Above the Horizon

Above The Horizon
View from the Public Roof over Budapest

ARCHITECTURAL VISION

Socially responsible behaviour is dependent on repetitive individual and collective exposure to our cultural evolution. Many museums today seem to see their visitors as the largest threat to their own collections and exhibitions. This attitude leaves museums “passive” in their performative role as cutting-edge institutions and in their relationship to the public at large.

To enable the New Hungarian National Gallery and the Ludwig Museum to have the desired active role; interacting and communicating with their audience, our project is based on the following principles:

The wish to unify two museums in one building while maintaining a strong individual identity for each.

We are situating both institutions under a singular public roof that is always accessible. Thus the roof becomes an inherent part of the City Park as does its` elevated continuation offering great views over the whole of Budapest.

Architecturally, we strive to create a museum building that offers exciting, modern and contemporary spaces that enable an art experience confidently suited to the display of art from varying epochs and styles.

We aim to create an inspirational environment for education and museum learning, where the thoughts and philosophical mindsets fundamental to any form of art creation and understanding are at the centre point.

The centre point of the building symbolises the meeting point of two art institutions, the meeting of light and earth at the horizon simultaneously resolving practicalities of daylighting and embodying gravity at the meeting of the Ludwig Museum and the New National Gallery.

In the heart of the building we envision a large open public space that serves both institutions. Here the visitors, local and from afar, young and old, are invited to start their journey of exploring art, in the Ludwig Museum and New National Gallery.

The juxtaposition of the two institutions beneath a common fabric creates a space where tensions serve to inspire – a metaphysical reaction field between collections, and beyond the individual mind.

Aerial View
The New National Gallery and Ludwig Museum

SITE RELATIONS

Situated in the North-East of the City Park the New National Gallery and Ludwig Museum form the new focal point at the end of an axis from the 1956 Monument. This together with the new Hungarian Museum of Architecture, and the Photography Museum forms a gateway to the park.

Our buildings' shape reacts to this visual axis and continues the park upwards on a public stairway from which visitors can enjoy elevated views above the trees and out over the entire city. With its two highpoints and the two gently tilting surfaces the building clearly reacts towards the pedestrian flow coming from Hermina út in the North, while simultaneously creating an extension of Napozórét to the South. This generous gesture towards Napozórét, is intended to strengthen the quality of the existing park structure, while adding variety to the experience of the park. The roof of the building is extended back to the public instead of merely occupying a large portion of the park. By enabling people to explore the roof of the building with a scalable surface, which is activated with café's, terraces and unobstructed views, we aim to create a genuine ownership among visitors as well as locals, integral to the strategy of making the two new museums a genuine part of Budapest.

Above The Horizon
View from Napozórét

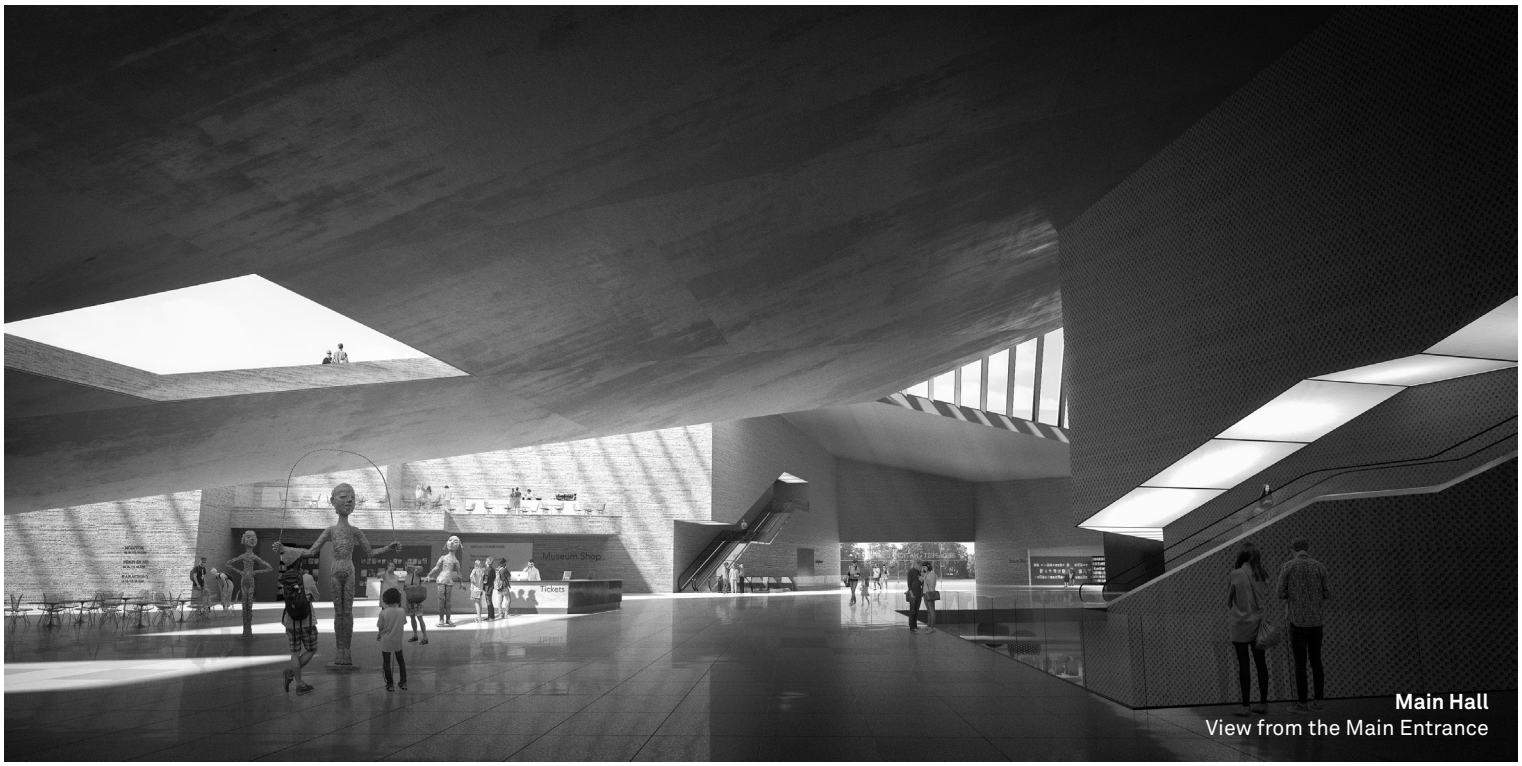
The scalable peak-like quality of the 40 metre volume creates a visible and attractive destination for the North East corner for the park, contributing to an enhanced flow of park visitors. The sloping volumes adopt different characteristics at different times of the day: shade or exposure, high or low – the choice is yours.

While clearly relating to one historical axis with the buildings' volume, the volume similarly reacts to pedestrian flows along the diagonal connection of Vajdahunyad stny as well as from Zichy Mihály út. As a result of this our building has multiple entrances from all sides with a main entrance from the new Museum Plaza between Zichy Mihály út and the New National Gallery and Ludwig Museum.

The entry plaza appears to float independently from the building due in part, to the ramped gallery down to the parking levels allowing the building volume to visually slide below grade.

The park plaza to the North invites visitors from the Metro, and residential areas, either visiting the institutions or simply traversing the park. The park plaza weaves beneath and between the existing trees and comprises a combination of paving and reinforced grass. The artefact delivery port is subtly integrated in the façade and the park plaza more than adequately accommodates even the largest vehicle manoeuvring under safe conditions whilst retaining an open, park-like quality.

The existing southern plinth in of the former building is removed and the terrain returned to a natural incline toward the park. Here the roofscape naturally fuses with the park landscape and at this point we envisage a large potential for hosted or spontaneous events with a natural amphitheatre. The proposed sporting development to the North West could similarly feed from the roofscape to form an integrated solution to terracing, event hosting and arrangements potentially offering a sizeable financial contribution to the institutions.



Main Hall
View from the Main Entrance

INTERNAL ORGANIZATION

PUBLIC ACCESS

Upon entering the generous entrance hall on the ground floor level from either the Museum Plaza in the East, or the alternative entrances on the north and west sides the public will be met by a large, open shared space with unique spatial qualities and ample amounts of daylight. This high central space forms both museums first meeting point with the visitor and allows for easy orientation with a central information point and ticketing counter. The concept of this space is that of a common, democratic, open agora. It should be considered as a shared space belonging both to the city and its inhabitants and to the museums.

From here visitors have direct access to both museums and their adjacent event-spaces, such as the learning centre, lecture halls, cinematheque and auditorium. From here we access the museums cafeteria and brasserie, as well as both museum shops and the cloakrooms.

Both restaurants can be accessed from the park-side without having to enter the building and thus allow for extended opening hours independent of museum opening hours.
In the evenings it is possible to close the museums and shops while still allowing access for special events, lectures and learning events.

GENERAL ORGANIZATIONAL PRINCIPLE

The four main exhibition volumes are divided both vertically and horizontally, with a sandwich layer of common and dedicated functions. This enables enormous flexibility in configuration and adaptation of both the exhibition, and common institution spaces independently of one another.

A volume that allows for movement in all directions, whilst allowing individual identity gives optimal conditions for robust development over time of the New National Gallery and Ludwig Museum.

VIP

VIP entrances are located in close proximity to the two entrances in direct connection to the event facilities in order to accommodate discrete arrival.

Exhibiton Space
New National Gallery

EXPERIENCING ART

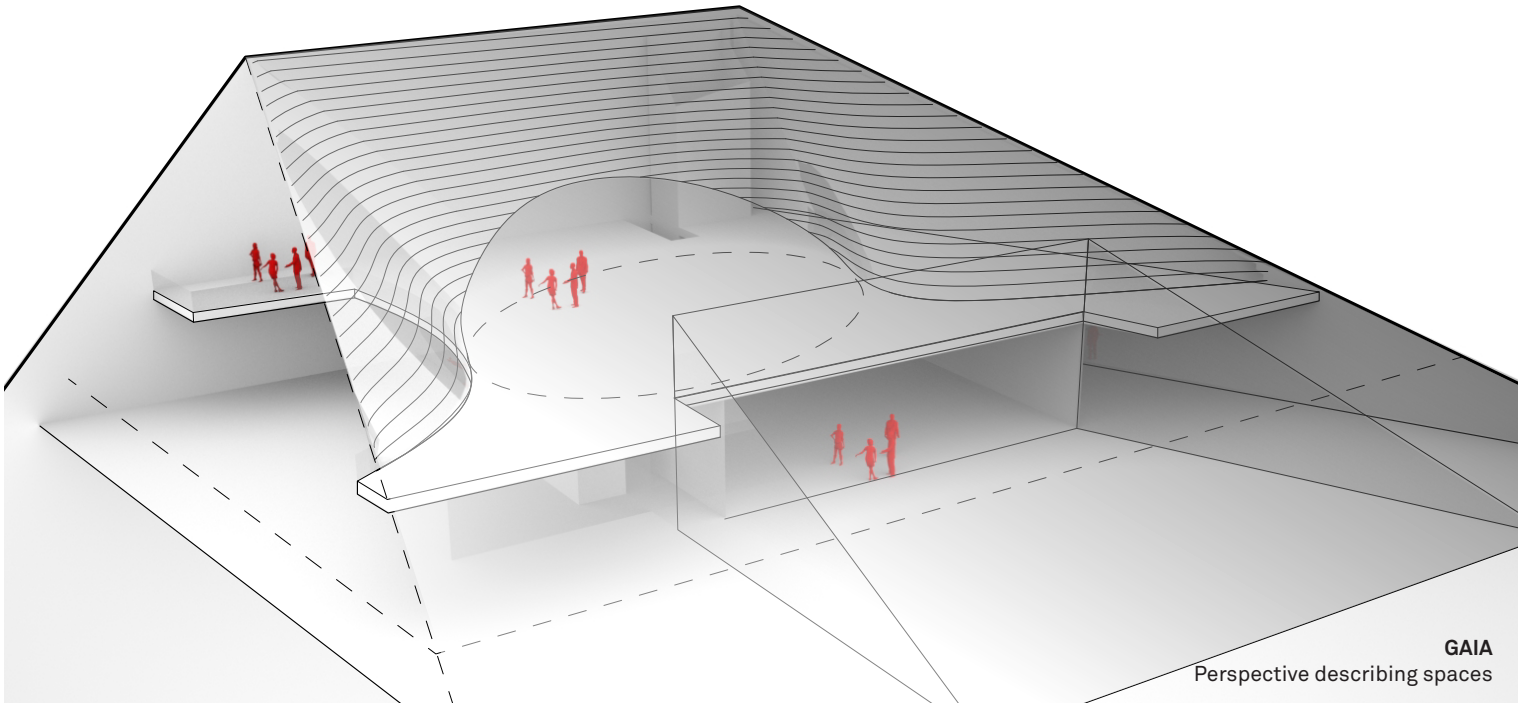
The permanent exhibitions of the museums are placed on level -7,00 with the potential for moving seamlessly from one museum to the other. In addition to that the New National Gallery will have a smaller portion of exhibition spaces located on level -14,00. The temporary exhibitions are placed on level +7,00m without a public connection between Ludwig Museum and the New National Gallery. The concepts would allow for connection of these spaces if desired at a later stage of the design process. All exhibition spaces can be easily accessed by either lifts or grand escalators connecting to the entrance hall.

EVENTS

All major event spaces are situated on the ground floor with direct access from the main hall through separate main museum entrances. Education rooms and museum learning are situated on level +3.5 with separate entrances. These spaces are closely linked to the exhibition spaces to allow for seamless integration in the museum experience of the two separate museums.

OFFICES

The offices for both institutions are located above the temporary exhibition levels, on level 3 (additionally on level 4 for the New National Gallery). The offices will receive sufficient amounts of daylight and offer break-out spaces that open up towards terraces on the public roof.



GAIA
Perspective describing spaces

GAIA

Gaia functions consist of two levels, Level 5 (+24) and Level 6 (+29).
Level 5 accommodates the Gaia hall with connected breakout spaces and foyer, flexible office spaces, meeting rooms and toilets. The Gaia hall has direct access to a designated roof terrace along one whole wall and can operate as either a closed volume or airy open space/foyer for any number of events.

There are four main vertical connections to the Level 6 comprising 2 elevators (one large dedicated) and two open flights of stairs.

GAIA
Void space between office and lab levels

The Gaia lab has a generous volume, stretching to the upper apex of The New National Gallery volume, thus dramatically equipped for expansive thought and investigation. The enveloping form of the Gaia Lab is intended developable to allow spatial variety within the same volume and the organic footplate opens out to a dedicated terrace.

The organic form of the Gaia lab is equally experiential from the flexible office space on Level 5 via void spaces toward the main facade.

ARTEFACT HANDLING

In order to optimize the area for artefact handling the main delivery dock is situated on grade, with direct access from Hermina str. The door of the loading dock will be subtly integrated into the facade. From this loading dock the artefacts are transported directly down to level -14,00 where they will be unpacked, stored, archived, restored and prepared for exhibition. There are two large elevators for artefact handling that can reach all the temporary and permanent exhibition areas and connected BOH corridors. These corridors also lead to the workshop areas that are located on upper levels to allow for direct daylight in the workshops of both the Ludwig Museum and the New National Gallery.

STAFF MOVEMENT

The dedicated staff entrance is located on the north-west side of the building from where the museums employees can access all areas within the entire building.

Level – 1 (-3.5) is dedicated to staff circulation, where the various lift cores can be accessed for vertical transport of goods to different museum areas. The same routes are used for maintenance and waste handling. Staff facilities are located on level 1, directly accessed from the staff entrance.

PARKING

Three underground parking levels are located north-west of the Museum under the new Museum Plaza with direct access from the parking near Hermina str. This route is also suggested for smaller goods deliveries. The upper two parking levels will be dedicated for museum visitors whereas the lowest parking level will be reserved for employees. The Main Hall of the building with access to both museums can be reached from every parking level via the lift batteries.

The Public Roof
Approaching from Hermina út

MATERIALS

The main loadbearing structure is of reinforced concrete. The external vertical walls are of rammed earth with additional core insulation. Rammed earth will contribute positively to the strategy for CO2 reduction. Internally the hygroscopic qualities of these walls will naturally assist regulation of humidity. The walkable surfaces are of stone for extreme durability.

The tilted glass walls have structural fins with incorporated photovoltaic and solar thermal panels for energy production.

Internally we aim to give the two institutions slight, yet recognizable variations in their material concept.

Conceptually the two opposed internal volumes form tensions – both in concrete but with differences in the surface treatment. The Ludwig museum will have a recognizably structured texture whereas the New National Gallery will have a more subtle honed surface.

The common floor is of light terrazzo or stone with a ceiling materiality that describes the volume above. Integration of acoustic absorption happens when necessary in the vertical surfaces.

The floors in the permanent exhibitions and New National Gallery temporary should be of solid wood while the temporary exhibitions in LM are intended to be polished concrete.

The ceilings of the white box exhibition spaces should appear homogenous and integrate acoustic treatment and artificial skylight, here a tensile fabric ceiling may be a good solution.
The main event areas will have warm, natural material to stimulate the senses and offer contrast to the predominant materials of stone and concrete – wood would be a natural choice.

Where possible all materials should be locally sourced and locally worked.

SUSTAINABLE INSTITUTIONS

Passive and active design strategies will be designed as integral parts of the architectural design, illustrating an aspirational approach towards various sustainability targets. The design concept demonstrates environmental awareness while optimizing the environmental quality for the users/spectators at the gallery.

PASSIVE DESIGN STRATEGIES

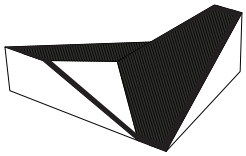
Programmatic design of spaces offers an opportunity to minimize the use of active systems. The non-gallery spaces take advantage of natural ventilation and daylight, while the gallery spaces utilize efficient LED lights as well as AC mechanical systems. The mechanical ventilation systems are operating when necessary to provide hygienic air exchange and ensure conservatory conditions for the gallery.

ACTIVE DESIGN STRATEGIES

The rooftop stairs on the sun exposed side are covered with PV to generate electricity on-site. Daylighting simulations demonstrate the amount of available irradiation on each of the rooftops in order to select the highest potential sun exposed side.

INDOOR COMFORT

The thermal storage capacity of the slab is sufficient to provide a nice and comfortable climate for the next day. The glass façade utilizes vertical external louvers with PV that provide shading to prevent overheating in summer. In addition, the PV units on the façade generate electricity.



Above the Horizon
Structure

STRUCTURAL SYSTEM

A simple, economic and efficient static system is developed for the structural system. All load bearing elements are of in situ-cast concrete.

Bi-axial hollow core slabs are recommended to reduce the dead load and the foundation load. The reduced weight of the slabs allows large spans, require less reinforcement and reduce CO2 emission. In addition, thermal activation building system, TABS, can be integrated in the slabs to activate the thermal mass of the building.

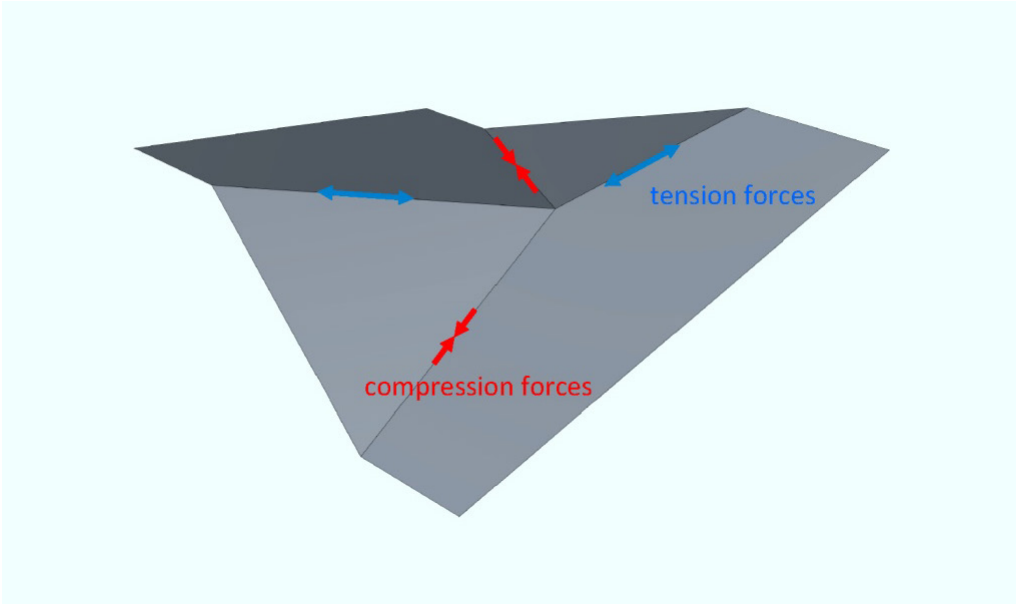
The large span of slabs allows columns to be placed in a regular grid of 12 m. Bi-axial hollow core slabs are flexible regarding openings and edges as they are able to cantilever approx. 3 m. The thickness of the slab can be adjusted in areas with larger spans.

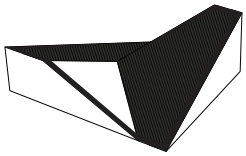
The roof is built of solid concrete plates, which follow the outer shape of the building and meet at a common intersection point. This point is supported by the surfaces resting against each other. The point is partly supported by compression and tension forces in the roof surfaces. This allows an open, column free entrance area beneath.

Vertical load transfer is achieved by load bearing outer walls and the inner columns. Concrete cores stiffen the structure for horizontal loads, such as wind and seismic.

The foundation consists of a base plate built as raft foundation. If necessary, the structure can be supported by foundation piles.

The concrete structure in the basement must be built watertight in accordance with the geo-technical report.





Above the Horizon
MEP Design

MEP DESIGN CONCEPTS

CONTENTS

A SUSTAINABLE APPROACH

Our approach to sustainable design is characterised by thinking around a number of topics that cover broader sustainability issues;

Positive Impact – be part of and contribute to the community.

Land use – re-use of land makes a significant contribution to the impact on the sustainability of a project.

Materials – use locally suitable materials for cladding and structure; materials selection based on an evaluation of the CO_2 associated with the construction process and also the cost and availability of materials.

Climate Change – consider the impact of future temperature changes. The expected increase in temperature will not necessarily require a change in cooling strategy, but, it will create higher energy demands which should be taken into consideration.

Energy – short term goal to be highly energy efficient, as set-out in the brief. The long term goal could be to be fully renewable.

Water – the aim of the design would be to make the development sustainable in water use.

Transport – based on a ‘green’ travel plan encouraging staff, students and visitors to arrive by public or other low-emissions modes of transport.

Operation – The buildings and building services should be simple to maintain and operate, allowing continual improvements in energy and water-use. The site should process waste material; a logistics centre located at the entrance to the site would optimise delivery and recycling.

Economic – Short term goals could be to increase local economic activity. A long term goal could be to help create a stable mixed local economy.

In truth economics sits alongside, or above, all areas of sustainability; no project, or any aspect of a project, can be truly considered sustainable unless it is economically viable.

DESIGN FOR ENVIRONMENTAL CONTROL

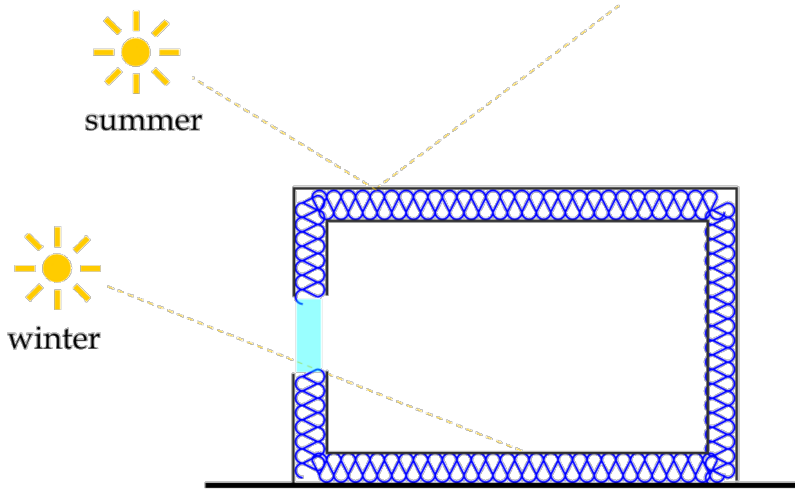
Designing the environment within a museum and archive building is a combination of art and science. Maintaining stable temperature and humidity is essential.

Creating the best environment for works of art and historic artefacts involves making appropriate decisions on temperature, humidity, air filtration and noise levels and making intelligent choices in the design of the building itself. Heat gains and losses, and daylight may be optimised by the correct choice of glazing systems and the placing of insulation and vapour barriers. A buffer zone approach, where a gallery or archive is wrapped in less climatically-sensitive spaces, or is placed underground, to provide passive protection from the external environment, is often very effective.

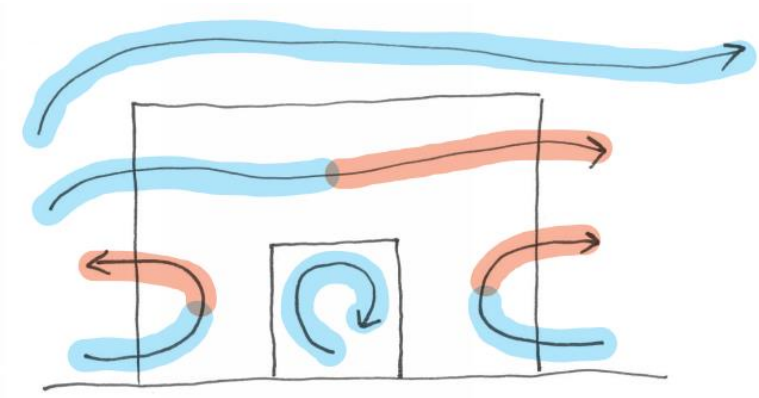
The starting point for the design of the building envelope is consideration of building orientation. This may be fixed, or at least suggested, by particular site constraints, access perhaps, or views. Whether this is the case or not, there may be some flexibility to adjust orientation to take advantage of environmental conditions. There are, in any case, some fairly straightforward rules that should be followed for the design of each façade dependent on orientation and the use of the spaces.

In all cases optimising daylight by careful glazing design and location will result in minimal heat loss and lowest energy use.

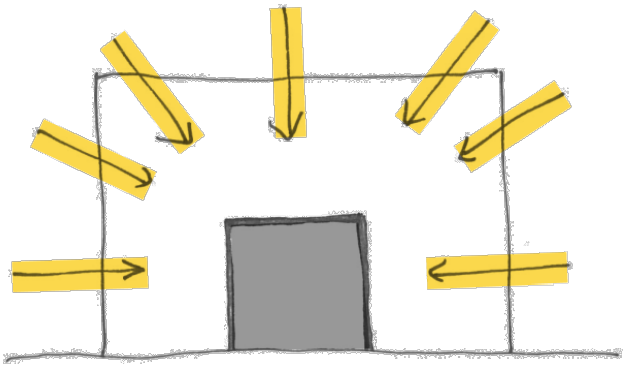
Likewise building fabric should be designed to suit particular space types. Archive and storage spaces, with relatively low occupancy and low heat load, will benefit from a thermally heavyweight construction to provide stability. Gallery spaces can also be thermally heavy, providing a good base stability level and the opportunity for a more passive approach to conditioning.



Facade



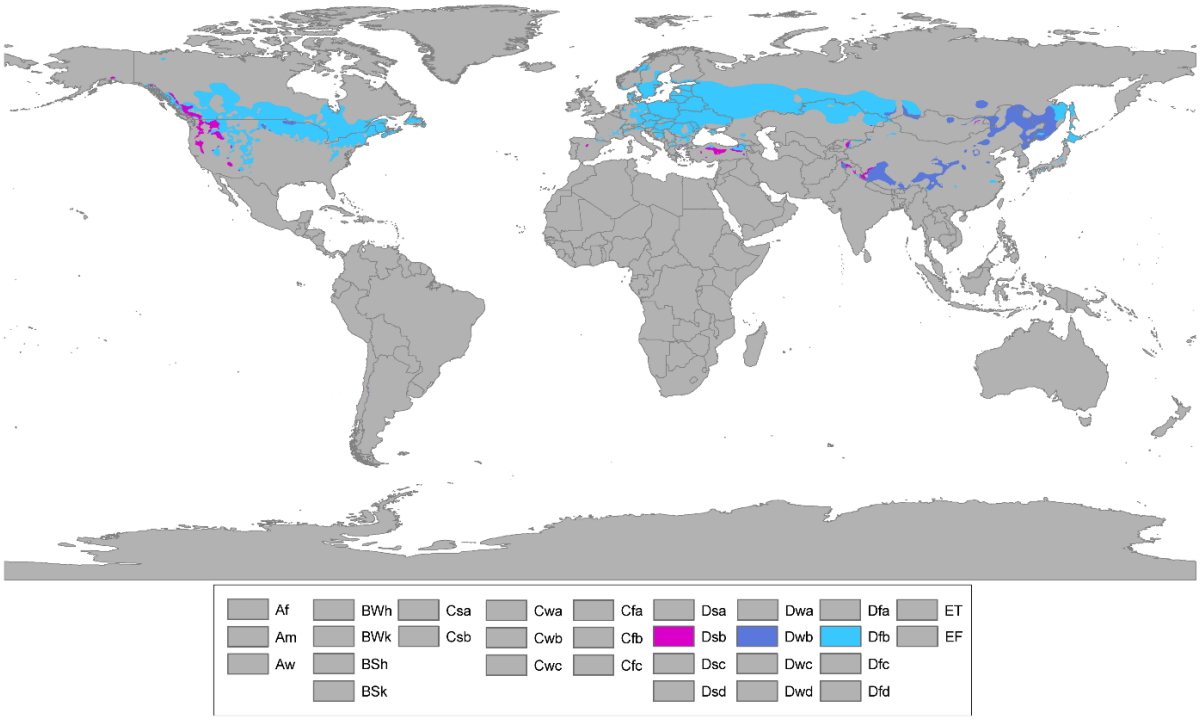
Natural ventilation (cross and single sided)

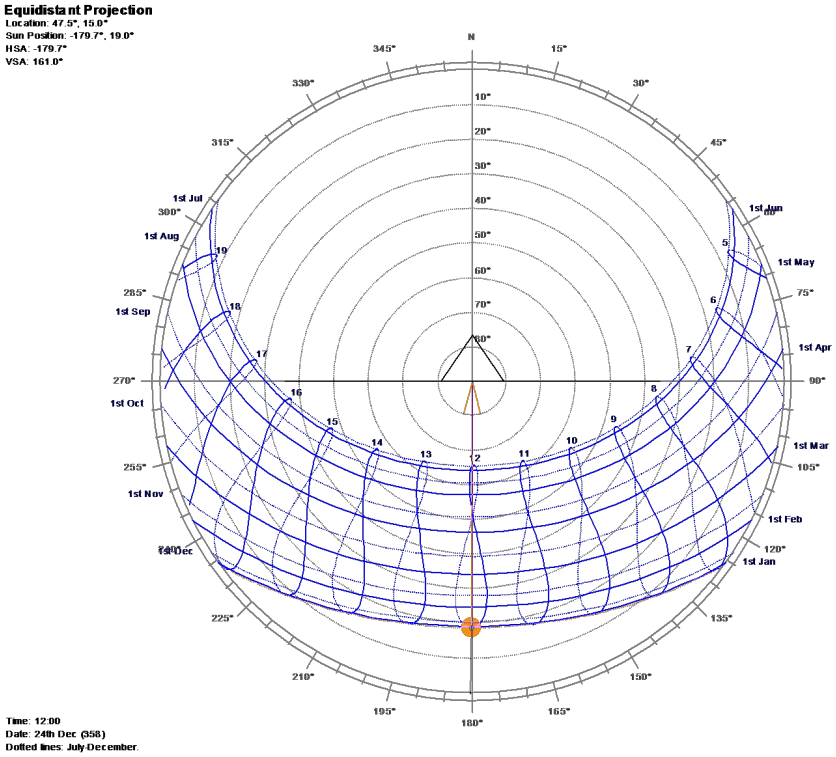


Daylight / artificially lit areas

CLIMATE

BUDAPEST – Dfb CLIMATE





Under the Koppen climate classification Budapest is defined as type Dfb; continental climate, characterised by cold winters and mild summers. These climates have an average temperature above 10 ° C in their warmest months, and a coldest month average below –3 ° C. The key to reducing energy use in these climates is through envelope design that minimises heat loss while reducing solar gain in summer.

PASSIVE DESIGN PRINCIPLES

BUILDING ASPIRATIONS

The Liget Budapest development housing the New National Gallery and Ludwig Museum is targeting a 2018 'almost zero-energy' aspiration, with a maximum overall energy performance (heating, cooling, ventilation, hot water production, lighting) of 85 kWh/m²/annum.

The following key passive design principles will improve energy performance and support user comfort:

1. **Site**
   Appropriate building orientation to respond to solar gains and microclimate

2. **Façade**
   Design façade to minimise heat loss in winter and solar gains in summer

3. **Natural ventilation**
   Place areas that can be naturally ventilated at perimeter of buildings

4. **Daylighting**
   Place areas requiring natural lighting at the perimeter

5. **Renewable / low carbon electricity**
   In addition to the district CHP scheme that is planned ground source heating and cooling and photovoltaic panels are proposed

6. **Plant efficiency and metering**
   Efficient plant in combination with extensive energy metering to reduce ongoing energy consumption

BUILDING PASSIVE DESIGN

Façade/envelope design

Optimising daylight by careful glazing design and location, in conjunction with high thermal performance from facades, will result in minimal heat loss and solar gain. Where extensive glazing is proposed this will have high thermal performance. To achieve the required energy performance the building fabric must also meet the maximum heat transfer criteria.

Thermal mass

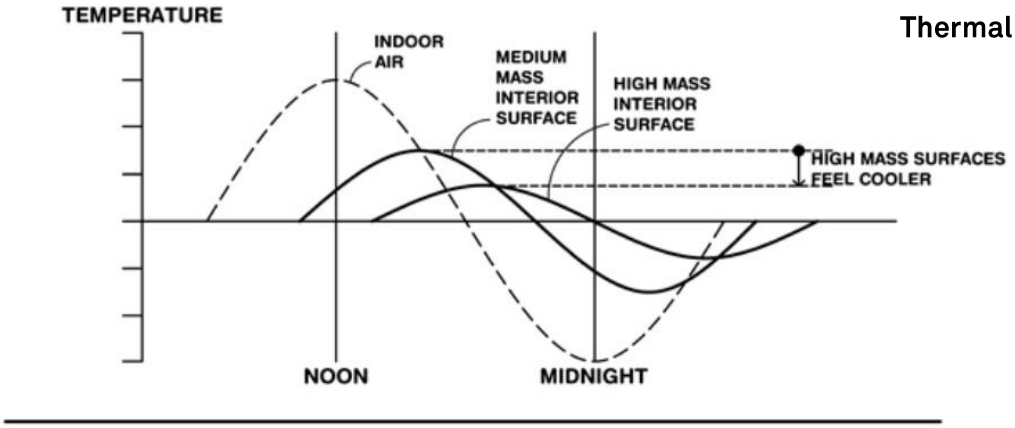
The energy performance of the building is significantly improved by using high mass interior materials such as exposed concrete slab floors and soffits and high mass walls to store winter passive heat and cooling energy in summer.

High mass interior surfaces like concrete, stone, brick or tile, are able to absorb or release energy without significant temperature change. This means that they feel warmer in winter, and cooler in summer, and reduce day-to-night temperature swings. The more stable surface temperature contributes to better occupant comfort and to more stable environmental conditions generally.

Maximum U-values (W/m².K)	
External wall	0.22
Flat roof	0.15
Suspended Slab	0.25
Glazed doors/windows	1.0-1.3
External door	1.3

Thermal Conductivity

Tabulated data source: Hungary: Hungarian Chamber of Engineers, 2011



Thermal mass

BULDING ORIENTATION

The treatment of each façade has been carefully considered taking into account orientation and space use:

South-facing facades
The facades that are predominantly south-facing have limited glazing, or glazing that is set-back and therefore shaded, providing daylight where required while minimising solar gain.

East/west-facing facades
There is a significant amount of predominantly east or west facing façade, some of which is fully glazed. In this case vertical fins deal with morning and afternoon sun. Other east and west facing facades are largely solid, controlling solar gain by minimising glazing area.

North-facing facades
Northern facades are ideal for harvesting natural light; glazing is balanced with solid façade to reduce winter heat loss.

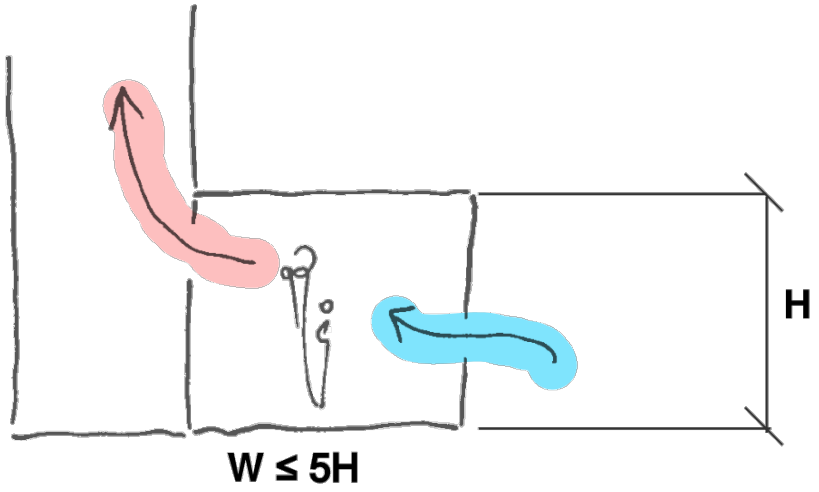
DAYLIGHTING

Access to the sky (visible sky angle) is key to achieving good daylight levels throughout the development. Spaces have been arranged to provide occupants with good levels of daylight and a good connection with the outside. This is particularly important for areas where people are working, but it is also important that visitors to the museum are able to connect to outside at some points.

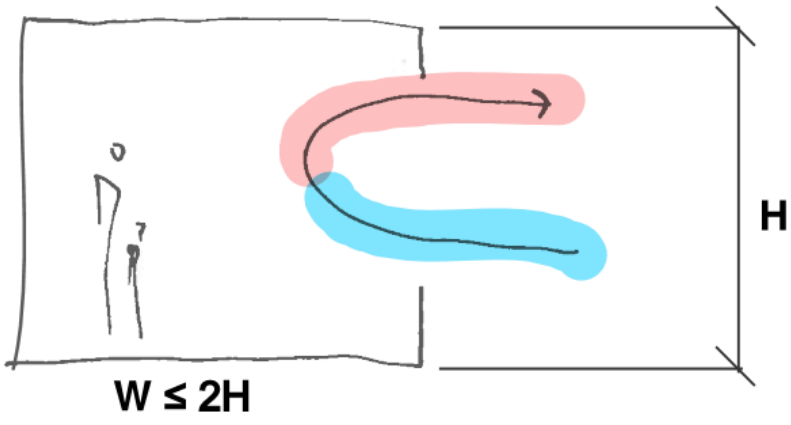
NATURAL VENTILATION

Natural ventilation operates most effectively where cross-ventilation is available, but through careful design, with high and low level openings, single-sided natural ventilation can also work very well.

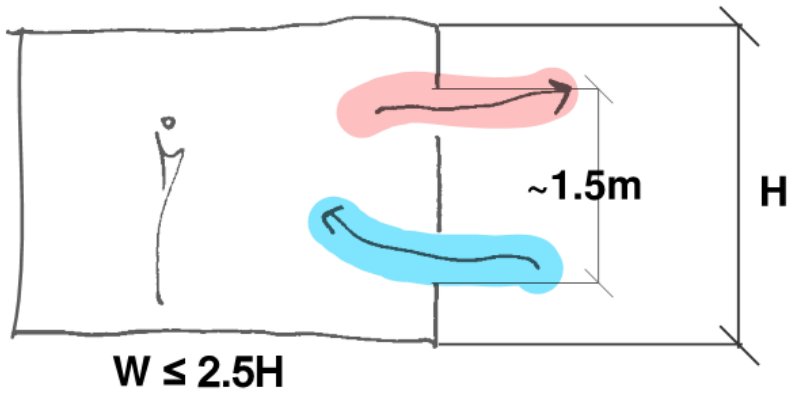
Following some basic rules in terms of clear room heights and depth of spaces allows effective ventilation of spaces such as offices and lecture rooms that do not requires a close level of environmental control.



Cross-ventilation



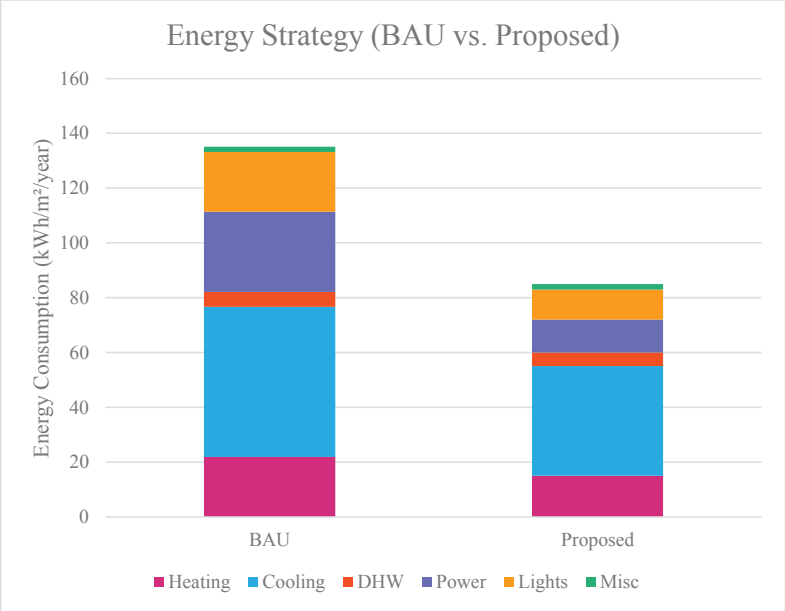
Single-sided ventilation

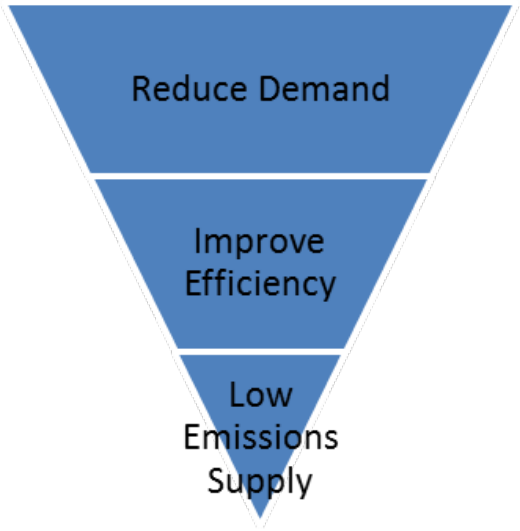


ENERGY STRATEGY

The building must consume no more than 85kWh/m²/annum. This will require a combination of a strong passive design strategy together with efficient plant and some contribution from renewable energy sources.

The graph demonstrates the difference between 'building-as-usual' (BAU) and the approach required to achieve 85 kWh/m²/annum:





REDUCE DEMAND

This is principally through the application of passive design, as described.

IMPROVE EFFICIENCY

We propose a number of measures that will reduce energy use, either directly or by enabling systems to be more efficiently managed;

Metering – measuring energy use will allow energy saving targets to be set and improvements monitored

Lighting – energy from lighting is typically a significant portion of any buildings energy use; low energy light fittings will make a worthwhile reduction in electricity use across the development

Demand driven operation – this will give good energy savings for both ventilation and lighting. In front-of-house public spaces ventilation controlled by a combination of temperature and CO_2 monitoring will ensure that systems will run only when required and then only to supply the amount of air needed. In teaching and back-of-house areas, occupancy sensors will ensure that lighting and ventilation systems operate only when needed. Demand driven control is particularly important in public areas that are likely to have shorter operating hours than the building as a whole.

Heat recovery and free-cooling – ventilation systems that recover waste heat from the exhaust air stream and use outside air to directly cool a space, when that air is at the right temperature, will minimise the heating and cooling energy needed to keep the building comfortable

LOW EMISSION SUPPLY

Combined Heating & Power (CHP) plant; connection to the planned district CHP scheme.
Ground source heating/cooling to reduce plant peaks and to provide low carbon cooling.
Photovoltaic panels to generate zero-carbon energy on-site.

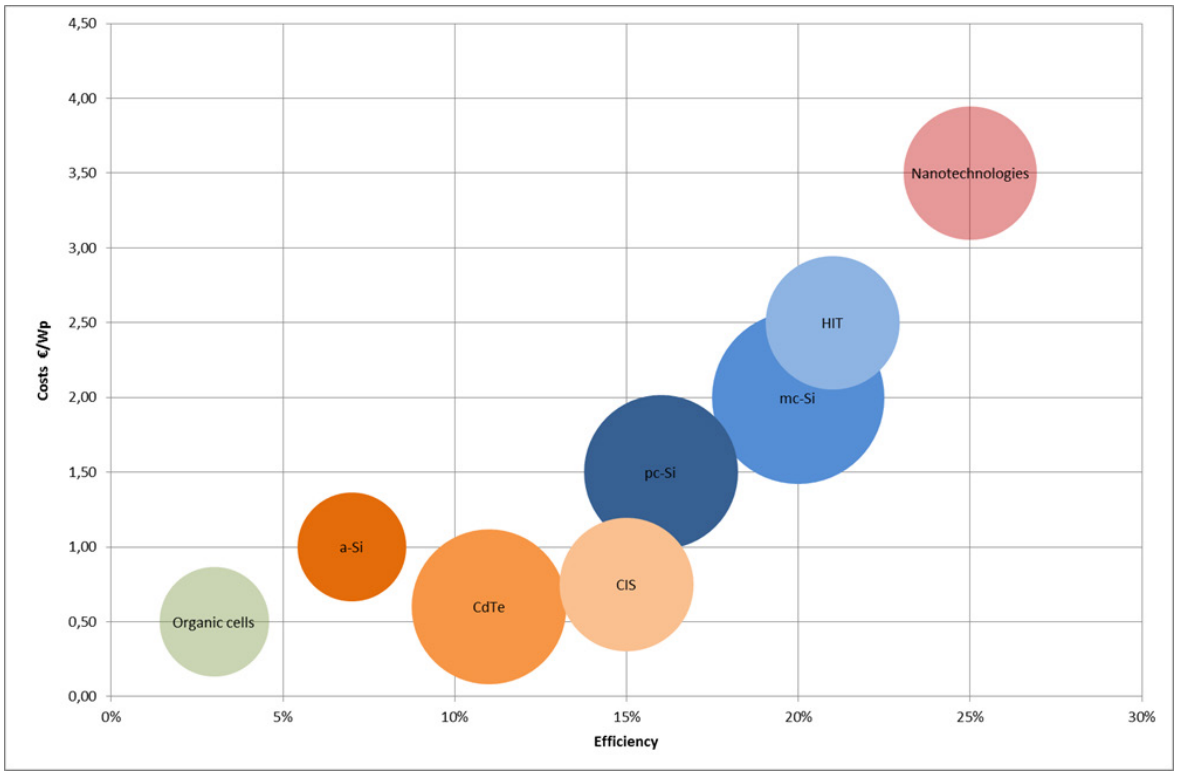
PHOTOVOLTAIC PANELS

The availability of solar insolation in Budapest together with improving efficiency of photovoltaic panels makes this an option worth considering.

At an angle of 35° (optimal panel inclination);

- **3880 kWh/m²/year** of solar insolation
- Capable of producing up to **265 kWh/m²/year of electricity** with high efficiency solar panels (refer to graph for PV efficiency and budget cost)

Vertical panels
- **2600 kWh/m²/year** of solar insolation
- Capable of producing up to **178kWh/m²/year** with high efficiency panels



WATER

The same approach is taken to the design of water systems, which also considers monitoring and reducing water-use throughout the life of the building, starting from a low baseline through specification of resource efficient equipment;

Rainwater harvesting – water collected from roof areas is recycled locally to flush cisterns.

Low-flush cisterns

Waterless urinals

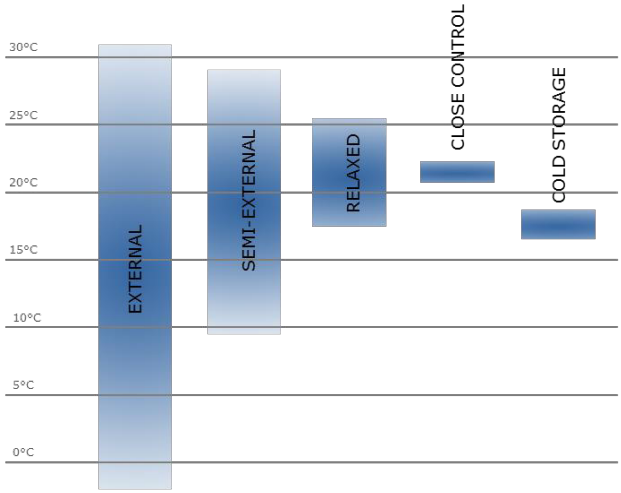
Aerating taps

TREATMENT OF SPACES

Various levels of environmental control are required for the different space types; close control for galleries and storage of artefacts, more relaxed control for lecture halls and offices and wider environmental bands for transient spaces such as lobby and circulation areas.

Permanent exhibition galleries;

These double-height galleries are located below ground, will not be subject to solar gain and, surrounded by earth, will have minimal fabric heat gain or loss; they will be inherently low-energy-use spaces. The provision of thermal mass will ensure natural stability such that environmental control systems can be turned-off, or run at very low levels, when the spaces are unoccupied. The height of these spaces makes displacement ventilation, through floor grilles, the most efficient approach, taking advantage of free-cooling and the natural buoyancy of warmed air to create comfortable conditions in the occupied zone with minimal energy input.



Environmental control in relation to spaces

Temporary exhibition galleries;

These spaces are located above ground. Breakout spaces will have good access to daylight. They will have close environmental control to meet the requirements of the international loan agreement for artefacts. The flexibility required in these spaces, and their reduced clear height, suggests a high-level supply system.

Event Halls;

High level supply providing flexibility in use of space and levels of occupancy.

Lecture Theatres;

Displacement ventilation with air-supply outlets beneath seats providing air where required in the occupied zone.

Offices;

Mixed-mode; where possible these will be naturally ventilated but will be capable of operating as mechanically ventilated spaces with heat-recovery units and local cooling where required.

Lobby and circulation spaces;

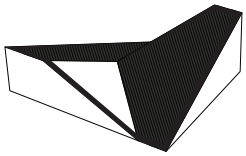
Where possible these will be naturally ventilated with additional ‘conditioning’ by overspill from adjacent spaces. Underfloor heating is proposed for these areas.

Workshops;

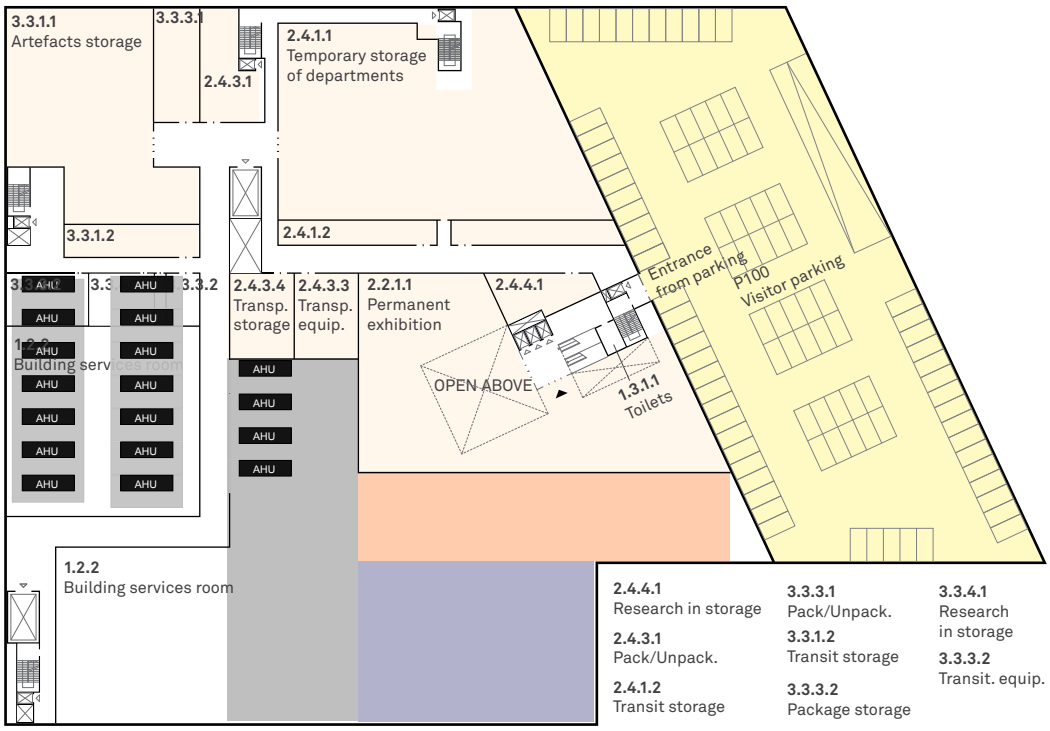
Natural ventilation with dedicated local process extract as required.

Ventilation

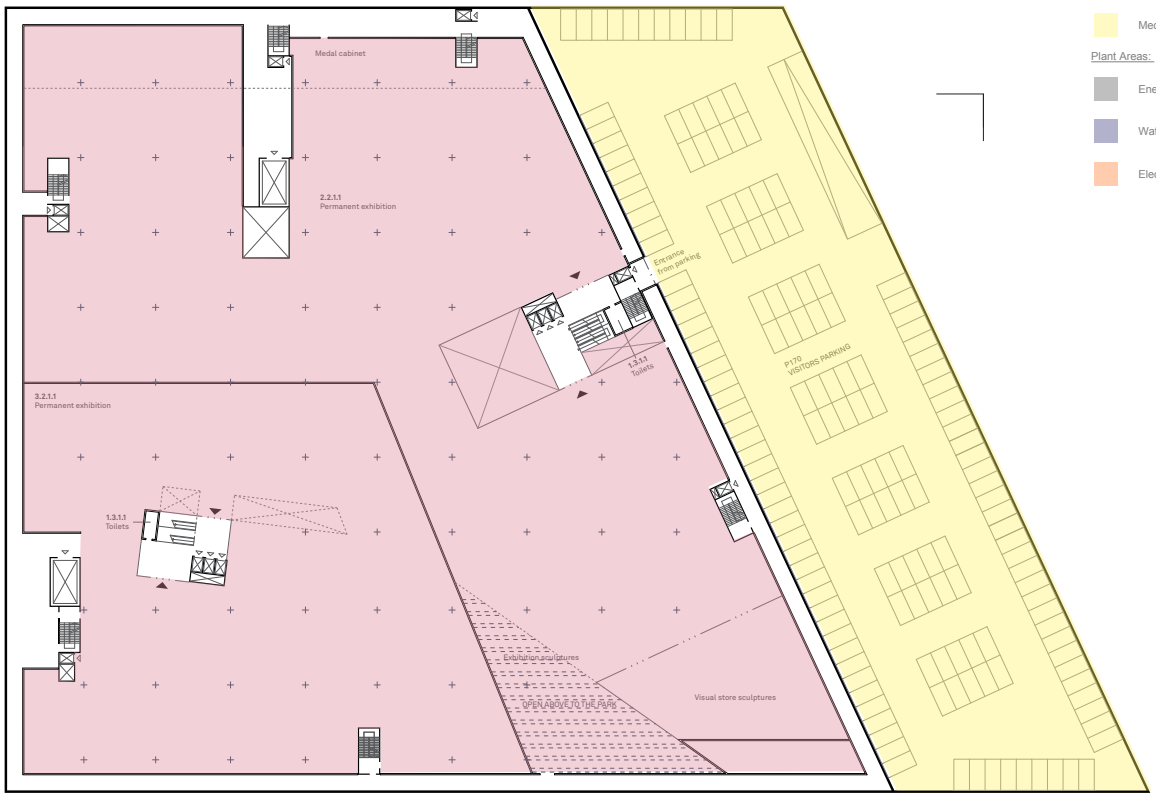
Ventilation strategy will vary depending on the space type and level of control required. The proposed approach is described on the sketches of floor plans and section indicating system types.



Above the Horizon
MEP Design: plans



Level -14,00



Level -7,00

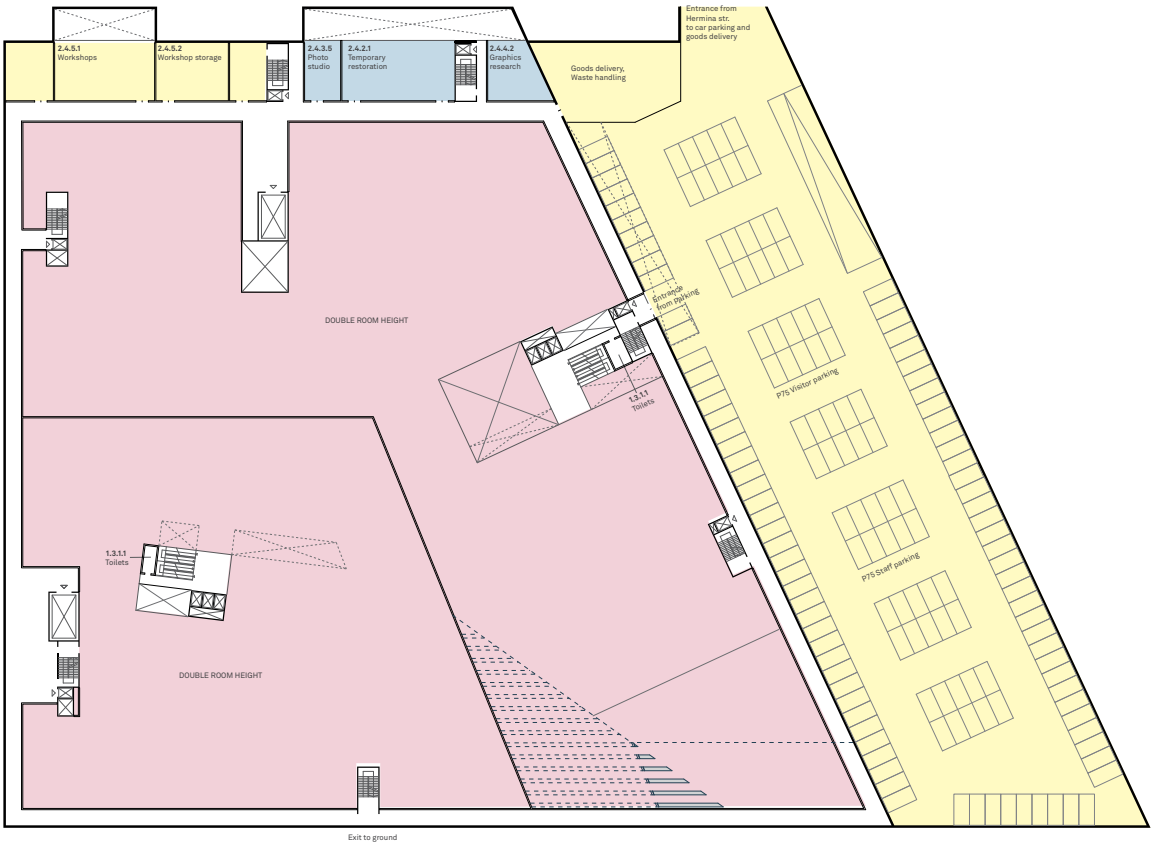
Legend

Systems:

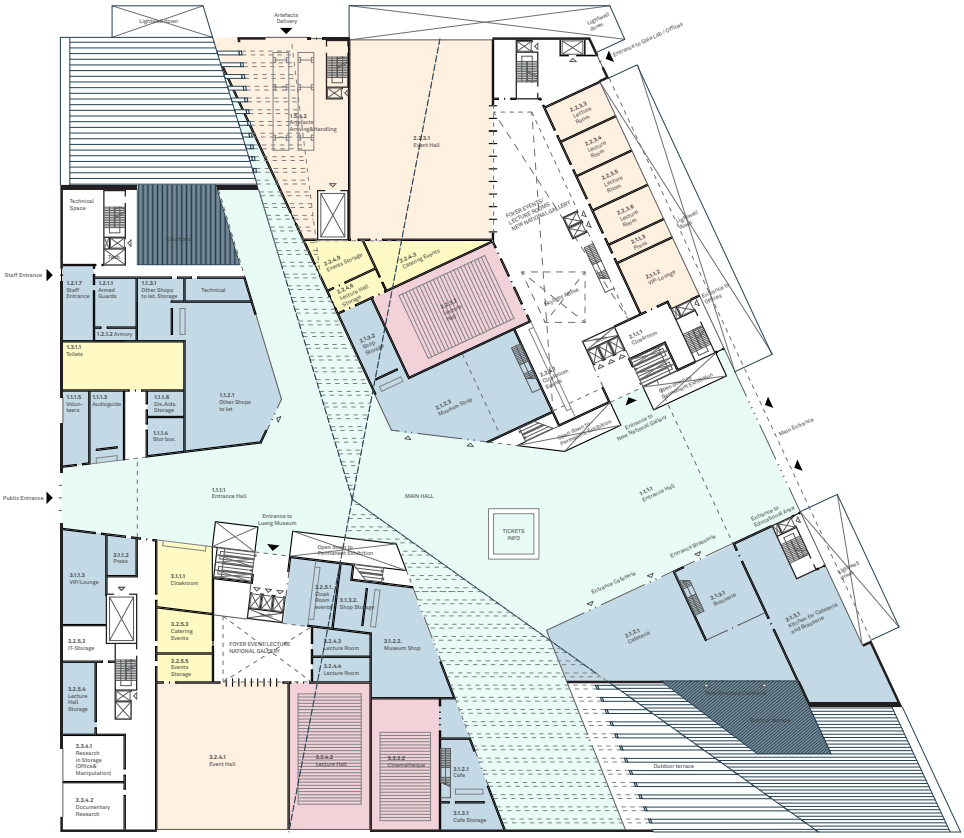
- All Air System - High Level Supply (Close Environmental Control)
- All Air System - Displacement Ventilation through Floor Grilles(Close Environmental Control)
- Mixed Mode/Local Cooling Units Min. Fresh Air with heat recovery
- Natural Ventilation + Heating
- Mechanical Ventilation / Local Extract

Plant Areas:

- Energy Centre
- Water Services Plantrooms
- Electrical/ IT Plantrooms



Level -3,50



Level +/-0,00

Legend

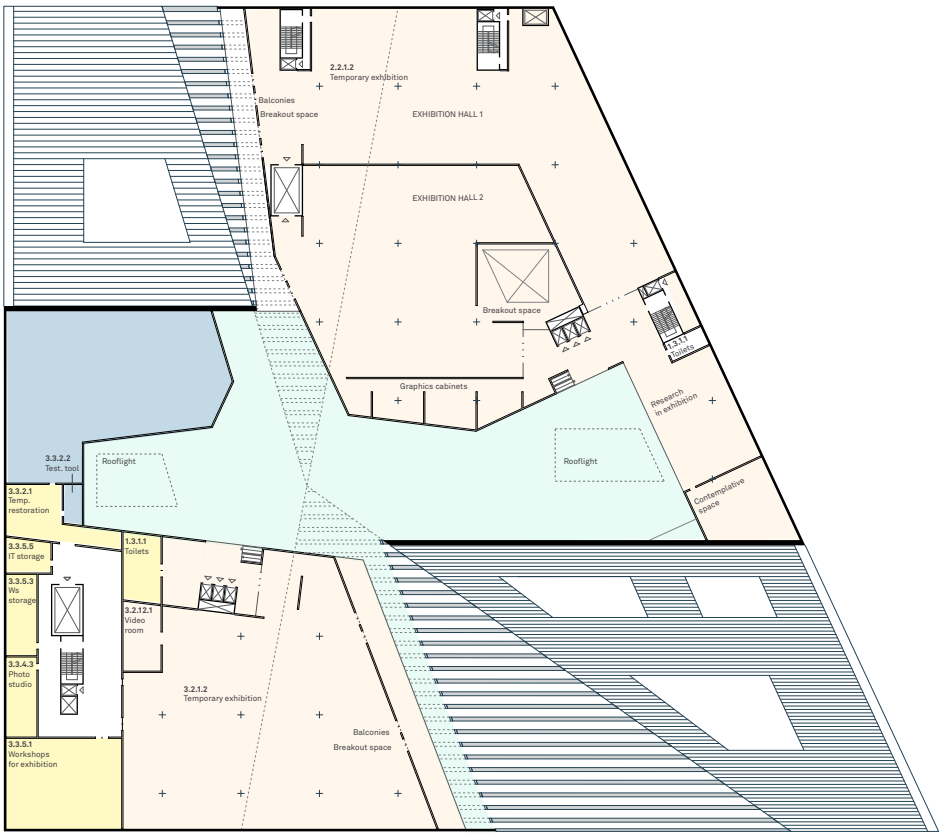
Systems:

- All Air System - High Level Supply (Close Environmental Control)
- All Air System - Displacement Ventilation through Floor Grilles(Close Environmental Control)
- Mixed Mode/Local Cooling Units Min. Fresh Air with heat recovery
- Natural Ventilation + Heating
- Mechanical Ventilation / Local Extract

Plant Areas:

- Energy Centre
- Water Services Plantrooms
- Electrical/ IT Plantrooms

Level +3,50



Level +7,00

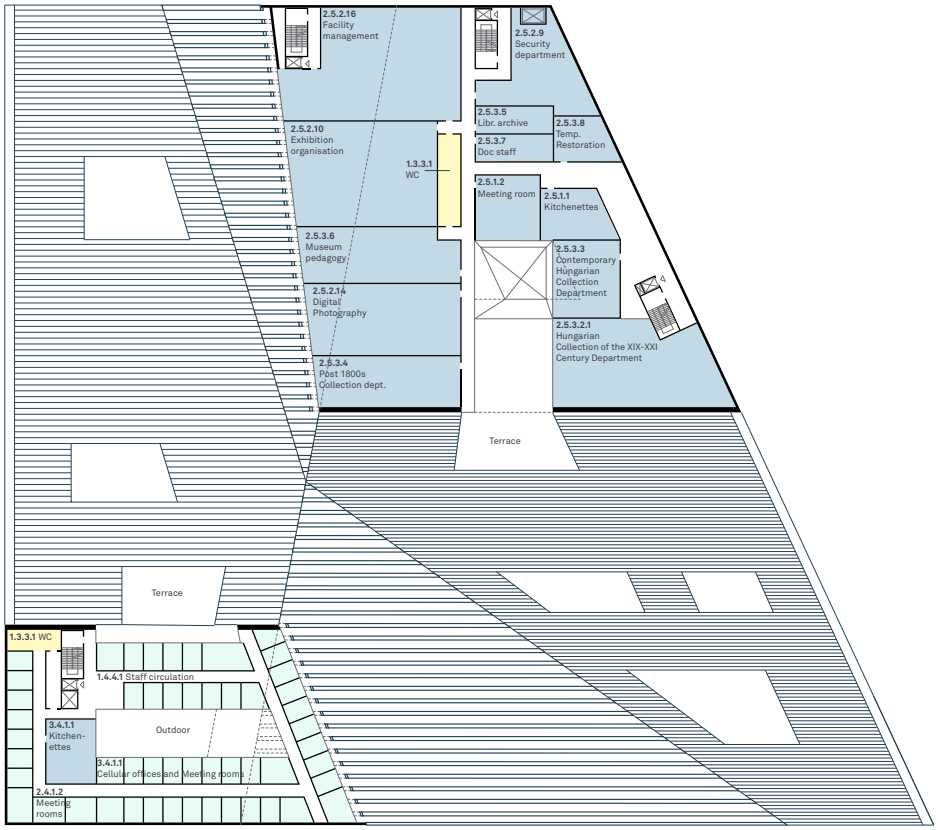
Legend

Systems:

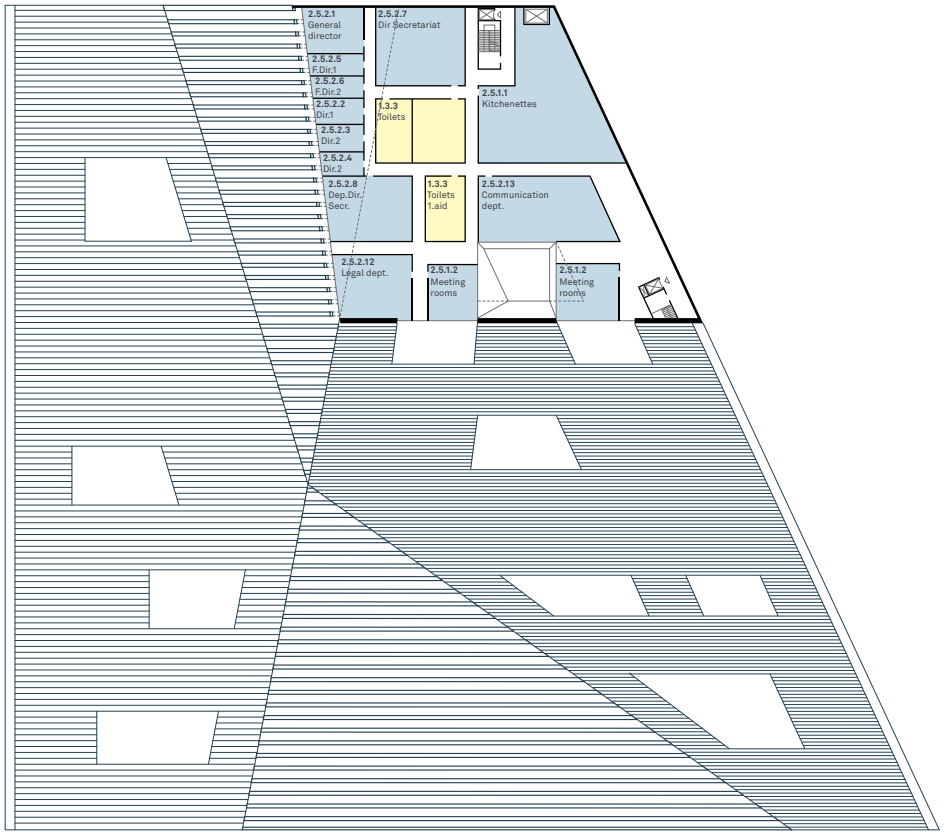
- All Air System - High Level Supply (Close Environmental Control)
- All Air System - Displacement Ventilation through Floor Grilles(Close Environmental Control)
- Mixed Mode/Local Cooling Units Min. Fresh Air with heat recovery
- Natural Ventilation + Heating
- Mechanical Ventilation / Local Extract

Plant Areas:

- Energy Centre
- Water Services Plantrooms
- Electrical/ IT Plantrooms



Level +14,00



Level +19,00

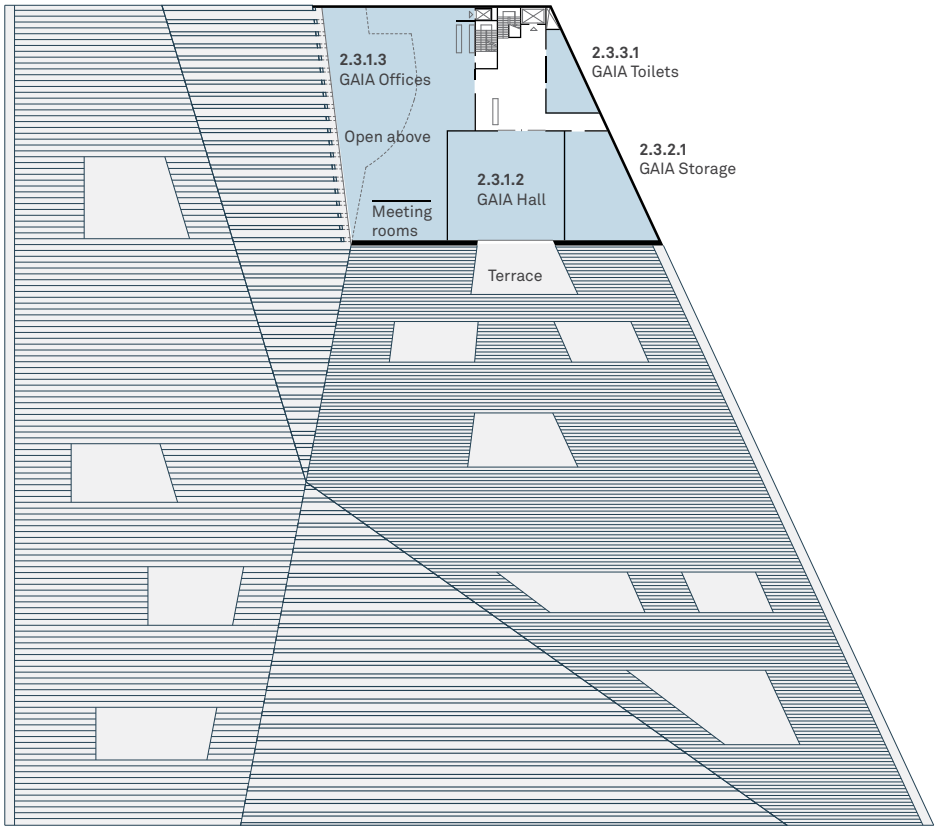
Legend

Systems:

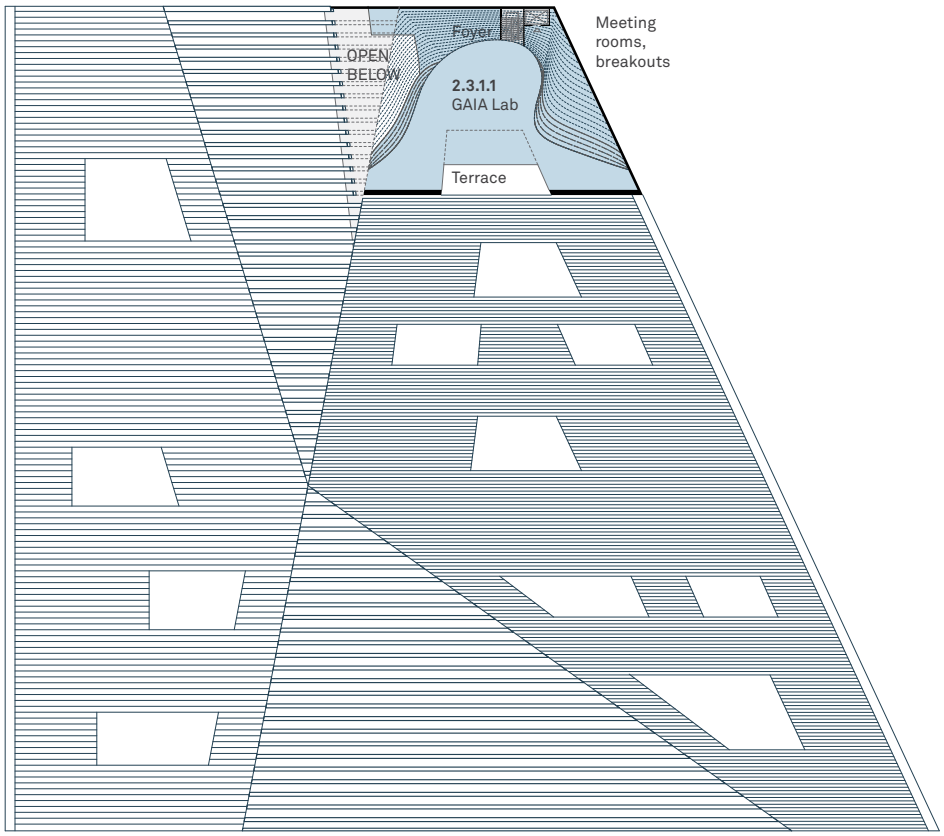
- All Air System - High Level Supply (Close Environmental Control)
- All Air System - Displacement Ventilation through Floor Grilles(Close Environmental Control)
- Mixed Mode/Local Cooling Units Min. Fresh Air with heat recovery
- Natural Ventilation + Heating
- Mechanical Ventilation / Local Extract

Plant Areas:

- Energy Centre
- Water Services Plantrooms
- Electrical/ IT Plantrooms



Level +24,00



Level +29,00

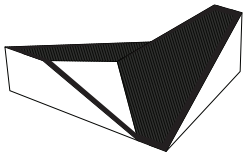
Legend

Systems:

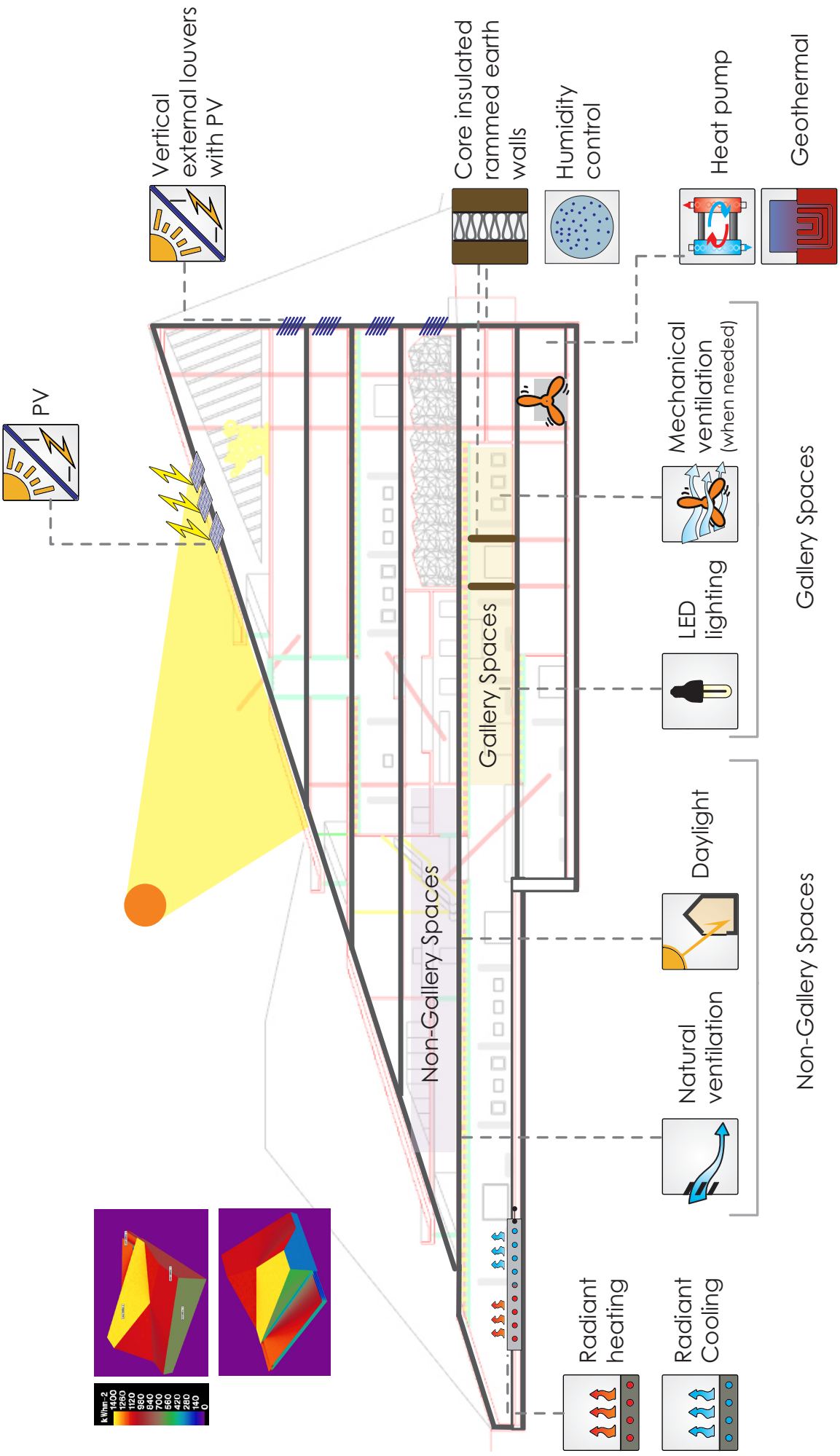
- All Air System - High Level Supply (Close Environmental Control)
- All Air System - Displacement Ventilation through Floor Grilles(Close Environmental Control)
- Mixed Mode/Local Cooling Units Min. Fresh Air with heat recovery
- Natural Ventilation + Heating
- Mechanical Ventilation / Local Extract

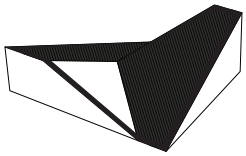
Plant Areas:

- Energy Centre
- Water Services Plantrooms
- Electrical/ IT Plantrooms



Above the Horizon
Building systems:section


Vertical external louvers with PV
Core insulated rammed earth walls
Humidity control
Heat pump
Geothermal
PV
Mechanical ventilation (when needed)
LED lighting
Gallery Spaces
Gallery Spaces
Non-Gallery Spaces
Daylight
Natural ventilation
Non-Gallery Spaces
Radiant heating
Radiant Cooling
kWhm-2
1400
1260
1120
980
840
700
560
420
280
140
0



Above the Horizon
Space list

LIGET BUDAPEST.

New National Gallery and Ludwig Museum - Space list

The list has to be filled in the blue cells with the design values .
The calculations are automatic.
The total and sub-total design values have to be in a ±10 % range, compared to the values given.

New National Gallery and Ludwig Museum — 51 816 m2

1. General spaces and service areas — 16 795 m2

Main Category	Sub Category	Code	Room Name	Lord Zone	Area	Designed Area
Hospitality		**1.1**			**1 640 m2**	**2 645 m2**
	reception	1.1.1			1 260 m2	2 265 m2
		1.1.1.1	Entrance hall	A	1 000 m2	2 000 m2
		1.1.1.2	Info, ticketing	A	100 m2	100 m2
		1.1.1.3	Audioguide	A	60 m2	60 m2
		1.1.1.4	Storage boxes	A	30 m2	30 m2
		1.1.1.5	Volunteer's room	A	50 m2	50 m2
		1.1.1.6	Disabled' aids storage	A	20 m2	25 m2
	consumption	1.1.2			300 m2	300 m2
		1.1.2.1	Other shops to let	A	300 m2	300 m2
	storages - service rooms	1.1.3			80 m2	80 m2
		1.1.3.1	Other shops storages	A	80 m2	80 m2
Service		**1.2**			**660 m2**	**3 130 m2**
	service staff	1.2.1			480 m2	485 m2
		1.2.1.1	Armed guards	D	50 m2	50 m2
		1.2.1.2	Armory	D	10 m2	10 m2
		1.2.1.3	Meeting room	D	60 m2	60 m2
		1.2.1.4	Lounge	D	70 m2	70 m2
		1.2.1.5	Tea kitchen	D	30 m2	30 m2
		1.2.1.6	Changing rooms	D	200 m2	205 m2
		1.2.1.7	Staff entrance	D	60 m2	60 m2
	building service rooms	1.2.2			180 m2	2 645 m2
		1.2.2.1	Building system control	D	40 m2	40 m2
		1.2.2.2	Security system control	D	40 m2	40 m2
		1.2.2.3	Building service storage	D	100 m2	100 m2
		1.2.2.4	Transformator room	D		50 m2
		1.2.2.5	Switch room	D		200 m2
		1.2.2.6	Elevator machinery	D		30 m2
		1.2.2.7	Heating machinery	D		75 m2
		1.2.2.8	Air conditioning/AHU	D		1 650 m2
		1.2.2.9	Water control room	D		100 m2
		1.2.2.10	Waste management	D		80 m2
		1.2.2.11	Uninterruptible Power Supply	D		30 m2
		1.2.2.12	Diesel generator	D		100 m2
		1.2.2.13	Sprinkler center and deposit	D		150 m2
Comfort		**1.3**				**655 m2**
	comfort - hospitality	1.3.1				400 m2
		1.3.1.1	Toilets	A		360 m2
		1.3.1.2	Baby care	A		20 m2
		1.3.1.3	First aid room	A		20 m2
	comfort - event	1.3.2				100 m2
		1.3.2.1	Toilets events	B		100 m2
	comfort - operation	1.3.3				155 m2
		1.3.3.1	Toilets for staff	D		135 m2
		1.3.3.2	First aid room	D		20 m2
Circulation		**1.4**				**10 365 m2**
	circulation - hospitality	1.4.1				2 670 m2
		1.4.1.1	Circulation	A		2 500 m2
		1.4.1.2	Stairs	A		100 m2
		1.4.1.3	Elevators/public	A		30 m2
		1.4.1.4	Parking entry	A		40 m2
	circulation - exhibition	1.4.2				1 869 m2
		1.4.2.1	Circulation	B		1 600 m2
		1.4.2.2	Stairs	B		230 m2
		1.4.2.3	GAIAI elevator	B		9 m2
		1.4.2.4	Elevators	B		30 m2
	circulation - Artifact handling	1.4.3				3 210 m2
		1.4.3.1	Staff circulation	C		2 500 m2
		1.4.3.2	Staff stairs	C		650 m2
		1.4.3.3	Artifact elevators	C		60 m2
	circulation - operation	1.4.4				2 616 m2
		1.4.4.1	Staff circulation	D		2 500 m2
		1.4.4.2	Staff stairs	D		100 m2
		1.4.4.3	Staff elevators	D		16 m2
Parking and delivery		**1.5**				
	parking - visitor	1.5.1				
		1.5.1.1	Parking		342	4000
		1.5.1.2	Bicycle storage		100	100
	parking - staff	1.5.2				
		1.5.2.1	Parking		74	1900
		1.5.2.2	Bicycle storage		60	50
	delivery - goods	1.5.3				
		1.5.3.1	Goods delivery		2	2

	delivery - artifact	1.5.4				
		1.5.4.1	Artifact delivery dock		2	2
		1.5.4.2	Artefact arriving / handling	C	150 m2	150 m2
2. New National Gallery spaces					**24 210 m2**	**24 051 m2**
Main Category	Sub Category	Code	Room Name	Lord Zone	Area	Designed Area
Hospitality		**2.1**			**1 350 m2**	**1 320 m2**
	reception	2.1.1			220 m2	190 m2
		2.1.1.1	Cloakroom	A	120 m2	70 m2
		2.1.1.2	VIP lounge	A	70 m2	90 m2
		2.1.1.3	Press room	A	30 m2	30 m2
	consumption	2.1.2			750 m2	750 m2
		2.1.2.1	Cafeteria	A	300 m2	300 m2
		2.1.2.2	Brasserie	A	150 m2	150 m2
		2.1.2.3	Museum shop	A	300 m2	300 m2
	storages - service rooms	2.1.3			380 m2	380 m2
		2.1.3.1	Kitchen (cafeteria, brasserie and catering)	A	300 m2	300 m2
		2.1.3.2	Shop storage	A	80 m2	80 m2
Exhibition		**2.2**			**15 065 m2**	**14 820 m2**
	exhibition	2.2.1			12 700 m2	12 600 m2
		2.2.1.1	Permanent exhibition	B	9 200 m2	9 200 m2
		2.2.1.2	Temporary exhibition	B	3 500 m2	3 400 m2
	museum learning	2.2.2			420 m2	320 m2
		2.2.2.1	IT & multimedia room	B	120 m2	120 m2
		2.2.2.2	Childrens classroom 1	B	50 m2	50 m2
		2.2.2.3	Childrens classroom 2	B	50 m2	50 m2
		2.2.2.4	Childrens classroom 3	B	50 m2	50 m2
		2.2.2.5	Childrens classroom 4	B	50 m2	50 m2
		2.2.2.6	Dining room	B	100 m2	100 m2
	events	2.2.3			1 520 m2	1 470 m2
		2.2.3.1	Event hall	B	800 m2	750 m2
		2.2.3.2	Lecture hall	B	300 m2	300 m2
		2.2.3.3	Lecture room I.	B	60 m2	60 m2
		2.2.3.4	Lecture room II.	B	60 m2	60 m2
		2.2.3.5	Lecture room III.	B	60 m2	60 m2
		2.2.3.6	Lecture room IV.	B	60 m2	60 m2
		2.2.3.7	Lecture room V.	B	60 m2	60 m2
		2.2.3.8	Lecture room VI.	B	60 m2	60 m2
		2.2.3.9	Lecture room VII.	B	60 m2	60 m2
	storages - service rooms	2.2.4			425 m2	430 m2
		2.2.4.1	Cloakroom - event hall	B	40 m2	50 m2
		2.2.4.2	IT storage	B	40 m2	40 m2
		2.2.4.3	Catering	B	80 m2	80 m2
		2.2.4.4	Museum learning storage	B	25 m2	20 m2
		2.2.4.5	Instrument storage	B	60 m2	60 m2
		2.2.4.6	Lecture hall storage	B	60 m2	60 m2
		2.2.4.7	Artist's changing room I.	B	30 m2	30 m2
		2.2.4.8	Artist's changing room II.	B	30 m2	30 m2
		2.2.4.9	Event storage	B	60 m2	60 m2
GAIA		**2.3**			**1 050 m2**	**1 050 m2**
	gaia	2.3.1			900 m2	900 m2
		2.3.1.1	GAIA LAB	B	400 m2	400 m2
		2.3.1.2	GAIA hall	B	200 m2	200 m2
		2.3.1.3	GAIA offices	B	300 m2	300 m2
	gaia - storages	2.3.2			100 m2	100 m2
		2.3.2.1	GAIA storages	B	100 m2	100 m2
	gaia - comfort	2.3.3			50 m2	50 m2
		2.3.3.1	GAIA toilets	B	50 m2	50 m2
Artifact handling		**2.4**			**2 330 m2**	**2 430 m2**
	collection - storages	2.4.1			1 300 m2	1 350 m2
		2.4.1.1	Temporary storages of departments	C	1 200 m2	1 250 m2
		2.4.1.2	Transit storage	C	100 m2	100 m2
	collection - care	2.4.2			140 m2	190 m2
		2.4.2.1	Temporary restoration	C	120 m2	170 m2
		2.4.2.2	Storage of the restoration tools	C	20 m2	20 m2
	collection - expedition	2.4.3			480 m2	485 m2
		2.4.3.1.	(Un)package room	C	120 m2	125 m2
		2.4.3.1.	Package storage	C	80 m2	80 m2
		2.4.3.1.	Transport equipments	C	100 m2	100 m2
		2.4.3.1.	Transport materials storage	C	120 m2	120 m2
		2.4.3.1.	Photo studio	C	60 m2	60 m2
	research	2.4.4			130 m2	125 m2
		2.4.4.1	Research in storage	C	30 m2	50 m2
		2.4.4.2	Graphics research	C	100 m2	75 m2
	exhibition care	2.4.5			280 m2	280 m2
		2.4.5.1	Workshops	C	160 m2	160 m2
		2.4.5.2	Workshop storages	C	120 m2	120 m2
Offices		**2.5**			**3 685 m2**	**3 731 m2**
	office - service	2.5.1			480 m2	460 m2
		2.5.1.1	Kitchenettes	D	240 m2	240 m2
		2.5.1.2	Meeting rooms	D	240 m2	220 m2
	offices	2.5.2			2 275 m2	2 311 m2
		2.5.2.1	General Director	D	50 m2	55 m2
		2.5.2.2	Deputy Director I.	D	20 m2	24 m2

		2.5.2.3	Deputy Director II.	D	20 m2	23 m2
		2.5.2.4	Deputy Director III.	D	20 m2	19 m2
		2.5.2.5	Financial Director	D	20 m2	23 m2
		2.5.2.6	Financial Deputy Director	D	20 m2	22 m2
		2.5.2.7	Directors' secretariate	D	150 m2	160 m2
		2.5.2.8	Deputy Directors' secretariate	D	100 m2	110 m2
		2.5.2.9	Security department	D	200 m2	170 m2
		2.5.2.10	Exhibition organisation department	D	350 m2	370 m2
		2.5.2.11	Interrnal auditor	D	15 m2	15 m2
		2.5.2.12	Legal department	D	80 m2	100 m2
		2.5.2.13	Communication department	D	220 m2	210 m2
		2.5.2.14	IT, Digitalization and Photography	D	250 m2	260 m2
		2.5.2.15	Finance department	D	340 m2	330 m2
		2.5.2.16	Facility management	D	420 m2	420 m2
	museum proffessionals	2.5.3			930 m2	960 m2
		2.5.3.1	National Gallery Science Secretary	D	20 m2	20 m2
		2.5.3.2	Hungarian Collection of the XIX-XXI. Century department	D	310 m2	310 m2
		2.5.3.3	Contemporary Hungarian Collection department	D	120 m2	120 m2
		2.5.3.4	Post 1800s Collection department	D	150 m2	180 m2
		2.5.3.5	Librarians, Archives	D	40 m2	40 m2
		2.5.3.6	Museum pedagogy	D	190 m2	190 m2
		2.5.3.7	Documentation staff	D	40 m2	40 m2
		2.5.3.8	Temporary restauration staff	D	60 m2	60 m2
Service		**2.6**			**730 m2**	**700 m2**
	storages - service rooms	2.6.1			730 m2	700 m2
		2.6.1.1	Locksmith workshop	D	35 m2	35 m2
		2.6.1.2	Carpenter workshop	D	70 m2	70 m2
		2.6.1.3	Electrifician workshop	D	40 m2	40 m2
		2.6.1.4	Plumber workshop	D	25 m2	25 m2
		2.6.1.5	Cleaning storages	D	40 m2	40 m2
		2.6.1.6	Furniture storage	D	150 m2	150 m2
		2.6.1.7	Administration document storage	D	50 m2	50 m2
		2.6.1.8	Publication storage	D	150 m2	120 m2
		2.6.1.9	Stationary storage	D	30 m2	30 m2
		2.6.1.10	Workshop storages	D	140 m2	140 m2

3. Ludwig Museum spaces — 11 095 m2 — 10 970 m2

Main Category	Sub Category		Room Name	Lord Zone	Area	Designed Area
Hospitality		**3.1**			**630 m2**	**680 m2**
	reception	3.1.1.			170 m2	220 m2
		3.1.1.1	Cloakroom	A	80 m2	95 m2
		3.1.1.2	Press room	A	30 m2	30 m2
		3.1.1.3	VIP lounge	A	60 m2	95 m2
	consumption	3.1.2			380 m2	380 m2
		3.1.2.1	Café	A	200 m2	200 m2
		3.1.2.2	Museum shop	A	180 m2	180 m2
	storages - service rooms	3.1.3			80 m2	80 m2
		3.1.3.1	Café storage	A	40 m2	40 m2
		3.1.3.2	Shop storage	A	40 m2	40 m2
Exhibition		**3.2**			**7 565 m2**	**7 425 m2**
	exhibition	3.2.1.			5 500 m2	5 400 m2
		3.2.1.1	Permanent exhibition	B	4 000 m2	3 900 m2
		3.2.1.2	Temporary exhibition	B	1 500 m2	1 500 m2
	experiences	3.2.2			240 m2	210 m2
		3.2.2.1	Video room	B	60 m2	
		3.2.2.2	Cinemateque	B	180 m2	210 m2
	museum learning	3.2.3			640 m2	615 m2
		3.2.3.1	Library, documents	B	450 m2	470 m2
		3.2.3.2	IT & multimedia room	B	60 m2	65 m2
		3.2.3.3	Workshop for museum learning I.	B	40 m2	40 m2
		3.2.3.4	Workshop for museum learning II.	B	40 m2	40 m2
		3.2.3.5	Dining room	B	50 m2	60 m2
	events	3.2.4			880 m2	860 m2
		3.2.4.1	Event hall	B	500 m2	490 m2
		3.2.4.2	Lecture hall	B	300 m2	300 m2
		3.2.4.3	Lecture room I.	B	40 m2	35 m2
		3.2.4.4	Lecture room II.	B	40 m2	35 m2
	storages - service rooms	3.2.5			305 m2	340 m2
		3.2.5.1	Cloakroom - event hall	B	80 m2	80 m2
		3.2.5.2	IT storage	B	40 m2	40 m2
		3.2.5.3	Catering	B	60 m2	60 m2
		3.2.5.4	Lecture hall storage	B	60 m2	60 m2
		3.2.5.5	Event hall storage	B	40 m2	40 m2
		3.2.5.6	Museum learning storage	B	25 m2	60 m2
Artifact handling		**3.3**			**1 710 m2**	**1 690 m2**
	collection - storages	3.3.1			800 m2	790 m2
		3.3.1.1	Artifact storage	C	700 m2	700 m2
		3.3.1.2	Transit storage	C	100 m2	90 m2
	collection - care	3.3.2			100 m2	95 m2
		3.3.2.1	Temporary restoration	C	80 m2	75 m2
		3.3.2.2	Restoration tools storage	C	20 m2	20 m2
	collection - expedition	3.3.3			280 m2	300 m2
		3.3.3.1	(Un)package room	C	100 m2	100 m2
		3.3.3.2	Package storage	C	100 m2	100 m2
		3.3.3.3	Transport equipment	C	20 m2	40 m2
		3.3.3.4	Photo studio	C	60 m2	60 m2
	research	3.3.4			150 m2	150 m2

		3.3.4.1	Research in storage (offices + manipulation)	C	75 m2	75 m2
		3.3.4.2	Documentary research (offices)	C	75 m2	75 m2
	exhibition care	3.3.5			380 m2	355 m2
		3.3.5.1	Workshop for exhibition	C	270 m2	250 m2
		3.3.5.3	Workshop storages (exhibition)	C	60 m2	60 m2
		3.3.5.5	IT storage (exhibition)	C	40 m2	35 m2
		3.3.5.6	Chemicals cabinet	C	10 m2	10 m2
Offices		**3.4**			**710 m2**	**710 m2**
	office - service	3.4.1			110 m2	110 m2
		3.4.1.1	Kitchenettes	D	55 m2	55 m2
		3.4.1.2	Meeting rooms	D	55 m2	55 m2
	offices	3.4.2			600 m2	600 m2
		3.4.2.1	Cellular offices and meeting rooms	D	600 m2	600 m2
Service		**3.5**			**480 m2**	**465 m2**
	storages - service rooms	3.5.1			480 m2	465 m2
		3.5.1.1	Cleaning storages	D	20 m2	20 m2
		3.5.1.2	Administration documents storage	D	40 m2	40 m2
		3.5.1.3	Facility management workshops	D	80 m2	60 m2
		3.5.1.4	Storage - technical devices	D	50 m2	50 m2
		3.5.1.5	Storage - accumulators	D	50 m2	50 m2
		3.5.1.6	Electric forklift lot	D	20 m2	20 m2
		3.5.1.7	Charging station	D	30 m2	30 m2
		3.5.1.8	Storage - stationary	D	10 m2	10 m2
		3.5.1.9	Storage - brochures and publication	D	100 m2	100 m2
		3.5.1.10	Storage - accessories	D	30 m2	30 m2
		3.5.1.11	Storage - museum learning	D	50 m2	55 m2

4. New National Gallery and Ludwig Museum - Land use

Built in area	14 300 m2
Hard landscaping	5 200 m2
Green area	