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- Mark Walstrom



The House in Liget

connecting people with the park

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The Vision

With the design of the New National Gallery and Ludwig Museum we want to give back to the city. We want to offer a sustainable, cost-effective house of the highest architectural quality. Our scheme unifies the two different institutions by embracing their individuality. Városliget was the first public park in the world and it is our vision to support this unique place with a building that continually adds more value to the residents and visitors of Budapest for many years to come.

Architectural Concept

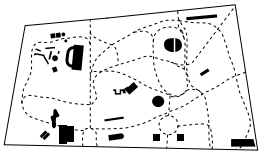
Our architectural concept has developed from three main points of departure:

Public house in the Public Park

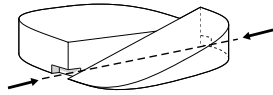
Városliget has added great value to the city of Budapest and its residents for more than 200 years. The park marks Budapest as a historic city that matches cities like Berlin, Paris, and London where unique green areas have become part of the cities' identity.

Today, the park remains as a layered recreational space with all sorts of programs and offers. The New National Gallery and Ludwig Museums should fit seamlessly into this self-grown park structure with respect to the historical environment. That is why we propose a round shaped building with no front or back. The museums embrace the park as the park embraces them.

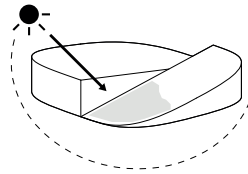
The two-winged house offers an open and transparent meeting point for the residents and visitors of Városliget. The shared programs, the café, and the rooftop with the stunning view of the surrounding park and city, reestablishes the visual connection between Buda and Pest along the historical axis. These spaces are all open to the public and invite people to interact with the new building.



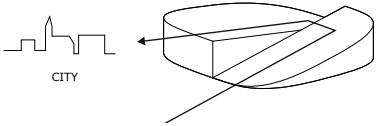
The museums act as the converging point. The House unifies the visitor experience of the ambitious Liget Museum Park project.



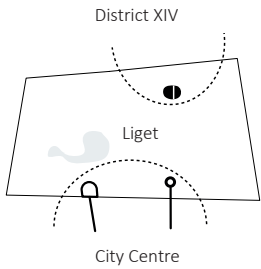
The two equally significant entrances connect through the intersecting spine of the building. The spine creates an arcade of open public programs.



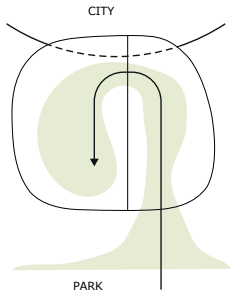
The unique building form provides a south facing public terrace that entices passive users to engage with the internal galleries.



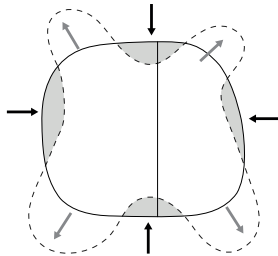
The building orientation emphasises the visual connection between Buda and Pest along the historical axis.



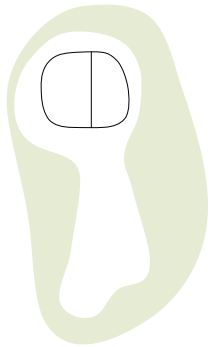
The museums not only relate to the historical axis but also strengthen the relationship between the park and the northern districts. Our building has no "back side".



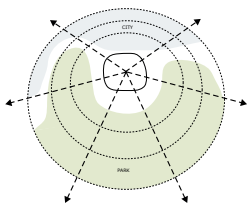
The building articulates and integrates the natural landscape into the built form.



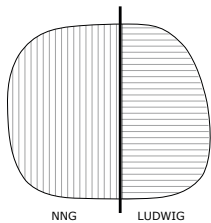
The shape of the building reacts and weaves to the varying programs with multiple entrances for different functions that can extend into the park.



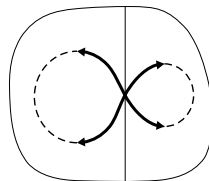
The house sits respectfully in the organic shaping of the park.



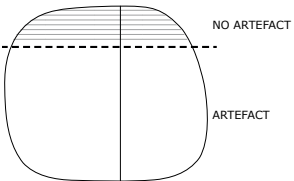
As the most prominent of the new park museums, the house offers an accessible roof with the highest viewpoint that provides an overview of all the different programs within the park.



The house is divided into two autonomous museum wings that have equal prominence yet differing and unique spatial qualities.



The building has a clear circulation path that is a rich and engaging experience that is easy to figure out.



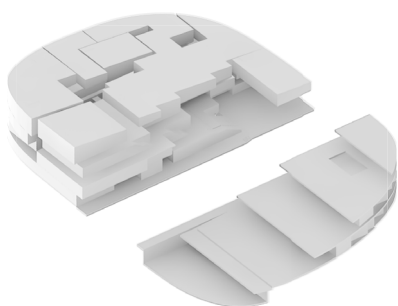
Clear security boundaries are established to provide maximum safety for artifacts.

Tension within program

Maintaining two essentially different art experiences and unifying them at the same time is the core of our architectural concept. It is basically about duality; the ambivalence and relation between daylight and shading, heavy structures and transparent materials, order and chaos, building and park. From this play of contrasts the two museums come out united. The size and shape of the building makes it clearly recognizable and identifiable. The oppositely oriented slopes of the roof strongly indicate the independence of each institution while at the same time uniting them in the movement from ground level to the view point on top. The idioms of both the interior and exterior of the two wings, visible through the partly transparent façade, stress their difference in content; The Ludwig comprising a horizontal layout of flowing terraces with a generic pattern of movement, and the NNG being more of an organized boxes-within-a-box layout with a choreographed flow and controlled climatic conditions. Both museums comprise a wide range of flexible and unique spaces in each their way. The building offers inviting community spaces for everyone to interact with. Spaces for educational purposes are situated close to the façade in the transitional zone between the museum and the city, thus supporting the interaction between museum and community.

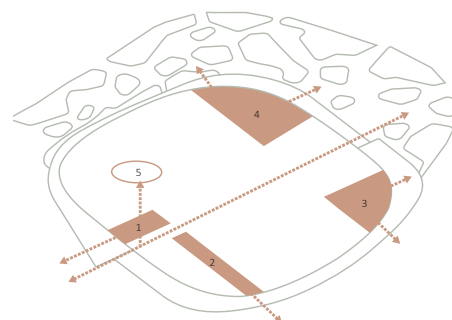
“Like in Liget”

We are not envisioning the new museum to be an iconic building outshining the skyline of the city. However, we do image this building as a distinguished example of contemporary design that epitomizes the present zeitgeist. Significance in contemporary architecture comes from within; understanding the urban and cultural context of a project and adding value and cohesion to the community through sustainable methods. These values that shape the museum’s atmosphere and experience is what is going to make it remarkable and a place to return to – again and again.



SPLIT: BOX & VINEYARD

The independence of the two institutions is physically formalised through the clear distinction between their exhibition experiences. The two distinct typologies were derived from the specific requirements for each institution. The NNG box configuration provides enclosed environments suitable for their collection while the vineyard terracing of the LM allows audiences to experience contemporary art in a dynamic multi-faceted way.



- 1 - Cafeteria
- 2 - Cafe
- 3 - Event hall
- 4 - Children's education
- 5 - Gala

ENTRANCES - PUBLIC ACCESS

The organic shape of the building reacts to its park surroundings and provides an open, transparent meeting point for the residents and visitors of Városliget. With multiple entrances and public programs such as cafes and children's education, the house extends its influence into the park.

The spine that runs through the centre of the building creates an arcade of public spaces that encourage passers-by to enter the building. The galleries on either side of the spine can create teaser exhibitions to entice patrons to visit. These teasers break down the traditional barriers between the public and art and invite visitors to become part of the conversation.





Building description

As museums move into the first decade of the 21st century, they are purposely transforming the nature of the relationship between the visitor and their collections. Equipped with new and a more sophisticated understanding of the many different ways in which people learn, museums are reshaping the experience of the visitor in ways that had not been possible, or even anticipated.

Originally intended to describe metaphorically the dissolving of the boundaries between the culture of museums and communities that they serve, the concept of a “museum without boundaries” has often been used in connection with discussions of outreach and, more recently, community engagement. This progression reflects a growing recognition that museums’ efforts to develop new audiences will be successful only if they are grounded in a sophisticated and sympathetic understanding of how to forge strong and durable relationships, both social and educational, with these audiences.

Our building embodies the idea of the “museum without boundaries” through a multivalent relationship with the surrounding park and greater context of Budapest.

The façade

The open and transparent façade design allows for passers-by to experience the exhibitions and activity from outside the museum as well as for the audience to experience the park from within the museum. The cut that divides the building in two shade from the sun during the day but allow for the museum to open up to the park at night.

The duality in the selection of genuine, honest materials adds to the tectonic qualities of the façade. The mixture of glass panels and ceramic tiles unites contemporary design with the traditional use of cladding in Budapest’s construction history. The diversity of the materials adds to the shifting play of light and shadow reflecting the light from both inside and outside. The vertical structure blends in with the surrounding trees, and blurs



the line between building and park. It is almost like a curtain or a veil partly revealing the subject underneath.

Building shape

The building has a round shape with no front or back, and it is possible to enter the building from both the street and the park side of the house. The experience of the building is constantly changing as you walk around it. It has a specific identity from every angle possible.

Entrance hall

From the main entry hall it is possible to recognize the clear difference between the two museums, and you get to experience both museums at one time. From here the visitor has a clear overview of the building's activities and program. The shared office and learning facilities overlook the entrance and add up to the life and activity level of the building.

The central spine

The spine that runs through the centre of the building creates an arcade of public spaces that encourage passers-by to enter the building. It can be accessed through the entrances facing both the park and the street. The galleries on either side of the spine can create teaser exhibitions to entice patrons to visit. These teasers break down the traditional barriers between the public and art and invite visitors to become part of the conversation. The central spine creates equality between the two museums, and offers the viewer an opportunity of appreciating and exploring the differences and history between the NNG and LM.

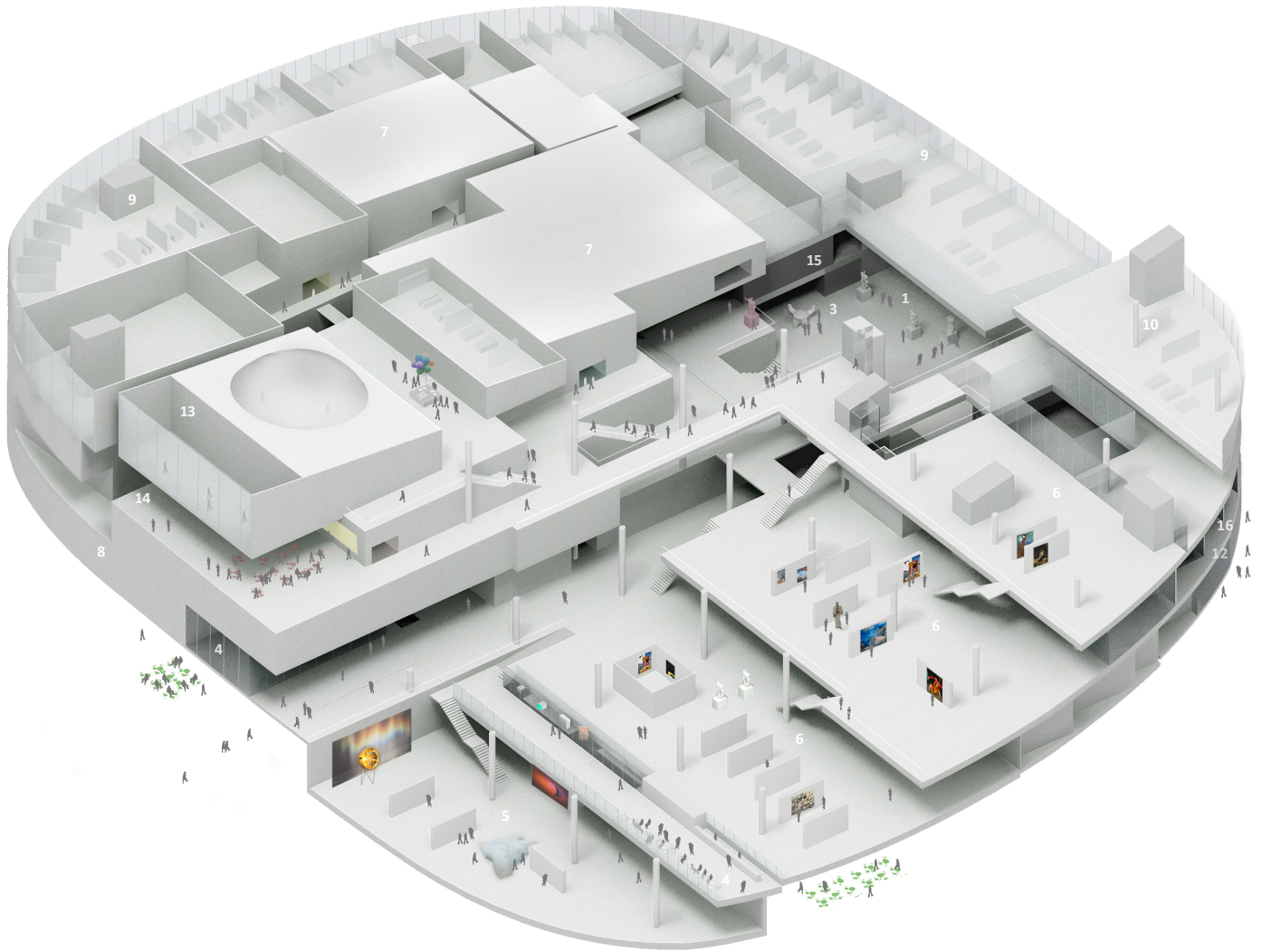
Museums

The New National Gallery and the Ludwig Museum will house exceptional collections from the Hungarian National Gallery and Museum of Fine Arts showcasing Hungarian Art History and European relics from the beginning of the 19th century to present day as well as the Contemporary Collection from 1945 onwards.

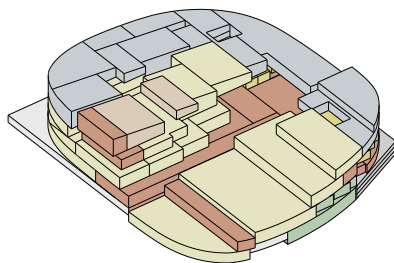
The layout of the museums allow for the visitors to experience these comprehensive collections in a new way every time they return to the museums. The flexibility of the gallery spaces plays a large role in showing the collections in an innovative but easy way, which is also relevant with regards to minimizing the running costs for the institutions.

Gallery spaces

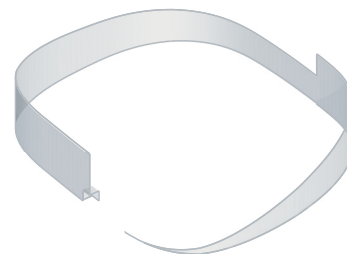
The building comprises two independent yet connected galleries each with their own significant layout and identity. However, all gallery spaces have a minimum room height of 5.5M. The visitor will be provided a diverse range



- | | |
|-------------------------------------|-----------------------------------|
| 1 - Main entrance Hall | 9 - National Gallery Offices |
| 2 - Park Entrance | 10 - Ludwig Offices |
| 3 - Sculpture atrium space | 11 - National Gallery Event Space |
| 4 - Cafeteria, Cafe | 12 - Ludwig Event Space |
| 5 - Ludwig Temporary Exhibition | 13 - Gaia |
| 6 - Ludwig Permanent Exhibition | 14 - Braserie |
| 7 - National Gallery Permanent Exh. | 15 - National Gallery Learning |
| 8 - National Gallery Temporary Exh. | 16 - Ludwig Learning |



- hospitality
- gaia
- exhibition
- education
- offices
- artefact handling
- parking
- MEP



PROGRAM

The independent operation of both museums is ensured through a physical disconnection of programs. Connection between the museums is established through the ground floor that bridges between the two institutions with a variety of shared programs such as hospitality, retail and a public circulation arcade.

FACADE

The envelope that combines the NNG and the LM establishes two architectural marks of equal importance facing both the north and south edges of the park. Passers-by will experience a rhythm and ever-shifting silhouette through a spiralling movement of the facade as the building blends into and erupts from the landscape.

of experiences within the galleries from the traditional to the cutting edge. Display and methodology will change accordingly to create an exciting and dynamic arts experience.

Ludewig Museum

We have chosen a horizontal structure of flowing terraces for the exhibition of the contemporary collection. A large part of the LM's collection are large-scale installations and call for open spaces in order to take in the entire piece of art. The terracing of gallery spaces allows audiences to experience these works in a new three dimensional way. The open vineyard configuration of the LM collection is partly lit with artificial lighting supported by ambient daylight from the roof.

New National Gallery

The NNG galleries are black boxes overlapping each other on three different levels making room for break-out spaces in between the galleries. No natural light is allowed into the boxes. It is possible to control the environment and settings of each box. In between the boxes naturally lit break-out spaces allow for the visitor to reflect upon the exhibition. The break-out spaces also function as way finding elements helping the audience to not get lost in the maze of black boxes. At night, when the sun is set, the cut façade of the NNG opens up and creates a new and engaging dialogue with the public.

Circulation/wayfinding

Clear circulation paths allow visitors to experience the art in their own way and on their own terms. One continuous spiral guides visitors on a chronological and thematic linear tour of the permanent collections of both the NNG and the LM. This creates a rich and engaging experience that is easy to figure out and allows visitors to view the art in an authentic and fun experience. The circulation path is a natural result of the building form that rises and twists and falls with the surrounding park.

Furthermore the galleries are spread over three floors with bridging connections between the galleries. This creates opportunities for return visitors to short cut between their favorite exhibitions.

GAIA

The GAIA dome is situated at the highest point of the building marking the historical axis and offering a stunning view back to Buda. Adjacent to GAIA is an outdoor terrace that can be catered for summer events. Furthermore a space comprising a lounge for special occasions has been added. If connected to the kitchen this space could serve as a staff canteen.

Structure

In order to keep construction and running costs low, the building structure is made from pre-fabricated building components that serve structural, architectural and environmental needs.

Artifact handling

Unloading and loading of artifacts take place at grade in a covered indoor garage due to security and insurance matters. The handling of artifacts is separated from other operational loading. It is possible to load and unload into all gallery spaces through a free clearance of 4.5M at any point. Artifacts that are already located in the building can travel between the different galleries on each floor via bridges and elevators.

Parking

The parking area is located underground according to the demands in the brief. Visitor and staff parking is amalgamated yet clearly segregated. There is no exhibition galleries located above visitor parking area. Furthermore the parking is clearly separated from the artifact handling.





NEW NATIONAL GALLERY AND LUDWIG MUSEUM

Site relations

The core of the landscape proposal consists of re-pairing, re-composing and re-assembling the existing path system with the ambition to set up the new building as a clear destination in the greater park. This clarification of the way-finding system must offer to the visitors a more intuitive promenade in the park and lead them naturally from one point of interest to the other.

The stand alone building is located in the heart of a great loop which opens up the city's neighbourhood at the east, the large lawn at the west and provides a continuous and obstacle-free promenade.

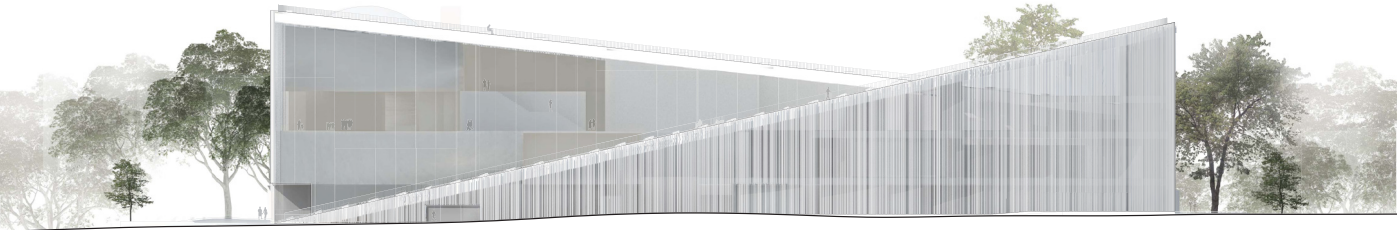
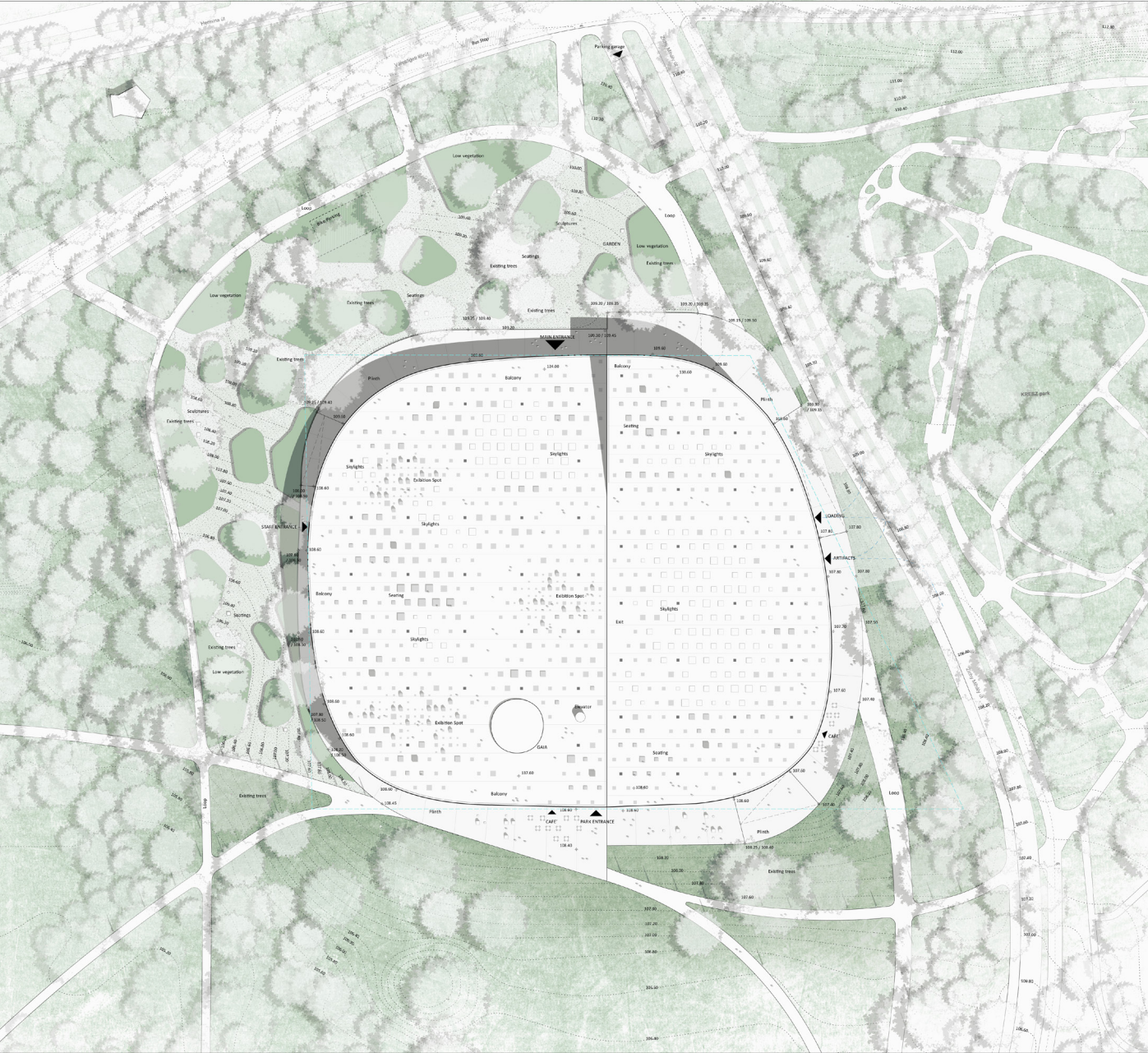
Both Museums are gathered on a common plinth that is symbolically split to demarcate each institution along the historic axis. Café terraces and outdoor programmed events can be installed on this large podium which also encourages a fluidity of walkers through and around the building.

The new building sits respectfully in the landscape on a remodelled hillock that recasts the former plateau into a softened topography and provides easy access to the plinth. Particular attention is paid to integrate existing trees of exceptional quality.

The museums' main entrance is reached through a tranquil and shaded garden on the northeast side of the building. The garden incorporates existing trees and introduces low-lying, dense islands of vegetation. This garden sets up a gate between Városligeti Road and the Museum. It offers a calm and relaxing atmosphere, seating facilities for walkers and visitors and expands both institutions reach further into the park.

The southwest of the building embraces the open lawn in front of it as a gentle slope that forms the roof of the Ludwig Museum. It articulates the new building as a natural balcony to experience the park and creates an emblematic destination for visitors and residents.

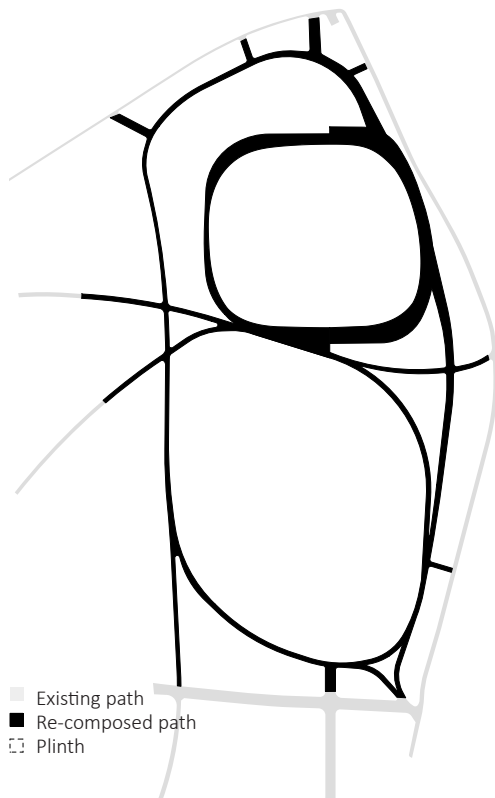
The sloped roof is designed as a tilted plaza that combines seating, deck chairs and viewing platforms. An inviting lighting system ensures the continual use of this unique public space into the night.



There is no defined path up the roof slope. Instead, visitors are encouraged to meander at their own pace at a comfortable gradient and experience the entirety of the surrounding park. Disabled access is provided by a elevator that arrives at a viewing balcony on the top of the New National Gallery.

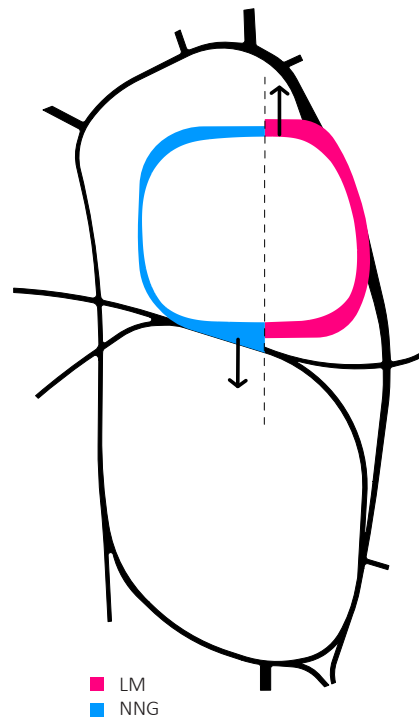
The bike garage for visitors is concealed under a camouflaged green island of the entrance garden. Close to the museum entrance is a bus stop for temporary arrivals of groups arriving along Városligeti road. Truck access for deliveries and handling of artefacts is located on the southeast with access from from Zichy Mihály Street.

Regarding the present sporting facilities to the northwest of the site, they should be moved to activate park's spots with program deficit. The Entrance fronting Stefánia Street at the extreme south of the park provides nice and large spaces opening up along Városligeti ring road, a great offer of outdoor sport and activities can be realised there. The newly created free space should develop in a more organic dialogue between the new cultural facilities and the emblematic Vajdahunyad Castle and Széchenyi Bath.



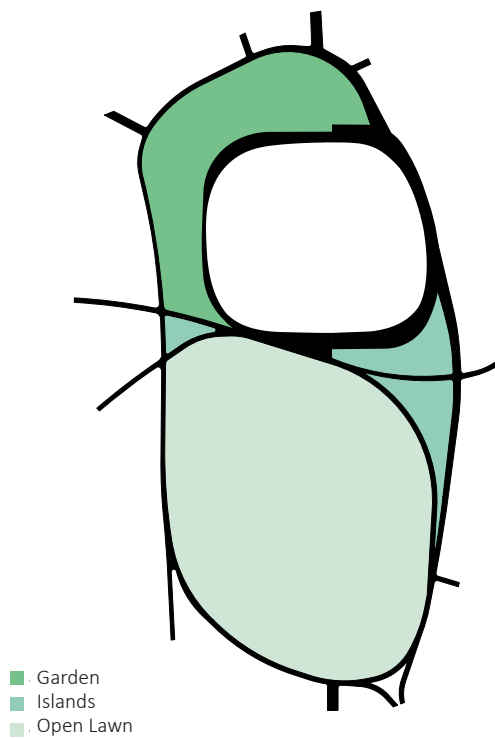
Orientation system

The clarification of the path system proceeds in assembling former and new traces to obtain clearer routes and looping promenades.



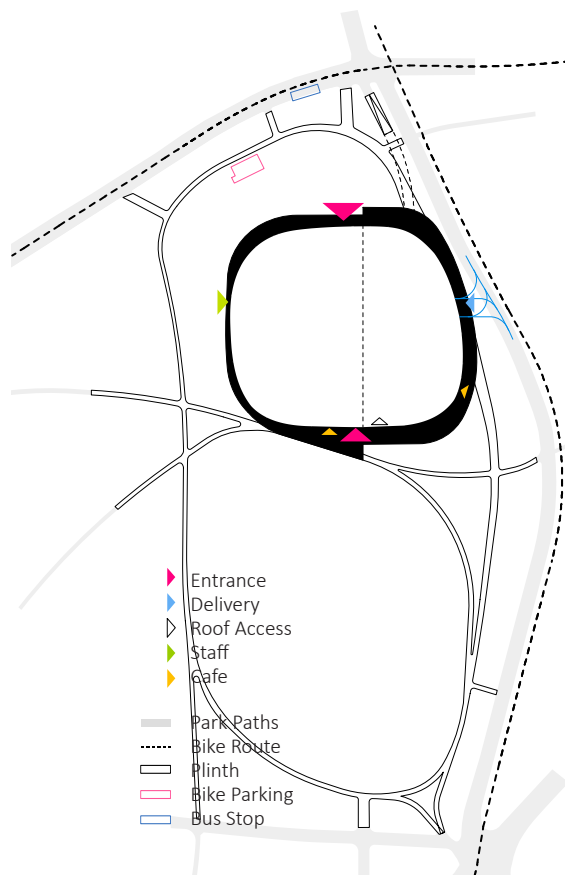
The Plinth

Both Museums are gathered on a common plinth that is symbolically split to demarcate each institution along the historic axis.



Green strategy

The main access is through a tranquil garden which extends both institutions scope further into the park. The western edge is bordered with solitary trees and includes a café terrace that is set in the foreground of the great lawn.



Transport and accessibility

The plinth gathers the different pedestrian accesses, main entrance, park entrance, staff entrance and deliveries.





Supporting structure

The building consists of two oppositely inclined roof structure, constructed from concrete waffle slabs. The structural system underneath the two roof surfaces functions principally from:

- The structure beneath the NNG roof (Figure 2) is built up of a series of concrete walls (vertical and horizontal planes), stacked as Tetris bricks (Lego System), transferring the loads from the walls and slabs above. The system reach towards the waffle slab of the roof, ultimately supported by columns placed upon the concrete system (Lego System). In addition to this, a single steel-concrete composite slab is suspended from the ceiling, supported by wires.
- Under the roof of the LM (Figure 3), the structural system consists of a conventional layout of columns and ribbed concrete slabs. The columns continue to the roof structure and supports the waffle slab.

The lateral stability of the structure is ensure by concrete cores, transferring horizontal loads from the waffle slab of the roof to the foundation.

The basement level consists of the same principle as the floors above. An exception is the three parking levels, which consist of a regular grid of columns, supporting straight concrete slab.

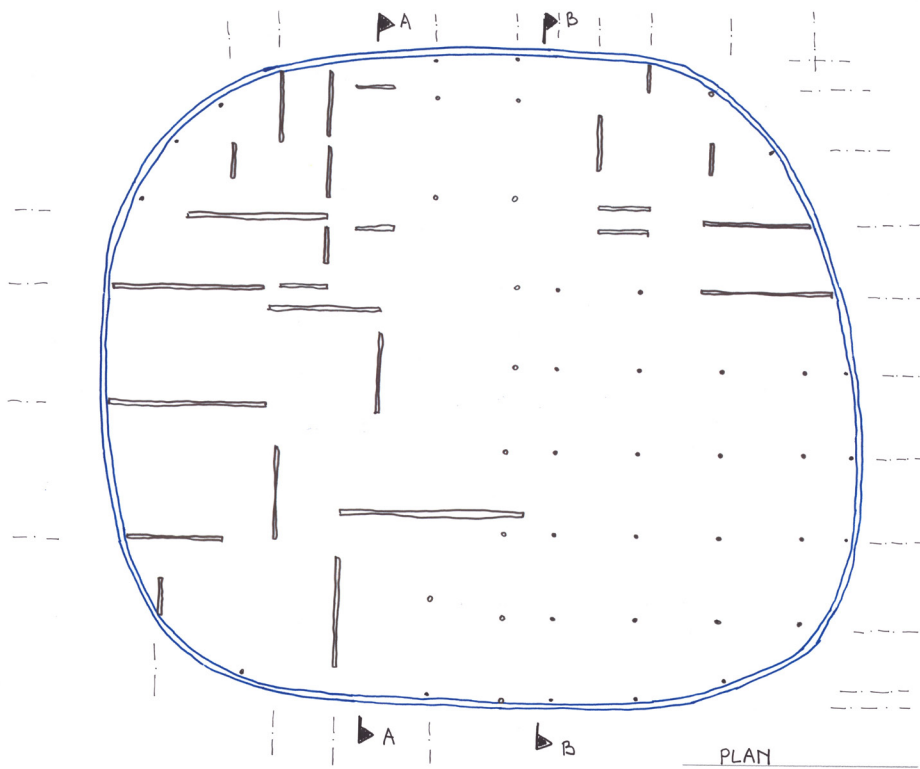


Figure 1 Structural plan

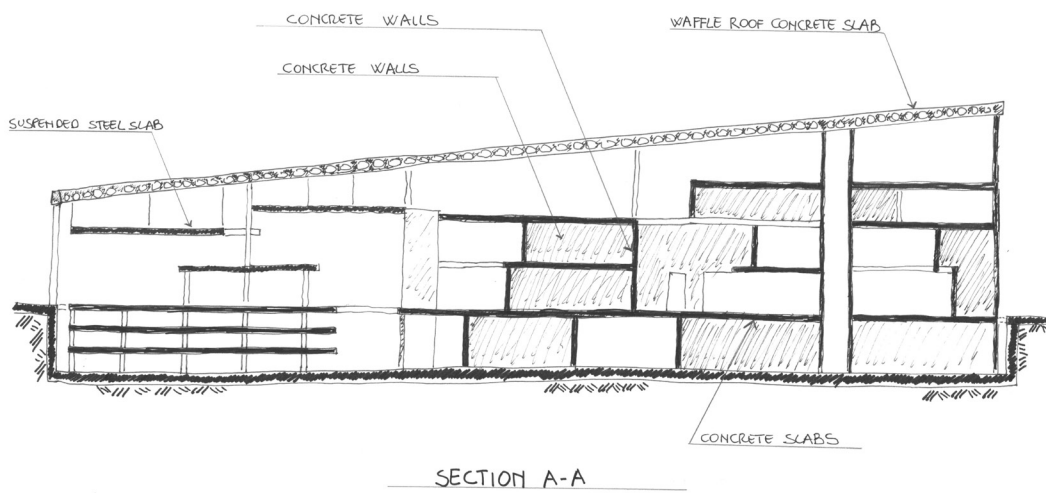


Figure 2 Section A-A

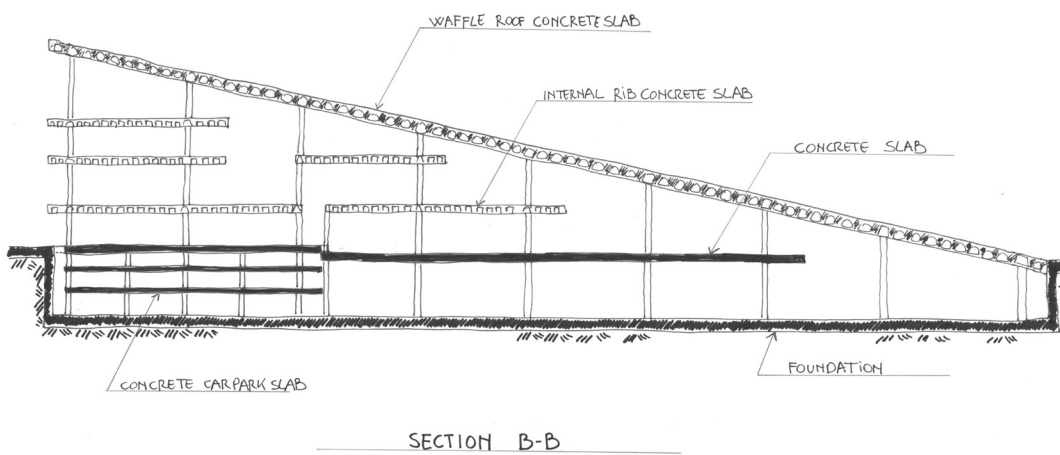


Figure 3 Section B-B

Fire strategies

In the design of the new museum in the Liget area of Budapest, flexibility and interaction are key factors of the design. At the same time we want to create a building that is safe for its visitors and employees. To achieve this we used the added value of a performance based approach regarding the fire safety design of the museum. Especially with the large open space which houses the permanent collection, which requires a smart approach when it comes to creating an safe space. For this area, which will be around 7.500 and 11.000 m², we see possibilities in using a smoke extract system to allow people to exit the building safely, by extracting the smoke and heat of a potential fire.

Considering the function of the building we assume the fire load to be limited and therefore this could allow for having large fire compartments. In further design stages this will be determined by using CFD models which can determine the smoke spread based on the fire load and fire growth. This principle is demonstrated in Figure 1.

If the fire load, because of the type of art and materials, turns out to be higher as expected at this stage a water mist system is one of the options we see as suitable for this design. With the current possibilities with these kind of systems we can limit the spread of fire without flooding the museum and therefor prevent the art to be damaged by water because the system produces very small droplets (like mist).

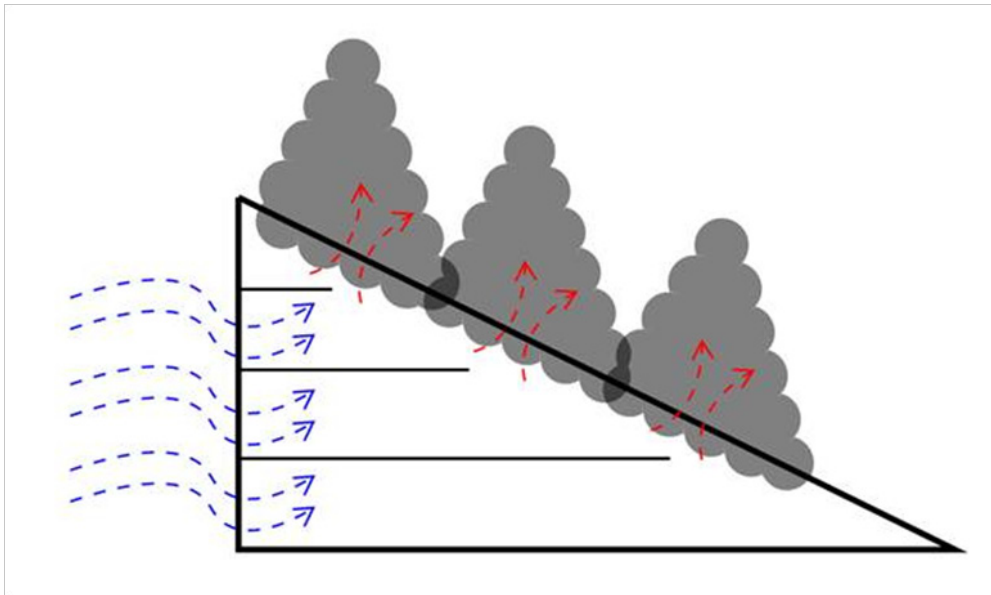


Figure 1 Principle of smoke extraction system

Sustainability concepts

To obtain a zero energy building an integrated design method is applied to the project development. It focuses on minimizing the energy consumption while maintaining all the qualities of a contemporary building created to adjust to the future. The integrated design method comprises three steps:

- 1 REDUCE through a well-planned design
- 2 OPTIMIZE through technical solutions
- 3 PRODUCE through building integrated energy conversion of renewable energy

Following these three steps we obtain a zero energy building.

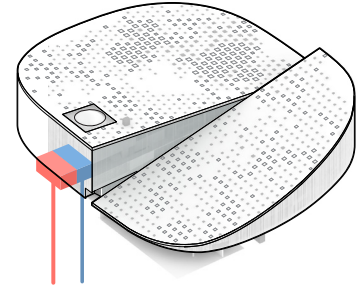
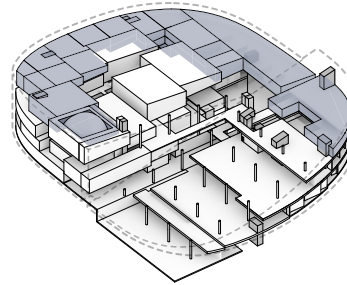
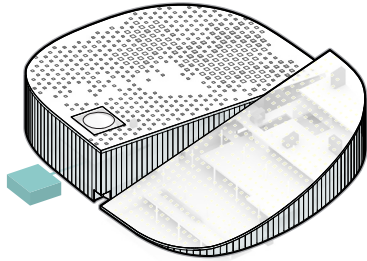
Façade and envelope concept

The developed façade concept aims at good views to the surrounding areas and combines high thermal insulation with optimized daylight qualities and efficient solar control for the building.

The proposed insulated glazing units have double layer selective low-e coated suspended films inside the glazing creating three gas filled cavities for optimal thermal performance. The adaptive shading / glare protection systems allows views to the outside, while fully controlling the sun-/daylight entering the building.

The developed roofscape contains a highly insulated roof system with pixelated skylights that have clear insulated glazings with solar coatings and an interior movable cone system to block direct sunlight, convert incoming daylight to diffuse radiation and be able to control the amount of incoming light and thus the daylight levels automatically.

Together with optimized roof and basement insulation the highly airtight envelope of the building will significantly reduce heating consumption in winter together with optimized solar control in summer periods. Automated openings are integrated into the façade system to allow for controlled natural ventilation in intermediate seasons especially in the high volume areas.



REDUCE

- Compact volume and high performance envelope
- Placement of functions based on solar exposure
- Utilization of thermal mass and natural ventilation
- Daylight optimization in galleries
- Rainwater collection system

REDUCE

A combination of compact geometry, highly insulated roof and basement constructions and an airtight building envelope will significantly reduce the heating consumption. The façade combines high thermal insulation with optimized daylight qualities and efficient solar control.

For museums, electricity usage from artificial light accounts for a large part of the overall energy consumption. Daylight is therefore utilized as broadly as possible.

Workspaces are placed near the perimeter of the facade with low solar exposure, in order to obtain a full benefit from the natural daylight

The roof contains skylights with an interior movable cone system to block direct sunlight and converting incoming daylight to diffuse radiation.

Automated openings in the façade system allows for controlled natural ventilation.

Rainwater from rooftop and surroundings is collected along the perimeter of the building and stored for sanitary use.

OPTIMIZE

- Energy efficient lighting with daylight control
- On demand displacement ventilation system
- Low velocity ductwork and energy recovery
- Heating and cooling via thermo active slabs

OPTIMIZE

To lower the energy consumption and internal heat gains from artificial lighting further, energy efficient LEDs with daylight control is used to the widest extend.

The main ventilation system consists of displacement ventilation with low velocity ductwork, and efficient heat recovery. Above the displacement zones the air volume is allowed to stratify.

All open areas and the art display rooms on the different levels will be equipped with a radiant floor heating and cooling system.

This system is combined with a special low-e surface finish on ceilings, creating a heat mirror effect by reflecting the surface temperature of the conditioned floor.

PRODUCE

- ATEs system for heating and cooling
- Integrated PV-panels on south facing roof

PRODUCE

The building will be connected to a geothermal borehole heat exchanger system under the basement of the building to supply the radiant and air systems.

The roofscape area will be equipped with high performance photovoltaic cells and antislip covered walkable photovoltaic modules.

Technical Installations

The main technical room is placed in the basement of the building, with horizontal distribution through service-trenches to ensure easy maintenance without disturbing the main operations of the museum. A second, smaller, part of the services will be positioned under the roof to discharge heat directly to the outside air.

The electrical and mechanical services are positioned at ground floor level at the façade, with horizontal distribution in service trenches and vertical distribution through local risers. On the floors, horizontal distribution of cables will take place through integrated raised floor plenums.

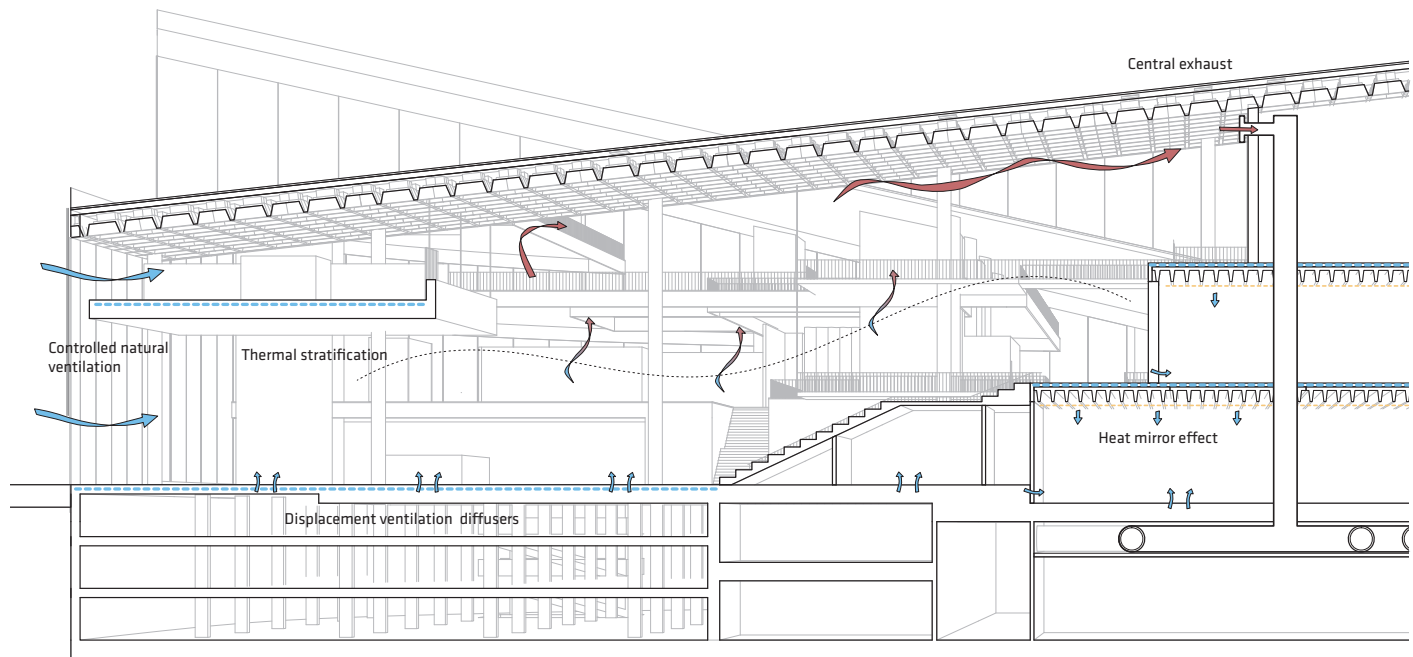
Ventilation and indoor climate concept- exhibitions

The indoor climate concept combines low temperature radiant heating and cooling with the principles of displacement ventilation, thermal stratification for large air volumes and a thermal mirror effect to minimize heating and cooling consumption of the building.

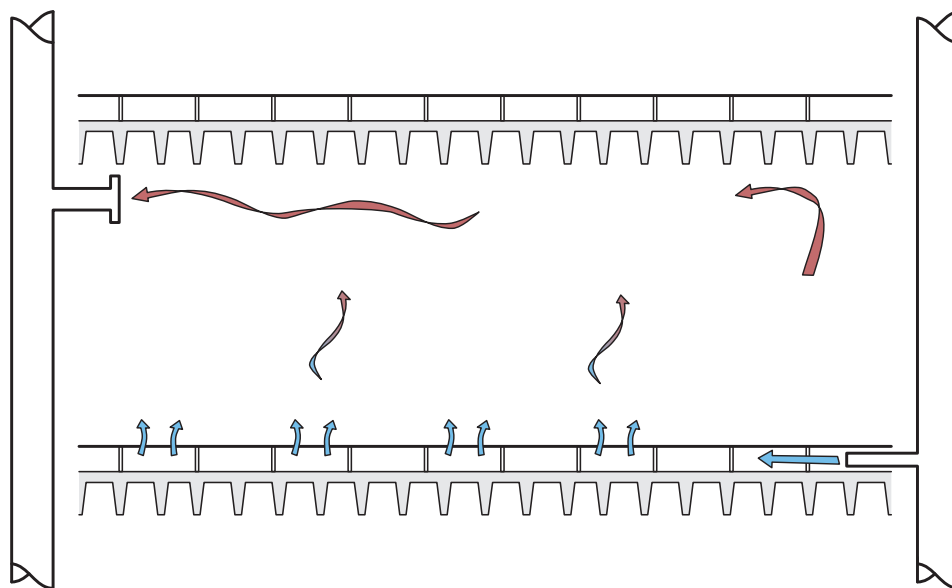
All open areas and the art display rooms on the different levels will be equipped with a radiant floor heating and cooling system, convective perimeter heating along the facades and receive conditioned fresh air via a displacement ventilation system through low mounted wall or floor diffusers. Displacement ventilation requires the air to be distributed through the ductwork with a low velocity, which in turn lowers the pressure loss and greatly reduces the energy required by the fans in the air-handling units. The air is supplied slightly below room temperature into the room creating a sea of fresh air in the occupied zones of all levels. Above these cool air displacement ventilation zones the air volume is allowed to stratify in summer periods, drastically reducing the need of cooling.

Incoming solar loads through façade and skylights are absorbed at the floor surface and directly removed via the fluid system prior to heating up the air above. This way the high cooling temperatures around 17°C can be utilized for cooling and the floor surface temperature is kept slightly below room temperature.

This radiant cooling system is combined with a special low-e surface finish on the suspended diffuse glass ceilings creating a so called heat mirror effect for thermal radiation. Rather than emitting its own temperature the low-e surface will reflect the surface temperature of the conditioned floor back to the occupants below. This effect significantly reduces heating and cooling loads



Low velocity ductwork



Displacement ventilation in exhibition areas and lecture halls.

and provides excellent thermal comfort for the occupants as the mean surface temperatures are increased in winter and reduced in summer.

These suspended light ceiling cavities may as well also contain the extremely efficient (LED) artificial lighting fixtures to remove their dissipated heat from the room volume.

Via automated openings integrated into the large facades a hybrid ventilation scheme will be possible where natural ventilation via these operable systems can be utilized to remove excess heat in the upper air volume of the large spaces. As the mechanical ventilation systems will be controlled by air quality sensor, their operation time and associated fan power will be reduced in times where natural ventilation can assist in intermediate seasons.

Displacement ventilation outdoor air rates are designed to ensure optimal air quality and all ventilation systems are controlled depending on air quality sensor signals for each zone. Energy for heating, cooling, and humidification is also reduced through the CO₂ monitoring and the building management system by only supplying air to galleries when occupied. When unoccupied, air is recirculated in order to maintain temperature and humidity in the galleries.

Return air of the ventilation system is taken at ceiling level in the single height spaces and at high or intermediate levels within the large volumes and ducted to the mechanical rooms in the basement for highly efficient recovery of sensible and latent heat into the supply air stream.

Comfortable supply air temperatures are guaranteed in summer periods by an indirect evaporative cooling system, evaporating water in the return air stream and efficiently transferring the achieved low temperature without humidifying the supply air stream. Using these systems comfortable supply air temperatures are achieved with very little supplemental heating and almost no additional cooling.

Ventilation and indoor climate concept- offices

The climate concept for the offices uses the same scheme for heating and cooling as the exhibition galleries, whereas the ventilation consists solely of on-demand based natural ventilation, regulated by the CO₂ levels. The system utilizes the natural wind and thermal buoyancy to drive the air flow and is controlled by a motorized damper. A heating element the ventilation opening will allow for space heating as well as preventing cold drafts in the winter.

Energy generation and renewable energy concept

The building will be connected to a geothermal borehole heat exchanger system under the basement of the building. This Aquifer Thermal Energy Storage (ATES) system will provide free geothermal cooling power to supply the radiant and the air systems in intermediate seasons. In winter mode the borehole system is providing low temperature heat to a high performance heat pump unit, that will also be used in peak summer periods to provide chilled water for dehumidification of fresh air and the radiant systems.

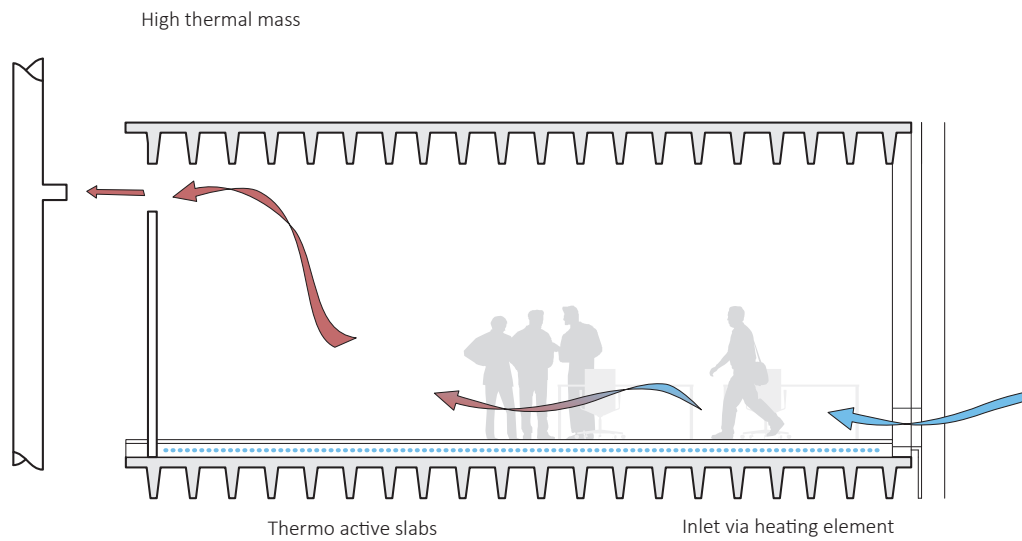
The roofscape area will be equipped with elevated pixel areas of high performance photovoltaic cells and antislip covered walkable photovoltaic modules in between. The walkable photovoltaic modules are colored silver/grey by nano transparent microstructure without PV performance losses. As the photovoltaic panels follow the low slope of both museums avoiding self shading effects between the modules is easy and allowing a coverage of up to 60 % of the roof area in between the pixels.

The resulting 4500 m² of active high performance photovoltaic system will provide a peak electric power of up to 750 kWp and generating about 675'000 kWh of electricity per year in Budapest climatic conditions.

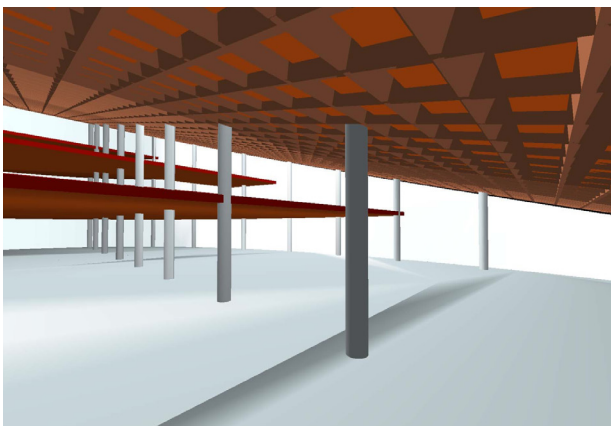
If the city grid is used as the balancing storage system, the total buildings total weighted source (primary) energy consumption of about 56 kWh/m²a is balanced by the produced solar power on the roof, thus achieving a truly zero energy museum.

Acoustics

Through a series of analysis and simulations, we have tested the acoustic performance of the waffle structural ceiling.



Natural ventilation in offices

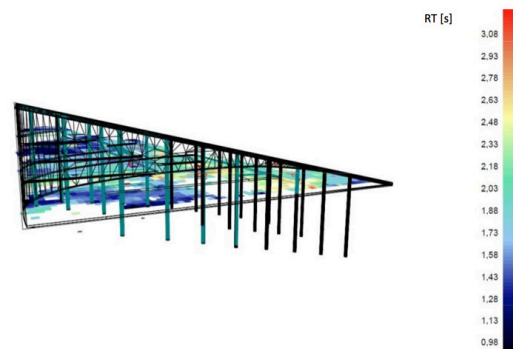


Interior view of the Ludwig building. The darker the color the higher absorption coefficient assigned. Notice the red panels placed in the waffle pattern. These are placed to both block and scatter the direct sunlight and at same time absorb the higher frequencies. In all simulations; the floor has been modeled as a wooden floor on joints, walls are painted concrete, ceiling under plateaus are considered acoustically treated as well as edges of the floors (no rails and plan design considered). Three "main" generic simulations have been run with the room interior shown above:

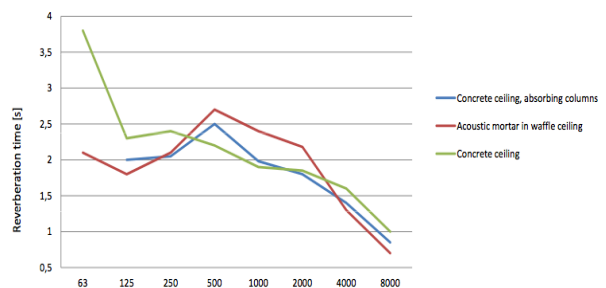
With the waffle pattern in smooth concrete and with absorptive columns.

With the waffle pattern plastered in acoustic mortar (no absorptive columns)

With the waffle pattern in smooth concrete (no absorptive columns)



Averaged reverberation time (RT) over frequencies



Even, averaged, distribution of the reverberation time, corresponding to the green graph on the right, is shown in the plot above. The waffled shaped ceiling has great abilities when it comes to distributing the reverberant energy in the room. Appropriate RT times for a room of this type is approximately 2.5 sec.

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

48.855 m²

1. General spaces and service areas

13.582 m²

Main Category	Sub Category	Code	Room Name	Lord Zone	Area	Designed Area
Hospitality		1.1			1.640 m ²	1.670 m ²
	reception	1.1.1			1.260 m ²	1.305 m ²
		1.1.1.1	Entrance hall	A	1.000 m ²	1.045 m ²
		1.1.1.2	Info, ticketing	A	100 m ²	95 m ²
		1.1.1.3	Audioguide	A	60 m ²	55 m ²
		1.1.1.4	Storage boxes	A	30 m ²	32 m ²
		1.1.1.5	Volunteer's room	A	50 m ²	58 m ²
		1.1.1.6	Disabled' aids storage	A	20 m ²	20 m ²
	consumption	1.1.2			300 m ²	288 m ²
		1.1.2.1	Other shops to let	A	300 m ²	288 m ²
Service	storages - service rooms	1.1.3			80 m ²	77 m ²
		1.1.3.1	Other shops storages	A	80 m ²	77 m ²
Service		1.2			660 m ²	3.508 m ²
	service staff	1.2.1			480 m ²	521 m ²
		1.2.1.1	Armed guards	D	50 m ²	52 m ²
		1.2.1.2	Armory	D	10 m ²	11 m ²
		1.2.1.3	Meeting room	D	60 m ²	60 m ²
		1.2.1.4	Lounge	D	70 m ²	67 m ²
		1.2.1.5	Tea kitchen	D	30 m ²	18 m ²
		1.2.1.6	Changing rooms	D	200 m ²	246 m ²
		1.2.1.7	Staff entrance	D	60 m ²	67 m ²
	building service rooms	1.2.2			180 m ²	2.987 m ²
		1.2.2.1	Building system control	D	40 m ²	43 m ²
		1.2.2.2	Security system control	D	40 m ²	43 m ²
		1.2.2.3	Building service storage	D	100 m ²	110 m ²
		1.2.2.4	Transformer room	D		20 m ²
		1.2.2.5	Switch room	D		40 m ²
		1.2.2.6	Elevator machinery	D		150 m ²
		1.2.2.7	Heating machinery	D		90 m ²
		1.2.2.8	Air conditioning/AHU	D		2.200 m ²
		1.2.2.9	Water control room	D		20 m ²
		1.2.2.10	Waste management	D		116 m ²
		1.2.2.11	Uninterruptible Power Supply	D		15 m ²
		1.2.2.12	Diesel generator	D		40 m ²
		1.2.2.13	Sprinkler center and deposit	D		100 m ²
Comfort		1.3				656 m ²
	comfort - hospitality	1.3.1				260 m ²
		1.3.1.1	Toilets	A		235 m ²
		1.3.1.2	Baby care	A		12 m ²
		1.3.1.3	First aid room	A		13 m ²
	comfort - event	1.3.2				80 m ²
		1.3.2.1	Toilets events	B		80 m ²
	comfort - operation	1.3.3				316 m ²
		1.3.3.1	Toilets for staff	D		280 m ²
		1.3.3.2	First aid room	D		36 m ²
Circulation		1.4				7.748 m ²
	circulation - hospitality	1.4.1				782 m ²
		1.4.1.1	Circulation	A		470 m ²
		1.4.1.2	Stairs	A		150 m ²
		1.4.1.3	Elevators/public	A		12 m ²
		1.4.1.4	Parking entry	A		150 m ²
	circulation - exhibition	1.4.2				3.988 m ²
		1.4.2.1	Circulation	B		3.700 m ²
		1.4.2.2	Stairs	B		270 m ²
		1.4.2.3	GAIAI elevator	B		6 m ²
		1.4.2.4	Elevators	B		12 m ²
	circulation - Artifact handling	1.4.3				1.195 m ²
		1.4.3.1	Staff circulation	C		1.100 m ²
		1.4.3.2	Staff stairs	C		35 m ²
		1.4.3.3	Artifact elevators	C		60 m ²
	circulation - operation	1.4.4				1.783 m ²
		1.4.4.1	Staff circulation	D		1.380 m ²
		1.4.4.2	Staff stairs	D		375 m ²
		1.4.4.3	Staff elevators	D		28 m ²
Parking and delivery		1.5				
	parking - visitor	1.5.1				
		1.5.1.1	Parking		342	9700
		1.5.1.2	Bicycle storage		100	170
	parking - staff	1.5.2				
		1.5.2.1	Parking		74	1500
		1.5.2.2	Bicycle storage		60	100
delivery - goods		1.5.3				
		1.5.3.1	Goods delivery		2	45

delivery - artifact	1.5.4				
1.5.4.1	Artifact delivery dock			2	215
1.5.4.2	Artefact arriving / handling	C		150 m2	169 m2

2. New National Gallery spaces 24.210 m2 24.011 m2

Main Category	Sub Category	Code	Room Name	Lord Zone	Area	Designed Area
Hospitality		2.1			1.350 m2	1.317 m2
	reception	2.1.1			220 m2	220 m2
		2.1.1.1	Cloakroom	A	120 m2	115 m2
		2.1.1.2	VIP lounge	A	70 m2	65 m2
		2.1.1.3	Press room	A	30 m2	40 m2
	consumption	2.1.2			750 m2	740 m2
		2.1.2.1	Cafeteria	A	300 m2	290 m2
		2.1.2.2	Brasserie	A	150 m2	157 m2
		2.1.2.3	Museum shop	A	300 m2	293 m2
	storages - service rooms	2.1.3			380 m2	357 m2
		2.1.3.1	Kitchen (cafeteria, brasserie and catering)	A	300 m2	280 m2
		2.1.3.2	Shop storage	A	80 m2	77 m2
Exhibition		2.2			15.065 m2	15.021 m2
	exhibition	2.2.1			12.700 m2	12.705 m2
		2.2.1.1	Permanent exhibition	B	9.200 m2	9.165 m2
		2.2.1.2	Temporary exhibition	B	3.500 m2	3.540 m2
	museum learning	2.2.2			420 m2	344 m2
		2.2.2.1	IT & multimedia room	B	120 m2	140 m2
		2.2.2.2	Childrens classroom 1	B	50 m2	51 m2
		2.2.2.3	Childrens classroom 2	B	50 m2	51 m2
		2.2.2.4	Childrens classroom 3	B	50 m2	51 m2
		2.2.2.5	Childrens classroom 4	B	50 m2	51 m2
		2.2.2.6	Dining room	B	100 m2	108 m2
	events	2.2.3			1.520 m2	1.511 m2
		2.2.3.1	Event hall	B	800 m2	795 m2
		2.2.3.2	Lecture hall	B	300 m2	298 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	461 m2
		2.2.4.1	Cloakroom - event hall	B	40 m2	68 m2
		2.2.4.2	IT storage	B	40 m2	44 m2
		2.2.4.3	Catering	B	80 m2	83 m2
		2.2.4.4	Museum learning storage	B	25 m2	25 m2
		2.2.4.5	Instrument storage	B	60 m2	62 m2
		2.2.4.6	Lecture hall storage	B	60 m2	55 m2
		2.2.4.7	Artist's changing room I.	B	30 m2	32 m2
		2.2.4.8	Artist's changing room II.	B	30 m2	35 m2
		2.2.4.9	Event storage	B	60 m2	57 m2
GAIA		2.3			1.050 m2	949 m2
	gaia	2.3.1			900 m2	846 m2
		2.3.1.1	GAIA LAB	B	400 m2	370 m2
		2.3.1.2	GAIA hall	B	200 m2	205 m2
		2.3.1.3	GAIA offices	B	300 m2	271 m2
	gaia - storages	2.3.2			100 m2	65 m2
		2.3.2.1	GAIA storages	B	100 m2	65 m2
	gaia - comfort	2.3.3			50 m2	38 m2
		2.3.3.1	GAIA toilets	B	50 m2	38 m2
Artifact handling		2.4			2.330 m2	2.349 m2
	collection - storages	2.4.1			1.300 m2	1.311 m2
		2.4.1.1	Temporary storages of departments	C	1.200 m2	1.200 m2
		2.4.1.2	Transit storage	C	100 m2	111 m2
	collection - care	2.4.2			140 m2	145 m2
		2.4.2.1	Temporary restoration	C	120 m2	120 m2
		2.4.2.2	Storage of the restoration tools	C	20 m2	25 m2
	collection - expedition	2.4.3			480 m2	482 m2
		2.4.3.1.	(Un)package room	C	120 m2	124 m2
		2.4.3.1.	Package storage	C	80 m2	80 m2
		2.4.3.1.	Transport equipments	C	100 m2	96 m2
		2.4.3.1.	Transport materials storage	C	120 m2	118 m2
		2.4.3.1.	Photo studio	C	60 m2	64 m2
	research	2.4.4			130 m2	132 m2
		2.4.4.1	Research in storage	C	30 m2	32 m2
		2.4.4.2	Graphics research	C	100 m2	100 m2
	exhibition care	2.4.5			280 m2	279 m2
		2.4.5.1	Workshops	C	160 m2	162 m2
		2.4.5.2	Workshop storages	C	120 m2	117 m2
Offices		2.5			3.685 m2	3.605 m2
	office - service	2.5.1			480 m2	455 m2
		2.5.1.1	Kitchenettes	D	240 m2	232 m2
		2.5.1.2	Meeting rooms	D	240 m2	223 m2
	offices	2.5.2			2.275 m2	2.198 m2
		2.5.2.1	General Director	D	50 m2	50 m2

		2.5.2.5	Financial Director	D	20 m2	18 m2
		2.5.2.6	Financial Deputy Director	D	20 m2	18 m2
		2.5.2.7	Directors' secretariate	D	150 m2	143 m2
		2.5.2.8	Deputy Directors' secretariate	D	100 m2	90 m2
		2.5.2.9	Security department	D	200 m2	200 m2
		2.5.2.10	Exhibition organisation department	D	350 m2	350 m2
		2.5.2.11	Internal auditor	D	15 m2	15 m2
		2.5.2.12	Legal department	D	80 m2	128 m2
		2.5.2.13	Communication department	D	220 m2	237 m2
		2.5.2.14	IT, Digitalization and Photography	D	250 m2	285 m2
		2.5.2.15	Finance department	D	340 m2	302 m2
		2.5.2.16	Facility management	D	420 m2	295 m2
	museum professionals	2.5.3			930 m2	952 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	307 m2
		2.5.3.3	Contemporary Hungarian Collection department	D	120 m2	119 m2
		2.5.3.4	Post 1800s Collection department	D	150 m2	148 m2
		2.5.3.5	Librarians, Archives	D	40 m2	39 m2
		2.5.3.6	Museum pedagogy	D	190 m2	217 m2
		2.5.3.7	Documentation staff	D	40 m2	42 m2
		2.5.3.8	Temporary restauration staff	D	60 m2	60 m2
Service		2.6			730 m2	770 m2
	storages - service rooms	2.6.1			730 m2	770 m2
		2.6.1.1	Locksmith workshop	D	35 m2	35 m2
		2.6.1.2	Carpenter workshop	D	70 m2	76 m2
		2.6.1.3	Electricician 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	45 m2
		2.6.1.6	Furniture storage	D	150 m2	147 m2
		2.6.1.7	Administration document storage	D	50 m2	59 m2
		2.6.1.8	Publication storage	D	150 m2	168 m2
		2.6.1.9	Stationary storage	D	30 m2	43 m2
		2.6.1.10	Workshop storages	D	140 m2	132 m2
3. Ludwig Museum spaces					11.095 m2	11.262 m2
Main Category	Sub Category	Room Name		Lord Zone	Area	Designed Area
Hospitality		3.1			630 m2	673 m2
	reception	3.1.1.			170 m2	170 m2
		3.1.1.1	Cloakroom	A	80 m2	80 m2
		3.1.1.2	Press room	A	30 m2	30 m2
		3.1.1.3	VIP lounge	A	60 m2	60 m2
	consumption	3.1.2			380 m2	398 m2
		3.1.2.1	Café	A	200 m2	205 m2
		3.1.2.2	Museum shop	A	180 m2	193 m2
	storages - service rooms	3.1.3			80 m2	105 m2
		3.1.3.1	Café storage	A	40 m2	50 m2
		3.1.3.2	Shop storage	A	40 m2	55 m2
Exhibition		3.2			7.565 m2	7.636 m2
	exhibition	3.2.1.			5.500 m2	5.630 m2
		3.2.1.1	Permanent exhibition	B	4.000 m2	3.995 m2
		3.2.1.2	Temporary exhibition	B	1.500 m2	1.635 m2
	experiences	3.2.2			240 m2	243 m2
		3.2.2.1	Video room	B	60 m2	61 m2
		3.2.2.2	Cinemateque	B	180 m2	182 m2
	museum learning	3.2.3			640 m2	592 m2
		3.2.3.1	Library, documents	B	450 m2	449 m2
		3.2.3.2	IT & multimedia room	B	60 m2	61 m2
		3.2.3.3	Workshop for museum learning I.	B	40 m2	41 m2
		3.2.3.4	Workshop for museum learning II.	B	40 m2	41 m2
		3.2.3.5	Dining room	B	50 m2	50 m2
	events	3.2.4			880 m2	876 m2
		3.2.4.1	Event hall	B	500 m2	493 m2
		3.2.4.2	Lecture hall	B	300 m2	301 m2
		3.2.4.3	Lecture room I.	B	40 m2	40 m2
		3.2.4.4	Lecture room II.	B	40 m2	42 m2
	storages - service rooms	3.2.5			305 m2	295 m2
		3.2.5.1	Cloakroom - event hall	B	80 m2	77 m2
		3.2.5.2	IT storage	B	40 m2	30 m2
		3.2.5.3	Catering	B	60 m2	68 m2
		3.2.5.4	Lecture hall storage	B	60 m2	58 m2
		3.2.5.5	Event hall storage	B	40 m2	40 m2
		3.2.5.6	Museum learning storage	B	25 m2	22 m2
Artifact handling		3.3			1.710 m2	1.717 m2
	collection - storages	3.3.1			800 m2	794 m2
		3.3.1.1	Artifact storage	C	700 m2	698 m2
		3.3.1.2	Transit storage	C	100 m2	96 m2
	collection - care	3.3.2			100 m2	101 m2
		3.3.2.1	Temporary restoration	C	80 m2	81 m2
		3.3.2.2	Restoration tools storage	C	20 m2	20 m2
	collection - expedition	3.3.3			280 m2	289 m2
		3.3.3.1	(Un)package room	C	100 m2	99 m2
		3.3.3.2	Package storage	C	100 m2	98 m2
		3.3.3.3	Transport equipment	C	20 m2	21 m2
		3.3.3.4	Photo studio	C	60 m2	71 m2
	research	3.3.4			150 m2	158 m2

exhibition care		3.3.5		380 m2	375 m2
		3.3.5.1	Workshop for exhibition	C	270 m2
		3.3.5.3	Workshop storages (exhibition)	C	60 m2
		3.3.5.5	IT storage (exhibition)	C	40 m2
		3.3.5.6	Chemicals cabinet	C	10 m2
Offices		3.4		710 m2	706 m2
	office - service	3.4.1		110 m2	113 m2
		3.4.1.1	Kitchenettes	D	55 m2
		3.4.1.2	Meeting rooms	D	55 m2
	offices	3.4.2		600 m2	593 m2
		3.4.2.1	Cellular offices and meeting rooms	D	600 m2
Service		3.5		480 m2	530 m2
	storages - service rooms	3.5.1		480 m2	530 m2
		3.5.1.1	Cleaning storages	D	20 m2
		3.5.1.2	Administration documents storage	D	40 m2
		3.5.1.3	Facility management workshops	D	80 m2
		3.5.1.4	Storage - technical devices	D	50 m2
		3.5.1.5	Storage - accumulators	D	50 m2
		3.5.1.6	Electric forklift lot	D	20 m2
		3.5.1.7	Charging station	D	30 m2
		3.5.1.8	Storage - stationary	D	10 m2
		3.5.1.9	Storage - brochures and publication	D	100 m2
		3.5.1.10	Storage - accessories	D	30 m2
		3.5.1.11	Storage - museum learning	D	50 m2

4. New National Gallery and Ludwig Museum - Land use					
		Built in area			16.418 m2
		Hard landscaping		2.231 m2	
		Green area		1.058 m2	