NEW

NEIGHBORHOOD FOR EDUCATIONAL WONDER

March 3, 2025

LTAID Lithuanian Development Cooperation

CPVA

Agency for Restoration

New European Bauhaus

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CEAS

GRA GOLDAKOVSKIY GROUP ARCHITECTS

Handbook

adaptability | community | sustainability

Project financed from the Lithuanian Fund for Development Cooperation and Humanitarian Aid

INTRODUCTION
FUTURE SCHOOL FOR UKRAINE

The Future School for Ukraine project addresses the urgent need to rebuild Ukraine's war-damaged education system. With one in seven schools reported as severely damaged or destroyed, approximately 1.9 million students lack access to safe learning environments. This initiative focuses on providing adaptive, practical solutions to restore education infrastructure and ensure that students can continue learning despite the challenges of war. By prioritizing both immediate functionality and long-term resilience, the project lays the groundwork for a sustainable and future-ready school system.

Led by Lithuania, the project launched a global architectural competition to develop a free-to-use, ready-to-implement school design for Ukraine. An international jury selected the most effective proposal based on key criteria, including adaptability, practicality, and alignment with modern educational needs. Before the competition, experts convened in a workshop to define core requirements, ensuring that the designs addressed local challenges. The winning concept, Neighborhood for Educational Wonder, is now being refined to create flexible, scalable school models that can be implemented across various regions.

A core aspect of the project is its integration with the New European Bauhaus (NEB), which promotes sustainability, inclusivity, and quality design. These principles guided the competition's evaluation criteria, ensuring that the new schools would be more than just functional structures—they would foster a sense of community and well-being. The initiative also serves as a pilot for the New European Bauhaus Laboratory: Public Infrastructure for Ukraine, reinforcing the idea that rebuilding efforts should improve, rather than merely restore, public spaces.

Beyond addressing the immediate need for schools, the project contributes to broader reconstruction efforts by setting a precedent for well-planned, adaptable public infrastructure. The adaptive technical design is expected to be completed by the summer of 2025, providing a blueprint for future school construction. Its emphasis on sustainability and community-centered planning ensures that the new schools will remain relevant and functional in the long term.

Funding from the Lithuanian Fund for Development Cooperation and Humanitarian Aid plays a crucial role in bringing this project to life. By supporting this initiative, Lithuania is actively contributing to Ukraine's recovery, emphasizing the importance of international cooperation in rebuilding essential services. The collaboration between Lithuania, the NEB, and global experts highlights the potential of well-designed, sustainable solutions to address critical post-war challenges.

sensitive architecture to enhance human life
designing tomorrow, elevating today.

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1 NEW TOOLBOX

An approach that breaks down complexity into more manageable components. From the spatial layout to the modular panel.

In our toolbox, we gather the tools required to construct the Neighborhood for Educational Wonder the winning proposal for the “Future School for Ukraine” project financed from the Lithuanian Fund for Development Cooperation and Humanitarian Aid.

The box features three interconnected layers: Design Principles, Design Strategy, and Design for Adaptability.

The Design Principles establish the foundational values guiding the neighborhood’s development. The modular school concept embraces a holistic, inclusive approach that integrates sustainability, adaptability, and circular design while fostering a deep connection with the principles of the New European Bauhaus.

These include adaptability, which ensures the architecture can evolve over time; courtyards, which serve as central gathering spaces that foster interaction, inclusivity and a sense of community; and sustainability, which prioritizes environmental responsibility through energy efficiency.

The Design Strategy provides a roadmap for implementation, outlining the design decisions while addressing logistical and practical considerations.

Finally, Design for Adaptability emphasizes the importance of tailoring the neighborhood to the specific contexts and challenges of Ukraine, a country marked by its vast and diverse geography. Being site-specific is crucial to ensure the architecture responds to local climatic conditions, cultural nuances, and community needs. This approach allows for flexibility in scaling the project and adapting its components to suit urban centers, rural settings, or regions affected by conflict, ensuring relevance and impact across varied contexts.

This toolbox is not merely a collection of concepts but a dynamic and practical guide that equips designers and stakeholders to build the educational neighborhood.

1.1 DESIGN PRINCIPLES
REBUILDING COMMUNITIES

The design is centered on three main principles:

• Adaptability and flexibility

The principle of adaptability is addressed with a modular customizable system that allow flexibility and reconfigurability from the urban level to the detail of the product. By integrating modularity at every scale, this approach supports a responsive and resilient design paradigm. It encourages innovation and user engagement, reduces waste by extending the utility of materials and spaces, and ensures that the built environment remains relevant and functional in the face of future uncertainties.

• Courtyards and community

Designing around a public void, whether covered or uncovered, offers immense potential to create spaces that are both dynamic and engaging. This concept draws from the tradition of the hortus conclusus, or "enclosed garden," a design archetype rooted in medieval European and Islamic architecture, where a central void serves as the heart of the spatial composition. These voids create areas of calm and contemplation, offering a respite from the surrounding environment while maintaining a vital connection to it.

• Sustainability and resilience

Generating renewable energy and implementing green roofs to mitigate heat island effects and through modularity and prefabrication reducing construction timelines in the effort to reduce carbon dioxide emissions. Together, these strategies represent a holistic effort to mitigate the impacts of climate change.

A modular customizable system that offers endless possibility for flexibility and reconfigurability.

1 **THE LITTLE GARDEN OF PARADISE**
UPPER RHENISH MASTER, STÄDEL, 1410-1420

To address the principle of adaptability, a modular customizable system is proposed, offering flexibility and reconfigurability. This system predominantly utilizes concrete and timber, selected for their widespread availability and quick deployment across the country.

Additionally, the implementation plan includes various options for the reuse of scraps, such as landscape infill and iconic exterior facades. Notably, finishing products are crafted from a specially formulated mixture of recovered aggregates, comprising entirely recycled minerals.
This approach aligns with a production philosophy rooted in innovation and sustainability, ensuring resource efficiency and environmental responsibility throughout the project lifecycle.
The void, serving as the heart of the proposal, embodies the essence of community within a multipurpose educational neighborhood. Functioning as the nucleus from which the entire design emanates, the courtyards serve as the most public spaces, adaptable to diverse functions and atmospheres. Whether covered or uncovered, verdant or equipped, these courtyards are envisioned as dynamic hubs of activity, evolving to suit the needs of the hosted functions.
The framework of the courtyards cascades through the connections and functions between them.
By designing around this public void, the project opens boundless possibilities for creating dynamic and engaging spaces that resonate with the vibrancy of community life.

To address sustainability, the design is conceptualized as a modular system that can be easily assembled and dismantled. Incorporating principles of design for disassembly, the prefabricated components offer customization to suit specific site conditions while significantly reducing construction timelines and minimizing CO_2 emissions.
Designed as a modular system, the architecture allows for the use of the buildings depending on occupancy levels, maximizing resource efficiency and reducing waste.
Additionally, ample green spaces are integrated throughout the neighborhood, promoting biophilia and enhancing overall well-being.
The counter-walls serve a dual purpose, hosting natural insulation to optimize energy efficiency while housing the mechanical, electrical, and plumbing systems within a compact footprint. Further sustainability features include the incorporation of photovoltaic panels to generate renewable energy and the implementation of green roofs to mitigate heat island effects and promote biodiversity.

1.2
NEW ROOTS
NEB PRINCIPLES

The design is grounded in the three guiding values of the New European Bauhaus, aiming to build a beautiful and sustainable Neighborhood for Educational Wonder:

• **Beauty**

Activating spaces culturally and socially ensures that architecture enhances quality of life beyond functionality. The design prioritizes human-centered spaces, using color, materiality, and spatial flows to create an inspiring environment that stimulates learning and well-being. By connecting people, it fosters opportunities for social interaction, strengthening community ties and creating a sense of belonging. It integrates natural and built elements, ensuring that neighborhood is not just educational institutions but a place that reflect local identity and cultural expression.

• **Inclusion**

Ensuring accessibility and affordability strengthens resilience. The courtyards serve as the heart of the proposal, fostering interaction and inclusivity through interconnected spaces and flexible layouts that adapt to diverse needs. The design makes education accessible to all, with modular structures that prioritize equity, adaptability, and collective well-being. By consolidating social structures and integrating inclusive planning, the project cultivates a way of living together, where collaboration and shared values redefine public spaces.

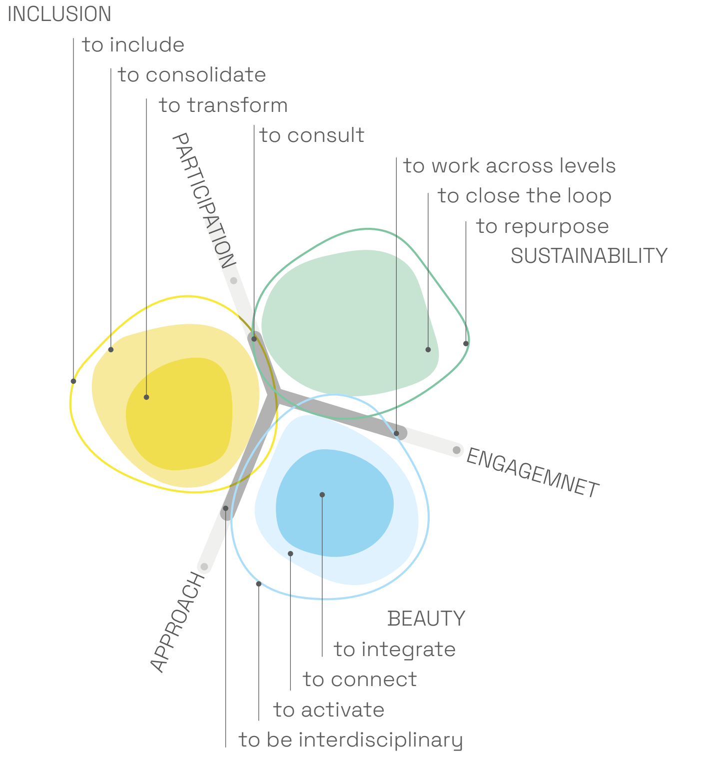
> Through beauty, inclusion, and sustainability, the project seeks to cultivate a sense of belonging while fostering a collective reconnection to the nature.

• **Sustainability**

Repurposing materials and knowledge minimizes environmental impact while promoting circularity. The design integrates climate-responsive strategies, prefabrication, and renewable energy solutions to reduce its ecological footprint and ensure long-term efficiency. By incorporating green roofs, passive cooling techniques, and locally sourced materials, the project aims at creating an environmentally responsible and future-ready spaces.

NEW embraces aesthetic quality, social inclusion, and environmental responsibility, becoming a hub of learning, community engagement, and system circularity. Through beauty, inclusion, and sustainability, the project seeks to cultivate a sense of belonging while fostering a collective reconnection to the nature.

2 THE NEB COMPASS - WORKING PRINCIPLES AND VALUES



1.3
DESIGN STRATEGY
A ROADMAP TO SYSTEM IMPLEMENTATION

Here we align the project's aesthetic, functional, and environmental goals with technical execution on a strategic level. By addressing spatial planning, material selection, and systems integration, we lay the groundwork for effective implementation, drawing the direction to transform ideas into practical, sustainable, and resilient buildings.

This roadmap anticipates challenges and fosters interdisciplinary collaboration to ensure efficiency and a cohesive architectural vision.

- **Flow and zoning strategy**
- **Structural strategy**
- **Fire safety strategy**
- **Mechanical electrical and plumbing strategy**
- **Performance**

This roadmap anticipates challenges and fosters interdisciplinary collaboration to ensure efficiency and a cohesive architectural vision.

Zoning and flows

Access

DBN V.2.2-3:2018 Buildings and Structures. Educational institutions. Dead-end roads must end in a ring road with 10m radius and a turning area of 12m by 12m.

Access to perimetral road should be no less than 3.5 m.

A minimum of 1.5m wide strip of greenery should be designed around the building. 3 m of greenery if is facing the street.

Flows and corridors

Minimum corridor width: 2.2 m / 2.8 m in recreational areas

Maximum corridor length: 60 m

Zoning

DBN B.2.2-3:2018 Buildings and Structures. Educational Institutions. Requirements for Functional Zones. School grounds should include the following functional zones: educational, training-production, research, physical and sports, recreational, service, and residential.

Parking spaces

DSTU B.2.2-7, DSanPiN 145, and 9.2 DBN B.2.2-5, located at least 25 meters from school buildings. For general education institutions and vocational schools, a vegetable storage area may also be included, with the size determined by the project brief. Temporary car parking for employees may also be included in the service zone at least 15 meters away from the school building.

DBN B.2.2-12:2019 Planning and Development of Territories. 15 parking spaces and 1 bus stand should be planned 15 m away (radially taken) from all windows and doors of the building

Landscaping areas

DBN V.2.2-3:2018 Buildings and Structures. educational institutions. 5 requirements for the development of sites. General Requirements. 5.18 The landscaping area of land plots should be 45-50% of the total plot area (including green recreation areas, plots for growing vegetables and berries, protective strips, and shrub plantings along the plot perimeter). If the plot directly adjoins green areas (parks, gardens, squares) or in rural locations or during reconstruction, landscaping may be reduced, but not below 30%. Tall trees should be planted at least 10 meters away from walls with windows of classrooms, and shrubs no closer than 5 meters.

Waste management

Waste collection areas should be located at least 20 meters away from children's playgrounds, recreational areas, and places with high people density. One container per 200 people and staff.

Structural strategy

Dimensions and transportability

The optimized module from the trans-portation point of view is 240cm standard width. Such kind of panel can be overlapped laying down on the truck trailers, reducing delivery amount.

Joints

Dry joints allow for easier disassembly, repair, and replacement, contributing to longevity and sustainability. Wet joints are faster to install and less reliant on highly skilled labour, reducing both project time and costs. In our case it is preferable to use wet joints.

Foundations

Considering that we are in the case of low-rise buildings, foundation beams and / or plinths will be provided. Just in case of very weak soil, a switch to raft foundations will be expected. The choice depends on the results of soil surveys.

Concrete panels

Due to prefabrication technology and mostly to components shipping matters, it's advisable to keep panels length under 16m (better 12m) for ordinary main slabs (panels without beams). Longer spans will thus need double frame arrangement: main frame with precast lowered beams and secondary with hollow core panels. Thicknesses depend on spans: we can consider a ratio between thickness of slabs and spans of indicatively 1/25 – 1/30.

Materiality

Rubble reuse for finishings, gabion walls and landscape infills. To be evaluate other potentials also with precast supplier.

Adding floors

We can consider using spans like those employed in large, covered spaces by relying on robust beams supporting a lighter superstructure above.

Skylights and openings

Minor openings (80cm, and probably 120cm) will be directly integrated into the precast wall panels, while major ones (240cm) will be created by distancing the side panels and adding upper lintels. Similarly to vertical opening in walls, minor skylights (e.g., A x B < 100 x 100cm) can be integrated in slab hol-low core panels by means of appropri-ate holes. Linear skylights, extended to the whole slab width, will be simply created just distancing two facing panels. Other (major) ones will need a system of transfer beams surrounding the holes.

Fire safety strategy

DBN B.1.1-7:2016 Fire Safety of Construction Sites.If the courtyard contains key functional areas (e.g., classrooms, canteens, gyms) or if the internal walls of the building only face the courtyard without external access, direct access to the courtyard is mandatory.

Fire trucks must have access to at least two sides of the building.

Fire safety accessibility to all classroom

Evacuation paths

DBN mandates convenient access for fire services. If the courtyard is surrounded, it is essential to ensure access either from the interior or via the roof. It's also recommended to include windows or doors that allow quick access for firefighters. quick access for firefighters.

DBN requires that all building areas have appropriate evacuation routes leading directly to open spaces. Fully enclosed courtyards must allow for safe egress through corridors or other exits that do not obstruct evacuation.

Each fire compartment does not exceed 2500 m². There should be no fewer than two emergency exits. The distance from a dead-end corridor to the emergency exit should be no more than 30 meters.

Distances

DBN B.2.2-12:2019 planning and devolment of the territories A road 6 m wide (double lane) or 3.5 m single lane placed 5 m from the building's wall. Fire safety vehicle need at least 8.5 m from the building's wall.

Emergency exit

Rooms allowing the presence of more than 50 people need at least 2 exit doors.

Fire compartments

Advisable to keep the building footprint at no more than 12,000 square meters. This is necessary for dividing the building into fire compartments. In our case, with the second degree of fire resistance and a one-story fire compartment layout, the maximum area should not exceed 6,000 square meters. For a two-story layout, it should not exceed 4,000 m². As a result, we will have 2-3 fire compartments.

Courtyards

Ensuring the availability of water connection points and fire hydrants near enclosed courtyards may also be necessary to meet DBN requirements.

Enclosed spaces may lead to smoke buildup, which poses an additional risk during evacuation. DBN suggests installing smoke removal systems or natural ventilation, particularly if the courtyard contains rooms that require regular access.

For buildings with a footprint of more than 10 hectares or a width of more than 100 meters, access for fire trucks must be provided from all sides. For buildings or structures with a width of 18-100 meters, access may be provided from one longitudinal side

The width (in clear span) of through driveways in buildings should be no less than 3.5 meters, and the height no less than 4.25 meters.

Mecanical, electrical and plumbing strategy

MEP layout

The fluids will mainly travel underground with a ring loop. The underground conduit system is valuable for maintaining ease of maintenance and allowing flexibility. The loop allows system resilience and redundancy for not much more investment than a business-as-usual distribution.

Technical rooms

Technical rooms modules must be thought of to be studied and repeated in different cases. There will be technical rooms on the roof with inverters for PV and AHU.

Energy centre

Heat Pumps are placed outside in a separate building. Generator set will be under the building to provide electricity and fresh air to the dual use shelter.

Electricity

Storage battery and genset but schools will still have to have a grid connection so that they can exchange energy during the season. To be able to take energy in the winter and be able to feed energy into the grid during the summer. The generator set will be provided for emergency purposes only.

Hot and cold fluids

Heat pumps with air condensation.

Hot and cold air

air distribution ducts running in the corridors and then into the different spaces without a false ceiling

Performance

Dormitory

Fire Safety
Wall material with fire resistance rating EI 45 for internal walls between rooms and EI 60 for walls facing evacuation routes.

Thermal resistance for external walls should be R equal to or greater than 3.3 $m^2 \cdot K/W$.

Acoustic Performance
Sound insulation between rooms should have an Rw of at least 55 dB.

Classrooms

Fire Safety
Wall material with fire resistance rating of at least EI 60 between classrooms and corridors. Exit corridors should have walls with REI 120 fire resistance standards.

Thermal resistance should be a minimum of R equal to or greater than 3.3 $m^2 \cdot K/W$ for external walls.

Sound insulation should have Rw of 50 to 55 dB to limit sound transfer between classrooms.

Offices

Fire Safety
Wall materials should have at least EI 30 rating for internal partitions and EI 45 rating for corridor-facing walls.

Thermal resistance for external walls should be a minimum of R equal to or greater than 3.0 $m^2 \cdot K/W$.

Sound insulation for walls should have Rw 50 dB especially between meeting rooms and open office areas.

Common spaces

Fire-resistant materials with at least EI 30 rating for internal walls and EI 45 rating for walls near exit routes.

Thermal resistance should be R equal to or greater than 3.0 $m^2 \cdot K/W$ for external walls of common spaces.

Sound insulation should have Rw 50 dB to minimize noise impact.

Theater

Fire Safety
Wall materials in the theater space should have high fire resistance with at least EI 60 rating especially surrounding stage and exit routes. Audience areas should have walls with REI 150 rating separating audience areas from backstage zones.

Thermal resistance should be R equal to or greater than 3.3 $m^2 \cdot K/W$ for large volume spaces

Sound insulation for theater walls should have an Rw of 60 to 65 dB to isolate performance noise

Canteen

Fire Safety
Kitchen wall materials should be non-combustible with an EI 60 rating for walls separating cooking areas from dining areas. Storage areas should have fire separation walls with REI 90.

Thermal resistance for external walls should be R equal to or greater than 3.3 $m^2 \cdot K/W$ to maintain comfort during high usage.

Sound insulation for walls should have Rw 55 dB to reduce kitchen noise transfer.

Gyms

Fire Safety
Wall materials should have fire resistance of at least EI 45 for walls surrounding the gym especially near evacuation routes.

Thermal resistance should be R equal to or greater than 3.0 $m^2 \cdot K/W$ in gyms due to variable occupancy.

Acoustic Performance
Sound insulation for walls should provide an Rw of at least 60 dB to contain impact noise.

1.4
LOW CARBON DESIGN
DESIGN PHILOSOPHY AND SUSTAINABILITY STRATEGY

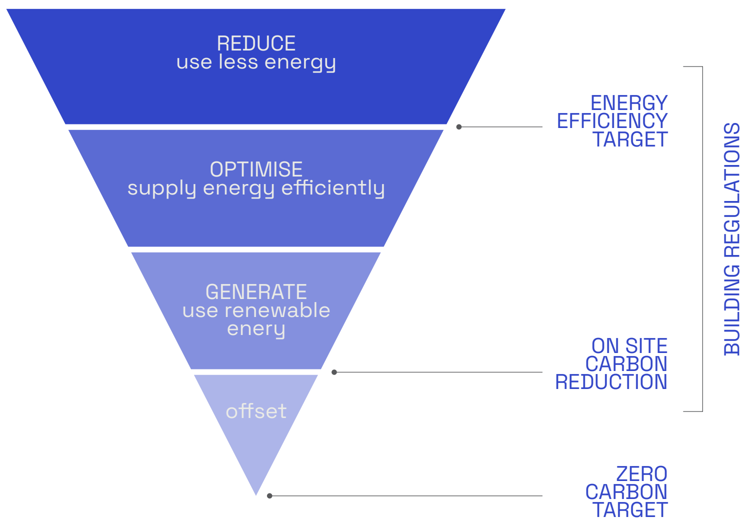
1.3.1 Design philosophy

The holistic approach of the proposal embraces true value of sustainability which lies at the balance of enhancing the quality of life, while also ensuring that environmental impacts are reduced, resources are effectively managed and long-term future of the project is well considered.

This approach aligns closely with the New European Bauhaus value of sustainability, from climate goals to circularity, zero pollution, and biodiversity.

The proposal considers a progressive approach, underpinned by “reduce-optimize-generate” concept in which it prioritizes sustainable strategies that will greatly influence the project’s overall performance.

By implementing a progressive energy and carbon reduction approach through demand reduction, energy efficiency, monitoring and feedback (through intelligent building systems with post-occupancy evaluation), energy sharing and generation, the proposal will lead the way to establish a quality precedent for the next generation of truly sustainable Ukraine schools.



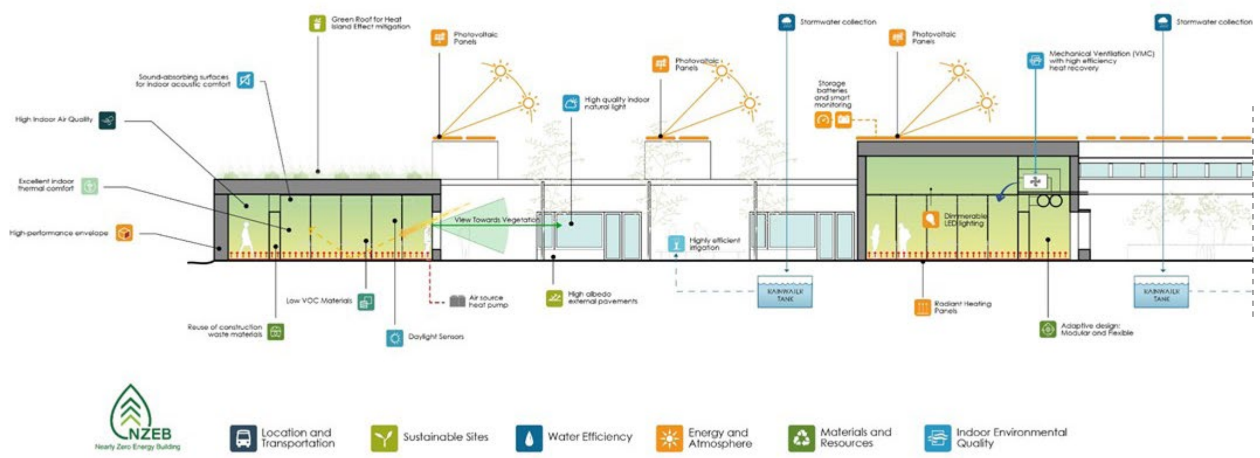
3 DESIGN APPROACH FOR REDUCING OPERATIONAL CARBON

1.3.2 Sustainability strategy

The design uses adaptive regenerative strategies that can be applied to any site or location. The project focuses on building solutions and technologies that adhere to sustainability, energy efficiency, and eco-friendliness principles, aiming for climate neutrality and low operating costs. It includes passive solar optimization, prefabrication, and rainwater harvesting to maximize energy efficiency and resource utilization while supporting the “full-day school” model. The building is designed to be sustainable from both climate and energy perspectives, integrating passive solutions and innovative technologies.

PV panels on roofs and on-site battery storage supply much of the renewable energy. Natural light sensors, heat recovery systems, rainwater management, green roofs, and outdoor spaces all help reduce energy demand and mitigate the Urban Heat Island effect while enhancing biodiversity.

The modular, circular design allows for easy disassembly and reuse, reducing waste. Construction scrap is repurposed, further minimizing waste. The building shields from noise and pollution, avoids microclimate issues, and connects with nature by preserving vegetation, enhancing the microclimate and local identity. The design ensures quality indoor and outdoor environments for students, with natural light, views of greenery, and excellent acoustic and thermal comfort for healthy learning spaces. Versatile outdoor areas support extracurricular activities, enriching the educational experience.



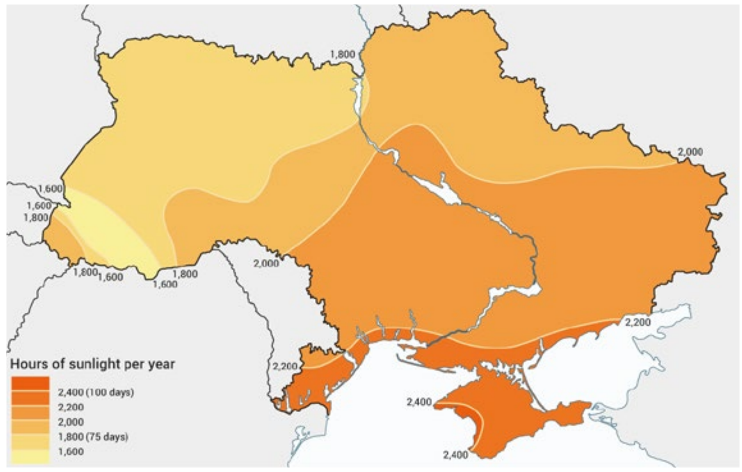
4 BIOCLIMATIC SECTION

1.5
CLIMATE RESPONSIVE DESIGN
CONSISTENTLY SITE SPECIFIC

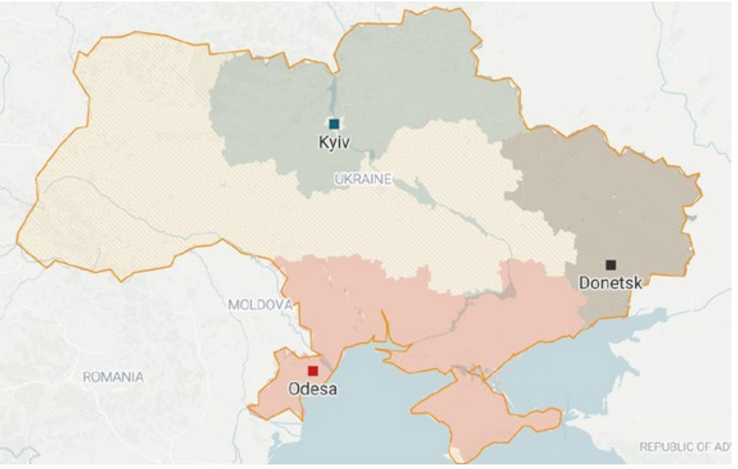
The project is organized as a grid of modules, a large spatial device that promises infinite possibilities of interior recombination from within the certainty of its boundary.

Given Ukraine's diverse climate conditions, ranging from humid continental regions with cold winters and hot summers to milder areas in the south, and its vast and varied territory, the design is envisioned to prioritize flexibility. This adaptability allows the architecture to respond effectively to local climatic variations, ensuring thermal comfort and energy efficiency across different zones.

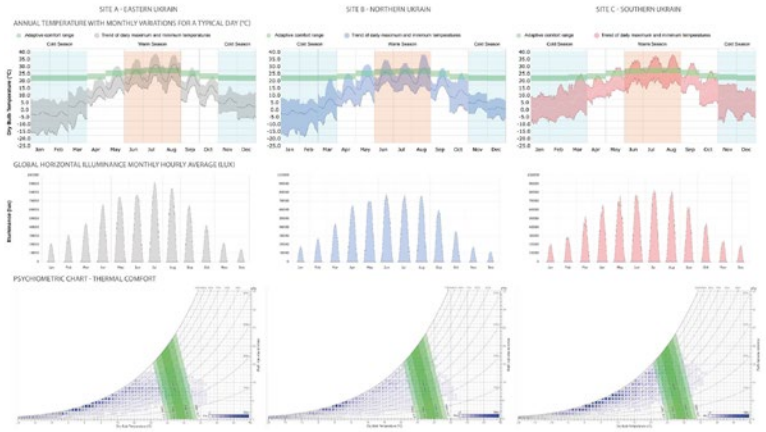
6 VEGETATION



5 SOLAR IRRADIATION



7 CLIMATE ZONE CONSIDERED



8 CLIMATE SITE ANALYSIS

Estimating energy consumption requires typical year trends for temperature, humidity, and solar radiation instead of specific real-year data, as anomalies can lead to inaccurate estimates. To support the creation of adaptive technical designs for new schools across Ukraine, three climate files representing different locations were analyzed as requested in the initial competition brief.

Despite differences in climate at the three sites, similar trends in temperature, illuminance, and thermal comfort allow using a single climate file for analysis. The Kyiv climate file was chosen for its wide temperature range and cold winters, serving as a good reference for designing a school that can be moved across Ukraine. This approach ensures the new "full-day school building" remains energy efficient and adaptable to various locations.

1.6
MODULAR PROCESS
DESIGN AND ASSEMBLY

This modular process begins with meticulous planning to align design, manufacturing, and assembly, ensuring each decision supports the next in a cohesive whole.

Panels are fabricated in controlled environments, where standardized dimensions and embedded features such as insulation or conduits enhance performance and quality control.

Logistics play a vital role, with careful coordination of manufacturing schedules, transportation routes, and on-site storage to streamline workflows.

On-site, the panels are rapidly assembled with minimal adjustments, enabled by precise detailing in joints, finishes, and integrated systems.

Throughout the process, robust communication and data management, often facilitated by Building Information Modeling (BIM), ensure that all stakeholders are aligned.

The result is a construction method that reduces waste, accelerates timelines, and delivers buildings with exceptional durability, thermal efficiency, and aesthetic flexibility.

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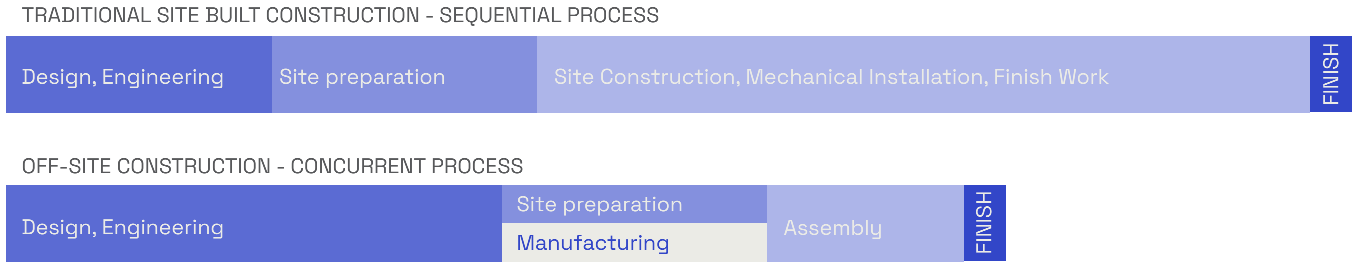
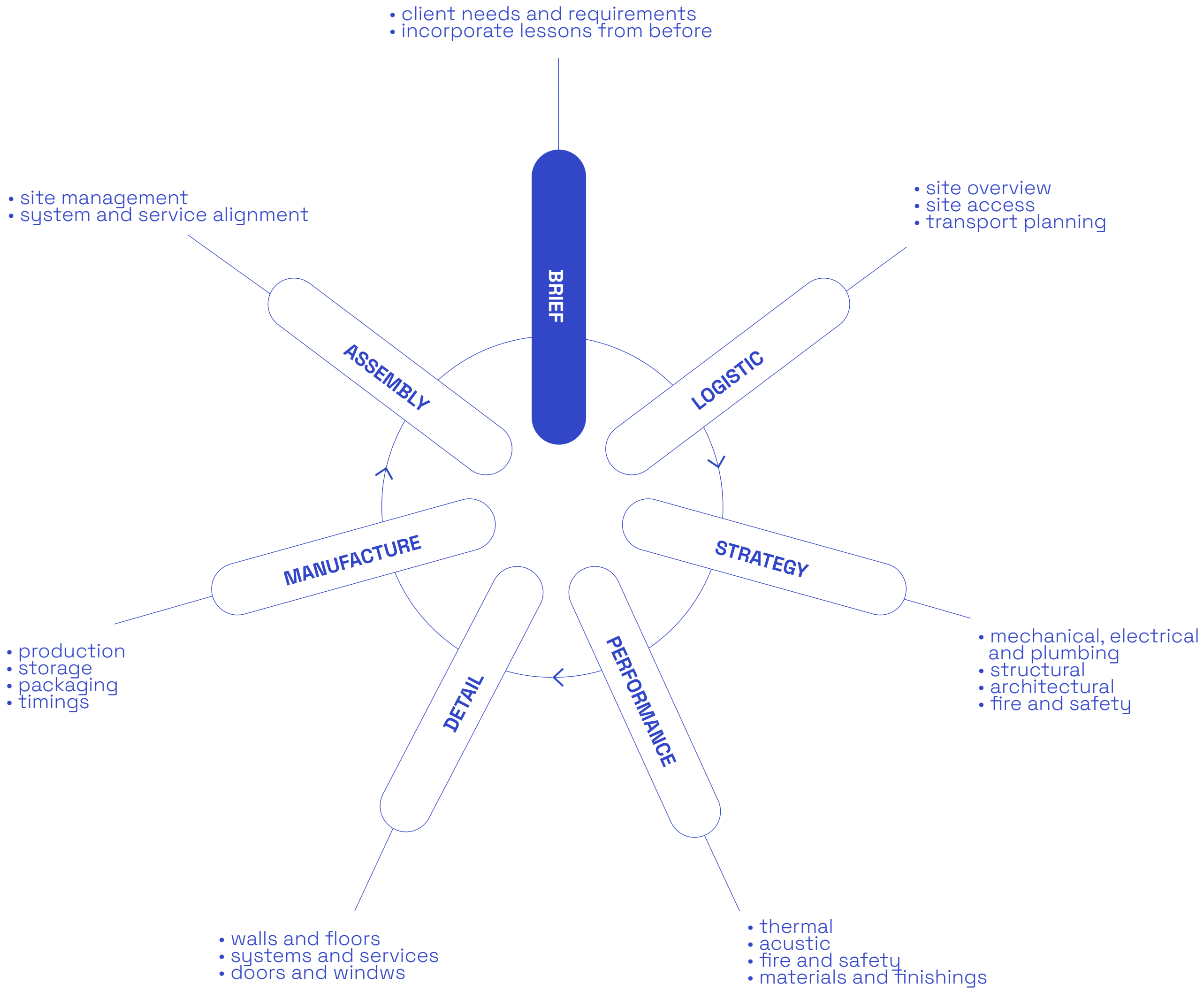


9 COMPARISON OF TRADITIONAL CONSTRUCTION AND MANUFACTURE AND ASSEMBLY

Offsite manufacturing offers two significant advantages: accelerating project delivery and enhancing quality. However, to fully leverage its potential, the design team must recognize that designing for manufacture and assembly (DfMA) differs fundamentally from traditional construction. This approach demands a distinct mindset and methodology from the outset, focusing on precision and coordination to align with manufacturing processes.

For offsite manufacturing to succeed, design information must be meticulously coordinated before production begins. Unlike traditional design and build contracts, where design intent often suffices, DfMA requires fully detailed and coordinated designs at an earlier stage. This level of detail ensures that production can proceed smoothly without delays or rework, which would otherwise disrupt the manufacturing process.



10 MODULAR DESIGN STAGES

Change control must be meticulously managed throughout the design and construction process, as design development is rarely a straightforward, linear progression. Maintaining a clear and detailed record of decision-making is essential to ensure transparency and accountability while minimizing disruptions. A well-documented decision path enables the team to trace the rationale behind changes, fostering better collaboration and reducing the likelihood of repeated mistakes.

The module dimensions must align with standard transportation regulations and logistical constraints, as oversized loads can significantly increase costs and complexity.

Transporting modules from the factory to the site is a critical factor that influences the initial and ongoing decisions in modular design. The module dimensions must align with standard transportation regulations and logistical constraints, as oversized loads can significantly increase costs and complexity. For this reason, we adopted a modular width of 240 cm, which conforms to typical transportation norms, ensuring smooth delivery while maintaining structural efficiency. This decision impacts nearly every aspect of the design process, from structural integrity and material choices to interior layouts, as modules must fit seamlessly within these transportation parameters while remaining functional and aesthetically cohesive.

We must also account for site-specific constraints that affect how the modules are positioned once delivered. One of the most significant considerations is the type of crane that will be used. Crane selection is determined by factors such as the module's weight, dimensions, and the site's accessibility. Urban sites with tight spaces may require mobile cranes or specialized lifting equipment, while more open areas might allow for larger, fixed cranes with extended reach.

While offsite completion is generally preferred for its quality control and efficiency, balancing factory and site work is essential to ensure the modules arrive intact and are installed smoothly. By addressing these factors early in the design process, projects can achieve a seamless integration of modular construction with practical site implementation.

11 MODULAR PREFABRICATED CONCRETE PANELS

1.7 **WORKING IN EMERGENCIES** REBUILDING COMMUNITIES

The Neighbourhood for Educational Wonder is envisioned as an adaptable platform designed to be implemented swiftly in emergencies. Its construction leverages economical and efficient methods, ensuring rapid deployment.

The flexibility of its modular composition allows it to evolve over time, accommodating changing needs and scaling as required. This adaptability ensures the neighborhood remains a resilient and sustainable solution, capable of addressing both immediate challenges of conflict zones and long-term development goals.

These spaces address immediate needs while laying the foundation for recovery and renewal, empowering communities to rebuild their lives with strength and dignity.

Community Rebuilding

As hubs for restoring the social fabric in disrupted communities, these facilities provide essential services such as education, healthcare, and public gathering spaces, which are crucial for normalcy.

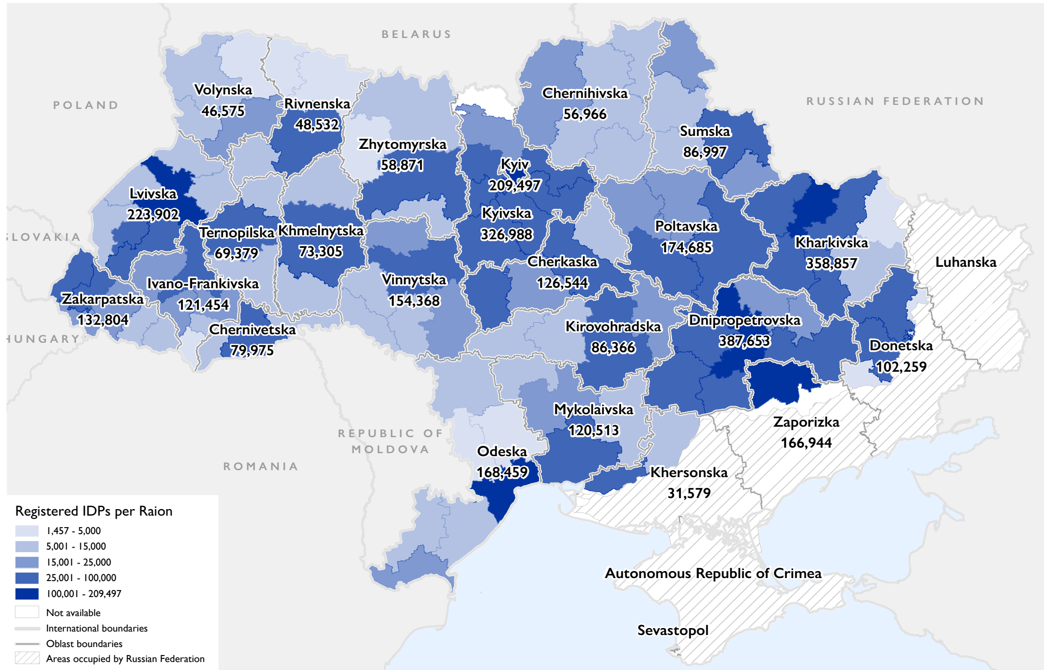
Cultural Sensitivity

Cultural sensitivity fosters trust and acceptance among community members. Engaging the community in the design process empowers individuals and ensures the architecture resonates with their needs and expectations. This approach makes the design not only functional but also symbolic, reinforcing dignity and a sense of belonging.

Psychological and Emotional Healing

The complex supports the psychological and emotional recovery of trauma-affected individuals. Dedicated areas for counseling, play, and creative activities provide critical outlets for expression and healing.

12 REGISTERED IDP PRESENCE AS OF 29 FEBRUARY 2024, BY RAION



2 NEW TOOLKIT

The toolkit is a set of elements that combined originates the neighborhood for educational wonder.

Inside the box we have a comprehensive set of tools to guide the implementation process. After the recognition of the advantages and challenges of modular construction and emergency contexts, the design focuses on three critical aspects: interior architecture, structural systems, and integrated building systems. These elements are key to achieving the required performance standards.

The design principles are systematically applied to create spaces characterized by specific qualities and dimensions, with each space further enhanced by functional devices that guarantee practicality and usability. These spaces are meticulously catalogued into an organized index, providing a clear reference.

By combining the entries from the catalogue, functional units can be created, each tailored with its unique structural and HVAC characteristics, forming cohesive and adaptable solutions for diverse needs.

2.1 **STRUCTURAL INTEGRITY** DESIGN FOR FLEXIBILITY

To create a system that supports adaptability, the first essential step is to categorize spaces based on their appearance and function, organizing them into clear and purposeful categories.

This categorization allows designers to address the diverse needs of each type of space with precision and flexibility. Spaces are typically grouped by their intended use—such as living, working, gathering, or transitional zones—and by their aesthetic qualities, which may range from open and minimal to richly detailed and enclosed. Each category is then defined by a set of attributes, including dimensions, insulation requirements, material selections, and incorporated devices or furnishings.

For example, a workspace may require modular dimensions to accommodate changes in occupancy, sound-insulating materials to ensure focus, and ergonomic furniture to support productivity. In contrast, a communal space may prioritize larger, open dimensions, durable materials to handle heavy use, and flexible furniture arrangements to encourage interaction. These attributes work together to activate the space, making it functional and responsive to its users' needs.

Key benefits of this industrial off-site production system include high-quality control, faster construction timelines (up to 50% time reduction), seismic resistance, cost savings, and flexibility for future expansions or disassembly.

Structures of all the buildings are conceived as totally prefabricated (except for the shelter), composed by a set of precast walls and slabs.
The followed procedure is named "off-site production / construction", or "Design for manufacturing and assembly", with the aim to minimize the on-site works to those strictly required and maximizing those in factories.
Ready-made components or blocks are transported to the site just for installation processes.

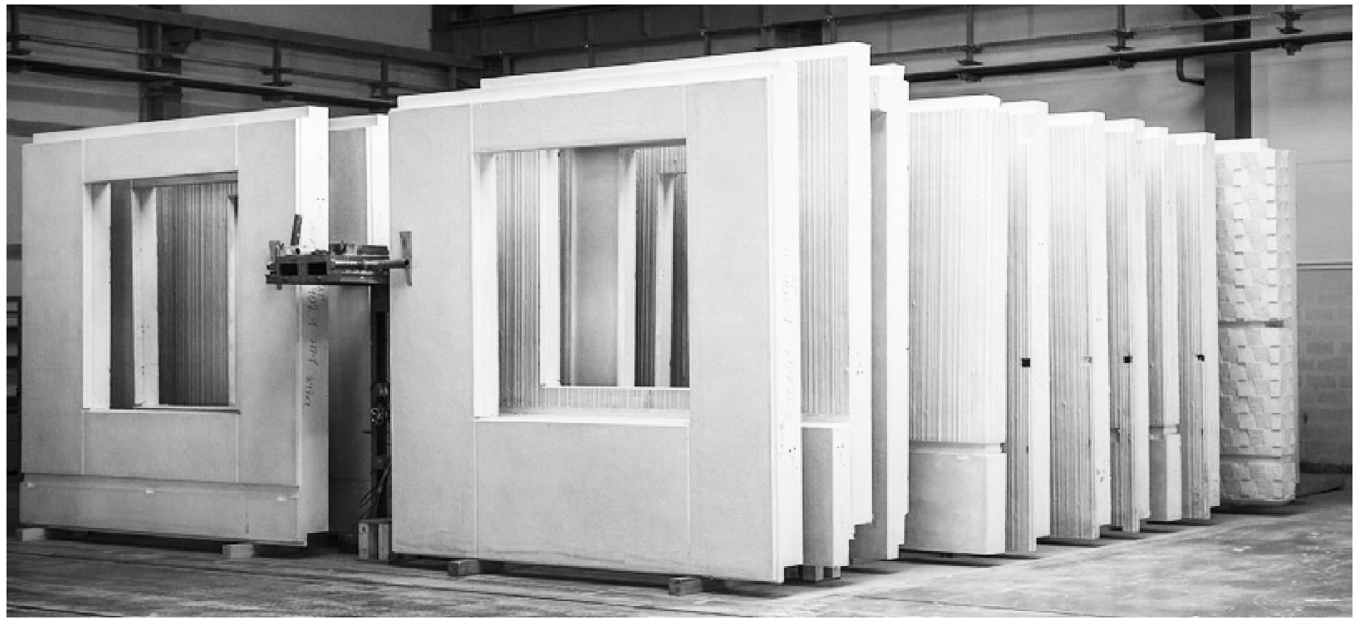
This option has been selected for the following reasons:

- Well-fitting and easily adaptable to the architectural and functional layouts.
- High flexibility of the structural general arrangement and expandability by simply adding, in the future, some similar elements and/or modules.
- Possibility to dismantle or better disassembly the structural elements with few operations, ensuring that the building can be recycled as efficiently as possible at the end of its lifespan.
- High Quality of the resulting system, since all the components are produced in factories (with maximum level of quality control, by means of a quality plan from manufacturing until installation) and simply assembled on field.
- Reduction of logistics cost, less risk of on-site accidents, save resources (and use of local ones), reduction of on-site waste production.
- High seismic resistance due to continuous walls (in both transverse directions) and rigid nodes (more than 0.3 ag/g of PGA is reachable).
- Greater spans allowed without intermediate supports, up to 12m and even more.
- High speed in installation, if compared with standard (ordinary) technologies (i.e. cast in situ reinforced concrete). In high rise buildings the standard rate of construction is one floor per week. The reduction of time in the erection of structures is about 50%.
- Reduction of unexpected events on field, since all the process is managed under a digital BIM approach end methodology (deep detailing in advance and strong multidisciplinary coordination); therefore, guaranteeing fixed construction costs.

- Easy installation (with wide diffuse and standard cranes), high durability, integrated thermal insulation, and predispositions for mechanical and electrical services.
- Technology and materials available in Ukraine, where precast elements factories are located and operative.

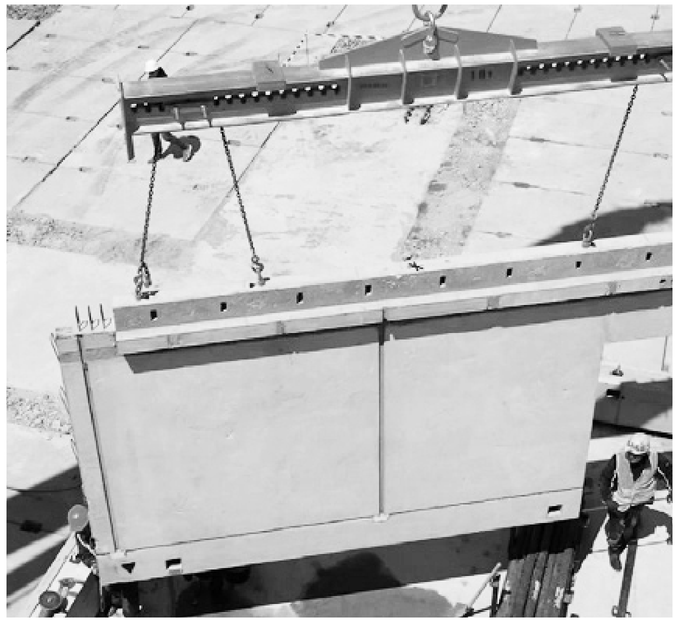
The main structural building elements are described as follows:

- Outer and (some) load bearing inner walls are made by "multi-layer" reinforced concrete panels, placed side by side to create continuous walls. The internal layer is made of a heavy strength reinforced concrete; the external outer layer is in glass fiber-reinforced concrete (GRC) which is a strong, flexible, durable, and rather light material; between these two support an insulation layer with appropriate thickness is installed.
- Slabs are made of hollow core panels, completed with a cast in situ topping, and placed side by side making a continuous horizontal plane.
- Joints between walls and slabs could be "wet-type" or "dry-type"; the first ones are made with reinforcement and concrete pouring, while the second ones are made by pins, bolts, ties, and so on, without any wet material addition.
- Prefabricated stairs, prefabricated balconies, ducts, and shafts complete the precast system.
- Only foundations and shelter are built as reinforced concrete structures. The Shelter, in particular, is an underground reinforced concrete box (or shell) with very thick walls and slabs: lower slab, perimetral walls, roof (see drawings for details).
- All the precast elements (vertical walls and hollow core slabs) are usually made with channels for electricity and plumbing plants, laid directly in factory (embedded elements).



13 RC PRECAST WALLS

14 RC PRECAST HOLLOW CORE SLABS



15 RC PRECAST WALLS ASSEMBLY

2.2 INTEGRATED BUILDING SYSTEM DESIGN FOR FLEXIBILITY

Emphasis is placed on the quality of both indoor and outdoor environments for students. The design's porosity, permeability to natural light, and views of vegetation, along with excellent indoor acoustic and thermal comfort, create healthy and effective learning environments.

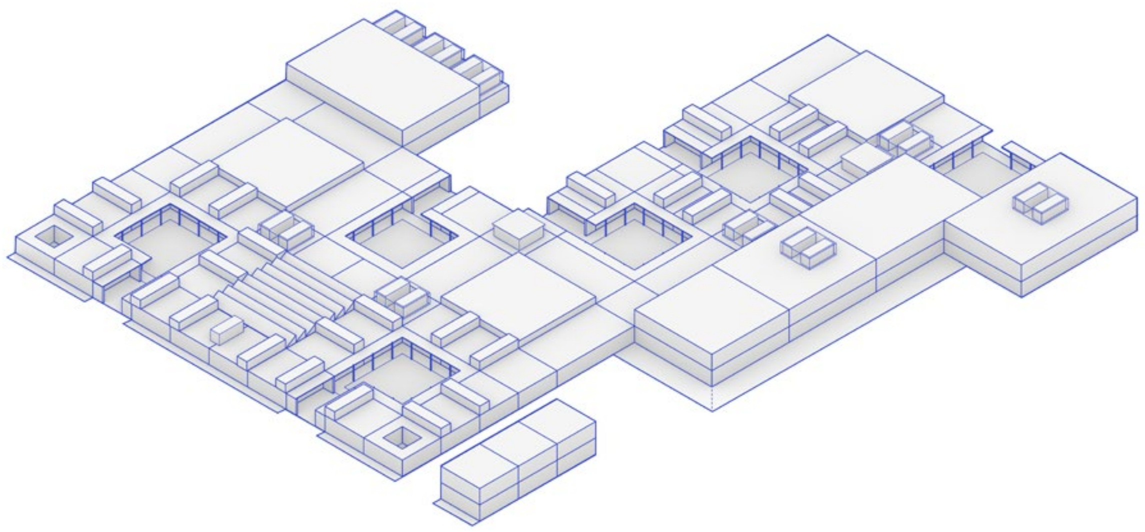
The design employs adaptive regenerative strategies that are versatile and applicable to any site within the hypothetical locations proposed in the competition brief. By prioritizing future-oriented building solutions and technologies that adhere to principles of sustainability, energy efficiency, and eco-friendliness, the project aims for climate neutrality and low operating costs. Integral to the design are passive solar optimization, prefabrication, and rainwater harvesting, which maximize energy efficiency and resource utilization while supporting the shift to a "full-day school" model.

Designed to be sustainable from both climate and energy perspectives, the building integrates passive solutions and innovative technologies. A significant portion of renewable energy is provided by PV panels on the roofs, supplemented by on-site energy storage with batteries. Natural light sensors and heat recovery systems, along with rainwater management and the creation of green roofs and outdoor areas, contribute to reducing the building's energy demand and mitigating the Urban Heat Island effect (UHI) while promoting biodiversity.

In terms of plant services, the principles of modularity and prefabrication are realized through the "Assembly", in which various elements are integrated to form functional units with unique electrical and mechanical characteristics leveraging our green and digital challenges to transform for the better.

Additionally, the design shields inner spaces from street noise and pollution, avoids creating local microclimate issues, and promotes silent pockets connected with the surrounding natural environment.

The design's porosity, permeability to natural light, and views of vegetation, along with excellent indoor acoustic and thermal comfort, create healthy and effective learning environments.



2.3
INTERNAL PRINCIPLES
DESIGN FOR FLEXIBILITY

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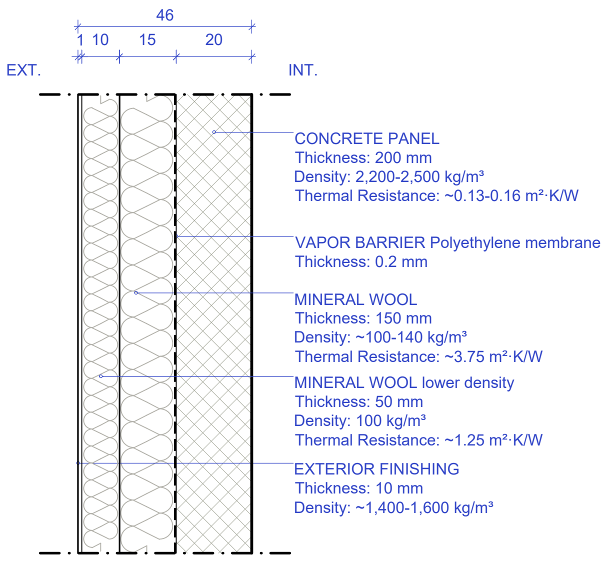
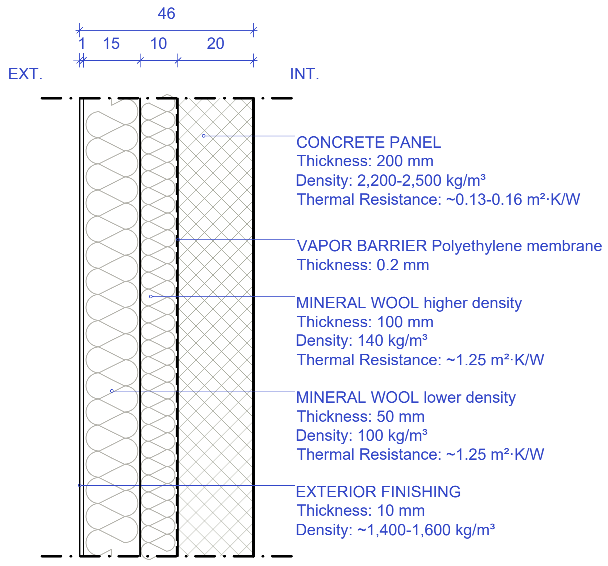
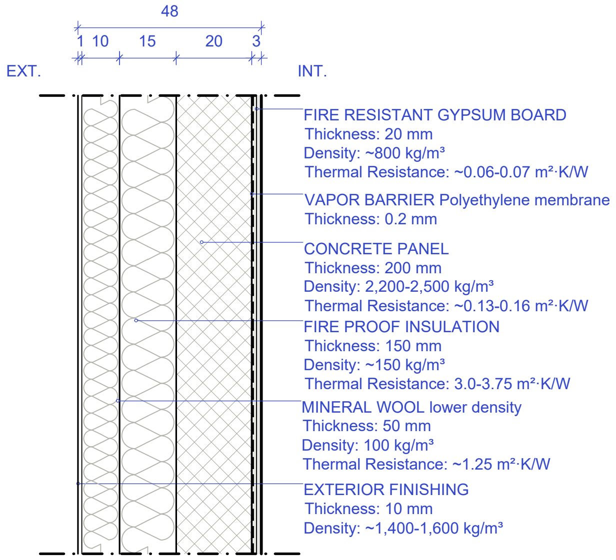
EXTERIOR WALLS:



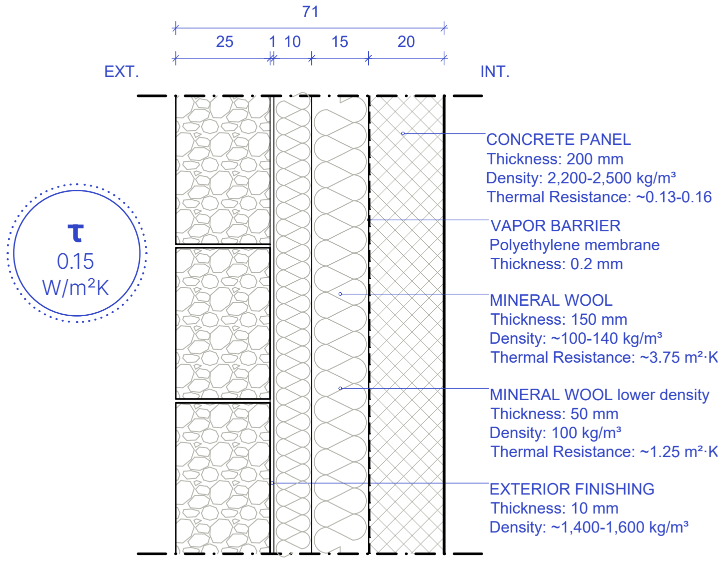
16 EXTERIOR WALL TIPOLOGY STRUCTURAL BASIC



17 EXTERIOR WALL TIPOLOGY STRUCTURAL ENHANCED INSULATION

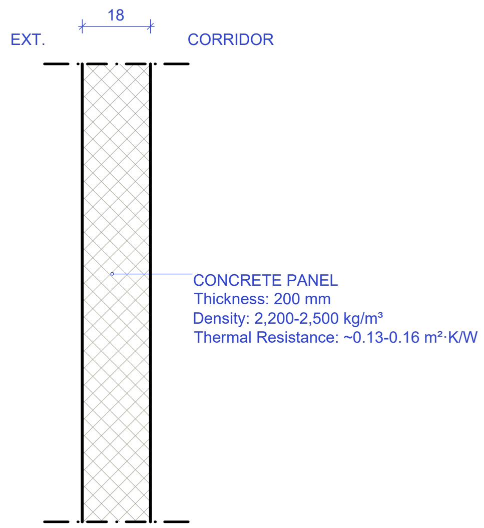


18 EXTERIOR WALL TIPOLOGY STRUCTURAL FIRE RESISTANT

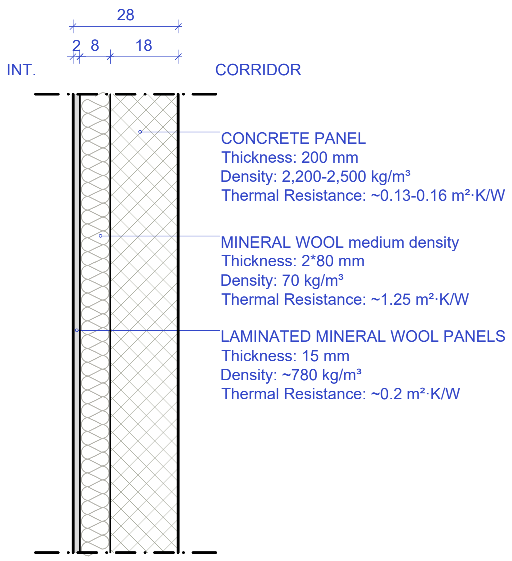


19 EXTERIOR WALL TIPOLOGY GABION GREENERY WALL

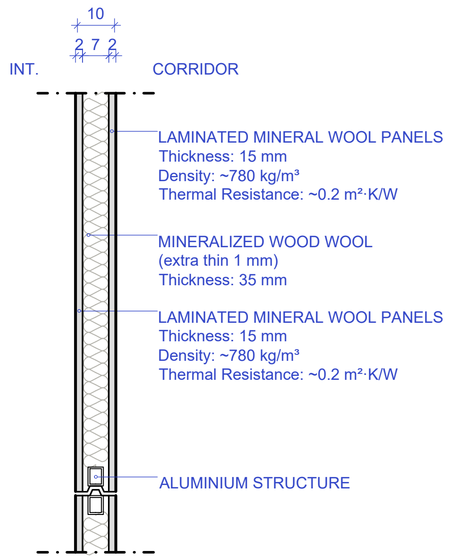
INTERIOR WALLS:



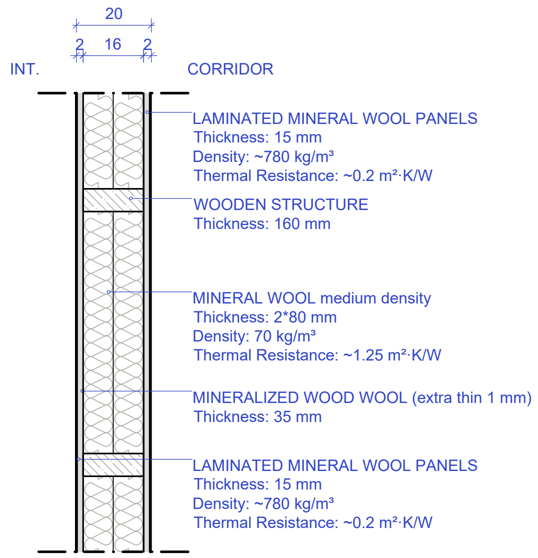
20 INTERIOR WALL TIPOLOGY STRUCTURAL NOT ACOUSTIC



21 INTERIOR WALL TIPOLOGY STRUCTURAL ACOUSTIC

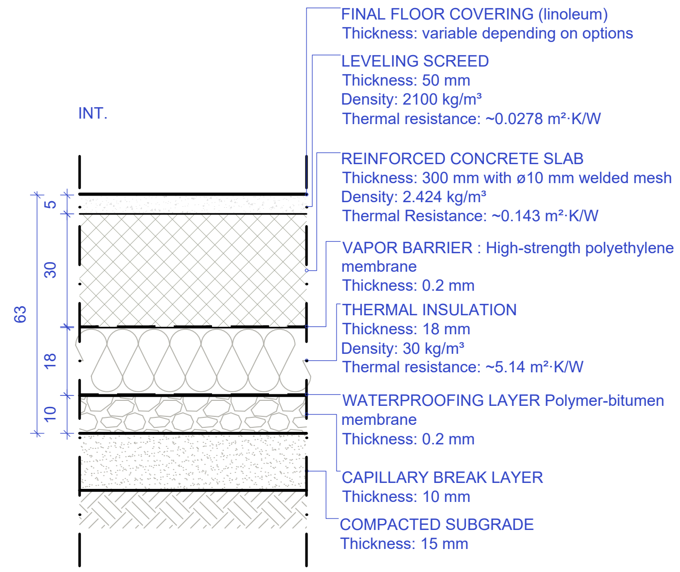


22 INTERIOR WALL TIPOLOGY MOVABLE

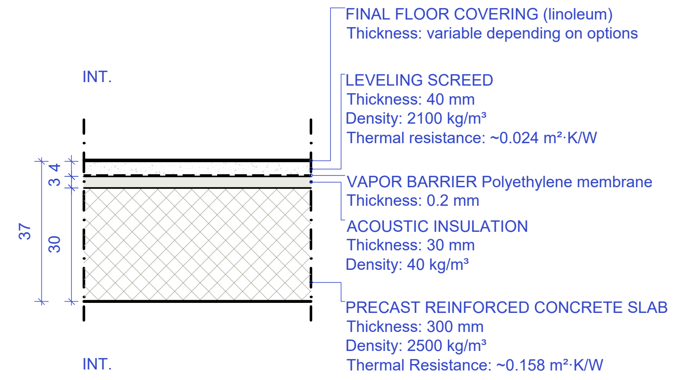


23 INTERIOR WALL TIPOLOGY LIGHT WALL

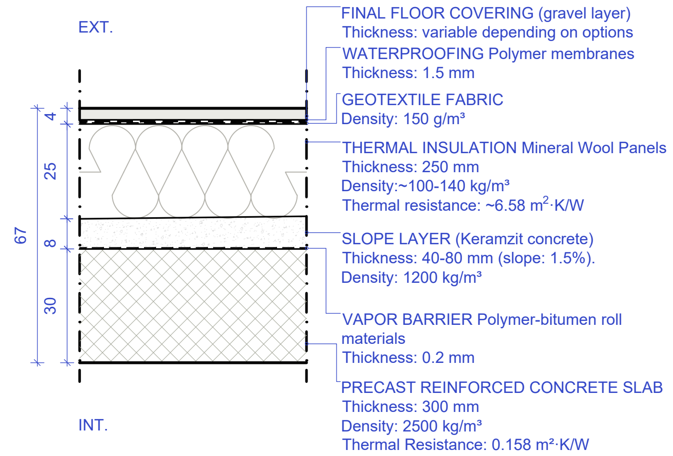
CEILINGS AND FLOORINGS:



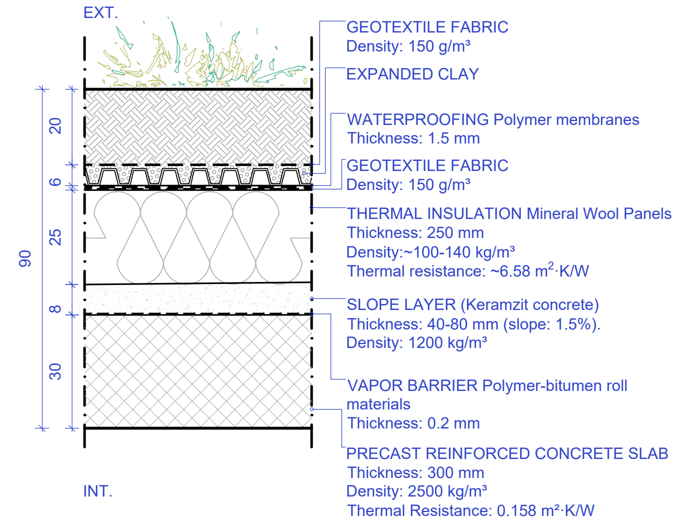
24 GROUND FLOOR SLAB



25 INTERFLOOR SLAB

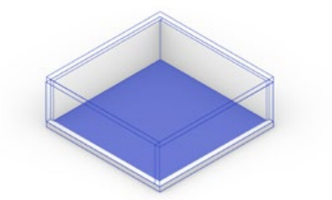


26 ROOF SLAB



27 GREEN ROOF

MATERIAL BOARD - FLOORS:



FL.01
Linoleum Type.A

FL.02
Linoleum Type.B

FL.03
Linoleum Type.C

FL.04
Tiles type.A

FL.05
Wooden floor Type.A

FL.06
Wooden floor Type.B

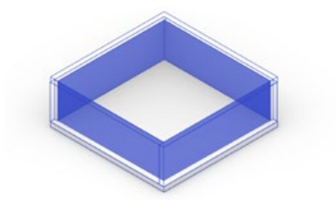
FL.07
Polished troweled concrete

FL.08
Polished troweled concrete outdoor

FL.09
Gravel outdoor

FL.10
Drivable interlocking pavers

MATERIAL BOARD - WALLS:



WA.01
Concrete panels

WA.02
Slide wood panels

WA.03
Fixed wood furniture

WA.04
Concrete panels + Acoustic panels type A RAL 7005

WA.05
Concrete panels + Acoustic panels type B metal RAL 9005

WA.06
Concrete panels + Acoustic panels type C - wood

WA.07
Wall tiles type. A

WA.08
Wall tiles type.B

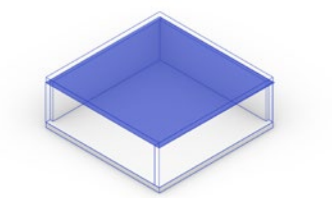
WA.09
Plaster in color A RAL 9001

WA.10
Plaster in color B RAL7047

WA.11
Aquapanel RAL 9001

WA.12
Texture plaster outdoor RAL 9001

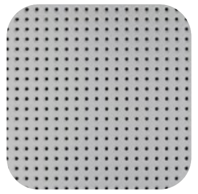
MATERIAL BOARD - CEILING:



CL.01
Polished concrete

CL.02
Baffle ceiling

CL.03
Metal suspended ceiling RAL 9005

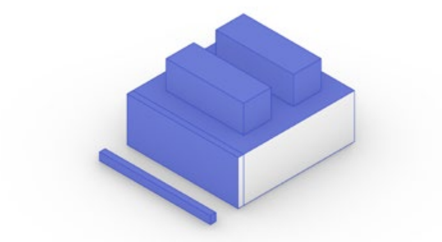


CL.04
Acoustic ceiling RAL 7047

CL.05
Plasterboard ceiling RAL 9001

CL.06
Aquapanel ceiling RAL 9001

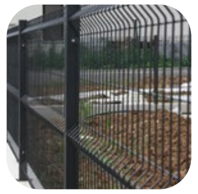
MATERIAL BOARD - EXTERIOR:



EX.01
Polished troweled concrete outdoor

EX.02
Green roof

EX.03
Metal mesh type A

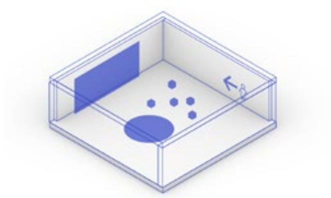


EX.04
Metal mesh type B

EX.05
Green metal mesh

EX.06
Texture plaster outdoor RAL 9001

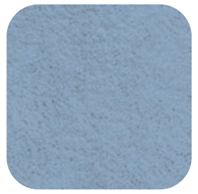
MATERIAL BOARD - FURNISHING ELEMENTS:



FE.01
Curtain type.A olive green

FE.02
Curtain type.B light gray

FE.03
Curtain type.C blue depths



FE.04
Rug type.A powder blue

FE.05
Rug/ rubber mat type.B classic blue

FE.06
Furniture type.A lemon yellow

FE.07
Furniture type.B sand

FE.08
Furniture type.C orange

FE.09
Furniture type.D sage green

FE.10
Wayfinding

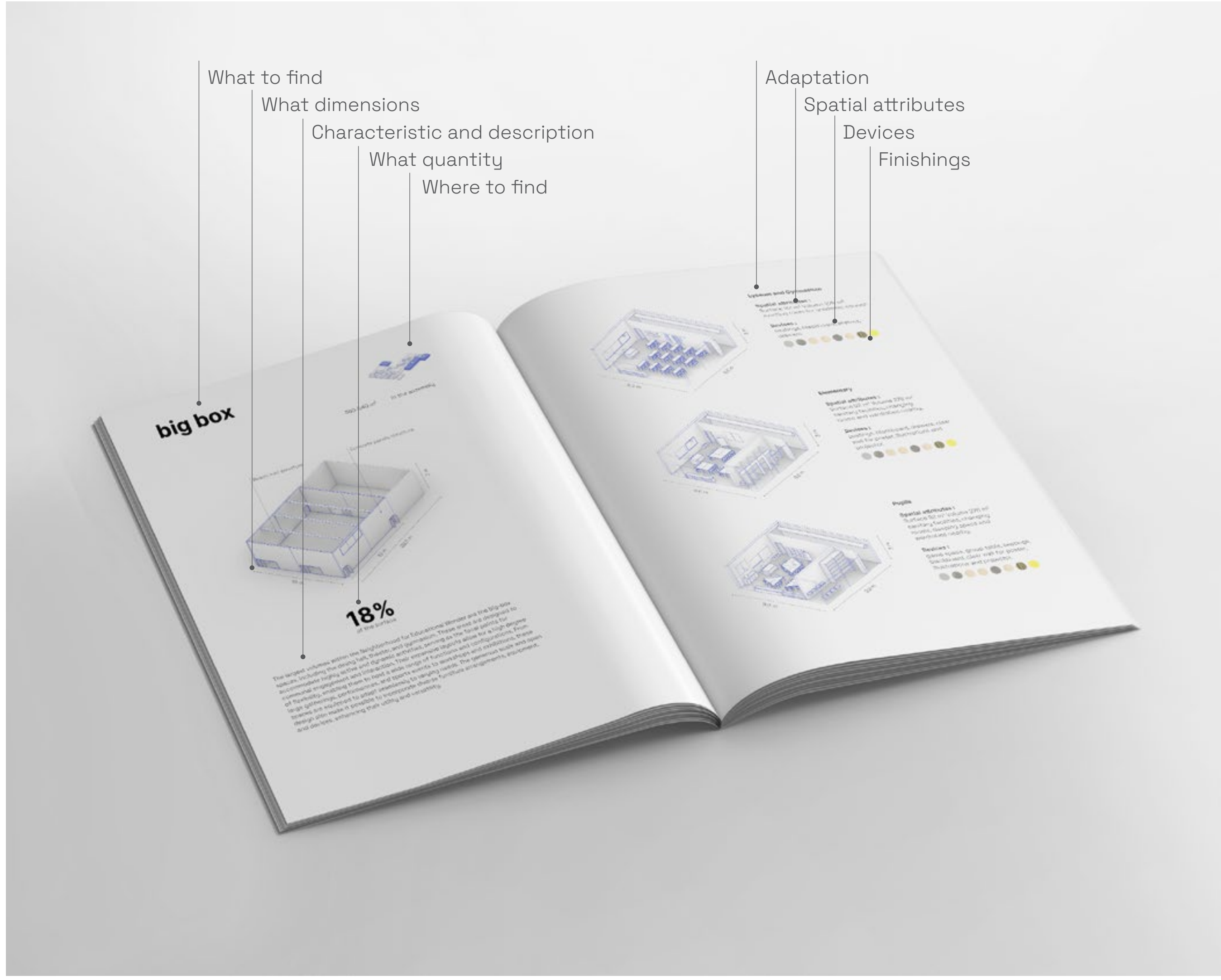
2.4 THE CATALOGUE AN INDEX OF SPACES

This section serves as a comprehensive catalogue, presenting an organized index of spaces that define the architectural framework. It provides a detailed exploration of the types, functions, and relationships of spaces within the project, offering a clear reference for understanding their design, purpose, and adaptability. By categorizing and detailing each space, the catalogue enables a cohesive and modular approach to design, ensuring that every element is both functional and flexible.

Each space is described not only by its dimensions and primary function but also by its adaptability to various needs and contexts. The modularity ensures the design remains relevant and responsive to evolving educational and community requirements.

The index also highlights spatial attributes and devices and how these elements contribute to the overall user experience. The spatial attributes are lighting, acoustics, and materiality. The decvices are furniture and flexible infrastructures.

This index of spaces is not static; it is a living document that evolves with the project's needs. By treating it as a reference tool, designers, stakeholders, and users can better understand how each space contributes to the whole, ensuring that the architecture remains flexible, functional, and deeply aligned with its intended purpose.

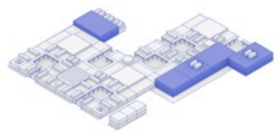


28 HOW TO READ THE CATALOGUE

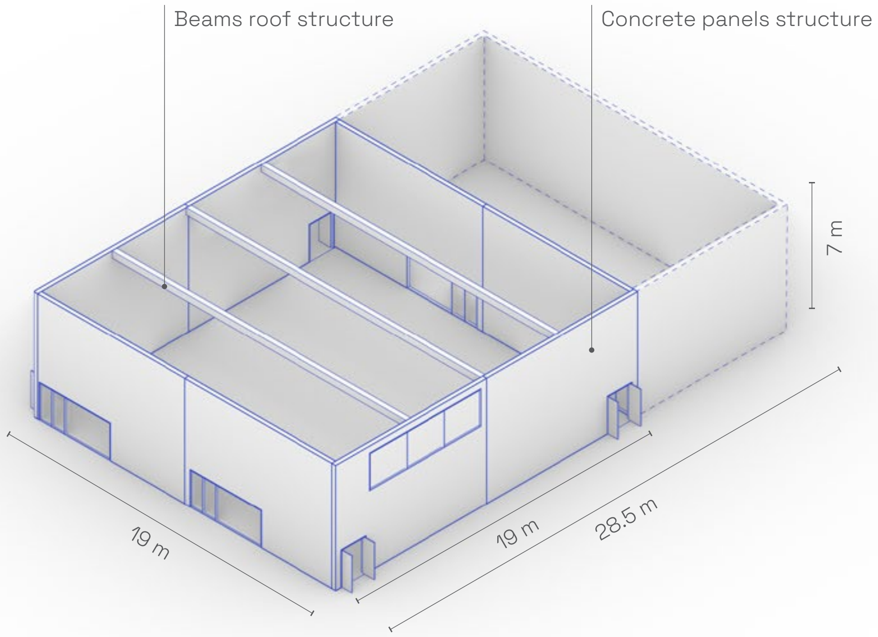
The index also highlights spatial attributes and devices and how these elements contribute to the overall user experience.

NEW INDEX OF SPACES

big box

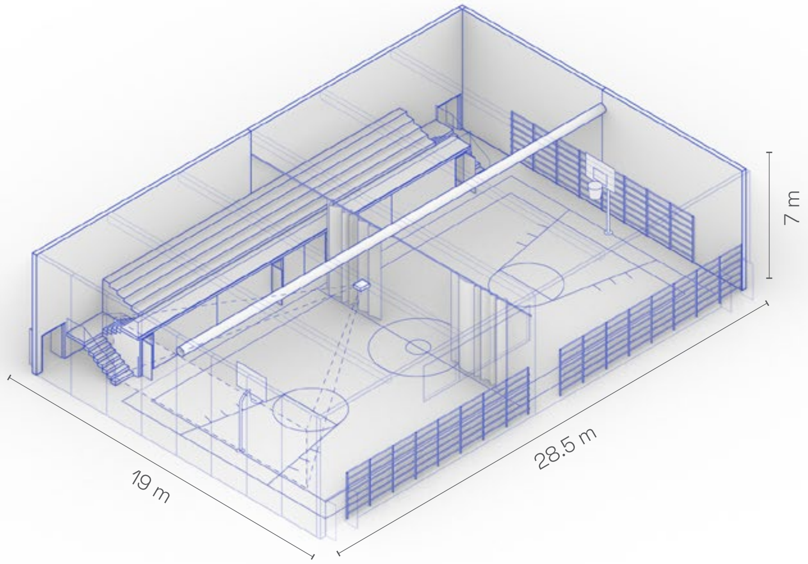


360-540 m² In the assembly



18%
of the surface

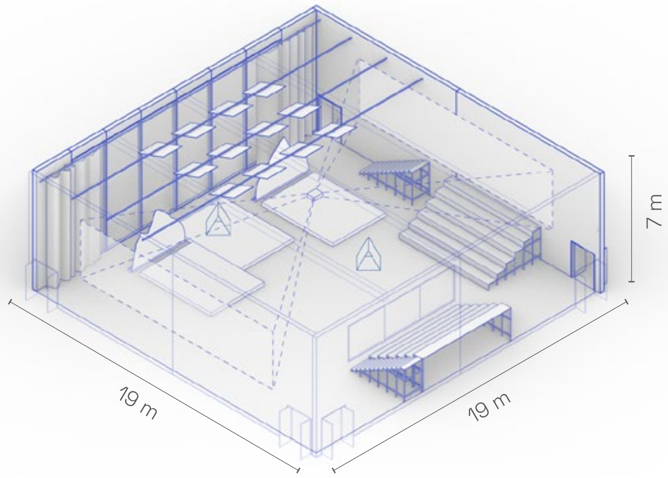
The largest volumes within the Neighborhood for Educational Wonder are the big-box spaces, including the dining hall, theater, and gymnasium. These areas are designed to accommodate highly active and dynamic activities, serving as the focal points for communal engagement and interaction. Their expansive layouts allow for a high degree of flexibility, enabling them to host a wide range of functions and configurations. From large gatherings, performances, and sports events to workshops and exhibitions, these spaces are equipped to adapt seamlessly to varying needs. The generous scale and open design also make it possible to incorporate diverse furniture arrangements, equipment, and devices, enhancing their utility and versatility.



Gym

Spatial attributes :
Surface 542 m² Volume 3790 m³
75 pupils dividable space.
Fire safety EI 60 stage and exit routes, audience areas EI 45.
Thermal resistance R= 3 m²·K/W.
Sound insulation Rw=60 dB

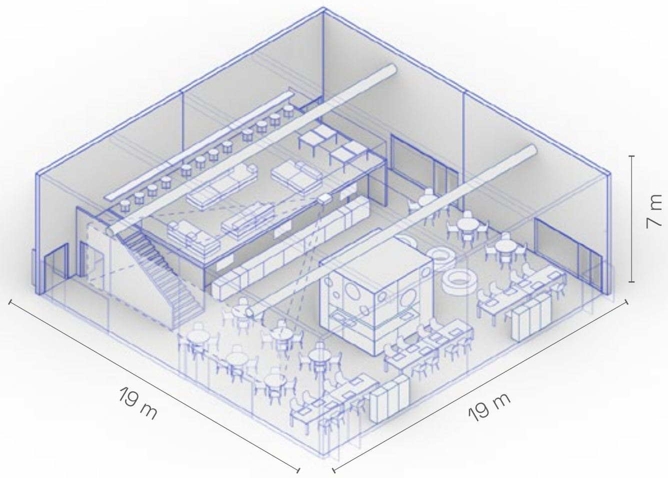
Devices :
spectator seating (up to 100 seats) portable amphitheatres, spatial separations (nets, curtains) designated access to allow the use of the space for community activities.



Theatre

Spatial attributes :
Surface 361 m² Volume 2527 m³
300 seats amphitheatre-style meeting space with stage, 0,7 m² per seat. Fire safety EI 60 stage and exit routes, audience areas REI 150. Thermal resistance R= 3.3 m²·K/W. Sound insulation Rw=60/65 dB

Devices :
portable stage and amphitheatre, easily storable chairs, curtains, ultimedia video and sound system (projector, screen, sound equipment, control consoles) and stage lighting equipment.

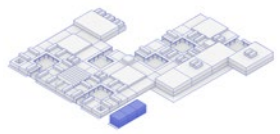


Dining hall

Spatial attributes :
Surface 361 m² Volume 2527 m³
200 of pupils seats with seating for first graders. Fire safety EI 60 for storage space REI 90. Thermal resistance R= 3.3 m²·K/W. Sound insulation Rw=55 dB

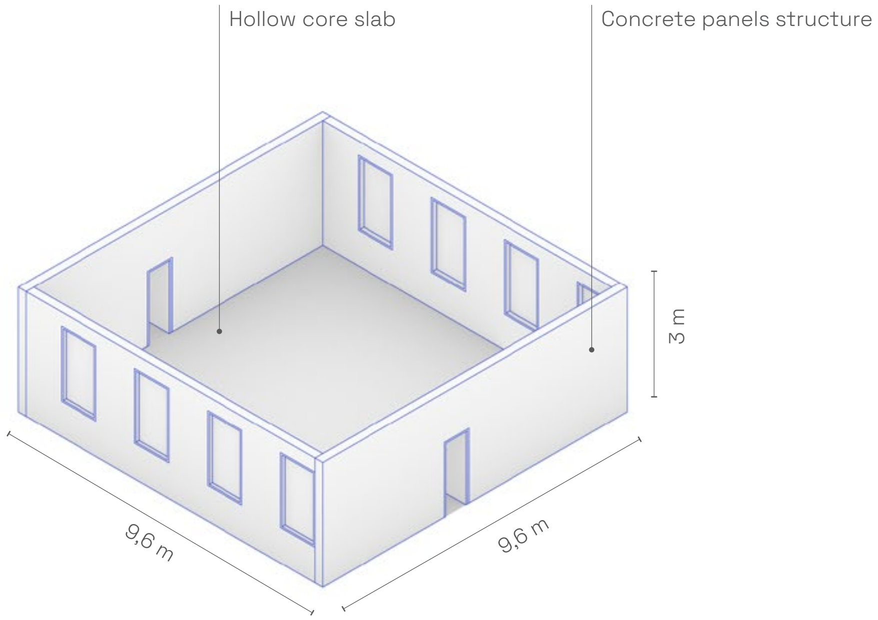
Devices :
snack bar with a youthful aesthetic, warming area for brought-in food must be provided, different types of seating, communal tables, dining tables of different heights, projector and sound system.

accomodation



92 m²

In the assembly



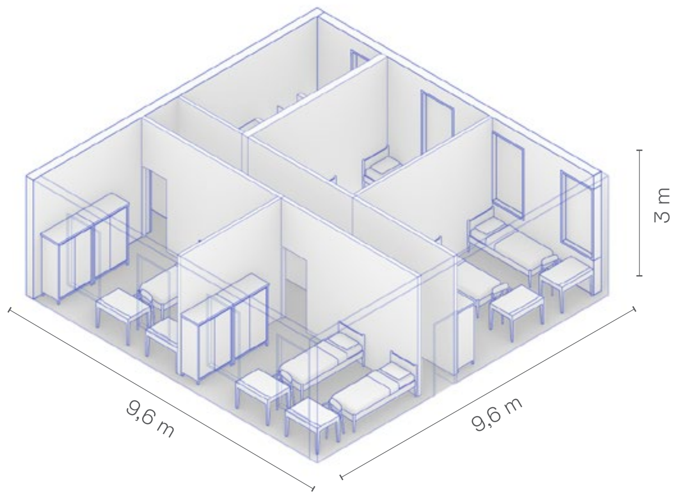
4%

of the surface

The accomodations comprises double rooms for pupils and single rooms for teachers, each to offer restful and productive spaces tailored to individual needs. Modularity for both rooms and windows, enabling seamless expansion to meet future needs.

Shared amenities include inviting lounge areas for social interaction a kitchenette with dining spaces, and a dedicated workstation for on-duty staff to ensure safety and support.

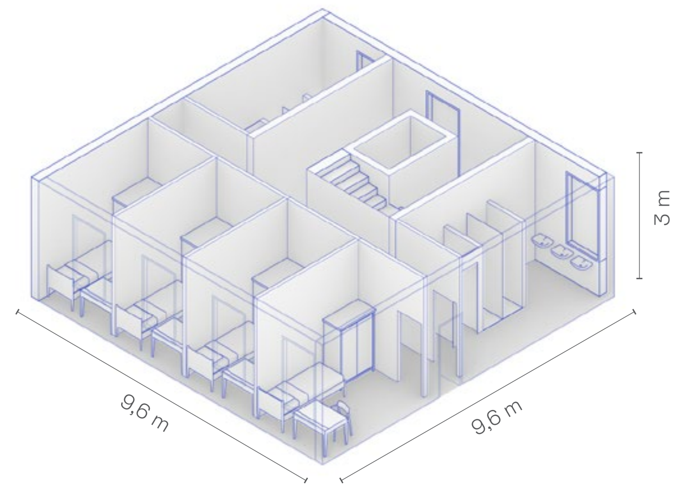
Fire safety EI 45. Thermal resistance R= 3.3 m²·K/W. Sound insulation Rw=55 dB



Double rooms

Spatial attributes :
Surface 92 m² Volume 276 m³
a set of architectural solutions that would make it easy to increase the number of seats as necessary by extending part of the building. Dorm room 8 m² per occupant. 3 Double room every single rooms.

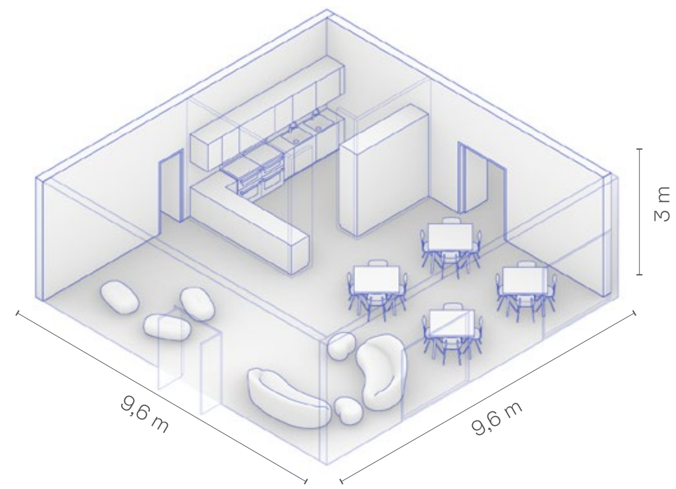
Devices :
the functional, ergonomic and aesthetic design of the facilities must allow pupils and teachers to have adequate rest or to engage in learning or work activities.



Single rooms

Spatial attributes :
Surface 92 m² Volume 276 m³
a set of architectural solutions that would make it easy to increase the number of seats as necessary by extending part of the building. Dorm room 8 m² per occupant. 1 Single room every 3 double rooms.

Devices :
the functional, ergonomic and aesthetic design of the facilities must allow pupils and teachers to have adequate rest or to engage in learning or work activities.

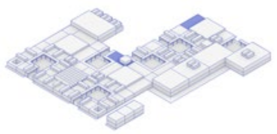


Common and recreation rooms

Spatial attributes :
Surface 92 m² Volume 276 m³

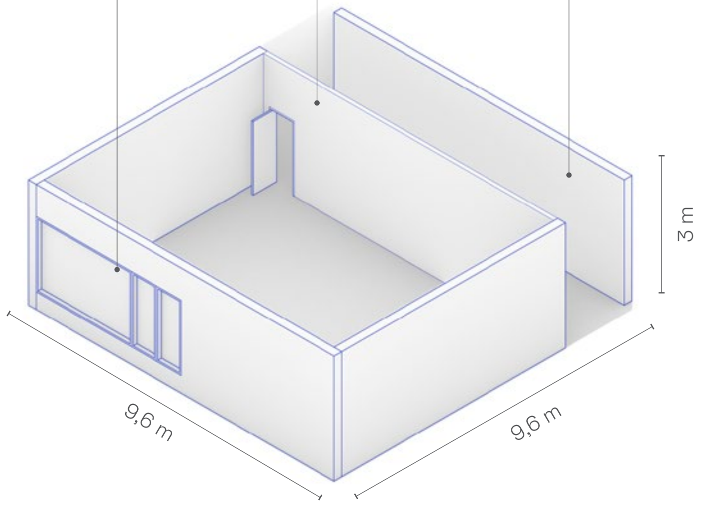
Devices :
common lounge facilities, a kitchenette with dining areas, an on-duty staff workstation, storage and support facilities.

office



92 m²

In the assembly

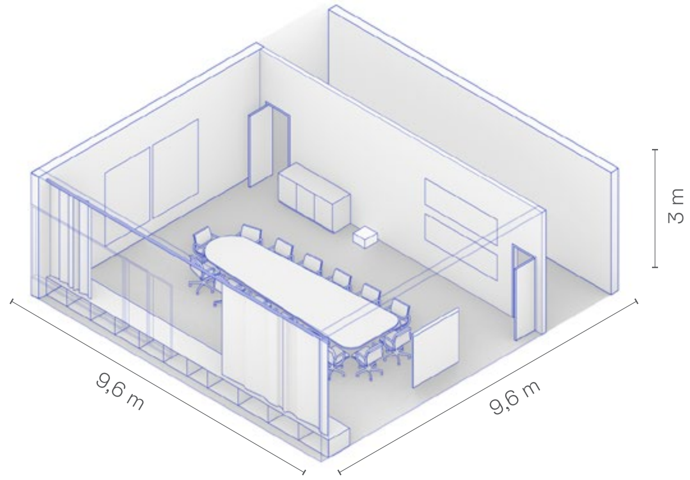


4%
of the surface

The office spaces are designed to support the administrative and operational needs of the complex, including offices for key personnel such as the school master, deputies, and clerical staff, as well as an archive for document storage.

A meeting room facilitates planning and collaboration, while utility rooms, including a workshop, and storage for furniture and inventory, ensure efficient day-to-day operations. These spaces are both functional and well-equipped, fostering organization and effective management.

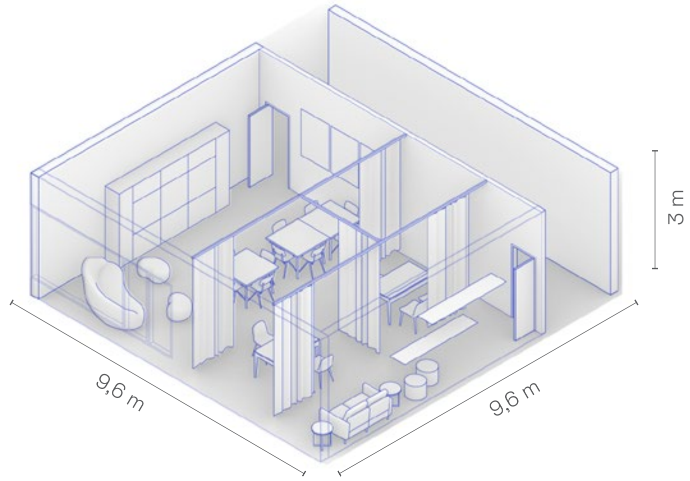
Fire safety EI 30. Thermal resistance R= 3 m²·K/W. Sound insulation Rw=50 dB



Meeting Spaces

Spatial attributes :
Surface 92 m² Volume 276 m³
meeting room for academic council.

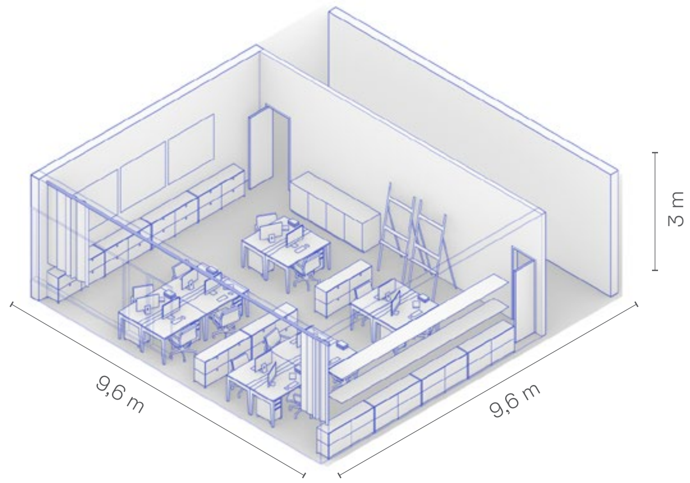
Devices :
seatings, boards, shelves, drawers.



Teachers' working premises

Spatial attributes :
Surface 92 m² Volume 276 m³
informal working.

Devices :
focus pod, coffee machine, informal seatings, boards, furniture for informal meetings and interviews.

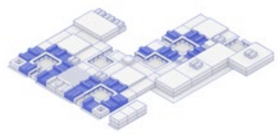


Offices

Spatial attributes :
Surface 92 m² Volume 276 m³
formal working.

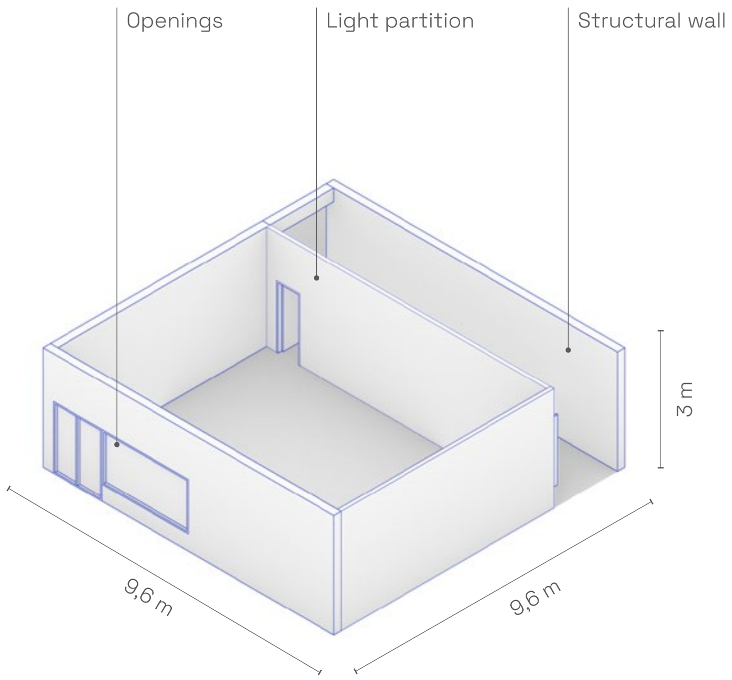
Devices :
shelves, desks, working stations, drawers, office appliances.

classroom



92 m²

In the assembly

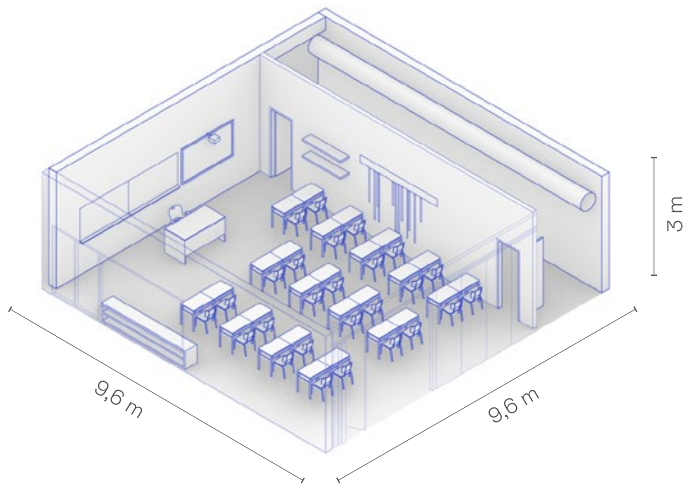


13%
of the surface

The classrooms are designed to flexibly adapt to the needs of gymnasium, lyceum, and elementary pupils, accommodating various teaching and learning styles.

With spatial and design elements that support whole-class instruction, small-group collaboration, and individual study, the spaces are highly versatile. Sliding partitions enable seamless reconfiguration and can adapt to diverse educational needs and age groups.

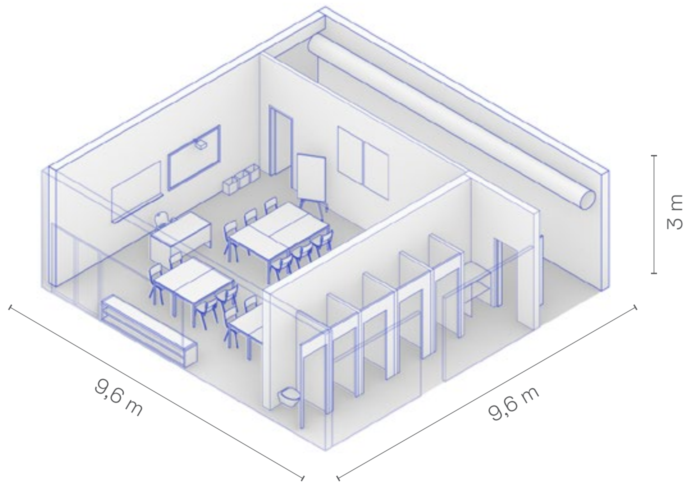
Fire safety EI 60 between classrooms and corridors; exit corridors REI 120, thermal resistance R = 3.3 m²·K/W, Sound insulation Rw 50 dB.



Lyceum and Gymnasium

Spatial attributes :
Surface 92 m² Volume 276 m³
meeting room for academic council.

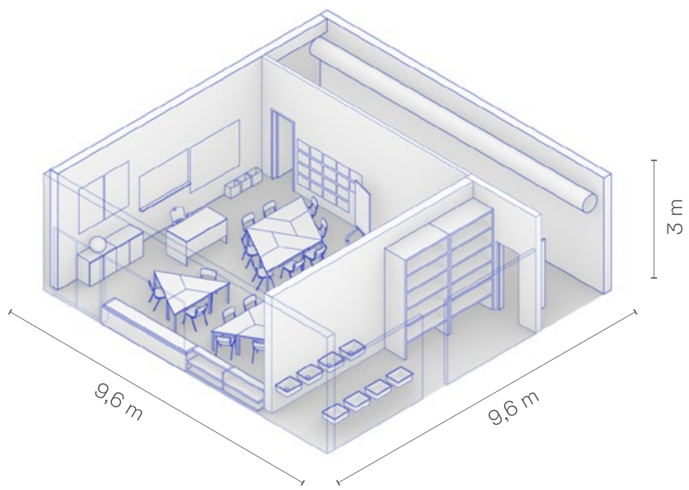
Devices :
seatings, blackboard, shelves, drawers.



Elementary

Spatial attributes :
Surface 92 m² Volume 276 m³
sanitary facilities, changing rooms and wardrobes nearby.

Devices :
seatings, blackboard, drawers, clear wall for poster, illustrations and projector.

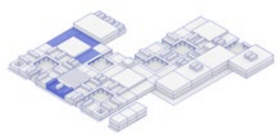


Pupils

Spatial attributes :
Surface 92 m² Volume 276 m³
sanitary facilities, changing rooms, sleeping space and wardrobes nearby.

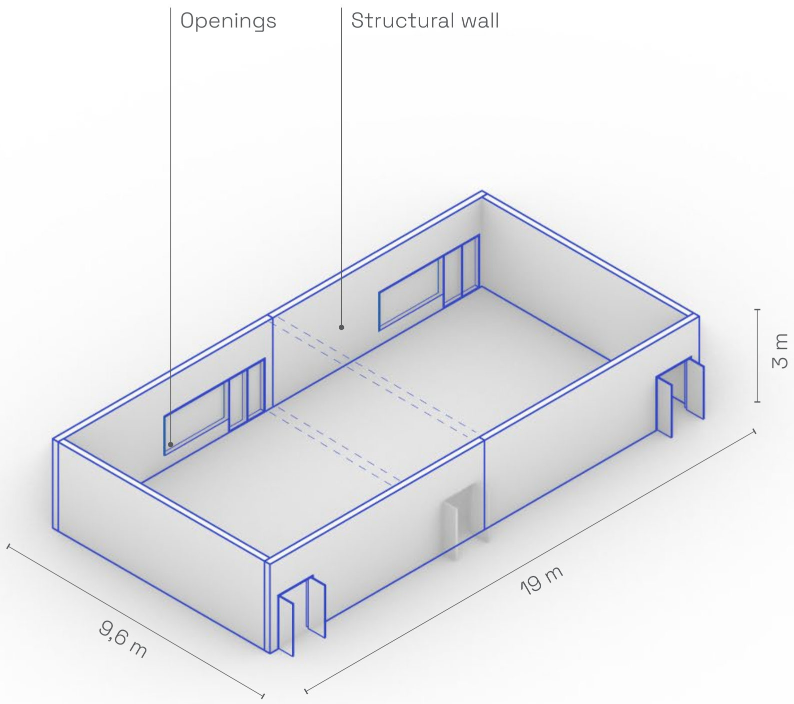
Devices :
game space, group table, seatings, blackboard, clear wall for poster, illustrations and projector.

laboratory



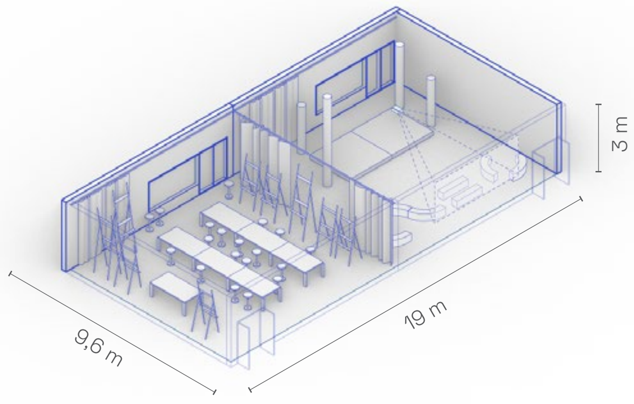
182 m²

In the assembly



7%
of the surface

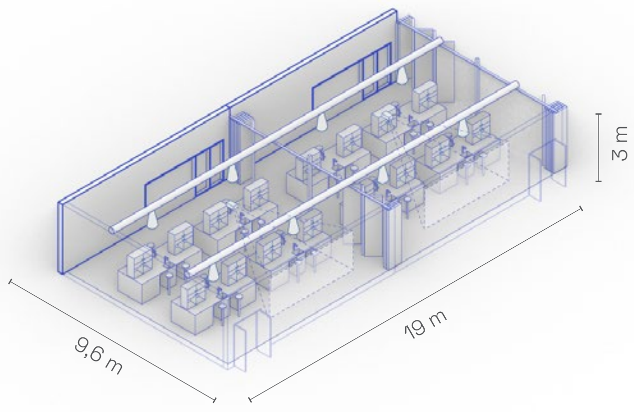
The design allow for separated blocks for specialized humanistic, scientific or workshops activities. These spaces are accessible independently from the main school building, enabling their convenient use for extracurricular programs and community engagement.



Humanistic Lab

Spatial attributes :
Surface 182 m^2 Volume 546 m^3
natural light, interconnected

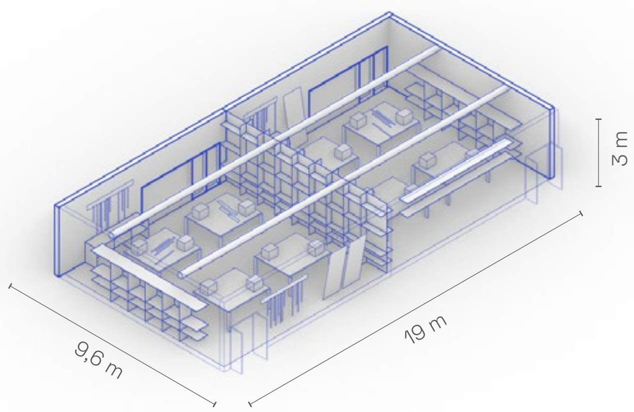
Devices :
movable stage, working tables, courtains, projector for multimedia activities



Scientific Lab

Spatial attributes :
Surface 182 m^2 Volume 546 m^3
Science laboratories, physics, chemistry, biology, interconnected

Devices :
working tables, extractor fan, scientific equipment, projector for multimedia activities

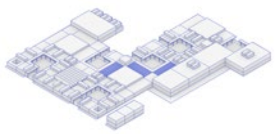


Workshop Lab

Spatial attributes :
Surface 182 m^2 Volume 546 m^3
Training workshop for pupils 4-9 with equipped wall

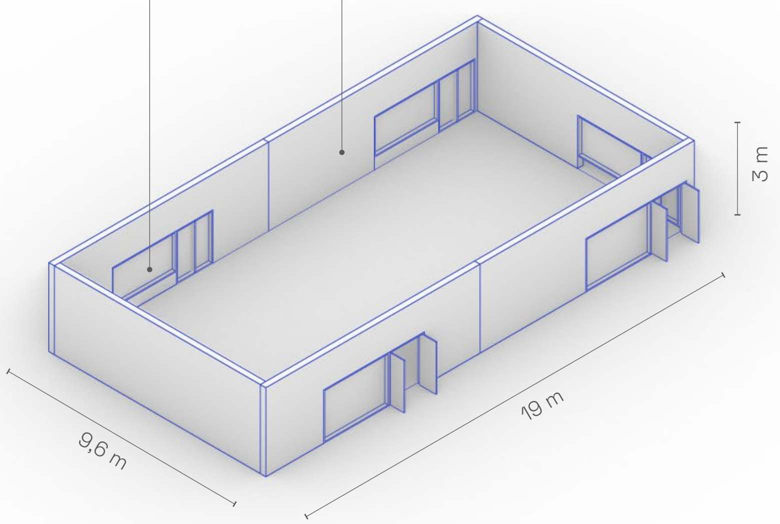
Devices :
Equipped wall, working tables.

common space



546 m²

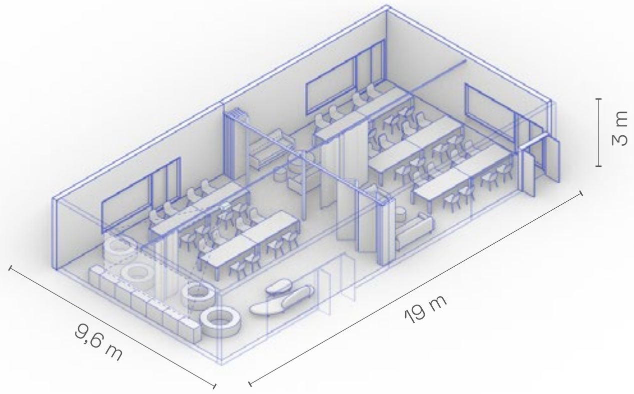
In the assembly



4%
of the surface

Community spaces within the design are intentionally shared with the surrounding community, fostering inclusivity and engagement. Facilities such as libraries, healthcare and prevention centers, and community premises are accessible through designated entries. This thoughtful arrangement ensures that these spaces serve both the immediate residents and the broader community. The specific activities and programs to be hosted in these areas will be determined in close consultation with the local community during the design adaptation process.

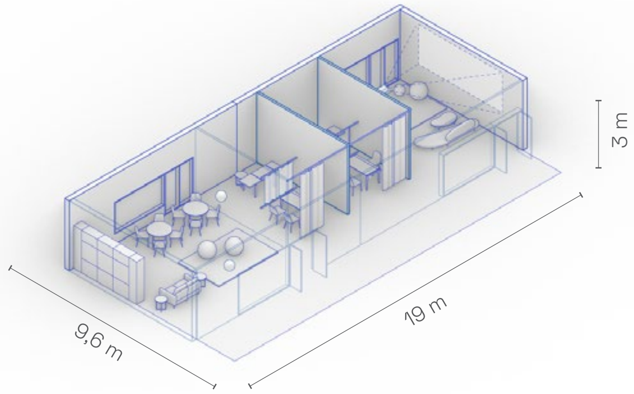
Fire safety EI 30. Thermal resistance R= 3 m²·K/W. Sound insulation Rw=50 dB



Community Space

Spatial attributes :
Surface 182 m² Volume 546 m³
community premises with designated access from the outside, easily subdivide it into several spaces

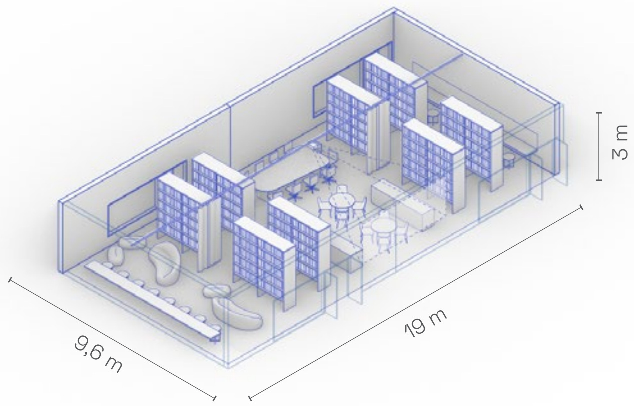
Devices :
seatings, boards, shelves, couches, desks, curtains



Medicine

Spatial attributes :
Surface 182 m² Volume 546 m³
psycho-physiological support, children with special needs, therapy room.

Devices :
hospital furniture, tables, courtains, projector.

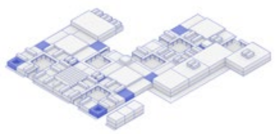


Library

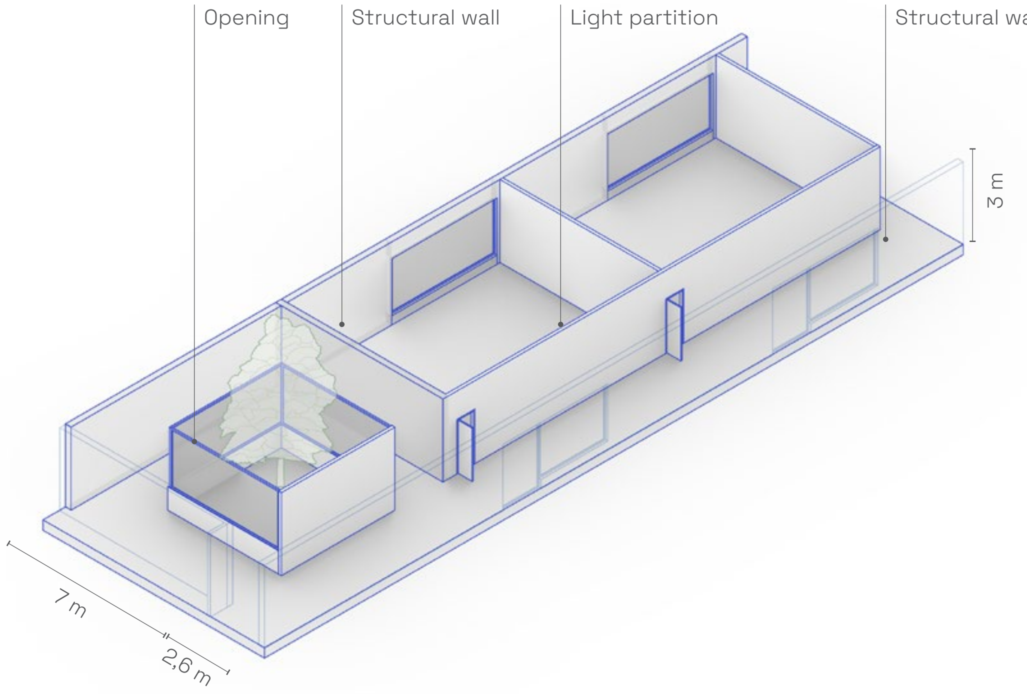
Spatial attributes :
Surface 182 m² Volume 546 m³
direct access to the outdoors, lounge/reading room and libraries.

Devices :
shelves, multi-seat table for group work, personal computer workstations, mobile couches.

transitional space

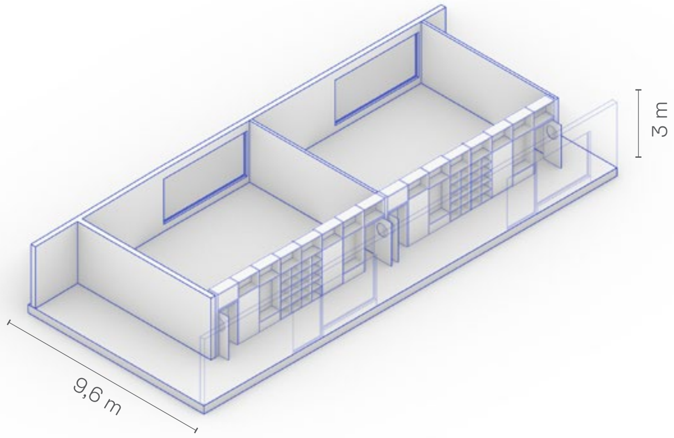


In the assembly



12%
of the surface

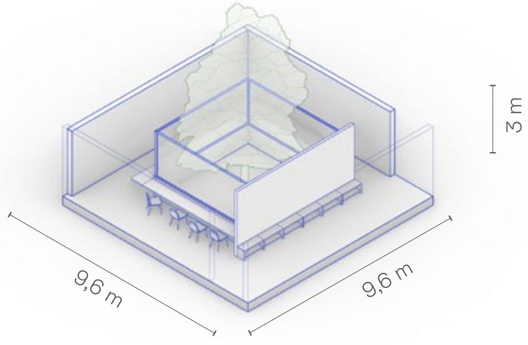
Transitional spaces are multifunctional areas that bridge different environments or purposes, serving as connectors and flexible platforms for various activities. These spaces are designed to integrate educational functions with broader community needs, creating a seamless and cohesive system.



Corridor

Spatial attributes :
Widht 260 cm
(of which furnished wall 50 cm)
multifunctional spaces to consolidate the contemporary educational functions into a coherent community system.

Devices :
seatings, shelves, lockers



Informal learning

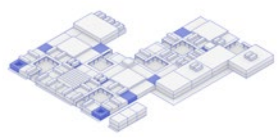
Spatial attributes :
Surface 160 m² Volume 480 m³
multifunctional spaces to consolidate the contemporary educational functions into a coherent community system.

Devices :
seatings, benches, storage space, natural light, greenery

29 DRATZ ARCHITEKTEN . KTE RECHENACKER . 2022

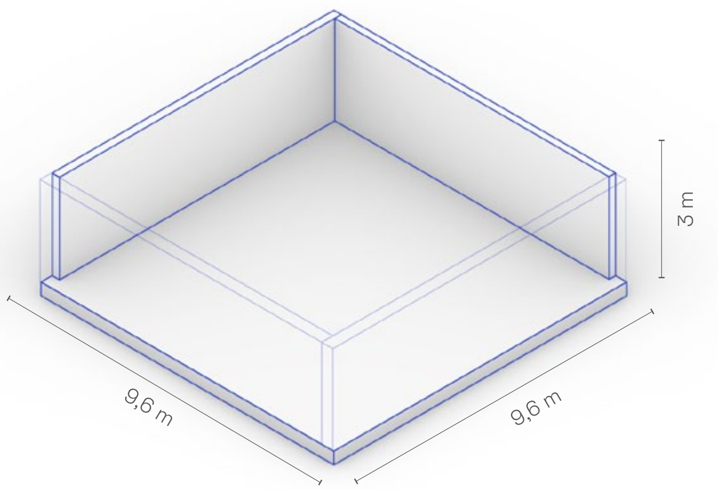
30 ARREA ARCHITECTURE . BOHINJ KINDERGARTEN . 2023

transitional space



92 m²

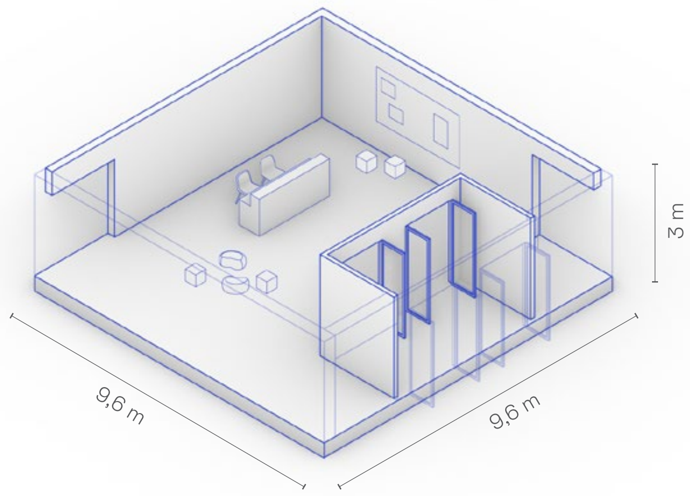
In the assembly



8%

of the surface

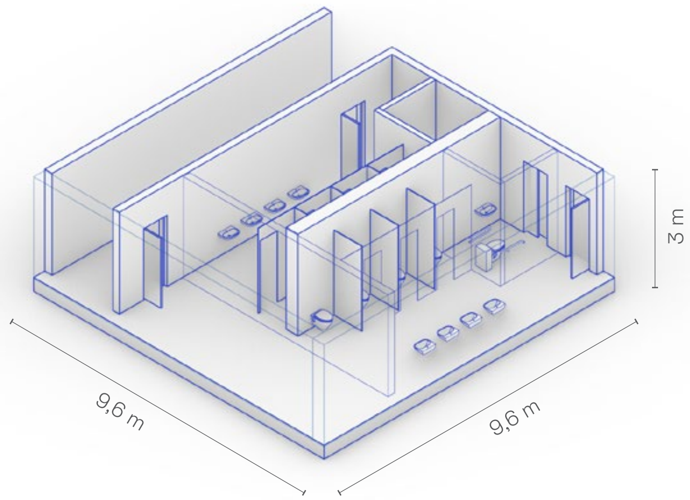
Transitional spaces are multifunctional areas that bridge different environments or purposes, serving as connectors and flexible platforms for various activities. These spaces are designed to integrate educational functions with broader community needs, creating a seamless and cohesive system.



Lobbies

Spatial attributes :
Surface 92 m² Volume 276 m³
clearly visible, s gathering,
self-development and
communication points

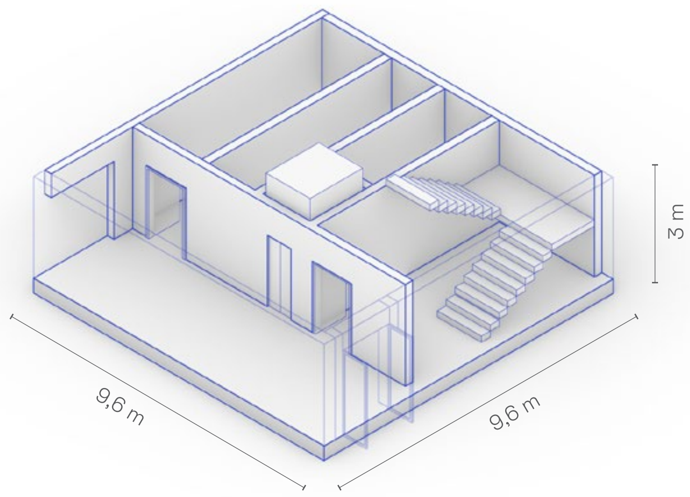
Devices :
reception desk, boards, couches, seatings



Sanitary facilities

Spatial attributes :
Surface 92 m² Volume 276 m³
serving when necessary as storage
and technical room

Devices :
toilette facilities

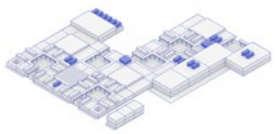


Vertical distribution

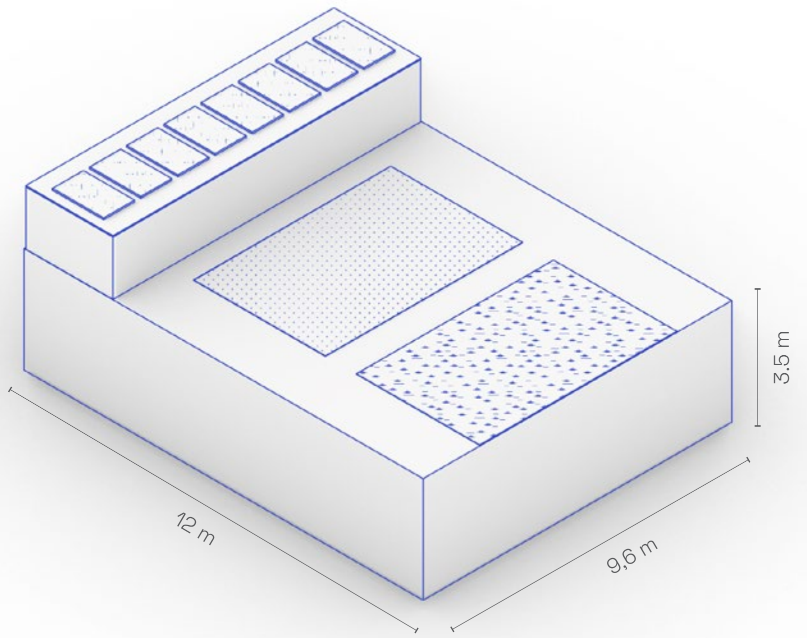
Spatial attributes :
Surface 92 m² Volume 276 m³
serving when necessary as storage
and technical room, stairs

Devices :
elevators

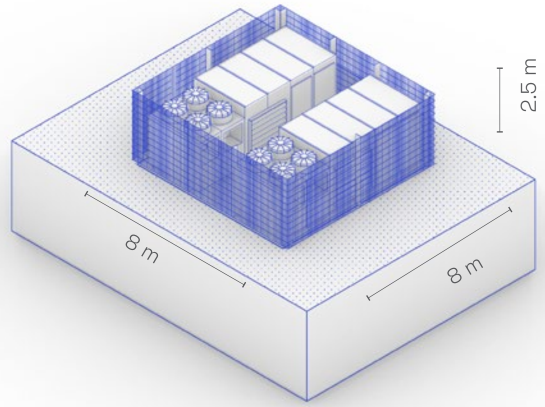
techincal box



In the assembly

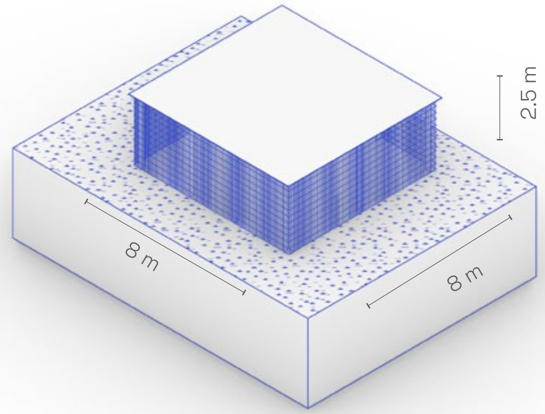


Technical boxes, positioned atop roofs support the internal operations of buildings. These structures house essential systems for energy production, lighting supply, and other technical functions, enabling seamless functionality within the space above and below.



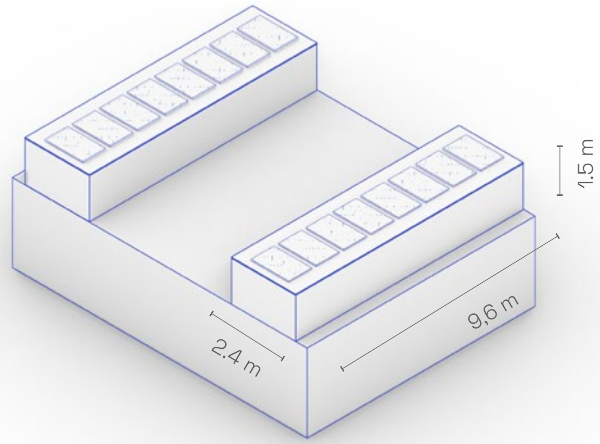
Tech spaces

Spatial attributes :
Surface 64 m² Volume 160 m³
mesh including the technical ATU



Tech storage

Spatial attributes :
Surface 64 m² Volume 160 m³
serving when necessary as storage and technical room

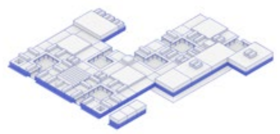


Skylights and PV surface

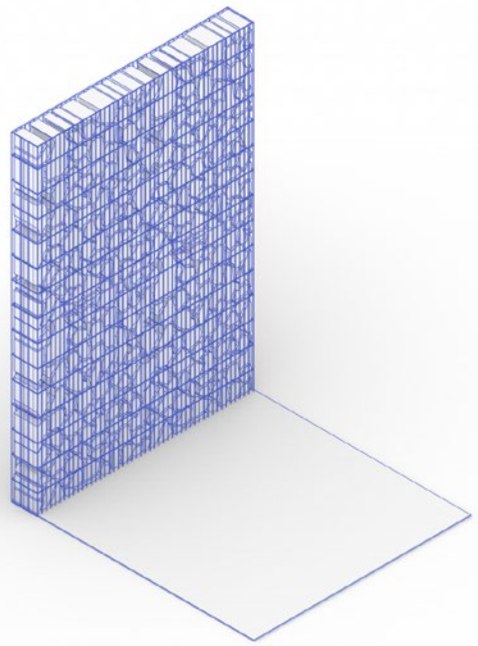
Spatial attributes :
Surface 23 m² Volume 35 m³
serving as skylight for classrooms

Devices :
PV panels

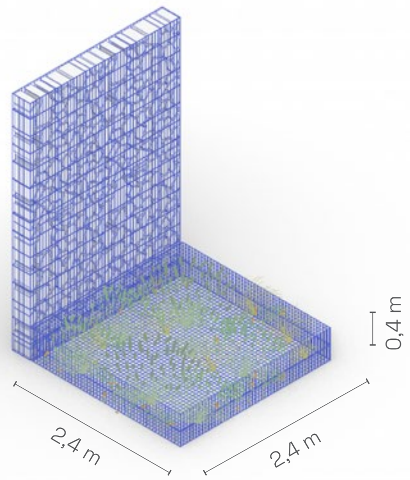
boundry



In the assembly



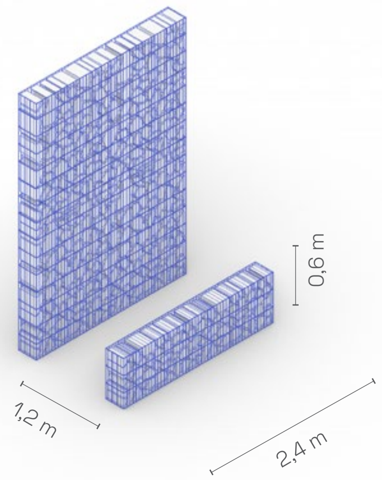
To prevent close contact between the surrounding environment and the walls of the school, various barrier elements can be employed. Options include gabion walls, which offer durability and a natural aesthetic, mesh fences for visibility and security, and greenery, which adds a soft, eco-friendly layer while enhancing the overall ambiance.



Green mesh

Applications :
street fronts,
serving as a natural filter between the street and the wall

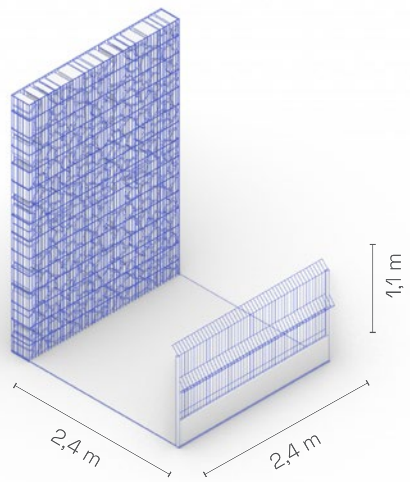
Devices :
support climbing plants, seating



Gabions

Applications :
street fronts,
serving as a natural filter between the street and the wall

Devices :
barrier, seating



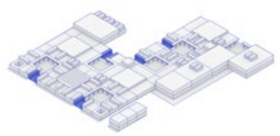
Vertical mesh

Applications :
street fronts, rooftop

Devices :

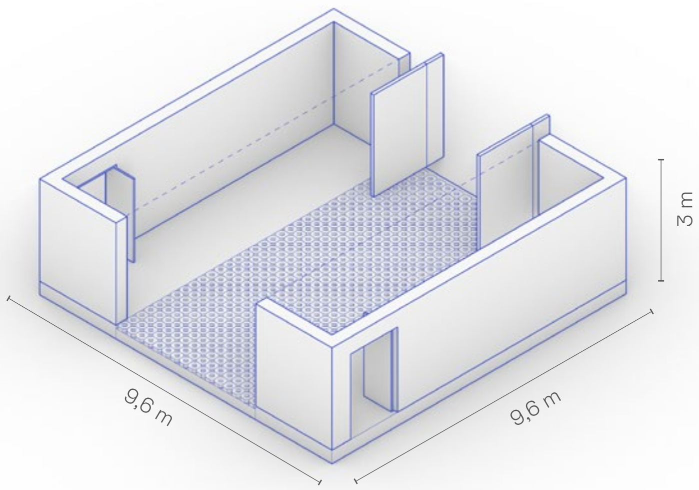
barrier

courtyard pocket



92 m²

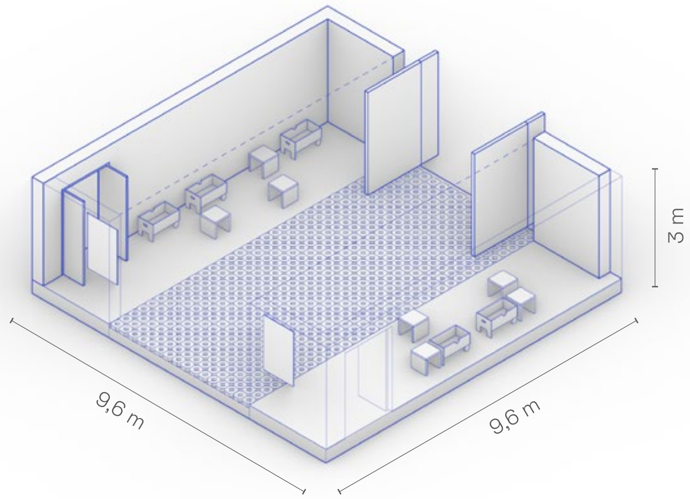
In the assembly



2%

of the surface

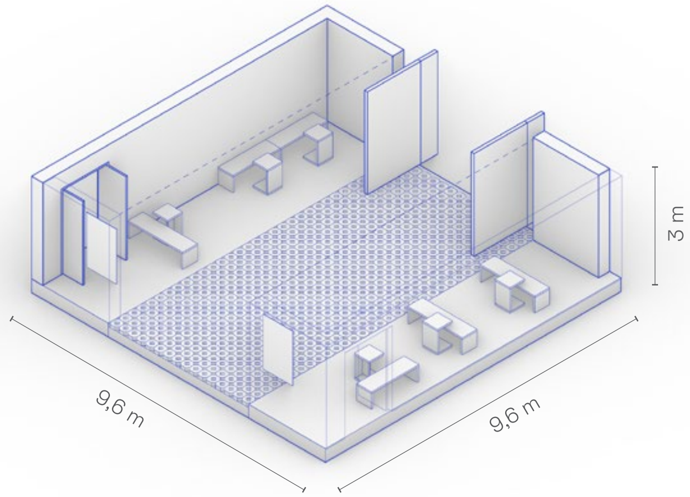
Courtyard pockets are designed to open the courtyards to the outside while maintaining the enclosed atmosphere of the central space. These pockets are equipped with furniture to facilitate small social gatherings and outdoor lessons, creating versatile and inviting areas for interaction and learning.



Elementary

Spatial attributes :
Surface 92 m^2 Volume 276 m^3 clearly visible, self-development and communication points

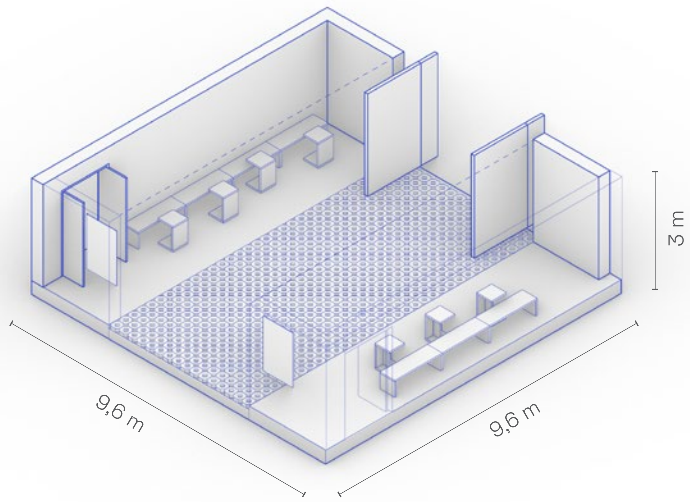
Devices :
seatings, toy storage cart, wayfinding



Gymnasium and Lyceum

Spatial attributes :
Surface 92 m^2 Volume 276 m^3 clearly visible, self-development and communication points

Devices :
benches, sidetables, digital-totem, wayfinding, digital screen

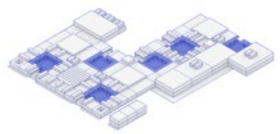


Teaching Staff

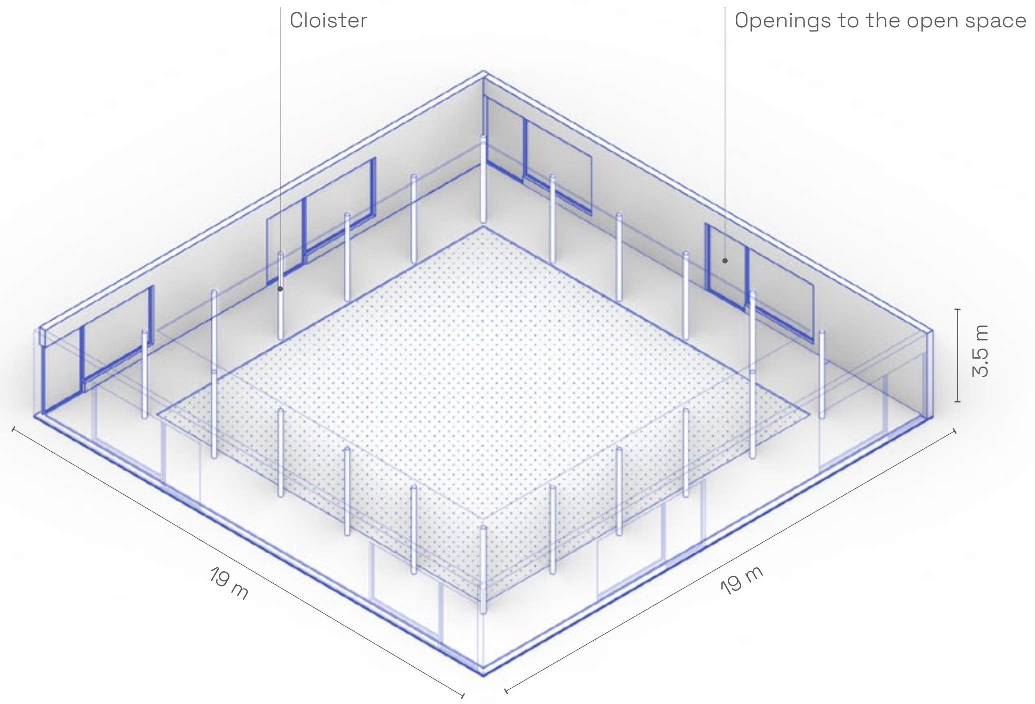
Spatial attributes :
Surface 92 m^2 Volume 276 m^3 clearly visible, self-development and communication points

Devices :
benches, sidetables, wayfinding, digital screen

courtyard



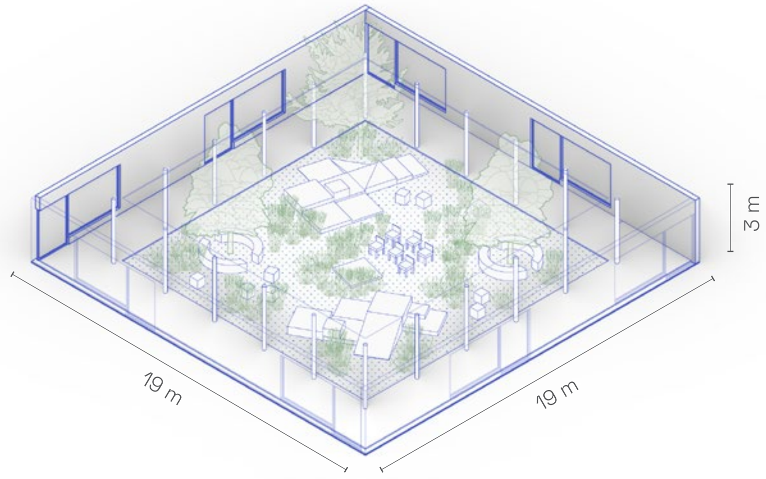
360 m^2 In the assembly



10%
of the surface

The square courtyards, each enclosed by a cloister and infused with greenery, forming intimate hortus conclusus spaces that serve as secret gardens and communal meeting points. These courtyards provide tranquil, enclosed environments that foster reflection, interaction, and connection with nature.

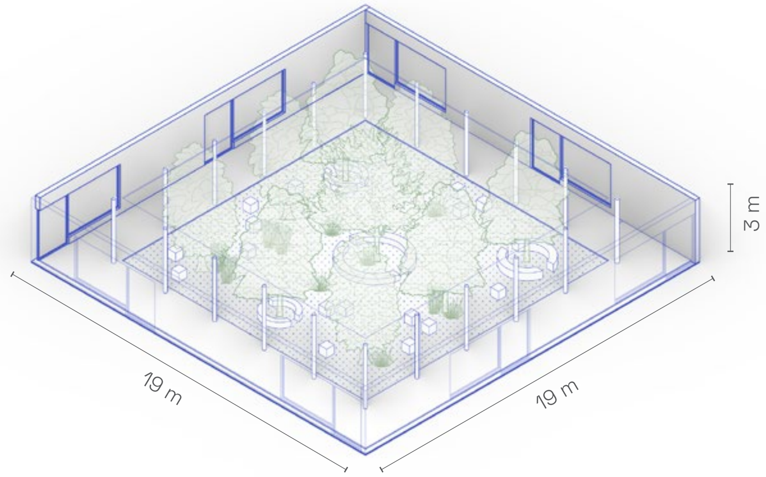
The surrounding cloisters offer shaded walkways and transitional spaces, blending the indoor and outdoor realms. These courtyards offer a shared sanctuary within the larger architectural matrix.



Pupils and Elementary

Spatial attributes :
Surface 361 m^2 Volume 1260 m^3
Elementary pupils 72 each courtyard.

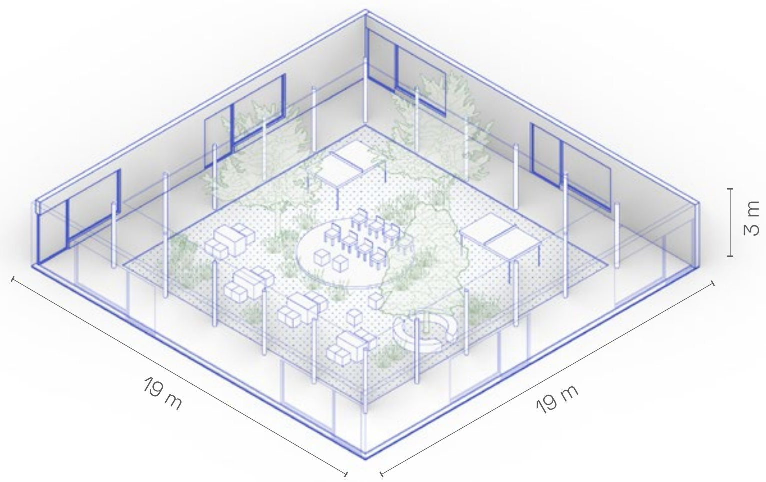
Devices :
seatings, greenery, learning ground, reading corner, sun, rain and snow covering shed.



Orchard

Spatial attributes :
Surface 361 m^2 Volume 1260 m^3

Devices :
seatings, greenery, educational and research area, meteorology and geography learning, sun, rain and snow covering shed, flower and ornamental nursery, vegetable garden.

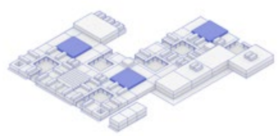


Gymnasium/Lyceum

Spatial attributes :
Surface 361 m^2 Volume 1260 m^3
Gymnasium pupils 250/Lyceum pupils 150 pupils

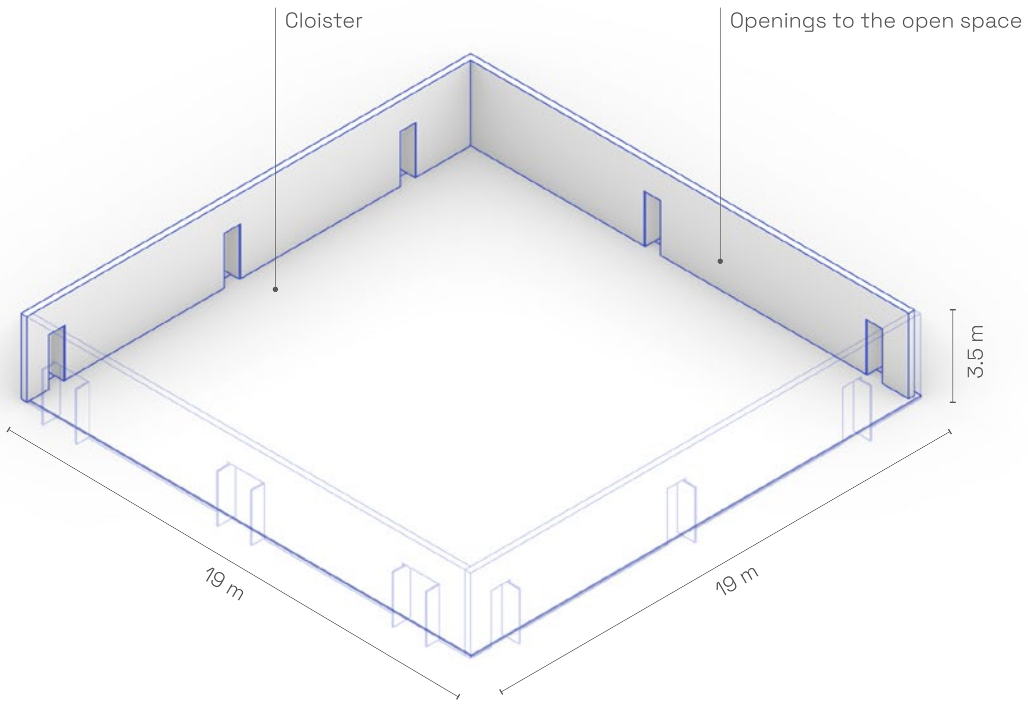
Devices :
active game, focus pod, tables, seatings, greenery, research area, sun, rain and snow covering shed.

leisure



360 m²

In the assembly



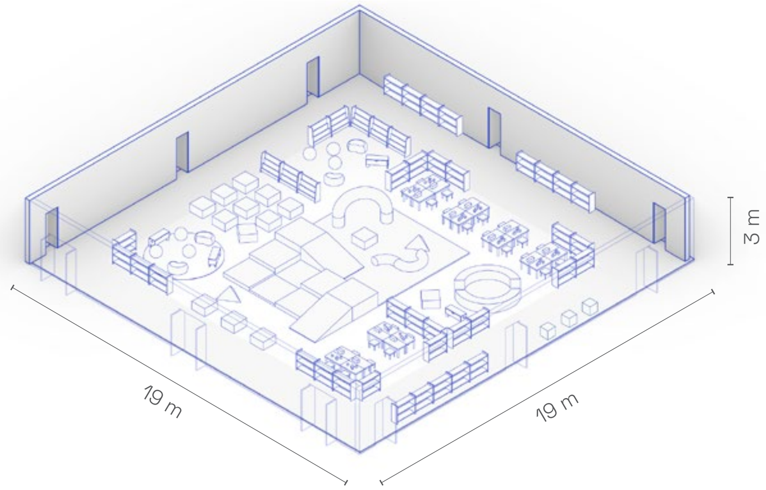
6%

of the surface

The leisure spaces are expansive, sky light-filled areas designed to support modern education and meaningful activities.

They include zones for interactive play, such as climbing walls and digital installations, as well as creative play areas. For quieter moments, soft corners with cushions and rugs offer relaxation, while reading corners provide books and comics with cozy seating.

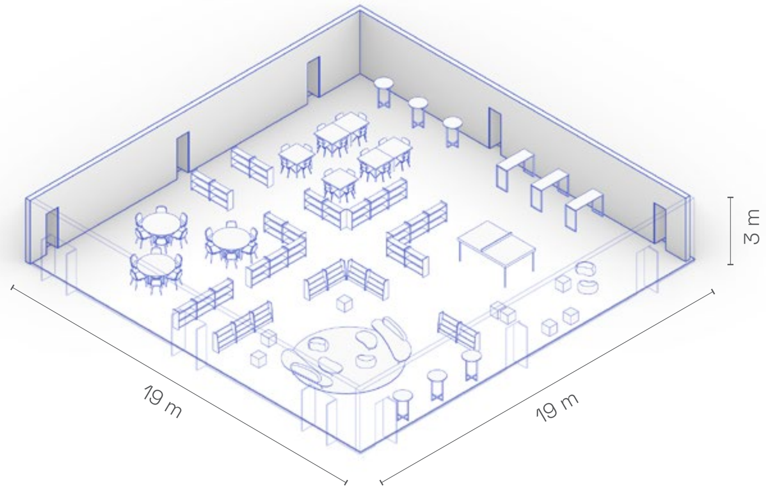
Pause zones serve as calming retreats for decompression while round tables support discussions and collaborative work.



Pupils and Elementary

Spatial attributes :
Surface 361 m² Volume 1260 m³

Devices :
creative play, interactive digital wall, climbing zone, sensorial play zone,

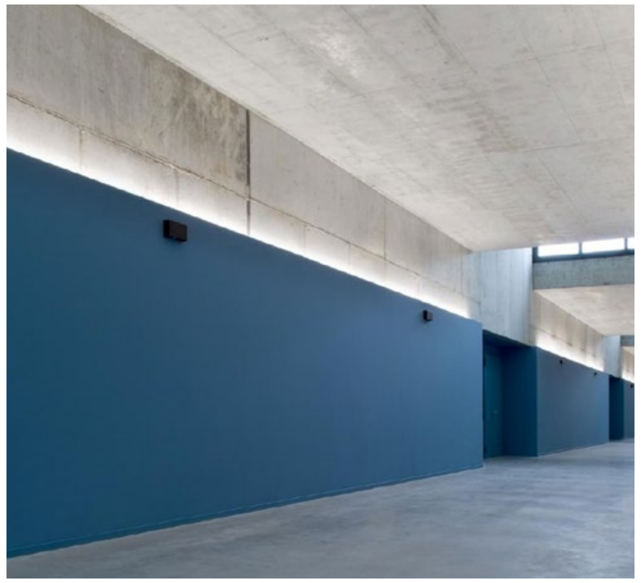


Gymnasium and Lyceum

Spatial attributes :
Surface 361 m² Volume 1260 m³

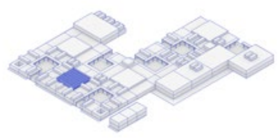
Devices :
maker space, interactive digital wall, climbing zone, social lounge, STEM station, armchairs and cushions, round tables

31 MIDE ARCHITETTI . ISISS D.SARTOR INSTITUTE . 2020



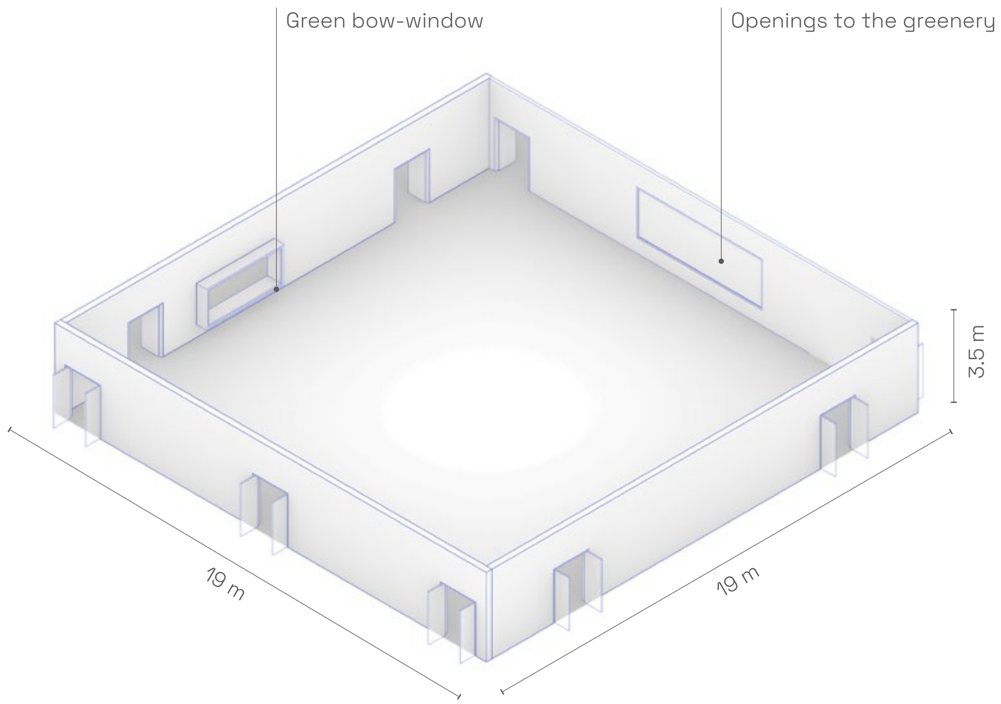
32 JOSEP FERRANDO . UNIVERSITY DI TELLA . 2019

greenhouse



360 m²

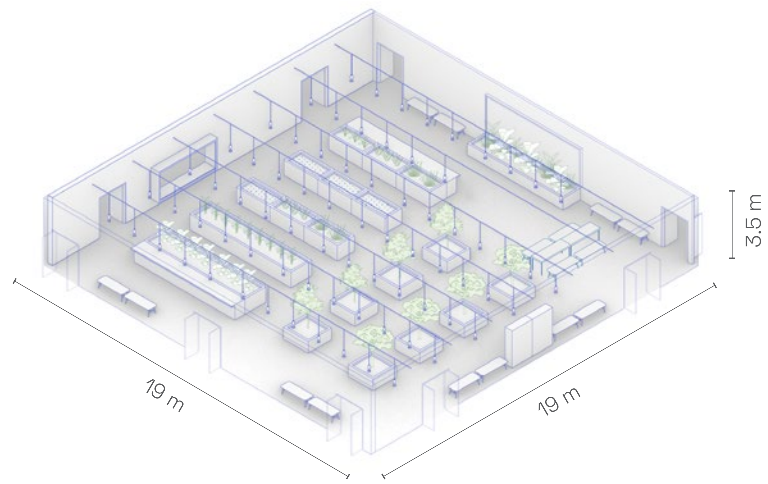
In the assembly



3%
of the surface

The design incorporates an indoor green space, creating a serene, lush environment within the school. This quiet oasis not only provides a calming retreat for students and staff but also serves a pedagogic and didactic purpose, allowing nature to become an integral part of the learning experience.

The space is enriched with vegetation that supports biodiversity, offering a habitat for small birds and fostering an appreciation for ecology and environmental stewardship.



Greenhouse

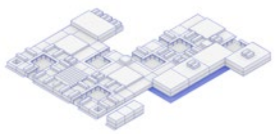
Spatial attributes :
Surface 361 m² Volume 1260 m³
non-slip vynil flooring and drainage system

Devices :
seatings, greenery, grow lights

33 KEW GARDEN . LONDON

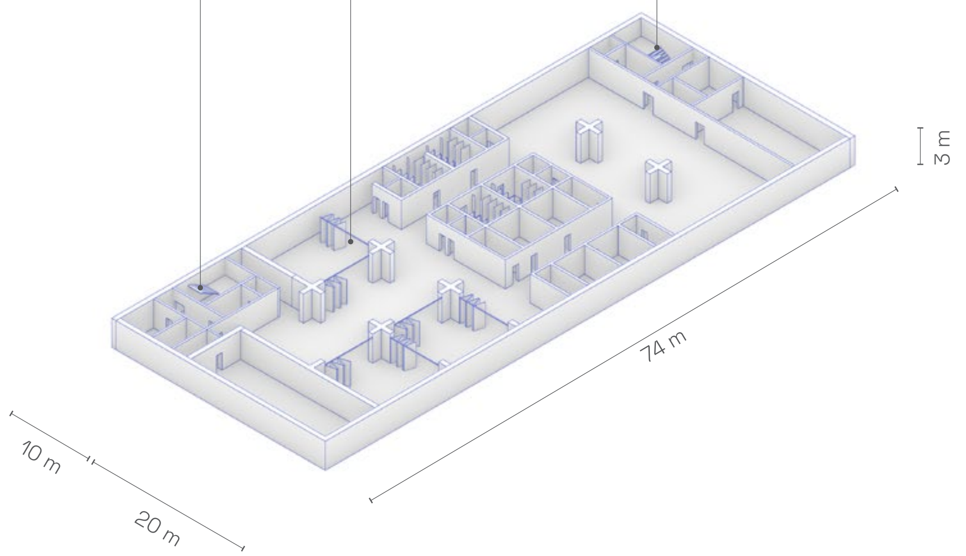
34 CIVIC ARCHITECTS . ITC . 2023

dual-use shelter



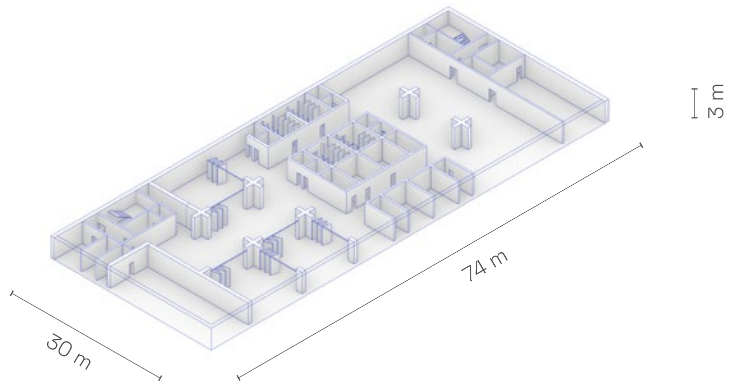
2200 m²

In the assembly



12%
of the surface

An underground bunker constructed from reinforced concrete, prioritizing maximum safety and resilience in emergencies. This approach integrates ergonomic and aesthetic considerations to ensure the shelter remains both functional and comfortable, with the potential for dual-use capabilities.



Dual-use shelter

Spatial attributes :
Surface 1600 m² Volume 4800 m³
underground reinforced concrete structure of protection level P-4
capacity up to 650 people

Devices :
seatings, greenery, grow lights

35 PURPOSE-BUILT SUBTERRANEAN SCHOOL, KHARKIV

2.5
THE FINISHINGS
SPACES AND MATERIALS

SPACE	FINISHING			
BIG BOX	FLOOR	WALL	CEILING	FURNISHING ELEMENTS
A. Gym	FL.01 linoleum type A	WA.04 concrete panels + acoustic panels type A	CL.02 baffle ceiling	FE.03 curtain type C
B. Theater	FL.05 wooden floor type A	WA.05 concrete panels + acoustic panels type B	CL.03 metal suspended ceiling	FE.03 curtain type C
C. Dining hall	FL.02 linoleum type B	WA.01/ 07 concrete panels/ wall tiles type A	CL.03 metal suspended ceiling	FE.03 curtain type C

SPACE	FINISHING			
ACCOMODATION	FLOOR	WALL	CEILING	FURNISHING ELEMENTS
A. Double rooms	FL.06 wooden floor type B	WA.09 plaster in color A	CL.05 plasterboard ceiling	FE.01/ 06 curtain type A/ furniture type A
B. Single rooms	FL.06 wooden floor type B	WA.09 plaster in color A	CL.05 plasterboard ceiling	FE.01/ 06 curtain type A/ furniture type A
C. Common and recreation rooms	FL.02 linoleum type B	WA.06 concrete panels + acoustic panels type C	CL.01/ 02 polished concrete/ baffle ceiling	FE.01/ 07 curtain type A/ furniture type B

SPACE	FINISHING			
OFFICE	FLOOR	WALL	CEILING	FURNISHING ELEMENTS
A. Meeting spaces	FL.03 linoleum type C	WA.10 plaster in color B	CL.01 polished concrete	FE.01/ 07 curtain type A/ furniture type B
B. Teachers working premises	FL.03 linoleum type C	WA.10 plaster in color B	CL.01 polished concrete	FE.01/ 07 curtain type A/ furniture type B
C. Offices	FL.03 linoleum type C	WA.10 plaster in color B	CL.01 polished concrete	FE.01/ 07 curtain type A/ furniture type B

SPACE	FINISHING			
CLASSROOM	FLOOR	WALL	CEILING	FURNISHING ELEMENTS
A. Gymnasyum and Lyceum	FL.03 linoleum type C	WA.01/02/03 concrete panels slide wood panels fixed furniture	CL.01/ 02 polished concrete/ baffle ceiling	FE.01/ 06 curtain type A/ furniture type A
B. Elementary	FL.03 linoleum type C	WA.01/02/03 concrete panels slide wood panels fixed furniture	CL.01/ 02 polished concrete/ baffle ceiling	FE.01/ 06 curtain type A/ furniture type A
C. Pupils	FL.03 linoleum type C	WA.01/02/03 concrete panels slide wood panels fixed furniture	CL.01/ 02 polished concrete/ baffle ceiling	FE.01/ 06 curtain type A/ furniture type A

SPACE	FINISHING			
LABORATORY	**FLOOR**	**WALL**	**CEILING**	**FURNISHING ELEMENTS**
A. Humanstic Lab	FL.02 linoleum type B	WA.01/02/03 concrete panels slide wood panels fixed furniture	CL.01/ 02 polished concrete/ baffle ceiling	FE.02/08/09 curtain type B/ furniture type C/ D
B. Scientific Lab	FL.02 linoleum type B	WA.01/02/03 concrete panels slide wood panels fixed furniture	CL.01/ 02 polished concrete/ baffle ceiling	FE.02/08/09 curtain type B/ furniture type C/ D
C. Workshop Lab	FL.02 linoleum type B	WA.01/02/03 concrete panels slide wood panels fixed furniture	CL.01/ 02 polished concrete/ baffle ceiling	FE.02/08/09 curtain type B/ furniture type C/ D

COMMON SPACE	**FLOOR**	**WALL**	**CEILING**	**FURNISHING ELEMENTS**
A. Community space	FL.02 linoleum type B	WA.04 concrete panels + acoustic panels type A	CL.01 polished concrete	FE.01/06/07 curtain type A/ furniture type A/ B
B. Medicine	FL.02 linoleum type B	WA.04 concrete panels + acoustic panels type A	CL.01 polished concrete	FE.01/ 07 curtain type A/ furniture type B
C. Library	FL.05 wooden floor type A	WA.06 concrete panels + acoustic panels type C	CL.01/ 02 polished concrete/ baffle ceiling	FE.01/06/07 curtain type A/ furniture type A/ B

SPACE	FINISHING			
TRANSITIONAL SPACES AND INFORMAL LEARNING	**FLOOR**	**WALL**	**CEILING**	**FURNISHING ELEMENTS**
A. Corridor	FL.07 polished concrete	WA.01/ 03 concrete panels/ fixed furniture	CL.01/ 02 polished concrete/ baffle ceiling	FE.10 wayfinding
B. Informal learning	FL.07 polished concrete	WA.01/ 03 concrete panels/ fixed furniture	CL.01/ 02 polished concrete/ baffle ceiling	FE.06/07 furniture type A/ B
C. Lobbies	FL.07 polished concrete	WA.01 concrete panels	CL.01/ 02 polished concrete/ baffle ceiling	FE.05/08/09 Rug/rubber mat type B furniture type A/ B
D. Sanitary facilities	FL.04 floor tiles type A	WA.08/ 11 wall tiles type B aquapanel	CL.06 plasterboard ceiling	FE.10 wayfinding
E. Vertical distribution	FL.07 polished concrete	WA.01 concrete panels	CL.01 polished concrete	FE.10 wayfinding

TECHNICAL BOX	**FLOOR**	**WALL**
A. Tech spaces	EX.01 polished concrete outdoor	EX.03 metal mesh type.A
B. Tech storage	EX.01/EX.02 polished concrete Green roofoutdoor	EX.03 metal mesh type.A
C. Skylights and PV surface	EX.01 polished concrete outdoor	EX.06 texture plaster outdoor

BOUNDRY	**A. GREEN MESH**	**B. GABIONS**	**C.VERTICAL MESH**
	EX.05 Green metal mesh	EX.03 metal mesh type.A	EX.04 metal mesh type.B

SPACE	FINISHING			
COURTYARD POCKET	FLOOR	WALL	CEILING	FURNISHING ELEMENTS
A. Elementary	FL.08/ 10 polished concrete drivable interlocking	WA.12 texture plaster outdoor	CL.01 polished concrete	FE.10 wayfinding
B. Gymnasyum and Lyceum	FL.08/ 10 polished concrete drivable interlocking	WA.12 texture plaster outdoor	CL.01 polished concrete	FE.10 wayfinding
C. Teaching staff	FL.08/ 10 polished concrete drivable interlocking	WA.12 texture plaster outdoor	CL.01 polished concrete	FE.10 wayfinding

COURTYARD	FLOOR	WALL	CEILING	FURNISHING ELEMENTS
A. Pupils and Elementary	FL.08/09 polished concrete gravel	WA.12 texture plaster outdoor	CL.01 polished concrete	FE.10 wayfinding
B. Orchard	FL.08/09 polished concrete gravel	WA.12 texture plaster outdoor	CL.01 polished concrete	FE.10 wayfinding
C. Gymnasyum and Lyceum	FL.08/09 polished concrete gravel	WA.12 texture plaster outdoor	CL.01 polished concrete	FE.10 wayfinding

SPACE	FINISHING			
LEISURE	FLOOR	WALL	CEILING	FURNISHING ELEMENTS
A. Pupils and Elementary	FL.06 wooden floor type B	WA.06 concrete panels + acoustic panels type C	CL.01/ 02 polished concrete/ baffle ceiling	FE.02/05/ 08/09/10 curtain type B/ Rug/ rubber mat type B furniture type C/ D wayfinding
B. Gymnasyum and Lyceum	FL.06 wooden floor type B	WA.06 concrete panels + acoustic panels type C	CL.01/ 02 polished concrete/ baffle ceiling	FE.02/05/ 08/09/10 curtain type B/ Rug/ rubber mat type B furniture type C/ D wayfinding

GREENHOUSE	FLOOR	WALL	CEILING	FURNISHING ELEMENTS
A. Greenhouse	FL.08/09 polished concrete gravel	WA.12 texture plaster outdoor	CL.01 polished concrete	FE.10 wayfinding

DUAL-USE SHELTER	FLOOR	WALL	CEILING	FURNISHING ELEMENTS
A. Dual-use shelter	FL.02 linoleum type B	WA.04 concrete panels + acoustic panels type A	CL.04 acoustic ceiling-gypsum	

2.6
THE ASSEMBLY
MATCHING THE CATALOGUE

This paragraph emphasizes how the various elements of the catalogoue can be integrated to form distinct functional units, each with unique structural and HVAC requirements.

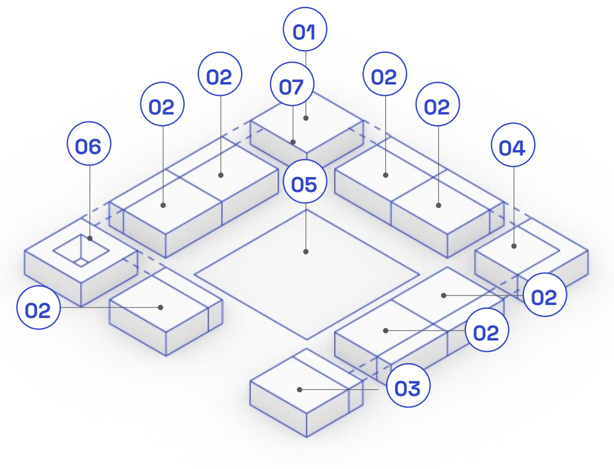
The assembly carefully considers the interplay between the various spaces detailed in the catalogue, prioritizing their relationships to enhance both functionality and flow throughout the design. By strategically positioning and connecting spaces, the assembly ensures a seamless integration of activities, fostering efficiency and cohesion.

For instance, communal areas such as courtyards or dining halls are intentionally located to act as central nodes, linking private and public spaces while encouraging interaction and engagement.

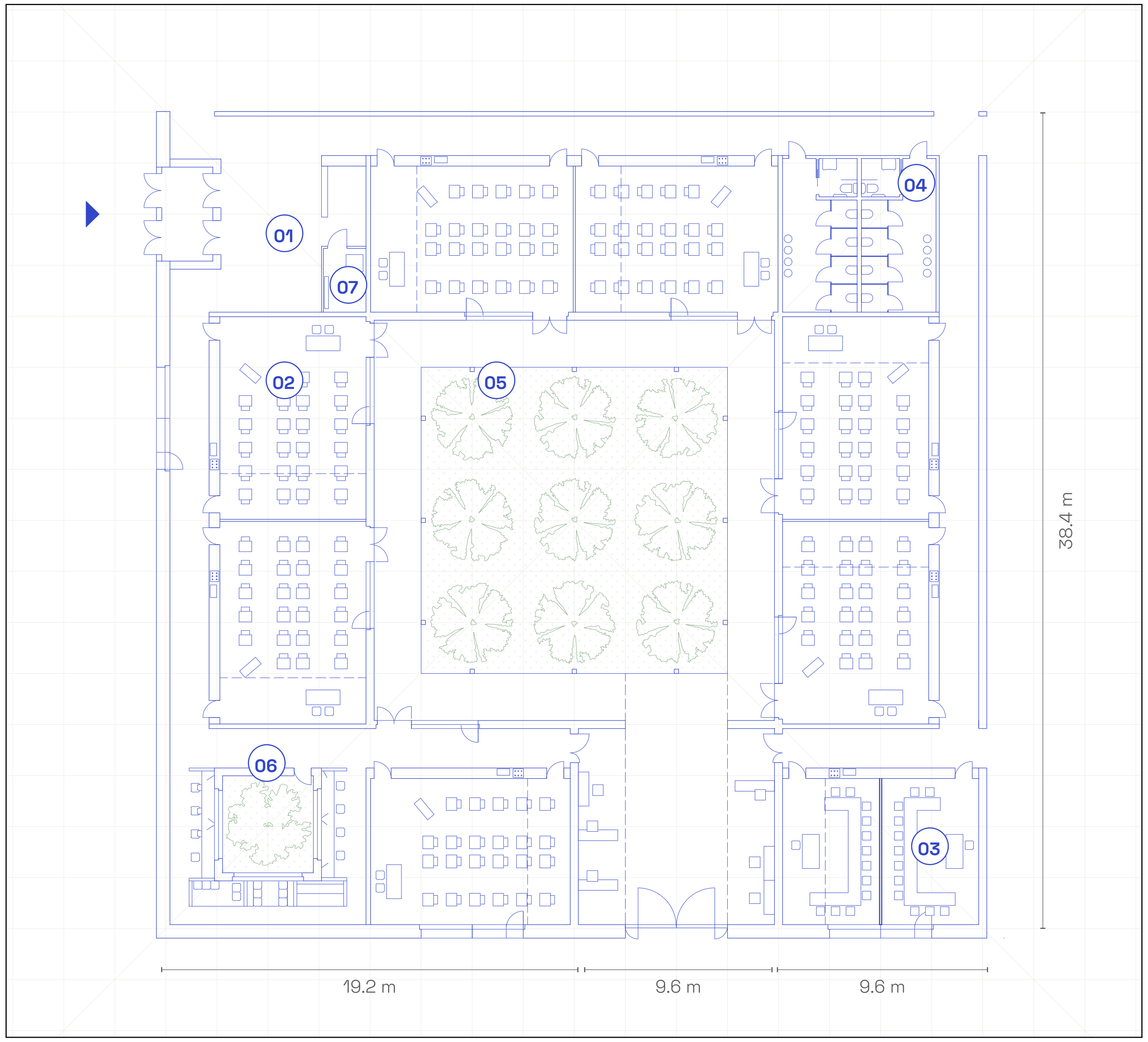
At the same time, specialized zones like classrooms or offices are thoughtfully arranged to maintain focus and privacy without feeling isolated. This layout creates a dynamic environment where each area supports and complements the others.

The assembly addresses the interplay between the different spaces of the catalogue, emphasizing how their relationships enhance functionality and flows.

#1 Classrooms

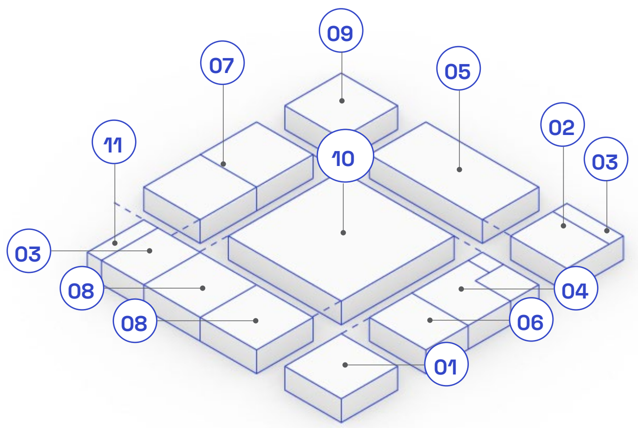


01. lobby
02. classroom
03. lingua franca
04. sanitary facilities
05. courtyard
06. personal learning
07. technical room

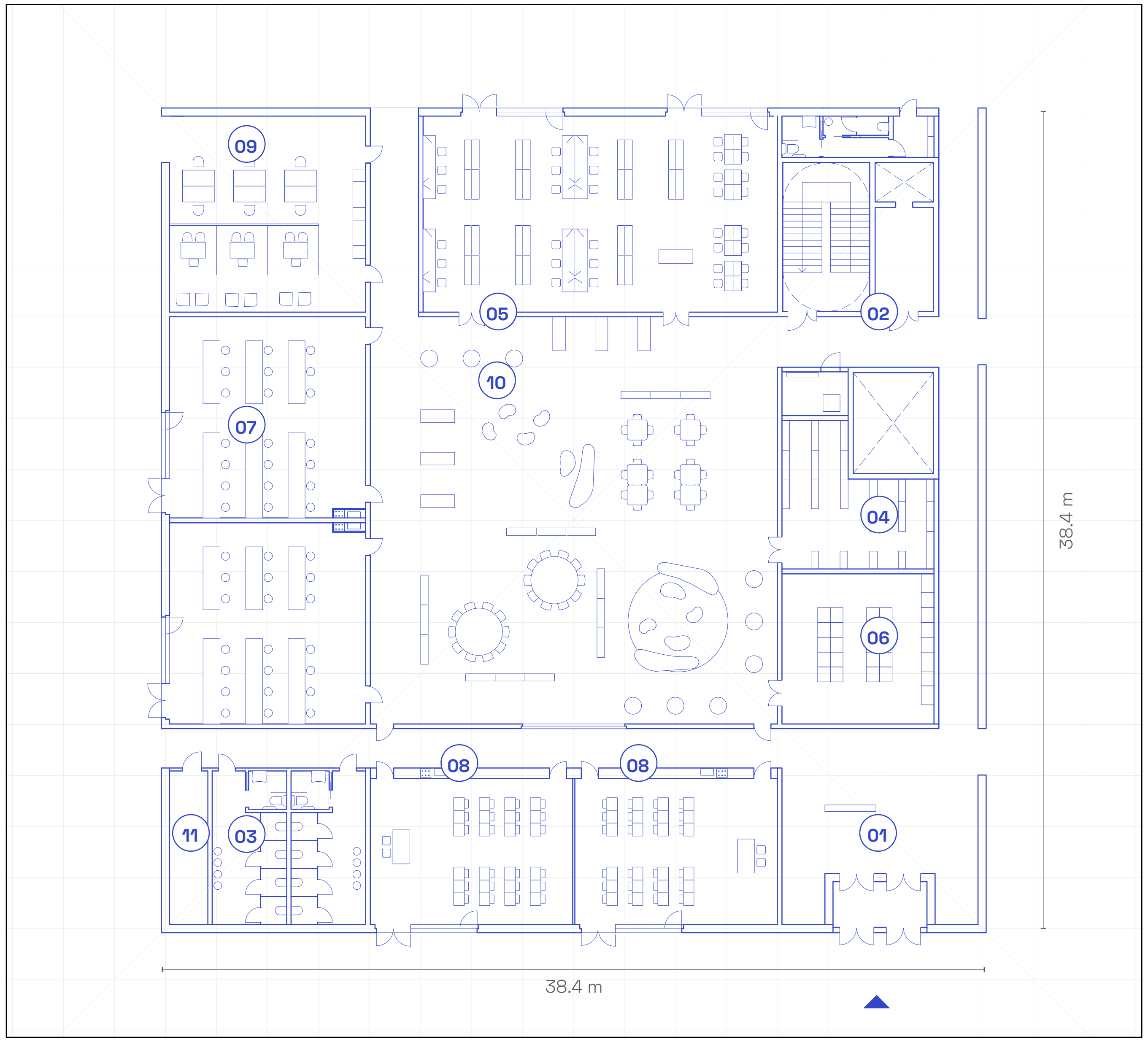



CLASS
1–7
COURTYARD
POCKET

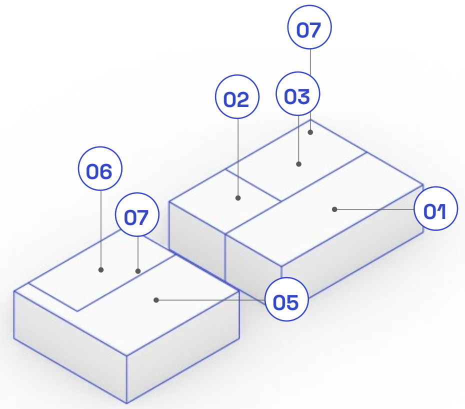
#2 Laboratories



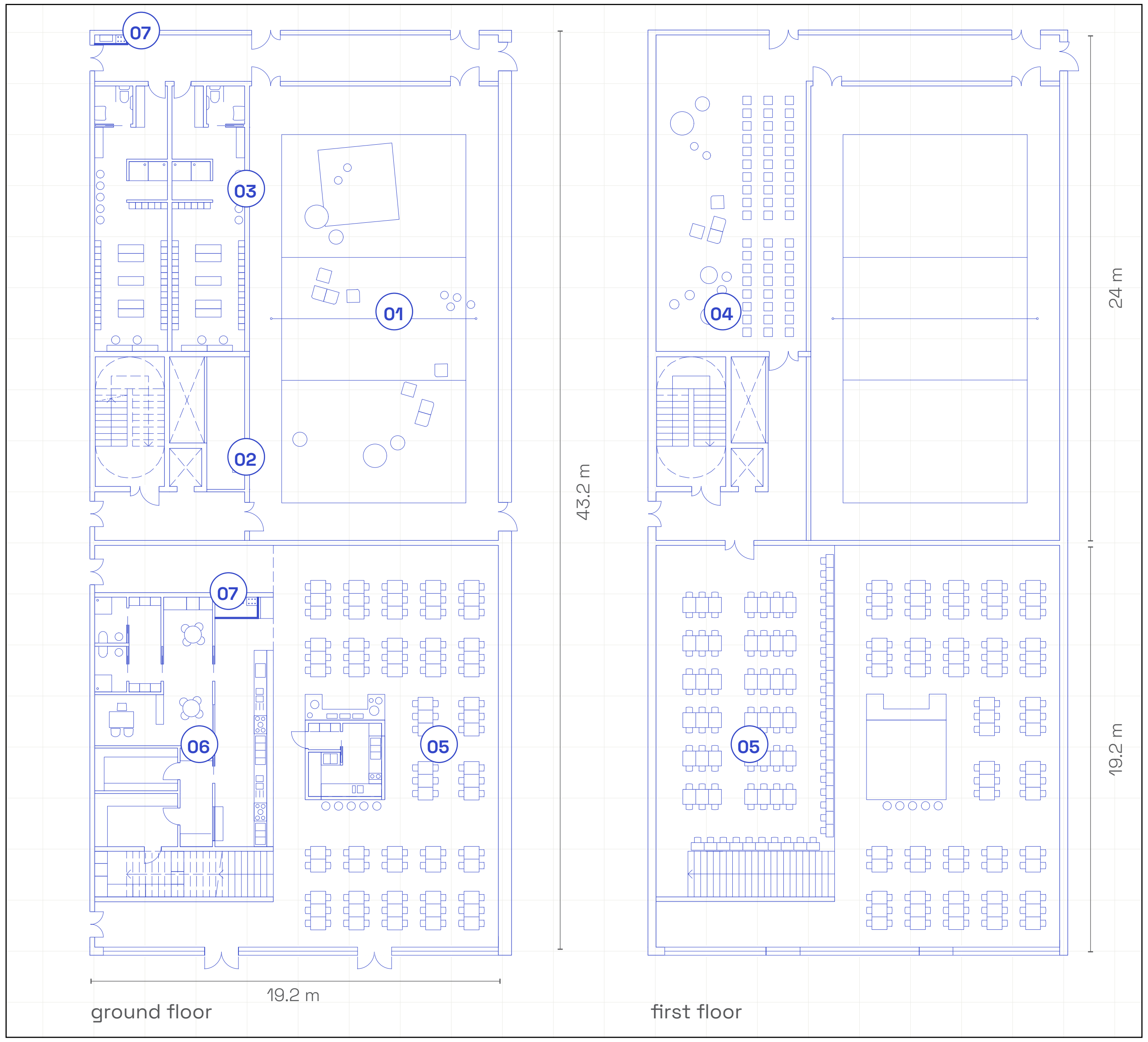
01. lobby
02. shelter access
03. sanitary facilities
04. book storage
05. library
06. school museum repository
07. laboratories
08. science classroom
09. offices
10. leisure
11. technical room



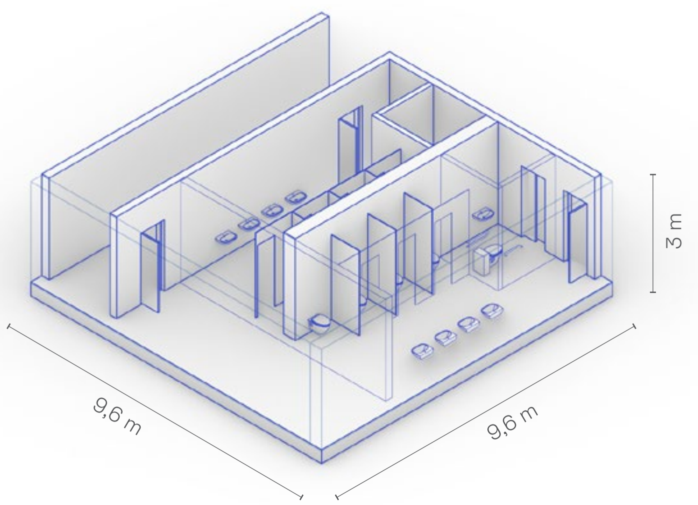
#3 Gym and Dining Hall



01. multi purpose hall for junior
02. changing room
03. storage
04. ancillary activities
05. catering
06. kitchen storage and buffet
07. sub distribution panel



Toilet focus



Building Regulations universal standards on not self-contained toilet cubicle.

Minimum overall dimensions:
910 mm * 1740 mm (exterior toilet tank).

Door arrangement:
650mm effective clear opening width.

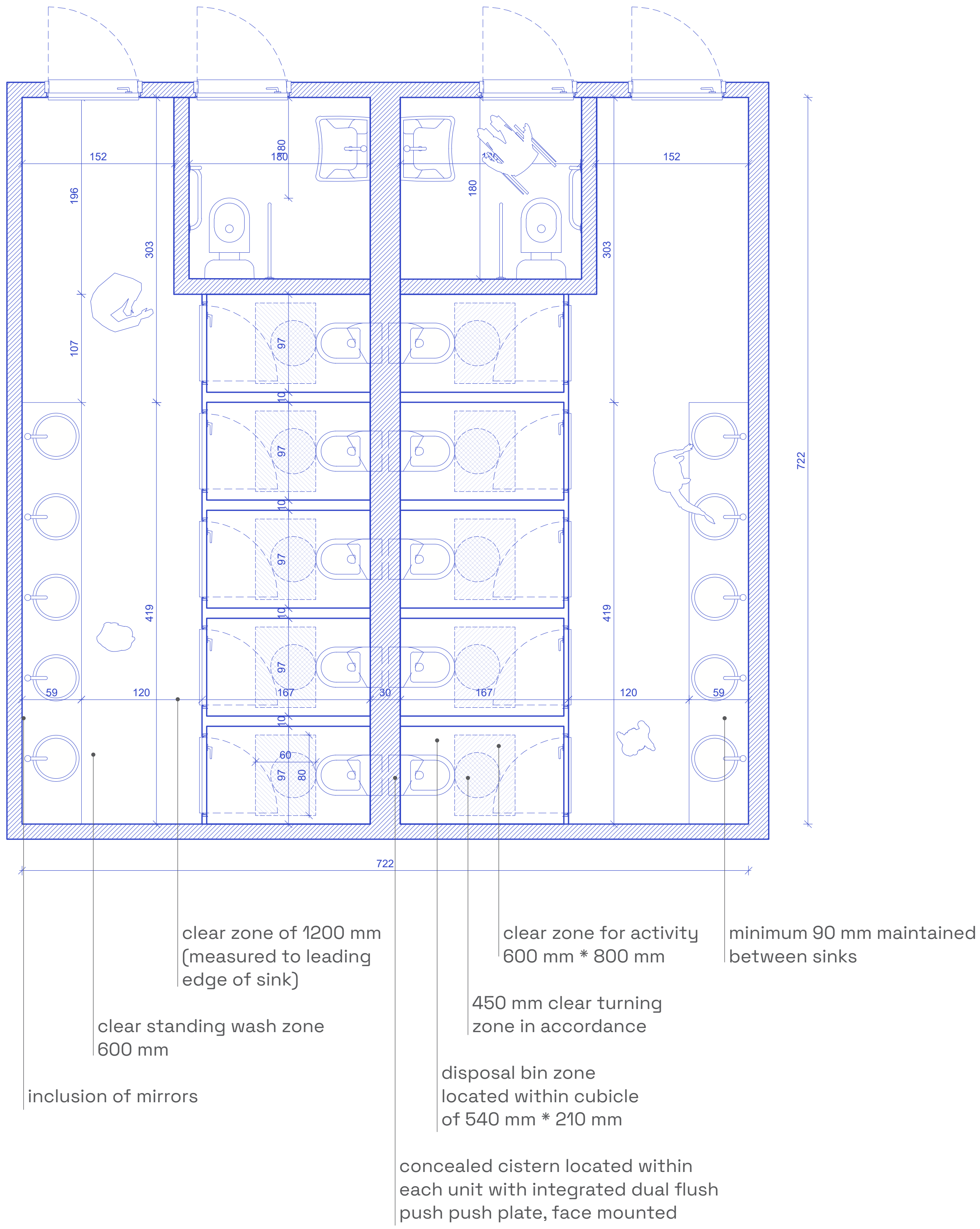
Turning space/ column of clearance/ activity zones:
465 mm diameter column of clearance between fixed sanitary ware and the door swing. 600 mm * 800 mm activity zone.

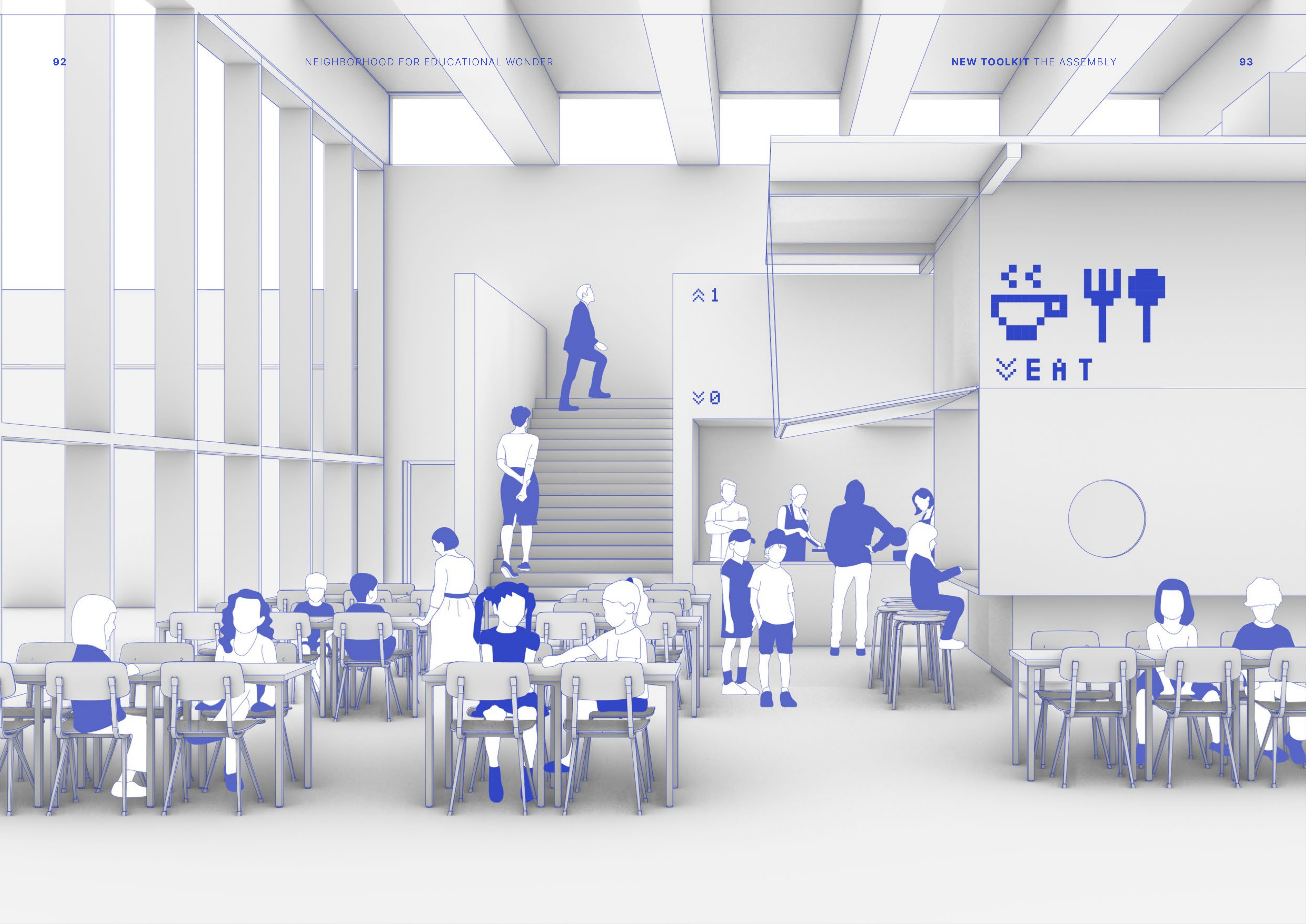
Equipment provided:
Hand wash facilities in a single-sex communal space for users of this type of toilet. Space provision for a sanitary bin.

Sanitary facilities of the catolgue

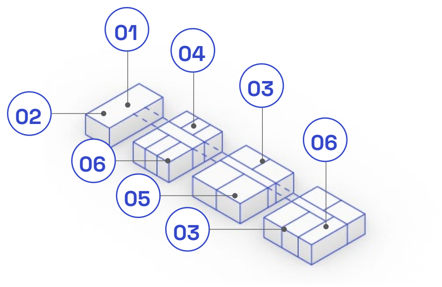
Spatial attributes :
Surface 92 m² Volume 276 m³
serving when necessary as storage and technical room

Devices :
toilette facilities

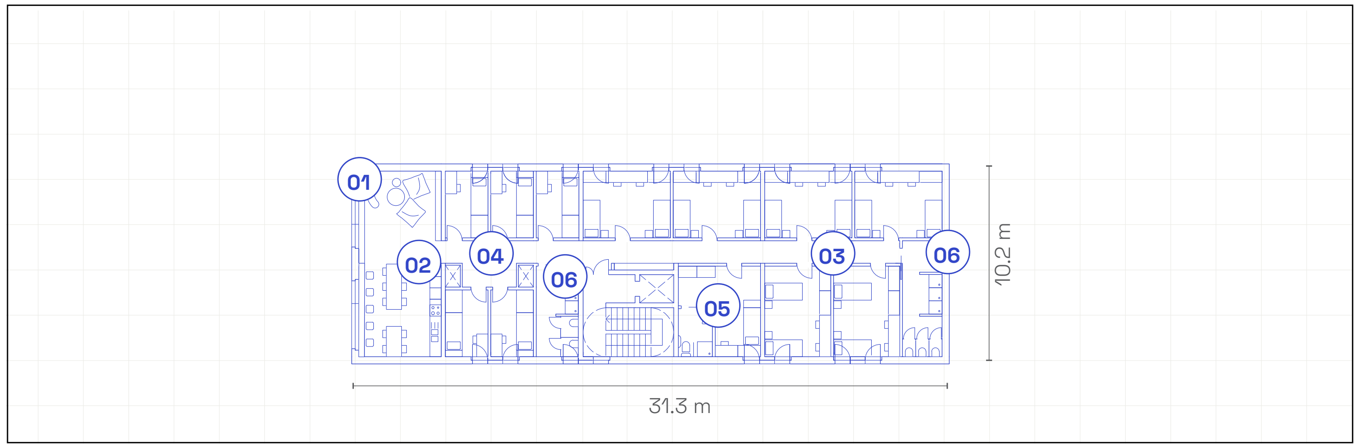



1
0
EAT

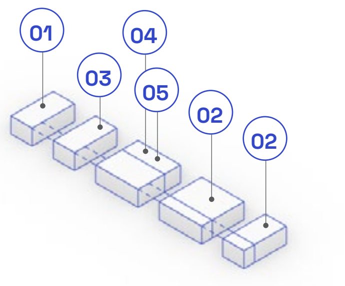
#4 Accomodations



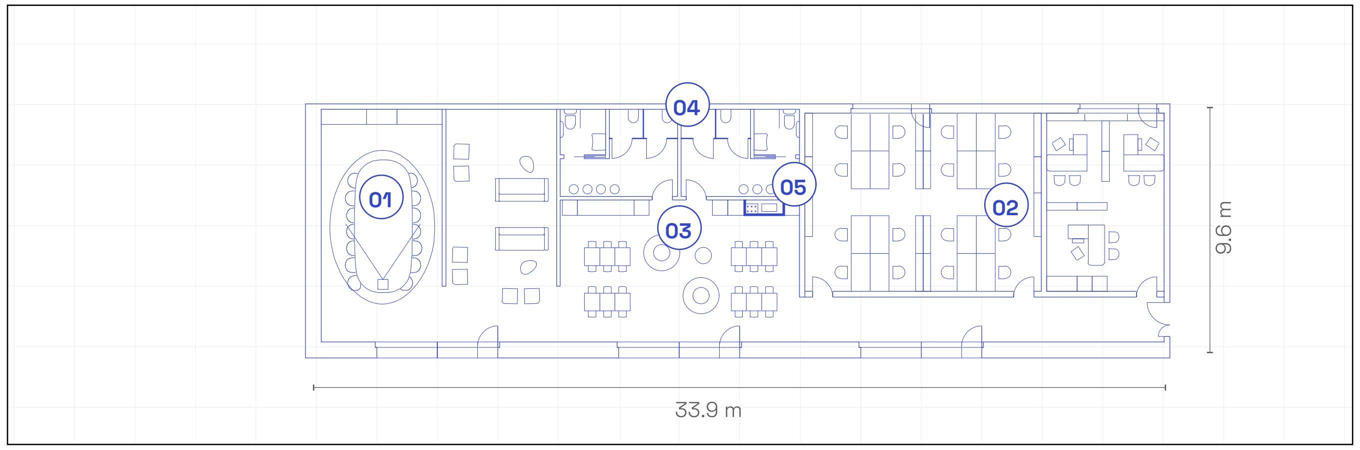
01. common room
02. kitchen
03. double room
04. single room
05. caretaker's room
06. sanitary facilities



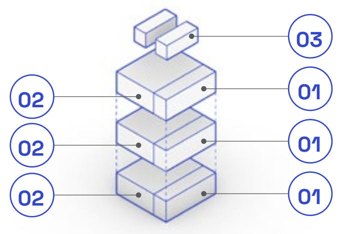
#5 Offices



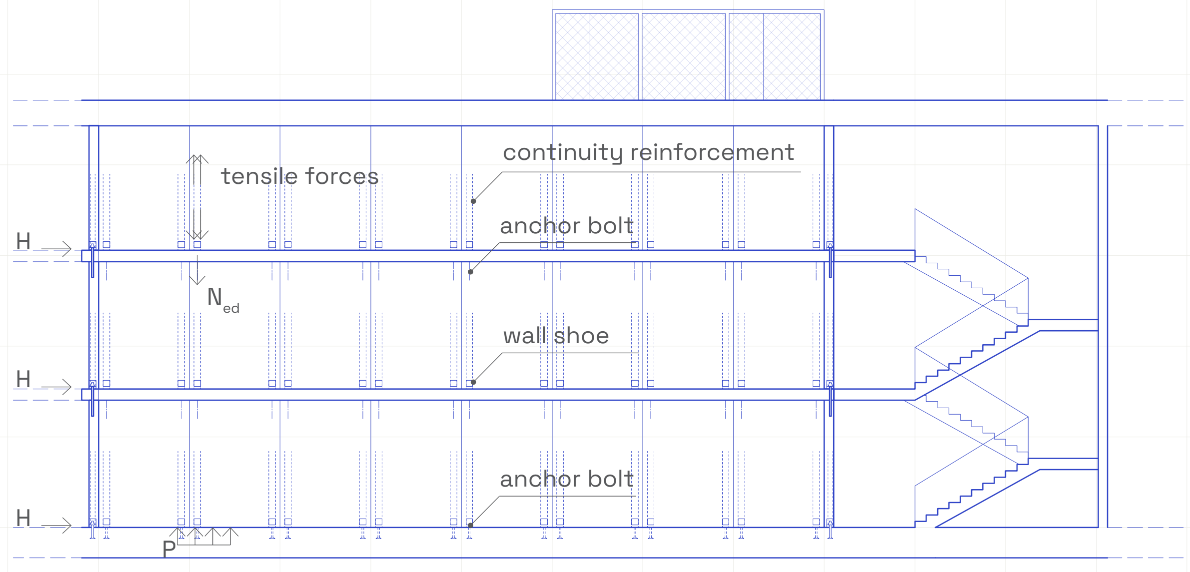
01. meeting room
02. office
03. teacher's working premises
04. sanitary facilities
05. sub distribution panel



#6 Floor Above



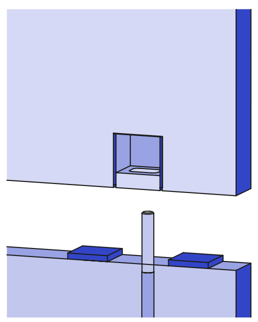
01. transitional space
02. classroom
03. AHU



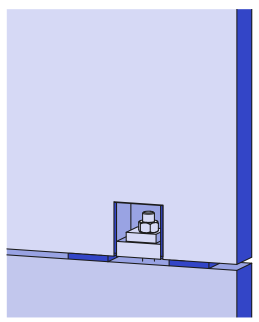
Structural behavior of the wall connections

Wall connections are designed to transfer tensile forces between the two connected wall elements. The compressive forces are transmitted via the grouting of the joint.

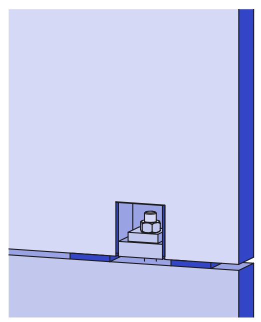
The wall is installed on preleveled shim plates



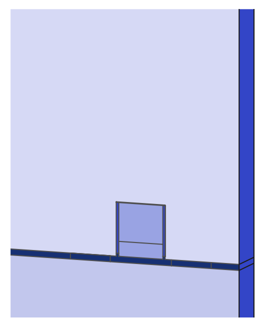
The nuts and washers are screwed on and tightened.

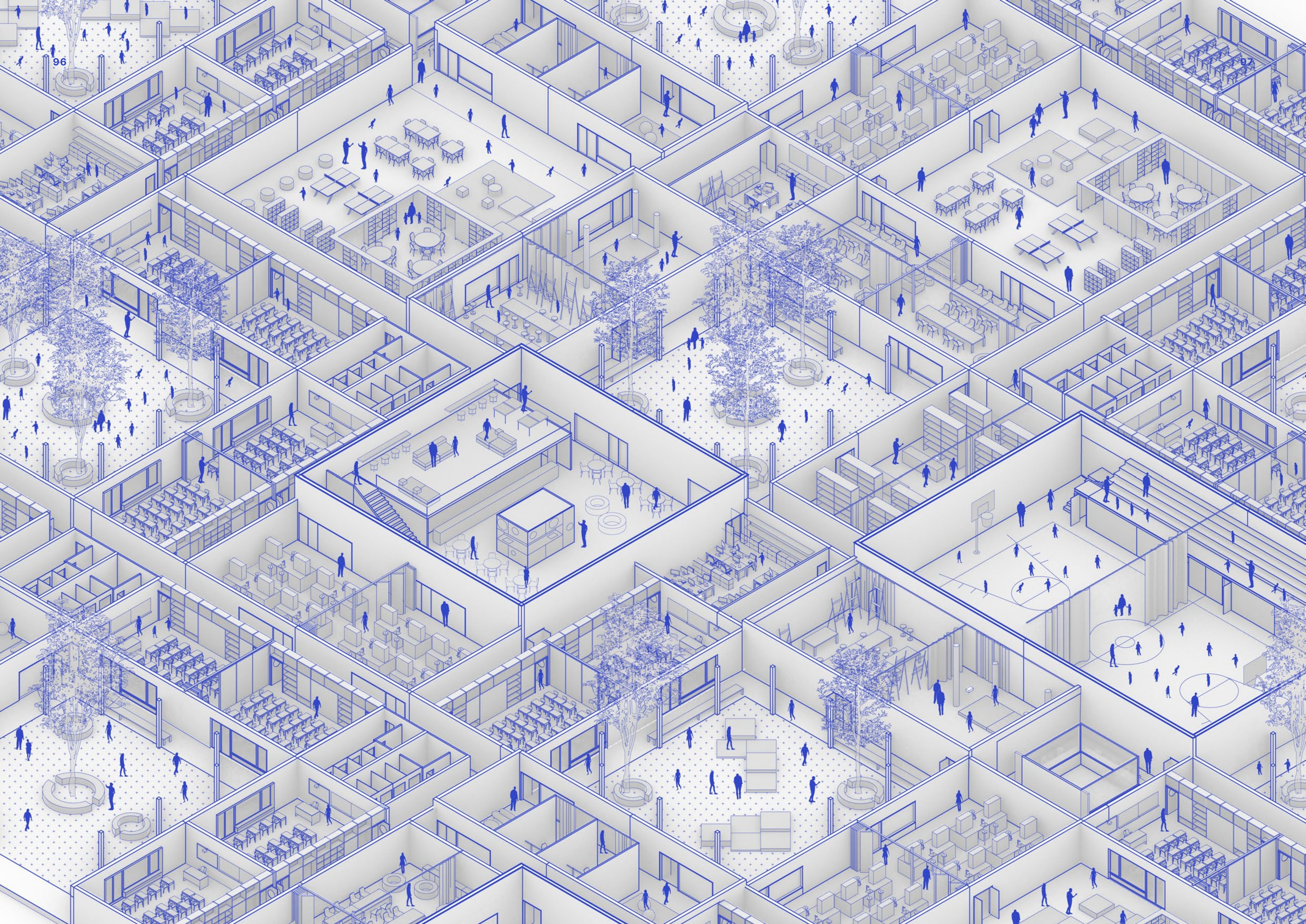


The connection is ready for grouting



The finalized connection after the grouting has hardened



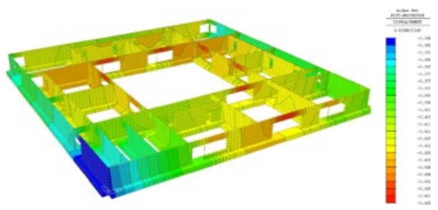


#1 Classrooms structure

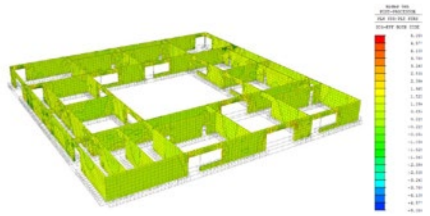
The functional blocks for the classrooms assembly are composed by modules characterized by a width of 9,60 m (lobby, classroom, sanitary facilities, and technical room) and 19,00 m for the courtyard. The precast wall foundations are made by reinforced concrete curbs with dimensions L x H equal to 150x60 cm. The precast walls, connected to each other by reinforced concrete joints, are characterized by a thickness of 18,00 cm. The roofs are made of precast hollow core slabs with a thickness of 30,00 cm.

The permanent load acting on the structures, in addition to the self-weight, has been assumed equal to 2,50 kN/m2, while the variable load (including accidental loads and snow load) is equal to 3,00 kN/m2.

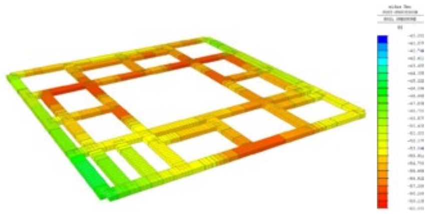
01



02



03

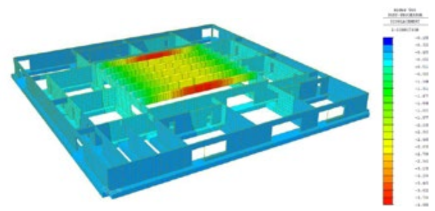


#2 Leisure structure

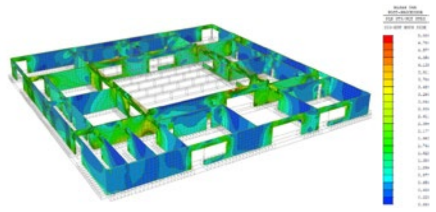
The functional blocks for the laboratories assembly are composed by modules characterized by a width of 9,60 m (lobby, shelter access, book storage, library, sanitary facilities, laboratories, offices, and technical room) and 19,00 m for the leisure. The precast wall foundations are made by reinforced concrete curbs with dimensions of 150x60 cm. The precast walls, connected to each other by reinforced concrete joints, are characterized by a thickness of 18,00 cm. The roofs of the 9,60 m modules are made by precast hollow core slabs with a thickness of 30,00 cm, while the roof of the leisure is made by precast beams (50x100 cm) and precast hollow core slabs with a thickness of 16,00 cm.

The permanent load acting on the structures, in addition to the self-weight, has been assumed equal to 2,50 kN/m2, while the variable load (including accidental loads and snow load) is equal to 3,00 kN/m2.

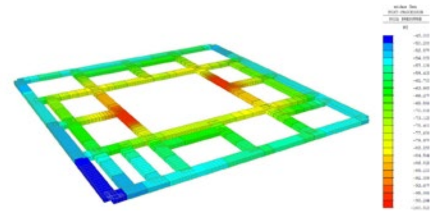
01



02



03

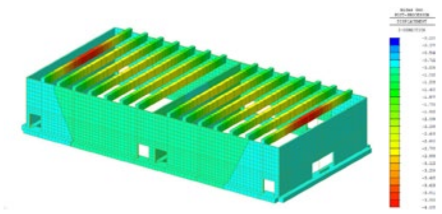


#3 Gym and Dining Hall structure

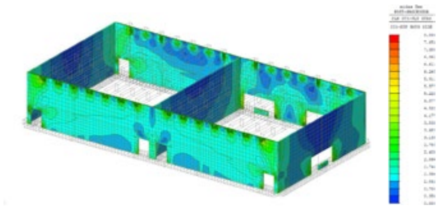
The functional blocks for the gym and dining hall assembly are composed by modules characterized by a width of 19,20 m and 24,00 m. The precast wall foundations are made by reinforced concrete curbs with dimensions of 150x60h cm. The precast walls, connected to each other by reinforced concrete joints, are characterized by a thickness of 18,00 cm. The roof is made by precast beams (50x100h cm) and precast hollow core slabs with a thickness of 16,00 cm.

The permanent load acting on the structures, in addition to the self-weight, has been assumed equal to 2,50 kN/m2, while the variable load (including accidental loads and snow load) is equal to 3,00 kN/m2.

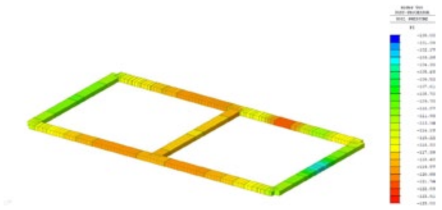
01



02



03



01. Vertical displacements
Serviceability limite state [cm]
02. Vertical wall stresses
Ultimate limit state [MPa]
03. Vertical soil pressure
Ultimate limit state [kPa]

#1 Classrooms daylight study

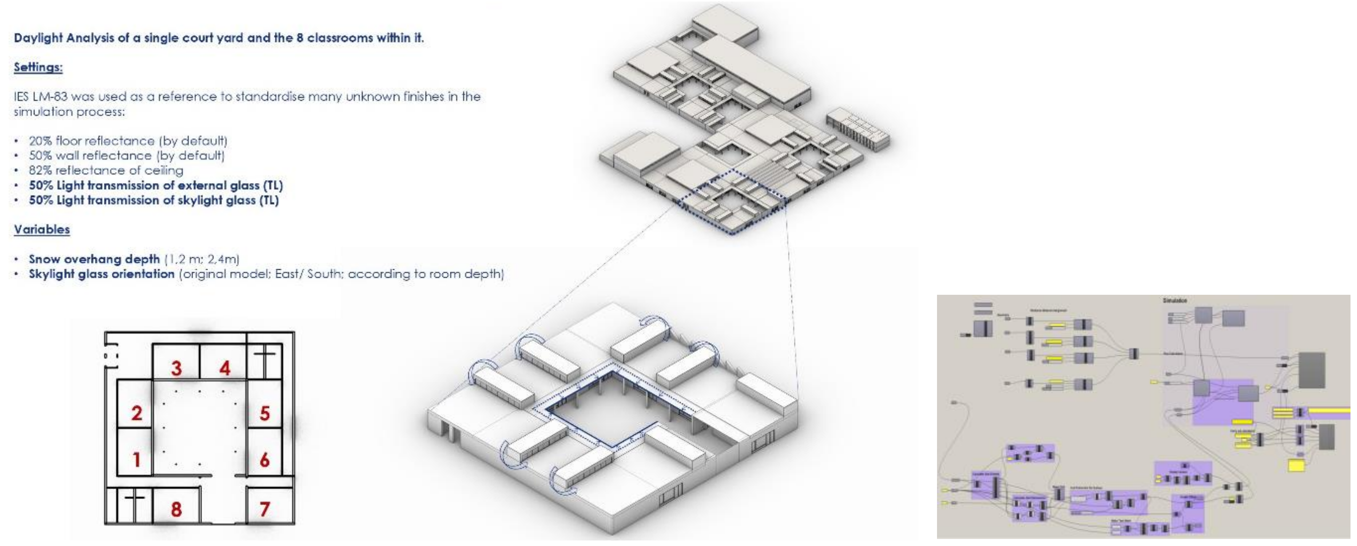
Recent studies have indicated the importance of natural light on the well-being and cognitive abilities of students. International research recorded a 40% increase in the fluency of oral reading among students exposed to high-intensity natural light. Poor lighting in indoor environments can increase the risk of myopia, whereas intense natural daylight has various health and cognitive benefits.

Intense natural light can enhance alertness, concentration, and cognitive performance, while color temperature influences mood and behavior. Additionally, daylight affects the body's circadian rhythm. Therefore, the lighting design considers both visual and non-visual effects of light to maximize student well-being.

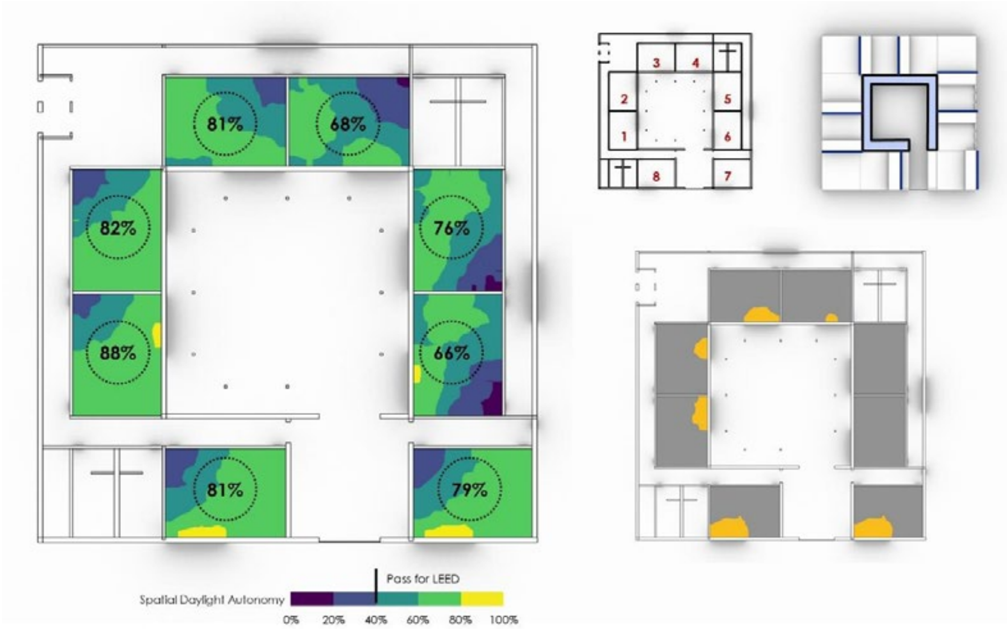
The project aimed to maximize natural light in indoor spaces. Detailed dynamic simulations were conducted, resulting in specific optimizations that made the building envelope permeable to natural light and ensured views of the outside. The simulation results showed that design elements such as skylights improved the distribution of natural light, with over 60% of the space being autonomous in terms of daylight throughout the year.

For these calculations, Deerns daylight specialists work with a mix of tools anchored around the 3D modeling software Rhinoceros 3D, and through the scripting tool Grasshopper (image below), the team is able to automate many of their processes.

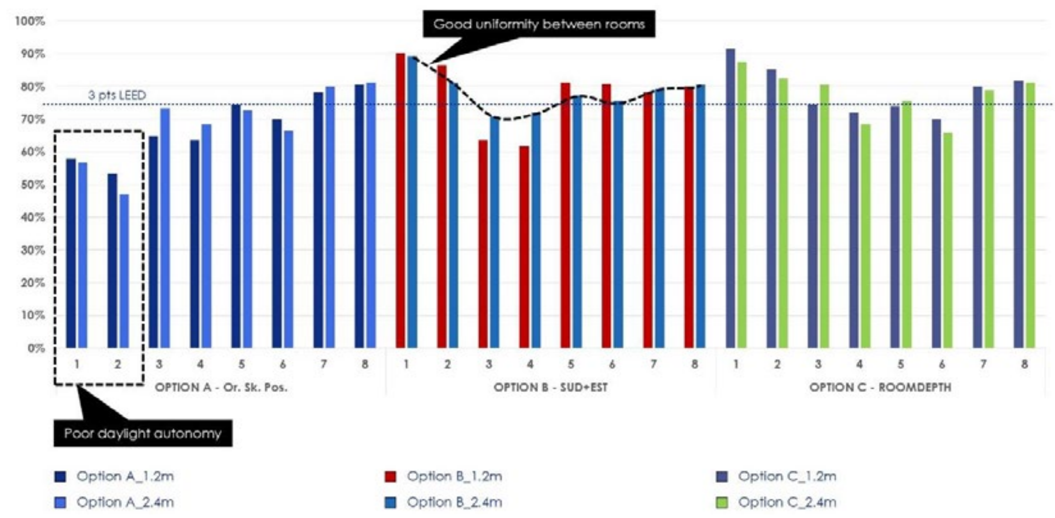
Several studies on the classroom module were iterated to optimize the availability of natural light through the presence of skylights combined with the depth of the outdoor porch to allow the use of outdoor spaces protected from rain and snow. The final solution with a 2.4m overhang depth provides some of the best daylight autonomy results and, most importantly, provides the best uniformity between rooms. This means no one classroom will be severely penalized compared to others.



36 DAYLIGHT ANALYSIS STUDY



37 CLASSROOM DAYLIGHT ANALYSIS



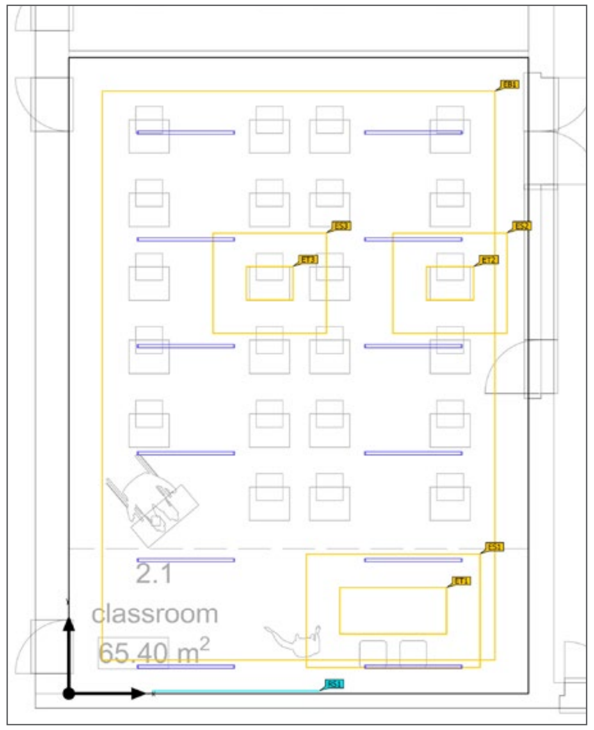
38 CLASSROOM COMPARISON

The optimization of natural light in the project is expected to improve student performance, particularly in tasks like reading, and positively affect their health, cognitive abilities, and circadian rhythm, thereby enhancing their well-being and promoting effective learning.

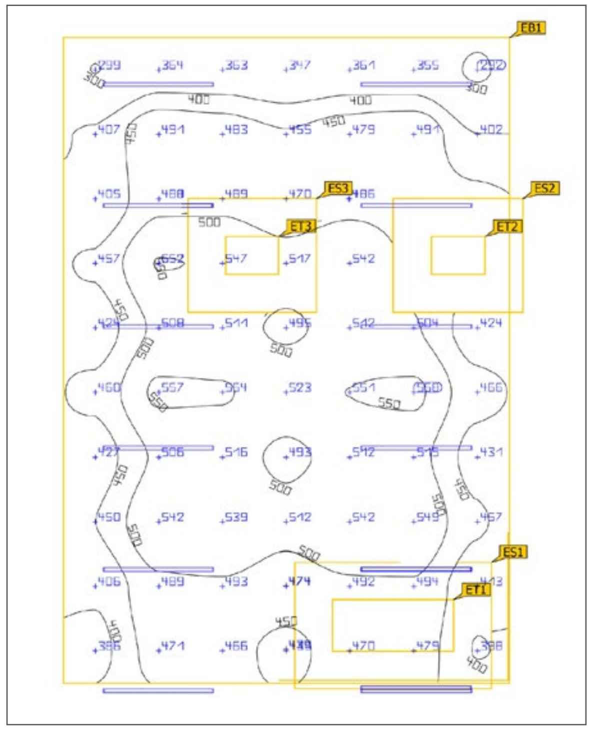
A light control system, combined with light sensors, will optimize artificial light flow based on the availability of natural light. It also allows for the variation of the color temperature of the indirect component throughout the day, following circadian cycles of daylight.

These solutions integrate the visual, biological, and emotional effects of light, influencing the well-being and individual performance of students.

#1 Classrooms
bioclimatic and interior lighting study



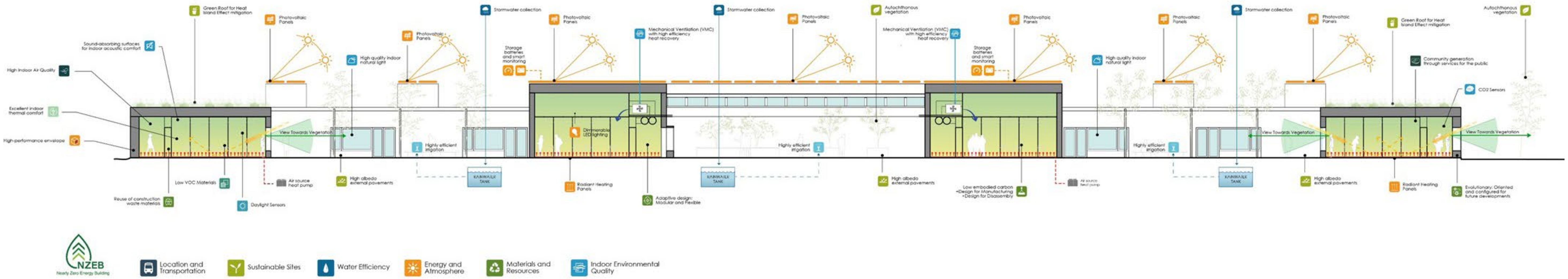
39 CALCULATION OBJECT



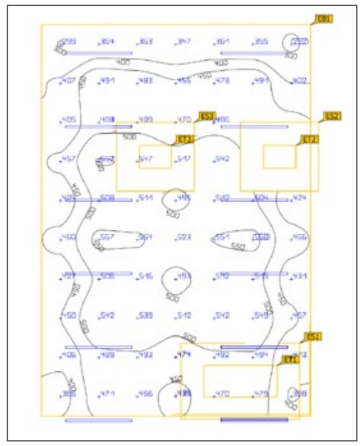
40 TEACHER DESK, STUDENTS DESKS CENTRAL AND SIDE

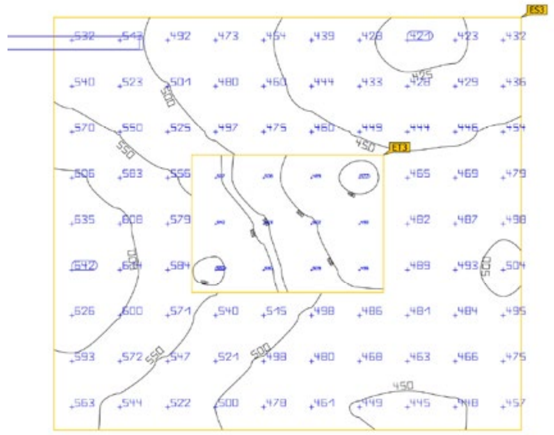
Properties	$\bar{E}$ (Target)	E_{min}	E_{max}	U_o (g_1) (Target)	g_2	Index
Cattedra Perpendicular illuminance Height: 0.800 m, Surrounding area: 0.500 m	628 lx (≥ 500 lx) ✓	510 lx	694 lx	0.81 (≥ 0.60) ✓	0.73	ET1
Surrounding area 1 Perpendicular illuminance Height: 0.800 m	496 lx (≥ 300 lx) ✓	342 lx	619 lx	0.69 (≥ 0.40) ✓	0.55	ES1
Background area 1 Perpendicular illuminance Height: 0.000 m, Wall zone: 0.500 m	470 lx (≥ 100 lx) ✓	292 lx	558 lx	0.62 (≥ 0.10) ✓	0.52	EB1
Banco laterale Perpendicular illuminance Height: 0.650 m, Surrounding area: 0.500 m	580 lx (≥ 500 lx) ✓	508 lx	645 lx	0.88 (≥ 0.60) ✓	0.79	ET2
Surrounding area 2 Perpendicular illuminance Height: 0.650 m	504 lx (≥ 300 lx) ✓	315 lx	667 lx	0.63 (≥ 0.40) ✓	0.47	ES2
Background area 1 Perpendicular illuminance Height: 0.000 m, Wall zone: 0.500 m	469 lx (≥ 100 lx) ✓	292 lx	558 lx	0.62 (≥ 0.10) ✓	0.52	EB1
Banco centrale Perpendicular illuminance Height: 0.640 m, Surrounding area: 0.500 m	512 lx (≥ 500 lx) ✓	477 lx	552 lx	0.93 (≥ 0.60) ✓	0.86	ET3
Surrounding area 3 Perpendicular illuminance Height: 0.640 m	502 lx (≥ 300 lx) ✓	421 lx	642 lx	0.84 (≥ 0.40) ✓	0.66	ES3
Background area 1 Perpendicular illuminance Height: 0.000 m, Wall zone: 0.500 m	467 lx (≥ 100 lx) ✓	292 lx	558 lx	0.63 (≥ 0.10) ✓	0.52	EB1

42 CALCULATION OBJECT

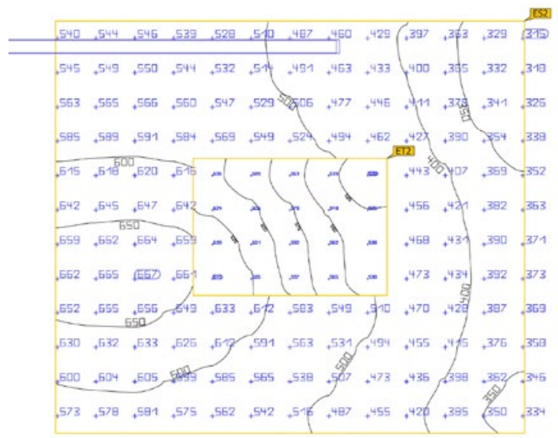


41 BIOCLIMATIC SECTION

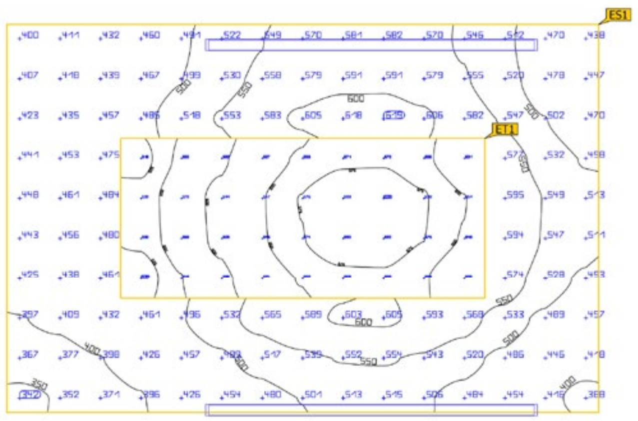




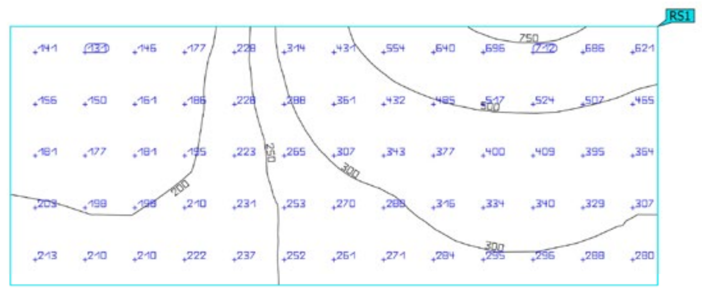
43 CENTRAL STUDENT DESK ZOOM IN



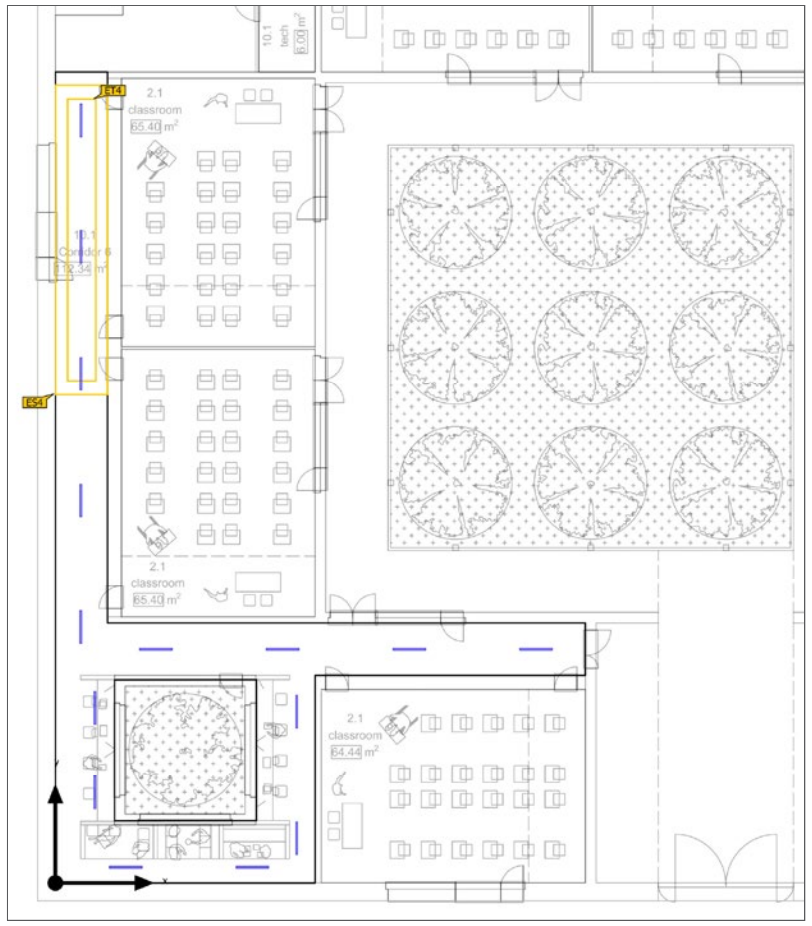
44 SIDE STUDENT DESK ZOOM IN



45 TEACHER DESK ZOOM IN



46 BLACKBOARD ZOOM IN



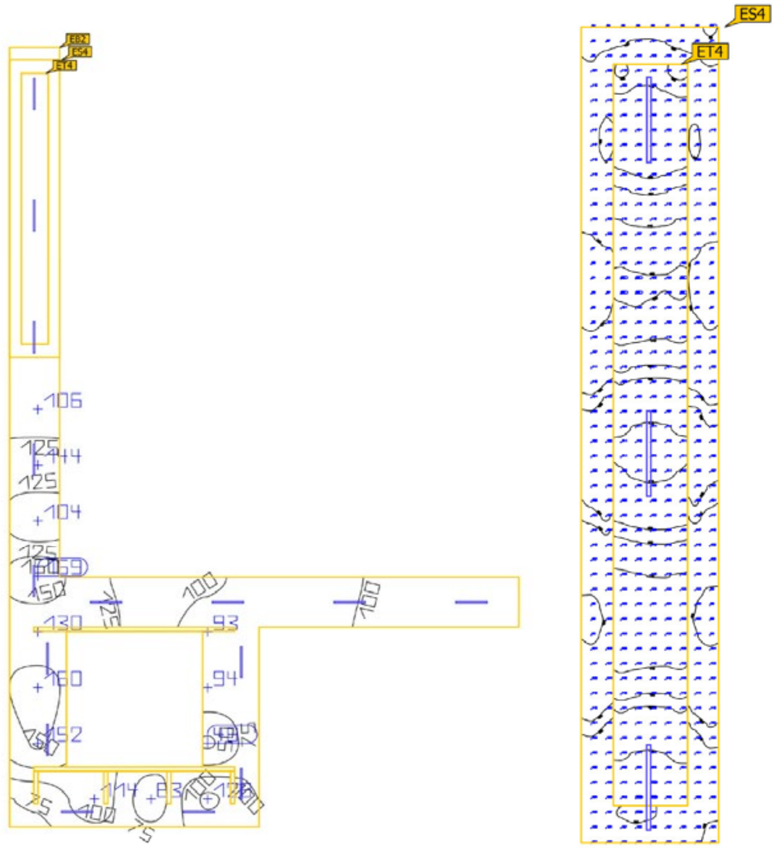
47 INFORMAL LEARNING SPACES

Properties	Ē (Target)	E_{min}	E_{max}	U_o (g_1) (Target)	g_2	Index
Corridoio Perpendicular illuminance Height: 0.000 m, Surrounding area: 0.500 m	121 lx (≥ 100 lx) ✓	98.8 lx	146 lx	0.82 (≥ 0.40) ✓	0.68	ET4
Surrounding area 6 Perpendicular illuminance Height: 0.000 m	114 lx (≥ 100 lx) ✓	88.7 lx	142 lx	0.78 (≥ 0.40) ✓	0.62	ES4
Background area 2 Perpendicular illuminance Height: 0.000 m, Wall zone: 0.500 m	116 lx (≥ 33.3 lx) ✓	47.6 lx	169 lx	0.41 (≥ 0.10) ✓	0.28	EB2

Utilisation profile: Traffic zones inside buildings (9.1 Circulation areas and corridors)

Notes on planning:
The results were calculated without consideration of objects and furniture. No results were determined on their surfaces.

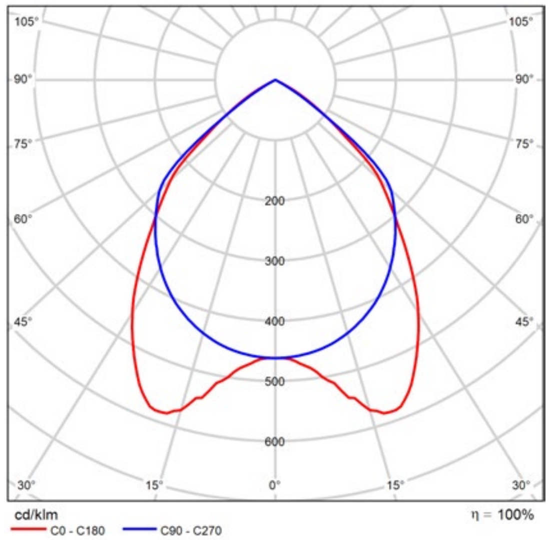
48 CALCULATION OBJECT



49 INFORMAL LEARNING SPACES ZOOM IN

Disano Illuminazione S.p.A - Liset 2.0 - a sospensione - diretta - Dark light - UGR<lt/>19 4000K CRI80 30W CLD-D-D Bianco

Article No.	22302009-1241
P	30.0 W
Φ_{Lamp}	3240 lm
$\Phi_{Luminaire}$	3240 lm
η	99.99 %
Luminous efficacy	108.0 lm/W
CCT	4000 K
CRI	80



Polar LDC

Glare evaluation according to UGR

ρ Ceiling		70	70	50	50	30	70	70	50	50	30
ρ Walls		50	30	50	30	30	50	30	50	30	30
ρ Floor		20	20	20	20	20	20	20	20	20	20
Room size X	Y	Viewing direction at right angles to lamp axis					Viewing direction parallel to lamp axis				
2H	2H	19.9	20.9	20.2	21.2	21.4	20.4	21.4	20.6	21.6	21.8
	3H	19.7	20.7	20.1	20.9	21.2	20.2	21.1	20.5	21.4	21.6
	4H	19.7	20.5	20.0	20.8	21.1	20.1	21.0	20.4	21.3	21.5
	6H	19.6	20.4	19.9	20.7	21.0	20.0	20.9	20.4	21.1	21.4
	8H	19.6	20.3	19.9	20.6	20.9	20.0	20.8	20.4	21.1	21.4
	12H	19.5	20.3	19.9	20.6	20.9	20.0	20.7	20.3	21.0	21.4
4H	2H	19.8	20.7	20.2	21.0	21.2	20.3	21.1	20.6	21.4	21.7
	3H	19.7	20.4	20.1	20.7	21.1	20.1	20.8	20.5	21.1	21.5
	4H	19.6	20.3	20.0	20.6	21.0	20.0	20.7	20.4	21.0	21.4
	6H	19.5	20.1	19.9	20.5	20.9	20.0	20.5	20.4	20.9	21.3
	8H	19.5	20.0	19.9	20.4	20.8	19.9	20.4	20.3	20.8	21.2
	12H	19.4	19.9	19.9	20.3	20.8	19.9	20.4	20.3	20.8	21.2
8H	4H	19.5	20.0	19.9	20.4	20.8	19.9	20.4	20.3	20.8	21.2
	6H	19.4	19.8	19.9	20.3	20.7	19.8	20.3	20.3	20.7	21.1
	8H	19.4	19.7	19.8	20.2	20.7	19.8	20.2	20.3	20.6	21.1
	12H	19.3	19.7	19.8	20.1	20.6	19.7	20.1	20.2	20.5	21.0
12H	4H	19.4	19.9	19.9	20.3	20.8	19.9	20.4	20.3	20.8	21.2
	6H	19.4	19.7	19.8	20.2	20.7	19.8	20.2	20.3	20.6	21.1
	8H	19.3	19.7	19.8	20.1	20.6	19.7	20.1	20.2	20.5	21.0

Variation of the observer position for the luminaire distances S

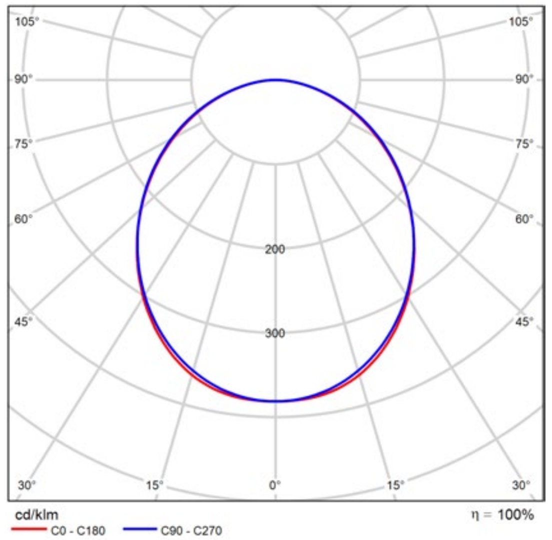
S = 1.0H	+1.1 / -3.1	+1.7 / -3.7
S = 1.5H	+2.3 / -9.7	+3.1 / -16.3
S = 2.0H	+4.0 / -25.8	+4.9 / -23.6
Standard table	BK00	BK00
Correction summand	1.4	1.8

Corrected glare indices referring to 3240lm Total luminous flux

UGR diagram (SHR: 0.25)

Disano Illuminazione S.p.A - Liset 2.0 - incasso - diffusore in policarbonato 4000K CRI80 28W CLD Bianco

Article No.	22302201-00
P	28.0 W
Φ_{Lamp}	2783 lm
$\Phi_{Luminaire}$	2783 lm
η	99.99 %
Luminous efficacy	99.4 lm/W
CCT	4000 K
CRI	80



Polar LDC

Glare evaluation according to UGR

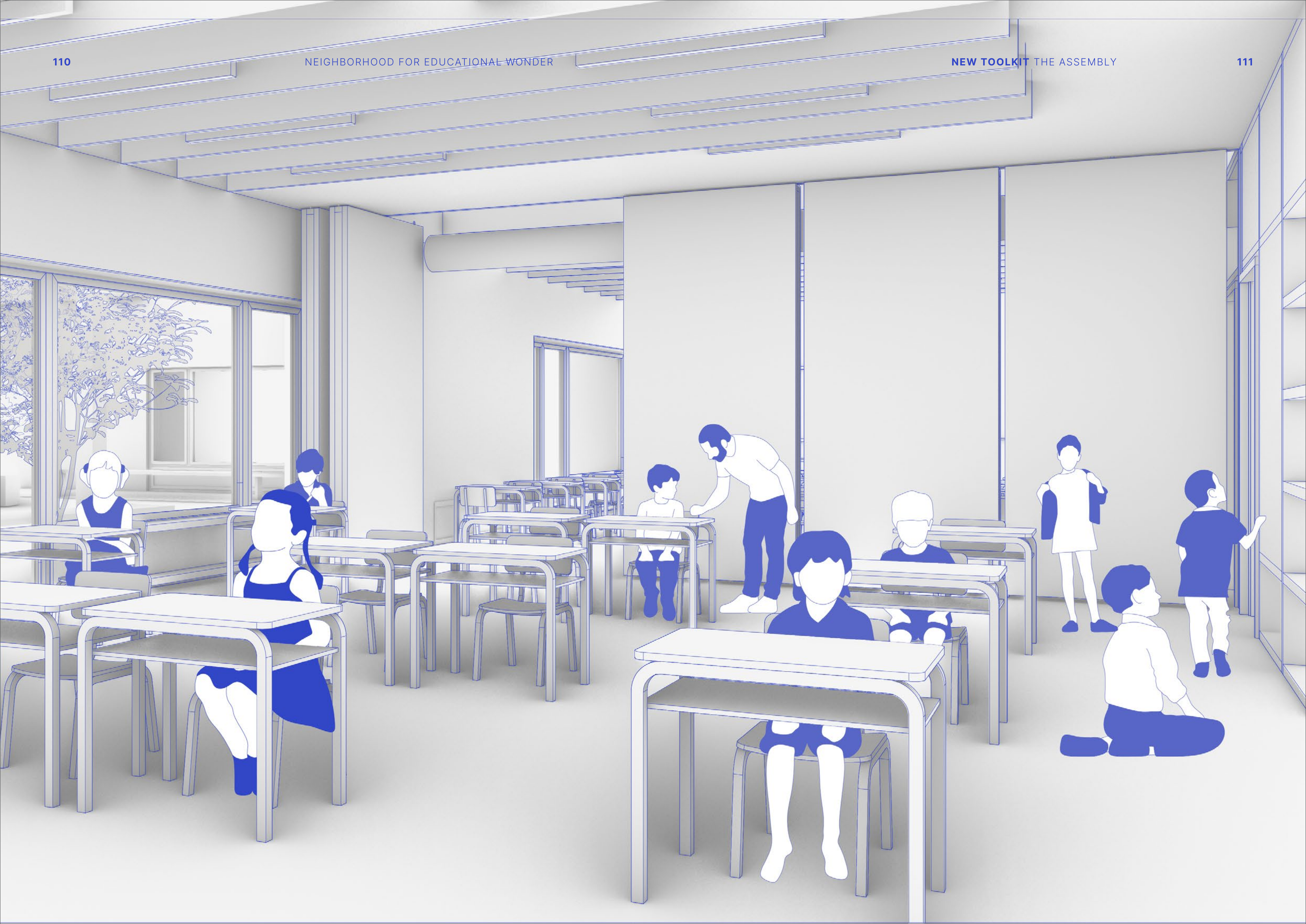
ρ Ceiling		70	70	50	50	30	70	70	50	50	30
ρ Walls		50	30	50	30	30	50	30	50	30	30
ρ Floor		20	20	20	20	20	20	20	20	20	20
Room size X	Y	Viewing direction at right angles to lamp axis					Viewing direction parallel to lamp axis				
2H	2H	22.1	23.5	22.4	23.7	23.9	22.3	23.6	22.6	23.9	24.1
	3H	23.6	24.8	23.9	25.1	25.3	23.8	25.0	24.1	25.3	25.5
	4H	24.2	25.3	24.5	25.6	25.9	24.4	25.5	24.7	25.8	26.1
	6H	24.6	25.7	24.9	26.0	26.3	24.8	25.9	25.2	26.2	26.5
	8H	24.7	25.7	25.1	26.1	26.4	25.0	26.0	25.3	26.3	26.6
	12H	24.8	25.8	25.2	26.1	26.5	25.1	26.1	25.4	26.4	26.7
4H	2H	22.8	23.9	23.1	24.2	24.5	22.9	24.1	23.3	24.4	24.6
	3H	24.4	25.4	24.8	25.7	26.1	24.6	25.6	25.0	25.9	26.3
	4H	25.1	26.0	25.5	26.4	26.7	25.4	26.2	25.8	26.6	27.0
	6H	25.7	26.5	26.1	26.8	27.2	25.9	26.7	26.3	27.1	27.5
	8H	25.9	26.6	26.3	27.0	27.4	26.1	26.8	26.6	27.2	27.7
	12H	26.0	26.7	26.5	27.1	27.5	26.3	26.9	26.7	27.3	27.8
8H	4H	25.4	26.2	25.9	26.6	27.0	25.6	26.3	26.1	26.7	27.2
	6H	26.1	26.7	26.6	27.2	27.6	26.3	26.9	26.8	27.4	27.8
	8H	26.4	26.9	26.9	27.4	27.9	26.6	27.1	27.1	27.6	28.1
	12H	26.6	27.1	27.1	27.5	28.0	26.9	27.3	27.3	27.8	28.3
12H	4H	25.5	26.1	25.9	26.5	27.0	25.6	26.3	26.1	26.7	27.1
	6H	26.2	26.7	26.7	27.2	27.6	26.4	26.9	26.9	27.4	27.9
	8H	26.5	27.0	27.0	27.4	27.9	26.7	27.2	27.2	27.6	28.1

Variation of the observer position for the luminaire distances S

S = 1.0H	+0.1 / -0.1	+0.1 / -0.1
S = 1.5H	+0.2 / -0.4	+0.2 / -0.4
S = 2.0H	+0.4 / -0.7	+0.4 / -0.7
Standard table	BK06	BK06
Correction summand	9.3	9.5

Corrected glare indices referring to 2783lm Total luminous flux

UGR diagram (SHR: 0.25)



#1 Classrooms analysis of photovoltaics on skylights

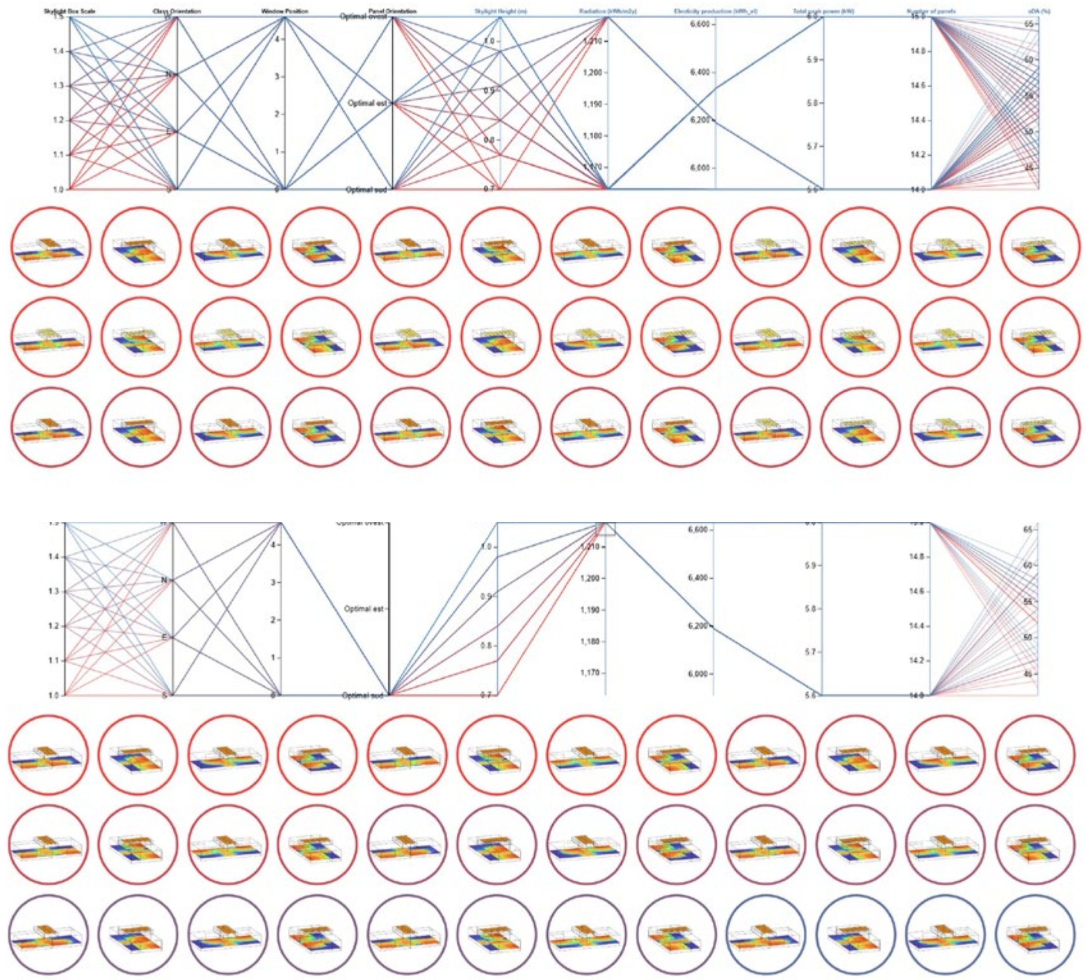
A parametric-iterative approach was used to identify areas with the highest exposure to solar radiation and to determine optimal configurations for photovoltaic panel placement on the classroom module.

The analysis aimed to optimize renewable energy production using parametric scripts, which tested various panel orientations and calculated the maximum number of panels, total system power, and estimated energy output for the site. The analysis can also evaluate photovoltaics potential, compare alternatives, and identify solutions that maximize energy production while minimizing costs.

Optimizing glazing surfaces and skylight configurations in classrooms is crucial for balancing energy efficiency, daylight performance, and photovoltaic (PV) production. Strategic adjustments, such as increasing skylight height and repositioning lateral windows, can significantly enhance the distribution of natural light, especially in classrooms facing North or West.

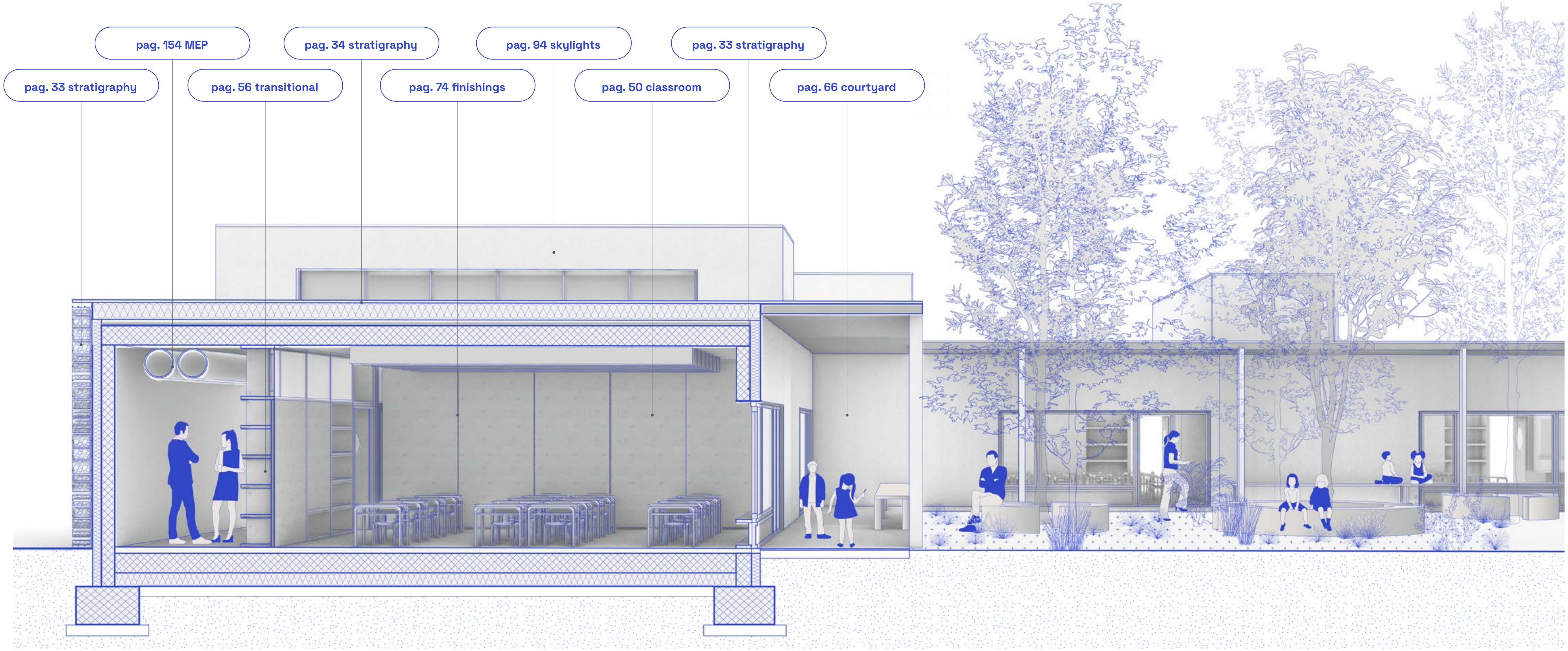
By optimizing the skylight configurations, it was possible to significantly increase photovoltaic production, with the highest potential in east and west-facing classrooms. The final configuration enables each classroom module to achieve a power output of 3.44 kW, with renewable energy production ranging from 3070 kWh to 3268 kWh, depending on orientation.

The next phases should investigate the required distance between glass and PV panels according to Ukrainian regulations, as this may impact daylight performance and PV energy production.



52 **ANALYSIS USING PARAMETRIC OPTIMIZERS TO STUDY PHOTOVOLTAIC PANEL CONFIGURATIONS AND LAYOUTS**

#1 Classrooms assembly



#2 Leisure


pag. 154 MEP
pag. 33 stratigraphy
pag. 68 leisure
pag. 92 structure
pag. 56 transitional

3 NEW AND BEYOND

Here are the upgrades previously explained, now applied to the case study that was submitted during the competition phase.

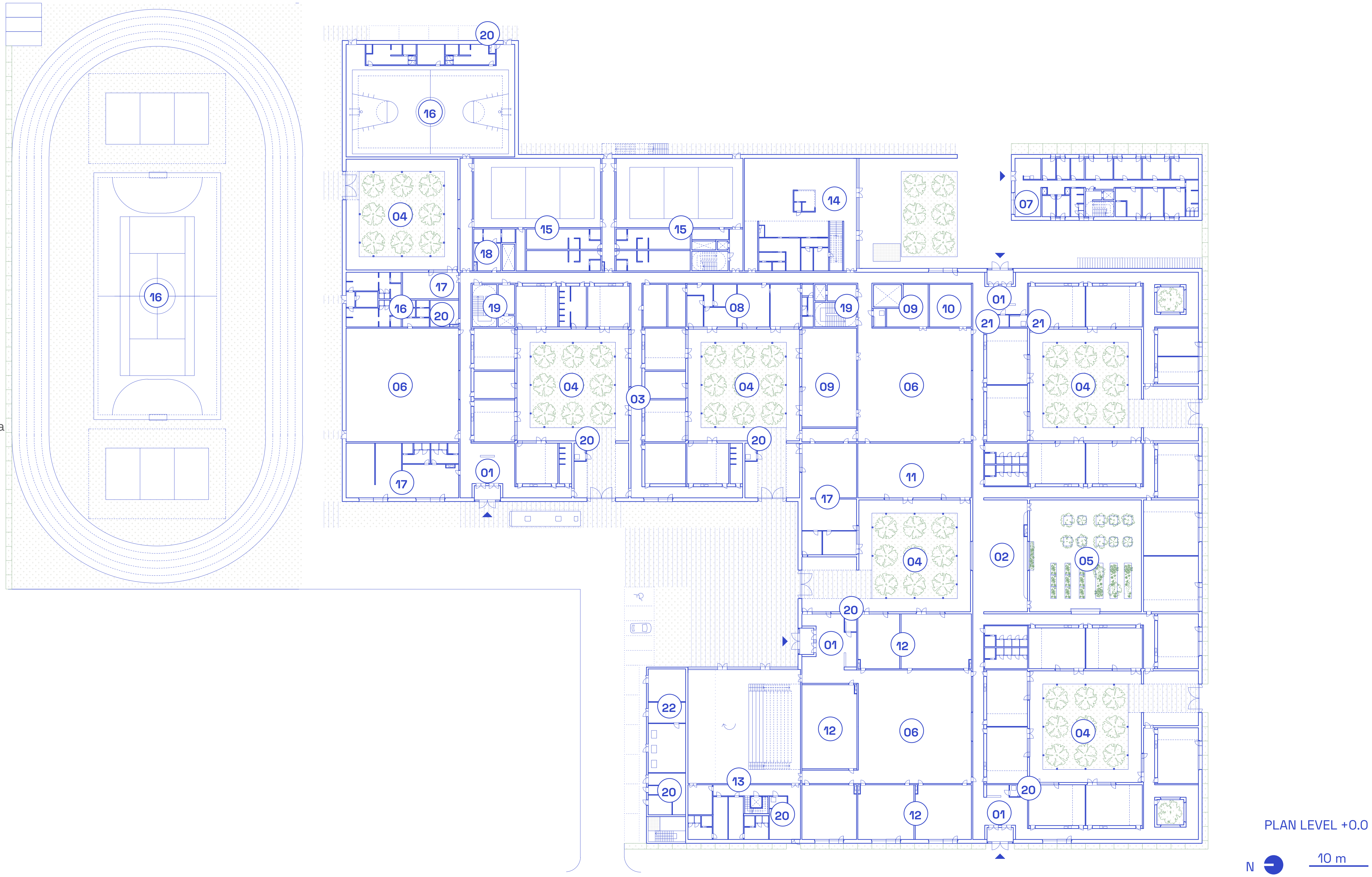
In the case study, we are showcasing the application of the principles outlined in the handbook.

Compared to the previous concept design, the courtyards have been redesigned to enhance maintenance and accessibility, offering a more open and functional layout. Additional details have been incorporated into various functions, improving both functionality and flows. The attention to detail has made these areas more practical and coherent with the brief.

Following the drawings and the cost estimation, we include an analysis of a possible school day at the Neighborhood for Educational Wonder, highlighting how the spaces facilitate learning and community interaction throughout the day.

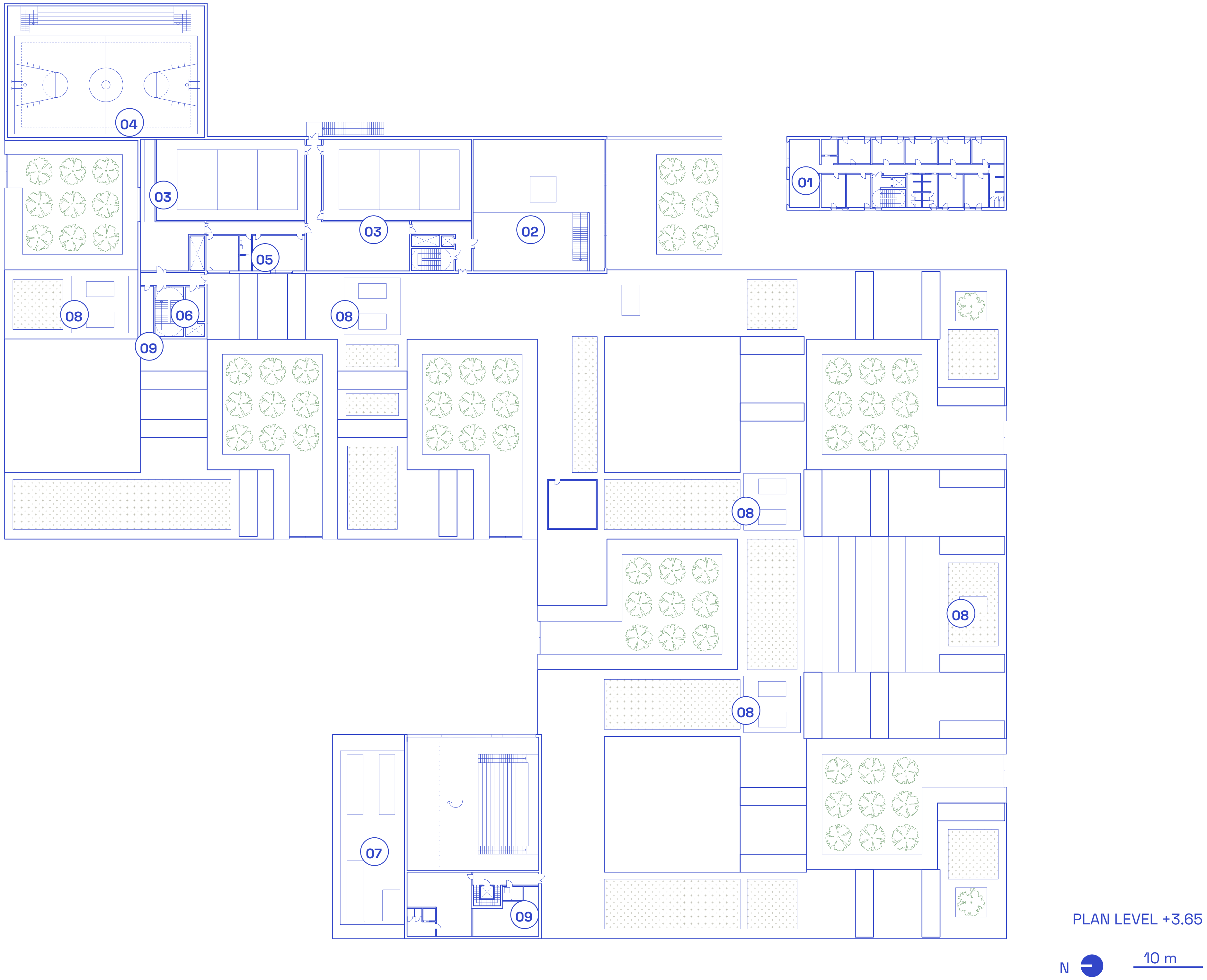
3.1
A CASE STUDY
TOOLS TO TEST

01. lobby
02. highschool
03. primary school
04. courtyard
05. greenhouse
06. leisure
07. dormitory
08. medicine
09. library + book storage
10. museum repository
11. community premises
12. laboratories
13. amphitheatre-style space
14. dining hall
15. multi purpose hall for junior
16. outdoor sports
17. offices + teachers' working premises
18. utility room
19. shelter access
20. electrical technical area
21. control room
22. mechanical technical area



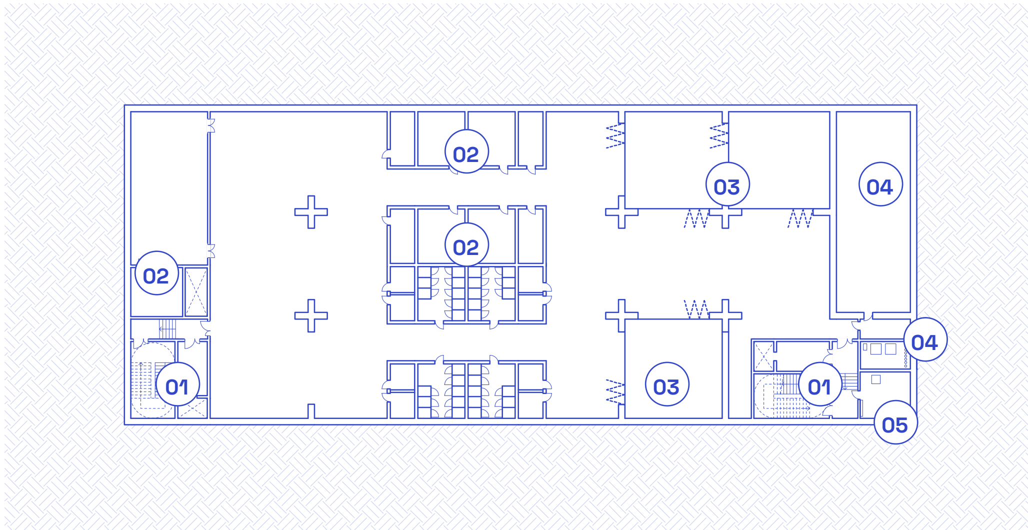
* Entrance and small corridors will be henanced and emphasized.
** All elements will be designed in accordance with UA norms and regulations.
** During the design development, a complete list of outdoor activity items and equipment will be positioned.

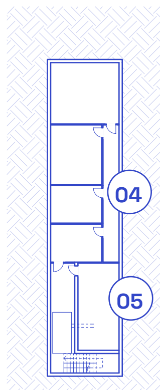
01. dormitory
02. dining hall
03. multi purpose hall for junior
04 sports and fitness multifunctional hall
05. offices + teachers' working premises
06. shelter access
07. energy center
08. mechanical technical area
09. electrical technical area



PLAN LEVEL +3.65

01. shelter access
02. ancillary facilities
03. training workshop
04. mechanical technical area
05. electrical technical area





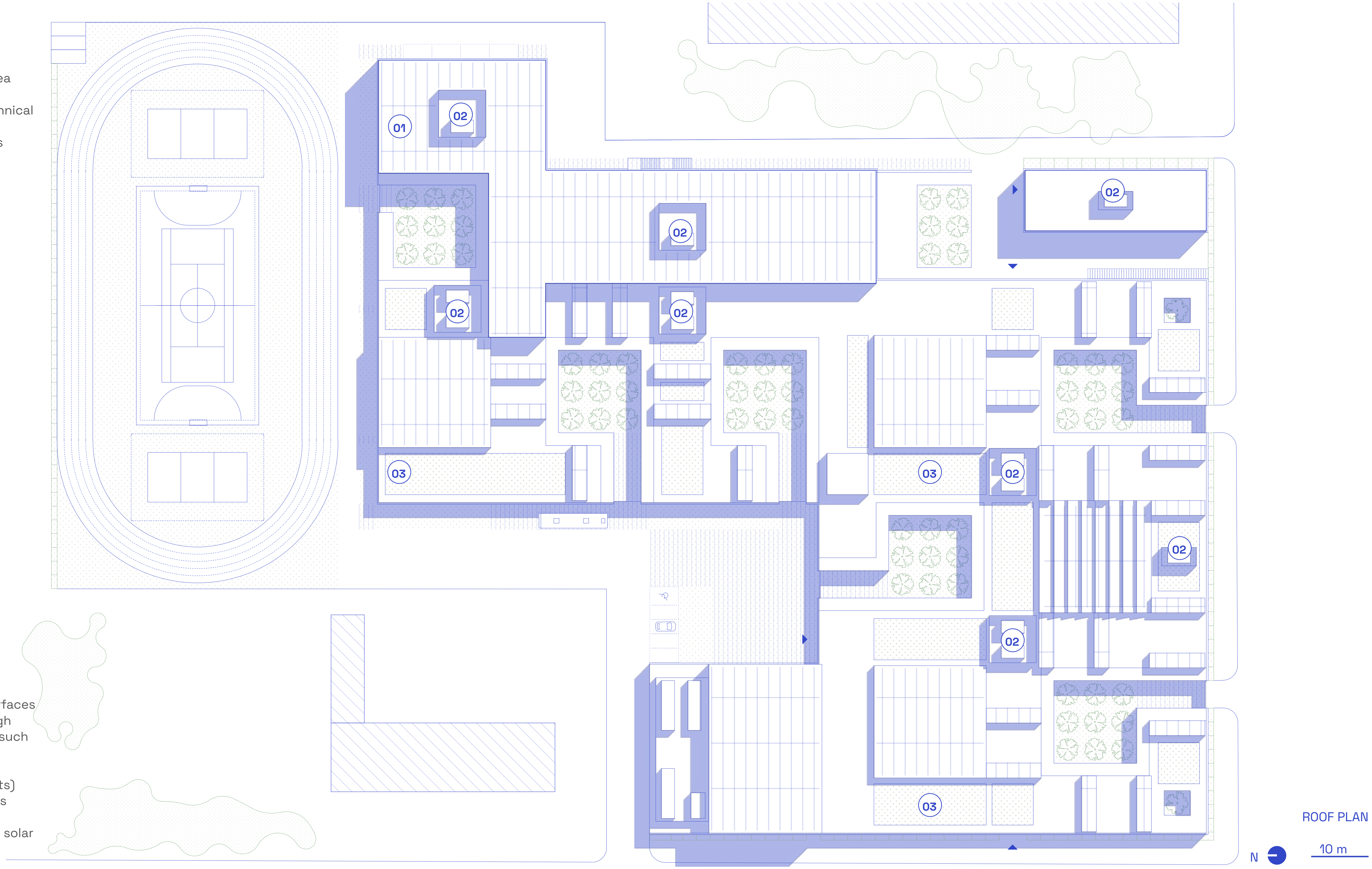
* Additional shelter's entries / exits further away from the building will be added.

PLAN LEVEL -4.0

N

10 m

01. photovoltaic area 639kWp
02. mechanical technical area
03. rooftop gardens

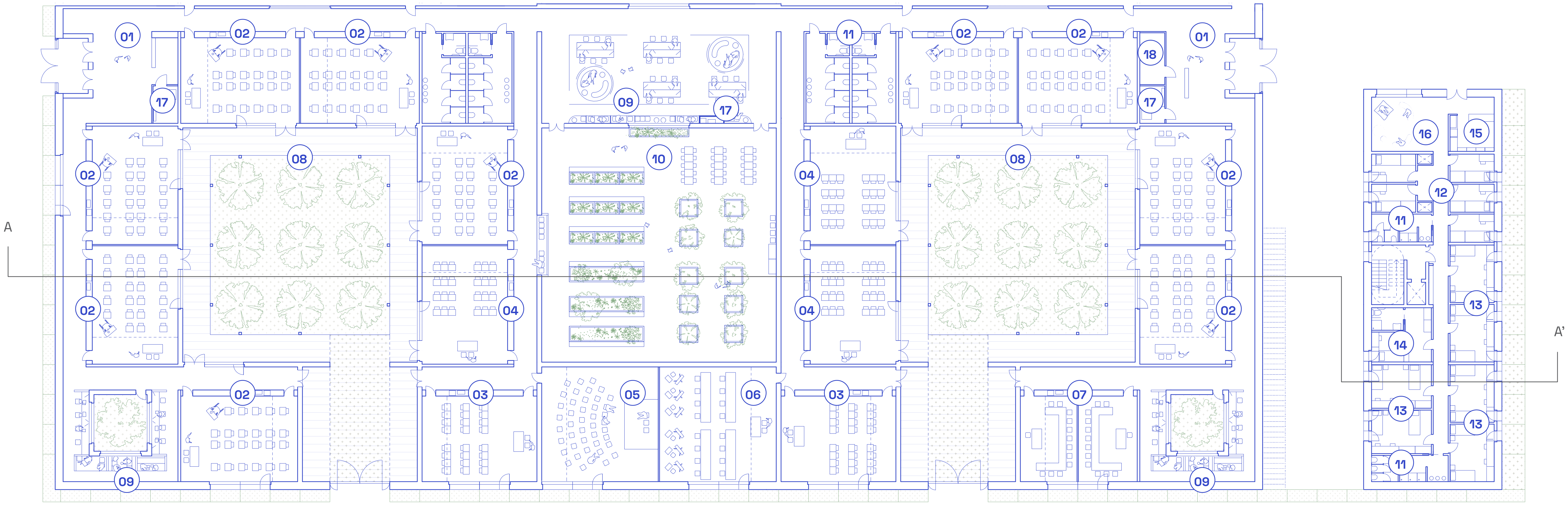


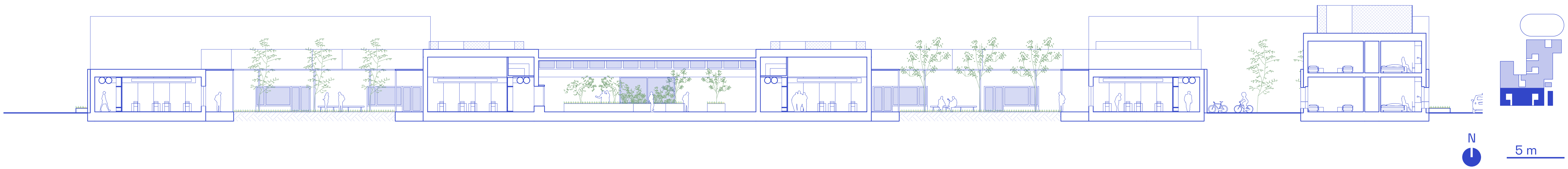
* The issue of snow accumulation on flat surfaces will be addressed through constructive solutions (such as roof slope design, construction types, and structural reinforcements) and engineering systems (including roof heating, meltwater drainage, and solar panels).

cost estimation chart code

#AA'_Plan and section

01. lobby (9.1)
02. classroom (2.1)
03. foreign language (2.2)
04. science class (2.3)
05. theater class (2.9)
06. art class (2.8)
07. lingua franca (x2) (2.10)
08. courtyard (6.3/ 6.4)
09. informal learning (2.12)
10. greenhouse (6.5)
11. sanitary facilities (2.11/ 4.2)
12. single room (x5) (4.1)
13. double room (x2) (4.1)
14. caretaker's room (4.4)
15. information counter (4.4)
16. common room (4.3)
17. technical room
18. control room

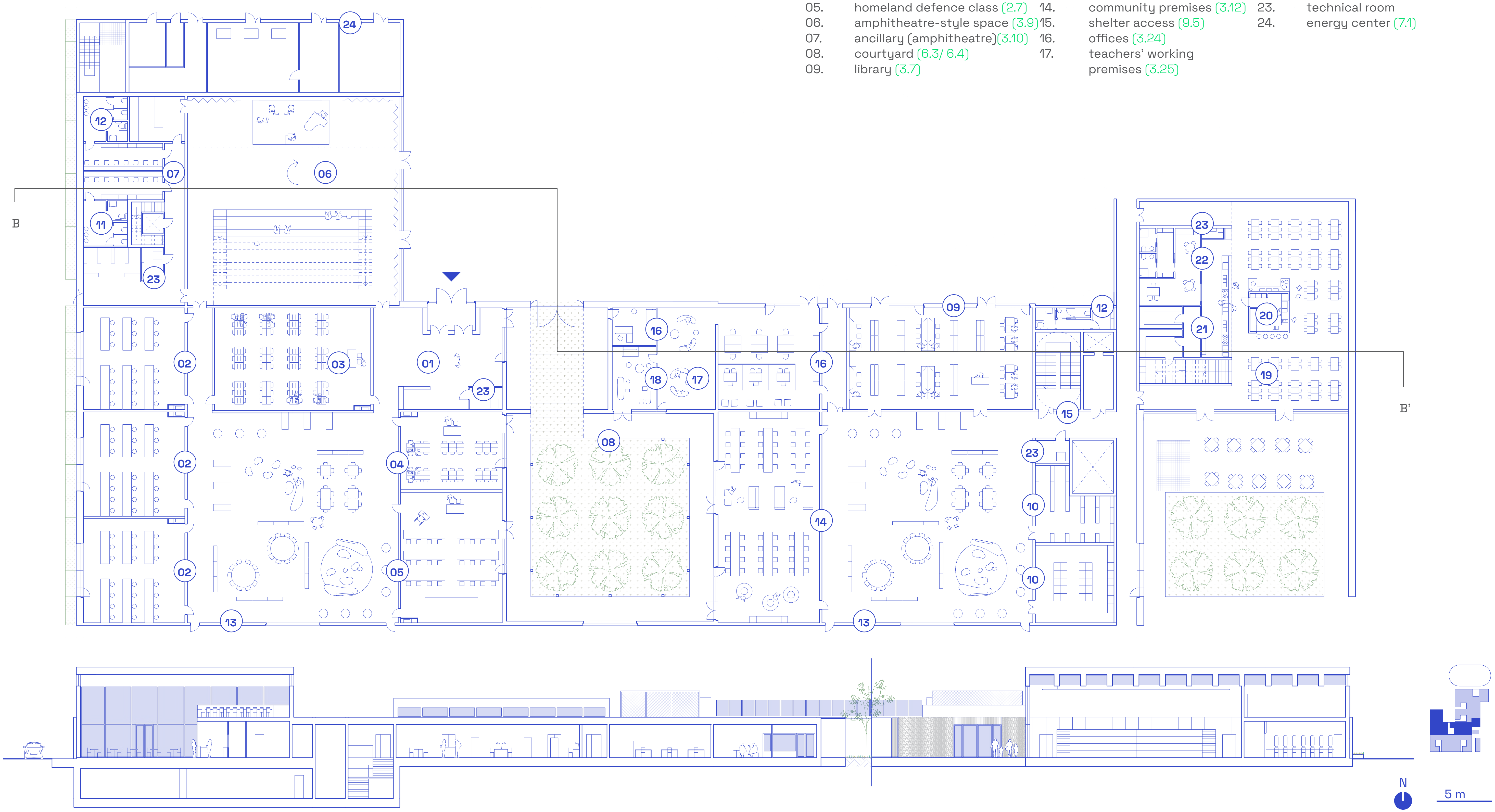




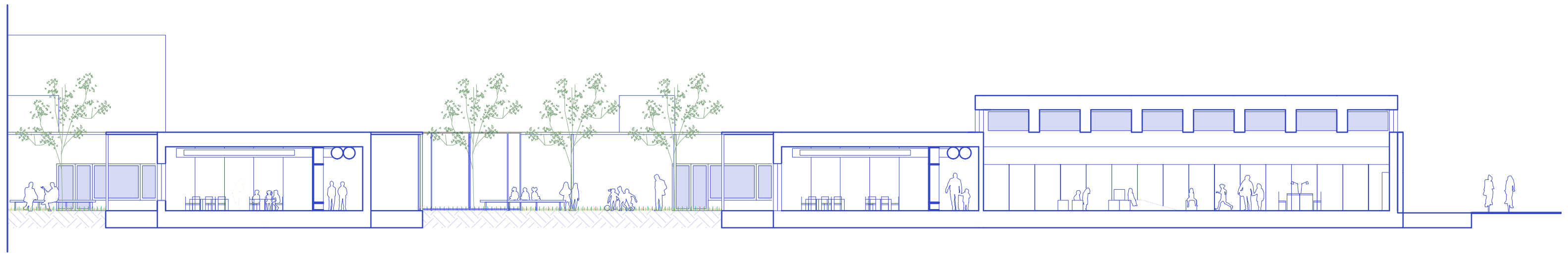
#BB'_Plan and section

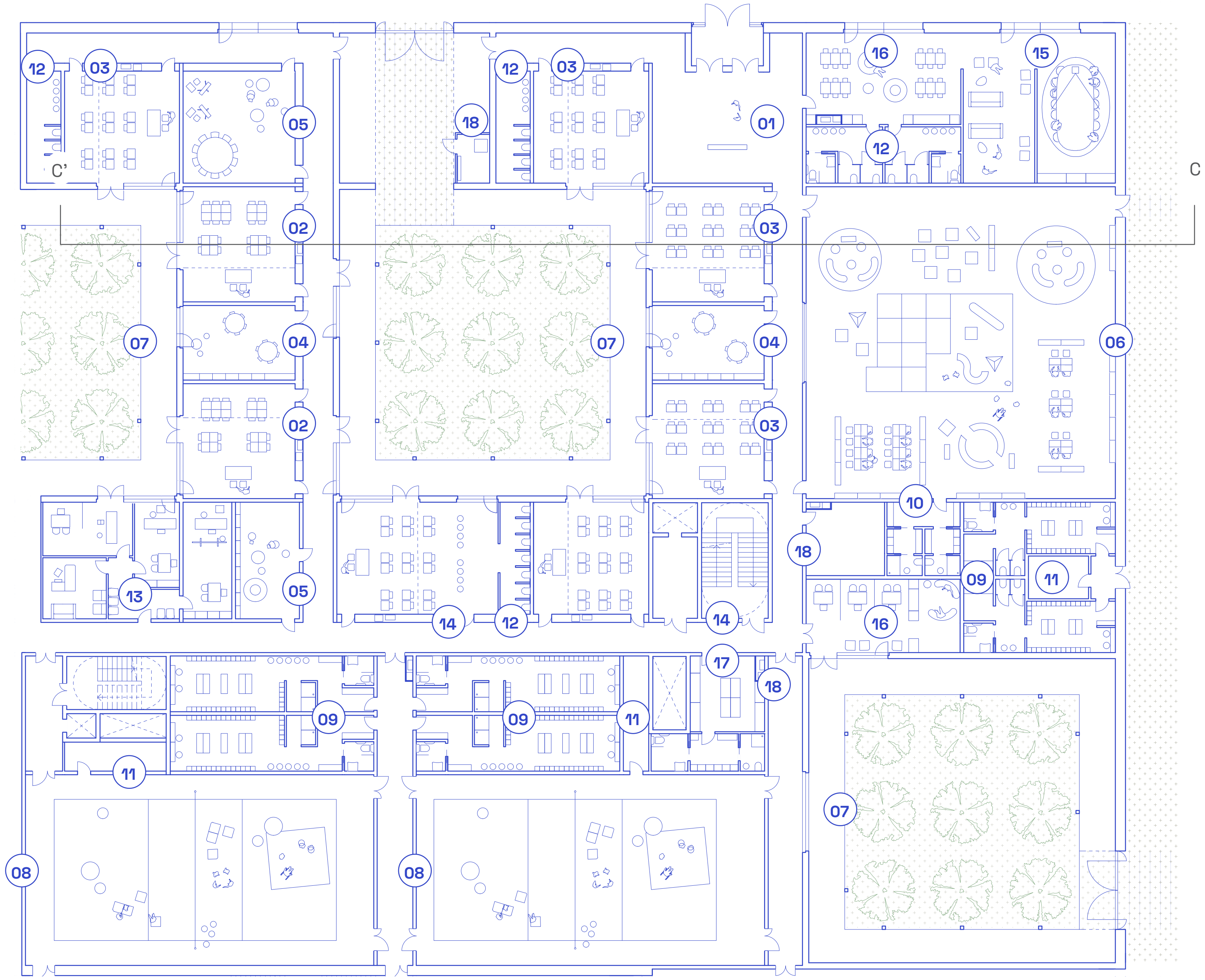
cost estimation chart code

01 . lobby (9.1)
02 . science laboratory (2.4)
03. computer practical training (2.5)
04. computer theory (2.6)
05. homeland defence class (2.7)
06. amphitheatre-style space (3.9)
07. ancillary (amphitheatre)(3.10)
08. courtyard (6.3/ 6.4)
09. library (3.7)
10. book storage (3.8)
11. school museum repository (3.11)
12 . sanitary facilities (3.10)
13. leisure (2.12)
14. community premises (3.12)
15. shelter access (9.5)
16. offices (3.24)
17. teachers' working premises (3.25)
18. physicological support room (3.19)
19. dining hall (3.13)
20. cafeteria (3.13)
21. food preparation + buffet (3.14/ 3.15)
22. staff and ancillary facilities (3.16)
23. technical room
24. energy center (7.1)



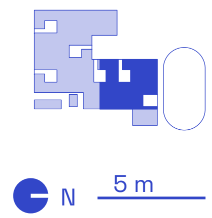
#CC'_Plan and section



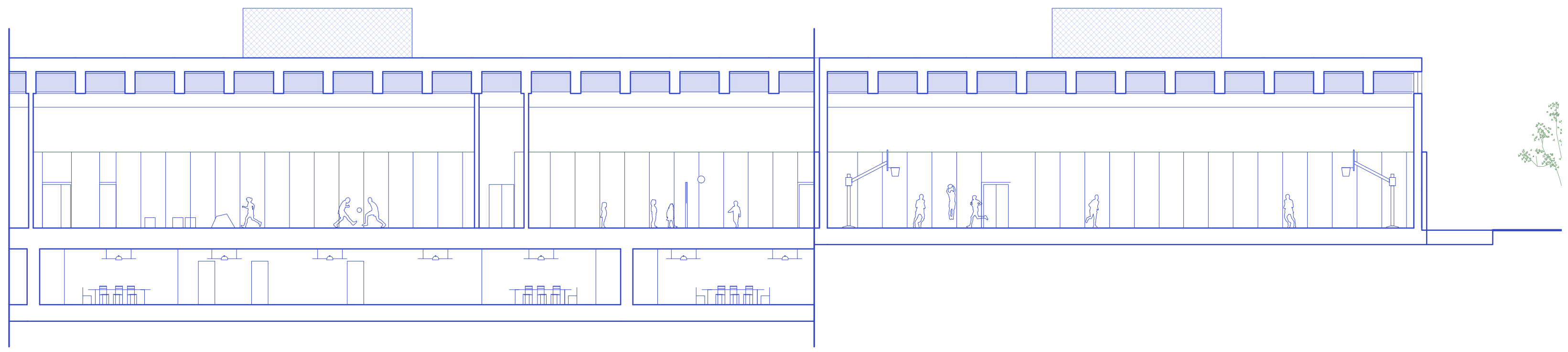


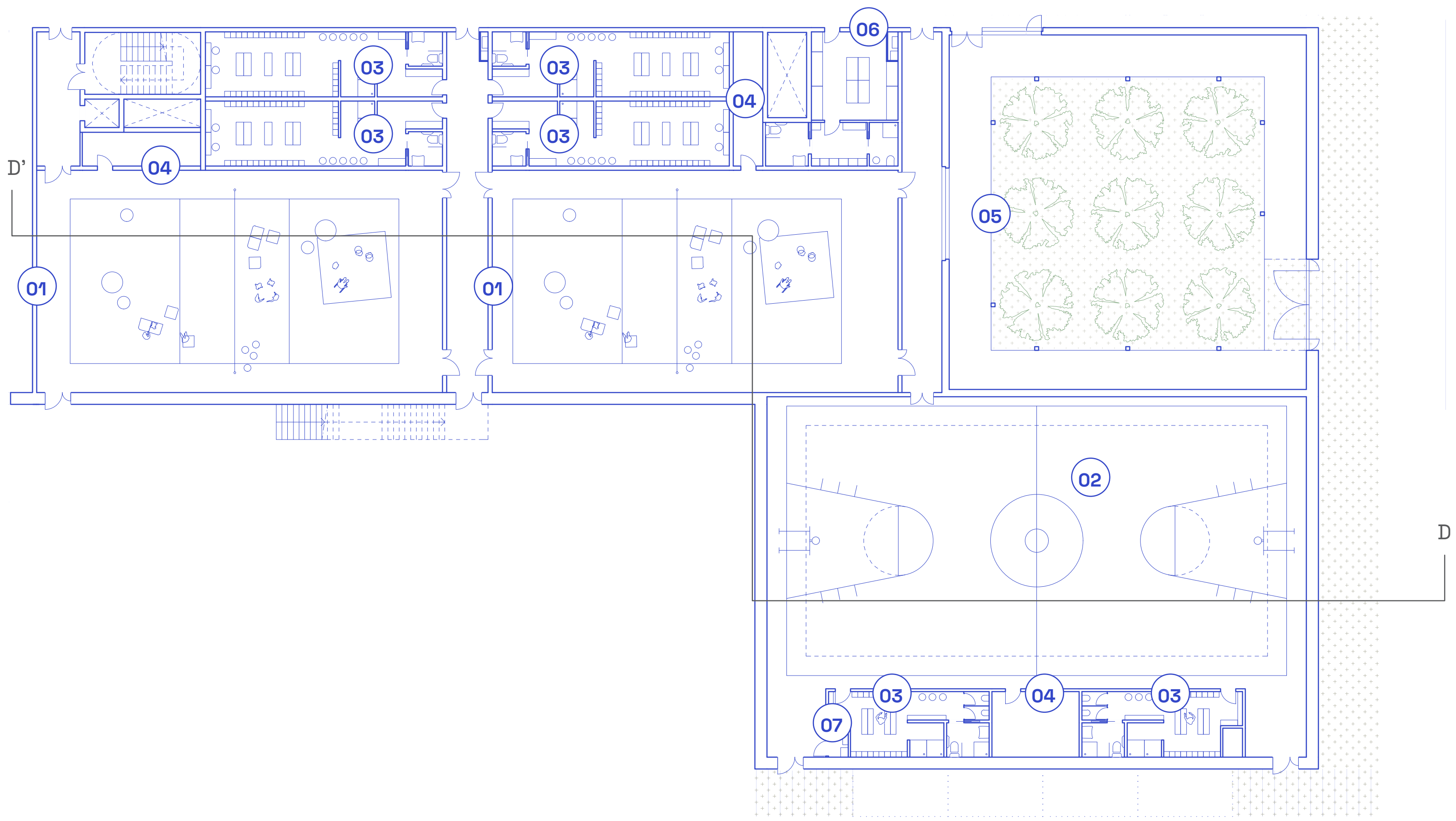
cost estimation chart code

01. lobby + watchman (9.1)
02. play and learning facilities (1.1)
03. classroom (1.4)
04. ancillary room (1.3)
05. recreation area (1.2)
06. leisure (1.5)
07. courtyard (6.1/6.2/6.8)
08. multi purpose hall for junior (3.2/3.3)
09. changing room (3.6)
10. phys. ed. teacher room (3.5)
11. storage (3.4)
12. sanitary facilities (1.6/3.28)
13. medicine (3.17-3.23)
14. shelter access (5.0)
15. meeting room (3.27)
16. teachers' working premises (3.25)
17. utility room (3.30)
18. technical room



#DD'_Plan and section

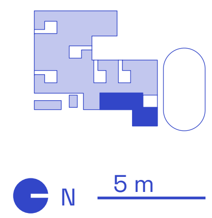




cost estimation chart code

01. multi purpose hall for junior (3.3)
02. sports and fitness multifunctional hall (3.2)
03. changing room (3.6)
04. storage (3.4)
05. courtyard (6.8)
06. utility room (3.30)
07. technical room

* The sports and fitness multifunctional hall includes a ground-level space designed to accommodate individuals with reduced mobility. If required, an elevator can also be implemented to enhance accessibility.



3.2 ENERGY STRATEGY TOOLS TO TEST

The planned energy strategy is oriented towards the concept of “NZEB (nearly Zero Energy Building)”, aiming to make this project as independent as possible from the local electricity grid. The goal is to minimize the use of on-site fossil fuels by electrifying all systems such as heat pumps, with the intention of minimizing carbon emissions and local air pollution. Dynamic energy simulations were conducted on a simplified but representative model to estimate the project’s energy needs and to compare possible plant configurations.

Although this activity is of a preliminary nature, as it is based on numerous hypotheses on the future operation, it nevertheless made it possible to evaluate the possible energy strategy. The geometric model was created from the design concept proposed by the working group.

From the model, the thermophysical characteristics of the envelope were then assigned, for both opaque and transparent surfaces, in order to allow the understanding of heat loss and summer solar loads. Subsequently, the model was subdivided into uniform thermal zones, corresponding to the various users planned for the building.

Based on the entered data and Kyiv’s hourly climatic information, an internal heat balance was performed to determine the heating, cooling, and electrical requirements. This allowed for a preliminary evaluation of potential strategies for producing heat-transfer fluids, leading to the final solution depicted in the energy strategy chart.

Achieving energy efficiency class A by Ukrainian standards will be provided with:

\ Integration of modern materials and technologies

\ Rational design to minimize heat losses.

\ Utilization of renewable energy sources.

3.2.1 Preliminary dynamic energy modelling

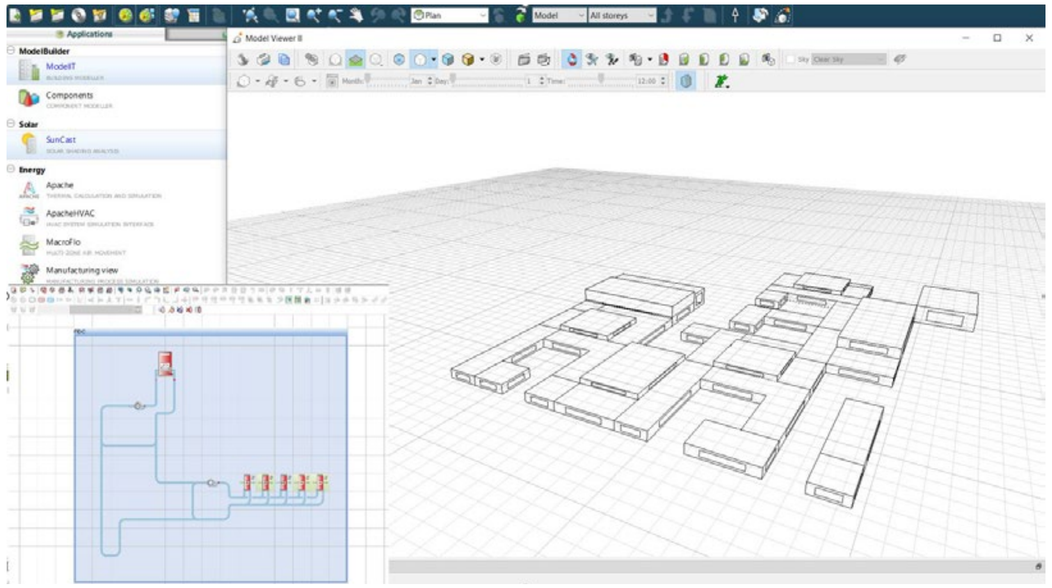
To guarantee a more accurate estimation of the “full-day school building” consumption, dynamic energy modelling was performed using the software IES VE powered by ApacheSim software as a calculation tool. The software allows to carry out dynamic energy simulation to provide a plausible picture of the actual consumption expected from a building over the year.

ApacheSim is an advanced sub-hourly dynamic thermal simulation tool for better calculation of building components. The dynamic thermal simulation tool is the basis for any simulation that considers the energy efficiency or sustainability of a building from the perspective of energy or carbon use. The software is fully adherent to all international standards and can be used to check the compliance with the major international sustainable rating systems (e.g., LEED and BREEAM following ASHRAE 90.1 standard).

The 3D model was developed based on the geometry of the intervention at its current design stage, utilizing the three-dimensional modeling software IES VE. Adjustments and simplifications were made as appropriate for this design stage, while efforts were made to minimize potential deviations in the building’s physical performance from reality. The model considers mutual shading between different volumes and the influence of solar shadings, with the envelope surfaces modeled according to their thermophysical characteristics.

The software then assigned to each building all the elements necessary to characterize the functioning of each interior space (hourly occupancy, internal loads, lighting levels, air exchange, natural ventilation), but also the thermophysical characteristics of the building envelope, for both opaque and transparent parts.

Using the application AphaceHVAC the actual building systems have been modeled properly, including the conditioning system.

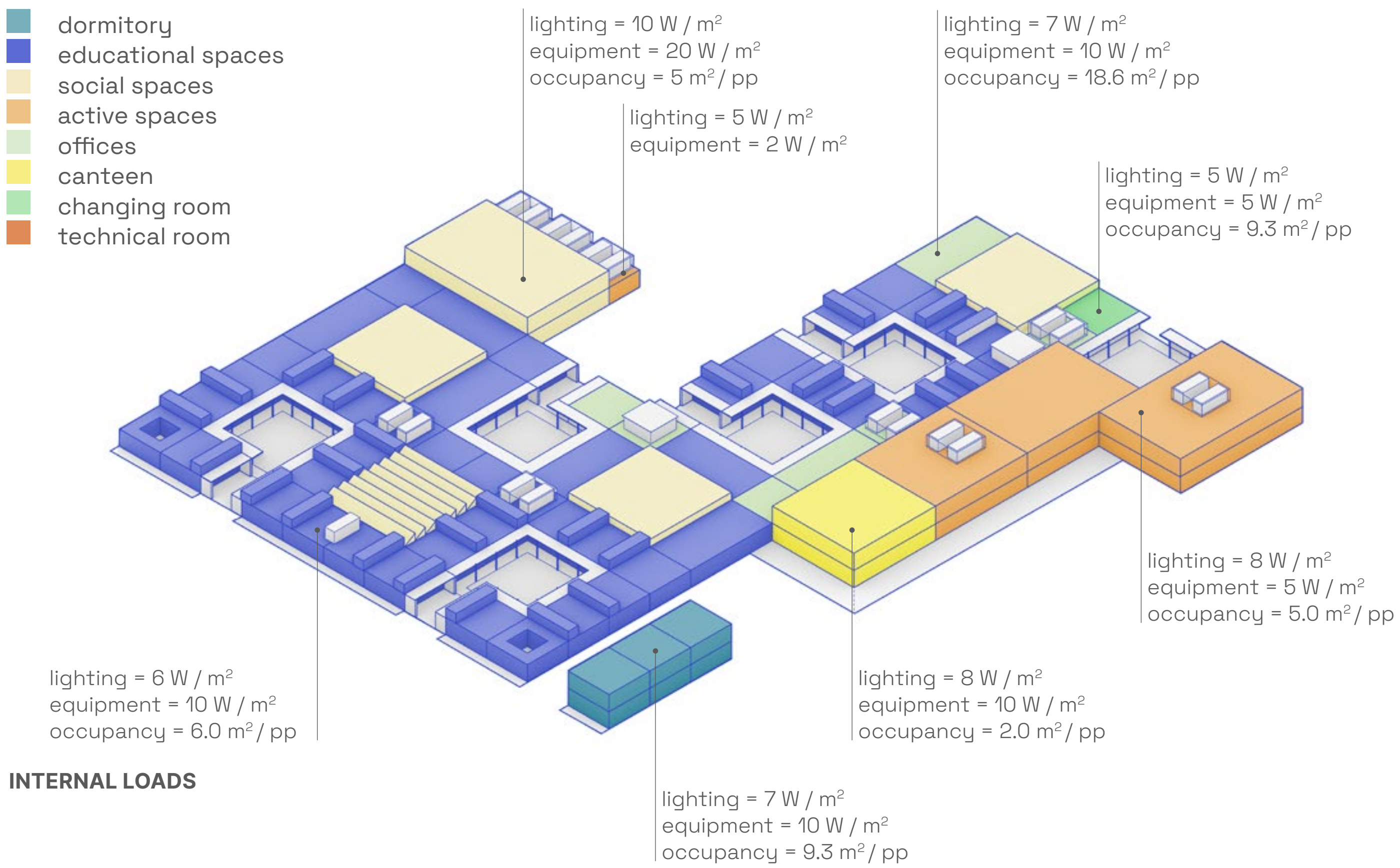


53 IES VE APACHEHVAC & MODEL VIEWER

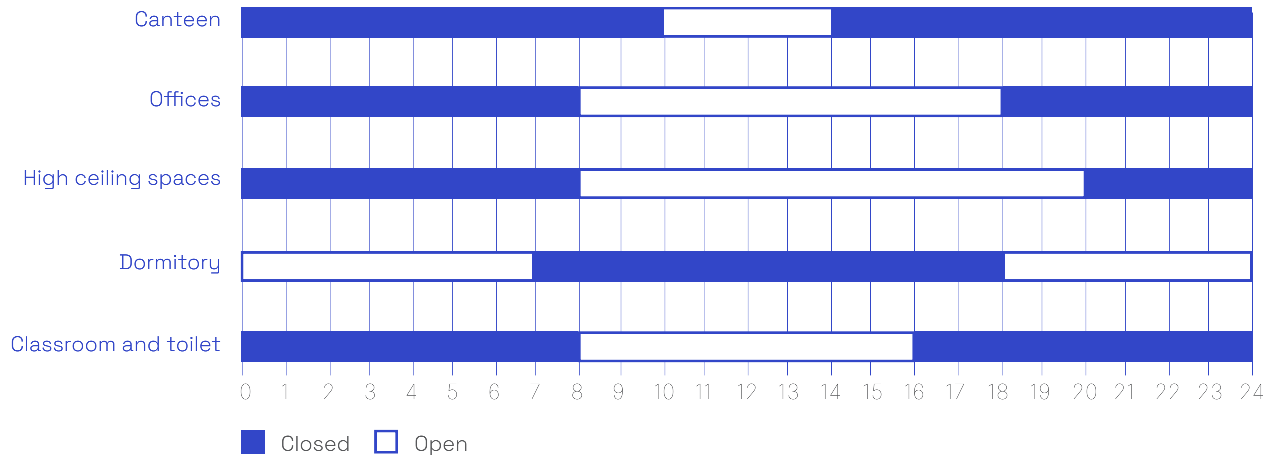
The following assumptions were made regarding the input values:

- For internal loads, values from ASHRAE 90.1 were used with modifications aligned with considerations made in the competition phase;
- Occupancy of persons aligned with indications from the architectural team;
- Stratigraphies aligned with the northern Italian climate zone, with data from the architects' team where available;
- Kiev Meteonorm v.8 climate file;
- WWR = 35%;
- Heat pump with COP = 3.5 and EER = 4.0.

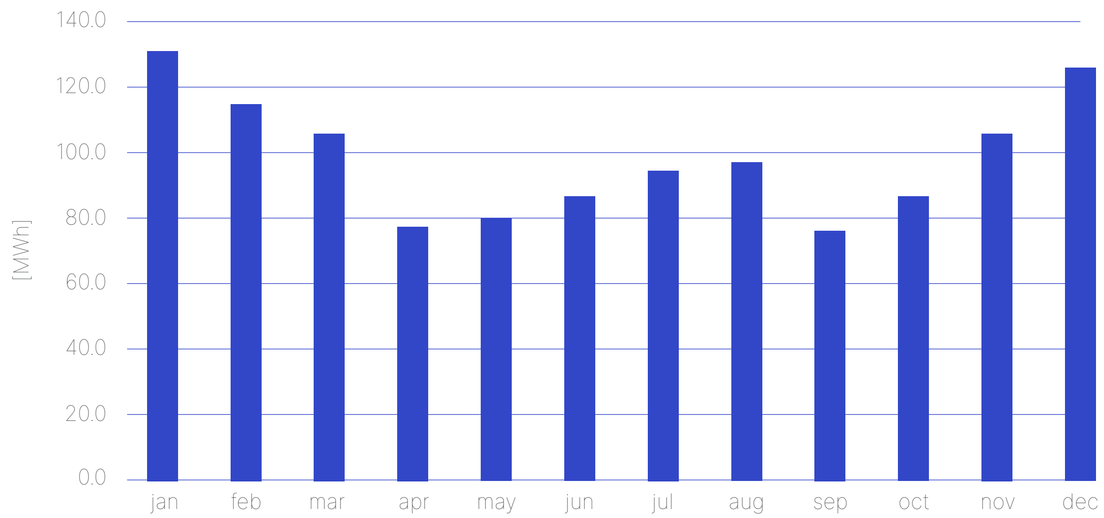
The figure below shows the input data for internal loads and the assumed stratigraphies aligned with a typical climate zone for this type of climate (with reference to Italy) and with data from the architects' team where available.



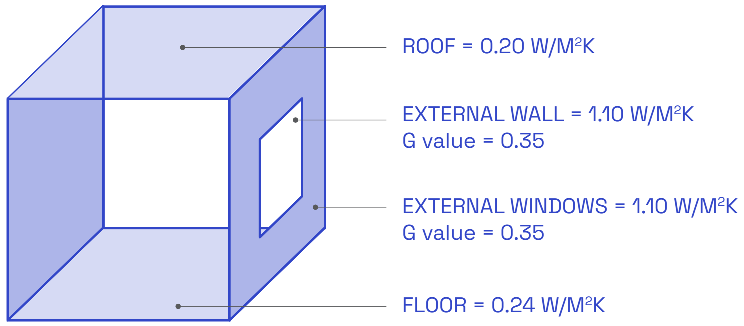
54 INTERNAL LOADS



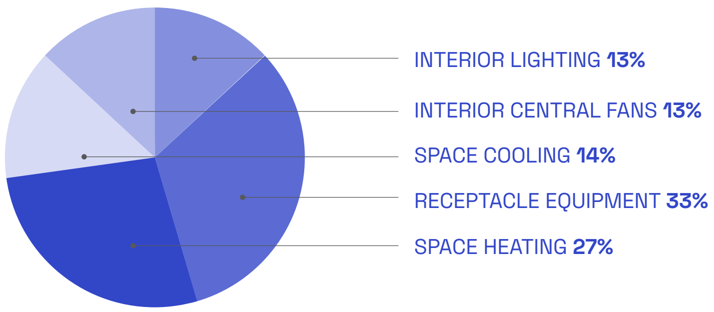
55 OPERATING TIME CHART



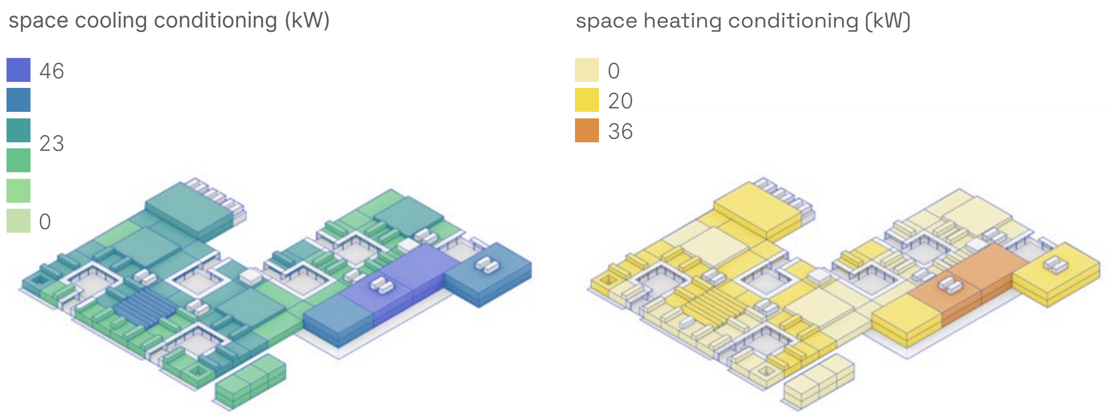
56 ANNUAL ELECTRICITY CONSUMPTION



57 STRATIGRAPHIES PERFORMANCES



58 ENERGY STRATEGY CHART



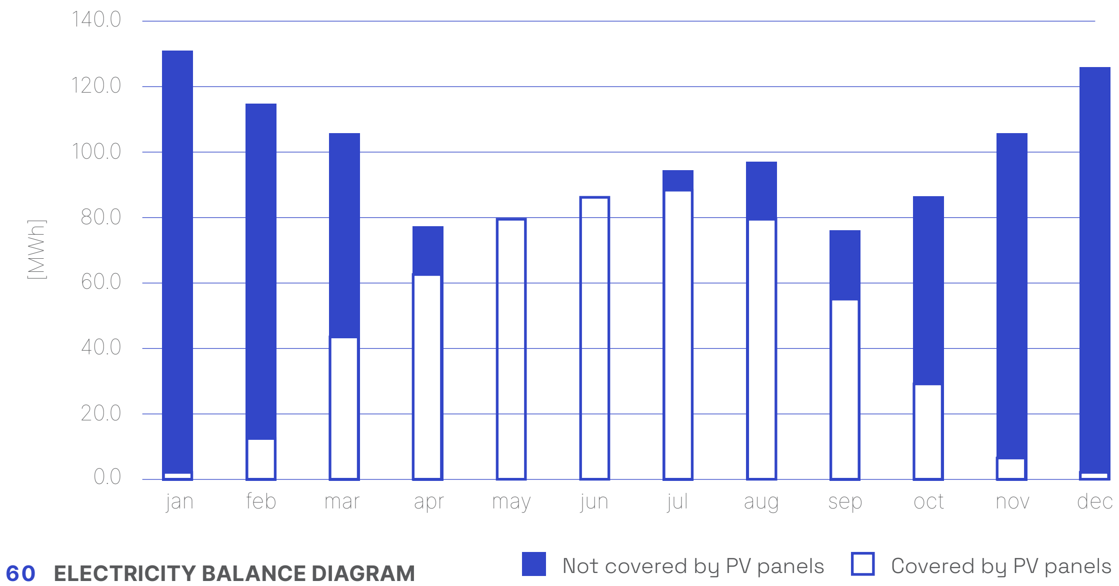
59 HEATING AND COOLING LOADS

3.2.2 Renewables potential

On-site renewable energy sources will enhance the reliability and autonomy of the energy production systems. The electricity needs will be largely met by local production from solar photovoltaic panels on the roofs, with an installation of about 550 kWp for all high ceilings' buildings (total roof considered = 4100 m2).

By optimizing the skylight configurations, it was possible to significantly increase photovoltaic production, with the highest potential in east and west-facing classrooms. With the addition of photovoltaic panels above the classrooms for 89 kWp, an installed capacity of 639 kWp is reached, producing a total of 556 MWh per year.

A comparison between the estimated annual consumption of the complex and the total PV production is shown below:



60 ELECTRICITY BALANCE DIAGRAM

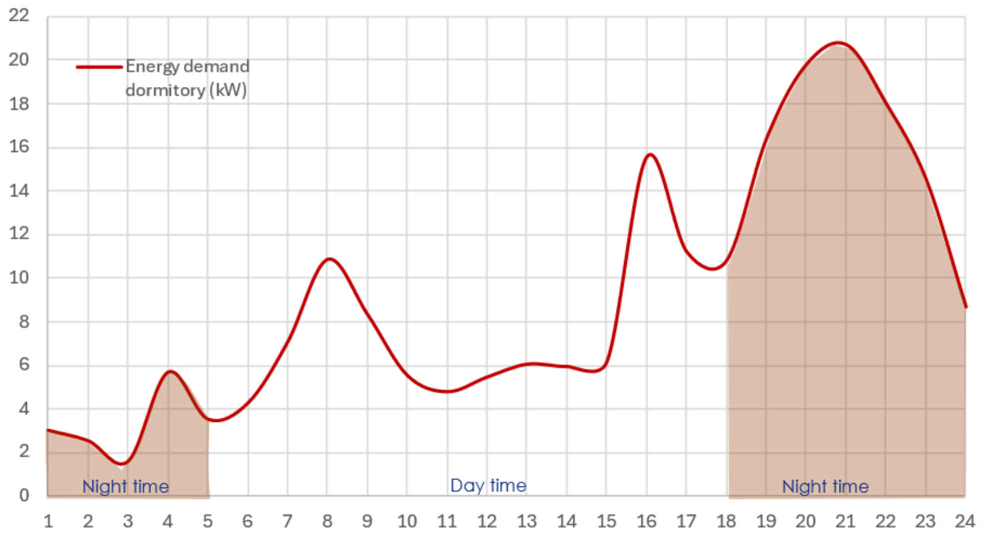
By integrating advanced energy-efficient technologies and renewable energy sources, the project aims to set a benchmark for sustainability and energy independence in educational facilities. Overall, with the energy contribution of photovoltaics, the energy strategy aims to achieve a reduction in consumption of about 47% compared to the case without photovoltaics.

The designated photovoltaic roofing offers a peak power of approximately 639 kW, avoiding 126 tCO_2e in emissions, equivalent to planting 2515 trees.

3.2.3 Battery energy analysis

Energy storage batteries will also be provided to reduce peak loads and extend the dormitory's energy autonomy by shifting excess energy production to periods of higher demand. This approach ensures that the dormitory can maintain consistent energy availability, even during times of low solar production.

To ensure that the dormitory meets minimum livability standards for at least one full day, it is projected that a battery with a capacity of no less than 105 kWh will be required. This capacity can be achieved through the use of modular batteries. The estimated cost for these batteries is approximately €70,000.



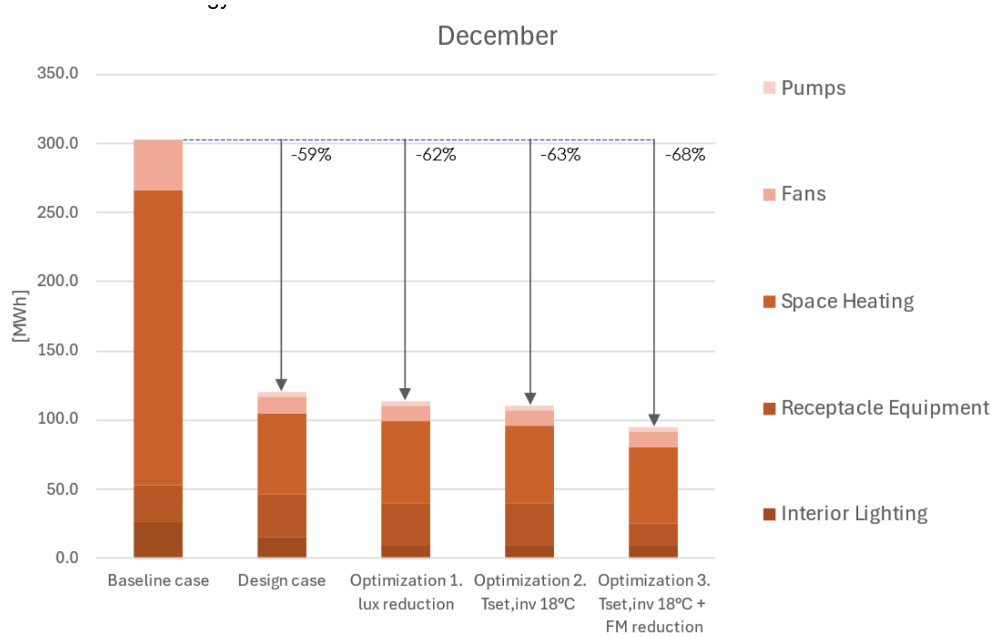
61 ENERGY TO BE STORED IN BATTERY

3.2.4 Transition mode analysis

To guarantee the continuity of the "full-day school building" even in the event of a lack of connection to the electricity grid, it was decided to analyze possible energy reduction scenarios for the month of December, which is the most critical from an energy point of view, in order to simultaneously define the size of the genset.

The reduction in energy required by the "full-day school building" in December as the following parameters change is shown below:

- reduction of the guaranteed lux;
- reduction of the winter setpoint temperature from 20°C to 18°C;
- reduction of equipment energy consumption by 50%, implementing a strategy similar to "demand response" ensures that, in the event of a decrease in supplied power, only the most critical equipment devices remain connected, prioritizing essential operations while reducing overall energy demand.



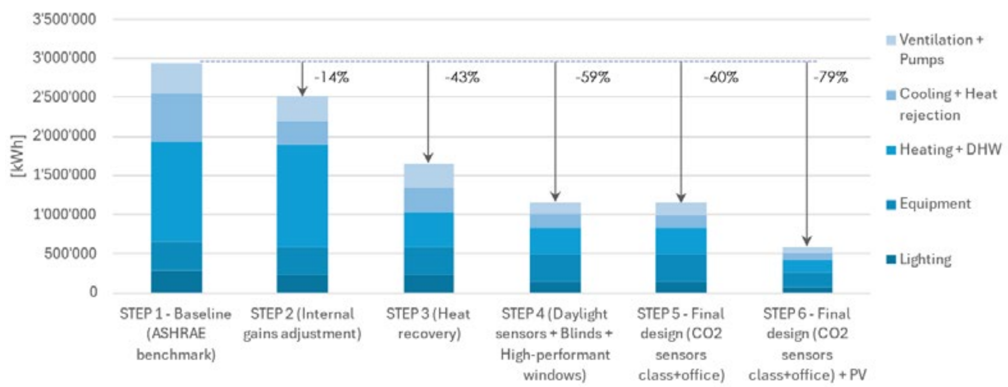
62 ENERGY TRANSITION MODE OPTIMIZATION

3.2.5 Final results from energy modelling

By studying the site's climate, using smart design strategies to reduce energy needs, and adopting the most efficient energy systems available, the building achieves outstanding energy performance while providing excellent comfort in terms of temperature and humidity. The dynamic energy simulation made it possible to assess the effectiveness of the various solutions proposed and to compare the energy consumption obtained with that of the ASHRAE baseline building, the reference for calculating scores and obtaining LEED certification.

From the model, energy saving strategies such as the use of lighting sensors and heat recovery were applied, achieving a reduction in annual energy consumption of 60% compared to the ASHRAE benchmark for this type of multifunctional building. Subsequently, implementing the contribution of the photovoltaic system resulted in a building that consumes 79% less energy than the ASHRAE benchmarks.

The results obtained from the analysis are shown below:



63 ENERGY STEP CONSUMPTION

3.3 MECHANICAL SERVICES TOOLS TO TEST

The aim of the project is to create a Carbon Zero School and Community Hub, in fact the proposed energy strategy uses 100% electric technologies such as heat pumps, with the intention of minimizing carbon emissions and local air pollution, exploit the opportunities offered by the local environment, using solar energy. A system with high-efficiency heat pumps is proposed to provide thermal energy for heating, cooling and domestic hot water (DHW) production.

The Mechanical systems included in the project are:

- Production and distribution of hot and chilled water
- Fresh air treatment plants, distribution and extraction
- Water and sanitation installations
- Sanitary water supply and discharges
- Water drainage networks
- Fire prevention system
- The Building Management System (BMS)

3.3.1 Standards

The systems envisaged in this study will be designed and built in compliance with the requirements of the European regulations on the subject or ASHRAE values. Furthermore, in the presence of more binding national rules or regulations, the more restrictive provisions will have to be considered even if issued during construction.

In particular, but not exclusively, the rules set out in the following paragraphs shall be observed.

- UNI EN 15251 - 2008 - Criteria for the design of the interior environment and for the assessment of the energy performance of buildings, in relation to indoor air quality, thermal environment, lighting and acoustics.
- UNI EN 15242 - 2008 - Ventilation of buildings. Calculation methods for determining air flows in buildings, including infiltration.
- UNI EN 13829 - 2008 - Thermal performance of buildings. Determination of the air permeability of buildings. Method of pressurization by means of a fan.
- UNI EN 13779 - 2008 - Ventilation of non-residential buildings. Performance requirements for ventilation and air conditioning systems.
- UNI 10339 - 2008 - Air conditioning systems for the well-being. General, classification and requirements. Rules for the request for a tender, the bid, the order and the supply.
- UNI EN 14511-1-2-3-4:2004 - Air conditioners, liquid coolers and heat pumps with electric compressor for heating and cooling
- UNI EN 13313:2004 - Refrigeration systems and heat pumps - Personnel competence
- UNI EN 13180:2004 - Ventilation of buildings - Pipeline network - Dimensions and mechanical requirements for flexible pipelines
- UNI EN 13136:2004 - Refrigeration systems and heat pumps: Pressure limiting devices and their pipes
- UNI EN 378-3: 2002 - Refrigeration systems and heat pumps - Safety and environmental requirements - Part 3: Installation on site and protection of persons
- UNI EN 1264-1:2013 - Water-powered radiant systems for heating and cooling integrated in structures - Part 1-2-3-4
- ARI 390:2003 - Performance rating of single package vertical air-conditioners and heat pumps
- ARI 210/240:2003 - Unitary air-conditioning and air-source heat pump equipment • ARI 890-2001 - Rating of Air Diffusers and Air Diffuser Assemblies
- ARI 410-2001 - Forced-Circulation Air-Cooling and Air-Heating Coils
- ARI 390-2001 - Single Package Vertical Air-Conditioners and Heat Pumps
- ASHRAE 33-2000 - Testing forced circulation air cooling and air heating coils
- EN 1736:2000 - Refrigerating systems and heat pumps - Flexible pipe elements, vibration isolators and expansion joints - Requirements, design and installation
- UNI EN 1861 - 2000 - Refrigeration systems and heat pumps. System flow diagrams and piping and instrumentation diagrams. Arrangement and symbols
- EUROVENT 1/5:1997 - Prescription for spark resistant fan construction
- EUROVENT 1/6:1997 - Performance testing of industrial fans using standardized airways
- EUROVENT 1/8:1996 - Prevention of explosions in fans
- UNI 10339:1995 - Air conditioning systems for the purpose of well-being. General, classification and requirements. Rules for the request for a tender, the bid, the order and the supply.
- ISO 13253:1995 - Ducted air-conditioners and air-to-air heat pumps. Testing and rating for performance.

3.3.2 Project criteria

The general design requirements for the design of the common parts and units of the school and community hub can be summarized as follows:

- safety (in the double sense of protecting people and protecting things against the risk of damage);
- functionality (understood as flexibility of use and ensuring the environmental conditions necessary for activities to be carried out under optimal conditions and in terms of environmental well-being for people);
- cost effectiveness (understood as the reduction of energy consumption and operating costs, maintenance and maintenance of the value over time of the works);
- sustainability and reduction of environmental impact.
  In reference to these criteria the systems listed below are also provided.
- Dedicated extraction on cleaning rooms, toilets, Changing rooms
- Water treatment systems (osmotic filters, activated carbon filters, sediment removal filters, anti-legionella treatments)
- Accounting for heat, cold and hot water
- Recovery of rainwater
- Irrigation with drip systems and humidity and rain sensors
- Dual mains for WC flushing boxes
- Reduction of water flows for different utilities
- Reduction of the environmental impact of refrigerants used in heat and cool production machines.

3.3.3 Design criteria

Heating requirements for heating

- The heating load is calculated according to UNI EN 12831 "Building heating systems. Method of calculation of the design thermal load".

Heating requirement for air conditioning

- Summer heat loads have been assessed using one of the following methods:
- calculation method based on transfer functions, as discussed in ASHRAE Fundamentals 1985, chapter 26;
- Method "Carrier" (Handbook of Air Conditioning System Design – Carrier Air Conditioning Company-Mc Graw – Hill 1965)

Closed circuit: hot and cold-water circuits

- Ranges of terminal elements determined designed on nominal equipment performance.
- Capacity of the secondary branches calculated on the maximum contemporary thermal loads of the area.
  Open circuit water
- The calculation of the flow rate of sanitary cold water is developed by applying the method of load units, according to UNI 9182 standard;
- Circuits dimensioned according to the limit speeds specified in the following paragraphs, derived from the limits prescribed by UNI 9182 above - table N10;
- Pressure losses as for closed circuits.

3.3.4 Production and distribution of hot and chilled water

The buildings are powered by a central heating and cooling plant.

To produce hot and cold fluids, heat pumps are installed on the roof, there will be booster heat pump machines for the production of DHW at high temperatures, primary/secondary circuits, collectors and related circulation electric pumps.

Independent circuits are provided for different area with different operating temperatures

- hot water for the batteries of air handling units;
- hot water for fan-coils and radiators and radiant floors;
- Domestic hot water;
- chilled water for air handling unit;
- chilled water fan coils.

The pumps for distribution are supplied via inverter and are designed to guarantee the necessary prevalence to the most disadvantaged hydraulic user. The pumping units for fluid circulation are provided with logic n+1 (n in operation + 1 reserve). At the start of each circuit above, an energy accounting group will be provided.

Closed circuits for hot and cold fluids originating from the thermal plant will develop horizontally around the structure through a loop circuit, this ensures power redundancy and improved flexibility of use in the case of modules replaced or integrated over time. Within the structure, the primary distribution of fluids will travel where possible to the ceiling of the hallways.

3.3.5 Fresh air treatment plants, distribution and extraction from toilets

The fresh air to the rooms is provided by a centralized system, with inlet and outlet air. The air treatment will be carried out by Air Handling Unit placed almost everywhere on the roofs of buildings.

The Fresh air treatment unit consists of the following sections:

- Silencers, provided on supply, return, extraction and external air intake;
- Filtration, with pre-filters and pocket filters on the external air intake, pocket filters on the take-off and high efficiency pocket end filters in delivery;
- Activated carbon filters + UV lamp;
- Rotary heat recovery system of the enthalpic type;
- Recirculation section, for controlling the external air flow;
- Batteries for preheating, cooling and dehumidification, post-heating;
- Humidification section with high pressure atomization system, without recirculation;
- Recirculation section controlled by CO2 sensor;
- Fan sections with high efficiency plug-fan fans and inverter driven electric motors;
- Section for air flow measurement.

For the different types of modules, different fresh air conditioning and distribution strategies will be envisaged.

- Classrooms, collective and similar recreational spaces: The primary and secondary school classrooms will use underfloor radiant panels as a heating system; this type of equipment provides optimal thermal comfort by maintaining even temperatures and avoids the spread of germs because of its hygienic nature; furthermore, it allows maximum efficiency because of low-temperature operation. To save time in construction, a kind of radiant panel with less thickness and for "dry" installation was also chosen. The distribution of fresh air will be mounted on the ceiling in the corridors. The radiant floor and fresh air treatment plant ensure renewal, the health and proper control of the relative humidity in summer and winter;
- Dormitories: The rooms will have crossflow heat recuperators with hydronic batteries for ventilation and freshness; the installation of the hot and chilled water batteries will prevent, in the first case, the introduction of external air with low temperature into the room, while in the second case it will ensure the cooling of the rooms for the period when the spaces will be used during the summer season. The distribution of fresh air and pipes will be under the ceiling on the corridor lines;
- Offices environment: The offices will be air-conditioned with a mixed primary air and fan coil system. Mechanical ventilation will be provided by an air handling unit (AHU) with rotary heat recovery system and hydronic hot and cold coils, and with ducted air distribution for each individual room;
- Gym and canteen: In these areas with large crowds is provided an all-fresh air system. by an air handling unit (AHU) with rotary heat recovery system and hydronic hot and cold coils, and with ducted air distribution;
- Sanitary facilities, changing rooms: Planned with underfloor heating and/or radiators and independent extraction systems at about 10 vol/h of extraction.

3.3.6 Water and sanitation installations

The water treatment technical room will be built for the treatment and distribution of cold water for technological uses and cold water for sanitary purposes as well as the production of domestic hot water.

The water treatment technical room will consist essentially of:

- Water filtration unit;
- previous-autoclave tank;
- pressure group;
- autoclave tank;
- Water treatment unit (softener unit);
- Chemical dosing units;

The following circuits will originate from the water plant:

- circuit supply cold water;
- cold water supply circuit to the kettle for production of ACS (10°F);
- Sweetened water supply circuit for the canteen (5°F);
- closed circuit filling circuit (7°F);
- Winter humidification circuit on the AHU (0°F);
- Hot water production for sanitary purposes.

Upstream of the line for the production of domestic hot water, sweetened water for cooking, the line serving the loading of closed-circuit installations and the humidification sections of air treatment units will be fitted with a water softening unit.

The equipment presents in the plant to service the production of domestic hot water will be the following:

- Booster heat pumps powered by the low temperature (45°C) hot water circuit;
- Kettle powered by the high-temperature (70°C) hot water;
- Group dosing of hot water chemicals;
- Chlorine dioxide generator and dosing unit for legionella bacteria;
- Hot water and sanitizing thermoregulation unit;
- Circuit network recirculation of domestic hot water.

3.3.7 Sanitary water supply and discharges

Distribution and schematics for water supply to sanitary services (cold water and hot) will be coated with 10 mm sheath (cold water) and with the same material, but in the thicknesses required by current legislation, for that domestic hot water. The exhaust system will be of the type with direct primary ventilation complete with ventilation secondary and will be made with heavy high density polyethylene pipes.

All water connections, hot and cold, to the sanitary appliances will be individually intercepted, together with the general interception of the individual toilet. Independent drainage networks must be provided for the “food” areas of the dormitories, refreshment points and food supplies in the canteens with degreaser systems.

3.3.8 Water drainage networks

Rainwater precipitated on roofing and impermeable areas not subject to polluting factors, where possible, will be collected and channeled to storage tanks located adjacent to the water plant. The water collected will be re-used through irrigation systems or, if surplus, channeled through an existing sewer rolling tank.

Independent drainage networks must be provided for the “food” areas of the dormitories, refreshment points and food supplies in the canteens with degreaser systems.

3.3.9 Fire-fighting equipment

The manual active fire protection system will consist of a network of hydrants located inside the building; as well as a series of external hydrants. All the premises of the complex are protected by hydrants with a hose length of 25 m, located in accessible locations in case of fire and in any case so as to cover all the protected areas. The sections of piping located near the external area shall be locally protected against frost. The pumping units and control components will be installed in the fire-fighting station.

3.3.10 Automatic control system for mechanical installations

The automatic control system of the mechanical installations is connected to the general building BMS system.

The Building Management System (BMS) includes the following functions:

- control of the cooling system;
- control of the air conditioning system;
- control of the general ventilation system (inlet and outlet);
- Monitoring of sanitary water systems;
- control of fire-fighting systems;
- communication interface with firefighting and smoke extraction systems;
- communication interface with the lighting control system (both artificial and natural);
- control of the counting systems for low-temperature hot water (primary circuit), low-temperature hot water (secondary user circuits), low-temperature cooled water (primary circuit), medium-temperature cooled water (secondary power supply circuits).

The system provides an operator interface on personal computers, using an open communication protocol.

The BMS system is characterized by the following features:

- stability of adjustments;
- Adequacy and reliability;
- Solidity;
- Protection against interference;
- Ease of use.

The system must be expandable by simply adding peripherals to the BMS network.

3.4 ELECTRICAL SERVICES
TOOLS TO TEST

Electrical systems used in the building are designed to provide a safe and reliable power supply to support various activities and functions within the school premises. These systems typically consist of several components and subsystems working together to distribute electricity efficiently and ensure functionality and safety for people and property.

The electrical systems included in the project are briefly:

- Power supply
- Emergency power system
- UPS System
- LV distribution;
- Lighting systems and controls;
- Safety systems;
- Security systems;
- Data and communication infrastructure;
- Building Management System (BMS).

Details of the implementations are given here.

3.4.1 Standards

Electrical systems must adhere to international and local building codes, safety regulations, and standards to ensure the well-being of occupants and comply with electrical safety requirements.

Here is presented a general compilation of the applicable standards for electrical systems, on the understanding that any existing or enacted national, regional or European legislation must be complied with.

- IEC International Electro-technical Commission
- IEC 60364: Electrical installations requirements for buildings
- CENELEC - Comité Européen de Normalisation Electrotechnique
- ISO: International Organization for Standardization
- ETSI: European Telecomunications Standards Institute
- EN 12464-1:2021 Light and lighting - Lighting of workplaces - Part 1: Indoor workplaces
- ISO 7240-1 “Fire detection and alarm systems - Part 1: General and definitions”;
- ISO 7240-14 “Fire detection and alarm systems - Part 14: Design, installation, commissioning and service of fire detection and fire alarm systems in and around buildings”;
- ISO 7240-19: Fire detection and alarm systems-Part 19: Design, installation, commissioning and service of sound systems for emergency purposes;
- ISO 30061: Emergency lighting

In the subsequent design phases, national and local standards must be verified and applied if more restrictive.

2.4.2 Technical data

Distribution system:	TN-S
Primary distribution:	MV rated voltage to be defined
Secondary distribution:	380V / 220V, 50 Hz, 3-phase, 4 wires
Drop voltage:	max 4%

3.4.3 Power assessment

	Lighting W/sm	Power W/sm
Primary education	6	10
Gymnasium and Lyceum.		
classroom	6	10
Laboratory	8	30
common spaces	4	5
Training workshops	6	10
Common-use education and community spaces		
Physical education and sport	10	5
Library, reading room, media room (40 seats)	6	10
Multi-purpose function space (300 seats)	10	20
Other spaces	6	10
Catering - Dining	6	10
Catering - Preparation and storage	10	500
Medicine and preventive healthcare	7	10
Office, service and ancillary facilities	7	10
Dormitory		
rooms	7	10
common spaces	7	10
Civil Protection. Dual-use shelter	6	10
Outdoor Area	1	1
Energy Center	4	5
Connections	4	5

3.4.4 Power supply

The building will be connected to the local electrical grid, which provides the primary source of power. The power supply is delivered through transformers, which step down the voltage to a suitable level for distribution within the school.

The main substation will be located inside the Energy Center, the substation includes medium voltage (MV) switchgear, the transformer and the Main-distribution panel (switchgear) which receives power from the transformer and distributes it to various areas within the school. It contains circuit breakers to protect against overloads and short circuits.

The distribution panels (DP) are located throughout the school building and receive power from the main distribution panel. Distribution panels further divide the electrical load and distribute power to specific areas or zones, such as classrooms, laboratories, administrative offices, gymnasiums, theatre, dormitory, shelter, etc.

Specific rooms such as laboratories will have a dedicated sub-distribution panel (SDP) supplied by the DP.

In the event of unavailability of the local electricity grid, it will be possible to evaluate the opportunity to implement the electricity supply with an appropriately sized cogeneration plant.

This option can be evaluated in the next design step based on specificity of the site.

3.4.5 Emergency system

Stand-by diesel engine-generator set will be provided to supply power to emergency systems, these systems are:

- Firefighting pumps;
- safety systems;
- mechanical system for heating;
- UPS;
- Emergency lighting;
- Shelter utilities;
- Lifts;
- All other equipment required during emergency procedure.

The diesel engine will be located in the Energy Center basement, in a protected area. Cabling shall be to fire survival/life safety standards, in accordance with fire safety strategy. There will be one fuel storage tanks, the minimum required autonomy of the Generator Set is 48 hours.Inside the generator room there is a daily tank. The fuel-oil inside tank will meet the generator demand and will be re-filled from the filling flange at grade level.

The generator exhaust system will be design in according to local standards, it includes the following:

- Sound attenuator if necessary, according to use.
- Chimney.

3.4.6 Uninterruptible Power Supplies

The project involves the use of UPS dedicated to providing safety power to safety systems and to provide power in continuity to all systems that require it, but which are not directly intended for the protection of building occupants.

3.4.7 Renewable Sources

This project includes a PV power system that will be connected to the electric net of the school. The inverter and interface switchboard will be installed in the technical room on the roof. A battery energy storage system for photovoltaic system will be installed in the technical room on the roof.

The storage capacity of the batteries must be verified ad defined for each site by a specific design considering actual daily, monthly and annual electricity consumption.

3.4.8 Earthing System

The building should have an effective grounding system, which includes grounding electrodes such as grounding rods, ground plates, or ground rings. These electrodes establish a connection with the Earth and provide a low-resistance path for fault currents to dissipate. The grounding electrode system should be installed and maintained in accordance with local codes and regulations.

3.4.9 Lighting systems and controls

Lighting systems play a crucial role in creating a safe and conducive learning environment for students and teachers. These systems are designed to provide adequate illumination in classrooms, corridors, libraries, gymnasiums, and other areas within the school premises.

The project includes lighting systems with LED sources in accordance with the initiative's environmental sustainability footprint. LED lighting offers several advantages, including long lifespans, reduced energy consumption, and lower maintenance costs compared to traditional lighting options.

In the next design phases, it will be important to develop lighting design that balances energy efficiency, visual comfort, and the specific needs of different spaces within the school.

General lighting:

General lighting provides overall illumination in classrooms and common areas. It typically consists of pendant linear fixtures that evenly distribute light throughout space. These fixtures are designed to provide a balance of brightness and minimize glare to ensure comfortable visibility.

Task lighting:

Task lighting is used to provide focused and localized illumination for specific activities. In classrooms, it may include adjustable desk lamps or overhead spotlights that can be directed towards individual work areas or instructional spaces like whiteboards or projectors. Task lighting helps students and teachers to perform tasks that require more focused attention.

Lighting controls:

Lighting controls enable schools to optimize energy usage and create comfortable lighting conditions. These controls include light switches, occupancy sensors, dimmers, and timers. Occupancy sensors can automatically turn off lights when a room is unoccupied, while dimmers provide flexibility to adjust lighting levels based on specific needs. Timers can be programmed to schedule lighting operation, ensuring lights are turned on and off at appropriate times.

Specialty lighting:

In spaces such as theatre and performance areas, gymnasium spaces, refectories, specific lighting packages will need to be designed for the needs of these venues.

The illumination levels shall comply with EN 12464-1:2021 Light and lighting - Lighting of workplaces - Part 1: Indoor workplaces.

Lighting controls will be ensured in the following ways:

Destination	Occupancy sensor	Lighting sensor	Local control
learning areas	x	x	
corridors		x	
office	x	x	
public and circulation areas		x	
Catering		x	
Theater			x
Physical education and sport			x
External Lighting			

3.4.10 Small power

Power outlets are installed in classrooms, computer labs, staff rooms, and other areas to provide electrical connections for devices such as computers, projectors, printers, and other electrical equipment.

Power outlets will be strategically placed throughout the school to ensure convenient access to electrical power.

Socket outlets, fused connection units and isolators will be provided to serve various fixed and portable equipment and general appliances throughout the facilities. Duplex socket outlets will be provided where there is likelihood that numerous equipment which requires plug-in points.

Equipment that requires fixed connection or heavy electric power outlets will be supplied by means of flexible cord, from suitable disconnect switches mounted adjacent to the equipment for maintenance purpose.

Classrooms will be designed with:

- one receptacle per wall;

- two duplex receptacles at the desk with two duplex RJ45;
- one duplex receptacle at the interactive whiteboard with one RJ45 outlet.

Workstations and private offices will be designed with:

- two duplex receptacles at the desk with two duplex RJ45.

Retractable towers can be used on the floor of the theatre, and where necessary.

Corridors and circulation areas will be designed with a receptacle spacing of approximately 15/ 20 meter, while building support rooms will be designed with one duplex receptacle every 15 square meters.

3.4.11 Safety systems

- Fire Alarms;
- Emergency Voice Alarm Communication (EVAC);
- Emergency lighting Illuminazione di emergenza.

The control panels will be installed in the control room near the Lyceum Entrance, compartmentalized room with REI resistance at least equal to the maximum of the building's structures, while the ordinary microphone base as well as VVF will be present in the porter's lodge and with prearranged referral to a permanently manned location.

3.4.11.1 Fire Alarms

An open protocol analogue addressable automatic fire alarm system will be provided to cover the building which shall comprise automatic detectors within the various areas and manual break glass units on all exits, stairways and escape routes.

Electronic sounders and visual beacons will be the means of audible and optical alarm for the system.

A central unit will manage the information from the terminals described above and will enable the activation of measures appropriate to the situation according to the emergency procedures of the complex and entered into the system's programming:

- doors closing;
- stopping the AHU;
- optical/acoustic signaling;
- activation of the EVAC system;
- forwarding of the danger alert to public intervention units or, in general, outside the facility.

3.4.11.2 Emergency Voice Alarm Communication (EVAC)

The main purpose of the Emergency Voice Alarm Communication system is the capillary diffusion in the building of the necessary information to make the occupants aware of an alert situation and the appropriate indications to manage it.

The reference standard for this part of the project is ISO 7240-19, which indicates the criteria for the positioning of sound diffusers, their connections and their management through appropriately approved and configured devices.

A Public Address System will be installed to afford the facility of general announcements.

The loudspeakers will be the same as the EVAC system.

3.4.11.3 Emergency lighting

Emergency lighting shall be provided through standalone self-contained LED battery units.

Together with integral inverter units permitting certain 220V luminaires to also serve as emergency fittings. The system shall be designed in accordance with ISO 30061: Emergency lighting and shall be of the non-maintained and maintained type with a duration of 2 hours and will be provided in all areas.

Signage to be internally illuminated.

3.4.12 Security systems

Security systems are those that protect the assets inside the building and are therefore all those that prevent or regulate the entry of people.

3.4.12.1 CCTV system

A CCTV system will be provided throughout the shelter external and internal areas. The system to be wired in Cat 6 cabling terminating in RJ45 outlets

3.4.12.2 Alarm system

Cable trays and conduits shall be provided within the building an alarm system with door monitoring, space PIR detectors and audible sounders.

3.4.13 BMS System

The installation of an integrated control, management and supervision system of the electrical and mechanical technological systems is planned, which basically consists of supervising the air-conditioning regulation system, implementing the control and command of the lighting circuits and integrating the alarms coming from the electrical/mechanical equipment.

The system allows for the structuring of several autonomous subsystems, guaranteeing the necessary characteristics of physical and functional independence and at the same time enabling the overall supervision of the plant in all its size and structure.

The architecture of the supervision and control system to be implemented is of the ‘Distributed Intelligence’ type.

The system will complement the building’s school bell system.

3.4.14 Data and communication infrastructure

School relies on electrical systems to support its data and communication needs. This includes wiring for network connections, telecommunications equipment, wi-fi systems.

Classrooms will be designed with:

- two duplex RJ45 outlet at the desk;
- one RJ45 outlet at the interactive whiteboard.

Workstations and private offices will be designed with:

- two duplex RJ45outlet.

Common spaces; dormitory:

- wi-fi coverage.

3.4.15 External lighting

The external access routes will be illuminated to afford safe access to and around the building

The scheme will be sympathetic to the overall aesthetics while complying with the standards.

The local planning conditions will be adhered to in all external lighting proposals.

3.4.16 Lightning Protection

Lightning protection: to be evaluated in the final design phase with appropriate simulation.

Overvoltage protection: provided in all cases.

3.5
MEP SYSTEM
TOOLS TO TEST

3.5.1 Mechanical Systems

Technical Data

For the Ukrainian school complex, starting from the climatic data of the project, mechanical installations were designed to obtain the following indoor ambient temperature standards:

Indoor temperatures:

All Spaces Temp. 20°C R.H. 50% ±10%

Dormitory / Physical education and sport / Catering
Temp. 26°C R.H. 50% ±10%

Office / multi-purpose function space / Shelter Temp. 25°C
R.H. 50% ±10%

Classrooms / recreation spaces: planned temperature mitigation (through Fresh air)

Maintaining the plant logic already explained above:

Classrooms/ offices / dormitories with mixed system: floor heating or fan coil plus fresh air system

Multi-purpose function space / Shelter / Physical education and sport / Catering with all fresh air system.

- The heat output of the generators is estimated at 1400 kW.
- The cooling output of the generators is estimated at 1600 kW (Contemporary factor 85%).
- The total power of the domestic hot water is estimated at 230 kW.

For domestic hot water, the Booster heat pumps powered by the low temperature (45 °C) hot water circuit will raise the temperature to 70 °C.

Heat fluids will be produced by N°3 multi-purpose heat pumps located on the roof of the plant's technical rooms. In the choice of multipurpose heat pumps it is planned to size the machines with logic (2+1) for the maximum thermal load requirements.

Fresh air and All Fresh air Systems will be managed by n°14 Air Handling Unit dedicated to the individual modules. All the AHU shall be placed in the cover, except for the shelter, as shown on the chart.

3.5.2 Electrical Systems

Technical data

Distribution system: TN-S

Primary distribution: MV rated voltage to be defined

Secondary distribution: 380V / 220V, 50 Hz, 3-phase, 4 wires

Drop voltage: max 4%

			POWER				
	Luce W/sm	FM W/sm	P/UM kW	UM N/ sm	Pinstalled kW	k utilization	P.Consumption kW
Station heating and cooling			327	3	981	0,8	785
Substation heating and cooling			50	1	50	0,8	40
Waterworks			35	1	35	0,8	28
Air Handling Unit (AHU)			30	14	420	0,8	336
Fire protection system			5	1	5	1	5
Primary education. 144 pupils (8 classes of 18 children)	6	10	0,016	767	12	0,7	9
Gymnasium and Lyceum. 400 pupils (16 classes of 25 children each)				2903			
classroom	6	10	0,016	1386	22	0,7	16
Laboratory	8	30	0,038	585	22	1	22
Common Areas	4	5	0,009	720	6	0,7	5
Training workshops	6	10	0,016	212	3	0,7	2
Common-use education and community spaces				3610			
Physical education and sport	10	5	0,015	1348	20	0,7	14
Library, reading room, media room (40 seats)	6	10	0,016	190	3	0,7	2
Multi-purpose function space (300 seats)	10	20	0,03	707	21	0,7	15
Other spaces	6	10	0,016	227	4	0,7	3
Catering - Dining	6	10	0,016	371	6	0,7	4
Catering - Preparation and storage	10	500	0,51	42	21	0,7	15
Medicine and preventive healthcare	7	10	0,017	170	3	0,7	2
Office, service and ancillary facilities	7	10	0,017	555	9	0,7	7
35 bed Dormitory				526			
rooms	7	10	0,017	290	5	0,7	3
common spaces	7	10	0,017	236	4	0,7	3
Civil Protection. Dual-use shelter	6	10	0,016	1465	23	0,8	19
Outdoor Area	1	1	0,002	10172	20	0,5	10
Energy Center	4	5	0,009	584	5	0,7	4
Connections	4	5	0,009	2387	21	0,5	11
Total:							**1358**

Electrical maximum demand is assessed at approximately:

Normal 1358 kVA.

Power supply

1600 kVA transformer will be installed for the electric school network.

The system will be prepared for the possible installation of a second transformer as a backup, one transformer active and other as backup.

Emergency system

In this project we take into consideration the worst case in which diesel driven standby generation plant will serve all the school loads, to ensure the school service even in case of lack of the electricity grid.

Generators will be 1350 kVA (COP (Continuous Power), 380V, 3-phase, 4-wire, 50Hz, and will be equipped with automatic transfer switch.

The diesel engine will be located in the basement, in a protected area.

There will be one fuel storage tanks of 10.000 L. The minimum required autonomy of the Generator Set is 48 hours.

Uninterruptible Power Supplies

At this stage of the project, it is estimated at 15 kVA UPS, able to provide safety power to safety systems and to office computers for fifteen minutes.

Renewable Sources

This project includes a PV power system that will be connected to the electric net of the school.

Photovoltaic generator – 639 kWp - will be installed on the roof.

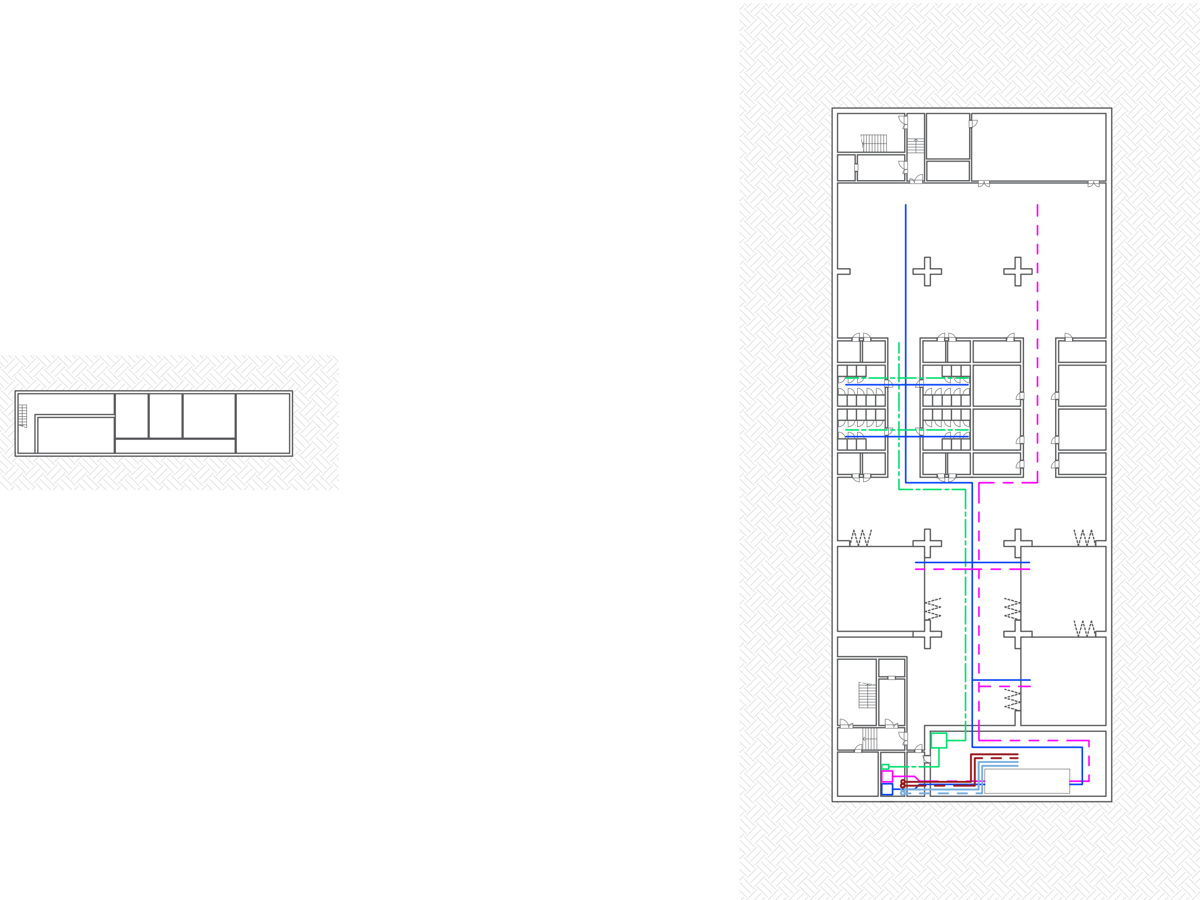
The inverter and interface switchboard will be installed in the technical room on the roof.

The energy analysis shows the advantage of storing energy produced by the photovoltaic system, so a storage PV of 105 kWh will be installed in the technical room on the roof.

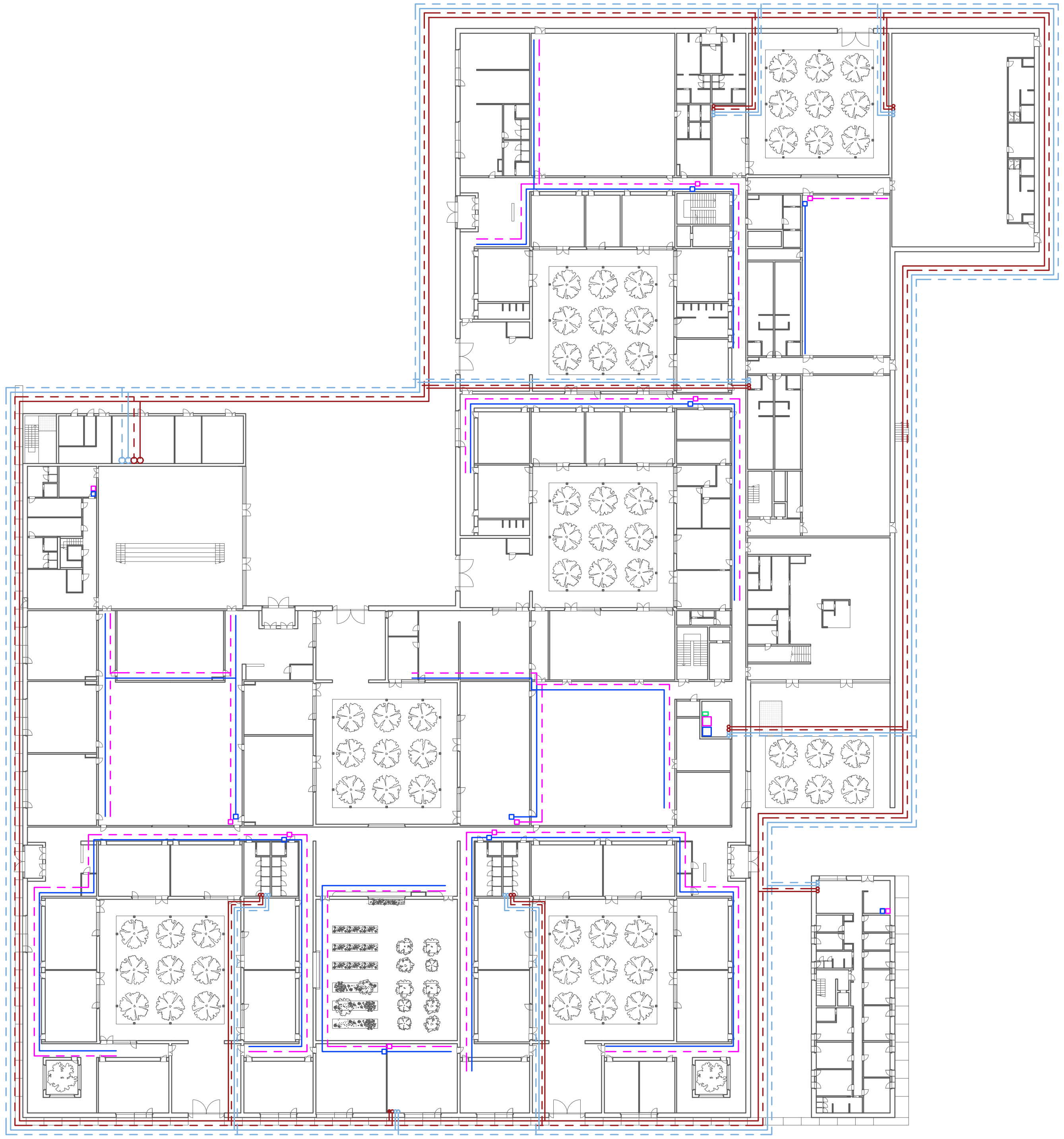
The system will be able to ensure the energy autonomy of the Dormitory during the hours when the photovoltaic system is not producing.

The storage capacity of the batteries must be verified ad defined for each site by a specific design considering actual daily, monthly and annual electricity consumption.

#Heating, ventilation and air conditioning ducts and pipes

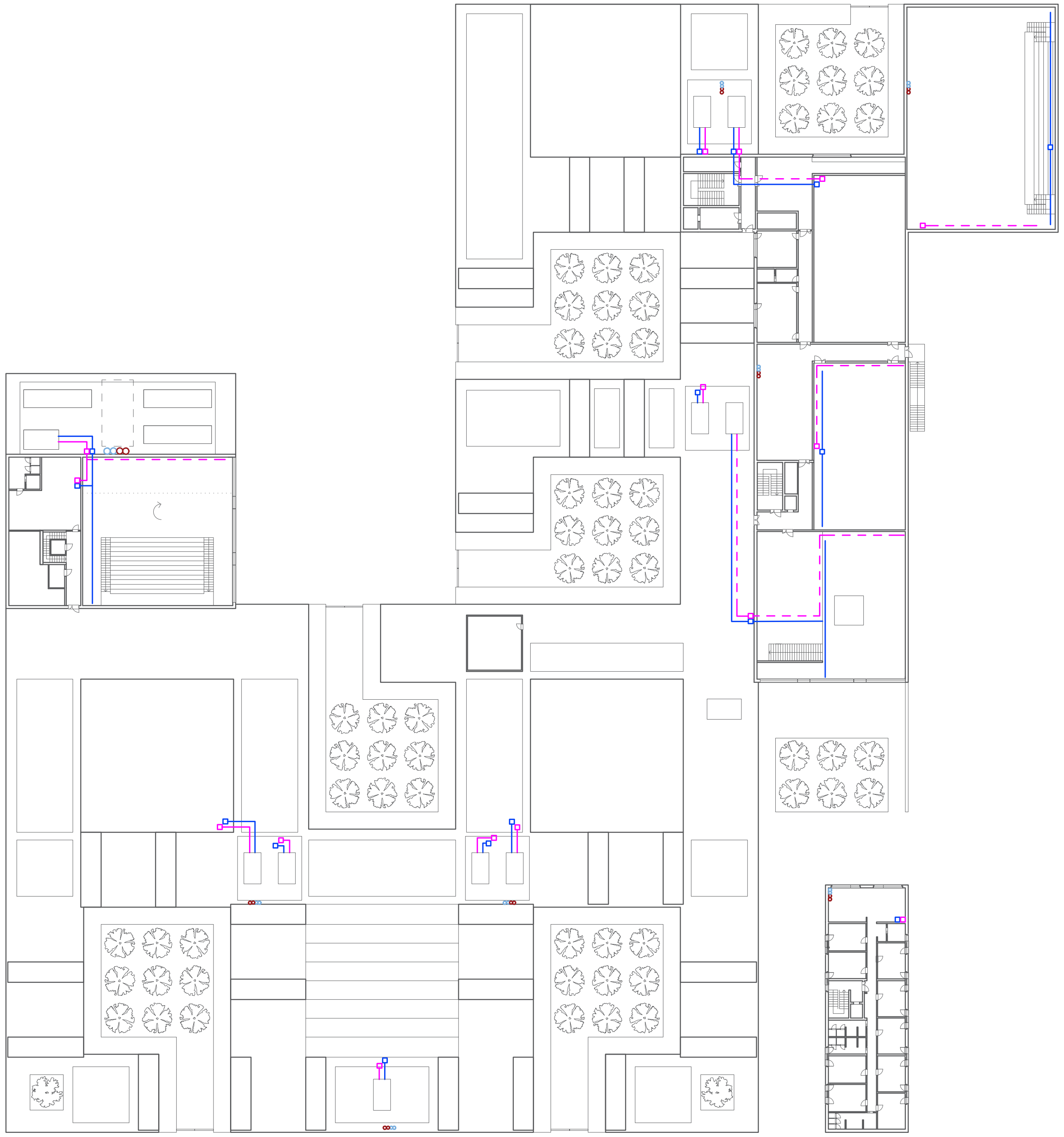


PLAN LEVEL -4.0



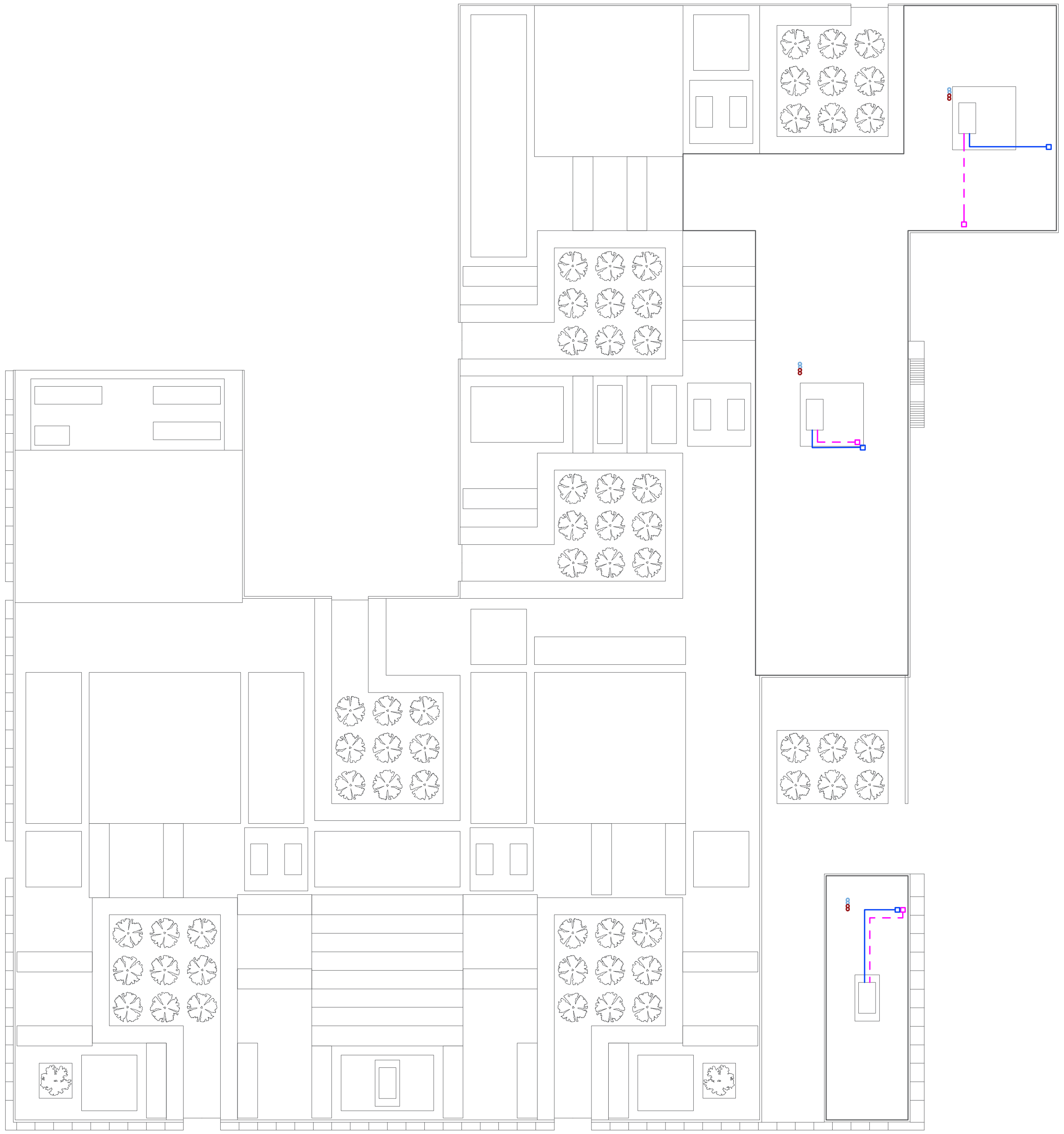
PLAN LEVEL +0.0

- air supply duct - primary distribution
- air return duct - primary distribution
- air extraction duct - primary distribution
- HVAC duct riser
- hot water supply pipe - primary distribution
- hot water return pipe - primary distribution
- chilled water supply pipe - primary distribution
- chilled water return pipe - primary distribution
- hydronic pipe riser



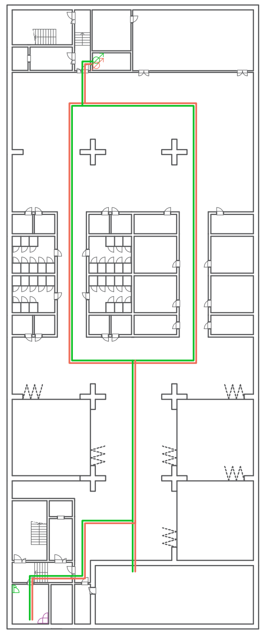
PLAN LEVEL +3.65

- air supply duct - primary distribution
- air return duct - primary distribution
- air extraction duct - primary distribution
- HVAC duct riser
- hot water supply pipe - primary distribution
- hot water return pipe - primary distribution
- chilled water supply pipe - primary distribution
- chilled water return pipe - primary distribution
- hydronic pipe riser

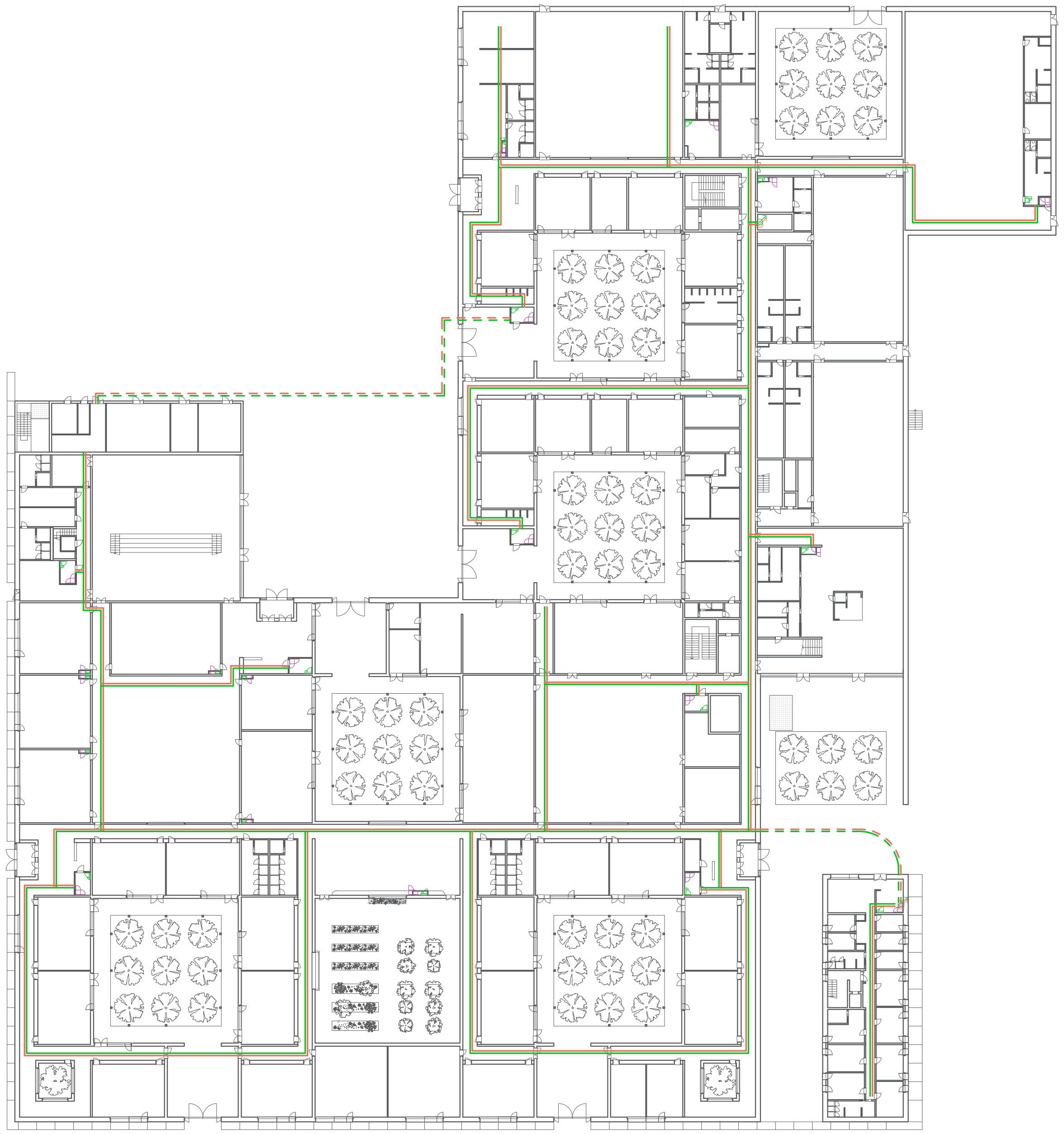


ROOF LEVEL

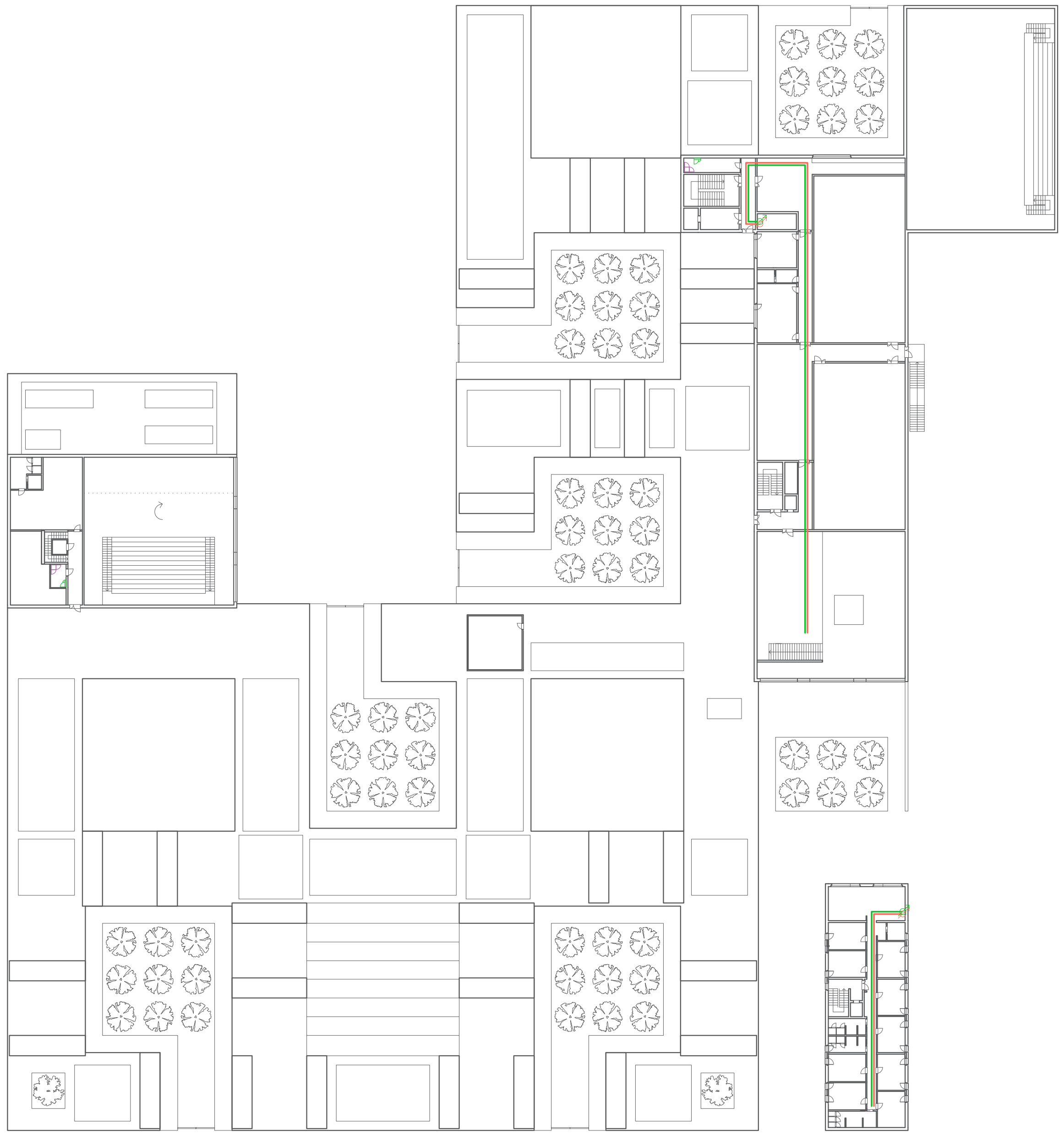
#electrical distribution



PLAN LEVEL -4.00



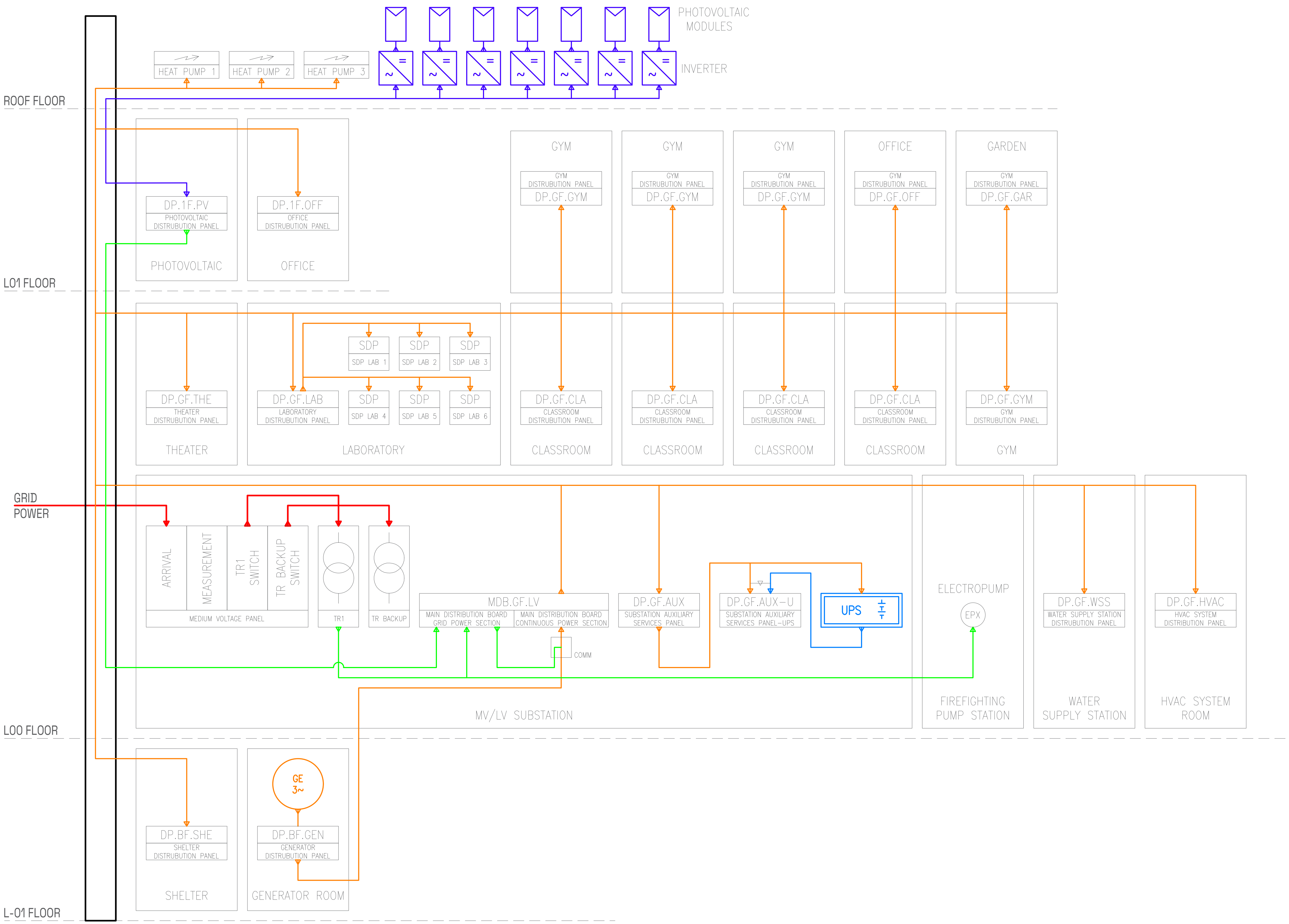
PLAN LEVEL 0.00



PLAN LEVEL +3.65

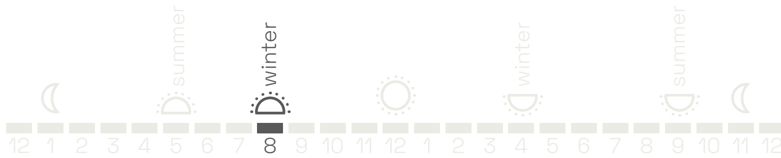
- cable tray 300x100mm - Low voltage systems
- underground distribution - Low voltage systems
- cable tray 200x100mm - Low current systems
- underground distribution - Low current systems
- DP Distribution Panel floor laying
- rack floor laying
- SDP Sub Distribution Panel wall-recessed/ wall-mounted
- Rack wall-mounted

#electrical distribution

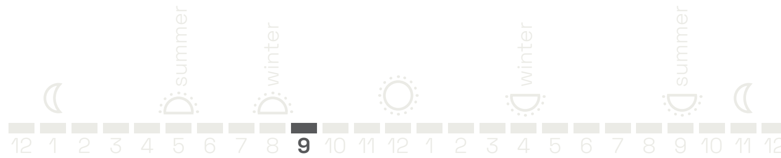


- medium voltage supply
- low voltage supply
- diesel generator supply
- ups supply
- photovoltaic supply
- distribution panel
- sub distribution panel

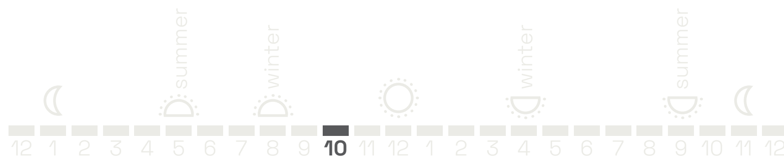
3.6
A NEW DAY
USER EXPERIENCE

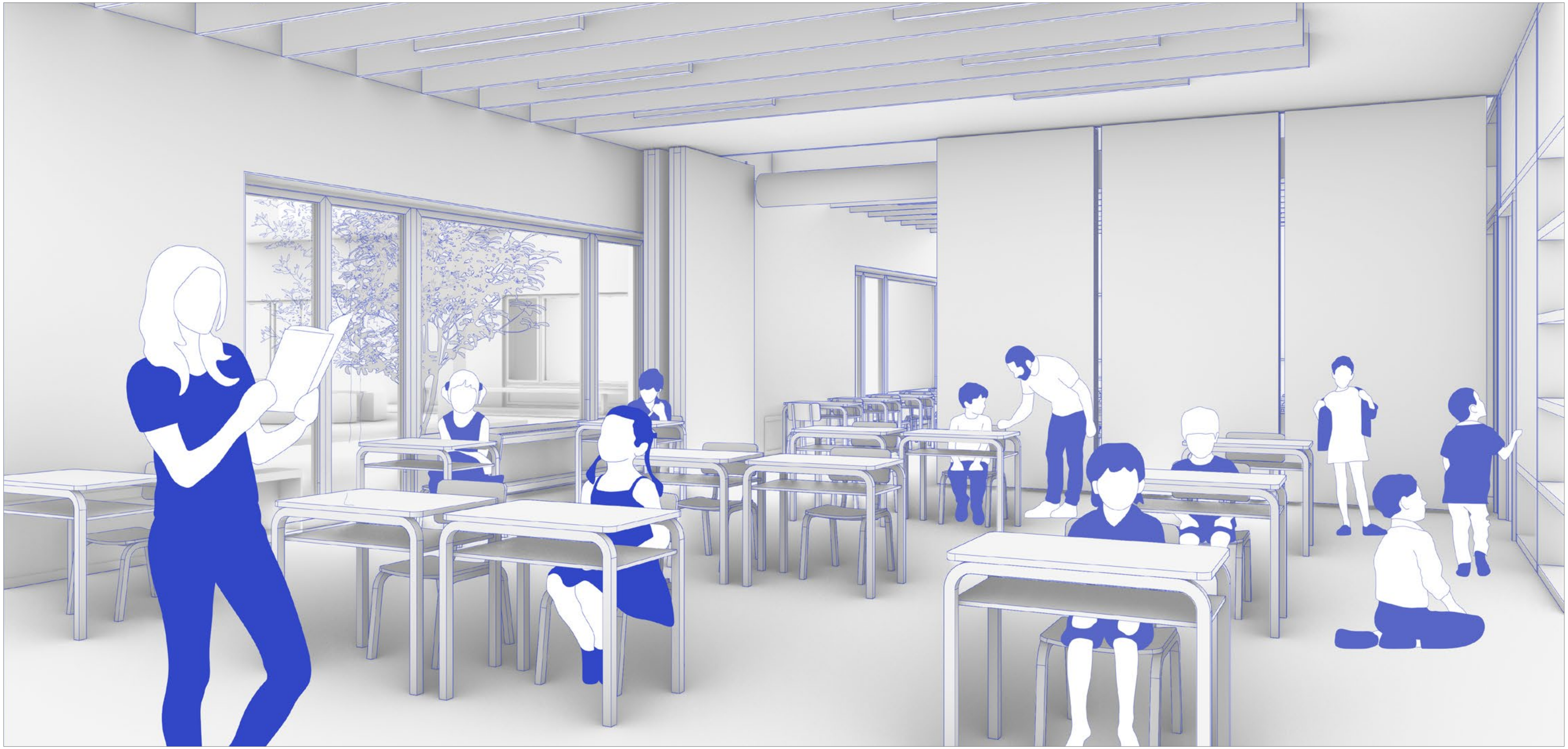


Nadiya walks into the NEW school alongside her friends.

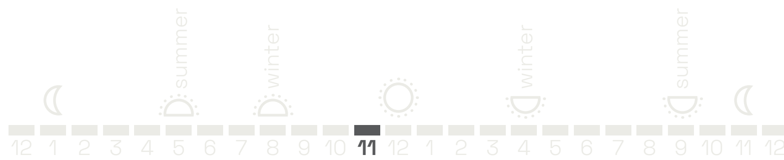


Nadiya walks through corridors that offer opportunities for informal learning and spontaneous interactions.

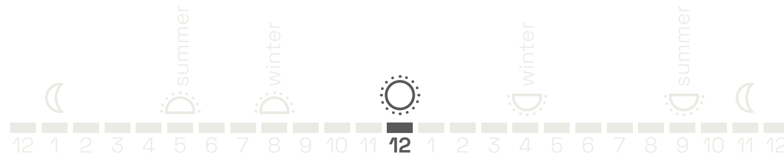


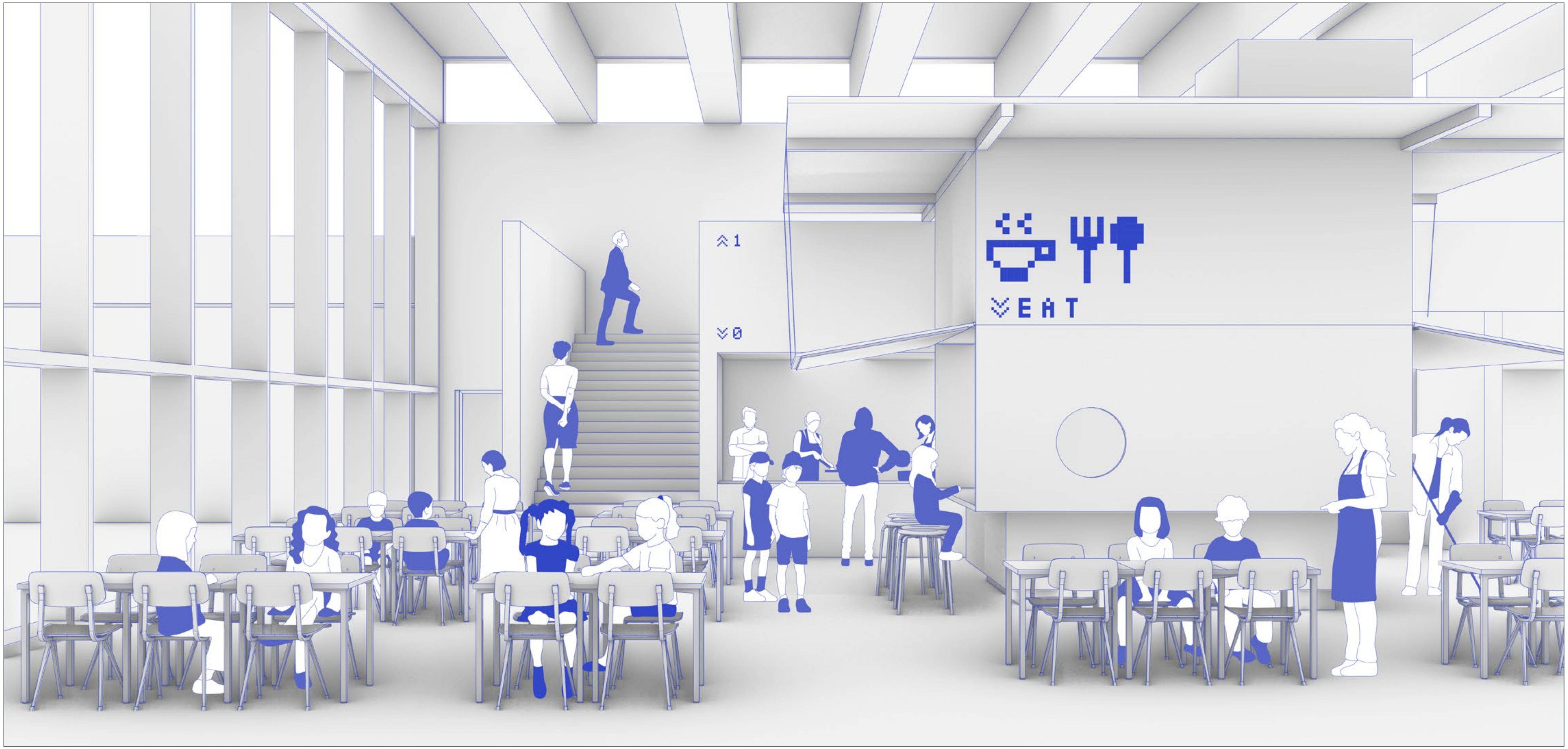


Nadiya listens during class as the teacher explains the lesson.

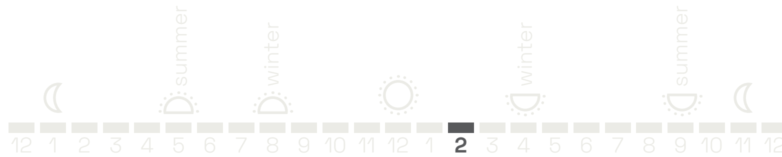


Nadiya laughs and runs around with her friends in the recreation space.

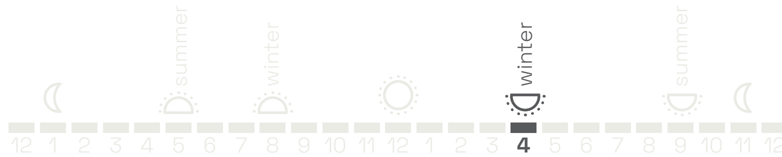




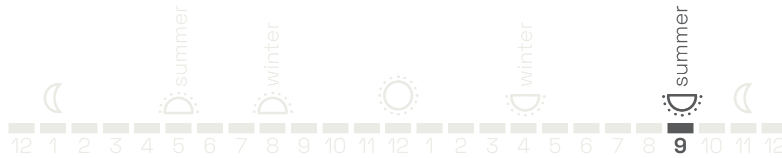
Nadiya shares a meal with her classmates and others from the school community.



Nadiya spends the afternoon tending to the rooftop garden.



Nadiya meets her parents at the school gates at the end of the day.



Nadiya returns to the neighborhood with her family alongside the entire community for an evening gathering.

3.7
GLOSSARY
TOOLS TO TEST

ACCESSIBILITY Designing environments that are usable by people with disabilities or other limitations, promoting equality in access.

ADAPTABILITY Ensuring that spaces and structures can evolve over time to meet the evolving needs and demands.

ANCILLARY Supportive spaces that facilitate the primary activities of a facility, such as storage, technical rooms, or administrative areas.

ASSEMBLY The process of connecting prefabricated modules on-site to form a complete structure.

AUTONOMY Achieving independence from external energy sources through renewable energy generation and storage.

BEAUTY In design under NEB principles enhances a given context by activating its unique qualities, fostering well-being and belonging through meaningful collective experiences, and integrating enduring cultural and social values.

BIOPHILIA Integrating natural elements like vegetation and daylight to enhance well-being.

BIM - Building Information Modeling - A digital tool for managing the design, coordination, and construction process.

CATALOGUE An organized index of spaces that details their types, functions, relationships, and adaptability, ensuring a flexible and functional design approach.

CARBON Addressing emissions reduction through strategies like energy-efficient design and renewable energy.

CIRCULARITY Emphasizing the reuse of materials, such as recycled aggregates for finishes and structures.

COMFORT The provision of conditions that ensure appropriate sound insulation and temperature regulation for users' well-being.

COMMUNITY Condition of sharing certain attitudes and interests in common enhanced by integrating equality, accessibility, and affordability, fostering equal access to opportunities and resources for all

CONNECTIVITY Creating seamless transitions between spaces and functions, enhancing user experience.

COURTYARDS Central public spaces, inspired by the hortus conclusus, designed to foster community interaction and connect the built environment with nature.

DFMA -Design for Manufacturing and Assembly - A methodology focusing on efficient production and rapid assembly.

EDUCATION Using design to enhance learning experiences, integrating adaptable and collaborative spaces for modern education.

EFFICIENCY Reducing energy consumption through design elements like passive solar optimization and thermal insulation.

ENGAGEMENT Involving the local community in the design process to ensure the architecture reflects their needs.

ENVIRONMENTAL RESPONSIBILITY Strategies to reduce ecological impact, such as renewable energy and green roofs.

FLEXIBILITY Allowing spaces and systems to adjust to various uses and conditions over time.

FUNCTIONAL ELEMENTS Design components that ensure practicality and usability, tailored to specific performance standards and needs.

FULL-DAY SCHOOL MODEL A school design that extends the day to include both academic and extracurricular activities, prioritizing sustainability and energy efficiency.

HARMONY Balancing aesthetic appeal, functionality, and integration with the local context.

HVAC - Heating, Ventilation, and Air Conditioning - Systems for maintaining indoor thermal comfort and air quality.

INCLUSIVITY Designing spaces that are accessible and usable for individuals of all ages and abilities.

INFORMAL LEARNING Learning that occurs organically through unstructured interactions, experiences, or environments outside traditional classrooms.

INNOVATION Employing advanced methods and technologies such as digital tools and efficient manufacturing techniques.

INSTALLATION On-site integration of prefabricated components or systems.

LEISURE SPACES Areas designed for relaxation and enjoyment.

MANUFACTURING The off-site production of building elements under controlled conditions.

MODULARITY A customizable system designed for flexibility and reconfigurability at various scales.

NEB The New European Bauhaus is a platform to experiment sustainable living in Europe and beyond providing access to EU funding for beautiful, sustainable, and inclusive projects.

OFFSITE A construction process where components are fabricated in factories and transported to the site.

ON-SITE Activities occurring at the construction location, including assembly and installation.

PARAMETRICS The use of computational tools to optimize design variables for performance, aesthetics, or sustainability.

PLACEMAKING Creating dynamic, engaging spaces that foster community interaction and identity.

PLUG AND PLAY Pre-engineered components designed for quick integration without further customization.

REBUILDING Restoring and revitalizing communities by providing essential services and spaces that promote social stability and normalcy.

RECREATIONAL Areas designated for activities that promote relaxation, play, or physical exercise.

RESOURCE EFFICIENCY Maximizing the use of materials and minimizing waste, often through prefabrication and modular processes.

RESILIENCE Designing for durability and the ability to adapt to climatic, environmental, or social challenges.

RESOURCING Leveraging local materials and skills to support sustainability and community development.

SUSTAINABILITY Strategies to generate renewable energy, to preserve or prolong usability, and reduce construction timelines and carbon emissions with the highest ambition to regenerate and reconnect to nature.

STRATEGY A roadmap for implementation, outlining the design decisions and addressing logistical, practical, and contextual considerations.

SYMBIOSIS Achieving mutual benefit between architecture, nature, and urban environments.

TOOLBOX A collection of modules - and strategies designed to support and streamline processes providing ready-to-use solutions.

3.8
BIBLIOGRAPHY
TOOLS TO TEST

- Clyde Zhengdao Li, Vivian WY. Tam, Xulu Lai, Yijun Zhou, Shan Guo. (2024). Carbon footprint accounting of prefabricated buildings: A circular economy perspective.
- Daneshgari P., Moore H. (2019). Prefabrication handbook for the construction industry.
- Dodge data analytics. (2020). Prefabrication and Modular Construction 2020.
- Durmisevic S. (2010). Transportability and adaptation through design for disassembly: The case of concrete buildings.
- Fianchini, M. (2017). Rinnovare la scuola dall'interno: scenari e strategie di miglioramento per le infrastrutture scolastiche.
- Gómez-Galán, J. (2018). Educational Architecture and Emerging Technologies: Innovative Classroom Models.
- Hasselbach R., Knaack U., Chung-Klatte S. (2018). Prefabricated systems: Principles of construction.
- Herbert G. (1984). The Dream of the Factory-Made House: Walter Gropius and Konrad Wachsmann.
- Hertzberger, H. (2008). Space and Learning.
- Hille, R. T. (2011). Modern Schools: A Century of Design for Education.
- Kim H., Lee D. (2012). Design Optimization for Modular Concrete Systems.
- Lange A. (2018). The Future of School Design.
- Lun Weisheng, Tan Tan, Xu Jinying, Wang Jing, Chen Ke, Shang Gao, Xue Fan. (2020). Design for Manufacture and Assembly (DfMA) in construction.
- Nair, P. (2014). Blueprint for Tomorrow: Redesigning Schools for Student-Centered Learning.
- National Construction Code (NCC). (2024). New prefabricated, modular and offsite construction handbook.
- National Institute of Building Sciences. (2008). Modular Construction in the 21st Century.
- Pezzetti, L. A. (2012). Architettura per la scuola: impianto, forma, idea.
- Rosana W.M. Wong, Becky P.Y. Loo. (2020). Sustainability implications of using precast concrete in construction.
- Sanchez V. K. (2014). Architectural System Structures: Integrating Design Complexity in Industrialised Construction.
- Smith R. E. (2011) Prefab Architecture: A Guide to Modular Design and Construction.
- Sanoff, H. (1994). School Design.
- Tosi, L. (2019). Fare didattica in spazi flessibili.
- Vishal G. G., Shital S. G., Shubham M. Z., Ujjwal D. N., Deelip B. K. (2024). The impact of modular construction on project delivery times.
- Wasim Salama. (2017). Design of concrete buildings for disassembly: An explorative review.
- Weyland B., & Attia S. (2015). Progettare scuole: tra pedagogia e architettura.

NEW

NEIGHBORHOOD FOR EDUCATIONAL WONDER

March 3, 2025

LTAID
Lithuanian Development Cooperation

CPVA

Agency for Restoration

New European Bauhaus

[SCANDURRA]

Deerns

CEAS

GRA
GOLDAKOVSKIY GROUP ARCHITECTS

Strategy Handbook

adaptability | community | sustainability

Project financed from the Lithuanian Fund for Development Cooperation and Humanitarian Aid