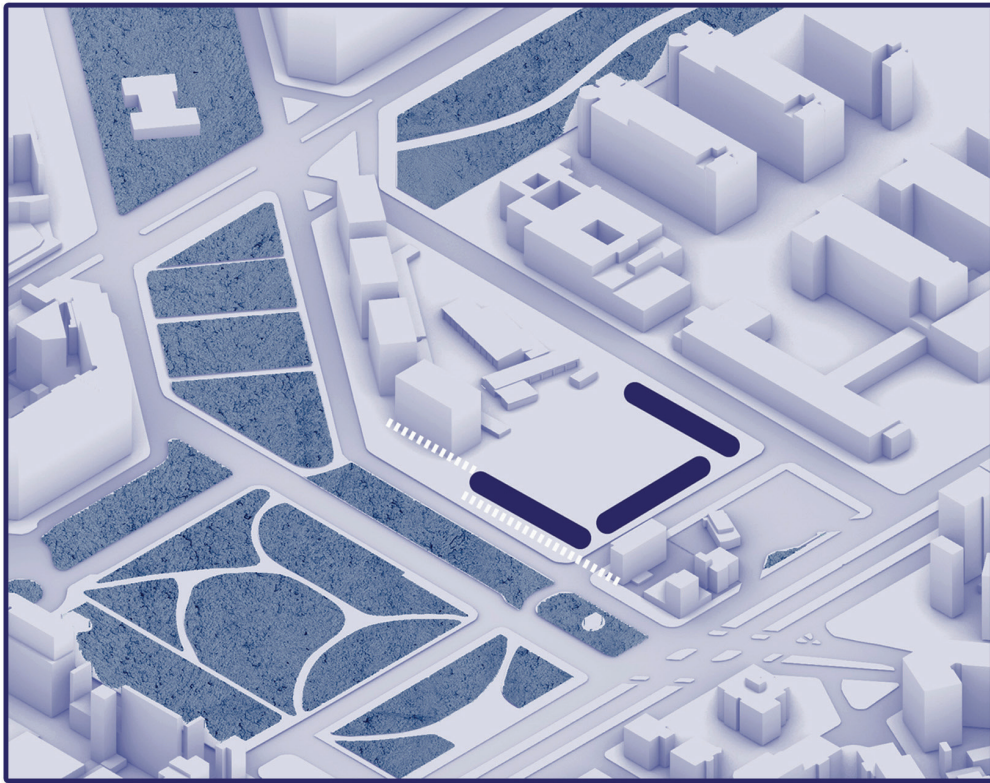


Fig.28 Urban Morphology Strategy

Non-adjacent urban block principle is decided to be followed. Therefore three side of school site which are facing the perimeter of urban plot are required to be shaped with volumes. On the front facade that faces to public square, street alignment with existing buildings is considered.

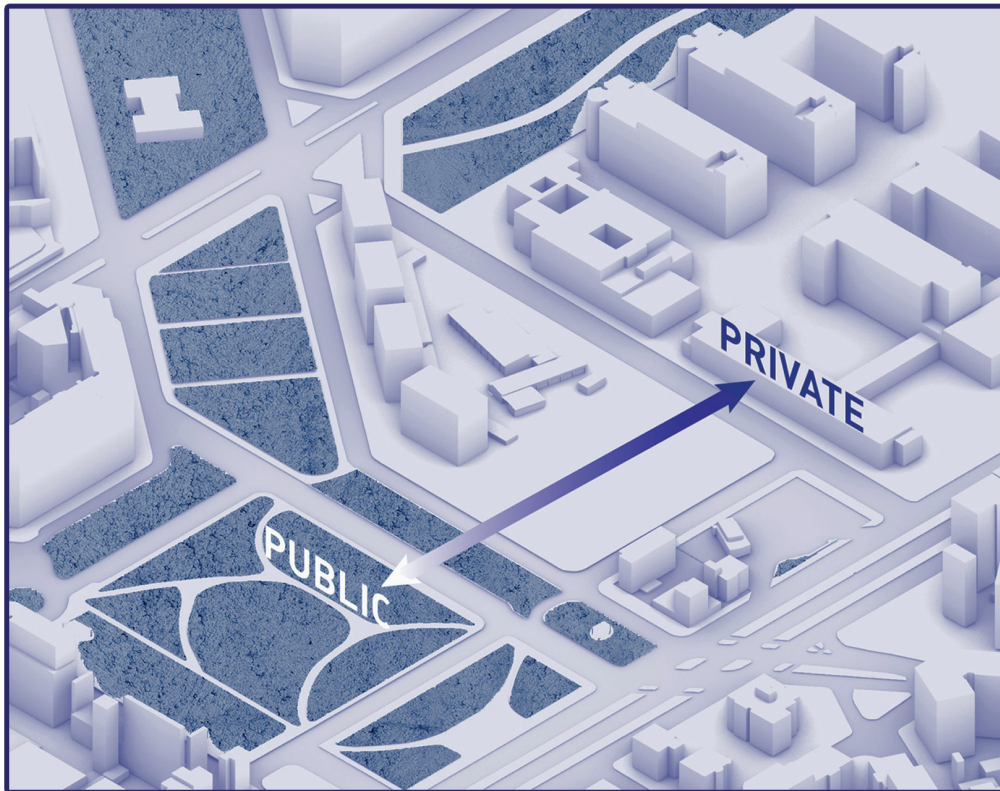


Fig.29 Publicity Privacy Strategy

Project site is located in a transition area between total openness to public of Piazza Tripoli and total restriction of commercial plot which is completely walled and surrounded by buildings of Banco Popolare di Milano (Milan Public Bank). Gradual transition between public to private is intended to break this tension. To achieve this intention, the public square is extended to site and while public shared functions as gym and entrance hall are placed facing the square, private school spaces as classrooms, library are placed facing the Via Massaua.

## School Programme and Time Relations

Other than contextual input, the necessities of school program gives the second set of instructions. The desired school programme for reconstruction is given as;

- 24 classrooms of 40sqm
- Special classroom of 100 sqm
- Gym that includes a real size basketball

hall

- Administrative offices that includes 3 rooms of 16 sqm.

Project provides the desired programme and enriches it with multi purpose interior and exterior spaces. The public school is aimed to serve the neighbourhood with its additional facilities as well. The gymnasium is shared with public during after school hours

Programme and functions' relationship with student's mental health is examined in consideration of time perception and an aim of fast or slow perception of time is identified for each school space. Student's mental relation to function is considered on two conditions; stress of not enough time and boredom from surplus time. When the function has possibility to cause both situations depending on the subjective competence of students; design is aimed to serve all options and flexibility is given higher importance to allow one to position themselves in the room for the best condition.

Main school spaces as classrooms, interior or exterior breaktime spaces, circulation and entrance hall is given higher importance for examination of time perception requirement and supportive functions are considered in relation to main functions.

Classrooms are the spaces where the most of the school time is spent and where the main school programme is taught. Therefore higher importance is given to classroom design. Students relation to classroom and their needs of time differentiates from one to another. Every class can potentially obtain a group of pupils who are coming from all scales between slow learners to fast learners. Depending on this outcome, the classroom space should provide different paces of time. In the project a gradual change of time perception is intended and a prototype classroom is design in detail.

In traditional classroom layout, students are placed in fixed seatings and the focused display surface is on a blind wall with board. As this situation allows different experiences of time pace, students are not encouraged to position themselves for their needs. The fixed layout also cannot changed efficiently to fit for changing requirements of different classroom activities by tutors. A flexible layout which is allowed by free plan and light-weight movable furnitures is recommended.

Enlargening of display area can provide a pupil a brief moment of relaxation and a break from stress or boredom by gazing into depths of other spaces. The extend of the gaze can be targeted to outside from the wide windows for slower time pace, or to corridor side through narrow translucent partitions.

A certain level of brightness is important to sustain an efficient workstation. But the level of brightness can be variable with the arrangement of artificial lightning for a gradual change from slow time to fast time perception.

A child due to its smaller size in comparison to an adult is already experiencing a bigger scale environment that has the impact of faster time perception. To show the difference, the same spatial experience for an average height primary school student is modelled. A non-fixed ceiling element is designed to allow gradual change in scale of the space and it can be adjusted in different heights depending on the age group.

Curvilinear forms have the impact of faster time perception but use of curvilinear forms is avoided for two reasons; consistence with the morphology of urban context and to reach the most practical free plan layout. Curvilinear forms are reached with the help of the ceiling elements and by wiping the corners out with fillet.



# CLASSROOM

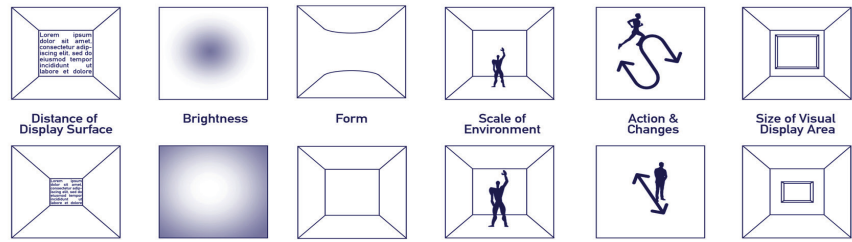


Fig.30 Design Tools for Classroom

# CLASSROOM PROTOTYPE

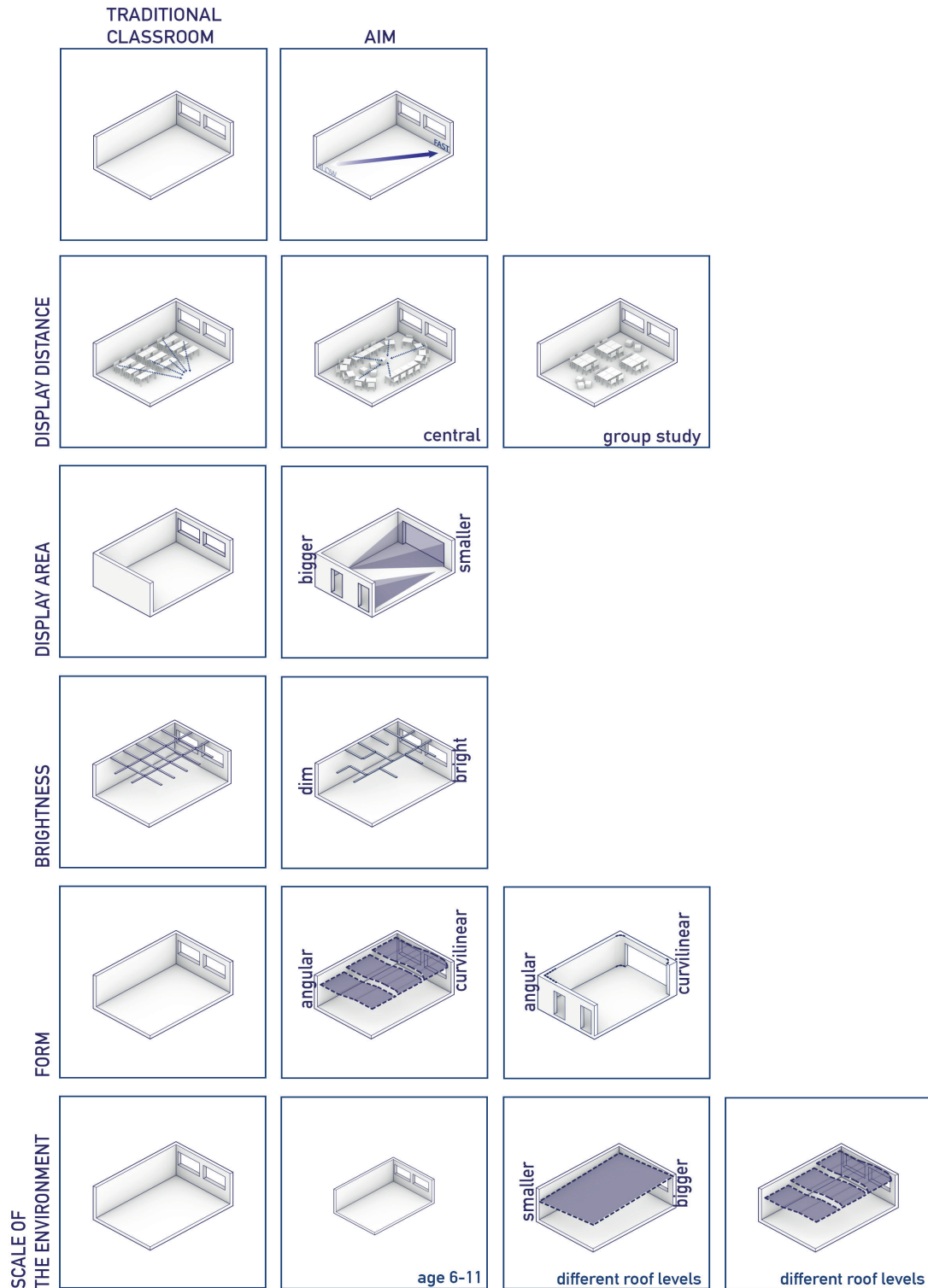


Fig.31 Prototype for Classroom

**COMMON SPACE  
INTERIOR/EXTERIOR**

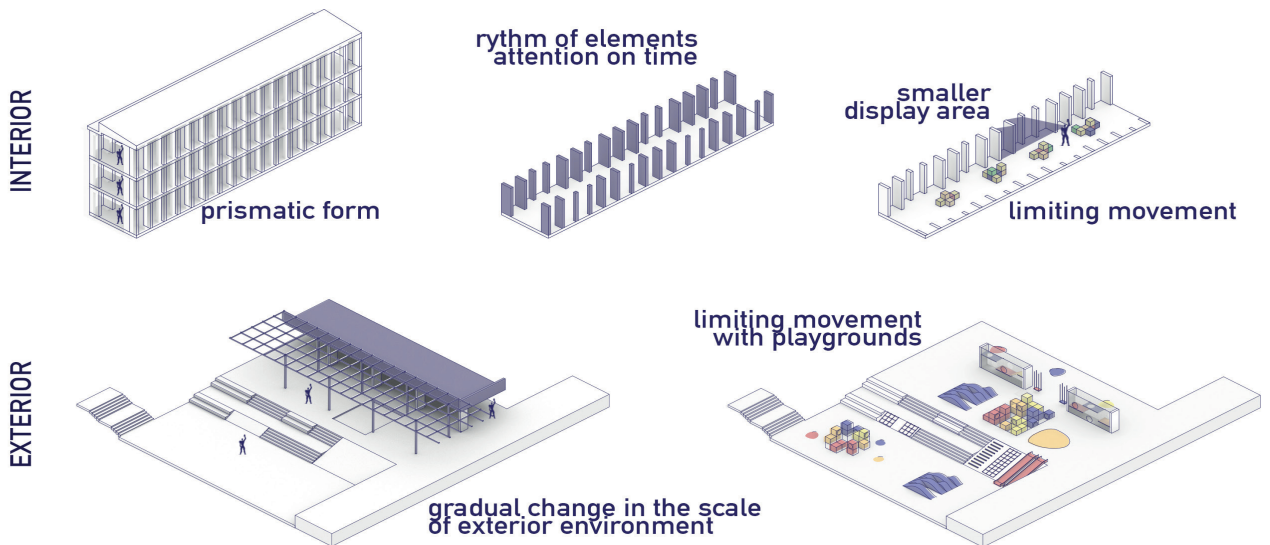
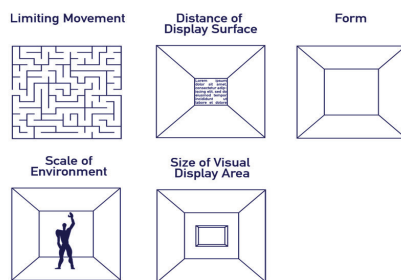


Fig.32 Design Tools for Common Spaces

Exterior or interior common spaces are considered as informal learning spaces where the students teach each other via play and communication. This sort of teaching and learning activity is not considered a source of stress or boredom due to two factors; the lack of necessity to learn a specific subject and the limited time of break activities and short time periods for break activities in comparison to lessons. In the result, slower time perception is aimed for all pupils. For this purpose, movement in exterior and interior spaces is limited with mobile furnitures and playgrounds that also allow different interactions between students. The courtyard or interior common spaces are designed with angular/prismatic forms. In the courtyard a permeable roof helps to create a slow passage from a scaled environment to infinite scale of sky. The rhythmic elements that cause to remind time is the main design element of interior common spaces to recall the attention to time.

## ENTRANCE HALL

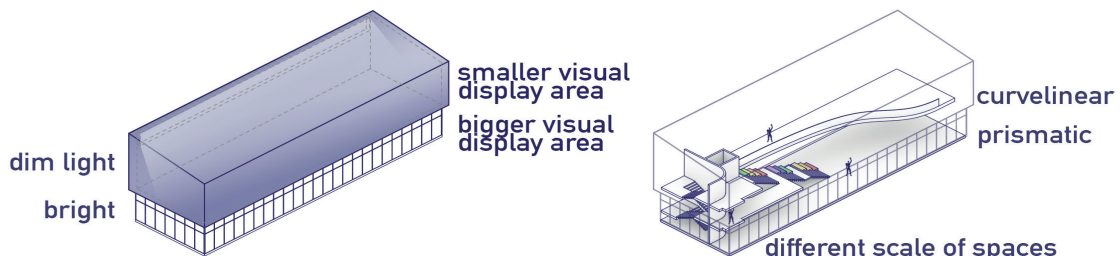
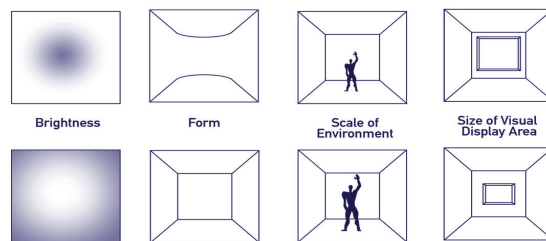


Fig.32 Design Tools for Entrance Hall

Entrance hall, which works as an interior break time space, is also a place of waiting during the start or at the end of the school day. To establish both situations, space is designed to allow different scales with the help of slabs that are located on different levels as well as inclined roof. While on the ground floor, time moves faster as the display surface includes all the neighbourhood due to complete glass facade, on upper floors, the opaque walls slows down the pace of time. The play with opaque and translucent surfaces also allows a play with changing brightness and dimness. Free plan of ground floor fastens time while the mobile furnitures on upper floor limits movement and slows down the time.

## CIRCULATION (VERTICAL)

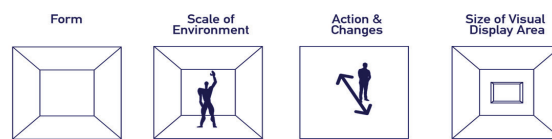
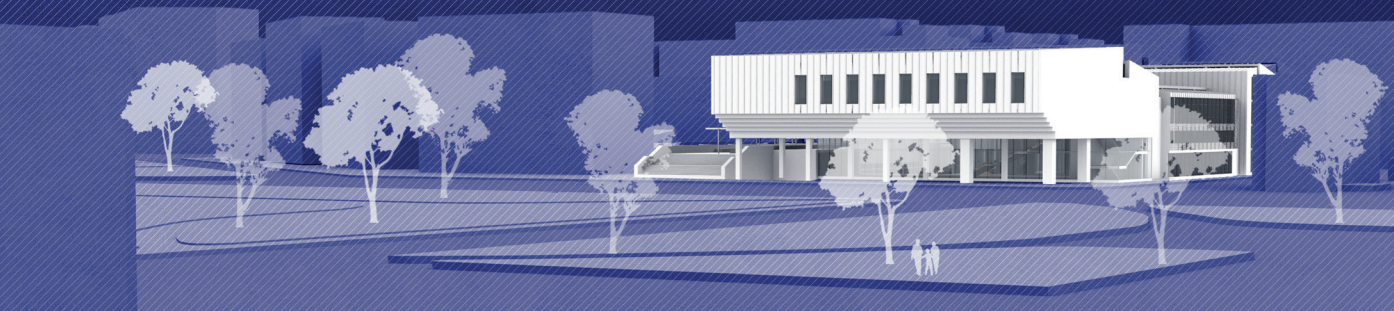


Fig.32 Design Tools for Circulation

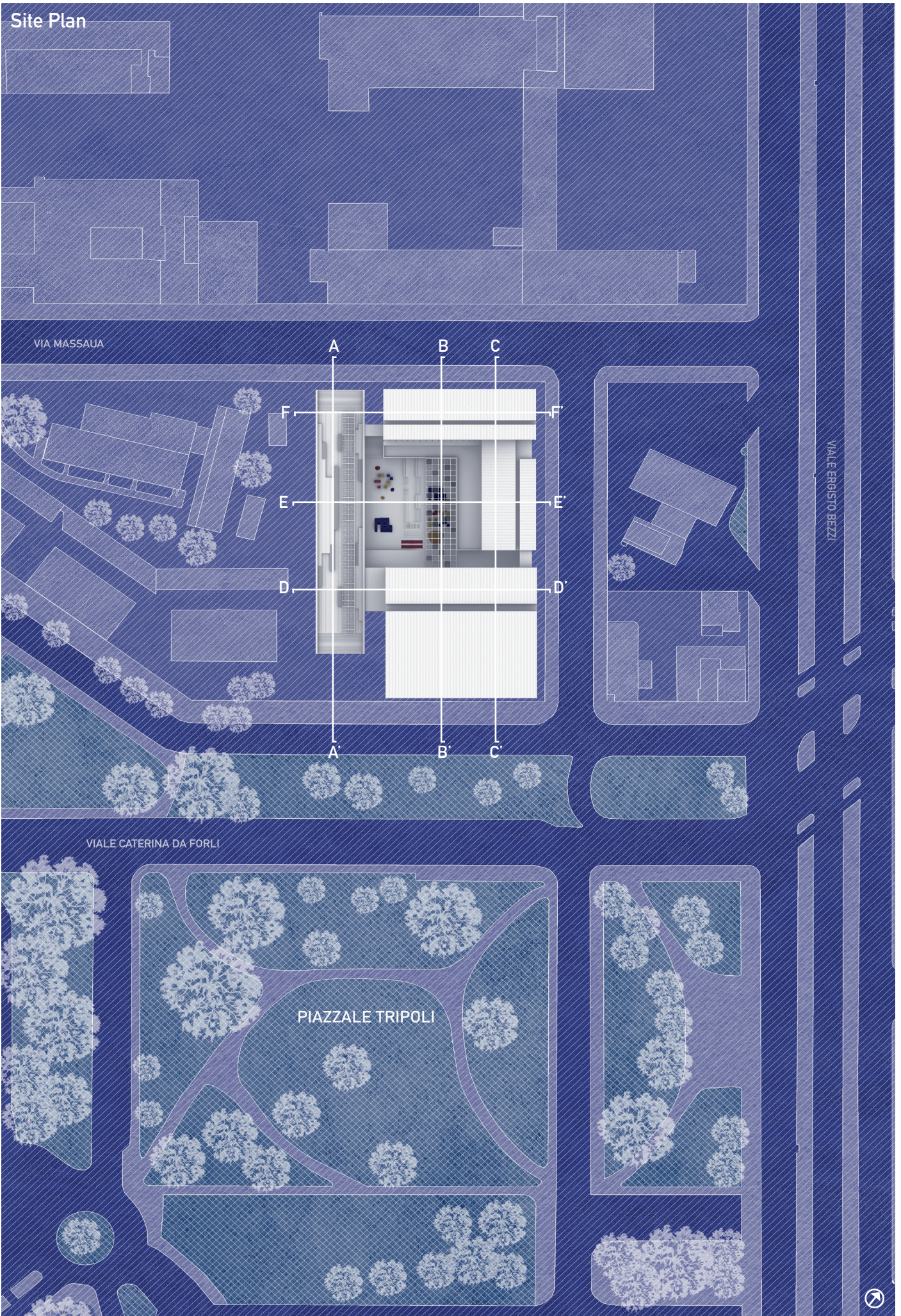
Circulation space when considered as corridor space is working primarily as a common space and time perception wise it is designed depending on those requirements. The vertical circulation spaces are designed to slow down the time with its prismatic form and narrow sizes which helps time principles with two different aspect; the display surface distance and size.

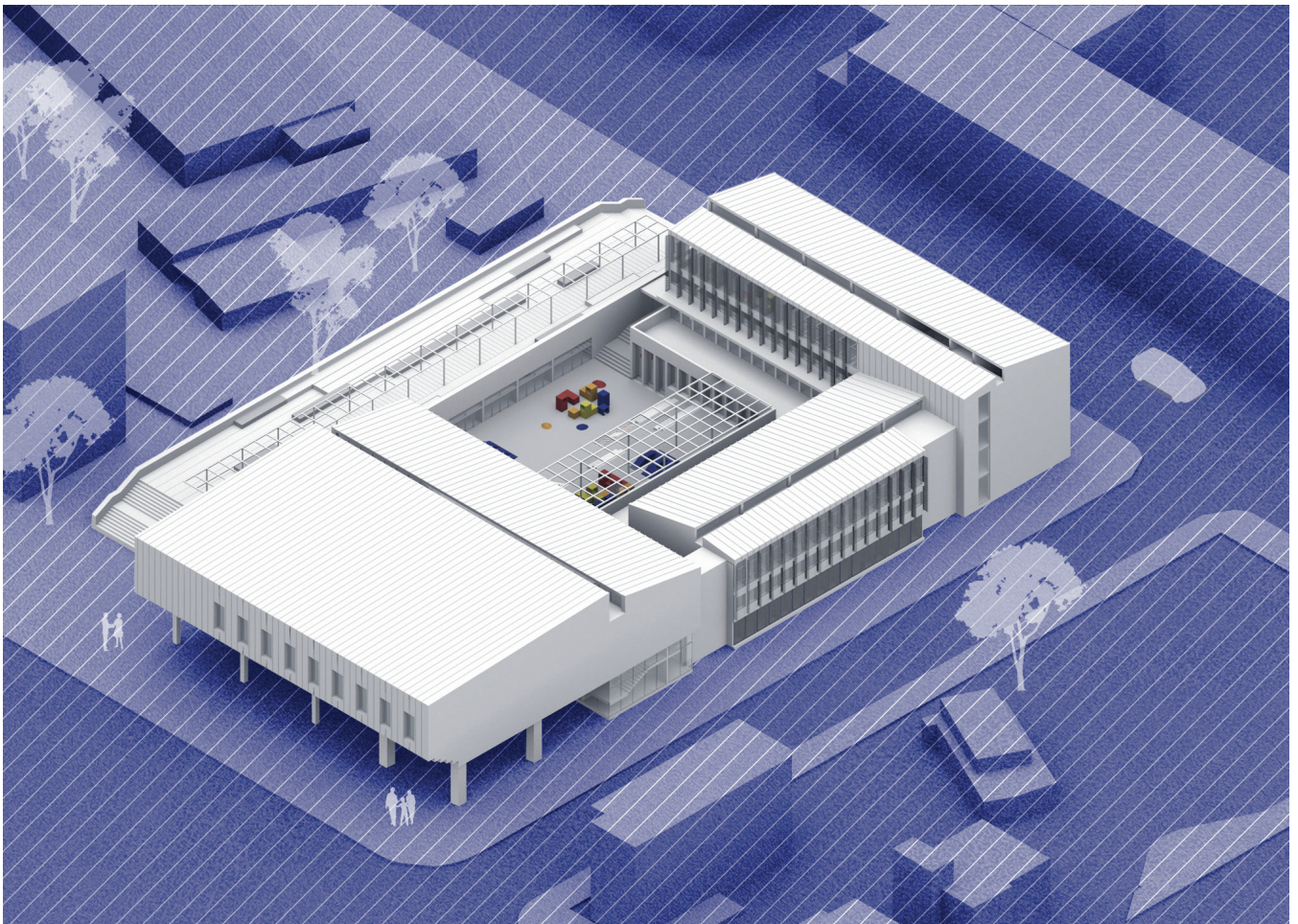
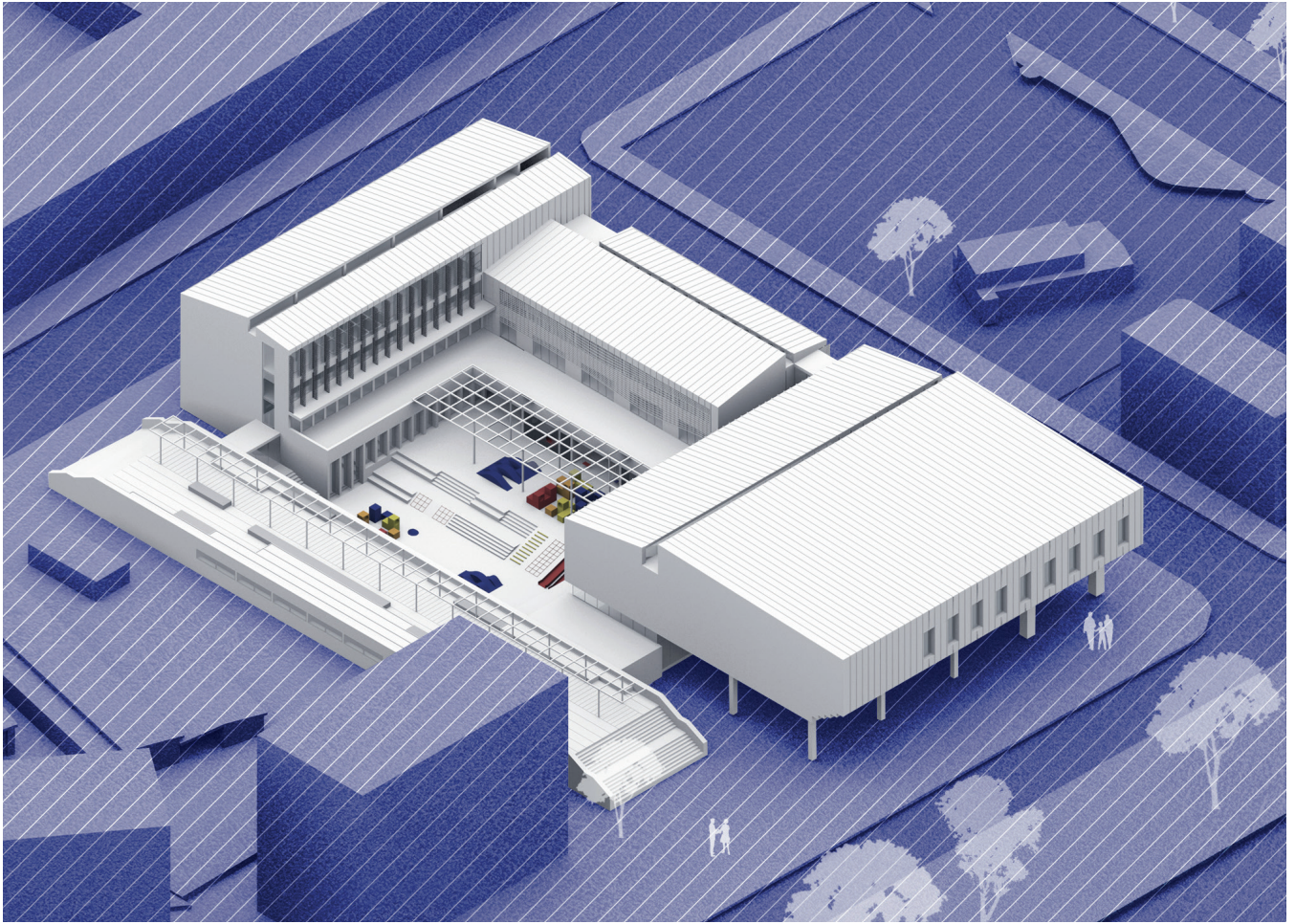
# Architectural Project



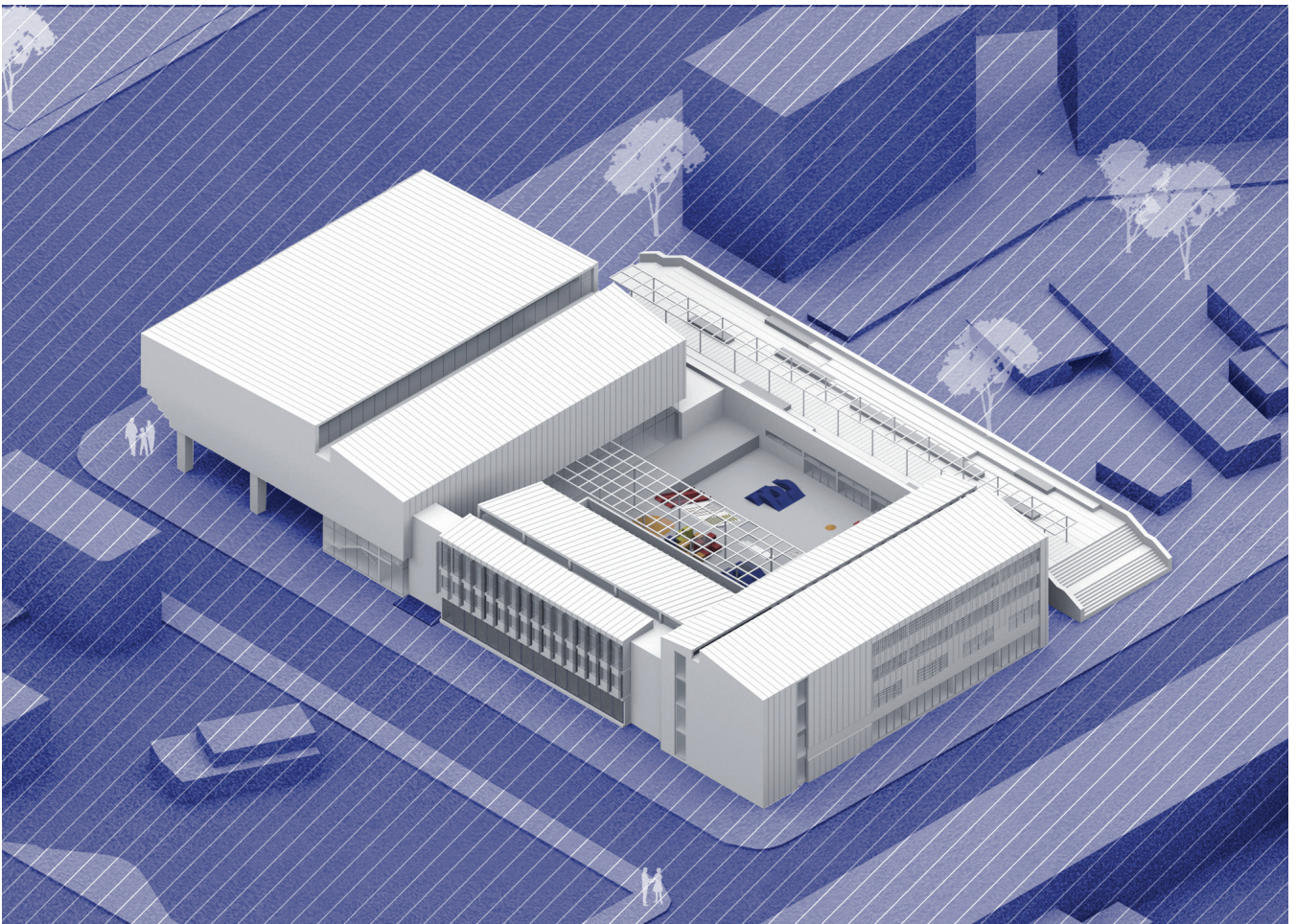
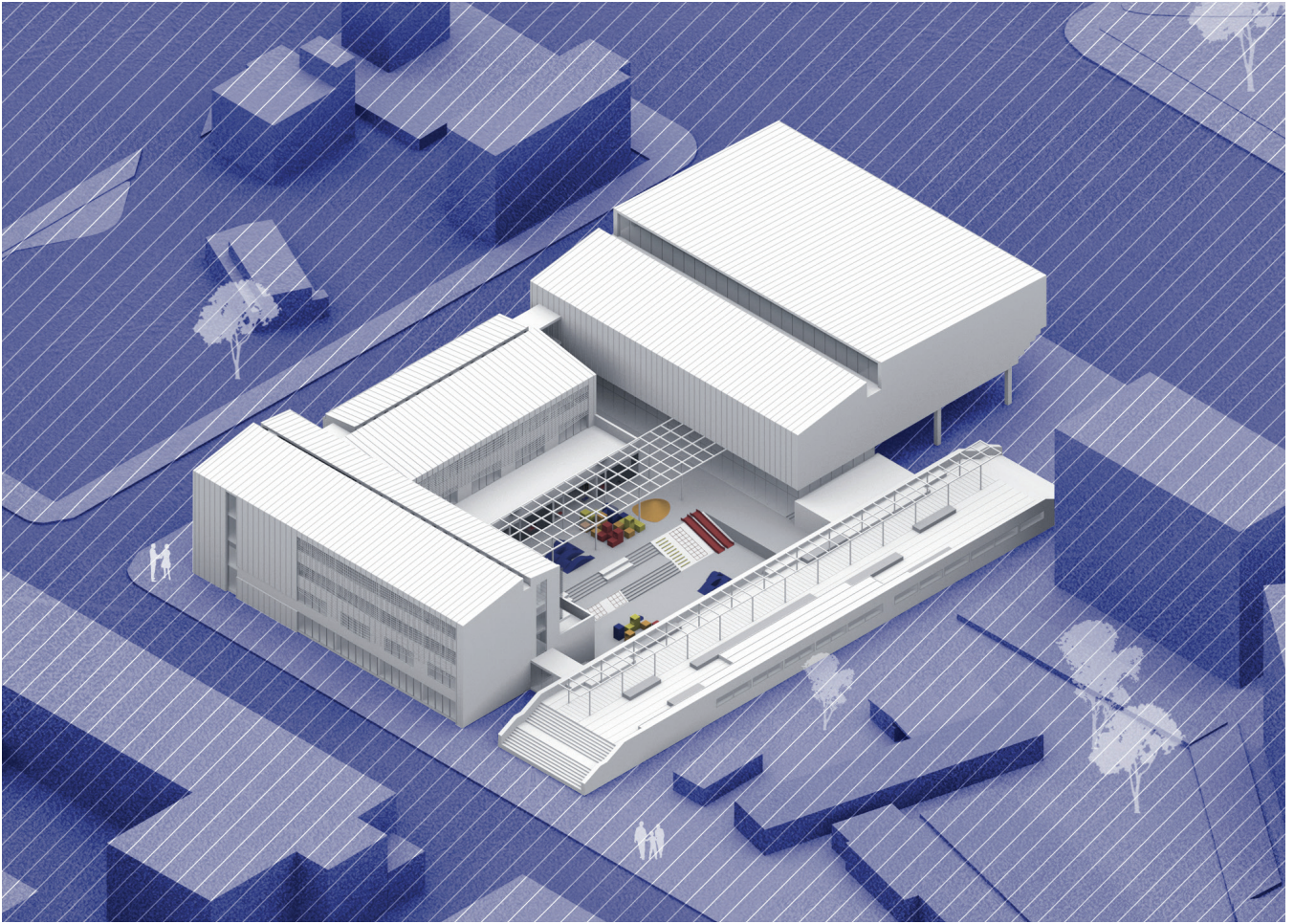


Site Plan

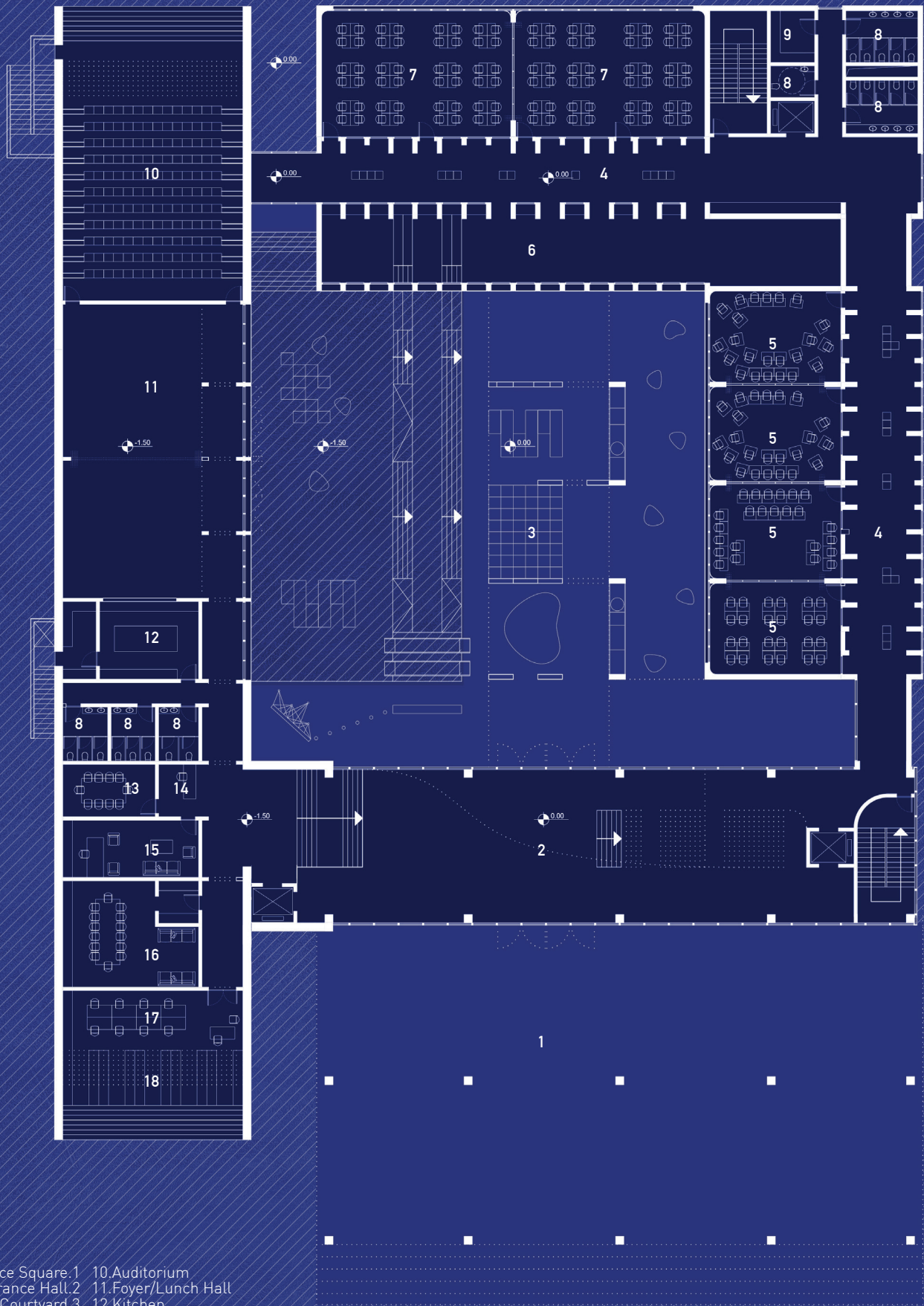








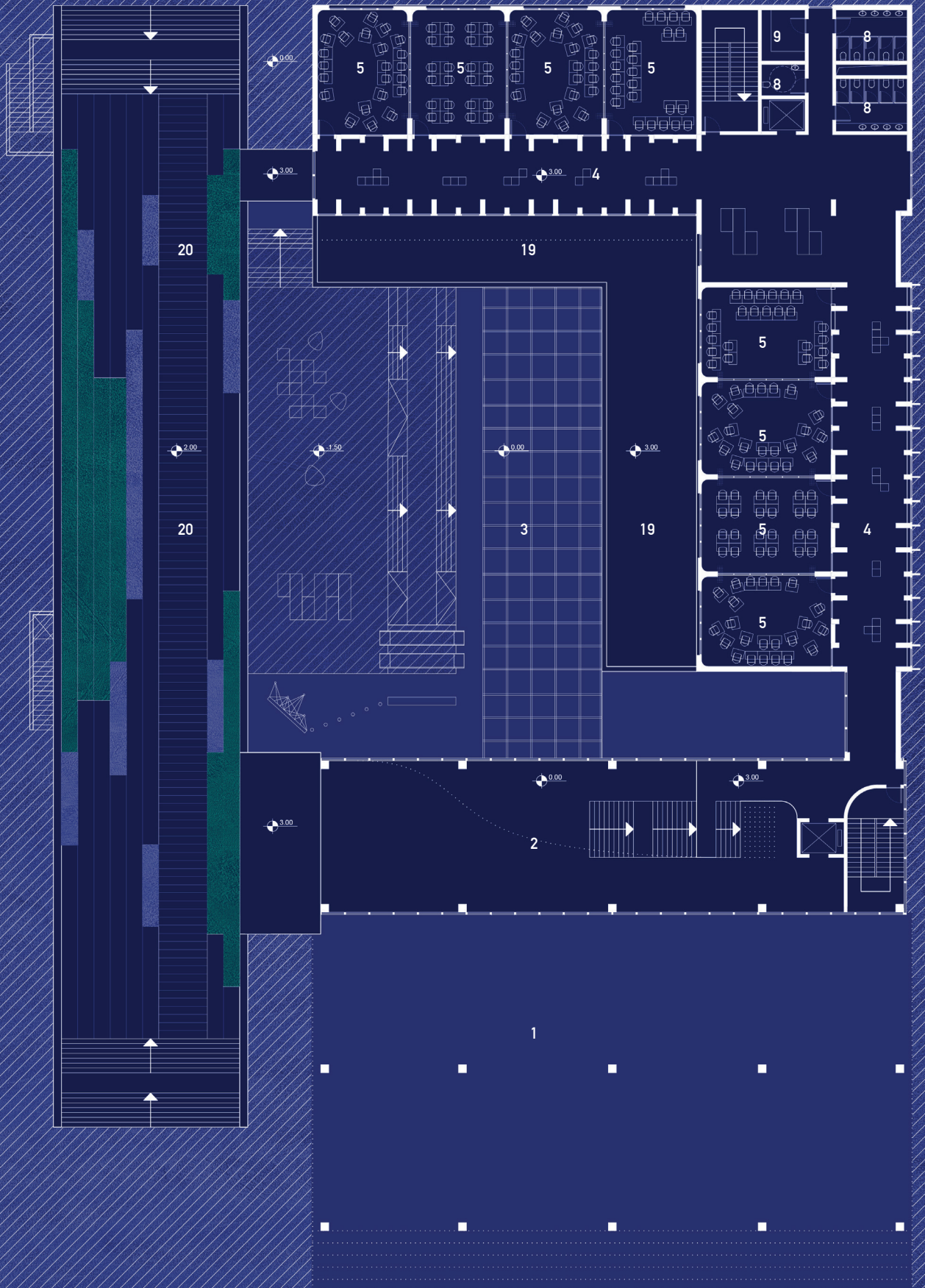
# Ground Floor Plan +0.00



- Entrance Square.1
- Entrance Hall.2
- Courtyard.3
- Corridor.4
- Classroom.5
- Special Class.6
- Library.7
- Toilet.8
- Storage.9
- 10.Auditorium
- 11.Foyer/Lunch Hall
- 12.Kitchen
- 13.Meeting Room
- 14.Secretary
- 15.Head Master's Office
- 16.Teachers' Hall
- 17. Administrative Office
- 18.Archive



# First Floor Plan +3.00

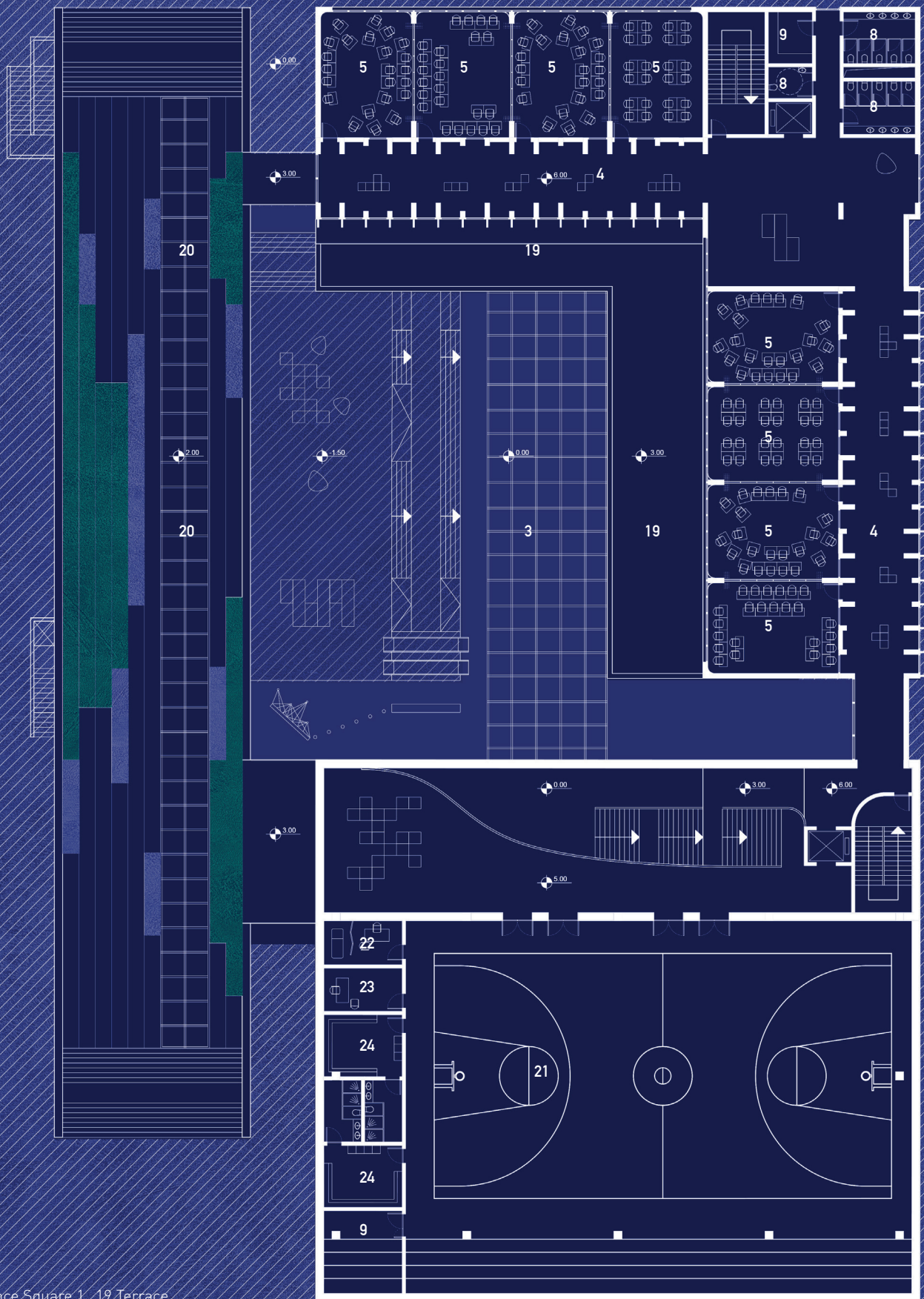


- Entrance Square.1
- Entrance Hall.2
- Courtyard.3
- Corridor.4
- Classroom.5
- Toilet.8
- Storage.9
- Terrace.19
- Public Pass.20

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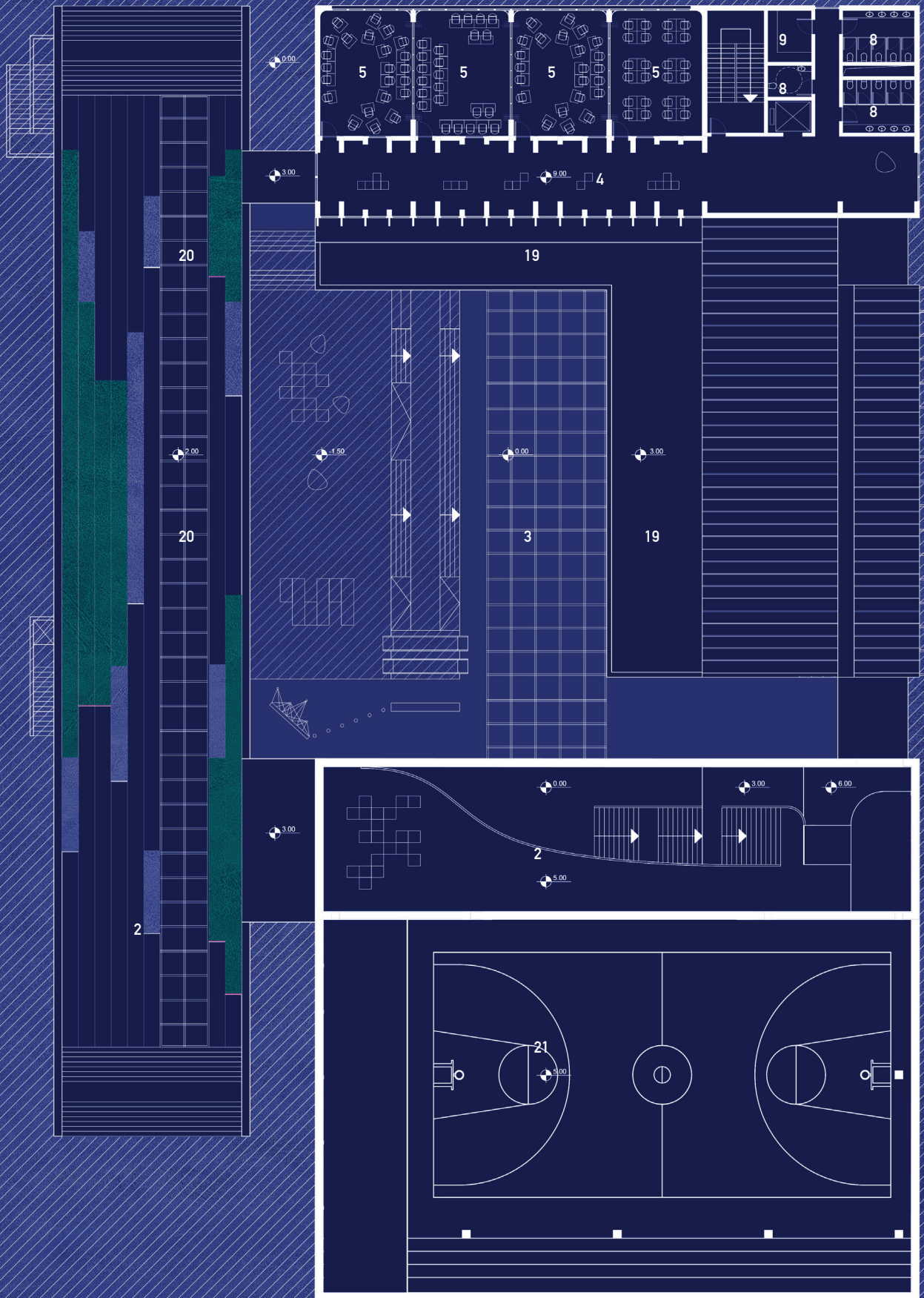
# Second Floor Plan +6.00



- Entrance Square. 1
- Entrance Hall. 2
- Courtyard. 3
- Corridor. 4
- Classroom. 5
- Toilet. 8
- Storage. 9
- 19. Terrace
- 20. Public Pass
- 21. Gymnasium
- 22. infirmary
- 23. Coach's Room
- 24. Dressing Room



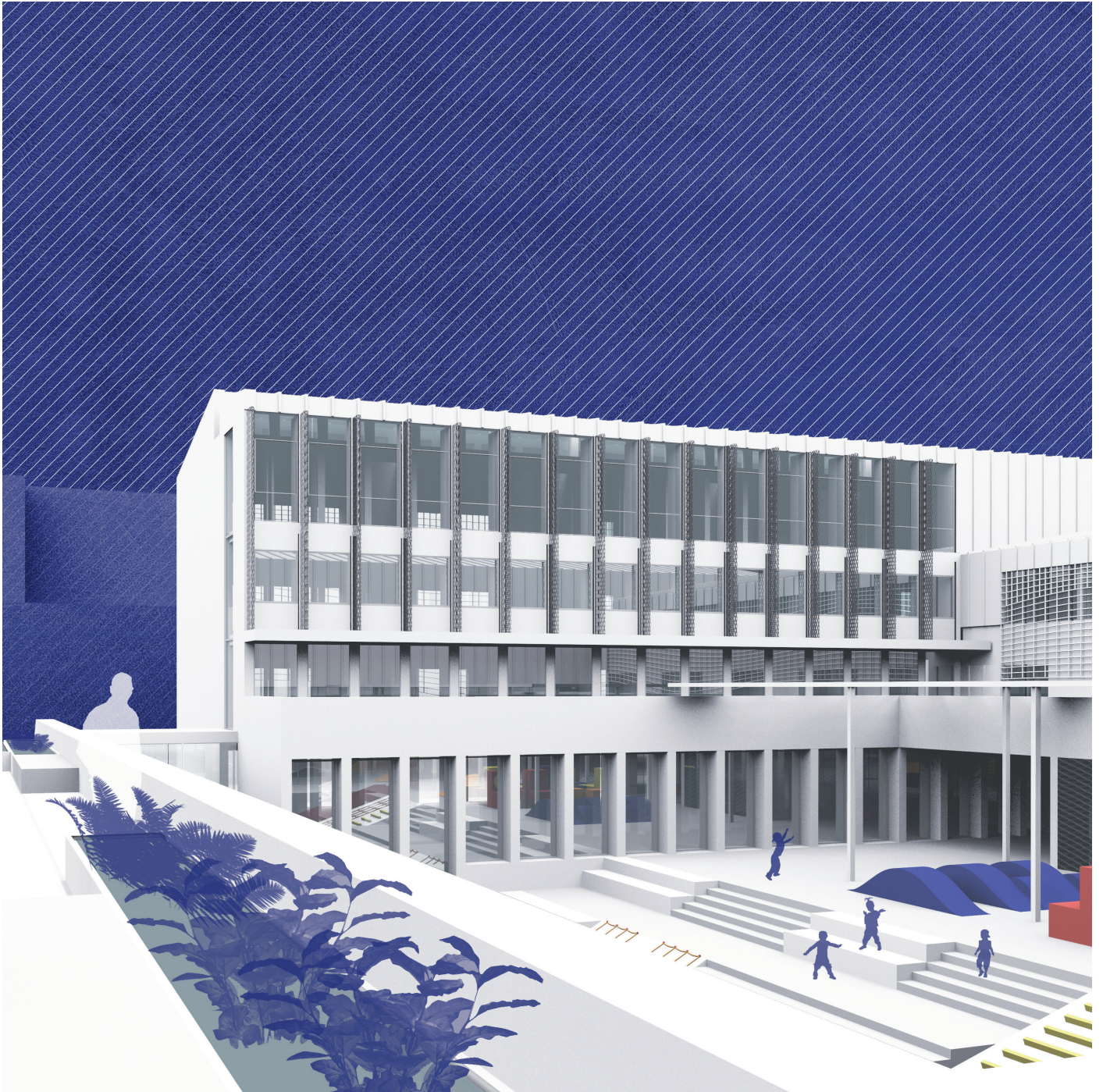
# Third Floor Plan +9.00

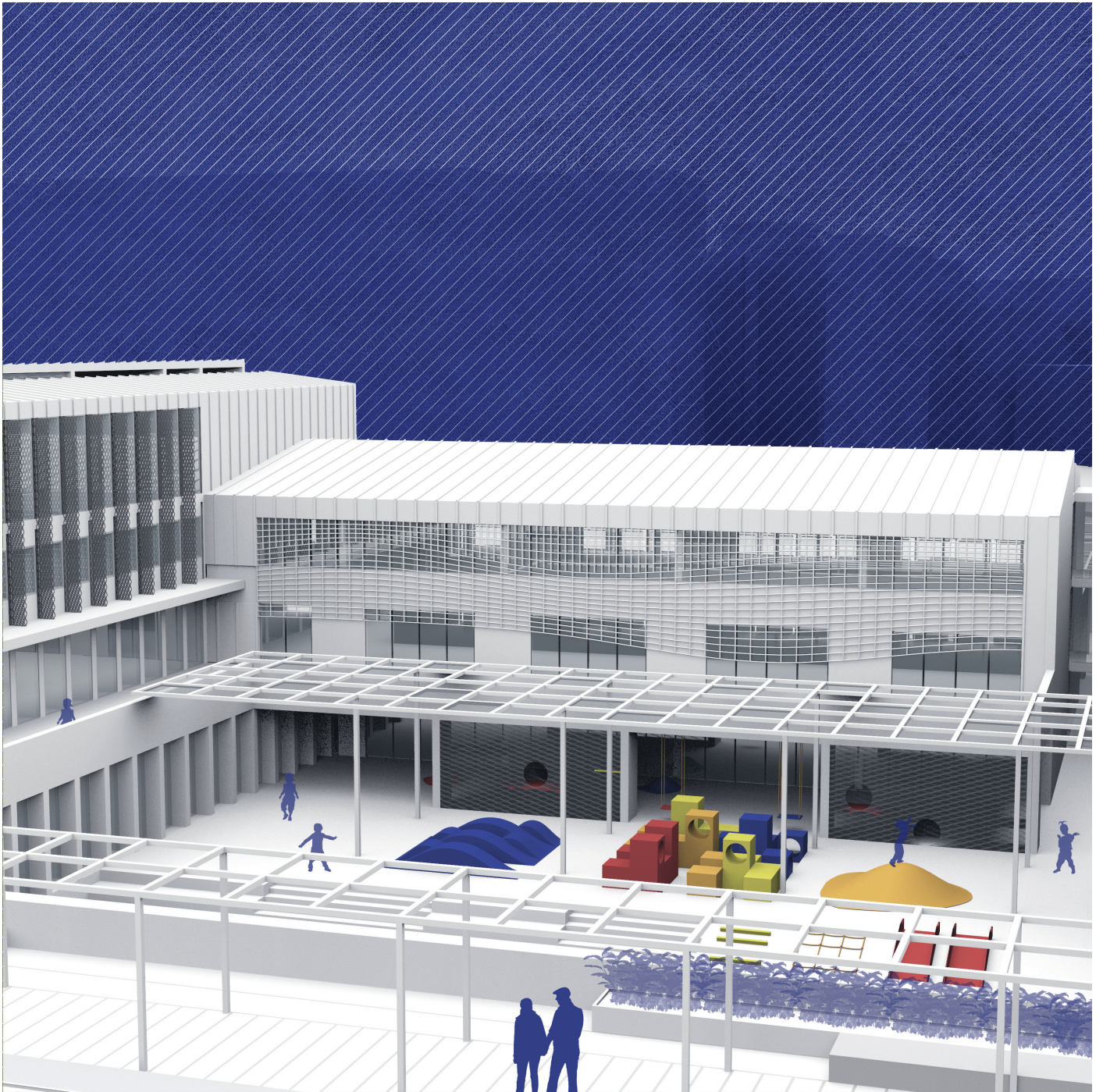


- Entrance Square.1
- Entrance Hall.2
- Courtyard.3
- Corridor.4
- Classroom.5
- Toilet.8
- Storage.9
- Terrace.19
- Public Pass.20
- Gymnasium.21

0 1 2 5

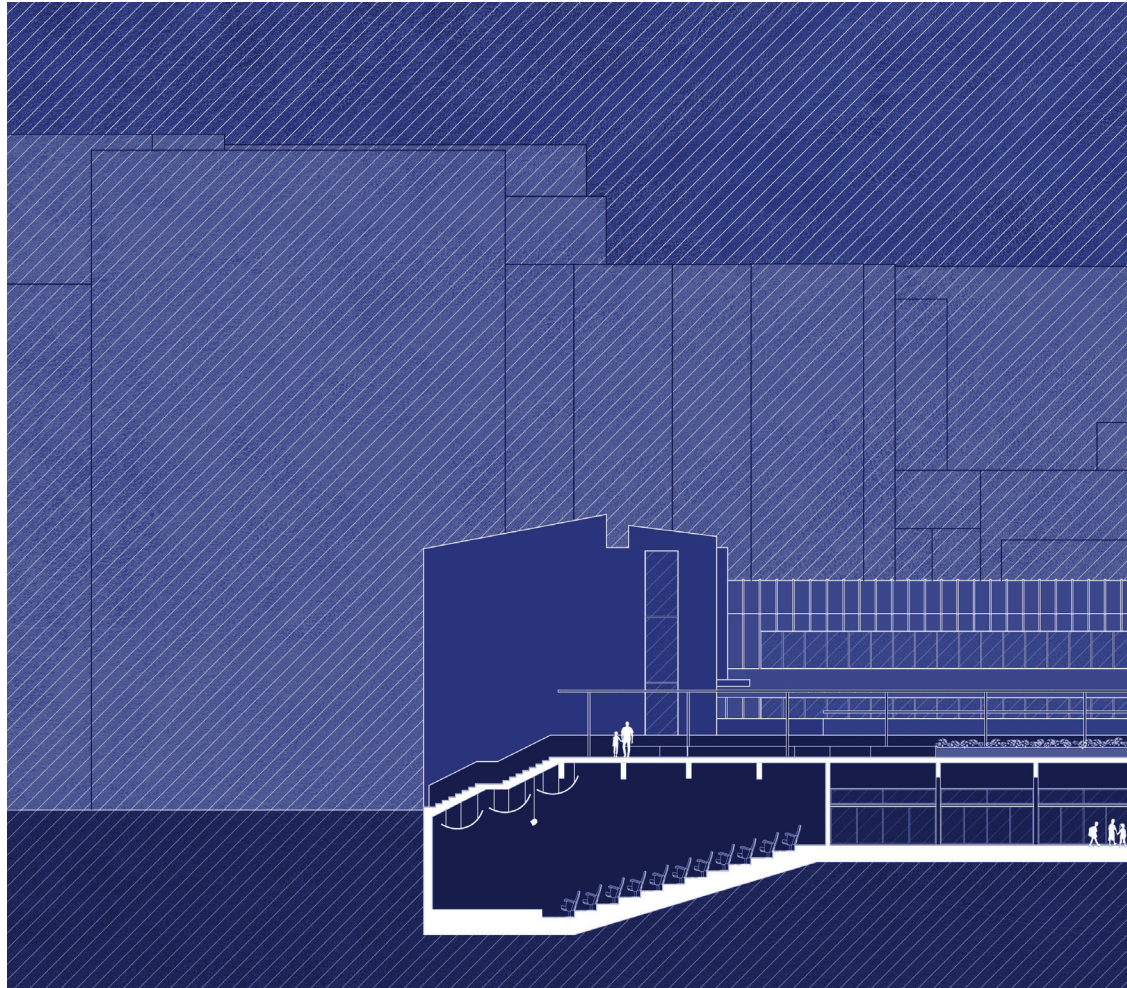






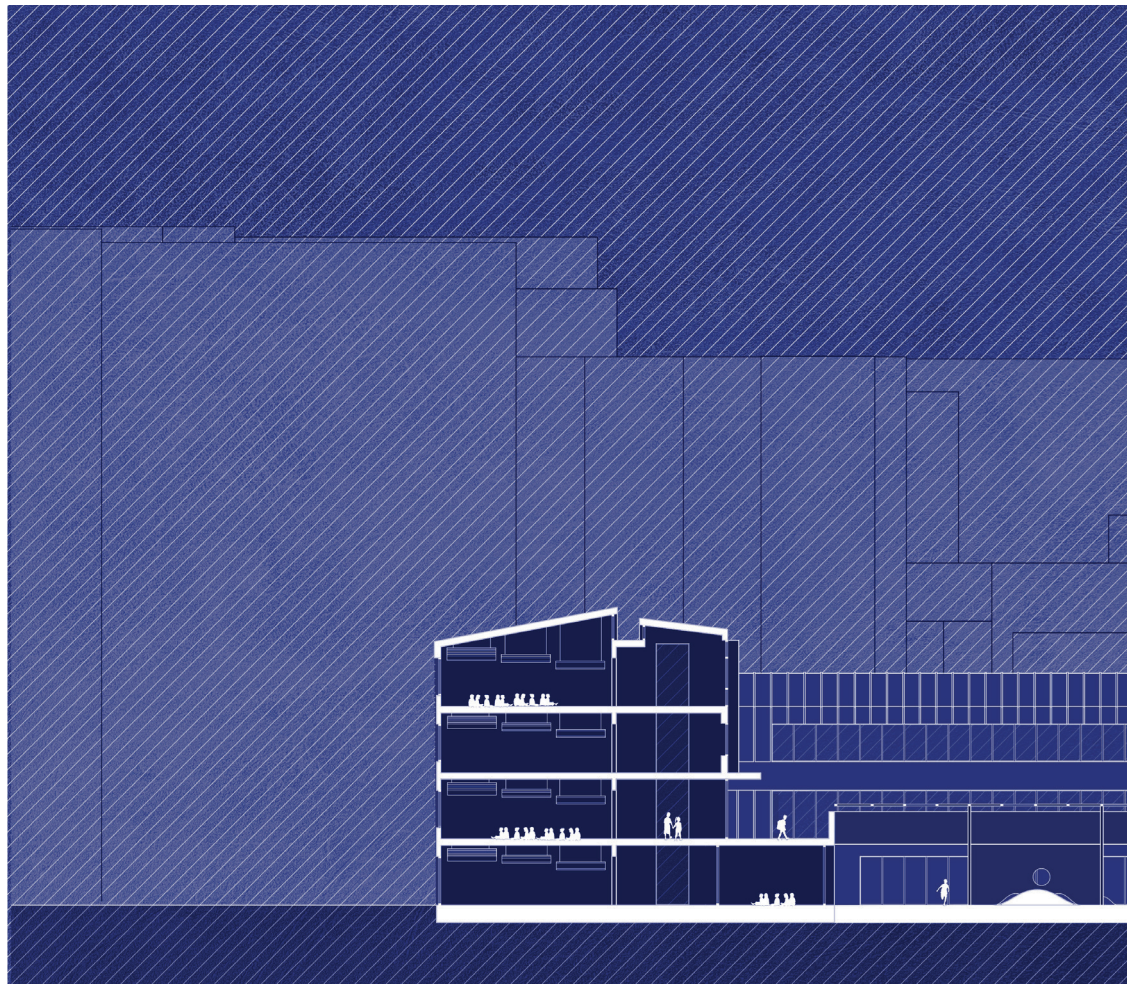
### A-A' Section

- Auditorium.10
- Foyer/Lunch Hall.11
- Kitchen.12
- Meeting Room.13
- Head M.'s Office.15
- 16.Teachers' Hall
- 17. Administrative Office
- 18.Archive
- 20.Public Pass

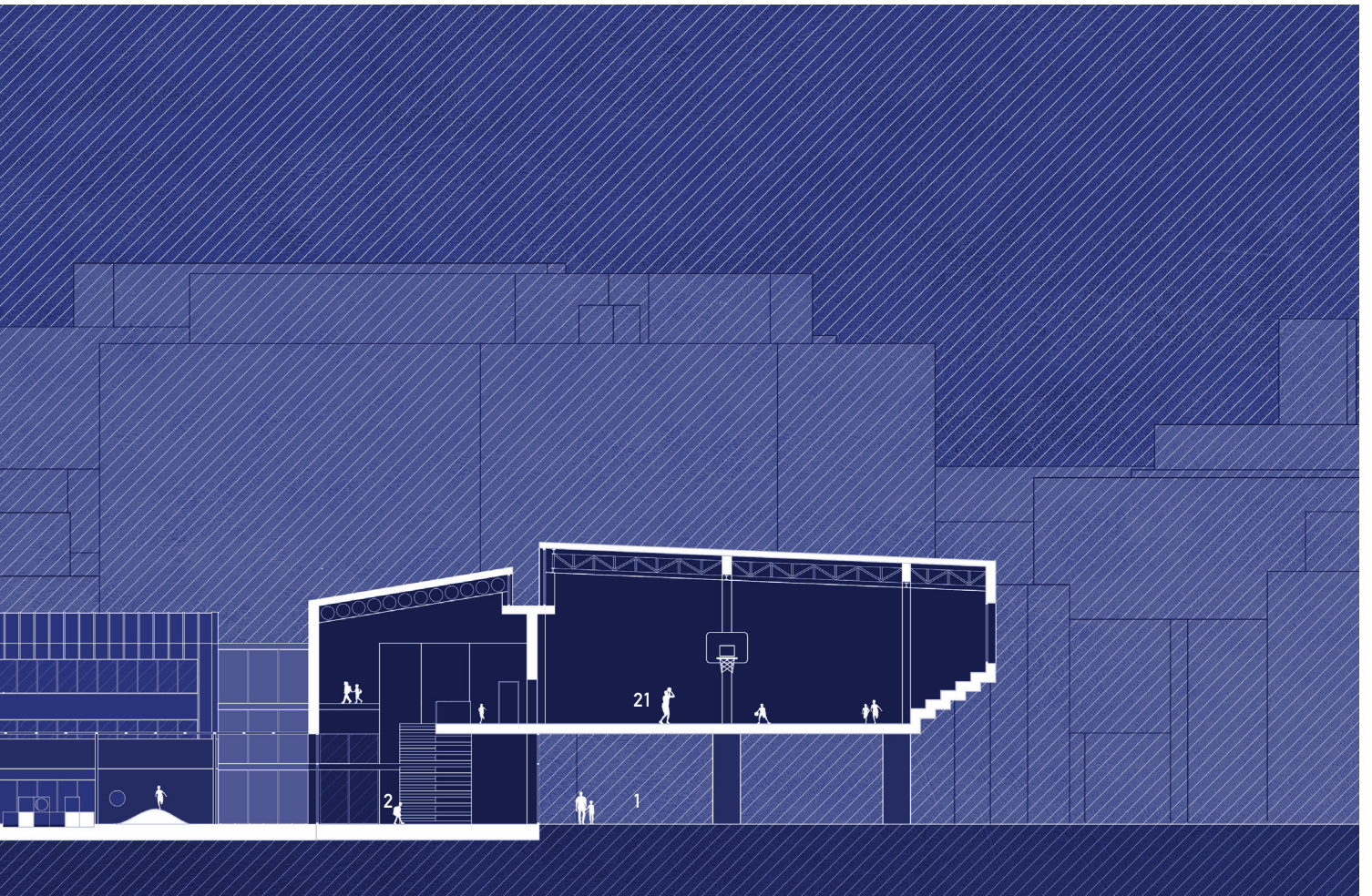
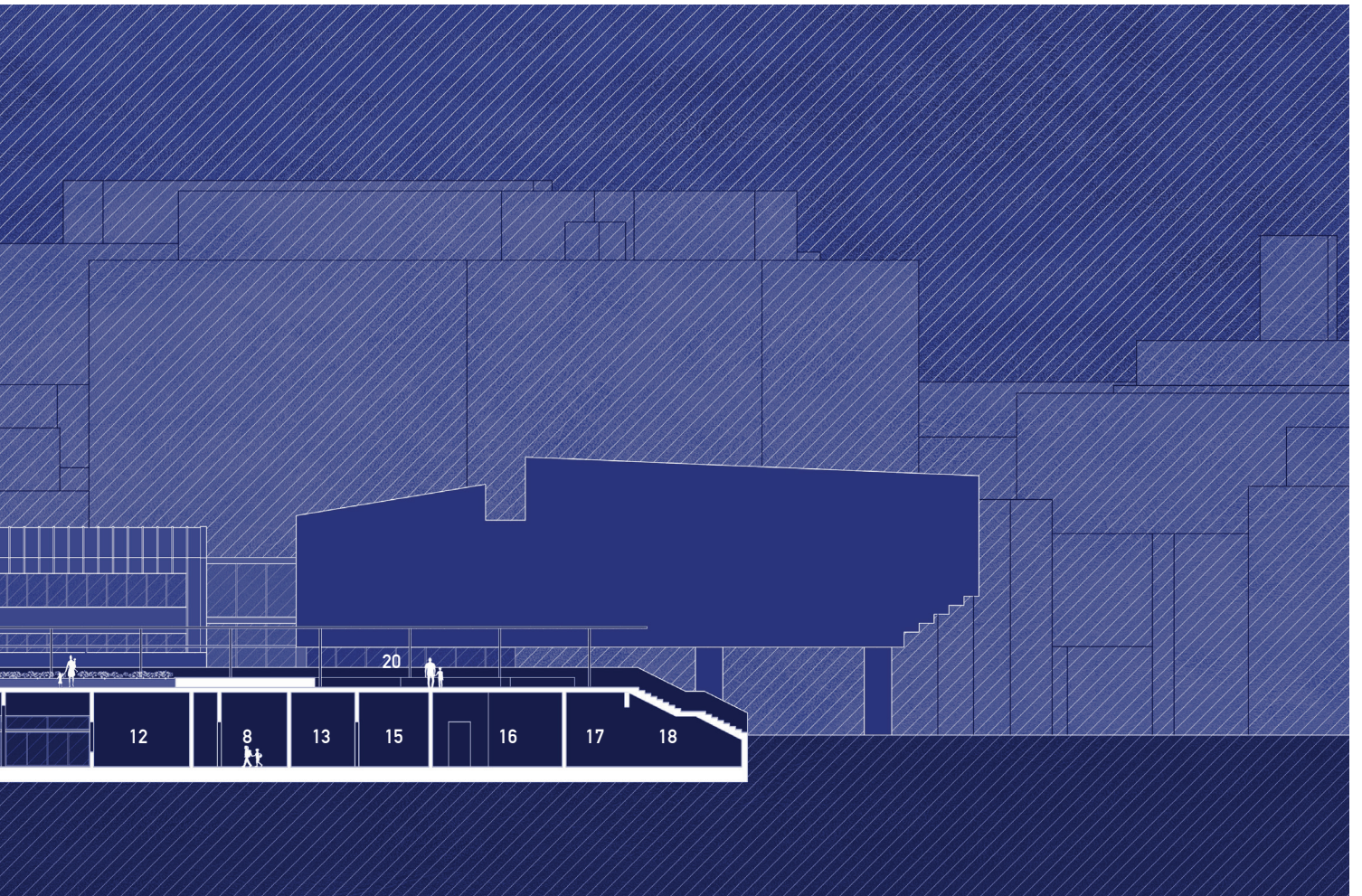


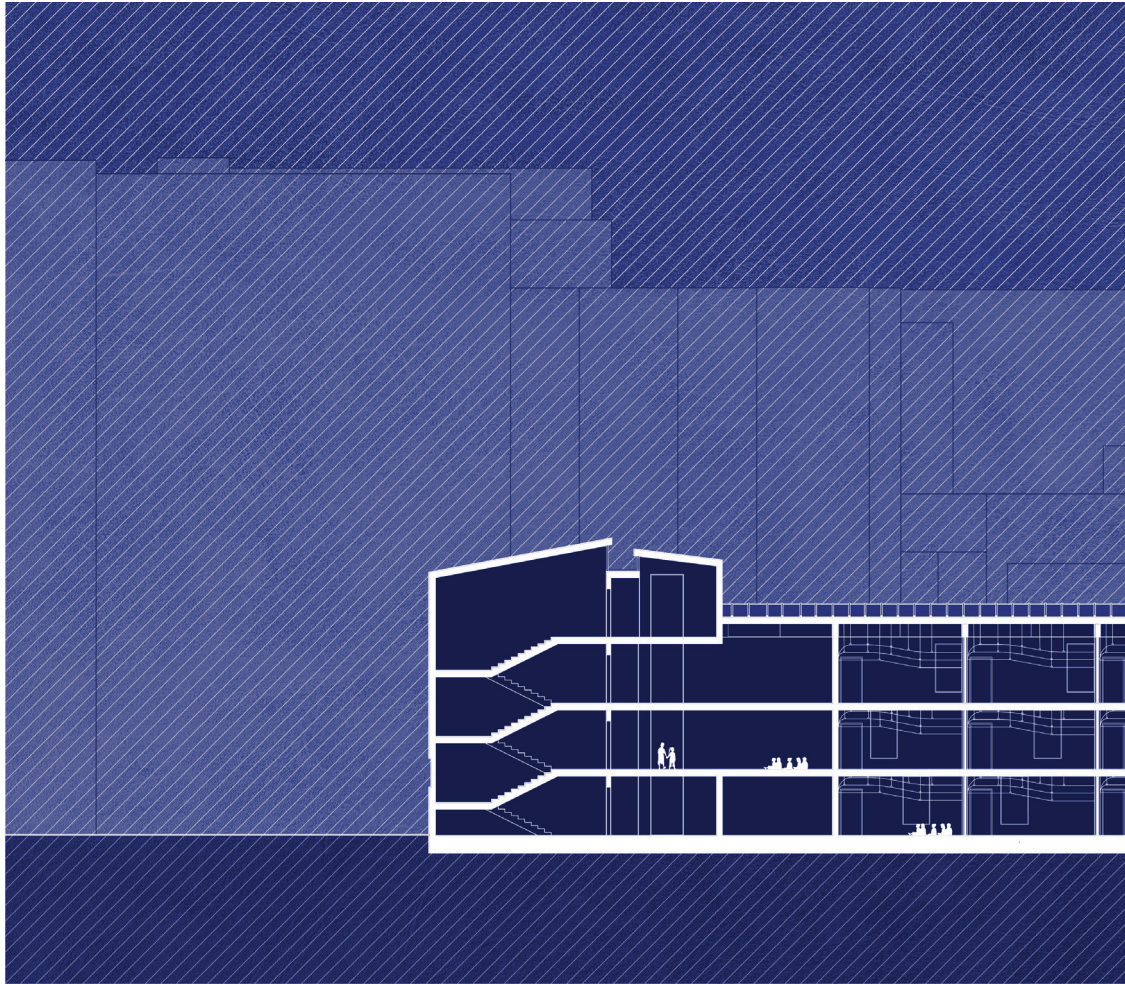
### B-B' Section

- Entrance Square.1
- Entrance Hall.2
- Courtyard.3
- Corridor.4
- 5.Classroom
- 6.Special Classroom
- 7.Library
- 21.Gymnasium



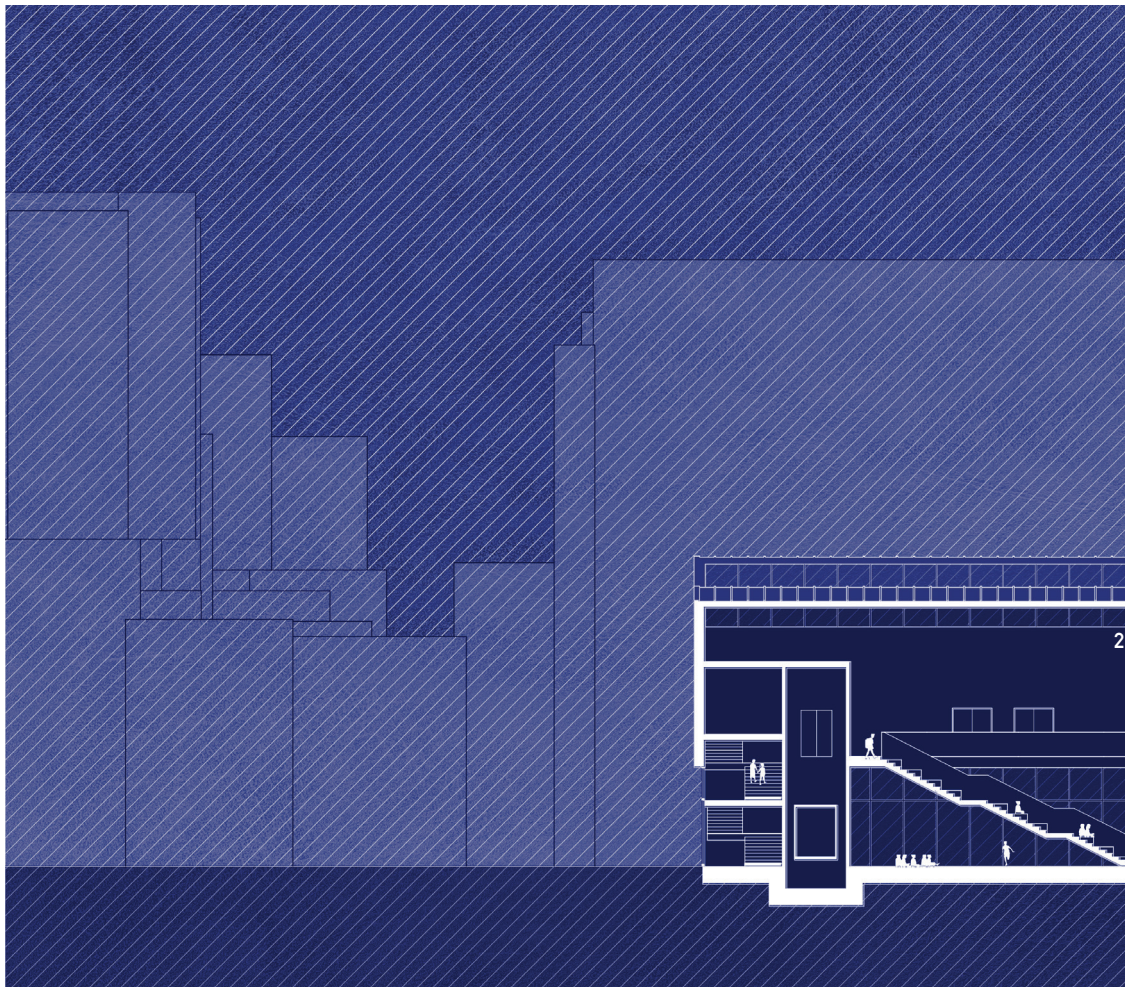






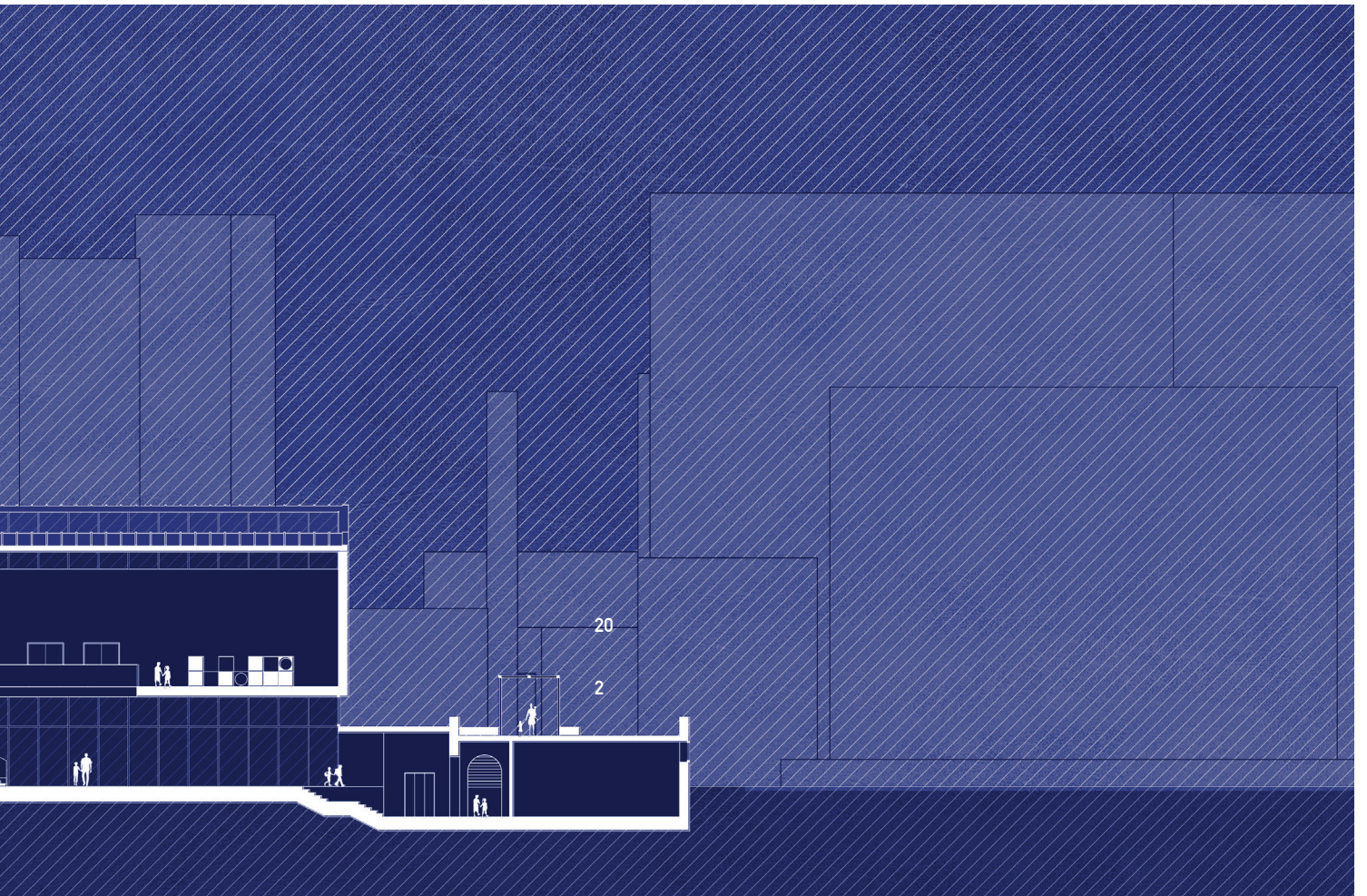
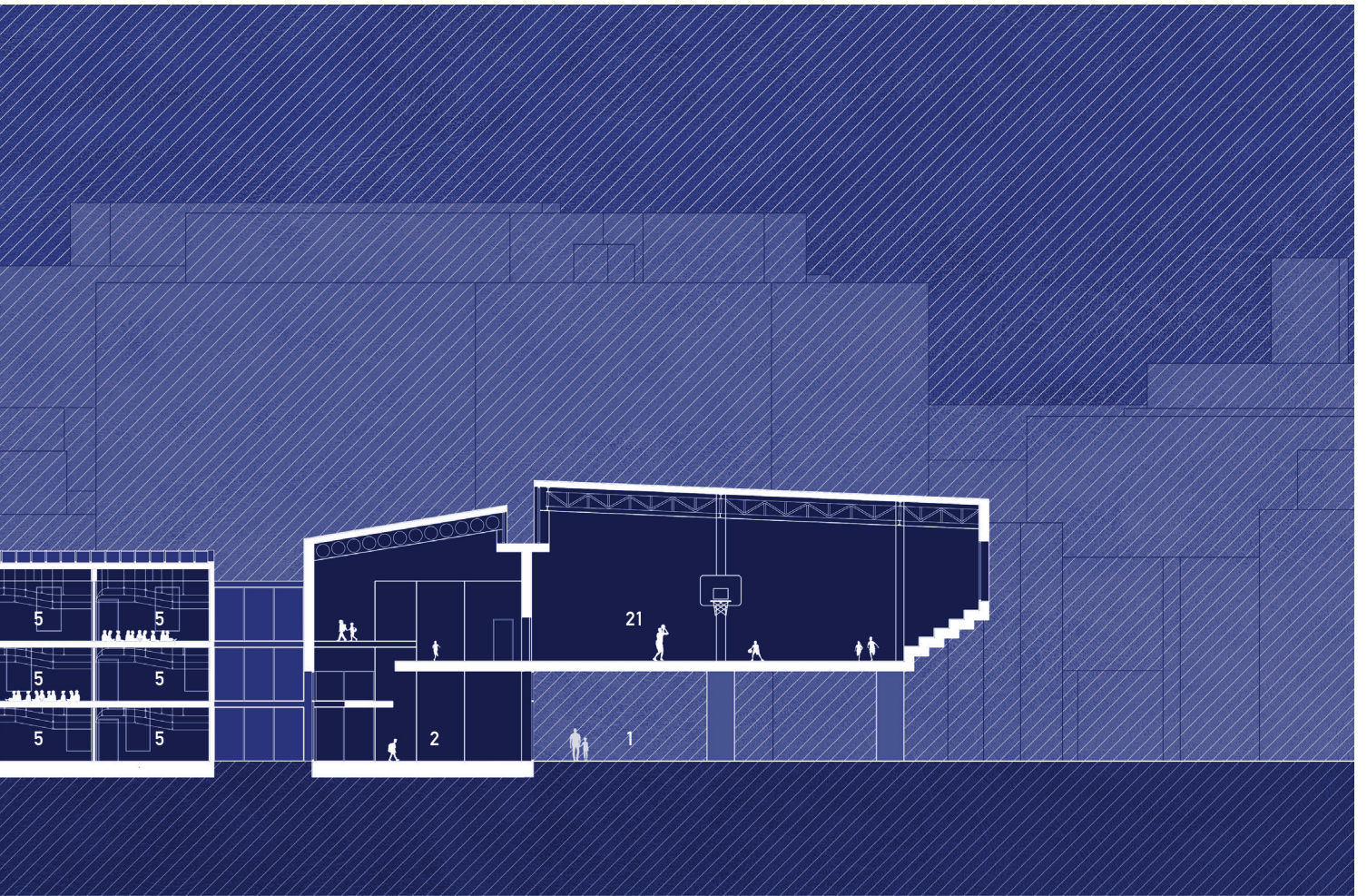
**C-C' Section**

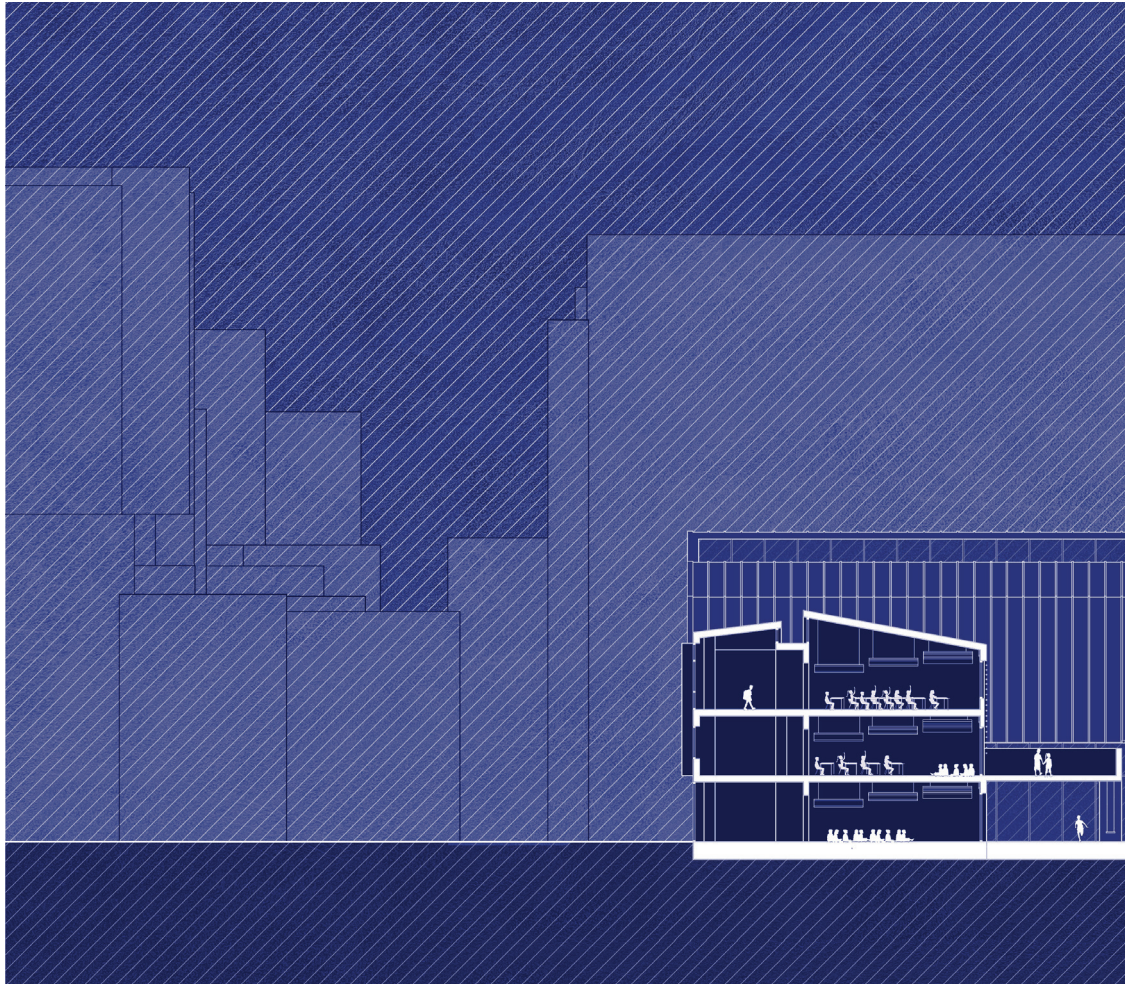
- Entrance Square.1
- Entrance Hall.2
- Corridor.4
- 5.Classroom
- 7.Library
- 21.Gymnasium



**D-D' Section**

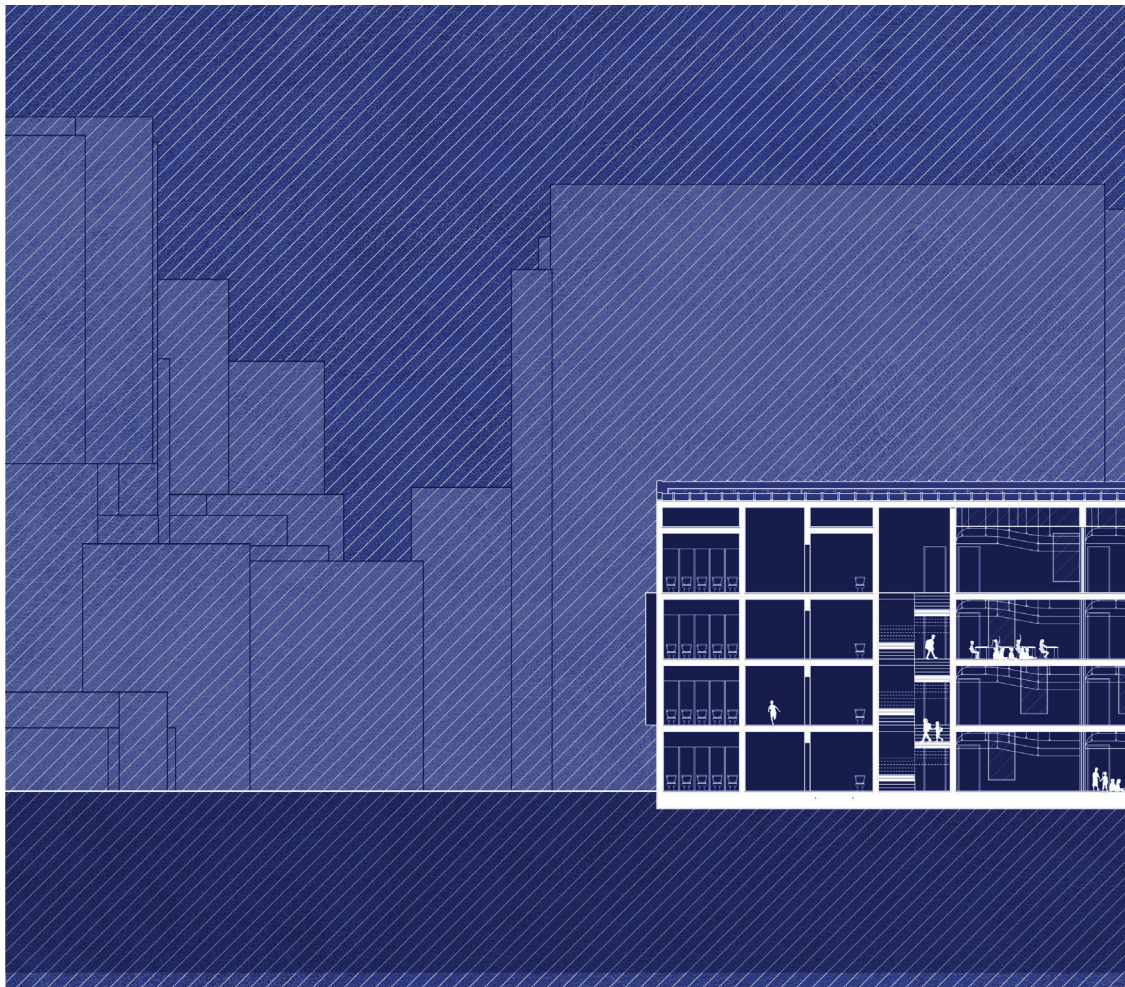
- 2.Entrance Hall
- 15.Head Master's Office
- 20.Public Pass





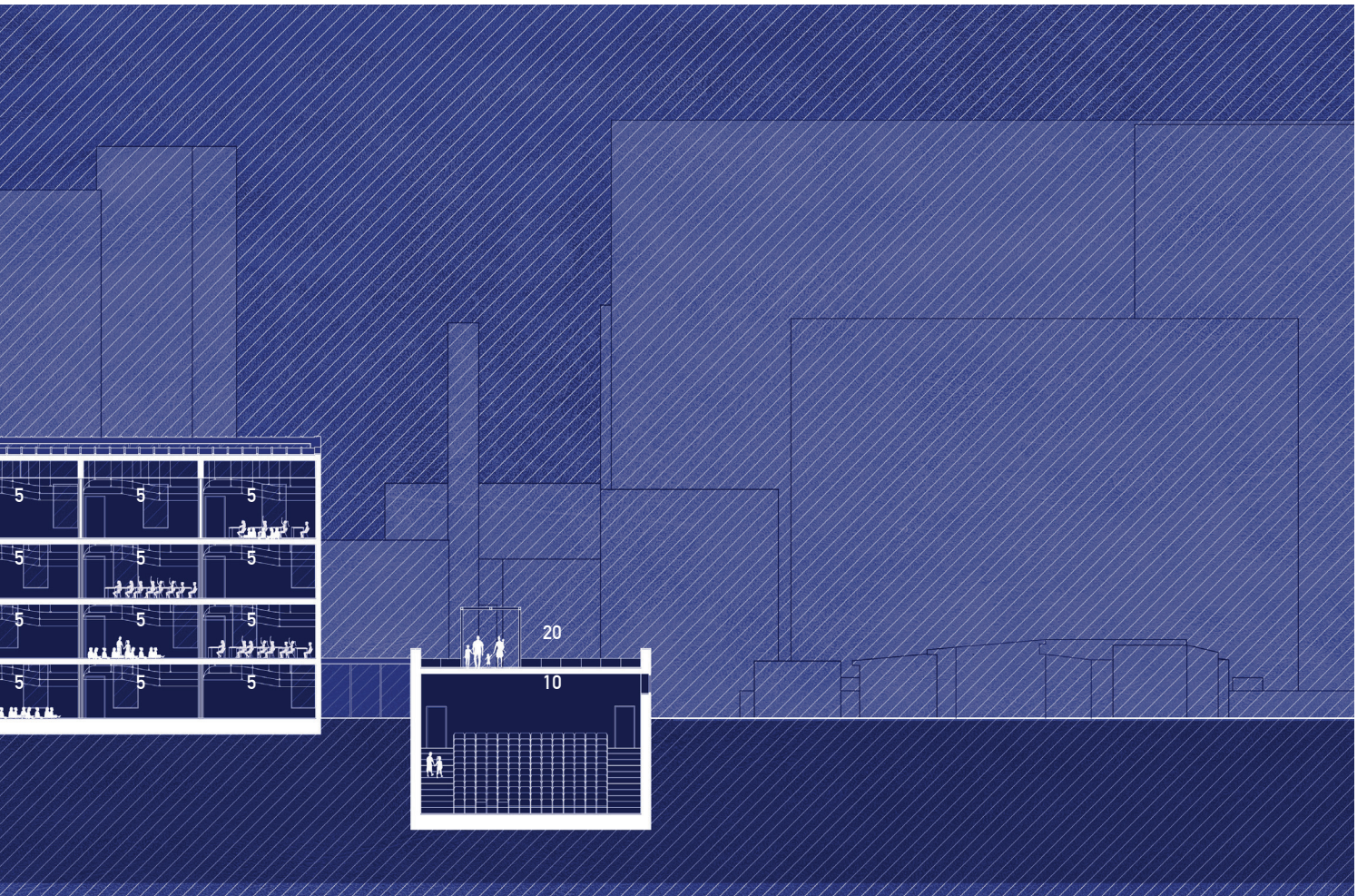
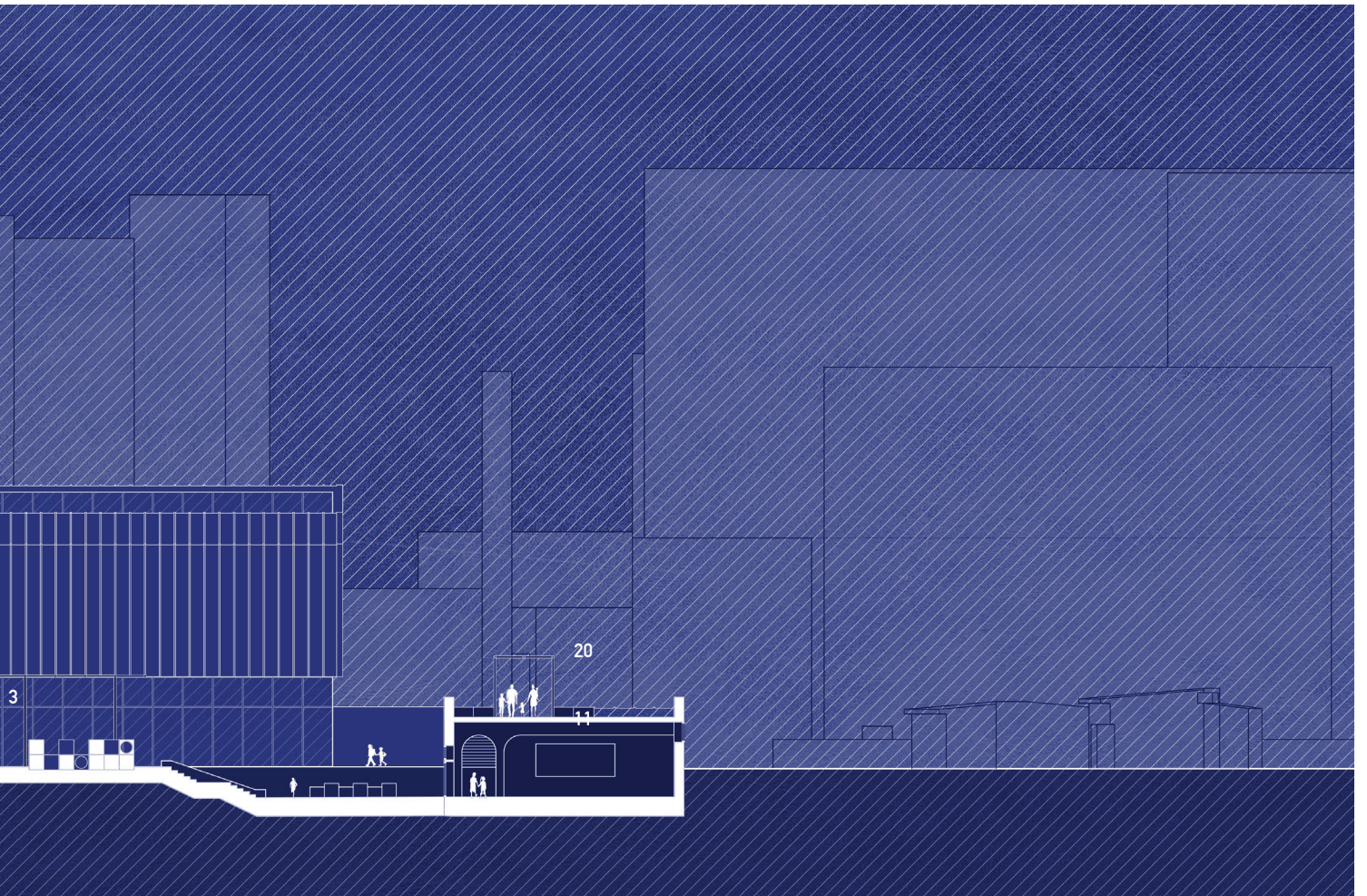
**E-E' Section**

Courtyard.3 11.Foyer/Lunch Hall  
 Corridor.4 19.Terrace  
 Classroom.5 20.Public Pass

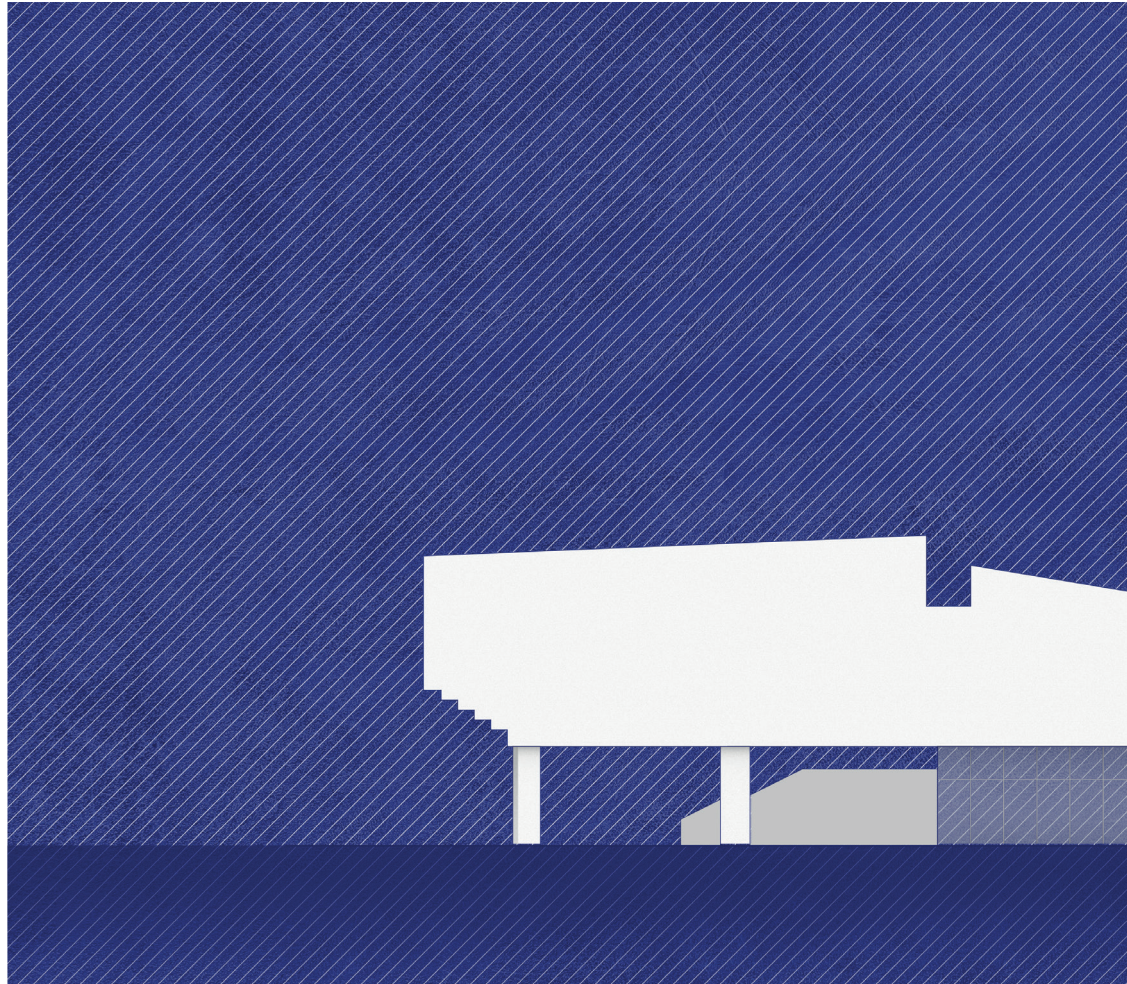


**F-F' Section**

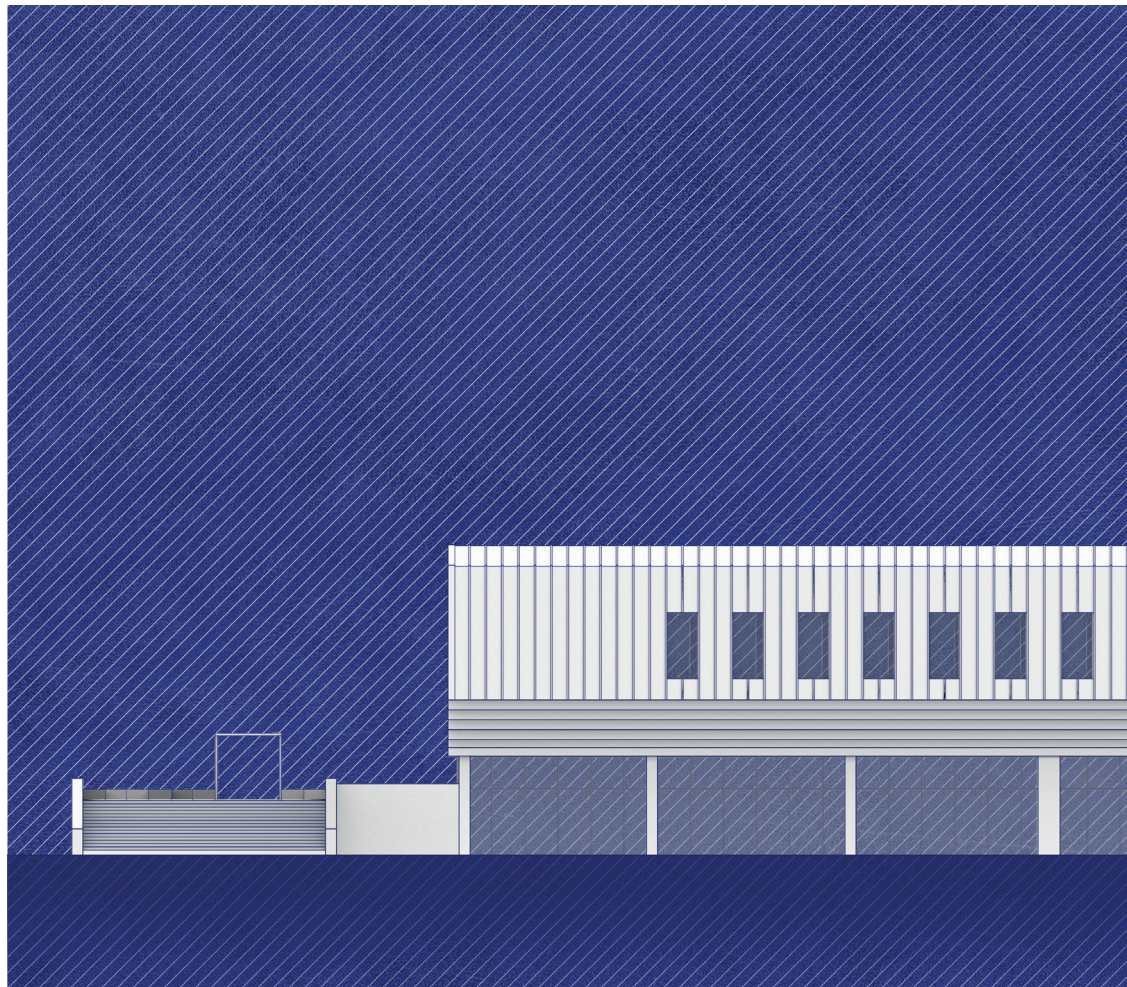
Classroom.5 10.Auditorium  
 Toilet.8 20.Public Pass

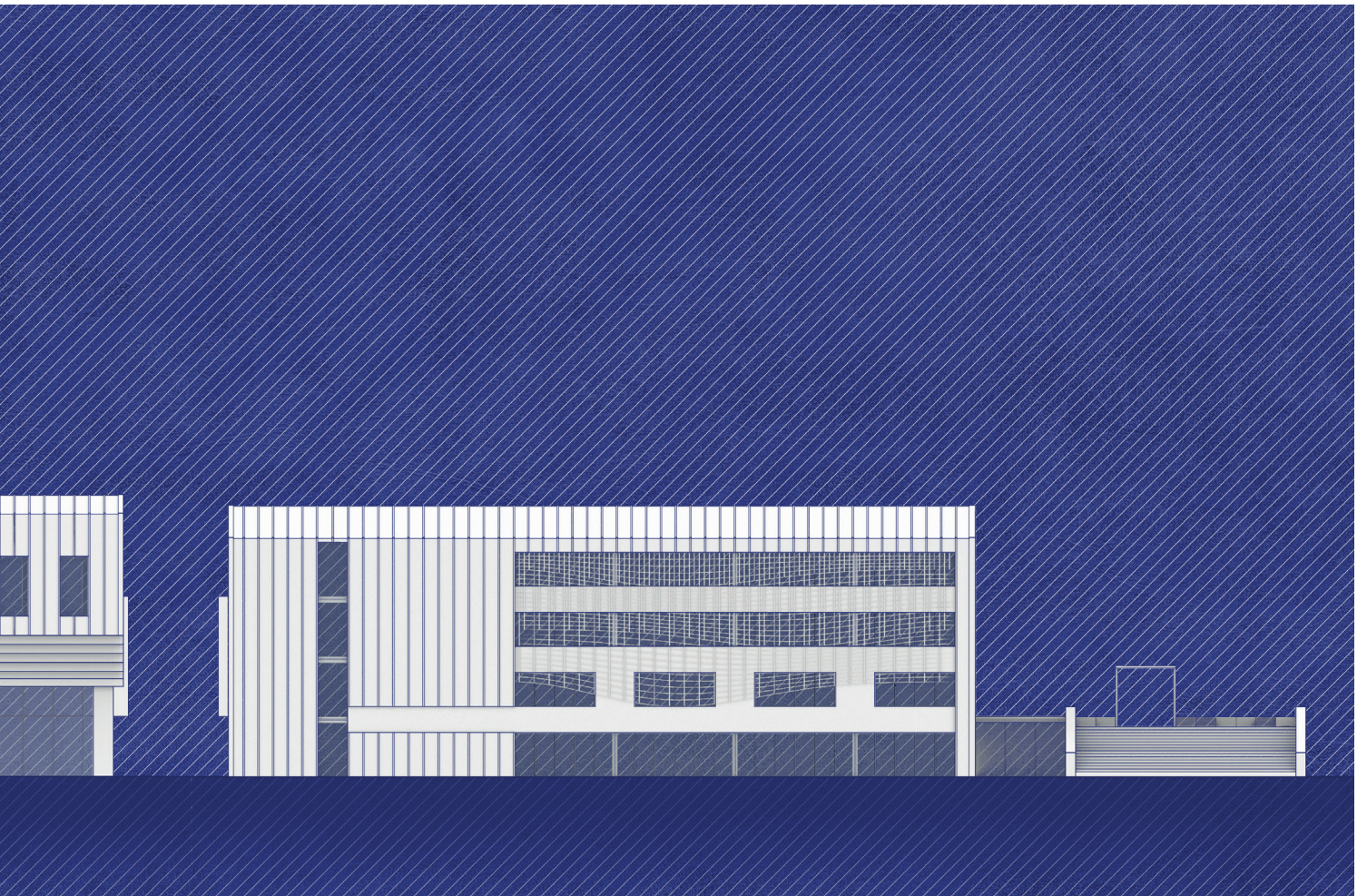
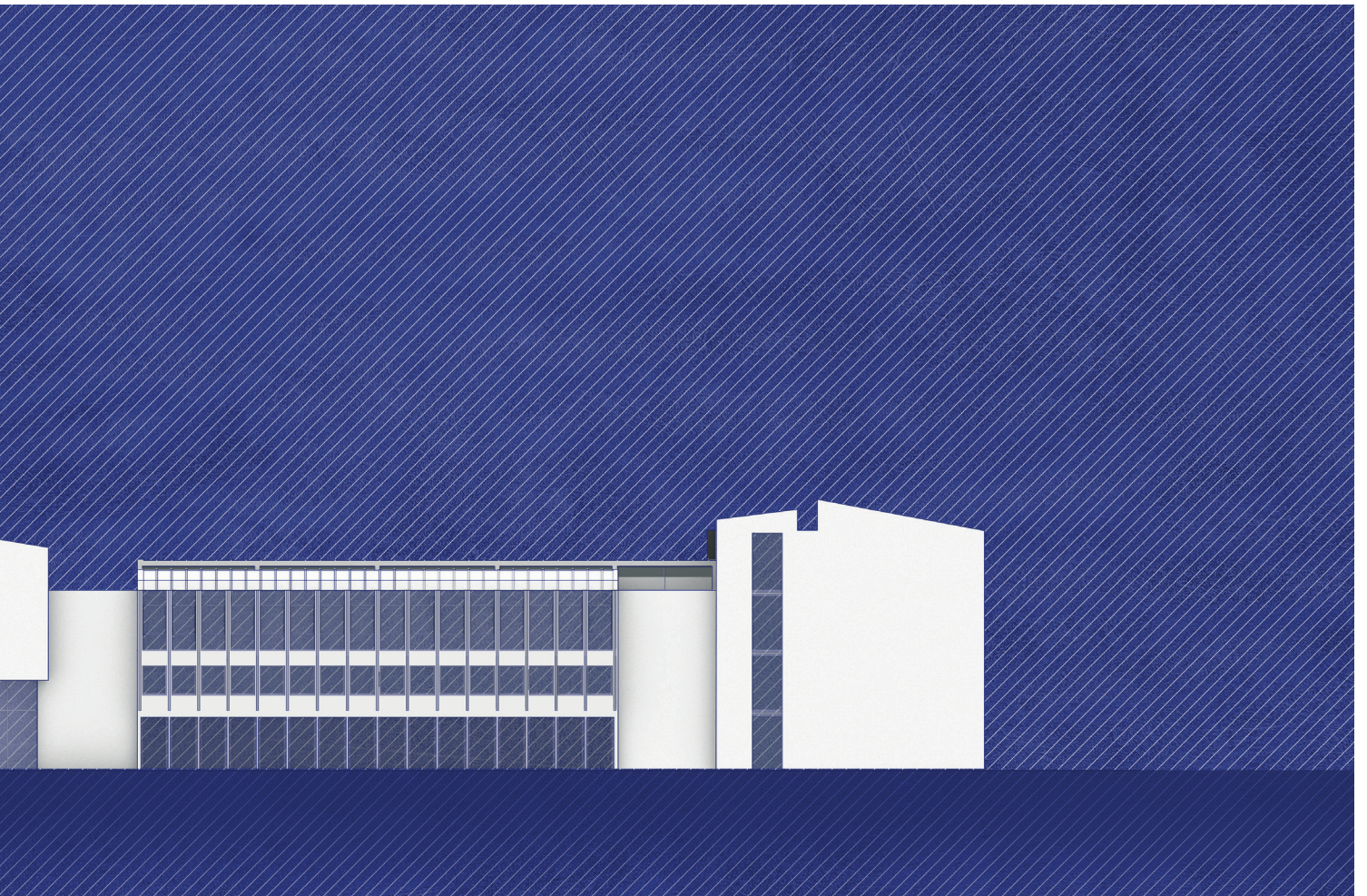


North East Elevation



South East Elevation  
North West Elevation

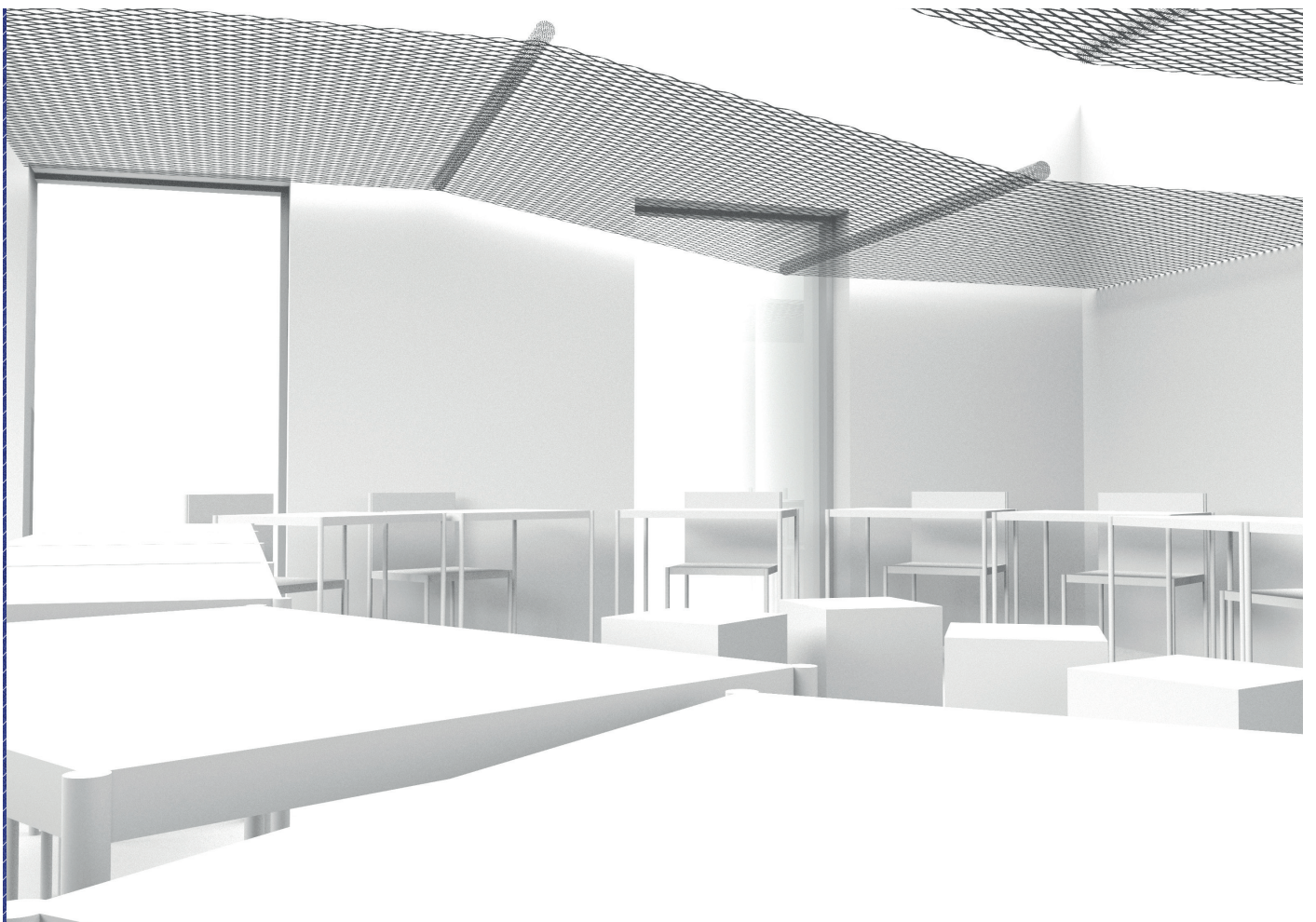






**Classroom for Faster Time Experience**





Classroom for Slower Time Experience



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